

Basler Electric

Rt. 143 • P. O. Box 269 • Highland, IL 62249-0269 U.S.A. • Phone: 618/654-2341 • Fax: 618/654-2351 • <http://www.basler.com>

December 2001

Enclosed is new information to update your catalog, including 5 new product bulletins plus several we've updated due to enhanced product functionality. All price sections have been modified and are also enclosed.

The enclosed Power Products Catalog on CD-ROM has been updated to Volume II. This CD is more than just a catalog! It includes Instruction Manuals, Application Notes, technical papers, and more. You'll also find a 3-1/2" **floppy disk** with pricing files in Adobe Acrobat (.pdf) format. Please take a moment to tell us if you'd like to receive future catalog updates on CD-ROM/floppy disk only and **skip the paper** - just check a box below and fax back.

Thank you.



Steve Walker, Director of Sales

I want to receive future catalog updates:

On CD-ROM, plus pricing files on floppy disk.

Remove me from your list for future catalog update mailings.

FAX BACK TO +1 618.654.2351 CORP. MARKETING COMMUNICATIONS

Name John DHAACK

Firm STATUSHOT CORP

Code on top line of mailing label (your personal record) GM-G-10USA-G-05792

HOW TO UPDATE YOUR BASLER ELECTRIC POWER PRODUCTS CATALOG

Current

<u>Publication No.</u>	<u>Description</u>	<u>Filing Instructions</u>
Index, December, 2000	Index-Power Products Catalog	Revision: Remove and destroy old index and replace with new index dated December, 2001.

PRODUCT BULLETINS (Orange Tab)

Digital Excitation Control Devices (Yellow Tab)

SZE-3, 8-00 Digital Excitation Control System (DECS-300) Revision: Remove and destroy bulletin SZE-3 dated 8-00 and replace with new bulletin SZE-4 dated 12-00.

NEW PRODUCT Digital Excitation Control System (DECS-200) Addition: Place new bulletin SZM-2 dated 8-01 behind SZE-4.

NEW PRODUCT Digital Excitation Control System (DECS-100) Addition: Place new bulletin SZN-1 dated 1-01 behind SZM-2.

Voltage Regulators (Yellow Tab)

NEW PRODUCT Voltage Regulator Addition: Place new bulletin SVE-1 dated 9-01 behind SVC-1.

NEW PRODUCT Voltage Regulators (AVC63-12 and AVC125-10) Addition: Place new bulletin SVL-2 dated 6-01 behind SVF-3.

SWA-6, 11-95 Voltage Regulator (APR series) Revision: Remove and destroy bulletin SWA-6 dated 11-95 and replace with new bulletin SWA-7 dated 8-01.

PRODUCT BULLETINS (Orange Tab), continued**Regulator Accessories (Yellow Tab)**

SRJ-3, 11-88	Paralleling Module (APM-2000)	Revision: Remove and destroy bulletin SRJ-3 dated 11-88 and replace with new bulletin SRJ-4 dated 8-01.
SRO-3, 6-91	Exciter Diode Monitor (EDM200)	Revision: Remove and destroy bulletin SRO-3 dated 6-91 and replace with new bulletin SRO-4 dated 8-01..
SRP-10, 2-94	Excitation Limiter (EL200)	Revision: Remove and destroy bulletin SRP-10 dated 2-94 and replace with new bulletin SRP-11 dated 3-01.

NEW TAB (Yellow Tab)

NEW TAB

Protection and Control
Devices

Addition: Place new tab "Protection and Control Devices" behind bulletin SRP-11.

Place new bulletin SDA-5 dated 8-01 behind new tab "Protection and Control Devices".

NEW TAB (Yellow Tab)

NEW TAB

BE1 Numerical Systems

Revision: Remove and destroy tab "BE1 Protective Devices" and replace with new tab "BE1 Numerical Systems"

SDA-3, 8-00

Standards, Dimensions, and
Accessories

Remove and destroy old bulletin SDA-3 dated 8-00.

UHQ-3, 3-00

Generator Protection System
(BE1-GPS100)

Revision: Remove and destroy bulletin UHQ-3 dated 3-00 and replace with new bulletin UHQ-4 dated 1-01.

NEW PRODUCT

Overcurrent Protection
System (BE1-1051)

Addition: Place new bulletin UHS-3 dated 8-01 behind new bulletin UHQ-4.

Multifunction O/C Protection
System (BE1-951)

Addition: Place new bulletin UHR-6 dated 1-01 behind new bulletin UHS-3.

Overcurrent Protection
System (BE1-851)

Addition: Place new bulletin UHM-7 dated 8-01 behind new bulletin UHR-6.

Current Diff. Protection
System (BE1-CDS220, 230)

Addition: Place new bulletin UHP-3 dated 2-01 behind new bulletin UHM-7.

Multifunction Metering
System (BE1-MMS100)

Addition: Place new bulletin LAD-5 dated 7-01 behind new bulletin UHP-3.

NEW TAB (YELLOW TAB)

Addition: Place new tab "BE1 Protective Relays" behind new bulletin LAD-5.

UDN-3, 1-98

V/Hz Overexcitation Relay
(BE1-24)

Remove and destroy UDN-3 dated 1-98.

UBP-4, 10-88

Sync Check Relay
(BE1-25)

Revision: Remove and destroy bulletin UBP-4 dated 10-88 and replace with new bulletin UBP-5 dated 1-01.

UBQ-2, 3-86

Sync-Check/Single Shot
Reclosing Relay (BE1-25/79S)

Remove and destroy UBQ-2 dated 3-86.

UBF-3, 4-96

Voltage Relays
(BE1-27, 59, 27/59)

Revision: Remove and destroy bulletin UBF-3 dated 4-96 and replace with new bulletin UBF-4 dated 3-01.

UBJ-6, 6-89

Temperature Relay
(BE1-49)

Remove and destroy UBJ-6 dated 6-89.

UHD-6, 7-96

Time Overcurrent Relay
(BE1-50/51B)

Revision: Remove and destroy bulletin UHD-6 dated 7-96 and replace with new bulletin UHD-8 dated 8-01.

BE1 Protective Relays (Yellow Tab), continued

UHD-5S, 7-96	CO/IAC Retrofit Kits (BE1-50/51B-219, 214, 218)	Remove and destroy UHD-5S dated 7-96. This information is now contained in UHD-8 dated 8-01.
UHE-5, 10-95	Time Overcurrent Relay (BE1-50/51M)	Revision: Remove and destroy bulletin UHE-5 dated 10-95 and replace with new bulletin UHE-6 dated 12-00.
UHR-4, 3-00	Multifunction Overcurrent Prot. System (BE1-951)	Remove and destroy bulletin UHR-4 dated 3-00. It has been replaced and moved to a new section.
UHM-5, 3-00	Overcurrent Protection System (BE1-851)	Remove and destroy bulletin UHM-5 dated 3-00. It has been replaced and moved to a new section.
UDU-4, 4-98	Distribution Feeder Protection (BE1-DFPR)	Remove and destroy bulletin UDU-4 dated 4-98.
UDA-7, 11-97	Time Overcurrent Relay (BE1-51, 51/27C, 51/27R)	Revision: Remove and destroy bulletin UDA-7 dated 11-97 and replace with new bulletin UDA-9 dated 12-00.
UDP-2, 1-88	Time O/C Relay with Torque Control (BE1-51TC)	Remove and destroy bulletin UDP-2 dated 1-88.
UDL-5, 10-96	Multiple Shot Reclosing Relay (BE1-79M)	Revision: Remove and destroy bulletin UDL-5 dated 10-96 and replace with new bulletin UDL-6 dated 11-00.
UBR-5, 6-99	Digital Frequency Relay (BE1-81O/U)	Revision: Remove and destroy bulletin UBR-5 dated 6-99 and replace with new bulletin UBR-6 dated 7-01.
UHC-2, 9-99	High Impedance Bus Diff. (BE1-87B)	Revision: Remove and destroy bulletin UHC-2 dated 9-99 and replace with new bulletin UHC-3 dated 1-01.
UHP-1, 9-98	Current Diff. Protection Sys. (BE1-CDS220, 230)	Remove and destroy bulletin UHP-1 dated 9-98. It has been replaced and moved to a new section.
UBK-5, 6-91	Differential Relay (BE1-87G)	Revision: Remove and destroy bulletin UBK-5 dated 6-91 and replace with new bulletin UBK-6 dated 7-01.

BE2 and 3 Protective Devices (Yellow Tab)

ULX-2, 4-99	Dimensions and Features (BE3 series)	Revision: Remove and destroy bulletin ULX-2 dated 4-99 and replace with new bulletin ULX-3 dated 7-01.
-------------	---	--

System Control Devices (Yellow Tab)

SZW-1, 4-00	Remote Display Panel (RDP-300)	Revision: Remove and destroy bulletin SZW-1 dated 4-00 and replace with new bulletin SZW-2 dated 1-01.
UKF-2, 11-77	Voltage Control Device	Remove and destroy bulletin UKF-2 dated 11-77.
LAD-1, 9-98	Feeder Automation Unit (FAU-200)	Remove and destroy bulletin LAD-1 dated 9-98. It has been replaced and moved to a new section.

PRICES (Orange Tab)

Discount Sheet

If a colored sheet titled "Discount Schedule DS-2" (green), "DS-3" (orange), "DS-6" (yellow), or "DS-7" (gray) is included in this packet, please remove and destroy the old Discount Schedule dated 1/1/00 and replace with the updated colored sheet dated 1/1/02.

Digital Excitation Control Devices (Yellow Tab)

PPDEC, 1/1/01 Price List, DECS Revision: Remove and destroy PPDEC pages 1-2 dated 1/1/01 and replace with new PPDEC pages 1-3 dated 1/1/02.

Voltage Regulators (Yellow Tab)

PPI, 1/1/01 Price List, Voltage Regulators Revision: Remove and destroy PPI pages 1-2 dated 1/1/01 and replace with new PPI pages 1-3 dated 1/1/02.

Regulator Accessories (Yellow Tab)

PPACI, 1/1/01 Price List, Voltage Regulator Accessories Revision: Remove and destroy PPACI pages 1-11 dated 1/01/01 and replace with new PPACI pages 1-10 dated 1/1/02.

NEW TAB: BE1 Numerical Systems (Yellow Tab)

NEW TAB BE1 Numerical Systems Addition: Insert new tab "BE1 Numerical Systems" behind PPACI. Insert PP1PR3 pages 1-7 dated 1/1/02.

NEW TAB: BE1 Protective Relays (Yellow Tab)

NEW TAB Price List, BE1 Protective Relays Revision: Remove and destroy old tab "BE1 Protective Devices" and replace with new tab "BE1 Protective Relays". Remove and destroy PP1PR3 pages 1-53 dated 1/1/01 and replace with PP1PR3 pages 8-50 dated 1/1/02.

Motor Protection and Control (Yellow Tab)

PP1PR5, 1/1/01 Price List, Motor Protection and Control Systems Revision: Remove and destroy PP1PR5 page 1 dated 1/1/01 and replace with PP1PR5 page 1 dated 1/1/02.

BE2 and 3 Protective Devices (Yellow Tab)

PP1PR2, 1/1/01 Price List, Protective Relays Revision: Remove and destroy PP1PR2 pages 1-2 dated 1/01/01 and replace with new PP1PR2 pages 1-2 dated 1/1/02.

PP1PR6, 1/1/01 Price List, Protective Relays Revision: Remove and destroy PP1PR6 pages 1-8 dated 1/1/01 and replace with new PP1PR6 pages 1-8 dated 1/1/02.

Automatic Synchronizers (Yellow Tab)

PPASI, 1/1/01 Price List, Automatic Synchronizers Revision: Remove and destroy PPASI pages 1-2 dated 1/1/01 and replace with new PPASI pages 1-2 dated 1/1/02.

System Control Devices (Yellow Tab)

PPSCI, 1/1/01 Price List, System Control Devices Revision: Remove and destroy PPSCI pages 1-7 dated 1/01/01 and replace with new PPSCI pages 1-6 dated 1/1/02.

Replacement and Specialty Products (Yellow Tab)

RSP, 1/1/01 Price List, Replacement and Specialty Products Revision: Remove and destroy RSP pages 1-3 dated 1/1/01 and replace with new RSP pages 1-8 dated 1/1/02.

POWER PRODUCTS CATALOG INDEX

PRODUCT BULLETINS (Orange Tab)

Class Definitions of Power Products Equipment (S-134, Feb. 1979)

Control and Protective Products for the Power Industry (DG-25)

Power Systems Protective Devices Reference Catalog (PD0BRO)

<u>MODEL</u>	<u>CLASS</u>	<u>FORM NUMBER</u>	<u>DESCRIPTION</u>
<u>Digital Excitation Control Devices (Yellow Tab)</u>			
DECS-15 Amp	Class 200	(SZK-5 9-99)	Digital Excitation Control System
DECS-300	Class 200	(SZE-4 12-00)	Digital Excitation Control System
DECS-200	Class 200	(SZM-2 8-01)	Digital Excitation Control System
DECS-100	Class 200	(SZN-1 1-01)	Digital Excitation Control System
<u>Voltage Regulators (Yellow Tab)</u>			
AEC Series	Class 200	(SWD-1 9-94)	Voltage Regulator
AVC63-4A	Class 300	(SVD-1 9-94)	Voltage Regulator
VR63-4, VR63-4A	Class 300	(SVB-6 11-95)	Voltage Regulator
AVC63-4	Class 300	(SVC-1 2-95)	Voltage Regulator
AVC110-6	Class 300	(SVE-1 9-01)	Voltage Regulator
VR63-4C	Class 300	(SVF-3 11-95)	Voltage Regulator
AVC63-12, 125-10	Class 300	(SVL-2 6-01)	Voltage Regulators
AVC63-7	Class 300	(SVP-1 9-96)	Voltage Regulator
APR Series	Class 200	(SWA-7 8-01)	Voltage Regulator
APR63-5, VR63-4, VR63-4A, VR63-4B	Class 200	(SVB-4 11-90)	UL Recognized Voltage Regulator
VR485 Series	Class 300	(SY-3 8-93)	Voltage Regulator
SSR Series	Class 200	(SX-6 9-92)	Voltage Regulator
SR-A	Class 200	(SA-2 1-97)	Voltage Regulator
<u>Exciter Regulators (Yellow Tab)</u>			
SSE	Class 200	(SHB-1 9-98)	Shunt Static Exciter-Regulator
SSE-N	Class 200	(TBY-1 9-93)	Negative Field Forcing SSE/ Regulator System
SSE System	Class 200	(SK-2 4-92)	Custom Design Excitation System Model SSE
ESS	Class 200	(SNV-2 6-92)	Excitation Support System
DSE110, 200	Class 100	(SNU-1 10-84)	Static Exciter-Regulator
NFF	Class 200	(SNW-1 4-86)	Negative Field Forcing Module
<u>Regulator Accessories (Yellow Tab)</u>			
UF312, UF324	Class 300	(SPV-1 5-73)	Underfrequency Protective Module
SBO Series	Class 200	(SP-5 5-95)	Excitation Support System
CBS212, 212A	Class 200	(SQA-2 11-93)	Current Boost System
CBS305, 320	Class 300	(SRR-3 12-87)	Excitation Support System
CBS344, 377	Class 300	(SPW-3 12-85)	Excitation Support System
MVC112	Class 100	(SRU-4 3-95)	Electronic Manual
MVC236	Class 200	(SRU-4 3-95)	Voltage Control Modules

Print additions/revisions are **bolded**.

December, 2001

<u>MODEL</u>	<u>CLASS</u>	<u>FORM NUMBER</u>	<u>DESCRIPTION</u>
<u>Regulator Accessories (Yellow Tab) - continued</u>			
MVC300	Class 300	(SRK-4 10-93)	Electronic Manual Volt. Control
Nulling Chassis	Class 300	(SRW-3 6-92)	Control Transfer Device
MVC Modules	All Classes	(SPC-3 11-87)	Manual Voltage Control Module
APM2000	Class 300	(SRJ-4 8-01)	Paralleling Module
SPM2000	Class 300	(SRL-1 6-83)	Three Phase Sensing and Paralleling Module
APM300	Class 300	(SPI 5-72)	Paralleling Module
UFOV250A, 260A	Class 200	(SPD-5 2-93)	Underfrequency/Overvoltage Module
VH Module	Class 300	(SPX-1 6-91)	Volts-Per-Hertz Module
PIT		(SP-2 11-89)	Power Isolation Transformer
CT		(SPB-6 3-96)	Current Transformer
EDM200	Class 200	(SRO-4 8-01)	Exciter Diode Monitor
EL200	Class 200	(SRP-11 3-01)	Excitation Limiter
<u>Protection and Control Devices (Yellow Tab)</u>			
BE1 Relays	Class 100	(SDA-5 8-01)	Stds, Dims, and Accessories
<u>BE1 Numerical Systems (Yellow Tab)</u>			
BE1-GPS100	Class 100	(UHQ-4 1-01)	Generator Protection System
BE1-1051	Class 100	(UHS-3 8-01)	Overcurrent Prot. System
BE1-951	Class 100	(UHR-6 1-01)	Multifunction O/C Prot. Sys.
BE1-851	Class 100	(UHM-7 8-01)	O/C Protection System
BE1-CDS220, 230	Class 100	(UHP-3 2-01)	Current Diff. prot. systems
BE1-MMS100	Class 100	(LAD-5 7-01)	Multifunction Metering Sys.
<u>BE1 Protective Relays (Yellow Tab)</u>			
BE1-25	Class 100	(UBP-5 1-01)	Sync-Check relay
BE1-25/79TR	Class 100	(UDW-1 3-95)	Sync-Check Reclosing relay (Drawout)
BE1-27, 59, 27/59	Class 100	(UBF-4 3-01)	Voltage relays
BE1-32R, 32O/U	Class 100	(UBU-5 3-96)	Directional Power relays
BE1-40Q	Class 100	(UBW-2 6-89)	Loss of Excitation relay
BE1-46N	Class 100	(UDJ-6 6-90)	Negative Sequence Overcurrent relay
BE1-47N	Class 100	(UDK-3 10-95)	Negative Sequence Voltage relay
BE1-50	Class 100	(UBC-5 10-87)	Instantaneous Overcurrent relay
BE1-50BF	Class 100	(UBT-7 6-00)	Breaker Failure relay
BE1-50/51B	Class 100	(UHD-8 8-01)	Time Overcurrent relay
BE1-50/51M	Class 100	(UHE-6 12-00)	Time Overcurrent relay
BE1-BPR	Class 100	(UHG-4 3-96)	Breaker Protection relay
BE1-51,51/27C, 51/27R	Class 100	(UDA-9 12-00)	Time Overcurrent relay

<u>MODEL</u>	<u>CLASS</u>	<u>FORM NUMBER</u>	<u>DESCRIPTION</u>
<u>BE1 Protective Relays (Yellow Tab) - continued</u>			
BE1-59N	Class 100	(UBG-6 10-95)	Ground Fault O/V relay
BE1-59NC	Class 100	(UHF-2 9-94)	Capacitor Neutral O/V relay
BE1-60	Class 100	(UBS-2 11-87)	Voltage Balance relay
BE1-67	Class 100	(UDQ-4 6-95)	Phase Dir. Time O/C relay
BE1-67N	Class 100	(UDR-2 5-95)	Ground Directional O/C relay
BE1-79	Class 100	(UBL-5 11-97)	Multiple Shot Reclosing Relay
BE1-79A	Class 100	(UHN-2 9-00)	Retrofit Reclosing relay
BE1-79M	Class 100	(UDL-6 11-00)	Multiple Shot Reclosing relay
BE1-79S	Class 100	(UBN-2 4-86)	Single Shot Reclosing relay
BE1-81O/U	Class 100	(UBR-6 7-01)	Digital Frequency relay
BE1-87B	Class 100	(UHC-3 1-01)	High Impedance Bus Differential
BE1-87G	Class 100	(UBK-6 7-01)	Differential relay
BE1-87T	Class 100	(UHA-4 9-94)	Transformer Differential relay
<u>Motor Protection and Control (Yellow Tab)</u>			
MPS100		(UPC-1 4-98)	Motor Protection System
MPS200, 210		(UPB-3 4-98)	Motor Protection Systems
SSE	Class 200	(SNX-1 4-91)	Excitation System for Brush-Type Motors
<u>BE2 and 3 Protective Devices (Yellow Tab)</u>			
BE3-GPR	Class 300	(UEG-5 3-99)	Generator Protective relay
BE3-32	Class 300	(UEE-4 9-94)	Reverse Power relay
PRP360	Class 300	(UEB-2 6-89)	Reverse Power relay
PRP320	Class 300	(UEA-4 6-89)	Synchronous Motor Pull-out
BE2-40	Class 200	(UCC-6 2-94)	Loss of Excitation relay
BE3 series	Class 400	(ULX-3 7-01)	Dimensions and features
BE3-25	Class 400	(ULA-1 3-98)	Synchronizing Check relay
BE3-27, 59, 27/59	Class 400	(ULB-2 9-98)	AC Voltage relay
BE3-27T, 59T, 27T/59T	Class 400	(ULC-2 9-98)	AC Voltage relay w/time delay
BE3-32	Class 400	(ULD-2 9-98)	Reverse Power relay
BE3-37, 51, 37/51	Class 400	(ULE-1 3-98)	AC Current relay
BE3-47	Class 400	(ULF-1 3-98)	Phase Sequence relay
BE3-47N, 47N/27	Class 400	(ULG-1 3-98)	Phase Balance relay
BE3-49R	Class 400	(ULH-1 3-99)	3 Input RTD Temp. trip relay
BE3-49R	Class 400	(ULI-1 3-99)	6 Input RTD Temp. trip relay
BE3-49TH, TL	Class 400	(ULJ-1 3-98)	Thermocouple relay

<u>MODEL</u>	<u>CLASS</u>	<u>FORM NUMBER</u>	<u>DESCRIPTION</u>
<u>BE2 and 3 Protective Devices, continued (Yellow Tab)</u>			
BE3-74SH, SL, SD	Class 400	(ULN-1 3-98)	Millivolt Sensing Alarm relay
BE3-74TL, TH, TD	Class 400	(ULO-1 3-98)	Milliamp Sensing Alarm relay
BE3-74VL, VH, VD	Class 400	(ULP-1 3-98)	DC Voltage relay
BE3-81O, U, O/U	Class 400	(ULL-1 3-98)	Frequency relay
BE3-81OT, UT, OT/UT	Class 400	(ULM-1 3-98)	Frequency relay w/time delay
<u>Automatic Synchronizers (Yellow Tab)</u>			
BE1-25A	Class 100	(UIM-7 3-99)	Automatic Synchronizer
PRS210, 220	Class 200	(UKB-2 6-89)	Auto-Synchronizing relay (3 phase)
BE3-25A	Class 300	(UMP-5 10-95)	Auto-Synchronizer (1 phase)
PRS250	Class 200	(UKH-2 6-89)	Veri-Sync relay
<u>System Control Devices (Yellow Tab)</u>			
DGC-1000	Class 100	(SNF-3 9-99)	Digital Genset Controller
DGC-2000	Class 100	(SNA-3 7-98)	Digital Genset Controller
RDP-300	Class 200	(SZW-2 1-01)	Remote Display Panel
RDP-110	Class 200	(SNE-2 2-99)	Remote Display Panel
ENGEN [®] -100/200	Class 200	(SND-3 6-99)	Engine Generator Controller
MOC2	Class 200	(SRA-6 5-92)	Motor Operated Control (Potentiometer)
ESD201, 202	Class 200	(UJO-2 2-97)	Energy Storage Device
PSS-100	Class 200	(SRC-1 3-99)	Microprocessor-based Power System Stabilizer
RA-70	Class 200	(SRS-4 6-00)	Microprocessor-based Reference Adjuster
SCP250	Class 200	(UKR-6 3-93)	VAR/Power Factor Controller
UMOS [®]		(LAB-2 4-00)	Utilities Management Operating System

PRICES (Orange Tab)

FA100001
S-125, 08/01/78
Authorized Warranty Repair Centers, 5/96
Discount Sheet, 1/1/00 or 1/1/02

Terms & Conditions of Sale
BLS Price Adjustment Clause
Discount Schedule

Digital Excitation Control Devices (Yellow Tab)

(PPDEC, January 1, 2002)

**Digital Excitation Control Systems
(Pages 1 through 3)**

Voltage Regulators (Yellow Tab)

(PPI, January 1, 2002)

Voltage Regulators (Pages 1 through 3)

NOTE: Exciter regulators are quoted per job by Basler Electric.

Regulator Accessories (Yellow Tab)

(PPACI, January 1, 2002)

**Voltage Regulator Accessories
(Pages 1 through 10)**

BE1 Numerical Systems (Yellow Tab)

(PP1PR3, January 1, 2002)

**BE1 Numerical Systems
(Pages 1 through 7)**

BE1 Protective Relays (Yellow Tab)

(PP1PR3, January 1, 2002)

**BE1 Protective Relays
(Pages 8 through 50)**

Motor Protection and Control (Yellow Tab)

(PP1PR5, January 1, 2002)

Motor Protection Systems (Page 1)

BE2 and 3 Protective Devices (Yellow Tab)

(PP1PR2, January 1, 2002)

Protective Relays (Pages 1 and 2)

(PP1PR6, January 1, 2002)

Protective Relays (Pages 1 through 8)

Automatic Synchronizers (Yellow Tab)

(PPASI, January 1, 2002)

Auto-Synchronizing Relays (Pages 1 and 2)

System Control Devices (Yellow Tab)

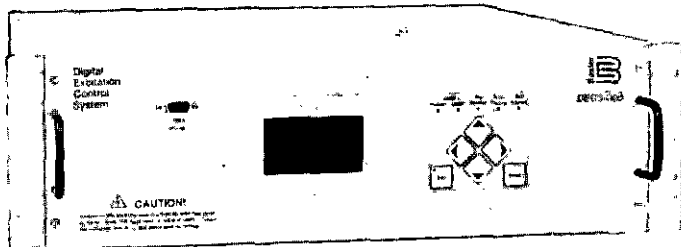
(PPSCI, January 1, 2002)

System Control Devices (Pages 1 through 6)

Replacement and Specialty Products (Yellow Tab)

(RSP, January 1, 2002)

**Replacement and Specialty Products
(Pages 1 through 8)**



DECS-300 Digital Excitation Control System

Digital Excitation Control Systems (DECS-300) are microprocessor-based devices intended for generator power management. These devices provide control signals for pulse width modulated power modules and SCR bridges manufactured by Basler Electric and other manufacturers. The DECS-300 provides precision control for generators of any size and is equally suited for exciter field or main field applications.

FEATURES

- Microprocessor-based design
- True RMS sensing, single or three phase
- Controls the firing of external bridges by outputting 4-20mA, 0-10Vdc or ± 10 Vdc
- 0.25% Voltage Regulation Accuracy
- Setup from front panel HMI or by PC with free Windows® setup software
- 40 standard stability selections
- User customizable stability selection
- Paralleling compensation
- Underfrequency compensation or V/Hz Ratio Limiter
- Softstart buildup
- Field Current Regulation Mode (Manual Mode)
- Autotracking between operating modes and between DECS-300 units
- Autotransfer to a back-up DECS-300 unit
- Remote set point control via:
 - Contact inputs
 - Proportional control via ± 10 Vdc or 4-20mA
 - Communications inputs RS-232 (ASCII) or RS-485 (Modbus™)
- Minimum Excitation Limiter (Internally generated or customizable)
- On and off-line Maximum Excitation Limiters
- VAR and Power Factor Controllers

(continued on next page)

WINDOWS® SOFTWARE

Interface for setting and communicating with Basler products
 Request BESTCOMS™ - DECS300-32
 (Windows® NT 3.51 or later, 95, 98, or Me)

ADDITIONAL INFORMATION

INSTRUCTION MANUAL

Request Publication 9310300990

**DESCRIPTION and
SPECIFICATIONS**
Pages 2 through 5

**FEATURES and
FUNCTIONS**
Pages 6 and 7

**INTERCONNECT
DIAGRAMS**
Pages 8 and 9

**FRONT, REAR VIEWS
and DIMENSIONS**
Pages 10 and 11

CUTOUT and ORDERING
Page 12

B Basler Electric

SPECIFICATIONS, continued

COM2: RS-485, located on rear panel and used to communicate with local or remote computers or other devices. 1200 to 19200 baud, 8N1 half duplex, Modbus™ protocol

REGULATION ACCURACY

AVR Mode	Voltage regulation equals $\pm 0.25\%$ over the load range at rated power factor and constant generator frequency. Steady state stability equals $\pm 0.1\%$ at a constant load and generator frequency. Temperature drift equals $\pm 0.5\%$ for 0 to 50°C temperature change. Underfrequency (volts/hertz) characteristic slope from 0 to 3.0 P.U. is adjustable in 0.1 P.U. increments. Voltage regulation error is within $\pm 2.0\%$ of the nominal voltage.
FCR Mode	Field current regulation equals $\pm 1.0\%$ of the nominal value for 10% of the bridge input voltage change or 20% of the field resistance change. Otherwise, $\pm 5.0\%$.
VAR Mode	$\pm 2.0\%$ of the nominal VA rating at the rated frequency.
PF Mode	± 0.02 PF in the set point PF for the real power between 10 and 100% at the rated frequency. (e.g.-set point PF = 0.80, PF regulation is from 0.78 to 0.82 PF.)
Autotracking	$\pm 0.5\%$ of the nominal field voltage change when transferring.

PARALLEL COMPENSATION

Can use either reactive droop or reactive differential (cross-current) compensation. Adjustable 10% of the rated generator voltage droop with optional 1 ampere or less or 5 amperes or less input. For parallel compensation, burden is less than 1VA.

FIELD OVERVOLTAGE PROTECTION

Adjustable in increments of 1.0Vdc from 1.0 to 900Vdc rated output voltage with a 0.2 to 30 second inverse time delay settable in increments of 0.1 second.

FIELD OVERCURRENT PROTECTION

Adjustable in increments of 0.1% steps of rated field current from 0 to 9999Adc excitation current setting with an inverse time delay (ANSI C50.13).

FIELD OVERTEMPERATURE PROTECTION

Adjustable from 0 to 300.0 degrees C or F in 0.1 steps. The parameters needed for the DECS-300 to calculate field temperature are: field ambient temperature, brush voltage drop, and field resistance. This feature is intended for generator main field applications and not for rotary exciter applications.

GENERATOR UNDERVOLTAGE PROTECTION

Adjustable in increments of 1Vac from 0 to 30kV sensing voltage setting with a 0.5 to 60 second inverse time delay (ANSI C50.13) settable in increments of 0.1 second.

GENERATOR OVERVOLTAGE PROTECTION

Adjustable in increments of 1Vac from 0 to 30kV sensing voltage with a 0.1 to 60 second inverse time delay (ANSI C50.13) settable in increments of 0.1 second.

LOSS OF SENSING

The loss of sensing is factory set at 50% of nominal. The time delay is adjustable for 0-30 seconds in 0.1 second increments.

SOFT-START

Functional in AVR and FCR with an adjustable rate of 1 to 200 volts per second in AVR, and 1 to 33% of the manual set point per second.

SPECIFICATIONS, continued

OVEREXCITATION LIMITING	Limiter response time is less than three cycles.
On-Line	Level One - Highest current level (instantaneous) set point adjustable from 0 to 9999Adc in 0.1% increments of the rated field current. Limiting occurs for a time period ranging from 0 to 60 seconds, settable in 1 second increments
	Level Two - Medium current level set point adjustable from 0 to 9999Adc in 0.1% increments of the rated field current. Limiting occurs for a time period ranging from 0 to 120 seconds, settable in 1 second increments.
	Level Three - Lowest current level set point adjustable from 0 to 9999Adc in 0.1% increments of the rated field current. Limiting occurs indefinitely.
Off-Line	Level One - Highest current level set point adjustable from 0 to 9999Adc in 0.1% increments of the rated field current. Limiting occurs for a time period ranging from 0 to 60 seconds, settable in 1 second increments.
	Level Two - Lowest current level set point adjustable from 0 to 9999Adc in 0.1% increments of the rated field current. Limiting occurs indefinitely.
UNDEREXCITATION LIMITING	Adjustments based on generator ratings.
MANUAL EXCITATION CONTROL	Regulates field current from 0 to 5000A in increments of 0.1% of the rated output current
VOLTAGE MATCHING	Matches utility bus RMS voltage with generator output RMS voltage within $\pm 0.15\%$ of the generator voltage
RFI (Radio Frequency Interference)	Meets IEC 60255-22-6 (RF Conducted) and IEC 60255-22-3 (Radiated Electro-magnetic Field)
FAST TRANSIENT	Meets IEC 60255-22-4
EMISSIONS	Meets CISPR11/EN55011 Level A
ENVIRONMENTAL	
Operating temperature	-40°C to +60°C
Storage temperature	-40°C to +85°C
Shock	15 Gs in each of three mutually perpendicular planes
Vibration	2Gs at 10 to 500Hz
Size	19 inch rack mount, 3 rack units high
Weight	13.5 lb. (6.12kg) net, 17 lb. (7.71kg) shipping

FEATURES/FUNCTIONS

Voltage Regulation

The DECS-300 regulates the generator RMS voltage to within 0.25% from no-load to full-load. It does this by utilizing digital signal processing and precise regulation algorithms developed by Basler Electric, utilizing the experience gained in many years of manufacturing tens of thousands of digital voltage regulators.

Output Signals

The DECS-300 sends an output signal of 4-20mA, 0-10Vdc, or ± 10 Vdc to the firing or control circuits of external power stages. The dc current from the power stages provides excitation to the field of the main generator or exciter. DECS-300 can control virtually any bridge, capable of accepting these signals, that is suitable for use on synchronous generators/motors.

Stability

The DECS-300 utilizes proportional (P), integral (I) and derivative (D) stability control. DECS-300 has 40 preprogrammed stability (PID) settings for both main field (20 settings) and exciter field (20 settings) applications. This means that a standard stability setting is already available for most applications/machines. The DECS-300 has a stability range that allows for customizing the stability settings to fine tune the stability to provide optimum customized generator transient performance. Setup software contains PID selection program to assist in determining the correct PID settings. The DECS-300 provides for customizing the stability and transient performance of the Min/Max Excitation Limiter and VAR/PF controllers by providing additional stability adjustments.

Underfrequency Limiter or V/Hz Ratio Limiter

DECS-300 is selectable for either Underfrequency Limiter or a V/Hz Ratio Limiter function. The underfrequency limiter slope can be tuned to have 0 to 3 times p.u. Volts/Hz, in 0.1Hz increments, and the frequency roll-off kneepoint can be set across a range of 45 to 65Hz, in 0.1Hz increments. This adjustability allows the DECS-300 to precisely match the operating characteristics of the prime mover and the loads being applied to the generator. The V/Hz Ratio Limiter clamps the regulation set point to prevent operation above a V/Hz level that is prescribed by the slope and roll-off settings as stated above. This feature is also useful for other potentially damaging system conditions such as a change in system voltage and reduced frequency situations that exceed the V/Hz ratio.

Softstart Voltage Buildup

Generator voltage overshoot can be harmful to the generator's insulation system if not controlled. DECS-300 has a softstart feature with a user-adjustable

setting to govern the rate at which the generator voltage is allowed to build up. This prevents the generator voltage from overshooting nominal voltage levels during start-up of the generator system.

Paralleling Compensation

DECS-300 has provisions to parallel two or more generators using reactive droop or reactive differential compensation with the addition of an external current transformer with secondary currents of 1 or 5Aac. The current input is rated at less than 1VA. This low burden means that existing metering CTs can be used and dedicated CTs are not required.

Set Point Control

DECS-300 has means for external set point adjustment of the controlling mode of operation. This eliminates the need for additional equipment like motor operated potentiometers for remote control or multiple point control for the excitation system. The operating mode's set point may be directly controlled by raise/lower contact inputs, auxiliary inputs of 4-20mA or ± 10 Vdc. The auxiliary input adjusts the operating mode across its predetermined adjustment range. The auxiliary input can be provided from other controlling devices such as a power system stabilizer. These devices modify the operation of the DECS-300 to meet specific operating characteristics and requirements for the machine under DECS-300 control. Two more methods of set point control may be achieved via the RS-232 communication port by using the Windows® based PC software or by the RS-485 port using Modbus™ protocol. Regardless of which method of set point is used (contact inputs, auxiliary input or communications with a PC or PLC), traverse rates of all modes of operation are independently adjustable. This means an operator can customize the rate of adjustment and "feel" to meet his/her needs.

Pre-position Inputs

DECS-300 provides the added flexibility of allowing a predetermined operating point for each mode of operation. With a contact input to the DECS-300, the operating mode is driven to an operating or regulation level assigned to that operation mode by the operator or user. The pre-position inputs operate in one of two modes, Maintain or Release. The Maintain mode prevents adjustment of the set point as long as the pre-position contact is closed. The release mode allows adjustment of the set point even though the pre-position is closed. This feature allows the DECS-300 to be configured for specific system and application needs.

Field Current Regulation Operating Mode

DECS-300 provides a manual channel of operation called Field Current Regulation, or FCR, Mode. In this

FEATURES/FUNCTIONS, continued

mode, DECS-300 regulates the DC output current of the power bridge. It does not rely on the sensing input to DECS-300 and is, therefore, a good source of backup excitation control when loss of sensing is detected. In this mode, control of the generator is totally dependent upon the operator to maintain nominal generator voltage as the load varies on the generator.

VAR/Power Factor Controller Operating Mode

DECS-300 has, as another standard feature, two modes of operation when the generator is in parallel with the utility power grid. The DECS-300 has both VAR and PF modes of operation. When the generator is in parallel with the utility grid, the DECS-300 can regulate the VAR output of the generator to a specific VAR level magnitude or it can vary the VAR output of the generator to maintain a specific power factor as the kW load varies on the generator.

Maximum Excitation Limiters

Each DECS-300 has integrated over/underexcitation limiters. Overexcitation limiters are present for both on-line and off-line excitation levels. This feature provides maximum overexcitation protection by having different settings for off-line operation where load levels require lower levels of excitation. When lower excitation levels are needed, lower limiter settings are required to properly protect the generator.

Minimum Excitation Limiter

The minimum excitation limiter limits the amount of excitation supplied to the field of the generator from dropping below unsafe operating levels. This prevents the machine from possibly slipping poles and from damaging the machine. It limits the amount of VARs being absorbed by the machine, based on user-definable settings.

An internally generated Underexcitation Limiting (UEL) curve can be utilized based on a VAR level at 0kW, or a customizable 5 point UEL curve can be selected to match specific generator characteristics.

Autotracking Between DECS-300 Operating Modes

DECS-300 is an intelligent device that can provide autotracking (autofollowing) of the controlling mode by the non-controlling modes. This allows the operator to initiate a controlled, bumpless transfer of the DECS-300 operating modes, causing minimum amounts of line disturbance for the power system. This feature can be used in conjunction with a set of protective relays to initiate a transfer to a backup mode of operation, such as FCR mode, upon the detection of a system failure or fault, i.e., loss of sensing.

Autotracking between DECS-300 Units

A DECS-300 can also follow (autotrack) a second DECS-300 unit. The first DECS-300 is put into a specific operating mode and follows the excitation level of the first. In the unlikely event of a failure of the first DECS-300, protective relays can initiate a transfer of control from the first to the second DECS-300.

Protective Functions

There are several protection functions built into the DECS-300 unit. These functions may be used as backup to the primary protection relays and can be assigned to up to four programmable output contacts via the PC software. The protection features offer fully adjustable tripping levels and time delays. The protective features are as follows:

- Generator Overvoltage
- Field Overcurrent
- Field Overvoltage
- Watchdog Timer
- Field Overtemperature
- Loss of Sensing
- Generator Undervoltage

Communications

DECS-300 comes complete with Windows® based PC software. This software makes the programming and customization of the DECS-300 easy and fast. The software comes with a PID selection program that allows the user to select stability settings quickly and easily in a user-friendly format. The PC software has a special monitoring function that allows the user to view all settings, a metering screen for viewing all machine parameters, and a control screen for remote control of the excitation system.

The rear-mounted RS-485 port supports Modbus™ communications protocol. This is an open protocol with all registers and operating instructions available in the instruction manual, to make it simple for the user to develop custom communications software.

Password Protection

All DECS-300 parameters are viewable via the front panel LCD display, the PC software or via Modbus™ without the need of a password. If the user wishes to change a setting, the proper password must be entered to allow access to the parameter. Two levels of password protection exist, one for global access of all parameters and one for a limited amount of access to parameters normally associated with operator control.

CONNECTIONS, continued

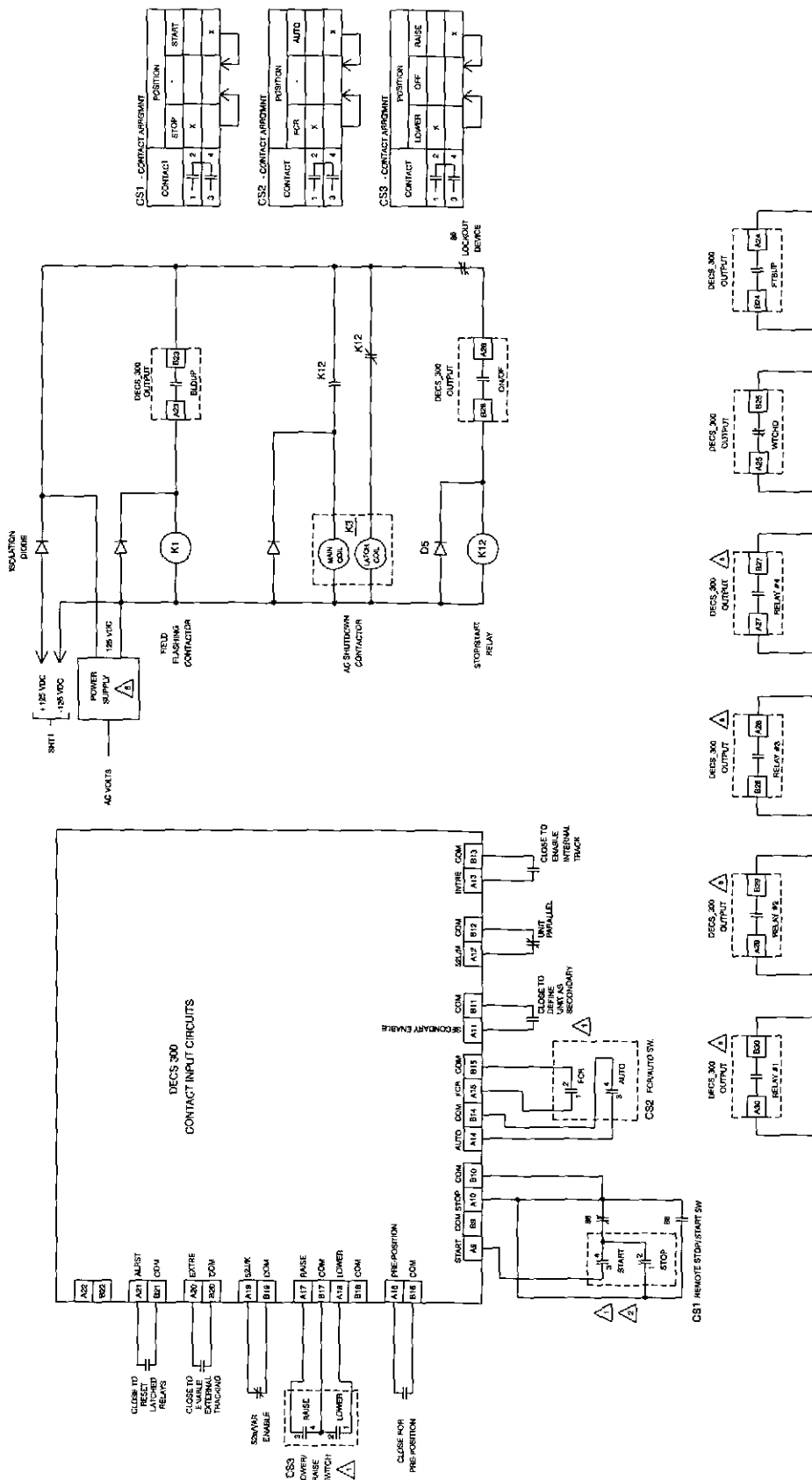
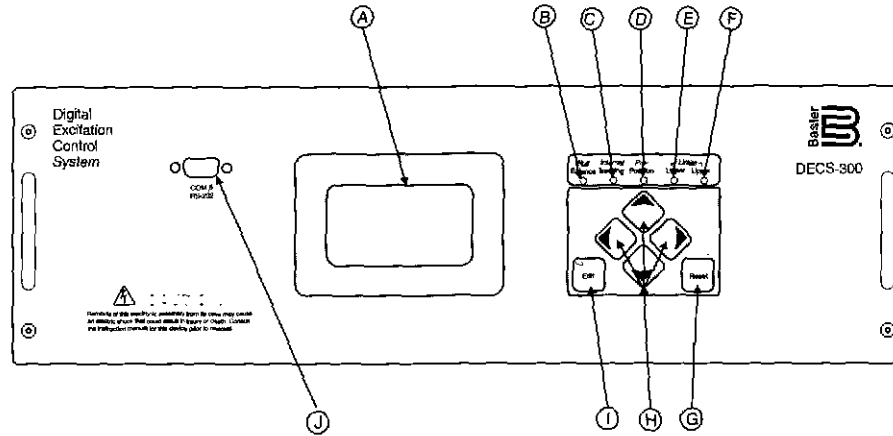


Figure 2 - Typical DC Connection Diagram

FRONT and REAR PANEL VIEWS

The front panel HMI (Human Machine Interface) is composed of several elements, including a backlit LCD screen, six pushbuttons and six LEDs. The LCD is the primary interface because it conveys the majority of the information between the DECS-300 and the user/operator. Front panel pushbuttons allow the user to view menu screens and modify the various screen settings and operating conditions. The LEDs announce their respective states.



- A) 64x128 pixel graphic LCD with backlighting. Primary source for receiving information from the DECS or when locally programming settings. Displays operations, setpoints, loop gains, metering, protection functions, system parameters and general settings.
- B) Null Balance LED – Turns ON when the inactive modes (AVR, FCR, VAR, or PF) match the active mode.
- C) Autotracking LED – All inactive modes (AVR, FCR, VAR, or PF) track the active mode to accomplish the bumpless transfer when changing active modes.
- D) Pre-Position LED – Turns ON at the predefined setting (within the limits of the setpoints) of the current mode.
- E) Lower Limit LED – Turns ON at the minimum setpoint value of the current (active) mode.
- F) Upper Limit LED – Turns ON at the maximum setpoint value of the current mode.
- G) Reset Pushbutton – Cancels editing sessions and can be used as a quick-access to the metering screen.
- H) Scrolling Pushbuttons – Scrolls UP/DOWN/LEFT/RIGHT through the menu tree or when in the EDIT mode, the LEFT/RIGHT scrolling pushbuttons select the variable to change and the UP/DOWN scrolling pushbuttons change the variable.
- I) Edit Pushbuttons – Enables settings changes. When the EDIT pushbutton is first pushed, an LED on the pushbutton turns ON to indicate the edit mode is active. When changes are complete (using the scrolling pushbuttons) and the EDIT pushbutton is pushed again, the LED turns OFF, indicating the changes are saved. If changes are not completed and saved within five minutes, the edit mode is exited without saving changes.
- J) Serial Port COM0 – D-type 9 pin connector. This port is dedicated to RS-232 (ASCII commands) communication with a computer terminal or PC running a terminal emulation program such as BESTCOMS™.

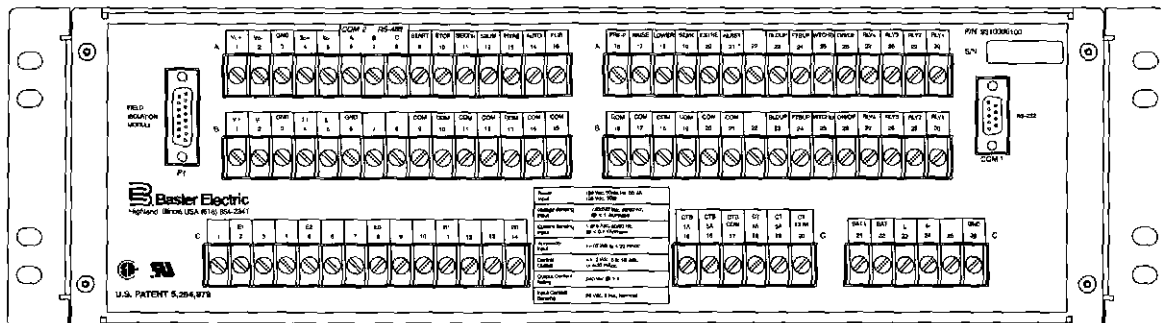
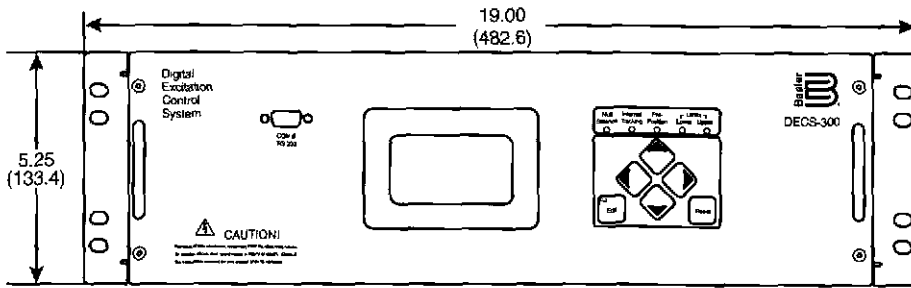
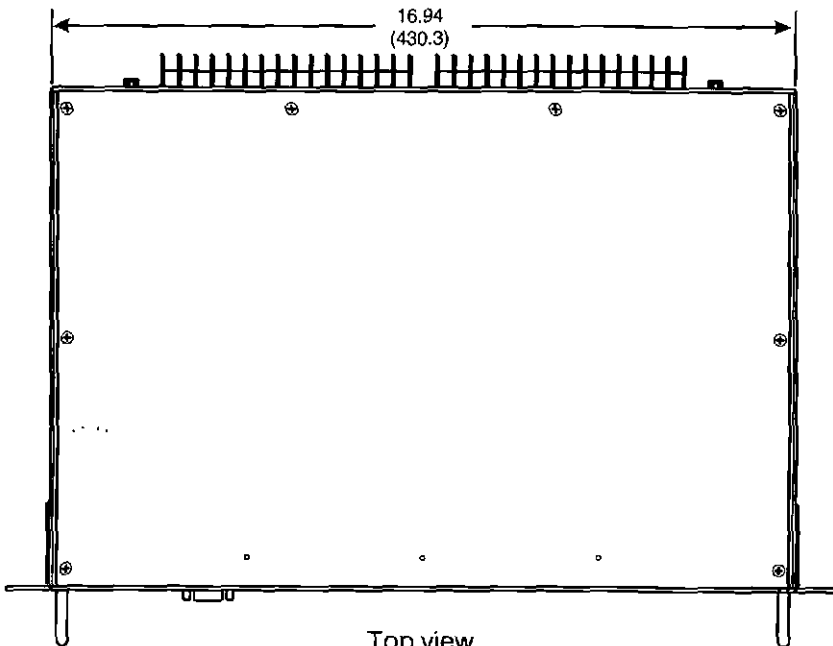


Figure 3 - Rear Panel View

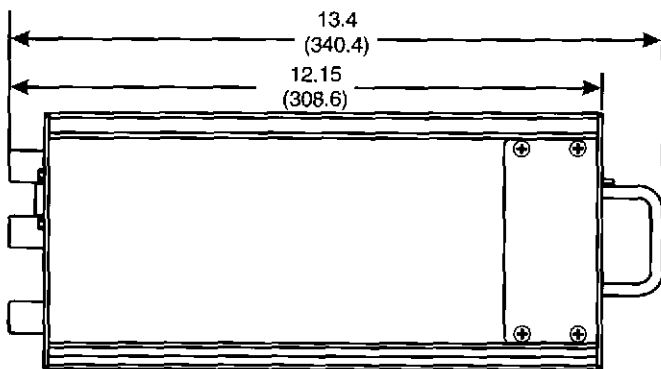
DIMENSIONS



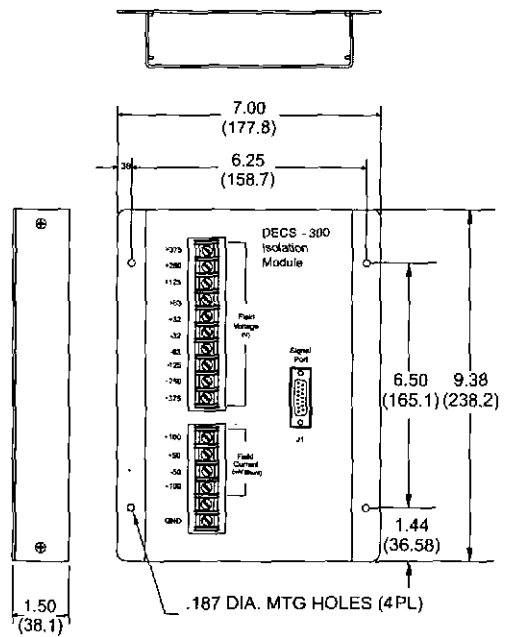
Front view



Top view



Side view



Isolation Module

Figure 4 - Dimensions

CUTOUT/MOUNTING INFORMATION

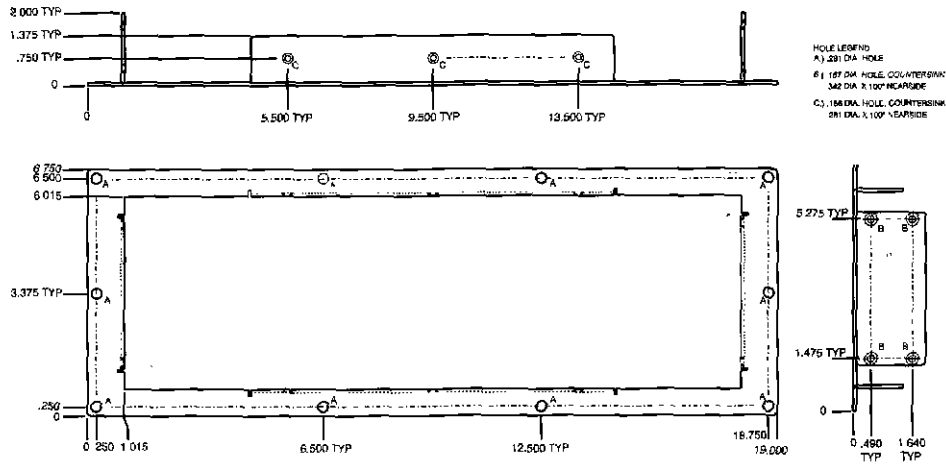


Figure 5 - Front Panel Cutout Dimensions
(Optional front panel mounting bracket, Basler P/N 9310304100)

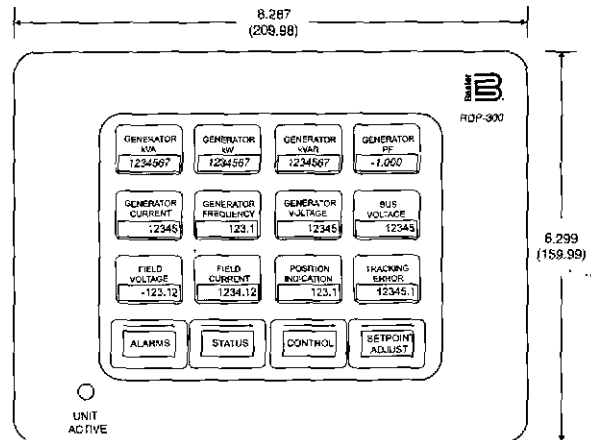
HOW TO ORDER

The DECS-300 is available in one of two power supply ranges. Model number designations are shown below.

Model	Power Supply
DECS-300-L	24/48 Vdc
DECS-300-C	120/125 Vac/Vdc

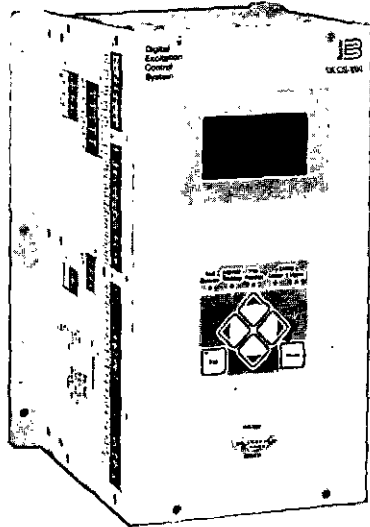
ACCESSORIES

- Front panel mounting bracket, Basler P/N 9310304100.
- Interconnection cable for dual DECS-300 applications, Basler P/N 9310300032.
- RDP-300 Remote Display Panel (shown on right), is a Human-Machine Interface (HMI) used to provide remote control, view metered quantities, and provide annunciation of system status and alarms available from the DECS-300 system. The RDP-300 features a touch-sensitive 6" diagonal monitoring screen, two-wire RS-485 Modbus™ communication protocol, and may be located up to 4000 feet away from the DECS-300. For more details, see Product Bulletin SNE.



Basler Electric





DECS-200 Digital Excitation Control System

One DECS-200 Digital Excitation Control System can accommodate 32Vdc, 63Vdc, or 125Vdc applications up to 15Adc. This unique flexibility provides precision control of generators of virtually any size. The DECS-200 also incorporates a pulse width modulated power stage, which improves system performances in non-linear load applications.

FEATURES

- Microprocessor-based design
- True RMS sensing, single or three phase
- 32Vdc, 63Vdc, and 125Vdc outputs at 15Adc
- 0.25% Voltage Regulation Accuracy
- Setup from front panel HMI or by PC with Windows® setup software included
- 20 standard stability selections
- User customizable stability selection
- Paralleling compensation
- Underfrequency compensation or V/Hz Ratio Limiter
- Soft start buildup
- Field Current Regulation Mode (Manual Mode)
- Autotracking between operating modes and between DECS-200 units (optional)
- Autotransfer to a back-up DECS-200 unit (optional)
- Minimum Excitation Limiter (Internally generated or customizable)
- On and off-line Maximum Excitation Limiters
- Var and Power Factor Controllers
- Exciter Diode Monitoring (EDM)
- Sequence of Events Recording
- Oscillography

(continued on next page)

WINDOWS® SOFTWARE

Interface for setting and communicating with Basler products
Request BESTCOMS™-DECS200-32
(Windows® NT 3.51 or later, 95, 98, or Me)

ADDITIONAL INFORMATION

INSTRUCTION MANUAL

Request Publication 9336900990

**DESCRIPTION and
SPECIFICATIONS**
Pages 2 through 5

**FEATURES and
FUNCTIONS**
Pages 6 and 7

**INTERCONNECT
DIAGRAM**
Page 8

**FRONT, SIDE VIEWS
and DIMENSIONS**
Pages 9 through 11

ORDERING
Page 12

B Basler Electric

P. O. BOX 269 HIGHLAND, ILLINOIS, U.S.A. 62249 PHONE 618-654-2341 FAX 618-654-2351

SZM-2
8-01

FEATURES, continued

- Voltage Matching
- Seven (7) generator protection features
- Programmable output contacts
- Front panel backlit LCD display
- Front panel mounted RS-232 and side RS-485 communications ports
- Modbus™ protocol for RS-485 input allows communications up to 4000 feet away
- <1% metering accuracy for 12 generator parameters
- Remote set point control via:
 - Contact inputs
 - Proportional control via $\pm 10\text{Vdc}$ or 4-20mA
 - Communications inputs RS-232 (ASCII) or RS-485 (Modbus™)
- Meets C37.90.1-1989 for Surge Withstand and Fast Transient
- UL recognized
- U.S. Patent Number 5,294,879

DESCRIPTION

The microprocessor based DECS-200 is a total excitation control system in one enclosure. It contains all the functionality necessary to limit, control, and protect a generator from operating outside of the machine's capability. An optional feature of DECS-200's sophisticated design allows the nonactive control mode within the unit to follow the active mode, permitting bumpless transfer between modes. The optional software also allows for unit-to-unit communication,

permitting autofollowing and transfer between DECS-200 units. It can also communicate to a PC via the front panel RS-232 port for local programming and metering, and it can communicate via Modbus™ protocol via the side RS-485 port for communications up to 4000 feet away from the DECS-200 unit. The DECS-200 has all the features, functionality, flexibility and programmability expected from a state-of-the-art microprocessor based product.

APPLICATIONS

The DECS-200 is an excitation control system used to control the output voltage, vars or power factor of a synchronous generator by varying or controlling the amount of dc excitation applied to the generator's exciter field. The DECS-200 is suitable for virtually any size machine.

SPECIFICATIONS

INPUTS

Control Power (style selectable)

16-60Vdc, Burden=30W. 85-132Vac, 50 or 60Hz, Burden=50VA. 90-150Vdc, Burden=30W.

AC Operating Power

DECS-200 Output	AC Voltage Nominal	1 or 3 Phase Power Input Range (50-400Hz)	Burden
32Vdc	60Vac	56-70Vac $\pm 10\%$	780VA
63Vdc	120Vac	100-139Vac $\pm 10\%$	1570VA
125Vdc	240Vac	190-277Vac $\pm 10\%$	3070VA

NOTE: To achieve the proper DECS-200 output voltage, the associated Operating Power must be provided.

Generator Voltage Sensing

Single-phase or three-phase line voltage, four ranges:

- 100V/50Hz nominal (85 to 127V), 120V/60Hz nominal (94 to 153V)
- 200V/50Hz nominal (170 to 254V), 240V/60Hz nominal (187 to 305V)
- 400V/50Hz nominal (340 to 508V), 400V/60Hz nominal (374 to 600V)
- 500V/50Hz nominal (425 to 625V), 600V/60Hz nominal (510 to 660V)

Bus Voltage Sensing

Single-phase line voltage (AC), four ranges:

- 100V/50Hz nominal (85 to 127V), 120V/60Hz nominal (94 to 153V)
- 200V/50Hz nominal (170 to 254V), 240V/60Hz nominal (187 to 305V)
- 400V/50Hz nominal (340 to 508V), 400V/60Hz nominal (374 to 600V)
- 500V/50Hz nominal (425 to 625V), 600V/60Hz nominal (510 to 660V)

SPECIFICATIONS, continued

- Generator Current Sensing** Two ac current sensing ranges and two channel (phase) inputs:
- 1A, phase B; 1A, phases A or C
 - 5A, phase B; 5A, phases A or C
- Sensing Burden** Voltage: Less than 1VA per phase.
Current: Less than 1VA.
Parallel Compensation: Less than 1VA.
- Contact Switching Inputs** 11 contact switching inputs are supplied with 24Vdc to accommodate dry contacts. Contacts are as follows:
- Start
 - Stop
 - Secondary DECS Enabled (optional)
 - Unit/Parallel Operation
 - AVR Mode
 - FCR Mode
 - Var/PF Enable
 - Pre-position
 - Raise Switch
 - Lower Switch
 - Alarm Rest
- Remote Set Point Control** (Accessory Input) Two separate analog inputs for remote set point control. Typically used to accept a signal from a Power System Stabilizer. Select one from the configuration menu.
- ±10Vdc
 - 4 to 20 milliamperes

OUTPUTS

DC OUTPUT POWER: DECS is available in three standard models to meet the following field requirements.

	DECS-200		DECS-200		DECS-200	
Rated Continuous Field Voltage	32 Vdc	45 Vdc*	63 Vdc	90 Vdc*	125 Vdc	180 Vdc*
Rated Continuous Field Current	15 Adc	15 Adc	15 Adc	15 Adc	15 Adc	15 Adc
Rated 10 Second Forcing Voltage*	50 Vdc	75 Vdc*	100 Vdc	150 Vdc*	200 Vdc	300 Vdc*
Rated 10 Second Forcing Current	30 Adc	30 Adc	30 Adc	30 Adc	30 Adc	30 Adc
Minimum Field Resistance	2.13 Ohm	3.0 Ohm*	4.2 Ohm	6.0 Ohm*	8.3 Ohm	12.0 Ohm*

NOTE: Above parameters with nominal RMS power input.

*These areas indicate D.C. output levels that may be up to 50% greater than listed if:

- 1) 3 phase input power is used, or
- 2) Field current is significantly lower than that listed.

Contact Output Ratings

- 7.0 Amps 120/240Vac, 24Vdc
- 0.7 Amps 48Vdc
- 0.2 Amps 125Vdc

Contacts are as follows:

- Watchdog
- Start/Stop
- Relay #1
- Relay #2
- Relay #3

COMMUNICATION

There are three communication ports, two RS-232 and one RS-485:

COM0: RS-232, 9 pin, sub-D connector located on front panel and used to communicate with local computers. 1200 to 19200 baud, 8N1 full duplex, ASCII commands

COM1: RS-232, 9 pin, sub-D connector located on right side panel and used to connect primary and backup DECS-200 units or other devices. 1200 to 19200 baud, 8N1 full duplex, unique ASCII commands, only used for optional autotracking

FEATURES/FUNCTIONS

Voltage Regulation

The DECS-200 regulates the generator RMS voltage to within 0.25% from no-load to full-load. It does this by utilizing digital signal processing and precise regulation algorithms developed by Basler Electric, utilizing the experience gained in many years of manufacturing tens of thousands of digital voltage regulators.

Stability

The DECS-200 utilizes proportional (P), integral (I) and derivative (D) stability control. DECS-200 has 20 pre-programmed stability (PID) settings for exciter field applications. This means that a standard stability setting is already available for most applications/machines. The DECS-200 has a stability range that allows for customizing the stability settings to fine tune the stability to provide optimum customized generator transient performance. Setup software contains PID selection program to assist in determining the correct PID settings. The DECS-200 provides for customizing the stability and transient performance of the Min/Max Excitation Limiter and var/PF controllers by providing additional stability adjustments.

Underfrequency Limiter or V/Hz Ratio Limiter

DECS-200 is selectable for either Underfrequency Limiter or a V/Hz Ratio Limiter function. The under-frequency limiter slope can be tuned to have 0 to 3 times p.u. Volts/Hz, in 0.1Hz increments, and the corner frequency roll-off point can be set across a range of 45 to 65Hz, in 0.1Hz increments. This adjustability allows the DECS-200 to precisely match the operating characteristics of the prime mover and the loads being applied to the generator. The Volts/Hz Ratio Limiter clamps the regulation set point to prevent operation above a V/Hz level that is prescribed by the slope of the DECS-200. This feature is also useful for other potentially damaging system conditions such as a change in system voltage and reduced frequency situations that exceed the V/Hz ratio.

Soft Start Voltage Buildup

Generator voltage overshoot can be harmful to the generator's insulation system if not controlled. DECS-200 has a soft start feature with a user-adjustable setting to govern the rate at which the generator voltage is allowed to build up. This prevents the generator voltage from overshooting nominal voltage levels during start-up of the generator system.

Paralleling Compensation

DECS-200 has provisions to parallel two or more generators using reactive droop or reactive differential compensation with the addition of an external current transformer with secondary currents of 1 or 5Aac. The current input is rated at less than 1VA. This low burden means that existing metering CTs can be used and dedicated CTs are not required.

Set Point Control

DECS-200 has means for external set point adjustment of the controlling mode of operation. This eliminates the need

for additional equipment like motor operated potentiometers for remote control or multiple point control for the excitation system. The operating mode's set point may be directly controlled by raise/lower contact inputs, auxiliary inputs of 4-20mA or ± 10 Vdc. The auxiliary input adjusts the operating mode across its predetermined adjustment range. The auxiliary input can be provided from other controlling devices such as a power system stabilizer. These devices modify the operation of the DECS-200 to meet specific operating characteristics and requirements for the machine under DECS-200 control. Two more methods of set point control may be achieved via the RS-232 communication port by using the Windows® based PC software or by the RS-485 port using Modbus™ protocol. Regardless of which method of set point is used (contact inputs, auxiliary input or communications with a PC or PLC), traverse rates of all modes of operation are independently adjustable. This means an operator can customize the rate of adjustment and "feel" to meet his/her needs.

Pre-position Inputs

DECS-200 provides the added flexibility of allowing a predetermined operating point for each mode of operation. With a contact input to the DECS-200, the operating mode is driven to an operating or regulation level assigned to that operation mode by the operator or user. The pre-position inputs operate in one of two modes, Maintain or Release. The Maintain mode prevents adjustment of the setpoint as long as the pre-position contact is closed. The release mode allows adjustment of the setpoint even though the pre-position is closed. This feature allows the DECS-200 to be configured for specific system and application needs.

Field Current Regulation Operating Mode

DECS-200 provides a manual channel of operation called Field Current Regulation, or FCR, Mode. In this mode, DECS-200 regulates the field current generated by the internal PWM power stage. It does not rely on the sensing input to DECS-200 and is, therefore, a good source of backup excitation control when loss of sensing is detected. In this mode, control of the generator is totally dependent upon the operator to maintain nominal generator voltage as the load varies on the generator.

Var/Power Factor Controller Operating Mode

DECS-200 has, as another standard feature, two modes of operation when the generator is in parallel with the utility power grid. The DECS-200 has both var and PF modes of operation. When the generator is in parallel with the utility grid, the DECS-200 can regulate the var output of the generator to a specific var level magnitude or it can vary the var output of the generator to maintain a specific power factor as the kW load varies on the generator.

Maximum Excitation Limiters

Each DECS-200 has integrated over/underexcitation limiters. Overexcitation limiters are present for both on-line and off-line excitation levels. This feature provides maximum overexcitation protection by having different settings for off-line operation where load levels require lower levels of excita-

FEATURES/FUNCTIONS, continued

tion. When lower excitation levels are needed, lower limiter settings are required to properly protect the generator.

Minimum Excitation Limiter

The minimum excitation limiter limits the amount of excitation supplied to the field of the generator from dropping below unsafe operating levels. This prevents the machine from possibly slipping poles and from damaging the machine. It limits the amount of vars being absorbed by the machine, based on user-definable settings.

An internally generated Underexcitation Limiting (UEL) curve can be utilized based on a var level at 0kW, or a customizable 5 point UEL curve can be selected to match specific generator characteristics.

Internal Autotracking Between DECS-200 Operating Modes

DECS-200 is an intelligent device that can provide autotracking (autofollowing) of the controlling mode by the non-controlling modes. This allows the operator to initiate a controlled, bumpless transfer of the DECS-200 operating modes, causing minimum amounts of line disturbance for the power system. This feature can be used in conjunction with a set of protective relays to initiate a transfer to a backup mode of operation, such as FCR mode, upon the detection of a system failure or fault, i.e., loss of sensing.

External Autotracking between Dual DECS-200 Units (Optional)

A DECS-200 can also follow (autotrack) a second DECS-200 unit. The second DECS-200 is put into a specific operating mode and follows the excitation level of the first. In the unlikely event of a failure of the first DECS-200, protective relays can initiate a transfer of control from the first to the second DECS-200.

Protective Functions

There are several protection functions built into the DECS-200 unit. These functions may be used as backup to the primary protection relays and can be assigned programmable output contacts via the PC software. The protection features offer fully adjustable tripping levels and time delays. The protective features are as follows:

- Generator Overvoltage
- Generator Undervoltage
- Field Overvoltage
- Field Overcurrent
- Watchdog Timer
- Loss of Sensing
- EDM Exciter Diode Monitor

Sequence of Events Recording (SER)

A sequence of event report (SER) is a very powerful tool when reconstructing the exact timing of an event or disturbance. The DECS-200 monitors its contact inputs and outputs for a change of state, system operation changes, and alarm conditions. If any of these events occurs, the DECS-200 will log that event with a date and time stamp. Date and time stamping of the event allows the user to

recreate a chain of events in the sequence in which they occurred. The DECS-200 can store 128 events in volatile memory, and those events are retrievable using BESTCOMS.

Oscillography (See Figure 6)

The data recording feature can record up to eight (8) oscillographic records stored in volatile memory. The user can select up to six (6) variables to be monitored when triggered by the DECS-200 BESTCOMS, a Logic Trigger, or a Level Trigger. Variables that can be selected are: generator voltage, current (single phase), frequency, kW, Power Factor, exciter field voltage, and current.

The user can utilize the DECS-200 BESTCOMS to trigger and save a record of a voltage step response during commissioning. Once commissioned, a logic trigger or level trigger can be used to activate the data recorder to capture the occurrence for review at a later time. DECS-200 alarms can also be used to start the data recorder. When an alarm condition occurs, an oscillographic record can be stored. A level trigger will initiate a record to be saved when a variable exceeds a predetermined setting. An example of this is when the exciter field current exceeds a predetermined setting.

The oscillographic records are recorded in accordance with the IEEE Standard Common Format for Transient Data Exchange (COMTRADE). Basler Electric can provide BESTWAVE, a COMTRADE viewer, which is a program that will allow the user to view the oscillography records saved by the DECS-200.

Communications

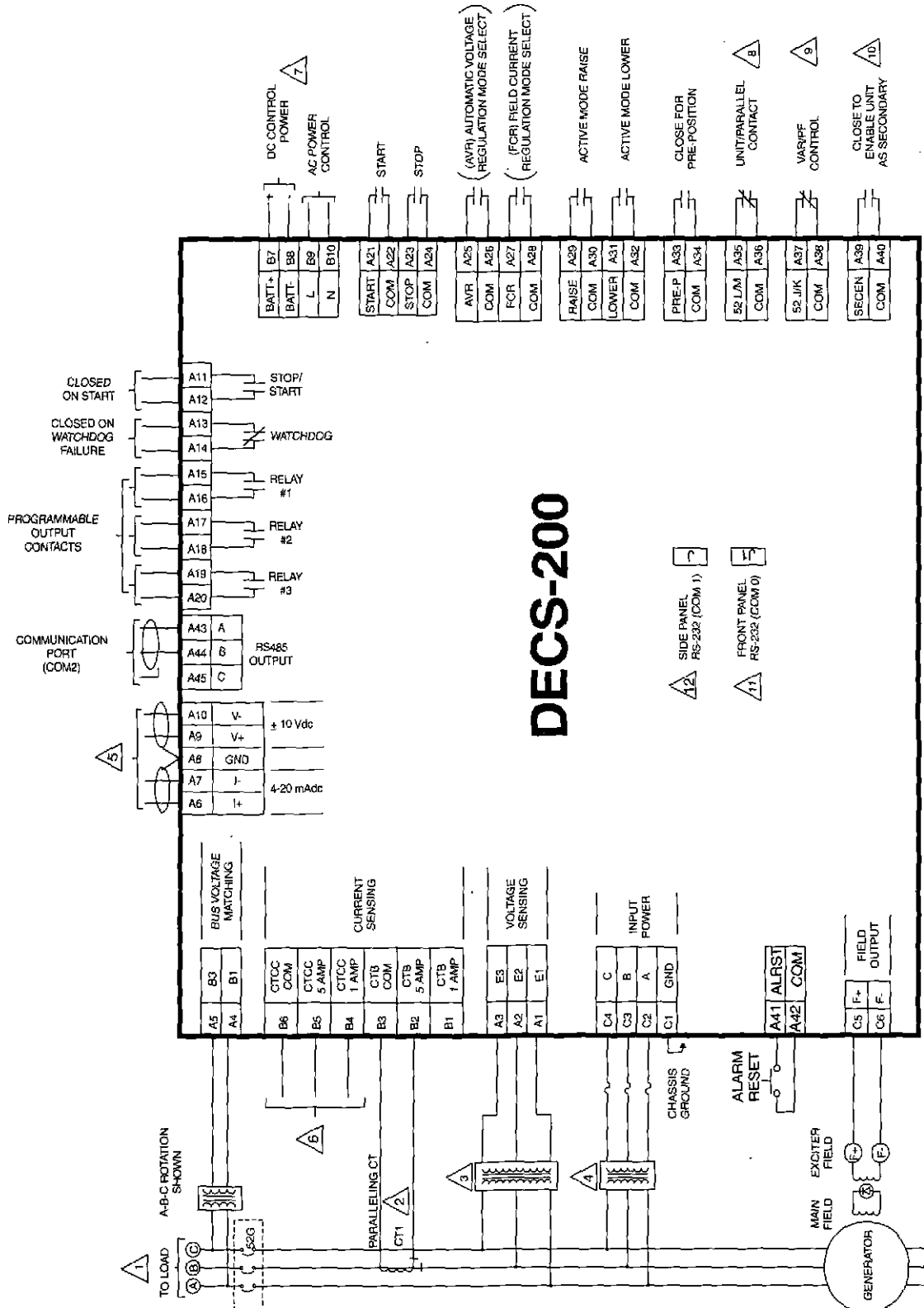
DECS-200 comes complete with Windows® based PC software. This software makes the programming and customization of the DECS-200 easy and fast. The software comes with a PID selection program that allows the user to select stability settings quickly and easily in a user-friendly format. The PC software has a special monitoring function that allows the user to view all settings, a metering screen for viewing all machine parameters, and a control screen for remote control of the excitation system.

The RS-485 port supports Modbus™ communications protocol. This is an open protocol with all registers and operating instructions available in the instruction manual, to make it simple for the user to develop custom communications software.

Password Protection

All DECS-200 parameters are viewable via the front panel LCD display, the PC software or via Modbus™ without the need of a password. If the user wishes to change a setting, the proper password must be entered to allow access to the parameter. Two levels of password protection exist, one for global access of all parameters and one for a limited amount of access to parameters normally associated with operator control.

CONNECTIONS



- NOTES:**
1. PHASE SEQUENCE: A B C SHOWN.
 2. CURRENT SENSING INPUT, 1 OR 5 AMPS, 50/60 HZ, @ <math><0.1\text{ VA/PHASE}</math>.
 3. VOLTAGE SENSING INPUT, 120/240/480/600 VAC, 50/60 HZ, @ <math><0.1\text{ VA/PHASE}</math> POTENTIAL TRANSFORMERS REQUIRED IF LINE VOLTAGE EXCEEDS 600 VAC.
 4. OPERATING POWER INPUT, REFERENCE SPECIFICATIONS FOR VOLTAGE RATINGS, FOR SINGLE PHASE OMIT ONE PHASE.
 5. ACCESSORY INPUT, $\pm 10\text{Vdc}$ OR $4\text{-}20\text{mAdc}$.
 6. CROSS CURRENT COMPENSATION CURRENT INPUT, 1 OR 5 AMPS, 50/60 HZ, @ <math><0.1\text{ VA/PHASE}</math>.
 7. CONTROL POWER INPUT.
 8. UNIT/PARALLEL CONTACT CLOSED FOR UNIT, OPEN FOR PARALLEL OPERATION.
 9. VARIPF CONTROL, OPEN TO ENABLE VAR OR PF FUNCTION.
 10. INPUT CONTACT TO ENABLE UNIT AS SECONDARY WHEN OPERATING IN REDUNDANT MODE.
 11. PORT USED FOR COMMUNICATION WITH COMPUTER, (BESTCOMS SOFTWARE).
 12. PORT USED FOR COMMUNICATION CONNECTION TO ANOTHER DECS-200 WHEN USED IN REDUNDANT MODE OPERATION.

Figure 1 - Typical AC Connection Diagram

DIMENSIONS

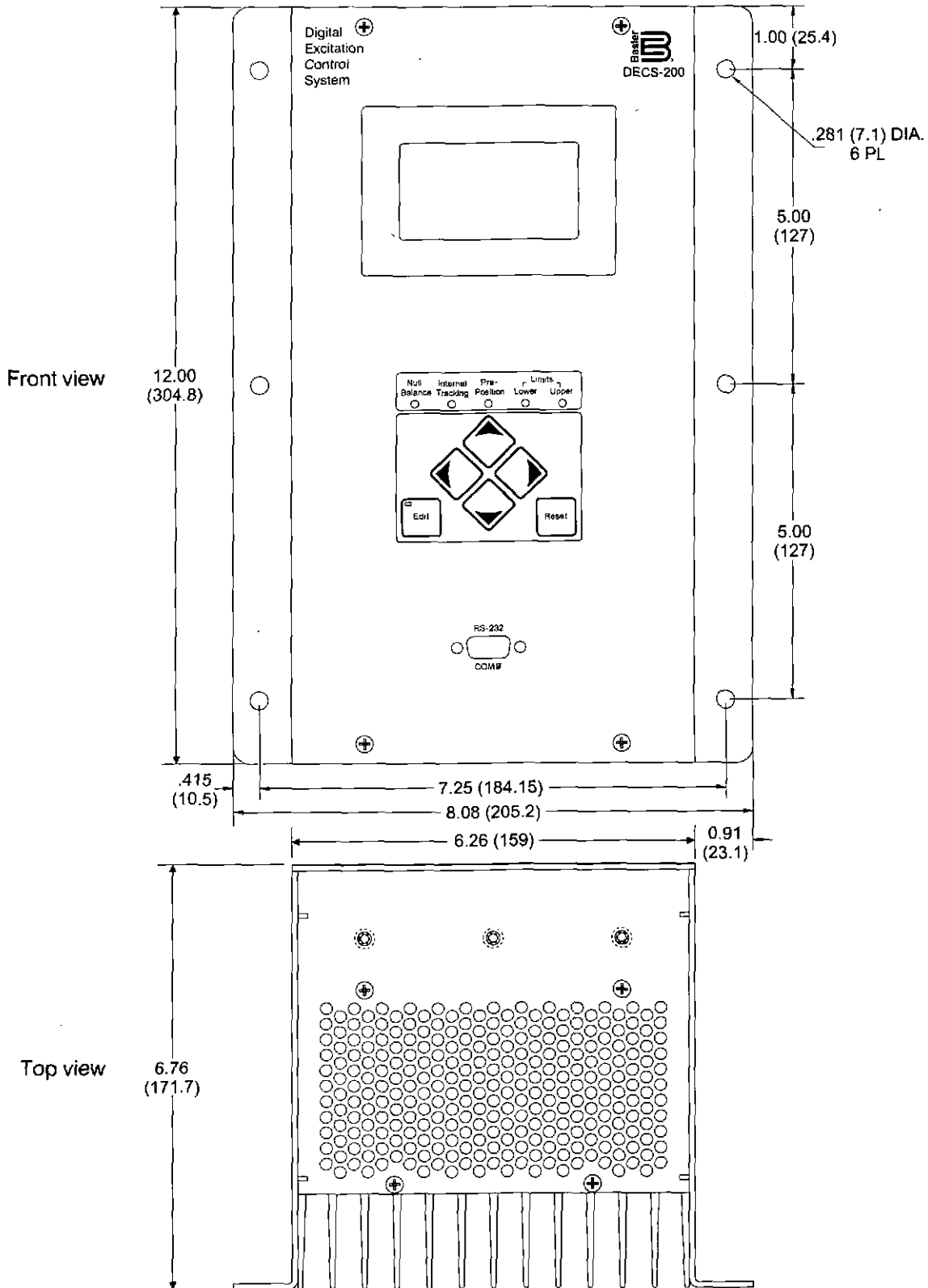


Figure 3 - Dimensions

ACCESSORIES

- Front panel mounting bracket, Basler P/N 9336905100. See Figure 4.
- Interconnection cable for dual DECS-200 applications, Basler P/N 9310300032.

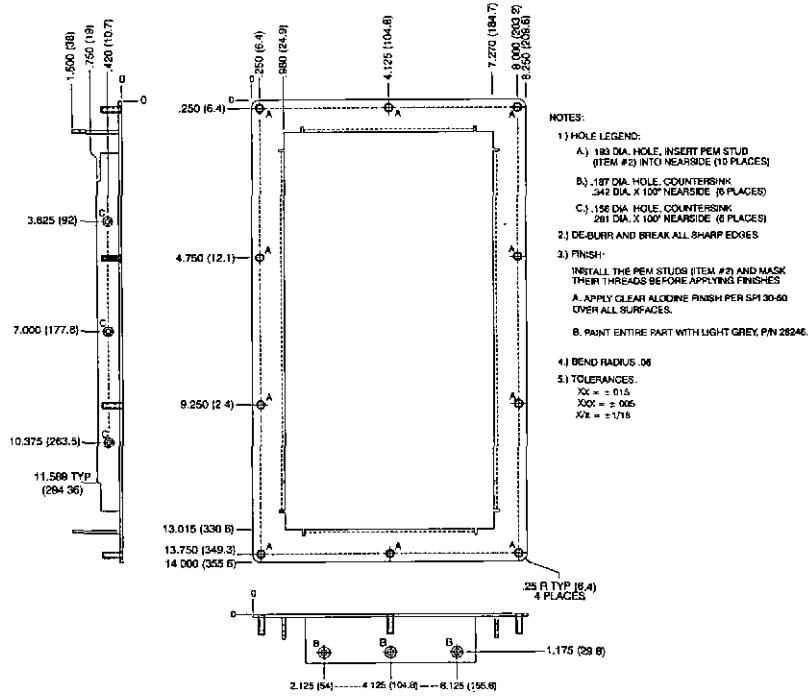


Figure 4 - Front Panel Mounting Bracket, P/N 9336905100

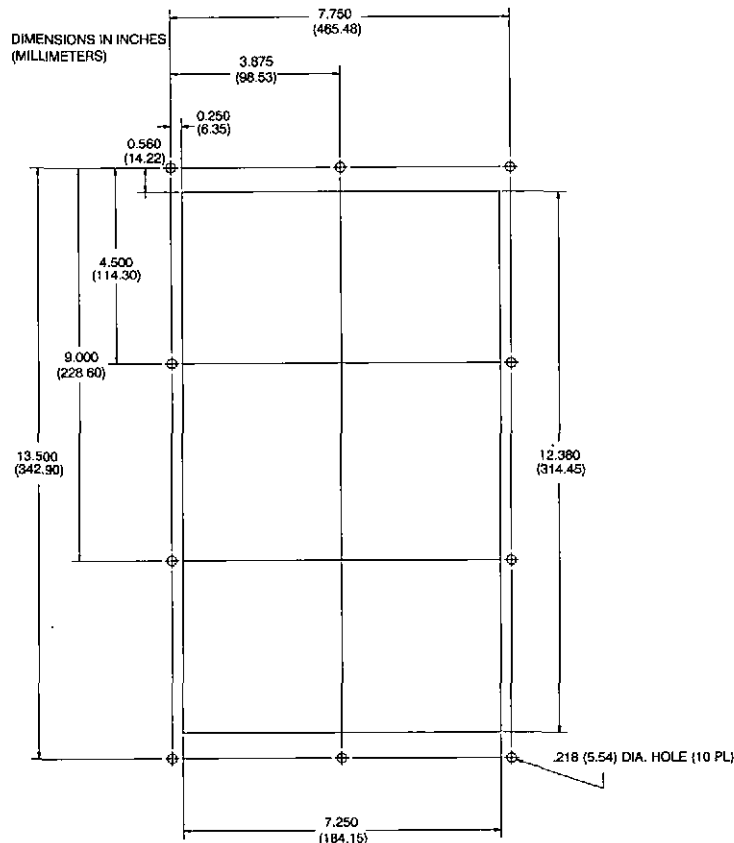
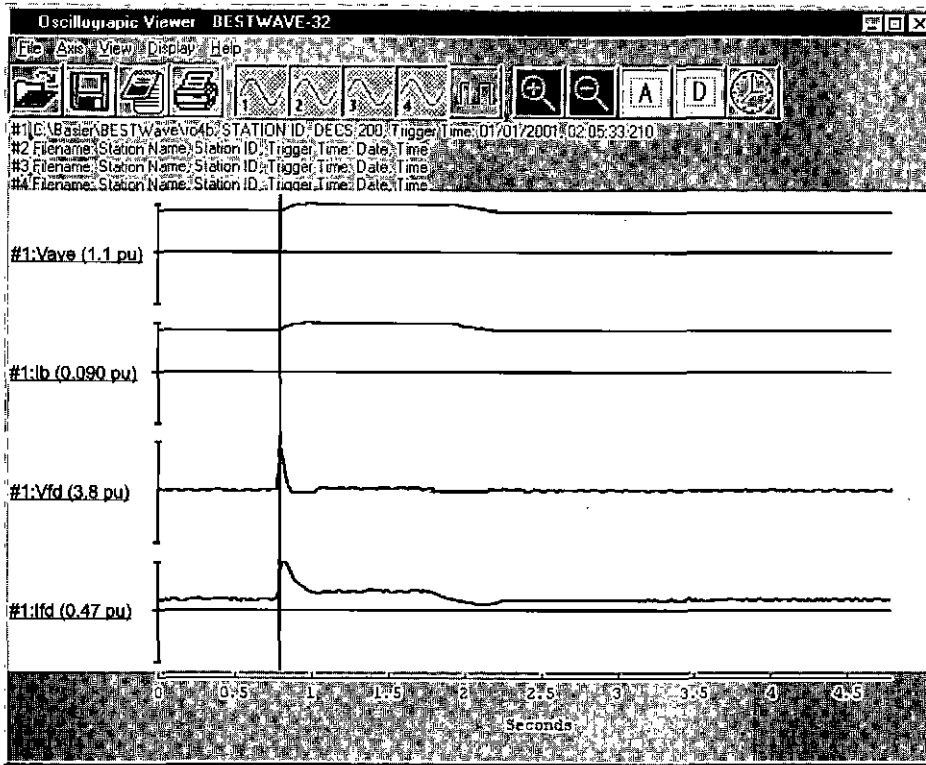


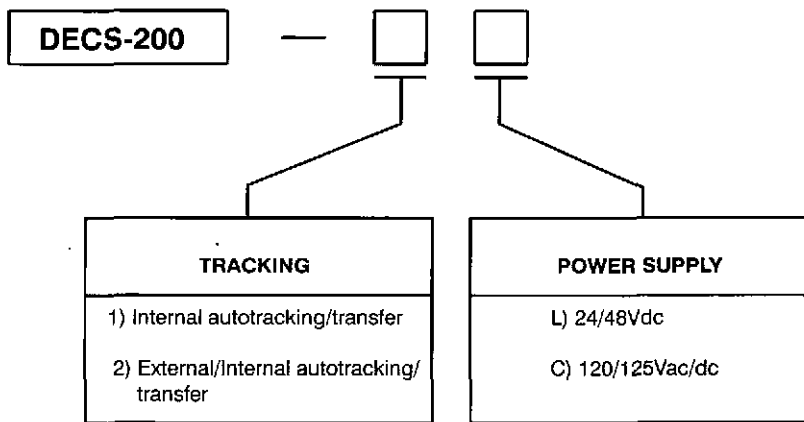
Figure 5 - Front Panel Cutout Dimensions
(Requires mounting bracket shown in Figure 4.)



P0007-18.CDR
06/10/01

Figure 6 - BESTCOMS Oscillography

HOW TO ORDER



B Basler Electric

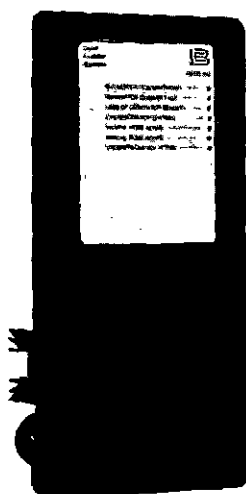


ROUTE 143, BOX 269, HIGHLAND, ILLINOIS U.S.A. 62249
 PHONE 618-654-2341 FAX 618-654-2351

P.A.E. Les Pins, 67319 Wasselonne Cedex FRANCE
 PHONE (33-3-88) 87-1010 FAX (33-3-88) 87-0808

<http://www.basler.com>, info@basler.com

Printed in U.S.A.



DECS-100 Digital Excitation Control System

Basler Electric offers a high powered, low-cost digital excitation control system, the DECS-100. This environmentally rugged product is ideally suited for controlling the output of brushless excited synchronous generators up to 5MW. The DECS-100 has a very impressive 7Adc output from a pulse width modulated power stage. The DECS-100 is perfect for machines that will be paralleled to other generators and/or to the utility system. It is ideal for distributed generation, co-generation and peak shaving applications. The DECS-100 is easy to use, and it has communications capability with a PC or a personal data assistant running Palm OS® 3.3 or newer software. The DECS-100 utilizes microprocessor technology and control algorithms pioneered by Basler Electric over the last 12 years. It shares many features and functions of our larger excitation control systems. The DECS-100 is Basler Electric's fifth generation of microprocessor-based excitation system.

FEATURES

- Microprocessor based
- 0.25% Voltage Regulation Accuracy
- 0.5% accuracy up to 40% THD (harmonics associated with 6 SCR load)
- 63Vdc @ 7Adc PWM output
- 0-3X V/Hz limiting
- Soft Start capability
- 20 standard stability selections and one customizable selection
- VAR/PF control
- Overexcitation limiting
- Voltage Matching
- Manual Mode (Field current regulation)
- Paralleling input from 1 or 5A CT secondaries
- Nominal sensing inputs of 120, 240, 480 and 600Vac
- Power Input from 50/60Hz shunt connections or PMGs operating at 50 to 400Hz
- Five generator protection functions including Loss of Sensing transfer to manual
- Alarm Contact Output
- Accessory input
- LED Annunciation of operating conditions
- Setup via PC or a PDA using Palm OS® 3.3 or newer via BESTCOMS software (included)
- UL recognized
- CSA approved
- CE compliant

WINDOWS® SOFTWARE

Interface for setting and communicating with Basler products
Request BESTCOMS™-DECS100-32
(Windows® NT 3.51 or later, 95, 98, or Me)

ADDITIONAL INFORMATION

INSTRUCTION MANUAL

Request Publication 9287500991

**DESCRIPTION and
SPECIFICATIONS**
Pages 2 and 3

**FEATURES and
FUNCTIONS**
Page 4

**INTERCONNECT
DIAGRAM**
Page 6

DIMENSIONS
Page 7

ORDERING
Page 8

**Basler Electric**

P. O. BOX 269 HIGHLAND, ILLINOIS, U.S.A. 62249 PHONE 618-654-2341 FAX 618-654-2351

SZN-1
1-01

DESCRIPTION

The DECS-100 is a microprocessor-based regulation system designed to control the output of a brushless excited synchronous generator. The DECS-100 is perfect for paralleling applications where generator to generator and/or generator to utility paralleling occurs with VAR/PF control and Overexcitation Limiting. The

DECS-100 offers high functionality, communications, and performance at an extremely affordable price. The DECS-100 is very rugged and offers an extremely robust mechanical design that is UL recognized, CSA approved, and CE compliant.

SPECIFICATIONS

INPUTS

Power Input

Voltage:	88-250Vac
Phase:	Single- or three-phase
Burden:	650VA
Frequency:	50 to 400Hz
Minimum Build-up Voltage:	6.0Vac

Sensing Input

Nominal Voltage Input:	100/120, 200/240, 400/480, 600Vac, Single- or three-phase
Burden:	<1VA
Current Input:	1 or 5 Amp (two models)
Burden:	<1 VA
Frequency:	50/60Hz

Accessory Input

± 1 Vdc creates a $\pm 10\%$ adjustment for AVR, FCR and VAR
 ± 1 Vdc creates a ± 0.1 PF adjustment in the PF mode
(adjusts only the active regulation mode)

OUTPUTS

DC Output

Continuous voltage:	63Vdc
Continuous current:	7.0Adc
10 second Forcing Voltage:	135Vdc (with nominal input applied)
10 second Forcing Current:	15.0Adc
Minimum Field Resistance:	9 Ohms

Alarm Contact Output

Dry Contact Rated: 120/240Vac - make 30A for 0.2S, carry 7A continuously, break 0.1A inductive

REGULATION ACCURACY

Regulation accuracy:	$\pm 0.25\%$ no load to full load
Temperature drift:	$\pm 0.5\%$ for a 40°C change in one hour
Response time:	<1 cycle to the limit of the A/D converter
THD:	$\pm 0.25\%$ for 20% THD and $\pm 0.5\%$ for 40% THD (distortion as seen with a 6 SCR load)

SPECIFICATIONS, continued

AGENCY APPROVALS

UL 508	"Industrial Control Equipment"
CSA C22.2 Number 14	"Industrial Control Equipment"
CE	EMC and LVD

MECHANICAL SPECIFICATIONS

Operating temperature:	-40°C to +70°C
Storage temperature:	-40°C to +80°C
Shock:	20 Gs in three mutually perpendicular planes
Vibration:	5-26Hz, 1.2Gs 27-52Hz, 0.036 inch double amplitude 53-500Hz, 5.0G
Salt Fog:	Per MIL-STD-810E, Method 509.3, 48 hours of testing
Weight:	2.42 lbs. (1.10 kg)
Shipping weight:	2.88 lbs. (1.31 kg)
Dimensions:	5.34" (135.6mm) wide x 10.82" (274.8mm) high x 2.84" (72.1mm) deep

ADJUSTMENTS

Adjustment Ranges

AVR Mode:	100/120, 200/240, 400/480, 600Vac
Fine Voltage Adjustment:	0-15% of nominal in 0.1% steps
Manual (FCR) Mode:	0.7Adc in 0.01Adc steps
VAR Mode:	-100 lead VAR to +100 lag VAR in 0.1% steps
PF Mode:	-0.6PF lead to +0.6PF lag in 0.001PF steps
OEL:	Instantaneous limit: 15A in 0.001Adc steps Time Delay to shutdown: 0-10 seconds in integer steps
Volts per Hertz:	Slope, 0-3V/Hz in 0.1V/Hz increments (See Figure 1) UF kneepoint, 40-65Hz in 0.1Hz increments
Parallel Droop:	0-10% in 0.01% increments
Softstart:	Generator Bias (beginning generator voltage) Time: 0-7200 seconds in 1 second steps
Voltage Matching Speed:	0-300 seconds in 0.01 second steps

Adjustment Methods

- Contact inputs (one for raise and one for lower)
- Auxiliary input ± 1 Vdc
- PC via BESTCOMS
- PDA via BESTCOMS

FEATURES/FUNCTIONS

PWM Power Stage

A 7.0A dc power stage provides fast response and great immunity to noise and sine wave distortion created by non-linear loads and makes the DECS-100 tolerant to many applications previously considered uncontrollable.

Sensing Input

The sensing input takes nominal voltage up to 600Vac without requiring expensive potential transformers. The adjustment range is capable of being controlled in 0.1Vac steps. This means that circulating current on paralleled generators, due to overly coarse adjustment steps, is no longer an issue.

Stability

20 standard stability ranges are provided, as well as one customizable stability range for customized performance. The PC BESTCOMS software provides PID selection software and a sophisticated response time program to facilitate verification of stability performance.

Front Panel Annunciation

The DECS-100 provides seven LEDs to indicate generator system and DECS-100 conditions without requiring connection to the communications device.

Protection

Four protection functions have the ability to be user-programmed to shut down the DECS-100 and close the alarm contact. They are:

- Generator Overvoltage
- Loss of Generator Voltage*
- Overexcitation Voltage
- Overexcitation Limiting

* Loss of sensing transfer is also selectable by the user in lieu of shutdown due to Loss of Sensing.

Overexcitation Limiting

This feature limits the output current of the DECS-100 to predetermined levels that are safe for the exciter/generator. There are adjustments for current threshold and time delay to customize the performance of the DECS-100 to meet the system's needs.

Voltage Matching

This function allows the DECS-100 to match the generator voltage. This feature replaces the same function in the automatic synchronizer, thereby saving money by allowing the use of a less expensive synchronizing device.

Softstart

Softstart functions as a voltage limiter during generator build-up. It limits the generator voltage overshoot typically present when machines are initially started.

VAR/PF Control

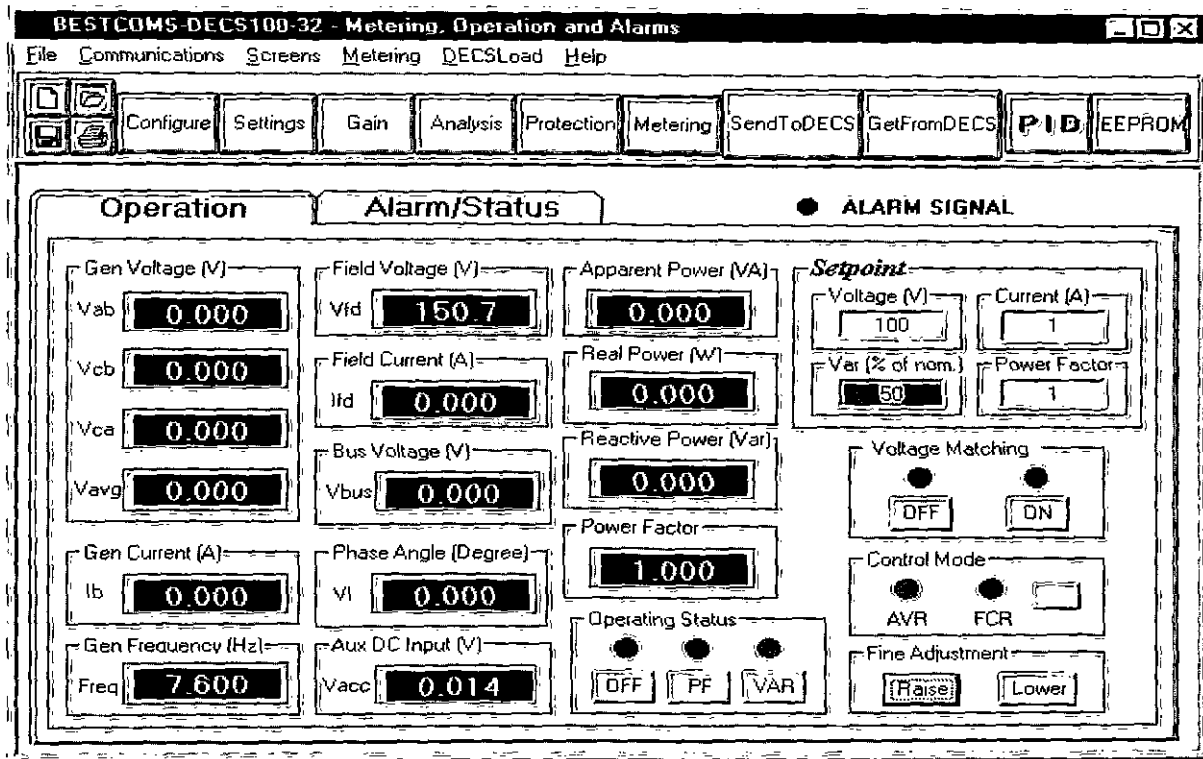
Integrated VAR/PF controls save the user the cost of purchasing and installing remote devices that perform the same functions. This function is typically used on utility-paralleled generators that cannot control the grid voltage. Once set, the VAR or PF of the generator output will be regulated.

External Adjustments

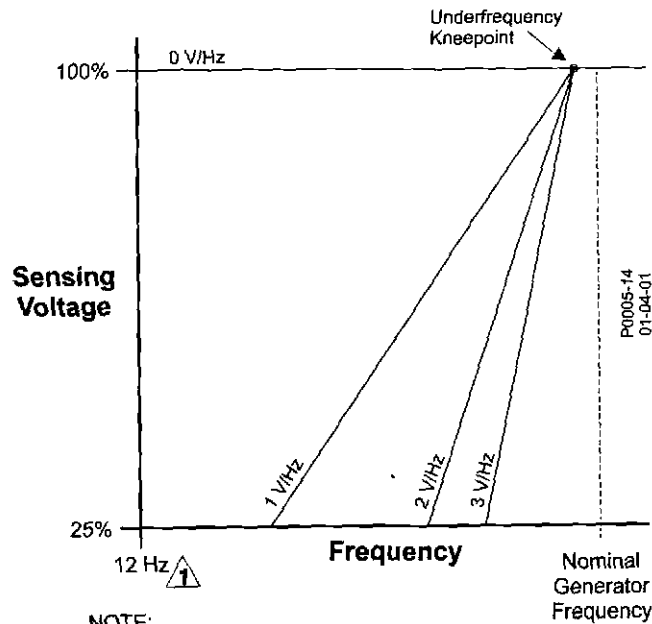
The DECS-100 allows for multiple points and methods of external adjustment of the active regulation mode. There are four methods for adjustment: contact input, auxiliary voltage input, PC adjustment, or PDA device operating on Palm OS® 3.3 or newer. The PC and Palm OS® 3 communications also can change operating modes and set points.

Communications

PC (Windows® 95, 98, NT, Me compatible) and PDA (or equivalent device using Palm OS® 3.3 or newer) communications software is provided by Basler Electric with the DECS-100. The PC BESTCOMS allows for total setup, control, and monitoring of all parameters of the DECS-100. The PC BESTCOMS allows for custom PID selection and has a monitoring screen for viewing all of the generator parameters in actual machine levels. The Palm OS® 3 BESTCOMS allows for most of the PC-based features while using a low cost communications tool. Both methods use the RS-232 DB9 connector located on the DECS-100. Both software packages are provided with every DECS-100 on a single CD-ROM along with the instruction manual and product bulletin.



Typical BESTCOMS PC Software Screen



NOTE:

⚠ DECS operation is not specified below 12Hz. Power must be removed below this frequency.

Figure 1 - Typical Volts per Hertz Curve

CONNECTIONS

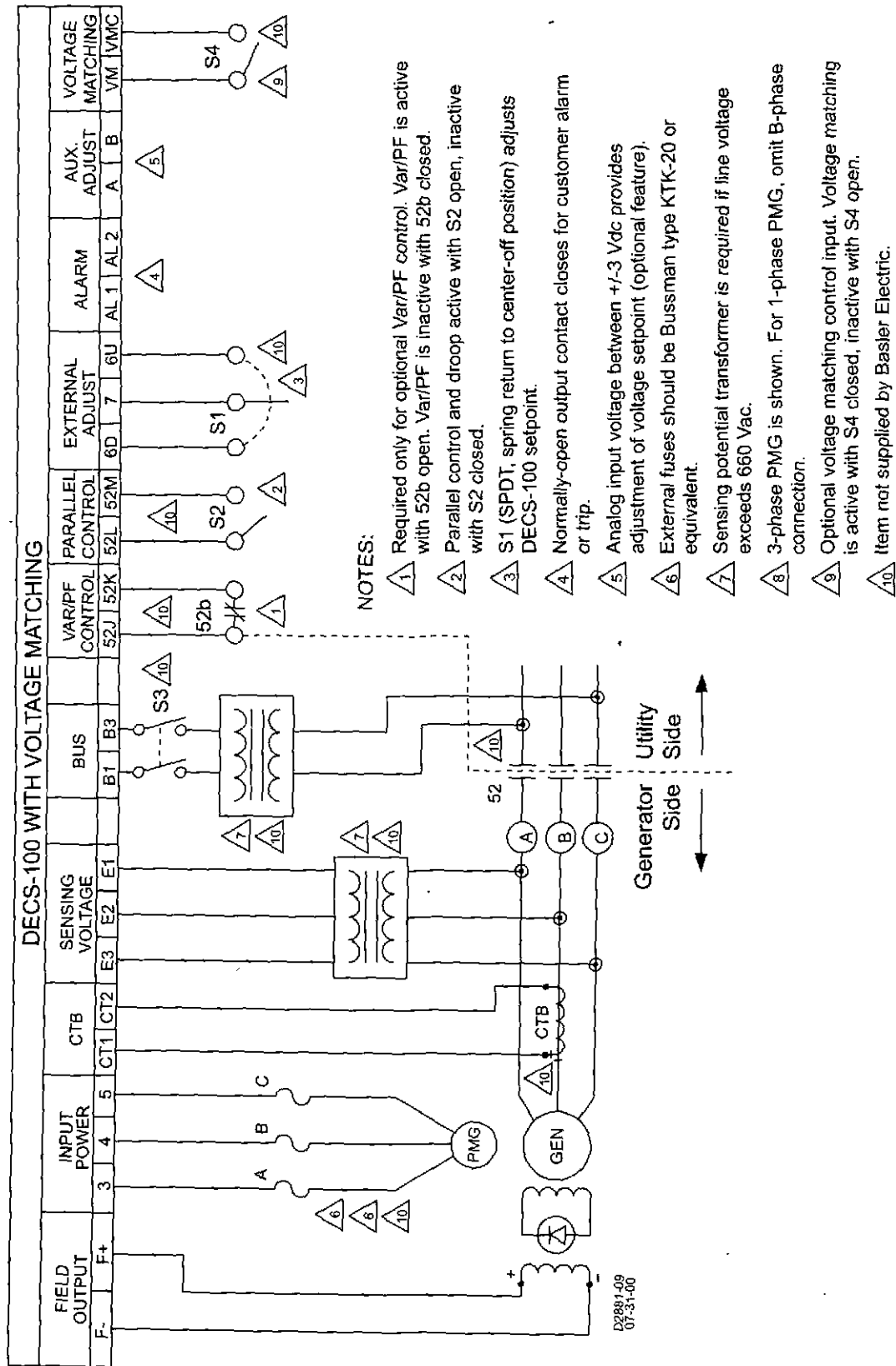


Figure 2 - Typical Connections for PMG Application with ABC Rotation and Three-Phase Sensing

DIMENSIONS

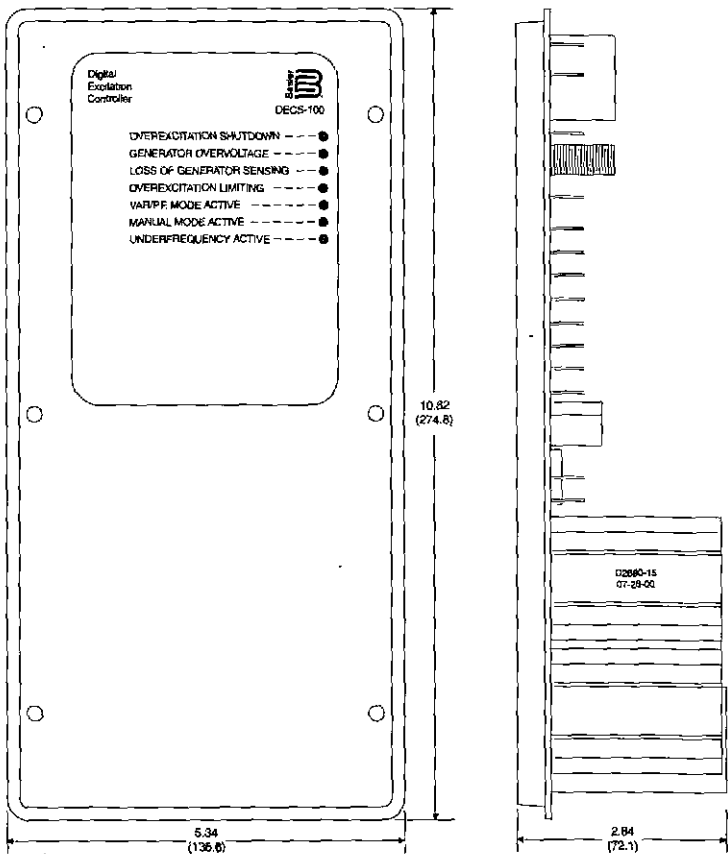


Figure 3 - DECS-100 Dimensions

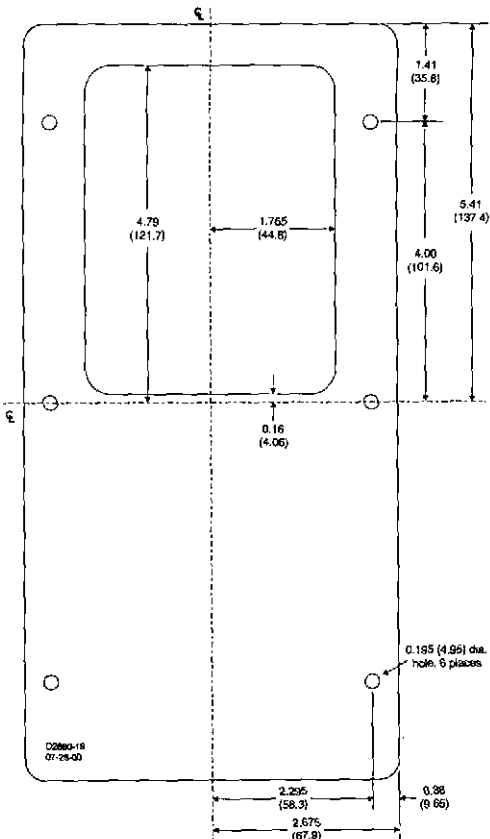
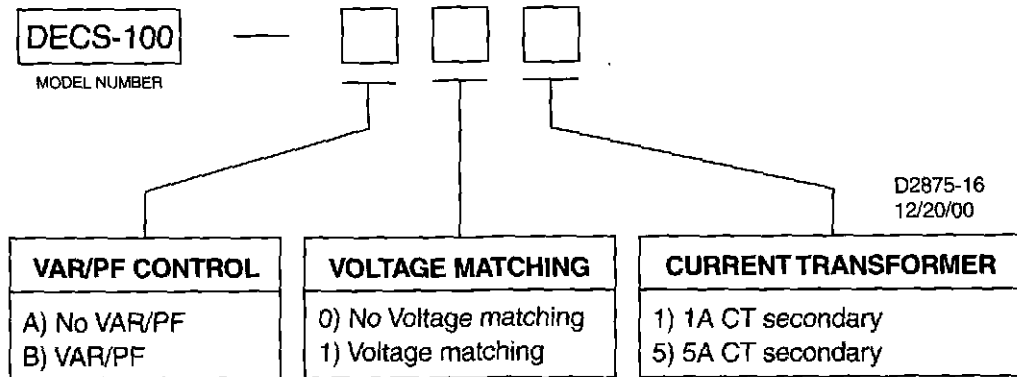


Figure 4 - Cutout and Drilling Dimensions

HOW TO ORDER

The DECS-100 is selected by the style chart below. For example, if a DECS-100 is required with VAR/PF control, voltage matching, and a 5 Amp CT, the complete model number would be DECS-100-B15.



Additional information:

- The DECS-100 is available in bulk-packaged shipments of 50 pieces. If this is desired, please inform your customer service representative.
- The DECS-100 is shipped with a CD-ROM that contains the Instruction Manual, Product Bulletin, BESTCOMS for PC Windows® NT 3.51 or later, 95, 98, or Me and BESTCOMS for Palm OS® 3.3 or newer users. Printed manuals and bulletins are available at an additional cost.

ACCESSORIES

DECS-100 is designed to operate with the following accessories. For additional product compatibility, please contact your application specialist at Basler Electric or your sales representative.

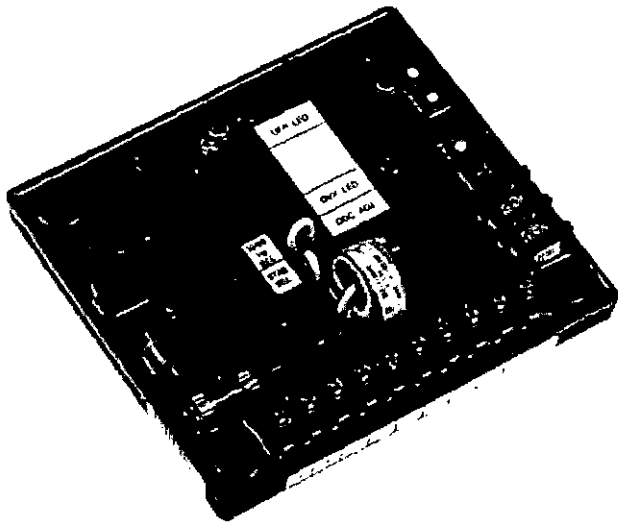
- MVC300 Manual Voltage Controller
- EDM200 Exciter Diode Monitor
- EL200 Min/Max Excitation Limiter
- SCP250 VAR/PF controller



ROUTE 143, BOX 269, HIGHLAND, ILLINOIS U.S.A. 62249
PHONE 618-654-2341 FAX 618-654-2351

P.A.E. Les Pins, 67319 Wasselonne Cedex FRANCE
PHONE (33-3-88) 87-1010 FAX (33-3-88) 87-0808

<http://www.basler.com>, info@basler.com



AVC110-6 VOLTAGE REGULATOR

Using enhanced technology, the AVC110-6 full wave voltage regulator is designed for use on 50/60 Hz brushless generators. This encapsulated regulator is small in size, ruggedly constructed, and incorporates solid state technology with frequency compensation, a build-up circuit, overexcitation shutdown, droop input, accessory input, and EMI filtering as standard.

FEATURES

- Integrated circuitry for compact size, simplicity, high reliability.
- Extremely rugged.
- Exciter field current 6A continuous, 10A forcing.
- Regulation accuracy better than $\pm 0.5\%$ no load to full load.
- Fast response.
- Frequency compensation.
- Overexcitation shutdown.
- EMI suppression.
- Accessory input.

ADDITIONAL INFORMATION INSTRUCTION MANUAL

Request Publication 9317700101

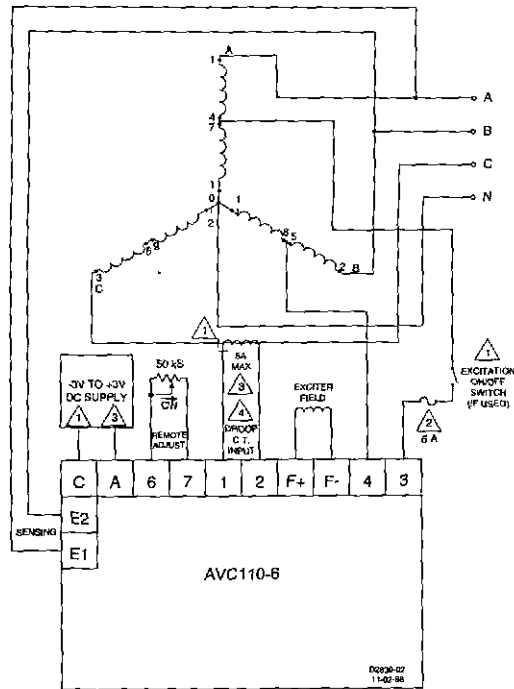


Figure 1 - Typical Interconnection Diagram
277/480V nominal, 3-phase, 4-wire wye
connection



P. O. BOX 269 HIGHLAND, ILLINOIS 62249, U.S.A. PHONE 618-654-2341 FAX 618-654-2351

SVE-1
9-01

SPECIFICATIONS

DC OUTPUT				EXCITER FIELD RESISTANCE		POWER INPUT		SENSING INPUT
MAX. CONT.		MAX FORCING 10 SEC (240Vac INPUT)		MIN. OHMS @ 25°C	MAX OHMS	SINGLE PHASE VOLTAGE RANGE	BURDEN	VOLTAGE ADJUST RANGE
AMP	VOLT	AMP	VOLT					
6	110	10	200	18.3	100	180-277Vac ±10% 50/60Hz 125Hz PMG	800VA	342-528Vac 50/60Hz

DC OUTPUT POWER: 6 Adc at 110 Vdc maximum continuous, 10 Adc at 200 Vdc 10 seconds forcing. (Forcing with 240 Vac nominal input).

EXCITER FIELD DC RESISTANCE: 18.3 ohms minimum; 100 ohms maximum.

AC POWER INPUT: Operating range: 180-277 Vac single phase, 50/60 Hz or 125Hz PMG ±10%. Burden 800VA.

SENSING INPUT: 342-528 Vac single phase, 50/60 Hz ±10% <5VA.

VOLTAGE ADJUST RANGE: 342-528 Vac.

REGULATION ACCURACY: Better than ±0.5% no load to full load.

RESPONSE TIME: Less than 1.5 cycles for ±5% change in sensing voltage.

EMI SUPPRESSION: Internal electromagnetic interference filtering.

PARALLEL COMPENSATION: 5A <10VA. Adjustable up to 6% droop for 0.8PF.

ACCESSORY INPUT: ±3Vdc signal causes a ±30% change in the regulation set point.

OVEREXCITATION SHUTDOWN: Field voltage shuts down after time delay if exciter field voltage exceeds a set point adjustable approx. 75-125Vdc. The time delay is inversely proportional to the magnitude of the detected overvoltage condition up to the 240 Vdc point, thus allowing nominal forcing for approximately 10 seconds. Beyond 240 Vdc, the field voltage is removed instantaneously.

VOLTAGE BUILDUP: Internal provisions for automatic voltage buildup from generator residual voltages as low as 5 Vac.

TERMINATIONS: Screw type.

POWER DISSIPATION: 35 Watts maximum.

OPERATING TEMPERATURE: -40°C (-40°F) to +60°C (+140°F).

STORAGE TEMPERATURE: -40°C (-40°F) to +70°C (+158°F).

VIBRATION: Withstands 1.5 Gs at 5 to 29 Hz; 0.036" double amplitude at 29 to 52 Hz; and 5 Gs at 52 to 500 Hz.

SHOCK: Withstands up to 15 Gs in each of three mutually perpendicular axes.

WEIGHT: 12.58 oz. (0.38 kg) Net.

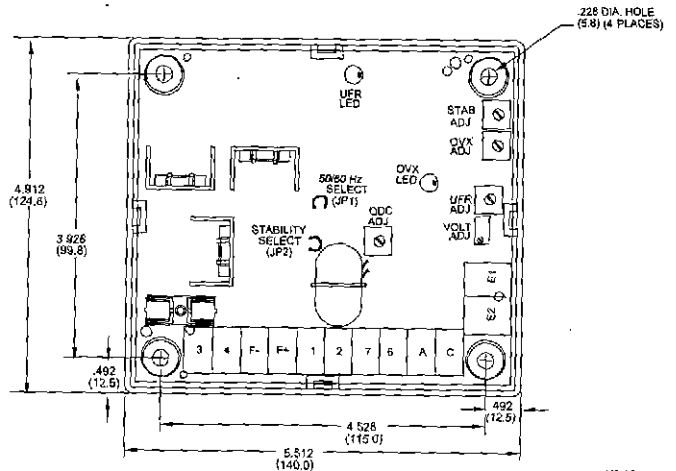


Figure 3 - Outline Drawing (Top view)

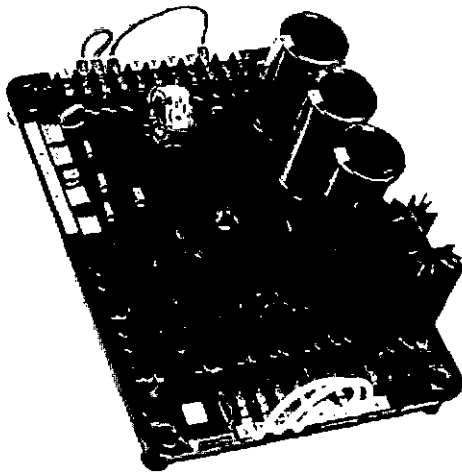
Basler Electric



ROUTE 143, BOX 269, HIGHLAND, ILLINOIS U.S.A. 62249
PHONE 618-654-2341 FAX 618-654-2351

P.A.E. Les Pins, 67319 Wasselonne Cedex FRANCE
PHONE (33-3-88) 87-1010 FAX (33-3-88) 87-0808

<http://www.basler.com>, info@basler.com



AVC63-12 and AVC125-10 Voltage Regulators

Using advanced technology and our many years of analog regulator design experience, Basler Electric offers two high powered, low-cost analog excitation controllers, the AVC63-12 and the AVC125-10. These environmentally rugged products are ideally suited for controlling the output of brushless excited synchronous generators up to 5MW. These devices offer higher powered output and accept a variety of accessory items for new and retrofit applications where high performance and reliability are mandatory. These devices utilize a pulse width modulated power stage, state-of-the-art circuitry, and advanced methods of noise immunity. They are UL recognized, CSA certified, and CE compliant.

FEATURES

- <1.0% accuracy voltage regulation
- 0.5% accuracy up to 20% THD (harmonic associated with 6 SCR loads)
- Outputs of 63Vdc @ 12A dc and 125Vdc @ 10A dc from a PWM output stage
- 1 or 2X V/Hz limiting (jumper selectable)
- Single- or three-phase average sensing
- Paralleling input from 1 or 5A CT secondaries
- Nominal sensing inputs of 120, 240, 50/60Hz or 400Hz
- Power input from shunt connections or PMGs operating at 50 to 400Hz
- Accessory input
- Overexcitation shutdown
- UL recognized
- CSA certified
- CE compliant

ADDITIONAL INFORMATION INSTRUCTION MANUAL

Request Publication 9337200991

DESCRIPTION and SPECIFICATIONS

Pages 2 and 3

INTERCONNECT DIAGRAM

Page 3

DIMENSIONS

Page 4

ORDERING

Page 4

 **Basler Electric**

P. O. BOX 269 HIGHLAND, ILLINOIS, U.S.A. 62249 PHONE 618-654-2341 FAX 618-654-2351

SVL-2
6-01

DESCRIPTION

The AVC63-12 and AVC125-10 voltage regulators are designed to control the output of a brushless excited synchronous generator. They are designed to be very rugged, are perfect for a variety of applications, and are especially suitable where the generator is installed in a harsh environment. They can accept supplemental control inputs for utility paralleling applications where a VAR/PF

control and Over/Under Excitation Limiter are used. These regulators are extremely flexible and offer jumper selection provisions for single- or three-phase sensing, 1 or 2X V/Hz, and can accept 1 or 5 Amp CTs. The power stage can accept a frequency range of 50-400Hz, and the sensing can be configured for 50/60 or 400Hz. They are UL recognized, CSA certified, and CE compliant.

SPECIFICATIONS

INPUTS

Power Input

	<u>AVC63-12</u>	<u>AVC125-10</u>
Voltage:	90-153Vac, single or three phase	180-264Vac, single or three phase
Burden:	1092VA	1750 V
Frequency:	50 to 400Hz	50 to 400Hz
Minimum Build-up Voltage:	6.0Vac	12.0Vac

Sensing Input

Sensing Voltage Range:	Style option A: 90-139Vac; Style option B: 180-264Vac
Burden:	<1VA
Current Input:	1 or 5 Amp
Burden:	<10 VA
Frequency:	Style option 1: 50/60Hz; Style option 2: 400Hz

Auxiliary Input

±3Vdc input for use with an SCP250 VAR/PF Controller or an EL200 Min/Max Excitation Limiter

OUTPUTS

DC Output

	<u>AVC63-12</u>	<u>AVC125-10</u>
Continuous voltage:	63Vdc	125Vdc
Continuous current:	12.0Adc	10.0Adc
10 second Forcing Voltage:	125Vdc	250Vdc
10 second Forcing Current:	24.0Adc	20Adc
Minimum Field Resistance:	5.25 Ohms	12.5 Ohms

(Forcing levels are determined with nominal input power applied.)

REGULATION ACCURACY

Regulation accuracy:	±0.5% of voltage set point no load to full load, average responding
Temperature drift:	±1% voltage variation for a 40°C change in ambient temperature
Response time:	≤4 msec

OVEREXCITATION SHUTDOWN

	<u>AVC63-12</u>	<u>AVC125-10</u>	<u>Time Delay</u>
Timing Initiation:	125Vdc ±10% 210Vdc ±10%	250Vdc ±10% 370Vdc ±10%	Approx. 10 sec. <1 sec.

AGENCY APPROVALS

UL 508	"Industrial Control Equipment"
CSA C22.2 Number 14	"Industrial Control Equipment"
CE	EMC and LVD
CE Conformity:	Radiated Emissions: EN50081-2 Radiated Immunity, Electric Field: EN61000-4-3 (10V/m) Radiated Immunity, Conducted: EN61000-4-6 (10VRMS) Conducted Emissions: EN50081-2 (EN55011, Class A) ESD Immunity: EN50082-2 (4kV contact, 8kV air) EFT Immunity: EN50082-2 (2kV coupling clamp)

SPECIFICATIONS, continued

AGENCY APPROVALS, continued

CE Conformity, continued:

Magnetic Immunity: EN50082-2 (30ARMS, 50Hz)
 Safety: EN61010-1

MECHANICAL SPECIFICATIONS

Operating temperature: -40°C to +70°C
 Storage temperature: -40°C to +70°C
 Shock: 20 Gs in three mutually perpendicular planes
 Vibration: 18-2000Hz, 4.5Gs
 Salt Fog: Per MIL-STD-810E, Method 509.3, 48 hours of testing
 Weight: 2.5 lbs. (1.10 kg)
 Shipping weight: 4.5 lbs. (1.98 kg)
 Unit dimensions: 6.376" (162.0mm) wide x 8.38" (212.8mm) high x 2.96" (75.2mm) deep

ADJUSTMENTS

Voltage Adjustment: Minimum of ±10% of nominal
 Volts per Hertz: UF kneepoint, 40-65Hz
 Parallel Droop: 0-10% with a load of 0.8PF lagging at rated input current
 Stability: Adjustment of min. to max. of the stability range
 External Voltage Adjustment: Via a 10kΩ 2 Watt external pot (not included)

CONNECTIONS

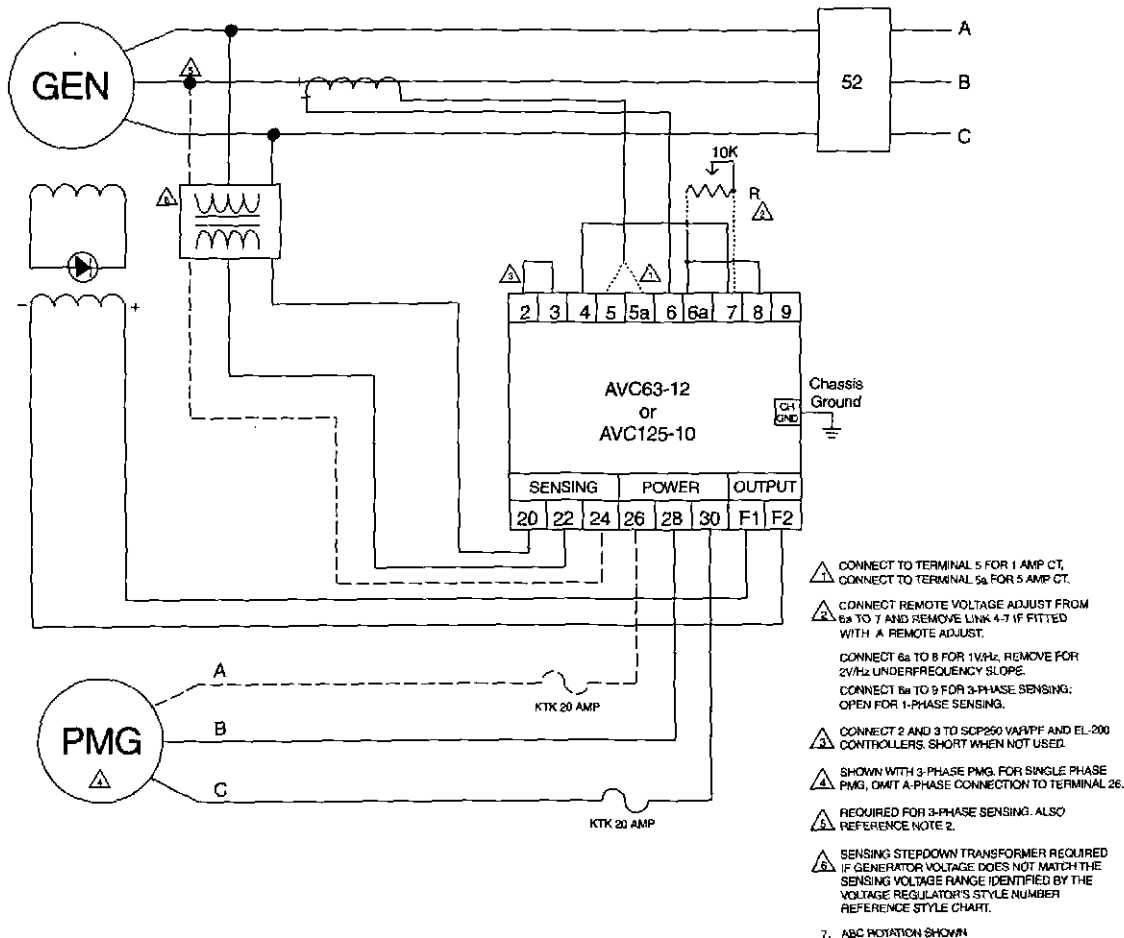


Figure 1 - Typical Connections

Consult Instruction Manual for detailed interconnection instructions.

DIMENSIONS

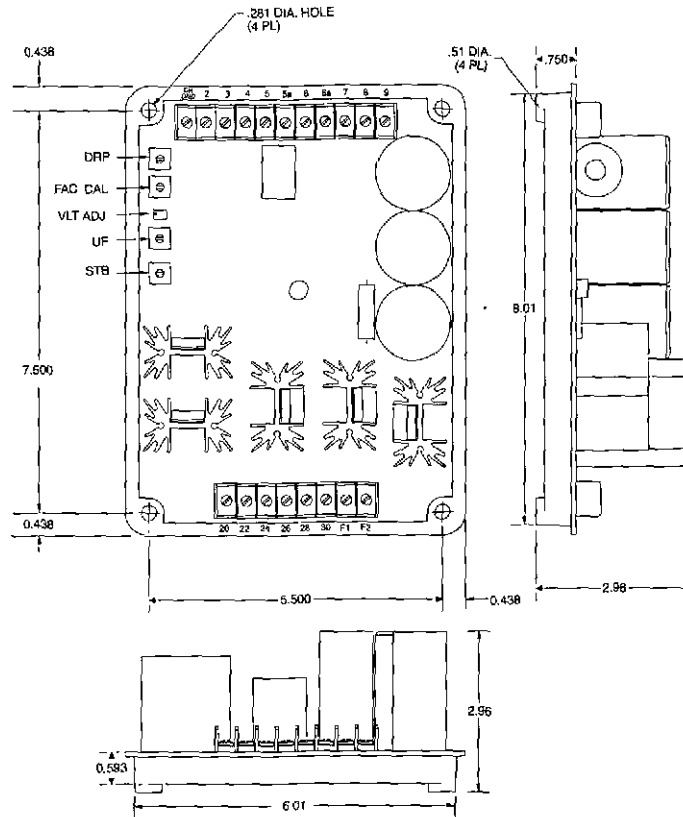
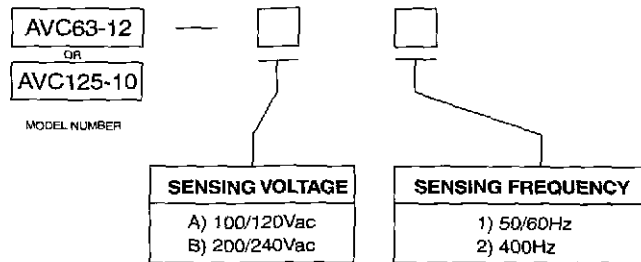


Figure 2 - Dimensions

HOW TO ORDER

These regulators are selected by the style chart below. For example, if an AVC125-10 is required with 200/240Vac sensing at 400Hz, the complete model number is AVC125-10-B2.



ACCESSORIES

The AVC63-12 and AVC125-10 are designed to operate with the following accessories. For additional product compatibility, please contact your application specialist at Basler Electric or your sales representative.

- MVC112 Manual Voltage Controller
- EDM200 Exciter Diode Monitor
- EL200 Min/Max Excitation Limiter
- SCP250 VAR/PF controller
- CBS212 and CBS212A
- RA70 Reference Adjuster External Voltage Adjust

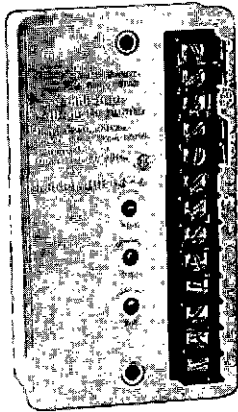
Basler Electric



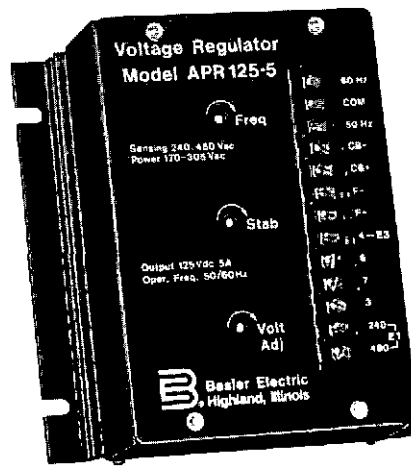
ROUTE 143, BOX 269, HIGHLAND, ILLINOIS U.S.A. 62249
PHONE 618-654-2341 FAX 618-654-2351

P.A.E. Les Pins, 67319 Wasselonne Cedex FRANCE
PHONE (33-3-88) 87-1010 FAX (33-3-88) 87-0808

<http://www.basler.com>, info@basler.com



APR 63-5/UL



APR 125-5

**CLASS 200 EQUIPMENT
APR SERIES
VOLTAGE REGULATOR**

The APR series voltage regulators provide a small, reliable and economical voltage regulator for 50 or 60 Hz brushless ac generators. The APR has frequency compensation which aids system block load pickup performance and controls excitation when operating below synchronous speed. The regulator is designed for prime and standby power applications for small and medium sized brushless generators. Accessory equipment can adapt the APR to a broad range of specialized applications.

FEATURES:

- Regulation Accuracy Better Than $\pm 0.25\%$
- Frequency Compensated
- Overexcitation Shutdown
- Solid State Voltage Buildup
- Moisture Proof Encapsulated Assembly
- Mechanically Rugged
- Remote Voltage Adjust Rheostat Supplied
- Small Size, Reliable, Low Cost
- EMI Filter is Built in
- Fast Response Time
- Applicable to 50 or 60 Hz Systems
- Complete Accessory Line Available
- CSA certified
- UL recognized

ADDITIONAL INFORMATION

INSTRUCTION MANUAL

Request publication 9168700990 (APR63-5)
Request publication 9168800990 (APR125-5)

FEATURES and APPLICATIONS this page
DESCRIPTION and SPECIFICATIONS Page 2
PERFORMANCE CURVES Page 3
DIMENSIONS and INTERCONNECT Page 4

DESCRIPTION:

The APR series voltage regulators are completely solid-state and use an electromagnetic interference (EMI) suppression circuit to reduce EMI generated by the regulator. Voltage is internally or remotely adjustable. The APR has a jumper selectable, frequency compensated operating characteristic as shown by Figures 1 and 2.

SPECIFICATIONS:

OUTPUT POWER:

Voltage Regulator	Output Voltage	Output Current	Forcing Voltage	Forcing Current
APR 63-5/UL	63.5 Vdc	5.0 Adc	100 Vdc	8.0 Adc
APR 125-5	125 Vdc	5.0 Adc	200 Vdc	8.0 Adc

EXCITER FIELD DC RESISTANCE:

Voltage Regulator	Minimum	Maximum
APR 63-5/UL APR 125-5	12.6 ohms 25 ohms	100 ohms 100 ohms

POWER DISSIPATED:

APR 63-5/UL	9 Watts (max.)
APR 125-5	25 Watts (max.)

AC INPUT POWER:

	Voltage	Burden
APR 63-5/UL	190 to 277 Vac, single phase, 50/60 Hz. $\pm 10\%$	650 VA (max.)
APR 125-5	190 to 277 Vac, single phase, 50/60 Hz. $\pm 10\%$	1000 VA (max.)

AC SENSING:

	Voltage	Burden
APR 63-5/UL	190-240, 380-480, single phase, 50/60 Hz. $\pm 10\%$	5 VA (max.)
APR 125-5	190-240, 380-480, single phase, 50/60 Hz. $\pm 10\%$	1 VA (max.)

ACCESSORY ITEMS:

POWER ISOLATION TRANSFORMER - Low voltage power isolation transformers can be used to provide electrical isolation and to match voltages from the generator to the regulator as follows:

APR 63-5/UL - BE18674
APR 125-5 - BE18674

APM 2000 PARALLELING MODULE - To parallel two or more generators using droop or cross current compensation, use this module and a current trans-

During start-up, the solid-state voltage build-up circuit operates from generator output residual voltages as low as 6Vac. The built-in over-excitation limiting removes the output power if the exciter field voltage exceeds a predetermined level. (See Figures 3 and 4). After removing power the regulator monitors the generator output and resets when the voltage has decreased below 6Vac.

VOLTAGE ADJUST RANGE: 170 to 264 Vac, 340 to 528 Vac.

REGULATION ACCURACY: $\pm 0.25\%$

VOLTAGE DRIFT: Less than $\pm 1\%$ voltage variation for a 50°C (90°F) temperature change.

RESPONSE TIME: One cycle.

FREQUENCY COMPENSATION: Refer to Figures 1 and 2.

EMI SUPPRESSION: Built-in

VOLTAGE BUILD-UP: Solid state build-up circuit operates from generator residual voltages as low as 6 Vac.

OVER EXCITATION SHUTDOWN: Shuts off field voltage if exciter exceeds the following (see Figures 4 and 5):

Model	Field Voltage
APR 63-5/UL APR 125-5	95-105 Vdc 170-190 Vdc

OPERATING TEMPERATURE: -40°C (-40°F) to +60°C (+140°F).

STORAGE TEMPERATURE: -65°C (-85°F) to 85°C (+185°F).

SHOCK: Withstands up to 15 G's in each of three mutually perpendicular axes.

VIBRATION: Withstands the following:

Frequency	Acceleration
5-26 Hz.	1.2 G
26-52 Hz.	0.036 in. displacement
53-500 Hz.	5 G

WEIGHT: APR 63-5/UL 2.5 lb. (1.1 kg) net
3.5 lb. (1.6 kg) shipping
APR 125-5 5.1 lb. (2.3 kg) net
6.1 lb. (2.8 kg) shipping

former with a 5 ampere nominal secondary such as the Basler CT series.

MVC 300 MANUAL VOLTAGE CONTROL - With an electronically regulated output, this control offers backup excitation for the regulator in critical applications.

CBS 305/320 SERIES CURRENT BOOST SYSTEM - Using electronics built into the APR and a current transformer to tap the generator line current, the CBS boosts the field current during short circuit or large motor starting.

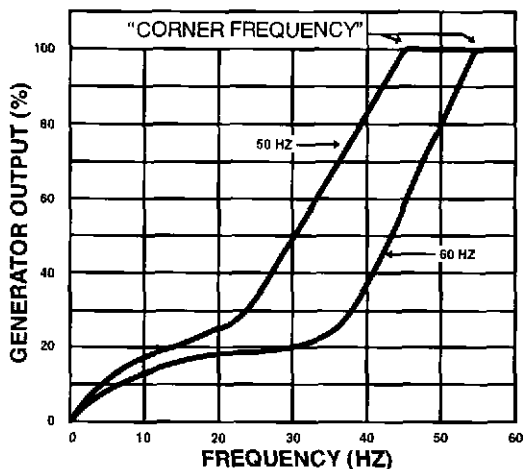


Figure 1 - Frequency Compensation Curves, APR 63-5/UL

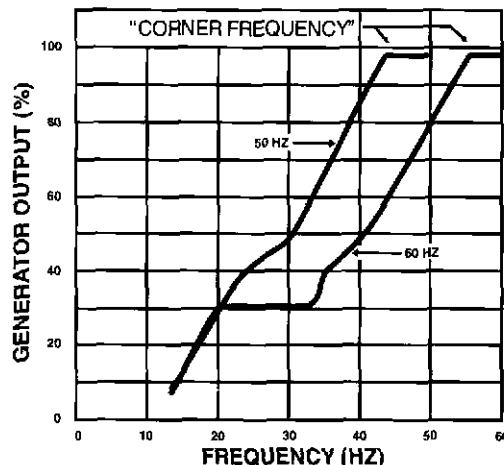


Figure 2 - Frequency Compensation Curves, APR 125-5

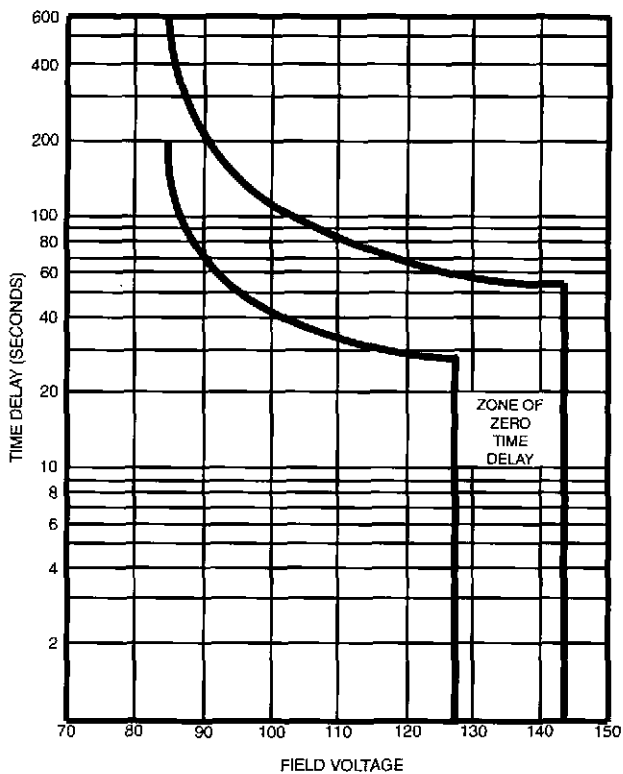


Figure 3 - Overexcitation Shutdown Characteristic Curves, APR 63-5/UL

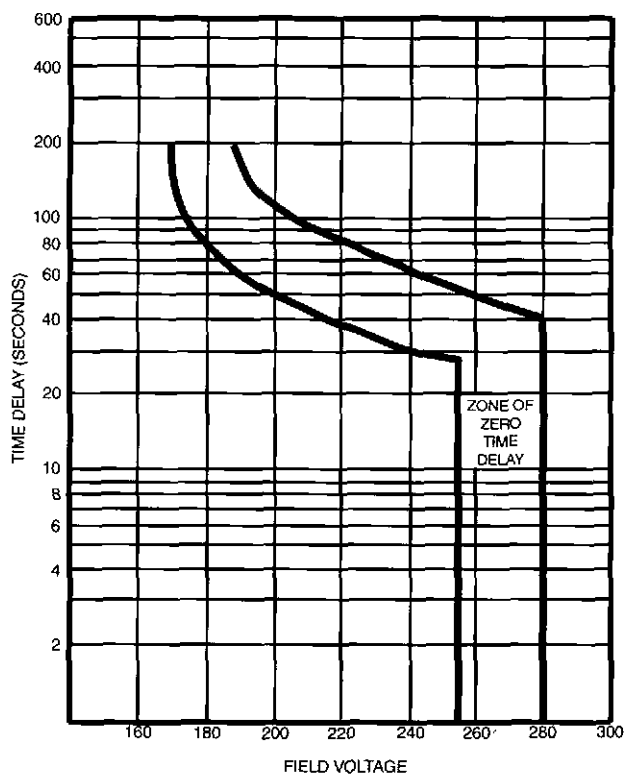


Figure 4 - Overexcitation Shutdown Characteristic Curves, APR 125-5

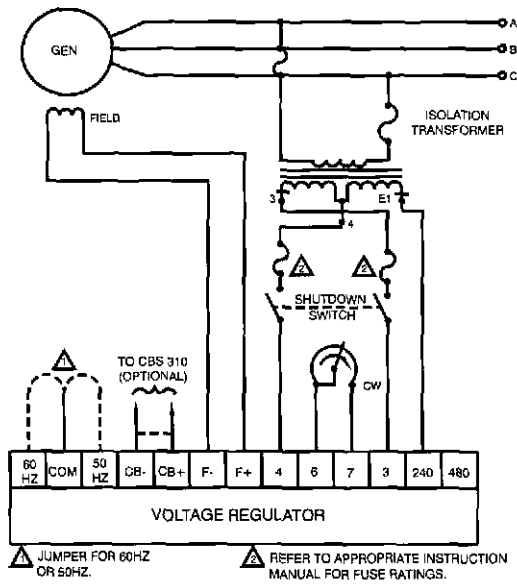


Figure 5 - Typical Interconnection

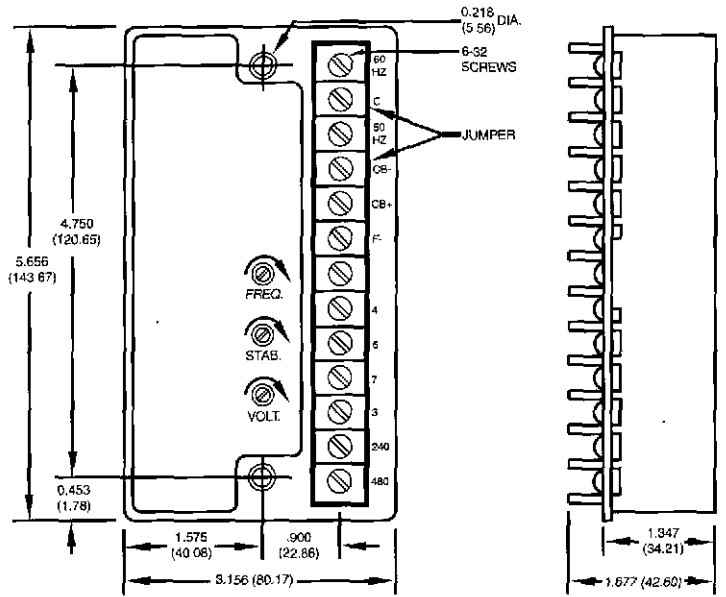


Figure 6 - Outline Drawing, APR 63-5/UL

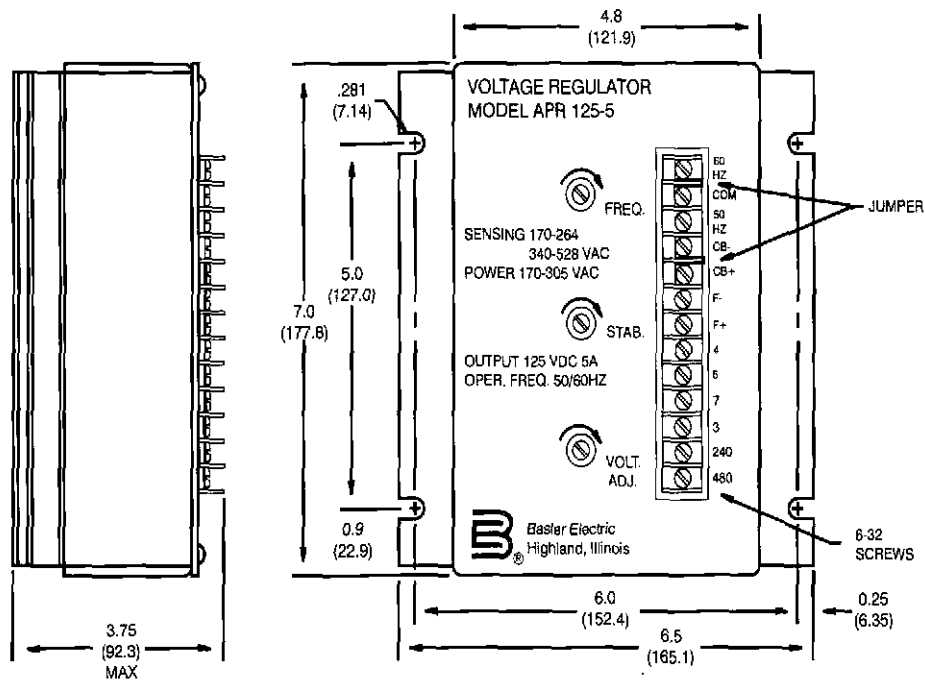
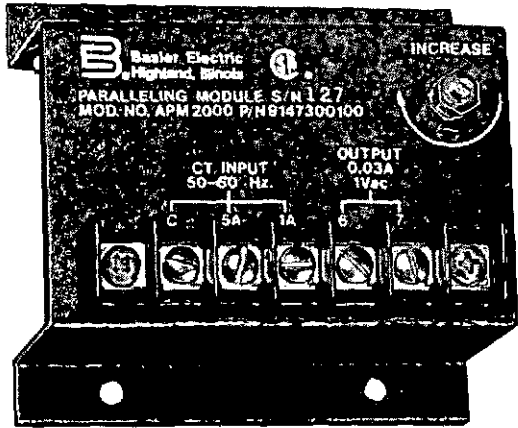


Figure 7 - Outline Drawing, APR 125-5

NOTE: All dimensions are in inches (millimeters).
All drawings and data subject to change without notice.

B Basler Electric





Class 300 Equipment APM 2000 Paralleling Module

APPLICATION

The APM 2000 Paralleling Module provides paralleling capability for the APR 63-5 and APR 125-5; and the XR2001, XR2002, and XR2004 (except XR2004V) series voltage regulators, allowing paralleled three phase generators to share reactive load and reducing circulating current between the generators.

DESCRIPTION

The APM 2000 Paralleling Module uses an external current transformer installed in the generator line B to sense the load. The resultant signal is converted to a voltage that is vectorially added to the sensing input voltage of the regulator to provide reactive droop compensation or reactive differential compensation for the generators.

FEATURES

- Low 5 VA burden
- Compact size
- Provides either reactive droop or reactive differential (cross current) compensation
- Adjustable droop of 5%
- Accepts either 1 amp or 5 amp current transformer secondary ratings
- Provision for external Unit-Parallel Switch
- Rugged construction
- CSA certified
- UL recognized

ADDITIONAL INFORMATION

INSTRUCTION MANUAL

Request Publication 9147300990

**DESCRIPTION and
SPECIFICATIONS**
this page

OUTLINE DRAWINGS
back page

**INTERCONNECT
DRAWING**
back page

**ORDERING
INFORMATION**
back page

B Basler Electric

ROUTE 143, BOX 269 HIGHLAND, ILLINOIS 62249, U.S.A. PHONE 618-654-2341 FAX 618-654-2351

SPECIFICATIONS

CURRENT TRANSFORMER REQUIREMENTS

Secondary Rating	Secondary Current at Rated Generator Load	Minimum Burden
1A	0.7 - 1.0 A	5 VA
5A	3.5 - 5.0 A	5 VA

- VOLTAGE DROOP:** Adjustable to 5% or more for 0.8 p.f. load.
- OPERATING TEMPERATURE RANGE:** -40° F (-40°C) to +158°F (+70°C)
- SHOCK:** Withstands 15 Gs in each direction
- VIBRATION:** Withstands the following vibration spectrum

Frequency	Acceleration
5-26 Hz	1.36 G
26-52 Hz	.036 inch displacement
52-260 Hz	5 G

- FINISH:** Dark Gray, lusterless, textured, baked enamel

ORDERING INFORMATION

Specify Basler Model APM 2000 Paralleling Module. For "Unit/Parallel" switch, select Basler P/N 05407 rotary two-position switch. Select current transformer ratio that provides secondary current within range shown above, and with a burden rating greater than 5 VA.

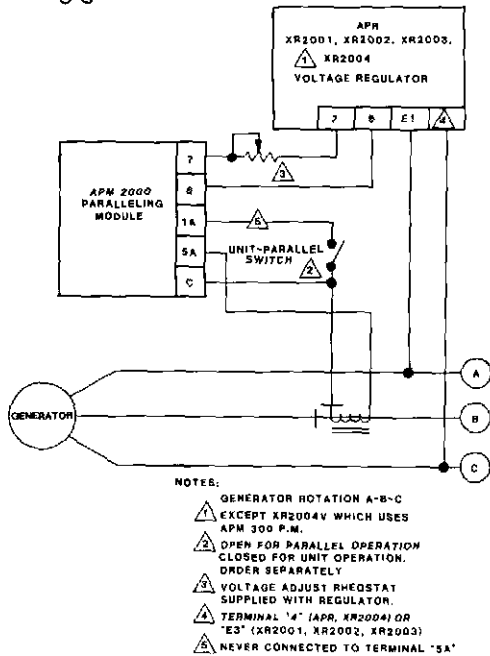


Figure 1 - Typical Interconnection Diagram

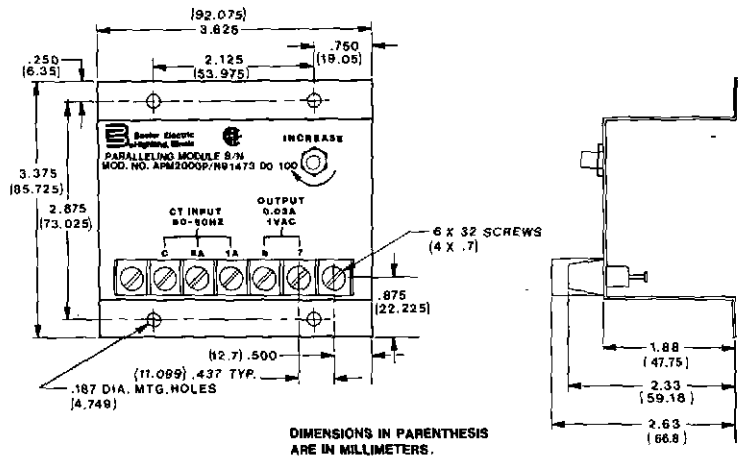


Figure 2 - Outline Drawing

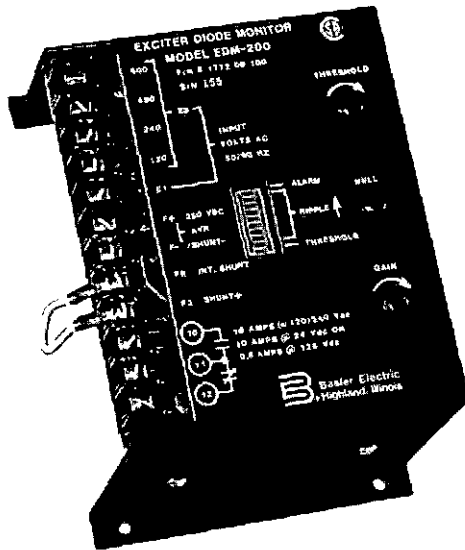
Basler Electric



ROUTE 143, BOX 269, HIGHLAND, ILLINOIS U.S.A. 62249
 PHONE 618-654-2341 FAX 618-654-2351

P.A.E. Les Pins, 67319 Wasselonne Cedex FRANCE
 PHONE (33-3-88) 87-1010 FAX (33-3-88) 87-0808

<http://www.basler.com>, info@basler.com



**Class 200 Equipment
EDM200
Exciter Diode Monitor
for Brushless Generator**

The Basler Model EDM 200 is a solid-state device using a form C contact for alarm indication. The EDM 200 is designed for behind-the-panel-mounting. A bargraph display provides easy on-site calibration.

APPLICATION

The EDM 200 Exciter Diode Monitor is used with brushless excited generators to monitor the operation of the rotating diodes of the exciter for alarm functions in the event of diode failure - shorted or open. Use with Basler SR, KR, XR, and APR series voltage regulators.

FEATURES

- Compatible with brushless generators.
- Accurately detects open or shorted diodes.
- Immune to false operation during transients.
- Easy to read bargraph display for calibration and monitoring.
- Precision solid-state circuitry.
- Rugged construction.
- CSA certified.
- UL approved.

ADDITIONAL INFORMATION

INSTRUCTION MANUAL

Request publication 9177200990

SPECIFICATIONS

Page 2

INTERCONNECTIONS

Page 3

OUTLINE, AND ORDERING

Page 4

B Basler Electric

P. O. BOX 269 HIGHLAND, ILLINOIS, U.S.A. 62249 PHONE 618-654-2341 FAX 618-654-2351

SRO-4
8-01

FUNCTIONAL DESCRIPTION

Power and Sensing Input

Power Input			Field Current Sensing Input
Voltage	VA	Frequency	
100-120 Vac $\pm 10\%$	10	50/60 Hz.	0.5 to 7 amperes or
200-240 Vac $\pm 10\%$	10	50/60 Hz	
380-480 Vac $\pm 10\%$	10	50/60 Hz.	20 to 100 mV
528-600 Vac $\pm 10\%$	10	50/60 Hz.	Shunt

OUTPUT: One N.O. and one N.C. relay contact rated at 10 amperes at 120/240Vac. 10 amperes at 24Vdc, or 0.5 amperes at 125Vdc.

INDICATOR: Bargraph display

TIME DELAY: Open diode - Approximately 15 seconds.
Shorted diode - Approximately 5 seconds.

EXCITER FREQUENCY: 50 to 400 Hz?

EXCITER DIODE CONFIGURATION: 3 phase, half or full-wave.

OPERATING TEMPERATURE: -40° C (-40° F) to 70° C (+157° F)

STORAGE TEMPERATURE: -65° C (-84° F) to +85° C (+185° F)

VIBRATION:

Frequency	Force
2-27 Hz.	1.3Gs
27-52 Hz	0.03 Inch double amplitude
52-260 Hz	5 Gs

SHOCK: Withstands up to 15Gs in each of three mutually perpendicular directions.

WEIGHT: 3 lbs., 10 oz., (1.65 kg.) net
4 lbs., 14oz., (2.22 kg.) shipping.

PRINCIPLES OF OPERATION:

Figure 1A shows the normal field current waveform generated by the rotary exciter diode rectifiers Induced into the exciter field current.

Figure 1B shows the exciter field current waveform generated when one diode rectifier opens. An open diode will cause the voltage rectifier to substantially increase the excitation to maintain the operating level. This constant, high level excitation could cause failure of the voltage regulator.

Figure 1C shows the exciter field current waveform generated when one diode shorts. A shorted diode causes very high current flow in the associated exciter armature winding causing excessive heating and probable failure of the exciter, and possibly the voltage regulator.

The Basler Model EDM 200 continuously monitors the induced ripple content in the input field circuit. When a diode failure is detected, the form C output contacts change state to actuate an alarm condition.

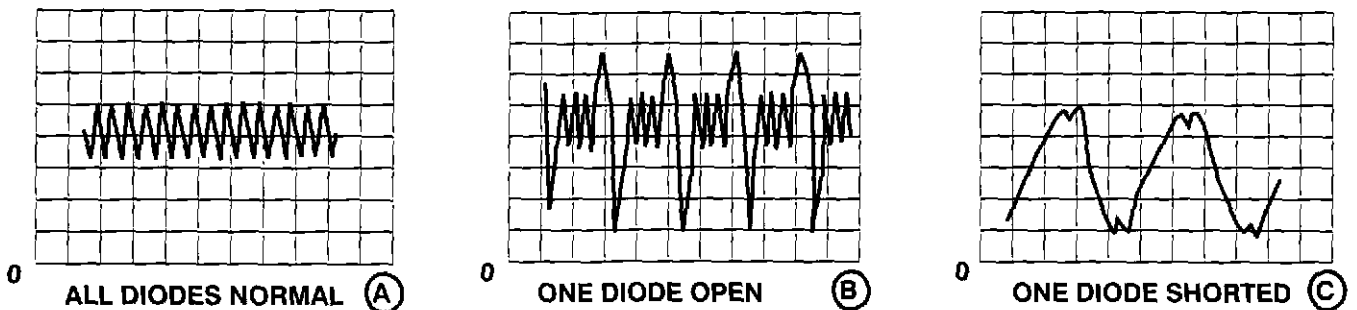


Figure 1 - Typical Rectifier Diode Waveform

INTERCONNECTIONS

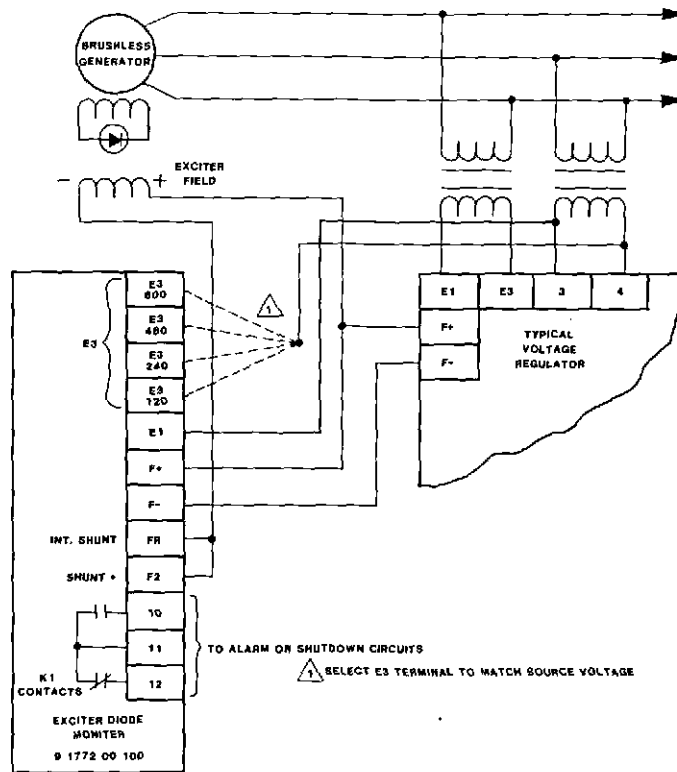


Figure 2 - Typical Interconnection, 0.5 TO 7 Amperes Exciter Current

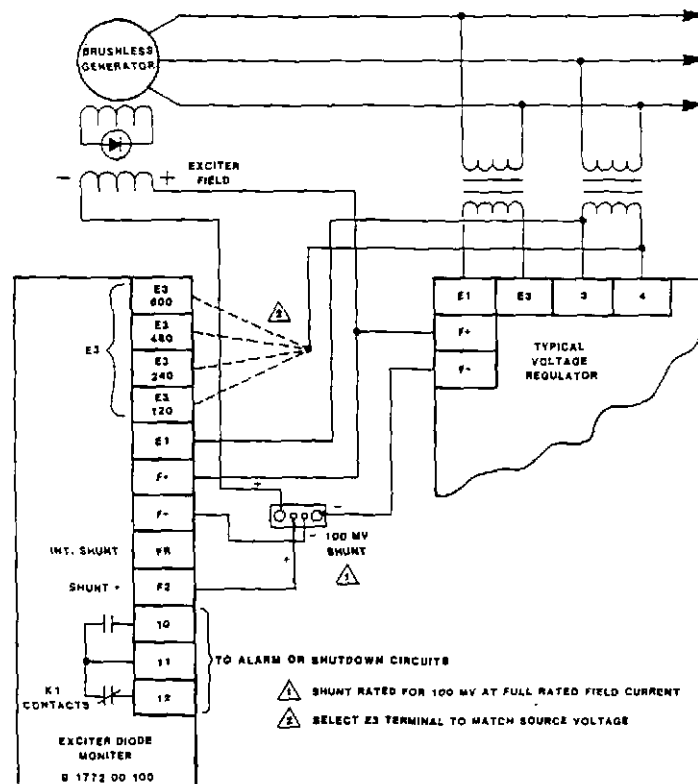


Figure 3 - Typical Interconnection, with 100 mV Shunt

OUTLINE DRAWING

NOTE: ALL DIMENSIONS
IN PARENTHESIS ARE IN
MILLIMETERS.

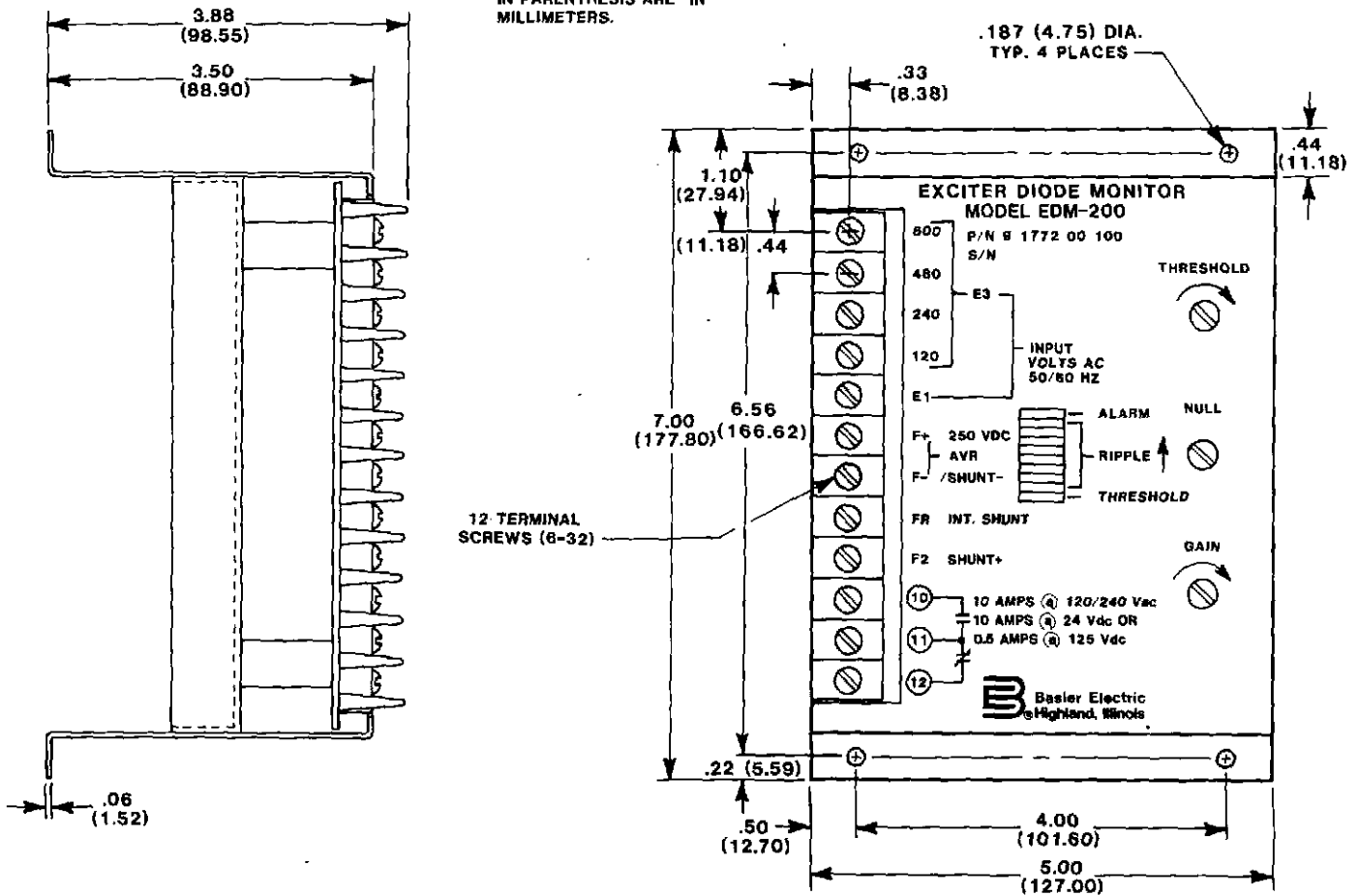


Figure 4 - Outline Drawing

SAMPLE SPECIFICATION

The excitation system shall include a device to give alarm indication for possible shutdown of the generating system in the event of an exciter rotating diode failure, either shorted or open. The device shall include a time delay of 15 seconds for an open diode and 5 seconds

for a shorted diode. The device shall include a means of calibration and adjustment using a built-in indicator. The device shall be a Basler EDM 200 Exciter Diode Monitor.

ORDERING INFORMATION

Specify by Model Number and Description: Basler Electric Model EDM 200 Exciter Diode Monitor.

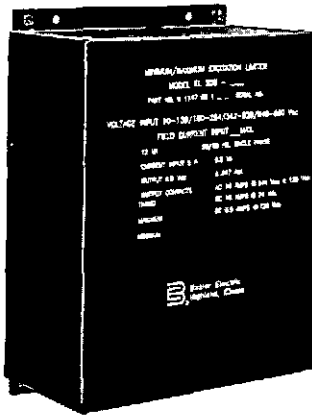
Basler Electric



ROUTE 143, BOX 269, HIGHLAND, ILLINOIS U.S.A. 62249
PHONE 618-654-2341 FAX 618-654-2351

P.A.E. Les Pins, 67319 Wasselonne Cedex FRANCE
PHONE (33-3-88) 87-1010 FAX (33-3-88) 87-0808

<http://www.basler.com>, info@basler.com



EL200 MINIMUM/MAXIMUM EXCITATION LIMITER

The minimum/maximum excitation limiter allows for safe operation of a generator or synchronous motor connected to the utility (infinite source). This is accomplished by controlling the field excitation within the operating limits of the generator's or synchronous motor's capability curve. The excitation limiter has become increasingly important in those applications where effective control of a generator means maximum utilization of the generator's total capability.

The excitation limiter, when used with a Basler automatic voltage regulator or a static exciter, offers excellent control of a generator operating in parallel with a utility grid. For proper operation of the EL200 with either a generator or synchronous motor, please refer to the Instruction Manual.

FEATURES:

- Easy to add to Basler excitation controls.
- Selectable curves for leading power factor limits.
- Both instantaneous limit and timed limit on overexcitation.
- Selectable inverse or definite time delay characteristics on over-excitation.
- LED indicators for easy calibration.
- Rugged solid-state design.
- CSA certified.

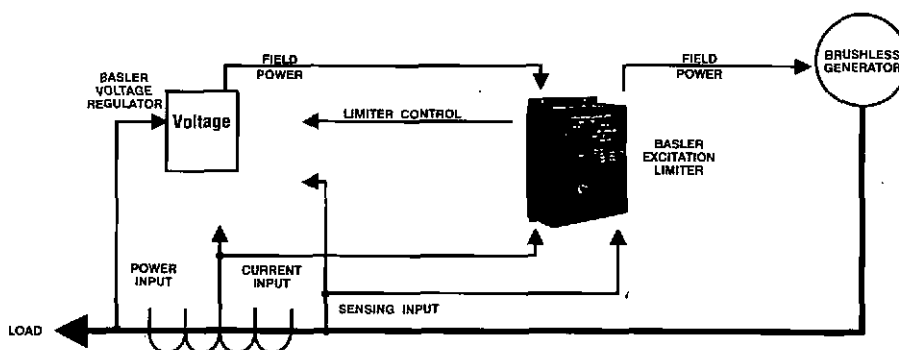


Figure 1 - Application Diagram

ADDITIONAL INFORMATION INSTRUCTION MANUAL

Request publication 9174700995

CAPABILITY CURVES
Page 2

**SPECIFICATION AND
ORDERING**
Page 3

**CONNECTIONS AND
DIMENSIONS**
Page 4

B Basler Electric

P. O. BOX 269 HIGHLAND, ILLINOIS, U.S.A. 62249 PHONE 618-654-2341 FAX 618-654-2351

SRP-11
3-01

DESCRIPTION

To prevent a loss of generator synchronization due to underexcitation but allowing the utilization of the generator's leading reactive load capacity, the underexcitation limiter offers a circular characteristic instead of setting a minimum field current level. Three curves are offered, selectable by a jumper, to match the generator capability curve. The three curves are illustrated in Figure 2, curves A, B, and C. The underexcitation limiter operates instantaneously to keep the generator operating within its leading power factor capability curve. When the underexcitation limiter is operating, an alarm relay is energized for external indication or connection to a time delay relay to initiate further action.

To prevent generator field overheating, a two-stage field current limiter first instantaneously limits the maximum field current, then, after a time delay, limits field current to a further reduced level. This two-stage action allows for high forcing current for a short time to allow for large load changes with fast response, but limits the time the field must endure the high current. The overexcitation relay is energized if either field current limiter is operating. The time delay for second state limiting may be selected as definite or inverse time and both times are adjustable. The inverse time curve range is shown in Figure 3. The timer will reset when the excitation returns to normal.

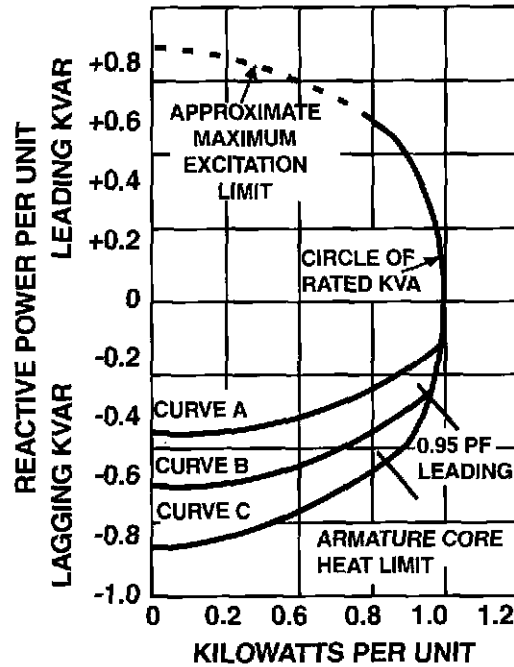


Figure 2 - Generator Reactive Capability Curves

Light emitting diodes (LEDs) are provided to indicate the operating status of the limiter and to aid in field calibration.

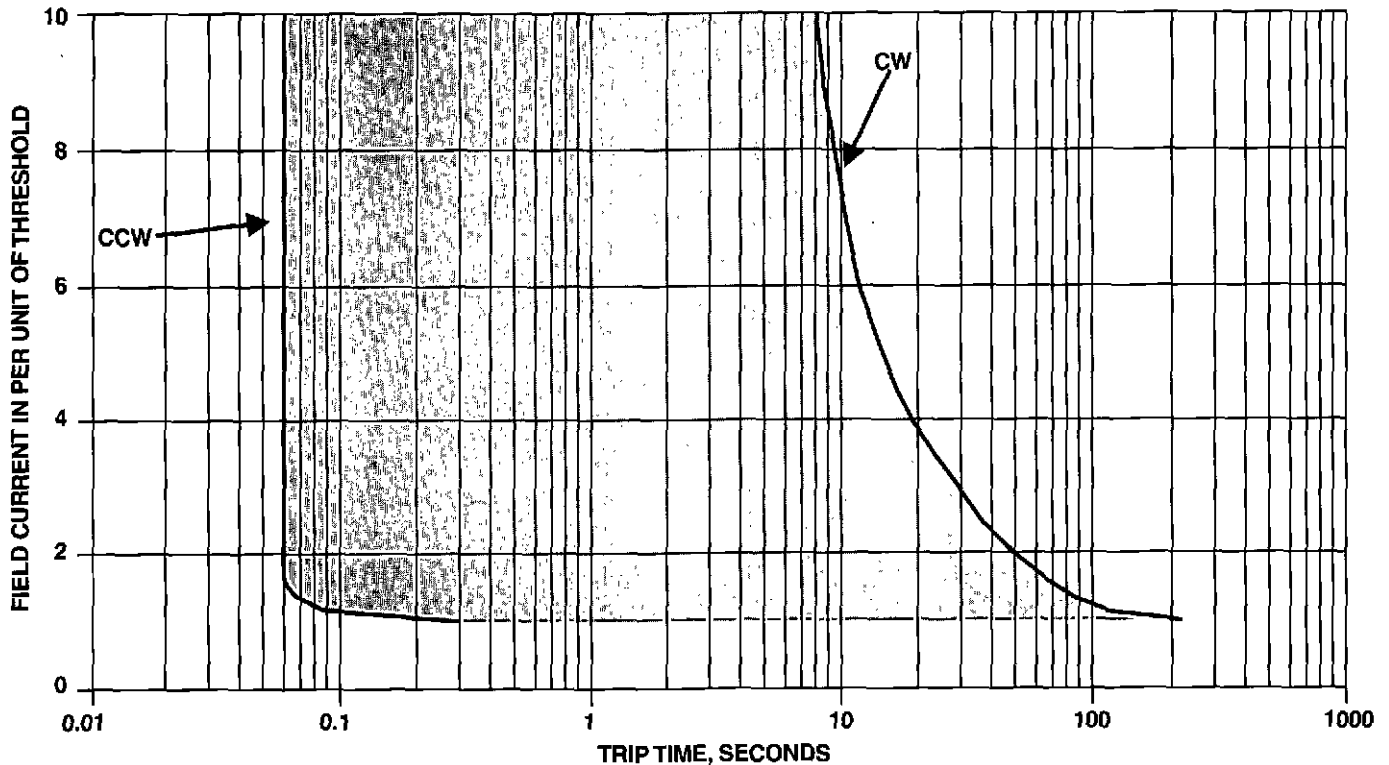


Figure 3 - Inverse Time Curve

SPECIFICATIONS

VOLTAGE INPUT

Tap Ranges: 90-139, 180-264, 342-528, 540-660 Vac
 Frequency: 50/60 Hz.
 Burden: 12 VA maximum.

CURRENT TRANSFORMER INPUT

Range: 0-5 Amperes continuous.
 CT Ratio: Select to provide 2.5 Amperes minimum at rated generator load.
 Burden: 0.5 VA maximum.

FIELD CURRENT INPUT

Model No.	Maximum Continuous Current
EL200-2	2 Amperes DC
EL200-7	7 Amperes DC
EL200-20	20 Amperes DC
EL200-36	36 Amperes DC

RELAY CONTACT OUTPUTS

Overexcitation Relay: Form C, one N.O. and one N.C.
 Underexcitation Relay: Form C, one N.O. and one N.C.
 Contact Rating: 10 Amperes at 120/240Vac, 10 Amperes at 24Vdc or 0.5 Amperes at 125Vdc.

LIMITING OUTPUT

±8Vdc to automatic voltage regulator.

SAMPLE ORDER SPECIFICATION

The Basler voltage regulator shall be equipped with a minimum/maximum excitation limiter. The minimum excitation limiter shall include field selectable curve characteristics to match the reactive capability of the generator. The maximum excitation limiter shall limit the maximum field current. Indicators shall illuminate for easy calibration of the system. Relay contacts shall be provided for excitation limiter annunciation.

ADJUSTMENT RANGE

Maximum Excitation Limit: Stage 1
 Stage 2
 Definite Time Delay: 0-60 seconds
 Inverse Time Delay: Adjustable 1x to 6x in Figure 3.
 Minimum Excitation Limit: See Figure 2.

STORAGE TEMPERATURE RANGE

-65°C (-85°F) to +85°C (+185°F)

OPERATING TEMPERATURE RANGE

-40°C (-40°F) to +70°C (+185°F)

SHOCK

Withstands up to 15 Gs

VIBRATION

Frequency	Force
5-29 Hz	1.5 Gs
29-52 Hz	0.036 in. double amplitude
52-500 Hz	6 Gs

WEIGHT

10 lbs (4.55 kg) net, 13 lbs (5.91 kg) shipping

HOW TO ORDER

Use the following to select the proper minimum/maximum excitation limiter.

If Using:	Full Load Excitation Current of:	Use Model #
SR-A, KR, AEC 63-7	0.5-2 2-7	EL200-2 EL200-7
SSR	2-7 5-20	EL200-7 EL200-20
SR-H SR-E	5-20 10-36	EL200-20 EL200-36
SSE/ SSE-N		Contact Basler Factory

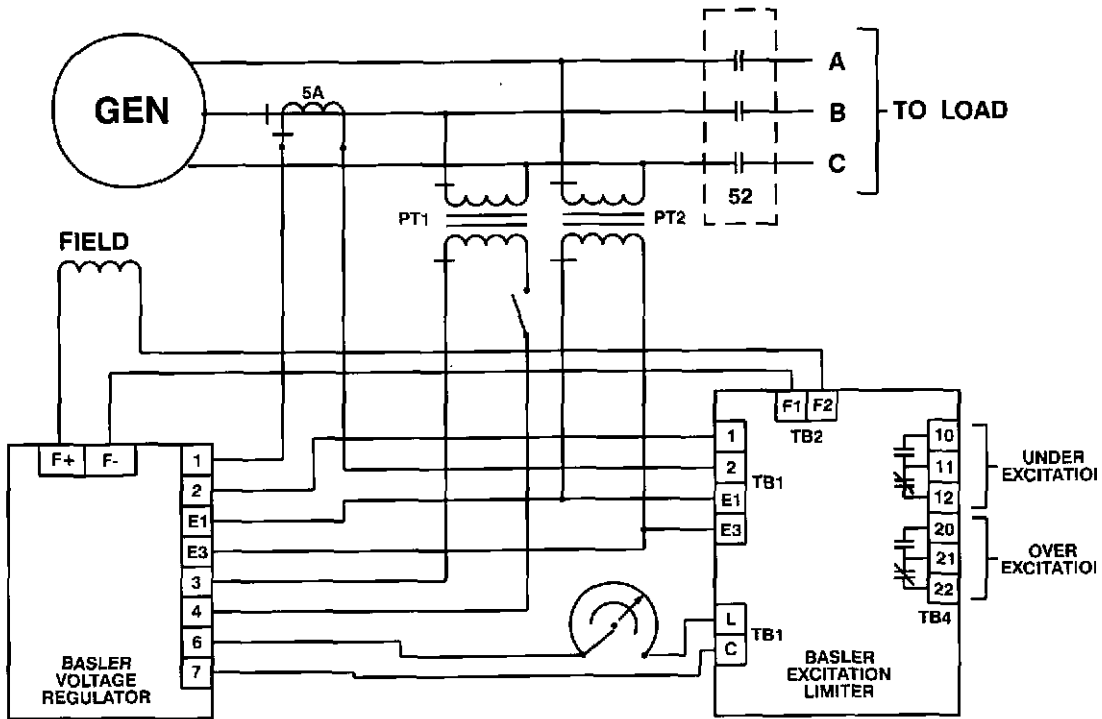


Figure 4 - Typical Interconnect

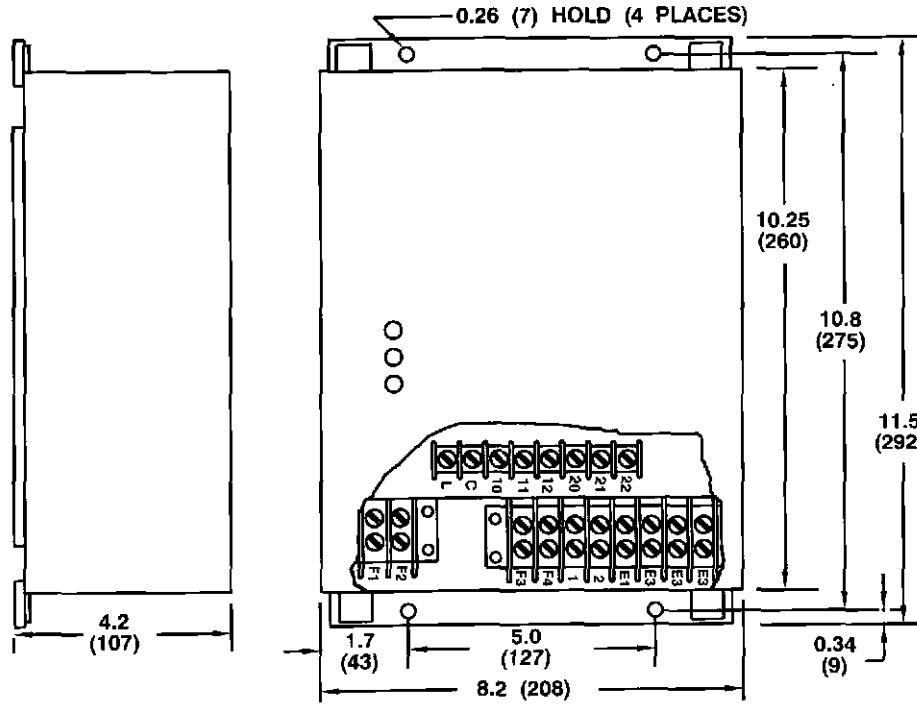


Figure 5 - Outline Drawing

NOTES: For more detailed interconnect drawings, see Instruction Manual 9174700995.
 All drawings and data subject to change without notice.
 Numbers of parentheses are in millimeters.

B Basler Electric



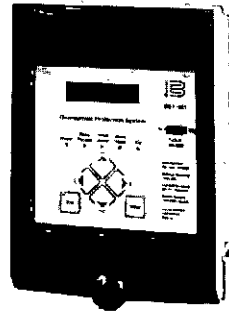
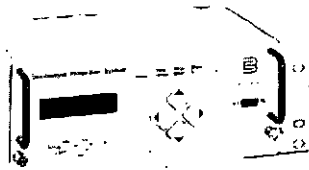
ROUTE 143, BOX 269, HIGHLAND, ILLINOIS U.S.A. 62249
 PHONE 618-654-2341 FAX 618-654-2351

P.A.E. Les Pins, 67319 Wasselonne Cedex FRANCE
 PHONE (33-3-88) 87-1010 FAX (33-3-88) 87-0808

<http://www.basler.com>, info@basler.com

Printed in U.S.A.

**PROTECTION and CONTROL DEVICES
STANDARDS, DIMENSIONS
and ACCESSORIES**



	*Case	Model No.	Relay Type	Bulletin
Numerical Systems	H, S	BE1-GPS100	Generator Protection System	UHQ
	X	BE1-1051	Overcurrent Protection System	UHS
	H,S	BE1-951	Overcurrent Protection System w/voltage	UHR
	F,H,S	BE1-851	Overcurrent Protection System	UHM
	X	BE1-CDS220	Current Differential Protection System	UHP
	H	BE1-MMS100	Multifunction Metering System	LAD
	Protective Relays	M	BE1-24	Volts per Hertz Overexcitation
S		BE1-25	Sync-Check	UBP
M		BE1-25/79S	Sync-Check/Single Shot Reclosing	UBQ
R		BE1-25/79TR	Sync-Check/Reclosing	UDW
S		BE1-27	Undervoltage	UBF
S		BE1-27/59	Over/Undervoltage	UBF
M,S		BE1-32O/U	Directional Over/Underpower	UBU
M,S		BE1-32R	Directional Power	UBU
S		BE1-40Q	Loss of Excitation	UBW
S		BE1-46N	Negative Sequence Overcurrent	UDJ
S		BE1-47N	Negative Sequence Voltage	UDK
S		BE1-49	Temperature	UBJ
S		BE1-50	Instantaneous Overcurrent	UBC
S		BE1-50BF	Breaker Failure	UBT
A, S		BE1-50/51B	Time Overcurrent	UHD
C		BE1-50/51M	Time Overcurrent	UHE
R		BE1-BPR	Breaker Protection	UHG
M,S		BE1-51	Time Overcurrent	UDA
M,S		BE1-51/27C	Time Overcurrent w/Voltage Control	UDA
M,S		BE1-51/27R	Time Overcurrent w/Voltage Restraint	UDA
M,S		BE1-51TC	Time Overcurrent w/Torque Control	UDP
S		BE1-59	Overvoltage	UBF
S		BE1-59N	Ground Fault Overvoltage	UBG
S		BE1-59NC	Capacitor Neutral Overvoltage	UHF
S		BE1-60	Voltage Balance	UBS
M		BE1-67	Phase Directional Time Overcurrent	UDQ
M		BE1-67N	Ground Directional Time Overcurrent	UDR
S		BE1-79M	Multishot Reclosing	UDL
S		BE1-79S	Single Shot Reclosing	UBN
M,S		BE1-81O/U	Digital Frequency	UBR
M,S		BE1-87B	High Impedance Bus Differential	UHC
S	BE1-87G	Variable Percentage Differential	UBK	
M	BE1-87T	Transformer Differential	UHA	
R	BE1-25A	Automatic Synchronizer	UIM	

* A=A1 Case size; C=C1; F=F1; H=H1; M=M1; R=19" rack; S=S1; X=MX

**WARRANTY
INFORMATION**
Page 2

RELAY STANDARDS
Pages 2 and 3

CONSTRUCTION
Pages 4 - 6

**DIMENSIONS and
DRILLING DIAGRAMS**
Pages 7 - 19

RELAY ACCESSORIES
Pages 20 - 24

B Basler Electric

P. O. BOX 269 HIGHLAND, ILLINOIS 62249, U.S.A. PHONE 618-654-2341 FAX 618-654-2351

SDA-5
8-01

WARRANTY

Basler Electric Company warrants its *BE1 Numerical Systems* to be free from defects in material and workmanship for a period of 7 years from date of shipment. It further warrants its *BE1 Protective Relays* to be free from defects in material and workmanship for a period of 5 years from date of shipment. To determine which of the two product lines an individual Protection and Control product belongs to, consult the table on the previous page (cover).

Basler Electric's sole obligation under its warranty shall be, at its option, to either issue a credit, or repair or replace an article or part thereof, which is proved to be other than as warranted.

If an article is claimed to be defective in material or workmanship, Basler Electric Company will either examine the articles on site or issue shipping instructions for return to the factory. This warranty shall not extend to any articles or parts that have been installed, used or serviced, other than in conformity with Basler Electric's applicable specifications, manuals, bulletins, or instructions, or if none, shall have been subjected to improper installation, misuse or neglect.

Complete warranty information can be found in Basler Electric's "Terms and Conditions of Sale" form FA100001, located in the pricing section of the Basler Electric Power Products Catalog.

RELAY STANDARDS

APPLICABLE STANDARDS

Basler Electric protective relays are designed to meet or exceed industry standards as well as those set by Basler Electric.

Industry Standards

- IEEE C37.90-1989, IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus.
- IEEE C37.90.1-1989, IEEE Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems.
- IEEE C37.90.2, IEEE Trial-Use Standard on Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers.
- IEC 255-5, Electrical Relays, Part 5: Insulation Tests for Electrical Relays.
- IEC 255-6, Electrical Relays, Part 6: Measuring Relays with more than one Input Energizing Quantity. Includes high frequency disturbance test.
- IEC 255-22-2, Electrical disturbance tests for measuring relays and protection equipment, Electrostatic Discharge Tests
- IEC 255-22-3, Electrical disturbance tests for measuring relays and protection equipment, Radiated Electromagnetic Field Disturbance Tests
- IEC 255-22-4, Electrical disturbance tests for measuring relays and protection equipment, Fast Transient Disturbance Tests
- IEC 255-22-6, Electromagnetic Compatibility (EMC), Immunity to Conducted Disturbances, Induced by Radio-frequency Fields
- IEC 255-25, Limits and Methods of Measurement of Radio Disturbance Characteristics of Industrial, Scientific and Medical (ISM) Radio-frequency Equipment

AGENCY RECOGNITION

Relays requiring certification are submitted for recognition under UL 508, as well as CSA certification and CE compliance. Many models are recognized. Check with Basler Electric for the latest list.

GENERAL SPECIFICATIONS

The following general specifications apply to all Basler BE1 Series protective relays. Functional specifications are found in the individual product bulletins.

Power supply voltages

Nominal Voltage	Operating Voltage Range	Frequency Range
48Vdc	24 to 60 Vdc	N/A
125Vdc 110/120 Vac	62 to 150 Vdc 90 to 132 Vac	N/A 40-70 Hz
24 Vdc	14 to 32 Vdc	N/A
48 Vdc 125 Vdc	24 to 60 Vdc 62 to 150 Vdc	N/A N/A
250 Vdc 230 Vac	140 to 280 Vdc 190 to 270 Vac	N/A 40-70 Hz

RELAY STANDARDS, Continued

Output contacts

Rated Voltage	Resistive			Inductive	
	Make 0.2 sec.	Carry Continuous	Break	Break	L/R
120/240 Vac	30A	7A	7A	0.3A	0.04
125 Vdc	30A	7A	0.3A	0.3A	0.04
250 Vdc	30A	7A	0.3A	0.3A	0.04
500 Vdc	15A	7A	0.1A	---	---

Output contact status is defined by Basler Electric as the state of the output contact when relay operating power has been removed. The following Tables define contact status for relays that have an "over" trip function, an "under" trip function or an "over/under" trip capability.

"Over" Trip Function

Contact Configuration	Operating Power OFF	Operating Power ON	
		Sensing Input Less Than Trip Setting	Sensing Input Greater Than Trip Setting
Normally Open (NO)	Open	Open	Closed
Normally Closed (NC)	Closed	Closed	Open

"Under" Trip Function

Contact Configuration	Operating Power OFF	Operating Power ON	
		Sensing Input Less Than Trip Setting	Sensing Input Greater Than Trip Setting
Normally Open (NO)	Open	Closed	Open
Normally Closed (NC)	Closed	Open	Closed

"Over/Under" Trip Function

Contact Configuration and Trip Function	Operating Power OFF	Operating Power ON	
		Sensing Input Less Than Trip Setting	Sensing Input Greater Than Trip Setting
NO (Over)	Open	Open	Closed
NC (Over)	Closed	Closed	Open
NO (Under)	Open	Closed	Open
NC (Under)	Closed	Open	Closed

Targets

Either current operated or internally operated targets may be selected. The individual relay product bulletin will identify the availability and configuration of targets for each model relay.

A current operated target requires a minimum of 0.2A (ac or dc) to flow through the output trip circuit to actuate the indicator. This target type can only be specified when the main output relay contacts are specified as normally open (NO).

An internally operated target is operated by an electronic signal in parallel with the output relay drive signal. This type of target may be selected for use with either normally open (NO) or normally closed (NC) output contacts.

Operating Temperature

-40° C (-40° F) to 70° C (158° F).

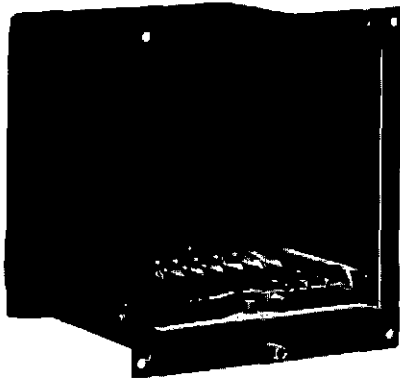
Vibration

Withstands 2g in each of three mutually perpendicular planes over the frequency range of 10 to 500 Hz without structural damage or degradation of performance.

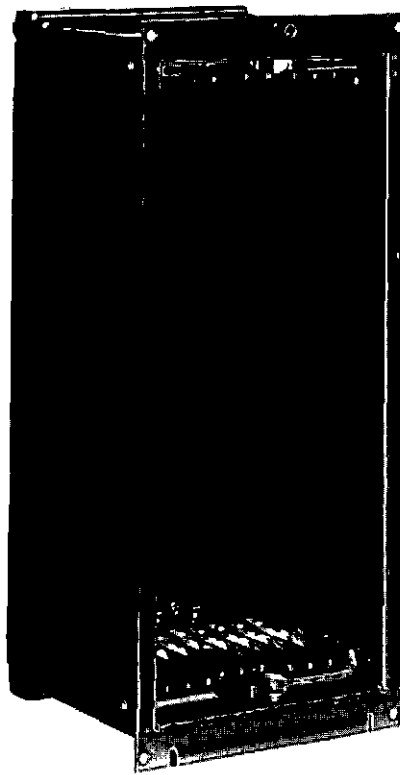
Shock

Withstands 15g in each of three mutually perpendicular planes without structural damage or degradation of performance.

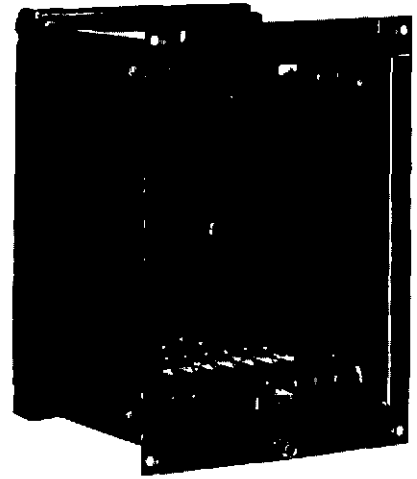
RELAY CASES



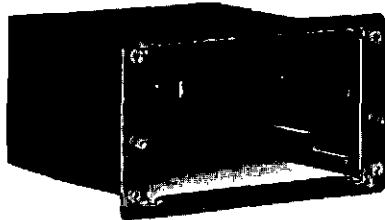
A1



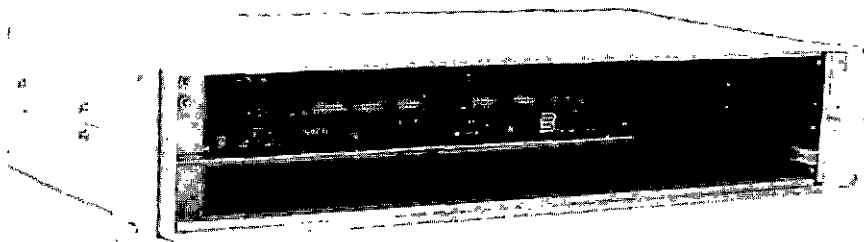
M1



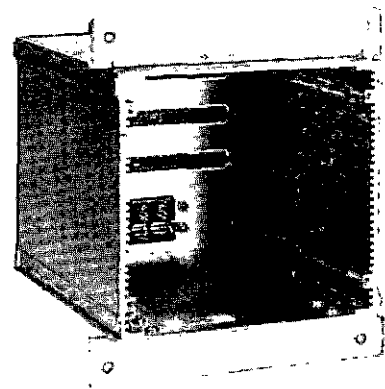
S1



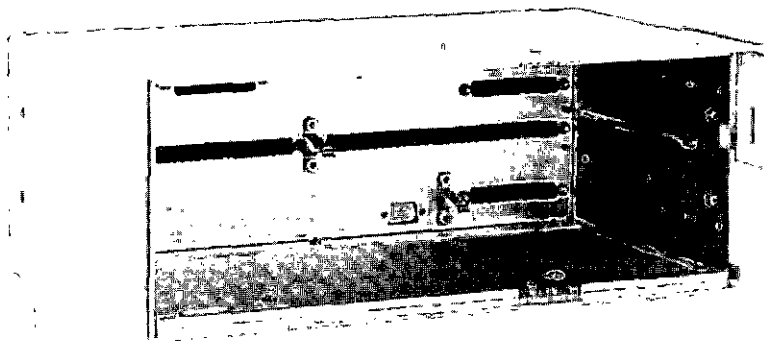
C1



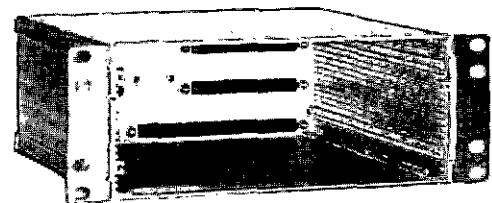
19" RACK



F1



MX RACK



H1 HALF-RACK

CONSTRUCTION OF A1, M1 and S1 CASES

Relay Case

Each case (A1, M1 and S1) consists of a fabricated steel and phenolic enclosure that is resistant to dust and moisture. They are designed to house either single or double-ended relay units with one or two connecting plugs as required for the specific relay type. Round, washer head terminal screws are located on the rear of the case for ease of connection. These cases are capable of semi-flush or projection mounting as shown in the dimension and drilling diagrams, pages 6 through 13.

Drawout Cradle

The relay unit (drawout cradle) is a steel frame that houses the motherboard, magnetics chassis and all printed circuit boards that are required for the specific relay type. Locking levers at the top and bottom secure the drawout cradle to the case and enable easy removal for inspection.

Connecting Plugs

One or two connecting plugs, as required, electrically connect the drawout cradle to the system interconnections at the top and/or bottom of the relay case. The contact fingers of the connecting plugs and the relay case and cradle terminal blocks are silver-plated.

Front Cover

The front cover is a gasketed phenolic frame with clear acrylic window to enable visual inspection of the relay's setting adjustments and indicators. The front cover is secured to the case by a flange at the top and a single sealable knob with screw inset at the bottom center of the front cover. The target reset lever projects from the bottom or front of the cover and enables the targets to be reset without removal of the front cover.

CONSTRUCTION OF C1 CASE

Relay Case

The C1 case is a fabricated steel enclosure resistant to dust and moisture. The case is available in only one size and is designed for semi-flush mounting. The case includes guides to support the cradle assembly when mounted horizontally or vertically. Round washer head terminal screws are located on the rear of the case for ease of connection, see page 14. External test provisions must be provided to test the relay in its case, or the drawout cradle may be removed for testing in a test jig.

Drawout Cradle

The relay unit (drawout cradle) consists of a steel chassis upon which all the parts for the relay are mounted. The cradle is designed so that the front cover cannot be installed on the case unless the cradle is fully inserted into the connection block on the rear of the relay case. Input current circuits are shorted when the cradle is removed from the case.

Front Cover

The front cover is molded out of clear flame retardant plastic conforming to the requirements of UL 508. The cover includes a target reset button that extends out from the front cover.

CONSTRUCTION OF RACK MOUNT CASES

Rack Mount Case

Rack mount cases conform to standard 19-inch rack mount dimensions. The heights of the cases are specified in terms of the number (n) of standard rack units. Each rack unit is 1.75 inches, and Basler cases range from 2 to 5 rack units. This is shown on page 16. The depth of rack mount cases varies depending on the relay model. Some relay models include built-in test provisions for testing the relay in the case. Other relay models require external provisions to test the relay in its case, or the relay module may be removed and tested in a test jig.

Construction

All relays are made with drawout capability. Some units have several drawout modules; others have one complete drawout assembly.

Front Cover

Front covers for rack mount cases come in two styles depending on the relay model. One has a glass window and the others are made with plastic windows. Covers include a means to reset targets without removing the cover.

CONSTRUCTION OF H1 and F1 CASES

Relay Cases

H1 and F1 cases are extruded, brushed aluminum, fabricated enclosures resistant to dust and moisture. Internal side extrusions act as a guide for the drawout assembly and provide a means to secure the drawout assembly in place with two knurled knobs on the faceplate. Surface mounted handles on the face of the drawout assembly facilitate extraction of the drawout assembly from the case. Terminal blocks in the rear of the case mate directly with the drawout assembly when it is in the fully-inserted position. Special automatic shorting terminal blocks at the rear of the case are used on all current transformer connections.

The H1 case is a half-rack design, two rack units (3.5") high. Using dovetail extrusions on the external sides of the case, two H1 cases can be fitted together to form a

standard 19" rack mount assembly. Optional adapter plates (pages 17 and 22) allow the H1 case to be used in a variety of applications. Two H1 case configurations are available. Relay style dictates which configuration will be used. The F1 case dimensions are similar to the Westinghouse FT11 case.

Drawout Assembly

The drawout assembly is a unitized, fabricated aluminum cradle. The assembly contains all of the PC boards used in the relay. The front of the drawout assembly serves as the face/cover for the relay assembly. Threaded bolts with knurled knobs on the faceplate fasten the drawout assembly securely to the case. Handles mounted on the faceplate aid in extracting the drawout assembly from the case.

CONSTRUCTION OF MX CASES

Relay Cases

MX cases are painted, aluminum fabricated enclosures, resistant to dust and moisture when fitted with the optional cover. Internally mounted guides on the ends of the case aid in directing the drawout assembly to the case terminals at the back of the case during insertion. Terminal blocks in the rear of the case mate directly with the drawout assembly when it is in the fully-inserted position. Special automatic shorting terminal blocks at the rear of the case are used on all current transformer connections.

Three MX case configurations are available. Relay style dictates which configuration will be used.

Drawout Assembly

The drawout assembly is a unitized, fabricated aluminum cradle. It contains all of the PC boards used with the relay. The front of the drawout assembly serves as the face/cover for the relay assembly. Locking levers at the ends of the drawout assembly face/cover aid in the extraction and insertion of the assembly, and provide a means for securing the assembly to the case. The drawout assembly is available in either vertical or horizontal configurations.

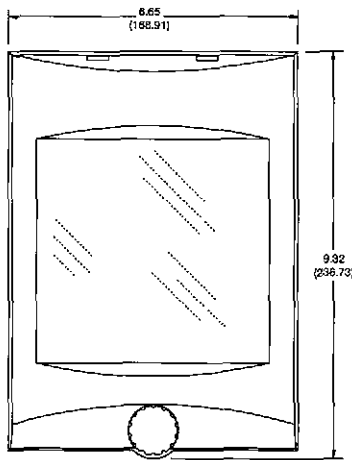
Front Cover

The optional front cover is a single piece, clear acrylic unit. Screw-driven levers at the ends of the cover secure it to the relay case. A target reset button is provided on the front of the cover.

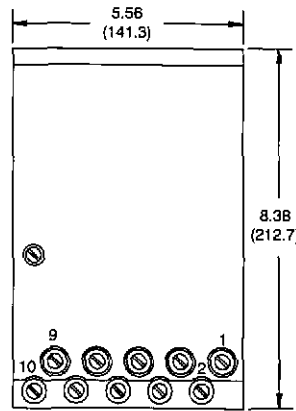
S1 DIMENSIONS and DRILLING DIAGRAM

SEMI-FLUSH MOUNT

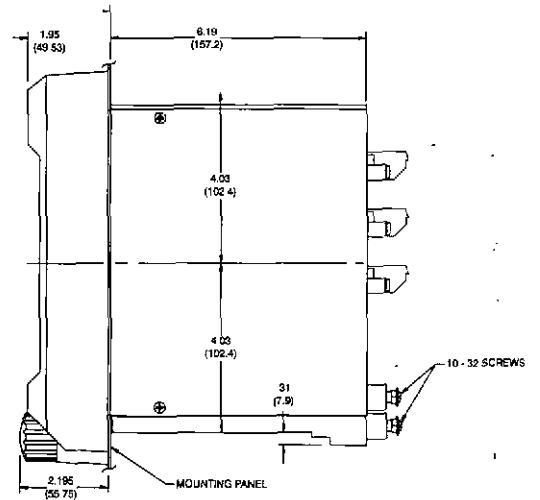
Relays may be mounted at any convenient angle.



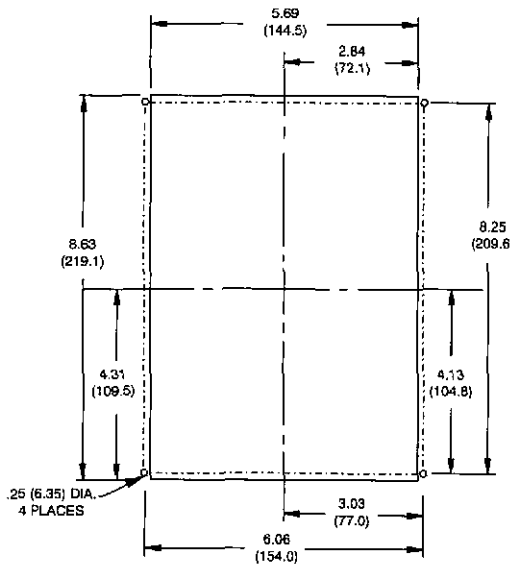
FRONT VIEW



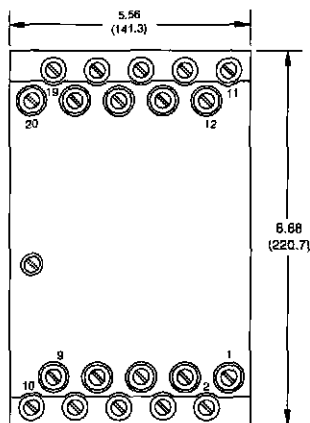
REAR VIEW
Single Ended Case



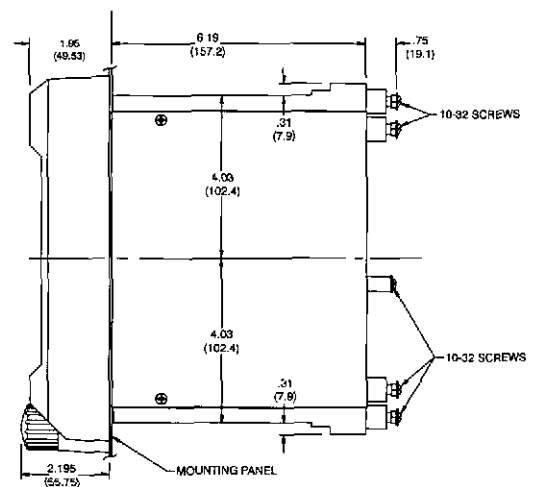
SIDE VIEW
Single Ended Case



DRILLING DIAGRAM
Single or Double Ended
(Rear of panel)



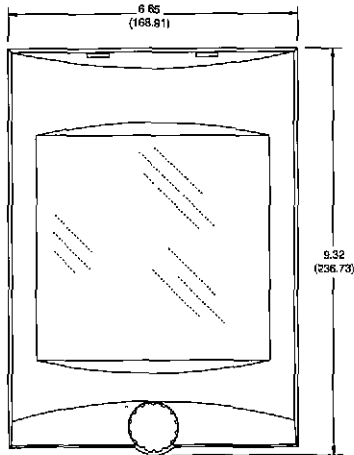
REAR VIEW
Double Ended Case



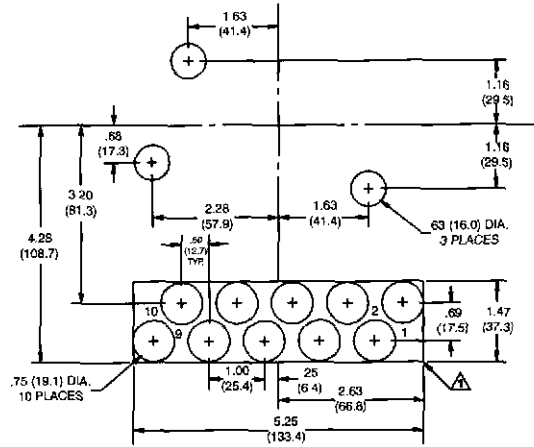
SIDE VIEW
Double ended Case

S1 DIMENSIONS and DRILLING DIAGRAM PROJECTION MOUNT

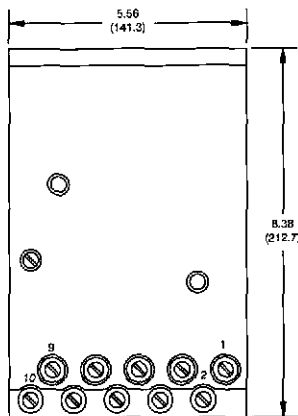
Relays may be mounted at any convenient angle.



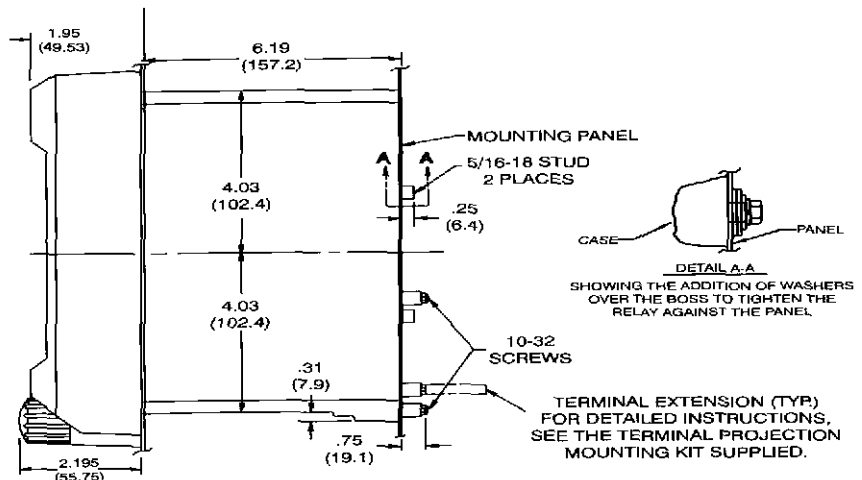
FRONT VIEW



DRILLING DIAGRAM
Single Ended (Rear of panel)



REAR VIEW
Single Ended Case

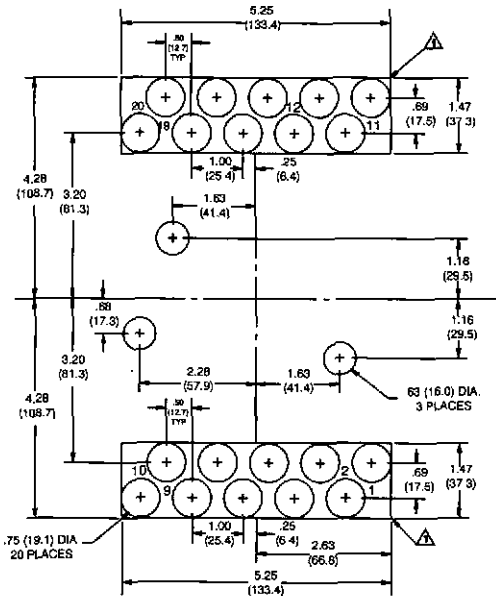


SIDE VIEW
Single Ended Case

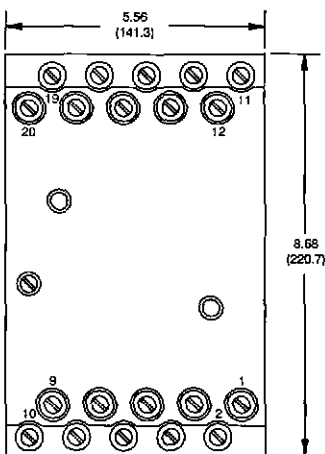
S1 DIMENSIONS and DRILLING DIAGRAM

PROJECTION MOUNT

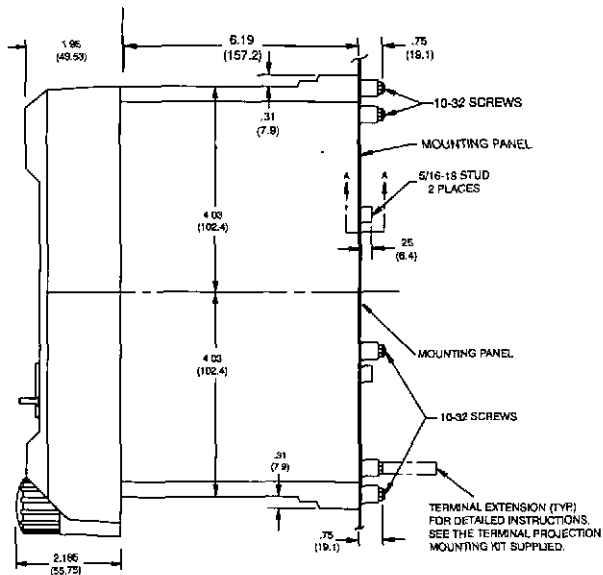
Relays may be mounted at any convenient angle.



DRILLING DIAGRAM Double Ended (Rear of panel)



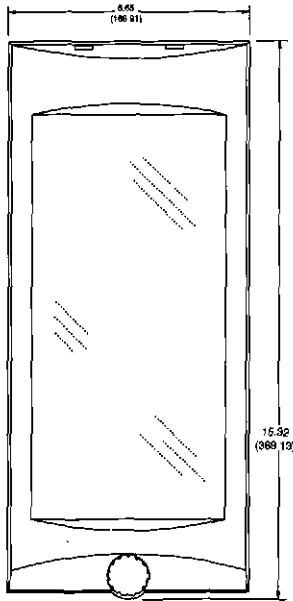
REAR VIEW Double Ended Case



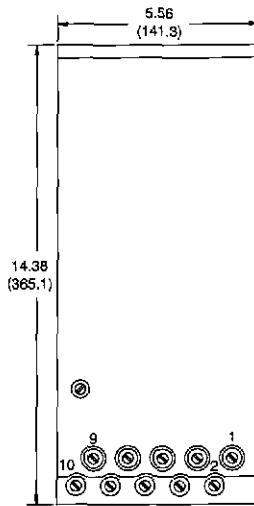
SIDE VIEW Double Ended Case

M1 DIMENSIONS and DRILLING DIAGRAM SEMI-FLUSH MOUNT

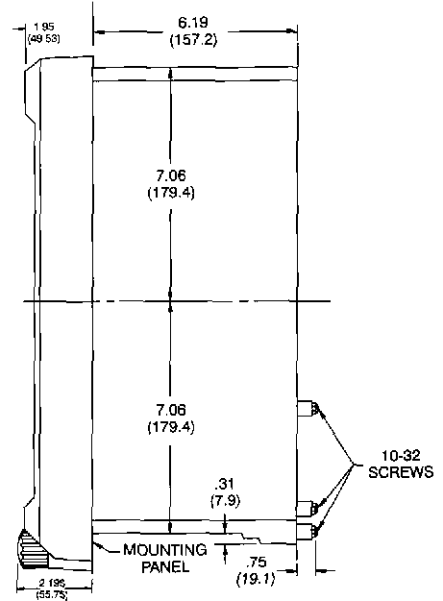
Relays may be mounted at any convenient angle.



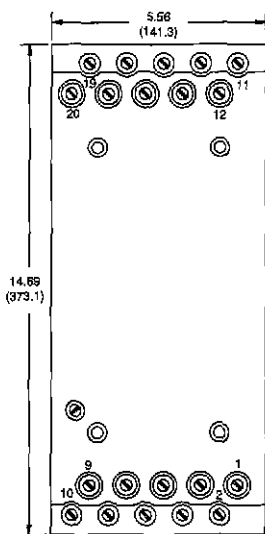
FRONT VIEW



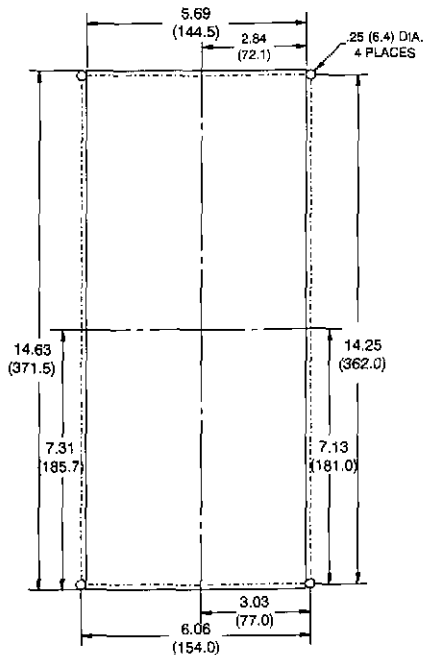
REAR VIEW
Single Ended Case



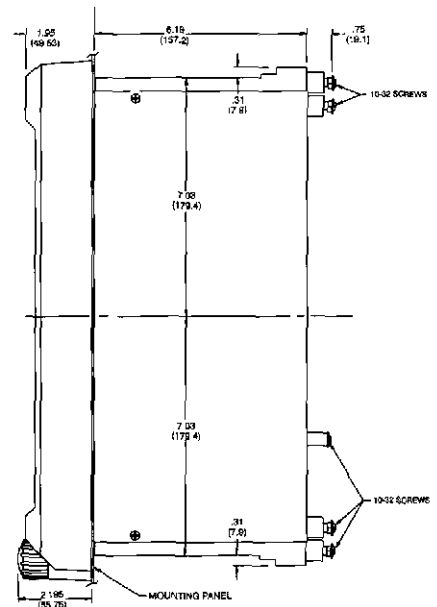
SIDE VIEW
Single Ended Case



REAR VIEW
Double Ended Case



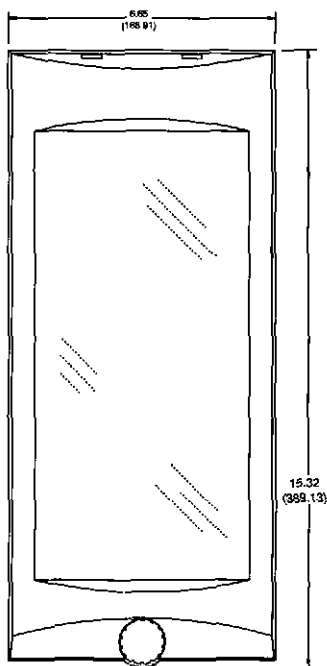
DRILLING DIAGRAM
Single or Double Ended
(Rear of panel)



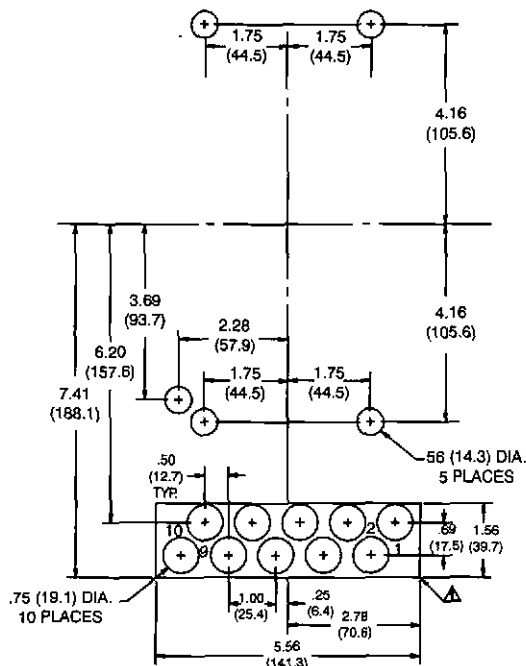
SIDE VIEW
Double ended Case

M1 DIMENSIONS and DRILLING DIAGRAM PROJECTION MOUNT

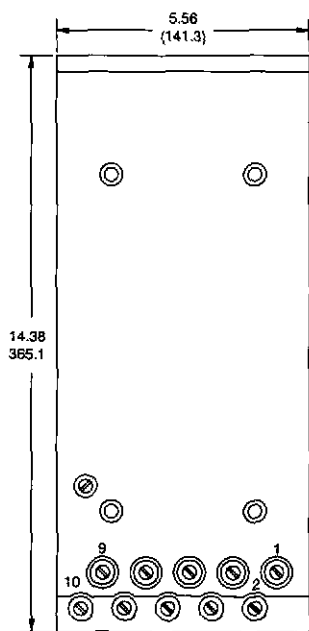
Relays may be mounted at any convenient angle.



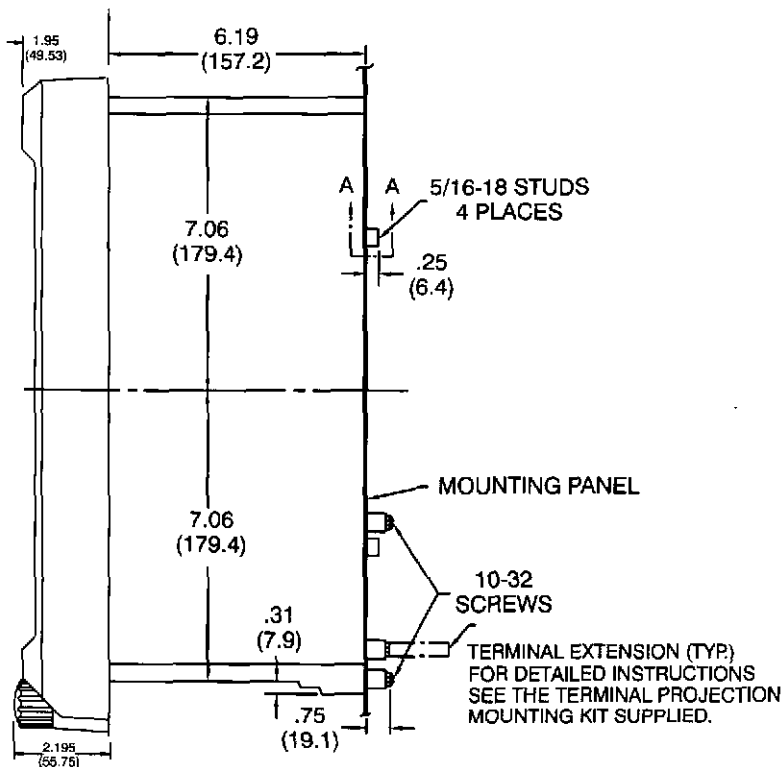
FRONT VIEW



DRILLING DIAGRAM
Single Ended (Rear of panel)



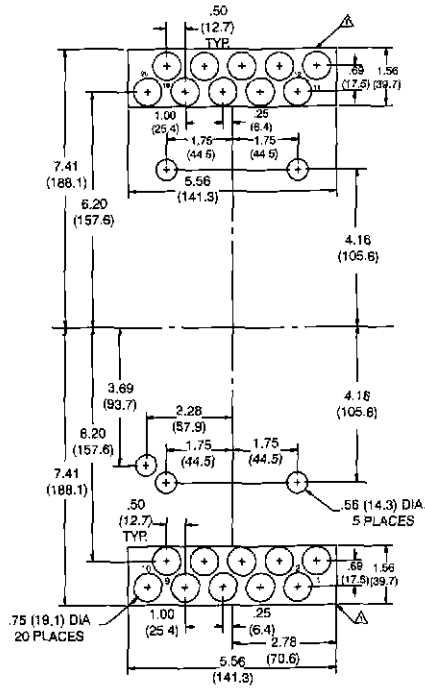
REAR VIEW
Single Ended Case



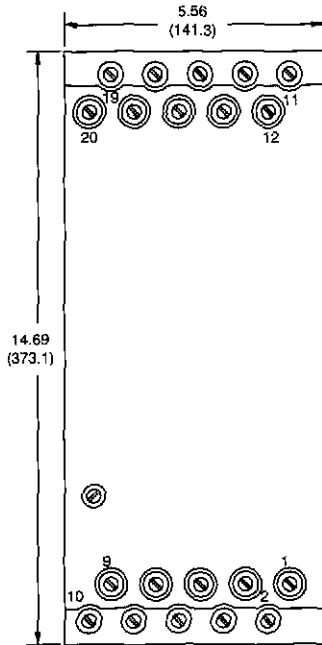
SIDE VIEW
Single Ended Case

M1 DIMENSIONS and DRILLING DIAGRAM PROJECTION MOUNT

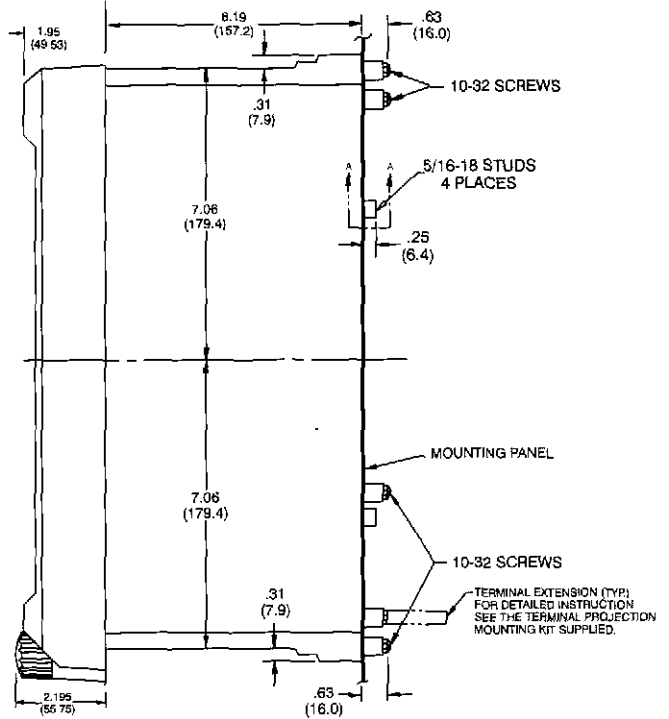
Relays may be mounted at any convenient angle.



DRILLING DIAGRAM Double Ended (Rear of panel)



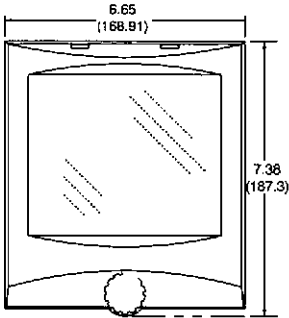
REAR VIEW
Double Ended Case



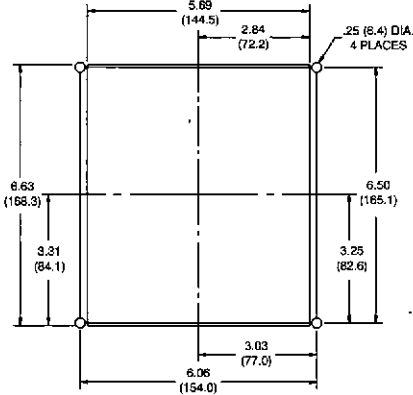
SIDE VIEW
Double Ended Case

A1 DIMENSIONS AND DRILLING DIAGRAM SEMI-FLUSH MOUNT

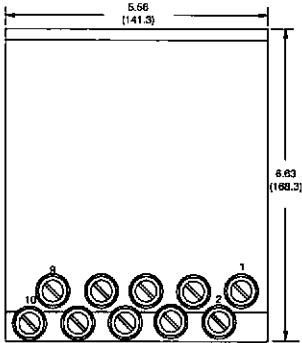
Relays may be mounted at any convenient angle.



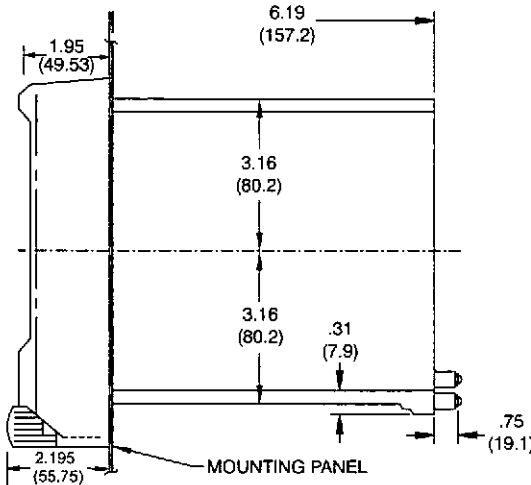
FRONT VIEW



**DRILLING DIAGRAM
(Rear of panel)**



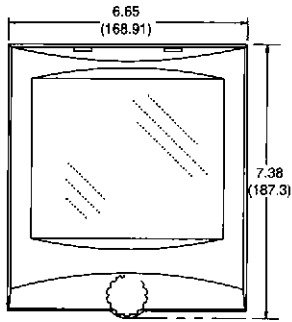
REAR VIEW



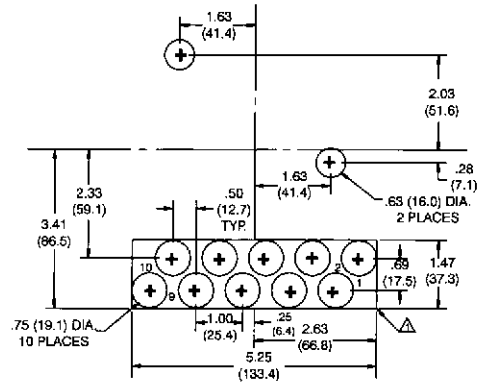
SIDE VIEW

A1 DIMENSIONS AND DRILLING DIAGRAM PROJECTION MOUNT

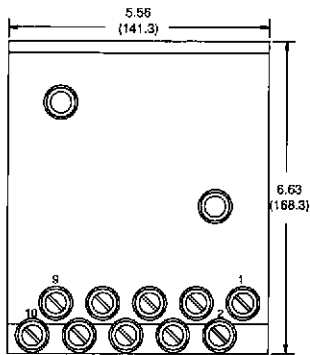
Relays may be mounted at any convenient angle.



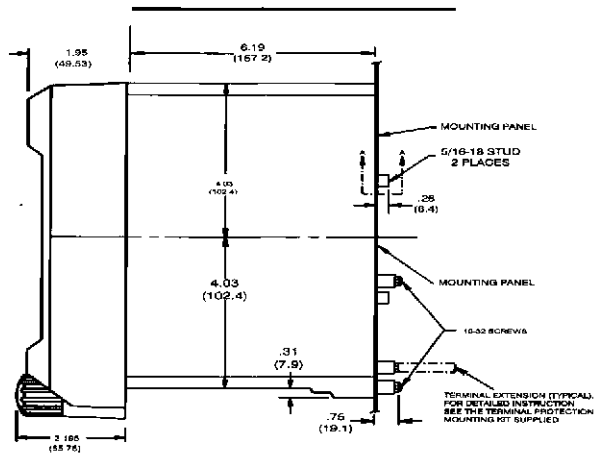
FRONT VIEW



**DRILLING DIAGRAM
(Rear of panel)**



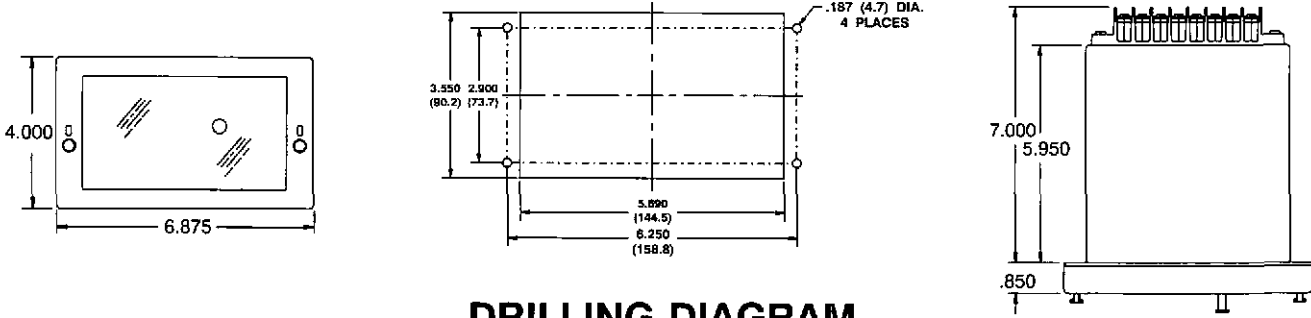
REAR VIEW



SIDE VIEW

C1 DIMENSIONS and DRILLING DIAGRAM

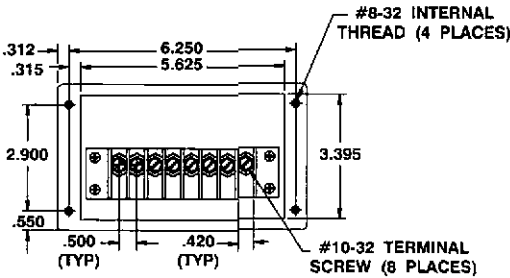
Relays may be mounted at any convenient angle.



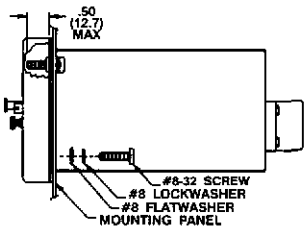
FRONT VIEW

DRILLING DIAGRAM
(Rear of panel)

TOP VIEW



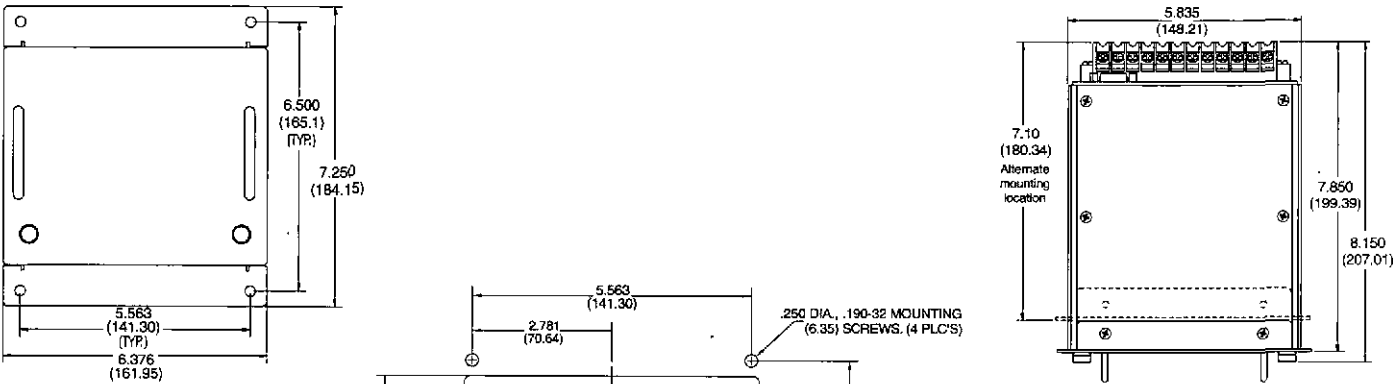
REAR VIEW



SIDE VIEW

F1 DIMENSIONS and CUTOUT DIAGRAM

Relays may be mounted at any convenient angle.



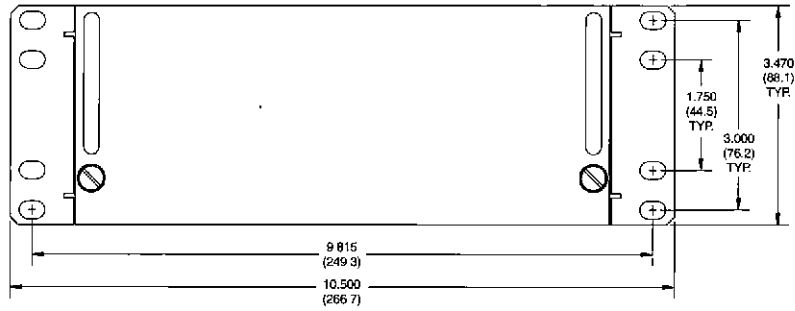
FRONT VIEW

TOP VIEW

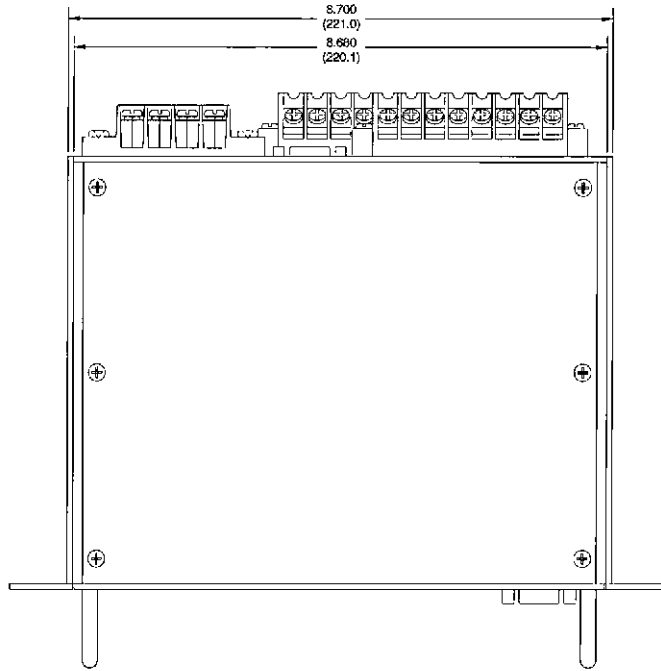
CUTOUT DIAGRAM

H1 DIMENSIONS

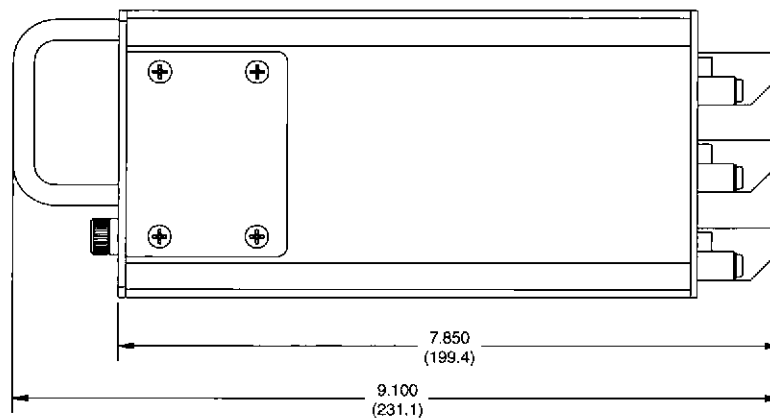
Relays may be mounted at any convenient angle.



FRONT VIEW

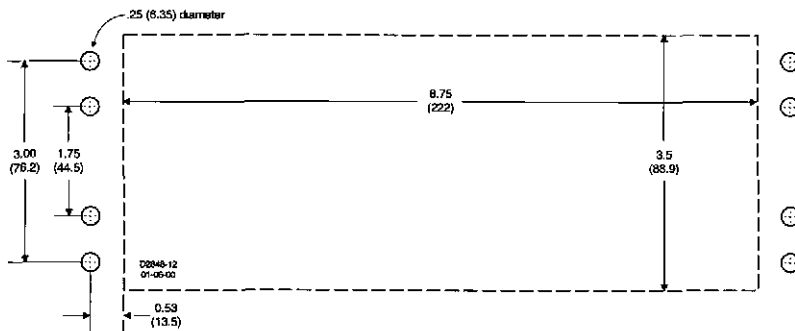


TOP VIEW

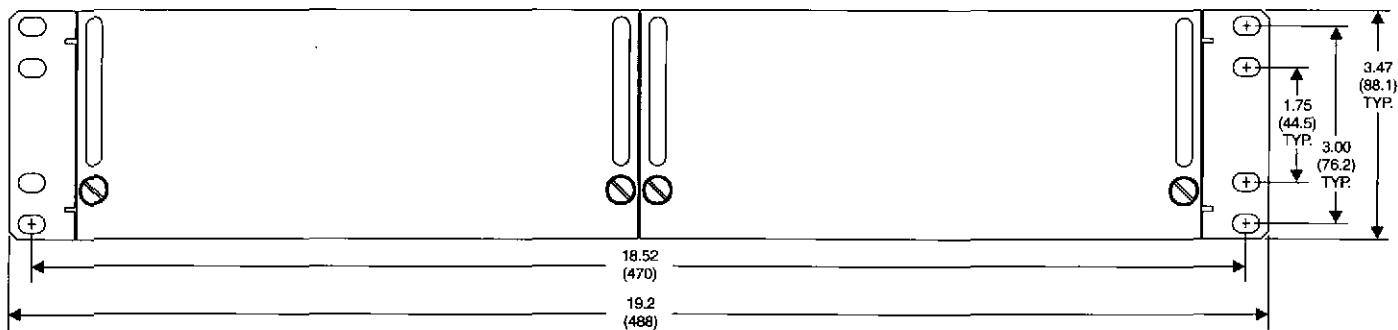
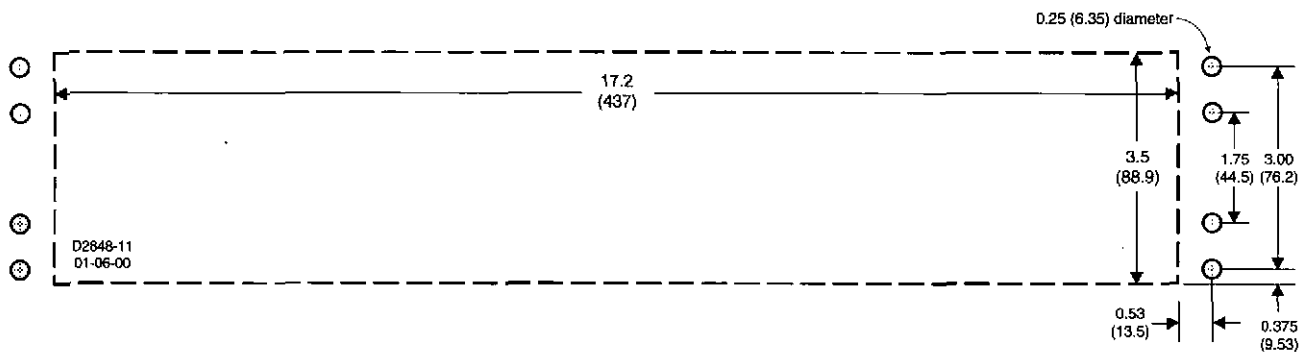


SIDE VIEW

H1 DIMENSIONS, continued



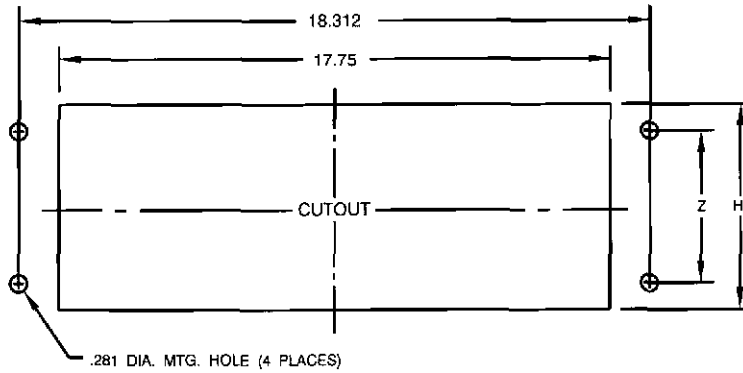
Single Relay H1 Mounting Plate Dimensions for Panel Mounting without an Escutcheon Plate



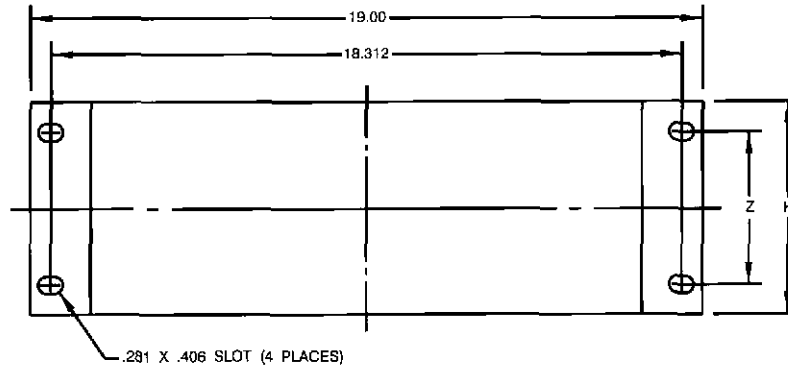
Two-Relay H1 Mounting Plate Dimensions for Panel Mounting without an Escutcheon Plate

19" RACK MOUNT DIMENSIONS and DRILLING DIAGRAM

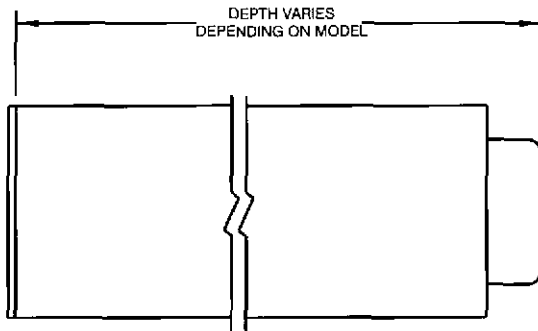
Relays may be mounted at any convenient angle.



FRONT VIEW



**DRILLING DIAGRAM
(Rear of panel)**



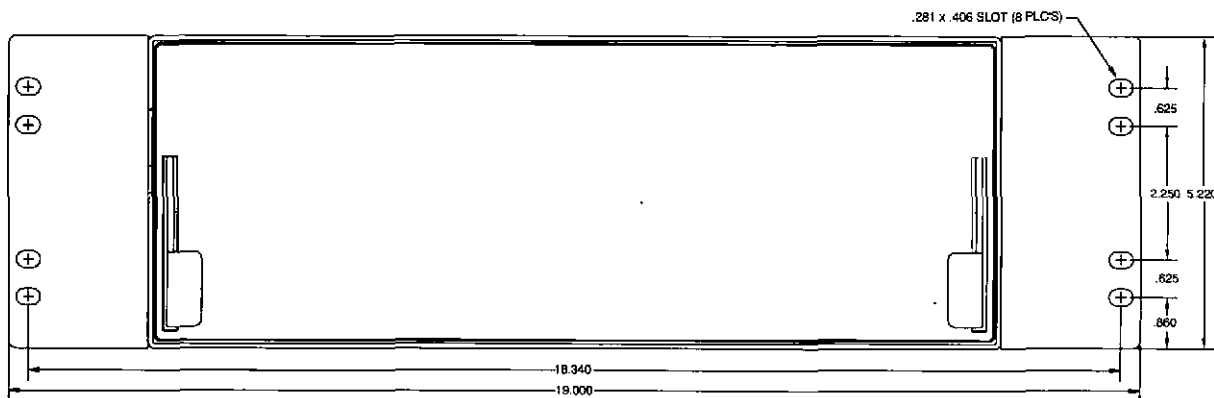
SIDE VIEW

NOTES:

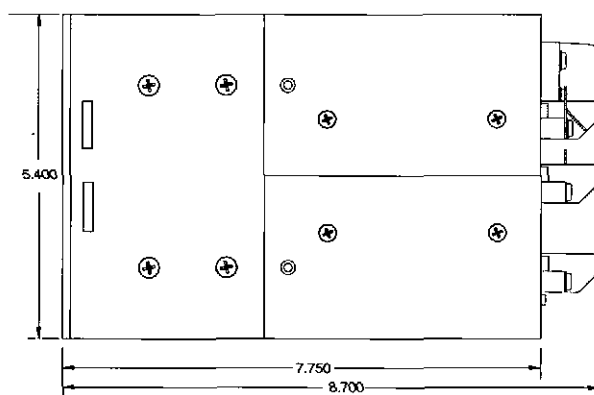
- 1) DIMENSION H = 1.750n + 0 / -0.031.
- 2) TOLERANCE TO BE ±0.015 UNLESS OTHERWISE SPECIFIED.
TOLERANCES TO BE NON-CUMULATIVE.
TOLERANCE BETWEEN ANY TWO SLOTS ±0.015.
N = RU = 1.75" nominal ±1/32

DIMENSION TABLE FOR RACK MOUNTED UNITS			
n	H	Z	H ₁
2	3.469	3.000	3.600
3	5.219	2.250	5.350
4	6.969	4.000	7.100
5	8.719	5.750	8.850

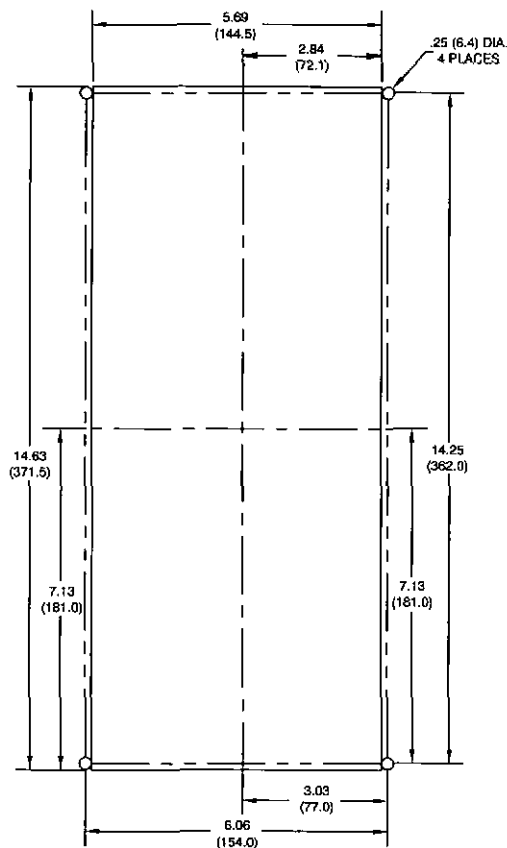
MX DIMENSIONS and DRILLING DIAGRAM



FRONT VIEW
HORIZONTAL RACK MOUNT

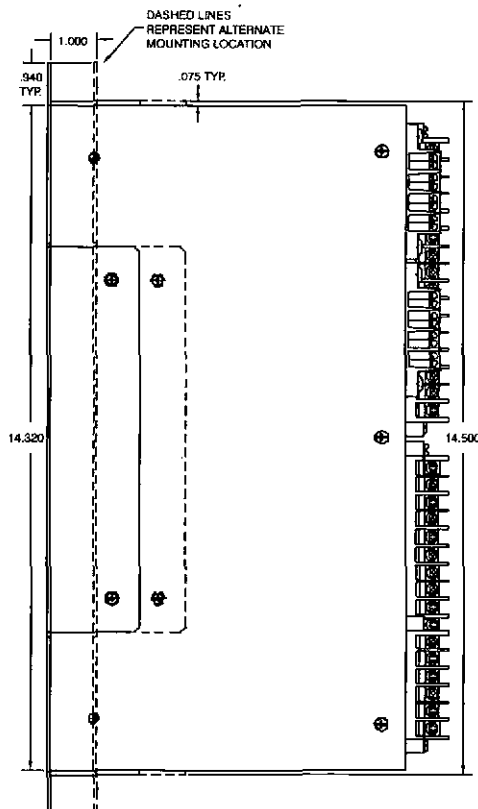


SIDE VIEW
HORIZONTAL RACK MOUNT



DRILLING DIAGRAM

These dimensions are for the vertical panel mount MX case or the horizontal panel mount MX case. Rotate this drawing ninety degrees for the horizontal panel mount MX case.



SIDE VIEW
VERTICAL PANEL MOUNT

RELAY ACCESSORIES

Accessories

The Basler Electric Company offers several accessories to aid in the testing, calibrating and troubleshooting of protective relays. The accessories available through Basler Electric are described in the paragraphs that follow.

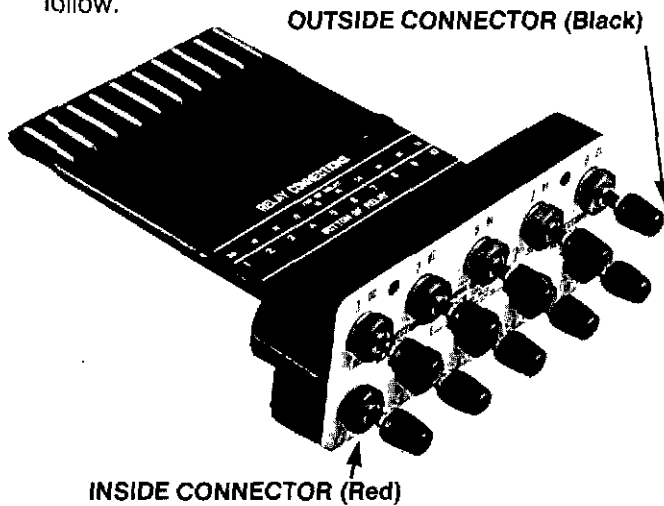
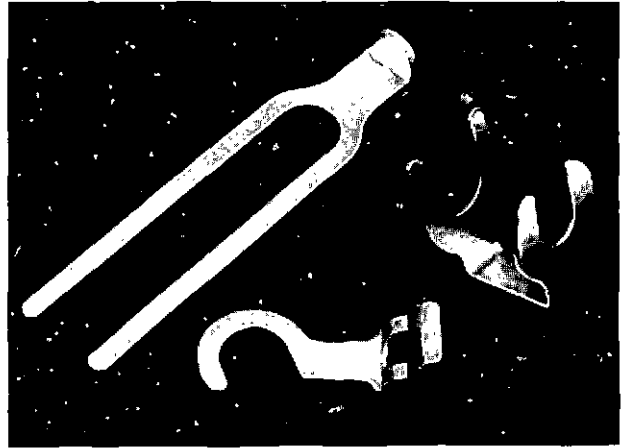


Figure 2 - Test Plug



LINKS AND TEST CLIPS

Links and test clips are provided with each test plug to facilitate any test connections required.

Extender Card

The extender card permits calibration and troubleshooting of the individual printed circuit boards outside of the drawout cradle assembly.

There are two extender card versions available to suit the user's particular need. Extender card, Part number 9112930101 (Figure 3), is keyed to fit Basler relay motherboard locations, and comes with numbered terminals for easy identification of particular circuits to be tested.

Test Plug

The test plug, Part number 10095 (Figure 2), provides a quick, easy method of testing a drawout case type relays without removing them from their cases. The test plug is simply substituted for the connecting plug with nothing left to disconnect. Insertion of the test plug enabled the user to access both the external stud connections and the internal relay connections.

The test plug consists of a black and red phenolic molding with 20 electrically separated contact fingers. The 10 fingers on the black side are connected to the inside binding posts with the black thumb nuts. The 10 fingers on the red side of the test plug are connected to the outside binding posts with the red thumb nuts and engage the relay case external stud connections.

When testing circuits connected to the bottom set of case terminals, the test plug will be inserted with the numbers 1 through 10 displayed in an upright manner. Likewise, when using the test plug in the upper part of the relay, the numbers 11 through 20 are displayed in an upright manner. It is impossible, due to the construction of the test plug, to insert it upside down.

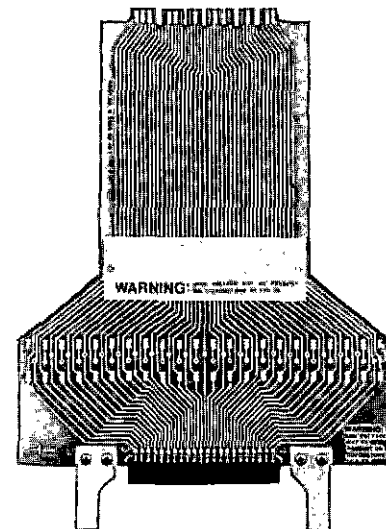


Figure 3 - Extender Card 9112930101

RELAY ACCESSORIES, continued

In operation, the printed circuit board to be calibrated or tested is removed from the cradle assembly and attached to the extender card connecting plug. The entire assembly (pc board and extender card) is then inserted into the vacated slot of the cradle assembly. All tests and adjustments can then be performed with ease.

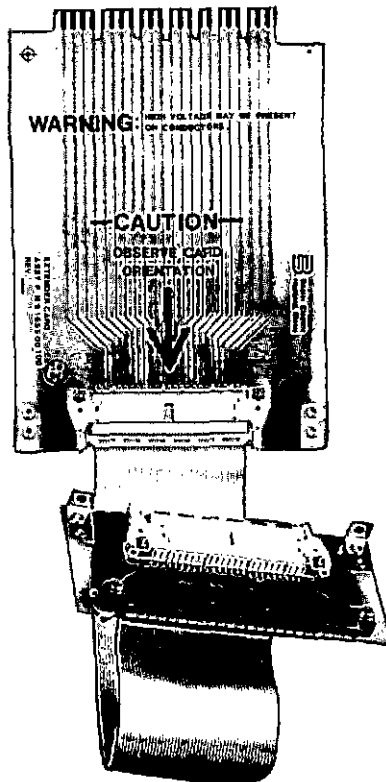


Figure 4 - Extender Card 9165500100

Extender card, Part number 9165500100 (Figure 4) is also keyed to fit motherboard locations. The desirable feature of this extender card is its two part construction, which connects one half of the board (with ribbon cable) to the other half. This allows the pc board to be placed on the workbench for easier access to both sides of the PC board. The operation is the same as that described above.

Bench test Fixture

A test fixture that consists of a cutaway case that includes a terminal block is available. This fixture was expressly designed for testing, without confinement, the relays that come in an A1 case. (These relays cannot use an extender card.) The bench test fixture can be used with the M1 and S1 cases.

Order Basler part number 9201111100. Includes extra paddle. Two test fixtures are required for double-ended relays (i.e. for 20-terminal cases).

Contact Sensing Module

Contact sensing modules are required with relays having contact inputs, and power supplies rated for either 250 Vdc or 230 Vac. (Types T, X and Z). These modules are designed to dissipate the excessive heat generated by the contact sensing circuits external to the relay, thereby keeping this energy outside of the relay case.

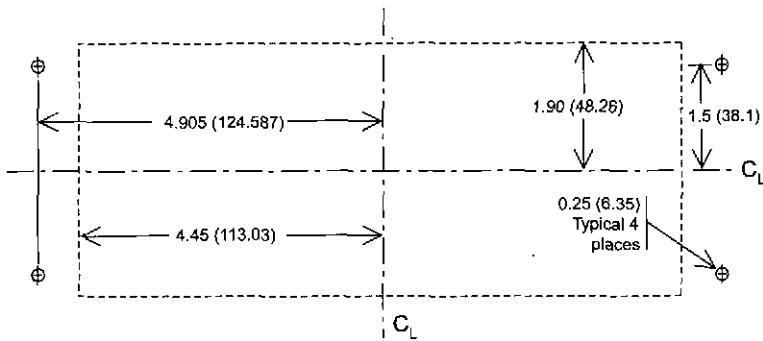
There are 12 input sensing modules available for use with the BE1 relay models. Six modules are available for relays styles with isolated contact sensing inputs and six modules are available for relay styles with non-isolated contact sensing inputs. The specific module required by a specific style relay is determined by the number of contacts that must be sensed by the device, and whether the relay uses an isolated contact (the control circuit is ac) or the relay uses a non-isolated contact (the control circuit is dc). In the former case (isolated sensing), the relay supplies the required dc voltage to the contact for sensing.

Module Selection Chart

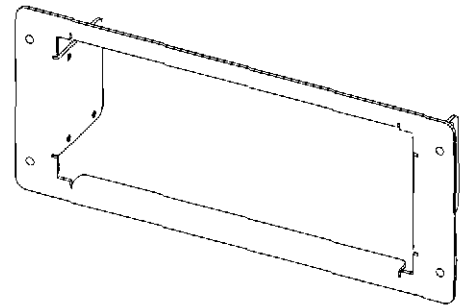
Number of Contact Inputs	Part Number of Contact Sensing Module	
	For Isolated Contact Sensing	For Non-Isolated Contact Sensing
1	9170206105	9170206111
2	9170206104	9170206110
3	9170206103	9170206109
4	9170206102	9170206108
5	9170206101	9170206107
6	9170206100	9170206106

Complete module specifications, mounting and outline dimensions, connection information and schematic diagrams for each of the above modules is contained within the Input Sensing Module Instruction Manual 9170206990, which is included with the module when shipped.

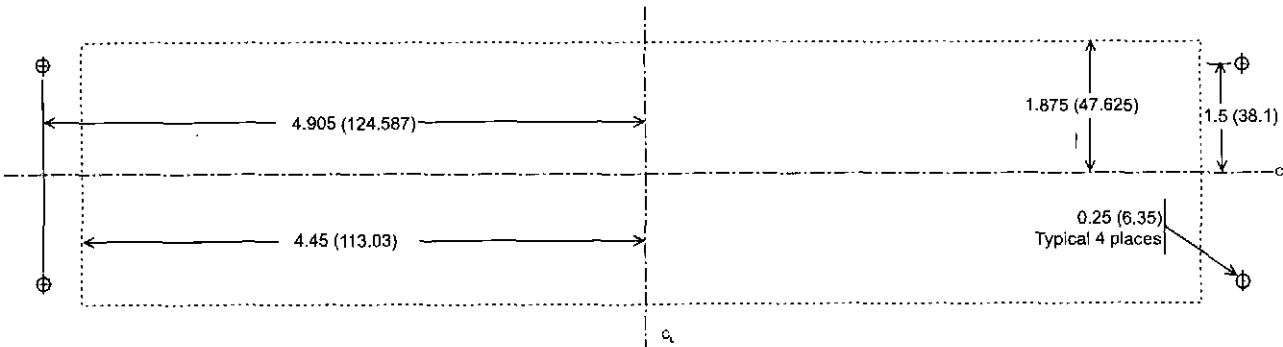
RELAY ACCESSORIES, continued



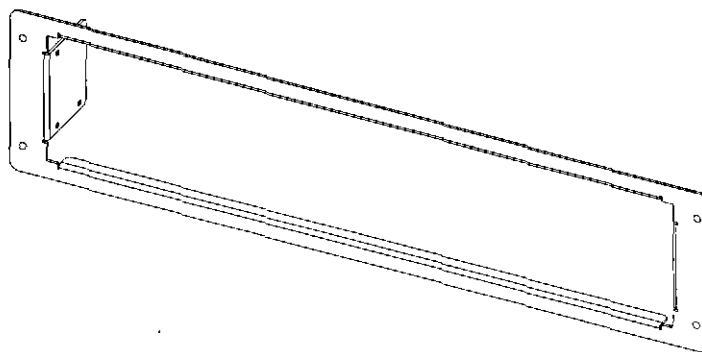
Single Relay H1 Mounting Plate Dimensions



9289900017 - Escutcheon plate to panel mount one H1 relay.

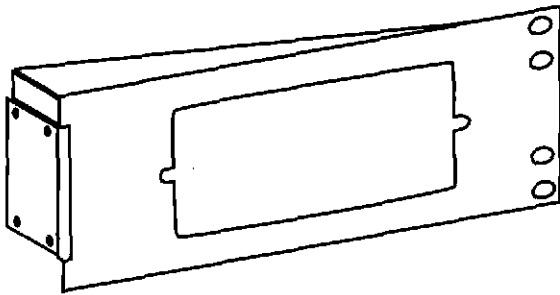


Two-Relay H1 Mounting Plate Dimensions

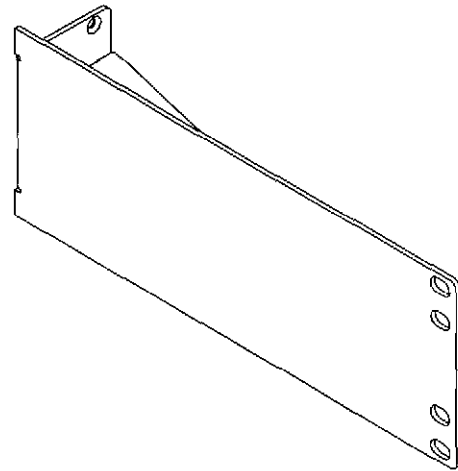


9289900016 - Escutcheon plate to panel mount two dovetailed H1 relays.

RELAY ACCESSORIES, continued



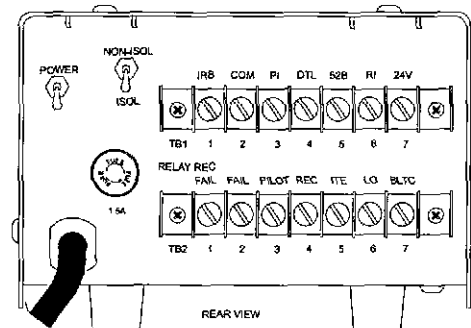
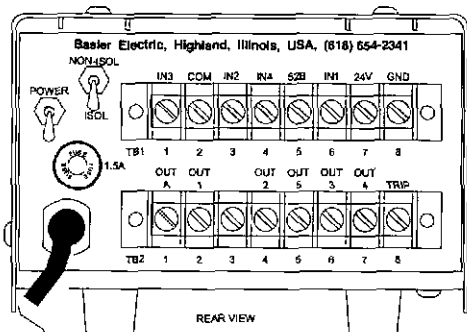
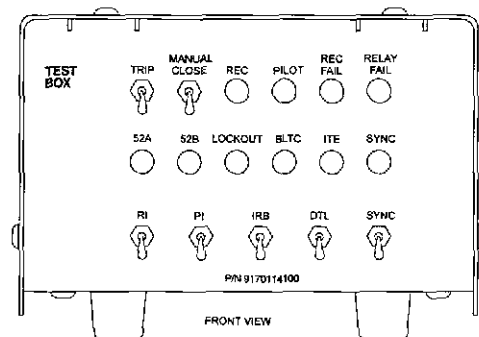
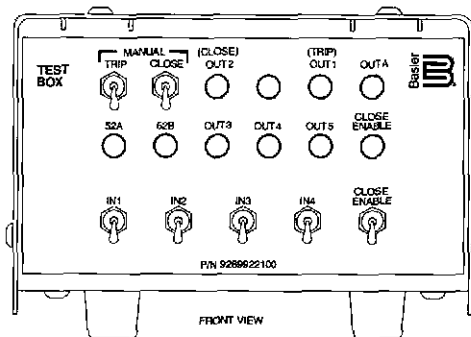
9289929100 - Adapter bracket for ABB FT test switch, to mount a single H1 case in a 19" rack.



9289924100 - Adapter bracket to mount single H1 case in 19" rack.

Test Boxes

Basler Electric test boxes simplify testing and demonstrating relay systems. These test boxes contain circuitry that simulates circuit breaker openings and closings and provide control for contact switching inputs to the relays. LEDs on the test boxes indicate the input and output contact status of the device. Part number 9289922100 is used with multifunction protection systems, and part number 9170114100 is used with the BE1-79M Multiple Shot Reclosing Relay.



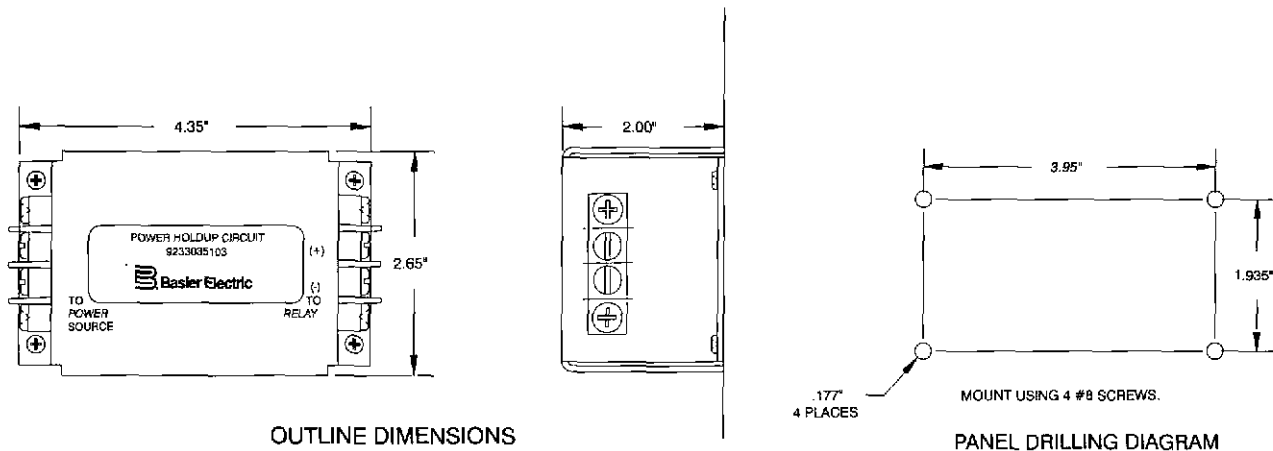
Multifunction Systems Test Box,
Part Number 9289922100

BE1-79M Test Box,
Part Number 9170114000

RELAY ACCESSORIES, continued

Power Holdup Assembly

Basler Electric power holdup assembly, Part number 9233035103 (pictured below), provides adequate supply decay delay to ensure the protective device output contacts can close. This action trips the breaker. The power holdup assembly may be mounted on the back of the relay case or remote from the relay.



RS-232 to RS-485 Converter

The isolated RS-232 to RS-485 converter (9314101100) is intended to interface between a computer (PC) or terminal with an RS-232 interface to one or more devices on either a 2-wire RS-485 or 4-wire RS-485 network.

B Basler Electric

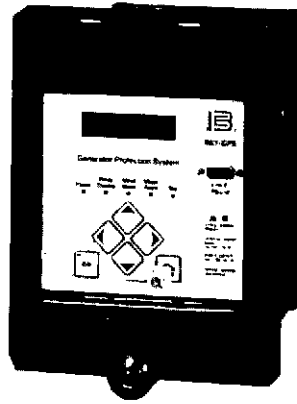
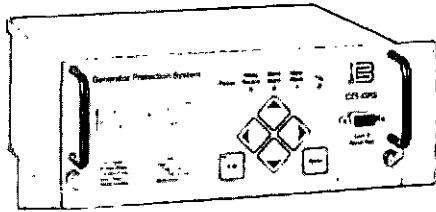


ROUTE 143, BOX 269, HIGHLAND, ILLINOIS U.S.A. 62249
PHONE 618-654-2341 FAX 618-654-2351

P.A.E. Les Pins, 67319 Wasselonne Cedex FRANCE
PHONE (33-3-88) 87-1010 FAX (33-3-88) 87-0808

<http://www.basler.com>, info@basler.com

Printed in U.S.A.



BE1-GPS100 GENERATOR PROTECTION SYSTEM

The BE1-GPS100 is a multifunction, programmable numerical protection, meter, and control relay. Functions provided include three phase voltage controlled, voltage restrained, or standard overcurrent, phase residual and independent ground overcurrent, negative sequence overcurrent, breaker failure, over/underfrequency, phase over/undervoltage, zero sequence over/undervoltage, and negative sequence overvoltage, forward or reverse power, loss of excitation, volts per hertz, sync check, sensitive third harmonic ground fault monitoring, breaker monitoring and control and metering functions, all in an integrated system.

ADVANTAGES

- BESTlogic provides the user with very high flexibility in configuring a protection and control system.
- Substantial functionality in a small package, useful where space is very limited but high functionality is needed.
- Programmable LCD display allows the relay to replace local indication and control functions, such as panel metering, alarm annunciation, and control switches.
- Three independent communication ports with protocol support allows integration with distributed control systems.
- Provides optional separate ground current input for those applications where this is required.
- Includes frequency tracking and voltage restrained overcurrent for backup and cogeneration applications.
- Available in fully drawout half rack case. Two Basler Electric half rack IEDs (Intelligent Electronic Devices) can be dovetailed together to mount in a standard 19-inch equipment rack with no special mounting hardware.
- Available in fully drawout S1 case with test paddle. The S1 case, with available adapter plates, fits cutout, drilling and behind panel projection dimensions for common Basler Electric, GE and Westinghouse unit case relays.

WINDOWS® SOFTWARE

Interface for setting and communicating with Basler protection products.
Request BESTCOMS™ for BE1-GPS100.

ADDITIONAL INFORMATION

INSTRUCTION MANUAL

Request publication 9318700990

TIMING CURVES

Request publication 9252000999

MODBUS™ INSTRUCTION MANUAL

Request publication 9318700991

DNP 3.0 INSTRUCTION MANUAL

Request publication 9318700992

FEATURES Pages 2 and 3
APPLICATIONS Page 3
FUNCTIONAL DESCRIPTION Pages 4 - 6
BESTlogic Pages 8 and 9
SPECIFICATIONS Pages 7, 10 - 11
ORDERING INFORMATION Page 12



FEATURES

PROTECTION

- Phase and Neutral Instantaneous Overcurrent elements with settable time delay: 50TP, 50TN
- Phase, Neutral, and Negative Sequence Time Overcurrent elements: 46, 51P, 51N, 151N
- Phase overcurrent element (51P) includes capability of voltage restraint or voltage control.
- Internally calculated phase residual, 3I0, available on all relays. Optional independent ground input available. Neutral overcurrent elements (50TN, 51N, 151N) monitor either ground or calculated residual.
- Negative sequence overcurrent element (46) includes algorithm for timing based on generator K factors or may use standard TOC curves.
- All U.S. and IEC timing curves plus user programmable curve.
- Phase Undervoltage and Overvoltage elements: 27P, 127P, 59P, 159P. Elements use a 1 of 3, 2 of 3, or 3 of 3 logic, and monitor either line-line or line-ground voltages.
- Auxiliary Undervoltage and Overvoltage elements: 27X, 127X, 59X, 159X. Elements monitor either fundamental or third harmonic on the optional auxiliary 4th VT input, or fundamental phase residual, 3V0, of the phase inputs.
- Negative Sequence Overvoltage element: 47
- Overexcitation, Volts per Hertz element: 24
- Four Under/Overfrequency elements: 81, 181, 281, 381
- Forward/Reverse Power: 32, 132
- Loss of Excitation (offset sloped VAR flow algorithm): 40Q, 140Q
- Breaker Failure protection function: BF
- 4 general purpose logic timers: 62, 162, 262, 362
- Inadvertent energization protection using 50 elements supervised by 81 and/or 27 elements
- 100% stator ground fault protection using auxiliary voltage elements for ground overvoltage and 3rd harmonic ground undervoltage
- Sync check and/or dead bus close supervision 25, 27X (Requires optional 4th VT sensing circuit)
- Programmable Logic using BESTlogic
- Two protection settings group controllable via relay logic, 43 Aux switches, and hardwired inputs. Setting group selection may control tripping logic.
- Fuse loss detection (60FL) protects against false trip due to loss of voltage sensing.

CONTROL

- Virtual breaker control switch—controllable from both HMI and com. ports: 101
- Four virtual selector switches—controllable from both HMI and com. ports: 43, 143, 243, 343
- Communication port control of 101 and #43 switches allows for SCADA control of relay and breaker.

INSTRUMENTATION

- Real time A, B, C phase current, voltage; frequency; and derived neutral and negative sequence current and voltage.
- Real Time 3 phase Watts, VARs, and Power Factor.

REPORTS

- Current demands for phase, ground, and negative sequence currents, and forward and reverse Watts and VARs—magnitudes and time stamps are recorded for today's peak, yesterday's peak, and peak since reset.
- kWh and kVARh, forward and reverse
- Breaker operations counter and contact interruption duty. Breaker operate time also available.

FAULT RECORDING

- 255 event sequence of events report with I/O and alarm sub-reports
- Fault Reporting; 1 or 2 oscillography records per fault report
- 16 fault summary reports; two most recent Fault Summary Records saved to non-volatile memory
- Total number of fault and oscillography records settable from 6 to 16
- Total of 240 cycles oscillography memory @ 12 samples/cycle
- COMTRADE format

COMMUNICATION PORTS

- Three independent general purpose communication ports
 - Front RS-232 ASCII communications
 - Rear RS-232 ASCII communications
 - Rear RS-485 ASCII, Modbus®, DNP®3.0, and TNP protocols
- IRIG-B time sync (unmodulated)

SELF TEST AND ALARM FUNCTIONS

- Relay fail, major alarm, and minor alarm LEDs, and fail-safe alarm output contact.
- Extensive internal diagnostics monitor all internal functions of the relay.
- More than 20 additional alarm points—programmable for major or minor priority including:
 - User defined logic state alarms that may be associated with any user specified relay logic state or relay protective element status.
 - Phase current, and forward and reverse Watt and VAR demand alarm.
 - Neutral and negative sequence unbalance demand alarms.

FEATURES, continued

- Three breaker alarm points programmable for slow trip, interruption duty threshold, or operations counter.
- Trip circuit voltage and continuity monitor.

PROGRAMMABLE I/O

- Four programmable inputs.
- Five programmable outputs and one dedicated programmable alarm output.

HARDWARE FEATURES

- Two case configurations
 - S1: Basler/GE style (with test plug)
 - H1: Half Rack
- Active CT technology for low burden and increased dynamic range.

- Flash Memory for upgrading embedded programming without changing chips.
- Integral HMI with 2x16 character display and keypad for editing settings and resetting targets and alarms.
- Wide range ac/dc power supply options provide long hold up time to ride through dips on power source. (100 ms with 4 output relays energized, upon complete loss of source. Starting voltage 125Vac for Option 1 (48/125Vac/dc) and 250Vac for Option 2 (125/250Vac/dc))
- Automatically adjusts sampling rate for sensed line frequency over the range of 10-75 Hz to provide high accuracy of protective elements over a wide operating range.

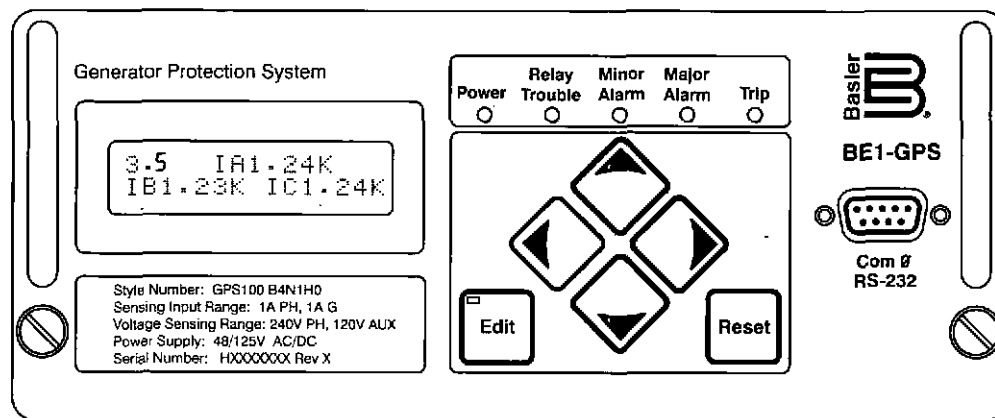


Figure 1 - Advanced HMI (Human Machine Interface)

APPLICATIONS

The BE1-GPS100 Generator Protection System provides three phase, ground, and negative sequence overcurrent, voltage, frequency, reverse power, loss of excitation, volts per hertz, and sync check protection and is intended for use in any generator protection application. Its unique capabilities make it ideally suited for applications with the following requirements:

- Applications that require the flexibility provided by wide setting ranges, multiple setting groups, multiple coordination curves, and an extremely versatile programmable logic, in one unit.
- Applications that require the economy and space savings provided by a multifunction unit. This one unit can provide all of the protection, control, metering, and local and remote indication functions required in many typical units.
- Retrofit applications requiring the features and functions of the GPS-100 in an S1 case.
- Applications where the small size and limited behind-panel projection facilitates modernizing protection, metering, and control systems in existing substations.
- Applications that wish to have the protection redundancy provided by having differential relaying in an independent protective relaying package.
- Applications that require communications and protocol support.
- Applications where drawout construction is desirable.
- Applications that require high accuracy across a wide frequency range.
- Applications where the capabilities of intelligent electronic devices (IEDs) are used to decrease relay and equipment maintenance costs.

FUNCTIONAL DESCRIPTION

The BE1-GPS100 is a multifunction, numerical relay that provides a comprehensive mix of protective functions to detect generator faults and abnormal operating conditions along with control and metering functions in an integrated system. This system is suitable for any generator application and many utility/cogeneration facility intertie applications. Twelve sample per cycle digital signal processing, with frequency compensation, extracts the fundamental component for high accuracy with distorted waveforms and at off-nominal frequency operation.

The unit has one set of three phase current and voltage sensing inputs to provide all common protective functions except generator differential, 87G (which, provided as a separate relay, prevents the "all your eggs in one basket" pitfall). The voltage sensing circuits automatically configure themselves internally for 1 phase, 3 phase 3 wire, or 3 phase 4 wire VT circuits. An optional 4th auxiliary voltage input is available for either generator ground sensing or bus voltage sensing.

The BE1-GPS100 can also be ordered with an optional independent ground current input, typically used for application with a separate ground CT such as a flux balancing window CT or to provide ground backup protection for the generator step up transformer.

The S1 and half rack cases are fully drawout with current circuit shorting provisions. Two Basler Electric half rack IEDs (Intelligent Electronic Devices) such as primary and backup BE1-GPS100s or the BE1-851 or -951 Overcurrent Protection Systems can be dovetailed together to mount in a standard 19" equipment rack with no special mounting hardware. Replacing an obsolete GE or Westinghouse single function relay with a GPS-100 in an S1 case upgrades existing protection and monitoring without having to cut the panel.

Three independent communications ports, along with built-in support for Modbus® and other common protocols, provide easy access to integrating the protection, control, metering, and status monitoring functions into a substation automation system. The

standard IRIG-B port provides time synchronization from a master clock.

Real time metering provides Watt, Watt-hour, VAR, VAR-hour, voltage, amp, and unbalance loading telemetry for the protected circuit. Contact sensing inputs and alarm monitoring functions provide real time status information. Remote control is provided by virtual control and selector switches with select-before-operate control of programmable outputs.

BESTlogic

BESTlogic programmable logic provides the user with high flexibility in configuring a protection and control system.

Each of the protection and control functions in the BE1-GPS100 is implemented as an independent function block that is equivalent to its single function, discrete device counterpart. Each independent function block has all of the inputs and outputs that the discrete component counterpart might have. Figures 5A and 5B show each of the independent function blocks available for use in the BE1-GPS100 and their associated logic I/O. Programming BESTlogic is equivalent to choosing the devices required by your protection and control scheme and drawing schematic diagrams to connect the logic inputs and outputs to obtain the desired operational logic.

The BE1-GPS100 relay can store, as user settings, one user programmable, custom logic scheme. To save you time and provide guidance, preprogrammed logic schemes have also been provided. Any of the preprogrammed schemes can be copied into the logic settings, then modified to the application's needs. User-programmable variable and virtual switch names make relay event reports user-friendly.

BESTlogic provides the protection engineer with the flexibility to set up this powerful multifunction system with the same freedom that was once enjoyed with single function, discrete devices. It is no longer necessary to compromise your standard protection and operating practices to work within the limitations in programmability of previous multifunction devices.

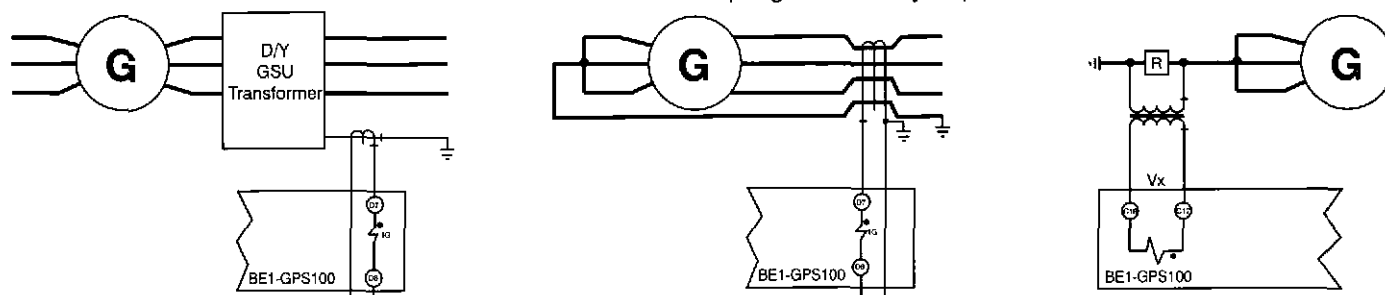
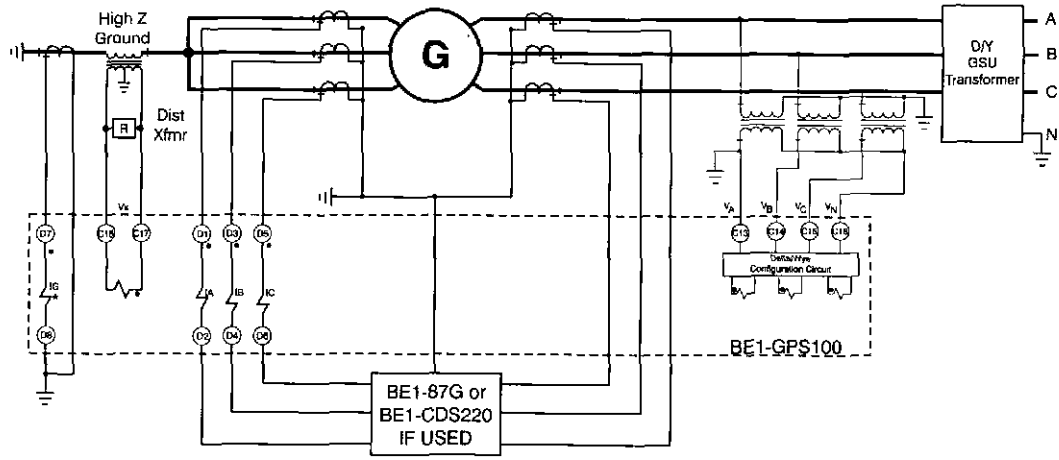


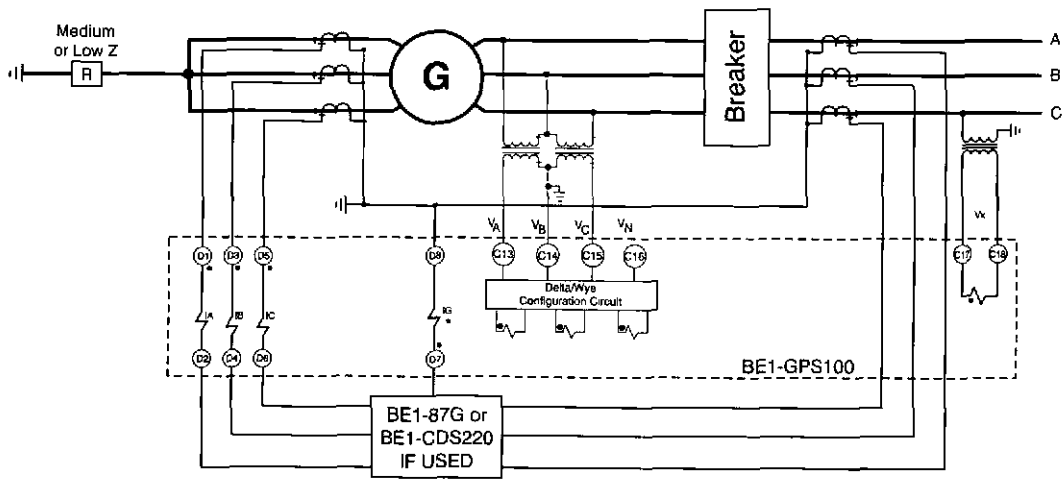
Figure 2A - Typical Alternate Connections for Vx and IG

FUNCTIONAL DESCRIPTION, continued



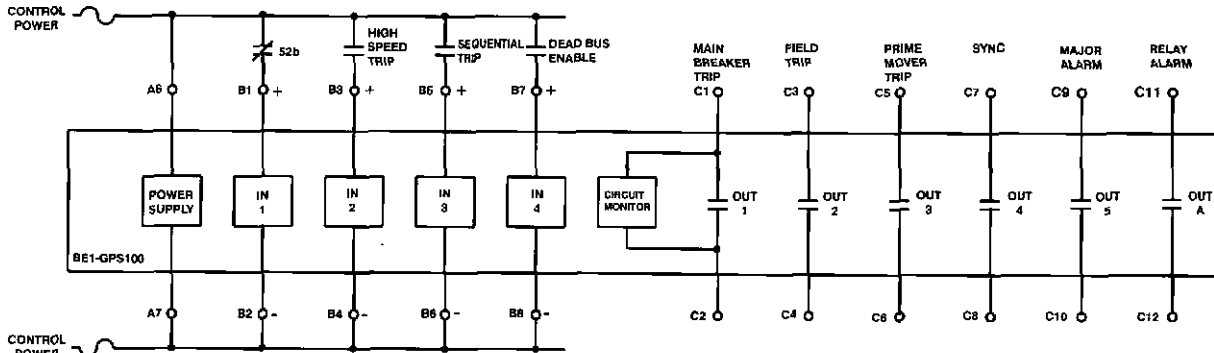
* Independent Ground input is optional.

Figure 2B - Typical External Sensing Connections, with Vx and IG Used for Stator Ground Fault



* Independent Ground input is optional.

Figure 2C - Typical External Sensing Connections, with Vx Used for Sync Check and IG Used for Ground Differential Overcurrent



NOTES:

- CONNECTIONS SHOWN ARE FOR USE WITH PRE-PROGRAMMED LOGIC. SCHEME LZ-W-25, LZ-W-25 PROVIDED LOW IMPEDANCE G ROUNDED GENERATOR PROTECTION WITH SEQUENTIAL TRIP AND SYNC CHECK LOGIC. ALL INPUTS AND OUTPUTS ARE FULLY PROGRAMMABLE USING BESTLOGIC.

Figure 3 - Typical External Connections

FUNCTIONAL DESCRIPTION, continued

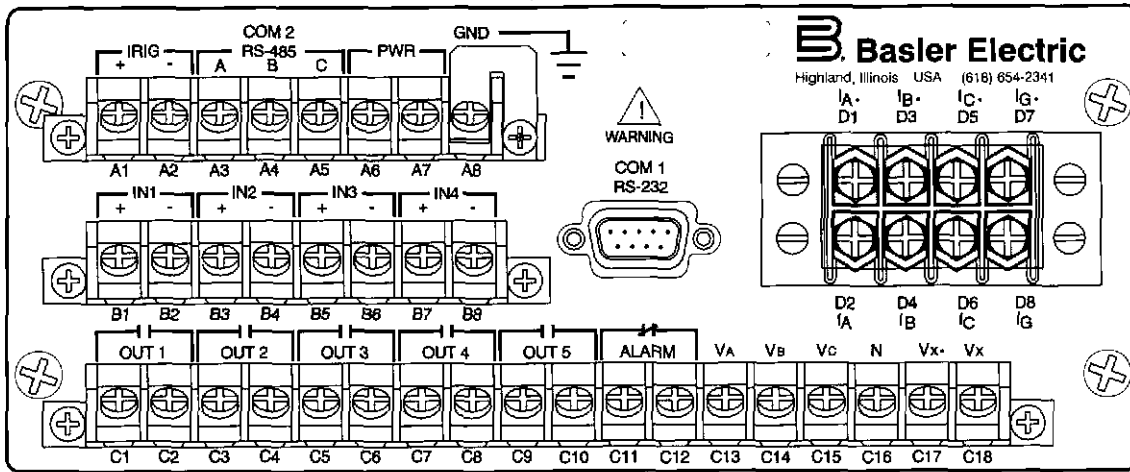
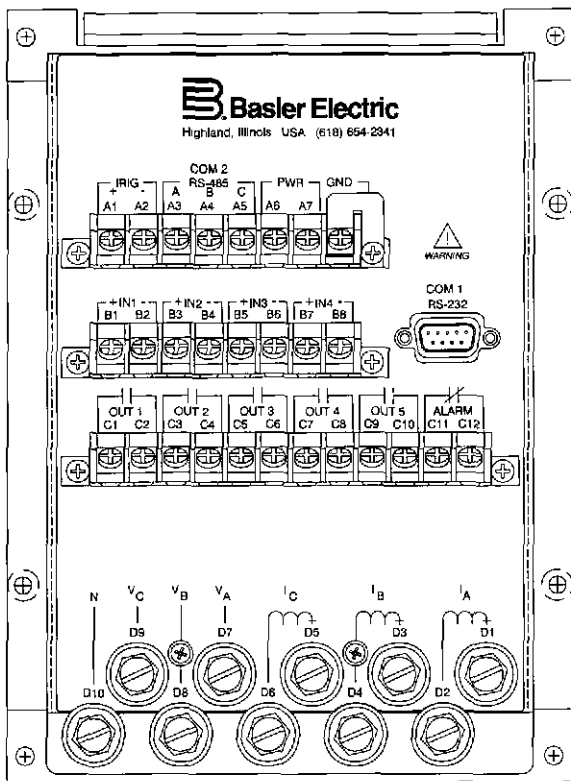
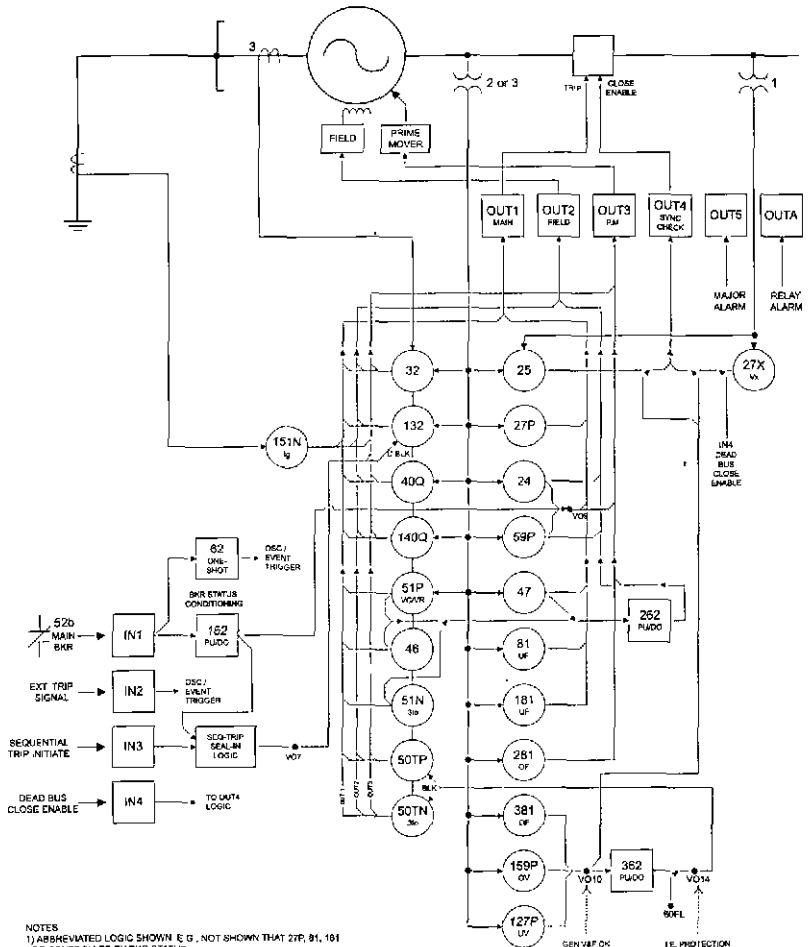


Figure 4A - BE1-GPS100 Rear Panel Connections



6 Figure 4B - S1 Rear Panel Connections



NOTES
 1) ABBREVIATED LOGIC SHOWN E.G., NOT SHOWN THAT 27P, 81, 101 ARE CONTROLLED BY BKR STATUS
 2) BKR, ONLY SHOWN FOR VO14 ALSO AFFECTS 27P, *27P, 47, 51P, 59P, AND 159P
 3) ALTERNATE USE OF I_g INCLUDES GROUND DIFFERENTIAL (C1 SIM OR FLUX BALANCE C1) AND WHITE NEUTRAL LEAD OF 5-STEP UP XFMR.
 4) PHASE DIFFERENTIAL USING SEPARATE RELAY (E.G. BE1-CDS OR 87G) NOT SHOWN BUT COMMON FOR GEN > 10MW.
 5) UNUSED FUNCTIONS INCLUDE: 127X, 58X, 158X, 5F, 5L-GROUP, 101, 43, 143, 243, 343.
 Based upon pre-programmed logic L2-V1-2

Figure 5 - Typical Application, Single Line

GENERAL SPECIFICATIONS

5 Amp CURRENT INPUTS

Continuous rating:	20A
One Sec. Rating:	400A
Saturation limit:	150A
Burden:	<10milliohms

1 Amp CURRENT INPUTS

Continuous rating:	4A
One Sec. rating:	250A
Saturation limit:	30A
Burden:	<22milliohms

PHASE AC VOLTAGE INPUTS

Continuous:	300V, Line to Line
One Sec. rating:	600V, Line to Neutral
Burden:	Less than 1VA @ 300Vac

AUXILIARY AC VOLTAGE INPUT

Continuous:	150V
One Sec. rating:	600V
Burden:	Less than 1VA @ 150Vac

A/D CONVERTER

Sampling Rate:	12/cycle, adjusted to input frequency 10-75Hz
----------------	---

POWER SUPPLY

Option 1:	DC range 35 - 150V AC range 55 - 135V
Option 2:	DC range 90 - 300V AC range 90 - 270V
Option 3:	DC range 17 - 32V
Burden:	6 watts continuous, 8 watts maximum with all outputs energized

TRIP CONTACTS

Make and carry:	30A (0.2sec)
Continuous:	7A
Break:	0.3A DC (L/R=0.04)

CONTROL INPUTS

Wetting voltage range:	Same as control power supply option.
Nominal Turn On/Off Voltage:	P.S. Option 1: 33Vdc P.S. Option 2: 83Vdc P.S. Option 3: 16Vdc
Control inputs recognize both DC and AC voltages.	
Burden:	P.S. Option 1: 36K Ω P.S. Option 2: 94K Ω P.S. Option 3: 15K Ω

COMMUNICATION PORTS

Response time:	<100mSec for metering and control functions
Baud rate:	300 - 19200

ELECTRICAL ENVIRONMENT

- IEEE C37.90-1989 Standard for Relays and Relay Systems Associated with Electric Power Apparatus
- IEC 255-5 Insulation Test for Electrical Relays Impulse and Dielectric Strength (2000Vac at 50/60Hz)
- IEEE C37.90.1-1989 Standard Surge Withstand Capability Tests for Relays and Relay Systems Associated with Electric Power Apparatus
- IEC 255-22-1 1MHz Burst Disturbance Tests for Electrical Disturbance Tests for Measuring Relays and Protection Equipment
- EN 61000-4-4 Electrical Fast Transient/Burst Immunity Test
- EN 61000-4-3 Radiated, Radio-frequency, Electromagnetic Field Immunity Test
- Type tested using a 5-watt, hand-held transceiver in the ranges of 144 and 440MHz with the antenna placed within 6 inches of the relay.
- IEEE C37.90.3 (Jan. 01) Draft Standard Electrostatic Discharge Tests for Protective Relays
- EN 61000-4-2 Electrostatic Discharge Immunity Test

MECHANICAL ENVIRONMENT

- Operating temperature range: -40°C to 70°C* (-40°F to 158°F)
*LCD Display is inoperative below -20°C.
- Storage temperature range: -40°C to 70°C (-40°F to 158°F)
- Humidity: Qualified to IEC 68-2-38, 1st Edition 1974, Basic Environmental Test Procedures, Part 2: Test Z/AD: Composite Temperature Humidity Cyclic Test
- Qualified to IEC 255-21-1 (Class 1) Vibration Tests for Electrical Relays
- Qualified to IEC 255-21-2 (Class 1) Shock and Bump Tests for Electrical Relays

CERTIFICATIONS

UL Recognized, File E97033
CSA Certified, File LR23131
DNP 3.0 IED Certified, Subset Level 2, 6/20/00,
by SUBNET Solutions, Inc.

CASE SIZE

H1: 10.50"W x 3.47"H x 9.10"D with mounting flanges (8.5"W without mounting flanges)
S1: 6.65"W x 9.32"H x 9.405"D

SHIPPING WEIGHT

H1: Approx. 10 pounds
S1: Approx. 16 pounds

WARRANTY

7 years

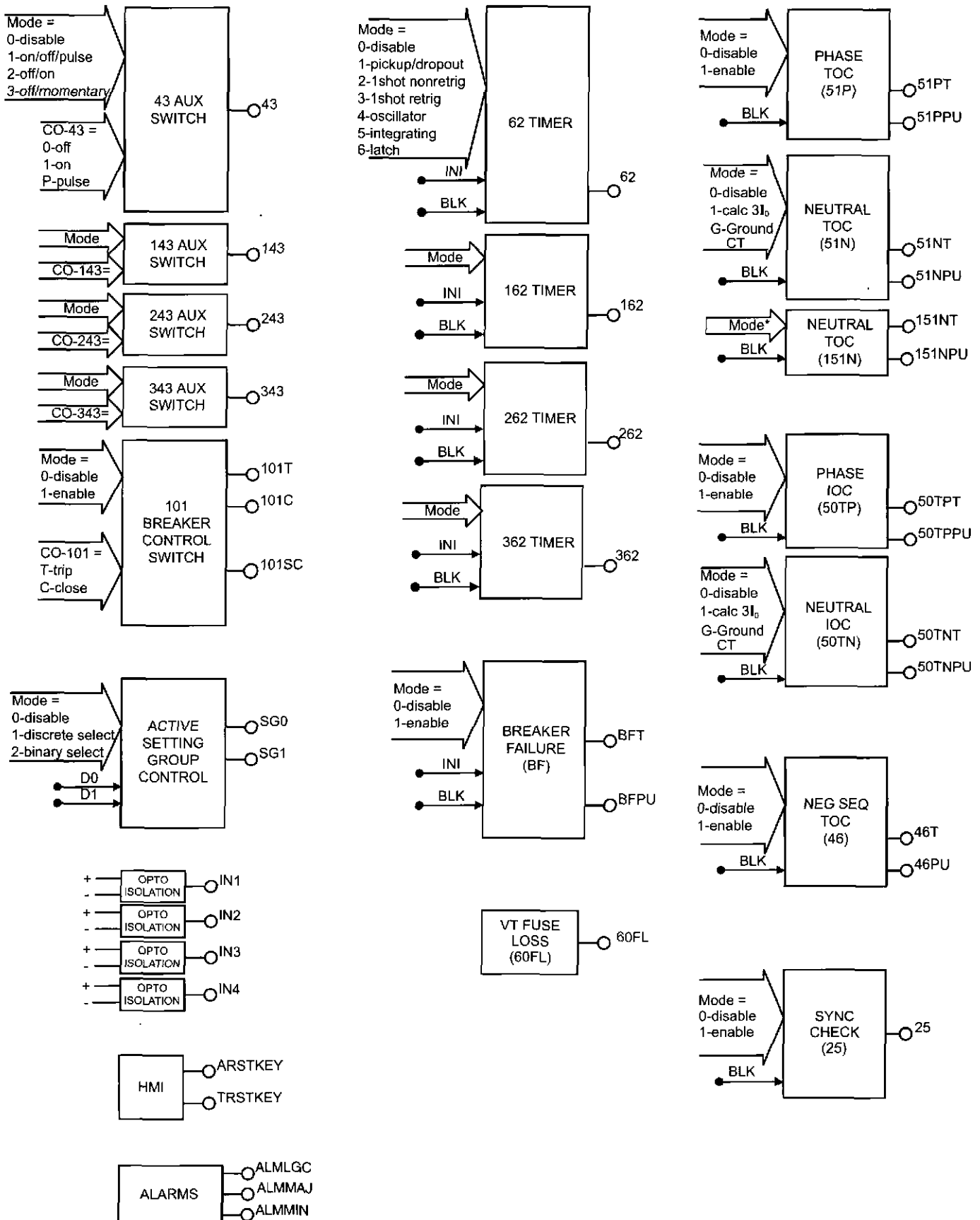
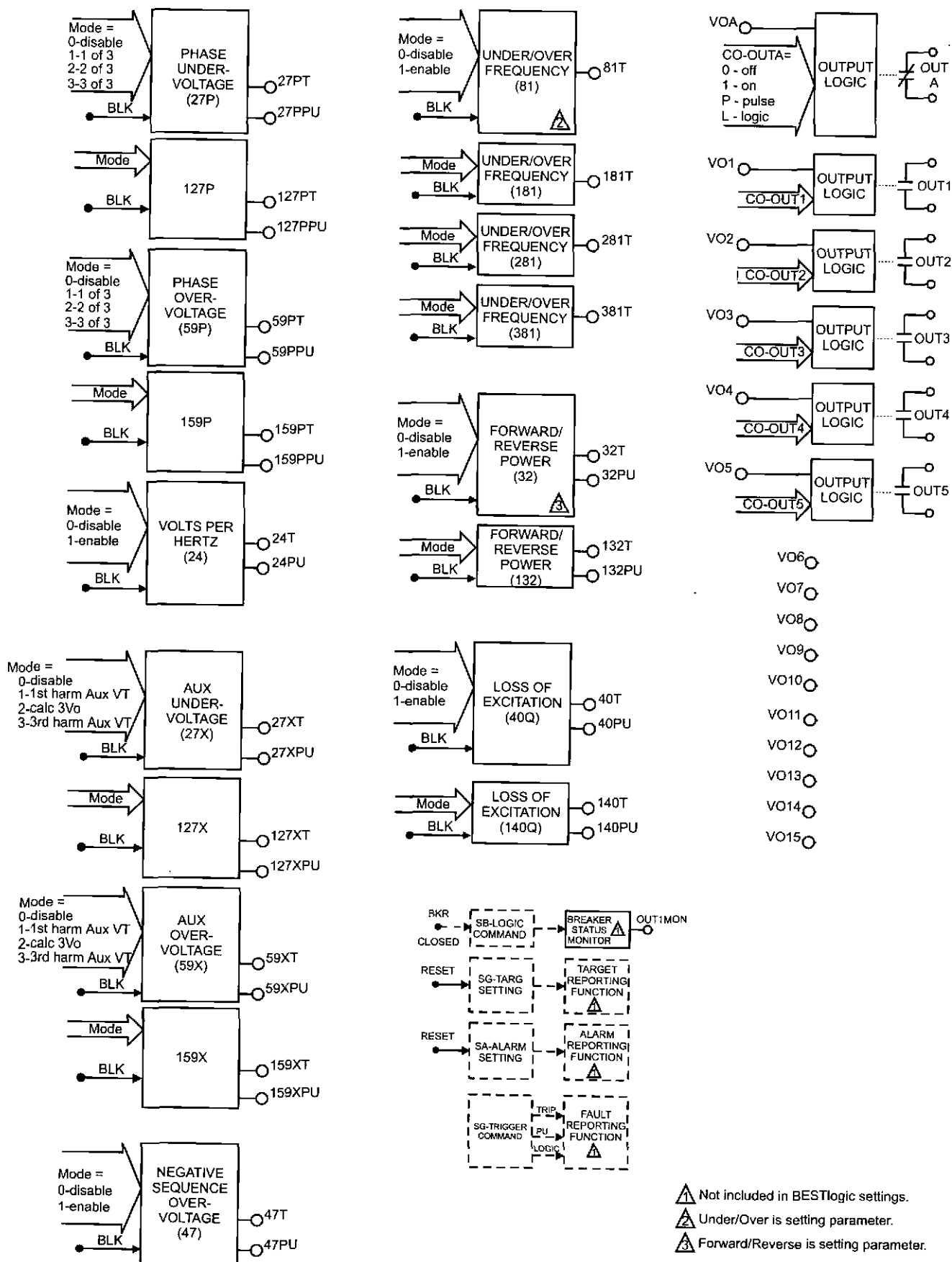


Figure 6A - BESTlogic Function Blocks



⚠ Not included in BESTlogic settings.
 ⚠ Under/Over is setting parameter.
 ⚠ Forward/Reverse is setting parameter.

Figure 6B - BESTlogic Function Blocks

PERFORMANCE SPECIFICATIONS

INSTANTANEOUS OVERCURRENT WITH SETTABLE DELAY (50TP, 50TN)

Pickup: 5A CT 0.5 - 150.0A
 1A CT 0.1 - 30.0A

PU time with TD=0.000 Sec
 2 cyc for P&G @ 5 x PU
 3 cyc for N&Q @ 5 x PU

Delay time: 0.000 - 60 sec

Time Accuracy: ±0.5% or ±½ cyc for P & N
 ±0.5% or ±1 cyc for Q

TIME OVERCURRENT (51P, 51N, 51N)

Pickup: 5A CT 0.5 - 16.0A
 1A CT 0.1 - 3.20A

Time dial: TD=K=0 - 99 for 46 curve
 TD=0.0 - 9.9 for all other curves

Time-Current Characteristics:
 The following expression describes the inverse time current characteristic for each curve:

$$T_T = \frac{AD}{M^{N-C}} + BD + K = \text{Time to trip}$$

$$T_R = \frac{RD}{M^2-1} = \text{Time for decaying reset}$$

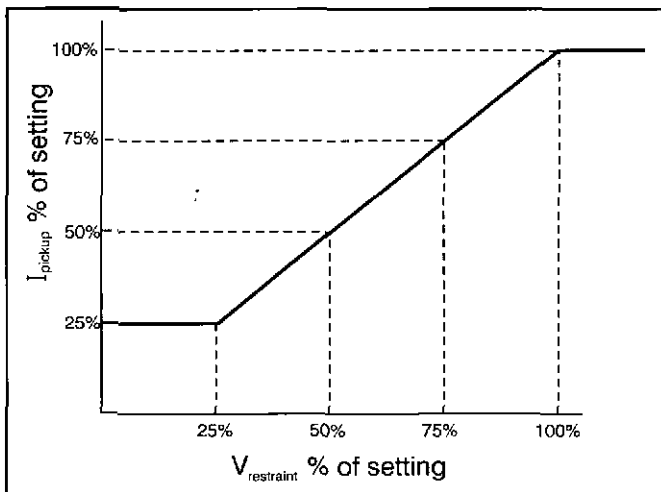
where D = Time dial, M = Multiple of PU and A, B, C, N, K and R are constants that govern the shape of each curve. The protection engineer can set the constants for the P (programmable) curve to achieve virtually any characteristic.

51P VOLTAGE CONTROL (27R)

Control Modes: Uncontrolled, voltage controlled, voltage restrained.

Control/Restraint Range: 30 - 250V

Restraint Mode Characteristic: (see below)



Curve Type	Constants					
	A	B	C	N	K	R
S1	0.2663	0.03393	1.000	1.2969	0.028	0.5000
S2	0.0286	0.02080	1.000	0.9844	0.028	0.0940
L1	5.6143	2.18592	1.000	1.000	0.028	15.750
L2	2.3955	0.00000	1.000	0.3125	0.028	7.8001
D	0.4797	0.21359	1.000	1.5625	0.028	0.8750
M	0.3022	0.12840	1.000	0.5000	0.028	1.7500
I1	8.9341	0.17966	1.000	2.0938	0.028	9.0000
I2	0.2747	0.1042	1.000	0.4375	0.028	0.8868
V1	5.4678	0.10814	1.000	2.0469	0.028	5.5000
V2	4.4309	0.0991	1.000	1.9531	0.028	5.8231
E1	7.7624	0.02758	1.000	2.0938	0.028	7.7500
E2	4.9883	0.0129	1.000	2.0469	0.028	4.7742
A	0.01414	0.00000	1.000	0.0200	0.028	2.0000
B	1.4636	0.00000	1.000	1.0469	0.028	3.2500
C	8.2506	0.00000	1.000	2.0469	0.028	8.0000
G	12.1212	0.00000	1.000	1.000	0.028	29.000
F	0.0000	1.00000	0.000	0.0000	0.028	1.0000
46	*	0	0	2	0.028	100
P	0 to 600	0 to 25	0 to 1	.5 to 2.5	0.028	0 to 30

S1, S2 = CO Short Inv, IAC Short Inv
 L1, L2 = CO Long Inv, IAC Long Inv
 D = CO Definite Time
 M = CO Moderately Inverse
 I1, I2 = CO Inverse, IAC Inverse
 V1, V2 = CO Very Inv, IAC Very Inv
 E1, E2 = CO Ext Inverse, IAC Ext. Inverse

A = IEC Standard Inverse
 B = IEC Very Inverse
 C = IEC Extremely Inverse
 G = IEC Long Time Inverse
 F = Fixed Time
 46 = Negative Sequence Overcurrent
 P = Programmable

* Constant A is variable for the 46 curve and is determined as necessary based on generator full load current, minimum pickup, and K factor settings.

NEGATIVE SEQUENCE OVERCURRENT (46)

Pickup: 5A CT 0.1-16.0A
 1A CT 0.02 - 3.20A

Time dial: TD=K=0 - 99 for 46 curve
 TD=0.0 - 9.9 for all other curves

Time-Current Characteristics: Same curves as 51 elements

BREAKER FAILURE (BF)

Time: 50 - 999mSec

Dropout: 5A CT 0.5A
 1A CT 0.1A

Time Accuracy: ±0.5% or +1¼ cyc / -½ cyc

VOLTS/HZ (24)

Pickup: 0.5 - 6V/Hz

Delay Time: Inverse Squared Curve

$$T_T = \frac{D_T}{(M-1)^2}$$

$$T_R = D_R \times \frac{ET}{FST} \times 100$$

T_T = Time to Trip
 T_R = Time to Reset
 D_T = Time Dial, Trip
 D_R = Time Dial, Reset
 Actual V/Hz
 M = Pickup V/Hz
 ET = Elapsed Time
 FST = Full Scale Trip Time (T_T)

PERFORMANCE SPECIFICATIONS, continued

SYNC CHECK (25)

Delta Phase Angle: 1 - 25 degrees
 Delta Voltage Magnitude: 1 - 20V
 Delta Frequency: 0.01 - 0.50Hz

PHASE OVER/UNDERVOLTAGE

(27P, 127P, 59P, 159P)

Mode: 1 of 3; 2 of 3; 3 of 3
 Pickup: 10.0-300V_{LL} or 10.0-300V_{LN}
 Delay Time: 0.050 - 600sec.

NEGATIVE SEQUENCE OVERVOLTAGE (47)

Pickup: 1.0 - 300V_{LN}
 Delay Time: 0.050 - 600sec.

AUXILIARY / 3V0 OVER/UNDERVOLTAGE

(27X, 127X, 59X, 159X)

Mode: Fundamental V_x, Phase 3V0,
 3rd Harmonic V_x
 Pickup: 1.0 - 150V
 Delay Time: 0.050 - 600 Sec.

FREQUENCY (81, 181, 281, 381)

Mode: Over, Under
 Pickup: 40.00 - 70.00 Hz
 Delay Time: 0.000 - 600 Sec.
 Time Accuracy: $\pm 0.5\%$ or +1 cyc / -0 cyc
 (Min. trip time affected by minimum 3 cyc security count)

POWER (32, 132)

Mode: Forward, Reverse
 Pickup: 5A: 1.0 - 6000 Watts, 3 ph
 1A: 1.0 - 1200 Watts, 3 ph
 Pickup Accuracy: $\pm 3\%$
 Delay Time: 0.050 - 600 Sec.

UNDEREXCITATION (40Q, 140Q)

Pickup: 5A: 1.0 - 6000 VARs, 3 ph
 1A: 1.0 - 1200 VARs, 3 ph
 Pickup Accuracy: $\pm 3\%$
 Delay Time: 0.050 - 600 Sec.

GENERAL PURPOSE LOGIC TIMERS

(62, 162, 262, 362)

Mode: PU.DO
 1 Shot, Non-Retrig.
 1 Shot, Retrig.
 Integrating
 Latch
 T1 and T2 Delay Time: 0.000 - 9999 Sec.
 Time Accuracy: $\pm 0.5\%$ or $\pm 3/4$ cyc

CURRENT PICKUP ACCURACY (All 46, 50 and 51)

Phase and Ground: 5A 2% or 50mA
 1A 2% or 10mA
 Neutral and Negative
 Sequence: 5A 3% or 75mA
 1A 3% or 75mA

VOLTAGE PICKUP ACCURACY (All 27, 47 and 59)

$\pm 2\%$ or $\pm 0.5V$

DEFINITE TIME ACCURACY UNLESS OTHERWISE STATED (All 27, 32, 40Q, 47 and 59)

Definite Time Accuracy: $\pm 0.5\%$ or ± 1 cyc

SETTING GROUPS

Setting Groups: 2
 Control Modes: External: Discrete input logic;
 Binary: Input logic

METERING

Current Range: 5A 0.5 to 15.0
 1A 0.1 to 3.0
 Current Accuracy: $\pm 1\%$

Phase Voltage
 Range: 3W 0 - 300 V_{LL}
 4W 0 - 300 V_{LL}
 0 - 173 V_{LN}

Phase Voltage Accuracy: $\pm 0.5\%$ for
 $50V < V_{LL} < 300V$

Auxiliary Voltage Range: 0 - 150V
 Auxiliary Voltage Accuracy: $\pm 0.5\%$ for
 $50V < V < 150V$

Watt/VAR: 5A 0 to ± 7500
 1A 0 to ± 1500

Watt Accuracy: 1% @ Unity PF
 VAR Accuracy: 1% @ Zero PF

Energy: 0 to $\pm 1.0E12$ (F/R registers)

Frequency: 10 - 75Hz
 Frequency Accuracy: 0.01Hz

DEMANDS (IA, IB, IC, IN, IQ, Fwd Watts, Rvs Watts, Fwd VARs, Rvs VARs)

Demand Interval: 1 - 60 min.
 Demand Mode: Thermal

BREAKER MONITORING

Duty Mode: I or I²
 Duty Alarm Range: 0 - to 100%
 Op Counter Alarm Range: 0 - 99999
 Trip Time Alarm Range: 20 - 1000mSec

ORDERING

SAMPLE STYLE NUMBER

The style number identification chart defines the electrical characteristics and operation features included in BE1-GPS100 relay. For example, if the style number were **BE1-GPS100 E3N1H0**, the device would have the following:

- (E) - 5 Amp nominal system with 5 Amp Independent Ground Input
- (3) - Three phase voltage sensing
- (N) - Not applicable
- (1) - 48/125Vac/Vdc power supply
- (H) - Half Rack drawout case
- (0) - ASCII Communications

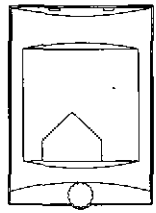
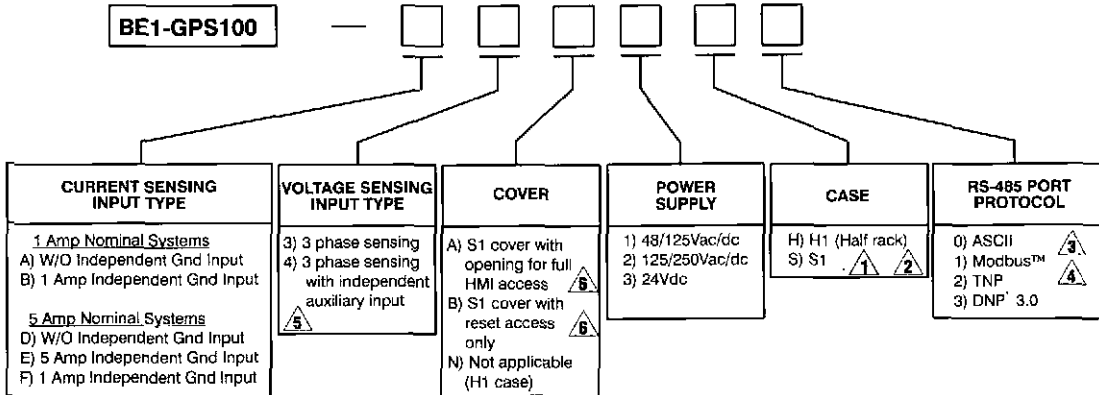


Figure 7A
Cover option A.

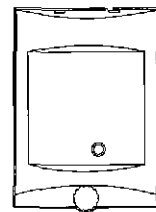


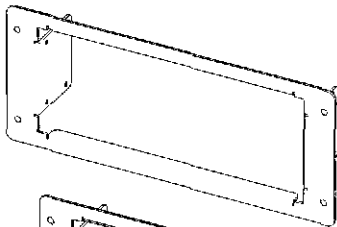
Figure 7B
Cover option B.

- NOTES:**
- ⚠ If case option is H, Cover option must be N.
 - ⚠ Case option must be H for Current Sensing input Type B, E, or F or voltage sensing option to be 4.
 - ⚠ ASCII communication is standard on Com0 (front RS-232) and Com1 (rear RS-232) ports.
 - ⚠ Consult your Basler Representative for availability of other protocol options.
 - ⚠ Aux VT input adds 25 Sync Check option.
 - ⚠ See Figures 7A and 7B.

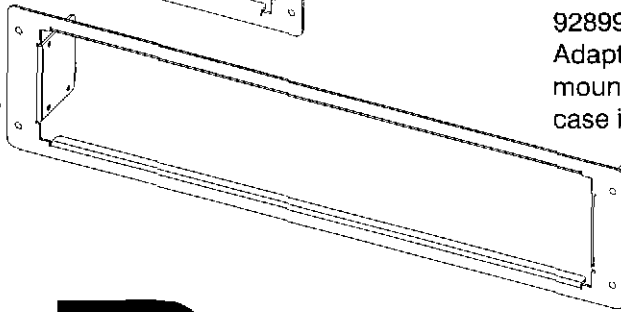
STANDARD ACCESSORIES

- 9180400108 H1 Test Case with 1 CT Terminal Block and 18-position Bottom Terminal Block
- 9239922100 Test box to facilitate bench testing.
- 9108551021 Adapter plate to mount an S1 case in a GE S2 or Westinghouse FT-21 cutout.
- 9108550122 Adapter plate to mount an S1 case in a Westinghouse FT-32 cutout.

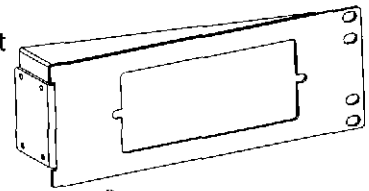
9289900017
Escutcheon plate to panel mount one H1 relay.



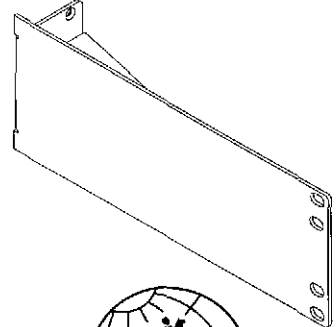
9289900016
Escutcheon plate to panel mount two dovetailed H1 relays.

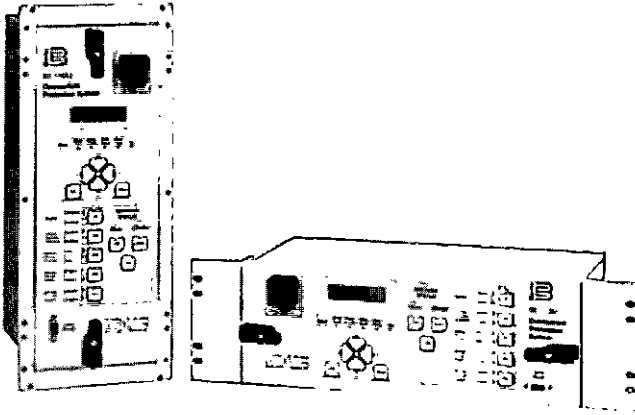


9289929100
Adapter bracket with cutout for ABB FT test switch, to mount a single H1 case in a 19" rack.



9289924100
Adapter bracket to mount a single H1 case in a 19" rack.





BE1-1051 OVERCURRENT PROTECTION SYSTEM

The BE1-1051 is a multifunction, numerical relay that provides three phase, ground, and negative sequence directional or non-directional overcurrent protection with permissive pilot logic, directional power, four shot recloser, breaker failure, over/underfrequency, over/undervoltage, sync check, breaker monitoring, control, and metering functions in an integrated system.

ADVANTAGES

- Each overcurrent element can be individually set for directional or non-directional control for maximum flexibility in any application.
- BESTlogic provides the user with complete flexibility in configuring a protection and control system. User programmable variable and switch names make these relays completely self documenting.
- Programmable LCD display allows the relay to replace local indication and control functions, such as panel metering, alarm annunciation, and control switches.
- Optional Direct Access Virtual Control panel can eliminate panel switches by allowing access to virtual control switch functions at the push of a button.
- Three independent communication ports with protocol support allows integration with distributed control systems.
- Optional Ethernet port with MMS/UCA2 protocol allows high performance, peer to peer communications for the next generation of integration systems.
- Provides optional separate ground current input for those applications where this is required.
- Includes frequency tracking and voltage restrained overcurrent for generator backup and cogeneration applications.
- Includes Real Time Clock with 8 hour capacitor ride through, and optional battery backup.
- Available in horizontal and vertical configurations to provide cost savings in any installation. All configurations are fully drawout and fit cutout, drilling, and behind panel projection dimensions for Basler, GE M1/M2 and Westinghouse FT32 cases.

FEATURES Pages 2 and 3
APPLICATIONS Page 3
FUNCTIONAL DESCRIPTION Pages 4 - 6
BESTlogic Pages 8 and 9
SPECIFICATIONS Pages 7, 10-11
ORDERING INFORMATION Page 12

WINDOWS® SOFTWARE

Interface for setting and communicating with Basler protection products
 Request BESTCOMS™ for BE1-1051

ADDITIONAL INFORMATION

INSTRUCTION MANUAL

Request publication 9334800990

TIMING CURVES

Request publication 9252000999

MODBUS™ INSTRUCTION MANUAL

Request publication 9334800991

DNP 3.0 INSTRUCTION MANUAL

Request publication 9334800992



FEATURES

PROTECTION

- Phase, Neutral, and Negative Sequence Instantaneous Overcurrent elements with settable time delay: 50TP, 150TP, 50TN, 150TN, 50TQ, 150TQ
- Phase, Neutral, and Negative Sequence Time Overcurrent elements: 51P, 51N, 151N, 51Q (51P elements can have voltage restraint)
- Each overcurrent element can be set for forward, reverse, or nondirectional control (67P, 67N, 67Q). Directional control is by Positive (671), Negative (672), Zero Sequence Voltage (670V) and Zero Sequence Current (670I) polarized directional units.
- Permissive Pilot logic function provides POTT or PUTT communication aided protection: P85.
- All U.S. and IEC timing curves plus user programmable curve
- Optional separate ground current input provides zero sequence current polarization and/or ground overcurrent protection for a separate ground CT.
- Switch onto fault, high speed overcurrent protection: SOTF
- Two directional power elements: 32, 132
- Overexcitation, volts per Hertz element: 24
- Phase undervoltage and overvoltage elements: 27P, 59P. Elements use 1 of 3, 2 of 3, or 3 of 3 logic, and monitor either line-line or line-ground voltages.
- Auxiliary Undervoltage and Overvoltage elements: 27X, 59X, 159X. Elements monitor either fundamental or third harmonic on the auxiliary 4th VT input or fundamental phase residual, 3V0, of the phase inputs.
- Negative Sequence Overvoltage element: 47
- Over/Under Frequency elements: 81, 181, 281, 381, 481, 581
- Breaker Failure protection function: 50BF
- Two general purpose logic timers: 62, 162
- Virtual lockout functions latch states in non-volatile memory: 86, 186
- Four protection setting groups with external or automatic (cold load pickup, load, unbalance, recloser shot) selection modes
- Sync check with dead line/dead bus voltage monitor logic, 25, 25VM (Requires optional 4th VT sensing circuit)
- Fuse loss detection protects against false trip due to loss of voltage sensing: 60FL
- Programmable Logic using BESTlogic

CONTROL

- Four shot recloser with zone sequence coordination and sequence controlled protective element blocking functions
- Virtual breaker control switch—controllable from both HMI and com. ports: 101
- Five virtual selector switches—controllable from both HMI and com. ports: 43, 143, 243, 343, 443
- *Virtual control functions include remote tagging functionality with trip circuit monitor interlock logic.*

- Hardwired "Emergency Trip" pushbutton
- Communication port control of 101 and #43 switches allows for SCADA control of relay and breaker
- Virtual switch functions can be operated directly from the front panel without scrolling the HMI when the optional Direct Access Virtual Control panel is selected.

INSTRUMENTATION

- Real time A, B, C phase current, voltage, and frequency and derived neutral and negative sequence current and voltage
- Real Time per phase and 3 phase Watts, Vars, and 3 phase Power Factor

REPORTS

- Current demands for phase, neutral, and negative sequence currents, and forward and reverse watts and vars—magnitudes and time stamps are recorded for today's peak, yesterday's peak, and peak since reset
- Demand registers stored in non-volatile memory
- Optional 4000 point log of demand readings
- kWh and kvarh, forward and reverse
- Breaker operations counter, contact interruption duty, breaker trip and close speed.
- Automatic Reclosing success statistics

FAULT RECORDING

- 255 event sequence of events report with I/O and alarm sub-reports
- 16 event summary reports provide information on faults and close events.
- Event Reporting; 1 or 2 oscillography records per event report
- Total number of oscillography records settable from 6 to 16
- Total of 240 cycles oscillography memory @ 16 samples/cycle
- COMTRADE format
- Load compensated distance to fault
- All SER, fault and oscillographic records saved to non-volatile memory

COMMUNICATION PORTS

- Three independent general purpose communication ports
 - Front RS-232 COM0 ASCII communications
 - Rear RS-232 COM1 ASCII communications
 - Rear RS-485 COM2 ASCII, Modbus™ or other common protocols
- Dual Ethernet port options include fiber optic 10baseF (COM3), and RJ45 10baseT connection (COM4) or redundant 10baseF connection (on COM3 and COM4).
- IRIG time sync (unmodulated)

FEATURES, continued

SELF TEST AND ALARM FUNCTIONS

- Relay fail, major alarm, and minor alarm LEDs, and fail-safe alarm output contact
- Extensive internal diagnostics monitor all internal functions of the relay
- More than 20 additional alarm points—programmable for major or minor priority including:
 - Phase current, and forward and reverse watt and var demand alarm
 - Neutral and negative sequence unbalance demand alarms
 - Three breaker alarm points programmable for slow trip, interruption duty threshold, or operations counter
 - Trip circuit voltage and continuity monitor
 - Close circuit monitor via BESTlogic
 - Voltage Min. and Max. alarms

PROGRAMMABLE I/O

- Eight programmable inputs
- Six programmable outputs and one dedicated programmable alarm output
- Output 1 and 6 are high speed (1/4 cycle nominal)
- Output 6 is Form C

HARDWARE FEATURES

- Three mounting configurations
 - MX Vert: M1, M2/FT31, FT32 size, fully drawout
 - MX Horiz: panel or 19" rack mount, fully drawout
- Active CT technology for low burden and increased dynamic range
- Flash Memory for upgrading embedded programming without changing chips
- Real Time Clock with 8 hour capacitor ride through, and optional battery backup
- Integral HMI with 2x16 character display

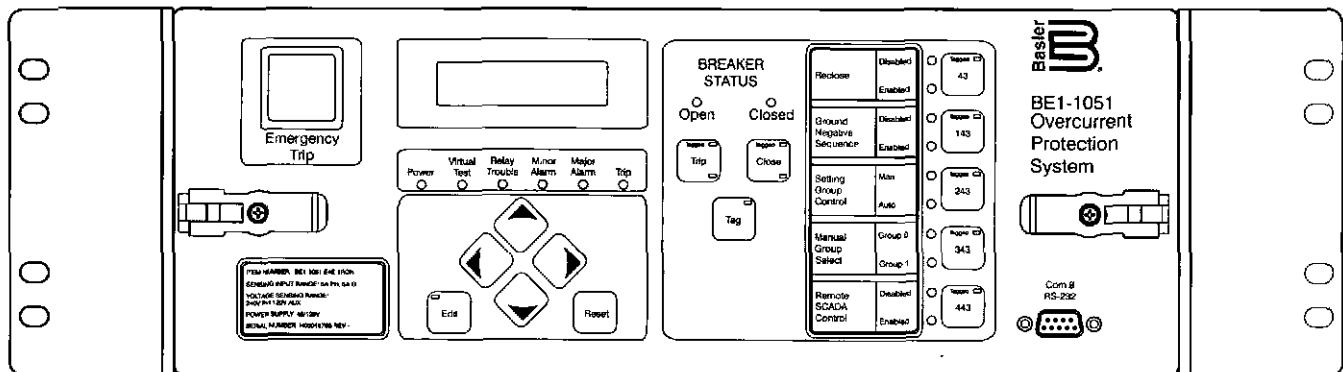


Figure 1 - Advanced HMI (Human Machine Interface) with optional Direct Access Virtual Control Panel

APPLICATIONS

The BE1-1051 Overcurrent Protection System provides three phase, ground, and negative sequence overcurrent, voltage and frequency protection and is intended for use in any directional or non-directional overcurrent protection application. Its unique capabilities make it ideally suited for applications with the following requirements:

- Applications that require low burden to extend the linear range of CTs.
- Applications that require high accuracy across a wide frequency range such as for motor, generator, and generator step-up transformer protection or in cogeneration facilities.
- Applications that require the flexibility provided by wide setting ranges, multiple setting groups, and multiple coordination curves in one unit.
- Applications that require the economy and space savings provided by a multifunction, multiphase unit. This one unit can provide all of the protection, control, metering, and local and remote indication functions required on a typical circuit.
- Applications that require directional control and fault locating.
- Transformer backup applications where overexcitation protection is required.
- Applications that require communications and protocol support.
- Applications where the capabilities of a digital multifunction relay are required, yet drawout construction is also desirable.
- Applications where bus protection is provided by a high speed overcurrent blocking scheme on the transformer bus mains instead of a dedicated bus differential circuit.
- Applications where the capabilities of intelligent electronic devices (IEDs) are used to decrease relay and equipment maintenance costs.

FUNCTIONAL DESCRIPTION

The BE1-1051 is a multifunction, numerical relay that provides a comprehensive mix of protective functions to detect faults and abnormal operating conditions in substations and on feeders, along with control and metering functions in an integrated system. Additional features included in this relay such as voltage restrained overcurrent (51V), overexcitation (24), synch check (25), over and under voltage (27/59) and over and under frequency (81O/U) make this system suitable for any directional or non-directional overcurrent application including feeder, transformer, generator, co-generation, bus, and load shedding applications. 16 sample per cycle digital signal processing with frequency compensation extracts the fundamental component for high accuracy with distorted waveforms and at off-nominal frequency operation.

The unit has one set of three phase current and voltage sensing inputs to provide all common protective functions for substation and feeder applications. The voltage sensing circuits automatically configure themselves internally for 3 phase 3 wire or 3 phase 4 wire VT circuits.

The BE1-1051 also can be ordered with an optional independent ground current input, typically used for application with a separate ground CT such as a flux balancing window CT, or to provide ground backup protection for the neutral or tertiary of a transformer. This optional current circuit provides zero sequence current polarization for directional overcurrent protection.

An optional fourth Auxiliary Voltage input is also available. This voltage input can be connected to line side potential for synch check (25) and dead line (25VM) closing supervision or to a ground sensing VT connection for ground fault protection on the delta side of a cogeneration inertie transformer.

For directional applications, all overcurrent elements can be independently set for forward, reverse, or non-directional control. The target reporting function in the BE1-1051 automatically adapts the targets as appropriate. For example, if the 150TP and the 51P functions are set for directional control, they post targets for an A phase fault as "167A" for directional instantaneous trip or "67TA" for directional time trip respectively. Directional control is by sequence directional elements. The zero sequence current polarized element uses the optional independent ground input for its polarization signal. The zero sequence voltage polarized element requires that the VT connection be 4W. The positive sequence directional element has memory voltage to provide reliable directional control for close in balanced three phase faults.

Three standard independent communications ports, along with two optional Ethernet ports that support common protocols, provide easy access to integrating the protection, control, metering, and status monitoring functions into a substation automation system. The standard IRIG-B port provides time synchronization from a master clock.

Real time metering provides Watt, Watt-hour, VAR, VAR-hour, voltage, amp, and unbalance loading telemetry for the protected circuit. Contact sensing inputs and alarm monitoring functions provide real time status information. Remote control is provided by virtual control and selector switches with select-before-operate control of programmable outputs.

BESTlogic

BESTlogic programmable logic provides the user with high flexibility in configuring a protection and control system.

Each of the protection and control functions in the BE1-1051 is implemented as an independent function block that is equivalent to its single function, discrete device counterpart. Each independent function block has all the inputs and outputs that the discrete component counterpart might have. Figures 5A and 5B show each of the independent function blocks available for use in the BE1-1051. Programming BESTlogic is equivalent to choosing the devices required by your protection and control scheme and drawing schematic diagrams to connect the inputs and outputs to obtain the desired operational logic.

The BE1-1051 relay can store, as user settings, one user programmable, custom logic scheme. To save you time, several preprogrammed logic schemes have also been provided. Any of the preprogrammed schemes may be copied into the logic settings without making any additional BESTlogic settings.

BESTlogic provides the protection engineer with the flexibility to set up this powerful multifunction system with the same freedom that was once enjoyed with single function, discrete devices. It is no longer necessary to compromise your standard protection and operating practices to deal with the limitations in programmability of previous multifunction devices.

Figures 2a, 2b, 2c, and 3 show typical external connections, and Figure 4 shows rear panel connections.

FUNCTIONAL DESCRIPTION, continued

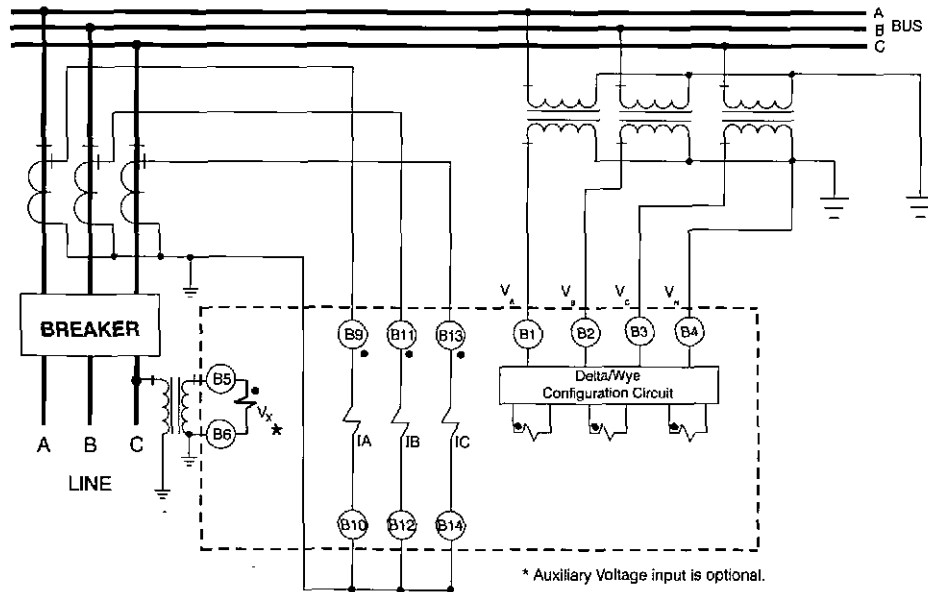


Figure 2A - Typical External Sensing Connections - Feeder Breaker Application

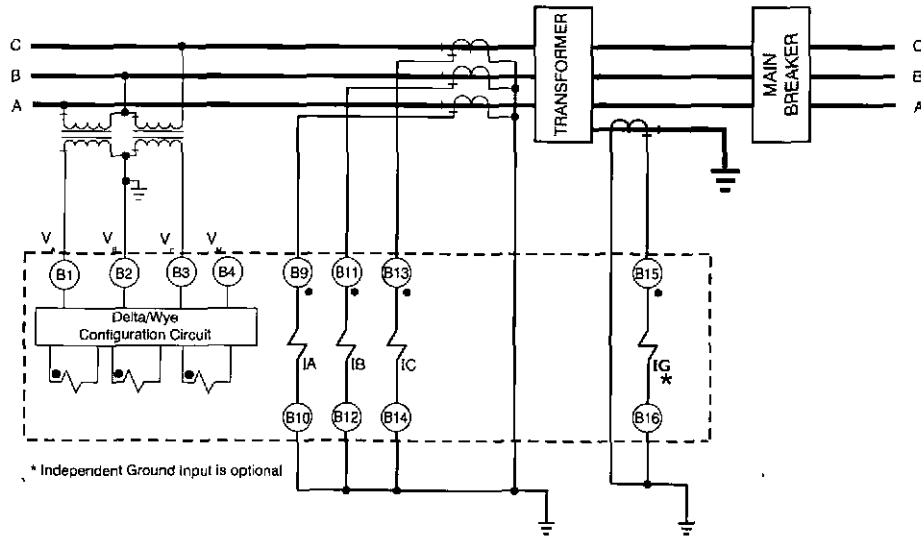


Figure 2B - Typical External Sensing Connections - Transformer Backup Application

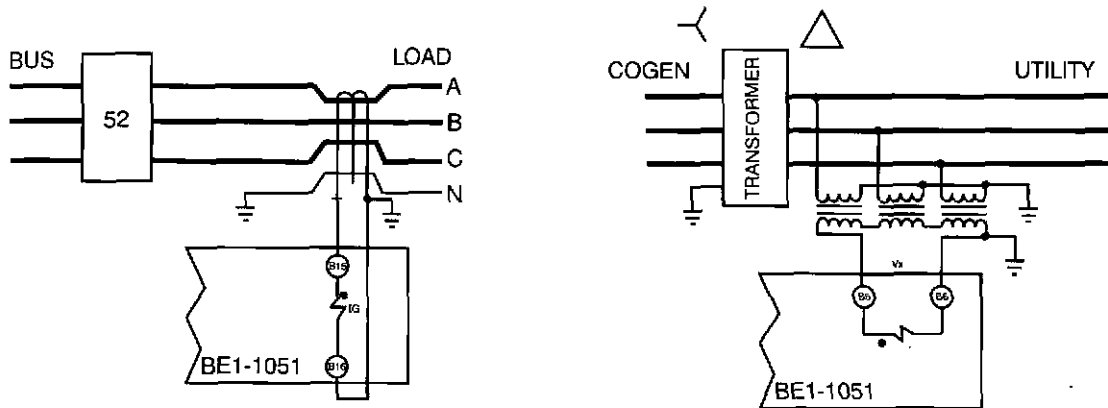
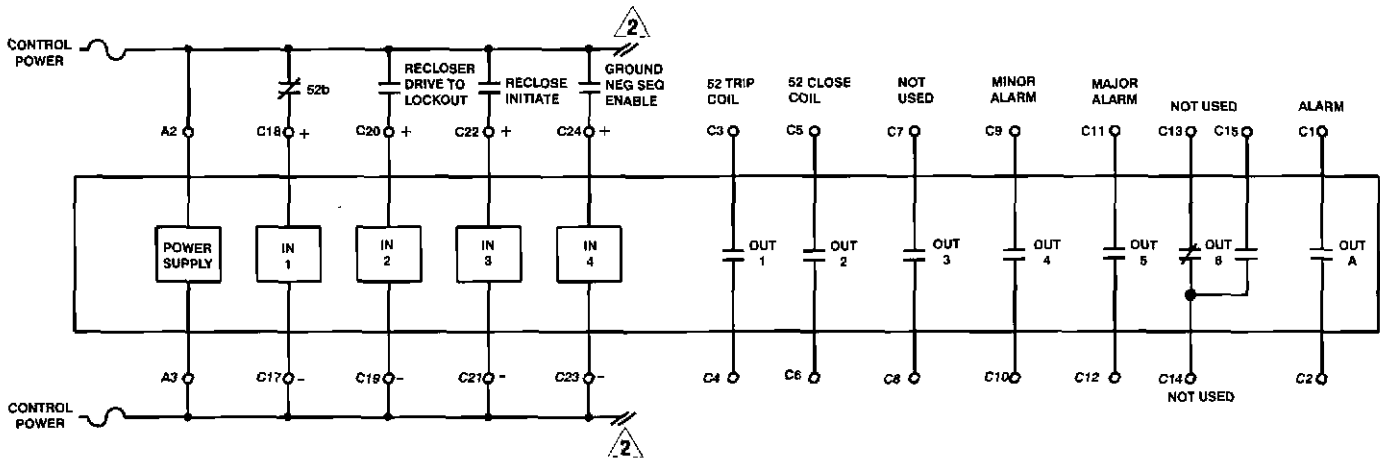


Figure 2C - Typical Alternate Connections for V_x and I_G

FUNCTIONAL DESCRIPTION, continued



NOTES:
 1) CONNECTIONS SHOWN ARE FOR USE WITH PRE-PROGRAMMED LOGIC SCHEME OC-W-79. OC-W-79 PROVIDES OVERCURRENT PROTECTION WITH RECLOSING CAPABILITIES. ALL INPUTS AND OUTPUTS ARE FULLY PROGRAMMABLE USING BESTlogc.

2) IN5, IN6, IN7, IN8 not shown.

Figure 3 - Typical External Connections

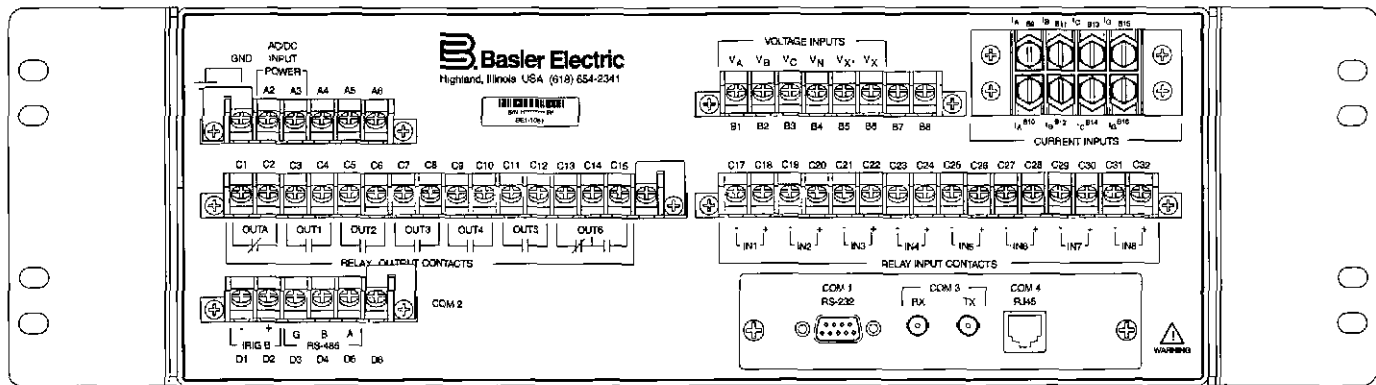


Figure 4 - BE1-1051 H1 Rear Panel Connections

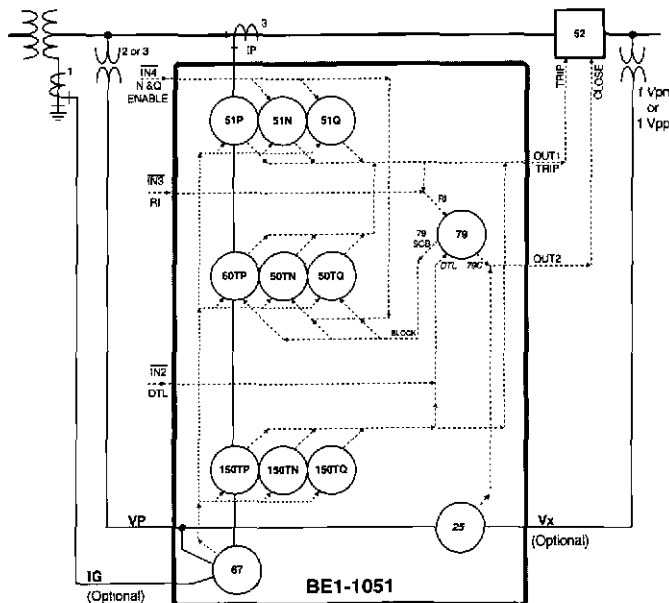


Figure 5 - Typical Application Single Line

GENERAL SPECIFICATIONS

5 Amp CURRENT INPUTS

Continuous rating:	20A
One Sec. Rating:	400A
Saturation limit:	150A
Burden:	<10milliohms @ 5A

1 Amp CURRENT INPUTS

Continuous rating:	4A
One Sec. rating:	250A
Saturation limit:	30A
Burden:	<22milliohms @ 1A

PHASE AC VOLTAGE INPUTS

Continuous:	300V, Line to Line
One Sec. rating:	600V, Line to Neutral
Burden:	Less than 1VA @ 300Vac

AUXILIARY AC VOLTAGE INPUT

Continuous:	150V
One Sec. rating:	600V
Burden:	Less than 1VA @ 150Vac

A/D CONVERTER

Sampling Rate:	16/cycle, adjusted to input frequency 10 - 75Hz
----------------	--

POWER SUPPLY

Option 1:	DC range 35 - 150V AC range 55 - 135V
Option 2:	DC range 90 - 300V AC range 90 - 270V
Option 3:	DC range 17 - 32V
Burden:	16 watts

TRIP CONTACTS

Make and carry:	30A (0.2sec)
Continuous:	7A
Break:	0.3A DC (L/R=0.04)

CONTROL INPUTS

Wetting voltage range:	Same as power supply option
PS Option L:	Burden 16kohm Nominal Turnon 16Vdc
PS Option Y; jumper low:	Burden 37.5Kohm Nominal Turnon 33Vdc
PS Option Y; jumper high:	Burden 95Kohm Nominal Turnon 83Vdc
PS Option Z; jumper low:	Burden 95Kohm Nominal Turnon 83Vdc
PS Option Z; jumper high:	Burden 190Kohm Nominal Turnon 165Vdc

COMMUNICATION PORTS

RS-232/RS-485 baud rate:	300 - 19200
Ethernet band rate:	10BaseT/10BaseF

DIELECTRIC STRENGTH

2000 Vac at 50/60 Hz in accordance with IEEE C37.90 1989 and IEC 255-5

SURGE WITHSTAND

Qualified to IEEE C37.90.1-1989, IEC 255-22-1

FAST TRANSIENT

Qualified to IEEE C37.90.1-1989, IEC 255-22-4

RADIO FREQUENCY INTERFERENCE (RFI)

Qualified to IEEE C37.90.2-1995, IEC 255-22-3

ELECTRO STATIC DISCHARGE (ESD)

Qualified to IEEE C37.90.3, IEC 255-22-2, IEC 1000-4-2.

ENVIRONMENT

Operating temperature range: -40°C to 70°C*
(-40°F to 158°F)

*LCD Display is inoperative below -20°C.

Storage temperature range: -40°C to 70°C
(-40°F to 158°F)

IEC 68-2-1 Basic Environmental Testing Procedures, Part 2: Tests-Test Ad: Cold (Type Test)
IEC 68-2-2 Basic Environmental Testing Procedures, Part 2: Tests-Test Bd: Dry Heat (Type Test)

IEC 68-2-30 Basic Environmental Testing Procedures, Part 2: Tests-Test Db and Guidance: Damp Heat, cyclic (12+12 cycle), (6 day type test)

IEC 68-2-56 Environmental Testing Part 2: Test-Cb: Damp Heat, Steady State, Primary for Equipment

VIBRATION

Qualified to IEC 255-21-1, Class 1

SHOCK

Qualified to IEC 255-21-2, Class 1

AGENCY RATINGS

UL pending, CSA pending

CASE SIZE

Horizontal: 5.40"(22.6mm)H x 14.63"(371.6mm)W
x 8.70"(220.9mm)D
7.70"(195.6mm)D (alternate mounting)
Vertical: 14.63"(371.6mm)H x 5.40"(22.6mm)W
x 8.70"(220.9mm)D
7.70"(195.6mm)D (alternate mounting)

SHIPPING WEIGHT

Approx. 16.5 pounds

WARRANTY

7 years

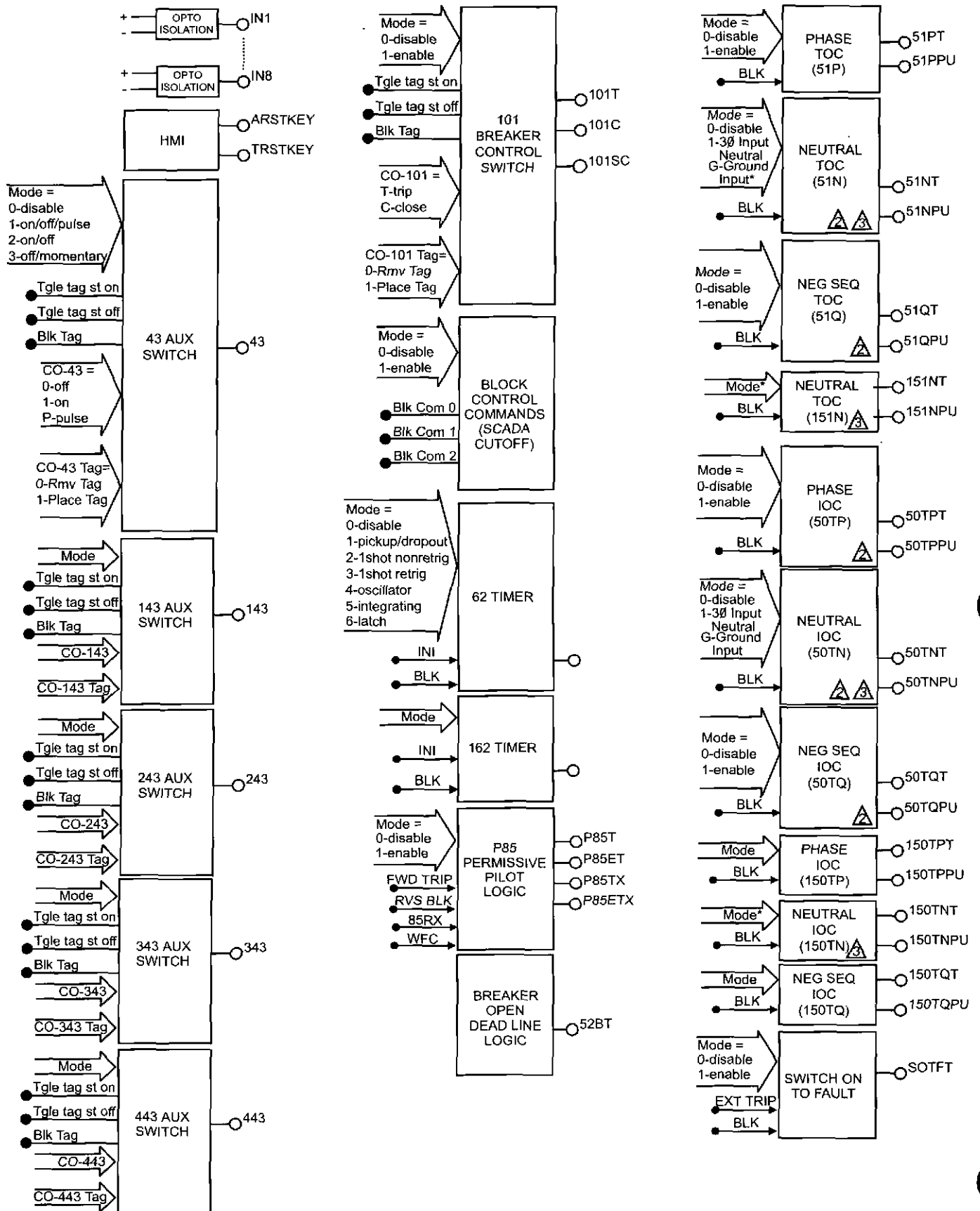


Figure 6A - BESTlogic Function Blocks

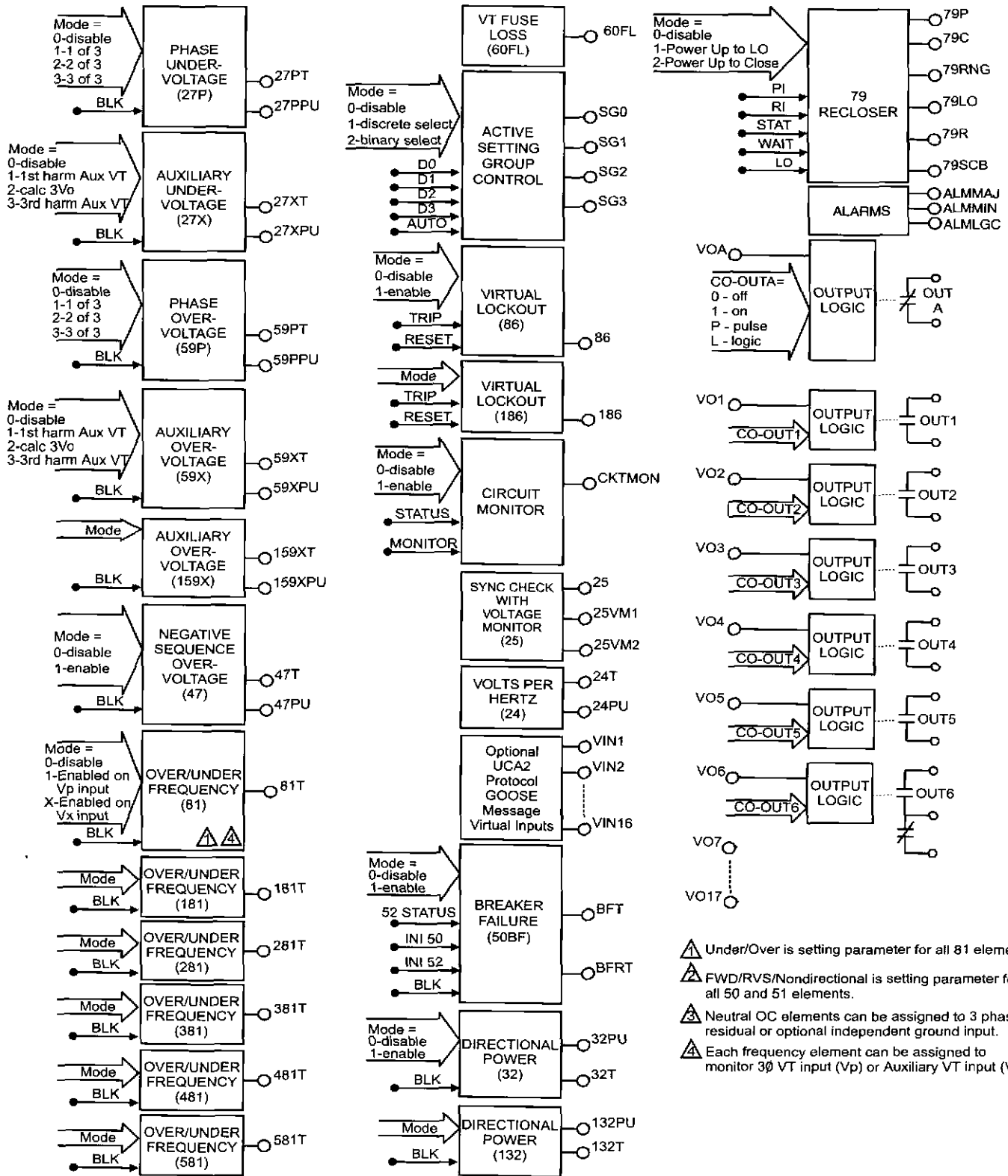


Figure 6B - BESTlogic Function Blocks

PERFORMANCE SPECIFICATIONS

INSTANTANEOUS OVERCURRENT WITH SETTABLE DELAY (50TP, 150TP, 50TN, 150TN, 50TQ, 150TQ)

Pickup: 5A CT 0.5 - 150.0A
 1A CT 0.1 - 30.0A

PU time with TD=0.000 Sec
 1¼ cyc for P, N & G @ 5 x PU
 2¼ cyc for Q @ 5 x PU

Delay time: 0.000 - 60 sec

Time Accuracy: ±0.5% or ±¼ cyc for P and N
 ±0.5% or ±¼ cyc for Q

TIME OVERCURRENT (51P, 51N, 151N, 51Q)

Pickup: 5A CT 0.5 - 16.0A
 1A CT 0.1 - 3.20A

Time dial: TD=K=0 - 99 for 46 curve
 TD=0.0 - 9.9 for all other curves

Time-Current Characteristics:
 The following expression describes the inverse time current characteristic for each curve:

$$T_T = \frac{AD}{M^N} + BD + K = \text{Time to trip}$$

$$T_R = \frac{RD}{M^2-1} = \text{Time for decaying reset}$$

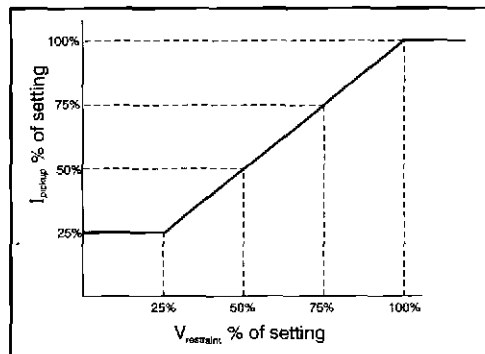
where D = Time dial, M = Multiple of PU and A, B, C, N, K and R are constants that govern the shape of each curve. The protection engineer can set the constants for the P (programmable) curve to achieve virtually any characteristic.

51P VOLTAGE CONTROL (27R)

Control Modes: Uncontrolled, voltage controlled, voltage restrained.

Control/Restraint Range: 30 - 250V

Restrainted Mode Characteristic: (see below)



SWITCH ONTO FAULT (SOTF)

Pickup: 5ACT 0.5-150.0A
 1ACT 0.1-30.0A

Hold Timer: 50-999 msec

Curve Type	Constants					
	A	B	C	N	K	R
S1	0.2663	0.03393	1.000	1.2969	0.028	0.5000
S2	0.0286	0.02080	1.000	0.9844	0.028	0.0940
L1	5.6143	2.18592	1.000	1.000	0.028	15.750
L2	2.3955	0.00000	1.000	0.3125	0.028	7.8001
D	0.4797	0.21359	1.000	1.5625	0.028	0.8750
M	0.3022	0.12840	1.000	0.5000	0.028	1.7500
I1	8.9341	0.17966	1.000	2.0938	0.028	9.0000
I2	0.2747	0.1042	1.000	0.4375	0.028	0.8868
V1	5.4678	0.10814	1.000	2.0469	0.028	5.5000
V2	4.4309	0.0991	1.000	1.9531	0.028	5.8231
E1	7.7624	0.02758	1.000	2.0938	0.028	7.7500
E2	4.9883	0.0129	1.000	2.0469	0.028	4.7742
A	0.01414	0.00000	1.000	0.0200	0.028	2.0000
B	1.4636	0.00000	1.000	1.0469	0.028	3.2500
C	8.2506	0.00000	1.000	2.0469	0.028	8.0000
G	12.1212	0.00000	1.000	1.000	0.028	29.000
F	0.0000	1.00000	0.000	0.0000	0.028	1.0000
46	*	0	0	2	0.028	100
P	0 to 600	0 to 25	0 to 1	.5 to 2.5	0.028	0 to 30

S1, S2 = CO Short Inv, IAC Short Inv
 L1, L2 = CO Long Inv, IAC Long Inv
 D = CO Definite Time
 M = CO Moderately Inverse
 I1, I2 = CO Inverse, IAC Inverse
 V1, V2 = CO Very Inv, IAC Very Inv
 E1, E2 = CO Ext Inverse, IAC Ext. Inverse

A = IEC Standard Inverse
 B = IEC Very Inverse
 C = IEC Extremely Inverse
 G = IEC Long Time Inverse
 F = Fixed Time
 46 = Negative Sequence Overcurrent
 P = Programmable

* Constant A is variable for the 46 curve and is determined as necessary based on generator full load current, minimum pickup, and K factor settings.

DIRECTIONAL CONTROL (ALL OVERCURRENT)

Mode: Forward, Reverse, Nondirectional

67P Polarization: Positive Sequence w/Memory Negative Sequence

67Q Polarization: Negative Sequence

67N Polarization: Selectable any combination Zero Sequence Voltage (Requires 4W VT) Zero Sequence Current (Requires IG) Negative Sequence

BREAKER FAILURE (BF)

P&N Fault detector: 5ACT 0.5-150A
 1ACT 0.1-30A

Time: 50 - 999mSec

Time Accuracy: ±0.5% or +1¼ cyc / - ¼ cyc

VOLTS/HZ (24)

Pickup: 0.5 - 6V/Hz

Delay Time: Inverse Squared Curve

$$T_T = \frac{D_T}{(M-1)^2}$$

$$T_R = \frac{ET}{D_R \times FST \times 100}$$

T_T = Time to Trip
 T_R = Time to Reset
 D_T = Time Dial, Trip
 D_R = Time Dial, Reset
 Actual V/Hz
 M = Pickup V/Hz
 ET = Elapsed Time
 FST = Full Scale Trip Time (T_T)

PERFORMANCE SPECIFICATIONS, continued

SYNC CHECK (25)

Delta Phase Angle: 1 - 45 degrees
 Delta Voltage Magnitude: 1 - 20V
 Delta Frequency: 0.01 - 0.50Hz

SYNC CHECK, VOLTAGE MONITOR (25VM)

Dead Threshold: 10 - 150V
 Live Threshold: 10 - 150V
 Dropout Time Delay: 0.050 - 60.0sec
 Logic: Dead Phase/Dead Aux.
 Dead Phase/Live Aux.
 Live Phase/Dead Aux.

Two Independent outputs: 25VM1 and 25VM2

PHASE OVER/UNDERVOLTAGE (27P, 59P)

Mode: 1 of 3; 2 of 3; 3 of 3
 Pickup: 10.0-300V
 Delay Time: 0.050 - 600sec.
 27 Inhibit: Disable, 10.0 - 300V

NEGATIVE SEQUENCE OVERVOLTAGE (47)

Pickup: 1.0 - 300V_{LN}
 Delay Time: 0.050 - 600sec.

AUXILIARY / 3V0 OVER/UNDERVOLTAGE (27X, 59X, 159X)

Mode: Fundamental V_x ,
 3 phase Residual (3V0),
 3rd Harmonic V_x
 Pickup: 1.0 - 150V
 Delay Time: 0.050 - 600 Sec.

FREQUENCY (81, 181, 281, 381, 481, 581)

Mode: Over, Under
 Pickup: 40.00 - 70.00 Hz
 Delay Time: 0.000 - 600 Sec.
 Time Accuracy: $\pm 0.5\%$ or $+1$ cyc / -0 cyc
 (Min. trip time affected by minimum 3 cycle security count)

GENERAL PURPOSE LOGIC TIMERS (62, 162)

Mode: PU.DO
 1 Shot, Non-Retrig.
 1 Shot, Retrig.
 Integrating
 Latch
 T1 and T2 Delay Time: 0.000 - 9999 Sec.
 Time Accuracy: $\pm 0.5\%$ or $\pm 1/4$ cyc

RECLOSER (79)

Mode: Power up to close,
 Power up to lockout
 Reclose Shots: 0 - 1 Pilot Reclose
 0 - 3 Delayed Reclose
 Reclose, Reset, Fail, Max. Cycle Timers: 0.100 - 600 Sec.
 Time Accuracy: $\pm 0.5\%$ or
 $+1/4$ cyc / -0 cyc

POWER (32, 132)

Mode: Forward, Reverse
 Pickup: 5A: 1.0 - 6000 Watts, 3 ph
 1A: 1.0 - 1200 Watts, 3 ph
 Pickup Accuracy: $\pm 3\%$
 Delay Time: 0.050 - 600 Sec.

CURRENT PICKUP ACCURACY (All 50, 51, 50BF)

Phase and Ground: 5A 2% or 50mA
 1A 2% or 10mA
 Neutral and Negative 5A 3% or 75mA
 Sequence: 1A 3% or 75mA

VOLTAGE PICKUP ACCURACY (All 27, 47 and 59)

$\pm 2\%$ or $\pm 0.5V$

DEFINITE TIME ACCURACY UNLESS OTHERWISE STATED (All 27, 32, 47 and 59)

Definite Time Accuracy: $\pm 0.5\%$ or $\pm 1/2$ cyc

SETTING GROUPS

Setting Groups: 4
 Control Modes: Automatic:CLP;Recloser shot;
 Dynamic load or unbalance
 External: Discrete input logic;
 Binary Input Logic

METERING

Current Range: 5A 0.5 to 15.0
 1A 0.1 to 3.0
 Current Accuracy: $\pm 1\%$

Phase Voltage Range: 3W 0 - 300 V_{LL}
 4W 0 - 300 V_{LL}
 Phase Voltage Accuracy: $\pm 0.5\%$ for $50V < V_{LL} < 300V$

Watt/VAR: 5A 0 to ± 7500
 1A 0 to ± 1500

Watt Accuracy: 1% @ Unity PF
 VAR Accuracy: 1% @ Zero PF

Energy: 0 to $\pm 1.0E12$ (F/R registers)

Frequency: 10 - 75Hz
 Frequency Accuracy: 0.01Hz

DEMANDS (IA, IB, IC, IN, IQ, Fwd Watts, Rvs Watts, Fwd VARs, Rvs VARs)

Demand Interval: 1 - 60 min.
 Demand Mode: Thermal

BREAKER MONITORING

Duty Mode: I or I²
 Duty Alarm Range: 0 - to 100%
 Op Counter Alarm Range: 0 - 99999
 Trip Time Alarm Range: 20 - 1000mSec

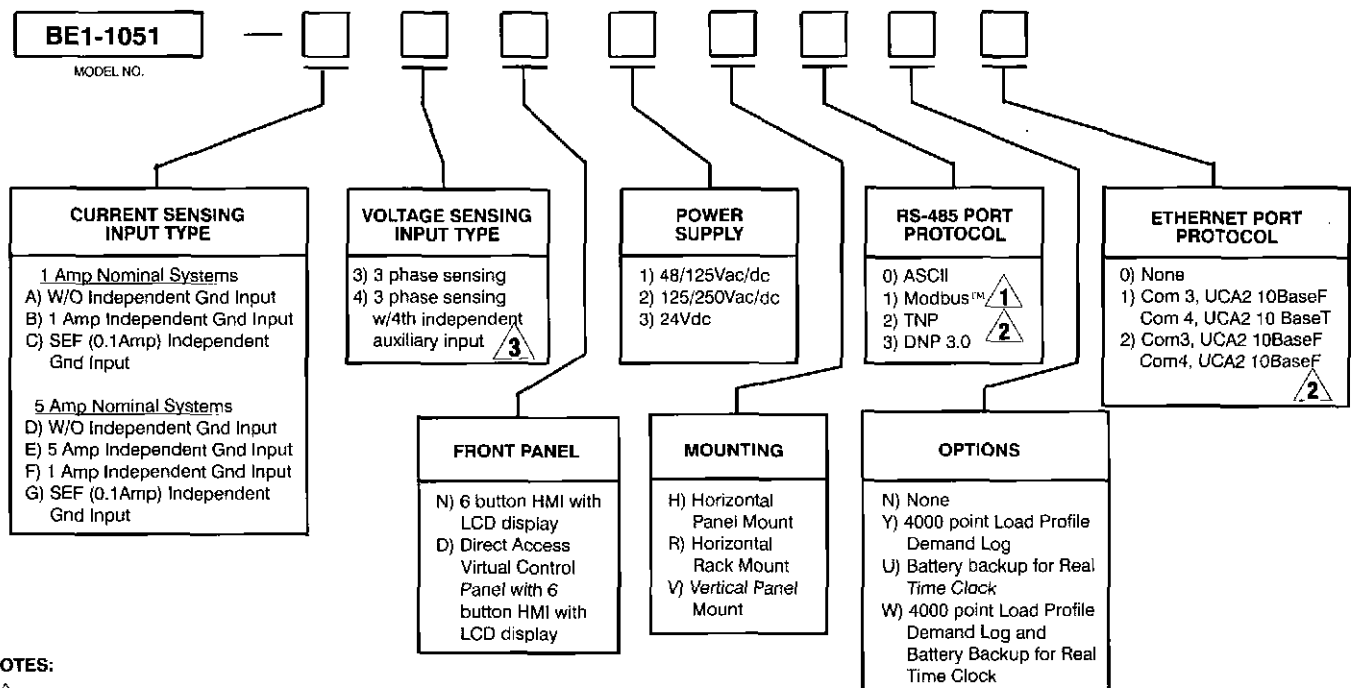
ORDERING

SAMPLE STYLE NUMBER

The style number identification chart defines the electrical characteristics and operation features included in BE1-1051 relays. For example, if the style number were BE1-1051 **E3N1R0U0**, the device has the following:

BE1-1051

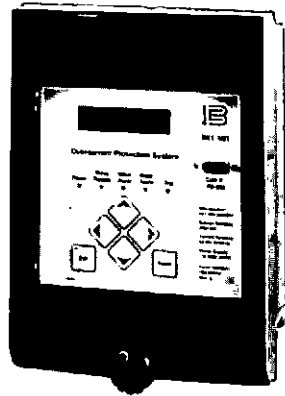
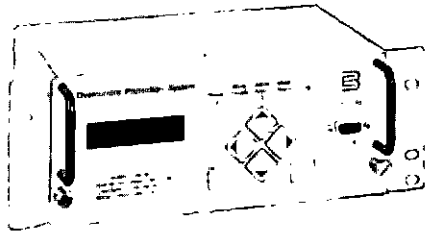
- (E) - 5 Amp nominal system with 5 Amp Independent Ground Input
- (3) - Three phase voltage sensing
- (N) - Standard 6-button HMI with LCD display
- (1) - 48/125Vac/Vdc power supply
- (R) - 19" Horizontal Rack Mount, Drawout Case
- (0) - ASCII Communications on Com 2
- (U) - Battery Backup for Real Time Clock
- (0) - Without Ethernet communications ports



NOTES:

- All units include three independent communications ports standard: Com0 (front RS-232), Com1 (rear RS-232, Com2 (rear RS-485). ASCII Communications is standard on Com0, Com1, and Com2.
- Consult your Basler Representative for availability of other protocol options.
- Adds 25 sync check option.





BE1-951 OVERCURRENT PROTECTION SYSTEM

The BE1-951 is a multifunction numerical relay that provides three phase, ground, and negative sequence directional or non-directional overcurrent protection with four shot recloser, forward or reverse power protection, breaker failure, over/underfrequency, over/undervoltage and overexcitation protection, sync check, breaker monitoring and control, sequential events, fault reporting, and metering functions, all in an integrated system.

ADVANTAGES

- Each overcurrent element can be individually set for forward or reverse directional or non-directional control for maximum flexibility in any application.
- Includes a sensitive forward or reverse power element for dispersed storage and generation (DSG), dual bus sources with tie capability, or any application requiring reverse power protection.
- Includes distance to the fault to aid in timely fault location and service restoration.
- BESTlogic provides the user with complete flexibility in configuring a protection and control system. User programmable variable and switch names make these relays completely self documenting.
- Programmable LCD display allows the relay to replace local indication and control functions, such as panel metering, alarm annunciation, and control switches.
- Three independent communication ports with protocol support allows integration with distributed control systems.
- Provides optional separate ground current input for those applications where this is required.
- Includes frequency tracking and voltage restrained overcurrent for backup and cogeneration applications.
- Available in fully drawout half rack case. Two Basler Electric half rack IEDs (Intelligent Electronic Devices) can be dovetailed together to mount in a standard 19-inch equipment rack with no special mounting hardware.
- Available in fully drawout S1 case with test paddle. The S1 case, with available adapter plates, fits cutout, drilling and behind panel projection dimensions for common Basler Electric, GE and Westinghouse unit case relays.

WINDOWS® SOFTWARE

Interface for setting and communicating with Basler protection products
Request BESTCOMS™ for BE1-951.

ADDITIONAL INFORMATION

INSTRUCTION MANUAL

Request publication 9328900990

TIMING CURVES

Request publication 9252000999

MODBUS™ INSTRUCTION MANUAL

Request publication 9328900991

DNP 3.0 INSTRUCTION MANUAL

Request publication 9328900992

FEATURES
Pages 2 and 3

APPLICATIONS
Page 3

**FUNCTIONAL
DESCRIPTION**
Page 4 - 6

BESTlogic
Pages 8 and 9

SPECIFICATIONS
Pages 7, 10-11

**ORDERING
INFORMATION**
Page 12

B Basler Electric

P. O. BOX 269 HIGHLAND, ILLINOIS, U.S.A. 62249 PHONE 618-654-2341 FAX 618-654-2351

UHR-6
1-01

FEATURES

PROTECTION

- Phase, Neutral, and Negative Sequence Instantaneous Overcurrent elements with settable time delay: 50TP, 150TP, 50TN, 150TN, 50TQ, 150TQ
- Phase, Neutral, and Negative Sequence Time Overcurrent elements: 51P, 51N, 151N, 51Q (51P elements can have voltage restraint)
- Each overcurrent element can be set for forward, reverse, or nondirectional control (67P, 67N, 67Q). Directional control is by Positive (671), Negative (672), Zero Sequence Voltage (670V) and Zero Sequence Current (670I) polarized directional units.
- All U.S. and IEC timing curves plus user programmable curve
- Minimizes transient overreach and overtravel on overcurrent elements
- Optional separate ground current input provides zero sequence current polarization and/or ground overcurrent protection for a separate ground CT.
- Phase Undervoltage and Overvoltage elements: 27P, 59P. Elements use a 1 of 3, 2 of 3, or 3 of 3 logic, and monitor either line-line or line-ground voltages.
- Auxiliary Undervoltage and Overvoltage elements: 27X, 59X, 159X. Elements monitor either fundamental or third harmonic on the optional auxiliary 4th VT input, or fundamental phase residual, 3V0, of the phase inputs.
- Overexcitation, volts per Hertz element: 24
- Forward or Reverse Power: 32
- Negative Sequence Overvoltage element: 47
- Over/Under Frequency elements: 81, 181, 281, 381, 481, 581
- Each 81 element can be assigned to monitor 3 phase VT input (VP) or Auxiliary voltage input (Vx).
- Breaker Failure protection function: BF
- Two general purpose logic timers: 62, 162
- Programmable Logic using BESTlogic
- Four protection setting groups with external or automatic (cold load pickup, load, unbalance, recloser shot) selection modes
- Sync check with dead line/dead bus voltage monitor logic, 25, 25VM (Requires optional 4th VT sensing circuit)
- Fuse loss detection protects against false trip due to loss of voltage sensing: 60FL

CONTROL

- Four shot recloser with zone sequence coordination and sequence controlled protective element blocking functions
- Virtual breaker control switch—controllable from both HMI and com. ports: 101
- Four virtual selector switches—controllable from both HMI and com. ports: 43, 143, 243, 343
- Virtual lockout latches: 86, 186. Status is stored in EEPROM.
- Communication port control of 101 and #43 switches allows for SCADA control of relay and breaker

INSTRUMENTATION

- Real time A, B, C phase current, voltage, and frequency and derived neutral and negative sequence current and voltage
- Real Time per phase and 3 phase Watts, Vars, and 3 phase Power Factor

REPORTS

- Current demands for phase, neutral, and negative sequence currents, and forward and reverse watts and vars—magnitudes and time stamps are recorded for today's peak, yesterday's peak, and peak since reset
- Optional 4000 point log of demand readings
- kWh and kvarh, forward and reverse
- Breaker operations counter and contact interruption duty

FAULT RECORDING

- 255 event sequence of events report with I/O and alarm sub-reports
- Fault Reporting; 1 or 2 oscillography records per fault report
- 16 fault summary reports; two most recent Fault Summary Records saved to non-volatile memory
- Total number of oscillography records settable from 6 to 16
- Total of 240 cycles oscillography memory @ 12 samples/cycle
- COMTRADE format
- Load compensated distance to fault

COMMUNICATION PORTS

- Three independent general purpose communication ports
 - Front RS-232 ASCII communications
 - Rear RS-232 ASCII communications
 - Rear RS-485 ASCII, Modbus™, DNP® 3.0, and TNP protocols
- IIRIG time sync (unmodulated)

SELF TEST AND ALARM FUNCTIONS

- Relay fail, major alarm, and minor alarm LEDs, and fail-safe alarm output contact
- Extensive internal diagnostics monitor all internal functions of the relay
- More than 20 additional alarm points—programmable for major or minor priority
 - Including:
 - Phase current, and forward and reverse watt and var demand alarm
 - Neutral and negative sequence unbalance demand alarms
 - Three breaker alarm points programmable for slow trip, interruption duty threshold, or operations counter
 - Trip circuit voltage and continuity monitor
 - Close circuit monitor via BESTlogic

PROGRAMMABLE I/O

- Four programmable inputs
- Five programmable outputs and one dedicated programmable alarm output

FEATURES, continued

HARDWARE FEATURES

- Two case configurations
 - S1: Basler/GE style (with test plug)
 - H1: Half Rack
- Active CT technology for low burden and increased dynamic range
- Flash Memory for upgrading embedded programming without changing chips
- Integral HMI with 2x16 character display
- Wide range ac/dc power supply options provide long holdup time to ride through dips on ac power source. (100 ms with 4 output relays energized, upon complete loss of source. Starting voltage 125Vac for Option 1 (48/125Vac/dc) and 250Vac for Option 2 (125/250Vac/dc)).

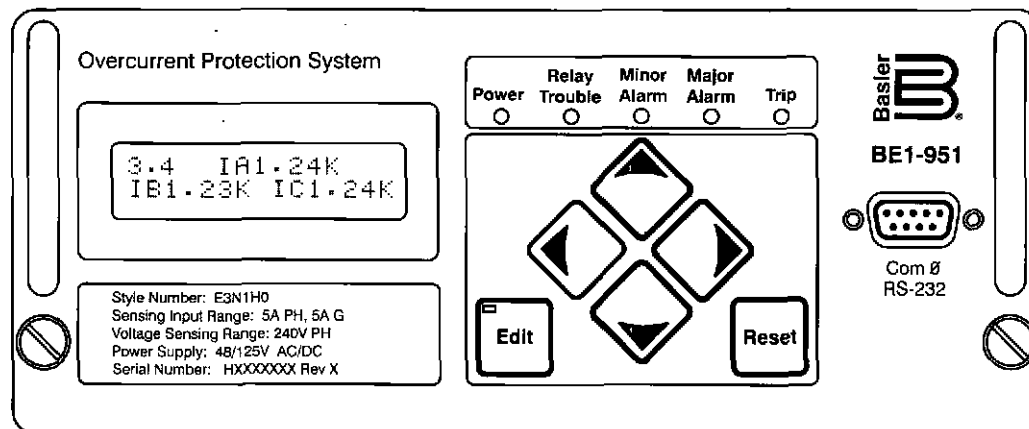


Figure 1 - Advanced HMI (Human Machine Interface) shown with optional Direct Access Virtual Control Panel

APPLICATIONS

The BE1-951 Overcurrent Protection System provides three phase, ground, and negative sequence overcurrent, voltage and frequency protection and is intended for use in any directional or non-directional overcurrent protection application. Its unique capabilities make it ideally suited for applications with the following requirements:

- Applications that require low burden to extend the linear range of CTs.
- Applications that require high accuracy across a wide frequency range such as for motor, generator, and generator step-up transformer protection or in cogeneration facilities.
- Applications that require the flexibility provided by wide setting ranges, multiple setting groups, and multiple coordination curves in one unit.
- Applications that require the economy and space savings provided by a multifunction, multiphase unit. This one unit can provide all of the protection, control, metering, and local and remote indication functions required on a typical circuit.
- Applications that require directional control and fault locating.
- Applications requiring protection of an intertie between dispersed storage and generation facilities (DSG) and a utility.
- Transformer backup applications where overexcitation protection is required.
- Applications that require communications and protocol support.
- Applications where the capabilities of a digital multifunction relay are required, yet drawout construction is also desirable.
- Applications where bus protection is provided by a high speed overcurrent blocking scheme on the transformer bus mains instead of a dedicated bus differential circuit.
- Applications where the small size and limited behind-panel projection facilitates modernizing protection and control systems in existing substations.

FUNCTIONAL DESCRIPTION

The BE1-951 is a multifunction, numerical relay that provides a comprehensive mix of protective functions to detect faults and abnormal operating conditions in substations and on feeders, along with control and metering functions in an integrated system. Additional features included in this relay such as voltage restrained overcurrent (51V), overexcitation (24), forward/reverse power (32), synch check (25), over and undervoltage (27/59) and over and underfrequency (81O/U) make this system suitable for any directional or non-directional overcurrent and over/underpower applications including feeder, transformer, generator, intertie, bus, and load shedding applications. Twelve sample per cycle digital signal processing with frequency compensation extracts the fundamental component for high accuracy with distorted waveforms and at off-nominal frequency operation.

The unit has one set of three phase current and voltage sensing inputs to provide all common protective functions for substation and feeder applications. The voltage sensing circuits automatically configure themselves internally for 1 phase, 3 phase 3 wire, or 3 phase 4 wire VT circuits.

The BE1-951 also can be ordered with an optional independent ground current input, typically used for application with a separate ground CT such as a flux balancing window CT, or to provide ground backup protection for the neutral or tertiary of a transformer.

An optional fourth Auxiliary Voltage input is also available. This voltage input can be connected to line side potential for sync check (25) and dead line (25VM) closing supervision or to a ground sensing VT connection for ground fault protection on the delta side of a cogeneration intertie transformer.

For directional applications, all overcurrent elements can be independently set for forward, reverse, or non-directional control. The target reporting function in the BE1-951 automatically adapts the targets as appropriate. For example, if the 150TP and the 51P functions are set for directional control, they post targets for an A phase fault as "167A" for directional instantaneous trip or "67TA" for directional time trip respectively. Directional control is by sequence directional elements. The zero sequence current polarized element uses the optional independent ground input for its polarization signal. The zero sequence voltage polarized element requires that the VT connection be 4W. The positive sequence directional element has memory voltage to provide reliable directional control for close in balanced three phase faults.

Three independent communications ports, along with built-in support for Modbus™ and other common protocols, provide easy access to integrating the protection, control, metering, and status monitoring functions into a substation automation system. The standard IRIG-B port provides time synchronization from a master clock.

Real time metering provides Watt, Watt-hour, VAR, VAR-hour, voltage, amp, and unbalance loading telemetry for the protected circuit. Contact sensing inputs and alarm monitoring functions provide real time status information. Remote control is provided by virtual control and selector switches with select-before-operate control of programmable outputs.

BESTlogic

BESTlogic programmable logic provides the user with high flexibility in configuring a protection and control system.

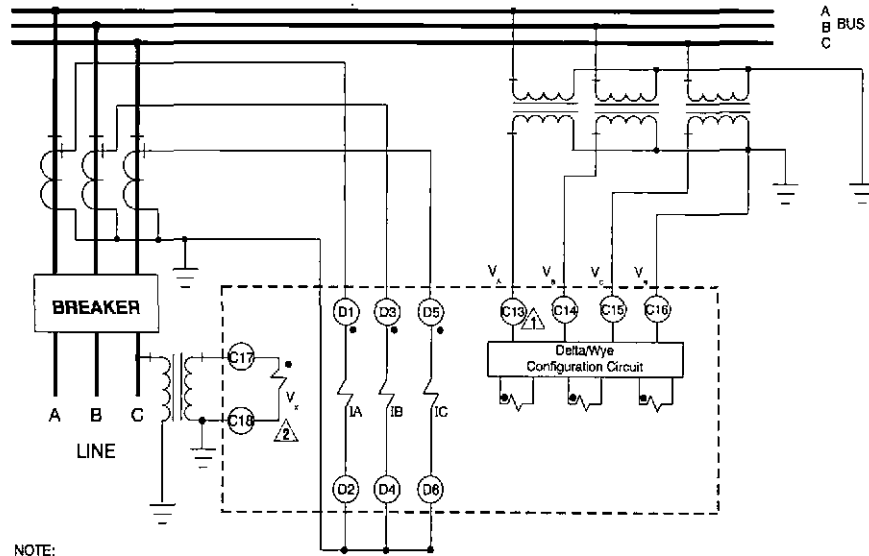
Each of the protection and control functions in the BE1-951 is implemented as an independent function block that is equivalent to its single function, discrete device counterpart. Each independent function block has all the inputs and outputs that the discrete component counterpart might have. Figures 5A and 5B show each of the independent function blocks available for use in the BE1-951. Programming BESTlogic is equivalent to choosing the devices required by your protection and control scheme and drawing schematic diagrams to connect the inputs and outputs to obtain the desired operational logic.

The BE1-951 relay can store, as user settings, one user programmable, custom logic scheme. To save you time, several preprogrammed logic schemes have also been provided. Any of the preprogrammed schemes may be copied into the logic settings without making any additional BESTlogic settings.

BESTlogic provides the protection engineer with the flexibility to set up this powerful multifunction system with the same freedom that was once enjoyed with single function, discrete devices. It is no longer necessary to compromise your standard protection and operating practices to deal with the limitations in programmability of previous multifunction devices.

Figures 2A, 2B, 2C and 3 show typical external connections, and Figures 4A and 4B show rear panel connections.

FUNCTIONAL DESCRIPTION, continued

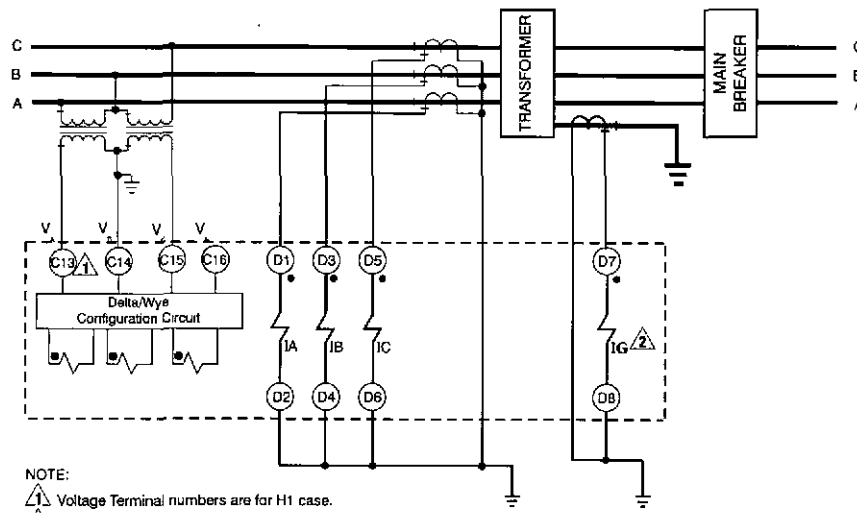


NOTE:

▲ Voltage Terminal numbers are for H1 case.

▲ Auxiliary Voltage input is optional and available on H1 case only.

Figure 2A - Typical External Sensing Connections - Feeder Breaker Application



NOTE:

▲ Voltage Terminal numbers are for H1 case.

▲ Independent Ground Input is optional and available on H1 case only.

Figure 2B - Typical External Sensing Connections - Transformer Backup Application

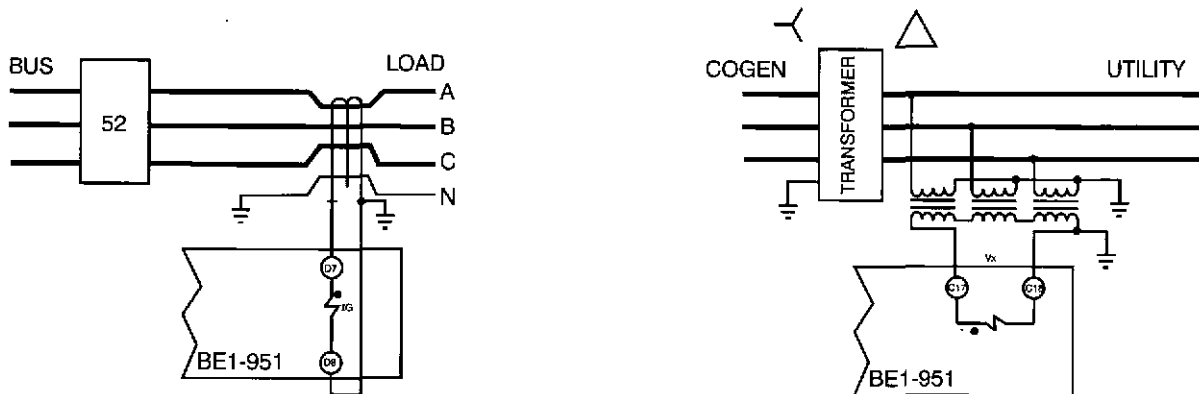
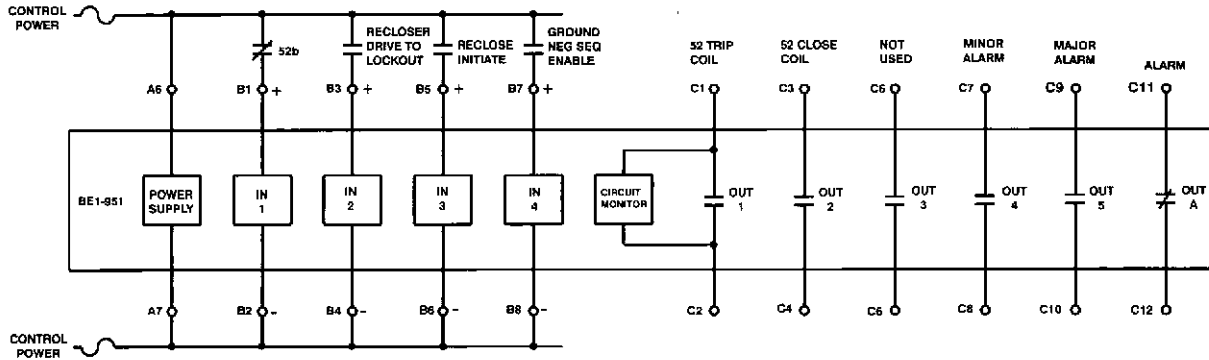


Figure 2C - Typical Alternate Connections for V_x and I_G

FUNCTIONAL DESCRIPTION, continued



NOTES:

- 1.) CONNECTIONS SHOWN ARE FOR USE WITH PRE-PROGRAMMED LOGIC SCHEME OC-W-79. OC-W-79 PROVIDES OVERCURRENT PROTECTION WITH RECLOSING CAPABILITIES. ALL INPUTS AND OUTPUTS ARE FULLY PROGRAMMABLE USING BESTLOGIC.

Figure 3 - Typical External Connections

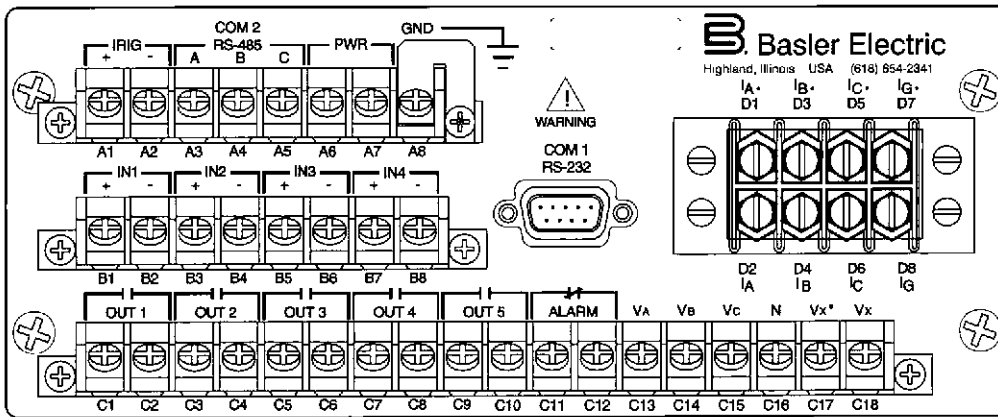


Figure 4A - BE1-951 H1 Rear Panel Connections

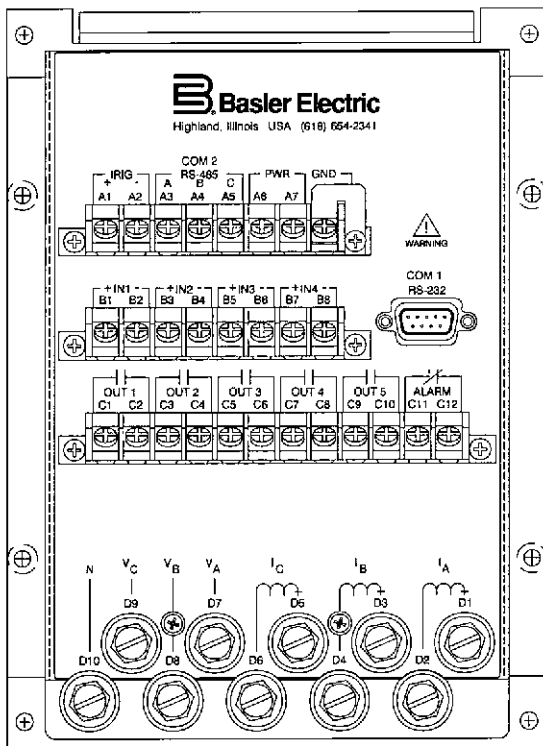
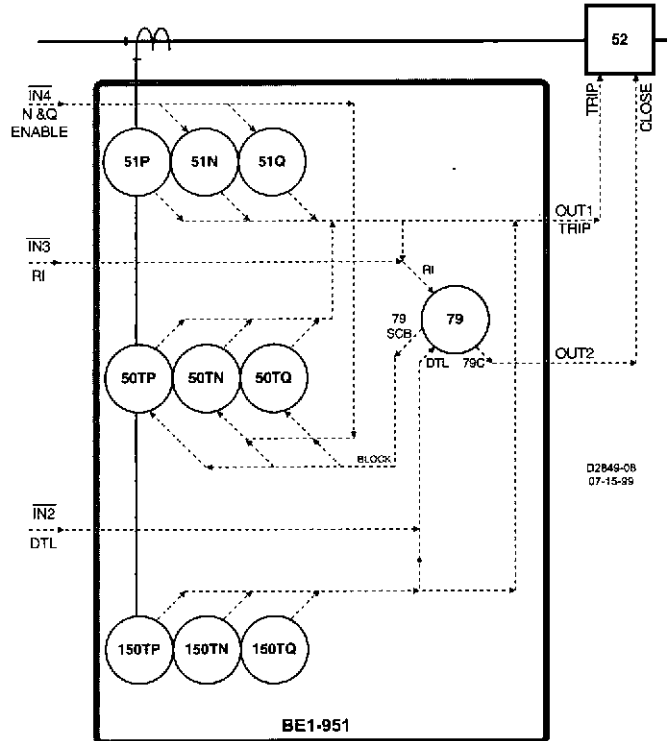


Figure 4B - BE1-951 S1 Rear Panel Connections



Based upon pre-programmed logic OC-W-79. Not all available protection and control functions are shown.

Figure 5 - Typical Application Single Line

GENERAL SPECIFICATIONS

5 Amp CURRENT INPUTS

Continuous rating:	20A
One Sec. Rating:	400A
Saturation limit:	150A
Burden:	<10milliohms

1 Amp CURRENT INPUTS

Continuous rating:	4A
One Sec. rating:	250A
Saturation limit:	30A
Burden:	<22milliohms

PHASE AC VOLTAGE INPUTS

Continuous:	300V, Line to Line
One Sec. rating:	600V, Line to Neutral
Burden:	Less than 1VA @ 300Vac

AUXILIARY AC VOLTAGE INPUT

Continuous:	150V
One Sec. rating:	600V
Burden:	Less than 1VA @ 150Vac

A/D CONVERTER

Sampling Rate:	12/cycle, adjusted to input frequency 10-75Hz
----------------	---

POWER SUPPLY

Option 1:	DC range 35 - 150V AC range 55 - 135V
Option 2:	DC range 90 - 300V AC range 90 - 270V
Option 3:	DC range 17 - 32V
Burden:	6 watts continuous, 8 watts maximum with all outputs energized

TRIP CONTACTS

Make and carry:	30A (0.2sec)
Continuous:	7A
Break:	0.3A DC (L/R=0.04)

CONTROL INPUTS

Wetting voltage range:	Same as control power supply option.
Nominal Turn On/Off Voltage:	P.S. Option 1: 33Vdc P.S. Option 2: 83Vdc P.S. Option 3: 16Vdc
Control inputs recognize both DC and AC voltages.	
Burden:	P.S. Option 1: 36K Ω P.S. Option 2: 94K Ω P.S. Option 3: 15K Ω

COMMUNICATION PORTS

Response time:	<100mSec for metering and control functions
Baud rate:	300 - 19200

ELECTRICAL ENVIRONMENT

- IEEE C37.90-1989 Standard for Relays and Relay Systems Associated with Electric Power Apparatus
- IEC 255-5 Insulation Test for Electrical Relays Impulse and Dielectric Strength (2000Vac at 50/60Hz)
- IEEE C37.90.1-1989 Standard Surge Withstand Capability Tests for Relays and Relay Systems Associated with Electric Power Apparatus
- IEC 255-22-1 1MHz Burst Disturbance Tests for Electrical Disturbance Tests for Measuring Relays and Protection Equipment
- EN 61000-4-4 Electrical Fast Transient/Burst Immunity Test
- EN 61000-4-3 Radiated, Radio-frequency, Electro-magnetic Field Immunity Test
- Type tested using a 5-watt, hand-held transceiver in the ranges of 144 and 440MHz with the antenna placed within 6 inches of the relay.
- IEEE C37.90.3 (Jan. 01) Draft Standard Electrostatic Discharge Tests for Protective Relays
- EN 61000-4-2 Electrostatic Discharge Immunity Test

MECHANICAL ENVIRONMENT

- Operating temperature range: -40°C to 70°C* (-40°F to 158°F)
*LCD Display is inoperative below -20°C.
- Storage temperature range: -40°C to 70°C (-40°F to 158°F)
- Humidity: Qualified to IEC 68-2-38, 1st Edition 1974, Basic Environmental Test Procedures, Part 2: Test Z/AD: Composite Temperature Humidity Cyclic Test
- Qualified to IEC 255-21-1 (Class 1) Vibration Tests for Electrical Relays
- Qualified to IEC 255-21-2 (Class 1) Shock and Bump Tests for Electrical Relays

CERTIFICATIONS

UL Recognized, File E97033
CSA Certified, File LR23131
DNP 3.0 IED Certified, Subset Level 2, 6/20/00,
by SUBNET Solutions, Inc.

CASE SIZE

H1: 10.50"W x 3.47"H x 9.10"D with mounting flanges (8.5"W without mounting flanges)
S1: 6.65"W x 9.32"H x 9.405"D

SHIPPING WEIGHT

H1: Approx. 10 pounds
S1: Approx. 16 pounds

WARRANTY

7 years

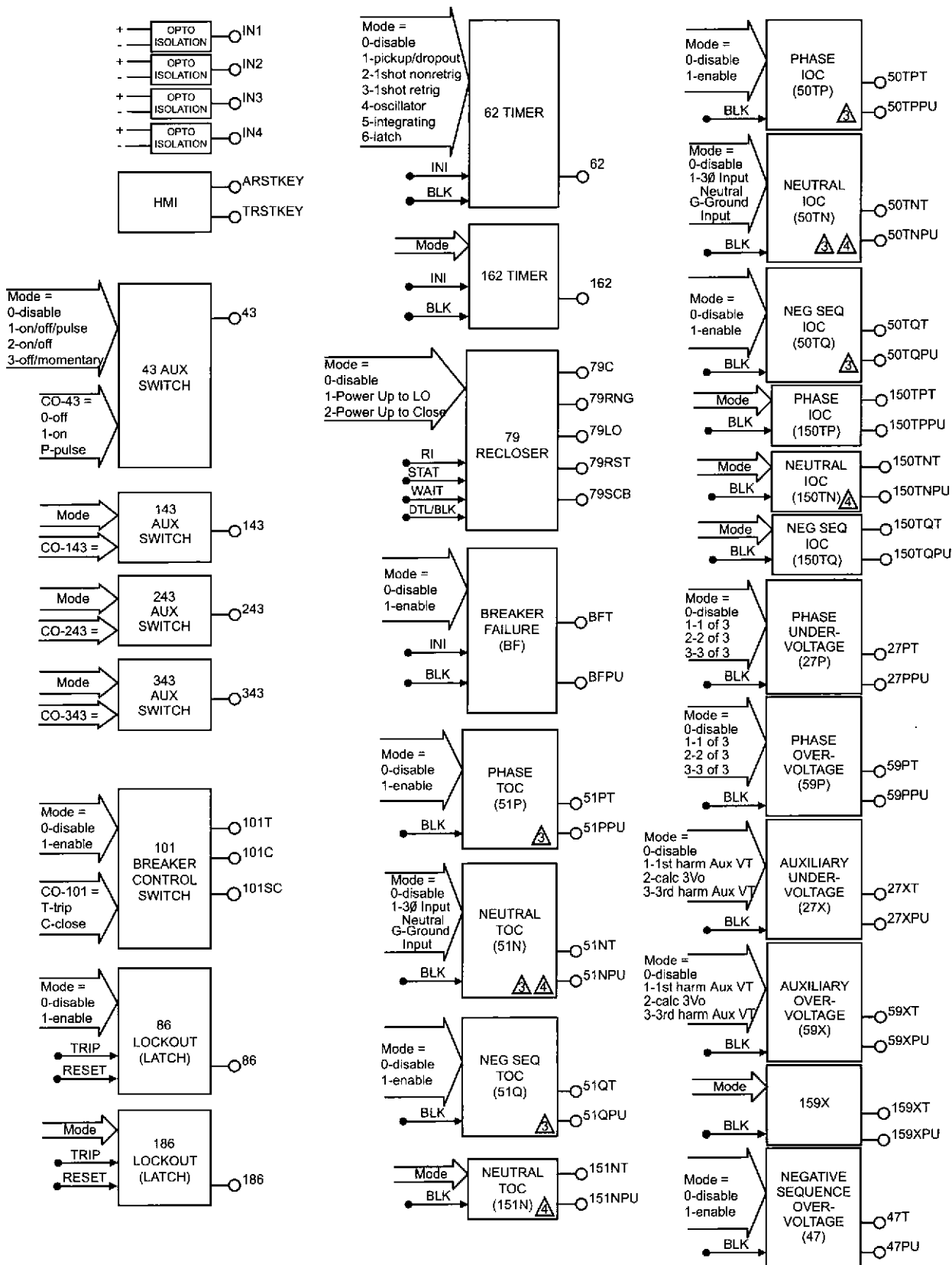


Figure 6A - BESTlogic Function Blocks

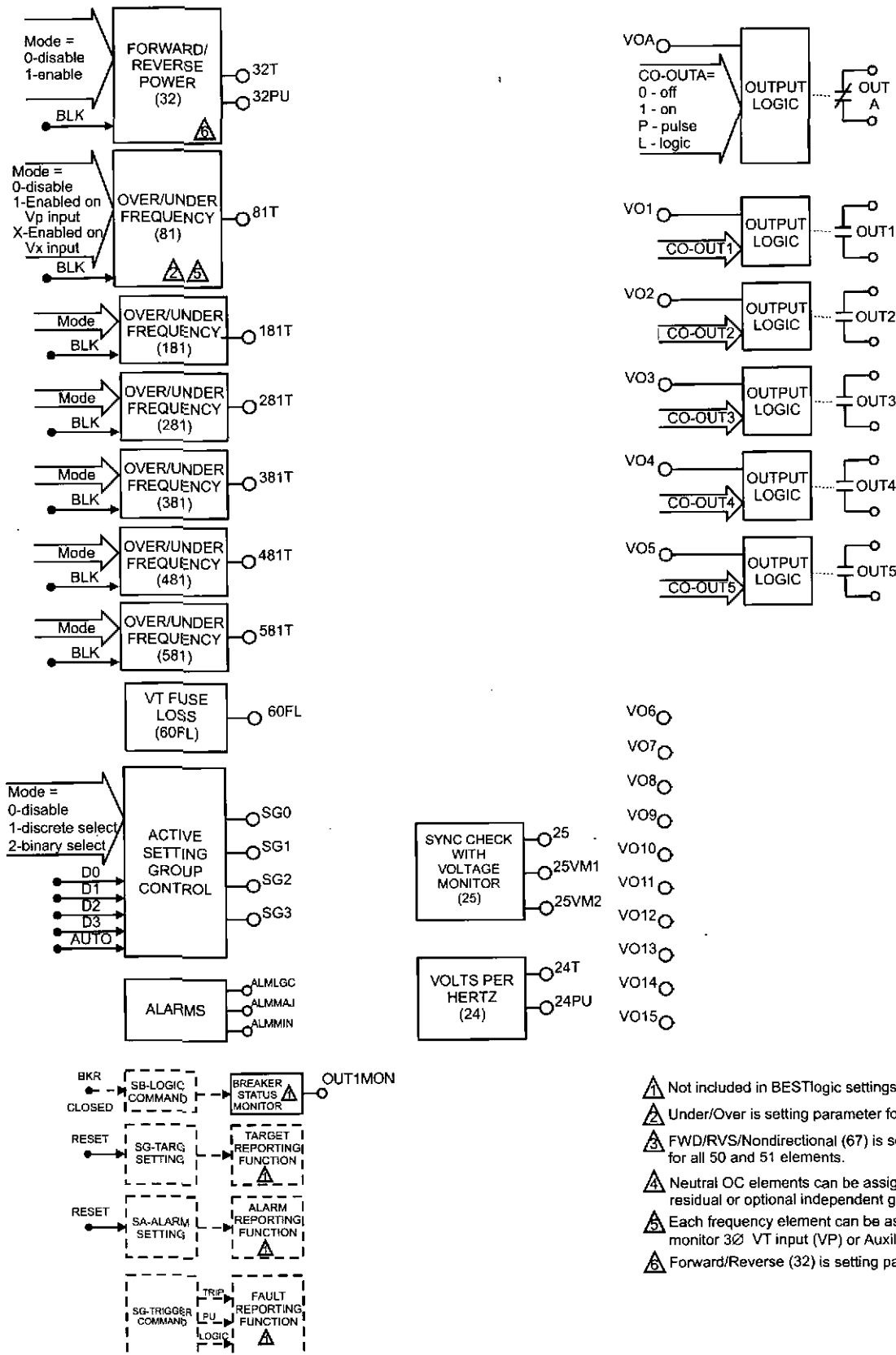


Figure 6B - BESTlogic Function Blocks

PERFORMANCE SPECIFICATIONS

INSTANTANEOUS OVERCURRENT WITH SETTABLE DELAY (50TP, 150TP, 50TN, 150TN, 50TQ, 150TQ)

Pickup: 5A CT 0.5 - 150.0A
 1A CT 0.1 - 30.0A

PU time with TD=0.000 Sec
 2 cyc for P, N & G @ 5 x PU
 3 cyc for Q @ 5 x PU

Delay time: 0.000 - 60 sec

Time Accuracy: ±0.5% or ±½ cyc for P and N
 ±0.5% or ±1 cyc for Q

TIME OVERCURRENT (51P, 51N, 151N, 51Q)

Pickup: 5A CT 0.5 - 16.0A
 1A CT 0.1 - 3.20A

Time dial: TD=K=0 - 99 for 46 curve
 TD=0.0 - 9.9 for all other curves

Time-Current Characteristics:
 The following expression describes the inverse time current characteristic for each curve:

$$T_T = \frac{AD}{M^{N-C}} + BD + K = \text{Time to trip}$$

$$T_R = \frac{RD}{M^2-1} = \text{Time for decaying reset}$$

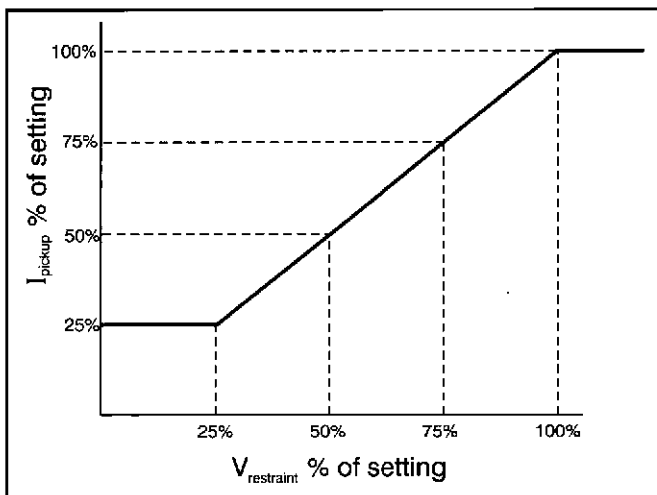
where D = Time dial, M = Multiple of PU and A, B, C, N, K and R are constants that govern the shape of each curve. The protection engineer can set the constants for the P (programmable) curve to achieve virtually any characteristic.

51P VOLTAGE CONTROL (27R)

Control Modes: Uncontrolled, voltage controlled, voltage restrained.

Control/Restraint Range: 30 - 250V

Restrainted Mode Characteristic: (see below)



Curve Type	Constants					
	A	B	C	N	K	R
S1	0.2663	0.03393	1.000	1.2969	0.028	0.5000
S2	0.0286	0.02080	1.000	0.9844	0.028	0.0940
L1	5.6143	2.18592	1.000	1.000	0.028	15.750
L2	2.3955	0.00000	1.000	0.3125	0.028	7.8001
D	0.4797	0.21359	1.000	1.5625	0.028	0.8750
M	0.3022	0.12840	1.000	0.5000	0.028	1.7500
I1	8.9341	0.17966	1.000	2.0938	0.028	9.0000
I2	0.2747	0.1042	1.000	0.4375	0.028	0.8868
V1	5.4678	0.10814	1.000	2.0469	0.028	5.5000
V2	4.4309	0.0991	1.000	1.9531	0.028	5.8231
E1	7.7624	0.02758	1.000	2.0938	0.028	7.7500
E2	4.9883	0.0129	1.000	2.0469	0.028	4.7742
A	0.01414	0.00000	1.000	0.0200	0.028	2.0000
B	1.4636	0.00000	1.000	1.0469	0.028	3.2500
C	8.2506	0.00000	1.000	2.0469	0.028	8.0000
G	12.1212	0.00000	1.000	1.000	0.028	29.000
F	0.0000	1.00000	0.000	0.0000	0.028	1.0000
46	*	0	0	2	0.028	100
P	0 to 600	0 to 25	0 to 1	.5 to 2.5	0.028	0 to 30

S1, S2 = CO Short Inv, IAC Short Inv A = IEC Standard Inverse
 L1, L2 = CO Long Inv, IAC Long Inv B = IEC Very Inverse
 D = CO Definite Time C = IEC Extremely Inverse
 M = CO Moderately Inverse G = IEC Long Time Inverse
 I1, I2 = CO Inverse, IAC Inverse F = Fixed Time
 V1, V2 = CO Very Inv, IAC Very Inv 46 = Negative Sequence Overcurrent
 E1, E2 = CO Ext Inverse, IAC Ext. Inverse P = Programmable

* Constant A is variable for the 46 curve and is determined as necessary based on system full load current setting, minimum pickup, and K factor settings.

DIRECTIONAL CONTROL (ALL OVERCURRENT)

Mode: Forward, Reverse, Nondirectional

67P Polarization: Positive Sequence w/Memory Negative Sequence

67Q Polarization: Negative Sequence

67N Polarization: Selectable any combination Zero Sequence Voltage (Requires 4W VT) Zero Sequence Current (Requires IG) Negative Sequence

BREAKER FAILURE (BF)

Time: 50 - 999mSec

Dropout: 5A CT 0.5A
 1A CT 0.1A

Time Accuracy: ±0.5% or +1¼ cyc / - ½ cyc

VOLTS/HZ (24)

Pickup: 0.5 - 6V/Hz

Delay Time: Inverse Squared Curve

$$T_T = \frac{D_T}{(M-1)^2}$$

$$T_R = \frac{ET}{D_R \times FST \times 100}$$

T_T = Time to Trip T_R = Time to Reset
 D_T = Time Dial, Trip D_R = Time Dial, Reset
 Actual V/Hz

M = Pickup V/Hz ET = Elapsed Time
 FST = Full Scale Trip Time (T_T)

PERFORMANCE SPECIFICATIONS, continued

SYNC CHECK (25)

Delta Phase Angle: 1 - 45 degrees
 Delta Voltage Magnitude: 1 - 20V
 Delta Frequency: 0.01 - 0.50Hz

SYNC CHECK, VOLTAGE MONITOR (25VM)

Dead Threshold: 10 - 150V
 Live Threshold: 10 - 150V
 Dropout Time Delay: 0.050 - 60.0sec
 Logic: Dead Phase/Dead Aux.
 Dead Phase/Live Aux.
 Live Phase/Dead Aux.

Two Independent outputs: 25VM1 and 25VM2

PHASE OVER/UNDERVOLTAGE (27P, 59P)

Mode: 1 of 3; 2 of 3; 3 of 3
 Pickup: 10.0-300V_{LL} or 10.0-300V_{LN}
 Delay Time: 0.050 - 600sec.

NEGATIVE SEQUENCE OVERVOLTAGE (47)

Pickup: 1.0 - 300V_{LN}
 Delay Time: 0.050 - 600sec.

AUXILIARY / 3V0 OVER/UNDERVOLTAGE (27X, 59X, 159X)

Mode: Fundamental V_x,
 3 phase Residual (3V0),
 3rd Harmonic V_x
 Pickup: 1.0 - 150V
 Delay Time: 0.050 - 600 Sec.

POWER (32)

Mode: Forward, Reverse
 Pickup: 5A: 1.0 - 6000 Watts, 3 ph
 1A: 1.0 - 1200 Watts, 3 ph
 Pickup Accuracy: ±3%
 Delay Time: 0.050 - 600 Sec.

FREQUENCY (81, 181, 281, 381, 481, 581)

Mode: Over, Under
 Pickup: 40.00 - 70.00 Hz
 Delay Time: 0.000 - 600 Sec.
 Time Accuracy: ±0.5% or +1 cyc / -0 cyc
 (Min. trip time affected by min. 3 cyc security count)

GENERAL PURPOSE LOGIC TIMERS (62, 162)

Mode: PU/DO
 1 Shot, Non-Retrig.
 1 Shot, Retriggering
 Integrating
 Latch
 T1 and T2 Delay Time: 0.000 - 9999 Sec.
 Time Accuracy: ±0.5% or ±¼ cyc

RECLOSER (79)

Mode: Power up to close,
 Power up to lockout
 Reclose Shots: 0 - 4
 Reclose, Reset, Fail,
 Max. Cycle Timers: 0.100 - 600 Sec.
 Time Accuracy: ±0.5% or
 +1¼ cyc/-0 cyc

CURRENT PICKUP ACCURACY (All 50 and 51)

Phase and Ground: 5A 2% or 50mA
 1A 2% or 10mA
 Neutral and Negative 5A 3% or 75mA
 Sequence: 1A 3% or 75mA

VOLTAGE PICKUP ACCURACY (All 27, 47 and 59)

Phase (V_{LL} or V_{LN}): ±2% or ±0.5V
 Phase 3V0 and V2: ±2% or ±0.5V

DEFINITE TIME ACCURACY UNLESS OTHERWISE STATED (All 27, 47 and 59)

Definite Time Accuracy: ±0.5% or ±1 cyc

SETTING GROUPS

Setting Groups: 4
 Control Modes: Automatic:CLP;
 Recloser shot;
 Dynamic load or unbalance
 External: Discrete input logic;
 Binary: Input Logic

METERING

Current Range: 5A 0.5 to 15.0
 1A 0.1 to 3.0
 Current Accuracy: ±1%
 Phase Voltage Range: 3W 0 - 300 V_{LL}
 4W 0 - 300 V_{LL}
 Phase Voltage Accuracy: ±0.5% for
 50V < V_{LL} < 300V
 Watt/VAR: 5A 0 to ±7500
 1A 0 to ±1500
 Watt Accuracy: 1% @ Unity PF
 VAR Accuracy: 1% @ Zero PF
 Energy: 0 to ±1.0E12
 (F/R registers)
 Frequency: 10 - 75Hz
 Frequency Accuracy: 0.01Hz

DEMANDS (IA, IB, IC, IN, IQ, Fwd Watts, Rvs Watts, Fwd VARs, Rvs VARs)

Demand Interval: 1 - 60 min.
 Demand Mode: Thermal

BREAKER MONITORING

Duty Mode: I or I²
 Duty Alarm Range: 0 - to 100%
 Op Counter Alarm Range: 0 - 99999
 Trip Time Alarm Range: 20 - 1000mSec

ORDERING

SAMPLE STYLE NUMBER

The style number identification chart defines the electrical characteristics and operation features included in BE1-951 relays. For example, if the style number were BE1-951 **E3N1H0Y**, the device would have the following:

- BE1-951
- (E)** - 5 Amp nominal system with 5 Amp Independent Ground Input
 - (3)** - Three phase voltage sensing
 - (N)** - Not applicable
 - (1)** - 48/125Vac/Vdc power supply
 - (H)** - Half Rack Case
 - (0)** - ASCII Communications
 - (Y)** - 4000 point Load Profile Demand Log

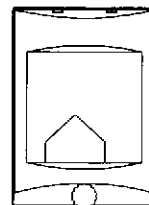


Figure 7A
Cover option A.

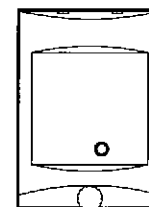
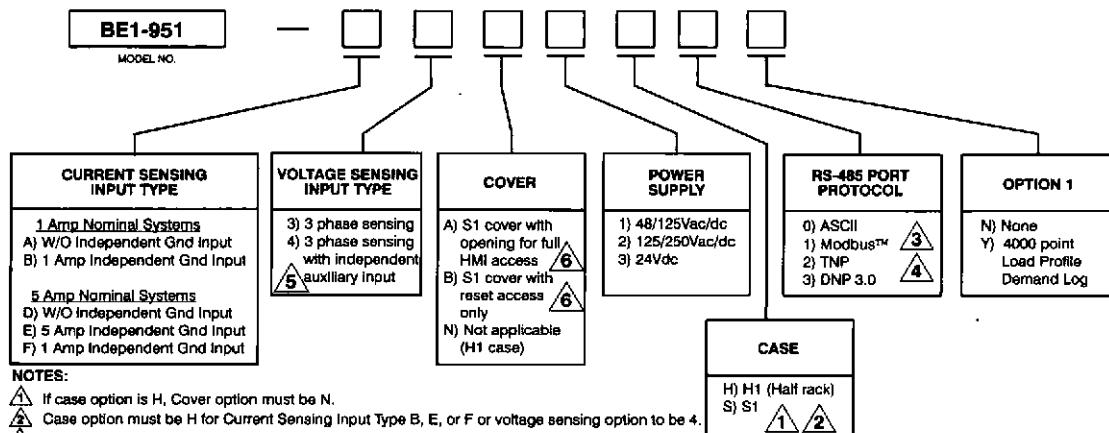


Figure 7B
Cover option B.



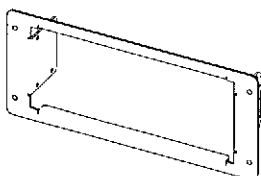
NOTES:

- ⚠ If case option is H, Cover option must be N.
- ⚠ Case option must be H for Current Sensing Input Type B, E, or F or voltage sensing option to be 4.
- ⚠ ASCII communication is standard on Com0 (front RS-232) and Com1 (rear RS-232) ports.
- ⚠ Consult your Basler Representative for availability of other protocol options.
- ⚠ Aux VT input adds 25 Sync Check option.
- ⚠ See Figures 7A and 7B.

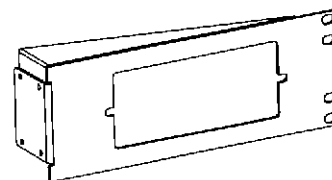
STANDARD ACCESSORIES

- 9180400110 Multifunction Relay S1 Test Case
- 9180400108 H1 Test Case with 1 CT Terminal Block and 18-position Bottom Terminal Block
- 9108551021 Adapter plate to mount an S1 case in a GE S2 or Westinghouse FT-21 cutout.
- 9108550122 Adapter plate to mount an S1 case in a Westinghouse FT-32 cutout.
- 9239922100 Test box to facilitate bench testing.

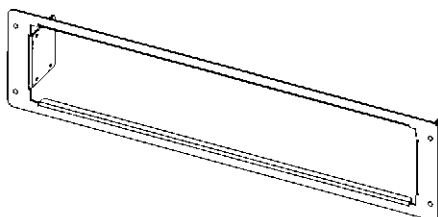
9289900017
Escutcheon plate to panel mount one H1 relay.



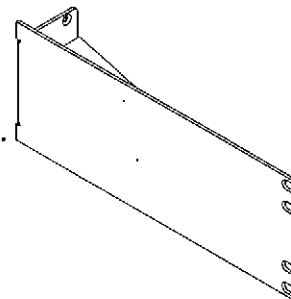
9289929100
Adapter bracket with cutout for ABB FT test switch, to mount a single H1 case in a 19" rack.

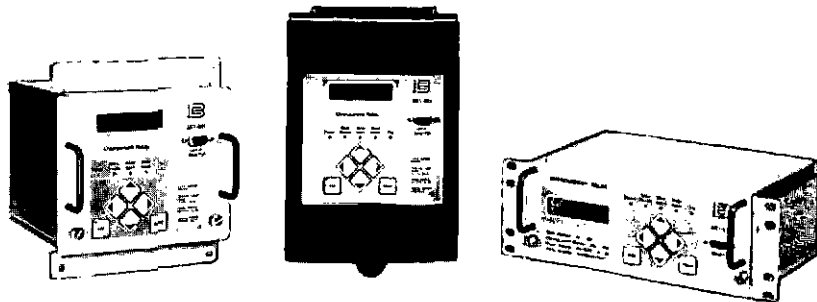


9289900016
Escutcheon plate to panel mount two dovetailed H1 relays.



9289924100
Adapter bracket to mount single H1 case in 19" rack.





BE1-851 OVERCURRENT PROTECTION SYSTEM

The BE1-851 is a multifunction, numerical relay that provides three phase, ground, and negative sequence overcurrent protection with four shot recloser, breaker failure, breaker monitoring, control, and metering functions in an integrated system.

ADVANTAGES

- Allows the user to select the optimal response characteristic separately for phase and ground elements. Choose between fundamental, RMS, or average sensing algorithms.
- BESTlogic provides the user with complete flexibility in configuring a protection and control system. User programmable variable and switch names make these relays completely self documenting.
- Programmable LCD display allows the relay to replace local indication and control functions, such as panel metering, alarm annunciation, and control switches.
- Three independent communication ports with protocol support allows integration with distributed control systems.
- Available in three case configurations to provide cost saving in any installation. All three are fully drawout and fit cutout, drilling and behind panel projection dimensions for common Basler Electric, GE, and Westinghouse overcurrent relays. One includes test paddle for testing in case.

FEATURES Pages 2 and 3
APPLICATIONS Page 3
FUNCTIONAL DESCRIPTION Pages 4-7
BESTlogic Pages 8 and 9
SPECIFICATIONS Pages 10 and 11
ORDERING INFORMATION Page 12

WINDOWS® SOFTWARE

Interface for setting and communicating with Basler protection products
Request BESTCOMS™ for BE1-851

ADDITIONAL INFORMATION

INSTRUCTION MANUAL
Request publication 9289900990

MODBUS™ INSTRUCTION MANUAL
Request publication 9289900992

TIMING CURVES
Request publication 9252000999

DNP® 3.0 INSTRUCTION MANUAL
Request publication 9289900995

B Basler Electric

P. O. BOX 269 HIGHLAND, ILLINOIS, U.S.A. 62249 PHONE 618-654-2341 FAX 618-654-2351

UHM-7
8-01

FEATURES

PROTECTION

- Sensing Input Type G
 - Phase and Neutral Instantaneous Overcurrent elements with settable time delay: 50TP, 150TP, 50TN, 150TN, 250TN, 350TN
 - Phase and Neutral Time Overcurrent elements: 51P, 51N, 151N
- Sensing Input Type H
 - Phase, Neutral, and Negative Sequence Instantaneous Overcurrent elements with settable time delay: 50TP, 150TP, 50TN, 150TN, 50TQ, 150TQ
 - Phase, Neutral, and Negative Sequence Time Overcurrent elements: 51P, 51N, 51Q
- All U.S. and IEC timing curves plus user programmable curve
- Responds to either Average AC, Fundamental, or Wide band RMS to 7th harmonic
- Minimizes transient overreach and overtravel on overcurrent elements
- Separate ground current input
- Breaker Failure protection function: BF
- Two general purpose logic timers: 62, 162
- Programmable Logic using BESTlogic
- Four protection setting groups with external or automatic (cold load pickup, load, unbalance, recloser shot) selection modes

CONTROL

- Four shot recloser with zone sequence coordination and sequence controlled protective element blocking functions
- Virtual breaker control switch—controllable from both HMI and com. ports: 101
- Four virtual selector switches—controllable from both HMI and com. ports: 43, 143, 243, 343

INSTRUMENTATION

- Real time A, B, C phase, neutral, and negative sequence currents
- 1% meter accuracy down to 10% of nominal current

REPORTS

- Current demands for phase, neutral, and negative sequence currents—magnitudes and time stamps are recorded for today's peak, yesterday's peak, and peak since reset
- Breaker operations counter and contact interruption duty

FAULT RECORDING

- 255 event sequence of events report with I/O and alarm sub-reports
- Fault Reporting; 1 or 2 oscillography records per fault report

- Fault summary reports; two most recent Fault Summary Records saved to non-volatile memory
- 16 fault records, 15 cycles long @ 24 samples/cycle
- COMTRADE format

COMMUNICATION PORTS

- Three independent general purpose communication ports
 - Front RS-232 ASCII communications
 - Rear RS-232 ASCII communications
 - Rear RS-485 ASCII, Modbus™, DNP or other common protocols
- IRIG-B time sync (unmodulated)

SELF TEST AND ALARM FUNCTIONS

- Relay fail, major alarm, and minor alarm LEDs, and fail-safe alarm output contact
- Extensive internal diagnostics monitor all internal functions of the relay
- More than 20 additional alarm points—programmable for major or minor priority Including:
 - Reclose fail and lockout
 - Phase demand overload alarm
 - Neutral and negative sequence unbalance demand alarms
 - Three breaker alarm points—programmable for slow trip, interruption duty threshold, or operations counter
 - Trip circuit voltage and continuity monitor
 - Close circuit monitor via BESTlogic

PROGRAMMABLE I/O

- Four programmable inputs
- Five programmable outputs and one dedicated programmable alarm output

HARDWARE FEATURES

- Three configurations, all full drawout
 - S1:Basler/GE style (testable in case)
 - H1:Half-rack
 - F1:Westinghouse FT11 size
- Active CT technology for low burden and increased dynamic range
- Flash Memory for upgrading embedded programming without changing chips
- Integral HMI with 2x16 character display
- Wide range ac/dc power supply options provide long hold up time to ride through dips on ac power source. (100 ms with 4 output relays energized, upon complete loss of source. Starting voltage 125Vac for Option 1 (48/125Vac/dc) and 250Vac for Option 2 (125/250Vac/dc))

FEATURES, continued

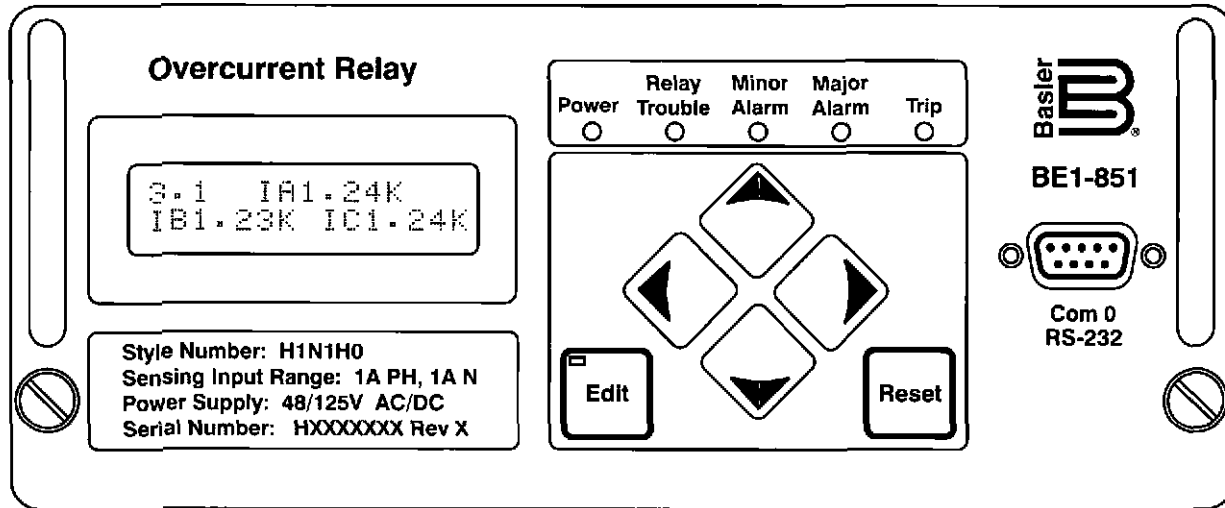


Figure 1 - Advanced HMI (Human Machine Interface)
H1 Half Rack Front panel shown

APPLICATIONS

The BE1-851 Overcurrent Protection System provides three phase, ground, and negative sequence overcurrent protection and is intended for use in any non-directional overcurrent protection application. Its unique capabilities make it ideally suited for applications with the following requirements:

- Applications that require low burden to extend the linear range of CTs.
- Applications that require the flexibility provided by wide setting ranges, multiple setting groups, and multiple coordination curves in one unit.
- Applications that require the economy and space savings provided by a multifunction, multiphase unit. This one unit can provide all of the protection, as well as local and remote indication, metering, and control functions required on a typical circuit.
- Applications that require communication capability.
- Applications that require specific current response characteristics.
 - The fundamental digital signal processing (DSP) algorithm provides rejection of harmonics and low transient overreach.
 - The RMS DSP algorithm provides true wide band RMS measurement.
 - The average DSP algorithm provides a flat response characteristic over a wide frequency range.
- Applications where the optional case configurations facilitate modernizing protection and control systems in existing substations. One electromechanical overcurrent or reclosing relay can be replaced by a BE1-851 relay. The remaining relays can be removed or left in service as backup.
- Applications where the capabilities of a digital multifunction relay are required, yet test paddles and/or drawout construction are also required.
- Applications where bus protection is provided by a high speed bus overcurrent blocking scheme instead of a dedicated bus differential circuit.
- Applications where the capabilities of intelligent electronic devices (IEDs) are used to decrease relay and breaker maintenance costs.

FUNCTIONAL DESCRIPTION

The BE1-851 is a multifunction, numerical relay that provides a comprehensive mix of protective, control and metering functions in an integrated system. This system is suitable for any nondirectional overcurrent application including feeder applications, generator applications, cogeneration applications, and transformer backup.

The BE1-851 has the unique ability to provide specific current response characteristics. It does this in three different ways:

- The Fundamental twenty-four sample per cycle Digital Signal Processing (DSP) algorithm provides rejection of harmonics and low transient overreach.
- The RMS DSP algorithm provides true wide band RMS measurement.
- The Average DSP algorithm provides a flat response characteristic over a wide frequency range.

These characteristics are independently settable for phase and neutral quantities.

The unit has one set of three phase and neutral current sensing inputs to provide all common protective functions for substation and feeder applications. Selection of sensing input Type G offers additional application flexibility by providing the Protection Engineer with three additional ground currents in lieu of the negative sequence function.

The half rack case is fully drawout with current circuit shorting provisions. Two Basler Electric half rack IEDs (Intelligent Electronic Devices) such as primary and backup BE1-851 or the BE1-951 or BE1-GPS100 can be dovetailed together to mount in a standard 19" equipment rack with no special mounting hardware.

The S1 and F1 cases allow savings in modernizing existing facilities. One overcurrent or reclosing relay can be removed from the panel and replaced with a state-of-the-art communicating multifunction relay. Remaining relays can be removed or left in place for backup. Available adapter plates broaden the types of relays that can be readily replaced with no panel cutting.

Three independent communications ports, along with built-in support for Modbus™ and other common protocols, provide easy access to integrating the protection, control, metering, and status monitoring

functions into a substation automation system. The standard IRIG-B port provides time synchronization from a master clock.

Real time metering provides amp and unbalance loading telemetry for the protected circuit. Contact sensing inputs and alarm monitoring functions provide real time status information. Remote control is provided by virtual control and selector switches with select-before-operate control of programmable outputs.

BESTlogic

BESTlogic programmable logic provides the user with high flexibility in configuring a protection and control system.

Each of the protection and control functions in the BE1-851 is implemented as an independent function block that is equivalent to its single function, discrete device counterpart. Each independent function block has all the inputs and outputs that the discrete component counterpart might have. Figures 6A and 6B show each of the independent function blocks available for use in the BE1-851. Programming BESTlogic is equivalent to choosing the devices required by your protection and control scheme and drawing schematic diagrams to connect the inputs and outputs to obtain the desired operational logic.

The BE1-851 relay can store, as user settings, one user programmable, custom logic scheme. To save you time, several preprogrammed logic schemes have also been provided. Any of the preprogrammed schemes may be copied into the logic settings without making any additional BESTlogic settings.

BESTlogic provides the protection engineer with the flexibility to set up this powerful multifunction system with the same freedom that was once enjoyed with single function, discrete devices. It is no longer necessary to compromise your standard protection and operating practices to deal with the limitations in programmability of previous multifunction devices.

Figures 2A, 2B, 2C, and 3 show typical external connections, and Figures 5A, 5B and 5C show rear panel connections.

FUNCTIONAL DESCRIPTION, continued

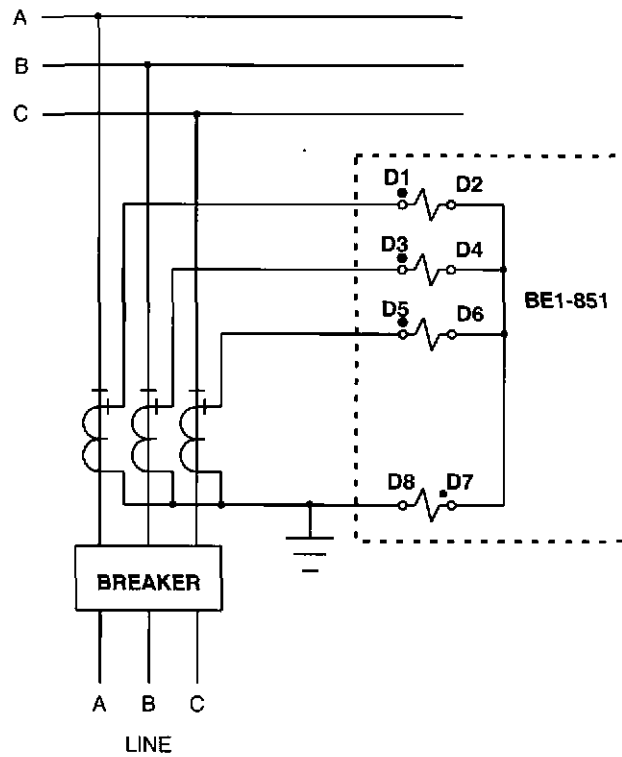


Figure 2A - Typical External Sensing Connections - Feeder Breaker Application

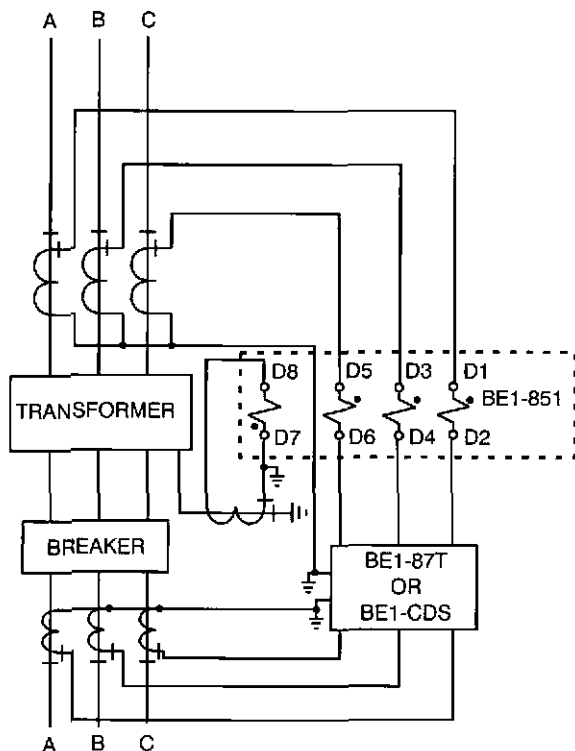


Figure 2B - Typical External Sensing Connections - Transformer Backup Application

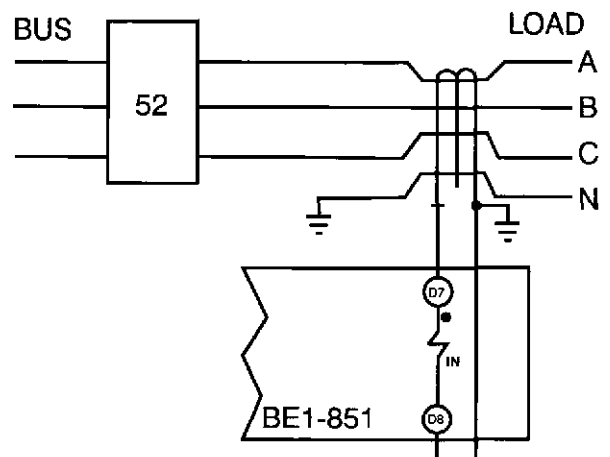


Figure 2C - Alternate Connections for I_N

FUNCTIONAL DESCRIPTION, continued

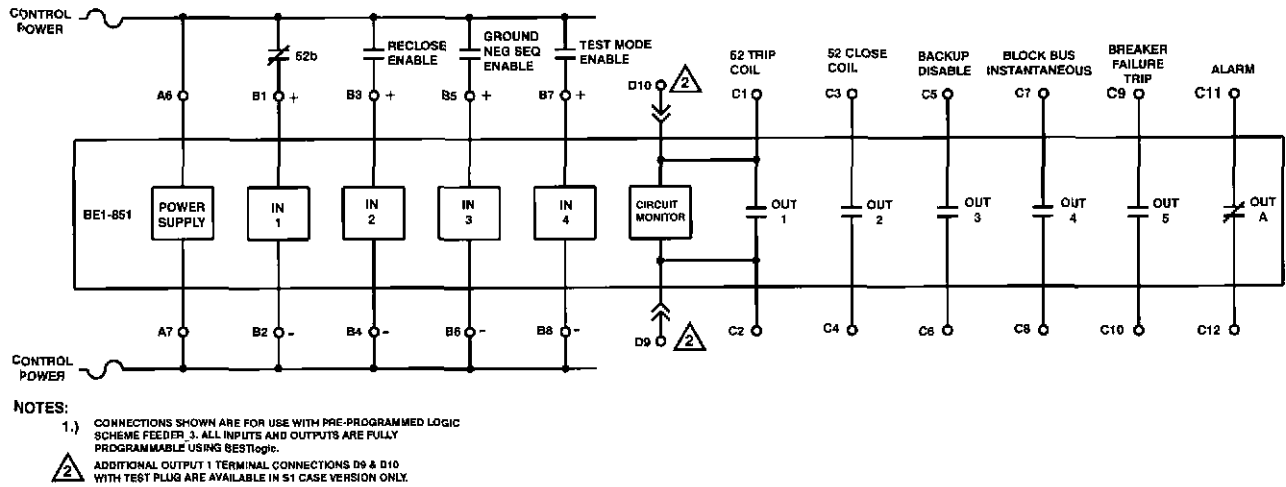
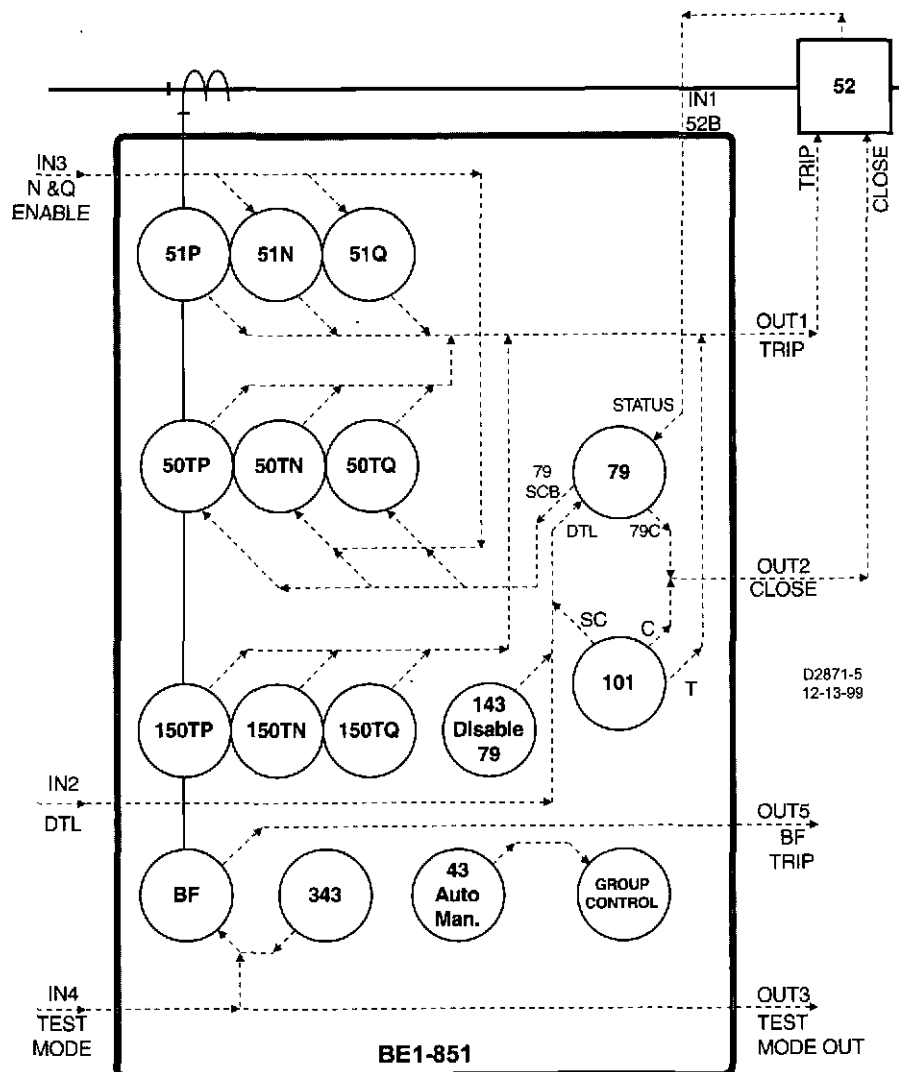


Figure 3 - Typical External Connections



Based upon pre-programmed logic FEEDER_3.
Not all available protection and control functions are shown.

Figure 4 - Typical Application Single Line

FUNCTIONAL DESCRIPTION, continued

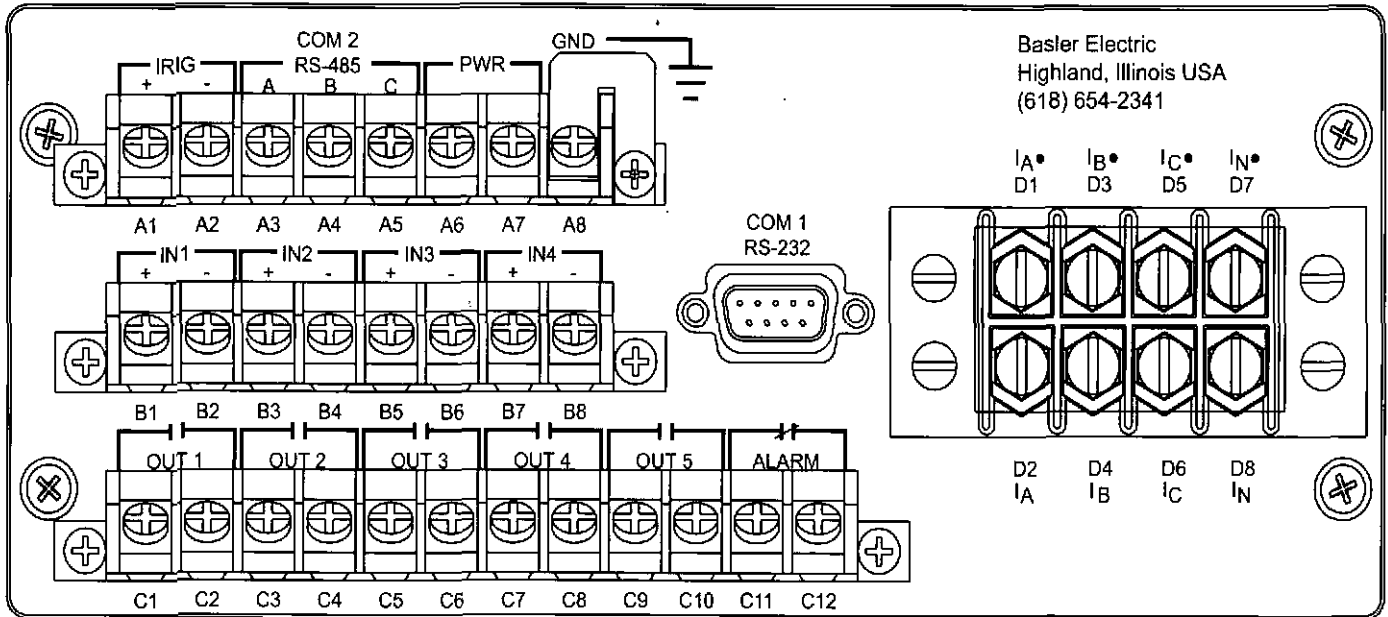
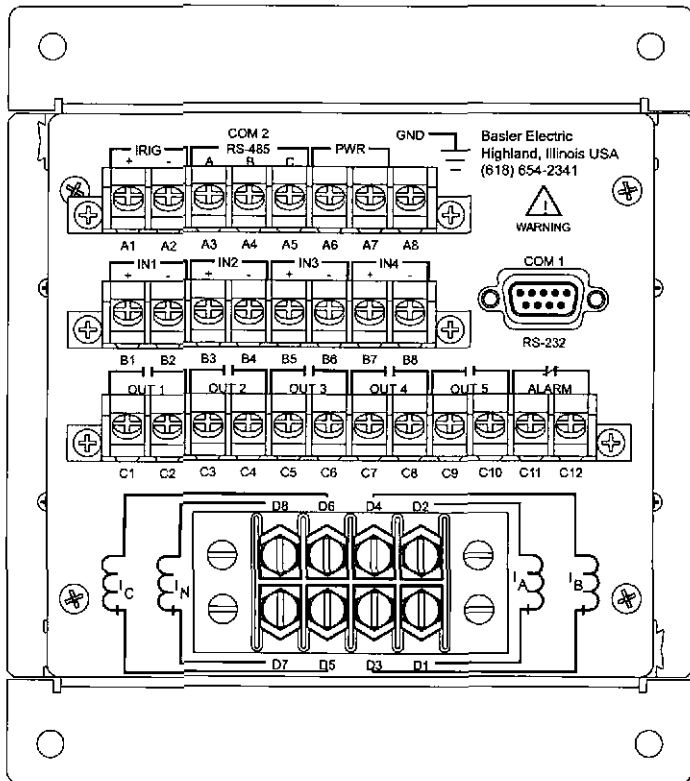
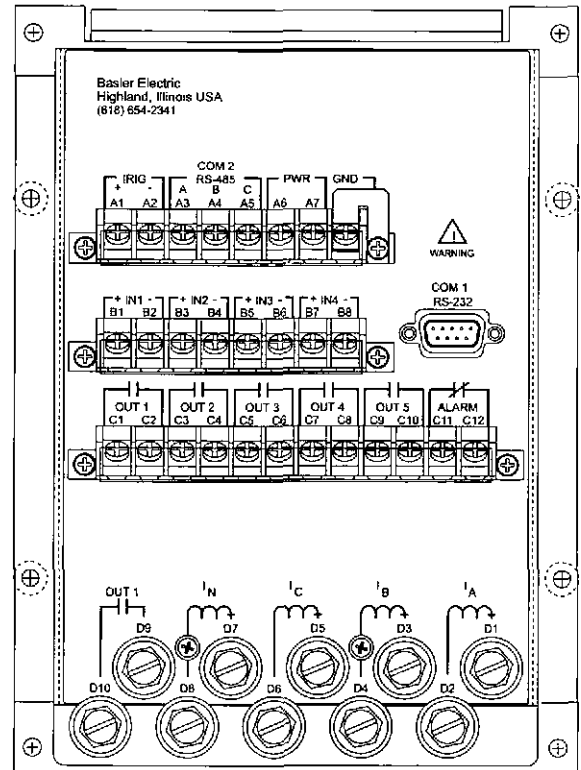


Figure 5A - BE1-851 H1 Rear Panel Connections



D2585-06
3-13-97



D2585-03
4-10-97

Figure 5B - BE1-851 F1 Rear Panel Connections

Figure 5C - BE1-851 S1 Rear Panel Connections

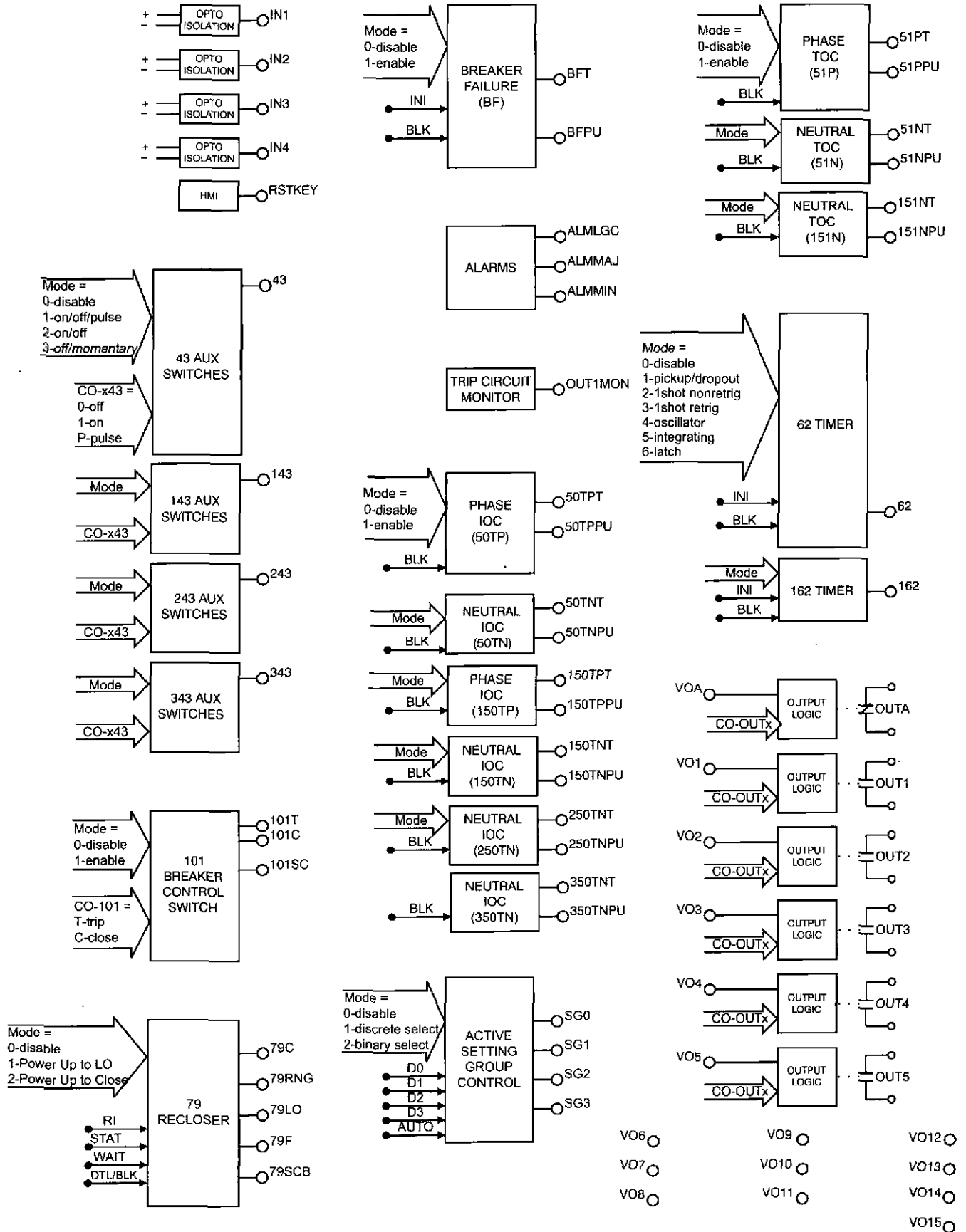


Figure 6A - BESTlogic Sensing Input Type G Function Blocks

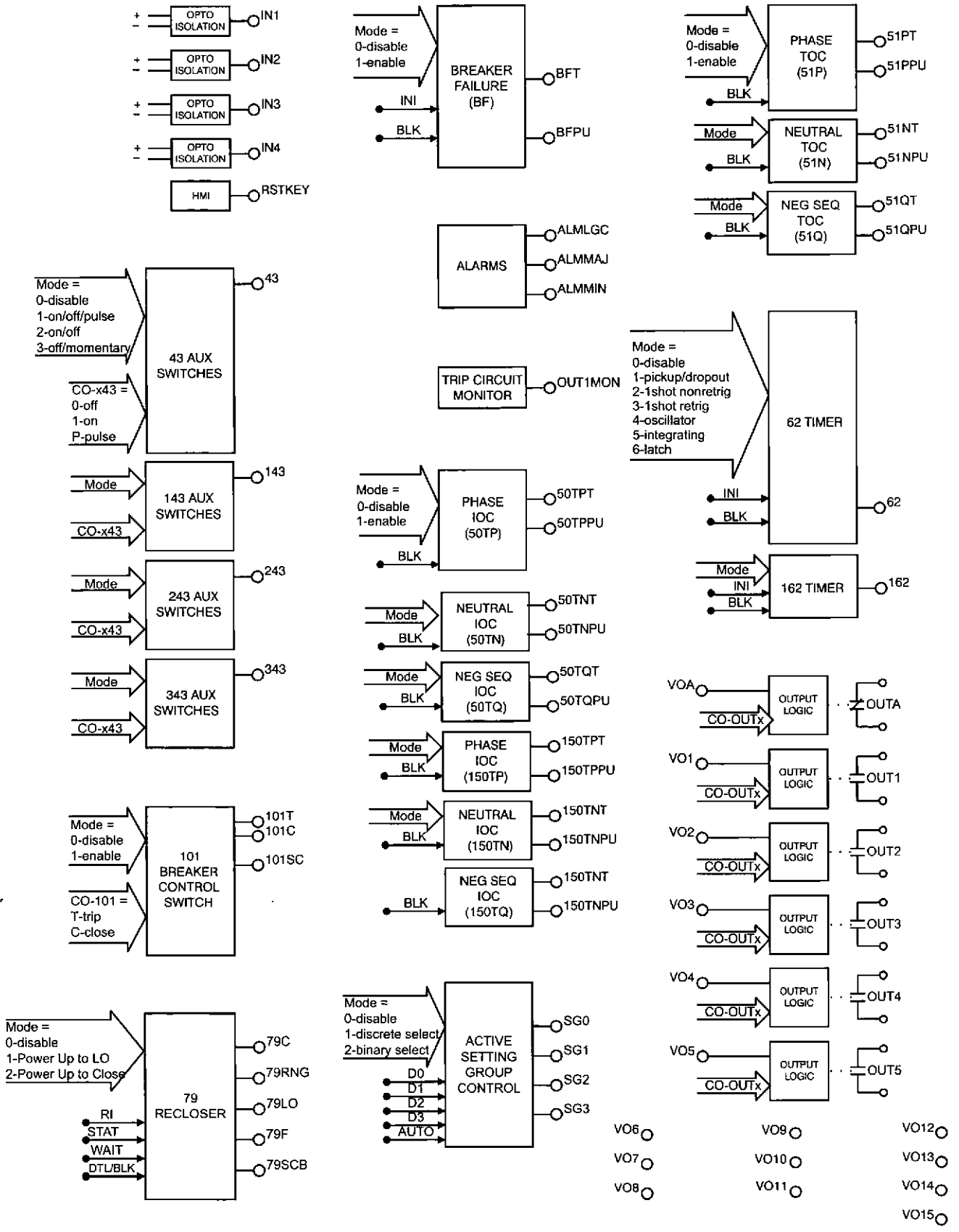


Figure 6B - BESTlogic Sensing Input Type H Function Blocks

GENERAL SPECIFICATIONS

5 Amp CURRENT INPUTS

Continuous: 20 Amps
 One Sec. Rating: 400 Amps
 Saturation limit: 150 Amps
 Max. Burden: <10 milliohms

1 Amp CURRENT INPUTS

Continuous: 4 Amps
 One Sec. rating: 250 Amps
 Saturation limit: 30 Amps
 Max. Burden: <22 milliohms

A/D CONVERTERS

Sampling Rate: 24/cycle

POWER SUPPLY

Option 1: DC Range 35-150V
 AC Range 55-135V
 Option 2: DC Range 90-300V
 AC Range 90-270V
 Option 3: DC Range 17-32V
 Burden: 6 W continuous, 8 W maximum
 with all outputs energized

OUTPUT CONTACTS

Make and carry: 30A (0.2sec)
 Continuous: 7A
 Break: 0.3A DC (L/R=0.04)
 @ 125Vdc or 250Vdc

CONTROL INPUTS

Wetting Voltage Max.: Same as control power
 supply option.

Nominal Turn On/Off Voltage:
 P.S. Option 1: 33Vdc
 P.S. Option 2: 83Vdc
 P.S. Option 3: 16Vdc

Control inputs recognize both DC and AC voltages.

Burden: P.S. Option 1: 36K Ω
 P.S. Option 2: 94K Ω
 P.S. Option 3: 15K Ω

COMMUNICATION PORTS

Response Time: <100mSec for metering and
 control functions
 Baud Rate: 300-19200

ELECTRICAL ENVIRONMENT

- IEEE C37.90-1989 Standard for Relays and Relay Systems Associated with Electric Power Apparatus
- IEC 255-5 Insulation Test for Electrical Relays Impulse and Dielectric Strength (2000Vac at 50/60Hz)
- IEEE C37.90.1-1989 Standard Surge Withstand Capability Tests for Relays and Relay Systems Associated with Electric Power Apparatus
- IEC 255-22-1 1MHz Burst Disturbance Tests for Electrical Disturbance Tests for Measuring Relays and Protection Equipment
- EN 61000-4-4 Electrical Fast Transient/Burst Immunity Test
- EN 61000-4-3 Radiated, Radio-frequency, Electromagnetic Field Immunity Test
- Type tested using a 5-watt, hand-held transceiver in the ranges of 144 and 440MHz with the antenna placed within 6 inches of the relay.
- IEEE C37.90.3 (Jan. 01) Draft Standard Electrostatic Discharge Tests for Protective Relays
- EN 61000-4-2 Electrostatic Discharge Immunity Test

MECHANICAL ENVIRONMENT

- Operating temperature range: -40°C to 70°C* (-40°F to 158°F)
 *LCD Display is inoperative below -20°C.
- Storage temperature range: -40°C to 70°C (-40°F to 158°F)
- Humidity: Qualified to IEC 68-2-38, 1st Edition 1974, Basic Environmental Test Procedures, Part 2: Test Z/AD: Composite Temperature Humidity Cyclic Test
- Vibration: 2g at 10 to 500Hz
- Shock: 15g drop test

CERTIFICATIONS

UL Recognized, File E97033
 CSA Certified, File LR23131-140S
 (Patent #5309312: Overcurrent Protection Relay With Communications)
 DNP 3.0 IED Certified, Subset Level 2, 6/20/00,
 by SUBNET Solutions, Inc.

CASE SIZE

F1: 6.376"W x 7.25"H x 8.15"D
 H1: 10.50"W x 3.47"H x 9.10"D with mounting
 flanges (8.5"W without mounting flanges)
 S1: 6.65"W x 9.32"H x 8.38"D

SHIPPING WEIGHT

F1: Approx. 11 pounds
 H1: Approx. 10 pounds
 S1: Approx. 16 pounds

WARRANTY

7 years

PERFORMANCE SPECIFICATIONS

INSTANTANEOUS OVERCURRENT WITH SETTABLE DELAY (50TP, 150TP, 50TN, 150TN, 50TQ, 150TQ)

Pickup: 5A CT: 0.5-150.0A
 1A CT: 0.1-30.0A
 PU time with TD=0.000 Sec
 1¼ cyc for P&N @ 5 x PU
 2¼ cyc for Q @ 5 x PU
 Delay time: 0.000 - 60 sec
 Time Accuracy: ±0.5% or ±¼ cyc for P&N
 ±0.5% or ±1 cyc for Q

TIME OVERCURRENT (51P, 51N, 51Q)

Pickup: 5A CT: 0.50-16.0A
 1A CT: 0.10-3.20A
 Time Dial: TD=K=0 - 99 for 46 curve
 TD=0.0 - 9.9 for all other curves
 Time-Current Characteristics:
 The following expression describes the inverse time current characteristic for each curve:

$$T_T = \frac{AD}{M^{N \cdot C}} + BD + K = \text{Time to trip}$$

$$T_R = \frac{RD}{M^{2-1}} = \text{Time for decaying reset}$$

where D = Time dial, M = Multiple of PU and A, B, C, N, K and R are constants that govern the shape of each curve. The protection engineer can set the constants for the P (programmable) curve to achieve virtually any characteristic.

BREAKER FAILURE (BF)

Time: 50-999 mSec
 Dropout: 5A CT: 0.5A
 1A CT: 0.1A
 Time Accuracy: ±0.5% or +1¼ cyc/ -¼ cyc

GENERAL PURPOSE LOGIC TIMERS (62, 162)

Mode: PU.DO
 1 Shot, Non-Retrig.
 1 Shot, Retrig.
 Integrating
 Latch
 T1 and T2 Delay Time: 0.000 - 9999 sec.
 Time Accuracy: ±0.5% or ±½ cyc

RECLOSER (79)

Mode: Power up to close
 Power up to lockout
 Reclose Shots: 0 - 4
 Reclose, Reset, Fail,
 Max. Cycle Timers: 0.100 - 600 sec.
 Time Accuracy: ±0.5% or +1¾ cyc/ -0 cyc

Curve Type	Constants					
	A	B	C	N	K	R
S1	0.2663	0.03393	1.000	1.2969	0.028	0.5000
S2	0.0286	0.02080	1.000	0.9844	0.028	0.0940
L1	5.6143	2.18592	1.000	1.000	0.028	15.750
L2	2.3955	0.00000	1.000	0.3125	0.028	7.8001
D	0.4797	0.21359	1.000	1.5625	0.028	0.8750
M	0.3022	0.12840	1.000	0.5000	0.028	1.7500
I1	8.9341	0.17966	1.000	2.0938	0.028	9.0000
I2	0.2747	0.1042	1.000	0.4375	0.028	0.8868
V1	5.4678	0.10814	1.000	2.0469	0.028	5.5000
V2	4.4309	0.0991	1.000	1.9531	0.028	5.8231
E1	7.7624	0.02758	1.000	2.0938	0.028	7.7500
E2	4.9883	0.0129	1.000	2.0469	0.028	4.7742
A	0.01414	0.00000	1.000	0.0200	0.028	2.0000
B	1.4636	0.00000	1.000	1.0469	0.028	3.2500
C	8.2506	0.00000	1.000	2.0469	0.028	8.0000
G	12.1212	0.00000	1.000	1.000	0.028	29.000
F	0.0000	1.00000	0.000	0.0000	0.028	1.0000
P	0 to 600	0 to 25	0 to 1	.5 to 2.5	0.028	0 to 30

S1, S2 = CO Short Inv, IAC Short Inv
 L1, L2 = CO Long Inv, IAC Long Inv
 D = CO Definite Time
 M = CO Moderately Inverse
 I1, I2 = CO Inverse, IAC Inverse
 V1, V2 = CO Very Inv, IAC Very Inv
 E1, E2 = CO Ext Inverse, IAC Ext. Inverse
 A = IEC Standard Inverse
 B = IEC Very Inverse
 C = IEC Extremely Inverse
 G = IEC Long Time Inverse
 F = Fixed Time
 P = Programmable

CURRENT PICKUP ACCURACY

Phase and Neutral: 5A: 2% or 50mA
 1A: 2% or 10mA
 Negative Sequence: 5A: 3% or 75mA
 1A: 3% or 75mA

SETTING GROUPS

Setting Groups: 4
 Control Modes: Automatic: CLP; Dynamic load or unbalance; External: Discrete input logic; Binary Input Logic

METERING

Current Range: 5A: 0.5 to 15.0
 1A: 0.1 to 3.0
 Current Accuracy: ±1%

DEMANDS (IA, IB, IC, IN, IQ)

Demand Interval: 1 - 60 min.
 Demand Mode: Thermal

BREAKER MONITORING

Duty Mode: I or I²
 Duty Alarm Range: 0-100%
 Op Counter Alarm Range: 0-99999
 Trip Time Alarm Range: 20-1000 mSec

ORDERING

SAMPLE STYLE NUMBER

The style number identification chart below defines the electrical characteristics and operation features included in the BE1-851 relay. For example, if the style number were **BE1-851 H5N1H0**, the device would have the following:

- BE1-851** Overcurrent Protection System
- (H)** - Three Phase, Neutral, and Negative Sequence Protection
- (5)** - 5 Amp Nominal System with 5 Amp Independent Ground Input
- (N)** - Not applicable
- (1)** - 48/125 Vac/dc Power Supply
- (H)** - Half Rack Drawout Case
- (0)** - ASCII Communications

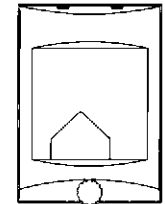
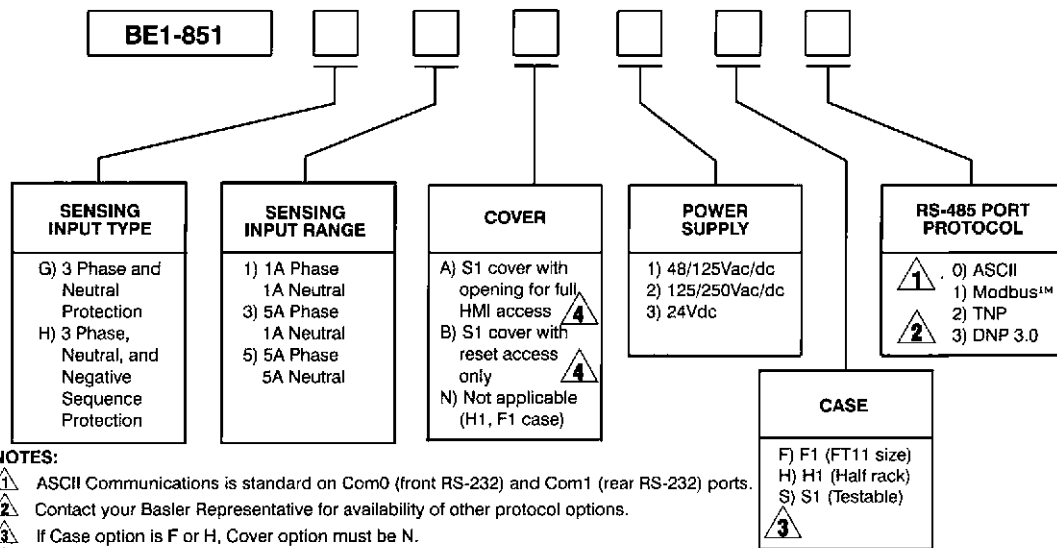


Figure 7A
Cover option A.

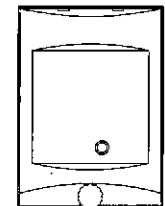


Figure 7B
Cover option B.

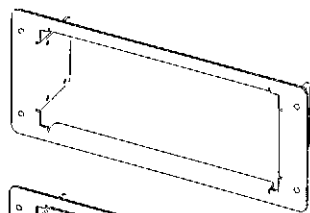
NOTES:

- 1** ASCII Communications is standard on Com0 (front RS-232) and Com1 (rear RS-232) ports.
- 2** Contact your Basler Representative for availability of other protocol options.
- 3** If Case option is F or H, Cover option must be N.
- 4** See Figures 7A and 7B.

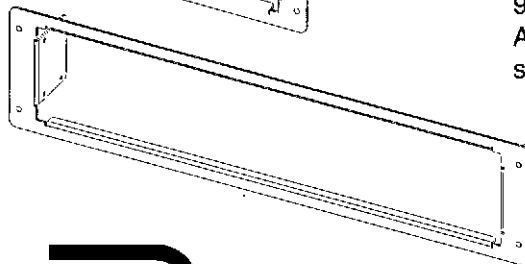
STANDARD ACCESSORIES

- 9180400110 Multifunction Relay S1 Test Case.
- 9180400106 H1 test case with 1 CT Terminal Block and 12-position Bottom Terminal Block.
- 9180400107 F1 test case with 1 CT Terminal Block.
- 9108551021 Adapter plate to mount an S1 case in a GE S2 or Westinghouse FT-21 cutout.
- 9108550122 Adapter plate to mount an S1 case in a Westinghouse FT-32 cutout.
- 9239922100 Test box to facilitate bench testing.

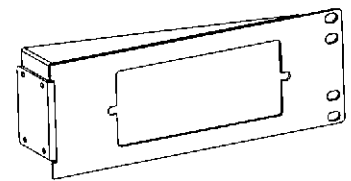
9289900017
Escutcheon plate to panel mount one H1 relay.



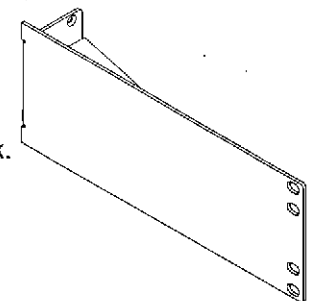
9289900016
Escutcheon plate to panel mount two dovetailed H1 relays.

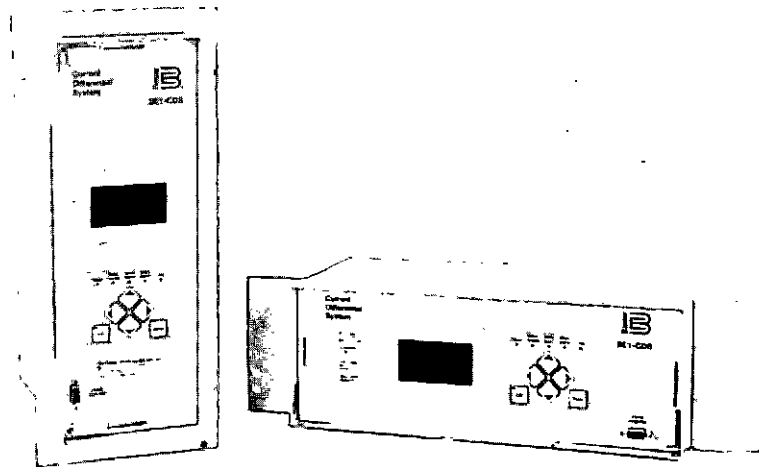


9289929100
Adapter bracket with cutout for ABB FT test switch, to mount a single H1 case in a 19" rack.



9289924100
Adapter bracket to mount single H1 case in 19" rack.





BE1-CDS CURRENT DIFFERENTIAL PROTECTION SYSTEMS

The **BE1-CDS Current Differential Protection Systems** are multifunction, numerical relays that provide percentage restrained differential protection along with overcurrent, breaker failure, control, metering, monitoring, and alarm functions in an integrated system. Available in 3 phase, 2 restraint (CDS220), and 3 phase, 3 restraint (CDS230).

ADVANTAGES

- All versions include harmonic restraint as well as phase shift and tap compensation for use in transformer applications. Detailed current check report provides record of proper CT connections.
- Includes frequency compensation for high accuracy in generator and motor differential applications.
- BESTlogic provides the user with complete flexibility in configuring a protection and control system. User programmable variable and switch names make the CDS relays completely self-documenting.
- Each CT circuit is low burden and isolated to allow improving zones of protection with fewer costly CTs.
- Optional programmable LCD display allows the relay to replace local indication and control functions such as panel metering, alarm annunciation, and control switches.
- Three independent communications ports with protocol support allow integration with distributed control systems.
- The CDS220 is available in horizontal and vertical configurations to provide cost savings in any installation. The CDS220 is fully drawout and fits cutout, drilling, and behind-panel projection dimensions for common Basler Electric, GE, and Westinghouse differential relays.

WINDOWS® SOFTWARE

Interface for setting and communicating with Basler protection products.
Request BESTCOMS for BE1-CDS.

ADDITIONAL INFORMATION

INSTRUCTION MANUAL

Request publication 9313900990

TIMING CURVES

Request publication 9252000999

MODBUS™ INSTRUCTION MANUAL

Request publication 9313900991

DNP® 3.0 INSTRUCTION MANUAL

Request publication 9313900992

FEATURES Pages 2 and 3
APPLICATIONS Page 4
FUNCTIONAL DESCRIPTION Pages 4 - 6
BESTlogic Pages 8 and 9
SPECIFICATIONS Pages 7, 10 - 11
ORDERING INFORMATION Page 12



FEATURES

PROTECTION

- Percentage Restrained Current Differential with harmonic restraint: 87
- Percent Restraint characteristic can be percent of maximum or percent of average through current.
- 2nd Harmonic sharing feature enhances security to transformer inrush.
- Optional Restricted Ground Fault: 87ND (requires optional independent ground input)
- Phase, Neutral, and Negative Sequence Instantaneous Overcurrent elements with settable time delay: 50TP, 150TP, 250TP, 50TN, 150TN, 250TN, 50TQ, 150TQ, 250TQ
- Phase, Neutral, Ground, and Negative Sequence Time Overcurrent elements: 51P, 151P, 251P, 51N, 151N, 251N, 51Q, 151Q, 251Q
- All U.S. and IEC timing curves plus user programmable curve
- Responds to fundamental component of the power system currents
- Minimizes transient overreach and overtravel on overcurrent elements
- Breaker Failure protection function: BF
- Lockout function (Available in CDS230): 86, 186
- Two general purpose logic timers: 62, 162
- Programmable logic using BESTlogic
- Four protection settings groups with external or automatic (cold load pickup, and/or dynamic) selection modes

CONTROL

- Virtual Breaker Control Switch—controllable from both HMI and com. ports: 101
- Eight virtual selector switches—controllable from both HMI and com. ports: 43, 143, 243, 343, 443, 543, 643, 743

INSTRUMENTATION

- Real time A, B, C phase, neutral and negative sequence currents for each 3 phase CT input circuit
- Real time ground current for optional independent ground input
- Real time tap and phase compensated restraint and operate currents for each differential element
- Real time 2nd and 5th harmonic restraint currents for each differential element
- 1% meter accuracy down to 10% nominal current

REPORTS

- Current Demands for phase, neutral and negative sequence for designated CT input—magnitudes and time stamps are recorded for today's peak, yesterday's peak, and peak since

reset (calculation settable for thermal, sliding block average, and block average)

- Optional 4000 point log of demand reading
- Breaker operations counter and contact wear duty
- Transformer through-fault duty statistics

FAULT RECORDING

- 255 event sequence of events report with I/O and alarm sub-reports
- Fault Reporting; 1 or 2 oscillography records per fault report
- Fault summary reports; two most recent Fault Summary Records saved to non-volatile memory
- Total number of fault and oscillography records settable from 6 to 16
- Total of 240 cycles oscillography memory @ 24 samples/cycle
- COMTRADE format
- SER and Fault reporting doubled when Load Profile option is selected

COMMUNICATIONS PORTS

- Three independent general purpose communication ports
 - Front RS-232 ASCII communications
 - Rear RS-232 ASCII communications
 - Rear RS-485 ASCII, Modbus®, or other common protocols
- IRIG-B time sync (unmodulated)

SELF TEST AND ALARM FUNCTIONS

- Relay Fail, major alarm and minor alarm LEDs, and fail-safe alarm output contact
- Extensive internal diagnostics monitor all internal functions of the relay
- More than 20 additional alarm points—programmable for major or minor priority, including:
 - Phase demand overload alarm
 - Neutral and negative sequence unbalance demand alarms
 - Three breaker alarm points—programmable for slow trip, interruption duty threshold, or operations counter
 - Three transformer alarm points—programmable for through fault operations or accumulated through fault duty

SELF TEST AND ALARM FUNCTIONS

- Transformer differential alarm monitors Iop/Ires characteristics to alarm if nearing trip condition on load. Diagnostics provide indication of polarity, phase shift and tap mismatch conditions

FEATURES, continued

SELF TEST AND ALARM FUNCTIONS, continued

- Trip circuit voltage and continuity monitor
- Programmable logic alarms

PROGRAMMABLE I/O

- All current based functions are individually programmable for which CT input circuit is monitored
- Eight programmable contact sensing inputs
- Six programmable outputs and one dedicated programmable alarm output
- Outputs 1 and 6 are high speed (1/4 cycle nominal)
- Output 6 is Form C

HARDWARE FEATURES

- CDS220
 - MX Vert: M1, M2/FT31, FT32 size, fully drawout
 - MX Horiz: panel or 19" rack mount, fully drawout
- CDS230
 - 19" rack mount, non-drawout
- Active CT technology for low burden and increased dynamic range
- Flash Memory for upgrading embedded programming without changing chips
- Optional HMI with Graphic LCD display
- Optional cover (see below)

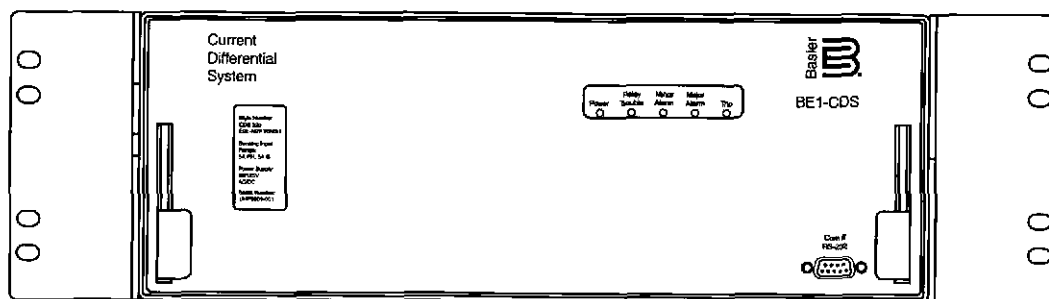
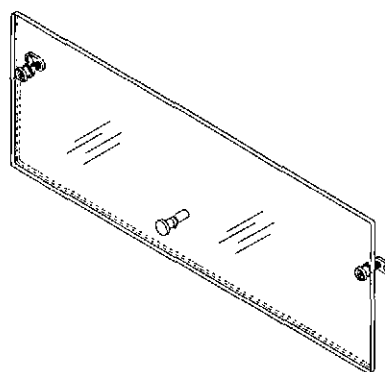


Figure 1 - Standard Front Panel
CDS220 Horizontal Rack Mount version shown

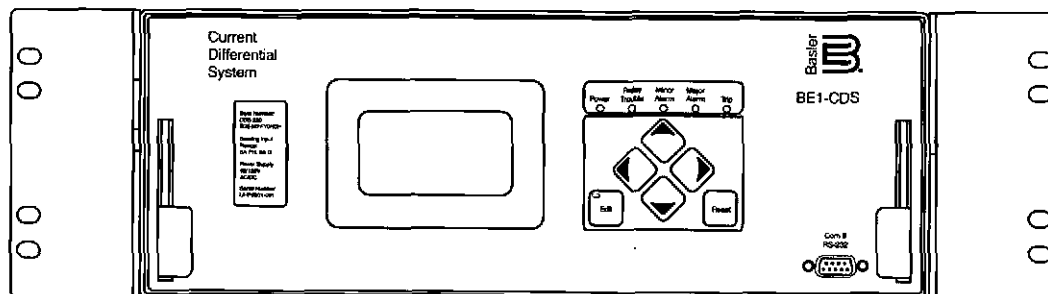


Figure 2 - Optional Advanced HMI (Human Machine Interface)
CDS220 Horizontal Rack Mount version shown

APPLICATIONS

The BE1-CDS Current Differential Protection System provides percentage restrained differential protection along with multiple overcurrent elements and is intended for use in any low impedance current differential protection application including transformer, generator, motor, and bus protection. Its unique capabilities make it ideally suited for applications with the following requirements:

- Applications that require low burden to extend the linear range of CTs.
- Applications where dedicated CTs for the differential are not available. Unlike traditional differential relays, dedicated CT circuits are not required because each CT input is isolated from the others and phase shift compensation can be accomplished internally.
- Applications that require high accuracy across a wide frequency range such as for motor, generator, and generator step-up transformer protection or in cogeneration facilities.
- Applications that require the flexibility provided by wide settings ranges, multiple setting groups, and multiple coordination curves in one unit.
- Applications that require the economy and space savings provided by a multifunction, multiphase unit. This one unit can provide all the protection as well as local and remote indication, metering, and control required on a typical circuit.
- Applications that require harmonic restraint to aid security for the differential.
- Applications that require communication capability and protocol support.
- Applications where the optional case configurations facilitate modernizing protection and control systems in existing substations.
- Applications where the capabilities of a digital multifunction relay are required, yet drawout construction is also desirable.
- Applications where bus protection is provided by a high speed overcurrent blocking scheme on the transformer bus mains instead of dedicated bus differential circuit.
- Applications where the capabilities of intelligent electronic devices (IEDs) are used to decrease relay and equipment maintenance costs.

FUNCTIONAL DESCRIPTION

The BE1-CDS relays use advanced digital signal processing to enhance differential protection. Numerical technology allows this multifunction relay to provide unprecedented flexibility, security, and performance in differential protection.

Numerical design, with **16 bit A/D** precision, **frequency tracking**, **digital filters**, and **active CTs** provides high accuracy and wide dynamic range, resulting in wide settings ranges. The differential protection element can even handle mismatch between current inputs with a **tap adjust range of 10:1**.

The percentage restrained differential element can be set to respond to either percent of **maximum** through current or percent of **average** through current. Maximum restraint is recommended, because it uses information from the best-performing CT to restrain the differential element. The flexibility provided by numerical design allows us to also offer average restraint to emulate the operating characteristic of common electromechanical differential relays.

To improve security from misoperation on false differential caused by CT saturation, the differential protection element includes a **transient monitor** that monitors the restraint and operate currents to detect false differential current caused by CT saturation. The relay then modifies its response to enhance security under this condition.

To improve security from misoperation during inrush in transformer protection applications, the percentage restrained differential element includes **2nd harmonic restraint**. Since the 2nd harmonic component of inrush current may not be equally shared on all three phases, misoperation can occur on a phase with low 2nd harmonic content. Our unique method of **2nd harmonic sharing** improves security by allowing the harmonic restraint elements to respond to the ratio of operate current to the sum of harmonic current measured on all three phases. This is superior to other methods of cross blocking, since each phase element operates independently in its comparison of operating current to harmonic current. Thus, security is en-

FUNCTIONAL DESCRIPTION, continued

hanced without sacrificing dependability, because a faulted phase will not be restrained by inrush on unfaulted phases.

To further enhance security from false tripping on inrush, the operating characteristic responds only to the fundamental component of this highly distorted current – reducing sensitivity to inrush current, yet allowing improved sensitivity to power system faults.

Advanced digital signal processing also provides flexibility for application of differential relays with simpler CT connections. **Phase shift and zero sequence compensation** can be done internally in the relay, eliminating the need for special CT connections. Connecting CTs in wye simplifies CT circuit checkout and reduces burden on the CT circuit itself, reducing the likelihood of misoperation caused by CT saturation. The internal zero sequence compensation can even accommodate additional ground sources such as zig-zag grounding banks within the zone of protection.

With **all CT inputs isolated and low burden**, and the ability to connect all CTs in wye, the need for dedicated CTs for differential protection is eliminated, allowing zones of protection to be improved with fewer CTs required. However, the BE1-CDS can also accept traditional differential CT connections to make retrofit and modernization projects simple.

BESTlogic

BESTlogic programmable logic provides the user with high flexibility in configuring a protection and control system.

Each of the protection and control functions in the BE1-CDS is implemented as an independent function block that is equivalent to its single function, discrete device counterpart. Each independent function block has all the inputs and outputs that the discrete component counterpart might have. Figures 6A and 6B show each of the independent function blocks available for use in the BE1-CDS. Programming BESTlogic is equivalent to choosing the devices required by your protection and control scheme and drawing schematic diagrams to connect the inputs and outputs to obtain the desired operational logic.

The BE1-CDS relay can store, as user settings, one user programmable, custom logic scheme. To save you time, several preprogrammed logic schemes have also been provided. Any of the preprogrammed schemes may be copied into the logic settings without making any additional BESTlogic settings.

BESTlogic provides the protection engineer with the flexibility to set up this powerful multifunction system with the same freedom that was once enjoyed with single function, discrete devices. It is no longer necessary to compromise your standard protection and operating practices to deal with the limitations in programmability of previous multifunction devices.

Figure 5 shows rear panel connections.

FUNCTIONAL DESCRIPTION, continued

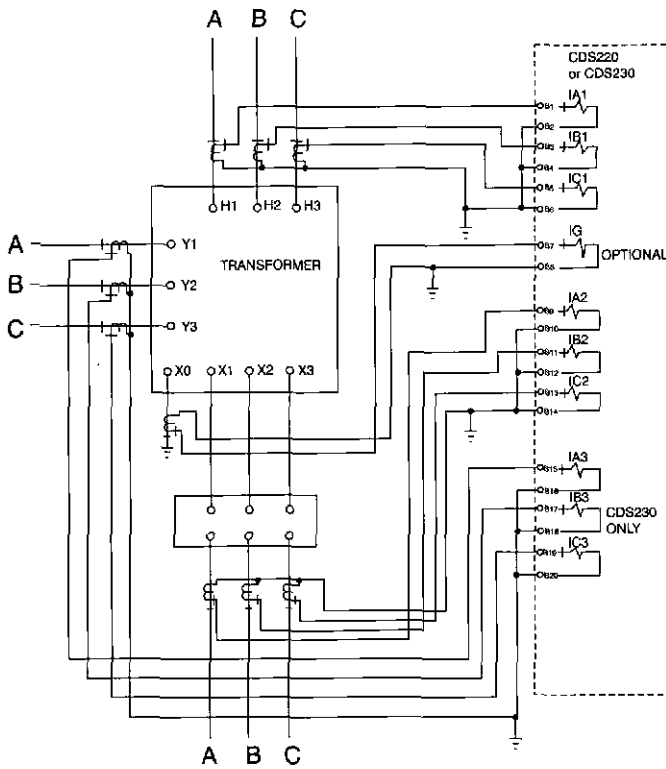
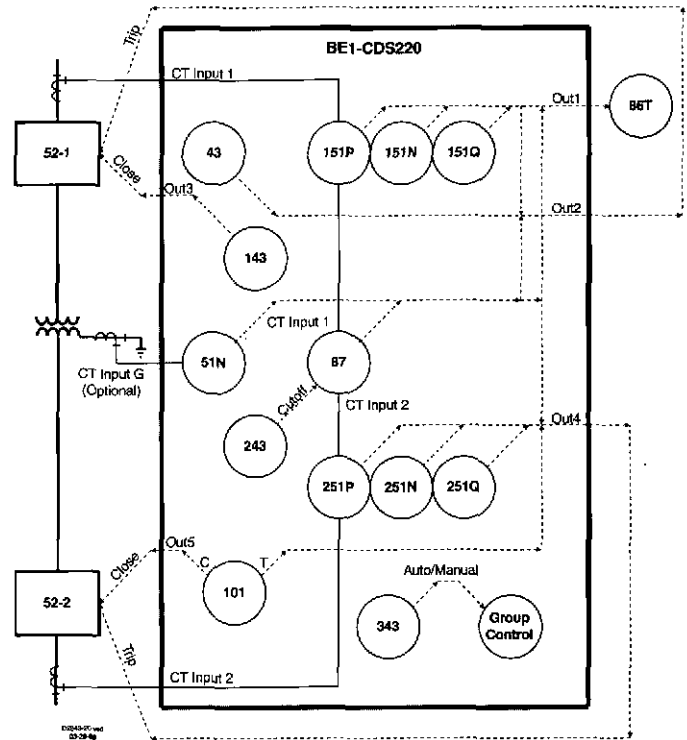


Figure 3 - Typical AC Connections



* Based on preprogrammed logic TX-W-CTL. Not all available protection and control functions are shown.

Figure 4 - Typical Application Single Line

D2690-01

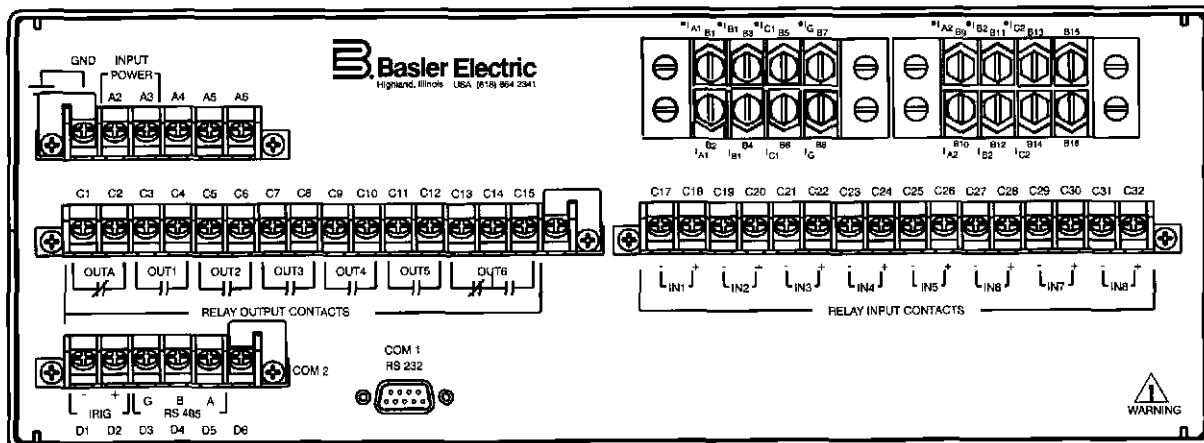


Figure 5 - CDS220 Rear Panel Connections

GENERAL SPECIFICATIONS

5 Amp CURRENT INPUTS

Continuous:	20 Amps
One Sec. Rating:	400 Amps
Saturation limit:	150 Amps
Burden:	<10 milliohms @ 5A

1 Amp CURRENT INPUTS

Continuous:	4 Amps
One Sec. rating:	250 Amps
Saturation limit:	30 Amps
Burden:	<22 milliohms @ 1A

A/D CONVERTERS

Sampling Rate:	144/cycle*
Output of digital filter:	24/cycle*
* Adjusted to input frequency 40-63Hz	

POWER SUPPLY

Option L:	DC Range 17 - 32V
Option Y:	DC Range 35 - 150V AC Range 55 - 135V
Option Z:	DC Range 90 - 300V AC Range 90 - 270V
Burden:	16 Watts

TRIP CONTACTS

Make and carry:	30A (0.2sec)
Continuous:	7A
Break:	0.3A DC (L/R=0.04)

CONTROL INPUTS

Wetting voltage range:	Same as power supply option
PS Option L:	Burden 16kohm Nominal Turnon 16Vdc
PS Option Y:	Low setting burden 37.5Kohm Nominal Turnon 33Vdc High setting burden 95Kohm Nominal Turnon 83Vdc
PS Option Z:	Low setting burden 95Kohm Nominal Turnon 83Vdc High setting burden 190Kohm Nominal Turnon 165Vdc

COMMUNICATION PORTS

Response Time:	<100mSec for metering and control functions
Baud Rate:	300 - 19200
500Vdc in accordance with UL-508	
2000Vac hipot	

ELECTRICAL ENVIRONMENT

- IEEE C37.90-1989 Standard for Relays and Relay Systems Associated with Electric Power Apparatus
- IEC 255-5 Insulation Test for Electrical Relays Impulse and Dielectric Strength (2000Vac at 50/60Hz)
- IEEE C37.90.1-1989 Standard Surge Withstand Capability Tests for Relays and Relay Systems Associated with Electric Power Apparatus
- IEC 255-22-1 1MHz Burst Disturbance Tests for Electrical Disturbance Tests for Measuring Relays and Protection Equipment
- EN 61000-4-4 Electrical Fast Transient/Burst Immunity Test
- EN 61000-4-3 Radiated, Radio-frequency, Electro-magnetic Field Immunity Test
- Type tested using a 5-watt, hand-held transceiver in the ranges of 144 and 440MHz with the antenna placed within 6 inches of the relay.
- IEEE C37.90.3 (Jan. 01) Draft Standard Electrostatic Discharge Tests for Protective Relays
- EN 61000-4-2 Electrostatic Discharge Immunity Test

MECHANICAL ENVIRONMENT

- Operating temperature range: -40°C to 70°C* (-40°F to 158°F)
*LCD Display is inoperative below -20°C.
- Storage temperature range: -40°C to 70°C (-40°F to 158°F)
- Humidity: Qualified to IEC 68-2-38, 1st Edition 1974, Basic Environmental Test Procedures, Part 2: Test Z/AD: Composite Temperature Humidity Cyclic Test
- Qualified to IEC 255-21-1 (Class 1) Vibration Tests for Electrical Relays
- Qualified to IEC 255-22-2 (Class 1) Shock and Bump Tests for Electrical Relays

CERTIFICATIONS

UL Recognized, File E97033
CSA Certified, File LR23131
DNP 3.0 IED Certified, Subset Level 2, 6/20/00,
by SUBNET Solutions, Inc.

CASE SIZE (Vertical unit)

5.40"W x 14.63"H x 8.70"D behind panel
(5.40"W x 14.63"H x 7.70"D alternate mounting)

CASE SIZE (Horizontal unit)

14.63"W x 5.40"H x 8.70"D behind panel
(14.63"W x 5.40"H x 7.70"D alternate mounting)

CASE SIZE (Rack mount)

14.63"W x 5.40"H x 8.70"D without flanges

SHIPPING WEIGHT

Approx. 16.5 pounds

WARRANTY

7 years

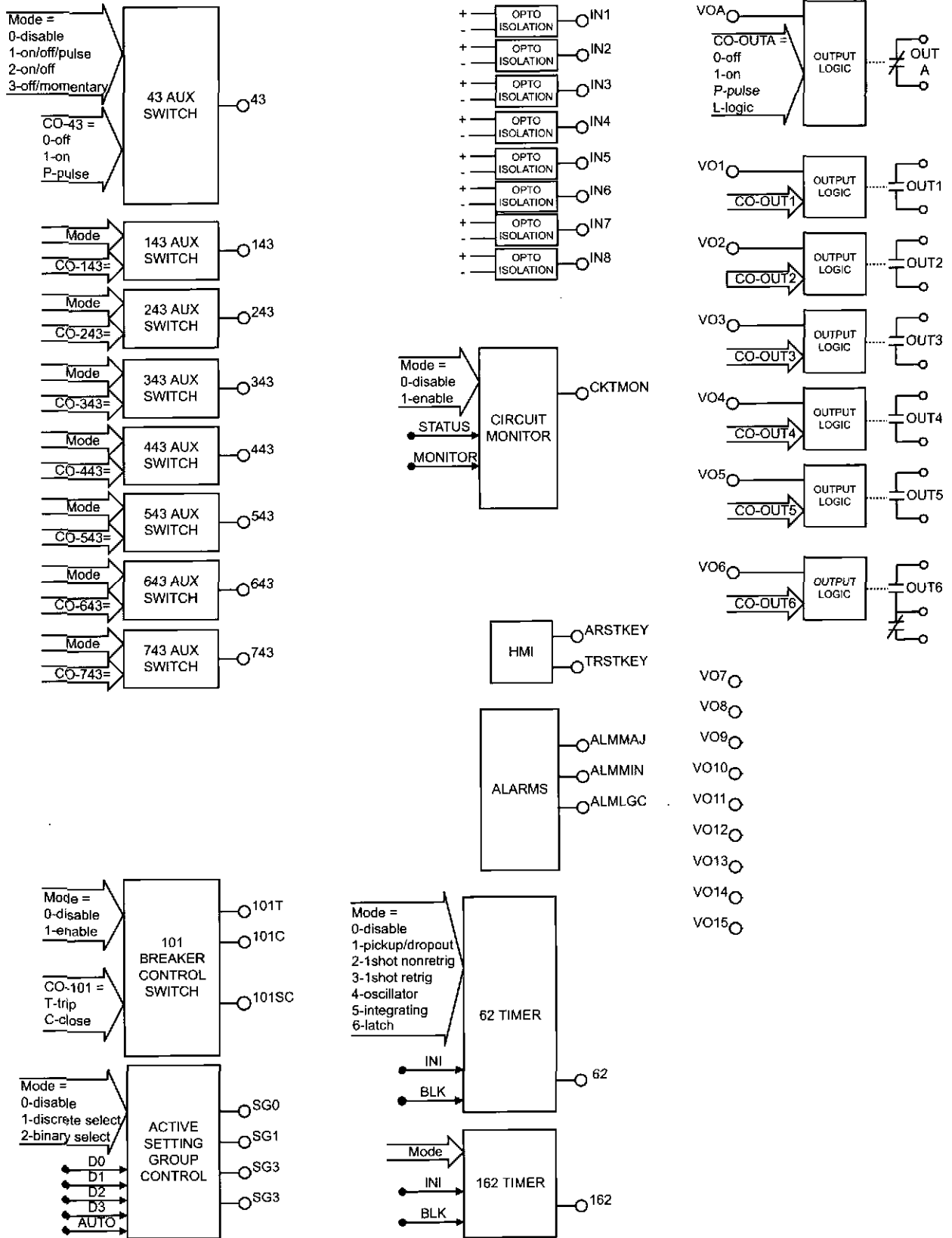
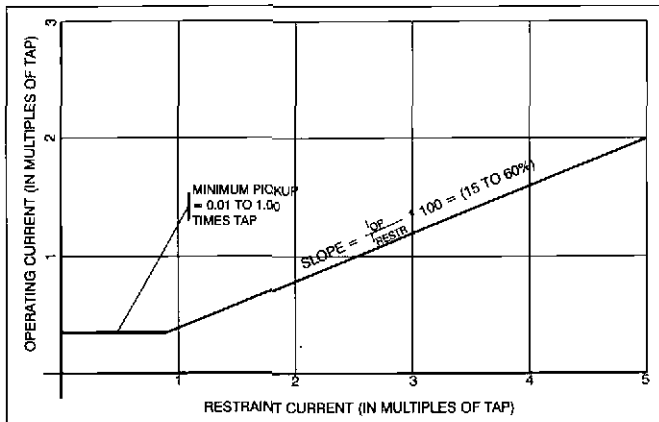


Figure 6A - CDS220 and CDS230 BESTlogic Function Blocks

PERFORMANCE SPECIFICATIONS

PERCENTAGE RESTRAINED DIFFERENTIAL (87R)



Tap: 5A CT 2.0-20 Amps
1A CT 0.4-4.0 Amps

Minimum PU 0.10-1.00 times tap

Restraint Method Maximum Average

Restraint Slope: 15-60%, off

2nd & 5th Harmonic 5-75%, off

Response Time: <2 cycles @ 5 x pickup
<3 cycles @ 1.5 x pickup

UNRESTRAINED DIFFERENTIAL (87U)

Unrestrained PU 1-21 times Tap up to 150A Symmetrical

Response Time: <1 cycle @ 5 x pickup
<2 cycles @ 1.5 x pickup

RESTRICTED EARTH FAULT GROUND DIFFERENTIAL (87ND)

Tap: 5A CT 2.0-20 Amps
1A CT 0.4-4.0 Amps

Minimum PU 0.10-1.00 times tap

Restraint Slope 15-60%

Curve Type	Constants					
	A	B	C	N	K	R
S1	0.2663	0.03393	1.000	1.2969	0.028	0.5000
S2	0.0286	0.02080	1.000	0.9844	0.028	0.0940
L1	5.6143	2.18592	1.000	1.000	0.028	15.750
L2	2.3955	0.00000	1.000	0.3125	0.028	7.8001
D	0.4797	0.21359	1.000	1.5625	0.028	0.8750
M	0.3022	0.12840	1.000	0.5000	0.028	1.7500
I1	8.9341	0.17966	1.000	2.0938	0.028	9.0000
I2	0.2747	0.1042	1.000	0.4375	0.028	0.8868
V1	5.4678	0.10814	1.000	2.0469	0.028	5.5000
V2	4.4309	0.0991	1.000	1.9531	0.028	5.8231
E1	7.7624	0.02758	1.000	2.0938	0.028	7.7500
E2	4.9883	0.0129	1.000	2.0469	0.028	4.7742
A	0.01414	0.00000	1.000	0.0200	0.028	2.0000
B	1.4636	0.00000	1.000	1.0469	0.028	3.2500
C	8.2506	0.00000	1.000	2.0469	0.028	8.0000
G	12.1212	0.00000	1.000	1.000	0.028	29.000
F	0.0000	1.00000	0.000	0.0000	0.028	1.0000
P	0 to 600	0 to 25	0 to 1	.5 to 2.5	0.028	0 to 30

S1, S2 = CO Short Inv, IAC Short Inv
L1, L2 = CO Long Inv, IAC Long Inv
D = CO Definite Time
M = CO Moderately Inverse
I1, I2 = CO Inverse, IAC Inverse
V1, V2 = CO Very Inv, IAC Very Inv
E1, E2 = CO Ext Inverse, IAC Ext. Inverse

A = IEC Standard Inverse
B = IEC Very Inverse
C = IEC Extremely Inverse
G = IEC Long Time Inverse
F = Fixed Time
P = Programmable

INSTANTANEOUS OVERCURRENT WITH SETTABLE DELAY (50TP, 150TP, 250TP, 50TN, 150TN, 250TN, 50TQ, 150TQ, 250TQ)

Pickup: 5A CT 0.5-150.0 Amps
1A CT 0.1-30.0 Amps

Pickup Time: 1/4 cyc @ 5 times PU
2 cyc @ 1.5 times PU
4 cyc @ 1.05 times PU

Delay Time 0.00-60.0 Sec
PU time with TD=0.000 Sec

1/4 cyc for P, N, & G @ 5 x PU
2/4 cyc for Q @ 5 x PU

Delay time: 0.000 - 60 sec

Time Accuracy: ±0.5% or ±1/4 cyc for P & N
±0.5% or ±1 cyc for Q

TIME OVERCURRENT (51P, 151P, 251P, 51N, 151N, 251N, 51Q, 151Q, 251Q)

Pickup: 5A CT 0.5-16.0 Amps
1A CT 0.1-3.2 Amps

Time Dial: TD=K=0-99 for 46 curve
TD=0.0 - 9.9 for all other curves

Time-Current Characteristics: Same curves as 51 elements

PERFORMANCE SPECIFICATIONS, continued

BREAKER FAILURE (BF)

Time: 50 - 999mSec
 Dropout: 5A CT 0.5A
 1A CT 0.1A
 Time Accuracy: $\pm 0.5\%$ or $+1\frac{1}{4}$ cyc / $-1\frac{1}{2}$ cyc

GENERAL PURPOSE LOGIC TIMERS

(62, 162, 262, 362)

Mode: PU/DO
 1 Shot, Non-Retrig.
 1 Shot, Retriggering
 Integrating
 Latch
 T1 and T2 Delay Time: 0.000 - 9999 Sec.
 Time Accuracy: $\pm 0.5\%$ or $\pm \frac{1}{2}$ cyc

CURRENT PICKUP ACCURACY (All 50 and 51)

Phase and Ground: 5A 2% or 50mA
 1A 2% or 10mA
 Neutral and Negative Sequence: 5A 3% or 75mA
 1A 3% or 75mA

SETTING GROUPS

Setting Groups: 4
 Control Modes: Automatic: CLP; Dynamic load or unbalance
 External: Discrete input logic
 Binary: Input Logic

METERING

Current Range: 5A 0.5 to 15.0
 1A 0.1 to 3.0
 Current Accuracy: $\pm 1\%$
 Frequency: 40 - 63Hz

DEMANDS (IA, IB, IC, IN, IQ)

Demand Interval: 1 - 60 min.
 Demand Mode: Thermal
 Sliding Block Average
 Block Average

BREAKER MONITORING

Duty Mode: I or I²
 Duty Alarm Range: 0 - to 100%
 Op Counter Alarm Range: 0 - 99999
 Trip Time Alarm Range: 20 - 1000mSec

TRANSFORMER MONITORING

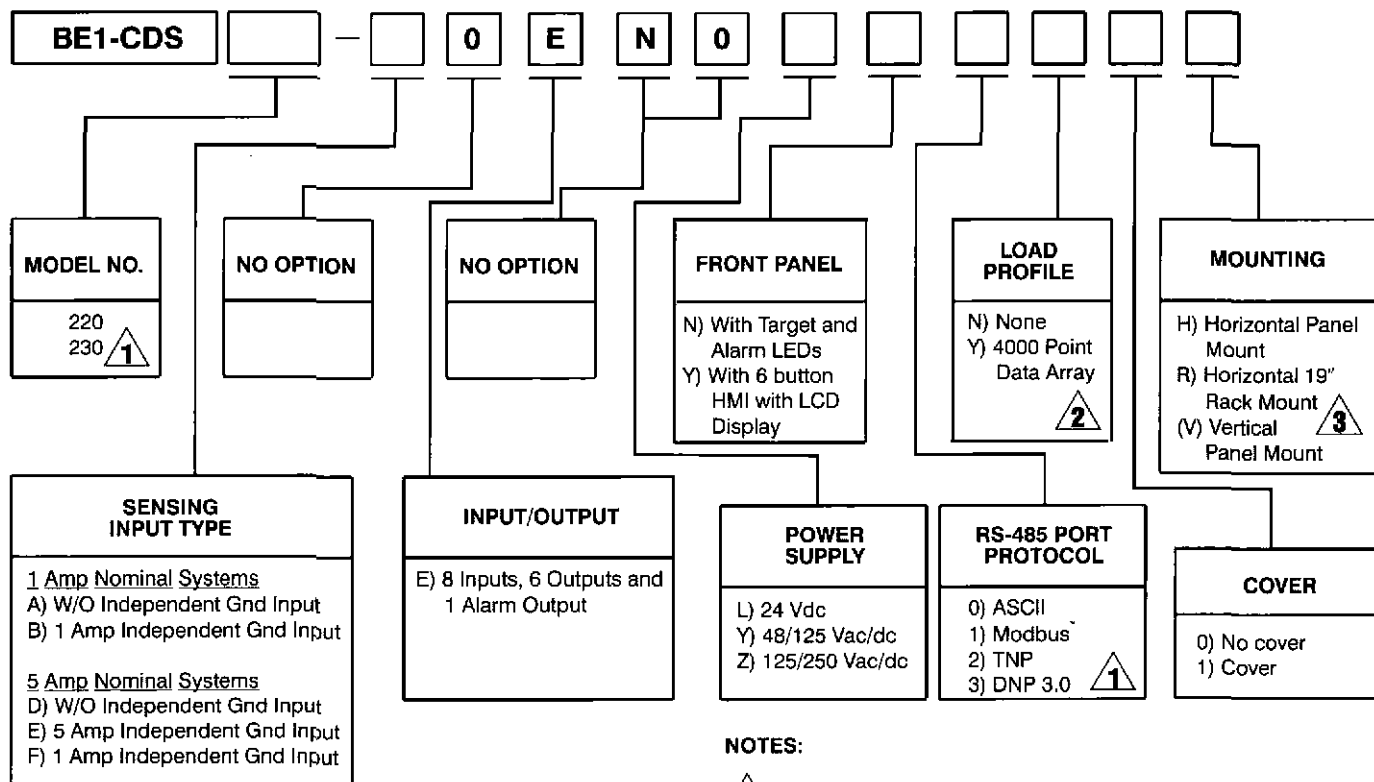
Accumulated Duty Alarm: 0-100%
 Fault Counter Alarm: 0-99999

ORDERING

SAMPLE STYLE NUMBER

The style number identification chart defines the electrical characteristics and operation features included in BE1-CDS Relays. For example, if the style number were **CDS220 E0E-N0Y-Y0N0R**, the device would have the following:

- (E) - 5 Amp Nominal System with 5 Amp Independent Ground Input
- (0) - No Option
- (E) - 8 inputs, 6 programmable outputs, and 1 alarm output
- (N) - No Option
- (0) - No Option
- (Y) - 48/125 Vac/dc Power Supply
- (Y) - Six button HMI with graphic LCD
- (0) - ASCII Communications
- (N) - No Load Profile Recording
- (0) - No Cover
- (R) - Horizontal with 19" Rack Mount Brackets



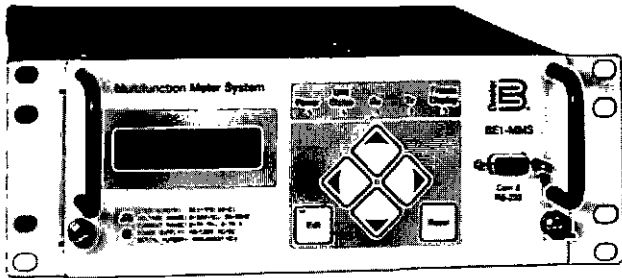
NOTES:

- ▲1 Consult your Basler Representative for availability.
- ▲2 Doubles SER and oscillography memory.
- ▲3 CDS230 not available in vertical mounting.

STANDARD ACCESSORY

9180400109 MX Test Case with 2 CT Terminal Blocks.





BE1-MMS100 MULTIFUNCTION METERING SYSTEM

The BE1-MMS100 is an economical, microprocessor based, multifunction revenue-accurate power metering system that provides multifunction revenue-accurate power metering, contact status monitoring, and output control functions in an integrated system.

ADVANTAGES

- Provides accurate metering of voltage, current, Watts, VARs, and bi-directional energy measurements.
 - Measures individual and total harmonic distortion up to the 31st harmonic.
 - Monitors discrete inputs from utility kWh pulse initiators.
 - Stores Minimum and Maximum Energy Values.
 - Stores 36 days* of 15 minute average data for Volts, Amps, Watts, VARs, Power Factor, frequency and accumulated pulse counts, plus values for imported, exported and total kWh, kVARh, and kVAh, and elapsed time since last reset or it stores 12 oscillographic records* of 21 cycles each at 64 samples per cycle.
 - Monitors the status of input contacts from breakers, targets, switches, etc.
 - Provides control outputs through built-in interposing relays.
 - Available in fully drawout half rack case. Two Basler Electric half rack IEDs (Intelligent Electronic Devices) can be dovetailed together to mount in a standard 19-inch equipment rack with no special mounting hardware.
- * History is limited to 18 days or oscillography is limited to 6 events for the DNP 3.0 option.

WINDOWS® SOFTWARE

Interface for setting and communicating with Basler metering products.
Request BESTCOMS for BE1-MMS100.

ADDITIONAL INFORMATION

INSTRUCTION MANUAL

Request publication 9326700991

UMOS® SOFTWARE BULLETIN

Request publication LAB

MODBUS™ INSTRUCTION MANUAL

Request publication 9326700993

DNP INSTRUCTION MANUAL

Request publication 9326700992

FEATURES

Page 2

APPLICATIONS

Pages 2-3

FUNCTIONAL DESCRIPTION

Pages 3-8

SPECIFICATIONS

Pages 9-10

ORDERING INFORMATION

Page 11

Basler Electric

P. O. BOX 269 HIGHLAND, ILLINOIS, U.S.A. 62248 PHONE 618-654-2341 FAX 618-654-2351

LAD-5
7-01

FEATURES

METERING

- True RMS measurements of voltage per phase, current per phase, Watts per phase and total, VARs per phase and total, PF, frequency, and phase angle.
- Energy imported, exported, and total kWh, kVARh and kVAh.
- Measures pulses from utility pulse initiators.
- Measures individual and total harmonic distortion on the voltage and current inputs up to the 31st harmonic.

LOGGING AND RECORDING

- Historical data logging of voltage per phase, current per phase, Watts per phase and total, VARs per phase and total, Power Factor, frequency and pulse count every 15 minutes and imported, exported and total kWh, kVARh and kVAh and total elapsed time since last reset for up to 36 days*.

OR

Optional oscillographic recording of 12 events*, 12 cycles each at 64 samples per cycle.

- Min/Max logging of voltage per phase, current per phase and total, imported, exported, and total kWh, kVARh and kVAh, and elapsed time since last reset.
- Event logging and alarming with sequence of events time stamped to ± 10 msec accuracy including configuration changes, set point and min/max events.

* History is limited to 18 days or oscillography is limited to 6 events for the DNP 3.0 option.

CONTROL

- Four non-wetted status inputs and six output relays.

COMMUNICATION PORTS

- Three independent general purpose communication ports.
 - Front RS-232 ASCII and TNP communications
 - Rear RS-232 TNP communications
 - Rear RS-485 Modbus™ or other common protocols
- IRIG time sync (unmodulated)

HARDWARE FEATURES

- Case configuration is H1 (half rack).
- Active CT technology for low burden and increased dynamic range
- Flash Memory for upgrading embedded programming without changing chips.
- Integral HMI with 2x16 character display.
- Wide range ac/dc power supply options provide long holdup time to ride through dips on ac power source. (100ms with four output relays energized, upon complete loss of source. Starting voltage 125Vac for Option 1 (48/125Vac/Vdc) and 250Vac for Option 2 (125/250Vac/Vdc)).

APPLICATIONS

The BE1-MMS100 is ideal for use by utility, industrial, commercial and institutional customers for feeder monitoring and automation, tenant sub-billing, budgetary cost allocation and outage detection. Its unique capabilities make it ideally suited for the following applications:

- Utility sub-metering
- Commercial/Industrial metering
- Substation automation
- Genset applications

And where the following is required:

- A panel meter is needed to read three phase V, I, Watts, VARs, frequency, Watt-hours or VAR-hours.
- Monitoring of energy utilizing a utility meter's pulse contacts.
- Provisions for output contacts capable of replicating metering pulse contacts.

- Metering data logging and the ability to communicate with a central computer running SCADA software.
- Remote or local interrogation/operation of the metering device.
- High sample oscillographic recording.
- Drawout case construction.

UTILITY SUBSTATION AUTOMATION

By using one BE1-MMS100 on each feeder and connecting it to communicate with a central computer running SCADA software such as Basler Electric's UMOS®, the benefit of a complete energy management system can be realized. The BE1-MMS100 provides the system operator with real time analog measurements as well as historical data for planners. The BE1-MMS100 also provides the operator with status inputs and controllable outputs. Together, the BE1-MMS100 and UMOS® interact through the computer screens that form the operators' interface or HMI.

APPLICATIONS, continued

Within this interface reports can be generated and printed for further use. Some of the screens and reports provided by UMOs[®] are:

SCREENS	REPORTS
Alarm Panel	Daily Summary
Event Log	Detail
Sequence of Events Log	Volts and Amps
Strip Charts	On/Off Peak
Forecast Strip Charts	Monthly Peaks
Load Control Schedules	Fault
One-line Diagrams	Relay Settings
Fault Reports	
Oscillographic Records	
Relay Settings	

METERING POWER CONTRACTS

A BE1-MMS100 can be connected on each power circuit and log metering data for various customers. Using the "call home" and dial-up modes of operation within the BE1-MMS100 and BESTCOMS software, the logged data can be automatically transferred at various intervals.

UTILITY SUB-METERING

The BE1-MMS100 and a Basler Electric BE1 protective relay can be dovetailed together to form a standard 19-inch rack feeder unit for metering, protection and control. The combination provides the advantage of high metering accuracy that is normally unavailable within protective relays due to their wide dynamic range with the protection required for reliable feeder operation.

COMMERCIAL/INDUSTRIAL METERING

The BE1-MMS100 can be applied anywhere a panel meter is needed to measure and record energy consumption or generation. When applied to the incoming feeders of buildings or areas within a facility, accurate data can be obtained for tenant sub-billing or energy consumption costing. When applied to electrical machinery or equipment, the BE1-MMS100 provides measurement of harmonic distortion up to the 31st harmonic.

FUNCTIONAL DESCRIPTION

INPUT SIGNALS

CT/PT Input Signals

The BE1-MMS100 accepts the following input signal combinations:

- 1, 2 or 3 ac voltages supplied from 67 or 120Vac PTs
- 1, 2, 3 or 4 ac currents supplied from 1A or 5A CTs, specified at time of order.

Meter input signals are supplied from PTs and CTs as paired sets of input signals. Input signals are processed in pairs, with the exception of the neutral current input.

The BE1-MMS100 samples the seven input waveforms at the rate of 64 samples per cycle and computes true RMS voltages (3), true RMS currents (4), and uses paired I-V input samples to compute true RMS Watts and VARs.

Voltage inputs are processed as either phase-to-neutral or phase-to-phase. The voltage input configuration is set via the front panel or BESTCOMS.

New data vectors containing voltage, current and the relative phase angle for I-V pairs are available at the

communication port once per second. The kW, kVAR and frequency data are also available once per second. The voltage, current, kW, kVAR, Power Factor and frequency information is displayed and updated on the BE1-MMS100 LCD display once per second.

Once per minute the BE1-MMS100 computes the kWh, kVARh and kVAh values and displays the imported, exported and accumulated kWh, kVARh and kVAh on the LCD display. Also, on the minute, the BE1-MMS100 computes the first 31 harmonic values for the voltage or current inputs and the total harmonic distortion (THD%).

Once every 15 minutes the BE1-MMS100 stores in flash memory the phase average of Volts, Amps, kW, kVAR, Power Factor and frequency values. The historical data is stored to flash memory once every 15 minutes or on a power down event. Flash memory will accommodate 36 days of data storage. Data is retained for 36 days and is available for downloading to a master station via the communication port.

Similarly, imported, exported, and accumulated kWh, kVARh and kVAh and elapsed time values are accumulated every minute and kept in RAM, and on a power down event, are transferred to EEPROM.

FUNCTIONAL DESCRIPTION, continued

INPUT SIGNALS, continued

Status and Alarm Input Signals

The BE1-MMS100 accepts the discrete input signal combinations on four channels.

The inputs can be configured as pulsed (MCD) or sustained status inputs on each of the four input channels. The BE1-MMS100 requires a dc contact sense voltage for the contacts and accepts pulses on the discrete input channels (total of four channels available). The BE1-MMS100 stores ten MCD events on each input channel.

Inputs are scanned at 10 millisecond intervals. A debouncing algorithm checks to verify that contacts remain closed for at least three read cycles before "counting" the transition as a valid pulse.

Momentary changes of up to 20 per second are acceptable on each channel, with provision that only the first ten will be stored for each channel.

When a contact transition event occurs, the BE1-MMS100 sets a status bit "on" in the communication port status message. The event will be detected by the substation computer, RTU or master station on the next poll.

For those systems incorporating dial-up communications, the event bit can trigger a "call home" communications session. In this session, the BE1-MMS100 dials a prestored telephone number and establishes a data communications session with the host. During this session, data, including the event that initiated the call, is uploaded from the BE1-MMS100 to the host.

Pulse Input Signals

The four status inputs can be configured as pulse meter inputs. As a Pulse Transducer, the BE1-MMS100 accepts the following input signal combinations: 1, 2, 3 or 4 Form A or B contact inputs from a utility pulse initiator.

Metering output signals (pulses) are supplied as dc inputs from metering KYZ contacts. The BE1-MMS100 uses dc sense voltages on the contacts and accepts pulses on the status input channels (total of four channels available).

Pulse repetition rates of up to 20 per second on each channel are acceptable.

Inputs are scanned at 10 millisecond intervals. A debouncing algorithm checks to verify that contacts

remain closed for at least three read cycles before "counting" the transition as a valid pulse.

Once per minute the BE1-MMS100 computes the pulse count on a per channel basis and reports the data via the communication port.

Once every fifteen minutes and on power down, the BE1-MMS100 stores the total pulse count in flash RAM for the 15 minute interval on a per channel basis. Data is retained for 36 days and is available for downloading to a master station via the communication port.

OUTPUT SIGNALS

Discrete Output Signals

The BE1-MMS100 has six Form "A" output contacts for use in control or for pulse inputs. Pulse outputs can be set to represent watts, vars, pulse in 1, pulse in 2, pulse in 3, pulse in 4, or the sum of any of these. The maximum output pulse rate is 30 per minute.

The relays operate on a select and operate basis.

Communications Ports

The BE1-MMS100 has three physical serial ports:

- An RS-232 port on the front of the unit.
- An RS-232 port on the rear of the unit.
- An RS-485 port on the rear of the unit.

The user has a choice of using either the rear RS-232 port for data acquisition and control, or the RS-485 port. The choice is made using the HMI setup procedures.

The BE1-MMS100 supports three data acquisition and control protocol forms (only applicable to the rear ports):

- A Basler TNP data format identical to the ET V4.4 format is used to maintain product compatibility.
- Extended TNP data formats are used for the one-minute and fifteen-minute values.
- Modbus™ data formats.
- DNP 3.0 data formats.

The port supports an 8,N,1 byte format and will connect at the following baud rates: 300, 600, 1200, 2400, 4800, 9600, and 19,200.

DISPLAY FEATURES

The BE1-MMS100 has five (5) indicating LEDs, a keypad and a LCD display.

FUNCTIONAL DESCRIPTION, continued

INDICATORS

Power indicator is the green LED on the left hand side of the indicator group. This is used to indicate operating power applied; the power supply is operational and within specifications.

Unit Status is a red LED next to the green Power LED. This LED flashes once per second when unit is working properly.

Rx is a red LED. This LED flashes when the rear port Rx (receive) signal line is high.

Tx is a red LED. This LED flashes when the rear port Tx (transmit) signal line is high.

Freeze Display indicator is on the right hand side of the indicator group and is used to indicate that the LCD is "frozen", or locked on present display.

The LED in the EDIT key illuminates when the unit is in program setup mode.

KEYPAD USAGE

There are six pushbuttons: Up arrow, Down arrow, Left arrow, Right arrow, EDIT, and RESET.

The RESET pushbutton is used to set the time interval for 15 minute averages, the elapsed time indicator, and the imported, exported, and accumulated kWh, kVARh and kVAh. The reset function has a prompt to avoid accidental operation.

The EDIT pushbutton is used to set the unit in set up mode. In set up mode the protocol, the delta or wye configuration, the port baud rate, the address, and call home phone number are selected. If password protection is used, the proper password must be entered to operate the EDIT pushbutton.

The arrow pushbuttons are used to set and change the numeric parameters.

LCD DISPLAY USAGE

The LCD display is a 16 character by two-line display. When the unit is first powered up, the LCD displays "Executing Application", then switches to the "top level" display, which shows the Model Number and software version.

If no keys are pressed, the LCD switches to metering mode and alternately displays the various parameters measured. This is called scrolling. When the down arrow key is pressed, "Freeze Display" LED lights up and the display locks on the last screen. Press again and the display resumes scrolling, or it will automatically resume scrolling after five minutes. The Metering screens include:

Screen	Parameter	Digits
Metering "a"	kWh	10
	kVARh	10
Metering "b"	Wh Imported	10
Metering "c"	Wh Exported	10
Metering "d"	VARh Imported	10
Metering "e"	VARh Exported	10
Metering "f"	VAh Imported	10
Metering "g"	VAh Exported	10
Metering "h"	VAh Accumulated	10
Metering "i"	kW	10
	kVAR	10
Metering "j"	Volts A	6
	Volts B	6
	Volts C	6
Metering "k"	Amps A	6
	Amps B	6
	Amps C	6
Metering "l"	Amps N	6
Metering "m"	Frequency	3
	PF	3
Metering "n"	THD A	6
	THD B	6
	THD C	6
Metering "o"	Time	8
	Date	10
Metering "p"	Accumulated Time	10

There are three data acquisition and control protocol formats available through the front panel or via the communication ports. These formats are transducer network protocol (TNP, includes oldET), Modbus™, and distributed network protocol DNP. The user makes this choice using the HMI setup procedures.

The communication ports support an 8,N,1 byte format and connect at the following baud rates: 300, 600, 1200, 2400, 4800, 9600, and 19200.

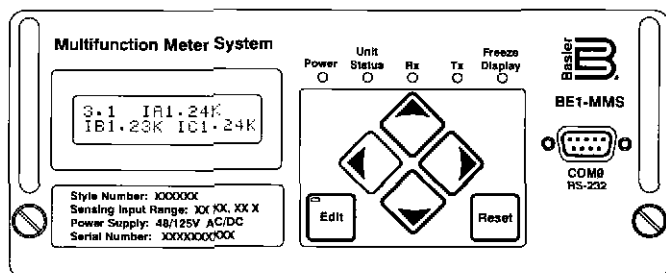


Figure 1 - Front panel of BE1-MMS100

FUNCTIONAL DESCRIPTION, continued

The block diagram below illustrates the hardware functions in the BE1-MMS100.

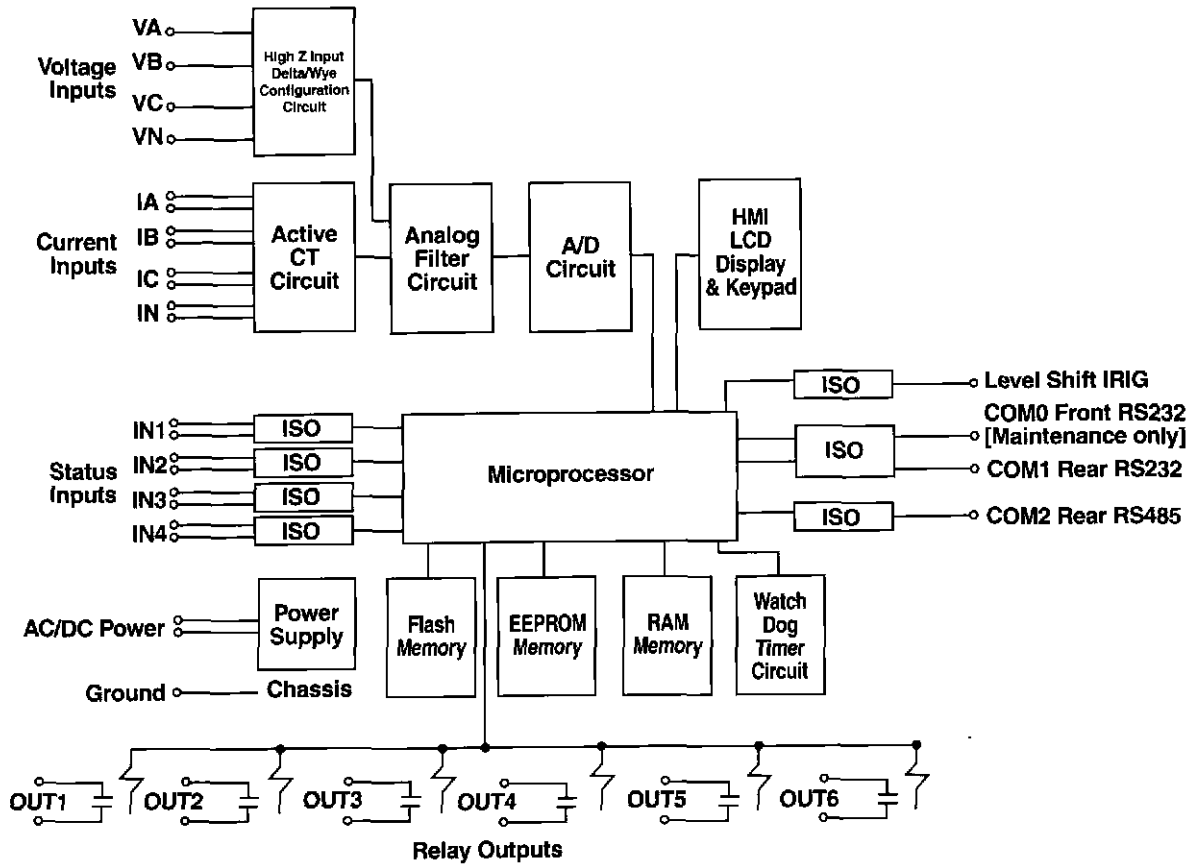


Figure 2 - Block diagram

FUNCTIONAL DESCRIPTION, continued

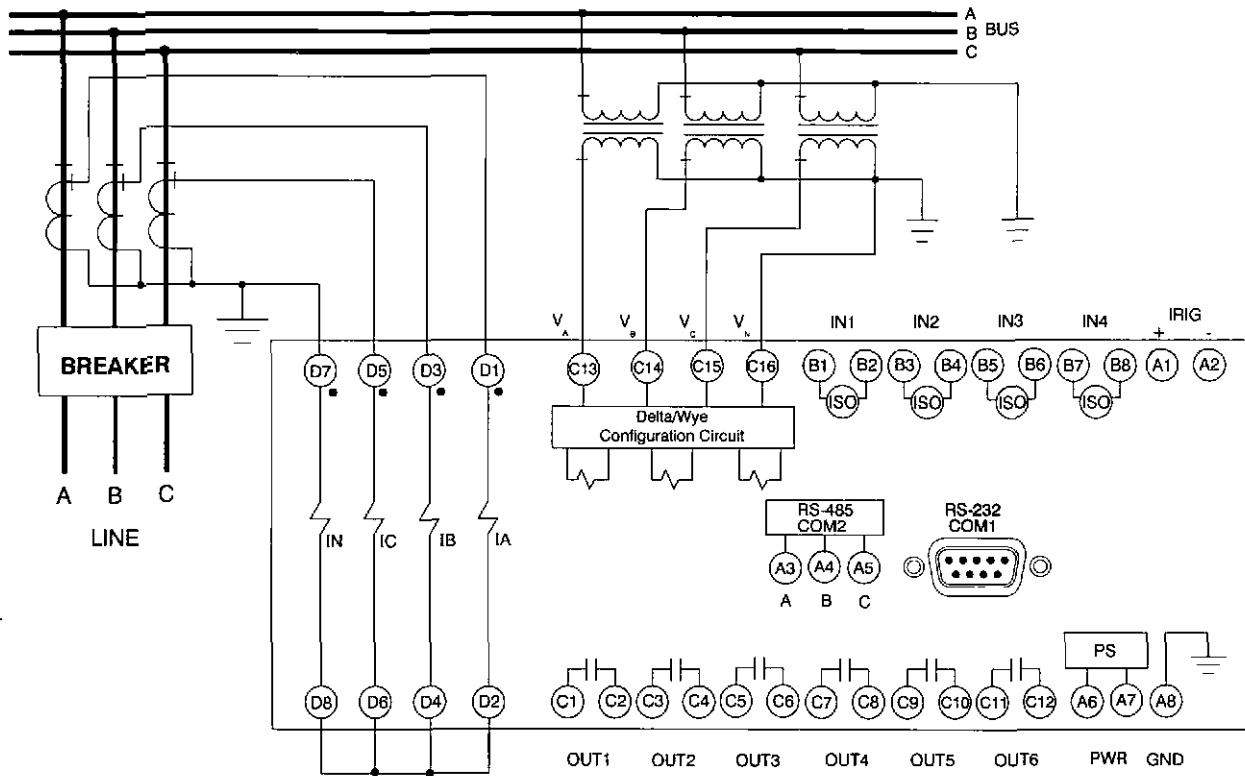


Figure 3 - Typical external connection diagram

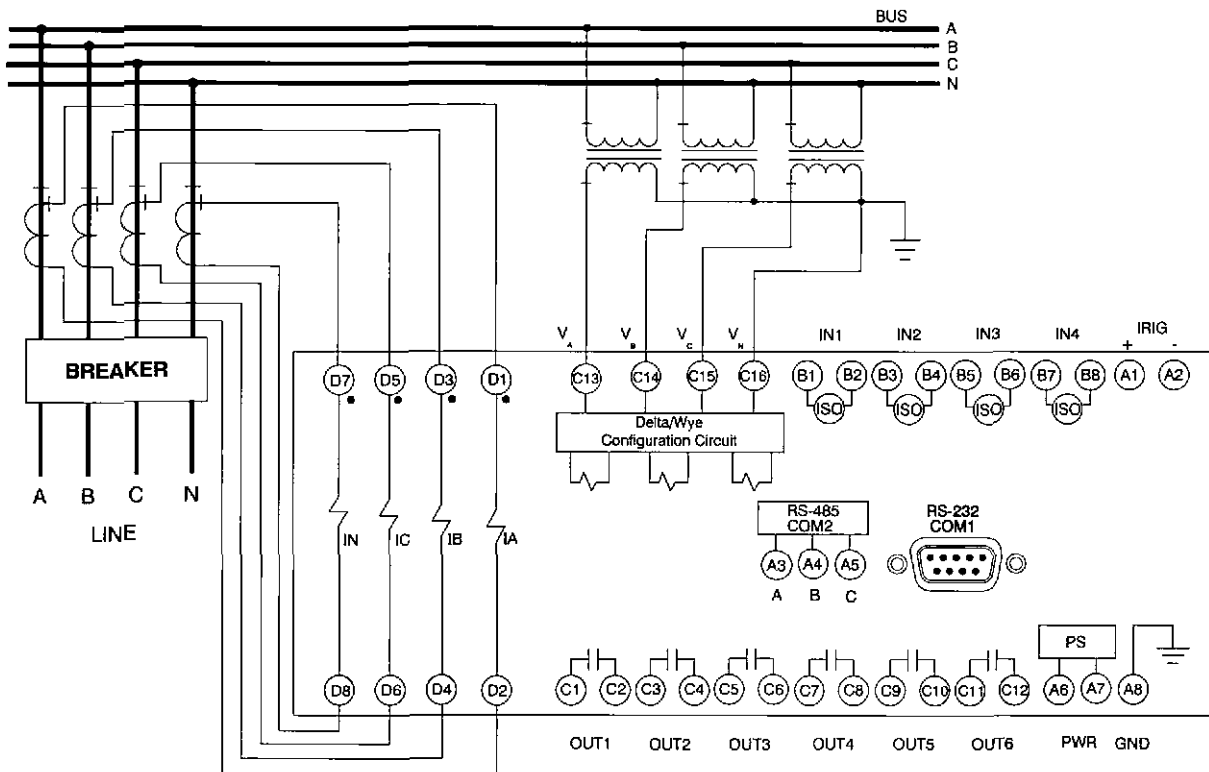


Figure 4 - Alternate external connection diagram

FUNCTIONAL DESCRIPTION, continued

Data Item	Data Description	Interval	Alarm Hi/Lo	Display	Historical	Min	Max	Day
Va	Voltage Input A	1 sec	X	Yes	15 min	X	X	36
Vb	Voltage Input B	1 sec	X	Yes	15 min	X	X	36
Vc	Voltage Input C	1 sec	X	Yes	15 min	X	X	36
Ia	Current Input A	1 sec	X	Yes	15 min	X	X	36
Ib	Current Input B	1 sec	X	Yes	15 min	X	X	36
Ic	Current Input C	1 sec	X	Yes	15 min	X	X	36
In	Current Input Neutral	1 sec	X	Yes	15 min	X	X	36
kWa	Kilowatts phase A pair inputs	1 sec	X		15 min	X	X	36
kWb	Kilowatts phase B pair inputs	1 sec	X		15 min	X	X	36
kWc	Kilowatts phase C pair inputs	1 sec	X		15 min	X	X	36
kW	Kilowatts for feed	1 sec	X	Yes	15 min	X	X	36
kWh Exp	Kilowatt hours - Exported	1 min		Yes	Total	X	X	
kWh Imp	Kilowatt hours - Imported	1 min		Yes	Total	X	X	
kWh Tot	Kilowatt hours - Accumulated	1 min		Yes	Total	X	X	
kVARa	Kilovars phase A pair inputs	1 sec	X		15 min	X	X	36
kVARb	Kilovars phase B pair inputs	1 sec	X		15 min	X	X	36
kVARc	Kilovars phase C pair inputs	1 sec	X		15 min	X	X	36
kVAR	kvar for feed	1 sec	X	Yes	15 min	X	X	36
kVARh Exp	kvarhours - Exported	1 min		Yes	Total	X	X	
kVARh Imp	kvarhours - Imported	1 min		Yes	Total	X	X	
kVARh Tot	kvarhours - Accumulated	1 min		Yes	Total	X	X	
kVAh Exp	kVAhours - Exported	1 min		Yes	Total	X	X	
kVAh Imp	kVAhours - Imported	1 min		Yes	Total	X	X	
kVAh Tot	kVAhours - Accumulated	1 min		Yes	Total	X	X	
Elapsed Time	Elapsed time since last RESET	1 sec		Yes	Total	X	X	
PF	Power Factor	1 sec	X	Yes	15 min			36
Freq	Frequency	1 sec	X	Yes	15 min			36
Ph A	Phase Angle A pair inputs	1 sec						
Ph B	Phase Angle B pair inputs	1 sec						
Ph C	Phase Angle C pair inputs	1 sec						
Pulse Ch 1	Pulse count on channel 1	1 min	X	Yes	15 min			36
Pulse Ch 2	Pulse count on channel 2	1 min	X	Yes	15 min			36
Pulse Ch 3	Pulse count on channel 3	1 min	X	Yes	15 min			36
Pulse Ch 4	Pulse count on channel 4	1 min	X	Yes	15 min			36
Status Ch 1	Status Input on Channel 1	1 cycle	X		10 count MCD			
Status Ch 2	Status Input on Channel 2	1 cycle	X		10 count MCD			
Status Ch 3	Status Input on Channel 3	1 cycle	X		10 count MCD			
Status Ch 4	Status Input on Channel 4	1 cycle	X		10 count MCD			
Relay Out 1	Output Relay Contacts Chan 1	On Demand						
Relay Out 2	Output Relay Contacts Chan 2	On Demand						
Relay Out 3	Output Relay Contacts Chan 3	On Demand						
Relay Out 4	Output Relay Contacts Chan 4	On Demand						
Relay Out 5	Output Relay Contacts Chan 5	On Demand						
Relay Out 6	Output Relay Contacts Chan 6	On Demand						
THD% - a	Total Harmonic Distortion Ph a	1 min	X	Yes				
THD% - b	Total Harmonic Distortion Ph b	1 min	X	Yes				
THD% - c	Total Harmonic Distortion Ph c	1 min	X	Yes				
fund - a	Phase A Fundamental	1 min						
fund - b	Phase B Fundamental	1 min						
fund - c	Phase C Fundamental	1 min						
harm n a*	Phase A Harmonic n	1 min						
harm n b*	Phase B Harmonic n	1 min						
harm n c*	Phase C Harmonic n	1 min						

Note: History is limited to 18 days for the DNP 3.0 option.

* where n is a number corresponding to a harmonic from 2 to 31

SPECIFICATIONS

5 Amp CURRENT INPUTS

Continuous rating: 20A
 One second Rating: 400A
 Saturation limit: 150A
 Burden: <10milliohms

1 Amp CURRENT INPUTS

Continuous rating: 4A
 One second rating: 80A
 Saturation limit: 30A
 Burden: <22milliohms

PHASE AC VOLTAGE INPUTS

Continuous rating: 300V, Line to Line
 One second rating: 600V, Line to Neutral
 Burden: <1VA @ 300Vac
 Sensing: 4-wire wye, 3 and 2½ elements
 3-wire wye, 3 elements
 3-wire delta, 2½ and 2 elements

INPUT RANGES

Voltage: 0-300Vac RMS
 Current: 0-3.0Aac, 1A CT sec.
 0-15.0Aac, 5A CT sec.

METERING ACCURACY

Standards

Meets or exceeds IEC 60687 – 1992
 Meets or exceeds IEEE C12.20 – 1995

At 50.0Hz or 60.0Hz @ 25° C ($0.1 I_{nom} < I < I_{max}$)

Voltage: $\pm 0.1\%$ of reading
 Current: $\pm 0.1\%$ of reading
 Watt (at $\pm 0.8PF$): $\pm 0.2\%$ of reading
 VAR (at $\pm 0.8PF$): $\pm 0.2\%$ of reading
 Maximum Temperature Error:
 $\pm .005\%$, full scale per °C on V and I
 $\pm .010\%$, full scale per °C on W and vars
 Power Factor (at $\pm 0.5PF$): 0.55% of reading
 Pulse Inputs: 99.999%
 Frequency: $\pm 0.01\%$

kWh, kVARh, and kVAh MEASUREMENTS

kWh (at $\pm 0.8PF$): 0.2% of reading
 kVARh (at $\pm 0.8PF$): 0.2% of reading
 kVAh (at $\pm 0.8PF$): 0.2% of reading

A/D CONVERTER

Sampling Rate: 64/cycle, adjusted to input frequency 10-75Hz

POWER SUPPLY

Option 1: DC range 35 - 150V
 AC range 55 - 135V

Option 2: DC range 90 - 300V
 AC range 90 - 270V
 Option 3: DC range 17 - 32V
 Burden: 6 watts continuous,
 8 watts maximum with all outputs energized

OUTPUT CONTACTS

Contact Current	Operating Voltage	Operational Notes
30 Amps	120Vac	0.2 seconds sustained
10 Amps	250Vac	Continuous
0.3 Amps	250Vdc	Break/Switched
10 Amps	30Vdc	Continuous

CONTROL INPUTS

Wetting voltage range: DC voltage same as control power supply option.

Nominal Turn On/Off Voltage:
 P.S. Option 1: 33Vdc
 P.S. Option 2: 83Vdc
 P.S. Option 3: 16Vdc

Burden:
 P.S. Option 1: 36K Ω
 P.S. Option 2: 94K Ω
 P.S. Option 3: 15K Ω

COMMUNICATION PORTS

Baud rate: 300 - 19200

IRIG

Supports IRIG Standard 200-98, format B002.
 Input Signal: Demodulated (dc level-shifted digital signal)

Logic-High Voltage: 3.5Vdc, minimum
 Logic-Low Voltage: 0.5Vdc, maximum
 Voltage Range: -10 to +10Vdc
 Resistance: Non-linear, approximately 4 kohms at 3.5Vdc, approximately 3W at 20Vdc

DIELECTRIC STRENGTH

2000 Vac at 50/60 Hz in accordance with IEEE C37.90 and IEC 255-5

SURGE WITHSTAND

Qualified to IEEE C37.90.1-1989

FAST TRANSIENT

Qualified to IEEE C37.90.1-1989

RADIO FREQUENCY INTERFERENCE (RFI)

Qualified to IEEE C37.90.2-1995

SPECIFICATIONS

ELECTRO STATIC DISCHARGE (ESD)

Qualified to European Norm standard
EN61000-4-2

ENVIRONMENT

Operating temperature range: -40°C to +70°C
(-40°F to +158°F)

Storage temperature range: -40°C to +80°C
(-40°F to 168°F)

Humidity: Qualified to IEC 68-2-38, 1st Edition
1974, Basic Environmental Test Procedures,
Part 2: Test Z/AD: Composite Temperature
Humidity Cyclic Test

Note: LCD Display is inoperative below -20°C.

VIBRATION / SEISMIC

Qualified to IEC255-21-1, Class 1

SHOCK

Qualified to IEC255-21-2, Class 1

CERTIFICATIONS

UL Recognized, File E97033

CSA Certified, File LR23131

CASE SIZE

H1: 10.50"W x 3.47"H x 9.10"D with mounting
flanges (8.5"W without mounting flanges)

SHIPPING WEIGHT

H1: Approx. 10 pounds

WARRANTY

7 years

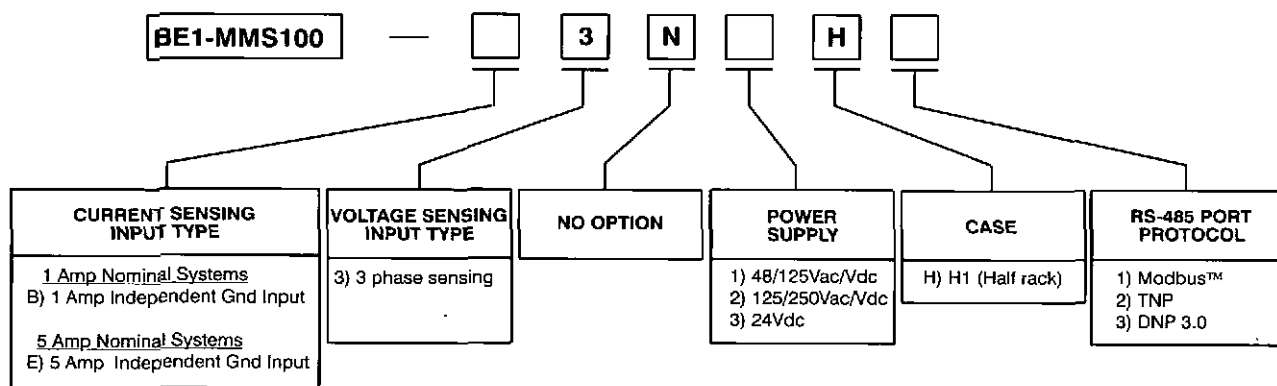
ORDERING

SAMPLE STYLE NUMBER

The style number identification chart defines the electrical characteristics and operation features included in the BE1-MMS100. For example, if the style number were BE1-MMS100 **E3N1H3**, the device would have the following:

BE1-MMS100

- (E) - 5 Amp nominal system with 5 Amp Independent Ground Input
- (3) - Three phase voltage sensing
- (N) - Not applicable
- (1) - 48/125Vac/Vdc power supply
- (H) - Half rack case
- (3) - DNP 3.0 communications

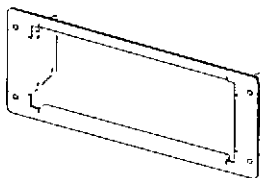


STANDARD ACCESSORIES

9180400108 H1 Test Case with 1 CT Terminal Block and 18-position Bottom Terminal Block

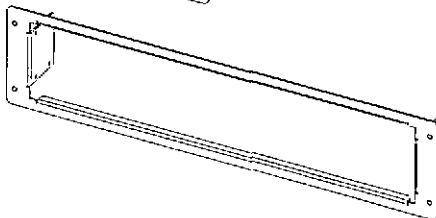
9289900017

Escutcheon plate to panel mount one H1 relay.



9289900016

Escutcheon plate to panel mount two dovetailed H1 relays.



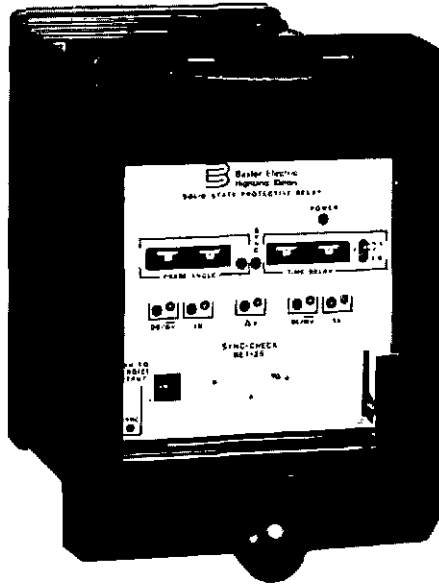
 **Basler Electric**



ROUTE 143, BOX 269, HIGHLAND, ILLINOIS U.S.A. 62249
PHONE 618-654-2341 FAX 618-654-2351

P.A.E. Les Pins, 67319 Wasselonne Cedex FRANCE
PHONE (33-3-88) 87-1010 FAX (33-3-88) 87-0808

<http://www.basler.com>, info@basler.com



BE1-25 Sync-Check Relay

The BE1-25 Sync-Check Relay monitors the voltages on both sides of a circuit breaker and determines that proper phase angle and voltage exist prior to closing the circuit breaker.

FEATURES

- Phase angle limit is adjustable over the range of 1 to 99 degrees.
- Time delay is adjustable over a range of 1 to 99 cycles or 0.1 to 99 seconds.
- Voltage monitoring circuits provide independent determination of bus and line voltage levels for selectable closing conditions.
- Voltage difference provides additional verification of proper breaker closing conditions.
- Expandable phase window option provides the capability to quickly close critical system ties under emergency conditions.
- Separate sync and voltage monitor output contacts are available.
- Optional external selection of voltage conditions.
- Qualified to the requirements of
 - IEEE C37.90-1978, C37.90a-1974, and IEC 255 for surge withstand capability;
 - IEEE C37.90.1-198X for fast transient;
 - IEC 255-5 for impulse.
- UL Recognized under Standard 508, UL File #E97033.
- Five year warranty.

ADDITIONAL INFORMATION INSTRUCTION MANUAL

Request publication 9170200990

APPLICATIONS
Page 2

SPECIFICATIONS
Pages 4 - 6

CONNECTIONS
Page 7

**ORDERING
INFORMATION**
Page 8

B Basler Electric

P. O. BOX 269 HIGHLAND, ILLINOIS, U.S.A. 62249 PHONE 618-654-2341 FAX 618-654-2351

UBP-5
1-01

APPLICATION

The primary application of this relay is in situations that require verification that synchronism exists prior to closing a circuit breaker. These include the paralleling of a generator to a system, reestablishing an intercon-

nection between two parts of a power system, and supervision of fast transfer schemes where fast pickup and dropout of the phase measuring circuit and required.

DESCRIPTION

General

The basic BE1-25 is a solid state synchronism check relay, designed to permit breaker closure only after the specified phase angle conditions have been verified and the condition satisfied for a specified time period. The design provides for ease of setting the phase angle and time period requirement through front panel thumbwheel switches. The design also includes up to five optional voltage measuring circuits to verify various line and bus voltage conditions prior to permitting breaker closure.

The BE1-25 Sync-Check relay is designed to measure the phase angle between the monitored single phase voltages on the line and bus sides of a breaker and verify this angle is less than or equal to the front panel setting. If the measured angle has met this criteria for the time period defined by the front panel setting, the output relay is energized and the breaker will be

permitted to close. The allowable phase angle is adjustable over the range of 1 to 99 degrees. The time delay requirement is adjustable over either of two ranges: 1 to 99 cycles, 50/60 Hz (using the bus frequency as the reference); or, 0.1 to 99 seconds (using the internal crystal reference). (See Figure 1).

An optional target may be specified to indicate operation of the sync-check function.

In order to control the operation of the relay, one additional input (in addition to the Bus and Line potentials and power supply) is required. This input defines the position of the circuit breaker. If the breaker is open the relay will perform its function. When the breaker closes this input changes state and deenergizes the output. This input uses a contact of the breaker (52b) to define position. Two configurations of this input's circuitry – Isolated contact sensing and Nonisolated contact sensing – provide additional flexibility to the control/protection circuit designer. With isolated contact sensing, the relay monitors a current through a dedicated contact. With non-isolated contact sensing, the relay senses the presence of voltage at its input due to the closure of a non-dedicated contact.

Voltage Monitoring

To supplement the basic sync-check function of the BE1-25, optional voltage measuring circuits may be included. These include magnitude measurements of the line and bus inputs, which may be used by the voltage monitoring logic to determine whether the input is live, dead or overvoltage. CONDITION switches, either on the voltage monitor card or external to the relay, determine the desired relay response to these voltage conditions. MODE switches are included on the voltage monitor card to define the desired mode of operation for the Dead Bus/Bus Not Overvoltage (DB/OV) measuring elements. One MODE switch is provided for each voltage input so that the operation of the relay can be tailored to the specific application.

When the MODE switches are in the NORMAL position (up), the two measuring elements associated with an input establish separate live and dead reference levels for the input signal.

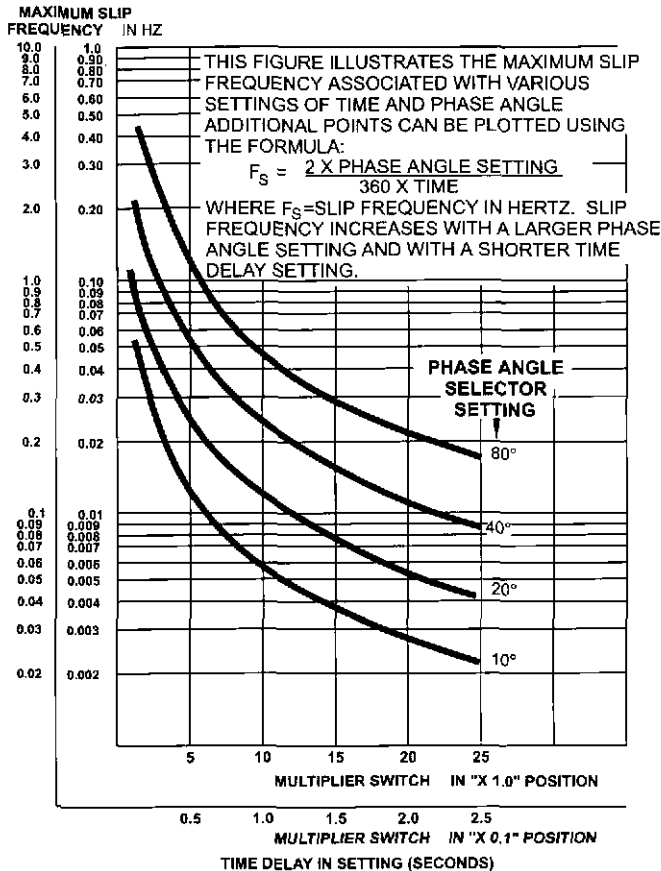


Figure 1 - Slip Frequency vs. Time Delay

DESCRIPTION, continued

When the MODE switches are in the NOT OVERVOLT-AGE position (down), the two measuring elements associated with each input establish separate dead/live and not-overvoltage reference levels for the input signal. (See Figure 2).

CONDITION switches provide the means of selecting the desired action to be taken by the BE1-25 relay. Switch selections include: Live Line/Live Bus (Sync-Check only), Live Line/Dead Bus, Dead Line/Live Bus, and Dead Line/Dead Bus. When any of the selected voltage conditions have been satisfied, the voltage monitor circuit will energize either the sync-check output relay, or the separate (optional) voltage monitor output relay. (It is installed when specified by the style number).

With this logic, when the MODE switches are in the Normal Position, a DEAD level is defined as a monitored voltage level below the DEAD reference setting. A LIVE level is defined as a monitored voltage above the LIVE reference setting.

When the MODE switches are in the NOT OVERVOLT-AGE position, a DEAD level is defined as a monitored voltage less than the LIVE reference setting, a LIVE level is defined as a monitored voltage greater than the LIVE reference setting and less than the NOT OVERVOLT-AGE reference setting. The input is considered to be Overvoltage when it exceeds this reference setting.

This flexibility allows the relay to be used to permit closing a generator breaker onto a dead bus, as well as, preventing closure if the bus voltage is too high.

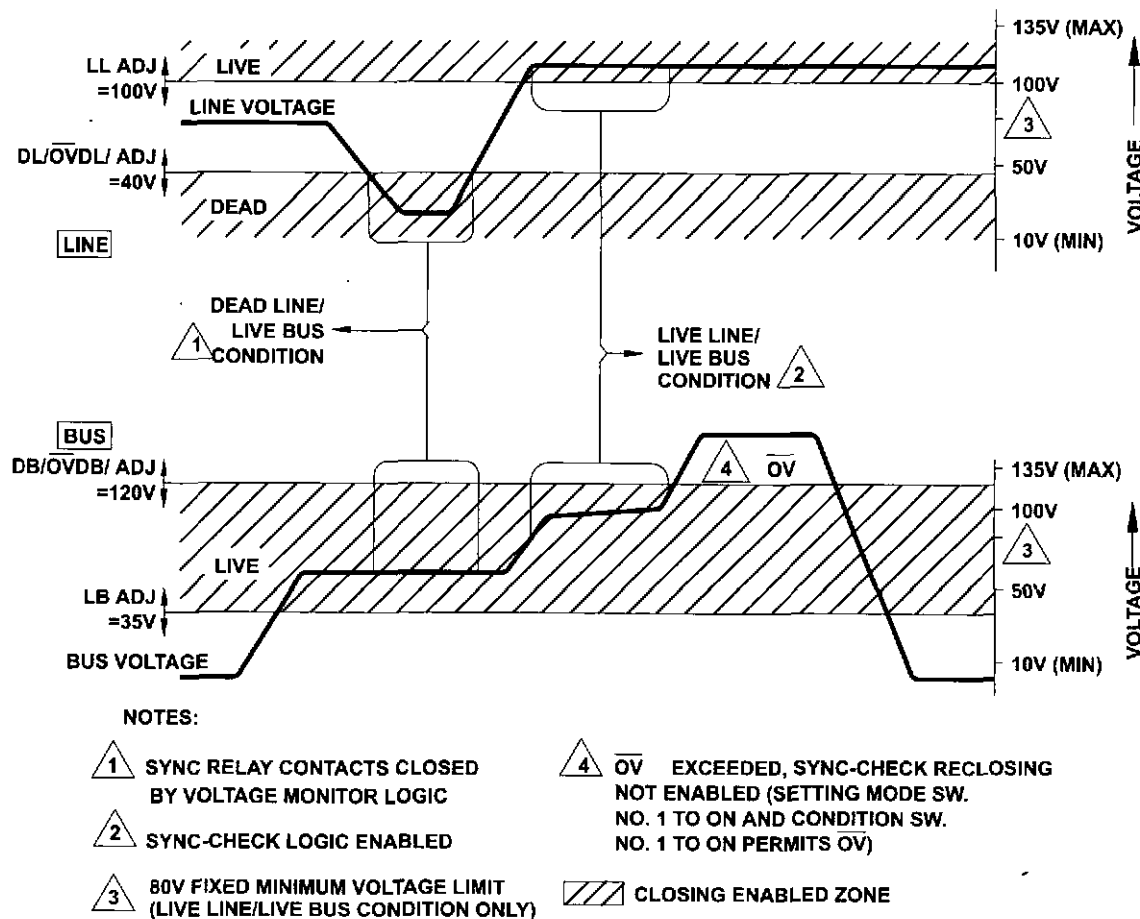


Figure 2 - Voltage Monitor Acceptance Zones

OPTIONS

Voltage Difference

Another voltage monitoring function may be included to monitor the vector voltage difference between the two inputs. This function provides an internal backup to the voltage monitoring and sync-check functions to prevent the closure of a generator breaker if this difference is too great even though the phase angle and voltage level monitoring circuits indicate proper closing conditions have been met. See Figure 3.

A separate contact output may be included with the voltage monitoring option when selected by the style number. This contact may be used in the breaker closing circuit to provide a separate supervised closing circuit or indication of the existing voltage conditions to the supervisory control system.

Push-to-Energize Output

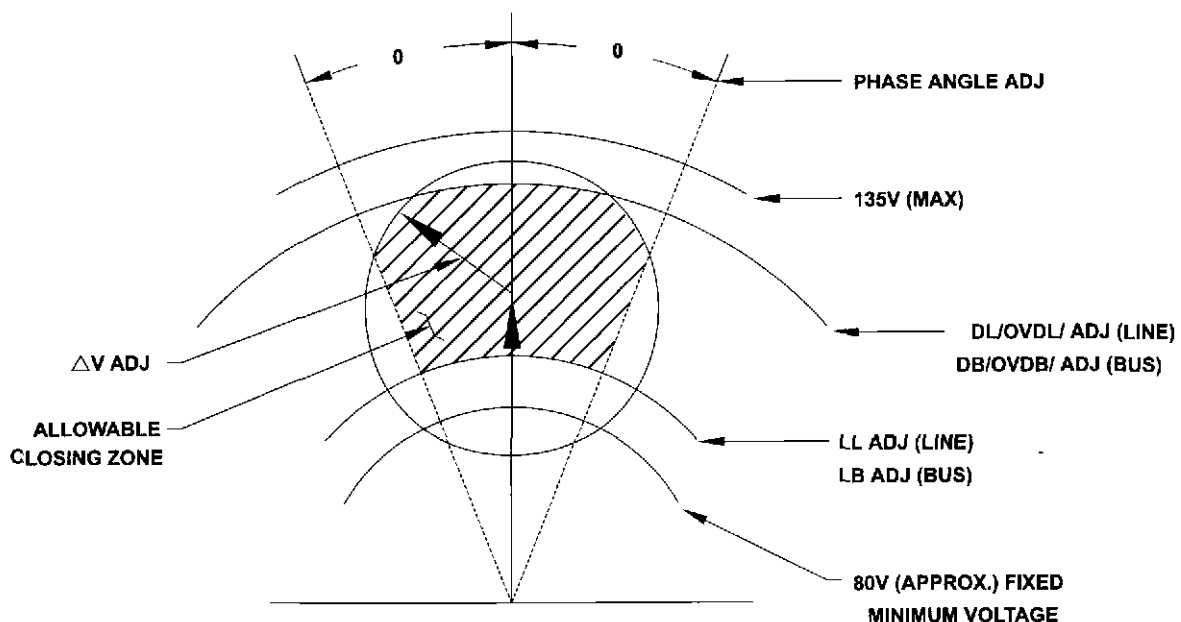
Push-to-Energize Output push buttons are available and provide a means of verifying external output wiring without the inconvenience of having to test the entire relay in the panel for this wiring check. These optional push buttons are provided for each isolated output function within the relay. They are accessible from the front of the relay and actuated by inserting a small nonconductive rod through the metal cover of the cradle assembly.

Expandable Window

An Expandable Window option is available to enable a local operator, through a switch, or a remote dispatcher, through the supervisory control system to expand the preset phase angle window by a preprogrammed ratio under emergency conditions. Under normal conditions the phase angle setting is determined for a distribution or transmission line breaker by the calculated angular difference that will exist for expected load flow through the total system. Under emergency conditions, the load flow throughout the system may result in an excessive phase angle separation across the controller breaker.

In order to reestablish load on a previously faulted line quickly, it may be necessary to expand the allowable phase window. With this option, closing a contact input to the relay expands the preset phase setting by a preprogrammed multiple. Programming the multiple to 2 or 3 is accomplished by moving a jumper on the circuit card. Opening the contact input restores the phase angle limit to the front panel setting.

For a generator breaker the phase angle setting is determined by the maximum phase difference that can be tolerated by the generator when connected to the system. An excessive angle can result in excessive mechanical forces in the generator and its associated mountings. This option is not suggested for use in generator applications.



Relationship between ΔV and Θ is:

$$\Delta V = \sin \Theta V_{bus} \quad \Theta = \sin^{-1} \frac{\Delta V}{V_{bus}}$$

Figure 3 - Closing zone Using Voltage Difference, Sync-Check, and Line/Bus Voltage Monitor

SPECIFICATIONS

FUNCTIONAL DESCRIPTION

The specifications on these pages define the many features and options that can be combined to satisfy an application requirement. The block diagram, Figure 4, illustrates how various standard features, as well as the options, function together.

INPUTS

Voltage Sensing (Phase Angle Measurement)

Standard system potential transformers (PTs) with 120V nominal secondaries supply the Sync-Check Relay's input transformer with single-phase line and bus voltage. The voltage sensing inputs are capable of 160% of nominal voltage continuously, and operate with a maximum burden of 1 VA over the voltage range of 80 to 130V, 40 to 70 Hz.

Contact Sensing

The Sync-Check Relay monitors the state of external user-supplied contacts. These contacts must have a minimum rating of 0.05A at 250 Vdc. Depending on the selection option, they current through the contacts may be obtained from the relay itself (isolated contact sensing), or from a dc source with a voltage rating equal to the relay's power supply input (non-isolated contact sensing).

User-supplied contacts perform the following functions.

Breaker (52b) - Form B auxiliary contact of the controller breaker used to determine the state of the breaker.

Extend Phase Angle Option - Form A contact causes the Phase Acceptance Angle to widen by a factor of 2 or 3 (depending upon the position of a field adjustable jumper).

Remote Switching Option - Four sets of user-supplied form A contacts allow external control of the relay's response to various live/dead conditions. Without this option, control is obtained by DIP switches on voltage monitor board.

Power Supply Status Output

The power supply output relay is energized and its NC output contact is opened when power is applied to the relay. Normal internal relay operating voltage maintains the power supply status output relay in a continuously energized state with its output contact open. If the power supply output voltage falls below the requirements of proper operation, the power supply output relay is deenergized, closing the NC output contact.

Power Supply

One of our power supplies may be selected to provide internal operating power. These are described in Table 1. The burden is given in Table 2.

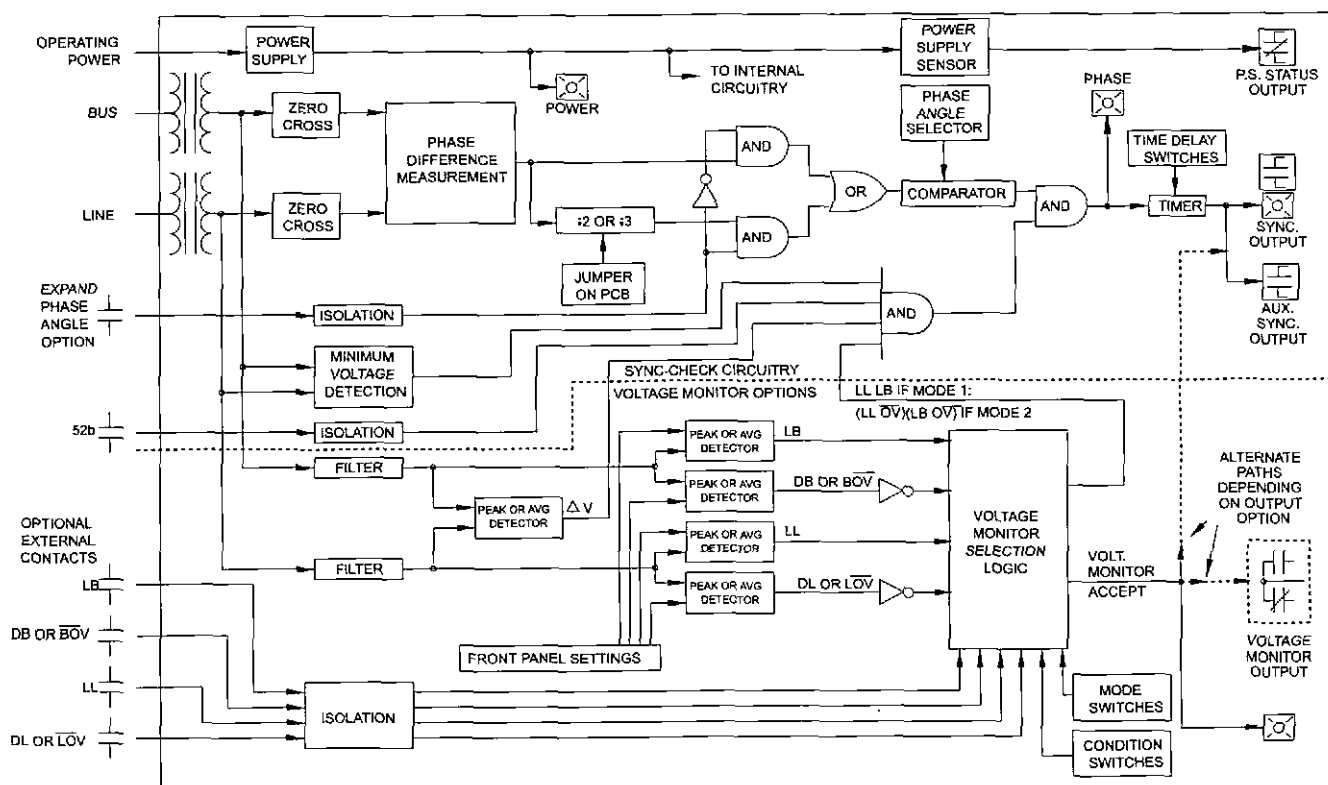


Figure 4 - Functional Block Diagram

SPECIFICATIONS, continued

Type	O	P	R	T*
Nominal Voltage	48 Vdc	125 Vdc 120Vac	24 Vdc	250 Vdc 230 Vac

* External modules required for contact sensing when type T power supply is specified.

Table 1 - Power Supply Options

Relay Configuration	Burden According to Sources of Operating Power						
	50 Hz 100 Vac	60 Hz 120 Vac	125 Vdc	48 Vdc	24 Vdc	250 Vdc	60 Hz 230 Vac
Without Voltage Monitor	12 VA	18 VA	9 W	9W	9W	12 W	28 VA
With Voltage Monitor	20 VA	26 VA	15 W	15 W	15 W	21 W	41 VA

Table 2 - Burden

OUTPUT CONTACTS

Refer to Bulletin SDA

Resistive Rating

ACCURACY

Phase Angle

Phase angle selection is within ± 0.5 or $\pm 5.0\%$ (whichever is greater) of the front panel setting for degrees, for a nominal input frequency of 50/60 Hz, a sensing input range of 80 to 135 volts, and at -25°C . Phase angle setpoint accuracy is ± 0.5 or $\pm 4\%$ (whichever is greater) from a reference measurement at 25°C , at nominal input voltages of 80 to 130 Vac.

OPTIONS

Timing

The time delay is within 25 msec or 5% of the front panel setting for time (whichever is greater) for a nominal input frequency of 50/60 Hz at 25°C . over the full temperature, voltage, and frequency range, accuracy is ± 10 mSec or $\pm 2\%$ (whichever is greater) of the time delay at 25°C . Selection of 00 time delay inhibits the closing of the sync-check output.

Option A6 allows time delay selection in 0.1 second increments over a range of 0.1 to 9.9 seconds, and in 1 second increments over a range of 01 to 99 seconds.

Option A7 provides an adjustable time delay in range of 01-99 cycles in one-cycle increments.

Line and Bus Voltage Monitor

The optional voltage monitor circuitry provides four front panel-mounted controls to define live bus, live

line, dead bus, and dead line limit levels. These controls provide continuous adjustment over the range of 10 to 135 Vac. Four condition switches determine the closing conditions that the relay will recognize. Response time is 50 msec or less.

Voltage Difference (ΔV) Monitor

The front panel control permits continuous adjustment of the allowable limit of voltage difference between the line and bus voltages over a range of 1-135 Vac. The setpoint shall not vary more than 0.5V or 5% (whichever is greater) from a reference measurement at 25°C with nominal input frequency, and with temperature and voltage within specified operating range. This setpoint shall not vary more than 3% from a reading at 25°C over the limited range of $+15$ to $+40^{\circ}\text{C}$.

Targets

Magnetically latched, manually reset, target indicators are optionally available to indicate that an output has tripped. Either internally operated or current operated targets may be specified. Current operated targets require 0.2 A in the output trip circuit to actuate, and trip circuit current must not exceed 20 A for 0.2 seconds, 7 A for 2 minutes, and 3 A continuous. Current operated targets may be selected only when normally open (NO) output contacts have been specified.

SURGE WITHSTAND CAPABILITY

Qualified to ANSI/IEEE C37.90a-1974, Surge Withstand Capability Test and IEC 255, Impulse Test and Dielectric Test.

MECHANICAL

Operating Temperature

-40°C (-40°F) to $+70^{\circ}\text{C}$ ($+158^{\circ}\text{F}$)

Storage Temperature

-65°C (-85°F) to $+100^{\circ}\text{C}$ ($+212^{\circ}\text{F}$)

Weight

13.5 pounds maximum

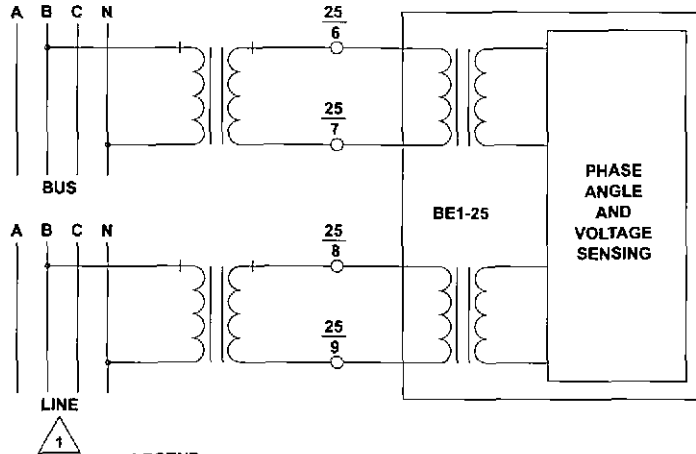
SHOCK

In standard tests, the relay has withstood 15g in each of three mutually perpendicular axes without structural damage or degradation of performance.

VIBRATION

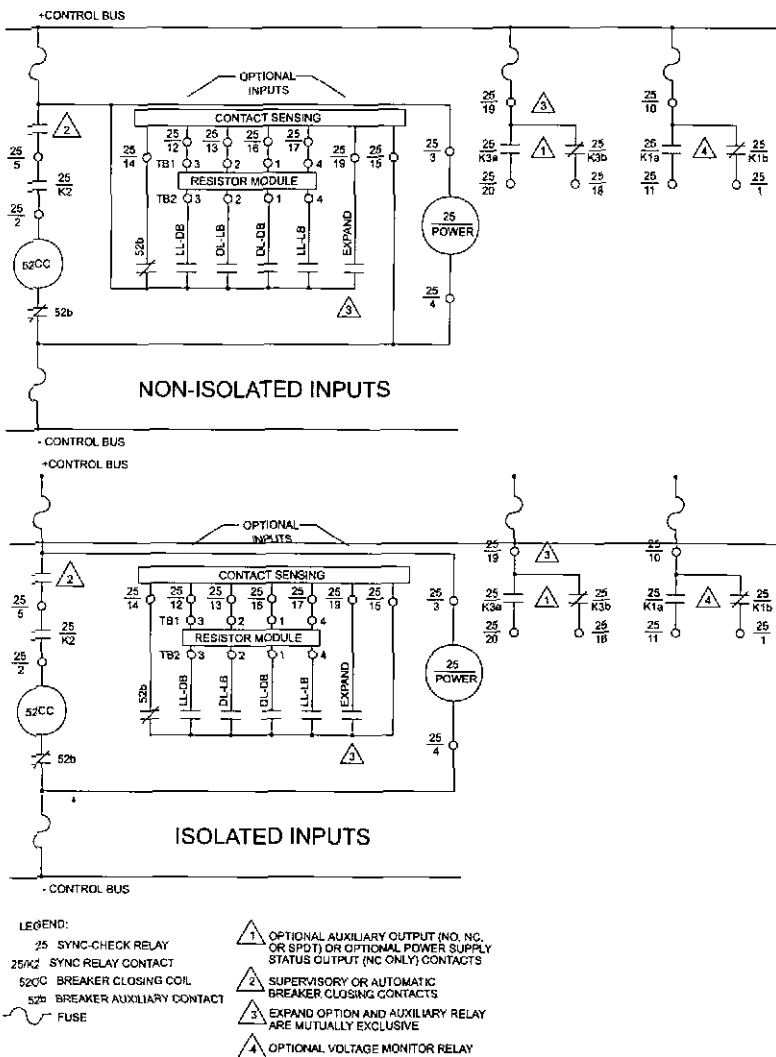
In standard tests, the relay has withstood 2g in each of three mutually perpendicular axes swept over the range of 10 to 500 Hz for a total of six sweeps, 15 minutes for each sweep, without structural damage or degradation of performance.

CONNECTIONS



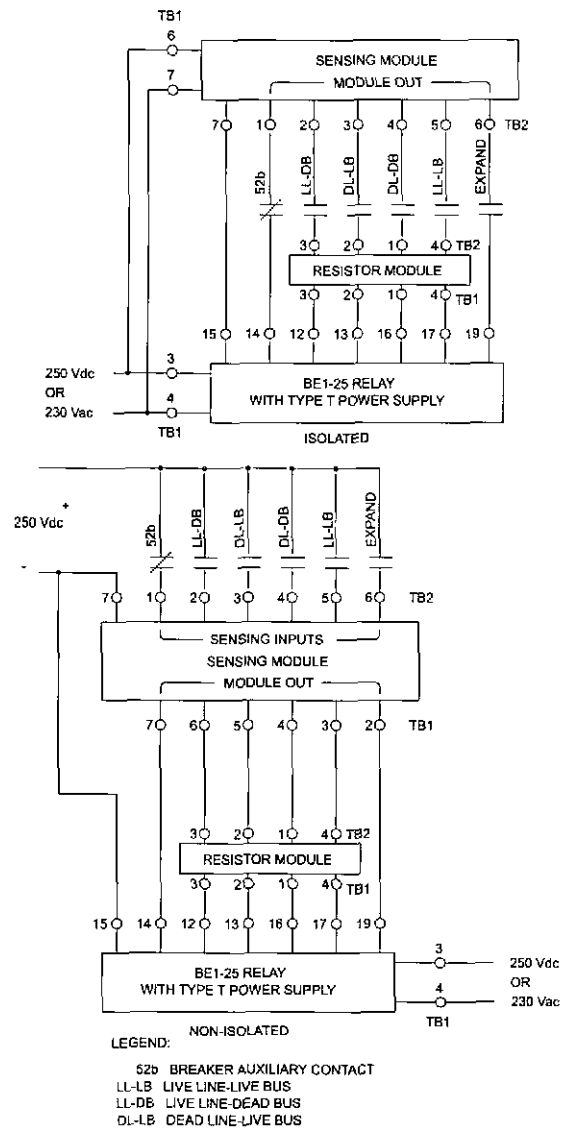
LEGEND:
 25 SYNC-CHECK RELAY
 1 SHOWN LINE-TO-NEUTRAL. COULD ALSO BE WIRED LINE-TO-LINE.

Figure 5 - Voltage and Phase Sensing



LEGEND:
 25 SYNC-CHECK RELAY
 25/K2 SYNC RELAY CONTACT
 52CC BREAKER CLOSING COIL
 52b BREAKER AUXILIARY CONTACT
 FUSE
 1 OPTIONAL AUXILIARY OUTPUT (NO, NC, OR SPDT) OR OPTIONAL POWER SUPPLY STATUS OUTPUT (NC ONLY) CONTACTS
 2 SUPERVISORY OR AUTOMATIC BREAKER CLOSING CONTACTS
 3 EXPAND OPTION AND AUXILIARY RELAY ARE MUTUALLY EXCLUSIVE
 4 OPTIONAL VOLTAGE MONITOR RELAY

Figure 6 - Control Circuit Connections (Typical)



LEGEND:
 52b BREAKER AUXILIARY CONTACT
 LL-LB LIVE LINE-LIVE BUS
 LL-DB LIVE LINE-DEAD BUS
 DL-LB DEAD LINE-LIVE BUS

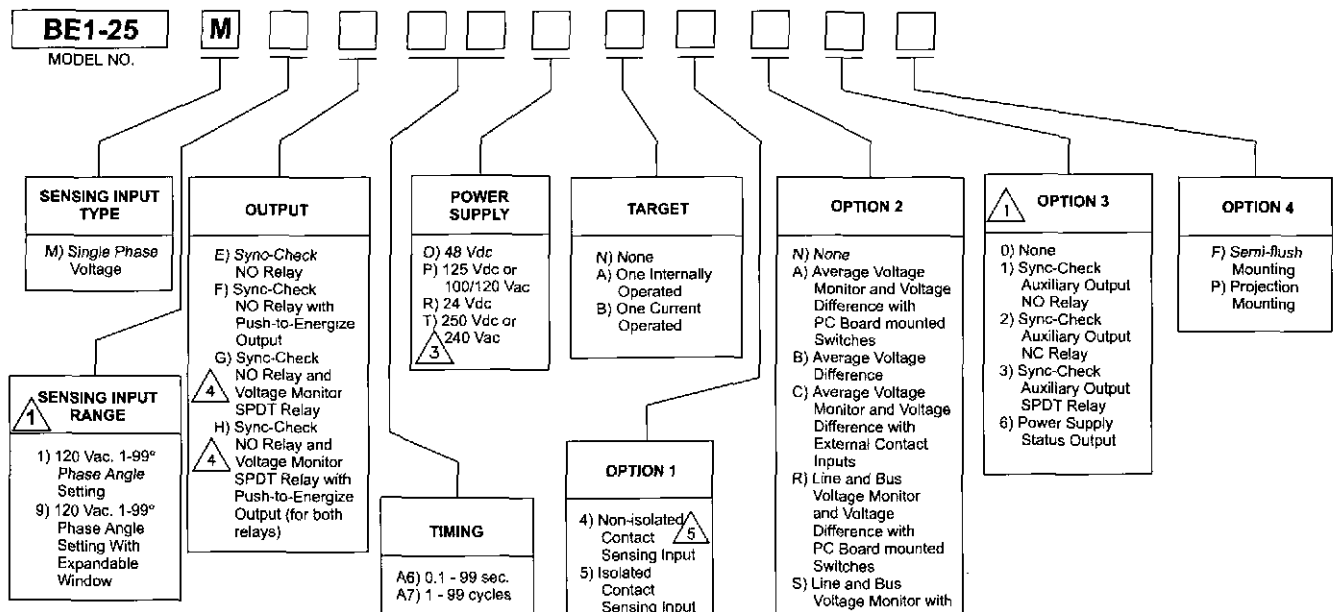
Figure 7 - Contact Sensing Using Modules (Only for Relays with Type T Power Supply)

ORDERING

SAMPLE STYLE NUMBER

The style number **BE1-25M1EA6PN4R0F** describes a BE1-25 Sync Check Relay having the following features:

- (M) - Sensing Input Type - Single-phase voltage
- (1) - Sensing Input Range - 120 Vac nominal 1-99° phase setting
- (E) - Output - Sync-check, NO
- (A6) - Timing - 0.1 to 99 seconds
- (P) - Power Supply - 125 Vdc or 100/120 Vac external power source
- (N) - Target - None
- (4) - Option 1 - Nonisolated contact sensing
- (R) - Option 2 - Line and bus voltage monitor with voltage difference, and PC board mounted switches
- (0) - Option 3 - None
- (F) - Option 4 - Semi-flush mounting



CONTACT SENSING MODULES
(Required when Type T Power Supply is specified)

Relay Options	Number of Contacts Sensed	Module Ordering Number	
		Isolated Contact Sensing	Non-Isolated Contact Sensing
Voltage Monitor with External Contact Inputs plus Expandable Phase Window	6	9170206100	9170206106
Voltage Monitor with External Contact Inputs	5	9170206101	9170206107
Expandable Phase Window	2	9170206104	9170206110
None of the above	1	9170206105	9170206111

- NOTES:**
- 1. When Sensing Input Range "9" is selected from the style chart, Option 3 must be "0".
 - 2. All relays are supplied in an "S1" size case.
 - 3. Requires Contact Sensing Module. See chart.
 - 4. Not available if Option 2 is "N", "B", or "T".
 - 5. Non-isolated Contact Sensing requires DC power.

STANDARD ACCESSORIES:

The following accessories are available for the BE1-25 Sync-Check Relay.

Test Plug

To allow testing of the relay without removing system wiring, order two test plugs, Basler Electric part number 10095.

Extender Board

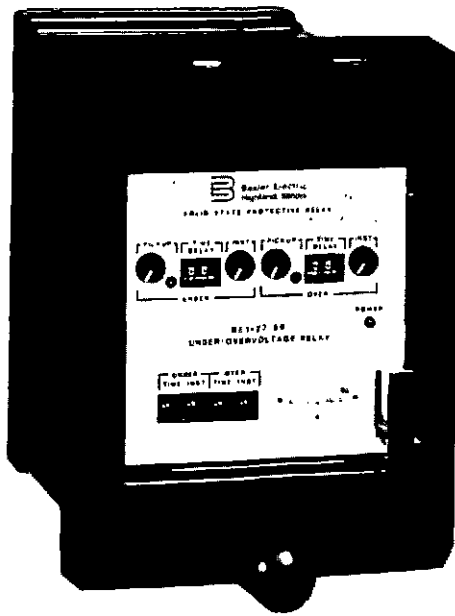
The extender board permits troubleshooting of the printed circuit board outside of the relay cradle. Order Basler Electric part number 9165500100.



ROUTE 143, BOX 269, HIGHLAND, ILLINOIS U.S.A. 62249
PHONE 618-654-2341 FAX 618-654-2351

P.A.E. Les Pins, 67319 Wasselonne Cedex FRANCE
PHONE (33-3-88) 87-1010 FAX (33-3-88) 87-0808

<http://www.basler.com>, info@basler.com



**BE1-27, BE1-59
BE1-27/59
VOLTAGE RELAYS**

The BE1-27 Undervoltage, BE1-59 Overvoltage and BE1-27/59 Under/Overvoltage Relays' solid-state design provides a reliable response to protect power system equipment from adverse voltage conditions.

ADVANTAGES

- Pickup continuously adjustable over a wide range.
- Instantaneous functions offer immediate response to extreme voltage conditions.
- Individually adjustable definite, short inverse, medium inverse, or long inverse timing for each time-delayed under/overvoltage function.
- Low sensing and supply burdens.
- Warranty 5 years.

ADDITIONAL INFORMATION

INSTRUCTION MANUAL

Request Publication 9170600990

STANDARDS, DIMENSIONS and ACCESSORIES

Request Bulletin SDA

APPLICATION Page 2
SPECIFICATIONS Pages 3 - 5
EXTERNAL CONNECTIONS Page 6
ORDERING INFORMATION Pages 7 and 8



APPLICATION

PURPOSE

The BE1-27 Undervoltage, BE1-59 Overvoltage and the BE1-27/59 Under/Overvoltage Relays are solid-state devices which provide reliable protection for generators, motors, and transformers against adverse system voltage conditions.

APPLICATION

Electric power systems are designed to operate with relatively constant voltage. Loads utilizing commercial electric power are designed to operate at a constant input voltage level with some tolerance. Radical voltage variations on a power system are indicative of a system malfunction. Protective relays which monitor system voltage and provide an output signal when the voltage goes outside predetermined limits find a variety of applications. Some of these applications include motor and transformer protection, interface protection for cogeneration systems, ground fault detection, and supervision of automatic transfer switching schemes.

Motor Protection

When selecting the type of protection for motor applications, the motor type, voltage rating, horsepower, thermal capability during start-up, and exposure to automatic transfer restarting following a voltage interruption need to be considered. During motor start-up, a low terminal voltage condition will inhibit the motor from reaching rated speed. The BE1-27 undervoltage relay will detect this low voltage condition and trip. Critical applications requiring continuous motor operation and applications where overloads during start-up may be maintained for a given time period usually have a definite time or inverse time delay characteristic incorporated to avoid unnecessary tripping during low voltage dips. If the undervoltage condition persists for the established time delay, the relay output contacts are used to either trip the unit off line or sound an alarm at the annunciator panel, allowing the station operator to take corrective action. The BE1-59 Overvoltage relay is applied to insure the voltage does not exceed the limits established by the machine manufacturer for proper operation. Overvoltage conditions stress the insulation level of the equipment and may cause a dielectric breakdown, resulting in a flashover to ground.

Automatic Transfer Switching

Distribution substations are sometimes designed with duplicate supply circuits and transformers to eliminate service interruptions due to faults located on the primary feeder. In order to restore service within a given acceptable time period, automatic transfer switching can be applied to initiate the throwover from primary power to the

alternate power source. The BE1-27 Undervoltage Relay can initiate switching after a given time delay to avoid transfer switching during temporary low voltage conditions. To return the substation to normal service upon the restoration of primary voltage, the BE1-59 overvoltage relay supervises the transition to its normal operating condition.

Cogeneration

Utilities employ the use of a voltage check scheme to supervise reclosing at the substation when cogenerators are connected to a radial distribution feeder and the cogenerator is capable of supplying the entire load when the utility circuit breaker is open. During a faulted condition, the utility requires the cogenerator to be disconnected from the system before reclosing the utility breaker. If the cogenerator remains connected to the system, the utility may attempt to reclose onto an energized line. This could result in reconnecting two systems out of synchronism. The BE1-27 undervoltage relay monitoring the line voltage at the substation will inhibit reclosing of the utility circuit breaker if the line remains energized by the cogenerator.

At the interface between the utility and the cogenerator, overvoltage and undervoltage relays are installed as minimum protection to provide an operating voltage window for the cogenerator. During faulted conditions when the cogenerator may become overloaded, the BE1-27 Undervoltage Relay will detect the decline in voltage and remove the cogenerator from the system. The BE1-59 Overvoltage Relay will protect the system from overvoltage conditions that may result when power factor correction capacitors are located on the feeder.

Transformer Protection

Voltage relays can be applied to protect large transformers from damage as a result of overexcitation. The concern for transformer overvoltage may be minimized in many power system applications where proper voltage control of the generating unit is provided. However, where a tap changing regulating transformer is located between the generating source and the load, some form of voltage protection may be required to supplement the tap changing control and to prevent equipment damage due to over, as well as undervoltages resulting from a failure of the tap changing control. The BE1-27/59 Under/Overvoltage Relay is well suited for these applications.

Ground Fault Detection

In a three-phase, three-wire system, a single conductor may break or the insulation may deteriorate resulting in a high resistance ground fault which may be sensed by an overvoltage relay connected to a grounded wye, broken delta set of voltage transformers (VT's).

SPECIFICATIONS

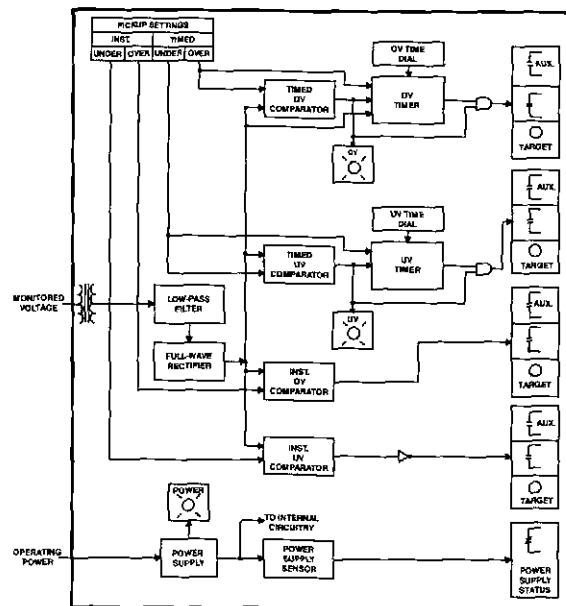


Figure 1 - Functional Block Diagram

FUNCTIONAL DESCRIPTION

The specifications on these pages define the many features and options that can be combined to exactly satisfy an application requirement. The block diagram, Figure 1, illustrates how the various standard features, as well as options, function together.

INPUTS

Voltage Sensing

A system voltage transformer with standard 120/240 Volt secondary supplies the Under/Overvoltage Relay's input transformer with a single-phase voltage from the monitored circuit. This voltage is scaled, filtered, and rectified to represent the voltage magnitude of the monitored circuit.

Nominal sensing input ratings, defined by the style number, are 120 or 240 Vac with a maximum burden of 1 VA single phase at 40 to 70 Hz. The maximum continuous voltage rating is 360 Vac for 120 Vac nominal, and 480 Vac for 240 Vac nominal.

System Voltages

The BE1-27, BE1-59, and BE1-27/59 relays are available with three sensing input ranges. The 55 to 160V range is intended for use with nominal system voltages of 120V or 69V ($120/\sqrt{3}$). The 110 to 320 volt range is intended for use with nominal system voltages of 240V, 208V ($120 \times \sqrt{3}$), or 277V ($480/\sqrt{3}$). The 1 to 40V range is intended for use with a wye/broken delta VT configuration with 120V or 69V ($120/\sqrt{3}$) line-to-ground secondary voltages.

Power Supply

One of five power supply types may be selected to provide internal operating power. They are described in Table 1.

Table 1 - Power Supply Options

Type	K	J	L	Y	Z
Nominal Voltage	48 Vdc	125 Vdc 120 Vac	24 Vdc	48 Vdc 125 Vdc	250 Vdc 230 Vac
Burden	6.5 W	7.5 W 19 VA	7.0 W	6.5 W 7.5 VA	9.5 W 25.0 VA

PICKUP SETTINGS

Front panel potentiometers, continuously adjustable over the range defined by the style number, establish the voltage pickup levels. One potentiometer is provided for each timed and instantaneous function. Actual pickup is within 2% of 0.5 volt of the setting, whichever is greater. Dropout is within 2% of actual pickup, occurring in 50 milliseconds or less.

PICKUP COMPARATORS

The monitored system voltage is compared individually to each pickup setting. When the system voltage is greater than the timed overvoltage setting, the appropriate pickup

SPECIFICATIONS, continued

indicator is illuminated and the corresponding time delay circuit is initiated. If the adverse voltage condition is present at the end of the programmed time delay, the appropriate output relay is energized and, if present, the associated target indicator is enabled.

TIMING

Timed functions are available with instantaneous, definite, short inverse, medium inverse, or long inverse timing characteristics. Timing characteristics are individually selectable for undervoltage and overvoltage functions. Definite time is adjustable from 0.0 to 9.9 seconds in 0.1 second increments and accurate within 5% or 50 milliseconds (whichever is greater) of the setting. Inverse time is adjustable from 00 to 99 in increments of 01. The setting defines a curve as illustrated in Figure 2. Inverse timing is accurate within 5% of the time described by the curve. A setting of 00 will produce an instantaneous response on either definite or inverse timing.

INSTANTANEOUS FUNCTIONS

Instantaneous undervoltage and overvoltage functions are available to provide immediate response to extremely adverse voltage conditions.

When the system voltage is greater than the instantaneous overvoltage setting or less than the instantaneous undervoltage setting, the appropriate output relay is energized and, if present, the associated target indicator is enabled. This occurs in less than 50 milliseconds when the instantaneous pickup setting is exceeded by 1 volt or 5%, whichever is greater.

POWER SUPPLY STATUS OUTPUT

The power supply output relay is energized and its NC output contact is opened when power is applied to the relay. Normal internal relay operating voltage maintains the power supply status output relay in a continuously energized state with its output contact open. If the power supply output voltage falls below the requirements of proper operation, the power supply output relay is de-energized, closing the NC output contact.

TARGETS

Magnetically latched, manually reset, target indicators are optionally available to indicate that an output has tripped. Either internally operated or current operated targets may be specified. Current operated targets require 0.2A in the output trip circuit to actuate, and trip circuit current must not exceed 30A for 0.2 seconds, 7A for 2 minutes, and 3A continuous. Current operated targets may be selected

only when normally open (NO) output contacts have been specified.

OUTPUTS

Output contacts are rated as follows:

Resistive

120/240 Vac - make 30A for 0.2 seconds, carry 7A continuously, break 7A.

250 Vdc - make and carry 30A for 0.2 seconds, carry 7A continuously, break 0.1A.

500 Vdc - make and carry 15A for 0.2 seconds, carry 7A continuously, break 0.3A.

Inductive

120/240 Vac, 125 Vdc, 250 Vdc - break 0.3A
(L/R = 0.04).

Push-to-Energize Output Pushbuttons

Applying a thin non-conducting rod through a hole in the front panel energizes each output relay for testing the external trip circuits.

SURGE WITHSTAND CAPABILITY

Qualified to IEEE C39.90.1-1989, Surge Withstand Capability Test and IEC 255, Impulse Test and Dielectric Test.

MECHANICAL

Operating Temperature

-40°C (-40°F) to +70°C (+158°F).

Storage Temperature

-65°C (-85°F) to +100°C (+212°F)

Weight

14 pounds

Shock

In standard tests, the relay has withstood 15g in each of three mutually perpendicular axes without structural damage or degradation of performance.

Vibration

In standard tests, the relay has withstood 2g in each of three mutually perpendicular axes swept over the range of 10 to 500 Hz for a total of six sweeps, 15 minutes for each sweep, without structural damage or degradation of performance.

SPECIFICATIONS, continued

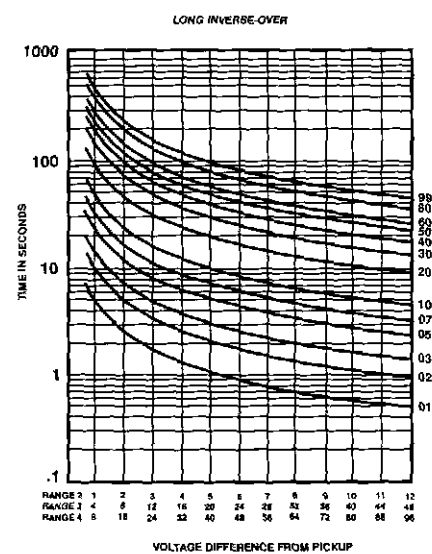
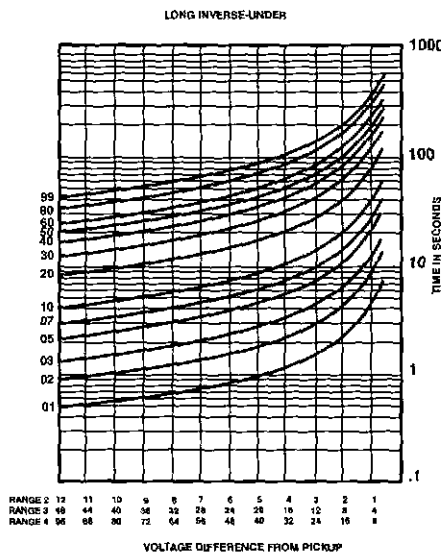
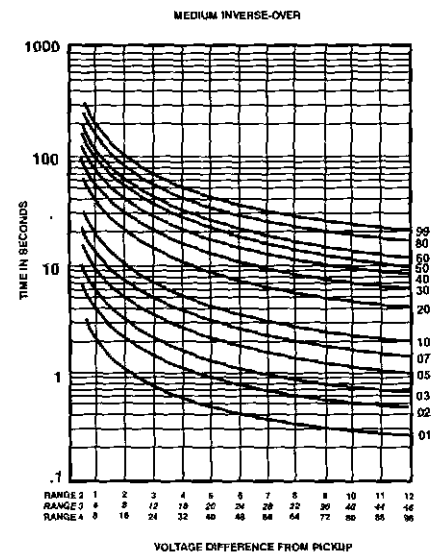
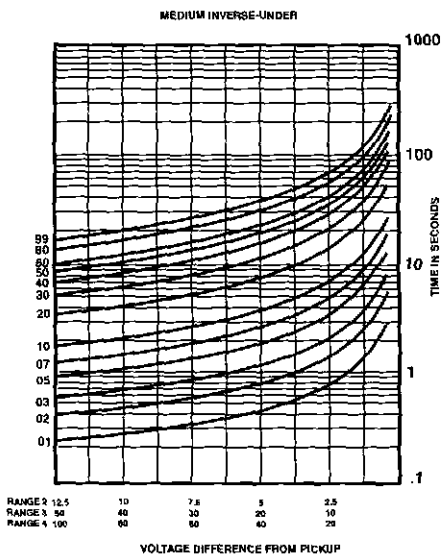
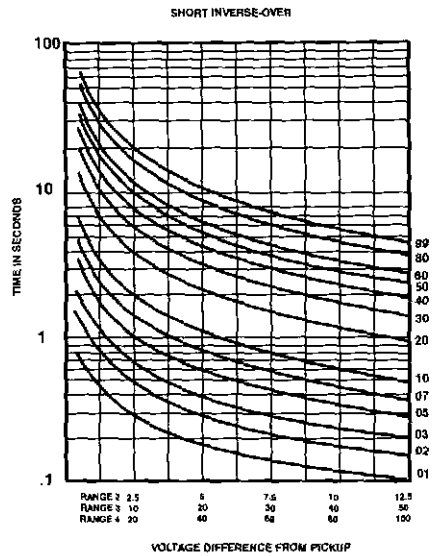
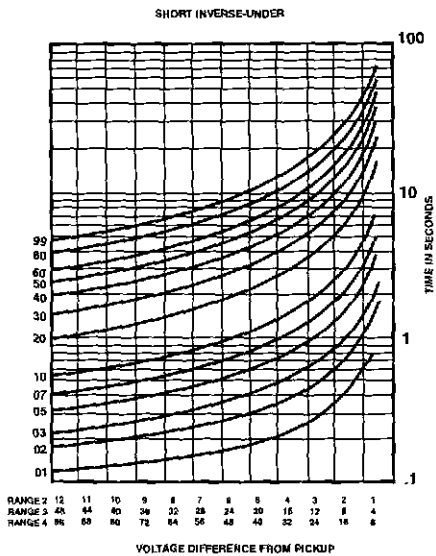


Figure 2 - Inverse Timing Characteristic Curves

CONNECTIONS

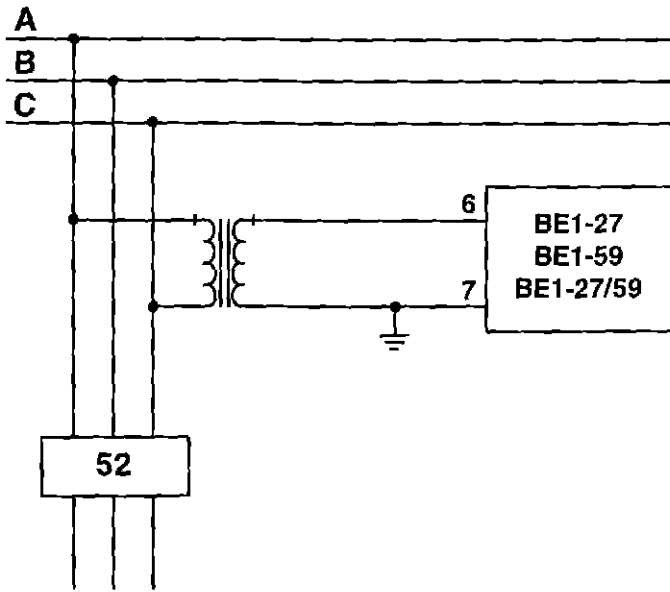


Figure 3 - Voltage Sensing

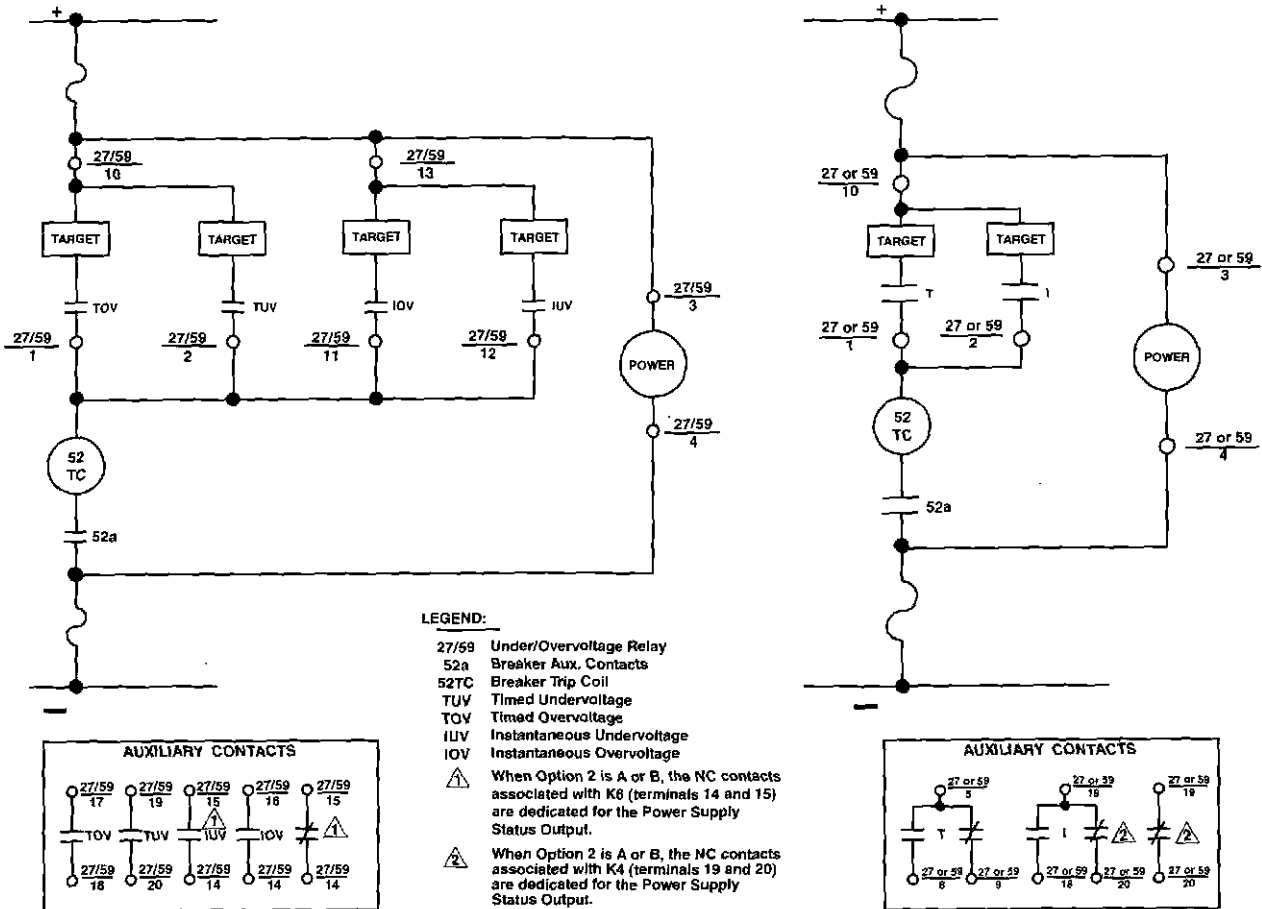
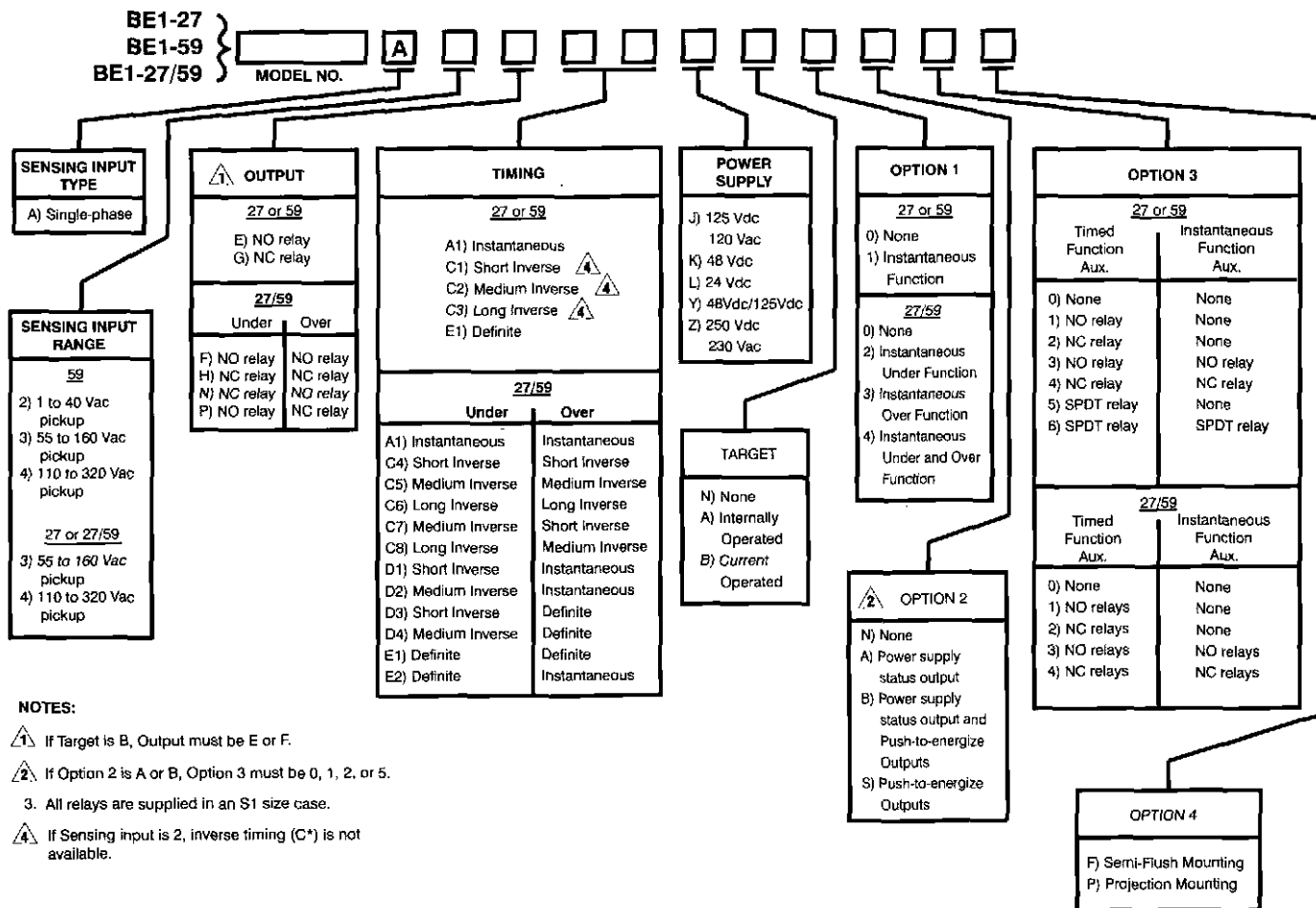


Figure 4 - Control Circuits

STYLE NUMBER IDENTIFICATION CHART



NOTES:

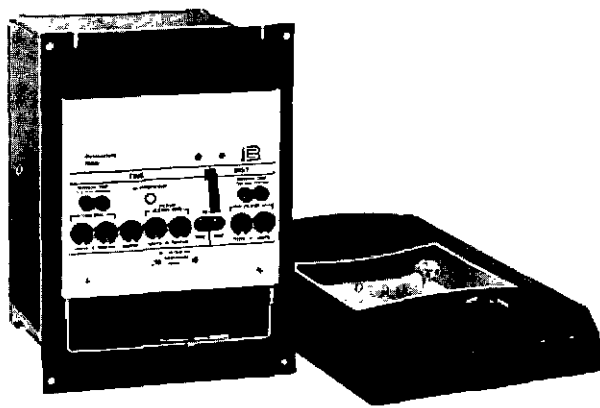
- ⚠ If Target is B, Output must be E or F.
- ⚠ If Option 2 is A or B, Option 3 must be 0, 1, 2, or 5.
- 3. All relays are supplied in an S1 size case.
- ⚠ If Sensing input is 2, inverse timing (C*) is not available.



ROUTE 143, BOX 269, HIGHLAND, ILLINOIS U.S.A. 62249
PHONE 618-654-2341 FAX 618-654-2351

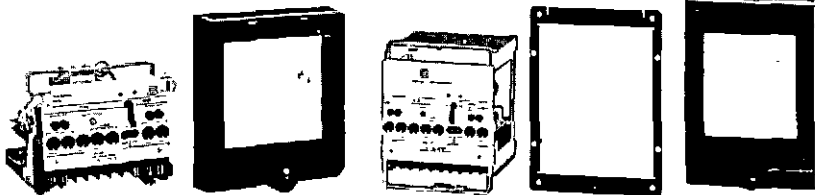
P.A.E. Les Pins. 67319 Wasselonne Cedex FRANCE
PHONE (33-3-88) 87-1010 FAX (33-3-88) 87-0808

<http://www.basler.com>, info@basler.com



BE1-50/51B in S1 Case

BE1-50/51B
TIME OVERCURRENT RELAY
and RETROFIT KITS
 219, 226 and 214, 225: CO and IAC
 218: IAC Complete Replacement



BE1-50/51B-219, 226

BE1-50/51B-214, 225

The BE1-50/51B Time Overcurrent Relay provides economical overload and fault protection for generators, transformers, lines and motors.

ADVANTAGES

- Self powered from 50/60Hz systems, available for 5 or 1 amp CT secondaries.
- Models available to replicate decaying reset of electromechanical relay disks when current goes to zero.
- Ten field selectable curves.
- Independent instantaneous overcurrent function.
- Drawout construction, testable in the case.
- Qualified to the requirements of:
 - IEEE C37.90-1989, C37.90.1-1989, C37.90.2-1989, UL508
- Five year warranty.

ADDITIONAL INFORMATION

INSTRUCTION MANUAL

Request Publication 9252000991

RETROFIT KITS

Request Publication 9252000994 (214, 225)

Request Publication 9252000995 (218)

Request Publication 9252000981 (219, 226)

TIMING CURVES

Request Publication 9252000998 for IAC curves

Request Publication 9252000999 for CO and BS142 curves

STANDARDS, DIMENSIONS and ACCESSORIES

Request Publication SDA

<p>FEATURES and APPLICATION Page 2</p>
<p>FUNCTIONAL DESCRIPTION Page 3 - 6</p>
<p>SPECIFICATIONS Page 7</p>
<p>RETROFIT INFORMATION Pages 8 and 9</p>
<p>ORDERING INFORMATION Page 10</p>

B Basler Electric

ROUTE 143, BOX 269 HIGHLAND, ILLINOIS 62249, U.S.A. PHONE 618-654-2341 FAX 618-654-2351

UHD-8
8-01

FEATURES

- Ten field selectable, inverse, fixed time and British Standard (BS142) time overcurrent curves.
- Instantaneous overcurrent function.
- Wide setting ranges:
 - Time Overcurrent: 0.5 to 15.9 (5 Amp Unit)
 - 0.1 to 3.18 (1 Amp Unit)
- Inst. Overcurrent: 1 to 99 (5 Amp Unit)
- 0.2 to 19.8 (1 Amp Unit)
- Current pickup accuracy $\pm 2\%$.
- Timing accuracy $\pm 2\%$.
- Less than 10% transient overreach.
- Zero Pickup setting for safety during installation.
- Timed Overcurrent Reset - Selectable Instantaneous or Decay Characteristic.
- 5VA burden (at nominal) self powered from 50/60 Hz systems, utilizes standard 5 or 1 Amp CT secondaries.
- Drawout construction.
- Manual method for trip circuit testing.
- Standard magnetically latched targets for TOC and IOC.
- Direct reading front panel controls.
- UL recognized under standard 508.
- Qualified to the requirements of:
 - IEEE C37.90.1-1989 for SWC.
 - IEEE C37.90.2-1989 for RFI.
 - IEC 255-5 for impulse.
- Continuous automatic calibration.
- Time characteristics extend to 40 X Pickup.
- Positive visual indication that microprocessor is executing code.
- Two year warranty.

APPLICATION

The BE1-50/51B is a single phase self powered, micro-processor based time overcurrent relay. The relay is designed for use in applications requiring time delayed coordination for phase or ground overcurrent conditions.

The relay can be used to provide coordinated protection for overhead and underground distribution circuits. Other applications include overcurrent back-up protection for transformers and generators, and the protection of neutral grounding resistors and reactors.

Since all of the time-current characteristics are included within the relay, a standard relay may be ordered before the coordination study is completed, thereby allowing the physical construction to proceed. This is also an advantage as changes in the system configuration or coordination may be accomplished without a hardware change. Table 1 lists typical applications for each of the time-current characteristic curves.

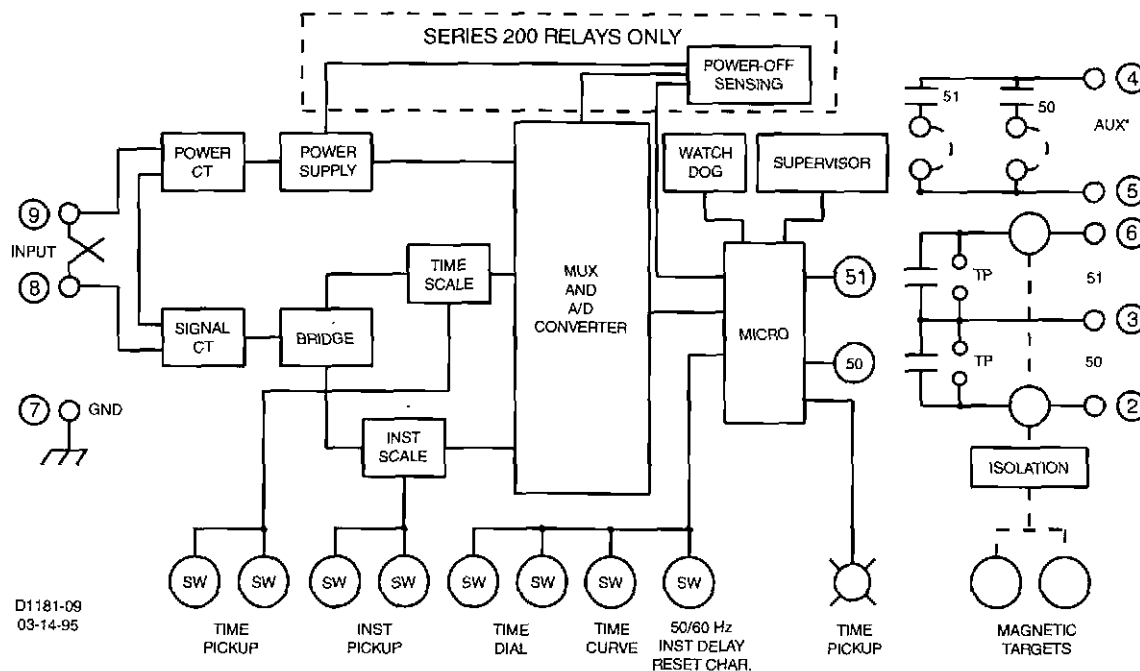
Models are included (200 series) which have memory to replicate the decaying reset of electromechanical relays even when power to the relay is lost. Use the 200 series for applications that require coordination with the resetting of nearby electromechanical relays.

The instantaneous overcurrent element is standard in the relay. This element is designed to minimize transient overreach. The instantaneous element includes selectable delay characteristics for improved coordination with downstream devices and customer requirements.

Table 1 - Time-Current Characteristics

CHARACTERISTIC CURVE		TYPICAL PROTECTIVE APPLICATION	APPLICATION COMMENTS
SWITCH DESIGNATION	NAME		
S	Short Inverse	Generator or Bus	Relatively short time, desirable where preserving system stability is a critical factor.
L	Long Inverse	Motors	Provides protection for starting surges and short duration overloads.
D	Definite Time	General Use	Timing relatively independent of current. Useful in sequential tripping schemes.
M	Moderately Inverse	Transmission and feeder lines. Useful for both phase and ground application.	Accommodates moderate load changes, as may occur on parallel lines where one line may occasionally have to carry both loads.
I	Inverse	Feeder lines or back-up protection for other types of relays.	Provides additional variations of the inverse characteristic, thereby allowing flexibility in meeting load variations, or in coordinating with other relays.
V	Very Inverse		
E	Extremely Inverse		
B	BS142 Very Inverse		
C	BS142 Extremely Inverse		
F	Fixed Time	General Use	Fixed time delay defined by dial setting. Useful in sequential tripping schemes.

FUNCTIONAL DESCRIPTION



* Aux. output is not provided on IAC or CO replacement units.

Figure 1 - Functional Block Diagram

CURRENT INPUT

A single phase of ac current from a 5 Amp, or 1 Amp, 50/60 Hz, system current transformer (CT) is applied to the BE1-50/51B. This input current provides both the power and sensing quantity for the relay.

The current applied to the relay provides the energy for the internal power supply. When sufficient current is available, the Active/Pickup LED will turn green. In applications where circuit loading conditions are less than that required to illuminate the LED, the relay remains operable and will provide overcurrent protection.

The sensing input transformer provides the quantity to be scaled and measured by the Time and Instantaneous functions. Ranges, ratings, and accuracies apply as described in Table 2.

Scaling of the input signal is accomplished by separate networks for the time and instantaneous functions. The scale factors are established by the front panel pick-up settings. Pickup settings of 00 provide maximum sensitivity as a safety precaution for the installation process. Pickup will occur when the input current level is adequate to power the unit.

MICROPROCESSOR

The setting of the TIME DIAL, TIME CURVE selector switch, and circuit board jumpers provide the microprocessor with ten operating parameters for the desired response by the relay. The microprocessor performs the program operations based on the input current level and internal software program. When the Active/Pickup LED is green, the microprocessor is active and executing code.

Operating power from the power supply is applied to the microprocessor supervisor circuit. When the input current falls below an acceptable level, the supervisor circuit interrupts the microprocessor and halts further operation.

The watchdog timer monitors the microprocessor for specific pulses indicating proper program operation. If something occurs to disrupt the microprocessor, these pulses stop, the watchdog timer times out and sends a reset pulse to the microprocessor. The microprocessor resets and resumes normal operation.

Table 2 - Current Sensing Capabilities

50/60 Hz System CT Secondary	Time Element Pickup Range	Time Element Max. Continuous Current	Time Element Max. Current For 1 Second	Instantaneous Pickup Range	Time Element Pickup Accuracy	Instantaneous Pickup Accuracy
5 Amp	0.5 to 15.9 Amps in 0.1 Amp Steps	14 Amps	400 Amps	1 to 99 Amps in 1 Amp Steps	2% from 0.5 to 15.9 Amps	2% from 1 to 99 Amps
1 Amp	0.1 to 3.18 Amps in .02 Amp Steps	2.8 Amps	80 Amps	0.2 to 19.8 Amps in 0.2 Amp Steps	2% from 0.1 to 3.18 Amps	2% from 0.2 to 19.8 Amps

FUNCTIONAL DESCRIPTION, continued

OUTPUTS

The TIME contacts (51 and 51AUX) are closed in accordance with conditions defined by the selected time characteristic equation and the sensed current magnitude. If the sensed current exceeds the INST PICKUP setting, the INST contacts (50) are closed.

Breakers controlled by the output contacts can be manually trip tested by inserting a jumper between the TIME and INST MANUAL TRIP test points on the front panel.

TIME ELEMENT CHARACTERISTIC SHAPES FOR CO and BS142 CURVES

All time characteristic curves follow the relation:

$$T_T = \frac{AD}{M^N-C} + BD + K = \text{Time to trip}$$

$$T_R = \frac{RD}{M^2-1} = \text{Time for decaying reset}$$

Table 3.

Curve Type	Constants					
	A	B	C	N	K	R
S	0.2663	0.03393	1.000	1.2969	0.028	0.500
L	5.6143	2.18592	1.000	1.0000	0.028	15.750
D	0.4797	0.21359	1.000	1.5625	0.028	0.875
M	0.3022	0.12840	1.000	0.5000	0.028	1.750
I	8.9341	0.17966	1.000	2.0938	0.028	9.000
V	5.4678	0.10814	1.000	2.0469	0.028	5.500
E	7.7624	0.02758	1.000	2.0938	0.028	7.750
B	1.4636	0.00000	1.000	1.0469	0.028	3.250
C	8.2506	0.00000	1.000	2.0469	0.028	8.000
F	0.0000	1.00000	0.000	0.0000	0.000	1.000

S=Short Inverse M=Moderately Inverse B=BS142 Very Inverse
 L=Long Inverse I=Inverse C=BS142 Extremely Inverse
 D=Definite Time V=Very Inverse F=Fixed Time
 E=Extremely Inverse

Where **D** is the time dial setting (0.0 to 9.9) and **M** is the multiple of pickup. **A, B, C, N, K and R** are constants defining the shape of the curve. The constants have been selected to provide a very close match to the characteristics of electromechanical relays. The constants are provided in Table 3 for each characteristic curve shape. Figure 2 illustrates the characteristic shapes. Constants for IAC curves can be found in the manuals provided with 200 series models.

The Active/Pickup LED on the front panel will turn red when the applied current just exceeds the PICKUP setting (See Figure 4).

RESET

Reset occurs when the current level is less than pickup. Internal switch provides selection of either an Instantaneous or a decaying reset characteristic.

The instantaneous reset characteristic forces the timer to zero when the input current falls below 95% of setting. This fast reset characteristic prevents the ratcheting effect on electro-mechanical relay disks that occurs for repeated faults.

The decaying reset characteristic replicates the decaying reset of electromechanical relay disks. Models with dash numbers in the 200 series continue the decaying process even when the input current goes to zero. Models with dash numbers in the 100 series reset immediately when the input current drops below the minimum required to power-up the relay (.5A for 5A models and 0.1A for 1A models).

TIME DIAL RANGE AND ACCURACY

The TIME DIAL range is 0.0 to 9.9 in 0.1 steps. A setting of 0.0 results in instantaneous operation without intentional time delay.

INSTANTANEOUS ELEMENT CHARACTERISTICS

The characteristic for phase faults is faster because the relay will be powered-up. However, the tripping characteristic for ground applications is slightly longer to allow time to power-up the relay. This longer trip time for ground applications is beneficial because it helps avoid nuisance trips. These timing characteristics are shown in Figure 3.

Additional definite time delays of 0.1, 0.2 or 0.3 seconds may be added to the instantaneous element on 100 series units; 200 series units have only 0.1 seconds. The definite delay is determined by switches on the circuit card.

OUTPUTS

Separate output contacts are provided for the TIME (51) and INST (50) trip functions. An additional auxiliary output relay (51 AUX) is included. This output operates simultaneously with the TIME output relay. All output contacts are configured normally open (NO).

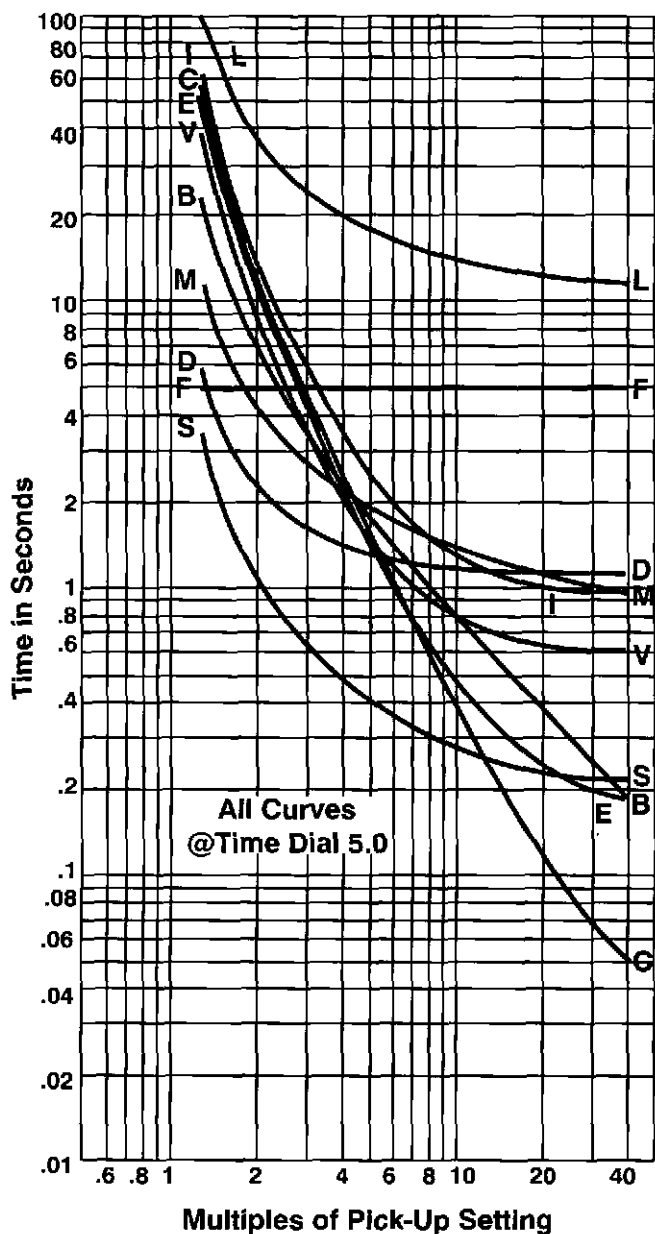
MANUAL TRIP TESTING

The relay is provided with front panel test points to allow shorting the output terminals to verify external control circuit wiring.

TARGETS

Two target indicators are provided as a standard feature of the BE1-50/51B. These magnetically latched, current operated targets provide visual indication of trip by the TIME or INST output contact. These targets must be manually reset after the abnormal condition has been removed or corrected.

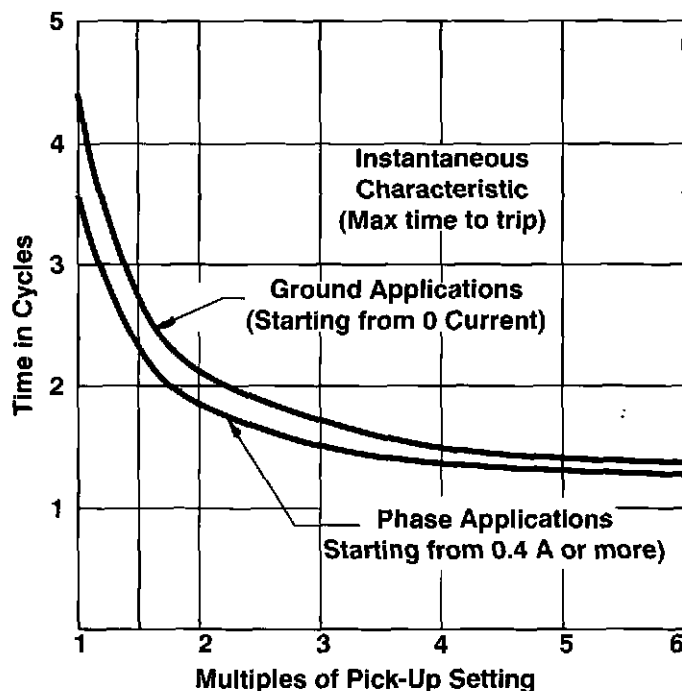
FUNCTIONAL DESCRIPTION, continued



CO and BS142 curves in both 100 and 200 series models:

- | | | |
|-----------------|----------------------|---------------------------|
| S=Short Inverse | M=Moderately Inverse | B=BS142 Very Inverse |
| L=Long Inverse | I=Inverse | C=BS142 Extremely Inverse |
| D=Definite Time | V=Very Inverse | F=Fixed Time |
| | E=Extremely Inverse | |

Figure 2 - Time-Current Characteristics

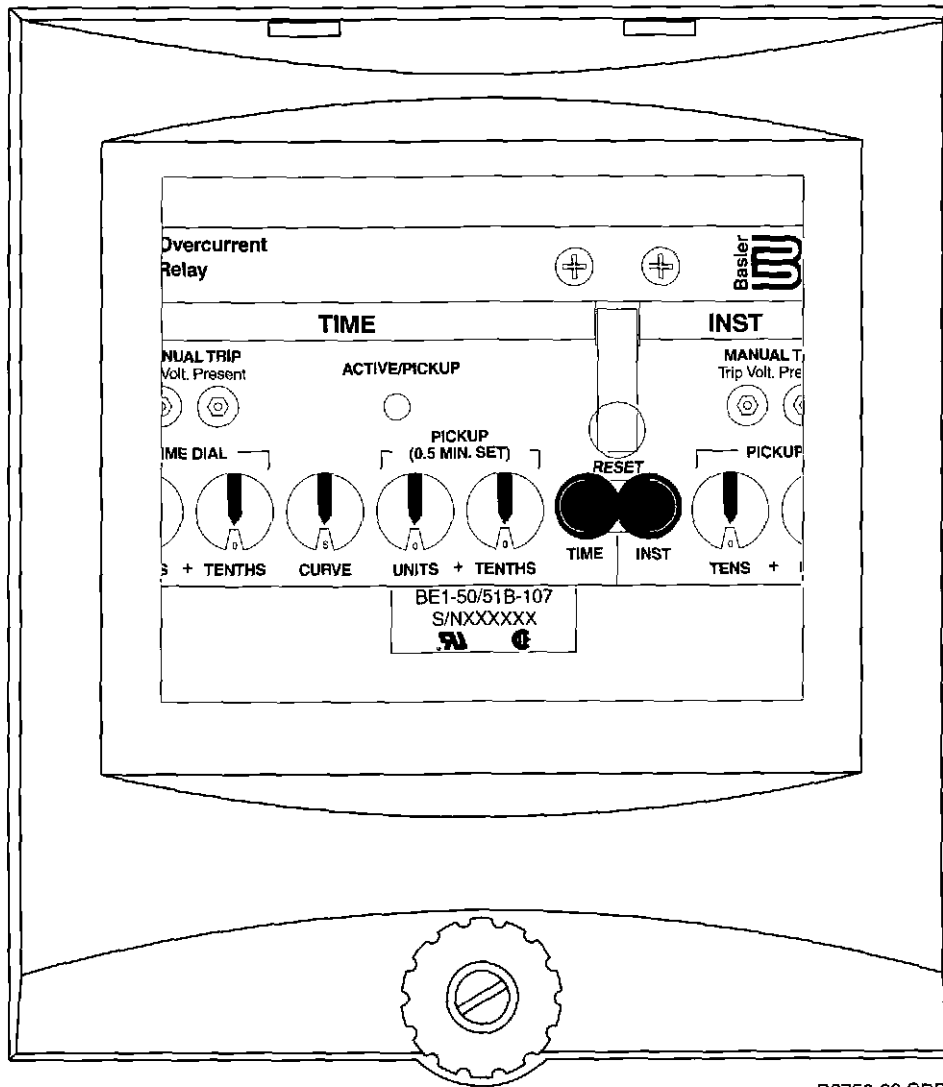


IAC curves in 200 series models only:

- Short Inverse
- Inverse
- Very Inverse
- Extremely Inverse
- Long Inverse

Figure 3 - Instantaneous Characteristics

FUNCTIONAL DESCRIPTION, continued



D2750-22.CDR
12-04-00

Figure 4 - Front Panel, S1 Case

SPECIFICATIONS

CURRENT SENSING INPUT:	Continuous Current	One Second Current
5 Amp Unit	14.0 Amps	400 Amps
1 Amp Unit	2.8 Amps	80 Amps

TIME PICKUP RANGE:

5 Amp Unit: 0.5 to 15.9 Amps in 0.1 Amp steps
 1 Amp Unit: 0.1 to 3.18 Amps in 0.02 Amp steps

TIME DROPOUT:

Not less than 95% of pickup value.

TIME PICKUP ACCURACY:

± 2% of setting

TIME DIAL RANGE:

0.0 to 9.9 in 0.1 steps

TIME CHARACTERISTICS:

Nine inverse time and 1 fixed time function can be selected by a front panel switch. Characteristic curves are defined by the time characteristic equation. The fixed time characteristic provides delays of 0.0 to 9.9 seconds corresponding to the dial setting.

INVERSE TIMING ACCURACY:

± 2%, ±1 cycle for multiples of pickup from 2 to 40. Below multiples of 2, errors may increase directly proportional to the value of $\frac{1}{(M^N-1)}$.

FIXED TIME ACCURACY:

±2% or 30 milliseconds, whichever is greater.

TIME RESET:

Instantaneous or decay as selected by jumper.

INST PICKUP RANGE:

5 Amp Unit: 1 to 99 Amps in 1 Amp steps
 1 Amp Unit: 0.2 to 19.8 Amps in 0.2 Amp steps

INST DROPOUT:

95% of pickup

INST PICKUP ACCURACY:

± 2% of setting

INST CHARACTERISTIC:

Industry accepted shape. Longer time for ground applications. Additional definite delays of 0.1, 0.2 and 0.3 seconds are user selectable by jumpers.

INST TRANSIENT RESPONSE:

Less than 10% overreach with system time constants up to 40 milliseconds.

BURDEN: Burden is non-linear and resistive.

5 Amp Unit: 4.8 Ohms @ 0.5A & 0.2 Ohms @ 5A
 1 Amp Unit: 120 Ohms @ 0.1A & 5 Ohms @ 1A

TARGETS:

Magnetically latched, manually reset for TIME and INST output functions.

Operate Current: 0.2 Amp minimum

Coil Resistance: 0.1 Ohm

Operate Time: < 1 millisecond

OUTPUTS: (50, 51 and 51 Aux)

Resistive:

250 Vdc-Make and carry 30 Amps for 0.2 seconds, 7 Amps for 2 minutes and 3 Amps continuously, break 0.3 Amp.

Inductive:

250 Vdc- Break 0.3 Amp (L/R = 0.04)

ISOLATION:

2000 Vac at 50/60 Hz for one minute (1500 Vac for one minute across open contacts) in accordance with IEC 255-5 and IEEE C37.90-1-1989 (Dielectric Test).

SURGE WITHSTAND CAPABILITY:

Qualified to IEEE C37.90.1-1989

Standard Surge Withstand Capability (SWC)

Tests for Protective Relays and Relay Systems.

FAST TRANSIENT:

Qualified to IEEE C37.90.1-1989

IMPULSE TEST:

Qualified to IEC 255-5

RADIO FREQUENCY INTERFERENCE (RFI):

Qualified to IEEE C37.90.2-1989. Field tested using five watt transceiver operating at random frequencies centered around 144 MHz and 440 MHz.

TEMPERATURE:

Operating Range -40° C (-40° F) to 70° C (158° F).
 Recommended Storage Range -50° C (-58° F) to 50° C (122° F).

SHOCK:

15g in each of three mutually perpendicular planes.

VIBRATION:

2g in each of three mutually perpendicular planes swept over the range of 10 to 500 Hz for a total of 6 sweeps, 15 minutes per sweep.

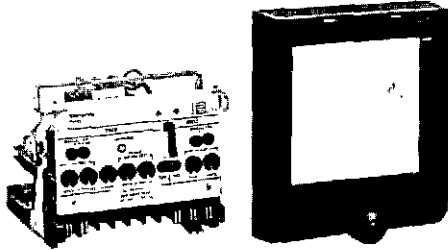
CASE SIZE:

A1 or S1

NET WEIGHT:

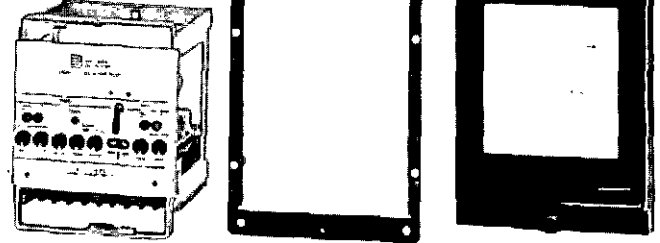
8.6 pounds

RETROFIT FEATURES and ADVANTAGES



BE1-50/51B-219/226 Cradle and cover

The BE1-50/51B-219 and -226 retrofit kits consist of a cradle and a cover and provides for installing a Basler BE1-50/51B single-phase time overcurrent relay in an existing CO case without making any wiring changes.



BE1-50/51B-214/225 Cradle, adapter plate and cover

The BE1-50/51B-214 and -225 retrofit kits consist of a cradle, an adapter plate, and a cover and provides for installing a Basler BE1-50/51B single-phase time overcurrent relay in an existing IAC case without making any wiring changes.

The BE1-50/51B-218 is a complete replacement relay with a case.

ADVANTAGES

- The 219 or 226 kit is a direct replacement for a CO drawout cradle.
- The 214 or 225 kit is a direct replacement for an IAC drawout cradle.
- No electrical or mechanical rework is required to panels during retrofit.
- Competitively priced.
- One model replaces more than 100 IAC or 40 CO models listed on next page.
- Patent #5,751,532.
- Numerous technical advantages:
 - All units are equipped with an instantaneous element.
 - Instantaneous element can be set lower, because the relay is corrected for transient overreach. Therefore, the range does not need to be as high as on the IAC relay.
 - Ten selectable curves and wide pickup ranges.
 - Lower burden extends linear range of CTs.
 - Self-calibration feature eliminates need for recalibration, thereby reducing maintenance labor.

REPLACEABLE MODELS

These relays are self-powered and include memory to replicate the decaying reset of electro-mechanical relay disks.

CO models that may be retrofitted with the BE1-50/51B-219:

Curve	CO Model Numbers
Short Time	CO-2*11*1N
Long Time	CO-5*11*1N
Definite	CO-6*11*1N
Moderately Inverse	CO7*11*1N
Inverse	CO-8*11*1N
Very Inverse	CO-9*11*1N
Extremely Inverse	CO-11*11*1N

IAC models that may be retrofitted with the BE1-50/51B-214:

Curve	IAC Model Numbers
Inverse	12IAC51A***A 12IAC51B***A
Very Inverse	12IAC53A***A 12IAC53B***A
Extremely Inverse	12IAC77A***A 12IAC77B***A
Short Time	12IAC55A***A 12IAC55B***A
Long Time	12IAC66A**A 12IAC66B**A

NOTES: 1. * = any digit covering all pickup ranges, instantaneous, non-instantaneous, and 50 Hz and 60 Hz models.

2. Units with instantaneous elements are designated with a "B" for the eighth character in the model number.

ORDERING

MODEL NUMBER

BE1-50/51B Time Overcurrent Relay

HOW TO ORDER:

Designate the Model Number and the three-digit dash number from Table 4 to define the configuration desired.

Table 4.

DESCRIPTION	MODEL NUMBER (NOTE)
For 5 Amp System CT Secondaries Semi-Flush Mounting, A1 Size Case Drawout Construction, Testable-in-Case	BE1-50/51B-105 BE1-50/51B-205
Projection Mounting, S1 Size Case Drawout Construction, Testable-in-Case	BE1-50/51B-106 BE1-50/51B-206
Semi-Flush Mounting, S1 Size Case Drawout Construction, Testable-in-Case	BE1-50/51B-107 BE1-50/51B-207
Retrofit kit for IAC relays Cradle plugs into existing case. Adapter plate and new cover are included.	BE1-50/51B-214
Complete IAC replacement relay <i>with same terminal connections as IAC units.</i> S1 style case.	BE1-50/51B-218
Retrofit kit for CO relays. Cradle plugs into existing case. A new cover is provided.	BE1-50/51B-219
For 1 Amp System CT Secondaries Semi-Flush Mounting, A1 Size Case Drawout Construction, Testable-in-Case	BE1-50/51B-101 BE1-50/51B-201
Semi-Flush Mounting, S1 Size Case Drawout Construction, Testable-in-Case	BE1-50/51B-103 BE1-50/51B-203
Projection Mounting, S1 Size Case Drawout Construction, Testable-in-Case	BE1-50/51B-102 BE1-50/51B-202
Retrofit kit for IAC relays Cradle plugs into existing case. Adapter plate and new cover are included.	BE1-50/51B-225
Retrofit kit for CO relays Cradle plugs into existing case. A new cover is provided.	BE1-50/51B-226

NOTE: Model numbers ending in 200 series include memory to replicate the decaying reset characteristic of electromechanical relay disks even while the input current is zero. Model numbers ending in 100 series reset instantaneously (regardless of settings) when the input current drops below the minimum TOC pickup value.

ORDERING INFORMATION

All units are self powered and supplied with 10 switch selectable curves, TIME and INST functions and outputs, magnetically latched targets, and an auxiliary output contact.

STANDARD ACCESSORIES:

A test plug is available to allow testing of the relay without removing external wiring.

Order test plug: Basler part number: 10095.

NOTES

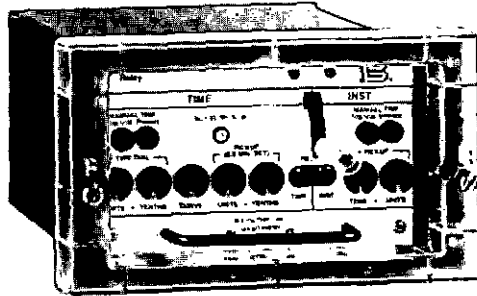
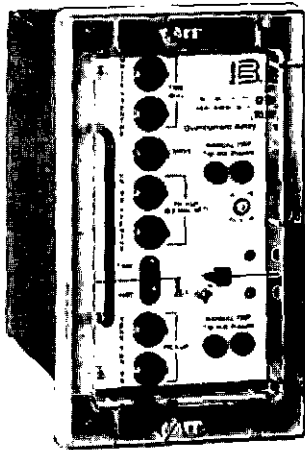
 **Basler Electric**

ROUTE 143, BOX 269, HIGHLAND, ILLINOIS U.S.A. 62249
PHONE 618-654-2341 FAX 618-654-2351

P.A.E. Les Pins, 67319 Wasselonne Cedex FRANCE
PHONE (33-3-88) 87-1010 FAX (33-3-88) 87-0808

<http://www.basler.com>, info@basler.com





**BE1-50/51M
TIME OVERCURRENT
RELAY**

The BE1-50/51M Time Overcurrent Relay provides economical overload and fault protection for generators, transformers, lines and motors.

ADVANTAGES

- Self powered from 50/60Hz systems, available for 5 or 1 amp CT secondaries.
- Models available to replicate decaying reset of electromechanical relay disks when current goes to zero.
- 10 Field selectable curves.
- Independent instantaneous overcurrent function.
- Drawout construction.
- Qualified to the requirements of:
 - IEEE C37.90-1989, C37.90.1-1989, C37.90.2-1989, UL508
- Five year warranty.

FEATURES and APPLICATIONS Page 2
FUNCTIONAL DESCRIPTION Page 3 - 6
SPECIFICATIONS Page 7
ORDERING INFORMATION Page 8

ADDITIONAL INFORMATION

INSTRUCTION MANUAL

Request Publication 9252000990

TIMING CURVES

Request Publication 9252000999

STANDARDS, DIMENSIONS and ACCESSORIES

Request Publication SDA



FEATURES

- Ten field selectable, inverse, fixed time and British Standard (BS142) time overcurrent curves.
- Instantaneous overcurrent function.
- Wide setting ranges:
Time Overcurrent: 0.5 to 15.9 (5 Amp Unit)
0.1 to 3.18 (1 Amp Unit)
- Inst. Overcurrent: 1 to 99 (5 Amp Unit)
0.2 to 19.8 (1 Amp Unit)
- Current pickup accuracy $\pm 2\%$.
- Timing accuracy $\pm 2\%$.
- Less than 10% transient overreach.
- Zero Pickup setting for safety during installation.
- Timed Overcurrent Reset - Selectable Instantaneous or Decay Characteristic.
- 5VA burden (at nominal) self powered from 50/60 Hz systems, utilizes standard 5 or 1 Amp CT secondaries.
- Drawout construction.
- Manual method for trip circuit testing.
- Standard magnetically latched targets for TOC and IOC.
- Direct reading front panel controls.
- UL recognized under standard 508.
- Qualified to the requirements of:
 - IEEE C37.90.1-1989 for SWC.
 - IEEE C37.90.2-1989 for RFI.
 - IEC 255-5 for impulse.
- Continuous automatic calibration.
- Time characteristics extend to 40 X Pickup.
- Positive visual indication that microprocessor is executing code.
- Two year warranty.

APPLICATION

The BE1-50/51M is a single phase self powered, micro-processor based time overcurrent relay. The relay is designed for use in applications requiring time delayed coordination for phase or ground overcurrent conditions.

The relay can be used to provide coordinated protection for overhead and underground distribution circuits. Other applications include overcurrent backup protection for transformers and generators, and the protection of neutral grounding resistors and reactors.

Since all of the time-current characteristics are included within the relay, a standard relay may be ordered before the coordination study is completed, thereby allowing the physical construction to proceed. This is also an advantage as changes in the system configuration or coordination may be accomplished without a hardware change. Table 1 lists typical applications for each of the time-current characteristic curves.

Models are included (200 series) which have memory to replicate the decaying reset of electromechanical relays even when power to the relay is lost. Use the 200 series for applications that require coordination with the resetting of nearby electromechanical relays.

The instantaneous overcurrent element is standard in the relay. This element is designed to minimize transient overreach. The instantaneous element includes selectable delay characteristics for improved coordination with downstream devices and customer requirements.

Table 1 - Time-Current Characteristics

CHARACTERISTIC CURVE		TYPICAL PROTECTIVE APPLICATION	APPLICATION COMMENTS
SWITCH DESIGNATION	NAME		
S	Short Inverse	Generator or Bus	Relatively short time, desirable where preserving system stability is a critical factor.
L	Long Inverse	Motors	Provides protection for starting surges and short duration overloads.
D	Definite Time	General Use	Timing relatively independent of current. Useful in sequential tripping schemes.
M	Moderately Inverse	Transmission and feeder lines. Useful for both phase and ground application. Feeder lines or back-up protection for other types of relays.	Accommodates moderate load changes, as may occur on parallel lines where one line may occasionally have to carry both loads. Provides additional variations of the inverse characteristic, thereby allowing flexibility in meeting load variations, or in coordinating with other relays.
I	Inverse		
V	Very Inverse		
E	Extremely Inverse		
B	BS142 Very Inverse		
C	BS142 Extremely Inverse		
F	Fixed Time	General Use	Fixed time delay defined by dial setting. Useful in sequential tripping schemes.

FUNCTIONAL DESCRIPTION

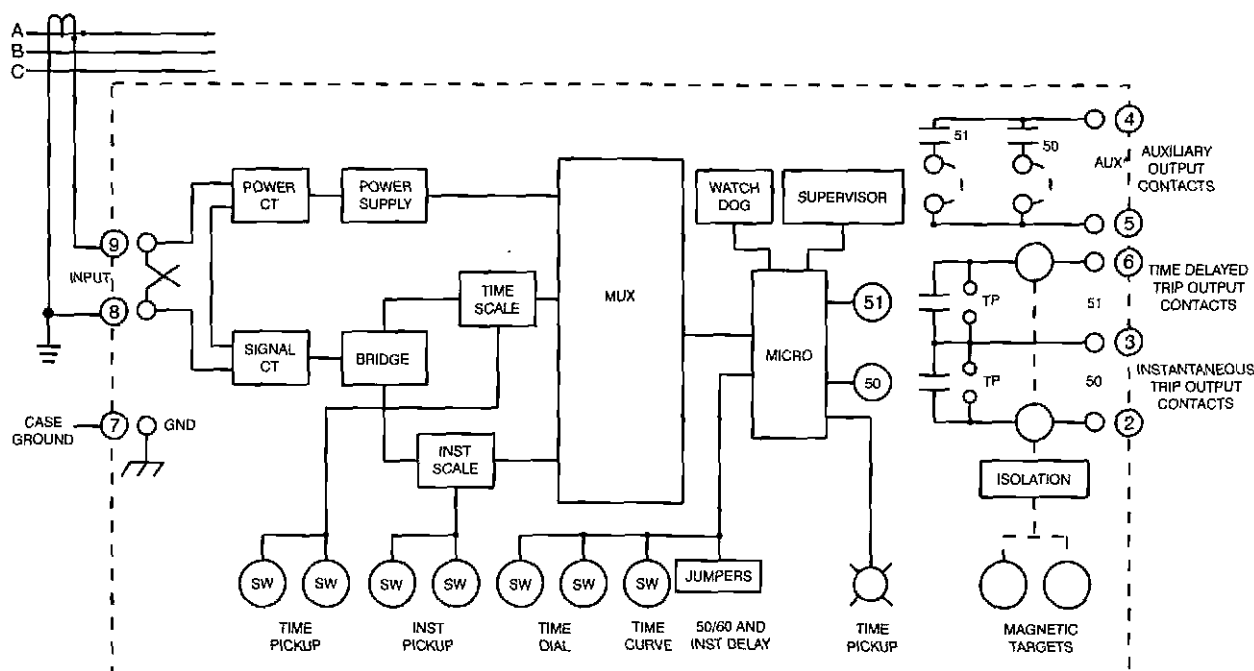


Figure 1 - Functional Block Diagram

CURRENT INPUT

A single phase of ac current from a 5 Amp or 1 Amp 50/60 Hz, system current transformer (CT) is applied to the BE1-50/51M. This input current provides both the power and sensing quantity for the relay.

The current applied to the relay provides the energy for the internal power supply. When sufficient current is available, the Active/Pickup LED will turn green. In applications where circuit loading conditions are less than that required to illuminate the LED, the relay remains operable and will provide overcurrent protection.

The sensing input transformer provides the quantity to be scaled and measured by the Time and Instantaneous functions. Ranges, ratings, and accuracies apply as described in Table 2.

Scaling of the input signal is accomplished by separate networks for the time and instantaneous functions. The scale factors are established by the front panel pickup settings. Pickup settings of 00 provide maximum sensitivity as a safety precaution for the installation process. Pickup will occur when the input current level is adequate to power the unit.

MICROPROCESSOR

The settings of the TIME DIAL, TIME CURVE selector switch, and circuit board jumpers provide the microprocessor with ten operating parameters for the desired response by the relay. The microprocessor performs the program operations based on the input current level and internal software program. When the Active/Pickup LED is green, the microprocessor is active and executing code.

Operating power from the power supply is applied to the microprocessor supervisor circuit. When the input current falls below an acceptable level, the supervisor circuit interrupts the microprocessor and halts further operation.

The watchdog timer monitors the microprocessor for specific pulses indicating proper program operation. If something occurs to disrupt the microprocessor, these pulses stop, the watchdog timer times out and sends a reset pulse to the microprocessor. The microprocessor resets and resumes normal operation.

Table 2 - Current Sensing Capabilities

50/60 Hz System CT Secondary	Time Element Pickup Range	Time Element Max. Continuous Current	Time Element Max. Current For 1 Second	Instantaneous Pickup Range	Time Element Pickup Accuracy	Instantaneous Pickup Accuracy
5 AMP	0.5 to 15.9 Amps in 0.1 Amp Steps	14 Amps	400 Amps	1 to 99 Amps in 1 Amp Steps	2% from 0.5 to 15.9 Amps	2% from 1 to 99 Amps
1 Amp	0.1 to 3.18 Amps in .02 Amp Steps	2.8 Amps	80 Amps	0.2 to 19.8 Amps in 0.2 Amp Steps	2% from 0.1 to 3.18 Amps	2% from 0.2 to 19.8 Amps

FUNCTIONAL DESCRIPTION, continued

OUTPUTS

The **TIME** contacts (51 and 51AUX) are closed in accordance with conditions defined by the selected time characteristic equation and the sensed current magnitude. If the sensed current exceeds the **INST PICKUP** setting, the **INST** contacts (50) are closed.

Breakers controlled by the output contacts can be manually trip tested by inserting a jumper between the **TIME** and **INST MANUAL TRIP** test points on the front panel.

TIME ELEMENT CHARACTERISTIC SHAPES

All time characteristic curves follow the relation:

$$T_T = \frac{AD}{M^N-C} + BD + K = \text{Time to trip}$$

$$T_R = \frac{RD}{M^2-1} = \text{Time for decaying reset}$$

Table 3.

Curve Type	Constants					
	A	B	C	N	K	R
S	0.2663	0.03393	1.000	1.2969	0.028	0.500
L	5.6143	2.18592	1.000	1.0000	0.028	15.750
D	0.4797	0.21359	1.000	1.5625	0.028	0.875
M	0.3022	0.12840	1.000	0.5000	0.028	1.750
I	8.9341	0.17966	1.000	2.0938	0.028	9.000
V	5.4678	0.10814	1.000	2.0469	0.028	5.500
E	7.7624	0.02758	1.000	2.0938	0.028	7.750
B	1.4636	0.00000	1.000	1.0469	0.028	3.250
C	8.2506	0.00000	1.000	2.0469	0.028	8.000
F	0.0000	1.00000	0.000	0.0000	0.000	1.000

S=Short Inverse M=Moderately Inverse B=BS142 Very Inverse
 L=Long Inverse I=Inverse C=BS142 Extremely Inverse
 D=Definite Time V=Very Inverse F=Fixed Time
 E=Extremely Inverse

Where **D** is the time dial setting (0.0 to 9.9) and **M** is the multiple of pickup. **A**, **B**, **C**, **N**, **K** and **R** are constants defining with the shape of the curve. The constants have been selected to provide a very close match to the characteristics of electromechanical relays. The constants are provided in Table 3 for each characteristic curve shape. Figure 2 illustrates the characteristic shapes.

The Active/Pickup LED on the front panel will turn red when the applied current just exceeds the **PICKUP** setting (See Figure 4).

RESET

Reset occurs when the current level is less than pickup. Jumper selection provides selection of either an Instantaneous or a decaying reset characteristic.

The instantaneous reset characteristic forces the timer to zero when the input current falls below 95% of setting. This fast reset characteristic prevents the ratcheting effect on electromechanical relay disks that occurs for repeated faults.

The decaying reset characteristic replicates the decaying reset of electromechanical relay disks. Models with dash numbers in the 200 series continue the decaying process even when the input current goes to zero. Models with dash numbers in the 100 series reset immediately when the input current drops below the minimum required to power-up the relay (.5A for 5A models and 0.1A for 1A models).

TIME DIAL RANGE AND ACCURACY

The **TIME DIAL** range is 0.0 to 9.9 in 0.1 steps. A setting of 0.0 results in instantaneous operation without intentional time delay.

INSTANTANEOUS ELEMENT CHARACTERISTICS

The characteristic for phase faults is faster because the relay will be powered up. However, the tripping characteristic for ground applications is slightly longer to allow time to power up the relay. This longer trip time for ground applications is beneficial because it helps avoid nuisance trips. These timing characteristics are shown in Figure 3.

Additional definite time delays of 0.1, 0.2, or 0.3 seconds may be added to the instantaneous element. The definite delay is determined by switches on the circuit card.

OUTPUTS

Separate output contacts are provided for the **TIME** (51) and **INST** (50) trip functions. An additional auxiliary output relay (51 AUX) is included. This output operates simultaneously with the **TIME** output relay. All output contacts are configured normally open (NO).

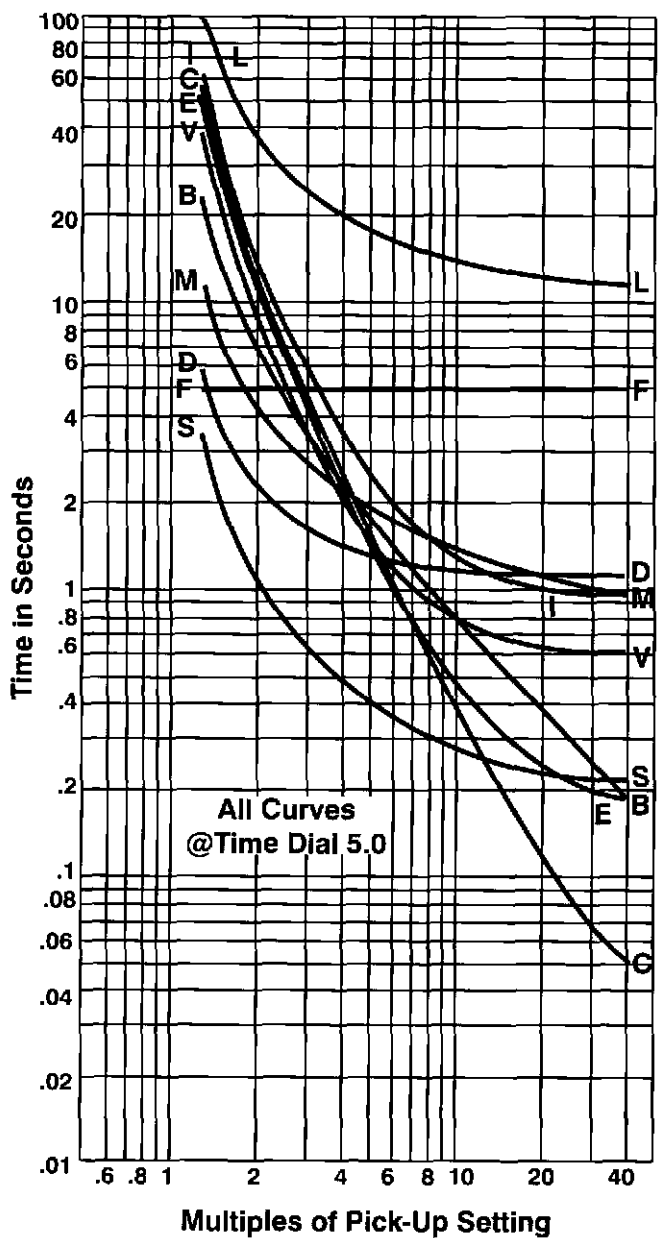
MANUAL TRIP TESTING

The relay is provided with front panel test points to allow shorting the output terminals to verify external control circuit wiring.

TARGETS

Two target indicators are provided as a standard feature of the BE1-50/51M. These magnetically latched, current operated targets provide visual indication of trip by the **TIME** or **INST** output contact. These targets must be manually reset after the abnormal condition has been removed or corrected.

FUNCTIONAL DESCRIPTION, continued



- | | | |
|-----------------|----------------------|---------------------------|
| S=Short Inverse | M=Moderately Inverse | B=BS142 Very Inverse |
| L=Long Inverse | I=Inverse | C=BS142 Extremely Inverse |
| D=Definite Time | V=Very Inverse | F=Fixed Time |
| | E=Extremely Inverse | |

Figure 2 - Time-Current Characteristics

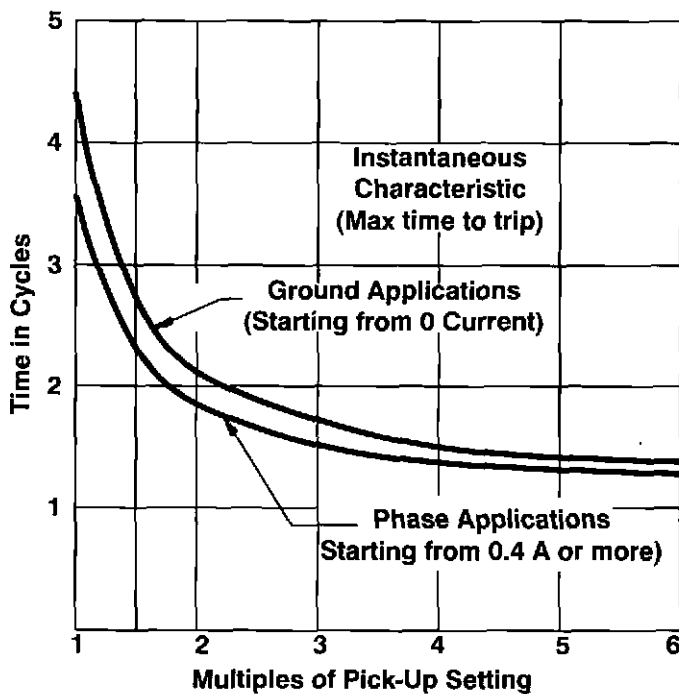
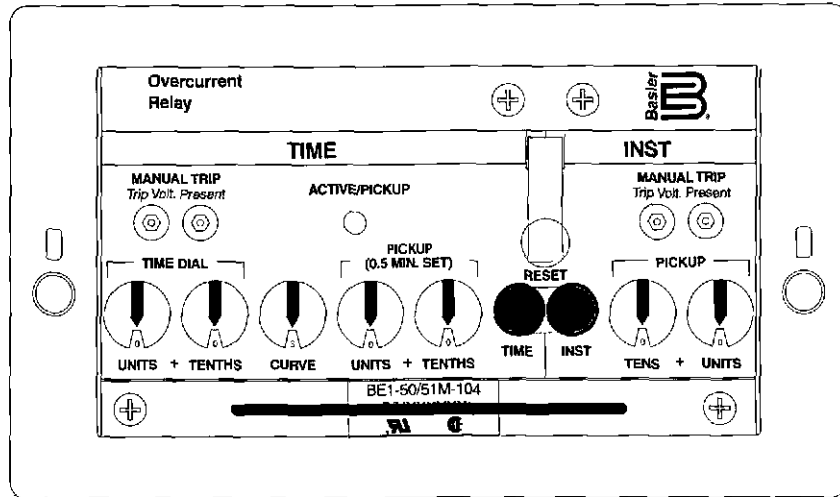


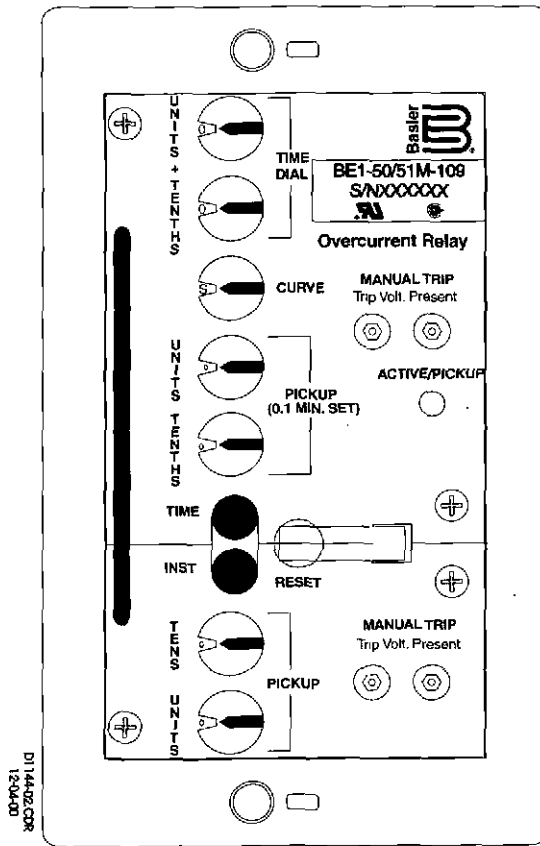
Figure 3 - Instantaneous Characteristics

FUNCTIONAL DESCRIPTION, continued



D1144-01 CDR
12/01/00

Figure 4 - Front Panel, Horizontal Mounting



D1144-02 CDR
12/04/00

Figure 5 - Front Panel, Vertical Mounting

SPECIFICATIONS

CURRENT SENSING INPUT:	Continuous Current	One Second Current
5 Amp Unit	10.0 Amps	400 Amps
1 Amp Unit	2.0 Amps	80 Amps

TIME PICKUP RANGE:

5 Amp Unit: 0.5 to 15.9 Amps in 0.1 Amp steps
1 Amp Unit: 0.1 to 3.18 Amps in 0.02 Amp steps

TIME DROPOUT:

Not less than 95% of pickup value.

TIME PICKUP ACCURACY:

± 2% of setting

TIME DIAL RANGE:

0.0 to 9.9 in 0.1 steps

TIME CHARACTERISTICS:

Nine inverse time and 1 fixed time function can be selected by a front panel switch. Characteristic curves are defined by the time characteristic equation. The fixed time characteristic provides delays of 0.0 to 9.9 seconds corresponding to the dial setting.

INVERSE TIMING ACCURACY:

± 2%, ± 1 cycle for multiples of pickup from 2 to 40. Below multiples of 2, errors may increase directly proportional to the value of $\frac{1}{(M^n-1)}$.

FIXED TIME ACCURACY:

± 2% or 30 milliseconds, whichever is greater.

TIME RESET:

Instantaneous or decay as selected by jumper.

INST PICKUP RANGE:

5 Amp Unit: 1 to 99 Amps in 1 Amp steps
1 Amp Unit: 0.2 to 19.8 Amps in 0.2 Amp steps

INST DROPOUT:

95% of pickup

INST PICKUP ACCURACY:

± 2% of setting

INST CHARACTERISTIC:

Industry accepted shape. Longer time for ground applications. Additional definite delays of 0.1, 0.2 and 0.3 seconds are user selectable by jumpers.

INST TRANSIENT RESPONSE:

Less than 10% overreach with system time constants up to 40 milliseconds.

BURDEN: Burden is non-linear and resistive.

5 Amp Unit: 4.8 Ohms @ 0.5A & 0.2 Ohms @ 5A
1 Amp Unit: 120 Ohms @ 0.1A & 5 Ohms @ 1A

TARGETS:

Magnetically latched, manually reset for TIME and INST output functions.

Operate Current: 0.2 Amp minimum

Coil Resistance: 0.1 Ohm

Operate Time: < 1 millisecond

OUTPUTS: (50, 51 and 51 Aux)

Resistive:

250 Vdc-Make and carry 30 Amps for 0.2 seconds, 7 Amps for 2 minutes and 3 Amps continuously, break 0.3 Amp.

Inductive:

250 Vdc- Break 0.3 Amp (L/R = 0.04)

ISOLATION:

2000 Vac at 50/60 Hz for one minute (1500 Vac for one minute across open contacts) in accordance with IEC 255-5 and IEEE C37.90-1-1989 (Dielectric Test).

SURGE WITHSTAND CAPABILITY:

Qualified to IEEE C37.90.1-1989

Standard Surge Withstand Capability (SWC)

Tests for Protective Relays and Relay Systems.

FAST TRANSIENT:

Qualified to IEEE C37.90.1-1989

IMPULSE TEST:

Qualified to IEC 255-5

RADIO FREQUENCY INTERFERENCE (RFI):

Qualified to IEEE C37.90.2-1989. Field tested using five watt transceiver operating at random frequencies centered around 144 MHZ and 440 MHZ.

TEMPERATURE:

Operating Range -40° C (-40° F) to 70° C (158° F).
Recommended Storage Range -50° C (-58° F) to 50° C (122° F).

SHOCK:

15g in each of three mutually perpendicular planes.

VIBRATION:

2g in each of three mutually perpendicular planes swept over the range of 10 to 500 Hz for a total of 6 sweeps, 15 minutes per sweep.

CASE SIZE:

C1 - 6.88" x 4.00"

7.00" Depth from mounting surface.

NET WEIGHT:

5.2 pounds

ORDERING

MODEL NUMBER

BE1-50/51M Time Overcurrent Relay

HOW TO ORDER:

Designate the Model Number and the 3 digit dash number from TABLE 4 to define the configuration desired.

Table 4.

DESCRIPTION	MODEL NUMBER (See Note)
<p>For 5 Amp System CT Secondaries</p> <p>Semi-Flush Horizontal Mounting C1 Size Case Drawout Construction</p>	<p>BE1-50/51M-104 BE1-50/51M-204</p>
<p>Semi-Flush Vertical Mounting C1 Size Case Drawout Construction</p>	<p>BE1-50/51M-109 BE1-50/51M-209</p>
<p>For 1 Amp System CT Secondaries</p> <p>Semi-Flush Horizontal Mounting C1 Size Case Drawout Construction</p>	<p>BE1-50/51M-100 BE1-50/51M-200</p>
<p>Semi-Flush Vertical Mounting C1 Size Case Drawout Construction</p>	<p>BE1-50/51M-108 BE1-50/51M-208</p>

NOTE: Model numbers ending in 200 series include memory to replicate the decaying reset characteristic of electromechanical relay disks even while the input current is zero. Model numbers ending in 100 series reset instantaneously (regardless of settings) when the input current drops below the minimum TOC pickup value.

ORDERING INFORMATION

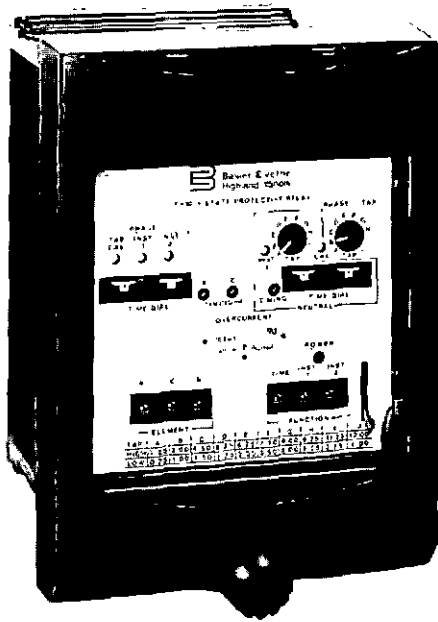
All units are self powered and supplied with 10 switch selectable curves, TIME and INST functions and outputs, magnetically latched targets, and an auxiliary output contact.

STANDARD ACCESSORIES:

A rack mounting plate is available to vertically mount four BE1-50/51M units in a standard 19 inch rack. Requires four rack units of space (7.0 inches high). Order Basler part number: 9252012001.

 **Basler Electric**





**BE1-51
BE1-51/27C
BE1-51/27R
TIME OVERCURRENT
RELAY**

The BE1-51 Series of Time Overcurrent Relays is microprocessor-based to provide versatile overload and fault protection on 50Hz or 60Hz systems.

ADVANTAGES

- One relay can simultaneously monitor three phases plus neutral currents.
- 16 field selectable characteristic curves, including inverse, definite, I²t, and BS 142 functions.
- Wide range sensing inputs with continuously adjustable pickup.
- Up to two instantaneous elements available.
- Large array of options, including voltage control and voltage restraint.
- Five year warranty.

ADDITIONAL INFORMATION

INSTRUCTION MANUALS

Request publication: BE1-51: 9137200997
BE1-51/27C: 9137200998
BE1-51/27R: 9137200999

TIMING CURVES

Request publication 9137200897

STANDARDS, DIMENSIONS & ACCESSORIES

Request Bulletin SDA

APPLICATION
Page 2

SPECIFICATIONS
Pages 3 - 6

**EXTERNAL
CONNECTIONS**
Pages 7 and 8

**ORDERING
INFORMATION**
Pages 9 - 12

APPLICATION

THE BE1-51 SERIES

Time overcurrent relays provide phase and ground fault protection for distribution circuits, generators, transformers and other major components of the power system. The relays need to be capable of a wide range of pickup settings and characteristics in order to coordinate properly with other protective devices in the power system.

The BE1-51 family of time overcurrent relays provides single or multiple phase current sensing within a single unit. These relays feature a pickup setting range of 0.5 to 12 amperes and a variety of timing characteristics for proper coordination.

The overcurrent timing functions provide a means to coordinate with other protective devices and to discriminate between fault currents and transitory overloads. Table 1 illustrates typical applications. An extended range timing option is available which delays the standard functions by a timing factor of approximately 5.7. This further enhances flexibility in meeting application objectives.

The optional neutral defeat function allows neutral current sensing to be disabled. This allows the user to energize desired circuits and block tripping due to unbalanced currents reflected in the neutral circuit. After the circuits are balanced, the neutral defeat function would be switched off and neutral protection would be enabled. The built-in test (BIT) provides an operational check to

confirm the integrity of outputs, LEDs and targets, and simplifies calibration.

INSTANTANEOUS OVERCURRENT MONITORING

One or two instantaneous outputs, individually adjustable for current level, may be specified as an aid in coordinating a relay scheme.

VOLTAGE CONTROL

The BE1-51/27C Time Overcurrent Relay provides voltage controlled backup phase fault protection for a generator and power system when protective devices located downstream from the generator fail to operate. The time overcurrent response is inhibited when the monitored system voltage is above the voltage control setting, allowing setting below load current levels. Instantaneous overcurrent response (if included) is not affected.

VOLTAGE RESTRAINT

Under fault conditions, system voltage may collapse to a low value compared to the relatively small voltage drop associated with overloads. The BE1-51/27R Time Overcurrent Relay with voltage restraint decreases the current pickup proportionally to this voltage reduction to increase overcurrent sensitivity of the relay during fault conditions. Neutral time overcurrent response and instantaneous overcurrent response (if included) are not affected.

Table 1 - Applications Summary

Function		Typical Protective Application	Special Characteristics
Number	Name		
B1	Short Inverse	Generator, busses	Relatively short time, desirable where preserving system stability is a critical factor.
B2, E2	Long Inverse	Motors	Provides protection for starting surges and overloads of short duration.
B3	Definite Time	General use	Timing relatively independent of current. Useful in sequential tripping schemes.
B4	Moderately Inverse	Transmission and feeder lines. Useful in both phase and ground fault applications.	Accommodates moderate load changes, as may occur on parallel lines where one line may occasionally have to carry both loads.
B5, E4, E5	Inverse	Feeder lines, or backup protection for other types of relays	Provides additional variations of the inverse characteristic, thereby allowing flexibility in meeting load variations, or in coordinating with other relays.
B6, E6	Very Inverse		
B7, E7	Extremely Inverse		
B8	I ² T	Motors	Prevents tripping from motor starting currents. Provides protection against light, medium and heavy overloads.
C1-C8	I ² T with Limits		
All of the above, Extended	Extended Timing Range	See B1 through C8 above	Provides a second set of the above listed curves with longer timing for increased flexibility.

SPECIFICATIONS

FUNCTIONAL DESCRIPTION

The specifications on these pages define the many features and options that can be combined to exactly satisfy an application requirement. A block diagram (Figure 1) is included to show how various standard features, as well as the options, relate to each other.

INPUTS

Current Sensing

In most models, two ranges are included (HIGH/LOW), each with its own pair of input terminals. Note: Units with three-phase-and-neutral sensing have single input ranges only. The current sensing characteristics at 100/120 Vac, 50/60 Hz, are shown in Table 2.

SENSING INPUT TYPE	MAXIMUM CONTINUOUS CURRENT*	BURDEN AT MAX. TAP VALUE
Single-Phase	20A	Less than 0.1 ohm per phase or neutral
Two-Phase and Neutral	20A	
Three-Phase	20A	
Three-Phase and Neutral	20A	

(*) The maximum 1 second current rating is 50 x the maximum tap current selected, or 500A, whichever is less. For ratings other than those specified by time curves, rating is calculated as follows:

$$I = (50 \times \text{tap value or } 500 \text{ A, whichever is less}) / \sqrt{T}$$

where, I = maximum current
T = Time of current flow in seconds

Table 2 - Sensing Burdens

Voltage Sensing (BE1-51/27C and BE1-51/27R)

The voltage input (when specified) imposes a less than nominal burden on the sensing transformers. The input is compatible with 100/120 Vac circuits, and is rated for 160 volts continuously at 50/60Hz \pm 10 Hz.

Power Supply Inputs

One of five power supply types may be selected to provide internal operating power. These are described in Table 3.

Type	O	P	R	S	T
Nominal Voltage	48Vdc	125 Vdc 120 Vac	24 Vdc	48 Vdc 125 Vdc	250 Vdc 230 Vac
Burden	6.6 W	6.7 W 12.8 VA	7.2 W	5.0 W 5.3 W	7.8 W 19.8 VA

All ac references are at 50/60 Hz.

Table 3 - Power Supply Options

OUTPUTS

All output contacts are rated as follows:

Resistive

120/240 Vac Make 30 A for 0.2 seconds, carry 7 A continuously, break 7 A.

250 Vdc Make and carry 30 A for 0.2 seconds, carry 7 A continuously, break 0.3 A.

500 Vdc Make and carry 15 A for 0.2 seconds, carry 7 A continuously, break 0.1 A.

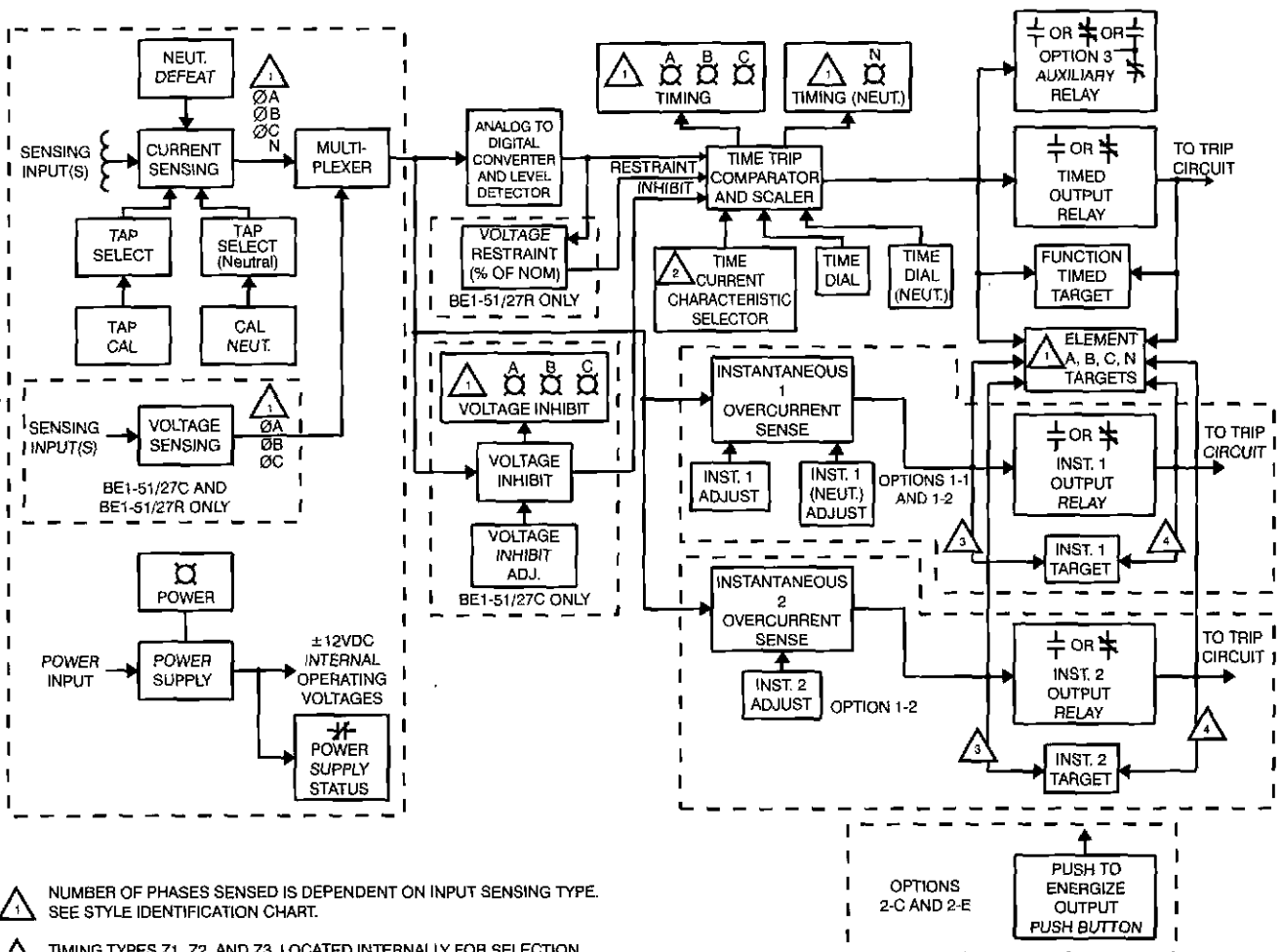
Inductive

120/240 Vac, 125 Vdc/250 Vdc - Make and carry 30 A for 0.2 seconds, carry 7 A continuously, break 0.3 A (L/R = 0.04).

PANEL CONTROLS AND INDICATORS

TAP SELECTOR: The time overcurrent pickup point is selected using a 10-position TAP SWITCH. Along with the TAP CAL control (described below), this allows simultaneous precise settings for all phase elements. A similar set of controls independently adjusts neutral pickup (if specified).

SPECIFICATIONS, continued



- 1 NUMBER OF PHASES SENSED IS DEPENDENT ON INPUT SENSING TYPE. SEE STYLE IDENTIFICATION CHART.
- 2 TIMING TYPES Z1, Z2, AND Z3. LOCATED INTERNALLY FOR SELECTION OF TIMING TYPES B1-B8 AND C1-C8 OR E2-E7. SEE STYLE IDENTIFICATION CHART.
- 3 CIRCUIT PATH FOR TYPE "A" TARGETS (INTERNALLY OPERATED).
- 4 CIRCUIT PATH FOR TYPE "B" TARGETS (CURRENT OPERATED).

Figure 1 - Functional Block Diagram

SPECIFICATIONS, continued

TAP CAL CONTROL: This control provides fine adjustment of the overcurrent pickup point between TAP selector settings. When the TAP CAL control is fully clockwise, the actual pickup will be within $\pm 5\%$ of the indicated TAP selector setting.

Time Overcurrent Pickup Measuring Accuracy $\pm 2\%$ of pickup setting

Time Overcurrent Pickup Dropout Ratio Better than 92% of pickup level

TIME DIAL: This pair of thumbwheel selectors determines the time delay between the sensing of a phase overcurrent condition and a relay trip. The time delay is selected over the range of 00 to 99. For relays with extended timing range (Option 2-D or 2-E), the actual time delay will be approximately 5.7 times the value shown in the curves.

Time Delay Accuracy $\pm 5\%$ of the characteristic curve value with repeatability of $\pm 2\%$

All phases of multiphase styles are set simultaneously and will exhibit the same time-current characteristic. The neutral element TIME DIAL is independently set.

TIMING INDICATOR: For each phase (or neutral) specified, there is an LED to indicate when the sensed current exceeds the time overcurrent pickup setting - unless the voltage control (if present) is above the preselected inhibit level.

POWER INDICATOR: A front panel LED illuminates to indicate the power supply is providing the internal operating voltages.

TARGET INDICATORS: Targets may be specified to indicate which phase (or neutral) element initiated the overcurrent condition, and which protective function caused an output (TIME, INST 1, or INST 2).

Element phase targets are always internally operated. Function targets may be either internally operated or current operated by a minimum of 0.2A through the output trip circuit. When current operated, the output circuit must be limited to 30A for 0.2 seconds, 7A for 2 minutes, and 3A continuously.

TIME CURRENT CHARACTERISTIC CURVE SELECTOR

The BE1-51 relays include up to 16 individual time curve types selected by means of a switch directly behind the front panel. The time curve groupings are identified as Z1, Z2 and Z3 in the style chart.

Option Z1 includes seven inverse time curve types and nine 1st time curve types. Option Z2 includes seven inverse time curve types, one 1st time curve and five British Standard inverse curves. Option Z3 includes the same curve types as Z1 but includes integrating timing to more closely simulate the operating characteristic of electromechanical relays. Extended timing can be included with Z1 and Z3 type timing to delay the relay operation.

OPTIONS

In addition to the range of choices indicated above, the following optional functions may be specified.

Volts Inhibit Adj (BE1-51/27C Models)

A front panel control provides continuous adjustment of the sensed voltage inhibit level over a range of 40-120 Vac. When the level is exceeded, operation of the time overcurrent circuitry is inhibited. The optional instantaneous overcurrent element is not affected by the voltage inhibit circuitry.

For each phase there is an LED to indicate that voltage has exceeded the inhibit level setting.

Voltage Restraint (BE1-51/27R Models)

The voltage restraint option compares the sensed voltage with the nominal voltage level. A decrease of the sensed voltage (between 100% and 25% of nominal) results in a proportional decrease of the time overcurrent pickup point as defined by the TAP selector/TAP CAL control (Figure 2). When the sensed voltage falls below 25% of nominal, the time overcurrent pickup point will be 25% of the TAP selector/TAP CAL control setting. The pickup point of the neutral time overcurrent and optional instantaneous overcurrent element(s) are not affected by voltage restraint.

Instantaneous Overcurrent

A front panel control provides the instantaneous overcurrent element with adjustment over the range of 1 to 40 times the phase overcurrent pickup point selected by the TAP selector/TAP CAL control. When the setting is exceeded, the inst. 1 output relay energizes (Figure 3). This element is not affected by the voltage control circuit of the BE1-51/27C or the voltage restraint circuit of the BE1-51/27R.

SPECIFICATIONS, continued

An additional independent control (Option 1-2) provides pickup point adjustment for a second instantaneous function. (This option is available on all BE1-51 relays and single-phase BE1-51/27C and BE1-51/27R units.)

For relays including neutral sensing, an independent control adjusts the neutral instantaneous overcurrent pickup point.

Instantaneous Overcurrent Pickup Measuring Accuracy	±2% of pickup setting
Instantaneous Overcurrent Dropout Ratio	Better than 98% of pickup level
Voltage Sensing Measuring Accuracy (BE1-51/27C and BE1-51/27R Only)	±2% of pickup setting (BE1-51/27C); ±2% of sensed voltage (BE1-51/27R)

Push-to-Energize-Output Pushbutton (Option 2-C or 2-E)

Applying a thin non-conducting rod through a hole in the front panel energizes trip relays for testing the external trip circuits.

Power Supply Status Output (Option 3-6)

The power supply status output relay is energized and its NC output contact is opened when power is applied to the relay. Normal internal relay operating voltage maintains the power supply status output relay continuously energized with its output contact open. If the power supply output voltage falls below the requirements of proper operation, the power supply output relay is de-energized, closing the NC output contact.

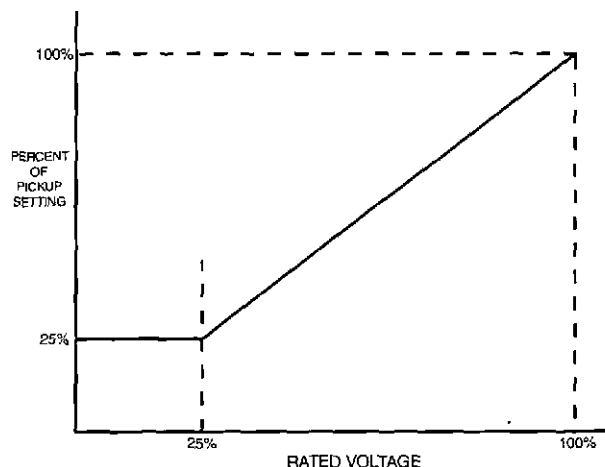


Figure 2 - Voltage Restraint Characteristic (BE1-51/27R)

SURGE WITHSTAND

Qualified to ANSI/IEEE C37.90.1-1989 Standard Surge Withstand Capability (SWC) Test for Protective Relays and Relay Systems.

ENVIRONMENT

Operating temperature range: -40°C to +70°C (-40°F to +158°F)
Storage temperature range: -65°C to +100°C (-85°F to +212°F)

VIBRATION

In standard tests, the relay has withstood 2g in each of three mutually perpendicular planes, swept over the range of 10 to 500 Hz for a total of six sweeps, 15 minutes each sweep, without structural damage or degradation of performance.

SHOCK

In standard tests, the relay has withstood 15g in each of three mutually perpendicular axes without structural damage or degradation of performance.

WEIGHT

Single-phase	13.0 lb max (5.9 kg)
Three-phase	14.0 lb max (6.4 kg)
Two-phase-and-neutral	14.0 lb max (6.4 kg)
Three-phase-and-neutral	14.4 lb max (7.2 kg)

AGENCY RATINGS

UL recognized per Standard 508, UL File number E97033.

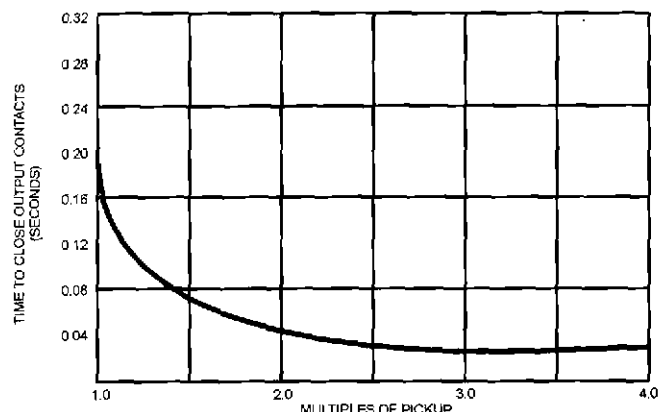


Figure 3 - Typical Instantaneous Function Response Time

CONNECTIONS

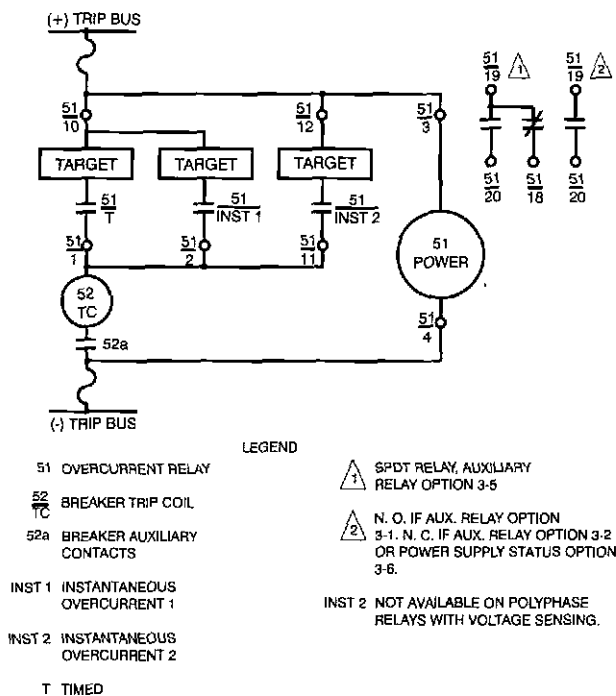


Figure 4 - Control Circuits

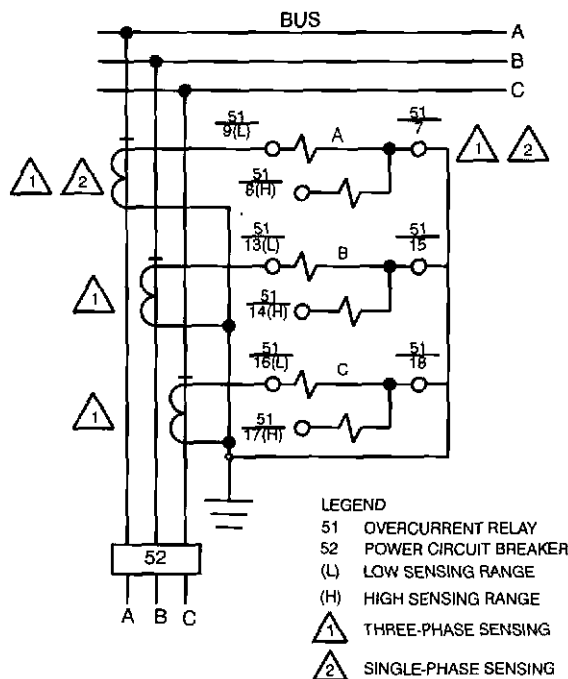


Figure 5 - Single-Phase and Three-Phase Current Sensing

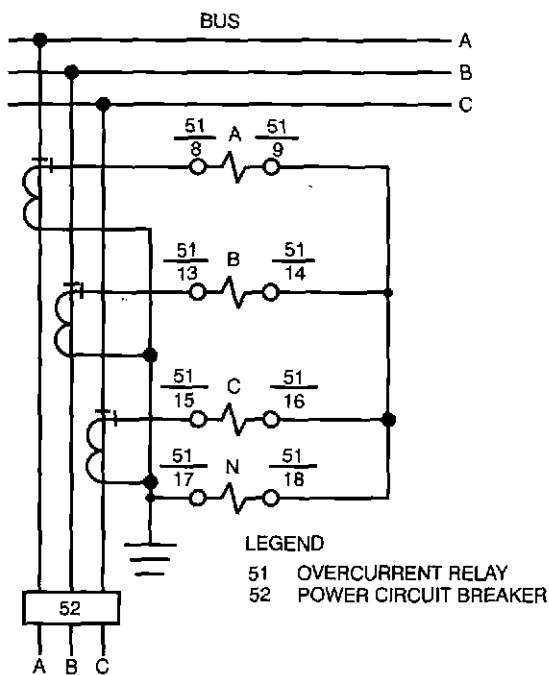


Figure 6 - Three-Phase-with-Neutral Current Sensing

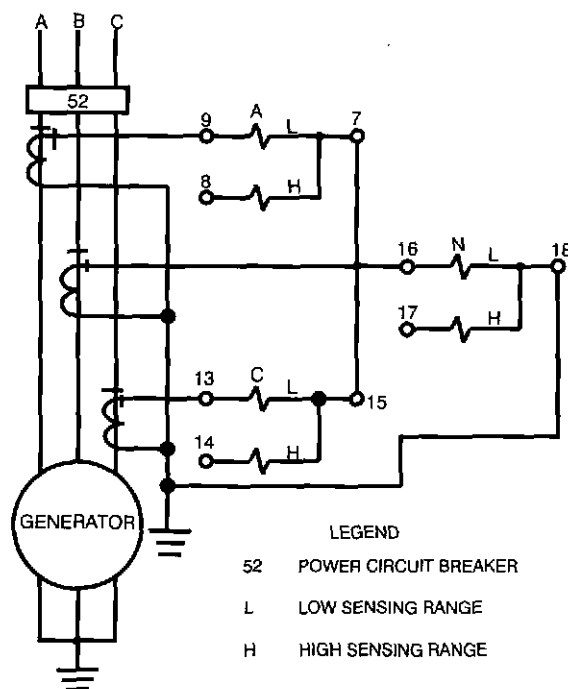


Figure 7 - Two-Phase-and-Neutral Current Sensing

CONNECTIONS, continued

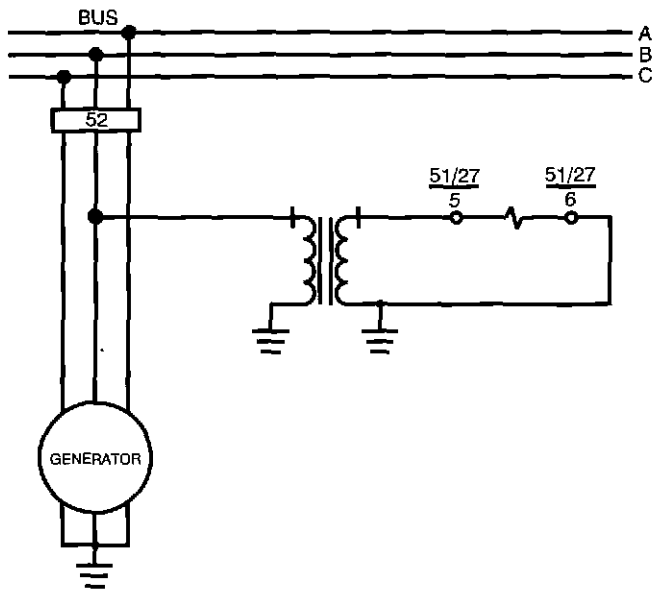


Figure 8 - Single-Phase Voltage Sensing
(BE1-51/27C and BE1-51/27R)

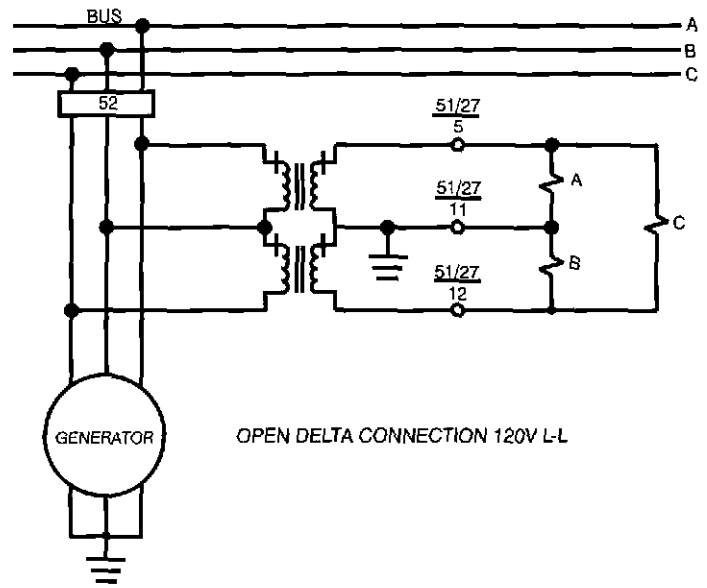


Figure 9 - 3-Phase 3-Wire Voltage Sensing
(BE1-51/27C and BE1-51/27R)

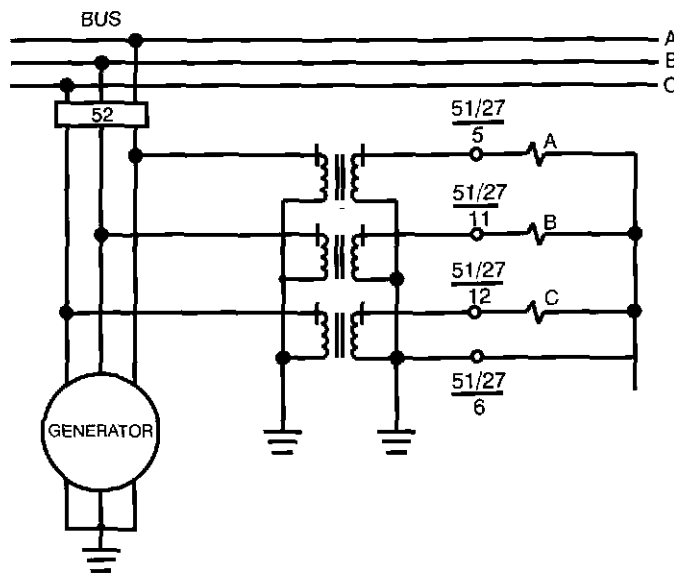


Figure 10 - 3-Phase 4-Wire Voltage Sensing
(BE1-51/27C and BE1-51/27R)

- LEGEND
- 51/27 OVERCURRENT RELAY WITH VOLTAGE CONTROL/ RESTRAINT, MODELS BE1-51/27C AND BE1-51/27R
 - 52 POWER CIRCUIT BREAKER

ORDERING

MODEL NUMBER

BE1-51, BE1-51/27C, and BE1-51/27R
Time Overcurrent Relays

STYLE NUMBER

The style number appears on the front panel, drawout cradle, and inside the case assembly. This style number is an alphanumeric combination of characters identifying the features included in a particular unit. The sample style number below illustrates the manner in which the various features are designated. The Style Number Identification Charts located at the end of this publication define each of the options and characteristics available for this device.

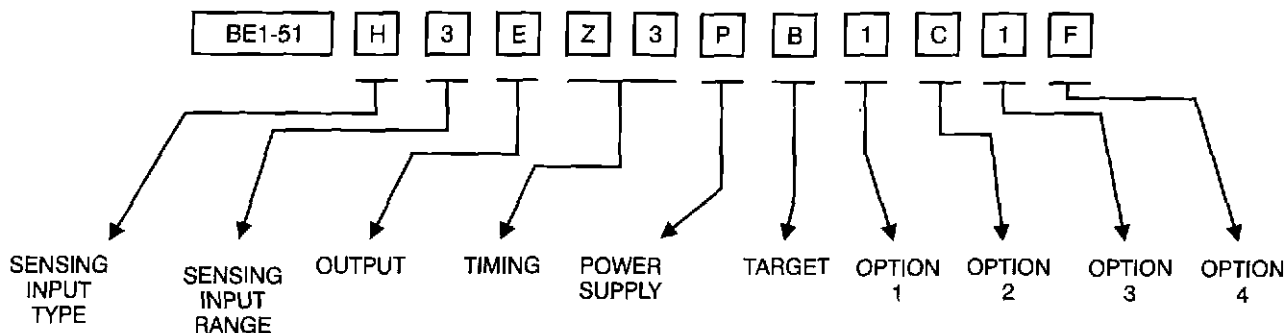
SAMPLE STYLE NUMBER: H3E Z3P B1C1F

The style number above describes a BE1-51 Time Overcurrent with Voltage Control Relay having the following features.

- (H) 3-phase and neutral current
- (3) 1.5 to 12 ampere time overcurrent pickup range
- (E) All output contacts are normally open.

- (Z3) B and C type time curves, integrated timing.
- (P) Internal operating power is obtained from an external 125 Vdc or 100/120 Vac source.
- (B) All targets are current operated.
- (1) One Instantaneous Overcurrent element for each sensing input.
- (C) Push-to-energize switches are included to verify external output connections.
- (1) Normally open auxiliary output contacts operate concurrently with the time overcurrent output relay.
- (F) The relay case is configured for flush mounting.

NOTE: Description of a relay must include both the model number and the complete style number as shown below.



HOW TO ORDER

Designate the model number followed by the complete style number.

BE1-51, Style No. □□□□□□□□□□
 BE1-51/27C, Style No. □□□□□□□□□□
 BE1-51/27R, Style No. □□□□□□□□□□

Complete the style number by selecting one feature from each column of the Style Number Identification Chart and entering its designation letter or number into the appropriate square. (Two squares are used to indicate time delay characteristics.) All squares must be completed.

STANDARD ACCESSORIES

The following standard accessories are available for the BE1-51, BE1-51/27C, and BE1-51/27R Time Overcurrent Relays.

Test Plug

Order Test Plug, Basler Electric part number 10095. (Two plugs may be required for complete testing capabilities).

Extender Board

The Extender Board will permit troubleshooting of the P. C. boards outside the relay cradle. Order Basler part number 9165500100.

ORDERING, continued

STYLE NUMBER IDENTIFICATION CHART

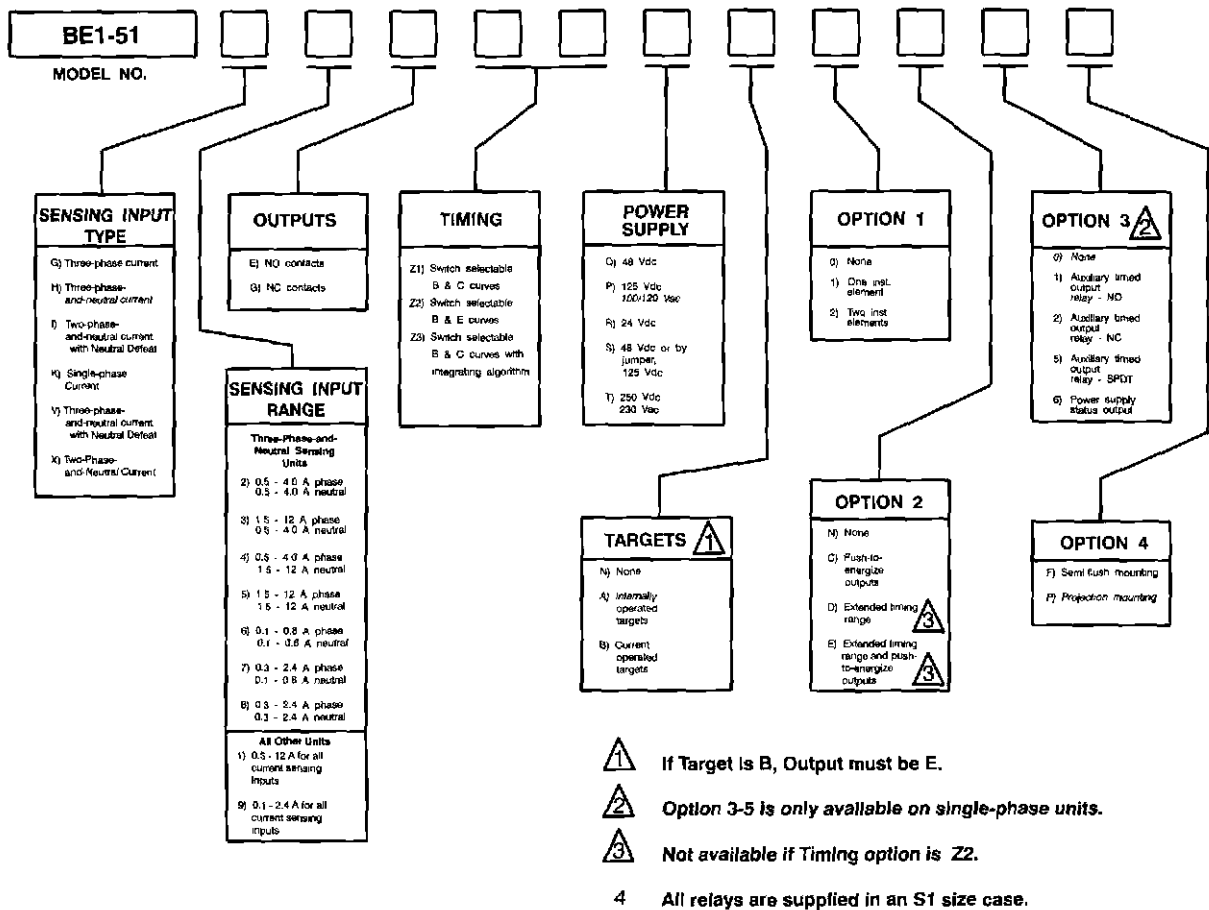
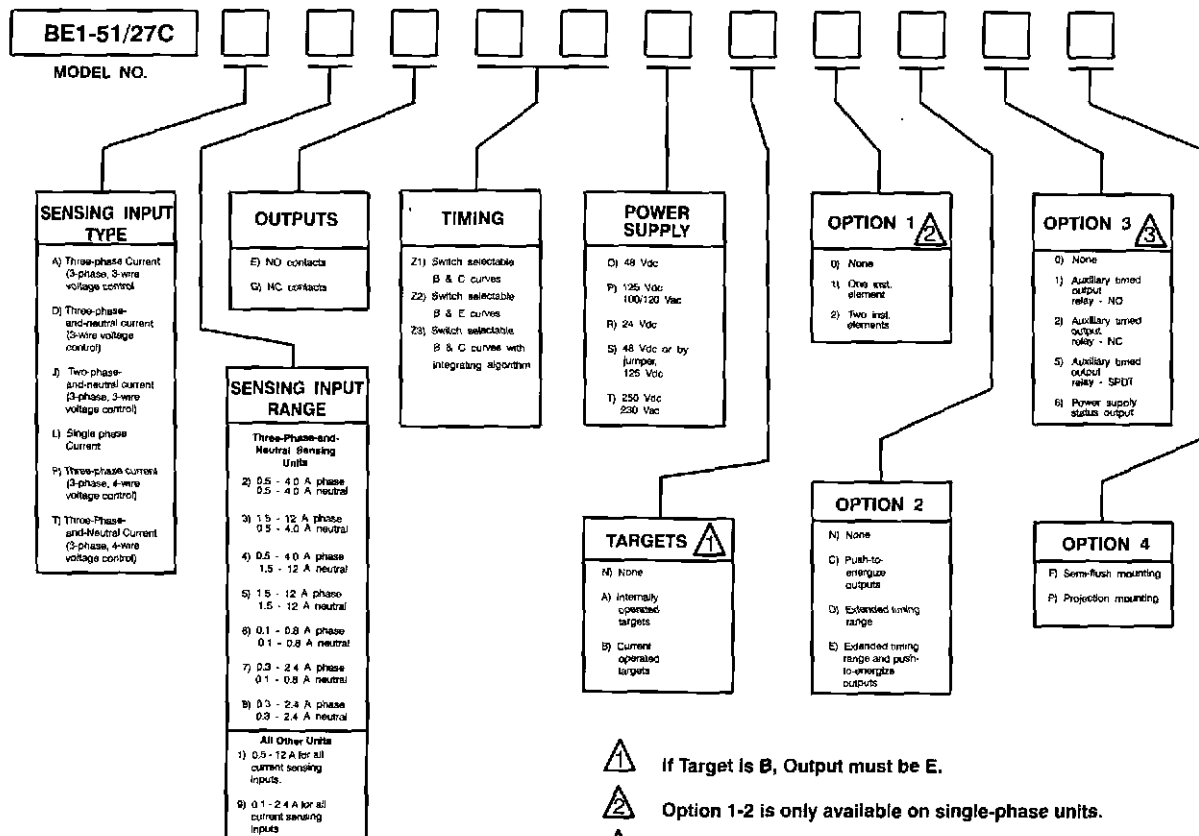


Table 2 - Timing Choices with Available Curves

Timing Choices	Z1	Z2	Z3 (Integrating)
Available Curves	Short Inverse	Short Inverse	Short Inverse
	Long Inverse	Long Inverse	Long Inverse
	Definite Time	Definite Time	Definite Time
	Moderately Inverse	Moderately Inverse	Moderately Inverse
	Inverse Time	Inverse Time	Inverse Time
	Very Inverse	Very Inverse	Very Inverse
	Extremely Inverse	Extremely Inverse	Extremely Inverse
	Pt	BS142 Long Inverse	Pt
	Pt with Limit 1	BS142 Inverse (1.3 sec)	Pt with Limit 1
	Pt with Limit 2	BS142 Inverse (2.9 sec)	Pt with Limit 2
	Pt with Limit 3	BS142 Very Inverse	Pt with Limit 3
	Pt with Limit 4	BS142 Extremely Inverse	Pt with Limit 4
	Pt with Limit 5		Pt with Limit 5
	Pt with Limit 6		Pt with Limit 6
	Pt with Limit 7		Pt with Limit 7
Pt with Limit 8		Pt with Limit 8	

ORDERING, continued

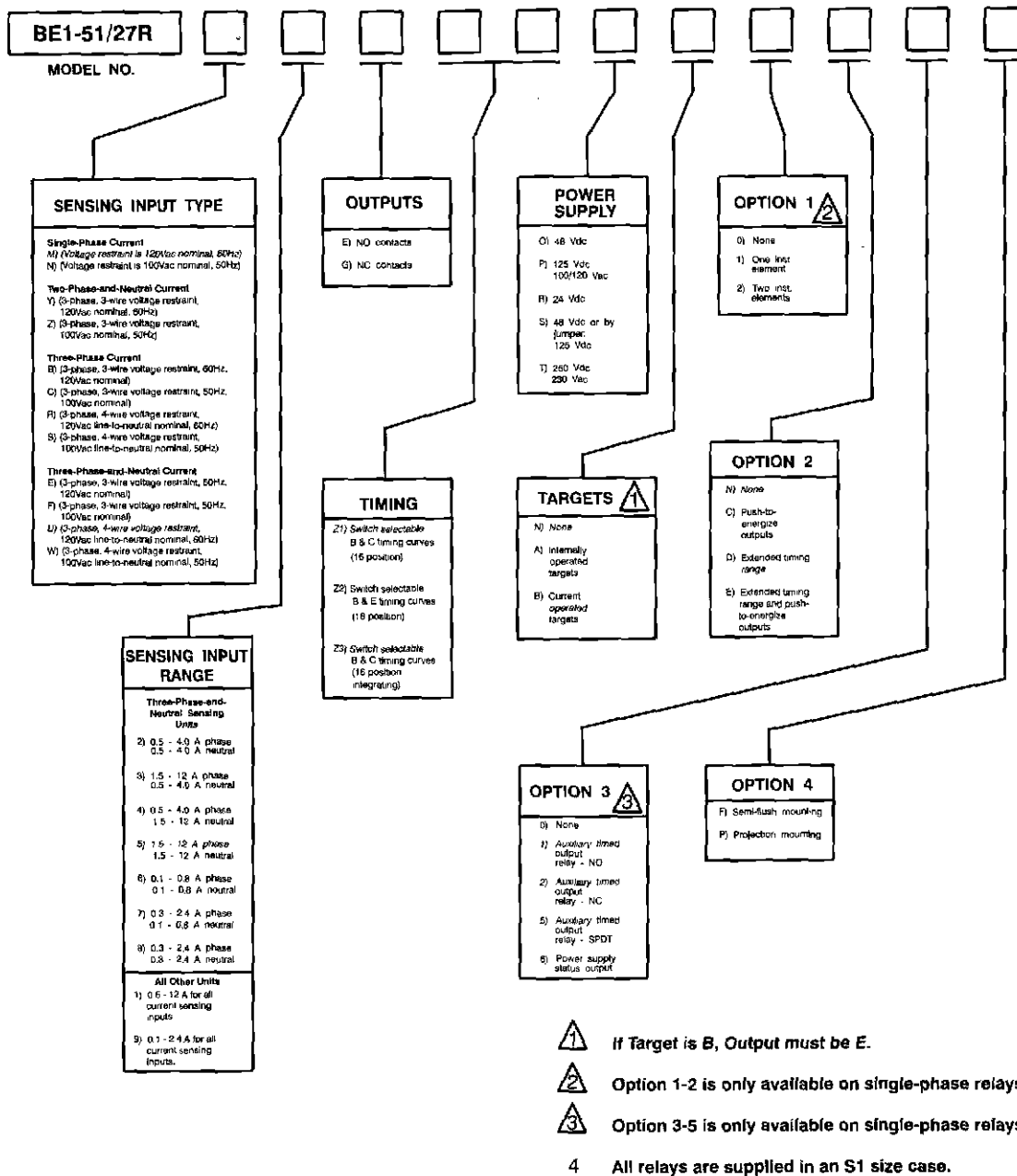
STYLE NUMBER IDENTIFICATION CHART

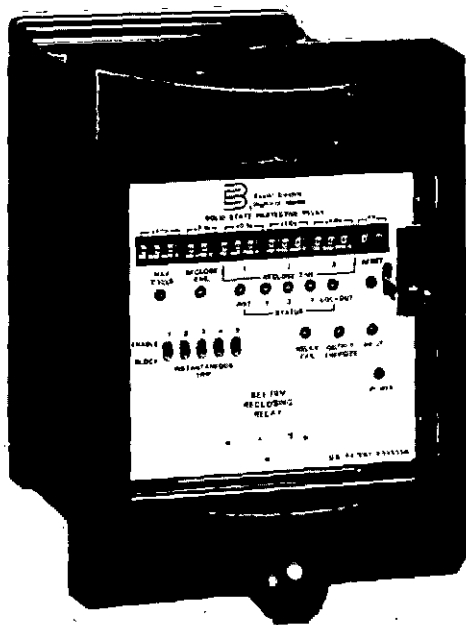


- If Target is B, Output must be E.
- Option 1-2 is only available on single-phase units.
- Option 3-5 is only available on single-phase units.
- 4 All relays are supplied in an S1 size case.

ORDERING, continued

STYLE NUMBER IDENTIFICATION CHART





BE1-79M MULTIPLE SHOT RECLOSING RELAY

The BE1-79M Multiple Shot Reclosing Relay is microprocessor based to provide versatility and control in automatic circuit breaker reclosing.

ADVANTAGES

- Contact selectable reclosing sequences are programmable for up to 4 reclosure attempts.
- Ability to resume reclosing sequence if control power is interrupted.
- Individually adjustable time-delayed reclosing attempts.
- Separate high speed "Pilot" reclose input and output are available for transmission reclosing applications.
- Self-monitoring circuitry with alarm output.
- Optional outputs to control tripping schemes, and block load tap changer operation during reclosing sequences.
- Optional controls limit the duration of reclose command output and the overall reclosing cycle.
- Optional contact inputs to inhibit the reset timer, inhibit all reclose timing, obtain an alarm prior to lockout, or to permit a special reclosing sequence.
- Qualified to the requirements of IEEE C37.90.1-1989 and IEC 255 for fast transient and surge withstand capability; IEC 255-5 for impulse.
- Five year warranty.

ADDITIONAL INFORMATION

INSTRUCTION MANUAL

Request Publication 9170100990

STANDARDS, DIMENSIONS & ACCESSORIES

Request Bulletin SDA

APPLICATION

Page 2

SPECIFICATIONS

Pages 2-6

EXTERNAL CONNECTIONS

Pages 6 and 7

ORDERING INFORMATION

Pages 7 and 8

B Basler Electric

P. O. BOX 269 HIGHLAND, ILLINOIS 62249, U.S.A. PHONE 618-654-2341 FAX 618-654-2351

UDL-6
11-00

APPLICATION

PURPOSE

The BE1-79M Multiple Shot Reclosing provides automatic reclosing of tripped circuit breakers in power transmission and distribution systems. The majority of overhead line fault may be cleared by momentarily de-energizing the line. An automatic reclosure of the breaker, after the fault clears, provides improved service continuity and system stability. This, in turn, allows higher loading by decreasing the likelihood of line loss.

In applications, several items should be considered. These include the desired number of reclosing attempts, time delay between tripping and reclosing, supervisory control requirements, and coordination.

Where most faults are attributable to heavy tree exposure, as in distribution networks, multiple reclosure attempts are common. This is because of low voltage levels and is desirable considering customer inconvenience during outages. The BE1-79M is programmable for 0, 1, 2, 3, or 4 reclosure attempts.

On distribution and subtransmission networks, it may be desirable to delay reclosing to allow motors to drop off and local generators to be separated. On the other hand, faster reclosing in transmission systems minimizes damage and system shock. Reclosing is generally delayed for dissipation and deionization of the arc in the interrupter. The BE1-79M incorporates up to one instantaneous and three delayed reclosure attempts, with adjustable time delays.

In integrating automatic reclosing into distribution and transmission networks, it may be expedient to include some type of supervisory control. Flexibility is essential to minimize both customer inconvenience and system damage. This flexibility is provided in the BE1-79M. Contact inputs are available to initiate reclosing, bypass instantaneous reclosures, inhibit reset timing, permit or temporarily block reclosing or drive the relay to lockout. These contacts may be provided from the supervisory, control or protection circuits.

For system coordination, the BE1-79M reclosing relay possesses the ability for automatic system control. Outputs are available to enable or block instantaneous tripping of the circuit breaker, and to block automatic transformer load tap changer operation during a reclosing sequence. These outputs can be normally open or normally closed.

The relay also includes the capability to collect data on the success of reclosing, by recording each reclosing attempt (by type) in its memory. Outputs are also available to provide status information about the reclosing system: lockout, reclose fail, or relay fail.

The extent of reclosing integration is dependent on your desires and the system requirements. The BE1-79M has the flexibility to fulfill both.

SPECIFICATIONS

FUNCTIONAL DESCRIPTION

The specifications on these pages define the many features and options that can be combined to satisfy an application requirement. The block diagram in Figure 1 illustrates how various standard features, as well as options, function.

INPUTS

Contact Sensing

The Multiple Shot Reclosing Relay monitors the state of external contacts within the protection/control system. These contacts must have a minimum rating of .025A at 250 Vdc. Depending on selected option, the current through the contacts may be obtained from the relay itself (isolated contact sensing), or from a dc source with the voltage rating equal to the relay's power supply input (non-isolated contact sensing).

Maximum Sensing burden, which is dependent on power supply type, is listed below.

Power Supply Type	K	J	L	Z	Y
Burden per Input	1.5W	2.5W	1.0W	5.5W	2.5W

Contact sensing current is filtered and optically isolated by the contact interface circuitry. User-supplied contacts perform the following functions.

Breaker (52b) – Form B auxiliary contact of the controlled breaker defines the position of the breaker.

Reclose Initiate (RI) – Form A contact closed to initiate a reclosing sequence consisting of an instantaneous attempt followed by up to three time-delayed attempts.

SPECIFICATIONS (Continued)

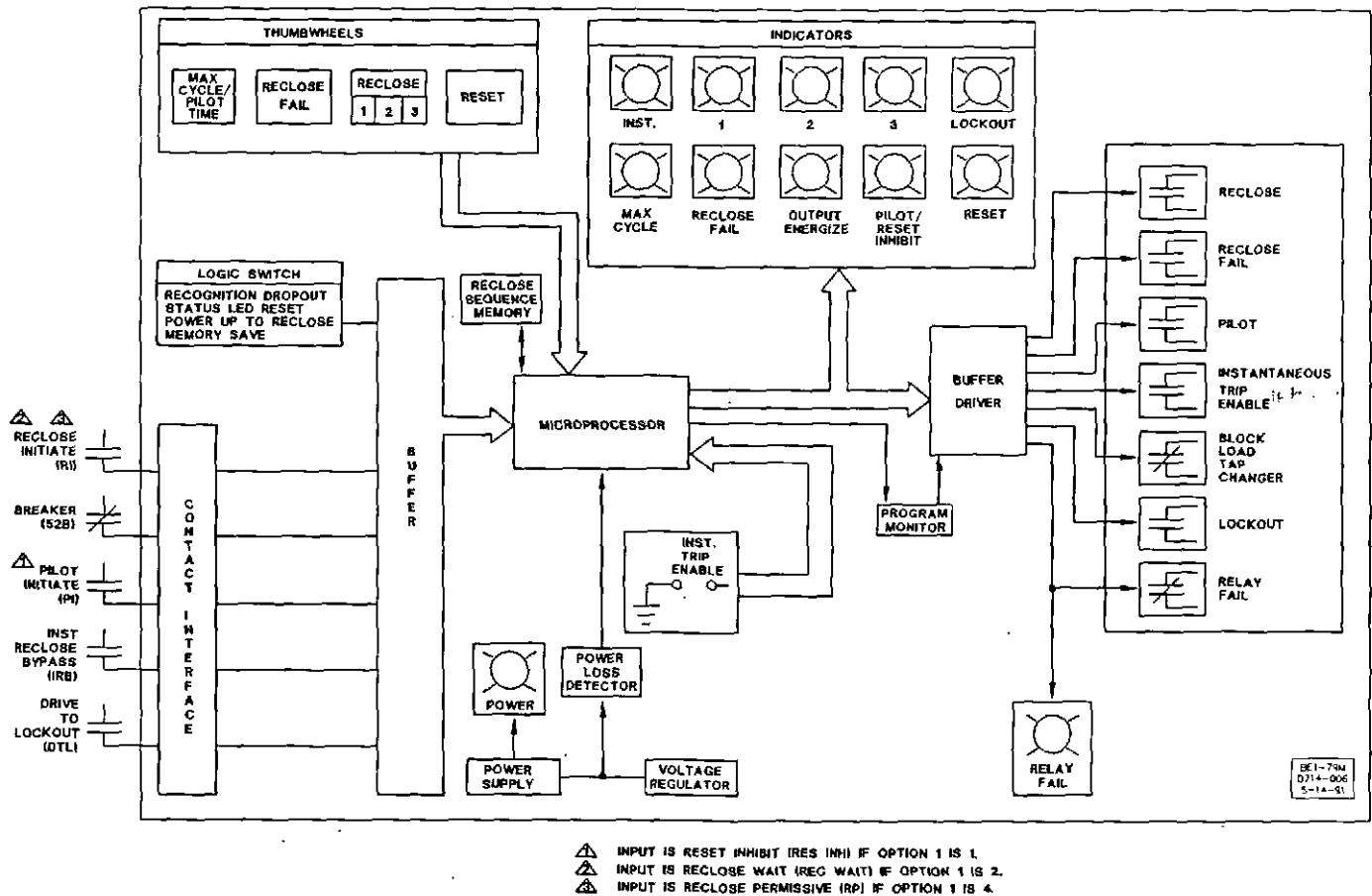


FIGURE 1. FUNCTIONAL BLOCK DIAGRAM

This contact is also required during the reclosing sequence to initiate each reclose time delay and subsequent reclose output closure.

Instantaneous Reclose Bypass (IRB) – Form A contact when closed bypasses the instantaneous reclose attempt in a normal reclosing sequence and initiates the reclosing sequence with the first time delayed reclosing attempt.

Drive-to-Lockout (DTL) – Form A contact which instantaneous drives the relay to the lockout condition when closed.

Pilot Initiate (PI) (Option) – Form A contact when closed initiates the pilot reclosing sequence consisting of an instantaneous attempt followed by up to two time-delayed attempts. This contact is also required during the pilot reclosing sequence to start each closure.

Reset Inhibit (RST INH) (Option) – Form A contact when closed inhibits the reset timer from timing. If this option is present, the 52b contact and RST INH must both be open to enable the reset timer to function.

Reclose Wait (RW) (Option) – Form A contact when closed, inhibits all timers from timing. All output contacts shall remain in their previous state, except reclose or pilot reclose which shall open if RW is closed. When RW is removed, reclosing will continue in the sequence to its next state (time delay or lockout). When this option is selected, "RI" is always logically "closed".

Reclose Permissive (RP) (Option) – Form A contact when closed permits a reclose sequence ("RI" is logically closed). When opened, all reclose time-delays are inhibited, the reclose or pilot reclose shall open, and the "IRB" and "PI" inputs are latching inputs. If RP is opened during a reclosing sequence, then closed, the relay will continue in the sequence to its next state (time-delay or lockout).

SPECIFICATIONS (Continued)

Power Supply

One of five power supply types may be selected to provide internal operating power. They are described in Table 1.

TABLE 1. POWER SUPPLY OPTIONS

Type	K	J	L	Z	Y
Nominal Voltage	48 Vdc	125 Vdc	24 Vdc	250 Vdc 230 Vac	48 Vdc 125 Vdc
Burden	9.0 W	19.5 W 36.0 VA	11.0 W	364.5 W 79.0 VA	9.0 W 19.5 W

Reclose

The reclose output contact is closed to energize the circuit breaker's closing coil. One instantaneous and up to three time-delayed reclosure attempts can be programmed. An instantaneous reclosure is defined as a reclose attempt with no intentional time delay. Each of the time-delayed reclosures are individually adjustable in 0.1 second increments from 0.1 to 99.9 seconds or 1.0 second increments from 1 to 999 seconds. The number of reclosing attempts before lockout is front panel programmable. Setting any of the reclosure time delays to 000 will produce lockout when that reclosing attempt is reached in the sequence.

Reclose Fail

The front panel programmable reclose fail option is available to limit the duration of the reclose command signal. Initiated at the onset of a reclose command output signal, the reclose fail time setting is compared to the time the reclose command signal is present. If the set time is exceeded before the breaker closes, the relay immediately goes to lockout, the reclose fail output contact is closed, and the reclose fail LED indicator illuminates. The reclose fail setting is adjustable in 0.1 second increments from 0.1 to 9.9 seconds. A setting of 00 inhibits the reclose fail timer and causes the reclose command signal to be continuous until the breaker closes.

Lockout

A normally open output contact is provided, as well as a front panel LED to indicate lockout. Lockout inhibits further relay operation and will occur for any of the following conditions:

- 1) The number of breaker trips in a sequence exceeds the number of programmed reclosure attempts.
- 2) Closure of the drive-to-lockout input contact,

3) Reclosure failure, or

4) The total reclosing sequence time exceeds the maximum cycle time setting.

To bring the relay out of lockout, the circuit breaker must be closed (manually or by other means) and then remain closed for the reset time delay setting.

Reset

When a breaker has been reclosed, the micro-processor initiates the reset timing function. If the breaker remains closed for the duration of the front panel programmable reset time setting, the relay automatically resets. However, if the breaker reopens prior to expiration of the rest time, the relay will proceed to the next reclose attempt, or, if programmed reclose attempts have been exhausted, to lockout. The reset timer is inhibited from timing if the reset inhibit option is selected and the input is present. The reset timing function is also initiated during the power-up sequence (except when the memory save function is enabled and the breaker is open). A front panel LED is illuminated to indicate that the relay is in the reset state. The relay must be in the reset state for a reclosing sequence to be initiated. The reset time setting is adjustable from 10 to 1000 seconds in 10 second increments, or 1 to 100 second, in 1 second increments. A setting of 00 produces the maximum time available (1000 or 100 seconds).

Power-up

When power is applied to the relay, from a non-powered-up state, the relay will assume either a "relay fail" condition (if the circuit breaker is closed) or a "lockout" condition (if the breaker is open), except when the "power-up to reclose" or "memory save" features are enabled.

Standard Programmable Features

Several functions are available with each relay that can be programmed by changing the setting on PC board mounted 16 position switch.

Memory Save

When this feature is enabled and power is removed, that point in the reclosing sequence is stored in memory. Upon power restoration, operation is then resumed from the exact point in the reclosing sequence where power was lost. With this feature disabled, the relay will undergo a normal power-up routine when power is restored.

Power-up to Reclose

When this feature is enabled, the relay will allow an immediate reclosing sequence from an initial power-up condition. When disabled, the relay will undergo a

SPECIFICATIONS (Continued)

normal power-up routine upon application of power.

Status LED Reset

When this feature is enabled, the reclosing status LEDs (INST, 1 2 3 4 and Pilot) will extinguish whenever the relay goes to the reset condition. When disabled these LED's will remain illuminated until power is removed or extinguished from the reset lever.

Recognition Dropout

When this feature is enabled, the time period between the RI or PI inputs dropout and 52b input recognition must be less than 200 milliseconds. When disabled, this time period must be less than 17.5 milliseconds.

Pilot Initiate

The pilot initiate option provides an additional input, output, and reclosing sequence. The pilot initiate reclosing sequence is as follows: The pilot initiate (PI) and breaker open (52b) contact signals are received, illuminating the pilot reclose LED and instantaneously closing the pilot reclose output contact. The pilot reclose output contact will remain closed until the breaker closes, or, if present, until the reclose fail time setting is exceeding. When the breaker closes, the reset timing function commences. If the breaker reopens before the relay resets, the relay will assume a normal reclosing sequence, beginning with the second time delayed attempt. Pilot initiate takes precedent over RI. An optional pilot timer is available with adjustable time delay of 0.03 to 0.99 seconds in 0.01 second increments.

Instantaneous Trip Enable

An instantaneous trip enable option is available to enable instantaneous tripping of the circuit breaker. Each of the five front panel switches defines the state of instantaneous trip enable output contacts for a particular point in the overall operation. With the switches in the enable position, the instantaneous trip enable output contacts are closed during the following periods:

Switch Enabled	Contact Closed	
	From	To
1	Lockout and/or reset	First trip
2	Instantaneous reclosure	Next trip
3	First time-delayed reclosure	Next trip
4	Second time-delayed reclosure	Next trip
5	Third time-delayed reclosure	trip

Instantaneous tripping may be enabled or disabled for any single trip or combination of trips. A "cold load"

feature is available which will keep the contact open for switch 1 until the relay goes to the reset condition.

Block Load Tap Changer

A normally closed or normally open contact is available to prevent the operation of a transformer's automatic load tap changer during a reclosing sequence. This contact is energized when a reclosing sequence is initiated and remains in its energized state until the relay either resets or reaches lockout. If a normally closed contact is selected, the contact is open during the reclosing sequence.

Reclosing Event Memory

The Reclosing Event Memory is included to provide the user with a method of automatically counting the number of instantaneous, 1st time-delay, 2nd time-delay, 3rd time-delay, pilot reclose attempts and the number of times the relay has gone to lockout. A maximum of 999 attempts for each reclose type can be stored in the relays memory. The memory is a non-volatile RAM (random access memory) and will retain data through all power interruptions.

Maximum Cycle

The maximum cycle time option limits the maximum duration of the total reclosing sequence. This front panel programmable timing function is initiated by the recognition of the first trip in a sequence, and continues until the unit is either reset or advanced to lockout. Failure to achieve reset before this set time has elapsed will advance the relay to lockout. A front panel LED illuminates to indicate that the maximum cycle time setting has been exceeded. The maximum cycle is adjustable from 1 to 1,000 seconds in 1 second increments. The 1000 second maximum cycle limit is obtained by a setting of 000.

Outputs

All output contacts are rated as follows:

Resistive

120/240 Vac – make 30 A for 0.2 seconds, carry 7 A continuously, break 7 A.

250 Vdc – make and carry 30 A for 0.2 seconds, carry 7 A continuously, break 0.1 A.

500 Vdc – make and carry 15 A for 0.2 seconds, carry 7 A continuously, break 0.1 A.

Inductive

120/240 Vac, 125 Vdc, 250 Vdc – break 0.3 A (L/R = 0.04)

Microprocessor

The input signals and front panel switches are read and interpreted by the microprocessor. The

SPECIFICATIONS (Continued)

microprocessor determines the course of action by selecting the proper reclosing sequence, and affecting output contacts accordingly. The microprocessor also performs all timing functions.

Program Monitor

Operation of the microprocessor is continuously monitored by the program monitor. Should the microprocessor fail to function properly, the program monitor will discontinue microprocessor operation, close the relay fail alarm output contact and reset all other output contacts.

Relay Fail

A normally closed output contact is provided to indicate a Multiple Shot Reclosing Relaying failure. This contact opens on completion of the power-up sequence and remains open until power is lost or the microprocessor malfunctions. A front panel LED is illuminated during power-up and in the event the Multiple Shot Reclosing Relay fails.

Built-in-Test (BIT)

The Built-in-Test is a quick test routine programmed into the BE1-79M relay. When initiated, the relay will perform a programmed sequence of events, each event occurring at one-second intervals. This sequence will quickly verify proper operation of all indicators and outputs incorporated into the unit.

Surge Withstand Capability

Qualified to ANSI/IEEE, C37.90.1 Surge Withstand Capability Test and IEC 255, Impulse Test and Dielectric Test.

Mechanical

Operating Temperature

-40°C (-40°F) to +70°C (+158°F)

Storage Temperature

-65°C (-85°F) to +100°C (+212°F)

Weight

13 pounds

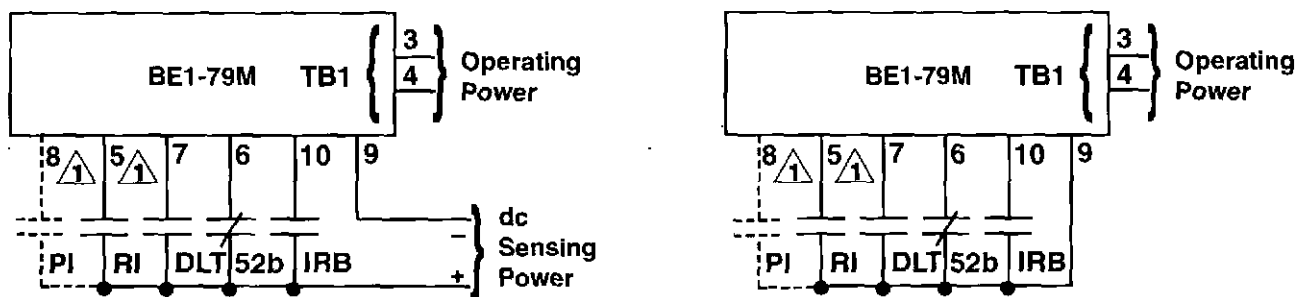
Shock

In standard tests, the relay has withstood 15g in each of three mutually perpendicular axes without structural damage or degradation of performance.

Vibration

In standard tests, the relay has withstood 2g in each of three mutually perpendicular axes swept over the range of 10 to 500 Hz for a total of six sweeps, 15 minutes for each sweep, without structural damage or degradation of performance.

CONNECTIONS



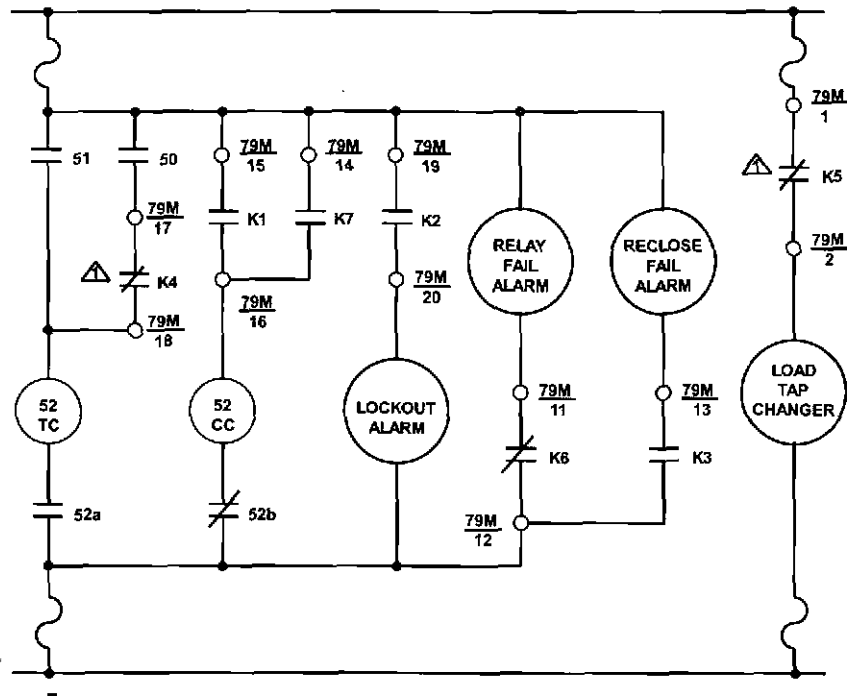
Legend:

- RI Reclose Initiate Sensing Input Contacts
- DTL Drive-to-Lockout Sensing Input Contacts
- 52b Circuit Breaker Sensing Input Contacts
- IRB Instantaneous Reclose Bypass Sensing Input Contacts
- PI Pilot Initiate Sensing Input Contacts (Optional)
- RST INH Reset Inhibit Sensing Input Contacts (Optional)
- REC WAIT Reclose Wait Sensing Input Contacts (Optional)
- RP Reclose Permissive Sensing Contacts (Optional)

- △ If Option 1 is 1
PI is Replaced with RST Inhibit
- If Option 1 is 2
RI is Replaced with REC Wait
- If Option 1 is 4
RI is Replaced with RP

Figure 2. Contact Sensing

CONNECTIONS, Continued



LEGEND:

79M MULTIPLE SHOT RECLOSING RELAY
 50 INSTANTANEOUS OVERCURRENT RELAY
 51 TIME OVERCURRENT RELAY
 52 CIRCUIT BREAKER
 52a CIRCUIT BREAKER AUXILIARY CONTACTS
 52b CIRCUIT BREAKER AUXILIARY CONTACTS
 K1 RECLOSING OUTPUT CONTACTS

K2 LOCKOUT ALARM OUTPUT CONTACTS
 K3 RECLOSE FAIL ALARM OUTPUT CONTACTS
 (LOCKOUT AND RESET-2, 5, 6, 8)
 K4 INSTANTANEOUS TRIP ENABLE OUTPUT CONTACTS
 (CONTROL OUTPUT-A, C)
 K5 BLOCK LOAD TAP CHANGER OUTPUT CONTACTS
 (CONTROL OUTPUT-B, C)

K6 RELAY FAIL ALARM OUTPUT CONTACTS
 K7 PILOT RECLOSING OUTPUT CONTACTS
 (LOCKOUT AND RESET-3, 5, 7, 8)
 TC TRIP COIL
 CC CLOSING COIL
 ~ CONTROL CIRCUIT FUSING (IF USED)
 ⚠ MAY BE NO OR NC

Figure 3 - Control circuits

ORDERING

MODEL NUMBER

BE1 -79M Multiple Shot Reclosing Relay.

STYLE NUMBER

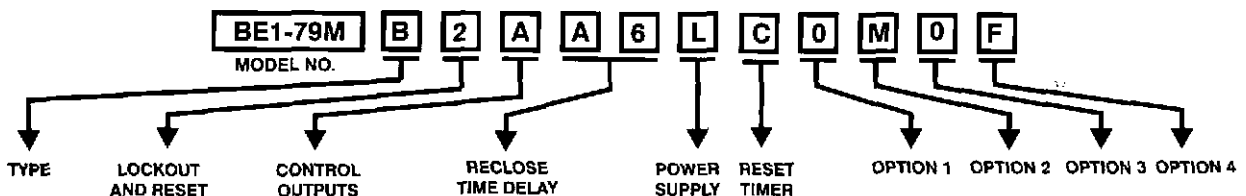
The style number appears on the front panel, drawout cradle, and inside the case assemble. This style number is an alphanumeric combination of characters identifying the features included in a particular unit. The sample style number below illustrates the manner in which the various features are designated. The Style Number Identification Chart (page 8) defines each of the options and characteristics for this device.

SAMPLE STYLE NUMBER: B2AA6LCOMOF

The style number above describes a BE1-79M Multiple Shot Reclosing Relay having the following features.

Type	(B) Multi-shot
Lockout and Reset	(2) Lockout and reset with reclose failure alarm
Control Outputs	(A) Instantaneous trip enable
Reclose Time Delay	(A6) 0.1 to 99.9 seconds
Power Supply	(L) 24 Vdc external operating power
Reset power	(C) 10 to 1000 seconds
Option 1	(0) None
Option 2	(M) Isolated contact sensing
Option 3	(0) None
Option 4	(F) Semi-flush mounting

Note: The description of a complete relay must include both the model number and the style number.



Sample Style Number Illustrated

ORDERING, continued

HOW TO ORDER:

Designate the model number followed by the complete Style Number:

BE1-79M Style No.

Complete the Style Number by selecting one feature from each column of the Style Number Identification Chart and entering its designation letter or number into the appropriate square. (Two squares are used to indicate timing). All squares must be completed.

STANDARD ACCESSORIES:

The following standard accessories are available for the BE1-79M Multiple Shot Reclosing Relay.

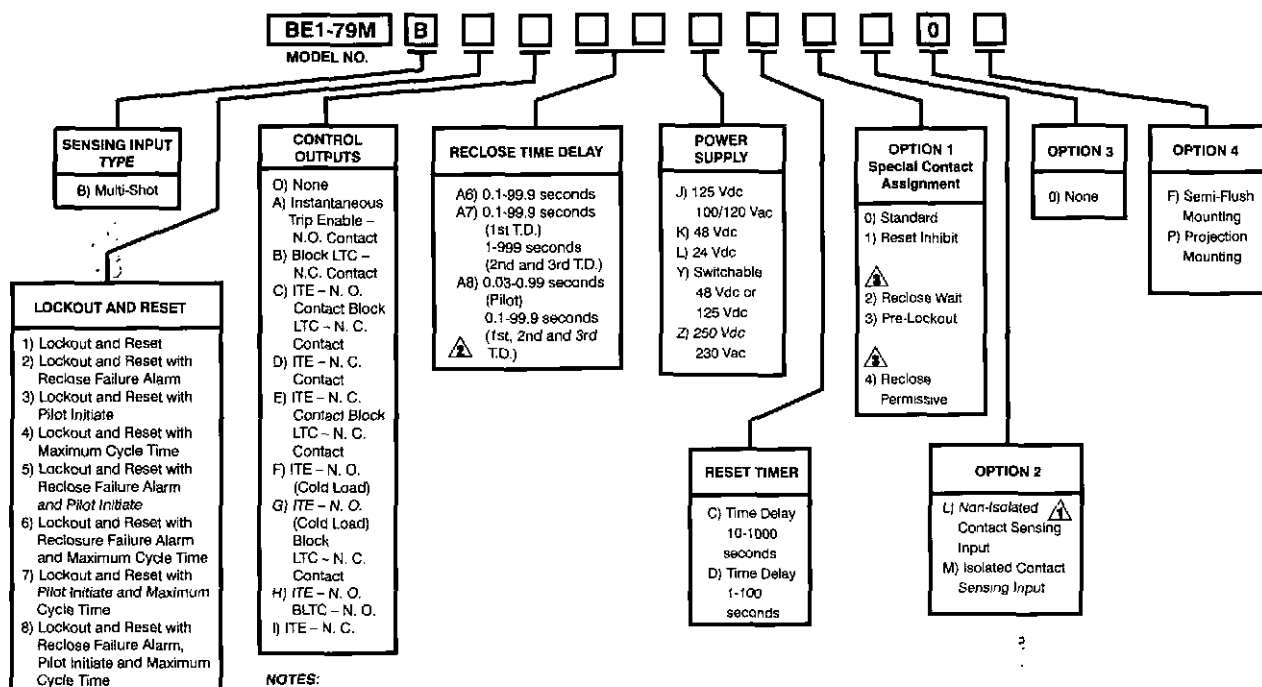
Test Plug

To allow testing of the relay without removing system wiring, order two test plugs, Basler part number 10095.

Extender Board

The Extender Board will permit troubleshooting of the P. C. boards outside the relay cradle. Order Basler part number 9165500100.

STYLE NUMBER IDENTIFICATION CHART



- NOTES:**
- ⚠ Non-isolated contact sensing L requires dc sensing power.
 - ⚠ Pilot Initiate Option required (L.O. and reset must be 3, 5, 7, 8).
 - ⚠ Not available with Pilot Initiate (L.O. and Reset must be 1, 2, 4, or 6).





BE1-810/U DIGITAL FREQUENCY RELAY

The BE1-810/U Digital Frequency Relay senses an ac voltage from a power system or generator to provide protection in the event that the frequency exceeds predetermined limits.

FEATURES

- Reliable solid-state digital circuitry.
- Up to 4 independent frequency set points.
- Over or underfrequency sensing selectable for each set point.
- Convenient, precise selection of the set point frequency over the nominal range of 40 Hz to 70 Hz.
- Individually adjustable time delays and LED indicators for each frequency set point.
- Optional definite time delay characteristic.
- Undervoltage inhibit prevents undesired relay operation and provides an indication of the inhibiting condition over the adjustable range of 40-120 Vac.
- Excellent timing accuracy and repeatability.
- Low sensing and supply burdens.
- Qualified to the requirements of
 - IEEE C37.90.1-1989 for surge withstand capability
 - IEEE C37.90.1-1989 for fast transient
 - IEC 255-5 for impulse
- Five year warranty.

ADDITIONAL INFORMATION INSTRUCTION MANUAL

Request Publication 9137300990

STANDARDS, DIMENSIONS and ACCESSORIES

Request Publication SDA

**FEATURES and
APPLICATIONS**
this page

**THEORY OF
OPERATION**
Pages 2 - 3

SPECIFICATIONS
Pages 5 - 7

**ORDERING
INFORMATION**
Page 8

B Basler Electric

P. O. BOX 269 HIGHLAND, ILLINOIS 62249, U.S.A. PHONE 618-654-2341 FAX 618-654-2351

UBR-6
7-01

THEORY OF OPERATION

POWER SUPPLY

A variety of power supply options allows a wide range of external voltage inputs for operation of the relay. Nominal outputs of these supplies are ± 12 Vdc. An LED indicator on the front panel illuminates when the power supply is operational.

SENSING

A single phase voltage is applied through an input transformer and filter circuit to the undervoltage inhibit logic and the zero-cross logic.

BURDEN

2 VA maximum at nominal input.

UNDERVOLTAGE INHIBIT

This circuit prevents energizing of the output relay(s) from occurring during an undervoltage condition associated with equipment startup. The circuit prevents operation of the relay logic. The undervoltage level is nominally factory set to 80 Vac but may be adjusted by a small screwdriver, through the front panel, to any value between 40 and 120 Vac.

ZERO-CROSS LOGIC

The zero-cross logic converts the sensed frequency to pulses synchronized to each positive-going zero crossing of the waveform. The pulse frequency represents the period of the waveform and is applied to the period measurement logic.

CRYSTAL OSCILLATOR

The crystal-controlled oscillator provides accurate 1 MHz and 2 MHz timing signals for the clock and the period measurement logic.

CLOCK

The clock allows a frequency comparison to be made for each cycle of sensed frequency by initiating the generation of reference periods that are synchronized with the beginning of each cycle of the sensed frequency.

MINIMUM PERIOD DIFFERENCE LOGIC

Each zero-cross pulse causes this logic to count clock pulses up to a maximum count representing the maximum measurable frequency (minimum period) limit. When the sensed frequency is less than this maximum limit, the count goes to completion and an EOPR (End of Period Reference) pulse is generated to initiate the maximum period difference logic.

MAXIMUM PERIOD DIFFERENCE LOGIC

Following the EOPR pulse, this logic counts clock pulses representing the minimum frequency (maximum period) limit. If zero-cross pulses have properly occurred before the count ends, the measured frequency converter computes the actual frequency within the limits.

MEASURED FREQUENCY CONVERTER

This logic converts the period of the sensed frequency into a binary number corresponding to the frequency within the minimum and maximum frequency limits. The binary number is then applied to the frequency comparator logic in each independent set point.

FREQUENCY COMPARATOR LOGIC

This logic compares the binary number representing the actual sensed frequency with the set point frequency selected on the front panel thumbwheel selectors. An output is provided when the sensed frequency is less than the set point frequency if the O/U toggle switch is set to U, or when the frequency exceeds the set point frequency if the O/U toggle switch is set to O. The resultant output consists of an enabling pulse if timing type E1 or E2 (definite time delays) is present.

DEFINITE TIME DELAY LOGIC (TIMING TYPE E1 AND E2)

The enable signal from the frequency comparator logic illuminates the PICKUP indicator and initiates the count of zero-cross pulses. When the TIME DELAY selector setting in cycles is reached, the logic enables the output circuit. The PICKUP indicator remains illuminated and the output relay remains energized until the frequency condition is corrected; when the sensed frequency returns to normal, reset of the output relay and extinguishing of the PICKUP indicator is instantaneous. The time delay selector is selectable over the range of 3 cycles to 990 seconds. An undervoltage condition prevents the operation of this logic.

OUTPUT CIRCUITS

The output signal from the time delay circuit is optically coupled to the output driver. The output driver supplies operating current to energize the output relay. Either normally open or normally closed contacts may be selected for the output relay, and an optional set of auxiliary relay contacts may be specified. Each set point of the relay will be supplied with its own output relay, and the contact configuration of all output relays will be the same. The output relay(s) will remain energized for the duration of the over or underfrequency condition.

THEORY OF OPERATION, continued

POWER SUPPLY STATUS OUTPUT

The optional power supply status output relay is energized and its NC output contact is opened when power is applied to the relay. Normal internal relay operating voltage maintains the power supply status output relay continuously energized with its output contact open. If the power supply output voltage falls below the requirements of proper operation, the power supply output relay is de-energized, closing the NC output contact.

TARGET INDICATOR CIRCUITS

When required, a target indicator for each set point will be supplied. All targets within a specific relay will be of the same type.

Signal (Internal) Operated Target Driver: The output from the time delay circuit is applied to this circuit to drive the target indicator. The indicator is tripped regardless of the current level in the trip circuit.

Current Operated Target Driver: This circuit will operate when a minimum current of 0.2 amp DC flows in the output circuit. A special reed relay in series with the output contact provides the signal to the target indicator.

Target Indicator: The target indicator(s) is visible on the front panel. The target indicator is magnetically latched and must be reset manually after the abnormal frequency condition has been corrected.

FUNCTIONAL DESCRIPTION

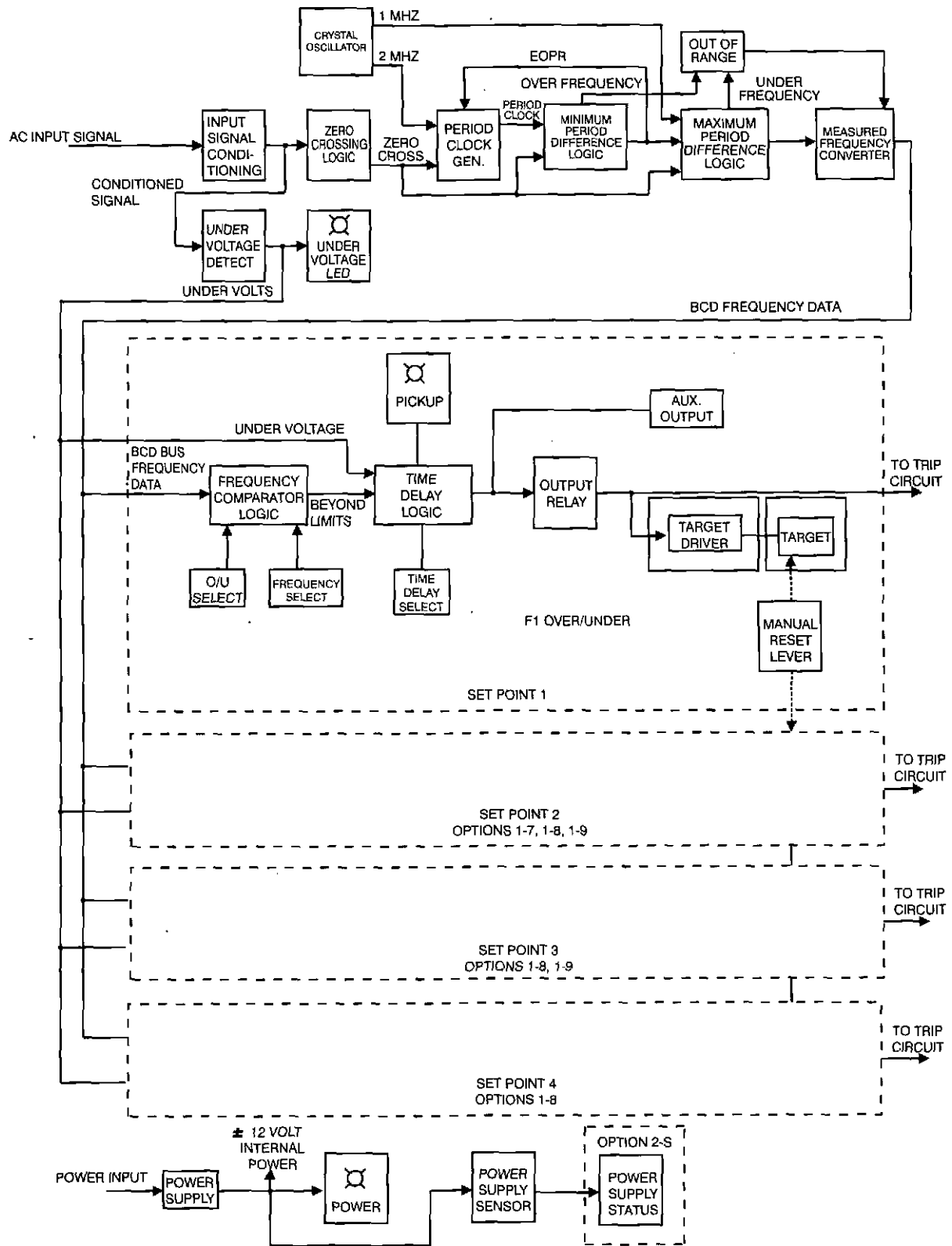


Figure 1 - Functional Block Diagram (Typical)

SPECIFICATIONS

ELECTRICAL

Power Input

One of five types of power supplies may be selected to provide Relay operating power.

Type	Nominal Input Voltage	Input Voltage Range	Burden at Nominal
K	48Vdc	24 to 60Vdc	4.4W
J	125Vdc 120Vac	62 to 150Vdc 90 to 132Vac	4.1W 10.1VA
L*	24Vdc	12 to 32Vdc	4.5W
Y	48Vdc 125Vdc	24 to 60Vdc 62 to 150Vdc	4.4W 4.1W
Z	250Vdc 230Vac	140 to 280Vdc 190 to 270Vac	5.5W 14.8VA

* Type L power supply may require 14 Vdc to begin operating. Once operating, the voltage may be reduced to 12 Vdc.

Frequency Sensing Input

The input sensing circuit is operational over the range of 40 to 132 Vac at 40-70 Hz. Maximum sensing burden is 2VA.

Outputs

Output contacts are rated as follows:

Resistive

120/240 Vac - make, break, and carry 7 A continuously.

250 Vdc - make and carry 30 A for 0.2 seconds, carry 7 A continuously, break 0.3 A.

500 Vdc - make and carry 15 A for 0.2 seconds, carry 7 A continuously, break 0.3 A.

Inductive

120 Vac, 125 Vdc, 250 Vdc - break 0.1 A (L/R = 0.04).

Power Indicator

A front panel LED illuminates when the power supply is providing operating voltages.

Undervoltage Inhibit Adjustment

Allows continuous adjustment of the undervoltage inhibit level for the sensed voltage between 40 and 120 Vac. Relay operation is inhibited if the sensed level is below the setting. Adjustment is by small screwdriver through the front panel.

Undervoltage Inhibit Indicator

This front panel red LED illuminates when the sensed voltage is less than the UNDERVOLTAGE INHIBIT adjustment level.

Each individual set point (1, 2, 3 and 4) has the following:

SET POINT FREQUENCY SELECTOR:

Each front panel FREQUENCY selector consists of four thumbwheel selectors providing selection of the

desired set point frequency, in increments of 0.01 Hz, over the allowable nominal sensing range of 40 - 70 Hz. When the sensed frequency goes outside the selected set point, the output relay is energized after a preset time delay (Figure 2). When the frequency returns to within the "normal" limit, and remains there for three cycles, the output relay resets.

SET POINT O/U SELECTOR: An individual front panel-mounted two position toggle switch determines the O - overfrequency (increasing frequency) or U - underfrequency (decreasing frequency) function for each setpoint.

SET POINT TIME DELAY SELECTOR: Each set point includes two thumbwheel selector switches to provide selection of the desired time delay between sensing of the abnormal frequency condition and energization of the output relay. Two types of time delay characteristics are available: timing types E1 and E2 (See Note 4, Style Number Identification Chart) provide a definite time delay characteristic adjustable over a range of 3 to 99 cycles in 1 cycle increments, 10 to 990 cycles in 1 cycle increments, 100 to 9900 cycles in 10 cycle increments, 0.1 to 9.9 seconds in 0.1 second increments, 1 to 99 seconds in 1 second increments, and 10 to 990 seconds in 10 second increments. Settings of 00, 01, or 02 cycles operate the same as 3 cycles, because the timing circuits require 3 cycle continuous excursion through the set point before tripping the output circuit.

SET POINT PICKUP INDICATOR: A front panel red LED illuminates during each time delay period and continues to illuminate while the set point output relay remains energized.

SPECIFICATIONS, continued

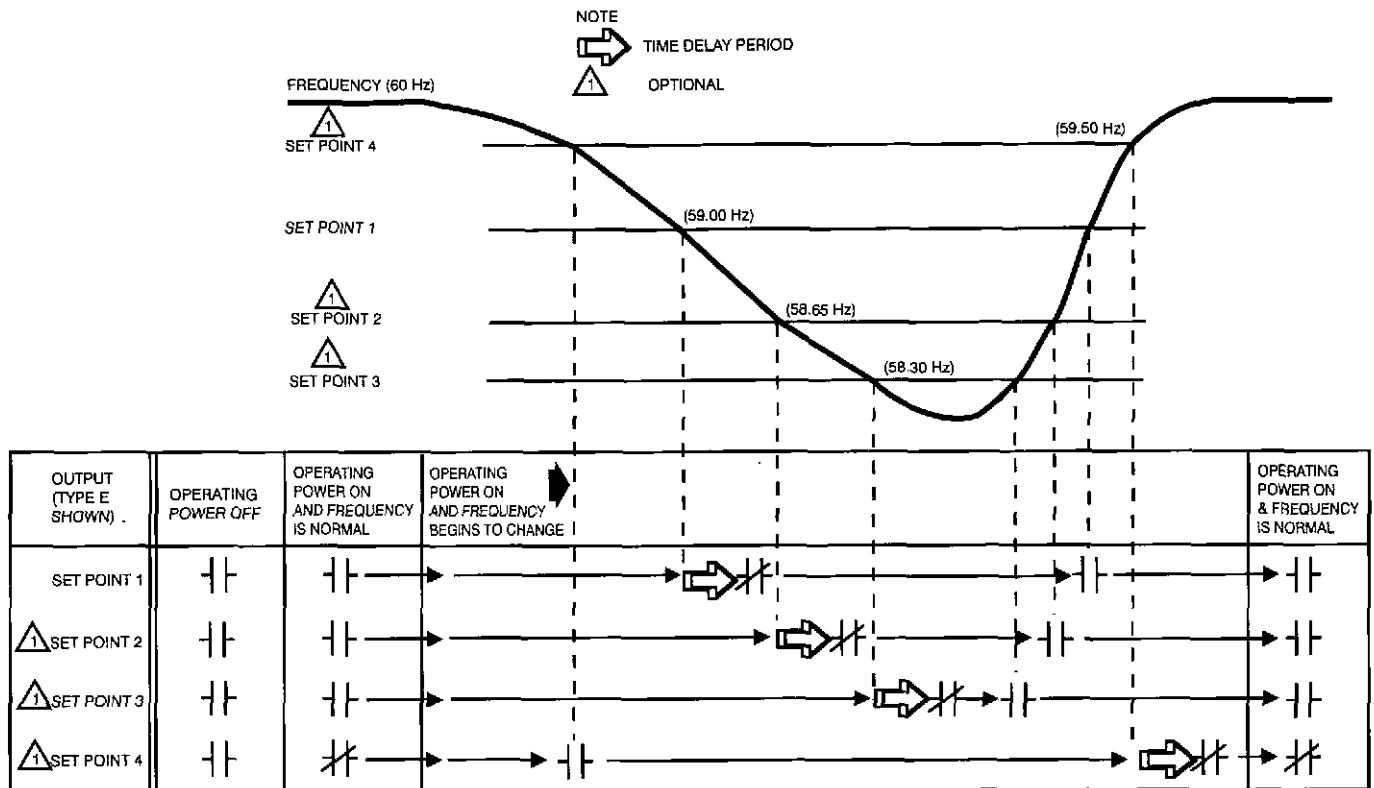


Figure 2 - Example of frequency set point and time delay selection with resultant outputs

Set Point Frequency Selectors: Thumbwheel switches provide frequency pickup settings in increments of 0.01 Hz (See Fig. 2).

Pickup: ±0.008 Hz of the set value.

Target Indicators: May be either internally operated or current operated (operated by a minimum of 0.2 A through the output trip circuit). When the target is current operated, the trip output circuit current must be limited to 30 A for 1 second, 7 A for 2 minutes, and 3 A continuously.

Timing Repeatability: ±5%.

AGENCY RATINGS

UL approved, CSA certified

ENVIRONMENTAL

Operating Temperature: -40°C to 70°C (-40°F to 149°F).

Storage Temperature: -65°C to +100°C (-85°F to 212°F).

Shock: 15 g in each of three mutually perpendicular axes.

Vibration: 2 g in each of three mutually perpendicular axes swept over the range of 10 to 500 Hz for a total of 6 sweeps, 15 minutes each sweep.

Radio Frequency Interference (RFI): Field tested with a five watt, hand-held transceiver operating at random frequencies centered around 144 MHz and 440 MHz, with the antenna located six inches from the relay in both horizontal and vertical planes.

Surge Withstand Capability: Qualified to IEEE C37.90.1-1989 *Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems*.

Fast Transient: Qualified to IEEE C37.90.1-1989.

Impulse Test: Qualified to IEC 255.5.

Weight:

S1 - Approx. 13 lbs. (1 or 2 set points)
 M1 - Approx. 18 lbs. (3 or 4 set points)

Case Size:

S1 - 6.65"W x 9.32"H x 9.40"D
 M1 - 6.65"W x 15.32"H x 9.40"D

SPECIFICATIONS, continued

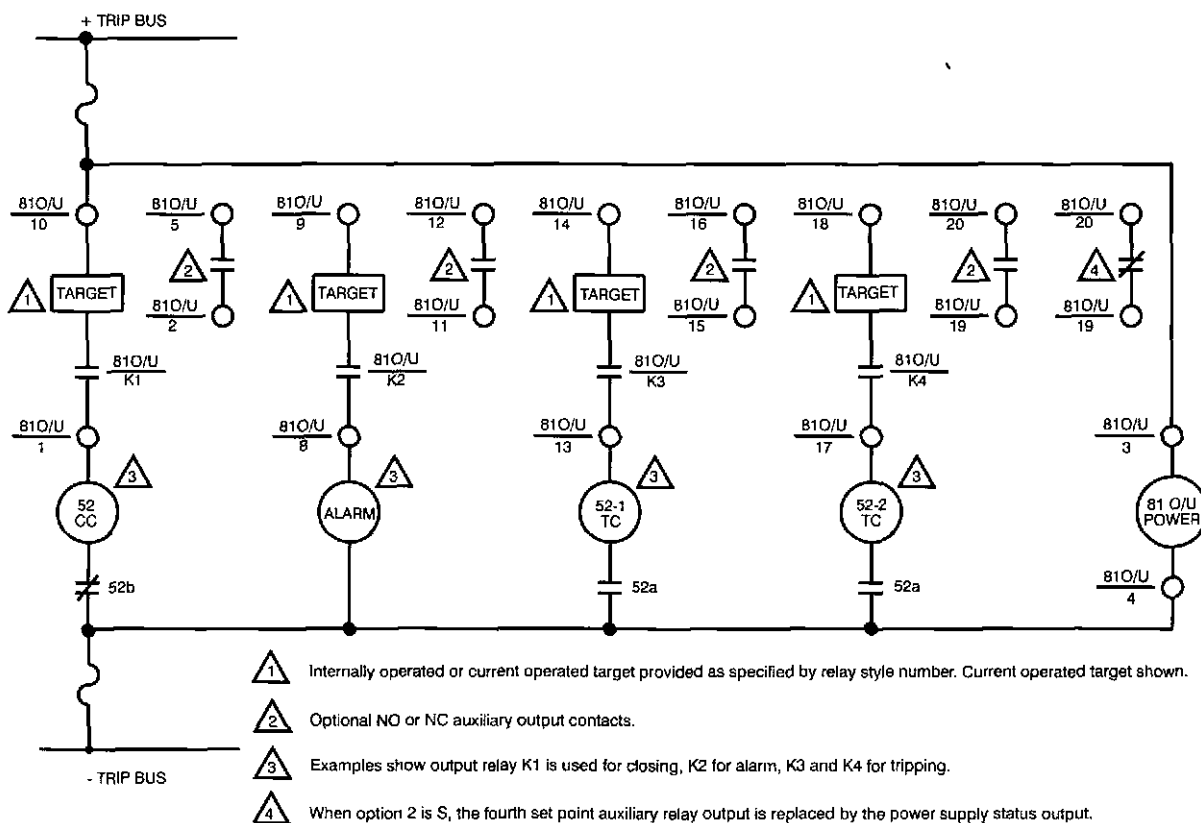


Figure 3 - Control Circuit External Connections

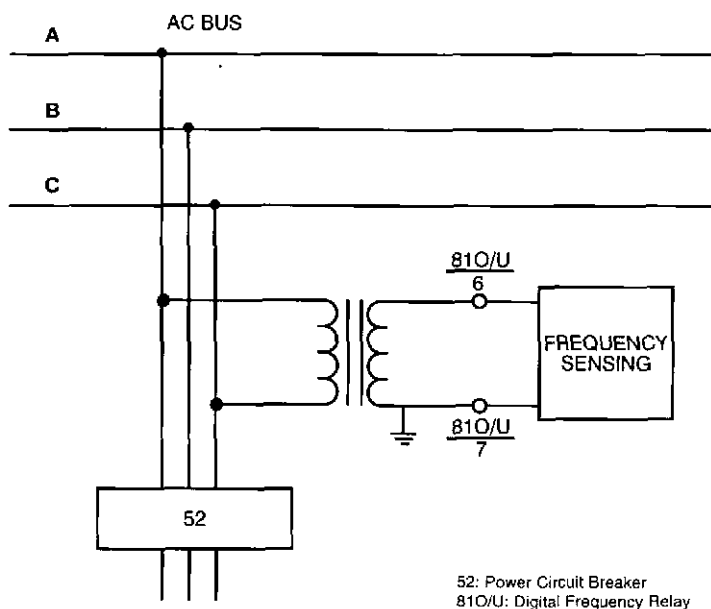


Figure 4 - Frequency Sensing External Connections

ORDERING INFORMATION

HOW TO ORDER:

Designate the model number followed by the complete Style Number.

BE1-810/U Style Number

Complete the Style Number by selecting one feature from each column of the Style Number Identification Chart and entering its designation letter or number in the appropriate square. (Two squares are used to indicate time delay characteristics.) All squares must be completed.

STANDARD ACCESSORIES:

The following accessories are available for use on the BE1-810/U Digital Frequency Relay.

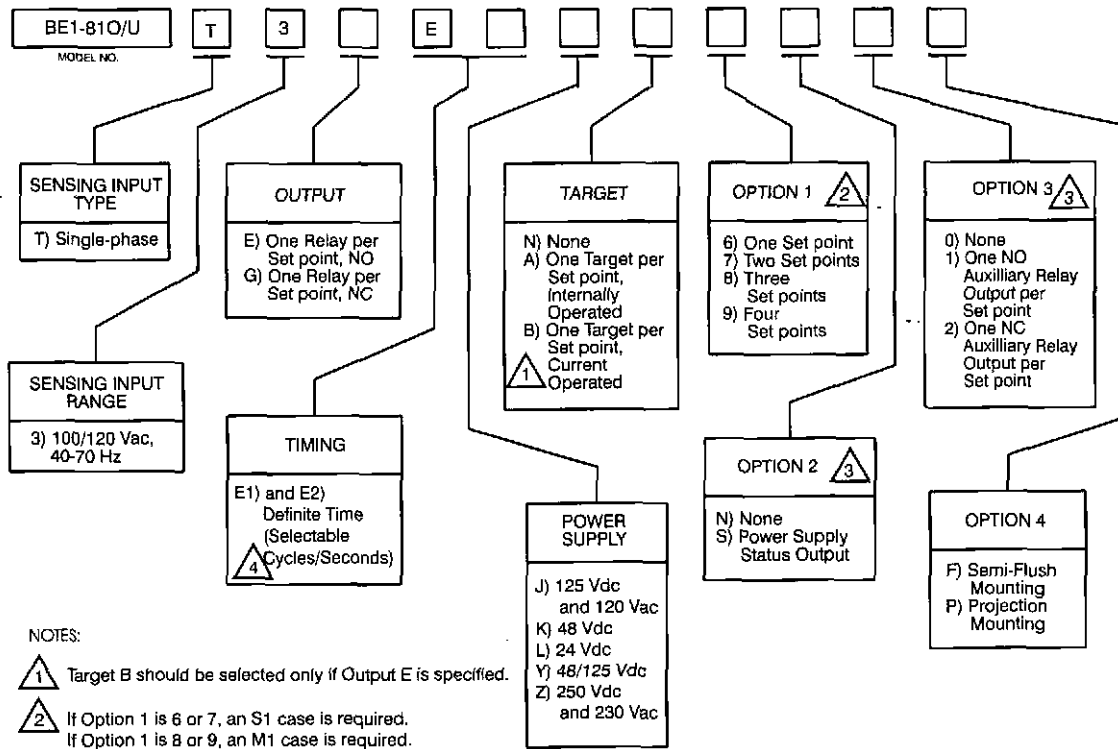
Test Plug

Order Test Plug, Basler part number 10095. (Two plugs required for complete testing capabilities.)

Extender Board

The extender board permits troubleshooting of the printed circuit boards outside the relay cradle. Order Basler Electric part number 9112930100.

STYLE NUMBER IDENTIFICATION CHART



NOTES:

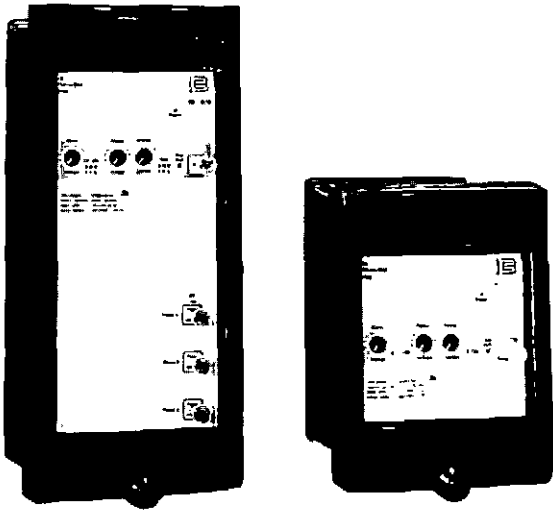
- 1 Target B should be selected only if Output E is specified.
- 2 If Option 1 is 6 or 7, an S1 case is required. If Option 1 is 8 or 9, an M1 case is required.
- 3 If Option 1 is 9 and Option 2 is S, the auxiliary relay (Option 3 is 1 or 2) associated with set point 4 is omitted.
- 4 BE1-810/U relays with hardware version M and higher, with definite timing option E1 or E2, now have their timing range extended. Earlier units with timing option E1 had a timing range of 3 cycles to 99 cycles and did not include range select switches on the individual set point boards. Earlier units with timing option E2 had a timing range of 3 cycles to 99 seconds. The new range for both timing options is identical at 3 cycles to 990 seconds (16.5 minutes). To provide rearward compatibility for users of the BE1-810/U with timing option E1, new units are shipped with the timing range switches set in default positions to emulate the E1 timing range.



ROUTE 143, BOX 269, HIGHLAND, ILLINOIS U.S.A. 62249
PHONE 618-654-2341 FAX 618-654-2351

P.A.E. Les Pins, 67319 Wasselonne Cedex FRANCE
PHONE (33-3-88) 87-1010 FAX (33-3-88) 87-0808

<http://www.basler.com>, info@basler.com



**BE1-87B
HIGH IMPEDANCE
BUS DIFFERENTIAL
RELAY**

The BE1-87B Bus Differential Relay provides economical high speed protection in a conventional package for all high impedance differential applications.

ADVANTAGES

- Proven performance of High Impedance Differential for optimum speed and selectivity.
- Available in single phase or three phase configurations to allow space and cost benefits.
- Fully drawout, testable in case design, compatible with existing panel mount configurations.
- CT Circuit Diagnostic function and Steady State Unbalance alarm to verify external wiring and prevent misoperation.
- Includes an intentional 20msec delay timer that can be inserted in the trip logic to aid in coordination when the bus is tapped with high speed fuses.
- Warranty 5 years.

APPLICATION Page 2
FUNCTIONAL DESCRIPTION Pages 3 - 5
SPECIFICATIONS Page 6
ORDERING INFORMATION Page 8

ADDITIONAL INFORMATION INSTRUCTION MANUAL

Request publication 9282300990

 **Basler Electric**

P. O. BOX 269 HIGHLAND, ILLINOIS, U.S.A. 62249 PHONE 618-654-2341 FAX 618-654-2351

UHC-3
1-01

APPLICATION

High impedance bus differential relaying is the leading means of bus protection on high voltage and critical application buses. The differential recognizes faults by detecting an unbalance between currents flowing into and out of the protected bus. The high impedance operate circuit (5kΩ) of the relay forces the unbalance currents through the CTs and limits the effect of unequal CT performance. For non-fault conditions, the resulting voltage across the relay's impedance is near zero. For an internal fault, however, the resulting voltage is essentially the open circuit voltage of the CTs. The relay defines a voltage level tripping threshold between fault and non-fault conditions. When a fault condition is detected, back-to-back SCRs gate and short out the high impedance of the operate circuit, thus clamping the voltage rise across the CT circuit and providing a low impedance path for differential current flow. Security of the relay is enhanced by using the current flow in the low impedance path (fault detector) to supervise a differential trip. Refer to the functional block diagram, Figure 1.

Fig 1

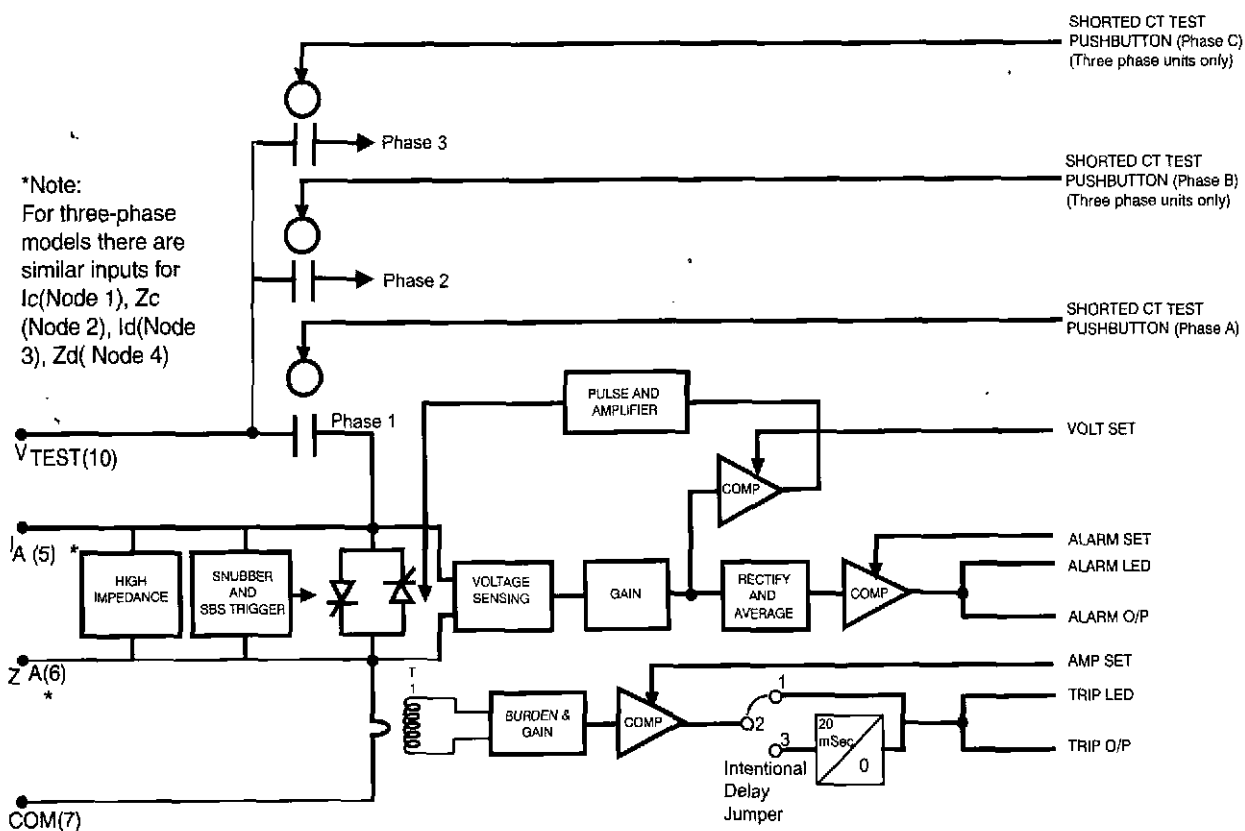


Figure 1 - Functional Block Diagram

FUNCTIONAL DESCRIPTION

PROTECTION

Based on industry standard operating philosophies, the BE1-87B uses solid state components to achieve high speed operation. The relay uses high impedance differential, supervised by a current fault detector circuit.

The relay monitors the summed current from the CTs associated with the protected bus. This differential current is applied to a fixed impedance within the relay. The relay measures the voltage developed across the impedance. When the measured voltage exceeds the trip threshold, a back-to-back SCR circuit is triggered, that provides a low impedance differential current path. The relay confirms that differential current is flowing (fault detector) before initiating a trip signal.

Overall trip times are less than 7 milliseconds above 1.5 multiples of current pickup, and less than 5.5 milliseconds above 6 multiples of pickup. See Figure 2.

The BE1-87B adds the availability of a three phase configuration to provide additional space and cost benefits.

As with any high impedance differential scheme, all CTs should have the same ratio. The voltage "clamping" of the SCRs allows use of multi-ratio CTs connected at less than full ratio. Contacts from an external "86" device should be added to short the differential input(s) after a trip, to limit the current carrying duty of the relay's shunt circuitry. See the Instruction Manual for more detailed information.

The extremely high speed operation of this relay makes it difficult to prevent tripping for faults on taps off the bus that are protected by fuses. An intentional 20msec. time delay can be inserted in the trip logic to aid in coordination with a high speed fuse in these applications.

MONITORING AND DIAGNOSTICS

The BE1-87B relay provides unique CT circuit monitoring functions to prevent misoperation of the bus protection system.

Mismatch of currents due to CT connection errors can cause detectable steady state unbalance to be developed under load. The BE1-87B uses a separate voltage comparison to detect any abnormal unbalance below fault levels. If a problem is detected, the relay will close an alarm contact and actuate a front panel CT overvoltage LED.

A second diagnostic function is included to detect a shorted CT. A shorted CT shunts the relay's differential impedance and can effectively disable the relay. This condition can occur for situations such as inadvertently leaving CT shorting switches open, and is not easily detected by conventional instrumentation. The BE1-87B includes a CT Test Circuit to allow detection of this condition. A test switch on the front of the relay is used to connect an external voltage source to excite the CT circuits (requires CT Diagnostic Test Source Assembly, Basler part number 9282300014. See Figure 4). If the CT circuits are connected properly (not shorted), the external voltage will be sufficient to light an LED on the relay's front panel.

SENSING INPUTS

The sensing input of the relay is designed to simultaneously sense voltage and current. The input appears as a high impedance until the voltage pickup is exceeded, then as a low impedance.

TEST INPUT

An additional input is provided to connect a test voltage to the differential circuit. This voltage is switched in to detect short circuits in the CT circuit.

OUTPUTS

The BE1-87B includes dual redundant trip outputs. It also includes an output for the Monitoring and Diagnostic functions, and a power supply fail contact.

HUMAN MACHINE INTERFACE (HMI)

All necessary settings are achieved using easily read front panel rotary switches. No special tools are required to apply or read settings.

SELF TESTS

The BE1-87B includes a power supply fail alarm. This normally closed output contact is held open during normal relay operations. In the event of a failure in the relay's power supply, the contact will drop out to the closed state, providing an alarm signal.

FUNCTIONAL DESCRIPTION, continued

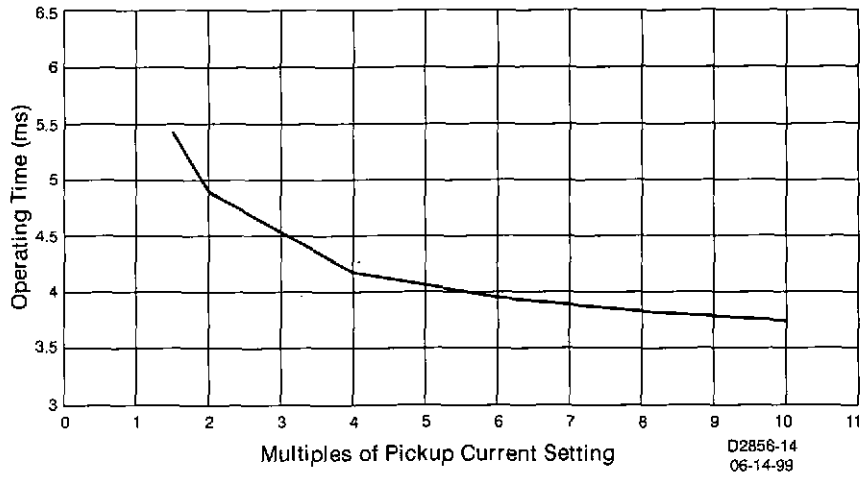


Figure 2 - Typical Pickup Current Response Time Without a Trip Delay

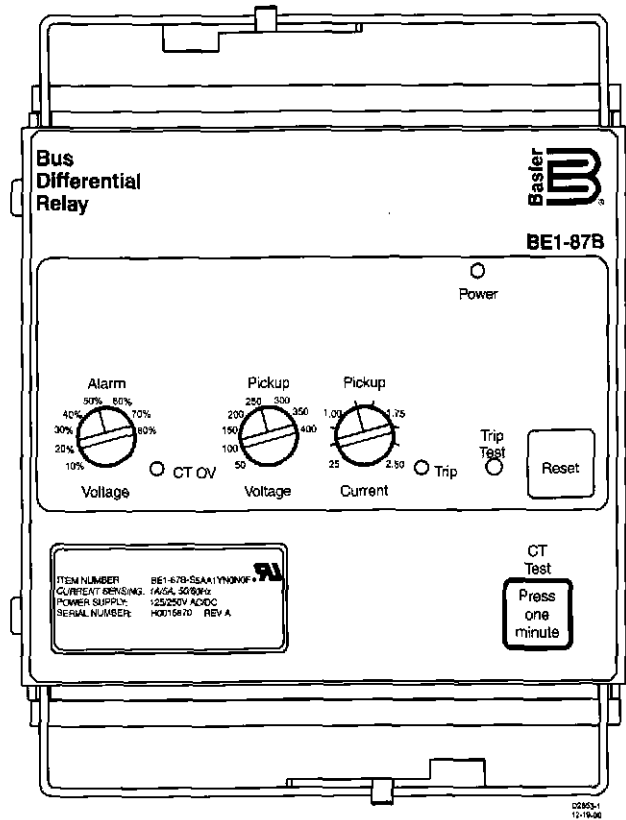


Figure 3 - Front Panel Layout (Single Phase Version)

FUNCTIONAL DESCRIPTION, continued

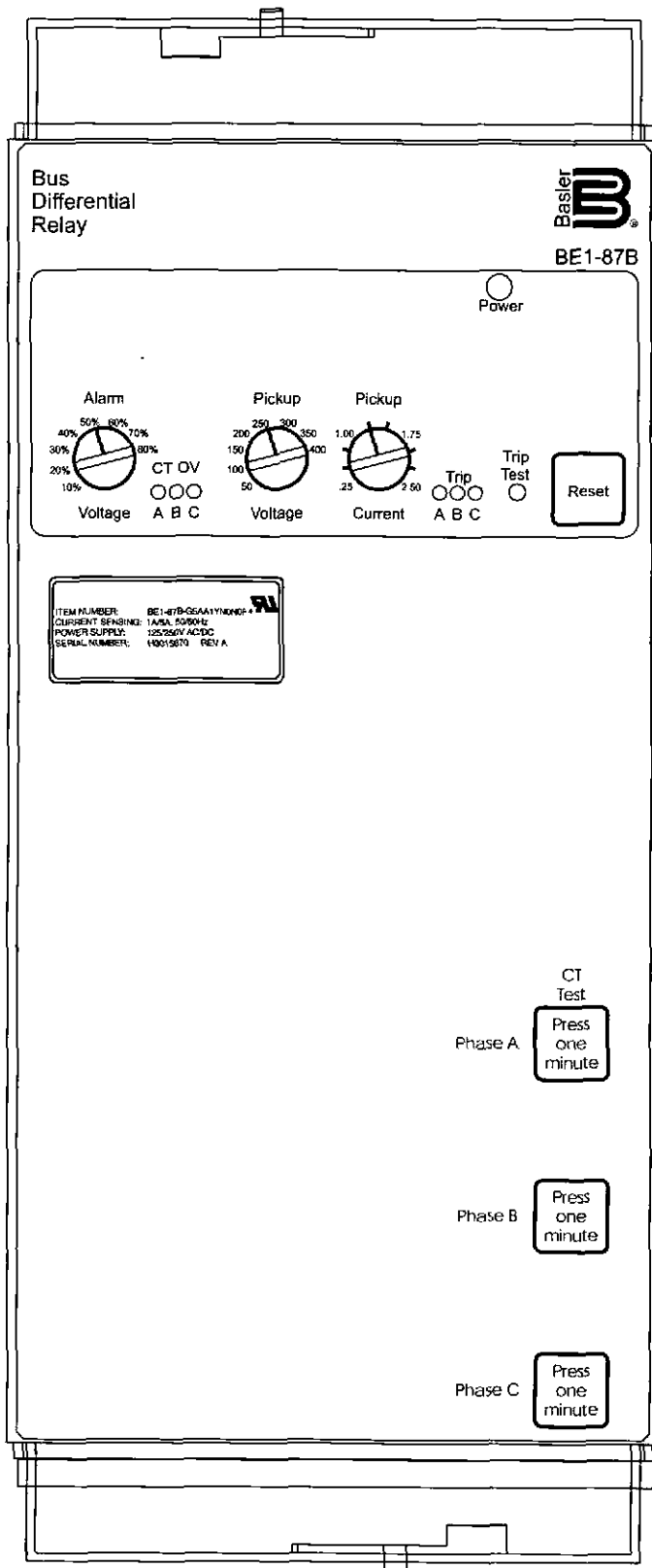


Figure 4 - Front Panel Layout (Three Phase Version)

GENERAL SPECIFICATIONS

FREQUENCY

50/60Hz

HIGH IMPEDANCE INPUTS

The high impedance unit of the relay provides a fixed impedance of 5000Ω. After operation of the SCR shorting, the impedance will be negligible.

TRIP CONTACTS

Make and carry: 30A (0.2sec) @250Vdc
 Continuous: 7A
 Break: 0.3A DC @ 125Vdc
 (L/R=0.04)

CURRENT AND VOLTAGE SETTINGS

Current Pickup: 0.25 - 2.5A in 0.25A increments
 Voltage Pickup: 50 - 400V in 50V increments (calibrated to 2 times setpoint to accommodate asymmetrical waveforms)
 Voltage Alarm Pickup: 10 - 80% of voltage setpoint in 10% increments

CURRENT RATING

10A rms continuous
 160A rms symmetrical at 1 second
 480A rms symmetrical at 5 cycles
 215A fully offset at 2 cycles

POWER SUPPLY

Input: 48/125 Volt nominal or 125/250 Volt nominal, depending on style selection. Each power supply is rated for operation at AC or DC voltage sources.

Type	Nominal Input Voltage	Input Voltage Range	Burden at Nominal
Y	48/125Vdc 110Vac	24-150Vdc 90-132Vac	7.5W 15.0VA
Z	125/250Vdc 110/230Vac	60 to 250Vdc 90-230Vac	7.5W 20.0VA

ENVIRONMENTAL

Operating conditions: Qualified to IEEE C37.90, IEC 255-14, and IEC 255-15

Operating temperature range: -40°C to 70°C
 (-40°F to 158°F)

Storage temperature range: -65°C to 85°C
 (-85°F to 185°F)

ISOLATION

In accordance with IEC 255-5 and ANSI/IEEE C37.90 one minute dielectric (high potential) tests as follows:
 All circuits to ground: 2000Vac or 2828Vdc
 Input to output circuits: 2000Vac or 2828Vdc

TRANSIENT SURGE (Fast Transient and SWC)

Qualified to IEEE C37.90.1-1989, IEC 255-22-4 and IEC 255-22-5.

RADIO FREQUENCY INTERFERENCE (RFI)

Qualified to ANSI C37.90.2 and IEC 255-22-3

ELECTROSTATIC DISCHARGE (ESD)

Qualified to ANSI/IEEE C37.90.3, eight kilovolts contact discharges and 15 kilovolts air discharges applied.

SEISMIC

Qualified to IEEE C37.98, IEC TC4CB

SHOCK VIBRATION AND BUMP

Qualified to IEC 255-21-1, IEC 255-21-2

AGENCY RATINGS

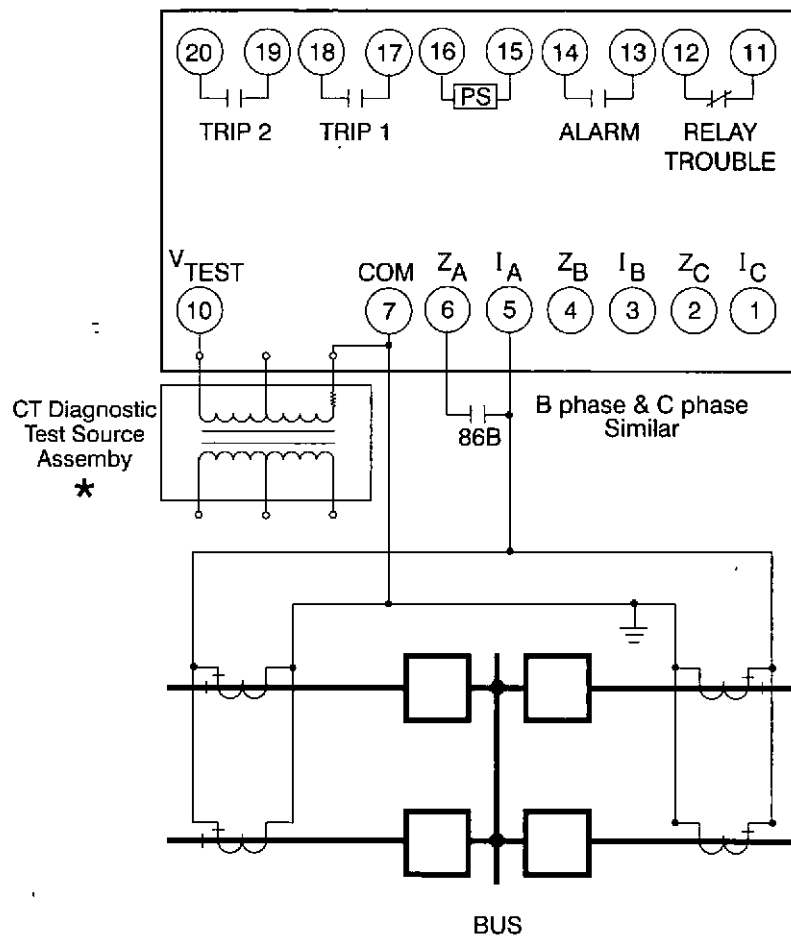
UL recognized

WEIGHT

Single phase: 14.3 pounds, 6.49 kg
 Three phase: 19.2 pounds, 8.7 kg

CASE SIZE

Single phase (S1): 6.65"W x 9.32"H x 9.40"D
 Three phase (M1): 6.65"W x 15.32"H x 9.40"D



* Optional Accessory, Basler P/N 9282300014

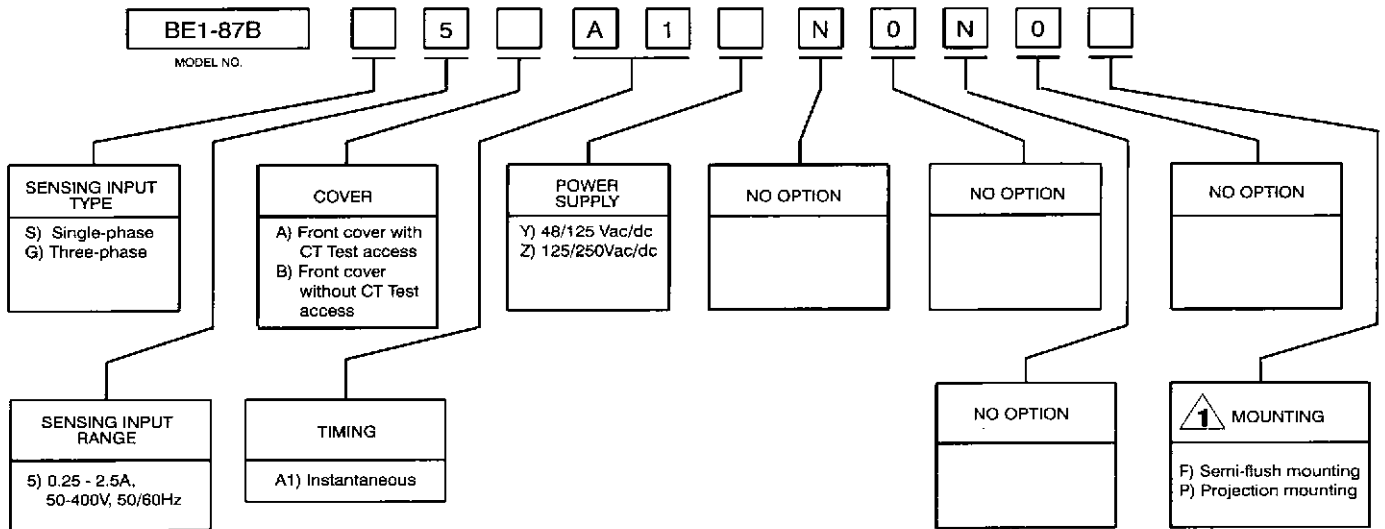
Figure 5 - Typical Connections Diagram


ORDERING

SAMPLE STYLE NUMBER

The style number identification chart defines the electrical characteristics and operation features included in the BE1-87B relay. For example, if the style number were **S5AA1YN0N0F**, the device would have the following:

- (S) - Single phase
- (5) - 5 Amp
- (A) - Front cover with CT Test access
- (A1) - Instantaneous timing
- (Y) - 48/125 Vac/dc Power Supply
- (N) - No Option
- (O) - No Option
- (N) - No Option
- (O) - No Option
- (F) - Semiflush Mounting

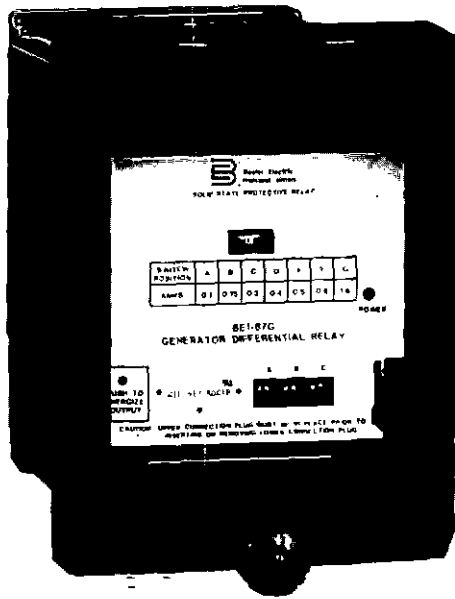


NOTES:
 Single phase relays are in S1 case. Three phase relays are in M1 case.

ACCESSORIES

CT Diagnostic Test Source Assembly for BE1-87B, Basler part number 9282300014.





**BE1-87G
VARIABLE PERCENTAGE
DIFFERENTIAL RELAY**

The BE1-87G is a single or three-phase solid-state variable percentage differential relay designed to provide selective, high-speed, differential protection for generators, motors, and shunt reactors.

ADVANTAGES

- Single or three-phase relays available.
- Variable percentage characteristic.
- Low operating burden.
- Balancing impedance in CT inputs provides excellent security during external faults or other transients.
- High speed operation.
- Seven sensitivity settings cover the range of 0.1 to 1.6A or 0.02 to 0.32A.
- Pickup accuracy within $\pm 5\%$ of the operate characteristic.
- Qualified to the requirements of
 - IEEE C37.90.2 for Radio Frequency Interference (RFI)
 - IEEE C37.90.1-1990 for Fast Transient and Surge Withstand Capability
 - IEC 255-5 and ANSI C37.90.1978 for Impulse and Dielectric tests.
- UL recognized under Standard 508, UL File #E97033.
- Five year warranty.

APPLICATIONS Pages 2-3
SPECIFICATIONS Pages 3-5
EXTERNAL CONNECTIONS Pages 6-7
ORDERING INFORMATION Pages 7-8

ADDITIONAL INFORMATION

INSTRUCTION MANUAL
Request Publication 9170800990

STANDARDS, DIMENSIONS & ACCESSORIES
Request Bulletin SDA



P. O. BOX 269 HIGHLAND, ILLINOIS, U.S.A. 62248 PHONE 618-654-2341 FAX 618-654-2351

UBK-6
7-01

APPLICATION

BASIC PRINCIPLES

Differential relaying is the most selective form of fault protection that may be applied to the individual elements, or zones, of ac power systems. Various types of differential relays and relaying systems have evolved to take advantage of the differential principle.

The BE1-87G is a single or three-phase solid-state variable percentage differential relay designed to provide selective, high-speed differential protection for generators, motors, and shunt reactors.

The selectivity of differential relaying is based on the ability of the relay to distinguish between an internal fault (within the protected zone) and an external fault. Under normal operating conditions the current into the protected zone equals the current out of the protected zone with a net operating current equal to zero. Internal faults upset this balance and result in a difference between the input and output currents. External faults have relatively little effect on the balance, because the current in still equals the current out of the protected zone. Therefore, by comparing the currents on both sides of the protected element or zone and detecting when these currents are not equal, a differential relay acts to isolate the element or zone from the system.

The BE1-87G typically trips a lockout relay (86), which in turn trips the generator breaker and, when present, the field and/or neutral breakers.

RESTRAINT CHARACTERISTICS

At high current levels, the inevitable difference in the saturation characteristics between current transformers requires a compensating decrease in relay sensitivity. The design of the BE1-87G provides a restraint factor that is proportional to input current.

Specifically, the BE1-87G compares the two sensed currents (in and out) to determine which is less. This lower current level becomes the restraining current. The difference between the two sensed currents (I_o) is compared to a reference established by the sensitivity setting and adjusted by an amount proportional to the restraining current. (The typical ratio is given in the formula on page 3.) This makes the BE1-87G more sensitive to low current internal faults, for which the relay should operate, and less sensitive to external faults with high levels of through current for which the relay should not operate.

THE VARIABLE PERCENTAGE PRINCIPLE

Figure 1 plots the tripping characteristics of two typical constant-percentage relays (one with a 10% slope, the other 25%). These are superimposed over the variable percentage characteristic of the BE1-87G relay to illustrate the improvement in sensitivity and security.

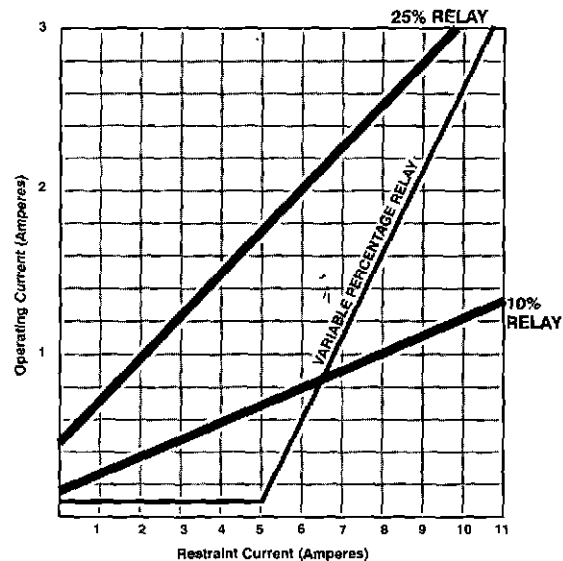


Figure 1 - Constant Percentage vs. Variable Percentage

In contrast to constant percentage relays, the BE1-87G's operating requirements are defined over two regions of the total operating range based on the level of the restraining current (I_r). When the restraining current is five amperes or less, the relay trips when the differential current exceeds the relay setting (I_o). But when the restraining current is greater than five amperes, the overall sensitivity is a combination of the front panel setting and the restraint factor.

For external faults, the system CTs will usually saturate to some extent. A stabilizing impedance in the relay design will force the CTs to perform more similarly under such conditions, thus reducing false "operate" current sensed by the relay. This, together with the variable percentage characteristic, provides security against false tripping.

SPECIFIC APPLICATIONS

The BE1-87G Variable Percentage Differential Relay is recommended for the following specific applications.

- Generators: Any terminal voltage, and a rating of 1000 kVA and above.
- Generators: Any kVA rating and a terminal voltage of 5kV and above.

APPLICATION, continued

- Generators: A terminal voltage of 2200 V or higher, and a rating of more than 500kVA.
- Motors rated 1500 horsepower and above.
- As primary protection on shunt reactors for transmission lines.
- Generator ground differential.

DESIGN HIGHLIGHTS

Some of the many advantages of the solid-state BE1-87G Variable Percentage Differential relay are summarized as follows.

- Seven sensitivity levels: from 0.1-1.6A or from 0.02A to 0.32A. Allows compensation for slight CT mismatch and provides the flexibility and adaptability necessary for many special applications such as split-winding generator protection.
- Stabilizing reactor: Minimizes dissimilar performance of system CTs. Reactor can be mounted remotely on three-phase units for flexibility of system installation.
- Minimum restraint: Using the smaller of the input currents as the restraint means a more accurate appraisal of the through current. This allows greater sensitivity while maintaining selectivity.
- Variable restraint characteristic (vs. constant restraint characteristic): Allows increased sensitivity to low current internal faults while providing increased security against high levels of through current caused by external faults.
- Single or three-phase availability: Either configuration can be provided in a Basler Electric S1, or drawout case.
- High-Speed Operation: The BE1-87G operates in 30 milliseconds for fault levels of 10 times the sensitivity setting, thus minimizing potential damage to the protected equipment.

SPECIFICATIONS

FUNCTIONAL DESCRIPTION

The specifications on these pages define the many features and options that can be combined to exactly satisfy an application requirement. The block diagram, Figure 2, illustrates how the various standard features and options function together.

INPUTS

Differential Current Sensing

System current transformers with nominal 5A secondaries supply the differential relay's input transformers with either single-phase or 3-phase currents, depending upon option selected. (See Figure 2.) These input currents are converted to analog voltages that are bandpass filtered, then presented to the current difference detector. The output of the latter, which represents the current difference between I_{in} and I_{out} , is then full-wave rectified and presented to the comparator as the operate current (I_o).

The two sensed inputs are also applied to a circuit that determines which input is smallest. This signal, after full-wave rectification, represents restraint current (I_r). However, I_r has no effect on determining the trip point until the lesser input exceeds approximately 5A. The ideal trip point occurs when:

$$I_o = I_s \text{ for } I_r \leq 5 \text{ A}$$

$$I_o = I_s + 0.5 (I_r - 5) \text{ for } I_r > 5 \text{ A}$$

where,

I_o is the operate current (i.e., the difference between inputs)

I_s is the front panel sensitivity setting

I_r is the restraint current (and is the lesser of two input currents)

The comparator implements the above equation and causes an output signal whenever the measured operate current is greater than the limit defined by Figure 3. If three phases are specified, the outputs of three comparators are ORed to determine a trip condition. If equipped with targets, the phase initiating the output will be indicated by a tripped target.

Sensing Burden

The steady state burden is always less than 1VA.

Table 1 shows the values in ohms.

Frequency	50	60
Burden per Phase	25 + j1.5 ohms	25 + j1 ohms

Table 1 - Sensing Burden (Typical)

POWER SUPPLY INPUTS

One of three wide range power supply types may be selected to provide internal operating power. They are described in Table 2 on page 4.

SPECIFICATIONS, continued

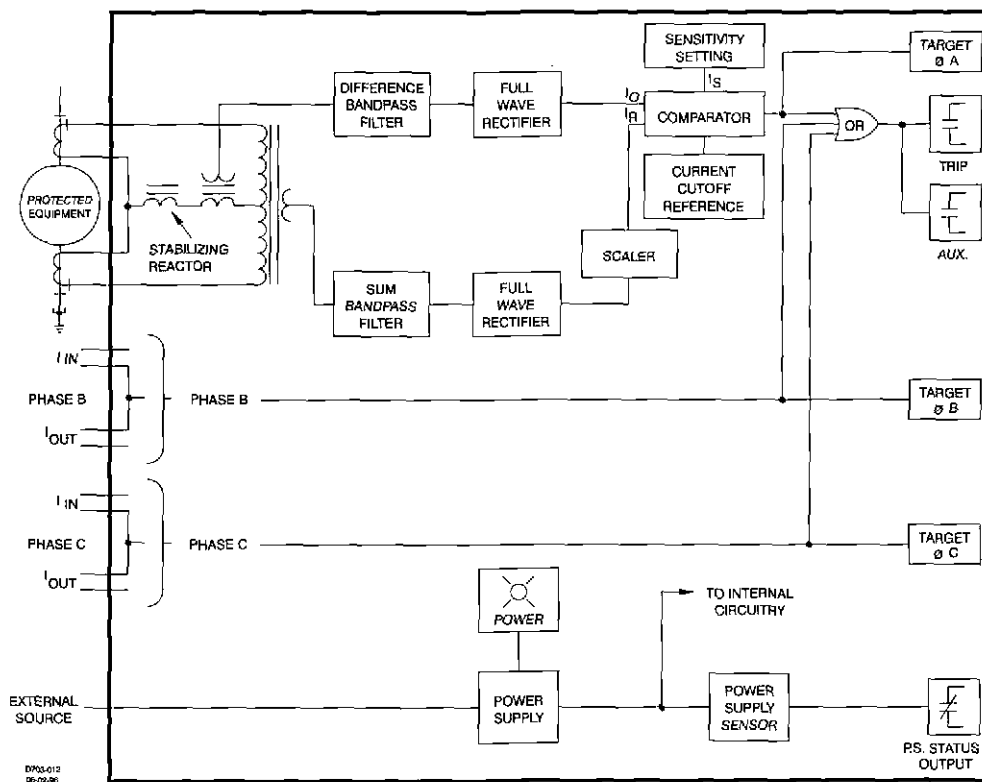


Figure 2 - Functional Block Diagram

Type	K (Mid Range)	J (Mid Range)	L (Low Range)*	Y (Mid Range)	Z (High Range)
Nominal Input Voltage	48Vdc	125Vdc 120Vac	24Vdc	48Vdc 125Vdc	250Vdc 230Vac
Input Voltage Range	24-60Vdc	62-150Vdc 90-132Vac	12-32Vdc	24-60Vdc 62-150Vdc	140-280Vdc 190-270Vac
Burden at Nominal (Maximum)	5.0W	5.5W 14.5W	5.5W	5.5W 6.0W	7.0W 20.0VA

*Type L power supplies may initially require 14Vdc to begin operating. Once operating, the voltage may be reduced to 12Vdc and operation will continue.

Table 2 - Power Supply Options

POWER SUPPLY STATUS OUTPUT

The power supply output relay is energized and its NC output contact is opened when power is applied to the relay. Normal internal relay operating voltage maintains the power supply status output relay in a continuously energized state with its output contact open. If the power supply output voltage falls below the requirements of proper operation, the power supply output relay is de-energized, closing the NC output contact.

PICKUP ACCURACY

The ideal characteristic is graphically illustrated in Figure 3.

DROPOUT RATIO

The dropout ratio is greater than 90% of the sensitivity setting.

TRIP TIME CHARACTERISTICS

Trip time characteristics are shown in Figure 4.

OUTPUTS

Output contacts are rated as follows:

SPECIFICATIONS, continued

Resistive

120/240 Vac - make 30 A for 0.2 seconds, carry 7 A continuously, break 7 A.

250 Vdc - make and carry 30 A for 0.2 seconds, carry 7 A continuously, break 0.3 A.

Inductive

120/240 Vac, 125 Vdc, 250 Vdc - make and break 0.1 A ($L/R = 0.04$).

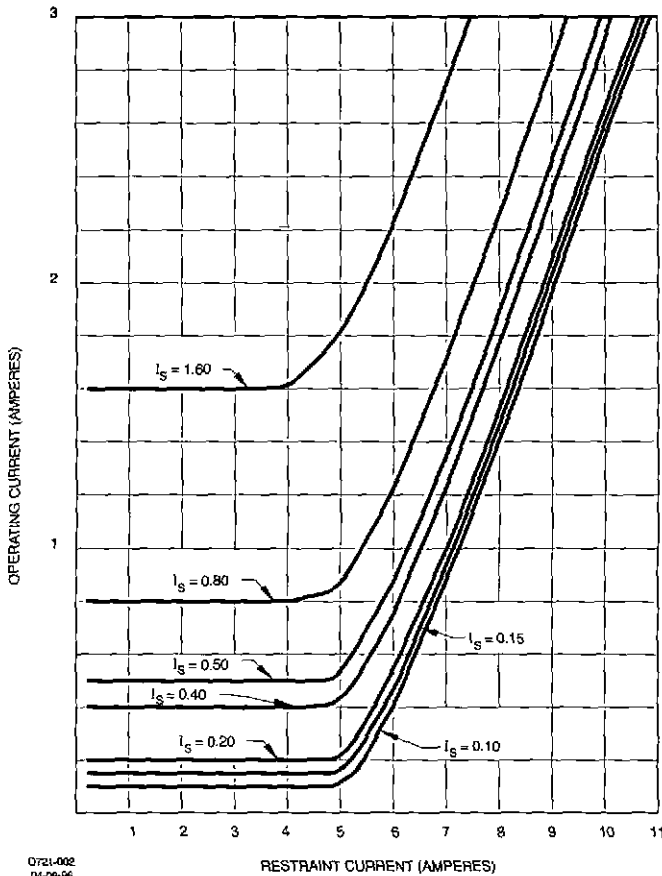


Figure 3 - Sensing Input Range 1, Operating Characteristics

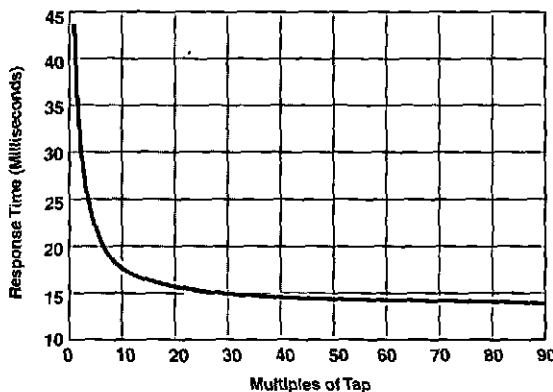


Figure 4 - Trip Delay Characteristics (Typical)

Push-to-Energize (Optional)

The unit may be equipped with a momentary pushbutton that is accessible through the front panel. To prevent accidental operation of this switch, it is recessed behind the front panel of the relay and is actuated by inserting a thin non-conducting rod through an access hole in the panel. When pushed, the switch operates the output relays and internally operated targets. Current operated targets will activate if the required 0.2A of minimum current is present.

TARGET

Magnetically latched, manually reset, target indicators are optionally available to indicate that an output has tripped. Either internally operated or current operated targets may be specified. Current operated targets require 0.2 A in the output trip circuit to actuate, and trip circuit current must not exceed 30 A for 1 second, 7 A for 2 minutes, and 3 A continuous. Current operated targets may be selected only when normally open (NO) output contacts have been specified.

SURGE WITHSTAND CAPABILITY

Qualified to IEEE C37.90.1-1989 *Surge Withstand Capability Test* and IEC 255-5 *Impulse Test and Dielectric Test*.

MECHANICAL

Operating Temperature Range
-40°C to 70°C (-40°F to 158°F)
-65°C to 100°C (-85°F to 212°F)

Shock

In standard tests, the relay has withstood 15g in each of three mutually perpendicular axes.

Vibration

In standard tests, the relay has withstood 2g in each of three mutually perpendicular axes swept over the range of 10 to 500 Hz for a total of six sweeps, 15 minutes for each sweep.

Weight

Single phase: 14.3 lbs., 6.48 kg.
Three phase: 19.2 lbs., 8.70 kg.

Case Size

S1: 6.65"W x 9.32"H x 9.40"D

CONNECTIONS

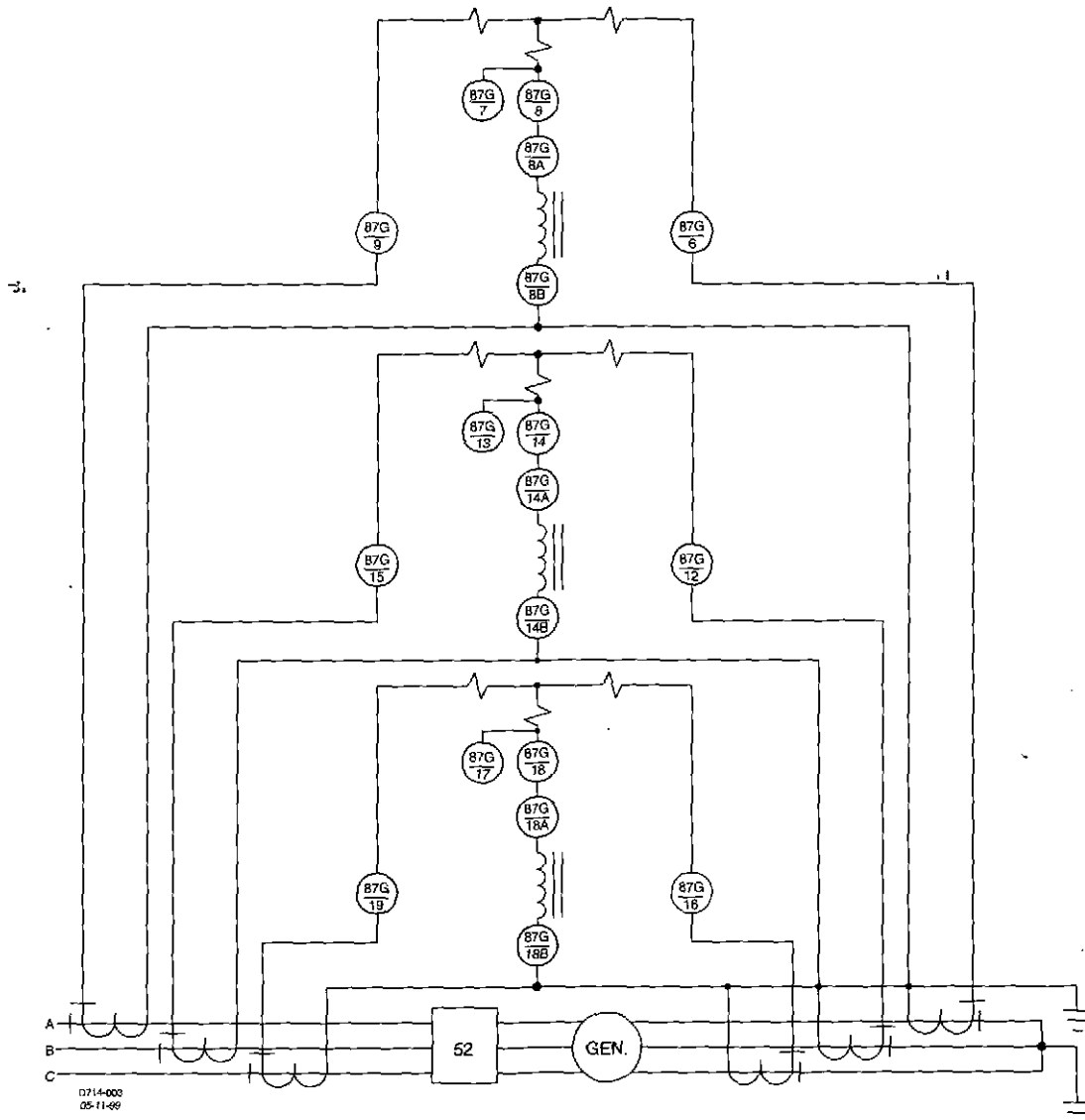
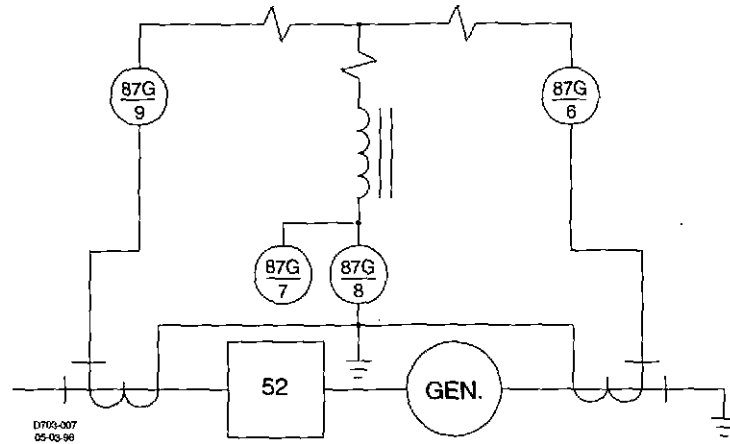


Figure 5 - Typical Single-Phase and Three-Phase Application Schemes

CONNECTIONS, continued

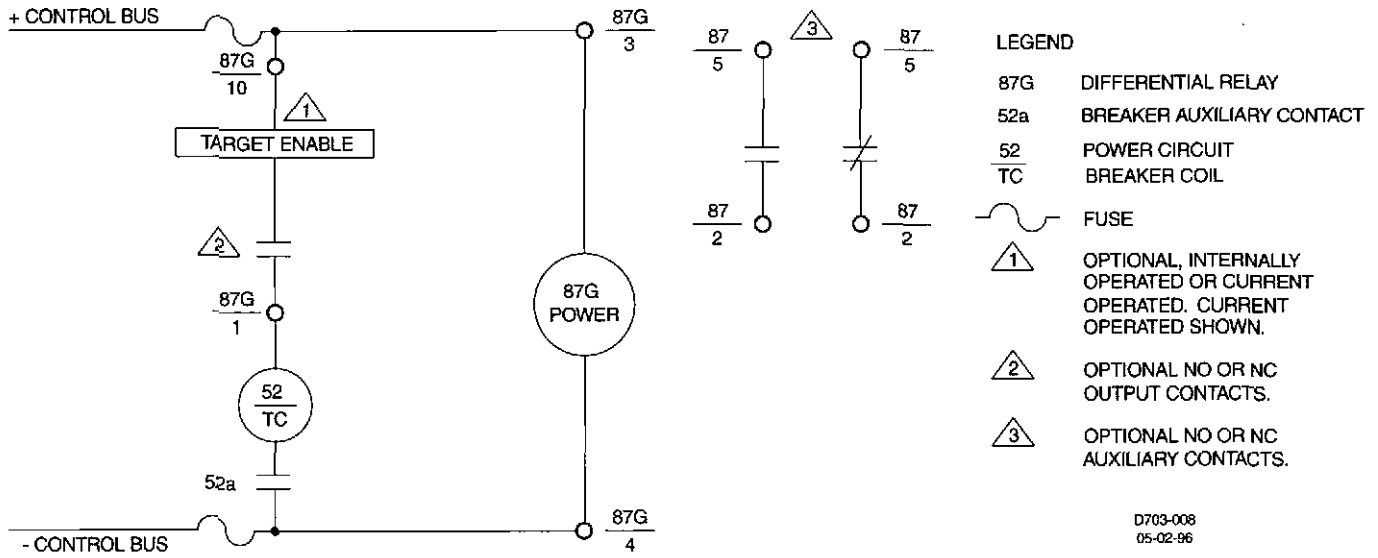


Figure 6 - Typical DC Control Connections

ORDERING

MODEL NUMBER

BE1-87G Variable Percentage Differential Relay

STYLE NUMBER

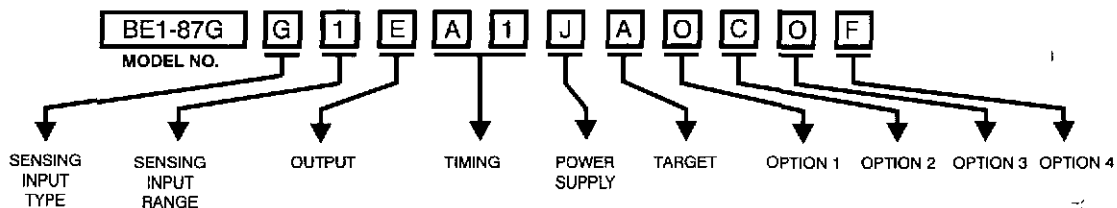
The style number appears on the front panel, drawout cradle, and inside the case assembly. This style number is an alphanumeric combination of characters identifying the features included in a particular unit. The sample style number below illustrates the manner in which the various features are designated. The Style Number Identification Chart (page 8) defines each of the options and characteristics available for this device.

SAMPLE STYLE NUMBER: G1EA1JAOCOF

The style number above describes a BE1-87G Variable Percentage Differential Relay having the following features.

Sensing Input Type	(G) Three-phase current
Sensing Input Range	(1) Switch selectable
Output	(E) One relay, NO
Timing	(A1) Instantaneous
Power Supply	(J) 125 Vdc or 100/120 Vac external power source
Target	(A) Internally operated, one per phase
Option 1	(O) None
Option 2	(C) Push-to-energize outputs
Option 3	(O) None
Option 4	(F) Semi-flush mounting

Note: The description of a complete relay must include both the model number and the style number.



ORDERING, continued

HOW TO ORDER:

Designate the model number followed by the complete Style Number:

BE1-87G Style No.

Complete the Style Number by selecting one feature from each column of the Style Number Identification Chart and entering its designation letter or number into the appropriate square. (Two squares are used to indicate timing). All squares must be completed.

STANDARD ACCESSORIES:

The following standard accessories are available for the BE1-87G Variable Percentage Differential Relay.

Test Plug

To allowing testing of the relay without removing system wiring, order two test plugs, Basler Electric part number 10095.

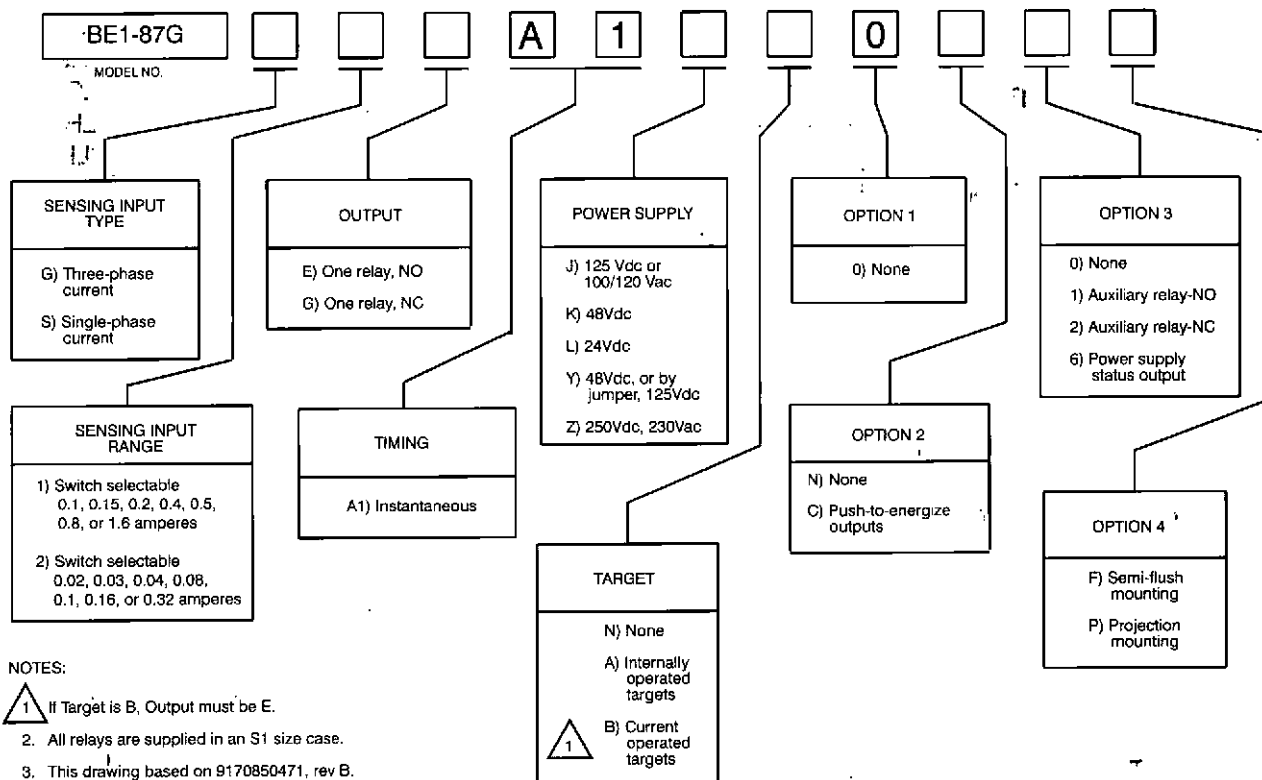
Extender Board

The Extender Board will permit troubleshooting of the printed circuit boards outside of the relay cradle. Order Basler Electric part number 9165500100.

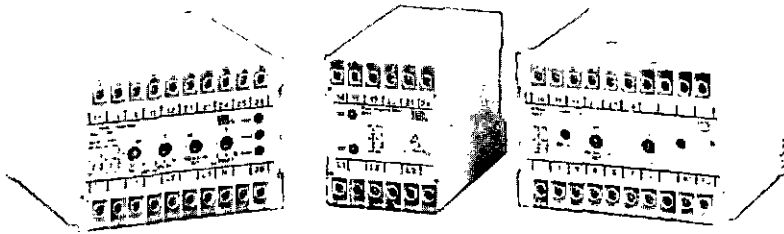
Stabilizing Reactor

For units shipped prior to 6/1/91, a stabilizing reactor, part number 9170818100, may be added for improved security.

STYLE NUMBER IDENTIFICATION CHART



BE3 SERIES MONITORING RELAYS



MODEL NUMBER	TYPE	INSTRUCTION MANUAL	PRODUCT BULLETIN
BE3-25	Sync-Check	9319100990	ULA
BE3-27	Under Voltage	9319200990	ULB
BE3-27T	Under Voltage with Time Delay	9319500990	ULC
BE3-27/59	Over/Under voltage	9319200990	ULB
BE3-27T/59T	Over/Under Voltage with Time Delay	9319500990	ULC
BE3-32	Reverse Power	9319800990	ULD
BE3-37	Under Current	9319900990	ULE
BE3-37/51	Under/Over Current	9319900990	ULE
BE3-47	Phase Sequence	9320200990	ULF
BE3-47N	Phase Balance	9320300990	ULG
BE3-47N/27	Phase Balance with Undervoltage	9320300990	ULG
BE3-49R (3 RTD)	Temperature Relay	9320500990	ULH
BE3-49R (6 RTD)	Temperature Relay	9320500991	ULI
BE3-49TH	Thermocouple Overtemperature	9320600990	ULJ
BE3-49TL	Thermocouple Undertemperature	9320600990	ULJ
BE3-51	Overcurrent	9319900990	ULE
BE3-59	Overvoltage	9319200990	ULB
BE3-59T	Overvoltage with Time Delay	9319500990	ULC
BE3-74SL	Millivolt Undervoltage	9320800990	ULN
BE3-74SH	Millivolt Overvoltage	9320800990	ULN
BE3-74SD	Millivolt Under/Overvoltage	9320800990	ULN
BE3-74TL	Milliamp Undercurrent	9321100990	ULO
BE3-74TH	Milliamp Overcurrent	9321100990	ULO
BE3-74TD	Milliamp Under/Overcurrent	9321100990	ULO
BE3-74VL	DC Undervoltage	9321400990	ULP
BE3-74VH	DC Overvoltage	9321400990	ULP
BE3-74VD	DC Under/Overvoltage	9321400990	ULP
BE3-81O	Over Frequency	9321500990	ULL
BE3-81U	Under Frequency	9321500990	ULL
BE3-81O/U	Over/Under Frequency	9321500990	ULL
BE3-81OT	Over Frequency with Time Delay	9321800990	ULM
BE3-81UT	Under Frequency with Time Delay	9321800990	ULM
BE3-81OT/UT	Over/Under Frequency with Time Delay	9321800990	ULM

B Basler Electric

ROUTE 143, BOX 269 HIGHLAND, ILLINOIS 62249, U.S.A. PHONE 618-654-2341 FAX 618-654-2351

ULX-3
7-01

FEATURES

Basler Electric BE3 Series Monitoring Relays provide a wide range of functions demonstrating the following common features:

PHYSICAL SPECIFICATIONS

Operating temperature 0°C to +60°C (+32°F to +140°F)
 Functional temperature -25°C to +70°C (-13°F to +158°F)
 Storage temperature -40°C to +70°C (-40°F to +158°F)
 Temperature coefficient 0.03% per °C (300ppm/°C)
 Relative humidity 95% non-condensing
 Mounting DIN rail 1.38" by 0.29" (35mm by 7.5mm) See page 4 for details.
 Case Complies with IEC 529, DIN 40050, BS 5490
 Weight Combined units: 1.32 lbs. (0.6 kg)
 Single unit: 0.88 lbs. (0.4 kg)
 Size See chart on page 3.
 Case material Complies with UL 94V0

INSULATION

Test voltage 4kV RMS 50Hz 1 min. between Input/Case/Auxiliary
 Impulse Test EMC 5kV transient complying with IEC 801/EN55020
 HF Interference EHF 2.5kV 1MHz complying with IEC 255-4
 Protection class II complying with IEC 348

APPLIED STANDARDS

General IEC144, BS5420, VDE/VDI0435, IEC947, EN60947
 Safety BS EN61010, DIN57411, VDE0411, ANSI C37
 Surge withstand IEC801/EN55020, ANSI C37-90a
 Radio screening RFI degree N complies with VDE0875

ELECTRICAL SPECIFICATIONS

U.L. Listed, CSA Certified, C.E. Compliant

INPUT

All units are self powered. Nominal voltage: 120 Vac, 240 Vac, 380 Vac, 480 Vac. For other nominal voltages, contact Basler Electric.
 Nominal current 5 amperes

OUTPUT

Relay Type D.P.D.T. (typical)
 AC Rating 250V, 5A, non-resistive, 1200VA
 DC Rating 125V, 1A, resistive, 120 Watts
 Mechanical Life 5 million operations

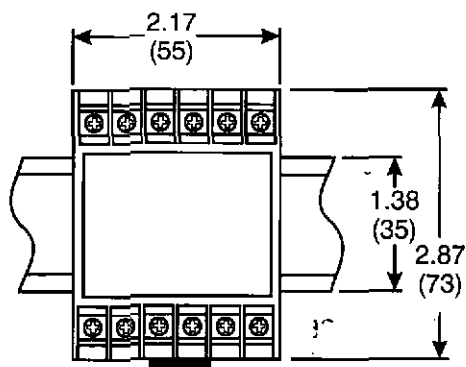
TYPICAL APPLICATIONS

APPLICATION	DEVICE NUMBER*													
	27	59	37	51	81U	81O	32	25	47	47N	74S	74T	49T	49R
Motor Devices	X	X	X	X	X				X	X	X	X	X	X
Generator Devices	X	X		X	X	X	X	X			X	X	X	X
Distribution Devices	X	X		X	X	X			X	X	X	X		
Transformer Devices	X	X		X					X	X	X	X	X	X
Process Control Devices			X								X	X	X	
Auto. Transfer Devices	X		X						X	X				

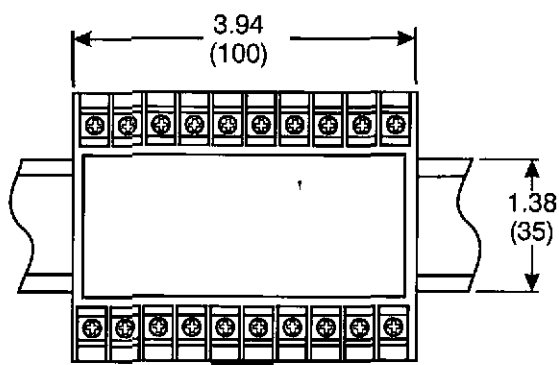
* ANSI/IEEE Device Numbers form an integral part of the Basler Electric Model Number.

CASE DIMENSIONS

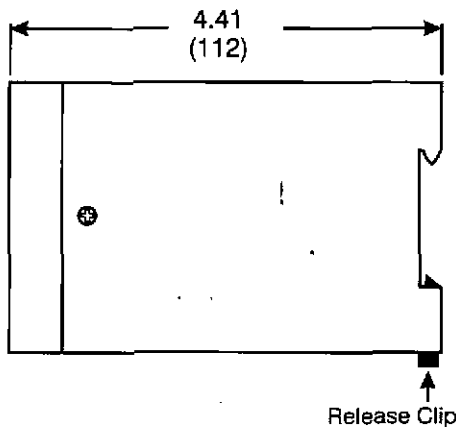
FRONT VIEW



FRONT VIEW



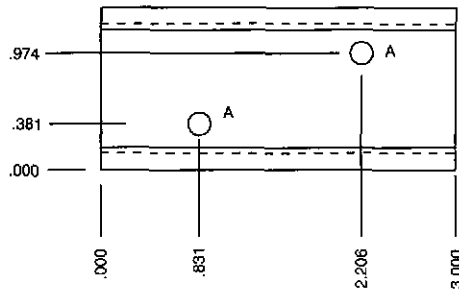
SIDE VIEW



MODEL NUMBER	CASE SIZE IN MILLIMETERS	CASE SIZE IN INCHES
BE3-25	100	3.94
BE3-27	55	2.17
BE3-27T	55	2.17
BE3-59	55	2.17
BE3-59T	55	2.17
BE3-27/59	100	3.94
BE3-27T/59T	100	3.94
BE3-32	100	3.94
BE3-37 1PH	55	2.17
BE3-37 3PH	100	3.94
BE3-51 1PH	55	2.17
BE3-51 3PH	100	3.94
BE3-37/51 1PH	100	3.94
BE3-47	55	2.17
BE3-47N	55	2.17
BE3-47N/27	55	2.17
BE3-49R	100	3.94
BE3-49TH/TL	55	2.17
BE3-74SL	55	2.17
BE3-74SH	55	2.17
BE3-74SD	100	3.94
BE3-74TL	55	2.17
BE3-74TH	55	2.17
BE3-74TD	100	3.94
BE3-74VL	55	2.17
BE3-74VH	55	2.17
BE3-74VD	100	3.94
BE3-81U	55	2.17
BE3-81UT	55	2.17
BE3-81O	55	2.17
BE3-81OT	55	2.17
BE3-81O/U	100	3.94
BE3-81OT/UT	100	3.94

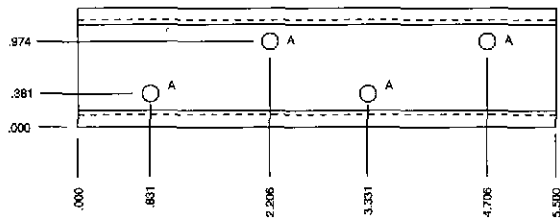
NOTE: Dimensions shown are in inches (millimeters).

MOUNTING ACCESSORIES



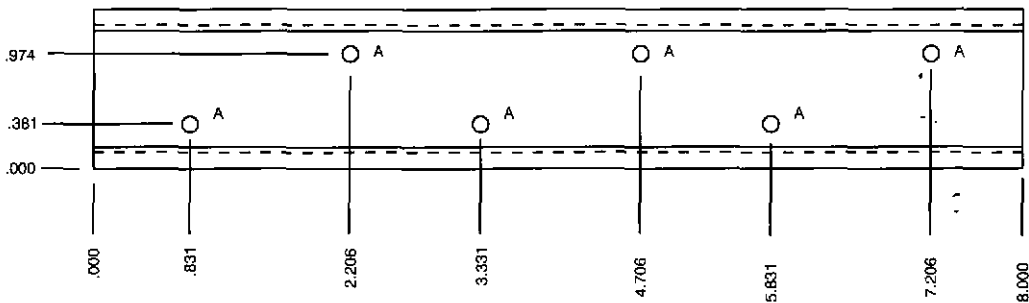
HOLES:
A .188 DIA., 2 PLCS.

Mounting Rail, Basler P/N 9 3239 00 001



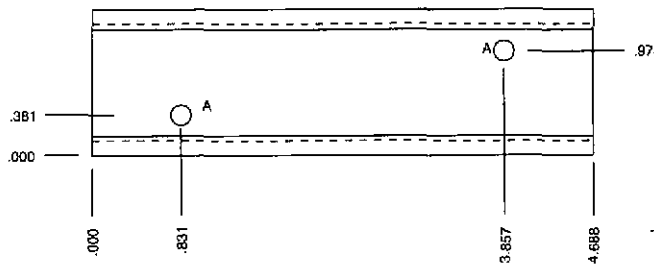
HOLES:
A .188 DIA., 4 PLCS.

Mounting Rail, Basler P/N 9 3239 00 002



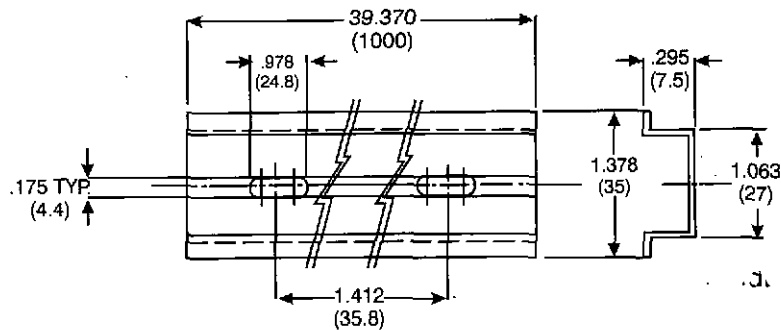
HOLES:
A .188 DIA., 6 PLCS.

Mounting Rail, Basler P/N 9 3239 00 003



HOLES:
A .188 DIA., 2 PLCS.

Mounting Rail, Basler P/N 9 3239 00 004



Standard DIN Rail, Basler P/N 17366

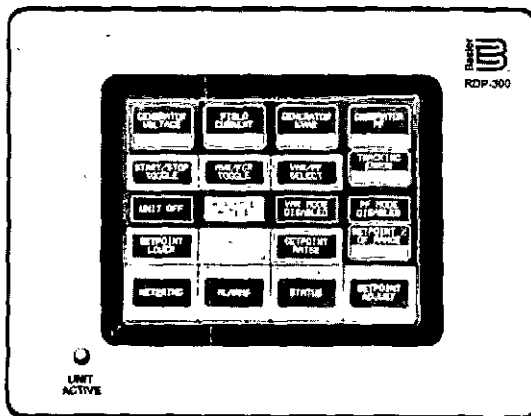
Rail end stops are also available. Use Basler P/N 32095.



ROUTE 143, BOX 269, HIGHLAND, ILLINOIS U.S.A. 62249
PHONE 618-654-2341 FAX 618-654-2351

P.A.E. Les Pins, 67319 Wasselonne Cedex FRANCE
PHONE (33-3-88) 87-1010 FAX (33-3-88) 87-0808

<http://www.basler.com>, info@basler.com



RDP-300 REMOTE DISPLAY PANEL

The RDP-300 Remote Display Panel is a Human-Machine Interface (HMI) used in conjunction with the DECS-300 Digital Excitation Control System to provide remote control, to view metered quantities, and to provide annunciation of system status and alarms available from the DECS-300 system. The RDP-300 uses a touch-sensitive 6" diagonal monitoring screen with two-wire, RS-485 Modbus™ communication protocol, which may be located up to 4000 feet away from the DECS-300 Controller.

FEATURES

RDP-300 Remote Display Panels have the following features:

- Six inch (diagonal) monochrome LCD with fluorescent backlight
- Touch screen covers made of tough, flexible material to withstand sustained use
- Direct access from any of the five screens to any of the other four screens
- Low power consumption
- NEMA 12/4 (Self-Certified) rating
- Suitable for semi-flush mounting
- Suitable for controlling a single remote DECS-300 excitation controller
- RS-485 serial communications with the DECS-300 for easy installation
- Predesigned structure for dedicated display of DECS-300 information
- No programming required, ready for immediate use

ADDITIONAL INFORMATION INSTRUCTION MANUAL

Request publication 9334500990

DESCRIPTION
Page 2

**SPECIFICATIONS
AND INTERCONNECT**
Page 3

**CUTOUT, OUTLINE,
AND ORDERING**
Page 4

B Basler Electric

P. O. BOX 269 HIGHLAND, ILLINOIS, U.S.A. 62249 PHONE 618-654-2341 FAX 618-654-2351

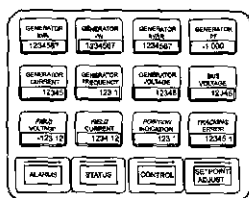
SZW-2
1-01

FUNCTIONAL DESCRIPTION

RDP-300 Remote Display Panels use microprocessor-based technology to provide remote control and annunciation status of a DECS-300 Digital Excitation Control System. A touch-sensitive display panel with five screens provides the control and display using Modbus™ protocol. Microprocessor-based technology allows the use of serial communications for quick and simple connection to the remote unit. RS-485 compatible signals ensure noise immunity over long distances. This combination of features in the RDP-300 yields significant savings in installation and setup costs for remote excitation control and monitoring.

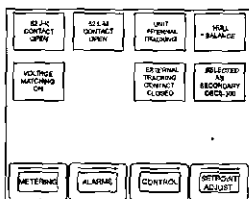
Note: Use of the RDP-300 precludes use of the DECS-300 RS-485 communication port with any other device.

METERING SCREEN



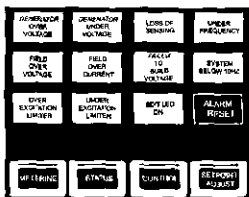
Displays generator quantities monitored by DECS-300 including Generator KVA, Generator kW, Generator kVAR, Generator PF, Generator Line Current, Generator Frequency, Generator Voltage, Bus Voltage, Field Voltage, Field Current, Position Indication, and Tracking Error.

STATUS SCREEN



Displays the DECS-300 present status of contact inputs and system conditions: 52 J-K Contact, 52 L-M Contact, Unit Internal Tracking, Null Balance, Voltage Matching On; "External Tracking" and "Selected as Secondary DECS-300" for use with redundant DECS-300 Controller systems.

ALARM SCREEN



Displays the following alarms: Generator Overvoltage, Generator Undervoltage, Loss of Voltage Sensing, Underfrequency Limit, Field Overvoltage, Field Overcurrent, Failed to Build Voltage, System Below 10Hz, Overexcitation Limiter, Underexcitation Limiter, Edit LED On. An "Alarm Reset" active touch-sensitive switch allows the alarms to be cleared after the condition causing the alarm is no longer present.

CONTROL SCREEN

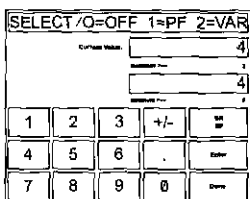


Provides an array of active touch-sensitive virtual switches, meters, and other indicators. Active touch-sensitive virtual switches: Start/Stop Toggle, AVR/FCR Toggle, VAR/PF Select, Set Point Raise, Set Point Lower. Metered quantities displayed: Generator Voltage, Field Current, Generator kVAR, Generator PF, Tracking Error, and Position Indication. Annunciation is provided for Unit On/Off, AVR/FCR Mode Active, VAR Mode Enabled, PF Mode Enabled, Set Point Low Limit, Set Point High Limit, and Preposition.

SET POINT ADJUST SCREEN



Provides an array of meters, active touch-sensitive virtual switches, and indicators to facilitate making set point changes. Metered quantities displayed: Generator Voltage, Field Current, Generator kVAR, Generator PF, and Position Indication. Active touch-sensitive virtual switches: AVR Set Point, FCR Set Point, kVAR Set Point, and PF Set Point. Selecting an active set point adjustment virtual switch enables a data entry display (below). The display returns to the previous screen when a new set point is entered.



SPECIFICATIONS

ELECTRICAL

Power Input

20.4 to 27.6Vdc, 20 Watts maximum

Memory

Five panels

HARDWARE

Display

Six inch diagonal monochrome LCD with fluorescent backlight

Touch Screen

Analog resistive

Resolution

320 wide x 240 high

Communication Port

RS-485 Interface

Used to communicate with DECS-300 with Modbus™ protocol

ENVIRONMENTAL AND PHYSICAL

Operating temperature

range 0°C to +50°C (32°F to +122°F)

Humidity

30 to 85% noncondensing

NEMA Rating

12/4

Weight

0.75 kilograms (1.65 pounds)

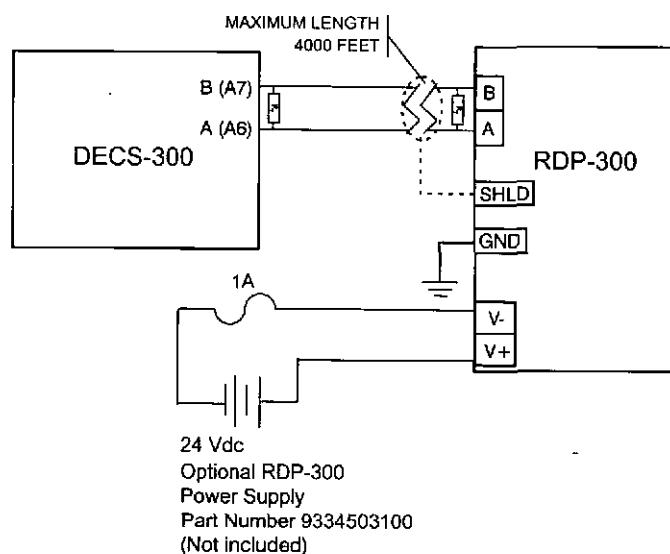
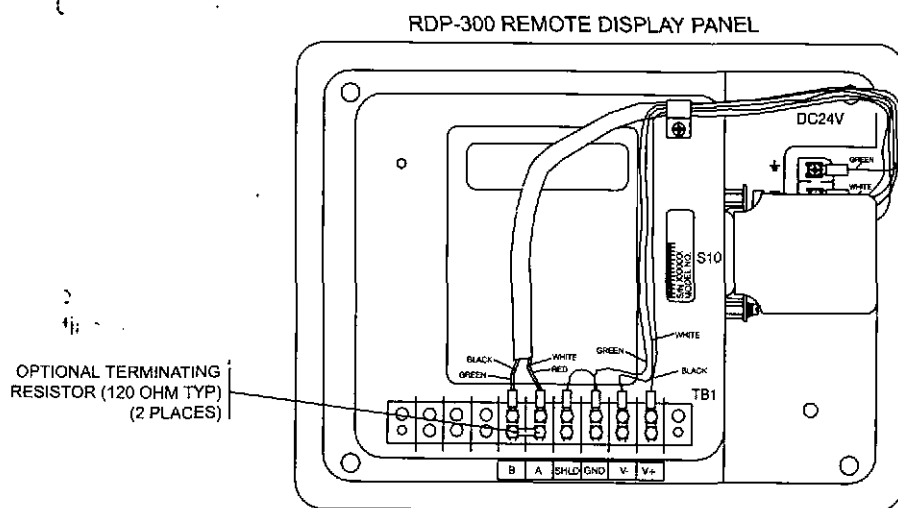


Figure 1 - Typical Interconnection Diagram

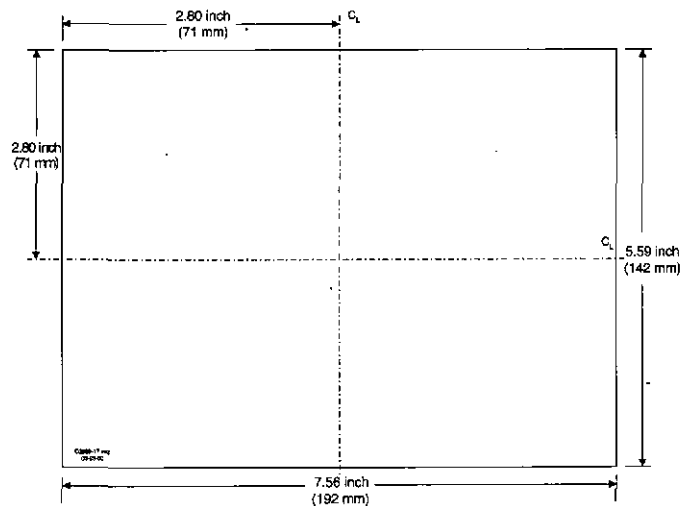


Figure 2 - Cutout Dimensions

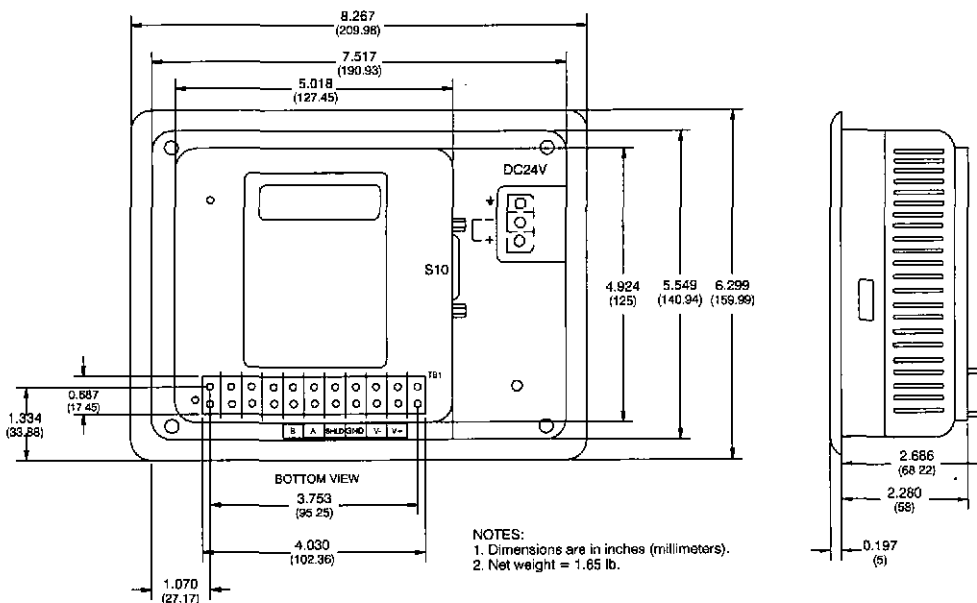


Figure 3 - Outline Diagram

ORDERING INFORMATION

Order Basler Electric Model Number RDP-300

OPTIONAL EQUIPMENT

Power supply shipped separately to power one RDP-300, order Basler P/N 93345C2100.

Power input requirements: ac or dc voltage, 85-265Vac, 47-440Hz, or 110-330Vdc.

Power output rating: 24Vdc, 31.2 Watts.

B Basler Electric



ROUTE 143, BOX 269, HIGHLAND, ILLINOIS U.S.A. 62249
PHONE 618-654-2341 FAX 618-654-2351

P.A.E. Les Pins, 67319 Wasselonne Cedex FRANCE
PHONE (33-3-88) 87-1010 FAX (33-3-88) 87-0808

GENERATOR/MOTOR MANUFACTURER SCHEDULE DS-3

Discount Schedule	Description	Quantities*	U - End User		S - Assembler		G/M-Gen/MtrMfr	
			Multiplier	Discount	Mult.	Disc.	Mult.	Disc.
EC-1	Digital Excitation Control Devices	1-3	1.0	0%	.90	10%	.81	19%
		4-9	.98	2%	.88	12%	.79	21%
		10-24	.96	4%	.86	14%	.77	23%
VR-1	Regulator	1-24	1.0	0%	.85	15%	.69	31%
VR-2	Regulator	1-24	1.0	0%	.82	18%	.75	25%
VR-3	Regulator	1-24	1.0	0%	.58	42%	.50	50%
AC-1	Accessory	1-24	1.0	0%	.88	12%	.72	28%
SE-1	Static Exciter	Consult Factory						
PR-2	Relays Class 200 & 300	1-3	1.0	0%	.80	20%	.80	20%
		4-9	.96	4%	.76	24%	.76	24%
		10-24	.94	6%	.74	26%	.74	26%
PR-3	Relays Generation II Class 100	1-49	1.0	0%	.90	10%	.90	10%
PR-4	BE3 Single Function Relays	1-24	1.0	0%	.75	25%	.75	25%
		25 & up	.90	10%	.75	25%	.75	25%
SC-1	System Control Devices	1-3	1.0	0%	.80	20%	.80	20%
		4-9	.96	4%	.76	24%	.76	24%
		10-24	.94	6%	.74	26%	.74	26%

* For quantities larger than listed, contact factory.

Class of Customer

Discount Schedule

U - End User: This class includes all purchasers not otherwise classified below. DS-1

S - Assemblers: These discounts apply only to switchgear and switchboard assemblers and engine-generator assemblers who incorporate Basler Electric products into their completed products, which they design, engineer, manufacture, advertise, sell, and service under their own trade names. DS-2

G/M - Generator/Motor Manufacturer: An original equipment manufacturer (OEM) which has an engineering design and total manufacturing capability for providing rotating generators or motors to the industry as an individual end item is a generator/motor manufacturer. These generators may be provided by the generator/motor manufacturer to the industry as part of an engine or motor generator set. DS-3

Prices and discounts are subject to change without notice.

Basler Electric retains the right to disallow these discounts at any time, if in the opinion of Basler Electric the equipment is not being sold in accordance with the intent of the qualifications stated herein.

Basler Electric Company Standard Terms & Conditions of Sale, Form FA100001, applies.

Discount Sheet DS-3

Effective 1/1/02

Supersedes Discount Sheet DS-3 dated 1/1/00

**15A DECS PRICING
DIGITAL EXCITATION CONTROL SYSTEM PRICING**

REFER TO DISCOUNT SCHEDULE EC-1

Model	Bulletin	Description	Shipping Weight	List Price
DECS 32-15 63-15 125-15	SZK	Digital Excitation Control System and Power Module*	15 lbs./ 6.8 kg.	\$2,451.00
STYLE NUMBER				
Specific Style	Variations	Description		Price Addition
<input type="checkbox"/>	A B	No Option Installed VAR/PF Regulation		STD \$725.00
<input type="checkbox"/>	1 2	No Option Installed Under/Over Excitation Field Limiting (UEL/OEL)		STD \$1058.00
<input type="checkbox"/>	C	Voltage Matching		STD
<input type="checkbox"/>	1 5	1 Amp Paralleling CT 5 Amp Paralleling CT		STD

*For DECS V2.0.9 and subsequent versions, DCIM modules are not required. BESTCOMS™ software is included in V2.0.9 and subsequent versions at no additional cost.

ACCESSORIES - DISCOUNT SCHEDULE EC-1

Basler Part Number	Description	Shipping Weight	List Price
9265304100	DECS Behind the Panel Mount Adapter Kit	10 lbs./ 4.6 kg.	\$184.00
9274500101 9274500102 9274500103	DECS Communication Package (DCIM) — Contains an Interface Module and Communications Diskette for DECS versions 2.0.7 and previous. (Interface Module and DOS software) (Interface Module and Windows®3.1 software) (Interface Module and Windows®95 software)	5.0 lbs./ 2.3 kg.	\$391.00 \$391.00 \$391.00
9293600100	DECS Free Wheeling Diode Module	Consult Factory	\$279.00
13615	0.1 Ω, 10W, 1% Resistor for Cross Current	2 lbs./ .9 kg.	\$3.00

NOTE: See DECS product bulletin (SZK) for ordering information. For ordering of accessories, use ordering numbering with description.

DIGITAL EXCITATION CONTROL SYSTEM PRICING

REFER TO DISCOUNT SCHEDULE SC-1

Model	Bulletin	Description	Shipping Weight	List Price
DECS-300	SZE	Digital Excitation Control System including Isolation Module, Communication Cable, and BESTCOMS™ DECS300-32 PC Communication Software	17 lbs./ 7.71 kg.	\$19,950.00

<u>Basler Part No.</u>	<u>DECS-300 Accessories</u>	<u>List Price</u>
9310304100	Front panel mounting bracket	\$40.00
9310300032	Interconnection cable for dual DECS-200 applications	\$45.00
BE31449-001	Control Power Transformer for DECS-200 and DECS-300 - powers two DECS units Discount Schedule EC-1	\$75.00

REFER TO DISCOUNT SCHEDULE EC-1

Model	Bulletin	Description	Shipping Weight	List Price
DECS-200	SZM	Digital Excitation Control System	20 lbs./ 9.1 kg.	\$3,800.00

STYLE NUMBER

Specific Style	Variations	Description	Price Addition
		Tracking	
<input type="checkbox"/>	1 2	Internal Auto-Tracking/Transfer *External/Internal Auto-Tracking/Transfer	STD \$2,200.00
		Control Power Supply Input	
<input type="checkbox"/>	L C	24/48Vdc 120/125Vac/Vdc	STD STD

<u>Basler Part No.</u>	<u>DECS-200 Accessories</u>	<u>List Price</u>
9336905-100	Front panel mounting bracket	\$40.00
9310300032	Interconnection cable for dual DECS-200 applications	\$45.00
BE31449-001	Control Power Transformer for DECS-200 and DECS-300 - powers two DECS units Discount Schedule EC-1	\$75.00

*NOTE: External/Internal Auto-Tracking/Transfer is intended for dual DECS-200 applications. Both units require external tracking to operate properly.

DIGITAL EXCITATION CONTROL SYSTEM PRICING

REFER TO DISCOUNT SCHEDULE EC-1

Model	Bulletin	Description	Shipping Weight	List Price
DECS-100	SZN	Digital Excitation Control System – BASE UNIT	2.88 lbs./ 1.31 kg.	\$825.00

STYLE NUMBER

Specific Style	Variations	Description	Price Addition
<input type="checkbox"/>	A B	No Option Installed VAR/PF Controller	STD \$475.00
<input type="checkbox"/>	0 1	No Option Installed Voltage Matching	STD \$50.00
<input type="checkbox"/>	1 5	1 Amp CT secondary 5 Amp CT secondary	STD STD

NOTE: Each DECS-100 comes with one CD-ROM. This CD contains a Product Bulletin, Instruction Manual, BESTCOMS for PCs using Windows® NT 3.51 or later, 95, 98, or Me and BESTCOMS for Palm OS®3 users. Printed literature is available upon request and should be added to the order as a separate line item. Bulletins are available at no charge for up to 10 copies, and printed and bound instruction manuals are available for \$5.00 each.

ACCESSORIES

Model	Bulletin	Description	Shipping Weight	List Price
RDP-300	SZW	Remote Display Panel Touch screen display for remote monitoring and control of DECS-300	1.65 lbs./ .75 kg.	\$2,850.00

**PRICING
VOLTAGE REGULATORS**

VR SERIES

REFER TO DISCOUNT SCHEDULE VR-3

Model	Product Bulletin	Shipping Weight	Price Each
VR63-4/UL	SVB-6	14 oz./0.5 kg.	\$318.00
VR63-4A/UL	SVB-6	14 oz./0.5 kg.	\$338.00
VR63-4B	-----	14 oz./0.5 kg.	\$357.00
VR63-4C/UL	SVF	14 oz./0.5 kg.	\$353.00

APR SERIES

REFER TO DISCOUNT SCHEDULE VR-3

Model	Product Bulletin	Shipping Weight	Price Each
APR63-5/UL	SWA	3.5 lbs./0.68 kg.	\$411.00
APR125-5	SWA	6.1 lbs./2.8 kg.	\$747.00
APR125-5X	-----	6.1 lbs./2.8 kg.	\$823.00

VR485 SERIES

REFER TO DISCOUNT SCHEDULE VR-3

Model	Product Bulletin	Shipping Weight	Price Each
VR485-100-L	SY	4.0 lbs./1.8 kg.	\$958.00
VR485-100-P	SY	4.0 lbs./1.8 kg.	\$958.00

NOTE: An external power transformer (BE 25089-001) is required for use and supplied with the VR485 regulator. This transformer pricing is included in the above VR485 prices.

Current transformer BE 23571-002 is an optional item and lists for \$105.00. Use accessory discount schedule SC-1 for current transformer pricing.

SSR SERIES

REFER TO DISCOUNT SCHEDULE VR-2

Model	Product Bulletin	Shipping Weight	Price Each
SSR32-12	SX	15 lbs./6.8 kg.	\$1,179.00
SSR63-12	SX	15 lbs./6.8 kg.	\$1,229.00
SSR125-12	SX	15 lbs./6.8 kg.	\$1,419.00

Option Breaker	Discount Schedule	Shipping Weight	Price Each
9185900014	AC-1	1.0 lb./0.5 kg.	\$198.00

AEC

REFER TO DISCOUNT SCHEDULE VR-3

Model	Product Bulletin	Shipping Weight	Price Each
AEC63-7	SWD	2.5 lbs./1.1 kg.	\$1,076.00
AEC42-7	SWD	1.0 lb./0.5 kg.	\$453.00

PPI

Effective: 1/1/02

Supersedes: PPI Dated 1/1/01

**PRICING
VOLTAGE REGULATORS**

SR-A SERIES

STANDARD SR-A PRODUCTS: These models are available with a 3-day standard lead time. See Bulletin SA-2 for specific style numbers.

REFER TO DISCOUNT SCHEDULE VR-2

Model	Product Bulletin	Shipping Weight	Price Each
SR4A	SA-2	14 lbs./6.4 kg.	\$1,278.00
SR8A	SA-2	14 lbs./6.4 kg.	\$1,682.00
SR32A	SA-2	20 lbs./9.1 kg.	\$1,713.00

SPECIAL ORDER SR-A MODELS WITH OPTIONAL FEATURES*: These models are available with an 8-week standard lead time. See Bulletin SA-2 for specific style numbers.

REFER TO DISCOUNT SCHEDULE VR-2

Model	Product Bulletin	Shipping Weight	Price Each
SR4A	SA-2	14 lbs./6.4 kg.	\$1,278.00
SR8A	SA-2	14 lbs./6.4 kg.	\$1,682.00
SR32A	SA-2	20 lbs./9.1 kg.	\$1,713.00
SR6A	SA-2	14 lbs./6.4 kg.	\$1,527.00
SR9A	SA-2	14 lbs./6.4 kg.	\$2,154.00
*OPTIONAL FEATURES		Price Added	
Parallel Provision Other Than Standard		\$279.00	
Buildup Relay Other Than Standard		\$111.00	
Voltage Adjust Rheostats Other Than Standard		\$168.00	

**PRICING
VOLTAGE REGULATORS**

AVC

REFER TO DISCOUNT SCHEDULE VR-3

Model	Product Bulletin	Shipping Weight	Price Each
AVC63-2.0	-----	0.23 lb./0.105 kg.	Refer to Factory
AVC63-2.5	-----	0.24 lb./0.107 kg.	Refer to Factory

REFER TO DISCOUNT SCHEDULE VR-3

Model	Product Bulletin	Description	Shipping Weight	Price Each
AVC63-4	SVC	Voltage Regulator	1.0 lb./0.5 kg.	\$237.00
AVC63-4A	SVD	Voltage Regulator	1.0 lb./0.5 kg.	\$290.00
AVC63-7	SVP	Voltage Regulator	0.7 lb/0.28 kg.	\$505.00
AVC110-6	SVE	Voltage Regulator	1.0 lb/0.5 kg.	\$505.00

REFER TO DISCOUNT SCHEDULE VR-3

Model	Product Bulletin	Description	Shipping Weight	Price Each
AVC63-12	SVL	Voltage Regulator	4.5 lb/1.98 kg.	\$941.00
AVC125-10	SVL	Voltage Regulator	4.5 lb/1.98 kg.	\$1,200.00

STYLE NUMBER

Specific Style	Variations	Description		Price Addition
□	A	Sensing Voltage 100/120 Vac		STD
	B	Sensing Voltage 200/240 Vac		STD
□	1	Sensing Frequency 50/60Hz		STD
	2	Sensing Frequency 400Hz		STD

**VOLTAGE REGULATOR ACCESSORIES
PRICE LIST**

UNDERFREQUENCY MODULE

The UFOV operates with the SR-A, SR-F, and SR-H voltage regulators. Overvoltage protection is available with use of the protection breaker. (See Bulletin SPD.)

MODEL NUMBER	INPUT (Vac)	GENERATOR FREQ. HZ.	SHIPPING WEIGHT	PRICE EACH
UFOV250	120/208/240	50	12 lbs./5.4 kg.	\$507.00
UFOV260	415/480/600	60	12 lbs./5.4 kg.	\$486.00

OVERVOLTAGE PROTECTION BREAKER FOR USE WITH UFOV

PART NUMBER	APPLICATION	SHIPPING WEIGHT	PRICE EACH
05390	Single Pole Breaker	1.0 lb./0.5 kg.	\$102.00
05391	Double Pole Breaker	1.0 lb./0.5 kg.	\$157.00

The UF Module is Underfrequency Protection that can be used with the KR-F, SR-A, and SR-H applications. (See Bulletin SPV).

MODEL NUMBER	INPUT (Vac)	GENERATOR FREQ. HZ.	SHIPPING WEIGHT	PRICE EACH
UF312	120	60	2.0 lbs./0.9 kg.	\$310.00
UF324	240	60	2.0 lbs./0.9 kg.	\$351.00
UF327	277	60	2.0 lbs./0.9 kg.	\$351.00

**VOLTAGE REGULATOR ACCESSORIES
PRICE LIST**

MANUAL VOLTAGE CONTROL

The MVC module, by means of a three-position switch, allows the generator voltage to be controlled either manually or automatically and provides the means for system voltage shutdown. (See Bulletins SPC, SRK and SRU.)

Model Number	Applicable Voltage Regulator	Nominal Voltage (Vac)	Output Rating Max. Continuous		Shipping Weight	Price Each
			Volt(dc)	Amps(dc)		
MVC104	SR4A, SR6A, SR4F, KR4FF	120	110	7	35 lbs./ 15.9 kg.	\$1,053.00
MVC 108	SR8A, SR9A, KR7FF	240	220	7	40 lbs./ 18.1 kg.	\$1,591.00
MVC232	SR32A, SR32H, SR63H	60/120	55/110	20	40 lbs./ 18.1 kg.	\$1,964.00
MVC300 MVC301	KR2FF -----or----- APR63-5 KR4FF, SR4A, SR4F	120 or 240	32 ---- 63	7 ---- 7	5.0 lbs./ 2.3 kg.	\$552.00
	-----or----- APR 125-5 KR7FF SR8A, SR8F		125	7		
MVC112	SSR32 SSR63 SSR125	120 120 240	32 63 125	12 12 12	15 lbs./ 6.8 kg.	\$1,505.00
MVC236	SR32A, SR32H, SR32E	60	32	36	18 lbs./ 8.2 kg.	\$1,612.00
	SR63H, SR63E	120	63	36		
	SR125H, SR125E	240	125	36		

Mode Select Switch (MVC236)		Shipping Weight	Price Each
04670	See notes 2 & 3 below	2.0 lbs./0.9 kg.	\$312.00
32257	See notes 2 & 3 below same as 04670, but with extra contacts	3.0 lbs./1.36 kg.	\$445.00
9 2043 06 100	Switchplate (04670)		\$395.00

Nulling Chassis for SSR/MVC112 or SR-E/H & MVC236		Shipping Weight	Price Each
9204304100	Up to 125 Vdc output rating.	15 lbs./6.8 kg.	\$358.00
28599	150-0-150 Vdc Nullmeter	3 lbs./1.36 kg.	\$450.00

- NOTE: (1) The MVC-300 operates at 50/60 Hz only. All other model operate at 50/60 Hz and 400 Hz.
(2) The MVC-236 does not include a Mode Switch. Use P/N 04670 given in above list.
(3) Part Number 04670 does not maintain agency approval for amperage requirements for the SRE Series Voltage Regulators.

Accessories Pricing PPACI
Effective: 1/1/02

Supersedes: PPACI dated 1/1/01
Discount Schedule AC-1

**EXCITATION SUPPORT SYSTEM (SERIES BOOST OPTION)
PRICE LIST**

An excitation Support System (SBO) consists of two (2) items: the Reservoir Assembly, and the Power Current Transformer(s) which must be ordered separately. The Excitation Support System makes it possible for the voltage regulator to deliver full forcing output during generator overload or generator short circuit conditions. The Excitation Support System is an ideal accessory for large motor starting applications. (See Bulletin SP-5 or consult with the factory for technical and/or ordering data).

RESERVOIR ASSEMBLY FOR SR8A AND SR8F VOLTAGE REGULATORS

Model Number	Input Volts	Input Freq.	Shipping Weight	Price Each
SBO181	208/240	60 Hz.	120 lbs./54.4 kg.	\$1,723.00
SBO182	416/480	60 Hz.	120 lbs./54.4 kg.	
SBO183	208/240	50 Hz.	120 lbs./54.4 kg.	
SBO184	380/480	50 Hz.	120 lbs./54.4 kg.	
SBO185	575/600	60 Hz.	120 lbs./54.4 kg.	
SBO186	575/600	50 Hz.	120 lbs./54.4 kg.	

RESERVOIR ASSEMBLY FOR KR2FF VOLTAGE REGULATORS

Model Number	Input Volts	Input Freq.	Shipping Weight	Price Each
SBO221	208/240	60 Hz.	50 lbs./22.7 kg.	\$889.00
SBO222	416/480	60 Hz.	50 lbs./22.7 kg.	
SBO223	575/600	60 Hz.	50 lbs./22.7 kg.	
SBO224	208/240	50 Hz.	50 lbs./22.7 kg.	
SBO225	380/480	50 Hz.	50 lbs./22.7 kg.	
SBO226	575/600	50 Hz.	50 lbs./22.7 kg.	

RESERVOIR ASSEMBLY FOR SR32A VOLTAGE REGULATORS

Model Number	Input Volts	Input Freq.	Shipping Weight	Price Each
SBO232	208/240	60 Hz.	50 lbs./22.7 kg.	\$889.00
SBO233	416/480	60 Hz.	50 lbs./22.7 kg.	
SBO234	208/240	50 Hz.	50 lbs./22.7 kg.	
SBO235	380/480	50 Hz.	50 lbs./22.7 kg.	
SBO236	575/600	60 Hz.	50 lbs./22.7 kg.	
SBO237	575/600	50 Hz.	50 lbs./22.7 kg.	

**VOLTAGE REGULATOR ACCESSORIES
PRICE LIST**

RESERVOIR ASSEMBLY FOR SR4A, SR4F, AND KR4FF VOLTAGE REGULATORS

Model Number	Input Volts	Input Freq.	Shipping Weight	Price Each
SBO241	208/240	60 Hz.	50 lbs./22.7 kg.	\$889.00
SBO242	416/480	60 Hz.	50 lbs./22.7 kg.	
SBO243	208/240	50 Hz.	50 lbs./22.7 kg.	
SBO244	380/480	50 Hz.	50 lbs./22.7 kg.	
SBO245	575/600	60 Hz.	50 lbs./22.7 kg.	
SBO246	575/600	50 Hz.	50 lbs./22.7 kg.	

RESERVOIR ASSEMBLY FOR SR8A*, SR8F*, AND KR7FF VOLTAGE REGULATORS

Model Number	Input Volts	Input Freq.	Shipping Weight	Price Each
SBO271	208/240	60 Hz.	50 lbs./22.7 kg.	\$1,005.00
SBO272	416/480	60 Hz.	50 lbs./22.7 kg.	
SBO273	208/240	50 Hz.	50 lbs./22.7 kg.	
SBO274	380/480	50 Hz.	50 lbs./22.7 kg.	
SBO275	575/600	60 Hz.	50 lbs./22.7 kg.	
SBO276	575/600	50 Hz.	50 lbs./22.7 kg.	

*Will operate with SR8A and SR8F regulator at reduced output (3.5A).

**POWER CURRENT TRANSFORMERS
(PART OF EXCITATION SUPPORT SYSTEM)**

Part Number	For Use with Reservoir Assembly	Shipping Weight	Price Each
BE2461	SBO220, 230, 240, OR 270 Series	48 lbs./21.8 kg.	\$304.00
BE2462	SBO180, 220, 230, 240, or 270 Series	95 lbs./43.1 kg.	\$493.00
BE2463	SBO180, 220, 230, 240, or 270 Series	69 lbs./31.3 kg.	\$479.00
BE2464	SBO180, 220, 230, 240, or 270 Series	53 lbs./24.0 kg.	\$467.00
BE2470	SBO202, 230, 240, OR 270 Series	77 lbs./34.9 kg.	\$501.00

NOTE: Transformer selection depends upon generator application. See Product Bulletin SP-5 for current transformer ratio chart, or consult the factory.

MEDIUM VOLTAGE POWER CURRENT TRANSFORMERS

Part Number	For Use with Reservoir Assembly	Shipping Weight	Price Each
BE15620	SBO230, 240, or 270 Series	70 lbs./31.8 kg.	\$1,213.00
BE15621	SBO230, 240, or 270 Series	65 lbs./29.5 kg.	\$1,188.00
BE15622	SBO230, 240, or 270 Series	65 lbs./29.5 kg.	\$1,225.00

NOTE: Transformer selection depends upon generator application. See Product Bulletin SP-5 for current transformer ratio chart, or consult the factory.

Accessories Pricing PPACI
Effective: 1/1/02
Supersedes: PPACI dated 1/1/01
Discount Schedule AC-1

**VOLTAGE REGULATOR ACCESSORIES
PRICE LIST**

CURRENT BOOST SYSTEM

The CBS212 provides excitation support for the SSR voltage regulators. The CBS must be used with the current transformers listed below. See Product Bulletin SQA.

Model Number	Output Volts	Output Amps	Regulator Model	Shipping Weight	Price Each
CBS212	50	20	SSR32-12	15 lbs./6.8 kg.	\$1,107.00
	100	20	SSR63-12		
CBS212A	220	20	SSR125-12	20 lbs./9.1 kg.	\$1,107.00

CURRENT TRANSFORMER FOR CBS 212

Part Number	For Use with Reservoir Assembly	Shipping Weight	Price Each
BE25925	CBS212 CBS212A	90 lbs./40.1 kg.	\$624.00
BE25926		85 lbs./38.6 kg.	\$610.00
BE25927		70 lbs./31.8 kg.	\$644.00
BE25928		140 lbs./63.5 kg.	\$610.00
BE25929		80 lbs./36.3 kg.	\$544.00
BE25930		55 lbs./24.9 kg.	\$535.00

CURRENT BOOST SYSTEM

The CBS344 and CBS377 provide excitation support for the KR4 and KR7 series regulators. The CBS must be used with one of the current transformers listed below. See Product Bulletin SPW.

Model Number	Output Volts	Output Amps	Regulator Model	Shipping Weight	Price Each
CBS344	90	3.5	KR4FFMX	5.0 lbs./2.3 kg.	\$614.00
CBS377	180	5.0	KR7FFMX	5.0 lbs./2.3 kg.	\$614.00

CURRENT TRANSFORMERS FOR CBS 344 OR CBS 377

Part Number	Window Size	Secondary Turns	Shipping Weight	Price Each
BE15486	0.9 x 4.5 inches	205/285/490	35 lbs./15.9 kg.	\$233.00
BE16866	1.5 x 8.0 inches	205/285/490	53 lbs./24.0 kg.	\$361.00

**VOLTAGE REGULATOR ACCESSORIES
PRICE LIST**

CURRENT BOOST SYSTEM

The CBS305/320 provides excitation support for the APR series regulators. The CBS 305/320 requires a current transformer and Current Boost Module for a complete Current Boost System. See Product Bulletin SRR.

Model Number	Output Volts	Output Amps	Regulator Model	Shipping Weight	Price Each
CBS305	90	7.2	APR63-5	3.6 lbs./1.6 kg.	\$358.00
CBS320	180	7.2	APR125-5	8.0 lbs./3.6 kg.	\$459.00

CURRENT TRANSFORMERS FOR CBS 305 OR CBS 320

Part Number	Use With:	Shipping Weight	Price Each
BE21331	APR63-5/CBS305	17 lbs./7.7 kg.	\$112.00
BE21432	APR63-5/CBS305 or APR125-5/CBS320	55 lbs./24.9 kg.	\$358.00
BE21433	APR125-5/CBS320	31 lbs./14.1 kg.	\$232.00

POWER ISOLATION TRANSFORMERS

These transformers provide voltage matching/isolation for voltage regulator power. They are specifically designed for generator control and are matched to the operational characteristics of the Basler family of voltage regulators. (See SP-2 for detailed information.)

LOW VOLTAGE POWER ISOLATION TRANSFORMERS

Transformer Model Number	Rating Data		Voltage Rating		Voltage Regulator	Shipping Weight	Price Each
	VA	Freq. Hz.	Primary (Vac.)	Sec. (Vac.)			
BE10317	500	50-400	208/240 416/480	120 x 240	KR4FF	21 lbs./ 9.5 kg.	\$249.00
BE18674	900	50-60	240/480 600	240/250	VR63-4 VR63-4A APR63-5 XR2001 XR2001F	30 lbs./ 13.6 kg.	\$319.00
BE11048	500	50-400	600	120 x 240	KR4FF	21 lbs./ 9.3 kg.	\$249.00
BE25825	2000	50-400	80	120	SSR 63	55 lbs./ 24.9 kg.	\$640.00

Accessories Pricing PPACI
Effective: 1/1/02
Supersedes: PPACI dated 1/1/01
Discount Schedule AC-1

**VOLTAGE REGULATOR ACCESSORIES
PRICE LIST**

LOW VOLTAGE POWER ISOLATION TRANSFORMERS (continued)

Transformer Model Number	Rating Data		Voltage Rating		Voltage Regulator	Shipping Weight	Price Each
	VA	Freq. Hz.	Primary (Vac.)	Sec. (Vac.)			
BE10647	640	50-400	208/240 416/480 600	120 x 139	KR2FF	30 lbs./ 13.6 kg.	\$275.00
BE22207	720	50-60	240/480 600	120	SSR32-12	55 lbs./ 24.9 kg.	\$524.00
BE10493	1000	50-400	208/240 416/480	120 x 240	SR4A, SR6A, SR4F, KR6F APR125-5	38 lbs./ 17.2 kg.	\$319.00
BE11049	1000	50-400	600	120 x 240	KR7FF, APR125-5	38 lbs./ 17.2 kg.	\$308.00
BE11304	1200	50-400	208/240 416/480	60 x 120	SR32A, SR32H	50 lbs./ 22.7 kg.	\$445.00
BE10494	2000	50-400	208/240 416/480	120 x 240	SR8A, SR9A	71 lbs./ 32.2 kg.	\$520.00
BE11050	2000	50-400	600	120 x 240	SR8F, SR63H, SSR63-12	71 lbs./ 32.2 kg.	\$487.00
BE22209	2400	50-60	240/480 600	120 x 240	SSR63-12 SSR125-12	55 lbs./ 24.9 kg.	\$584.00
BE12819	4000	50-60	208/240 416/480	240 x 480	SR125H, SR250H* SSR125-12	91 lbs./ 41.3 kg.	\$848.00

*For SR250H, two (2) BE12819, 4000 VA transformers must be used in parallel for 8000 VA.

**VOLTAGE REGULATOR ACCESSORIES
PRICE LIST**

HIGH VOLTAGE POWER ISOLATION TRANSFORMERS - See Bulletin SP-2.

Transformer Model Number	Rating Data		Voltage Rating		Voltage Regulator	Shipping Weight	Price Each
	VA	Freq. Hz.	Primary (Vac.)	Sec. (Vac.)			
BE13616	1000	50/60	2400/4160	120 x 240	SR4A, SR8A*, SR6A SR4F, SR8F*, APR125-5	42 lbs./ 19.1 kg.	\$716.00
BE17637	1000	50/60	10,000	120 x 240	SR4A, SR8A, APR125-5 SR4F, SR8F	42 lbs./ 19.1 kg.	\$1,920.00
BE13487	2000	50/60	2400/4160	120 x 240	SR8A, SR8F, SSR63-12, SR9A, SR63H	74 lbs./ 33.6 kg.	\$869.00
BE12818	4000	50/60	2400/4160	240 x 480	SR125H, SSR125-12, SR250H*	107 lbs./ 48.5 kg.	\$1,081.00
BE13652	4000	50/60	13800	240 x 480	SR125H, SR8F, SR250H* SR8A APR125-5	150 lbs./ 68.0 kg.	\$1,771.00
BE14014	1680	50/60	3300/6600	120 x 240	SR4A, SR8A, SR6A, SR9A, SR4F, SR8F, APR125-5	74 lbs./ 33.6 kg.	\$976.00
BE12693	3000	50/60	5500	120 x 240	SR4A, SR8A, APR125-5 SR4F, SR8F	65 lbs./ 29.5 kg.	\$1,071.00
BE22136	4000	50/60	7200	120/240 600	SR63H, SR63E, SSR63-12 SSR125-12 APR125-5	125 lbs./ 56.7 kg.	\$2,333.00
BE21327	4000	50/60	13800	120 x 240	APR125-5 SSR63-12 SSR125-12	160 lbs./ 72.6 kg.	\$2,201.00

*For operation at reduced power.

**VOLTAGE REGULATOR ACCESSORIES
PRICE LIST**

PARALLELING MODULE

The paralleling module provides reactive load compensation in parallel generator-regulator schemes. See Product Bulletin SPI and SRJ.

Model Number	Application	Shipping Weight	List Price Each
APM300	Paralleling Kit for KR-FF, and SRA regulators on three-phase generators.	5 lbs./ 2.3 kg.	\$173.00
APM2000	Paralleling Kit for APR and XR 2000 Voltage Regulators	5 lbs./ 2.3 kg.	\$141.00

BRUSHLESS EXCITER DIODE MONITOR

The new EDM200 module is a device added to the exciter field circuit to monitor the output of the brushless exciter power semiconductors. The EDM200 is compatible with all phase fired Basler Voltage Regulators. See Product Bulletin SRO.

Model	Operating Power			Exciter Field Current Sensing	Shipping Weight	List Price Each
	Voltage Input	VA	Frequency (Hz)			
EDM200	100-120 200-240 380-480 528-600	10	50-60	0-7 Amperes or 0-100 mV	4.0 lbs./ 1.8 kg.	\$849.00

MINIMUM/MAXIMUM EXCITATION LIMITER

The EL200 series minimum/maximum excitation limiter imposes limits on the solid-state voltage regulator to prevent insufficient or excessive values of exciter field current. This device helps assure safe generator operation. The EL200 series is compatible with Basler SR-A, SR-F, SR-H, SR-E, KR-FF, and XR voltage regulators. See Product Bulletin SRP.

Model	Field Power (Amperes)	Shipping Weight	List Price Each
EL200-2	0.5 - 2.0	13 lbs./5.9 kg.	\$1,386.00
EL200-7	2.0 - 7.0		\$1,147.00
EL200-20	5 - 20		\$1,553.00
EL200-36	10 - 36		\$1,816.00

**VOLTAGE REGULATOR ACCESSORIES
PRICE LIST**

EXTERNAL VOLTAGE ADJUST

Part Number	Application	Shipping Weight	List Price Each
03456	175 ohms, 25 W rheostat (supplied as part of SR-A regulator).	1.0 lb./0.5 kg.	\$44.00
06874	500 ohms, 25 W rheostat (supplied as part of SR-F, SR-H, KR-FF, and XR2000 regulators).	1.0 lb./0.5 kg.	\$35.00
17727	1000 ohms, 2 W rheostat, with locking, slotted shaft for use with VR series regulators and APR63-5.	1.0 lb./0.5 kg.	\$18.00
02682	5000 ohms, 2 W rheostat (supplied as part of SSR regulator).	1.0 lb./0.5 kg.	\$32.00
11521	20K ohm, 2 W rheostat, with locking slotted shaft for VR485 series regulators.	1.0 lb./0.5 kg.	\$57.00
02684	Knob for use with part numbers 03456, 06874, and 02682 above.	0.1 lb./0.005 kg.	\$ 1.00

CONTROL SWITCH

Part Number	Application	Shipping Weight	List Price Each
9174805106	Switch, rotary 3-position, momentary, action, with pistol grip handle, with blank dial plate.	3.0 lbs./1.4 kg.	\$276.00
9174805107	Switch (same as above); with "Frequency Control" dial plate.	3.0 lbs./1.4 kg.	\$276.00
9174805108	Switch (same as above); with "Voltage Control" dial plate.	3.0 lbs./1.4 kg.	\$276.00
05407	Power Switch for SR4A, SR6A, SR8A, SR9A, SR4F, and SR8F regulators. Also used as unit/parallel switch on SR-A, SR-H, and SR-F regulators.	1.0 lb./0.5 kg.	\$118.00
05914	"Manual-Off-Automatic" switch for SR-A and SR-F regulators. (DPDT 3-positions). Legend not included.	2.0 lbs./0.9 kg.	\$119.00
05872	"Manual-Off-Automatic" switch for SR-A, SR-H, and SR-F regulators. (DPDT 5-position "heavy duty" model). Legend not included.	2.0 lbs./0.9 kg.	\$249.00
07815	Manual-Off-Automatic Legend Plate for 05914.	1.0 lb./0.5 kg.	\$31.00
07817	Manual-Off-Automatic Legend Plate for 05872.	1.0 lb./0.5 kg.	\$31.00

Accessories Pricing PPACI
Effective: 1/1/02
Supersedes: PPACI dated 1/1/01
Discount Schedule AC-1

PROTECTION AND CONTROL DEVICES PRICING INSTRUCTIONS

Basler Electric BE1 Series Relays must be specified by Model and Style Numbers to define the relay completely. To develop a price for a specific relay, select the price page according to the relay model number. The base price of the relay is listed for each model. Directly below the model number on the left is a column of boxes representing each character in the style number. The possible options that may be incorporated in that position of the style number are listed to the right of each box. Check each character of the style number for possible price additions. The base price of the relay, together with the sum of the price additions for the style number selections is the total list price for the specific relay desired.

Pricing Example

THREE-PHASE TRANSFORMER DIFFERENTIAL

Model	Style Number											
BE1-87T	E	1	E	-	A1	J	-	D	1	N	1	F
\$4,800	STD	STD	STD		STD	STD		STD	STD	STD	\$100	STD

TOTAL PRICE: \$4,900.00

Instruction Manuals

Basler Electric BE1 Series Protective Relays are provided with an up-to-date instruction manual to enable our customer to properly apply, install, set, and operate the device.

One copy of the appropriate instruction manual will be packed and shipped in the individual carton with each unit.

Additional copies of instruction manuals may be ordered at any time. Charges for these manuals are:

Quantity	Price
1-9	No Charge
10 and Above	\$1.00 Net Charge

BE1 NUMERICAL SYSTEMS PRICE LIST

Model	Bulletin	Description	List Price
BE1-GPS100	UHQ	Multi-function Overcurrent Protection System Programmable three phase, neutral and negative sequence overcurrent protection with inverse time (51), two instantaneous with settable time delay (50T), breaker failure (BF), over/under voltage (27/59), six over/under frequency (81O/U), 4 shot recloser (79), two general purpose logic timers (62), instrumentation, demand metering, sequence of events (SER), fault summary reports, breaker monitoring, SCADA, and communications. Will operate on both 50 or 60 Hz systems.	\$2,675.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Addition
Current Sensing Input Type <input type="checkbox"/>	A	1 Amp Nominal System with No Independent Ground Input	STD
	B	1 Amp Nominal System with 1 A Independent Ground Input	\$175.00
	D	5 Amp Nominal System with No Independent Ground Input	STD
	E	5 Amp Nominal System with 5A Independent Ground Input	\$175.00
	F	5 Amp Nominal System with 1A Independent Ground Input	\$175.00
Voltage Sensing Input Type <input type="checkbox"/>	3	Three Phase Sensing	STD
	4	3 Phase Sensing with Fourth Independent Auxiliary Voltage Input <3>	\$125.00
Cover <input type="checkbox"/>	A	S1 Cover with Opening for Full HMI Access	STD
	B	S1 Cover with Reset Access Only	STD
	N	Not Applicable (H1 case) <4>	STD
Power Supply <input type="checkbox"/>	1	48 Vac/125 dc	STD
	2	125 Vac/250 dc	STD
	3	24 Vdc	\$50.00
Case <input type="checkbox"/>	H	Half Rack, Full Drawout Case	STD
	S	S1, Full Drawout Case with Test Paddle <2> <4>	\$250.00
RS-485 Port Protocol <input type="checkbox"/>	0	ASCII Protocol	STD
	1	Modbus™ Protocol	\$50.00
	2	TNP Protocol	\$100.00
	3	DNP 3.0 Protocol <1> <5>	\$100.00
Options <input type="checkbox"/>	N	No Option	STD
	U	Battery Backup for Real Time Clock <6>	\$50.00

- NOTES: <1> Consult your Basler Representative for availability of other protocol options.
 <2> Case option must be H for current sensing option to be B, E, F or for voltage sensing option to be 4.
 <3> Adds 25 sync check or 59/27-3N Stator Ground Fault protection.
 <4> If case option is H, cover option must be N.
 <5> All units include three independent communications ports standard: Com0 (front RS232), Com1 (rear RS232), Com2 (rear RS485). ASCII Communications is standard on Com0, Com1 and Com2.
 <6> Consult your Basler Representative for availability.

Packaged Discount Program

Applies to combination sales of:

- BE1-GPS100 Multifunction, Generator Protection System and BE1-87G Solid State, Generator Differential Relay with Sensing Input Type G (Three Phase Current).
- or
- BE1-GPS100 Multifunction, Generator Protection System and BE1-CDS220 Multifunction, Current Differential Protection System.

When a BE1-87G or BE1-CDS220 is ordered with a BE1-GPS 100, take a 20% discount off of the fully optioned list price of the BE1-GPS100. The discount applies only to each BE1-GPS100 that can be paired with one of the above listed differential relays on the same sales order.

Numerical Systems Pricing PP1PR3
 Effective: 1/1/02
 Supersedes: PP1PR3 Dated 1/1/01
 Discount Schedule PR-3

BE1 NUMERICAL SYSTEMS PRICE LIST

Model	Bulletin	Description	List Price
BE1-1051	UHS	Multi-function Overcurrent Protection System Programmable three phase overcurrent protection with voltage restrained phase inverse time (51V), neutral and negative sequence inverse time (51N/51Q), two instantaneous with settable time delay (50TP/N/Q), directional control (67), breaker failure (50BF), overexcitation (24), optional sync check w/ voltage monitor (25/25VM), over/under voltage (27/59), negative sequence voltage (47), loss of VT sensing (60FL), two general purpose logic timers (62), 4 shot recloser (79), over/under frequency (81O/U), permissive pilot logic (P85), Switch on to Fault logic (SOTF), instrumentation, demand metering, sequence of events (SER), fault reporting, distance to fault, breaker monitoring, SCADA, and communications. Will operate on both 50 or 60 Hz systems. Optional Ethernet Communications.	\$2500.00
Style Number			
Specific Style	Variations	Description	Price Additions
<input type="checkbox"/> Current Sensing Input Type	A	1 Amp Nominal System with No Independent Ground Input	STD
	B	1 Amp Nominal System with 1 Amp Independent Ground Input	\$175.00
	D	5 Amp Nominal System with No Independent Ground Input	STD
	E	5 Amp Nominal System with 5A Independent Ground Input	\$175.00
	F	5 Amp Nominal System with 1A Independent Ground Input	\$175.00
<input type="checkbox"/> Voltage Sensing Input Type	3	3 Phase Sensing	STD
	4	3 Phase Sensing with 4th independent auxiliary voltage input. <3>	\$125.00
<input type="checkbox"/> Front Panel	N	6 button HMI with LCD display.	STD
	D	Direct Access Virtual Control, & 6 button HMI with LCD display	\$450.00
<input type="checkbox"/> Power Supply	1	48/125 Vac/dc	STD
	2	125/250 Vac/dc	STD
	3	24 Vdc	\$50.00
<input type="checkbox"/> Mounting	H	Horizontal Panel Mount	STD
	R	Horizontal 19" Rack Mount	STD
	V	Vertical Panel Mount	STD
<input type="checkbox"/> RS 485 port protocol	0	ASCII Protocol	STD
	1	Modbus Protocol	\$50.00
	2	TNP Protocol Ψ	\$100.00
	3	DNP 3.0 Protocol <1> <2>	\$100.00
<input type="checkbox"/> Ethernet port protocol	N	None	STD
	U	Com3, UCA2 10BaseF; Com4, UCA2 10BaseT	\$1250.00
	W	Com3, UCA2 10BaseF; Com4, UCA2 10BaseF <2>	\$1450.00
<input type="checkbox"/> Option 1	N	No Option	STD
	Y	4000 Point Load Profile Demand Log	\$300.00

Ψ Consult Factory for Availability

NOTE:

- <1> All units include three independent communications ports standard: Com0 (front RS232), Com1 (rear RS232), Com2 (rear RS485). ASCII Communications is standard on Com0, Com1, and Com2.
- <2> Consult your Basler Representative for availability of other protocol options.
- <3> Adds 25 sync check option.

BE1 NUMERICAL SYSTEMS PRICE LIST

Model	Bulletin	Description	List Price
BE1-951	UHR	Multi-function Overcurrent Protection System Programmable three phase overcurrent protection with voltage restrained phase inverse time (51V), neutral and negative sequence inverse time (51N/51Q), two instantaneous with settable time delay (50TP/N/Q), breaker failure (BF), overexcitation (24), optional sync check w/voltage monitor (25/25VM), over/under voltage (27/59), negative sequence voltage (47), loss of VT sensing (60FL), two general purpose logic timers (62), 4 shot recloser (79), over/under frequency (81O/U), instrumentation, demand metering, sequence of events (SER), fault reporting, distance to fault, breaker monitoring, SCADA, and communications. Will operate on both 50 or 60 Hz systems. Overcurrent elements can be individually set for directional control.	\$1,870.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Addition
<input type="checkbox"/> Current Sensing Input Type	A	1 Amp Nominal System with No Independent Ground Input	STD
	B	1 Amp Nominal System with 1 A Independent Ground Input	\$175.00
	D	5 Amp Nominal System with No Independent Ground Input	STD
	E	5 Amp Nominal System with 5 A Independent Ground Input	\$175.00
	F	5 Amp Nominal System with 1 A Independent Ground Input	\$175.00
<input type="checkbox"/> Voltage Sensing Input Type	3	3 Phase Sensing	STD
	4	3 Phase Sensing with 4 th independent aux. Voltage input. <5>	\$125.00
<input type="checkbox"/> Cover	A	S1 Cover with opening for full HMI access	STD
	B	S1 Cover with Reset access only	STD
	N	Not Applicable (H1 Case) <1>	STD
<input type="checkbox"/> Power Supply	1	48/125 Vac/dc	STD
	2	125/250 Vac/dc	STD
	3	24 Vdc	\$50.00
<input type="checkbox"/> Case	H	Half Rack, Full Drawout Case	STD
	S	S1 Full Drawout Case with Test Paddle <1> <2>	\$250.00
<input type="checkbox"/> RS 485 Port Protocol	0	ASCII Protocol	STD
	1	Modbus™ Protocol	\$50.00
	2	TNP Protocol	\$100.00
	3	DNP® 3.0 Protocol <3> <4>	\$100.00
<input type="checkbox"/> Option 1	N	No Option	STD
	Y	4000 Point Load Profile Demand Log	\$200.00
	U	Battery Backup for Real Time Clock <6>	\$50.00
	W	4000 Point Load Profile Demand Log and Battery Backup for Real Time Clock <6>	\$250.00

- NOTES: <1> If case option is H, Cover option must be N.
 <2> Case option must be H for Current Sensing Input Type to be B, C, E, or F or for voltage sensing option to be 4.
 <3> All units include three independent communications ports standard: Com0 (front RS232), Com1 (rear RS232), Com2 (rear RS485). ASCII Communications is standard on Com0, Com1, and Com2.
 <4> Consult your Basler Representative for availability of other protocol options.
 <5> Auxiliary voltage input adds 25 sync check option.
 <6> Consult your Basler Representative for availability.

Protective Relay Pricing PP1PR3
 Effective: 1/1/02
 Supersedes: PP1PR3 Dated 1/1/01
 Discount Schedule PR-3

BE1 NUMERICAL SYSTEMS PRICE LIST

Model	Bulletin	Description	List Price
BE1-851	UHM	Multifunction Overcurrent Protection System Programmable three phase (P), neutral (N) and optional negative sequence (Q) overcurrent protection with inverse time (51), instantaneous with settable time delay (50T) breaker failure (BF), 4 shot recloser (79), general purpose logic timers (62), instrumentation, demand metering, sequence of events (SER), fault reporting, breaker monitoring, SCADA, and communications. Will operate on both 50 or 60 Hz systems.	\$1,210.00
Style Number			
Specific Type	Variations	Description	Price Additions
<input type="checkbox"/> Sensing Input Type	G	Three Phase and Neutral Protection	STD
	H	Three-Phase, Neutral and Negative Sequence Protection	STD
<input type="checkbox"/> Sensing Input Type	1	1 Amp Phase, 1 Amp Neutral	STD
	3	5 Amp Phase, 1 Amp Neutral	STD
	5	5 Amp Phase, 5 Amp Neutral	STD
<input type="checkbox"/> Cover	A	S1 Cover with Opening for Full HMI Access	STD
	B	S1 Cover with Reset Access Only	STD
	N	Not Applicable (H1, F1 Case) <3>	STD
<input type="checkbox"/> Power Supply	1	48/125 Vac/dc	STD
	2	125/250 Vac/dc	STD
	3	24 Vdc	\$50.00
<input type="checkbox"/> Case	H	Half Rack, Full Drawout Case	STD
	F	FT11 Size, Full Drawout Case	\$125.00
	S	S1 Full Drawout Case with Test Paddles	\$250.00
<input type="checkbox"/> RS 485 Port Protocol	0	ASCII Protocol	STD
	1	Modbus™ Protocol	\$50.00
	2	TNP Protocol	\$100.00
	3	DNP 3.0 Protocol <2> <3>	\$100.00

Notes:

- <1> ASCII Communications is standard on Com0 (Front RS232) and Com1 (Rear RS232) ports.
- <2> Consult your Basler Representative for availability of other protocol options.
- <3> If case option is F or H, cover option must be N.
- <4> All units include three independent communications ports standard: Com0 (front RS232), Com1 rear RS232), Com2 (rear RS485). ASCII Communications is standard on Com0, Com1, and Com2.

BE1 NUMERICAL SYSTEMS PRICE LIST

Model	Bulletin	Description	List Price
BE1-CDS220	UHP	Multifunction Current Differential Protection System Programmable multifunction, numerical relay that provides percentage restrained differential protection along with overcurrent, breaker failure, control, metering, monitoring, and alarm functions in an integrated system. Will operate on both 50 and 60 Hz systems.	\$2,475.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Addition
Sensing Input Type <input type="checkbox"/>	A	1 Amp Nominal System with No Independent Ground Input	STD
	B	1 Amp Nominal System with 1 Amp Independent Ground Input	\$175.00
	D	5 Amp Nominal System with No Independent Ground Input	STD
	E	5 Amp Nominal System with 5 Amp Independent Ground Input	\$175.00
	F	5 Amp Nominal System with 1 Amp Independent Ground Input	\$175.00
No option <input type="checkbox"/>	0		STD
I/O <input type="checkbox"/>	E	Six programmable outputs, one alarm output, and eight contact sensing inputs.	STD
No option <input type="checkbox"/>	N		STD
No option <input type="checkbox"/>	0		STD
Power Supply <input type="checkbox"/>	L	24 Vdc	\$50.00
	Y	48/125 Vac/dc	STD
	Z	125/250 Vac/dc	STD
Front Panel <input type="checkbox"/>	N	LED Target and alarm indication	STD
	Y	Six button HMI with graphic LCD display	\$375.00
RS 485 port protocol <input type="checkbox"/>	0	ASCII Protocol	STD
	1	Modbus™ Protocol	\$50.00
	2	TNP Protocol	\$100.00
	3	DNP® 3.0 Protocol <1>	\$100.00
Load Profile <input type="checkbox"/>	N	No load profile recording	STD
	Y	With 4000 point load profile recording	\$200.00
Cover <input type="checkbox"/>	0	No cover	STD
	1	With cover	\$75.00
Mounting <input type="checkbox"/>	H	Horizontal with panel mounting flange	STD
	R	Horizontal with 19" rack mount brackets	STD
	V	Vertical	STD

NOTE: <1> Consult your Basler Representative for availability of other protocol options.

REFER TO DISCOUNT SCHEDULE PR-3

Numerical Systems Pricing PP1PR3
Effective: 1/1/02
Supersedes: PP1PR3 Dated 1/1/01
Discount Schedule PR-3

BE1 NUMERICAL SYSTEMS PRICE LIST

Model	Bulletin	Description	Shipping Weight	List Price
BE1-MMS100	LAD	Multifunction Metering System	6.0 lbs./2.7 kg.	\$1,600.00
SPECIFIC STYLE NUMBER ORDER INFORMATION				
Specific Style	Variations	Description Select One Character From Each Group		Price Addition
<input type="checkbox"/> Current Sensing Input Type	B E	1 Amp Phase, 1 Amp Ground 5 Amp Phase, 5 Amp Ground		STD STD
<input type="checkbox"/> Voltage Sensing Input Type	3	Three Phase Sensing		STD
<input type="checkbox"/> No Option	N			STD
<input type="checkbox"/> Power Supply	1 2 3	48/125 Vac/dc 125/250 Vac/dc 24 Vdc		STD STD \$50.00
<input type="checkbox"/> Case	H	Half Rack, Full Drawout Case		STD
<input type="checkbox"/> RS-485 Port Protocol	1 2 3	Modbus™ Protocol TNP Protocol DNP 3.0 Protocol <1>		STD STD STD

Note: <1> Consult your Basler Representative for availability of other protocol options.

PROTECTIVE RELAY PRICE LIST

Model	Bulletin	Description	List Price
BE1-25	UBP	Sync-Check Relay (25)	\$1,325.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Addition
<input type="checkbox"/>	M	Single Phase Voltage	STD
Sensing	1	Phase Angle Range 1-99 Degrees	STD
<input type="checkbox"/>	9	Phase Angle Range 1-99 Degrees with Expandable Window <1>	\$95.00
<input type="checkbox"/>	E	One Relay Output	STD
	F	One Relay Output with Push-to-Energize Output	STD
	G	Separate Sync and Voltage Monitor Relay Outputs	\$50.00
	H	Separate Sync and Voltage Monitor Relay Outputs with Push-to-Energize Outputs	\$50.00
<input type="checkbox"/> <input type="checkbox"/>	A6	Definite Time Delay (0.1-99 Seconds)	STD
	A7	Definite Time Delay (1-99 Cycles)	STD
<input type="checkbox"/>	O	Power Supply, 48 Vdc	STD
	P	Power Supply, 125 Vdc/120 Vac	STD
	R	Power Supply, 24 Vdc	\$50.00
	T	Power Supply, 250 Vdc/240 Vac <3>	\$100.00
<input type="checkbox"/>	N	Without Targets	STD
	A	Target - Internally Operated - Sync	\$85.00
	B	Target - Current Operated - Sync	\$85.00
Option 1	4	Non-Isolated Contact Sensing Input(s)	STD
<input type="checkbox"/>	5	Isolated Contact Sensing Input(s)	\$30.00
Option 2	N	Without Voltage Monitor	STD
<input type="checkbox"/>	A or R	Voltage Monitor with Voltage Difference and Internal Function Select	\$375.00
	S	Voltage Monitor with Internal Function Select	\$300.00
	B or T	Voltage Difference	\$250.00
	C or U	Voltage Monitor & Voltage Difference with External Function Select <2>	\$425.00
	V	Voltage Monitor with External Function Select <2>	\$350.00
Option 3	0	Without Auxiliary Output <1>	STD
<input type="checkbox"/>	1	Sync-Check Aux. Output (NO) <1>	\$50.00
	2	Sync-Check Aux. Output (NC) <1>	\$50.00
	3	Sync-Check Aux. Output (SPDT) <1>	\$50.00
	6	Power Supply Status Output <1>	\$70.00
<input type="checkbox"/>	F	Semi-Flush Mounting	STD
	P	Projection Mounting	\$45.00

NOTES: All relays are in an S1 case.

<1> If sensing is 9, Option 3 must be 0.

<2> To facilitate testing when Option 2 is U or V, a special test plug is available with resistors to match those mounted on the rear of the case (and bypassed by the normal plug).

<3> An external contact sensing module is required when Type T power supply is selected. Purchase order must show appropriate part number for external module as a separate line item.

Numerical Systems Pricing PP1PR3

Effective: 1/1/02

Supersedes: PP1PR3 Dated 1/1/01

Discount Schedule PR-3

PROTECTIVE RELAY PRICE LIST

Test Plug with Resistors for Non-Isolated Contact Sensing BE1-25 Relays <1>	
Power Supply Type	Test Plug Part Number
Type O-48 Vdc	9170111101
Type P-125 Vdc/120 Vac	9170111103
Type T-250 Vdc/240 Vac	9170111105

BE1-25 CONTACT SENSING MODULES (Required when Type T power supply is specified.)				
Relay Options	Number of Contacts	Order Module Number		
		If Option 1 is 5	If Option 1 is 4	Price Addition
Voltage Monitor with External Contact Inputs Plus Expandable Phase Window	6	9170206100	9170206106	N/C
Voltage Monitor with External Contact Inputs	5	9170206101	9170206107	N/C
Expandable Phase Window	2	9170206104	9170206110	N/C
None of the Above	1	9170206105	9170206111	N/C

Note: <1> See Test Accessories at end of PP1PR3 section for prices.

PROTECTIVE RELAY PRICE LIST

Model	Bulletin	Description	List Price
BE1-25/79TR (Drawout Unit)	UDW	Sync-Check Reclosing Relay (25/79) Units may be interconnected to form reclosing systems for a group of breakers.	
Part Number		Description	
9278700100		3 Phase, 125 Vdc, Horizontal Mount	\$2,770.00
9278700101		3 Phase, 48 Vdc, Horizontal Mount	\$2,770.00
9278700102		3 Phase, 125 Vdc, Vertical Mount	\$2,770.00
9278700103		3 Phase, 48 Vdc, Vertical Mount	\$2,770.00
9278700104		1 Phase, 125 Vdc, Horizontal Mount	\$2,575.00
9278700105		1 Phase, 48 Vdc, Horizontal Mount	\$2,575.00
9278700106		1 Phase, 125 Vdc, Vertical Mount	\$2,575.00
9278700107		1 Phase, 48 Vdc, Vertical Mount	\$2,575.00
Communication Options		Description	Price Adder
Standard P/N		Terminal Communications via RS-232 Ports	STD
Request Special P/N		DNP Protocol via RS-485 Port	\$250.00
Request Special P/N		Modbus Protocol via RS-485 Port	\$250.00

NOTES:

1. 3 Phase and 1 phase pertain to the voltage monitor.
2. All units are for 19 inch rack or panel mounting (horizontal or vertical).

PROTECTIVE RELAY PRICE LIST

Model	Bulletin	Description	List Price
BE1-27	UBF	Undervoltage Relay (27)	\$640.00
BE1-59	UBF	Overvoltage Relay (59)	\$640.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Addition
<input type="checkbox"/>	A	Single-Phase Sensing	STD
<input type="checkbox"/>	2	Sensing Input Range 1-40 Vac (59 only) <5>	STD
	3	Sensing Input Range 55-160 Vac	STD
	4	Sensing Input Range 110-320 Vac	STD
Output <input type="checkbox"/>	E, G	One Relay Output <1>	STD
<input type="checkbox"/>	A1	Instantaneous	STD
<input type="checkbox"/>	C1-C3	Inverse Time Delay <5>	\$95.00
	E1	Definite Time Delay	\$90.00
<input type="checkbox"/>	J	Power Supply, 125 Vdc/120 Vac	STD
	K	Power Supply, 48 Vdc	STD
	L	Power Supply, 24 Vdc	\$50.00
	Y	Power Supply, 48/125 Vdc	STD
	Z	Power Supply, 250 Vdc/240 Vac	\$60.00
Target <input type="checkbox"/>	N	Target - None	STD
	A	Target - Internally Operated <1>	STD
	B	Target - Current Operated	STD
Option 1 <input type="checkbox"/>	0	No Option Installed	STD
	1	Instantaneous Element	\$150.00
Option 2 <input type="checkbox"/>	N	No Option Installed	STD
	S	Push-to-Energize Outputs	STD
	A	Power Supply Status Output <2>	\$70.00
	B	Power Supply Status Output and Push-to-Energize Outputs <2>	\$70.00
Option 3 <input type="checkbox"/>	0	No Option Installed	STD
	1,2,5	One Auxiliary Relay <3>	\$50.00
	3,4,6	Two Auxiliary Relays <4>	\$100.00
<input type="checkbox"/>	F	Semi-Flush Mounting	STD
	P	Projection Mounting	\$45.00

NOTE: All relays are supplied in an S1 case.

<1> If target is B, output must be E.

<2> If option 2 is A or B, option 3 must be 0, 1, 2, or 5.

<3> If option 1 is 0, option 3 must be 0, 1, 2, or 5.

<4> If option 3 is 3, 4 or 6, option 1 must be 1.

<5> If sensing input Range is 2, Timing can not be C1, C2, or C3.

PROTECTIVE RELAY PRICE LIST

Model	Bulletin	Description	List Price
BE1-27/59	UBF	Under/Overvoltage Relay (27/59)	\$900.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Addition
<input type="checkbox"/>	A	Single Phase Sensing	STD
<input type="checkbox"/>	3	Sensing Input Range 55-160 Vac	STD
	4	Sensing Input Range 110-320 Vac	STD
<input type="checkbox"/>	F,H, N,P	Two Relay Outputs <1>	STD
<input type="checkbox"/> <input type="checkbox"/>	A1	Instantaneous	STD
	C4-C8,	Inverse Time Delays	\$190.00
	D1-D4	Inverse Time Delays	\$190.00
	E1,E2	Definite Time Delays	\$180.00
<input type="checkbox"/>	J	Power Supply, 125 Vdc/120 Vac	STD
	K	Power Supply, 48 Vdc/120 Vac	STD
	L	Power Supply, 24 Vdc	\$50.00
	Y	Power Supply, 48/125 Vdc	STD
	Z	Power Supply, 250 Vdc/240 Vac	\$60.00
Target <input type="checkbox"/>	N	Target - None	STD
	A	Target - Internally Operated <1>	STD
	B	Target - Current Operated	STD
Option 1 <input type="checkbox"/>	0	No Option Installed	STD
	2	Instantaneous Undervoltage Element	\$145.00
	3	Instantaneous Overvoltage Element	\$145.00
	4	Instantaneous Overvoltage and Under Voltage Elements	\$290.00
Option 2 <input type="checkbox"/>	N	No Options Installed	STD
	S	Push-to-Energize Outputs	STD
	A	Power Supply Status Output <2>	\$70.00
	B	Power Supply Status Output and Push-to-Energize Outputs <2>	\$70.00
Option 3 <input type="checkbox"/>	0	None	STD
	1,2	Two Auxiliary Relay <3>	\$100.00
	3,4	Four Auxiliary Relays <4>	\$170.00
<input type="checkbox"/>	F	Semi-Flush Mounting	STD
	P	Projection Mounting	\$45.00

NOTE: All relays are supplied in an S1 case.

<1> If target is B, output must be F.

<2> If option 2 is A or B, option 3 must be 0, 1, or 2.

<3> If option 1 is 0, option 3 must be 0, 1, or 2.

<4> If option 3 is 3 or 4, option 1 must be 2, 3, or 4.

Protective Relay Pricing PP1PR3

Effective: 1/1/02

Supersedes: PP1PR3 Dated 1/1/01

Discount Schedule PR-3

PROTECTIVE RELAY PRICE LIST

Model	Bulletin	Description	List Price
BE1-32R	UBU	Directional Overpower Relay (32)	\$855.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Addition
Sensing <input type="checkbox"/>	A	Single-Phase Voltage	STD
	B,V	30° Phase Shift Sensing	\$40.00
	C	Scott "T" Sensing	\$400.00
	D	Three Element Sensing (M1 Case)	\$750.00
	E	Two Element Sensing (M1 Case)	\$500.00
<input type="checkbox"/>	1,4,7	Low Range	\$65.00
	2,5,8	Mid Range	STD
	3,6,9	High Range	\$30.00
Output <input type="checkbox"/>	E,G	One Relay Output <2>	STD
<input type="checkbox"/> <input type="checkbox"/>	A1	Instantaneous Timing	STD
	E1	Definite Timing	\$160.00
	D1	Inverse Timing	\$210.00
<input type="checkbox"/>	O	Power Supply, 48 Vdc	STD
	P	Power Supply, 125 Vdc/120 Vac	STD
	R	Power Supply, 24 Vdc	\$50.00
	S	Power Supply, 48/125 Vdc	STD
	T	Power Supply, 250 Vdc/240 Vac	\$60.00
Target <input type="checkbox"/>	N	Target - None	STD
	A,B	Target - One <2>	STD
<input type="checkbox"/>	0	No Option Available	STD
<input type="checkbox"/>	N	No Option Installed	STD
	S	Power Supply Status Output <1>	\$70.00
Option 3 <input type="checkbox"/>	0	No Option Installed	STD
	1,2,5	Auxiliary Relay <1>	\$50.00
<input type="checkbox"/>	F	Semi-Flush Mounting	STD
	P	Projection Mounting	\$45.00

NOTES: Case size is S1 when sensing is A, B, C, or V.

Case size is M1 when sensing is D or E.

<1> Power supply status output is not available when #5 under option 3 is selected.

<2> If output is G, target must be N or A.

PROTECTIVE RELAY PRICE LIST

Model	Bulletin	Description	List Price
BE1-32 O/U	UBU	Directional Over/Underpower Relay (32)	\$1,035.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Addition
Sensing <input type="checkbox"/>	A	Single Phase Voltage	STD
	B,V	30° Phase Shift Sensing	\$40.00
	C	Scott "T" Sensing	\$400.00
	D	Three Element Sensing (M1 Case)	\$750.00
	E	Two Element Sensing (M1 Case)	\$500.00
<input type="checkbox"/>	1,4,7	Low Range	\$65.00
	2,5,8	Mid Range	STD
	3,6,9	High Range	\$30.00
Output <input type="checkbox"/>	F,H,N,P	Two Relay Outputs <2>	STD
<input type="checkbox"/> <input type="checkbox"/>	A1	Instantaneous Timing	STD
	E1	Definite Timing	\$280.00
	E2	Definite (Under)/Instantaneous (Over)	\$155.00
	D3	Inverse (Over)/Definite (Under)	\$265.00
<input type="checkbox"/>	O	Power Supply, 48 Vdc	STD
	P	Power Supply, 125 Vdc/120 Vac	STD
	R	Power Supply, 24 Vdc	\$50.00
	S	Power Supply, 48/125 Vdc	STD
	T	Power Supply, 250 Vdc/240 Vac	\$60.00
Target <input type="checkbox"/>	N	Target - None	STD
	C, D, E, F	Target - Two <2>	STD
<input type="checkbox"/>	O	No Option Available	STD
<input type="checkbox"/>	N	No Option Installed	STD
	S	Power Supply Status Output <1>	\$70.00
Option 3 <input type="checkbox"/>	0	No Option Installed	STD
	5	Auxiliary Relay SPDT	\$50.00
	3, 4, 7, 8	Auxiliary Relays, Two	\$100.00
<input type="checkbox"/>	F	Semi-Flush Mounting	STD
	P	Projection Mounting	\$45.00

NOTES: Case size is S1 when sensing is A, B, C, or V.
Case size is M1 when sensing is D or E.

<1> Power supply status output is not available when #3, 4, 5, 7 or 8 under option 3 is selected.

<2> If output is H, targets must be N or C. If output is N or P, targets must be N, C, E, or F.

Protective Relay Pricing PP1PR3

Effective: 1/1/02

Supersedes: PP1PR3 Dated 1/1/01

Discount Schedule PR-3

PROTECTIVE RELAY PRICE LIST

Model	Bulletin	Description	List Price
BE1-40Q	UBW	Loss of Excitation Relay (40)	\$1,750.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Additions
<input type="checkbox"/>	F W	Single Phase Sensing, 60 Hz Single Phase Sensing, 50 Hz	STD STD
<input type="checkbox"/>	3 6 9	120 Vac 208 Vac 240 Vac	STD STD STD
Output <input type="checkbox"/>	E G	Normally Open Output Normally Closed Output <1>	STD STD
<input type="checkbox"/>	E1	Definite Time	STD
<input type="checkbox"/>	O P R S T	Power Supply, 48 Vdc Power Supply, 125 Vdc/120 Vac Power Supply, 24 Vdc Power Supply, 48/125 Vdc Power Supply, 250 Vdc/240 Vac	STD STD \$50.00 STD \$60.00
Target <input type="checkbox"/>	N A,B	No Target Target <1>	STD STD
<input type="checkbox"/>	0 1	None Push-to-Energize	STD STD
Option 2 <input type="checkbox"/>	N S	None Power Supply Status Output	STD \$70.00
Option 3 <input type="checkbox"/>	0 1,2,5	None Auxiliary Relay <2>	STD \$50.00
<input type="checkbox"/>	F P	Semi-Flush Mounting Projection Mounting	STD \$45.00

NOTES: All relays are supplied in an S1 case.
 <1> If output is G, target must be A or N.
 <2> If option 3 is 5, option 2 must be N.

Protective Relay Pricing PP1PR3
 Effective: 1/1/02
 Supersedes: PP1PR3 Dated 1/1/01
 Discount Schedule PR-3

PROTECTIVE RELAY PRICE LIST

Model	Bulletin	Description	List Price
BE1-46N	UDJ	Negative Sequence Overcurrent Relay (46)	\$1,800.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Additions
<input type="checkbox"/>	G	Three Phase Negative Sequence Current	STD
<input type="checkbox"/>	1	3 to 5 Amps Nominal (60 Hz)	STD
	2	3 to 5 Amps Nominal (50 Hz)	STD
	3	0.6 - 1.0 Amps Nominal (60 Hz)	\$50.00
	4	0.6 - 1.0 Amps Nominal (50 Hz)	\$50.00
Output <input type="checkbox"/>	E	Alarm - NO; Trip - NO	STD
	F	Alarm - NO; Trip - NC	STD
	G	Alarm - NC; Trip - NC	STD
	H	Alarm - NC; Trip - NO <2>	STD
<input type="checkbox"/> <input type="checkbox"/>	B8	I_2^2T	STD
<input type="checkbox"/>	O	Power Supply, 48 Vdc	STD
	P	Power Supply, 125 Vdc/120 Vac	STD
	R	Power Supply, 24 Vdc	\$50.00
	S	Power Supply, 48/125 Vdc	STD
	T	Power Supply, 250 Vdc/240 Vac	\$60.00
Target <input type="checkbox"/>	N	Target - None	STD
	A	Target - Internally Operated <2>	STD
	B	Target - Current Operated	STD
Option 1 <input type="checkbox"/>	0	No Option Installed	STD
	1	External Meter for I_2 Level <1>	\$700.00
	2	Push-to-Energize Outputs	STD
	3	External Meter for I_2 Level and Push-to-Energize Outputs <1>	\$700.00
<input type="checkbox"/>	N	No Option Installed	STD
	A	Oscillograph Start Contact (NO)	\$85.00
	B	Oscillograph Start Contact (NC)	\$85.00
<input type="checkbox"/>	0	No Option Installed	STD
	1	Auxiliary Output Contact (NO)	\$50.00
	2	Auxiliary Output Contact (NC)	\$50.00
<input type="checkbox"/>	F	Semi-Flush Mounting	STD
	P	Projection Mounting	\$45.00

NOTES: All relays are supplied in S1 case.

<1> Purchase order must show part number for external meter as separate item if Option 1-1 or 1-3 is selected.

Part Number	Description	Price Addition
9170000001	External Meter for I_2	Included Above

<2> If output is F, G, or H, target must be N or A.

Protective Relay Pricing PP1PR3

Effective: 1/1/02

Supersedes: PP1PR3 Dated 1/1/01

Discount Schedule PR-3

PROTECTIVE RELAY PRICE LIST

Model	Bulletin	Description	List Price
BE1-47N	UDK	Negative Sequence Voltage Relay (47)	\$890.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Addition
<input type="checkbox"/>	E	Three Phase Voltage (Line-to-Line)	STD
<input type="checkbox"/>	3	120 Volt, 60 Hz Nominal	STD
	4	100 Volt, 50 Hz Nominal	STD
	5	208 Volt, 60 Hz Nominal	STD
	6	173 Volt, 50 Hz Nominal	STD
Output <input type="checkbox"/>	E	One Relay; 47N - NO <6>	STD
	F	Two Relays; 47N - NO; 27/59 - NO	\$135.00
	G	One Relay; 47N - NC <6>	STD
	H	Two Relays; 47N - NC; 27/59 - NC	\$135.00
	N	Two Relays; 47N - NO; 27/59 - NC	\$135.00
	P	Two Relays; 47N - NC; 27/59 - NO	\$135.00
<input type="checkbox"/> <input type="checkbox"/>	A1	47N Timing - Instantaneous	STD
	D1	47N Timing - Inverse	\$195.00
	E1	47N Timing - Definite	\$160.00
<input type="checkbox"/>	O	Power Supply, 48 Vdc	STD
	P	Power Supply, 125 Vdc/120 Vac	STD
	R	Power Supply, 24 Vdc	\$50.00
	S	Power Supply, 48/125 Vdc	STD
	T	Power Supply, 250 Vdc/240 Vac	\$60.00
Target <input type="checkbox"/>	N	Targets - None	STD
	A	One Target, Internally Operated 47N	STD
	B	One Target, Current Operated, 47N <1>	STD
	C	Two Targets, Internally Operated, 47N & 27/59 <5>	STD
	D	Two Targets, Current Operated, 47N & 27/59 <2>	STD
Option 1 <input type="checkbox"/>	0	Undervoltage (27) Element - Not Included	STD
	1	27 Timing - Instantaneous	\$220.00
	2	27 Timing - Inverse	\$385.00
	3	27 Timing - Definite	\$355.00
Option 2 <input type="checkbox"/>	N	Overvoltage (59) Element - Not Included	STD
	R	59 Timing - Instantaneous	\$220.00
	S	59 Timing - Inverse	\$385.00
	T	59 Timing - Definite	\$355.00
<input type="checkbox"/>	0	No Option Installed	STD
	1	One Auxiliary Output: 47N - NO	\$50.00
	2	One Auxiliary Output: 47N - NC	\$50.00
	3	Two Auxiliary Outputs: 47N - NO <3> 27/59 - NO	\$100.00
	4	Two Auxiliary Outputs: 47N - NC <3> 27/59 - NC	\$100.00
	7	Two Auxiliary Outputs: 47N - NO <3> 27/59 - NC	\$100.00
	8	Two Auxiliary Outputs: 47N - NC <3> 27/59 - NO	\$100.00
<input type="checkbox"/>	F	Semi-Flush Mounting	STD
	P	Projection Mounting	\$45.00

NOTE: All relays are supplied in an S1 case.

<1> If target is B, output must be E.

<2> If target is D, output must be F.

<3> Option 1 must be 1, 2, or 3, and/or option 2 must be R, S, or T.

<4> If target is A, output must be E or G.

<5> If target is C, output must be F, H, N, or P.

<6> If output is E or G, option 1 must be O and option 2 must be N.

Protective Relay Pricing PP1PR3

Effective: 1/1/02

Supersedes: PP1PR3 Dated 1/1/01

Discount Schedule PR-3

PROTECTIVE RELAY PRICE LIST

Model	Bulletin	Description	List Price
BE1-50	UBC	Instantaneous Overcurrent Relay (50)	\$710.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Addition
Inputs <input type="checkbox"/>	E	Two Phase and Neutral Sensing	\$425.00
	F	Single Phase Sensing	STD
	G	Three Phase Sensing	\$335.00
	J	Three Phase and Neutral Sensing	\$515.00
Sensing <input type="checkbox"/>	1-7	Sensing Input Range <1>	STD
Output <input type="checkbox"/>	E, G	One Relay Output (All Input Types)	STD
	F, H	Three Relay Outputs (Optional for Inputs Types E & G only)	\$105.00
	J, K	Four Relay Outputs (Optional for Input Type J only)	\$135.00
<input type="checkbox"/>	A1	Instantaneous Timing	STD
Power Supply <input type="checkbox"/>	F	Sensing Input Current Power Supply (Type F Input only)	\$130.00
	G	Sensing Input Current Power Supply (Type G Input only)	\$255.00
	H	Sensing Input Current Power Supply (Type J Input only)	\$315.00
	O	Power Supply, 48 Vdc <1>	STD
	P	Power Supply, 125 Vdc/120 Vac <1>	STD
	R	Power Supply, 24 Vdc <1>	\$50.00
	S	Power Supply, 48/125 Vdc <1>	STD
T	Power Supply, 250 Vdc/240 Vac <1>	\$60.00	
Target <input type="checkbox"/>	N	Target - None	STD
	A,B	One Target <3 & 4>	STD
	G,H	Three Targets <3 & 4>	STD
	J,K	Four Targets <3 & 4>	STD
<input type="checkbox"/>	0	No Option Installed	STD
	1	Push-to-Energize Outputs	STD
Option 2 <input type="checkbox"/>	N	No Option Installed	STD
	D-H,J,K	Sensing Range-Ground Fault (For Sensing Types E & J only) <1>	\$65.00
<input type="checkbox"/>	0	No Option Installed	STD
	1,2,5	Auxiliary Relay	\$50.00
	6	Power Supply Status Output <2>	\$70.00
<input type="checkbox"/>	F	Semi-Flush Mounting	STD
	P	Projection Mounting	\$45.00

NOTE: All relays are supplied in an S1 case.

<1> When power supply is O, P, R, S, or T then sensing must be 2, 4 or 6 and option 2 must be N, E, or J.

<2> Power supply status output available only with power supply types O, P, R, S and T.

<3> If targets are a desired option, the number of targets must be the same as the number of inputs.

<4> If target is B, H, or K then output must be E, F or J.

Protective Relay Pricing PP1PR3

Effective: 1/1/02

Supersedes: PP1PR3 Dated 1/1/01

Discount Schedule PR-3

PROTECTIVE RELAY PRICE LIST

Model	Bulletin	Description	List Price
BE1-50 BF	UBT	Breaker Failure Relay (50 BF)	\$2,800.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Addition
<input type="checkbox"/>	E	Two Phase and Neutral Sensing	STD
	F	Three Phase Sensing	STD
Sensing <input type="checkbox"/>	1	0.25 to 2.0 Amp	STD
	2	Phase: 1.0 to 8.0 Amp Neutral: 0.25 to 2.0 Amp <3>	STD
	3	1.0 to 8.0 Amp	STD
	4	Phase: 0.25 to 2.0 Amp Neutral: 1.0 to 8.0 Amp <3>	STD
<input type="checkbox"/>	F	NO Output Contacts <2>	STD
<input type="checkbox"/> <input type="checkbox"/>	E1	Definite Time	STD
<input type="checkbox"/>	J	Power Supply, 125 Vdc/120 Vac	STD
	K	Power Supply, 48 Vdc	STD
	L	Power Supply, 24 Vdc	\$50.00
	Z	Power Supply, 250 Vdc/240 Vac <1>	\$60.00
<input type="checkbox"/>	A	Target - Internally Operated	STD
	B	Target - Current Operated	STD
Option 1 <input type="checkbox"/>	4	Non-Isolated Contact Sensing	STD
	5	Isolated Contact Sensing	\$30.00
Option 2 <input type="checkbox"/>	N	No Option Installed	STD
	S	Push-to-Energize Outputs	STD
	A	Power Supply Status Output	\$70.00
	B	Power Supply Status Output and Push-to-Energize Outputs	\$70.00
Option 3 <input type="checkbox"/>	0	No Option Installed	STD
	1	Instantaneous Trip	\$85.00
	3	Supervisory Contact Sensing Input	\$95.00
	4	Instantaneous Trip and Supervisory Contact Sensing Input	\$180.00
<input type="checkbox"/>	F	Semi-Flush Mounting	STD
	P	Projection Mounting	\$45.00

NOTES: All relays are supplied in an S1 size case.

<1> External contact sensing module is required as separate line item on purchase order if Power Supply Type Z is specified.

CONTACT SENSING MODULES			
Option 3	Module Ordering Number		Price Addition
	If Option 1 is 5	If Option 1 is 4	
0 or 1	9170206105	9170206111	N/C
3 or 4	9170206104	9170206110	N/C

<2> When option 2 is N or S, three output relays are provided.
When option 2 is A or B, two output relays are provided.

<3> Sensing input type must be E.

Protective Relay Pricing PP1PR3
Effective: 1/1/02
Supersedes: PP1PR3 Dated 1/1/01
Discount Schedule PR-3

PROTECTIVE RELAY PRICE LIST

Model	Bulletin	Description	List Price
BE1-50/51B	UHD	<p style="text-align: center;"><u>SINGLE PHASE</u> Time Overcurrent Relay (51) Ten Field Selectable Standard Timing Curves Current Sensing Power Supply Two Targets; TOC and Instantaneous Auxiliary Output Relay Testable in Case 50/60 Hz Operation</p>	
Part Number (Note)		Description	
		<p style="text-align: center;">For 5 Amp System CT Secondaries TOC Sensing Input Range .5 to 15.9 Amps Instantaneous Sensing Input Range 1 to 99 Amps</p>	STD
	BE1-50/51B-105	Semi Flush Mounting A1 Case Size	\$420.00
	BE1-50/51B-205	Semi Flush Mounting A1 Case Size	\$430.00
	BE1-50/51B-107	Semi Flush Mounting S1 Case Size	\$420.00
	BE1-50/51B-207	Semi Flush Mounting S1 Case Size	\$430.00
	BE1-50/51B-106	Projection Mounting S1 Case Size	\$470.00
	BE1-50/51B-206	Projection Mounting S1 Case Size	\$480.00
		<p style="text-align: center;">For 1 Amp System CT Secondaries TOC Sensing Input Range .1 to 3.18 Amps Instantaneous Sensing Input Range .2 to 19.8 Amps</p>	STD
	BE1-50/51B-103	Semi Flush Mounting S1 Case Size	\$430.00
	BE1-50/51B-203	Semi Flush Mounting S1 Case Size	\$440.00
	BE1-50/51B-101	Semi Flush Mounting A1 Case Size	\$430.00
	BE1-50/51B-201	Semi Flush Mounting A1 Case Size	\$440.00
	BE1-50/51B-102	Projection Mounting S1 Case Size	\$480.00
	BE1-50/51B-202	Projection Mounting S1 Case Size	\$490.00

RETROFIT BE1-50/51B RELAYS

Part Number	Bulletin	Description	List Price
BE1-50/51B-214	UHD	IAC Retrofit kit (5A)	\$360.00
BE1-50/51B-225	UHD	IAC Retrofit Kit (1A)	\$370.00
BE1-50/51B-218	UHD	IAC Replacement relay	\$420.00
BE1-50/51B-219	UHD	CO Retrofit kit (5A)	\$400.00
BE1-50/51B-226	UHD	CO Retrofit Kit (1A)	\$410.00

NOTE: Part numbers ending in 200 series include memory to replicate the decaying reset characteristic of electromechanical disks even while the input current is zero. Part numbers ending in 100 Series reset instantaneously (regardless of setting) when the input current drops below the minimum TOC pickup value.

Protective Relay Pricing PP1PR3
 Effective: 1/1/02
 Supersedes: PP1PR3 Dated 1/1/01
 Discount Schedule PR-3

PROTECTIVE RELAY PRICE LIST

Model	Bulletin	Description	List Price
BE1-50/51M	UHE	SINGLE PHASE Time Overcurrent Relay (51) Ten Field Selectable Standard Timing Curves Current Sensing Power Supply Two Targets; TOC and Instantaneous Auxiliary Output Relay Drawout Case: Testable external to case 50/60 Hz Operation	
Part Number (Note 1)		Description	
		For 5 Amp System CT Secondaries TOC Sensing Input Range .5 to 15.9 Amps Instantaneous Sensing Input Range 1 to 99 Amps	STD
		Semi Flush Mounting	
BE1-50/51M-104		Case Size: C1 Horizontal	\$360.00
BE1-50/51M-204		Case Size: C1 Horizontal	\$370.00
BE1-50/51M-109		Case Size: C1 Vertical	\$360.00
BE1-50/51M-209		Case Size: C1 Vertical	\$370.00
		For 1 Amp System CT Secondaries TOC Sensing Input Range .1 to 3.18 Amps Instantaneous Sensing Input Range .2 to 19.8 Amps	STD
		Semi Flush Mounting	
BE1-50/51M-100		Case Size: C1, Horizontal	\$370.00
BE1-50/51M-200		Case Size: C1, Horizontal	\$380.00
		Semi Flush Mounting	
BE1-50/51M-108		Case Size: C1, Vertical	\$370.00
BE1-50/51M-208		Case Size: C1, Vertical	\$380.00

NOTE:

1. Part numbers ending in 200 series include memory to replicate the decaying reset characteristic of electromechanical disks even while the input current is zero. Part numbers ending in 100 series reset instantaneously (regardless of setting) when the input current drops below the minimum TOC pickup value.

2. 19 inch rack mounted plate for mounting four vertical units:
 Basler Part Number: 9252012001
 List Price: \$35.00

PROTECTIVE RELAY PRICE LIST

Model	Bulletin	Description	List Price
BE1-BPR	UHG	Programmable Breaker Protection Relay. Includes capabilities for monitoring, data capture and communications.	
Part Number		Description	
BE1-BPR-300		Basic Model for 48/125V AC/DC - Horizontal Mount	\$2,050.00
BE1-BPR-302		Enhanced Model for 48/125V AC/DC Horizontal Mount	\$2,590.00
BE1-BPR-301		Basic Model for 125/250V AC/DC Horizontal Mount	\$2,050.00
BE1-BPR-303		Enhanced Model for 125/250V AC/DC Horizontal Mount	\$2,590.00
BE1-BPR-309		Basic Model for 48/125V AC/DC - Vertical Mount	\$2,050.00
BE1-BPR-311		Enhanced Model for 48/125V AC/DC Vertical Mount	\$2,590.00
BE1-BPR-310		Basic Model for 125/250V AC/DC Vertical Mount	\$2,050.00
BE1-BPR-312		Enhanced Model for 125/250V AC/DC Vertical Mount	\$2,590.00

NOTE: The following capabilities are only in the enhanced model:

*Accumulated contact duty, Fault Record List, Fault Summary Report and Oscillographic Data

PROTECTIVE RELAY PRICE LIST

Model	Bulletin	Description	List Price
BE1-51	UDA	<u>Single-Phase</u> Time Overcurrent Relay (51)	\$935.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Addition
<input type="checkbox"/>	K	Single-Phase Current Sensing	STD
<input type="checkbox"/>	1	Sensing Input Range 0.5 to 12 Amps	STD
	9	Sensing Input Range 0.1 to 2.4 Amps	STD
Output <input type="checkbox"/>	E, G	Contact Output <1>	STD
Timing <input type="checkbox"/> <input type="checkbox"/>	Z1	Switch Selectable Standard and I ² T Timing Curves	STD
	Z2	Switch Selectable Standard and British Timing Curves	STD
	Z3	Switch Selectable B & C Curves with Integrating Algorithm	STD
<input type="checkbox"/>	O	Power Supply, 48 Vdc	STD
	P	Power Supply, 125 Vdc/120 Vac	STD
	R	Power Supply, 24 Vdc	\$50.00
	S	Power Supply, 48/125 Vdc	STD
	T	Power Supply, 250 Vdc/240 Vac	\$60.00
Target <input type="checkbox"/>	N	Without Targets	STD
	A,B	With Targets <1>	STD
<input type="checkbox"/>	0	Without Instantaneous Element	STD
	1	One Instantaneous Element	\$95.00
	2	Two Instantaneous Elements	\$190.00
<input type="checkbox"/>	N	No Option Installed	STD
	C	Push-to-Energize Outputs	STD
	D	Extended Timing Range <2>	\$30.00
	E	Push-to-Test Outputs and Extended Timing <2>	\$30.00
<input type="checkbox"/>	0	No Option Installed	STD
	1,2,5	Auxiliary Time Overcurrent Output Relay	\$50.00
	6	Power Supply Status Output	\$70.00
<input type="checkbox"/>	F	Semi-Flush Mounting	STD
	P	Projection Mounting	\$45.00

NOTE: All relays are supplied in an S1 case.

<1> If target is B, output must be E.

<2> Not available if timing is Z2.

PROTECTIVE RELAY PRICE LIST

Model	Bulletin	Description	List Price
BE1-51	UDA	<u>Two Phase With Neutral</u> Time Overcurrent Relay (51)	\$1,350.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Addition
<input type="checkbox"/>	X I	Two Phase with Neutral Current Two Phase with Neutral Defeat	STD \$65.00
<input type="checkbox"/>	1 9	Sensing Input Range 0.5 to 12 Amps Sensing Input Range 0.1 to 2.4 Amps	STD STD
Output <input type="checkbox"/>	E,G	Contact Output <1>	STD
Timing <input type="checkbox"/> <input type="checkbox"/>	Z1 Z2 Z3	Switch Selectable Standard and I ² T Timing Curves Switch Selectable Standard and British Timing Curves Switch Selectable B & C Curves with Integrating Algorithm	STD STD STD
<input type="checkbox"/>	O P R S T	Power Supply, 48 Vdc Power Supply, 125 Vdc/120 Vac Power Supply, 24 Vdc Power Supply, 48/125 Vdc Power Supply, 250 Vdc/240 Vac	STD STD \$50.00 STD \$60.00
Target <input type="checkbox"/>	N A,B	Without Targets With Targets <1>	STD STD
<input type="checkbox"/>	0 1 2	Without Instantaneous Element One Instantaneous Element Two Instantaneous Elements	STD \$190.00 \$380.00
<input type="checkbox"/>	N C D E	No Option Installed Push-to-Energize Outputs Extended Timing Range <2> Push-to-Energize Outputs and Extended Timing Range <2>	STD STD \$30.00 \$30.00
<input type="checkbox"/>	0 1,2 6	No Option Installed Auxiliary Time Overcurrent Output Relay Power Supply Status Output	STD \$50.00 \$70.00
<input type="checkbox"/>	F P	Semi-Flush Mounting Projection Mounting	STD \$45.00

NOTES: All relays are supplied in an S1 case.

<1> If target is B, output must be E.

<2> Not available if timing is Z2.

PROTECTIVE RELAY PRICE LIST

Model	Bulletin	Description	List Price
BE1-51	UDA	<u>Three Phase</u> Time Overcurrent Relay (51)	\$1,190.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Addition
<input type="checkbox"/>	G	Three Phase Current Sensing	STD
<input type="checkbox"/>	1	Sensing Input Range 0.5 to 12 Amps	STD
	9	Sensing Input Range 0.1 to 2.4 Amps	STD
Output <input type="checkbox"/>	E,G	Contact Output <1>	STD
Timing <input type="checkbox"/> <input type="checkbox"/>	Z1	Switch Selectable Standard and I ² T Timing Curves	STD
	Z2	Switch Selectable Standard and British Timing Curves	STD
	Z3	Switch Selectable B & C Curves with Integrating Algorithm	STD
Power Supply <input type="checkbox"/>	O	Power Supply, 48 Vdc	STD
	P	Power Supply, 125 Vdc/120 Vac	STD
	R	Power Supply, 24 Vdc	\$50.00
	S	Power Supply, 48/125 Vdc	STD
	T	Power Supply, 250 Vdc/240 Vac	\$60.00
Target <input type="checkbox"/>	N	Without Targets	STD
	A,B	With Targets <1>	STD
<input type="checkbox"/>	0	Without Instantaneous Element	STD
	1	One Instantaneous Element	\$180.00
	2	Two Instantaneous Elements	\$360.00
<input type="checkbox"/>	N	No Option Installed	STD
	C	Push-to-Energize Outputs	STD
	D	Extended Timing Range <2>	\$30.00
	E	Push-to-Test Outputs and Extended Timing <2>	\$30.00
<input type="checkbox"/>	0	No Option Installed	STD
	1,2	Auxiliary Time Overcurrent Output Relay	\$50.00
	6	Power Supply Status Output	\$70.00
<input type="checkbox"/>	F	Semi-Flush Mounting	STD
	P	Projection Mounting	\$45.00

NOTE: All units in S1 case.

<1> If target is B, output must be E.

<2> Not available if timing option is Z2.

PROTECTIVE RELAY PRICE LIST

Model	Bulletin	Description	List Price
BE1-51	UDA	Three Phase With Neutral Time Overcurrent Relay (51)	\$1,565.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Addition
<input type="checkbox"/>	H	Three Phase and Neutral Current	STD
	V	Three Phase with Neutral Defeat	\$65.00
<input type="checkbox"/>	2	Sensing Input Range: Phase 0.5 to 4.0 A; Neutral 0.5 to 4.0 A	STD
	3	Sensing Input Range: Phase 1.5 to 12 A; Neutral 0.5 to 4.0 A	STD
	4	Sensing Input Range: Phase 0.5 to 4.0 A; Neutral 1.5 to 12 A	STD
	5	Sensing Input Range: Phase 1.5 to 12 A; Neutral 1.5 to 12 A	STD
	6	Sensing Input Range: Phase .1 to 0.8; Neutral 0.1 to 0.8 A	STD
	7	Sensing Input Range: Phase 0.3 to 2.4 A; Neutral 0.1 to 0.8 A	STD
	8	Sensing Input Range: Phase 0.3 to 2.4 A; Neutral 0.3 to 2.4 A	STD
Output <input type="checkbox"/>	E,G	Contact Output <1>	STD
Timing <input type="checkbox"/> <input type="checkbox"/>	Z1	Switch Selectable Standard and I ² T Timing Curves	STD
	Z2	Switch Selectable Standard and British Timing Curves	STD
	Z3	Switch Selectable B & C Curves with Integrating Algorithm	STD
Power Supply <input type="checkbox"/>	O	Power Supply, 48 Vdc	STD
	P	Power Supply, 125 Vdc/120 Vac	STD
	R	Power Supply, 24 Vdc	\$50.00
	S	Power Supply, 48/125 Vdc	STD
	T	Power Supply, 250 Vdc/240 Vac	\$60.00
Target <input type="checkbox"/>	N	Without Targets	STD
	A,B	With Targets <1>	STD
<input type="checkbox"/>	0	Without Instantaneous Element	STD
	1	One Instantaneous Element	\$220.00
	2	Two Instantaneous Elements	\$405.00
<input type="checkbox"/>	N	No Option Installed	STD
	C	Push-to-Energize Outputs	STD
	D	Extended Timing Range <2>	\$30.00
	E	Push-to-Energize Outputs and Extended Timing <2>	\$30.00
<input type="checkbox"/>	0	No Option Installed	STD
	1,2	Auxiliary Time Overcurrent Output Relay	\$50.00
	6	Power Supply Status Output	\$70.00
<input type="checkbox"/>	F	Semi-Flush Mounting	STD
	P	Projection Mounting	\$45.00

NOTES: All units in S1 size case.

<1> If target is B, output must be E.

<2> Not available if timing option is Z2.

Protective Relay Pricing PP1PR3

Effective: 1/1/02

Supersedes: PP1PR3 Dated 1/1/01

Discount Schedule PR-3

PROTECTIVE RELAY PRICE LIST

Model	Bulletin	Description	List Price
BE1-51/27C	UDA	<u>Single Phase</u> Time Overcurrent Relay with Voltage Control (51/27C)	\$990.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Addition
<input type="checkbox"/>	L	Single-Phase Current Sensing	STD
<input type="checkbox"/>	1	Sensing Input Range 0.5 to 12 Amps	STD
	9	Sensing Input Range 0.1 to 2.4 Amps	STD
Output <input type="checkbox"/>	E, G	Contact Output <1>	STD
Timing <input type="checkbox"/> <input type="checkbox"/>	Z1	Switch Selectable Standard and I ² T Timing Curves	STD
	Z2	Switch Selectable Standard and British Timing Curves	STD
	Z3	Switch Selectable B & C Curves with Integrating Algorithm	STD
<input type="checkbox"/>	O	Power Supply, 48 Vdc	STD
	P	Power Supply, 125 Vdc/120 Vac	STD
	R	Power Supply, 24 Vdc	\$50.00
	S	Power Supply, 48/125 Vdc	STD
	T	Power Supply, 250 Vdc/240 Vac	\$60.00
Target <input type="checkbox"/>	N	Without Targets	STD
	A,B	With Targets <1>	STD
<input type="checkbox"/>	0	Without Instantaneous Element	STD
	1	One Instantaneous Element	\$95.00
	2	Two Instantaneous Elements	\$190.00
<input type="checkbox"/>	N	No Option Installed	STD
	C	Push-to-Energize Outputs	STD
	D	Extended Timing Range <2>	\$30.00
	E	Push-to-Test Outputs and Extended Timing <2>	\$30.00
<input type="checkbox"/>	0	No Option Installed	STD
	1,2,5	Auxiliary Time Overcurrent Output Relay	\$50.00
	6	Power Supply Status Output	\$70.00
<input type="checkbox"/>	F	Semi-Flush Mounting	STD
	P	Projection Mounting	\$45.00

NOTE: All relays are in an S1 size case.

<1> If target is B, output must be E.

<2> Not available if timing is Z2.

PROTECTIVE RELAY PRICE LIST

Model	Bulletin	Description	List Price
BE1-51/27C	UDA	<u>Three Phase</u> Time Overcurrent Relay with Voltage Control (51/27C)	\$1,825.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Addition
<input type="checkbox"/>	P	Three Phase Current, 3P4W Voltage	STD
	A	Three Phase Current, 3P3W Voltage	STD
<input type="checkbox"/>	1	Sensing Input Range 0.5 to 12 Amps	STD
	9	Sensing Input Range 0.1 to 2.4 Amps	STD
Output <input type="checkbox"/>	E,G	Contact Output <1>	STD
Timing <input type="checkbox"/> <input type="checkbox"/>	Z1	Switch Selectable Standard and I ² T Timing Curves	STD
	Z2	Switch Selectable Standard and British Timing Curves	STD
	Z3	Switch Selectable B & C Curves with Integrating Algorithm	STD
<input type="checkbox"/>	O	Power Supply, 48 Vdc	STD
	P	Power Supply, 125 Vdc/120 Vac	STD
	R	Power Supply, 24 Vdc	\$50.00
	S	Power Supply 48/125 Vdc	STD
	T	Power Supply, 250 Vdc/240 Vac	\$60.00
Target <input type="checkbox"/>	N	Without Targets	STD
	A,B	With Targets <1>	STD
<input type="checkbox"/>	0	Without Instantaneous Element	STD
	1	One Instantaneous Element	\$180.00
<input type="checkbox"/>	N	No Option Installed	STD
	C	Push-to-Energize Outputs	STD
	D	Extended Timing Range <2>	\$30.00
	E	Push-to-Test Outputs and Extended Timing <2>	\$30.00
<input type="checkbox"/>	0	No Option Installed	STD
	1,2	Auxiliary Time Overcurrent Output Relay	\$50.00
	6	Power Supply Status Output	\$70.00
<input type="checkbox"/>	F	Semi-Flush Mounting	STD
	P	Projection Mounting	\$45.00

NOTES: All units in S1 size case.
 <1> If target is B, output must be E.
 <2> Not available if timing is Z2.

PROTECTIVE RELAY PRICE LIST

Model	Bulletin	Description	List Price
BE1-51/27C	UDA	<u>Three Phase with Neutral</u> Time Overcurrent Relay with Voltage Control (51/27C)	\$1,825.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Addition
<input type="checkbox"/>	D	Three Phase and Neutral Current, 3P3W Voltage	STD
	T	Three Phase and Neutral Current, 3P4W Voltage	STD
<input type="checkbox"/>	2	Sensing Input Range: Phase 0.5 to 4.0 A; Neutral 0.5 to 4.0 A	STD
	3	Sensing Input Range: Phase 1.5 to 12 A; Neutral 0.5 to 4.0 A	STD
	4	Sensing Input Range: Phase 0.5 to 4.0 A; Neutral 1.5 to 12 A	STD
	5	Sensing Input Range: Phase 1.5 to 12 A; Neutral 1.5 to 12 A	STD
	6	Sensing Input Range: Phase .1 to 0.8; Neutral 0.1 to 0.8 A	STD
	7	Sensing Input Range: Phase 0.3 to 2.4 A; Neutral 0.1 to 0.8 A	STD
	8	Sensing Input Range: Phase 0.3 to 2.4 A; Neutral 0.3 to 2.4 A	STD
Output <input type="checkbox"/>	E, G	Contact Output <1>	STD
Timing <input type="checkbox"/> <input type="checkbox"/>	Z1	Switch Selectable Standard and I ² T Timing Curves	STD
	Z2	Switch Selectable Standard and British Timing Curves	STD
	Z3	Switch Selectable B & C Curves with Integrating Algorithm	STD
<input type="checkbox"/>	O	Power Supply, 48 Vdc	STD
	P	Power Supply, 125 Vdc/120 Vac	STD
	R	Power Supply, 24 Vdc	\$50.00
	S	Power Supply 48/125 Vdc	STD
	T	Power Supply, 250 Vdc/240 Vac	\$60.00
Target <input type="checkbox"/>	N	Without Targets	STD
	A,B	With Targets <1>	STD
<input type="checkbox"/>	0	Without Instantaneous Element	STD
	1	One Instantaneous Element	\$180.00
<input type="checkbox"/>	N	No Option Installed	STD
	C	Push-to-Energize Outputs	STD
	D	Extended Timing Range <2>	\$30.00
	E	Push-to-Test Outputs and Extended Timing <2>	\$30.00
<input type="checkbox"/>	0	No Option Installed	STD
	1,2	Auxiliary Time Overcurrent Output Relay	\$50.00
	6	Power Supply Status Output	\$70.00
<input type="checkbox"/>	F	Semi-Flush Mounting	STD
	P	Projection Mounting	\$45.00

NOTES: All units in S1 size case.
 <1> If target is B, output must be E.
 <2> Not available if timing is Z2.

PROTECTIVE RELAY PRICE LIST

Model	Bulletin	Description	List Price
BE1-51/27R	UDA	<u>Single Phase</u> Time Overcurrent Relay with Voltage Restraint (51/27R)	\$1,025.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Addition
<input type="checkbox"/>	M	Single Phase Current and 60 Hz Voltage	STD
	N	Single Phase Current and 50 Hz Voltage	STD
<input type="checkbox"/>	1	Sensing Input Range 0.5 to 12 Amps	STD
	9	Sensing Input Range 0.1 to 2.4 Amps	STD
Output style="text-align: center;"> <input type="checkbox"/>	E, G	Contact Output <1>	STD
Timing style="text-align: center;"> <input type="checkbox"/> <input type="checkbox"/>	Z1	Switch Selectable Standard and I ² T Timing Curves	STD
	Z2	Switch Selectable Standard and British Timing Curves	STD
	Z3	Switch Selectable B & C Curves with Integrating Algorithm	STD
<input type="checkbox"/>	O	Power Supply, 48 Vdc	STD
	P	Power Supply, 125 Vdc/120 Vac	STD
	R	Power Supply, 24 Vdc	\$50.00
	S	Power Supply, 48/125 Vdc	STD
	T	Power Supply, 250 Vdc/240 Vac	\$60.00
Target style="text-align: center;"> <input type="checkbox"/>	N	Without Target	STD
	A,B	With Target <1>	STD
<input type="checkbox"/>	0	Without Instantaneous Element	STD
	1	One Instantaneous Element	\$95.00
	2	Two Instantaneous Elements	\$190.00
<input type="checkbox"/>	N	No Option Installed	STD
	C	Push-to-Energize Outputs	STD
	D	Extended Timing Range <2>	\$30.00
	E	Push-to-Test Outputs and Extended Timing <2>	\$30.00
<input type="checkbox"/>	0	No Option Installed	STD
	1,2,5	Auxiliary Time Overcurrent Output Relay	\$50.00
	6	Power Supply Status Output	\$70.00
<input type="checkbox"/>	F	Semi-Flush Mounting	STD
	P	Projection Mounting	\$45.00

NOTE: All relays are in an S1 size case.

<1> If target is B, output must be E.

<2> Not available if timing is Z2.

PROTECTIVE RELAY PRICE LIST

Model	Bulletin	Description	List Price
BE1-51/27R	UDA	<u>Three Phase</u> Time Overcurrent Relay with Voltage Restraint (51/27R)	\$2,090.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Addition
<input type="checkbox"/>	R	Three Phase Current, 60 Hz, 3P4W Voltage	STD
	S	Three Phase Current, 50 Hz, 3P4W Voltage	STD
	B	Three Phase Current, 60 Hz, 3P3W Voltage	STD
	C	Three Phase Current, 50 Hz, 3P3W Voltage	STD
<input type="checkbox"/>	1	Sensing Input Range 0.5 to 12 Amps	STD
	9	Sensing Input Range 0.1 to 2.4 Amps	STD
Output <input type="checkbox"/>	E, G	Contact Output <1>	STD
Timing <input type="checkbox"/> <input type="checkbox"/>	Z1	Switch Selectable Standard and I ² t Timing Curves	STD
	Z2	Switch Selectable Standard and British Timing Curves	STD
	Z3	Switch Selectable B & C Curves with Integrating Algorithm	STD
<input type="checkbox"/>	O	Power Supply, 48 Vdc	STD
	P	Power Supply, 125 Vdc/120 Vac	STD
	R	Power Supply, 24 Vdc	\$50.00
	S	Power Supply, 48/125 Vdc	STD
	T	Power Supply, 250 Vdc/240 Vac	\$60.00
Target <input type="checkbox"/>	N	Without Targets	STD
	A,B	With Targets <1>	STD
<input type="checkbox"/>	0	Without Instantaneous Element	STD
	1	One Instantaneous Element	\$180.00
<input type="checkbox"/>	N	No Option Installed	STD
	C	Push-to-Energize Outputs	STD
	D	Extended Timing Range <2>	\$30.00
	E	Push-to-Test Outputs and Extended Timing <2>	\$30.00
<input type="checkbox"/>	0	No Option Installed	STD
	1,2	Auxiliary Time Overcurrent Output Relay	\$50.00
	6	Power Supply Status Output	\$70.00
<input type="checkbox"/>	F	Semi-Flush Mounting	STD
	P	Projection Mounting	\$45.00

NOTE: All relays are supplied in an S1 case.

<1> If target is B, then output must be E.

<2> Not available if timing is Z2.

Protective Relay Pricing PP1PR3
Effective: 1/1/02
Supersedes: PP1PR3 Dated 1/1/01
Discount Schedule PR-3

PROTECTIVE RELAY PRICE LIST

Model	Bulletin	Description	List Price
BE1-51/27R	UDA	Three Phase with Neutral Time Overcurrent Relay with Voltage Restraint (51/27R)	\$2,820.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Addition
<input type="checkbox"/>	U	Three Phase and Neutral Current, 60 Hz, 3P4W Voltage	STD
	W	Three Phase and Neutral Current, 50 Hz, 3P4W Voltage	STD
	E	Three Phase and Neutral Current, 60 Hz, 3P3W Voltage	STD
	F	Three Phase and Neutral Current, 50 Hz, 3P3W Voltage	STD
<input type="checkbox"/>	2	Sensing Input Range: Phase 0.5 to 4 A; Neutral 0.5 to 4 A	STD
	3	Sensing Input Range: Phase 1.5 to 12 A; Neutral 0.5 to 4 A	STD
	4	Sensing Input Range: Phase .05 to 4 A; Neutral 1.5 to 12 A	STD
	5	Sensing Input Range: Phase 1.5 to 12 A; Neutral 1.5 to 12 A	STD
	6	Sensing Input Range: Phase 0.1 to 0.8 A; Neutral 0.1 to 0.8 A	STD
	7	Sensing Input Range: Phase 0.3 to 2.4 A; Neutral 0.1 to 0.8 A	STD
	8	Sensing Input Range: Phase 0.3 to 2.4 A; Neutral 0.3 to 2.4 A	STD
	Output <input type="checkbox"/>	E,G	Contact Output <1>
Timing <input type="checkbox"/> <input type="checkbox"/>	Z1	Switch Selectable Standard and I ² t Timing Curves	STD
	Z2	Switch Selectable Standard and British Timing Curves	STD
	Z3	Switch Selectable B & C Curves with Integrating Algorithm	STD
<input type="checkbox"/>	O	Power Supply, 48 Vdc	STD
	P	Power Supply, 125 Vdc/120 Vac	STD
	S	Power Supply, 24 Vdc	\$50.00
	R	Power Supply, 48/125 Vdc	STD
	T	Power Supply, 250 Vdc/240 Vac	\$60.00
Target <input type="checkbox"/>	N	Without Targets	STD
	A,B	With Targets <1>	STD
<input type="checkbox"/>	0	Without Instantaneous Element	STD
	1	One Instantaneous Element	\$210.00
<input type="checkbox"/>	N	No Option Installed	STD
	C	Push-to-Energize Outputs	STD
	D	Extended Timing Range <2>	\$30.00
	E	Push-to-Energize Outputs and Extended Timing <2>	\$30.00
<input type="checkbox"/>	0	No Option Installed	STD
	1,2	Auxiliary Time Overcurrent Output Relay	\$50.00
	6	Power Supply Status Output	\$70.00
<input type="checkbox"/>	F	Semi-Flush Mounting	STD
	P	Projection Mounting	\$45.00

NOTES: All units in S1 size case.

<1> If target is B, then output must be E.

<2> Not available if timing is Z2.

Protective Relay Pricing PP1PR3

Effective: 1/1/02

Supersedes: PP1PR3 Dated 1/1/01

Discount Schedule PR-3

PROTECTIVE RELAY PRICE LIST

Model	Bulletin	Description	List Price
BE1-59N	UBG	Ground Fault Overvoltage Relay (59N)	\$820.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Additions
<input type="checkbox"/>	A	Single-Phase Voltage	STD
<input type="checkbox"/>	1 - 4	Sensing Input Tuned for 50 Hz	STD
	5 - 8	Sensing Input Tuned for 60 Hz	STD
Output <input type="checkbox"/>	E, G	One Relay Output <2>	STD
	F, H	Two Relay Outputs <1> <1 & 2>	STD
<input type="checkbox"/> <input type="checkbox"/>	A1	Instantaneous	STD
	D1	Inverse	\$110.00
	E1	Definite	\$130.00
	F1	Over: Instantaneous; Under: Definite <1>	\$130.00
	F2	Over: Instantaneous; Under: Inverse <1>	\$110.00
	F3	Over: Definite; Under: Instantaneous <1>	\$130.00
	F4	Over: Definite; Under: Inverse <1>	\$235.00
	F5	Over: Inverse; Under: Instantaneous <1>	\$110.00
	F6	Over: Inverse, Under: Definite <1>	\$235.00
	F7	Over: Definite; Under: Definite <1>	\$265.00
<input type="checkbox"/>	J	Power Supply, 125 Vdc/120 Vac	STD
	K	Power Supply, 48 Vdc	STD
	L	Power Supply, 24 Vdc	\$50.00
	Y	Power Supply, 48/125 Vdc	STD
	Z	Power Supply, 250 Vdc/240 Vac	\$60.00
Target <input type="checkbox"/>	N	Without Targets	STD
	C,D	With Targets <2>	STD
Option 1 <input type="checkbox"/>	0	No Option Installed	STD
	1,2	Undervoltage Element Tuned to Third Harmonic with Supervision	\$690.00
<input type="checkbox"/>	N	No Option Installed	STD
	S	Push-to-Energize Outputs	STD
<input type="checkbox"/>	0	No Option Installed	STD
	1,2	One Auxiliary Output Relay	\$50.00
	3,4	Two Auxiliary Output Relays <1>	\$100.00
<input type="checkbox"/>	F	Semi-Flush Mounting	STD
	P	Projection Mounting	\$45.00

NOTE: Case size for all relays is S1.

<1> Requires selection of the undervoltage element (option 1-1).

<2> If target is D, output must be E or F. -

PROTECTIVE RELAY PRICE LIST

Model	Bulletin	Description	List Price
BE1-59NC	UHF	Capacitor Neutral Overvoltage Relay (59 NC)	\$1,030.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Addition
<input type="checkbox"/>	A	Single-Phase Voltage	STD
<input type="checkbox"/>	1 - 4	Sensing Input Tuned for 50 Hz	STD
	5 - 8	Sensing Input Tuned for 60 Hz	STD
Output <input type="checkbox"/>	E	Two NO Relays (setpoint 1 and setpoint 2)	STD
<input type="checkbox"/> <input type="checkbox"/>	E2	Setpoint 1, Definite (00-99.9 Sec.) Setpoint 2, Definite (00-99.9 Sec.)	STD
	D1	Setpoint 1, Inverse Setpoint 2, Definite (00-99.9 Sec.)	STD
	D2	Setpoint 1, Inverse Setpoint 2, Inverse	STD
<input type="checkbox"/>	J	Power Supply, 125 Vdc/120 Vac	STD
	K	Power Supply, 48 Vdc	STD
	L	Power Supply, 24 Vdc	\$50.00
	Y	Power Supply, 48/125 Vdc	STD
	Z	Power Supply, 250 Vdc/240 Vac	\$60.00
Target <input type="checkbox"/>	C	Internally Operated	STD
	D	Current Operated	STD
Option 1 <input type="checkbox"/>	0	No Option Installed	STD
<input type="checkbox"/>	S	Push-to-Energize Outputs	STD
<input type="checkbox"/>	0	No Option Installed	STD
	1	Two Auxiliary Output Relays	\$100.00
<input type="checkbox"/>	F	Semi-Flush Mounting	STD
	P	Projection Mounting	\$45.00

NOTE: Case size for all relays is S1.

Protective Relay Pricing PP1PR3
 Effective: 1/1/02
 Supersedes: PP1PR3 Dated 1/1/01
 Discount Schedule PR-3

PROTECTIVE RELAY PRICE LIST

Model	Bulletin	Description	List Price
BE1-60	UBS	Voltage Balance Relay (60)	\$1,170.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Addition
☐	A	Single-Phase, Both Inputs	STD
	B	3P4W, Both Inputs	\$375.00
	C	3P3W, Both Inputs	\$275.00
	D	Input 1: 3P4W; Input 2: 3P3W	\$325.00
	E	Input 1: Single Phase; Input 2: 3P4W	\$175.00
	F	Input 1: Single Phase; Input 2: 3P3W	\$125.00
☐	1	Sensing Range: 60 to 125% of Nominal	STD
Output ☐	F	Two Relays: Both NO <2>	STD
	H	Two Relays: Both NC	STD
	N	Two Relays: Ckt. #1 - NO; Ckt. #2 - NC	STD
	P	Two Relays: Ckt. #1 - NC; Ckt. #2 - NO	STD
☐ ☐	A1	Instantaneous Timing	STD
☐	O	Power Supply, 48 Vdc	STD
	P	Power Supply, 125 Vdc/120 Vac	STD
	R	Power Supply, 24 Vdc	\$50.00
	S	Power Supply, 48/125 Vdc	STD
	T	Power Supply, 250 Vdc/240 Vac	\$60.00
Target ☐	N	Target - None	STD
	C	Targets - Two Internally Operated	STD
	D	Targets - Two Current Operated <2>	STD
Option 1 ☐	0	No Option Installed	STD
	1	Power Supply Status Output <3>	\$70.00
☐	N	No Option Installed	STD
	C	Push-to-Energize Outputs	STD
Option 3 ☐	0	No Option Installed	STD
	1	Two NO Auxiliary Output Contacts <3>	\$100.00
	2	Two NC Auxiliary Output Contacts <3>	\$100.00
	3	Two SPDT Auxiliary Output Contacts <3>	\$100.00
☐	F	Semi-Flush Mounting	STD
	P	Projection Mounting	\$45.00

NOTE: Case size for all relays is S1.

<1> Sensing nominals are: 120 Vac for single phase; 208 Vac L-L for Wye; 120 Vac L-L for Delta

<2> When target is D, output must be F.

<3> When option 1 is a "1" and option 3 is a "1", "2", or "3", the circuit #2 auxiliary output relays is dedicated for the power supply status output. The circuit #1 auxiliary output relay operates when the main output relay for either circuit #1 or circuit #2 operates.

PROTECTIVE RELAY PRICE LIST

Model	Bulletin	Description	List Price
BE1-67	UDQ	Single Phase Phase Directional Time Overcurrent Relay(67)	\$1,600.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Addition
<input type="checkbox"/>	A	Single-Phase Current Sensing	STD
<input type="checkbox"/>	1	Sensing Input Range 0.5 - 12 A, 60 Hz	STD
	2	Sensing Input Range 0.5 - 12 A, 50 Hz	STD
Output <input type="checkbox"/>	E, F	Contact Output <1>	STD
<input type="checkbox"/> <input type="checkbox"/>	Z2	Switch Selectable Curves	STD
<input type="checkbox"/>	K	Power Supply, 48 Vdc	STD
	J	Power Supply, 125 Vdc/120 Vac	STD
	L	Power Supply, 24 Vdc	\$50.00
	Y	Power Supply, 48/125 Vdc	STD
	Z	Power Supply, 250 Vdc/240 Vac	\$60.00
Target <input type="checkbox"/>	N	Without Targets	STD
	A,B	With Targets <1>	STD
<input type="checkbox"/>	0	Without Instantaneous Element	STD
	1	Instantaneous Element, Non-Directional	\$95.00
	3	Instantaneous Element, Directional	\$260.00
<input type="checkbox"/>	N	None	STD
	C	Push-to-Energize Outputs	STD
<input type="checkbox"/>	1	Continuously Adjustable Characteristic Angle	\$95.00
	2	Switch Selectable Characteristic Angle	STD
	3	Continuously Adjustable Characteristic Angle and Power Supply Status Alarm	\$170.00
<input type="checkbox"/>	4	Switch Selectable Characteristic Angle and Power Supply Status Alarm	\$70.00
	5	Continuously Adjustable Characteristic Angle with Limited Region of Operaton	\$185.00
	6	Continuously Adjustable Characteristic Angle with Limited Region of Operation and Power Supply Status Output	\$255.00
<input type="checkbox"/>	F	Semi-Flush Mounting	STD
	P	Projection Mounting	\$45.00

NOTE: Relays are in an M1 size case.
<1> When target is B, output must be E.

PROTECTIVE RELAY PRICE LIST

Model	Bulletin	Description	List Price
BE1-67	UDQ	<u>Three Phase</u> Phase Directional Time Overcurrent Relay (67)	\$3,275.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Addition
<input type="checkbox"/>	B	Three Phase Open Delta Voltage	STD
<input type="checkbox"/>	1	Sensing Input Range 0.5 - 12 A, 60 Hz	STD
	2	Sensing Input Range 0.5 - 12 A, 50 Hz	STD
Output <input type="checkbox"/>	E,F	Contact Outputs <1>	STD
<input type="checkbox"/> <input type="checkbox"/>	Z2	Switch Selectable Curves	STD
<input type="checkbox"/>	K	Power Supply, 48 Vdc	STD
	J	Power Supply, 125 Vdc/120 Vac	STD
	L	Power Supply, 24 Vdc	\$50.00
	Y	Power Supply, 48/125 Vdc	STD
	Z	Power Supply, 250 Vdc/240 Vac	\$60.00
Target <input type="checkbox"/>	N	Without Targets	STD
	A,B	With Targets <1>	STD
<input type="checkbox"/>	0	Without Instantaneous Element	STD
	1	Instantaneous Element, Non-Directional	\$95.00
	3	Instantaneous Element, Directional	\$260.00
<input type="checkbox"/>	N	None	STD
	C	Push-to-Energize Outputs	STD
<input type="checkbox"/>	1	Continuously Adjustable Characteristic Angle	\$95.00
	2	Switch Selectable Characteristic Angle	STD
	3	Continuously Adjustable Characteristic Angle and Power Supply Status Alarm	\$170.00
<input type="checkbox"/>	4	Switch Selectable Characteristic Angle and Power Supply Status Alarm	\$70.00
	5	Continuously Adjustable Characteristic Angle with Limited Region of Operaton	\$185.00
	6	Continuously Adjustable Characteristic Angle with Limited Region of Operation and Power Supply Status Output	\$255.00
<input type="checkbox"/>	F	Semi-Flush Mounting	STD
	P	Projection Mounting	\$45.00

NOTES: Relays are in an M1 size case.
<1> When target is B, output must be E.

PROTECTIVE RELAY PRICE LIST

Model	Bulletin	Description	List Price
BE1-67N	UDR	Ground Directional Time Overcurrent Relay (67N)	\$1,720.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Addition
<input type="checkbox"/>	A	Zero Sequence Current, Voltage or Dual Polarized	STD
<input type="checkbox"/>	1	Sensing Input Range 0.5-6.0 A (60 Hz)	STD
	2	Sensing Input Range 0.5-6.0 A (50 Hz)	STD
	3	Sensing Input Range 0.1-1.2 A (60 Hz)	STD
	4	Sensing Input Range 0.1-1.2 A (50 Hz)	STD
Output <input type="checkbox"/>	E,F	Contact Outputs <1>	STD
<input type="checkbox"/> <input type="checkbox"/>	Z2	Switchable Selectable Curves	STD
<input type="checkbox"/>	K	Power Supply, 48 Vdc	STD
	J	Power Supply, 125 Vdc/120 Vac	STD
	L	Power Supply, 24 Vdc	\$50.00
	Y	Power Supply, 48/125 Vdc	STD
	Z	Power Supply, 250 Vdc/240 Vac	\$60.00
Target <input type="checkbox"/>	A,B	With Targets <1>	STD
<input type="checkbox"/>	0	Without Inst Element	STD
	1	Inst Element, Non Directional	\$85.00
	3	Inst Element, Directional	\$255.00
	4	2 Inst Elements; 1 Non Dir. and 1 Directional	\$335.00
<input type="checkbox"/>	C	Push-to-Energize Outputs	STD
<input type="checkbox"/>	0	No Option Installed	STD
	1,2,5	Auxiliary Output Relay	\$50.00
<input type="checkbox"/>	F	Semi-Flush Mounting	STD
	P	Projection Mounting	\$45.00

NOTE: Case size for all relays is M1.
 <1> When target is B, output must be E.

Protective Relay Pricing PP1PR3
 Effective: 1/1/02
 Supersedes: PP1PR3 Dated 1/1/01
 Discount Schedule PR-3

PROTECTIVE RELAY PRICE LIST

Model	Bulletin	Description	List Price
BE1-79	UBL	<u>Single Phase</u> Multiple Shot Reclosing Relay (79)	\$1,350.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Addition
<input type="checkbox"/>	A	Three Shot Type	STD
Lockout <input type="checkbox"/>	0	No Option Installed	STD
	1	Lockout and Reset <1>	\$130.00
	2	Reset Only <1>	\$65.00
	3	Lockout Only	\$65.00
<input type="checkbox"/>	N	No Option Installed	STD
	A	Instantaneous Trip Enable – NO Contact	\$130.00
	B	Instantaneous Trip Enable – NC Contact	\$130.00
<input type="checkbox"/> <input type="checkbox"/>	A1	Switch Selectable Time Delay	\$30.00
	A5	Continuously Adjustable Time Delay	STD
<input type="checkbox"/>	B	Power Supply, 48 Vdc	STD
	C	Power Supply, 125 Vdc/120 Vac	STD
	D	Power Supply, 24 Vdc	\$50.00
	X	Power Supply, 250 Vdc/240 Vac <2>	\$100.00
Timer <input type="checkbox"/>	N	No Timer Installed	STD
	A	Switch Selectable Reset Timer <1>	STD
Option 1 <input type="checkbox"/>	0	No Option Installed	STD
	2	Max. Reclose Signal: 2 - 3 Seconds <3>	\$20.00
	3	Max. Reclose Signal: 5 - 6 Seconds <3>	\$20.00
Option 2 <input type="checkbox"/>	L	Non-Isolated Contact Sensing <2>	STD
	M	Isolated Contact Sensing <2>	\$30.00
Option 3 <input type="checkbox"/>	0	No Option Installed	STD
	1	Reclose Fail Alarm <3>	\$60.00
	6	Power Supply Status Output	\$70.00
<input type="checkbox"/>	F	Semi-Flush Mounting	STD
	P	Projection Mounting	\$45.00

NOTE: All relays are supplied in an S1 case.

<1> If lockout "1" or "2" is selected then timer must be A.

<2> If type X power supply is selected, the purchase order must show one of the following contact modules as a separate line item.

CONTACT SENSING MODULES		
Isolated Contact Sensing (Option 2-M)	Non-Isolated Contact Sensing (Option 2-L)	Price Addition
9146301104	9146301105	N/C

<3> If option 3 is a "1", option 1 must be "2" or "3".

PROTECTIVE RELAY PRICE LIST

Model	Bulletin	Description	List Price
BE1-79A	UHN	Retrofit Reclosing Relay (ACR)	
Part Number		Description	
BE1-79A-100		ACR Retrofit Relay (w/o Case)	\$1,060.00
BE1-79A-101		ACR Retrofit with Hold-Up Circuit (w/o Case)	\$1,160.00
BE1-79A-200		ACR Retrofit Relay (with S1 Case)	\$1,310.00

Protective Relay Pricing PP1PR3
 Effective: 1/1/02
 Supersedes: PP1PR3 Dated 1/1/01
 Discount Schedule PR-3

PROTECTIVE RELAY PRICE LIST

Model	Bulletin	Description	List Price
BE1-79M	UDL	Multiple Shot Reclosing Relay (79)	\$1,275.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Addition
<input type="checkbox"/>	B	Three Shot Type Plus Instantaneous	STD
Lockout <input type="checkbox"/>	1	Lockout and Reset	STD
	2	Lockout, Reset, & Reclose Fail Alarm	\$55.00
	3	Lockout, Reset, & Pilot Initiate	\$45.00
	4	Lockout, Reset, & Maximum Cycle Time	\$50.00
	5	Lockout, Reset, Reclose Fail Alarm & Pilot Initiate	\$85.00
	6	Lockout, Reset, Reclose Fail Alarm & Maximum Cycle Time	\$105.00
	7	Lockout, Reset, Pilot Initiate & Maximum Cycle Time	\$95.00
	8	Lockout, Reset, Reclose Fail Alarm, Pilot Initiate, & Maximum Cycle Time	\$140.00
<input type="checkbox"/>	O	No Option Installed	STD
	A,D,F	Instantaneous Trip Enable	\$45.00
	B	Block Transformer LTC Operation	\$35.00
	C,E,G,H,I	Instantaneous Trip Enable and Block Transformer LTC Operation	\$80.00
<input type="checkbox"/> <input type="checkbox"/>	A6,A7	Reclose Time Delays	STD
	A8	Reclose Time Delays & Pilot Timer <1>	\$40.00
<input type="checkbox"/>	K	Power Supply, 48 Vdc	STD
	J	Power Supply, 125 Vdc/120 Vac	STD
	L	Power Supply, 24 Vdc	\$50.00
	Y	Power Supply, 48/125 Vdc	STD
	Z	Power Supply, 250 Vdc/240 Vac	\$60.00
<input type="checkbox"/>	C,D	Reset Time Delay	STD
<input type="checkbox"/>	0	No Option Available	STD
	1	Reset Inhibit <2>	\$35.00
	2	Reclose Wait	\$30.00
	3	Pre-Lockout Alarm <2>	\$35.00
	4	Reclose Permissive	\$30.00
<input type="checkbox"/>	L	Non-Isolated Contact Sensing	STD
	M	Isolated Contact Sensing	\$30.00
<input type="checkbox"/>	0	No Option Available	STD
<input type="checkbox"/>	F	Semi-Flush Mounting	STD
	P	Projection Mounting	\$45.00

NOTES: All relays are supplied in an S1 size case.

<1> Pilot initiate option required (lockout must be 3, 5, 7, 8).

<2> Not available with pilot initiate (lockout must be 1, 2, 4, or 6).

PROTECTIVE RELAY PRICE LIST

Model	Bulletin	Description	List Price
BE1-79S	UBN	Single Shot Reclosing Relay (79)	\$1,300.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Addition
<input type="checkbox"/>	B	Single Shot with Reclose Initiate and Reclose Cancel	STD
<input type="checkbox"/>	1	Lockout and Reset	STD
<input type="checkbox"/>	N	No Option Available	STD
<input type="checkbox"/> <input type="checkbox"/>	A2 A3 A4	Time Delay Range, 0.1 - 2 Seconds Time Delay Range, 1 - 20 Seconds Time Delay Range, 5 - 60 Seconds	STD STD STD
<input type="checkbox"/>	B C D X	Power Supply, 48 Vdc Power Supply, 125 Vdc/120 Vac Power Supply, 24 Vdc Power Supply, 250 Vdc/240 Vac <1>	STD STD \$50.00 \$100.00
<input type="checkbox"/>	B C D	Reset Time Range, 5-60 Seconds with 95 Second Max. Trial Timer <2> Reset Time Range, 5-60 Seconds with 15 Second Max. Trial Timer <2> Reset Time Range, 5-60 Seconds without Max. Trial Timer <2>	STD STD STD
<input type="checkbox"/>	4 5	Non-Isolated Contact Sensing <1> Isolated Contact Sensing <1>	STD \$30.00
<input type="checkbox"/>	N S F D	No Option Installed Voltage Monitor <2> Power Supply Status Output Voltage Monitor with Power Supply Status Output <2>	STD \$500.00 \$70.00 \$570.00
<input type="checkbox"/>	0 2 3	Continuous Reclose Signal Max. Reclose Signal 2 - 3 Seconds Max. Reclose Signal 5 - 6 Seconds	STD STD STD
<input type="checkbox"/>	F P	Semi-Flush Mounting Projection Mounting	STD \$45.00

NOTE: All relays are supplied in a S1 size case.

<1> Purchase order must show part number of external module as separate item if type X power supply is selected.

Option 1	Contact Sensing	Module P/N	Price Addition
#4	Non-Isolated	9146301103	N/C
#5	Isolated	9146301102	N/C

<2> Max. Trial Timer is only included when the voltage monitor (option 2-S or 2-D) is included.

Protective Relay Pricing PP1PR3
 Effective: 1/1/02
 Supersedes: PP1PR3 Dated 1/1/01
 Discount Schedule PR-3

PROTECTIVE RELAY PRICE LIST

Model	Bulletin	Description	List Price
BE1-810/U	UBR	Over/Under Frequency Relay (81)	\$1,325.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Addition
<input type="checkbox"/>	T	Single Phase Sensing	STD
<input type="checkbox"/>	3	120 Volt Nominal, 40 - 70 Hz	STD
<input type="checkbox"/>	E	One Output Contact, NO Each Setpoint	STD
	G	One Output Contact, NC Each Setpoint	STD
<input type="checkbox"/> <input type="checkbox"/>	E1	Definite Time Delay, Each Setpoint	STD
	E2	Definite Time (selectable cycles/seconds) <4>	STD
<input type="checkbox"/>	J	Power Supply, 125 Vdc/120 Vac	STD
	K	Power Supply, 48 Vdc	STD
	L	Power Supply, 24 Vdc	\$50.00
	Y	Power Supply, 48/125 Vdc Selectable	STD
	Z	Power Supply, 250 Vdc/240 Vac	\$60.00
<input type="checkbox"/>	N	Without Targets	STD
	A	Target - Internally Operated for Each Setpoint	STD
	B	Target - Current Operated for Each Setpoint <2>	STD
Option 1 <input type="checkbox"/>	6	One Frequency Setpoint	STD
	7	Two Frequency Setpoints	\$655.00
	8	Three Frequency Setpoints	\$1,125.00
	9	Four Frequency Setpoints	\$1,525.00
Option 2 <input type="checkbox"/>	N	No Option Installed	STD
	S	Power Supply Status Output <3>	\$70.00
Option 3 <input type="checkbox"/>	0	No Auxiliary Relay Installed	STD
	1	One Contact, NO, Each Setpoint <1 & 3>	\$50.00
	2	One Contact, NC, Each Setpoint <1 & 3>	\$50.00
<input type="checkbox"/>	F	Semi-Flush Mounting	STD
	P	Projection Mounting	\$45.00

NOTES: Options 1-6 and 1-7 (1 and 2 setpoints) are supplied in an S1 size case.

Options 1-8 and 1-9 (3 and 4 setpoints) are supplied in an M1 size case.

<1> Prices for these optional capabilities are shown per frequency setpoint and must be multiplied by the number of setpoints included in the unit.

<2> Target option B may only be selected when output is E.

<3> If option 1 is 9 and option 2 is S, the auxiliary relay contact associated with setpoint 4 is omitted.

<4> Timing option E1 and E2 are the same. See note 4 of Product Bulletin UBR.

Protective Relay Pricing PP1PR3

Effective: 1/1/02

Supersedes: PP1PR3 Dated 1/1/01

Discount Schedule PR-3

PROTECTIVE RELAY PRICE LIST

Model	Bulletin	Description	List Price
BE1-87B	UHC	Single phase high impedance bus differential relay	\$1,660.00
BE1-87B	UHC	Three phase high impedance bus differential relay	\$3,700.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Addition
<input type="checkbox"/>	S	Single Phase	STD
Sensing Input Type	G	Three Phase	STD See Above
<input type="checkbox"/>	5	0.25-2.5 A, 50-400V, 50/60Hz	STD
Sensing Input Range			
<input type="checkbox"/>	A	Front Cover with CT Test Access	STD
Cover	B	Front Cover without CT Test Access	STD
<input type="checkbox"/> <input type="checkbox"/>	A1	Instantaneous	STD
Timing			
<input type="checkbox"/>	Y	48/125 Vac/dc	STD
Power Supply	Z	125/250 Vac/dc	STD
<input type="checkbox"/>	N		STD
No Option			
<input type="checkbox"/>	0		STD
No Option			
<input type="checkbox"/>	N		STD
No Option			
<input type="checkbox"/>	0		STD
No Option			
<input type="checkbox"/>	F	Semi Flush Mount Case	STD
Case	P	Projection Mount Case	\$45.00

Accessory		
Basler Part Number	Description	List Price Each
9282300014	CT Diagnostic Test Source Assembly	\$330.00

Protective Relay Pricing PP1PR3
 Effective: 1/1/02
 Supersedes: PP1PR3 Dated 1/1/01
 Discount Schedule PR-3

PROTECTIVE RELAY PRICE LIST

Model	Bulletin	Description	List Price
BE1-87G	UBK	<u>Single Phase</u> Variable Percentage Differential Relay (87G)	\$1,100.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Addition
<input type="checkbox"/>	S	Single-Phase Sensing	STD
<input type="checkbox"/>	1	0.1 - 1.6 Amp Sensitivity	STD
	2	0.02 - 0.32 Amp Sensitivity	STD
Output <input type="checkbox"/>	E, G	One Relay Output <1>	STD
<input type="checkbox"/> <input type="checkbox"/>	A1	Instantaneous Timing	STD
<input type="checkbox"/>	J	Power Supply, 125 Vdc/120 Vac	STD
	K	Power Supply, 48 Vdc	STD
	L	Power Supply, 24 Vdc	\$50.00
	Y	Power Supply, 48/125 Vdc Selectable	STD
	Z	Power Supply, 250 Vdc/240 Vac	\$60.00
Target <input type="checkbox"/>	N	Without Targets	STD
	A,B	With Targets <1>	STD
<input type="checkbox"/>	0	No Option Available	STD
<input type="checkbox"/>	N	No Option Installed	STD
	C	Push-to-Energize Outputs	STD
<input type="checkbox"/>	0	No Option Installed	STD
	1,2	Auxiliary Relay	\$50.00
	6	Power Supply Status Output	\$70.00
<input type="checkbox"/>	F	Semi-Flush Mounting	STD
	P	Projection Mounting	\$45.00

NOTE: All relays are supplied in an S1 case.
 <1> If target is B, output must be E.

Protective Relay Pricing PP1PR3
 Effective: 1/1/02
 Supersedes: PP1PR3 Dated 1/1/01
 Discount Schedule PR-3

PROTECTIVE RELAY PRICE LIST

Model	Bulletin	Description	List Price
BE1-87G	UBK	<u>Three Phase</u> Variable Percentage Differential Relay (87G)	\$1,880.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Addition
<input type="checkbox"/>	G	Three-Phase Sensing	STD
<input type="checkbox"/>	1	0.1 - 1.6 Amp Sensitivity	STD
Output <input type="checkbox"/>	E, G	One Relay Output <1>	STD
<input type="checkbox"/> <input type="checkbox"/>	A1	Instantaneous Timing	STD
<input type="checkbox"/>	J	Power Supply, 125 Vdc/120 Vac	STD
	K	Power Supply, 48 Vdc	STD
	L	Power Supply, 24 Vdc	\$50.00
	Y	Power Supply, 48/125 Vdc Selectable	STD
	Z	Power Supply, 250 Vdc/240 Vac	\$60.00
Target <input type="checkbox"/>	N	Without Targets	STD
<input type="checkbox"/>	A,B	With Targets <1>	STD
<input type="checkbox"/>	0	No Option Available	STD
<input type="checkbox"/>	N	No Option Installed	STD
	C	Push-to-Energize Outputs	STD
<input type="checkbox"/>	0	No Option Installed	STD
	1,2	Auxiliary Relay	\$50.00
	6	Power Supply Status Output	\$70.00
<input type="checkbox"/>	F	Semi-Flush Mounting	STD
	P	Projection Mounting	\$45.00

NOTES: Relays are in an S1 size case.
<1> When target is B, output must be E.

PROTECTIVE RELAY PRICE LIST

Model	Bulletin	Description	List Price
BE1-87T	UHA	<u>Single Phase</u> Transformer Differential Relay (87T)	\$2,380.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Addition
<input type="checkbox"/>	A	Single-Phase, Two Input	STD
	B	Single Phase, Three Input	\$435.00
	C	Single Phase, Four Input	\$830.00
	D	Single Phase, Five Input	\$1,195.00
<input type="checkbox"/>	1	Sensing Input, 2.0-8.9 A, 60 Hz	STD
	2	Sensing Input, 0.4-1.78 A, 50 Hz	STD
	3	Sensing Input, 2.0-8.9 A, 50 Hz	STD
	4	Sensing Input, 0.4-1.78 A, 60 Hz	STD
<input type="checkbox"/>	E	Two NO Output Contacts: One Restrained/One Unrestrained	STD
<input type="checkbox"/> <input type="checkbox"/>	A1	Instantaneous Timing	STD
<input type="checkbox"/>	K	Power Supply, 48 Vdc	STD
	J	Power Supply, 125 Vdc/120 Vac	STD
	L	Power Supply, 24 Vdc	\$50.00
	Y	Power Supply, 48/125 Vdc Selectable	STD
	Z	Power Supply, 250 Vdc/240 Vac	\$60.00
<input type="checkbox"/>	N	Without Targets	STD
	C	Two Internally Operated Targets	STD
	D	Two Current Operated Targets	STD
<input type="checkbox"/>	0	No Option Installed	\$50.00
	1	% Iop Display and High Speed Op.	STD
<input type="checkbox"/>	N	No Option Installed	STD
	S	Push-to-Energize Outputs	STD
<input type="checkbox"/>	0	No Option Installed	STD
	1	NO Auxiliary Contacts	\$100.00
	2	NC Auxiliary Contacts	\$100.00
	5	SPDT Auxiliary Contacts	\$100.00
<input type="checkbox"/>	F	Semi-Flush Mounting	STD
	P	Projection Mounting	\$45.00

NOTE: All units in M1 size case.

Protective Relay Pricing PP1PR3
Effective: 1/1/02
Supersedes: PP1PR3 Dated 1/1/01
Discount Schedule PR-3

PROTECTIVE RELAY PRICE LIST

Model	Bulletin	Description	List Price
BE1-87T	UHA	<u>Three Phase</u> Transformer Differential Relay (87T)	\$4,800.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Addition
<input type="checkbox"/>	E	Three Phase, Two Input	STD
	G	Three Phase, Three Input <1>	\$1,165.00
<input type="checkbox"/>	1	Sensing Input, 2.0-8.9 A, 60 Hz	STD
	2	Sensing Input, 0.4-1.78 A, 50 Hz	STD
	3	Sensing Input, 2.0-8.9 A, 50Hz	STD
	4	Sensing Input, 0.4-1.78 A, 60 Hz	STD
Output <input type="checkbox"/>	E	Two NO Output Contacts: One Restrained/One Unrestrained	STD
	F	Four NO Output Contacts: Three Restrained (1 per phase/One Unrestrained) <2>	\$110.00
<input type="checkbox"/> <input type="checkbox"/>	A1	Instantaneous Timing	STD
<input type="checkbox"/>	K	Power Supply, 48 Vdc	STD
	J	Power Supply, 125 Vdc/120 Vac	STD
	L	Power Supply, 24 Vdc	\$50.00
	Y	Power Supply, 48/125 Vdc Selectable	STD
	Z	Power Supply, 250 Vdc/240 Vac	\$60.00
<input type="checkbox"/>	N	Without Targets	STD
	C	Five Internally Operated Targets	STD
	D	Three (phase) Internally Operated and Two Current Operated Targets	STD
<input type="checkbox"/>	0	No Option Installed	\$150.00
	1	% Iop Display and High Speed Op.	STD
<input type="checkbox"/>	N	No Option Installed	STD
	S	Push-to-Energize Outputs	STD
Option 3 <input type="checkbox"/>	0	No Option Available	STD
	1	NO Auxiliary Contacts <3>	\$100.00
	2	NC Auxiliary Contacts <3>	\$100.00
	5	SPDT Auxiliary Contacts <3>	\$100.00
<input type="checkbox"/>	F	Semi-Flush Mounting	STD
	P	Projection Mounting	\$45.00

NOTES: All units in M1 size case.

<1> Output must be E, option 3 must be 0.

<2> Sensing must be E, option 3 must be 0.

<3> Auxiliary contacts are only available if sensing is NOT G and output is E.

Protective Relay Pricing PP1PR3

Effective: 1/1/02

Supersedes: PP1PR3 Dated 1/1/01

Discount Schedule PR-3

PROTECTIVE RELAY PRICE LIST

REFER TO DISCOUNT SCHEDULE PR-3

Mounting and Miscellaneous Accessories		
Basler Part Number	Description	List Price Each
9233035103	Power Supply hold up circuit 120 Vac/125 Vdc	\$185.00
9108551021	Adapter Plate to Mount an S1 Case in a GE S2 or Westinghouse FT-21 Cutout.	\$35.00
9108551022	Adapter Plate to Mount an S1 Case in Westinghouse FT-32 Cutout.	\$35.00
9289924100	Adapter Bracket to Mount a single H1 Case in a 19" Rack.	\$40.00
9289929100	H1 Extender Bracket for FT Switch	\$40.00
9289900016	Escutcheon Plate to Panel Mount Two Dovetailed H1 Relays	\$50.00
9289900017	Escutcheon Plate to Panel Mount One H1 Relay	\$45.00
9272013101	Escutcheon Plate to Panel Mount One Horizontal BE1-BPR Relay	\$50.00
9252012001	19" Rack Mounted Plate for Mounting 4 Vertical BE1-50/51M Units.	\$45.00

Test Accessories		
Basler Part Number	Description	List Price Each
9165500100	Flexible Circuit Card Test Extender for BE1 Relays	\$210.00
9112930101	Fixed Circuit Card Test Extender for BE1 Relays	\$210.00
10095	Test Plug (All BE1 Relays)	\$415.00
9170111101	Test Plug Adapter with Resistors for BE1-25 Relays for 48 Vdc.	\$425.00
9170111103	Test Plug Adapter with Resistors for BE1-25 Relays for 125 Vdc/120 Vac.	
9170111105	Test Plug Adapter with Resistors for BE1-25 Relays for 250 Vdc/240 Vac. Note: These adapters are required only when Option 2 is U or V which embody an "external function select".	
9201111100	Test Block Assembly: PCB and component servicing of all BE1 relays except BE1-25 and BE1-79M. Consists of a terminal block with all 10 terminals in place, a paddle, and minimum metal framing for relay cradle retention. Assembly can be used in top or bottom position.	\$200.00
9180400104	Test Case for S1 Relays	\$300.00
9180400105	Test Case for M1 Relays	\$300.00
9180400110	S1 Test Case for BE1-851, BE1-951 and BE1-GPS100	\$300.00
9180400106	H1 Test Case with 1 CT Terminal Block and 12 position Bottom Terminal Block (851)	\$300.00
9180400108	H1 Test Case with 1 CT Terminal Block and 18 position Bottom Terminal Block (GPS100, MMS100, 951)	\$300.00
9180400107	F1 Test Case with 1 CT Terminal Block (851)	\$300.00
9180400109	MX Test Case with 2 CT Terminal Blocks (CDS220)	\$300.00
9170114100	BE1-79M Test Box to Facilitate Bench Testing	\$650.00
9231542100	BE1-DFPR Test Box to Facilitate Bench Testing	\$750.00
9272010100	BE1-BPR Test Box to Facilitate Bench Testing	\$650.00
9278708100	BE1-25/79TR Low Profile Test Box	\$650.00
9289922100	BE1-851, 951, GPS100 Test Box to Facilitate Bench Testing	\$650.00

PROTECTIVE RELAY PRICE LIST

Parts		
Basler Part Number	Description	List Price Each
<1>	Standard S1 Case	\$225.00
<1>	Standard A1 Case	\$225.00
<1>	Standard C1 Case	\$225.00
<1>	Standard M1 Case	\$225.00
<1>	Standard S1 Cover	\$75.00
<1>	Standard A1 Cover	\$75.00
<1>	Standard C1 Cover	\$75.00
<1>	Standard M1 Cover	\$75.00

NOTE:

<1> Must specify relay model and style number.

MOTOR PROTECTION SYSTEMS PRICE LIST

Model	Bulletin	Description	List Price
MPS100	UPC	Motor Protection System	\$990.00
Style Number			
Specific Type	Variations	Description	Price Additions
<input type="checkbox"/>	1 5	1 Amp Nominal Current 5 Amp Nominal Current	STD STD
<input type="checkbox"/>	1 2	Power Supply, 120 Vac Power Supply, 240 Vac	STD STD
<input type="checkbox"/>	V	Vertical Fixed Case	STD
<input type="checkbox"/>	1	RS485 with Modbus™	STD

Model	Bulletin	Description	List Price
MPS200	UPB	Motor Protection System	\$2,115.00
MPS210	UPB	Motor Protection System with Control	\$2,240.00
Style Number			
Specific Type	Variations	Description	Price Additions
<input type="checkbox"/>	C P	RTD-Copper, 10 Ohms RTD-Platinum, 100 Ohms or Nickel, 120 Ohms	STD STD
<input type="checkbox"/>	1 2 3	Power Supply, 115/230 Vac Power Supply, 110/250 Vdc Power Supply, 24/48 Vdc	STD STD STD
<input type="checkbox"/>	D V H	M1 Drawout Case Vertical Fixed Case Horizontal Fixed Case	\$275.00 STD STD
<input type="checkbox"/>	1	RS485 with Modbus™	STD

Motor Protection & Control Pricing PP1PR5
 Effective: 1/1/02
 Supersedes: PP1PR5 Dated 1/1/01
 Discount Schedule PR-3

**PROTECTIVE RELAYS
PRICE LIST**

CLASS 200 MODELS

REFER TO DISCOUNT SCHEDULE PR-2

Model Number	Relay Name	Basler Bulletin	Shipping Weight	List Price Each
BE2-40-1	LOSS OF EXCITATION RELAY (200 Amps Turns)	UCC	10 lbs./4.5 kg.	\$1,296.00
BE2-40-2	LOSS OF EXCITATION RELAY (800 Amps Turns)	UCC	11 lbs./5.0 kg.	\$1,436.00
BE2-40-3	UNDER EXCITATION RELAY (200 Amps Turns)	UCC	10 lbs./4.5 kg.	\$1,366.00
BE2-40-4	OVER EXCITATION RELAY (200 Amps Turns)	UCC	10 lbs./4.5 kg.	\$1,366.00
BE2-40-5	UNDER EXCITATION RELAY (800 Amps Turns)	UCC	11 lbs./5.0 kg.	\$1,482.00
BE2-40-6	OVER EXCITATION RELAY (800 Amps Turns)	UCC	11 lbs./5.0 kg.	\$1,482.00
BE2-40-11	OVER EXCITATION RELAY (10 Amps Turns)	UCC	15 lbs./6.8 kg.	\$1,366.00
BE2-40-12	UNDER EXCITATION RELAY (10 Amps Turns)	UCC	15 lbs./6.8 kg.	\$1,366.00

CLASS 300 MODELS

REFER TO DISCOUNT SCHEDULE PR-2

Model Number	Relay Name	Basler Bulletin	Shipping Weight	List Price Each
BE3-32-1A	REVERSE POWER RELAY - Single-Phase for ac Trip Circuit	UEE	4.5 lbs./2.0 kg.	\$356.00
BE3-32-1D	REVERSE POWER RELAY - Single-Phase for dc Trip Circuit	UEE	4.5 lbs./2.0 kg.	\$356.00
BE3-32-3A	REVERSE POWER RELAY - Three-Phase for ac Trip Circuit	UEE	6.25 lbs./2.8 kg.	\$446.00
BE3-32-3D	REVERSE POWER RELAY - Three-Phase for dc Trip Circuit	UEE	6.25 lbs./2.8 kg.	\$446.00
PRP 320	SYNCHRONOUS POWER RELAY - OUT RELAY (60 Hz)	UEA	9.0 lbs./4.1 kg.	\$992.00
PRP 340	SYNCHRONOUS POWER RELAY - OUT RELAY (50 Hz)	UEA	9.0 lbs./4.1 kg.	\$992.00

**PROTECTIVE RELAYS
PRICE LIST**

CLASS 300 MODELS

REFER TO DISCOUNT SCHEDULE PR-3

BASE UNIT:

Model Number	Basler Bulletin	Relay Name	Shipping Weight	List Price Each
BE3-GPR	UEG	GENERATOR PROTECTION	6.0 lbs./2.72 kg.	
STYLE NUMBER				
Specific Style	Variations	Description Select One Character From Each Group		List Price Each
	S	Stand Alone		\$993.00
	P	Paralleled Gen		\$1360.00
	1	3-Phase Overcurrent		\$105.00
	2	Neutral Ground Fault		STD
	N	No Option		STD
	B	Phase Balance		\$83.00
	O	No Option		STD
	V	Reactive Current*		\$83.00
	N	No Option		STD
	S	Sync Check*		\$99.00
	F	Semi-Flush Mounting		\$78.00
	B	Behind-the-Panel		STD

*Available only with the "Paralleled Gen" option.

AUXILIARY POWER SUPPLIES:

Basler Part Number	Input Voltage	Output Voltage	Output Wattage	List Price Each
9313700100	120 Vac/125 Vdc	24 Vdc	15 Watts	\$105.00
9313700101	230 Vac/250 Vdc	24 Vdc	15 Watts	\$105.00
9313700102	120 Vac/125 Vdc	12 Vdc	15 Watts	\$105.00
9313700103	230 Vac/250 Vdc	12 Vdc	15 Watts	\$105.00

PROTECTIVE RELAY PRICE LIST
BE3 RELAY PRICING INSTRUCTIONS

BE3 relays must be specified by Model and Style numbers to define the relay completely. To develop a price for a specific relay, select the price page according to the relay model number. The base price of the relay is listed for each model. Directly below the model number on the left is a column of boxes representing each character in the style number. To the right of each box are listed the possible options that may be incorporated in that position of the style number. Check each character of the style number for possible options that may be incorporated in that position of the style number. Check each character of the style number for possible price additions. The base price of the relay added to the price additions for the style number is the total relay list price.

Shipping weight: BE3-49T is 5.0 lbs./2.3 kg.
 All other BE3 relays are 3.0 lbs./1.4 kg.

Pricing Example

Three Phase Time Overcurrent

Model	Style Number				
BE3-51	3	E	1	A	1
\$145	\$100	STD	STD	STD	STD

TOTAL PRICE: \$245.00

PROTECTIVE RELAY PRICE LIST

Model	Bulletin	Description	List Price
BE3-25	ULA	Sync-Check Relay	\$210.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Addition
<input type="checkbox"/>	1	Single-Phase Sensing	STD
<input type="checkbox"/>	A	120 Vac Nominal Input	STD
	B	240 Vac Nominal Input	STD
	C	380 Vac Nominal Input	\$27.00
	D	480 Vac Nominal Input	\$27.00
	S	Special Voltage	\$40.00
<input type="checkbox"/>	1	Frequency 50/60 Hz	STD
	2	Frequency 400 Hz	\$20.00
<input type="checkbox"/>	N	External Power Not required	STD
<input type="checkbox"/>	4	Energize the Output for Sync	STD
	5	Energize the Output for Sync or Dead Bus	\$25.00

Model	Bulletin	Description	List Price
BE3-27	ULB	Undervoltage Relay	\$126.00
BE3-59	ULB	Overvoltage Relay	\$126.00
BE3-27/59	ULB	Under/Overvoltage Relay	\$186.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Addition
<input type="checkbox"/>	1	Single-Phase Sensing	STD
	3	Three-Phase, Three-Wire Sensing	STD
	4	Three-Phase, Four-Wire Sensing	\$30.00
<input type="checkbox"/>	A	120 Vac Nominal Input	STD
	B	240 Vac Nominal Input	STD
	C	380 Vac Nominal Input	\$27.00
	D	480 Vac Nominal Input	\$27.00
	S	Special Voltage	\$40.00
<input type="checkbox"/>	1	Frequency 50/60 Hz	STD
	2	Frequency 400 Hz	\$20.00
<input type="checkbox"/>	N	External Power Not Required	STD
<input type="checkbox"/>	1 (59)	Energize the Output to Trip	STD
	2 (27)	De-Energize the Output to Trip	STD
	3 (27/59)	Energize the Output to Trip (59)	STD
		De-Energize the Output to Trip Under (27)	STD

Protective Relay Pricing PP1PR6
 Effective: 1/1/02
 Supersedes: 1/1/01
 Discount Schedule PR-4

PROTECTIVE RELAY PRICE LIST

Model	Bulletin	Description	List Price
BE3-27T	ULC	Undervoltage Relay with 0-10 sec. Time Delay	\$150.00
BE3-59T	ULC	Overvoltage Relay with 0-10 sec. Time Delay	\$150.00
BE3-27T/59T	ULC	Under/Overvoltage Relay with 0-10 sec. Time Delay	\$210.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Addition
<input type="checkbox"/>	1	Single-Phase Sensing	STD
	3	Three-Phase, Three-Wire Sensing	STD
	4	Three-Phase, Four-Wire Sensing	\$30.00
<input type="checkbox"/>	A	120 Vac Nominal Input	STD
	B	240 Vac Nominal Input	STD
	C	380 Vac Nominal Input	\$27.00
	D	480 Vac Nominal Input	\$27.00
	S	Special Voltage	\$40.00
<input type="checkbox"/>	1	Frequency 50/60 Hz	STD
	2	Frequency 400 Hz	\$20.00
<input type="checkbox"/>	N	External Power Not Required	STD
<input type="checkbox"/>	1 (59T)	Energize the Output to Trip	STD
	2 (27T)	De-Energize the Output to Trip	STD
	3 (27T/59T)	Energize the Output to Trip (59T)	STD
		De-Energize the Output to Trip (27T)	

Model	Bulletin	Description	List Price
BE3-32	ULD	Reverse Power Relay	\$210.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Addition
<input type="checkbox"/>	1	Single-Phase Sensing	STD
	3	Three-Phase, Three-Wire Sensing	STD
<input type="checkbox"/>	A	120 Vac Nominal Input	STD
	B	240 Vac Nominal Input	STD
	C	380 Vac Nominal Input	\$27.00
	D	480 Vac Nominal Input	\$27.00
	S	Special Voltage	\$40.00
<input type="checkbox"/>	1	Frequency 50/60 Hz	STD
	2	Frequency 400 Hz	\$20.00
<input type="checkbox"/>	N	External Power Not Required	STD
<input type="checkbox"/>	1	Energize the Output to Trip	STD

PROTECTIVE RELAY PRICE LIST

Model	Bulletin	Description	List Price
BE3-37	ULE	Under Current Relay	\$145.00
BE3-51	ULE	Over Current Relay	\$145.00
BE3-37/51	ULE	Under/Over Current Relay	\$205.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Addition
<input type="checkbox"/>	1 3*	Single-Phase Sensing Three-Phase Sensing	STD \$100.00
<input type="checkbox"/>	E	5 Amp (CT) Nominal Output	STD
<input type="checkbox"/>	1 2	Frequency 50/60 Hz Frequency 400 Hz	STD \$20.00
<input type="checkbox"/>	A B C D E	External Power 120 Vac External Power 240 Vac External Power 380 Vac External Power 480 Vac External Power 24 Vdc	STD \$27.00 \$27.00 \$27.00 \$27.00
<input type="checkbox"/>	1 (51) 2 (37) 3 (37/51)	Energize the Output Relay to Trip De-energize the Output Relay to Trip Energize the Output Relay to Trip Over (51) De-energize the Output Relay to Trip Under (37)	STD STD STD

* Available for BE3-37 and BE3-51 only.

Model	Bulletin	Description	List Price
BE3-47	ULF	Phase Sequence Relay	\$103.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Addition
<input type="checkbox"/>	3	Three-Phase, Three-Wire Sensing	STD
<input type="checkbox"/>	A B C D S	120 Vac Nominal Input 240 Vac Nominal Input 380 Vac Nominal Input 480 Vac Nominal Input Special Voltage	STD STD \$27.00 \$27.00 \$40.00
<input type="checkbox"/>	2 3 4	Frequency 400 Hz Frequency 50 Hz Frequency 60 Hz	\$20.00 STD STD
<input type="checkbox"/>	N	External Power Not Required	STD
<input type="checkbox"/>	2	De-energize the Output to Trip	STD

Protective Relay Pricing PP1PR6
Effective: 1/1/02
Supersedes: 1/1/01
Discount Schedule PR-4

PROTECTIVE RELAY PRICE LIST

Model	Bulletin	Description	List Price
BE3-47N	ULG	Voltage Balance Relay	\$142.00
BE3-47N/27	ULG	Voltage Balance/Undervoltage Relay	\$169.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Addition
<input type="checkbox"/>	3	Three-Phase, Three-Wire Sensing	STD
<input type="checkbox"/>	A	120 Vac Nominal Input	STD
	B	240 Vac Nominal Input	STD
	C	380 Vac Nominal Input	\$27.00
	D	480 Vac Nominal Input	\$27.00
	S	Special Voltage	\$40.00
<input type="checkbox"/>	2	Frequency 400 Hz	\$20.00
	3	Frequency 50 Hz	STD
	4	Frequency 60 Hz	STD
<input type="checkbox"/>	N	External Power Not Required	STD
<input type="checkbox"/>	2	De-energize the Output to Trip	STD

Model	Bulletin	Description	List Price
BE3-49R	ULH	Temperature Relay (3-RTD)	\$825.00
BE3-49R	ULI	Temperature Relay (6-RTD)	\$825.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Addition
<input type="checkbox"/>	5	RTD Sensing	STD
<input type="checkbox"/>	H	3 x 10 Ohms, Copper	STD
	I	3 x 100 Ohms, Platinum	\$32.00
	J	6 x 10 Ohms, Copper	STD
	K	6 x 100 Ohms, Platinum	\$32.00
<input type="checkbox"/>	5	Frequency dc	STD
<input type="checkbox"/>	A	120 Vac External Power	STD
	B	240 Vac External Power	\$40.00
<input type="checkbox"/>	1	Energize the Output to Trip	STD

Protective Relay Pricing PP1PR6
 Effective: 1/1/02
 Supersedes: 1/1/01
 Discount Schedule PR-4

PROTECTIVE RELAY PRICE LIST

Model	Bulletin	Description	List Price
BE3-49TL	ULJ	Thermocouple Temperature Relay Low Trip 0-80%	\$189.00
BE3-49TH	ULJ	Thermocouple Temperature Relay High Trip 40-120%	\$189.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Addition
<input type="checkbox"/>	6	Thermocouple Sensing	STD
<input type="checkbox"/>	N P R	J Type Thermocouple K Type Thermocouple Other (Specify)*	STD STD *
<input type="checkbox"/>	5	Frequency dc	STD
<input type="checkbox"/>	A B C D E	120 Vac External Power 240 Vac External Power 380 Vac External Power 480 Vac External Power 24 Vdc External Power	STD STD \$27.00 \$27.00 \$27.00
<input type="checkbox"/>	1 2	Energize the Output to Trip De-energize the Output to Trip	STD STD

*Consult Factory

Model	Bulletin	Description	List Price
BE3-74SL	ULN	Millivolt Sensing Alarm Relay Low Trip 0-80%	\$164.00
BE3-74SH	ULN	Millivolt Sensing Alarm Relay High Trip 40-120%	\$164.00
BE3-74SD	ULN	Millivolt Sensing Alarm Relay High/Low Trip (2 relays)	\$380.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Addition
<input type="checkbox"/>	7	Transducer/Shunt Sensing	STD
<input type="checkbox"/>	F G S	50 Millivolt Nominal Input 100 Millivolt Nominal Input 10 Millivolt to 999 Millivolt	STD STD \$50.00
<input type="checkbox"/>	5	Frequency dc	STD
<input type="checkbox"/>	A B C D E	120 Vac External Power 240 Vac External Power 380 Vac External Power 480 Vac External Power 24 Vdc External Power	STD STD \$27.00 \$27.00 \$27.00
<input type="checkbox"/>	1 2 3	Energize the Output to Trip (74SH) De-energize the Output to Trip (74SL) Energize the Output to Trip De-energize the Output to Trip (74SD)	STD STD STD STD

*Consult Factory

Protective Relay Pricing PP1PR6
Effective: 1/1/02
Supersedes: 1/1/01
Discount Schedule PR-4

PROTECTIVE RELAY PRICE LIST

Model	Bulletin	Description	List Price
BE3-74TL	ULO	Milliamp Sensing Alarm Relay Low Trip 0-80%	\$164.00
BE3-74TH	ULO	Milliamp Sensing Alarm Relay High Trip 40-120%	\$164.00
BE3-74TD	ULO	Milliamp Sensing Alarm Relay High/Low Trip (2 relays)	\$227.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Addition
<input type="checkbox"/>	7	Transducer Sensing	STD
<input type="checkbox"/>	L	0 - 1 mA Nominal Input	STD
	M	4-20 mA Nominal Input	STD
	V	0-20 mA Nominal Input	STD
<input type="checkbox"/>	5	Frequency dc	STD
<input type="checkbox"/>	A	120 Vac External Power	STD
	B	240 Vac External Power	STD
	C	380 Vac External Power	\$27.00
	D	480 Vac External Power	\$27.00
	E	24 Vdc External Power	\$27.00
<input type="checkbox"/>	1	Energize the Output to Trip (74TH)	STD
	2	De-energize the Output to Trip (74TL)	STD
	3	Energize the Output to Trip De-energize the Output to Trip (74TD)	STD

Model	Bulletin	Description	List Price
BE3-74VL	ULP	DC Volts Sensing Low Trip 0-80%	\$130.00
BE3-74VH	ULP	DC Volts Sensing High Trip 40-120%	\$130.00
BE3-74VD	ULP	DC Volts Sensing High/Low Trip (2 relays)	\$220.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Addition
<input type="checkbox"/>	8	Dc Voltage	STD
<input type="checkbox"/>	Q	1 Vdc Nominal Input	STD
	T	10 Vdc Nominal Input	STD
	U	100 Vdc Nominal Input	STD
	S	1 to 300 Vdc Nominal Input	\$50.00
<input type="checkbox"/>	5	Frequency dc	STD
<input type="checkbox"/>	A	120 Vac External Power	STD
	B	240 Vac External Power	STD
	C	380 Vac External Power	\$27.00
	D	480 Vac External Power	\$27.00
	E	24 Vdc External Power	\$27.00
<input type="checkbox"/>	1	Energize the Output to Trip (74VH)	STD
	2	De-energize the Output to Trip (74VL)	STD
	3	Energize the Output to Trip De-energize the Output to Trip (74VD)	STD

*Consult Factory

Protective Relay Pricing PP1PR6
 Effective: 1/1/02
 Supersedes: 1/1/01
 Discount Schedule PR-4

PROTECTIVE RELAY PRICE LIST

Model	Bulletin	Description	List Price
BE3-81U	ULL	Underfrequency Relay	\$175.00
BE3-81O	ULL	Overfrequency Relay	\$175.00
BE3-81O/U	ULL	Over/Under Frequency Relay	\$246.00

STYLE NUMBER

Specific Style	Variations	Description	Price Addition
<input type="checkbox"/>	1	Single-Phase Sensing	STD
<input type="checkbox"/>	A	120 Vac Nominal Input	STD
	B	240 Vac Nominal Input	STD
	C	380 Vac Nominal Input	\$27.00
	D	480 Vac Nominal Input	\$27.00
	S	Special Voltage	\$40.00
<input type="checkbox"/>	2	Frequency 400 Hz	\$20.00
	3	Frequency 50 Hz	STD
	4	Frequency 60 Hz	STD
<input type="checkbox"/>	N	External Power Not Required	STD
<input type="checkbox"/>	1	Energize the Output to Trip (81O)	STD
	2	De-energize the Output to Trip (81U)	STD
	3	Energize the Output to Trip De-energize the Output to Trip (81O/U)	STD

Model	Bulletin	Description	List Price
BE3-81UT	ULM	Underfrequency Relay with 0-10 sec. Time Delay	\$190.00
BE3-81OT	ULM	Overfrequency Relay with 0-10 sec. Time Delay	\$190.00
BE3-81OT/UT	ULM	Over/Under Frequency Relay with 0-10 sec. Time Delay	\$250.00

STYLE NUMBER

Specific Style	Variations	Description	Price Addition
<input type="checkbox"/>	1	Single-Phase Sensing	STD
<input type="checkbox"/>	A	120 Vac Nominal Input	STD
	B	240 Vac Nominal Input	STD
	C	380 Vac Nominal Input	\$27.00
	D	480 Vac Nominal Input	\$27.00
	S	Special Voltage	\$40.00
<input type="checkbox"/>	2	Frequency 400 Hz	\$20.00
	3	Frequency 50 Hz	STD
	4	Frequency 60 Hz	STD
<input type="checkbox"/>	N	External Power Not Required	STD
<input type="checkbox"/>	1	Energize the Output to Trip (81OT)	STD
	2	De-energize the Output to Trip (81UT)	STD
	3	Energize the Output to Trip De-energize the Output to Trip (81OT/UT)	STD

Protective Relay Pricing PP1PR6
 Effective: 1/1/02
 Supersedes: 1/1/01
 Discount Schedule PR-4

**AUTOMATIC SYNCHRONIZER
PRICE LIST**

REFER TO DISCOUNT SCHEDULE PR-3

Model Number	Bulletin	Description	List Price
BE1-25A	UIM	Automatic Synchronizer Includes: Synchronizing Module with Power Supply, Test Module, and Chassis	\$3,700.00

Option Modules:

Voltage Acceptance Options

<input type="checkbox"/> <input type="checkbox"/>	A0 A1 A2	None Voltage Difference Limit Voltage Difference Limit, High and Low Bus Voltage Limits	----- \$470.00 \$550.00
---	----------------	---	-------------------------------

Frequency Matching Options

<input type="checkbox"/> <input type="checkbox"/>	F0 F5	None Proportionally Pulsed Correction	----- \$765.00
---	----------	--	-------------------

Voltage Matching Options (V1, V2, V3 requires a voltage acceptance option of A1 or A2)

<input type="checkbox"/> <input type="checkbox"/>	V0 V1 V2 V3	None Continuous Correction Contact Closure Pulsed Correction Contact Closure Proportionally Pulsed Correction	----- \$575.00 \$635.00 \$720.00
---	----------------------	--	---

Dead Bus Closing

<input type="checkbox"/> <input type="checkbox"/>	D0 D1	None Dead Bus Closing	----- \$560.00
---	----------	--------------------------	-------------------

Accessories (No Discounts)

Part Number	Description	List Price
Basler P/N 9146624100	Module Extender Card	\$365.00
Basler P/N 9146631106	Kit to upgrade from F0, F1 or F3 to F5 (includes MCU & F5 modules)	\$1,300.00

(For descriptive information, see Bulletin UIM)

**AUTOMATIC SYNCHRONIZER
PRICE LIST**

REFER TO DISCOUNT SCHEDULE SC-1

VERI-SYNC RELAY

Model Number	Input Voltage	Shipping Weight	List Price Each
PRS250	120/240 Vac, 50/60 Hz	7.5 lbs./3.4 kg.	\$467.00

(For descriptive information, see Product Bulletin UKH.)

Model Number	Input Voltage	Shipping Weight	List Price Each
BE3-25A	Basic Unit	5.0 lbs./2.3 kg.	\$824.00

STYLE NUMBER

Style Number	Variations	Description	Price Each
<input type="checkbox"/>	A B C W	<u>Frequency Matching</u> American Bosch (Summing Point) Barber Colman (Summing Point) Contact Outputs Woodward (Summing Point)	STD STD STD STD
<input type="checkbox"/>	0 1 2	<u>Voltage Matching</u> Not included Summing Point Output (Compatible with Basler XR, KR, SR Voltage Regulator Families and Basler SSE and SER-CB Excitation Systems) Contact Outputs	STD \$210.00 \$136.00
<input type="checkbox"/>	N D	<u>Dead Bus Closing</u> Not Included Included	STD \$43.00

(For descriptive information, see Product Bulletin UMP.)

**SYSTEM CONTROL DEVICES
PRICE LIST**

REFER TO SCHEDULE SC-1

DGC-1000 and DGC-2000

Model Number	Description	Product Bulletin	Shipping Weight	List Price Each
DGC-1000	Digital Genset Controller	SNF	2 lbs./0.91 kg.	\$1,050.00
STYLE NUMBER				
Specific Style	Variations	Description		Price Addition
<input type="checkbox"/>	N A	No Auxiliary I/O 4 inputs/8 outputs	.25 lbs./0.11 kg.	Standard \$175.00
<input type="checkbox"/>	0 1 2	No Dial Out Modem Standard Dial Out Modem Extended Temperature Range Dial Out Modem		Standard \$425.00 \$590.00
<input type="checkbox"/>	N ⚠ C	No Communications Option Enhanced Communications		Standard \$940.00

⚠ Requires dial-out modem option above.

Model Number	Description	Product Bulletin	Shipping Weight	List Price Each
DGC-2000	Digital Genset Controller	SNA	5.75 lbs./2.61 kg.	\$2,000.00

DGC-1000 and DGC-2000 OPTIONAL EQUIPMENT (Shipped Separately)

Model Number	Description	Product Bulletin	Shipping Weight	List Price Each
RDP-110	Remote display panel to meet NFPA-110 requirements	SNE	6.0 lbs./13.23 kg	\$450.00
Specific Style	Variations			
<input type="checkbox"/>	S Surface Mounting (Projection) F Semi-Flush Mounting			STD STD
<input type="checkbox"/>	1 For use with DGC-1000 2 For use with DGC-2000			STD STD

P/N 29760	Audible alarm horn for DGC-1000	SNF	0.4 lbs./18 kg	\$35.00
-----------	---------------------------------	-----	----------------	---------

PPSCI
Effective: 1/1/02
Supersedes: PPSCI Dated 1/1/01
Discount Schedule SC-1

**SYSTEM CONTROL DEVICES
PRICE LIST**

REFER TO SCHEDULE SC-1

Model Number	Description	Product Bulletin	Shipping Weight	List Price Each
SCP250	VAR/Power Factor Controller	UKR	8.0 lbs./3.6 kg.	\$887.00

MOTOR OPERATED CONTROLS

For those control systems requiring remote or multi-point adjustment of regulators, governors, and other devices, Basler Electric manufactures the MOC-2 series of motor operated controls. Control switches are available for "Raise-Off-Lower" control and are listed in Regulator Accessories Price List. See Bulletin SRA for more information.

POTENTIOMETER

Model Number	Shipping Weight	List Price Each
MOC 2	10.5 lbs./4.8 kg.	\$708.00

Special Adders:	Price Each
Custom Pot, Single Turn	\$97.00
Custom Pot, Three Turn	\$128.00
Custom Voltage	\$129.00
Return-to-Center	\$129.00
Dual Pots	Consult Factory

ENERGY STORAGE DEVICE

This module stores energy to trip circuit breakers or lockout relays after removal of voltage. Use when tripping power from a station battery is not available. See Product Bulletin UJO.

REFER TO DISCOUNT SCHEDULE SC-1

Model Number	Voltage	Description	Shipping Weight	List Price Each
ESD201	120/240	Energy Storage Device	2.9 lbs./1.32 kg.	\$441.00
ESD202	240	Energy Storage Device	1.2lbs./0.54 kg.	\$163.00

OPTIONAL:

Description	Shipping Weight	List Price Each
Conversion Mounting Plate to ESD200 footprint (shipped loose for customer mounting) P/N 9110600009	2.0 lbs./0.91 kg.	\$46.00

**SYSTEM CONTROL DEVICES
PRICE LIST**

REFER TO SCHEDULE SC-1

ENGEN_®-100 and ENGEN_®-200

ENGEN _® -100	Engine/Generator Set Controller	SND	4.0 lbs./1.8 kg.	\$550.00
ENGEN _® -200	Engine/Generator Set Controller	SND	4.0 lbs./1.8 kg.	\$600.00

ENGEN_®-100 OPTIONAL EQUIPMENT

Linear Actuator	Work Ratings	Shipping Weight	List Price Each
Model 0175	0.3 ft-lbs.	2.5 lbs./1.13 kg.	\$140.00
Model 0250	0.7 ft-lbs.	4.0 lbs./1.8 kg.	\$175.00
Model 0300	1.3 ft-lbs.	7.5 lbs./3.4 kg.	\$250.00

NOTE: Please note, prior to ordering push or pull type, flange or basemount, and 12 or 24 Vdc must be specified.

**SYSTEM CONTROL DEVICES
PRICE LIST**

REFER TO SC-1 FOR DISCOUNT SCHEDULE

Model	Bulletin	Description	Shipping Weight	List Price
PSS-100	SRC	Microprocessor-Based Power System Stabilizer including setup and metering software	11.0 lbs./ 5.0 kg.	\$15,000.00
SPECIFIC STYLE NUMBER ORDERING INFORMATION				
Specific Style	Variations	Description Select One Character From Each Group		Price Addition
<input type="checkbox"/>	Y Z	48/125 Vac/Vdc Power Supply 125/230 Vac/Vdc Power Supply		STD STD
<input type="checkbox"/>	1 5	1 Amp CT Input 5 Amp CT Input		STD STD

Example: PSS-100 Z 5

Optional Services	Net Price
<i>PSS Settings Analysis</i> — Requires system information supplied by the customer. Refer to factory for required information.	\$7,800.00
<i>Power System Study</i> — This study will determine the information required to perform the PSS Settings Analysis, including the final PSS Settings. Refer to factory for required information.	\$20,400.00
<i>Field PSS Programming and PSS Settings Validation</i> — Provided the PSS Settings Analysis has been completed along with all customer supplied information, Basler standard field service policy and pricing will apply.	Refer to Field Service Policy

MICRO-BASE REFERENCE ADJUSTER
 Replaces Motor Operated Potentiometer
 REFER TO SC-1 FOR DISCOUNT SCHEDULE

Model	Bulletin	Description	Shipping Weight	List Price
RA-70A	SRS	Micro-Base Reference Adjuster for Interfacing with Automatic Voltage Regulator Rheostat Type Control	6.0 lbs./ 2.7 kg.	\$979.00

SPECIFIC STYLE NUMBER ORDER INFORMATION

Specific Style	Variations	Description Select One Character From Each Group		Price Addition
<input type="checkbox"/>	D S	Power Supply, 125 Vac/dc Power Supply, 24 Vdc		STD \$103.00
<input type="checkbox"/>	C V	Raise/Lower Contact or 4-20 mA Programmable Logic Input Control Raise/Lower Contact or 0-10 Vdc Programmable Logic Input Control		STD \$72.00
<input type="checkbox"/>	1 2 3 4 7	500 Ohms; SRF, SRH/E, SSE 175 Ohms; SRA, SRN 5,000 Ohms; SSR, APR-125 1,000 Ohms; APR 63 10,000 Ohms; Rheostat Output *See Note Below		STD STD STD STD STD
<input type="checkbox"/>	O R	Single Reference Signal Output (Rheostat Type) Dual Reference Signal Output (Rheostat Type)		STD \$273.00

Model	Bulletin	Description	Shipping Weight	List Price
RA-70M	SRS	Micro-Base Reference Adjuster for Interfacing with Manual Voltage Regulator Potentiometer Type Control	6.0 lbs./ 2.7 kg.	\$1,082.00

SPECIFIC STYLE NUMBER ORDER INFORMATION

Specific Style	Variations	Description Select One Character From Each Group		Price Addition
<input type="checkbox"/>	D S	Power Supply, 125 Vac/dc Power Supply, 24 Vdc		STD \$103.00
<input type="checkbox"/>	C V	Raise/Lower Contact or 4-20 mA Programmable Logic Input Control Raise/Lower Contact or 0-10 Vdc Programmable Logic Input Control		STD \$72.00
<input type="checkbox"/>	N T	-0.1, +0.1 ma Null Signal (Meter not included) Autotrack and Null Signal (Meter not included)		STD \$834.00
<input type="checkbox"/>	5 6 7 8	1,250 Ohms Potentiometer Output 2,500 Ohms Potentiometer Output 10,000 Ohms; Applicable to MVC 301, MVC 236 5,000 Ohms; Applicable to SSE Manual *See Note Below		STD STD STD STD

Examples: RA-70 A D C 1 O or RA-70 M D V T 8

NOTE: *For resistances not specified, please contact factory.

NOTE: For RA70M when manual control applicability is "8", then Option "V" for raise lower contact on 0-10 Vdc input must be selected.

PPSCI
 Effective: 1/1/02
 Supersedes: PPSCI Dated 1/1/01
 Discount Schedule SC-1

**MICRO-BASE REFERENCE ADJUSTER
POTENTIOMETER TYPE OUTPUT**

Replaces Motor Operated Potentiometer
REFER TO SC-1 FOR DISCOUNT SCHEDULE

Model	Bulletin	Description	Shipping Weight	List Price
RA-70P	SRS	Micro-Base Reference Adjuster Potentiometer Type Output	6.0 lbs./2.7 kg.	\$1,082.00
SPECIFIC STYLE NUMBER ORDER INFORMATION				
Specific Style	Variations	Description Select One Character From Each Group		Price Addition
<input type="checkbox"/>	D	Power Supply, 125 Vac/dc		STD
	S	Power Supply, 24 Vdc		\$103.00
<input type="checkbox"/>	C	4-20 mA Programmable Logic Input Control		STD
	V	0-10 Vdc Programmable Logic Input Control		\$72.00
<input type="checkbox"/>	5	1,250 Ohms Potentiometer Output		STD
	6	2,500 Ohms Potentiometer Output		STD
	7	10,000 Ohms Potentiometer Output		STD
	8	5,000 Ohms Potentiometer Output		STD
		*See Note Below		

Example: RD-70 P D C 8

NOTE: * For resistances not specified, please contact factory.

AUXILIARY ACCESSORIES COMMON TO THE THREE MODELS

Basler Part Number	Description	Shipping Weight	List Price Each
P/N 23332	Nullmeter Switchboard Type, 1% Accuracy 270° Dial	2.0 lbs./9.1 kg.	\$391.00
P/N 27832	Panel Type, 2% Accuracy NOTE: Used only with RA-70M	1.0 lb./0.5 kg.	\$170.00
P/N 27824	Position Meter Switchboard Type, 1% Accuracy 270° Dial	1.0 lb./0.5 kg.	\$391.00
P/N 27825	Position Meter-Horizontal Edgewise Type, 2% Accuracy	1.0 lb./0.5 kg.	\$170.00
P/N BE25982-001	120Vac/120 Vac, 50 VA Isolation Transformer *See Note Below	8.0 lbs./3.6 kg.	\$85.00

NOTE: * Where multiple RA-70s are being used, only one isolation transformer is required.
Three units maximum per transformer.
Not required with single power source.

REPLACEMENT AND SPECIALTY PRODUCTS PRICE LIST

SSR SERIES

REFER TO DISCOUNT SCHEDULE VR-2

SSR On Caterpillar Adapter Kit	Product Bulletin	Shipping Weight	Price Each
SSR32-12	SXX	25 lbs./11.3 kg.	\$1,715.00
SSR63-12	SXX	25 lbs./11.3 kg.	\$1,839.00

SR-F SERIES

REFER TO DISCOUNT SCHEDULE VR-1

Model	Product Bulletin	Shipping Weight	Price Each
SR4F1	SB	50 lbs./22.7 kg.	\$4,196.00
SR4F3	SB	50 lbs./22.7 kg.	\$4,323.00
SR8F1	SB	50 lbs./22.7 kg.	\$4,722.00
SR8F3	SB	50 lbs./22.7 kg.	\$4,814.00

SR-H SERIES AND SR-E SERIES

REFER TO DISCOUNT SCHEDULE VR-1

Model	Product Bulletin	Shipping Weight	Price Each
SR32H	SA-3	29 lbs./13.2 kg.	\$3,379.00
SR32E	SA-3	29 lbs./13.2 kg.	\$3,930.00
SR63H	SA-3	29 lbs./13.2 kg.	\$3,464.00
SR63E	SA-3	29 lbs./13.2 kg.	\$4,010.00
SR125H	SA-3	29 lbs./13.2 kg.	\$3,555.00
SR125E	SA-3	29 lbs./13.2 kg.	\$4,138.00
SR250H	SA-3	29 lbs./13.2 kg.	\$3,623.00
SR250E	SA-3	29 lbs./13.2 kg.	\$4,323.00

SURGE SUPPRESSOR - Use across field winding of generator for transient voltage protection.

REFER TO DISCOUNT SCHEDULE VR-1

Part Number	Use For Fields Rated	Shipping Weight	Price Each
11854	32, 63, OR 125 Vdc	5.0 lbs./2.3 kg.	\$170.00
11855	250 Vdc	5.0 lbs./2.3 kg.	\$318.00

KR SERIES

REFER TO DISCOUNT SCHEDULE VR-2

Model	Product Bulletin	Shipping Weight	Price Each
KR2FF	SD	7.0 lbs./3.2 kg..	\$937.00
KR4FFMX	SD	7.0 lbs./3.2 kg.	\$940.00
KR7FFMX	SD	7.0 lbs./3.2 kg.	\$1,195.00

REPLACEMENT AND SPECIALTY PRODUCTS PRICE LIST

XR2002 SERIES

REFER TO DISCOUNT SCHEDULE VR-2

Model	Product Bulletin	Shipping Weight	Price Each
XR2002F	SUB	3.0 lbs./1.4 kg.	\$1,471.00

KT3B

REFER TO DISCOUNT SCHEDULE VR-1

Model	Product Bulletin	Shipping Weight	Price Each
KT3B	SED	7.0 lbs. /3.2 kg.	\$976.00

THREE-PHASE SENSING AND PARALLELING MODULE

The SPM 2000 adds three-phase sensing capability and reactive load compensation to the XR2002 Voltage Regulator Model. See Product Bulletin SRL.

REFER TO DISCOUNT SCHEDULE AC-1

Model Number	Application	Shipping Weight	List Price Each
SPM2000	Three-Phase sensing and paralleling module for the XR2002 Voltage Regulator.	7.0 lbs./3.2 kg.	\$542.00

VOLTS PER HERTZ MODULE

The VH 300 Series can be added to standard 50/60 HZ SR-A, SR-F, and SR-E Voltage Regulators. The Module adjusts regulated voltage proportional to frequency over the range of 30 to 70 Hz. The VH 3XX connects between sensing terminals and generator voltage. See Product Bulletin SPX.

REFER TO DISCOUNT SCHEDULE AC-1

Model	Generator Sensing Voltage at 60 Hz	Generator Sensing Voltage at 30 Hz	Nominal Output Voltage	Shipping Weight	Price Each
VH324	240 Vac	120 Vac	120 Vac, 1 Phase	10 lbs./4.5 kg.	\$448.00
VH348	480 Vac	240 Vac	120 Vac, 1 Phase		\$448.00
VH360	600 Vac	300 Vac	120 Vac, 1 Phase		\$448.00

REPLACEMENT AND SPECIALTY PRODUCTS PRICE LIST

AUTOMATIC SYNCHRONIZER

REFER TO DISCOUNT SCHEDULE SC-1

Model Number	Description	Product Bulletin	Shipping Weight	Price Each
PRS211	Breaker Closing Time Equalizer	UKA	5.5 lbs./2.5 kg.	\$1,655.00
PRS370	Automatic Synchronizer	UMC	6.0 lbs./2.7 kg.	\$1,282.00

AUTO-SYNCHRONIZING RELAYS - THREE PHASE

REFER TO DISCOUNT SCHEDULE SC-1

Model Number	Input Voltage	Shipping Weight	List Price Each
PRS210	120 Vac, 50/60 Hz	36 lbs./16.3 kg.	\$5,222.00
	208 Vac, 50/60 Hz		\$5,222.00
PRS220	120 Vac, 50/60 Hz	36 lbs./16.3 kg.	\$5,066.00
	208 Vac, 50/60 Hz		\$5,066.00
PRS 230	120 Vac, 50/60 Hz	36 lbs./16.3 kg.	\$4,759.00
	208 Vac, 50/60 Hz		\$4,759.00

(For descriptive information, see Product Bulletin UKB.)

SYSTEM CONTROL DEVICES

REFER TO DISCOUNT SCHEDULE SC-1

Model Number	Description	Product Bulletin	Shipping Weight	List Price Each
SCP210	Frequency Controller	UKM	9.0 lbs./4.1 kg.	\$2,477.00
SCP230	Kilowatt Controller	UKK	25 lbs./11.3 kg.	\$2,931.00
SCP240	Kilovar Controller	UKL	25 lbs./11.3 kg.	\$2,931.00
SCP260	Voltage Control Device	UKF	12 lbs./5.4 kg.	\$1,400.00

MOTOR OPERATED CONTROLS

AUTOTRANSFORMER

REFER TO DISCOUNT SCHEDULE SC-1

Model Number	Description	Product Bulletin	Shipping Weight	List Price Each
MOC 2	Motor Operated Control	SRB	16 lbs./ 7.3 kg.	\$1,176.00

REPLACEMENT AND SPECIALTY PRODUCTS PRICE LIST

REFER TO DISCOUNT SCHEDULE PR-3

Model	Bulletin	Description	List Price
BE1-25/79S	UBQ	Sync-Check/Single Shot Reclosing Relay (25/79)	\$2,295.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Addition
<input type="checkbox"/>	B	Single Shot Reclosing with Reclose Initiate and Cancel Inputs	STD
<input type="checkbox"/>	1	Lockout and Reset	STD
<input type="checkbox"/>	N	No Option Available	STD
<input type="checkbox"/> <input type="checkbox"/>	A2	Time Delay Range (0.1 to 2 Seconds)	STD
	A3	Time Delay Range (1 to 20 Seconds)	STD
	A4	Time Delay Range (5 to 60 Seconds)	STD
<input type="checkbox"/>	B	Power Supply, 48 Vdc	STD
	C	Power Supply, 125 Vdc/120 Vac	STD
	D	Power Supply, 24 Vdc	\$50.00
	X	Power Supply, 250 Vdc/240 Vac <1>	\$100.00
<input type="checkbox"/>	B	Reset Time Range (5-60 Seconds with 95 Sec Max Trial Time <2>	STD
	C	Reset Time Range (5-60 Seconds) with 15 Sec Max Trial Time <2>	STD
	D	Reset Time Range (5-60 Seconds) Without Max Trial Time Limit <1>	STD
Option 1 <input type="checkbox"/>	4	Non-Isolated Contact Sensing <1>	STD
	5	Isolated Contact Sensing <1>	\$30.00
Option 2 <input type="checkbox"/>	N	Without Voltage Monitor Capability	STD
	R	Voltage Monitor with Voltage Difference	\$205.00
	S	Voltage Monitor	\$195.00
	T	Voltage Difference	\$140.00
	A	Voltage Monitor with Voltage Difference and SPDT Output Contact	\$275.00
	B	Voltage Monitor with SPDT Output Contact	\$265.00
	C	Voltage Monitor with Voltage Difference and Power Supply Status Output	\$265.00
	D	Voltage Monitor with Power Supply Status Output	\$235.00
<input type="checkbox"/>	0	Continuous Reclose Signal	STD
	2	Maximum Reclose Signal (2-3 Seconds)	\$20.00
	3	Maximum Reclose Signal (5-6 Seconds)	\$20.00
<input type="checkbox"/>	F	Semi-Flush Mounting	STD
	P	Projection Mounting	\$45.00

NOTE: Case size will be an S1 only when option 2 is N or F. All others will be supplied in an M1 case.

<1> Purchase order must show part number of external module as a separate item if Type X Power Supply is selected.

Option 1	Contact Sensing	Module P/N	Price Addition
#4	Non-Isolated	9146301103	N/C
#5	Isolated	9146301102	N/C

<2> Max. Trial Timer is included only when option 2 is not N or F.

Replacement and Specialty Products Pricing RSP
Effective: 1/1/02
Supersedes: PP1PR3 Dated 1/1/01

REPLACEMENT AND SPECIALTY PRODUCTS PRICE LIST

REFER TO DISCOUNT SCHEDULE PR-3

Model	Bulletin	Description	List Price
BE1-49	UBJ	Temperature Relay (49)	\$1,050.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Addition
<input type="checkbox"/>	P	Sensing Input - RTD	STD
<input type="checkbox"/>	1	Input Type - 10 ohms, Copper	STD
	2	Input Type - 100 ohms, Platinum	STD
Output <input type="checkbox"/>	L	One Relay Output	STD
	M	One Relay Output	\$55.00
	F	Two Relay Outputs	\$55.00
	H	Two Relay Outputs	\$55.00
	J	Two Relay Outputs	\$55.00
	N	Two Relay Outputs	\$55.00
	P	Two Relay Outputs	\$55.00
	R	Two Relay Outputs	\$55.00
	S	Two Relay Outputs	\$55.00
	T	Two Relay Outputs	\$55.00
<input type="checkbox"/>	A1	Instantaneous	STD
<input type="checkbox"/>	B	Power Supply, 48 Vdc	STD
	C	Power Supply, 125 Vdc/120 Vac	STD
	D	Power Supply, 24 Vdc	\$50.00
	E	Power Supply, 120 Vac, Isolated <1>	\$50.00
	W	Power Supply, 48/125 Vdc	STD
	X	Power Supply, 250 Vdc/240 Vac	\$60.00
Target <input type="checkbox"/>	N	Target, None	STD
	A,B	Target, One <2>	STD
<input type="checkbox"/>	O	No Option Available	STD
<input type="checkbox"/>	N	No Option Installed	STD
	S	Power Supply Status Output	\$70.00
<input type="checkbox"/>	0	No Option Installed	STD
	1,2,5	Auxiliary Relay	\$50.00
<input type="checkbox"/>	F	Semi-Flush Mounting	STD
	P	Projection Mounting	\$45.00

NOTES: All relays are supplied in an S1 case.

<1> If a grounded RTD is to be used, power supply type E must be selected.

<2> If target is B, output must be F, J, L, N or S.

<3> If a grounded RTD is to be used, power supply type E must be selected.

Replacement and Specialty Products Pricing RSP

Effective: 1/1/02

Supersedes: PP1PR3 Dated 1/1/01

REPLACEMENT AND SPECIALTY PRODUCTS PRICE LIST

REFER TO DISCOUNT SCHEDULE PR-3

Model	Bulletin	Description	List Price
BE1-51TC	UDP	<u>Three Phase</u> Time Overcurrent Relay with Torque Control (51TC)	\$1,760.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Addition
<input type="checkbox"/>	G	Three-Phase Current Sensing	STD
<input type="checkbox"/>	1	Sensing Input Range 0.5 to 12 Amps	STD
<input type="checkbox"/>	9	Sensing Input Range 0.1 to 2.4 Amps	STD
<input type="checkbox"/>	E, F	Contact Output <2>	STD
<input type="checkbox"/>	Z1	Switch Selectable Standard and I ^t Timing Curves	STD
<input type="checkbox"/>	Z2	Switch Selectable Standard and British Timing Curves	STD
<input type="checkbox"/>	K	Power Supply, 48 Vdc	STD
<input type="checkbox"/>	J	Power Supply, 125 Vdc/120 Vac	STD
<input type="checkbox"/>	L	Power Supply, 24 Vdc	\$50.00
<input type="checkbox"/>	Z	Power Supply, 250 Vdc/240 Vac <1>	\$60.00
<input type="checkbox"/>	N	Without Targets	STD
<input type="checkbox"/>	A,B	With Targets <2>	STD
<input type="checkbox"/>	0	Without Instantaneous Element	STD
<input type="checkbox"/>	1	One Instantaneous Element	\$190.00
<input type="checkbox"/>	C	Isolated Contact Sensing	\$35.00
<input type="checkbox"/>	D	Non-Isolated Contact Sensing	STD
<input type="checkbox"/>	L	Isolated Contact Sensing with Extended Timing	\$65.00
<input type="checkbox"/>	M	Non-Isolated Contact Sensing with Extended Timing	\$30.00
<input type="checkbox"/>	0	No Option Installed	STD
<input type="checkbox"/>	1,2	Auxiliary Time Overcurrent Output Relay	\$50.00
<input type="checkbox"/>	6	Power Supply Status Output	\$70.00
<input type="checkbox"/>	F	Semi-Flush Mounting	STD
<input type="checkbox"/>	P	Projection Mounting	\$45.00

NOTE: All relays are supplied in an M1 case.

<1> If type Z power supply is selected, the purchase order must show one of the following contact modules as a separate line item.

CONTACT SENSING MODULES		
Isolated Contact Sensing (Option 2-C or L)	Non-Isolated Contact Sensing (Option 2-D or M)	Price Addition
9170206103	9170206109	N/C

<2> If target is B, then output must be E.

Replacement and Specialty Products Pricing RSP

Effective: 1/1/02

Supersedes: PP1PR3 Dated 1/1/01

REPLACEMENT AND SPECIALTY PRODUCTS PRICE LIST

REFER TO DISCOUNT SCHEDULE PR-3

Model	Bulletin	Description	List Price
BE1-51TC	UDP	<u>Three Phase with Neutral</u> Time Overcurrent Relay with Torque Control (51TC)	\$2,390.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Addition
<input type="checkbox"/>	H	Three Phase and Neutral Current	STD
<input type="checkbox"/>	2	Sensing Input Range: Phase -0.5 to 4 A; Neutral -0.5 to 4 A	STD
<input type="checkbox"/>	3	Sensing Input Range: Phase -1.5 to 12 A; Neutral -0.5 to 4 A	STD
<input type="checkbox"/>	4	Sensing Input Range: Phase -0.5 to 4 A; Neutral -1.5 to 12 A	STD
<input type="checkbox"/>	5	Sensing Input Range: Phase -1.5 to 12 A; Neutral -1.5 to 12 A	STD
Output <input type="checkbox"/>	E,F	Contact Output <2>	STD
Timing <input type="checkbox"/> <input type="checkbox"/>	Z1	Switch Selectable Standard and I ² t Timing Curves	STD
	Z2	Switch Selectable Standard and British Timing Curves	STD
<input type="checkbox"/>	K	Power Supply, 48 Vdc	STD
	J	Power Supply, 125 Vdc/120 Vac	STD
	L	Power Supply, 24 Vdc	\$50.00
	Z	Power Supply, 250 Vdc/240 Vac <1>	\$60.00
<input type="checkbox"/>	N	Without Targets	STD
	A,B	With Targets <2>	STD
<input type="checkbox"/>	0	Without Instantaneous Element	STD
	1	One Instantaneous Element	\$230.00
Option 2 <input type="checkbox"/>	C	Isolated Contact Sensing	\$35.00
	D	Non-Isolated Contact Sensing	STD
	L	Isolated Contact Sensing with Extended Timing	\$65.00
	M	Non-Isolated Contact Sensing with Extended Timing	\$30.00
<input type="checkbox"/>	0	No Option Installed	STD
	1,2	Auxiliary Time Overcurrent Output Relay	\$50.00
	6	Power Supply Status Output	\$70.00
<input type="checkbox"/>	F	Semi-Flush Mounting	STD
	P	Projection Mounting	\$45.00

NOTE: All relays are supplied in an M1 case.

<1> If type Z power supply is selected, the purchase order must show one of the following contact modules as a separate line item.

CONTACT SENSING MODULES		
Isolated Contact Sensing (Option 2-C or L)	Non-Isolated Contact Sensing (Option 2-D or M)	Price Addition
9170206103	9170206109	N/C

<2> If target is B, then output must be E.

Replacement and Specialty Products Pricing RSP

Effective: 1/1/02

Supersedes: PP1PR3 Dated 1/1/01

REPLACEMENT AND SPECIALTY PRODUCTS PRICE LIST

REFER TO DISCOUNT SCHEDULE PR-3

Model	Bulletin	Description	List Price
BE1-81	UBM	Underfrequency Relay (81)	\$1,500.00
STYLE NUMBER			
Specific Style	Variations	Description	Price Addition
<input type="checkbox"/>	T	Single-Phase Sensing	STD
<input type="checkbox"/>	1	120 Volt, 60 Hz Nominal	STD
	2	120 Volt, 50 Hz Nominal	STD
Output <input type="checkbox"/>	E, G	One Relay Output <1>	STD
<input type="checkbox"/> <input type="checkbox"/>	D1	Inverse Time Delay	STD
	E1	Definite Time Delay	STD
<input type="checkbox"/>	B	Power Supply, 48 Vdc	STD
	C	Power Supply, 125 Vdc/120 Vac	STD
	D	Power Supply, 24 Vdc	\$50.00
	E	Power Supply, 120 Vac, Isolated	\$40.00
	W	Power Supply, 48/125 Vdc	STD
	X	Power Supply, 250 Vdc/240 Vac	\$60.00
Target <input type="checkbox"/>	N	Without Target	STD
	A,B	With One Target <1>	STD
<input type="checkbox"/>	0	No Option Installed	STD
	2	Sensing Input Power Supply (with Type C or E Power Supply only)	\$20.00
<input type="checkbox"/>	N	No Option Installed	STD
	S	Power Supply Status Output	\$70.00
<input type="checkbox"/>	0	No Option Installed	STD
	1,2,5	Auxiliary Relay	\$50.00
<input type="checkbox"/>	F	Semi-Flush Mounting	STD
	P	Projection Mounting	\$45.00

NOTE: All relays are supplied in an S1 case.

<1> Target option B may only be selected when output is E.

Replacement and Specialty Products Pricing RSP
Effective: 1/1/02
Supersedes: PP1PR3 Dated 1/1/01