Service Information

Pow-R-Con™

DYN2-94025-004

DYN2-94026-004

MODELS:

DYN2-94025-004	Pow-R-Con with Keypad/Display Panel mounted in cover
DYN2-94026-004	Pow-R-Con without Keypad/Display Panel
DYNK-55100-001	Keypad/Display Panel only
DYNA-29900-001	Pow-R-Con with Keypad/Display Panel for remote mounting

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1.0 INTRODUCTION

1.1 GENERAL

The Barber-Colman Pow-R-Con™ provides integrated, multi-function control and monitoring of single or multiple generator units. The following features are available with a Pow-R-Con module interfaced to an engine/generator:

- Measurement, Annunciation, and Control Setup
- Isochronous Load Sharing
- Auto-Synchronizing
- Load Commanding/Blending
- Dead Bus

Programming and monitoring of all operational functions are available to the user through either a dedicated Keypad/Display Panel or by connecting a laptop computer with the Front End Software installed to the Pow-R-Con.

WARNING

ALWAYS turn off alternator or battery charging device before installing or removing battery from the system. Failure to do so may result in damage to the control system.

1.2 POW-R-CON PART NUMBERS

- DYN2-94025-004-Pow-R-Con with Keypad/Display Panel mounted in cover
- DYNA-94026-004-Pow-R-Con without Keypad/Display Panel
- DYNK-55100-001 Keypad/Display Panel only
- DYNA-29900-001 Pow-R-Con with Keypad/Display Panel for remote mounting

1.3 STANDARD FUNCTIONS

The Pow-R-Con is used for digital synchronizing, soft loading/unloading, load sharing and power measurement of 50 and 60 Hz generators. State-of-the-art technology is provided in a self-contained module with easy field wiring. A 16-bit microcontroller is used for phase, frequency, voltage match, digital setup, and power measurement. The Pow-R-Con utlitlizes PID control of frequency and phase matching which results in very stable output. Parameters are monitored, and setup performed by means of a backlit Keypad/Display Panel that may be mounted integral to the Pow-R-Con or be remotely mounted. RS-485 terminals are provided for connecting to a PC for monitoring, adjusting, and setup.

CAUTION

DO NOT connect the keypad/display panel and the front end softward simultaneously. Doing so will result in damage to the product.

1.3.1 Display and Programming

Two (2) models of the Pow-R-Con are available to permit a variety of user monitoring and editing configurations. The following functions are accessible with each Pow-R-Con:

- Selectable nominal input voltage from 120 to 480 VAC and nominal input frequency of 50 or 60 Hz.
- Digital “true rms” readouts of currents/voltages, real/reactive power and power factor for each phase, and total real power, average power factor and frequency for three-phase.
- Status indication of major outputs and inputs with LED’s.
- Synchroscope on the keypad/display during synchronization.
- Control Mode Display which includes standby, ILS, blend, command, and diagnostics.
- User selectable Synch Hold action. When enabled the Pow-R-Con emulates the DYN2-94025-002 when disabled the Pow-R-Con emulates the DYN2-94025-003. The default setting is enabled.

1.3.2 Model DYN2-94025-004 (w/ Integral Keypad/ Display Panel)

Model DYN2-94025-004 is provided with an integral Keypad/Display Panel flush-mounted on the front of the Pow-R-Con. The Pow-R-Con unit can be configured with the keypad/display panel. The keypad/display panel can be remote mounted if desired. Measured parameters are computed as “true rms” quantities based on waveform sampling with a high-speed 12-bit A/D converter.

The LCD display provides English language readout of all values and functions necessary for the command and setup of the associated generator unit. A monitoring function provides analog performance characteristics of the generator.

The display is a 2 line by 20 character backlit LCD and the keypad has seven (7) environmently protected keys for scrolling through the menus or, viewing and entering parameters. The display has four (4) modes: Moni-

tor, Review, Program, and Setup. In the monitor mode, the display will automatically scroll through screens showing phase 1-N, 1-2, 2-N, 2-3, 3-N, 3-1, average of all three phases and the current control mode. In monitor mode, pressing the left or right key allows the user to select which phase is displayed. The selected phase is displayed until the ESC key is pressed. In the review mode, all parameters are display only and cannot be changed by the user. In program mode the user can make changes to parameter values. To enter program mode the user is required to enter a password. Setup mode is used to make initial power and CT profile entries for each associated generator. Fifteen (15) color-coded LED's are used to indicate controller and system status.

During synchronizing, the display becomes a synchroscope, with the phase difference shown as a bar graph. The bar graph is displayed when the two frequencies are close to each other, and displays as a moving character when they are further apart at the start of the synchronizing process.

1.3.3 Model DYN2-94026-004 (w/o Integral Keypad/ Display Panel)

Model DYN2-94026-004 is offered without a Keypad/Display Panel and is intended to be used in conjunction with the user's laptop PC, and Barber-Colman Protocol Software. Model DYNA-29900-004 is a DYNA 94026-004 Pow-R-Con and a separate DYNK-55100-001 Keypad/Display Panel for Remote Mounting. The Pow-R-Con is provided with RS-485 terminals to connect to the PC for monitoring, adjusting, and setup. A RS-485 to R-232 converter Barber-Colman part number DYNK-10379 is available separately.

1.3.4 Auto-Synchronizing

Auto-Synchronizing is used in prime power installations, standby power installations and other situations where it is desirable to parallel an engine/generator. The Pow-R-Con incorporates automatic synchronizing to match the frequency, phase, and voltage of an incoming generator to the frequency and phase of the bus, the utility or another generator. The synchronizer compares the incoming generator to the frequency and phase to be matched and controls its speed and phase to assure synchronization within a minimum of time.

This unit comes equipped with the ability to retain the synchronization adjustments, similar to Version 2, or discard them, similar to Version 3.

1.3.5 Isochronous Load Sharing

The object of isochronous load sharing is to proportionally divide a common load between two or more engine/generator sets while maintaining a fixed frequency. Each Pow-R-Con compares the load of its generator unit with the load applied to all other units in operation, through the paralleling lines, and either decreases or increases the engine fuel to maintain its proportional share of the total load.

1.3.6 Load Commanding/Blending

Blending loads with the Pow-R-Con allows for soft loading, unloading and power setting of the controlled generator. The following additional functions are provided:

- Adjustable ramp up and ramp down timers
- Adjustable minimum and maximum power setting
- Remote potentiometer input or internal digital setting for setting power level

1.3.7 Dead Bus Mode

Dead Bus Mode is used to connect an active generator to an inactive bus. When the bus is dead (i.e. zero current, zero voltage), the Pow-R-Con has nothing to synchronize to. To bypass this, the Pow-R-Con monitors the voltage level and when it falls below a user-defined level, it declares the bus dead. When the dead bus feature is enabled in software and the dead bus input terminal (53) is connected to common, the Pow-R-Con will provide a signal to close the generator breaker. When the breaker is closed, the generator will pick up all of the load present on the bus. This is a single unit function. Subsequent generators can Auto-Synchronize to the live bus provided by this generator.

2.0 INSTALLATION

2.1 SPECIFICATIONS

Input Voltage: 3-phase, 50/60 Hz, 120-480 VAC ± 15%

Input Current: 3-phase, 5A at Max. gen. load

Burden: 1.25 VA per phase at 5.0 A

Load Sharing: ± 0.5% Accuracy

Output Full Load: 1.5-5.0 VDC (Paralleling Lines)

Operating Temperature:

DYN2 94025-004 -20 to 55° C (-4 to 131° F)

DYN2 94026-004 -20 to 70° C (-4 to 158° F)

Shipping/Storage Temperature: -40 to 85° C

2.2 MOUNTING

2.2.1 Pow-R-Con

(4) 7/32" thru holes are provided for mounting the Pow-R-Con. See Figure 2-1 for dimensional information.

2.2.2 Remote Keypad/Display Panel

1. Select a mounting location that gives the display a minimum of 2.0 inches (50.8 mm) of back clearance.
2. Cut 5.400±.020 by 5.400±.020 inches (136.00±.51 mm) square in panel.
3. Insert display through cabinet and slide retainer bracket over studs on back of display.
4. Secure bracket with nuts provided using a 7/16 nut driver or socket.

2.3 POWER SUPPLY

Nominal Voltage range: 24 VDC

Operating Voltage range: 16-30 VDC

Maximum current requirement: .5 A

2.4 FIELD WIRING

Quick-connect screw terminals are conveniently located on outboard sides of the Pow-R-Con unit. See following sections and Tables 1-6 for Terminal descriptions and wiring.

Terminal blocks will accept a maximum of 16 Awg. The wire used for Input/output wiring must be twisted and shielded, with a minimum of (5) twists per foot.

CAUTION

Excessive line lengths can result in line losses that will effect operation of Pow-R-Con unit.

All terminal locations, numbers, and labels can be found on Figure 2-1 or marked on the side of the Pow-R-Con unit.

2.5 REQUIREMENT FOR UL LISTING

CAUTION

For UL listing this device requires a 3 amp type 3AG or equivalent fuse to be wired into the battery + supply terminal.

Kit p/n DYNK--10419 is available from manufacture. The kit includes a fuse, fuse holder and installation drawing.

2.6 BASIC CONNECTIONS

DANGER

This equipment uses lethal voltages. Before installing and/or servicing unit, disconnect and secure all voltage sources. Failure to do so may result is personal injury and/or equipment damage.

2.6.1 Generator Voltage Connections

Connect the generator voltage lines to the Generator Voltage Inputs, Terminals 1, 2 and 3. If a PT (Voltage) transformer is being used, the wires should be routed from the PT transformer to the terminals.

2.6.2 Generator Current Connections

Connect each phase of the generator current lines to an individual current transformer. The current transformer should be selected so that the current supplied to the Pow-R-Con unit is 5 Amps. Connect the CT output lines to the Generator Current Inputs, Terminals 4, 5 and 6.

CAUTION

The Generator Current Terminals have a maximum rating of 5 Amps. Exceeding this rating may result in damage to the Pow-R-Con unit.

2.6.3 CT Common

Connect the generator common (ground) line to the CT Common, Terminal 7.

2.6.4 Battery

Battery Positive Terminal to Terminal 23 and Battery Negative Terminal to Terminal 24.

2.6.5 Remote Keypad/Display Panel

WARNING

DO NOT connect the keypad/display panel and the front end softward simultaneously. Doing so will result in damage to the product.

When located within 10 feet of the main controller, connect Pow-R-Con, Terminal 23 to Keypad/Display panel, Terminal 1 and Pow-R-Con, Terminal 24 to Keypad/Display panel, Terminal 2.

For larger distances, a local 16-30 volt DC power source is required. DC Power Source Positive Terminal to Keypad/Display panel, Terminal 1 and DC Power Source Negative Terminal to Keypad/Display panel, Terminal 2.

The display can be mounted up to 4000 ft. away from the main controller when using proper wiring (Battery +/- twisted, RS-485 shielded).

2.7 AUTO-SYNCHRONIZING

2.7.1 Automatic Connections

Voltage Increase Relay, Terminal 16 and Common, Terminal 17 to generator voltage regulator.

Voltage Decrease Relay, Terminal 18, and Common, Terminal 17 to generator voltage regulator.

Synch Enable input, Terminal 38 connected to the Common, Terminal 39 to enable the Automatic function.

Governor Speed Set Output, Terminal 28 connected to engine governor.

Governor Reference Input, Terminal 29 connected to engine governor only when using an external reference voltage.

Breaker Close Relay Output, Terminal 21 and Terminal 22 connected to generator circuit breaker.

WARNING

Prior to actually closing the generator breaker to the bus or to another generator, thoroughly check that the phase rotation and voltages are correct.

2.8 ISOCHRONOUS LOAD SHARING

2.8.1 Load Sharing Connections

Forward Power On Relay Output, Terminals 10 and 11 to downstream engine/generator control.

Forward Power Off Relay Output, Terminals 12 and 13 to downstream engine/generator control.

Reverse Power On Relay Output, Terminals 14 and 15 to engine/generator control.

Breaker Trip Relay Output, Terminals 19 and 20 to generator ci rcuit breaker.

Breaker Close Relay Output, Terminals 21 and 22 to generator circuit breaker.

Breaker Aux input terminal 40 and common terminal 39 connect to the main breaker's auxiliary contacts. When the breaker closes Pow-R-Con control mode changes to Isochronous Load Sharing.

An optional remote potentiometer (5K) may be connected to the Remote Speed Set, Terminals 30, 31 and 32 to manually adjust the engine speed/frequency.

Parallel Line Input/Output, Terminals 36 and 37 to additional Pow-R-Con units.

2.8.2 Droop Connections

Droop Input, Terminal 35 connected to the Parallel Line, Terminal 37 to enable the Droop function.

2.9 LOAD RAMPING

2.9.1 Blend Mode Connections

Blend Mode Enable Input, Terminal 46 connected to the Common, Terminal 45 to enable the Blend Mode.

Load Generator Enable Input, Terminal 41 connected to the Common, Terminal 45 or to the PLC.

Unload Generator Enable Input, Terminal 43 connected to the Common, Terminal 45 or to the PLC.

Parallel Line Input/Output, Terminals 36 and 37 to additional Pow-R-Con units.

Breaker Trip Enable Input, Terminal 44 connected to Common, Terminal 42 to enable Breaker Trip Relay Output, Terminal 19 and 20.

2.9.2 Command Mode Connections

Command Mode Enable Input, Terminal 48 connected to the Common, Terminal 47 to enable the Command Mode.

Load Generator Enable Input, Terminal 41 connected to the Common, Terminal 45 or to the PLC.

Unload Generator Enable Input, Terminal 43 connected to the Common, Terminal 45 or to the PLC.

Breaker Trip Enable Input, Terminal 44 connected to Common, Terminal 42 to enable Breaker Trip Relay Output, Terminal 19 and 20.

Optional: Remote Power Set Potentiometer Input, Terminals 25, 26 and 27 to remote potentiometer (5K) to manually adjust power level.

2.10 DEAD BUS CONNECTIONS

Dead Bus Enable Input, Terminal 51 connected to the Common, Terminal 52 to enable the Dead bus Mode.

TABLE 2-1

HIGH VOLTAGE INPUTS

NOMENCLATURE	DESIGNATION	TERMINAL	DESCRIPTION
Generator Voltage Input	Gen Volt	1 2 3	3-phase generator voltage input of 120 to 480 VAC and frequency 50/60 Hz. Nominal voltage and frequency is entered through keypad/display interface. Wire to generator PT (Voltage Transformer).
Generator Current Input	Gen Cur	4 5 6 7	0-5 A CT connections of generator current for phases 1, 2 and 3 respectively and CT common (Terminal 7). Wire to generator CT (Current Transformer).
Bus Voltage Input	Bus Volt	8 9	Line to line (L1-L3) bus voltage input of 120 to 480 VAC and frequency 50/60 Hz. Nominal voltage is entered through keypad/display interface. Wire to Utility Power or Utility Power PT (Voltage Transformer) if one exists.

TABLE 2-2

BREAKER CONTROL			
NOMENCLATURE	DESIGNATION	TERMINAL	DESCRIPTION
Forward Power On Relay Output	Forward Power On	10 11	Normally open contact rated at 5A at 120VAC resistive which is energized when generator power goes above adjustable preset percentage (20-120%) of full load. Wire to Pow-R-Con of additional auxiliary generator.
Forward Power Off Relay Output	Forward Power Off	12 13	Normally open contact rated at 5A at 120VAC resistive which is energized when generator power goes below adjustable preset percentage (10-100%) of full load, after forward power relay is energized. Wire to Pow-R-Con of additional auxiliary generator.
Reverse Power On Relay Output	Reverse Power On	14 15	Normally open contact rated at 5A at 120VAC resistive which is energized when generator goes into reverse power beyond adjustable preset percentage (0-40%) of full load. Wire to breaker open (latched control).
Voltage Increase Relay Voltage Decrease Relay Output	Voltage Increase Voltage Decrease	16 17 18	Normally open contacts rated at 5A at 120VAC resistive which are energized during synchronizing to increase or decrease generator voltage to match bus voltage magnitude. Terminal 17 is common. Wire to generator voltage regulator.
Breaker Trip Relay Output	Breaker Trip Output	19 20	Normally open contact rated at 10A at 240VAC resistive for breaker tripping when separating from bus in unload operation. Wire to generator circuit breaker.
Breaker Close Relay Output	Breaker Close Output	21 22	Normally open contact rated at 10A at 240VAC resistive for breaker closing when synchronized to bus. Wire to generator circuit breaker.

TABLE 2-3

POWER CONNECTIONS

NOMENCLATURE	DESIGNATION	TERMINAL	DESCRIPTION
Battery ± Input	Batt + Batt -	23 24	16-30 VDC power source for optional door mounting of display unit. Wire to main battery circuit. To comply with UL requirements the positive battery terminal must be fused. See section 2.5.
Shield			Wire shielding termination screws.

TABLE 2-4

ANALOG INPUTS/OUTPUTS

NOMENCLATURE	DESIGNATION	TERMINAL	DESCRIPTION
External Power Set Potentiometer Input	CCW Pwr Set CW	25 26 27	Remote (external) power level setting capability for power level in command mode. Wire to 5K external potentiometer.
Governor Speed Set Output	Gov Spd Set	28	Generator governor's speed setting. Wire to generator's governor.
Governor Reference Input	Gov Ref	29	Generator governor's speed reference voltage input. . Wire to generator's governor if being used as an input. If the unit is providing an internal reference signal, no connection is made.
Remote Speed Set Potentiometer Input	CCWSpeed SetCW	30 31 32	Remote (external) speed setting capability for engine speed/frequency. Wire to 5K external potentiometer.
Power Monitor Output	+ Power Monitor -	33 34	4-20 mA output proportional to generator power measured by Pow-R-Con™. Wire to external power meter.
Droop Input	Droop Input	35	When jumpered to Terminal 37, changes load sharing from isochronous to droop. Paralleling lines are not connected.
Parallel Line Input/Output	Paralleling Lines	36 37	Connect to system paralleling lines. DC voltage proportional to generator power measured by Pow-R-Con™.
Shield			Wire shielding termination screws.

TABLE 2-5

DIGITAL INPUTS/OUTPUTS			
NOMENCLATURE	DESIGNATION	TERMINAL	DESCRIPTION
Synch Enable Input	Synch Enable	38	Digital input to enable synchronizer. Digital inputs are enabled by connection to common (Terminal 39). Jumper to common or wire to PLC.
Common	Common	39	Common connections for digital inputs.
Breaker Auxiliary Input	Breaker Aux.	40	Digital input indicating generator breaker status. A signal from a breaker auxiliary contact must be connected between Terminal 40 and one of the common terminals (Terminals 39, 42, 45, 47) to operate in any of load sharing modes. Jumper to common or wire to PLC.
Load Generator Enablel nput	Load Gen	41	Activates ramping load to generator. Once input is enabled, ramping continues until generator output matches load sharing level in blend mode or command level in command mode. Not active in normal ILS mode. Jumper to common or wire to PLC. Unload generator enable input overrides load generator enable input.
Common	Common	42	Common connections for digital inputs.
Unload Generator Enable Input	Unload Gen	43	Activates ramping down load to generator. Once input is enabled, ramping continues until generator output reaches adjustable low limit. Jumper to common or wire to PLC. Unload generator enable input overrides load generator enable input.
Breaker Trip Enable Input	Breaker Trip	44	Activates breaker trip relay to separate generator from bus when low limit is reached in blend or command mode or immediately activates breaker trip relay in normal ILS mode. This input must be enabled and breaker trip reached before breaker trip relay is energized. Jumper to common or wire to PLC.
Common	Common	45	Common connections for digital inputs.
Blend Mode Enable Input	Blend Mode	46	Digital input to select blend mode for load ramping function. Jumper to common or wire to PLC.
Common	Common	47	Common connections for digital inputs.
Command Mode Enable Input	Command Mode	48	Digital input to select command mode for load ramping function. If neither command nor blend inputs are selected then load ramping function is inactive, and Pow-R-Con operates in normal load sharing mode. Jumper to common or wire to PLC.
RS-485 Interface or Remote Keypad/Display Panel	RS-485 A RS-485 B	49 50	RS-485 interface for cabinet door mounting of display unit or remote PC connection.
Bridge Integrator Enable Input	Bridge Int	51	Digital input to enable bridge integrater for governor speed set. Do not enable in auto-synch and command modes. Jumper to common or wire to PLC.
Common	Common	52	Common connections for digital inputs.
Dead Bus Mode Enable Input	Dead Bus	53	Digital input to select dead bus mode for auto-synching bypass. If dead bus is not active, the Pow-R-Con operates in Auto-Synchronizing mode. Jumper to common or wire to PLC. Dead bus hardware input is not active until enabled in software.

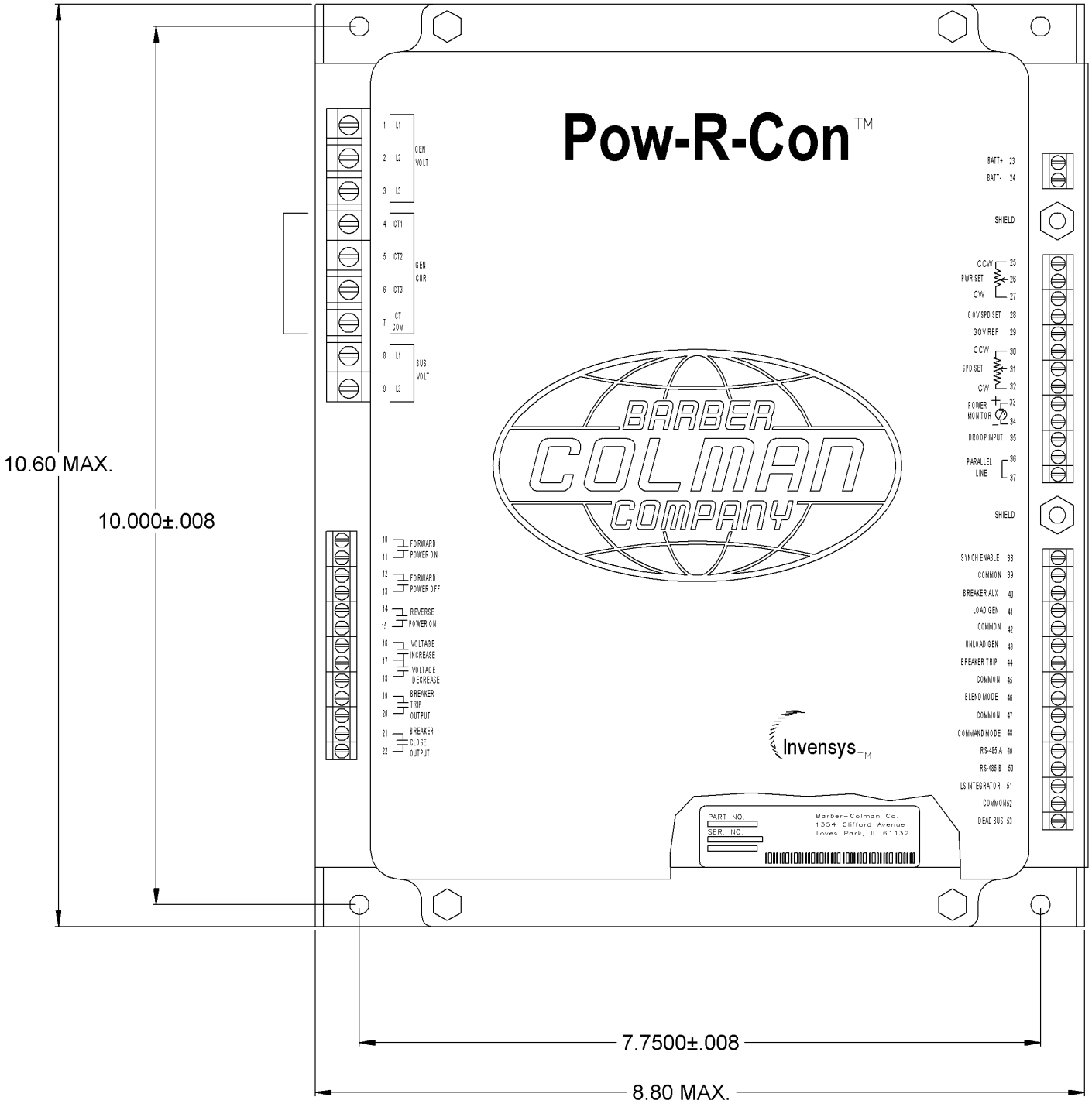
TABLE 2-6

KEYPAD/DISPLAY PANEL CONNECTIONS

NOMENCLATURE	TERMINAL	DESCRIPTION
Batt +	1	Wire to 18-28 VDC power source (from Terminal 23 of Pow-R-Con unit).
Batt -	2	Wire to 18-28 VDC power source (from Terminal 24 of Pow-R-Con unit).
Shield	3	Connect to shielding termination terminals (B/T Terminals 24/25 or 37/38)
RS-485 A	4	Wire to Terminal 49 of Pow-R-Con™.
RS-485 B	5	Wire to Terminal 50 of Pow-R-Con™.

Note: Terminal No. 1 is the terminal nearest the side edge.

FIGURE 2-1


Pow-R-Con™
BARBER COLMAN COMPANY
Invensys™
1 L1
2 L2
3 L3
GEN VOLT
4 CT1
5 CT2
6 CT3
7 CT COM
GEN CUR
8 L1
9 L3
BUS VOLT
10 FORWARD POWER ON
11
12 FORWARD POWER OFF
13
14 REVERSE POWER ON
15
16 VOLTAGE INCREASE
17
18 VOLTAGE DECREASE
19 BREAKER TRIP OUTPUT
20
21 BREAKER CLOSE OUTPUT
22
BATT+ 23
BATT- 24
SHIELD
CCW 25
PWR SET 26
CW 27
GOV SPD SET 28
GOV REF 29
CCW 30
SPD SET 31
CW 32
POWER MONITOR 33
34
DROOP INPUT 35
PARALLEL LINE 36
37
SHIELD
SYNCH ENABLE 38
COMMON 39
BREAKER AUX 40
LOAD GEN 41
COMMON 42
UNLOAD GEN 43
BREAKER TRIP 44
COMMON 45
BLEND MODE 46
COMMON 47
COMMAND MODE 48
RS-485 A 49
RS-485 B 50
LS INTEGRATOR 51
COMMON52
DEAD BUS 53
PART NO.
SER. NO.
Barber-Colman Co.
1354 Clifford Avenue
Loves Park, IL 61132
10.60 MAX.
10.000±.008
7.7500±.008
8.80 MAX.

3.0 SETTINGS

3.1 GENERAL

User settings are entered through the Keypad/Display Panel on the controller or from a laptop through the RS-485 interface and front-end software.

Dip switches are provided for selecting the type of governor.

3.2 GOVERNOR SETTINGS

Dip switches are provided for setting the type of governor that the Pow-R-Con unit is used with. See Table 3-1 for proper governor settings. If you have a governor that is not listed, consult the factory.

Switch (1) and Switch (2) interact with each other and must be set based on the type of governor being controlled.

Most electronic speed governors control speed by comparing an input speed signal to a reference. This reference is typically iether a mid voltage between a minimum and a maximum voltage or the reference is the same as the system ground.

In the first method the governor controls eninge speed by comparing the governor set speed input to the mid voltage reference. The governor set speed input swings both sides of the reference voltage to increase or decrease the engine speed as needed. The governor or the Pow-R-Con itself can supply the reference voltage. If the governor supplies the reference voltage switch (1) is set to off and switch (2) is set to on. If the governor does not supply the references switch 1) is set to on and R174 can be adjusted so the Pow-R-Con uses a lower internal reference. The governor reference (terminal 29) on the Pow-R-Con must be connected to the reference terminal on the governor.

In the second method the governor uses ground as reference and controllers speed between this reference and a positive voltage. This voltage is typically 5 or 10 volts and is supplied from the governor. When the governor set supplies the voltage, switch (1) and switch (2) should be set to off and the Pow-R-Con will then generate its own internal reference. The Pow-R-Con governors reference should be connected to this positive voltage (10 VDC maximum). Do not connect the Pow-R-Con governor reference (terminal 29) to ground. If the governor does not supply 5 or 10 volts use the suggested switch settings from Table 3-1 or contact the manufacturer.

Switch (3)-Governors have varying levels of sensitivity to the changes in the speed set (voltage) signal sent out by the Pow-R-Con. In other words, the total system gain of the governor and the Pow-R-Con may be too high or too low. If this is the case, the switch position should be placed in the ON position. In the ON position, the R173 potentiometer is enabled. The potentiometer can be used to vary the gain of the Pow-R-Con

TABLE 3-1
GOVERNOR SETTINGS

Governor	SWITCH POSITIONS -004					Interconnection
1=ON 2=OFF	1	2	3	4	5	Schematic
Barber-Colman	1	0	0	1	0	
Cummins EFC	1	0	0	1	0	
Cummins QST	0	0	1	1	0	
Cummins QSK	0	0	1	1	0	
Deutz EMR	0	0	1	1	0	
GAC	0	0	1	0	1	
Heinzmann	1	1	0	0	1	
Scania DEC-2	0	0	1	0	1	
MTU DDEC	0	0	1	1	0	
MTU MDEC	0	1	1	1	0	
Woodward 8290	1	1	1	1	0	
Woodward 2301A	0	1	1	1	0	
Barber-Colman DPG -2201	0	0	0	1	0	

to match the requirements of the governor. In this case, the gain of the Governor Speed Set Signal is being adjusted. Otherwise, the switch should be in the OFF position and the fixed gain of the Governor Speed Set Signal will be used.

Switch (4)-Governors that increase speed with a positive voltage change are called forward acting. For forward acting governors the switch should be in the ON position and Switch (5) should be OFF.

Swith (5)-Governors that decrease speed with a positive voltage change are called reverse acting. For reverse acting governors the switch should be in the ON position and Switch (4) should be OFF.

Note: If both switch (4) and switch (5) are in the ON position, no damage will occur. However, the system will not operate properly.

The dip switches are located under the cover. The cover can be removed by removing (4) hex nuts (Figure 2-1). Pow-R-Con units with an integral display will have wires connected to the backside of the cover/display. For support of the cover with display, attach the top (2) holes in the cover to the bottom (2) baseplate (cover) studs.

CAUTION

DO NOT use the wires to support the weight of the cover. It could result in damage to the unit.

CAUTION

ALWAYS practice safe static procedures when working in or around the PC board assembly. Failure to do so may result in damage to static-sensitive parts.

3.3 KEYPAD/DISPLAY PANEL

CAUTION

DO NOT connect the keypad/display panel and the front end softward simultaneously. Doing so will result in damage to the product.

If you have a unit with a keypad/display panel, complete the following procedure. If you do not have a unit with a keypad/display panel, go to Section 3.4 for PC Front-end Software Setup.

Refer to Section 5.2 for instructions on how to access each of the menus listed in this section.

3.3.1 Power-up

Each time power is applied to the Pow-R-Con and the display panel, the following information will be displayed and verified during Pow-R-Con initialization:

- Panel Display Version (> 0.51G)
- Comm rate at 1200, 4800
- Controller Version (> 0.50)

TABLE 3-2
KEYPAD/DISPLAY PANEL
SYSTEM SET-UP MENU OPTIONS

DISPLAY SCREEN	RANGE	DEFAULT
Setup System		
Gen Power 1 KW	0-2500	1
Sys Volt 120 VAC	120, 240, 480	120
Bus Freq 60 Hz	50, 60	60
PT Ratio 1	1-600	1
CT Ratio A 1.0	1.0-999.9	1.0
CT Ratio B 1.0	1.0-999.9	1.0
CT Ratio C 1.0	1.0-999.9	1.0
Bridge Int Off	On, Off	Off
Dead Bus Off	On, Off	Off

3.3.2 Set-up System

WARNING

The following Pow-R-Con set-up procedure MUST be completed prior to operating the engine/generator. Failure to perform this set-up could result in overloading and/or causing damage to the engine/generator equipment.

The Pow-R-Con comes from the factory with default values for all parameters. Refer to Table 3-2 for ranges and default values.

In set-up, the following parameters will be entered:

- Generator Power - 100% power rating of the generator being controlled by the Pow-R-Con unit. This parameter is used to calculate many of the generator output load setpoints that are entered as percentages.
- System Voltage – voltage level being fed into the Pow-R-Con unit, after (downstream) of the potential transformer (if used). This value is used for voltage matching during auto-synchronization. Select one of three input voltages for the following ranges: Select 120 for100v to 160v range; select 240 for 160v to 320v range; select 480 for 320v to 600v range.
- Bus Frequency – This value is used for frequency matching during auto-synchronization. Two choices exist which are 50 or 60 Hz.
- Potential (Voltage) Transformer Ratio - ratio of the in-line to out-line voltage of the step down transformer. If no transformer is used, the ratio entered is (1). This parameter is used to scale the generator output voltage to calculate generator power output.
- Current Transformer Ratio A - ratio of the line-to-line current of the step down transformer. This parameter is used to scale the generator output current to calculate generator power output. The resulting current to the unit should be a maximum of 5 A at rated generator power output.
- Current Transformer Ratio B - ratio of the line-to-line current of the step down transformer. This parameter is used to scale the generator output current to calculate generator power output. The resulting current to the unit should be a maximum of 5 A at rated generator power output.
- Current Transformer Ratio C - ratio of the line-to-line current of the step down transformer. This parameter is used to scale the generator output current to calculate generator power output. The resulting current to the unit should be a maximum of 5 A at rated generator power output.
- Bridge Integrator – enable or disable the the aiblity of the Pow-R-Con to eliminate steady state error with the integrator portion of the governor speed set PID control scheme for load control. Integral control will eliminate steady state errors from the control system (Proportional and Derivative control will not). This function requires the use of an input signal for activation. This function should only be used during Blend tracking and ILS standby modes. Do not use this for auto-synch or command modes.
- Dead Bus – enable or disable the ability of the Pow-R-Con to bring a generator on-line during a bus power outage if voltage is lower than a user-defined voltage level. This function requires the use of an input signal for activation. When enabled, auto-synchronizing is bypassed and the breaker is closed.

TABLE 3-3
KEYPAD/DISPLAY PANEL
LOAD SHARE SET-UP MENU OPTIONS

Program L/s setup		
Parall Volt 3.000 V	0-2500	1
PT Ratio 1	1-600	1
CT Ratio A 1.0	1.0-999.9	1.0
CT Ratio B 1.0	1.0-999.9	1.0
CT Ratio C 1.0	1.0-999.9	1.0
Gen Power 1 KW	0-2500	1
Dead Bus Off	On, Off	Off
DB Level 10 VAC	0 - 30	10
Synch Hold On	On, Off	On

3.3.3 Program Load Share Set-up

For Keypad/Display Panel Load Sharing menu structure and default values refer to Table 3.3.

Several values that were used in System Set-up, Section 3.3.2 can be reused here:

- Potential (Voltage) Transformer Ratio
- Current Transformer Ratio A
- Current Transformer Ratio B
- Current Transformer Ratio C
- Generator Power

In L/s Set-up, the following parameters will be entered:

- Parallel Voltage – total voltage range that the paralleling lines will use to compute proportional load share. This voltage sets the gain of the load sharing circuit. A higher voltage will cause a more rapid system response to load sharing but will also result in a less stable system. A lower voltage will result in lower proportional gain. This will allow a larger steady state error to exist in the system.
- Potential (Voltage) Transformer Ratio - ratio of the in-line to out-line voltage of the step down transformer. If no transformer is used, the ratio entered is (1). The Pow-R-Con is capable to accept voltages in the range of 120Vac to 480 VAc. The generator voltage can be 480 VAC or greater and the installer prefers to use a lower voltage such as 120VAC as the actual voltage connected to the terminals. The transformer is used to reduce the voltage. The PT ratio is used to make the appropriate scaling of the voltage. This parameter is used to scale the generator output voltage for display and to calculate generator power output.
- Current Transformer Ratio - ratio of the line current to the stepped down current. The output current of the generator can be 100's or 1000's of amps which cannot be taken directly to the Pow-R-Con. The current transformer is used to reduce the actual input current. The CT ratio is used to make the appropriate scaling of this current. This parameter is used to scale the generator output current for display and to calculate generator power output. The resulting current to the unit should be a maximum of 5 A at rated generator power output.
- The Pow-R-Con is a three phase generator control. It requires 3 current transformers and three corresponding current transform scaling constants (1 per phase). These are referred to as CT ratio A, B and C.
- Generator Power - is the programmed 100% power rating of the generator being controlled by the Pow-R-Con unit. This parameter is used as the basics to calculate many of the generator output load setpoints that are entered as percentages of the 100% power rating.
- Dead Bus – enable or disable the ability of the Pow-R-Con™ to bring a generator on-line during a bus power outage. This function requires the use of an input signal for activation. When enabled, auto-synchronizing is bypassed and the breaker is closed when sync enable input is energized and the bus is determined to be dead.
- Dead Bus Voltage - maximum voltage level that is allowable across the Bus Voltage Input terminals that will allow the unit to close to the bus. Some residual bus voltage often exists due to noise in the lines.

- Synch Hold – The Pow-R-Con adjusts the speed of the governor during the sync'ing process. The voltage on the setpoint can be "held" or let go (back to starting point) at the time the breaker closes. If the bus frequency is stable the sync hold can imporve load sharing accuracy after the breaker closes. If sync hold is enabled, the unit will hold the speed offset required to synchronize when the unit is synchronized. If not enabled, after the engine is synchornized the speed offset required to synchronize will be removed.

TABLE 3-4
KEYPAD/DISPLAY PANEL
LOAD SHARE RELAYS MENU OPTIONS

DISPLAY SCREEN	RANGE	DEFAULT
Program L/s relays		
Pwr ON Lvl 60 %	20-120	60
Pwr OFF Lvl 30 %	10-100	30
Rev Pwr Lvl 20 %	0-40	20
Fpwr ON Del 10 SEC	0-300	10
Fpwr ON Del 10 SEC	0-300	10

3.3.4 Program Load Share Relay

For Keypad/Display Panel Load Sharing menu structure and default values refer to Table 3-4.

In L/s Relay, the following parameters will be entered:

- Forward Preset Power Level On – is a programmable generator power output level, that is a percentage of rated power, used to bring a downstream generator on-line. The unit will calculate the power level using the Generator Power entered previously and compare it to the power calculated through the voltage and current lines. The Forward Power On Relay Output contact is closed at this level after the Forward Power On Time has elapsed.
- Forward Preset Power Level Off - is a programmable power generation level, that is a percentage of rated power, used to take a downstream generator off-line. The unit will calculate the power level using the Generator Power entered previously and compare it to the power calculated through the voltage and current lines. The Forward Power Off Relay Output contact is closed at this level after the Forward Power Off Time has elapsed.
- Reverse Preset Power Level – is a programmable power absorption level, that is a percentage of full generator power, used to take a generator off line when current flows into a generator (reverse power). At the set reverse power level of the generator the Reverse Power On Relay Output contact will be closed causing the generator to go off line. The unit calculates the reverse power level using the Generator Power entered previously and compare it to the power measured through the voltage and current lines. The Reverse Power On Relay Output contact is closed at this level after an internally calculated period of time has elapsed.
- Forward Power On Time – length of time that the generator needs to exceed the Forward Preset Power Level On before the Forward Power On Relay Output contact will be closed.
- Forward Power Off Time - length of time that the generator needs to fall below the Forward Preset Power Level Off before the Forward Power Off Relay Output contact will be closed.

TABLE 3-5
KEYPAD/DISPLAY PANEL
SYNCHRONIZATION MENU OPTIONS

DISPLAY SCREEN	RANGE	DEFAULT
Program Synch		
Phas Over 15 %	1-100	15
Phas Prop 35 %	1-100	35
Phas Intg 30 %	1-100	30
Freq Over 28 %	1-100	28
Freq Prop 50 %	1-100	50
Freq Intg 75 %	1-100	75
Volt Match 1.0 %	+/- 1.0-15.0	1.0
Freq Match .12 Hz	+/- 0.1-0.25	.12
Phase Match 10 DEG	+/- 2-20	10

3.3.5 Program Synch

For Keypad/Display Panel Synchronizing Mode menu structure and default values refer to Table 3-5. The default values entered at the factory for the Synchronizing parameters are safe values that will synchronize the generator to the bus. The potential drawback to using the default values may be the time needed to achieve synchronization versus the time required by the application to get a generator on-line.

Auto Synchronizer performance may be checked and improved. Refer to Auto Synchronizing Calibration, Section 4.5 for instructions.

In Synch, the following parameters will be entered:

- Phase Overall Gain – acts as a sensitivity adjust for the phase control terms. The higher the gain, the more aggressive the correction by all the phase PID terms.
- Phase Proportional Gain – will produce a corrective action based on the magnitude of the phase difference. This is essentially an amplifier. The higher the gain, the more aggressive the correction.
- Phase Integral Gain – The drawback of using only proportional control is it will introduce a steady state error proportional to the magnitude of the original difference. The steady state phase error is corrected using the integral term. The speed of the corrective action is changed by the phase integral gain and the magnituded of the proportional phase error. If an error remains, the control will continue to adjust. A larger gain value will increase the rate of change. This type of control will eliminate steady state error, but set too high it will introduce system instability.
- Frequency Overall Gain – acts as a sensitivity adjust for the frequency control terms. The higher the gain, the more aggressive the correction.
- Frequency Proportional Gain – will produce a corrective action based on the magnitude of the frequency difference. This is essentially an amplifier. The higher the gain, the more aggressive the correction.
- Frequency Integral Gain – The drawback of using only proportional control is it will introduce a steady state error proportional to the magnitude of the original difference. The steady state frequency error is corrected using the integral gain term. the speed of the corrective action is changed by the frequency integral gain and the magnitude of the proportional frequency error. If an error remains constant, the control response will continue to increase over time. A larger gain value will increase the rate of change. This type of control will eliminate steady state error. However, it will introduce system instability.
- Voltage Match Window – range of the difference between bus voltage and generator voltage that the synchronizer will allow to exist at the time the Pow-R-Con initiates the closing of the Breaker Close Relay Output.
- Frequency Match Window – range of the difference between bus frequency and generator frequency that the synchronizer will allow to exist at the time of the Pow-R-Con initiates the closing of the Breaker Close Relay Output.
- Phase Match Window – range of the difference between bus phase and generator phase that the synchronizer will allow to exist at the Pow-R-Con initiates the closing of the Breaker Close Relay Output.

TABLE 3-6
KEYPAD/DISPLAY PANEL
COMMAND MODE MENU OPTIONS

DISPLAY SCREEN	RANGE	DEFAULT
Program Command		
Pwr Input Pot	Key, Pot	Pot
Pwr LO Limit 10 %	1-100	10
Pwr HI Limit 80 %	1-120	80
Pwr Set Lvl 50 %	1-120	50
Trip Level 15 %	1-120	15
Ramp Up 20 SEC	0-300	20
Ramp Down 20 SEC	0-300	20

3.3.6 Program Command

For Keypad/Display Panel Command Mode menu structure and default values refer to Table 3-6.

In Command Mode, the following parameters will be used:

- Power Set Select – enables the use of an external potentiometer set the generator power output rather than use the keypad or PC software to set the power level.
- Power Low Limit - generator power output level that is a percentage of rated power output that the user wants to bring the generator on-line and hold until a ramping signal is provided to the Load Generator Enable Input. The unit will calculate the power level using the Generator Power entered previously. The forward power off relay output contact is closed at this level.
- Power High Limit – is the generator power output level as a percentage of the generator power rating that the generator will produce when the Pow-R-Con is commanded to ramp to high limit. The unit will calculate the power level using the Generator Power entered previously.
- Power Set Level – generator power output level that is a percentage of rated power output that the user wants to achieve after the ramping signal has been provided to the Load Generator Enable Input. The unit will calculate the power level using the Generator Power. This value is used when the Power Set Select is Key Board.
- Trip Level – maximum generator power output level that is a percentage of rated power output that the user wants to open the breaker after the ramping signal has been provided to the Unload Generator Enable Input. The unit will calculate the power level using the Generator Power entered previously. Once the generator output is below this level, the breaker will open provided the Break Trip Enable Input is energized.
- Ramp Up Time – length of time it will take for the generator output to ramp from Power Low Limit to Power Set Level. The time starts when Load Generator Enable Input is energized.
- Ramp Down Time – length of time it will take for the generator output to ramp from Power Set Level to Power Low Limit. The time starts when a signal is provided to the Unload Generator Enable Input.

TABLE 3-7
KEYPAD/DISPLAY PANEL
BLEND MODE MENU OPTIONS

DISPLAY SCREEN	RANGE	DEFAULT
Program Blend		
Pwr LO Limit 10 %	1-100	10
Trip Level 50 %	1-120	50
Ramp Up 20 SEC	0-300	20
Ramp Down 20 SEC	0-300	20

3.3.7 Program Blend

For Keypad/Display Panel Blend Mode menu structure and default values refer to Table 3-7.

In Blend Mode, the following parameters will be entered:

- Power Low Limit - generator power output level that is a percentage of rated power output that the user wants to bring the generator on-line and hold until a ramping signal is provided to the Load Generator Enable Input. The unit will calculate the power level using the Generator Power entered previously.
- Trip Level – maximum generator power output level that is a percentage of rated power output that the user wants to open the breaker after the ramping signal has been provided to the Unload Generator Enable Input. The unit will calculate the power level using the Generator Power entered previously. Once the generator output is below this level, the breaker will open with a signal provided to the Breaker Trip Enable Input.
- Ramp Up Time – length of time it will take for the generator output to ramp from Power Low Limit to load sharing level measured on the paralleling lines. The time starts when a signal is provided to the Load Generator Enable Input.
- Ramp Down Time – length of time it will take for the generator output to ramp from load sharing level to Power Low Limit. The time starts when a signal is provided to the Unload Generator Enable Input.

3.4 PC FRONT END SOFTWARE SETUP

CAUTION

DO NOT connect the keypad/display panel and the front end softward simultaneously. Doing so will result in damage to the product.

WARNING

The following Pow-R-Con set-up procedure MUST be completed prior to operating the engine/generator. Failure to perform this set-up could result in overloading and/or causing damage to the engine/generator equipment.

If you have a unit without a keypad/display panel, complete the following procedure. If you are using a unit with a keypad/display panel, go to Section 3.3 for Keypad/Display Panel Setup. ***b***

Refer to section 5.3 for instructions on how to access each of the menus listed in this section.

3.4.1 Equipment

The following equipment is required to install the setup information and to calibrate or check the settings of the Pow-R-Con:

- IBM Compatible computer with a minimum 486 processor running at 66MHZ or greater
- 8 Megabytes RAM
- 3.5 in. floppy disc drive
- 5 Megabytes free hard drive space
- Free serial comm. port (Software defaults to comm. port 1)
- DOS available. (Must restart computer under DOS if Win 95/98 is installed)
- Mouse useful but not required
- Barber Colman RS 485 Converter – To convert from RS-232 to RS-485 (p/n DYNK-55000)

Note: The output of the converter connects to terminals 49 (RS-485 A), and 50 (RS-485 B).

3.4.2 PC Front End Softwarde Set-up

Install of Pow-R-Con front-end software on Windows 98 second edition.
Note: an Internet connection is required to download the latest version of software from ***www.dynaproducts.com***.

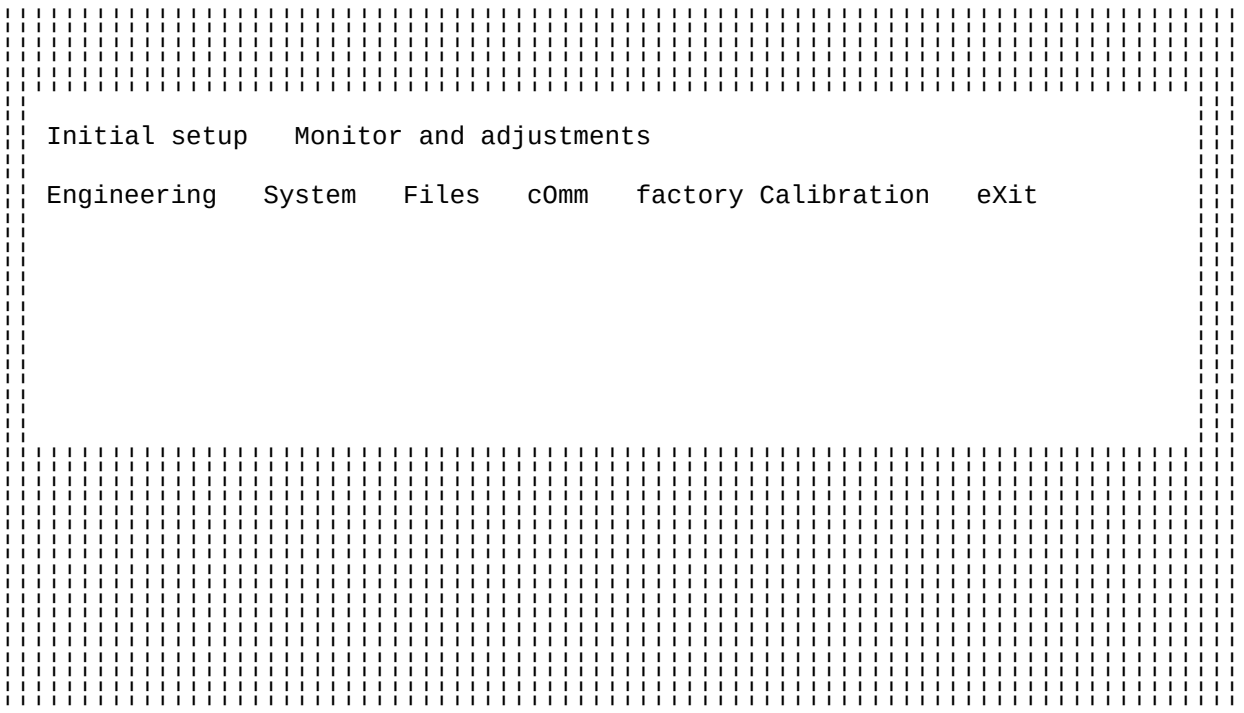
1. Use the browser of your choice to navigate to the DYNA Products home page at the web address above.
2. Select "software" which will display a list of downloadable software.
3. Select "Pow-R-Con Software DYN2-94025-004 - XXX94025.exe" by clicking on "XXX94025.exe". The current version is 0.62b, which give a file name of 06294025.exe. As new versions are released the version number will be incremented. Always download the latest version.
4. Download the software to a directory of your choice. For this example the directory used is "c:\bcpc".
5. Use windows explorer to double click on file 06294025 in directory c:\bcpc. A DOS window will appear and the program will self-extract into several files.
6. Close the DOS window by clicking on the "X" in the upper let corner of the DOS window.
7. Use windows explorer to select the file 94025062 in directory c:\bcpc by right clicking on the file and create a shortcut.
8. Move the short cut to the desktop if desired.
9. Right click on the shortcut and select "Properties" in the popup menu. In the properties window select "Program" then select "Advanced". In the "Advanced Program Settings" select "Prevent MS-DOS based programs from detecting Windows".
10. Click on the "OK" in the "Advanced Program Settings then click on the "OK" in the "Shortcut Properties".
11. Run the program by double clicking the icon created above.

The first screen to appear should be the Copyrights Screen which is a rectangular data block within a "woven outline pattern" showing:

Barber Colman Controller Communications
Copyright 1993 ©
Barber Colman
All Rights Reserved

The second screen to appear is the LOG IN screen. The cursor will be in the NAME field, type BCC and press the ENTER key. The cursor will jump to the PASSWORD field. Type OEM and press the ENTER key. As you type, the password wil be displayed as astericks.

PC FRONT END HOME PAGE FIGURE 3-8



Once the password has been entered, the third screen will appear with:

Checking Communications with 94025 at 4800 baud.(baud rate may be different)

Note: If a red error screen appears, indicating noise or failure in communications, recheck input power to the Pow-R-Con, RS-485, and laptop interface connections.

If the setup information has not been set into the Pow-R-Con for the specific generator being used, the following message will appear:

"This unit is not setup properly. Before running the engine, select the Setup sub-menu from the Engineering menu and perform the setup of the Pow-R-Con. Please press any key to continue."

Note: If the PT ratio and the CT ratio are both 1 the above message will appear. The factory defaults for the PT and CT ratio are both 1.

Once the communications check has been completed, the Main Menu, figure 3-8, will appear:

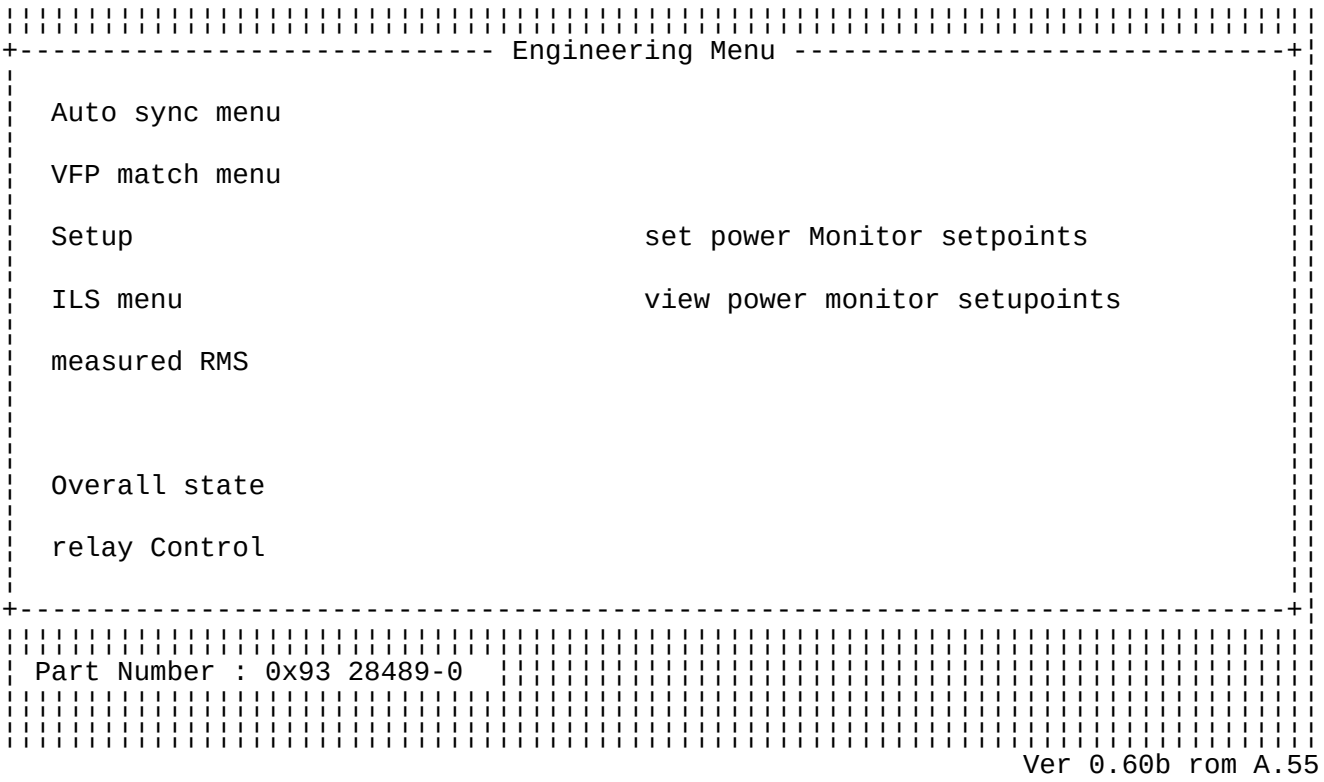
Opening any of these sub-menus can be done by using the arrow keys or the mouse to highlight the word and pressing ENTER. Typing the capitalized letter (hot key) of the file name also accesses the menu.

To complete the set-up procedure:

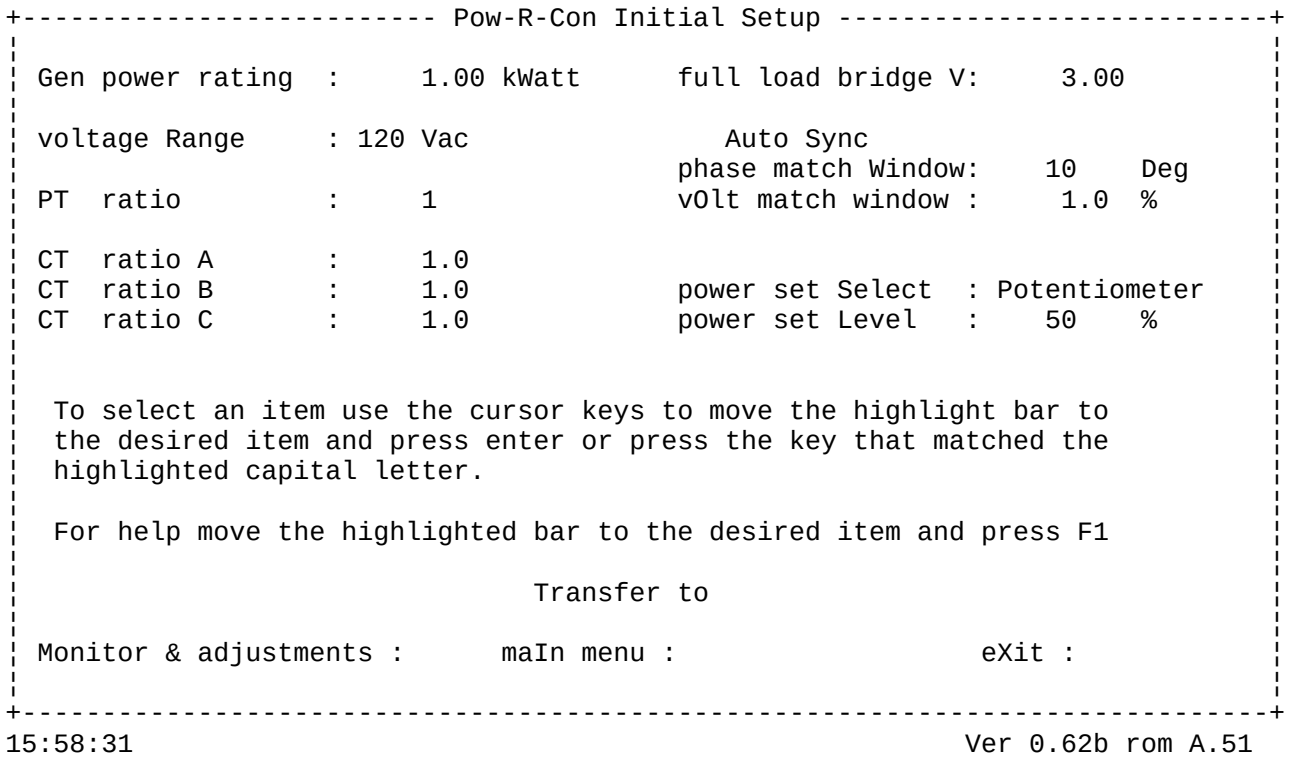
1. Open the Engineering screen, figure 3-9.
2. In the Engineering screen, open the Setup screen, figure 3-10.

The information listed on the Setup screen must be entered in order for the Pow-R-Con to operate. (The factory calibration uses this information to measure and determine operating parameters.) Information is set by using the arrow keys or the mouse to highlight the parameter being inserted. For those functions which do not automatically enter the new value, one must hit the ENTER key to install the proper data prior to changing the screen by hitting ESC. The values shown in the Setup screen are default values.

ENGINEERING MENU FIGURE 3-9



POW-R-CON INITIAL SETUP FIGURE 3-10



WARNING

The following Pow-R-Con set-up parameters MUST be entered prior to operating the engine/generator. Failure to perform this set-up could result in overloading and/or causing damage to the engine/generator equipment.

In set-up, the following parameters will be entered:

- Generator Power - 100% power rating of the generator being controlled by the Pow-R-Con unit. This parameter is used to calculate many of the generator output load setpoints that are entered as percentages.

  Range: 0-2500 Default: 1

- System Voltage – voltage level being fed into the Pow-R-Con unit, after (downstream) of the potential transformer (if used). This value is used for voltage matching during auto-synchronization. Select one of three input voltages for the following ranges: Select 120 for100v to 160v range; select 240 for 160v to 320v range; select 480 for 320v to 600v range.

  Range: 120, 240, 480 Default: 120

- Bus Frequency – nominal oscillation speed of the alternating power.

  Range: 50, 60 Default: 60

- Potential (Voltage) Transformer Ratio - ratio of the in-line to out-line voltage of the step down transformer. If no transformer is used, the ratio entered is (1). This parameter is used to scale the generator output voltage to calculate generator power output.

  Range: 1-600 Default: 1

- Current Transformer Ratio A - ratio of the line-to-line current of the step down transformer. This parameter is used to scale the generator output current to calculate generator power output. The resulting current to the unit should be a maximum of 5 A at rated generator power output.

  Range: 1.0-999.9 Default: 1.0

- Current Transformer Ratio B - ratio of the line-to-line current of the step down transformer. This parameter is used to scale the generator output current to calculate generator power output. The resulting current to the unit should be a maximum of 5 A at rated generator power output.

  Range: 1.0-999.9 Default: 1.0

- Current Transformer Ratio C - ratio of the line-to-line current of the step down transformer. This parameter is used to scale the generator output current to calculate generator power output. The resulting current to the unit should be a maximum of 5 A at rated generator power output.

  Range: 1.0-999.9 Default: 1.0

- Bridge Integrator – enable or disable the hardware integrator portion of the governor speed set PID control scheme for load control. Integral control will eliminate steady state errors from the control system. Once enabled in software this function requires the use of an input signal for activation. This function should only be used during Blend tracking and ILS standby modes. Do not use this in auto-synch or command modes. In a two Pow-R-Con system only one of two systems should have the integration enabled.

  Range: On, Off Default: Off

- Dead Bus – enable or disable the ability of the Pow-R-Con to bring a generator on-line during a bus power outage if voltage is lower than a user-defined voltage level. This function requires the use of an input signal for activation. When enabled, auto-synchronizing is bypassed and the breaker is closed when sync enable is energized.

  Range: On, Off Default: Off

Escape from Setup when completed to return to the main menu.

ENGINEERING RELAY CONTROL MENU FIGURE 3-11

```
+----------------------- Engineering Relay Control Menu -----------------------+
|                                                                              |
|                                        control mode      : system standby    |
|  for power on lvl  :    60    %                                              |
|                                                                              |
|  for power off lvl :    30    %                                              |
|                                                                              |
|  rev power lvl     :    20    %                                              |
|  for power on del  :    10    Sec                                            |
|  for power off del :    10    Sec                                            |
|  rev power del     :     0    Sec                                            |
|                                                                              |
|  rev pres pow level:     0.000kWatt                                          |
|                                                                              |
|                                                                              |
|                                                                              |
+------------------------------------------------------------------------------+
                                                              Ver 0.60b rom A.55
```

3.4.3 Engineering Relay Control

For Relay Control Menu structure refer to figure 3-11.

In the Relay Control Menu, the following parameters will be entered:

- Forward Preset Power Level On – generator power output level that is a percentage of rated power output that the user wants to bring a downstream generator on-line. The unit will calculate the power level using the Generator Power entered previously. The Forward Power On Relay Output contact is closed at this level after the Forward Power On Time has elapsed.

  Range: 20-120 Default: 60

- Forward Preset Power Level Off - power generation level that is a percentage of rated power output that user wants to take a downstream generator off-line. The unit will calculate the power level using the Generator Power entered previously. The Forward Power Off Relay Output contact is closed at this level after the Forward Power Off Time has elapsed.

  Range: 10-100 Default: 30

- Reverse Preset Power Level – power absorption level that is a percentage of full generator power rating that user will allow the generator to absorb before the Reverse Power On Relay Output contact will be closed. The unit will calculate the power level using the Generator Power entered previously. The Reverse Power On Relay Output contact is closed at this level after an internally calculated period of time has elapsed.

  Range: 0-40 Default: 20

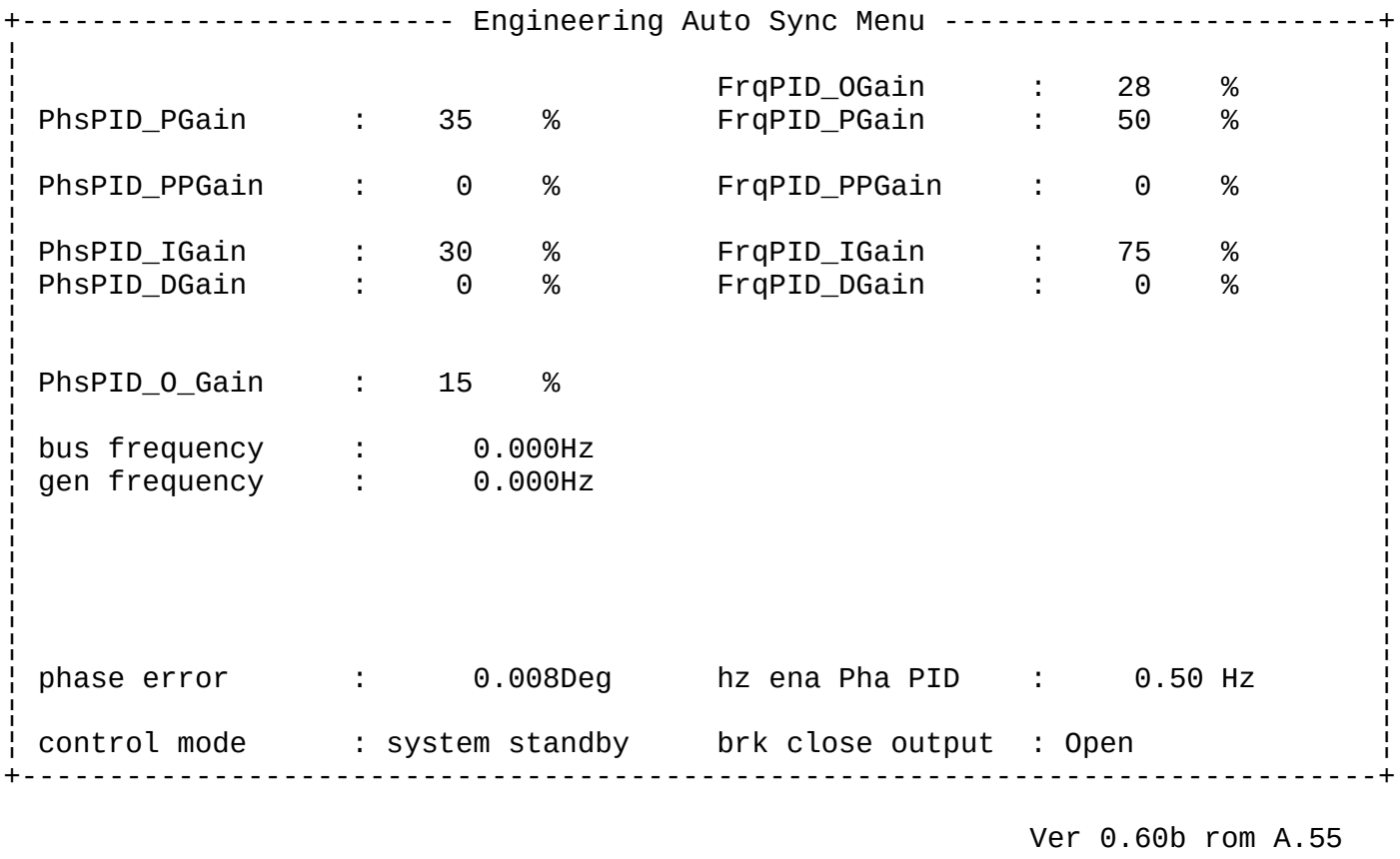
- Forward Power On Time – length of time that the generator needs to exceed the Forward Preset Power Level On before the Forward Power On Relay Output contact will be closed.

  Range: 0-300 Default: 10

- Forward Power Off Time - length of time that the generator needs to fall below the Forward Preset Power Level Off before the Forward Power Off Relay Output contact will be closed.

  Range: 0-300 Default: 10

ENGINEERING AUTO SYNCH MENU FIGURE 3-12



3.4.4 Engineering Auto Synch

For Front-end Softward Synchronizing Mode menu structure refer to figure 3-12. The default values entered at the factory for the Synchronizing parameters are safe values that will synchronize the generator to the bus. The potential drawback to using the default values may be the time needed to achieve synchronization versus the time required by the application to get a generator on-line.

Auto Synchronizer performance may be checked and improved. Refer to Auto Synchronizing Calibration, Section 4.5 for instructions.

In the Auto Synch Menu, the following parameters can be changed:

- Phase Overall Gain – acts as a sensitivity adjust for other phase control parameters. The higher the gain, the more aggressive the correction.

  Range: 0-100 Default: 15

- Phase Proportional Gain – will produce a corrective action based on the magnitude of the phase difference. This is essentially an amplifier. The higher the gain, the more aggressive the correction. The drawback of proportional control is it will introduce a steady state error proportional to the magnitude of the original difference. On the upside, proportional control will not cause a system instability.

  Range: 0-100 Default: 35

- Phase Integral Gain – will initiate a corrective action that is changed at a rate proportional to the phase error. If an error remains constant, the control response will continue to increase over time. A larger gain value will increase the rate of change. This type of control will eliminate steady state error. However, it will introduce system instability.

  Range: 0-100 Default: 30

- Frequency Overall Gain – acts as a sensitivity adjust for other frequency control parameters. The higher the gain, the more aggressive the correction. This parameter will not initiate a corrective action, it is a scaling factor.

  Range: 0-100 Default: 28

- Frequency Proportional Gain – will produce a corrective action based on the magnitude of the frequency difference. This is essentially an amplifier. The higher the gain, the more aggressive the correction. The drawback of proportional control is it will introduce a steady state error proportional to the magnitude of the original difference. On the upside, proportional control will not cause a system instability.

Range: 0-100 Default: 50

- Frequency Integral Gain – will initiate a corrective action that is changed at a rate proportional to the frequency error. If an error remains constant, the control response will continue to increase over time. A larger gain value will increase the rate of change. This type of control will eliminate steady state error. However, it will introduce system instability.

Range: 0-100 Default: 75

ENGINEERING VOLTAGE MATCH MENU FIGURE 3-13

```
+---------------------- Engineering Voltage Match Menu -----------------------+
| control mode      : system standby                                           |
| bus frequency     :     0.000Hz                                              |
| gen frequency     :     0.000Hz                                              |
| un phase error    :     0.008Deg                                             |
| match voltage     : Zero                                                     |
|       freq        : Zero                                                     |
|       phase       : Zero              volt match win    :     1.0  %       |
|                                       abs volt err      :     0    Vrms    |
|                                                                            |
|                                       freq match win    :     0.12 Hz      |
|                                       rms freq err      :     0.000Hz      |
| gen freq present  :    False Bool     phase match win   :    10    Deg     |
| synch input       : Open              phase match err   :     0.005Deg     |
|                                       Phase predic win  :     1.00 Sec     |
|                                       phase predictor   :     0.005Deg     |
|                                                                            |
| breaker aux       : Open                                                   |
| brk close output  : Open              dead bus v max    :    10    Vrms    |
+----------------------------------------------------------------------------+

                                                          Ver 0.60b rom A.55
```

3.4.5 Engineering VFP (Voltage Frequency Phase) Match

For Front-end Software VFP Match menu structure refer to figure 3-13.

In the VFP Match menu, the following parameters can be changed:

- Dead Bus V Max – maximum voltage level that is allowable across the Bus Voltage Input terminals that will allow the unit to close to the bus. Some residual bus voltage often exists due to noise in the lines.
- Voltage Match Window – range of the difference between bus voltage and generator voltage that the synchronizer will require along with a frequency match and phase match before closing the Breaker Close Relay Output contact.

Range: ±1.0-±15.0 Default: 1.0

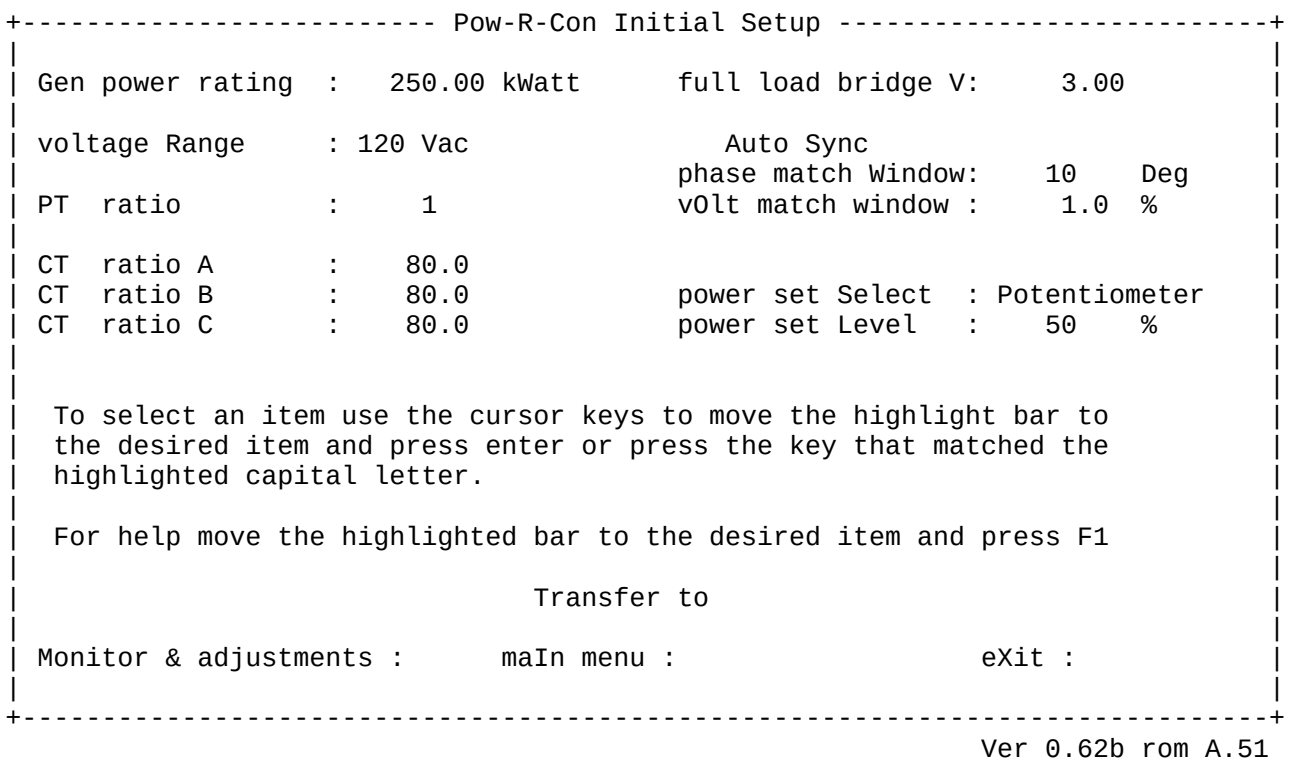
- Frequency Match Window – range of the difference between bus frequency and generator frequency that the synchronizer will require along with voltage match and phase match before closing the Breaker Close Relay Output contact.

Range: ±0.1-±25.0 Default:: 0.12

- Phase Match Window – range of the difference between bus phase and generator phase that the synchronizer will require along with frequency match and phase match before closing the Breaker Close Relay Output contact.

Range: ±2-±20 Default:: 10.000

POW-R-CON INITIAL SETUP FIGURE 3-14



3.4.6 Additional Engineering Screens

The Front-end Software has additional screens which can be used to assess the function of the Pow-R-Con unit.

3.4.6.1 Initial Setup

The Pow-R-Con setup can be accessed through the engineering menu as previously described. It can also be accessed through the main menu and the Initial Setup menu option, figure 3-14. This menu has additional parameters that can be accessed.

In set-up, the following parameters will be entered:

- Generator Power - 100% power rating of the generator being controlled by the Pow-R-Con unit. This parameter is used to calculate many of the generator output load setpoints that are entered as percentages.

  Range: 0-2500 Default: 1

- System Voltage – voltage level being fed into the Pow-R-Con unit, after (downstream) of the potential transformer (if used). This value is used for voltage matching during auto-synchronization. Select 120 for100v to 160v range; select 240 for 160v to 320v range; select 480 for 320v to 600v range.

  Range: 120, 240, 480 Default: 480

- Bus Frequency – oscillation speed of the alternating power. This value is used for frequency matching during auto-synchronization.

  Range: 50, 60 Default: 60

- Potential (Voltage) Transformer Ratio - ratio of the in-line to out-line voltage of the step down transformer. If no transformer is used, the ratio entered is (1). This parameter is used to scale the generator output voltage to calculate generator power output.

  Range: 1-600 Default: 1

- Current Transformer Ratio A - ratio of the line-to-line current of the step down transformer. This parameter is used to scale the generator output current to calculate generator poweroutput. The resulting current to the unit should be a maximum of 5 A at rated generator power output.

  Range: 1.0-999.9 Default: 1.0

- Current Transformer Ratio B - ratio of the line-to-line current of the step down transformer. This parameter is used to scale the generator output current to calculate generator power output. The resulting current to the unit should be a maximum of 5 A at rated generator power output.

  Range: 1.0-999.9 Default: 1.0

- Current Transformer Ratio C - ratio of the line-to-line current of the step down transformer. This parameter is used to scale the generator output current to calculate generator power output. The resulting current to the unit should be a maximum of 5 A at rated generator power output.

  Range: 1.0-999.9 Default: 1.0

- Full Load Bridge Voltage – total voltage range that the paralleling lines will use to compute proportional load share. A higher voltage will cause a more rapid system response to load sharing but will also result in a less stable system. A lower voltage will result in lower resolution requiring larger variations in loads before a system correction will occur.

  Range: 0-5.000 Default: 3.000

- Phase Match Window – range of the difference between bus phase and generator phase that the synchronizer will require along with frequency match and phase match before closing the Breaker Close Relay Output contact.

  Range: ±2-±20 Default: 10.000

- Voltage Match Window – range of the difference between bus voltage and generator voltage that the synchronizer will require along with a frequency match and phase match before closing the Breaker Close Relay Output contact.

  Range: ±1.0-±15.0 Default: 1.0

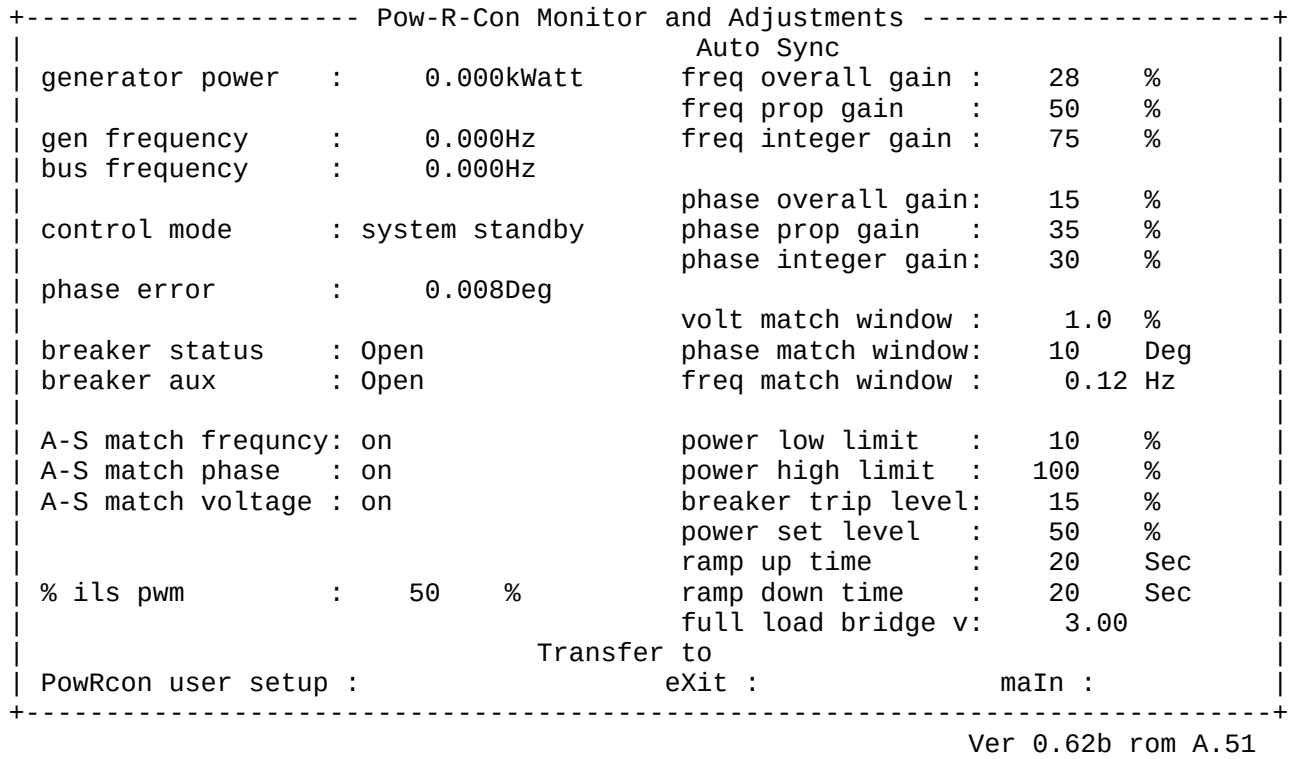
- Power Set Select – enables the use of an external potentiometer to set the generator power output rather than use the keyboard or PC software to set the power level.

  Range: Pot , key Default: pot

- Power Set Level – generator power output level that is a percentage of rated power output that the user wants to achieve after the ramping signal has been provided to the Load Generator Enable Input. The unit will calculate the power level using the Generator Power entered previously and match it to the power calculated through the voltage and current lines. This value is used in the absence of the Power Set Select.

  Range: 0-120 Default: 50

POW-R-CON MONITOR AND ANDJUSTMENTS FIGURE 3-15



3.4.6.2 Monitor and Adjustments

The Monitor and Adjustments screen, figure 3-15 allows the user to view the settings as well as the real time status of various operating parameters.

- Power Low Limit - generator power output level that is a percentage of rated power output that the user wants to bring the generator on-line and hold until a ramping signal is provided to the Load Generator Enable Input. The unit will calculate the power level using the Generator Power entered previously and match it to the power calculated through the voltage and current lines.

  Range: 0-100 Default: 10

- Power High Limit – is the generator power output level as a percentage of the generator power rating that the generator will produce when the Pow-R-Con closes. The unit will calculate the power level using the Generator Power entered previously and compare it to the power calculated through the voltage and current lines.

  Range: 0-120 Default: 80

- Power Set Level – generator power output level that is a percentage of rated power output that the user wants to achieve after the ramping signal has been provided to the Load Generator Enable Input. The unit will calculate the power level using the Generator Power entered previously and match it to the power calculated through the voltage and current lines. This value is used as initial load level, when Key Pad is used to set Command Mode, High Load Level, instead of Power Set Potentiometer.

  Range: 0-120 Default: 50

- Breaker Trip Level – maximum generator power output level that is a percentage of rated power output that the user wants to open the breaker after the ramping signal has been provided to the Unload Generator Enable Input. The unit will calculate the power level using the Generator Power entered previously and match it to the power calculated through the voltage and current lines. Once the generator output is below this level, the breaker will open with a signal provided to the Breaker Trip Enable Input.

  Range: 0-40 Default: 15

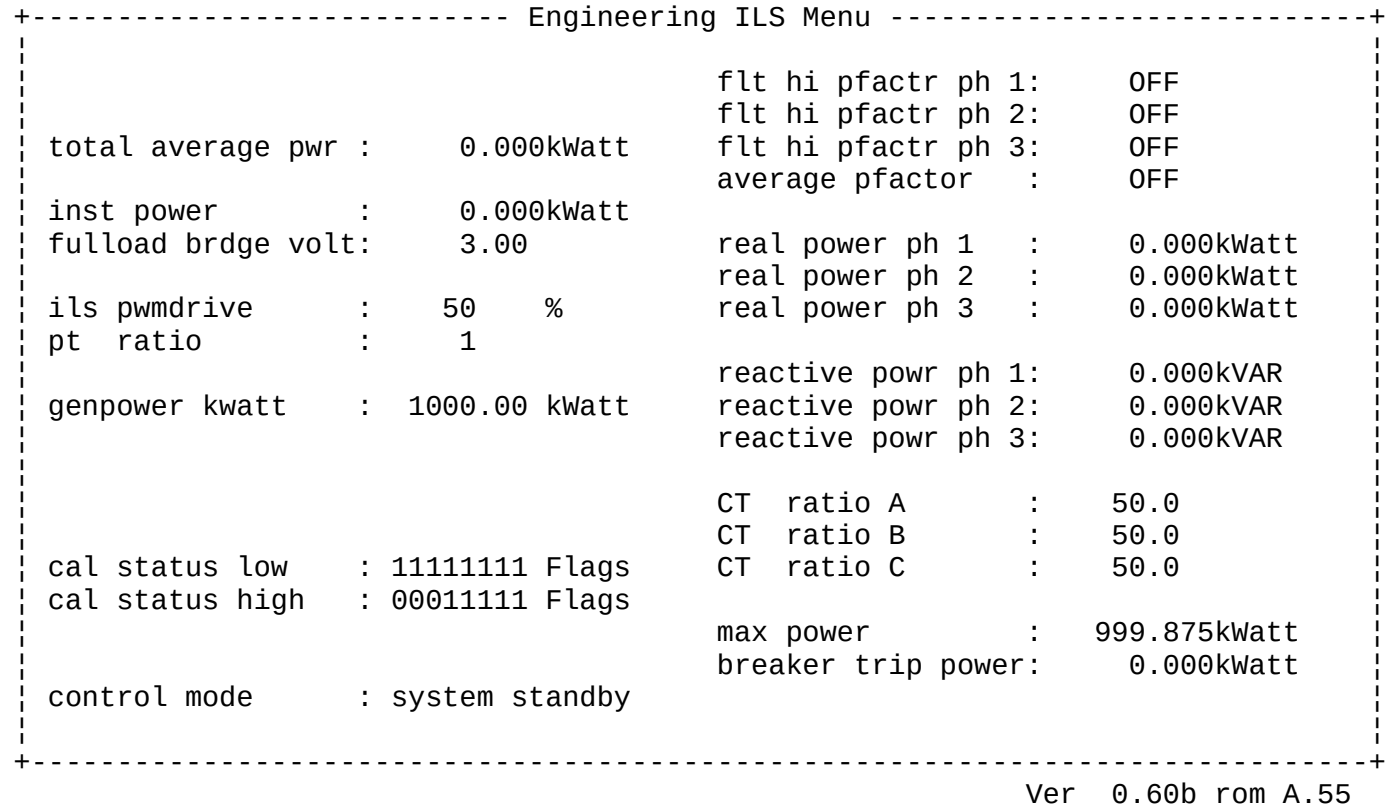
- Ramp Up Time – length of time it will take for the generator output to ramp from Power Low Limit to Power Set Level. The time starts when a signal is provided to the Load Generator Enable Input.

  Range: 0-300 Default: 10

- Ramp Down Time – length of time it will take for the generator output to ramp from Power Set Level to Power Low Limit. The time starts when a signal is provided to the Unload Generator Enable Input.

  Range: 0-300 Default: 10

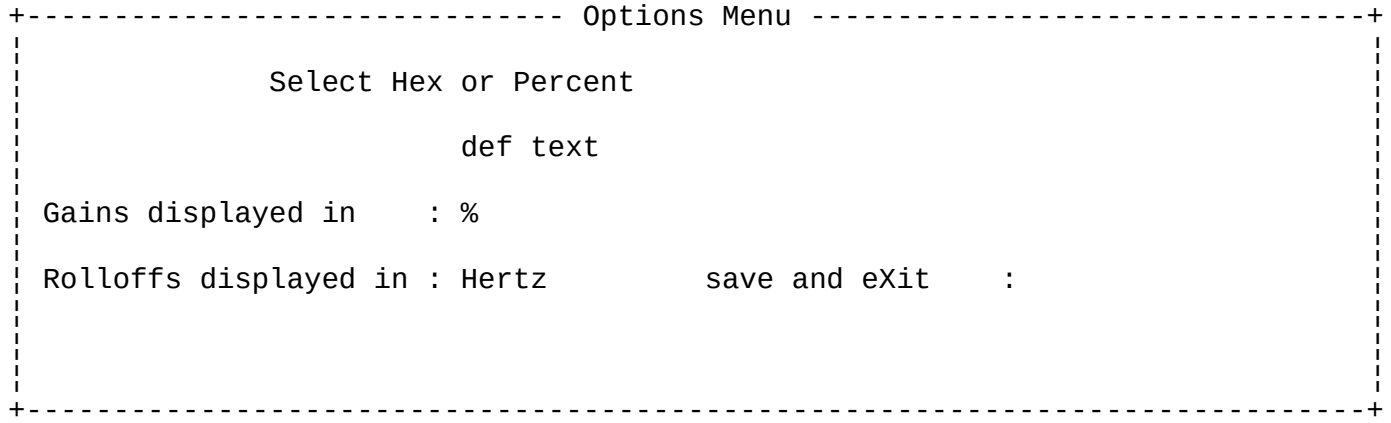
ENGINEERING ILS MENU FIGURE 3-16



3.4.6.3 Engineering ILS

Allows the user to monitor generated power, figure 3-16.

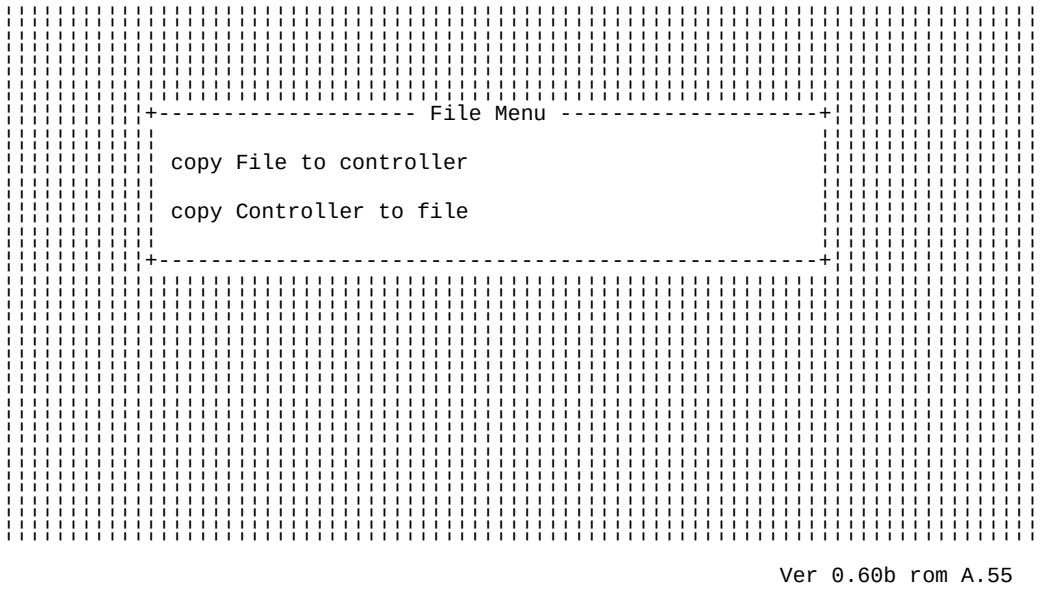
OPTIONS MENU FIGURE 3-17



3.4.6.4 System

The System screen, figure 3-17 allows the user to specify whether the gains and rolloffs are displayed in percentages or in hexidecimal.

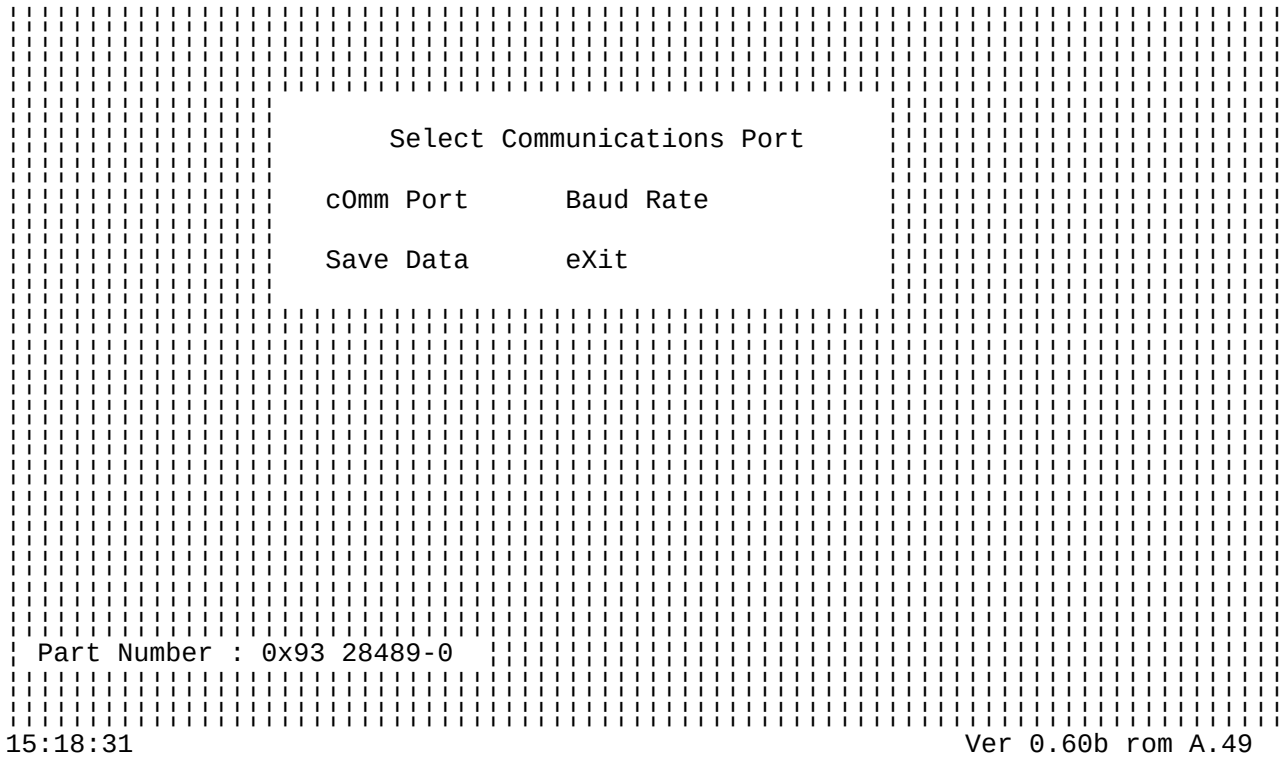
FILE TRANSFER MENU FIGURE 3-18



3.4.6.5 Files

The Files screen, figure 3-18 allows the user to either save an existing Pow-R-Con configuration complete with current user-defined parameter values to disk or to download a saved Pow-R-Con configuration to a Pow-R-Con unit.

COMMUNICATIONS OPTIONS MENU FIGURE 3-19



3.4.6.6 Communications

The Communications screen, figure 3-19 allows the user to select the com port that the Pow-R-Con unit will be connected to. It also allows the user to select the baud rate of the system.

3.4.6.7 Factory Calibration

WARNING: - Factory Calibration Screen Settings within this menu MUST NOT be changed or altered in any way. Unauthorized changes may render the Pow-R-Con inoperative or give false readings, which may have undesirable results.

4.0 CALIBRATION

4.1 GENERAL

Most user adjustments are made through the Keypad/Display Panel on the controller or from a laptop through the RS-485 interface and front-end software. Droop (R146) and Load Pulse (R148) adjustments are made by potentiometers under the cover.

Dip switches (see Section 3.2 for proper settings) are provided for selecting the type of governor with potentiometers to adjust the span and the offset of the speed setting output to the governor.

4.2 ISOCHRONOUS LOAD SHARING

4.2.1 Droop Calibration

The Droop potentiometer (R146) is located under the cover. The cover can be removed by removing (4) hex nuts (Figure 1). Pow-R-Con units with an integral display will have wires connected to the backside of the cover/display.

CAUTION

DO NOT use the wires to support the weight of the cover. It could damage the unit.

There are (2) sets of potentiometers located on the circuit board. The Droop potentiometer is located in the lower set and is the one on the right.

The Droop potentiometer should be set fully counter-clockwise when not operating in droop.

4.2.1.1 Droop to Primary Generator

1. Autosynch the generators at no load
2. Apply a load to the system and note the load carried by generator being drooped compared to the primary generator.
3. Remove load from system.
4. If generator carries more load than the primary generator, increase the droop by turning the Droop potentiometer clockwise.
5. If generator carries less load than the primary generator, decrease the droop by turning the Droop potentiometer counter-clockwise.
6. Repeat Steps 2-5. Droop is properly set when baseline generator load and drooped generator load are equal.

4.2.2 Load Pulse Calibration

The Load Pulse potentiometer should be set fully CCW when the Load Pulse feature is not in use.

The Load Pulse potentiometer (R148) is located under the cover. The cover can be removed by removing (4) hex nuts (Figure 1). Pow-R-Con units with an integral display will have wires connected to the backside of the cover/display.

CAUTION

DO NOT use the wires to support the weight of the cover. It could damage the unit.

There are (2) set of potentiometers located on the circuit board. The Load Pulse potentiometer is located in the lower set and is the one on the left.

With the engine/generator system powered and loaded with the typical system load, follow the instructions below:

1. With Load Pulse off (fully CCW), apply maximum anticipated load change to engine/generator, note engine/generator speed change.
2. Turn Load Pulse to 50% and apply maximum anticipated load change, note engine/generator speed change and associated response. A small droop should be seen prior to the control response which may include an engine/generator speed overshoot.
3. Based upon speed change and control response, continue adjusting Load Pulse until the droop and control response overshoot are equal.

4.3 POWER LEVEL POT CALIBRATION

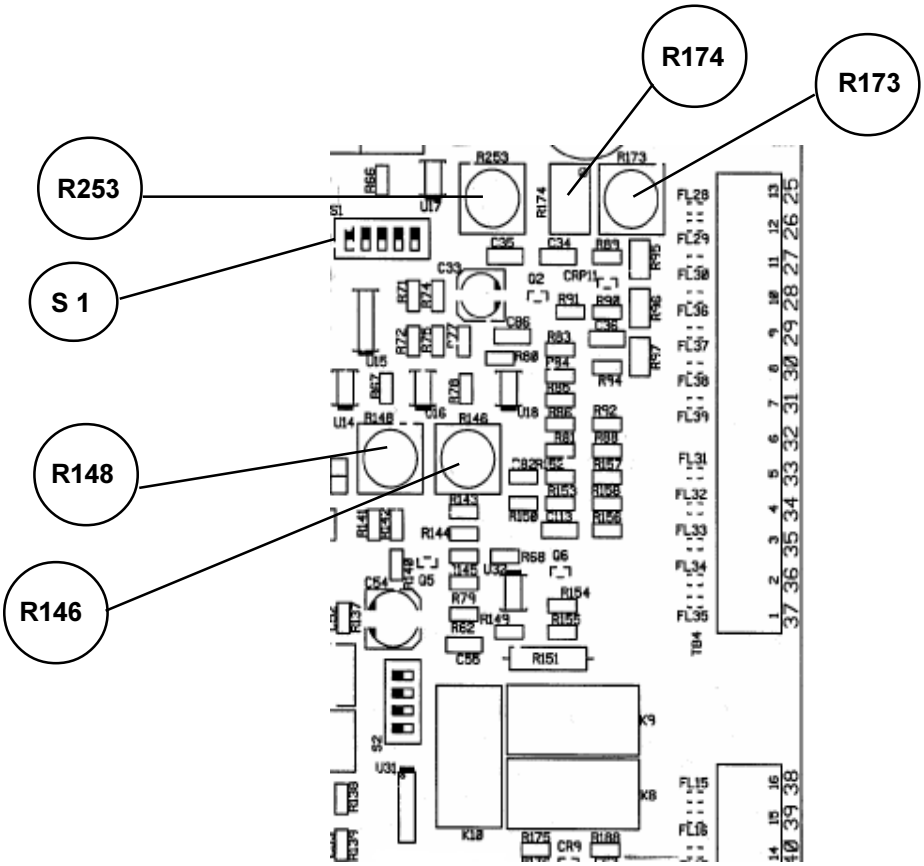
CAUTION

It is the user's responsibility to ensure that the voltage levels entered into the Pow-R-Con are correct. The Pow-R-Con will not reject the calibration. It will accept any entries made.

4.3.1 Keypad/Display Panel

1. Select Setup Mode.
2. Enter Password. Press the ENT, DEC, SCROLL (left), and SELECT keys for the password.
3. Select System Screen.
4. Select Power Pot.
5. Select Power Pot CCW, then press Enter to calibrate
6. Turn the Power Pot knob clockwise until the hard stop is reached.
7. Read voltage across the CCW power set terminals, Terminals 26 and 27.
8. If desired voltage is present, press Enter to accept.
9. Turn the Power Pot knob clockwise until the hard stop is reached.

DIP SWITCH & POTENTIOMETER LOCATIONS
FIGURE 4



R146	DROOP
R148	LOAD PULSE
R173	GOVERNOR SPAN
R174	GOVERNOR REFERENCE
R253	INTEGRATION TIME

10. Select Power Pot CW, then press Enter to calibrate.
11. Read voltage across the CW power set terminals, Terminals 25 and 26.
12. If desired voltage is present, press Enter to accept.

To ensure calibration, turn the Power Pot knob fully counter-clockwise and clockwise and re-verify the voltage levels.

CAUTION

DO NOT leave the Power Pot knob in the full CW position. This will cause the generator to go to maximum calibrated power production when Command mode is activated.

4.3.2 Front-end Software

1. Enter Calibration screen by selecting Calibration.
2. Select Cal. Power Set Low.
3. Press Enter if new calibration or F10 if re-calibrating.
4. Turn the Power Pot knob counter-clockwise until the hard stop is reached.
5. Read voltage across the CCW power set terminals, Terminals 25 and 26.
6. If desired voltage is present, press Enter twice to accept.
7. Enter Cal. Power Set High.
8. Press Enter if new calibration or F10 if re-calibration.
9. Turn the Power Pot knob clockwise until the hard stop is reached.
10. Read voltage across the CW power set terminals, Terminals 26 and 27.
11. If desired voltage is present, Press Enter twice to accept.
12. Press Escape to get back to the main menu.

To ensure calibration, turn the Power Pot knob fully counter-clockwise and clockwise and re-verify the voltage levels.

CAUTION

DO NOT leave the Power Pot knob in the full CW position. This will cause the generator to go to maximum calibrated power production when Command mode is activated.

4.4 4 TO 20 MA CALIBRATION

4.4.1 Keypad/Display Panel

1. Select Setup Mode.
2. Enter Password. Press the ENT, DEC, SCROLL (left), and SELECT keys for the password.
3. Select Power Monitor.
4. With engine running with no load:
5. Press Enter and Inc/Dec to adjust I Low Power Value until meter reads zero.
6. Press Enter to accept
7. Press Escape when completed.
8. With full load on engine:
9. Press Enter and Inc/Dec to adjust I High Power until meter reads full load value.
10. Press Enter to accept.
11. Press Escape when completed.

4.4.2 Front-end Software

1. Select Set Pow. Mon. Setpts.
2. With engine running with no load:
3. Increase/decrease Dutycyc Low until meter reads zero.
4. Press Enter to accept
5. With full load on engine:
6. Increase/decrease Dutycyc High until meter reads full load value.
7. Press Enter to accept
8. Press Escape when completed to get back to main menu.

Step through remaining Functions/Parameters to customize Pow-R-Con for proper application. Exit out to DOS shell when calibration is complete.

4.5 AUTO SYNCHRONIZING

For Keypad/Display Panel Synchronizing Mode menu structure and default values refer to Table 3-4. The default values can be changed by following the same principles outlined in Section 3.3.1, Set-up Mode with the following change. In step (2), use either of the **SCROLL** keys to access **Program** mode rather than **Set-up** mode. Then use the **SCROLL** keys to select **Synch**. Finally, use the **SCROLL** keys to select the parameters that need to be changed.

CAUTION

This procedure MUST be performed prior to placing the Pow-R-Con in unsupervised control of the engine/generator.

CAUTION

Before proceeding, insure that engine governor installation and calibration have been properly performed according to manufacturer's requirements.

Note: The Pow-R-Con will not function unless the frequency of the generator being brought on-line reaches a frequency equal to the generator already on-line within ± 1.5 Hz.

Note: Interaction occurs between phase and frequency elements during normal operation. To eliminate this interaction during calibration, only one set of values is evaluated at a time.

Note: Prior to making any Pow-R-Con adjustments, record all previously set-up parameters or refer to menu structure charts for default values for phase and frequency control inputs.

To aid in checking or improving the performance of the Auto Synchronizer, a Synchroscope, dual channel recorder with two frequency channels, one for the bus and one for the generator, or an AC voltmeter from the same phase across the generator breaker can be used.

Prior to performing the calibration procedure, disconnect the wires from the Breaker Close Relay Output, Terminal 21 and Terminal 22. This will prevent actually closing the breaker. It is recommended that a light or ohmmeter be connected to the Breaker Close Relay Output to indicate when a closure signal is given.

4.5.1 Frequency Calibration

Note: Frequency calibration should be performed prior to phase calibration.

The control input parameters to be evaluated to achieve calibration are:

- Frequency Overall Gain
- Frequency Proportional Gain
- Frequency Integral Gain
- Frequency Derivative Gain (front-end software only - contact factory to change the default value)

Use the following steps as a guide to obtain initial calibration. Additional adjustments may be required to optimize the operation of each engine/generator unit.

1. Set all phase and frequency control input parameters to zero (0) or OFF.
2. Set the Frequency Overall Gain value to 50%. The Frequency Overall Gain acts as a sensitivity adjust for the other frequency control input values.
3. Switch between Sync Disable and Sync Enable to observe any instability using a synchroscope or oscilloscope.
4. Set the Frequency Proportional Gain value to 10%.
5. Switch between Sync Disable and Sync Enable to observe any instability.
6. Continue increasing the Frequency Proportional Gain value by doubling the previous input value (i.e., 10%, 20%, 40%) until an instability is observed when switching between Sync Disable and Sync Enable.
7. When the system becomes unstable, decrease the previous input value by half the previous input value increase (i.e., 10%, 20%, 40%, 30%).
8. Switch between Sync Disable and Sync Enable to observe any instability.
9. If the system continues to be unstable, decrease the previous input value by half the previous input value decrease (i.e., 10%, 20%, 40%, 30%, 25%). Otherwise increase the previous input value by half the previous input value decrease (i.e., 10%, 20%, 40%, 30%, 35%).
10. Repeat Steps 8 and 9 until the Frequency Proportional Gain value is set within 2%.
11. Repeat Steps 4-10 for the Frequency Integral Gain value (if being used).
12. If system stability cannot be achieved, reduce the Frequency Proportional and Frequency Integral Gain values to zero (0), and set the Frequency Overall Gain value higher or lower as indicated by the scenarios below:
    a. If the system experiences fast oscillations, reduce the Frequency Overall Gain to 25% and repeat Steps 4-11.
    b. If the system experiences slow oscillations, reduce the Frequency Overall Gain to 75% and repeat Steps 4-11.
13. Continue in this manner, adjusting the Frequency Overall Gain to achieve the correct sensitivity for the system.
14. Reset frequency back to as close to bus frequency as possible. If sync stability is not achievable verify frequency using the above calibration steps 1-4.

4.5.2 Phase Calibration

Note: Phase calibration should be performed after frequency calibration. If Frequency calibration has not been completed, refer to previous section, Frequency Calibration, Section 3.2.1.

The control input parameters to be evaluated to achieve calibration are:

- Phase Overall Gain
- Phase Proportional Gain
- Phase Integral Gain
- Phase Derivative Gain (front-end software only - contact factory to change the default value)

Use the following steps as a guide to obtain initial calibration. Additional adjustments may be required to optimize the operation of each engine/generator unit. It may be necessary to readjust the frequency parameters after performing the phase calibration.

1. Set the Phase Overall Gain value to 50%. The Overall Gain acts as a sensitivity adjust for the other phase control input values.

2. Switch between Sync Disable and Sync Enable to observe any instability using a synchroscope or oscilloscope.
3. Set the Phase Proportional Gain value to 10%.
4. Switch between Sync Disable and Sync Enable to observe any instability.
5. Continue increasing the Phase Proportional Gain value by doubling the previous input value (i.e., 10%, 20%, 40%) until an instability is observed when switching between Sync Disable and Sync Enable.
6. When the system becomes unstable, decrease the previous input value by half the previous input value increase (i.e., 10%, 20%, 40%, 30%).
7. Switch between Sync Disable and Sync Enable to observe any instability.
8. If the system continues to be unstable, decrease the previous input value by half the previous input value decrease (i.e., 10%, 20%, 40%, 30%, 25%). Otherwise increase the previous input value by half the previous input value decrease (i.e., 10%, 20%, 40%, 30%, 35%).
9. Repeat Steps 8 and 9 until the Phase Proportional Gain value is set within 2%.
10. Repeat Steps 4-10 for the Phase Integral Gain value (if being used).
11. If system stability cannot be achieved, reduce the Phase Proportional and Phase Integral Gain values to zero (0), and set the Phase Overall Gain value higher or lower as indicated by the scenarios below:
    a. If the system experiences fast oscillations, reduce the Phase Overall Gain to 25% and repeat Steps 4-11.
    b. If the system experiences slow oscillations, reduce the Phase Overall Gain to 75% and repeat Steps 4-11.
12. Continue in this manner, adjusting the Phase Overall Gain to achieve the correct sensitivity for the system.

5.0 OPERATION

5.1 GENERAL

The Pow-R-Con is a stand-alone panel containing the microprocessor controls and field wiring terminals to connect to a generating unit. It also contains terminals for connecting it to a network of generators. The monitoring, commanding, and setup functions are performed through the use of a Keypad/Display Panel or the Front End Software and an external laptop computer.

Prior to operating the system, Section 3.0 of this manual which details how to set up the Pow-R-Con for the user's specific application must be completed. There are also many settings that can be changed to enhance and improve the performance of the Pow-R-Con unit. For general guidelines on how to use the keypad to change settings, refer to the Section 5.2 For general guidelines on how to use the Front End Software to change settings, refer to Section 5.3.

After the Setup Procedure has been properly completed, the engine governor must be properly calibrated. Refer to Section 4.0 of this manual which details how to calibrate the Pow-R-Con.

5.2 KEYPAD/DISPLAY PANEL

5.2.1 Diagnostics

The following keys are provided for user monitoring and editing:

ESC - Escape key

This key is used to select Monitor, Program, Review, or Setup modes. It may be pressed to return to the previous function at any time.

SCROLL - Scroll key

From the automatic monitoring mode, pressing the left or right SCROLL key allows the desired phase-to-phase, phase-to-neutral, or average set of values to be displayed on the LCD. Press ESC to return to automatic monitoring.

Press ENTER and the display should lock on the desired phase-to-phase, phase-to-neutral, or average value. Press the ESC key twice to return display to scrolling.

In the Review, Program, or Setup modes, the Scroll key allows forward or reverse display of the various menu selections.

SELECT - Select key

Pressing the Select key places the unit in the mode or data entry point shown on the LCD display.

INCREASE / DECREASE - Increase and Decrease keys.

When a data entry is selected, the value is changed by pressing the Increase or Decrease key.

ENTER - Enter key

When a desired data entry value is displayed, pressing the ENTER key will store the parameter value into non-volatile memory for use by the program.

Also, pressing ENTER during the monitor mode will stop the display from scrolling. Pressing ENTER again causes scrolling to resume.

During initial power up, the Liquid Crystal Display (LCD) on the Keypad/Display Panel displays the panel revision level, then reverts to automatically scrolling through the following measured phase-to-phase, phase-to-neutral, and average values:

- Phase (1-N, 1-2, 2-N, 2-3, 3-N, 3-1, and AVG)

When the above phases are being displayed the items are displayed for each phase (as appropriate).

- Volts
- AMPS
- Hertz
- kWatt
- kVAR
- PF

After the AVG values are displayed the control mode is displayed.

From the Monitor Mode, Review Mode is entered by pressing ESC on the keypad/display panel, followed by the SELECT key. Program or Setup modes are entered by pressing the SCROLL key followed by the SELECT key. Pressing the SCROLL key without pressing the SELECT key will loop through the three mode choices with each keystroke.

Press SCROLL to advance or reverse within the major menu item selected (e.g. Sync to Command), or press ESC to return to the previous major menu item (e.g. REVIEW to PROGRAM).

The modes from which the controlling data in the program can be reviewed and edited are as follows:

REVIEW (parameters cannot be edited in this mode)

- Sync
- Command
- Blend
- Load Share setup
- Load Share relays

PROGRAM

- Sync
- Command
- Blend
- Load Share setup
- Load share relays

SETUP

- System
- Power pot
- Power Monitor

All of the Pow-R-Con entry descriptions, ranges, and default values are provided in the Keypad/Display Panel menu structure tables. Refer to Section 3.0 of this manual for more detailed information about each menu parameter. Refer to sections 4.3.1 and 4.4.1 for details on Power level and Power monitor.

5.3 FRONT END SOFTWARE

The Barber-Colman Pow-R-Con is factory calibrated. When supplied with the required set-up information of the particular installation, it will permit proper operation of the engine/generator.

Note: The setup information can be pre-set in the Pow-R-Con "off-site" without having the engine/generator attached. The Pow-R-Con must be attached to the proper operating engine/generator to test the calibration or to improve the operation by changing the calibration software.

The Front End Software is a DOS based program running on a PC. This tool provides an alternate method to access and edit parameters. Each of the Front End pages provides groups of parameters organized to make the programming task easier than using the keypad display panel.

Manuevering from menu to menu in the Front-end software is simple. Sub-menus can be selected by using the arrow keys or the mouse to highlight the word and pressing ENTER. Typing the capitalized letter (hot key) of the menu name also accesses the menu.

Parameters are selected in the same fashion. Values are entered by typing the appropriate value on the keyboard and pressing ENTER. Once again, Pow-R-Con parameters are password protected. Refer to Section 3.0 of this manual for more detailed information about each menu parameter.

5.4 SYSTEM FUNCTIONS

This section is divided into four (4) functional sections:

- Auto-Synchronizing
- Isochronous Load Sharing
- Load Ramping/Blending
- Dead Bus

5.4.1 Auto-Synchronizing

The Auto-Synchronizer provides the following features:

- Adjustable Breaker Closing Angle Window for Phase/Frequency Match
- Adjustable Voltage match window
- Adjustable Phase and Frequency Gains for the closed loop synchronizing control
- LED Indication for Sync Enable, Voltage not matched, Frequency not matched, and Phase not matched
- Voltage Match Relay Output and Voltage Match Control
- Selectable Synch Hold Capability
- Breaker Control
- Synchroscope indication

The synchronizer monitors voltage, frequency and phase of the generator and the bus and provides a speed input to the governor to bring these parameters within the adjustable windows for synchronization. The synchronizer has a maximum capture range of ± 2.0 generator Hz. A normally open relay contact is closed for breaker control when the generator is synchronized. LED lamps are provided to indicate a voltage, frequency and phase mismatch.

CAUTION

Do not activate the Load Sharing Bridge Integrator during auto-synchronization. The action of the bridge integrator function will interfere with synchronization.

The user can choose not to use the auto-synchronizing function and manually close the breaker. It would be the user's responsibility to manually adjust the engine speed to achieve the correct frequency and phase. When doing so, the Pow-R-Con will have no knowledge of where the generator is compared to the bus with respect to voltage, frequency and phase.

5.4.1.1 Automatic

The Automatic Mode is enabled when the Synch Enable Input is activated. The logic for closing the Synch Enable Input is determined by the installer and is external to the Pow-R-Con; typically relay logic, a PLC or a manual switching device. If you have a keypad/display panel, the SYNCH ENABLE, VOLT NOT MATCHED, FREQ NOT MATCHED, and PHASE NOT MATCHED LED's will come on. The Synchronizer begins its continuous monitoring of the difference between voltage, phase and frequency of the Generator and the Bus. The synchronizer com-

putes error and drives the error to be within the user-defined windows for Breaker closure.

When deciding what values to use for the matching windows, consideration must be given to the application, equipment being controlled, and the equipment using the power. In general, if the objective is to produce power as quickly as possible, the matching window values are typically set wide. This will provide quickest synchronization time.

CAUTION

Setting windows wide will cause larger inrush current to exist. Review the rating of the control breaker.

On the other hand, if power generation is not an emergency, the matching window values should be tighter. The values should not be so tight that the equipment cannot achieve them. In this case, the generator will never come on-line. So, the matching window values should be as tight as the equipment being controlled can achieve.

As the voltage builds and reaches approximately 50% of the desired voltage, the synchronizer will compare its frequency to the bus frequency. If the difference between the frequencies is greater than the user-defined value, the synchronizer will set a voltage as a governor control signal through the Governor Speed Set Output to adjust the engine speed which will adjust the generator frequency. The synchronizer will continue to compare the generator frequency to the bus frequency and make any necessary adjustments until the frequency error is within the user-defined window. When this occurs, if using a unit with a keypad/display, the FREQ NOT MATCHED LED will go off.

When the difference between the generator frequency and the bus frequency is approximately $\pm$ 0.5 Hz, the generator phase is compared to the bus phase. If the difference between the phases is greater than the user-defined value, the synchronizer will set a voltage as a governor control signal through the Governor Speed Set Output to adjust the engine speed which will adjust the generator phase. The synchronizer will continue to compare the generator phase to the bus phase and make any necessary adjustments until the phase error is within the user-defined window. When this occurs, the PHASE NOT MATCHED LED will go off.

Voltage syncrhonization is performed in parallel with frequency and phasae sychronization. If the difference between the voltages is outside the user-defined window, the synchronizer will prompt a change to the generator voltage regulator by closing the contact of the Voltage Increase Relay Output or the Voltage Decrease Relay Output to adjust the generator voltage. The synchronizer will continue to compare the generator voltage to the bus voltage and prompt any necessary adjustments until the voltage error is within the user-defined window. When this occurs, the VOLT NOT MATCHED LED will go off.

When the synchronizer measures that the voltage, frequency and phase are within the user-defined windows, it closes the Breaker Close Relay Output contacts. After the breaker has closed, the auxiliary contacts of the breaker are brought back to the Pow-R-Con to confirm that the Generator is connected to the Bus. At this time the contact closure to the synch enable should be removed. This should be done so that when the breaker is opened, the Pow-R-Con unit isn't receiving a signal to synchronize and subsequently send a signal to close the breaker. This can create a potentially dangerous situation depending on why the breaker was opened because the generator breaker will continue to toggle on and off, thereby momentarily reconnecting the generator to the system. In extreme reverse power situations this could cause substantial damage to the engine/generator.

Auto Synchronizer performance may be checked and improved. Refer to Auto Synchronizing Calibration, Section 4.5 for instructions.

5.4.1.2 SYNCH HOLD

"Synch Hold" can provide improved load share balance. The "Synch Hold" feature is enabled when the "Synch Hold" option is selected as **On** through the Keypad/Display panel or Front End Software.

When Pow-R-Con unit goes through the auto-synchronizing process, the synchronizer will set a voltage as a governor control signal through the Governor Speed Set Output to adjust the engine speed which will adjust the generator frequency and phase. When the unit is in synchronization and the breaker closes, a specific voltage will be present on the Governor Speed Set Output. In "Synch Hold" the Pow-R-Con holds on to the voltage level used to synchronize, and then begins to adjust this voltage based on load share requirements in the load share mode. Without "Synch Hold" the Pow-R-Con does not hold onto the voltage level used to cause synchronization.

This feature is generally used when there is a stable bus frequency. In general, utility power in the United States is very stable and using the "Synch Hold" function would be desirable, if very fast synchronizing is not required.

With the "Synch Hold" enabled, it would be the same as having a Pow-R-Con, Version 2.

This feature is not used when synchronizing to an unstable bus. An unstable bus is a power source that has a noticeable frequency fluctuation that is measurable over reasonable amount of time. If the unit where to synchronize the generator on the high side of a fluctuating bus frequency, the generator would spend most of its time in reverse power. In these situations, it is the user's responsibility to manually adjust the engine speed to provide a generator frequency that would equal the nominal, or average of the bus frequency fluctuation.

As a result of having "Synch Hold" disabled, once the breaker is closed, the voltage on the Governor Speed Set Output will return to the initial voltage setting prior to synchronizing.

With the Synch Hold disabled, it would be the same as having a Pow-R-Con, Version 3.

5.4.2 Isochronous Load Sharing (ILS)

Isochronous Load Sharing provides the following features:

- Built-In Paralleling Relay
- Adjustable Forward Power On, Forward Power Off, Reverse Power Relay and LED Indication
- Forward Power On and Off Adjustable Time Delay
- Adjustable Load Pulse Sensitivity (Potentiometer)
- Remote Adjustable Governor Speed Set (Potentiometer)

ILS can provide governor control in four (4) modes:

- Single unit isochronous
- Single unit droop
- Parallel unit isochronous
- Parallel unit droop

Isochronous Load Sharing is used to proportionally divide a common load between two or more engine/generator sets while maintaining a fixed frequency. Each Pow-R-Con compares its generator load with the load of all other units in operation using the paralleling lines. The parallel line voltage either decreases or increases indicating the engine's proportional share of the total load. The voltage across the paralleling lines is proportionally related to generator power output by:

Overall Load = Prop * System Load Capacity

Overall Load = Prop * (GPR1+GPR2+…+GPR_n)

Where GPR is Generator Power Rating

Parallel Line Volt = Prop * Parallel Volt Setting

Individual Gen Output = Prop * GPR_n

For example:

(3) generators rated at 200 KW, 250 KW, and 350 KW operating in ILS mode carrying a system load of 500 KW would have the following power output:

500 = Prop * (200 + 250+ 350)

Prop = (500/800) = .625

Individual Gen Output 1 = .625 * 200 = 125 KW

Individual Gen Output 2 = .625 * 250 = 156.25 KW

Individual Gen Output 3 = .625 * 350 = 218.75 KW

If the parallel line voltage range was initially set to 3.0 volts, the parallel line voltage for this load would be:

Parallel Line Volt = .625 * 3.0 = 1.875 V

Prior to operating the system in ILS mode, the Program Load Share Setup, Section 3.3.2 must be completed.

5.4.2.1 Droop

The droop feature is used to put a generator on line with an infinite bus, generally a utility.

The infinite bus frequency is fixed; therefore without the paralleling lines to communicate power level, the power will either overload the engine/generator or cause shutdown on reverse current, depending upon whether the reference speed for the engine/generator is below or above the Bus frequency.

Without additional equipment, there are not paralleling lines to connect when connecting to an infinite Bus. Droop provides a means to be in load sharing mode with an infinite Bus.

Refer to Droop Calibration, Section 4.2.1 and Droop To Infinite Bus, Section 4.2.1.1, for Droop calibration instructions.

Multiple generators can be droop pralleled to an inifinite Bus. All engine/generators should be set to the same droop when connected to the bus. Once the engine/generators are paralleled in droop on an infinite bus, the speed of the generator decreases as load is picked up until a balance between speed and load is achieved.

Droop is adjustable from 0 to 10% of the engine/generator speed. Any droop setting will result in a corresponding decrease in frequency of the generator output since engine speed and frequency are proportional. Droop is also proportional to the current load carried by the generator to the maximum load rating of the generator.

$$\text{Droop Speed} = \text{Eng Spd} * \left(1 - \frac{\%\ \text{Droop}}{100} * \frac{\text{Load}}{\text{Load Rating}}\right)$$

$$\text{Droop Freq} = \text{Gen Freq} * \left(1 - \frac{\%\ \text{Droop}}{100} * \frac{\text{Load}}{\text{Load Rating}}\right)$$

For example:

A 100 KW generator operating at an engine speed of 5000 RPM generates 120 VAC at 60 Hz. With a droop setting of 10% and a load of 50 KW, the engine speed will droop to:

$$\text{Droop Speed} = 5000 * \left(1 - \frac{10}{100} * \frac{50}{100}\right)$$

Droop Speed = 4750 RPM

$$\text{Droop Freq} = 60 * \left(1 - \frac{10}{100} * \frac{50}{100}\right)$$

Droop Freq = 57 Hz

The amount of Droop set into the engine/generator system should be minimized. The engine/generator system should be set-up so that the resulting full load droop will be divided about the desired output, half on the high side, half on the low side.

Refer to Droop Calibration, Section 4.2.1 and Droop To Primary Generator, Section 4.2.1.1, for Droop calibration instructions. To activate droop remove the paralleling from terminals 36 and 37. Then short terminal 35 to 37.

5.4.2.2 Load Pulse

Load Pulse feature is used to minimize the engine/generator speed change when a block change in load occurs. The Load Pulse feature senses generator load changes and signals the governor to increase or decrease engine fuel to minimize the change in engine speed.

The Load Pulse should be adjusted to provide the fastest system response that will be stable. Generally a compromise can be found between the generator speed change and the associated response overshoot. If too much Load Pulse is used, the control response can be too abrupt and cause a sizable overshoot in engine speed, which in turn will again invoke the Load Pulse, potentially causing another droop in engine speed. These oscillations are generally undesirable.

It should be noted that Load Pulse can only be optimized for one load change condition or a small range of load change scenarios. Load Pulse will not provide consistent results over a large range of load change conditions. In this case, the Load Pulse should be used to optimize system performance for the maximum block load change scenario.

Refer to Section 4.2.2 For Load Pulse calibration instructions.

5.4.2.3 Load Sharing

Generally, a single generator will begin by carrying the required load. As the total power requirement of the system builds, the generator begins to approach its maximum power production capability. As this occurs, two conditions need to be met to signal a generator to be brought on-line. The first condition is that the generator power output has exceeded a user-defined power level. The second condition is that the generator has maintained or exceeded that level for a user-defined period of time. When these conditions are met, the Forward Power On Relay Output contact is closed and the Forward Power Off Relay Output Contact is opened. When this occurs, if using a unit with a keypad/display, the FORWARD PWR ON LED will come on and the FORWARD PWR OFF LED will go off. This same scenario can be used to bring additional generators on-line.

The user can use the Forward Power On Relay Output contact closure to automatically send a signal to the downstream generator control system. When the breaker for the downstream generator is closed, the load will be immediately redistributed to all generator.

In a similar, but reverse fashion, as the power requirement of the system decreases, it falls below a level where a single generator can produce sufficient power for the system. As this occurs, two conditions need to be met to signal a generator to be taken off-line. The first condition is that the generator power output has fallen below a user-defined power level. The second condition is that the generator has maintained or exceeded that level for a user-defined period of time. When these conditions are met, the Forward Power Off Relay Output contact is closed and the Forward Power On Relay Contact is opened. When this occurs, if using a unit with a keypad/display, the FORWARD PWR OFF LED will come on and the FORWARD PWR ON LED will go off. This same scenario can be used to take additional generators off-line.

The user can use the Forward Power Off Relay Output contact closure to automatically send a signal to the downstream Pow-R-Con Breaker Trip Enable Input either through a PLC or directly. The Breaker Trip Enable Input will close the Breaker Trip Relay Output to open the downstream generator's breaker. The load currently being carried by the downstream generator will be instantly picked-up by the remaining generators on-line.

The Pow-R-Con measures the connected generator power. A voltage is placed on the internal bridge and is proportional to the maximum power rating of the generator. This power level is communicated between Pow-R-Con's via the paralleling lines. As power increases the bridge voltage is increased toward the programmed maximum voltage. (For example 3 volt = 100% power). In load share mode all Pow-R-Con bridge voltages are tied together via the paralleling lines causing a bridge imbalance on each of the Pow-R-Con's. The bridge imbalance in turn causes the set speed voltage to the governor to increase or decrease in order to re-balance the bridge voltage on each Pow-R-Con. An optional remote speed potentiometer may be used to adjust the engine speed/frequency.

The real and reactive power (kW/kVAR), power factor and individual phase voltage and current magnitudes ("true rms") can be monitored through the display. The generator rated voltage, current, and full load output in kW are used for scaling. A 4-20 mA output is provided for external monitoring of the generator output power.

Under some circumstances, the generator may begin to absorb power from the system. If this occurs, two conditions need to be met to signal the user that a reverse power condition exists. The first condition is that the power absorption has exceeded a user-defined level. The second condition is that the generator has maintained that output for a Pow-R-Con determined period of time. The unit uses an inverse time algorithm to calculate the reverse power time delay. When these conditions are met, the Reverse Power On Relay Output contact is closed. When this occurs, if using a unit with a keypad/display, the REVERSE PWR ON LED will come on.

The user can use the Reverse Power On Relay Output contact closure to automatically send a signal to the Pow-R-Con Breaker Trip Enable Input either through a PLC or directly. The Breaker Trip Enable Input will close the Breaker Trip Relay Output to open the generator's breaker. The load currently being carried by the generator will be instantly picked-up by the remaining generators on-line.

When bringing generators on and off-line in ILS mode, a shock to the system will be experienced due to the block load change. Depending upon the application and the time allowed to bring generating units on-line, this may be necessary. If power generation is not a solution to an emergency, then Blend Mode, Section 5.4.3.1 or Command Mode, Section 5.4.3.2 or a combination may be a better option.

5.4.3 Load Ramping Operation

The following load ramping features are available with the Pow-R-Con:

- Individually Adjustable 5 Seconds to 5 minutes Up/Down Electronic Ramps times
- Adjustable Low and High Power Limit
- Remote Adjustable Power Level (Keypad or Potentiometer)
- Individual Load Control
- Adjustable Breaker Trip Limit
- LED Indication -High and Low Limit, Command Mode, Blend Mode, Load Generator, Unload Generator, Breaker Trip

There are two modes of operation for the load ramping function:

- Blend
- Command

The primary function of the load ramp is to control the generator power output independent of the system load sharing voltage monitored on the paralleling lines. In Blend Mode, the disconnect from the paralleling lines is temporary and the voltage on the lines is used to determine the generator power output. In Command Mode, the disconnect from the paralleling lines is permanent and the generator power output is user-defined.

5.4.3.1 Blend Mode

The Blend Mode is enabled when the Blend Mode Enable Input is activated. The Blend Mode Enable input can be activated any number of ways, two common approaches would be with a PLC or a manual switching device. If you have a keypad/display panel, the BLEND MODE LED will come on. With the Blend Mode enabled, the Pow-R-Con will initially not connect the internal unit paralleling lines to the system paralleling lines.

After the generator has been synchronized to the bus and the breaker is closed, the Pow-R-Con holds the generator power output at the user-defined low limit. The user will see a decrease in the load carried by the generators already on-line equal to the low limit power output. When a signal is provided to the Load Generator Enable Input, the Pow-R-Con will begin increasing the generator power output. This is referred to as "ramping." The LOAD GENERATOR LED will come on. The Load Generator Enable Input can be activated any number of ways, two common approaches would be with a PLC or a manual switching device. The Pow-R-Con will monitor the voltage level on the paralleling lines and increase the generator power output to that level over a user-defined time interval. As the power output increases, the power carried by other generators decreases an equal amount. This soft loading will prevent the block loading and system shock that occurs when closing the generator breaker when operating in ILS mode.

When the generator power output is equal to the level on the paralleling lines, the internal unit paralleling lines are tied to the external system paralleling lines and normal load sharing between the generators is resumed. The LOAD GENERATOR LED will go off.

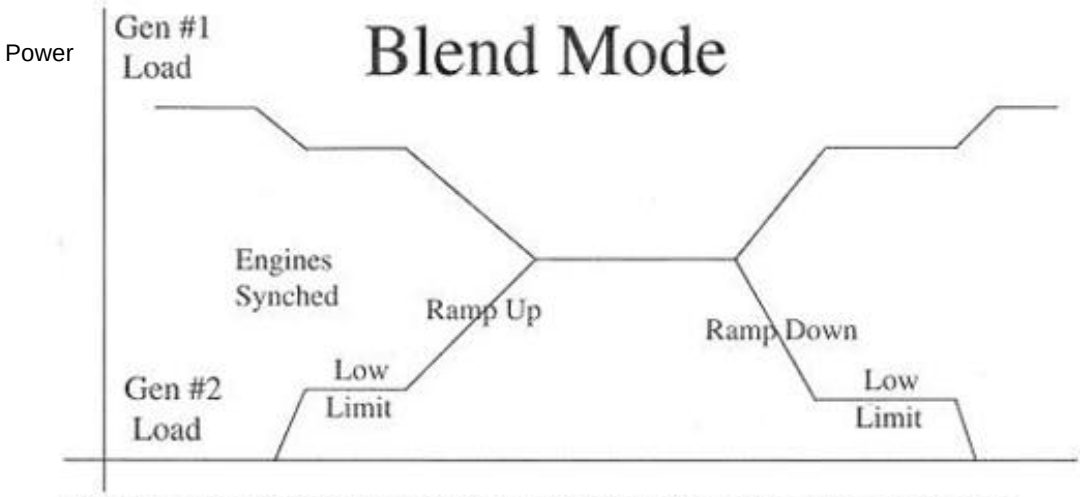
At this point, it appears as if the unit is functioning in ILS mode, but as long as the Blend Mode Enable Input is activated, the unit is in Blend Mode. The Blend Mode Load Sharing function operates identically to the ILS Load Sharing function.

Conversely, if the generator is already sharing the load and the load has decreased enough to warrant taking the generator off-line, the user sends a signal to the Unload Generator Enable Input. The Unload Generator Enable Input can be activated any number of ways, two common approaches would be with a PLC or a manual switching device. The Pow-R-Con will disconnect the internal unit paralleling lines from the external system paralleling lines. The UNLOAD GENERATOR LED will come on. The generator power output will start decreasing to a user-defined low limit. The generator power output is decreased to the user-defined low limit over a user-defined time interval. When the low limit is reached, the UNLOAD GENERATOR LED will go off. As the generator power output is decreased, the generators remaining in load sharing will pick-up the load.

In Blend Mode, ramping is not a function of input signal. Stated another way, the ramping does not occur as long as there is a signal. When a ramping signal is provided, the unit determines an end point destination. If at any time, the signal is removed, the destination still exists. The unit is seeking to reach a power production level in a user-defined amount of time. It basically calculates a slope from the user-defined low limit to the current loading level. Based upon which input was activated, the unit knows whether the slope is positive or negative. To cancel the ramp, the user has to activate the opposite input.

Another feature of Blend Mode is the user-defined Breaker Trip Level. When the user-defined breaker trip level is reached, and a signal is provided to the Breaker Trip Enable Input, the Breaker Trip Relay Output contact is closed to open the generator circuit breaker. As usual, the Breaker Trip Enable Input can be acti-

FIGURE 5-1



1.Gen #1's Pow-R-Con Forward Power On Relay Sends Start Signal to Gen #2.
2.Gen #1's Parallel Lines are Monitored by Gen #2's Pow-R-Con and Gen #2 is Synchronized.
3.Gen #2 is Loaded to the Preset Low Limit.
4.Upon Receiving Ramp Up Signal, Gen #2 is Ramped Up Until Each Engine is Proportionally Carrying its Share of the Load.
5.The Paralleling lines are Connected, and Proportional Load Sharing Continues.
6.Gen #2 Receives a Ramp Down Signal, and the Paralleling Lines are Disconnected and Unit is Ramped Down to the Low Limit.
7.Breaker Trip Signal Sent to Gen #2 and Engine is Taken Off Line.

vated any number of ways, two common approaches would be with a PLC or a manual switching device. The beauty is that it is the user's choice when that signal is sent. The generator will stay on-line at the user-specified low limit indefinitely. If necessary, the whole blend mode process could be started over again, ramp up, load share, and ramp back down.

5.4.3.2 Command

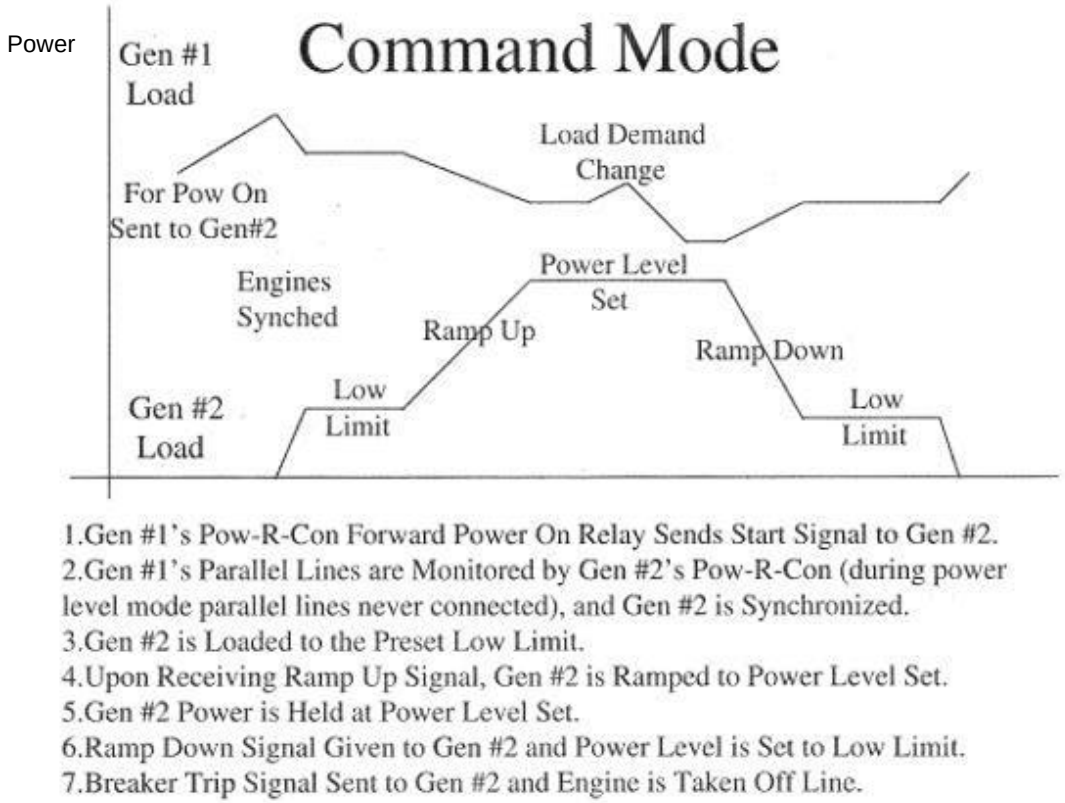
The Command Mode is enabled when the Command Mode Enable Input is activated. The Command Mode Enable input can be activated any number of ways, two common approaches would be with a PLC or a manual switching device. If you have a keypad/display panel, the COMMAND MODE LED will come on. With the Command Mode enabled, the Pow-R-Con will disconnect the internal unit paralleling lines from the system paralleling lines. This will prevent the block loading and system shock that occurs when closing the generator breaker when operating in ILS mode.

After the generator breaker is closed, the Pow-R-Con holds the generator power output at the user-defined low limit. When a signal is provided to the Load Generator Enable Input, the Pow-R-Con will begin increasing the generator power output. This is referred to as "ramping." The LOAD GENERATOR LED will come on. The Load Generator Enable Input can be activated any number of ways, two common approaches would be with a PLC or a manual switching device. The Pow-R-Con will increase the generator power output until it reaches a user-defined level which can be set in the unit or remotely with a potentiometer. The generator power output is increased to the user-defined level over a user-defined time interval.

When the generator power output reaches the user-defined level, the LOAD GENERATOR LED will go off. The Pow-R-Con will hold the generator power output at the user-defined level until the user sends a signal to the Unload Generator Enable Input. The Unload Generator Enable Input can be activated any number of ways, two common approaches would be with a PLC or a manual switching device. The UNLOAD GENERATOR LED will come on. The generator power output will start decreasing to a user-defined low limit. The generator power output is decreased to the user-defined low limit over a user-defined time interval. When the low limit is reached, the UNLOAD GENERATOR LED will go off.

In Command Mode, ramping is not a function of input signal. Stated another way, the ramping does not occur as long as there is a signal. When a ramping signal is provided, the unit has a

FIGURE 5-2



user-defined destination. If at any time, the signal is removed, the destination still exists. The unit is seeking to reach a power production level in a user-defined amount of time. It basically calculates a slope from the user-defined low limit to the user-defined high level. Based upon which input was activated, the unit knows whether the slope is positive or negative. To cancel the ramp, the user has to activate the opposite input.

Another feature of Command Mode is the user-defined Breaker Trip Level. When the user-defined breaker trip level is reached, and a signal is provided to the Breaker Trip Enable Input, the Breaker Trip Relay Output contact is closed to open the generator circuit breaker. As usual, the Breaker Trip Enable Input can be activated any number of ways, two common approaches would be with a PLC or a manual switching device. The beauty is that it is the user's choice when that signal is sent. The generator will stay on-line at the user-specified low limit indefinitely. If necessary, the whole blend mode process could be started over again, ramp up, hold, and ramp back down.

Do not activate the Bridge Integrator during Command Mode. The Bridge Integrator will not allow the Pow-R-Con to make a steady state adjustment to the engine speed. The Bridge Integrator will continuously attempt to eliminate any steady state errors that exist. Command Mode uses a steady state error to achieve a load level.

To reiterate, Command Mode does not sense a load requirement. Command Mode simply generates a user-defined level of power. The user needs to know that a load exists.

See Figure 5-2

5.4.4 Dead Bus

The Dead Bus Mode is enabled when the Dead Bus option is selected as **On** through the Keypad/Display panel or Front End Software and the Dead Bus Enable Input is activated. The Dead Bus Enable input can be activated any number of ways, two common approaches would be with a PLC or a manual switching device. If you have a keypad/display panel, the DEAD BUS LED will come on. With the Dead Bus enabled, the Pow-R-Con will monitor the bus voltage to determine that no voltage or frequency exists on the Bus. When this condition exists, the Pow-R-Con will by-pass Auto-Synchronizing and close the Breaker Close Relay Output contacts. The generator will begin to pick up the system load. At this point, the generating system can enter into ILS, Blend Mode, or Command Mode.

APPENDIX

The following procedure must be complete to allow the Pow-R-Con to be calibrated with a Barber-Colman DPG-2201 controller.

1. Wire per Figure AP-20*, except do not connect the Pow-R-Con governor speed set terminal 28 to the DPG-2201 controller at this time.
2. On the Pow-R-Con verify the switch one is set per table 3-1 and turn R174 20 turns CCW. See Figure 4 for location of switch one and R174.
3. Set remote speed potentiometer (if equipped) to 50%.
4. Tune the DPG-2201controller per DYNA 313 until it is running at 50/60 generator hertz. Stop the engine.
5. Connect the Pow-R-Con governor speed set terminal 28 to the DPG-2201 controller.
6. Start the engine it should be running a few generator hertz below the 50/60 generator hertz set above. Adjust R173 until the generator is running at 50/50 hertz.

*Figure AP-20 is available on our web site: www.dynaproducts.com

Go to Product Overview section, select Integrated Paralleling Systems, then select DYN2-94026 Pow-R-Con.

WARNING
Barber-Colman requires an independent overspeed shut down device to prevent loss of engine control which may cause personal injury and/or equipment damage.

- NOTE -
Barber-Colman believes that all information provided herein is correct and reliable and reserves the right to update at any time. Barber-Colman does not assume any responsibility for its use unless otherwise expressly undertaken.

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