Electronic Modular Control Panel 3 (EMCP3)

Introduction and Specifications

Foreword

This presentation was prepared by Caterpillar Service Training to be a training overview of the EMCP3 for Caterpillar generator set service personnel. This presentation provides a description of the different levels of EMCP3, system specifications, wiring, optional modules, and an introduction to programming. As always, the proper service information for EMCP3 in SIS should be used for the latest specific details for operation, adjustments, programming and troubleshooting. Thank You.

Objectives

- System Overview
- Features
- System Interface
- Optional Modules
- Display Functions

System Overview

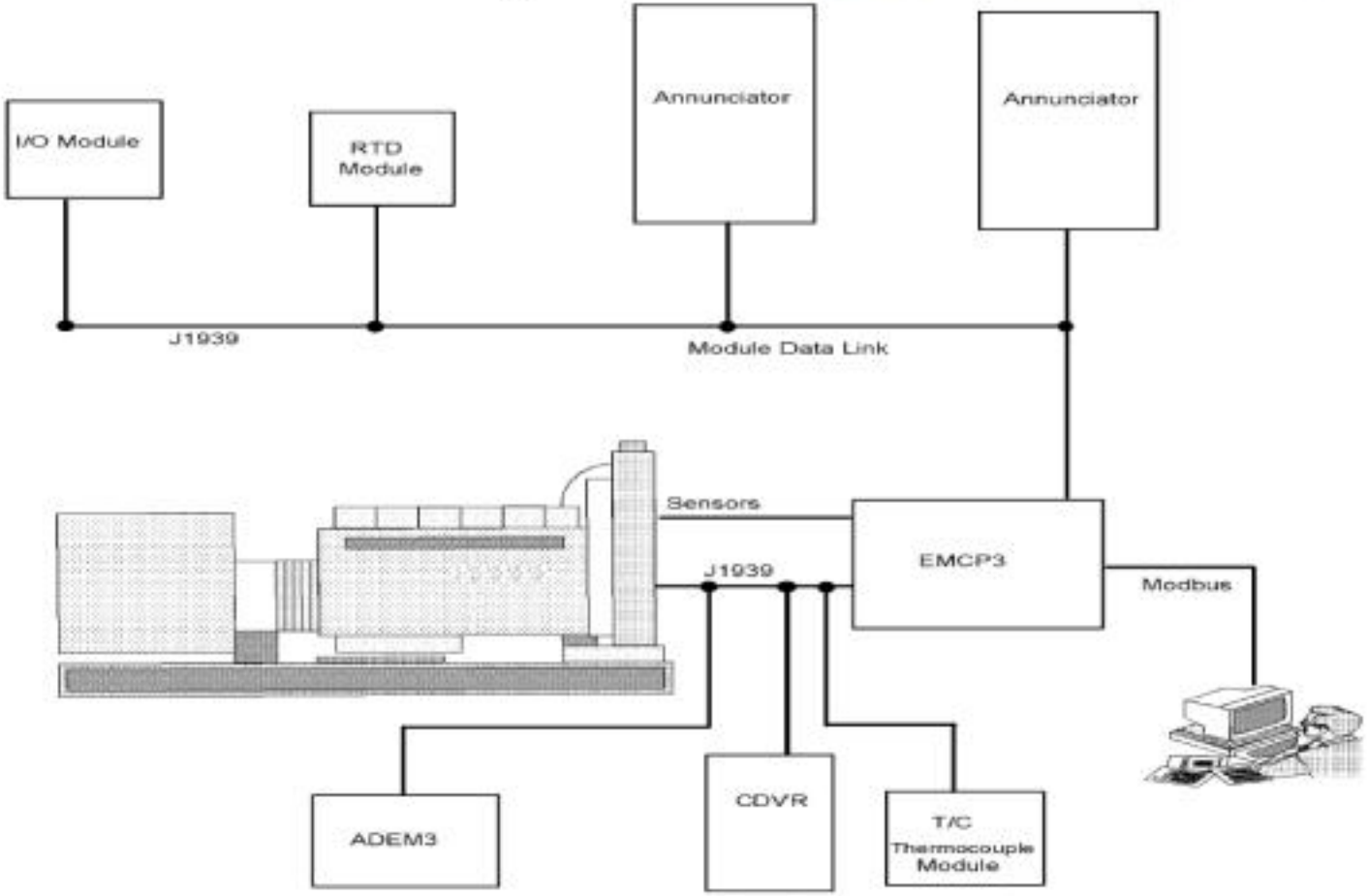
- General System Strategy
- Block Diagrams
  - ADEM3
  - No ADEM3
- Product Compatibility
  - Olympian Branded
  - Caterpillar Branded
  - Standard Configurations
- Publications & Part Numbers

Control System Strategy

- Common look and feel
- Superior features at competitive pricing
- Scalable – purchase only what is needed
- Flexible & configurable to adapt to site specific requirements

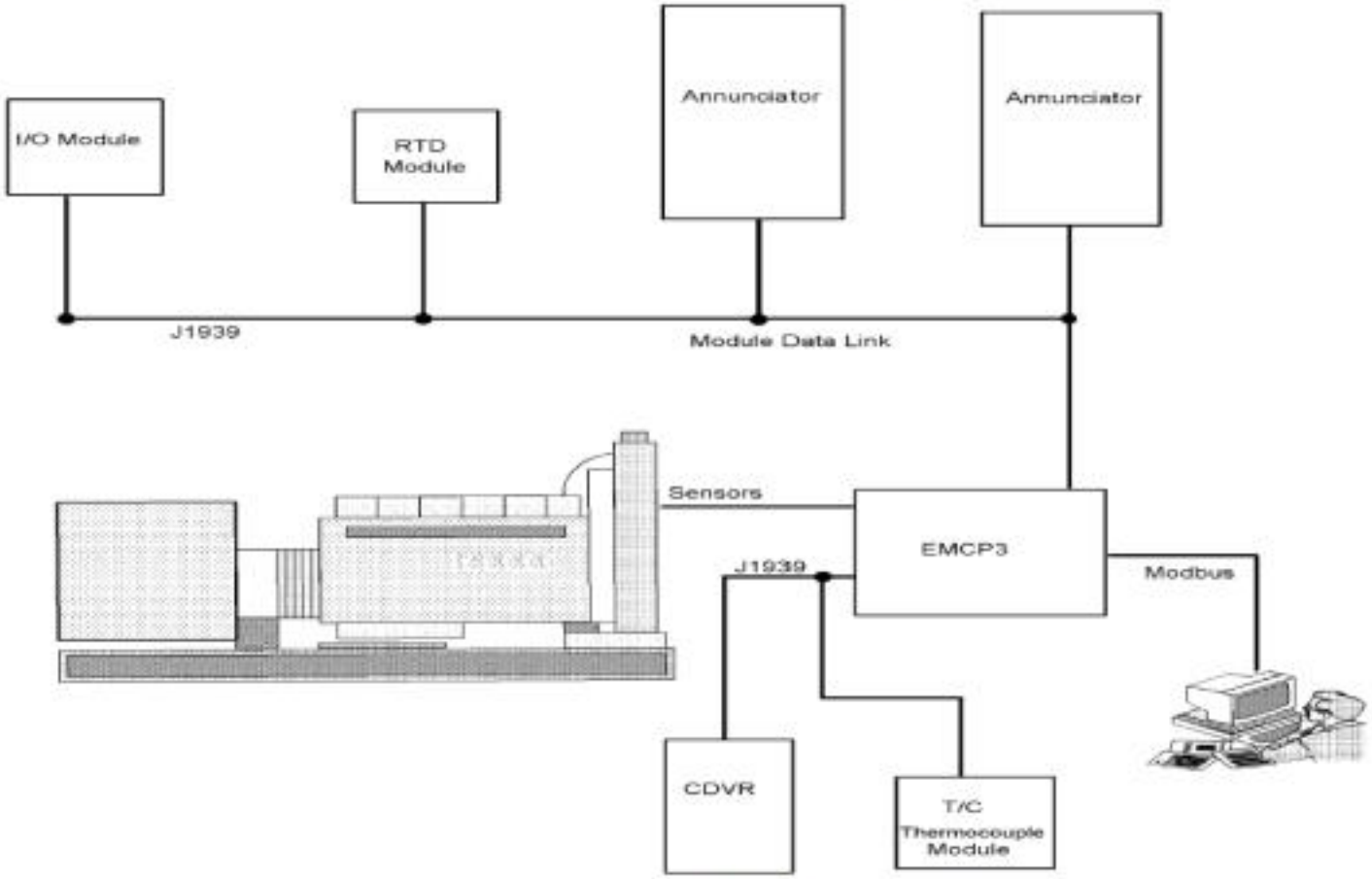
Block Diagram

EUI Engine with ADEM3



Block Diagram

MUI Engine without ADEM3



Product Comparison
Olympian

Current Product	 2001	 4001	Custom Solutions	 A6K
EMCP3	 EMCP 3.1	 EMCP 3.2	N/A EMCP 3.3	 EMCP 3.4

Product Comparison
Caterpillar

Current Product		 EMCP-II	 EMCP-II+	 EMCP-II+P
EMCP3	 EMCP 3.1	 EMCP 3.2	 EMCP 3.3	 EMCP 3.4

EMCP 3.X Production Dates

EMCP 3.1	EMCP 3.3 (3500)	EMCP 3.4
Available Date: ❖ TBD	Available Date: ❖ **June 2004** ➢ EMCP II+- Standard ➢ EMCP 3.3 - Optional in EMCP II+Box ❖ **September 2004** ➢ Only Offering	Available Date: ❖ 2005

Standard Configuration

EMCP 3.1	EMCP 3.2	EMCP 3.3	EMCP 3.4
			
Standard for European sourced product	Standard for N. American sourced small product	Standard for Caterpillar large product	Option for full-featured paralleling
No options	Few options	Many options	Many options

Standard Configuration

	Olympian	Cat < 1MW	Cat 1 – 5.5MW
EMCP 3.1	Standard	N/A	N/A
EMCP 3.2	Option	Standard	N/A
EMCP 3.3	N/A	Option	Standard
EMCP 3.4	Option	Option	Option

Publications

- **System Operation, Troubleshooting, Testing & Adjusting**
  - RENR7902


CATERPILLAR®

RENR7902
December 2003

Systems Operation
Troubleshooting
Testing and Adjusting

EMCP3

8NS1-Up (Generator Set)

Part Numbers
D3500 ADEM3 System

- Control panel: 247-3343
- Schematic: 249-0606
- ADEM3 control: 206-2710
- Control assembly wiring diagram: 236-5138

EMCP3 Features

- EMCP3.X Control Systems
  - Communication
  - Functionality
  - Optional Modules
  - Input/Output

EMCP3.1
Feature Summary

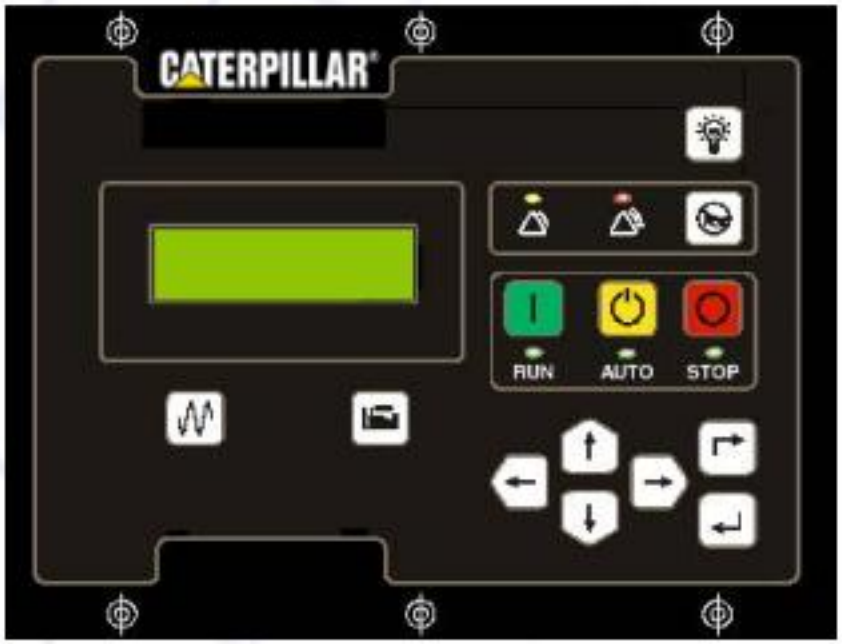
- **Olympian Standard replaces 2000 series**
- **Communication**
  - Data link local to ADEM3 (J1939)
  - Hardwire sensor input without ADEM3
- **Functionality**
  - Fault log up to 20 faults
  - 3 Phase Generator input Voltage and Current
  - Engine Controls
  - Engine Protection
    - High coolant Temp
    - Low oil Pressure
    - Overspeed
    - Fail to Start

EMCP3.1 I/O

- 6 discrete sinking inputs
  - Digital In1 reserved for E-Stop
  - Digital In2 reserved for Remote Initiate (Non – A3)
- 2 analog resistive sender inputs
  - Passive Analog1 for Oil Pressure (Non – A3)
  - Passive Analog2 for Coolant Temperature (Non – A3)
- 1 Magnetic Pick-Up input
- 6 relay outputs
  - Relay1 Normally Open for Starter Motor Relay
  - Relay2 Normally Open for Fuel Control Relay (Non-A3)

EMCP3.2
Feature Summary

- Caterpillar ≤1MW standard replaces EMCPII
- Additional Communications
  - MODBUS RTU remote to customer (RS-485)
  - Module Data Link (J1939)
- Additional Functionality
  - Over/Under Voltage and Freq Protection
  - Generator and Main status indicator
- Optional Modules
  - Annunciator
  - Discrete I/O
  - Digital Voltage Regulator (CDVR)
  - Remote Monitoring
- - 40°C Panel Option

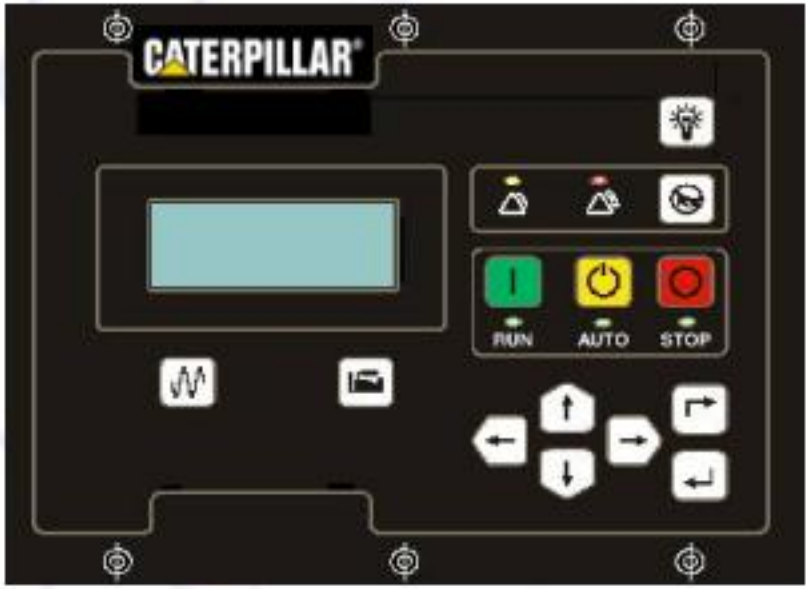


EMCP3.2
I/O

- Inputs
  - 2 more spare discrete sinking inputs (8 total)
  - 1 spare Passive analog resistive sender inputs (3 total)
  - 1 Magnetic Pick-Up input (like EMCP3.1)
- Outputs
  - 2 additional relay outputs (8 total)
  - 1 new spare sinking output (1 total)

EMCP3.3
Feature Summary

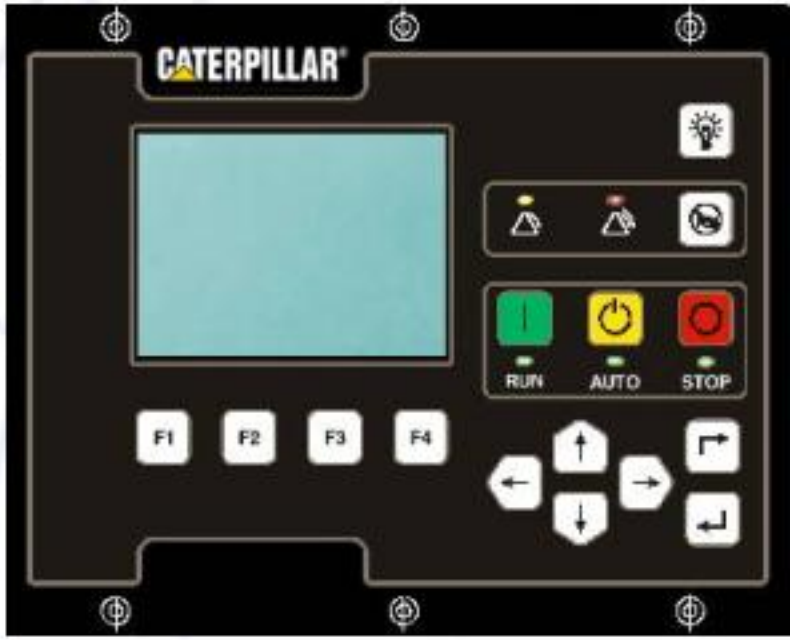
- Caterpillar 1-5.5MW standard replaces EMCPII+
- Additional Functionality
  - Advanced Engine Monitoring
    - More Pressures and Temperatures from ADEM3
    - Fuel Consumption
  - Emergency Override
  - 400 Hz Capable
- Additional Optional Modules
  - Resistive Temperature Device (RTD)
  - Thermocouple (TC)
- Larger Display
- Additional Output
  - 1 more spare sinking output (2 total)



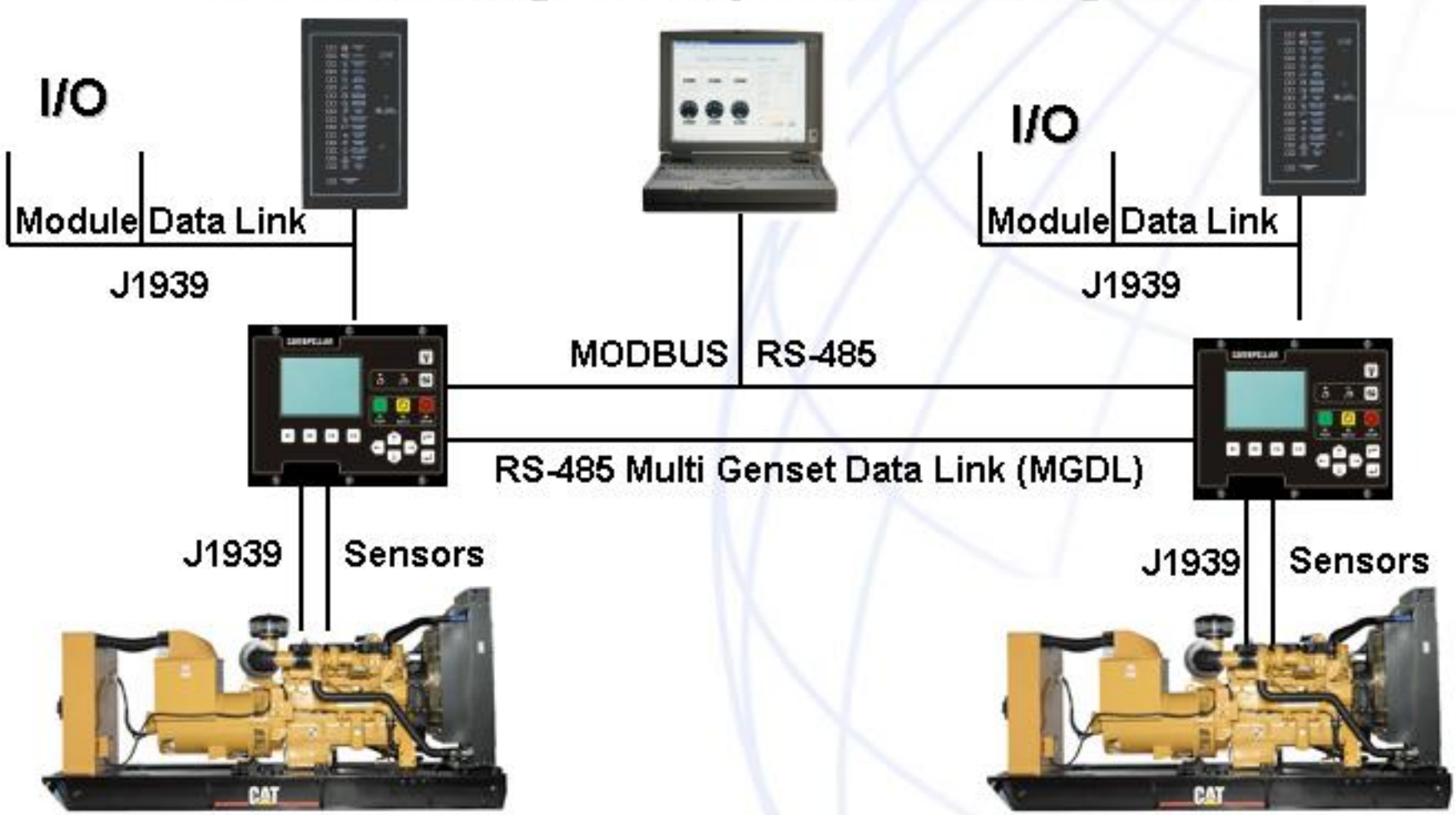
EMCP3.4
Feature Summary

- Option on all Olympian replaces 6000 series
- Option on Caterpillar <5MW replaces EMCPII+P
- Additional Communications
  - Multi-Genset Data Link (RS-485)
- Functionality
  - Advanced control, metering and protection
    - Sync check, fail to sync, phase sequence
  - Auto-sync & load sharing control
  - Three phase utility AC Input Voltage
- Additional I/O
  - 8 more Discrete sinking inputs (16 total)
  - 2 more spare sinking output (4 total)
  - Two new 4-20mA inputs
  - KVAR/pf control output

- Larger Display with 2 more buttons



EMCP3.4
Paralleling Component Diagram



System Interface

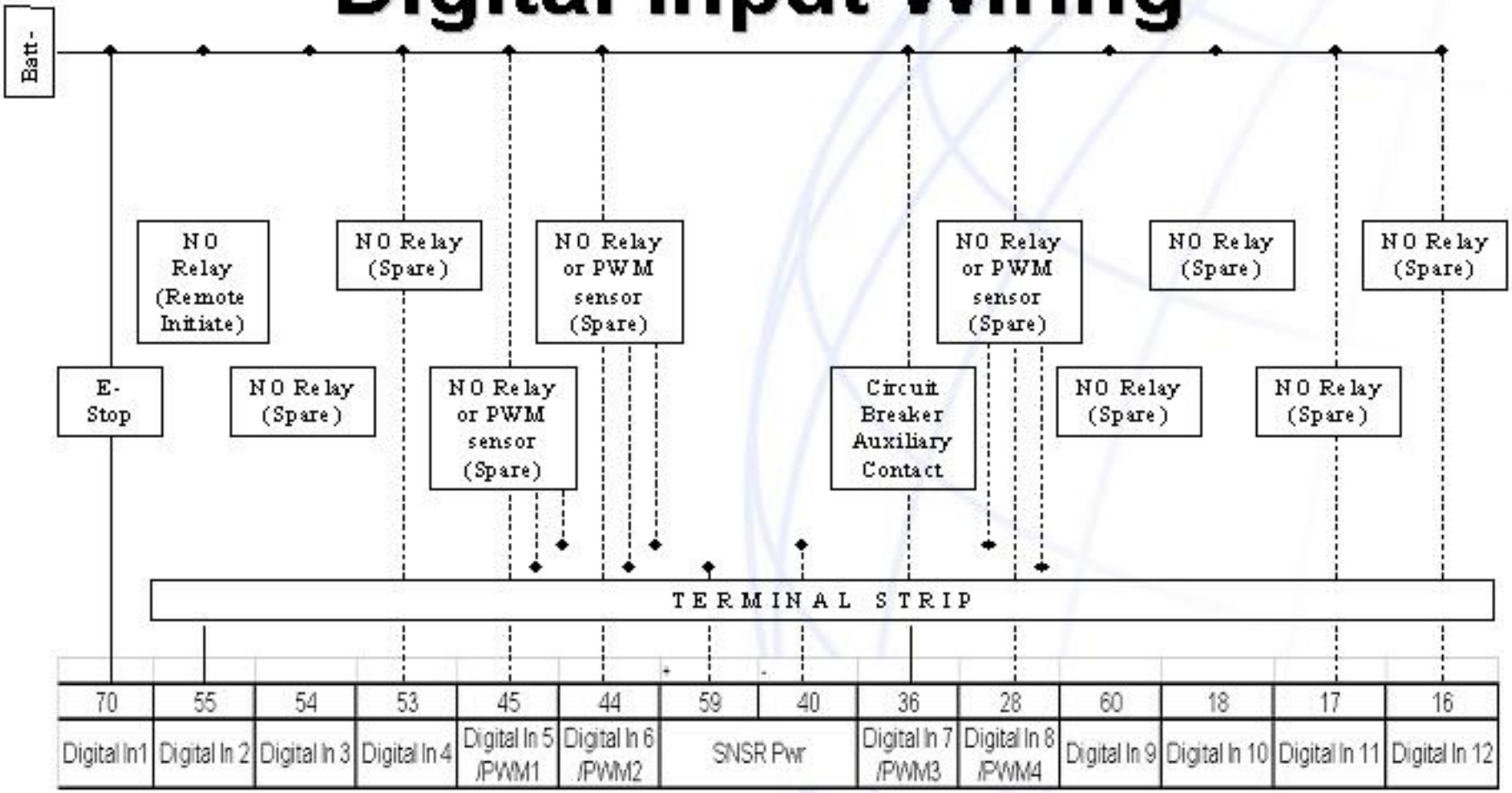
- Inputs/Outputs
  - Digital & Analog Inputs
  - Speed Sensor
  - Voltage & Current Sensing
  - Digital & Relay Outputs
  - Desired Speed & Voltage
  - Data Links
  - J1 70 Pin Connector

Note: All wiring diagrams based on D3500 A3 systems.

System Interface I/O
Digital Inputs

- Discrete low side (sinking) inputs
- Set to activate on:
  - Active High (normally closed contact)
  - OR Active Low (normally open contact)
- Digital In 1 wired to ground through E-Stop Switch
- Digital In 2 wired to ground through Remote Initiate Switch
- Digital In 5,6,7,8 accept PWM signal
- Other Digital In configured to monitor pressures, temperatures, & levels

System Interface I/O
Digital Input Wiring



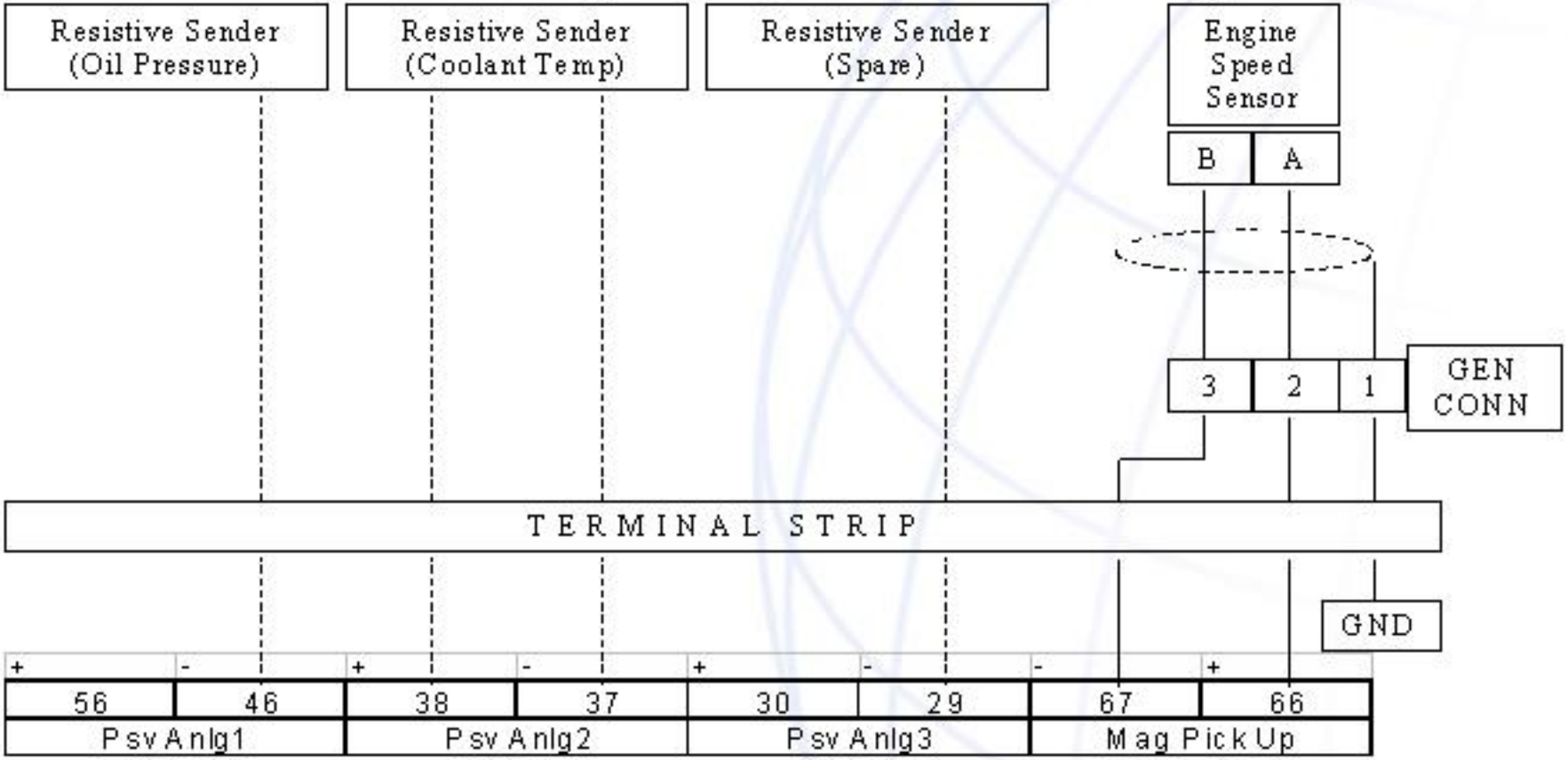
System Interface I/O
Analog Inputs

- Resistive senders (0-2000 Ohm)
- Passive analog 1 for Oil Pressure (Non-A3)
- Passive Analog 2 for Coolant Temp (Non-A3)
- Passive Analog 3 spare (not EMCP3.1)

System Interface I/O
Speed Sensor

- Magnetic Pick Up (MPU) used to determine RPM
- MPU- and MPU+ shielded by ground wire
- Internal resistance of 142 Ohms
- Independent MPU used by EMCP3 only

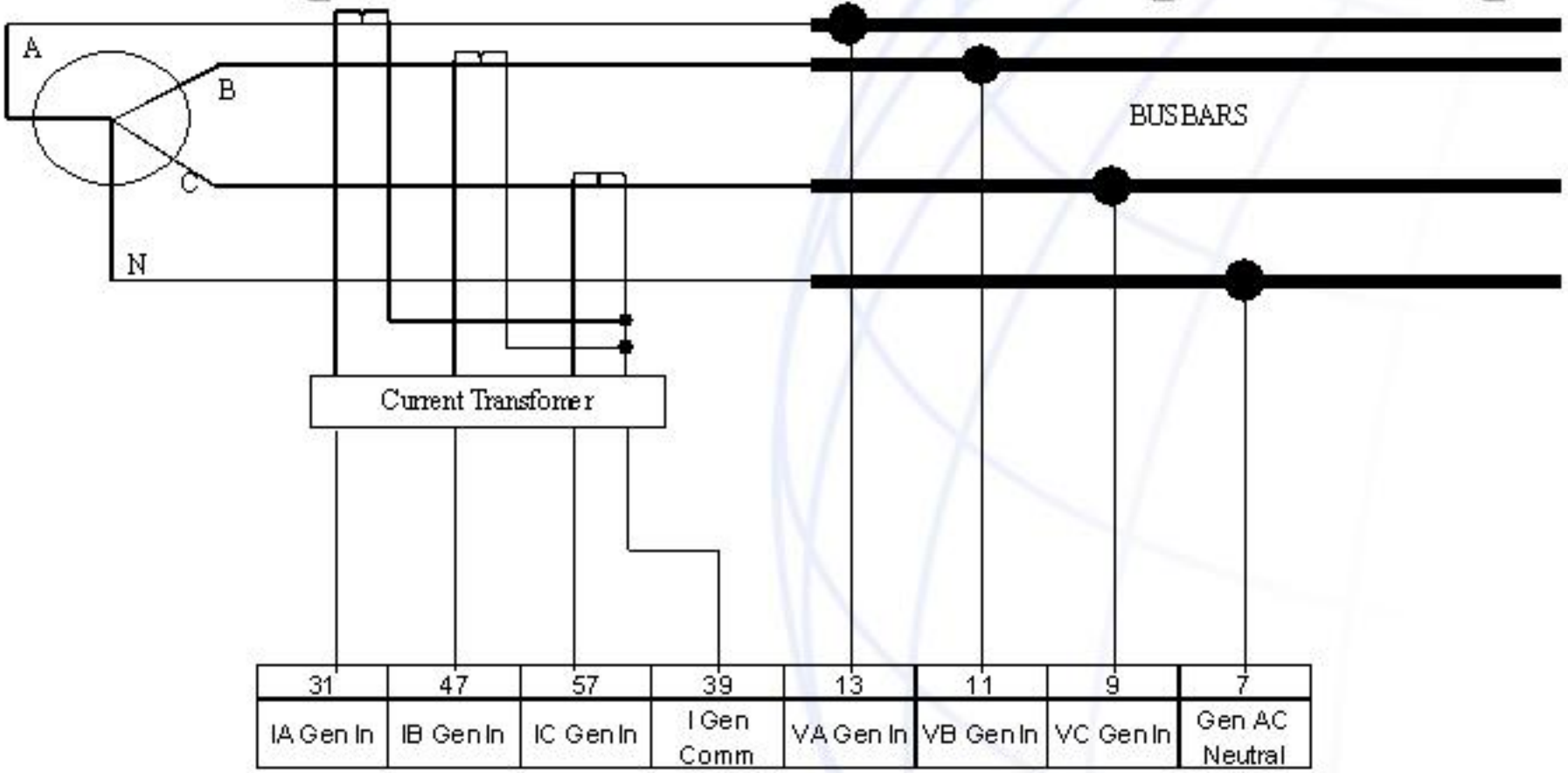
System Interface I/O
Analog Input Wiring



System Interface I/O Voltage and Current Sensing

- **Three Phase Generator Current**
  - 0-7V RMS AC voltage input, 60Hz
  - 0-5A RMS AC current input for L0-L2
  - IA Gen In, IB Gen In, IC Gen In, I Gen AC Common
- **Three Phase Generator Voltage**
  - 0-6V/0-30V RMS AC voltage input, 60Hz
  - 0-600vac for L0-L2
  - VA Gen In, VB Gen In, VC Gen In, Gen AC Neutral
- **Three Phase Utility Voltage (EMCP3.4)**
  - 0-6V/0-30V RMS AC voltage Input, 60Hz
  - VA Bus In, VB Bus In, VC Bus In, Gen AC Neutral

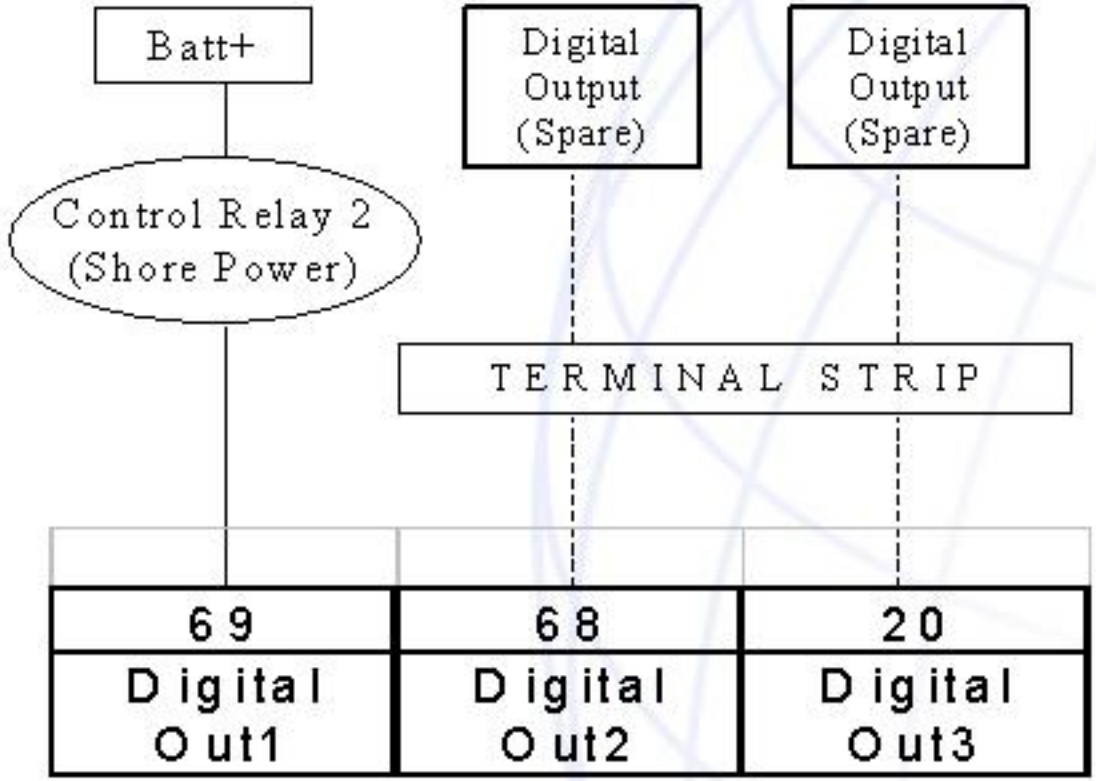
System Interface I/O
Voltage/Current Sensing Wiring



System Interface I/O Digital Outputs

- 300mA low side (sinking) drivers
- Convey On/Off information to operate relays, solenoids, and indicator lamps
- Examples:
  - Shore Power Control Relay
  - Ether
  - Pre-lube

System Interface I/O
Digital Output Wiring



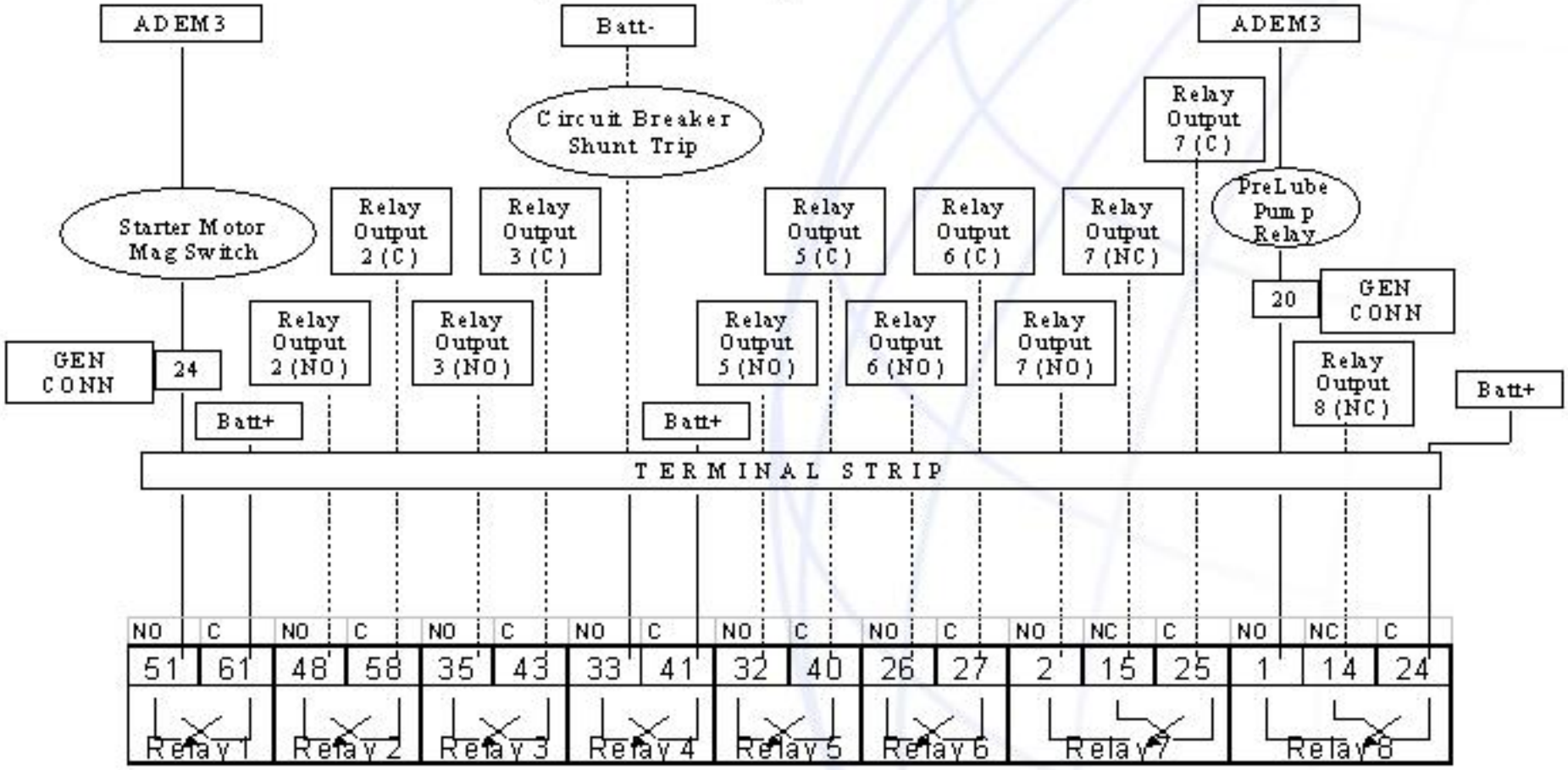
System Interface I/O
Relay Outputs

- Relay 1 through 6 are Form-A
  - One Normally Open (NO) contact
- Relay 7 & 8 are Form-C
  - One NO contact
  - One Normally Closed (NC) contact
- Current Capabilities
  - Switching DC Loads
    - Maximum Current: 2 Amps at 30 DCV
    - Minimum Current: 300 mA contact load
  - Switching Resistive AC Loads
    - 10 A @ 120 ACV
    - 5 A @ 240 ACV

System Interface I/O Relay Outputs

- Relay1 configured for Starter Motor
- Relay2 configured for Fuel Control (Non-A3)
- All other Relays
  - Controlled by corresponding digital selector
  - Set to activate on:
    - Active High (NC)
    - OR Active Low (NO)

System Interface I/O
Relay Output Wiring



System Interface I/O Desired Speed & Voltage

- **ADEM3 systems**
  - Desired speed from EMCP3 to ECM over J1939 data link
  - Desired voltage from EMCP3 to CDVR over J1939 data link
- **Non-ADEM3 EUI and PEEC systems**
  - Desired speed from potentiometer and speed brick
  - Desired voltage from switch on voltage regulator

System Interface I/O
Data Links – CAN2.0 J1939

- Non-isolated, shielded data link for local communication
- Main branch maximum 800 ft long
- Local branches maximum 3.3 ft from main
- Terminating resistors required to reduce reflection

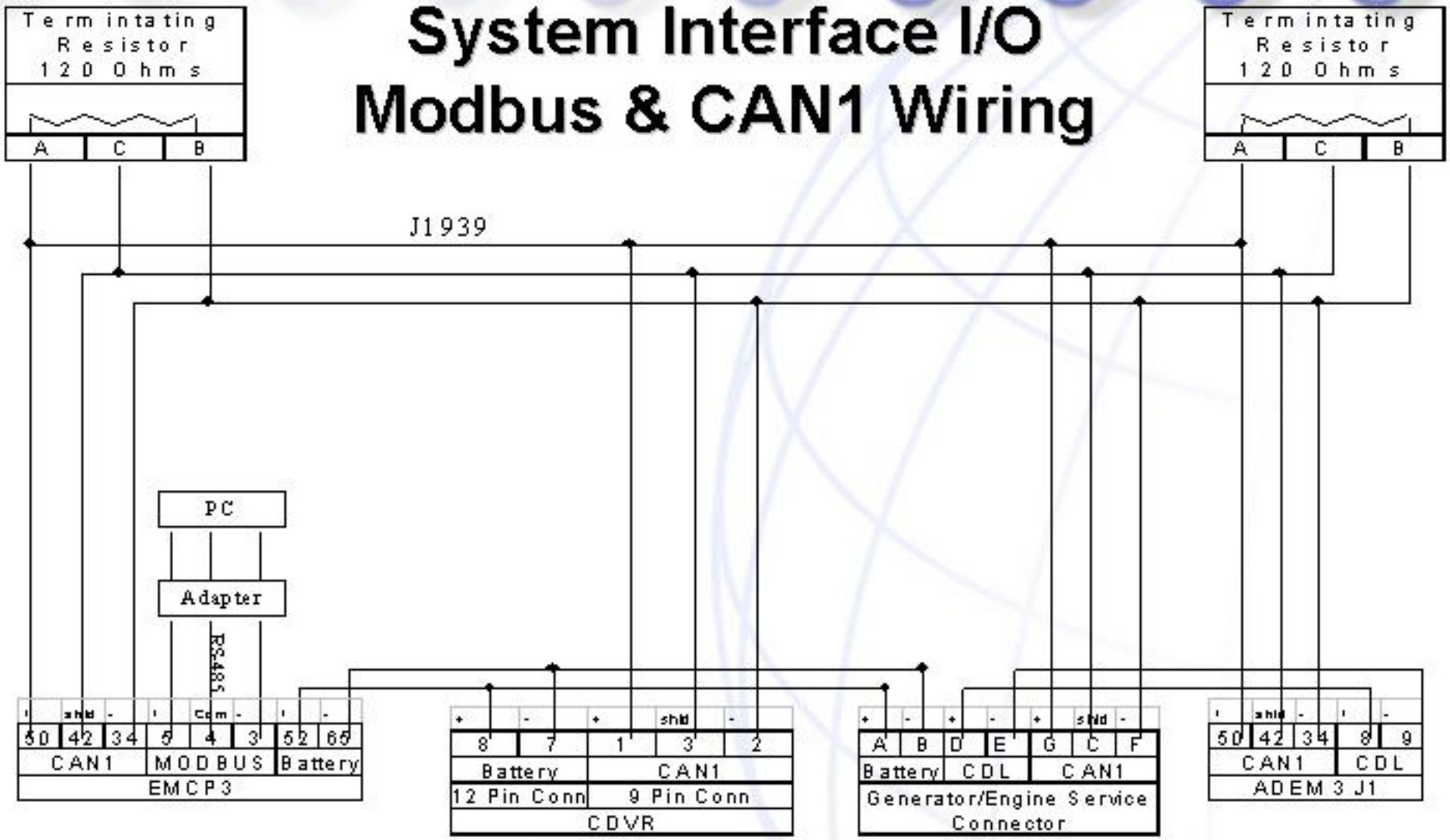
System Interface I/O Data Links – CAN2.0 J1939

- **CAN1 Data link from EMCP3 to:**
  - ADEM3
  - Engine and Generator Service Connectors
  - CDVR
- **CAN2 Data link (not EMCP3.1)**
  - Annunciator Module
  - Resistive Thermocouple Device/Thermocouple Module
  - Discrete I/O Module

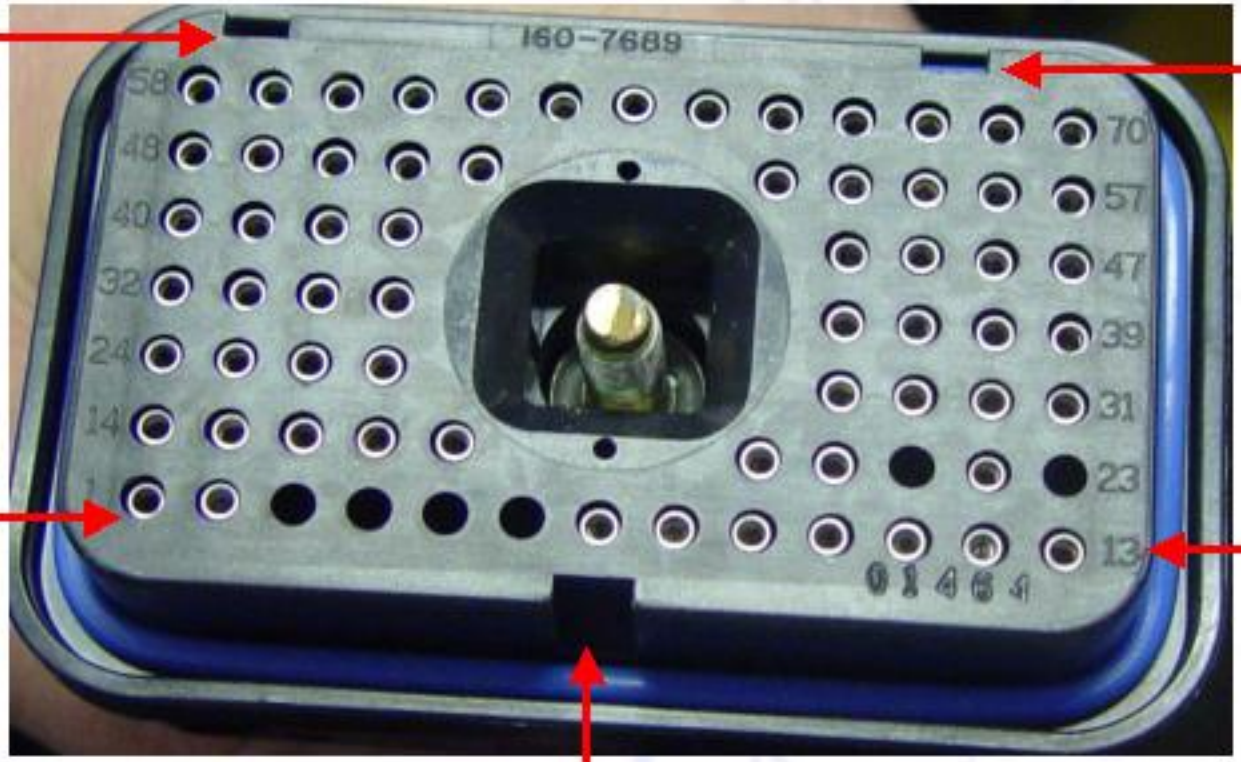
System Interface I/O Data Link - MODBUS

- MODBUS
  - Communication with PC built into control strategy
  - No need for communication module
- Optically isolated, half duplex RS-485 data link for SCADA

System Interface I/O
Modbus & CAN1 Wiring



System Interface I/O
J1 70 Pin Connector



Optional Modules

- Annunciator
- Discrete I/O
- Thermocouple (TC)
- Resistive Temperature Device (RTD)

Optional Module Annunciator

Dealer configurable with replaceable film

16 LED pairs announce events, diagnostics, and ready signals

LED pair indicates network/module status

Lamp Test Button

- LED's
- Horn

Alarm Acknowledge

Horn and Silencer

Optional Module Annunciator

- Can be installed remotely up to 800 ft
- Designed for two on package and two remotely located
- Communicate over CAN2 with no discrete input point wiring
- Each LED pair has four settings configured with Cat Service Tool
  - Suspect Parameter Number (SPN)
  - Trigger Type (disabled, general event, specific event)
  - Trigger Severity Level
  - Failure Mode Identifier (FMI)

Optional Module Discrete I/O

- Mount on genset or remote
- System designed for 2 I/O Modules
- Configured with Cat Service Tool
- Communicate over CAN2 with no discrete input point wiring
- Non-volatile memory allows for functionality during set point configuration and communication through CAN2

Optional Module Discrete I/O

- Reads 12 Discrete Inputs with 4 return channels
  - Sinking input with external switch closure to BATT (-)
  - Warning inputs will automatically reset as input goes non-active
  - Shutdown inputs will reset when reset message received on J1939
- Sets 8 Form-C Relay Outputs
  - 2 Amp @ 30 VDC
  - General event output activates for and alarm &/or shutdown
  - Specific event output activates for programmed SPN and FMI

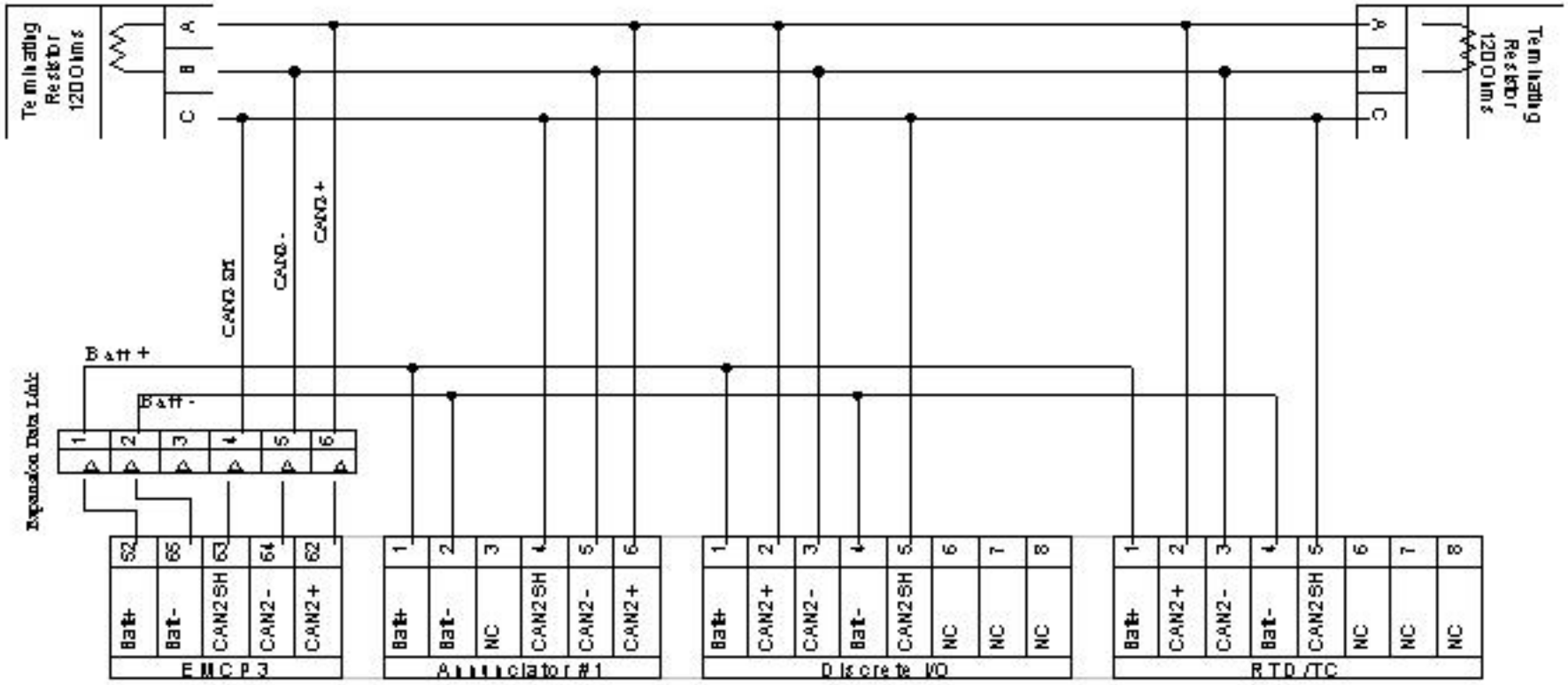
Optional Module
TC & RTD

- Thermocouple (TC)
  - Reads 20 inputs from type J or K thermocouples
- Resistive Temperature Device (RTD)
  - Scans 8 inputs from platinum RTD sensors
  - Sensor type 2, 3, or 4-wire RTD
  - Sensor resistance of 100 ohms
  - Temperature coefficient configurable for 5 types of platinum

Optional Module TC & RTD

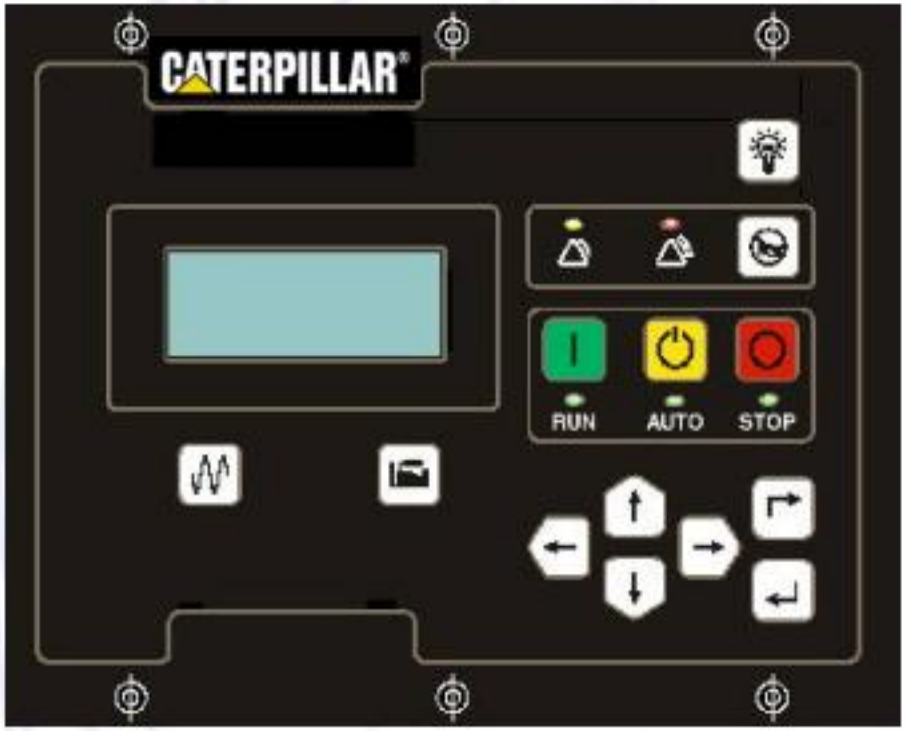
- Diagnostics
  - Open/Short circuits in sensors
  - Over/Under temperature warnings and shutdowns (set points configurable with Cat Service Tool)
  - Broadcasts data on J1939
  - Stores 20 diagnostic log entries in non-volatile memory
- EMCP3 displays info and performs engine shutdown

Optional Module Wiring
CAN2

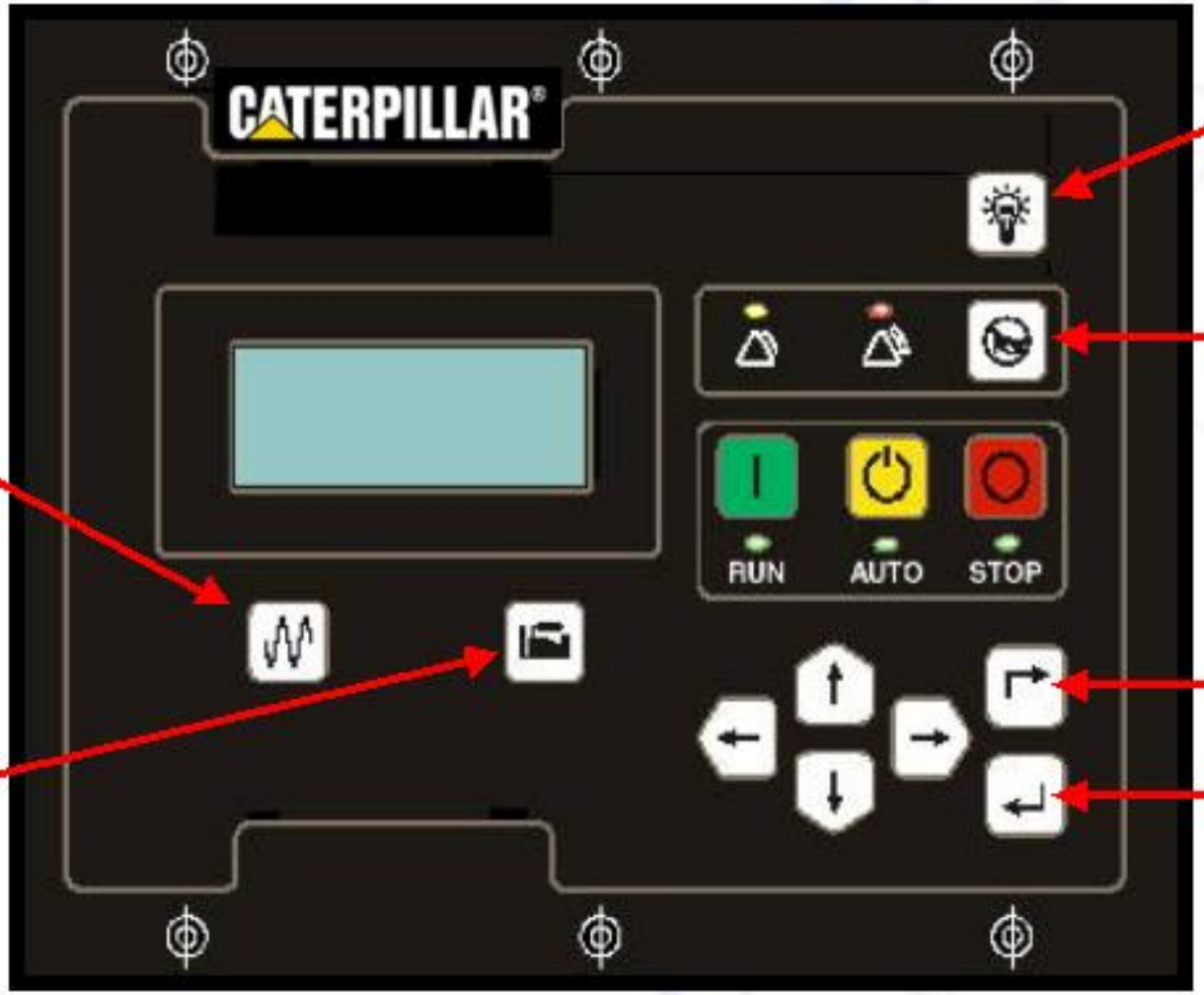


Display Functions

- Navigation Keys
- Password Entry
- Event Viewing & Clearing
- Setpoint programming



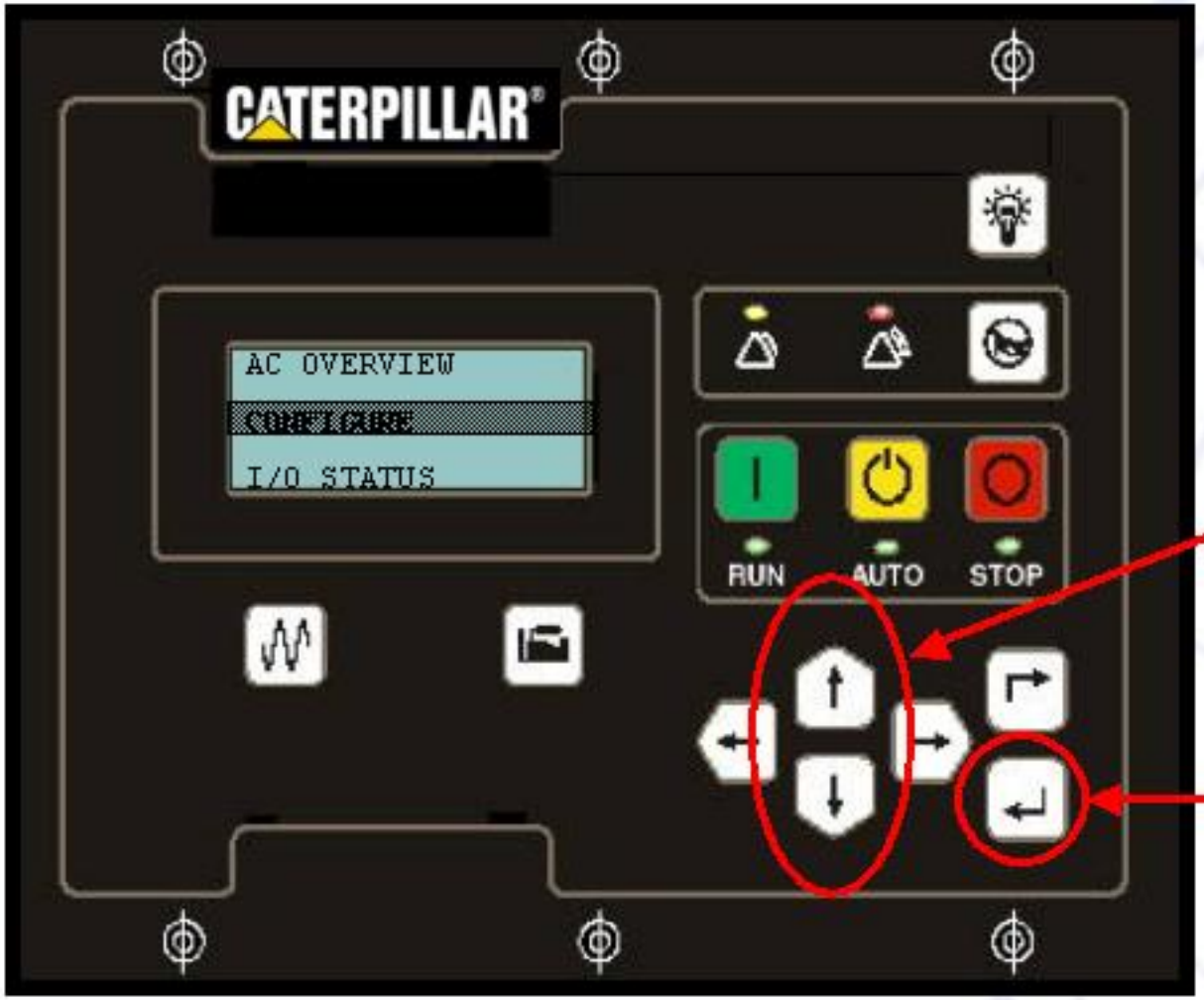
Navigation Keys



Password Entry

- Level 1 for customer
- Level 2 for technician to program all set points
- Level 3 for resetting hours and energy meters (call Caterpillar for password)
- Passwords time out in 10 min. and need to be disabled during service

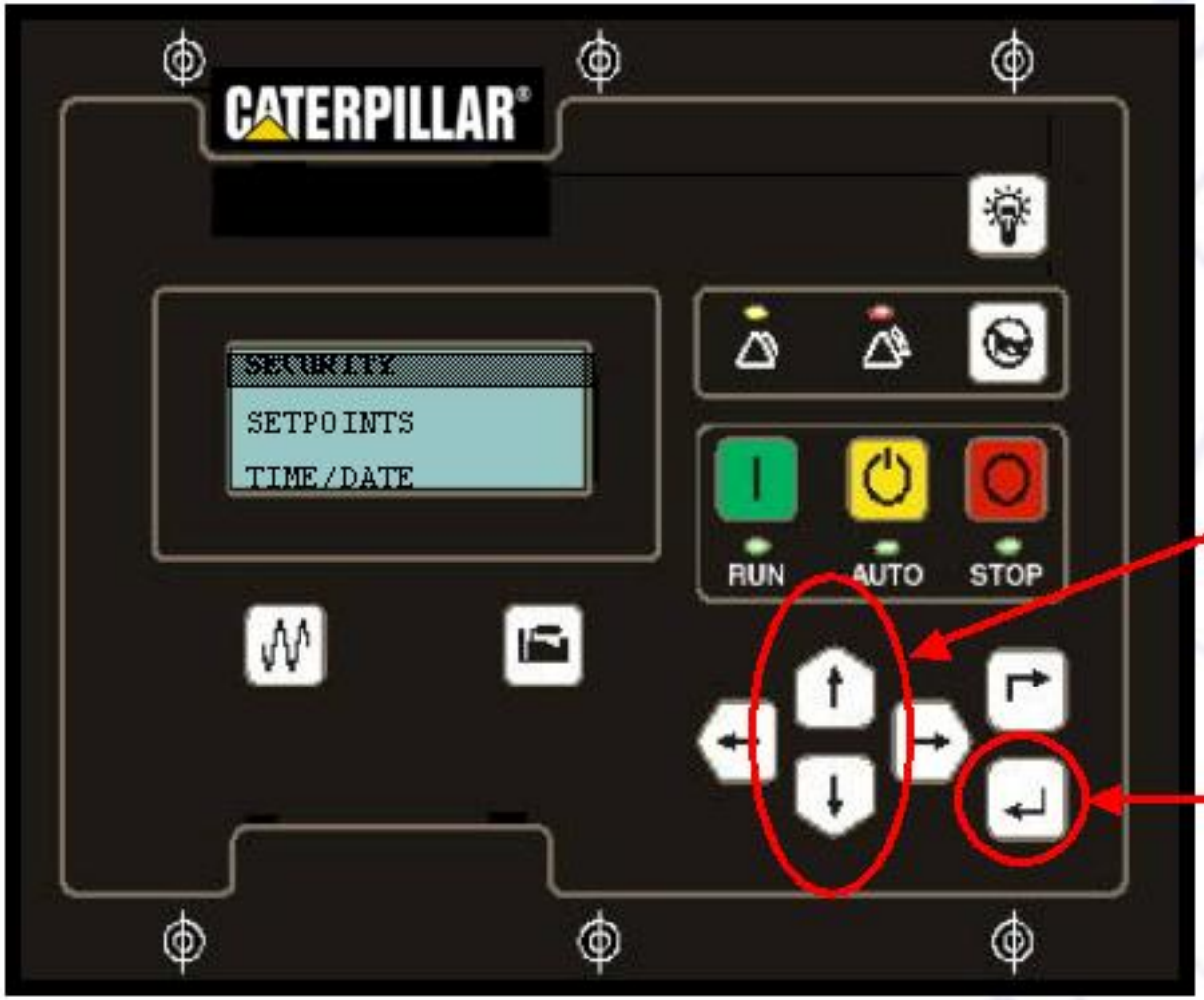
Password Entry



Press UP or DOWN to highlight CONFIGURE

Press ENTER to select CONFIGURE

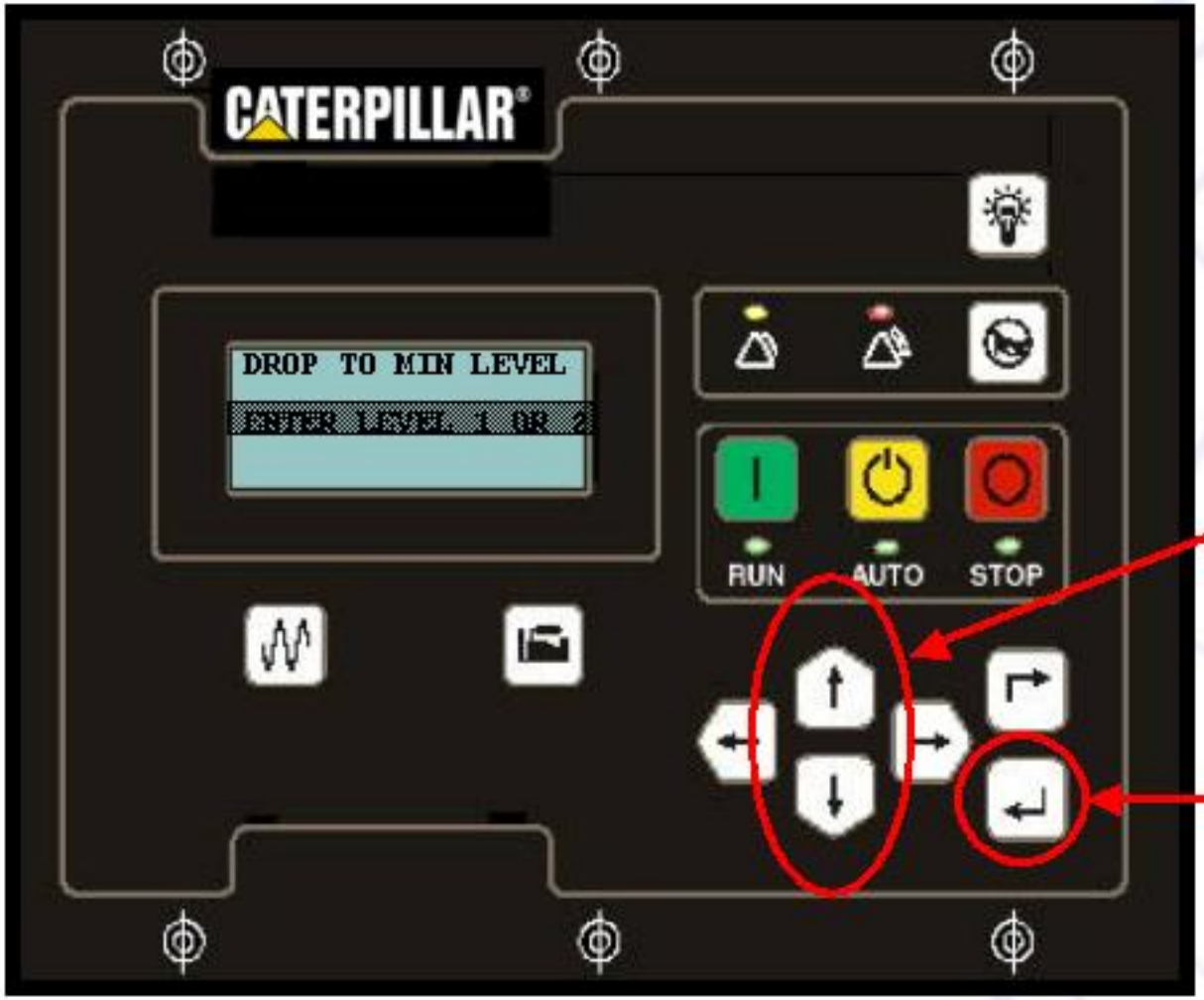
Password Entry



Press UP or DOWN to highlight SECURITY

Press ENTER to select SECURITY

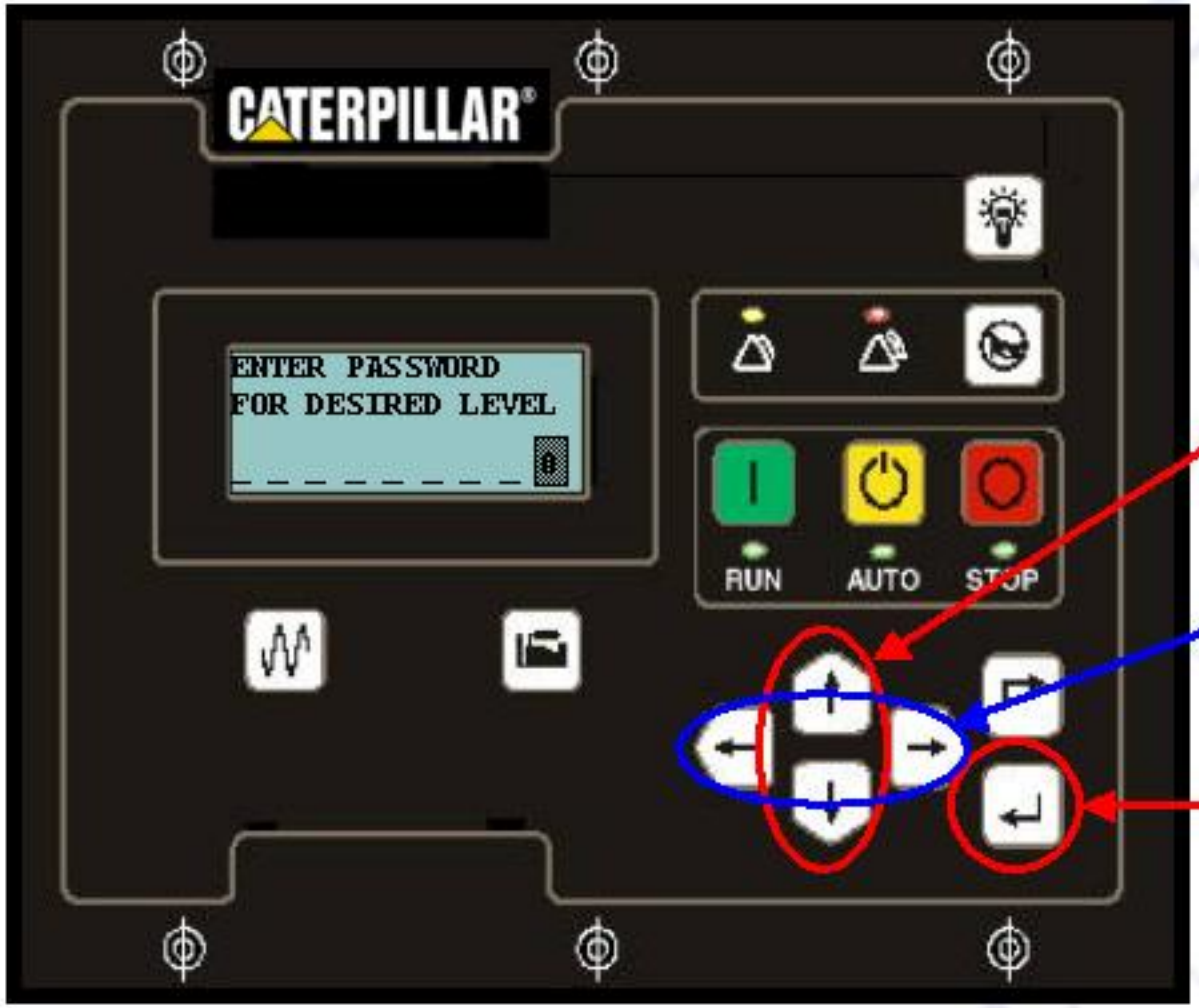
Password Entry



Press UP or DOWN to highlight ENTER LEVEL 1 OR 2

Press ENTER to select ENTER LEVEL 1 OR 2

Password Entry



Press UP or DOWN to increment/decrement highlighted digit

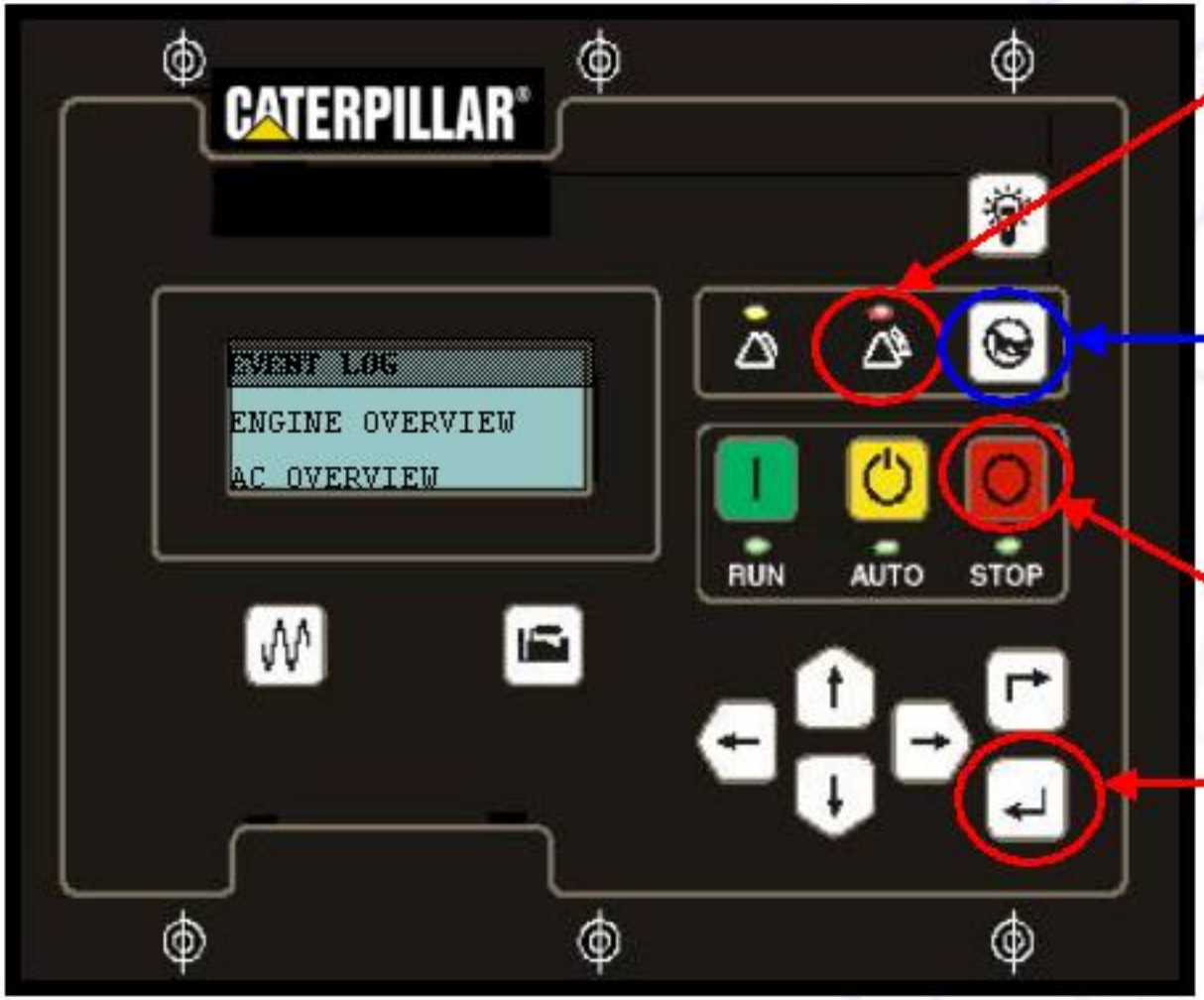
Press RIGHT or LEFT to change position of highlighted digit

Press ENTER to submit password

Password Entry

- Password length
  - Maximum 16 digits
  - Minimum 1 digit
  - Disabled when 0
- EMCP3 displays padlock if level too low to change parameter

Event Viewing & Clearing



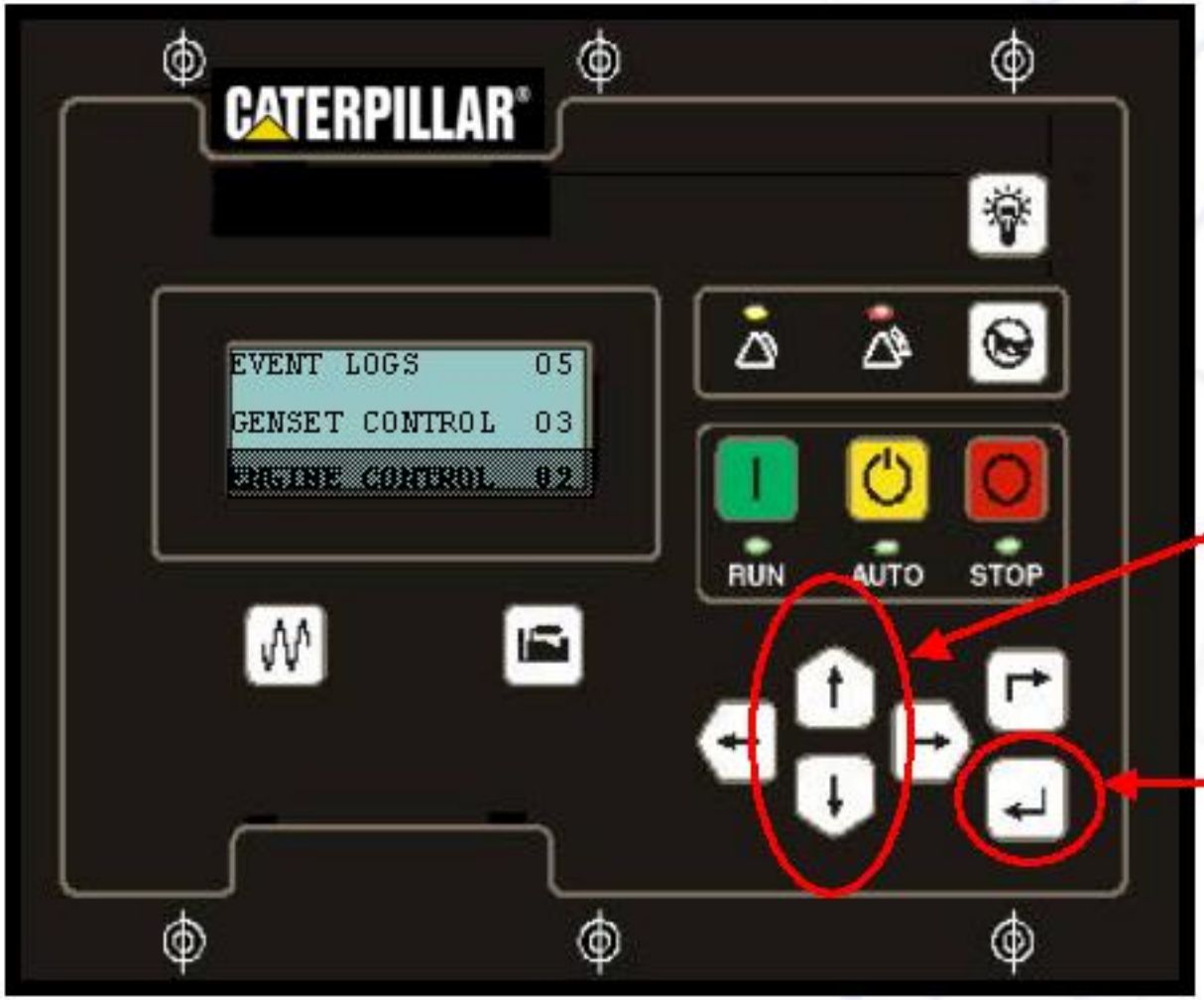
Flashing red light is unacknowledged shutdown event

Press ALARM ACKNOWLEDGE to silence horn and stop flashing

Press STOP to shut down engine

Highlight EVENT LOG and press ENTER

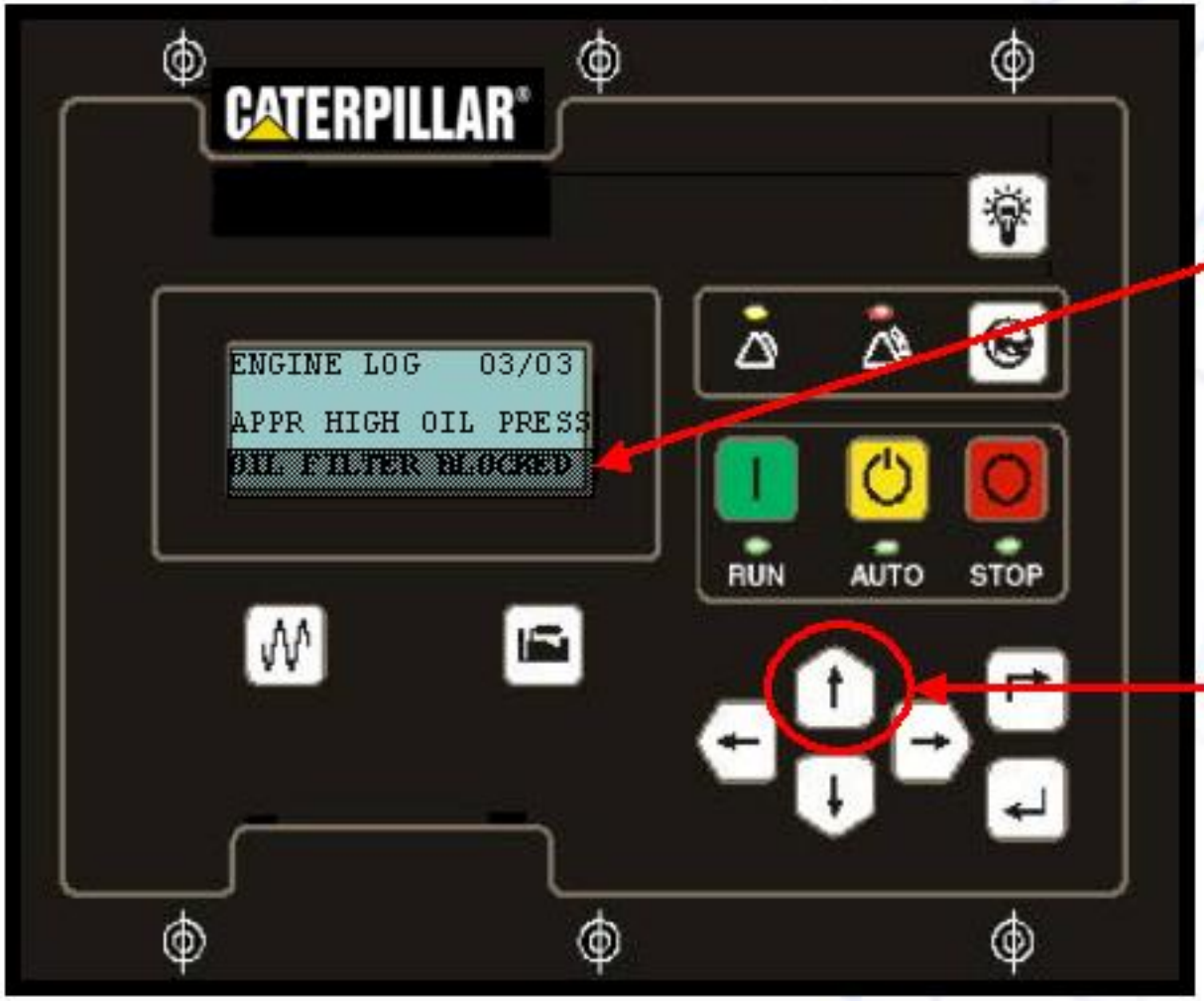
Event Viewing & Clearing



Select ECM

Press ENTER to view event log

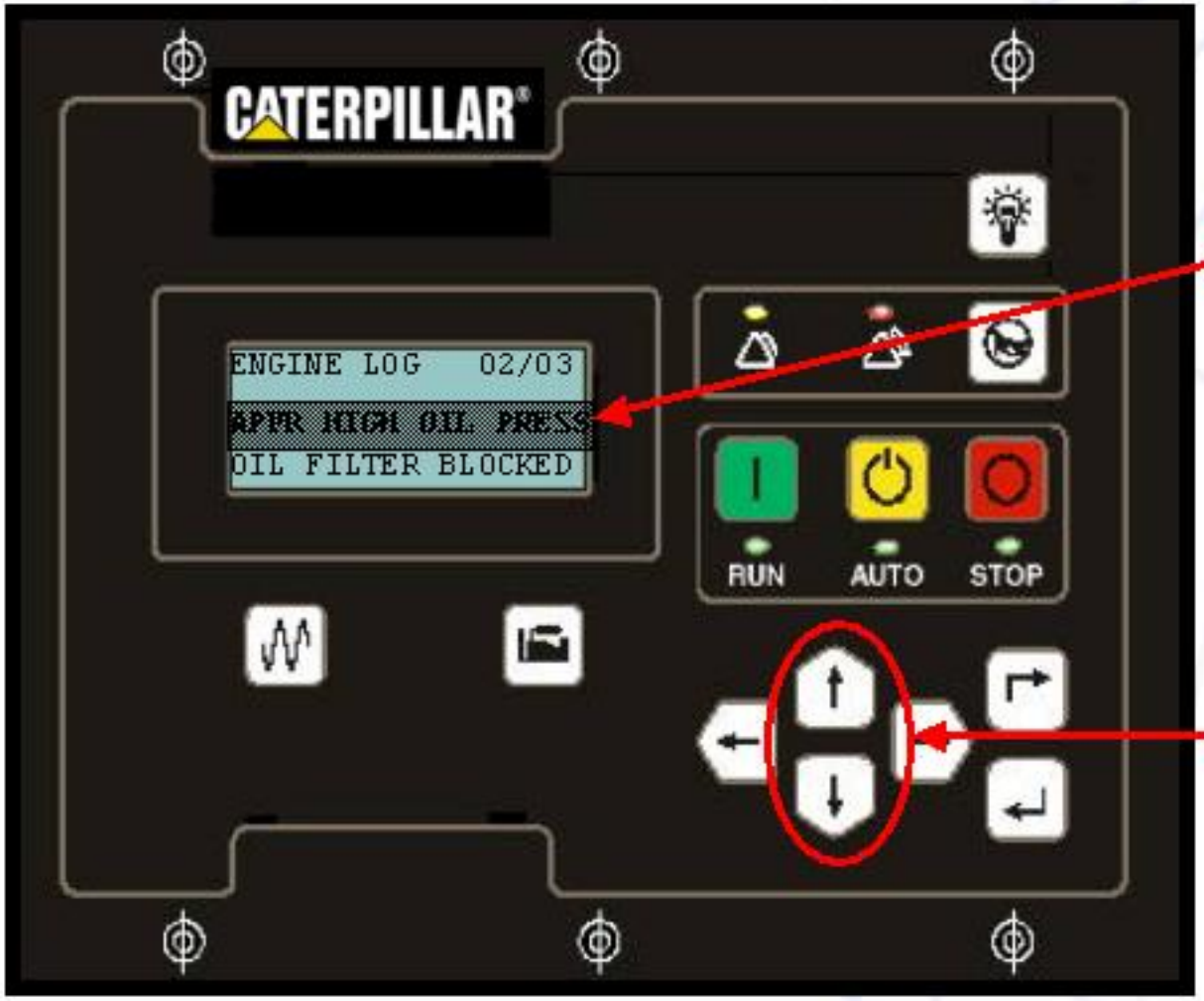
Event Viewing & Clearing



Fault 3 of 3 is Oil filter blocked

Scroll up for previous event

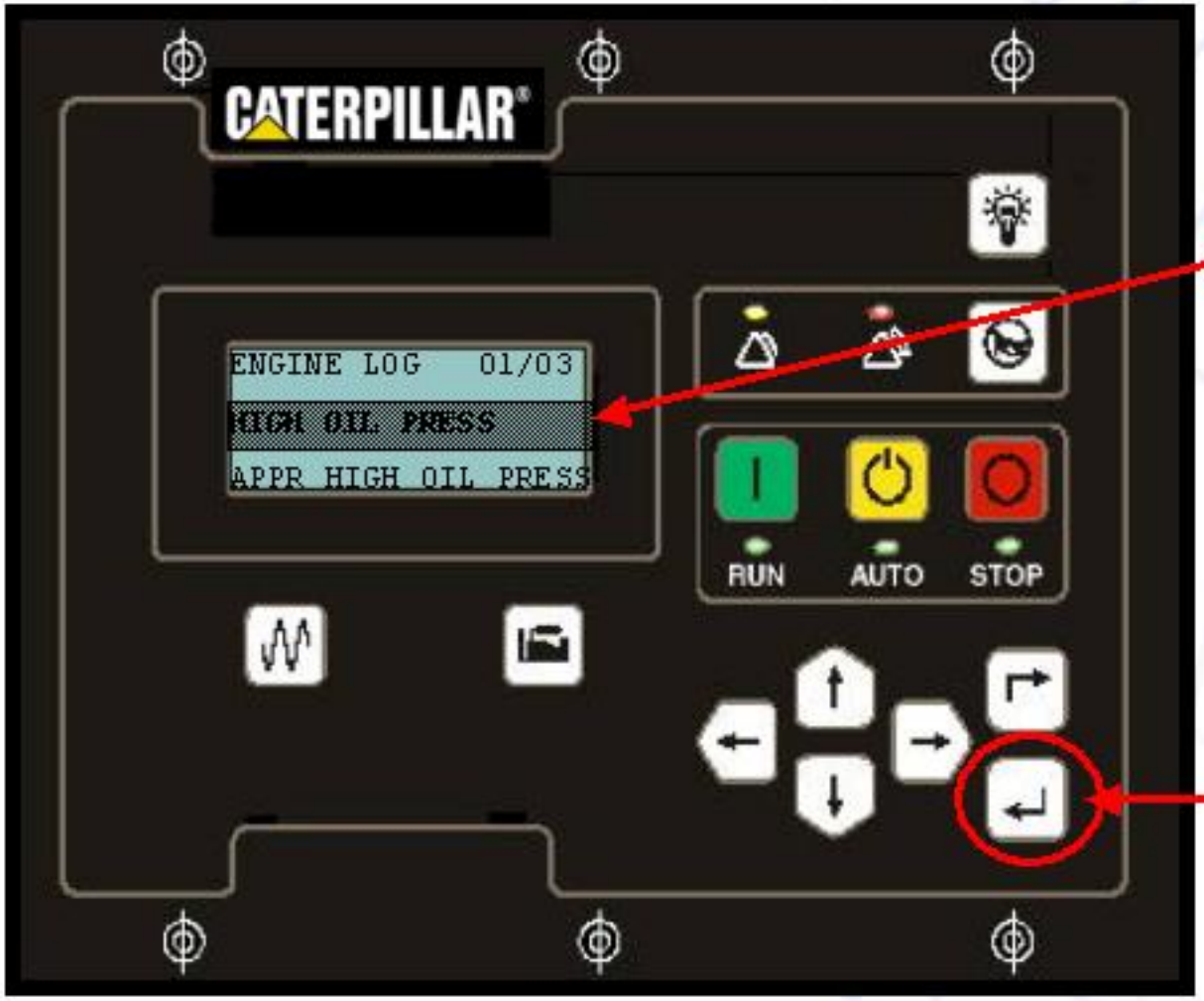
Event Viewing & Clearing



Fault 2 of 3
Approaching High Oil Pressure

Scroll up or down for other events

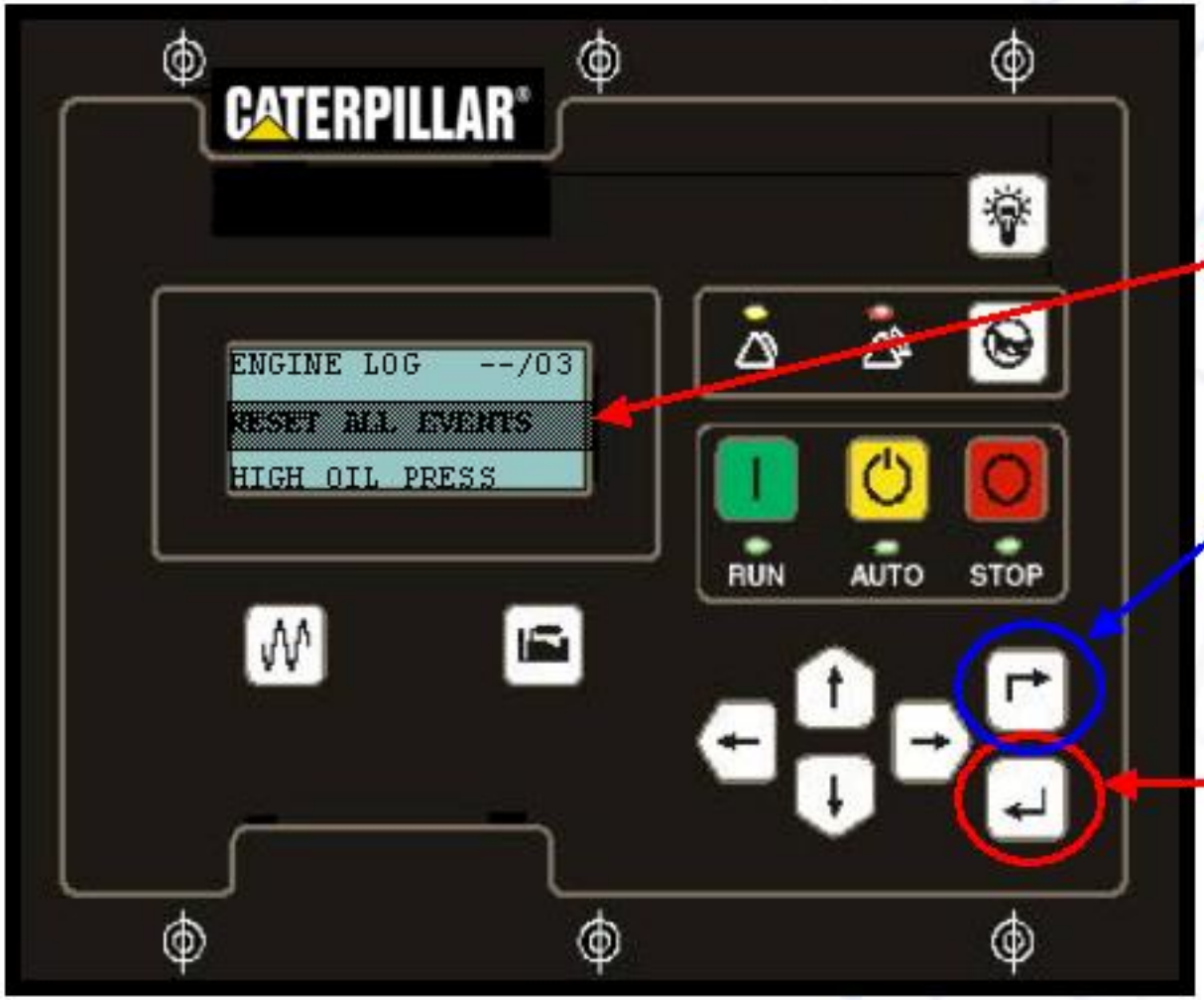
Event Viewing & Clearing



Fault 1 of 3 High Oil Pressure

After condition has been repaired, Press ENTER

Event Viewing & Clearing

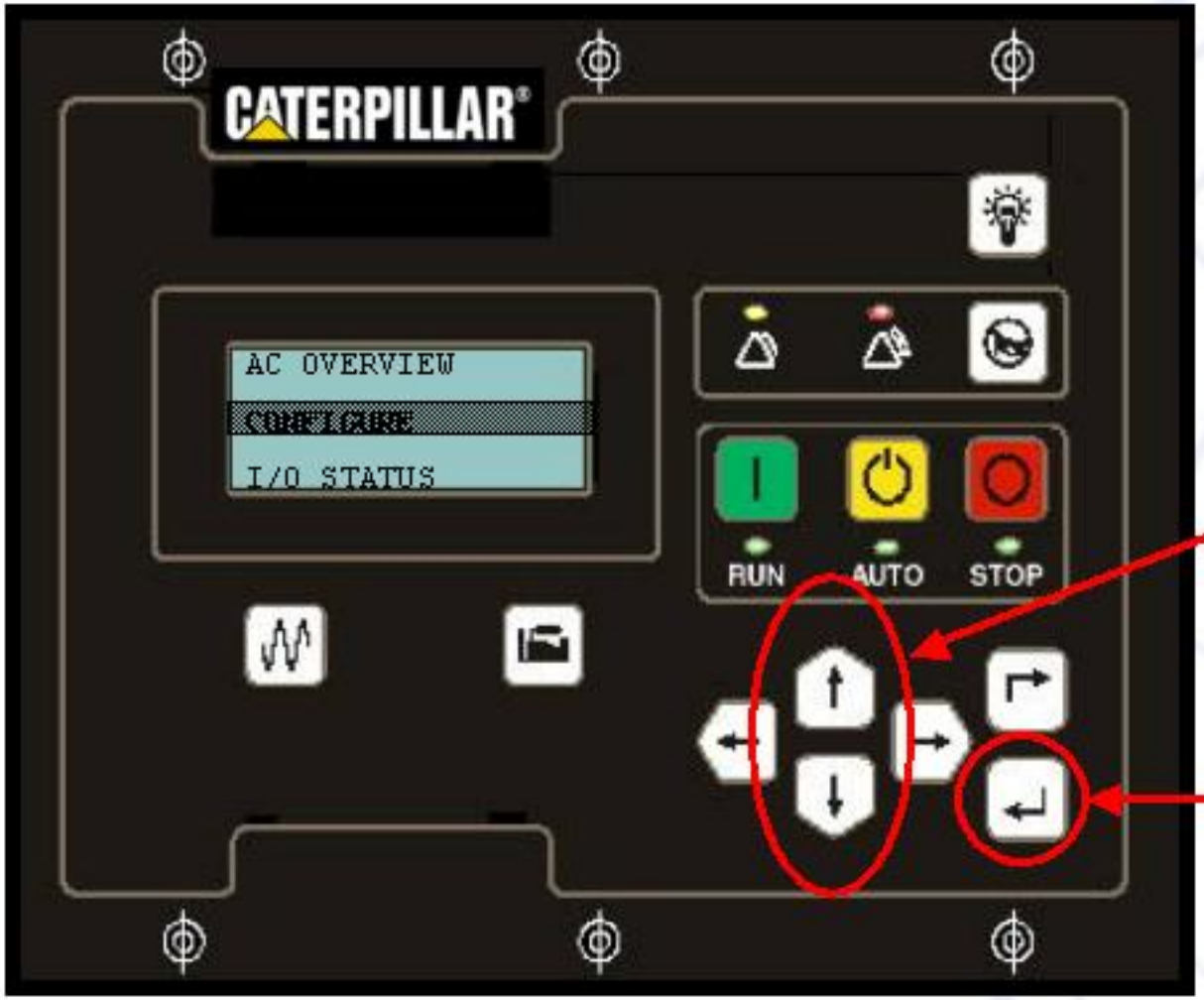


RESET ALL EVENTS will be highlighted if condition repaired and control in STOP

Press ESCAPE twice to return to main menu

Press ENTER to clear fault and turn off shutdown light

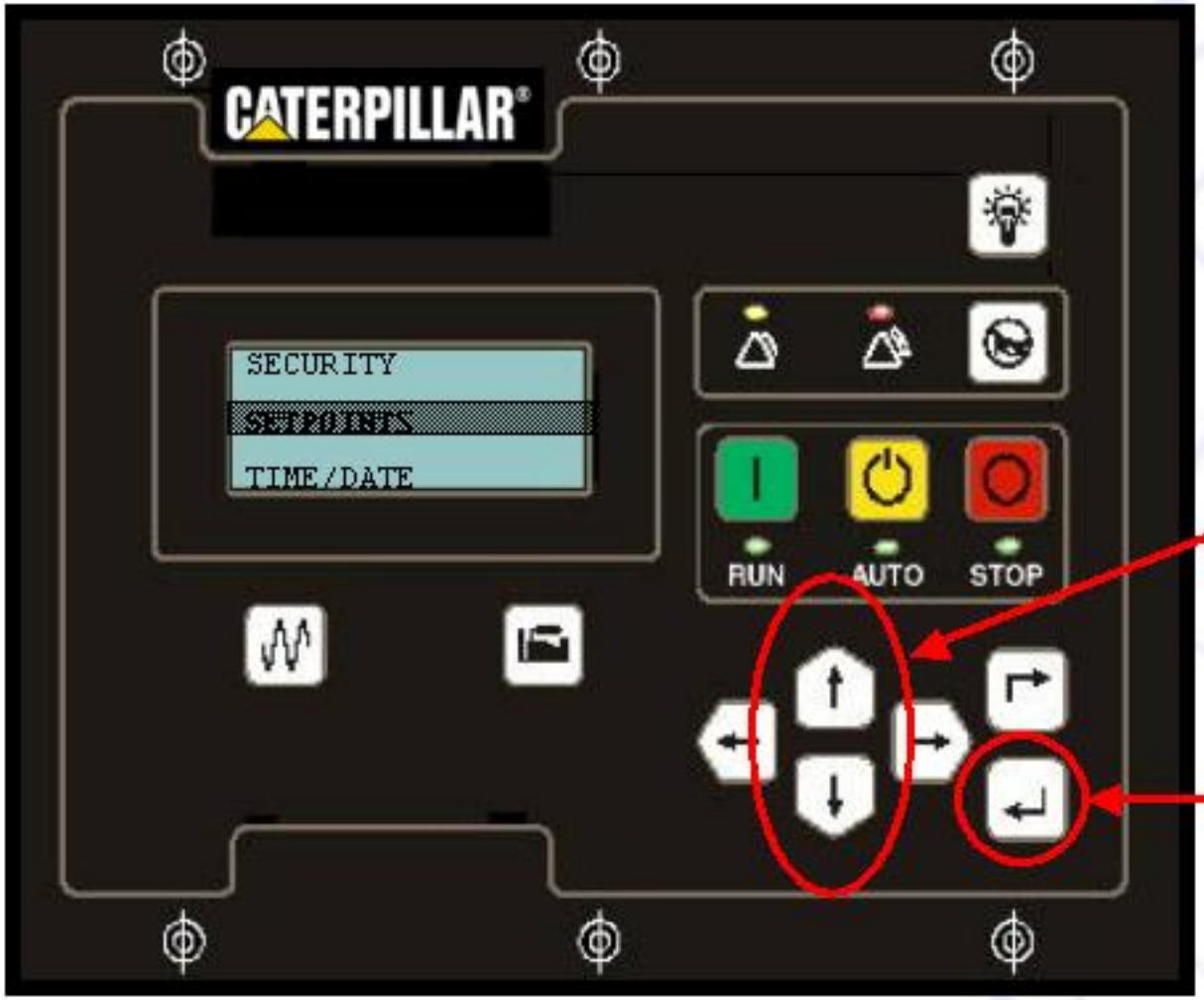
Setpoint Programming



Press UP or DOWN to highlight CONFIGURE

Press ENTER to select CONFIGURE

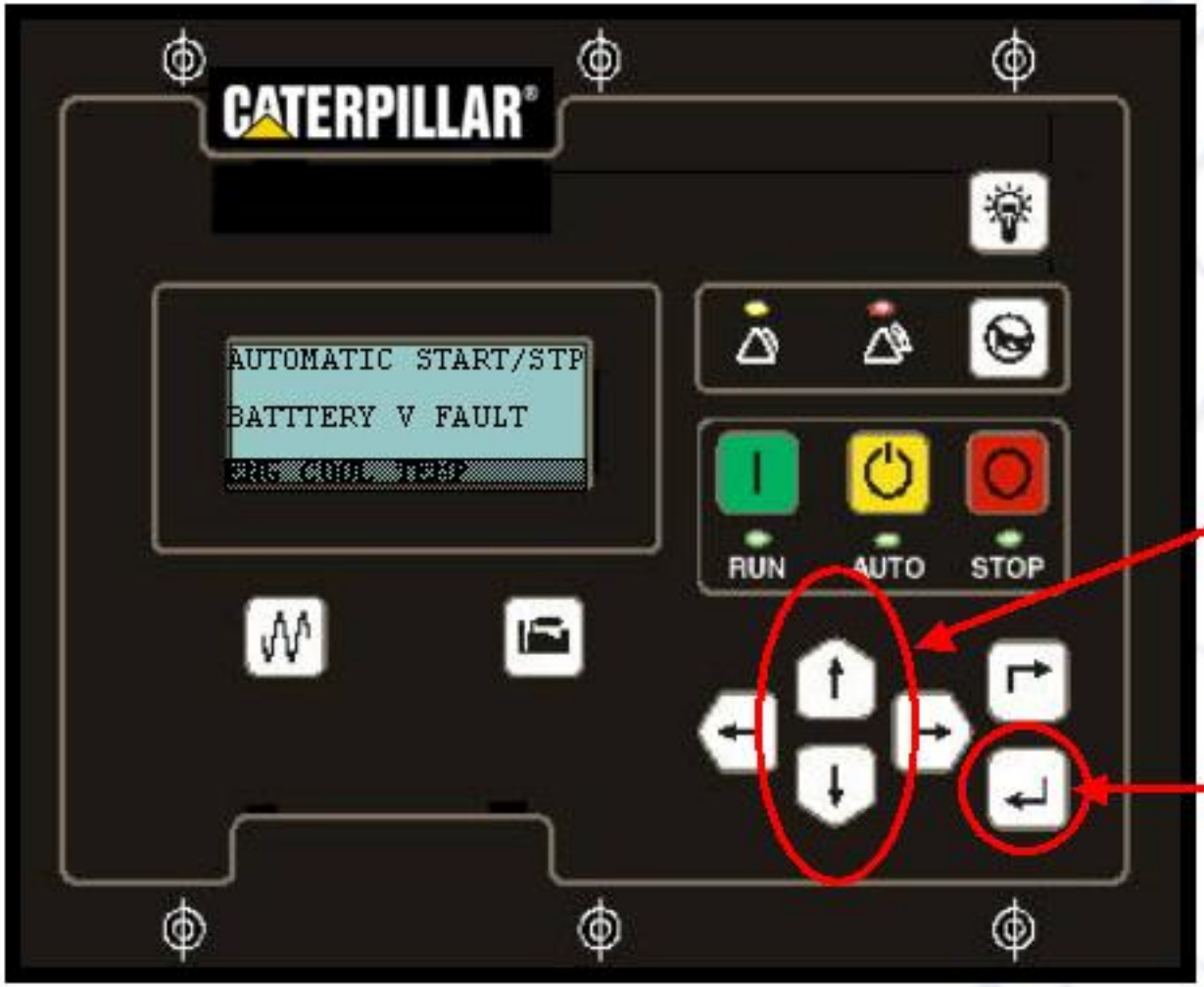
Setpoint Programming



Press UP or DOWN to highlight SETPOINT

Press ENTER to select SETPOINTS

Setpoint Programming

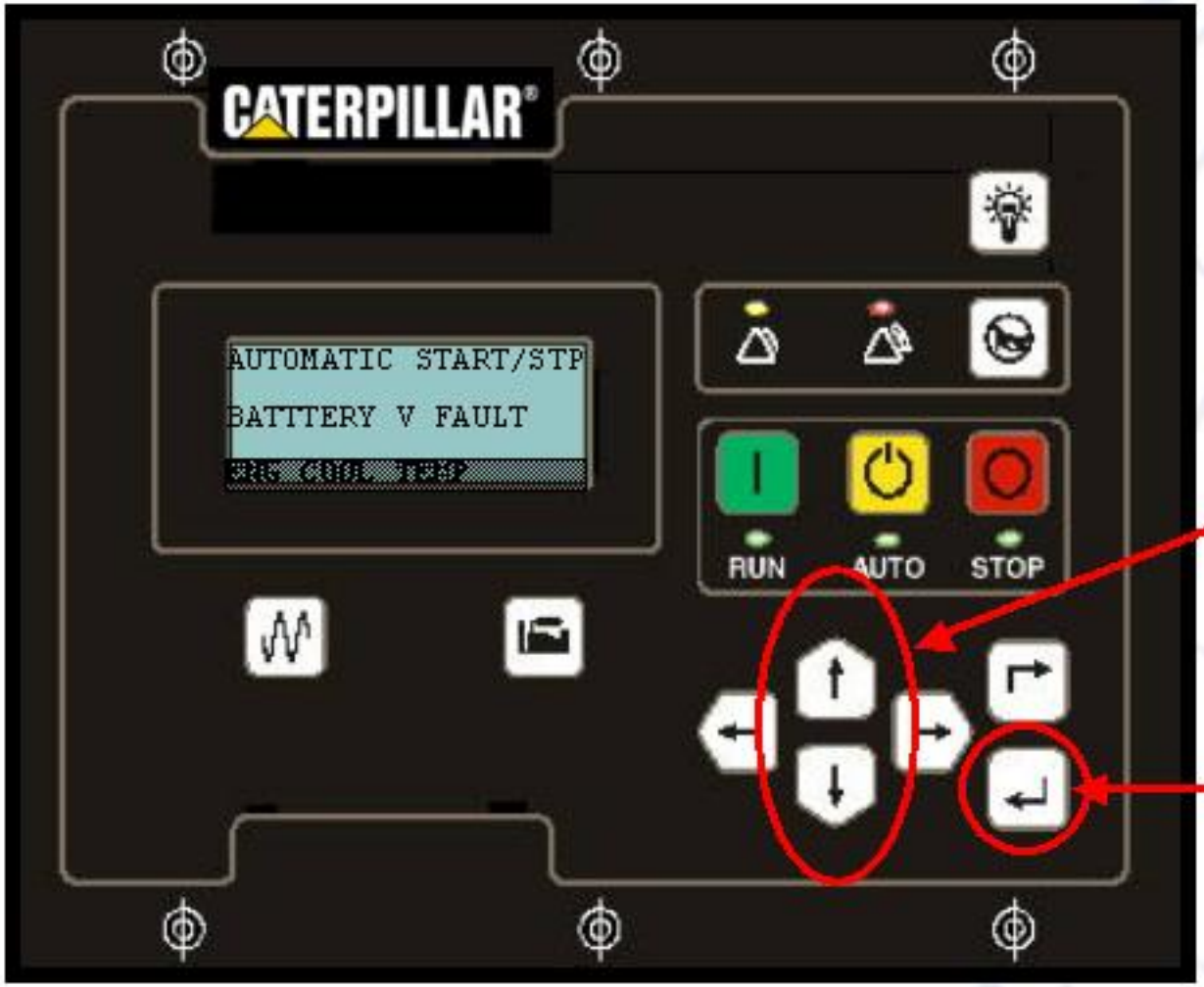


Press UP or DOWN to highlight Setpoint option

Ex: ENG COOL TEMP

Press ENTER to select ENG COOL TEMP

Setpoint Programming

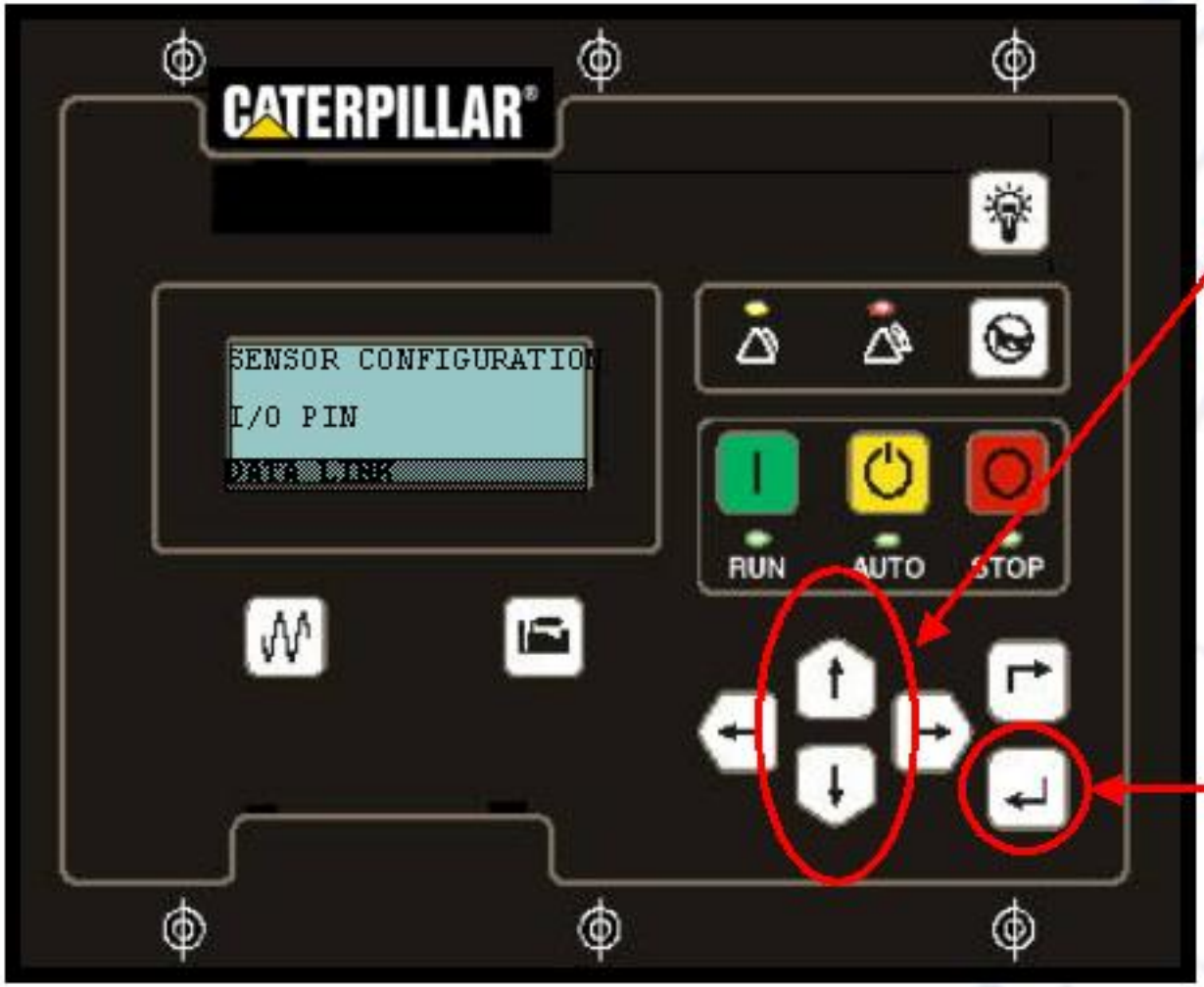


Press UP or DOWN to highlight Setpoint option

Ex: ENG COOL TEMP

Press ENTER to select ENG COOL TEMP

Setpoint Programming



Press UP or DOWN to choose sensor signal source

ADEM3 or ADEM 4 uses DATA LINK

All other gensets use I/O PIN

Press ENTER to select DATALINK