PCC3.3 Control System Overview

The PowerCommand® 3.3 Control System (PCC3.3) consists of a PCC3300 generator set (genset) controller, AUX104 AVR Power Stage, and a HMI320 user interface. The PCC3.3 Control System has the ability to interface with other optional modules over the PCCnet network. The PCC3300 is a microprocessor-based generator set monitoring, metering, and genset control system. The HMI320 provides a simple operator interface to the Genset, while the PCC3300 provides digital voltage regulation, remote start / stop control and generator set protection functions.

The PCC3.3 control system is suitable for use on gensets utilizing 50Hz or 60Hz Full Authority Electronic (FAE) Cummins diesel or natural gas engines as well as Hydro Mechanical (HM) Engines. Gensets equipped with the PCC3.3 control system can be applied in paralleling or non-paralleling applications, and use re-connectable alternators with voltages from 190 to 45000 VAC L-L. The control system is designed for mounting on the generator set, and is usually powered from the generator set starting batteries over a voltage range from 8 VDC to 32 VDC.

PCC3.3 Genset Control Part Numbers

Control Module Part Numbers

Internal Part Number	Description
0327-1601-01	PCC3300 Control Assembly
0300-6315-01	HMI320- Digital Display Panel (with Circuit Breaker buttons)
0300-6315-02	HMI320- Digital Display Panel (without Circuit Breaker buttons)
0300-6315-03	HMI320- Digital Display Panel (Remote)
0327-1593	AUX104 – AVR Power Stage (only with FAE)
0327-1507	External Governor Power Module (only with HM)
0300-5929	HMI113 – Universal Annunciator
0300-6050-01	HMI112 – LED Bargraph
0300-6366-02	HMI114 – LED Bargraph
A028T766	AUX105 Control Assembly
0630-3440	Common Connector Diagram

PCC3.3 Genset Control System Features

- Paralleling or Standalone Genset Applications.
- Operates on 12 / 24 VDC nominal battery voltage.
- FAE Engine support utilizing PGI SAE-J1939 protocol support.
- Hydro Mechanical Engine support utilizing PGI SAE-J1939 protocol support
  - ➢ Electronic Governor.
  - ➢ Engine Monitoring and Protection.
  - ➢ Glow plug or Spark Ignition Control (Spark Ignition Feature is not currently available.)
- Digital Automatic Voltage Regulator (AVR)
- PCCNet Communications.
- MODBus Communications.
- Low power sleep mode, with configurable Wake-In-Auto mode.
- Direct 3 Phase voltage sensing for voltages up to 600 VAC L-L, and using PTs voltages up to 4500 VAC L-L.
- 3 Phase current sensing using either 1 Amp or 5 amp secondary CTs.
- Engine start/stop control and protection features.
- Amp-Sentry protection for use with Cummins Generator Technologies (CGT) alternators.
- HMI320 and HMI220 Operator Panel Display support.
- Advanced serviceability using a PC based software service tool.
- Environmental protection. The control system is designed for reliable operation in harsh environments. The core control board is a potted module that is fully protected from the elements.
- Configurable Inputs and Outputs

Type	Number
Digital Discrete Inputs	27
Digital Relay Outputs	6
Digital Relay Driver Outputs	8
Analog Inputs	2
Analog Outputs	2

Functions

- Synchronizing
- Dead Bus Close
- Load Share
- Load Demand
- Load Govern

- Permissive Sync Check
- Breaker Control
- Gen CB Shunt Trip
- Fail to Disconnect
- Power Transfer Control

PCC3.3 Genset Control On Board LEDs

The PCC3300 has 4 light emitting diodes (LEDs) on the control board. These LEDs are used to indicate to the operator the status of the PCC3300 genset control. The following table summarizes their operation.

LED	Color	Operation
DS6	RED	LED is continuously on when the common alarm command is active.
DS3	GREEN	Continuously blinking when the controller is powered up and in awake mode.
DS4	RED	This LED blinks when MODBUS data transfer occurs on J14. It glows continuously when protocol is changing from MON to MODBUS or vice-versa. This LED is off for MON protocol.
DS9	RED	This LED blinks when MODBUS data transfer occurs on TB15. It glows continuously when protocol is changing from MON to MODBUS or vice-versa. This LED is off for MON protocol.

AUX105 Control On Board LED–

AUX105 has 1 green LED, DS3 on the control board which blinks @ 1 sec when the controller is powered up and is in awake mode. The LED blinks approx. 4 times as fast when downloading to Aux105. The LED also blinks approx. 4 times faster if the Application becomes corrupted. (Board is in boot block)

PCC3.3 Control Inputs and Outputs

Discrete Inputs Signals

- Manual
- Auto
- Remote start signal.
- Remote Emergency Stop.
- Local Emergency Stop.
- Backup Start Disconnect (Configurable Input #33)
- Fault Reset (Configurable Input # 10)
- Bi-Directional System Wake Up Input.
- Rupture Basin (Configurable Input #12)
- Start Type (Configurable Input #11)
- Low Fuel (Configurable Input # 6)
- Coolant level (Configurable input # 5)
- Configurable Input #1
- Configurable Input #2
- Configurable Input #13
- Configurable Input #14
- Genset CB A Status
- Genset CB B Status (Configurable input #26)
- Genset CB Tripped Status (Configurable input #27)
- Genset CB Inhibit (Configurable input #28)
- Utility CB A Status
- Utility CB B Status (Configurable input #23)
- Utility CB Tripped Status (Configurable input #24)
- Utility CB Inhibit (Configurable input #25)
- Single Mode Verify (Configurable input #29)
- Load Demand Stop (Configurable input #31)
- Ramp Load/Unload (Configurable input #32)
- Synchronizer Enable (Configurable input #30)
- Transfer Inhibit (Configurable input #20)
- Retransfer Inhibit (Configurable input #21)

Analog Inputs Signals

- Battery Voltage
- 3-Phase Genset Current Transformer (CTs), 5Amp or 1Amp capable.
- 3-phase Genset line-neutral (LN) voltage sensing
- External speed bias input
- External voltage bias input.
- 3-phase Genset bus or Utility Source CTs.
- 3-phase Genset bus or Utility Source voltage sensing.
- Optional Genset Neutral CT.

Only available if utility source current sensing is single phase or not used.

- KW load setpoint (Configurable Analog Input #1)
- KVAR load setpoint (Configurable Analog Input #2)

Discrete Outputs Signals

- Starter relay driver.
- Fuel shut-off relay driver.
- Key-switch relay driver.
- Glow plug relay driver. (Configurable Output # 8)

Analog Output Signals

- Speed Bias Output (Configurable Analog Output #1)
- Voltage Bias Output (Configurable Analog Output #2)
- Field coil - AVR PWM command (4 Amp continuous, 6 Amp peak)

- Delayed off command relay driver (Configurable Output # 10)
- Oil Priming Pump relay driver. (Configurable Output # 6)
- Switched B+ relay driver.
- Ready to Load Driver (Configurable Output # 5)
- Wake-up in Auto
- Load Dump Relay Driver. (Configurable Output # 11)
- Configurable Output #1, #2, #3, and #4 relay contacts, 5A @ 30 V DC.
- Genset CB Open Control (Relay output – ratings 5A 30Vdc inductive L/R=7msec.)
- Genset CB Close Control (Relay output – ratings 5A 30Vdc inductive L/R=7msec.)
- Utility CB Open Control (Relay output – ratings 5A 30Vdc inductive L/R=7msec.)
- Utility CB Close Control (Relay output – ratings 5A 30Vdc inductive L/R=7msec.)

Bidirectional Discrete Signals

- First start arbitration (Compatible with PCC3100, PCC3200/1)

Bidirectional Analog Signals

- KW load share (Compatible with PCC3100, PCC3200/1))
- KVAR load share (Compatible with PCC3100, PCC3200/1)

PCC3.3 Communications

TB15 (RS485 Port) – This communication port is used by PCC3300 and HMI320 to communicate with a computer running a PC based service tool. TB15 can also be used by the PCC3300 to communicate with external devices like a Programmable Logic Controller (PLC) via the MODBUS protocol.

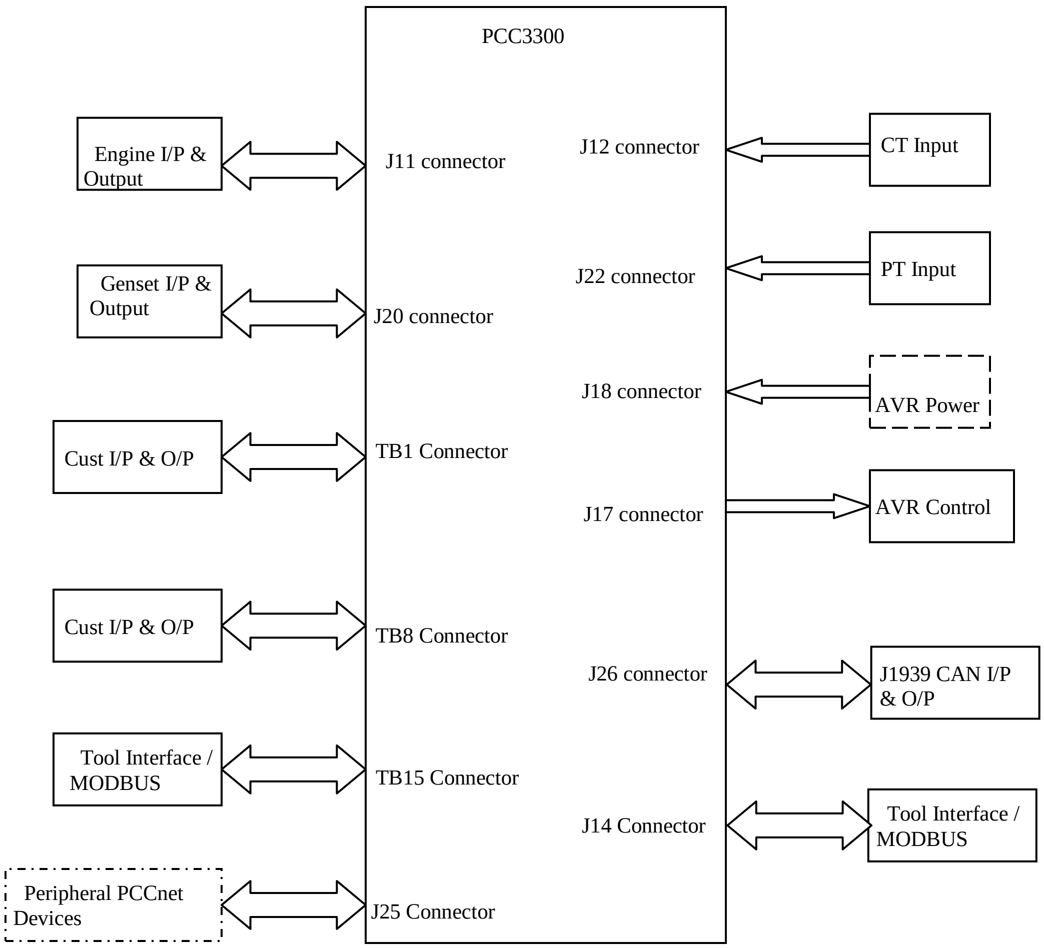
J14 (RS232 Port) - This communication port is used by PCC3300 to communicate with a computer running a PC based service tool. This port can also be used by the PCC3300 to communicate with the external devices like PLC via the MODBUS protocol.

J25 (PCCNet)- This communication port is used to connect the PCC3300 to other PCCNet devices such as the HMI320, HMI112, HMI114, and HMI113.

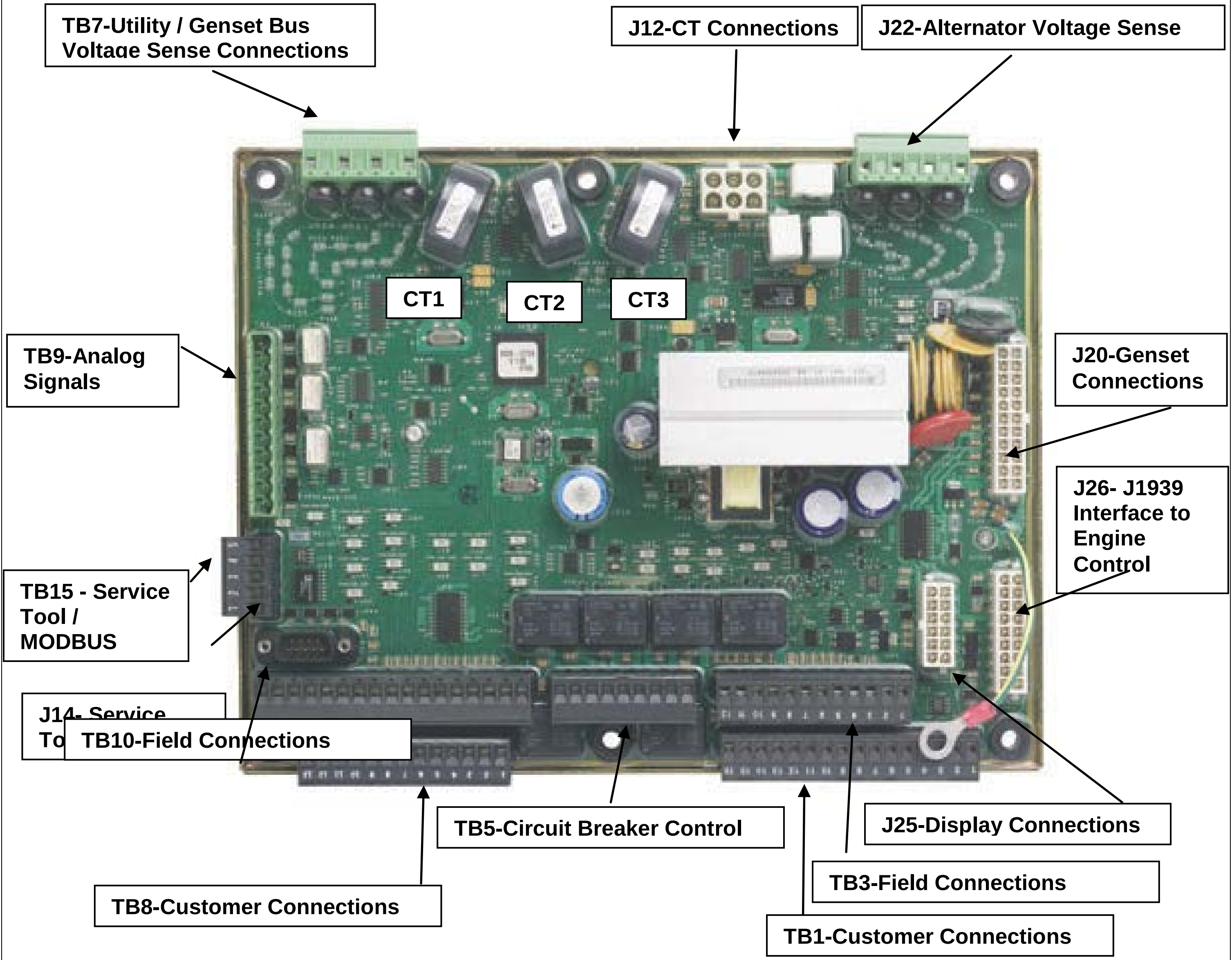
J29 (PCCNet)- This communication port is used to connect the HMI320 to the PCC3300 and other PCCNet devices such as the HMI112, HMI114, and HMI113.

J26 (J1939 – CAN)- This communication port is used to connect the AUX105 HMECM module to the PCC3300 for Hydro Mechanical Engine support.

PCC3.3 Control Inputs and Outputs Overview



PCC3300 Circuit Boad Connections



TB1 Connections

Customer Connections TB1

Connector Pin	Signal Name	Signal Type	Function / Connect To
TB1 – 1	PCCnet A	Network Interface	Network Data A
TB1 – 2	PCCnet B	Network Interface	Network Data B
TB1 – 3	PCCnet Shield / B+ Return	Return	
TB1 - 4	Ready To Load	Low-Side Output	20ma Low Side Relay Driver. (Ground is available when ready to load status is active). The output logic can be reversed.
TB1 – 5	B+ Output (3A)	B+	Internally protected by self resetting fuse.
TB1 – 6	Configurable Relay 1 –A	Relay Contact	Relay contacts of rating 3.5A @ 30 V DC
TB1 – 7	Configurable Relay 1 – B	Relay Contact	
TB1 – 8	Configurable Relay 2 – A	Relay Contact	Relay contacts of rating 3.5A @ 30 V DC
TB1 – 9	Configurable Relay 2 – B	Relay Contact	
TB1 – 10	Remote Start Return	Return	Put a dry contact between TB1-10 and TB-11. Can be configured as Active Open or Active Close.
TB1 – 11	Remote Start	Switched Input	
TB1 -12	Configurable Input 1	Switched Input	Put a dry contact between TB1-12 and TB-13. Can be configured as Active Open or Active Close
TB1 – 13	Configurable Input – Common	Return	Common return for the two Configurable fault inputs

Customer Connections TB1			
Connector Pin	**Signal Name**	**Signal Type**	**Function / Connect To**
TB1 – 14	Configurable Input 2	Switched Input	Put a dry contact between TB1-14 and TB-13. Can be configured as Active Open or Active Close
TB1 -15	Remote ESTOP Return	Return	Remote Normally Closed ESTOP switch
TB1 -16	Remote ESTOP	Switched Input	Remote Normally Closed ESTOP switch.

TB8 Connections

Customer Connections TB8			
Connector Pin	**Signal Name**	**Signal Type**	**Function / Connect To**
TB8 – 1	Discrete Return	Return	Ground Signal
TB8 – 2	Discrete Return	Return	Ground Signal
TB8 – 3	Delayed Off Relay Driver	Low-Side Driver	20 ma low side driver.
TB8 – 4	Switched B+ Relay Driver	Low-Side Driver	20 ma low side driver.
TB8 – 5	Remote Fault Reset (Configurable Input #10)	Switched Input	Put a dry contact between TB8-5 and TB8 -1. Can be configured as Active Open or Active Close. This is a wakeup input.
TB8 – 6	Start Type (Configurable Input #11)	Switched Input	Put a dry contact between TB8-6 and TB8 -2. Can be configured as Active Open or Active Close. To be used for Emergency / Non Emergency Start.
TB8 – 7	Configurable Input 13	Switched Input	Put a dry contact between TB8-7 and TB8-12. Can be configured as Active Open or Active Close

Customer Connections TB8			
Connector Pin	**Signal Name**	**Signal Type**	**Function / Connect To**
TB8 – 8	Configurable Input 14	Switched Input	Put a dry contact between TB8-8 and TB8-13. Can be configured as Active Open or Active Close.
TB8 – 9	Configurable Output 4 Relay Driver	Low-Side Driver	20ma Low side Driver. Ground is available when active. The output logic can be reversed.
TB8 – 10	Configurable Output 3 Relay Driver	Low-Side Driver	20ma Low side Driver. Ground is available when active. The output logic can be reversed.
TB8 –11	Load Dump Relay Driver	Low-Side Driver	20ma Low Side Relay Driver. (Ground is available when under-frequency or overload condition occurs) The output logic can be reversed.
TB8 – 12	Discrete Input Return	Return	
TB8 – 13	Discrete Input Return	Return	

J20 - Genset Connections

J20-Genset Connections			
Connector Pin	**Signal Name**	**Signal Type**	**Function / Connect to**
J20 – 1	Chassis Ground	Chassis Ground	Lug attached to Genset Body
J20 – 2	B+ return	Return	Battery (-)Negative
J20 – 3	Switched B+ Relay Driver	Low-Side Driver	

J20-Genset Connections			
Connector Pin	**Signal Name**	**Signal Type**	**Function / Connect to**
J20 – 4	B+ Return	Return	Battery (-) negative
J20 – 5	Discrete Input Return	Return	Return for configurable input # 5 , J20- 17
J20 – 6	Discrete Input Return	Return	Return for configurable input # 6 , J20- 18
J20 – 7	B+ Return	Return	Battery (-) negative
J20 – 8	Discrete Input Return	Return	Return for input # 12 , J20- 19
J20 – 9	B+ Input	B+	Battery (+) Positive (power to control module)
J20 – 10	B+ Input	B+	Battery (+) Positive (power to control module)
J20 – 11	Starter Disconnect Input	Analog Input	Charging Alternator
J20 – 12	B+ return	B+	Battery (-) negative
J20 – 13	Relay Coil B+ Supply	Fused B+ Supply	FS0, Switched B+, Starter Relay Coils
J20 – 14	FSO Relay Driver	Low-Side Driver	Low Side of FSO Relay Coil. Ground signal is available when FSO relay driver is active.
J20 – 15	Starter Relay Driver	Low-Side Driver	Low Side of Starter Relay Coil Ground signal is available when Start / Crank relay driver is active.
J20 – 16	Oil Priming Pump Relay Driver	Low-Side Driver	Low side of Oil Priming Pump Relay Coil. Ground signal is available when Oil Priming Pump relay driver is active.
J20 – 17	Configurable Input # 5	Switched Input	Defaulted to Low Coolant Level Switch (wake-up)
J20 – 18	Configurable Input # 6	Switched Input	Defaulted to Low Fuel Level Switch (wake-up)

J20-Genset Connections			
Connector Pin	**Signal Name**	**Signal Type**	**Function / Connect to**
J20 – 19	Configurable Input # 12	Switched Input	Defaulted to Rupture Basin switch (wake-up)
J20 – 20	B+ Input	B+	Battery (+) Positive (power to control module)
J20 – 21	B+ Input	B+	Battery (+) Positive (power to control module)
J20 – 22	Alt Flash Input	Analog Source	Charging Alternator

J12 – Genset CT Connections

Genset CT Connections			
Connector Pin	**Signal Name**	**Signal Type**	**Connect to**
J12- 1	CT1	Analog Input	CT1- X1
J12 -2	CT2	Analog Input	CT2-X1
J12 -3	CT3	Analog Input	CT3-X1
J12 -4	CT1 COMMON	Analog Return	CT1- X2 / X3
J12 -5	CT2 COMMON	Analog Return	CT2- X2 / X3
J12 -6	CT3 COMMON	Analog Return	CT3- X2 / X3

J22 – Genset Voltage Sensing

Genset Voltage sensing connections			
Connector Pin	**Signal Name**	**Signal Type**	**Connect to**
J22- 1	L1	Analog Input	Alternator Terminal U (R)

Genset Voltage sensing connections			
Connector Pin	**Signal Name**	**Signal Type**	**Connect to**
J22 -2	L2	Analog Input	Alternator Terminal V (Y)
J22 -3	L3	Analog Input	Alternator Terminal W (B)
J22 -4	N	Analog Input	Alternator Terminal Neutral

For voltage levels above 600 L-L, a external PT is required to be used for voltage sensing. Refer Potential Transformer (PT) section 1.11 for appropriate PT ratio selection.

J17 – Field Winding Connections

Alternator Field Winding Connections		
Connector Pin	**Signal Name**	**Connect to**
J17- 1	Field +	Alternator Field X+ (F1)
J17 -2	Field -	Alternator Field XX- (F2)

J18 – Field Power Connections

AVR power connections		
Connector Pin	**Signal Name**	**Connect to**
J18- 1	PMG 1 / Shunt L1	Refer wiring diagram 0630-3440 for PMG or Shunt Connection
J18 -2	PMG 2 / Shunt L2	
J18 -3	PMG 3	

TB15 Connections

Tools Interface Connections

Connector Pin	Signal Name	Signal Type	Connect To
TB15 – 1	RS 485 Shield	Network Interface	Network Shield
TB15 – 2	NA		
TB15 – 3	RS485_DATA_A / MODBUS	Network Interface	Network Data A
TB15 – 4	RS485_DATA_B / MODBUS	Network Interface	Network Data B
TB15 – 5	Bi-Directional System Wakeup	Bi-Directional Signal	System wake-up signal

J25 – Display Connections

Display Connections			
Connector Pin	**Signal Name**	**Signal Type**	**Connect To**
J25 – 1			
J25 – 2	Local E-Stop	Switched Input	Normally Close Local Estop Switch
J25 – 3	PCCNet A	Network Interface	Network Data A
J25 – 4	PCCNet B	Network Interface	Network Data B
J25 – 5	Bi-Directional System Wakeup	Bi-Directional Signal	System wake-up signal for HMI.
J25 – 6	Discrete Input Return	Return	
J25 – 7	Discrete Input Return	Return	
J25 – 8	B+ Return	Return	Battery (-) negative available for HMI module (Display or Bar graph)

Display Connections			
Connector Pin	**Signal Name**	**Signal Type**	**Connect To**
J25 – 9	B+ Return / PCCnet Shield	Return	PCC Net harness shield.
J25 – 10	Manual	Switched Input	Manual Run command. Give ground to activate
J25 – 11	Auto	Switched Input	Auto command. Give ground to activate.
J25 – 12	B+	B+	Battery (+) positive available for HMI module (Display or Bar graph)

J26 – J1939 Interface to Engine Control

Display Connections			
Connector Pin	**Signal Name**	**Signal Type**	**Connect To**
J26 – 1	J1939 Shield	Network Interface	
J26 – 2	Backup Start Disc +		
J26 – 3	AVR PWM -	AUX105 Interface	AUX105 PWM- Pin
J26 – 4	PCCNet Shield	Network Interface	
J26 – 5	AVR B+ Return	Return	AUX105 B+ Return
J26 – 6	N/A		
J26 – 7	Field Current-		
J26 – 8	B+ Return	Return	
J26 – 9	AVR B+	B+ Supply	B+ Input to AUX105
J26 – 10	J1939 Low	Network Interface	CANL Interface to Engine Control Module (ECM)

Display Connections			
Connector Pin	**Signal Name**	**Signal Type**	**Connect To**
J26 – 11	J1939 High	Network Interface	CANH Interface to Engine Control Module (ECM)
J26 – 12	PCCNet A	Network Interface	Network Data A
J26 – 13	PCCNet B	Network Interface	Network Data B
J26 - 14	Field Current+		
J26 - 15	Keyswitch Low Side Driver	Low Side Driver	To negative side of Keyswitch Relay coil.
J26 – 16	AVR PWM+	AUX105 Interface	AUX105 PWM+ Pin
J26 – 17	N/A		
J26 – 18	KeySwitch B+ out/B+ out	AUX105 Interface	

TB10 – Breaker Status Connections

Breaker Status Connections			
Connector Pin	**Signal Name**	**Signal Type**	**Description of Default Function**
TB10 - 1	Return	Return	Use as signal return for switch inputs.
TB10 - 2	Return	Return	Use as signal return for switch inputs.
TB10 - 3	Utility CB Pos A Switch	Switch Input	The 'a' contact from utility main breaker; control uses this to determine breaker position. When closed the control is in load govern mode. Note that the ‘a’ contact mirrors the position of the breaker.
TB10 - 4	Utility CB Pos B/Configurable Input #23 Switch	Switch Input	The 'b' contact from utility main breaker; control uses this only to determine breaker contact failure by comparing it to the 'a' contact; this feature can be enabled/disabled. Note that a ‘b’ contact is the inverse of breaker position.
TB10 - 5	Utility CB Tripped Switch	Switch Input	Use to indicate to control that utility main is tripped. Control will consider source unavailable.
TB10 - 6	Utility CB Inhibit/Configurable Input #25 Switch	Switch Input	Opens utility main if closed; inhibits closure if utility main is open.
TB10 - 7	Genset CB Pos A Switch	Switch Input	The 'a' contact from genset breaker; control uses this to determine breaker position. Note that the ‘a’ contact mirrors the position of the breaker.
TB10 - 8	Genset CB Pos B/Configurable Input #26 Switch	Switch Input	The 'b' contact from genset breaker; control uses this only to determine breaker contact failure by comparing it to the 'a' contact; this feature can be enabled/disabled. Note that a ‘b’ contact is the inverse of breaker position.
TB10 - 9	Return	Return	Use as signal return for switch inputs.

Breaker Status Connections			
Connector Pin	**Signal Name**	**Signal Type**	**Description of Default Function**
TB10 - 10	Genset CB Tripped Switch	Switch Input	Use to indicate to control that genset breaker is tripped. Control will consider source unavailable for PTC applications.
TB10 - 11	Genset CB Inhibit/Configurable Input #28 Switch	Switch Input	Opens genset breaker if closed; inhibits closure if genset breaker is open.
TB10 – 12	Utility Single Mode Verify/Configurable Input #29 Switch	Switch Input	Use to enable utility single genset application type. Must be connected to a switch input return to enable utility single.
TB10 – 13	Sync Enable/Configurable Input #30 Switch	Switch Input	Use to enable synchronizing when in manual or when genset application type is synchronize only; (otherwise sync enabling is automatically done by the control).

TB5 – Breaker Control Connections

Breaker Control Connections			
Connector Pin	**Signal Name**	**Signal Type**	**Description of Default Function**
TB5 - 1	Genset CB Close Status	Relay Output	Contact for closing genset breaker; ratings 5A 30Vdc inductive L/R=7msec.
TB5 - 2			
TB5 - 3	Genset CB Open Status	Relay Output	Contact for opening genset breaker; ratings 5A 30Vdc inductive L/R=7msec.
TB5 - 4			
TB5 - 5			
TB5 - 6	Utility CB Close Status	Relay Output	Contact for closing utility breaker; ratings 5A 30Vdc inductive L/R=7msec.
TB5 - 7			
TB5 - 8	Utility CB Open Status	Relay Output	Contact for opening utility breaker; ratings 5A 30Vdc inductive L/R=7msec.
TB5 - 9			

TB3 – Customer I/O Connections

Customer I/O Connections			
Connector Pin	**Signal Name**	**Signal Type**	**Description of Default Function**
TB3 - 1	Return	Return	Use as signal return for switch inputs.
TB3 - 2	Master CAN shield	Shield	CAN shield connection point.
TB3 - 3	Master CAN L	CAN Data	CAN port for control to control communications, referred to as the system bus. System Bus is currently not available.
TB3 - 4	Master CAN H	CAN Data	CAN port for control to control communications, referred to as the system bus. System bus is currently not available

Customer I/O Connections			
Connector Pin	**Signal Name**	**Signal Type**	**Description of Default Function**
TB3 - 5	Configurable Output #20 Status	Low-Side Output	Configurable output #20; intended to drive a relay coil; default is set by trim Configurable Output #20 Event Code. Ratings 250mA, 3A inrush, 30VDC, 100uA off state leakage.
TB3 - 6	Configurable Output #21 Status	Low-Side Output	Configurable output #21; intended to drive a relay coil; default is set by trim Configurable Output #21 Event Code. Ratings 250mA, 3A inrush, 30VDC, 100uA off state leakage.
TB3 - 7	Spare Output for future use		
TB3 - 8	Configurable Output #22 Status	Low-Side Output	Configurable output #22; intended to drive a relay coil; default is set by trim Configurable Output #22 Event Code. Ratings 250mA, 3A inrush, 30VDC, 100uA off state leakage.

TB3 - 9	Transfer Inhibit/Configurable Input #20 Switch	Switch Input	Normally inhibits transfer to genset; under some conditions it is ignored; not the same as genset cb inhibit. This input is applicable when the genset application type is power transfer control.
TB3 - 10	Retransfer Inhibit/Configurable Input #21 Switch	Switch Input	Normally inhibits retransfer to utility; under some conditions it is ignored; not the same as utility cb inhibit. This input is applicable when the genset application type is power transfer control.
TB3 - 11	Master First Start Output Status	Bidirectional Arbitration	Connects from genset to genset for use in first start arbitration. Can be connected to other PCC3300 gensets or to the bus pt/first start module on PCC3100 or PCC3200/1 gensets.
TB3 - 12	Return	Return	Return for master first start TB3-11.

TB9 – Analog I/O Connections

Customer I/O Connections			
Connector Pin	**Signal Name**	**Signal Type**	**Description of Default Function**
TB9 - 1	kW Load Setpoint	Analog Input	Analog Input which sets the genset kW output level when the genset is in load govern mode. Maximum kW output is limited by the genset base load setting. Input range is 0-5VDC.
TB9 - 2	Analog Return	Analog Return	Use as a signal return for analog inputs on TB9-1 and TB9-3.
TB9 - 3	kVAR Load Setpoint	Analog Input	Analog Input which sets the genset kVAR output level when the genset is in load govern mode. Input range is 0-5VDC.
TB9 - 4	Voltage Bias Output / Configurable	Analog Output	Analog Output which allows for sharing of kVAR load between gensets when paralleling to non-PCC based gensets. Output range is +/- 10VDC.

Customer I/O Connections			
Connector Pin	**Signal Name**	**Signal Type**	**Description of Default Function**
	Analog output #2 Output Predictor		Default output range is a +/- 25% offset from nominal voltage over a +/- 5VDC range. Voltages above +5VDC are clamped at +25% voltage offset and voltages below – 5VDC are clamped at -25% voltage offset.
TB9 - 5	Speed Bias Output / Configurable Analog output #1 Output Predictor	Analog Output	Analog Output which allows for sharing of kW load between gensets when paralleling to non-PCC based gensets. Output range is +/- 10VDC. Default output range is +/-100% offset of nominal speed over a +/- 3VDC range. Voltages at or below – 3VDC command the speed to zero and voltages at or above + 3VDC command the speed to twice rated.
TB9 - 6	Analog Return	Analog Return	Use as a signal return for analog outputs on TB9-4 and TB9-5.
TB9 - 7	kW Load Share Level	Bidirectional Analog	Connects from genset to genset when paralleling to enable gensets to share kW load. In addition can be used as an input from a master synchronizer for frequency/phase matching. Note that kW load share + is TB9 - 7 and kW load share – is TB9 – 8.

TB9 - 8			
TB9 - 9	Load Share Shield	Shield	Load share shield connection point.
TB9 - 10 TB9 - 11	kVAR Load Share Level	Bidirectional Analog	Connects from genset to genset when paralleling to enable gensets to share kVAR load. In addition can be used as an input from a master synchronizer for voltage matching. Note that kVAR load share + is TB9 - 10 and kVAR load share – is TB9 - 11.

TB7 – Genset Bus/Utility Bus Voltage Sensing

Breaker Control Connections			
Connector Pin	**Signal Name**	**Signal Type**	**Description of Default Function**
TB7 - 1	Genset Bus L1L2 Voltage OR Utility L1L2 Voltage	AC Voltage Input	Genset bus or utility L1 voltage measurement, up to 600VAC line to line direct connect, 45kVAC line to line max with potential transformers. Genset bus voltage sensing applies to isolated bus only, and utility multiple genset application types. Utility voltage sensing applies to utility single and power transfer control genset application types.
TB7 - 2	Genset Bus L2L3 Voltage OR Utility L2L3 Voltage	AC Voltage Input	Genset bus or utility L2 voltage measurement, up to 600VAC line to line direct connect, 45kVAC line to line max with potential transformers. Genset bus voltage sensing applies to isolated bus only, and utility multiple genset application types. Utility voltage sensing applies to utility single and power transfer control genset application types.

Breaker Control Connections			
Connector Pin	**Signal Name**	**Signal Type**	**Description of Default Function**
TB7 - 3	Genset Bus L3L1 Voltage OR Utility L3L1 Voltage	AC Voltage Input	Genset bus or utility L3 voltage measurement, up to 600VAC line to line direct connect, 45kVAC line to line max with potential transformers. Genset bus voltage sensing applies to isolated bus only, and utility multiple genset application types. Utility voltage sensing applies to utility single and power transfer control genset application types.
TB7 - 4	Neutral	AC Voltage Input	Genset bus or utility neutral voltage reference, up to 600VAC line to line direct connect, 45kVAC line to line max with potential transformers. If delta voltage connection leave unconnected.

CT1 – Genset Bus/Utility L1 Current Sensing

Breaker Control Connections			
Coupling	**Signal Name**	**Signal Type**	**Description of Default Function**
CT1 1• CT1	Genset Bus L1 Current OR Utility L1 Current	AC Current Input	Genset bus or utility L1 current measurement. Route external CT secondary wiring through CT such that current flows through the onboard CT entering at 1• when the measured source is providing power. Accepts 1A or 5A CT secondaries, maximum CT primary of 10000A. Genset bus current sensing applies to isolated bus only, and utility multiple genset application types. Utility current sensing applies to utility single and power transfer control genset application types.

CT2 – Genset Bus/Utility L2 or Genset Neutral Current Sensing

Breaker Control Connections			
Coupling	**Signal Name**	**Signal Type**	**Description of Default Function**
CT2 1• CT2	Genset Bus L2 Current OR Utility L2 Current OR Genset Neutral Current	AC Current Input	Genset bus/utility L2 or genset neutral current measurement. Route external CT secondary wiring through CT such that current flows through the onboard CT entering at 1• when the measured source is providing power. Accepts 1A or 5A CT secondaries, maximum CT primary of 10000A. Genset bus current sensing applies to isolated bus only, and utility multiple genset application types. Utility current sensing applies to utility single and power transfer control genset application types.

CT3 – Genset Bus/Utility L3 Current Sensing

Breaker Control Connections			
Coupling	**Signal Name**	**Signal Type**	**Description of Default Function**
CT3 1•	Genset Bus L3 Current OR Utility L3 Current	AC Current Input	Genset bus or utility L3 current measurement. Route external CT secondary wiring through CT such that current flows through the onboard CT entering at 1• when the measured source is providing power. Accepts 1A or 5A CT secondaries, maximum CT primary of 10000A. Genset bus current sensing applies to isolated bus only, and utility multiple genset application types. Utility current sensing applies to utility single and power transfer control genset application types.
CT3			

Refer wiring diagram 0630-3440 for connection details. The wiring diagram is also available at "Commercial and ESB Genset Controls Database / Common Connector scheme wiring Diagram".

Power Limits

Signal Name	**Power Limit**
Fused B+ (TB1, J25):	Internally fused at 3 A
Keyswitch B+ (J11):	Internally fused at 1.85A, shared with Relay Supply
Relay Supply (J20):	Internally fused at 1.85A, shared with Keyswitch B+
Relay Supply (J25):	Internally fused at 1.85A, shared with Keyswitch B+
Battery Charger Alternator Flash (J20):	Internally Fused at 1.5A
Return pins:	5A/pin using 18 AWG wire

Internal Fusing:

- The PCC3300s internal fusing protection is temperature dependant. It will allow 2X rated current at 20°C (about room temp), and allow rated current at 85°C.
- The internal fusing is a current limiting device that self resets once the short circuit is removed and it's cooled down.

AUX105 Control Inputs and Outputs Overview

Input signals to the AUX105 control are:

- Coolant Temperature signal
- Lube Oil Pressure signal.
- Oil Temperature signal
- Intake Manifold Temperature signal
- Battery Voltage signal.
- Magnetic Pick up signal.
- Key Switch I/p signal
- Field Power

Output signals from the AUX105 control are:

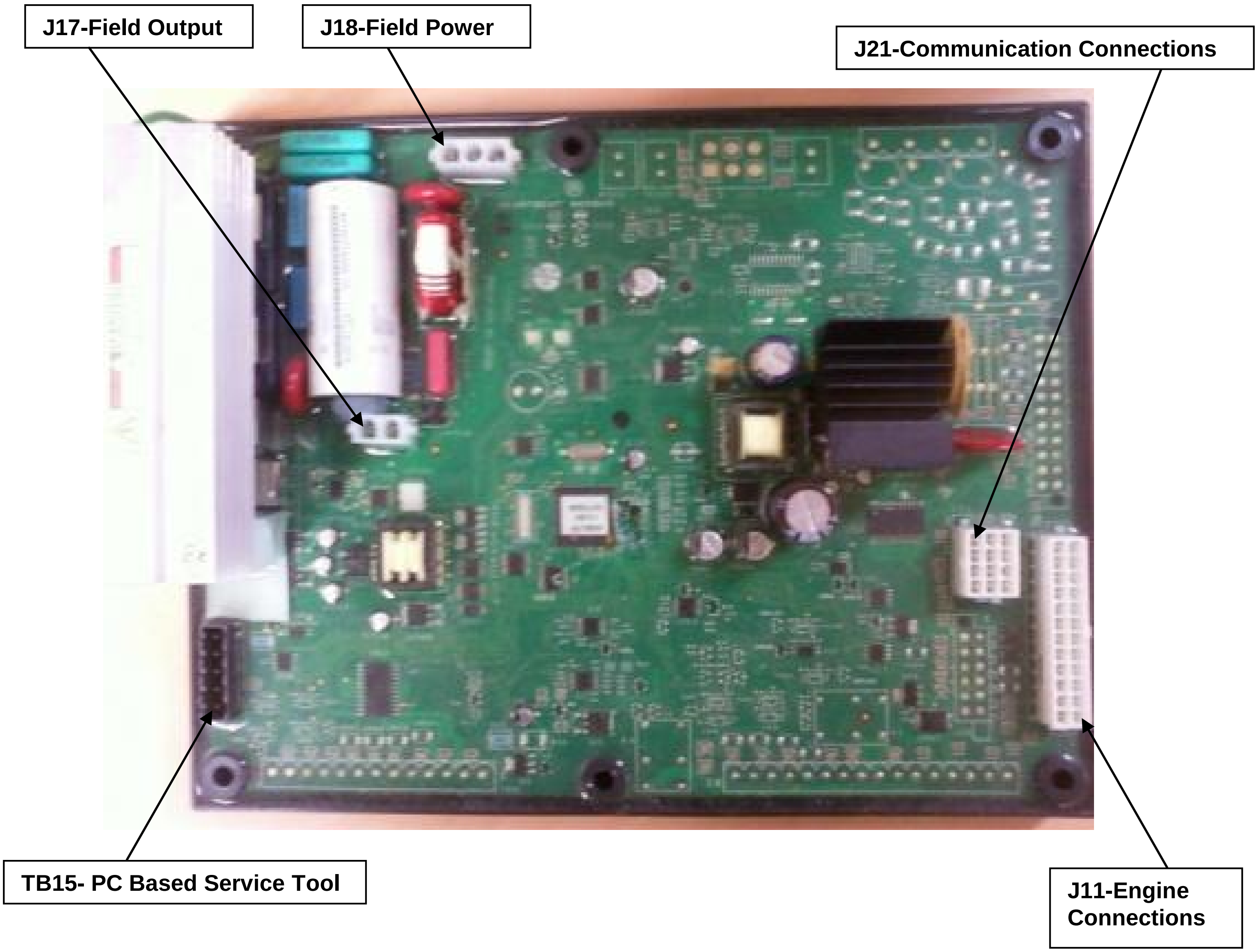
- Glow plug / Spark Ignition (Spark Ignition Feature is not currently available.)
- Governor drive PWM command
- Field Excitation o/p

AUX105 Communication Ports:

- PC Tool Interface – This RS-485 communication port is to allow the AUX105 control to communicate with a personal computer running a PC based service tool and for firmware up gradation as well as for engine protection verification. This port **DOES NOT** allow the control to communicate via MODBUS protocol.
- J1939 CAN Port – This CAN port is used to connect to the PCC3300

AUX105 Circuit Board Connections

Arrow points to pin 1 on the connector



Connection Details

J11 Connections (Pin outs are same as that of J11 on PCC2300)

J11-Engine Connections		
Connector Pin	**Signal Name**	**Connect to**
J11 – 1	Oil Pressure Sender (active) + 5V	
J11 -2	Oil Pressure Sender or Switch Return	
J11 -3	Oil Pressure Sender	
J11 – 4	Governor Drive -	Governor PWM low side driver
J11 – 5	Governor Drive +	Governor Drive + (for Low Side Driver)
J11 -6	Relay Coil B+	Coil of Glow Plug Relay
J11-7	Glow Plug / Ignition Control Relay Driver	Low side of the relay coil.
J11 – 8	Magnetic Pick Up Shield	
J11 – 9	Magnetic Pick Up Supply	
J11 -10	Magnetic Pick Up Return	
J11 -11	Coolant Temp Sender	
J11 -12	Coolant Temp Sender Return	
J11 -13	Lube Oil Temp Sender	
J11 -14	Lube Oil Temp Sender Return	
J11 -15	Intake Manifold Temp Sender	
J11 -16	Intake Manifold Temp Sender Return	
J11 -17	NA	
J11 -18	NA	
J11 -19	NA	
J11 -20	NA	
J11 – 21	NA	
J11 -22	NA	

J11-Engine Connections		
Connector Pin	**Signal Name**	**Connect to**
J11 -23	NA	
J11 -24	NA	

J21 Connections

J21 Connections		
Connector Pin	**Signal Name**	**Connect to**
J21- 1	Battery- in	
J21 -2	J1939 CAN (+)	
J21 -3	J1939 CAN (-)	
J21 -4	J1939 CAN (Shield)	
J21 -5	Battery- in	
J21 -6	Battery- in	
J21 -7	PCCNet RS485 Shield	
J21 -8	PCCNet RS485 A	
J21 -9	ECM Fused B+	
J21 -10	Battery + in	
J21 -11	Keyswitch in (wakeup)	
J21 -12	PCCNet RS485 B	

J17 – Field Winding Connections

Field Connections		
Connector Pin	**Signal Name**	**Connect to**
J17- 1	AVR Field +	X+ (F1)
J17 -2	AVR Field -	XX- (F2)

J18 – Field Power Connections

Shunt Connections		
Connector Pin	**Signal Name**	**Connect to**
J18- 1	PMG P2 / Shunt L1	
J18 -2	PMG P3 / Shunt L2	
J18 -3	PMG P4	

TB15 Connections

Tools Interface Connections

Connector Pin	Signal Name	Connect To
TB15 – 1	RETURN	Network Power Supply Return
TB15 – 2	NA	NA
TB15 – 3	RS485_DATA_A (Data +)	Network Data A
TB15 – 4	RS485_DATA_B (Data -)	Network Data B
TB15 – 5	Bi-Directional System Wakeup	

PCC3.3 Installation Overview

PCC3.3 Control System Power Consumption

The PCC3.3 control will consume 60mA of current in the sleep mode. While not in sleep mode the PCC3.3 control will consume less than 2.0 Amps of current. This current draw doesn't include other application specific devices such as, external actuators, relay coils, or display lamps.

AUX105 Control Power Consumption

The AUX105 control will consume 0 mA of current (PCC3300 turns off power to AUX105 via a Relay) in sleep mode. While not in sleep mode, it will consume around 160 mA of current. This doesn't include PCC3300 as well as any other application specific devices such as the optional operator panel, external actuators, relay coils, or display lamps.

PCC3.3 Mounting Guidelines

The PCC3.3 control system is suitable for non-engine mounting. As such, it should not be directly mounted on the engine, but may be mounted on a suitable frame on top of the alternator, on a frame supported from the genset base rail, or on a stand alone mounting frame isolated from the vibration of the genset. Appropriate vibration isolators should be used to make sure that the control system is not subjected to vibration levels beyond their capability.

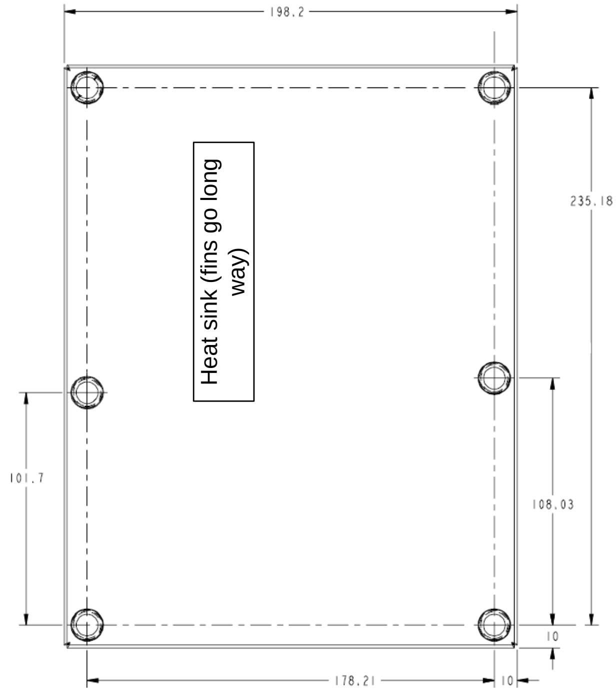
To avoid occurrences of the control system being exposed to conditions beyond its specifications, care should be taken not to mount it close to the engine exhaust pipes. Also mounting in a manner that would expose the PCC3.3 control system to direct sunlight, rain/snow should be avoided.

Orientation:

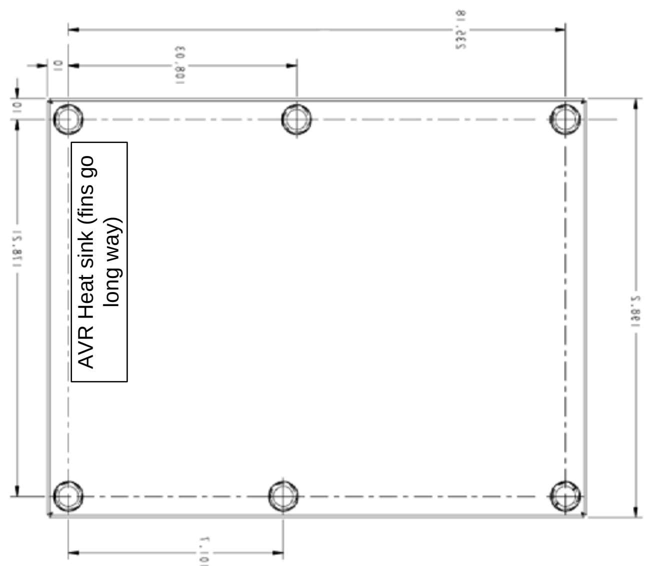
All boards can be mounted in any orientation, with the following exceptions:

1. Don't mount the boards upside down. Connectors should not be in a downward orientation, allowing gravity & vibration to disconnect them.
2. The heat sinks must have its heat sink fins mounted in an up/down (vertical) orientation to allow proper heat load conduction/cooling.

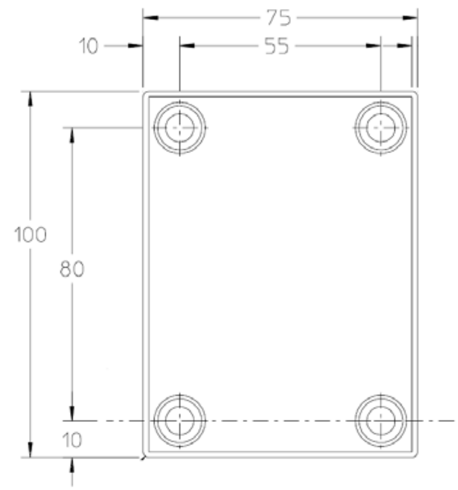
PCC 3300:
Use shell 0319-5674-02
Height: 60mm



PCC 2300 AND Aux 105 (HM ECM/AVR PS):
Use shell 0319-5674-02
Height: 70mm



Aux 104 (Governor Powerstage):
Use shell 0319-2318 (outer dim's & hole pattern)
Height: 40mm



PCC3.3 Separation of Circuits Specifications

The different circuits of the control system – different circuit boards as well as independent circuits, relays, switches and wiring should follow the separation of circuits' guidelines as outlined in 'UL 2200 – Stationary Engine Generator Assemblies, Section 24' and/or 'CSA C22.2 No 14' standards.

- All factory-installed wiring within an engine generator assembly must be insulated.
- The factory-installed wiring must also be separated from insulated and un-insulated live parts and from conductors of other circuits using barriers which are made of insulating/grounded material and are at least 0.028 inch (0.71 mm) thick.
- This barrier must not be spaced more than 1/16 inch (1.6 mm) from the enclosure walls, component-mounted panels, and other parts that provide separated compartments.
- High voltage / high current AC circuits should not be mixed with analog circuits / DC circuits / network wires and conductors.

PCC3.3 Enclosure Specifications

The enclosure for the PCC3.3 system components must be designed and used such that they follow the guidelines set forth by the 'UL 50' and 'UL 50E' standards. Adhering to these standards provides:

- Protection of the operators from hazardous components, high voltages and currents inside the enclosure
- Protection from airborne foreign solid objects like dust and dirt
- Protection from water and non-corrosive liquids

- Some types of enclosure specified by the standard also provide protection against rain, sleet, snow

Depending on the application and environmental conditions, the 'Enclosure Type Number' must be selected as specified by the standard.

PCC3.3 Vibration Specifications

The control system is designed to withstand vibration levels of 6.0 Grms in the range of 20 -2000 Hz range. The PCC3.3 mounting system should be designed such that the vibration levels exposed to the system are not higher 6.0 Grms in the range of 20 – 2000 Hz.

PCC3.3 Temperature Specifications

The PCC3300 and AUX105 are designed for proper operation without recalibration in ambient temperatures from -40 DegC to + 70 DegC, and storage from -55 DegC to +80DegC. The PCC3300 and AUX105 will operate with humidity levels up to 95% (non-condensing) and at altitude up to 13,000 feet (5000 meters).

The HMI320 is designed for proper operation in ambient temperatures from 20 Deg C to+70 Deg C, and for storage from –30 Deg C to +80 Deg C.

The PCC3300 and AUX105 are fully encapsulated to provide resistance to dust and moisture. The HMI320 has a single membrane surface, which is impervious to the effects of dust, moisture, oil, and exhaust fumes.

The control system is specifically designed and tested for resistance to RFI / EMI. The control system includes transient voltage surge suppression to provide compliance to referenced standards.

PCC3.3 Harnessing Guidelines

PCC3300 Control Connector Info				
	Connector Housing		**Connector Pins**	
Ref	**Internal P/N**	**Man/ Man P/N**	**Internal P/N**	**Man / Man P/N**
TB1	0323-1678-15	Amp/Tyco 1-796635-6, MOLEX 39862-0116, Magnum - EM256516H-BKL1		
TB8	0323-2325-03	Amp/Tyco 1-796635-3, MOLEX 39862-0113, Magnum - EM256513H-BKL1		
TB15	0323-2192-04	Amp/Tyco 796641-5 , MOLEX 39520-0005		
J11	0323-2161	Amp/Tyco / 770587-1	0323-2466	Amp/Tyco / 770904-1/770988-1/171637-1
J12	0323-1932	Amp/Tyco / 1-480704-0	0323-1200	Amp/Tyco / 350536-1/350550-1
J17	0323-2098	Amp/Tyco / 1-480698-0	0323-1200	Amp/Tyco / 350536-1/350550-1
J18	0323-2444	Amp /Tyco / 1-480700-0	0323-1200	Amp/Tyco / 350536-1/350550-1
J20	0323-2446	Amp /Tyco / 770586-1	0323-2466	Amp/Tyco / 770904-1/770988-1/171637-1
J22	0323-2226-03	Amp /Tyco / 282809-4		
J25	0323-2445	Amp /Tyco / 770581-1	0323-2466	Amp/Tyco / 770904-1/770988-1/171637-1

- For ECM CAN connection, use minimum 0.8 sq. mm (18 Gauge), 2 conductors, Twisted Shielded Cable. Connect the shield at J11 -17and leave shield un-connected at the ECM side of the cable.
- Network connections: Use Belden 9729 24 gauge twisted, stranded, shielded cable. Shield should be grounded at one end. Total network length can not exceed 4000 feet. Up to 20 nodes can be

connected to the network. (Note -Any communications wire connected to the genset should be stranded cable.)

- For MODBUS serial communication refer page 32 of the document "MODBUS over Serial Line – Specification and Implementation Guide ". This document is available at http://www.modbus.org/docs/Modbus_over_serial_line_V1.pdf
- For connecting Battery supply (B+) to the PCC3.3 control system, use two twisted pair wires minimum 1 sq mm cable size (16 Gauge).
- For connecting FSO and Starter solenoids make sure to use appropriate wire size based on the current drawn by the solenoids.
- For connecting CTs on J12 use three twisted pair wires minimum 1 sq mm (16 Gauge).
- For connecting to the onboard CT1, CT2, CT3 use three wires minimum 1 sq mm (16 Gauge) passed thru the CTs.
- For All other connections use minimum 0.8 Sq mm (18 Gauge) wires.

AUX105 Control Connector Info				
	Connector Housing		Connector Pins	
Ref	**Internal P/N**	**Man/ Man P/N**	**Internal P/N**	**Man / Man P/N**
J11	0323-2161	Amp/Tyco / 790587-1	0323-2466	Amp/Tyco / 770904-1/770988-1/171637-1
J21	0323-2455	Amp/Tyco / 794200 -1	0323-2466	Amp/Tyco / 770904-1/770988-1/171637-1
J17	0323-2098	Amp/Tyco / 1-480698-0	0323-1200	Amp/Tyco / 350536-1/350550-1
J18	0323-2444	Amp /Tyco / 1-480700-0	0323-1200	Amp/Tyco / 350536-1/350550-1

AUX105 Wiring Information

- For connecting the Magnetic Pick up, use minimum 0.8 sq. mm (18 Gauge), 2 conductors, Twisted Shielded Cable. Connect the shield at AUX105 J11 -8 and leave shield un-connected at the magnetic pick up side of the cable.
- For connection of CAN, use minimum 0.8 sq. mm (18 Gauge), 2 conductors, Twisted Shielded Cable. Connect the shield at AUX105 J21 – 4 and leave shield un-connected at the PCC3300 side of the cable. There should be a maximum distance of 0.1 m between the CAN connections. Please refer J1939-11 Std for further details.

- For connecting Battery Supply, use two twisted pair wires minimum 1 sq mm cable size (16 Gauge).
- For all other connections use minimum 0.8 Sq mm (18 Gauge) wires.
- The Electronic Governor feature may require an external Governor Power Module. Governor PWM output from the AUX105 control board is connected as input to the Governor Power Module by a minimum 0.8 sq. mm (18 Gage), 2 conductors, Twisted Shielded Cable.

Engine Sensors

Temperature Sensor (Onan/PGBU)

Internal P/N.	Man / Man P/N	Temp Range	Measurement Function	Threading
0193-0529-1	AirPax / 5024-0250	-40 to +300 F	Coolant, Lubricating Oil, Fuel	3/8-18 NPTF
0193-0529-2	AirPax / 5024-0274	-40 to +300 F	Coolant, Lubricating Oil, Fuel	M14 X 1.5 with "O" Ring
0193-0529-3	--	-40 to +300 F	Intake Manifold Temperature	M16 X 1.5 with "O" Ring

Temperature Sensor Connector (Onan/PGBU)

Internal P/N.	Man	Man P/N	Comments
0323-1755	Packard	121621893	Plastic shell with seal
0323-1818	Delphi	12124075	Socket Connector

Temperature Sensor (Cummins/EBU)

Internal P/N.	Man / Man P/N	Resistive Temp Range	Measurement Function	Threading
4954905	--	-40 to +300 F	Coolant, Lubricating Oil, Fuel	M14 X 1.5 with "O" Ring
3408345	--	-40 to +300 F	Intake Manifold Temperature	Seal O Ring

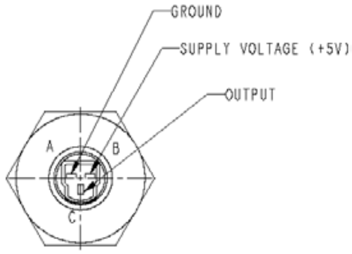
Oil Pressure Sensor

The AUX105 control can be programmed to use one of the following pressure sender / switch. A software trim allows selection between analog senders and a switch. The trim parameter for this is, Oil Pressure Sensor Type = Sender, Switch. A software trim allows selection between two or three wire sender if a Sender is chosen as Oil Pressure Sensor Type. The trim parameter for this is Oil Pressure Sender Type = 3-wire, 2-wire (0-100 PSIG), 2-wire (0-200 PSIG).

Internal P/N.	Man/ Man P/N	Sensor Type	Range / Unit	Resistance / Voltage
0193-0444	Kavlico	3-wire Active Sender	0-100 PSIG	0-5 V DC

	P165-5110	(Capacitive)		
0309-0641-XX	Stewart Warner	Switch	-	-

Three Wire Oil Pressure Sensor



Internal P/N.	Man	Man P/N	Comments
0193-0444	Kavlico	P165-5110	3-wire Active Sender

Oil Pressure Switch

The internal P/N for Lube Oil Pressure Switch is 0309-0641-XX. XX - depends on the trip pressure point. Select proper lube oil pressure switch.

If an oil pressure switch is used, the active state (active high or active low) of the switch must be configured using a PC based service tool. A software trim allows selection of the active state of the switch. The trim parameter for this is, Oil Pressure Switch Polarity = Active Low, Active High.

Oil Pressure Switch Selection Matrix

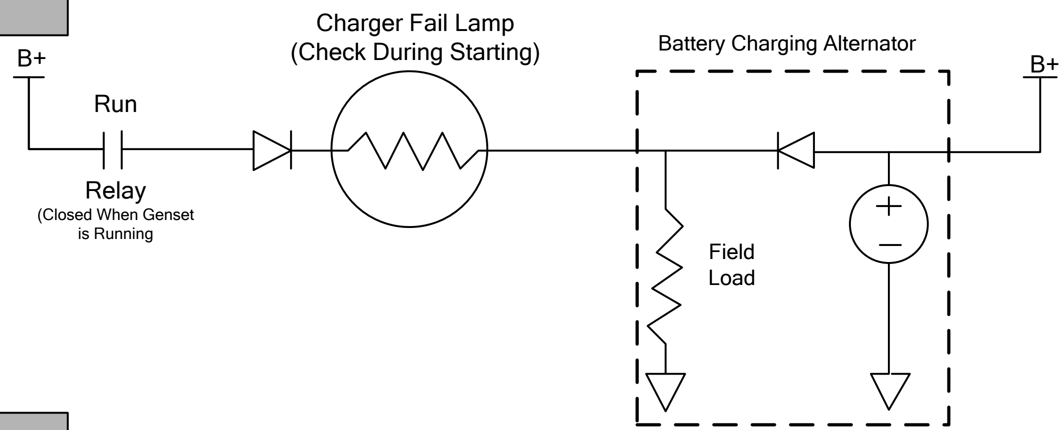
Part Number	Sensor Type	Switch Polarity
0309-0641-01	Switch	Active High
0309-0641-02	Switch	Active Low

For more switch options refer part drawing of 0309-0641.

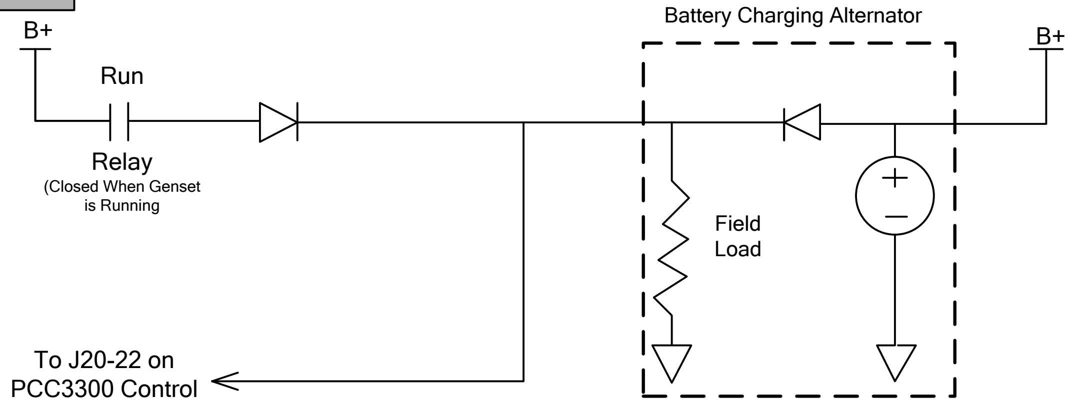
PCC3.3 Battery Charging Alternator Connections

With PCC3300 control, the battery charging alternator connections are to be made as shown.

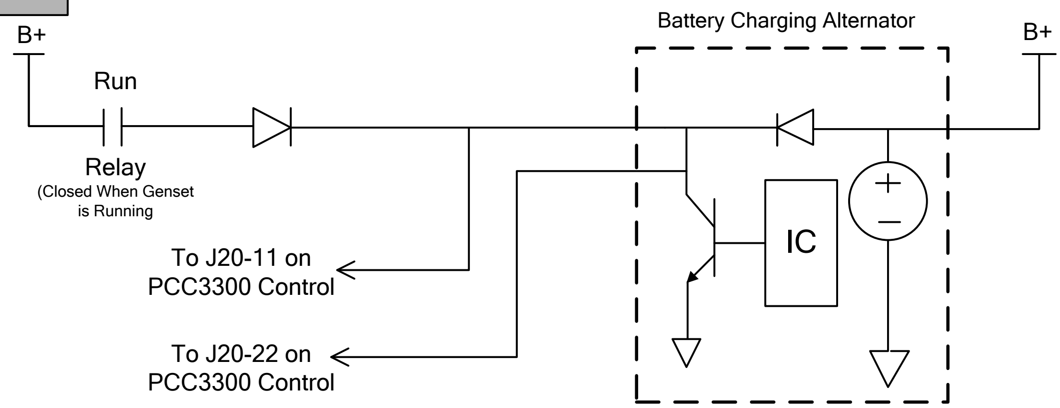
Bulb Diagnostic
For ref. only



NonIC Type Charger



IC Type Charger



PCC3.3 Current Transformer Selection Rules

Use the CT Ratio Calculator for finding the appropriate CT ratio and required specifications for particular voltage and KVA rating of the genset. The CT Rules embedded in the CT Ratio Calculator are designed to select a range of appropriate CTs such that there is ample measurement signal needed to reduce the effects of noise, while still providing enough bandwidth to measure large currents required for AmpSentry™ operations. The calculator is available at 'pgaxcdfs01\depts$\ibecpe\PCC3300\ Application Guide', on the Commercial and ESB Genset Database, and via the 'OEM Setup Tool' in InPower.

PCC3.3 Current Transformer Programming Rules

The PCC3300 has to be programmed with two parameters so it can properly measure Genset Current.

Parameter Name	Parameter Function
Genset Primary CT Current	Tells the PCC3300 what the CT Ratio is. If the CT Ratio is 1000/500:5, Genset Primary CT Current should be set to a value of 500.
Genset CT Secondary Current	Tells the PCC3300 what type of CT is applied to its input, either 5Amp or 1Amp.

The CT Parameters can be programmed into the PCC3300 control via one of the following methods:

1. Enter an appropriate value through the HMI320.
2. Select a feature that will be downloaded using the Manufacturing Tool.
3. Program an appropriate value in the Genset Primary CT Current parameter and Genset CT Secondary Current using a PC Based Service Tool (e.g. InPower).

NOTE: The PCC3300 control will automatically double the entered CT ratio when switching from high nominal voltage (above 300V) to lower nominal voltage (below 300V). This is referred to as the "CT Doubling Rule"

Entering a CT ratio using the HMI320:

- To be added later

Entering a CT Ratio using a PC Based Service Tool (e.g. InPower):

- To be added later

PCC3.3 Current Transformer Diagnostics

The PCC3.3 contains two fault codes used to indicate that the entered CT Ratio is incorrect for the entered voltage and kVA. Both faults are evaluated upon leaving setup mode.
The Genset 'CT Ratio Too Small' (2814) is a shutdown fault and is used to indicate that the entered CT Ratio is too small for the entered voltage and kVA settings. Using the CT Calculator confirm the correctness of the chosen CT Ratio. Using the Programming Rules verify that the PCC3300 has been programmed correctly.

The 'Genset CT Ratio Too Large' (2815) is a warning fault and is used to indicate that the entered CT Ratio is too large for the entered voltage and kVA Settings Using the CT Calculator confirm the correctness of the chosen CT Ratio. Using the Programming Rules verify that the PCC3300 has been programmed correctly.

PCC3.3 Potential Transformer Selection Rules

For Genset Nominal Voltage levels up to 600V L-L Rms no external PT is required for voltage sensing. For Genset Nominal Voltage levels above 600 V L-L Rms an appropriate PT is required to be used so as to reduce the voltage input sensed by the PCC3300.

The PT is required to have a primary voltage ranging from 601 V to 45000 V (as per the application) and secondary voltage ranging from 110 to 600 V.

The following rules must be observed when selection a PT:

If Genset PT Secondary Voltages is below 300V, then

(Genset PT Secondary Voltage/ Genset PT Primary Voltage) must be greater then (300 / Genset Nominal Voltage)

And

(Genset PT Secondary Voltage/ Genset PT Primary Voltage) must be less then 3% (.030) * (300 / Genset Nominal Voltage)

If Genset PT Secondary Voltages is above 300V, then

(Genset PT Secondary Voltage/ Genset PT Primary Voltage) must be greater then (600 / Genset Nominal Voltage)

And

(Genset PT Secondary Voltage/ Genset PT Primary Voltage) must be less then 3% (.030) * (600 / Genset Nominal Voltage)

‘Genset PT Ratio Too Small’ (2816) is a shutdown fault used to indicate that the entered PT ratio is too small for the given Genset Nominal Voltage. The ‘Genset PT ratio Too Large’ (2817) is a warning that is used to indicate that the entered PT ratio is too large for the given Genset Nominal Voltage. Review the PT Selection Rules and Potential Transformer Programming Rules to assess the accuracy of PT Ratio programmed.

PCC3.3 Potential Transformer Programming Rules

Entering a PT ratio using the HMI320:

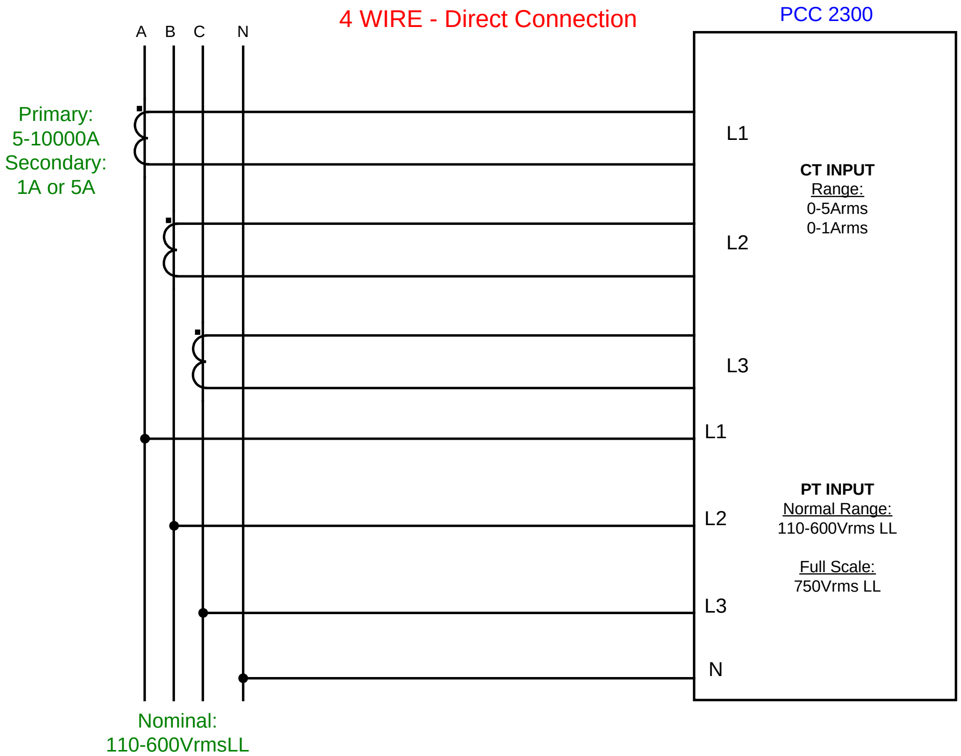
- To be added later

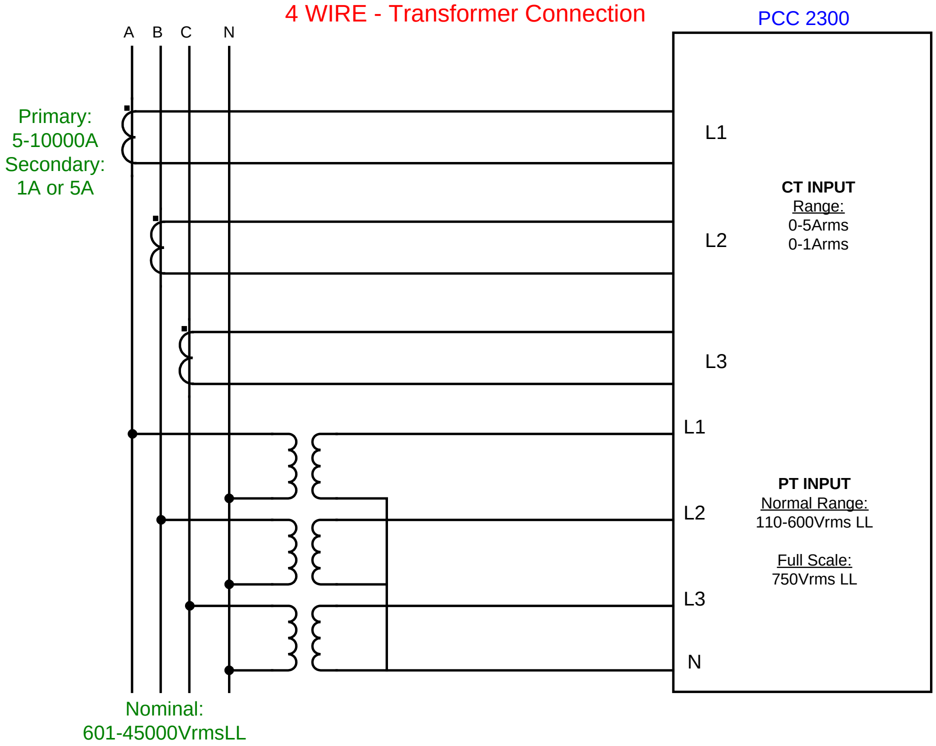
Entering a PT Ratio using a PC Based Service Tool (e.g. InPower):

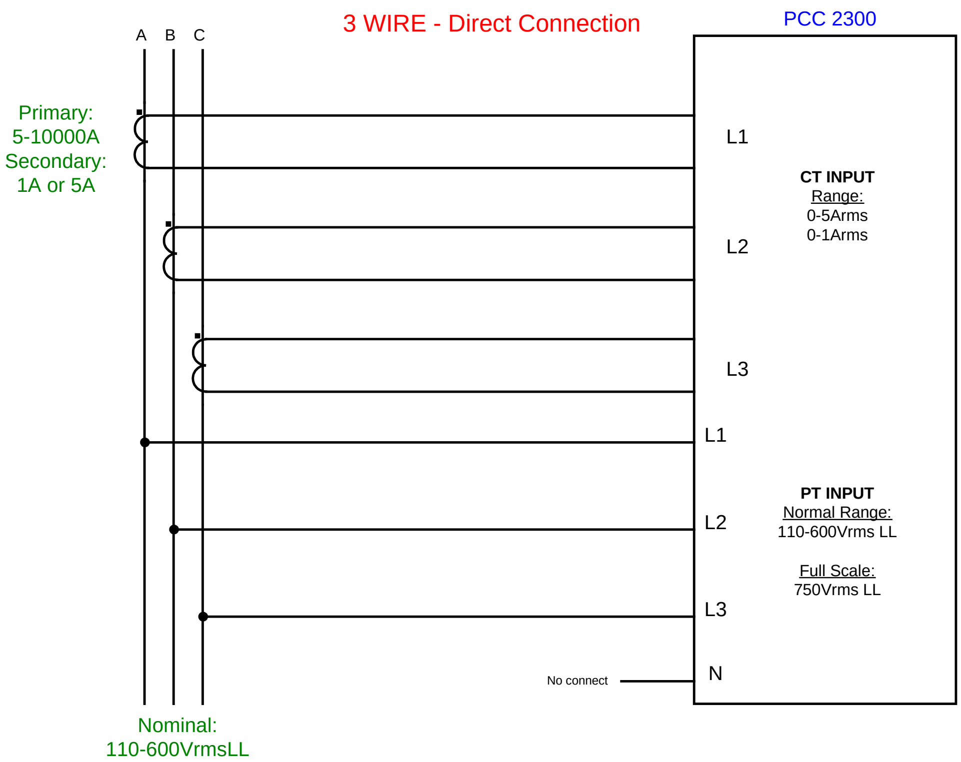
- To be added later

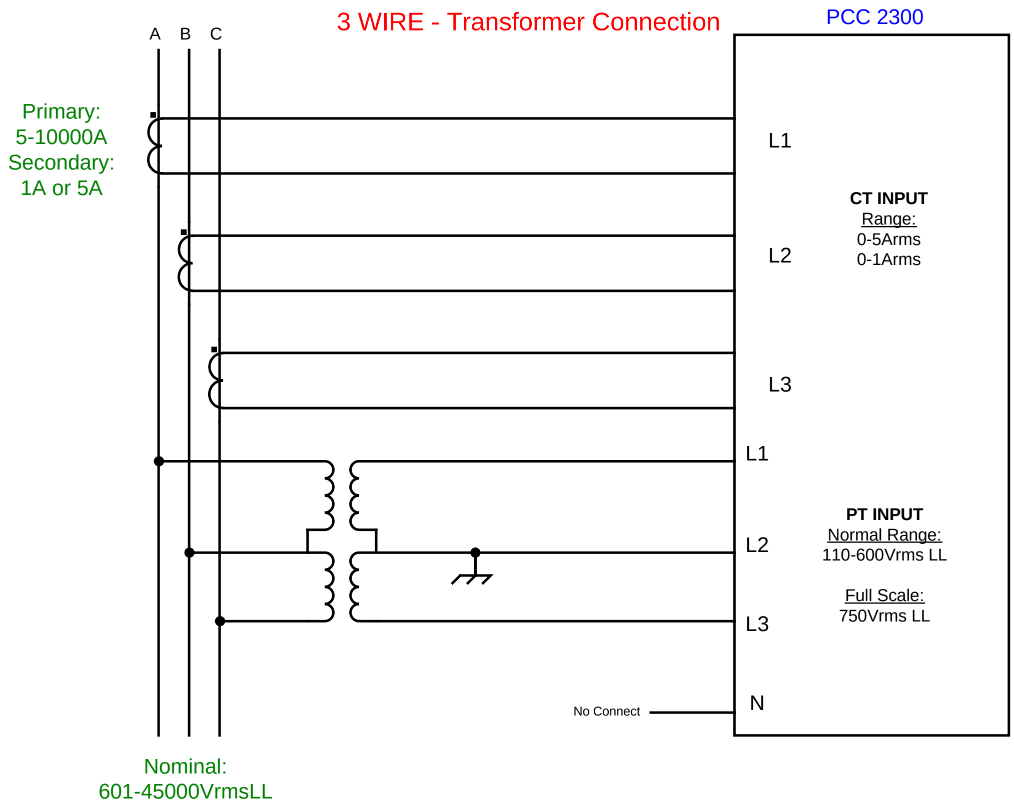
PCC3.3 Potential Transformer Connection Diagrams

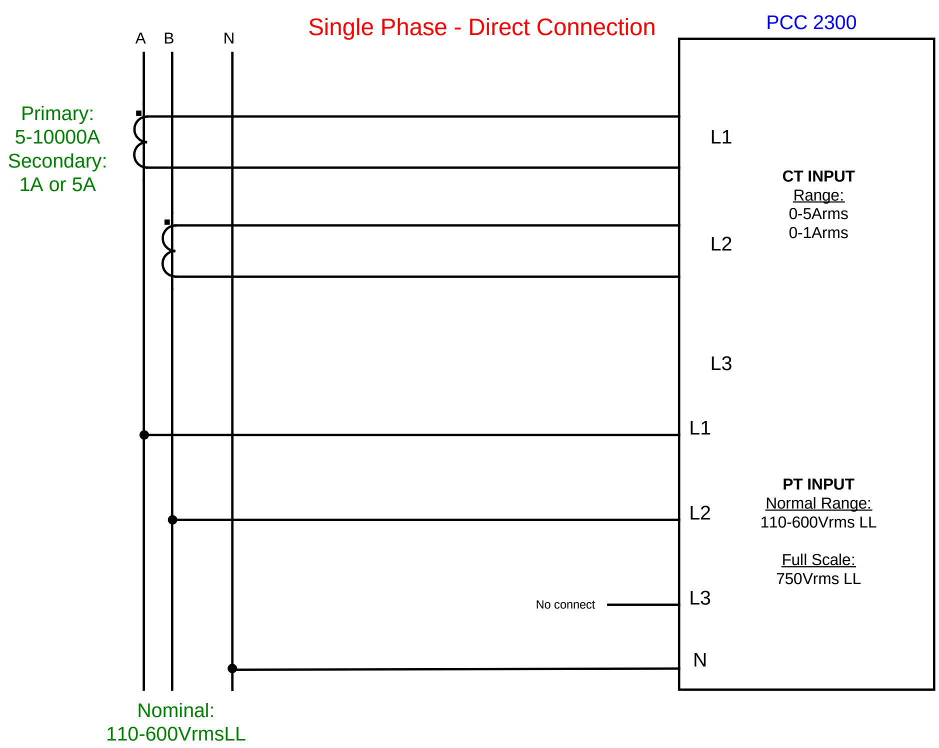
CT / PT connection diagrams for various voltage levels and alternator connections are shown below:




4 WIRE - Transformer Connection
PCC 2300
A
B
C
N
Primary:
5-10000A
Secondary:
1A or 5A
L1
L2
L3
CT INPUT
Range:
0-5Arms
0-1Arms
L1
L2
L3
N
PT INPUT
Normal Range:
110-600Vrms LL
Full Scale:
750Vrms LL
Nominal:
601-45000VrmsLL


3 WIRE - Direct Connection
PCC 2300
A
B
C
Primary:
5-10000A
Secondary:
1A or 5A
L1
L2
L3
CT INPUT
Range:
0-5Arms
0-1Arms
L1
L2
L3
N
No connect
PT INPUT
Normal Range:
110-600Vrms LL
Full Scale:
750Vrms LL
Nominal:
110-600VrmsLL


3 WIRE - Transformer Connection
PCC 2300
A B C
Primary:
5-10000A
Secondary:
1A or 5A
L1
CT INPUT
Range:
0-5Arms
0-1Arms
L2
L3
L1
PT INPUT
Normal Range:
110-600Vrms LL
L2
Full Scale:
750Vrms LL
L3
No Connect
N
Nominal:
601-45000VrmsLL


Single Phase - Direct Connection
PCC 2300
A B N
Primary:
5-10000A
Secondary:
1A or 5A
L1
CT INPUT
Range:
0-5Arms
0-1Arms
L2
L3
L1
PT INPUT
Normal Range:
110-600Vrms LL
L2
Full Scale:
750Vrms LL
No connect
L3
N
Nominal:
110-600VrmsLL

Switch Control

PCC3.3 Single Genset Control Features

PCC3.3 Off Mode Operation

The PCC3.3 Control System can be placed into Off Mode by pressing the Stop button on the HMI320. When the control system is transferring into Off Mode the Green LED above the Stop button will flash, once the control system has successfully transferred into Off Mode the Green LED will be lit solid.

When in Off Mode the genset will not stop and not run. If the PCC3.3 control system is configured for low power sleep mode, it may go to sleep in off mode.

PCC3.3 Auto Mode Operation

The PCC3.3 Control System can be placed into Auto Mode by pressing the Auto button on the HMI320. When the control system is transferring into Auto Mode the Green LED above the Auto button will flash, once the control system has successfully transferred into Auto Mode the Green LED will be lit solid.

When the PCC3.3 control system is in the Auto mode, it is ready to receive a remote signal from a remote device such as a Transfer Switch (TS) control or MODBus message. In Auto mode the genset can also start if an exercise scheduler program becomes active. Once a remote start signal is received the control will initiate the start sequence. The start sequence begins with the engine Pre-Lube Cycle if *Prelube Cycle Enable* = Enabled, and a Time Delay to Start for the *Time Delay to Start* trim. If the Start Mode is set to Emergency the genset will start cranking while Pre-Lube is active, if Start Mode is set to non-emergency the genset will not start cranking until the Pre-Lube cycle has been complete. After completing the Pre-Lube cycle (for non-emergency) and Time Delay to Start, the PCC3.3 control system commands the genset to start cranking by turning on the starter Low-Side Relay driver on Pin J20 -15. At this point, the control system verifies that engine is rotating by monitoring the Average Engine Speed parameter coming from the ECM. If the engine speed is zero after two seconds from engaging the starter the control system turns off the starter, waits two seconds and then re-engages the starter. At this point, if engine speed is still zero the control issues a Fail To Crank (1438) shutdown fault.

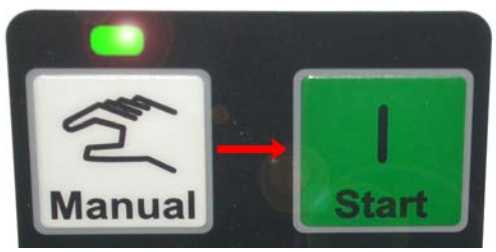
Once the engine speed is greater then the Start Disconnect speed, the starter is disengaged. For *Start Mode* = Emergency engine will accelerate to rated speed and voltage and bypass all the idle warm-up delays. For Start Mode = Non-emergency, the engine will warm-up in idle speed until the *Idle Warm-up Time* delay has expired or the engine coolant temperature is greater then the *Idle Warm-up Coolant Temperature*. At this point the engine will accelerate to rated speed and voltage. Upon reaching rated speed and voltage the 'Ready To Load' command will become active.

Once the remote start signal is removed or the exerciser program has expired the genset will go into cool-down at rated speed if the genset was running with load that is greater than 10% of genset rating. The genset will run in cool-down at rated mode for the *Rated Cooldown Time* trim setting. The purpose of the cool-down at rated is to cool-down and preserve the engine.

After the cool-down at rated is completed if the operator has set a *Time Delay to Stop* trim, the generator set will run at rated speed for an extended amount of time equal to the *Time Delay to Stop* trim. After the Time Delay to Stop is complete, the genset enters the cool down at Idle speed. After the cool down at Idle speed expires, the genset is shut down via a normal stop.

PCC3.3 Manual Run Mode Operation

The PCC3.3 Control System can be place in Manual Run by pressing the Manual button and then the Start button on the HMI320. When the control system is transferring into Manual Run mode the Green LED above the manual button will flash, once the control system has successfully transferred into Manual Run Mode the Green LED will be lit solid. If the Manual button is pressed, but the Start button is not, the control system will not start and the control system will revert back to 'Off' after 3 seconds.



After the Start button is pressed on the HMI320, the PCC3.3 Control system enters Manual Run mode which begins with the start sequence. The start sequence begins with the engine Pre-Lube Cycle *Prelube Cycle Enable* if Enabled. After completing the Pre-Lube cycle is complete, the PCC3.3 control system commands the genset to start cranking by turning on the starter Low-Side Relay driver on Pin J20 -15. At this point, the control system verifies that engine is rotating by monitoring the Average Engine Speed parameter coming from the ECM. If the engine speed is zero after two seconds from engaging the starter the control system turns off the starter, waits two seconds and then re-engages the starter. At this point, if engine speed is still zero the control issues a Fail To Crank (1438) shutdown fault.

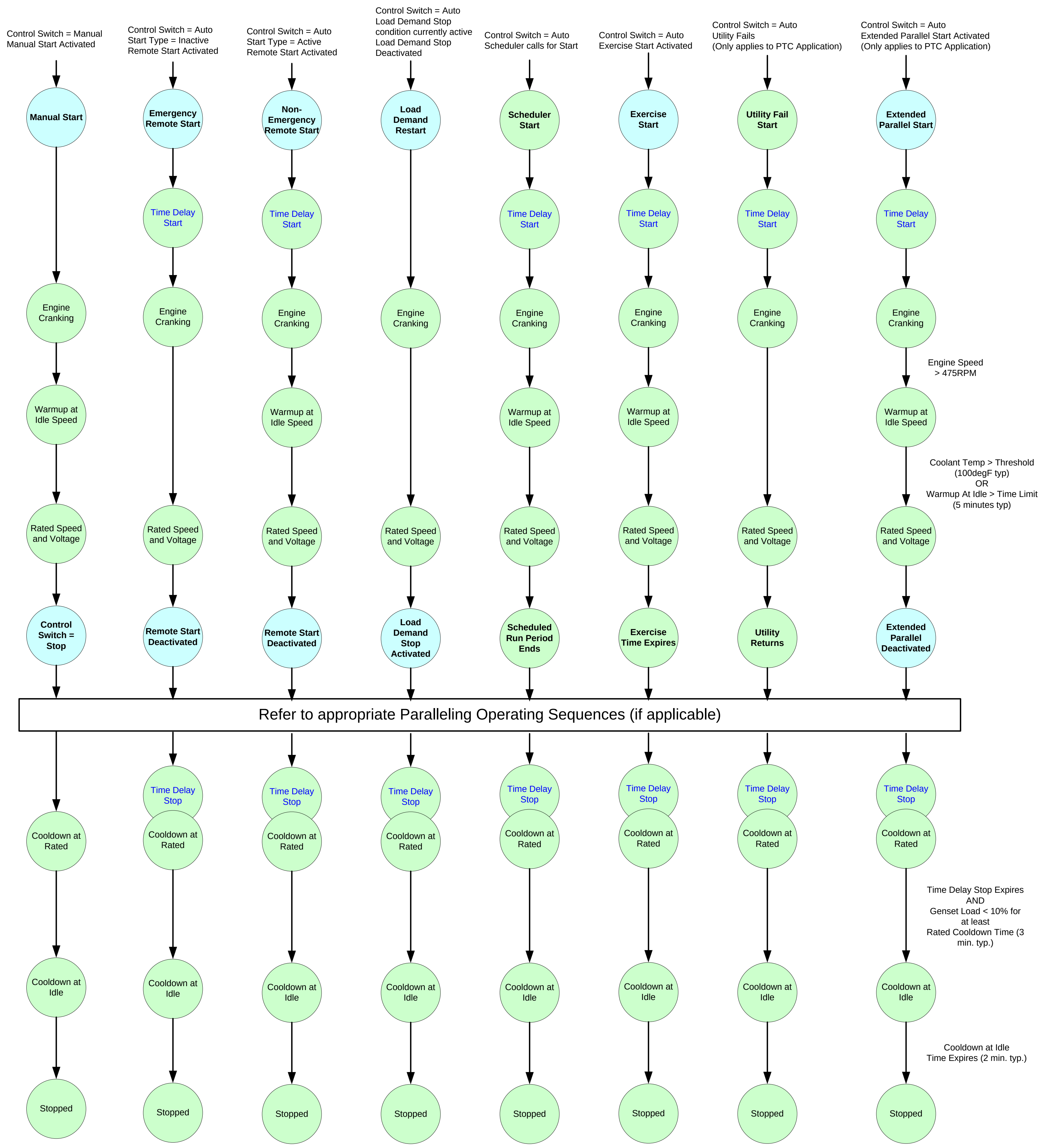
Once the engine speed is greater then the Start Disconnect speed, the starter is disengaged. For Start Mode = Emergency engine will accelerate to rated speed and voltage and bypass all the idle warm-up delays. At this point, an engine is allowed will warm-up at idle speed until the *Idle Warmup Time* delay has expired or the engine coolant temperature is greater then the *Idle Warmup Coolant Temperature*. Upon completing the warm-up sequence, the engine will be commanded to accelerate to rated speed and the genset to rated voltage. Upon reaching rated speed and voltage the 'Ready To Load' command will become active.

Once the PCC3.3 receives a stop command by placing the control system in Off mode, will go into cool-down at rated speed if the genset was running with load that is greater than 10% of genset rating. The genset will run in cool-down at rated mode for the *Rated Cooldown Time* trim setting. The purpose of the cool-down at rated is to cool-down and preserve the engine.

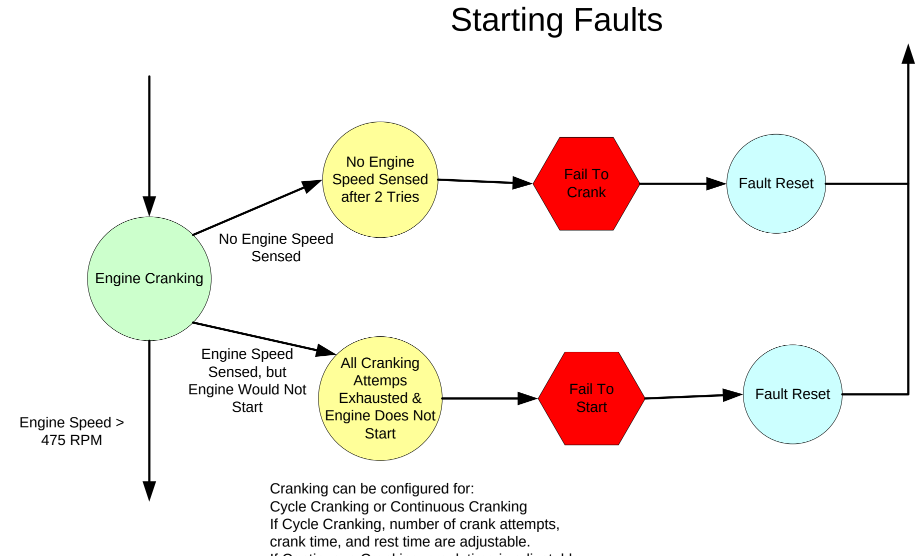
After the cool-down at rated is completed the genset will cool-down at Idle speed. After the cool down at Idle speed time expires, the genset is shut down via a normal stop.

PCC3.3 Modus Operandi Summary

PCC3300 Genset Starting & Stopping Sequences



Starting Faults

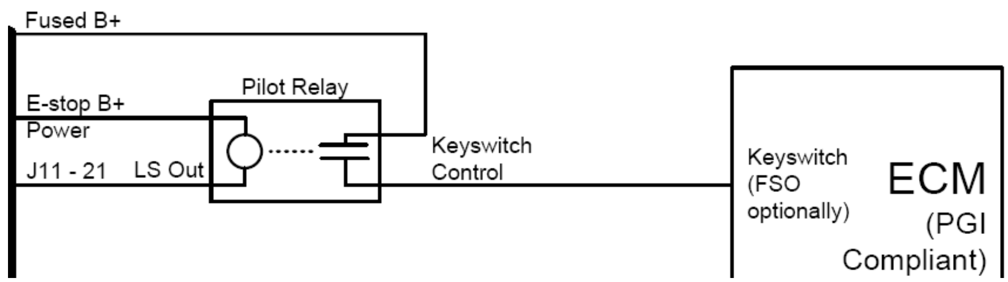


PCC3.3 Keyswitch Operation

The ECM's keyswitch input is required to be on to turn on the ECM and subsequently start fueling when nonzero engine speed is present. It must be turned off to stop fueling of the engine. Since the ECM is the fueling controller, the Keyswitch is the PCC3.3's primary means of stopping the engine.

While the Keyswitch is on J1939 and there is non-zero engine speed, CAN datalink communications are maintained. The ECM Keyswitch input is controlled by a Keyswitch Relay.

(Refer the below diagram for Keyswitch connection)



Start Mode

PCC3.3 Remote Start Operation

The PCC3300 control accepts a signal from remote devices to automatically start the generator set when set in 'Auto' mode and immediately accelerates to rated speed and voltage. Remote start signals can come from a variety of optional sources, they are listed below: -

a. Signal on TB1-11 (Active Ground or Active Open as per the configuration) through any power control device like 'Automatic Transfer Switch'
b. Through MODBUS
c. Through PC based service tool
d. Through Exercise Scheduler

The PCC3.3 can be configurable for start time delay of 0-300 seconds prior to starting after receiving a remote start signal, and for time delay stop of 0-600 seconds prior to ramp to shut down after receiving signal to stop (removal of start command) in normal operation modes. Default for both time delay periods is 0.

PCC3.3 Local and Remote Emergency Stops

Remote Emergency Stop

For operation of the genset, a short between TB1-15 and TB1-16 must be present. The control enters an emergency stop mode when the short is removed. Before the genset can be restarted, the control must be manually reset by re-applying the short and acknowledging the fault.

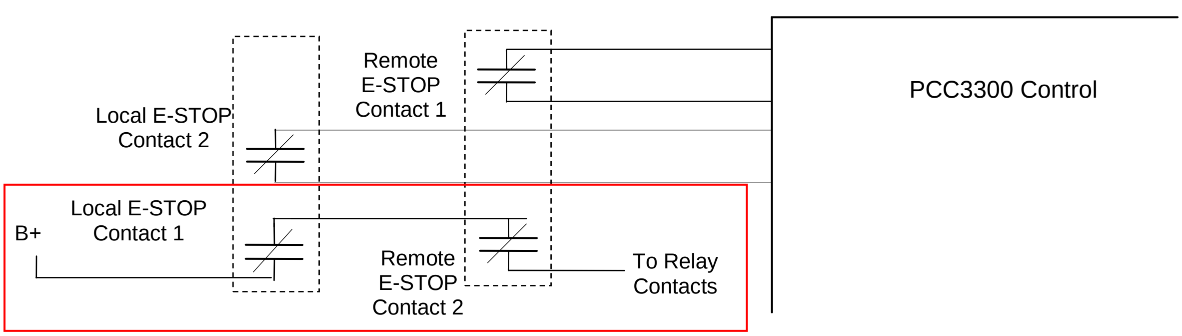
Local Emergency Stop

For operation of the genset, a short between J25-2 and J25- 6 must be present. The control enters an emergency stop mode when the short is removed. Before the genset can be restarted, the control must be manually reset by re-applying the short and acknowledging the fault.

It is also required to have physical interruption of the Keyswitch, FSO and Starter relays when emergency stop (either local or remote) is active. In order to achieve this, a second NC switch contact should be added to the Estop switch such that when a Estop button is pressed, this second NC contact is opened. The second NC contact should be wired in series with B+ and the Keyswitch, FSO, and Starter relay coils. Thusly, when the Estop button is pressed, power is removed from the Keyswitch, FSO, and Starter relay coils which in turns de-energizes the relays and prevents further genset operation.

The diagram shown below illustrates one possible way to do this. Power to the fuel shutoff valve is provided serially through the two second contacts of e-stop switch.

Refer to Wiring Diagram: 0630-3270 for complete illustration.



PCC3.3 Low Power Sleep Mode

The control system is designed to include a low-power sleep mode. When in this mode the PCC3.3 will be completely powered down, except for the low power wake-up sensing circuitry. In this mode the control system will draw less then 60mA of current from the genset starting batteries. The control system can be woken up upon receiving any of the below listed wake-up signals.

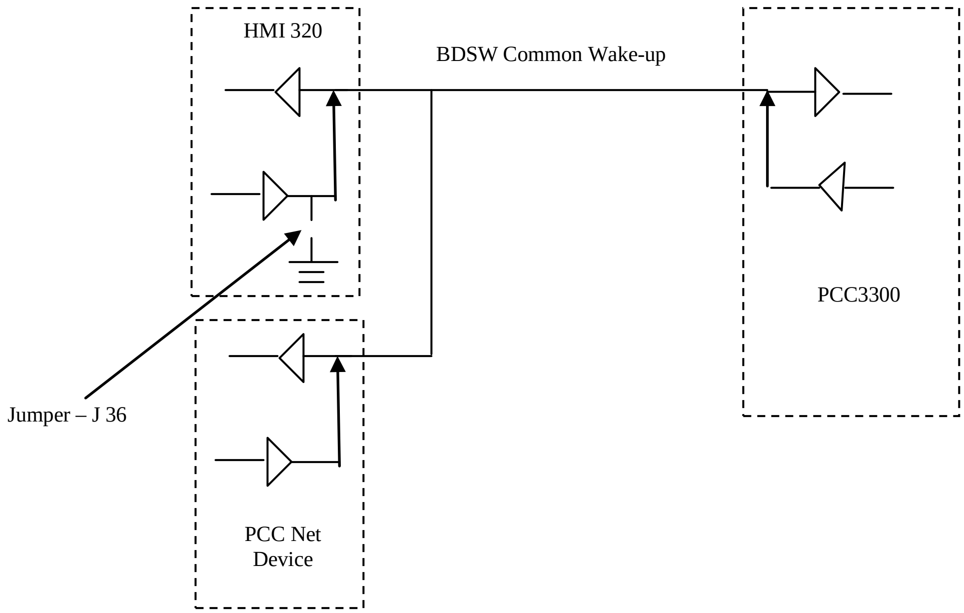
- Local Estop
- Remote Estop
- Manual start command
- PC tool wake-up (Bi-Directional System Wakeup)
- Remote Start command
- Auto (Configurable)
- Rupture Basin (Configurable Input #12)
- Low Fuel Level Input (Configurable Input #6)
- Low Coolant Level Input (Configurable Input #5)

The controller will not go into sleep mode during any of the following conditions:

- Prelube Cycle Enable(trim) is set to Enabled
- Active Modbus Communications are present
- Power Down Mode Enabled (trim) is set Disabled
- Active Fault Reset Command is present
- Any active shutdown or warning fault is present
- Any of the active wake-up signals listed above are active.

All the PCCNet devices existing within the PCC3.3 control system are linked together via the Bi-Directional System Wakeup (BDSW) pin. Each individual device drives the BDSW pin to GND if its internal sleep mode logic is not satisfied. When an individual device determines that it would like to go to sleep, it releases the BDSW pin from GND and then starts monitoring the BDSW pin's status. Once, the BDSW pin is no longer at GND, each device enter sleep mode by removing power from itself. This only happens when all of the devices that have been linked together via the BDSW link release the BDSW pin. In effect, this method assures that all the connected devices go to sleep simultaneously and if and only if each individual devices' sleep mode criteria have been satisfied.

Below is a circuit diagram of the BDSW scheme used by the PCC3.3 control system.



For the HMI 320, if a jumper is placed across J36 (backside of HMI), it will force the BDSW common wakeup line continuously at GND, which will force all the connected devices to be always awake.

AUX105 Sleep Mode

Following description assumes that the PCC3300 is Awake. If PCC3300 enters sleep mode, it removes power to AUX105 (Via J21). While attempting to download calibration to AUX105, please ensure that the PCC3300 does not enter sleep mode.

The AUX105 control is configured to include a low-power sleep mode.
If Aux105 controller enters in Stop/Off mode, and if Keyswitch turns OFF as well as PC tool is not connected, then the AUX105 controller enters sleep mode after approx 5 sec. In this mode AUX105 control will draw 0 mA of current from the genset starting batteries. The AUX105 control can be woken up upon receiving any of the below listed wake-up signals.

- Keyswitch status ON
- PC tool wake-up (Bi-Directional System Wakeup)

The controller will not go into sleep mode during any of the following conditions:

- Any of the active wake-up signals listed above are active.
- Shutdown Fault is active

PCC3.3 Setup Mode

In this mode, the controller is placed in a basic genset configuration setup mode and will not allow the genset to start until put back setup mode is exited. While in setup mode, all of the outputs (Starter , FSO, Keyswitch, Glow plug, Oil priming pump, Field Connections, Customer Outputs) are forced into their off (de-energized) states and will not be placed back into normal operation control until the setup mode is exited.

When genset is running, setup mode is not entered until the Controller Mode state is Ready, Waiting For Powerdown or Emergency Shutdown.

Entering Setup mode is required to be done manually while using PC based service tool by setting the parameter Setup Mode Enable = Enable. Upon entering in setup mode, a timer is enabled. Leaving setup mode can be done either by manually setting Setup Mode Enable = Disabled, or by having the timer exceed the value of the max time allowed in setup mode. This timer will be reset each time a trim save occurs.

Some trim parameters need setup mode enabled in order for them to be changed. These parameters have been evaluated to be critical to the genset and therefore shall only be allowed to be changed in a known state. A note is written for such parameters in Trim table – section 10

When setting up the PCC3.3 control system through the HMI320, the HMI320 automatically enables setup mode on the PCC3300 for trims which require this condition.

AUX105 Setup

The Trims specific to AUX105 are saved in PCC3300 through Tool or Operator Panel. These parameters are read by AUX105 on cycling of Key Switch. AUX105 retains these only as long as Power is applied and Key Switch is not cycled again. AUX105 does not have any Trims other than those required for the IDA logger.

Some of these AUX105 Specific Trims need Setup Mode enabled and cannot be changed when the genset is running. These are “Setup interlocked” parameters. When genset is running, Setup Mode does not get enabled to prevent any changes in “Setup interlocked” trim parameters. To enable the Setup Mode, the controller state needs to be Ready, Off or Emergency Shutdown.

When setting up AUX105-PCC3300 control system through Operator Panel, the HMI automatically enables Setup Mode for trims which require the condition 'Setup Mode Enabled'. Through HMI also, the controller will not allow the setting up of "Setup interlocked" trims while genset is running.

In the HMECM Control System, the PCC3300-AUX105 data transfer is as follows:

The manufacturing tool or InPower needs only to be connected to PCC3300 for any trim setting / adjustments. There is no need for any Setup / Adjustments directly to HMECM from Manufacturing Tool or InPower.

At every power up / reset or when forced by Key switch Recycle, the AUX105 reads Interface parameters from PCC3300. If an AUX105 related change is carried out at PCC3300, the PCC3300 writes the new value of the parameter to AUX105.

(Refer Fig A)

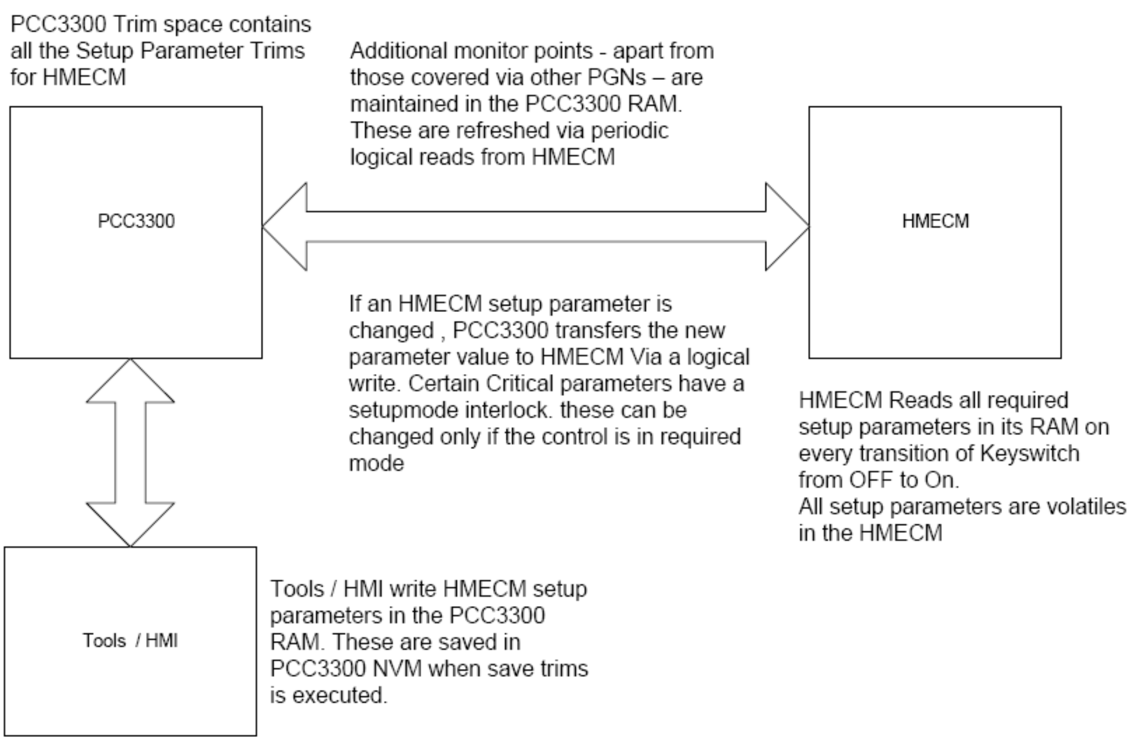


Fig A

PCC3.3 Nominal Battery Voltage Processing

The PCC3.3 control system provides the ability to work with either 12 VDC or 24 VDC nominal battery voltages. Furthermore, the control provides diagnostic faults that are issued when a low battery voltage, weak battery, or high battery voltage condition are determined.

The control system provides field adjustable trims to select either 12 V or 24 V battery operations, and appropriate fault thresholds.

PCC3.3 Configurable Input Functions

The controller provides 23 configurable inputs; with some of those having default functionality assigned which can adjusted through trims available in PC based service tool (InPower) and HMI320.

Input Number	Default Function	Connector / Pin
Configurable I/P # 1	None	TB1- 12 Signal and TB1-13 Return
Configurable I/P # 2	None	TB1- 14 Signal and TB1-13 Return
Configurable I/P # 5	Low Coolant Level Switch	J20-17 Signal and J20 -5 Return
Configurable I/P # 6	Low Fuel Level Switch	J20-18 Signal and J20 -6 Return
Configurable I/P # 10	Remote Fault Reset Switch	TB8-5 Signal and TB8-1 Return
Configurable I/P # 11	Start Type	TB8-6 Signal and TB8-2 Return
Configurable I/P # 12	Rupture Basin Switch	J20-19 Signal and J20-8 Return
Configurable I/P # 13	None	TB8- 7 Signal and TB8 -12 Return
Configurable I/P # 14	None	TB8 -8 Signal and TB8 -13 Return
Configurable I/P # 33	Backup Start Disconnect	J26-2 Signal and J26-8 Return
Configurable I/P # 26	Genset CB B Status	TB10-8 Signal and TB10 – 9 Return
Configurable I/P # 27	Genset CB Tripped Status	TB10-10 Signal and TB10-16 Return
Configurable I/P # 28	Genset CB Inhibit	TB10-11 Signal and TB10-16 Return
Configurable I/P # 23	Utility CB B Status	TB10-4 Signal and TB10 – 2 Return
Configurable I/P # 24	Utility CB Tripped Status	TB10-5 Signal and TB10- 2 Return
Configurable I/P # 25	Utility CB Inhibit Status	TB10-6 Signal and TB10-1 Return
Configurable I/P # 29	Single Mode Verify	TB10-12 Signal and TB10-17 Return
Configurable I/P # 31	Load Demand Stop	TB10-14 Signal and TB10-17 Return
Configurable I/P # 32	Ramp Load/Unload	TB10-15 Signal and TB10-17 Return
Configurable I/P # 30	Synchronizer Enable	TB10-13 Signal and TB10-9 Return
Configurable I/P # 20	Transfer Inhibit	TB3-9 Signal and TB3-12 Return
Configurable I/P # 21	Retransfer Inhibit	TB3-10 Signal and TB3-12 Return

For Configurable Inputs 1,2,13 and 14 a fault code is assigned with a 16 character text string associated for display on an HMI320 when the fault becomes active. The default genset response of each fault is 'None' and display text will not be having any initial definition.

Diagnostic Code	Event Name	Default Response
1573	Configurable Input #1	None
1312	Configurable Input #2	None
1317	Configurable Input #13	None
1318	Configurable Input #14	None

In addition to default functions, the configurable inputs can be mapped for the functions defined below.

1	Default
2	Do Nothing
3	Manual Run Switch
4	Low Fuel in Day Tank Switch
5	Low Coolant Switch #2
6	High Alt Temperature Switch
7	Ground Fault Switch
8	PTC Mode Switch
9	Masterless Load Demand Enable Switch
10	Low Engine Temperature Switch
11	Extended Parallel Switch
12	Exercise Switch
13	Battle Short Switch
14	Battery Charger Failed Switch
15	Low Engine Temperature Switch
16	Speed Droop Enable Switch
17	Voltage Droop Enable Switch
18	Safety Wire Loop

For using these functions a trim ‘Function Pointer’ is required to be used.

A trim ‘Factory Lock’ is available for preventing the modification of the Function Pointer for each of the configurable inputs. When Factory Lock is set as ‘Locked’, the end customer will not be able to modify the preset function pointer for any other desired function. To modify the Function Pointer, the Factory Lock is required to be set as ‘Unlocked’.

The configurable inputs can be configured as active open or active close using the trim ‘Active State Selection’

PCC3.3 Configurable Output Functions

The PCC3.3 control system provides 10 configurable outputs; with some of those having default functionality assigned which can adjusted through trims available in PC based service tool and HMI320.

Input Number	Default Function	Connector / Pin
Configurable O/P # 1	Default configured for Customer Input #1 Fault code 1540	TB1- 6 TB1-7 (Dry Contact Relay Output)
Configurable O/P # 2	Default configured for Customer Input #1 Fault code 1541	TB1- 8 TB1-9 (Dry Contact Relay Output)
Configurable O/P # 3	Default configured for Customer Input #1 Fault code 1463	TB8-10
Configurable O/P # 4	Default configured for Customer Input #1 Fault code 1465	TB8-9
Configurable O/P # 5	Ready To Load	TB1-4
Configurable O/P # 6	Oil Priming Pump	J20-16
Configurable O/P # 7		J25-1
Configurable O/P # 8	None	J11-7
Configurable O/P # 10	Delayed Off	TB8-3
Configurable O/P # 11	Load Dump	TB8-11

In addition to default functions, the configurable outputs can be mapped for the functions defined below --

1	Default
2	Do Nothing
3	Common Warning
4	Common Shutdown
5	Rated to Idle Transition Event
6	Fault Code Function #1
7	Fault Code Function #2
8	Fault Code Function #3
9	Fault Code Function #4
10	Fault Code Function #5

Each output can be configured to activate upon any fault code or event code which is set for particular fault code function. E.g. If a configurable output is mapped for Fault Code Function #1 and Fault code Function #1 is mapped for fault code 151 (High Coolant Temperature) , then the particular customer output will be active when fault code 151 is active.

The trim ‘Function Pointer’ is required to be used to set under what condition the configurable output becomes active. A trim ‘Factory Lock’ is available for preventing the modification of Function Pointer trim. When Factory Lock is set as ‘Locked’, the end customer will not be able to modify Function Pointer trim for specific output. To modify the Function Pointer trim, the Factory Lock is required to be set as ‘Unlocked’.

The functionality of outputs can be reversed, Active for True Condition or Active for False Condition, using the “Invert Bypass” trim. When set as “Bypassed”, the output will be active for True Condition When set as “Not Bypassed”, the output will be active for False Condition.

PCC3.3 Starter Control

Engine Starting

The PCC3.3 Control System uses a primary and a backup starter disconnect. The primary starter disconnect signal is Engine RPM signal taken from the ECM over the J1939 CAN link. The backup starter disconnect signal is taken from main alternator output frequency. Engine speed is derived from the main alternator output frequency using the Freq to Speed Gain Multiplier (trim).

Engine starting type can be Emergency or Non-Emergency type. Refer section PCC3.3 Modus Operandi Summery for more details on sequence of operation for engine starting and stopping functions.

Cycle Cranking

In PCC3.3, two cranking modes are available which are ‘Cycle Cranking’ and ‘Continuous Cranking’. Cycle cranking consists of the engine cranking and then resting. It is configurable for number of starting cycles (Min- 1, Max – 7, Default 3) and duration of crank and rest periods. The PCC3300 controls the starter and it includes starter protection algorithms to prevent the operator from specifying a starting sequence that might be damaging.

Continuous cranking mode is a single cranking sequence which times out after specified time which can also be configured. (Min 40 Sec, Max 100 Sec, Default – 75 Sec)

(Refer the trim table – section 10 for crank and rest periods time duration for cycle crank mode)

Time Delay Start and Stop (Cool down)

PCC3.3 Fault Reset Process

The following process needs to be followed in order to reset a warning level fault.

1. Clear Fault Condition:

a. For example, if a High Battery Voltage fault is active, first the battery voltage needs to be reduced below the *High Battery Voltage Threshold*. For ECM generated warning faults, consult the engine service manual on how to clear the warning fault. Refer to the fault diagnostic section to determine the fault condition for each fault in question.

2. Issue a Fault Reset Command.

The following process needs to be followed in order to reset a shutdown level fault.

1. Control Switch Position must be ‘Off’, or “Auto” and Enable Remote Fault Reset (Trim) = Enabled and Remote Start = Off.
2. Average Engine Speed must equal 0.
3. Controller Mode must be “Stop Emergency”.
4. Remote Emergency Stop switch is closed.
5. Local Emergency Stop switch is closed.
6. Clear the Fault Condition.
   1. For example, if Configurable Input #1 Fault (1573) is active, first Configurable Input #1 should be deactivated. For ECM generated shutdown faults, consult the engine service manual on how to clear the shutdown fault. Refer to the fault diagnostic section to determine the fault condition for each PCC generated fault in question.
7. Issue a Fault Reset Command.

Fault Reset Command

The fault reset command can come from four different sources. Upon activation by one of the sources, the Fault Reset Command parameter becomes active for one second. While active, all active faults will be attempted to be reset. The available fault reset inputs are:

- External Fault Reset Switch
- PCCnet Fault Reset
- MODBus Fault Reset
- MON (PCTool) Fault Reset

Remote Fault Reset Command

Remote Fault Reset Enables shutdown faults to be reset from a remote location while the genset is still in auto mode. To enable remote fault reset, the Remote Fault Reset trim is required to be enabled. For resetting shutdown faults remotely, the controller needs to be in Auto Mode, all the remote start signals are required to be inactive, Engine Speed needs to be 0, and any of fault resets become active.

PCC3.3 Real Time Clock

The PCC3300 control system includes a real time clock function. The Real Time Clock (RTC) is used for calculating controller on time, recording fault occurrence times, supporting factory test, and for the automatic scheduler feature. Once programmed, the real time clock accurately* calculates seconds, minutes, hours, date of the month, month, day of the week, and year with leap year compensation valid up to 2100. The clock operates in 24 hour format and automatically adjusts the end of the month for months fewer than 31 days.

When battery power is removed from the PCC3300, the RTC remains powered via internal circuitry on the PCC3300. The internal circuitry will provide power to the RTC for about one hour, after which the RTC will become reset to 0 Seconds, 0 Hour, 0 Minutes, 0 Month, 0 Date, 0 Year. Under this condition, the "RTC Power Interrupt" Fault (1689) will become active indicating that the clock needs to be reset.

The RTC also has supports Daylights Savings Time, which is a convention used to advance the time by one hour so afternoons have more daylight then mornings. The DST logic adds the DST Adjustment time to the current time when the current time is equal to the DST Start Time. The DST logic subtracts the DST Adjustment time from the current time when the current time is equal to the DST End Time. To Enable DST, the trim Daylight Savings Enabled needs to be set to Enabled. To setup DST, specify the values for the following trims.

Trim	Value	Meaning
Daylight Savings End Day	Monday - Sunday	Calendar Day in which DST Ends
Daylight Savings End Hour	02 – 19 hours	Hour (24 Hr) in which DST Ends
Daylight Savings End Month	1 – 12 months	Month in which DST Ends
Daylight Savings End Week Occurrence in Month	First Occurrence – Last Occurrence	Occurrence of Daylight Savings End Day in which DST Ends
Daylight Savings Start Day	Monday - Sunday	Calendar Day in which DST Starts
Daylight Savings Start Hour	02 – 19 hours	Hour (24 Hr) in which DST Starts
Daylight Savings Start Month	1 – 12 months	Month in which DST Starts
Daylight Savings Start Week Occurrence in Month	First Occurrence – Last Occurrence	Occurrence of Daylight Savings End Day in which DST Starts
Daylight Savings Time Adjustment	0 – 120 minutes	Amount of time to be added or subtracted from current time for DST adjustment.

For Example: If DST Ends on the 1st Wednesday in April at 02:00 AM every year, and DST Starts on the 2nd Thursday in September at 3:00 PM every year, and DST Adjusts the clock by 1 hour each time, the parameters should be set to the following values.

Trim	Value
Daylight Savings End Day	Wednesday
Daylight Savings End Hour	02
Daylight Savings End Month	4
Daylight Savings End Week Occurrence in Month	First Occurrence
Daylight Savings Start Day	Thursday
Daylight Savings Start Hour	15
Daylight Savings Start Month	9
Daylight Savings Start Week Occurrence in Month	Second Occurrence
Daylight Savings Time Adjustment	60

*The real time clock is accurate with 30 minutes over the course of 1 calendar year.

PCC3.3 Exercise Scheduler

The exercise scheduler is a feature that automatically starts the genset for exercise. This feature prevents common problems which result from mechanical equipment sitting for long periods of time. In order for the automatic exerciser to work, the PCC3.3 control system needs to be in 'Auto' mode, the RTC needs to be set (Fault 1689 is not active), and the trim Exercise Scheduler Enable needs to be set to Enable.

The PCC3.3 can be programmed to run up to 12 independent programs, all which can either be one time events or repeating events. Furthermore, each program can be programmed to exercise the genset in two run modes, no load and with Load.

Each independent program has the following trims which establish its behavior. "X" can have a value from 1 thru 12, once for each available program.

Trim	Value	Meaning
Scheduler Program x Enable	Enable – Disable	Enables or Disables Schedule X
Scheduler Program x Start Minute	0 – 59	Specifies at what minute Program X with start.
Scheduler Program x Start Hour	0 – 23	Specifies at what hour Program X will start.
Scheduler Program x Start Day	Monday – Sunday	Specifies at what day Program X will start.
Scheduler Program x Run Mode	No Load / Load	Specifies if Program X will exercise the genset with Load or No Load.

Scheduler Program x Repeat Interval	Once, Twice…	Specifies the repeating behavior of Program X
Scheduler Program x Duration Hours	0 – 23	Specifies how many hours Program X will run.
Scheduler Program X Duration Minutes	1 – 59	Specifies how many minutes Program X will run.

For example, if it was desired to have a Program that ran on every Monday at 8:12 AM for 1 Hour and 30 Minutes with Load the trims should be defined like this

Trim	**Value**
Scheduler Program x Enable	Enable
Scheduler Program x Start Minute	12
Scheduler Program x Start Hour	8
Scheduler Program x Start Day	Monday
Scheduler Program x Run Mode	Load
Scheduler Program x Repeat Interval	Every Week
Scheduler Program x Duration Hours	1
Scheduler Program X Duration Minutes	30

The following table is the Exercise Scheduler table which contains the information for Programs 1 thru 12.

	Scheduler Program Enable	**Scheduler Program Start Day**	**Start Time**		**Scheduler Program Duration**		**Scheduler Program Run Mode**	**Schedule Repeat Interval**
			Hr	**Min**	**Hr**	**Min**		**Week**
Program 1								
Program 2								
Program 3								
Program 4								
Program 5								
Program 6								
Program 7								
Program 8								
Program 9								

Program 10								
Program 11								
Program 12								

Another sub-feature of the Exercise Scheduler is the ability to program exceptions to the scheduler programs. Exceptions are anti-programs and can either be on time events or repeating. The PCC3.3 can have up to 6 independent exceptions. The following are the trims needed to define an exception.
Each independent program has the following trims which establish its behavior. "X" can have a value from 1 thru 12, once for each available program.

Trim	Value	Meaning
Scheduler Exception x Enable	Enable – Disable	Enables or Disables Exception X
Scheduler Exception x Minute	0 – 59	Specifies at what minute Exception X with start.
Scheduler Exception x Hour	0 – 23	Specifies at what hour Exception X will start.
Scheduler Exception x Date	0 - 31	Specifies the date in which Exception X will start.
Scheduler Exception x Month	0 - 12	Specifies which Month Exception X will start.
Scheduler Exception x Repeat	Once, Every Year.	Specifies the repeating behavior of Exception X
Scheduler Exception x Duration Hours	0 – 23	Specifies how many hours Exception X will be valid for.
Scheduler Exception X Duration Minutes	1 – 59	Specifies how many minutes Exception X will be valid for.
Scheduler Exception X Duration Days	0 – 44	Specifies how many days Exception X will be valid for.

For example, if it was desired to have an Exception that stopped all programmed activity from December 25th at 1:00 AM until Jan 2nd the trims should be defined like this

Trim	Value
Scheduler Exception x Enable	Enable
Scheduler Exception x Minute	0
Scheduler Exception x Hour	1
Scheduler Exception x Date	25
Scheduler Exception x Month	12
Scheduler Exception x Repeat	Every Year.
Scheduler Exception x Duration	23

Hours	
Scheduler Exception X Duration Minutes	1
Scheduler Exception X Duration Days	7

The following is the Exercise Scheduler which contains all the exceptions 1 - 6.

	Scheduler Exception Enable	**Scheduler Exception**		**Scheduler Exception Time**		**Scheduler Exception Duration**			**Scheduler Exception Repeat (Interval)**
		Month	**Date**	**Hour**	**Minute**	**Days**	**Hours**	**Minutes**	
Exception 1									
Exception 2									
Exception 3									
Exception 4									
Exception 5									
Exception 6									

The following are a set over rules used to define schedules and exceptions –

1. If there is a running program and the next programmed program(s) overlap with the existing running program, the existing program will run as it is and next overlapping program(s) will not start even, if the first program is expires before the next overlapping program is scheduled to stop.
2. If program is running and exception becomes active, the PCC3.3 control system will ignore the newly activated exception(s) and will continue to run the active program expires.
3. If there is an active exception and the next exception(s) overlap with the existing active exception, the existing exception will continue to be active as it is and the next exception(s) will be ignored.
4. If an exception and program are scheduled to become active at the same time, then the exception will become active and the program will be ignored.
5. If a program is active and running (or an exception is active) and control system loses power before the program or exception can expire, the active program or exception will not be

started again when power is restored to the control system even if there is time remaining in the program/exception.

Remote Start command behavior on exercise scheduler –

While in exercise scheduler mode, ie a scheduled program is active and control system is in 'Auto' mode, if the PCC3.3 control system receives a remote start command, the genset will continue to run. If remote start command is removed and the exercise scheduler program is still active, the genset will continue to run until scheduler time lapses.

PCC3.3 Engine Prelube Operation

To avoid the premature wear and damage to various rotating and sliding parts of the engine after long standstill periods, the PCC3.3 has an Engine Prelube Feature can be initiated prior to engine cranking and periodically. Oil pre-lubrication is achieved with the PCC3.3 by activating a Low-Side output (J20-16) for turning on an external oil prelube pump relay. The engine prelube function is enabled by setting the trim *Prelube Function Enable* trim to Enable.

Engine Prelube has three operational modes - crank with prelube, crank after prelube, and cyclical.

Crank with prelube is an operational mode that is enabled when the *start mode* equals emergency and the genset is starting in Auto mode. With start mode equal emergency it is important to get the genset up to rated speed and voltage as quickly as possible, thusly delaying engine cranking until prelube completes isn't a good idea. The prelube ouput is turned on for the *Prelube Timeout Period* or until the engine oil pressure is greater then the *Prelube Oil Pressure Threshold* at the same time as the engine starter.

Crank after prelube is an operational mode that is enabled when the *start mode* equals non-emergency and the genset is start in Auto mode or the genset is start in Manual Run mode. In this mode, cranking of the engine is delayed until the Engine Prelube process has finished. After receiving a start command, the prelube ouput is turned on for the *Prelube Timeout Period* or until the engine oil pressure is greater then the *Prelube Oil Pressure Threshold*.

Cyclical prelube is an operational mode that is enabled by setting the trim *Prelube Cycle Enable* to Enable. When enabled, the prelube output is turned on every *Prelube Cycle Time* for the *Prelube Timeout Period* or until the engine oil pressure is greater then the *Prelube Oil Pressure Threshold*.

PCC3.3 Fuel Shutoff (FSO) Operation

On FAE engines the FSO acts as a backup fuel shutoff. Thusly it is open, meaning the fuel is not shutoff and fuel shutoff command is active, under all conditions except as listed below:

a) When there is a active shutdown fault

b) When controller is in Setup Mode

PCC3.3 Ready To Load Operation

The Ready To Load output is used to indicate to external devices that the genset is available to accept electrical load. Typically this is wired into a TS control or PLC. When genset reached 90 % of rated frequency and rated nominal voltage, the 'Ready to Load' status becomes active. When active the Low-Side driver on pin TB1-4 becomes active and can be used to activate the Low-Side of a relay coil.

PCC3.3 Load Dump Operation

The PCC3.3 control has a load dump feature which is used to activate a Low-Side relay driver on TB8-11. Once activated the load dump relay can be used to instruct other equipment that the genset is overload and load needs to be removed from it.

There are four configurable methods in which load dump is determined - Underfrequency, kW overload, both, or ECM Based Derate request. With underfrequency determination if the genset frequency drops below the *Load Dump Underfrequency Threshold* for the *Load Dump Underfrequency Set Time,* the load dump command, load dump output, and load dump fault become active. With kW overload determination, if the Alternator % Application Total kW is greater then the *Load Dump Overload Threshold* for the *Load Dump Overload Set Time* the load dump command, load dump output, and load dump fault become active. With both determinations, if either the kW Overload or Underfrequency criterion becomes active, then so does the load dump.

If the ECM request derate based on its internal parameters, the PCC3.3 will also activate the load dump process instructing external devices to derate the genset and remove loads.

PCC3.3 Delayed Off Operation

The PCC3.3 has a delayed off feature which activates a Low-Side relay driver on pin TB8-3. The Delayed Off function is active while the genset is running. However, when a normal stop happens, the Delayed Off output stays active for the *Delay Off FSO Relay Time*. This feature can be used to keep external devices active for a certain period of time after the genset has stopped running.

AUX105 Spark Ignition /Glow Plug Control

Pin J11-7 on the AUX105 control is configurable as below.

I. Glow Plug Control

Glow plug is used as a Cold starting aid. Glow plugs heat up the air going in for combustion for Diesel Engine.

In PCC3300 when Engine Application Type = Hydro Mechanical, Setup Flag = True (it is set true after AUX105 reads all the setup parameters from PCC3300), Glow Plug Enable = Enabled, and Fuel System = Diesel the Glow Plug Function is enabled and Pin J11-7 on the AUX105 control can be used to drive Glow Plugs via external Relay.

Six trim parameters may be needed to be adjusted for the glow plugs preheat control logic to work effectively. Adjusting the six trims will allow for tailoring of the glow plug preheat logic for specific engine applications. Setting Glow Plug = Disabled disables the glow plug preheat logic.

AUX105 sets the glow plug OUTPUT, ON or OFF on receiving Glow Plug / Spark Ignition Command and CAN Datalink Status as Active.

Glow Plug Parameters:

Max Glow Time –

The trim parameter Max Glow Time (in sec) controls the Maximum time for which the glow plugs will remain ON. Default value is 60 seconds.

Pre-Heat Setup

Time at Min-Temperature--

This parameter sets the Preheat Timer value. Default value is 15 seconds. For this much time the glow plug will remain ON if the engine temperature is below the Minimum Temperature value. For temperatures between the Min and Max temp, the Pre-heat time is interpolated between these temps and between the time at min temp and 0 sec. If the time is too short then one can experience hard starting. If the time is too high then there will be a delay in starting and excessive usage of battery because glow plugs are big load on the battery.

Minimum Temperature –

Sets the temperature at and below which the glow plugs will turn on for the full pre-heat time. Default is -5 Deg F.

Maximum Pre-Heat Temperature –

If the Coolant Temperature exceeds the Maximum Pre-Heat Temperature then the Pre-Heat functionality is disabled. Default is 77 Deg F.

Post Glow Setup

If the pre-heat time is not sufficient for a smooth startup of the engine then Post Glow is enabled. This allows the Glow plug to remain ON during the cranking of the engine. It also helps to reduce the white smoke during start up until the engine reaches the operating temperature.

Maximum Temperature –

If the Coolant Temperature exceeds the Maximum Post Glow Temperature then the Post Glow functionality is disabled. Default is 50 Deg F.

Maximum Time –

This parameter sets the maximum time value for Post Glow function. Default is 5 seconds.

II. Spark Ignition Control (The spark ignition feature is currently not available)

Pin J11-7 on the AUX105 control can be alternatively configured as Spark Ignition Control output.

When Setup Flag = True and the trim parameter Fuel System = Gas, pin J11-7 can be used to control an external spark ignition control module. Pin J11-7 is turned on simultaneously with the fuel solenoid and held on as long as the genset is running. Both drivers stay on while the engine speed is above 150 rpm. When a shutdown command is received the fuel solenoid is disabled but the ignition control module driver stays on until the RPM drops below 150 RPM. By running the ignition system by this delayed output, all of the fuel downstream of the fuel solenoid will burn following genset stop / shutdown. This will remove the occasional fuel flash in the exhaust system after stop / shutdown.

AUX105 Governor Control

The AUX105 controller provides electronic governing capability for a generator set. It supports isochronous speed governing as defined below.

- The maximum allowed rated current for the actuator drive for the governor power stage is 6.0A continuous max; 10 Amps for 1 second.
- The governing system is suitable for use with Gensets using Cummins EFC normally closed actuators, Woodward, FORD Gas, or Barber-Coleman actuators with similar drive characteristics.
- It provides speed governor set-points of 1500 RPM and 1800 RPM. The governor set-point is a Trim. (50 Hz or 60 Hz).
- The Optional Display allows the operator to adjust frequency within plus or minus 5% of rated speed.

- The controller provides ramping at Startup and ability to program the cranking fueling for tuning up the start up of the engine before the governor algorithm is enabled.

Governor Module Connections

Connector Pin	Signal Name	Comments
J1 – 1	Gov PWM -	
J1 – 2	Gov PWM +	
J1 – 3	B+	Battery +
J1 – 4	Actuator	Low side of actuator
J1 – 5	Return	GND

Connector Part Number for Governor Module Connections

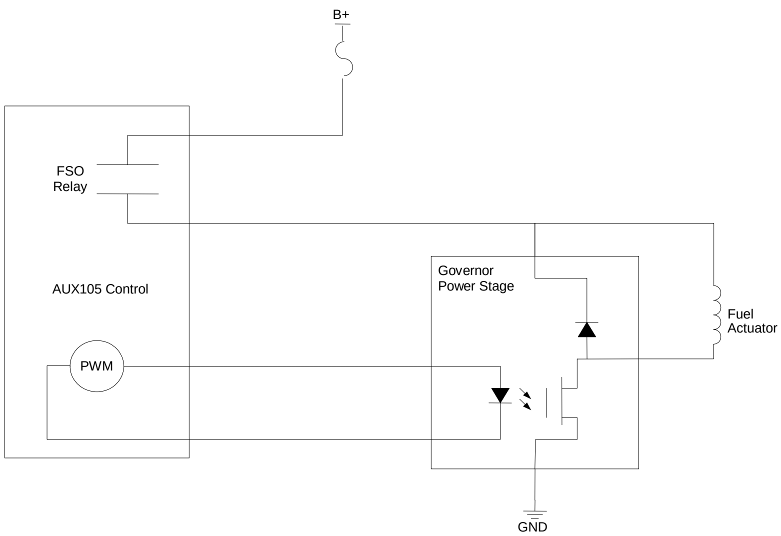
AUX105 Control Connector Info				
	Connector Housing		Connector Pins	
Ref	Internal P/N	Man / P/N	Internal P/N	Man / P/N
J1	0323-2216	Amp/Tyco / 1-480763-0	0323-1200	Amp/Tyco / 770008-3

Wiring Information

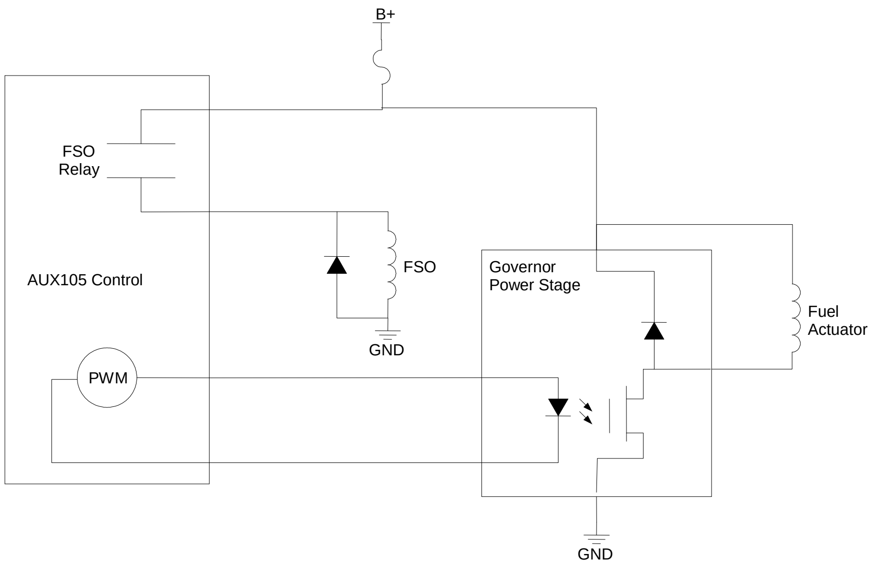
The electronic fuel actuator is driven by the output of the Governor Power Module. Use twisted pair wires minimum 1 sq mm (16 Gage). Power to the Governor Power Module is derived from the genset starting battery but should be connected to the Governor Power Module as indicated in the diagrams “Applications without FSO” and “Applications with FSO” as appropriate.

Electronic Governor Connections

Applications Without FSO



Applications With FSO



Engine Speed Sensing

In case of Engine application Type = Hydro Mechanical, the control system requires an engine speed input from a Magnetic Pickup speed sensor. The magnetic pickup signal needs to be calibrated for number of engine flywheel teeth. The table shown below lists the number of flywheel teeth for some common engine types.

Common Number of Flywheel Teeth

Engine Type		Number of Flywheel Teeth
Cummins 4B, 6B		159
Cummins 4C		138
Ford 4cycl Gas		104
Kubota Engines		105
Cummins L10, NT855		118
Komatsu 3.3L		110
Cummins V28, K19, K38, K50		142
Ford V6 and V10 gas		133

PCC3.3 Paralleling Genset Control Features

PCC3.3 Paralleling Applications

The genset control is configured to operate in a paralleling application by setting the Genset Application Type trim to a paralleling application type. The paralleling application types are as follows: Synchronizer Only, Isolated Bus Only, Utility Single, Utility Multiple and Power Transfer Control. Figure 0-1 Paralleling Application Topologies shows general control and sensing connections for each of the topologies. Figure 0-1 provides a symbol key for the sequence flow diagrams that follow.

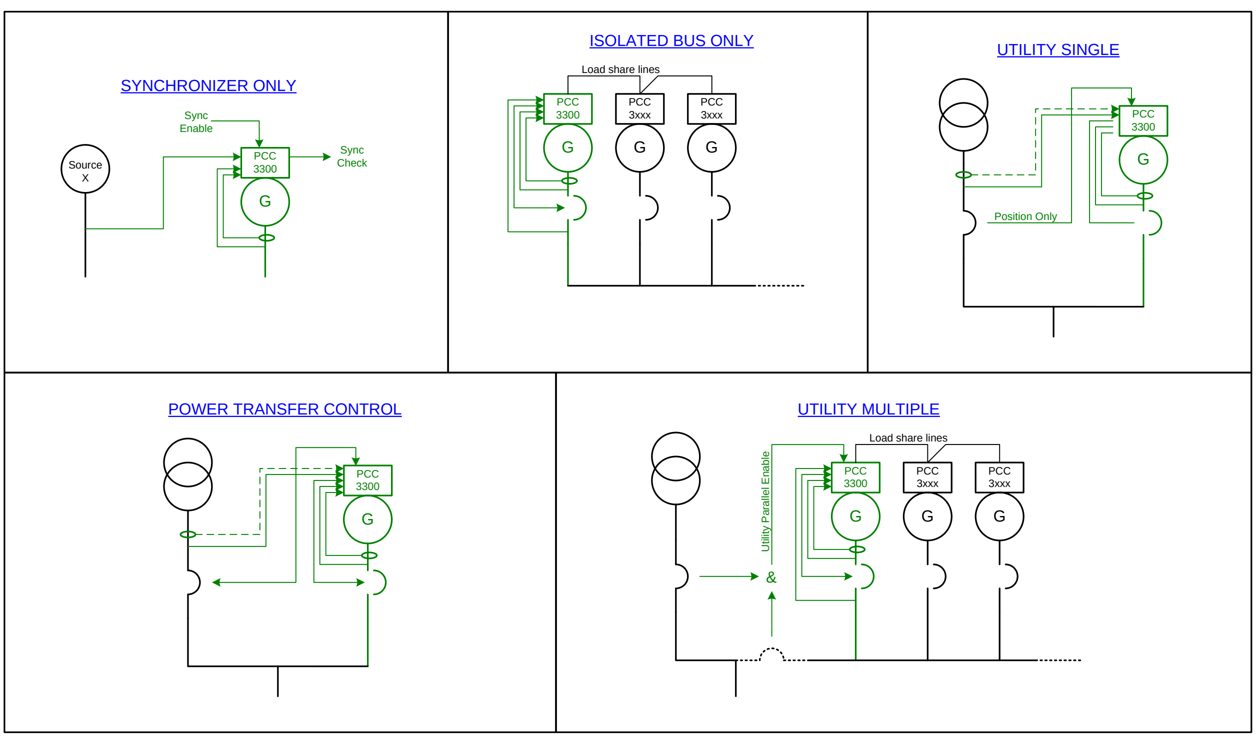


Figure 0-1 Paralleling Application Topologies

Sync Only

The sync only paralleling application type allows the genset synchronizer to be manually turned on through a hard wired input. One application of this function would be for use with a closed transition transfer switch. See Figure 0-2 for operation details.

Isolated Bus Only

The isolated bus only paralleling application type allows the genset to operate in parallel on a common bus with multiple gensets. See Figure 0-3 for operating details.

Utility Single

The utility single paralleling application type allows a single genset operate in parallel with a single utility source. Note that Utility Single Mode Verify/Configurable Input #29 Switch must be connected to a switch input return to enable utility single. See Figure 0-4 and Figure 0-5 for operating details.

Utility Multiple

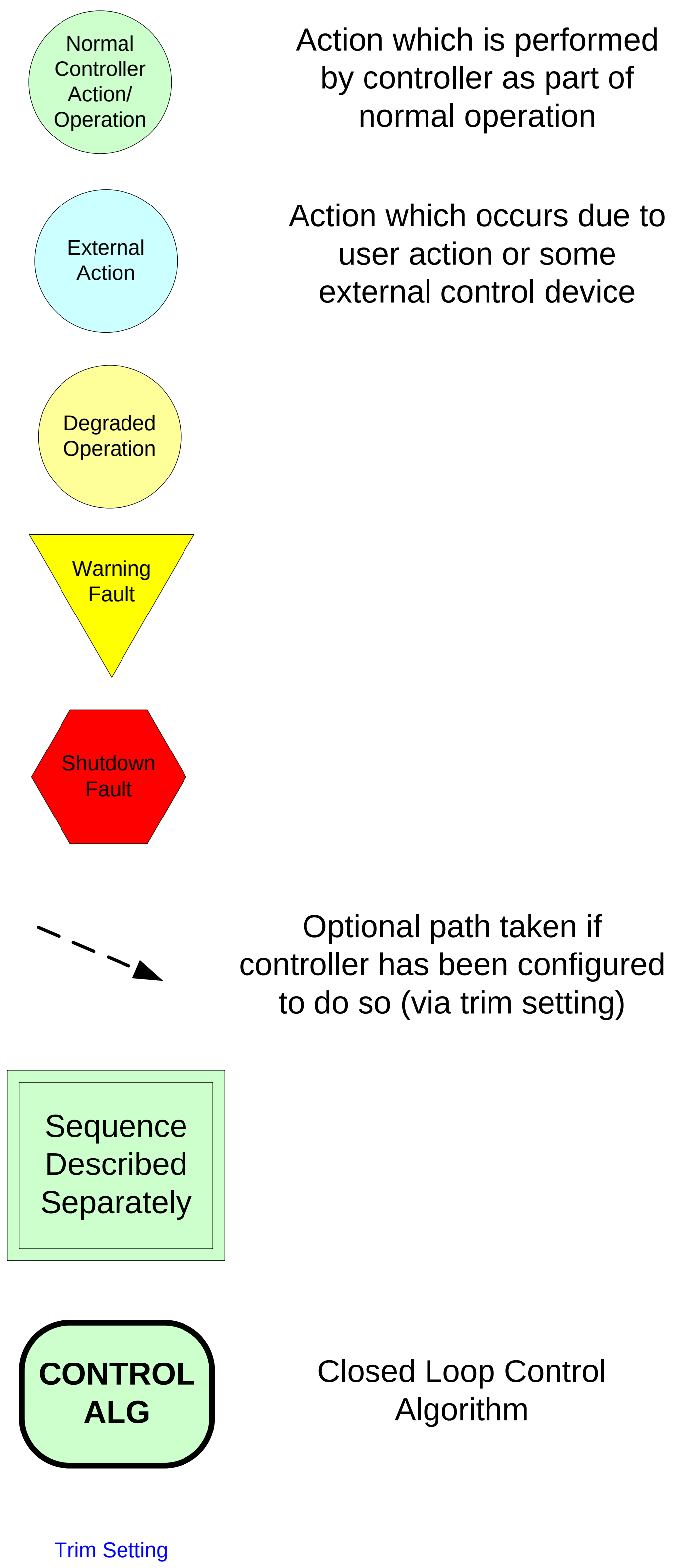
The utility multiple application type allows the genset to operate on a common bus multiple gensets and in parallel with a single utility source. See Figure 0-6 for operating details.

Power Transfer Control

The power transfer control application type allows a genset to operate with a single utility source.

PCC3300 PARALLELING OPERATING SEQUENCES

KEY to Symbols



KEY:
Green Fill = Normal Operation
Yellow Fill = Warning Faults/Degraded Operation
Red Fill = Shutdown Fault
Blue Text = Trim Settings
Double Border = see other sequence for details

Figure 0-1

PCC3300 SYNCHRONIZE ONLY SEQUENCES

Sequence is applicable in the following scenarios:
1. Genset Application Type (trim) = Synchronize Only

Notes:
1. Sync Check function runs independently of the Synchronizer. That is, if sync check conditions are met, the sync check event will go active regardless of whether or not the synchronizer is running.
2. The Sync Check event can be mapped to a configurable output for external use.

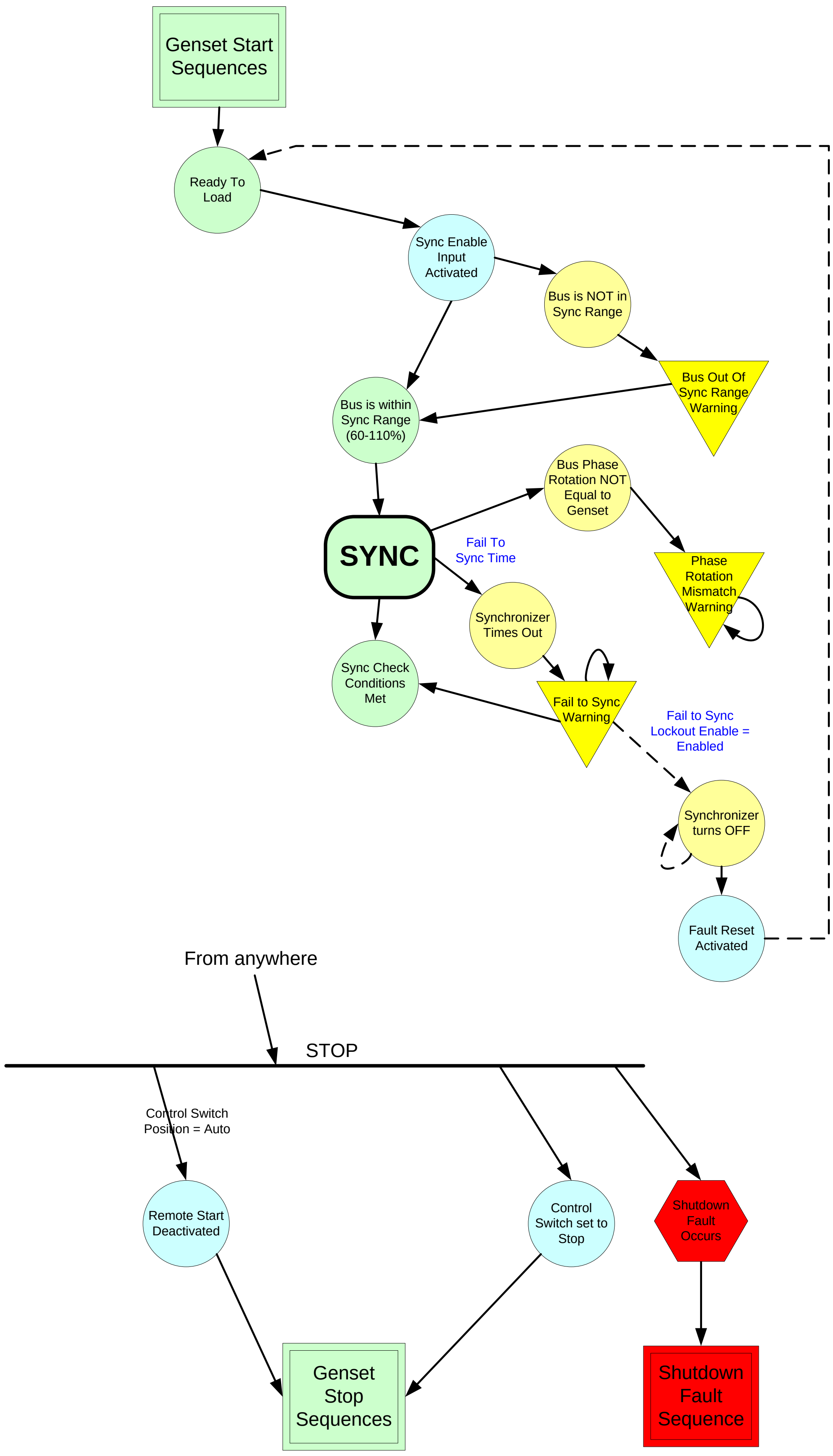


Figure 0-2

PCC3300 ISOLATED BUS SEQUENCES

Sequence is applicable in the following scenarios:
1. Genset Application Type (trim) = Isolated Bus Only
2. Genset Application Type (trim) = Utility Multiple AND Utility Breaker is OPEN

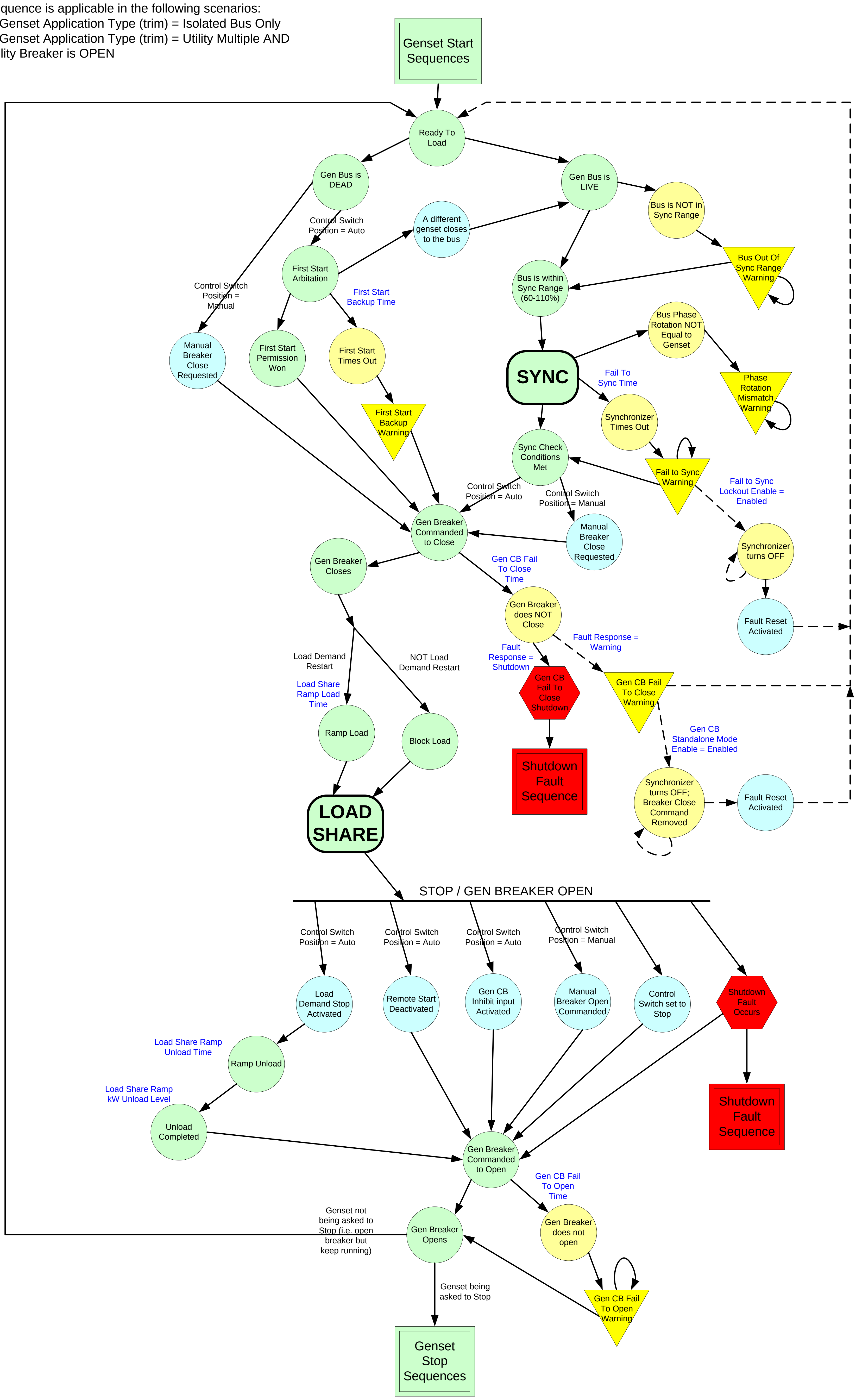


Figure 0-3

PCC3300 UTILITY SINGLE SEQUENCES – FROM GENSET START/STOP VIEWPOINT

Sequence is applicable in the following scenarios:
1. Genset Application Type (trim) = Utility Single

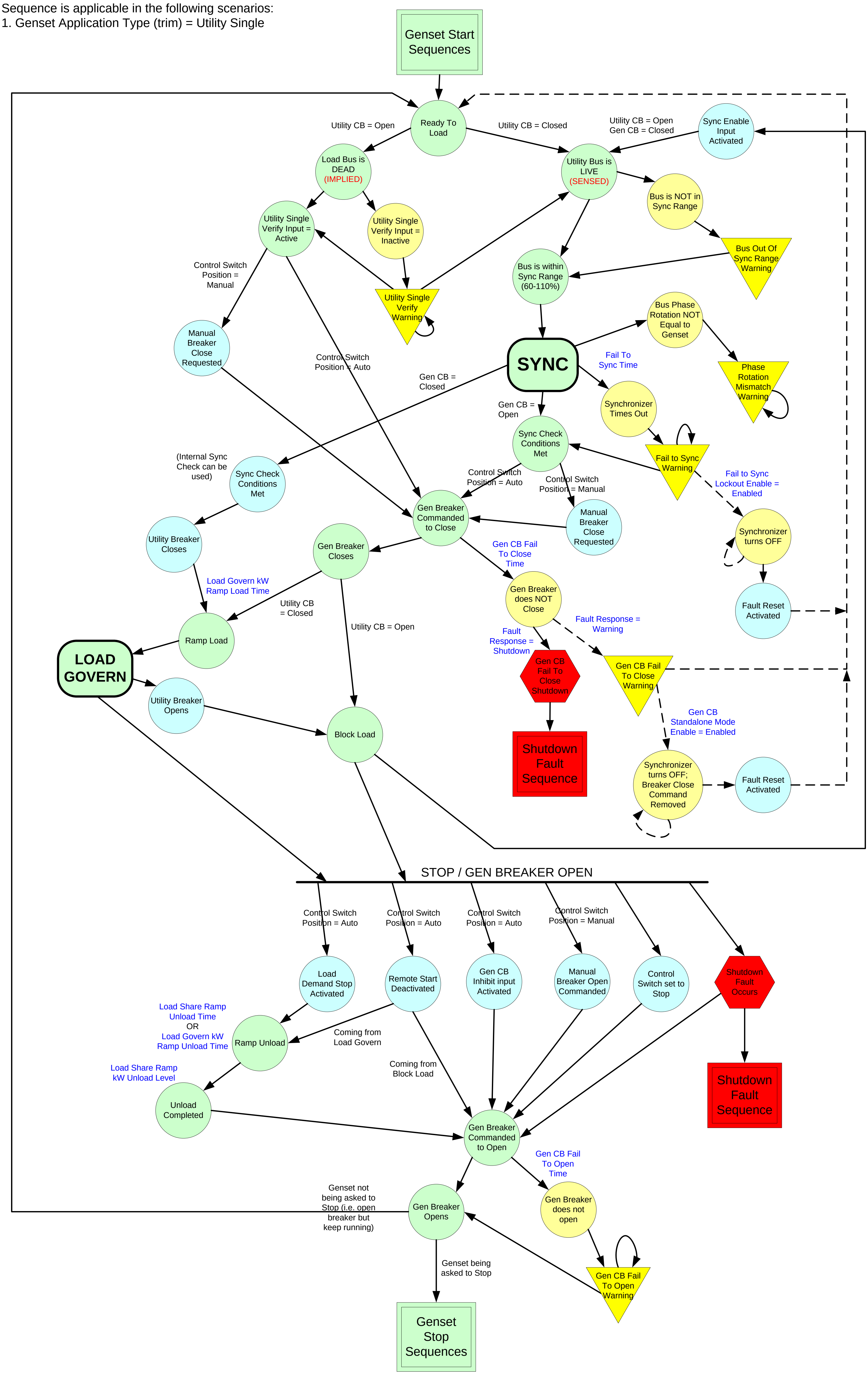
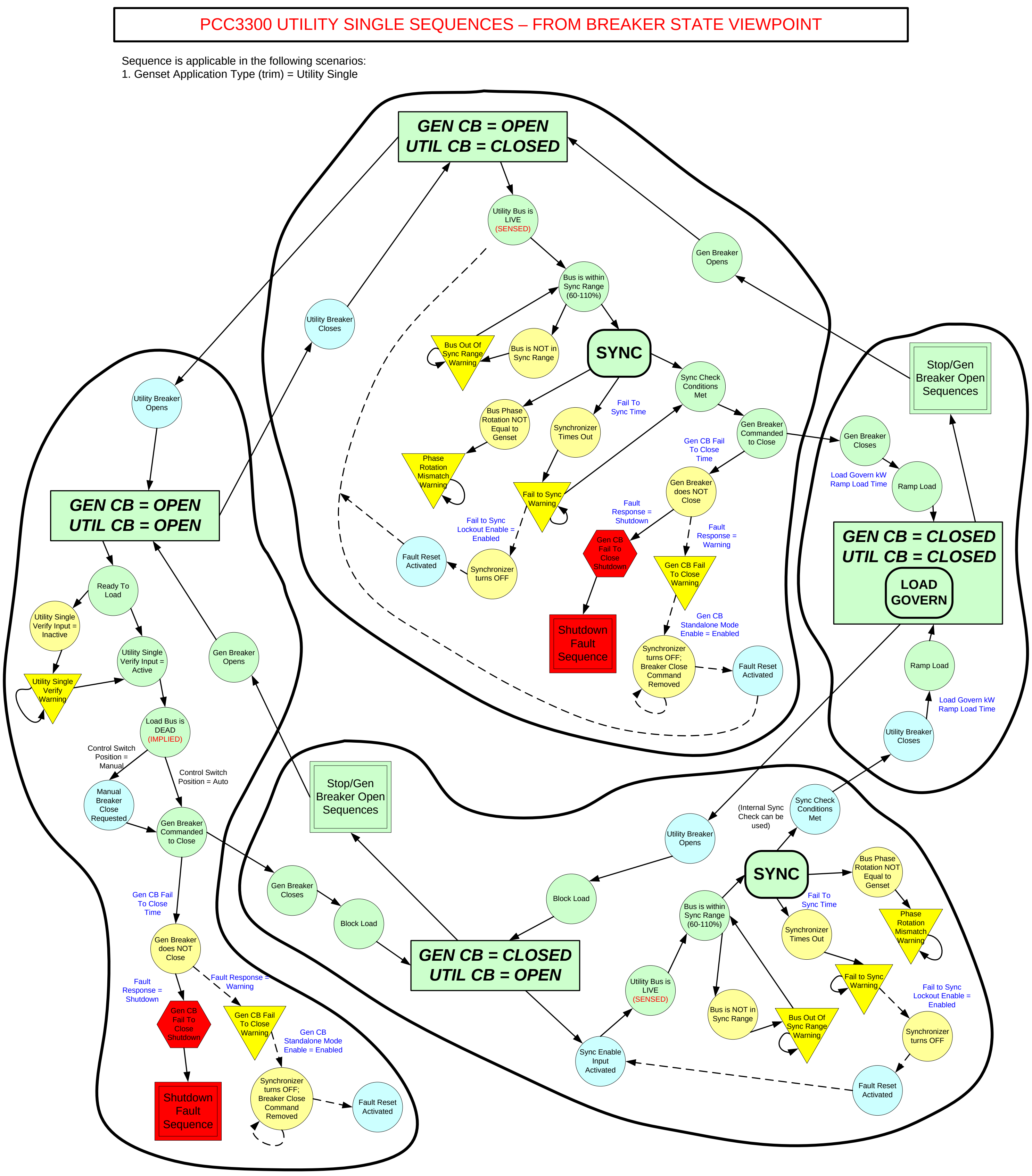


Figure 0-4



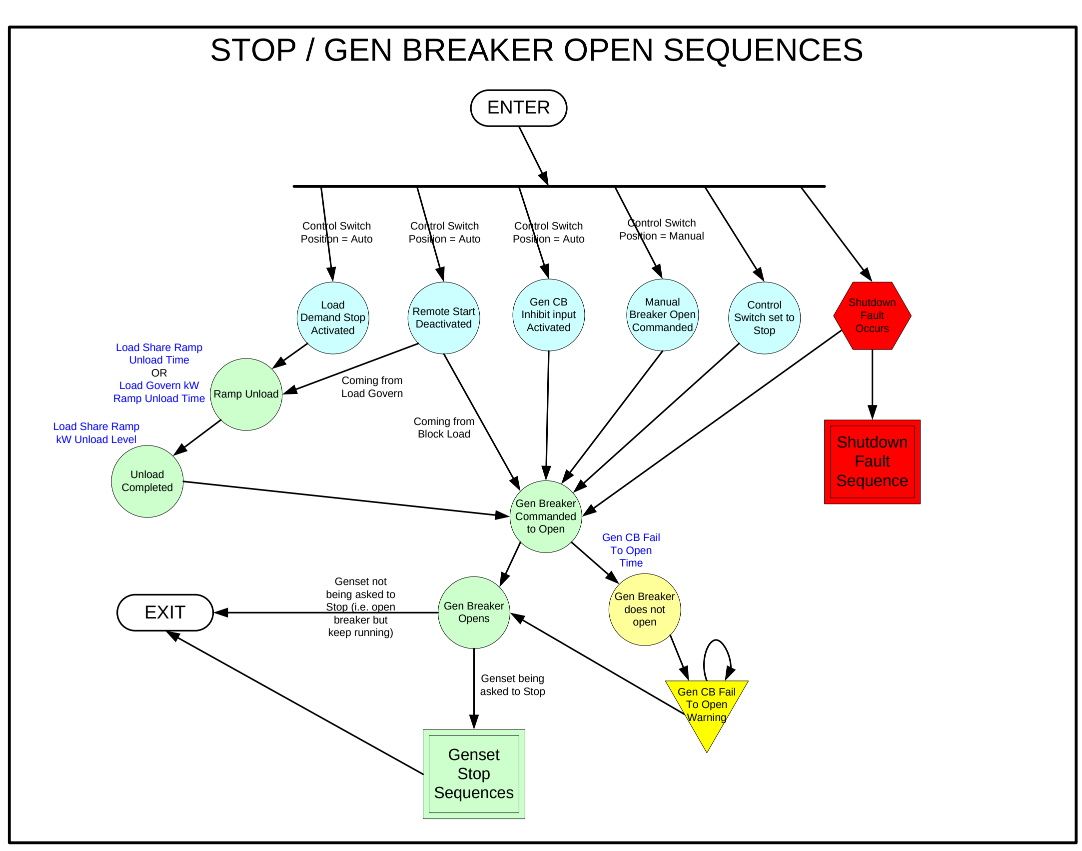


Figure 0-5

PCC3300 UTILITY MULTIPLE SEQUENCES

Sequence is applicable in the following scenarios:
1. Genset Application Type (trim) = Utility Multiple

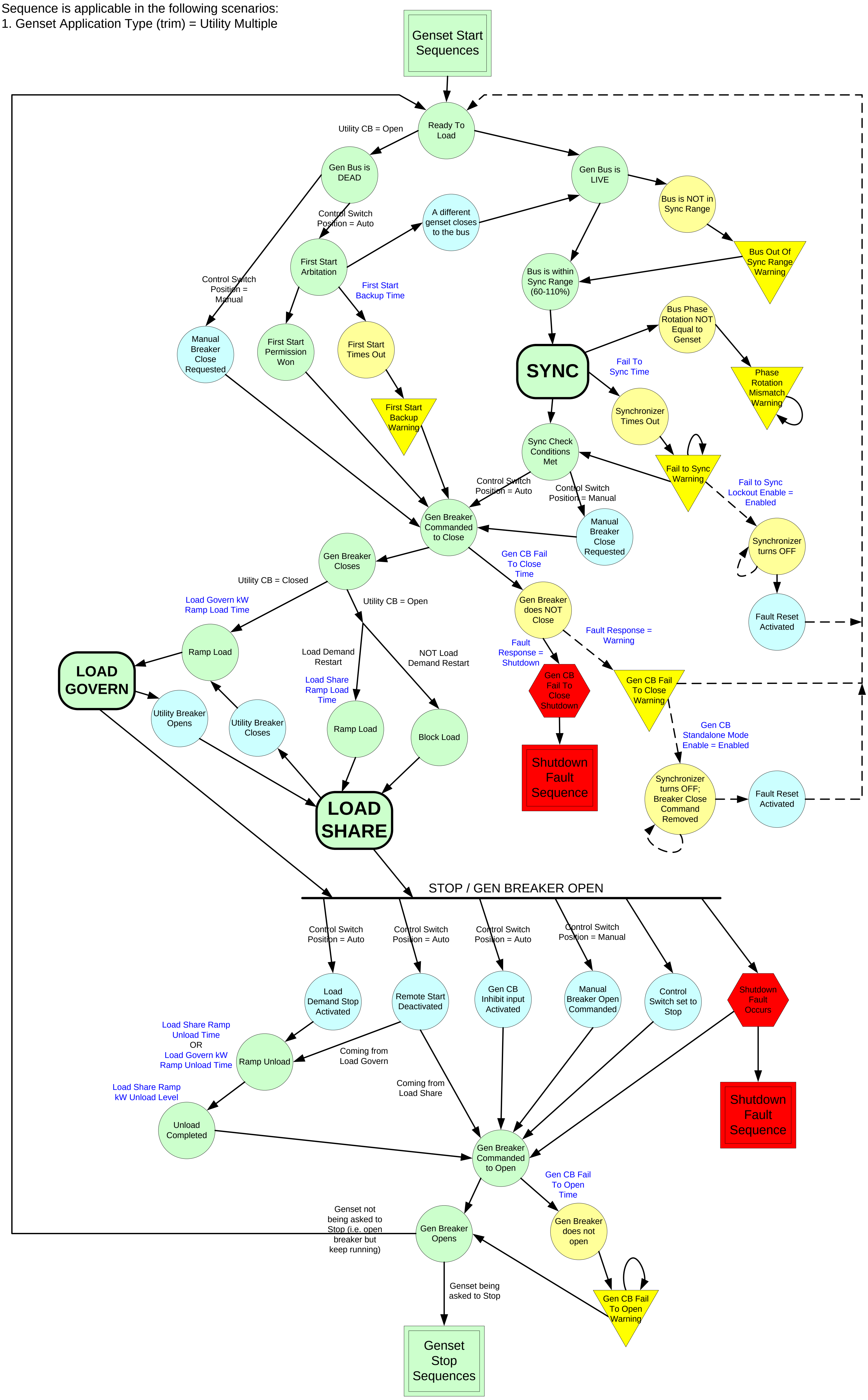
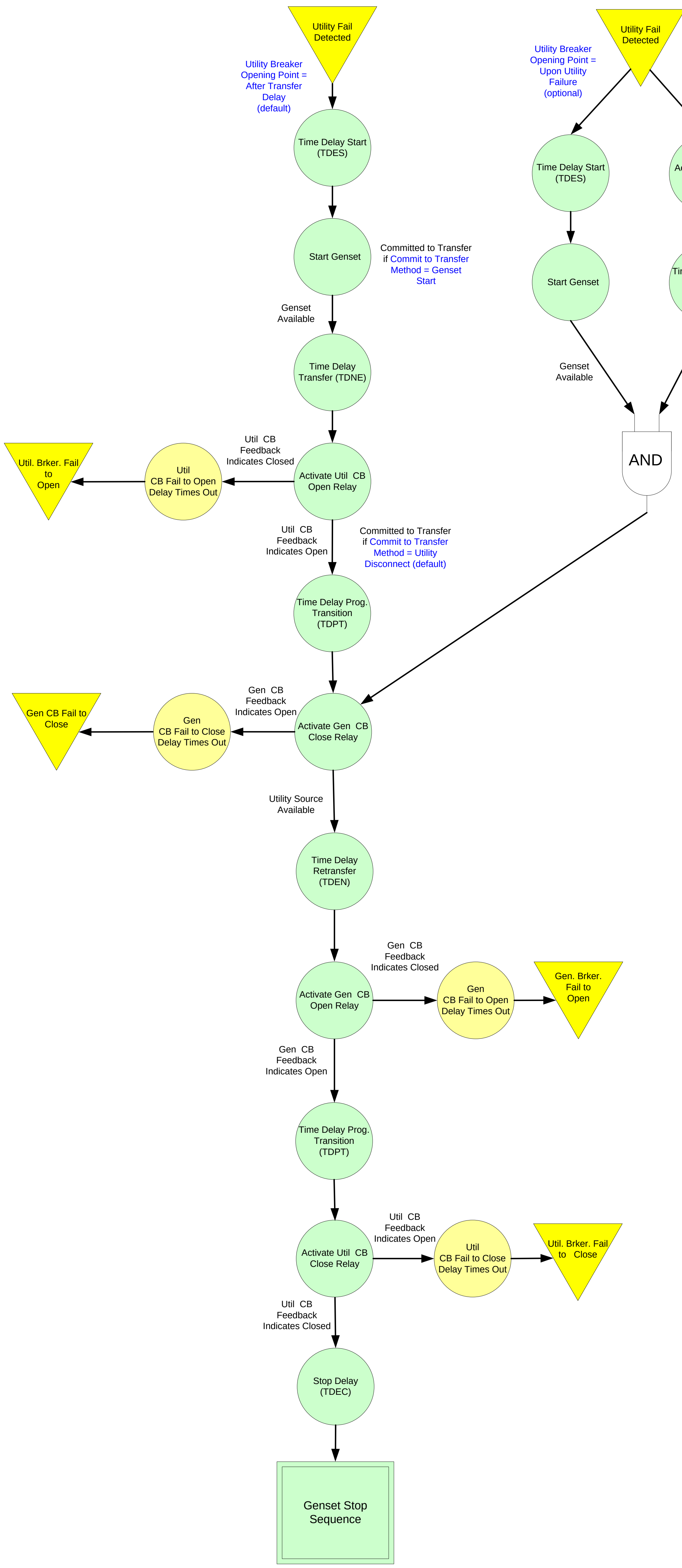
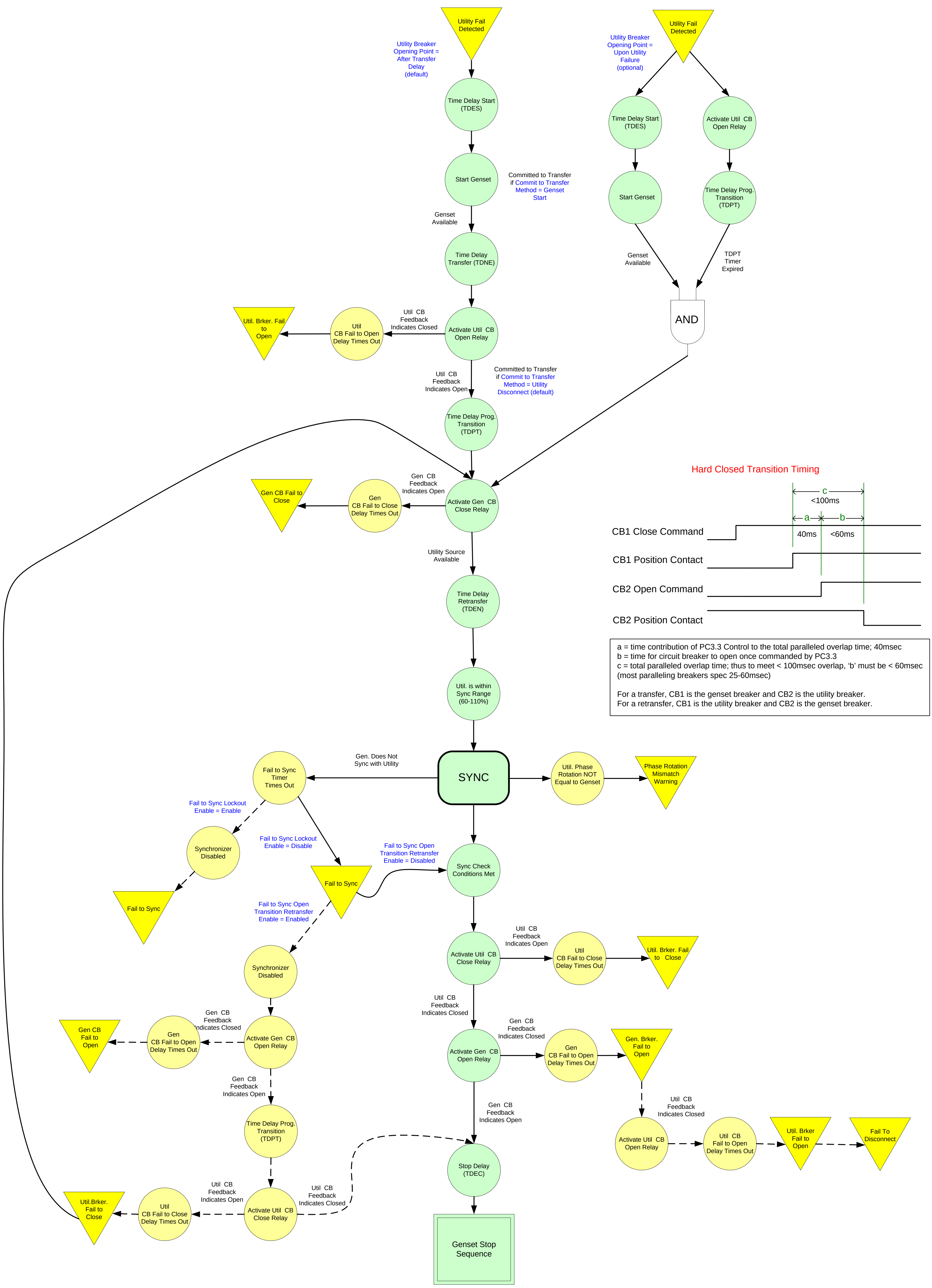


Figure 0-6

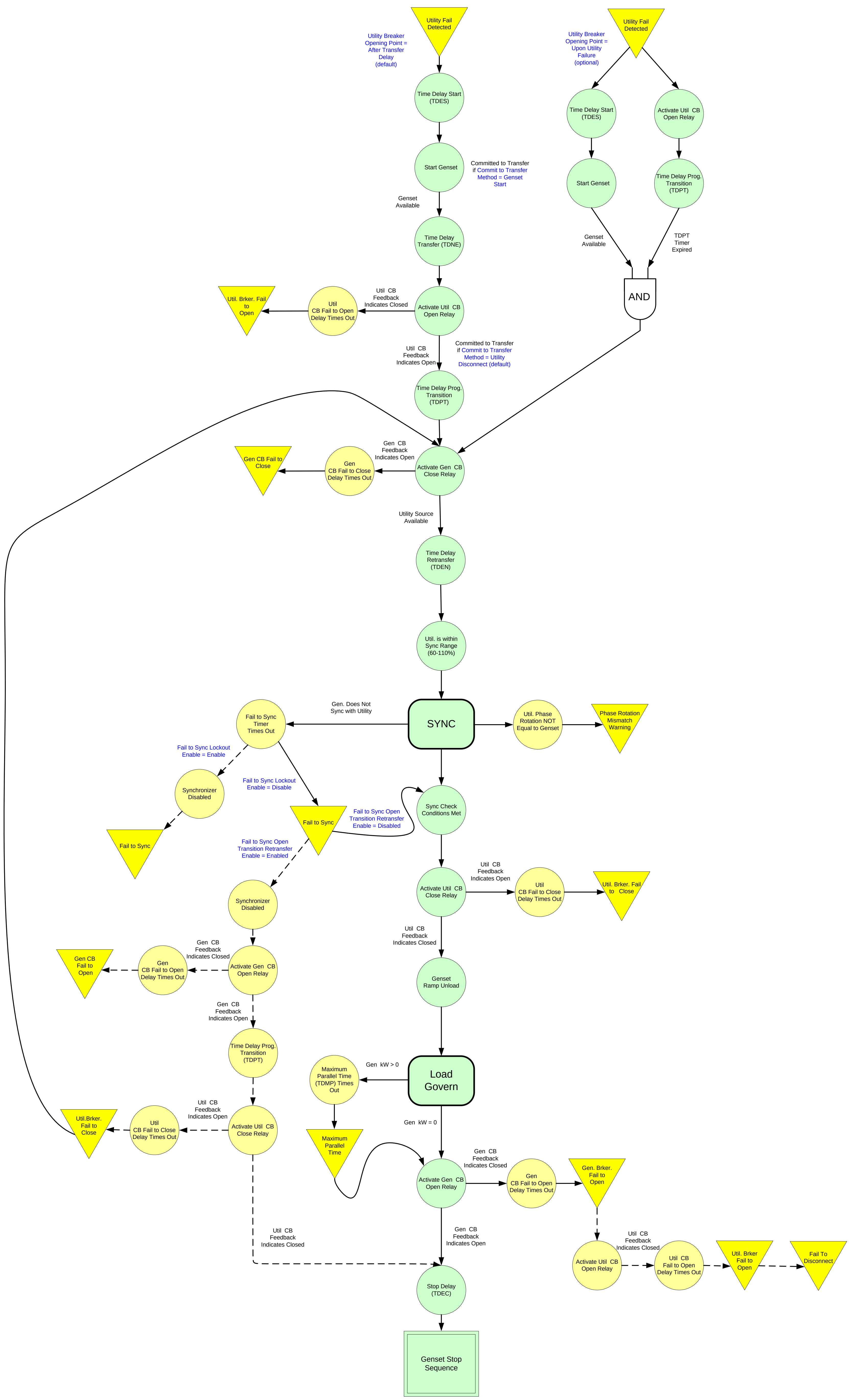
PCC3300 POWER TRANSFER CONTROL – UTILITY FAIL/RETURN – OPEN TRANSITION



PCC3300 POWER TRANSFER CONTROL – UTILITY FAIL/RETURN – HARD CLOSED TRANSITION

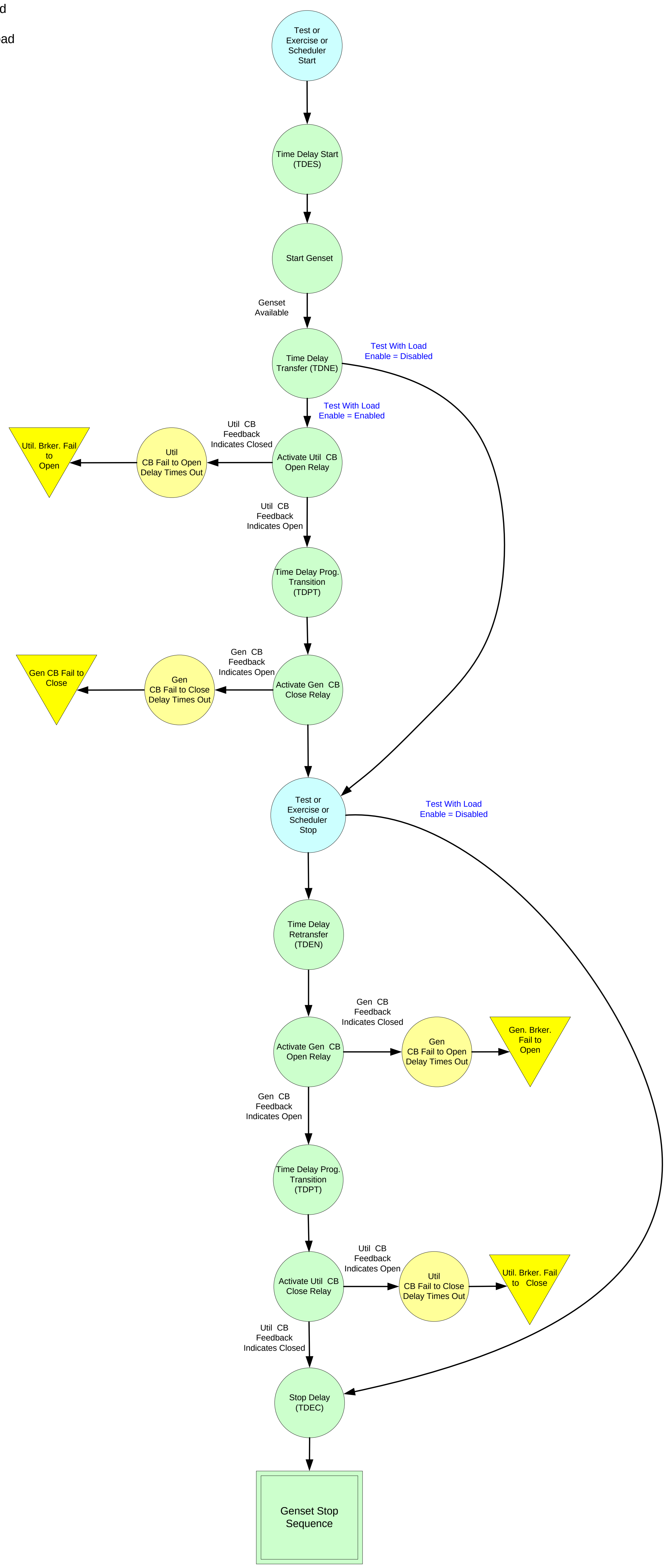


PCC3300 POWER TRANSFER CONTROL – UTILITY FAIL/RETURN – SOFT CLOSED TRANSITION



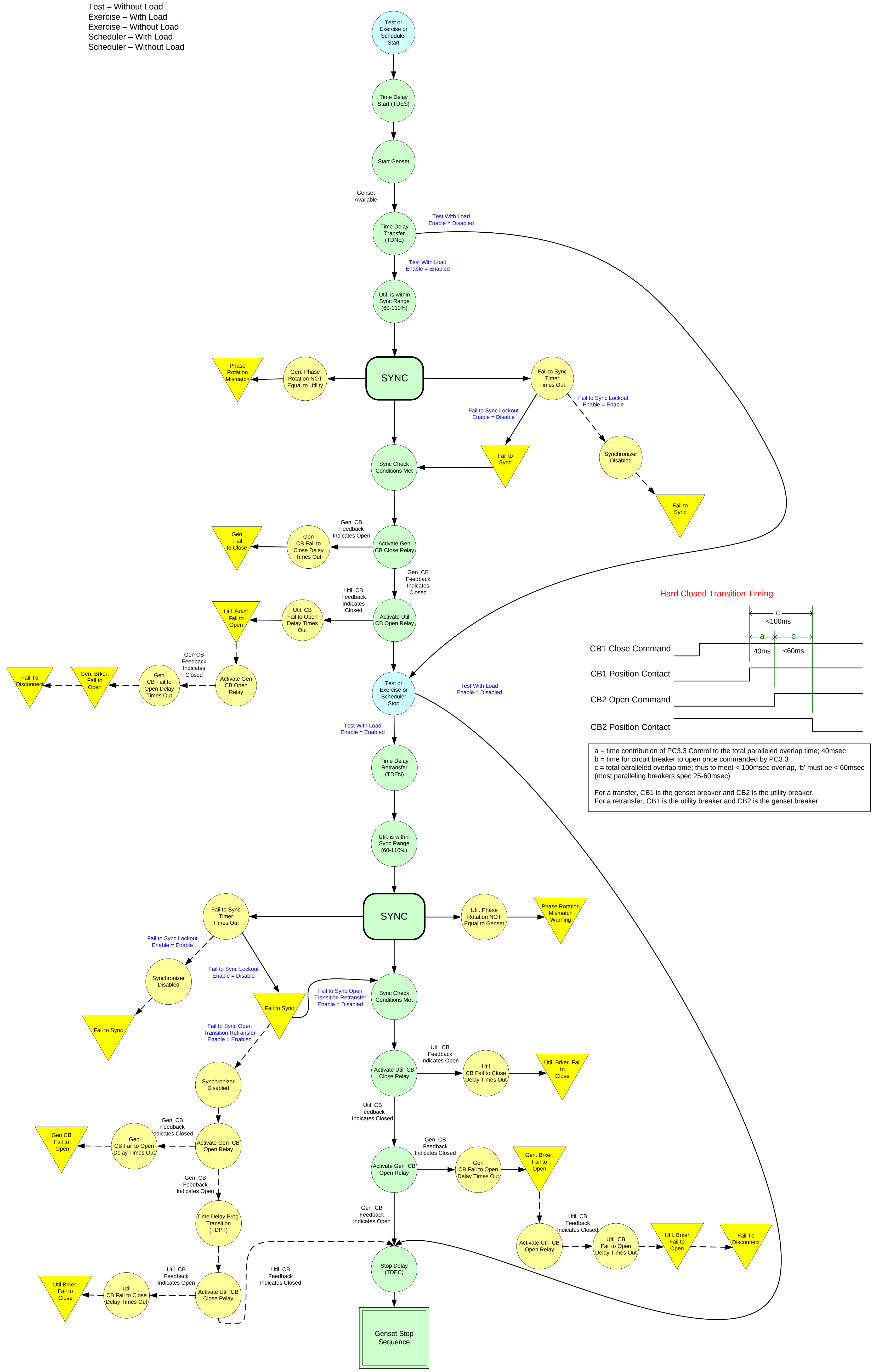
PCC3300 POWER TRANSFER CONTROL – TEST/EXERCISE/SCHEDULER – OPEN TRANSITION

This sequence applies to:
Test – With Load
Test – Without Load
Exercise – With Load
Exercise – Without Load
Scheduler – With Load
Scheduler – Without Load



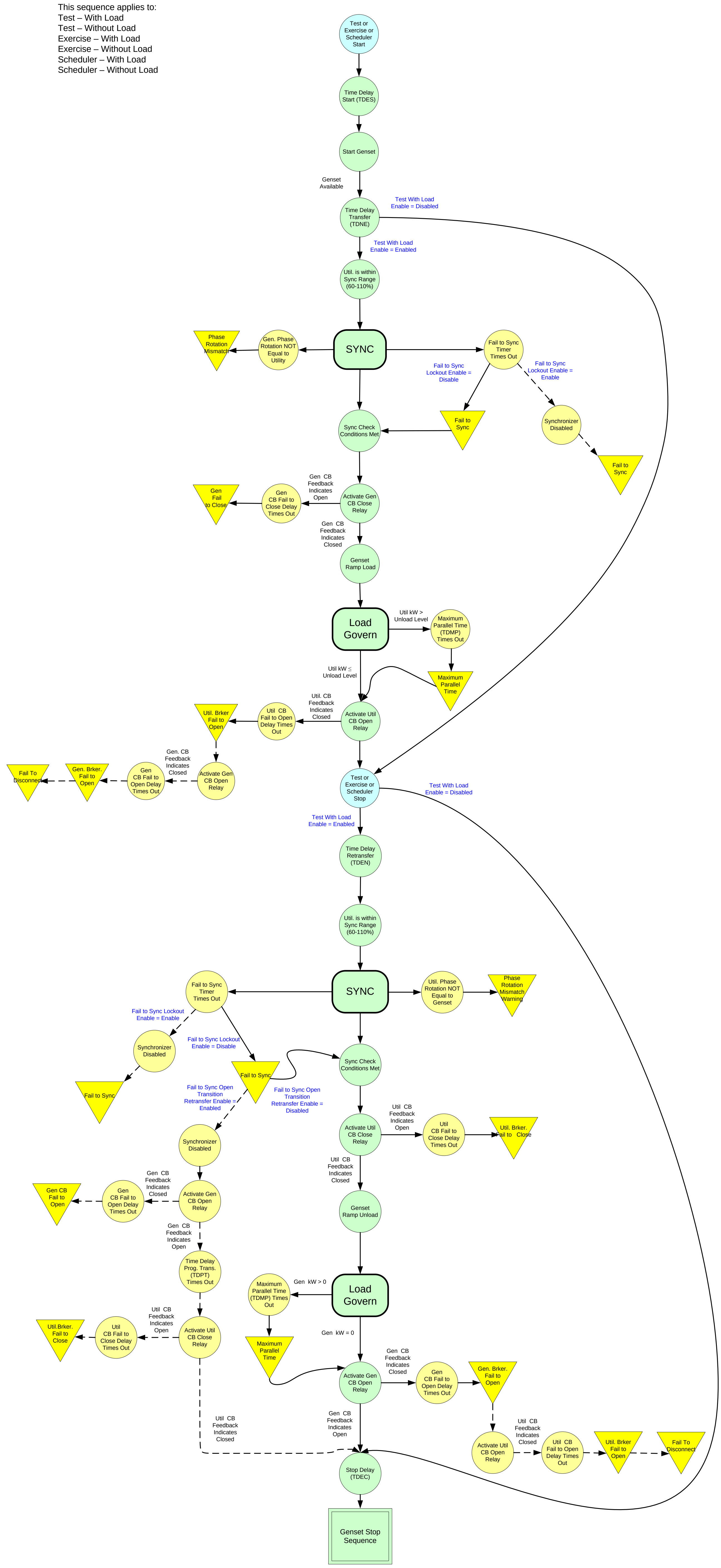
PCC3300 POWER TRANSFER CONTROL – TEST/EXERCISE/SCHEDULER – HARD CLOSED TRANSITION

This sequence applies to:
Test – With Load
Test – Without Load
Exercise – With Load
Exercise – Without Load
Scheduler – With Load
Scheduler – Without Load



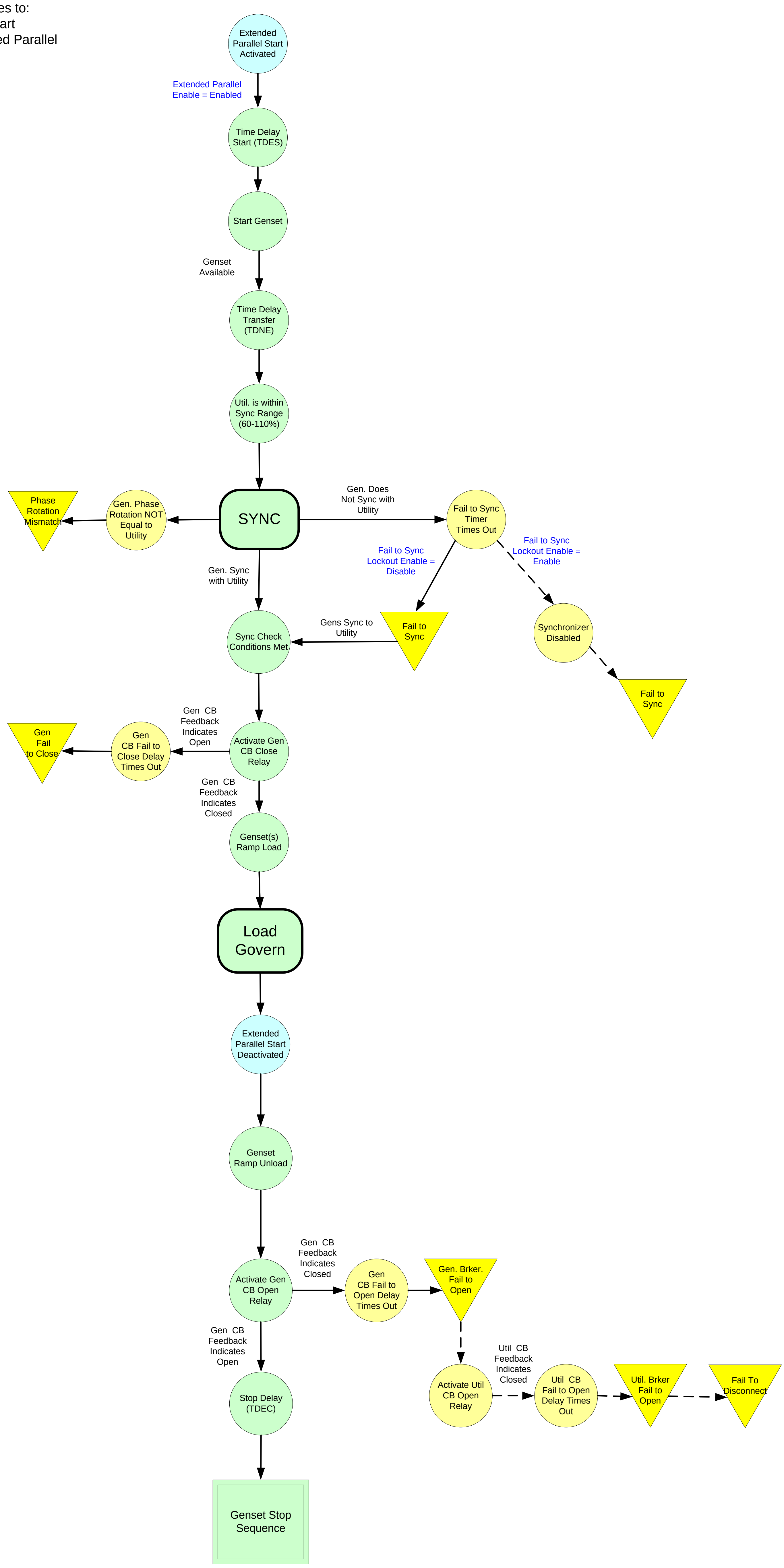
PCC3300 POWER TRANSFER CONTROL – TEST/EXERCISE/SCHEDULER – SOFT CLOSED TRANSITION

This sequence applies to:
Test – With Load
Test – Without Load
Exercise – With Load
Exercise – Without Load
Scheduler – With Load
Scheduler – Without Load



PCC3300 POWER TRANSFER CONTROL – EXTENDED PARALLEL

This sequence applies to:
Extended Parallel Start
Scheduler – Extended Parallel



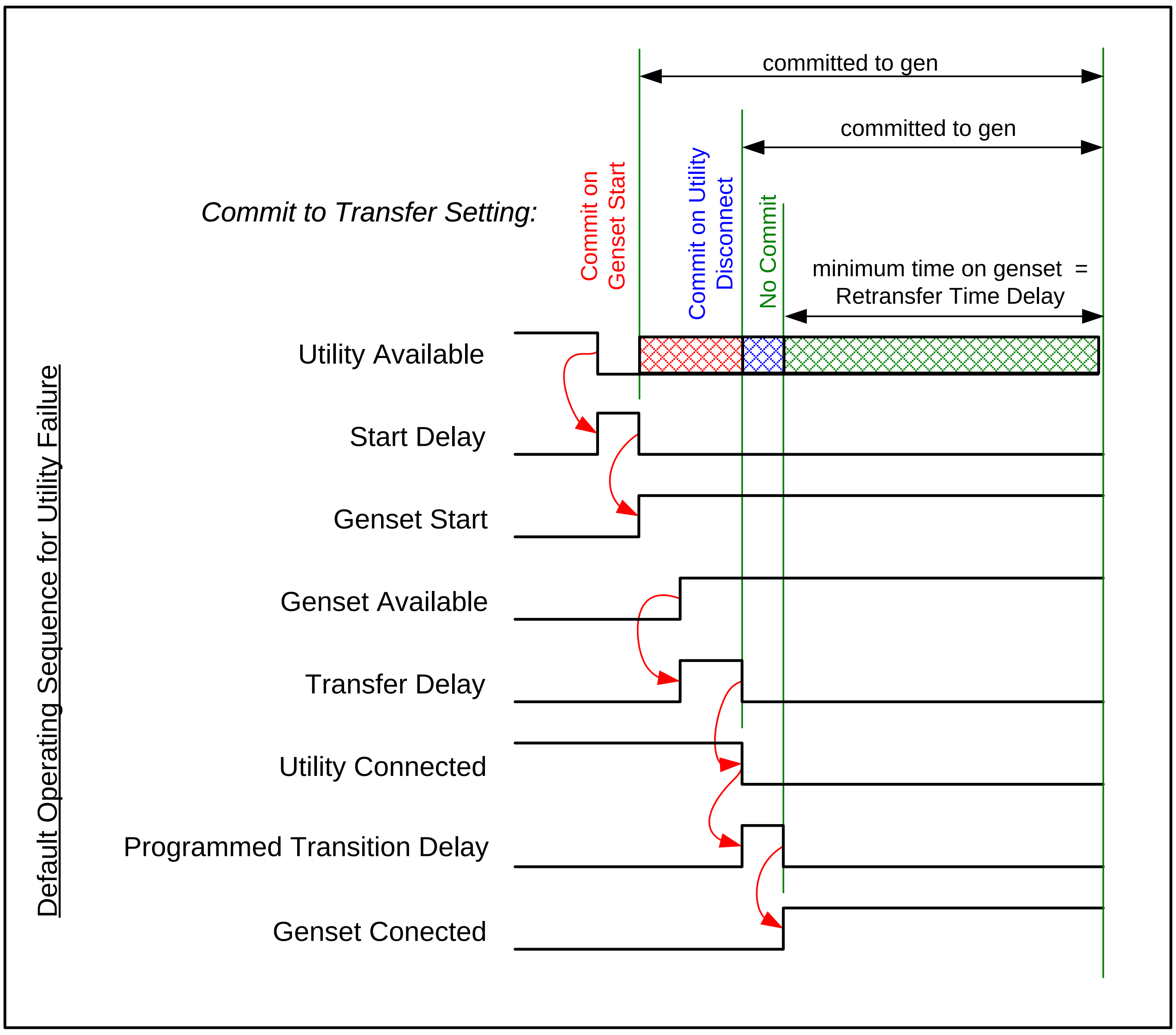
Commit to Transfer Options

Commit to Transfer refers to the point in time at which the system will commit to transferring to the genset source after the utility has failed. After this point in time, the system will attempt to connect the loads to the genset source even if the utility source returns. Once the loads get connected to the genset source, they will then be powered by the genset source for at least the retransfer time delay. At any time prior to this commitment point, if the utility source returns, the system will instead return to (or stay on) the utility source. This feature provides a trim with 3 options for commit to transfer: Disabled, Genset Start, or Utility Disconnect (default). These are described below in text and graphically.

***No Commit* –** If the utility fails and then returns before the genset has connected to the loads, the system will just stay on the utility or reclose to the utility if the utility breaker had been opened. This setting is for applications that prefer to use the utility at any time it is available. Downside is that the genset may be repeatedly started and stopped for short periods if the utility is intermittent on a short time scale.

***Genset Start* –** If the utility fails, system will commit to transfer to the genset source as soon as the genset is commanded to start (occurs after any start delay has expired) and remain on the genset source for at least the retransfer time delay even if the utility returns. This configuration is targeted for systems having UPS backup which require a guaranteed amount of time of good power to recharge the batteries. (If the utility were to repeatedly fail and return without transferring to the genset, eventually the batteries may be drained.) If the genset source fails to become available within the adjustable Commit to Transfer Timeout period, the system will abort the commit to transfer and return to the utility source if it is available. Commit to transfer will also be aborted if the genset is in a fault shutdown state, or has active transfer inhibit, active genset breaker inhibit, active genset breaker contact fault, active genset breaker tripped fault or active genset breaker fail to close fault. NOTE: If it is desired that the commit to transfer occur as soon as the utility fails, the start delay must be set to zero.

***Utility Disconnect (default)* –** If the utility fails and returns before opening the utility breaker, system will remain on the utility source. If the utility fails and the utility breaker has been opened, system will continue to transfer to the genset source even if the utility becomes available. At this point, this means that the system will be powered by the genset source for a minimum of the retransfer time delay setting. This setting at least guarantees that the gensets will run for a minimum amount of time, avoiding issues such as wet stacking. If the genset source fails to become available within the adjustable Commit to Transfer Timeout period, the system will abort the commit to transfer and return to the utility source if it is available. Commit to transfer will also be aborted if the genset is in a fault shutdown state, or has active transfer inhibit, active genset breaker inhibit, active genset breaker contact fault, active genset breaker tripped fault or active genset breaker fail to close fault.

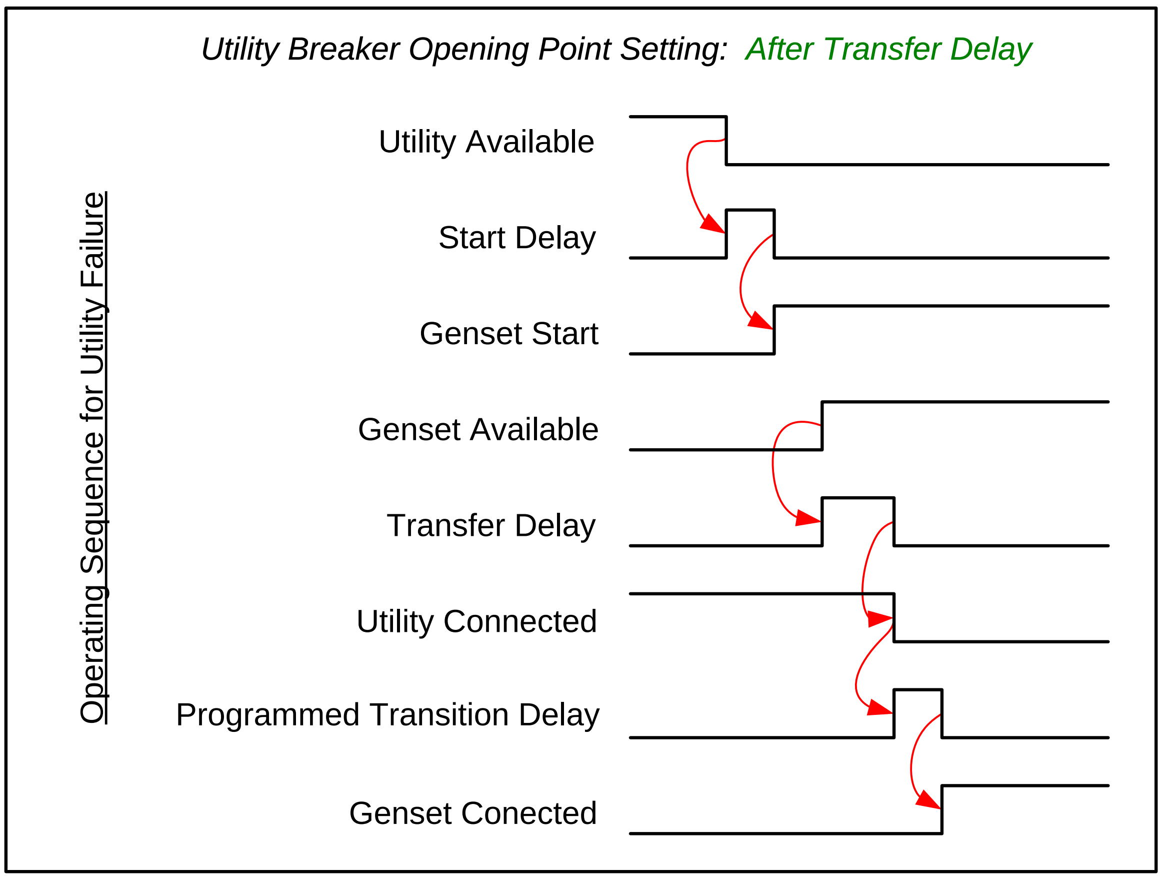


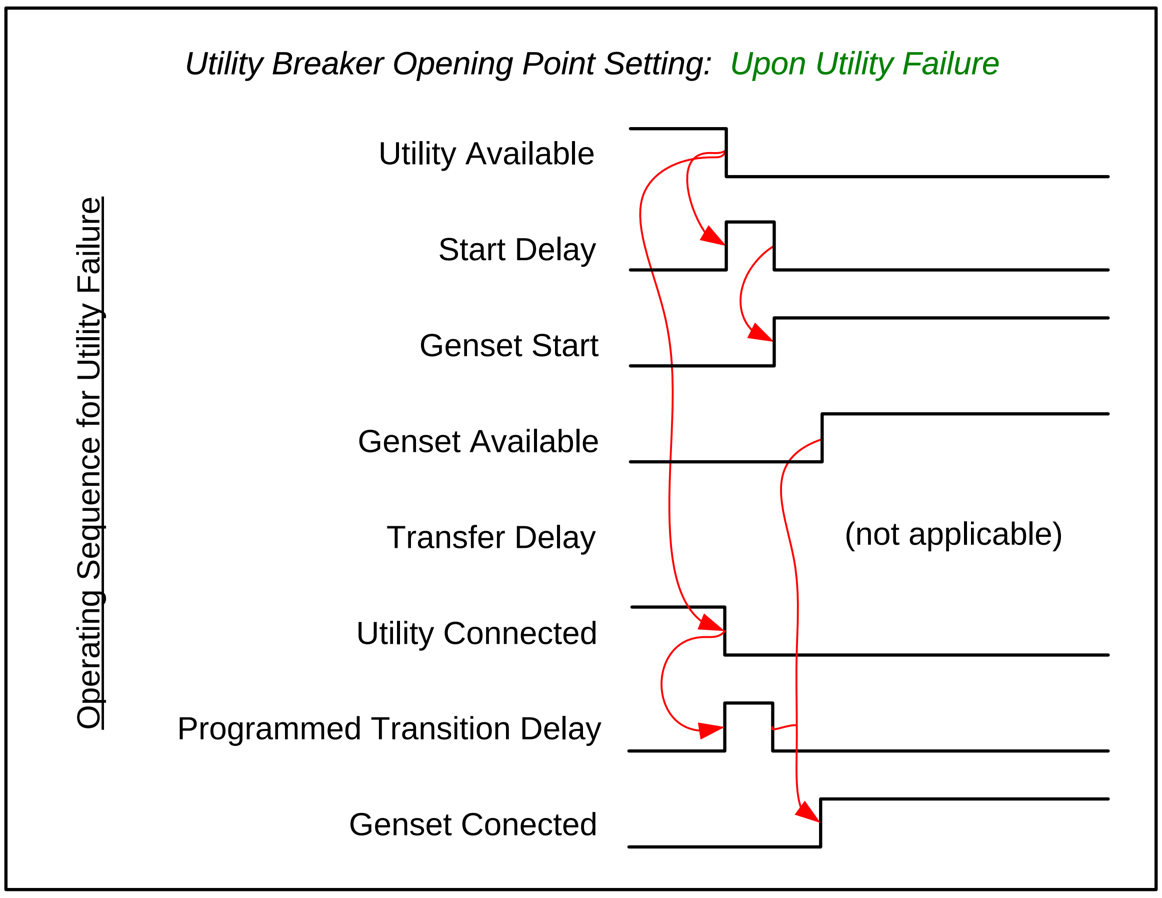
Utility Breaker Opening Point on Utility Failure Options

When the utility fails, some applications prefer to remain connected to the utility source until a genset source is available and ready to transfer to, while other applications will prefer to disconnect from the utility source immediately upon utility failure. Typically the latter method is preferred when the loads are sensitive to a bad power source such as motors being sensitive to a single phasing situation. A trim provides two possible settings: After Transfer Delay (default), or After Utility Failure. These are described further below in text and graphically.

After Transfer Delay (default) – Upon utility failure, genset starts and becomes available. Then the transfer delay times. When the transfer delay timer expires, the utility breaker is opened.

Upon Utility Failure – Upon utility failure, the utility breaker is opened immediately. Programmed transition delay starts timing and genset is started simultaneously. When the genset becomes available and the programmed transition delay is expired, the genset breaker shall close. If the genset fails to become available within an adjustable amount of time or the gen breaker fails to close and the utility source is available and the programmed transition delay is expired, system shall reclose to the utility source. If a transfer inhibit was active, system would still immediately open the utility source, but would not close to the genset.





PCC3.3 Paralleling Control Functions

The following paralleling control functions apply when the Genset Application Type trim is set to a paralleling application type. The paralleling application types are as follows: Synchronizer Only, Isolated Bus Only, Utility Single, Utility Multiple and Power Transfer Control. Table 0-1 Paralleling Functions vs. Genset Application Type and Figure 0-1 Paralleling Functions per Genset Application Type show the availability of the paralleling functions for each Genset Application Type.

Table 0-1 Paralleling Functions vs. Genset Application Type

Function		*Standalone*	*Sync Only*	*Isolated Bus Only*	*Utility Single*	*Utility Multiple*	*Power Transfer Control*
Synchronizing	Across Gen CB		√	√	√	√	√
	Across Util CB		√		√		√
Dead Bus Close				√	√	√	
Load Share				√		√	
Load Demand				√		√	
Load Govern					√	√	√
Permissive Sync Check			√	√	√	√	√
Breaker Control	Genset Breaker			√	√	√	√
	Utility Breaker						√
Fail to Disconnect							√
Power Transfer Control							√

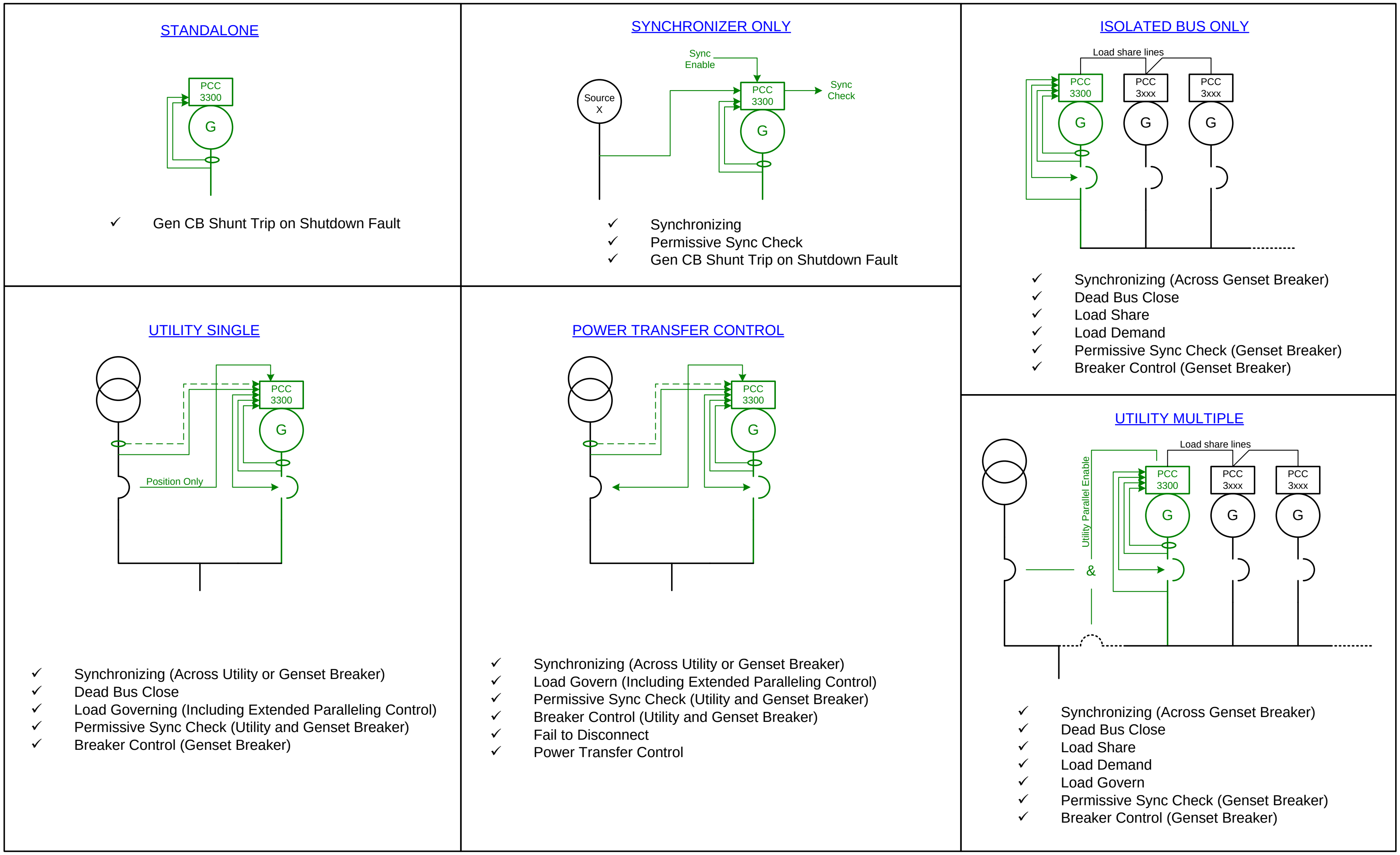


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Figure 0-1 Paralleling Functions per Genset Application Type

PCC3.3 Paralleling: Synchronizing

The frequency/phase matching control provides for two methods of automatic frequency synchronizing. The first is Phase Match which will attempt to drive the phase error to zero. A phase offset adjustment is included for cases where a phase shift exists due to a delta / wye transformer for example. The second method of synchronizing is Slip Frequency which will attempt to drive a fixed frequency difference between the two sources. In some cases this is used to insure that power will flow in the desired direction at the initial time the sources are paralleled, or with a genset whose governing cannot be accurately enough controlled to phase match (such as gas gensets). The control provides one method of automatic voltage synchronizing which is voltage match. This method will attempt to drive the voltage error to zero. See Table 0-2 Synchronizer Trims for available settings.

In most cases synchronizing is automatically initiated by the control when necessary. For utility single this is true when the utility breaker is closed and the genset is synchronizing to the bus and closing the genset breaker. However when the utility breaker is open and the genset breaker is closed and it is desired to synchronize to the utility to allow the utility breaker to close the synchronizer must be enabled manually. This is done by connecting sync enable/configurable input #30 to a return.

Dead Bus Close

See Table 0-3 Dead Bus Close Trim for available settings.

Isolated Bus Only and Utility Multiple Genset Application Type

First start arbitration is used in a multi-genset system to control which genset gets to close to a dead bus. Only one genset is allowed to close to a dead bus. All others must synchronize. The genset controls arbitrate with each other through an interconnected first start signal. Once a genset has reached the ready to load state and the bus is sensed as being dead, it can join in the arbitration. When the arbitration completes, one genset has "won" permission to close and will be allowed to command its breaker to close. At the same time this genset puts the interconnected arbitration signal into an inhibit state which tells all other gensets that they do not have permission to close. Once the permitted genset has closed to the dead bus, then the other gensets will see the genset bus go live and begin synchronizing to it.

If a genset has been waiting to win permission to close to a dead bus and it has not received that permission within a set amount of time, it will assume that the first start system has failed and will close its breaker to the dead bus. This is the First Start Backup function. This prevents a situation where no genset closes to the bus due to a failed first start system. **It does present a risk of**

multiple gensets closing to the dead bus, but this risk is reduced by setting the first start backup time delays to be significantly different on each genset. E.g. 10 sec, 20sec, 30 sec, etc. Then the assumption is that all gensets were started at the same time.

Utility Single Genset Application Type

Since the bus sensing for utility single is on the line side of the utility breaker there is no direct voltage sensing on the genset bus. Therefore the dead bus close function must rely on the breaker position of the utility main breaker to determine whether the bus is dead. In this application when the utility breaker is sensed open through feedback to the control the bus is considered dead and the genset breaker is allowed to close once it has reached the ready to load state.

PCC3.3 Paralleling: Load Share

The load share function manages the genset's kW and kVAR production when it is connected to a common bus with other gensets while isolated from the utility bus. Each genset must determine how much of the total bus load to take. The desired result is for each genset to take its equal share of the load relative to its own rating while maintaining the bus frequency and voltage at the nominal values. (i.e. Each would end up taking the same % load.) Sharing of kW is controlled by fuel (speed). Sharing of kVAR is controlled by excitation (voltage). See Table 0-4 Load Share Trims for available settings.

Isochronous

In order to share load while maintaining fixed frequency and voltage, some form of communication between the gensets must occur. (The other option with no communication is speed and voltage droop.) This is accomplished via the "load share lines". There is a pair for kW and a pair for kVAR.

PCC3xxx Controller Compatibility for Paralleling

When a paralleling system consists of different models of PCC3xxx genset controls, some adjustments are necessary in order to insure transparent load sharing performance. These adjustments are NOT necessary if the controls are all identical control model.

SYMPTOMS

What are the symptoms or issues if these adjustments are not made or are made improperly?

1. Reverse kVAR (Loss of Field) shutdowns may occur.
2. Bus Voltage may shift from nominal. (I.E. It may look like voltage droop.)

3. With the control default kVAR balance settings, the kVAR sharing will not be balanced.
4. Even after balancing the kVAR sharing at one kVAR load condition, the kVAR sharing may not be balanced at a different kVAR load.
5. kVAR sharing will not be equal when V/Hz is acting (e.g. during a large kW transient or overload condition).
6. Reverse kW or Reverse kVAR shutdowns may occur during Master Synchronizing with MCM3320 or SYNC1320 control.

APPLICABLE CONTROL MODELS

What control models does this apply to?

- PCC3100
- PCC3200
- PCC3201
- PCC3300 (PC3.3)

SETTINGS CHANGES

What settings changes are necessary to insure compatability?

Parameter	**PCC3100[1]**		**PCC3200**		**PCC3201 Full Authority Application**		**PCC3201 Two-Box Application**		**PCC3300**	
	Default	Change To	Default	Change To	Default	Change To	Default	Change To	Default	Change To
ReactivePowerScale[2]	695	820	-	-	-	-	-	-	-	-
Load Share kW Gain[3]	6	5	1.0	2.21	1.0	2.21	1.0	1.15	1.0	No change
Load Share kVAR Gain[3]	300	No change	1.0	0.94	1.0	0.94	1.0	0.94	1.0	No change
Load Share kW Balance[4]	165	No change	0	No change	0	No change	0	No change	0	No change
Load Share kVAR alance[4]	0	29	0	No change	0	No change	0	No change	0	No change
V/Hz Method	-	-	-	-	-	-	-	-	Relative Knee	**DO NOT**

									Frequency	**CHANGE**
V/Hz Slope	**See Note 5: "V/Hz Characteristic" below**									

Notes:

1. **PCC3100 Minimum Code Version:** For optimal compatability with other PCC3xxx controls, the PCC3100 code versions should be greater than or equal to the code versions listed in the table below, "PCC3100 Minimum Code Version".

PCC3100 Minimum Code Version

sw p/n	Description	Version
0326-6047	PGI Std.	2.06
0326-0368	PCC Std. P7	3.01
0326-6046	PCC Ventura 1	2.04
0326-0198	PCC Ventura 2	2.03
0326-0148	PCC Std. P7	2.06
0326-0187	PCC Sentinel	2.03
0326-6472	QSM 11	2.03
0326-6397	PGI Std. P7	2.07
0326-5853	GCP PCS	1.27
0326-6049	PGI Sentinel	2.04
0326-6052	PGI Ventura 2	2.04
0326-6050	PGI Ventura 1	2.03
0326-6393	Astr'l Army	2.11

2. **ReactivePowerScale** cannot be changed from the operator panel. InPower is required to change this. Currently InPower 7.5 does not support this variable, but InPower 8.0 will.

   Until InPower 8.0 is available, an updated 21.srv file is available and is attached here:  21.srv
   It should be used to replace the same file at: D:\ProgramFiles\PowerGeneration\InPower\Data\. Suggest renaming existing file first.

3. **Load Share Gains:** If instability occurs while load sharing with the gains listed in the table above, reduce all gains proportionally by the same amount. If load share gains are reduced AND system is using a MCM3320 or SYNC1320 for master synchronizing, refer to documentation for these controls. Depending on how much the gains have been reduced, some settings in these devices may need to be altered in order to insure system stability during master synchronizing.

4. **Load Share Balance:** The Balance settings in the above table are the nominal starting points. When gensets are load sharing, further refinement of the settings may be required to balance out the sharing.

5. **V/Hz Characteristic:** Ideally every genset in a paralleled system should have the same V/Hz characteristic, but in a system of different genset models and/or control system models, they may not be the same. The V/Hz Characteristic has two components. First is the Knee Frequency. This is the frequency at which the voltage will begin to decrease in order to help the engine recover. There should normally be no need to adjust this as all paralleling gensets have a default Knee Frequency of 1 Hz below the nominal frequency of 50 or 60Hz. The second component is the V/Hz Slope. This determines how much the voltage is decreased for a given decrease in frequency below the Knee Frequency.

When should one be concerned with checking and adjusting the V/Hz Slope so that they are the same across gensets?

One should consider this when any one of the following is true:

- system has kW load steps in excess of 50-75% of online capacity
- system has genset kW ratings that cover more than a 2:1 range
- system has a reverse kVAR time delay setting that is **less** than 10 seconds (default setting is 10 sec)

What symptom would one see if the V/Hz Slope setting was an issue?

If the V/Hz slope settings are too different from one genset to another, kVAR sharing will be unbalanced during load transients that depress the bus frequency by more than 1Hz below nominal. Then, if there is very little kVAR load, it may result in reverse kVAR flowing into one or more generators for the duration of the transient. In very extreme cases of a long duration transient (heavy load step) and significant V/Hz setting difference, genset(s) could shut down on a reverse kVAR fault.

How does one check and adjust the V/Hz Slope?

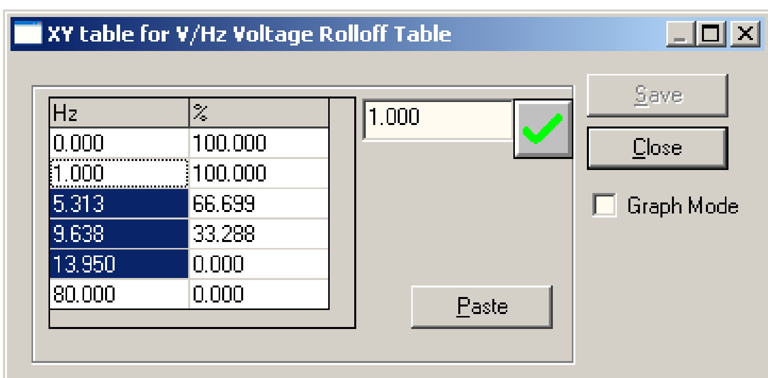
Process for reviewing and harmonizing the V/Hz Slope setting:

1. Get the current V/Hz slope setting from each genset. See below for details by controller model.
2. Convert V/Hz slope settings to common units of %V/Hz. See below for details by controller model.
3. Determine which has the **largest** slope setting.
4. Set all gensets to the largest slope setting by working the calculations in reverse as needed.
5. Test the system with as large a load transient as possible and monitor frequency, voltage, and kVAR sharing.

System Example:

To demonstrate the method, consider a system consisting of 3 gensets: one with PCC3100, one with PCC3201, and one with PCC3300 genset controllers.

1. From the PCC3100 HMI, the "REG VHZ" number was found to be 8.
2. Using the formula for PCC3100 V/Hz slope (from section below): = 76 / 8 = 9.5 %V/Hz
3. From the PCC3201 InPower connection, the "V/Hz Rollof Table" was found to be:



4. Slope is calculated by using row 2 and row 3 numbers: (100% - 66.699%) / (1.00-5.313) = -7.72%V/Hz
5. Ignoring the minus sign, the PCC3201 V/Hz Slope = 7.72%V/Hz.
6. From the PCC3300 HMI, the V/Hz Rolloff Slope was found to be 5.3 %V / Hz. No conversion is needed for the PCC3300.

7. Thus the found slopes, all in units of %V/Hz are:

    PCC3100 = 9.5 %V/Hz

    PCC3201 = 7.72 %V/Hz

    PCC3300 = 5.3%V/Hz

8. Choose the largest setting to use for all gensets: 9.5 %V/Hz
9. PCC3100 needs no change. (If it did, calculate 76 / 9.5 = 8 -- Round to the nearest integer.)
10. PCC3201 needs to be changed as follows (refer to above screen shot of the table):
11. Leave the % column settings as they are.
12. Also leave the Hz column values of 0,1 and 80 as they are. (These should not be changed as they define the knee frequency.)
13. Only change the highlighted values in the screen shot above. Thus need new values for 5.313, 9.638, and 13.95.
14. Each delta in the % column for these rows is 33% from one row to the next.
15. Calculate the Hz delta for this 33%V delta with the new desired V/Hz Slope number: (33%) / (9.5% V/Hz) = 3.5 Hz
16. Thus the increments in the Hz column are 3.5Hz for the ones that need to be changed.
17. 5.313 point is instead 1.00 + 3.5 = 4.5Hz (previous Hz number + delta of 3.5Hz)
18. 9.638 point is instead 4.5 + 3.5 = 8.0Hz
19. 13.95 point is instead 8.0 + 3.5 = 11.5Hz
20. PCC3300 is much easier to change. Just change the V/Hz Rollof Slope from 5.3 to 9.5.
21. Done!
22. Test the system with load steps.

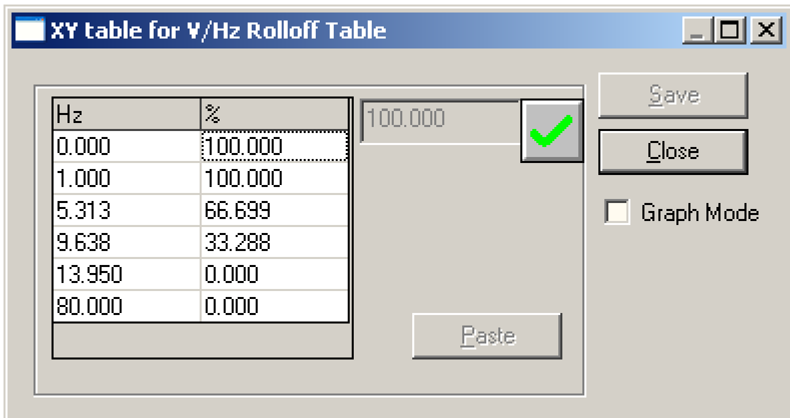
How to determine V/Hz Slope by Controller Model:

PCC3100 V/Hz Slope

- The V/Hz slope setting can be found from the HMI under the Gov/Reg settings in the Setup/Cal menu. It is called “REG VHZ”. This number ranges from 5 to 27, depending on the genset model.
- To convert this number to common units of %V/Hz, compute (76 / REG VHZ).

PCC3200/3201 V/Hz Slope

- The V/Hz slope setting can be found with InPower as the parameter called "V/Hz Rolloff Table". It is not available from the HMI.
- It will look like this, but perhaps with different numbers:



- To compute the common units of %V/Hz in the above example table, use the 2nd and 3rd rows as follows:
- (100% - 66.699%) / (5.313Hz – 1.000Hz) = 7.72%V / Hz
- When working the calculation in reverse to set a new V/Hz, change the values in the Hz column at rows 3, 4, and 5 so that the slope calculated from row 2 to 3 is the same as that from row 3 to 4 and from row 4 to 5. Leave the % column numbers as they are, and leave rows 1, 2 and 6 as they are.

PCC3300 V/Hz Slope

- The V/Hz slope setting can be found with InPower as the parameter "V/Hz Rolloff Slope", or from the HMI under the Genset Setup menu.
- The number is already in the common units of %V/Hz.

LOAD SHARE WIRING POLARITY

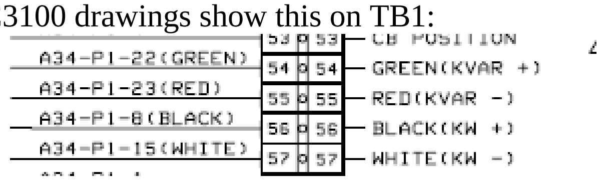
What about Load Share Wiring Polarity?

The +/- marking for the kW and kVAR load sharing signals are backwards on the PCC3100 in relation to all other PCC3xxx controls. The correct connections are shown in the table below. If any connections are reversed, when multiple gensets are online, reverse kW or reverse kVAR shutdowns will likely occur. If just one genset is online, it may show a speed or voltage droop at no load.

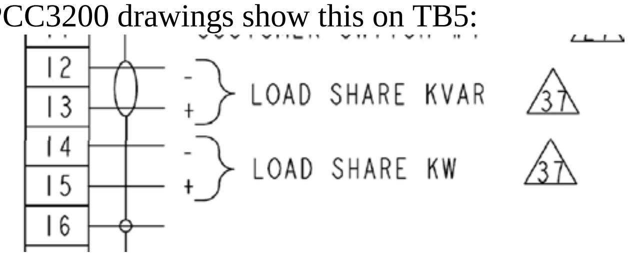
CORRECT LOAD SHARE CONNECTIONS BETWEEN PCC3XXX CONTROLS					
Signal	**PCC3100**	**PCC3200**	**PCC3201**	**PCC3300**	**MCM3320 / SYNC1320**
Load Share kW +	TB1-57	TB5-15	TB3-51	TB9-8	TB9-8
Load Share kW –	TB1-56	TB5-14	TB3-52	TB9-7	TB9-9
Load Share kVAR +	TB1-55	TB5-13	TB3-53	TB9-10	TB9-10
Load Share kVAR –	TB1-54	TB5-12	TB3-54	TB9-11	TB9-9

For reference, here is what the published drawings show…PCC3100 is the only one that has the polarity marked backwards on the drawing.

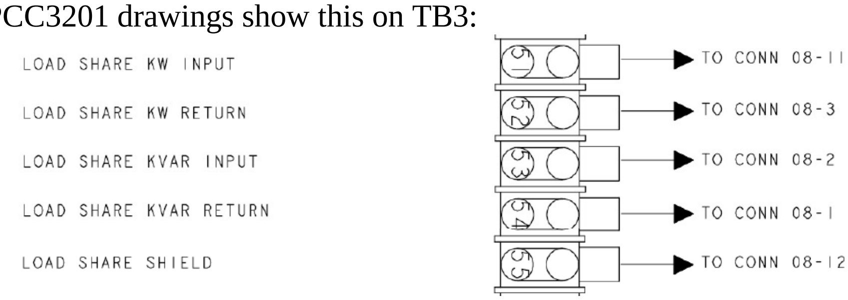
PCC3100 drawings show this on TB1:



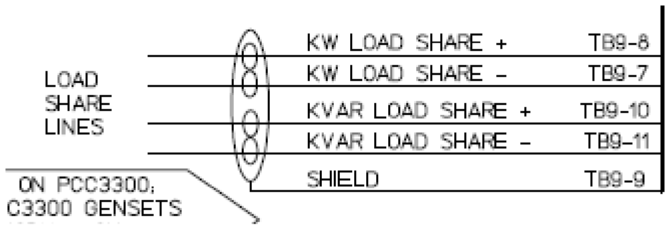
PCC3200 drawings show this on TB5:



PCC3201 drawings show this on TB3:



PCC3300 drawings show this on TB9:



PCC3.3 Paralleling: Droop

Droop is a passive means of having paralleled gensets share kW (via speed droop) and kVAR (via voltage droop). In the case of speed droop, as kW load increases, speed (i.e. fueling) is reduced, forcing other gensets to pick up more kW thus resulting in a balance. In the case of voltage droop, as lagging kVAR increases, voltage (i.e. excitation) is reduced, forcing other gensets to pick up more lagging kVAR thus resulting in a balance. Droop can be used on an isolated bus for passive sharing among gensets. It can also be used in parallel with a utility source in which case it acts like a base load function, but will additionally help support a utility source with a frequency that sags due to system overloads. In this type of application, kW output is primarily set by the utility frequency based on where it falls on the speed droop characteristic. kW output is adjusted via the genset frequency adjust variable. kVAR output is primarily set by the utility voltage based on where it falls on the voltage droop characteristic. kVAR output is adjusted via the genset voltage adjust variable.

All gensets may be operated in droop, but this leads to a frequency which changes with load. Another alternative is to operate one of the sets as a “lead” unit in the isochronous mode. The other sets operating in droop will be forced to go to the isochronous speed and thus they will be effectively base-loaded. The lead unit then takes up all the changes in load that occur while maintaining a fixed frequency bus. As an example, if the genset set to operate in isochronous mode at a frequency of 57Hz were run in parallel with a genset operating in droop set as shown in Figure 0-1 Load Share - Droop kW with a nominal frequency of 60Hz the genset in droop would be loaded at 50% kW. If it were desired to run both gensets at 60Hz and still load the genset operating in droop to 50% set the Frequency Adjust trim on the genset operating in droop to 3 to increase the 0% kW output frequency to 63Hz.

Figure 0-1 Load Share - Droop kW is a graphical representation of speed droop. In this case the Speed Droop Percentage trim has been set to 10%. As can be seen from the graph at 100% kW output the genset will be operating at 90% of nominal frequency. In other words for a nominal frequency of 60Hz the genset will be running at 54Hz at full load.

Figure 0-2 Load Share - Droop kVAR is a graphical representation of voltage droop. In this case the Voltage Droop Percentage trim has been set to 5%. As can be seen from the graph at 100% kVAR output the genset will be operating at 95% of nominal voltage. In other words, for a nominal voltage of 480VAC the genset will be running at 456VAC at full load.

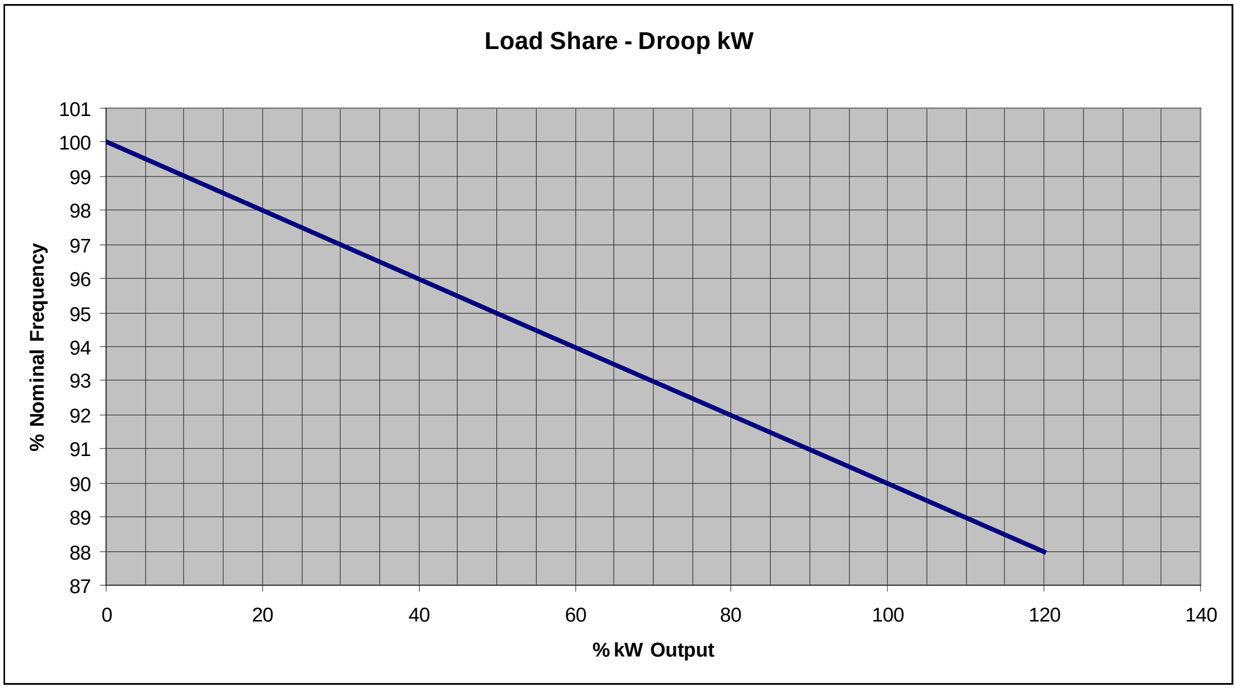


Figure 0-1 Load Share - Droop kW

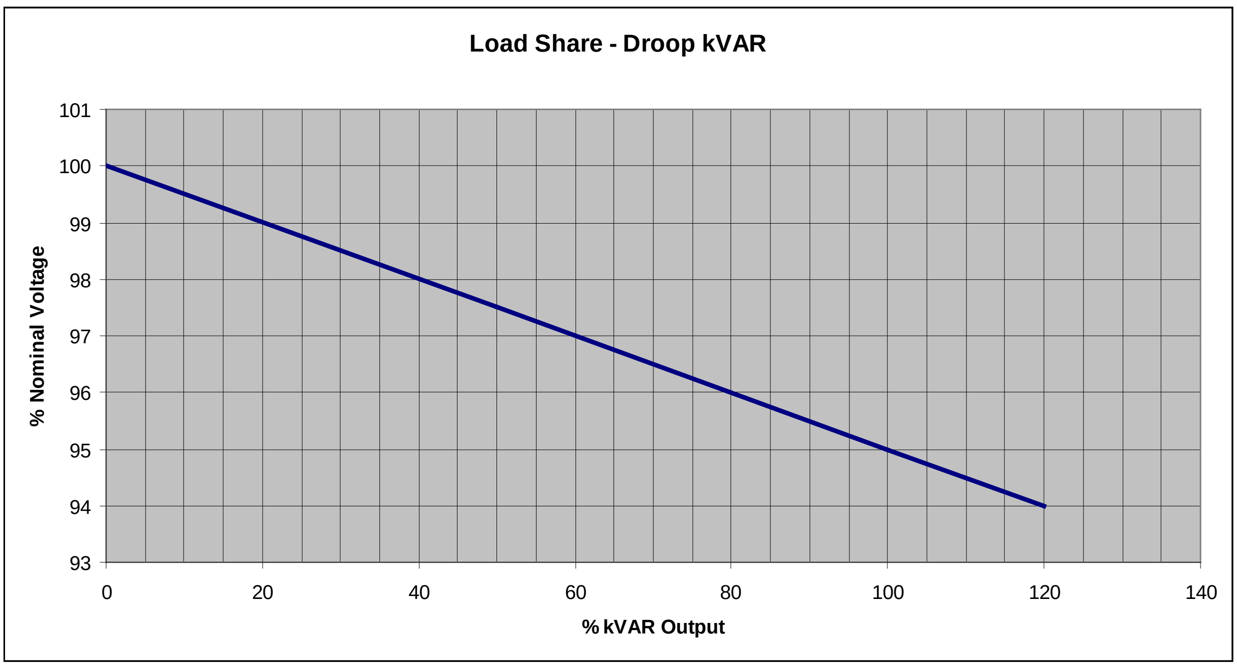


Figure 0-2 Load Share - Droop kVAR

PCC3.3 Paralleling: Load Demand

Load Demand is used primarily for two purposes. The first is to temporarily shut down a genset when there is excess generating capacity. The second would be to take a genset offline for maintenance if the operator preferred to ramp unload the genset. Load demand is only applicable in conjunction with an active remote start. Load Demand shutdown works both in Load Share and Load Govern states. If load demand stop request is activated, the Load Share or Load Govern function sees this and ramps down the genset load at a prescribed rate. The Load Share or Load Govern function will alert the Load Demand function when the ramp down is complete and it's ok to turn off the genset. Then the Load Demand stop command will be passed to GC to allow the genset stop process to commence. The ramp down will not occur if the speed is in droop mode, but instead the load demand shutdown will occur immediately.

PCC3.3 Paralleling: Load Govern / Utility Parallel

Load Govern applies when a genset(s) is in parallel with the utility. The kW and kVAR setpoints may come from external analog inputs or from internal register settings. The user must choose. Some internal register settings can be entered either in engineering units of kW or kVAR, or alternatively in percent. All load govern modes will maintain genset output within genset standby rating. That is, maximum kW output will be 100% of kW standby rating and maximum kVAR output will be 60% of standby kVA rating. Output limits may be further restricted by derates and maximum output trim settings. See Table 0-5 Load Govern Trims for applicable settings. In applications where voltage changes quickly on the utility a droop function can be added by setting the utility parallel voltage control method trim to load govern with droop feed forward. The droop function can inject a quick compensation signal, which will assist the load govern control loop stability, while the main load govern controller adjusts to the difference.

Internal Extended Parallel Control

Load Govern kW Method – There are three modes for kW control

Genset kW – This is often called "base load". In this mode, the control regulates genset kW output to a fixed setpoint value.

Genset kW w/Utility Constraint – This is the same as "Genset kW", but with the added ability to limit the utility kW level to a fixed value. This is often used to prevent the utility kW import level from dropping below some threshold should the load level drop. This method is only valid with Genset Application Type = Utility Single, or PTC.

Utility kW – This is often called "peak shave". In this mode the control adjusts genset kW output in order to maintain a fixed setpoint kW level on the utility. This method is only valid with Genset Application Type = Utility Single, or PTC.

Figure 0-1 Load Govern Internal Control System Operation provides examples demonstrating how the system will operate based on the Load Govern kW method.

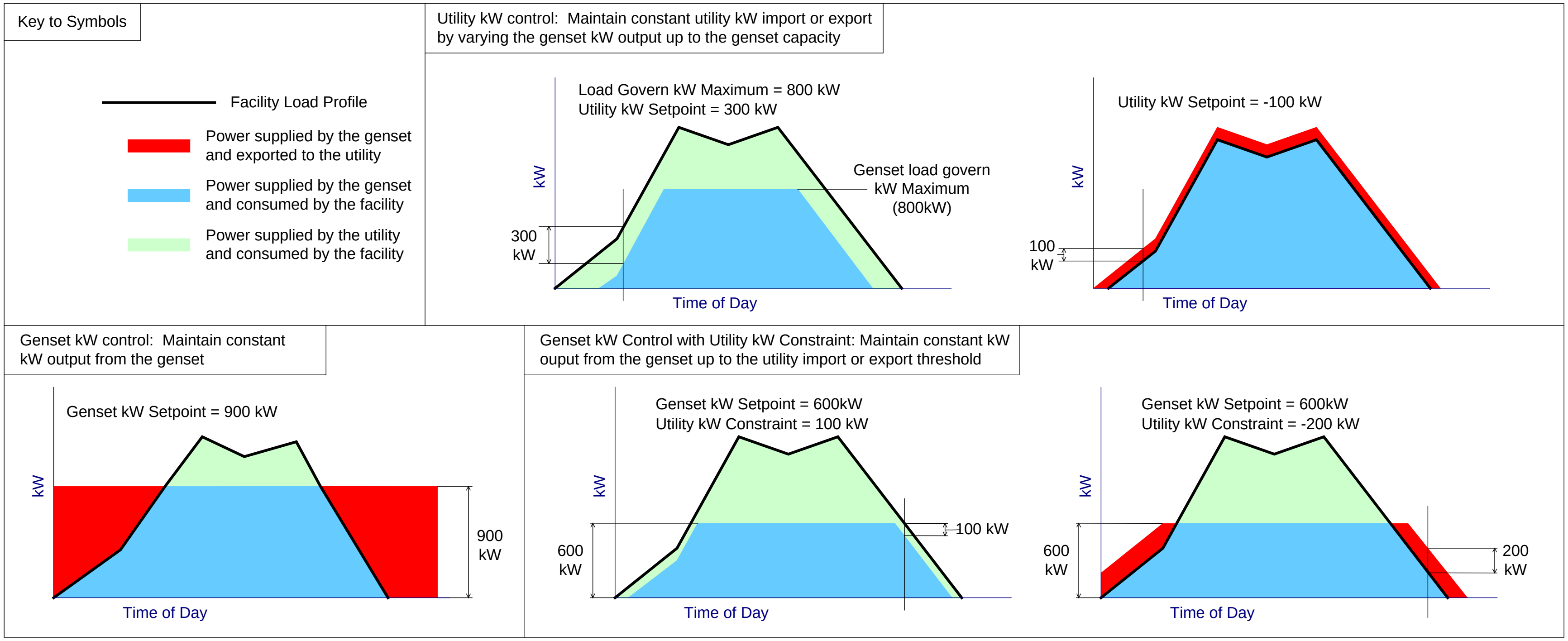


Figure 0-1 Load Govern Internal Control System Operation

Extended Parallel kVAR Method – There are 4 modes for kVAR control

Genset kVAR – In this mode, the control regulates genset kVAR output to a fixed setpoint value.

Utility kVAR – In this mode, the control adjusts genset kVAR output in order to maintain a fixed setpoint kVAR level on the utility. This method is only valid with Genset Application Type = Utility Single, or PTC

Genset Power Factor – In this mode, the control adjusts genset kVAR output to maintain a fixed genset power factor.

Utility Power Factor – In this mode, the control adjusts genset kVAR output to maintain a fixed utility power factor. This method is only valide with Genset Application Type = Utility Single, or PTC.

External Extended Parallel Control

External extended parallel controls allow each gensets kW and kVAR output to be controlled by an external voltage source. This is done through kW load setpoint/configurable analog input #1 and kVAR load setpoint/configurable analog input #2 for the kW and kVAR output respectively. Figure 0-2 Load Govern/Extended Parallel External kW Control shows the expected genset kW output based on the voltage applied to kW load setpoint/configurable analog input #1 and the analog return. Figure 0-3 Load Govern/Extended Parallel External kVAR Control shows the expected genset kVAR output based on the voltage applied to kVAR load setpoint/configurable analog input #2 and the analog return. When this control method is used and it is desired to unload the genset the analog voltage input(s) must be immediately taken below 0.5VDC. At that point the control takes control of unloading and ramps the genset gradually from the current output level. Any delay in the voltage going from the current setpoint to below 0.5VDC will cause the genset to track the voltage and it will appear to block unload.

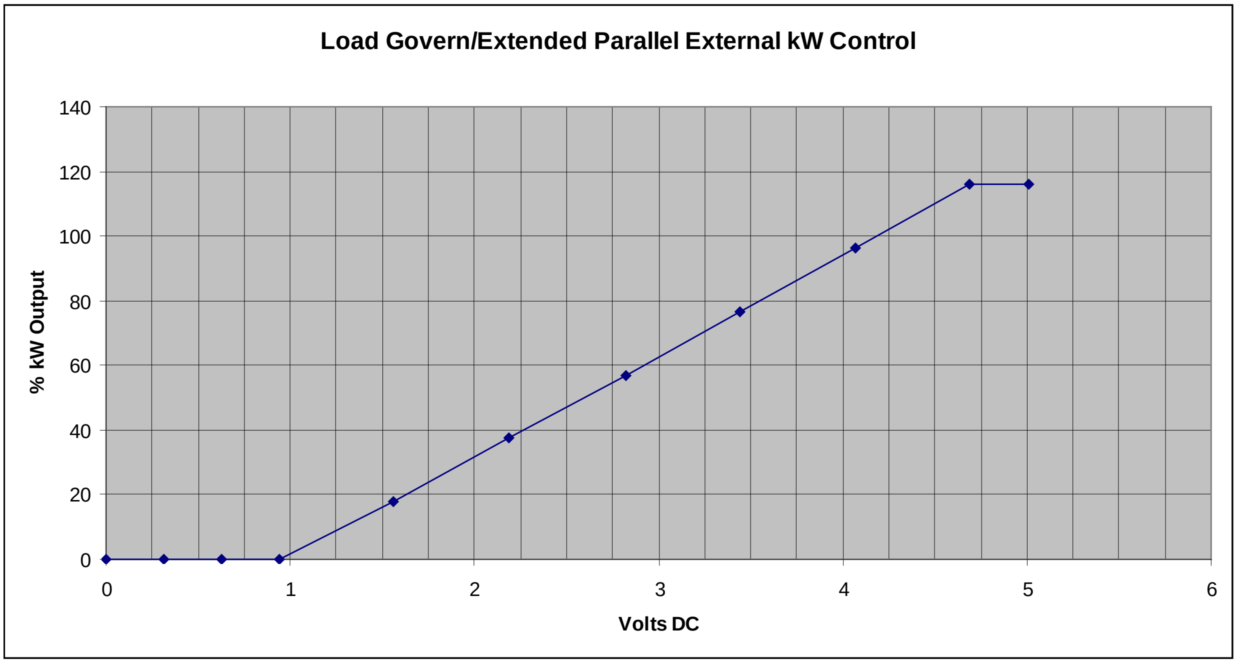


Figure 0-2 Load Govern/Extended Parallel External kW Control

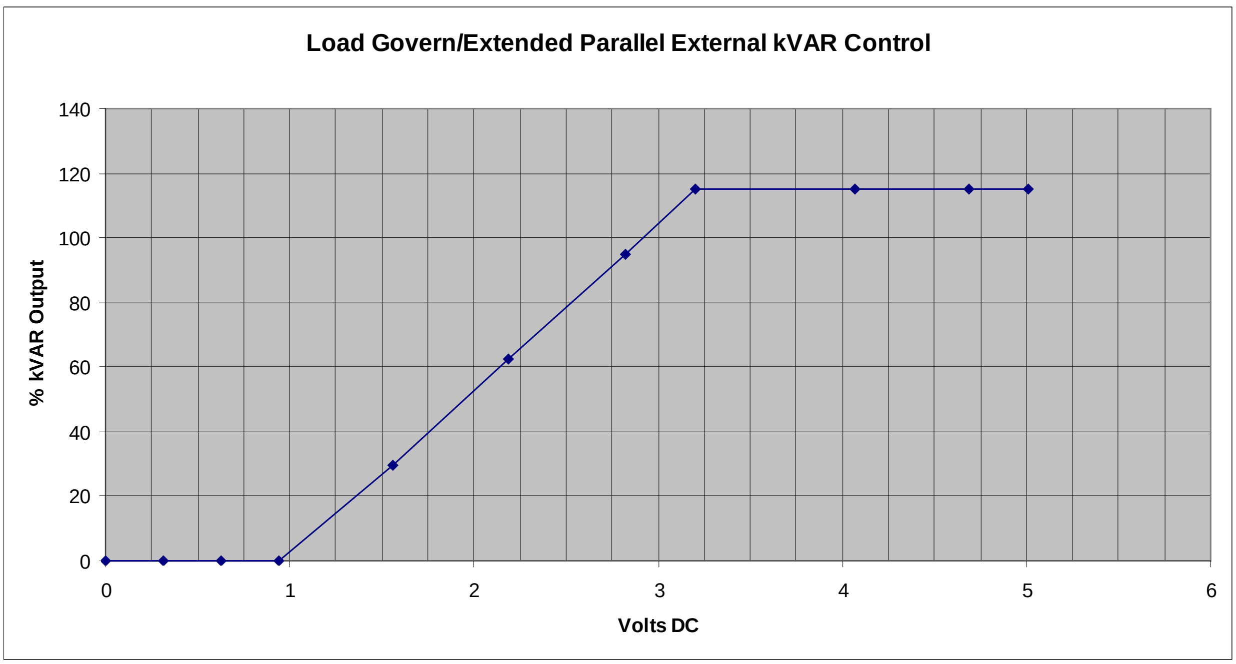


Figure 0-3 Load Govern/Extended Parallel External kVAR Control

Droop Extended Parallel Control

Droop can be used in load govern operation to base load a group of gensets against a utility source. In this case the utility frequency dictates the %kW load and the utility voltage dictates the %kVAR on the gensets. As an example, using Figure 0-1 Load Share - Droop kW, if it were desired to run both gensets at 50% kW in a 60Hz application the following could be done. Set the Frequency Adjust trim on the gensets operating in droop to 3 to increase the 0% kW output frequency to 63Hz. In that way the gensets will run at 50% load when it is connected to the utility which is at 60Hz. A similar approach can be used for kVAR base load.

PCC3.3 Paralleling: Permissive Sync Check

The Sync Check function monitors the genset and bus LL voltages, frequencies, phase rotations, and L1-L1 voltage phase relationship in order to determine whether the two sources can be paralleled. Note that the bus LL voltage connections vary based on the Genset Application Type trim. The function is called “permissive” because the parameters must fit within some boundaries inside which it is permitted to close a breaker and parallel. These boundaries are adjustable via trims; see Table 0-6 Permissive Sync Check Trims. The output of this function serves the permissive gen cb close function, the PTC function, breaker control function, and can be configured to drive a configurable customer output. The output of this function operates independently of the synchronizer control itself, thus allowing an external device to perform the synchronization and then get a sync check indication from this controller.

PCC3.3 Paralleling: Breaker Control Interface

See Table 0-7 Breaker Control Trims for applicable settings.

Non-Power Transfer Control Applications

The circuit breaker control and monitor function manages closing the genset breaker, opening the genset breaker and sensing/determining both genset and utility breaker positions. The genset breaker is controlled with two separate relays – one for closing and one for opening. The control logic is arranged such that the genset breaker is always either being told to close or always being told to open (except for a short delay between telling it to open and telling it to close). The logic is set up so that opening takes priority over any close. There are only two functions which can close the breaker -- either dead bus close or the permissive close (sync check). In single genset applications, the relay contact which was used for breaker closing is capable of being trim enabled to trip the breaker on fault shutdowns only and breaker position is not sensed.

Power Transfer Control Applications

PTC applications add utility breaker control and additional diagnostics. Also, for PTC applications, the breaker close and breaker open commands are only maintained until the breaker is sensed to be in the desired position. The exception to this is the gen breaker open command which can be continuously maintained depending on what logic is active. This differs from NON-PTC applications where breaker commands are always continuously maintained.

PCC3.3 Paralleling: Fail To Disconnect

Fail to disconnect applies to power transfer control paralleling applications. When enabled, this function will attempt to disconnect the utility source from the genset source through the breaker control interface when one source breaker fails to open when commanded. One example of this would be when a transfer to the genset is initiated and the utility has been unloaded the control would then send an open command to the utility breaker to complete the transfer. If the utility breaker fails to open, this logic will attempt to disconnect the two sources by sending an open command to the genset breaker through the breaker control function. If the control is not able to open either breaker then the fail to disconnect diagnostic will become active. See Table 0-8 Fail To Disconnect Trim for applicable setting.

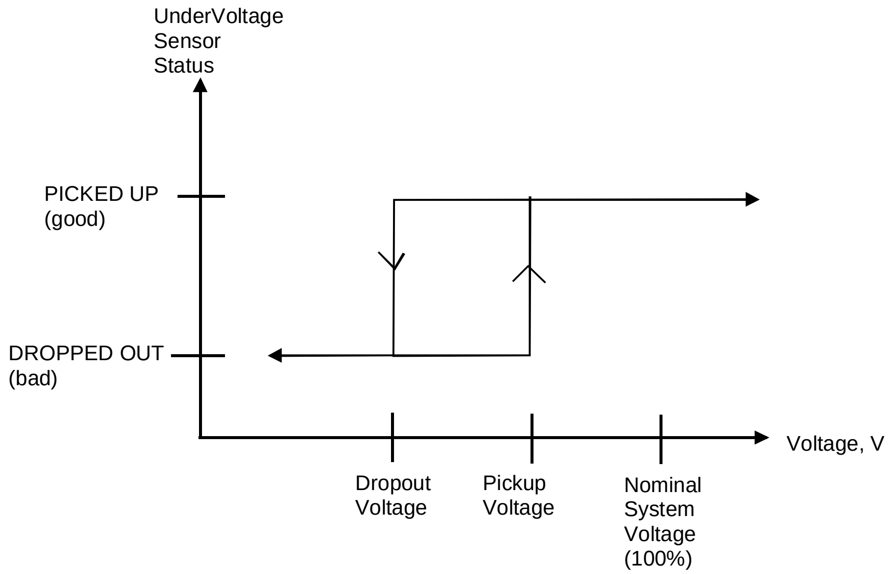
PCC3.3 Paralleling: Power Transfer Control

The Power Transfer Control (PTC) function applies when the Genset Application Type is Power Transfer Control. PTC primarily means that the genset controller is controlling both the genset breaker and a utility breaker in a transfer pair arrangement. PTC is only for use in a single genset / single utility arrangement. PTC's primary job is to keep loads powered. PTC completely manages the system by automatically starting the genset and transferring load when it detects utility failure, or when a test or exercise with load is called for. Transfer refers to transitioning from the utility source to the generator source. Retransfer refers to transitioning from the generator source to the utility source. Transfers/retransfers between the two live sources can be configured as open transition, hard closed transition (<100msec overlap), and soft closed transition (load is ramped). NOTE: To meet the hard closed transition <100msec overlap, the controller will consume up to 40msec of the 100msec, leaving 60msec for the external breaker opening circuit to operate. PTC can also operate in extended paralleling mode, providing base load or peak shave functionality (via the Load Govern function). PTC has numerous built-in configurable sensors to determine the availability of the utility and genset sources. PTC has adjustable timers as well, including programmed transition delay, transfer delay, retransfer delay, and maximum parallel time. Transfer Inhibit/Configurable Input #20 Switch and Retransfer Inhibit/Configurable Input #21 Switch inputs allow external devices to block a transfer or retransfer when desired, except in some circumstances (e.g. retransfer inhibit will be ignored if the genset source fails and the utility is available). An override input allows inhibits and most timers to be bypassed in order for a pending action to occur immediately. An input can be configured to allow control of PTC mode being either Auto or Manual. PTC Mode applies only to the operation of the breaker pair. An external device would control this and provide appropriate indication to the use of its state. (The PC3.3 system does not use this signal to determine "Not In Auto". This is only determined from the HMI control switch position.) See Table 0-9 Power Transfer Control Trims for applicable settings.

Power Transfer Control Source Availability Sensors

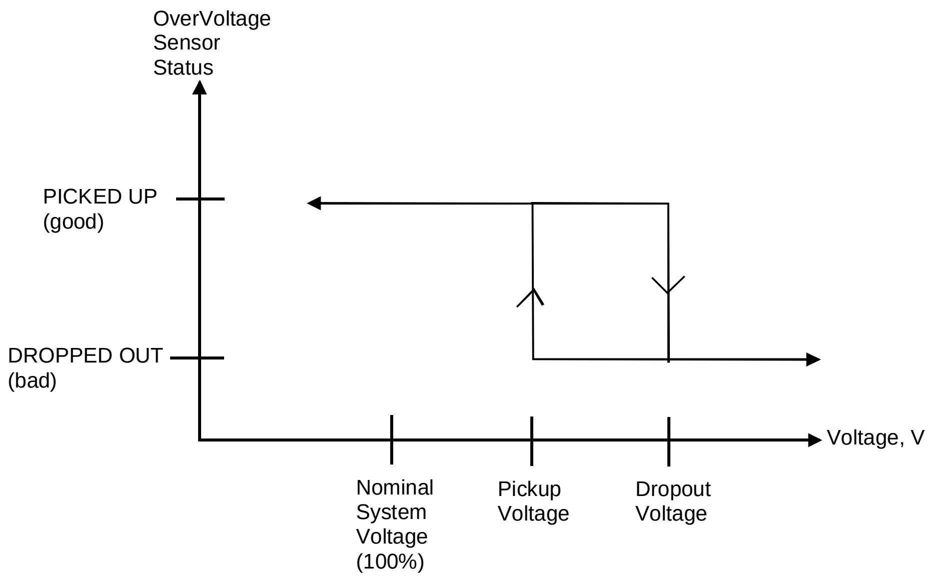
The power transfer control sensors are used to determine whether or not a source is acceptable. Source acceptability is used to drive whether or not to start gensets, whether or not to switch the loads to a different source, and whether or not two sources can be paralleled. The following sensors are available for the utility and genset source: undervoltage, overvoltage, under/overfrequency, loss of phase, and phase rotation. The undervoltage sensor is enabled by default, all other sensors can be enabled as desired for a given application.

Shown below are reference diagrams to help understand how the undervoltage, overvoltage, and frequency sensors work in terms of threshold settings.



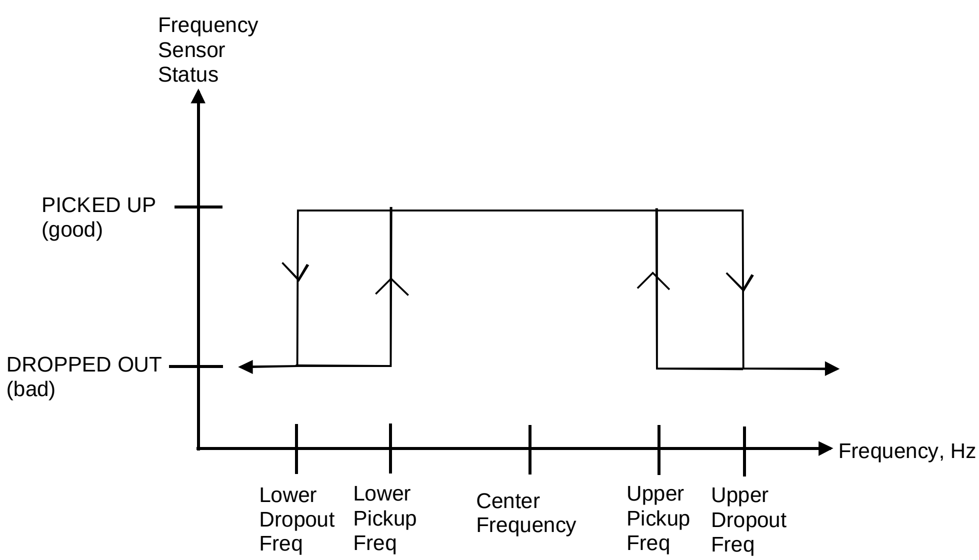
Pickup Voltage = Pickup Percentage * Nominal Voltage
Dropout Voltage = Dropout Percentage * Pickup Percentage * Nominal Voltage

Figure 0-1 Undervoltage Sensor Operation



Pickup Voltage = Pickup Percentage * Dropout Percentage * Nominal Voltage
Dropout Voltage = Dropout Percentage * Nominal Voltage

Figure 0-2 Overvoltage Sensor Operation



Lower Pickup Freq = (1 - Pickup Bandwidth) * Center Frequency
Upper Pickup Freq = (1 + Pickup Bandwidth) * Center Frequency
Lower Dropout Freq = (1 - Pickup Bandwidth - Dropout Bandwidth) * Center Frequency
Upper Dropout Freq = (1 + Pickup Bandwidth + Dropout Bandwidth) * Center Frequency

Figure 0-3 Frequency Sensor Operation

Paralleling Cummins and Non-Cummins Gensets

Background

The primary issue that arises when a Cummins genset is going to be paralleled to a non-Cummins genset is how to handle the isolated bus load sharing. Traditionally there are two main ways for load sharing to occur: Droop and Isochronous. Droop sharing requires no communication between gensets and thus is the easiest method to load share especially when gensets from different manufacturers must parallel. The unpleasant disadvantage of droop is that bus frequency and voltage are load dependent. In many markets today, this is unacceptable. Much more desirable is to have constant frequency and voltage regardless of load. This is Isochronous load sharing and requires the gensets to communicate their real and reactive loads with each other and drive signals to their speed and voltage controls to balance the loads. The problem today is that there is no standard for how this is done. Each manufacturer has its own method and they are typically not directly compatible with one another.

A second issue that arises is how to handle the automatic first start / dead bus close functionality. Cummins gensets have a built in mechanism for getting the first genset onto a dead bus. Non-Cummins gensets also have various methods, but they are not directly compatible with the Cummins method.

This article reviews methods for dealing with load sharing and dead bus closing when paralleling a Cummins genset(s) to non-Cummins genset(s).

Methods for Load Sharing

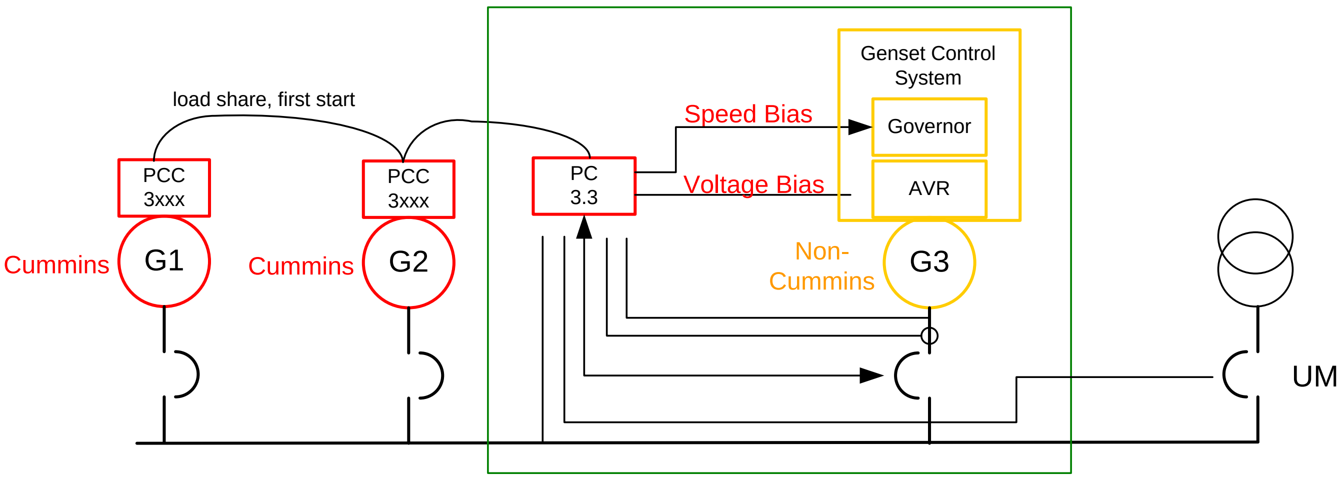
Table 1.2-1 Methods for Load Sharing between Cummins and non-Cummins gensets

Method	Advantages	Disadvantages	Comments
1. Add PC3.3 Control System to the Non-Cummins genset control system via speed and voltage bias signals	Paralleling functionality is all Cummins	Added cost	
2. Cummins Isochronous Load Sharing Interface Module (ILSI)	Provides isochronous kW sharing	kVAR sharing must use Voltage Droop Does not support load sharing done via digital communications (such as CAN or RS485)	The ILSI translates PCC kW analog load share signals to other analog load share signals such as Woodward, Barber Colman, Governors America, Heinzmann, etc.
3. Droop	Simple	Frequency and Voltage are load dependent	

4. Base Load	Fairly Simple	Must understand the system load profile very well. Makes using Load Demand more of a challenge.	Method works by operating either the Cummins gensets in Base Load and the non-Cummins in Load Share, or vica versa. The gensets in load share take up the changes in the load.
5. Woodward Load Share Gateway Module	Provides isochronous kW and kVAR sharing to Woodward digital load sharing communications systems	Unknown – module has not bee tested by Cummins	This method has not been tested by Cummins and is thus not yet sanctioned by Cummins. Requires two modules – one for kW and one for kVAR
6. Add Non-Cummins Paralleling Control to PC3.3 Controlled Cummins Genset via speed and voltage bias	Common paralleling functionality	Added cost	

Add PCC3.3 Control System to Non-Cummins Genset

In this application, the PC3.3 is applied to an existing non-PCC genset control system for the primary purpose of providing PCC compatible paralleling. Refer to the figure below for the primary system interfaces.



Primary PC3.3 Interfaces Used:

- Speed Bias Output
- Voltage Bias Output
- Genset Voltage Sensing
- Genset Current Sensing
- Genset Bus Voltage Sensing
- Genset Breaker Position
- Genset Breaker Close
- Genset Breaker Open
- Utility Breaker Position (Load Govern Enable)

Trim Settings (apart from the usual):

- ECM CAN Enable = Disabled
- AVR Enable = Disable
- Starter Owner = ECS (so that PCC3300 is not doing the cranking control)
- External Bias Commands Enable = Enabled
- Speed Bias Output Settings as appropriate
- Voltage Bias Output Setting as appropriate

Table 1.2-2 Function Breakdown

Function	**Performed by PC3.3 ?**	**Performed by Non-Cummins ?**	**Comments**
Engine Cranking	No	Yes	

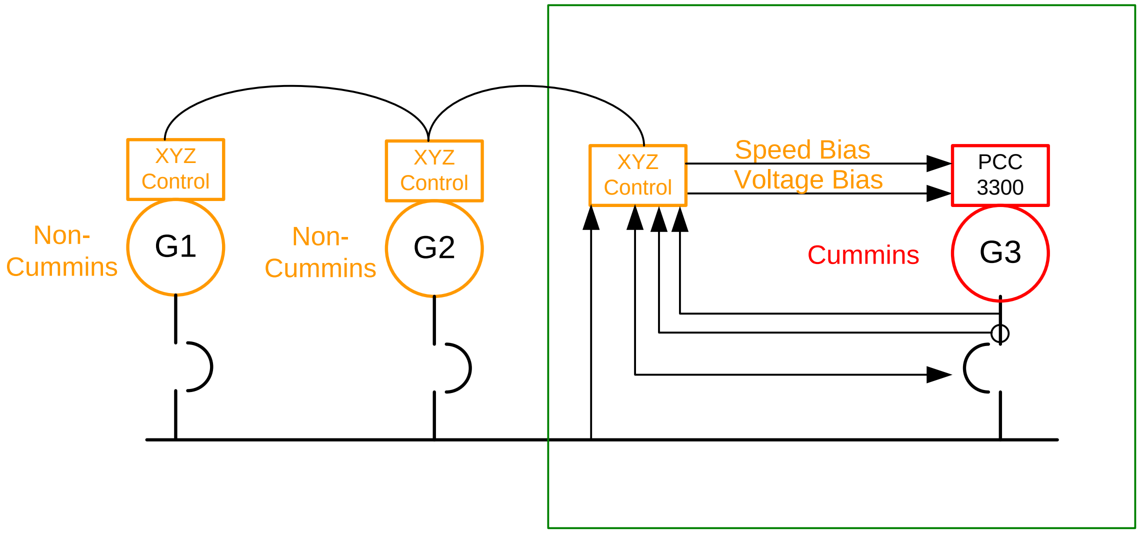
Engine Protection	No	Yes	
Engine Control	No	Yes	
Speed Governor	No	Yes	
Voltage Regulator	No	Yes	
Generator Protection	Optional	Yes	PC3.3 alternator protection settings may need to be adjusted
Generator AC Metering	Yes	Yes	
Genset Bus AC Voltage Metering	Yes	No	
First Start / Dead Bus Close	Yes	No	
Synchronizer	Yes	No	
Sync Check	Yes	No	
Isochronous Load Sharing	Yes	No	
Load Governing	Yes	No	
Paralleling Protections	Yes	No	

Interface Considerations:

- Protection settings: Make sure that generator protection setting are properly coordinated or turned off in one control or the other.
- Will genset be operated from the PC3.3? If so, need an output telling the non-Cummins control to start the genset. How do this?
- Or else system remote start needs to go to both the PC3.3 and non-Cummins control.
- PC3.3 shutdown output must cause shutdown fault on non-Cummins control and visa versa.
- Is it appropriate to use the keyswitch interface?

Add Non-Cummins Paralleling Control to PC3.3 Controlled Cummins Genset

In this application, the Non-Cummins paralleling control system is added to the PC3.3 Controlled Cummins Genset and operates via the speed and voltage bias lines. Refer to the figure below for an overview.



Method for Dead Bus Close

Inhibit Breaker Close Until Bus is Live

The most straightforward way to deal with dead bus closing in a system of Cummins and non-Cummins gensets is to prevent the non-Cummins gensets from closing their breakers until the bus is live. This allows the Cummins gensets to handle the dead bus closing function. The logic should be qualified with at least one of the Cummins gensets as being available to run (in Auto, and no Shutdown). Depending on the system and how many Cummins vs. nonCummins gensets there are, this method could be reversed, inhibiting the Cummins gensets from closing until the bus is live.

For implementation, this logic could be implemented in a PLC (gives greatest flexibility and robustness for failure scenarios), or alternatively it could conceivably done with hardwired logic using breaker contacts, gen cb inhibit inputs, etc.

PCC3.3 Single Genset and Paralleling Control Features

PCC3.3 Automatic Voltage Regulator

The PCC3.3 control system includes an integrated 3 phase voltage regulation system that is compatible with shunt and PMG excitation systems. The voltage regulation system is a 3 phase MOSFet type regulator for superior motor starting and steady state performance. Excitation power can either derived directly from the generator L-N terminals, generator L-L terminals, or a Permanent Magnet Generator (PMG). Positive voltage build up during startup is ensured by the use of efficient semiconductors in the power circuitry.

AVR Enable/Disable feature

The PCC3300 control provides automatic voltage regulating (AVR) capability for the generator set when the AVR feature is enabled on the genset. The field adjustment trim parameter *AVR Enable* = Enable / Disable is used to enable the AVR.

Digital Output Voltage Regulation

The PCC3300 control supports digital output voltage regulation as defined below.

- Voltage setpoint algorithm sets the level of the automatic voltage regulation. It is adjustable.
- The maximum allowed rated current for the field coil for the regulation is 4.0 Amps RMS and maximum 6.0 Amps for 10 seconds.
- The control provides voltage ramping at startup if the AVR algorithm is enabled, such that voltage overshoot can be controlled. AVR boot enable logic supports the step by step voltage ramping.
- A PC based service tool or HMI320 can be used by the operator to adjust the voltage within plus or minus 5.0% of rated voltage.

Torque-Matched Volts/Hz Overload Control

A frequency measuring circuitry monitors the generator output and provides output under-speed protection of the excitation system, by reducing the output voltage proportionally with speed.

PCC3.3 V/Hz Torque Matching

In order to improve the genset response of large transient load acceptances, the PCC3.3 contains a V/Hz roll off or torque matching feature. This feature reduces the output voltage of the genset as the frequency decreases in order to remove the total load, in kW, from the engine. This allows the engine to stay in its torque band and recover quicker from large block loads. The voltage roll-off set point and rate of decay are adjustable in the control system.

There are two parameters need to configure the torque matching feature

- *%Volts/Hz Slope Setting* defines how much (in %) to reduce the voltage based on the amount the frequency has dipped from the *%V/Hz Knee Frequency.*
- *%V/Hz Knee Frequency* defines for frequency dips lower then the *%V/Hz Knee Frequency* the voltage will be decreased at the *%V/Hz Slope Setting.* The default is 1.0Hz and it has a range from 0.5 to 10.0Hz.

PCC3.3 Battle Short Mode

The Battle Short mode prevents the genset from shutting down on a shutdown faults except some critical shutdown faults. **All shutdown faults, including those overridden by Battle Short, must be acted upon immediately to ensure the safety and well being of the operator and the genset.**

Warning

Use of the Battle Short mode can cause a fire or electrical hazard, resulting in severe personal injury or death and / or property and equipment damage. Operation of the genset must be supervised during Battle Short mode operation.

This feature should only be used during supervised, temporary operation of the genset. The faults that are overridden during Battle Short mode consist of faults that can affect genset performance or cause permanent **engine, alternator, or connected equipment damage. Operation may void generator set warranty if damage occurs that relates to fault condition.**

When Battle Short mode is enabled, **the Warning** status indicator is lit, along with displayed **fault code 1131 – Battle Short Active.**

With Battle Short mode enabled and an overridden shutdown fault occurs, the shutdown fault is announced but the genset does not shut down, and **fault code 1416 – Fail To Shut Down** is displayed.

The Fault Acknowledgement/Reset button will clear the fault message, but the faults will remain in the Fault / History table and Active Shutdown table.

Battle Short is disabled and a shutdown occurs immediately if any of the following critical shutdown faults occurs:

1) Overspeed – Fault Code 234, 1992 (application dependant)
2) Estop - Fault Code 1433, 1434
3) Loss of Speed Sense - 115 and 236 (application dependant)
4) Loss of Voltage Sense - Fault Code 2335
5) CAN Datalink Failure - Fault Code 781

6) Unannounced Engine Shutdown – Fault Code 1247
7) Engine Shutdown – Fault Code 1245
8) Cooldown Completed – Fault Code 1336
9) Genset AC Meter Failed Fault – FC 9517
10) Fail To Crank Fault – FC 1438
11) Fail To Start Fault – FC 359

Moving the customer installed Battle Short switch to OFF with an active but overridden shutdown fault or a shutdown fault that was overridden at any time will cause **Fault code 1123 – Shutdown After Battle Short** to become active.

The software for the Battle Short feature must be installed at the factory or ordered and installed by an authorized service representative. When installed, the InPower service tool is required to enable the Battle Short mode feature and to configure a Customer Input for an external switch input. This switch (customer supplied) allows the operator to enable/disable the Battle Short mode.

PCC3.3 Setup, Save Trims and Adjustments

Applying a PCC3300 control to a new application, the following parameters should be ensured to have appropriate values. Many of these can be adjusted using the HMI320 but some might require use of genset Manufacturing Tool and / or a PC based service tool. There will be different calibrations for various engine families.

PCC3.3 Saving Of Adjustments

When adjustments are made to the PCC3300 they are made to volatile (RAM) memory and must be saved to nonvolatile (EE) memory. In order to do this a save trims command must be sent to the controller. Upon receiving the save trims command; the PCC3300 waits for zero engine speed and then writes all of the internal parameters in volatile memory to nonvolatile memory.

A save trims command can come from a PC Based Service tool or via a MODBus message. Before initiating a start sequence the genset control refreshes all of the parameters in its memory, thusly any unsaved changes to trim parameters will be lost following a start command.

Important Warning: Nonvolatile memory has a limited number of write cycles, around 10*10^5 given today's technology. Thusly, it is important when attaching the controller to PLCs or other MODBus masters, that a save trims command **not be** repeatedly sent to the controller. A save trims command should only be sent to the controller after a parameter change.

PCC3.3 Significant Genset Parameters

The following are a list of significant critical genset parameters that need to be configured correctly prior to operation of the genset. This list is not inclusive of **every** parameter that needs configuration, these are just the biggest ones.

A. Genset Application Type – This setting is the primary application setting for the genset. It determines how the genset will be used. The available settings are Standalone, Synchronize Only, Isolated Bus Only, Utility Single, Utility Multiple, and Power Transfer Control.

B. KVA Rating – The genset KVA rating and application type (Prime, Standby, Base) should be properly set before the genset is started. All the overload protection thresholds correspond to set KVA rating

C. Frequency – The genset frequency should be set as per the required one (i.e. 50 Hz / 60 Hz)

D. Nominal Voltage – The nominal voltage should be set as per the voltage rating of alternator. Setting up a different nominal voltage other than the referred on alternator nameplate may cause damage to alternator. This parameter is required to be set within 3 phase high connection genset nominal voltage hi limit and low limit or 3 phase low connection genset nominal voltage hi limit and low limit. If the Nominal Voltage is greater then 601 volts, the Genset PT Primary Voltage and Genset PT Secondary Voltage also need be configured per the installed PT.

E. CT ratio – Controller should be calibrated for correct CT ratio, both Primary and Secondary Settings. Failing to do so, will cause an error in metered load (Amp, KVA, KW) sensed by controller causing mal-functioning of alternator protection.

F. AVR gains – Refer genset tuning for setting up the gains.

List of trims available through Service Tool and HMI320 –

SystemName	DefaultValue	LowerLimit	UpperLimit	Unit	PC Based Service Tool	Operator Panel	SystemDescription	Notes
Application Rating Select	Standby				X	X	Selects genset's standby/prime/base application rating.	Setup mode interlocked.
3 ph high conn Genset nom voltage hi limit	480	110	45000	Volts	X	X	High voltage setpoint limit for the high connection on a reconnectable alternator	
3 ph high conn Genset nom voltage lo limit	416	110	45000	Volts	X	X	Low voltage setpoint limit for the high connection on a reconnectable alternator	
3 ph low conn Genset nom voltage hi limit	240	110	45000	Volts	X	X	High voltage setpoint limit for the low connection on a reconnectable alternator	
3 ph low conn Genset nom voltage lo limit	208	110	45000	Volts	X	X	Low voltage setpoint limit for the low connection on a reconnectable alternator	
Genset Primary CT Current	5	5	10000	Amps	X	X	Genset CT primary current	Setup mode interlocked.
Genset CT Secondary Current	1 Amp			Amps	X	X	Genset CT secondary current	

Genset Delta/Wye Connection	Wye				X	X	Delta or Wye for Genset connection	Setup mode interlocked.
Genset L12 Voltage Adjust	100	90	110	%	X	X	Genset L12 voltage adjust trim	
Genset L1 Current Adjust	100	90	110	%	X	X	Genset L1 current adjust trim	
Genset L23 Voltage Adjust	100	90	110	%	X	X	Genset L23 voltage adjust trim	
Genset L2 Current Adjust	100	90	110	%	X	X	Genset L2 current adjust trim	
Genset L31 Voltage Adjust	100	90	110	%	X	X	Genset L31 voltage adjust trim	
Genset L3 Current Adjust	100	90	110	%	X	X	Genset L3 current adjust trim	

SystemName	**DefaultValue**	**LowerLimit**	**UpperLimit**	**Unit**	**PC Based Service Tool**	**Operator Panel**	**SystemDescription**	**Notes**
Genset Nominal Voltage	1	1	45000	Volts	X	X	Genset nominal line-line voltage. This parameter is required to be set within 3 phase high connection genset nominal voltage hi limit and low limit or 3 phase low connection genset nominal voltage hi limit and low limit	Setup mode interlocked.

Genset PT Primary Voltage	600	600	45000	Volts	X	X	Genset PT primary voltage	Setup mode interlocked.
Genset PT Secondary Voltage	100	100	600	Volts	X	X	Genset PT secondar voltage	Setup mode interlocked.
Genset Single Phase L1N Voltage Adjust	100	90	110	%	X	X	Genset Single Phase L1N voltage adjust trim	
Genset Single Phase L2N Voltage Adjust	100	90	110	%	X	X	Genset Single Phase L2N voltage adjust trim	
Single/3 Phase Connection	Three Phase				X	X	Setup mode interlocked. Genset's single phase/3 phase metering setup configuration.	Setup mode interlocked.
Genset Source Name	Genset				X	X	Name for the genset source	
Prime kVA rating (single phase/ 50Hz)	1	1	6000	KVA	X	X		Setup mode interlocked.
Prime kVA rating (single phase/ 60Hz)	1	1	6000	KVA	X	X		Setup mode interlocked.
Prime kVA rating (3 phase/ 50Hz)	1	1	6000	KVA	X	X		Setup mode interlocked.
Prime kVA rating (3 phase/ 60Hz)	1	1	6000	KVA	X	X		Setup mode interlocked.

SystemName	DefaultValue	LowerLimit	UpperLimit	Unit	PC Based Service Tool	Operator Panel	SystemDescription	Notes
Single phase Genset nom voltage hi limit	240	110	600	Volts	X	X	High voltage setpoint limit for the single phase connected alternator	
Single phase Genset nom voltage lo limit	208	110	600	Volts	X	X	Low voltage setpoint limit for the single phase connected alternator	
Power Factor rating (single phase)	1	0.7	1		X	X	Genset single phase power factor rating	Setup mode interlocked.
Standby kVA rating (single phase/ 50Hz)	1	1	6000	KVA	X	X		Setup mode interlocked.
Standby kVA rating (single phase/ 60Hz)	1	1	6000	KVA	X	X		Setup mode interlocked.
Standby kVA rating (3 phase/ 50Hz)	1	1	6000	KVA	X	X		Setup mode interlocked.
Standby kVA rating (3 phase/ 60Hz)	1	1	6000	KVA	X	X		Setup mode interlocked.

Power Factor rating (three phase)	.8	0.7	1	X	X	Genset three phase power factor rating	Setup mode interlocked.

SystemName	DefaultValue	LowerLimit	UpperLimit	Unit	PC Based Service Tool	Operator Panel	SystemDescription	Notes
Genset Current Measurement Floor Limit	1.2	0.1	10	%	X	X	The Genset Current Measurement Floor Limit(trim) shall be a setup trim allowing the operating range floor % to be adjusted to a higher value removing the Genset CT Ratio Too Large fault at the cost of acknowledging that the measurement system is not optim	
Genset Voltage Measurement Floor Limit	2.0	0.1	10	%	X	X	The Genset Voltage Measurement Floor Limit(trim) shall be a setup trim allowing the operating range floor % to be adjusted to a higher value removing the Genset PT Ratio Too Large fault at the cost of acknowledging that the measurement system is not optim	

Base kVA rating (3 phase/ 60Hz)	1	1	6000	KVA	X			Setup mode interlocked.
Base kVA rating (3 phase/ 50Hz)	1	1	6000	KVA	X		Base kVA rating (3 ph / 50Hz)	Setup mode interlocked.
Base kVA rating (single phase/ 50Hz)	1	1	6000	KVA	X			Setup mode interlocked.
Base kVA rating (single phase/ 60Hz)	1	1	6000	KVA	X			Setup mode interlocked.

SystemName	DefaultValue	LowerLimit	UpperLimit	Unit	PC Based Service Tool	Operator Panel	SystemDescription	Notes
High AC Voltage Delay	10	0.1	10	Sec	X	X	Time delay before High AC Voltage fault becomes active.	
Instantaneous High AC Voltage Threshold	130	125	150	%	X	X	Percent of desired voltage at which Instantaneous High AC Voltage fault becomes active.	
Lost AC AVR PWM Threshold	25	0	50	%	X	X	Sets the AVR PWM threshold for Loss of AC Voltage Sensing Fault	
Lost AC Speed Threshold	1200	0	2000	RPM	X	X	Sets the Lost AC Speed threshold for Loss of AC Voltage Sensing Fault	

Lost AC Voltage Threshold	10	0	25	%	X	X	Sets average voltage threshold for Loss of AC Voltage sensing fault.
Lost AC Current Threshold	25	0	150	%	X	X	Sets current threshold for Loss of AC Voltage sensing fault
Low AC Voltage Delay	10	2	20	Sec	X	X	Time delay before Low AC Voltage fault becomes active
Max Field Time	15	3	30	Sec	X	X	The maximum allowed time at Max Field Duty Cycle.
Overfrequency Delay	20	1	20	Sec	X	X	Time delay before Overfrequency fault becomes active.
Overfrequency Enable	Disabled				X	X	Enables overfrequency diagnostic.
Overfrequency Threshold	6	2	10	Hz	X	X	Number of Hertz Alternator Line Frequency may be over nominal frequency before Overfrequency fault becomes active.
Overload Warning Set Time	60	1	120	Sec	X	X	The time delay until an overload condition is reported as a fault
Overload Warning Threshold	105	80	140	%	X	X	Sets the Overload Warning fault trip threshold as percentage of genset application kW rating.
Reverse kVAR Threshold	20	15	50	%	X	X	Sets the Reverse kVAR fault trip threshold as percentage of Standby kW rating.

SystemName	DefaultValue	LowerLimit	UpperLimit	Unit	PC Based Service Tool	Operator Panel	SystemDescription	Notes
Reverse kVAR Time Delay	10	10	60	Sec	X	X	Sets the Reverse kVAR fault trip time delay	
Reverse kW Threshold	10	5	30	%	X	X	Sets the Reverse kW fault trip threshold as percentage of Standby kW rating.	
Reverse kW Time Delay	3	1	15	Sec	X	X	Sets the Reverse kW fault trip time delay	
Underfrequency Delay	10	5	20	Sec	X	X	Time delay before Underfrequency fault becomes active.	
Underfrequency Threshold	6	2	10	Hz	X	X	Number of Hertz Alternator Line Frequency may be under nominal frequency before Underfrequency fault becomes active.	
Low AC Voltage Threshold	85	50	95	%	X	X	Percent of desired voltage at which Low AC Voltage fault becomes active.	
High AC Voltage Threshold	110	105	125	%	X	X	Percent of desired voltage at which High AC Voltage fault becomes active	

Lost AC Time Delay	1	0	25.5	Sec	X	X	Sets the time delay for the Loss of AC Voltage Sensing fault.
Voltage Bias OOR Check Enable	Disabled				X	X	Enable for the Voltage Bias OOR faults.
Voltage Bias OOR High Limit	5.00	-5	5	Volts	X	X	High limit for the Voltage Bias OOR fault.
Voltage Bias OOR Time	1.0	0	10	Sec	X	X	Time limit for the Voltage Bias OOR faults.

SystemName	DefaultValue	LowerLimit	UpperLimit	Unit	PC Based Service Tool	Operator Panel	SystemDescription	Notes
Voltage Bias Input Scaling Table	See Notes				X		XY scaling table for the Voltage Bias input.	Default scaling is: Input(-5.00, -2.50, 2.50, 5.00)V Output(-25.00, -12.50, 12.50, 25.00)%
Speed Bias Input Scaling Table	See Notes				X		XY scaling table for the Speed Bias input.	Default scaling is: Input(-5.00, -2.50, 2.50, 5.00)V Output(-10.00, -5.00, 5.00, 10.00)%
Speed Bias OOR Check Enable	Disabled				X	X	Enable for the Speed Bias OOR faults.	
Speed Bias OOR High	5.00	-5	5	Volts	X	X	High limit for the Speed Bias	

Limit							OOR fault.	
Speed Bias OOR Low Limit	-5.00	-5	5	Volts	X	X	Low limit for the Speed Bias OOR fault.	
Speed Bias OOR Time	1.0	0	10	Sec	X	X	Time limit for the Speed Bias OOR faults.	
Voltage Bias OOR Low Limit	-5.00	-5	5	Volts	X	X	Low limit for the Voltage Bias OOR fault.	
Genset 3 Phase Fast Average Voltage Single Phase Filter K1	0.180	0	1	N/A	X		First filter K for the single phase calculation of Genset 3 Phase Fast Average Voltage.	
SystemName	**DefaultValue**	**LowerLimit**	**UpperLimit**	**Unit**	**PC Based Service Tool**	**Operator Panel**	**SystemDescription**	**Notes**
Genset 3 Phase Fast Average Voltage Single Phase Filter K2	0.180	0	1	N/A	X		Second filter K for the single phase calculation of Genset 3 Phase Fast Average Voltage.	
Fault Code 1117 Enable	Enabled				X	X	Used to Enable/Disable fault 1117 (Power Lost With Ignition On) on the genset control. Fault will be ignored with a disabled setting.	
Keyswitch Minimum On Time	4.0	0.1	5	Sec	X	X	Minimum time the keyswitch driver command needs to be on before CAN datalink health will be checked	

Keyswitch Reset Delay	5.0	0.5	10	Sec	X	X	A trim that sets the delay time for the keyswitch when resetting the ECS
Datalink Failed Timer	3.0	0.1	10	Sec	X		A trim that sets a delay time for a shutdown based upon a Datalink Failure
CAN Failure Retries	3	1	10	N/A	X	X	Sets the maximum number of CAN communication retries
ECM Datasave Time Delay	30.0	0	60	Sec	X	X	A trim that sets the delay time for the ECM Dataplate saves
Engine Information 2 PGN65288 Enable	Enabled				X		A trim that enables this PGNs processing
Engine Information PGN65170 Enable	Enabled				X		A trim that enables this PGNs processing
Exhaust Port Temperature 5 PGN65183 Enable	Enabled				X		A trim that enables this PGNs processing
Exhaust Port Temperature 4 PGN65184 Enable	Enabled				X		A trim that enables this PGNs processing
Exhaust Port Temperature 3 PGN65185 Enable	Enabled				X		A trim that enables this PGNs processing
Exhaust Port Temperature 2 PGN65186 Enable	Enabled				X		A trim that enables this PGNs processing

SystemName	DefaultValue	LowerLimit	UpperLimit	Unit	PC Based Service Tool	Operator Panel	SystemDescription	Notes
Exhaust Port Temperature 1 PGN65187 Enable	Enabled				X		A trim that enables this PGNs processing	
Intake Manifold Information 2 PGN65189 Enable	Enabled				X		A trim that enables this PGNs processing	
Intake Manifold Information 1 PGN65190 Enable	Enabled				X		A trim that enables this PGNs processing	
Engine Fuel Level/Pressure 2 PGN65243 Enable	Enabled				X		A trim that enables this PGNs processing	
Turbocharger PGN65245 Enable	Enabled				X		A trim that enables this PGNs processing	
Fuel Economy Liquid PGN65266 Enable	Enabled				X		A trim that enables this PGNs processing	
Ambient Conditions PGN65269 Enable	Enabled				X		A trim that enables this PGNs processing	
Water In Fuel Indicator PGN65279 Enable	Enabled				X		A trim that enables this PGNs processing	
Speed Gov Owner	ECS				X		Tells the GCS which box is going to do the speed governing	

SystemName	DefaultValue	LowerLimit	UpperLimit	Unit	PC Based Service Tool	Operator Panel	SystemDescription	Notes
ECM CAN Enable					X	X	Set to Disabled if there is no ECM (HMECM or otherwise) connected to the control.	Setup mode interlocked.
Keyswitch Engine Stop Delay	30.0	0	120	Sec	X		A trim that sets the delay time for the keyswitch when initialy shutting down on datalink failure	
QSX15/CM570 Application Enable	Disabled				X	X	Used to enable the control adaptions for the QSX15/CM570 genset application.	Setup mode interlocked.
SystemName	DefaultValue	LowerLimit	UpperLimit	Unit	PC Based Service Tool	Operator Panel	SystemDescription	Notes
Auto Sleep Enable					X	X	Trim to determine if the Auto input is used as a wake-up or not	
Power Down Mode Enable	Enable				X	X	Trim to enable sleep mode	
Power Down Mode Time Delay	600	0	600	Sec	X	X	Timer setting for the Power Down delay feature	
Max Setup Mode Time	600	30	3600	Sec	X		Max time allowed in Setup Mode.	

SystemName	DefaultValue	LowerLimit	UpperLimit	Unit	PC Based Service Tool	Operator Panel	SystemDescription	Notes
Alternator Model Number	0				X	X	Number indentifying this gensets alternator model number.	Modbus uses addresses 43240 - 43259 for the 20 char text string.
Alternator Serial Number	0				X	X	Unique number indentifying this gensets alternator serial number.	Modbus uses addresses 43260 - 43279 for the 20 char text string.
Calibration Part Number	0				X	X	The unique calibration part number loaded into this control.	Typically set by the Pctool at time of production download.
Calibration Revision Date	0				X	X	The revision date of the calibration part number loaded into this control.	

Daylight Savings End Day	Sunday				X	X	Use to set the day of the week when daylight savings time ends.	
Daylight Savings End Hour	2	0	23		X	X	Use to set the hour of the day when daylight savings time ends.	
Daylight Savings End Month	11	1	12		X	X	Use to set the month when daylight savings time ends.	
Daylight Savings End Week	Second Week				X	X	Use to set the week of the month when daylight savings time ends.	
Daylight Savings Start Day	Sunday				X	X	Use to set the day of the week when daylight savings time starts.	
Daylight Savings Start Hour	2	0	23		X	X	Use to set the hour of the day when daylight savings time starts.	
Daylight Savings Start Month	3	1	12		X	X	Use to set the month when daylight savings time starts.	
Daylight Savings Start Week	Third Week				X	X	Use to set the week of the month when daylight savings time starts.	
SystemName	**DefaultValue**	**LowerLimit**	**UpperLimit**	**Unit**	**PC Based Service Tool**	**Operator Panel**	**SystemDescription**	**Notes**

Daylight Savings Time Adjustment	60	0	120	Minute	X	X	Use to set the amount of daylight savings time adjustment applied.	
Daylight Savings Time Enable	Disabled				X	X	Use to enable the daylight savings time feature.	
Engine Serial Number	0				X	X	Unique number indentifying this genset's engine.	
Exercise Scheduler Enable	Disabled				X	X	Enables the exercise scheduler.	
Genset Model Number	0				X	X	Number indentifying the model of this genset.	
Genset Serial Number	0				X	X	Unique number indentifying this genset.	
SystemName	**DefaultValue**	**LowerLimit**	**UpperLimit**	**Unit**	**PC Based Service Tool**	**Operator Panel**	**SystemDescription**	**Notes**
Starter Disconnect Speed	475	100	600			X	Sets the engine speed at which the cranking algorithm disengages the starter	

SystemName	DefaultValue	LowerLimit	UpperLimit	Unit	PC Based Service Tool	Operator Panel	SystemDescription	Notes
Engine Model Number	0				X	X	Number indentifying the model of this genset's engine.	Modbus uses addresses ?? - ?? for the 20 char of this string. Uses logical numbers ? - ? to hold each of the 20 characters.
Scheduler Exception Setup Table					X		Used to adjust all of the scheduled exceptions from the PC Tool.	
Scheduler Programs Setup Table					X		Used to adjust all of the scheduled programs from the PC Tool.	

Factory Installed Feature List RW		X	X	List of feature installed at the factory. This table consists of a single column named "Feature Part Number" with 20 rows each row containing a 12 character string.
Field Installed Feature List RW		X	X	List of feature installed in the field. This table consists of a single column named "Feature Part Number" with 20 rows each row containing a 12 character string.
Auto Switch Active State Selection	Active Closed	X	X	Auto switch input software logic state inversion bypass control

SystemName	DefaultValue	LowerLimit	UpperLimit	Unit	PC Based Service Tool	Operator Panel	SystemDescription	Notes
Configurable Input #13 Active State Selection	Active Closed				X	X	Configurable Input #13 input software logic state inverion bypass control	
Configurable Input #13 Fault Text	Customer Input 3				X	X	Trim to define the 20 character string for use by the Operator panel when this fault becomes active.	
Configurable Input #13 Input Function Pointer_	Default				X		Configurable Input #13 Input function pointer. Feeds input signal to alternate function input if value not set to default.	
Configurable Input #14 Active State Selection	Active Closed				X	X	Configurable Input #14 input software logic state inverion bypass control	
Configurable Input #14 Fault Text	Customer Input 4				X	X	Trim to define the 20 character string for use by the Operator panel when this fault becomes active.	
Configurable Input #14 Input Function Pointer_	Default				X		Configurable Input #14 Input function pointer. Feeds input signal to alternate function input if value not set to default	

Configurable Input #1 Active State Selection	Active Closed				X	X	Configurable Input #1 input software logic state inversion bypass control	
Configurable Input #1 Factory Lock	Not Locked				X	X	Config Input #1 Factory Lock	
Configurable Input #1 Fault Text	Customer Input 1				X	X	Trim to define the 20 character string for use by the Operator panel when this fault becomes active.	Uses Modbus addresses 40600 - 40619.
Configurable Input #1 Input Function Pointer_	Default				X		Configurable Input #1 Input function pointer. Feeds input signal to alternate function input if value not set to default	
SystemName	**DefaultValue**	**LowerLimit**	**UpperLimit**	**Unit**	**PC Based Service Tool**	**Operator Panel**	**SystemDescription**	**Notes**
Configurable Input #2 Active State Selection	Active Closed				X	X	Configurable Input #2 input software logic state inversion bypass control	
Configurable Input #2 Factory Lock	Not Locked				X	X	Configurable Input #2 Factory Lock	
Configurable Input #2 Fault Text	Customer Input 2				X	X	Trim to define the 20 character string for use by the Operator panel when this fault becomes active.	Uses Modbus addresses 40620 -

40639.

Configurable Input #2 Input Function Pointer_	Default	X		Configurable Input #2 Input function pointer. Feeds input signal to alternate function input if value not set to default.
Configurable Input #13 Factory Lock	Not Locked	X	X	Configurable Input #13 Factory Lock
Configurable Input #14 Factory Lock	Not Locked	X	X	Configurable Input #14 Factory Lock
Coolant Level/Configurable Input #5 Active State Selection	Active Closed	X	X	Coolant Level input software logic state inversion bypass control
Coolant Level/Configurable Input #5 Factory Lock	Locked	X	X	Coolant Level Factory Lock
Coolant Level/Configurable Input #5 Function Pointer_	Default	X		Coolant Level Input function pointer. Feeds input signal to alternate function input if value not set to default
Fault Reset/Configurable Input #10 Active State Selection	Active Closed	X	X	Fault Reset input software logic state inversion bypass control
Fault Reset/Configurable Input #10 Factory Lock	Not Locked	X	X	Fault Reset Factory Lock

SystemName	DefaultValue	LowerLimit	UpperLimit	Unit	PC Based Service Tool	Operator Panel	SystemDescription	Notes
Fault Reset/Configurable Input #10 Function Pointer_	Default				X		Fault Reset Input function pointer. Feeds input signal to alternate function input if value not set to default	
Local E-stop Active State Selection	Active Open				X	X	Local E-stop input software logic state inverion bypass control	
Low Fuel/Configurable Input #6 Active State Selection	Active Closed				X	X	Low Fuel input software logic state inversion bypass control	
Low Fuel/Configurable Input #6 Factory Lock	Locked				X	X	Low Fuel Factory Lock	
Low Fuel/Configurable Input #6 Function Pointer_	Default				X	X	Low Fuel Input function pointer. Feeds input signal to alternate function input if value not set to default	
Manual Switch Active State	Active Closed				X	X	Manual input software logic state inverion bypass control	
Remote Start Switch Active State Selection	Active Closed				X	X	Remote Start input software logic state inversion bypass control	

SystemName	DefaultValue	LowerLimit	UpperLimit	Unit	PC Based Service Tool	Operator Panel	SystemDescription	Notes
Rupture Basin/Configurable Input #12 Active State Selection	Active Closed				X	X	Rupture Basin input software logic state inversion bypass control	
Rupture Basin/Configurable Input #12 Factory Lock	Not Locked				X	X	Rupture Basin Factory Lock	
Rupture Basin/Configurable Input #12 Function Pointer_	Default				X	X	Rupture Basin Input function pointer. Feeds input signal to alternate function input if value not set to default	
Start Type/Configurable Input #11 Active State Selection	Active Closed				X	X	Start Type input software logic state inversion bypass control	
Start Type/Configurable Input #11 Factory Lock	Not Locked				X	X	Start Type Factory Lock	
Start Type/Configurable Input #11 Function Pointer_	Default				X		Start Type Input function pointer. Feeds input signal to alternate function input if value not set to default	
Ramp Load/Unload/Configurable Input #32 Factory Lock	Not Locked				X	X	Factory Lock for the Ramp Load/Unload input.	

Remote E-stop Active State Selection	Active Open		X		Remote E-stop input software logic state inverion bypass control
Delayed Off / Configurable Output #10 Factory Lock	Not Locked		X	X	Prevents Output Function Pointer and Invert Bypass from being modified unless in Factory mode
Delayed Off / Configurable Output #10 Output Function Pointer_	Default		X		Points to the function that controls the output
Delayed Off / Configurable Output #10 Invert Bypass	Bypassed		X	X	Controls wheither the output function is inverted or not. Bypassed = function not inverted
Configurable Output #1 Factory Lock	Not Locked		X	X	Prevents Output Function Pointer and Invert Bypass from being modified unless in Factory mode
Configurable Output #1 Event Code	Fault Code 1540 0	65535	X	X	The event code for this output.
Configurable Output #1 Output Function Pointer_	Default		X		Points to the function that controls the output
Configurable Output #1 Invert Bypass	Bypassed		X	X	Controls wheither the output function is inverted or not. Bypassed = function not inverted

Configurable Output #2 Factory Lock	Not Locked				X	X	Prevents Output Function Pointer and Invert Bypass from being modified unless in Factory mode	

SystemName	DefaultValue	LowerLimit	UpperLimit	Unit	PC Based Service Tool	Operator Panel	SystemDescription	Notes
Configurable Output #2 Event Code	Fault Code 1541	0	65535		X	X	The event code for this output.	
Configurable Output #2 Output Function Pointer_	Default				X	X	Points to the function that controls the output	
Configurable Output #2 Invert Bypass	Bypassed				X	X	Controls wheither the output function is inverted or not. Bypassed = function not inverted	
Configurable Output #3 Factory Lock	Not Locked				X	X	Prevents Output Function Pointer and Invert Bypass from being modified unless in Factory mod	
Configurable Output #3 Event Code	Fault Code 1463	0	65535		X	X	The event code for this output.	
Configurable Output #3 Output Function Pointer_	Default				X		Points to the function that controls the output	
Configurable Output #3 Invert Bypass	Bypassed				X	X	Controls wheither the output function is inverted or not.	

							Bypassed = function not inverted	
Configurable Output #4 Factory Lock	Not Locked				X	X	Prevents Output Function Pointer and Invert Bypass from being modified unless in Factory mode	
Configurable Output #4 Event Code	Fault Code 1465	0	65535		X	X	The event code for this output.	
Configurable Output #4 Output Function Pointer_	Default				X		Points to the function that controls the output	
Configurable Output #4 Invert Bypass	Bypassed				X	X	Controls wheither the output function is inverted or not. Bypassed = function not inverted	
Fault Code Function #1 Fault/Event Code	0	0	65535		X	X	The fault/event code for this configurable fucntion output.	
SystemName	**DefaultValue**	**LowerLimit**	**UpperLimit**	**Unit**	**PC Based Service Tool**	**Operator Panel**	**SystemDescription**	**Notes**
Fault Code Function #2 Fault/Event Code	0	0	65535		X	X	The fault/event code for this configurable fucntion output.	
Fault Code Function #3 Fault/Event Code	0	0	65535		X	X	The fault/event code for this configurable fucntion output.	
Fault Code Function #4 Fault/Event Code	0	0	65535		X	X	The fault/event code for this configurable fucntion output.	

Fault Code Function #5 Fault/Event Code	0	0	65535	X	X	The fault/event code for this configurable fucntion output.	
Glow Plug / Configurable Output #8 Factory Lock	Not Locked			X	X	Prevents Output Function Pointer and Invert Bypass from being modified unless in Factory mode	
Glow Plug / Configurable Output #8 Output Function Pointer	Default			X	X	Points to the function that controls the output	Setup mode interlocked.
Glow Plug / Configurable Output #8 Invert Bypass	Bypassed			X	X	Controls wheither the output function is inverted or not. Bypassed = function not inverted	
Load Dump / Configurable Output #11 Factory Lock	Not Locked			X	X	Prevents Output Function Pointer and Invert Bypass from being modified unless in Factory mode	
Load Dump / Configurable Output #11 Output Function Pointer_	Default			X		Points to the function that controls the output	
Load Dump / Configurable Output #11 Invert Bypass	Bypassed			X	X	Controls wheither the output function is inverted or not. Bypassed = function not inverted	
Local Status / Configurable Output #7 Factory Lock	Not Locked			X	X	Prevents Output Function Pointer and Invert Bypass from being modified unless in	

							Factory mode	
Local Status / Configurable Output #7 Output Function Pointer_	Default				X		Points to the function that controls the output	
SystemName	**DefaultValue**	**LowerLimit**	**UpperLimit**	**Unit**	**PC Based Service Tool**	**Operator Panel**	**SystemDescription**	**Notes**
Local Status / Configurable Output #7 Invert Bypass	Bypassed				X	X	Controls wheither the output function is inverted or not. Bypassed = function not inverted	
Oil Priming Pump / Configurable Output #6 Factory Lock	Not Locked				X	X	Prevents Output Function Pointer and Invert Bypass from being modified unless in Factory mode	
Oil Priming Pump / Configurable Output #6 Output Function Pointer_	Default				X		Points to the function that controls the output	
Oil Priming Pump / Configurable Output #6 Invert Bypass	Bypassed				X	X	Controls wheither the output function is inverted or not. Bypassed = function not inverted	
Ready To Load / Configurable Output #5	Not Locked				X	X	Controls wheither the output function is inverted or not. If	

Factory Lock							bypassed the function is not inverted	
Ready To Load /Configurable Output #5 Output Function Pointer_	Default				X		Points to the function that controls the output	
Ready To Load /Configurable Output #5 Invert Bypass	Bypassed				X	X	Controls wheither the output function is inverted or not. Bypassed = function not inverted	
Oil Priming Pump / Configurable Output #6 Output Function Pointer	Default				X	X	Points to the function that controls the output	Setup mode interlocked.
Ready To Load /Configurable Output #5 Output Function Pointer	Default				X	X	Points to the function that controls the output	Setup mode interlocked.
Local Status / Configurable Output #7 Output Function Pointer	Default				X	X	Points to the function that controls the output	Setup mode interlocked.

SystemName	**DefaultValue**	**LowerLimit**	**UpperLimit**	**Unit**	**PC Based Service Tool**	**Operator Panel**	**SystemDescription**	**Notes**
Load Dump / Configurable Output #11 Output Function Pointer	Default				X	X	Points to the function that controls the output	Setup mode interlocked.

Configurable Output #3 Output Function Pointer	Default				X	X	Points to the function that controls the output	Setup mode interlocked.
Configurable Output #4 Output Function Pointer	Default				X	X	Points to the function that controls the output	Setup mode interlocked.
Configurable Output #1 Output Function Pointer	Default				X	X	Points to the function that controls the output	Setup mode interlocked.
Configurable Output #2 Output Function Pointer	Default				X	X	Points to the function that controls the output	Setup mode interlocked.
Battle Short Enable	Disabled				X	X	Trim to enable Battle Short.	
Delayed Shutdown Enable	Disabled				X	X	Enables the Delayed Shutdown feature.	
Delayed Shutdown Time Delay	2.0	0	3		X	X	Sets the shutdown fault delayed time delay for the Delayed Shutdown feature.	
Enable Remote Fault Reset	Disabled				X	X	Trim to enable Remote Fault Reset.	

SystemName	DefaultValue	LowerLimit	UpperLimit	Unit	PC Based Service Tool	Operator Panel	SystemDescription	Notes

Site ID	Site 1				X	X	name of site	
LCL Detection Response	None				X	X	Sets low coolant level fault response to None Warning or Shutdown.	
LCT Warning Clear Time	1	0	30	Minutes	X	X	Sets time to clear the low coolant temp fault.	
LCT Warning Set Time	1	0	30	Minutes	X	X	Sets time to set the low coolant temp fault.	
LCT Warning Threshold	70	-20	100	Deg F	X	X	Sets threshold for the low coolant temp fault.	
12 V Low Battery Voltage Running Threshold	12	12	16	Volts	X	X	Sets 12V low battery voltage fault threshold for genset operation while in rated mode	
12 V Low Battery Voltage Stopped Threshold	12	11	13	Volts	X	X	Sets 12V low battery voltage fault threshold for genset operation in all modes except rated	
24 V Low Battery Voltage Running Threshold	24	24	28	Volts	X	X	Sets 24V low battery voltage fault threshold for genset operation while in rated mode	
24 V Low Battery Voltage Stopped Threshold	24	22	26	Volts	X	X	Sets 24V low battery voltage fault threshold for genset operation in all modes except rated	
Adjustable Freq/Speed Gain	30	0	240		X	X	Sets the rpm/Hz conversion factor when the Freq to Speed Gain Select trim is set to this	Setup mode interlocked.

SystemName	DefaultValue	LowerLimit	UpperLimit	Unit	PC Based Service Tool	Operator Panel	SystemDescription	Notes
							trim	
Alternate Frequency Switch	60Hz				X	X	Sets the genset nominal frequency.	Setup mode interlocked.
AVR Damping Effect (50 Hz)	78.00	0	99.99		X	X	This is damping effect used to calculate K4.	
K1 (50 Hz)	4.00	0	100		X	X	This gain affects the overall regulator gain in 50 Hz applications. Similar to proportional gain. PCF scale factor = 0.01	
K2 (50 Hz)	1.00	0.02	99.99		X	X	This is gain 2 in 50 Hz applications. (1-K2) is z plane zero location. PCF scale factor = 0.01	
K3 (50 Hz)	84.00	0	100		X	X	This is gain 3 in 50 Hz applications. K3 is z plane pole location. (K3+K4) is z plane zero location. PCF scale factor = 0.01	

AVR Damping Effect (60 Hz)	79.00	0	99.99		X	X	This is damping effect used to calculate K4. PCF scale factor = 1/100
K1 (60 Hz)	4.00	0	100		X	X	This gain affects the overall regulator gain in 60 Hz applications. Similar to proportional gain. PCF scale factor = 0.01
K2 (60 Hz)	1.00	0.02	99.99		X	X	This is gain 2 in 60 Hz applications. (1-K2) is z plane zero location. PCF scale factor = 0.01
K3 (60 Hz)	86.00	0	100		X	X	This is gain 3 in 60 Hz applications. K3 is z plane pole location. (K3+K4) is z plane zero location. PCF scale factor = 0.01
AVR Gain Adjust Trim	1	0.05	10		X	X	A trim that allows the user to modify the overall gain of the AVR
Continuous Crank Engage Time	75	40	100	Sec	X	X	Sets the maximum amount of time to engage the starter when using the continuous cranking method
Cycle / Cont Crank Select	Cycle				X	X	Selects whether to use continuous cranking or cycle cranking when attempting to

							start engine	
Cycle Crank Engage Time	15	2	20	Sec	X	X	Sets the maximum amount of time to engage the starter during a single crank attempt when using the cycle cranking method	
Cycle Crank Rest Time	15	7	40	Sec	X	X	Sets the amount of time to wait between crank attempts	
SystemName	**DefaultValue**	**LowerLimit**	**UpperLimit**	**Unit**	**PC Based Service Tool**	**Operator Panel**	**SystemDescription**	**Notes**
Delayed Off FSO Relay Time	0	0	120	Sec	X	X	Time delay between when the Delayed Off Command turns off and Run Command turns off	
Frequency Adjust	0	-6	6	Hz	X	X	A method of adding in a frequency offset to the base frequency subject to high and low limit calibrations	
Frequency Options	60Hz or 50Hz			Hz	X	X	Sets the allowed options for the Alternate Frequency Switch	Setup mode interlocked.
Genset Idle Enable	Enabled				X	X	Enables or Disable idling of genset with external governor.	
Idle Cooldown Time	2	0	60	Min	X	X	Sets time to run at idle before	

							shutting down genset on normal stops	
Idle Speed	800	700	1100	RPM	X	X	Sets the speed at which the engine will idle subject to high and low limit calibrations	Setup mode interlocked.
Idle to Rated Ramp Time	0	0	30	Sec	X	X	The time over which the speed reference is to ramp from idle speed to rated speed	
Idle Warmup Coolant Temp	100	-40	300	Deg F	X	X	Coolant temperature threshold to end idle warmup time	
Idle Warmup Time	0	0	3600	Sec	X	X	Sets maximum idle warmup time. Warmup time may be less if coolant temperature exceeds threshold	
Load Dump Activation Method	Overload or Overfreq				X	X	Enables the load dump output as a function of the overload and underfrequency conditions	
Load Dump Overload Set Time	60	0	120	Sec	X	X	The time delay until the load dump overload condition is set active	

SystemName	DefaultValue	LowerLimit	UpperLimit	Unit	PC Based Service Tool	Operator Panel	SystemDescription	Notes
Load Dump Overload Threshold	105	80	140	%	X	X	The load dump overload threshold as a percentage of the genset application rating	
Load Dump Underfrequency Offset	3	0	10	Hz	X	X	The frequency amount which the load dump underfrequency threshold is below the final frequency reference	
Load Dump Underfrequency Set Time	3	0	20	Sec	X	X	The time delay until the load dump underfrequency condition is set active	
Low Fuel in Day Tank Time	2	0	20	Sec	X	X	Fault time delay from switch input.	
Low Fuel Set/Clear Time	2	2	60	Sec	X	X	A trim that sets the delay time for generating the inactive and active fault reports to the event handler	
Max Idle Time	10	0	20	Minutes	X	X	Sets the fault time for the Too Long in Idle fault.	
Nominal Battery Voltage	24V			Volts	X	X	Selects the genset's nominal battery operating voltage	Setup mode interlocked.

PMG/Shunt Excitation	PMG				X	X	The type of excitation power source PMG or Shunt	Setup mode interlocked.
Prelube Cycle Enable	Disabled				X	X	Enables Or Disables the cyclic mode of prelube operation	Setup mode interlocked.
Prelube Cycle Time	168	1	1000	Hours	X	X	Sets the period of the Prelube Cycle Iteration	
Prelube Function Enable	Disabled				X	X	Selects whether the Prelube function is enabled or disabled. This is Setup mode interlocked	

SystemName	DefaultValue	LowerLimit	UpperLimit	Unit	PC Based Service Tool	Operator Panel	SystemDescription	Notes
Prelube Oil Pressure Threshold	3	0	10	PSI	X	X	The oil pressure value which when reached the prelube driver will turn off	
Prelube Timeout Period	10	0	30	Sec	X	X	Sets the maximum time for which the Prelube Driver will Remain ON	
Rated Cooldown Time	0	0	600	Sec	X	X	Minimum time to spend at rated speed less than 10% load before normal shutdown is allowed	

Rated to Idle Ramp Time	2	0	30	Sec	X	X	The time over which the speed reference is to ramp from rated speed to idle speed	
Rated to Idle Transition Delay	0	0	10	Sec	X	X	Sets the delay time for transitioning from Rated to (low speed)Idle mode. 0 seconds = feature is disabled.	
Rupture Basin Time	2	0	20	Sec	X	X	fault time delay	
Start Time Delay	0	0	300	Sec	X	X	Sets the time to wait from receiving a valid remote start signal until starting the genset	
Starter Owner	0				X	X	Tells the GCS which control system has starter control	Setup mode interlocked.
Starting to Rated Ramp Time	1	0	30	Sec	X	X	The time over which the speed reference is to ramp from starting speed to rated speed	
Time Delay to Stop	0	0	600	Sec	X	X	Sets time to run at rated speed before going to cooldown at idle. Does not apply to manual runs	
V/Hz Rolloff Slope	2.2	0	10	%	X	X	The amount of voltage roll off when the frequency is below the knee frequency	
Voltage Ramp Time	1.25	0	5	Sec	X	X	The time period over which the voltage setpoint command should rise from 0% to the target voltage	

Max Crank Fuel Duty Cycle	100	50	100	%	X		Max Fuel Command during cranking.	
SystemName	**DefaultValue**	**LowerLimit**	**UpperLimit**	**Unit**	**PC Based Service Tool**	**Operator Panel**	**SystemDescription**	**Notes**
12 V High Battery Voltage Threshold	16	14	17	Volts	X	X	Sets 12V high battery voltage fault threshold	
12 V Weak Battery Voltage Threshold	8	6	10	Volts	X	X	Sets 12V weak battery voltage fault threshold	
24 V High Battery Voltage Threshold	32	28	34	Volts	X	X	Sets 24V high battery voltage fault threshold	
24 V Weak Battery Voltage Threshold	14.4	12	16	Volts	X	X	Sets 24V weak battery voltage fault threshold	
Genset Exercise Time	0	0	25	Hours	X	X	Sets the total exercise time not including warmup at idle or idle cooldown time	
High Battery Voltage Set Time	60	2	60	Sec	X	X	The time delay until a high battery voltage condition is reported as a fault	
Low Battery Voltage Set Time	60	2	60	Sec	X	X	The time delay until a low battery voltage condition is reported as a fault	
Governor Gain Adjust	1.0	0.05	10		X	X	A trim that allows the user to modify the overall gain of the governor	

Voltage Adjust	0.00	-5	5	%	X	X	A trim that allows the user to add/subtract an offset to the nominal voltage when calculating the voltage setpoint
Weak Battery Voltage Set Time	2	1	5	Sec	X	X	The time delay until a weak battery condition is reported as a fault
AVR Enable	Enabled				X		Enables the AVR
Charging Alternator Fault Time Delay	120.0	2	300	Sec	X	X	Sets the time delay for the charging alt failure fault
Frequency to Speed Gain Select	30 rpm/Hz			RPM / Hz	X	X	Sets the rpm/Hz conversion factor which is a function of the poles of the alternator and/or any gearboxes

SystemName	DefaultValue	LowerLimit	UpperLimit	Unit	PC Based Service Tool	Operator Panel	SystemDescription	Notes
Crank Attempts	3	1	7		X	X	Sets the maximum number of times to engage the starter when attempting to start engine using the cycle cranking method	
V/Hz Knee Frequency	1	0	10	Hz	X	X	The frequency below the current target frequency below which the V/Hz will begin to roll off the voltage setpoint.	

Shunt Gain Multiplier	1.5	0.5	10		X	X	The additional overall AVR gain added in Shunt applications	
V/Hz Method	Relative Knee Frequency				X	X	Sets the knee frequency logic characteristic of the V/Hz curve either fixed knee or relative (to Target Speed) knee frequency.	Setup mode interlocked.
Speed/Frequency Delay	4.0	0.5	10	Sec	X	X	Sets the delay time for generating the Speed/Frequency mismatch fault	
Speed/Frequency Threshold	1.5	0.5	20	Hz	X	X	Sets the threshold for generating the Speed/Frequency mismatch fault	
Voltage Reconnection Trim Enable	Disable				X			
Modbus Communications Lost Response Method	Do Nothing				X	X	When set to Reset Commands will reset the modbus control logicals to an inactive state when Modbus communications are lost	
Modbus Baud Rate	9600				X	X	Sets the modbus baud rate for this node	
Modbus Failure Time Delay	4	0	10		X	X	Time delay before the control activates the modbus failure fault after the master is sensed as no longer present.	

Modbus Node Address	2	1	247		X	X	Sets the modbus address for this node	
Modbus Parity	None				X	X	Sets the modbus parity for this node	
Protocol Mode	0	0	1		X		Protocol Mode for Mon and Modbus	
SystemName	**DefaultValue**	**LowerLimit**	**UpperLimit**	**Unit**	**PC Based Service Tool**	**Operator Panel**	**SystemDescription**	**Notes**
HMI220 PCCnet Failure Response Type	Non-Crit Device Resp				X	X	Selects the genset reaction to a loss of an HMI220 Operator Panel as critical or non-critical.	
HMI320 PCCnet Failure Response Type	Non-Crit Device Resp				X	X	Selects the genset reaction to a loss of an HMI320 Operator Panel as critical or non-critical.	
Keyswitch Engine Stop Delay OP	30.0	0	120		X	X	A trim that sets the delay time for the keyswitch when initialy shutting down on datalink failure	
HMI113 Fault 1 Text					X	X	Twenty (20) character text string to enter the configurable fault text for this fault.	
HMI113 Fault 2 Text					X	X	Twenty (20) character text string to enter the configurable fault text for this fault.	
HMI113 Fault 3 Text					X	X	Twenty (20) character text string to enter the configurable fault	

							text for this fault.	
PCCnet Device Failure Time Delay	10	0	250	Sec	X	X	Selects the time allowed for arbitration to occur before a PCCnet failure fault is generated.	
HMI113 Output 1 Fault/Event	0	0	65535		X	X	Parameter to allow for the entry of the fault/event code which will turn the output relay on and off.	
HMI113 Output 3 Fault/Event	0	0	65535		X	X	Parameter to allow for the entry of the fault/event code which will turn the output relay on and off.	
SystemName	**DefaultValue**	**LowerLimit**	**UpperLimit**	**Unit**	**PC Based Service Tool**	**Operator Panel**	**SystemDescription**	**Notes**
HMI113 Output 4 Fault/Event	0	0	65535		X	X	Parameter to allow for the entry of the fault/event code which will turn the output relay on and off.	
HMI113 Annunciator PCCnet Failure Response Type	Non-Crit Device Resp				X	X	Selects the genset reaction to a loss of an Annunciator as critical or non-critical.	
HMI113 Output 2 Fault/Event	0	0	65535		X	X	Parameter to allow for the entry of the fault/event code which will turn the output relay on and off.	

Table 0-1 Primary Genset Application Trim

Parameter Name	Default Value	Lower Limit or States	Upper Limit	Eng Unit	Available in InPower	Available on HMI	Description
Genset Application Type	Standalone	0: Standalone 1: Synchronize Only 2: Isolated Bus Only 3: Utility Single 4: Utility Multiple 5: Power Transfer Control			X	X	Primary setting which configures genset application.

Table 0-2 Synchronizer Trims

Parameter Name	Default Value	Lower Limit or States	Upper Limit	Eng Unit	Available in InPower	Available on HMI	Description
Fail To Sync Lockout Enable	Disable	0: Disable 1: Enable			X	X	If enabled synchronizer will turn off on a fail to sync.
Fail To Synchronize Time	120	10	900	seconds	X	X	Sets the fail to synchronize diagnostic time delay.
Frequency Match Ki	20	0	250		X	X	Sets integral gain for the frequency match PI loop.

Parameter Name	Default Value	Lower Limit or States	Upper Limit	Eng Unit	Available in InPower	Available on HMI	Description
Frequency Match Kp	30	1	300		X	X	Sets overall gain for the frequency matching control.
Isolated Bus Speed Control Method	Constant	0: Constant 1: Droop			X	X	Sets the speed control method for isolated bus paralleling.
Isolated Bus Voltage Control Method	Constant	0: Constant 1: Droop			X	X	Sets the voltage control method for isolated bus paralleling.
Phase Match Kp	150	10	1500		X	X	Sets overall gain for the phase matching control.
Slip Frequency	0.1	-3	3	Hz	X	X	Sets the synchronizer slip frequency. Requires that Sync Speed Control Method = Slip Frequency.
Sync Phase Offset	0	-50	50	deg	X		Sets a sync phase offset to accommodate sync across transformer with phase shift.
Synchronizer Speed Control Method	Phase Match	0: Phase Match 1: Slip Frequency 2: External			X	X	Sets the speed control method for synchronizing.
Synchronizer Voltage Control Method	Voltage Match	0: Voltage Match 1: External			X	X	Sets the voltage control method for synchronizing.
Voltage Match Ki	50	0	255		X	X	Sets integral gain for the voltage match PI

Parameter Name	Default Value	Lower Limit or States	Upper Limit	Eng Unit	Available in InPower	Available on HMI	Description
							loop.
Voltage Match Kp	400	10	800		X	X	Sets overall gain for the voltage matching control.
Voltage Match Ramp Rate	1	0	60	seconds	X	X	sets the ramp time for voltage match output limits to soften sync transition

Table 0-3 Dead Bus Close Trim

Parameter Name	Default Value	Lower Limit	Upper Limit	Eng Unit	Available in InPower	Available on HMI	Description
First Start Backup Time	10	3	120	seconds	X	X	Adjust to different setting on each genset in system. Reduces the chance of gensets closing simultaneously in the event that the Master First Start function fails.

Table 0-4 Load Share Trims

Parameter Name	Default Value	Lower Limit	Upper Limit	Eng Unit	Available in InPower	Available on HMI	Description
Load Share kVAR	0	-5	5	%	X	X	Use to adjust kVAR sharing balance

Parameter Name	Default Value	Lower Limit	Upper Limit	Eng Unit	Available in InPower	Available on HMI	Description
Balance							between gensets.
Load Share kVAR Gain	1	0.1	10		X	X	Overall kVAR load share gain adjustment.
Load Share kW Balance	0	-5	5	%	X	X	Use to adjust kW sharing balance between gensets.
Load Share kW Gain	1	0.1	10		X	X	Overall kW load share gain adjustment.
Load Share Ramp kW Unload Level	5	0	100	%	X	X	kW level when load sharing at which genset is considered unloaded (for breaker opening).
Load Share Ramp Load Time	30	5	900	seconds	X	X	Sets kW and kVAR ramp load time for 100% change.
Load Share Ramp Unload Time	30	5	900	seconds	X	X	Sets kW ramp unload time for 100% kW change. kVAR rate fixed at 15%/sec.
Speed Droop Percentage	5	0	15	%	X	X	Sets the speed droop percent from no load to full load.
Voltage Droop Percentage	4	0	15	%	X	X	Sets the voltage droop percent from no load to full load 0.8PF.

Table 0-5 Load Govern Trims

Parameter Name	Default Value	Lower Limit or States	Upper Limit	Eng Unit	Available in InPower	Available on HMI	Description
Controlled Shutdown Max Ramp Unload Time	60	0	300	seconds	X	X	Maximum ramp unload time during a shutdown with cooldown.
Genset kVAR Setpoint	0	0	32000	kVAR	X	X	Sets the genset load govern kVAR base load internal operating setpoint in units of kVAR. Requires that Load Govern kVAR Setpoint Source = Internal and Load Govern kVAR Method = Genset kVAR.
Genset kVAR Setpoint Percent	0	0	60	%	X	X	Sets the genset load govern kVAR base load internal operating setpoint in % of standby kVA rating. Requires that Load Govern kVAR Setpoint Source = Internal and Load Govern kVAR Method = Genset kVAR.
Genset kW Setpoint	0	0	32000	kW	X	X	Sets the genset load govern kW base load internal operating setpoint in units of kW. Requires that Load Govern kW Setpoint Source = Internal and Load Govern kW Method = Genset kW.

Parameter Name	Default Value	Lower Limit or States	Upper Limit	Eng Unit	Available in InPower	Available on HMI	Description
Genset kW Setpoint Percent	0	0	100	%	X	X	Sets the genset load govern kW base load internal operating setpoint in % of standby rating. Requires that Load Govern kW Setpoint Source = Internal and Load Govern kW Method = Genset kW.
Genset Power Factor Setpoint	0.80	0.7	1	PF	X	X	Sets the load govern setpoint for genset power factor control. Requires that Load Govern kVAR Setpoint Source = Internal and Load Govern kVAR Method = Genset Power Factor.
Load Govern kVAR Ki	50	0	250		X	X	Sets the integral gain for kVAR load governing control.
Load Govern kVAR Kp	120	0	1000		X	X	Sets the proportional gain for kVAR load governing control.
Load Govern kVAR Maximum	60	0	60	%	X	X	Sets the nominal maximum kVAR output as a percentage of Genset Standby KVA when paralleled to the utility.
Load Govern kVAR Method	Genset Power Factor	0: Genset kVAR 1: Genset Power Factor 2: Utility kVAR 3: Utility Power Factor			X	X	Use to select how genset kVAR output will be controlled when paralleled to utility.

Parameter Name	Default Value	Lower Limit or States	Upper Limit	Eng Unit	Available in InPower	Available on HMI	Description
Load Govern kVAR Ramp Load Time	20	0	900	seconds	X	X	Sets load govern kVAR ramp load rate = Genset Standby kVA * 0.6/ this time.
Load Govern kVAR Ramp Unload Time	20	0	900	seconds	X	X	Sets load govern kVAR ramp unload rate = Genset Standby KVA * 0.6/ this time.
Load Govern kVAR Setpoint Source	Analog Input	0: Analog Input 1: Internal			X	X	Use to select whether kVAR/PF load govern setpoint is set internally or by external analog input.
Load Govern kW Ki	60	0	250		X	X	Sets the integral gain for kW load governing control.
Load Govern kW Kp	60	0	1000		X	X	Sets the proportional gain for kW load governing control.
Load Govern kW Maximum	80	0	100	%	X	X	Sets the nominal maximum kW output as a percentage of Genset Standby KVA when paralleled to the utility
Load Govern kW Method	Genset kW	0: Genset kW 1: Genset kW w/Utility Constraint 2: Utility kW			X	X	Use to select how genset kW output will be controlled when paralleled to utility.
Load Govern kW Ramp Load Time	20	0	900	seconds	X	X	Sets load govern kW ramp load rate = Genset Standby kW rating/ this time.

Parameter Name	Default Value	Lower Limit or States	Upper Limit	Eng Unit	Available in InPower	Available on HMI	Description
Load Govern kW Ramp Unload Time	20	0	900	seconds	X	X	Sets load govern kW ramp unload rate = Genset Standby kW rating/ this time.
Load Govern kW Setpoint Source	Analog Input	0: Analog Input 1: Internal			X	X	Use to select whether kW load govern setpoint is set internally or by external analog input.
Utility kVAR Setpoint	0	-32000	32000	kVAR	X	X	Sets the utility kVAR peak shave internal operating setpoint in units of kVAR. Requires that Load Govern kVAR Setpoint Source = Internal and Load Govern kVAR Method = Utility kVAR
Utility kVAR Setpoint Percent	0	-320	320	%	X	X	Sets the utility kVAR peak shave internal operating setpoint in % of genset standby kVA rating. Requires that Load Govern kVAR Setpoint Source = Internal and Load Govern kVAR Method = Utility kVAR.
Utility kW Constraint	50	-32000	32000	kW	X	X	Sets the utility kW minimum load level for constrained base load mode of operation. Requires that Load Govern kW Setpoint Source = Internal and Load Govern kW Method = Genset kW w/Utility Constraint.

Parameter Name	Default Value	Lower Limit or States	Upper Limit	Eng Unit	Available in InPower	Available on HMI	Description
Utility kW Constraint Percent	0	-320	320	%	X	X	Sets utility kW minimum load level for constrained base load mode in % of genset standby rating. Requires that Load Govern kW Setpoint Source = Internal and Load Govern kW Method = Genset kW w/Utility Constraint.
Utility kW Setpoint	50	-32000	32000	kW	X	X	Sets the utility kW peak shave internal operating setpoint in units of kW. Requires that Load Govern kW Setpoint Source = Internal and Load Govern kW Method = Utility kW.
Utility kW Setpoint Percent	0	-320	320	%	X	X	Sets the utility kW peak shave internal operating setpoint in % of genset standby rating. Requires that Load Govern kW Setpoint Source = Internal and Load Govern kW Method = Utility kW.
Utility Parallel Speed Control Method	Load Govern	0: Constant 1: Droop			X	X	Sets the speed control method for utility paralleling.
Utility Parallel Voltage Control Method	Load Govern	**0: Load Govern** **1: Droop** **2: Load**			X	X	Sets the voltage control method for utility paralleling.

Parameter Name	Default Value	Lower Limit or States	Upper Limit	Eng Unit	Available in InPower	Available on HMI	Description
		Govern with Droop Feed Forward					
Utility Power Factor Setpoint	0.80	0.7	1	PF	X	X	Sets the internal setpoint for utility power factor control mode when paralleled to utility. Requires that Load Govern kVAR Setpoint Source = Internal and Load Govern kVAR Method = Utility Power Factor.
Utility Unloaded Level	50	-32768	32767	kW	X	X	Sets threshold at which utility source is considered as unloaded.

Table 0-6 Permissive Sync Check Trims

Parameter Name	Default Value	Lower Limit	Upper Limit	Eng Unit	Available in InPower	Available on HMI	Description
Permissive Frequency Window	1	0.001	1	Hz	X	X	Sets the maximum frequency difference allowed for permissive close.
Permissive Phase Window	15	0.1	20	deg	X	X	Sets the permissive +/- phase angle window for the sync check function.

Permissive Voltage Window	5	0.5	10	%	X	X	Sets the permissive +/- voltage acceptance window for the sync check function.
Permissive Window Time	0.5	0.5	5	seconds	X	X	Sets the permissive acceptance window dwell time for the sync check function.

Table 0-7 Breaker Control Trims

Parameter Name	Default Value	Lower Limit or States	Upper Limit	Eng Unit	Available in InPower	Available on HMI	Description
Genset Breaker Position Contacts	Dual Contacts	0: Single Contact 1: Dual Contact			X	X	Sets whether using single a contact or dual a/b contact for genset breaker feedback.
Genset CB Fail To Close Standalone Mode Enable	Disable				X	X	Enables genset to run standalone if gen cb fails to close.
Genset CB Fail To Close Time Delay	0.26	0.1	1	seconds	X	X	Sets genset breaker fail to close time delay.
Genset CB Fail To Open Time Delay	1	0.2	5	seconds	X	X	Sets genset breaker fail to open time delay.
Genset CB Open To Close Delay	100 msec	0	1000	msec		X	set to avoid breaker anit-pump
Genset CB Recharge Delay	10	0	60	seconds	X	X	Sets time required between successive genset breaker close commands. Allows breaker close spring to recharge.

Parameter Name	Default Value	Lower Limit or States	Upper Limit	Eng Unit	Available in InPower	Available on HMI	Description
Genset CB Shunt Trip Enable	Disable	0: Disable 1: Enable			X	X	Enables breaker shunt trip function for shutdown faults when Genset Application Type = Standalone.
Utility Breaker Position Contacts	Dual Contacts	0: Single Contact 1: Dual Contact			X	X	Sets whether using single a contact or dual a/b contact for utility breaker feedback.
Utility CB Fail To Close Time Delay	0.26	0.1	1	seconds	X	X	Sets utility breaker fail to close time delay.
Utility CB Fail To Open Time Delay	1	0.2	5	seconds	X	X	Sets utility breaker fail to open time delay.
Utility CB Recharge Delay	10	0	60	seconds	X	X	Sets time required between successive utility breaker close commands. Allows breaker close spring to recharge.

Table 0-8 Fail To Disconnect Trim

Parameter Name	Default Value	Lower Limit	Upper Limit	Eng Unit	Available in InPower	Available on HMI	Description
Fail To Disconnect Enable	Enable				X	X	Enables the fail to disconnect logic for utility paralleling.

Table 0-9 Power Transfer Control Trims

Parameter Name	Default Value	Lower Limit or States	Upper Limit	Eng Unit	Available in InPower	Available on HMI	Description
Fail To Sync Open Transition Retransfer Enable	Disable	0: Disable 1: Enable			X	X	Use to enable an open transition retransfer upon a fail to sync when Genset Application Type = Power Transfer Control.
Genset Center Frequency	60	45	65	Hz	X	X	Sets the center frequency for the genset frequency sensor bandwidth settings.
Genset Frequency Drop-Out Bandwidth	1	0.3	5	%	X	X	Sets drop-out delta for genset frequency sensor as percent of center frequency.
Genset Frequency Drop-Out Delay	5	0.1	15	seconds	X	X	Sets drop-out time delay for genset frequency sensor.
Genset Frequency Pick-Up Bandwidth	10	0.3	20	%	X	X	Sets pick-up range of genset frequency sensor as percent of center frequency.
Genset Frequency Sensor Enable	Disable	0: Disable 1: Enable			X	X	Use to enable genset frequency sensor.
Genset Loss of Phase Drop-Out Delay	1	1	10	seconds	X	X	Sets drop-out time delay for genset loss of phase sensor.
Genset Loss of Phase Sensor Enable	Disable	0: Disable 1: Enable			X	X	Use to enable genset loss of phase sensor.

Parameter Name	Default Value	Lower Limit or States	Upper Limit	Eng Unit	Available in InPower	Available on HMI	Description
Genset Overvoltage Drop-Out Delay	3	0.5	120	seconds	X	X	Sets drop-out time delay for genset overvoltage sensor.
Genset Overvoltage Drop-Out Percentage	110	105	135	%	X	X	Sets drop-out as percent of nominal voltage for genset overvoltage sensor.
Genset Overvoltage Pick-Up Percentage	95	95	99	%	X	X	Sets pick-up as percent of drop-out setting for genset overvoltage sensor.
Genset Overvoltage Sensor Enable	Disable	0: Disable 1: Enable			X	X	Use to enable genset overvoltage sensor.
Genset Phase Rotation Sensor Enable	Disable	0: Disable 1: Enable			X	X	Use to enable genset phase rotation sensor.
Genset Undervoltage Drop-Out Delay	5	0.1	30	seconds	X	X	Sets drop-out time delay for genset undervoltage sensor.
Genset Undervoltage Drop-Out Percentage	90	75	98	%	X	X	Sets drop-out as percent of pick-up setting for genset undervoltage sensor.

Parameter Name	Default Value	Lower Limit or States	Upper Limit	Eng Unit	Available in InPower	Available on HMI	Description
Genset Undervoltage Pick-Up Percentage	90	85	100	%	X	X	Sets pick-up as percent of nominal voltage for genset undervoltage sensor.
Genset Voltage Sensor Type	Line to Line	0: Line to Line 1: Line to Neutral			X	X	Sets the type of sensing to use for genset voltage sensors.
Maximum Parallel Time (TDMP)	20	0	1800	seconds	X	X	Sets the maximum time that the genset can remain paralleled to the utility during closed transition transfers.
Programmed Transition Delay (TDPT)	3	0	60	seconds	X	X	Sets the time delay from when one source opens until the other closes during open transition transfers.
Retransfer Delay (TDEN)	600	0	1800	seconds	X	X	Sets the amount of time that the utility source must be available before the control will retranfer to that source.
System Phase Rotation	L1-L2-L3	0: L1-L2-L3 1: L1-L3-L2			X	X	Defines system phase rotation for use with rotation sensors.
Test With Load Enable	Disabled	0: Disabled 1: Enabled			X	X	Use to choose whether a test is with load or without load.
Transfer Delay (TDNE)	10	0	120	seconds	X	X	Sets the amount of time that the genset source must be available before the control will tranfer to that source.

Parameter Name	Default Value	Lower Limit or States	Upper Limit	Eng Unit	Available in InPower	Available on HMI	Description
Transition Type	Open Transition	0: Open Transition 1: Hard Closed Transition 2: Soft Closed Transition			X	X	Sets the load transfer transition type for use when Genset Application Type = Power Transfer Control.
Utility Center Frequency	60	45	65	Hz	X	X	Sets the center frequency for the utility frequency sensor bandwidth settings.
Utility Frequency Drop-Out Bandwidth	1	0.3	5	%	X	X	Sets drop-out delta for utility frequency sensor as percent of center frequency.
Utility Frequency Drop-Out Delay	5	0.1	15	seconds	X	X	Sets drop-out time delay for utility frequency sensor.
Utility Frequency Pick-Up Bandwidth	10	0.3	20	%	X	X	Sets pick-up range of utility frequency sensor as percent of center frequency.
Utility Frequency Sensor Enable	Disable	0: Disable 1: Enable			X	X	Use to enable utility frequency sensor.
Utility Loss of Phase Drop-Out Delay	1	1	10	seconds	X	X	Sets drop-out time delay for utility loss of phase sensor.
Utility Loss of Phase Sensor Enable	Disable	0: Disable 1: Enable			X	X	Use to enable utility loss of phase sensor.

Parameter Name	Default Value	Lower Limit or States	Upper Limit	Eng Unit	Available in InPower	Available on HMI	Description
Utility Overvoltage Drop-Out Delay	3	0.5	120	seconds	X	X	Sets drop-out time delay for utility overvoltage sensor.
Utility Overvoltage Drop-Out Percentage	110	105	135	%	X	X	Sets drop-out as percent of nominal voltage for utility overvoltage sensor.
Utility Overvoltage Pick-Up Percentage	95	95	99	%	X	X	Sets pick-up as percent of drop-out setting for utility overvoltage sensor.
Utility Overvoltage Sensor Enable	Disable	0: Disable 1: Enable			X	X	Use to enable utility overvoltage sensor.
Utility Phase Rotation Sensor Enable	Disable	0: Disable 1: Enable			X	X	Use to enable utility phase rotation sensor.
Utility Undervoltage Drop-Out Delay	0.5	0.1	30	seconds	X	X	Sets drop-out time delay for utility undervoltage sensor.
Utility Undervoltage Drop-Out Percentage	90	75	98	%	X	X	Sets drop-out as percent of pick-up setting for utility undervoltage sensor.
Utility Undervoltage Pick-Up Percentage	90	85	100	%	X	X	Sets pick-up as percent of nominal voltage for utility undervoltage sensor.

Parameter Name	Default Value	Lower Limit or States	Upper Limit	Eng Unit	Available in InPower	Available on HMI	Description
Utility Voltage Sensor Type	Line to Line	0: Line to Line 1: Line to Neutral			X	X	Sets the type of sensing to use for utility voltage sensors.

AUX105 Setup Trims and Adjustments

OEM Engine Setup Parameters (Trims)

The parameters listed below are as they appear in the OEM Engine Setup screens in the Operator Panel. Not all of these are "setup mode interlocked" parameters.

AUX105 has 90 Setup Mode parameters and on power up and every key switch recycle; AUX105 reads all the setup parameters from PCC3300 after which the system enters in Ready mode.

While applying an HMECM control to a new application, these parameters should be ensured to have appropriate values. These can be adjusted using the Operator Panel as well as genset Manufacturing Tool and / or a PC based service tool. These Setup Mode parameters are monitor points in AUX105 and can be adjusted and saved only through Tool or Operator Panel connected to PCC3300.

Model Specific features like nominal voltage, frequency, Engine protection values Governor Gains, etc have to be assigned appropriate values at manufacturing time via Feature Codes. Creating New Feature codes for a new application shall be a responsibility of the corresponding application engineering team.

NOTE: All 90 Setup Mode parameters can be seen in the service tool connected to PCC3300.
The default values of the parameters have been reviewed.

AUX105 – PCC3300 Interface Parameters							
Parameter Name	**PC Based Service Tool connected to PCC3300**	**Operator Panel connected to PCC3300**	**Lower Limit**	**Upper Limit**	**Default Value**	**Units**	**Notes**
ECM CAN Enable	X	X	Enable or Disable		Enable		Setup interlocked
ECM Datasave Time Delay	X	X	0	60	30.0	sec	
CAN Failure Retries	X	X	0	10	3		
Keyswitch Minimum On time	X	X	0.1	5	4.0	sec	
Fault Code 1117 Enable	X	X	Disabled or Enabled		Enabled		

AUX105 – PCC3300 Interface Parameters							
Parameter Name	**PC Based Service Tool connected to PCC3300**	**Operator Panel connected to PCC3300**	**Lower Limit**	**Upper Limit**	**Default Value**	**Units**	**Notes**
Starter Owner	X	X	GCS or ECS		GCS		Setup interlocked
Prelube Function Enable	X	X	Disabled or Enabled		Disabled		Setup interlocked
Idle Speed	X	X	700	1100	800	rpm	Setup Mode Parameter & Setup interlocked
Charging Alternator Fault Time Delay	X	X	2	300	120.0	sec	
Alternate Frequency Switch	X	X	50 or 60		60	Hz	Setup interlocked
Adjustable Freq/speed gain	X	X	0	240	30.00	Rpm/ Hz	Setup interlocked
Frequency to Speed Gain Select			60 rpm/Hz or 30 rpm/Hz or 20 rpm/Hz or 36 rpm/Hz or Adjustable Freq/Speed Gain		30		Setup Mode Parameter & Setup interlocked
V / Hz Knee Frequency	X	X	0	10	1.0	Hz	
V/Hz Knee Frequency 50Hz	X	X	0	10	1	Hz	
V/Hz Knee Frequency 60Hz	X	X	0	10	1	Hz	
V / Hz Rolloff Slope	X	X	0	10	2.2	%/Hz	
V/Hz Rolloff Slope 50Hz	X	X	0	10	2.2	%/Hz	
V/Hz Rolloff Slope 60Hz	X	X	0	10	2.2	%/Hz	
Starting to Rated Ramp Time	X	X	0	30	1.0	sec	
Disconnect Speed	X	X	100	600	450	Rpm	Setup Mode Parameter & Setup interlocked
Nominal Battery Voltage	X	X	12 or 24		24	VDC	Setup Mode Parameter & Setup interlocked

AUX105 – PCC3300 Interface Parameters							
Parameter Name	PC Based Service Tool connected to PCC3300	Operator Panel connected to PCC3300	Lower Limit	Upper Limit	Default Value	Units	Notes
24 V High Battery Voltage Threshold	X	X	28	34	32.0	VDC	Setup Mode Parameter
24 V Weak Battery Voltage Threshold	X	X	12	16	14.4	VDC	
24 V Low Battery Voltage Running Threshold	X	X	24	28	24.0	VDC	Setup Mode Parameter
24 V Low Battery Voltage Stopped Threshold	X	X	22	26	24.0	VDC	Setup Mode Parameter
12 V High Battery Voltage Threshold	X	X	14	17	16.0	VDC	Setup Mode Parameter
12 V Weak Battery Voltage Threshold	X	X	6	10	8.0	VDC	
12 V Low Battery Voltage Running Threshold	X	X	12	16	12.0	VDC	Setup Mode Parameter
12 V Low Battery Voltage Stopped Threshold	X	X	11	13	12.0	VDC	Setup Mode Parameter
High Battery Voltage Set Time	X	X	2	60	60	sec	Setup Mode Parameter
Low Battery Voltage Set Time	X	X	2	60	60	sec	Setup Mode Parameter
Weak Battery Voltage Set Time	X	X	1	5	2	sec	
Glow Plug Enable	X	X	Disable or Enable		Disable		Setup interlocked
Min Time at Preheat Temperature	X	X	0	120	15.0	sec	
Min Preheat Temperature	X	X	-100	300	-5	Deg F	
Max Preheat Temperature	X	X	-100	300	77	Deg F	
Max Preheat Glow Time	X	X	0	120	60.0	sec	
Max Post Glow Temperature	X	X	-100	300	50	Deg F	
Max Post Glow Time	X	X	0	30	5	sec	
Teeth Pulses Per Revolution	X	X	0	250	110	Teeth	Setup Mode Parameter & Setup interlocked
Dither Factor	X	X	0	30	15	%	Setup Mode Parameter

AUX105 – PCC3300 Interface Parameters							
Parameter Name	PC Based Service Tool connected to PCC3300	Operator Panel connected to PCC3300	Lower Limit	Upper Limit	Default Value	Units	Notes
Initial Crank Fuel Duty Cycle	X	X	0	50	25.0	%	Setup Mode Parameter
Initial Crank Fueling Period	X	X	0	10	2.0	sec	Setup Mode Parameter
Crank Fueling Ramp Rate	X	X	5	100	25.0	%/sec	Setup Mode Parameter
Max Crank Fuel Duty Cycle	X	X	50	100	100.0	%	Setup Mode Parameter
Crank Exit Fuel Duty Cycle	X	X	0	100	25.0	%	Setup Mode Parameter
Governor Enable Engine Speed	X	X	601	1400	1100	rpm	Setup Mode Parameter & Setup interlocked
Governor Preload Offset	X	X	0	100	0	%	Setup Mode Parameter
Maximum Governor Duty Cycle	X	X	0	100	95	%	Setup Mode Parameter & Setup interlocked
Minimum Governor Duty Cycle	X	X	0	100	20	%	Setup Mode Parameter & Setup interlocked
Duty Cycle Gain Compensation Enable	X	X	Disable or Enable		Disable		Setup Mode Parameter
Duty Cycle Compensation Starting Duty Cycle (X1)	X	X	1	50	50.0	%	Setup Mode Parameter
Duty Cycle Compensation End Duty Cycle (X2)	X	X	50.1	100	100.0	%	Setup Mode Parameter
Duty Cycle Compensation Starting Gain (Y1)	X	X	1	5	1.0	%	Setup Mode Parameter
Duty Cycle Compensation End Gain (Y2)	X	X	0	10	2.0	%	Setup Mode Parameter
GK1 High(50Hz)	X	X	0	65530	1200		Setup Mode Parameter
GK1 (50 Hz)	X	X	0	65530	1200		Setup Mode Parameter
GK1 Low(50Hz)	X	X	0	65530	1200		Setup Mode Parameter

AUX105 – PCC3300 Interface Parameters							
Parameter Name	**PC Based Service Tool connected to PCC3300**	**Operator Panel connected to PCC3300**	**Lower Limit**	**Upper Limit**	**Default Value**	**Units**	**Notes**
GK2 (50Hz)	X	X	0	65530	300		Setup Mode Parameter
GK3 (50Hz)	X	X	0	65530	28800		Setup Mode Parameter
Governor Damping Effect (50Hz)	X	X	0.6	0.95	0.8		Setup Mode Parameter
Gain Windowing Enable	X	X	Disable or Enable		Disable		Setup Mode Parameter
GK1 High(60Hz)	X	X	0	65530	1696		Setup Mode Parameter
GK1 (60Hz)	X	X	0	65530	1696		Setup Mode Parameter
GK1 Low(60Hz)	X	X	0	65530	1696		Setup Mode Parameter
GK2 (60Hz)	X	X	0	65530	240		Setup Mode Parameter
GK3 (60Hz)	X	X	0	65530	28800		Setup Mode Parameter
Governor Damping Effect (60Hz)	X	X	0.6	0.95	0.8		Setup Mode Parameter
Governor Speed Delta High	X	X	50	1000	150		Setup Mode Parameter
Governor Speed Delta Low	X	X	50	1000	150		Setup Mode Parameter
GK1(Idle)	X	X	0	65530	1200		Setup Mode Parameter
GK2(Idle)	X	X	0	65530	300		Setup Mode Parameter
GK3(Idle)	X	X	0	65530	28800		Setup Mode Parameter
Gov Damping Effect(Idle)	X	X	0.6	0.95	0.8		Setup Mode Parameter
Coolant Temperature Sensor Type	X	X	PGBU or EBU		PGBU		Setup Mode Parameter & Setup interlocked
Oil Pressure Sensor Type	X	X	Switch or Sender		Sender		Setup Mode Parameter & Setup interlocked
Oil Pressure Sender Type	X	X	2-wire or 3-wire or (0-200) 2-wire		3-Wire		Setup Mode Parameter & Setup interlocked

AUX105 – PCC3300 Interface Parameters							
Parameter Name	**PC Based Service Tool connected to PCC3300**	**Operator Panel connected to PCC3300**	**Lower Limit**	**Upper Limit**	**Default Value**	**Units**	**Notes**
Oil Pressure Switch Polarity	X	X	Active Low or Active High		Active High		Setup Mode Parameter & Setup interlocked
Intake Manifold Temperature Sensor Enable	X	X	Disable or Enable		Enable		Setup Mode Parameter & Setup interlocked
Intake Manifold Temperature Sensor Type	X	X	PGBU or EBU		PGBU		Setup Mode Parameter & Setup interlocked
Oil Temperature Sensor Enable	X	X	Disable or Enable		Enable		Setup Mode Parameter & Setup interlocked
Oil Temperature Sensor Type	X	X	PGBU or EBU		PGBU		Setup Mode Parameter & Setup interlocked
HCT Shutdown/w Cooldown Threshold	X	X	180	300	216	Deg F	Setup Mode Parameter
HCT Shutdown Threshold	X	X	180	300	219	Deg F	Setup Mode Parameter
HCT Shutdown Set Time	X	X	2	10	2	sec	Setup Mode Parameter
HCT Warning Threshold	X	X	150	290	208	Deg F	Setup Mode Parameter
HCT Warning Set Time	X	X	2	10	2	sec	Setup Mode Parameter
HOT Protection Enable	X	X	Disabled or Enabled		Enabled		Setup Mode Parameter
HOT Shutdown Threshold	X	X	220	250	230	Deg F	Not seen if “HOT Protection Enable” is disabled Setup Mode Parameter

AUX105 – PCC3300 Interface Parameters							
Parameter Name	**PC Based Service Tool connected to PCC3300**	**Operator Panel connected to PCC3300**	**Lower Limit**	**Upper Limit**	**Default Value**	**Units**	**Notes**
HOT Shutdown Set Time	X	X	2	10	2	sec	Not seen if "HOT Protection Enable" is disabled Setup Mode Parameter
HOT Warning Threshold	X	X	200	240	221	Deg F	Not seen if "HOT Protection Enable" is disabled Setup Mode Parameter
HOT Warning Set Time	X	X	2	10	2	sec	Not seen if "HOT Protection Enable" is disabled Setup Mode Parameter
LOP Enable Time	X	X	2	10	10	sec	Setup Mode Parameter
LOP Shutdown Threshold	X	X	13	100	35	psi	Setup Mode Parameter
LOP Warning Threshold	X	X	19	100	40	psi	Setup Mode Parameter
LOP Idle Shutdown Threshold	X	X	10	100	10	psi	Setup Mode Parameter
LOP Idle Warning Threshold	X	X	15	100	15	psi	Setup Mode Parameter
LOP Shutdown Set Time	X	X	2	15	8	sec	Setup Mode Parameter
LOP Warning Set Time	X	X	2	15	8	sec	Setup Mode Parameter
High IMT Protection Enable	X	X	Disabled or Enabled		Enabled		Setup Mode Parameter
High IMT Shutdown Threshold	X	X	140	167	162	Deg F	Not seen if "High IMT Protection Enable" is disabled Setup Mode Parameter

AUX105 – PCC3300 Interface Parameters							
Parameter Name	**PC Based Service Tool connected to PCC3300**	**Operator Panel connected to PCC3300**	**Lower Limit**	**Upper Limit**	**Default Value**	**Units**	**Notes**
High IMT Shutdown Set Time	X	X	2	10	5	sec	Not seen if "High IMT Protection Enable" is disabled Setup Mode Parameter
High IMT Warning Threshold	X	X	122	167	149	Deg F	Not seen if "High IMT Protection Enable" is disabled Setup Mode Parameter
High IMT Warning Set Time	X	X	2	10	5	sec	Not seen if "High IMT Protection Enable" is disabled Setup Mode Parameter
Overspeed Shutdown Set Time	X	X	0	2	0	sec	Setup Mode Parameter
Overspeed Trip Level (50Hz)	X	X	0	1875	1725	rpm	Setup Mode Parameter
Overspeed Trip Level (50Hz) - 20	X	X	0	1250	1150	rpm	Setup Mode Parameter
Overspeed Trip Level (50Hz) - 60	X	X	0	3750	3450	rpm	Setup Mode Parameter
Overspeed Trip Level (60Hz)	X	X	0	2250	2075	rpm	Setup Mode Parameter
Overspeed Trip Level (60Hz) - 20	X	X	0	1500	1380	rpm	Setup Mode Parameter
Overspeed Trip Level (60Hz) - 60	X	X	0	4500	4140	rpm	Setup Mode Parameter
Fuel System	X	X	Diesel or Gas		Diesel		Setup Mode Parameter & Setup interlocked
Number of HM Setup Parameters	X	NA	NA	NA	NA	NA	Setup Mode Parameter
GK2 Gain Adjust	X	NA	5	1000	100	%	Setup Mode Parameter
GK3 Gain Adjust	X	NA	5	1000	100	%	Setup Mode Parameter
Governor Damping Effect Adjust	X	NA	95	105	100	%	Setup Mode Parameter
Governor Ramp Time	X	NA	0	30	0.25	sec	Setup Mode Parameter

Genset Tuning

Parameter	Comments
K1(50Hz)	Sets overall AVR gain in 50Hz applications. This is a true proportional gain which is multiplied against the voltage error signal.
K2(50Hz)	Controls the recovery shape of voltage transients in 50Hz applications. This is a true integral gain which is multiplied against the sum of all previous errors.
K3(50Hz)	Affects high frequency characteristics of the AVR algorithm in 50Hz applications. Adjust for voltage stability reasons.
Damping Effect (50Hz)	Affects high frequency characteristics of the AVR algorithm in 50Hz applications. Adjust for voltage stability reasons.
K1(60Hz)	Sets overall AVR gain in 60Hz applications. This is a true proportional gain which is multiplied against the voltage error signal.
K2(60Hz)	Controls the recovery shape of voltage transients in 60Hz applications. This is a true integral gain which is multiplied against the sum of all previous errors.
K3(60Hz)	Affects high frequency characteristics of the AVR algorithm in 60Hz applications. Adjust for voltage stability reasons.
Damping Effect (60Hz)	Affects high frequency characteristics of the AVR algorithm in 60Hz applications. Adjust for voltage stability reasons.

Work instruction ET-6011 describes the procedure for tuning a genset equipped with the PCC3300 control. The remainder of this genset tuning section should not be necessary if the document above is correct and complete.

The PCC3300 control uses a standard 4 coefficient PID algorithm running at an execution rate of once per zero cross of the generator AC waveform. Standard values for the K1-K4 and Damping terms for both 60 and 50Hz for Newage range alternators are listed below. Insert ET-6011 – This document covers how to tune a genset.

Regulator Gains					
Newage BC/UC Generators Under 200kW Open circuit time constants 1.2sec or less		Newage BC/UC Generators Over 200kW and below 400kW Open circuit time constants 1.3 sec – 2.2sec		Newage Generators Over 400kW (non-P7) Open circuit time constants 2.3sec or greater	
60Hz	50Hz	60Hz	50Hz	60Hz	50Hz
K1 = 3.50	K1 = 3.50	K1 = 4.5	K1 = 4.5	K1 = 5.0	K1 = 5.0
K2 = 1.00	K2 = 1.00	K2 = 0.80	K2 = 0.80	K2 = 0.50	K2 = 0.50
K3 = 86.0	K3 = 84.0	K3 = 86.0	K3 = 84.0	K3 = 86.0	K3 = 84.0
K4 = 11.06 (calc.)	K4 = 12.48 (calc.)	K4 = 11.06 (calc.)	K4 = 12.48 (calc.)	K4 = 11.06 (calc.)	K4 = 12.48 (calc.)
Damping = 79.0	Damping = 78.0	Damping = 79.0	Damping = 78.0	Damping = 79.0	Damping = 78.0
Shunt Gain Multiplier = 1.5		Shunt Gain Multiplier = 1.5		Shunt Gain Multiplier = 1.5	

Notes:

- The values of K3, K4 and the Damping factor are set for basic stability reasons and should not need to be adjusted, but can be adjusted if necessary.
- The value of K1 should be adjusted to meet the specification for percent off rated voltage during a load acceptance, and prevent large voltage overshoots during offloads and during engine/alternator startup.
- The value of K2 should be adjusted to control the recovery characteristics of the voltage during large load acceptance and rejection transients. Values of K2 which are too high can cause unstable voltage performance and values too low can cause slow performance or steady state voltage offset errors.

In general, K1 increases and K2 decreases in value with increasing generator size, but can vary in different applications.

Conversion from PCC2100 to PCC3300 for initial PCC2100 K2 values >= 0.010

The following conversion formulas can be used when converting PCC2100 gains to PCC3300 gains when the value of the PCC2100 K2 gain is 0.010 or greater.

Gain	Conversion Formula to PCC3300/3300 gains	Conditions and Restrictions
K1	K1(PCC3300) = K1(PCC2100)	
K2	K2(PCC3300) = 100 * K2(PCC2100) / 2	0.010 <= PCC2100 K2 <= 0.040
K3	K3(PCC3300) = (100 * K3(PCC2100)) + 3.0	PCC2100 K3 >= 0.70
Damping	Damping(PCC3300) = 79.0 + 2.5 * (100 * (Damping(PCC2100) – 0.91))	0.91 <= PCC2100 Damping <= 0.99
Damping	Damping(PCC3300) = 79.0 + 2.0 * (100 * (Damping(PCC2100) – 0.91))	0.8 <= PCC2100 Damping < 0.91

If an initial value of PCC2100 gain does not fall within the given criteria, use the closest equivalent and tune the PCC3300 for proper performance.

Conversion from PCC2100 to PCC3300 for initial PCC2100 K2 values < 0.010

The following conversion formulas can be used when converting PCC2100 gains to PCC3300 gains when the value of the PCC2100 K2 gain is less than 0.010.

Gain	Conversion Formula to PCC3300/3300 gains	Conditions and Restrictions
K1	K1(PCC3300) = K1(PCC2100)	
K2	K2(PCC3300) = 100 * K2(PCC2100) / 2.4	PCC2100 K2 < 0.010 AND PCC2100 Damping <= 0.92
K2	K2(PCC3300) = 100 * K2(PCC2100) / 4.0	PCC2100 K2 < 0.010 AND PCC2100 Damping > 0.92
K3	K3(PCC3300) = (100 * K3(PCC2100)) - 2.0	PCC2100 K3 >= 0.70 AND PCC2100 Damping <= 0.92
K3	K3(PCC3300) = (100 * K3(PCC2100)) + 4.0	PCC2100 K3 >= 0.70 AND PCC2100 Damping > 0.92
Damping	Damping(PCC3300) = 100 * Damping(PCC2100) – 12.0	0.8 <= PCC2100 Damping <= 0.92
Damping	Damping(PCC3300) = 100 * Damping(PCC2100) – 14.0	0.92 < PCC2100 Damping < 0.99

If an initial value of PCC2100 gain does not fall within the given criteria, use the closest equivalent and tune the PCC3300 for proper performance. Due to the non-linear relationship in the lower two PCC3300 zeroes at these lower K2 gain levels, the accuracy of this conversion is not as good as the one for the higher K2 gain values.

V/Hz Curve

The PCC3300 control uses a simple breakpoint and slope approach to the V/Hz curve to allow for the matching of the torque curve of the engine during a large transient load acceptance. The two adjustment points are the V/Hz Knee Frequency which set the point at which the V/Hz curve starts, and the V/Hz Roll-off Slope which sets the roll-off slope of the voltage set point as a function of frequency error.

The default V/Hz settings are listed below:

Parameter	**Default Value**
V/Hz Knee Frequency	1.0 Hz
V/Hz Roll-off Slope	2.2 %V/Hz
V/Hz Knee Frequency (50Hz)	1.0 Hz
V/Hz Roll-off Slope (50Hz)	2.2 %V/Hz
V/Hz Knee Frequency (60Hz)	1.0 Hz
V/Hz Roll-off Slope (60Hz)	2.2 %V/Hz

On changing the values of ‘V/Hz Knee Frequency’, the corresponding 50 Hz and 60 Hz parameter values will change. Likewise, on changing the values of ‘V/Hz Roll-off Slope’, the corresponding 50 Hz and 60 Hz parameter values will change. But, the reverse is not true.

For example, if the value of **V/Hz Knee Frequency** is changed to say 1.3 Hz, then the values of V/Hz Knee Frequency (50Hz) and V/Hz Knee Frequency (60Hz) will change to 1.3 Hz. Similarly, if the value of **V/Hz Roll-off Slope** is changed to say 2.4 %V/Hz, then the values of V/Hz Roll-off Slope (50Hz) and V/Hz Roll-off Slope (60Hz) will change to 2.4 %V/Hz.

But, for 50 Hz settings, if the value of V/Hz Knee Frequency (50Hz) is changed to say 1.4 and/or the value of V/Hz Roll-off Slope (50Hz) is changed to say 2.5 %V/Hz, the values of V/Hz Knee Frequency and/or V/Hz Roll-off Slope **SHALL NOT** change.

For 60 Hz settings, if the value of V/Hz Knee Frequency (60Hz) is changed to say 1.4 and/or the value of V/Hz Roll-off Slope (60Hz) is changed to say 2.5 %V/Hz, the values of V/Hz Knee Frequency and/or V/Hz Roll-off Slope **SHALL NOT** change.

The voltage set point command is calculated from the frequency error between commanded frequency and the actual frequency. For example, a voltage set point of 94.5% of nominal would be commanded if there is a frequency error of 3.5Hz under nominal. There is no offset to voltage for errors above nominal frequency.

Note: There are only one V/Hz settings per calibration so the values must be used for both 50 and 60Hz operation. If a particular application requires vastly different V/Hz settings for 50Hz and 60Hz operation, it will be required to create separate software features for those applications.

Governor (The description here is taken from the help document for service tool)

Tuning Governor Idle

These parameters set the instantaneous Idle mode governor gains GK1 (Idle), GK2 (Idle), GK3 (Idle) and Governor Damping Effect (Idle) when genset is running at idle speed.

GK1(Idle)	This is a true proportional gain which is multiplied against the Speed error signal.
GK2(Idle)	This is a true integral gain which is multiplied against the sum of all previous errors.
GK3(Idle)	Affects high frequency characteristics of the governor algorithm. Adjust for Idle mode speed stability reasons.
Governor Damping Effect (Idle)	Affects high frequency characteristics of the governor algorithm. It slows the overall response of governor during Idle operation

Tuning Governor Rated

The following gain characteristics allow tuning of the governor when genset is running in Rated.

GK1(50Hz)	Sets overall governor gain in 50Hz applications. This is a true proportional gain which is multiplied against the frequency error signal.
GK2(50Hz)	Controls the recovery shape of speed transients in 50Hz applications. This is a true integral gain which is multiplied against the sum of all previous errors.
GK3(50Hz)	Affects high frequency characteristics of the governor algorithm in 50Hz applications.

	Adjust for frequency stability reasons.
GK1 High (50Hz)	Sets GK1 (50Hz) value to GK1 High (50Hz) when the Governor Speed Error exceeds governor speed delta high value. This is used in 50Hz application.
GK1 Low (50Hz)	Sets GK1 (50Hz) value to GK1 Low (50Hz) when the Governor Speed Error exceeds governor speed delta low value. This is used in 50Hz application.
Governor Damping Effect (50Hz)	Affects high frequency characteristics of the governor algorithm in 50Hz applications. Adjust for frequency stability reasons.
GK1(60Hz)	Sets overall governor gain in 60Hz applications. This is a true proportional gain which is multiplied against the speed error signal.
GK2(60Hz)	Controls the recovery shape of frequency transients in 60Hz applications. This is a true integral gain which is multiplied against the sum of all previous errors.
GK3(60Hz)	Affects high frequency characteristics of the governor algorithm in 60Hz applications. Adjust for frequency stability reasons.
GK1 High (60Hz)	Sets GK1 (60Hz) value to GK1 High (60Hz) when the Governor Speed Error exceeds governor speed delta high value. This is used in 60Hz application.
GK1 Low (60Hz)	Sets GK1 (60Hz) value to GK1 High (60Hz) when the Governor Speed Error exceeds governor speed delta high value. This is used in 60Hz application.
Governor Damping Effect (60Hz)	Affects high frequency characteristics of the governor algorithm in 60Hz applications. Adjust for frequency stability reasons.
Governor Gain Adjust	This trim allows the user to modify the overall gain of the governor. It should be set to nominal value when loading the Gains. This parameter shall be adjusted to minimize the hunting due to Genset to Genset variations.
Governor Enable Speed	This is the engine speed at which the governor is enabled when the genset start calls for the starting without an idle warm up period. This parameter is very important to HM systems in the cold start scenario. If the genset is going to start in cold conditions, this parameter needs to be set as high as possible to ensure that the engine is as warm as possible when the governor is enabled and the engine can respond to the fueling commands to increase speed in a timely manner (helps prevent over fueling). This parameter is used in conjunction with the governor preloads and the ramp times to help prevent over fueling.

	If the genset will not ever be started in the cold, this trim can be set anywhere within its adjustment range with little if any consequence to performance.

Notes:

A good starting point for any new engine application is to start with a set of released gains for an engine of a similar type and size should they already exist.

If a set of pre-developed gains are not available, the gains listed above should work well enough to start most engines and to allow them to run smoothly.

The value of GK1 should be adjusted to meet the specification for percent off rated voltage during a load acceptance, to prevent large voltage overshoots during offloads, and during engine/alternator startup.

The value of GK2 should be adjusted to control the recovery characteristics of the engine during large load acceptance and rejection transients. GK2 is a true integral type gain and is applied to the governor output as GK2 times the sum of all the previous governor error. Values of GK2 which are too high can cause unstable voltage performance and values too low can cause slow performance or steady state voltage offset errors.

The values of GK3, GK4 and the Damping factor are used to set the basic steady state stability of the engine, but also influence the overall speed of response of the governor in transient situations. Adjustment of GK3 and the Damping factor is an iterative process started by finding the engine load level which produces the worst steady state engine performance (note: GK1 and GK2 may have to be adjusted first to allow the engine to be transitioned smoothly into this) and adjusting GK3 until the best performance is observed, then doing the same for the Damping factor. Repeat this process at least once to ensure that the best possible values for GK3 and the Damping term have been determined.

Step-By-Step Procedure for Determining Engine and Alternator Control Parameters

Determine 60Hz governor gains, Regulator gains, and V\Hz curve values with PMG excitation.

Start genset to rated speed and adjust the GK3 and Damping term for 60Hz operation to allow the engine to run smoothly in steady state operation (note: GK1 and/or GK2 may need to be adjusted to allow this to happen). Apply various loads up to 100% rated and verify the steady state operation at all load levels. Most engines have some load level which is inherently less stable than others and must be found to determine the correct value for GK3 and the Damping term. Note: It is important to control the steady state performance of the engine. Unstable engine performance will be carried over into the generator output voltage. Very fast increases or decreases in engine speed, even if the magnitude of the increase or decrease is small, will tend be carried into the alternator voltage as large increases and decreases in voltage at the same frequency as the engine speed changes.

Do a series of load steps to determine the transient characteristics of the genset. Tuning of the governor GK1 and GK2 values, the settings of the V/Hz curve and the values of K1 and K2 (mostly K1) for the regulator must be done concurrently. In general, these values should be adjusted to achieve the maximum possible performance from both the engine and the alternator. A production test spec (if available) should give the full load step transient performance levels for any given genset model. This is a very iterative process and many require some time to find the best combination of gains to fit the application. In general, adjust GK1 to control the peak frequency during transients and adjust GK2 to control the recovery shape of the frequency transient. A V/Hz slope too steep will cause the engine to recover too quickly and recover to nominal speed very poorly and a V/Hz curve too shallow will cause a very slow engine recovery from a transient.

Re-verify steady state voltage and governor performance.

Determine 50Hz governor gains, Regulator gains, and V\Hz curve values.

Follow the same process as used at 60Hz. The order of 50Hz vs 60Hz testing can be reversed.

Gain Windowing Setup

Gain Windowing Enable –

This parameter either enables or disables the gain windowing feature. When this feature is enabled GK1 gain value is changed dynamically based on the speed error value. This helps to improve the transient response of the genset. If the values are not tuned properly one may observe oscillation after transient load conditions.

Governor Speed Delta High –

This trim sets the governor speed error high limit. The purpose of this trim is to allow the gain switching when the engine speed is greater than reference speed plus Governor Speed Delta High value. At this condition the GK1 high value is used for PID calculation. This parameter is covered under governor control setup

Governor Speed Delta Low –

This trim sets the governor speed error low limit. The purpose of this trim is to allow the gain switching when the engine speed is less than reference speed minus Governor Speed Delta Low value. At this condition the GK1 Low value is used for PID calculation. This parameter is covered under governor control setup

Determine correct values for the startup fueling parameters.

a) Adjust the Initial Crank Fueling Command, Initial Crank Fueling Period, Crank Fueling Ramp Rate and Max Crank Fueling Command parameters to control the way the engine transitions through the cranking stage of the engine startup. The controls default values should work well.

b) The value of the Crank Exit Fueling Command parameter should be set to the governor duty at which the engine runs when at rated speed, or to a value slightly higher.

Cranking Fueling Control

The following cranking fuel control characteristics are provided to "tune up" the genset startup to suit the application. Cold weather applications might need a longer cranking period and OR higher levels of cranking fuel. Following parameters should be chosen to make sure the genset starts up quickly enough but does not overshoot or produces excessive smoke at startup.

Initial Crank Fueling Duty Cycle	The Initial Cranking Fuel Duty Cycle can be chosen to suit the engine / application. Sets the initial value assigned to Governor Duty Cycle at entry in Crank State. Value too small will cause increase in starting time and increased use of starter and batteries. Value too large will cause excess fueling which will effect in smoke at startup, possible over-speed or Crank exit value to large. Start with a low value and go on increasing till smooth start is observed.
Initial Crank Fueling Period	The Initial Cranking Fuel Period can be chosen to suit the engine / application. Sets the period for which the value of Initial Crank Fuel Duty Cycle is assigned to Gov Duty Cycle, after entry in Crank State. Value too large will cause increase in starting time and increased use of starter and batteries. Value too small will cause excess fueling which will effect in smoke at startup, possible over-speed or Crank exit value to large. Start with a low value and go on increasing till smooth start is observed.
Crank Fueling Ramp Rate	The Cranking fuel is ramped up during cranking after initial cranking fueling period is over. The rate of ramping up of fueling can be chosen to suit the engine / application. Value too large will cause increase in starting time and increased use of starter and batteries. Value too small will cause excess fueling which will effect in smoke at startup, possible over-speed or Crank exit value to large.
Max Crank Fuel Duty Cycle	Sets the level to which the Governor Duty Cycle is limited during Crank State. The Maximum Crank fuel duty cycle can be chosen to suit the engine / application. If the value is too small then it will cause increase in starting time and increased use of starter and batteries. Value too large will cause excess fueling which will effect in smoke at startup, possible over-speed or Crank exit value to large.
Crank Exit	The value at which the Gov Duty Cycle is held after disengaging the starter until

Fueling Command	Governor is enabled.
Governor Enable Engine Speed	The Value of speed above which the electronic governor starts controlling the value of Gov Duty Cycle
Governor Ramp Time	Sets the minimum governor speed reference ramp rate. This basically controls the ramping of the set point for speed control logic during cranking to Idle or Governor enable Speed. Value too low will cause speed overshoot. Value too high will cause increase in starting time.

Notes: Fueling will be initially set to the Initial Crank Fueling Duty Cycle value and will remain at that value for the Initial Crank Fueling Period. After this period expires, the fuel command will be ramped at the Crank Fueling Ramp Rate until the Maximum Crank Fueling limit is reached. Upon reaching the Starter Disconnect Speed, the fueling command is pulled back to the Crank Exit Fueling Duty Cycle value until the Governor Enable Engine Speed is reached. When the Governor Enable Engine Speed is reached the governor is enabled, the speed setpoint is set to the sensed engine speed value at this point, and the setpoint is ramped to rated speed in a time equal to the Governor Ramp Time. The diagram below illustrates these set points.

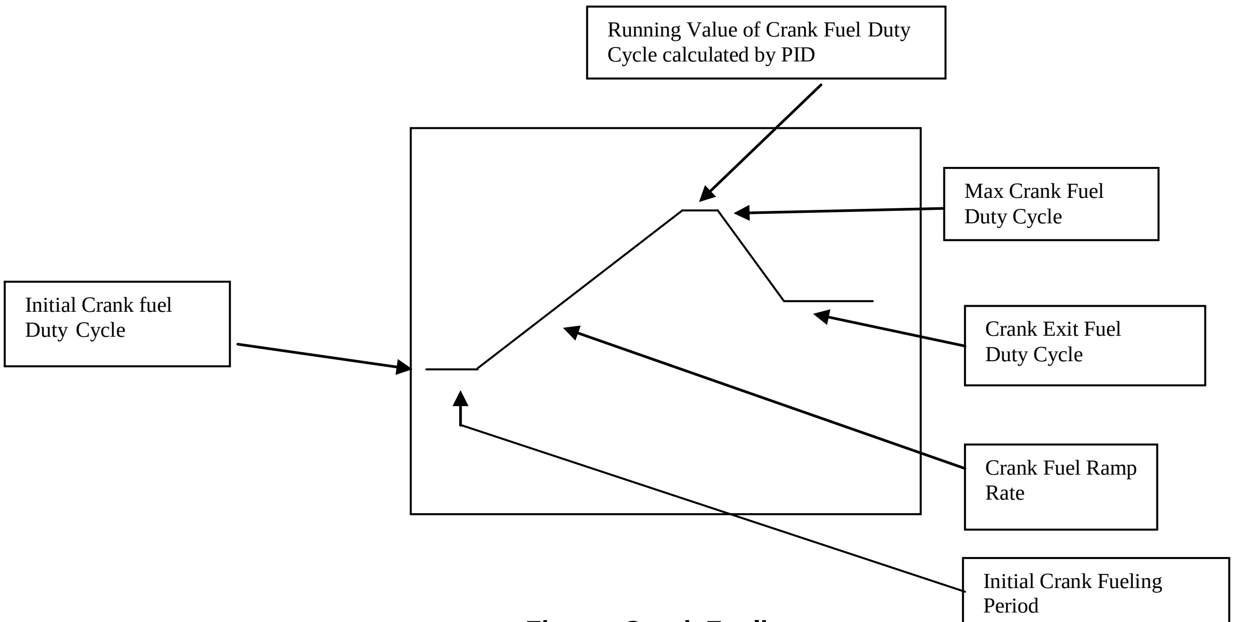


Figure: Crank Fueling

Non-Linear Actuator Compensation

It is actively used in gaseous fuel applications that use a butterfly valve for fuel actuator that has non-linear fuel flow characteristics over its full range of throttle positions. This helps in tuning the Governor of

Gaseous fueled engines. It helps to maintain a linear relationship between commanded Governor Duty Cycle and fueling across the full range of governor outputs, one needs to double the Governor Gain when operating above 50% Duty Cycle.

Parameters

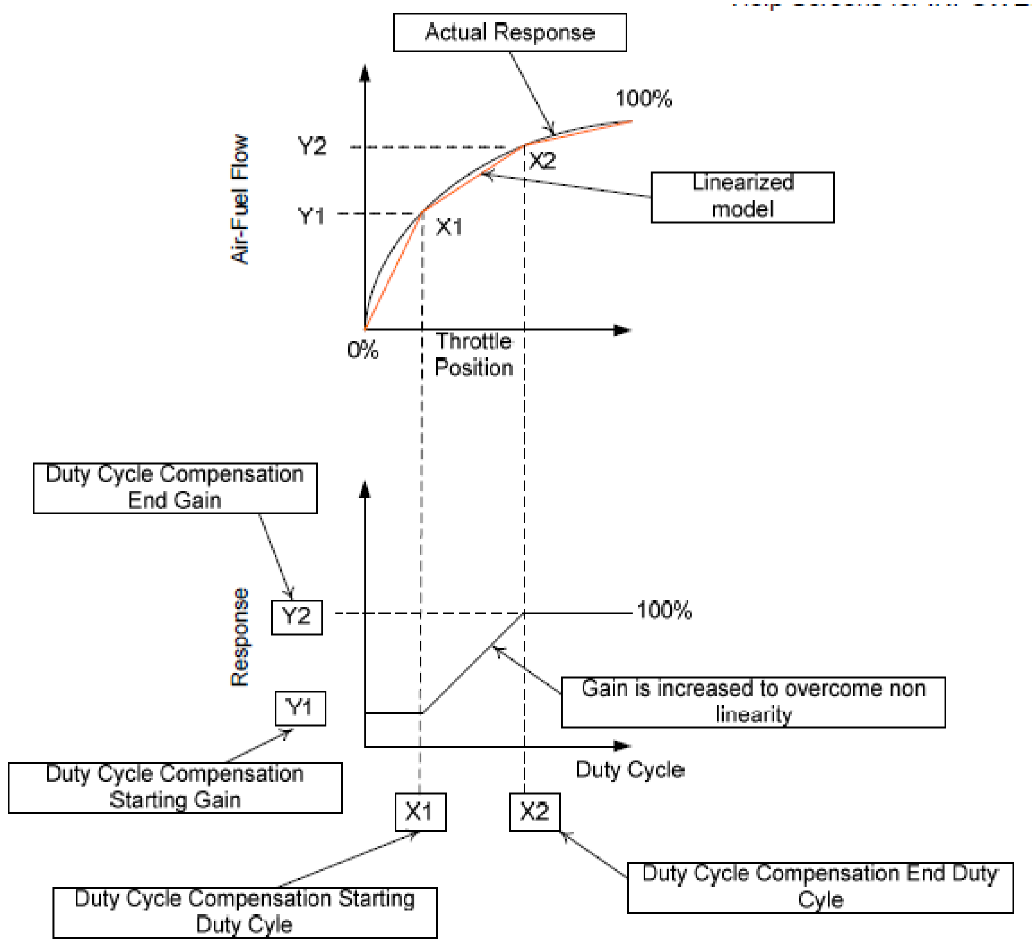
Duty Cycle Gain Compensation Enable – This trim Enables the Gov Gain vs. Gov Duty Cycle compensation feature.

Duty Cycle Gain Compensation X1 – This is Duty Cycle Compensation Starting Duty Cycle.

Duty Cycle Gain Compensation X2 – This is Duty Cycle Compensation End Duty Cycle

Duty Cycle Gain Compensation Y1 / Duty Cycle Compensation Starting Gain

Duty Cycle Gain Compensation Y2 / Duty Cycle Compensation End Gain



Non-Linear Compensation Graph

Figure : Non Linear Actuator (Duty) Cycle Compensation

Governing General

Minimum Duty Cycle –

This parameter sets the minimum limit for governor duty cycle. When the error is maximum on positive side and the PID tries to control the speed this is the value which will be driving the actuator. One has to tune the minimum value such as the PID works properly.

Maximum Duty Cycle –

This parameter set the maximum limit for governor duty cycle. This trims primary purpose is to protect the power electronics in the control. We have a typical rating of 4A continuous, 6A peak on our governor drives, the Max Duty Cycle needs to be set to protect those limits if the max possible actuator current can exceed this. If the actuator current cannot exceed this (a many do not), then just set the limit high, perhaps 90-95%. Do not set it too high as this will cause hammering of the actuator at the full open position. This will cause excessive wear of the actuator. The high value also may cause instability in the control system.

The Maximum Duty cycle can be achieved by using the Governor PWM override command available in the Inpower Tool. One can gradually increase the Override value to determine the Maximum Duty Cycle at which the Actuator is either full open or full close depending on the type.

Governor Preload Offset –

Sets the Integral Term of the governor so smooth transition takes place from Cranking to Speed Set point. This parameter shall be adjusted after gain tuning to smooth out the starting operating. If the value too small the Speed will drop after crank and if the value is too high the speed will surge.

Dither Factor –

Dither is a method of introducing small amount of noise into the speed governing system. The purpose of this feature is to prevent the fuel actuators from becoming stuck. Therefore dither should be used in applications where the fuel actuators are prone to sticking. This feature has adjustable dither amplitude (0% to 30% of governor duty cycle).

The exact value is a function of the application. The Typical values are in limits of 10-15%. There is a performance trade off when using this. One will typically gets worse steady state performance while using this, but if the actuator is sticking when a transient event occurs, and there is no dithering, the freq deviations could potentially be very high, out of spec or causing an over speed event.

Do not use dithering if the governor output is being used as a set point source for some other smart device or actuator, which is driving the actuator itself. The dither function is disabled by setting the dither factor to 0%.

Alternator Startup

The alternator will be started up and brought to rated voltage when the engine speed reaches rated speed. The PWM command to the field coil will now be stepped through an AVR Boot Table until the sensed voltage goes above the value of the AVR Boot Threshold trim. The regulator will now bring the voltage up to rated voltage. The purpose of the AVR Boot Table is to aid alternator startup whilst preventing over voltage conditions. The value of the AVR Boot Table and the AVR Boot Threshold can be set to bring the voltage up both as quickly and as smoothly as possible, but should already be set in the calibration to their ideal values. The AVR Boot Table has different values depending on value of the Excitation Source trim.

Setup for Gain Tuning

In order to properly set up the alternator control parameters it is convenient to setup the PC based service tool to be used to monitor.

This is a list of all of the parameters which affect genset performance. A correct value should be determined for each of the parameters listed.

Note: For any parameters that have something listed in the "Value" column, it is recommended that the parameter stay at that value during testing. Some parameters should never be changed during testing and are listed as never to be changed.

Parameter	Value	Comments
AVR Parameters		
K1(50Hz)		Sets overall AVR gain in 50Hz applications. This is a true proportional gain which is multiplied against the voltage error signal.
K2(50Hz)		Controls the recovery shape of voltage transients in 50Hz applications. This is a true integral gain which is multiplied against the sum of all previous errors.
K3(50Hz)		Affects high frequency characteristics of the AVR algorithm in 50Hz applications. Adjust for voltage stability reasons.
Damping Effect (50Hz)		Affects high frequency characteristics of the AVR algorithm in 50Hz applications. Adjust for voltage stability reasons.
K1(60Hz)		Sets overall AVR gain in 60Hz applications. This is a true proportional gain which is multiplied against the voltage error signal.
K2(60Hz)		Controls the recovery shape of voltage transients in 60Hz applications. This is a true integral gain which is multiplied against the sum of all previous errors.

Parameter	Value	Comments
K3(60Hz)		Affects high frequency characteristics of the AVR algorithm in 60Hz applications. Adjust for voltage stability reasons.
Damping Effect (60Hz)		Affects high frequency characteristics of the AVR algorithm in 60Hz applications. Adjust for voltage stability reasons.

Shunt Gain Multiplier –

This gain is applicable only for shunt excitation system. This is an additional overall AVR gain. Default value is set as 1.5 with a range of 0.5 to 10.

Load Govern and Synchronizer Tuning

14. Tuning Paralleling Gains (as applicable) Paralleling loops are external control mechanisms that feed into the standard governor and voltage regulator algorithms.

    Note: It is strongly recommended that both reactive and resistive loads are tested in paralleling applications.

    Three control loops may require adjustment for tuning paralleling:

    a. Synchronizer (Tune **Kp**, **Ki**, and **Kd** for all products except PCC3300. For PCC3300, tune only **Kp** and **Ki.**)

    Synchronization is the process of matching genset sine wave output (frequency, voltage, and phase angle) with another source. The objective of tuning Synchronizer gains is to achieve the quickest contactor close (synchronization) on genset startup with adequate stability margin. Alter the overall governor and sync gains (per step 7) to test stability margin.

    Perform the following tests and adjust gains as required. In addition, plot voltage and phase angle vs. time as required.

    ☐ Startup Performance

    With the bus live, start genset and record sync response. Attempt with zero and non-zero "Start to Rated Time" variable. Response may improve with non-zero time, as sync will not turn on until reaching the end of the speed ramp.

☐ Dead Bus/Live Bus Performance

With the Genset running at rated load, connect another source to the bus and record sync response. Similarly, disconnect additional source from the bus, allowing the bus to go dead and verify that sync turns off quickly.

☐ Constant Speed and Hold-in (±2% typical goal) Performance

At various loads (with 0.8 power factor) and various degrees out of phase, turn on synchronizer and measure transient response and ability to adjust and hold zero phase.

☐ Load Step Performance

To simulate varying loads while synchronizing, apply various load steps (with 0.8 power factor) and observe sync performance.

☐ Bus Frequency and Voltage Change Performance

Observe sync response to changing bus frequency by altering frequency in 0.5 or 1Hz steps. Similarly, observe sync response to changing bus voltage by altering voltage in 1-2% steps.

b. Load Share ("island mode") or Genset to Genset Paralleling (Once synchronized, tune **Kp** only.)

Perform the following tests and adjust gains as required.

☐ Evaluate steady state performance per step 8, observing frequency and voltage stability performance.

☐ Evaluate transient performance per step 9, observing frequency and voltage stability performance.

☐ Repeat steady state and transient tests, observing power performance (both real power kW and reactive kVAR.)

c. Load Govern ("utility parallel") or Genset to Utility Paralleling (Once synchronized, tune **Kp**, **Ki**, and **Kd** for all products except PCC3300. For PCC3300, tune only **Kp** and **Ki.**)

Note: Load Govern paralleling gains may require readjustment per application in the field due to local utility voltage and frequency variation.

Perform the following tests and adjust gains as required.

☐ Evaluate startup performance per step 10, observing speed ramp stability.

☐ Evaluate steady state performance per step 8, observing power stability performance (both real power kW and reactive kVAR.)

☐ Evaluate transient performance (step change in set point) per step 9, observing power stability performance (both real power kW and reactive kVAR.)

15. Final Performance Measurement

Overall performance of the Genset should now be measured and the Genset should hence be performance classified via the relevant performance standards. Return to any step and further adjust additional parameters as applicable.

Controller Calibration

The internal circuitry of the 2300 control may need to be calibrated. There are three different components which may need this. They are voltage measurement for display, voltage measurement for regulation, and current measurement for display.

The internal circuits must be calibrated in the following order.

Voltage Measurement for Regulation.

The goal of this is to calibrate the regulation circuitry so it regulates the genset to the desired nominal voltage.

With a PC Based Service Tool:

1) Connect to the control with your PC based service tool.
2) Verify the Nominal Voltage Trim is set to the desired value.
3) Adjust the trim Voltage Regulation Calibration 50Hz or Voltage Regulation Calibration 60Hz for your desired application. Adjust the trim so regulated voltage matches the desired nominal voltage measured with a known calibrated voltage meter.
4) Save the adjustments by doing a Save Trims with your PC based service tool.

With the Operator Panel:

1) Go to Setup and press ‘OK’
2) . Select ‘Adjust Droop and press ‘OK’
3) ’Select ‘Adjust Voltage’ and press ‘OK’
4) Voltage can be adjusted to + / - 5 % using HMI Up / Down keys with scaling of 0.1 %
5) Press ‘OK to save the parameter.

Voltage Measurement for Display

With a PC Based Service Tool:

1) Connect to the control with your PC based service tool.
2) Verify the Nominal Voltage Trim is set to the desired value.
3) Adjust the trim Alternator LX-N 50Hz Voltage Display Adjust or Alternator LX-N 60Hz Voltage Display Adjust trim for your application. Each line will need to be adjusted independently. The

goal is to have the value read by the PC based service tool correspond to the actual voltage being produced.

4) Save the adjustments by doing a Save Trims with your PC based service tool.

With the Operator Panel:

1) Go to Setup and press 'OK'
2) Go to 'Calibration Setup' and press 'OK'
3) Select L2 voltage and press 'OK'. The password screen will ask to enter Level 1 password which 574. Enter the password using HMI Up / Down keys and press 'OK'
4) After entering correct password, again Press 'OK' selecting L12 voltage.
5) Adjust the HMI voltage display with calibrated meter reading by decreasing or increasing the voltage adjust %.
6) The procedure is required for all the 3 phases. (Once correct password is entered, for other two parameters password is not required)

Current for Measurement for Display

With a PC Based Service Tool:

1) Apply a load to the genset and monitor the current with a calibrated current meter.
2) Connect to the control with your PC based service tool.
3) Verify the ct ratio settings and power ratings are correct for your application.
4) Adjust the LX 50Hz Current Adjust or LX 60Hz Current Adjust trim for your current application so the 2300 control measured current matches the current read by the know current meter. Each of the three lines will have to be adjusted independently of each other.
5) Save the adjustments by doing a save trims with your PC based service tool.

With the Operator Panel:

1) Go to Setup and press 'OK'
2) Go to 'Calibration Setup' and press 'OK'
3) Select L1 current and press 'OK'. The password screen will ask to enter Level 1 password which 574. Enter the password using HMI Up / Down keys and press 'OK'.
4) After entering correct password, again Press 'OK' selecting L1 current.
5) Adjust the HMI current display with calibrated meter reading by decreasing or increasing the L1 %.
6) The procedure is required for all 3 phases. (Once correct password is entered, for other two parameters password is not required.

Protections and Faults

The 3300 control features genset protection functions and fault detection.

On operation of a protective function the control will indicate a fault by flashing the fault code on the optional display panel (HMI) .The warning or shutdown LED will glow and the fault code will be displayed. The nature of the fault and time of occurrence are logged in the control. The service manual and PC based service tool provide service keys and procedures to handle fault condition based on the service codes provided.

Fault Code List

Shown below is a list of faults and there corresponding fault code number.

- Shutdown faults will shutdown the genset bypassing all cool-down cycles, or stop delays if set.
- Warning faults will be issued to notify the genset operator about the problem, but the 2300 control will not shutdown the genset.
- Derate faults will be issued with activation of 'Load Dump Command'. (Signal available on TB8-11) Genset will not shutdown, but the corresponding fault code status will be active and can be used to configure the 'Configurable outputs'
- None (Event) Faults do not give any warning or shutdown, but only indicate status of controller. The corresponding fault code is active on occurrence of the condition and can be used to configure 'Configurable Outputs'

Shutdown Faults -

Fault Code	Description
111	Engine Control Module Critical Internal Failure
115	Eng Crank Sensor Error
151	High Coolant Temp
155	High Intake Manf 1 Temp
214	High Oil 1 Temp
228	Low Coolant Pressure
234	Crankshaft Speed High
235	Low Coolant Level
236	Both Engine Speed Signals Lost
254	FSO_PWM_HIGH_CONTROL_ERROR
266	High Fuel Temperature
342	Calibration Code Fail

359	Fail To Start
415	Low Oil Rifle Press
449	Inj Metering 1 Press High
556	Crankcase Press High
781	CAN data link failure
783	Intake Manf 1 Rate Error
1242	DUAL_ACCEL_CONFORMANCE_ERROR
1244	Engine Normal Shutdown
1245	Engine Shutdown Fault
1247	Engine Quiet Shutdown
1257	Ctrl Mod ID In State Fail
Fault Code	Description
1336	Cooldown Complete
1433	Local Emergency Stop
1434	Remote Emergency Stop
1438	Fail To Crank
1443	Dead Battery
1445	Short Circuit
1446	High AC Voltage
1447	Low AC Voltage
1448	Under frequency
1459	Reverse Power
1461	Loss of Field (Reverse KVAR)
1472	Over Current
1517	Failed Module Shutdown
1918	Fuel Level Low
1992	Crankshaft Sensor High
2335	AC Voltage Sensing Lost (Excitation Fault)
2336	Bad Checksum
2661	At Least One Unacknowledged Most Severe Fault - Condition Exists
2814	Genset CT Ratio Low
2816	Genset PT Ratio Low
2896	Critical PCCnet Dev Fail
2914	Genset AC Meter Failed
2972	Field Overload
3631	AUX105 Setup Mismatch Shutdown

Warning Faults –

Fault Code	Description
122	Manifold 1 Press High
123	Manifold 1 Press Low
124	Manifold 1 Press High
135	High Oil Rifle 1 Pressure
141	Low Oil Rifle 1 Pressure
143	Low Oil Rifle Pressure
144	High Coolant 1 Temp
145	Low Coolant 1 Temp
153	High Intake Manf 1 Temp
154	Low Intake Manf 1 Temp
187	Sensor Supply 2 Low
195	High Coolant 1 Level
196	Low Coolant 1 Level
197	Low Coolant Level
212	High Oil 1 Temperature
213	Low Oil 1 Temperature
221	Air Pressure Sensor High
222	Air Pressure Sensor Low
223	Oil Burn Valve Sol Low
224	Oil Burn Valve Sol High
227	Sensor Supply 2 Low
231	High Coolant Pressure
232	Low Coolant Pressure
238	Sensor Supply 3 Low
239	Main Supply High
245	Fan Control Low
261	High Fuel Temperature
263	High Fuel 1 Temperature
265	Low Fuel 1 Temperature
271	Low Fuel Pump Press

272	High Fuel Pump Press
281	Cylinder Press Imbalance
285	CAN Mux PGN Rate Err
286	CAN Mux Calibration Err
287	CAN Mux Accel Data Err
295	Key On Air Press Error
322	Inj 1 Solenoid Low Curr
323	Inj 5 Solenoid Low Curr
324	Inj 3 Solenoid Low Curr
325	Inj 6 Solenoid Low Curr
331	Inj 2 Solenoid Low Curr
332	Inj 4 Solenoid Low Curr
343	ECM Hardware Failure
351	Injector Supply Failure
352	Sensor Supply 1 Low
386	Sensor Supply 1 High

Fault Code	Description
418	High H2O In Fuel
422	Coolant Level Data Error
425	Oil Temperature Error
427	CAN Data Link Degraded
435	Oil Press Switch Error
441	Low Battery 1 Voltage
442	High Battery 1 Voltage
451	Inj Metering 1 Press High
452	Inj Metering 1 Press Low
546	Fuel Delivery Press High
547	Fuel Delivery Press Low
553	APC Pressure High
554	APC Pressure Error
559	Inj Metering 1 Press Low
611	Engine Hot Shut Down
689	Crankshaft Speed Error
697	ECM Temperature High
698	ECM Temperature Low
731	Crankshaft Mech Misalign

781	CAN Data Link Failure
782	SAE J1939 Data Link 2 Engine Network No Data Received - Condition Exists
1124	Delayed Shutdown
1131	Battle Short Active
1132	Controlled Shutdown
1246	Unknown Engine Fault
1248	Engine Warning
1256	Ctrl Mod ID In State Error
1357	Oil Remote Level Low
1363	Intake Manf 1 Press Low
1367	High Prefilter Oil Press
1368	Low Prefilter Oil Press
1376	Camshaft Speed Error
1411	High Out Freq Adjust Pot
1412	High Droop Adjust Pot
1416	Fail To Shutdown
1417	Power Down Failure

1418	High Gain Adjust Pot
1427	Overspeed Relay Error
1428	LOP Relay Error
1429	HET Relay Error
1431	Pre-LOP Relay Error
1432	Pre-HET Relay Error
1435	Low Coolant Temperature
1439	Low Day Tank Fuel Sw
1441	Low Fuel Level
1442	Weak Battery
1444	Overload
Fault Code	Description
1449	Overfrequency
1464	Load Dump Fault
1469	Speed/Hz Mismatch
1471	Over Current
1518	Failed Module Warning
1548	Inj 7 Solenoid Low Curr

1549	Inj 8 Solenoid Low Curr
1551	Inj 10 Solenoid Low Curr
1552	Inj 11 Solenoid Low Curr
1553	Inj 12 Solenoid Low Curr
1554	Inj 13 Solenoid Low Curr
1555	Inj 14 Solenoid Low Curr
1556	Inj 15 Solenoid Low Curr
1557	Inj 16 Solenoid Low Curr
1597	ECM Device/Component
1622	Inj 9 Solenoid Low Curr
1689	Real Time Clock Power
1695	Sensor Supply 5 High
1696	Sensor Supply 5 Low
1843	Crankcase Press High
1844	Crankcase Press Low
1845	H2O In Fuel Sens High
1846	H2O In Fuel Sense Low
1852	Pre-High H2O In Fuel
1853	Annunciator Input 1 Fault
1854	Annunciator Input 2 Fault
1855	Annunciator Input 3 Fault
1891	Change Oil
1893	CAN EGR Valve Comm
1894	CAN VGT Comm Error
1896	EGR DL Valve Stuck
1899	Low EGR Dif Pressure
1911	Inj Metering 1 Press High
1917	Fuel Level High
1933	High EGR Data Link Volt
1934	Low EGR Data Link Volt
1935	EGR DL Cmd Source Err
1942	THD AZ Error
1944	HMI 113 Out Config Error
1961	High EGR DL EDU Temp
1974	Crankcase Press High
2185	Sensor Supply 4 High

Fault Code	Description
2186	Sensor Supply 4 Low
2215	Fuel Pump Press Low
2249	APC 2 Pressure Low
2261	Fuel Pump Press High
2262	Fuel Pump Press Low
Fault Code	Description
2265	High Fuel Lift Pump Volt
2266	Low Fuel Lift Pump Volt
2292	APC Flow High
2293	APC Flow Low
2311	EFI Control Valve Fail
2342	Too Long In Idle
2377	High Fan Control Voltage
2539	High Voltage Bias
2541	Low Voltage Bias
2545	Keysw Reset Required
2555	Low GHC 1 Voltage
2556	High GHC 1 Voltage
2653	Exhaust St 2 Temp High
2657	Exhaust St 1 Temp High
2678	Charging Alternator Fail
2815	Genset CT Ratio High
2817	Genset PT Ratio High
2895	PCCnet Device Failed
2917	High Genset Bus Voltage
2921	High Genset Bus Current
2922	High Genset Neutral Curr
2923	High Genset Bus kW
2924	High Genset Bus kVAR
2925	High Genset Bus kVA
2934	High Ambient Temp
2935	Low Ambient Temp
2936	Fuel Level High
2937	Fuel Level Low
2938	Ground Fault Switch
2939	MODBUS Failure

2942	Shutdown Override Fail
2943	Manual Sw Config Fail
2944	Auto Switch Config Fail
2945	Rupture Basin Switch
2946	Exhaust St 2 Temp Low
2947	Exhaust St 1 Temp Low
2948	Exhaust St 2 Temp High
2949	Exhaust St 1 Temp High
2951	Alternator 1 Temp High
2952	Alternator 1 Temp Low
2953	Alternator 1 Temp High
2954	Alternator 2 Temp High
2955	Alternator 2 Temp Low
2956	Alternator 2 Temp High
2957	Alternator 3 Temp High
2958	Alternator 3 Temp Low
2959	Alternator 3 Temp High
Fault Code	Description
2971	Test/Exercise Fault
2973	Charge Press IR Error
2977	Low Coolant Level 2 Sw
2978	Low Intake Manf 1 Temp
2979	High Alternator Temp Sw
2981	High Drive Bearing Temp
2982	Low Drive Bearing Temp
2983	High Drive Bearing Temp
2984	High Free Bearing Temp
2985	Low Free Bearing Temp
2986	High Free Bearing Temp
2992	High Intake Manf 1 Temp
2993	Battery Charger Sw Fail
3629	AUX105 Setup Mismatch Warning

Derate Faults-

Fault Code	Description
146	Pre-High Engine Coolant Temperature
421	High Oil Temperature
488	High Intake Manf 1 Temp
1243	Engine Derated

None Faults (Events)-

Fault Code	Description
1122	Rated to Idle Delay
1463	Not In Auto
1465	Ready to Load
1483	Common Alarm
1540	Common Warning
1541	Common Shutdown

Paralleling Fault and Events

Fault/Event Code	Fault/Event Name	Genset Response	PanelText	Description
1121	Fail To Disconnect	Warning	Fail to Disconnect	Controller was unable to open the genset and utility breaker.
1219	Utility Breaker Tripped	Warning	Utility CB Tripped	The utility breaker has tripped.
1223	Utility Frequency	Warning	Utility Frequency Error	The utility frequency sensor has determined that the utility frequency is or has been outside of the sensor dropout bandwidth.
1224	Genset Overvoltage	Warning	High Genset Voltage	The genset overvoltage sensor has determined that the genset voltage is or has been above the sensor dropout threshold.
1225	Genset Undervoltage	Warning	Low Genset Voltage	The genset undervoltage sensor has determined that the genset voltage is or has been below the sensor dropout threshold.
1226	Genset Frequency	Warning	Genset Frequency Error	The genset frequency sensor has determined that the genset frequency is or has been outside of the sensor dropout bandwidth.
1328	Genset Breaker Tripped	Warning	Genset CB Tripped	The genset breaker has tripped.
1451	Gen / Bus Voltages Out of Calibration	Warning	Genset/Bus V Mismatch	The genset and bus voltage sensing do not agree to within the Genset to Bus Voltage Cal Check Threshold while the genset breaker is closed.
1452	Genset Breaker Fail To Close	Warning	Genset CB Fail To Close	The genset breaker has failed to close within the Genset CB Fail To Close Time Delay.
1453	Genset Breaker Fail To	Warning	Genset CB Fail To	The genset breaker has failed to open within the Genset CB

Fault/Event Code	Fault/Event Name	Genset Response	PanelText	Description
	Open		Open	Fail To Open Time Delay.
1454	Genset Breaker Position Contact	Warning	Genset CB Pos Error	The genset breaker position contacts do not agree. For example the A contact is closed indicating that the breaker is closed while the B contact is closed indicating that the breaker is open.
1455	Utility Breaker Position Contact	Warning	Utility CB Pos Error	The utility breaker position contacts do not agree. For example the A contact is closed indicating that the breaker is closed while the B contact is closed indicating that the breaker is open.
1456	Bus Out Of Synchronizer Range	Warning	Bus Out Of Sync Range	Bus voltage and/or frequency are not within the 60 to 110% range of nominal genset voltage and/or frequency.
1457	Fail To Synchronize	Warning	Fail To Synchronize	The synchronizer has been running for the Fail To Synchronize Time.
1458	Sync Phase Rotation Mismatch	Warning	Sync Ph Rot Mismatch	The genset and bus have opposite phase rotations.
1475	First Start Backup	Warning	First Start Backup Fail	The first start arbitration did not provide first start signal within the
1912	Utility Loss Of Phase	Warning	Utility Loss Of Phase	The utility loss of phase sensor has determined that the utility source has lost one or two phases.
1913	Genset Loss Of Phase	Warning	Genset Loss Of Phase	The genset loss of phase sensor has determined that the genset has lost one or two phases.
1914	Utility Phase Rotation	Warning	Utility Ph Rotation Error	The utility phase rotation sensor has determined that utility phase rotation does not match the System Phase Rotation.
1915	Genset Phase Rotation	Warning	Genset Ph Rotation Error	The genset phase rotation sensor has determined that genset phase rotation does not match the System Phase

Fault/Event Code	Fault/Event Name	Genset Response	PanelText	Description
				Rotation.
1916	Sync Check OK	NONE	Sync Check OK	The genset and bus/utility are synchronized, ok to close breaker.
1999	Maximum Parallel Time	Warning	Maximum Parallel Time	The maximum utility parallel time was reached. The control will open the genset breaker.
2328	Utility Available	NONE	Utility Available	All enabled utility sensors have determined that the utility source is available.
2331	Utility Undervoltage	Warning	Low Utility Voltage	The utility undervoltage sensor has determined that the utility voltage is or has been below the sensor dropout threshold.
2332	Utility Connected	NONE	Utility Connected	The utility breaker is closed.
2333	Genset Connected	NONE	Genset Connected	The genset breaker is closed.
2358	Utility Overvoltage	Warning	High Utility Voltage	The utility overvoltage sensor has determined that the utility voltage is or has been above the sensor dropout threshold.
2396	Utility Breaker Fail To Close	Warning	Utility CB Fail To Close	The utility breaker has failed to close within the Utility CB Fail To Close Time Delay.
2397	Utility Breaker Fail To Open	Warning	Utility CB Fail To Open	The utility breaker has failed to open within the Utility CB Fail To Open Time Delay.
2779	Utility Unloaded Event	NONE	Utility Unloaded	Indicates that the utility source kW level is below the Utility Unloaded Level.
2965	Genset Available	NONE	Genset Available	All enabled genset sensors have determined that the genset source is available.

Rated to Idle Delay: Any Non-Zero value (Max 10 Seconds) for Rated to Idle Transition Delay is required to enable this event. On rated to idle RPM transition, the genset continues to run at rated RPM for defined time and fault code 1122 is active and remains active until genset leaves Idle Running condition (either stop or again rated frequency and voltage condition)

Not In Auto : Whenever genset is Not In Auto Mode, 1463 is active

Ready to Load : When genset reaches 90% of rated voltage and frequency, 1465 is active

Common Alarm: On any active common alarm, 1483 is active

Common Warning: On any active warning, 1540 is active

Common Shutdown: On any active shutdown 1541 is active.

Engine Protection

- **Over Speed Shutdown** – Engine Over Speed default setting is 115% of the rated engine speed nominal. Control includes time delays to prevent nuisance shutdown signals.

- **Low Lube Oil Pressure Warning/Shutdown -** Level is preset (configurable with a PC based service tool). Control includes time delays to prevent nuisance warning/shutdown signals.

- **High Engine Temperature Warning/Shutdown** - Level is preset (configurable with PC based service tool. Control includes time delays to prevent nuisance warning/shutdown signals.

- **High Engine Temperature Shutdown with Cooldown** - Level is preset (configurable with PC based service tool and HMI) to match the capabilities of the engine used. Control includes time delays to prevent nuisance shutdown signals.

- **High Intake Manifold Temperature Warning/Shutdown** - Level is preset (configurable with PC based service tool and HMI) to match the capabilities of the engine used. Control includes time delays to prevent nuisance warning/shutdown signals.

- **High Oil Temperature Warning/Shutdown** - Level is preset (configurable with PC based service tool and HMI) to match the capabilities of the engine used. Control includes time delays to prevent nuisance warning/shutdown signals.

- **Low Coolant Temperature Warning** - Indicates that engine temperature may not be high enough for a 10-second start or proper load pickup. Level is preset (configurable with a PC based service tool) to match the capabilities of the engine used. Control includes time delays to prevent nuisance warning signals.

- **Low Battery Voltage Warning** - Indicates battery charging system failure by continuously monitoring battery voltage. Control includes time delays to prevent nuisance warning signals.

- **High Battery Voltage Warning** – Indicates battery charging system is of higher level by continuously monitoring battery voltage. Control includes time delays to prevent nuisance warning signals.

- **Weak Battery Voltage Warning** - Control system will test the battery bank each time the generator set is signaled to start, and indicate a warning if the generator set battery indicates impending failure. Control includes time delays to prevent nuisance warning signals.

- **Setup Mismatch Warning/Shutdown –** All the AUX105 setup parameters are read from the PCC3300 correctly when the key switch turns ON. Setup Shutdown Fault will occur when HMECM receives less than required setup parameters and the Setup Warning Fault will occur when the PCC3300 has more HMECM Setup parameters than AUX105.

- **Loss of Speed Sense Shutdown -** Indicates magnetic pickup failure (after the starter has disengaged or the engine is in govern state). The control will stop the genset when magnetic pickup fails to detect pulses after a set delay.

- **Fail to Crank Shutdown -** Control has signaled starter to crank the engine but engine does not rotate.

- **Cranking Lockout** - The control will not allow the starter to attempt to engage or to crank the engine when the engine is rotating (when control senses the valid engine RPM above the threshold value.)

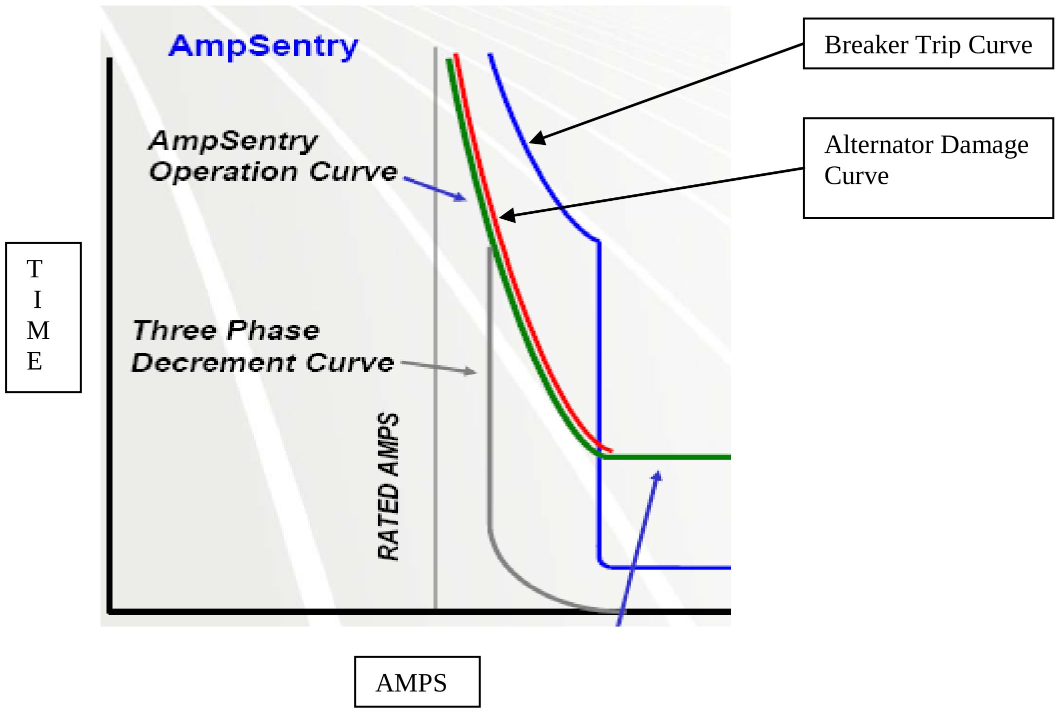
- **Sensor Failure Indication** – Out of range high / low diagnostic logic is provided on the base control to detect analog sensor or interconnecting wiring failures.

Alternator Protection

- **High / Low AC Voltage Shutdown** - High voltage default to 110% of the rated voltage for 10 seconds time delay and instantaneous voltage default to 130% of the rated voltage. Low AC voltage default to 85% of the rated voltage for 10 seconds time delay.

- **Over current Warning/Shutdown** – Shutdown set to be below alternator damage curve up until maximal measureable point. Currents above the maximal measureable point shutdown after the HCT Shutdown Time Delay. Warning level set to half of the shutdown threshold.

- **Amp Sentry Protection –**



Circuit breakers usually can not protect alternator in short circuit faults. But the power command 3300 alternator protection is based upon the alternator thermal damage curve called as Amp-Sentry protection.

- **Under/Over Frequency** - Under frequency default to - 6Hz of the 50 Hz / 60 Hz frequency for 10 seconds time delays. Over frequency default to + 6Hz of the 50 Hz / 60 Hz frequency for 10 seconds time delays.

- **Loss Of Sensing AC Voltage Shutdown** – Loss of sensing AC voltage detects the loss of voltage sensing or senses the loss of zero crosses. This fault will also be the primary way to detect short circuit conditions.

- **Overexcitation Shutdown** – Over excitation is used to detect short circuit alternator faults.

- **Reverse Power (KW) Shutdown –** Reverse power default to 10 % of standby Kw rating for a 3 seconds time delay.

- **Reverse KVAR Shutdown –** Reverse KVAR default to 20 % of standby Kw rating for a 10 seconds time delay.

PCC Net Devices

3300 control supports PCC net devices which are categorized as active or passive.

Active PCC net Devices –

Active PCCnet devices can cause the genset to start or stop or can be used in a critical control situation. Loss of these devices from the network can cause a loss of control situation.

The following are active PCC net devices -
HMI 320 - Operator Panel
HMI 113 – Universal Annunciator
AUX 101 and 102 – I/O expansion modules

Every active PCCnet device is non-critical unless specified as critical and will generate a warning fault if sensed as having left the network

For critical active device, each lost PCCnet device will generate a shutdown fault if sensed as having left the network

Passive PCC net Devices

Passive PCCnet devices either display genset related information only, or cannot ever cause an unsafe or loss of control situation if the device leaves the network.

Following are the passive PCC Net devices

HMI 112/HMI 114 – Bargraph module
Battery chargers (Future- Release 2 control)

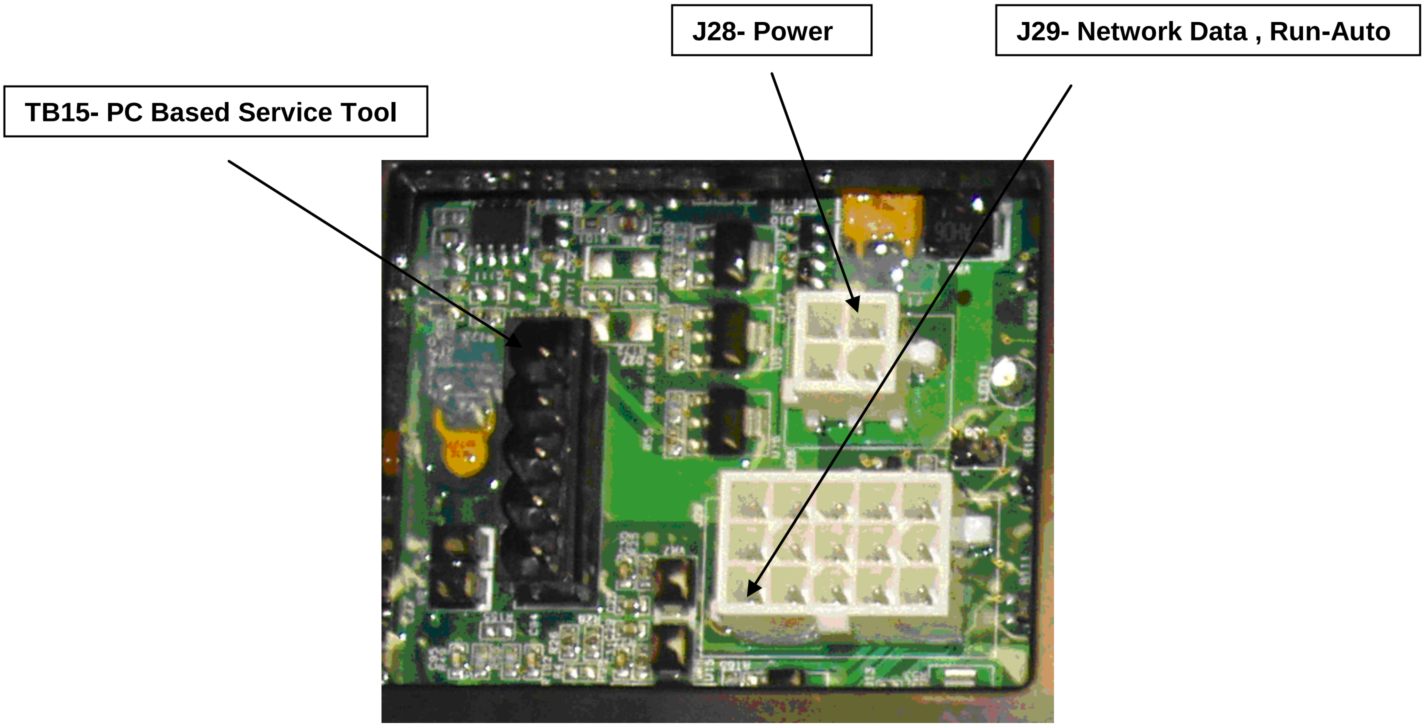
Display Panel (HMI 320)

The control is available with an optional display panel (HMI320 – Internal Part number 0300-6315-02) that may be either locally or remotely mounted. The display is composed of an adjustable contrast backlit LCD display, with a series of 5 generator status LED lamps. The display is accompanied by a set of 19 tactile feel membrane switches that are used by the operator to navigate through control menus, and to make control adjustments. It is configurable for both units of measurement, i.e. – (SAE [Society of Automotive Engineers] and Metric). The HMI320 can operate on 12V or 24V DC.

The Run/Off/Auto switch function is integrated into the display panel; therefore an external switch is not required with the display panel option. The control displays current active faults, and a time-ordered history of previous faults.

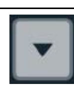
Display Panel Front

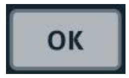
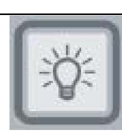
(0300-6315-02)



Display Panel Rear

HMI320 Buttons Functions

Symbol	Button Function
	Navigate Right
	Navigate Left
	Navigate Up
	Navigate Down
	Navigate Back
	Home

	Ok/ Enter
	Soft Button
	Soft Button
	Soft Button
	Soft Button
	Stop
	Start
	MANUAL
	Auto
	Circuit Breaker Open
	Circuit Breaker Close
	FAULT ACKNOWLEDGE /RESET
	PANEL LAMP

HMI320 LCD Feature Specification

LCD Type	FSTN, Positive, Transflective
Dimensions	121.92 (L) * 90.42 (H) mm
Diagonal	144.78 mm
Resolution	320 X 240
Controller	Epson SID 13700

HMI320 LCD Mechanical Specifications

Outline Area	153.54 (L) * 120.24 (W) * 18.9 (H)
Viewing Area	120.14 (L) * 92.14 (W) mm
Active Area	115.18 (L) * 86.38 (W) mm
Dot Size	0.34 (L) * 0.34 (W) mm
Dot Pitch	0.36 (L) * 0.36 (W) mm

HMI320 LCD Ratings

Operating Temperature **-20 deg C – 70 deg C**

(without heater)	
Operating Temperature (with heater)	**-40 deg C – 70 deg C**
Storage Temperature	**-40 deg C – 70 deg C**
Storage Humidity	**20 – 90 %RH**

Vibration Specification

The HMI board is designed to withstand vibration levels of 20Hz to 100 Hz at a constant displacement of 0.15mm and 100Hz to 500Hz at a constant acceleration of 6 g's

HMI Connections

J28 – Power Connections

Connector Pin	Signal Name	Connect To Comments
J28-1	Fused B+	B+ supply to HMI
J28-2	N/A	
J28-3	B+ Return	Return / GND to HMI
J28-4	N/A	

J29 – Data and Run/ Auto Connections

Connector Pin	Signal Name	Connect To / Comments
J29-1	PCC Net A (+)	Network Data A
J29-2	PCC Net B (-)	Network Data B
J29-3	Bi-directional System Wakeup	
J29-4	Auto	Configurable as Wake-up
J29-5	N/A	
J29-6	Run	Manual run command

J29-7	N/A	
J29-8	N/A	
J29-9	Lamp Test	A ground signal is available on pressing Lamp Test.
J29-10	Reset	A ground signal is available on pressing Reset.
J29-11	N/A	
J29-12	N/A	
J29-13	N/A	
J29-14	N/A	
J29-15	N/A	

Tools Interface Connections		
Connector Pin	**Signal Name**	**Connect To**
TB15 – 1	RETURN	Network Power Supply Return
TB15 – 2	B +ve	Network Power Supply
TB15 – 3	RS485_DATA_A	Network Data A
TB15 – 4	RS485_DATA_B	Network Data B
TB15 – 5	Bi-Directional System Wakeup	

Note: J29 must be disconnected to use PCTool on TB15

Connector Part Numbers

Display Panel Connector Info				
	Connector Housing		Connector Pins	
Ref	Internal P/N	Man / P/N	Internal P/N	Man / P/N
J28	0323-2091	1- 770174-1	0323-2466	Amp/Tyco / 770904-1/770988-1/171637-1
J29	0323-2456	1-770190-1	0323-2466	Amp/Tyco / 770904-1/770988-1/171637-1
TB15	0323-2192-04	Amp/Tyco 796641-5 , MOLEX 39520-0005		

Wiring Diagrams
Refer to wiring diagram 0630-3440 for the connection details of control.

LED Indicating Lamps

On back side (connector side) of HMI, there is one green LED (LED 11), which blinks continuously when HMI is powered up and in awake mode.

The display panel (HMI) includes LED indicating lamps for the following functions:

Genset Running	**GREEN**
Remote Start	**GREEN**
Not In Auto	**RED**
Shutdown	**RED**
Warning	**YELLOW**
CB OPEN	**GREEN**
CB CLOSE	**GREEN**
Manual	**GREEN**
Auto	**GREEN**
Stop	**GREEN**
Heart Beat (LED11 at the back of the display panel)	**GREEN**

Rules for HMI 320

Manual / Auto / Off Functions –

HMI verifies the controller state when PCC Net is active and is indicated by corresponding LED. For Example- If HMI input 'Auto' button is pressed, then HMI verifies that the controller is also in the same state, and then the Auto LED on HMI glows solid. If PCC net is not active, with no feedback from controller, then the Auto LED keeps on blinking. The same is applicable for Manual and Stop functions.

For manual start operation after pressing manual button 

, manual LED will glow. If start button 

is not pressed within 10 seconds, manual LED will go off, with controller mode again going back to stop mode.

When genset is running in Manual mode, with PCC Net active, then on pressing the Stop Button once, will initiate the shutdown with cool-down cycle. If Stop Button is pressed twice, genset will shutdown bypassing all cool-down modes.

When genset is running in Manual mode, with PCC Net inactive, then on pressing the Stop Button once, genset will shutdown bypassing all cool-down modes.

When genset is running in Auto mode with PCC Net active or inactive, then on pressing the Stop Button once genset will shutdown bypassing all cool-down modes
If PCC Net fails (inactive) while genset is running in Auto or Manual mode, genset will continue to run, and will shutdown on pressing Stop button.

Status LEDs, Panel Lamp, Reset Functions –
The genset status indicator LEDs glow continuously as per genset status when PCC Net is active. If genset is running and PCC Net is not active, then only 'Genset Running' LED will flash (blinking mode) while all other LEDs will be off.

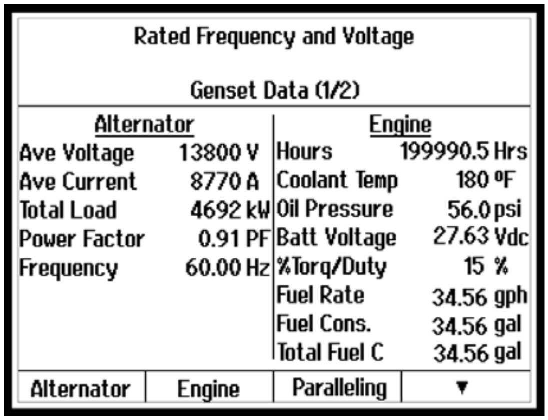
If PCC Net fails when genset is not running, all LEDs will be off.

Lamp Test – On pressing Lamp Test Button  all LEDs glow on HMI. If button is pressed and held for 3 seconds, J29 – Pin 9 goes low (i.e Ground signal is available) and can be used to drive a panel lamp (0.5 A Rating)

Reset Input – On pressing reset button on HMI, will send PCC Net reset command to genset controller Also Pin 10 on J29 connector of HMI goes low, (i.e. Ground signal is available on pressing Reset Button). This can be used as backup for reset function. If PCC Net fails, this pin can be used for remote fault reset function.

When PCC Net is not active, and If Home button is pressed and held,  HMI will enter into Demo Mode allowing navigation of all the screens. In this case Line 1 of HMI screen will flash as "Demo Mode". To Power Down the HMI is the only way to come out of Demo Mode.

Default Screen – When HMI powered up and PCC net is active, HMI goes to default screen, i.e. Genset Data Page 1.



While on any screen, if No Activity is done for 20 minutes, the HMI will go back to default screen, i.,e Genset Data Page 1

For adjusting parameters using HMI, passwords are required for some of the parameters. Controller will ask for Level 1 or Level 2 password. Level 1 password is 574 and Level 2 password is 1209.

When a level 1 password entry screen is presented to the user (when a level 1 parameter adjustment is requested), the HMI accepts the level 1or level 2 password as a valid entry.
When a level 2 password entry screen is presented to the user (when a level 2 parameter adjustment is requested), the HMI shall accepts the level 2 password as a valid entry.
If a valid level 1 password is entered, the HMI unlocks all of the level 1 parameters only.
If a valid level 2 password is entered, the HMI unlocks all of the level 1 and 2 parameters.
If there has been no panel activity (i.e. no front panel buttons have been pushed) for 5 minutes, the HMI relocks all of the previously unlocked parameters.

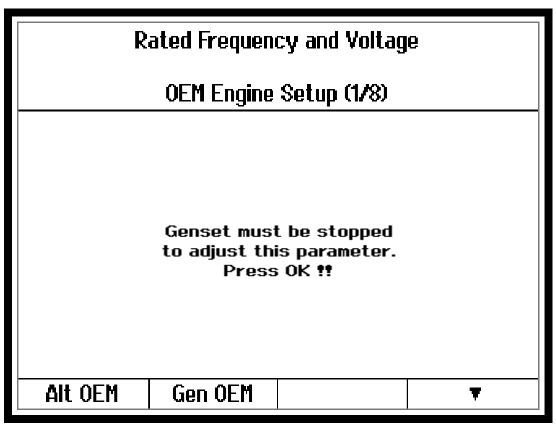
If an invalid password is entered, the HMI shall give an error indicating that an invalid password was entered

HMI Adjust Screen and Navigation Rules –

Adjust screens are screens that consist of parameter(s) which have values that can be changed. The Adjustable Parameter value may be numerical or text. Numerical values maybe incremented and decremented, or are have selectable values. Adjustable parameters are accessed through the LCD and can be incremented or decremented.

To select the parameter to adjust, the cursor shall move using the up/down buttons. Moving between screens shall use the ▲and ▼soft keys. Hitting the OK button will pop up either a password menu screen if appropriate or an adjustment window for the selected parameter. Correct entry of the appropriate password will continue directly with the editing of the parameter by creating an adjustment window for the selected parameter.

If the controller cannot be put in setup mode a popup screen will be displayed with the following message "!Genset must be off to adjust this parameter" (As shown below). Hitting Ok will close this window. Hitting the cancel button will close the adjustment window and restore the parameter to its original value and take the controller out of setup mode.



HMI320 Operating Modes

The HMI320 operates in one of four defined modes;

1) Standby Mode (Sleep Mode)

2) Backlight Off Mode

3) Normal Operation Mode

4) Off Mode

1) Standby Mode (Sleep Mode)

The HMI320 “Standby Mode” is intended to help conserve battery life while the Genset system is not running. This mode helps to ensure that the Genset system can be placed in a standby mode for longer durations of time without depleting the battery power.

- HMI320 is powered down.
- The system (HMI) comes out of ‘Sleep Mode’ when it receives a bi-directional wakeup.
- All other system peripherals and circuit components should be powered down.
- The current drawn in this mode is less than 1mA.
- The HMI320 has the ability to disable this feature by installing a jumper (J36) between wakeup pin and ground pin.

2) Backlight Off Mode

The HMI320 “Backlight off Mode” is intended to conserve power by turning off power to the backlight.

- HMI320 is awake.
- Backlighting is powered down.

3) Normal Operation Mode

The HMI320 is capable of normal, continuous operation within the range of 6 – 31V.

4) Off Mode

HMI320 is in the Off mode only when B+ (power input) is absent.

When in ‘Off’ mode, all circuit components and system peripherals will have no power to them.

HMI320 Screens Sequences

Screen Depth 0	Screen Depth 1	Screen Depth 2	Screen Depth 3	Screen Depth 4	System Name
Home Page					
	Genset Data				
		Average Voltage			Genset LL Average Voltage
		Average Current			Genset Average Current
		Total kW			Genset Total kW
		Total PF			Genset Total Power Factor
		Frequency			Genset Frequency OP
		Engine Hours			Engine Running Time OP
		Coolant Temp			Coolant Temperature OP
		Oil Pressure			Oil Pressure
		Batt Voltage			Battery Voltage OP
		% Torque/Duty Cycle			Percent Engine Torque/Duty Cycle
		Fuel Rate			Fuel Rate
		Fuel Consumption			Fuel Consumption Since Reset
		Tot Fuel Consumption			Total Fuel Consumption
		Application kW kVA Amps			Genset Application kW rating
		Application kW kVA Amps			Genset Application kVA rating
		Rated Current			Genset Application Nominal Current
		Standby kW kVA Amps			Genset Standby kW rating
		Standby kW kVA Amps			Genset Standby kVA rating
		Rated Current			Genset Standby Nominal Current
	Engine Data				
		Engine Hours			Engine Running Time OP
		CoolantTemp			Coolant Temperature OP

		Engine Speed			Average Engine Speed OP
		Battery			Battery Voltage OP
		Oil Pressure			Oil Pressure
		Oil Temp			Oil Temperature
		Manf Temp			Intake Manifold Temperature
		Boost Pressure			Boost Pressure
		Glow Plug Cmd			Glow Plug Command
		Rail Press Abs			Fuel Outlet Pressure
		Fuel Inlet Temp			Fuel Temperature
		Coolant Press			Coolant Pressure
		Pump Press Abs			Fuel Supply Pressure
		Crankcase Pressure			Crankcase Pressure
		Aftercooler Temp			Aftercooler Temperature
		Ambient Press			Barometric Absolute Pressure
		Oil Pressure			Oil Pressure Switch Status
	Alternator Data				
		L1 L-L			Genset L1L2 Voltage
		L1 L-N			Genset L1N Voltage
		L1 Amps			Genset L1 Current OP
		L2 L-L			Genset L2L3 Voltage
		L2 L-N			Genset L2N Voltage
		L1 Amps			Genset L2 Current OP
		L3 L-L			Genset L3L1 Voltage
		L3 L-N			Genset L3N Voltage
		L3 Amps			Genset L3 Current OP
		Frequency			Genset Frequency OP
		AVR Duty Cycle			AVR PWM Command OP
		L1 kW			Genset L1 kW
		L1 kVA			Genset L1 KVA OP
		L1 PF			Genset L1 Power Factor
		L2 kW			Genset L2 kW
		L2 kVA			Genset L2 KVA OP

		L2 PF			Genset L2 Power Factor
		L3 kW			Genset L3 kW
		L3 kVA			Genset L3 KVA OP
		L3 PF			Genset L3 Power Factor
		Total kW			Genset Total kW
		Total kVA			Genset Total KVA OP
		Total PF			Genset Total Power Factor
		Neutral Current			Genset Neutral Current
		Ground Current			Ground Current
		Alt Bearing , NDE			Non-Drive End Bearing Temperature (Aux101)
		Alt Bearing , DE			Drive End Bearing Temperature (Aux101)
		Alt Winding, L1			Alternator Temperature 1 (Aux101)
		Alt Winding, L2			Alternator Temperature 2 (Aux101)
		Alt Winding, L3			Alternator Temperature 3 (Aux101)
	History/About				
		Starts			Total Start Attempts OP
		Runs			Total Number of Runs OP
		Engine Hours			Engine Running Time OP
		Control Hours			Controller On Time OP
		kW Hours			Genset Total Net kWh
		Genset Model Number			Genset Model Number
		Genset Serial Number			Genset Serial Number
		Nominal Voltage			Genset Nominal Voltage
		Wye/Delta			Genset Delta/Wye Connection
		Prime/Standby			Application Rating Select
		Controller Type			Controller Device Type
		Calibration Part			Calibration Part Number
		Calibration Date			Calibration Revision Date
		Firmware Version			Firmware Version Number
		ECM Code			ECM Code OP
		HMI Boot Ver			HMI Local Parameter

		HMI Firmware Ver			HMI Local Parameter
		Bargraph 0			Bargraph_0 Firmware Version
		Bargraph 1			Bargraph_1 Firmware Version
		Aux 101-0			Aux101-0 Software Version
		Aux101-1			Aux101-1 Software Version
		Aux101-3			Aux101-3 Software Version
		Aux101-4			Aux101-4 Software Version
		Aux101-5			Aux101-5 Software Version
		@0-5			50Hz kW Load Profile Table Row Pointer
		@5-10			50Hz kW Load Profile Table Row Pointer
		@10-15			50Hz kW Load Profile Table Row Pointer
		@15-20			50Hz kW Load Profile Table Row Pointer
		@20-25			50Hz kW Load Profile Table Row Pointer
		@25-30			50Hz kW Load Profile Table Row Pointer
		@30-35			50Hz kW Load Profile Table Row Pointer
		@35-40			50Hz kW Load Profile Table Row Pointer
		@40-45			50Hz kW Load Profile Table Row Pointer
		@45-50			50Hz kW Load Profile Table Row Pointer
		@50-55			50Hz kW Load Profile Table Row Pointer
		@55-60			50Hz kW Load Profile Table Row Pointer
		@60-65			50Hz kW Load Profile Table Row Pointer
		@65-70			50Hz kW Load Profile Table Row Pointer
		@70-75			50Hz kW Load Profile Table Row Pointer
		@75-80			50Hz kW Load Profile Table Row Pointer
		@80-85			50Hz kW Load Profile Table Row Pointer
		@85-90			50Hz kW Load Profile Table Row Pointer
		@90-95			50Hz kW Load Profile Table Row Pointer
		@95-100			50Hz kW Load Profile Table Row Pointer
		@>100			50Hz kW Load Profile Table Row Pointer
		@0-5			60Hz kW Load Profile Table Row Pointer
		@5-10			60Hz kW Load Profile Table Row Pointer
		@10-15			60Hz kW Load Profile Table Row Pointer
		@15-20			60Hz kW Load Profile Table Row Pointer
		@20-25			60Hz kW Load Profile Table Row Pointer

		@25-30			60Hz kW Load Profile Table Row Pointer
		@30-35			60Hz kW Load Profile Table Row Pointer
		@35-40			60Hz kW Load Profile Table Row Pointer
		@40-45			60Hz kW Load Profile Table Row Pointer
		@45-50			60Hz kW Load Profile Table Row Pointer
		@50-55			60Hz kW Load Profile Table Row Pointer
		@55-60			60Hz kW Load Profile Table Row Pointer
		@60-65			60Hz kW Load Profile Table Row Pointer
		@65-70			60Hz kW Load Profile Table Row Pointer
		@70-75			60Hz kW Load Profile Table Row Pointer
		@75-80			60Hz kW Load Profile Table Row Pointer
		@80-85			60Hz kW Load Profile Table Row Pointer
		@85-90			60Hz kW Load Profile Table Row Pointer
		@90-95			60Hz kW Load Profile Table Row Pointer
		@95-100			60Hz kW Load Profile Table Row Pointer
		@>100			60Hz kW Load Profile Table Row Pointer
	Faults				
		Act Shutdown Faults			
			Fault Code		Active Shutdown Faults List Table Row Pointer
			Source		Active Shutdown Faults List Table Row Pointer
			Real Time		Active Shutdown Faults List Table Row Pointer
			Engine Time		Active Shutdown Faults List Table Row Pointer
			(fault text)		Active Shutdown Faults List Table Row Pointer
			Fault Code		Active Shutdown Faults List Table Row Pointer
			Source		Active Shutdown Faults List Table Row Pointer
			Timestamp		Active Shutdown Faults List Table Row Pointer
			Engine Time		Active Shutdown Faults List Table Row Pointer
			(faukt text)		Active Shutdown Faults List Table Row Pointer
		Act Warning Faults			
			Fault Code		Active Warning Faults List Table Row Pointer

			Source		Active Warning Faults List Table Row Pointer
			Timestamp		Active Warning Faults List Table Row Pointer
			Engine Time		Active Warning Faults List Table Row Pointer
			(fault text)		Active Warning Faults List Table Row Pointer
			Fault Code		Active Warning Faults List Table Row Pointer
			Source		Active Warning Faults List Table Row Pointer
			Timestamp		Active Warning Faults List Table Row Pointer
			Engine Time		Active Warning Faults List Table Row Pointer
			(fault text)		Active Warning Faults List Table Row Pointer
		Fault History			
			Control Hours		Fault History List Table Row Pointer
			Occurrences		Fault Occurrence Table Row Pointer
			Engine Hours		Fault History List Table Row Pointer
			Fault Code		Fault History List Table Row Pointer
			(fault text)		Fault History List Table Row Pointer
			Control Hours		Fault History List Table Row Pointer
			Occurrences		Fault Occurrence Table Row Pointer
			Engine Hours		Fault History List Table Row Pointer
			Fault Code		Fault History List Table Row Pointer
			(fault text)		Fault History List Table Row Pointer
	Setup				
		Display Options			
			Power Mgmt		HMI Local Parameter
			Units		HMI Local Parameter
			Language		HMI Local Parameter
			Backlight Timer		HMI Local Parameter
			Sleep Timer		HMI Local Parameter
			Sleep Mode		HMI Local Parameter
			Contrast		HMI Local Parameter
		Clock Setup			
			Real Time Clock		Clock Mode

			Real Time Clock		Clock Hour
			Real Time Clock		Clock Minute
			(Second)		Clock Second
			Real Time Clock		Clock Date
			Real Time Clock		Clock Month
			Real Time Clock		Clock Year
			Daylight Saving Time		Daylight Savings Time Enable
			Adjustment		Daylight Savings Time Adjustment
			Start Mon		Daylight Savings Start Month
			Start Week		Daylight Savings Start Week Occurrence in Month
			Start Day		Daylight Savings Start Day
			Start Hour		Daylight Savings Start Hour
			End Month		Daylight Savings End Month
			End Week		Daylight Savings End Week Occurrence in Month
			End Day		Daylight Savings End Day
			End Hour		Daylight Savings End Hour
		MODBUS Setup			
			Node Address		Modbus Node Address
			Baud Rate		Modbus Baud Rate
			Parity		Modbus Parity
			Failure Time Delay		Modbus Failure Time Delay
			Lost Response		Modbus Communications Lost Response Method
			Slave Message Count		Modbus Slave Message Count
			No Response Count		Modbus No Response Count
			CRC Error Count		Modbus CRC Errors Count
			Exception Count		Modbus Exception Count
			Clear Counters		Modbus Clear Counters
			Reset Modbus Commands		Reset Modbus Commands
			Stop Bits		Modbus Stop Bits

			Node Address		Modbus Node Address (J14)
			Baud Rate		Modbus Baud Rate (J14)
			Parity		Modbus Parity (J14)
			Stop Bits		Modbus Stop Bits (J14)
			Bus Message		Modbus Bus Message Count (J14)
			Slave Response		Modbus Slave Message Count (J14)
			No Response		Modbus No Response Count (J14)
			CRC Response		Modbus CRC Error Count (J14)
			Exception Count		Modbus Exception Count (J14)
		Adjust			
			Average Voltage		Genset LL Average Voltage
			Voltage Adjust		Voltage Adjust OP
			Frequency		Final Frequency Reference OP
			Frequency Adjust		Frequency Adjust
			Rated/Idle Switch		Rated/Idle Switch (PCCnet)
			Keyswith Status		Keyswitch Status
			Keyswitch Override Enable		Keyswitch Override Enable
			Ketswitch Override		Keyswitch Override Cmd
			Exercise Switch		Exercise Switch (PCCnet)
			Man Warm Byp		Manual Warmup Bypass
			AVR Gain		AVR Gain Adjust Trim
			Governor Gain		Governor Gain Adjust OP
			Start/Stop Delay		Start Time Delay
			Stop Delay		Time Delay to Stop
		Calibration			
			L12 Voltage		Genset L1L2 Voltage
			L23 Voltage		Genset L2L3 Voltage
			L31 Voltage		Genset L3L1 Voltage
			L12 Adjust		Genset L12 Voltage Adjust
			L23 Adjust		Genset L23 Voltage Adjust

			L31 Adjust		Genset L31 Voltage Adjust
			L1N Voltage		Genset L1N Voltage
			L2N Voltage		Genset L2N Voltage
			L1N Adjust		Genset Single Phase L1N Voltage Adjust
			L2N Adjust		Genset Single Phase L2N Voltage Adjust
			L1 Control		Genset L1 Current OP
			L1 Control		Genset L2 Current OP
			L3 Control		Genset L3 Current OP
			L1 Adjust		Genset L1 Current Adjust
			L2 Adjust		Genset L2 Current Adjust
			L3 Adjust		Genset L3 Current Adjust
			Neutral Control		Genset Neutral Current
			Neutral Adjust		Genset Neutral Current Adjust
			L12 Control		Genset Bus L1L2 Voltage
			L23 Control		Genset Bus L2L3 Voltage
			L31 Control		Genset Bus L3L1 Voltage
			Bus L1 Adjust		Genset Bus L12 Voltage Adjust
			L23 Adjust		Genset Bus L23 Voltage Adjust
			L31 Adjust		Genset Bus L31 Voltage Adjust
			L1 Control		Genset Bus L1 Current
			L2 Control		Genset Bus L2 Current
			L23 Control		Genset Bus L3 Current
			L1 Adjust		Genset Bus L1 Current Adjust
			L2 Adjust		Genset Bus L2 Current Adjust
			L3 Adjust		Genset Bus L3 Current Adjust
			Par App Type		Paralleling Application
			L12 Control		Utility L1L2 Voltage
			L23 Control		Utility L2L3 Voltage
			L31 Control		Utility L3L1 Voltage
			Utility L1-L2 Voltage		Utility L12 Voltage Adjust
			Utility L2-L3 Voltage		Utility L23 Voltage Adjust
			Utiity L3-L1 Voltage		Utility L31 Voltage Adjust

			L1 Control		Utility L1 Current
			L2 Control		Utility L2 Current
			L3 Control		Utility L3 Current
			Utility L1 Current		Utility L1 Current Adjust
			Utility L2 Current		Utility L2 Current Adjust
			Utility L3 Current		Utility L3 Current Adjust
			Current		Ground Current
			Calibration		Ground Current Adjust
		Configurable I/O			
			Active		Configurable Input #1 Active State Selection
			Function		Configurable Input #1 Input Function Pointer
			Response		Configurable Input #1 Fault Response
			Customer Fault 1 Text		Configurable Input #1 Fault Text
			Active		Configurable Input #2 Active State Selection
			Function		Configurable Input #2 Input Function Pointer
			Response		Configurable Input #2 Fault Response
			Customer Fault 2 Text		Configurable Input #2 Fault Text
			Active		Configurable Input #13 Active State Selection
			Function		Configurable Input #13 Input Function Pointer
			Response		Configurable Input #13 Fault Response
			Customer Fault 3 Text		Configurable Input #13 Fault Text
			Active		Configurable Input #14 Active State Selection
			Function		Configurable Input #14 Input Function Pointer
			Response		Configurable Input #14 Fault Response
			Customer Fault 4 text		Configurable Input #14 Fault Text
			Active		Coolant Level/Configurable Input #5 Active State Selection
			Function		Coolant Level/Configurable Input #5 Function Pointer
			Active		Low Fuel/Configurable Input #6 Active State Selection
			Function		Low Fuel/Configurable Input #6 Function Pointer

			Response		Low Fuel FC 1441 Genset Response
			Active		Fault Reset/Configurable Input #10 Active State Selection
			Function		Fault Reset/Configurable Input #10 Function Pointer
			Active		Start Type/Configurable Input #11 Active State Selection
			Function		Start Type/Configurable Input #11 Function Pointer
			Active		Rupture Basin/Configurable Input #12 Active State Selection
			Function		Rupture Basin/Configurable Input #12 Function Pointer
			Response		Rupture Basin Level Response
			Event Code		Configurable Output #1 Event Code
			Function		Configurable Output #1 Output Function Pointer
			Invert Bypass		Configurable Output #1 Invert Bypass
			Event Code		Configurable Output #2 Event Code
			Function		Configurable Output #2 Output Function Pointer
			Invert Bypass		Configurable Output #2 Invert Bypass
			Event Code		Configurable Output #3 Event Code
			Function		Configurable Output #3 Output Function Pointer
			Invert Bypass		Configurable Output #3 Invert Bypass
			Event Code		Configurable Output #4 Event Code
			Function		Configurable Output #4 Output Function Pointer
			Invert Bypass		Configurable Output #4 Invert Bypass
			Function		Ready To Load /Configurable Output #5 Output Function Pointer
			Invert Bypass		Ready To Load /Configurable Output #5 Invert Bypass
			Function		Oil Priming Pump / Configurable Output #6 Output Function Pointer
			Invert Bypass		Oil Priming Pump / Configurable Output #6 Invert Bypass
			Function		Local Status / Configurable Output #7 Output Function Pointer
			Invert Bypass		Local Status / Configurable Output #7 Invert Bypass
			Function		Delayed Off / Configurable Output #10 Output Function Pointer

			Invert Bypass		Delayed Off / Configurable Output #10 Invert Bypass
			Function		Load Dump / Configurable Output #11 Output Function Pointer
			Invert Bypass		Load Dump / Configurable Output #11 Invert Bypass
			Function #1 Fault/Event Code		Fault Code Function #1 Fault/Event Code
			Function #2 Fault/Event Code		Fault Code Function #2 Fault/Event Code
			Function #3 Fault/Event Code		Fault Code Function #3 Fault/Event Code
			Function #4 Fault/Event Code		Fault Code Function #4 Fault/Event Code
			Function #5 Fault/Event Code		Fault Code Function #5 Fault/Event Code
			Active		Transfer Inhibit/Configurable Input #20 Active State Selection
			Function		Transfer Inhibit/Configurable Input #20 Function Pointer
			Active		Retransfer Inhibit/Configurable Input #21 Active State Selection
			Function		Retransfer Inhibit/Configurable Input #21 Function Pointer
			Active		Utility CB Pos B/Configurable Input #23 Active State Selection
			Function		Utility CB Pos B/Configurable Input #23 Function Pointer
			Active		Utility CB Tripped/Configurable Input #24 Active State Selection
			Function		Utility CB Tripped/Configurable Input #24 Function Pointer
			Active		Utility CB Inhibit/Configurable Input #25 Active State Selection
			Function		Utility CB Inhibit/Configurable Input #25 Function Pointer

			Active		Genset CB Pos B/Configurable Input #26 Active State Selection
			Function		Genset CB Pos B/Configurable Input #26 Function Pointer
			Active		Genset CB Tripped/Configurable Input #27 Active State Selection
			Function		Genset CB Tripped/Configurable Input #27 Function Pointer
			Active		Genset CB Inhibit/Configurable Input #28 Active State Selection
			Function		Genset CB Inhibit/Configurable Input #28 Function Pointer
			Active		Utility Single Mode Verify/Configurable Input #29 Active State Selection
			Function		Utility Single Mode Verify/Configurable Input #29 Function Pointer
			Active		Sync Enable/Configurable Input #30 Active State Selection
			Function		Sync Enable/Configurable Input #30 Function Pointer
			Active		Load Demand Stop/Configurable Input #31 Active State Selection
			Function		Load Demand Stop/Configurable Input #31 Function Pointer
			Active		Extended Parallel/Configurable Input #32 Active State Selection
			Function		Extended Parallel/Configurable Input #32 Function Pointer
			Active		Backup Start Disconnect/Configurable Input #33 Active State Selection
			Function		Backup Start Disconnect/Configurable Input #33 Function Pointer
			Event Code		Configurable Output #20 Event Code
			Function		Configurable Output #20 Output Function Pointer
			Invert Bypass		Configurable Output #20 Invert Bypass
			Event Code		Configurable Output #21 Event Code
			Function		Configurable Output #21 Output Function Pointer
			Invert Bypass		Configurable Output #21 Invert Bypass
			Event Code		Configurable Output #22 Event Code

			Function		Configurable Output #22 Output Function Pointer
			Invert Bypass		Configurable Output #22 Invert Bypass
			Response		kW Load Setpoint / Configurable Analog Input #1 Analog Input Function Pointer
			OOR Check		kW Load Setpoint OOR Check Enable
			Function		kVAR Load Setpoint / Configurable Analog Input #2 Analog Input Function Pointer
			OOR Check		kVAR Load Setpoint OOR Check Enable
			Function		Speed Bias Output / Configurable Analog Output #1 Analog Output Function Pointer
			Engr Low Setpoint		Speed Bias Output / Configurable Analog output #1 Engineering In Low Setpoint
			Engr High Setpoint		Speed Bias Output / Configurable Analog output #1 Engineering In High Setpoint
			Low Setpoint		Speed Bias Output / Configurable Analog output #1 Analog Out Low Setpoint
			High Setpoint		Speed Bias Output / Configurable Analog output #1 Analog Out High Setpoint
			Units Scaling		Configurable Analog Output #1 Engineering Units Fucntion Scaling
			Engr Low Function		Speed Bias Output / Configurable Analog output #1 Engineering In Low Function Setpoint
			Engr High Fuinction		Speed Bias Output / Configurable Analog output #1 Engineering In High Function Setpoint
			Low Function		Speed Bias Output / Configurable Analog output #1 Analog Out Low Function Setpoint
			High Function		Speed Bias Output / Configurable Analog output #1 Analog Out High Function Setpoint
			Function		Voltage Bias Output / Configurable Analog Output #2 Analog Output Function Pointer
			Engr Low Setpoint		Voltage Bias Output / Configurable Analog output #2 Engineering In Low Setpoint
			Engr High Setpoint		Voltage Bias Output / Configurable Analog output #2 Engineering In High Setpoint
			Low Setpoint		Voltage Bias Output / Configurable Analog output #2 Analog Out Low Setpoint
			High Setpoint		Voltage Bias Output / Configurable Analog output #2 Analog Out High Setpoint
			Units Scaling		Configurable Analog Output #2 Engineering Units

					Fucntion Scaling
			Engr Low Function		Voltage Bias Output / Configurable Analog output #2 Engineering In Low Function Setpoint
			Engr High Function		Voltage Bias Output / Configurable Analog output #2 Engineering In High Function Setpoint
			Low Function		Voltage Bias Output / Configurable Analog output #2 Analog Out Low Function Setpoint
			High Function		Voltage Bias Output / Configurable Analog output #2 Analog Out High Function Setpoint
		Genset Setup			
			Nominal Voltage		Genset Nominal Voltage
			Wye/Delta		Genset Delta/Wye Connection
			Single/3 Phase		Single/3 Phase Connection
			Prime/Standby		Application Rating Select
			Frequency Switch		Alternate Frequency Switch
			Idle Speed		Idle Speed
			Source Name		Genset Source Name
			Site ID		Site ID
			Power Down Enable		Power Down Mode Enable
			Power Down Delay		Power Down Mode Time Delay
			Auto Sleep Enable		Auto Sleep Enable
			Exercise Time		Genset Exercise Time
			AVR Gain		AVR Gain Adjust Trim
			Governor Gain		Governor Gain Adjust OP
			Voltage Ramp		Voltage Ramp Time
			AVR Damping		AVR Damping Effect (50 Hz)
			AVR Damping		AVR Damping Effect (60 Hz)
			V/Hz Slope		V/Hz Rolloff Slope
			V/Hz Knee		V/Hz Knee Frequency OP
			Cycle/Crank		Cycle / Cont Crank Select
			Attempts		Crank Attempts OP

			Engage Time		Continuous Crank Engage Time
			Engage Time		Cycle Crank Engage Time
			Rest Time		Cycle Crank Rest Time
			Disconnect Speed		Starter Disconnect Speed
			Start/Stop Delay		Start Time Delay
			Stop Delay		Time Delay to Stop
			Delayed Shutdown		Delayed Shutdown Enable
			Delayed Shutdown Delay		Delayed Shutdown Time Delay
			Ctrld Shutdown Unload Time		Controlled Shutdown Max Ramp Unload Time
			Ctrld Shutdown Advance		Controlled Shutdown Advance Notice Delay
			N Curr CT Prim		Genset Neutral CT Primary Current
			Delayed Off FSO Relay		Delayed Off FSO Relay Time
			Idle Warmup Coolant Temp		Idle Warmup Coolant Temp
			Idle Warmup Time		Idle Warmup Time
			Max Idle Time		Max Idle Time
			Idle to Rated Ramp		Idle to Rated Ramp Time
			Rated to Idle Delay		Rated to Idle Transition Delay
			Rated to Idle Ramp		Rated to Idle Ramp Time
			Rated Cooldown Time		Rated Cooldown Time
			Idle Cooldown Time		Idle Cooldown Time
			Prelube Cycle Enable		Prelube Cycle Enable
			Prelube Cycle Time		Prelube Cycle Time
			Oil Press		Prelube Oil Pressure Threshold

			Threshold		
			Prelube Timeout		Prelube Timeout Period
			Load Dump Activation		Load Dump Activation Method
			Overload Threshold		Load Dump Overload Threshold
			Overload Set Time		Load Dump Overload Set Time
			Underfreq Thres		Load Dump Underfrequency Threshold
			Underfrequency Offset		Load Dump Underfrequency Offset
			Underfrequency Set Time		Load Dump Underfrequency Set Time
			V/Hz Knee 50Hz		V/Hz Knee Frequency 50Hz
			V/Hz Slope 50Hz		V/Hz Rolloff Slope 50Hz
			V/Hz Knee 60Hz		V/Hz Knee Frequency 60Hz
			V/Hz Slope 60Hz		V/Hz Rolloff Slope 60Hz
			Overload Warning Threshold		Overload Warning Threshold
			Overload Warning Set Time		Overload Warning Set Time
			Reverse kW Threshold		Reverse kW Threshold
			Reverser kW Time Delay		Reverse kW Time Delay
			Reverse kVAR Threshold		Reverse kVAR Threshold
			Reverse kVAR Time Delay		Reverse kVAR Time Delay
			Low Coolant Level		LCL Detection Response
			LCT Warning Threshold		LCT Warning Threshold
			LCT Warning Set Time		LCT Warning Set Time

			LCT Warning Clear Time		LCT Warning Clear Time
			Low Fuel Set/Clear Time		Low Fuel Set/Clear Time
			Low Fuel in Day Tank Time		Low Fuel in Day Tank Time
			Rupture Basin Time		Rupture Basin Time
			Scheduler Enable		Exercise Scheduler Enable
			Program Select		Scheduler Program Select
			Program Enable		Scheduler Program x Enable
			Prog Run Mode		Scheduler Program x Run Mode
			Prog Start Day		Scheduler Program x Start Day
			Prog Start Hour		Scheduler Program x Start Hour
			Prog Start Min		Scheduler Program x Start Minute
			Prog Duration Hrs		Scheduler Program x Duration Hours
			Prog Duration Mins		Scheduler Program x Duration Minutes
			Prog Repeat Interval		Scheduler Program x Repeat Interval
			Exception Select		Scheduler Exception Select
			Exception Enable		Scheduler Exception x Enable
			Exception Month		Scheduler Exception x Month
			Exception Date		Scheduler Exception x Date
			Exception Hour		Scheduler Exception x Hour
			Exception Minute		Scheduler Exception x Minute
			Exc Duration Days		Scheduler Exception x Duration Days
			Exc Duration Hours		Scheduler Exception x Duration Hours
			Exc Duration Mins		Scheduler Exception x Duration Minutes
			Exception Repeat		Scheduler Exception x Repeat

			Warning Threshold		High Alternator Temperature 1 Threshold (Aux101)
			Warning Time		High Alternator Temperature 1 Time (Aux101)
			Shutdown Threshold		High Alternator Temperature 1 Shutdown Threshold
			Shutdown Time		High Alternator Temperature 1 Shutdown Time
			Warning Threshold		High Alternator Temperature 2 Threshold (Aux101)
			Warning Time		High Alternator Temperature 2 Time (Aux101)
			Shutdown Threshold		High Alternator Temperature 2 Shutdown Threshold
			Shutdown Time		High Alternator Temperature 2 Shutdown Time
			Warning Threshold		High Alternator Temperature 3 Threshold (Aux101)
			Warning Time		High Alternator Temperature 3 Time (Aux101)
			Shutdown Threshold		High Alternator Temperature 3 Shutdown Threshold
			Shutdown Time		High Alternator Temperature 3 Shutdown Time
			Warning Threshold		High Drive End Bearing Temperature Threshold (Aux101)
			Warning Time		High Drive End Bearing Temperature Time (Aux101)
			Shutdown Threshold		High Drive End Bearing Temperature Shutdown Threshold
			Shutdown Time		High Drive End Bearing Temperature Shutdown Time
			Threshold		High Exhaust Stack Temperature 1 Threshold (Aux101)
			Time		High Exhaust Stack Temperature 1 Time (Aux101)
			Threshold		High Exhaust Stack Temperature 2 Threshold (Aux101)
			Time		High Exhaust Stack Temperature 2 Time (Aux101)
			Threshold		High Oil Temperature Threshold (Aux101)
			Time		High Oil Temperature Time (Aux101)
			Threshold		High Intake Manifold Temperature 1 Threshold (Aux101)
			Time		High Intake Temperature 1 Time (Aux101)
			Warning Threshold		High Non-Drive End Bearing Temperature Threshold (Aux101)

			Time		High Non-Drive End Bearing Temperature Time (Aux101)
			Shutdown Threshold		High Non-Drive End Bearing Temperature Shutdown Threshold
			Shutdown Time		High Non-Drive End Bearing Temperature Shutdown Time
			Threshold		High Fuel Level Threshold (Aux101)
			Time		High Fuel Level Time (Aux101)
			Threshold		Low Fuel Level Threshold (Aux101)
			Time		Low Fuel Level Time (Aux101)
			Threshold		Very Low Fuel Level Threshold (Aux101)
			Time		Very Low Fuel Level Time (Aux101)
			Fuel Level 100% Resist		Fuel Level 100 Percent Resistance (Aux101)
			Fuel Level 0% Resist		Fuel Level Zero Percent Resistance (Aux101)
			Fuel Tank Capacity		Fuel Tank Capacity (Aux101)
		PCCnet Setup			
			HMI220 Fail Rsp		HMI220 PCCnet Failure Response Type
			HMI320 Fail Rsp		HMI320 PCCnet Failure Response Type
			HMI113 Fail Rsp		HMI113 Annunciator PCCnet Failure Response Type
			Aux101 0 Fail Rsp		Aux101 Device 0 PCCnet Failure Response Type
			Aux101 1 Fail Rsp		Aux101 Device 1 PCCnet Failure Response Type
			Active HMI220		Active PCCnet HMI220 Operator Panels
			Expect HMI220		Expected PCCnet HMI220 Operator Panels
			Active HMI320		Active PCCnet HMI320 Operator Panels
			Expect HMI320		Expected PCCnet HMI320 Operator Panels
			Active Aux101 0		Active PCCnet AUX101 Device 0 Modules
			Expect Aux101 0		Expected PCCnet AUX101 Device 0 Modules
			Active Aux101 1		Active PCCnet AUX101 Device 1 Modules
			Expect Aux101 1		Expected PCCnet AUX101 Device 1 Modules
			Active HMI113		Active PCCnet HMI113 Annunciators

			Expect HMI113		Expected PCCnet HMI113 Annunciators
			PCCnet Device Failure Time Delay		PCCnet Device Failure Time Delay
			HMI113 O1 Flt		HMI113 Output 1 Fault/Event
			HMI113 O1 Stat		HMI113 Output 1 Signal Status
			HMI113 O2 Flt		HMI113 Output 2 Fault/Event
			HMI113 O2 Stat		HMI113 Output 2 Signal Status
			HMI113 O3 Flt		HMI113 Output 3 Fault/Event
			HMI113 O3 Stat		HMI113 Output 3 Signal Status
			HMI113 O4 Flt		HMI113 Output 4 Fault/Event
			HMI113 O4 Stat		HMI113 Output 4 Signal Status
			HMI113 Flt 1 Stat		HMI113 Fault 1 Status
			Flt 1 Text		HMI113 Fault 1 Text
			HMI113 Flt 2 Stat		HMI113 Fault 2 Status
			Flt 2 Text		HMI113 Fault 2 Text
			HMI113 Flt 3 Stat		HMI113 Fault 3 Status
			Flt 3 Text		HMI113 Fault 3 Text
		OEM Setup			
			OEM Genset Setup		
				Gen Ser #	Genset Serial Number
				Gen Mod #	Genset Model Number
				Alt Ser #	Alternator Serial Number
				Alt Mod #	Alternator Model Number
				Eng Ser #	Engine Serial Number
				Frequency Range	Frequency Options
				Prime/Standby	Application Rating Select
				Standby kVA Rating	Standby kVA rating (3 phase/ 50Hz)

				Standby kVA Rating	Standby kVA rating (3 phase/ 60Hz)
				Standby kVA Rating	Standby kVA rating (single phase/ 50Hz)
				Standby kVA Rating	Standby kVA rating (single phase/ 60Hz)
				Prime kVA Rating	Prime kVA rating (3 phase/ 50Hz)
				Prime kVA Rating	Prime kVA rating (3 phase/ 60Hz)
				Prime kVA Rating	Prime kVA rating (single phase/ 50Hz)
				Prime kVA Rating	Prime kVA rating (single phase/ 60Hz)
				Genset Idle Enable	Genset Idle Enable
				Remote Fault Reset	Remote Fault Reset Enabled
				Battle Short	Battle Short Enable
				Fail To Shutdown Delay	Fail To Shutdown Delay
				Delayed Shutdown	Delayed Shutdown Enable
				Delayed Shutdown Delay	Delayed Shutdown Time Delay
				Customer Fault 1 Factory Lock	Configurable Input #1 Factory Lock
				Customer Fault 2 Factory Lock	Configurable Input #2 Factory Lock
				Coolant Level 5 factory Lock	Coolant Level/Configurable Input #5 Factory Lock
				Low Fuel/#6 Factory Lock	Low Fuel/Configurable Input #6 Factory Lock
				Fault Reset/#10 Factory Lock	Fault Reset/Configurable Input #10 Factory Lock
				Start Type/#11 Factory Lock	Start Type/Configurable Input #11 Factory Lock
				Rupture Basin/#12	Rupture Basin/Configurable Input #12 Factory Lock

				Factory Lock	
				Customer Fault 3 Factory Lock	Configurable Input #13 Factory Lock
				Customer Fault 4 Factory Lock	Configurable Input #14 Factory Lock
				Output 1 Factory Lock	Configurable Output #1 Factory Lock
				Output 2 Factory Lock	Configurable Output #2 Factory Lock
				Output 3 Factory Lock	Configurable Output #3 Factory Lock
				Output 4 Factory Lock	Configurable Output #4 Factory Lock
				Ready To Load/#5 Factory Lock	Ready To Load / Configurable Output #5 Factory Lock
				Oil Priming Pump/#6 Factory Lock	Oil Priming Pump / Configurable Output #6 Factory Lock
				Local Status/#7 Factory Lock	Local Status / Configurable Output #7 Factory Lock
				Delayed Off/#10 Factory Lock	Delayed Off / Configurable Output #10 Factory Lock
				Load Dump/#11 Factory Lock	Load Dump / Configurable Output #11 Factory Lock
				Reset Fuel Consumption	Reset Fuel Consumption
				Reset Runs	Reset Runs
				Reset Starts	Reset Start Attempts
				Genset Reset All Energy Meters	Genset Reset All Energy Meters
				Timestamp - Second	Genset Reset All Energy Meters Timestamp - Second
				Timestamp - Minute	Genset Reset All Energy Meters Timestamp - Minute
				Timestamp - Hour	Genset Reset All Energy Meters Timestamp - Hour
				Timestamp - Day	Genset Reset All Energy Meters Timestamp - Day

				Timestamp - Month	Genset Reset All Energy Meters Timestamp - Month
				Timestamp - Year	Genset Reset All Energy Meters Timestamp - Year
				Transfer Inhibit/#20 Factory Lock	Transfer Inhibit/Configurable Input #20 Factory Lock
				Retransfer Inhibit/#21 Factory Lock	Retransfer Inhibit/Configurable Input #21 Factory Lock
				Utility CB Pos B/#23 Factory Lock	Utility CB Pos B/Configurable Input #23 Factory Lock
				Utility CB Tripped/#24 Factory Lock	Utility CB Tripped/Configurable Input #24 Factory Lock
				Utility CB Inhibit/#25 Factory Lock	Utility CB Inhibit/Configurable Input #25 Factory Lock
				Genset CB Pos B/#26 Factory Lock	Genset CB Pos B/Configurable Input #26 Factory Lock
				Genset CB Tripped/#27 Factory Lock	Genset CB Tripped/Configurable Input #27 Factory Lock
				Genset CB Inhibit/#28 Factory Lock	Genset CB Inhibit/Configurable Input #28 Factory Lock
				Utility Single Mode Ver/#29 Factory Lock	Utility Single Mode Verify/Configurable Input #29 Factory Lock
				Sync Enable/#30 Factory Lock	Sync Enable/Configurable Input #30 Factory Lock
				Load Demand Stop/#31 Factory Lock	Load Demand Stop/Configurable Input #31 Factory Lock
				Ramp Load/Unload/#32 Factory Lock	Extended Parallel/Configurable Input #32 Factory Lock

				Backup Start Disc/#33 Factory Lock	Backup Start Disconnect/Configurable Input #33 Factory Lock
				kW Load Setpt/AI #1 Factory Lock	kW Load Setpoint / Configurable Analog Input #1 Factory Lock
				kVAR Load Setpt/AI #2 Factory Lock	kVAR Load Setpoint / Configurable Analog Input #2 Factory Lock
				Configurable Output #20 Factory Lock	Configurable Output #20 Factory Lock
				Configurable Output #21 Factory Lock	Configurable Output #21 Factory Lock
				Configurable Output #22 Factory Lock	Configurable Output #22 Factory Lock
				Speed Bias Out/AO #1 Factory Lock	Speed Bias Output / Configurable Analog Output #1 Output Factory Lock
				Voltage Bias Out /AO #2 Factory Lock	Voltage Bias Output / Configurable Analog Output #2 Factory Lock
				Reset All Energy Meters	Genset Bus Reset All Energy Meters
				Timestamp - Second	Genset Bus Reset All Energy Meters Timestamp - Second
				Timestamp - Minute	Genset Bus Reset All Energy Meters Timestamp - Minute
				Timestamp - Hour	Genset Bus Reset All Energy Meters Timestamp - Hour
				Timestamp - Day	Genset Bus Reset All Energy Meters Timestamp - Day
				Timestamp - Month Timestamp - Month	Genset Bus Reset All Energy Meters Timestamp - Month

				Timestamp - Year	Genset Bus Reset All Energy Meters Timestamp - Year
				Utility Reset All Energy Meters	Utility Reset All Energy Meters
				Timestamp - Second	Utility Reset All Energy Meters Timestamp - Second
				Timestamp - Minute	Utility Reset All Energy Meters Timestamp - Minute
				Timestamp - Hour	Utility Reset All Energy Meters Timestamp - Hour
				Timestamp - Day	Utility Reset All Energy Meters Timestamp - Day
				Timestamp - Month	Utility Reset All Energy Meters Timestamp - Month
				Timestamp - Year	Utility Reset All Energy Meters Timestamp - Year
			OEM Engine Setup		
				ECM CAN Enable	ECM CAN Enable
				Datasave Delay	ECM Datasave Time Delay OP
				Keysw Retries	CAN Failure Retries OP
				Keyswitch Minimum On Time	Keyswitch Minimum On Time
				Fault Code 1117 Enable	Fault Code 1117 Enable
				Starter Owner	Starter Owner
				Oil Priming Pump Enable	Prelube Function Enable
				Idle Speed	Idle Speed
				QSX15/CM570	QSX15/CM570 Application Enable
				Disconnect Speed	Starter Disconnect Speed
				Char Alt Flt Dly	Charging Alternator Fault Time Delay OP
				Alternate Freq Switch	Alternate Frequency Switch

				Freq/Speed	Frequency to Speed Gain Select OP
				Freq/Speed	Adjustable Freq/Speed Gain
				V/Hz Knee	V/Hz Knee Frequency OP
				V/Hz Slope	V/Hz Rolloff Slope
				Start to Rated Ramp	Starting to Rated Ramp Time
				Gov Ramp Time	Governor Ramp Time
				V/Hz Knee 50Hz	V/Hz Knee Frequency 50Hz
				V/Hz Slope 50Hz	V/Hz Rolloff Slope 50Hz
				V/Hz Knee 60Hz	V/Hz Knee Frequency 60Hz
				V/Hz Slope 60Hz	V/Hz Rolloff Slope 60Hz
				Nominal Battery Voltage	Nominal Battery Voltage
				24V High Battery	24 V High Battery Voltage Threshold OP
				24V Weak Battery	24 V Weak Battery Voltage Threshold OP
				24V Low battery	24 V Low Battery Voltage Running Threshold
				24V Low Battery Stop	24 V Low Battery Voltage Stopped Threshold
				12V Weak Battery	12 V Weak Battery Voltage Threshold OP
				High Battery Set Time	High Battery Voltage Set Time OP
				Low Battery Set Time	Low Battery Voltage Set Time OP
				Weak Battery Set Time	Weak Battery Voltage Set Time OP
				Enable	Glow Plug Enable
				Time At Min Temp	Min Time at Preheat Temperature
				Min Temp	Min Preheat Temperature
				Max Temp	Max Preheat Temperature
				Max Glow Time	Max Preheat Glow Time
				Max Temp	Max Post Glow Temperature
				Time	Max Post Glow Time

				Teeth Pulses/Rev	Teeth Pulses Per Revolution
				Fuel Duty Cycle	Initial Crank Fuel Duty Cycle
				Fueling Period	Initial Crank Fueling Period
				Crank Fueling Ramp Rate	Crank Fueling Ramp Rate
				Max Crnk Fuel DC	Max Crank Fuel Duty Cycle
				Crank Exit Fuel DC	Crank Exit Fuel Duty Cycle
				Governor Enable Engine Speed	Governor Enable Engine Speed OP
				Gov Preload Offset	Governor Preload Offset
				Max Duty Cycle	Maximum Duty Cycle
				Min Duty Cycle	Minimum Duty Cycle
				Dither Factor	Dither Factor
				Enable	Duty Cycle Gain Compensation Enable
				X1	Duty Cycle Gain Compensation X1
				X2	Duty Cycle Gain Compensation X2
				Y1	Duty Cycle Gain Compensation Y1
				Y2	Duty Cycle Gain Compensation Y2
				GK1 High	GK1 High(50Hz)
				GK1	GK1 (50Hz)
				GK1 Low	GK1 Low(50Hz)
				GK2	GK2 (50Hz)
				GK3	GK3 (50Hz)
				Damping	Governor Damping Effect (50Hz)
				GK1 High	GK1 High(60Hz)
				GK1	GK1 (60Hz)
				GK1 Low	GK1 Low(60Hz)
				GK2	GK2 (60Hz)
				GK3	GK3 (60Hz)
				Damping	Governor Damping Effect (60Hz)
				Enable	Gain Windowing Enable
				High	Governor Speed Delta High

				Low	Governor Speed Delta Low
				GK1	GK1(Idle)
				GK2	GK2(Idle)
				GK3	GK3(Idle)
				Damping	Gov Damping Effect(Idle)
				Cool Tmp Sens Type	Coolant Temperature Sensor Type
				Sensor Type	Oil Pressure Sensor Type
				Sender Type	Oil Pressure Sender Type
				Switch Polarity	Oil Pressure Switch Polarity
				Enable	Intake Manifold Temperature Sensor Enable
				Sensor Type	Intake Manifold Temperature Sensor Type
				Enable	Oil Temperature Sensor Enable
				Sensor Type	Oil Temperature Sensor Type
				Shtdwn/w Cool Th	HCT Shutdown/w Cooldown Threshold
				Shutdown Thresh	HCT Shutdown Threshold
				Shutdown Set Time	HCT Shutdown Set Time
				Warning Thresh	HCT Warning Threshold
				Warning Set Time	HCT Warning Set Time
				Protection Enable	HOT Protection Enable
				Shutdown Thresh	HOT Shutdown Threshold
				Shutdown Set Time	HOT Shutdown Set Time
				Warning Thresh	HOT Warning Threshold
				Warning Set Time	HOT Warning Set Time
				Enable Time	LOP Enable Time OP
				Shutdown Thresh	LOP Shutdown Threshold
				Warning Thresh	LOP Warning Threshold
				Idle Shutdown	LOP Idle Shutdown Threshold

				Th	
				Idle Warning Th	LOP Idle Warning Threshold
				Shutdown Set Time	LOP Shutdown Set Time
				Warning Set Time	LOP Warning Set Time
				Protection Enable	High IMT Protection Enable
				Shutdown Thresh	High IMT Shutdown Threshold
				Shutdown Set Time	High IMT Shutdown Set Time
				Warning Thresh	High IMT Warning Threshold
				Warning Set Time	High IMT Warning Set Time
				50Hz Trip Level	Overspeed Trip Level (50Hz)
				50Hz Trip Lvl-20	Overspeed Trip Level (50Hz) - 20
				50Hz Trip Lvl-36	Overspeed Trip Level (50Hz) - 36
				50Hz Trip Lvl-60	Overspeed Trip Level (50Hz) - 60
				50Hz Trip Lvl-Adj	Overspeed Trip Level (50Hz) - Adjustable
				60Hz Trip Level	Overspeed Trip Level (60Hz)
				60Hz Trip Lvl-20	Overspeed Trip Level (60Hz) - 20
				60Hz Trip Lvl-36	Overspeed Trip Level (60Hz) - 36
				60Hz Trip Lvl-60	Overspeed Trip Level (60Hz) - 60
				60Hz Trip Lvl-Adj	Overspeed Trip Level (60Hz) - Adjustable
				Fuel System	Fuel System
			OEM Alt Setup		
				Ser High Limit	3 ph high conn Genset nom voltage hi limit
				Ser Low Limit	3 ph high conn Genset nom voltage lo limit
				Par High Limit	3 ph low conn Genset nom voltage hi limit

				Par Low Limit	3 ph low conn Genset nom voltage lo limit
				Single Phase High Limit	Single phase Genset nom voltage hi limit
				Single Phase Low Limit	Single phase Genset nom voltage lo limit
				PT Primary	Genset PT Primary Voltage
				PT Sec	Genset PT Secondary Voltage
				CT Primary	Genset Primary CT Current
				CT Sec	Genset CT Secondary Current
				Excitation	Excitation Source
				Excitation Disable Override	Excitation Disable Override
				AVR Enable	AVR Enable
				K1 (50 Hz)	K1 (50 Hz)
				K1 (60 Hz)	K1 (60 Hz)
				K2 (50 Hz)	K2 (50 Hz)
				K2 (60 Hz)	K2 (60 Hz)
				K3 (50 Hz)	K3 (50 Hz)
				K3 (60 Hz)	K3 (60 Hz)
				AVR Damping	AVR Damping Effect (50 Hz)
				AVR Damping	AVR Damping Effect (60 Hz)
				High AC Voltage Threshold	High AC Voltage Threshold OP
				High AC Voltage Trip	High AC Voltage Trip Characteristic
				High AC Voltage Delay	High AC Voltage Delay
				Low AC Voltage Threshold	Low AC Voltage Threshold OP
				Low AC Voltage Delay	Low AC Voltage Delay
				Lost AC Voltage Threshold	Lost AC Voltage Threshold
				Lost AC Voltage Delay	Lost AC Time Delay OP
				Underfrequency Threshold	Underfrequency Threshold

				Underfrequency Delay	Underfrequency Delay
				Overfrequency Enable	Overfrequency Enable
				Overfrequency Threshold	Overfrequency Threshold
				Overfrequency Delay	Overfrequency Delay
				Speed/Frequency Threshold	Speed/Frequency Threshold OP
				Speed/Frequency Delay	Speed/Frequency Delay OP
				Max Field Time	Max Field Time
				Protection Enable	Genset Neg Seq Overcurrent Protection Enable
				Threshold	Genset Neg Seq Overcurrent Protection Threshold
				K Factor	Genset Neg Seq Overcurrent Protection K Factor
				Reset Time	Genset Neg Seq Overcurrent Protection Reset Time
				Protection Enable	Custom Overcurrent Protection Enable
				Threshold	Custom Overcurrent Threshold
				Time Characteristic	Custom Overcurrent Time Characteristic
				Gnd CT Prim Crnt	Ground CT Primary Current
				Crnt Threshold	Ground Fault Current Threshold
				Crnt Threshold %	Ground Fault Current Threshold Percent
				Delay	Ground Fault Current Delay
		Paralleling Setup			
			Basic		
				Gen App Type	Genset Application Type
				1st St Backup Time	First Start Backup Time
				Nominal Voltage	Utility Nominal Voltage

				Delta/Wye	Utility Delta/Wye Connection
				PT Primary	Utility PT Primary Voltage
				PT Secondary	Utility PT Secondary Voltage
				CT Primary	Utility CT Primary Current
				CT Secondary	Utility and Genset Neutral CT Secondary Current
				Pos Contacts	Utility Breaker Position Contacts
				Nominal Voltage	Genset Bus Nominal Voltage
				Delta/Wte	Genset Bus Delta/Wye Connection
				PT Primary	Genset Bus PT Primary Voltage
				PT Secondary	Genset Bus PT Secondary Voltage
				CT Primary	Genset Bus CT Primary Current
				CT Secondary	Genset Bus CT Secondary Current
				Pos Contacts	Genset Breaker Position Contacts
				Fail to Close Delay	Genset CB Fail To Close Time Delay
				Fail to Open Delay	Genset CB Fail To Open Time Delay
				Voltage	Permissive Voltage Window
				Phase	Permissive Phase Window
				Time	Permissive Window Time
				Frequency	Permissive Frequency Window
				Cntrl Method	Synchronizer Voltage Control Method
				Kp	Voltage Match Kp
				Ki	Voltage Match Ki
				Util Metering Config	Utility Current Metering Configuration
				Cntrl Method	Synchronizer Speed Control Method
				Slip Frequency	Slip Frequency
				Kp	Frequency Match Kp
				Ki	Frequency Match Ki
				Kp	Phase Match Kp
				Lockout Enable	Fail To Sync Lockout Enable
				Sync Time	Fail To Synchronize Time
				Cntrl Method	Isolated Bus Speed Control Method
				Droop	Speed Droop Percentage

				Freq Adjust	Frequency Adjust
				Total kW	Genset Total kW
				Speed Droop	Speed Droop Enable Switch (PCCNet)
				OOR Flt Enable	Speed Bias OOR Check Enable
				OOR Hi Limit	Speed Bias OOR High Limit
				OOR Lo Limit	Speed Bias OOR Low Limit
				OOR Time	Speed Bias OOR Time
				Speed Bias Scaling Table	Speed Bias Scaling Table Row Pointer
				Speed Bias Scaling Table	Speed Bias Scaling Table Row Write Pointer
				Cntrl Method	Isolated Bus Voltage Control Method
				Droop	Voltage Droop Percentage
				Volt Adjust	Voltage Adjust OP
				Total kVAR	Genset Total kVAR
				Volt Droop	Voltage Droop Enable Switch (PCCNet)
				OOR Flt Enable	Voltage Bias OOR Check Enable
				OOR Hi Limit	Voltage Bias OOR High Limit
				OOR Lo Limit	Voltage Bias OOR Low Limit
				OOR Time	Voltage Bias OOR Time
				Voltage Bias Scaling Table	Voltage Bias Scaling Table Row Pointer
				Voltage Bias Scaling Table	Voltage Bias Scaling Table Row Write Pointer
				kW Balance	Load Share kW Balance
				Total kW	Genset % Standby Total kW
				kW Gain	Load Share kW Gain
				kVAR Balance	Load Share kVAR Balance
				Total kVAR	Genset Total kVARs per Standby kVA
				kVAR Gain	Load Share kVAR Gain
				Ramp Load	Load Share Ramp Load Time
				Ramp Unload	Load Share Ramp Unload Time
				Ramp Unload Level	Load Share Ramp kW Unload Level
				Base Load	Genset kW Setpoint Percent
				PF Level	Genset Power Factor Setpoint

				kW Kp	Load Govern kW Kp
				kW Ki	Load Govern kW Ki
				kVAR Kp	Load Govern kVAR Kp
				kVAR Ki	Load Govern kVAR Ki
				kW Ramp Load	Load Govern kW Ramp Load Time
				kW Ramp Unload	Load Govern kW Ramp Unload Time
				kVAR Ramp Load	Load Govern kVAR Ramp Load Time
				kVAR Ramp Unload	Load Govern kVAR Ramp Unload Time
				kW Max	Load Govern kW Maximum
				kW Max Delayed	Load Govern kW Maximum Delayed
				kVAR Max	Load Govern kVAR Maximum
				Control Method	Utility Parallel Voltage Control Method
				Droop	Voltage Droop Percentage
				Control Method	Utility Parallel Speed Control Method
				Droop	Speed Droop Percentage
			Power Transfer Control		
				Transition Type	Transition Type
				Test With Load	Test With Load Enable
				Failt to Disc En	Fail To Disconnect Enable
				Failt to Sync OT Retran	Fail To Sync Open Transition Retransfer Enable
				Sys Phase Rot	System Phase Rotation
				Ext Parallel En	Extended Parallel Enable
				Cmt to Trans Mthd	Commit to Transfer Method
				Prog Trans(TDPT)	Programmed Transition Delay (TDPT)
				Transfer(TDNE)	Transfer Delay (TDNE)
				Retransfer(TDEN)	Retransfer Delay (TDEN)
				Max Parallel	Maximum Parallel Time (TDMP)

				Genset Exercise	Genset Exercise Time
				Start Delay	Start Time Delay
				Stop Delay	Time Delay to Stop
				Trans Timeout	Commit to Transfer Timeout
				Fail to Open Delay	Utility CB Fail To Open Time Delay
				Fail to Close Delay	Utility CB Fail To Close Time Delay
				Opening Point	Utility Breaker Opening Point
				kW	Load Govern kW Method
				kW	Load Govern kVAR Method
				kW Source	Load Govern kW Setpoint Source
				kW Setpoint	Genset kW Setpoint
				kW Setpoint %	Genset kW Setpoint Percent
				kVAR Source	Load Govern kVAR Setpoint Source
				kVAR Setpoint	Genset kVAR Setpoint
				kVAR Setpoint %	Genset kVAR Setpoint Percent
				kW Constraint	Utility kW Constraint
				kW Constraint %	Utility kW Constraint Percent
				kW Setpoint	Utility kW Setpoint
				kW Setpoint %	Utility kW Setpoint Percent
				kVAR Setpoint	Utility kVAR Setpoint
				kVAR Setpoint %	Utility kVAR Setpoint Percent
				Utility	Utility Power Factor Setpoint
				Genset	Genset Power Factor Setpoint
				Enable	Genset Frequency Sensor Enable
				Center Frequency	Genset Center Frequency
				Drop-Out BW	Genset Frequency Drop-Out Bandwidth
				Pick-Up BW	Genset Frequency Pick-Up Bandwidth
				Lower Drop-Out	Genset Frequency Lower Drop-Out Threshold
				Lower Pick-Up	Genset Frequency Lower Pick-Up Threshold
				Upper Pick-Up	Genset Frequency Upper Pick-Up Threshold
				Upper Drop-Out	Genset Frequency Upper Drop-Out Threshold

				Drop-Out Delay	Genset Frequency Drop-Out Delay
				Sensor Type	Genset Voltage Sensor Type
				Enable	Genset Overvoltage Sensor Enable
				Drop-Out	Genset Overvoltage Drop-Out Percentage
				Drop-Out	Genset Overvoltage Drop-Out Threshold
				Pick-Up	Genset Overvoltage Pick-Up Percentage
				Pick-Up	Genset Overvoltage Pick-Up Threshold
				Drop-Out Delay	Genset Overvoltage Drop-Out Delay
				Drop-Out	Genset Undervoltage Drop-Out Percentage
				Drop-Out	Genset Undervoltage Drop-Out Threshold
				Pick-Up	Genset Undervoltage Pick-Up Percentage
				Pick-Up	Genset Undervoltage Pick-Up Threshold
				Drop-Out Delay	Genset Undervoltage Drop-Out Delay
				Enable	Utility Frequency Sensor Enable
				Center Frequency	Utility Center Frequency
				Drop-Out BW	Utility Frequency Drop-Out Bandwidth
				Pick-Up BW	Utility Frequency Pick-Up Bandwidth
				Lower Drop-Out	Utility Frequency Lower Drop-Out Threshold
				Lower Pick-Up	Utility Frequency Lower Pick-Up Threshold
				Upper Pick-Up	Utility Frequency Upper Pick-Up Threshold
				Upper Drop-Out	Utility Frequency Upper Drop-Out Threshold
				Drop-Out Delay	Utility Frequency Drop-Out Delay
				Util Unloaded Lvl	Utility Unloaded Level
				Sensor Type	Utility Voltage Sensor Type
				Enable	Utility Overvoltage Sensor Enable
				Drop-Out	Utility Overvoltage Drop-Out Percentage
				Drop-Out	Utility Overvoltage Drop-Out Threshold
				Pick-Up	Utility Overvoltage Pick-Up Percentage
				Pick-Up	Utility Overvoltage Pick-Up Threshold
				Drop-Out Delay	Utility Overvoltage Drop-Out Delay
				Drop-Out	Utility Undervoltage Drop-Out Percentage
				Drop-Out	Utility Undervoltage Drop-Out Threshold
				Pick-Up	Utility Undervoltage Pick-Up Percentage
				Pick-Up	Utility Undervoltage Pick-Up Threshold

				Drop-Out Delay	Utility Undervoltage Drop-Out Delay
				Enable	Genset Loss of Phase Sensor Enable
				Drop-Out Delay	Genset Loss of Phase Drop-Out Delay
				Enable	Utility Loss of Phase Sensor Enable
				Drop-Out Delay	Utility Loss of Phase Drop-Out Delay
	Save/Restore				
	Help				
		Right			HMI Local Parameter
		Left			HMI Local Parameter
		Up			HMI Local Parameter
		Down			HMI Local Parameter
		Back			HMI Local Parameter
		Home			HMI Local Parameter
		OK/Enter			HMI Local Parameter
		Stop			HMI Local Parameter
		CB Open			HMI Local Parameter
		CB Close			HMI Local Parameter
		Manual			HMI Local Parameter
		Man Start			HMI Local Parameter
		Auto			HMI Local Parameter
		Genset Run			HMI Local Parameter
		Remote Start			HMI Local Parameter
		Not In Auto			HMI Local Parameter
		Shutdown			HMI Local Parameter
		Warning			HMI Local Parameter
	Advanced Status				
		Adv Genset Status			
			Pos kWh L1 L2 L3		Genset L1 Positive kWh
			Pos kWh L1 L2		Genset L2 Positive kWh

			L3		
			Pos kWh L1 L2 L3		Genset L3 Positive kWh
			Neg kWh L1 L2 L3		Genset L1 Negative kWh
			Neg kWh L1 L2 L3		Genset L2 Negative kWh
			Neg kWh L1 L2 L3		Genset L3 Negative kWh
			Pos kVARh L1 L2 L3		Genset L1 Positive kVARh
			Pos kVARh L1 L2 L3		Genset L2 Positive kVARh
			Pos kVARh L1 L2 L3		Genset L3 Positive kVARh
			Neg kVARh L1 L2 L3		Genset L1 Negative kVARh
			Neg kVARh L1 L2 L3		Genset L2 Negative kVARh
			Neg kVARh L1 L2 L3		Genset L3 Negative kVARh
			kVAh L1 L2 L3		Genset L1 kVAh
			kVAh L1 L2 L3		Genset L2 kVAh
			kVAh L1 L2 L3		Genset L3 kVAh
			L1 %L-L %L-N		Genset L1L2 Voltage%
			L1 %L-L %L-N		Genset L1N Voltage%
			L2 %L-L %L-N		Genset L2L3 Voltage%
			L2 %L-L %L-N		Genset L2N Voltage%
			L3 %L-L %L-N		Genset L3L1 Voltage%
			L3 %L-L %L-N		Genset L3N Voltage%
			Genset Average Voltage%		Genset Average Voltage%
			3 Ph Fast Avg Voltage %		Genset 3 Phase Fast Average Voltage Percent
			L1 %kW %kVA %Amps		Genset % Application L1 kW
			L1 %kW %kVA %Amps		Genset % Application L1 kVA

			L1 %kW %kVA %Amps		Genset % Application L1 Current
			L2 %kW %kVA %Amps		Genset % Application L2 kW
			L2 %kW %kVA %Amps		Genset % Application L2 kVA
			L2 %kW %kVA %Amps		Genset % Application L2 Current
			L3 %kW %kVA %Amps		Genset % Application L3 kW
			L3 %kW %kVA %Amps		Genset % Application L3 kVA
			L3 %kW %kVA %Amps		Genset % Application L3 Current
			Genset % Application Total kW		Genset % Application Total kW
			Genset % Application Total kVA		Genset % Application Total kVA OP
			Genset % Standby L1 Current		Genset % Standby L1 Current
			Genset % Standby L2 Current		Genset % Standby L2 Current
			Genset % Standby L3 Current		Genset % Standby L3 Current
			Genset % Standby Total kVA		Genset % Standby Total kVA
			Genset % Standby Total kW		Genset % Standby Total kW
			Total Positive kWh		Genset Total Positive kWh
			Total Negative kWh		Genset Total Negative kWh

			Total Net kWh		Genset Total Net kWh
			Total Positive kVARh		Genset Total Positive kVARh
			Total Negative kVARh		Genset Total Negative kVARh
			Total Net kVARh		Genset Total Net kVARh
			Total kVAh		Genset Total kVAh
			Total kVAR		Genset Total kVAR
			Timestamp - Second		Genset Reset All Energy Meters Timestamp - Second
			Timestamp - Minute		Genset Reset All Energy Meters Timestamp - Minute
			Timestamp - Hour		Genset Reset All Energy Meters Timestamp - Hour
			Timestamp - Day		Genset Reset All Energy Meters Timestamp - Day
			Timestamp - Month		Genset Reset All Energy Meters Timestamp - Month
			Timestamp - Year		Genset Reset All Energy Meters Timestamp - Year
			kVAR L1 L2 L3		Genset L1 kVAR
			kVAR L1 L2 L3		Genset L2 kVAR
			kVAR L1 L2 L3		Genset L3 kVAR
			Ph Diff L1 L2 L3		Genset L1L2 Phase Difference
			Ph Diff L1 L2 L3		Genset L2L3 Phase Difference
			Ph Diff L1 L2 L3		Genset L3L1 Phase Difference
			Phase Rotation		Genset Phase Rotation
			Connected Bargraph Modules		Number of Connected Bargraph Modules
			Prelube Mode		Prelube Mode
			Current %		Genset Negative Sequence Current %
			Amb Temp (Aux 101)		Ambient Temperature (Aux101)
			Alt Temp 1 (Aux		Alternator Temperature 1 (Aux101)

			101)		
			Alt Temp 2 (Aux 101)		Alternator Temperature 2 (Aux101)
			Alt Temp 3 (Aux101)		Alternator Temperature 3 (Aux101)
			DE Bearing Temp (Aux101)		Drive End Bearing Temperature (Aux101)
			NDE Bearing Temp (Aux101)		Non-Drive End Bearing Temperature (Aux101)
			Exh Stk Temp 1 (Aux101)		Exhaust Stack Temperature 1 (Aux101)
			Exh Stk Temp 2 (Aux 101)		Exhaust Stack Temperature 2 (Aux101)
			Fuel Level (Aux101)		Fuel Level (PCCnet)
			Fuel Level % (Aux101)		Fuel Level % (PCCnet)
			Intake Man Temp 1 (Aux101)		Intake Manifold Temperature 1 (Aux101)
			Oil Temp (Aux101)		Oil Temperature (Aux101)
			Input 1 Voltage		Aux101 0 Analog Input 1 Voltage
			Input 2 Voltage		Aux101 0 Analog Input 2 Voltage
			Output 1 Signal Status		Aux101 0 Outputs 1-8 Signal Status
			Output 2 Signal Status		Aux101 0 Outputs 1-8 Signal Status
			Output 3 Signal Status		Aux101 0 Outputs 1-8 Signal Status
			Output 4 Signal Status		Aux101 0 Outputs 1-8 Signal Status
			Output 5 Signal Status		Aux101 0 Outputs 1-8 Signal Status
			Output 6 Signal Status		Aux101 0 Outputs 1-8 Signal Status
			Output 7 Signal Status		Aux101 0 Outputs 1-8 Signal Status
			Output 8 Signal		Aux101 0 Outputs 1-8 Signal Status

			Status		
			Input 1 Signal Status		Aux102 0 Inputs 9-12 Signal Status
			Input 2 Signal Status		Aux102 0 Inputs 9-12 Signal Status
			Input 3 Signal Status		Aux102 0 Inputs 9-12 Signal Status
			Input 4 Signal Status		Aux102 0 Inputs 9-12 Signal Status
			Output 9 Signal Status		Aux102 0 Outputs 9-16 Signal Status
			Output 10 Signal Status		Aux102 0 Outputs 9-16 Signal Status
			Output 11 Signal Status		Aux102 0 Outputs 9-16 Signal Status
			Output 12 Signal Status		Aux102 0 Outputs 9-16 Signal Status
			Output 13 Signal Status		Aux102 0 Outputs 9-16 Signal Status
			Output 14 Signal Status		Aux102 0 Outputs 9-16 Signal Status
			Output 15 Signal Status		Aux102 0 Outputs 9-16 Signal Status
			Output 16 Signal Status		Aux102 0 Outputs 9-16 Signal Status
			Input 1 Voltage		Aux101 1 Analog Input 1 Voltage
			Input 2 Voltage		Aux101 1 Analog Input 2 Voltage
			Output 1 Signal Status		Aux101 1 Outputs 1-8 Signal Status
			Output 2 Signal Status		Aux101 1 Outputs 1-8 Signal Status
			Output 3 Signal Status		Aux101 1 Outputs 1-8 Signal Status
			Output 4 Signal Status		Aux101 1 Outputs 1-8 Signal Status
			Output 5 Signal Status		Aux101 1 Outputs 1-8 Signal Status
			Output 6 Signal Status		Aux101 1 Outputs 1-8 Signal Status

			Output 7 Signal Status		Aux101 1 Outputs 1-8 Signal Status
			Output 8 Signal Status		Aux101 1 Outputs 1-8 Signal Status
			Input 1 Signal Status		Aux102 1 Inputs 9-12 Signal Status
			Input 2 Signal Status		Aux102 1 Inputs 9-12 Signal Status
			Input 3 Signal Status		Aux102 1 Inputs 9-12 Signal Status
			Input 4 Signal Status		Aux102 1 Inputs 9-12 Signal Status
			Output 9 Signal Status		Aux102 1 Outputs 9-16 Signal Status
			Output 10 Signal Status		Aux102 1 Outputs 9-16 Signal Status
			Output 11 Signal Status		Aux102 1 Outputs 9-16 Signal Status
			Output 12 Signal Status		Aux102 1 Outputs 9-16 Signal Status
			Output 13 Signal Status		Aux102 1 Outputs 9-16 Signal Status
			Output 14 Signal Status		Aux102 1 Outputs 9-16 Signal Status
			Output 15 Signal Status		Aux102 1 Outputs 9-16 Signal Status
			Output 16 Signal Status		Aux102 1 Outputs 9-16 Signal Status
		Adv Controller Status			
			Start Countdown		Start Countdown
			Stop Countdown		Stop Countdown
			Time At No Load		Time At No Load
			Time at Rated Cooldown		Time at Rated Cooldown
			Exercise Time Remaining		Exercise Time Remaining
			Config In #1 Sw		Configurable Input #1 Switch

			Config In #2 Sw		Configurable Input #2 Switch
			Config In #13 Sw		Configurable Input #13 Switch
			Config In #14 Sw		Configurable Input #14 Switch
			Config In #5 Sw		Coolant Level/Configurable Input #5 Switch
			Config In #6 Sw		Low Fuel/Configurable Input #6 Switch
			Config In #10 Sw		Fault Reset/Configurable Input #10 Switch
			Config In #11 Sw		Start Type/Configurable Input #11 Switch
			Config In #12 Sw		Rupture Basin/Configurable Input #12 Switch
			Auto Switch		Auto Switch
			Manual Switch		Manual Switch
			Battery Charger Failed		Battery Charger Failed Switch
			High Alt Temp		High Alt Temp Switch
			Low Coolant #2 Switch		Low Coolant #2 Switch
			Low Engine Temperature		Low Engine Temperature Switch
			Low Fuel In Day Tank		Low Fuel In Day Tank Switch
			Remote Start Cmd Inputs		Remote Start Command Inputs
			Start Type Cmd Inputs		Start Type Command Inputs
			Battle Short Cmd Inputs		Battle Short Command Inputs
			Config Out #1 Status		Configurable Output #1 Status
			Config Out #2 Status		Configurable Output #2 Status
			Config Out #3 Status		Configurable Output #3 Status
			Config Out #4 Status		Configurable Output #4 Status

			Config Out #5 Status		Ready To Load /Configurable Output #5 Status
			Config Out #6 Status		Oil Priming Pump / Configurable Output #6 Status
			Config Out #7 Status		Local Status / Configurable Output #7 Status
			Glow Plug/Spark Ignition Status		Glow Plug / Spark Ignition Output Status
			Config Out #10 Status		Delayed Off / Configurable Output #10 Status
			Config Out #11 Status		Load Dump / Configurable Output #11 Status
			Config In #27 Sw		Transfer Inhibit/Configurable Input #20 Switch
			Config In #21 Sw		Retransfer Inhibit/Configurable Input #21 Switch
			Config In #23 Sw		Utility CB Pos B/Configurable Input #23 Switch
			Config In #24 Sw		Utility CB Tripped/Configurable Input #24 Switch
			Config In #25 Sw		Utility CB Inhibit/Configurable Input #25 Switch
			Config In #26 Sw		Genset CB Pos B/Configurable Input #26 Switch
			Config In #27 Sw		Genset CB Tripped/Configurable Input #27 Switch
			Config In #28 Sw		Genset CB Inhibit/Configurable Input #28 Switch
			Config In #29 Sw		Utility Single Mode Verify/Configurable Input #29 Switch
			Config In #30 Sw		Sync Enable/Configurable Input #30 Switch
			Config In #31 Sw		Load Demand Stop/Configurable Input #31 Switch
			Config In #32 Sw		Extended Parallel/Configurable Input #32 Switch
			Config In #33 Sw		Backup Start Disconnect/Configurable Input #33 Switch
			External Speed		External Speed Bias Input

			Bias Input		
			External Voltage Bias Input		External Voltage Bias Input
			PTC Mode Sw Cmd Inputs		PTC Mode Switch Command Inputs
			Extended Parallel Sw Cmd Inputs		Extended Parallel Switch Command Inputs
			Load Demand Stop Request Inputs		Load Demand Stop Request Inputs
			Config Out #20 Status		Configurable Output #20 Status
			Config Out #21 Status		Configurable Output #21 Status
			Config Out #22 Status		Configurable Output #22 Status
			Gen CB Open		Genset CB Open Command
			Gen CB Close		Genset CB Close Command
			Util CB Open		Utility CB Open Command
			Util CB Close		Utility CB Close Command
		Adv Engine Status			
			Water in Fuel Indicator		Water in Fuel Indicator
			Turbocharger 1 Speed		Turbocharger 1 Speed
			Turbocharger 2 Boost Pressure		Turbocharger 2 Boost Pressure
			Gov Start Ramp		Speed Ramp State
			Prelube State		Prelube State
			Pre-Filter Oil Pressure		Pre-Filter Oil Pressure
			Post-Filter Oil Pressure		Post-Filter Oil Pressure
			Charger Flash Voltage		Battery Charger Alternator Flash Voltage OP

			Manf Temp 2		Intake Manifold 2 Temperature
			Manf Temp 3		Intake Manifold 3 Temperature
			Manf Temp 4		Intake Manifold 4 Temperature
			Port 1		Exhaust Port 1 Temperature
			Port 2		Exhaust Port 2 Temperature
			Port 3		Exhaust Port 3 Temperature
			Port 4		Exhaust Port 4 Temperature
			Port 5		Exhaust Port 5 Temperature
			Port 6		Exhaust Port 6 Temperature
			Port 7		Exhaust Port 7 Temperature
			Port 8		Exhaust Port 8 Temperature
			Port 9		Exhaust Port 9 Temperature
			Port 10		Exhaust Port 10 Temperature
			Port 11		Exhaust Port 11 Temperature
			Port 12		Exhaust Port 12 Temperature
			Port 13		Exhaust Port 13 Temperature
			Port 14		Exhaust Port 14 Temperature
			Port 15		Exhaust Port 15 Temperature
			Port 16		Exhaust Port 16 Temperature
			Port 17		Exhaust Port 17 Temperature
			Port 18		Exhaust Port 18 Temperature
			Port 19		Exhaust Port 19 Temperature
			Port 20		Exhaust Port 20 Temperature
	Load Demand Status				
	Power Status				
	Paralleling Status				
		Sync Status			Synchronizer Status
		Bus Status			Bus Status
		Close Allowed			Permissive Close Allowed
		Phase Match			Phase Matched

		Voltage Match			Voltage Matched
		Freq Match			Frequency Matched
		Phase			Phase Match Error
		Frequency			Permissive Frequency Match Error
		Voltage			Permissive Voltage Match Error
		kW Setpoint			Load Govern kW Target
		kVAR Setpoint			Load Govern kVAR Target
		PF Setpoint			Power Factor Setpoint
		Spd Cnt Mode			Paralleling Speed Control Mode
		Volt Cnt Mode			Paralleling Voltage Control Mode
		Inhibit			Genset CB Inhibit Command
		Tripped			Genset CB Tripped Command
		Inhibit			Utility CB Inhibit Command
		Tripped			Utility CB Tripped Command
		Current Based Pos			Utility Current Based Breaker Position
		Op Trans Type			PTC Operating Transition Type
		Frequency			Genset Frequency Sensor Status
		Overvolt			Genset Overvoltage Sensor Status
		Undervolt			Genset Undervoltage Sensor Status
		Phase Rot			Genset Phase Rotation Sensor Status
		Loss of Phase			Genset Loss of Phase Sensor Status
		Trans Inhibit			Transfer Inhibit Cmd
		Retrans Inhibit			Retransfer Inhibit Cmd
		Override Sw			Override Switch Command
		Frequency			Utility Frequency Sensor Status
		Overvolt			Utility Overvoltage Sensor Status
		Undervolt			Utility Undervoltage Sensor Status
		Phase Rot			Utility Phase Rotation Sensor Status
		Loss of Phase			Utility Loss of Phase Sensor Status
		Genset Bus L1L2 Voltage			Genset Bus L1L2 Voltage
		Genset Bus L1N Voltage			Genset Bus L1N Voltage
		Genset Bus L1 Current			Genset Bus L1 Current

		Genset Bus L2L3 Voltage			Genset Bus L2L3 Voltage
		Genset Bus L2N Voltage			Genset Bus L2N Voltage
		Genset Bus L2 Current			Genset Bus L2 Current
		Genset Bus L3L1 Voltage			Genset Bus L3L1 Voltage
		Genset Bus L3N Voltage			Genset Bus L3N Voltage
		Genset Bus L3 Current			Genset Bus L3 Current
		Genset Bus Frequency			Genset Bus Frequency
		Genset Bus L1 kW			Genset Bus L1 kW
		Genset Bus L1 kVA			Genset Bus L1 kVA
		Genset Bus L1 Power Factor			Genset Bus L1 Power Factor
		Genset Bus L2 kW			Genset Bus L2 kW
		Genset Bus L2 kVA			Genset Bus L2 kVA
		Genset Bus L2 Power Factor			Genset Bus L2 Power Factor
		Genset Bus L3 kW			Genset Bus L3 kW
		Genset Bus L3 kVA			Genset Bus L3 kVA
		Genset Bus L3 Power Factor			Genset Bus L3 Power Factor
		Genset Bus Total kW			Genset Bus Total kW
		Genset Bus Total kVA			Genset Bus Total kVA
		Genset Bus Total Power Factor			Genset Bus Total Power Factor

		Utility L1L2 Voltage			Utility L1L2 Voltage
		Utility L1N Voltage			Utility L1N Voltage
		Utility L1 Current			Utility L1 Current
		Utility L2L3 Voltage			Utility L2L3 Voltage
		Utility L2N Voltage			Utility L2N Voltage
		Utility L2 Current			Utility L2 Current
		Utility L3L1 Voltage			Utility L3L1 Voltage
		Utility L3N Voltage			Utility L3N Voltage
		Utility L3 Current			Utility L3 Current
		Utility Frequency			Utility Frequency
		Utility L1 kW			Utility L1 kW
		Utility L1 kVA			Utility L1 kVA
		Utility L1 Power Factor			Utility L1 Power Factor
		Utility L2 kW			Utility L2 kW
		Utility L2 kVA			Utility L2 kVA
		Utility L2 Power Factor			Utility L2 Power Factor
		Utility L3 kW			Utility L3 kW
		Utility L3 kVA			Utility L3 kVA
		Utility L3 Power Factor			Utility L3 Power Factor
		Utility Total kW			Utility Total kW
		Utility Total kVA			Utility Total kVA
		Utility Total kVA			Utility Total Power Factor
		Genset Bus L1 Positive kWh			Genset Bus L1 Positive kWh
		Genset Bus L2 Positive kWh			Genset Bus L2 Positive kWh
		Genset Bus L3 Positive kWh			Genset Bus L3 Positive kWh

		Genset Bus L1 Negative kWh			Genset Bus L1 Negative kWh
		Genset Bus L2 Negative kWh			Genset Bus L2 Negative kWh
		Genset Bus L3 Negative kWh			Genset Bus L3 Negative kWh
		Genset Bus L1 Positive kVARh			Genset Bus L1 Positive kVARh
		Genset Bus L2 Positive kVARh			Genset Bus L2 Positive kVARh
		Genset Bus L3 Positive kVARh			Genset Bus L3 Positive kVARh
		Genset Bus L1 Negative kVARh			Genset Bus L1 Negative kVARh
		Genset Bus L2 Negative kVARh			Genset Bus L2 Negative kVARh
		Genset Bus L3 Negative kVARh			Genset Bus L3 Negative kVARh
		Genset Bus Total Positive kWh			Genset Bus Total Positive kWh
		Genset Bus Total Negative kWh			Genset Bus Total Negative kWh
		Genset Bus Total Net kWh			Genset Bus Total Net kWh
		Genset Bus Total Positive kVARh			Genset Bus Total Positive kVARh
		Genset Bus Total Negative kVARh			Genset Bus Total Negative kVARh
		Genset Bus Total Net kVARh			Genset Bus Total Net kVARh
		Hour			Genset Bus Reset All Energy Meters Timestamp - Hour
		Min			Genset Bus Reset All Energy Meters Timestamp - Minute
		Sec			Genset Bus Reset All Energy Meters Timestamp -

					Second
		Day			Genset Bus Reset All Energy Meters Timestamp - Day
		Month			Genset Bus Reset All Energy Meters Timestamp - Month
		Year			Genset Bus Reset All Energy Meters Timestamp - Year
		Utility L1 Positive kWh			Utility L1 Positive kWh
		Utility L2 Positive kWh			Utility L2 Positive kWh
		Utility L3 Positive kWh			Utility L3 Positive kWh
		Utility L1 Negative kWh			Utility L1 Negative kWh
		Utility L2 Negative kWh			Utility L2 Negative kWh
		Utility L3 Negative kWh			Utility L3 Negative kWh
		Utility L1 Positive kVARh			Utility L1 Positive kVARh
		Utility L2 Positive kVARh			Utility L2 Positive kVARh
		Utility L3 Positive kVARh			Utility L3 Positive kVARh
		Utility L1 Negative kVARh			Utility L1 Negative kVARh
		Utility L2 Negative kVARh			Utility L2 Negative kVARh
		Utility L3 Negative kVARh			Utility L3 Negative kVARh
		Utility Total Positive kWh			Utility Total Positive kWh
		Utility Total Negative kWh			Utility Total Negative kWh
		Utility Total Net kWh			Utility Total Net kWh
		Utility Total Positive kVARh			Utility Total Positive kVARh

		Utility Total Negative kVARh			Utility Total Negative kVARh
		Utility Total Net kVARh			Utility Total Net kVARh
		Hour			Utility Reset All Energy Meters Timestamp - Hour
		Min			Utility Reset All Energy Meters Timestamp - Minute
		Sec			Utility Reset All Energy Meters Timestamp - Second
		Day			Utility Reset All Energy Meters Timestamp - Day
		Month			Utility Reset All Energy Meters Timestamp - Month
		Year			Utility Reset All Energy Meters Timestamp - Year
		Genset Bus L1 kVAR			Genset Bus L1 kVAR
		Genset Bus L2 kVAR			Genset Bus L2 kVAR
		Genset Bus L3 kVAR			Genset Bus L3 kVAR
		Genset Bus Total kVAR			Genset Bus Total kVAR
		L1-L2			Genset Bus L1L2 Phase Difference
		L2-L3			Genset Bus L2L3 Phase Difference
		L3-L1			Genset Bus L3L1 Phase Difference
		L1			Genset Bus L1 kVAh
		L2			Genset Bus L2 kVAh
		L3			Genset Bus L3 kVAh
		Total			Genset Bus Total kVAh
		Phase Rot			Genset Bus Phase Rotation
		Utility L1 kVAR			Utility L1 kVAR
		Utility L2 kVAR			Utility L2 kVAR
		Utility L3 kVAR			Utility L3 kVAR
		Utility Total kVAR			Utility Total kVAR
		L1-L2			Utility L1L2 Phase Difference
		L2-L3			Utility L2L3 Phase Difference
		L3-L1			Utility L3L1 Phase Difference
		Utility L1 kVAh			Utility L1 kVAh
		Utility L2 kVAh			Utility L2 kVAh

		Utility L3 kVAh			Utility L3 kVAh
		Utility Total kVAh			Utility Total kVAh
		Phase Rot			Utility Phase Rotation
	Paralleling Status-Iso Bus Sc 1				
		ES State			ES State
		Genset Avg Voltage			Genset LL Average Voltage
		Genset Frequency			Genset Frequency OP
		Genset kW			Genset Total kW
		Genset kVAR			Genset Total kVAR
		Genset PF			Genset Total Power Factor
		Genset CB Pos			Genset CB Position Status
		Phase Error			Phase Match Error
		Load Demand Stop			Load Demand Stop Command
		Bus Avg Voltage			Genset Bus LL Average Voltage
		Bus Frequency			Genset Bus Frequency
		Bus kW			Genset Bus Total kW
		Bus kVAR			Genset Bus Total kVAR
		Bus PF			Genset Bus Total Power Factor
	Paralleling Status-Util Sin Sc 1				
		ES State			ES State
		Genset Avg Voltage			Genset LL Average Voltage
		Genset Frequency			Genset Frequency OP
		Genset kW			Genset Total kW
		Genset kVAR			Genset Total kVAR
		Genset PF			Genset Total Power Factor

		Genset CB Pos			Genset CB Position Status
		Phase Error			Phase Match Error
		Util CB Pos			Utility CB Position Status
		Bus Avg Voltage			Utility LL Average Voltage
		Bus Frequency			Utility Frequency
		Bus kW			Utility Total kW
		Bus kVAR			Utility Total kVAR
		Bus PF			Utility Total Power Factor
	Paralleling Status-Util Mul Sc 1				
		ES State			ES State
		Genset Avg Voltage			Genset LL Average Voltage
		Genset Frequency			Genset Frequency OP
		Genset kW			Genset Total kW
		Genset kVAR			Genset Total kVAR
		Genset PF			Genset Total Power Factor
		Genset CB Pos			Genset CB Position Status
		Phase Error			Phase Match Error
		Util CB Pos			Utility CB Position Status
		Load Demand Stop			Load Demand Stop Command
		Bus Avg Voltage			Genset Bus LL Average Voltage
		Bus Frequency			Genset Bus Frequency
		Bus kW			Genset Bus Total kW
		Bus kVAR			Genset Bus Total kVAR
		Bus PF			Genset Bus Total Power Factor
	Paralleling Status-Syn Only Sc 1				
		ES State			ES State
		Genset Avg			Genset LL Average Voltage

		Voltage			
		Genset Frequency			Genset Frequency OP
		Genset kW			Genset Total kW
		Genset kVAR			Genset Total kVAR
		Genset PF			Genset Total Power Factor
		Phase Error			Phase Match Error
		Bus Avg Voltage			Utility LL Average Voltage
		Bus Frequency			Utility Frequency
		Bus kW			Utility Total kW
		Bus kVAR			Utility Total kVAR
		Bus PF			Utility Total Power Factor
	Paralleling Status-PTC Sc 1				
		ES State			ES State
		Genset Avg Voltage			Genset LL Average Voltage
		Genset Frequency			Genset Frequency OP
		Genset kW			Genset Total kW
		Genset kVAR			Genset Total kVAR
		Genset PF			Genset Total Power Factor
		Genset CB Pos			Genset CB Position Status
		Phase Error			Phase Match Error
		Util CB Pos			Utility CB Position Status
		Genset Availability Status			Genset Availability Status
		Utility Availability Status			Utility Availability Status
		PTC State			PTC State
		Bus Avg Voltage			Utility LL Average Voltage
		Bus Frequency			Utility Frequency
		Bus kW			Utility Total kW
		Bus kVAR			Utility Total kVAR

		Bus PF			Utility Total Power Factor
		Transtion Type			Active Transition Type
		Transtion Timer			Active Transition Timer
	LBNG Engine Data				
		Engine Speed			Average Engine Speed OP
		Engine Hours			Engine Running Time OP
		HT Coolant Temperature			Coolant Temperature OP
		HT Coolant Pressure			Coolant Pressure
		LT Coolant Temperature			Coolant 2 Temperature
		LT Coolant Pressure			Coolant 2 Pressure
		Pre-Filter Oil Pressure			Pre-Filter Oil Pressure
		Oil Pressure			Oil Pressure
		Oil Temperature			Oil Temperature
		DE/NDE			DE/NDE Cylinder Viewpoint Reference
		Bank A 1			Exhaust Port 1 Temperature
		Bank A 2			Exhaust Port 3 Temperature
		Bank A 3			Exhaust Port 5 Temperature
		Bank A 4			Exhaust Port 7 Temperature
		Bank A 5			Exhaust Port 9 Temperature
		Bank B 1			Exhaust Port 2 Temperature
		Bank B 2			Exhaust Port 4 Temperature
		Bank B 3			Exhaust Port 6 Temperature
		Bank B 4			Exhaust Port 8 Temperature
		Bank B 5			Exhaust Port 10 Temperature
		Bank A 6			Exhaust Port 11 Temperature
		Bank A 7			Exhaust Port 13 Temperature
		Bank A 8			Exhaust Port 15 Temperature
		Bank A 9			Exhaust Port 17 Temperature
		Bank B 6			Exhaust Port 12 Temperature

		Bank B 7			Exhaust Port 14 Temperature
		Bank B 8			Exhaust Port 16 Temperature
		Bank B 9			Exhaust Port 18 Temperature
	Auxiliary Status				
		GIB Isolator			GIB Isolator Open (Aux101)
		Engine Heaters			Engine Coolant PreHeater Ctrl Status
		HT Coolant Temperture			Coolant Temperature OP
		Coolant Circ Pump			Engine Coolant Pump Ctrl Status
		Alt Heaters Status			Alternator Heater Status
		Lube Oil Priming Pump			Oil Priming Pump Control Status
		Oil Pressure			Oil Pressure
		Oil Lube Status			Oil Priming State
		Oil Heater			Engine Oil PreHeater Ctrl Status
		Oil Temperature			Oil Temperature
		Derate Authorization			Derate Authorization
		Start System Status			Start System Status
		Vent Fan Status			Ventilator Fan Status
		Louvres Status			Louvres Status
		Rad Fan Status			Radiator Fan Status
		DC PSU Status			DC PSU Unavailable (Aux101)
		Start Inhibit No 1			Start Inhibit No1 (Aux101)
		Start Inhibit No 2			Start Inhibit No2 (Aux101)
		Start Inhibit No 3			Start Inhibit No3 (Aux101)
		Start Inhibit No 1 Text			Start Inhibit No1 Fault Text
		Start Inhibit No 2 Text			Start Inhibit No2 Fault Text
		Start Inhibit No 3 Text			Start Inhibit No3 Fault Text

	Gas Engineer Data				
		Internal MCM Temp			Internal MCM700 Temperature
		Isolated Battery V			MCM700 Battery Voltage
		Speed Bias			Speed Bias Reference (%)
		Sensed kW Load			Genset Total kW
		Int SSM558 Temp Bank A			Internal SSM558 1 Temperature
		Isolated Battery V Bank A			SSM558 1 Isolated Battery Voltage
		Int SSM558 Temp Bank B			Internal SSM558 2 Temperature
		Isolated Battery V Bank B			SSM558 2 Isolated Battery Voltage
		Exhaust Back Press			Exhaust Back Pressure
		DE/NDE			DE/NDE Cylinder Viewpoint Reference
		Bank A 1			Knock Level Cylinder 1
		Bank A 2			Knock Level Cylinder 3
		Bank A 3			Knock Level Cylinder 5
		Bank A 4			Knock Level Cylinder 7
		Bank A 5			Knock Level Cylinder 9
		Bank B 1			Knock Level Cylinder 2
		Bank B 2			Knock Level Cylinder 4
		Bank B 3			Knock Level Cylinder 6
		Bank B 4			Knock Level Cylinder 8
		Bank B 5			Knock Level Cylinder 10
		Bank A 6			Knock Level Cylinder 11
		Bank A 7			Knock Level Cylinder 13
		Bank A 8			Knock Level Cylinder 15
		Bank A 9			Knock Level Cylinder 17
		Bank B 6			Knock Level Cylinder 12
		Bank B 7			Knock Level Cylinder 14
		Bank B 8			Knock Level Cylinder 16

		Bank B 9			Knock Level Cylinder 18
		DE/NDE			DE/NDE Cylinder Viewpoint Reference
		Bank A 1			Spark Timing Cyl 1
		Bank A 2			Spark Timing Cyl 3
		Bank A 3			Spark Timing Cyl 5
		Bank A 4			Spark Timing Cyl 7
		Bank A 5			Spark Timing Cyl 9
		Bank B 1			Spark Timing Cyl 2
		Bank B 2			Spark Timing Cyl 4
		Bank B 3			Spark Timing Cyl 6
		Bank B 4			Spark Timing Cyl 8
		Bank B 5			Spark Timing Cyl 10
		Bank A 6			Spark Timing Cyl 11
		Bank A 7			Spark Timing Cyl 13
		Bank A 8			Spark Timing Cyl 15
		Bank A 9			Spark Timing Cyl 17
		Bank B 6			Spark Timing Cyl 12
		Bank B 7			Spark Timing Cyl 14
		Bank B 8			Spark Timing Cyl 16
		Bank B 9			Spark Timing Cyl 18
		DE/NDE			DE/NDE Cylinder Viewpoint Reference
		Bank A 1			Knock Count Cyl 1
		Bank A 2			Knock Count Cyl 3
		Bank A 3			Knock Count Cyl 5
		Bank A 4			Knock Count Cyl 7
		Bank A 5			Knock Count Cyl 9
		Bank B 1			Knock Count Cyl 2
		Bank B 2			Knock Count Cyl 4
		Bank B 3			Knock Count Cyl 6
		Bank B 4			Knock Count Cyl 8
		Bank B 5			Knock Count Cyl 10
		Bank A 6			Knock Count Cyl 11
		Bank A 7			Knock Count Cyl 13
		Bank A 8			Knock Count Cyl 15
		Bank A 9			Knock Count Cyl 17

		Bank B 6			Knock Count Cyl 12
		Bank B 7			Knock Count Cyl 14
		Bank B 8			Knock Count Cyl 16
		Bank B 9			Knock Count Cyl 18
	Gas System Data				
		Downstream Valve			Downstream Valve Command Status
		Upstream Valve			Upstream Valve Command Status
		VPS Status			VPS Status
		Upstream Gas Pressure			Gas Supply Pressure
		Gas Inlet Pressure Bank A			Fuel Valve 1 Inlet Absolute Pressure
		Gas Mass Flow Rate Bank A			Gas Mass Flow
		Control Valve Position Bank A			Fuel Valve 1 Position
		Gas Outlet Pressure Bank A			Fuel Valve 1 Outlet Absolute Pressure
		Manifold Pressure Bank A			Intake Manifold Pressure 1
		Manifold Temperature Bank A			Intake Manifold Temperature
		Throttle Position Bank A			Throttle 1 Position
		Comp Out Pressure Bank A			Compressor Outlet Pressure
		Turbo Speed			Turbocharger 1 Speed
		Comp Bypass Position			Compressor Bypass Position
Aux101 Setup					

	Sensor Type				Aux101 0 Analog Input 1 Sensor Type
	Analog Function				Aux101 0 Analog Input 1 Function Pointer_
	Discrete Function				Aux101 0 Input 1 Function Pointer
	Fault Text				Aux101 0 Input 1 Fault Text
	Sensor Type				Aux101 0 Analog Input 2 Sensor Type
	Analog Function				Aux101 0 Analog Input 2 Function Pointer
	Discrete Function				Aux101 0 Input 2 Function Pointer
	Fault Text				Aux101 0 Input 2 Fault Text
	Sensor Type				Aux101 0 Analog Input 3 Sensor Type
	Analog Function				Aux101 0 Analog Input 3 Function Pointer
	Discrete Function				Aux101 0 Input 3 Function Pointer
	Fault Text				Aux101 0 Input 3 Fault Text
	Sensor Type				Aux101 0 Analog Input 4 Sensor Type
	Analog Function				Aux101 0 Analog Input 4 Function Pointer
	Discrete Function				Aux101 0 Input 4 Function Pointer
	Fault Text				Aux101 0 Input 4 Fault Text
	Sensor Type				Aux101 0 Analog Input 5 Sensor Type
	Analog Function				Aux101 0 Analog Input 5 Function Pointer
	Discrete Function				Aux101 0 Input 5 Function Pointer
	Fault Text				Aux101 0 Input 5 Fault Text
	Sensor Type				Aux101 0 Analog Input 6 Sensor Type
	Analog Function				Aux101 0 Analog Input 6 Function Pointer
	Discrete Function				Aux101 0 Input 6 Function Pointer
	Fault Text				Aux101 0 Input 6 Fault Text
	Sensor Type				Aux101 0 Analog Input 7 Sensor Type
	Analog Function				Aux101 0 Analog Input 7 Function Pointer
	Discrete Function				Aux101 0 Input 7 Function Pointer
	Fault Text				Aux101 0 Input 7 Fault Text
	Sensor Type				Aux101 0 Analog Input 8 Sensor Type

	Analog Function				Aux101 0 Analog Input 8 Function Pointer
	Discrete Function				Aux101 0 Input 8 Function Pointer
	Fault Text				Aux101 0 Input 8 Fault Text
	Event Code				Aux101 0 Output 1 Fault/Event
	Function				Aux101 0 Output 1 Function Pointer
	Event Code				Aux101 0 Output 2 Fault/Event
	Function				Aux101 0 Output 2 Function Pointer
	Event Code				Aux101 0 Output 3 Fault/Event
	Function				Aux101 0 Output 3 Function Pointer
	Event Code				Aux101 0 Output 4 Fault/Event
	Function				Aux101 0 Output 4 Function Pointer
	Event Code				Aux101 0 Output 5 Fault/Event
	Function				Aux101 0 Output 5 Function Pointer
	Event Code				Aux101 0 Output 6 Fault/Event
	Function				Aux101 0 Output 6 Function Pointer
	Event Code				Aux101 0 Output 7 Fault/Event
	Function				Aux101 0 Output 7 Function Pointer
	Event Code				Aux101 0 Output 8 Fault/Event
	Function				Aux101 0 Output 8 Function Pointer
	Active State Select				Aux102 0 Input 11 Active State Selection
	Function				Aux102 0 Input 11 Function Pointer
	Fault Text				Aux102 0 Fault 11 Text
	Active State Select				Aux102 0 Input 12 Active State Selection
	Function				Aux102 0 Input 12 Function Pointer
	Fault Text				Aux102 0 Fault 12 Text
	Active State Select				Aux102 0 Input 9 Active State Selection
	Function				Aux102 0 Input 9 Function Pointer
	Fault Text				Aux102 0 Fault 9 Text
	Active State Select				Aux102 0 Input 10 Active State Selection
	Function				Aux102 0 Input 10 Function Pointer
	Fault Text				Aux102 0 Fault 10 Text

	Event Code				Aux102 0 Output 9 Fault/Event
	Function				Aux102 0 Output 9 Function Pointer
	Event Code				Aux102 0 Output 10 Fault/Event
	Function				Aux102 0 Output 10 Function Pointer
	Event Code				Aux102 0 Output 11 Fault/Event
	Function				Aux102 0 Output 11 Function Pointer
	Event Code				Aux102 0 Output 12 Fault/Event
	Function				Aux102 0 Output 12 Function Pointer
	Event Code				Aux102 0 Output 13 Fault/Event
	Function				Aux102 0 Output 13 Function Pointer
	Event Code				Aux102 0 Output 14 Fault/Event
	Function				Aux102 0 Output 14 Function Pointer
	Event Code				Aux102 0 Output 15 Fault/Event
	Function				Aux102 0 Output 15 Function Pointer
	Event Code				Aux102 0 Output 16 Fault/Event
	Function				Aux102 0 Output 16 Function Pointer
	Sensor Type				Aux101 1 Analog Input 1 Sensor Type
	Analog Function				Aux101 1 Analog Input 1 Function Pointer
	Discrete Function				Aux101 1 Input 1 Function Pointer
	Fault Text				Aux101 1 Input 1 Fault Text
	Sensor Type				Aux101 1 Analog Input 2 Sensor Type
	Analog Function				Aux101 1 Analog Input 2 Function Pointer
	Discrete Function				Aux101 1 Input 2 Function Pointer
	Fault Text				Aux101 1 Input 2 Fault Text
	Sensor Type				Aux101 1 Analog Input 3 Sensor Type
	Analog Function				Aux101 1 Analog Input 3 Function Pointer
	Discrete Function				Aux101 1 Input 3 Function Pointer
	Fault Text				Aux101 1 Input 3 Fault Text
	Sensor Type				Aux101 1 Analog Input 4 Sensor Type
	Analog Function				Aux101 1 Analog Input 4 Function Pointer
	Discrete Function				Aux101 1 Input 4 Function Pointer
	Fault Text				Aux101 1 Input 4 Fault Text

	Sensor Type				Aux101 1 Analog Input 5 Sensor Type
	Analog Function				Aux101 1 Analog Input 5 Function Pointer
	Discrete Function				Aux101 1 Input 5 Function Pointer
	Fault Text				Aux101 1 Input 5 Fault Text
	Sensor Type				Aux101 1 Analog Input 6 Sensor Type
	Analog Function				Aux101 1 Analog Input 6 Function Pointer
	Discrete Function				Aux101 1 Input 6 Function Pointer
	Fault Text				Aux101 1 Input 6 Fault Text
	Sensor Type				Aux101 1 Analog Input 7 Sensor Type
	Analog Function				Aux101 1 Analog Input 7 Function Pointer
	Discrete Function				Aux101 1 Input 7 Function Pointer
	Fault Text				Aux101 1 Input 7 Fault Text
	Sensor Type				Aux101 1 Analog Input 8 Sensor Type
	Analog Function				Aux101 1 Analog Input 8 Function Pointer
	Discrete Function				Aux101 1 Input 8 Function Pointer
	Fault Text				Aux101 1 Input 8 Fault Text
	Event Code				Aux101 1 Output 1 Fault/Event
	Function				Aux101 1 Output 1 Function Pointer
	Event Code				Aux101 1 Output 2 Fault/Event
	Function				Aux101 1 Output 2 Function Pointer
	Event Code				Aux101 1 Output 3 Fault/Event
	Function				Aux101 1 Output 3 Function Pointer
	Event Code				Aux101 1 Output 4 Fault/Event
	Function				Aux101 1 Output 4 Function Pointer_
	Event Code				Aux101 1 Output 5 Fault/Event
	Function				Aux101 1 Output 5 Function Pointer
	Event Code				Aux101 1 Output 6 Fault/Event
	Function				Aux101 1 Output 6 Function Pointer
	Event Code				Aux101 1 Output 7 Fault/Event
	Function				Aux101 1 Output 7 Function Pointer
	Event Code				Aux101 1 Output 8 Fault/Event
	Function				Aux101 1 Output 8 Function Pointer

	Active State Select				Aux102 1 Input 11 Active State Selection
	Function				Aux102 1 Input 11 Function Pointer
	Fault Text				Aux102 1 Fault 11 Text
	Active State Select				Aux102 1 Input 12 Active State Selection
	Function				Aux102 1 Input 12 Function Pointer
	Fault Text				Aux102 1 Fault 10 Text
	Active State Select				Aux102 1 Input 9 Active State Selection
	Function				Aux102 1 Input 9 Function Pointer
	Fault Text				Aux102 1 Fault 12 Text
	Active State Select				Aux102 1 Input 10 Active State Selection
	Function				Aux102 1 Input 10 Function Pointer
	Fault Text				Aux102 1 Fault 9 Text
	Event Code				Aux102 1 Output 9 Fault/Event
	Function				Aux102 1 Output 9 Function Pointer
	Event Code				Aux102 1 Output 10 Fault/Event
	Function				Aux102 1 Output 10 Function Pointer
	Event Code				Aux102 1 Output 11 Fault/Event
	Function				Aux102 1 Output 11 Function Pointer
	Event Code				Aux102 1 Output 12 Fault/Event
	Function				Aux102 1 Output 12 Function Pointer
	Event Code				Aux102 1 Output 13 Fault/Event
	Function				Aux102 1 Output 13 Function Pointer
	Event Code				Aux102 1 Output 14 Fault/Event
	Function				Aux102 1 Output 14 Function Pointer
	Event Code				Aux102 1 Output 15 Fault/Event
	Function				Aux102 1 Output 15 Function Pointer
	Event Code				Aux102 1 Output 16 Fault/Event
	Function				Aux102 1 Output 16 Function Pointer

Operator and Service Adjustments

The operator panel includes provisions for adjustment and calibration of the voltage regulation and control functions in the generator set. Refer to the Setup and Trims section for a table of parameters adjustable by the optional display panel.

Generator Set Data

Access to the control and software part number, the generator set rating in KVA, and generator set model number is provided from the optional display panel.

The optional display panel also allows the user to view various data logs and the 32 most recent faults. Data logs made available by the display panel are: engine run time, controller on time, number of runs, and number of start attempts.

In order to service the genset using the optional display panel a password (primary – 574, secondary 1209) must be entered when prompted.

Engine and Alternator Data

For Engine Application Type = FAE, the optional display panel allows the operator to view many engine and alternator related data sets. They include:

Engine	Alternator
Starting Battery Voltage	Voltage (3 phase LL and LN)
Engine Speed	Current (3 phase)
Engine Coolant Temperature	Line Frequency
Engine Lube Oil pressure	KW (Total and Per Phase)
Engine Lube Oil Temperature	KVA (Total and Per Phase)
Intake Manifold Temperature	P.F. (Total and Per Phase)
Intake Manifold Pressure (Abs)	Kwh
Fuel Rail Pressure (Abs)	KVAh
Fuel Inlet Temperature	KVARh
Coolant Pressure	AVR Duty cycle
Pump Pressure	
After Coolant temperature	
Ambient Pressure	
Crank Pressure	

HMECM OEM Engine Setup Data

Access to the control and software part number is provided from the optional display panel.

In order to setup the OEM engine setup parameters using the optional display panel a password of 1209 must be entered when prompted.

HMECM Engine Data

For Engine Application Type = HM, the optional display panel allows the operator to view engine related data sets. They include:

Starting Battery Voltage	Intake Manifold Temperature
Engine Speed	Oil Temperature
Engine Coolant Temperature	Engine Running Hours
Engine Lube Oil pressure (for switch as well as sender)	Glow Plug Command

Electrical Wiring Harness Schematic

Refer to internal wiring diagrams 0630-3440.

Mechanical Drawings

For the 3300 control, refer drawing 0319-6130 for dimensional details of control module.

For the optional display panel, refer internal drawing 0319-XXXX (To be added later)

AUX105 OEM Engine Setup Data

Access to the control and software part number is provided from the optional display panel.

In order to setup the OEM engine setup parameters using the optional display panel a password of 1209 must be entered when prompted.

AUX105 Engine Data

The optional display panel allows the operator to view engine related data sets. They include:

Starting Battery Voltage	Intake Manifold Temperature
Engine Speed	Oil Temperature
Engine Coolant Temperature	Engine Running Hours
Engine Lube Oil pressure (for switch as well as sender)	Glow Plug Command

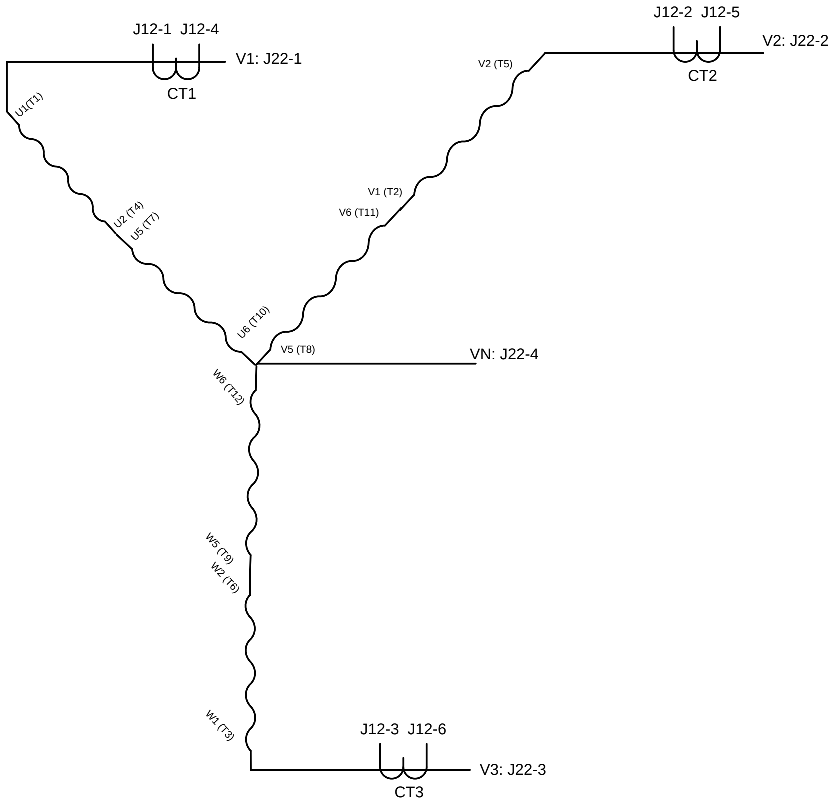
Alternator Connections

A fast acting UL certified ceramic fuse with a rating of (10) ten amperes shall be placed inline with the Excitation Inputs J18-1 and J18-2.

Alternator Reconnection Wiring Diagrams

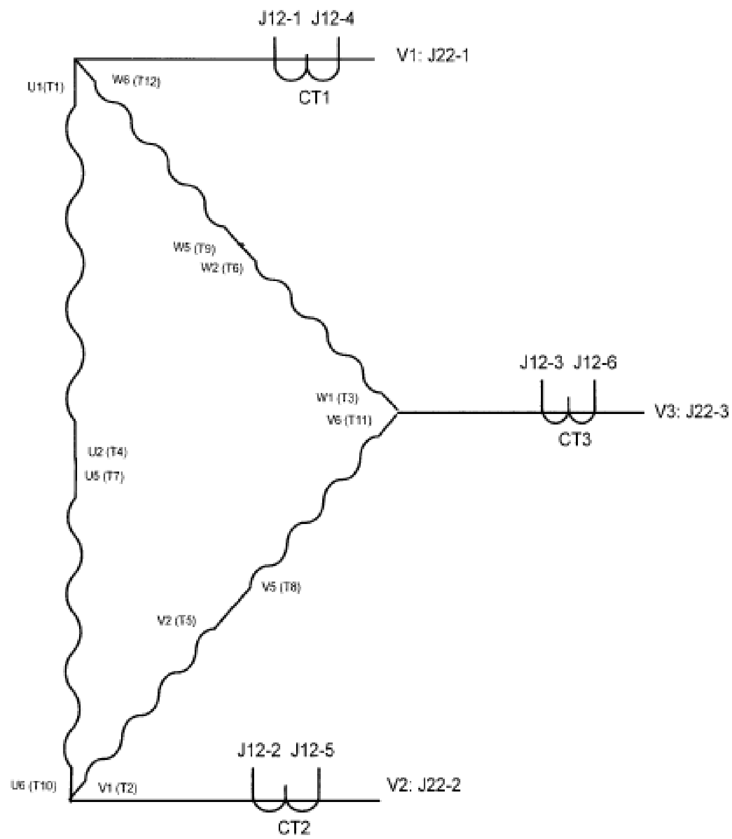
Series Star

Series star connection yields an output voltage of 220-277/380-480 volts.


J12-1 J12-4
V1: J22-1
CT1
U1(T1)
U2 (T4)
U5 (T7)
U6 (T10)
V5 (T8)
VN: J22-4
V2 (T5)
V1 (T2)
V6 (T11)
J12-2 J12-5
V2: J22-2
CT2
W6 (T12)
W5 (T9)
W2 (T6)
W1 (T3)
J12-3 J12-6
V3: J22-3
CT3

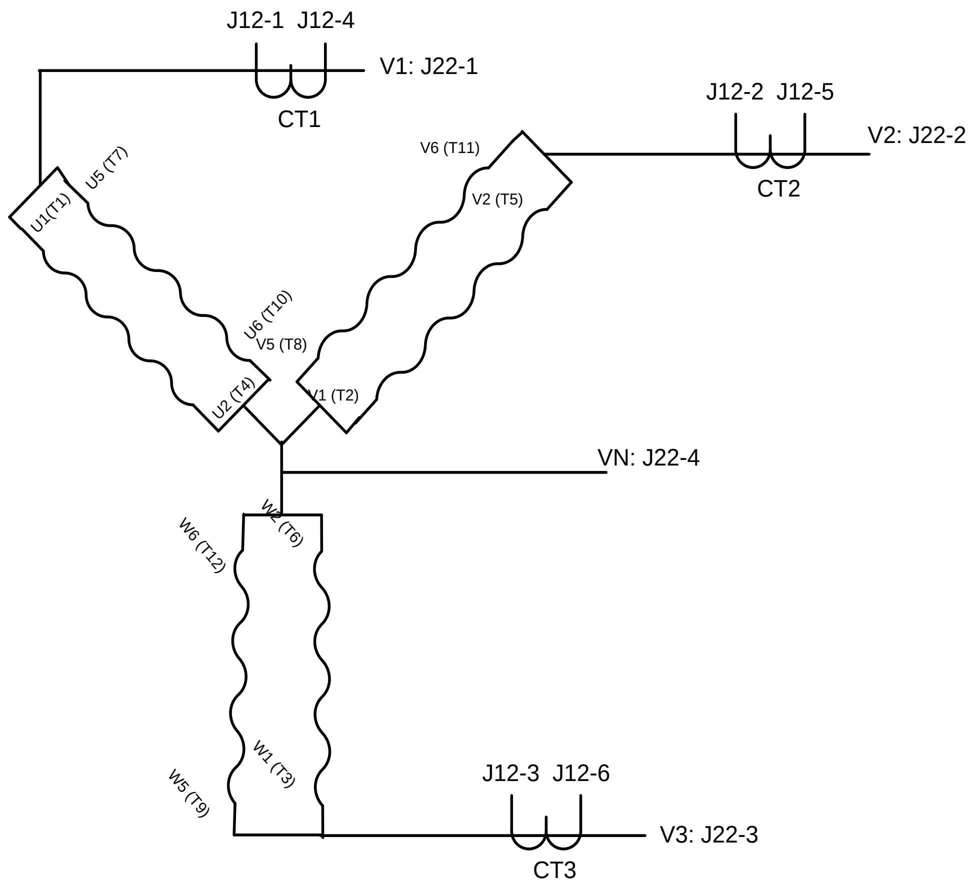
Series delta

Series delta provides for an output voltage of 110-120/220-240 volts. Figure 17.2.1 shows the correct series delta connections. Note: Sense N must not be connected in three phase delta connections



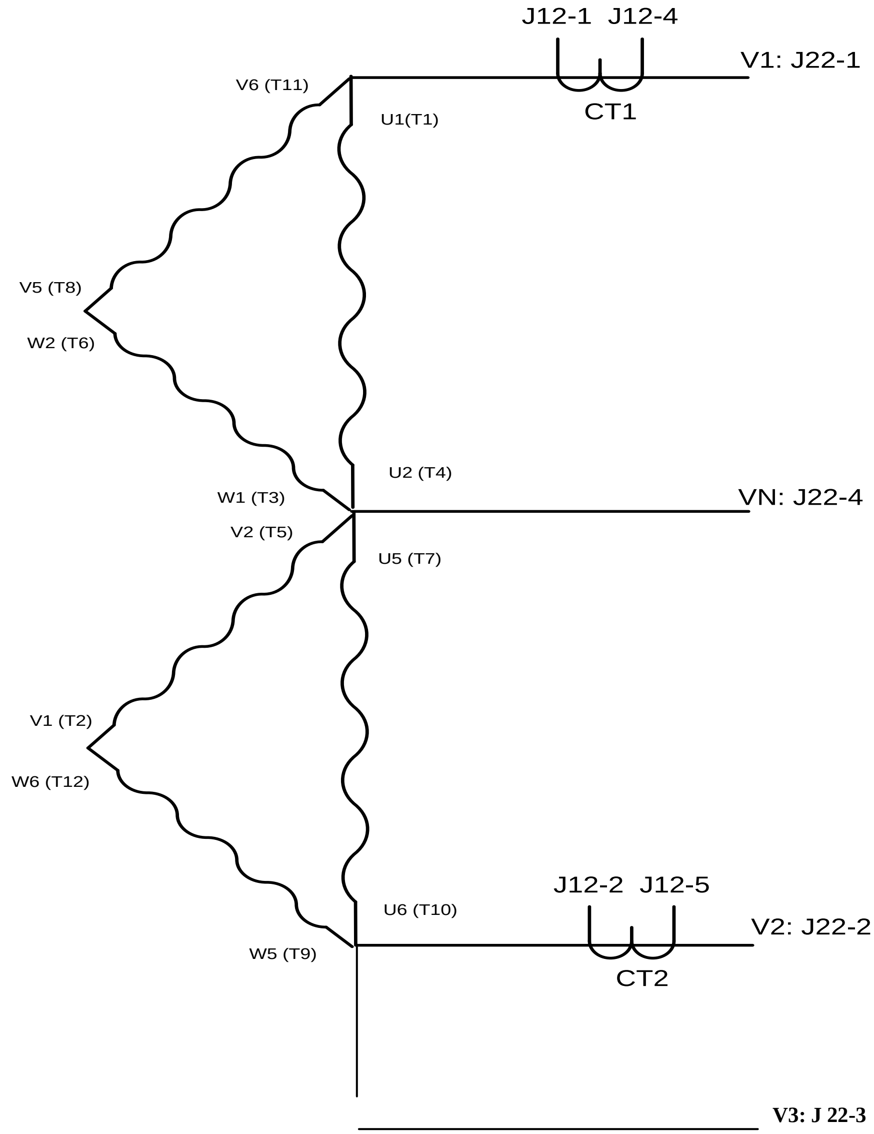
Parallel star

Parallel star alternator configuration yields an output voltage of 110-139/190-240 volts.



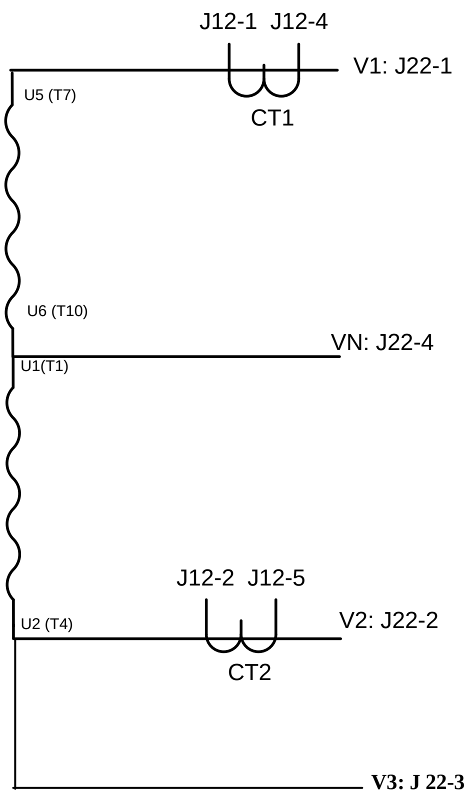
Double Delta

The double delta alternator configuration yields an output voltage of 110-120/220-240 volts.



Single Phase

Single phase provides for an output voltage of 110-120/220-240 volts. Single phase alternator connection is shown in Figure 17.5.1.



3. Modbus –

The 2300 genset control contains data that can be read using a remote device communicating with the 2300 control via Modbus RTU (Remote Terminal Unit) protocol on a two-wire RS485 master/slave multi-drop bus. In this arrangement the remote device is the master and the 2300 control is the slave.

The modbus interface allows monitoring of all basic engine , alternator and other genset ‘Read Only’ parameters. Modbus interface will also allow for the writing to any parameter which is not considered to be a “factory setup” parameter, or is a “one time use” field setup parameter. Additionally the interface will allow for the remote starting and stopping of the genset.

Multi-Drop Network Mode		
PCC3300 Controller Pins		
Hi(+)	Lo (-)	Shield
TB15-3	TB15-4	TB15-1

The 2300 control is configured to communicate at a baud rate of 9600 using eight (8) data bits , one stop bit with none parity. Of these the baud rate and parity are configurable.

Baud Rate Options – (2400 / 4800 / 9600 / 19200 / 38400)
Parity Options (None / Odd / Even)
Number of Stop bits – Non configurable as the controller is in RTU mode.

The control provides the ability to read all Read Only and Read/Write registers in the Modbus Registers Table via the Holding Registers function. From 1 to 40 contiguous registers can be read at a time.

Register Mapping -
The convention for register map addresses is as follows -

40xxx -- Genset control registers
400xx -- General data registers (voltage, current, etc) primarily for genset

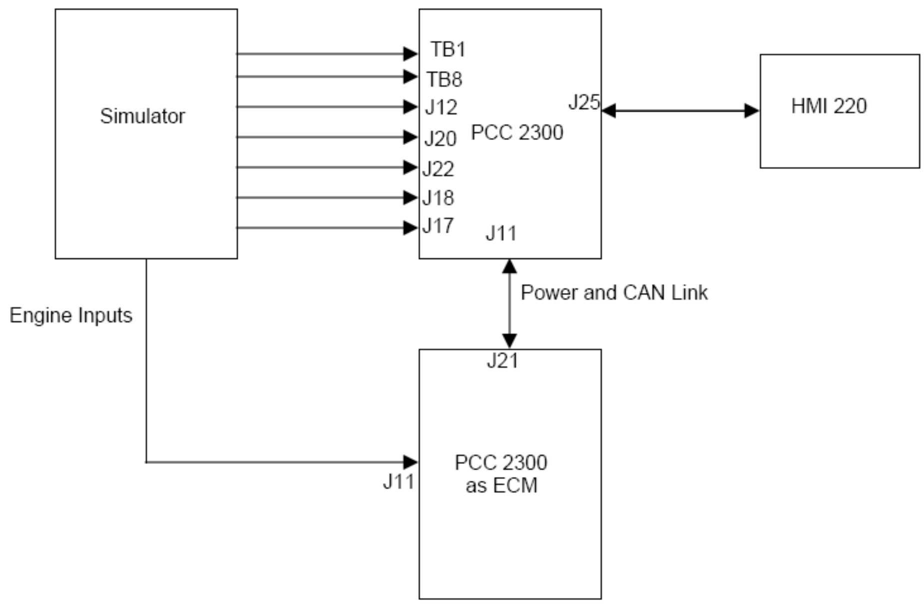
43xxx – Genset setup and data registers
46xxx – Genset setup and data registers

4x0xx, 4x1xx, 4x2xx, 4x5xx, 4x7xx Read Only parameters
4x3xx, 4x6xx, 4x8xx, 4x9xx Read/Write parameters
4x4xx -- Fault Bitmaps

MODBUS register mapping document is available at "pgaxcdfs01\depts$\ ibecpe \ PCC3300 \ Application Guide"

4. Simulator Setup –
4.1 PHASE 1:

The PCC3300 simulator setup is available with Universal Simulator system. The release-1 control requires two different 2300 boards, one working as ECM connected to other on CAN link
as release-1 does not support 'Hydro-Mechanical' system. The connection scheme for simulator is shown below.



Part Numbers for Simulator Setup –

Simulator : 0300-5461

PCC3300 : 0327 -1636

HM ECM :

Simulator Harness : 0338-5194

HMI 220: 0300 -6314-02

Following settings are required for simulator setup –

Simulator Calibration – 142 flywheel teeth

Control Calibration

Genset Frequency – 60 Hz

Genset Nominal Voltage – 190 (L-L)

Genset PT primary voltage – 600 V

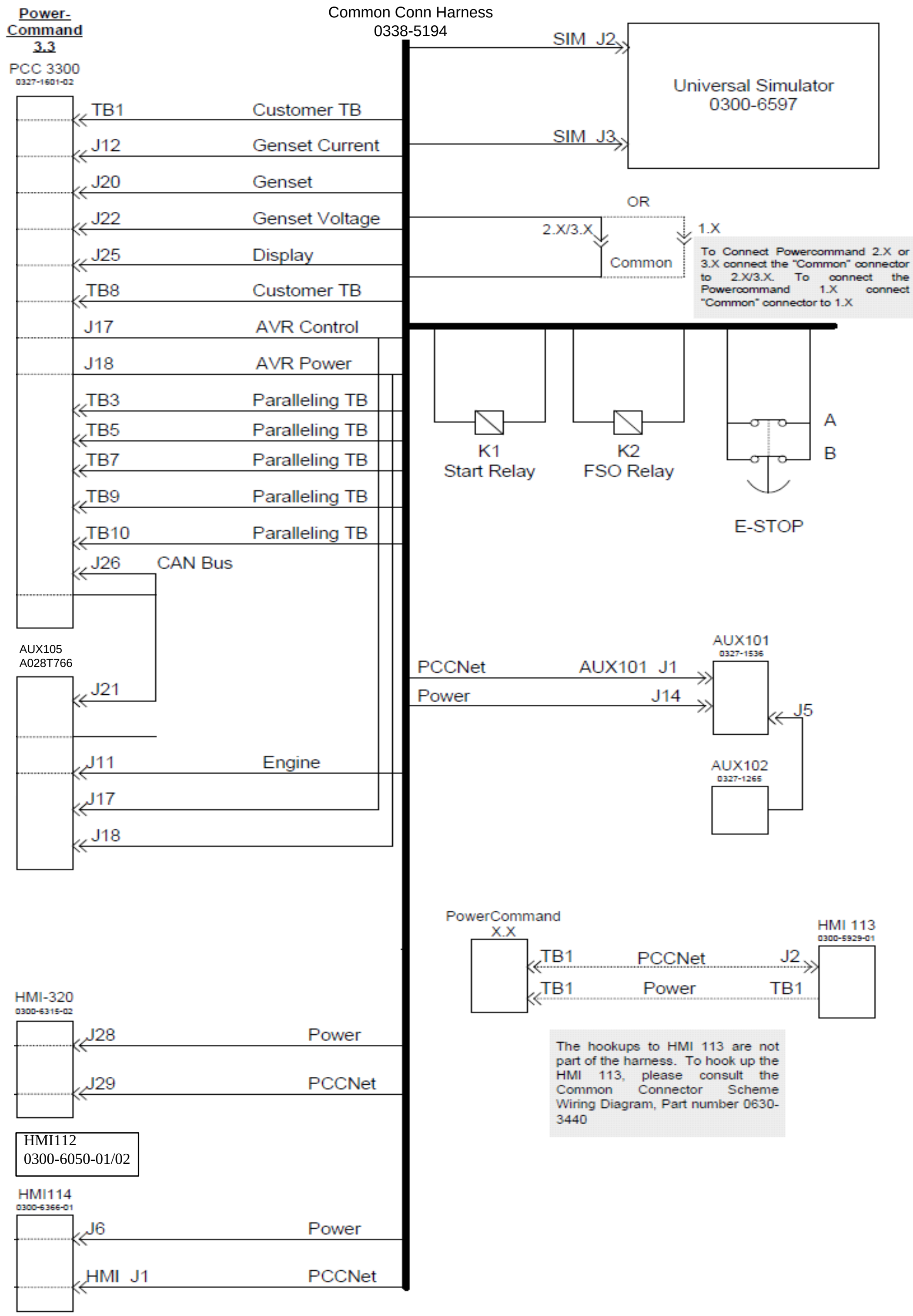
Genset PT secondary voltage – 240 V

Appropriate CT ratio corresponding to genset KVA rating.

ECM CAN – Enable

PMG/Shunt Excitation - Shunt

5.2 PHASE 2:



AUX105 and PCC 3300 Simulator System Setup

Part Numbers for Simulator Setup –

0327-1601-02 PCC3300 Control

0300-6315-02 HMI 320

0338-5194 Harness

A028T766 - HMECM Board

*Aux105 doesn't go to sleep until a Relay is added to isolate Key Switch Low side driver output of PCC3300 from Key switch discrete input of AUX105.

1. Updating of the Wedge Simulator Software is supported via the InPower.

2. Update the PCC3300 Software.
3. Update the Aux105 Software

4. Following settings are required in PCC3300 for simulator setup –

Setup Mode Enable - Enabled

AVR PWM Command PGN65425 Enable – Enabled

Genset primary CT Current – 5500

Teeth Pulses Per Revolution 142

Standby kVA rating (3 phase/ 60Hz) 500.0 (To run at 60Hz)

Standby kVA rating (3 phase/ 50Hz) 500.0 (To run at 50Hz)

Crank Exit Fuel Duty Cycle 50.0

Glow Plug Enable – Enabled (If needed)

Genset Nominal Voltage 208V (Normally it is the default setting)

Save Trims

Setup Mode Enable – Disabled

5. **After calibrating PCC3300, if there's a Short Circuit Fault Occurring and not clearing,
The fault can be cleared in following steps.

Factory Test Mode Enable	Enabled
Calibration NVM Lock	Unlocked
Load Default Calibration Command	Load Default Values
Save Trims	

6. Give Power Cycle to the system.

Controls Comparison –

Refer the file "Corporate controls.mdb" for comparison data with controllers 1301, 2100, 3100, 3200 available at "Commercial and ESB Genset Controls Database / Corporate Control Comparison".

Do we need to update this too for AUX105?

Certifications

The PCC3300 control meets or exceeds the requirements of the following codes and standards:

(The connector seals indicated in the connector seals sections above are required).

UL:

UL 508 Recognized marked

UL NRGU

AmpSentry protective relay certified

CSA:

CSA marked

C282 compliant

22.2 compliant

NFPA:

NFPA 99 compliant

NFPA 110 compliant

- Requires added components (Annunciator)

Mil Standard:

MS 202C, Method 101 compliant

IEEE:

C62.41 compliant.

C37.90 compliant.

ISO:

BS 7698-4:1993, ISO 8528-4:1993 compliant

Emission Performance Requirement:

EN50081-1 (1992)

EN50081-2 (1992)

EN61000-6-4(2001)

Immunity performance requirements:

EN 50082-1 (1997)

EN 50082-2 (1997)

EN 61000-6-2 (2001)

CE Marking: The control system is suitable for use on generator sets to be CE-marked.

Reference

For additional information refer the SYDD copies available at “pgaxcdfs01\depts$\ ibecpe \ PCC3300 \ SyDD Copies For Reference Only \ 6-27-07 snapshot.

Analog Inputs – Refer PCC3300_AnalogInputs.doc

Analog Output – Refer PCC3300_AnalogOutputs.doc

Configurable / Discrete Inputs – Refer PCC3300_DiscreteInputs.doc

Configurable / Discrete Outputs – Refer PCC3300_DiscreteOutputs.doc

CAN datalink , Kew Switch logic – Refer PCC3300_J1939ECMCAN.doc

RTC (Real Time Clock), Exercise Scheduler – Refer PCC3300_DataRecording.doc

MODBUS – Refer PCC3300_Modbus.doc

Revision History:

Revision 1 – Initial release of paralleling content only, single genset data has not been updated.

Revision 2 – ??

Revision 3 – Added section under Paralleling/Load Share concerning the load sharing compatability between PCC3xxx controls.

Revision 4 – Added AUX105 related information

Revision 5 – Added PTC Operating Sequence drawings

Revision 6 – Added note regarding PTC Mode switch

Revision 7 – Added HMI320 information

Revision 1.4 – Changed revision to match Version Manager revision number. Added material for Paralleling Compatibility, and Paralleling of Non-Cummins and Cummins gensets.