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1. Introduction

The Cabin Control Display (CCD) is the user interface/controller for the Dynasys Auxiliary Power and Climate Control Unit (APCCU). The Auxiliary Power Unit (APU) is a self-contained, stand-alone power generator for use with class 8 trucks which provides both 120VAC power for the CCU as well as 12VDC recharging for the Truck's batteries while in operation. The Climate Control Unit (CCU) [or HVAC system] provides climate control for the truck bunk. Additional items or features include optional single duplex 120VAC convenience outlet, optional Power Distribution Center (PDC) with dedicated circuit breakers. The Dynasys system uses the truck's diesel fuel supply and 12VDC battery source. This system does not require the usage of the trucks cooling and A/C system. The Dynasys APCCU provides significant fuel savings, reduction of truck engine wear, reliability, increased driver comforts, and legislative compliance.

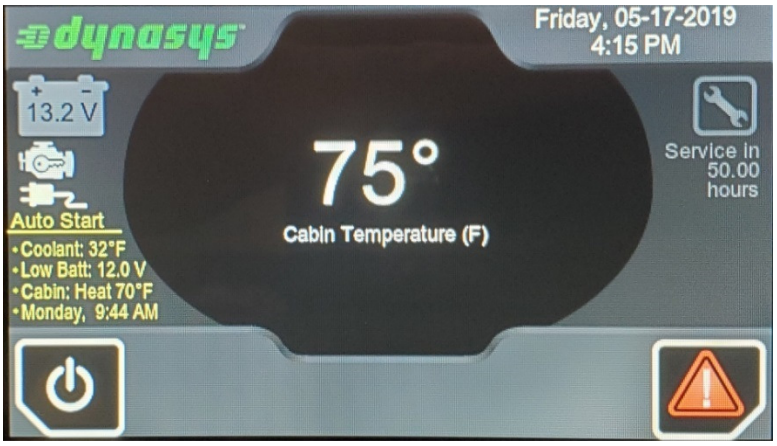
The Cabin Control Display mounts inside the truck cabin and provides the user with convenient interface controls for cabin temperature, monitor APU engine activities and outputs, Service History, Active/Historical Alarm Faults, and Automatic Starting Controls. On the back of the CCD, the 6-pin connector houses the cabin temperature sensor and the 12-pin connector is for Power and a CAN-Bus connection to the APCCU control module. This CAN-Bus connection is the communication link between the Display and Controller but also allows for the system to be updated with any future software updates and monitor the APCCU's full performance status for diagnostic purposes.

2. Display Unit

The Cabin Control Display is the interface for the operator to control the Dynasys APCCU. There are 8 buttons on the display. All of them are soft buttons meaning that their functionality will vary based on which screen you are on or what conditions exist so a quick visual guide at the bottom of the screen indicates what the button will do for each screen. The 4 navigation buttons in the middle are generally used to move up/down/left/right on the screen most of the time. If their functionality is not for navigating the screens, then that alternate functionality will be displayed for the operator.

The following sections describe how the Cabin Control Display controls for the Inactive Screen, Main Screen, Menu Screen, Engine Status Screen, Service Screen, Active Alarms Screen, Alarm History Screen, Password & Secure Settings Screen, and About Screen.

3. Display – Inactive Screen



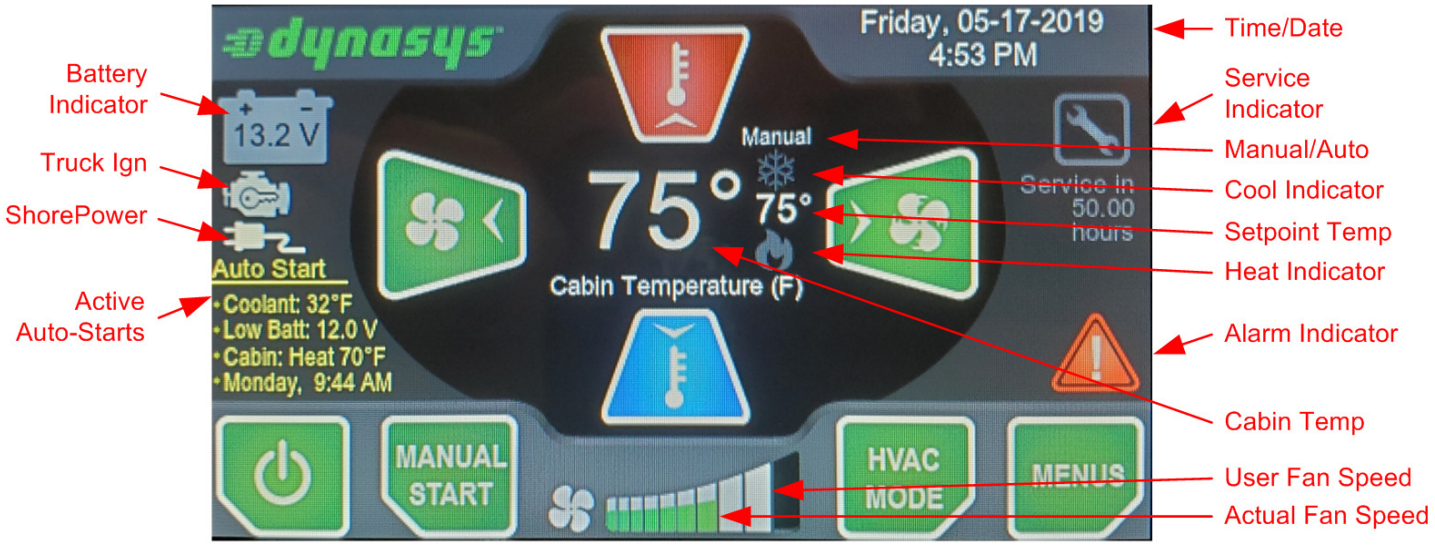
The Inactive Screen is displayed when the Power button is pressed on the Main screen or from power-up of the system. All functions are disabled in Inactive Mode (except for Low Battery AutoStart).

The Inactive screen can show the Battery Voltage, Shore Power, Truck Ignition, and Auto-Start options are displayed on the left side of the screen. The Cabin Temperature is display in the middle of the screen. And Date/Time, hours until the next Scheduled Service, and Active Alarm Faults are displayed on the right side of the screen.

Push the Power button on the far left to Activate the system and go to the Main Screen. If any Alarms/Faults are active, the Alarm Button will be displayed in the lower right corner which the operator can press to go directly to the Active Alarms Screen. If no button is pressed after the pre-defined time(s) configured in the Display Settings Menu, the screen will step into a Screen Saver / Standby Mode. Press the down button to wake up the system and return to the inactive screen.

All AutoStart functions are disabled in Inactive mode with the exception of the Low Battery Auto-Start feature which is allowed to start the APU so that it can charge the batteries back up.

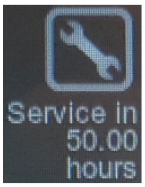
4. Display – Main (Active) Screen



The Main (Active) Screen is displayed when the System is turned on and active. All major functionality of the APCCU and status information is displayed conveniently on the main screen for the operator.

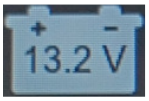
Like the Inactive Screen, if no button is pressed after the pre-defined time(s) configured in the Display Settings Menu, the screen can step into a Screen Saver / Standby Mode. Press the down button to wake up the system and return to the inactive screen.

Main (Active) Screen – General Status Indicators

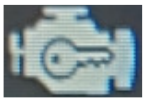


Service Indicator – The indicator is normally in GRAY and shows how many hours until the next service is due. When a service is due, this will high-light in YELLOW and show how long it has been overdue. You can easily go to the Service Menu screen by pressing the MENU button and go to the Service Menu (brought to the top when a Service is due as long as an Alarm is not active) to see what Service Maintenance Item(s) are due.

Alarm Indicator – This icon will appear when any Alarms are Active and need immediate attention. Press the Menu button and go to the Alarm Menu (brought to the top when an Alarm is active) to see what Alarm/Fault is active.



Battery Indicator – This icon in the top left corner shows the current battery voltage of the CCU.

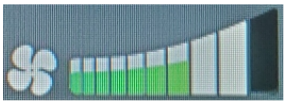


Truck Ignition Indicator – This indicator will show-up under the Battery Icon when the Truck Ignition is on.

Shore Power Indicator – This indicator will show-up under the Battery Icon when the CCU has been plugged into a 120VAC receptacle through the optional Shore Power unit.

Auto-Start Indicators – The list of any Auto-Start option(s) that are currently enabled will show up on the left side of the screen. The Auto-Start's text will change to RED when that specific Auto-Start is Active and requiring the APU to run.

Cabin HVAC Controls Indicator – The actual Cabin Temperature is displayed in the center of the screen for both the Active and Inactive Mode screens. Just to the right of the displayed value (Active Mode) is the setpoint temperature for the system as well as the heat(flame), cool(snowflake), or dual (both) symbols. Just above the Setpoint Temp, you will see the screen display either "Manual" for Manual HVAC Modes, or "Auto" for Auto-Start HVAC Modes. The Heat symbol turns red when the heater(s) are On and gray when the heater(s) are Off. Likewise the Cool symbol will turn blue when the A/C is On and gray when A/C is Off.

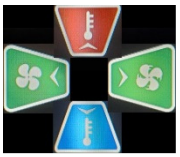


Fan Control Indicator – The 10-segment bar graph below the Cabin Temperature is the Fan Speed from minimum speed(left) to maximum speed(right). The larger white bars indicate the Users current Fan Speed Command for the system. The CCU will use this as the desired fan control speed unless forced or limited to different speed based on the Active Heating or Cooling HVAC mode. A smaller portion of the bars will fill in a different color to indicate the current fan speed setting driving the fan. That portion of the bars will be Green if actual fan speed is below the User Speed, Gray if equal to the User Speed, or Red if above the User Speed.

Button Operation

Power Button – Toggles the system between the ACTIVE and INACTIVE mode. NOTE: Please put the system into the INACTIVE mode first to force a complete save of all settings to memory before disconnecting power to the APCCU unit for service or storage.

Engine Button – Toggles control of the engine between Auto-Start and Manual control. If the Engine is already running because an Auto-Start feature is active, then this button will be to "Go To Manual" and "Exit Manual" control. If the engine is Off, then this button will be to "Start Engine" or "Stop Engine" and the Status of the Engine can been seen in the Button box on the screen. **E-STOP Function:** Press and hold the Engine Button for 2 seconds for E-STOP, press and hold again for 2 seconds to release the E-STOP.

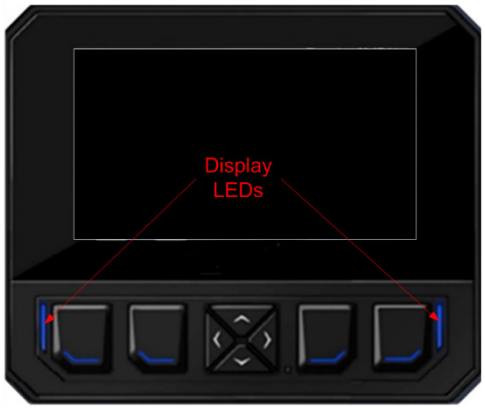


Navigation Buttons – Press **Left**(Decrease) or **Right**(Increase) to change the Users Fan Speed setting. Press **Up**(Increase) or **Down**(Decrease) to change the Setpoint Temperature (displayed in the center of the screen) for the active HVAC mode, when done there is a 5 second delay for the setting to be locked in.

HVAC Button – If the Engine was manually started, this will toggle between the Manual_**OFF/HEAT/COOL/DUAL** HVAC modes. Otherwise this will toggle between the AutoStart_**OFF/HEAT/COOL/DUAL** HVAC modes.

Menu Button – This will go to the Main Menu Screen.

5. Screen Saver



ACTIVE SCREEN: From the last button press, the Screen will stay at the Active Brightness for the length of the Active Duration time and go to Inactive.

INACTIVE SCREEN: The screen will go to the Inactive Brightness for the length of the Inactive Duration time and then go to Screen-Off. Any button press during this time will bring it back to an Active Screen.

SCREEN-OFF: The screen will go blank and the LED's on either side of the buttons will flash GREEN every 5 seconds for the length of 5 minutes and then go to Stand-by. Any button press during this time will bring it back to an Active Screen.

STAND-BY: The entire display will shut-down into Stand-By to conserve energy and will wake up every 5 seconds just to check status's and flash the LED's RED/GREEN. Once in this mode you must press Down-Button to wake up the display and bring it back to the Active Screen.

The Brightness and Duration of the Active and Inactive Screens can be configured in the Display Settings Menu.

6. Main Menu Screen

The Main Menu Screen will display when you press the far right button to access the Menu. If everything is running fine the menu to the left is displayed.

QUICK ACCESS TO SERVICES AND ALARMS
If any Services are due but no alarms are active the Service menu is brought to the top of the list as the first item selected. If any Alarms are active, then the Active Alarms Menu is brought to the top of the list. This provides the operator with a single button double-press option to immediately view any alarms or services that need the operator's attention.

7. Engine Status Screen

The Engine Status Screen gives the operator real-time feedback of the APU Engine sensors, the Generator output Status, and the outputs controlling the APU. This is just a status screen so no actions can be taken.

Screen 1

Engine Hours – Total Hours the APU Engine has run
Cover Sw: Switch opens if cover is not properly installed
Coolant Level Sw: Switch opens if coolant is too low
Low Oil Pressure Sw: Switch closes if Low Oil Pressure
Coolant Temp: Verifies Reading is Inside or Outside Valid Range

Screen 2

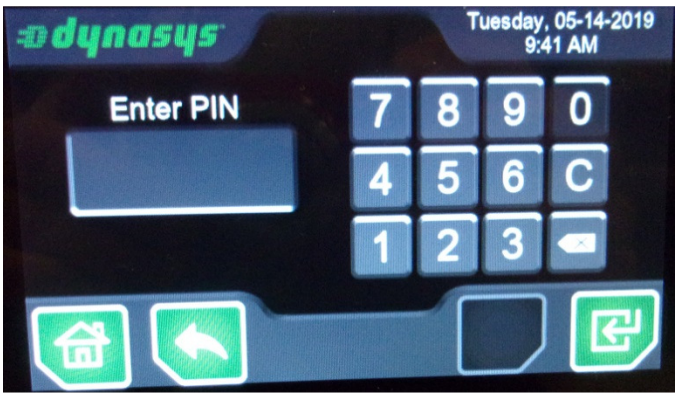
Engine Temp: Engine Coolant Temperature (either in °F or °C)
Generator Frequency: Frequency of 120VAC power
Generator Engine RPM: RPM Calculated from Generator Frequency
Engine Speed Sensor: RPM measured by Engine Speed Sensor
Compressor: Output status for the DC Compressor

Screen 3

Starter Relay (K1): Output Status
Alternator: Output Status
Fan Relays (K4 & K5): Output Status
Glow Plug Relay (K3): Output Status
Fuel Pull Relay (K2): Output Status
Fuel Hold Relay: Output Status
Fuel Pump: Output Status

8. Settings Screen

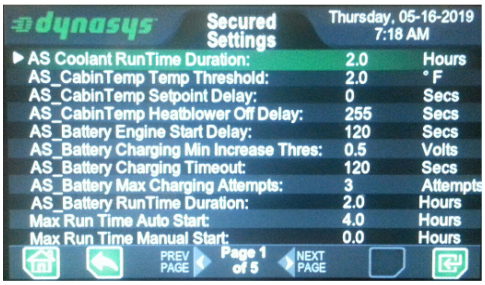
Auto Start – Configure the Time, Coolant Temp, and Low Battery Auto-Start features
Clock – Set Year/Month/Hour/Min and Time Format
Display – Active/Inactive Brightness and durations
Temp Units – Choose to display temps in °F or °C
Language – Choose language (Only English so far)
Secured Settings – Service Technician accessible configurations and settings.

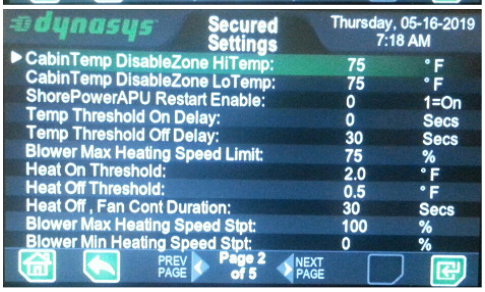


To gain access to the settings in the Secured Settings, the Service Technician needs to enter a valid 4-digit PIN# into the display. Use the Navigation buttons to select each value and press the enter button(far right). Once the 4th digit is entered the PIN# will be verified against the programmed PIN# in memory.

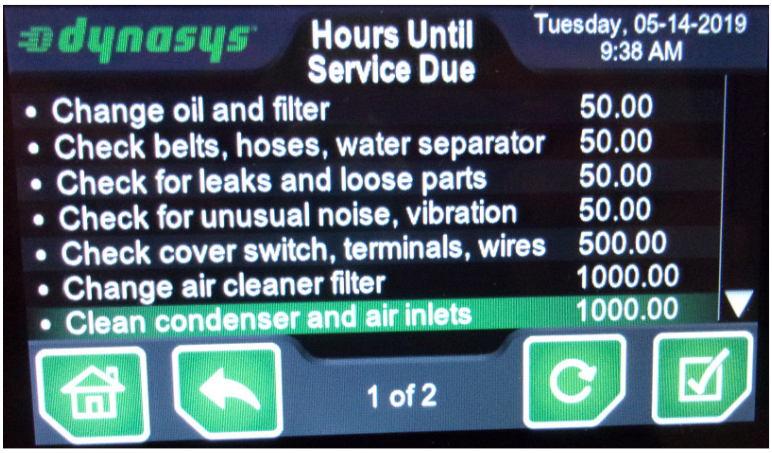
The system comes with a factory default PIN# in memory but once in the Secured Settings Menu the operator can change this to a new PIN# if desired.

Continuing to the Secured Settings screen will show all of the configurable values available in the APCCU controller regarding operation of the Auxiliary Power Unit and Climate Control Unit. These values are critical to the proper operation of the unit and anyone that makes changes to these values must know what they are doing and how it will affect the operation of the system. (A full list of all Variables and Settings Minimum Value, Maximum Value, and Default Value is available at the end of the document)





9. Service Screen



The service screen shows each service item and the remaining amount of Engine Hours left until the next service is due for each. The hours will count down when the APU is running.

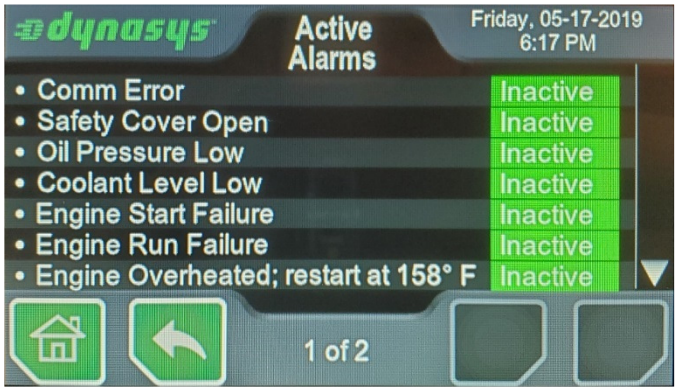
RESETTING SERVICE HOURS

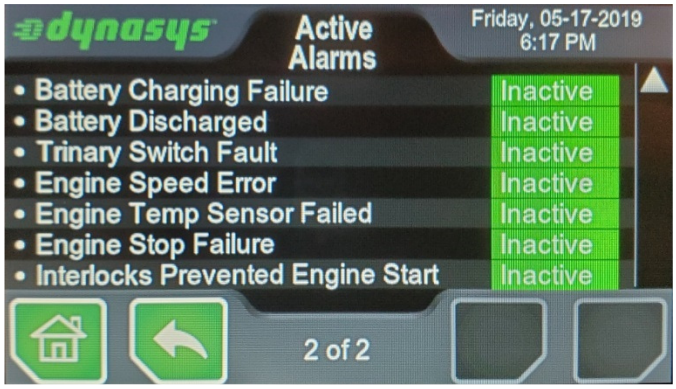
Use the Up/Down buttons to Highlight/Select the desired service item that you want to reset and then press the Check Mark button. This will reset the Service Item to the next service level per the chart below:

Service Reminders		Total Operating Hours							
		50	500	1000	2000	3000	4000	5000	6000
Page 1	Change Engine Oil & Filter	x		x	x	x	x	x	x
	Check Belts, Hoses, & Water Separator	x	x	x	x	x	x	x	x
	Check for Leaks & Loose Parts	x	x	x	x	x	x	x	x
	Check for Unusual Noise & Vibration	x	x	x	x	x	x	x	x
	Check Cover Switch, Terminals, & All Wiring		x	x	x	x	x	x	x
	Change Air Cleaner Filter			x	x	x	x	x	x
	Clean Condenser and Air Inlets			x	x	x	x	x	x
Page 2	Change Fuel Filter				x		x		x
	Change Engine Coolant				x		x		x
	Check Engine Speed				x		x		x

10. Active Alarms Screen

The Active Alarms screen will show the operator the real-time status of all available Alarm Faults on the Dynasys APCCU controller. This is just a status screen so no actions can be taken.





Screen 1

Comm Error – Communication between the Display and Controller has been interrupted/lost.
Safety Cover Open – The cover on the APU unit is not in place or latched down properly.
Oil Pressure Low – The APU's Engine Oil Pressure is Low when Running. (Engine will Shutdown)
Coolant Level Low – The coolant level in the APU is low.
Engine Start Failure – The Engine failed to start properly and is shut down. (Check other active Faults for the reason)
Engine Run Failure – The Engine encountered a problem while running and is shut down (Check other Faults for reason)
Engine Overheated; restart at 158°F – The Engine has reached the upper temp limit. If the temp rises a small margin past this it will shut down and not be allowed to start again until the temperature drops under 158°F.

Screen 2

Battery Charging Failure – While running, the battery voltage failed to charge up to an acceptable level.
Battery Discharged – The battery voltage has fallen below an acceptable level. (The APCCU functionality is disabled)
HVAC Pressure Circuit Fault – APCCU is trying to run the Compressor but the HVAC Pressure Circuit has turned it off.
Engine Speed Error – The 120VAC feed from the APU is missing or outside of the allowed frequency range.
Engine Temp Sensor Failed – The signal from the Engine Temp Sensor is outside of the valid range. (Open / Shorted)
Engine Stop Failure – The Engine failed to stop properly (Check other faults for reason)
Interlocks Prevented Engine Start – The Engine was not allowed to start because one or more interlocks were not met.

Screen 3

Water Valve Fault – Feedback signal from WaterValve is missing or valve did not achieve target position.

11. Alarm History Screen

The Alarm History Screen shows a history of faults that have occurred along with a timestamp of when the fault occurred up to a total of 20 faults. General Engine Failures may also be accompanied by additional faults at the same time indicating the reason for the general fault.

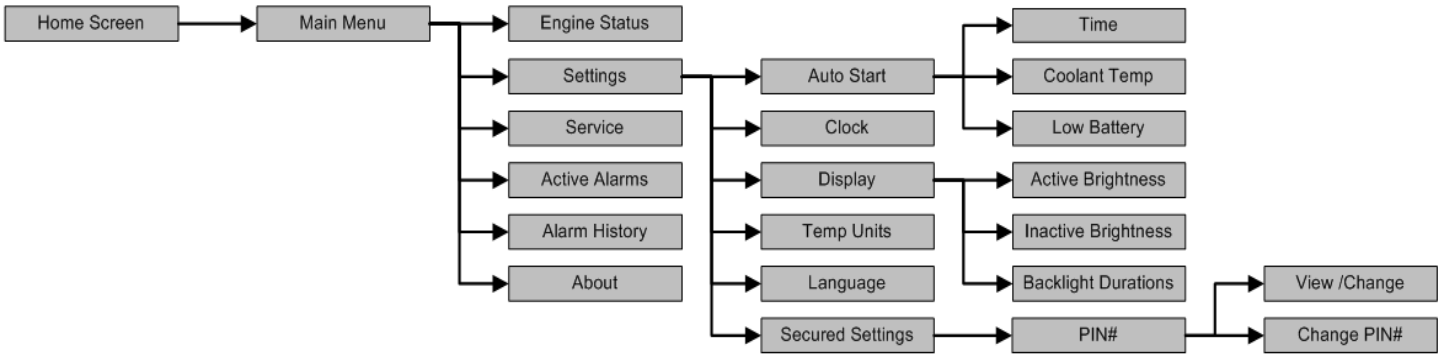
ERASING ALARM HISTORY

Press the erase button on the far right to erase the entire Alarm History log. A confirmation request will pop-up to ensure this is the action you want to take.

12. About Screen

The about screen displays total number of hours the Engine has run on the unit as well as the Part Number and Revision of software installed in the Display and the APCCU controller. This is just a status screen so no actions can be taken.

13. Menu Screens Hierarchy



14. All saved values

The following is a list of all values stored by the APCCU. They are saved when the system is put Inactive.

PR#	Main Menu	Sub-Menu 1	Sub-Menu 2	VAR#	Parameter Name	Min	Default	Max	Units	Notes
1	Settings	About (or)	Engine Status		Engine Hours	0	0	214748364.8	Hours	
2	Settings	Clock			Year	2000	2019	2999	Year	
3	Settings	Clock			Month	1	1	12	Month	(1-12 = JAN-DEC)
4	Settings	Clock			Date	1	1	31	Date	
5	Settings	Clock			Day	1	3	7	Day	(1-7 = SUN-SAT)
6	Settings	Clock			Hour	0	0	23	Hour	
7	Settings	Clock			Minute	0	0	59	Min	
8	Settings	Clock			12/24h	0 (=12h)	0 (=12h)	1 (=24h)	Flag	(0=12h, 1=24h)
9					Unit_Model Number		all "0"		[Alpha-Numeric]	
10					Unit_Serial Number		all "0"		[Alpha-Numeric]	
11					APCCU_Model_Number		all "0"		[Alpha-Numeric]	
12					APCCU_Serial Number		all "0"		[Alpha-Numeric]	
13					Display_Model_Number		all "0"		[Alpha-Numeric]	
14					Display_Serial Number		all "0"		[Alpha-Numeric]	
15	Settings	Auto-Start	Time		AS TimerStart Enable/Mode	0 (=Off)	0 (=Off)	3	Flag	(0=Off, 1=Once, 2=Daily, 3=Weekly)
16	Settings	Auto-Start	Time		AS Timer Start Day	1	2	7	Day	(1-7 = SUN-SAT)
17	Settings	Auto-Start	Time		AS Timer Start Hour	0	8	23	Hour	
18	Settings	Auto-Start	Time		AS Timer Start Min	0	0	59	Min	
19	Settings	Auto-Start	Time		AS Timer RunTime Duration	0.1	2.0	24.0	hours	
20	Settings	Auto-Start	Coolant Temp		AS Coolant Temp Enable	0	0	1	Flag	(0=Off, 1=On)
21	Settings	Auto-Start	Coolant Temp		AS Coolant Cold Threshold	-40	20	35	degF	
22	Settings	Secured(PIN#)	View/Chng:Pg1:	v1	AS Coolant RunTime Duration	0.1	2.0	24.0	hours	
23	Home	HVAC Button (	If Engine Off)		AS CabTemp Enable/Mode	0 (=Off)	0 (=Off)	3	Flag	(0=Off, 1=Heat, 2=Cool, 3=Both)
24	Settings	Secured(PIN#)	View/Chng:Pg1	v2	AS CabTemp Temp Threshold	0.0	2.0	10.0	degF	
25	Home	Up/Down (If	HVAC = Heat)		AS CabTemp Heat Setpoint	32	70	90	degF	
26	Home	Up/Down (If	HVAC = Cool)		AS CabTemp Cool Setpoint	59	75	95	degF	
27	Home	Up/Down (If	HVAC = Dual)		AS CabTemp Dual Setpoint	59	72	90	degF	
28	Settings	Secured(PIN#)	View/Chng:Pg1	v3	AS CabTemp Setpoint Delay	0	15	600	Sec	
29	Settings	Secured(PIN#)	View/Chng:Pg1	v4	AS CabTemp Heat BlowerOff Delay	5	15	60	Min	(Changed in AX8)
30	Settings	Auto-Start	Low Battery		AS Low Batt Enable	0 (=Off)	0 (=Off)	1 (=On)	Flag	(0=Off, 1=On)
31	Settings	Auto-Start	Low Battery		AS Low 12V Battery Threshold	11.5	12.3	13.0	VDC	
32	Settings	Auto-Start	Low Battery		AS Low 24V Battery Threshold	23.0	24.6	26.0	VDC	
33	Settings	Secured(PIN#)	View/Chng:Pg1:	v5	AS Low Battery Start Delay	0	120	600	Sec	
34	Settings	Secured(PIN#)	View/Chng:Pg1:	v6	AS Charging Min Increase Thres	0.0	0.5	6.0	VDC	
35	Settings	Secured(PIN#)	View/Chng:Pg1:	v7	AS Charging Timeout	0	120	600	Sec	
36	Settings	Secured(PIN#)	View/Chng:Pg1:	v8	AS Max Charge Attempts	0	3	10	# Trys	
37	Settings	Secured(PIN#)	View/Chng:Pg1:	v9	AS_Batt RunTime Duration	0.1	2.0	24.0	hours	
38	Settings	Secured(PIN#)	View/Chng:Pg1:	v10	Max Run Time Auto Start	0.1	4.0	24.0	hours	
39	Home	HVAC Button (	If Manual Start)		Man CabTemp Enable/Mode	0 (=Off)	0 (=Off)	3	Flag	(0=Off, 1=Heat, 2=Cool, 3=Both)
40	Home	Up/Down (If	HVAC = Heat)		Man Heat Only Setpoint	59	70	90	degF	
41	Home	Up/Down (If	HVAC = Cool)		Man Cool Only Setpoint	32	75	95	degF	
42	Home	Up/Down (If	HVAC = Dual)		Man Heat/Cool Setpoint	59	72	90	degF	
43	Home	Left/Right			Man Fan Speed Setting	0	50	100	%	(Display offers steps of 10%)
44	Settings	Secured(PIN#)	View/Chng:Pg1:	v11	Max Run Time Manual Start	0.0	0.0	24.0	hours	(0=Disabled, Else x=RunTime)
45	Settings	Secured(PIN#)	View/Chng:Pg2:	v1	CabinTemp DisableZone HiTemp	32	70	95	degF	Same=Disabled
46	Settings	Secured(PIN#)	View/Chng:Pg2:	v2	CabinTemp DisableZone LoTemp	32	70	95	degF	Same=Disabled
47	Settings	Secured(PIN#)	View/Chng:Pg2:	v3	ShorePowerAPU restart Enable	0 (=Off)	0 (=Off)	1 (=On)	Flag	(0=Off, 1=On)
48	Settings	Secured(PIN#)	View/Chng:Pg2:	v4	Temp Threshold On Delay	0	0	600	Sec	
49	Settings	Secured(PIN#)	View/Chng:Pg2:	v5	Temp Threshold Off Delay	0	30	600	Sec	
50	Settings	Secured(PIN#)	View/Chng:Pg2:	v6	Blower Max Heating Speed Limit	0	70	100	%	
51	Settings	Secured(PIN#)	View/Chng:Pg2:	v7	Heat On Threshold	0	2.0	10	degF	
52	Settings	Secured(PIN#)	View/Chng:Pg2:	v8	Heat Off Threshold	0	0.5	10	degF	
53	Settings	Secured(PIN#)	View/Chng:Pg2:	v9	Heat Off , Fan Cont Duration	0	30	600	Sec	
54	Settings	Secured(PIN#)	View/Chng:Pg2:	v10	Blower Max Heating Speed Stpt	0	70	100	%	
55	Settings	Secured(PIN#)	View/Chng:Pg2:	v11	Blower Min Heating Speed Stpt	0	20	100	%	
56	Settings	Secured(PIN#)	View/Chng:Pg3:	v1	Cool On Threshold	0	2.0	10	degF	
57	Settings	Secured(PIN#)	View/Chng:Pg3:	v2	Cool Off Threshold	0	1.0	10	degF	
58	Settings	Secured(PIN#)	View/Chng:Pg3:	v3	Blower Max Cooling Speed Stpt	0	100	100	%	
59	Settings	Secured(PIN#)	View/Chng:Pg3:	v4	Blower Min Cooling Speed Stpt	0	30	100	%	
60	Settings	Display			Active Backlight Brightness	25	100	100	%	
61	Settings	Display			Active BackLight Duration	0	120	600	Sec	0=Always On, 1&up=Seconds)
62	Settings	Display			Inactive Backlight Brightness	0	50	100	%	
63	Settings	Display			Inactive BackLight Duration	0	120	600	Sec	0=Always On, 1&up=Seconds)
64	Settings	Language			Language	0 (=Eng)	0 (=Eng)	2	Flag	(0=English, 1=Spanish, 2=French, 3=...)
65	Settings	Temp Units			TemperatureUnit	0 (=°F)	0 (=°F)	1 (=°C)	Flag	(0=°F, 1=°C)
66	Settings	Secured(PIN#)	View/Chng:Pg3:	v5	AS_Batt Battery Type	0 (=12V)	0 (=12V)	1 (=24V)	Flag	(0=12V, 1=24V, 2=Auto?)

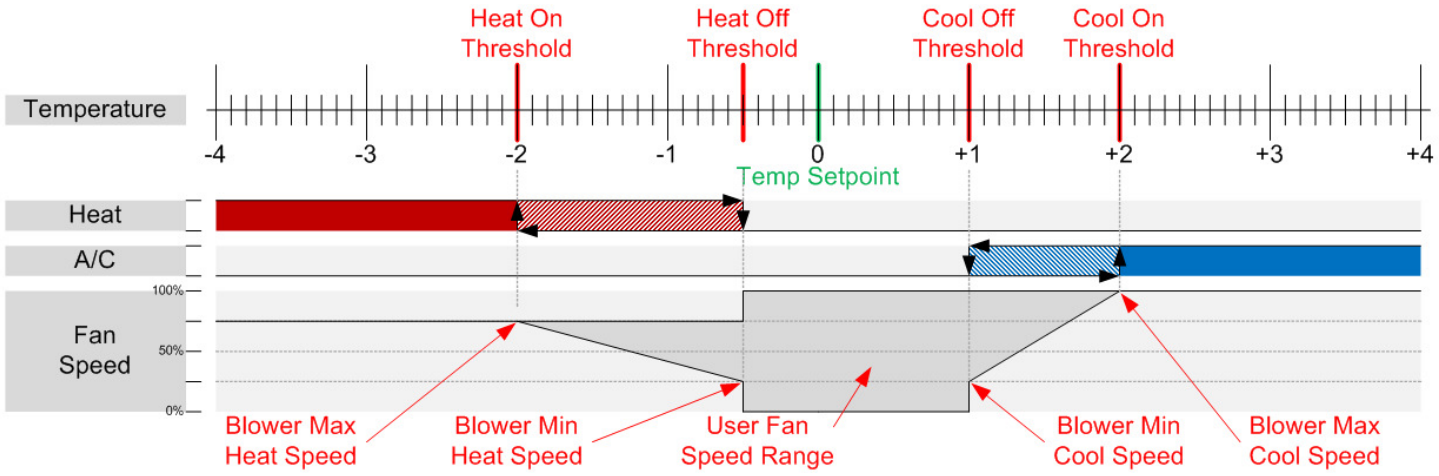
PR#	Main Menu	Sub-Menu 1	Sub-Menu 2	VA R#	Parameter Name	Min	Default	Max	Units	Notes
67	Settings	Secured(PIN#)	View/Chng:Pg3:	v6	EngSpd - Started RPM	200	800	8000	RPM	
68	Settings	Secured(PIN#)	View/Chng:Pg3:	v7	EngSpd - Min Running RPM	200	2000	8000	RPM	
69	Settings	Secured(PIN#)	View/Chng:Pg3:	v8	EngSpd - Min Running RPM	200	2725	8000	RPM	
81	Settings	Secured(PIN#)	View/Chng:Pg3:	v9	EngSpd - Number of Teeth per Rev	1	86	255	Teeth/Rev	
70	Settings	Secured(PIN#)	View/Chng:Pg3:	v10	EngSpd - Gen Freq to RPM scaling	1.0	4.0	40.0	RPM/Hz	
71	Settings	Secured(PIN#)	View/Chng:Pg3:	v11	GlowPlug Duration 14F	0	30	60	Sec	
72	Settings	Secured(PIN#)	View/Chng:Pg4:	v1	GlowPlug Duration 14to32F	0	30	60	Sec	
73	Settings	Secured(PIN#)	View/Chng:Pg4:	v2	GlowPlug Duration 32to50F	0	30	60	Sec	
74	Settings	Secured(PIN#)	View/Chng:Pg4:	v3	GlowPlug Duration 50to86F	0	3	60	Sec	
75	Settings	Secured(PIN#)	View/Chng:Pg4:	v4	GlowPlug Duration 86F	0	0	60	Sec	
76	Settings	Secured(PIN#)	View/Chng:Pg4:	v5	EngRunSol Pull Coil Duration	0	1	10	Sec	
77	Settings	Secured(PIN#)	View/Chng:Pg4:	v6	Starter Relay Timeout	0	2	10	Sec	
78	Settings	Secured(PIN#)	View/Chng:Pg4:	v7	Max StarterRelay Typ Duration	0	15	30	Sec	
79	Settings	Secured(PIN#)	View/Chng:Pg4:	v8	Max StarterRelay Cold Duration	0	30	30	Sec	
80	Settings	Secured(PIN#)	View/Chng:Pg4:	v9	StarterRelay DurColdTempStpt	-40	32	100	degF	
82	Settings	Secured(PIN#)	View/Chng:Pg4:	v10	ECM Restart Delay	0	10	300	Sec	
83	Settings	Secured(PIN#)	View/Chng:Pg4:	v11	Consec Start Attempts	0	3	10	# Trys	0=No Limit
84	Settings	Secured(PIN#)	View/Chng:Pg5:	v1	Oil Pres Alarm Delay (Starting)	0	10	10	Sec	
85	Settings	Secured(PIN#)	View/Chng:Pg5:	v2	Oil Pres Alarm Delay (Running)	0	2	10	Sec	
86	Settings	Secured(PIN#)	View/Chng:Pg5:	v3	Engine Max CoolantTemp	-40	104	210	degC	
87	Settings	Secured(PIN#)	View/Chng:Pg5:	v4	Engine Cooling Fan Duration	0	90	600	Sec	

15. Operation of the Climate Control

The APCCU Climate Control Functions are not allowed to operate when the System is Inactive (with the exception of Low-Battery Auto-Start if enabled). Push the power button on the far left to Activate the system.

Manual HVAC Control – When the system is active you can press the "Start Engine" button to start the APU and then press the "HVAC Mode" button to select between the Heat Mode, Cool Mode, Dual Mode, or Off(Fan Only). Pressing the Up/Down buttons will change the Setpoint Temperature for the current mode (If not Off). Press the Left/Right buttons to change the User Fan Speed setting. The system will then use the selected HVAC Mode, Setpoint Temperature, and User Fan Speed along with the Secured Settings (shown in Red Text) to turn On/Off the Heating and/or Cooling, and drive the Fan to the highest of either the User Fan Speed (when not limited during Heating) or the Setpoint Fan Speed based on the difference between the Actual Cabin Temperature and Setpoint Temperature per the following diagram. (This excludes the effects of any associated time delays for this functionality)

CLIMATE CONTROL FUNCTIONAL DIAGRAM - Heat, Cool, and Blower Fan states per default values



16. Operation of the Auto-Start Functions

The APCCU Auto-Start Functions are not allowed to operate when the System is Inactive (with the exception of Low Battery). While the system is Active and the Auto-Start Functions are enabled they will operate per the following list. All Auto-Start functions can be aborted by putting the System into the Inactive State or activating E-STOP.

Time Start – Set and Configured in the Auto-Start Settings Menu, this can start the APU either Once, Daily, or Weekly at the defined Day / Time and remains running for the pre-defined duration (0.1 to 24.0 hours) in the Secured Settings.

Coolant Temperature – Set and Configured in the Auto-Start Settings Menu, this starts the APU if the Engine Coolant Temperature drops below the defined threshold (adjustable from -40 to 35 °F) and remains on for a pre-defined duration (1 to 60 minutes) in the Secured Settings.

Cabin Temperature – Set and Configured from the Main Screen when the Engine is Off, this starts the APU if the Cabin Temperature drifts away from the defined Setpoint Temperature more than the defined Heat/Cool Threshold differential (after a set delay time). It will run Heating or Cooling to bring the Cabin Temperature back to the Setpoint Temperature. Once there Heating and Cooling will turn off and the Blower will run for the defined Fan Continuation Duration time at which time the system will turn back off.

Low Battery – Set and Configured in the Auto-Start Settings Menu, this starts the APU when required to maintain a minimum voltage level for the truck battery. If the Battery voltage is below the threshold for the Low Battery Auto-Start can be (adjustable from 11.5 to 13.0 VDC [12V Battery] or 23.0 to 26.0 VDC [future 24V Battery option]) for longer than the defined Low Battery Timer, the APU will start up to charge the battery for a pre-defined duration. If the Battery Voltage does not begin to increase sufficiently after starting, the APU will shutoff, pause for a few seconds, and then the APU will try starting and charging the battery again for up to the maximum define Battery Charging Attempts. If unsuccessful the APU will stop trying and the Battery Charging Failure Alarm will turn on.

17. Shore Power Mode

The APCCU enters Shore Power Mode whenever shore power (external 120VAC source) is connected to the system. If the APU is running and shore power is connected, then the APU engine will turn off, the Main Screen will display the Shore Power Icon, all Auto-Starts are ignored, and Manual Temperature control is enabled. When connected to shore power only Heater 1 is allowed for current limitation reasons. From the secured settings the operator can enable or disable the ability to manually re-start the APU engine while in Shore Power Mode. When shore power is disconnected the APCCU will return to Active Mode with no HVAC active and Auto-Starts are functional.

18. Truck Ignition Interlock

The APCCU is interlocked with the Truck Ignition switch to prevent the APU from running while the truck engine is on. There are two exceptions; the Low Battery Auto-Start and Coolant Temperature Auto-Start functions are the only instances that will allow the APU to run while the truck is on. If the truck engine is on, the Main Screen will display the Truck Ignition Icon and prevent the APU from being Manually Started.

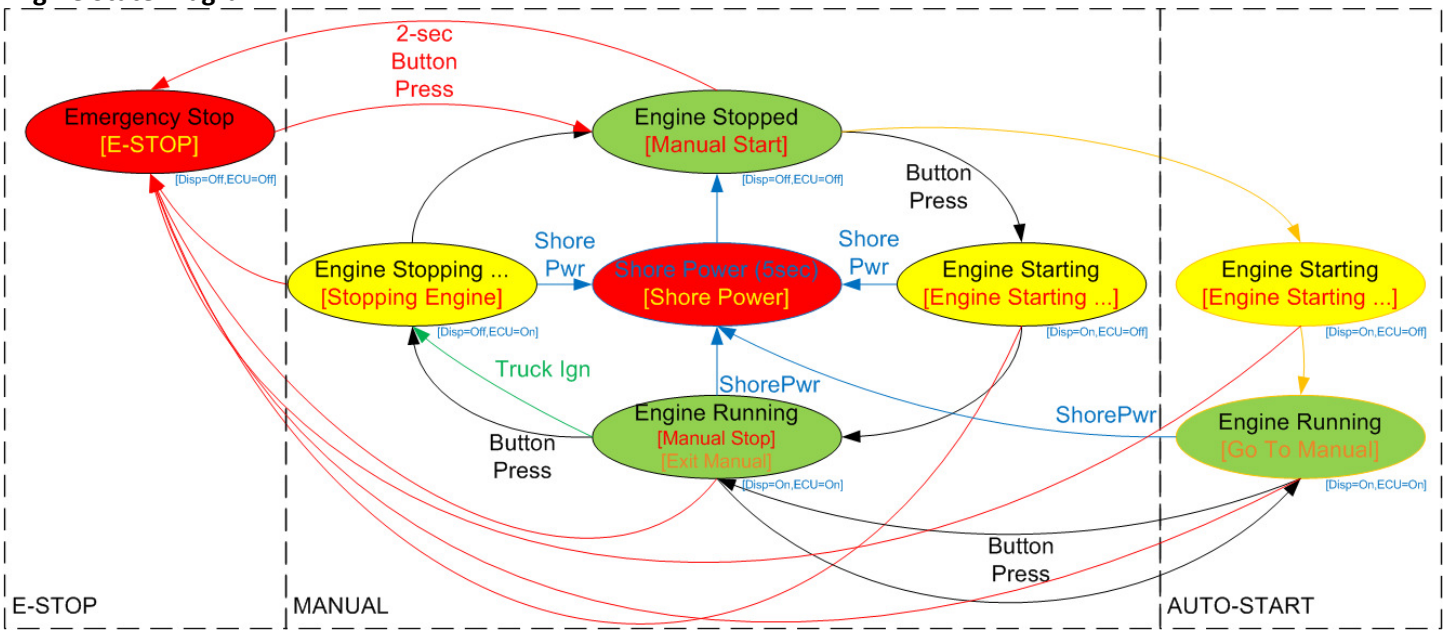
19. E-STOP Feature

The APCCU is programmed with an available E-STOP feature. Press and hold the Engine Button for at least 2 seconds (regardless of the Engine or Buttons operational state) to enter the E-STOP mode. This forces the engine to immediately shut down and locks it Off while E-STOP is active and any Auto-Start conditions that were Active will be deactivated. When E-STOP mode is no longer needed the operator must press and hold the Engine Button again for at least 2 seconds to deactivate E-STOP mode. Normal operation of Manual Start and all of the Auto-Start options to start the engine are then allowed again.

20. Engine Controls

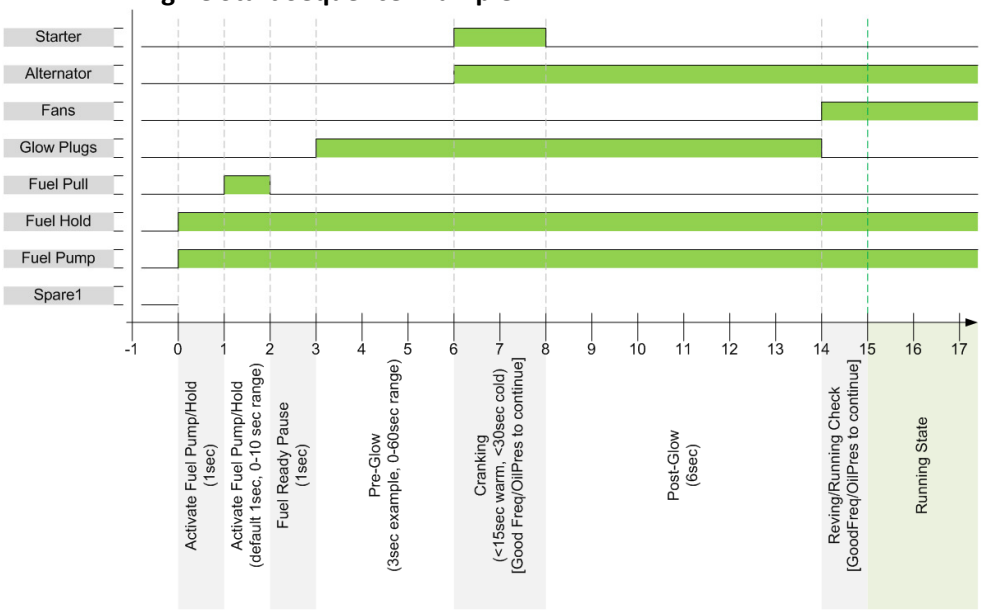
The APU Engine is controlled by the APCCU. In Manual Control the operator can press the Engine "Manual Start" button to turn the APU Engine On and the Engine "Manual Stop" button to turn the APU Engine Off. The APU Engine can also be started by one of the Auto-Start functions and after running its pre-determined time will turn the APU Engine back off. While an Auto-Start function is active, the APU Engine button can be used to toggle Engine Mode between Manual and Auto (If active). The Truck Ignition input and Shore-Power connected input can force the APU Engine Off when not needed. Below is a state diagram for operation of the Engine Modes. The Button Text for the current state in the diagram is shown in the square brackets [].

Engine State Diagram

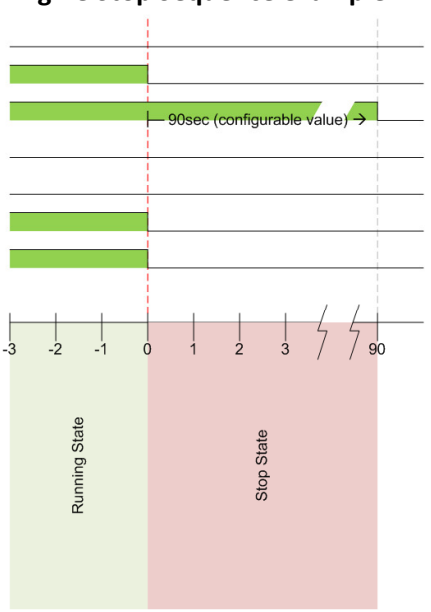


Starting and Stopping of the APU engine follows a pre-defined sequence controlled by the APCCU. The diagram below is an example of that process:

Engine Start Sequence Example



Engine Stop Sequence example



21. Troubleshooting Tips

CCD is blank	• **Screen might be in low power mode. Watch for the side LEDs to flash briefly every 5 seconds indicating it's still active but in low power mode. Press the down button to wake the display up.** • **No power (Logic) to the APCCU.** o **Check that the Display cable is properly connected between the APCCU and the CCD.** o **Check that 12V power is connected to APCCU on J2 pin-1** o **Check that the Disconnect is in the closed position** o **Check the 12V 5A fuse to the APCCU is good** o **Truck battery may be completely discharged or too low to run**
APCCU system is on, but no outputs are functional	• **No Power (Output) to APCCU.** o **Check that 12V power is connected to APCCU on J2 pin-3** o **Check that the Disconnect is in the closed position** o **Check the 12V 30A fuse to the APCCU is good**
APCCU shows the error "COMM ERROR"	• **Communication link between the CCD (Display) and APCCU (Controller) is not functioning. Check that the Display cable is properly connected between the APCCU and the CCD. The communication link between the two units is not functioning.**
APU won't start (CCD goes blank, resets and system is in Inactive Mode)	• **The truck battery is not sufficiently charged to keep the APCCU powered up thru the APU start sequence. Charge the battery by running the truck engine or connecting to Shore Power.**
APU won't start (Disabled or Interlock Fault)	• **The Truck Ignition may be on. Check if the Engine w/ Key symbol is on the Main Screen showing Truck Ignition is On.** • **Shore Power may be connected and APU restarts are disabled. Check if the 120V Plug symbol is on the Main Screen showing Shore Power is connected.** • **The Disable Temperature Zone setup by a Service Tech may be preventing the APU from running if outside the defined range.** • **Engine Start Delay may be active after just stopping and APU is waiting for configured length of time before re-starting again.** • **Check the Active Faults Screen for anything that would disable the engine:** o **An Engine Start, Run, or Stop Fault has occurred (see below)** o **Engine may have Overheated and shutdown to cool.** o **Engine Charge Fault may be active.** • **Check the Engine Status Screen for any of the following conditions:** o **Cover Switch is Open. Verify Cover is installed on APU properly.** o **Coolant Temperature Sensor failed. Check/Replace sensor.** o **Coolant Level may be low. Check/Refill coolant.** o **Engine Oil Pressure Sensor Input may not indicate low oil as expected.**
APU won't Start (Engine Start Failure)	• **If also Low Oil Pressure Fault – Engine Oil Pressure did not come up as expected during the start-up sequence.** • **If no other fault present with Engine Start Failure, possible causes are:** o **Right after Cranking – Starter ran too long** o **Engine Revs and Faults – Generator Input Sporadic or not detected.** *(Note Start Failure appears after all allowed Re-Start attempts have been used)*
APU won't Start or Stay Running	• **If also Low Oil Pressure Fault – Engine Oil Pressure is not what is expected while running.**

(Engine Run Failure)	• **If also Engine Speed Error – 120VAC Input is not detected. Check Engine, Generator and cabling for 120VAC feed to the APCCU.**
APU won't Stop (Engine Stop Failure)	• **Engine Oil Pressure did not drop as expected within 10sec of trying to stop.** • **Generator Frequency did not drop as expected within 10sec of trying to stop.**
APU Shut off with no alarm	• **The Secured Settings have a maximum run time for both manual and auto-starts. After this duration the APU will automatically shut off.** • **The APU will automatically turn off at the completion of an Auto-Start function (after the appropriate duration for time, coolant temperature and low battery Auto-Starts; and after the Cabin Temp Auto-Start reaches the appropriate temperature)**
HVAC system won't run (APU is running)	• **Engine Speed Error– 120VAC Input is not detected. Check Engine, Generator and cabling for 120VAC feed to the APCCU on connector J1.**
HVAC system won't run (Shore Power is connected)	• **Shore Power symbol On – 120VAC Input is not detected. Check cabling for 120VAC feed to the APCCU on connector J1.** • **Shore Power symbol Off – Check contactor switch connection from Shore Power unit to APCCU on connector J4.**

CCD is blank	• **Screen might be in low power mode. Watch for the side LEDs to flash briefly every 5 seconds indicating it's still active but in low power mode. Press the down button to wake the display up.**
	• **No power to the APCCU.**
	  ○ **Check that the Display cable is properly connected between the APCCU and the CCD.**
	  ○ **Check that 12V power is connected to APCCU on J2**
	  ○ **Check that the Disconnect is in the closed position.**
	  ○ **Check the 12V 5A fuse to the APCCU.**
	  ○ **Truck battery may be completely discharged or too low to run.**

HVAC Heating won't turn on *(No Heat Flame displayed)*	• **The APCCU is currently set in the wrong mode for Heat. Press the HVAC Button to scroll through to the correct Heating/Cooling Mode.**

HVAC Heating won't turn on
(Heat Flame color is Gray)
	• **The APCCU doesn't think that Heat is needed.**
	  ○ **Cabin Temp isn't far enough from the Setpoint Temp for Heat yet.**
	  ○ **Check the Heat Offsets in the Configuration Settings if Cabin Temp is farther away from Setpoint Temp than expected.**

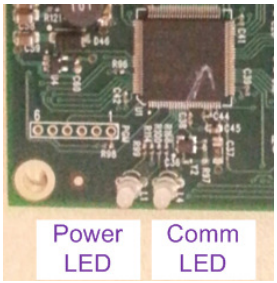
HVAC Heating won't turn on *(Heat Flame color is Red)*	• **The APU must be running or on Shore Power for the HVAC fan to run. Start the APU or connect Shore Power.** *(NOTE: On Shore Power, only Heater 1 will turn on)* • **No 120VAC power detected. Ensure the generator output is connected to the APCCU and working properly.**
HVAC Cooling won't turn on. *(No A/C Snowflake displayed)*	• **The APCCU is currently set in the wrong mode for Cooling. Press the HVAC Button to scroll through to the correct Heating/Cooling Mode.**

HVAC Cooling won't turn on.
(A/C Snowflake is Gray)
	• **The APCCU doesn't think that Cooling is needed.**
	  ○ **Cabin Temp isn't far enough from the Setpoint Temp for Cooling yet.**
	  ○ **Check the Cooling Offsets in the Configuration Settings if Cabin Temp is farther away from Setpoint Temp than expected.**

HVAC Cooling won't turn on. *(A/C Snowflake is Blue)*	• **The APU must be running or on Shore Power for the HVAC fan to run. Start the APU or connect Shore Power.** • **No 120VAC power detected. Ensure the generator output is connected to the APCCU and working properly.** • **Trinary Switch state indicates that the A/C coolant pressure is outside of the allowed range for operation. Check A/C charge pressure.**

HVAC Fan won't turn on	• **The APU must be running or on Shore Power for the HVAC fan to run. Start the APU or connect Shore Power.** • **No 120VAC power detected. Ensure the generator output is connected to the APCCU and working properly.**
HVAC Fan Speed doesn't match Manual Setting	• **The APU may be off. The APU must be running (or Shore Power connected) for the HVAC fan to run. Start the APU or connect Shore Power.** • **The HVAC fan is prevented from running at full speed during Heating.** • **The HVAC fan runs faster than the User Setting if called for by Heating or Cooling per the Min/Max Limits of the fan for the active mode.**
Water Valve Fault / Not working	• **Water Valve Feedback voltage outside expected range** • **Water Valve Feedback indicated that the Actual Position did not reach the Commanded Position within the time allowed.**

22. Status Indicator Lights on the Control Board



The APCCU controller as two LED's in the lower left corner that indicate the general status of the board. While the APCCU is running at full power the LED's will be on constantly. If the APCCU goes to low power mode, the LED's will flash briefly every 5 seconds to continue to indicate the Power and Comm status while conserving power.

Power Status LED (L1)

OFF = No 12V Logic Power, check 5A fuse in harness
RED = Both 12V powers outside 9-14.5V range
YEL = One of the 12V powers outside 9-14.5V range
GRN = Both 12V powers inside 9-14.5V range

Comm Status LED (L4)

OFF = No 12V Logic Power
RED = System is INACTIVE
YEL = System is ACTIVE but no Comm with Display
GRN = System is ACTIVE and operating

23. Troubleshooting Tools

APU Stopped	APU Starting	APU Running	502209	Desc.
○	○	○	J4-3	Trinary Fan Sw
○	○	○	J4-4	Trinary Comp Sw
●	●	●	J5-9	Cover Sw
●	●	●	J5-10	Oil Pressure Sw
○	○	○	J4-5	Shore Power Sw
●	●	●	J5-11	Coolant Level Sw
○	○	○	J4-7	Truck Ignition
●	●	●	J5-12	Coolant Temp(OvrTemp)
○	○	●	J1-1&2	120V_L/N
○	○	○	J4-1&2	Spare 1&2 (Interlock Err)
○	○	●	J5-8	Engine Speed (Eng Fault)
○	○	○	J6-1	A/C Heater 1
○	○	○	J6-2	A/C Heater 2
○	○	○	J7-3	A/C Compressor (TMR)
○	○	○	J7-2	A/C Blower Fan
○	○	○	J7-1	DC Condensor
○	◪	○	J5-14	APU Starter
○	◪	●	J5-7	APU Alternator
○	○	●	J5-6	APU Fans
○	◪	○	J5-5	APU Glow Plugs
○	◪	○	J5-4	APU Fuel Pull
○	●	●	J5-3	APU Fuel Hold
○	●	●	J5-2	APU Fuel Pump
○	○	○	J5-1	APU Compressor (TMR)
○	○	○	J4-12	DC WaterValve
○	○	○	J4-6	DC Blower Fan
●	●	●	COMM	Actv | Error | InActv
●	●	●	PWR	OK | 1Bad | 2Bad

An optional LED panel can be plugged into the CAN-cable between the APCCU and the Display (using an adapter) that allows the service technician to easily watch all the inputs and outputs on the APCCU.

CAN-Based LED Module for the APCCU

Trinary Fan Switch - A/C system pressure high, turn on Condenser
Trinary Compressor Switch - A/C system pressure is Ok to run Compressor
APU Cover Switch - Cover is installed properly)
APU Engine Oil Pressure Switch - Low Oil Pressure
Shore Power is Active
APU Coolant Level Switch - Coolant Level is Ok
Truck Ignition is On
APU Engine Temp Sensor is in acceptable Range (Blips if above OverTemp threshold)
120VAC power is detected
Spare Input 1 or 2 Active (Flashing if Engine won't start because of an Interlock Error)
Engine Speed detected (Flashing if Engine has an active Fault)
Output to AC Heater 1 Active
Output to AC Heater 2 Active
Output to A/C Compressor Active (Flashes if waiting for safety timer to expire)
Output to AC Blower Motor is Active
Output to DC Condenser Active
Output to APU Starter (Relay K1) Active
Output to APU Alternator Active
Output to APU Fans (Relays K4 & K5) Active
Output to APU Glow Plugs (Relay K3) Active
Output to APU Fuel Pull Solenoid (Relay K2) Active
Output to APU Fuel Hold Solenoid Active
Output to APU Fuel Pump Active
Output to APU Compressor Active (Flashes if waiting for safety timer to expire)
PWM command to Water Valve is Active
PWM command to DC Blower Motor is Active
GRN=Active, YEL=CommError, RED=Inactive (mimics APCCU board)
GRN=Both12VOk, YEL=One12VOk, RED=Neither12VOk (mimics APCCU board)

Other Application Notes:

- There's a 1 second delay from powerup before functionality starts (able to reflash before program locks-up)
- There's a 60 second delay from powerup for all Battery Monitoring conditions (faults & autostarts)
- Settings from Display to CCU are handshake/repeated, so the CCU implements time-lock (1-2s) on mode changes before temperature changes are allowed.
- Pull-Ups for Digital Inputs are only ON while the APCCU LED's are on.
- System is designed to run between -40 to 95 degF for a cabin temperature, and can Read between -50 to 140 degF.

General APCCU Connections: