7 Diagnostics

7.1 Preliminary Diagnostics

DANGER

The procedures in this section must be performed by certified technicians who have been trained in the use and service of high-voltage hybrid-electric vehicles and high-voltage components.

- Voltage above 30 volts should be considered potentially dangerous and are referred to as High Voltage or HV.
- Always wear appropriate personal safety equipment and take appropriate precautions when working with high-voltage components or wiring.
- Never service a component if high voltage is present.

Before starting with any diagnostic procedures, always verify the complaint. Next perform a visual inspection of the following:

1. All fluid levels are within proper operating levels.

   Note- the PAS fluid level must be checked and or filled at a system fluid temp not less than 10C. If circumstances arise where it does need to be filled at a temp less than 10C then it will need re-checking later at a system temp above 10C to avoid overflowing when the system is at the maximum operating temperature. Fluid will need to be removed from the reservoir if the reservoir is overfilled beyond the prescribed marks.

2. 12 volt battery condition and state of charge have been tested.

3. All electrical connectors connected and secure.

Test for blown fuses.
Check all connectors to ensure they are properly mated.
Check that the Inertia Switches have not been tripped.
Look for other wiring concerns.
Check all ground connections to ensure they are clean and tight.

4. Vacuum hoses are connected.

5. All intake and exhaust components are secure and not leaking.

6. Check for hybrid vehicle operation and verify if any service lights are on.

7. If HYBRID ENABLED LED is OFF - check that the conventional mode jumper connector C163P, has not been removed from under the dash (it is typically tie strapped to the steering column).

8. Check for DTCs and info codes on PCM, ESS and VCU. Repair any Faults before proceeding.

9. Fuel lines secure and not leaking.

10. Verify fuel supply.

    Verify there is ¼ tank or greater of fuel, and does the fuel pump operate?
    Has the fuel filter been serviced?

11. Verify engine condition.

    Is the compression good with less than a 10% variation between cylinders?
    Verify that the valve train is operating as per manufactures specifications.
    Has normal maintenance been performed?
    Has the fuel injection system been properly maintained?

7.2 Ford PCM / Hybrid VCU Interaction

The hybrid system interacts with many of the Ford base vehicle controls. Always verify the hybrid VCU DTC's and all items listed in this section before investigating Ford base vehicle complaints or PATS related issues.

Follow the recommended procedures for retrieving and clearing Diagnostic Trouble Codes (DTC) as described in the Ford E-450 5.4 L Service Manual.

Note: The PCM Calibration used in the Azure Hybrid Vehicle is not part of the Ford Released calibrations. Do not Reprogram the Ford PCM with a Factory calibration.

For PCM failures contact Azure for a pre-programmed Ford PCM

When connecting the Ford IDS service tool to a 2008 or 2009 Balance Production Hybrid vehicle the technician may need to manually enter the PCM part number (8C2A-12A650-SD) to establish communications between the PCM and IDS tool.

7.2.1 FORD - DTC P0605 is always present on early production 2008 Balance Hybrid vehicles.

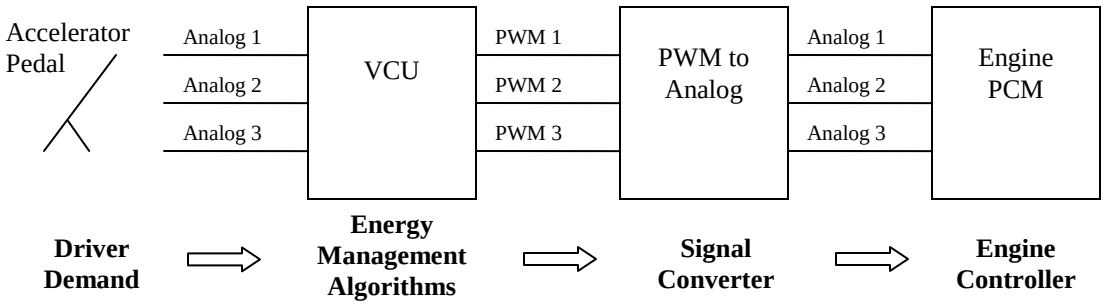
This DTC is set because a development PCM calibration is used in these vehicles. There are no drivability concerns or fault lights related to the P0605 fault code.

7.2.2 FORD- DTC P0743/ P0748/ P0960/ P0962

The hybrid VCU takes control of the transmission control solenoids. If any transmission solenoid faults are present, remove the C163 conventional mode jumper wire, and jumper pins 30 and 87a on relays K12 and K8. Clear fault codes and retest in conventional mode. If faults are still present, follow Ford diagnostic procedures with the inclusion of the Azure transmission control wiring and repair as necessary. If faults do not reappear, refer to Azure wiring schematics and repair wiring or relays as required. Refer to wiring diagrams.

7.2.3 Ford- APP Faults

The VCU controls the APP signal by sending out a PWM signal to the PAC (PWM to Analog Controller) and the PAC in turn sends out an Analog signal to the PCM APP inputs. For any APP related faults please check for VCU faults first and verify PAC operation. Use Balance Diagnostic tool to manual control APP inputs and use the Ford IDS tool to monitor APP inputs. If the inputs and outputs do not match refer to Azure wiring diagrams and repair as required.



7.2.4 Instrument Cluster

The VCU acts as a gateway between the instrument cluster and any Ford installed control modules including RCM and ABS. Any loss of instrument cluster functionality or intermittent instrument cluster displays should be verified with the Balance Diagnostic Tool before continuing with Ford Diagnostics. Refer to Pin Point Tests for Loss of CAN 1 communications and Loss of CAN 2 communications

The VCU also controls Brake warning lamp, Oil Lamp and Charge Lamp inputs to the instrument cluster. Refer to the Azure wiring schematics and the Ford diagnostic material for additional details about these circuits.

Instrument Cluster (IC) Diagnostics

There are 2 nuisance faults that may be flagged by the IC:

1. U100 - Lost communication with ECM/PCM
2. B1352 - Ignition key in circuit failure

These faults do not indicate a problem with the IC unless there is another functional issue observed with the IC.
Verify the VCU functionality/ communications before investigating any RCM and ABS communications faults.

7.2.5 PATS

The VCU acts as a gateway for the PATS CAN signals to the instrument cluster. If power, ground or CAN communications to the VCU are lost a PATS fault may be set and cause the vehicle not to operate. Use the Balance Diagnostic tool to check VCU communication and function first when a PATS fault is present.

The vehicles do not support the Ford E-450 CEI option for PATS based on a computer chip-embedded ignition key.

7.2.6 ABS Strategy

If ABS is active or faulty, regenerative braking will be disabled. It will be restored once the ABS condition clears AND the driver requests an acceleration torque.

7.3 Overview of Hybrid DTC's

7.3.1 Vehicle Control Unit (VCU)

The hybrid system is made up of several components. Each component has its own fault reporting. The VCU monitors these components via CAN communications and depending on the severity of the fault condition will set a DTC (Diagnostic Trouble Code) and will illuminate the "HYBRID SERVICE" LED.

There are two types of VCU faults:

1. Active Vehicle DTCs: the fault is currently in fault mode.
2. Stored Vehicle DTCs: The fault has been active at some point in the past.
    - Up to 16 Faults are stored in the fault buffer along with freeze frame data until they are cleared with the diagnostic tool.

Diagnostic Disabling

If the 12V battery voltage falls below 9.5V, all diagnostics are disabled. After 1s (to allow for momentary voltage drops during 12V starter cranks), low voltage diagnostics for the PCM and the ESS are re-enabled as these components are able to operate below the 9.5V threshold. All other diagnostics will remain disabled until the battery voltage is greater than or equal to 10V.

Diagnostic Mode

All diagnostics are disabled when the vehicle is in diagnostic mode. Diagnostic mode can only be entered using the BDT (Balance Diagnostic Tool) when the vehicle is in Key on (but not start or run). This mode allows for manual control of the various output controls from the VCU and allows for module reprogramming.

7.3.2 ESS (Energy Storage System) Info Codes

1. Active Codes: the code is currently active.
2. Stored Codes: ESS stored codes are saved in the Battery Control Module (BCM) memory until they are manually cleared. Active or stored critical codes may also be accompanied by a VCU DTC.

7.3.3 DMoC Info Codes

When a DMoC fault is set, the VCU sets a fault and also stores an additional DMoC info code in the freeze frame data and in the DMOC INFO CODES tab of the Balance Diagnostic Tool (BDT).

DMoC faults are put into 2 categories:

a- Non-critical Faults- (EE3LastError or EE3PSFaults = 0-127) can be reset by the VCU and the hybrid system affected will continue to operate normally until the fault occurrence exceeds a predetermined rate.

b- Critical Faults- (EE3LastErroro r EE3PSFaults = greater than128) A DMoC critical fault will disable the DMoC until the following power cycle

The fault history EE3PSFaults1(2, 3) provides the enumerated history for the most recent 4 fault entries stored, whereas the fault history EE3LastError provides a bit field error code history (also 4 entries) that can log multiple faults simultaneously. Keep in mind that for the majority of faults, both fault histories correlate with each other (ie: if only 1 fault occurred at any given time) but some faults are ONLY displayed under EE3PSFaults, and so they should be the first ones to be checked. In addition, since they are enumerated, it is easier to understand what the fault is.

Both the EE3PSFaults and EE3LastError history can ONLY be cleared via ccShell, as they are stored within the DMoC. The Balance Diagnostic Tool currently does not support this functionality.

The “Active Inverter State” will display any currently active DMoC faults.

If history faults are displayed but no VCU DTC’s are present than there is not a current issue with the DMoC.

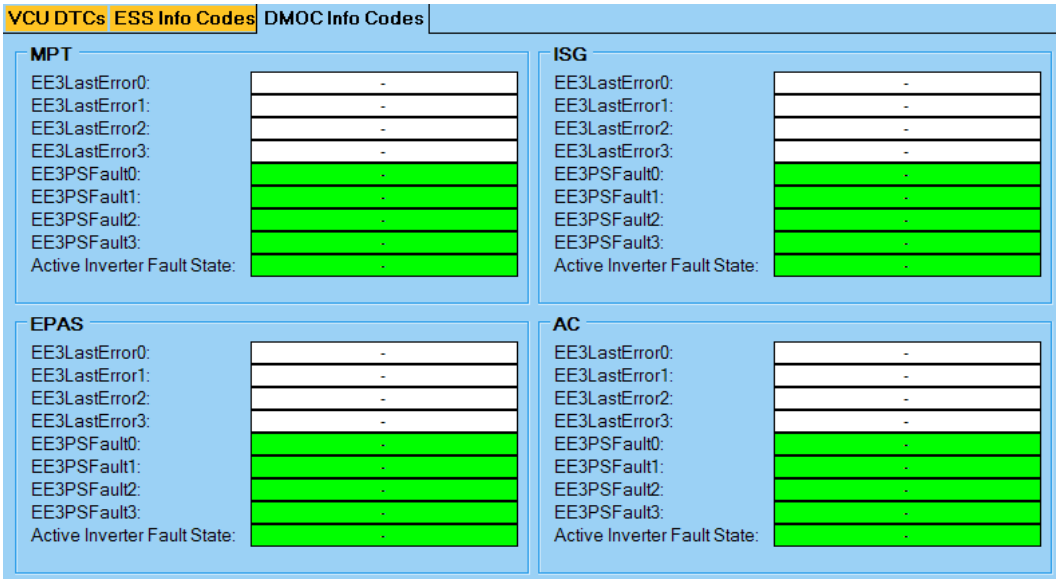


Figure 30: DMoC info Codes

7.4 VCU DTC's

NOTE- When performing diagnostics on vehicles with multiple active DTC's always perform diagnostics for active Communications DTC's first.

C1000 Inertia Switch Tripped

Description:	The Inertia switch input is open. The vehicle will be set to a “Forced Traction Disable” and The HYBRID SERVICE light will flash.
Possible Causes:	• Inertia Switch has been tripped (open Circuit) • Faulty Inertia Switch • Connection or Wiring fault • Blown Fuse F014
Diagnostic Aids:	• Refer to appropriate Azure wiring schematics. • Reset inertia switch and retest

P0121- Throttle / Pedal Position Sensor Switch "A" Circuit Range /Performance

Description:	MY 2008- The accelerator pedal tracks 1 & 2 and 1 & 3 are different by more than 5%. If no faults are present on tracks 2 & 3 then the vehicle will continue to operate normally and the Hybrid Service light be on solid. If faults are present for track 2, track 3 or both as well as the P0121, then the vehicle will be set to a "Forced Conventional Limp Home Mode" and The HYBRID SERVICE light will flash. MY 2009- The accelerator pedal tracks 1 & 2 are different by more than 5%. The vehicle will be set to a "Forced Conventional Limp Home Mode" and The HYBRID SERVICE light will flash.
Possible Causes:	• APP track 1 connectivity. • APP sensor fault.
Diagnostic Aids:	• Use Balance diagnostic tool to monitor Accelerator Pedal Track 1, 2, 3 inputs. • Refer to appropriate Azure wiring schematics. • Refer to appropriate Ford Diagnostics for APP sensor track 1 signal.

P0122 – Throttle/Pedal Position Sensor/Switch "A" Circuit Low

Description:	MY 2008- The VCU has detected that the Accelerator Pedal track 1 input signal to the VCU has a short Circuit to Ground or an Open Circuit. The input voltage is less than 0.16 volts. If no faults are present on tracks 2 & 3 then the vehicle will continue to operate normally and the Hybrid Service light be on solid. If faults are present for track 2, track 3 or both as well as the P0122, then the vehicle will be set to a "Forced Conventional Limp Home Mode" and The HYBRID SERVICE light will flash. MY 2009- The VCU has detected that the Accelerator Pedal track 1 input signal to the VCU has a short Circuit to Ground or an Open Circuit. The input voltage is less than 0.3 volts. The vehicle will be set to a "Forced Conventional Limp Home Mode" and The HYBRID SERVICE light will flash.
Possible Causes:	• APP Sensor track 1 wiring short circuit to ground. • Faulty APP sensor. • Open Circuit.
Diagnostic Aids:	• Refer to appropriate Azure wiring schematics and check all electrical connections related to APP input. • Use BDT to monitor Accelerator Pedal track 1. • Refer to appropriate Ford Diagnostics for APP sensor. • Refer to the appropriate Ford Wiring schematics.

P0123 - Throttle/Pedal Position Sensor/Switch "A" Circuit High

Description:	MY 2008- The VCU has detected that the Accelerator Pedal track 1 input signal to the VCU has short Circuit to battery power or short circuit to VREF (5 volt +). The Accelerator Pedal track 1 signal voltage to the VCU is greater than 4.78 volts to set this fault. If no faults are present on tracks 2 & 3 then the vehicle will continue to operate normally and the HYBRID SERVICE light will be on solid. If faults are present for track 2, track 3 or both as well as the P0123, then the vehicle will be set to a "Forced Conventional Limp Home Mode" and The HYBRID SERVICE light will flash. MY 2008- The VCU has detected that the Accelerator Pedal track 1 input signal to the VCU has short Circuit to battery power or short circuit to VREF (5 volt +). The Accelerator Pedal track 1 signal voltage to the VCU is greater than 4.95 volts to set this fault. The vehicle will be set to a "Forced Conventional Limp Home Mode" and The HYBRID SERVICE light will flash.
Possible Causes:	• Accelerator Pedal track 1 Wiring short circuit to power. • Accelerator Pedal track 1 Wiring short circuit to VREF power. • Faulty APP sensor
Diagnostic Aids:	• Refer to appropriate Azure wiring schematics and check all electrical connections related to Accelerator Pedal track 1 input signal. • Use Balance Diagnostic tool to monitor Accelerator Pedal track 1. • Refer to appropriate Ford Diagnostics for APP sensor. • Refer to the appropriate Ford Wiring schematics.

P0124– Throttle / Pedal Position Sensor Switch "A" Circuit Intermittent

Description:	MY 2008-The accelerator pedal track 1 slew rate exceeds 300%/s. If no faults are present on tracks 2 & 3 then the vehicle will continue to operate normally and the Hybrid Service light be on solid. If faults are present for track 2, track3 or both as well as the P0124, then the vehicle will be set to a "Forced Conventional Limp Home Mode" and The HYBRID SERVICE light will flash. MY 2009- The accelerator pedal track 1 slew rate exceeds 300%/s. The vehicle will be set to a "Forced Conventional Limp Home Mode" and The HYBRID SERVICE light will flash.
Possible Causes:	• APP track 3 connectivity. • APP sensor fault.
Diagnostic Aids:	• Use Balance diagnostic tool to record APP track 1, 2, 3 and compare signals. • Refer to appropriate Azure wiring schematics. • Refer to appropriate Ford Diagnostics for APP sensor track 1 signal.

P0217 ENG- Engine Coolant Over Temperature Condition

Description:	The VCU has detected that engine temperature has exceeded 123°C. The temperature gauge in the instrument cluster will read "H", the electric radiator cooling fans will be on. (Engine On Only)
Possible Causes:	• Base vehicle issue (thermostat or mechanical engine failure) • Low coolant level • Radiator Blockage • Radiator fan failure • Fan control or wiring
Diagnostic Aids:	• Using Balance Diagnostic Tool, verify manual fan control, if fans operate normally then follow ford E450 2008 diagnostic procedures else refer to appropriate wiring schematics. • Refer to Temperature gauge reads "H" overheating for fan on/off temperatures.

P0221 – Throttle / Pedal Position Sensor Switch "B" Circuit Range /Performance

Description:	MY 2008- The accelerator pedal tracks 1 & 2 and 2 & 3 are different by more than 5%. If no faults are present on tracks 1 & 3 then the vehicle will continue to operate normally and the Hybrid Service light will be on solid. If faults are present for track 1, track 3 or both as well as the P0221, then the vehicle will be set to a "Forced Conventional Limp Home Mode" and The HYBRID SERVICE light will flash. MY 2009- The accelerator pedal tracks 1 & 2 are different by more than 5%. The vehicle will be set to a "Forced Conventional Limp Home Mode" and The HYBRID SERVICE light will flash.
Possible Causes:	• APP track 2 connectivity. • APP sensor fault.
Diagnostic Aids:	• Use Balance diagnostic tool to monitor Accelerator Pedal Track 1, 2, 3 inputs. • Refer to appropriate Azure wiring schematics. • Refer to appropriate Ford Diagnostics for APP sensor track 2 signal.

P0222 – Throttle/Pedal Position Sensor/Switch "B" Circuit Low

Description:	MY 2008- The VCU has detected that the Accelerator Pedal track 2 input signal to the VCU has a short Circuit to Ground or an Open Circuit. The input voltage is less than 0.53 volts. If no faults are present on tracks 1 & 3 then the vehicle will continue to operate normally and the Hybrid Service light will be on solid. If faults are present for track 1, track 3 or both as well as the P0222, then the vehicle will be set to a "Forced Conventional Limp Home Mode" and The HYBRID SERVICE light will flash. MY 2009- The VCU has detected that the Accelerator Pedal track 2 input signal to the VCU has a short Circuit to Ground or an Open Circuit. The input voltage is less than 0.14 volts. The vehicle will be set to a "Forced Conventional Limp Home Mode" and The HYBRID SERVICE light will flash.
Possible Causes:	• APP Sensor track 2 wiring short circuit to ground. • Faulty APP sensor. • Open Circuit.
Diagnostic Aids:	• Refer to appropriate Azure wiring schematics and check all electrical connections related to Accelerator Pedal track 2. • Use BDT to monitor Accelerator Pedal track 2. • Refer to appropriate Ford Diagnostics for APP sensor. • Refer to the appropriate Ford Wiring schematics.

P0223 - Throttle/Pedal Position Sensor/Switch "B" Circuit High

Description:	MY 2008- The VCU has detected that the Accelerator Pedal track 2 input signal to the VCU has short Circuit to battery power or short circuit to VREF (5 volt +). The Accelerator Pedal track 2 signal voltage to the VCU is greater than 4.67 volts to set this fault. If no faults are present on tracks 1 & 3 then the vehicle will continue to operate normally and the Hybrid Service light will be on solid. If faults are present for track 1, track 3 or both as well as the P0223, then the vehicle will be set to a "Forced Conventional Limp Home Mode" and The HYBRID SERVICE light will flash. MY 2009- The VCU has detected that the Accelerator Pedal track 2 input signal to the VCU has short Circuit to battery power or short circuit to VREF (5 volt +). The Accelerator Pedal track 2 signal voltage to the VCU is greater than 3.75 volts to set this fault. the vehicle will be set to a "Forced Conventional Limp Home Mode" and The HYBRID SERVICE light will flash.
Possible Causes:	• APP track 2 Wiring short circuit to power. • APP track 2 Wiring short circuit to VREF power. • Faulty APP sensor
Diagnostic Aids:	• Refer to appropriate Azure wiring schematics and check all electrical connections related to Accelerator Pedal track 2 input signal. • Use BDT to monitor Accelerator Pedal track 2. • Refer to appropriate Ford Diagnostics for APP sensor. • Refer to the appropriate Ford Wiring schematics.

P0224- Throttle / Pedal Position Sensor Switch "B" Circuit Intermittent

Description:	MY 2008- The raw accelerator pedal track 2 slew rate exceeds 300%/s. If no faults are present on tracks 1 & 3 then the vehicle will continue to operate normally and the Hybrid Service light will be on solid If faults are present for track 1, track 3 or both as well as the P0224, then the vehicle will be set to a "Forced Conventional Limp Home Mode" and The HYBRID SERVICE light will flash. MY 2009- The raw accelerator pedal track 2 slew rate exceeds 300%/s. The vehicle will be set to a "Forced Conventional Limp Home Mode" and The HYBRID SERVICE light will flash.
Possible Causes:	• APP track 2 connectivity. • APP sensor fault.
Diagnostic Aids:	• Use Balance diagnostic tool to record APP track 1, 2, 3 and compare signals. • Refer to appropriate Azure wiring schematics. • Refer to appropriate Ford Diagnostics for APP sensor track 2 signal.

P0226 – Throttle / Pedal Position Sensor Switch "C" Circuit Range /Performance

Description:	MY 2008 only-The accelerator pedal tracks 1 &3 and 2 & 3 are different by more than 5%. If no faults are present on tracks 1 & 2 then the vehicle will continue to operate normally and the Hybrid Service light will be on solid.
Possible Causes:	• APP track 3 connectivity. • APP sensor fault. • 2008 software loaded in 2009 platform
Diagnostic Aids:	• Use Balance diagnostic tool to monitor Accelerator Pedal Track 1, 2, 3 inputs. • Refer to appropriate Azure wiring schematics. • Refer to appropriate Ford Diagnostics for APP sensor track 3 signal.

P0227– Throttle/Pedal Position Sensor/Switch "C" Circuit Low

Description:	MY 2008 only-The VCU has detected that the Accelerator Pedal track 3 input signal to the VCU has a short Circuit to Ground or an Open Circuit. The input voltage is less than .25 volts. The vehicle will continue to operate normally and the Hybrid Service light will be on solid.
Possible Causes:	• Accelerator Pedal track 3 wiring short circuit to ground. • Faulty APP sensor. • Open circuit. • 2008 software loaded in 2009 platform
Diagnostic Aids:	• Refer to appropriate Azure wiring schematics and check all electrical connections related to Accelerator Pedal track 3. • Use BDT to monitor Accelerator Pedal track 3. • Refer to appropriate Ford Diagnostics for APP sensor. • Refer to the appropriate Ford Wiring schematics.

P0228 - Throttle/Pedal Position Sensor/Switch "C" Circuit High

Description:	MY 2008 only-The VCU has detected that the Accelerator Pedal track 3 input signal to the VCU has short Circuit to battery power or short circuit to VREF (5 volt +). The Accelerator Pedal track 3 input signal voltage to the VCU is greater than 4.39 volts to set this fault. The vehicle will continue to operate normally and the Hybrid Service light will be on solid.
Possible Causes:	• Accelerator Pedal track 3 Wiring short circuit to power. • Accelerator Pedal track 3 short circuit to VREF power. • Faulty APP sensor.
Diagnostic Aids:	• Refer to appropriate Azure wiring schematics and check all electrical connections related to Accelerator Pedal track 3 input signal. • Use BDT to monitor AAP track 3. • Refer to appropriate Ford Diagnostics for APP sensor. • Refer to the appropriate Ford Wiring schematics.

P0229 – Throttle/Pedal Position Sensor/Switch "C" Circuit Intermittent

Description:	The raw accelerator pedal track 3 slew rate exceeds 300%/s. If no faults are present on tracks 1 & 2 then the vehicle will continue to operate normally and the Hybrid Service light will be on solid.
Possible Causes:	• APP track 3 connectivity. • APP sensor fault.
Diagnostic Aids:	• Use Balance diagnostic tool to record APP track 1, 2, 3 and compare signals. • Refer to appropriate Azure wiring schematics. • Refer to appropriate Ford Diagnostics for APP sensor track 3 signal.

P0504 Brake Switch "A"/ "B" Correlation

Description:	VCU brake switch digital input does not correspond with CAN reported PCM brake ON/OFF (BOO). The HYBRID SERVICE light will be on solid.
Possible Causes:	• Wiring harness or connection problem from brake switch to VCU. • Wiring harness or connection problem from brake switch to PCM.
Diagnostic Aids:	• Use BDT (Balance Diagnostic Tool) on CAN 1 and monitor "Brake ON/OFF signal. • Compare "Brake ON/OFF signal on the BDT display with the BOO, on FORD IDS tool. • Refer to appropriate Azure wiring schematics. • Refer to appropriate Ford wiring schematics.

P0531 A/C Refrigerant Pressure Sensor "A" Circuit Range/Performance

Description:	The Cab AC switch input to the VCU switches faster than max defined frequency of 25 Hz. The vehicle will continue to operate normally and the Hybrid Service light will be on solid.
Possible Causes:	• AC Switch circuit - intermittent connection. • Faulty AC switch (if equipped).
Diagnostic Aids:	• Use Balance diagnostic tool to monitor AC switch Input. • Refer to appropriate Azure wiring schematics and check all electrical connections related to AC switch Input to VCU.

P0705 – Transmission Range Sensor "A" Circuit (PRNDL Input)

Description:	The PCM reports lever position fault. The engine will be forced on and stay running and the Hybrid Service light will be on solid.
Possible Causes:	• Base vehicle failure Lever position.
Diagnostic Aids:	• Refer to Ford Diagnostics.

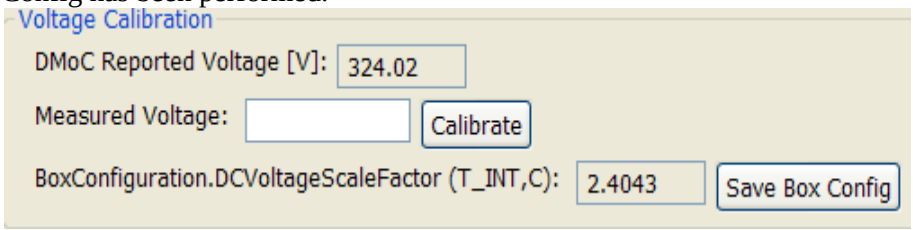
P0915- Gear Shift Position Circuit Range Performance

Description:	The PCM reports gear position fault. The vehicle will be set to a "forced Convention Limp Home Mode" and the HYBRID SERVICE light will flash.
Possible Causes:	• Base vehicle failure with transmission gear position.
Diagnostic Aids:	• Refer to Ford Diagnostics.

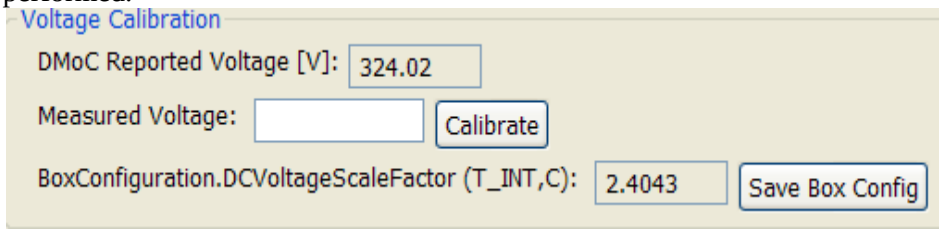
P0A0F Eng -Engine Failed to Start

Description:	The engine has failed to start when cranked above calibrated threshold of 125 rpm. The HYBRID SERVICE light will flash and the vehicle will be set to Forced EV mode with delayed traction disabled depending on the state of charge.
Possible Causes:	• Base vehicle engine failure including loss of fuel, spark or sensor signal. • Loss of VCU to PCM enable signal. • Loss of PCM power or ground.
Diagnostic Aids:	• Verify communication with PCM with either Balance Diagnostic Tool or IDS. If no communication, test for proper powers, grounds. If other CAN communications faults are present, troubleshoot and resolve them first. • C163 conventional mode jumper and test for vehicle start. If no start, refer to Ford diagnostics. • Refer to appropriate Azure wiring schematics.

P0A1B- Drive Motor "A" Control Module

Description:	The traction motor DMoC state does not match the state being commanded by the VCU . The vehicle will be set to a "Forced Conventional Mode" and The HYBRID SERVICE light will be on solid.
Possible Causes:	• Traction motor DMoC was just reprogrammed to new software without the Voltage calibration performed. • Faulty traction motor DMoC. • No HV to DMoC (blown Fuse). • Incorrect DMoC software.
Diagnostic Aids:	• Compare the ESS buss voltage to the reported voltage from the traction motor DMOC and use ccShell to recalibrate DMoC voltage. Ensure that Save Box Config has been performed.  • Use ccShell to load the latest software and calibrations. *Refer to* https://extranet.azuredynamics.com *for the latest software.* • Contact Azure TechLine techline@azuredynamics.com for support.

P0A1E- Starter Generator Control Module

Description:	The ISG DMoC state does not match the state being commanded by the VCU. The Body Builder AC will be shut off and the engine will be forced on and stay running and the HYBRID SERVICE light will be on solid.
Possible Causes:	• ISG DMOC was just reprogrammed with new software without the voltage calibration being performed. • Faulty ISG DMoC. • Incorrect DMoC Software.
Diagnostic Aids:	• Compare the ESS buss voltage to the reported voltage from the ISG DMOC and use ccShell to recalibrate DMoC voltage. Ensure that Save Box Config has been performed.  • Reprogram ISG DMOC with latest software from Azure. • Contact Azure TechLine techline@azuredynamics.com for support.

P0A1F -Battery Energy Control Module

Description:	The ESS does not respond to a connect command from the VCU for greater than 2 seconds. The vehicle will be set to “Forced Conventional mode” and the HYBRID SERVICE light will be on solid.
Possible Causes:	• ESS Isolation resistance is too low. (less that 2 Mohms at key on) • Internal ESS failure.
Diagnostic Aids:	• Using Balance Diagnostic Tool check for any ESS Info codes, repair as required. • Using the BDT verify that the isolation resistance of the ESS diagnostics are 2 mohms at key on engine off.

P0A3C- Drive Motor "A" Inverter Over Temperature

Description:	The traction DMoC temperature exceeds 75°C. The instrument Cluster temperature gauge will read "H" The DMoC plenum fans will be on.
Possible Causes:	• Faulty traction motor DMoC. • Blockage of air flow to cooling fins. • Faulty DMoC Plenum fan operation.
Diagnostic Aids:	• Use Balance Diagnostic tool to manually turn on Plenum fans to confirm operation. • Visually inspect traction motor Controller cooling fins, plenum fan shroud for blockages. • Refer to Azure wiring Schematic.

P0A3E- Generator Inverter Over Temperature

Description:	The ISG DMoC temperature has exceed 75°C. The instrument cluster temperature gauge will read "H". The DMoC plenum fans will be on.
Possible Causes:	• Faulty ISG DMoC (temperature sensor). • Blockage of air flow to cooling fins. • Faulty DMOC plenum fan operation.
Diagnostic Aids:	• Use BDT to manually turn on Plenum fans to confirm operation.

Air Cooled Components	Over temp as displayed on temperature gauge	Plenum Fan On temp	Plenum Fan Off temp
ISG Inverter	75 °C	Eng on- 35°C Eng Off 40°C	30°C 35°C

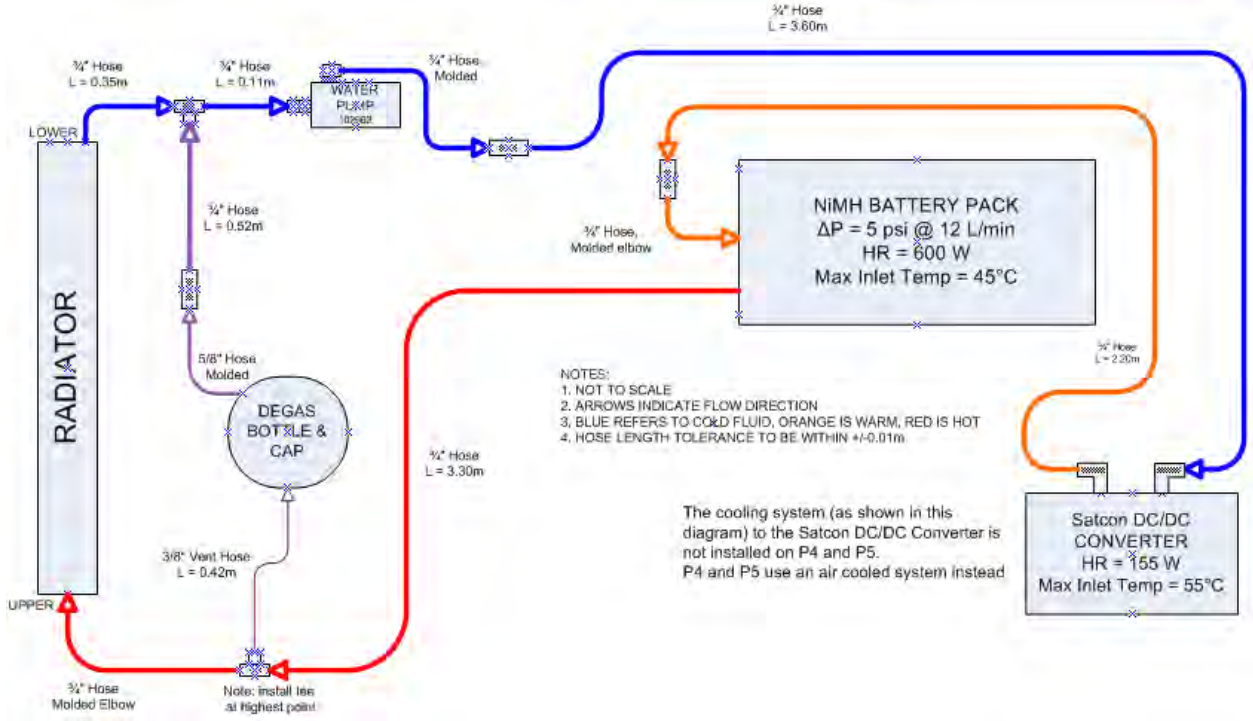
- Visually inspect ISG motor Controller cooling fins, plenum fan shroud for blockages.
- Refer to diagnostic by description Plenum Fan not functioning.

P0A77 – A/C Position Sensor Circuit

Description:	The reported air conditioning speed reported by the A/C DMoC is less than 5 rpm and the A/C reported torque is greater than 10 Nm.
Possible Causes:	Failed A/C motor speed sensor.
Diagnostic Aids:	•

P0A7E –Hybrid Battery Pack Over Temperature

Description:	Maximum ESS module temperature has exceeded 70° C. The temperature will be in the "H".
Possible Causes:	• Low temp coolant pump inoperable. • Radiator fans inoperable.. • Low coolant level. • Blocked or kinked coolant hose. • Internal ESS Module failure.
Diagnostic Aids:	• Using Balance Diagnostic tool check for any ESS Info codes. • Using Balance Diagnostic tool check ESS module temperatures. If all temperatures are close to being equal than look for external cooling system issue. If module temperature is greater than 10°C higher than the other modules, replace ESS. • Check Electronics cooling level or kinked hose. • Using the Balance Diagnostic Tool, manually activate the low temperature cooling pump and Radiator Fans to confirm operation. • Check radiator fan fuse F039 (80 amp). • Check Coolant pump fuse F011 (10 amp) and K3 low Temp Cooling Pump Relay.



P0A92 – Hybrid Generator Performance

Description:	The ISG fails to crank engine above a calibrated threshold of 125 rpm 3 consecutive times. The HYBRID SERVICE light will be on solid. VCU will attempt to start the engine with the starter. If both starter and ISG starts fail, the HYBRID SERVICE light will flash and the vehicle will be set to Forced EV mode with delayed traction disabled depending on the state of charge.
Possible Causes:	• ISG motor failure. • ISG DMoC failure • ISG belt failure. • ISG belt slippage or failed belt tensioner. • Speed sensor failed or intermittent.
Diagnostic Aids:	• If DTC P0C2F is present, investigate first. • If ISG Info codes are present, investigate them first. • Using Azure Balance Diagnostic Tool record the ISG- "Rotational Speed" and PCM- 'Engine Speed" confirm that the signal profiles are the same. The ISG "Rotational Speed" should be 2.5 x the Engine Speed". If the profiles match then diagnose a ISG DMoC or ISG Motor issue. If the profiles do not match or the ISG Rotational Speed is erratic when compared to Engine Speed, look for slipping belt, miss adjusted of Faulty ISG Speed sensor. • Refer to appropriate Azure wiring schematics. • Check ISG speed sensor adjustment and operation, refer to ISG speed sensor not functioning.

P0AA6- Hybrid Battery Voltage System Isolation Fault

Description:	The ESS continuously monitors isolation resistance between the high voltage buss and chassis ground. If the isolation resistance is less than 2 Mohms at key on or less than 500 Kohms while the vehicle is running this fault will be set. The vehicle will be set to "Forced Conventional mode" and the HYBRID SERVICE light will be on solid.
Possible Causes:	• ESS Service disconnect Pin is removed. • Internal ESS ground fault. • Isolation failure in EPAS Motor or EPAS Motor Controller. • Isolation failure in ISG Motor or ISG Motor Controller. • Isolation failure in Traction Motor or Traction Motor Controller. • High Voltage cabling Isolation failure. • Isolation failure in DC-DC converter. • Isolation failure in AC Motor or Controller.
Diagnostic Aids:	• Refer to Isolation Resistance Testing. • Refer to ESS Info Codes ESS – Input: DBS Fault.

P0AE1 Hybrid Battery Precharge Contactor Circuit

Description:	ESS reports a precharge state of 'Precharge failed' The vehicle will be set to "Forced Conventional mode" and the HYBRID SERVICE light will be on solid.
Possible Causes:	• ESS failure. • Short or unintended load on the high voltage Buss at time of precharge.
Diagnostic Aids:	• Using Balance Diagnostic tool check for any ESS Info codes, repair as required. • Isolate the Battery from the other HV components and attempt to start vehicle, using the Balance Diagnostic tool monitor the Precharge state and determine if the precharge Fail is still active- if yes, replace ESS if No, perform individual component testing of each HV component and look for a short in a component or wiring. • Refer to appropriate Azure wiring schematics.

P0C2F ENG - Internal Control Module Drive Motor/Generator Engine Speed Sensor Performance

Description:	The reported ISG speed differs from 2.5 x the reported engine speed by +-1000rpm for more than 5 seconds. The hybrid system will set to Forced Conventional mode and the hybrid service light will be on solid.
Possible Causes:	• Broken or slipping ISG belt. • Failed or maladjusted ISG speed sensor. • Wiring issue between DMoC and speed sensor. • Failed belt tensioner. • Failed DMoC speed sensor circuit
Diagnostic Aids:	• **If accompanied by DTC U0120, follow diagnostic procedures for U0120 first.** • Using the Balance Diagnostic Tool, record ISG speed and engine speed and compare the values. Note: The ISG spins 2.5 times faster than the engine RMP. • Check ISG belt and tensioner condition. • Refer to diagnostic by Description ISG speed sensor not functioning. • Refer to appropriate Azure wiring schematics.

P0C76 Hybrid Battery System Discharge Time too long

Description:	The ESS reports disconnected but the high voltage buss remains above 100 volts for greater than45 seconds. This indicates a high voltage Powertrain shutdown fault. The vehicle will be set to "Forced Conventional mode" and the HYBRID SERVICE light will be on solid.
Possible Causes:	• ESS contactors did not open. • Buss voltage incorrect.
Diagnostic Aids:	• Using Balance Diagnostic tool check for any ESS Info codes. • Using Balance Diagnostic tool check for any VCU DTC's.

P1A00 Drive motor "A" Critical Fault

Description:	The Traction Motor Controller has reported inverter state is "critical fault". Specific fault state reported by ECU captured in freeze frame data and a DMOC Info Code is stored. The vehicle will be set to "Forced Conventional mode" and the HYBRID SERVICE light will be on solid.
Possible Causes:	• Faulty traction motor Controller (DMoC). • Faulty Traction Motor. • Faulty Wiring.
Diagnostic Aids:	• Refer to Motor Controller info Codes DMoC Info Codes and freeze frame data for additional information.

P1A01 Drive Motor "A" Inverter Fault

Description:	The traction motor DMoC has reported an DMoC non-critical fault. Specific fault state reported by ECU captured in freeze frame data and a DMoC Info Code is stored. The Hybrid Service light will be on solid. If the fault monitor count exceeds three, the vehicle will be set to "Forced Conventional mode" and the HYBRID SERVICE light will be on solid.
Possible Causes:	• Faulty traction motor Controller. • Faulty traction Motor. • Faulty Wiring.
Diagnostic Aids:	• Refer to Motor Controller info Codes DMoC Info Codes and freeze frame data for additional information.

P1A02 – Drive Motor "A" Stator Over Temperature

Description:	The traction motor stator temperature has hit it s "Overheat" limit of 200°C. The instrument cluster temperature gauge will be in the "Red" or "H".
Possible Causes:	• Open circuit on Stator Temperature sensor. • Failed sensor. • Motor has overheated due to blocked air flow to motor.
Diagnostic Aids:	• Check wiring for opens and shorts to ground. • Measure resistance between C174P pin "G" and pin "H" pin of the 19-pin connector at traction motor. A functioning sensor should read between .150K• and .250K• @ room temperature. • Measure resistance between C174P pin "U" and pin "V" pin of the 19-pin connector at traction motor. A functioning sensor should read between 25K• and 45K• @ room temperature. Note: pins U & V are not populated on all models of traction motor. • Refer To Azure Wiring Schematic.

P1A04- Drive Motor "A" Position/ Sensor Transmission Output Speed Sensor Correlation

Description:	The motor speed reported by traction DMoC differs from the PCM reported OSS by more than 1500 rpm. The vehicle will be set to a "Forced Conventional Mode" and The HYBRID SERVICE light will be on solid. The VCU will switch from using the Traction Motor OSS for the vehicle controls and the Instrument Cluster speed display and instead use the PCM reported transmission output shaft speed signal (OSS) and calculated vehicle speed.
Possible Causes:	• Check traction motor speed sensor. • Speed sensor wiring issue. • Broken / slipping traction motor drive coupler.
Diagnostic Aids:	• Using Balance Diagnostic tool and the ford IDS tool, monitor and compare the OSS reading to the traction motor reported speed. • Check sensor function, refer to???

P1A10- Generator Inverter Critical Fault

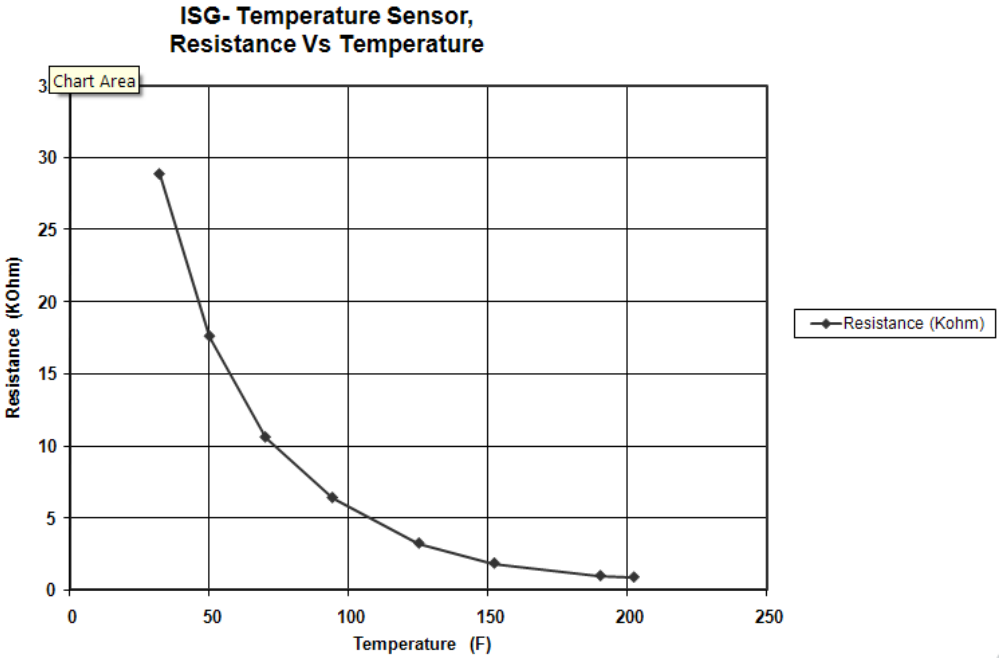
Description:	The ISG DMoC has reported the state is “critical fault”. Specific fault state reported by DMoC is captured in VCU freeze frame data ISG Info code. The Body Builder AC will be shut off, the engine will be forced on and stay running and the Hybrid Service light will be on solid.
Possible Causes:	• Faulty ISG DMoC. • Faulty ISG Motor.
Diagnostic Aids:	• Refer to DMoC info Codes DMoC Info Codes.

P1A11 Generator Inverter Fault

Description:	The ISG DMoC has reported inverter state is “non-critical fault”. Specific fault state reported by DMOC is captured in VCU freeze frame data ISG Info code. The HYBRID SERVICE light will be on solid. If the fault monitor count exceeds 3, the Body Builder AC will be shut off, and the engine will be forced on and stay running.
Possible Causes:	• Faulty ISG DMoC. • Faulty ISG Motor. • Wiring fault.
Diagnostic Aids:	• Refer to DMoC info Codes DMoC Info Codes and freeze frame data for additional information.

P1A12 - Generator Stator Over Temperature

Description:	The ISG stator temperature has hit its “Overheat” limit of 200 ° C The instrument cluster temperature gauge will read “H”.
Possible Causes:	• Open circuit on stator temperature sensor. • Failed sensor. • ISG motor has overheated due to blocked air flow to motor.
Diagnostic Aids:	• Check wiring for open circuits and shorts to ground. • Inspect for blocked air flow to ISG motor / Cooling fins. • Measure resistance across C261P pin H and Pin J resistance should be ~9.4 Kohm @ 21°C refer to chart below. If sensor out of spec, visually inspect for damaged wiring to sensor. If wiring ok, replace ISG Motor. • Refer To Azure Wiring Schematic.



P1A20 Battery Control Module Fault

Description:	The VCU has detected that the ESS pack state is 'Alert' The ESS has detected a non-critical system fault. The HYBRID SERVICE light will be on solid.
Possible Causes:	• ESS internal Failure. • Failure of ESS inputs.
Diagnostic Aids:	• Using Balance Diagnostic tool check for any ESS Info codes, repair as required. • Refer to appropriate Azure wiring schematics.

P1A21 Battery Control Module Critical Fault

Description:	The VCU has detected that the ESS pack state is 'Forced Disconnect' The ESS has detected a critical system fault. The vehicle will be set to “Forced Conventional mode” and the HYBRID SERVICE light will be on solid.
Possible Causes:	• ESS internal Failure. • Ground Isolation Fault.
Diagnostic Aids:	• Using Balance Diagnostic tool check for any ESS Info codes, repair as required.

P1A22 - System Isolation Fault Warning

Description:	The ESS continuously monitors isolation resistance between the high voltage buss and chassis ground. If the Isolation resistance drops below a calibrated threshold this fault will be set. The Pack state is in 'Alert' Mode but the contactors are still closed. The HYBRID SERVICE light will be on solid.
Possible Causes:	• ESS Service disconnect Pin is removed. • Internal ESS ground fault. • Isolation failure in EPAS Motor or EPAS DMoC. • Isolation failure in ISG Motor or ISG DMoC. • Isolation failure in Traction Motor or Traction Motor DMoC. • High voltage cabling Isolation failure. • Isolation failure in DC/DC converter. • Isolation failure in AC Motor or Controller.
Diagnostic Aids:	• Refer to Isolation Resistance Testing • Refer to ESS Info Codes ESS – Input: DBS Fault

P1A30- Hybrid Voltage Measurement Correlation

Description:	The Difference between the maximum and minimum reported component high voltage reading is greater than 30 volts. The vehicle will be set to "Forced Conventional mode" and the HYBRID SERVICE light will be on solid.
Possible Causes:	• Wiring or connection problem. • Improper Voltage calibration on one of the DMoCs. • Motor controller or ESS internal failure. • Blown high voltage fuse in junction box or ESS.
Diagnostic Aids:	• Use Balance Diagnostic tool to compare voltage readings from each component to the ES buss voltage. All voltages should be +-5 volts of each other. If a DMoC is out of voltage specification. Use ccShell to recalibrate the voltage. • Refer to appropriate Azure wiring schematics.

P1A31 Starter Performance

Description:	If the 12 volt starter fails to crank engine rpm above 125 rpm 3 consecutive times, this fault will be set. The VCU will attempt to start the engine with the ISG. The HYBRID FAULT light will be on unless the attempt to start with the ISG also fails. If both starter and ISG starts fail, the HYBRID SERVICE light will flash and the vehicle will be set to Forced EV mode with delayed traction disabled depending on the state of charge.
Possible Causes:	• 12 volt starter failure. • Low 12 volt battery voltage. • Wiring issue to starter. Note: All starter wiring is done by Azure.
Diagnostic Aids:	• Use BDT (Balance Diagnostic Tool) to manually enable the starter relay control. • Check power and ground connections including F007 (30 Amp) fuse and K7 starter relay. • Refer to appropriate Azure wiring schematics. • Jumper pin 30 and pin 87 of K7 the starter relay to confirm wiring to the starter.

P1A32- Hybrid Control Module Command Engine Pedal Correlation

Description:	This is an engine Pedal Command Fault. The difference between VCU's PCM APP command and actual PCM APP feedback from the PCM exceeds 10% for more than 2 seconds. The vehicle will be set to "Forced Conventional Limp Home mode" and the HYBRID SERVICE light will flash.
Possible Causes:	• Faulty wiring between VCU and PAC circuit. • Faulty wiring between PAC and PCM circuit. • PAC power or ground faults. • Faulty PAC module.
Diagnostic Aids:	• Check PCM for APP faults. • To verify APP functionality, use the Balance Diagnostic Tool in "Diagnostics Mode" to manually control individual PAC APP command outputs and confirm they match the corresponding APP signals read by the IDS tool. • If the AAP readings in the above step do not match, then remove accelerator pedal intercept at C122P and remove connector C238 at APP sensor and test Ford wiring by installing C122S into the APP. Clear faults with IDS tool and verify APP operation following Ford vehicle diagnostics - if the pedal functions normally, then the problem is with the Hybrid wiring or PAC module on the hybrid harness. • Refer to wiring schematics.

P1A33 AUX - Alternator - DC/DC System Performance

Description:	Fault monitoring begins after the system has been started in hybrid mode. Fault is set if the engine is on, the dc/dc is enabled and the 12 volt battery voltage drops below 11.5 volts for 15 seconds with the radiator fans off or below 11.0 volts with the Radiator fans running. The hybrid service light will be on solid.
Possible Causes:	• DC/DC failure. • Alternator failure. • Blown fuse or faulty wiring.
Diagnostic Aids:	• Using Balance Diagnostic Tool monitor input variable "12 volt Battery Voltage" when the system is running in hybrid mode with the engine off. • Refer to Alternator and DC/DC System Performance. • Refer to appropriate wiring Schematics.

P1A40- Electric Power Steering Inverter Over Temperature

Description:	The EPAS DMoC temperature has exceeded 75°C. The instrument Cluster temperature gauge will read “H” or in the RED. The EPAS shroud fan will be on.
Possible Causes:	• Faulty EPAS DMoC. • Blockage of air flow to cooling fins. • Faulty EPAS DMoC fan operation.
Diagnostic Aids:	• Visually inspect traction motor Controller cooling fins, plenum fan shroud for blockages. • Refer to Azure wiring Schematic.

P1A41 – Electric power Steering Motor Stator Over Temperature

Description:	The EPAS motor stator temperature has hit it s “Overheat” limit of 200°C. The instrument cluster temperature gauge will be in the “Red” or “H”.
Possible Causes:	• Open circuit on Stator Temperature sensor. • Failed sensor. • Motor has overheated due to blocked air flow to motor.
Diagnostic Aids:	• With the Motor at Room temperature, Measure resistance across C338P pins 9 and pin 10 resistance should be less than 1ohms, if greater than1 ohms replace EPAS Motor. • If motor temperature sensor is within spec Refer To Azure Wiring Schematic and repair wiring issue.

P1A43- Electric Power Steering Inverter Critical Fault

Description:	The traction DMoC has reported inverter state is “critical fault”. Specific fault state reported by ECU captured in freeze frame data and a DMoC Info Code is stored. The engine will be forced on and stay running and the Hybrid Service light will be on solid.
Possible Causes:	• Faulty EPAS motor Controller. • Faulty EPAS Motor. • Faulty Wiring.
Diagnostic Aids:	• Refer to Motor Controller info Codes DMoC Info Codes and freeze frame data for additional information

P1A44- Electric power Steering Inverter Fault

Description:	The EPAS DMoC has reported an inverter non-critical fault. Specific fault state reported by ECU captured in freeze frame data and a DMoC Info Code is stored. The engine will be forced on and stay running and the Hybrid Service light will be on solid.
Possible Causes:	• Faulty EPAS motor Controller. • Faulty EPAS Motor. • Faulty Wiring.
Diagnostic Aids:	• Refer to Motor Controller info Codes DMoC Info Codes and freeze frame data for additional information.

P1A45- Electric Power Steering Control Module

Description:	The EPAS DMoC state does not match the state being commanded by the VCU. The engine will be forced on and stay running and the Hybrid Service light will be on solid.
Possible Causes:	• EPAS motor control was just reprogrammed to new software without the Voltage calibration performed. • Faulty EPAS motor Controller. • Incorrect DMoC software.
Diagnostic Aids:	• Compare the ESS buss voltage to the reported voltage from the EPAS DMoC and use ccShell to recalibrate DMoC voltage. • Reprogram Motor Controller with latest software from Azure

P1A46- Electric Power Steering under Speed Fault

Description:	The reported EPAS speed has dropped 600 rpm below the requested set point for greater than 1 second. The engine will be forced on and stay running and the Hybrid Service light will be on solid.
Possible Causes:	• Faulty EPAS Motor. • Tight or seized Pump bearings. • Slipping pump belt. • Low fluid level or air in the PS lines
Diagnostic Aids:	• Remove EPAS belt and manually spin EPAS pump. If pump is hard to turn by hand, replace pump. • Check belt tension. • For intermittent faults, turn the steering wheel to full lock and hold to see if fault re-appears.

P1A47- Electric Power Steering Position Sensor Fault

Description:	The reported EPAS speed is less than 300 rpm and the then torques reported by the EPAS motor Controller is greater than 13 NM. The engine will be forced on and stay running and the HYBRID SERVCIE light will be on solid.
Possible Causes:	• Faulty EPAS Motor/ speed senor. • Tight or seized Pump bearings.
Diagnostic Aids:	• Remove EPAS belt and manually spin EPAS pump. If pump is hard to turn by hand, replace pump. • Check belt tension.

P1A57-Inclimometer Circuit low

Description:	The VCU has detected that Inclinometer analog input signal to the VCU has a short Circuit to Ground. The Inclinometer output voltage is less than .2 volts. The engine will always stay running and the Hybrid Service light be on solid.
Possible Causes:	• Failed Inclinometer. • Wiring short circuit to ground.
Diagnostic Aids:	• Unplug Inclinometer and clear fault with Balance diagnostic tool. Start the vehicle and see if the fault reappears. Note: An unplugged sensor should cause a P1A58. If the P1A57 reappears then there is a short circuit in the harness. Repair as required. If no, replace the Inclinometer. • Refer to appropriate Azure wiring schematics and check all electrical connections related to Inclinometer.

P1A58-Inclimometer Circuit High

Description:	The VCU has detected that Inclinometer analog input signal to the VCU has short Circuit to battery power or short circuit to VREF (5 volt +) or an open Circuit. The Inclinometer analog input voltage to the VCU is greater than 4.8 volts to set this fault. The engine will always stay running and the Hybrid Service light be on solid.
Possible Causes:	• Faulty Inclinometer. • Wiring short circuit to power. • Wiring short circuit to VSENS power. • Open circuit in the wiring.
Diagnostic Aids:	• Check for open circuit to Inclinometer. • Refer to appropriate Azure wiring schematics and check all electrical connections related to Inclinometer. • Refer to Diagnostic by Description Inclinometer does not read correctly

P1A5A- Charge Lamp Circuit low

Description:	The VCU has detected that Engine Alternator Fault input signal to the VCU has a short Circuit to Ground. The input voltage is less than 0.1 volt.
Possible Causes:	Wiring short circuit to ground.
Diagnostic Aids:	• Refer to appropriate Azure wiring schematics and check all electrical connections related to Engine Alternator Fault input. • Refer to the appropriate Ford Wiring schematics.

P1A5B- Charge Lamp Circuit High

Description:	The VCU has detected that Engine Alternator Fault input signal to the VCU has a short Circuit to battery power or short circuit to VREF (5 volt +). The input voltage is has exceeded 4.98 volt.
Possible Causes:	• Wiring short circuit to power. • Wiring short circuit to VSENS power. • Open circuit in the wiring.
Diagnostic Aids:	• Refer to appropriate Azure wiring schematics and check all electrical connections related to Engine Alternator Fault input. • Refer to the appropriate Ford Wiring schematics.

P1A5C- Inclinometer Fault

Description:	The VCU has detected that the Inclinometer value fails to change value over 5 km distance. The engine will remain on and the Hybrid Service light be on solid.

Possible Causes:	• Failed inclinometer.
Diagnostic Aids:	• Refer to appropriate Azure wiring schematics and check all electrical connections related Inclinometer input. • Use BDT to confirm inclinometer operation

P1A70 A/C Inverter Over Temperature

Description:	The Air Conditioning EPAS DMoC temperature has exceeded 75°C. The Hybrid Service light be on solid.
Possible Causes:	• Faulty A/C DMoC. • Blockage of air flow to cooling fins. • Faulty A/C DMoC fan operation.
Diagnostic Aids:	• Visually inspect A/C DMoC cooling fins, A/C fan for blockages. • Refer to Azure wiring Schematic.

P1A71 A/C Motor Stator Over Temperature

Description:	The A/C motor stator temperature has hit it s “Overheat” limit of 200°C. The Hybrid Service light be on solid.
Possible Causes:	• Open circuit on Stator Temperature sensor. • Failed sensor. • Motor has overheated due to blocked air flow to motor.
Diagnostic Aids:	

P1A73 A/C Inverter Critical Fault

Description:	The A/C DMoC has reported inverter state is “critical fault”. Specific fault state reported by VCU captured in freeze frame data and a DMoC Info Code is stored. The A/C will be disabled and the Hybrid Service light be on solid. .
Possible Causes:	• Faulty A/C motor Controller. • Faulty A/C Motor. • Faulty Wiring.
Diagnostic Aids:	• Refer to A/C DMoC info Codes DMoC Info Codes and freeze frame data for additional information.

P1A74 - A/C Inverter Fault

Description:	The A/C DMoC has reported an inverter non-critical fault. Specific fault state reported by VCU captured in freeze frame data and a DMoC Info Code is stored. The A/C will be disabled and the Hybrid Service light be on solid.

Possible Causes:	• Faulty A/C DMoC. • Faulty A/C Motor. • Faulty Wiring.
Diagnostic Aids:	• Refer to DMoC info Codes DMoC Info Codes and freeze frame data for additional information.

P1A75 A/C Control Module

Description:	The A/C DMoC state does not match the state being commanded by the VCU. The A/C will be disabled and the Hybrid Service light be on solid.
Possible Causes:	• A/C DMoC was just reprogrammed to new software without the Voltage calibration performed. • Faulty A/C DMoC. • Incorrect DMoC software.
Diagnostic Aids:	• Compare the ESS buss voltage to the reported voltage from the EPAS DMoC and use ccShell to recalibrate DMoC voltage. • Verify Software level and Reprogram DMoC with the latest software from Azure if necessary.

P2109 – Throttle/Pedal Position Sensor "A" Minimum Stop Performance

Description:	MY2008- The accelerator pedal track 1 signal is below 9%. If no faults are present on tracks 2 & 3 then the vehicle will continue to operate normally and the Hybrid Service light be on solid. If faults are present for track 2, track 3 or both as well as the P02109, then the vehicle will be set to a "Forced Conventional Limp Home Mode" and The HYBRID SERVICE light will Flash. Note: APP track 1 is an inverted signal when compared to tracks 2 & 3. MY2009- The accelerator pedal track 1 signal is below 2%. The vehicle will be set to a "Forced Conventional Limp Home Mode" and The HYBRID SERVICE light will Flash.
Possible Causes:	• APP track 1 short to Vbat or VREF. • APP track 1 connectivity. • APP sensor fault.
Diagnostic Aids:	• Refer to appropriate Azure wiring schematics. • Refer to appropriate Ford Diagnostics for APP sensor.

P2113 – Throttle/Pedal Position Sensor "B" Minimum Stop Performance

Description:	MY 2008- The accelerator pedal track 2 signal is below 9%. If no faults are present on tracks 1 & 3 then the vehicle will continue to operate normally and the Hybrid Service light will be on solid. If faults are present for track 1, track 3 or both as well as the P02113, then the vehicle will be set to a "Forced Conventional Limp Home Mode" and The HYBRID SERVICE light will Flash. MY 2009- The accelerator pedal track 2 signal is below 2%. The vehicle will be set to a "Forced Conventional Limp Home Mode" and The HYBRID SERVICE light will Flash.
Possible Causes:	• APP track 2 short to ground • APP track 2 connectivity • APP sensor fault
Diagnostic Aids:	• Refer to appropriate Azure wiring schematics. • Refer to appropriate Ford Diagnostics for APP sensor.

P2114 – Throttle/Pedal Position Sensor "C" Minimum Stop Performance

Description:	The accelerator pedal track 3 signal is below 9%. The vehicle will continue to operate normally and the Hybrid Service light will be on solid.
Possible Causes:	• APP track 3 short to ground. • APP track 3 connectivity. • APP sensor fault.
Diagnostic Aids:	• Refer to appropriate Azure wiring schematics. • Refer to appropriate Ford Diagnostics for APP sensor.

P2163- Throttle / Pedal Position Sensor "A" Maximum Stop Performance

Description:	MY 2008- The accelerator pedal track 1 signal is above 91%. If no faults are present on tracks 2 & 3 then the vehicle will continue to operate normally and the Hybrid Service light be on solid. If faults are present for track 2, track 3 or both as well as the P02163, then the vehicle will be set to a "Forced Conventional Limp Home Mode" and the HYBRID SERVICE light will flash. Note: APP track 1 is an inverted signal when compared to tracks 2 & 3. MY 2009- The accelerator pedal track 1 signal is above 98%. The vehicle will be set to a "Forced Conventional Limp Home Mode" and the HYBRID SERVICE light will flash.
Possible Causes:	• APP track 1 short to ground. • APP track 1 connectivity. • APP sensor fault.
Diagnostic Aids:	• Refer to appropriate Azure wiring schematics. • Refer to appropriate Ford Diagnostics for APP sensor.

P2164- Throttle / Pedal Position Sensor "B" Maximum Stop Performance

Description:	MY 2008- The accelerator pedal track 2 signal is above 91%. If no faults are present on tracks 1 & 3 then the vehicle will continue to operate normally and the Hybrid Service light will be on solid. If faults are present for track 1, track 3 or both as well as the P02164, then the vehicle will be set to a "Forced Conventional Limp Home Mode" and The HYBRID SERVICE light will be Flash. MY 2009- The accelerator pedal track 2 signal is above 98%. The vehicle will be set to a "Forced Conventional Limp Home Mode" and The HYBRID SERVICE light will be Flash.
Possible Causes:	• APP track 2 short to power. • APP track 2 connectivity. • APP sensor fault.
Diagnostic Aids:	• Refer to appropriate Azure wiring schematics. • Refer to appropriate Ford Diagnostics for APP sensor.

P2165- Throttle / Pedal Position Sensor "C" Maximum Stop Performance

Description:	The accelerator pedal track 3 signal is above 91%. The vehicle will continue to operate normally and the Hybrid Service light will be on solid.
Possible Causes:	• APP track 3 short to power. • APP track 3 connectivity. • APP sensor fault.
Diagnostic Aids:	• Refer to appropriate Azure wiring schematics. • Refer to appropriate Ford Diagnostics for APP sensor.

P250A –Engine Oil Level Sensor Circuit

Description:	The Engine Oil Level switch input to the VCU switches faster than max defined frequency of 1 Hz.
Possible Causes:	Engine Oil Level switch Circuit - intermittent connection.
Diagnostic Aids:	• Use Balance diagnostic tool to monitor Engine Oil Level switch Input. • Refer to appropriate Azure wiring schematics and check all electrical connections related to Engine Oil Level switch Input to VCU.

P2519- A/C Request "A" Circuit

Description:	The Body Builder A/C request input to the VCU switches faster than max defined frequency of 25 Hz. The vehicle will continue to operate normally and the Hybrid Service light will be on solid.
Possible Causes:	A/C request - intermittent connection.
Diagnostic Aids:	• Use Balance diagnostic tool to monitor A/C request Input. • Refer to appropriate Azure wiring schematics and check all electrical connections related to A/C request Input to VCU.

P2533- Ignition Switch Run/Start Position Circuit

Description:	The Key Start input to the VCU switches faster than max defined frequency of 5 Hz. The vehicle will continue to operate normally and the Hybrid Service light will be on solid.
Possible Causes:	Key Start circuit - intermittent connection.
Diagnostic Aids:	• Use BDT to monitor Key-Start input. • Confirm C310S-D3 connectivity. • Refer to appropriate Azure wiring schematics and check all electrical connections related to Key Start Input to VCU.

U0100 ENG - Lost Communication with ECM/PCM "A"

Description:	Fault monitoring begins 2 seconds after the PCM has been powered on by the VCU. The VCU will monitor the PCM CAN messages. If any PCM message is arriving too slow, or any message is not being received at all, this fault will set. The vehicle will be set to "Forced Conventional Limp Home mode" and the HYBRID SERVICE light will flash.
Possible Causes:	• External E-Stop circuitry/ short to ground. (pre-production only) • Failed Can1 terminator resistor. • Failed PCM. • Faulty power and ground circuits to PCM module. • Faulty wiring, routing or connection problems on CAN 1.
Diagnostic Aids:	• Place vehicle in conventional mode and perform Ford base vehicle diagnostics to confirm the PCM is operating normally. • Use BDT (Balance Diagnostic Tool) to manually enable PCM relay and confirm Vbatt at Ford PCM fuse #23 (at Ford under hood power distribution panel). • Refer Azure wiring schematic • Refer to pinpoint test procedure Loss of CAN 1 Communications.

U010F Lost Communication With Air Conditioning Module

Description:	If any Traction Motor DMoC CAN message is arriving too slow, or any message is not being received at all, this fault will set. The Body Air conditioning will be disabled and The HYBRID SERVICE light will be on solid.
Possible Causes:	• CAN terminator resistor failure CAN 2. • Faulty A/C DMoC. • Failed 12 volt power or grounds toA/C DMoC. • Wiring or connection problems.
Diagnostic Aids:	• Use BDT (Balance Diagnostic Tool) to check A/C function. • Refer Azure wiring schematic • Refer to pinpoint test procedure Loss of CAN 2 communications.

U0110- Lost Communication with Drive Motor Control Module "A"

Description:	If any Traction Motor DMoC CAN message is arriving too slow, or any message is not being received at all, this fault will set. The vehicle will be set to a "Forced Conventional Mode" and The HYBRID SERVICE light will be on solid.
Possible Causes:	• CAN terminator resistor failure CAN 2. • Faulty traction DMoC. • Failed 12 volt power or grounds to ISG DMoC. • Wiring or connection problems.
Diagnostic Aids:	• Follow diagnostic by description Traction DMoC not functioning or not communicating. • Follow diagnostic by description Loss of CAN 2 communications. • Refer to appropriate Azure wiring schematics.

U0111 – Lost Communication with Battery Control Module "A"

Description:	Fault monitoring begins 1 second after the ESS has been powered on by the VCU. The VCU will monitor the ESS CAN messages. If any ESS message is arriving too slow, or any message is not being received at all, this fault will set. The vehicle will be set to "Forced Conventional mode" and the HYBRID SERVICE light will be on solid.
Possible Causes:	• Can terminator resistor failure CAN 2. • Failed ESS. • Failed power or grounds to ESS. • Wiring or connection problems.
Diagnostic Aids:	• Follow diagnostic by description ESS not communicating. • Follow diagnostic by description Loss of CAN 2 communications. • Refer to appropriate Azure wiring schematics.

U0120 Lost Communication with Starter / Generator Control Module

Description:	The VCU has detected a message is being received too slowly, or no message is received at all for any ISG CAN message. The Body Builder AC will be shut off, the engine will be forced on and stay running, and the Hybrid Service light will be on solid.
Possible Causes:	• CAN terminator resistor failure CAN 2. • Faulty ISG DMoC. • No HV power (blown fuse). • Failed 12 volt power or grounds to ISG DMoC. • Wiring or connection problems.
Diagnostic Aids:	• Follow diagnostic by description ISG DMoC not functioning or not communicating. • Follow diagnostic by description Loss of CAN 2 communications. • Refer to appropriate Azure wiring schematics.

U0121 ABS- Lost Communication with Anti-Lock Brake System (ABS) Control Module

Description:	The VCU will start to monitor this CAN message 5 seconds after the ABS module is powered up. If any ABS message is arriving too slowly, or any message is not being received at all, this fault will set. The VCU will disable the regenerative braking. The hybrid service light will be on solid and the vehicle will continue in hybrid operation.
Possible Causes:	• Failed Can1 terminator resistor. • Failed ABS module. • Faulty power and ground circuits to ABS module. • Faulty wiring, routing or connection problems on CAN 1.
Diagnostic Aids:	• Perform Ford base vehicle diagnostics and confirm ABS system is operating normally. • Refer to pinpoint test procedure Loss of CAN 1 communications.

U0131- Lost Communication with Power Steering Control Module

Description:	The VCU has detected a message period greater than 2x specified rate, or no message received at all for any EPAS CAN message. The engine will be forced on and stay running and the Hybrid Service light be on solid.
Possible Causes:	• Electrical noise on CAN 2. • Can terminator resistor failure CAN 2. • Faulty EPAS motor Controller. • Failed power or grounds to EPAS DMoC. • Wiring or connection problems.
Diagnostic Aids:	• Follow diagnostic by description EPAS DMoC not functioning or not communicating. • Follow diagnostic by description Loss of CAN 2 communications. • Refer to appropriate Azure wiring schematics.

U0151- Lost Communication with Restraint Control Module

Description:	RCM CAN message is arriving too slow, or any RCM message is not being received at all, this fault will set. The Hybrid Service light will be on solid.
Possible Causes:	• Can terminator resistor failure CAN 1. • Faulty Restraint Control Module. • Wiring or connection problems.
Diagnostic Aids:	• Follow diagnostic by description Loss of CAN 1 communications. • Refer to appropriate Azure wiring schematics. • Refer to Ford diagnostic relating to restraint control module.

U0155 – Lost Communication with Instrument Panel Cluster (IPC) control Panel

Description:	The VCU will monitor the IPC CAN messages. If any IPC message is arriving too slow, or any message is not being received at all, this fault will set. The HYBRID SERVICE light will be on solid.
Possible Causes:	• Can terminator resistor failure CAN 2. • Failed instrument cluster. • Faulty wiring or connection problems.
Diagnostic Aids:	• Refer to appropriate Azure wiring schematics. • Refer to pinpoint test procedure Loss of CAN 2 communications. • Refer to Ford diagnostics for IPC.

U0311 Software Incompatibility With Drive Motor Control Module

Description:	The SW revision reported by the TM DMoC is NOT 4. The vehicle will be set

	to a “Forced Conventional Mode” and The HYBRID SERVICE light will be on solid.
Possible Causes:	• The TM DMoC has the incorrect software level loaded.
Diagnostic Aids:	• Reprogram the TM DMoC with the correct software level. Refer to https://extranet.azuredynamics.com for the latest software version.

U1030 Software Incompatibility With Air Conditioning Module

Description:	The SW revision reported by the A/C DMoC is NOT 4. The vehicle will be set to a “Forced Conventional Mode” and The HYBRID SERVICE light will be on solid.
Possible Causes:	• The A/C DMoC has the incorrect software level loaded.
Diagnostic Aids:	• Reprogram the A/C DMoC with the correct software level. Refer to https://extranet.azuredynamics.com for the latest software version.

U1031 Software Incompatibility With Power Steering Control Module

Description:	The SW revision reported by the EPAS DMoC is NOT 4. The vehicle will be set to a “Forced Conventional Mode” and The HYBRID SERVICE light will be on solid.
Possible Causes:	• The EPAS DMoC has the incorrect software level loaded.
Diagnostic Aids:	• Reprogram the EPAS DMoC with the correct software level. Refer to https://extranet.azuredynamics.com for the latest software version.

U1032 Software Incompatibility With Starter / Generator Control Module

Description:	The SW revision reported by the ISG DMoC is NOT 4. The vehicle will be set to a “Forced Conventional Mode” and The HYBRID SERVICE light will be on solid.
Possible Causes:	• The ISG DMoC has the incorrect software level loaded.
Diagnostic Aids:	• Reprogram the ISG DMoC with the correct software level. Refer to https://extranet.azuredynamics.com for the latest software version.

U1300, U1301, U1302, U1303, 1304, U1305, U1306, U1307- VCU Low Memory Margin……

Description:	These are internal VCU software monitors that aid in development.
Possible Causes:	• NA.
Diagnostic Aids:	• Save then Clear faults using Balance Diagnostic Tool . If faults reoccur, record the faults and contact. Email saved DTC's to techline@azuredynamics.com If faults frequently reappear or are continually active contact • Product Support / Techline Support Toll Free Number: 1-866-473-1636 Phone: 905-607-3486

U1310, U1311, U1312, U1313, 1314, U1315, U1316 – VCU CPU……

Description:	These are internal VCU software monitors that aid in development.
Possible Causes:	• NA.
Diagnostic Aids:	• Save then Clear faults using Balance Diagnostic Tool . If faults reoccur, record the faults and contact. Email saved DTC's to techline@azuredynamics.com If faults frequently reappear or are continually active contact • Product Support / Techline Support Toll Free Number: 1-866-473-1636 Phone: 905-607-3486

7.5 DMOC Info Codes

When a fault occurs on the DMoC it is logged into a short (4 fault) error history that is read with the BDT under the DTC's /Info codes under EE3PSFault0, 1, 2 or 3.

A VCU DTC will also be set with any DMoC's info code and the specific DMoC info code is captured in the Freeze Frame Data under ISG, TM, AC, or EPAS.

The table below shows both critical and non-critical faults related to the DMoC's.

Note: All DMoC's (EPAS, ISG, AC and TM) report the same info codes.

DMOC INFO CODES		
0	PS_FLT_NO_FAULTS	NO FLT
1	PS_FLT_UNKNOWN_FAULT	NON-CRITICAL FAULTS
2	PS_FLT_ERROR_ON_ENABLE	
3	PS_FLT_RELAY_ERROR_AT_READY	
4	PS_FLT_RELAY_ERROR_AT_ENABLED	
5	PS_FLT_CHARGED_ERROR	
6	PS_FLT_HARDWARE_OV	
7	PS_FLT_HARDWARE_OC	
8	PS_FLT_SOFTWARE_OC	
9	PS_FLT_SOFTWARE_OV	
10	PS_FLT_DC_BUS_UNDER_VOLTAGE	
11	PS_FLT_OVERSPEED	
12	PS_FLT_SVPWM_ERROR	
13	PS_FLT_SPEED_SENSOR_ERROR	
128	PS_FLT_DESAT	CRITICAL FAULTS
129	PS_FLT_CURRENT_CALIB_FAULT	
130	PS_FLT_EXTERNAL_PS_DISABLE_AT_ENABLED	
131	PS_FLT_KERNAL_DISPATCHER_ERROR	
132	PS_FLT_UNDEFINED_CASE_ERROR	
200	DMOC_FAULT_CAUSE_PS_OFF	
201	DMOC_FAULT_CAUSE_NO_COMMAND1_CAN	
202	DMOC_FAULT_CAUSE_NO_COMMAND2_CAN	
203	DMOC_FAULT_CAUSE_NO_VCUQUIZ_CAN	
204	DMOC_FAULT_CAUSE_NO_DMOCQUIZ_CAN	
205	DMOC_FAULT_CAUSE_CAN_OVERFLOW	
206	DMOC_FAULT_CAUSE_UNKNOWN_CAN_FAULT	
207	DMOC_FAULT_CAUSE_UNKNOWN_SW_FAULT	
208	DMOC_FAULT_CAUSE_CAN_BUS_ERROR	
255	DMOC_FAULT_CAUSE_IS_NOT_ASSIGNED	

Enumerated Fault Codes (EE3PSFault0...)

New code (since November 2007) also includes an enumerated error, the ISR2PSActiveError, which will display the worst case error that occurred in a human readable form. The fault history EE3PSFault0, EE3PSFault1, etc provides the enumerated history for the last 4 faults. These error codes were released for external use on P1 in November 2007, so the following codes are fixed. Additional codes may be added as the fault handling improves (below from ctl_pub.h).

(0) - PS_FLT_NO_FAULTS

This is the desired state, NO_FAULTS (0) indicates that no fault condition is active. Or in the error history, means no fault has occurred since the error history was cleared.

(1) - PS_FLT_UNKNOWN_FAULT

This fault should never occur in production code. This indicates that the powerstage state machine detected that the PWM outputs were disabled, but no known cause could be attributed. Usually this results during code development, when new fault handling has not been implemented completely/correctly. All instances of this fault should be treated seriously and diagnosed so that proper fault reporting can be implemented.

(2) -PS_FLT_ERROR_ON_ENABLE

Description:	This fault is flagged if after enabling the gate drivers, a fault is immediately detected.
Possible Causes:	• Problem with fault clearing circuit. • Fault active while trying to enable (Hardware overvoltage might cause this?).
Diagnostic Aids:	• Use ccShell to load the latest software and calibrations. *Refer to* https://extranet.azuredynamics.com *for the latest software,* If fault persists, replace controller.

(3) - PS_FLT_RELAY_ERROR_AT_READY
(4) - PS_FLT_RELAY_ERROR_AT_ENABLED

These faults are very similar, indicating that the contactor was detected to be open when it was commanded closed. These faults only distinguish if the DMoC was switching (enabled) at the time the fault was detected.

This hardware configuration is controlled by parameter change. EE2ContactorIsInternal will default to TRUE (1) for most applications. If your DMoC does not have an internal contactor, this parameter should be set to FALSE (0). Follow the appropriate diagnostics path below:

Description:	Contactor state is not closed when powerstage state is READY or ENABLED.
Possible Causes:	Blown Fuse internal to DMoC Calibration error, check that your unit is calibrated for an external contactor. Shielding grounding problem. If the CAPS_CHARGED signal is still noisy, the contactor state may still register a fault.
Diagnostic Aids:	• Verify that EE2ContactorIsInternal = 0. • Use ccShell to load the latest software and calibrations. *Refer to* https://extranet.azuredynamics.com *for the latest software,* if fault persists, replace controller. • Look at variable ISR2ContactorState, it should be EXTERNAL, if noisy, it may be possible to trigger EXTERNAL_CRITICAL_FAULT, in which case you need to resolve the noise issue.

(5) - PS_FLT_CHARGED_ERROR

Description:	The "Charged Error" fault is often observed as a nuisance in systems with a lot of noise or bad grounding.
Possible Causes:	• Problem with vehicle 12 volt supply (input to DMoC). • Bad grounding, cable routing, or external noise. • Incorrect software
Diagnostic Aids:	• Use ccShell to load the latest software and calibrations. *Refer to* https://extranet.azuredynamics.com *for the latest software* • Verify grounding is correct.

(6) - PS_FLT_HARDWARE_O volt

Description:	The hardware over voltage fault is caused by the controller hardware detecting a voltage above 90% of full scale (500 volts). This almost always corresponds to 450 volts DC). The purpose of the hardware protection is to stop the DMOC from switching when it detects a dangerously high voltage. In general this protection is faster than any software over voltage protection which is usually set to a lower voltage.
Possible Causes:	• Inaccurate software voltage calibration allows the DC bus to go to too high a voltage. • Other component on high voltage bus is causing a voltage spike. • Failed DMoC- Noisy signal from power board where high voltage DC is scaled down to 0-5 volts range. • Contactor opening or fuse blowing during regen. • PM motor overspeed and back EMF voltage is too high. • Battery is over charged.

Diagnostic Aids:	• Verify Battery voltage is within the recommended range. • Recalibrate DMoC voltage with ccShell. • Check that grounding and shielding is done properly to prevent noise. • Log ISR1UsDC, ISR2EstBatCurrent, ISR2Hertz. • A loss of motor control stability at high speed might put too much current onto the bus, particularly for permanent magnet motors. • Contact- Azure Dynamics Product Support / Techline Support

(7)- PS_FLT_HARDWARE_OC

Description:	All hardware over current faults will trigger the enumerated fault code PS_FLT_HARDWARE_OC. The EE3LastError detects each fault individually.
Possible Causes:	• Wrong or corrupt Software/ calibration. • Damaged motor. Motor inductance is not correct. • Bad speed sensor or noisy speed sensor. Bad reading of rotor position causes DMoC to produce voltage vectors that are incorrect and cause an over current. • System dynamics are too fast for DMoC to control. A rotor speed that quickly changes or is spinning very fast may need carefully tuned current loop parameters to avoid over current. • Faulty DMoC-IGBT problems. A blown IGBT or gate driver may cause the DMOC to poorly control the current. • Current sensor may be damaged.
Diagnostic Aids:	• Use ccShell to load the latest software and calibrations. *Refer to* https://extranet.azuredynamics.com *for the latest software* • Use ccShell scope tool to capture current waveforms (ISR1IsU, ISR1IsV and ISR1IsW) at highest sampling rate 10kHz (EE1LoggingRate=1). Also check rotor position waveform, ISR1FluxPosition. • Contact- Azure Dynamics Product Support / Techline Support

(8)- PS_FLT_SOFTWARE_OC

The Software Over Current fault is primarily used for testing or in applications where additional motor protection is required. The easiest way to trigger a fault is to set an artificially low value for EE1SoftOCLimit. Any time the motor current exceeds this value the Software Over Current fault will be triggered.

Description:	This fault is flagged if the motor currents exceed the calibratible threshold EE1SoftOCLimit. Note: that a value less than or equal to zero will disable this fault handling.
Possible Causes:	• Wrong or corrupt Software/ calibration.
Diagnostic Aids:	• Use ccShell to load the latest software and calibrations. *Refer to*

	https://extranet.azuredynamics.com *for the latest software* • Check the value of EE1SoftOCLimit is zero or negative. • Contact- Azure Dynamics Product Support / Techline Support

(9)- PS_FLT_SOFTWARE_O volts

Description:	The software O volts fault is flagged when software detects an overvoltage condition. The threshold for this error detection is set by parameter calibration. In case of a Hardware OV, this fault may be triggered simultaneously. Triggered when the filtered DC Voltage exceeds the calibrated value of EE1MaxSwitchingVdc.
Possible Causes:	• Inaccurate software voltage calibration allows the DC bus to go to too high a voltage. • Other component on high voltage bus is causing a voltage spike. • Failed DMoC- Noisy signal from power board where high voltage DC is scaled down to 0-5 volts range. • Contactor opening or fuse blowing during regen. • PM motor over speed and back EMF voltage is too high. • Battery is over charged. •
Diagnostic Aids:	• Verify Battery voltage is within the recommended range. • Recalibrate DMoC voltage with ccShell. • Check that grounding and shielding is done properly to prevent noise. • Log ISR1UsDC, ISR2EstBatCurrent, ISR2Hertz. • A loss of motor control stability at high speed might put too much current onto the bus, particularly for permanent magnet motors. • Contact- Azure Dynamics Product Support / Techline Support

(10)- PS_FLT_DC_BUS_UNDER_VOLTAGE

Description:	The DC bus voltage drops below the EE2PSOffBat (The minimum Powerstage Operating Threshold, typically 100 volts) while the power stage is enabled. Note that the battery voltage must be above EE2PSOnBat (typically 120 volts) before the powerstage will enable. Since in many applications the DMoC does not receive an OFF signal, the HV bleeding away is a normal shutdown event, therefore this fault is only flagged if the DMoC was switching (torque was commanded) when the DC Bus Voltage drops out. This fault is meant to highlight abnormal shutdown sequences, it is really more a warning than a fault.

Possible Causes:	• Abnormal shutdown sequence. • Wrong or corrupt Software/ calibration • Faulty HV battery • Faulty VCU control
Diagnostic Aids:	• Confirm the shutdown sequence for the DMoC was correct, with all torque request being zeroed at least EE2PSIdleTime before the HV dropped below EE2PSOffBat. • Use ccShell to load the latest software and calibrations. *Refer to* https://extranet.azuredynamics.com *for the latest software*

(11)- PS_FLT_OVERSPEED

Description:	The motor Controller has detected that the motor speed in RPM has exceeded the calibrated limit of EE2PosOverspeed in the positive direction, or EE2NegOverspeed in the reverse direction.
Possible Causes:	• Over speed of the Motor • Noisy speed sensor signal • Failed speed sensor/connection issue.
Diagnostic Aids:	• Confirm the shutdown sequence for the DMoC was correct, with all torque request being zeroed at least EE2PSIdleTime before the HV dropped below EE2PSOffBat. • Use ccShell to load the latest software and calibrations. *Refer to* https://extranet.azuredynamics.com *for the latest software*

(12) - PS_FLT_SVPWM_ERROR

Description:	This results from calibration settings which reference an unsupported operating mode. Note: This "fault" cannot be cleared so it is really more like a critical fault. Contact Azure for details
Possible Causes:	• Incorrect Software
Diagnostic Aids:	• Use ccShell to load the latest software and calibrations. *Refer to* https://extranet.azuredynamics.com *for the latest software* • Contact- Azure Dynamics Product Support / Techline Support.

(13)- PS_FLT_SPEED_SENSOR_ERROR

Description:	Speed discontinuity which exceeds the calibratable threshold

	EE2SpeedDeltaFaultThr.
Possible Causes:	• Speed Sensor Noise or Disconnect. • Speed sensor harness or connector connectivity.
Diagnostic Aids:	• Log ISR2Hertz and/or ISR1FluxPosition and ISR1MPosition. • Repair harness or connection issue

(128) - DESAT

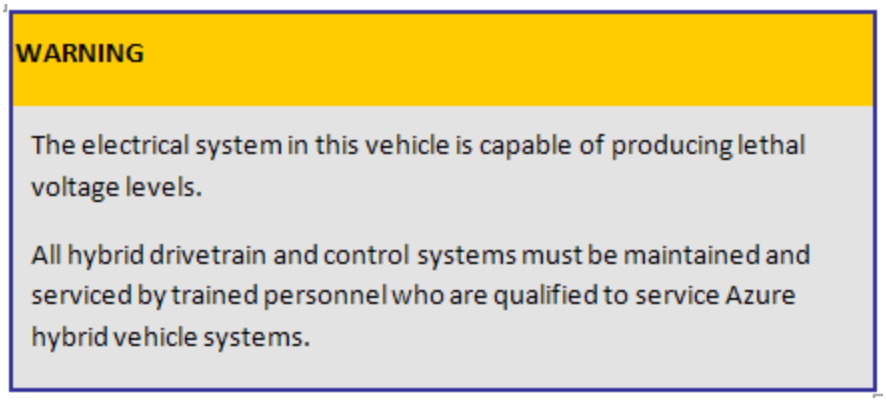
There are three levels of over-current protection in the DMoCs, each with the ability to act with different response times and trip levels. The three levels are:

Software Over-Current - slowest response time, trip level can be adjusted by changing software parameters

Hardware Over-Current - medium response time, trip level is fixed in hardware, high trip level

Desaturation Detection - fastest response time, trip level is fixed in hardware, highest trip level.

Description:	This fault indicates that one or more of the IGBTs experienced an excessive current. This is the last level of hardware protection, triggering a critical fault which requires power cycling the DMoC to re-enable.
Possible Causes:	• Motor that is being driven by the DMoC has a phase-to-phase short. • The cable to the motor has a phase-to-phase short. • Failed DMoC -Current sensor failure or disconnected. The IGBT or other internal circuitry of the DMoC (DMoC) has catastrophically failed. • Faulty DMoC grounding.

Diagnostic Aids:	 • Disconnect motor cables and measure the resistance between each phase and ground. The resistance should be greater than 1.0 MegaOhm. • Perform Isolation Resistance test Isolation Resistance Testing • Disconnect motor cables and safely isolate them from both the motor and the phase windings. For ISG or TM , Restart the vehicle in hybrid mode and attempt to move the vehicle forward in forward or reverse. If fault is on a EPAS DMoC, Using the BDT, enable diagnostic mode and then enable high voltage mode. Manually engage EPAS system. If fault reappears, replace DMoC.

(129)- PS_FLT_CURRENT_CALIB_FAULT

Description:	The DMoC has detected an internal hardware failure (current calibration outside of allowed bounds) indicating a possible problem with the current sensors.
Possible Causes:	Offset calibration out of range due to extreme cold temperatures (below -20°C on some hardware). . Failed DMoC- Current sensor failure or disconnect (internal failure).
Diagnostic Aids:	• Verify temperature is not extremely cold. • Use ccShell scope tool to log currents and voltages: at 10kHz logging rate log the following: ISR2IdF, ISR2IqF, ISR1IsV, and ISR1IsW, send the captured data to Azure for analysis. • If the above test okay, replace the DMoC.

(130)- PS_FLT_EXTERNAL_PS_DISABLE_AT_ENABLED

Description:	This fault is flagged if the DMoC receives an external disable signal from the VCU via a hardware input signal while the Powerstage was enabled.
Possible Causes:	Problem with external disable wiring. If the external disable signal is not wired properly, then noise could trigger this fault. Wiring connectivity issue between VCU and DMoC
Diagnostic Aids:	• Check that the External Disable input to the DMoC is wired properly. • Verify VCU shutdown sequencing is correct.

(131)- PS_FLT_KERNEL_DISPATCHER_ERROR

Description:	The DMoC has run out of code execution time. Usually only seen during software development.
Possible Causes:	• Wrong or corrupt Software/ calibration • Motor controller failure.
Diagnostic Aids:	• Use ccShell to load the latest software and calibrations. *Refer to* https://extranet.azuredynamics.com *for the latest software* • If software level is correct replace DMoC

*(*132)- PS_FLT_UNDEFINED_CASE_ERROR

Description:	This fault indicates a corruption of the powerstage state variable. This variable has been set to an invalid state. All changes in software to the powerstage state variable should happen through the powerstage FSM. No other code should write to the state.
Possible Causes:	• Wrong or corrupt Software/ calibration • Motor controller failure.
Diagnostic Aids:	• Use ccShell to load the latest software and calibrations. *Refer to* https://extranet.azuredynamics.com *for the latest software* • If software level is correct replace DMoC

(206)- DMOC_FAULT_CAUSE_UNKNOWN_CAN_FAULT

Description:	This is a CAN fault, that is not specifically enumerated in the P1 extension module, refer to the ISR2CANComState for more information.
Possible Causes:	• Can Bus Errors or other problems (grounding)
Diagnostic Aids:	• Verify that ISR2CANComState is not ONLINE. • Use other CAN analyzer tool to look for CAN bus errors (CANKing for

	example). • Check grounding and CAN wiring.

(208)- DMOC_FAULT_CAUSE_CAN_BUS_ERROR

Description:	This CAN fault is triggered if ISR2CANComState is not ONLINE
Possible Causes:	• Can Bus Errors or other problems (grounding) • DMoC failure
Diagnostic Aids:	• Verify that ISR2CANComState is not ONLINE. • Use other CAN analyzer tool to look for CAN bus errors (CANKing for example). • Check grounding and CAN wiring.

7.6 ESS INFO Codes

The ESS (Energy Storage System) Info codes are the component level faults that are monitored and stored in the ESS. The VCU monitors the fault status of the ESS and will set and store system level faults based on the state and level of fault stored in the ESS.

ESS Diagnostics

There are two controller hardware revision levels in the NiMH battery pack: the newer Algonia and older CBCM type controllers. Unfortunately the stored fault definitions conflict on two faults. The BDT accommodates the conflict by displaying both codes, and the diagnosis will need to proceed based on the controller type. The codes displayed for these two faults are as follows:

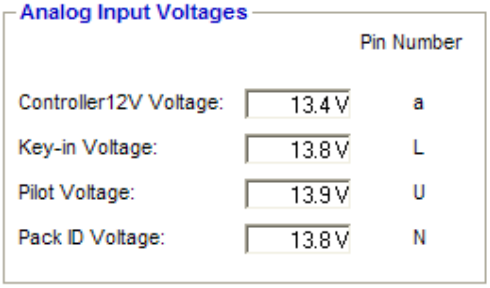
- Input: DBS (CBCM) or Service Disconnect (Alagonia)
- Input: Default Param Loaded (CBCM) or DBS (Alagonia)

Note_ No ESS DTC (P1A20) is flagged by the VCU when the only active ESS fault reported by the pack is a failed CBCM/Alagonia HW; however, the CBCM/Alagonia HW Failed fault will be recorded in the ESS fault buffer. This DTC has been disabled by the VCU due to frequent invalid reporting of the fault by the ESS.

7.6.1 ESS – INPUT: PILOT

Description:	a. The ESS measured "Pilot" voltage (external 12 volt ignition supply for the pack's contactors), on pin "U" of the pack's 31 position low voltage connector, has dropped below 7.5 volts while the ignition is ON. b. NOTE: If the Pilot Fault has been triggered, the CBCM can no longer guarantee the operation of the battery pack contactors. If the contactors are open when this fault occurs, the CBCM will prevent any precharge attempts. If the contactors are closed when the fault occurs, the contactors may open on their own. The Pilot input is the Contactor Power supply.
Possible Causes:	• 12 volt battery/ low voltage (below 7.5 volts) • Open circuit "Pilot" contactor 12 volt supply (blown fuse, tripped inertia switch, intermittent/corroded connection) • Open service disconnect access panel contact switch • ESS 12 volt ignition input (pin "L") shorted to battery 12V
Diagnostic Aids:	See pinpoint test below

Test step	Result / Action
1 Perform preliminary diagnostics. *Were any issues found?*	*Yes* Repair and retest. *No* Go to step 2
2 Check the Battery Software • Key ON, do not go to the high volt mode. • Using the Balance Diagnostic Tool , check the software version *Is the latest version of software loaded? Refer to https://extranet.azuredynamics.com for the latest software.*	*Yes* Go to step 3 *No* Load latest software and retest.
3 Check for Battery Faults • Key ON, do not go to the high volt mode. • Using the Balance Diagnostic Tool, Record and clear codes. • Cycle the key OFF and back ON.	*Yes* Go to step 4 *No*

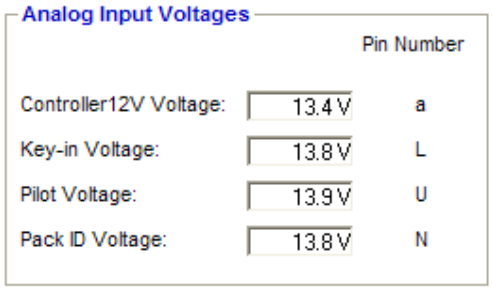
Test step	Result / Action
• Check for faults. *Does the Pilot Fault return?*	No fault found
4 Check Power to the Battery Pack. • Key OFF, connector C053S reconnected: • Key ON, do not go to the high volt mode. • Using the Balance Diagnostic Tool, check the Pilot Voltage. (refer to illustration)  *Is battery voltage higher than 7.5 volts?*	*Yes* Clear faults and recheck. *No* Go to step 5
5 Check Power to the Battery Pack. • Key OFF, connector C053S disconnected from the battery pack. • Key ON, measure the voltage from pin U (12 volt power) to pin Z (ground) *Is battery voltage present?*	*Yes* Go to step 6 *No* Refer to the proper wiring diagram and repair fault. Check inertia switch
6 Check Connector • Key OFF, connector C053S disconnected • Check for loose or pushed pins at both sides of the connector. • Confirm that the ESS access panel lid is securely fastened. *Are any issues found*	*Yes* Repair as required. *No* Replace battery pack

7.6.2 ESS – Input: Pack ID

Description:	The Pack Identifier Signal was measured and found to be invalid. This condition is checked just once after the CBCM wakes up. If the Pack Identifier signal is lost after the CBCM initialization sequence is complete, it will not be noticed.

	NOTE: If the Pack Identifier Fault is set, it is likely that the CAN Link Lost Fault will be set as well.
Possible Causes:	• Open, intermittent, or corroded 12 volt battery connection to pin "N", at key ON. • 12 volt battery voltage is low. below 7.5V •
Diagnostic Aids:	• See pinpoint test below

Test step	Result / Action
1 Perform preliminary diagnostics. *Were any issues found?*	*Yes* Repair and retest. *No* Go to step 2
2 Check the Battery Software • Key ON, do not go to the high volt mode. • Using the Balance Diagnostic Tool , check the software version *Is the latest version of software loaded? Refer to https://extranet.azuredynamics.com for the latest software.*	*Yes* Go to step.3 *No* Load latest software and retest.
3 Clear Codes • Key ON, but do not start the vehicle: • Using the Balance Diagnostic tool, clear all battery codes. • Cycle the key OFF and then back ON and restart the vehicle. • Check for codes. *Does the Input: Pack ID Fault return?*	*Yes* Go to step 4 *No* No fault found
4 Check Power to the Battery Pack. • Key OFF, connector C053S reconnected: • Key ON, do not go to the high volt mode. • Using the Balance Diagnostic Tool, check the Pilot Voltage. (refer to illustration)	*Yes* Clear faults and recheck. *No* Go to step 5

Test step	Result / Action
 *Is battery voltage higher than 7.5 volts?*	
5 Check Power to the Battery Pack. • Key OFF, connector C053S disconnected from the battery pack. • Key ON, measure the voltage from pin U (12 volt power) to pin Z (ground) *Is battery voltage present?* NOTE: this circuit is fed from the fuse panel and is live at all times.	*Yes* Go to step 6 *No* Refer to the proper wiring diagram and repair fault. Check inertia switch
6 Check Connector • Check both sides of the connector for loose or pushed pins, corrosion, or other electrical faults *Are any issues found*	*Yes* Repair as required. *No* Replace battery pack

7.6.3 ESS – Input: CAN $21A

Description:	The CBCM has not received a properly formatted $21A message within the timeout period (2000ms). NOTE: If this fault occurs and the pack was connected (contactors closed) then the pack will stay connected.
Possible Causes:	• Electrical Noise on CAN 2 • CAN 2 terminator resistor failure • Failed VCU • Faulty power and ground circuits to ESS • Faulty wiring or connection problems •

Diagnostic Aids:	• Use the Balance Diagnostic tool and confirm the latest ESS software has been loaded. *Refer to https://extranet.azuredynamics.com for the latest software* • Confirm VCU communications with Balance Diagnostic tool • Follow diagnostic by description Loss of CAN 2 communications • Refer to appropriate Azure wiring schematics

7.6.4 ESS – Input: A2D Fault

Description:	The CBCM has lost communication with its on board external A2D chip or the power on calibration of the current sensor has failed.
Possible Causes:	• Internal battery pack fault
Diagnostic Aids:	• Use Balance Diagnostic tool and record all faults • Reprogram ESS to latest software, clear codes and retest, *Refer to https://extranet.azuredynamics.com for the latest software*

7.6.5 ESS – Input: DBS Fault

Description:	The high voltage battery pack is electrically isolated from the vehicle chassis. It monitors the system to detect any faults that would allow a high voltage connection to the vehicle chassis. This fault indicates that the ESS has detected a ground fault that would allow current flow to the chassis. If the ground fault isn't internal to the pack, it could mean there is a ground fault elsewhere on the HV buss. This fault could also mean that the pack was keyed on with the service disconnect pin not installed as the isolation resistance can't be properly measured with the service disconnect pin out. With the key on and the disconnect pin out, it will read 0 kohms.
Possible Causes:	• ESS Service disconnect Pin is removed • Internal ESS ground Fault • Isolation failure in EPAS Motor or EPAS Motor controller • Isolation failure in ISG Motor or ISG Motor Controller • Isolation failure in Traction Motor or Traction Motor Controller • High Voltage cabling Isolation failure • Isolation failure in DC/DC converter • Isolation failure in AC Motor or Controller
Diagnostic Aids:	• Confirm ESS service disconnect pin is installed • Use Balance Diagnostic tool and record all faults • Reprogram ESS to latest software, clear codes and retest, *Refer to https://extranet.azuredynamics.com for the latest software* • Turn key on, high voltage off (contactors open), and read pack's reported isolation resistance value. If less than 2000 kohms, pack has internal isolation fault, replace pack. • Turn key on, high voltage on (contactors closed), and monitor the reported isolation resistance value for 10 minutes and if less than 1000 kohms, high voltage buss has a isolation fault, Refer to Isolation Resistance Testing

7.6.6 ESS-MISC: Invalid DBS State

Description:	The CBCM has entered an invalid state.
Possible Causes:	• Internal battery pack software fault.
Diagnostic Aids:	• Use Balance Diagnostic tool and record all faults • Reprogram ESS to latest software, clear codes and retest, *Refer to https://extranet.azuredynamics.com for the latest software.*

7.6.7 Misc: Invalid Pack State

Description:	System has entered an invalid state
Possible Causes:	• Internal battery pack software fault.
Diagnostic Aids:	• Use Balance Diagnostic tool and record all faults • Reprogram ESS to latest software, clear codes and retest, *Refer to https://extranet.azuredynamics.com for the latest software.*

7.6.8 Misc: Invalid Precharge State

Description:	System has entered an invalid state
Possible Causes:	• Internal battery pack software fault.
Diagnostic Aids:	• Use Balance Diagnostic tool and record all faults • Reprogram ESS to latest software, clear codes and retest, *Refer to https://extranet.azuredynamics.com for the latest software.*

7.6.9 Input: Default Param Loaded

Description:	This fault indicates that the proper parameters were not loaded to the battery during a software update. The system is operating using default values which may affect the system operation. NOTE: This code will be set during battery programming and must be cleared

	when programming is completed. Failure to clear the code may result in unnecessary diagnostics.
Possible Causes:	• ESS was programmed and faults were not cleared • ESS was programmed and parameters were not loaded
Diagnostic Aids:	• Use Balance Diagnostic tool and record all faults • Reprogram ESS to latest software, clear codes and retest, *Refer to https://extranet.azuredynamics.com for the latest software.*

7.6.10 Precharge: Positive Relay Short

Description:	The battery pack current exceeded 5.0A when only the precharge contactor was closed.
Possible Causes:	• Internal ESS fault
Diagnostic Aids:	• Use Balance Diagnostic tool and record all faults • Reprogram ESS to latest software, clear codes and retest, *Refer to https://extranet.azuredynamics.com for the latest software.*

7.6.11 Precharge: System Short

Description:	The battery pack has detected a system short fault either because the link voltage failed to rise or the current failed to decrease during the precharge sequence. The system monitors how long it takes for the link voltage to rise to the same level as the pack voltage and for the current flow to drop. This would normally indicate an external short on the high voltage buss. A short will prevent the voltage from achieving the proper level and cause the current to continue to flow.
Possible Causes:	• Vehicle high voltage buss is shorted (positive to negative). • Component on high voltage buss is drawing current during precharge

	(when it should be off). • Internal battery pack hardware of software fault.
Diagnostic Aids:	• Use Balance Diagnostic tool and record all faults. • Reprogram ESS to latest software, clear codes and retest, *Refer to https://extranet.azuredynamics.com for the latest software.* • Check for short on high voltage buss. • Isolate each component and retest.

7.6.12 Precharge: Timeout

Description:	ESS precharge timeout. This code is set during ESS precharge timeouts. If the vehicle key is cycled three or more times within a minute, the ESS will timeout allowing its precharge resistor to cool. After the timeout the ESS will allow precharge automatically. The link voltage failed to rise to 95% of pack voltage within 1500 ms.
Possible Causes:	• Vehicle high voltage buss is shorted (positive to negative). • Component on high voltage buss is drawing current during precharge (when it should be off). • Internal battery pack hardware of software fault.
Diagnostic Aids:	• Use Balance Diagnostic tool and record all faults • Reprogram ESS to latest software, clear codes and retest, *Refer to https://extranet.azuredynamics.com for the latest software* • Check for short on high voltage buss. • Isolate each component and retest.

7.6.13Module: Under Voltage

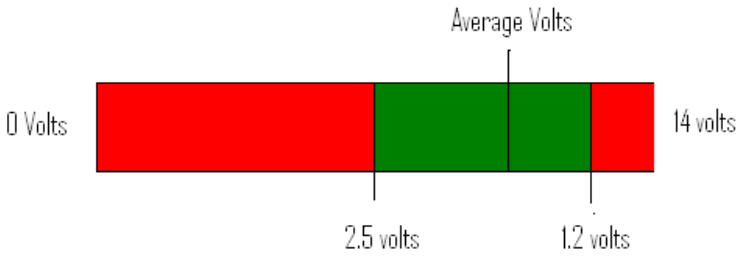
Description:	At least one of the module voltages in the battery pack is less than 7.5 volts and remains in this condition for 2 sec.
Possible Causes:	• Hybrid system is over-discharging pack (VCU software, traction motor, ISG

	motor, DC to DC converter, EPAS, Air Con). • Pack modules are weak or poorly balanced. • Pack is cold (below 0°C). • Internal battery pack fault (module voltages are being misread due to hardware or software fault).
Diagnostic Aids:	• Use Balance Diagnostic too l and record all faults. If a Critical SOC fault is found refer to Critical: State of Charge (soc) first • Confirm SOC is greater than 10%

7.6.14 Module: Over Voltage

Description:	At least one of the module voltages in the battery pack is greater than or = 16.0 volts and remains in this condition for 2 sec.
Possible Causes:	• Hybrid system is over-charging pack (VCU software, traction motor, ISG motor,). • Pack modules are weak or poorly balanced. • Pack is cold (below 0°C). • Internal battery pack fault (module voltages are being misread due to hardware or software fault).
Diagnostic Aids:	• Use Balance Diagnostic too l and record all faults. If a Critical SOC fault is found refer to Critical: State of Charge (SOC) fault first. • Confirm SOC is less than 90%

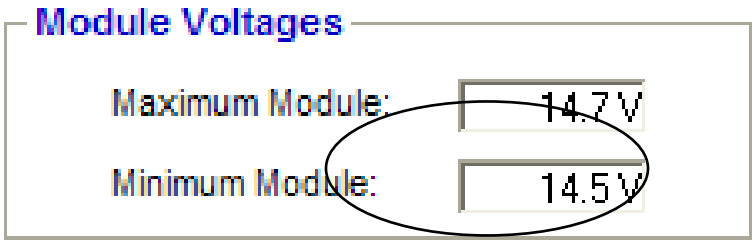
7.6.15 Module: Delta Voltage

Description:	Difference between average module voltage and maximum or minimum module voltage exceeds predetermined level (greater than1 volt). One of the following conditions is TRUE for 20 seconds: • The average module voltage of the pack minus the minimum module voltage is • 2.5 volts • The maximum module voltage minus the average module voltage of the pack is • 1.2V  • Pack modules may be weak or poorly balanced. A single or multiple modules may be failing or have failed. • Internal battery pack fault (module voltages are being misread due to hard or software fault) • This may be more evident during cold (below 0°C) operation or during aggressive operation where there are longer and heavier charge/ discharge rates.
Possible Causes:	• Pack modules are weak or poorly balanced. Replace pack. • Pack is cold (below 0°C). • Internal battery pack fault (module voltages are being misread due to hardware or software fault).
Diagnostic Aids:	• See pinpoint test below.

Test step	Result / Action
1 Perform preliminary diagnostics. • Perform preliminary diagnostic section. *Were any issues found?*	*Yes* Repair and retest. *No* Go to step 2
2 Check for Battery Faults and Software Version. • Key ON, using the Azure Battery Diagnostic	*Yes* Diagnose any SOC faults. After repairs are complete,

Test step	Result / Action
software, verify the latest software is loaded to the battery pack. • Check for active and historic faults. *Are any critical SOC faults present?* Note: Delta voltage faults are easily set if the SOC is at a critical point. Fix SOC faults before proceeding with this or any other faults.	clear all faults and retest *No* Go to step 3
3 Check Module Voltages • Key ON, using the Azure Battery Diagnostic software, check the minimum and maximum module voltages. NOTE: Only proceed if the SOC is greater than 40% and the pack has not undergone recent heavy charge/ discharge. • Pack voltage divided by 28 = the average module voltage. • Subtract the minimum module voltage from the average voltage • Subtract the average module voltage from the maximum module voltage. *Are the results of the first greater than 2.5 volts or the second greater than 1.2 volts?* Note: this would indicate weak modules. Under resting conditions, the module voltages should be within 0.2 volts minimum to maximum.	*Yes* Replace the pack *No* Go to step 4
4 Attempt to go to the High Volt Mode . • Key ON, Using the Azure Battery Diagnostic software, clear the battery faults. • Attempt to go to the high volt mode. *Is battery voltage higher than 7.5 volts?*	*Yes* Go to step 5 *No* Replace the pack

Test step	Result / Action
5 Monitor Module Voltages. • Key ON, Engine Running, using the Azure Battery Diagnostic software, check the minimum and maximum module voltages. • Pack voltage divided by 28 = the average module voltage. • Subtract the minimum module voltage from the average voltage • Subtract the average module voltage from the maximum module voltage. *Are the results of the first greater than 1.2 volts or the second greater than 0.7V?* Note: this would indicate weak modules.	*Yes* Allow the system to charge the pack with no load. If the voltages do not recover to within the limits, replace the pack *No* Go to step 6
6 Check Module Voltages Under Load. • Use the Balance Diagnostic software to record minimum and maximum module voltages • In a safe area, perform several heavy acceleration and deceleration runs. Do not violate any laws. NOTE: It is recommended that one person drives while a second operates the software. • Save the trace. NOTE: save as raw data. It may be necessary to send the recording to Azure Dynamics for analysis. *Does the Delta Voltage go higher than 1.2 volts for greater than 2 seconds?*	*Yes* Replace the pack *No* No fault at this time. This may be an indication of a weakening pack that may exhibit problems in colder operation.



7.6.16 Critical Delta Voltage

Description:	

	This code indicates that the system has detected a Delta Voltage sufficiently high to cause a critical fault. Once the critical fault has been set, the system will limit the power to 0 kW and the contactors will open after 2 minutes. Once the critical fault has been set, the system has to be powered down before the contactors can reset.
Possible Causes:	• Pack modules are weak or poorly balanced. Replace pack. • Pack is cold (below 0°C). • Internal battery pack fault (module voltages are being misread due to hard or software fault). Replace pack.
Diagnostic Aids:	• Use BDT to monitor pack Minimum and Maximum module voltages modules. If the SOC is greater than 45% & the voltage delta is greater than 2 volts replace the ESS.

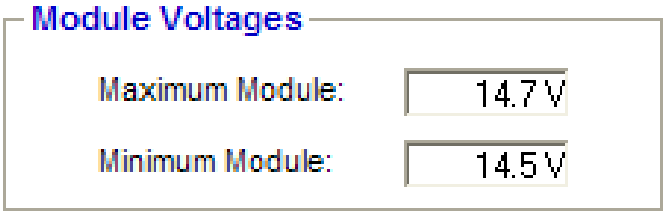


Figure 31

7.6.17 Module: Over Temperature

Description:	At least one of the module temperatures in the battery pack is greater than or = 65°C and remains in this condition for 5 sec.
Possible Causes:	• Faulty ESS temperature Sensor • Low or no coolant • Blocked or kinked coolant hose.
Diagnostic Aids:	• Use Balance Diagnostic tool to monitor readings • If all sensors read close to the same readings then check for a coolant issue • If only one sensor reads high , then replace ESS

	• Sensor range is -40° C to 85°C. 87° C = sensor failure.

7.6.18 Module : Delta Temperature

Description:	The (maximum module temperature – minimum module temperature) is greater than or = 15°C and remains in this condition for 5 sec.
Possible Causes:	• Check coolant level and temperature. • Check cooling system pumps and fans. • Check for kinks or obstructions in the coolant hoses. • Check for air trapped in coolant system.
Diagnostic Aids:	• Use Balance Diagnostic tool to monitor readings • If all sensors read close to the same readings then check for a coolant issue • If only one sensor reads high , then replace ESS Sensor range is -40°C to 85°C. 87°C = sensor failure.

7.6.19 Critical: Over Temperature

Description:	At least one of the modules is greater than65°C for greater than 5 sec Note: Typical temperature change from coolant to max module temperature shouldn't exceed 20°C.
Possible Causes:	• Coolant level and temperature • Failed cooling system pumps and fans • Kinks or obstructions in the coolant hoses, air trapped in coolant system • Multiple internal battery pack module temperature sensor or wiring failures. Replace pack. • Internal battery pack thermal failure. Replace pack.
Diagnostic Aids:	• Check coolant level and temperature.

	• Check cooling system pumps and fans.. • Check for kinks or obstructions in the coolant hoses. • Check for air trapped in coolant system.

7.6.20 Critical: Over Temperature

Description:	• At least battery module temperature is greater than or = 75°C. • Critical fault, contactors will open after 2 minutes.
Possible Causes:	• Coolant level and temperature • Failed cooling system pumps and fans • Kinks or obstructions in the coolant hoses, air trapped in coolant system • Multiple internal battery pack module temperature sensor or wiring failures. Replace pack. • Internal battery pack thermal failure. Replace pack.
Diagnostic Aids:	• Check coolant level and temperature. • Check cooling system pumps and fans. • Check for kinks or obstructions in the coolant hoses. • Check for air trapped in coolant system.

7.6.21 Module: Module Sense Lev1

Description:	This indicates the loss of 1 of the 4 battery module temperature sensors in the pack.
Possible Causes:	• One of the four module temperature sensors in the battery pack has failed, the secondary sensor is being used to report module temperatures. • One of the four module temperature sensors in the battery pack has failed, the secondary sensor is being used to report module temperatures.

Diagnostic Aids:	• Replace ESS

7.6.22 Module: Module Sense Lev 2

Description:	This indicates the loss of 2 or more of the 4 battery module temperature sensors in the pack. Temperature data for that section of the pack is invalid.
Possible Causes:	Multiple internal battery pack module temperature sensor or wiring failures.
Diagnostic Aids:	• Replace ESS

7.6.23 Critical: State of Charge (SOC)

Description:	The ESS state of Charge has went above 95% SOC or below 5% SOC. This does not necessarily mean there is a battery issue.
Possible Causes:	• Pack SOC is too high or too low. • Hybrid systems is overcharging or over discharging pack (VCU software, traction motor, ISG motor, dc/dc converter, EPAS, Air Condition).
Diagnostic Aids:	• Check for other VCU DTC's before continuing • Most likely not an ESS failure but a vehicle fault.

7.6.24 Critical: Control Parameter

Description:	The following conditions have occurred at the same time: • KeyIn = FALSE • CAN Link Lost Fault = TRUE
Possible Causes:	• Disconnected pack CAN wiring OR pack microcontroller ignition (low voltage connector pin “a”). Unless this is intermittent, then pack will not be able to restart or re-enable high voltage. • Internal battery pack software fault. Replace pack.
Diagnostic Aids:	• If a history fault, this can be ignored as it is a known bug that has no negative effect. • If "Active" ESS should be replaced and Azure Techline notified.

7.6.25 Misc: Contactor

Description:	The CBCM has found that either the positive or negative contactor has opened while being commanded to close. (i.e. Link Voltage does not match Pack Voltage even though contactors have been closed).
Possible Causes:	• Internal battery pack fault (contactor shorted or welded shut, link or pack voltage being misread, software fault).
Diagnostic Aids:	• Use Balance Diagnostic tool and record all faults • Reprogram ESS to latest software, clear codes and retest, *Refer to https://extranet.azuredynamics.com for the latest software.*