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FUEL CHARGING AND CONTROLS - TURBOCHARGER - INGENIUM I6 3.0L PETROL

TURBOCHARGER (G2400961)

mcx30.com

ELECTRIC SUPERCHARGER COOLING 3.0L MHEV

**WARNINGS:**

- A risk assessment must be performed before any work is undertaken.
- All hybrid electric vehicle work must be performed by a suitably qualified person.
- Appropriate Personal Protection Equipment (PPE) must be worn when working on or near a hybrid electric vehicle high voltage system.
- The hybrid electric vehicle battery pack casing must not be opened due to the risk of exposure to hazardous voltage, which may cause serious injury or death.
- The electric power inverter converter casing must not be disassembled due to the risk of exposure to hazardous voltage, which may cause serious injury or death.
- If the hybrid electric vehicle battery pack is damaged or overcharged, there is a risk of exposure to hazardous voltage and/or highly corrosive electrolyte mist. If liquid or vapor is observed leaking from the hybrid electric vehicle battery pack, take the following action:
 - Evacuate the area
 - Notify manager
 - Do not breathe smoke/vapour
 - Contain spillage using spill kit
 - Wash any spillage off body and clothing (remove contaminated clothing)
- If the hybrid electric vehicle warning indicator is illuminated, the Battery Energy Control Module (BECM) cannot isolate the high voltage cables. Live working will be necessary to rectify the fault.
- The motor generator can generate a voltage if the wheels are rotated, even if the hybrid electric vehicle system has been made safe.

**CAUTION:**

Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.



NOTES:

- If a control module or a component is at fault or may be at fault and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual, or determine if any prior approval program is in operation, prior to the installation of a new module/component.
- Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer-approved diagnostic system).
- When performing voltage or resistance tests, always use a digital multimeter that has the resolution ability to view 3 decimal places. For example, on the 2 volts range can measure 1mV or 2 K Ohm range can measure 1 Ohm. When testing resistance always take the resistance of the digital multimeter leads into account.
- Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.
- Inspect connectors for signs of water ingress, and pins for damage and/or corrosion.
- If DTCs are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.
- Check JLR claims submission system for open campaigns. Refer to the corresponding bulletins and SSMs which may be valid for the specific customer complaint and complete the recommendations as required.

Visual Inspection

MECHANICAL	ELECTRICAL
■ Electric supercharger ■ Cooling circuit to the electric supercharger	■ 12 volt supply to the electric supercharger outside of expected range ■ 48 volt supply to the electric supercharger outside of expected range ■ Electric supercharger internal memory corrupted
■ Ebooster bypass valve	■ Connector is disconnected, connector pin is backed out, connector pin corrosion
■ Post turbocharger compressor pressure sensor	■ Connector is disconnected, connector pin is backed out, connector pin corrosion
■ Compressor bypass valve ■ Mechanical performance main turbocharger ■ Charge air cooler restriction	■ Connector is disconnected, connector pin is backed out, connector pin corrosion ■ Valve tolerance out of range
■ TMAP post WCAC sensor ■ Ambient pressure sensor	■ Connector is disconnected, connector pin is backed out, connector pin corrosion ■ Sensor tolerance out of range ■ Offset TMAP post WCAC sensor ■ Offset ambient pressure sensor

MECHANICAL	ELECTRICAL
- Compressor bypass A solenoid - Mechanical integrity - Frozen	- Fuse failure - Connector is disconnected, connector pin is backed out, connector pin corrosion - Solenoid tolerance out of range

SYMPTOM CHART

SYMPTOM	POSSIBLE CAUSES	ACTION
Poor acceleration and lack of power, when cold, poor acceleration and lack of power, when hot, yellow warning lamp illuminated	- Powertrain control module connector is disconnected, connector pin is backed out, connector pin corrosion - Offset post turbocharger compressor pressure sensor - Blocked pressure sensor pipe between pressure sensor and pipe connection - Post turbocharger compressor pressure sensor connector is disconnected, connector pin is backed out, connector pin corrosion	- Inspect powertrain control module connectors for signs of water ingress, and pins for damage and/or corrosion - Using the Jaguar Land Rover approved diagnostic equipment, record all engine airpath pressure sensors (MAP, Post compressor, post charge air cooler and ambient pressure) With the ignition on all pressure sensors values should be close to ambient pressure. There will be some sensor to sensor tolerance differences so they all wont be exactly ambient pressure, if the sensor reporting the DTC shows an offset high of greater than 150hPa then the electrical harness needs to be inspected before replacing the sensor - Refer to the electrical circuit diagrams and inspect post turbocharger compressor pressure sensor circuit for short circuit to ground, short circuit to power, open circuit, high resistance - Using the Jaguar Land Rover approved diagnostic equipment check datalogger signal 0x033C to read sensor voltage, value must be 0.2 volts or above, but not more than 4.75 Volts. A higher voltage implies short circuit to 5 volts or open circuit harness failure. Less than 0.2 volts indicates short circuit to ground. If reading is within range, then the sensor is electrically connected and harness is OK. Disconnect sensor connector, with ignition on, inspect for 5 Volts between pin 1 (ground) and pin 3 (5 Volt) if not 5 volts a line is open circuit Disconnect sensor connector, with ignition on, inspect voltage between pin 1 (ground) and pin 2 (signal). Typically, this should be approximately 5.8 volts - Install new post turbocharger compressor pressure sensor, only when diagnosed as failed - Inspect TMAP post WCAC sensor connectors for signs of water ingress, and pins for damage and/or corrosion - Refer to the electrical circuit diagrams and inspect TMAP post WCAC sensor circuit for short circuit to ground, short circuit to power, open circuit, high resistance - Check powertrain control module for related ambient pressure DTCs and refer to relevant DTC index, rectify these first - Be aware of what the actual expected atmospheric pressure is in your location and compare to the manifold sensor for an additional cross check. Check the boost pressure sensor, manifold sensor and ambient pressure sensor values at ignition on only, All sensors should read atmospheric pressure. If the boost sensor is reading higher than the ambient and manifold pressure sensor, inspect the electrical connections for correct installation - Using the Jaguar Land Rover approved diagnostic equipment check datalogger signal - Boost Pressure Control (0xF470) - Inspect connectors for signs of water ingress, and pins for damage and/or corrosion

SYMPTOM	POSSIBLE CAUSES	ACTION
	■ Post turbocharger compressor pressure sensor - Wiring integrity short circuit to ground, short circuit to power, open circuit, high resistance ■ Post turbocharger compressor pressure sensor failure ■ Offset TMAP post WCAC sensor ■ Offset ambient pressure sensor ■ Other ambient pressure related DTCs ■ TMAP post WCAC sensor connector is disconnected, connector pin is backed out, connector pin corrosion ■ TMAP post WCAC sensor harness failure - Wiring integrity short circuit to ground, short circuit to power, open circuit, high resistance ■ TMAP post WCAC sensor failure	■ Refer to the electrical circuit diagrams and inspect the TMAP post charge air cooler temperature sensor circuit for ■ Short circuit to ground ■ Short circuit to power ■ Open circuit ■ High resistance ■ Test air intake system, charge air system for air leaks ■ Install new turbocharger, only when diagnosed as failed ■ Inspect compressor bypass valve for mechanical integrity ■ Inspect air intake system, low pressure intake for blockages or restriction ■ Inspect exhaust system, for blockages or restriction ■ Inspect charge air pressure sensor for blockage ■ Refer to the electrical circuit diagrams and inspect the charge air pressure sensor circuit for ■ Short circuit to ground ■ Short circuit to power ■ Open circuit ■ High resistance ■ Inspect connectors for signs of water ingress, and pins for damage and/or corrosion ■ Inspect for restriction in the charge air cooler ■ Inspect compressor bypass throttle for restricted movement ■ Inspect for stuck open compressor bypass valve ■ Inspect integrity of charge hose between the charge air cooler and the throttle body ■ Inspect integrity of charge hose between the main turbocharger and the electric supercharger / compressor bypass throttle ■ If this DTC is reported on its own please complete the following: ■ Inspect for mechanical integrity of the compressor at the electric supercharger for evidence of damage to the blades ■ Inspect the hose from the electric supercharger to the charge air cooler for integrity

SYMPTOM	POSSIBLE CAUSES	ACTION
	■ TMAP post charge air cooler temperature sensor - Wiring integrity ■ Air intake system, charge air system high pressure charge air leak ■ Turbocharger seized ■ Compressor bypass valve stuck open ■ Air intake system, low pressure intake blocked or restricted ■ Charge air pressure sensor blocked ■ Charge air pressure sensor - Wiring integrity ■ Damaged compressor blades on the electric supercharger ■ Restriction in the WCAC ■ Compressor bypass throttle not closing fully ■ Offset boost pressure sensors ■ Stuck open compressor bypass valve	
Poor acceleration		■ Inspect powertrain control module connectors for signs of water ingress, and pins for damage and/or corrosion

SYMPTOM	POSSIBLE CAUSES	ACTION
and lack of power, when hot	■ Powertrain control module connector is disconnected, connector pin is backed out, connector pin corrosion ■ Offset post turbocharger compressor pressure sensor ■ Blocked pressure sensor pipe between pressure sensor and pipe connection ■ Post turbocharger compressor pressure sensor connector is disconnected, connector pin is backed out, connector pin corrosion ■ Post turbocharger compressor pressure sensor - Wiring integrity short circuit to ground, short circuit to power, open circuit, high resistance ■ Post turbocharger compressor pressure sensor failure ■ Offset TMAP post WCAC sensor ■ Offset ambient pressure sensor	■ Using the Jaguar Land Rover approved diagnostic equipment, record all engine airpath pressure sensors (MAP, Post compressor, post charge air cooler and ambient pressure) With the ignition on all pressure sensors values should be close to ambient pressure. There will be some sensor to sensor tolerance differences so they all wont be exactly ambient pressure, if the sensor reporting the DTC shows an offset high of greater than 150hPa then the electrical harness needs to be inspected before replacing the sensor ■ Refer to the electrical circuit diagrams and inspect post turbocharger compressor pressure sensor circuit for short circuit to ground, short circuit to power, open circuit, high resistance ■ Using the Jaguar Land Rover approved diagnostic equipment check datalogger signal 0x033C to read sensor voltage, value must be 0.2 volts or above, but not more than 4.75 Volts. A higher voltage implies short circuit to 5 volts or open circuit harness failure. Less than 0.2 volts indicates short circuit to ground. If reading is within range, then the sensor is electrically connected and harness is OK. Disconnect sensor connector, with ignition on, check for 5 Volts between pin 1 (ground) and pin 3 (5 Volt) if not 5 volts a line is open circuit Disconnect sensor connector, with ignition on, check voltage between pin 1 (ground) and pin 2 (signal). Typically, this should be approximately 5.8 volts ■ Install new post turbocharger compressor pressure sensor, only when diagnosed as failed ■ Inspect TMAP post WCAC sensor connectors for signs of water ingress, and pins for damage and/or corrosion ■ Refer to the electrical circuit diagrams and inspect TMAP post WCAC sensor circuit for short circuit to ground, short circuit to power, open circuit, high resistance ■ Inspect powertrain control module for related ambient pressure DTCs and refer to relevant DTC index, rectify these first ■ Be aware of what the actual expected atmospheric pressure is in your location and compare to the manifold sensor for an additional cross check. Inspect the boost pressure sensor, manifold sensor and ambient pressure sensor values at ignition on only, All sensors should read atmospheric pressure. If the boost sensor is reading higher than the ambient and manifold pressure sensor, inspect the electrical connections for correct installation ■ Using the Jaguar Land Rover approved diagnostic equipment check datalogger signal ■ Boost Pressure Control (0xF470) ■ Inspect connectors for signs of water ingress, and pins for damage and/or corrosion ■ Refer to the electrical circuit diagrams and inspect the TMAP post charge air cooler temperature sensor circuit for ■ Short circuit to ground ■ Short circuit to power ■ Open circuit ■ High resistance ■ Test air intake system, charge air system for air leaks ■ Install new turbocharger, only when diagnosed as failed ■ Inspect compressor bypass valve for mechanical integrity ■ Inspect air intake system, low pressure intake for blockages or restriction ■ Inspect exhaust system, for blockages or restriction ■ Inspect charge air pressure sensor for blockage

SYMPTOM	POSSIBLE CAUSES	ACTION
	■ Other ambient pressure related DTCs ■ TMAP post WCAC sensor connector is disconnected, connector pin is backed out, connector pin corrosion ■ TMAP post WCAC sensor harness failure - Wiring integrity short circuit to ground, short circuit to power, open circuit, high resistance ■ TMAP post WCAC sensor failure ■ TMAP post charge air cooler temperature sensor - Wiring integrity ■ Air intake system, charge air system high pressure charge air leak ■ Turbocharger seized ■ Compressor bypass valve stuck open ■ Air intake system, low pressure intake blocked or restricted	■ Refer to the electrical circuit diagrams and inspect the charge air pressure sensor circuit for ■ Short circuit to ground ■ Short circuit to power ■ Open circuit ■ High resistance ■ Inspect connectors for signs of water ingress, and pins for damage and/or corrosion ■ Inspect for restriction in the charge air cooler ■ Inspect compressor bypass throttle for restricted movement ■ Inspect for stuck open compressor bypass valve ■ Inspect integrity of charge hose between the charge air cooler and the throttle body ■ Inspect integrity of charge hose between the main turbocharger and the electric supercharger / compressor bypass throttle ■ If this DTC is reported on its own please complete the following: ■ Inspect for mechanical integrity of the compressor at the electric supercharger for evidence of damage to the blades ■ Inspect the hose from the electric supercharger to the charge air cooler for integrity

SYMPTOM	POSSIBLE CAUSES	ACTION
	■ Charge air pressure sensor blocked ■ Charge air pressure sensor - Wiring integrity ■ Damaged compressor blades on the electric supercharger ■ Restriction in the WCAC ■ Compressor bypass throttle not closing fully ■ Offset boost pressure sensors ■ Stuck open compressor bypass valve	
Engine judders and shakes, when hot	■ Connector is disconnected, connector pin is backed out, connector pin corrosion ■ Compressor bypass control actuator - Wiring integrity ■ Compressor bypass control actuator - Mechanical integrity ■ Compressor bypass control actuator failure	■ Inspect connectors for signs of water ingress, and pins for damage and/or corrosion ■ Refer to the electrical circuit diagrams and inspect the compressor bypass control actuator circuit for ■ Fuse failure ■ Short circuit to ground ■ Short circuit to power ■ Open circuit ■ High resistance ■ Inspect compressor bypass control actuator for ■ Wiring integrity ■ Mechanical integrity ■ Frozen ■ Install new compressor bypass control actuator, only when diagnosed as failed

SYMPTOM	POSSIBLE CAUSES	ACTION
Powertrain control module overheating	▪ Coolant leak	▪ Inspect powertrain control module cooling pipes for leakage / blockage

CONTROL MODULE CAVITY

INPUT/OUTPUT	CIRCUIT DESCRIPTION
PCM ▪ O_T_CPRC1 ▪ Output from PCM	Compressor bypass A solenoid
PCM ▪ O_V_5VCOP ▪ Output 5 volts from PCM ▪ I_A_COP ▪ Analog input to PCM ▪ G_R_COP / G_R_COT ▪ Ground reference from PCM	Post turbocharger compressor pressure sensor
PCM ▪ O_V_5VBPS ▪ Output 5 volts from PCM ▪ I_A_BPS ▪ Analog input to PCM ▪ G_R_BPTS ▪ Ground reference from PCM ▪ I_A_BTS ▪ Analog input to PCM	TMAP post WCAC sensor

INPUT/OUTPUT	CIRCUIT DESCRIPTION
PCM ▪ O_T_EBBPOS ▪ Output from PCM ▪ O_T_EBBNEG ▪ Output from PCM ▪ O_V_5VEBB ▪ Output 5 volts from PCM ▪ I_A_EBB ▪ Analog input to PCM ▪ G_R_EBB ▪ Ground reference from PCM	Ebooster bypass valve
PCM ▪ B_D_PMZ_CANH ▪ Communication ▪ B_D_PMZ_CANL ▪ Communication	Communication bus
Electric supercharger ▪ C2-1 - +	12V Supply
Electric supercharger ▪ C2-2 - I/O	CAN Low
Electric supercharger ▪ C2-3 - I/O	CAN High
Electric supercharger ▪ C2-4 - Gnd	Ground
Electric supercharger ▪ C1-1 - + 48V	48V Power
Electric supercharger ▪ C1-2 - - 48V	48V Ground

DIAGNOSTIC ROUTINES

ROUTINE	DESCRIPTION OF ROUTINE
Routine 0x0202 - On-Demand Self-Test	The purpose of the on-demand self-test functionality is to detect Powertrain control module circuit faults

DATALOGGER SIGNALS

DATALOGGER SIGNALS	DESCRIPTION	DISPLAYED UNITS
Ebooster bypass valve 0x0591 0x0427 0x033E 0x033C	- Supercharge Control Valve - Desired Position - Filtered - Turbocharger Bypass Valve Position - Commanded - Boost Absolute Pressure - Raw Value Boost - Absolute Pressure - Raw sensor input voltage	% % - KPa - Volts
TMAP post WCAC sensor 0xF470 0x0341	- Boost Pressure Control - Boost Air Temperature - Raw physical value	- KPa °C

DTC INDEX

For a list of Diagnostic Trouble Codes (DTCs) that could be set on this vehicle, please refer to Section 100-00. REFER to: [Diagnostic Trouble Code Index - INGENIUM I6 3.0L Petrol, Vehicles With: MHEV, DTC: Powertrain Control Module \(PCM\) B1087-88 to P0634-00](#) (100-00 General Information, Description and Operation).