

# ENGINE MANAGEMENT SYSTEM

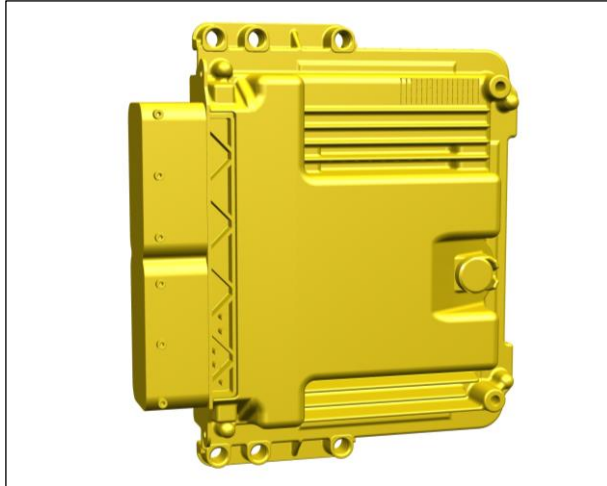


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**1. ENGINE MANAGEMENT SYSTEM (EMS)  
DESCRIPTION**

Engine Management System (*EMS*) comprises of Electronic Control Unit (*ECU*), sensors, actuators and control algorithms that determine the performance of the Engine as a whole and as part of the vehicle.

The Electronic Control Unit consist of a 32-bit microprocessor with peripheral devices like ignition driver, ADCs device and I/O drivers. Microprocessor controls the injection parameters as well as some of the vehicle related outputs such as Fan, AC drivability in gears, variable turbine turbocharger, EGR etc. The ECU receives input from various sensors located on the engine and the vehicle, and decides the injection quantity, injection timing, number of injections best suited for the engine to work with maximum efficiency and safety. It is the 'Brain' of the Engine Management System. Being the most important component of the Engine management system, ECU apart from ensuring the optimum working of the Vehicle, also keeps an eye on the working of the sensors and actuators. Whenever a malfunction/fault occurs in the component or the system the ECU alerts the user by glowing MIL indicator on instrument cluster. ECU also does the following:

- Stores a DTC in its memory (*indicates the faulty component/system*).
- Stores a context frame (*list of parameters indicating the operating condition during the fault generation*) in its memory.

When the malfunction poses a threat to the vehicle, the ECU with its control algorithms operates the vehicle in Limp Home Mode (*safe mode*). This protects the component from damage with some degradation in performance of the vehicle.

**NOTE**

- For certain faults and for failure of some sensors the EMS switches to reduced torque or Limp Home mode. During this mode the vehicle performance will be restricted and MIL lamp will be ON.

**MAKE:** BOSCH Diesel Common Rail System

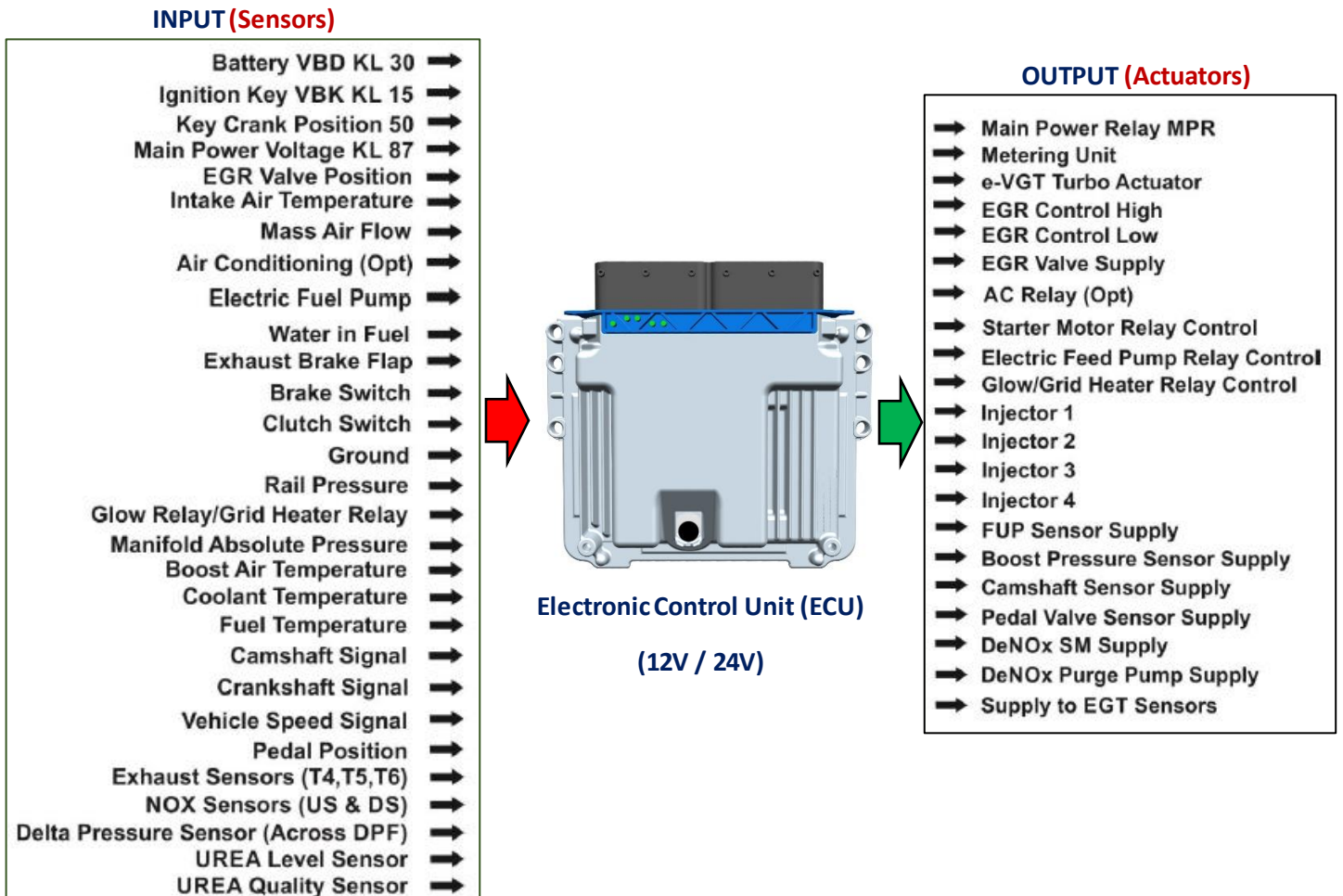
**MODEL / TYPE:**

MD1CS018 : 12V

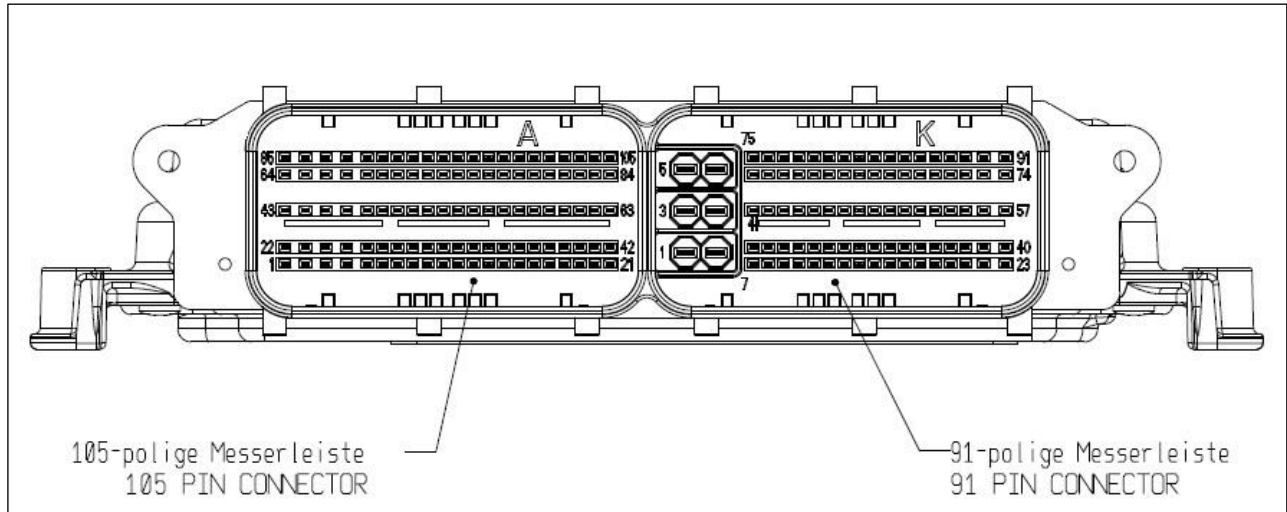
MD1CC898 : 24V

## 3.3L NG Engine Management System (EMS)

(Input and Output Overview)



## ELECTRONIC CONTROL UNIT (ECU) CONNECTOR DETAILS

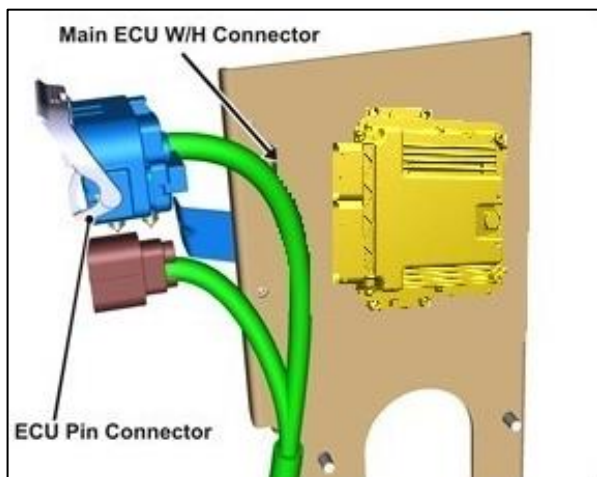


### TIGHTENING TORQUE TABLE

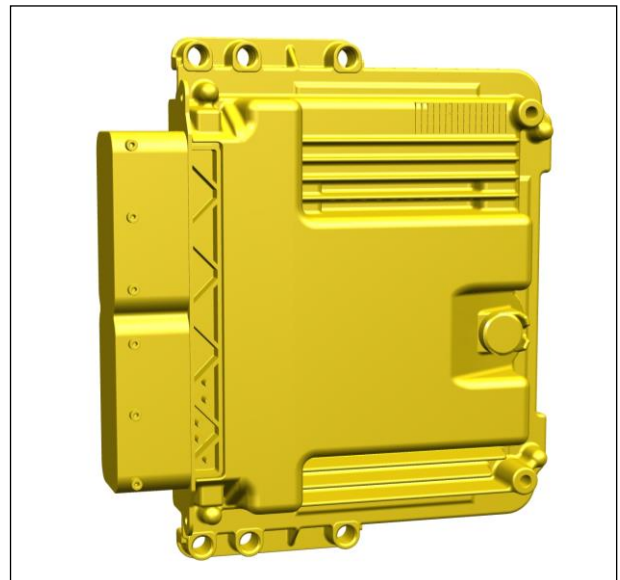
DESCRIPTION	TORQUE
Hex FL Nut AM6	1.0 Kgfm
Hex FL Screw M6X30	1.0 Kgfm

### REMOVAL

1. Open the side flap of battery and disconnect the battery negative terminal.
2. Disconnect the both connectors of EMS. *(Remove EMS wiring harness connector first then main wiring harness connector).*



3. Remove the six mounting screws and take out the ECU.



### FITMENT

1. Locate the ECU on mounting brackets and fit the six mounting bolts.  
Tightening torque for Bolts - 1 Kgfm.
2. Connect the electrical connections (*Main W/H and EMS W/H*).
3. Connect the battery negative terminal and close the side flap.

VEHICLE CONNECTOR PINOUT DETAILS 24V

Pin No.	Name
K01	Battery plus 1
K02	Battery minus 1
K03	Battery plus 2
K04	Battery minus 2
K05	Battery plus 3
K06	Battery minus 3
K78	Controller Area Network 0 (Inter ECU Communication, Diagnostics)
K77	No termination resistance
K88	Ignition switch
K74	T50 Switch
K75	Controller Area Network 1 (Flash programming, CCP)
K76	Termination resistance = 120 Ohm
K68	Switched battery UB 25 (High side driver)
K41	Main brake switch I_S_BRKMN
K08	Redundant brake switch I_S_BRKRED
K45	Accelerator pedal position 1 O_V_5VAPP1
K61	Accelerator pedal position 1 I_A_APP1
K63	Accelerator pedal position 1 G_R_APP1
K44	Accelerator pedal position 2 O_V_5VAPP2
K83	Accelerator pedal position 2 I_A_APP2
K84	Accelerator pedal position 2 G_R_APP2
K18	I_S_CRCPOS Cruise control (+)/ PTO RPM (+)
K37	I_S_CRCNEG Cruise control (-)/ PTO RPM (-)
K12	I_S_CRCOFF Cruise control (off)
K32	I_S_CRCRES Cruise control (resume)
K62	Remote acceleration pedal position 1
K85	Remote acceleration pedal position 2
K40	Main exhaust brake switch
K86	Torque limitation switch 1
K42	PTO switch
K22	AC pressure switch
K65	Torque limitation switch 2
K48	Clutch switch 1
K58	Clutch switch 2
K19	PTO vehicle switch _S_PTOMOD
K67	PTO RPM selector 1 I_S_PTRPM1
K14	PTO RPM selector 2 I_S_PTRPM2
K16	PTO RPM selector 3 I_S_PTRPM3
K64	Remote Acc. pedal selector switch I_S_RMTEN
K80	Parking brake switch I_S_BRKPS
K66	Cabinet tilt switch I_S_CBT
K82	DPF regeneration stop switch I_S_DPFRST

Pin No.	Name
K15	A/C medium pressure switch I_S_ACCHL
K70	G_R_DIG
K72	Grid heater relay O_S_IMPH
K30	Fuel heater relay O_S_FLHT
K69	OBD/ MIL lamp O_S_OBD
K17	Water in fuel switch I_S_WFS
K36	Battery UB 61 (High side driver) O_V_RH61
K90	Starter relay O_S_STRT
K89	Battery UB 62 (High side driver) O_V_RH62
K59	Electric engine coolant pump O_S_EECP
K47	DPF stop indication LED O_S_DPSILP
K91	Reduction agent tank heating valve O_V_RH32
K28	Reduction agent tank heating valve O_S_RATH
K34	Vehicle speed sensor signal from cluster I_F_VSS
K57	Ambient temperature sensor Continental: I_A_ATS
K60	Ambient temperature sensor Continental: G_R_ATS
K81	Catalyst temperature sensor 2 (Upstream) I_A_EXT1
K31	Catalyst temperature sensor 2 (Upstream) G_R_EXT1
K39	Temperature sensor SCR T6 (Upstream) I_A_CATTSPRE
K56	Post - Catalyst temperature sensor 1 (Downstream) I_A_CATTSPPOST
K79	Post - Catalyst temperature sensor 1 (Downstream) G_R_CATTSPPOST
K73	Reduction agent electro-mechanical relay O_V_RH31
K29	Reduction agent electro-mechanical relay O_S_MRHH
K21	Reduction agent pressure hose heater O_S_PHH
K50	Reduction agent throttle hose heater O_S_THH
K26	Reduction agent suction hose heater O_S_SHH
K65	I_A_PHH
K25	Reduction agent supply module heater O_S_SMH
K24	Reduction agent pump pressure sensor V_V_5VPRAS
K54	Reduction agent pump pressure sensor I_A_PRAS

## EMS (3.3LNG BSVI)

Pin No.	Name
K53	Reduction agent pump pressure sensor G_R_PRAS
K51	Reduction agent reverting valve O_V_RH52
K27	Reduction agent reverting valve O_S_RARV
K71	Reduction agent pump control O_V_RH51
K09	Reduction agent pump control O_T_RAPMP
K07	Reduction agent pump control G_G_RAPMP
K10	Reduction agent dosing valve BOSCH (B 444 043 224) O_T_RAMVH
K11	Reduction agent dosing valve BOSCH (B 444 043 224) O_T_RAMVL
K49	Engine speed output O_F_ENGN
K87	Vehicle speed output signal O_F_VSS
K33	I_A_EKPDF

## ENGINE CONNECTOR PINOUT DETAILS 24V

Pin No.	Name
A13	Controller Area Network 2 (Inter ECU Communication) B_D_CANH2
A12	Controller Area Network 2 (Inter ECU Communication) B_D_CANL2
A54	Communication interface 1 (LIN) (12V LIN support) B_D_COM1
A48	EGR valve position feedback sensor O_T_EGRPOS
A49	EGR valve position feedback sensor O_T_EGRNEG
A52	EGR valve position feedback sensor V_V_5VEGR
A51	EGR valve position feedback sensor I_A_EGR
A50	EGR valve position feedback sensor G_R_EGR
A10	Rail pressure sensor BOSCH (0 281 006 914) O_V_5VRAILPS
A31	Rail pressure sensor BOSCH (0 281 006 914) I_A_RAILPS
A32	Rail pressure sensor BOSCH (0 281 006 914) G_R_RAILPS
A97	Coolant temperature sensor BOSCH: (0 280 130 093) I_A_CTS
A102	Battery plus output 41 (High side driver) O_V_RH41
A69	Blower control relay O_S_BLWR
A86	EGR cooling bypass valve O_S_EGRBV
A40	Oil pump control relay O_S_OILP
A75	EKP relay diagnostic feedback signal O_S_PSPRLY2
A11	Fuel temperature sensor BOSCH: (0 280 130 093) I_A_FTS1
A88	EGR temperature sensor T3 Sensata: (DARTS 200D) I_A_TEGR
A78	Oil pressure switch I_S_OPSW
A73	Battery plus output 81 (High side driver) O_V_RH81
A42	Glow plug relay O_S_GLWRLY
A74	EKP pump relay O_S_PSPRLY1
A71	High exhaust temperature indication lamp O_S_EXTLP
A85	DOC Temperature sensor upstream T4 Sensata: (DARTS 200D) I_A_DOCTSUP
A80	Oil temperature sensor I_A_OTS
A57	Oil temperature sensor G_R_OTS
A38	DPF Temperature sensor upstream T5 Sensata: (DARTS 200D) I_A_TPFLTUS



## EMS (3.3LNG BSVI)

Pin No.	Name
A46	Battery plus output 23 (High side driver) O_V_RH23
A47	AC condenser relay O_S_ACCRLY
A39	Glow time indication lamp O_S_GLWLP
A09	Boost pressure and temperature sensor BOSCH: (0 281 006 076) O_V_5VBPS
A33	Boost pressure and temperature sensor BOSCH: (0 281 006 076) I_A_BPS
A68	Boost pressure and temperature sensor BOSCH: (0 281 006 076) I_A_BTS
A34	Boost pressure and temperature sensor BOSCH: (0 281 006 076) G_R_BPS
A28	Battery plus output 22 (High side driver) O_V_RH22
A70	AC compressor relay O_S_ACRLY
A26	Differential pressure sensor signal Continental: (A2C7371850) I_A_PFD
A25	Differential pressure sensor signal Continental: (A2C7371850) G_R_PFD
A96	PFM sensor BOSCH: (0 280 B07 022) O_V_5VPM
A92	PFM sensor BOSCH: (0 280 B07 022) I_D_SENTU3
A93	PFM sensor BOSCH: (0 280 B07 022) I_D_SENTU4
A81	PFM sensor BOSCH: (0 280 B07 022) G_R_PFM
A99	E - Viscous fan actuator O_T_FAN
A100	MAHLE BEHR (EF35) Fan speed sensor I_F_FSS
A04	MAHLE BEHR (EF35) Fan speed sensor G_S_FSS
A53	Gear neutral switch I_S_GNSW
A37	Coolant level switch I_S_CLSW
A87	DPF regeneration start switch I_S_DPFRSW
A90	Oil level switch I_S_OLS
A84	Crankshaft speed sensor -Inductive sensor (DG6) (Tonewheel with slots) BOSCH: (0 281 002 315) I_F_CRSP
A105	Crankshaft speed sensor -Inductive sensor (DG6) (Tonewheel with slots) BOSCH: (0 281 002 315) I_F_CRSNEG
A83	Crankshaft speed sensor -Inductive sensor (DG6) (Tonewheel with slots) BOSCH: (0 281 002 315) G_R_CRS
A08	Camshaft speed sensor -Hall effect type sensor -CPS4 (Tonewheel with slots) BOSCH: (0 232 B00 698) O_V_5VCAS

Pin No.	Name
A82	Camshaft speed sensor -Hall effect type sensor -CPS4 (Tonewheel with slots) BOSCH: (0 232 B00 698) I_F_CAS
A104	Camshaft speed sensor -Hall effect type sensor -CPS4 (Tonewheel with slots) BOSCH: (0 232 B00 698) G_R_CAS
A19	Exhaust throttle valve actuator O_T_TVAPOS
A18	Exhaust throttle valve actuator O_T_TVANEG
A21	ETVA position feedback sensor V_V_5VTVA
A20	ETVA position feedback sensor I_A_TVA
A17	ETVA position feedback sensor G_R_TVA
A61	EVGT O_T_VGTPOS
A60	EVGT O_T_VGTNEG
A63	EVGT position feedback sensor V_V_5VVT
A62	EVGT position feedback sensor I_A_VGT
A59	EVGT position feedback sensor G_R_VGT
A06	Metering unit BOSCH: (0 928 400 757) O_V_MEU
A05	Metering unit BOSCH: (0 928 400 757) O_T_MEU
A45	Bank 1 Inj. 1 Cyl.1 O_P_SVH11
A22	Bank 1 Inj. 1 Cyl.1 O_P_SVL11
A65	Bank 1 Inj. 2 Cyl.4 O_P_SVH12
A23	Bank 1 Inj. 2 Cyl.4 O_P_SVL12
A43	Bank 2 Inj. 1 Cyl.3 O_P_SVH21
A01	Bank 2 Inj. 1 Cyl.3 O_P_SVL21
A44	Bank 2 Inj. 2 Cyl.2 O_P_SVH22
A02	Bank 2 Inj. 2 Cyl.2 O_P_SVL22



## EMS (3.3LNG BSVI)

### VEHICLE CONNECTOR PINOUT DETAILS 12V

Pin No.	Name
K02	Battery minus 1
K04	Battery minus 2
K06	Battery minus 3
K60	CAN Interface 1
K77	With termination resistor
K58	CAN Interface 2
K75	Without termination resistor
K59	CAN-Interface 3
K76	CAN-Interface 3
K14	LIN-Interface
K15	KLINE-Interface
K28	Vehicle speed sensor input signal
K71	Engine speed output signal
K35	Vehicle speed output
K72	Coolant temperature indication output signal
K26	Vehicle speed sensor ground
K49	Catalytic temp sensor 1 (downstream)
K81	Catalytic temp sensor 1 (downstream)
K66	After DPF/ upstream SCR (T6)
K01	Battery plus 1
K03	Battery plus 2
K05	Battery plus 3
K19	O_S_MRLY
K16	I_S_T15
K52	Brake switch
K85	Redundant brake switch
K36	OBD lamp
K23	Glow indication lamp
K22	DPF Regeneration Lamp
K38	Water in fuel lamp
K39	Check Engine Lamp
K80	Start switch T50 input
K12	Ambient Temperature Sensor
K83	Ambient Temperature Sensor
K41	PTO Switch on/off
K84	Parking brake switch
K46	Clutch Switch 1 (270254509950)
K47	Clutch Switch 2 (270254509950)
K53	4L indication
K51	Regeneration (start) Momentary Switch
K63	Cabin Tilt switch
K30	A/C Pressure sensor switch
K62	Coolant Level switch
K67	Exhaust brake main switch
K50	Oil pressure switch (265454500139)
K08	Accelerator Pedal Module O_V_5VAPP1
K29	Accelerator Pedal Module I_A_APP1
K24	Accelerator Pedal Module G_R_APP1

Pin No.	Name
K09	Accelerator Pedal Module O_V_5VAPP2
K31	Accelerator Pedal Module I_A_APP2
K25	Accelerator Pedal Module G_R_APP2
K07	Remote Accelerator Pedal Module O_V_5VRMTAPP2
K34	Remote Accelerator Pedal Module G_R_RMTAPP2
K56	High exhaust system temperature lamp
K43	Differential lock
K69	O_T_FAN
K68	Reverse gear switch
K45	A/C On/Off Switch
K44	Cruise Control Switches CRCON (ON)
K32	Cruise Control Switches CRCPOS (Increment/PTO increment)
K79	Cruise Control Switches CRCNEG (Decrement/ PTO decrement)
K64	Cruise Control Switches CRCNL (Cancel/Resume)
K86	A/C compressor relay
K57	Oil bypass relay
K21	A/C condenser relay
K73	Grid heater relay
K18	V_V_PERMBAT
K90	O_T_RAMVH Dosing valve RAMV
K37	O_T_RAMVL Dosing valve RAMV
K27	I_F_RAULS Reduction Agent; UL& Temp sensor
K48	G_R_RAULS Reduction Agent; UL& Temp sensor
K74	O_S_MPHS Magnetic Coil Pump
K20	O_T_RAMCP Magnetic Coil Pump
K40	O_T_RAPP Reduction agent purge pump
K55	O_S_SCRMRLY SCR main relay

## EMS (3.3LNG BSVI)

### ENGINE CONNECTOR PINOUT DETAILS 12V

Pin No.	Name
A13	Remote Accelerator Pedal Module O_V_5VRMTAPP1
A72	Remote Accelerator Pedal Module I_A_RMTAPP1
A73	Remote Accelerator Pedal Module I_A_RMTAPP2
A61	Pre-supply pump Relay O_S_PSP
A57	PTO RPM selector 1 switch I_S_PTRPM1
A02	PTO RPM selector 2 switch I_S_PTRPM2
A01	PTO RPM selector 3 switch I_S_PTRPM3
A75	PTO Vehicle/ Remote Acc. pedal sel. switch I_S_ACPSSW
A70	Regeneration stop switch latchable I_S_MRSSW
A47	Intake throttle valve actuator and position sensor (RKL-E 5.9 NC) O_T_TVAPOS
A91	Intake throttle valve actuator and position sensor (RKL-E 5.9 NC) O_T_TVANEG
A08	Intake throttle valve actuator and position sensor (RKL-E 5.9 NC) O_V_5VTVA
A50	Intake throttle valve actuator and position sensor (RKL-E 5.9 NC) I_A_TVA
A69	Intake throttle valve actuator and position sensor (RKL-E 5.9 NC) G_R_TVA
A94	EGR Actuator & Position Sensor O_T_EGRPOS
A90	EGR Actuator & Position Sensor O_T_EGRNEG
A07	EGR Position sensor O_V_5VEGR
A52	EGR Position sensor I_A_EGR
A100	EGR Position sensor G_R_ETVA
A92	Exhaust Throttle valve actuator and position sensor O_T_ETVAPOS
A68	Exhaust Throttle valve actuator and position sensor O_T_ETVANEG
A05	Exhaust Throttle valve actuator and position sensor O_V_5VETVA
A74	Exhaust Throttle valve actuator and position sensor I_A_ETVA
A37	Upstream DPF (T5) I_A_EGRCWTS
A99	Upstream DPF (T5) G_R_EGRCWTS
A59	Upstream DOC (T4) I_A_TBTS_UP
A51	Coolant Temp. Sensor (Engine) I_A_CTS

Pin No.	Name
A28	Coolant Temp. Sensor (Engine) G_R_CTS
A96	Oil temperature sensor I_A_OTS
A12	Particle filter, differential pressure sensor O_V_5VPFDP
A78	Particle filter, differential pressure sensor I_A_P FDP
A55	Particle filter, differential pressure sensor G_R_P FDP
A16	Crankshaft Speed Sensor (Inductive) I_F_CRSPOS
A15	Crankshaft Speed Sensor (Inductive) I_F_CRSNEG
A35	Crankshaft Speed Sensor (Inductive) G_R_CRS
A09	Camshaft Speed Sensor (Hall) O_V_5VCAS
A49	Camshaft Speed Sensor (Hall) I_F_CAS
A81	Camshaft Speed Sensor (Hall) G_R_CAS
A10	Boost pressure sensor with temp. sensor O_V_5VBPS
A76	Boost pressure sensor with temp. sensor I_A_BTS
A97	Boost pressure sensor with temp. sensor I_A_BPS
A31	Boost pressure sensor with temp. sensor G_R_BPS
A89	Boost Pressure Actuator Feedback Sensor Signal O_T_EVGTPOS
A93	Boost Pressure Actuator Feedback Sensor Signal O_T_EVGTNEG
A06	Boost Pressure Actuator Feedback Sensor Signal O_V_5VEVGT
A53	Boost Pressure Actuator Feedback Sensor Signal I_A_EVGT
A34	Air Mass Flow METER O_V_5VSENT
A39	Air Mass Flow METER I_D_SENT2
A38	Air Mass Flow METER I_D_SENT1
A29	Air Mass Flow METER G_R_SENT2
A11	Rail pressure sensor O_V_5VRAILPS
A71	Rail pressure sensor I_A_RAILPS
A83	Rail pressure sensor G_R_RAILPS
A77	Fuel Temperature Sensor I_A_FTS
A32	Fuel Temperature Sensor G_R_FTS
A58	Exhaust gas temp. sensor 1 I_A_THPEGRPOST
A30	Exhaust gas temp. sensor 1 G_R_THPEGRPOST
A104	EGR temp sensor I_A_TEGR
A54	EGR temp sensor G_R_TEGR
A41	SCR Warning Lamp O_S_SCRLP

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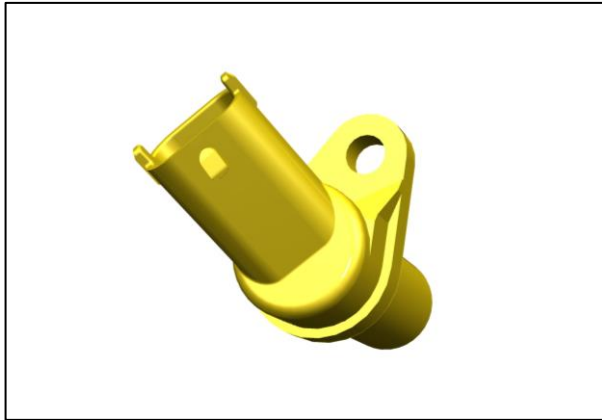
## EMS (3.3LNG BSVI)

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Pin No.	Name
A40	Gear Neutral Indicator O_S_GNSW
A14	E-Viscos Fan Visco Fan Drive EF 35 (BorgWarner MAHLE Behr) O_V_5VFSS
A27	E-Viscos Fan Visco Fan Drive EF 35 (BorgWarner MAHLE Behr) I_T_FSS
A56	E-Viscos Fan Visco Fan Drive EF 35 (BorgWarner MAHLE Behr) G_R_FSS
A20	Starter relay O_S_STRTH
A21	Starter relay O_S_O_S_STRTL
A62	Glow plug control unit O_T_GLW
A36	Glow plug control unit I_T_GLW
A105	Gear Neutral Switch I_S_GNSW
A42	Fuel heater relay O_S_FHRLY
A63	Electrical thermostat control relay O_S_ETC
A98	Water in fuel sensor
A19	EGR cooling by-pass
A18	EGR Coolant Water Pump
A17	High pressure pump (CP4) with Fuel metering unit
A23	Cyl. 1: O_P_INJVH11
A43	Cyl. 1: O_P_INJVL11
A22	Cyl. 4: O_P_INJVH12
A44	Cyl. 4: O_P_INJVL12
A64	Cyl. 3: O_P_INJVH21
A85	Cyl. 3: O_P_INJVL21
A65	Cyl. 2: O_P_INJVH22
A86	Cyl. 2: O_P_INJVL22

**4. EMS SYSTEM SENSORS**

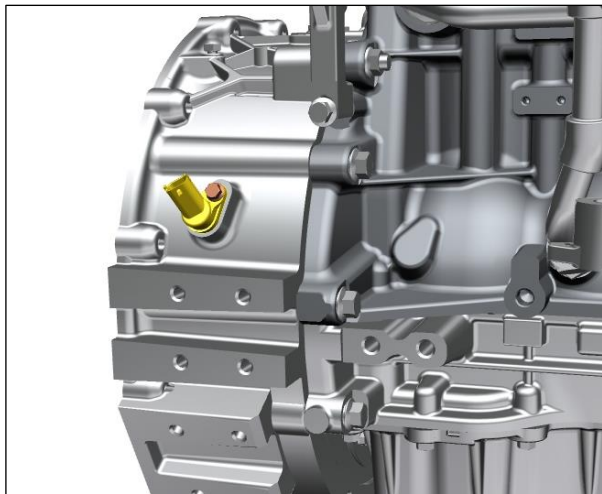
**A. CRANKK SPEED SENSOR**



The crank speed sensor is a magnetic field sensitive transducer and generates a voltage output proportional to the rate of change of the magnetic field near a "Missing tooth" configuration. It monitors the rotating speed (*rpm*), the position of crankshaft/ piston and speed fluctuations of the engine and gives continuous feedback to the ECU. In other words it gives engine speed and piston position signal to the ECU. The sensor gap should be  $1.0\pm 0.5\text{mm}$ . If the gap between the tone wheel and crank speed sensor is not correct, the engine will not start or may misfire.

**LOCATION**

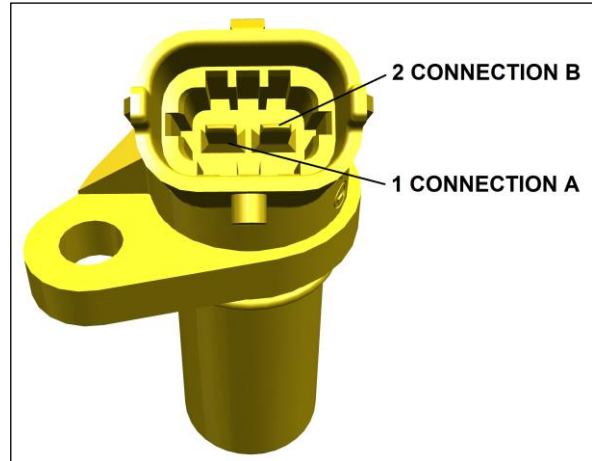
The crank speed sensor is fitted on the cylinder crank case.



**TIGHTENING TORQUE**

DESCRIPTION	TORQUE
Hex bolt M6	$8 \pm 2\text{Nm}$

**CONNECTOR DETAILS**



**PIN OUT DETAILS**

PIN NO	DESCRIPTION
PIN 1	Crank shaft sensor(+)
PIN 2	Crank shaft sensor(-)

**REMOVAL**

1. Remove one mounting bolt.
2. Take out the crank speed sensor.

**NOTE**

- *Rotation speed sensor must not be removed from its packaging until immediately prior to installation in the vehicle or the test device.*
- *Grease O-ring prior to installation with a mineral oil based grease.*

**INSPECTION**

Measure resistance across the terminals pin 1 and 2 using Digital multimeter; it should be  $525 \Omega - 640 \Omega$ .

**REFITMENT**

1. Locate the sensor on cylinder crankcase and fix with partially self-sealing cylinder screw M6x12. Tightening torque:  $8 \pm 2\text{Nm}$ .
2. Connect wiring harness connector to the crank speed sensor.

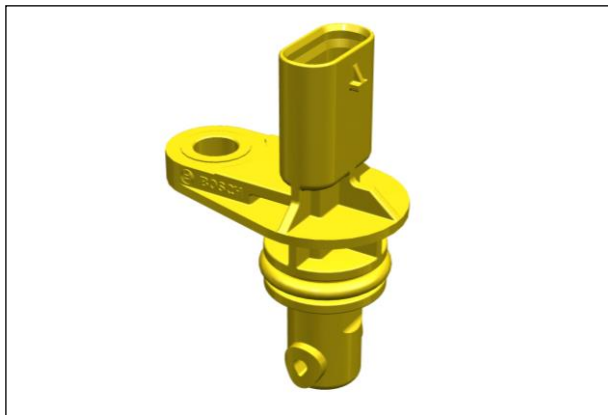
**NOTE**

- *While fitment of crank speed sensor specified air gap to be maintain. (Air gap  $1.0\text{mm} \pm 0.5\text{mm}$ ).*
- *Fix with partially self-sealing cylinder screw M6*

# EMS (3.3LNG BSVI)

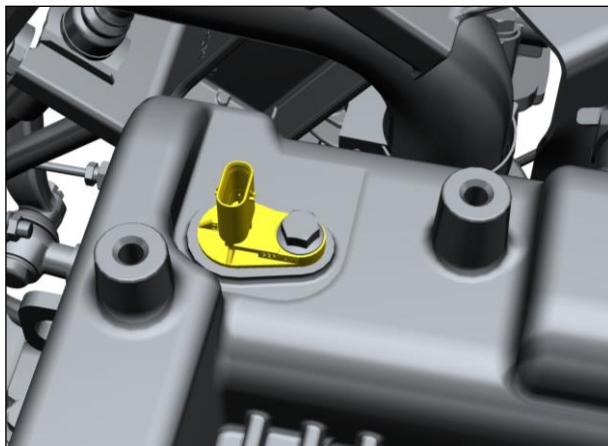
## B. CAM SHAFT POSITION SENSOR

The cam sensor is a magnetic field sensitive transducer and generates a voltage output proportional to the rate of change of the magnetic field near a "camshaft lobe" configuration. The cam sensor senses the position of the flag on the Exhaust camshaft and gives feed back to the ECU regarding the cylinder No.1 (90° BTDC). The sensor gap should be 0.5mm to 1.5mm. If the gap is not correct and also the position of camshafts with respect to crank shaft (*set during assembly*), the engine will not start or may misfire. While the engine is running and the cam sensor fails then the engine will continue to run till the engine is stopped, but will not start again.



### LOCATION

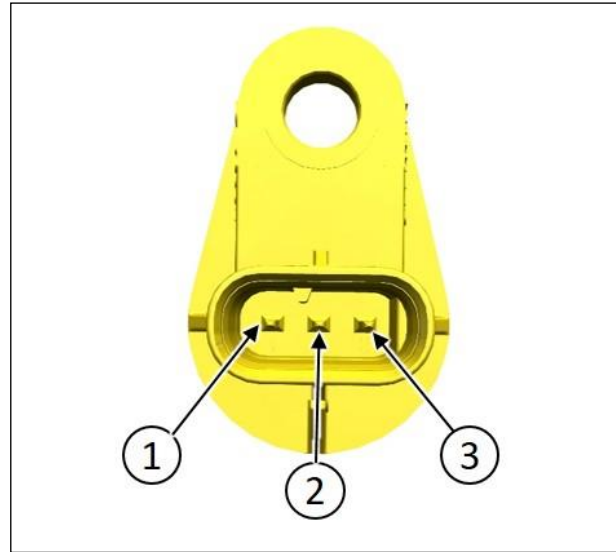
The cam sensor is fitted on cylinder head cover.



### TIGHTENING TORQUE

DESCRIPTION	TORQUE
Hex bolt M6	5 to 8 Nm

## CONNECTOR DETAILS



### PIN DETAILS

PIN NO	DESCRIPTION
Pin 1	Supply
Pin 2	Ground
Pin 3	Output

### REMOVAL

1. Remove engine cover.
2. Disconnect the wiring harness connector from cam shaft position sensor.
3. Remove one mounting bolt of sensor and take out the cam position sensor from its location.

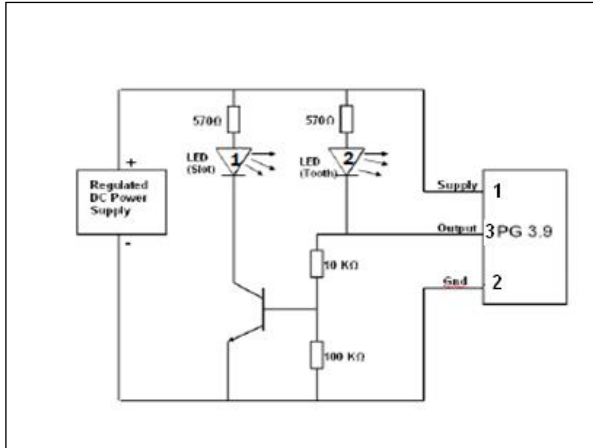
### INSPECTION

Connect regulated 5V DC power supply to pin no.1 and Ground to pin no. 2 of the sensor.

Connect LED 1 with resistor 570Ω to the NPN transistor collector. Emitter is grounded.

Connect another LED 2 along with a series resistor (570Ω) between pin 3 and pin 1.

Connect the base of the transistor with resistors (10kΩ and 100kΩ) as shown in the figure. Move a ferromagnetic piece of material in front of the sensor head.



The LED 2 will be glow when the material in the near the sensor head and the LED 1 will glow when the material is away from the sensor head.

### NOTE

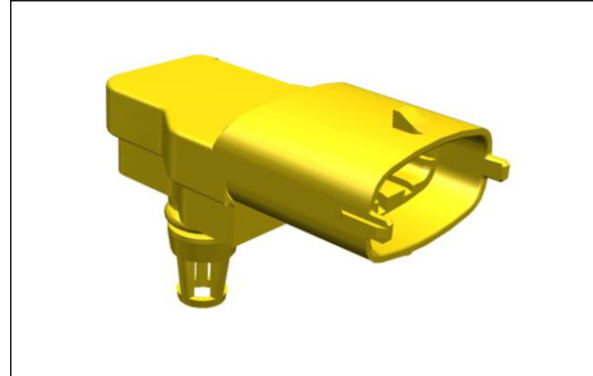
*The above mentioned method does not check the functionality of the sensor throughout its range. It can only give a rough indication. To check the full functionality, the sensors must be tested on a suitable test bench*

### REFITMENT

1. Locate the cam shaft position sensor and fit one mounting bolt and tighten with specified torque.  
Tightening torque for bolt – 5 to 8 Nm
2. Connect the wiring harness connector to the cam shaft position sensor.
3. Fit engine cover.

### C. BOOST PRESSURE SENSOR

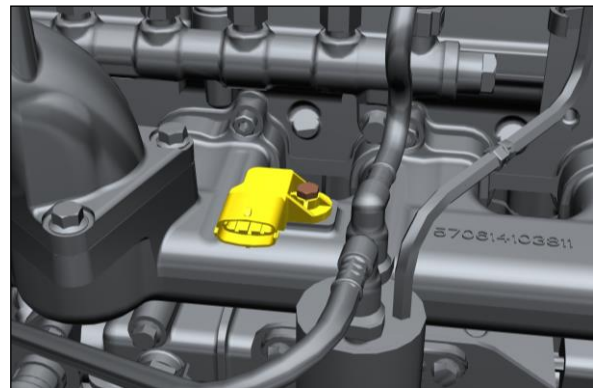
This sensor is fitted in the outlet of intake manifold and gives the pressure of the air entering the intake manifold to the EMS ECU.



Fuel quantity and injection timing are optimized based on these inputs.

### LOCATION

This sensor is fitted on intake manifold outlet near the pipe connecting intercooler to engine intake.



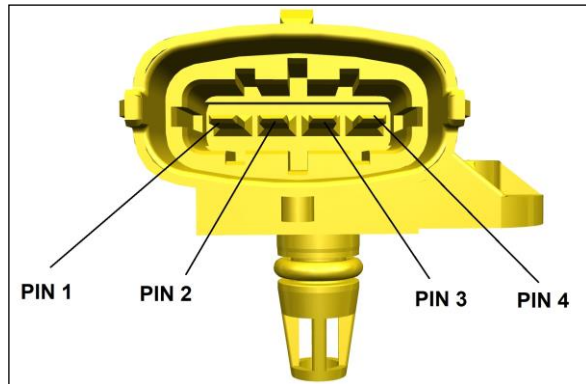
### TIGHTENING TORQUE

DESCRIPTION	TORQUE
Hex screw M4	4 to 6 Nm



## EMS (3.3LNG BSVI)

### CONNECTOR DETAILS



### PIN OUT DETAILS

PIN NO	DESCRIPTION
Pin 1	GROUND
Pin 2	NTC
Pin 3	+5 V
Pin 4	U. (PRESSURE) OUTPUT SIGNAL

### REMOVAL

1. Disconnect the battery negative terminal from battery.
2. Disconnect the electrical connection from sensor.
3. Remove one mounting Bolt of sensor and take out the sensor from its location.

### INSPECTION

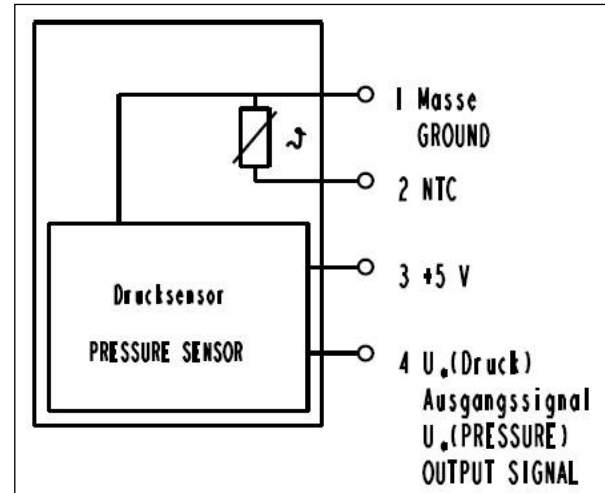
- Connect regulated 5V power supply to pin no.3 and Ground to pin no. 1 of the sensor.
- Check the output voltage at pin no. 4 with respect to ground. At standard atmospheric pressure  $p_{amb}=935 \text{ mbar}$ , the output voltage should be  $U_{out}=1.165 \text{ V}$

Disconnect the power supply. Connect a multimeter across connector pins 1 and 2 and measure the resistance across it. It should show a nominal resistance of  $1.707 \text{ k}\Omega \pm 5\%$  at  $27^\circ\text{C}$ . The circuit should not be open. It is enough to check the resistance at room temperature.

### NOTE

*The above mentioned method does not check the functionality of the sensor throughout its range.*

*It can only give a rough indication. To check the full functionality, the sensors must be tested on a suitable test bench.*



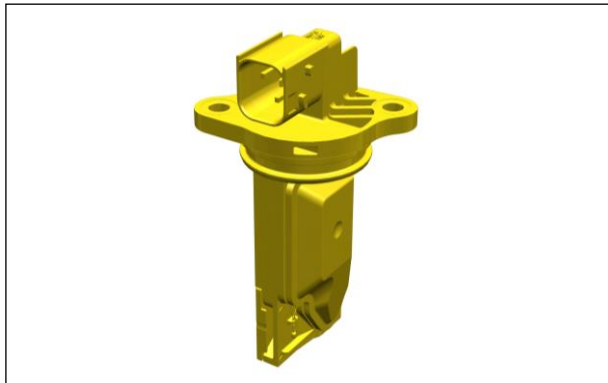
### REFITMENT

1. Locate the Booster Pressure sensor on intake manifold and fit one mounting bolt.
2. Connect the electrical connection to the MAP sensor.



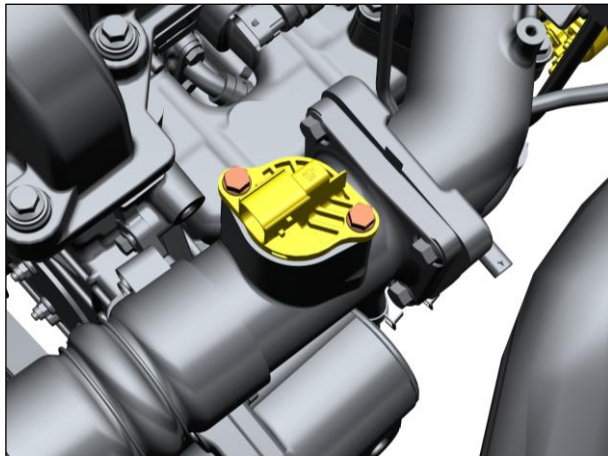
**D. PFM SENSOR**

EMS measures the mass and temperature of air entering intake by using this sensor. PFM sensor has 4-pole connector and provides the frequency input signal at A13 which corresponds to flow of air and Analog input at A23 which corresponds to temperature of air intake. It is mounted in the intake air duct between the air cleaner and turbo charger.



**LOCATION**

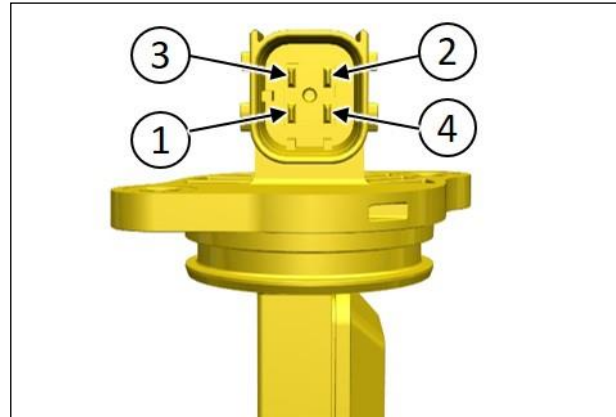
This sensor is mounted between air filter and turbocharger.



**TIGHTENING TORQUE**

DESCRIPTION	TORQUE
Hex screw M5	10.0 Nm

**CONNECTOR DETAILS**

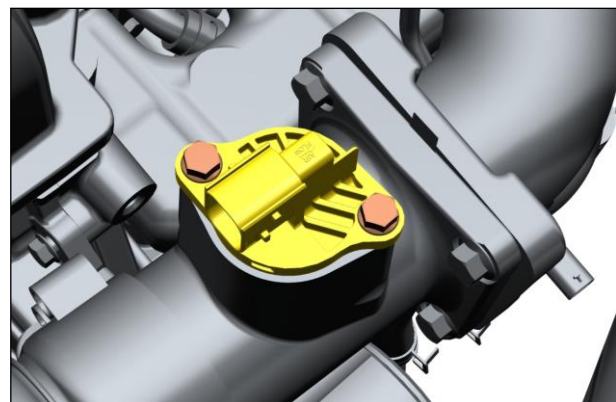


**PIN OUT DETAILS**

PIN NO	DESCRIPTION
1	VDD (5V), Source
2	Sent 1, Dynamic Pressure P
3	GND, Ground
4	Sent 2, Absolute Pressure P and Air Temperature

**REMOVAL**

1. Disconnect the electrical connection from sensor.
2. Remove two mounting bolts of sensor and take out from its location.



**REFITMENT**

1. Locate sensor assembly in the housing and fit two mounting bolts.
2. Connect the wiring harness connector to the sensor.

# EMS (3.3LNG BSVI)

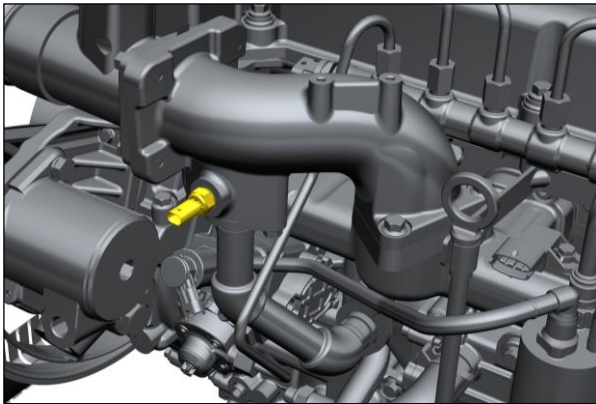
## E. EGR TEMPERATURE SENSOR

The EGR Temperature Sensor detects the temperature of the incoming Air stream. It is also used for detecting ambient temperature on a cold start and intake air temperature as the engine heats up the coming air.

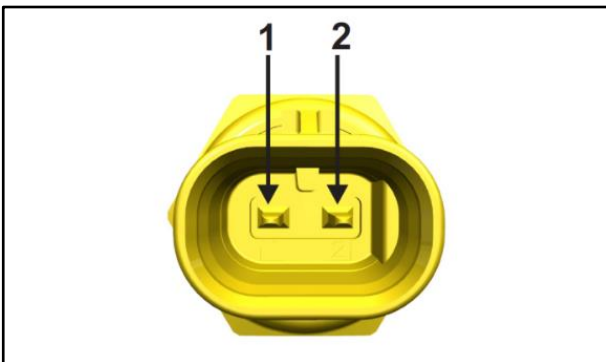


### Location

The sensor is mounted on the air intake pipe, Intake Manifold.



### Connector Details



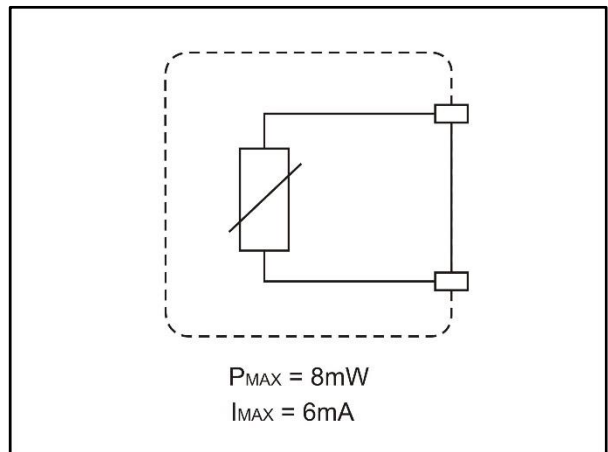
PIN No.	Description
1	Sensor Signal
2	Sensor Return

### Removal

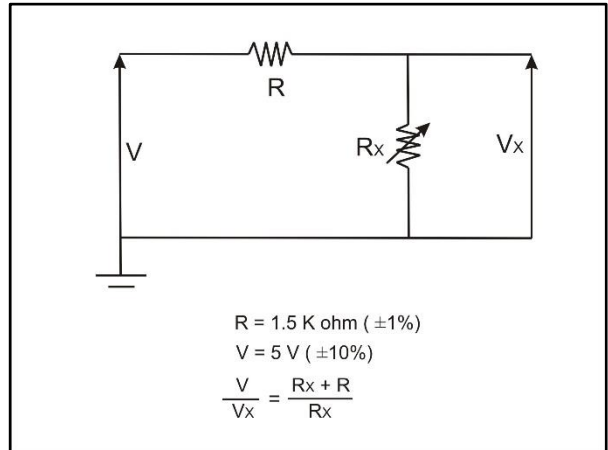
1. Disconnect the wiring harness connector from sensor.
2. Remove the sensor by loosening it with the help of a spanner.

### Inspection

### Schematic Diagram



### Test Circuit



**Resistance to Temperature Table**

T (°C)	Resistance (Ω)	± Tol. (%)	± Tol. (K)
-40	220348.8	16.7	3.4
-20	77418.1	14.4	3.1
0	29846.1	12.3	3
20	12868.3	10.7	2.9
25	10584.1	10.3	2.8
40	6091.2	9.3	2.8
60	3124.2	8.1	2.7
80	1717.4	7	2.6
100	1002.4	5.8	2.3
120	615.3	4.7	2
140	394.2	3.5	1.6
160	261.1	3	1.5
180	178	3.3	1.8
200	124.6	4	2.3
220	88.2	4.7	2.8
240	63.4	5.3	3.5
260	46.3	6.1	4.1
280	34.3	6.9	4.8
300	25.7	7.9	5.3

**Refitment**

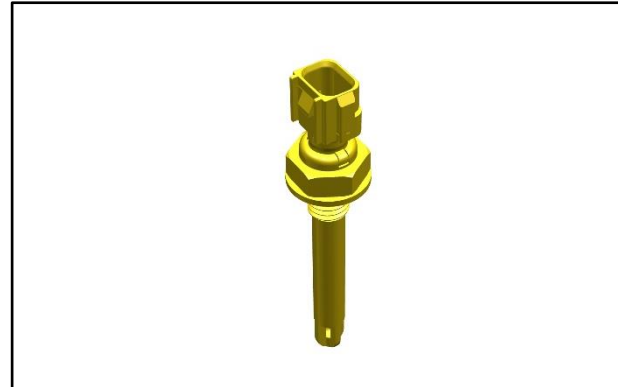
1. Locate sensor on the Intake manifold and fit the adaptor.
2. Connect the wiring harness connector to the sensor.

**Tightening Torque**

Description	Torque (Nm)
Adaptor M12 x 1	20 ± 2

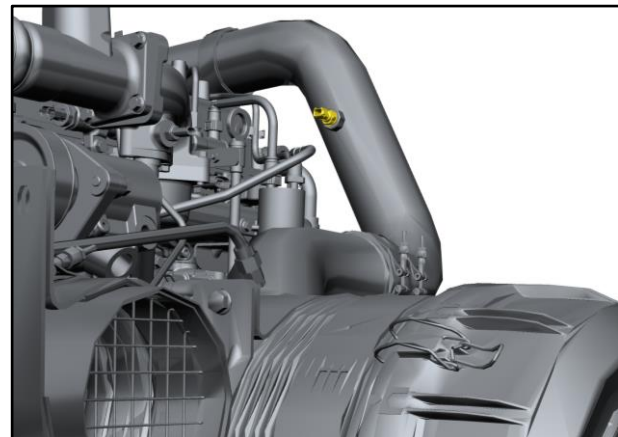
**F. AMBIENT TEMPERATURE SENSOR**

This sensor gives Information about ambient temperature of the air entering in the engine. This input is used by the ECU for cutting of Adblue dosing below specified ambient temperature.

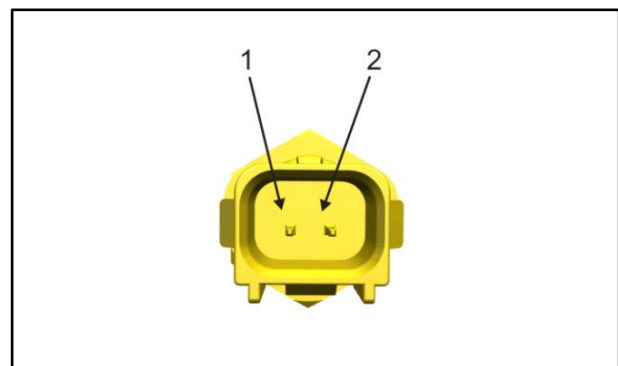


**Location**

This sensor is mounted in between air filter and turbocharger.



**Connector Details**



PIN No.	Description
1	ECU Ground
2	NTC

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## EMS (3.3LNG BSVI)

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### Removal

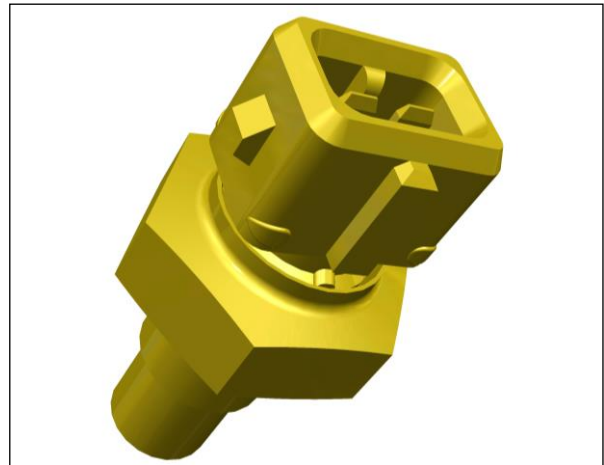
1. Disconnect the wiring harness connector from sensor.
2. Remove the sensor by loosening it with the help of a suitable spanner.

### Inspection

1. Range of Intake Air temperature:  
Min. air Intake Temp. : -40°C  
Max. air Intake Temp.: +110°C
2. Range of ambient Temperature (under hood condition)  
Min. ambient Temp. : -40°C  
Max. ambient Temp. : +110°C
3. For supply voltage between 7.5V and 9V the maximum airflow with guaranteed accuracy 100kg/h.

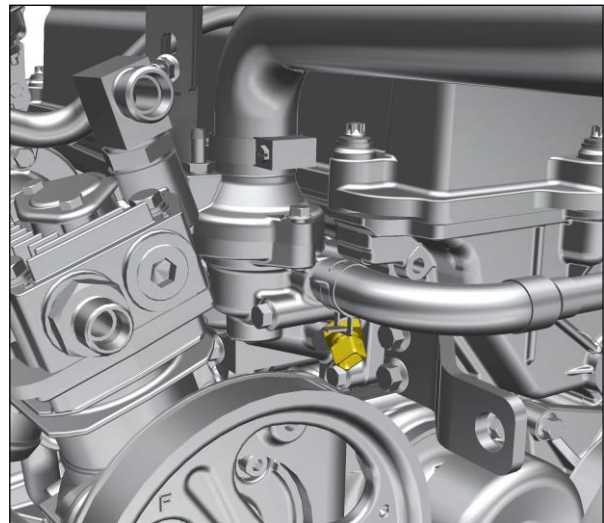
### G. COOLANT TEMPERATURE SENSOR

This sensor is made of semi conductor material (*NTC*) which changes its resistance when exposed to variable temperature source. Resistance decreases as temperature increases. It provides temperature signal to the HVAC controller. The sensor mounted on the thermostat housing provides signal to the EMS. Corrections for injection parameters are done by the EMS based on coolant temperature to run the engine with maximum efficiency at all temperatures.

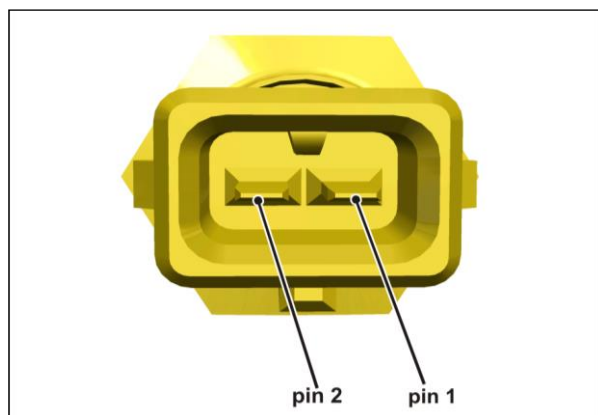


### LOCATION

1. The sensor, which gives signal to EMS, is fitted on thermostat housing.



**CONNECTOR DETAILS**



**NOTE**

*The above mentioned method does not check the functionality of the sensor throughout its range. It can only give a rough indication. To check the full functionality, the sensors must be tested on a suitable test bench.*

**REFITMENT**

1. Tighten the coolant temperature sensor on thermostat housing.
2. Connect the wiring harness connector to the coolant temperature sensor.

**PIN DETAILS**

PIN NO	DESCRIPTION
1	Sensor signal
2	Sensor return

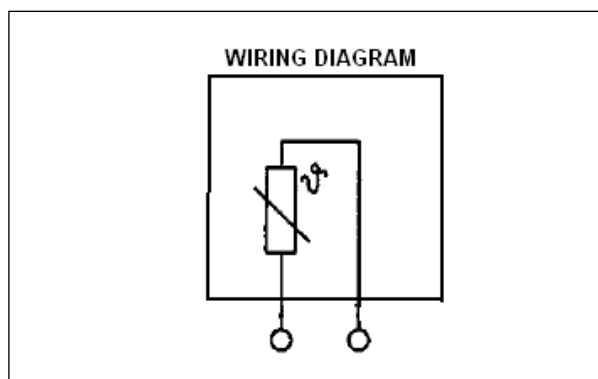
**REMOVAL**

1. Drain the coolant. (*Refer Engine Section*)
2. Disconnect the wiring harness connector from the sensor.
3. Loosen and remove sensor from the thermostat housing.

**INSPECTION**

Connect a multimeter across the two terminals and measure the resistance across it. It should show a resistance of 1.160k $\Omega$  at 25°C. The circuit should not be open (high value of resistance).

Checking the resistance at room temperature is sufficient.



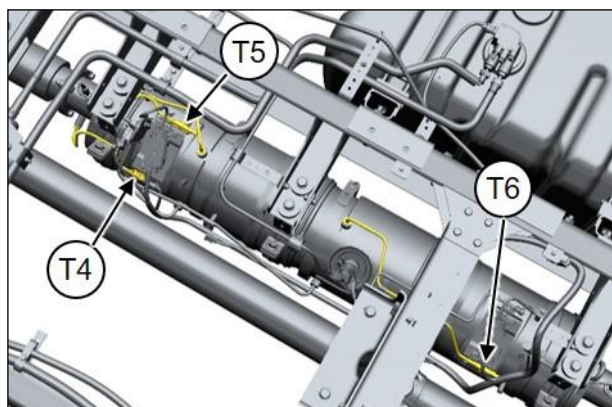
## EMS (3.3LNG BSVI)

### H. EXHAUST TEMPERATURE SENSORS WITH ROUTING T4, T5 and T6

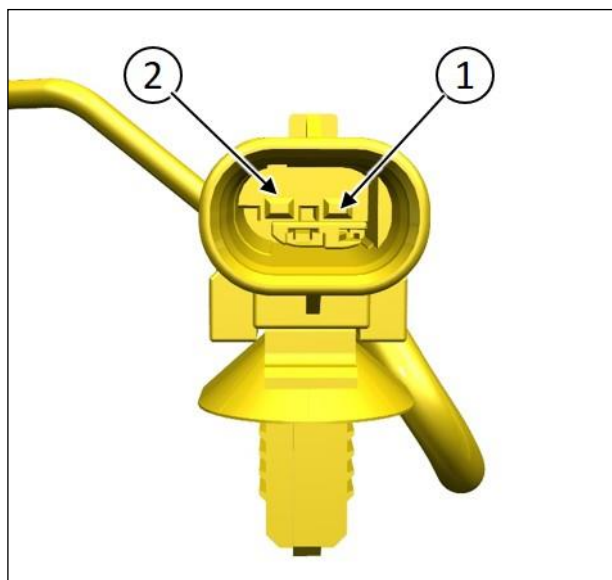
T4, T5, T6 are the exhaust gas temperature sensors.

#### LOCATION

T4 is mounted just before DOC, T5 is mounted before DPF and T6 is mounted after DPF.



#### CONNECTOR DETAILS



#### PIN DETAILS

PIN NO	DESCRIPTION
1	+ Signal. Grey Pin
2	- Ground. White Pin

#### REMOVAL

1. Disconnect the electrical connection.
2. Unscrew Hex. Nut M12X1.25 SW14 (T4) M14X1.5 SW17 (T5 and T6) to remove the sensors.

#### REFITMENT

1. Tighten Hex. Nut M12X1.25 SW14 (T4) M14X1.5 SW17 (T5 and T6) to fix the sensors.
2. Connect all the electrical connection of the sensors.

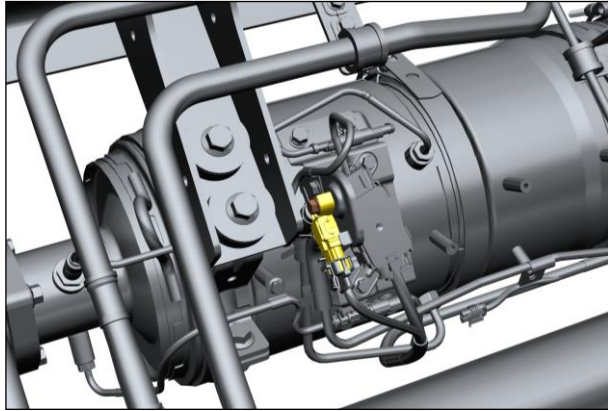
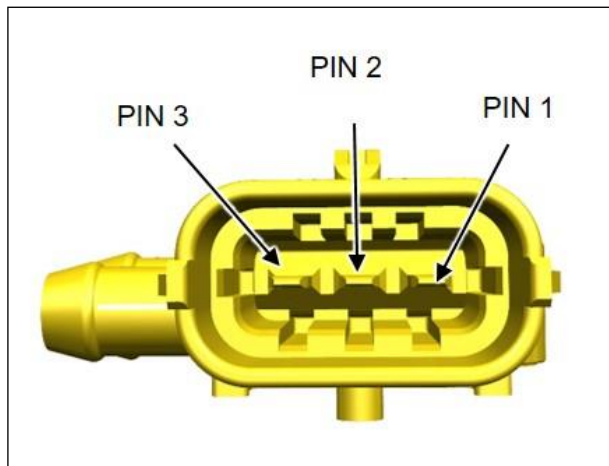


**I. DIFFERENTIAL PRESSURE SENSOR (DPS)**

DPS senses the differential pressure across the after treatment component. The sensor provides the ECU with the differential pressure which is used to determine the health of the trap.

**LOCATION**

DPS is placed across the DPF.

**CONNECTOR DETAILS****PIN DETAILS**

PIN NO	DESCRIPTION
1	Vcc
2	Ground
3	Vout

**REMOVAL**

1. Disconnect the electrical connection.
2. Unscrew Hex. FL screw M6X22 to remove the DPS from mounting bracket.

**REFITMENT**

1. Tighten Hex. FL screw M6X22 to fix the DPS on mounting bracket.
2. Connect all the electrical connection of the DPS.



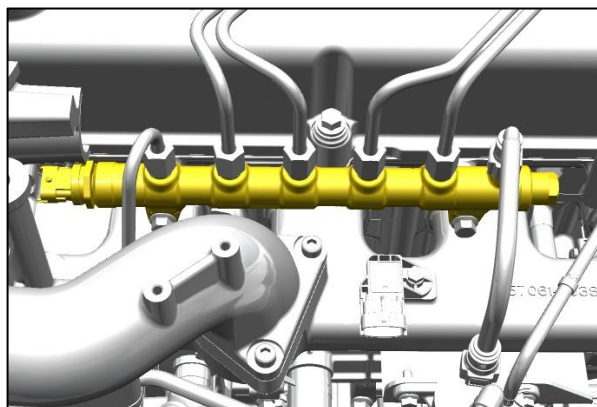
## EMS (3.3LNG BSVI)

### J. RAIL PRESSURE SENSOR

This sensor is fitted on the fuel rail and gives a close loop control of the rail pressure. Fuel is maintained at a high pressure in the fuel rail depending on requirement of the engine.

#### LOCATION

The Rail Pressure Sensor mounted on the rail of common rail fuel injection system, provides the information of fuel pressure present in the rail to ECU. This sensor consists of piezo-resistive elements whose resistance changes with the pressure acting on the piezo element.



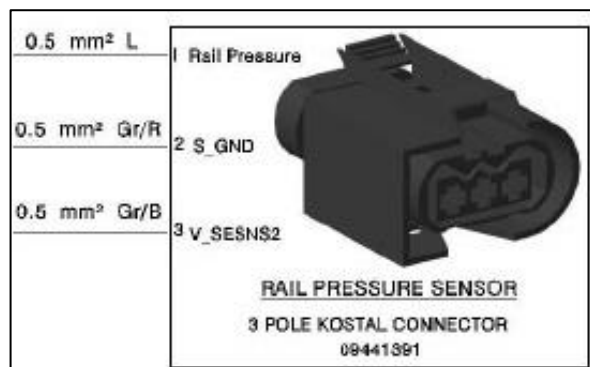
### INSPECTION

1. Check Battery Voltage (12.5±3 volts).
2. Check Rail pressure sensor pins for damage
3. Check Rail pressure sensor connector for damage.
4. Check Rail pressure signal lines for continuity.

#### PIN DETAILS

PIN NO	DESCRIPTION
Pin 1	Rail Pressure
Pin 2	S-GND
Pin 3	V_SESNS2

#### CONNECTOR DETAILS

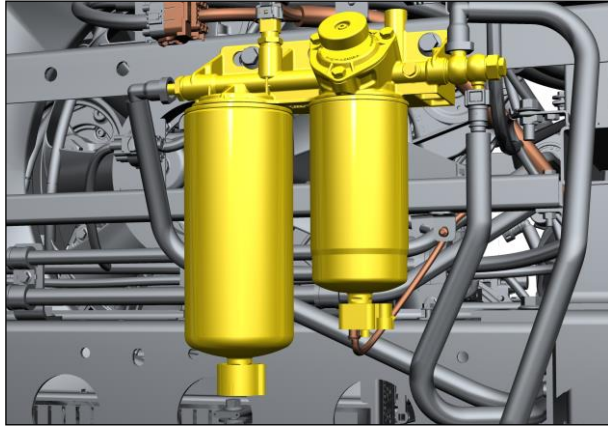


#### NOTE

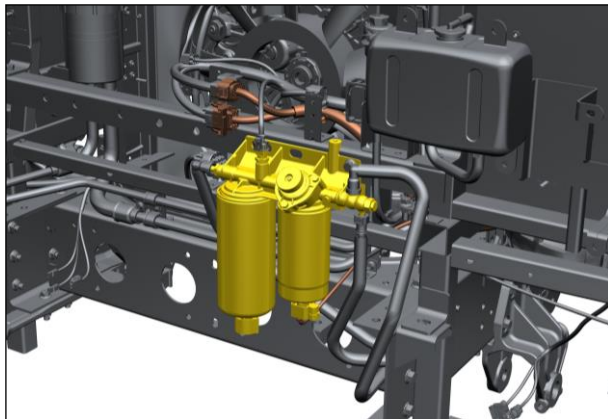
*The rail pressure sensor should not be removed from the rail. In case the sensor is faulty consult M/S BOSCH service Engineer.*

**K. WATER IN FUEL SENSOR**

It measures the water percentage in fuel and gives indication on the instrument cluster. The water collected to be drained when the indicator glows in Instrument panel.

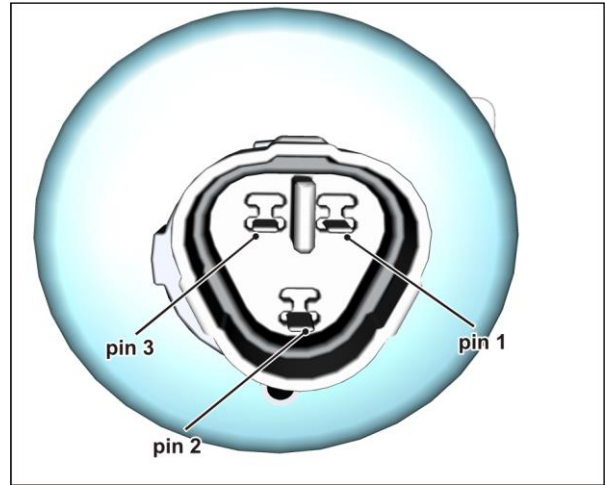


**LOCATION**



1. This sensor which gives the signal to EMS ECU is fitted on fuel filter, near the intake manifold.
2. Fuel filter mounted on chassis.

**CONNECTOR DETAILS**

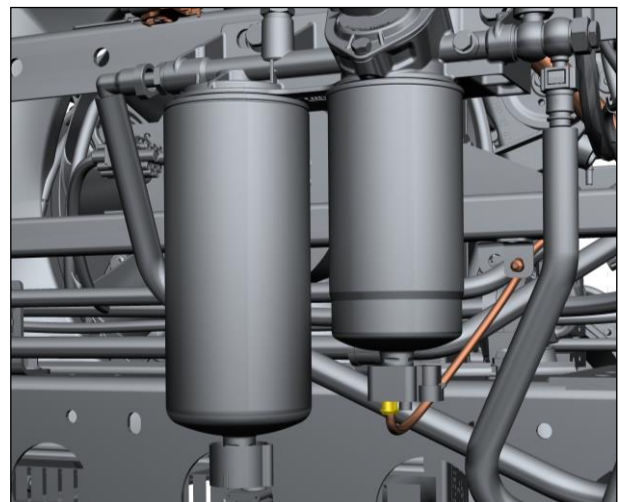


**PIN DETAILS**

PIN NO	DESCRIPTION
Pin 1	Ground (Brown)
Pin 2	Output (Blue)
Pin 3	Ignition (Red)

**REMOVAL**

1. Disconnect the electrical connection of water in fuel sensor.
2. Rotate the sensor in anti-clockwise direction and take out the sensor.



**REFITMENT**

1. Fit the sensor by rotating in clockwise direction.
2. Connect the electrical connection of the sensor.

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## EMS (3.3LNG BSVI)

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### INSPECTION

- Connect a multimeter across the pin 2 and 3 terminals and measure the resistance across it. It should show a resistance of  $5.229\text{ k}\Omega \pm 10\%$  at  $27^\circ\text{C}$ . The circuit should not be open (high value of resistance).
- Checking the resistance at room temperature is sufficient.

**Note:** The above mentioned method does not check the functionality of the sensor throughout its range. It can only give a rough indication. To check the full functionality, the sensors must be tested on a suitable test bench.

### NOTE

*In case the sensor is faulty consult M/S BOSCH service Engineer.*

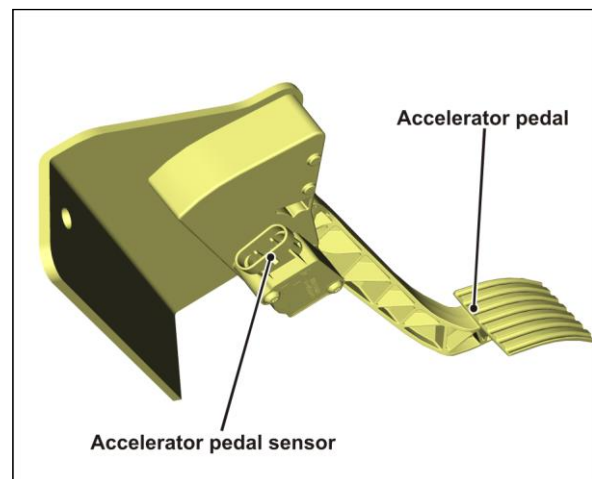
### L. ACCELERATOR PEDAL SENSOR

This sensor is secured to the accelerator pedal inside it contains an axially-located shaft connected to two potentiometers: a main one and one safety one.

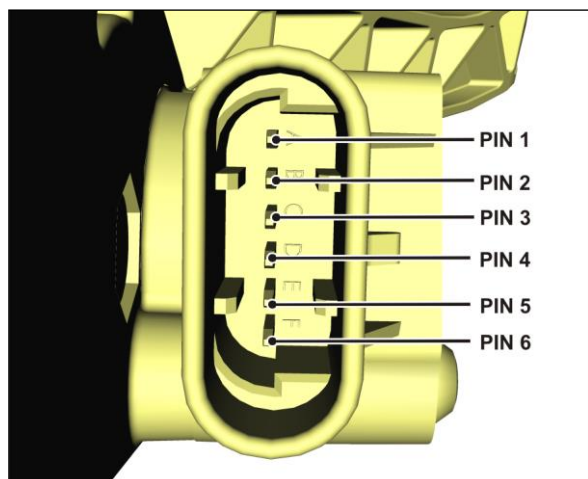
A coil spring on the shaft ensures the correct amount of resistance to pressure while a second spring ensures return following release.

The redundant signal reading makes it possible to continuously monitor the plausibility of the readings in order to guarantee complete safety whilst driving even if there is a failure.

The accelerator pedal position is converted into an electrical voltage signal and sent to the EMS ECU by the potentiometer connected to the pedal. The accelerator pedal position signal is processed together with the information relating to the engine rpm to produce the desired torque and engine speed.



### CONNECTOR DETAILS

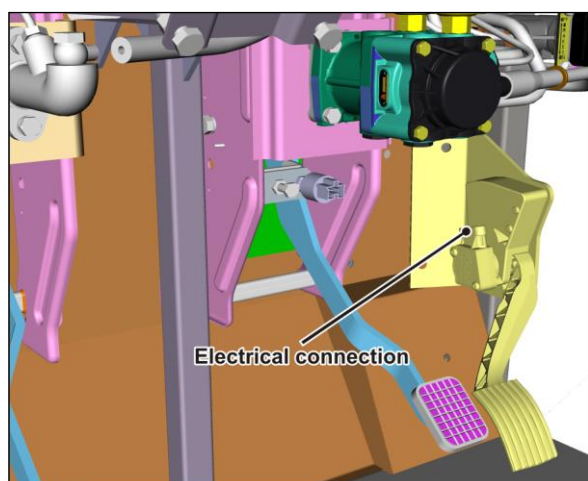


### PIN OUT DETAILS

PIN NO	DESCRIPTION
PIN1	APS Signal 1
PIN 2	GND 1
PIN 3	APS Supply 1
PIN 4	APS Supply 2
PIN 5	GND 2
PIN 6	APS Signal 2

### REMOVAL

1. Disconnect the accelerator pedal electrical connector from the accelerator pedal module.



2. Loosen and remove the 3 mounting bolts and remove the accelerator pedal module.

### INSPECTION

Check the resistance

- 1.7K ohm +/- 0.8 between terminals 1 and 5
- 1.2K ohm +/- 0.5 between terminals 2 and 3

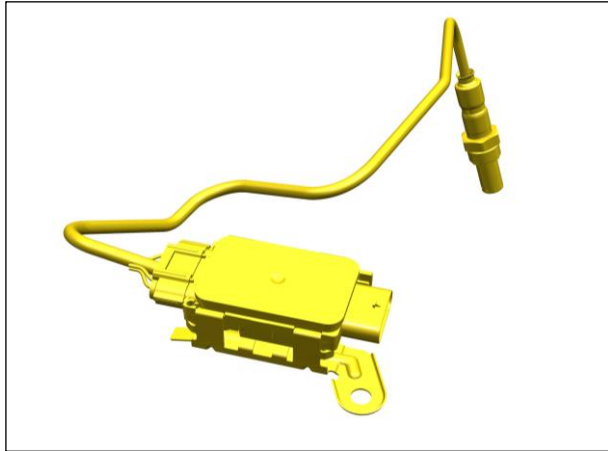
### REFITMENT

1. Locate accelerator pedal module and fit mounting nuts.
2. Connect the accelerator pedal electrical connector to the accelerator pedal module.

## EMS (3.3LNG BSVI)

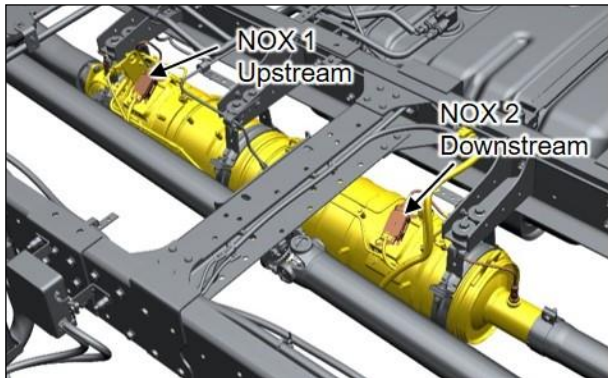
### M. NOx sensor (upstream/downstream) with routing

There are two NOx sensors (upstream & downstream). Upstream NOx gives the value of engine out NOx and downstream NOx gives the value of tail pipe NOx in ppm. This sensors used for NOx control calibration.

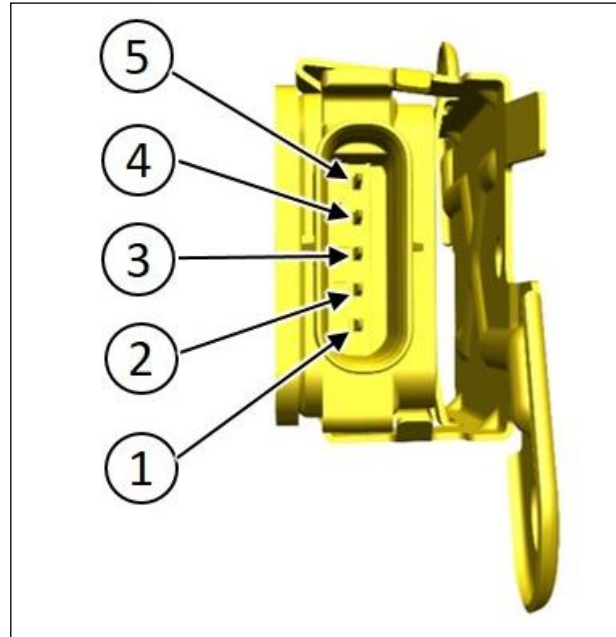


#### LOCATION

NOx sensor upstream is mounted before DOC.  
NOx sensor downstream is mounted after SCR.



### CONNECTOR DETAILS

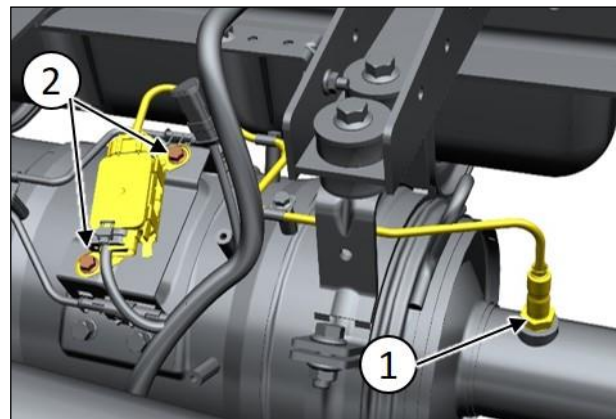


#### PIN OUT DETAILS

PIN NO	DESCRIPTION
PIN1	UBATT
PIN 2	GND
PIN 3	CAN LOW
PIN 4	CAN HIGH
PIN 5	Ground/Open depending on sensor position

#### REMOVAL

1. Disconnect electrical connections.
2. Apply <50 Nm torque while sensor loosening (1). Remove Hex FL screws M6X14 (2 nos.) from sensor bracket (2)



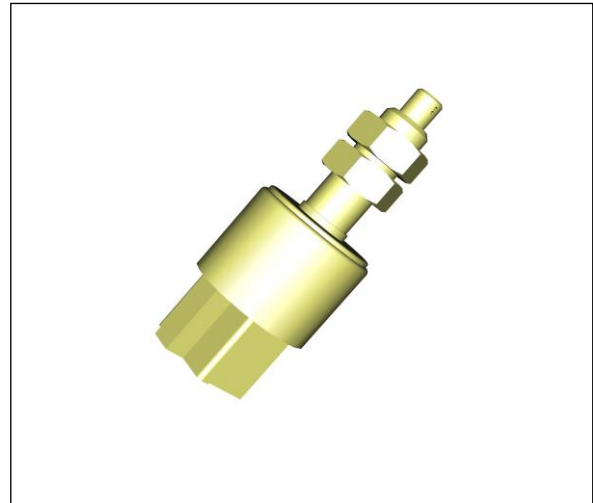


**REFITMENT**

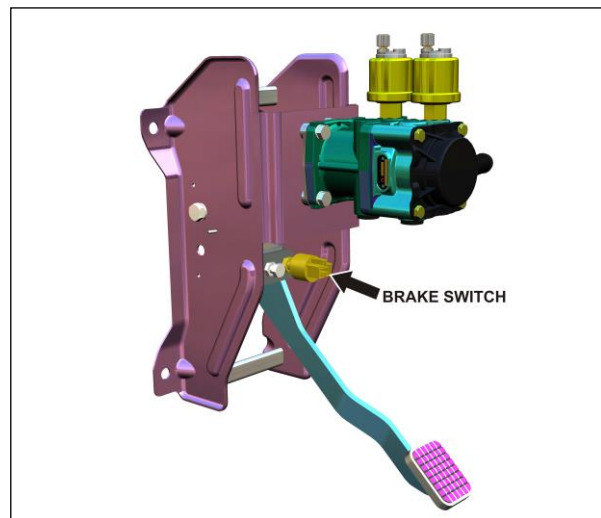
1. Fit the sensor (1) with tightening torque 60 +10/-20 Nm.
2. Tighten Hex FL screws M6X14 (2 nos.) on the bracket (2).

**NOTE**

*Tightening torque 60 +10/-20 Nm valid with BOSCH recommended mounting boss.*

**N. BRAKE SWITCH**

The brake pedal is fitted with a Brake switch, which provides the information to ECU about the brake pedal application. It gives signal to tail lamp, EMS and ABS ECU.

**LOCATION**

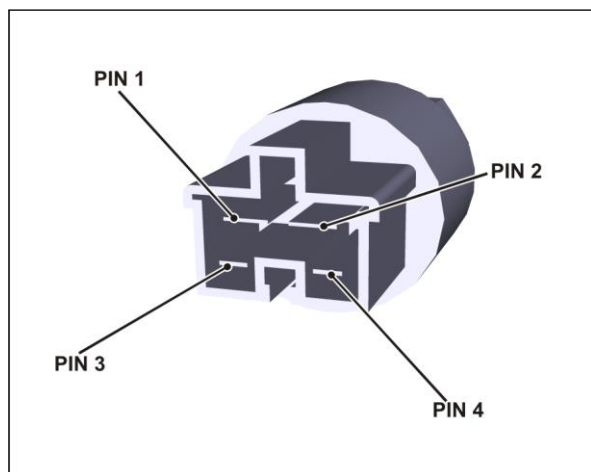
Brake switch fitted on brake light switch mounting bracket.

**TIGHTENING TORQUE**

DESCRIPTION	TORQUE
Hex screw M8	4 to 5 Nm

## EMS (3.3LNG BSVI)

### CONNECTOR DETAILS

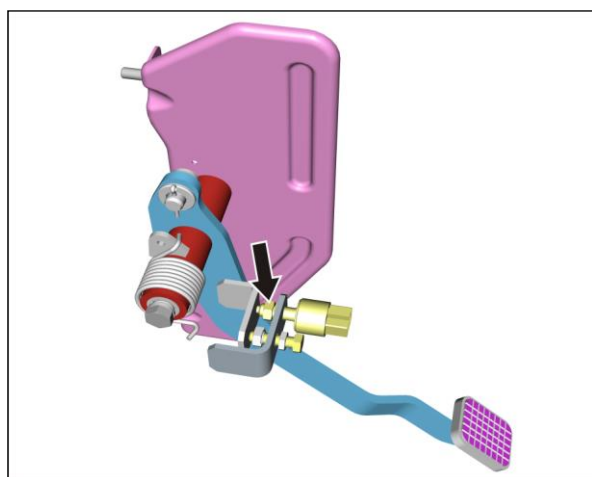


### PIN OUT:

PIN No.	DESCRIPTION
PIN 1	Ground
PIN 2	Brake pedal signal to EMS
PIN 3	Ground
PIN 4	Brake pedal signal to transfer case ECU

### REMOVAL

1. Disconnect electrical connections of brake switch.
2. Loosen the mounting nut of brake switch and take out the brake switch by rotating anticlockwise direction.



### INSPECTION

Disconnect the connector and check the continuity between the following pins. When the pedal is depressed there should be connectivity and when it is released to rest position there should not be connectivity.

### NOTE

*For switch adjustment details, refer brake section.*

### REFITMENT

Fit the brake light switch on the mounting bracket and tighten its mounting nut.

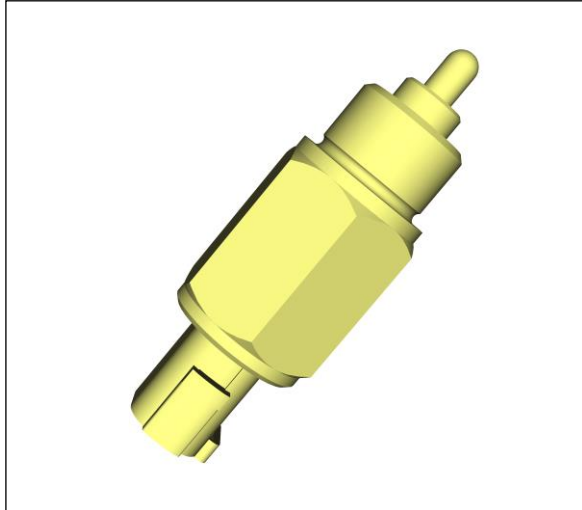
### NOTE

*Refer brake section for brake switch adjustment details.*



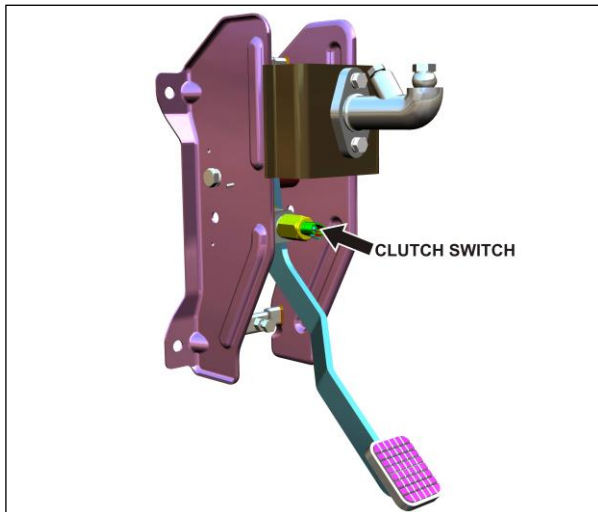
**O. CLUTCH SWITCH**

It provides information to ECU before the gear change which helps in faster gear change detection. Based on this input the ECU maintains optimum fuel supply. It also gives signal to Transfer case ECU.



**LOCATION**

It is fitted on clutch switch mounting bracket.



**NOTE**

A faulty clutch switch may disable the semi cruise functionality on Vehicle thus impacting fuel economy to some extent.

**TIGHTENING TORQUE**

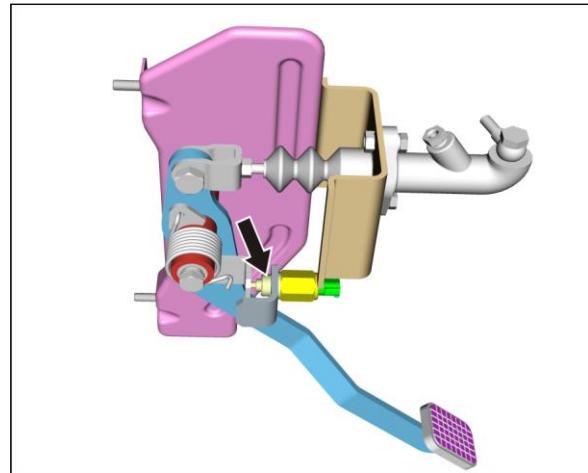
DESCRIPTION	TORQUE
Against steel face	8 kgfm
For AL casting	1.5 to 3.0 kgfm

**CONNECTOR DETAILS**

PIN No.	DESCRIPTION
PIN 1	Signal Output
PIN 2	Ground

**REMOVAL**

1. Disconnect the electrical connection from the clutch switch.
2. Loose and remove lock nut of clutch switch and take out the clutch switch.



**INSPECTION**

Disconnect the connector and check the continuity between the pins. When the pedal is depressed there should be connectivity and when released to rest position there should not be connectivity.

**REFITMENT**

1. Fit the clutch light switch on the mounting bracket and tighten its mounting nut.

**NOTE**

*Refer clutch section for clutch switch adjustment details.*

*A faulty switch may disable the semi cruise functionality on vehicle thus impacting fuel economy to some extent.*

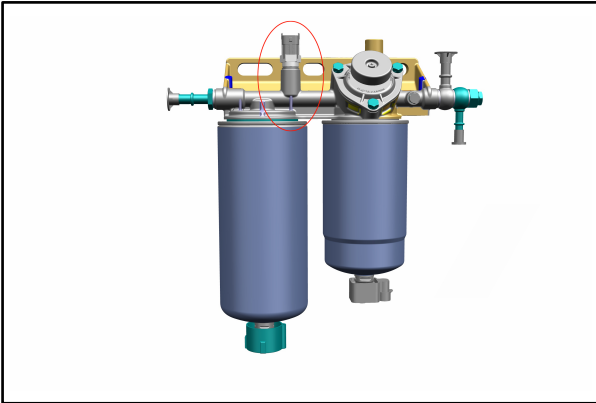
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## EMS (3.3LNG BSVI)

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### P. FUEL TEMPERATURE SENSOR

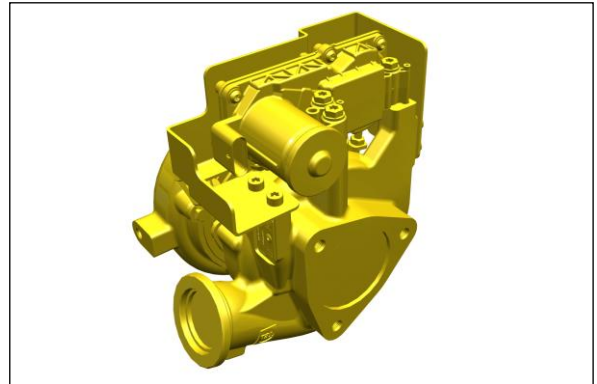
The fuel temperature sensor, mounted on the fuel filter assembly, provides information to the ECU regarding fuel temperature.



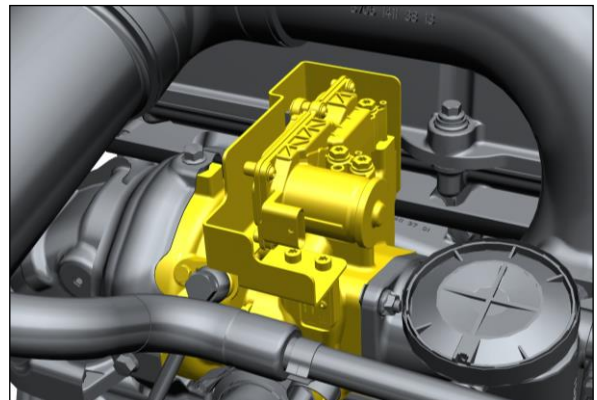
### 5. EMS SYSTEM ACTUATORS

#### A. ELECTRIC ACTUATOR FOR eVGT

EVGT turbocharger is an electronic device that controls the boost pressure depending on input from ECU. It has electronic actuator along with an internal stopper which restricts the actuator movement in desired zones.

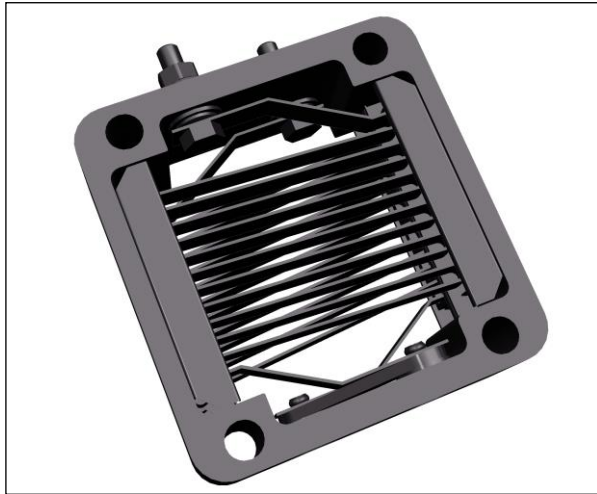


#### LOCATION



**B. GRID HEATER 24VOLT: (If Applicable)**

It is a simple heating coil fitted on the intake manifold of the engine to aid for start-ability of the engine in extreme cold ambient conditions.

**CONNECTOR DETAILS**

It has a supply and ground connections through the wiring harness.

The duration of grid heater to be in 'ON' of 'OFF' state is controlled by grid heater relay and calibration data in the ECU

**C. INJECTORS**

Fuel injectors are normally closed solenoid valves which operate when the electromagnetic core is energized by the ECU. Based on the Engine operating conditions, ECU adjust the injection pulse width to inject the precise amount of fuel injected.

**INJECTOR FUNCTION****• Injector not triggered:**

The fuel, which comes from the rail\* under high pressure, reaches the control chamber and the high pressure chamber of the jet via the high pressure fuel feed. The bore to the fuel return line is closed via the valve mushroom, which is actuated by a spring.

The hydraulic force (F1), which will be exerted through the high pressure of the fuel on the nozzle needle in the control chamber, is greater than hydraulic force (F2) which is effected on the tip of the nozzle, since the surface of the control piston in the control chamber is larger than the surface of the tip of the nozzle.

The nozzle of the injector is closed.

**• Injector triggered:**

Solenoid operated actuator presses on the valve piston and the valve mushroom opens a hole that connects the control chamber with the fuel return line.

That causes a pressure drop in the control chamber and the hydraulic force (F2x), which affects the nozzle needle, is larger than the force (F1x) on the control piston in the control chamber.

## EMS (3.3LNG BSVI)

The nozzle needle moves upwards and the fuel reach the combustion chamber via the 7 spray holes.

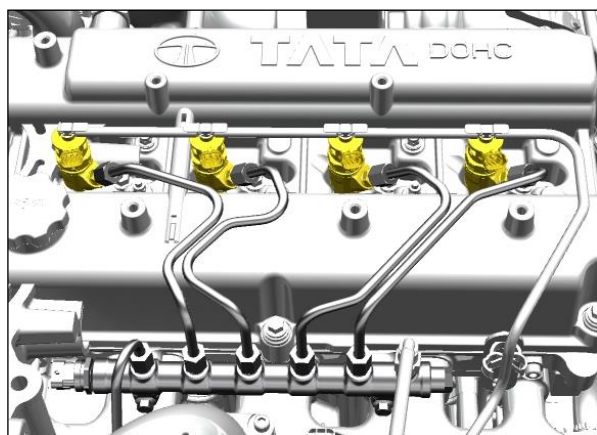
When the engine is no longer running, the valve, which connects the control chamber with the fuel return line and the injector nozzle, is closed through the spring force. A small amount of fuel will be directed for lubrication purposes between the nozzle needle and the guide from the high pressure side directly into the return line.

### NOTE

*The above mentioned method does not check the functionality of the sensor throughout its range. It can only give a rough indication. To check the full functionality, the sensors must be tested on a suitable test bench.*

### LOCATION

Injectors are mounted in cylinder head and connected with HP pipes and back leak tube.



### TIGHTENING TORQUE

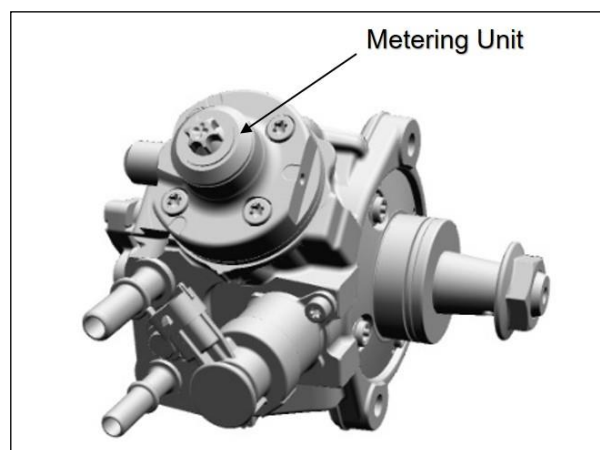
DESCRIPTION	TORQUE
Injector claw bolt M8	3.5 Kgfm

## D. HIGH PRESSURE FUEL PUMP

The high pressure fuel pump is a demand controlled radial piston pump.

The high pressure Pump supplies the volume flow for the generation of the high pressure of the fuel in the rail\*, providing the necessary fuel quantity to the injectors for all operating conditions of the engine.

High pressure pump (CP4) is used to raise the fuel pressure upto 2000 bar. It has an internal transfer pump which raises the pressure upto 5 bar and this is provided to high pressure section. It has three ports, inlet, high pressure outlet and fuel return. The High Pressure Pump is integrated with a Metering unit.



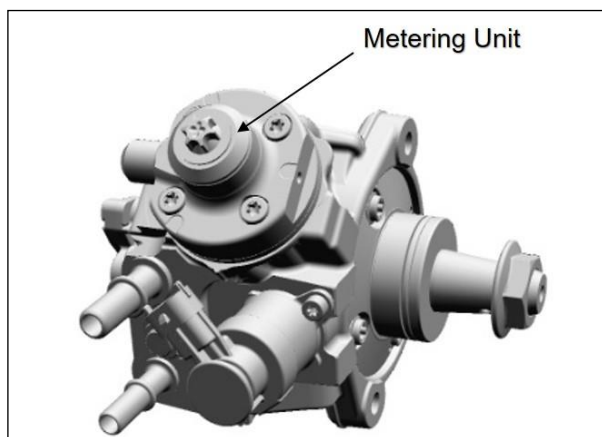
**E. METERING UNIT**

Metering unit regulates the delivery of fuel from the internal low pressure transfer pump (ITP), which is integrated into the diesel common rail pump (DCP), to the high pressure pump elements.

With that, the amount of fuel delivered by the high pressure pump can already be adjusted to the requirements of the engine on the low pressure side of the system.

The power consumption of the high pressure pump is reduced, improving the efficiency of the engine.

The volumetric control valve is directly screwed to the diesel common rail pump (DCP).

**METERING UNIT FUNCTION****METERING UNIT not triggered:**

The piston closes the link between the two connections by means of the force generated by the spring, without utilizing electrical current.

The fuel delivery to the high pressure pump is interrupted.

**METERING UNIT triggered:**

The force exerted by the anchor is proportional to the electrical current and works against the force of the spring.

Thus, the opening between the two connections is proportional to the electrical current (proportional directional control valve).

**F. DeNOx SYSTEM**

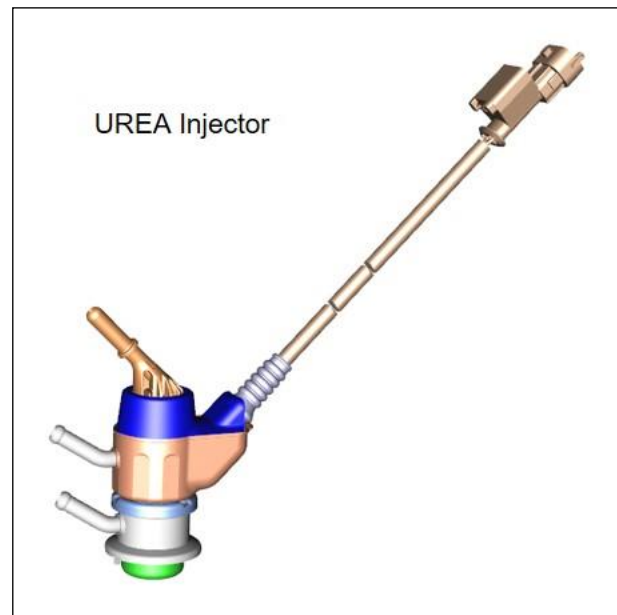
DeNOx system consists of the below parts:

1. Supply Module
2. Dosing Module
3. Level & temperature sensors

Supply consists of pump with integrated level sensor. This is used to supply adblue at desired pressure to the supply module.

Supply module is used to generate the necessary DEF pressure (approx. 6bar). It also consists of a purge pump, which sucks the adblue back into the tank once the engine is shut off. It has integrated level & adblue temperature sensor.

Dosing module consists of a DEF injector with 3 equispaced holes to inject urea inside the mixer. It is mounted over the exhaust mixer. As its tip comes into contact with exhaust gas, it needs coolant to control the tip temperature.



**Reagent Used:** Adblue which is a 32.5% urea solution is being used as reagent for SCR system.

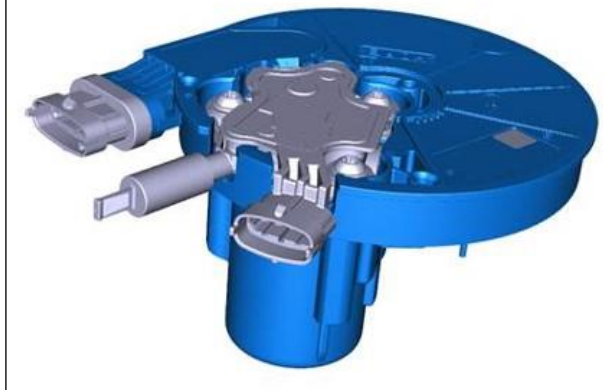
**Driver Warning System:** Necessary attributes of driver warning system have been accounted through below methodology.

**Low Reagent level:** There is an indication in the cluster for current reagent level as shown in the below picture. Whenever the adblue level is less than a specified threshold, driver warning & corresponding inducements are set.



## EMS (3.3LNG BSVI)

UREA Level Sensor



**Low quality urea indicator:** The DeNOx system is equipped with urea quality sensor. Whenever the quality is less than specified threshold (27%), corresponding fault gets triggered & MIL gets popped up.

UREA Quality Sensor



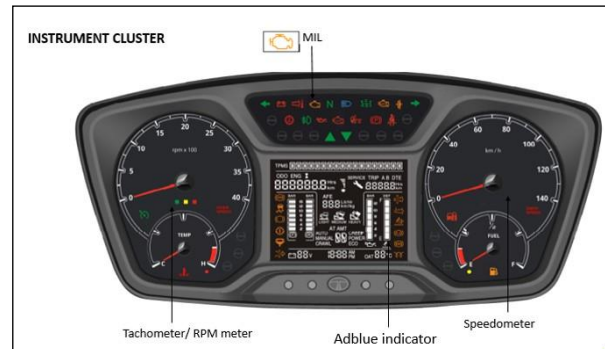
**Low / High Urea consumption:** With the help of UREA level sensor, whenever the adblue consumption is deviated beyond specified tolerance, error gets triggered & MIL gets popped up.

**DeNOx system tampering:** If any of the critical components of DeNOx system including dosing module, supply module, pipe etc. are damaged or removed, corresponding faults get triggered, MIL & warning lamp gets popped up and corresponding inducements are triggered.

**EGR valve tampering:** If any error triggering EGR to go off would attract MIL & warning lamp to be on.

### MIL location:

The MIL is to be seen in the instrument pack .The symbol confirms to ISO 2575, 1982 Symbol 4.36 (See picture below). It is located in the vehicle instrument panel.



**G. EXHAUST GAS RECIRCULATION VALVE (EGR)**

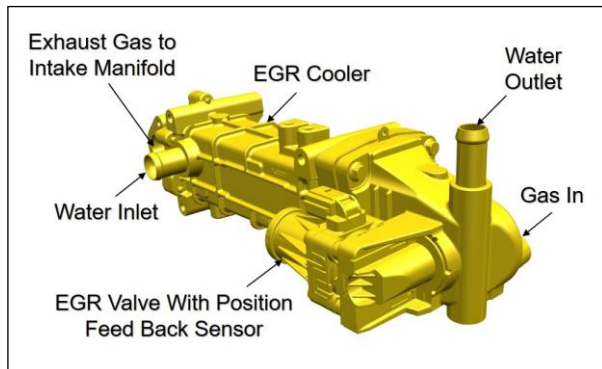
The EMEGR valve (electric motor driven exhaust gas recirculation valve) employs an electric DC Motor and gear box

An eccentric drive translates the gear box output from rotating motion to linear stroke

An angle sensor located on the output shaft of the gear box detects the indirect position of valve poppet. The position sensor is programmed such that at valve stroke of typically 6mm results into voltage difference of 3V. A return spring ensures that the valve returns back to its closed position

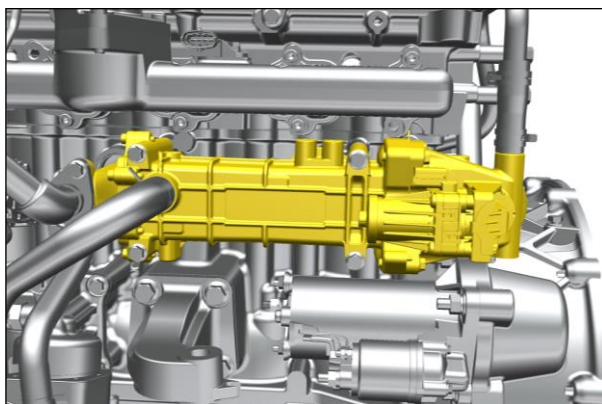
The EMEGR valve has to be driven by closed loop system. It is impossible to use EMEGR valve without using the feedback sensor signal.

The EGR Cooler is a exchanger that is used to cool the exhaust gases before they are recirculated to the intake manifold. The hot exhaust gases are routed into the EGR cooler from the exhaust pipes through metal tubes that are surrounded by engine coolant. The cooled exhaust gas is more effective to help to reduce the pollutants.



**LOCATION**

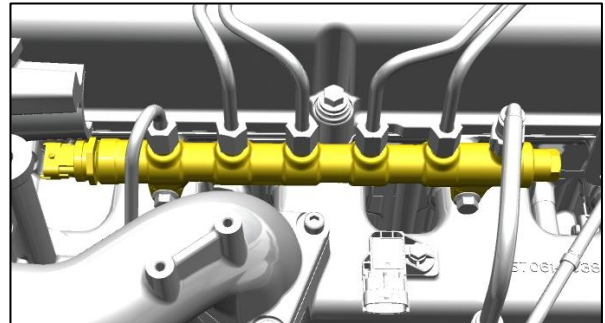
EGR valve fitted with EGR cooler. And both assemblies mounted in the cylinder block.



**TIGHTENING TORQUE**

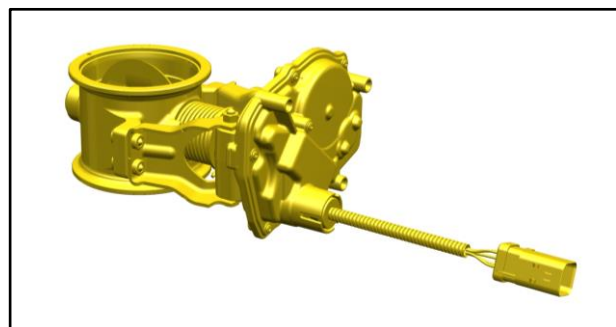
DESCRIPTION	TORQUE
Allen bolt M8	20 Nm

**H. COMMON RAIL**



Its function is to maintain the desired high pressure inside. It has a rail pressure sensor to provide the pressure feedback to ECU. It also has a relief valve which allows the fuel to leak if the pressure exceeds beyond the desired set point. Rail pressure control is a closed loop control operated through ECU PID governing. It is critical to maintain the desired rail pressure to achieve the emission legislative limits.

**I. EXHAUST THROTTLE VALVE**



Exhaust throttle valve is a butterfly valve with an electrical actuator and motor. It is used as a part of engine thermal management strategy for 3.3L BSVI engine. It is majorly operated during cold phase for improving the exhaust temperatures through throttling, creating additional restriction to the exhaust flow and reducing A/F ratio up to the desired extent.

It is again controlled by PIDs calibrated inside the ECU. Actual & desired positions of the butterfly valve are compared & corresponding to the error, actuator position is commanded to meet the set point.