EMR 3
CAN BUS specification

Version 11-3

Overview

1. SAE J1939-Standard CAN Messages

The following messages are described in the standard SAE J1939.
SAE-J1939/21
SAE-J1939/71
SAE-J1939-73
DIN ISO 11898

All send messages are available on the Bus also after switching Ignition Key off till EMR3 resets itself. The Period between switching Ignition Key Off and the reset of the EMR3 takes about 15 Seconds depending on load, engine state … etc.

1.1. EEC1:

Defaults values for transmission rate and CAN Identifier s. CAN Code Specification.

Byte	Data	Comment
Byte 1	Status EEC1	Bits 1 to 4 Engine / Retarder torque mode Bits 5 to 8 not defined
Byte 2	Requested engine torque in % related to Md_{max}	1% /Bit, Offset -125%, indicated torque, i.e. 0xCDh means 205-125 = 80% of Md_{max}
Byte 3	Actual Engine torque in % related to Md_{max}	1% /Bit, Offset -125%, indicated torque, i.e. 0xCDh means 205-125 = 80% of Md_{max}
Byte 4-5	Engine speed	0,125 rpm /Bit
Byte 6	Source address of the controlling device for engine torque	0x00h if EMR3 controls the engine torque else the source address of the TSC1message identifier which is controlling the torque
Byte 7	Engine starter mode	s. separate list
Byte 8	Engine demand percent torque	The limiting torque of the gearbox is used. TSC1-TE message is the source. 1% /Bit Offset -125% i.e. 0xCDh means 205-125 = 80% of Md_{max}

Byte 1: Engine torque mode:

Output Value Bits 1-4	Active Mode	Comment
0x0	Low Idle Governor / Overrun	Overrun means no injection
0x1	Accelerator Pedal	
0x2	Cruise Control	with positive torque
0x3	Power Take Off	PTO control active via MSS (multiple state switch) or MFLv (multifunction control unit)
0x4	Road Speed Limiter	
0x5	ASR Control	
0x6	Transmission Control	Speed control / torque control Speed / torque limit control
0X7	ABS Control	not used
0x8	Torque Limitation	not for fuel limitation (s. 0xC) engine is working at limited torque (max. torque curve)
0x9	High Speed Governor	
0xA	Engine Retarder Control / Break System	only positive torque or speed request
0xB	Remote Acceleration	not used
0xC	Fuel Limitation	
0xD	PTO Active	PTO activation via CAN or VCU torque request
0xE	VCM Control	Vehicle Control Mode (drivability) Then Byte 2 is set to 0xFFh
0xF	Not available	not used

Gray displayed information are actually not available – ignore these data!

Byte 3:
The value of Byte 3 is the actual engine torque in percent of the reference engine torque of the message engine configuration.
The torque values of Byte 3, TSC1 and the points 1 to 5 of the message engine configuration are directly comparable to each other because of the same reference value Mdmax.

Byte 7: Engine starter mode values:

Output value	Start Status
0xF0	start not requested
0xF1	cranking active, gear not engaged
0xF2	cranking active, gear engaged
0xF3	cranking finished
0xF4	cranking inhibited due to engine is already running
0xF5	cranking inhibited due to engine is not ready for start
0xF6	cranking inhibited due to drive train engaged
0xF7	cranking inhibited due to immobilizer is locked
0xFC	cranking inhibited due to unknown reason (blind meshing, max. duration is over etc.)
0xFE	error condition (not supported)
0xFF	crank control is not available

If there is no "gear engaged switch" information available, the value 0xF2h will not be sent. Instead of this value 0xF1h will be sent if cranking is active.
0xF6h, "drive train engaged" is the clutch state for EMR3.

1.2. EEC2:

Defaults values for transmission rate and CAN Identifier s. CAN Code Specification.

Byte	Data	Comment
Byte 1	Status EEC2	
Byte 2	Accelerator Pedal Position	0,4 % / Bit, 0xFEh if pedal is in error state, 0xFFh if pedal is not available
Byte 3	Percent Load at current speed = Engine torque related to max. engine torque at engine speed	1% / Bit, indicated torque, 0xFEh if percent load can not be calculated, i,e. because of injection path errors.
Byte 4-8		= 0xFFh - not available

Byte 1: Status EEC2:

Output Value Bits	Status	Comment
Bits 8, 7	Not defined	= 11
Bits 6, 5	Road Speed Limit State	00 = active, 01 = not active
Bits 4, 3	Status of Accelerator Pedal Kick-Down switch	00 = not active, 01 = active, 10 = error, 11= not available, (Kick down switch not enabled)
Bits 2, 1	Low idle switch	00 = not active, 01 = active, 10 = error, 11= not available, (Low idle switch not enabled)

Gray displayed information are actually not available – ignore these data!

Byte 3
The value of Byte 3 is the actual engine torque in percent of the maximal available engine torque at the actual engine speed. The maximal available engine torque depends on the limiting torque curve and engine protection values. Notice that the limiting torque curves are selectable by switches or CAN (protection messages). This includes the influence of the boost pressure.TSC1 limits are not considered in this Byte!

The maximal available engine torque is like considered in torque points 1 to 5 of the engine configuration message.

1.3. Engine Temperature:

Defaults values for transmission rate and CAN Identifier CAN Code Specification .

If any data isn't available the corresponding Bytes will be set to 0xFFh.

Byte	Data	Comment
Byte 1	Coolant temperature	1°C /Bit, Offset -40 °C
Byte 2	Fuel temperature	1°C /Bit, Offset -40 °C
Byte 3, 4	Engine oil temperature	0,03125 °C /Bit, Offset -273°C
Byte 5-8		= 0xFFh - not available

1.4. Engine Fluid Level / Pressure:

Defaults values for transmission rate and CAN Identifier s. CAN Code Specification.

It depends on the application which sensors and data are available.

Byte	Data	Comment
Byte 1	Fuel delivery pressure	4 kPa/Bit, 1/25bar /Bit
Byte 3	Oil level	= 0xFFh - not available
Byte 4	Oil pressure	4 kPa/Bit, 1/25bar /Bit, not in receive msg,
Byte 5, 6	Crankcase pressure not available	= 0xFFh - not available
Byte 8	Coolant level	0.4%/Bit, Offset 0%
Bytes 2, 7		= 0xFFh - not available

Gray displayed information are actually not available – ignore these data!

Byte 1:
The fuel delivery pressure is measured by the low fuel pressure sensor which is located between the main fuel filter and the Fuel Control Unit (FCU).

1.5. Inlet / Exhaust Conditions

Defaults values for transmission rate and CAN Identifier s. CAN Code Specification.

It depends on the application which sensors and data are available.

Byte	Data	Comment
Byte 1		= 0xFFh - not available
Byte 2	Boost pressure	2 kPa/Bit = 1/50 bar/Bit
Byte 3	Intake manifold temperature i.e. boost temperature	1°C /Bit, Offset -40 °C
Byte 4		= 0xFFh - not available
Byte 5	Air filter differential pressure	0,05 kPa / Bit, range 0 to 12.5 kPa
Byte 6,7	Exhaust gas temperature	= 0xFFh - not available
Byte 8		= 0xFFh - not available

Gray displayed information are actually not available – ignore these data!

1.6. Ambient Conditions

Defaults values for transmission rate and CAN Identifier s. CAN Code Specification.

It depends on the application which sensors and data are available.

Byte	Data	Comment
Byte 1	Barometric pressure (absolute)	0,5 kPa/Bit = 1/200 Bar/Bit
Byte 4, 5	Ambient air temperature	don't care!
Bytes 2, 3 ,6, 7, 8		= 0xFFh - not available

Gray displayed information are actually not available – ignore these data!

1.7. Vehicle Electrical Power

Defaults values for transmission rate and CAN Identifier s. CAN Code Specification.

It depends on the application which sensors and data are available.

Byte	Data	Comment
Byte 3, 4	Alternator potential (voltage)	= 0xFFh - not available
Byte 7, 8	Battery potential (voltage) , supplied through switched device	0,05 V /Bit
Bytes 1, 2, 5, 6		= 0xFFh - not available

1.8. Fuel Economy

Defaults values for transmission rate and CAN Identifier s. CAN Code Specification.

It depends on the application which sensors and data are available.

Byte	Data	Comment
Byte 1, 2	Fuel rate	0,05 L/h /Bit
Byte 3, 4	Instantaneous fuel economy km/l	1/512 km/L /Bit
Bytes 5, 6, 7, 8		= 0xFFh - not available

Gray displayed information are actually not available – ignore these data!

1.9. Engine Hours, Revolutions

Defaults values for transmission rate and CAN Identifier s. CAN Code Specification.

Byte	Data	Comment
Byte 1to 4	Total engine hours	0,05h /Bit; Byte1 is LSB, Byte 4 is MSB
Byte 5 to 8	Total engine revolutions	don't Care

Total engine hours are only be accumulated when the engine is running!

1.10. EEC3

Defaults values for transmission rate and CAN Identifier s. CAN Code Specification.

Byte	Data	Comment
Byte 1	Nominal friction percent torque	1% / Bit, Offset = –125%, range 0 to 125 %
Byte 2, 3	Engine's desired operating speed	0,125 rpm/Bit
Byte 4	Engine's operating speed asymmetry adjustment	1 ratio/Bit
Bytes 5,6,7,8		= 0xFFh - not available

Gray displayed information are actually not available – ignore these data!

Byte 1
This data is a percentage value related to reference max. torque value Md_{max} defined in the message engine configuration.
The nominal friction depends on the engine speed and the engine temperature.

1.11. Cruise Control / Vehicle Speed

Defaults values for transmission rate and CAN Identifier s. CAN Code Specification.

Byte	Data	Comment
Byte 1	Measured SW1	
Byte 2, 3	Wheel based vehicle speed	1 / 256 km/h = 1 / 412 mph
Byte 4	Measured_CC_SW1	
Byte 5	Measured_CC_SW2	
Byte 6	Cruise Control set speed	1km/h / Bit
Byte 7	State CC	
Byte 8	Measured idle SW1	

The binary value 11, indicating not available for a switch state will also be sent, when the switch is disabled by configuration parameters for a special application.
Gray displayed information are actually not available – ignore these data!

Byte 1: Measured SW1:

Output Value Bits	Status	Comment
Bits 4, 3	Parking brake switch	00 = not active, 01 = active, 10 = error, 11= not available
Bits 8 ,7 ,6 ,5 ,2 ,1		all set to 1= not available

Byte 4: Measured CC_SW1:

Output Value Bits	Status	Comment
Bits 8, 7	Clutch switch	00 = not active, 01 = active, 10 = error, 11= not available
Bits 6, 5	Brake switch	00 = not active, 01 = active, 10 = error, 11= not available
Bits 4, 3	Cruise control enable switch	00 = CC not enabled by parameter 01 = CC enabled by parameter 11 = not available
Bits 2, 1	Cruise control active	00 = CC is not active, 01 = CC is active

Byte 5: Measured CC_SW2:

Output Value Bits	Status	Comment
Bits 8, 7	Cruise control accelerator switch	00 = not active, 01 = active, 10 = error, 11= not available
Bits 6, 5	Cruise control resume /hold switch	00 = not active, 01 = active, 10 = error, 11= not available
Bits 4, 3	Cruise control coast switch (decelerate)	00 = not active, 01 = active, 10 = error, 11= not available
Bits 2, 1	Cruise control set switch	11= not available

Byte 7: State_CC:

Output Value Bits	Status	Comment
Bits 6 to 8	Cruise control state (of the cruise controller)	000 =off/ disabled, 001 = hold 010 = accelerating 011 = decelerating 100 = resuming 101 = set (use actual vehicle speed) 110 = accelerator override 111 = not available
Bits 1 to 5	PTO (Power takeoff) state	PTO function is on, if constant speed is selected or PTO functionality is usable by the switches (Same, up- down and hold switches for engine speed) 00000 = off/disabled 00001 = hold 00101 = set 00110 = decelerate 00111 = resume 01000 = accelerate 01010 = constant speed 1 01011 = constant speed 2 01100 = constant speed 3 01101 = constant speed 4

Byte 8: Measured_Idle_SW1:

Output Value Bits	Status	Comment
Bits 8, 7	Engine shut down override switch	00 = not active, 01 = active, 10 = error, 11= not available
Bits 6, 5	Engine test mode switch	Indicates, that the test mode parameter setting is actual used, i.e. for EOL tests ,s. specification for EMR3 programming). It is a parameter of the data set. 00 = not active, 01 = active, 10 = error, 11= not available
Bits 4, 3	Idle decrement switch	Even if there is no switch, these bits will be set if the EMR3 is decrementing the low idle value 00 = not active, 01 = active, 10 = error, 11= not available
Bits 2, 1	Idle increment switch	Even if there is no switch, these bits will be set if the EMR3 is incrementing the low idle value 00 = not active, 01 = active, 10 = error, 11= not available

1.12. Software ID

Defaults values for transmission rate and CAN Identifier s. CAN Code Specification.

Byte	Data	Comment
Byte 1	Number of software identification fields	Each field delimited by ASCII '*'
Byte 2-8	Software Identification	ASCII formatted

Byte 2-8:
The format is XXXVYYY
X = Main software identifier.
V = ASCII char "v"
Y = Software version identifier.

Example:

ID	*Byte1*	*Byte2*	*Byte3*	*Byte4*	*Byte5*	*Byte6*	*Byte7*	*Byte8*
SWID (18FEDA00)	*01*	*34*	*39*	*31*	*56*	*32*	*31*	*32*
ASCII :		*4*	*9*	*1*	*v*	*2*	*1*	*2*

Software Version: 491v212

End of Example

1.13. Engine Configuration

Defaults values for transmission rate and CAN Identifier s. CAN Code Specification.
EMR3 uses mode 2 of the engine configuration message, defined in SAE-J1939-71 chapter 5..4.1

Byte	Data	Comment
Byte 1,2	Engine speed at idle (point 1)	0,125 rpm /Bit **point 1 = idle**
Byte 3	Percent torque at idle (point 1)	1% /Bit, Offset = –125%
Byte 4, 5	Engine speed (point 2)	0,125 rpm /Bit **point 2 = rated speed**
Byte 6	Percent torque (point 2)	1% /Bit, Offset = –125%
Byte 7, 8	Engine speed (point 3)	0,125 rpm /Bit **point 3 = maximal engine torque**
Byte 9	Percent torque (point 3)	1% /Bit, Offset = –125%
Byte 10, 11	Engine speed (point 4)	0,125 rpm /Bit
Byte 12	Percent torque (point 4)	1% /Bit, Offset = –125%
Byte 13, 14	Engine speed (point 5)	0,125 rpm /Bit
Byte 15	Percent torque (point 5)	1% /Bit, Offset = –125%
Byte 16, 17	Engine speed at high idle engine torque = 0 (point 6)	0,125 rpm /Bit **point 6 = high idle**
Byte 18, 19	Droop	0,0122% /Bit
Byte 20, 21	Reference engine torque (maximum torque of engine torque map)	1 Nm /Bit This is a configuration parameter in EMR3
Byte 22, 23	Maximum momentary engine override speed	0,125 rpm /Bit
Byte 24	Maximum momentary engine override time limit	0.1s /Bit
Byte 25	Requested speed control range lower limit	10 rpm /Bit Min. engine speed value for TSC1 messages
Byte 26	Requested speed control range upper limit	10 rpm /Bit Max. engine speed value for TSC1 messages
Byte 27	Requested torque control range lower limit	1% /Bit, Offset = –125% Min. engine torque value for TSC1 messages
Byte 28	Requested torque control range upper limit	1% /Bit, Offset = –125% Max. engine torque value for TSC1 messages

Byte 18,19 Droop:

$$\text{Droop} = (n_{max} - n_{rated}) / n_{rated} * 100\ \%$$ n = speed, resolution droop 0,0122% /Bit

Bytes 20, 21: Reference torque
This parameter is the 100% reference value for all defined indicated engine torque parameters. It's only defined once and doesn't change if a different engine torque map becomes valid.

Data update
The values will be modified in following cases

- the torque map has been changed
- Gain has been modified / a new droop is selected
- power reduction (engine protection) is active.

Boost pressure (smoke limiter), road speed limits or limits set in TSC1 will not modify the data values.

This message uses more than 8 data bytes, therefore the Multipacket Transport (Appendix 1) will be used.

The message will be transmitted periodically.

1.14. TSC1 Message

Defaults values for transmission rate and CAN Identifier s. CAN Code Specification.

Byte	Data	Comment
Byte 1	Control Bits SAE J1939/71, Parameter 3.3.1	
Bit 1, 2	Override control mode	
Bit 3, 4	Requested speed control condition	
Bit 5, 6	Override control priority	
Bit 7, 8	Not defined	
Byte 2,3	Requested speed / speed limit	0,125 rpm /Bit
Byte 4	Requested torque / torque limit	1% /Bit, Offset –125%
Byte 5-8	Not defined	

Byte 1 Bits 1, 2 Override Control Mode:

00 Override disabled – disable any existing control commanded by the source of this command.
01 speed control, no limits will be changed
Bytes 2 and 3 for requested speed
Byte 4 will be ignored
10 torque control, no limits will be changed
Bytes 2 and 3 will be ignored
Byte 4 for requested torque
11 set limits
´ Bytes 2 and 3 are the limit of speed control.
Byte 4 contents the limit for torque control

Byte 1 Bits 5, 6 Priority Bits

00 Highest Priority
01 High Priority
10 Low Priority
11 Lowest Priority

Byte 4
Torque ranges are shown in the following table:

Message	Torque set point range	Torque limit range	
TSC1_TE	0% to 125%	0% to 125 %	incoming Values < 0 set to 0

Set point calculation

The requested speed value is the set point engine speed at full load. Without load the engine speed will be higher and calculated using the droop.

Example
Requested speed 2000 rpm, droop = 5%
*then speed without load n = 2000 * (1+droop) = 2100 rpm*
End of example

Control mode selection

For switching from speed control mode to torque control mode the engine has to operate at low idle speed ± 100 1/min and engine torque value has to be less than 10%.

For switching from torque control mode to speed control mode the engine has to operate at low idle speed ± 100 1/min.

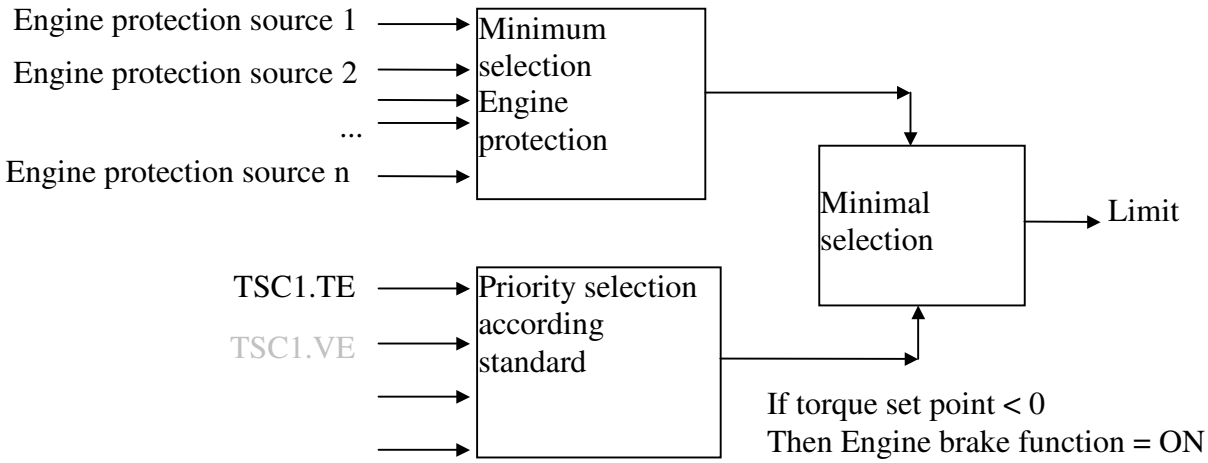
Priority Bits

The data process regarding to the priority bits of TSC1 messages is shown in Fig. 7 of the SAE-J1939/71 document.

Limitation

All incoming TSC1 limits are proofed for validity and only messages with valid data will be checked for their priority. The values are stored into a priority table. This table is necessary to search for the limit with the highest priority. If the higher priority is assigned to more than one limit, EMR3 will compare the limits and use the lowest limit. If a TSC1 message with new valid limit has been received, the corresponding memory place in the table will be overridden. If a TSC1 message fails, goes to time out error, doesn't give new valid limits or includes control mode set to zero, then the previous valid data (limits and priority) are used for searching the lowest limit of messages with highest priority.

When limitations are send via the TSC1 message, then both limits in the message must be valid. The engine speed limit bytes must be less or equal 0xFAFFh and the engine torque limit must be less or equal 0xFAh.
Limitations can be deactivated by using high values, i.e. 0xFAFFh for engine speed limit or 0xFAh for engine torque limit.



Example for set point speed operation in a standard Can Function:

ID	*Byte1*	*Byte2*	*Byte3*	*Byte4*	*Byte5*	*Byte6*	*Byte7*	*Byte8*
TSC1 (0C000003x)	*01*	*80*	*25*	*00*	*FF*	*FF*	*FF*	*FF*

Engine set point speed = 1200 rpm
End of Example

2. Diagnostic Messages

These messages are specified in SAE-J1939-73. There are 12 messages described, but not all messages are supported from EMR3. A request for a non available messages will be answered by EMR3 with a negative acknowledgment (NACK). The negative and positive acknowledgment are shown in Appendix 3.

Messages that require more than 8 data bytes have to be transferred with the „Multipacket Transport Protocol“ (SAE-J1939-21) - see Appendix 1.

2.1. Diagnostic Readiness (DM5) / Number of faults

The number of faults are transmitted on request. There are two kind of faults displayed in this message - active and previously active faults (= passive faults).
Active faults are faults that are currently active. Passive faults (= previously active faults) are faults which have been active in the past and are not currently active.

Request for reading DM5 (Standard Request)
EMR3 receives this messages as a request to send the number of faults, which have occurred at least once and are active or passive at that moment.

Defaults values for transmission rate and CAN Identifier s. CAN Code Specification .

Data Length:	3 Bytes
Data Page:	0
PDUF :	234
PDUS :	EMR3 Device Nr
Parameter group number:	00EA00

Byte	Data	Comment
Byte 1-3	00 FE CE	PGN-Nr. Of message DM5, LSB first

Answer DM5

Data Length: 8 Bytes
Data Page: 0
PDUF: 254
PDUS: 206
Parameter group number: 65230 (00 FE CE)

Byte	Data	Comment
Byte 1	Number of active faults	
Byte 2	Mode1: Count of passive faults stored in the error memory of EMR3 Mode2: Count of all faults (active faults + passive faults) stored in the error memory	Deutz standard is Mode1 Applications which have to be compatible with EMR2 Controllers use Mode2
Byte 3	OBD Compliance	Identifies the OBD compliance of the responding controler
Byte 4-8	not defined	don't care

Example:

ID	*Byte1*	*Byte2*	*Byte3*	*Byte4*	*Byte5*	*Byte6*	*Byte7*	*Byte8*
DM5 (18FECE00)	*00*	*01*	*05*	*00*	*00*	*00*	*00*	*00*

Byte 1: 00 - no active faults
Byte 2: 01 - 1 passive fault stored in the error memory
Byte 3: 05 - "Not intended to meet OBD II compliance"

End of Example

2.2. Active faults (DM 1)

The transmission rate is according to SAE-J1939.
That means :

1. The standard update rate is 1s, if at least one active faults exists.
2. The message will be transmitted immediately, if a fault becomes active or inactive.
3. Within one second only the first change of state of the fault will be transmitted immediately. If the fault changes his state (active / passive) more than one time within a second, the DM1-message will be transmitted at the end of the second with the actual state of the fault.

The following messages will be transmitted if there is only one active fault.

DM1:

Transmission rate:	see above
Data Length:	variable
Data Page:	0
PDUF:	254
PDUS:	202
Priority:	s. Appendix 3
Parameter group number:	65226 (00FECA)

Byte 1	Lamp state (LS)
Byte 2	Lamp state (LS) reserved =FF
Byte 3, 4	Suspect Parameter Number (SPN)
Byte 5	Bit 6 to 8 SPN Bit 1 to 5 Failure mode identifier (FMI)
Byte 6	Bit 8 not defined Bit 1 to 7 Occurrence counter (OC)
Byte 7, 8	= 0xFFh - not defined

LS: see Appendix 2
SPN: see Appendix 3 Error codes
FMI: see Appendix 3 Error codes
OC: The Occurrence Counter displays how often a fault got active since the fault memory has been cleared the last time.

The following data will be send once, if the last active fault switched passive and there is no active fault in the error memory left:
(according to standard SAE-J1939/21 Juli94)
LS=0, SPN= 0, FMI = 0, OC = 0

The Multipacket Transport (SAE-J1939/21 July 94) will be used if there is more than one active fault. The data stream is:
LS, SPN, FMI, OC, SPN, FMI, OC, SPN, FMI, OC .....etc.

2.3. Passive Faults (DM2)

Passive faults (= previously active faults) are faults which have been active in the past and are not currently active. They are transmitted on request.

Request for reading DM2 (Standard Request)

Data Length: 3 Bytes
Data Page: 0
PDUF : 234
PDUS : EMR3 Device Nr
Parameter group number: 00EA00

Byte	Data	Comment
Byte 1-3	00 EA 00	PGN-Nr. Of message DM2, LSB first

Answer passive Faults (Standard DM2)
If there is only one fault stored:
Data length: 8 Bytes
Data Page: 0
PDUF: 254
PDUS: 203
Parameter group number: 65227 (00FECB)

Byte 1	Lamp state (LS)
Byte 2	Lamp state (LS) reserved = FF
Byte 3, 4	Suspect Parameter Number (SPN)
Byte 5	Bit 6 to 8 SPN Bit 1 to 5 Failure Mode Identifier (FMI)
Byte 6	Bit 8 = CM = 1 Bit 1 to 7 Occurrence counter (OC)
Byte 7, 8	not defined, value is 0xFFh

LS: see Appendix 2
SPN: see Appendix 3 Error codes
FMI: see Appendix 3 Error codes
CM: SPN Conversation Method
OC: The Occurrence Counter displays how often a fault got active since the fault memory has been cleared the last time.

The Multipacket Transport (SAE-J1939/21 July 94) is used, if the count of passive faults in the error memory is higher than one. The format of the data stream is:
LS, SPN, FMI, CM, OC, SPN, FMI, CM, OC, SPN, FMI, CM, OC, SPN, FMI, CM, OC, ...

The following data will be send, if there is no fault stored
SPN = 0, FMI = 0, OC= 0, LS according to actual lamp state.

2.4. Freeze Frame Parameters (DM4)

A Freeze Frame is defined as the list of parameters recorded at the time a diagnostic trouble code was captured**.** They are also described in the error memory specification. Due to its size on every request only one Freeze Frame will be transmitted. For the first request for DM4, ECU transmits the freeze frame parameters of the first fault entry of the error memory. On the second request for DM4, the freeze frame parameters for the second fault entry will be transmitted and so on.

Freeze Frames aren't available for all kind of faults.

Request for reading DM4 (Standard Request)

Data Length: 3 Bytes
Data Page: 0
PDUF : EAh = 234d
PDUS : EMR3 Device Nr (00)
Parameter group number: 00EA00

Byte	Data	Comment
Byte 1-3	00 EA 00	PGN-Nr. Of message DM4, LSB first

Answer DM4 : Freeze Frame Parameter

A Freeze Frame contains more than 8 data bytes, therefore the Multipacket Transport will be used.

Data length
Data Page: 0
PDUF: 254
PDUS: 205
Parameter group number: 65229 (00FECD)
Source Address: EMR2 Device Nr. (00)

Byte	Data	Comment
Byte 1	Number of the following data bytes	0x10h
Byte 2	DTC (Diagnostic trouble code) Byte1	Suspect parameter number SPN
Byte 3	DTC (Diagnostic trouble code) Byte2	Suspect parameter number SPN
Byte 4	DTC (Diagnostic trouble code) Byte3	Bits 6 to 8: SPN Bits 1 to 5 Failure Mode (FMI) Bit5 MSB
Byte 5	DTC (Diagnostic trouble code) Byte4	Bit 8 Conversion Method Bits 1 to 7 Occurrence counter (OC)
Byte 6		=FF not available
Byte 7	Boost pressure	2 kPa/Bit = 1/50 bar/Bit
Bytes 8, 9	Engine Speed	0,125 rpm / Bit
Byte 10	Engine % Load at current speed	Actual Engine load indicated 1% / Bit s. EEC2 Byte 3
Byte 11	Engine coolant temperature	1°C /Bit, Offset –40 °C
Byte 12, 13	Vehicle speed	1/256 km/h/ Bit if data is not available 0xFFh will be transmitted
Bytes 14	Applicable value 1	
Bytes 15	Applicable value 2	
Bytes 16	Applicable value 3	
Bytes 17	Applicable value 4	

Bytes 2 to 5: DTC
DTC and SPN are described in the appendix

Timestamps of minimum and maximum values
A timer starts when an error becomes active. The minimum and maximum values will be build in the time when the error is still active, no matter if the override button has been pressed or not. The absolute time off a minimum or maximum value is the occurrence time plus the time of the stamp.

If no fault present:
The message above is used too, if there are no fault entry and freeze data available. In that case the 8 data bytes(no Multipacked Transport necessary then) filled as follow: Number = 0, DTC = 0, Bytes 6 to 8 = 0xFFh.

Byte	Data	Comment
Byte 1	Number of the following data bytes	Byte 1 = 0x00h if no fault is present
Byte 2 to 5	DTC	DTC = 0
Byte 6 to 8		= 0xFFh

2.5. Diagnostic Data Clear (DM3 Replacement, DM11)

DM3 Replacement:
Request for DM3 (Standard Request)

Defaults values for transmission rate and CAN Identifier s. CAN Code Specification .

On request for DM3 all passive faults (and the depending Freeze Frames) stored in the error memory will be cleared.

Request message:

Data Length: 3 Bytes
Data Page: 0
PDUF : 234
PDUS : EMR3 Device Nr
Parameter group number: 00EA00

Byte	Data	Comment
Byte 1-3	00 FE CC	PGN-Nr. Of message DM3, LSB first

Answer for DM3 request
The answer of EMR3 will be a positive Acknowledgment.

Example for clearing passive Errors (DM3):

ID	*Byte1*	*Byte2*	*Byte3*	*Byte4*	*Byte5*	*Byte6*	*Byte7*	*Byte8*
Request (18EA0003)	*CC*	*FE*	*00*	*00*	*00*	*00*	*FF*	*FF*

Answer EMR3 (positive Acknowledgment): Delete passive Error is done

Acknowledgment (18E8FF00)	*00*	*FF*	*FF*	*FF*	*FF*	*CC*	*FE*	*00*

The result may be checked with DM2:

Reading passive Errors:

Request (18EA0003)	*CB*	*FE*	*00*

Answer EMR3: no passive Error

Request (18FECB00)	*xx*	*FF*	*00*	*00*	*00*	*00*	*FF*	*FF*

End of Example

DM11:
Request for reading DM11 (Standard Request)

Defaults values for transmission rate and CAN Identifier s. CAN Code Specification .

When the EMR3 receives the standard request message, using the PGN of the diagnostic message DM11 in the data area, only the active errors will be cleared in the error memory 1, including their freeze frame parameters. The entries of the passive faults will be left untouched

Data Length: 3 Bytes
Data Page: 0
PDUF : 234
PDUS : EMR3 Device Nr
Parameter group number: 00EA00

Byte	Data	Comment
Byte 1-3	00 FE D3	PGN-Nr. Of message DM11, LSB first

Answer for DM11 request
The answer of EMR3 will be a positive Acknowledgment.

Proprietary EMR3 Specific CAN Messages based on SAE - J1939

There is only a small range available in the standard for proprietary messages. Therefore the receivers of the messages should use the complete identifier including the source address as a filter for the input buffers of the CAN controller.

2.6. Measured Data 1

Defaults values for transmission rate and CAN Identifier s. CAN Code Specification.

Byte	Data	Comment
Byte 1	Preheat information	
Byte 2-3	Engine speed	0,125 rpm /Bit
Byte 4	Boost pressure	2 kPa/ Bit = 1/50 Bar/ Bit
Byte 5	Pedal position 0 to 100%	0,4% / Bit
Byte 6	Coolant temperature	1°C /Bit, -40°C Offset
Byte 7	Oil pressure	4 kPa/ Bit = 1/25 Bar /Bit
Byte 8	Can set point status	

Byte 1: Preheat information

Bit	
1	Preheat active
2	Ready for start
3	Post heat active
4	Glow plugs active
5	Flame glow plugs active
6	Flame fuel valve active
7	Push button active
8	Status preheat sense line (1= preheat active, 0 = preheat not active)

Byte 8: Can set point status

Value	**Can set point status**
0	Initialization after power on
1 or 2	engine not started, waiting for start
3	engine starts (is cranking)
4	engine has started, is running, waiting for Can messages with speed or torque demand
5 *[1)]	engine is running, CAN messages for speed or torque control used
6	CAN messages for speed or torque demand failed (timeout) - EMR uses substitute input source for setpoint i.e. accelerator pedal
7	Push button active
8	Status preheat sense line (1= preheat active, 0 = preheat not active)

1) *depending on the software version 0xFFh will be send instead of 0x05h.*

2.7. Measured Data 2

Defaults values for transmission rate and CAN Identifier s. CAN Code Specification.

Byte	Data	Comment
Byte 1	Droop	1% / bit
Bytes 2-3	set point data engine speed, droop calculated	0,125 rpm /Bit
Byte 4	source of set point data engine speed	
Byte 5, 6	engine speed, sensor 1 (crank shaft)	0,125 rpm /Bit
Byte 7, 8	engine speed, sensor 2 (cam shaft) calculated as crank shaft speed	0,125 rpm /Bit

Gray displayed information are actually not available – ignore these data!

Byte 1: Droop
Droop = $(n_{max} - n_{rated}) / n_{rated} * 100$ %
n = engine speed

Bytes 2, 3: Set point data engine speed, droop calculated (=engine set point at no load)
This is a data inside EMR3 after selection of the source of requested speed at the input of the speed governor, calculated with droop .

Byte 4: Source of set point data engine speed:
This value shows, which signal is the source of the actual set point data.

0 No set point data
1 Pedal input (Analog / PWM input)
2 Hand throttle lever
3 Error value used
4 TSC1.TE
5 reserved (for TSC1.xx)
6 reserved (forSAE-J1587 PID 91 accelerator pedal)
7 Constant speed 1
8 Constant speed 2
9 Frozen engine speed (actual engine speed saved)
10 Frozen engine speed (set point speed saved)
11 special function (hold)
12 special function (min)
13 special function (max)
14 reserved (for PTO)
15 idle calibration mode
16 reserved (for VP2 pedal data)

2.8. Measured Data 3

Defaults values for transmission rate and CAN Identifier s. CAN Code Specification.

Byte	Data	Comment
Byte 1	Power reduction	1% / bit
Byte 2	Maximum available engine torque at current speed	1% / bit
Byte 3, 4	Maximum available engine speed	0,125 rpm /Bit
Byte 5, 6	Hold engine speed	0,125 rpm /Bit
Byte 7, 8	Rail Fuel Pressure	1 Mpa/ Bit, range 0 to 251 Mpa

Gray displayed information are actually not available – ignore these data!

Power reduction
This is the actual value of the power reduction, calculated by the internal engine protection functions and the CAN message engine protection. The limits set by the message TSC1 have no influence on this value.
The value of no power reduction is 100%

Maximum available engine torque at current speed
The maximum available indicated engine torque at current speed in percent of the actual torque curve.
Engine protection functions and CAN messages, i.e. TSC1, can limit this data to a lower value. In that case not 100% of the torque is available.
If there are no limitations or power reductions active, the available engine torque is given by the torque curve. In that case the value of maximum available engine torque at current speed will be 100%.

Maximal available engine speed
The maximal available engine speed varies because of engine protection functions and other CAN messages.

Hold engine speed
Is one of the following data, depending on which data is actual used:

- Frozen engine speed (actual engine speed saved)
- Frozen engine speed (set point speed saved)

If none of both data is actual used the value will be 0xFFh.

2.9. Measured Data 4

Defaults values for transmission rate and CAN Identifier s. CAN Code Specification.

Byte	Data	Comment
Byte 1	Switch status 1	Bit 1, 2: Water in fuel indicator Bit 3, 4: Engine break switch Bit 5, 6: Engine stop switch Bit 7, 8: Engine start switch Values: On = 1, Off = 0, not available/ enabled = 11
Byte 2	Switch status 2	Bit 1, 2: Low idle switch throttle 2 (hand gas lever) On = 1, Off = 0, not available/ enabled = 11
Byte 3	Throttle 2 (hand gas lever)	Range 0 to 100%, 0,4 % / Bit, 0xFEh if throttle is in error state, 0xFFh if throttle is not available
Byte 4	PWM throttle value	Range 0 to 100%, 0,4 % / Bit, 0xFEh if PWM throttle is in error state (SRC) 0xFFh if PWM throttle is not available
Byte 5	Multiply State Switches Additional Set Point Input Switches	Bits 1,2,3: Network speed set point number Values = 0 to 4 Bit 7: = not available (disabled by parameter or out of range) Bits 4,5,6: Network torque/droop line number 0 to 4 = number 7 = not available (disabled by parameter or out of range) Bits 7, 8: = 0xFFh = not defined
Bytes 6, 7	Customer pressure	resolution depends on application output of sensor input curve
Byte 8	Multiply State Switches 2	Bits 1,2,3: Network PID parameter selection number 0 to 4 = number 7 = not available (disabled by parameter or out of range)

Gray displayed information are actually not available – ignore these data!

2.10. Measured Data 5

Defaults values for transmission rate and CAN Identifier s. CAN Code Specification.

Byte	Data	Comment
Byte 1, 2	Customer Temperature 1	0,03125 °C / Bit, Offset –273°C
Byte 3, 4	Customer Temperature 2	0,03125 °C / Bit, Offset –273°C
Byte 5, 6	Cylinder head temperature	0,03125 °C / Bit, Offset –273°C
Byte 7	Oil level status information	If the oil level sensor measurement is analog: Bit 0: oil level to too low oil level ≤ low limit Bit 1: refill request oil level ≤ refill request limit Bit 2: refill stop request refill stop request limit ≤oil level Bit 3: = oil level too high oil level ≥ max limit Bit 7 = oil level measurement not possible, because engine is running Bit 8 = oil level measurement not possible because of timer for oil flow back to pan time is running / hasn't already elapsed. Bit 4 to 6 = 0 All bits are zero if level is ok. If the oil level sensor is digital: Bit 0=1 and Bit 1=1 if oil level is too low Bit 0=0 and Bit 1=0 if oil level is ok 0xFEh = Sensor signal error 0xFFh = oil level measurement disabled by parameter
Byte 8	Oil level (extended range)	1% / Bit , range 0 to 150% Too high level detection can set values more than 100%. This data is also available when the engine is running. Byte 7 gives information if the content of Byte 3 is valid or not. 0xFEh = Sensor error 0xFFh = Sensor not enabled by parameter

Gray displayed information are actually not available – ignore these data!

2.11. Measured Data 8

Defaults values for transmission rate and CAN Identifier s. CAN Code Specification.

Byte	Data	Comment
Bytes 1	Lamp commands 1	useful if lamp controller of the dashboard are controlled by the CAN bus. It is not an output pin state of EMR3 This information is always available, no matter if lamps are at the output pins or not. Bit 1: engine protection lamp demand (engine limits exceeded) Bit 2: warning lamp (malfunction lamp) for all faults, that means system faults i.e. broken wires, memory problems and so on, and if physical engine parameter exceed limits Bit 3: stop lamp (for engine protection, and systems faults) Bit 4: OBD lamp demand not in all applications available Bit 5 Maintenance lamp demand Bit 6 Warning Temperature Lamp Bit 7 Warning Oil Lamp Bit 8 Charge indicator lamp demand (on if D+ pin is low) Values on= 1, off or not available= 0 s. also Appendix Lamp Status for details
Byte 2	Lamp commands 2	useful if lamp controller of the dashboard are controlled by the CAN bus. It is not an output pin state of EMR3 This information is always available, no matter if lamps are at the output pins or not. Bits 1,2 Preheat lamp demand Values on= 01, off = 00, blinking = 10 not available = 11 Bits 3 to 8 = 0

Gray displayed information are actually not available – ignore these data!

Bytes 3, 4	Actual limp home status / Engine protection (only for monitoring functions, not for system faults)	The actual limp home 1 /2 status bits show the actual valid status s. also DM4 for freezing in fault condition Bit 1,2: limp home (i.e. constant engine speed) Bit 3,4 power reduction Bit 5,6 forced idle Bit 7,8 shutdown Bit 9,10 shutdown demand Bit 11,12 engine shutdown by driver in time during shutdown demand yes =1, no = 0 Bit 13,14 engine start protection Bit 15,16 rail pressure estimating Values active =01, passive 00, not available 11
Byte 5	Status of engine protection override (only for monitoring functions, not for system faults)	Bit 1 power reduction override Bit 2 force low idle timer override Bit 3 forced low idle override Bit 4 engine shutdown timer override Bit 5 engine start protection override Values: active =1, passive = 0,
Bytes 6	Engine protection phase (only for monitoring functions, not for system faults)	values see separate list
Byte 7	Engine running status	Bits 1 to 4, values: 0h = engine is not running 1h = engine is cranking 2h = engine is running Bit 8: if a fault is active it is set to 1 else to 0 Bits 5 to 7 = 0, not used.
Bytes 8	Controller status	Bit 1,2 EMR3 stops CAN Bus operating 00 = EMR 3 intents not to stop CAN Bus operating 01 = EMR 3 intends to stop CAN Bus operating 11 = this function is disabled by configuration parameter If EMR3 gets the command to be switched off, it will send this message one time with Bit 1 set to 0 Bit 8 actual use of data set 0 = customer data set active 1 = Test bench data set active Bit 3 to 7 = 11, not available

Gray displayed information are actually not available – ignore these data!

Byte 6 Engine protection phase:

Engine not running	Engine running
0 = no protection	0 = no protection
1 = start protection active (starter disabled)	3 = warning active
2 = start protection override active (phase 1 override)	4 = warning and power reduction active
3 = warning active	5 = power reduction override in warning state active
14 = engine shutdown done by the protection function, start fuel amount is still set zero, Diagnosis lamp blinks quickly	6 = low idle force pre warning (timer)
15 = engine shutdown done in time by the driver during engine shutdown demand or signal in shutdown range and shutdown demand set after T15 on	7 = override of low idle force timer in low idle force pre warning state,delays forced idle, engine is in forced low idle state
	8 = forced low idle active,
	9 = override of forced low idle state
	10 = shut down pre warning (timer) running
	11= override of shut down timer, in shut down pre warning state,delays shut down
	12 = shutdown demand to the driver
	13 = no reaction of the driver to engine shutdown demand
	17 = engine running due to 16 override and engine start command and 2

2.12. Measured Data 9 (fan data)

Defaults values for transmission rate and CAN Identifier s. CAN Code Specification.

Byte	Data	Comment
Byte 1, 2	Fan speed	1 rpm / bit
Byte 3	Fan speed clutch value	0.4 %, range 0 to 100 % only if PWM is sent to clutch else 0xFFh This is the clutch input value.
Byte 4	Fan speed range	If Linnig clutch is used
Byte 5	PWM Load limiting	0,4 % / Bit
Byte 6,7,8	not available	not available, value is 0xFFh

Gray displayed information are actually not available – ignore these data!

2.13. Engine Protection (receive message)

Defaults values for transmission rate and CAN Identifier s. CAN Code Specification.

Byte	Data	Comment
Byte 1	Power reduction	1% /Bit, range 0% to 100% 0% = engine stop
Byte 2	Start Lock	Lock status (Engine Start Lock 1): 0x00h = no engine start prohibition 0x01h = engine stops and engine start prohibition will be active 0xFFh = not defined (no protection)
Byte 3	Engine protection demands	values 0 = no engine protection, no action 1 = force idle 2 = release forced idle caused by command 1 3 = engine shutdown immediately 4 = engine shutdown procedure timer, override possible etc. 5 = normal engine stop procedure 6 = special engine stop procedure 1 i.e. used to reduce load before engine stop or to cool down the engine 7 = override engine protection same procedure like override push button
Byte 4to8		not defined, value is 0xFFh

Gray displayed information are actually not available – ignore these data!

Depending on the application, ignition key has to be switched of to release start prohibition.

Not all engine protection functions are available in every applications, i.e. engine shutdown is not allowed for some applications.

Byte 1: **Power reduction:**
Reduces the max. engine torque.
The base for the percentage value is the max. torque curve 1

0% causes the EMS to switch off the engine.
100% means no power reduction.

If there is more than one source for power reduction active, i.e. internal power protection by temperature and this message, the lowest value (= the highest reduction) will be used.
If there is a timeout of a message the last valid data will be used furthermore for the calculation.

Byte 2 Start Lock
As long as the start is forbidden, the value 0x01h has to be send. Sending the 0x00h will release the start lock. This value is used for normal operation with no start prohibition. It can not release a start prohibition which is caused by other sources, i.e. internal engine protection functions or other CAN bus messages.

Start lock Actuators
If the starter is controlled by EMR3 then start prevention means also not cranking, else cranking is possible. The injection fuel mass will be set to zero

Example:
No Limiting or shut off demand:

ID	*Byte1*	*Byte2*	*Byte3*	*Byte4*	*Byte5*	*Byte6*	*Byte7*	*Byte8*
EngPrt (0CFF0303x)	*64*	*00*	*00*	*FF*	*FF*	*FF*	*FF*	*FF*

Shut off demand if engine running or start lock demand if engine not running:

ID	*Byte1*	*Byte2*	*Byte3*	*Byte4*	*Byte5*	*Byte6*	*Byte7*	*Byte8*
EngPrt (0CFF0303x)	*00*	*00*	*00*	*FF*	*FF*	*FF*	*FF*	*FF*

50% Limiting demand:

ID	*Byte1*	*Byte2*	*Byte3*	*Byte4*	*Byte5*	*Byte6*	*Byte7*	*Byte8*
EngPrt (0CFF0303x)	*32*	*00*	*00*	*FF*	*FF*	*FF*	*FF*	*FF*

Start Lock demand:

ID	*Byte1*	*Byte2*	*Byte3*	*Byte4*	*Byte5*	*Byte6*	*Byte7*	*Byte8*
EngPrt (0CFF0303x)	*64*	*01*	*00*	*FF*	*FF*	*FF*	*FF*	*FF*

End of Example

2.14. Engine Stop request (receive message)

Defaults values for transmission rate and CAN Identifier s. CAN Code Specification.

Byte	Data	Comment
Byte 1	Engine stop demand	01 H = engine will be stopped immediately
Byte 2	Start Lock	Lock status (Engine Start Lock 2): 0x00h = no engine start prohibition 0x 01h = engine stops and engine start prohibition will be active 0x FFh = not defined (no protection)
Byte 3-8		Not Defined = 0xFFh

To release the engine stop demand, ignition key has to be switched of and the after-run time has to elapse before switching ignition key on again.

Byte 1 Engine stop demand
This message allows an engine shutoff additional to the message engine protection. Each CAN-bus node is able to stop the engine independent from the source address of the message. This message should not be send periodically.

If at least one engine stop demand has been received the engine will be stopped.

If the engine is not running and EMR 3 is receives an engine stop demands, then the engine will not be able to start (start prevention). In that case it is necessary to send the engine stop command as long as the start is forbidden.

Byte 2 Start Lock
This data is as defined in the engine protection message. Here each CAN-bus node is able to set the start prohibition.
When EMR3 has received a start lock command, it stores the source address of the node which has activated the start lock, because only the same can bus node can release the start lock. If more than 1 node has forced a start lock, then all these nodes has to release the start lock to allow EMR3 to reset the engine start lock 2.
The value 00h is used on two ways. The first way is to use normal operation with no start prohibition and the other way is to release a start lock which was caused by this command (byte 2).
It can not release a start prohibition which is caused by other sources, i.e. internal engine protection functions or other CAN bus messages.

Start lock actuators
If the starter is controlled by EMR3 then start prevention means also not cranking, else cranking is possible. The injection fuel mass will be set to zero.

2.15. Limitation

Defaults values for transmission rate and CAN Identifier s. CAN Code Specification.

In this section the possibility will describe for limitation or engine shut off. If an limitation will be send depends on the Function of he engine

Byte	Data	Comment
Byte 1	Active limitation 1	
Byte 2	Active limitation 2	
Byte 3	Actual torque map	
Byte 4	Engine speed limit	
Byte 5	Engine torque limit	
Byte 6	Source of power reduction	
Byte 7	Engine stop	
Byte 8	Reserved	

Gray displayed information are actually not available – ignore these data!

Active limitation 1

Bit 8 Max. torque curve reached
Bit 7 Max. engine speed limit reached (Engine speed limit)
Bit 6 Engine speed limit TSC1 reached (TSC1 Engine speed limit)
Bit 5 Engine torque limit TSC1 reached (TSC1 Engine torque limit)
Bit 4 Power reduction active
Bit 3 engine shutdown protection / start prevention active
Bit 2 limp home function active
Bit 1 Road speed limitation active (configured limit reached)

A bit will only be set, when the depending function is limiting the engine at this moment. If there is a limit set, but the engine is working at a point below this limit, the corresponding bit will not be set.

Active Limitation 2

Bit 1,2,7, 8 reserved = 0
Bit 6 Rail limp home
Bit 5 overrun condition
Bit 4 smoke limitation
Bit 3 limitation by barometric pressure

Actual torque map

This is the number of the selected max. torque curve, even when the engine is actually not working at this limit

1 = max. torque curve 1
2 = max. torque curve 2
3 = max. torque curve 3
4 = max. torque curve 4
5 = max. torque curve 5
6 = kick down curve
7 = power boost torque curve

Engine speed limit

1 normal speed limit (configuration parameter)
2 TSC1.AE
3 TSC1.DE
4 TSC1.PE
5 TSC1.TE
6 TSC1.VE

This is the number of the actual lowest engine speed limit, even when the engine is actually not working at this limit

Engine torque limit

1 normal limitation by max. torque curve
2 TSC1.AE
3 TSC1.AR
4 TSC1.DE
5 TSC1.DR
6 Reserved
7 Minimum Torque Limit
8 TSC1.PE
9 TSC1.TE
10 TSC1.TR
11 TSC1.VE
12 TSC1.VR
13 minimum torque limit is torque max
14 Reserved
15 limit by engine protection

This is the number of the actual lowest engine torque limit, even when the engine is actually not working at this limit.

Source of power reduction
0 = no power reduction
1 = Boost Air Temperature Monitoring
2 = Coolant Temperature Monitoring
3 = Fuel Temperature Monitoring
4 = Oil Temperature Monitoring
5 = Oil Pressure High Monitoring
6 = Oil Pressure Low Monitoring
7 = Boost Pressure Monitoring
9 = Coolant Level Monitoring
12 = Misfire Detection
13 = Rail pressure Monitoring by metering unit
14 = Rail pressure sensor Monitoring
16 = Low Fuel Pressure Monitoring
18 = Gearbox Oil Temperature Monitoring
19 = Hydraulic Oil Temprature Monitoring
20 = Air Filter Monitoring

The number of the signal that sets the highest reduction will be send in this byte.
The engine mustn't work at the limit to get a value different from zero. It is sufficient that a limit is set.

Example:

Power reduction 20% of max. torque curve because of coolant temperature is too high, that means 80% of power is available. The engine may work at 10% of max. power, but the value of the byte will be 2.

End of Example

Engine stop

1 = no special engine stop, normal engine stop
2 = Engine shutdown for engine protection
3 = CAN Message Engine Stop Request
4 = Boost Air Temperature too High
5 = Coolant temperature too high
6 = Fuel Temperature too high
7 = Oil Temperature too high
8 = Oil Pressure too low
9 = Boost Air Pressure
10 = Boost Air Pressure deviation
11 = Coolant level too low
13 = shut down is due to injection
14 = Rail Pressure
15 = Rail Pressure Sensor
16 = Low Fuel Pressure
17 = Fan Control
18 = Customer Temperature 1
19 = Customer Temperature 2
20 = Air Filter
21 = Fuel Filter
22 = Oil Level
23 = Preheat
24 = Battery Voltage
25 = Reserved
26 = Engine Speed
27 = Engine Stop Switch

The value of this byte shows the reason, why EMR3 has shut off the engine.

2.16. State of Inputs 1

Defaults values for transmission rate and CAN Identifier s. CAN Code Specification.

These data give information about the input pins, regardless for what they used for, that means independent from the output pin assignment .

Byte	Data	Comment
Byte 1	Digital Input Pins 1 Measured at the hardware inputs	Bit 1: override switch input Bit 2: droop choice input Bit 3: EMR3-S: controller mode input EMR3-E: = 0 Bit 4: EMR3-S: power boost input EMR3-E: = 0 Bit 5: manual heating or reserve1 Bit 6: speed switch (+) Bit 7: speed switch (-) Bit 8: speed switch (hold/resume) Values: high = 1, low = 0
Byte 2	Digital Input Pins 2 Measured at the hardware inputs	Bit 1: Input water in fuel indicator Bit 2: Input engine break switch Bit 3: Input engine stop switch Bit 4: Input engine start switch Bit 5: Input low idle switch throttle 2 (hand gas lever) Values: high = 1, low = 0
Byte 3	Network controller mode / power boost	0,05 V / Bit, 0 to 5V Only for EMR3-E available, EMR3-S controller sets this byte to 0xFFh and uses Byte1 - Bits3 and 4 instead.
Byte 4	Network speed set point voltage	0,05 V / Bit, 0 to 5V
Byte 5	Network torque / droop line voltage	0,05 V / Bit, 0 to 5V
Byte 6	Pre control input	0,05 V / Bit, 0 to 5V
Byte 7, 8	Reserve Pulse Input (EMR3-E)	= 5 rpm /Bit Pulses / rpm is a parameter

Gray displayed information are actually not available – ignore these data!

2.17. State of Outputs

Defaults values for transmission rate and CAN Identifier s. CAN Code Specification.

Byte	Data	Comment
Byte 1	External EGR output,	PWM / Switch
Byte 2	Internal EGR output	PWM / Switch
Byte 3	Reserve 1	PWM / Switch
Byte 4	Reserve 2 (only EMR3-E)	PWM / Switch
Byte 5	Torque	PWM / Switch
Byte 6	Fan Control	PWM / Switch
Byte 7	Digital outputs1	Bit 1,2: engine running output Bit 3,4: OBD Lamp output Bit 5,6: Starter output Bit 7,8: Fuel valve for flame start Values: on = 01, off = 00, 10 = error of output, 11 = disabled output
Byte 8	Digital outputs 2	Bit 1,2: warning temperature Bit 3,4: warning oil Bit 5,6: preheat lamp Bit 7,8: engine brake flap Values: on = 01, off = 00, 10 = error of output, 11 = disabled output

Gray displayed information are actually not available – ignore these data!

Data format for PWM / Switch Outputs
if PWM: 0% to 100%, 1% / Bit
if Switch: on =100, off = 0
Error = 0xFEh
Disabled by parameter = 0xFFh

2.18. Function mode control (receive message)

Defaults values for transmission rate and CAN Identifier s. CAN Code Specification.

This message allows to switch to different modes without using external switches.
It depends on the application which options are enabled by configuration parameters.
Each single value for selection can be disabled (i.e. number of selectable constant speeds).

Byte	Data	Comment
Byte 1	Number of engine torque map	
Byte 2	Droop selection, number of droop engine speed governor	
Byte 3	Engine speed mode	
Byte 4	Controller mode	
Byte 5	Droop value	0,25% / bit, range 0% to 50%
Byte 6	PID selection for engine speed governor	
Byte 7	Droop selection, number of droop high idle governor	
Byte 8	Pedal choice	

Number of engine torque map:
0= no modification of torque map
1= switch to torque map 1
2= switch to torque map 2
3= switch to torque map 3
4= switch to torque map 4
5= switch to torque map 5

Droop selection
0 = no modification of droop
1 = selects engine speed depended droop 1
2 = selects engine speed depended droop 2
3= selects engine speed depended droop 3
4= use byte 5 as droop value

Engine speed mode
0= no modification of speed mode
1= freeze and use the actual engine speed
2= freezes the requested engine speed
3= switches to variable engine speed (TSC1, Pedal..)
4= switches to constant speed 1 (Genset)
5= switches to constant speed 2 (Genset)
6= switches to constant speed 1
7= switches to constant speed 2
8= switches to constant speed 3
9= switches to constant speed 4

Controller mode	0= no modification of controller mode 1= engine speed governor 2= engine torque governor
PID engine speed governor	0= no modification of PID 1=PID set 1 selected 2=PID set 2 selected
Droop selection (high idle governor)	0 = no modification of droop 1 = High idle droop 1 2 = High idle droop 2
Pedal choice	0 = no modification of pedal choice 1 = Pedal 1 2 = Pedal 2

Default status
Default value for droop is "droop 1".
Default status for controller mode is a configuration parameter.

Limp home status
If the primary setpoint source fails (i.e TSC1 Message due to timeout) then the secondary one (depending on priority order i.e. accelerator pedal or constant speed) will be used for setpoint calculation. In that case it depends on the application which droop will be used.

Example:
Droop1 and Torque map 1 demand:

ID	*Byte1*	*Byte2*	*Byte3*	*Byte4*	*Byte5*	*Byte6*	*Byte7*	*Byte8*
FMC (18FF0203x)	*01*	*01*	*00*	*00*	*00*	*00*	*01*	*00*

End of Example

2.19. Controller Configuration1

Defaults values for transmission rate and CAN Identifier s. CAN Code Specification.

Byte	Data	Comment
Byte 1, 2	Rated engine power	0,5 KW/Bit; No Offset; Range: 0 to 32,127.5 kW
Byte 3, 4	Rated engine speed	0,125 rpm / Bit
Byte 5 to 8		not defined = 0xFFh

3. CAN Bus Diagnosis

CAN Bus start operation
After switching the system on, the diagnostic functions for the CAN bus starts after a configurable waiting time ECU_INIT (~ 10s). If a receive message is still missing after this time elapsed, then the message is in the time out condition.

After the waiting time ECU_INIT elapsed, the normal timeout monitoring starts. In this mode the waiting time is different from the above one (~8 * standard transmission rate).

Engine start condition
While starting the engine, the supply voltage usually drops down. To avoid faults due to low supply voltages there is another configurable waiting time where CAN Bus monitoring is disabled. This time starts when engine starts cranking and ends when low idle speed has been reached plus a configurable time delay.
If a receive message is still missing when this time elapsed, then the message is in the time out condition.
After this waiting time elapsed, the normal timeout monitoring starts. In this mode the waiting time is different from the above one (~8 * standard transmission rate).

Supply voltage
Even when the engine is already running and the supply voltage decreases below a minimal threshold (configurable), the normal timeout monitoring will be disabled. It will be enabled again, after the voltage raised to normal values (configurable) again and a configurable waiting time elapsed.
If a receive message is still missing after this time elapsed, then the message is in the time out condition.
After this waiting time elapsed, the normal timeout monitoring starts. In this mode the waiting time is different from the above one (~8 * standard transmission rate).

Setpoint sources
If the CAN Bus is the source of the engine speed or torque setpoint and a pedal is also connected to the EMR3, the CAN setpoint has higher priority and the pedal is the redundant source. The following functions will be used:

If the CAN Bus message which delivers the setpoint is in the timeout condition, then the redundant source will be used. Once switched over to the redundant value no return to the CAN bus setpoint is possible till the engine has been stopped.

CAN BUS stops operation
All members of the CAN Bus must be switched on/ off at the same time, else receive messages could be missing and faults might be generated.
The DEUTZ experience is, that the fault message "receive message is missing" is not sufficient if they occur seldom, because nobody knows if this is caused by indeterminate switch off conditions or by CAN Bus disturbances.
Therefore EMR3 will set a data before it ends stopping the CAN Bus messages.

All other nodes can decide if they need the CAN BUS messages from EMR3 furthermore.

Receive Messages missing, time out
Defaults values for transmission rate, timeout and CAN Identifier s. CAN Code Specification.

Not valid data
Not valid data, (i.e. caused by a short circuit of a sensor), have to be set to 0xFEh according to the standard SAE-J1939.

Missing or not valid data of a CAN-Bus will be replaced by error values inside the EMR3. These error values are configuration parameters, which can be normal error values in the normal operation range or error values outside the operation range.
Error values in the normal operation range are used like valid data for the other functions of EMR3, but error messages will be generated.

EMR functions will not work with data set to error values outside the normal operation range. Alternative function will be used to get a proper operation of the system, i.e. limp home function.
If a data becomes valid again, this valid value will be used again for normal operation, if not other specified in the function specification. Set point values for engine speed or engine torque will not get valid again after a fault detection..

Error Memory
Faults of the CAN-bus are transmitted via CAN-Bus and the ISO9141 Bus and will be stored into the error memory of EMR3.
The diagnostic lamp will be activated.
The reason for a fault must be unambiguously determinable.

Engine protection message
If an engine protection message fails, the last valid value will be used and the error messages will be generated.

Appendix 1: Multipacket Transport

If more then 8 data bytes must be send they have to be separated in different packets. The first message is the Broadcast Announce Message (BAM), which tells the receiver which message will be send in packages. After that the data packets will be send.

BAM:

Transmission rate:	s. below.
Data length:	8
Data Page:	0
PDUF:	236
PDUS:	255
Priority:	6
Parameter group number:	60416
Source Address: ID:	Device- Nr. EMR

Byte 1	32
Byte 2, 3	Number of used data bytes of all packets without the byte of packet number
Byte 4	number of Packets
Byte 5	reserved FF
Byte 6 to 8	Parameter group number

Die „parameter group number“ and the transmission rate are the same as in the message specified, which data are transferred with the Multipacket Transport (i.e. DM 1, DM 2)

The data packets:

Transmission rate:	see above
Data length:	8
Data Page:	0
PDUF:	235
PDUS:	External Device Nr
Priority:	6
Parameter group number:	00Ebxxh
Source Address: ID:	Device- Nr. EMR

Byte 1	Packet Nr.
Byte 2 to 8	Data

There may be less than 8 useful data bytes in the last data packet, so the rest of the data bytes are set to FF. The External Device No. is global (255) if the message is send cyclically, else it is the Device No. of the device which made a request.

Appendix 2: Lamp status

Malfunction Lamp status

consist of 2 Bit values:
00 not active (not lightened)
01 active (lightened)

7 not defined

Bit 1,2 Engine Protection Lamp

- is active, if a valid data is out of normal operating range, i.e. in warning range, power reduction range, engine shutdown demand range, start protection range or shutdown range.
- is not active, if the data value is coming back out of the warning range and
  is below the recovery limit.

Bit 3,4 Warning Lamp
is active, if the diagnostic lamp of EMR is continuously lightened, otherwise it
is inactive. That means it is active not only if a data value is in the warning range, it is also set, if an electronic part of the EMR System has a fault which does not causes an automatically shut off of the engine, i.e. broken wire.

Bit 5,6 Stop lamp (for engine protection)
active, if the EMR diagnostic lamp is blinking to show an critical fault. That means an engine shut off is necessary.

Bit 7,8 Emission Related Lamp

DM1 and DM2 have a second Byte for Lamp Status, but the contents are not specified (=FF)

After switching power supply the EMR diagnostic lamp is lightened for a test, but the bits defined above will not be set active for that reason.

Appendix 3: Error codes, SPN, DTC

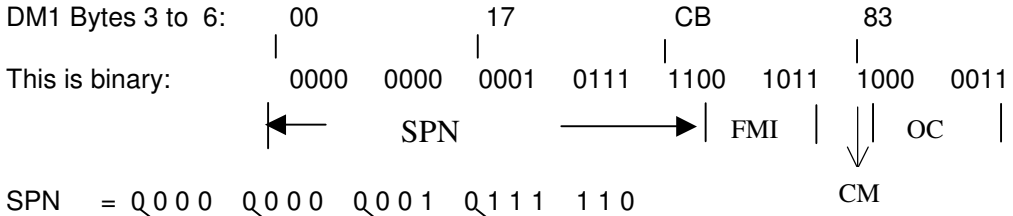
The diagnostic trouble code DTC consist on the SPN (suspect parameter number) to see which parameter is faulty, and the FMI (failure mode identifier), which shows the kind of error.
DTC consist on 19 Bits SPN, 5 Bits FMI, 1 bit conversation method CM and 7 Bits Occurrence Counter

The SPN (suspect parameter number) values are the same values as described in the standard.
For special faults, not defined in the standard, the SPN values are configurable.
Each error message can be enabled separately by a configuration parameter.
The error codes SPN and FMI are listed in a separate document.

There are 4 different ways to interpret the SPN Bytes as defined in SAE-J1939-73 OCT1998. 5.7.1.7

The following example shows how to interpret the received bytes of message DM1, using version 1, for a test tool connected to EMR3.

EXAMPLE DM1 Received, Version 1 EMR1 and EMR2 compatible:



SPN = 0 0 0 0 0 0 0 0 0 0 0 1 0 1 1 1 1 1 0

= 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1 1 1 1 1 0

= 0 0 B E

= 0x00BEh = 190d = Engine Speed Error

FMI = 01011 = 11d

OC = 0000011 = 3

So the fault 190 with kind of error 11 has occurred 3 times.

Software routine for SPN: Read Bytes 3 to 5 and shift right 5 times,
Or equivalent: Read Bytes 3 to 5 and divide by 20h = 32d
0017CB / 20h = BE = 190d

Appendix 4: Acknowledgment

according to SAE-J1939-21

Transmission rate:	Once, after receiving a message which needs an Acknowledge.
Data length:	8 Bytes
Data Page:	0
PDUF:	232
PDUS:	255
Priority:	6
Parameter group number:	59647 (E8FF)
Source Address: ID:	EMR Device Nr.

Byte 1	0 for positive Acknowledge 1 for negative Acknowledge
Byte 2 to 5	not defined
Byte 6 to 8	parameter group number of the message, which needs an Acknowledge

Appendix 5: Hardware Information CAN

Terminal Resistor:
On both ends of the CAN Bus terminate resistors are necessary.
They must external of the EMR3 controller, because EMR3 does not provide internal CAN BUS termination resistors.

EMR3 switched off
EMR3 will not influence the CAN BUS data transfer, when EMR3 is switched off by the power supply.
That means EMR 3 will not influence the p physical can bus parameter.