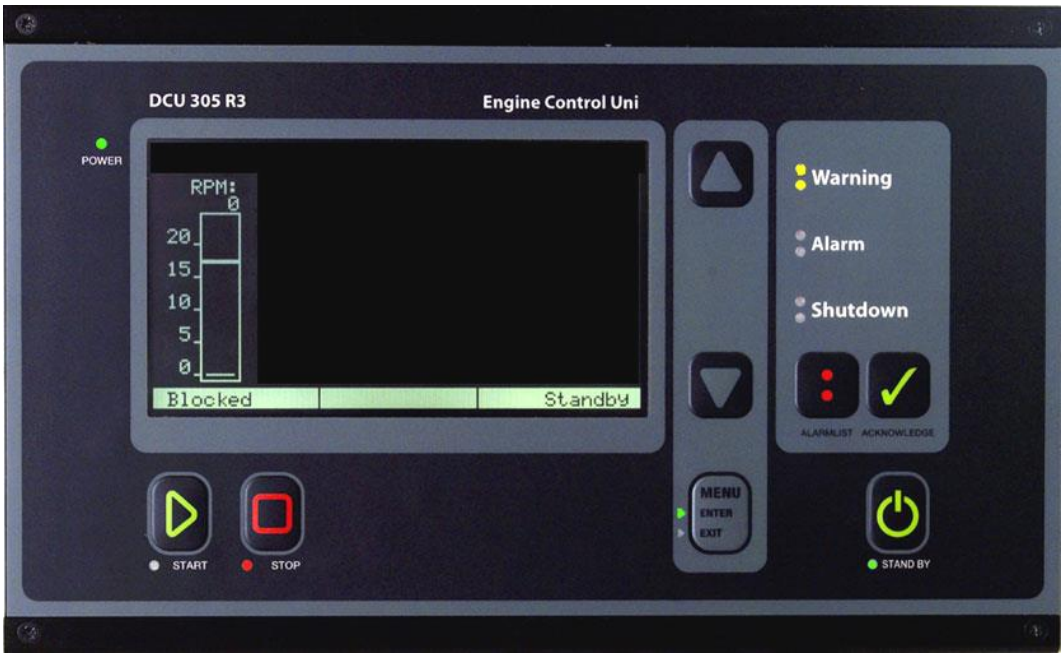
DCU 305 R3

CAN / J1939 Manual

Diesel Engine Control Unit



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Document information

Document revisions

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August 2005	Created
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February 2006	DM1 as text from 6.40
November 2007	Altered Menu layout, and additional spn/fmi alarms from 6.53

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Related articles

- DCU 305 R3 Communication Manual.
- DCU 305 R3 Installation Manual.
- Rudolf R3 User's Manual, English.
- Rudolf R3 Configuration Software.
- [a] SAE, J1939-71
- [b] SAE, J1939-73
- [c] Conrad Etschberger, "Controller Area Network"

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Introduction

About this manual

This manual has been published primarily for professionals and qualified personnel. A person using this material is assumed to have basic knowledge in marine systems, and about the DCU 305 R3.

Note: Auto-Maskin continuously upgrades its products and reserves the right to make changes and improvements without prior notice.

All information in this manual is based upon information at the time of printing.

For updated information, please contact your dealer.

Assumptions

This document describes the DCU 305 R3 referring to it as the *DCU*.

Classification Societies Requirements

The DCU is classified as both alarm/monitoring and as a shutdown system. Society's approvals for shutdown systems, like for instance DNV, demand a redundant system. Since the CAN bus is not redundant, bus shutdown switches and pickups must be hardwired to the DCU to obtain a classified shutdown system. However, together with hardwired signals, the CAN signals can be used to make a complete alarm/monitoring and shutdown system.

Wiring

The CAN Bus

The CAN bus consist of two wires. CAN_High, and CAN_Low. Between units CAN_H should be connected to CAN_H and CAN_L to CAN_L. They must not be crossed like one would on some other communication cables. Maximum theoretical cable length for the Whole CAN bus is 250 meters. It has to be a separate cable. The cable must be a twisted pair with shield, and at least 0.5 mm2 (20AWG), and max 0.8 mm2 (18AWG). If possible the cable should be approved for CAN / J1939 usage.

The minimum bending radius is 8 times the cable diameter. Bending and fastening the cable must be done with caution. Insufficient space between the wires, or between the wires and the shield, due to squeezing or sharp bends, can cause degradation of the signal.

CAN_H is pin 7 and CAN_L is pin 2 in P10 on the back of the DCU panel. No other pins should be connected. The shield should normally be connected at only one end. We suggest connecting it at the engine side, but in some cases best performance is obtained connecting the shield at both ends, especially if the cable is long. This however enables ground loops.

Bus Termination Resistor

A CAN bus is meant to connect many units together in a bus network. The case where it goes only from the engine controller to the DCU is a special case. In both ends of the bus, a 120 ohm resistor must be connected. The DCU has such a termination resistor internally. If the installation has several units (more than two) connected to the CAN bus, AND the DCU is not at the end of the bus, then you have to specify "CAN card without J1" when ordering the DCU. Alternatively J1 or R4 can be removed from the CAN card.

There is a possibility that the CAN bus will work also with the resistor at only one end, but then only for very short cable lengths, and it can make it unreliable.

If, by accident, 24volts are connected to on one of the CAN_H/L inputs, this could cause the 120 ohm resistor on the CAN card to burn.

Cable Placement

You may bundle the CAN cable together with other communication cables.

We recommend that you do not bundle communication cables (like the CAN cable) together with cables carrying high voltages, high currents, or who are connected to inductive loads like contactors or motors.

Using shielded cables lowers the interference from bundled cables with approximately 20dB, but does not remove the potential problem completely.

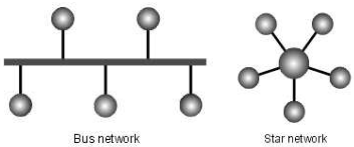
If the installation has cables carrying currents that are pulse width modulated (giving a magnetic field with a wide frequency range around the cable), like for instance from a frequency converter, then those cables should be located apart from the communication cables / the CAN cable, with a distance of at least 5 cm, and if possible with its own ground plane (its own cable duct) in order to avoid inducing noise in the other cables. If this cannot be done, using twisted pair cable for the communication cables is utmost important.

Maximum cable length from the bus to each node is 30 centimeters / 12 inches. Thus it is recommended to run the bus cable via the nodes like in a daisy chain.

Connecting Devices

If the CAN bus connects other installations that does not have their power input directly wired to exactly the same physical point as the DCU and the engine controller, or if it is a long cable, then a CAN repeater with galvanic isolation should be used between the locations.

Bus Network



The CAN bus must be wired as a bus network [c]. Star networks are not allowed. If you have to use a star network, a CAN repeater must be used between the bus and each network node, making it several bus networks.

CAN repeaters

CAN repeaters are used if galvanic isolation is needed, or if a star network branch is needed [c]. The shield on the CAN cables on both sides of the CAN repeater shall NOT be connected together.

CAN / J1939 – DCU 305 R3

CAN Circuit

The CAN circuit in the DCU is tolerant to some electrostatic discharge, and has a design that filters out noise when used along with a twisted pair cable. There is no galvanic isolation.

Some precautions, like touching a ground point with your bare hands before working with / on the equipment, are recommended. Also don't use clothing that makes you statically charged. If you have moved around, please touch a ground point again before continuing.

Troubleshooting

Without any power on, you can measure the resistance between CAN_H and CAN_L. As it should be one 120 ohms resistor at both ends, you should measure about 60 ohms. It need not be accurate at all.

If an instrument is showing a DC voltage of about 0.5 to 2.0 volts (not zero volts) between CAN_L and CAN_H, that is a indication that there is CAN data present on the cable. It is not reliable however. And it may vary depending on the instrument.

In order to measure the CAN signal a scope must be used, for instance the *Fluke 123 Scopemeter*. Use 1 volt per division and from 50 to 500 microseconds.

An oscilloscope is also nice when having noise problems, or for deciding which shield connection that gives the best signal. (Either end, both ends or none).

Using the scope, the CAN signal is measured between CAN_L and CAN_H. The signal consists of square pulses with a height of typically 2.0 to 2.5 volts. These pulses come in bursts.

The 120 ohm resistor at each end of the CAN bus prevents too much over (under) shooting on the pulse edges. Some overshoot is ok.

When there's no data on the CAN cable the CAN_H and CAN_L wires should be 2.5 volts above zero volts (zero volts is available on the RK-66 terminal unit).

When there are pulses then CAN_L goes to 1.5 volts above zero volt, and CAN_H goes to 3.5 volts above zero volt. The exact voltage is NOT important. To measure, use red probe on CAN_H, and black on CAN_L or zero volt (0V).

Bus Speed

The 250Kbit/second rate is used.

Signals

The CAN signals are received as parameters in groups. Each group (burst) may contain several parameters / signals. Each group is identified with its Parameter Group Number (PGN). A group with signals is sent as a package on the CAN bus, typically some times per second. The signal / parameter is identified with its Suspect Parameter Number (SPN).

The current max number of PGNs that can be received is 16 different ones, but that can be increased in future firmware revision if needed. Several signals can be extracted from one PGN.

"Fuel Rate", "Engine Hours" and "Battery Voltage" from CAN are handled in a fixed way by the DCU firmware. These signals will, if chosen from CAN in Rudolf, replace the internal DCU signals.

In current firmware revision at least one CAN signal must be defined on one of the channels in the range 12 to 17, if CAN is to be used.

Auto-Maskin AS can make measurements / logs on an engine in order to figure out which signals are available from the engine.

Some engines may have proprietary CAN signals. If so, and they shall be used, documentation should be supplied.

Broadcasted DM1 diagnostics is supported and described in a separate chapter.

Fuel Rate

If "Fuel Rate" from CAN is in use under Analog inputs in Rudolf, then fuel total and average values are calculated by the DCU and available in a separate view.

Engine Hours

If “Total Engine Hours” is selected as J1939 (CAN) in Rudolf, the DCU will read the value from the engine controller and make it available in a separate view.

Battery Voltage

If “Start Batter Voltage” is J1939 (CAN) in Rudolf, the range for the bar graph is zero to 50 volts.

J1939 (CAN) supports three different voltages, Alternator, Electrical and Battery. It varies from engine brand which one(s) is sent from the engine. This can be selected in Rudolf.

Even if selecting to read voltage via CAN, the DCU measures its own voltage on terminals 1 and 2 in order to decide if it needs to give an alarm for low battery voltage.

Analogue Bar Graphs

The range for the bar graphs are according to the J1939 (CAN) specification, and for some very few instruments, with a range starting on for instance –273 degrees, this results in a almost stationary bar graph.

Broken Wire [CAN]

This alarm is issued when there's no longer any CAN data being received on the CAN bus on P10.

The alarm will come if there is a broken wire in the can bus, on powering off the engine controller, or if P10 on the back of the DCU is disconnected.

CAN Status Screen

A screen for the status of the CAN connection exists. It is reached from the Menu screen.

Depending on the firmware version, during normal operation, there will be a Rx counter counting, or the text “Receiving”.

In the latest firmware version you have to select “More” to see the counters mentioned below.

If for instance the CAN cable has been disconnected or the engine controller has been off, then the value for "CAN1708reSt's" will have increased with 1,2,3,5 or 7 times the number of for instance

disconnections of the cable. The value it is incremented with (for each event) indicates the reason for the event. Further more, the "CANerrorCodes" will have increased as well.

If "CANerrorCodes" increase frequently, then it could be poor contact, or a lot of signal interference.

If "CANwarning" is "Yes", that could be lack of power to the engine controller.

Depending on firmware version, there are other functions on this screen that is for Auto-Maskin usage only.

DM1 Diagnostics

If the engine controller has discovered a problem with for instance a sensor or a component, and broadcasts the "DM1" message, then this will give an Alarm or a Warning on the DCU.

If the DM1 message indicates "Protect Lamp" (value out of normal operational range), or "Red Stop Lamp" (Fault justifying shutting down the engine), then the DCU will give an Alarm with the text "Diagnostics:.....".

If only "Amber Warning Lamp" (Problems that do not justify shutting down the engine), or "Malfunction Indicator Lamp" (Emission related problems) is indicated, the DCU will only give a Warning.

The alarm/warning text for Diagnostics is somewhat different from other alarm/warning texts, as it dynamically updates the text showing the fault codes for each fault in turn if there is more than one.

There's a limit of 16 simultaneous faults for the dynamic update. The total number of faults will be correctly shown also if there are more .

Example: "Diagnostics: (3) 2: SPN= 110 FMI=2" means that the engine controller is sending active diagnosis for 3 SPNs, and that the second SPN is number 110, and has the Fault Mode Indication (type of fault) 2. See the diagnostics chapter at the end of this document.

If the fault situation ceases, but the alarm has not been acknowledged, then the alarm text will read "Diagnostics: (0) ....." and the remaining text should be ignored. The text/alarm will disappear when acknowledged.

In the event log only the text "Diagnostics" is shown.

It is possible (but not recommended), to configure the "Protect Lamp" to give only a Warning.

It is possible to specify that if it's only a specific SPN being reported as faulty, no alarm/warning should be given.

It is possible to disable the DM1 Diagnostics functionality completely.

From firmware version 6.40 the DM1 message data is also available in Modbus/Comli registers.

From firmware version 6.40 there's a screen for showing the active diagnostic codes as readable text.

From firmware version 6.53 the vendor may have configured specific alarms for specific spn/fmi codes that will appear in addition to the alarm/warning mentioned above if they occure.

It is possible for Auto-Maskin to add texts for a specific engine / vendor.

If diagnostics history is wanted, engine diagnosis equipment must be connected to the engine.

Compatibility

The implementation / usage of the J1939 standard [a][b] may differ slightly from engine (controller) to engine (controller), depending on the vendor. Thus a setup that works with one engine controller (configuration), may need some minor adoptions before it will support all signals from another controller. Most signals are however the same, and will work on most engines.

The DCU support reception of PGNs sent in packets [a], and reception of single- or multi-packet DM1 diagnosis broadcasted messages [b].

DM1 SPN number display for diagnosis is supported up to 65535, and when coded according to revision 4 of [b] 5.7.1.7

Auto-Maskin AS can make proprietary solutions.

Diagnostics

SPNs

A complete list of SPN numbers can be obtained in the SAE J1939-71 [a] (available from the SAE organization). SPN numbers can also be vendor specific, and a vendor may have used a SPN slightly different from below, or may be using SPN numbers not listed below.

This list is intended as help in case you don't have any vendor provided information available.

16	Fuel filter (suction side) differential pressure (see also 1382)
21	Engine ecu temperature (use 1136)
22	Extended crankcase blow-by pressure
46	Pneumatic supply pressure
51	Throttle position
52	Engine intercooler temperature
53	Transmission synchronizer clutch value
54	Transmission synchronizer brake value
59	Shift finger gear position
60	Shift finger rail position
69	Two speed axle switch
72	Blower bypass valve position
73	Auxiliary pump pressure
74	Maximum vessel speed limit
81	Particulate trap inlet pressure
82	Air start pressure
86	Cruise control set speed
87	Cruise control high set limit speed
88	Cruise control low set limit speed
90	Power takeoff oil temperature
91	Throttle / Accelerator pedal position 1
92	Percent load at current speed
94	Fuel delivery pressure 35
95	Fuel filter differential pressure

96	Fuel level
97	Water in fuel indicator
98	Engine oil level
99	Engine oil filter differential pressure
100	Engine oil pressure
101	Crankcase pressure
102	Boost pressure
103	Turbocharger 1 speed . 37
104	Turbocharger lube oil pressure 1
105	Intake manifold 1 temperature
106	Air inlet pressure
107	Air filter 1 differential pressure
108	Barometric pressure
109	Coolant pressure
110	Engine coolant temperature
111	Coolant level
112	Coolant filter differential pressure
114	Net battery current
115	Alternator current
123	Clutch pressure
124	Transmission oil level
126	Transmission filter differential pressure
127	Transmission oil pressure
129	Injector metering rail 2 pressure (duplicate, use 1349)
132	Inlet air mass flow rate
136	Auxiliary vacuum pressure reading
137	Auxiliary gage pressure reading 1
138	Auxiliary absolute pressure reading
156	Injector timing rail 1 pressure
157	Injector metering rail 1 pressure
158	Battery potential (voltage), switched
159	Gas supply pressure
160	Main shaft speed
161	Input shaft speed
162	Transmission requested range
163	Transmission current range
164	Injection control pressure
166	Rated engine power
167	Alternator potential (voltage)
168	Electrical potential (voltage)
172	Air inlet manifold temperature
173	Exhaust gas temperature
174	Fuel temperature

175	Engine oil temperature 1
176	Turbo oil temperature
177	Transmission oil temperature
182	Trip fuel
183	Fuel rate
184	Instantaneous fuel economy
185	Average fuel economy
186	Power takeoff speed
187	Power takeoff set speed
188	Engine speed at idle, point 1 (engine configuration)
189	Rated engine speed
190	Engine speed
191	Output shaft speed
228	Engine timing
233	Unit number (power unit)
234	Software identification
235	Total idle hours
236	Total idle fuel used
237	System identification number
244	Trip distance
245	Total distance
246	Total hours
247	Total engine hours
248	Total power takeoff hours
249	Total engine revolutions
250	Total fuel used
253	Personality module
411	Exhaust gas recirculation differential pressure
412	Exhaust gas recirculation temperature
441	Auxiliary temperature 1
442	Auxiliary temperature 2
444	Battery 2 potential (voltage)
512	Driver's demand engine - percent torque
513	Actual engine - percent torque
514	Nominal friction - percent torque
515	Engine's desired operating speed / Secondary throttle position
516	Absolute vessel speed
517	Navigation-based vessel speed
518	Requested torque/torque limit
519	Engine's desired operating speed asymmetry adjustment
522	Percent clutch slip
523	Current gear
524	Selected gear

525	Requested gear
526	Actual gear ratio
528	Engine speed at point 2 (engine configuration)
529	Engine speed at point 3 (engine configuration)
530	Engine speed at point 4 (engine configuration)
531	Engine speed at point 5 (engine configuration)
532	Engine speed at high idle, point 6 (engine configuration)
533	Maximum momentary engine override speed, point 7 (engine configuration)
534	Maximum momentary override time limit (engine configuration)
535	Requested speed control range lower limit (engine configuration)
536	Requested speed control range upper limit (engine configuration)
537	Requested torque control range lower limit (engine configuration)
538	Requested torque control range upper limit (engine configuration)
539	Percent torque at idle, point 1 (engine configuration)
540	Percent torque at point 2 (engine configuration)
541	Percent torque at point 3 (engine configuration)
542	Percent torque at point 4 (engine configuration)
543	Percent torque at point 5 (engine configuration)
544	Reference engine torque (engine configuration)
545	Gain (kp) of the endspeed governor (engine configuration)
558	Accelerator pedal 1 low idle switch
559	Accelerator pedal kickdown switch
560	Driveline engaged
561	ASR engine control active
573	Torque converter lockup engaged
574	Shift in process
578	Drive axle temperature
580	Altitude axle temperature
581	Transmission gear ratio
582	Axle weight
583	Pitch weight
584	Latitude weight
585	Longitude weight
586	Make weight
587	Model weight
588	Serial number
589	Alternator speed
590	Idle shutdown timer state
591	Idle shutdown timer function
592	Idle shutdown timer override
593	Idle shutdown has shutdown engine
594	Idle shutdown driver alert mode
598	Clutch switch

604	Transmission neutral switch
605	Refrigerant high pressure switch
606	Momentary engine overspeed enable
607	Progressive shift disable
620	5 Volt sensor DC power supply
651	Injector cylinder 1
652	Injector cylinder 2
653	Injector cylinder 3
654	Injector cylinder 4
655	Injector cylinder 5
656	Injector cylinder 6
678	Digital sensor supply
681	Gear shift inhibit request
682	Torque converter lockup disable request
683	Disengage driveline request
684	Requested percent clutch slip
695	Override control mode
696	Requested speed control conditions
701	Auxiliary i/o #01
702	Auxiliary i/o #02
703	Auxiliary i/o #03
704	Auxiliary i/o #04
705	Auxiliary i/o #05
706	Auxiliary i/o #06
707	Auxiliary i/o #07
708	Auxiliary i/o #08
709	Auxiliary i/o #09
710	Auxiliary i/o #10
711	Auxiliary i/o #11
712	Auxiliary i/o #12
713	Auxiliary i/o #13
714	Auxiliary i/o #14
715	Auxiliary i/o #15
716	Auxiliary i/o #16
723	Secondary engine speed
740	Lockup clutch actuator
767	Transmission reverse direction switch
768	Range high actuator
769	Range low actuator
770	Splitter direct actuator
771	Splitter indirect actuator
772	Shift finger rail actuator 1
773	Shift finger gear actuator 1

778	Transmission high range sense switch
779	Transmission low range sense switch
780	Shift finger neutral indicator
781	Shift finger engagement indicator
782	Shift finger center rail indicator
783	Shift finger rail actuator 2
784	Shift finger gear actuator 2
786	Defuel actuator
787	Inertia brake actuator 94
788	Clutch actuator
875	Refrigerant low pressure switch
897	Override control mode priority
898	Requested speed/speed limit
899	Engine torque mode
903	Transmission forward direction switch
911	Service component identification
912	Service component identification
913	Service component identification
914	Service distance
915	Service delay/calendar time based
916	Service delay/operational time based
917	High resolution total vessel distance
918	High resolution trip distance
927	Location resolution trip distance
928	Axle location
930	Drive axle location
957	Number of forward gear ratios
958	Number of reverse gear ratios
959	Seconds of reverse gear ratios
960	Minutes of reverse gear ratios
961	Hours of reverse gear ratios
962	Day of reverse gear ratios
963	Month of reverse gear ratios
964	Year of reverse gear ratios
965	Number of software identification fields
966	Engine test mode switch
967	Idle decrement switch
968	Idle increment switch . 106
969	Remote accelerator enable switch
970	Auxiliary engine shutdown switch
971	Engine derate switch . 107
972	Accelerator interlock switch
974	Remote accelerator pedal position

975	Estimated percent fan speed
976	PTO state
977	Fan drive state
978	Remote pto variable speed control switch
979	Remote pto preprogrammed speed control switch
980	PTO enable switch
981	PTO accelerate switch
982	PTO resume switch
983	PTO coast/decelerate switch
984	PTO set switch
985	A/c high pressure fan switch
986	Requested percent fan speed
988	Trip group 1
989	Trip group 2 - proprietary
990	Total compression brake distance
991	Trip compression brake distance
992	Trip service brake distance
993	Trip service brake applications
994	Trip fan on time
995	Trip fan on time due to the engine system
996	Trip fan on time due to a manual switch
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1000	Trip distance in top gear
1001	Trip drive fuel used
1002	Trip pto moving fuel used
1003	Trip pto non-moving fuel used
1004	Trip idle fuel used
1005	Trip cruise fuel used . 116
1006	Trip drive fuel economy
1007	Trip drive fuel used (gaseous)
1008	Trip pto moving fuel used (gaseous)
1009	Trip pto non-moving fuel used (gaseous)
1010	Trip idle fuel used (gaseous)
1011	Trip cruise fuel used (gaseous)
1012	Trip drive fuel economy (gaseous)
1013	Trip maximum engine speed
1014	Trip average engine speed
1015	Trip drive average load factor
1016	Total drive average load factor
1017	Total engine cruise time
1018	Trip maximum speed

1019	Trip cruise distance
1020	Trip number of hot shutdowns
1021	Trip number of idle shutdowns
1022	Trip number of idle shutdown overrides
1023	Trip sudden decelerations
1024	Trip time in vsl
1025	Trip time in top gear 121
1026	Trip time in gear down
1027	Trip time in derate by engine
1028	Total engine pto fuel used
1029	Trip average fuel rate
1030	Total engine pto fuel used (gaseous)
1031	Trip average fuel rate (gaseous)
1032	Total ecu distance
1033	Total ecu run time
1034	Trip cruise time
1035	Trip pto time
1036	Trip engine running time
1037	Trip idle time
1038	Trip air compressor on time
1039	Trip fuel (gaseous)
1040	Total fuel used (gaseous)
1081	Wait to start lamp
1082	Engine coolant load increase
1083	Auxiliary i/o channel #1
1084	Auxiliary i/o channel #2
1089	Auxiliary equipment supply pressure
1107	Engine protection system timer state
1108	Engine protection system timer override
1109	Engine protection system approaching shutdown
1110	Engine protection system has shutdown engine
1111	Engine protection system configuration
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1115	Highest possible gear . 132
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1117	Desired rated exhaust oxygen
1118	Desired exhaust oxygen
1119	Actual exhaust oxygen
1120	Articulation angle
1122	Alternator bearing 1 temperature
1123	Alternator bearing 2 temperature
1124	Alternator winding 1 temperature

1125	Alternator winding 2 temperature
1126	Alternator winding 3 temperature
1127	Turbocharger 1 boost pressure
1128	Turbocharger 2 boost pressure
1129	Turbocharger 3 boost pressure
1130	Turbocharger 4 boost pressure
1131	Intake manifold 2 temperature
1132	Intake manifold 3 temperature
1133	Intake manifold 4 temperature
1134	Engine intercooler thermostat opening
1135	Engine oil temperature 2
1136	Engine ecu temperature
1137	Exhaust gas port 1 temperature
1138	Exhaust gas port 2 temperature
1139	Exhaust gas port 3 temperature
1140	Exhaust gas port 4 temperature
1141	Exhaust gas port 5 temperature
1142	Exhaust gas port 6 temperature
1143	Exhaust gas port 7 temperature
1144	Exhaust gas port 8 temperature
1145	Exhaust gas port 9 temperature
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1147	Exhaust gas port 11 temperature
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1381	Fuel supply pump inlet pressure
1382	Fuel filter (suction side) differential pressure
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1390	Absolute fuel valve inlet pressure
1391	Outlet to inlet fuel valve differential pressure
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1394	Cylinder 2 ignition transformer secondary output
1395	Cylinder 3 ignition transformer secondary output
1396	Cylinder 4 ignition transformer secondary output
1397	Cylinder 5 ignition transformer secondary output
1398	Cylinder 6 ignition transformer secondary output
1399	Cylinder 7 ignition transformer secondary output
1400	Cylinder 8 ignition transformer secondary output
1401	Cylinder 9 ignition transformer secondary output
1402	Cylinder 10 ignition transformer secondary output
1403	Cylinder 11 ignition transformer secondary output
1404	Cylinder 12 ignition transformer secondary output

1405	Cylinder 13 ignition transformer secondary output
1406	Cylinder 14 ignition transformer secondary output
1407	Cylinder 15 ignition transformer secondary output
1408	Cylinder 16 ignition transformer secondary output
1409	Cylinder 17 ignition transformer secondary output
1410	Cylinder 18 ignition transformer secondary output
1411	Cylinder 19 ignition transformer secondary output
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1414	Cylinder 2 ignition timing
1415	Cylinder 3 ignition timing
1416	Cylinder 4 ignition timing
1417	Cylinder 5 ignition timing
1418	Cylinder 6 ignition timing
1419	Cylinder 7 ignition timing
1420	Cylinder 8 ignition timing
1421	Cylinder 9 ignition timing
1422	Cylinder 10 ignition timing
1423	Cylinder 11 ignition timing
1424	Cylinder 12 ignition timing
1425	Cylinder 13 ignition timing
1426	Cylinder 14 ignition timing
1427	Cylinder 15 ignition timing
1428	Cylinder 16 ignition timing
1429	Cylinder 17 ignition timing
1430	Cylinder 18 ignition timing
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1433	Desired ignition timing #1
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1439	EBS red warning signal
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1448	Cylinder 5 combustion time

1449	Cylinder 6 combustion time
1450	Cylinder 7 combustion time
1451	Cylinder 8 combustion time
1452	Cylinder 9 combustion time
1453	Cylinder 10 combustion time
1454	Cylinder 11 combustion time
1455	Cylinder 12 combustion time
1456	Cylinder 13 combustion time
1457	Cylinder 14 combustion time
1458	Cylinder 15 combustion time
1459	Cylinder 16 combustion time
1460	Cylinder 17 combustion time
1461	Cylinder 18 combustion time
1462	Cylinder 19 combustion time
1463	Cylinder 20 combustion time
1464	Desired combustion time
1465	Average engine combustion time
1468	Drive channel mode
1476	Engine oil specific resistance
1477	Engine oil kinematic viscosity
1478	Engine oil relative dielectricity
1482	Source address of controlling device for transmission control
1483	Source address of controlling device for engine control
1574	Laser strike vertical deviation
1575	Modify set point
1576	Mast position
1577	Blade duration and direction
1578	Blade control mode
1579	Laser tracer target deviation
1580	Laser tracer vertical distance
1581	Laser tracer horizontal deviation
1583	Laser tracer information
1584	Service component identification
1586	Speed of forward vessel
1587	Distance to forward vessel
1588	Adaptive cruise control set speed
1589	Adaptive cruise control set distance mode
1590	Adaptive cruise control mode
1591	Path curvature
1601	Local minute offset
1602	Local hour offset
1603	Adjust seconds
1604	Adjust minutes

1605	Adjust hours
1606	Adjust month
1607	Adjust day
1608	Adjust year
1609	Adjust local minute offset
1610	Adjust local hour offset
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1636	Intake manifold 1 air temperature (high resolution)
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1639	Fan speed
1653	Limiting speed governor enable switch
1654	Limiting speed governor increment switch
1655	Limiting speed governor decrement switch
1656	Engine automatic start enable switch
1665	Turbo oil level switch
1666	Automatic gear shifting enable switch
1675	Engine starter mode
1676	Auxiliary heater water pump status
1677	Auxiliary heater mode
1679	Engine heating zone
1681	Battery main switch hold state
1682	Battery main switch hold request
1683	Auxiliary heater mode request
1684	Auxiliary heater coolant pump request
1685	Request engine zone heating

1686	Request cab zone heating
1687	Auxiliary heater output coolant temperature
1688	Auxiliary heater input air temperature
1689	Auxiliary heater output power percent
1690	Auxiliary heater maximum output power
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1694	Gas mass flow sensor fueling correction
1695	Exhaust gas oxygen sensor fueling correction
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1712	Extended range requested speed control range upper limit (engine configuration)
1713	Hydraulic oil filter restriction switch
1745	Vessel motion inhibit
1746	Security device
1759	Blade height set point - high resolution
1761	Catalyst tank level
1762	Hydraulic pressure
1763	Hydraulic pressure mode indicator
1764	Hydraulic pressure governor switch
1765	Requested fuel valve 1 position
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1767	Specific heat ratio
1768	Low limit threshold for maximum rpm from engine
1769	High limit threshold for minimum continuous engine rpm
1770	Low limit threshold for maximum torque from engine
1771	High limit threshold for minimum continuous torque from engine
1772	Maximum continuous engine rpm
1773	Minimum continuous engine rpm
1774	Maximum continuous engine torque
1775	Minimum continuous engine torque
1784	Minimum continuous engine speed limit request
1785	Maximum continuous engine speed limit request
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1813	VDC information signal
1814	VDC fully operational
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1816	ROP engine control active
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1819	YC brake control active
1820	Ramp / wheel chair lift position
1834	Total average fuel rate
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1836	Trailer abs status
1837	Convoy driving lamp select
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1845	Transmission torque limit
1846	Default engine torque limit
1857	Winch oil pressure switch
2430	Main radiator/engine coolant level
2432	Engine demand - percent torque
2433	Right manifold exhaust gas temperature
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2536	Transmission mode 1 indicator
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2582	Hydraulic brake pressure supply state circuit 1
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2584	Hydraulic brake pressure warning state circuit 1
2585	Hydraulic brake pressure warning state circuit 2
2588	Maximum speed limit 1
2589	Maximum speed limit 2
2590	Maximum speed limit 3

2591	Maximum speed limit 4
2592	Maximum speed limit 5
2593	Maximum speed limit 6
2594	Maximum speed limit 7
2595	Applied speed limit
2596	Selected maximum speed limit
2597	Implement left facing work light command
2598	Implement left facing work light
2599	Fire apparatus pump engagement
2600	Payload percentage
2601	Travel velocity control position
2602	Hydraulic oil level
2603	Pneumatic supply pressure request
2607	Auxiliary equipment supply pressure request
2613	Drive axle lube pressure
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2793	Laser strike data latency
2794	Absolute laser strike position
2795	VGT 1 actuator position
2796	Transfer case selector switch
2799	Turbocharger 2 compressor outlet temperature
2800	Turbocharger 3 compressor outlet temperature
2801	Turbocharger 4 compressor outlet temperature
2802	Data memory usage
2803	Keep-alive battery consumption
2804	FMS-standard diagnostics supported
2805	FMS-standard requests supported

FMI – Failure Mode Identifier Values

In order to make sense of the FMI failure indication you should be at least a technician and have the SAE J1939-73 [b] document available (It can be obtained from the SAE organization).

In its simplest form this can be used for instance as a indication of short circuit to ground. Below is an extraction of the codes from SAE J1939-73 [b], please refer there or to other general or vendor specific information for further details.

0. Data valid, but way above normal operational range.
1. Data valid, but way below normal operational range.
2. Data erratic, intermittent, or incorrect.
3. Above normal, or shorted to +.
4. Below normal, or shorted to -.
5. Current below normal, or circuit broken.
6. Current above normal, or short circuit to ground.
7. Mechanical system not responding, or out of adjustment.
8. Abnormal frequency, pulse width, or period.
9. Abnormal update rate.
10. Abnormal rate of change.
11. Root cause unknown.
12. Intelligent device or component out of order.
13. Out of calibration.
14. Special instructions.
15. Data valid, but a bit above normal operational range.
16. Data valid, but much above normal operational range.
17. Data valid, but a bit below normal operational range.
18. Data valid, but much below normal operational range.
19. Erroneous network data received (by engine brain).
31. Other problem.