

Anybus[®] X-gateway[™]

Application Note *Monitoring J1939 Diagnostic Trouble* *Codes*

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1. Overview

The J1939 protocol provides several standard ways to retrieve diagnostic and service information from an ECU. The X-gateway supports the 2 most commonly used diagnostic messages. This document explains what information is contained within these messages and how it can be monitored by a controller using the X-gateway.

2. J1939 Diagnostics Explained

This section provides background information for J1939 diagnostic messages. The use of the messages in the X-gateway and by a controller is covered in the succeeding sections.

2.1 *J1939 Diagnostic Message Types*

J1939 provides 19 different diagnostic messages that can be used to monitor, test, and clear diagnostic information in devices on the network. These messages are commonly referred to as DM messages. The X-gateway provides support for 2 diagnostic messages: DM1 and DM2.

The diagnostic message DM1 provides a list of the Active Diagnostic Trouble Codes. These are the DTC's that are currently active on the device.

The DM2 diagnostic message provides the list of Previously Active Diagnostic Trouble Codes. These are the DTC's which are not currently active, but have been active at some time in the past.

2.2 *Diagnostic Trouble Codes*

A Diagnostic Trouble Code, or DTC, is a collection of values that are used to specify an issue in the device. A DTC is not a single value, or code, but a set of information.

The following information is contained within a DTC.

Suspect Parameter Number	(SPN) The SPN identifies the J1939 data parameter that is the source of the issue. Each J1939 parameter is assigned an SPN. See the <i>J1939 Data Mapping Explained.pdf</i> document for details on J1939 parameter definitions.
Failure Mode Indicator	(FMI) The FMI value indicates the type of issue that has occurred. FMI values are defined in Appendix A of the <i>J1939-73</i> specification.
Occurrence Count	The number of times this DTC issue has occurred.
Conversion Method	Specifies how the SPN and FMI are to be handled or

translated. This is primarily used to handle older versions of the diagnostic protocols.

2.3 Contents of a DM1 Message

An Active DTC message contains the following parameters.

Protect Lamp Status	Lamp to indicate a problem with a vehicle system that is most likely not electronic subsystem related. e.g. Coolant Temperature has exceeded its defined range.
Amber Warning Lamp Status	Lamp to indicate a problem with the vehicle system but the vehicle does not need to be stopped immediately.
Red Stop Lamp Status	Lamp to indicate a problem that is severe enough to warrant stopping the vehicle.
Malfunction Indicator Lamp Status	Lamp to indicate when there is an emission related trouble code active.
DTC[0] DTC[1] ... DTC[n]	The DTC list contains 1 or more DTC's. Each entry in the list contains an SPN, FMI, Occurrence Count, and Conversion Method.

2.4 Contents of a DM2 Message

The Previously Active DTC message data is in the same format as described above for the DM1 message.

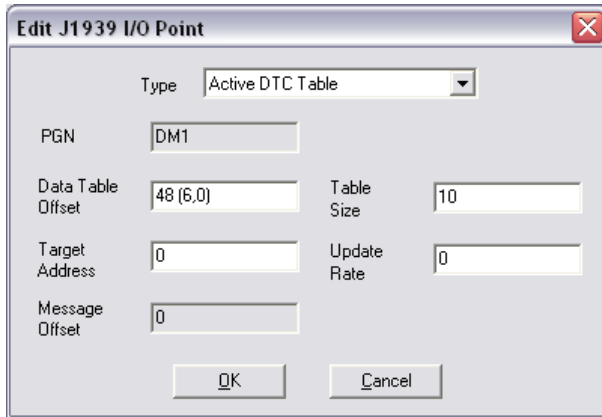
The lamp status values in the DM2 message indicate the current status of the lamps for the ECU. i.e. The lamp status values for the DM1 and DM2 message will be the same for a given point in time.

3. Configuring Diagnostic Tables in the X-gateway

The X-gateway provides a means to easily configure monitoring of the DM1 or DM2 messages. The DM1 and DM2 input data point type handles all data parsing transparently.

3.1 *Configuring a DM1 Message Data Point*

DM1 messages from a device can be monitored through the X-gateway by configuring an Active DTC Table input data point in the input I/O table.



The screenshot shows a dialog box titled "Edit J1939 I/O Point". It contains several input fields and a dropdown menu. The "Type" dropdown is set to "Active DTC Table". The "PGN" field is set to "DM1". The "Data Table Offset" field is set to "48 (6,0)". The "Table Size" field is set to "10". The "Target Address" field is set to "0". The "Update Rate" field is set to "0". The "Message Offset" field is set to "0". There are "OK" and "Cancel" buttons at the bottom.

An Active DTC Table data point is configured by selecting the Active DTC Table from the Type drop down list.

The PGN and Message Offset fields are automatically populated when the Active DTC Table type is selected.

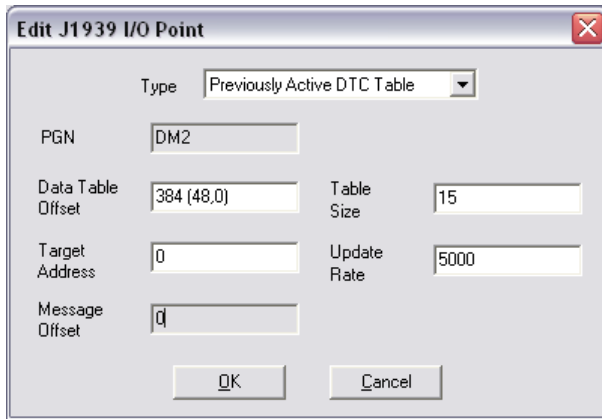
The Data Table Offset and Target Address fields are set in the same manner as in normal input data points. (See *J1939 Data Mapping Explained.pdf*)

The Table Size field should be set to the maximum number of DTC entries that will be stored by the X-gateway. The X-gateway will allocate this much space in the input data table for the DTC list. If the device sends more DTC's in the DM1 message, the list will be truncated when transferred to the input data table.

DM1 messages are automatically transmitted whenever there are active DTC's, or if there is a change in the active DTC list. Hence, there is no need to request the messages, so the Update Rate field should be set to 0.

3.2 Configuring a DM2 Message Data Point

DM2 messages from a device can be monitored through the X-gateway by configuring a Previously Active DTC Table input data point in the input I/O table.



The screenshot shows a dialog box titled "Edit J1939 I/O Point". It contains several input fields and a dropdown menu. The "Type" dropdown is set to "Previously Active DTC Table". The "PGN" field contains "DM2". The "Data Table Offset" field contains "384 (48,0)" and the "Table Size" field contains "15". The "Target Address" field contains "0" and the "Update Rate" field contains "5000". The "Message Offset" field contains "0". At the bottom, there are "OK" and "Cancel" buttons.

A Previously Active DTC Table data point is configured by selecting the Previously Active DTC Table from the Type drop down list.

The PGN and Message Offset fields are automatically populated when the Previously Active DTC Table type is selected.

The Data Table Offset and Target Address fields are set in the same manner as in normal input data points. (See *J1939 Data Mapping Explained.pdf*)

The Table Size field should be set to the maximum number of DTC entries that will be stored by the X-gateway. The X-gateway will allocate this much space in the input data table for the DTC list. If the device sends more DTC's in the DM2 message, the list will be truncated when transferred to the input data table.

DM2 messages are transmitted only on request. In order to receive DM2 messages from the device the Update Rate field must be non-zero. Since DM2 message may be fairly large it is recommended to set the Update Rate field to at least several seconds (several thousand milliseconds).

4. Monitoring Diagnostic Tables

Once Active or Previously Active DTC Tables have been configured in the X-gateway input table, the DTC information is available to the controller to read.

4.1 *DTC Table Format in the Input Table*

Both the Active and Previously Active DTC tables have the same format within the input table. The format consists of a 16-bit table header followed by the 16-bit DTC entries.

4.1.1 DTC Table Header

The DTC Table header is located at the front of the location allocated for the DTC Table in the input table. The 16-bit header consists of the following fields.

Bit Location	Size	Description	Data Range
0	2 bits	Protect Lamp Status	00 – Off 01 – On
2	2 bits	Amber Warning Lamp Status	00 – Off 01 – On
4	2 bits	Red Stop Lamp Status	00 – Off 01 – On
6	2 bits	Malfunction Lamp Status	00 – Off 01 – On
8	6 bits	Entry Count The number of DTC entries in the table.	0 – <i>TableSize</i>
15	1 bit	Overflow Indicator	0 – DM1 message entries fit in DTC table 1 – DM1 message had more than <i>TableSize</i> entries.

4.1.2 DTC Table Entries

The DTC list in the DTC table consists of an array of 32-bit DTC entries that are each in the following format.

Bit Location	Size	Description
0	3 bits	SPN bits 16-18
3	5 bits	FMI
8	8 bits	Occurrence Count
16	16 bits	SPN bits 0-15

4.2 Example DTC Monitoring

Based on the example configuration for the Active and Previously Active DTC Tables shown in the *Configuring Diagnostic Tables in the X-gateway* section above the DTC data will be at the following data table offsets and registers for a controller.

Based on the Data point configuration, the Active DTC Table had a data table offset of 6 bytes, and the Previously Active DTC Table had an offset of 48 bytes.

Note that some X-gateway's insert status data at the front of the table offsetting the data.

AB7665 Data Table Offset (bytes)	AB7615 Data Table Offset (bytes)	AB7665 Modbus Register	AB7612 Modbus Register	Data Description
10	6	30006	30004	Active DTC Table Header
12	8	30007	30005	Active DTC Entry 1
16	12	30009	30007	Active DTC Entry 2
20	16	30011	30009	Active DTC Entry 3
24	20	30013	30011	Active DTC Entry 4
28	24	30015	30013	Active DTC Entry 5
32	28	30017	30015	Active DTC Entry 6
36	32	30019	30017	Active DTC Entry 7
40	36	30021	30019	Active DTC Entry 8
44	40	30023	30021	Active DTC Entry 9
48	44	30025	30023	Active DTC Entry 10
52	48	30027	30025	Previously Active DTC Table Header
54	50	30028	30026	Previously Active DTC Entry 1
58	54	30030	30028	Previously Active DTC Entry 2
62	58	30032	30030	Previously Active DTC Entry 3
66	62	30034	30032	Previously Active DTC Entry 4
70	66	30036	30034	Previously Active DTC Entry 5
74	70	30038	30036	Previously Active DTC Entry 6
78	74	30040	30038	Previously Active DTC Entry 7
82	78	30042	30040	Previously Active DTC Entry 8
86	82	30044	30042	Previously Active DTC Entry 9
90	86	30046	30044	Previously Active DTC Entry 10
94	90	30048	30046	Previously Active DTC Entry 11
98	94	30050	30048	Previously Active DTC Entry 12
102	98	30052	30050	Previously Active DTC Entry 13
106	102	30054	30052	Previously Active DTC Entry 14
110	106	30056	30054	Previously Active DTC Entry 15

5. Support

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