Anybus X-gateway
PROFIBUS to J1939 Gateway
User Manual

Part No**. AB7615**
For Firmware Revision **1.07.01** and Later
Manual Revision 2.00
Doc.Id. HMSI-168-26

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Preface

Important User Information

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There are many applications of the Anybus X-gateway module. Those responsible for the use of this device must satisfy themselves that all necessary steps have been taken to verify an application meets all performance and safety requirements including any applicable laws, regulations, codes, and standards.

The illustrations and samples in this guide are intended solely for the purpose of example. HMS Industrial Networks does not assume responsibility or liability for actual use based upon the examples shown in this publication.

	FAIL-SAFE OR CRITICAL OPERATIONS
	This product is not designed, intended, authorized, or warranted to be suitable for use or resale as control equipment in, or for other applications related to, hazardous or potentially-hazardous environments or applications requiring high-availability or fail-safe performance, such as in the operation of nuclear facilities, aircraft navigation or communications systems, air traffic control, life support, public works, weapons systems, or any other application in which the failure of a product could lead to property damage, death, personal injury, or environmental damage.

Related Documentation

Document Name	Author	Web Page
PROFIBUS-DP Specification	PROFIBUS International	www.profibus.com
J1939 Recommended Practice	SAE	www.sae.org

Table 1-1 Related Documentation

PROFIBUS is a trademark of PROFIBUS International.

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Anybus X-gateway Module Description

Overview

The Anybus PROFIBUS to J1939 X-gateway allows you to monitor and control data on a J1939 heavy duty vehicle network from a PROFIBUS-DP device. Data from J1939 messages are mapped to I/O table locations, making them accessible to the PROFIBUS network. The X-gateway acts as a PROFIBUS-DP slave, allowing J1939 data to be exchanged with a PROFIBUS-DP master device using I/O messaging.

Examples of applications of the PROFIBUS to J1939 Gateway:

- An interface used on a diesel generator package to access engine parameters from a Programmable Logic Controller (PLC).

- An on-vehicle gateway used to interface the J1939 vehicle network to an on board industrial automation based control system.

Theory of Operation

The X-gateway provides centralized data storage, the "PassageWay™", for data that is shared between the J1939 and PROFIBUS networks. Data is placed into the PassageWay by one network interface, allowing the data to be read through the other network interface.
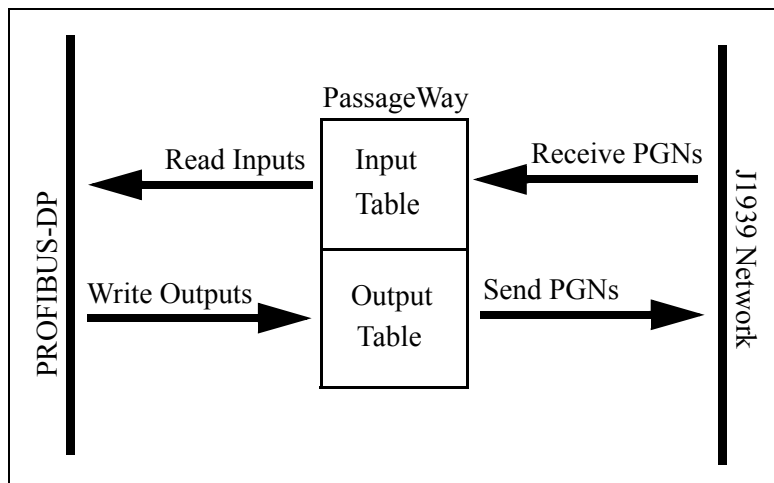
Figure 1-1 Anybus X-gateway PassageWay Operation

The X-gateway appears as a single device on either network using standard protocol mechanisms. No special, or extended, protocol features are required of the devices on either network to read and write the data flowing through the Passage-Way; all cross-network activity is transparent to the devices on either network.

J1939 Features

- Transmission and reception of all types of fixed-length J1939 messages, including PDU1, PDU2, broadcast and destination specific.

- Monitoring of DM1 (active diagnostics) and DM2 (previously active diagnostics) messages.

- Complete network address management including address claim, protection, and yield on higher priority conflict.

- Network address can be self-configurable over a range of addresses.

- J1939 Transport Protocol for transmission and reception of large messages (9 - 1785 bytes). Both connection based (RTS/CTS) and broadcast (BAM) are supported.

- Configurable CAN bus-off reset option will reset the network interface and attempt to return to online when a CAN bus-off condition is detected.

PROFIBUS Features

- PROFIBUS-DP slave.

- Cyclic I/O data transmission.

- Device diagnostic message transmission.

- Baud rates ranging from 9.6 Kbps to 12 Mbps.

System Requirements

The following hardware and software components are needed to use the Anybus PROFIBUS to J1939 X-gateway.

Required Hardware
- X-gateway module.

- J1939 network connection.

- PROFIBUS-DP network connection

- PROFIBUS-DP master device.

- 24 VDC power connection

- PC with an RS-232 communications port or USB serial adapter to execute Anybus X-gateway Configuration Tool (BWConfig).

- RS-232 null-modem cable to connect PC running BWConfig to the X-gateway.

Optional Hardware
- DIN rail to mount the X-gateway.

Required Software
- Anybus X-gateway Configuration Tool software (BWConfig) to configure the X-gateway. BWConfig requires that the PC be running Microsoft Windows 98, NT, 2000, or XP.

Hardware Description

All connections, whether power or fieldbus, to the X-gateway are made on one end of the module. Phoenix-style connectors are provided for power and J1939 connections. A 9-pin D-Subminiature connector is provided for PROFIBUS connection. There is a 9-pin D-Subminiature connector for the auxiliary RS-232 port that is used for device configuration. See "Connectors" Page 9-1 for more details on the connectors.

Also on the end of the X-gateway are switches that set the PROFIBUS network configuration. 2 Rotary switches are used to set the network address. A single DIP switch allows internal network termination to be enabled and disabled. See "Anybus X-gateway Configuration Tool (BWConfig)" Page 3-1 for details on configuring the PROFIBUS network interface.

On the front of the X-gateway module are 5 LEDs that are used for status indication. These LEDs provide visual status for the overall module, the J1939 interface, and the PROFIBUS interface. See "X-gateway LEDs" Page 7-1 for details on how the LEDs are used.

The back of the module has a DIN rail mount to allow the module to be mounted on a DIN rail.

Installation

Installation and Operation Requirements

- Power, input and output (I/O) wiring must be in accordance with Class 1, Division 2 wiring methods - article 501-4(b) of the National Electric Code, NFPA 70 and in accordance with local codes.

- **Warning - Explosion Hazard** - Substitution of components may impair suitability for Class 1, Division 2.

- **Warning - Explosion Hazard** - When in hazardous locations turn off power before replacing or wiring modules.

- **Warning - Explosion Hazard** - Do not disconnect equipment unless power has been switched off or the area is known to be nonhazardous.

- Terminal tightening torque must be between 5-7 lbs-in (0.5-0.8 Nm).

- For use in Class 2 circuits only.

- Suitable for surrounding temperature of 65 degrees C maximum.

- Use 60/75 C copper wire only.

Power and Network Connections

The power and network connections to the X-gateway are made on the end of the module. The figure below indicates the location of each connector.
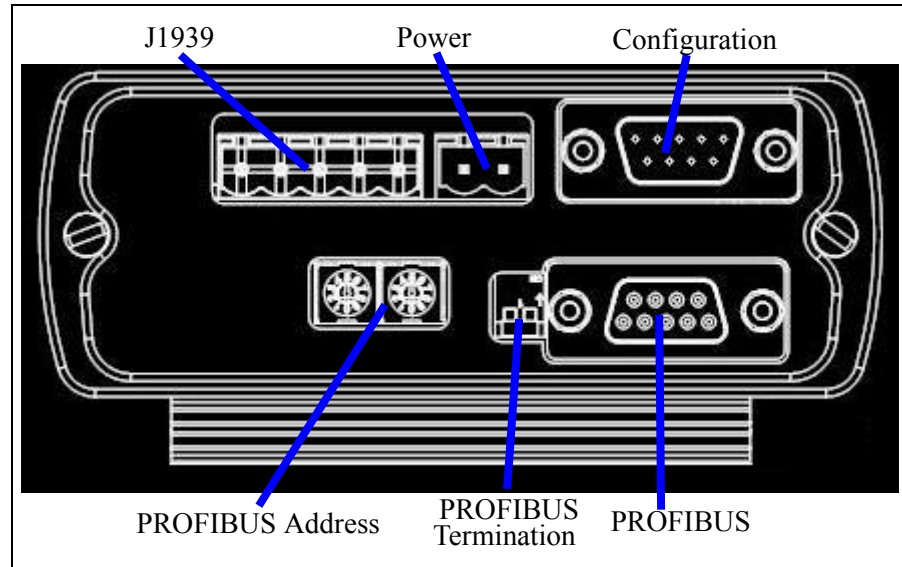
Figure 2-1 X-gateway Power and Network Connections

The PROFIBUS address is set with two switches:

10x(setting of right switch) + 1x(setting of left switch)

Connecting Power

The power connection is a 2-pin terminal block located on the end of the module. The female terminal block connector is provided with the X-gateway. Connections to be made are illustrated below.

24VDC Common

24 VDC +
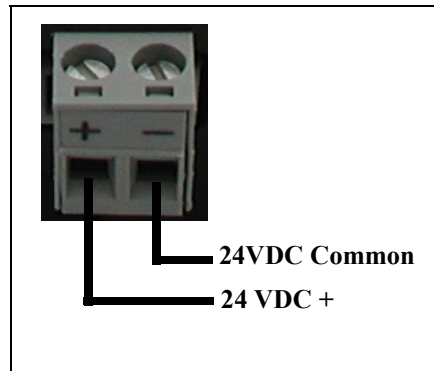
Figure 2-2 Power Connection

The X-gateway requires 24 volts DC power. The module will start immediately when power is applied (There is no On/Off switch on the module).

Connecting J1939

The J1939 network connection is a 5-pin terminal block located next to the power connection on the end of the module. The female terminal block connector is provided with the X-gateway. Connections to be made are illustrated below.

24VDC +
J1939 CAN High
J1939 CAN Shield
J1939 CAN Low
24VDC Common
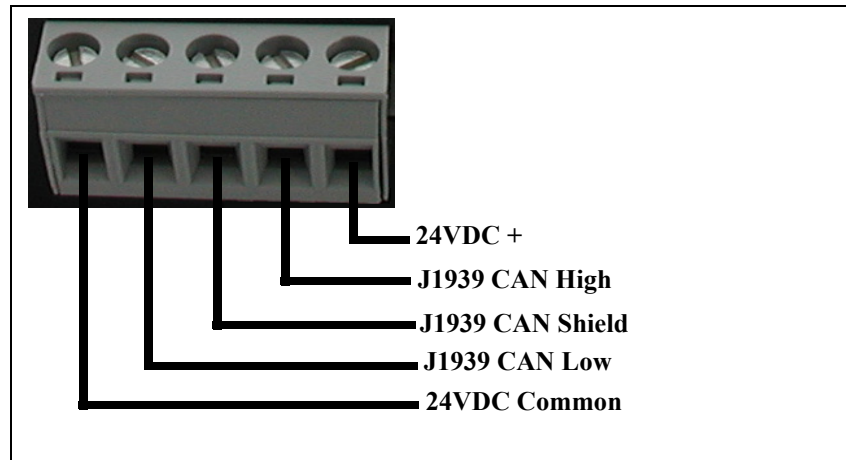
Figure 2-3 J1939 Connection

The CAN High and Low signal lines should be connected to the CAN High and Low connections respectively on all devices on the network. The signal lines should not be swapped on any device connections.

Note: The 24VDC terminals on pins 1 and 5 are physically connected to the power on the 2-pin power connector. The module may alternatively be powered from these pins.

Connecting to PROFIBUS

The PROFIBUS network connection is a 9-pin D-Subminiature female connector located on the end of the module next to the PROFIBUS termination switch. Connections to be made are as shown below.

Pin	Connection
3	B-Line
4	RTS
5	GND Bus
6	+5 V Bus
8	A-Line

The +5V Bus and GND Bus connections are used for bus termination. Some devices like optical transceivers (RS-485 to fiber optics) might require external power from these pins.

The RTS connection is used in some equipment to determine the direction of transmission.

In typical applications only the A-Line, B-Line and Shield connections are used.

For information on setting the PROFIBUS network configuration (address, baud rate, etc.), see "Anybus X-gateway Configuration Tool (BWConfig)" on page 3-1.

Configuration Port Connector

The configuration port is the 9-pin D-Subminiature female connector on the end of the X-gateway. The connector has a standard RS-232 DTE pin configuration. The connections to be made as shown below.

Pin	Connection
2	Receive Data
3	Transmit Data
5	Signal Ground

The X-gateway is connected to a PC for configuration using a null-modem cable and a 9 pole dsub gender-shifter (male-male). A null-modem cable has pins 2 and 3 swapped so that the PC's Transmit line is connected to the X-gateway's Receive line, and the PC's Receive line is connected to the X-gateway's Transmit line.

Note: The X-gateway does not make use of the modem control signals specified for a DTE connector. Connecting the module through devices, such as isolation modules, which assume control of these lines may cause the BWConfig communications to be unreliable.

Configuration

This chapter describes how the Anybus PROFIBUS to J1939 X-gateway is configured using the Anybus X-gateway Configuration Tool (BWConfig). Detailed descriptions of each configurable parameter in the gateway are provided as well as how they are set in the tool.

Anybus X-gateway Configuration Tool (BWConfig)

The Anybus X-gateway Configuration Tool allows you to configure the parameters associated with the J1939 network interface as well as to set up the contents and layout of the I/O table.

BWConfig is a Microsoft Windows application that communicates with a X-gateway over a standard RS-232 serial link using the PC serial port or USB serial adapter. BWConfig is compatible with Microsoft Windows 98, NT, 2000, and XP.

Installing the Tool

Install BWConfig from the CD by running *Setup.exe* which is found in the CD's root directory.

If you have downloaded BWConfig from the web site, unzip the downloaded file into a temporary directory and run *Setup.exe* which is found in the temporary directory.

Connecting to the X-gateway Module

Connect the PC running BWConfig to the X-gateway module using a standard Null-Modem (pins 2 and 3 swapped) serial cable between the PC serial port or USB adapter and the 9-pin D-Sub connector on the module. It does not matter which PC serial port you use, BWConfig will scan each available port and detect the connection automatically. No serial port configuration is required; BWConfig will automatically set the baud rate.

Starting the Tool

Launch BWConfig from the *Anybus Configuration* folder in the Windows Start Menu.

When BWConfig is started, it will attempt to locate a X-gateway module on one of the PC serial ports. If a module is found, the status area of the tool will be updated to show the module type and status of the module that was located.

If a module is not connected to the PC, or is powered off, when the tool is started, the status area will indicate that no module was detected. Make sure that the module is powered and the connection is made, then press the Refresh button on the BWConfig tool bar; this will cause the tool to rescan the serial ports for a module.

BWConfig User Interface

The Anybus X-gateway Configuration Tool's user interface is shown below.
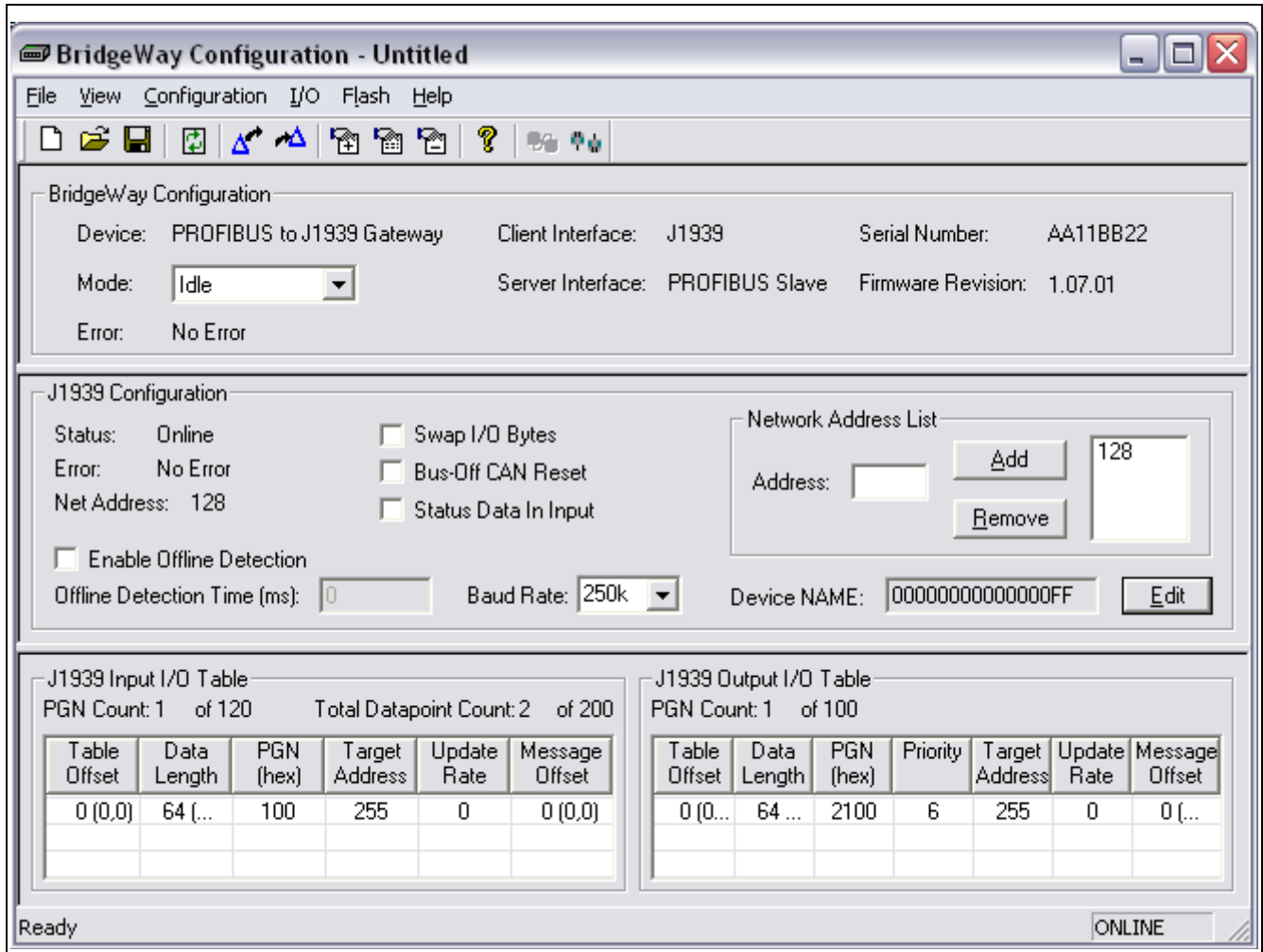
Figure 3-1 BWConfig User Interface

<u>Display Panes</u>

The BWConfig display is divided into 3 panes.

Anybus X-gateway Configuration	Module type and status information about the X-gateway module that was detected.
J1939 Configuration	Configuration of J1939 network parameters and status of the network interface.
J1939 I/O Configuration	Configuration of the content and layout of the I/O tables.

<u>Tool Operations</u>

The following operations are available through the BWConfig menus and tool bar.

New File	Create a new X-gateway configuration for the selected type of module.
Open File	Open a previously saved X-gateway configuration.
Save File	Save the current X-gateway configuration to a file.
Refresh Device Status	Refresh the module identity and status information. This will update the current status information shown by the tool. This can also be used to start the detection process if a module has not been detected by the tool, or the connection has been changed to a different module.
Upload Configuration	Read the configuration that is currently stored in the X-gateway module. This will overwrite any configuration that is displayed on the tool's user interface.
Download Configuration	Send the configuration shown on the tool's user interface to the X-gateway module.

Offline Configuration	Offline configuration will allow a configuration to be created and saved without being connected to a module.
Add I/O Point	Add a new input or output data point to the J1939 I/O configuration.
Edit I/O Point	Change the parameters associated with the selected input or output data point in the J1939 I/O configuration.
Remove I/O Point	Delete the selected input or output data point from the J1939 I/O configuration.
Flash Update	Perform a field upgrade of the X-gateway module's firmware. **Note:** Care should be taken when upgrading firmware, an incomplete update could cause irreparable harm to the module.

J1939 Network Configuration

The J1939 network configuration contains the parameters used by the X-gateway for J1939 address management and other network interface options. The parameters are described below. Refer to Figure 3-1 to see how each parameter is displayed on the user interface.

Parameter	Description	Allowable Range
Device NAME	The J1939 NAME to be used by the module in address claim messages. Each J1939 module should have a unique NAME. See the section "Setting the J1939 NAME" below for details on how the NAME is configured.	See the J1939-81 specification.
Network Address List	The list of addresses that the module is able to use on the J1939 network. The module will only claim a single address at a time. This is the list of possible addresses that it can use if it is unable to claim the first address. See "Address Management" on page 5-1 for details on how the address list is used.	Each address must be in the range 0-253. Up to 10 addresses may be in the list.
Enable Bus-Off CAN Reset	If this option is enabled, the module will reset the CAN controller and attempt to go back online after a bus-off condition is detected. If the option is disabled, the module will remain offline after a bus-off condition until it is power cycled. **For most applications, this option should be left disabled.**	Enabled or Disabled
Swap I/O Bytes	Enable or disable I/O data byte swapping. This option will swap bytes in the I/O tables on 16-bit boundaries. This is helpful when using PROFIBUS, which expects data to be stored in reverse byte orientation from J1939.	Enabled or Disabled

Table 3-1 J1939 Network Configuration Parameters

Parameter	Description	Allowable Range
Status Data in Input	Enable or disable the inclusion of status data in the Input table. This option will allow the user to configure the module to add J1939 status data to the front of the input table. This option provides the same data that is used in the PROFIBUS Diagnostic data, but that is readable directly in the input data. If this option is enabled, the usable J1939 device input data is reduced by 12 bytes to make room fo rthe status data. See "Input Table Organization" on page 6-4 for details on the input and status data.	Enabled or Disabled
Offline Detection Time	Enabling the Offline Detection will allow the module to detect when it is not connected to the J1939 network when there is no Output PGN's configured. See "Offline Detection" on page 5-14 for a complete discussion.	1000ms to 60000ms when Enabled
Baud Rate	The J1939 baud rate may be set to either 250K or 500K baud. ⚠️**Important:** The standard J1939 baud rate is 250K. Do not set the baud rate to a rate other then 250K unless you know for certain that the devices on the J1939 are communicating at the other baud rate.	250K 500K

Table 3-1 J1939 Network Configuration Parameters

Setting the J1939 NAME

The J1939 Device NAME dialog is shown below.

Figure 3-2 J1939 Device NAME Dialog

The NAME is a 64-bit value that must be unique for every module on a given J1939 network. The meaning and format of the data contained in the NAME value is defined in the J1939-81 specification.

The NAME value can be set 2 ways using the J1939 Device NAME dialog: directly or by component. To set the NAME value directly, simply type the desired value of each of the 8 bytes in hexadecimal using the top fields of the dialog. Each component of the NAME value is broken out and displayed in the lower fields of the dialog; components can be edited individually using these fields. Pressing the Apply button will update either set of fields to reflect the changes that were made.

Note: The J1939 interface is configured during X-gateway initialization. If the network configuration is changed, the module must be power cycled before the changes will take effect.

J1939 I/O Configuration

The J1939 I/O configuration is used to define the content and format of the I/O table. Data from J1939 messages that are to be monitored or transmitted is mapped to locations within the J1939 device input or output tables respectively.

Inputs Versus Outputs

The J1939 device input table holds data that is collected from the J1939 network and can be read on the PROFIBUS network. Input data points are associated with data from messages that are received on the J1939 network.

The J1939 device output table holds data that is written by a device on the PROFIBUS network to be transmitted on the J1939 network. Output data points are associated with data of messages that will be transmitted on the J1939 network.

I/O Configuration Limits

The I/O configuration is limited as follows:

- 244 bytes maximum in the J1939 device input table if the Status In Input option is disabled.
- 232 bytes maximum in the J1939 device input table if the Status in Input option is enabled
- 240 bytes maximum in the J1939 device output table
- 400 bytes total combined Input and Output table size including any status data and command registers.
- 200 total data points in the configuration. This is the combined number of input and output data points.
- Up to 120 different PGN's may be monitored by input data points
- Up to 100 different PGN's may be transmitted by output data points

Data Point Parameters

Each data point defines a single piece of data in the either the J1939 device input or output table. The data point parameters are organized in columns in the J1939 I/O configuration editor, shown below. Note that both Input and Output data points have the same parameters with the exception of the message priority; only the output data points have configurable message priority.

J1939 Output I/O Table

Table Offset	Data Length	PGN	Priority	Target Address	Update Rate	Message Offset
0 (0,0)	16 (2,0)	65281	6	10	100	0 (0,0)
16 (2,0)	16 (2,0)	65282	3	255	50	0 (0,0)
32 (4,0)	16 (2,0)	65283	7	255	75	0 (0,0)

Figure 3-3 J1939 Data Point Configuration

The data point editing dialog is shown below. This dialog is used to enter new, or edit existing data points in the I/O configuration Note that the output editor is shown; the input editor does not have the message priority parameter.

Edit J1939 I/O Point

Type	Output
PGN	65282
Priority	6
Data Table Offset	48 (6,0)
Data Length	24 (3,0)
Target Address	255
Update Rate	100
Message Offset	0 (0,0)

Figure 3-4 J1939 Data Point Editing Dialog

The parameters associated with I/O data points are described below.

Parameter	Description	Allowable Range
Table Offset	The offset into the J1939 device I/O table. If this is an input data point, the offset is into the input table; if this is an output data point, the offset is into the output table. The offset is in bits. It is displayed as both bits and the corresponding byte and bit, shown as (byte, bit). When entering this value in the editor: A single value will be interpreted as bits. 2 values separated by a comma or a period will be interpreted as a byte, bit combination. i.e. '16' and '2,0' are equivalent entries.	Input: 0-3999 bits 0-499 bytes Output: 0-3967 bits 0-495 bytes
Data Length	The amount of the data to be transferred between the I/O table and the J1939 message data. The length is in bits. It is displayed as both bits and the corresponding byte and bit, shown as (byte, bit). When entering this value in the editor: A single value will be interpreted as bits. 2 values separated by a comma or a period will be interpreted as a byte, bit combination. i.e. '16' and '2,0' are equivalent entries.	1-14280 bits 0-1785 bytes
PGN	The J1939 PGN associated with this data point. If this is an input data point, the message data from messages received with this PGN will be transferred into the Input table. If this is an output data point, a message with this PGN will be built and transmitted using data from the Output table.	Any valid J1939 PGN

Table 3-2 J1939 I/O Data Point Parameters

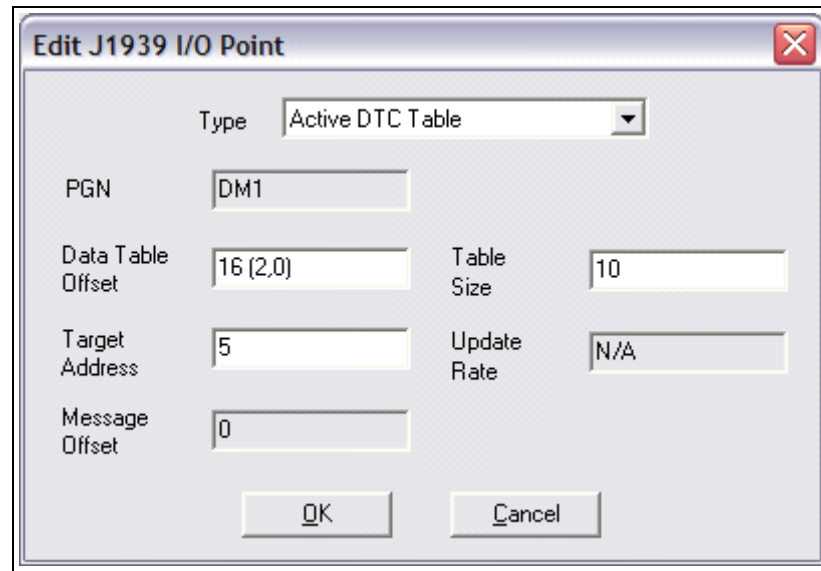| Parameter	Description	Allowable Range
Priority	The J1939 message priority to be used when transmitting this message. If this is an output data point, this is the message priority that will be used when the message is produced on the J1939 network. If this is an input data point, this value is ignored. J1939 messages are screened by PGN and target address; the message priority is ignored. The default priority is 6.	0-7
Target Address	The J1939 network address associated with the data point. If this is an input data point, messages received must match both the PGN and source address to be used for this data point. If the Target Address is 255, any message with a matching PGN, regardless of source address will be accepted. If this is an output data point, the destination address of the transmitted message will be set to the Target Address. The message will be broadcast if the Target Address is set to 255.	0-253, 255

Table 3-2 J1939 I/O Data Point Parameters (Continued)

Parameter	Description	Allowable Range
Update Rate	The desired update rate for the data point in milliseconds. If this is in input data point, the data point is expected to be updated (a message received with matching PGN and address) within the configured Update Rate. If no update is received within the configured time, the module will request the data point's PGN by transmitting a Request PGN to the Target Address. If the Update Rate is set to 0, the PGN will never be requested. If the Update Rate is non-zero for an input point, and no update is received after an update period, the data associated with the PGN in the input table is set to 0xFF. If this is an output data point, this is the rate at which the associated message will be transmitted on the network. If the Update Rate is set to 0, the message will only be transmitted when a Request PGN is received for the configured PGN.	0-65535
Message Offset	The offset into the message data where the data associated with the data point begins. This is the location where data will be transferred in and out of the message buffer. The offset is in bits. It is displayed as both bits and the corresponding byte and bit, shown as (byte, bit). When entering this value in the editor: A single value will be interpreted as bits. 2 values separated by a comma or a period will be interpreted as a byte, bit combination. i.e. '16' and '2,0' are equivalent entries.	0-14279 bits 0-1784 bytes

Table 3-2 J1939 I/O Data Point Parameters (Continued)

J1939 Diagnostic Tables

The X-gateway has the ability to monitor the commonly used diagnostic messages on J1939. The Active Diagnostics (DM1) and Previously Active Diagnostics (DM2) can be monitored by the X-gateway. Configuring diagnostic table monitoring is done through the input data points in much the same manner as data PGN configuration. The figure below shows the data point editor dialog when a diagnostic type is selected.

Figure 3-5 J1939 Data Point Editing Dialog for Diagnostics

The table below explains how the data point parameters are used when configuring a diagnostic table.

Parameter	Description	Allowable Range
Data Point Type	Set to Active DTC or Previously Active DTC to configure a diagnostic table.	Active DTC, Previously Active DTC
Table Offset	See Table 3-2.	
Table Size	The number of diagnostic entries this table can hold. This will be the maximum amount of diagnostics that can be placed into the table. If the J1939 diagnostic message from the device contains more diagnostics than fit in the table, only those that fit will be copied, and the high bit in the table header will be set to indicate that the table has overflowed. The table size is limited to 128 entries. Note that the total space occupied in the J1939 device input table will be (size * 4) + 2 bytes.	1-128
PGN	This will automatically be set to DM1 or DM2	DM1, DM2
Target Address	The J1939 address of the device from which this table is to monitor diagnostics.	0-253
Update Rate	See Table 3-2.	
Message Offset	This will automatically be set to 0	0

Table 3-3 Input Data Point Parameters for Diagnostic Tables

Note: See "J1939 Diagnostic Messages" on page 5-9 for details of the format of the diagnostic tables in the J1939 device input data table.

Note: The J1939 I/O configuration is initialized at X-gateway bootup and whenever a new configuration is downloaded to the module from BWConfig. Any changes made to the I/O configuration will take place immediately after the configuration is downloaded to the module.

PROFIBUS Network Configuration

PROFIBUS Network Address

The PROFIBUS network address is set using two rotary switches on the end of the X-gateway. Each switch sets a digit of the address from 1 to 9, allowing for a range of network addresses from 1 to 99.

The rotary switch nearest the 9-pin D-Sub PROFIBUS network connector sets the 10's digit. The other switch sets the 1's digit

Hint: If you look at the end of the X-gateway with the 9-pin D-Sub PROFIBUS network connector on your left, the node address is easier to read.

PROFIBUS Baud Rate

The PROFIBUS baud rate is set during the configuration of the PROFIBUS Master. The X-gateway has automatic baud rate detection so no configuration of the X-gateway itself is required.

9.6 Kbps	1.5 Mbps
19.2 Kbps	3 Mbps
93.75 Kbps	6 Mbps
187.5 Kbps	12 Mbps
500 Kbps	

Table 3-4 Supported PROFIBUS Baud Rates

PROFIBUS Network Termination

The end nodes on a PROFIBUS-DP network must be terminated to avoid reflections on the bus line. The X-gateway is equipped with a termination switch to enable termination for the node if it is required.

ON Position	Network termination enabled. If the module is the last or first module in the network, the bus termination should be set to ON, or an external connector used.
OFF Position	Network termination disabled.

Table 3-5 PROFIBUS Termination Switch Function

Note: If an external termination connector is used, the termination switch must be in the OFF position.

PROFIBUS Master Configuration

GSD File

Each device on a PROFIBUS-DP network has an associated GSD file containing all necessary information about the device. This file is used by the network configuration program during configuration of the network and PROFIBUS master.

The latest version of the GSD file for the Anybus X-gateway can be downloaded from HMS Industrial Networks' web site, or received by contacting HMS Industrial Networks.

Modular Interface

The X-gateway provide a modular interface to the PROFIBUS master. The I/O size and layout is defined in the PROFIBUS master configuration by combining I/O modules defined in the GSD file.

The size of the I/O tables configured using the modules in the PROFIBUS master configuration must exactly match the I/O sizes defined in the J1939 I/O configuration defined in BWConfig plus the status data, if enabled, and the command register. The actual modules used to make up the I/O tables is not as critical as the requirement that the total input and output sizes agree with the X-gateway's configuration.

The GSD file module collection includes several special purpose modules and a collection of general purpose modules. The modules that are provided are listed in the table below.

Module	Description	Data Size
Status/Cmd Registers	Combines the J1939 Status Data in the Input and the Command Register in the Output.	6 words in 2 words out
Status Registers	J1939 Status Data in the Input	6 words in
Command Register	Command Register in the Output	2 words out
IN/OUT: 1 Byte	Single byte in both Input and Output	1 byte in 1 byte out
IN/OUT: 1 Word	Single 16-bit word in both Input and Output	1 word in 1 word out
IN/OUT: 2 Words	2 16-bit words in both Input and Output	2 words in 2 words out
IN/OUT: 4 Words	4 16-bit words in both Input and Output	4 words in 4 words out
IN/OUT: 8 Words	8 16-bit words in both Input and Output	8 words in 8 words out
IN/OUT: 16 Words	16 16-bit words in both Input and Output	16 words in 16 words out
IN/OUT: 32 Words	32 16-bit words in both Input and Output	32 words in 32 words out
IN/OUT: 64 Words	64 16-bit words in both Input and Output	64 words in 64 words out
INPUT: 1 Byte	Single byte in Input	1 byte in
INPUT: 1 Word	Single 16-bit word in Input	1 word in
INPUT: 2 Words	2 16-bit words in Input	2 words in
INPUT: 4 Words	4 16-bit words in Input	4 words in
INPUT: 8 Words	8 16-bit words in Input	8 words in
INPUT: 16 Words	16 16-bit words in Input	16 words in
INPUT: 32 Words	32 16-bit words in Input	32 words in
INPUT: 64 Words	64 16-bit words in Input	64 words in

Module	Description	Data Size
OUTPUT: 1 Byte	Single byte in Output	1 byte out
OUTPUT: 1 Word	Single 16-bit word in Output	1 word out
OUTPUT: 2 Words	2 16-bit words in Output	2 words out
OUTPUT: 4 Words	4 16-bit words in Output	4 words out
OUTPUT: 8 Words	8 16-bit words in Output	8 words out
OUTPUT: 16 Words	16 16-bit words in Output	16 words out
OUTPUT: 32 Words	32 16-bit words in Output	32 words out
OUTPUT: 64 Words	64 16-bit words in Output	64 words out

Module combinations in the PROFIBUS master configuration are limited to a maximum of 24 modules.

Example Application

A system controller (PLC) on PROFIBUS requires some data that is collected by an ECU on J1939. There is also a piece of data that is determined by the system controller that would be beneficial for some of the ECUs that are on the J1939 network. Additionally, the active diagnostics for an ECU will be monitored by the controller.
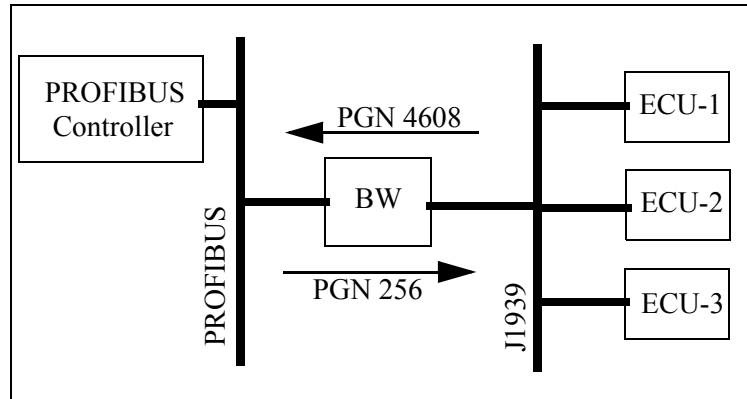
Figure 4-1 Example Application Network Diagram

The data required by the system controller is contained in the PGN 4608 message as 2 12-bit values. The values are packed into the first 3 bytes of the message as shown below.

Bit Byte	7	6	5	4	3	2	1	0
0	Value #1 bits 0-7							
1	Value #2 bits 0-3				Value #1 bits 8-11			
3	Value #2 bits 4-11							

Figure 4-2 Example PGN 4608 Message Data Format

Data from the system controller is to be produced using PGN 256. The data is a 16-bit value and will be placed into the first 2 bytes of the message data.

J1939 Network Configuration

The J1939 network configuration dialog from BWConfig is shown below. Refer to "Anybus X-gateway Configuration Tool (BWConfig)" on page 3-1 for more details on BWConfig.

Figure 4-3 Example J1939 Network Configuration

The J1939 device NAME has been set to an arbitrary value for the purpose of this example. The NAME should be set according to the vendor and application where the module is being used based on the J1939 specification. The network address list is set to a single address of 128.

Since this application is using PROFIBUS, I/O byte swapping has been enabled.

The Status Data In Input option has been enabled to provide J1939 status directly in the input table rather than relying on the controller's ability to read PROFIBUS diagnostic data.

J1939 I/O Configuration

Input Data Points

The input data points are responsible for determining where in the J1939 device input table the J1939 data is to be placed. It is desirable to be able to address the 2 values in our example as individual words at the PROFIBUS master. Since the values are packed into 3 bytes in the J1939 message, they need to be parsed out into 2 16-bit words in the input table

This application will store up to 20 diagnostic entries in the diagnostic table for the ECM at address 2. The diagnostic table will be requested from the ECM every 5 seconds.

The resulting J1939 input configuration from BWConfig is shown below.

Table Offset	Data Length	PGN	Target Address	Update Rate	Message Offset
0 (0,0)	12 (1,4)	17928	255	0	0 (0,0)
16 (2,0)	12 (1,4)	17928	255	0	0 (0,0)
32 (4,0)	656 (82,0)	DM1	2	5000	0 (0,0)

Figure 4-4 Example J1939 Input Configuration

2 data points have been defined for the incoming data from PGN 4608, 1 for each value in the message. The first data point copies the first value (12 bits starting at the beginning of the message) into the first word of the J1939 device input table. The second data point copies the second value (12 bits starting 12 bits into the message) into the second word of the input table.

Both data points monitor the network for messages with PGN 4608 and any source address (Target Address 255 specifies the "don't care" source address).

The actual locations of the 2 values in the PROFIBUS master's input table, taking account for the 6 words of J1939 status data, are words 6 and 7. (word 0 is the first word of the table)

The data point for the DM1 message was configured as shown below.

Figure 4-5 Example J1939 Diagnostic Data Point Configuration

The table length has been set to 20 entries. The target address specifies that the diagnostics of the ECM at address 2 are to be monitored by this data point. The diagnostic table will start at byte 4 of the J1939 device input data. After inserting the 6 words of status data at the front of the input table, the diagnostic data will start at word 8 in the PROFIBUS master's output data.

The update rate has been set to 5 seconds (5000ms). This will cause the X-gateway to send a request for the data to the ECM if the data has not been received within 5 seconds.

Output Data Points

The output data points determine what PGNs are going to be produced by the X-gateway on J1939, and what the content of those PGN messages is going to be.

Since the example application only needs to produce 16 bits of data in a single PGN message, the resulting configuration is quite simple. It is shown below.

Table Offset	Data Length	PGN	Priority	Target Address	Update Rate	Message Offset
0 (0,0)	16 (2,0)	256	6	255	100	0 (0,0)

J1939 Output I/O Table

Figure 4-6 Example J1939 Output Configuration

The single data point specifies that 2 bytes of data from the beginning of the J1939 device output table is going to be copied into the first 2 bytes of the message. The message will be transmitted with a PGN of 256 and a priority of 6 every 100ms. The message will be broadcast (Target Address 255) so that it can be seen by everyone on the network.

After accounting for the 4 bytes of command register, the data used for the PGN 256 message is located at word 2 of the PROFIBUS master's output data. (the output table starts at word 0)

PROFIBUS Master Configuration

The I/O table sizes and layout for the X-gateway are defined in the PROFIBUS master's configuration tool using modules define in the X-gateway's GSD file. The I/O size defined by the PROFIBUW module configuration must exactly the size defined by the J1939 I/O configuration in BWConfig.

The PROFIBUS module configuration for this application is shown below.

Module	Data Size
Status/Cmd Registers	6 words In / 2 words Out
OUTPUT: 1 Word	1 word Out
INPUT: 2 Words	2 words In
INPUT: 32 Words	32 words In
INPUT: 8 Words	8 words In
INPUT: 1 Word	1 word In

A module is provided in the GSD to handle the Status data in the Input table and the Command registers in the output table using a single module.

The ECM diagnostic data is 41 words long. There is not a module in the GSD that is 41 words long, so the data length must be made up be combining several modules. (32 + 8 + 1 = 41 words)

J1939 Interface

Address Management

The Anybus X-gateway address management is responsible for bringing the module online on the J1939 network with a unique network address in accordance to the J1939-81 specification. The address management will claim a configured address, if possible, and protect it against lower priority contending address claims. If a configured address is unable to be uniquely claimed, or is lost due to a higher priority contending claim, the module will be taken offline.

This manual will not discuss the address management protocol in detail; readers should reference the J1939-81 specification for complete details. The scope of this section is to explain how the configuration of the address list affects address management.

Single Configured Address

If a single address is configured in the address list, the module will attempt to claim that address. If the configured address is successfully claimed, the module will join the J1939 network using that address. If the address cannot be claimed, the module remains offline.

Multiple Configured Addresses

If more than one address is configured in the address list, the module will attempt to claim addresses in the order they appear in the list until it is either successful, or it runs out of addresses. Once an address is successfully claimed, the module will join the J1939 network using that address. If an address cannot be claimed, the module moves to the next address in the list and attempts to claim that address. If no addresses in the list can be claimed, the module remains offline.

Address Loss

If the module loses its current network address to a higher priority contending address claim, it will cease all network activity using that address. If the address list is configured with a single address, the module will remain offline after an address loss. If the address list has multiple addresses, the module will attempt to claim the next address on the list. If no addresses in the list can be successfully claimed, the module will remain offline.

Invalid Addresses

If the address configured is invalid (outside of the range 0-253), the module will remain offline and not attempt an address claim.

Request for Address Claimed

The X-gateway will respond to a Request for the Address Claimed PGN (0x00EE00) sent both destination specific and broadcast. The response is dependent on the current address management state, and is discussed below.

- If the module has successfully claimed an address and is online, the response will be an Address Claimed message with the current address.

- If the module is offline because it has lost its address to a higher priority claim and cannot successfully claim another address, the response will be a Cannot Claim Address message.

- If the module is in the process of attempting to claim an address, it will not respond to the request.

- If the module is offline because it has not yet attempted to claim an address, or the configured address is invalid, it will not respond to the request.

Communications Methods

The J1939 network interface supports reception and transmission of the following J1939 message types in accordance to the J1939-21 specification.

•PDU1 destination specific
•PDU1 broadcast
•PDU2 (broadcast)

Message Transmission

Messages are transmitted on the J1939 network according to the J1939 output configuration. Messages are assembled from data in the Output table and transmitted on a cyclic time basis, or in response to a request for the associated PGN.

Data Point to Message Relationship

Output data points with the same PGN and Target Address collectively define a single message to be transmitted on the network.

Message Assembly

Messages are assembled according to the output data points configured for the associated PGN and Target Address. Data is copied from the Output table to the message buffer based on the sizes and offsets of all output data points configured with the PGN and Target Address.

All bits in the message buffer that are not set from the Output table (ranges in the buffer that are not referenced by output data points) are set to 1.

The message length is set according to the size of the data point with the largest message offset. The length is rounded out to the nearest byte.

Note: Message length is strictly determined by the output data point configuration for a given message. The X-gateway does not know the required data length for all possible PGN's. The output data point configuration must provide a data point that will specify the end of the message to ensure that the correct size message is assembled.

Automatic Transmission

Messages are transmitted automatically based on the Update Time parameter in the output data points associated with the message. The smallest, non-zero Update Time of all data points associated with the message will be used.

If the Update Time is configured as 0, no automatic transmission will occur for the message. The only way that a message configured in this way will be transmitted is if a request is received for the associated PGN.

Automatic transmission for a message will occur Update Time milliseconds after the last transmission of the message, regardless of whether the last transmission was automatic or a response to a request PGN.

Handling Request PGNs

Requests received that reference a PGN in an output data point will cause a message transmission of that message. The message will be assembled and transmitted immediately in response to the request, regardless of the timing of the automatic transmission.

Requests received that reference a PGN not configured in an output data point will cause a NAK response if the request was destination specific. Broadcast requests for non-configured PGNs will be ignored.

Destination Addresses

The destination address used for message transmission is dependant on the associated output data point configuration or the request message, whichever caused the transmission. The rules for destination addressing follow.

- If the message PGN is a PDU2 type, all PDU2 messages are broadcast by definition.

- If the transmission is automatic and the Target Address set to 255, the message will be broadcast.

- If the transmission is automatic and the Target Address is not 255, the message will be destination specific to the Target Address.

- If the transmission is due to a request and the request was destination specific, the message will be destination specific to the source address of the request.

- If the transmission is due to a request and the request was broadcast, the message will be broadcast.

Message Priority

The priority of the message being transmitted is set to the priority configured in the Output Data Point. By specification, the default priority of J1939 messages is 6.

 Important: Care should be taken when changing the priority of messages to a value other than 6 as it may affect the performance of other traffic on the J1939 network.

Receiving Messages

Handled Messages

The following J1939 messages are handled by the X-gateway when they are

received from the network.

- Address Claimed messages are handled by address management. See "Address Management" on page 5-1.

- Request for Address Claimed messages are handled by address management. See "Address Management" on page 5-1.

- Request messages referencing PGNs configured in output data points trigger message transmission for the associated message. See "Message Transmission" on page 5-3.

- Messages with PGNs and source addresses matching configured input data points trigger an Input table update. See "Input Table Update" on page 5-6.

Input Table Update

Messages received with a PGN and source address matching that configured for

an input data point will be parsed according to the configured data points.

Input data points are combined according to PGN and Target Address. All input

data points with matching PGN and Target Address are combined to define the

handling for a given message.

If the Target Address is configured as 255, all incoming messages with a matching PGN will be parsed using the data point, regardless of source address. If the

Target Address is not 255, received messages must match both the PGN and

source address in order to be handled by the input data point. Received messages

are handled by all input data points that meet these rules; a given message may be

processed by more than one input data point.

If a received message passes an input data point's matching test, the data from its

message buffer is copied to the Input table according to the data point configuration. Data of the configured length is copied from the configured message buffer

offset to the configured Input table offset.

Parameter Timeout Indication

Parameter timeout indication has been provided to allow the PROFIBUS controller to determine if a device on the J1939 network has gone inactive.

Input data points configured with a non-zero update rate will indicate a timeout when the associated message is not received within the configured update rate.

The timeout indication is all bits in input table data for the input data point set to 1. This will effect all input data points associated with the PGN/Target Address. The result appears as if a message was received which contained 0xFF for all data bytes in the message.

Note: The timeout indication (all bits set to 1) will also be used for input data points with non-zero update rates whenever an offline status is detected.

Transport Protocol for Large Messages

The previous sections discussed message handling generically, ignoring message sizes. Messages with buffer sizes of 8 bytes or less can be directly sent and received on J1939. However, messages with buffer sizes greater than 8 bytes must be fragmented, transmitted, and reassembled using the J1939 transport protocol. This section will not discuss the details of the transport protocol, readers should reference the J1939-21 specification; this document will provide a description of when and how the transport protocol is used by the X-gateway.

Transmission of Large Messages

Messages larger than 8 bytes in length will be sent using transport protocol. If the destination address is 255, the message will be broadcast using BAM (Broadcast Announce Message) mechanisms. If the message is destination specific, a connection will be opened with the destination node and the message sent using RTS/ CTS (Request To Send/Clear To Send) mechanisms. For a complete discussion of BAM and RTS/CTS refer to the J1939-21 specification.

Reception of Large Messages

The X-gateway will receive large messages that are broadcast using BAM or sent to the module using RTS/CTS. Once a complete message is received and reassembled, it is processed generically as described in the previous sections.

Limitations

The current implementation of the transport protocol in the X-gateway is limited as described below.

* Only a single outgoing transport protocol session is active at a time, regardless of whether the message is transmitted using BAM or RTS/ CTS. Large messages are queued for transmission and transmitted in the order in which they are queued.

* The module supports up to 35 concurrent incoming transport protocol sessions. The concurrent sessions may be any mixture of BAM and RTS/ CTS sessions. Additional BAM sessions will be ignored and RTS connection requests will be denied once the limit is reached.

J1939 Diagnostic Messages

The DM1 (active diagnostics) and DM2 (previously active diagnostics) are the 2 most commonly used J1939 diagnostic messages. The X-gateway includes support for these 2 message types.

Using BWConfig, the user is able to configure an active or previously active diagnostic table (or both) for a given J1939 device. The X-gateway will update the tables based on the contents of DM1 or DM2 messages produced on J1939 by the device, and provide read access to the tables on PROFIBUS.

This section will describe how the diagnostic tables are handled. See "J1939 Diagnostic Tables" on page 3-14 for configuration details.

Diagnostic Table Format
The active and previously active diagnostic tables have the same format. The format consists of a table header followed by a list of table entries.

Table Header
The table header is a 16-bit word and provides an indication of the number of diagnostic entries that are currently in the table. It also contains the current J1939 lamp status information. The table header content is described below.

Bit	Description
0-1	J1939 Protect lamp status.
2-3	J1939 Amber Warning lamp status.
4-5	J1939 Red Stop lamp status.
6-7	J1939 Malfunction lamp status.
8-14	Entry count. The current number of entries in the table. If the Update Rate is non-zero, the Entry count is set to 0xFF to indicate a timeout.
15	Table overflow indication.

Table 5-1 J1939 Diagnostic Table Header Content

Table Entry

Each entry in the table contains information for a single diagnostic (J1939 SPN/ FMI). Each table entry is 4 bytes with bit fields as described in the tables below.

The J1939 SPN value may be encoded differently in the diagnostic message received from the ECU. Due to an early vagueness in the J1939-73 specification, there is not a definite means to tell how the SPN is encoded. ECU's that follow the current specification will set the SPN Conversion Method flag to 0 and will encode the SPN value in a specific way.   ECU's that follow the early specification will set the Conversion Method flag to 1; however, there are 3 ways that the SPN may be encoded in this case.

The X-gateway module, as of v2.03.01 provides the value of the Conversion Method in the diagnostic table entries. If the Conversion Method is set to 1, the user should refer to the ECU vendor to determine how the SPN is encoded.

The tables below illustrate how the SPN is stored in the diagnostic table entry for each type of SPN encoding described in the J1939-73 specification.

SPN Conversion Method 0:

Word	Byte	Bits	Description
0	0	0-2	J1939 SPN bits 16-18.
		3-7	J1939 FMI.
	1	0-6	Occurrence count.
		7	SPN Conversion Method (set to 0)
1	2	0-7	J1939 SPN bits 0-7
	3	0-7	J1939 SPN bits 8-15

Table 5-2 Diagnostic Table Entry Content for SPN Conversion Method 0

SPN Conversion Method 1 - Encoding version 1 - The least significant bits with the FMI and the upper 16 bits in Big Endian order.

Word	Byte	Bits	Description
0	0	0-2	J1939 SPN bits 0-2
		3-7	J1939 FMI.
	1	0-6	Occurrence count.
		7	SPN Conversion Method (set to 1)
1	2	0-7	J1939 SPN bits 11-18
	3	0-7	J1939 SPN bits 3-10

Table 5-3 Diagnostic Table Entry Content for SPN Conversion Method 1, Version 1

SPN Conversion Method 1 - Encoding version 2 - The least significant bits with the FMI and the upper 16 bits in Little Endian order.

Word	Byte	Bits	Description
0	0	0-2	J1939 SPN bits 0-2
		3-7	J1939 FMI.
	1	0-6	Occurrence count.
		7	SPN Conversion Method (set to 0)
1	2	0-7	J1939 SPN bits 3-10
	3	0-7	J1939 SPN bits 11-18

Table 5-4 Diagnostic Table Entry Content for SPN Conversion Method 1, Version 2

SPN Conversion Method 1 - Encoding version 3 - The most significant bits with the FMI and the lower 16 bits in Little Endian order.

Word	Byte	Bits	Description
0	0	0-2	J1939 SPN bits 16-18.
		3-7	J1939 FMI.
	1	0-6	Occurrence count.
		7	SPN Conversion Method (set to 0)
1	2	0-7	J1939 SPN bits 0-7
	3	0-7	J1939 SPN bits 8-15

Table 5-5 Diagnostic Table Entry Content for SPN Conversion Method 1, Version 3

Bus-Off Reset Option

The bus-off reset option allows the X-gateway to be configured to attempt to come back online after it has been knocked offline due to excessive CAN errors.

Option Disabled

If the bus-off reset option is disabled, the X-gateway will remain offline after a bus-off condition is detected; it will not participate in any J1939 network activity. The only way to bring the module back online is to power cycle the module.

Option Enabled

If the bus-off reset option is enabled, the X-gateway will reinitialize the CAN controller after a bus-off condition is detected. Once the controller is reinitialized, the module will attempt to go online and resume network activity on the J1939 network.

WARNING

It is suggested that the bus-off reset option be disabled for most applications. Severe network problems can arise if the option is enabled and the X-gateway module is the node that is causing the CAN errors.

Important: THIS OPTION SHOULD NEVER BE ENABLED WHEN THE MODULE IS USED ON A CONTROL NETWORK OF ANY KIND! IT SHOULD BE RESERVED FOR MONITORING NETWORKS.

Offline Detection

The X-gateway is able to detect whenever it is not connected to the J1939 network or when it is the only device on the network (lonely). In either case the module is not able to transmit or receive J1939 messages.

Online/Offline Status Indication

There is a variety of means to determine whether the X-gateway is online on the J1939 network.

J1939 Status LED	See "J1939 Status LED" on page 7-2.
J1939 Status Register	Bit 1 of the Input Status Register in the Input Assembly indicates online status. If the bit is set the module is online. If the bit is cleared the module is offline. See "J1939 Fault Codes" on page 7-5.
Anybus X-gateway Configruation Tool	The Anybus X-gateway Configuration Tool indicates the online and offline status in the J1939 Configuration pane.

Table 5-6 Online/Offline Status Indications

How Offline Detection Works

The X-gateway is considered "offline" when it is not able to successfully transmit messages on the J1939 network. In order to successfully transmit a message the module must receive an acknowlegement on the CAN network; if no acknowlegement is received for a transmitted message the module is then considered offline. This condition may occur when the module is not connected to the network, or if it is the only node on the network (lonely).

> **Important:** At least one other node besides the X-gateway module must be present on the J1939 network in order for the X-gateway to go online.

Offline Detection Message and Timer

S   X-gateway uses message transmission to determine whether it is online, i   e no data points configured in the Output Table, the module must transmit a special message, the Offline Detection Message, to test for online status.

The Offline Detection Message uses PGN 61184 (EF00h) with the source and destination address both set to the address of the X-gateway.

The Offline Detection Message may be enabled or disabled in the configuration. When the message is enabled, the Offline Detection Time determines how often the Offline Detection Message will be sent. This effectively determines the time within which an offline condition will be detected. If the application requies that the offline status be detected quickly the time should be set to a smaller value; if the application does not require quick detection the time may be set to a larger value.

Note: The offline detection mechanism is always active regardless of whether the X-gateway is in Run or Idle mode. The module will transmit Offline Detection Messages when it is in Idle mode. This ensures that the online status being reported is always correct.

Important: If periodic transmission of PGN 61184 could cause adverse affects in the network application, make sure to disable the Offline Detection in the configuration.

Important: The Offline Detection Time should be set as large as the application will allow. Although setting the time to a small value will provide quicker detection of an offline condition, there is a trade-off in that the Offline Detection Message is being transmitted more often. This trade-off could affect the performance of the X-gateway and of the J1939 network overall.

Offline Detection with Offline Detection Message Disabled

When the Offline Detection Message feature in the configuration is disabled offline detection will be performed on the messages transmitted by the output data points. An offline condition will be detected whenever an output message is transmitted. If the output data point transmission rate is large, an offline condition that occurs between transmissions will be detected at the next transmission. If no output data points are configured an offline condition will not be detected.

Offline Detection with Offline Detection Message Enabled

When the Offline Detection Message feature in the configuration is enabled offline detection will be performed on the messages transmitted by the output data points as well as the Offline Detection Message. As described above, an offline condition will be detected whenever an output message is transmitted. If the Offline Detection Time is less than the output message transmission rate, the Output Detection Message will be transmitted between output data point messages to increase the rate at which an offline condition will be detected. If output data point messages are transmitted at a faster rate than the Offline Detection Time, the Offline Detection Message will not be transmitted.

J1939 Baud Rate

The X-gateway is capable of supporting communication baud rates on the J1939 network of 250K and 500K baud. The correct baud rate must be configured through the BWConfig Baud Rate option in the J1939 Configuration pane.

Important: The standard baud rate for J1939 is 250K baud. Do not set the baud rate to 500K baud unless you are certain that all devices on the network are communicating at 500K baud.

Important: Configuring the module with the incorrect baud rate may cause other devices on the network to experience bus-off faults.

PROFIBUS Interface

Network Communication

Protocol

The Anybus PROFIBUS to J1939 X-gateway acts as a PROFIBUS-DP slave

node. It can be read from and written to by a PROFIBUS-DP master. The X-gate-

way will not initiate communication to other nodes on the PROFIBUS network; it

will only respond to incoming commands.

Details of the supported protocol features are listed below.

- PROFIBUS-DP EN 50 170 (DIN 19245).
- Protocol version 1.10.
- Baud rate range 9.6 Kbps - 12 Mbps.
- Cyclic I/O data transmission.
- Device diagnostic messages supported.

Physical Interface

Feature	Specification
Media	PROFIBUS bus line type A or B specified in EN50170.
Topology	Master-Slave.
Connector	9-pin D-Subminiature female.
Cable	Shielded twisted pair.
Isolation	The bus is galvanically isolated from the X-gateway electronics.
Termination	Switch selectable internal bus termination.

Table 6-1 PROFIBUS Physical Interface

Device Diagnostics

The X-gateway sends PROFIBUS device diagnostic messages to the PROFIBUS master whenever there is a change in module status. The diagnostic data contains information about the state of the module, the J1939 communications, and an indication of I/O data integrity. If the Status Data In Input option is set in the J1939 configuration, the information in the diagnostic message will also be included at the front of the input table. The diagnostic data is presented in detail in "PROFIBUS Device Diagnostic Data" on page 7-8

Interaction with I/O Tables

I/O Table Updates

The PROFIBUS interface in the X-gateway accesses the I/O tables as requests from the PROFIBUS master are processed; there is no buffering or timed updates of the I/O within the module. Safeguards are in place to ensure data integrity by prohibiting simultaneous access by the PROFIBUS and J1939 interfaces. There is no synchronization between the 2 network interfaces.

When output data is received from the PROFIBUS master, the module will copy the data to the Output table. The data is always placed at the beginning (offset 0) of the Output table. This data is available to be read by the J1939 interface as soon as it has been written.

When it is time to transmit input data to the PROFIBUS master, the module will retrieve the data that is currently in the Input table. Data is always read from the beginning (offset 0) of the Input table. The data will be what was placed there by the last write to the Input table by the J1939 interface.

Data Endian-ness

The X-gateway transfers I/O data between PROFIBUS and J1939 without regard to data content or format. Due to this, the user is responsible for making sure that the devices on either network understand the format of the data.

J1939 is a little endian protocol; values are transmitted least significant byte first. Hence, all data in the I/O tables is assumed to be stored as little endian by the J1939 nodes.

Care should be taken to make sure that the PROFIBUS master handles input data and transmits output data in a format usable by the target J1939 devices. Like-wise, the master must be aware of the format of the data collected from the J1939 devices.

The I/O Byte Swap option will aid this issue by swapping the bytes on 16-bit boundaries. However, the user is still responsible for knowing where in the I/O tables J1939 data has been mapped. See "J1939 Network Configuration" on page 3-6 for details on the I/O Byte Swap option.

Input Table Organization

The input data from the J1939 devices is in the input table in the format that is laid out by the mapping defined by the input data points configured with BWConfig. If the Status Data In Input option is not set, the J1939 data starts at the front of the input table. If the Status Data In Input option is set, the J1939 data will be offset by 12 bytes (6 words) in the input table, and the status data will be at the front of the table.

The status data included in the input table conforms to the format defined below. See the full details of the fields of this structure in "J1939 Status Data in the Input Table" on page 7-6.

Byte Offset	Description
0-1	X-gateway module status.
2-3	J1939 interface status
4-5	J1939 status code
6-7	J1939 CAN error counter
8-9	J1939 CAN bus-off counter
10-11	J1939 CAN receive overrun error counter

Table 6-2 J1939 Status Data Format

The GSD file for the X-gateway provides a module of the correct size for the status data to allow for easy PROFIBUS configuration when this option is set.

Output Table Organization

The output data for the J1939 devices is in the format that is laid out by the mapping defined by the output data points configured with BWConfig. The output table contains a 32-bit command register at the front of the table; hence, the J1939 device data is offset by 4 bytes in the output table.

The Command register is a bit string with the following bit definitions.

Bit	Description
0	Run Mode. Controls the run mode of the X-gateway. This bit must be set for the module to be in Run mode and transmit messages on J1939.
1	Reset Faults. Resets the J1939 network interface faults.
2	Not used.
3	Not used.
4	Reset the X-gateway module.
5-31	Not used.

Table 6-3 Output Command Register Bit Definitions

I/O Data Summary

The following diagram illustrates how the various components of the input data are used to create the input data accessible from PROFIBUS.
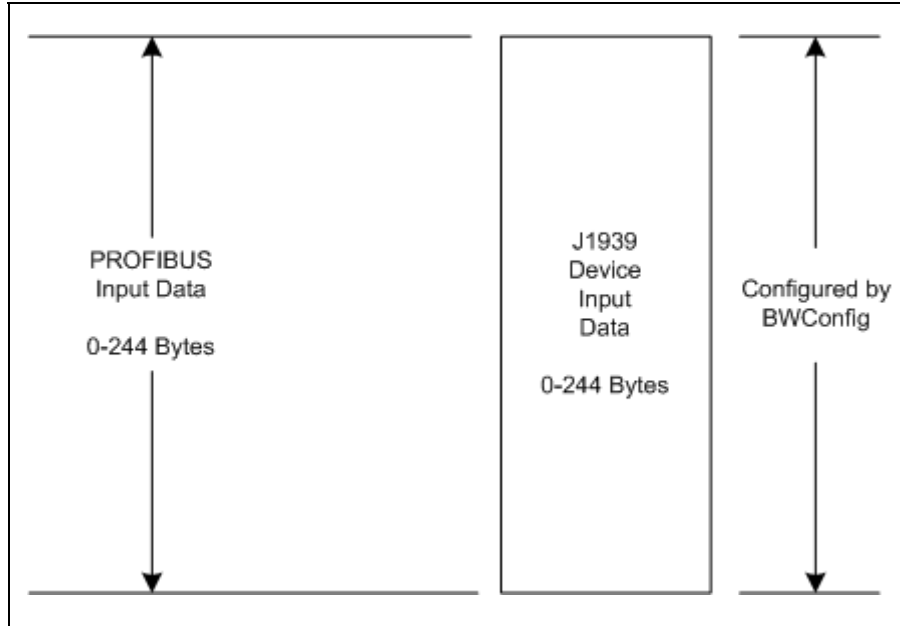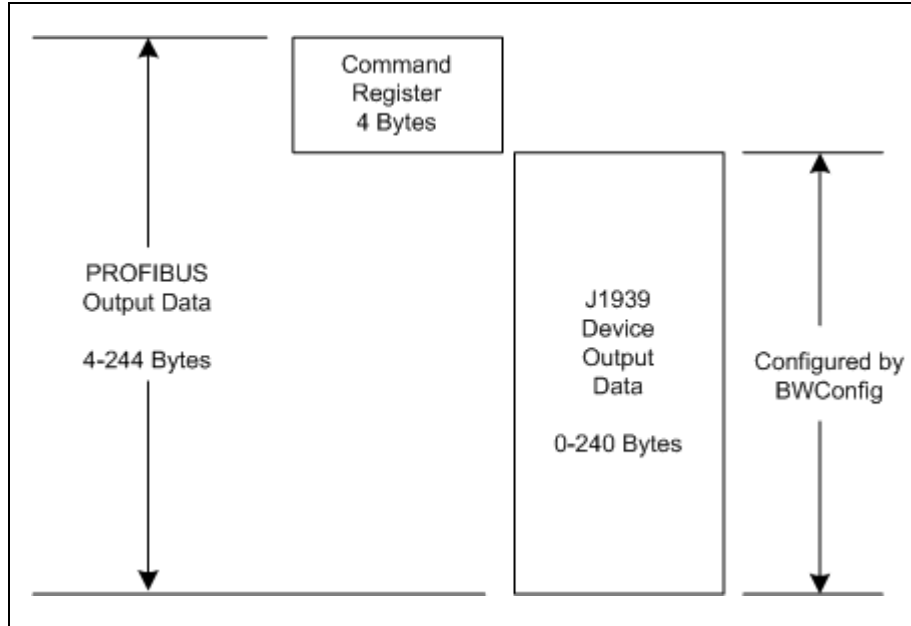

Figure 6-1 Input Data Association - Status In Input Option Disabled
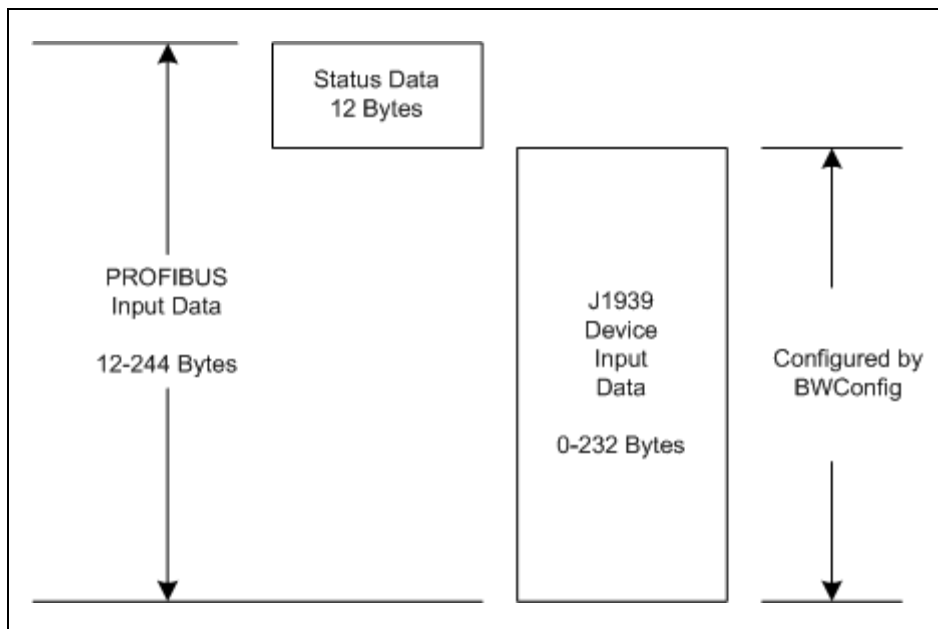
Figure 6-2 Input Data Association - Status In Input Option Enabled

The following diagram illustrates how the various components of the output data are used to create the output data accessible from PROFIBUS.

Figure 6-3 Output Data Association

Status and Diagnostics

X-gateway LEDs

There is a group of LED indicators on the front of the X-gateway that is used to annunciate the current status of the module and the network interfaces. The layout of the LEDs is shown below.
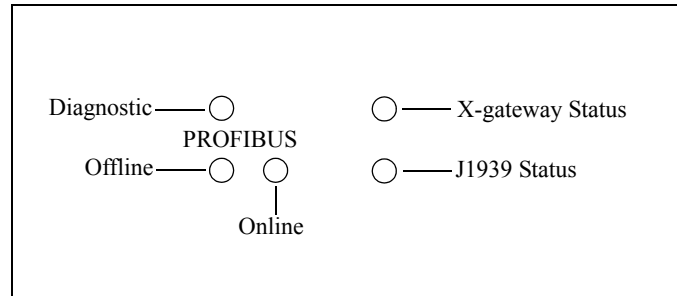

Figure 7-1 X-gateway LEDs

X-gateway Status LED

State	Summary	Description
Flashing Green	Idle	Module is in Idle mode.
Solid Green	Run	Module is in Run mode.
Solid Orange	Hardware Initialization	The LED will be in this state immediately after power is applied.
Flashing Red/Green	Error	A major, unrecoverable fault has been detected.
Red, Green, Orange Alternate Flashing	Self Test	A self test of the module is in progress.

Table 7-1 X-gateway Status LED States

Major unrecoverable faults are indicated by a series of green and red flashes. If the X-gateway Status LED is flashing red and green for an extended period of time, count the number of red and green flashes and call technical support.

J1939 Status LED

State	Summary	Description
Flashing Green	Initializing / Offline	The J1939 network interface is currently being initialized and is waiting to come online. The module is not participating in J1939 traffic.
Solid Green	Online	A J1939 network address has been successfully claimed and the module is online and active.
Flashing Red/Green	Online with Faults	The module is online and active on the J1939 network, but faults have been detected. Check the J1939 status code to determine the cause of the fault.
Solid Red	Offline	The module is not participating in the J1939 network.
Flashing Red	Offline with Faults	The module is not participating in the J1939 network and faults have been detected. Check the J1939 status code to determine the cause of the fault.

Table 7-2 J1939 Status LED States

PROFIBUS Online LED

State	Summary	Description
Off	Offline, or no module power	The X-gateway is either not powered, or not online on PROFIBUS.
Solid Green	Online	The X-gateway is online on the PRO-FIBUS network.

Table 7-3 PROFIBUS Online LED States

PROFIBUS Offline LED

State	Summary	Description
Off	Online, or no module power	The X-gateway is either not powered or is online on PROFIBUS.
Solid Red	Offline	The X-gateway is powered up, but is not participating in PROFIBUS activity.

Table 7-4 PROFIBUS Offline LED States

PROFIBUS Diagnostic LED

State	Summary	Description
Off	Normal	No diagnostics are present.
Flashing Red at 1Hz	Configuration error	The input and/or output length set in module configuration does not match the value(s) set during network configuration.
Flashing Red at 4Hz	Hardware error	An error occurred while initializing the PROFIBUS ASIC.

Table 7-5 PROFIBUS Diagnostic LED States

J1939 Status Codes

The status codes for the J1939 interface are displayed by the Anybus X-gateway Configuration Tool in the network configuration pane associated with the J1939 network. There are 2 status codes: a general status, and a J1939 fault status. The general status is displayed as a textual status. The J1939 fault status codes is a bit string, so the values are displayed in hexadecimal format to make them easier to decipher.

J1939 General Status

Value	Description
Initializing	The J1939 network interface is initializing.
Offline	The module is not participating in J1939 network activity.
Online	The module is online and participating in J1939 network activity.

Table 7-6 J1939 General Status Values

J1939 Fault Codes

Bit	Description
0	The address claim has failed. The Anybus X-gateway was unable to claim a unique J1939 network address and join network activity.
1	The CAN error counter has exceeded its warning limits at least one time since bootup or the last fault reset.
2	The CAN controller has reported a bus-off condition at least one time since bootup or the last fault reset.
3	A CAN receive overrun condition was detected at least one time since bootup or the last fault reset.
4	A J1939 transport protocol error has occurred at least one time since bootup or the last fault reset.
5	A receive message queue has overflowed at least one time since bootup or the last fault reset.
6	A transmit message queue has overflowed at least one time since bootup or the last fault reset.
7-15	Not used.

Table 7-7 J1939 Fault Code Bit Definitions

J1939 Status Data in the Input Table

If the Status Data In Input option is set in the configuration, the J1939 status data will be included at the front of the input table. The status data is 12 bytes long on contains the following information.

Byte Offset	Size in Bytes	Data Type	Name	Description
0	2	16-bit bit string	Module Status	The current status of the module. See the bit definitions below.
2	2	UINT	J1939 Interface Status	The current status of the J1939 interface. The following values are defined: 0x8000 Offline 0x8001 Online 0x8002 Initializing
4	2	16-bit bit string	J1939 Interface Faults	The current fault status of the J1939 interface. See the bit definitions in Table 7-7 Above.
6	2	UINT	CAN Error Counter	The number of CAN errors that have been accumulated. This counter is reset by the fault reset command bit.
8	2	UINT	CAN Bus-Off Counter	The number of CAN bus-off errors that have occurred. This counter is reset by the fault reset command bit.
10	2	UINT	CAN Overrun Counter	The number of CAN receive overrun errors that have occurred. This counter is reset by the fault reset command bit.

Table 7-8 J1939 Status Data Format

The Module Status word in the Status data is a bit string with the following bit definitions.

Bit	Description
0	Run/Idle Bit set indicates module is in Run mode.
1	J1939 Online Bit set indicates module is online and active on J1939 network.
2	J1939 Fault Bit set indicates that there is a fault on the J1939 network interface. See the value J1939 faults word for details.
3	PROFIBUS I/O Size Error. Bit set indicates a mismatch in I/O sizes between the X-gateway configuration and the PROFIBUS master configuration. This bit is only used in the PROFIBUS Diagnostic data; it is not used in the Status Data in the input table.
4-15	Not used.

Table 7-9 Module Status Word Bit Definitions

PROFIBUS Device Diagnostic Data

A PROFIBUS Diagnostic message is sent to the PROFIBUS master whenever there is a change in module status. The diagnostic data can be used by the master to determine the current status of the module, as well as a measure of I/O data integrity.

Diagnostic Data Format

The format of the PROFIBUS diagnostic data is the same as the status data in the input table described above. Note that this data appears after the 6 byte header in the PROFIBUS diagnostic message.

Static Diagnostic Control Bit

The X-gateway makes use of the *Static* bit in the diagnostic control byte to notify the PROFIBUS master that the I/O data integrity is in question. If the Static bit is set, it is suggested that the PROFIBUS master ignore the input data and stop updating the output data.

The Static bit is set in the diagnostic control byte if the X-gateway is not online on the J1939 network.

Specifications

Environmental Specifications

Temperature

Operating: 0 to 70 degrees Celsius

Non-Operating: -25 to 85 degrees Celsius

EMC Directive Compliance

This product is tested to meet the Council Directive 89/336/EC Electromagnetic

Compatibility (EMC) by applying the following standards, in whole or in part,

documented in a technical construction file:

- EN50081-2-EMC Generic Emission Standard, Part 2 - Industrial Environment

- EN50082-2-EMC Generic Immunity Standard, Part 2 - Industrial Environment

This product is intended for use in an industrial environment.

Electrical Specifications

DC Power

Operating voltage: 12-30v DC.

Current Requirements: 105-110 mA at 24 VDC.

Mechanical Specifications

Mechanical Rating
IP20/NEMA 1

DIN Rail Mount
The X-gateway connects to a DIN 3 rail.

Dimensions
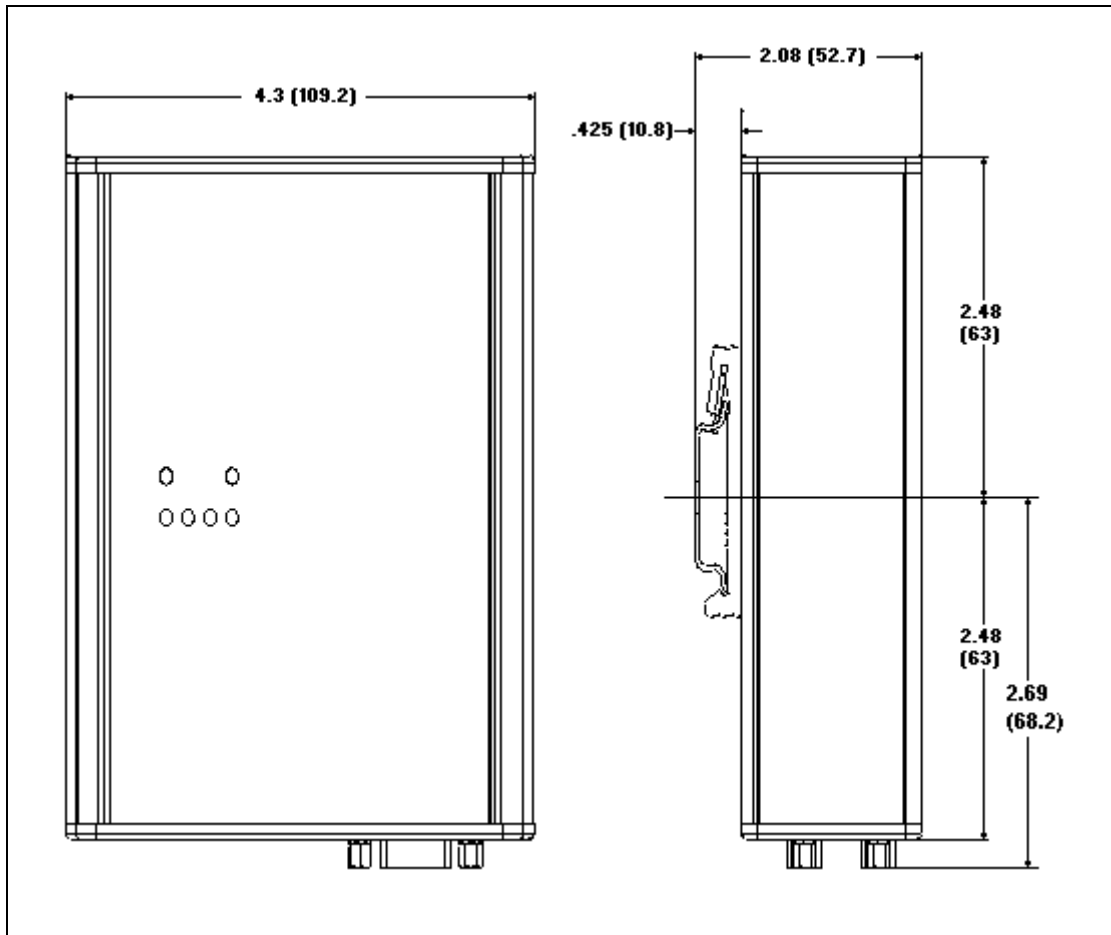
Figure 8-1 X-gateway Mechanical Dimensions

I/O Data Sizes

•Maximum 244 bytes input including the status data if the Status In Input option is enabled.

•Maximum 244 bytes output including the command register.

•Combined Input and Output size must not be more than 400 bytes.

•200 total J1939 data points maximum (input plus output)

•Up to 120 different PGN's may be monitored by input data points

•Up to 100 different PGN's may be transmitted by output data points

J1939 Specifications

Message Types

Supports transmission and reception of the following message types:

•PDU1 destination specific
•PDU1 broadcast
•PDU2

Addressing

Claims and protects a single configurable address.

Self-configurable using a list of addresses.

Transport Protocol Sessions

Support of J1939 transport protocol for large messages with the following limitations:

•Single outgoing session (either BAM or RTS/CTS).
•35 concurrent incoming sessions (any mixture of BAM and RTS/CTS).

Connectors

Power
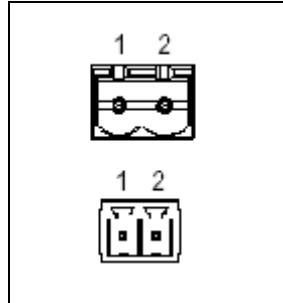
Pin	Connection
1	24 VDC +
2	24 VDC Common

Table 9-1 Power Connector Pin Definitions

Use Phoenix connector part number MSTB 2,5/2-ST-5,08 ABGY
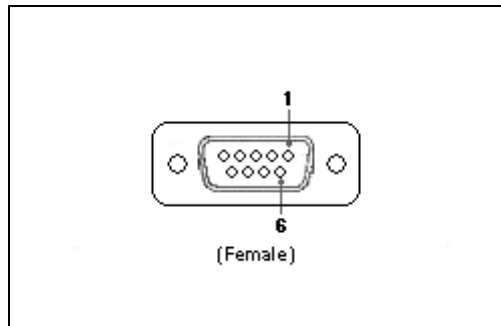
J1939
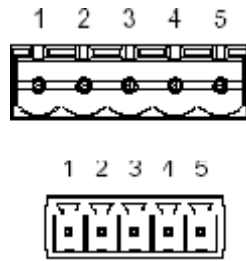
Pin	Signal
1	24 VDC Common
2	CAN Low
3	Shield
4	CAN High
5	24 VDC +

Table 9-2 J1939 Connector Pin Definitions

Use Phoenix connector part number MSTB 2,5/5-ST-5,08-ABGYAU.

Note: The 24VDC connections on the J1939 and Power connectors are physically connected internally. The module may be powered from either set of pins.

PROFIBUS

Pin	Connection
1	Not used
2	Not used
3	B-Line
4	RTS
5	GND Bus
6	+5 V Bus
7	Not used
8	A-Line
9	Not used

Table 9-3 PROFIBUS Connector Pin Definitions

Configuration RS-232
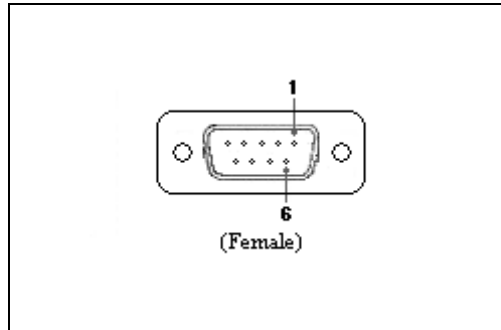
Pin	Connection
1	Not used
2	Receive Data
3	Transmit Data
4	Not used
5	Signal Ground
6	Not used
7	Not used
8	Not used
9	Not used

Table 9-4 Auxiliary RS-232 Pin Definitions

Support

For technical support consult the online FAQ (www.anybus.com), or contact the nearest support center:

Sales		Support	
HMS Sweden (Head Office)			
E-mail:	sales@hms-networks.com	E-mail:	support@hms-networks.com
Phone:	+46 (0) 35 - 17 29 56	Phone:	+46 (0) 35 - 17 29 20
Fax:	+46 (0) 35 - 17 29 09	Fax:	+46 (0) 35 - 17 29 09
Online:	www.anybus.com	Online:	www.anybus.com
HMS North America			
E-mail:	us-sales@hms-networks.com	E-mail:	us-support@hms-networks.com
Phone:	+1-312 - 829 - 0601	Phone:	+1-312-829-0601
Toll Free:	+1-888-8-Anybus	Toll Free:	+1-888-8-Anybus
Fax:	+1-312-629-2869	Fax:	+1-312-629-2869
Online:	www.anybus.com	Online:	www.anybus.com
HMS Germany			
E-mail:	ge-sales@hms-networks.com	E-mail:	ge-support@hms-networks.com
Phone:	+49 (0) 721-989777-000	Phone:	+49 (0) 721-989777-000
Fax:	+49 (0) 721-989777-010	Fax:	+49 (0) 721-989777-010
Online:	www.anybus.de	Online:	www.anybus.de
HMS Japan			
E-mail:	jp-sales@hms-networks.com	E-mail:	jp-support@hms-networks.com
Phone:	+81 (0) 45-478-5340	Phone:	+81 (0) 45-478-5340
Fax:	+81 (0) 45-476-0315	Fax:	+81 (0) 45-476-0315
Online:	www.anybus.jp	Online:	www.anybus.jp
HMS China			
E-mail:	cn-sales@hms-networks.com	E-mail:	cn-support@hms-networks.com
Phone:	+86 (0) 10-8532-3183	Phone:	+86 (0) 10-8532-3023
Fax:	+86 (0) 10-8532-3209	Fax:	+86 (0) 10-8532-3209
Online:	www.anybus.cn	Online:	www.anybus.cn
HMS Italy			
E-mail:	it-sales@hms-networks.com	E-mail:	it-support@hms-networks.com
Phone:	+39 039 59662 27	Phone:	+39 039 59662 27
Fax:	+39 039 59662 31	Fax:	+39 039 59662 31
Online:	www.anybus.it	Online:	www.anybus.it
HMS France			
E-mail:	fr-sales@hms-networks.com	E-mail:	fr-support@hms-networks.com
Phone:	+33 (0) 3 68 368 034	Phone:	+33 (0) 3 68 368 033
Fax:	+33 (0) 3 68 368 031	Fax:	+33 (0) 3 68 368 031
Online:	www.anybus.fr	Online:	www.anybus.fr
HMS UK & Eire			
E-mail:	uk-sales@hms-networks.com	E-mail:	support@hms-networks.com
Phone:	+44 (0) 1926 405599	Phone:	+46 (0) 35 - 17 29 20
Fax:	+44 (0) 1926 405522	Fax:	+46 (0) 35 - 17 29 09
Online:	www.anybus.co.uk	Online:	www.anybus.com
HMS Denmark			
E-mail:	dk-sales@hms-networks.com	E-mail:	support@hms-networks.com
Phone:	+45 (0) 35 38 29 00	Phone:	+46 (0) 35 - 17 29 20
Fax:	+46 (0) 35 17 29 09	Fax:	+46 (0) 35 - 17 29 09
Online:	www.anybus.com	Online:	www.anybus.com
HMS India			
E-mail:	in-sales@hms-networks.com	E-mail:	in-support@hms-networks.com
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Online:	www.anybus.com	Online:	www.anybus.com