

Anybus[®] X-gateway[™]

Application Note Interfacing to J1939 with PROFIBUS DP

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1. Overview

The Anybus X-gateway PROFIBUS to J1939 (part number AB7615) provides a gateway interface between PROFIBUS DP and J1939 networks. This document will discuss how to interface to the AB7615 using a PROFIBUS DP master. This will allow J1939 parameters to be monitored and controlled by a PROFIBUS-based controller.

1. Companion Files

The following companion files are provided with this document.

BwPdpExample.cfg BWConfig configuration file (BWConfig v1.14)

2. J1939 Data and the X-gateway I/O Table

The first step in any X-gateway system configuration is to determine what J1939 data parameters are of interest and where those parameters want to be located in the X-gateway I/O table. An overview of the process will be covered here; the reader should refer to the *J1939 Data Mapping Explained.pdf* document for further details.

After system analysis it is determined that the following J1939 parameters are to be monitored:

- Engine Speed
- Coolant Temperature
- Engine Oil Pressure
- Engine Oil Temperature
- Engine Hours

It has also been determined that the engine speed will be controlled by the PROFIBUS controller. This requires the following control parameters:

- Desired Engine Speed Setting
- Speed Control Mode
- Speed Control Condition
- Speed Control Priority

Most of the parameter data on a J1939 network is an 8-bit or 16-bit value. It is useful to arrange the I/O tables on 16-bit boundaries so that J1939 data parameter values are lined up with integer word data in the PROFIBUS controller data table.

2.1 Input Data Table

Parameter	PROFI Input Offset (bytes)	Data Table Offset (bytes)	PGN	Message Offset (byte.bit)	Data Length (byte.bit)	Rx Time	Scaling
Engine Speed	12	0	61444	3.0	2.0	0	0.125 RPM/bit 0 RPM offset
Coolant Temperature	14	2	65262	0.0	1.0	0	1 DegC/bit -40 DegC offset
Engine Oil Pressure	16	4	65263	3.0	1.0	0	4 kPa/bit 0 kPa offset
Engine Oil Temperature	18	6	65262	2.0	2.0	0	0.03125 DegC/bit -273 DegC offset
Engine Hours	20	8	65253	0.0	4.0	5s	0.05 hours/bit 0 hours offset

Note that all parameters are located on 16-bit word boundaries. 8-bit values will be stored in the low 8 bits of the word. Parameters longer than 16-bits, like Engine Hours, will be stored across multiple words with the least significant word stored first.

The PROFIBUS Input Offset column shows the offset of the data into the PROFIBUS I/O input data table as seen by the PROFIBUS master. The X-gateway status data is inserted at the front of the input table resulting in a 12 byte offset.

Most of the PGN messages are transmitted cyclically by the ECU. In these cases we can leave the receive timeout set to 0. The Engine Hours message is only transmitted on request; setting the receive timeout will cause the X-gateway to request the data.

2.2 Output Data Table

Parameter	PROFI Output Offset (bytes)	Data Table Offset (bytes)	PGN	Message Offset (byte.bit)	Data Length (byte.bit)	Tx Rate	Scaling
Engine Speed	4	0	0	1.0	2.0	10ms	0.125 RPM/bit 0 RPM offset
Speed Control Mode	6	2	0	0.0	0.2	10ms	See Vendor
Speed Control Condition	8	4	0	0.2	0.2	10ms	See Vendor
Speed Control Priority	10	6	0	0.4	0.2	10ms	See Vendor
PGN 0 Message Padding	13	9	0	7.7	0.1	10ms	Set to 1

Engine speed control includes 3 2-bit values that specify how the speed control command is to be handled by the ECU. The ECU vendor should be referenced to determine the correct use of these bits for the application.

The PROFIBUS Output Offset column shows the offset of the data into the PROFIBUS I/O output data table as seen by the PROFIBUS master. The X-gateway command register is inserted at the front of the output table resulting in a 4 byte offset.

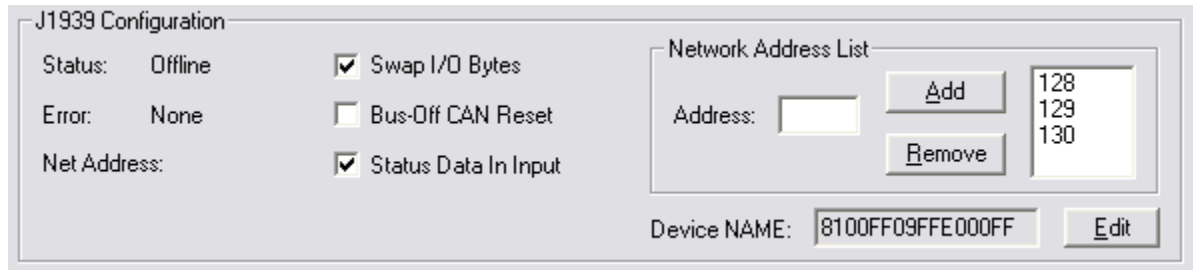
The PGN 0 message is required to be 8 bytes long. To force the X-gateway to transmit all 8 bytes, a pad bit must be configured at the end of the message. This pad bit is mapped in byte 13 to get a 16-bit word.

3. X-gateway Configuration

3.1 PROFIBUS Configuration

All PROFIBUS network configuration is set using switches on the outside of the X-gateway. See the *AB7615 User Manual, PROFIBUS Network Configuration* section for details.

3.2 J1939 Configuration



The screenshot shows the 'J1939 Configuration' window. On the left, the status is 'Offline', error is 'None', and net address is empty. Three options are checked: 'Swap I/O Bytes', 'Status Data In Input', and 'Bus-Off CAN Reset'. On the right, the 'Network Address List' contains three addresses: 128, 129, and 130. Below this, the 'Device NAME' is set to '8100FF09FFE000FF'.

Field	Value
Status	Offline
Error	None
Net Address	
Swap I/O Bytes	<input checked="" type="checkbox"/>
Bus-Off CAN Reset	<input checked="" type="checkbox"/>
Status Data In Input	<input checked="" type="checkbox"/>
Network Address List	128, 129, 130
Device NAME	8100FF09FFE000FF

Important: Set the Swap I/O Bytes option for PROFIBUS applications.

It is highly recommended to set the Status Data In Input option. This option inserts X-gateway status data at the front of the input data table. Although this data is also available via PROFIBUS Diagnostic messages, many master devices do not support the Diagnostic messages.

The address list and NAME have been set for arbitrary address configuration which allows the module to attempt several addresses if a conflict is found on the first. In most applications, this configuration will allow the module to join the J1939 network without conflicting with another device.

3.3 J1939 I/O Tables

3.3.1 J1939 Input Table

Table Offset	Data Length	PGN	Target Address	Update Rate	Message Offset
0 (0,0)	16 (2,0)	61444	255	0	24 (3,0)
16 (2,0)	8 (1,0)	65262	255	0	0 (0,0)
32 (4,0)	8 (1,0)	65263	255	0	24 (3,0)
48 (6,0)	16 (2,0)	65262	255	0	16 (2,0)
64 (8,0)	32 (4,0)	65253	255	5000	0 (0,0)

The input table has been configured based on the parameter table that was defined in the J1939 Data and X-gateway I/O Table section above. See that section for more details.

3.3.2 J1939 Output Table

Table Offset	Data Length	PGN	Priority	Target Address	Update Rate	Message Offset
0 (0,0)	16 (2,0)	0	3	0	10	8 (1,0)
16 (2,0)	2 (0,2)	0	3	0	10	0 (0,0)
32 (4,0)	2 (0,2)	0	3	0	10	2 (0,2)
48 (6,0)	2 (0,2)	0	3	0	10	4 (0,4)
72 (9,0)	1 (0,1)	0	3	0	10	63 (7,7)

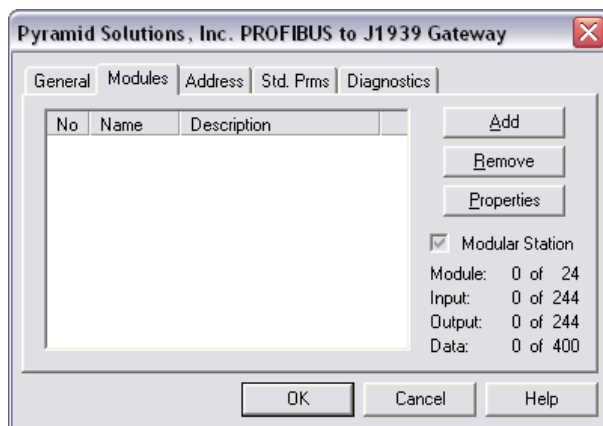
The output table has been configured based on the parameter table that was defined in the J1939 Data and X-gateway I/O Table section above. See that section for more details.

4. PROFIBUS DP Master Configuration

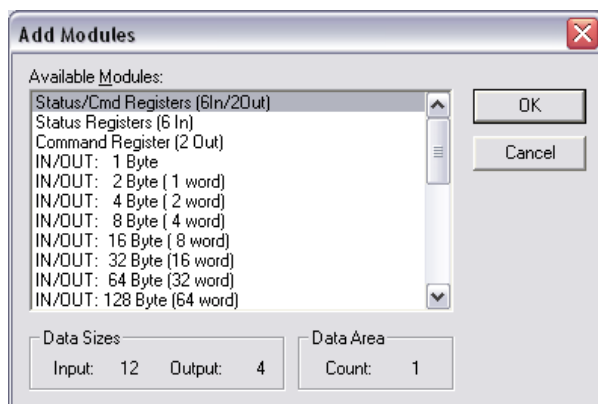
The I/O connection to the X-gateway from the PROFIBUS master is configured using the master's configuration tool and the X-gateway GSD file. The GSD file is available from the Pyramid Solutions support website, or is on the product CD.

The intent of this document is to provide an overview of the method that is used to configure the master, not to give an example for a specific type master device. Each PROFIBUS master has its own configuration tool; however all tools configure the X-gateway modular I/O in the same manner.

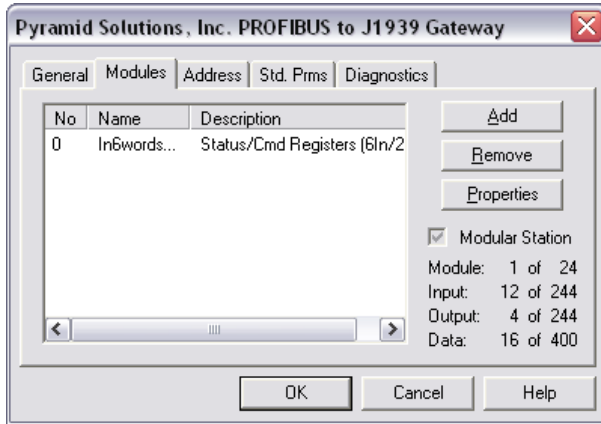
When the X-gateway module is added to the PROFIBUS master's I/O configuration, a modular I/O configuration dialog similar to the following is available.



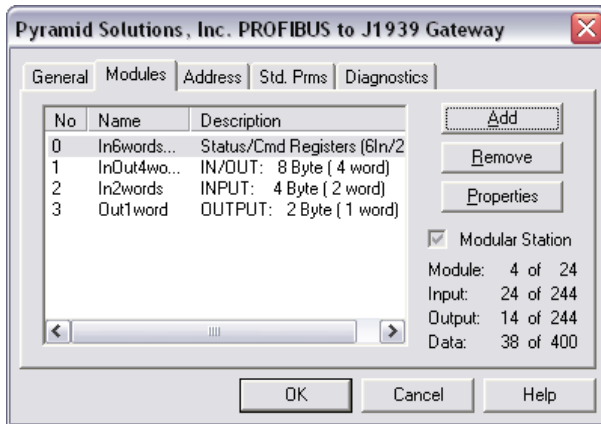
In order to configure the X-gateway I/O, modules must be added to the I/O table to “assemble” an I/O table of the correct size in the PROFIBUS master's I/O space. When a module is added, a list of available modules is provided, similar to the following dialog.



The X-gateway was configured with the Status Data In Input option enabled. The first module to add is the Status/Cmd Registers module. This module will allocate space for the 12 bytes of Status data in the Input table and 4 bytes of Command register in the output table.



Referring to the parameter data tables in the J1939 Data and X-gateway I/O Table section and the X-gateway configuration, there is 12 bytes of input parameter data and 10 bytes of output parameter data. Modules must be added to the PROFIBUS configuration that will allocate space for 12 input bytes and 10 output bytes. The combination of modules that are used is not as important as the fact that the total size must match the X-gateway I/O configuration size.



The configuration chose was 8 input/output bytes, 4 input bytes and 2 output bytes, providing a total of 12 input and 10 output bytes.

Note: The X-gateway configuration has a limit of 24 modules. Although it may be tempting to configure a module for each J1939 parameter, larger configurations will run into the module limit. It is usually best to configure the modules in the largest chunks possible to conserve module count.

5. J1939 Data Access From PROFIBUS DP

Once the X-gateway and PROFIBUS master have been configured, the PROFIBUS DP master is able to read and write J1939 data through the X-gateway using I/O messages.

5.1 *Monitoring Input and Status Data*

The data in the Input table follows the format laid out in the parameter table defined in the J1939 Data and X-gateway I/O Table section above with the X-gateway status data appended to the front of the table.

The Input table layout appears as follows. Example data values have been added for the notes that follow.

Input Table Offset (words)	Description	Example Raw Value	Example Engineering Unit Value
0	X-gateway Module Status	3	3
1	J1939 Interface Status	0x8001	0x8001
2	J1939 Interface Faults	0	0
3	CAN Error Counter	0	0
4	CAN Bus-Off Counter	0	0
5	CAN Overrun Counter	0	0
6	Engine Speed	14,400	1,800 RPM
7	Coolant Temperature	170	130 DegC
8	Engine Oil Pressure	20	80 kPa
9	Engine Oil Temperature	12,576	120 DegC
10	Engine Hours (low word)	4,660	59,215.4 hr
11	Engine Hours (high word)	18	

The first 6 words of status data is defined in the *AB7615 User Manual* in the *J1939 Status Data in the Input Table* section.

The data values in the Input table are “raw” values; i.e. they must be scaled to engineering units. The gain and offset is defined in the parameter table in the J1939 Data and X-gateway I/O Table section. For instance, the raw value of 14400 for Engine Speed equates to an RPM of 1800 after multiplying by the 0.125 gain value.

The Engine Hours parameter is a 32-bit value; hence it is stored in 2 words in the data table. The full 32-bit value can be obtained by multiplying the high word value by 65536 and adding it to the low word value. For instance, the high and low values of 18 and 4660 result in a raw Engine Hours value of 1,184,308 ($4660 + (18 \times 65536)$). Using the gain factor of 0.05, the engineering unit value is 59,215.4 hours.

5.2 Controlling Output Data

The data in the Output table follows the format laid out in the parameter table defined in the J1939 Data and X-gateway I/O Table section above with the X-gateway Command register inserted at the front.

The Output table layout appears as follows. Example data values have been added for the notes that follow.

Output Table Offset (words)	Description	Example Engineering Unit Value	Example Raw Value
0	Command Register	1	1
1	Unused		
2	Engine Speed Setting	1,800 RPM	14,400
3	Speed Control Mode	1	1
4	Speed Control Condition	0	0
5	Speed Control Priority	3	3
6	J1939 Msg Padding (set to 1)	1	1

The Command Register is defined in the *AB7615 User Manual* in Table 6-3. The Run/Idle mode of the X-gateway module is controlled with bit 0 of the Command register. The Run/Idle bit must be set in order for the X-gateway to transmit any messages on J1939.

The data values in the Output table are “raw” values; i.e. any engineering unit values must be scaled to raw values before they are written to the table. The gain and offset is defined in the parameter table in the J1939 Data and X-gateway I/O Table section. For instance, if the desired Engine Speed Setting is 1,800 RPM, the raw value of 14,400 is achieved by dividing 1,800 by the 0.125 gain value.

The 3 Speed Control parameters (Mode, Condition, and Priority) are each 2-bit values. Only the first 2 bits of each Output table word are used when building the message to be sent on J1939. i.e. The valid value range is 0-3.

The message padding bit value should be set to 1.

Any data written to the Output table will be transferred to the X-gateway on the next PROFIBUS I/O update. Once received by the X-gateway, the data will be used in the next scheduled J1939 message transmission.

6. Support

6.1 *Document History*

Summary of Recent Changes (1.00... 1.01)

Change	Page(s)
Corrected information in output data table and changed output table screenshot	3, 5
Updated sales and support information	11, 12

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