

# Anybus<sup>®</sup> X-gateway<sup>™</sup>

## *Application Note* *Interfacing J1939 with MicroLogix*

Doc. Id. SCM-1200-030  
Revision 1.00  
Nov 8<sup>th</sup> 2009



HMS Industrial Networks AB  
Box 4126  
300 04 Halmstad  
Sweden

Phone: +46 35 172900      FAX: +46 35 172909  
[www.anybus.com](http://www.anybus.com)

---

## TABLE OF CONTENTS

<b>1. OVERVIEW.....</b>	<b>1</b>
<b>2. COMPANION FILES .....</b>	<b>1</b>
<b>3. J1939 DATA AND THE X-GATEWAY I/O TABLE .....</b>	<b>1</b>
3.1 INPUT DATA TABLE .....	3
3.2 OUTPUT DATA TABLE .....	3
<b>4. X-GATEWAY CONFIGURATION .....</b>	<b>5</b>
4.1 ETHERNET CONFIGURATION .....	5
4.2 J1939 CONFIGURATION .....	5
4.3 J1939 I/O TABLES .....	6
4.3.1 J1939 Input Table .....	6
4.3.2 J1939 Output Table .....	6
<b>5. MICROLOGIX CONFIGURATION.....</b>	<b>7</b>
5.1 DATA FILES.....	7
5.2 MESSAGE INSTRUCTIONS.....	12
<b>6. J1939 DATA IN THE CONTROL PROGRAM .....</b>	<b>16</b>
6.1 MONITORING INPUT DATA .....	16
6.2 CONTROLLING OUTPUT DATA .....	17
6.3 MONITORING X-GATEWAY STATUS .....	19
<b>7. SUPPORT .....</b>	<b>20</b>
7.1 PRODUCT ASSISTANCE .....	20
7.2 CONTACT INFORMATION .....	21

## 1. Overview

The Ethernet to J1939 Gateway (part number AB7665) provides a gateway interface between EtherNet/IP and J1939 networks. This document will discuss how to interface to the AB7665 on EtherNet/IP using a Rockwell MicroLogix PLC. This will allow J1939 parameters to be monitored and controlled by the MicroLogix control program.

This document walks the reader through the steps that are taken to configure the X-gateway, the MicroLogix controller, and to use the J1939 data in the control program.

## 2. Companion Files

The following companion files are provided with this document.

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

MicroJ1939Interface.rss    MicroLogix configuration file (RSLogix 500 v8)

## 3. 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 MicroLogix 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 and configure the MicroLogix I/O files using 16-bit words (Integer N files) to provide simple access to all of the data values.

The following parameter tables were created based on the required parameters stated above.

### 3.1 Input Data Table

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

Note that all parameters are located on 16-bit 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.

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 to 5 seconds will cause the X-gateway to request the data at that rate.

### 3.2 Output Data Table

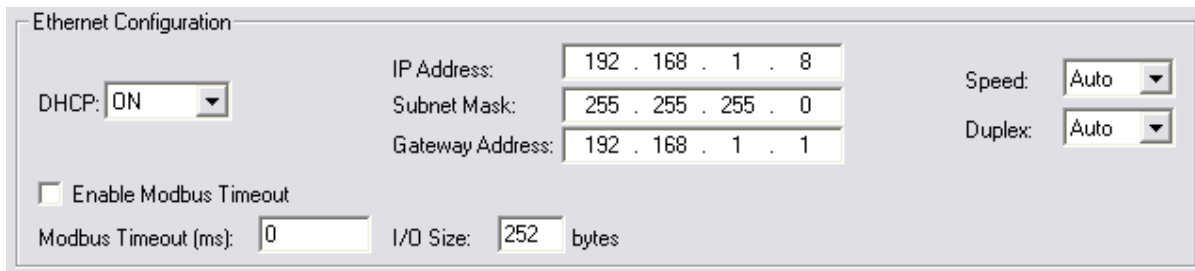
Parameter	Data Table Offset (bytes)	PGN	Message Offset (byte.bit)	Data Length (byte.bit)	Update Rate	Scaling
Engine Speed	0	0	1.0	2.0	10ms	0.125 RPM/bit 0 RPM offset
Speed Control Mode	2	0	0.0	0.2	10ms	See Vendor
Speed Control Condition	4	0	0.2	0.2	10ms	See Vendor
Speed Control Priority	6	0	0.4	0.2	10ms	See Vendor
PGN 0 Message Padding	8	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 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.

## 4. X-gateway Configuration

### 4.1 Ethernet Configuration



Ethernet Configuration

DHCP:

IP Address: 192 . 168 . 1 . 8

Subnet Mask: 255 . 255 . 255 . 0

Gateway Address: 192 . 168 . 1 . 1

Speed:

Duplex:

☐ Enable Modbus Timeout

Modbus Timeout (ms):  I/O Size:  bytes

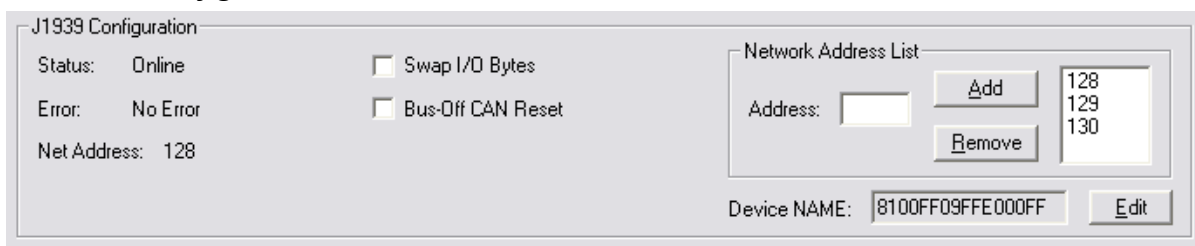
Set the DHCP and the IP Address parameters according to the Ethernet network configuration that will be used in the system.

**Important:** If the X-gateway is configured to use DHCP, it is highly recommended that an IP Address be configured for the X-gateway's MAC address in the DHCP server. This will guarantee that the module will always have the same IP address that will be configured in the MicroLogix configuration.

**Important:** Do not enable the Modbus timeout for EtherNet/IP applications.

The I/O size must be set to 252 bytes or less. The largest message that the MicroLogix can accept is 252 bytes. The value set here must match the value used when configuring the message instructions in the MicroLogix. (See the MicroLogix Configuration section below.)

### 4.2 J1939 Configuration



J1939 Configuration

Status: Online

Error: No Error

Net Address: 128

☐ Swap I/O Bytes

☐ Bus-Off CAN Reset

Network Address List

Address:

128  
129  
130

Device NAME:

**Important:** Do not set the Swap I/O Bytes option for EtherNet/IP applications.

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.

---

### 4.3 J1939 I/O Tables

#### 4.3.1 J1939 Input Table

J1939 Input I/O 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.

#### 4.3.2 J1939 Output Table

J1939 Output I/O 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)
64 (8,0)	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.



## 5. MicroLogix Configuration

Configuration in the MicroLogix consists of setting up data files and message instructions to read and write the data from the X-gateway module.

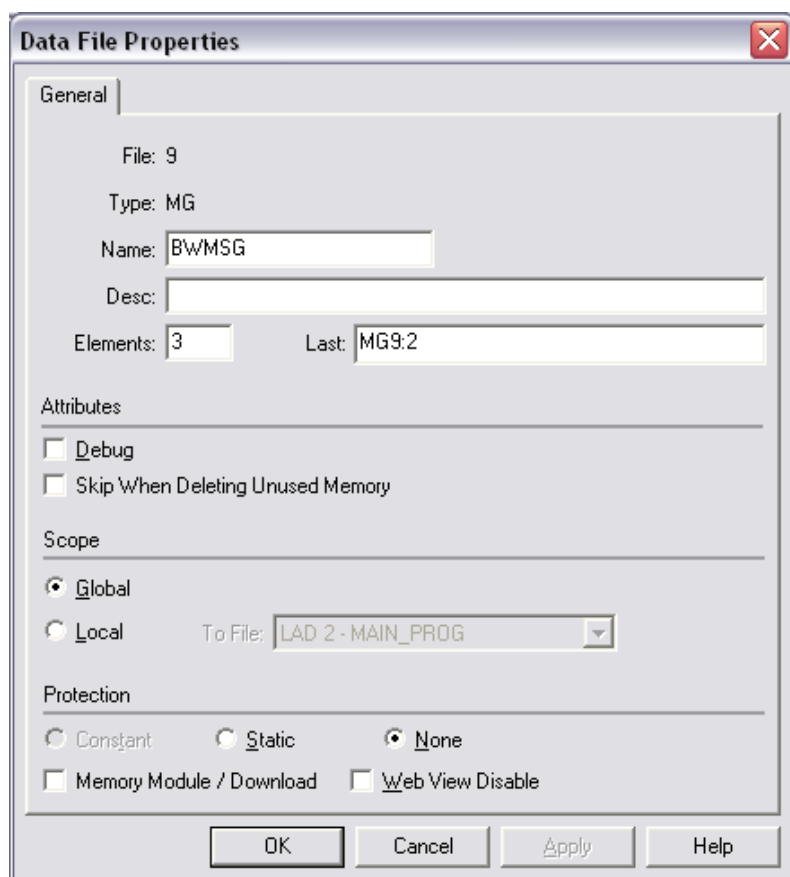
This example will set up the MicroLogix to read X-gateway input data and status data and write X-gateway output data. The status data is optional and may be omitted, but is recommended for diagnostic purposes.

### 5.1 *Data Files*

The message instructions require several data files in the MicroLogix configuration. The following data files will need to be added to the configuration.

#### Message Control File

The MG file is used by the message instruction to store its configuration and status. 3 MG file elements will be required, one for each message instruction.

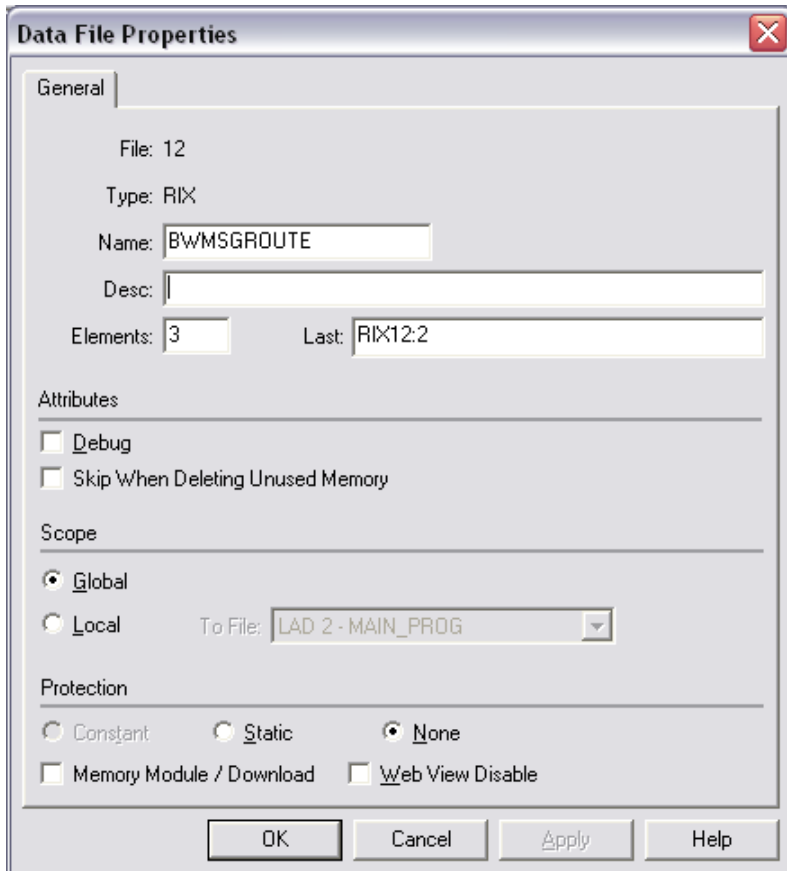


The image shows a 'Data File Properties' dialog box with the following fields and options:

- General** tab is selected.
- File: 9
- Type: MG
- Name: BWMMSG
- Desc: (empty field)
- Elements: 3
- Last: MG9:2
- Attributes** section:
  - ☐ Debug
  - ☐ Skip When Deleting Unused Memory
- Scope** section:
  - ☒ Global
  - ☐ Local To File: LAD 2 - MAIN\_PROG
- Protection** section:
  - ☐ Constant
  - ☐ Static
  - ☒ None
  - ☐ Memory Module / Download
  - ☐ Web View Disable
- Buttons: OK, Cancel, Apply, Help

### Extended Routing Information File

The RIX file is used by the message instruction to store the configuration and status when messages are routed to an Ethernet target. 3 RIX elements will be required, one for each message instruction.

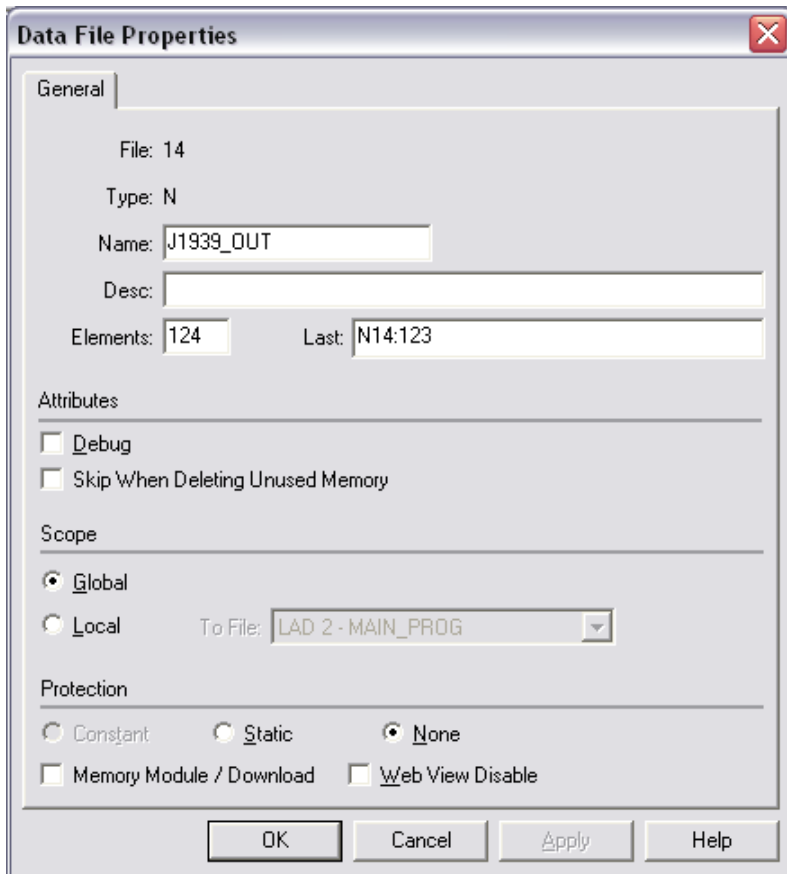


The image shows a 'Data File Properties' dialog box with the following fields and options:

- General** tab is selected.
- File: 12
- Type: RIX
- Name: BWMSGROUTE
- Desc: (empty text box)
- Elements: 3
- Last: RIX12:2
- Attributes** section:
  - ☐ Debug
  - ☐ Skip When Deleting Unused Memory
- Scope** section:
  - ☒ Global
  - ☐ Local To File: LAD 2 - MAIN\_PROG
- Protection** section:
  - ☐ Constant
  - ☐ Static
  - ☒ None
  - ☐ Memory Module / Download
  - ☐ Web View Disable
- Buttons at the bottom: OK, Cancel, Apply, Help.

### Integer File for X-gateway Output Data

This N file will store the contents of the output data to be sent to the X-gateway.

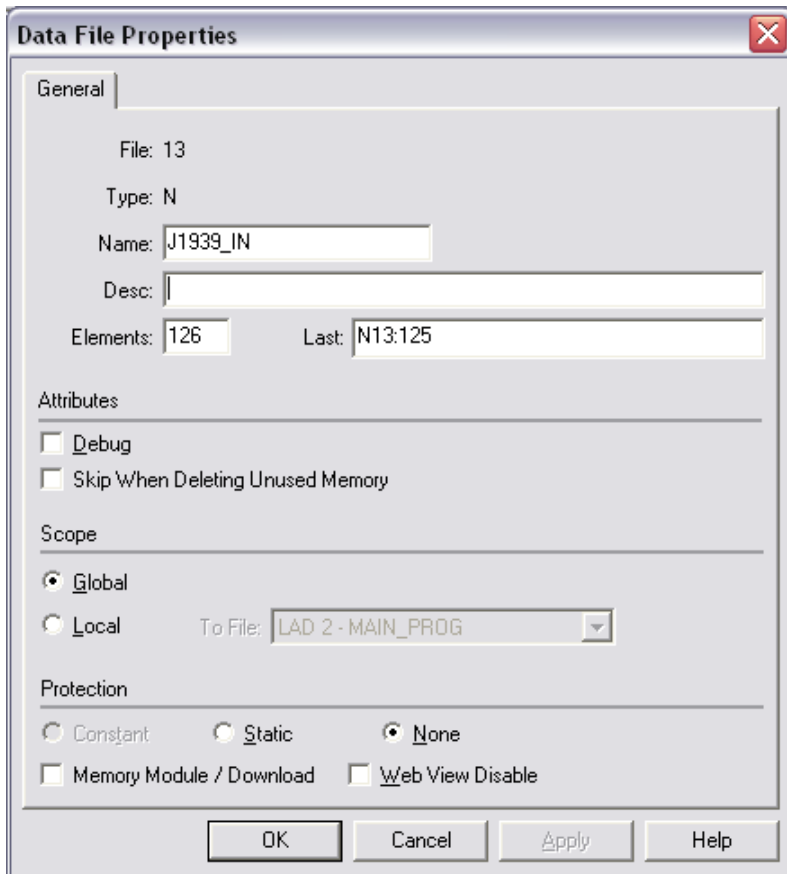


The integer file type was chosen to match the 16-bit boundaries that the I/O table was configured with in the X-gateway.

The size of the file should be set according to the I/O size configured in the X-gateway with BWConfig. In this case the I/O size was configured to 252 bytes. The output data is 4 bytes less than the I/O size, or 248 bytes, or 124 words.

### Integer File for X-gateway Input Data

This N file will store the contents of the input data received from the X-gateway.



The integer file type was chosen to match the 16-bit boundaries that the I/O table was configured with in the X-gateway.

The size of the file should be set according to the I/O size configured in the X-gateway with BWConfig. In this case the I/O size was configured to 252 bytes or 126 words.

### Integer File for X-gateway Status Data

This N file will store the contents of the status data received from the X-gateway.

The image shows a 'Data File Properties' dialog box with the following settings:

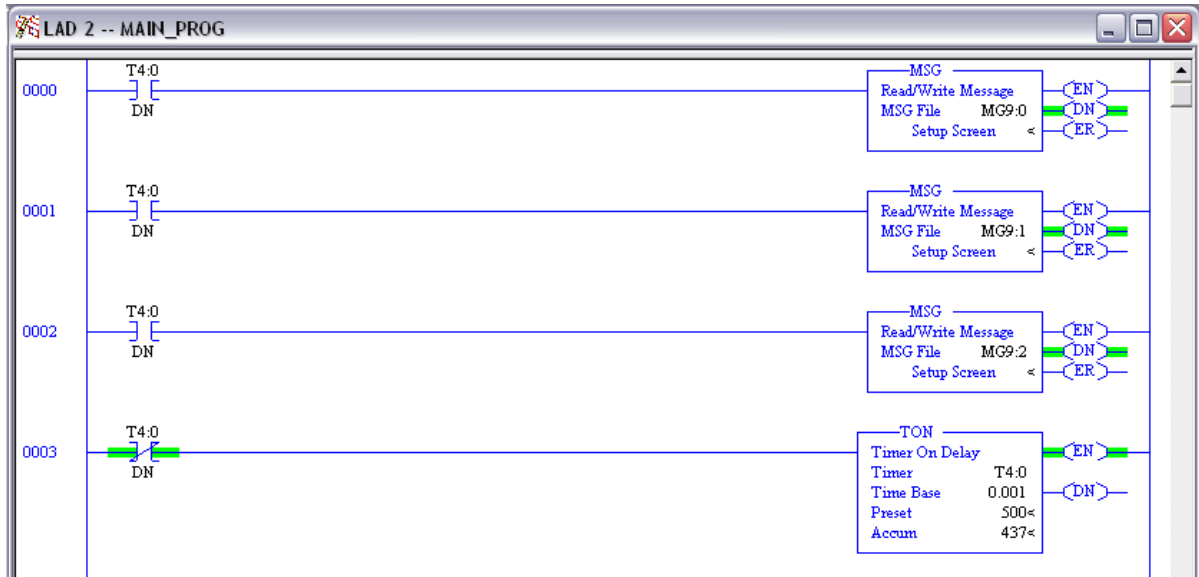
- General** tab is selected.
- File: 15
- Type: N
- Name: J1939\_STAT
- Desc: (empty text box)
- Elements: 5
- Last: N15:4
- Attributes** section:
  - ☐ Debug
  - ☐ Skip When Deleting Unused Memory
- Scope** section:
  - ☒ Global
  - ☐ Local (To File: LAD 2 - MAIN\_PROG)
- Protection** section:
  - ☐ Constant
  - ☐ Static
  - ☒ None
  - ☐ Memory Module / Download
  - ☐ Web View Disable
- Buttons: OK, Cancel, Apply, Help.

The size of the file is set to match the Status Assembly size defined for the X-gateway. The Status Assembly is 10 bytes, or 5 words. See the *AB7665 User Manual* for details on the Status Assembly.

## 5.2 Message Instructions

The MicroLogix program will require 3 message instructions, one to retrieve the X-gateway input data, one to retrieve the status data and one to send the output data.

In the ladder example below you can see the 3 message instructions. Note that they use the MG file elements that were added to the configuration above. The example uses a timer to cause the messages to be updated twice a second.



## Reading Input Data

X-gateway input data is read using a CIP Generic message.

The message will be a Read Assembly service to assembly instance 100.

The message receive size should be set to the I/O size configured in the X-gateway module, in the example this is 252 bytes.

Note the use of the N13 and RIX12 files created above.

Make sure to select the Channel associated with the Ethernet port; in this case it is channel 1.

MSG - MG9:0 : (1 Elements)

General MultiHop Send Data Receive Data

This Controller

Channel: 1 (Integral)

Communication Command: CIP Generic

Data Table Address (Receive): N13:0

Size in Bytes (Receive): 252 (Send): N/A

Target Device

Message Timeout: 33

Local / Remote: Local MultiHop: Yes

Extended Routing Info File(RIX): RIX12:0

Service: Read Assembly Service Code (hex): E

Class (hex): 4 (dec): 4

Instance (hex): 64 (dec): 100

Attribute (hex): 3 (dec): 3

Control Bits

Ignore if timed out (TO): 0

Break Connection (BK): 0

Awaiting Execution (EW): 0

Error (ER): 0

Message done (DN): 1

Message Transmitting (ST): 0

Message Enabled (EN): 0

Error

Error Code(Hex): 0

Error Description

No errors

The IP address of the X-gateway is entered into the MultiHop tab's information.

MSG - MG9:0 : (1 Elements)

General MultiHop Send Data Receive Data

Ins = Add Hop Del = Remove Hop

From Device	From Port	To Address Type	To Address
This MicroLogix	Channel 1	EtherNet/IP Device (str:)	192.168.1.8

## Writing Output Data

X-gateway output data is written using a CIP Generic message.

The message will be a Write Assembly service to assembly instance 150.

The message send size should be set to 4 bytes less than the I/O size configured in the X-gateway module, in the example this is 248 bytes.

Note that use of the N14 and RIX12 files created above.

Make sure to select the Channel associated with the Ethernet port; in this case it is channel 1.

MSG - MG9:1 : (1 Elements)

General | MultiHop | Send Data | Receive Data

This Controller

Channel: 1 (Integral)

Communication Command: CIP Generic

Size in Bytes (Receive): N/A (Send): 248

Target Device

Message Timeout: 33

Local / Remote: Local MultiHop: Yes

Extended Routing Info File(RIX): RIX12:1

Service: Write Assembly Service Code (hex): 10

Class (hex): 4 (dec): 4

Instance (hex): 96 (dec): 150

Attribute (hex): 3 (dec): 3

Control Bits

Ignore if timed out (TO): 0

Break Connection (BK): 0

Awaiting Execution (EW): 0

Error (ER): 0

Message done (DN): 1

Message Transmitting (ST): 0

Message Enabled (EN): 0

Error

Error Code(Hex): 0

Error Description

No errors

The IP address of the X-gateway is entered into the MultiHop tab's information.

MSG - MG9:1 : (1 Elements)

General | MultiHop | Send Data | Receive Data

Ins = Add Hop Del = Remove Hop

From Device	From Port	To Address Type	To Address
This MicroLogix	Channel 1	EtherNet/IP Device (str)	192.168.1.8



## Reading Status Data

X-gateway status data is read using a CIP Generic message.

The message will be a Read Assembly service to assembly instance 101.

The message receive size should be set to 10, the size of the X-gateway Status Assembly.

Note the use of the N15 and RIX12 files created above.

Make sure to select the Channel associated with the Ethernet port; in this case it is channel 1.

MSG - MG9: 2 : (1 Elements)

General MultiHop Send Data Receive Data

This Controller

Channel: 1 (Integral)

Communication Command: CIP Generic

Data Table Address (Receive): N15:0

Size in Bytes (Receive): 10 (Send): N/A

Target Device

Message Timeout: 33

Local / Remote: Local MultiHop: Yes

Extended Routing Info File (RIX): RIX12.2

Service: Read Assembly Service Code (hex): E

Class (hex): 4 (dec): 4

Instance (hex): 65 (dec): 101

Attribute (hex): 3 (dec): 3

Control Bits

Ignore if timed out (TO): 0

Break Connection (BK): 0

Awaiting Execution (EW): 0

Error (ER): 0

Message done (DN): 1

Message Transmitting (ST): 0

Message Enabled (EN): 0

Error

Error Code (Hex): 0

Error Description

No errors

The IP address of the X-gateway is entered into the MultiHop tab's information.

MSG - MG9: 2 : (1 Elements)

General MultiHop Send Data Receive Data

Ins = Add Hop Del = Remove Hop

From Device	From Port	To Address Type	To Address
This MicroLogix	Channel 1	EtherNet/IP Device (str.)	192.168.1.8

## 6. J1939 Data in the Control Program

Once the messages to the X-gateway have been configured in the MicroLogix, the control program is able to read and write J1939 data through the N13, N14, and N15 files.

### 6.1 Monitoring Input Data

The data in the J1939 Input file (N13) follows the format laid out in the parameter table defined in the J1939 Data and X-gateway I/O Table section above, with 4 bytes of Status Register added to front of the table.

The Input file appears as follows. (A Description of the elements has been added to the example configuration.)

Offset	Symbol	Description
N13:0	3	Status Register
N13:1	0	
N13:2	14400	Engine Speed
N13:3	170	Coolant Temperature
N13:4	20	Engine Oil Pressure
N13:5	12576	Engine Oil Temperature
N13:6	4660	Engine Hours (low word)
N13:7	18	Engine Hours (high word)
N13:8	0	
N13:9	0	
N13:10	0	

Below the table, there are input fields for 'N13:0', 'Radix: Decimal', 'Symbol:', 'Columns: 1', and 'Desc: Status Register'. At the bottom, there are buttons for 'N13', 'Properties', 'Usage', and 'Help'.

The data values in the input file are “raw” values; 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.

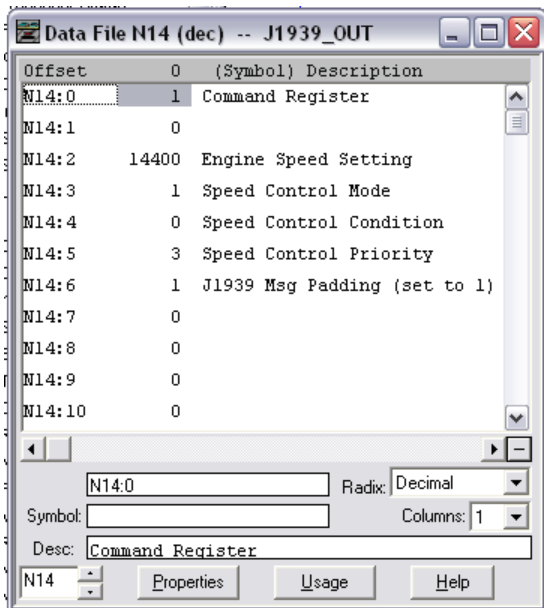
The Engine Hours parameter is a 32-bit value; hence it is stored in 2 words in the data file. The full 32-bit value can be obtained by multiplying the high word value by 65536 and adding it to the low word value. For instance, the high and low values of 18 and 4660 result in a raw Engine Hours value of 1184308 ( $4660 + (18 \times 65536)$ ).

The Status Register bit definitions are defined in the *AB7665 User Manual* in Table 5-4.

## 6.2 Controlling Output Data

The data in the J1939 Output file follows the format laid out in the parameter table defined in the J1939 Data and X-gateway I/O Table section above, with 4 bytes of Command Register added to front of the table.

The Output file appears as follows. (A Description of the elements has been added to the example configuration.)



The Command Register is defined in the *AB7665 User Manual* in Table 5-6. The Run/Idle 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 file are “raw” values. Any engineering unit values must be scaled to raw values before they are written to the Output file. 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 1800 RPM, the raw value of 14400 is achieved by dividing 1800 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 file 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.

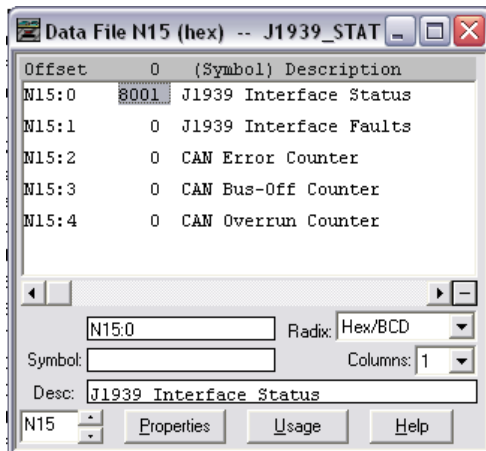
---

Any data written to the J1939 Output file will be transferred to the X-gateway on the next message instruction execution. Once received by the X-gateway, the data will be used in the next scheduled J1939 message transmission.

### 6.3 Monitoring X-gateway Status

The data in the J1939 Status file follows the format defined by the X-gateway Status Assembly. The Status Assembly is described in the *AB7665 User Manual* in Table 5-7.

The Status file appears as follows. (A Description of the elements has been added to the example configuration.)



## 7. Support

### 7.1 *Product Assistance*

#### HMS Sweden (Head Office)

E-mail: [support@hms-networks.com](mailto:support@hms-networks.com)  
Phone: +46 (0) 35 - 17 29 20  
Fax: +46 (0) 35 - 17 29 09  
Online: [www.anybus.com](http://www.anybus.com)

#### HMS North America

E-mail: [us-support@hms-networks.com](mailto:us-support@hms-networks.com)  
Phone: +1-312-829-0601  
Toll Free: +1-888-8-Anybus  
Fax: +1-312-738-5873  
Online: [www.anybus.com](http://www.anybus.com)

#### HMS Germany

E-mail: [ge-support@hms-networks.com](mailto:ge-support@hms-networks.com)  
Phone: +49-721-96472-0  
Fax: +49-721-964-7210  
Online: [www.anybus.com](http://www.anybus.com)

#### HMS Japan

E-mail: [jp-support@hms-networks.com](mailto:jp-support@hms-networks.com)  
Phone: +81-45-478-5340  
Fax: +81-45-476-0315  
Online: [www.anybus.com](http://www.anybus.com)

#### HMS China

E-mail: [cn-support@hms-networks.com](mailto:cn-support@hms-networks.com)  
Phone: +86 10 8532 3023  
Online: [www.anybus.com](http://www.anybus.com)

#### HMS Italy

E-mail: [it-support@hms-networks.com](mailto:it-support@hms-networks.com)  
Phone: +39 039 59662 27  
Fax: +39 039 59662 31  
Online: [www.anybus.com](http://www.anybus.com)

**HMS France**

E-mail: [mta@hms-networks.com](mailto:mta@hms-networks.com)  
Phone: +33 (0) 3 89 32 76 41  
Fax: +33 (0) 3 89 32 76 31  
Online: [www.anybus.com](http://www.anybus.com)

**7.2 Contact Information**

HMS Industrial Networks AB  
Box 4126  
300 04 Halmstad  
Sweden

Phone: +46 35 172900  
Fax: +46 35 172909

<http://www.anybus.com>