Anybus® X-gateway™

Application Note Interfacing J1939 with ModbusTCP

Doc. Id. SCM-1200-028
Revision 1.00
Nov 8th 2009

HMS Industrial Networks AB
Box 4126
300 04 Halmstad
Sweden

Phone: +46 35 172900 FAX: +46 35 172909
www.anybus.com

TABLE OF CONTENTS

1. Overview

The Ethernet to J1939 Gateway (part number AB7665) provides a gateway interface between Modbus TCP and J1939 networks. This document will discuss how to interface to the AB7665 on Ethernet using a Modbus TCP scanner. This will allow J1939 parameters to be monitored and controlled by a Modbus-based controller.

2. Companion Files

The following companion files are provided with this document.

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

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 Modbus 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 to line up with Modbus Input and Holding registers to provide simple access to all of the data values.

3.1 Input Data Table

Parameter	Input Register	Data Table Offset (bytes)	PGN	MessageOffset (byte.bit)	Data Length (byte.bit)	Rx Time	Scaling
Engine Speed	30003	0	61444	3.0	2.0	0	0.125 RPM/bit 0 RPM offset
Coolant Temperature	30004	2	65262	0.0	1.0	0	1 DegC/bit -40 DegC offset
Engine Oil Pressure	30005	4	65263	3.0	1.0	0	4 kPa/bit 0 kPa offset
Engine Oil Temperature	30006	6	65262	2.0	2.0	0	0.03125 DegC/bit -273 DegC offset
Engine Hours	30007,8	8	65253	0.0	4.0	5s	0.05 hours/bit 0 hours offset

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

Most of the PGN messages are transmitted cyclically by the ECU. In these case 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.

The register addresses are offset by 2 registers due to the inclusion of the status registers at the front of the input table by the X-gateway.

3.2 Output Data Table

Parameter	Holding Register	Data Table Offset (bytes)	PGN	MessageOffset (byte.bit)	Data Length (byte.bit)	Tx Rate	Scaling
Engine Speed	40005	0	0	1.0	2.0	10ms	0.125 RPM/bit 0 RPM offset
Speed Control Mode	40006	2	0	0.0	0.2	10ms	See Vendor
Speed Control Condition	40007	4	0	0.2	0.2	10ms	See Vendor
Speed Control Priority	40008	6	0	0.4	0.2	10ms	See Vendor
PGN 0 Message Padding	40009	8	0	7.7	0.1	10ms	Set to 1

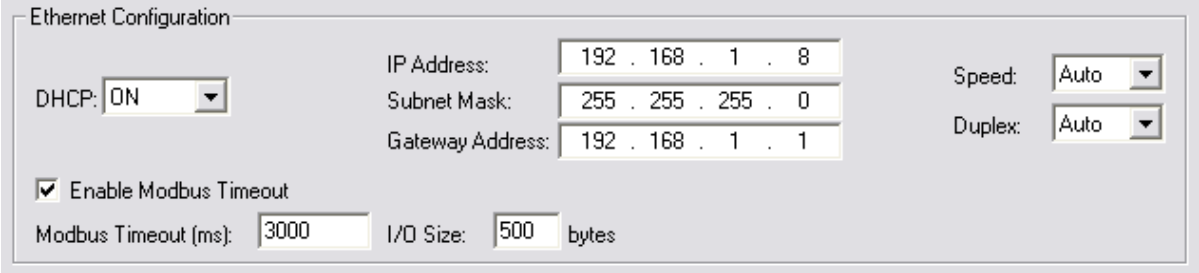
Engine speed control includes 3 2-bit values that specify how the speed control command is to be handled by the ECU. The ECU vendor should be referenced to determine the correct use of these bits for the application.

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.

The register addresses are offset by 2 registers due to the inclusion of the Run/Idle and Command registers at the front of the output table by the X-gateway.

4. X-gateway Configuration

4.1 Ethernet Configuration



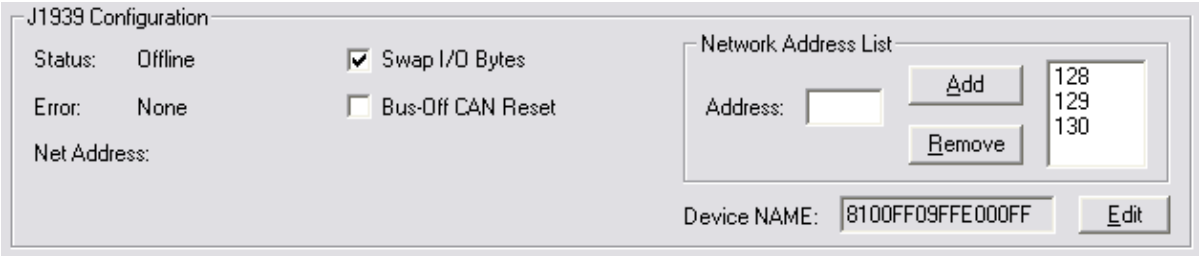
Set the DHCP and the IP Address parameters according to the Ethernet network configuration that will be used in the system.

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 Modbus scanner configuration.

Important: The Modbus Timeout parameter should be configured when using the X-gateway with Modbus TCP. The Timeout causes the module to stop transmitting on J1939 (a safe state) if the Modbus master stops communicating to the X-gateway.

The I/O size can typically be left at the default of 500 bytes for Modbus applications. Since all I/O access is done via Modbus registers, this provides the largest data table.

4.2 J1939 Configuration



Important: Set the Swap I/O Bytes option for Modbus TCP 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. J1939 Data Access From Modbus TCP

Once the X-gateway has been configured, the Modbus scanner is able to read and write J1939 data through the X-gateway using Modbus registers.

5.1 Monitoring Input Data

The data in the X-gateway Input registers follows the format laid out in the parameter table defined in the J1939 Data and X-gateway I/O Table section above.

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

Input Register	Description	Example Raw Value	Example Engineering Unit Value
30001	Status Register	3	3
30002	Unused		
30003	Engine Speed	14,400	1,800 RPM
30004	Coolant Temperature	170	130 DegC
30005	Engine Oil Pressure	20	80 kPa
30006	Engine Oil Temperature	12,576	120 DegC
30007	Engine Hours (low word)	4,660	59,215.4 hr
30008	Engine Hours (high word)	18	

The Status Register bit definitions are defined in the *AB7665 User Manual* in Table 6-7.

The data values in the Input registers 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 registers 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 x 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 X-gateway Holding (output) registers follows the format laid out in the parameter table defined in the J1939 Data and X-gateway I/O Table section above.

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

Holding Register	Description	Example Engineering Unit Value	Example Raw Value
40001	System Run/Idle Register	1	1
40002	Unused		
40003	Command Register	1	1
40004	Unused		
40005	Engine Speed Setting	1,800 RPM	14,400
40006	Speed Control Mode	1	1
40007	Speed Control Condition	0	0
40008	Speed Control Priority	3	3
40009	J1939 Msg Padding (set to 1)	1	1

The System Run/Idle Register is defined in the *AB7665 User Manual* in Table 6-9. The Command Register is defined in the manual in Table 6-10. The Run/Idle mode of the X-gateway module is controlled with the combination of the System Run Mode (bit 0) of the System Run/Idle register and the Local Run Mode (bit 0) of the Command register; both bits must be set to put the X-gateway in Run mode. The X-gateway must be in Run mode in order to transmit any messages on J1939.

The data values in the Holding registers are “raw” values; i.e. any engineering unit values must be scaled to raw values before they are written to the registers. 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 Holding register 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 X-gateway Holding registers using a Modbus Write command will be immediately available in the X-gateway Output table. Once received by the X-gateway, the data will be used in the next scheduled J1939 message transmission.

5.3 Monitoring X-gateway Status

The X-gateway status data is available through a set of Input registers. The status data is described in the *AB7665 User Manual* in Table 6-11.

The status data register layout appears as follows. Example data values have been added.

Input Register	Description	Example Value
30257	J1939 Interface Status	0x8001
30258	J1939 Interface Faults	0
30259	CAN Error Counter	0
30260	CAN Bus-Off Counter	0
30261	CAN Overrun Counter	0

6. Support

6.1 Product Assistance

HMS Sweden (Head Office)

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

HMS North America

E-mail:	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

HMS Germany

E-mail:	ge-support@hms-networks.com
Phone:	+49-721-96472-0
Fax:	+49-721-964-7210
Online:	www.anybus.com

HMS Japan

E-mail:	jp-support@hms-networks.com
Phone:	+81-45-478-5340
Fax:	+81-45-476-0315
Online:	www.anybus.com

HMS China

E-mail:	cn-support@hms-networks.com
Phone:	+86 10 8532 3023
Online:	www.anybus.com

HMS Italy

E-mail:	it-support@hms-networks.com
Phone:	+39 039 59662 27
Fax:	+39 039 59662 31
Online:	www.anybus.com

HMS France

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

6.2 Contact Information

HMS Industrial Networks AB
Box 4126
300 04 Halmstad
Sweden

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

http://www.anybus.com