Anybus® X-gateway™

Application Note Interfacing J1939 with Modbus RTU

Doc. Id. SCM-1200-029
Revision 1.00
Nov 8th 2009

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1. Overview

The J1939 to Modbus Interface module (part number AB7612) provides a gateway interface between Modbus RTU and J1939 networks. This document will discuss how to interface to the AB7612 using a Modbus RTU scanner. This will allow J1939 parameters to be monitored and controlled by a Modbus-based controller.

1. Companion Files

The following companion files are provided with this document.

BwRtuExample.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 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.

2.1 Input Data Table

Parameter	Input Register	Data Table Offset (bytes)	PGN	MessageOffset (byte.bit)	Data Length (byte.bit)	Rx Time	Scaling
Engine Speed	30001	0	61444	3.0	2.0	0	0.125 RPM/bit 0 RPM offset
Coolant Temperature	30002	2	65262	0.0	1.0	0	1 DegC/bit -40 DegC offset
Engine Oil Pressure	30003	4	65263	3.0	1.0	0	4 kPa/bit 0 kPa offset
Engine Oil Temperature	30004	6	65262	2.0	2.0	0	0.03125 DegC/bit -273 DegC offset
Engine Hours	30005,6	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 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

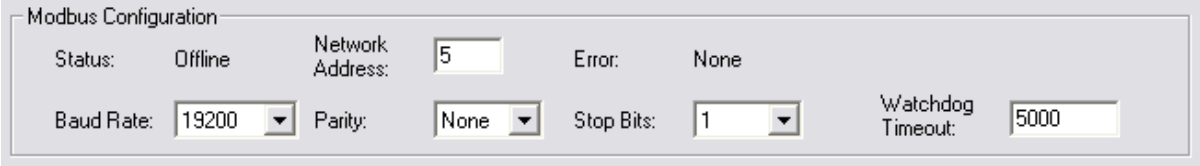
Parameter	Holding Register	Data Table Offset (bytes)	PGN	MessageOffset (byte.bit)	Data Length (byte.bit)	Tx Rate	Scaling
Engine Speed	40001	0	0	1.0	2.0	10ms	0.125 RPM/bit 0 RPM offset
Speed Control Mode	40002	2	0	0.0	0.2	10ms	See Vendor
Speed Control Condition	40003	4	0	0.2	0.2	10ms	See Vendor
Speed Control Priority	40004	6	0	0.4	0.2	10ms	See Vendor
PGN 0 Message Padding	40005	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.

3. X-gateway Configuration

3.1 Modbus Configuration

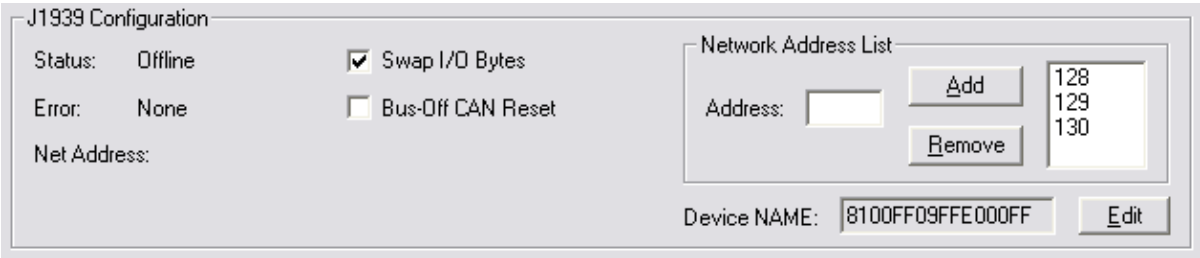


Set the Baud Rate, Parity and Stop Bits as required by the Modbus network that is being used.

Set the Network Address to an unused device address on the Modbus network. This address will be used by the Modbus scanner when reading and writing data from the module.

Important: It is highly recommended that the Modbus Timeout parameter be set to a non-zero value. The Timeout causes the module to stop transmitting on J1939 (a safe state) if the Modbus master stops communicating with the X-gateway.

3.2 J1939 Configuration



Important: Set the Swap I/O Bytes option for Modbus RTU 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.

3.3 J1939 I/O Tables

3.3.1 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.

3.3.2 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.

4. J1939 Data Access From Modbus RTU

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.

4.1 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	Engine Speed	14,400	1,800 RPM
30002	Coolant Temperature	170	130 DegC
30003	Engine Oil Pressure	20	80 kPa
30004	Engine Oil Temperature	12,576	120 DegC
30005	Engine Hours (low word)	4,660	59,215.4 hr
30006	Engine Hours (high word)	18	

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.

4.2 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	Engine Speed Setting	1,800 RPM	14,400
40002	Speed Control Mode	1	1
40003	Speed Control Condition	0	0
40004	Speed Control Priority	3	3
40005	J1939 Msg Padding (set to 1)	1	1

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.

4.3 Monitoring X-gateway Status

The X-gateway status and diagnostic data is available through a set of Input registers. The status and diagnostic data is described in the *AB7612 User Manual* in the *Modbus Interface – Diagnostic Registers* section.

The status and diagnostic data register layout appears as follows.

Input Register	Description
32001	Modbus Interface Status Register
32002	Modbus Message Counter
32003	Modbus Error Counter
32004	Modbus Exception Response Counter
32005	Modbus Slave Message Counter
32006	Modbus No Response Counter
32007	Modbus Receive Overrun Counter
32008	J1939 Interface Status Register
32009	J1939 Fault Register
32010	CAN Error Counter
32011	CAN Bus-Off Counter
32012	CAN Receive Overrun Counter

5. Support

5.1 Product Assistance

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