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Interfacing to J1939 with Modbus TCP

Part No. BW4031
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Overview

The Ethernet to J1939 Gateway (part number BW4031) provides a gateway interface between EtherNet/IP, Modbus TCP and J1939 networks. This document will specifically discuss how to interface to the BW4031 via Modbus TCP from a Modbus TCP Master, enabling J1939 parameters to be monitored and controlled by the Modbus TCP Master.

Companion Files

The following companion files are provided with this document.

BwTcpExample.bwnxg	BWConfig configuration file (BWConfig 2.0 v1.0.57.0)

J1939 Data and the BridgeWay I/O Table

The first step in any BridgeWay system configuration is to determine what J1939 data parameters are of interest and where those parameters want to be located in the BridgeWay 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 the data values.

Input Data Table

Parameter	Input Register	Data **Table** Offset (bytes)	PGN	MessageOffset (byte.bit)	Data Length (byte.bit)	Rx Time	Scaling
Engine Speed	30003	4	61444	3.0	2.0	0	0.125 RPM/bit 0 RPM offset
Coolant Temperature	30004	6	65262	0.0	1.0	0	1 DegC/bit -40 DegC offset
Engine Oil Pressure	30005	8	65263	3.0	1.0	0	4 kPa/bit 0 kPa offset
Engine Oil Temperature	30006	10	65262	2.0	2.0	0	0.03125 DegC/bit -273 DegC offset
Engine Hours	30007,8	12	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 BridgeWay 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 BridgeWay.

Output Data Table

Parameter	Holding Register	Data Table Offset (bytes)	PGN	MessageOffset (byte.bit)	Data Length (byte.bit)	Tx Rate	Scaling
Engine Speed	41029	4	0	1.0	2.0	10ms	0.125 RPM/bit 0 RPM offset
Speed Control Mode	41030	6	0	0.0	0.2	10ms	See Vendor
Speed Control Condition	41031	8	0	0.2	0.2	10ms	See Vendor
Speed Control Priority	41032	10	0	0.4	0.2	10ms	See Vendor
PGN 0 Message Padding	41033	12	0	7.7	0.1	10ms	Set to 1

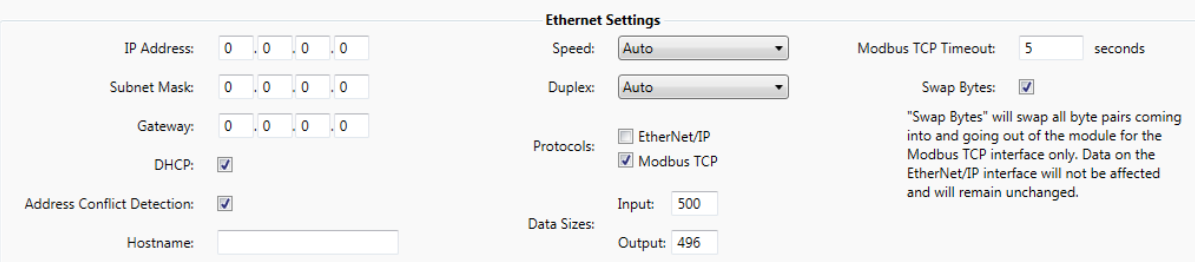
Engine speed control includes 3 2-bit values that specify how the speed control command is to be handled by the ECU. The ECU vendor should be referenced to determine the correct use of these bits for the application.

The PGN 0 message is required to be 8 bytes long. To force the BridgeWay 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 Command register at the front of the output table by the BridgeWay.

BridgeWay Configuration

Ethernet Configuration



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

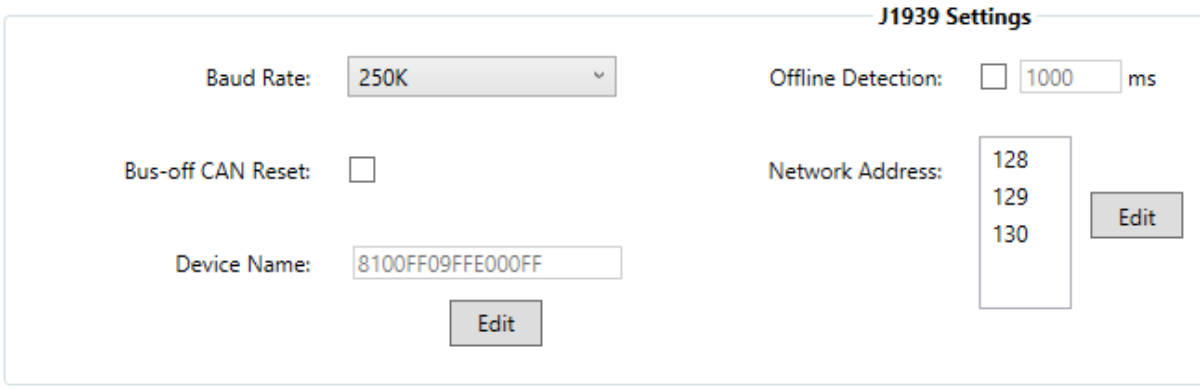
Important: If the BridgeWay is configured to use DHCP, it is highly recommended that an IP Address be configured for the BridgeWay's MAC address in the DHCP server. This will guarantee that the module will always have the same IP address that will be configured in the Modbus scanner configuration.

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

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.

The Swap Bytes option should be enabled to put the IO data in the right byte orientation for the Modbus TCP master as Modbus is a big-endian network and J1939 is little endian.

J1939 Configuration



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.

J1939 I/O Tables

J1939 Input Table

Table Address	PGN	PGN Label	PGN Position (byte.bit)	Data Bits	Data Bytes. Bits	Update Rate	Target Address	PGN Acronym	SPN	SPN Name	Description
300001.0			0.0	32	4.0						Reserved for status register
300003.0	61444	Electronic Engine Controller 1	3.0	16	2.0	0	255	EEC1	190	Engine Speed	
300004.0	65262	Engine Temperature 1	0.0	8	1.0	0	255	ET1	110	Engine Coolant Temperature	
300005.0	65263	Engine Fluid Level/Pressure 1	3.0	8	1.0	0	255	EFL/P1	100	Engine Oil Pressure	
300006.0	65262	Engine Temperature 1	2.0	16	2.0	0	255	ET1	175	Engine Oil Temperature 1	
300007.0	65253	Engine Hours, Revolutions	0.0	32	4.0	5000	255	HOURS	247	Engine Total Hours of Operation	

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

J1939 Output Table

Table Address	PGN	PGN Label	PGN Position (byte.bit)	Data Bits	Data Bytes. Bits	Update Rate	Priority	Target Address	PGN Acronym	SPN	SPN Name	Description
401027.0			0.0	32	4.0							Reserved for command register
401029.0	0	Torque/Speed Control 1	1.0	16	2.0	10	3	0	TSC1	898	Engine Requested Speed/Speed Limit	
401030.0	0	Torque/Speed Control 1	0.0	2	0.2	10	3	0	TSC1	695	Engine Override Control Mode	
401031.0	0	Torque/Speed Control 1	0.2	2	0.2	10	3	0	TSC1	696	Engine Requested Speed Control Conditions	
401032.0	0	Torque/Speed Control 1	0.4	2	0.2	10	3	0	TSC1	897	Override Control Mode Priority	
401033.0	0	Torque/Speed Control 1	7.7	1	0.1	10	3	0	TSC1			message padding

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

J1939 Data Access from Modbus TCP

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

Monitoring Input Data

The data in the BridgeWay Input registers follows the format laid out in the parameter table defined in the J1939 Data and BridgeWay 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 is shown in the *BW4031 User Manual* in Table 26.

The data values in the Input registers are “raw” values; i.e. they must be scaled to engineering units. The gain and offset are defined in the parameter table in the J1939 Data and BridgeWay 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.

Controlling Output Data

The data in the BridgeWay Holding (output) registers follows the format laid out in the parameter table defined in the J1939 Data and BridgeWay 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
41027	Command Register	1	1
41028	Unused		
41029	Engine Speed Setting	1,800 RPM	14,400
41030	Speed Control Mode	1	1
41031	Speed Control Condition	0	0
41032	Speed Control Priority	3	3
41033	J1939 Msg Padding (set to 1)	1	1

The Command Register is shown in the *BW4031 User Manual* in Table 28. The Run/Idle mode of the BridgeWay module is controlled by the Local Run Mode (bit 0) of the Command register. The BridgeWay must be in Run mode in order to transmit any configured output table 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 are defined in the parameter table in the J1939 Data and BridgeWay 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 BridgeWay Holding registers using a Modbus Write command will be immediately available in the BridgeWay Output table. Once received by the BridgeWay, the data will be used in the next scheduled J1939 message transmission.

Monitoring BridgeWay Status

The BridgeWay status data is available through a set of Input registers. The status data is described in the *BW4031 User Manual* in Table 29.

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

Input Register	Description	Example Value
31025	J1939 Interface Status	0x0001
31026	J1939 Interface Faults	0
31027	CAN Error Counter	0
31028	CAN Bus-Off Counter	0
31029	CAN Overrun Counter	0

Support

Technical Product Assistance

If you require BridgeWay product technical support by phone:

- Call 248-549-1200
- Dial 0 for the Operator
- Ask for BridgeWay Support

If you require support by email:

- productsupport@pyramidsolutions.com
- Subject: “BW4031 Support Request”
- Provide a detailed explanation of your question or issue in the email text.

You can also obtain BW4031 files and information online at the following URL:
http://pyramidsolutions.com/support/network-connectivity-support/

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