AN414 – Protocol Converter to Convert CANopen® to J1939

Introduction

Axiomatic's Protocol converter can perform data routing and data rescaling between all three interfaces (two CAN ports and one RS485 port). Depending on the Protocol Converter firmware, the interfaces include two J1939 CAN channels and one Modbus RTU (P/N: AX140100), or one J1939 CAN and one CANopen® and Modbus RTU (P/N: AX140200) or two J1939 CAN and one J1587 (P/N: AX140400). Furthermore, the AX140100 and AX140400 also support direct, low-level routing of J1939 messages between the two CAN channels. This provides a fast filtering/gateway option for connecting two J1939 buses, even those with different baud rates.

The firmware is designed such that all configurations can be made using the Axiomatic Electronic Assistant software.

Versions

The standard AX140100 product has 24 Modbus messages that can be configured for read or write functions, 56 CAN Input Messages, and 24 CAN output messages that can each be mapped to 5 different input signals. The AX140100 does not support TCP.

The AX140100-100 model uses a special firmware version geared towards receiving many CAN messages. AX140100-100 has 4 Modbus messages that can be configured for read or write functions, 120 CAN Input Messages and 4 CAN output messages that can each be mapped to 5 different input signals.

The AX140200 Protocol Converter's J1939 interface can be configured to read in CAN frames with both 11bit and 29bit identifiers and can convert from CANopen® to J1939. The module's CANopen® settings are configured via CAN2, using third party CANopen® tools to configure the various objects.

Latency

Latency is dependent on bus load, but a typical delay from converting CANopen® to J1939 is 100msec.

Setting the J1939 Baud Rate

The J1939 baud rate can be changed as many times as needed, but only if the bootloader is not started. Setting the "Force Bootloader to Load on Reset" flag programs the current interface baud rates into the bootloader

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data block. This will prevent further changes from being made to the J1939 baud rate. The configuration can only be reset by reprogramming the Protocol Converter application using the Axiomatic Electronic Assistant and a CAN-USB adaptor.

All J1939 interfaces of the protocol converter support the Axiomatic Electronic Assistant configuration tool. In case the baud rate is mistakenly programmed to a wrong value, the other J1939 interface (or CANopen® interface in case of CANopen® capable devices, object 5600h) can be used to reprogram the J1939 baud rate.

The device needs to be restarted (power cycled) before it can use the new CANopen® parameters.

Modbus RTU Network Parameters (AX140100 & AX140200 only)

Modbus RTU parameters include settings for the RS485 port, such as baud rate, data bits, parity and stop bits. The list of available baud rates contains predefined values starting from 1200 bps up to 115200 bps, and an entry for defining a custom baud rate.

The device needs to be restarted (power cycled) before it can use the new Modbus RTU parameters.

In case Odd or Even parity is selected for use with 8-bit UART data, the “UART Data Bits” setpoint needs to be set to 9 bits to accommodate the 8 data bits and the parity bit.

Low-level UART mode (AX140100 & AX140200 only)

The AX140100 and AX140200 firmware supports low level CAN <-> RS485 direct data forwarding. The “RS485 mode” setpoint controls whether this type of data forwarding is active.

To forward received CAN data into RS485 as is, the CAN Input Signals’ “Data Destination” setpoint needs to be set as “2 – DIRECT RS485 FORWARDING”.

The inverse of this process, the configuration of RS485 data forwarding into CAN, is done using the “Start char #1”, “Start char #2”, “End char #1” and “End char #2” setpoints. Also “Forward raw RS485 to CAN” needs to be set to “Yes”.

The start and end chars define the one or two char sequences needed to parse the RS485 message stream and generate the CAN messages from this. To use neither a start nor end char, it needs to be set to ‘-1’.

The “CAN ID for recvd RS485 msgs” and “Use 11bit ID” setpoints define the CAN ID to use when forwarding the received RS485 data.

J1587 Network Parameters (AX140400 only)

J1587 network parameters include settings for the RS485 port, such as baud rate, data bits, parity and stop bits. The list of available baud rates contains values starting from 1200 bps up to 115200 bps.

The device needs to be restarted (power cycled) before it can use the new J1587 parameters.

CAN Output Message Specification

The AX140100 supports up to 24 CAN output messages for both J1939 interfaces in total.

The AX140200 supports 12 CAN output messages and AX140400 supports 16 CAN output messages for both J1939 interfaces in total. Each message can hold up to 5 signals.

The special CAN to Modbus slave version, AX140100-100, supports only 4 output messages. This is because the main purpose of that Protocol Converter version is to listen to CAN messages and make the received data available in Modbus.

CAN Input Message Specification

The AX140100 supports up to 56 CAN input messages for both J1939 interfaces in total. The AX140200 and AX140400 support 32 CAN input messages in total. Each message can hold one input signal.

The special CAN to Modbus version, AX140100-100, supports 120 CAN input messages.

It must be noted that if multiple CAN Input Signals are listening to the same PGN, only the last one with the same PGN will send a trigger signal to the other Protocol Converter function blocks. For example, if CAN Input Signals #1, #2 and #4 are configured to receive the same PGN, only CAN Input Signal #4 can be used as a trigger source in other Protocol Converter functions.

J1939-J1939 Low-Level Routing Definition

The low-level routing feature will handle the received CAN frames before the frames are passed over to J1939/CANopen® stack(s). This way, all received messages can be routed, independent of the higher-level device configuration.

In case a Custom ID filter is used, and the specified ID is equal to or below 0x7FF, the ID is assumed to be received in an 11-bit ID CAN frame. To properly initialize the CAN filters, a power cycle is needed after configuring Custom IDs with values equal to or below 0x7FF (2047 dec).

The low-level routing feature can parse the configured PGNs (Match PGN filter configuration) from TP frames and forward the necessary set of frames to the other CAN interface.

CANopen® RPDO Parameters

Devices with a CANopen® interface, such as the AX140200 and AX140300, support basic configuration of the CANopen® parameters using the Axiomatic Electronic Assistant. The PDO Parameters for the first four receive PDOs can be configured using this setpoint group. The CANopen® RPDO Parameter settings are only applied at device boot up. After changing these parameters, a power cycle is needed before the new settings can be used.

CANopen TPDO Parameters

Devices with a CANopen® interface, such as the AX140200 and AX140300, support basic configuration of the CANopen® parameters using the Axiomatic Electronic Assistant. The PDO Parameters for the first four transmit PDOs can be configured using this setpoint group. The CANopen® TPDO Parameter settings are only applied at device boot up. After changing these parameters, a power cycle is needed before the new settings can be used.

Master and Slave Function

The units support both Master and Slave functions, and these are selectable.

References

For more details, review the user manual found on the Axiomatic website at: https://www.axiomatic.com.

Axiomatic Electronic Assistant KIT Part Numbers: **AX070502** or **AX070506K.**

All CANopen® parameters are configured using the CANopen® interface and an EDS file supplied with the device. The configuration can be done using CANopen® tools available on the market.

Version	Date	Authors	Comments
1.00	December 17, 2020	Greg Laronde / Sue Thomas	Initial Release
1.01	July 6, 2023	Kiril Mojsov	Legacy Updates & Marketing Review

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