Ethernet – CAN(/FD) Gateway
Protocol Specification

for 10BASE-T1S Media Gateway
(firmware v1.1)

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Changes

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26.03.2025	Initial release	MM
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1. Introduction

The **10BASE-T1S Media Gateway** product can realize a gateway between Ethernet and CAN(/FD). This document describes the gateway communication protocol over Ethernet to create a bi-directional bridge between the Ethernet (10BASE-T1S or 100BASE-TX port) and the CAN(/FD) bus.

Figure 1 10BASE-T1S Media Gateway

The Media gateway offers one 10BASE-T1S Single-Pair Ethernet port available over the D-SUB connector, and one 10/100BASE-TX Ethernet with the RJ-45 connector. CAN(/FD) bus, that is also accessible on the D-SUB9 connector, is internally connected into the MCU that realizes the bridge between CAN(/FD) and Ethernet. The device can be configured either through the ten on-board DIP switches or over its web server.

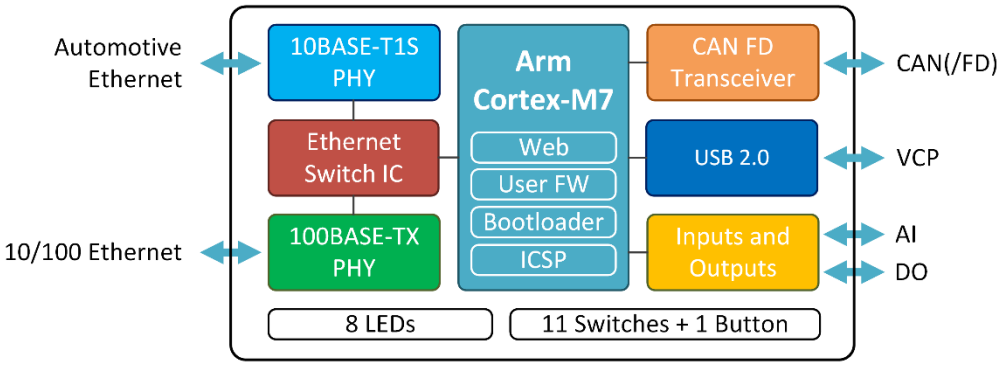

Figure 2 10BASE-T1S Media Gateway block diagram

CAN(/FD) frames received by the MCU are converted into TCP or UDP packets (with the format described by this document) and then transmitted via an internal Ethernet switch to either the 10BASE-T1S or RJ-45 port. Vice versa, TCP or UDP packets (with the format described by this document) that are addressed for the IP address of this device and the port of the gateway protocol (see 3.1) are forwarded by the Ethernet switch toward the MCU and then transmitted onto the CAN(/FD) bus.

2. Product Specification

10BASE-T1S Media Gateway
p/n: 10BASET1S-MG

Specification

- 10BASE-T1S port
- 10/100BASE-TX port
- CAN(/FD) channel
- USB Type-C 2.0
- Digital output (open-drain)
- Analogue input (0-30V)
- Built-in DIP switches for easy configuration
- Web interface for advanced configuration
- Open communication protocol over Ethernet, USB, and CAN(/FD) for integration
- Can be used as a USB-CAN(/FD) or Ethernet-CAN(/FD) interface
- USB or external power

3. Gateway Communication Protocol

CAN and CAN FD frames, upon conversion to Ethernet packets, are represented by the format outlined in the following sections. To transmit a CAN(/FD) message, the Ethernet packet must be directed to the device on the port that is always one port higher than the device port allocated for the communication protocol. Received CAN(/FD) frames and received error frames are forwarded onto this port as well. The user must select the destination IP address and can select own destination port for UDP packets.

3.1. Ethernet

Ethernet port default configuration:

IP address	**192.168.1.100**
Subnet mask	255.255.255.0
Default gateway	192.168.1.1
Web port	80
Communication protocol port	8000
Gateway protocol port	**8001** (e.g. 8000+1)
Protocol	TCP or UDP

The media gateway offers the gateway communication over TCP/IP or UDP and its Ethernet parameters can be changed. This can be done over the device's embedded web server (Google Chrome web browser is recommended), or over the basic communication protocol.

UDP packet structure:

Ethernet Header (14B)	**IP Header (20 B)**	**UDP Header (8B)**	**DATA (X B)**
Destination address + Source address + Length	Destination IP address (4B)	UDP Destination Port (2B)	CAN Message Rx (xB), CAN Message Tx or CAN Error Packet(xB)

TCP packet structure:

Ethernet Header (14B)	**IP Header (20 B)**	**TCP Header (20-60B)**	**DATA (X B)**
Destination address + Source address + Length	Destination IP address (4B)	TCP Destination Port (2B)	CAN Message Rx (xB), CAN Message Tx or CAN Error Packet(xB)

The rest of the documentation refers to DATA part only. The Destination IP address and Destination Port can be changed over the web or by the communication protocol.

3.2. CAN bus

All CAN bus settings like baud rate, sample point etc. can be changed over the web server or the communication protocol. Also, the CAN(/FD) to Ethernet frame forwarding can be configured by the web or the communication protocol.

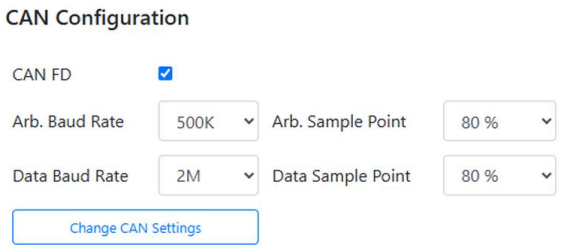

Figure 3 CAN(/FD) channel configuration over web

The protocol which the messages are transmitted (TCP, UDP, or over USB) is configurable. If nothing is selected, the gateway functionality is **disabled**. The UDP and TCP cannot be selected simultaneously. The CAN(/FD) frame forwarding can be white-listed for particular CAN IDs. It can be set up in the CAN ID Filtering textbox – for example: "0x123, 0x456".

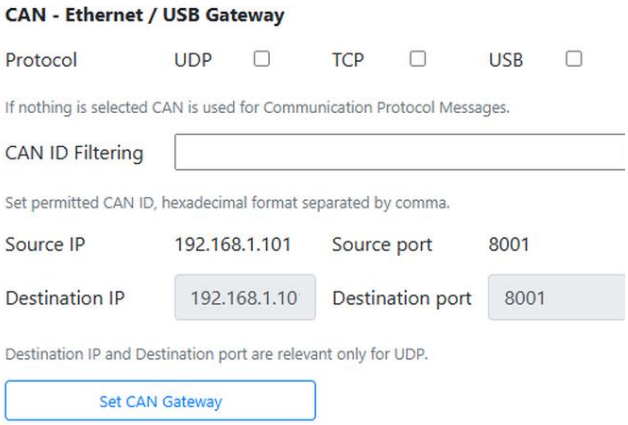

Figure 4 Ethernet – CAN(/FD) gateway configuration over web

3.3. Virtual COM port

The virtual COM port is available through the USB port. The VCP is primarily used for communication messages with special message format described in *10BASE-T1S Communication Protocol Specification*. But it can be also used for the gateway protocol. The data section is the same as the Ethernet packet data section.

VCP configuration: 115200 Baud, 8 data bits, no parity, 1 stop bit.

VCP (USB) packet structure:

DATA (X B)
CAN Message Rx (xB), CAN Message Tx (xB) or CAN Error Packet(11B)

4. Message Specification

4.1.1. Transmit CAN Frame

This message transmits a CAN frame. The structure of the frame differs when the Extended ID is set. Without the Extended ID, the header (protocol frame data before the data part) is 5 bytes long. With Extended ID it is 7 bytes long. The format of ID is LSB.
When the frame is sent on the bus, it is also echoed back to Ethernet.

Request for a standard ID (EXT ID bit is 0):

DATA 0	DATA 1	DATA 2	DATA 3	DATA 4	DATA 5	DATA 6…n
Message Type	Channel	Message Flags	ID0	ID1	DLC	DATA

Request for an Extended ID (EXT ID bit is 1):

DATA 0	DATA 1	DATA 2	DATA 3	DATA 4	DATA 5	DATA 6	DATA 7	DATA 8…n
Message Type	Channel	Message Flags	ID0	ID1	ID2	ID3	DLC	DATA

Message type: 0x20

Channel: must be set to 0

Message Flags:

bit 7							bit 0
Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	RTR	EXT ID

- Bit 1: **RTR**
  - 0 – Data frame
  - 1 – Remote frame
- Bit 0: **EXT ID**
  - 0 – Standard ID. Request without data is 5 bytes
  - 1 – Extended ID. Request without data is 7 bytes

ID: CAN ID Little Endian format

DLC: Number of data bytes 0-8

4.1.2. Transmit CAN FD Frame

This message transmits a CAN FD frame. The structure of the frame differs when the Extended ID is set. Without the Extended ID, the header (protocol frame data before the data part) is 5 bytes long. With Extended ID it is 7 bytes long. The format of ID is LSB.
When the frame is sent on the bus, it is also echoed back to Ethernet.

Request for a standard ID (EXT ID bit is 0):

DATA 0	DATA 1	DATA 2	DATA 3	DATA 4	DATA 5	DATA 6…n
Message Type	Channel	Message Flags	ID0	ID1	DLC	DATA

Request for an Extended ID (EXT ID bit is 1):

DATA 0	DATA 1	DATA 2	DATA 3	DATA 4	DATA 5	DATA 6	DATA 7	DATA 8…n
Message Type	Channel	Message Flags	ID0	ID1	ID2	ID3	DLC	DATA

Message Type: 0x21

Channel: must be set to 0

Message Flags:

bit 7							bit 0
Reserved	Reserved	Reserved	Reserved	ESI	BRS	Reserved	EXT ID

- Bit 3: **ESI**
  - 0 – Transmitting node is error active
  - 1 – Transmitting node is error passive
- Bit 2: **BRS**
  - 0 – FDCAN frames transmitted / received without bit rate switching
  - 1 – FDCAN frames transmitted / received with bit rate switching
- Bit 0: **EXT ID**
  - 0 – Standard ID. Request without data is 5 bytes
  - 1 – Extended ID. Request without data is 7 bytes

ID: CAN ID Little Endian format

DLC: Number of data bytes 0-64

4.1.3. CAN Frame Received

Message response has similar structure as Transmit Frame. The only difference is the timestamp is added (data bytes 3 to 10). The Timestamp represents the number of microseconds since the start of the CAN channel. For this message, no request is needed, device transmits it automatically once a CAN frame is received from the bus.

Response if frame with a standard ID was received (EXT ID bit is 0):

DATA 0	DATA 1	DATA 2	DATA 3…10	DATA 11	DATA 12	DATA 13	DATA 14…n
Message Type	Channel	Message Flags	Timestamp	ID0	ID1	DLC	DATA

Message type: 0x20

Channel: must be set to 0

Message Flags:

bit 7							bit 0
Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	RTR	EXT ID

- Bit 7-2: **Reserved**
- Bit 1: **RTR**
  - 0 – Data frame
  - 1 – Remote frame
- Bit 0: **EXT ID**
  - 0 – Standard ID. Request without data is 5 bytes
  - 1 – Extended ID. Request without data is 7 bytes

Timestamp: 64-bit number representing duration in microseconds from channel start

ID: CAN ID Little Endian format

DLC: Number of data bytes 0-64

Response if frame with Extended ID was received (EXT ID bit is 1):

DATA 0	DATA 1	DATA 2	DATA 3...10	DATA 11
Message Type	Channel	Message Flags	Timestamp	ID0
DATA 12	**DATA 13**	**DATA 14**	**DATA 15**	**DATA 16-n**
ID1	ID2	ID3	DLC	DATA

Meaning of the fields is the same as in transmission request message.

4.1.4. CAN FD Frame Received

Message response has similar structure as Transmit Frame. The only difference is the timestamp is added (data bytes 3 to 10). The Timestamp represents the number of microseconds since the start of the CAN FD channel. For this message, no request is needed, device transmits it automatically once a CAN FD frame is received from the bus.

Response if frame with a standard ID was received (EXT ID bit is 0):

DATA 0	DATA 1	DATA 2	DATA 3...10	DATA 11	DATA 12	DATA 13	DATA 14-n
Message Type	Channel	Message Flags	Timestamp	ID0	ID1	DLC	DATA

Message Type: 0x21

Channel: must be set to 0

Message Flags:

bit 7							bit 0
Reserved	Reserved	Reserved	Reserved	ESI	BRS	Reserved	EXT ID

- Bit 7-4, 1: **Reserved**
- Bit 3: **ESI**
  - 0 – Transmitting node is error active
  - 1 – Transmitting node is error passive
- Bit 2: **BRS**
  - 0 – FDCAN frames transmitted / received without bit rate switching
  - 1 – FDCAN frames transmitted / received with bit rate switching
- Bit 0: **EXT ID**
  - 0 – Standard ID. Request without data is 5 bytes.
  - 1 – Extended ID. Request without data is 7 bytes.

Timestamp: 64-bit number representing duration in microseconds from channel start

ID: CAN ID Little Endian format

DLC: Number of data bytes 0-64

Response if frame with Extended ID was received (EXT ID bit is 1):

DATA 0	DATA 1	DATA 2	DATA 3...10	DATA 11
Message Type	Channel	Message Flags	Timestamp	ID0
DATA 12	**DATA 13**	**DATA 14**	**DATA 15**	**DATA 16...n**
ID1	ID2	ID3	DLC	DATA

Meaning of the fields is the same as in transmission request message.

4.1.5. CAN Error Received

This message is sent asynchronously when there is some error related to CAN (typically the CAN error frame).

Response:

DATA 0	DATA 1	DATA 2	DATA 3…10
Message Type	Channel	Error Type	Timestamp

Message type: 0x30

Channel: Always 0

Error type:

- 0: Bit Stuff Error
- 1: Form Error
- 2: Acknowledge Error
- 3: Bit Error
- 4: CRC Error
- 5: TX Buffer Full

Timestamp: 64-bit number representing duration in microseconds from start of the CAN(/FD) channel.

5. How to Use

At first, enable the CAN(/FD) Gateway function by selecting the protocol (TCP / UDP/ USB - see Figure 4). Even if no protocol is selected, the CAN(/FD) frames are transmitted to the CAN bus after issuing the Transmit CAN(/FD) frame commands.

5.1. Message Examples

The bytes here represent only the DATA section of packet (see 3.1).

Command	Bytes [hex]
Transmit CAN Frame Channel 0, format = CAN, ID = 0x01FF, DLC = 7, Data (hex) = 05 04 50 06 06 08 14	0x20 0x00 0x00 0xFF 0x01 0x07 0x05 0x04 0x50 0x06 0x06 0x08 0x14 0xFE
Transmit CAN FD Frame Channel 0, format = CAN FD, BRS, ID = 0x01FF, DLC = 7, Data (hex) = 05 04 50 06 06 08 14	0x21 0x00 0x14 0xFF 0x01 0x07 0x05 0x04 0x50 0x06 0x06 0x08 0x14 0x12
CAN Frame Received Channel 0, format = CAN, ID = 0x01FF, DLC = 7, Data (hex) = 05 04 50 06 06 08 14, Timestamp = 91 601 865µs (1.526698 min)	0x20 0x00 0x00 0x09 0xbb 0x75 0x05 0x00 0x00 0x00 0x00 0xff 0x01 0x07 0x05 0x04 0x50 0x06 0x06 0x08 0x14
CAN Error Frame Received Channel 0, Error type = 0 (Bit Stuff Error), Timestamp = 652 185 335µs (10.869756 min)	0x30 0x00 0x00 0xf7 0x8e 0xdf 0x26 0x00 0x00 0x00 0x00

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