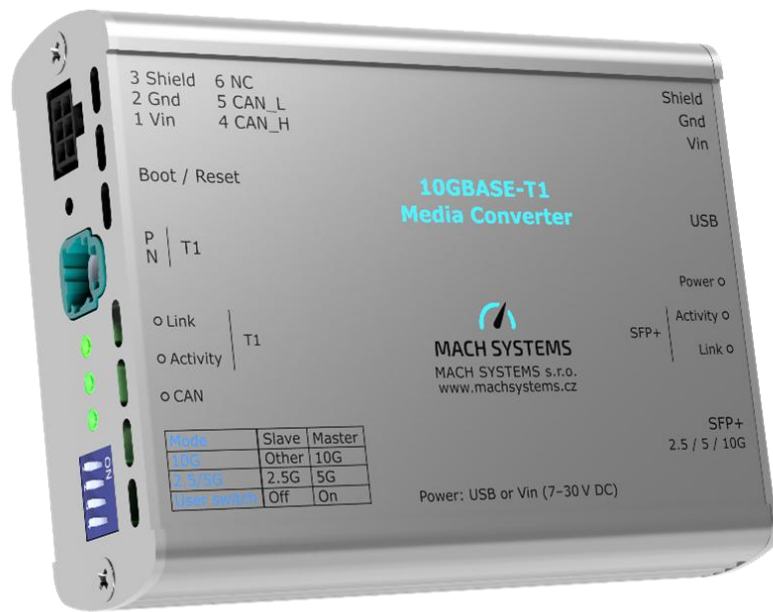


10GBASE-T1 Media Converter

User Manual



CHANGES

Date	Description	Created By	Review By
31.10.2025	Initial release	PK	MM

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1 Introduction

The **10GBASE-T1 Media Converter** is a Multigigabit Automotive Ethernet (MultiGBASE-T1) to Standard Ethernet (MultiGBASE-T) converter that supports 10GBASE-T1, 5GBASE-T1, and 2.5GBASE-T1 standards. The media converter realizes a bi-directional physical layer conversion between a 2.5/5/10 gigabit automotive Ethernet (IEEE 802.3ch) and a wire / optical fibre SPF+ module. The media converter features a Rosenberger H-MTD connectors (USCAR 777-U-002-1-Z01 compliant) on T1 side. The device supports OPEN Alliance's MACsec (TC17) and the Sleep/Wake-up (TC10) functionality.

The master/slave T1 mode and speed selection can be easily configured using the on-board switches. Advanced configuration, status information, and cable diagnostics are available via USB through a free PC application. Additionally, the media converter can function as a USB to CAN(/FD) interface, operating simultaneously with its conversion function.

The user can programmatically configure the device over USB or CAN(/FD) with the help of the open communication protocol that allows to read status information, configure port parameters, and enables to easily integrate the converter into any system. A free-of-charge PC application is available to visualise the device's status, configure its parameters and use the advanced functions.

Product web site: <https://www.machsystems.cz/en/products/embedded-networking/gateways-and-bus-converters/10gbase-t1-media-converter>



Figure 1 Front sides



Figure 2 Rear side

2 Features

- MultiGig-T1 media converter
- 2.5/5/10GBASE-T1 support (IEEE 802.3ch)
- OPEN Alliance's MACsec (TC17) support
- OPEN Alliance's Sleep/Wake-up (TC10) support
- Rosenberger H-MTD automotive Ethernet connector
- SFP+ slot compatible with any XFI/USXGMII support module
- On-board switches for configuration
- On-board status LEDs
- Automatic polarity detection on T1 port
- Frame generator mode
- Free-of-charge PC application
- USB VCP for status information, advanced configuration, and cable diagnostic
- USB-CAN(/FD) interface function
- Power over USB PD (Type-C), terminal block, or Molex connector
- USB for configuration, status and port diagnostic
- Can be used as a USB to CAN(/FD) interface
- Aluminium enclosure
- DIN rail mounting possibility

3 Technical Specification

Communication channels	
Automotive Ethernet	10GBASE-T1, 5GBASE-T1, 2.5GBASE-T1 (IEEE 802.3ch)
SFP+ Ethernet	10GBASE-R / 5GBASE-R / 2.5GBASE-R 10G USXGMII / 5G USXGMII / 2.5G USGMII
CAN	CAN-HS channel with CAN FD support (ISO 11898-1:2015; CAN2.0A/B; ISO CAN FD)
USB	USB 2.0 CDC with USB PD support up to 20V
Electrical	
Power	USB PD 10W minimum requirement External 7 – 30 V DC (polarity and surge protection) over a 3-pin or 6-pin Molex block
Consumption	10 Gbit/s: 200 mA @ 12 V <i>Note: The consumption has been measured without an SFP+ module, the total power consumption depends on an SFP+ module used.</i>
LEDs	4 Dual-colour LEDs 2 RGB colour LEDs
Transceiver	10GBASE-T1: Infineon MV-Q3244
Mechanical	
Connectors	MultiGBASE-T1: Rosenberger H-MTD SFP+ slot: Generic cage CAN bus and power: 6-pin terminal block (Molex Micro-Fit) Power: 3-pin terminal block (TE) USB 2.0 PD: USB Type-C
Buttons and switches	4 DIP switches 1 Push button
Dimensions (L x W x H)	108 x 82 x 33 mm
Weight	182 g
Operating temperature	-20 to 70 °C
Protection	IP20
Placement	Table (adhesive pads included) DIN-rail mount (sold separately)
Enclosure	Aluminium profile

Table 1 Technical specification

4 Device Description

4.1 Overview

The media converter features five connectors, six LEDs, four DIP switches, and one push button.

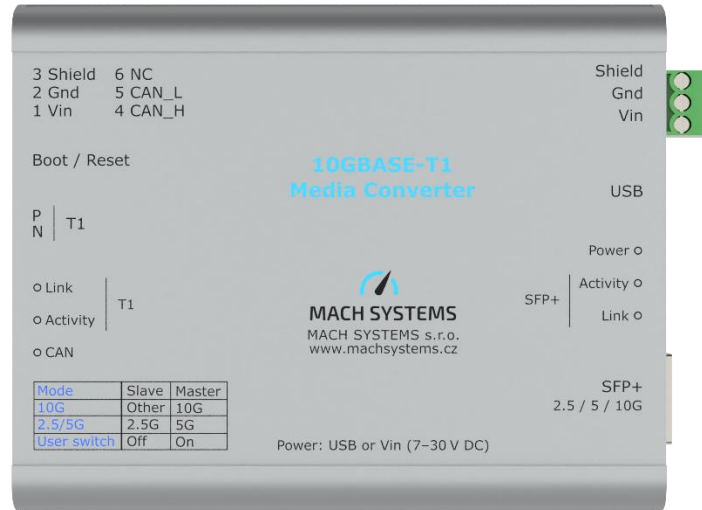


Figure 3 Top view

4.2 Power

The 10GBASE-T1 Media Converter can be powered over USB PD, or externally via a removable 3-pin terminal block, or via the 6-pin Molex Micro-Fit connector. The device can request the power up to 20V over the USB-PD. The minimum sufficient power for USB PD is 10W (voltage 5V and current 2A). The external power range is 7 - 30 V DC. If the power supply is insufficient (for example, when the device is powered via USB without USB PD support), the LINK LEDs will turn red.

All grounds are connected together.

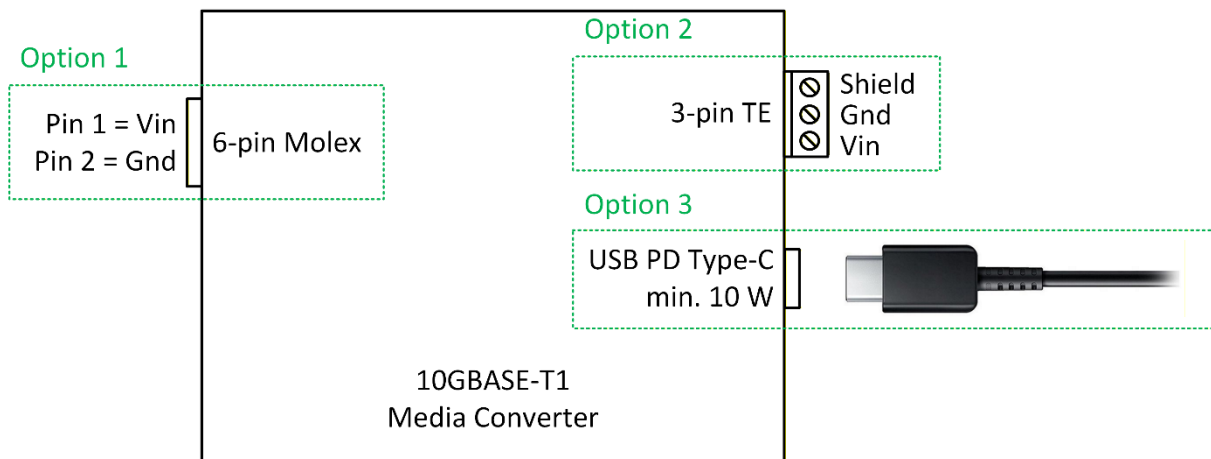


Figure 4 Power options

Figure 5 depicts the internal power block. When the external power is connected, there is no power drawn from USB if the USB PD negotiated voltage is lower than the external voltage.

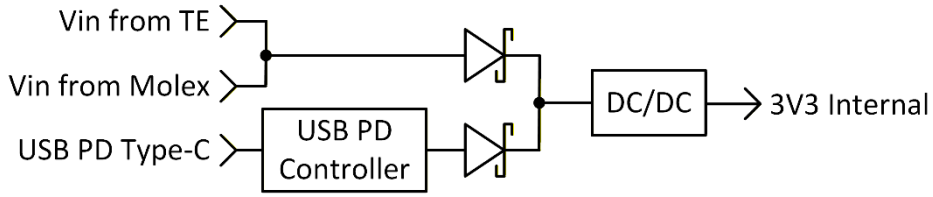


Figure 5 Power diagram

4.3 Connectors

4.3.1 Rosenberger H-MTD

The 2-pin Rosenberger H-MTD (p/n: E6S20A-40MT5-Z) is used for 10G (or 5G/2.5G) BASE-T1 channel on the 10GBASE-T1 Media Converter.

Mating connector p/n: E9K10A-1AQX5-Z

	Pin	Name	Description
<p>Front view</p>	1	T1-P	Positive
	2	T1-N	Negative

Table 2 Rosenberger H-MTD connector - pin assignment

4.3.2 SFP+ connector

The media converter is equipped with a standard SFP+ connector and supports both copper and optical SFP+ modules. However, some third-party SFP+ modules may not reliably support 5G or 2.5G T1 speeds. To ensure full compatibility, we offer our own SFP+ RJ-45 module (P/N: 10GSFP1-RJ45), which is fully validated with the media converter and operates reliably at 10G and 5G T1 speeds.

The second option is a USXGMII-based module. This solution supports all T1 speeds (10G, 5G and 2.5G). However, auto-negotiation is not supported in this mode. The link speed must be manually forced on the connected link partner, which may not always be possible depending on the partner device.

The third option is a dedicated 2.5G SFP (P/N: 2.5GSFP1-RJ45), module. This module operates reliably at 2.5G without requiring manual speed forcing on the link partner. However, it supports only 2.5G operation and does not provide multi-speed capability.

T1 Speed	Third-Party Standard SFP+ Module	MACH SYSTEMS 10GSFP1-RJ45	MACH SYSTEMS 2.5GSFP1-RJ45	USXGMII SFP+ Module
10G	✓	✓	✗	✓ (Speed Forced on Link Partner)
5G	✗	✓	✗	✓ (Speed Forced on Link Partner)

2.5G	✗	✗	✓	✓ (Speed Forced on Link Partner)
------	---	---	---	-------------------------------------

4.3.3 Molex Micro-Fit

The 6-pin Molex Micro-Fit connector (p/n: 43045-0600) contains a CAN bus, shield, and optionally power input pins.

Mating connector p/n: 43025-0600

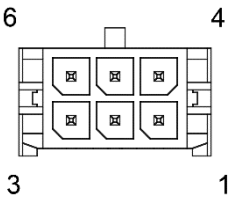
	Pin	Name	Description
 <p>Front view</p>	1	Vin	Power input positive (7 – 30 V DC)
	2	Gnd	Power input negative
	3	PE	Shield (connected to the conductive enclosure)
	4	CAN_H	
	5	CAN_L	
	6		Not connected

Table 3 Molex Micro-Fit connector - pin assignment

4.3.4 TE 3-pin

The 3-pin TE connector (p/n: 284512-3) can be optionally used for power input. It is a removable terminal block.

Mating connector p/n: 284506-3

Note: The mating connector is included in the scope of delivery.

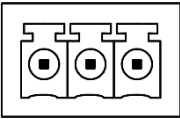
	Pin	Name	Description
 <p>Front view</p>	1	Vin	Power input positive (7 – 30 V DC)
	2	Gnd	Power input negative
	3	Shield	Shield (connected to the aluminium enclosure)

Table 4 TE power - pin assignment

4.4 Switches

There are 4 DIP switches for converter configuration. Conversion behaviour is further explained in 5.2.

The function of DIP1-3 is predefined and cannot be changed. The function of DIP4 (user switch) is selectable from the PC application (see 5.5) or over communication protocol. The DIP4 default function is not assigned, but can be selected and save to EEPROM over communication protocol.

No.	Name	Description
-----	------	-------------

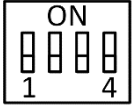
 <p>Front view</p>	1	Mode	On: Master mode Off: Slave mode
	2	10G	On: 10 Gbit/s Off: 2.5Gbit/s or 5Gbit/s depending on 2.5G/5G switch configuration
	3	2.5G/5G	On: 5Gbit/s Off: 2.5Gbit/s <i>Note: The function of the switch is relevant only if 10G switch is set to other</i>
	4	User switch	The function of the user switch is mappable onto three possibilities: <ul style="list-style-type: none"> • Not assigned (default) • USXGMII mode: On: USXGMII enabled Off: USXGMII disabled • TC10 mode: On: TC10 enabled Off: TC10 mode disabled • Packet generator: On: Packet generator enabled Off: Packet generator disabled

Table 5 Switches

4.5 LEDs

The 10G BASE-T1 Media Converter contains 6 status LEDs in total.

4.5.1 Front Panel

3 LEDs are on the front panel.

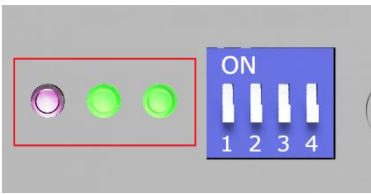
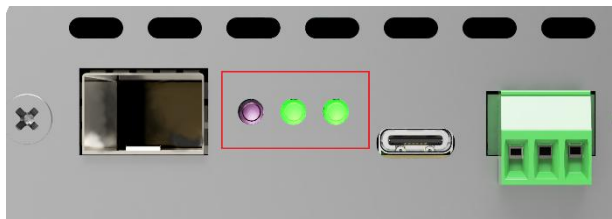
	
LED Name	Note
T1 Link	Magenta on: 10GBASE-T1 link Cyan on: 5GBASE-T1 link Blue on: 2.5GBASE-T1 link Red on: The power source is not sufficient for powering of the device Off: no link
T1 Activity	Green blinking: T1 activity Off: No activity Red blinking: Ethernet Communication Error
CAN Activity / Error	Green on: CAN channel on Green blinking: CAN activity Red blinking: Error frame received Red on: CAN bus error

Table 6 Status LEDs on front panel

4.5.2 Rear Panel

3 LEDs are on the rear panel.



LED Name	Note
SFP+ link LED	Magenta on: 10GBASE-R link Cyan on: 5GBASE-R link Blue on: 2.5GBASE-R link Red on: The power source is not sufficient for powering of the device Off: no link
SFP+ activity LED	Green blinking: SFP+ module Ethernet activity Off: No activity
Power LED	Green on: The device is powered Off: The device is not powered

Table 7 Status LEDs on rear panel

4.6 User Button

The push button (tactile switch) can be used to initiate a firmware update. If the button is held down during power-up, the device will enter boot mode. This method should only be used when a USB firmware update is not possible. To perform a firmware update via this method, please contact the manufacturer. To return the device to normal operation, power it off and restart without pressing the button.

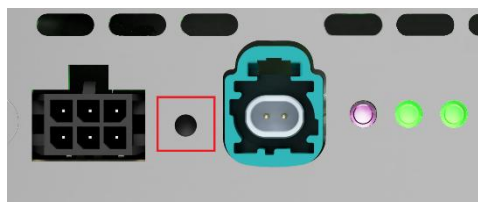


Figure 6 User button

4.7 CAN Bus Termination

There are no internal termination resistors inside the device. Therefore, the user has to make sure the CAN bus is properly terminated at both ends of the network.

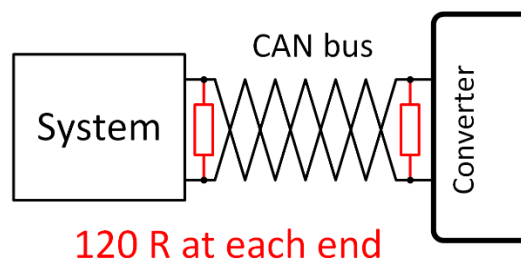


Figure 7 CAN bus termination

4.8 USB

USB Type-C connector uses the standard USB 2.0 pinout, and can be used for firmware upload or as a virtual COM port (see 5.5). When powering the device via USB, a USB Power Delivery (PD) profile providing at least 10 W must be negotiated with the PD source.

4.9 Galvanic Isolation

The device does **not** have any galvanic isolation. All ground signals are connected. The user has to make sure there are no ground loops in his setup.

5 Usage

5.1 Quick Start

The **10GBASE-T1 Media Converter** can be easily used like this:

- **Connect SFP+ module** standard SFP+ module for 10Gbit/s speed on T1 port or USXGMII for multigigabit on T1 port.
- **Connect cables** to the automotive Ethernet port and the standard Ethernet port (RJ-45, or optical connector depending on your module)
- **Configure the device – by built-in DIP switches:**
 - Set Speed and Master/slave configuration manually and enable USXGMII is using the USXGMII module
- **Power the device – either over:**
 - USB PD
 - 3-pin terminal block
 - 6-pin Molex connector

5.2 Physical-Layer Conversion

The media converter realizes a full-duplex physical-layer conversion between 10GBASE-T1 or 5GBASE-T1 or 2.5GBASE-T1 to SFP+ module. The T1 communication speed and Master/Slave settings can be set manually by the user by dipswitches, or programmatically over USB or CAN(/FD).

The parameters of the T1 port must be compatible with the link partner on the opposite side. The correct speed (identical on both devices) and the proper master/slave configuration should be selected using the DIP switches. The configuration of the SFP+ module must also match the T1 port settings. Most SFP+ modules support only the 10GBASE-R interface; therefore, for proper operation, the T1 port must be set to 10GBASE-T1. If other speeds are required on the T1 side, USXGMII-compatible modules must be used instead. For 2.5 Gbit/s operation, legacy SFP or SFP+ modules supporting 2.5GBASE-X can also be used.

The polarity of the T1 link is automatically detected and corrected. Most multi-rate SFP+ modules support rate matching, allowing the device connected via the RJ-45 interface to operate at a different speed than the SerDes interface on the host side. Although the T1 port speed must match the SerDes speed of the SFP+ module, the remote device connected through the RJ-45 connector can run at a lower or higher Ethernet speed.

5.3 TC10 Sleep/Wake-up

The device supports OPEN Alliance TC10 sleep and wake functionality used in automotive Ethernet. When enabled, the device can automatically enter a low-power Sleep state and later resume operation through a Wake request, either initiated locally or by the connected link partner.

Before TC10 can be used, it must be enabled. This can be done by assigning the TC10 function to a DIP switch or by forcing it on through the communication protocol or PC application. If TC10 is disabled, the link remains permanently active and does not react to sleep or wake signalling. After TC10 is enabled, the device can enter or exit sleep mode on command, or it can respond to a request from the opposite link partner. Local control is available through the communication protocol and PC tool.

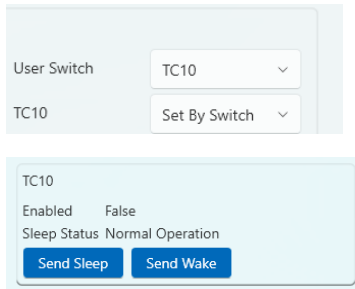


Figure 8 TC10 setup in PC application

5.4 TC17 MACsec

The device supports MACsec (Media Access Control Security) according to OPEN Alliance TC-17 recommendations, providing frame-level authentication, integrity protection, and optional encryption for Ethernet links. When enabled, MACsec ensures that all communication over the link is protected against unauthorized access or tampering.

MACsec can be enabled manually by command or configured to activate automatically after device startup. Configuration is possible through the communication protocol or the PC application; configuration over CAN is not supported.

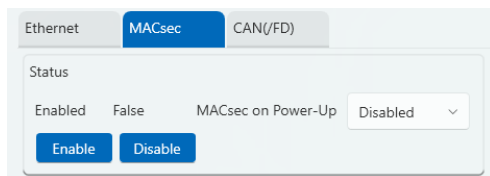


Figure 9 Enabling MACsec in PC App

To establish secure communication, the user must configure the Security Associations (SA). Two transmit (TX) keys and up to four receive (RX) keys can be defined. For each TX key, the user assigns an Association Number (AN) that determines which RX key is used for decryption by the link partner. The SSCI (Short Secure Channel Identifier) must also be set by the user, ensuring proper identification of each security channel.

When using extended packet numbering (XPN) ciphers, a Salt value must be configured. The user can also define the Secure Channel Identifier (SCI) and select the cipher suite, choosing from AES-128, AES-128-XPN, AES-256, or AES-256-XPN. The Encryption TX Index determines which TX key is currently used for encryption, and the TCI (Tag Control Information) options can be adjusted according to the required frame protection mode.

The PC application displays detailed MACsec statistics, including actual packet numbers for each association, counts of received, transmitted, dropped, and error packets, as well as entity-level statistics such as total transmitted packets, encrypted frames, protected frames, and control frames. These indicators allow verification of proper MACsec operation and monitoring of link security status.

Entity Counters		Statistics	
TX Packets Controlled Port Disable Counter	0	TX Packets Counter	0
TX Packets Untagged Counter	0	TX Error Packets Counter	0
TX Packets No Active SA Counter	0	TX Packets Dropped	0
TX Packets Too Long Counter	0	TX Packets Counter	0
TX Octets Protected	0	RX Error Packets Counter	0
TX Octets Encrypted	0	RX Packets Dropped	0
TX Octets Controlled	0		
TX Octets Uncontrolled	0	Packet Numbers	
RX Packets Controlled Port Disable Counter	0	TX0	0
RX Packets Bad Sec Tag Counter	0	TX1	0
RX Packets No Sec Tag Counter	0	RX0	0
RX Packets No Active SA Error Counter	0	RX1	0
RX Octets Validate Counter	0	RX2	0
RX Octets Decrypted Counter	0	RX3	0
RX Octets Controlled	0		
RX Octets Uncontrolled	0		

Figure 10 MACsec statistics

5.5 PC Application

The user can use the free-of-charge application to access the media converter over USB VCP.

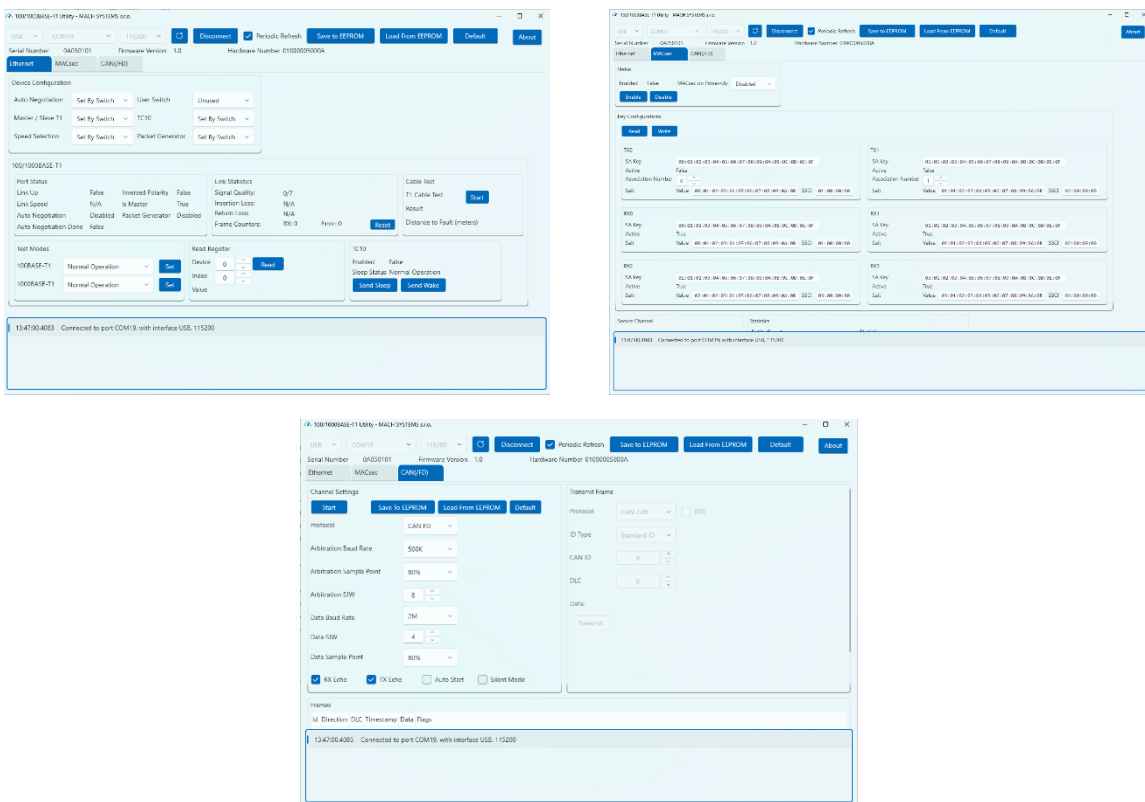


Figure 11 PC application

The application allows to read status information, configure port parameters, set up MACsec, send TC10 sleep/wake-up request use the Multigig test modes, and run cable tests. The application also allows to use the device as a USB to CAN/(FD) interface and to transmit and receive CAN and CAN FD frames.

5.6 Frame Generator Mode

The frame generator function must be disabled for normal communication and should be enabled only for testing purposes. The generated frames contain no specific MAC source or destination. All bytes have the same pattern: 0xA5 and 0x5A in alternation.

5.7 Cable Harnesses

Cable harnesses are available as optional accessories. See Chapter 7 for ordering information.

5.7.1 Rosenberger H-MTD

This is a Rosenberger H-MTD female to female wire harness connected by a shielded twisted-pair cable. H-MTD connectors are wired 1:1.

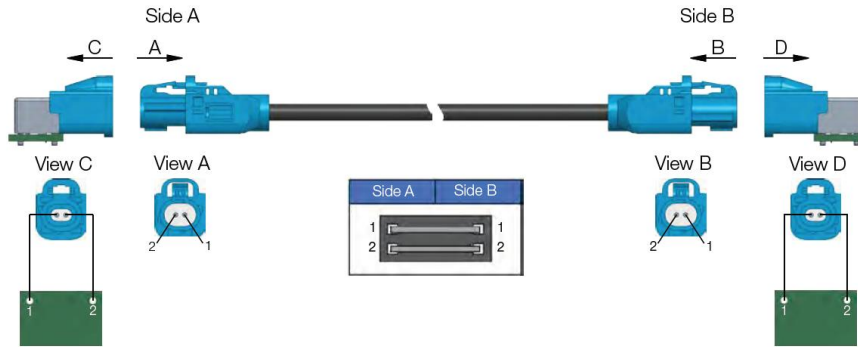


Figure 12 Rosenberger H-MTD cable harness

Source: Rosenberger Hochfrequenztechnik GmbH & Co. KG

5.7.2 Molex Micro-Fit

This is a Molex Micro-Fit 6-pin to an open-end wire harness. The wires are 0.65 mm² (22 AWG).



Figure 13 Molex Micro-Fit cable harness

The following table shows the wire colours:

Pin Number	Colour	Note
1	Red	Twisted together
2	Black	
3	Green/Yellow	Twisted together
4	White	
5	Green	

6	Blue	
---	------	--

Table 8 Molex Micro-Fit cable harness colours

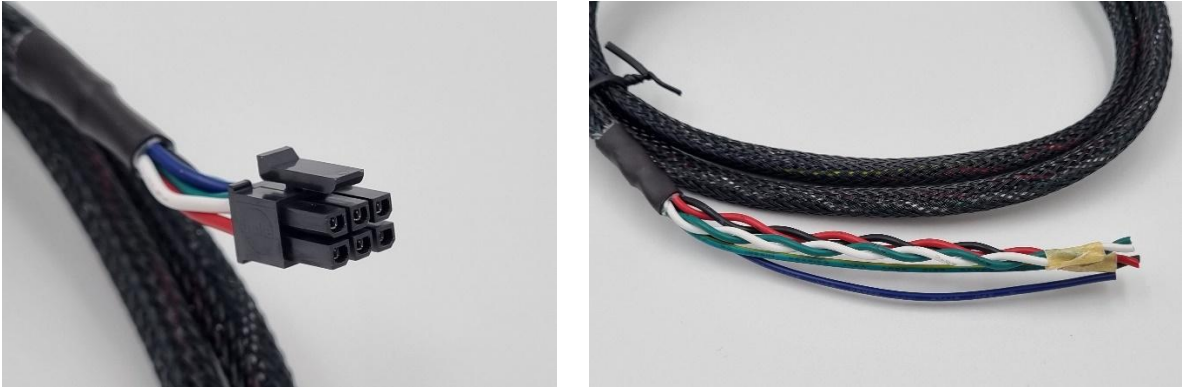
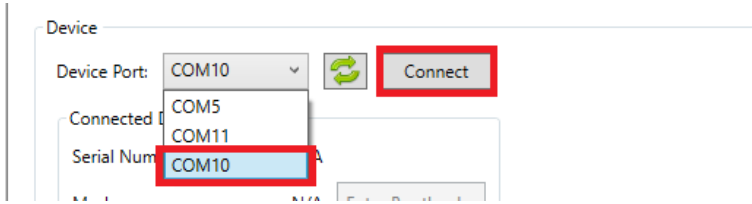


Figure 14 Molex Micro-Fit cable harness details

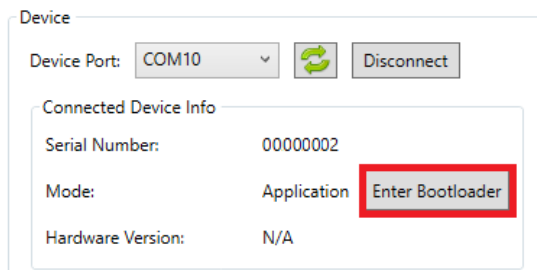
5.8 Firmware Update

The MACH SYSTEMS USB Firmware Updater application can be used to update the device’s firmware.

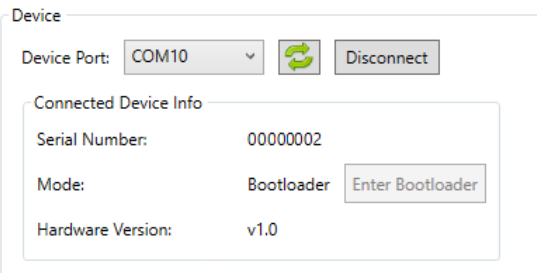
1. Connect the device to a computer using a USB cable.
2. Select the correct port and press “Connect”.



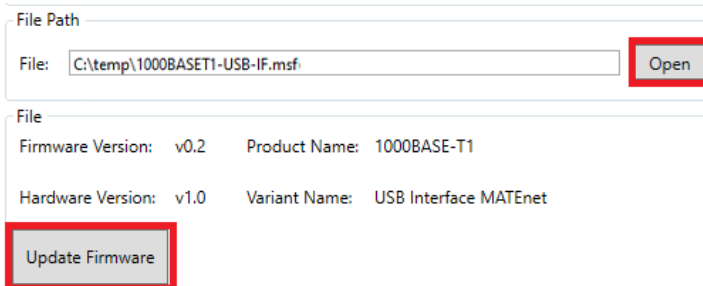
3. Press “Enter Bootloader”.



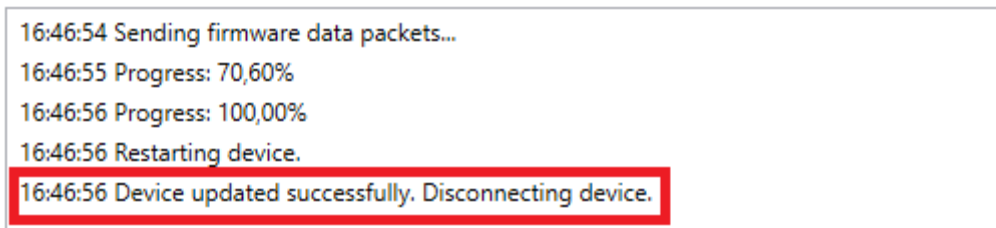
4. Wait a few moments and then connect to the device again; it should be in Bootloader mode now.



5. Open the correct firmware file and “Update Firmware”.



6. You should see in the output console that the device was flashed successfully. The device shall restart to the application automatically.



6 Legal Information

6.1 Usage Warning

WARNING FOR ALL USERS

WARNING! - YOUR USE OF THIS DEVICE MUST BE DONE WITH CAUTION AND A FULL UNDERSTANDING OF THE RISKS!

THIS WARNING IS PRESENTED TO INFORM YOU THAT THE OPERATION OF THIS DEVICE MAY BE DANGEROUS. YOUR ACTIONS CAN INFLUENCE THE BEHAVIOR OF A DISTRIBUTED EMBEDDED SYSTEM, AND DEPENDING ON THE APPLICATION, THE CONSEQUENCES OF YOUR IMPROPER ACTIONS COULD CAUSE SERIOUS OPERATIONAL MALFUNCTION, LOSS OF INFORMATION, DAMAGE TO EQUIPMENT, AND PHYSICAL INJURY TO YOURSELF AND OTHERS. A POTENTIALLY HAZARDOUS OPERATING CONDITION IS PRESENT WHEN THE FOLLOWING TWO CONDITIONS ARE CONCURRENTLY TRUE: THE PRODUCT IS PHYSICALLY INTERCONNECTED TO A REAL DISTRIBUTED EMBEDDED SYSTEM; AND THE FUNCTIONS AND OPERATIONS OF THE REAL DISTRIBUTED EMBEDDED SYSTEM ARE CONTROLLABLE OR INFLUENCED BY THE USE OF THE CAN NETWORK. A POTENTIALLY HAZARDOUS OPERATING CONDITION MAY RESULT FROM THE ACTIVITY OR NON-ACTIVITY OF SOME DISTRIBUTED EMBEDDED SYSTEM FUNCTIONS AND OPERATIONS, WHICH MAY RESULT IN SERIOUS PHYSICAL HARM OR DEATH OR CAUSE DAMAGE TO EQUIPMENT, DEVICES, OR THE SURROUNDING ENVIRONMENT.

WITH THIS DEVICE, YOU MAY POTENTIALLY:

- CAUSE A CHANGE IN THE OPERATION OF THE SYSTEM, MODULE, DEVICE, CIRCUIT, OR OUTPUT.
- TURN ON OR ACTIVATE A MODULE, DEVICE, CIRCUIT, OUTPUT, OR FUNCTION.
- TURN OFF OR DEACTIVATE A MODULE, DEVICE, CIRCUIT, OUTPUT, OR FUNCTION.
- INHIBIT, TURN OFF, OR DEACTIVATE NORMAL OPERATION.
- MODIFY THE BEHAVIOR OF A DISTRIBUTED PRODUCT.
- ACTIVATE AN UNINTENDED OPERATION.
- PLACE THE SYSTEM, MODULE, DEVICE, CIRCUIT, OR OUTPUT INTO AN UNINTENDED MODE.

ONLY THOSE PERSONS WHO:

(A) ARE PROPERLY TRAINED AND QUALIFIED WITH RESPECT TO THE USE OF THE DEVICE,

(B) UNDERSTAND THE WARNINGS ABOVE, AND

(C) UNDERSTAND HOW THIS DEVICE INTERACTS WITH AND IMPACTS THE FUNCTION

AND SAFETY OF OTHER PRODUCTS IN A DISTRIBUTED SYSTEM AND THE APPLICATION FOR WHICH THIS DEVICE WILL BE APPLIED, MAY USE THE DEVICE.


PLEASE NOTE THAT YOU CAN INTEGRATE THIS PRODUCT AS A SUBSYSTEM INTO HIGHER-LEVEL SYSTEMS. IN CASE YOU DO SO, MACH SYSTEMS s.r.o. HEREBY DECLARES THAT MACH SYSTEMS s.r.o.'s WARRANTY SHALL BE LIMITED TO THE CORRECTION OF DEFECTS, AND MACH SYSTEMS s.r.o. HEREBY EXPRESSLY DISCLAIMS ANY LIABILITY OVER AND ABOVE THE REFUNDING OF THE PRICE PAID FOR THIS DEVICE, SINCE MACH SYSTEMS s.r.o. DOES NOT HAVE ANY INFLUENCE ON THE IMPLEMENTATIONS OF THE HIGHER-LEVEL SYSTEM, WHICH MAY BE DEFECTIVE.

6.2 Disposal and Recycling Information



When this product reaches its end of life, please dispose of it according to your local environmental laws and guidelines.

6.3 Declaration of Conformity


MACH SYSTEMS

EU Declaration of Conformity (DoC)

We

Company Name	MACH SYSTEMS s.r.o.	City	Prague
Postal Address	Pocernicka 272/96	Country	Czech Republic
Postcode	108 00		

declare that the DoC is issued under our sole responsibility and belongs to the following product:

10GBASE-T1 Media Converter
MultiGBASE-T1 Media Converter

Objects of the declaration:

Product	Product Number
10GBASE-T1 Media Converter	10GBASET1-MC
MultiGBASE-T1 Media Converter	MULTIGBASET1-MC

The objects of the declaration described above is in conformity with the relevant Union harmonisation legislation:

2014/30/EU: EMC Directive
2011/65/EU + 2015/863/EU: RoHS 2 + amendment


The following harmonised standards and technical specifications have been applied:

EN 61326-1:2022-11	EN 61000-6-3:2020
EN IEC 63000	

Signed for and on behalf of: MACH SYSTEMS s.r.o.

Place of issue: Prague, Czech Republic

Date of issue: February 20th 2026

Signature: 

Name, function: Miroslav Machacek, Managing Director

MACH SYSTEMS s.r.o.
www.machsystems.cz

6.4 Patents, Copyrights and Trademarks

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7 Ordering Information

See the [product web page](#).

8 Contact

MACH SYSTEMS s.r.o.

www.machsystems.cz

info@machsystems.cz

Czech Republic



Company registration: 29413893

EU VAT number: CZ29413893