1000BASE-T1 SPY mini

USER MANUAL

July 2019

Manual-Version: 2.2

Hardware-Version:1.0

CONTENT

1 GENERAL INFORMATION

1.1 Functionality and Features of the 1000BASE-T1 SPY mini

Figure 1-1: 1000BASE-T1 SPY mini

The **Technica Engineering 1000Base-T1 SPY mini** samples 1000Base-T1 Frames directly on the bus without influence of the original network. The data Frames are enhanced with additional in-formation as an exact timestamp and the bus port which the data was originally sent on. All data can be recorded on a PC or datalogger for detailed offline analysis.

Timestamps are in 0.04 µs resolution and synchronous to all connected lines.

Optionally other Use Cases (Frame Generator, Trigger Generator, …) can be upgraded.

Features:

- **2 Ports** 1000Base-T1 1GBit/s full duplex on a single unshielded twisted pair.
- **2 Ports** Gigabit Ethernet 1000 BaseTX
- 6x Digital Trigger Input
- 6x Digital Trigger Output
- **802.1AS synchronization**
- Automotive Tyco nanoMQS Connector for 1000Base-T1 and Power Supply
- Robust steel case
- DIP Switches for easy configuration
- Selection of multiple UseCases:
  - Two independent MediaConverters
  - 2x SPY for listening on a 1000Base-T1 Channel

General Information:

Power requirement:	8 to 16 Volt DC (nominal 12 Volt DC)
Power consumption:	4 to 7 Watt
Size:	110 x 108 x 28 mm
Weight:	0,4 kg
International Protection:	IP 2 0
Operating temperature:	-20 to +80 °Celsius

LINKS:

The User can download the latest firmware and documentation for the 1000BASE-T1 SPY mini here:

https://technica-engineering.de/en/produkt/1000base-t1-spy-mini/

1.2 Warranty and Safety Information

Before operating the device, read this manual thoroughly and retain it for your reference.
The latest documentation for the 100BASE-T1 SPY mini can be downloaded here:
https://technica-engineering.de/en/produkt/1000base-t1-spy-mini/

Use the device only as described in this manual.
Use only in dry conditions.
Do not apply power to a damaged device.

Do not open the device. Otherwise warranty will be lost.

This device is designed for engineering purpose only.
Special care has to be taken for operation.
Do not use this device in a series production car.
As this device is likely to be used under rough conditions, warranty is limited to 1 year.
Manufacturer liability for damage caused by using the device is excluded.
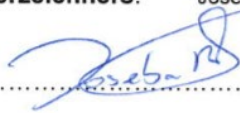
1.3 Declaration of conformity

EG-Konformitätserklärung

gemäß der EG-Richtlinie 2004/108/EG (elektromagnetische Verträglichkeit) vom 15. Dezember 2004

Hiermit erklären wir, dass das nachstehend bezeichnete Gerät in seiner Konzeption und Bauart sowie in der von uns in Verkehr gebrachten Ausführung den grundlegenden Sicherheits- und Gesundheitsanforderungen der EG-Richtlinie 2004/108/EG entspricht. Bei einer mit uns nicht abgestimmten Änderung des Gerätes verliert diese Erklärung ihre Gültigkeit.

Hersteller: Technica Engineering
                       Leopoldstr. 236
                       80807 München

Bevollmächtigter: Joseba Rodriguez

Beschreibung des Gerätes:
                       1000BASE-T1 SPY_mini

Datum der Erklärung: 05.03.2018

Name des Unterzeichners: Joseba Rodriguez

Unterschrift: ....

Figure 1-2: Declaration of conformity

2 HARDWARE INTERFACES

2.1 Connectors

On the label on top of the device you can see an overview about all HW-Interfaces of the 1000BASE-T1 SPY mini
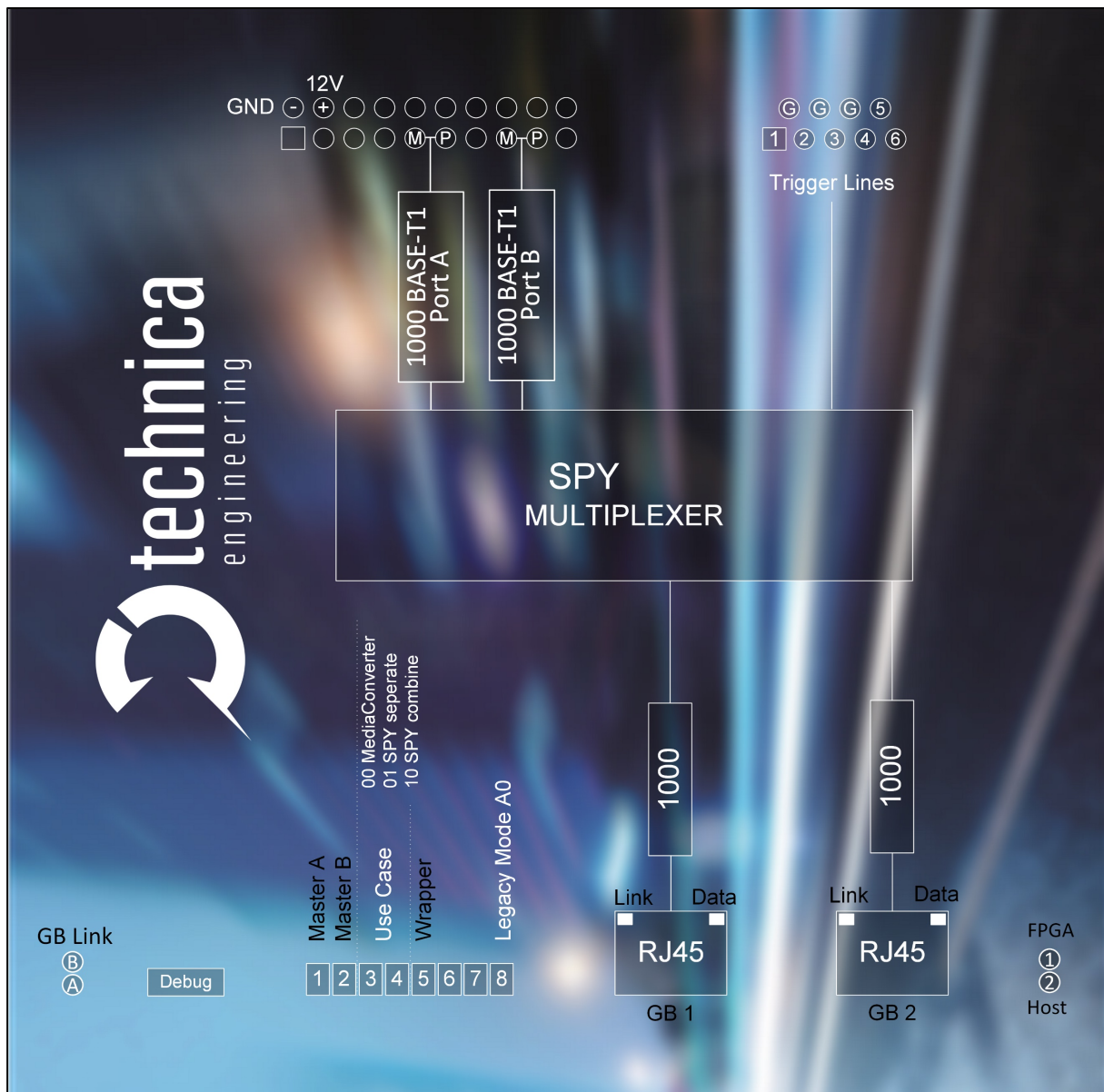

Figure 2-1: Label of 1000BASE-T1 SPY mini with pinning information

2.1.1   Power and 1000BASE-T1 Connector

Power supply for the device is supplied by Pin 18 (12 Volt) and Pin 20 (Ground).

Warning: If you apply a voltage higher than 18 Volt, the device will be damaged!
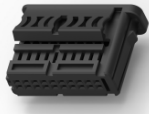The Tyco Electronics (TE) Nano Micro Quad Lock System (NanoMQS) is used.

Name	Picture	Part Number
20POS NANOMQS REC HSG CODE A		2141404-1
NANOMQS RECEPTACLE TERMINAL		2-1703930-1

Table 2-1: Parts of black MQS connector

Pin	Function	Pin	Function
1	n.c.	2	n.c.
3	1000Base-T1 Port_B, Positive	4	n.c.
5	1000Base-T1 Port_B, Positive	6	n.c.
7	n.c.	8	n.c.
9	1000Base-T1 Port_A, Positive	10	n.c.
11	1000Base-T1 Port_A, Negative	12	n.c.
13	n.c.	14	n.c.
15	n.c.	16	n.c.
17	n.c.	18	VCC 12Volt
19	n.c.	20	GND

Table 2-2: Pinning information Tyco nano MQS connector

Note: No 100BASE-T1 Support by the 1000BASE-T1 Ports. The device is only for 1000BASE-T1 suitable.

2.1.1.1   Official Crimp Tool
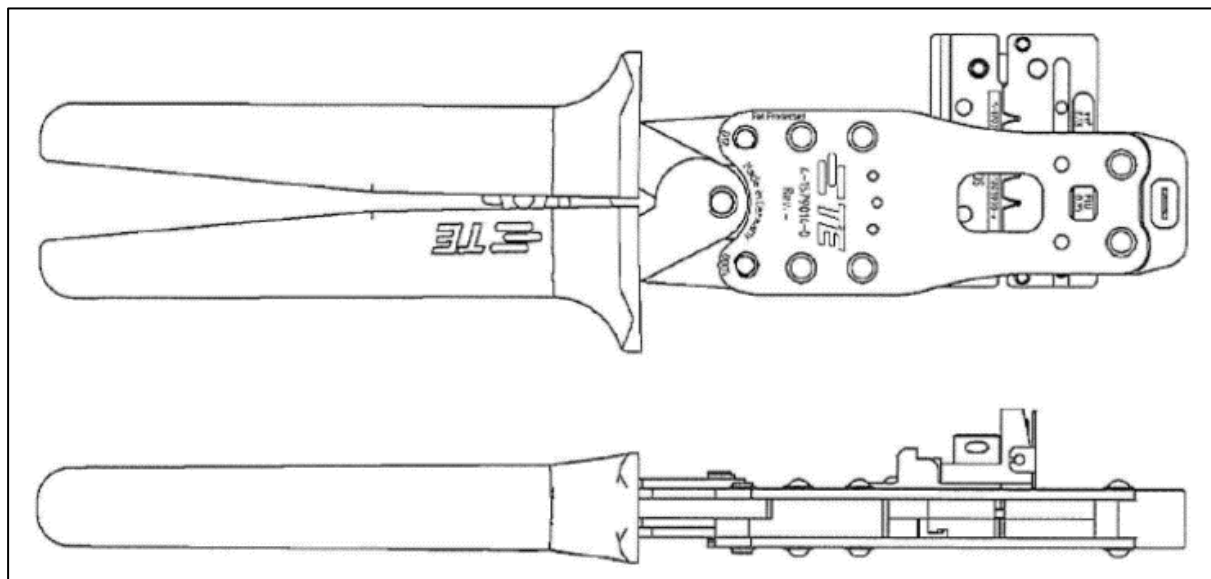
Name	TE CONNECTIVITY CS11K NANO-MQS, 0.13-0.35 SQ.M
TE Internal Number	4 -1579014 – 0
Distributor	Börsig GmbH www.boersig.com
Address	Siegmund-Loewe-Str. 5 74172 Neckarsulm

2.1.2   SubD 9 Trigger Connector

Standard SubD 9 Pos. female connector.
This connector is used for digital input and output trigger functions.

Pin	Function
1	Digital Trigger Input / Output 1
2	Digital Trigger Input / Output 2
3	Signal Ground Reference
4	Signal Ground Reference
5	Signal Ground Reference
6	Digital Trigger Input / Output 3
7	Digital Trigger Input / Output 4
8	Digital Trigger Input / Output 5
9	Digital Trigger Input / Output 6

Table 2—3: Pinning information SubD9 Connector

Digital Trigger Output:
Digital Trigger Output Voltage is 3.3 Volt Level with a 4.7 KOhms pull-up resistor Active Low. Drive Strength 20 mA

Digital Trigger Input:
Digital Trigger Input is a Voltage 3.3 Volt Level with a 4.7 KOhm pull-up resistor Active LOW.

Note: The Trigger Connector has no function on firmware version 1.2.1.

2.1.3   RJ45 Ethernet connectors

There are two RJ45 Standard Ethernet connectors of the front side for Gigabit Ethernet.
Depending on the selected Use Case they are forced to be 100 Mbit/s or Gigabit Ports.

2.2 Other Interfaces

2.2.1 Status LEDs

The 1000Base-T1 SPY mini has several status LEDs at the front side of the case.

LED	State
Host	Toggles slowly (approx. 2sec)
FPGA	On
GB A	On when 1000BASE-T1 link is detected on port 1
GB B	On when 1000BASE-T1 link is detected on port 2
RJ45 (orange)	On when link is detected

Table 2-3: Description LEDs

2.2.2 DIP-Switches

The DIP Switches are for configuration of the 1000BASE-T1 SPY mini.
Up is the same as ON.
Down is the same as OFF.
Further information about the configuration you can find in CHAPTER 3.

3 CONFIGURATION OF THE DEVICE

The 1000Base-T1 SPY mini is configured by 8 **DIP Switches** on the front of the device.

DIP-Switch	Status	Description
1	ON (up)	1000Base-T1 Port A is set to Master.
	OFF (down)	1000Base-T1 Port A is set to Slave.
2	ON (up)	1000Base-T1 Port B is set to Master.
	OFF (down)	1000Base-T1 Port B is set to Slave.
3 to 4		Use Case Selection. Binary Coded from 00 to 11. Please see CHAPTER 4 for further information.
5	ON (up)	Wrapper enabled
	OFF (down)	Wrapper disabled
8	ON (up)	Legacy mode: A0. Compatible only with A0 PHYs from Marvell
	OFF (down)	Legacy mode: A2. Compatible with A2 PHYs from Marvell or any other IEEE conform PHY

Table 3-1 Configuration of DIP-Switches

Note: After changing switches 1 and 2, a hardware reset is not required. These switches can be changed on real time. After changing the rest of the switches, a hardware reset is required.

4 USE CASES

Four different Use Cases can be configured by DIP Switch 3 and 4 for the 1000Base-T1_SPY_mini. After changing these switches, a hardware reset is required.

4.1 Dual Media Converter Mode

The simplest Use Case is the double Media Converter, selected by setting the DIP switches 3 and 4 to "00" (both switches down). The 1000Base-T1 Spy mini will act similar to completely independent Media Converters from 1000Base-T1 to Gigabit Ethernet in full-duplex mode.

The two data streams of the two Media Converters are completely independent of each other. Both data streams are full duplex and the RJ45 Ports are input/output. The PC can send data.

There are no buffers in this Use Case.
The RJ45 Ports work in Gigabit Ethernet (1000 Mbit/s) Mode in this Use Case.
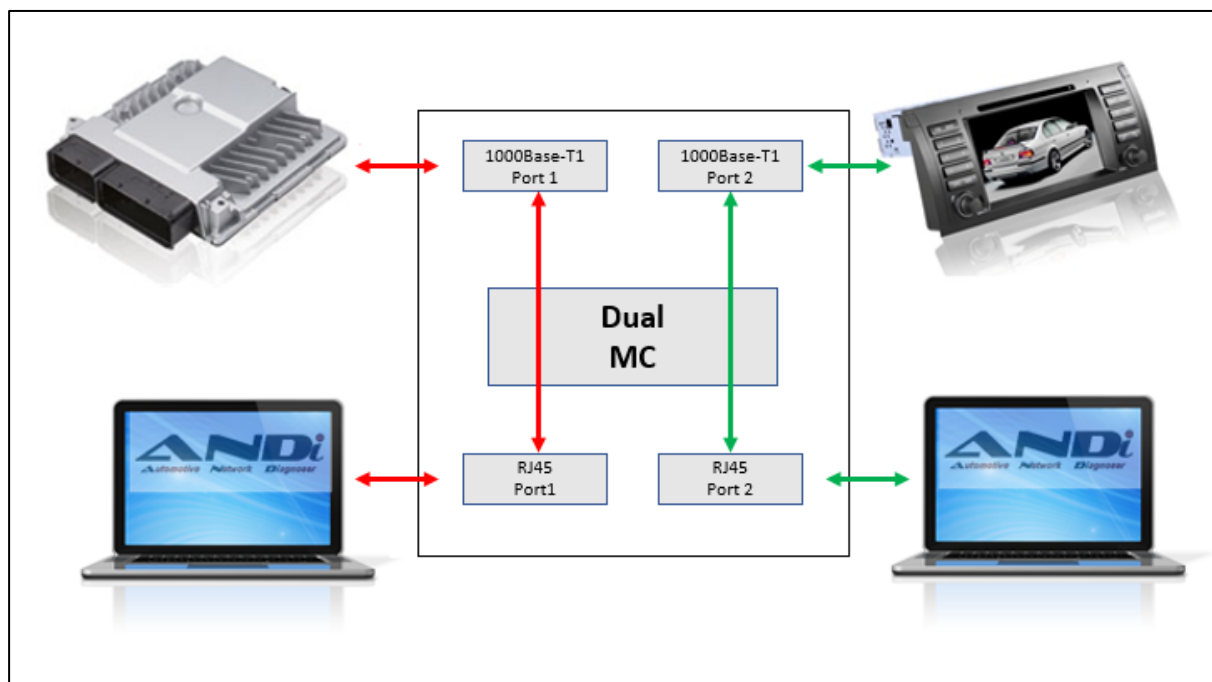

Figure 4-1: Dual Media Converter Mode

4.2 Spy Mode Independent

The user can select this mode by setting the DIP switches 3 and 4 to "01" (DIP Switch 3 down and DIP Switch 4 up).

In this mode the copied data from the two 1000Base-T1 Ports are logged independently through the 2 Ethernets ports. There is no communication from Ethernet to 1000Base-T1. The RJ45 Ports are output only. The communication between the two 1000Base-T1 ports is possible.
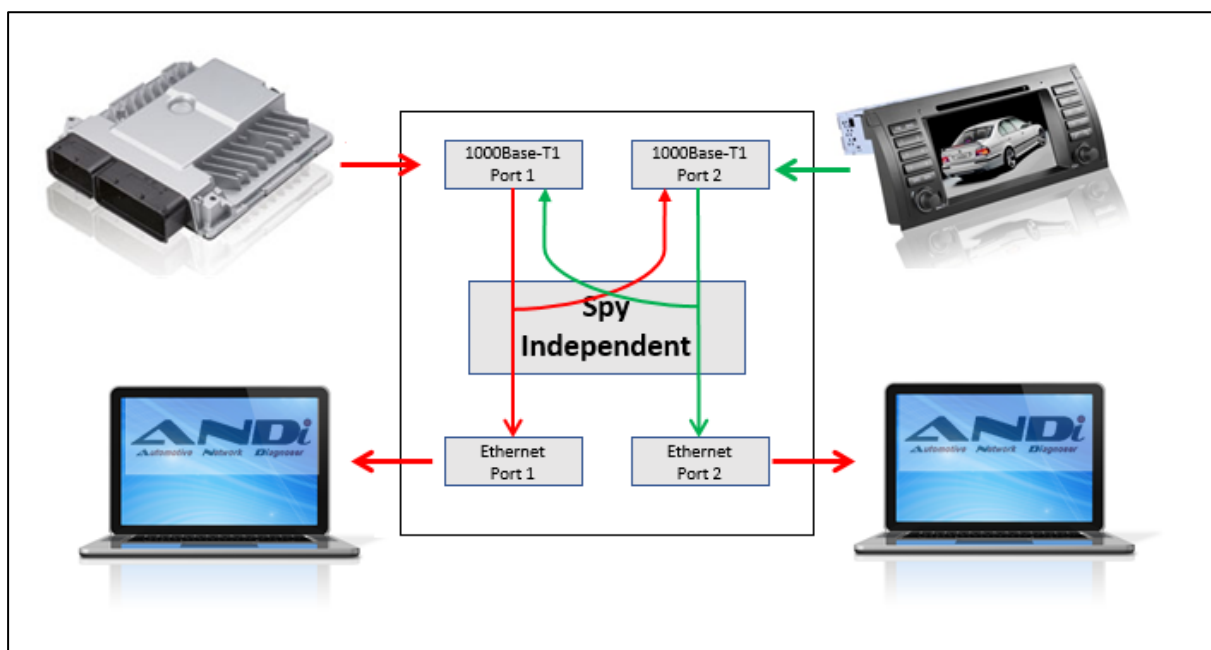This mode is very powerful in combination with the TimeStamp Feature (see Chapter 4.4).

Figure 4-2: SPY mode independent

4.3 Spy Mode Combined

The user can select this mode by setting the DIP switches 3 and 4 to "10" (DIP Switch 3 up and DIP Switch 4 down).

In this mode the copied data from the two 1000Base-T1 Mbit/s are logged into one 1000Mb/s stream and are sent on one Gigabit link. To do a collision resolution the packets are buffered on each 1000Base-T1 Port.

In the Spy Mode, the signals received in 1000Base-T1 Port 1 and 1000Base-T1 Port 2 are combined in one stream and sent on Ethernet Port. The PC is not able to send data. The RJ45 Ports are output only. The communication between the two 1000Base-T1 ports is possible.

This mode is very powerful in combination with the TimeStamp Feature (see CHAPTER 4.4).
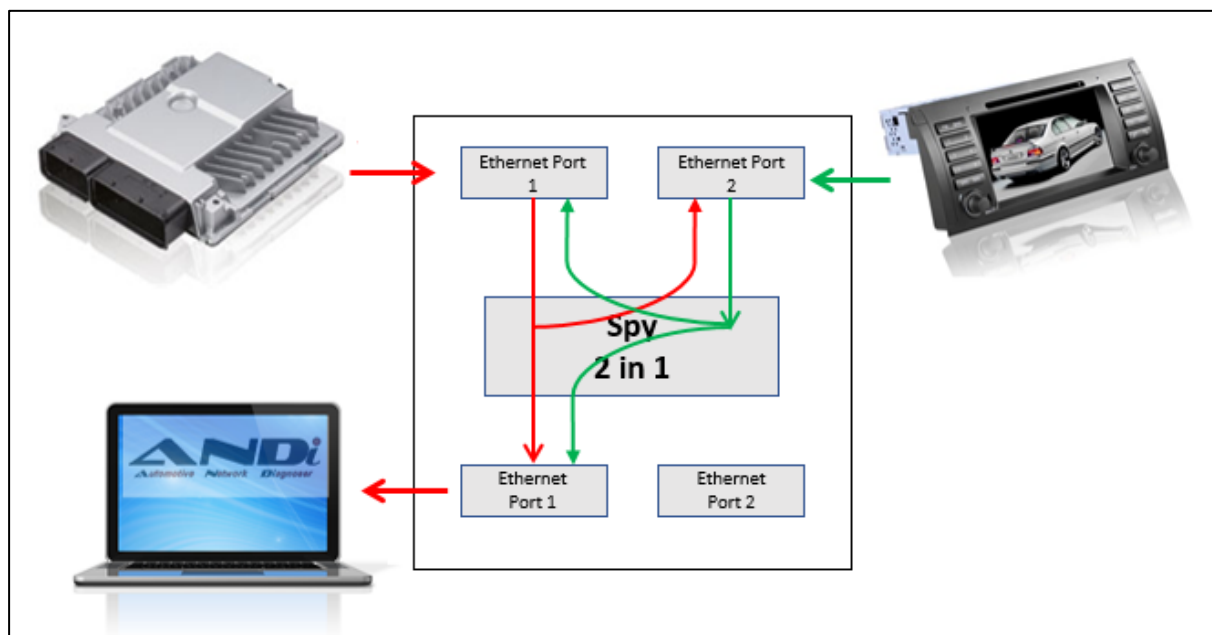
Figure 4-3: UseCase "10": Spy Mode Combined

Note: This mode, in combination with the Wrapper mode (see CHAPTER 4.4) activates the 802.1AS Synchronization on the device (see CHAPTER 5.1).

4.4   Spy Mode with wrapper

The user can activate the wrapper by setting the DIP Switch 5 to the up position. With this feature, a header is added on the Ethernet sent frame. The packet received in the 1000Base-T1 port will be logged through the corresponding Ethernet Port into an Ethernet RAW frame. The following picture shows the structure of an Ethernet 1000Base-T1 PY mini RAW frame, in this use case:
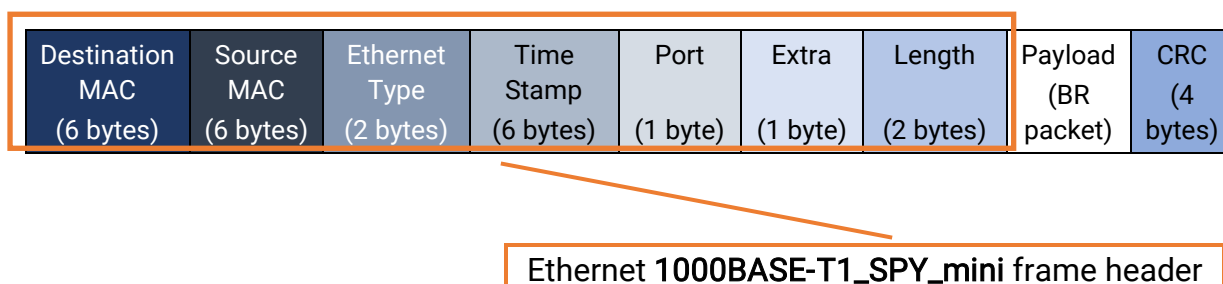
Destination MAC (6 bytes)	Source MAC (6 bytes)	Ethernet Type (2 bytes)	Time Stamp (6 bytes)	Port (1 byte)	Extra (1 byte)	Length (2 bytes)	Payload (BR packet)	CRC (4 bytes)

Ethernet **1000BASE-T1_SPY_mini** frame header

Figure 4-4: 1000BASE-T1 SPY mini wrapped frame

Field Name	No. of bytes	Value
Destination MAC address	6	FF:FF:FF:FF:FF:FF
Source MAC address	6	00:50:C2:E4:30:00 (address of this device)
Ethernet Type	2	0x2282
Time stamp	6	See the note below
Port	1	See the note below
Extra	1	0x00
Length	2	Length of the ethernet gigabit SPY mini frame
Payload	x	BroadR-Reach packet
CRC	4	CRC of the ethernet gigabit SPY mini frame

Table 4-1: Values of 1000BASE-T1 SPY mini frame header

Note: The data Frames are enhanced with additional information as an exact timestamp and the bus port the data was originally sent on. Timestamps are in 0.04 µs resolution and synchronous to all connected lines.

With this feature the user can record the exact time when the first byte in the preamble field of a frame was received on a 1000Base-T1 port of the 1000Base-T1 SPY mini. It is also possible to see the complete frame including the preamble and the CRC in Wireshark. Normally this information is re-moved by your network interface.

The following table shows the values of *Port* field:

Port	Value
1000BASE-T1 A	0x01
1000BASE-T1 B	0x02

Table 4-2: Values of Field "Port" in wrapped frame

The following picture shows an example of a 1000Base-T1 payload frame encapsulated in a 1000Base-T1 RAW frame, with header:

Figure 4-5: Screenshot of 1000BASE-T1_SPY_mini frame

5 1000Base-T1 SPY mini LUA Dissector for wrapped data

In order to dissect the 1000Base-T1 SPY mini RAW Ethernet Frames, a LUA file for Wireshark is available on Technica Engineering website. To install the LUA file in Wireshark, the user must do the following steps:

1. Close Wireshark in case that the program is running on PC.

2. Download the .ZIP file that contains all the LUA files, through this website:

   https://technica-engineering.de/produkt/1000base-t1-spy-mini/

   https://technica-engineering.de/wp-content/uploads/2018/06/1000BaseT1_SPY_Mini_Wireshark_Dissector.zip

3. Extract the downloaded ZIP file. This file should contain the following LUA file: 1000BaseT1_SPY_Mini_ETH_wrapper.lua

4. Copy or move the LUA file in Wireshark plugins folder. The path should be: C:\Program Files\Wireshark\plugins\(Wireshark Version Number).

   Note: Wireshark Version Number depends on the Wireshark version installed on the PC

5. Copy or move the LUA file in Wireshark plugins folder. The path should be: C:\Program Files\Wireshark\plugins\(Wireshark Version Number).

   Note: Wireshark Version Number depends on the Wireshark version installed on

6. To copy or move the LUA files to the specified Wireshark plugins folder, Administrator rights will be needed. In that case, this window should appear. Press Continue to proceed with the copy.
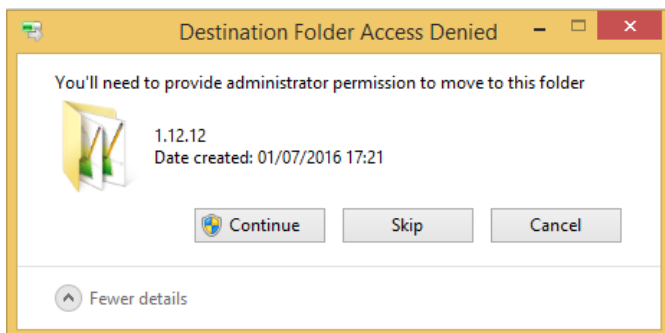

Figure 5-1: Dialog Box for Administrator rights

7. Run Wireshark.

5.1   802.1 AS Synchronization

When the user selects the SPY Combined Mode (see CHAPTER 4.3) with the Wrapper enabled (see CHAPTER 4.4) the 802.1AS Synchronization is automatically enabled.

With this functionality, the device will be able to synchronize with any master device. In this case, the device will use the same timestamping as the master device, and this includes the maintenance of synchronized time during normal operation and following addition, removal, or failure of network components and network reconfiguration.

5.1.1   PTP of 802.1 AS Protocol

In an 802.1AS topology, the com-
munication between a Master and a
Slave Node is as you can see in the
picture to the right.

For a generic time t_x, the Slave device can
correct this time as follows:

$$tx'\,(ns) = tx + t1 + t2 + \Delta t \text{ - } Path\ Delay$$

With t3, t4, t5 and t6, the slave device can
calculate the Path Delay as follows:

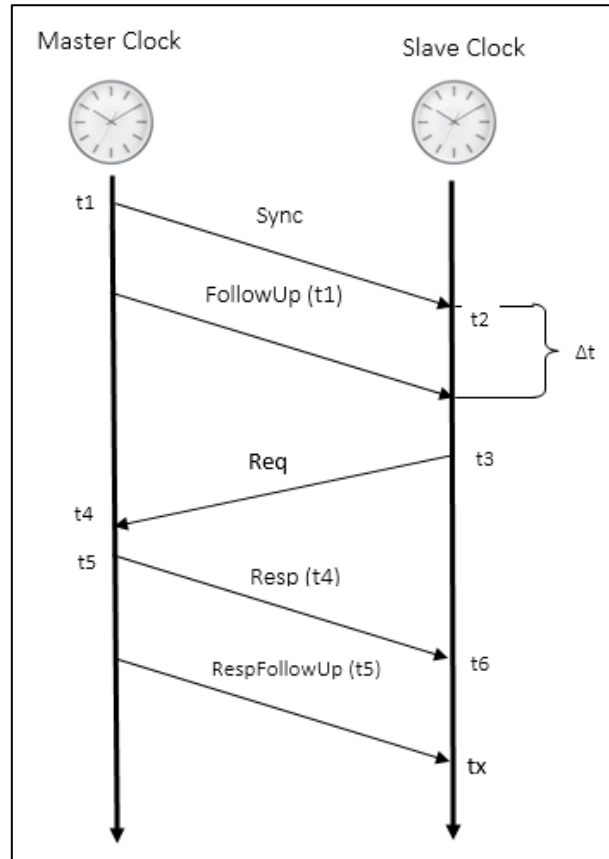$$PathDelay\,(ns) = \frac{(t6 - t3) - (t5 - t4)}{2}$$

Figure 5-2: Timing PTP

5.1.2 802.1 AS (PTP) in 1000Base-T1 SPY Mini

The 1000Base-T1 SPY Mini device works only as a Slave device, sending Request messages to the Master device through GB-2 port.

Connecting a Master Device to this port, the device will synchronize its internal clock and it will use this corrected clock as Timestamping on the Wrapper Mode. If this functionality is not enabled, or the Master device is not connected to the GB2 on this working mode, the device will use its internal clock as Timestamping, without correction.
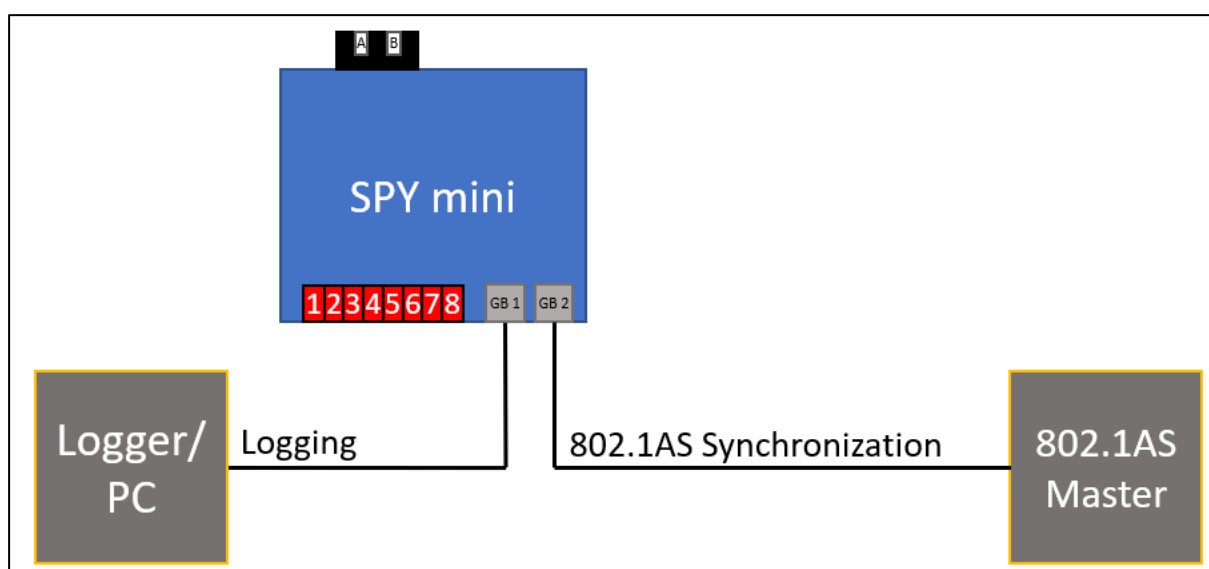

Figure 5-3: Master / Salve Configuration

6 ADDITIONAL INFORMATION

- For the SPY mode -independent or combined-, the delay between two BroadR-Reach ports is around 1.19µs. The delay is independent of the Ethernet packet frame size.
- The SPY is especially built for testing AVB. For minimum delay the SPY must be set to SPY Use Case. When using automotive AVB profile the time synchronization is not influenced by the SPY.
- There is no special handling of AVB frames as this is not necessary.
- There is a problem on the device. Please, remove the power supply and restart the board.
- Some Ethernet Adapters must have the VLAN & Packet Priority option disabled. Please, change this configuration, going to Ethernet Adapter Properties/Advanced/Packet Priority & VLAN. If this option is enabled, just disabled. Otherwise, it should be enabled.
- No 100BASE-T1 support. Device is only for 1000BASE-T1 suitable

7 LIST OF FIGURES

8 CHANGELOG

Version	Chapter	Description	Date
1.0	All	First release	01.06.2018
1.1	6.4 table 4	Correction of Ethertype	06.08.2018
2.1	All	Second release with new design	06.08.2018
2.1.1	All	Correction bugs	25.02.2018
2.1.2	4.1	Correction pinning table	09.05.2019
2.2	All	General upgrade	05.06.2019

9 CONTACT

If you have any questions regarding this product, please feel free to contact us:

Technica Engineering GmbH
Leopoldstr. 236
80807 München
Germany

Technical support:
support@technica-engineering.de

General information:
Info@technica-engineering.de

Most current user manuals and product information:
https://technica-engineering.de/