



TEF1002 TRM

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<https://wiki.trenz-electronic.de/display/PD/TEF1002+TRM>

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4 Overview

The Trenz Electronic TEF1002-02 carrier is a baseboard for Trenz Electronic 4 x 5 SoMs. It is a PCIe x1 card and also hosts and LPC FMC connector.

See page "[4 x 5 cm carriers](https://wiki.trenz-electronic.de/display/PD/4+x+5+SoM+Carriers)"¹ to get information about the SoMs supported by the TEF1002 carrier board.

Refer to trenz.org/tef1002-info² for the current online version of this manual and other available documentation.

4.1 Key Features

- Carrier for 4x5 modules
- LPC FMC
- SFP+ connector
- PCIe x1
- SATA connector with pin 7 power configuration for SATADoM
- RJ45 Gigabit Ethernet connector
- micro-usb to JTAG/UART bridge
- 2x 8 lane high speed connectors (firefly)
- micro usb connector
- micro SD card connector
- 4x LED (2User, Power and Status)
- Module reset button
- 10x configuration/user dip switch
- MAX10 CPLD

4.2 Block Diagram

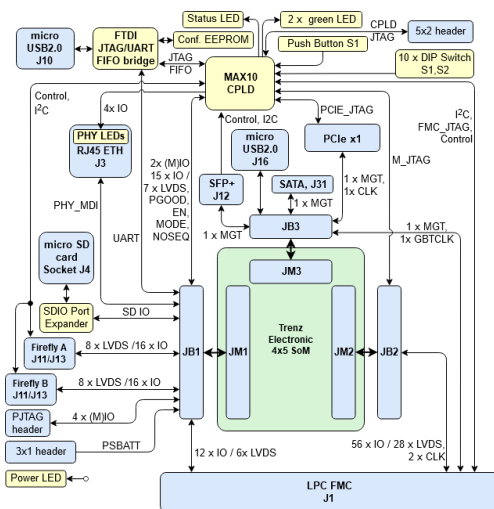


Figure 1: TEF1002 block diagram

4.3 Main Components

¹ <https://wiki.trenz-electronic.de/display/PD/4+x+5+SoM+Carriers>

² <http://trenz.org/tef1002-info>

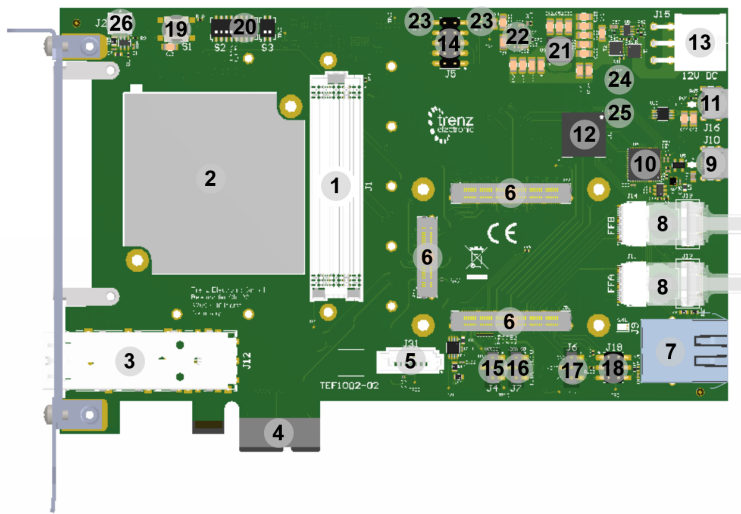
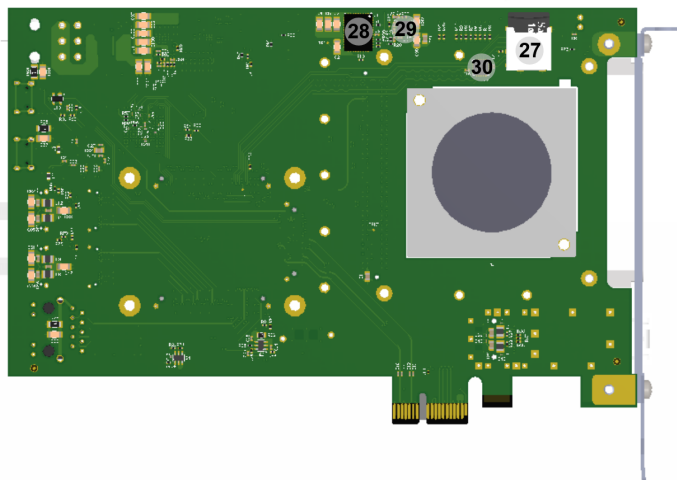


Figure 2: TEF1002 main components



1. ANSI/VITA 57.1 compliant FMC LPC connector, J1
2. Cooling fan 5VDC M1 (45X5MM, 0.7W, 1.06CFM), M1
3. SFP+ connector, J12
4. PCIe x1 connector, J3
5. SATA connector with pin 7 power configuration, J31
6. Trenz Electronic 4 x 5 modules B2B connectors, JB1 ... JB3
7. RJ45 Gigabit Ethernet connector, J9
8. 2x high speed LVDS arrangement of connectors J11, J13, J14, J18
9. Micro-USB2 connector, J10
10. FTDI FT2232H USB2 to JTAG,UART/FIFO Bridge, U4
11. Micro-USB2 connector, J16
12. MAX10 10M08SAU169C8G CPLD, U11
13. 6-pin 12V power connector, J15
14. 5x2 CPLD JTAG pin header for TEI0004, J5
15. 3x1 jumper pin header (select VCCIOA), J4
16. 3x1 jumper pin header (select VCCA_SD), J7
17. 3x1 pin header (VBAT), J6
18. 2x3 pin header (MIO/PJTAG), J19
19. Push button, S1
20. 10x dip switch, S2, S3
21. DCDC LTM4638 @5.0V, U9
22. DCDC EN6338QI @3.3V, U10

23. 2x green LED (user), D1, D2
24. green LED (Power), D3
25. green LED (Status), D4
26. SD-Card connector (top loader),
27. DCDC EN5335QI (FMC_VADJ), U1
28. DCDC EN6338QI @3.3V (3V3FMC), U14
29. SDIO Level shifter TXS02612, U3

4.4 Initial Delivery State

Storage device name	Content	Notes
FTDI chip configuration EEPROM (93AA56B), U6	Xilinx License	Do not overwrite, see warning in related section
MAX10 System Controller CPLD (10M08SAU169C8G), U14	SC CPLD Firmware	

Table 1: Initial delivery state of programmable devices on the module.

4.5 Control Signals

To get started with TEF1002 board, some basic control signals are essential and are described in the following table:

Control signal	Switch / Button / LED / Pin	Signal Schematic Names	Connected to	Functionality	Notes
FMC_VADJ voltage selection	DIP switches S2-1, S2-2, S2-3	VID0 ... VID2	SC CPLD U11, pins K6, J5, K5	sets adjustable voltage for FMC connector	depends on SC CPLD configuration ³

³ <https://wiki.trenz-electronic.de/display/PD/TEF1002+SC+CPLD+MAX10>

Control signal	Switch / Button / LED / Pin	Signal Schematic Names	Connected to	Functionality	Notes
JTAG enable	DIP switch S2-4	JTAGEN	SC CPLD U11, pin E5	OFF: CPLD IOs ON: TEF1002 SC CPLD JTAG enabled,	function in OFF position depends on SC CPLD configuration (JTAG on pin header J5 (for TEI0004))
Module JTAG select	DIP switch S2-5	M_JTAGEN	B2B JB1, pin 90	When S2-6 OFF: OFF: Module SOC JTAG enabled, ON: Module SC CPLD JTAG enabled	(JTAG via micro USB J10)
FMC JTAG select	DIP switch S2-6	FMC_JTAG	SC CPLD U11,L3	OFF: Module JTAG enabled (see S2-5) ON: FMC JTAG enabled	depends on SC CPLD configuration ⁴ , (JTAG via micro USB J10)
Enable module power	DIP switch S2-7	CM0	SC CPLD U11, M3	Module power. Set ON to enable module power. (Power management depends on module.)	depends on SC CPLD configuration ⁵ , only available when 4x5 module installed

⁴ <https://wiki.trenz-electronic.de/display/PD/TEF1002+SC+CPLD+MAX10>

⁵ <https://wiki.trenz-electronic.de/display/PD/TEF1002+SC+CPLD+MAX10>

Control signal	Switch / Button / LED / Pin	Signal Schematic Names	Connected to	Functionality	Notes
No sequencing	DIP switch S2-8	CM1	SC CPLD U11, L2	Module Power management. Set ON to disable module CPLD power management. Power management depends on module and not all modules support extended power management with CPLD.	depends on SC CPLD configuration ⁶ , only available when 4x5 module installed
Boot Mode	DIP switch S3-1	CM2	SC CPLD U11, K2	Boot Mode for attached module (Default: OFF for primary SD boot and ON for primary QSPI boot. Depends also on module CPLD firmware).	depends on SC CPLD configuration ⁷ , only available when 4x5 module installed
FMC VADJ enable	DIP switch S3-2	USR0	SC CPLD U11, K1	ON: FMC VADJ enable also without installed FMC Card OFF: FMC_FADJ only enabled when FMC installed.	depends on SC CPLD configuration ⁸ , only available when 4x5 module installed
Reset	Push button S1	BUTTON	SC CPLD U11, N6	Module Reset, Low active module reset. Pin force Power one reset on FPGA/SoC.	depends on SC CPLD configuration ⁹
2x User LED	Green LEDs D1, D2	LED1, LED2	SC CPLD U11, J5, K5	Depends on User configuration, currently both off, if not otherwise programmed.	depends on SC CPLD configuration ¹⁰

⁶ <https://wiki.trenz-electronic.de/display/PD/TEF1002+SC+CPLD+MAX10>

⁷ <https://wiki.trenz-electronic.de/display/PD/TEF1002+SC+CPLD+MAX10>

⁸ <https://wiki.trenz-electronic.de/display/PD/TEF1002+SC+CPLD+MAX10>

⁹ <https://wiki.trenz-electronic.de/display/PD/TEF1002+SC+CPLD+MAX10>

¹⁰ <https://wiki.trenz-electronic.de/display/PD/TEF1002+SC+CPLD+MAX10>

Control signal	Switch / Button / LED / Pin	Signal Schematic Names	Connected to	Functionality	Notes
Board power indicator	Green LED D3	3V3IN	B2B JB1, pin 14, 16	ON: 3.3V on-board voltage available	-
Board status indicators	Green LED D4	-	SC CPLD U11, pin C2	ON: No failure. For other blinking status of this LED please refer to SC Firmware description ¹¹ .	depends on SC CPLD configuration ¹²
Enable module power	SC CPLD U11, D11	EN1	B2B JB1, pin 27	Module power. (Power management depends on module.)	In standard Firmware connected to CM0 (see above)
No sequencing	SC CPLD U11, E13	NOSE Q	B2B JB1, pin 8	Power management depends on module and not all modules support extended power management with CPLD.	In standard Firmware connected to CM1 (see above)
Boot Mode	SC CPLD U11, B11	MODE	B2B JB1, pin 31	Boot Mode for attached module. LOW for primary SD boot and HIGH for primary QSPI boot. (Depends also on module CPLD firmware).	In standard Firmware connected to CM2 (see above)
Module Reset	SC CPLD U11, E12	RESIN	B2B JB2, pin 17	Module Reset	In standard Firmware connected to BUTTON S1 (see above)

Table 2: TEF1002 Control Signals
¹¹ <https://wiki.trenz-electronic.de/display/PD/TEF1002+CPLD+Firmware>
¹² <https://wiki.trenz-electronic.de/display/PD/TEF1002+SC+CPLD+MAX10>

5 Signals, Interfaces and Pins

5.1 Board to Board (B2B) I/Os

I/O signals connected to the B2B connector:

B2B Connector	Interfaces	I/O Signal Count	Notes
JB1	User IO	15 single ended or 7 differential	TEF1002 CPLD
		16 single ended or 8 differential	FFA
		16 single ended or 8 differential	FFB
	MIO/PJTAG/User IO	4	Pinheader J19
	CPLD IO	2	Module CPLD IO to Carrier CPLD
	SD IO	6	-
	UART	2	-
	GbE PHY_MDIO + PHY_COM	8 +1	-
	Module Control	5	NOSEQ,, EN1, PGOOD, MODE, M_JTAGEN
JB3	User IO	12 single ended or 6 differential	LPC FMC
	MGTs (RX+TX)	4	PCIe x1, SFP+, LPC FMC, SATA
	MGTCLK	1 differential	-
	CLK	1 differential	-
	USB	1 differnetial	OTG-D_P, OTG-D_N

B2B Connector	Interfaces	I/O Signal Count	Notes
	USB Control	3	OTG-ID
JB2	User IO	56 single ended or 28 differential	LPC FMC
	CLK	2 differential	M2C
	JTAG	4	-

Table 3: General overview of B2B connectors

5.2 FMC LPC Connector

I/O signals and interfaces connected to the FPGA SoCs I/O bank and FMC connector J1:

FMC Connector J2 Pins and Interfaces	I/O Signal Count	diff.-pairs count	Connected to	VCCIO voltage	Notes
I/O	56	28	B2B JB2 connector	FMC_VAD J	pins usable as single ended I/O's or differential pairs
	12	6	B2B JB3 connector	FMC_VAD J	
Multi Gigabit Transceiver	-	2	B2B JB3 connector, pin 19, 21 and 20, 22	-	RX, TX
Gigabit Transceiver Clock	-	1	B2B JB3 connector, pin 31, 33	-	
I ² C (SDA, SCL)	2	-	SC CPLD U11, pin F9, J8	3V3IN	FMC I ² C Geographical Address pins GA0 and GA1 set to GND.
JTAG	5	-	SC CPLD U11, pin N7, M8, F8, M7, N8	3V3IN	TDO, TMS, TCK, TDI, TRST

FMC Connector J2 Pins and Interfaces	I/O Signal Count	diff.-pairs count	Connected to	VCCIO voltage	Notes
Clock Input	-	2	B2B JB3 connector	FMC_VAD J	2x reference clock inputs
Control Signals	2	-	SC CPLD U11, pin M5, E9	3V3IN	'PG_C2M', 'FMC_PRSENT'
Reference voltage (FMC_VREF)	-	-	-	-	Not Connected.

Table 4: FMC connector interface

5.3 SFP+ Interface

Connector J12 Pins and Interfaces	I/O Signal Count	diff.-pairs count	Connected to	VCCIO voltage	Notes
Multi Gigabit Transceiver	-	2	B2B JB3 connector, pin 13, 15 and 14, 16	-	RX, TX
Control	6		SC CPLD U11	3V3IN	TX_FAULT, TX_DIS, M-DEF0, RS0, RS1, LOS
I ² C (SDA, SCL)	2	-	SC CPLD U11, pin F9, J8	3V3IN	MUX via CPLD

Table 5: SFP+ interface

5.4 PCIe x1 card edge connector

Connector J3 Pins and Interfaces	I/O Signal Count	diff.-pairs count	Connected to	VCCIO voltage	Notes
Multi Gigabit Transceiver	-	2	B2B JB3 connector, pin 25, 27 and 26, 28	-	RX, TX

Connector J3 Pins and Interfaces	I/O Signal Count	diff.-pairs count	Connected to	VCCIO voltage	Notes
Clock	-	1	B2B JB3 connector, pin 32, 34	-	
JTAG	5	-	SC CPLD U11, M12, M13, L11, N12, G10	3V3IN	TDO, TMS, TCK, TDI, TRST

Table 6: PCIe x1 card edge connector

5.5 SATA connector

The SATA connector includes the pin 7 power configuration. This means that pin 7 (usually GND) is connected to a power switch U15, applying 5V to this pin. This gives the possibility to use SATADoMs with pin 7 power configuration. If a standard SATA device is connected the short (Current >0.5A) of Pin7 to GND is detected by the powerswitch and the powerswitch is switched OFF by the CPLD until a powercycle of TEF1002. There is also the possibility to remove the pin 7 power configuration by removing R82 and assembling R83 (0 Ohm, 2012 (0805)).

Connector J31 Pins and Interfaces	I/O Signal Count	diff.-pairs count	Connected to	VCCIO voltage	Notes
Multi Gigabit Transceiver, pin 5,6 and 2,3	-	2	B2B JB3 connector, pin 7, 9 and 8, 10	-	RX, TX
Pin 1,4	-	-	GND	GND	-
Pin 7	-	-	U15, pin 6,8	5V0_SAT A	Conneti on is via R82 0 Ohm resistor.

Table 7: SATA connector

5.6 High speed connectors FFA and FFB

There are two Firefly connector arrangements.

Connector, Pins and Interfaces	I/O Signal Count	diff.-pairs count	Connected to	VCCIO voltage	Notes
FFA, J11	-	8	B2B JB1 connector	-	-
FFA Control, J14	4	-	SC CPLD U11, pin C10, C9, E8, B9	3V3IN	MPRS, MSEL, INTL, RSTL
FFA I2C, J14	2	-	SC CPLD U11, pin E6, D6	3V3IN	
FFB, J11	-	8	B2B JB1 connector	-	-
FFB Control, J14	4	-	SC CPLD U11, pin A11, B10, A10, B9	3V3IN	MPRS, MSEL, INTL, RSTL
FFB I2C, J14	2	-	SC CPLD U11, pin A9, D8	3V3IN	

Table 8: FMC connector interface

The RSTL of both connectors are tied together.

5.7 microUSB JTAG/UART/FIFO Interface

The microUSB connector provides JTAG access to Module and FMC through the carriers USB to JTAG/UART/FIFO bridge. JTAG is routed for MUX to the CPLD. UART signals are connected to the module B2B connectors. For further description of the JTAG MUX see [dip switches \(see page 28\)](#) or SC CPLD Firmware. For other non-standard functionalities compare on-board connection and datasheet of FTDI FT2232H.

(CPLD JTAG access is via 2x5 pin header J5. See [pin header description \(see page 0\)](#))

5.8 microUSB

Connector J16, Pins and Interfaces	I/O Signal Count	LVDS-pairs count	Connected to	VCCIO voltage	Notes
DATA	-	1	B2B JB3 connector, pin 48, 50	-	-

Connector J16, Pins and Interfaces	I/O Signal Count	LVDS-pairs count	Connected to	VCCIO voltage	Notes
Power, Control	3	-	B2B JB3 pin 52, 54, 56	-	OTG-ID, VBUS_V_EN, USB-VBUS

Table 9: MicroUSB J16

5.9 RJ45 - Ethernet MagJack

Connector J9, Pins and Interfaces	I/O Signal Count	LVDS-pairs count	Connected to	VCCIO voltage	Notes
PHY_MDI	-	4	B2B JB1 connector, pin 3, 5, 9, 11, 15, 17, 21, 23	-	-
LED1	2	-	SC CPLD U11, pin B13, C12	3V3IN	green / yellow
LED2	2	-	SC CPLD U11, pin D12, C13	3V3IN	green / yellow

Table 10: Gigabit Ethernet Connector

5.10 micro SD-Card connector

The micro SD-Card connector J8 is connected to a TXS02612 SDIO port expander, which is used as levelshifter. Depending on the modules IO Voltage of the IO Bank where the SD-Card is connected Jumper J7 has to be set.

Connector J8 pin	Signal Schematic Name	Muxed to signal on Port Expander	Connected to	Notes
2, DAT3	SD-D3_LS	SD_D3	B2B JB1, pin 18	-
3, CMD	SD-CMD_LS	SD_CMD	B2B JB1, pin 26	-

Connector J8 pin	Signal Schematic Name	Muxed to signal on Port Expander	Connected to	Notes
5, CLK	SD-CCLK_LS	SD_CCLK	B2B JB1, pin 28	-
7, DAT0	SD-D0_LS	SD_D0	B2B JB1, pin 24	-
8, DAT1	SD-D1_LS	SD_D1	B2B JB1, pin 22	-
1, DAT2	SD-D2_LS	SD_D2	B2B JB1, pin 20	-
9, CARD detect	SD-CD	-	U11, pin M1	CPLD Firmware dependent, in default firmware not used

Table 11: micro SD-Card connector

6 On-board Peripherals

6.1 System Controller CPLD MAX10

The Intel/Altera MAX10 10M08SAU169C8G System Controller CPLD (U11) is the central system management unit where essential control signals are logically linked by the CPLD firmware. It generates output signals to control the system, the on-board peripherals and the interfaces. The JTAG and I²C between the on-board peripherals and the attached module are forwarded and controlled by the System Controller CPLD. A main task of the System Controller CPLD is the monitoring of the power-on sequence and configuring the state of the attached module. For detailed information, refer to the [firmware documentation of the SC CPLD](#)¹³. Table below lists the SC CPLD I/O signals and pins:

Signal name	SC CPLD Pin	Connected to	Function	Notes
ACBUS0	A4	FTDI U4, pin 22	GPIO's available to user	(FIFO or other FTDI functions when FTDI reprogrammed)
ACBUS1	B4	FTDI U4, pin 23		
ACBUS2	A5	FTDI U4, pin 24		
ACBUS3	B5	FTDI U4, pin 25		
ACBUS4	A6	FTDI U4, pin 26		
ACBUS5	B6	FTDI U4, pin 27		
ACBUS6	A7	FTDI U4, pin 28		
ACBUS7	A8	FTDI U4, pin 29		
ADBUS4	A2	FTDI U4, pin 17		
ADBUS5	B2	FTDI U4, pin 18		

¹³ <https://wiki.trenz-electronic.de/display/PD/TEF1002+CPLD+Firmware>

Signal name	SC CPLD Pin	Connected to	Function	Notes
ADBUS6	A3	FTDI U4, pin 19		
ADBUS7	B3	FTDI U4, pin 20		
TCK	G2	J5, 1	CPLD JTAG signals from pin header	Other functions possible with non standard CPLD firmware.
TDI	F5	J5, 9		
TDO	F6	J5, 3		
TMS	G1	J5, 5		
F_TCK	H3	FTDI U4, pin 12	Forwarded JTAG signals from FTDI chip.	(FIFO or other FTDI functions when FTDI reprogrammed)
F_TDI	H2	FTDI U4, pin 13		
F_TDO	G4	FTDI U4, pin 14		
F_TMS	F4	FTDI U4, pin 15		
M_TCK	H5	JB2, pin 100	4x5 Module JTAG	Bank with VCCIO is VREF_JTAG from Module
M_TDI	J2	JB2, pin 96		
M_TDO	J1	JB2, pin 98		
M_TMS	H6	JB2, pin 94		
FMC_TCK	F8	J1, pin D29	FMC JTAG	TRST not used
FMC_TDI	M7	J1, pin D30		

Signal name	SC CPLD Pin	Connected to	Function	Notes
FMC_TDO	N7	J1, pin D31		
FMC_TMS	M8	J1, pin D33		
FMC_TRST	N8	J1, pin D34		
PCIE_TCK	L11	J3, pin A5	PCIE JTAG	Currently not used
PCIE_TDI	N12	J3, pin A6		
PCIE_TDO	M12	J3, pin A7		
PCIE_TMS	M13	J3, pin A8		
PCIE_TRST	G10	J3, pin B9		
PCIE_PERSIST	F12	J3, pin A11	Indication that PCIe Bus is up (power, clocks)	
EN_FMC	L4	U14, pin 9	Enable switched 3.3V FMC power	pulled down
EN_FMC_VADJ	K7	U1, pin 41	Enable IO power FMC_VADJ	pulled down
EN_PER	F13	Q4, pin 5	Enable periphery power 3V3_PER	pulled down
FAN_FMC_EN	K8	Q1, pin 5	Enable FMC FAN	floating during configuration (no pull down)
FMC_PG_C2M	M5	J1, pin D1	Indicate that all FMC related powers are up	pulled up
FMC_PRESENT_M2C_L	E9	J1, pin H2	Indicate if FMC installed	Low when FMC present

Signal name	SC CPLD Pin	Connected to	Function	Notes
FMC_SCL	J8	J1, pin C31	I ² C 2-wire serial bus	MUX in CPLD
FMC_SDA	F9	J1, pin C30		
PG_FMC_VADJ	J6	U1, pin 35	Indicate FMC VADJ power is up	
FF_RSTL	B9	J13, pin 6 and J18, pin 6	Reset configuration	Both FF are resetted simultaneously when pulled LOW
FFA_INTL	E8	J13, pin 5	Indicate interrupt	LOW when fault condition, pulled up
FFA_MPRS	C10	J13, pin 3	Indicate FF Module installed	LOW when Module present, pulled up
FFA_MSEL	C9	J13, pin 4	Select attached FF Module	Pull low to use I ² C
FFA_SCL	D6	J13, pin 8	I ² C 2-wire serial bus	MUX in CPLD
FFA_SDA	E6	J13, pin 7		
FFB_INTL	A10	J18, pin 5	Indicate interrupt	LOW when fault condition, pulled up
FFB_MPRS	A11	J18, pin 3	Indicate FF Module installed	LOW when Module present, pulled up
FFB_MSEL	B10	J18, pin 4	Select attached FF Module	Pull low to use I ² C
FFB_SCL	D8	J18, pin 8	I ² C 2-wire serial bus	MUX in CPLD
FFB_SDA	A9	J18, pin 7		
CPLD_IO_1	B12	JB1, pin 88	(M)IOs from 4x5 Module	(M)IOs used for ETH PHY LEDs
CPLD_IO_2	A12	JB1, pin 92	(M)IOs from 4x5 Module	

Signal name	SC CPLD Pin	Connected to	Function	Notes
M10_RST	D1	J5, pin 6		Currently not used, functions possible with non standard CPLD firmware.
M10_RX	E4	J5, pin 8		
M10_TX	E3	J5, pin 7		
EN1	D11	JB1, pin 27	Enable on module power	Depends on module, on some similar to reset.
MODE	B11	JB1, pin 31	Boot Mode selection	For Zynq modules only. (LOW → SD, HIGH → primary QSPI)
NOSEQ	E13	JB1, pin 8	Disable module CPLD power management	Depends on module. On some modules no extended CPLD power management available.
PGOOD	C11	JB1, pin 29	Power good signal	This is only for monitoring, do not use as powerenable! Pulled up.
RESIN	E12	JB2, pin 17	Module Reset	Aktive LOW
M3.3VOUT	M4	JB2, pin 9 and 11	Indicates module power is up	Used for periphery power enable. Floating when no module installed (no pull down).
SFPA_LOS	M10	J12, pin 8	SFP signal loss	HIGH indicates signal loss
SFPA_M-DEF0	F10	J12, pin 6	SFP modul absent	HIGH when module physically absent
SFPA_RS0	N10	J12, pin 7	SFP rate select RX	LOW for 1000BASE-SX, HIGH for 10GBASE-SR
SFPA_RS1	M11	J12, pin 9	SFP rate select TX	LOW for 1000BASE-SX, HIGH for 10GBASE-SR
SFPA_SCL	L10	J12, pin 5	I ² C 2-wire serial bus	MUX in CPLD
SFPA_SDA	N9	J12, pin 4		

Signal name	SC CPLD Pin	Connected to	Function	Notes
SFPA_TX_DIS	M9	J12, pin 3	SFP transmitter disable	HIGH disables transmitter
SFPA_TX_FAULT	G9	J12, pin 2	Indicates SFP laser fault	HIGH indicates fault
VID0_FMC_VADJ	E10	U1, pin 34	FMC_VADJ Voltage select	Chip internal pulled up
VID1_FMC_VADJ	J7	U1, pin 33		
VID2_FMC_VADJ	L5	U1, pin 32		
VID0	K6	S2-1	For FMC_VADJ Voltage select	
VID1	N5	S2-2		
VID2	N4	S2-3		
JTAGEN	E5	S2-4		
FMC_JTAG	B1	S2-6	Enable FMC JTAG port	
CM0	M3	S2-7	Dips for module control signals	
CM1	L2	S2-8		
CM2	K2	S3-1		
USR0	C1	S3-2	User button	Currently used for override FMC VADJ enable
USB_OC	D9	U12, pin 5	USB overcurrent detection	
EN_5VSATA	E1	U15, pin 1	Enable SATA pin 7 power	
OC_VSATA	F1	U15, pin 2	Overcurrent detection SATA pin 7 power	

Signal name	SC CPLD Pin	Connected to	Function	Notes
BUTTON	N6	S1	Reset button	
SD-CD	M1	J8, pin 9	SD-Card card detect switch	Currently not used
LED1	J5	D1	User LED	
LED2	K5	D2		
-	C2	D4	Status LED	For further explanation see SC CPLD Firmware description
PHY_LED1	D12	J9	Phy LEDs	
PHY_LED1 R	C13	J9		
PHY_LED2	B13	J9		
PHY_LED2 R	C12	J9		
A_00_N	J10	JB1, pin 38	Module to CPLD communication	Currently "three wire" I ² C and RGPIO, see SC CPLD Firmware description
A_00_P	K10	JB1, pin 36		
A_01_N	L12	JB1, pin 35		
A_01_P	K11	JB1, pin 37		
A_02_N	J12	JB1, pin 41		
A_02_P	K12	JB1, pin 39		
A_03_N	H10	JB1, pin 44		
A_03_P	J9	JB1, pin 42		

Signal name	SC CPLD Pin	Connected to	Function	Notes
A_04_N	H13	JB1, pin 47		
A_04_P	J13	JB1, pin 45		
A_05_N	H8	JB1, pin 57		
A_05_P	H9	JB1, pin 55		
A_06_N	G12	JB1, pin 49		
A_06_P	G13	JB1, pin 51		
A_07	L13	JB1, pin 34		

Table 12: SC CPLD pin mapping

6.2 FTDI FT2232H

The TEF1002 board has an on-board microUSB 2.0 (J10) high-speed to JTAG/UART/FIFO IC FT2232H (U4) from FTDI. Channel A can be used as JTAG Interface (MPSSE) to program on module JTAG devices. Channel B can be used as UART Interface routed to the B2B connector. There is also a 256-byte serial EEPROM connected to the FT2232H chip pre-programmed with license code to support Xilinx programming tools.



Do not access the FT2232H EEPROM using FTDI programming tools. Doing so will erase normally invisible user EEPROM content and invalidate stored Xilinx JTAG license. Without this license the on-board JTAG will not be accessible any more with any Xilinx tools. Software tools from FTDI website do not warn or ask for confirmation before erasing user EEPROM content.

Refer to the FTDI datasheet to get information about other options of the FT2232H chip.

FTDI U4 pin	Signal Schematic Name	Connected to, Pin	Function	Notes
Pin 22	ACBUS0	SC CPLD U4, A4	GPIO's available to user	(FIFO or other FTDI functions when FTDI reprogrammed)
Pin 23	ACBUS1	SC CPLD U4, B4		
Pin 24	ACBUS2	SC CPLD U4, A5		
Pin 25	ACBUS3	SC CPLD U4, B5		
Pin 26	ACBUS4	SC CPLD U4, A6		
Pin 27	ACBUS5	SC CPLD U4, B6		
Pin 28	ACBUS6	SC CPLD U4, A7		
Pin 29	ACBUS7	SC CPLD U4, A8		
Pin 17	ADBUS4	SC CPLD U4, A2		
Pin 18	ADBUS5	SC CPLD U4, B2		
Pin 19	ADBUS6	SC CPLD U4, A3		
Pin 20	ADBUS7	SC CPLD U4, B3		
Pin 12	F_TCK	SC CPLD U4, H3	JTAG signals forward to SC CPLD U4	(FIFO or other FTDI functions when FTDI reprogrammed)
Pin 13	F_TDI	SC CPLD U4, H2		
Pin 14	F_TDO	SC CPLD U4, G4		

FTDI U4 pin	Signal Schematic Name	Connected to, Pin	Function	Notes
Pin 15	F_TMS	SC CPLD U4, F4		
Pin 32	BDBUS0	JB1, 91	UART	
Pin 33	BDBUS1	JB1, 86		

Table 13: FT2232H interface connections

6.3 SDIO Port Expander

The TEF1002 is equipped with the Texas Instruments TXS02612 SDIO Port Expander (U3), which is used as a SDIO level shifter. Port A is connected to the B2B connector J1. The IO Voltage VCCA_SD of this port is selected by jumper J7 and has to be set according to the module attached. Port B0 is directly connected to the microSD Card connector (J8).

Port Expander U3 pin	Signal Schematic Name	Connected to B2B Pin	Notes
Pin 6	SD-D0	JB1, Pin 24	Signals levelshiftet to 3.3V and connected to card holder (J8)
Pin 7	SD-D1	JB1, Pin 22	
Pin 1	SD-D2	JB1, Pin 20	
Pin 3	SD-D3	JB1, Pin 18	
Pin 4	SD-CMD	JB1, Pin 26	
Pin 9	SD-CCLK	JB1, Pin 28	

Table 14: SDIO Port Expander connections

6.4 Configuration DIP-switches

S2 and S3 provide 10 dip-switchs for configuration purpurses. Some of them are hard wired others are SC CPLD firmware dependent. If Firmware dependet, the functions in Notes are for the actual delivery firmware. For further descriptions see firmware description.

Switch	Signal Schematic Name	Connected to, Pin	Notes
S2-1	VID0	SC CPLD U11, K6	SC CPLD firmware dependent, used for FMC_VADJ, see table below. Select according to the IO capabilities of attached 4x5 SoM and FMC.
S2-2	VID1	SC CPLD U11, N5	
S2-3	VID2	SC CPLD U11, N4	
S2-4	JTAGEN	SC CPLD U11, E5	ON TEF1002 SC CPLD JTAG; OFF CPLD IOs, hard wired.
S2-5	M_JTAGEN	JB1, Pin 90	When S2-6 OFF: OFF 4x5 module FPGA/SOC JTAG, ON 4x5 module CPLD JTAG, hard wired.
S2-6	FMC_JTAG	SC CPLD U11, L3	SC CPLD firmware dependent. ON: FMC JTAG; OFF 4x5 module JTAG, see S2-5.
S2-7	CM0	SC CPLD U11, M3	SC CPLD firmware dependent, EN1
S2-8	CM1	SC CPLD U11, L2	SC CPLD firmware dependent, NOSEQ
S3-1	CM2	SC CPLD U11, K2	SC CPLD firmware dependent, BOOT MODE
S3-2	USR0	SC CPLD U11, K1	SC CPLD firmware dependent, Override FMC_EN_VADJ

Table 15: DIP-switches

S2-1	S2-2	S2-3	Output Voltage
OFF	OFF	OFF	3.3V
OFF	OFF	ON	2.5V
OFF	ON	OFF	1.8V
OFF	ON	ON	1.5V
ON	OFF	OFF	1.25V

S2-1	S2-2	S2-3	Output Voltage
ON	OFF	ON	1.2V
ON	ON	OFF	0.8V

Table 16: FMC_VADJ selection

6.5 Jumper

There are two voltage select jumpers available. J4 is used to select the SDIO signal voltage and J7 is used to select VCCIOA IO Voltage. Both have to be selected according to the attached 4x5 module capabilities (See TRM of your module).

Jumper	Power rail	3.3V	1.8V	Remark
J4	VCCIOA	1-2	2-3	Powers 4x5 bank, where FFA and FFB high speed signals are connected.
J7	VCCA_SD	1-2	2-3	Powers SDIO Levelshifter on 4x5 module side.

Table 17: Jumper positions

6.6 Push Button

There is on push button (S1) on the TEF1002. It is connected to the SC CPLD (U11 Pin N6). The function is firmware dependet. In the actual delivery firmware it is used as module reset connected to B2B JB2 Pin 17 (RESIN). For further descriptions see firmware description.

6.7 Pin Header

Pin header J5 (can be used with TEI0004 programming module or any other Quartus compatible JTAG programmer) for MAX10 CPLD Firmware programming. If dip switch S2-4 is set to OFF, JTAG pins can also be used as CPLD IOs, e.g. routed to FMC JTAG or as IO extension (not implemented in standard firmware).

Pi n	Signal Schematic Name	Connected to, pin	NOTE
1	TCK	U11, G2	If dip switch S2-4 is set to OFF, this pins can be used as CPLD IOs (not implemented in standard firmware)
2	GND	-	-
3	TDO	U11, F6	If dip switch S2-4 is set to OFF, this pins can be used as CPLD IOs (not implemented in standard firmware)

Pi n	Signal Schematic Name	Connected to, pin	NOTE
4	3V3IN	-	-
5	TMS	U11, G1	If dip switch S2-4 is set to OFF, this pins can be used as CPLD IOs (not implemented in standard firmware)
6	M10_RST	U11, D1	(not implemented in standard firmware), usable as CPLD IO
7	M10_TX	U11, E3	(not implemented in standard firmware), usable as CPLD IO
8	M10_RX	U11, E4	(not implemented in standard firmware), usable as CPLD IO
9	TDI	U11, F5	If dip switch S2-4 is set to OFF, this pins can be used as CPLD IOs (not implemented in standard firmware)
10	GND	-	-

Table 18: CPLD JTAG pin header J5

Pin 2 of the 3x1 pin header J6 is directly connected to the B2B connector JB1 PSBATT pin. Pin 10 is connected to GND. This pin header can be used to supply the modules VBAT pin.

 Check the TRM of the attached 4x5 Module for the correct Battery voltage. Do not short or swap polarity, this may damage the module!

Pinheader J19 is for PJTAG access or can be used as connector for the 4 IO pins.

Pi n	Signal Schematic Name	Connected to, pin	NOTE
1	PJTAG_TCK	JB1, 96	Check 4x5 module TRM for capability of connected IO
2	PJTAG_TDO	JB1, 100	Check 4x5 module TRM for capability of connected IO
3	PJTAG_TDI	JB1, 94	Check 4x5 module TRM for capability of connected IO
4	PJTAG_TMS	JB1-98	Check 4x5 module TRM for capability of connected IO

Pin	Signal Schematic Name	Connected to, pin	NOTE
5	GND	-	-
6	M3.3VOUT	-	Module 3.3V

Table 19: PJTAG pin header J19

6.8 On-board LEDs

There are 4 green LEDs on the board, two of them are for user purposes and controlled via the RGPIIO of the actual delivery firmware.

LED	Connected to	Function	Notes
D1	SC CPLD U11, Pin J5	User LEDs	SC CPLD firmware dependent
D2	SC CPLD U11, Pin K5		
D3	3V3IN	Power	ON when 3.3V generated from 12V input is up
D4	SC CPLD U11, Pin C2	Status	SC CPLD firmware dependent, for further description see firmware description.

Table 20: LED Overview

7 Power and Power-On Sequence

7.1 Power Consumption

Power consumption depends on the attached 4x5 module and configuration, as well as FPGA design. Generally a power supply with minimum current capability of 3A at 12V for system startup is recommended.

7.2 Power Distribution Dependencies

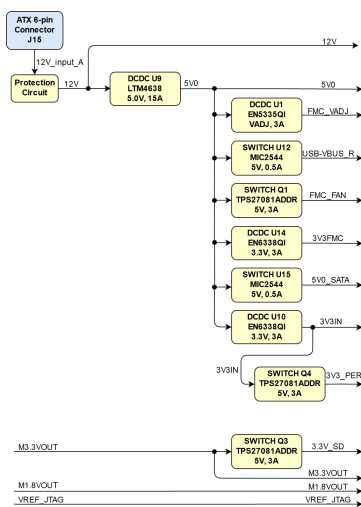


Figure 3: Power Distribution

7.3 Power-On Sequence

Power up sequence is depicted in the following figure. Most of the enables are handled by the SC CPLD and are therefore Firmware dependent. The Power up meets all criteria to power up 4x5 modules.

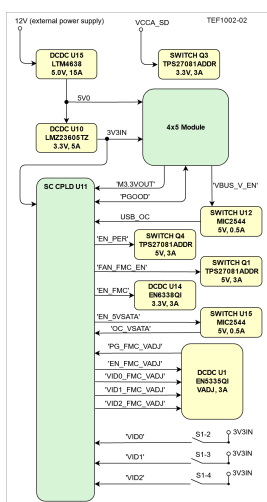


Figure 4: Power Sequence

7.4 Power Rails

In the following table power rails accessible for in or output on any connectors are summarized.

Connector, Pins	Voltage	Direction	Notes
J15, 1,2,3	12V	IN	TEF1002 supply voltage
J16, 1	5V	OUT	USB-VBUS_R
J6, 1	Depends on 4x5 Module	IN	Directly connected to B2B PSBATT pin
J2, 2	5V	OUT	FMC Fan Connector
JB1, 10,12	1,8V/3.3V	OUT	VCCIOA, selected by J4
JB1, 14,16	3.3V	OUT	Module supply voltage
JB1, 40	1.8V	IN	Module 1.8V output
JB1, 80	Depends on 4x5 Module	OUT	Directly connected to pinheader J6 PSBATT
JB1, 2,4,6	5V	OUT	Module power input
JB2, 1,3,5,7	5V	OUT	Module power input
JB2, 9,11	3.3V	IN	Module 3.3V output
JB2, 2,4,6,8,10	0,8V ... 3.3V	OUT	Module VCCIOB, VCCIOC, VCCIOD connected to FMC VADJ
JB2, 20	Depends on 4x5 Module	IN	Module DDR power output
JB2, 92	Depends on 4x5 Module	IN	VREF_JTAG
J13, 1,10	3.3V	OUT	FFA supply voltages
J18, 1,10	3.3V	OUT	FFB supply voltages

Table 21: Power Rails

8 Technical Specifications

8.1 Absolute Maximum Ratings

Parameter	Min	Max	Units	Reference Document
VIN supply voltage	-0.3	20	V	TPS6217 datasheet Note: voltage limitations are not valid for connected FMC module
Storage temperature	-40	+100	°C	SML-P11 LED datasheet

Table 22: Module absolute maximum ratings.

8.2 Recommended Operating Conditions

Parameter	Min	Max	Units	Reference Document
VIN supply voltage	11.4	12.6	V	12V nominal, ANSI/VITA 57.1 power specification for FMC connector
Board Operating Temperature Range	0	85	°C	10M08SAU169C8G CPLD datasheet

Table 23: Recommended Operating Conditions.

8.3 Physical Dimensions

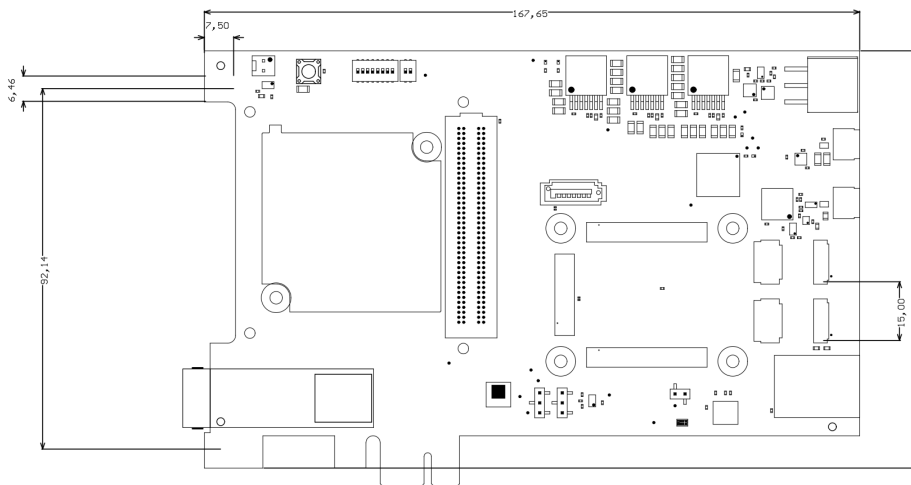


Figure 5: Physical dimensions drawing

9 Variants Currently In Production

Trenz shop TEF1002 overview page	
English page¹⁴	German page¹⁵

Table 24: Trenz Electronic Shop Overview

¹⁴ <https://shop.trenz-electronic.de/en/Products/Trenz-Electronic/>

¹⁵ <https://shop.trenz-electronic.de/de/Produkte/Trenz-Electronic/>

10 Revision History

10.1 Hardware Revision History

Date	Revision	Note	PCN	Documentation Link
2020-01-29	02	Prototypes	-	-
-	01	Prototypes	-	-

Table 25: Hardware Revision History

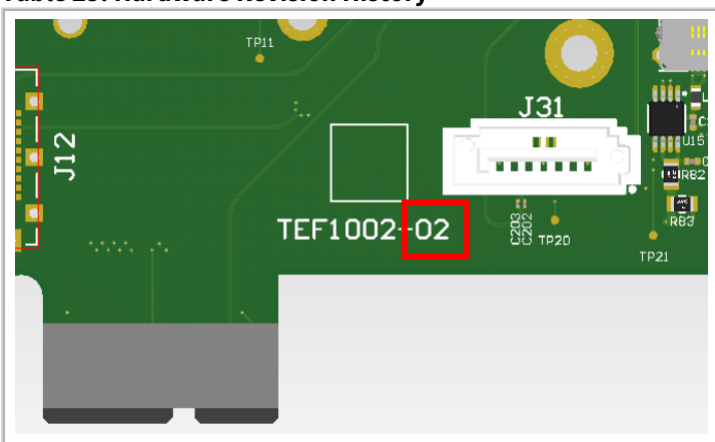


Figure 6: Hardware Revision Number

Hardware revision number is printed on the PCB board next to the module model number separated by the dash.

10.2 Document Change History

Date	Revision	Contributor	Description
 2020-04-06	v.34(see page 6)	John Hartfiel ¹⁶	typo correction
2020-01-29	v.28	Martin Rohrmüller	updated to REV02
2019-09-06	v.25	Martin Rohrmüller	initial version

¹⁶ <https://wiki.trenz-electronic.de/display/~j.hartfiel>

Date	Revision	Contributor	Description
--	all	John Hartfiel ¹⁷ , Martin Rohrmüller ¹⁸ , Susanne Kunath ¹⁹	• --

Table 26: Document change history.

¹⁷ <https://wiki.trenz-electronic.de/display/~j.hartfiel>

¹⁸ <https://wiki.trenz-electronic.de/display/~m.rohrmueller>

¹⁹ <https://wiki.trenz-electronic.de/display/~s.kunath>

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 2019-06-07

²⁰ <http://guidance.echa.europa.eu/>

²¹ <https://echa.europa.eu/candidate-list-table>

²² <http://www.echa.europa.eu/>