



TEMB0005 TRM

Revision v.33

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Online version of this document:

<https://wiki.trenz-electronic.de/display/PD/TEMB0005+TRM>

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4 Overview

The Trenz Electronic TEMB0005 is a carrier for the module TEM00005. The carrier is equipped with a LAN socket, a FTDI JTAG/UART to USB2.0 solution, three low speed and one high speed CRUVI B2B Connectors, a PMod Connector.

Refer to <http://trenz.org/temb0005-info> for the current online version of this manual and other available documentation.

4.1 Key Features

- **Modules**
 - TEM0005
- **RAM/Storage**
 - 2KB EEPROM
- **On Board**
 - FT2232H FTDI
 - 4x User LEDs
 - 2x Push Buttons
 - 2x MEMS Oscillators
- **Interface**
 - 1x Samtec Razor Beam (SS5) B2B Connector
 - 1x Samtec Razor Beam (SS4) High Speed CRUVI Connector
 - 3x Samtec Low Speed CRUVI Connectors
 - 1x PMod SMD (2x6) Connector
 - 1x SMD Header (1x6)
 - 1x RJ45 LAN Socket
 - 1x Micro USB2.0 Connector
- **Power**
 - 5V Input Power Supply
- **Dimension**
 - 115 x 70 mm
- **Notes**

4.2 Block Diagram

TEMB0005

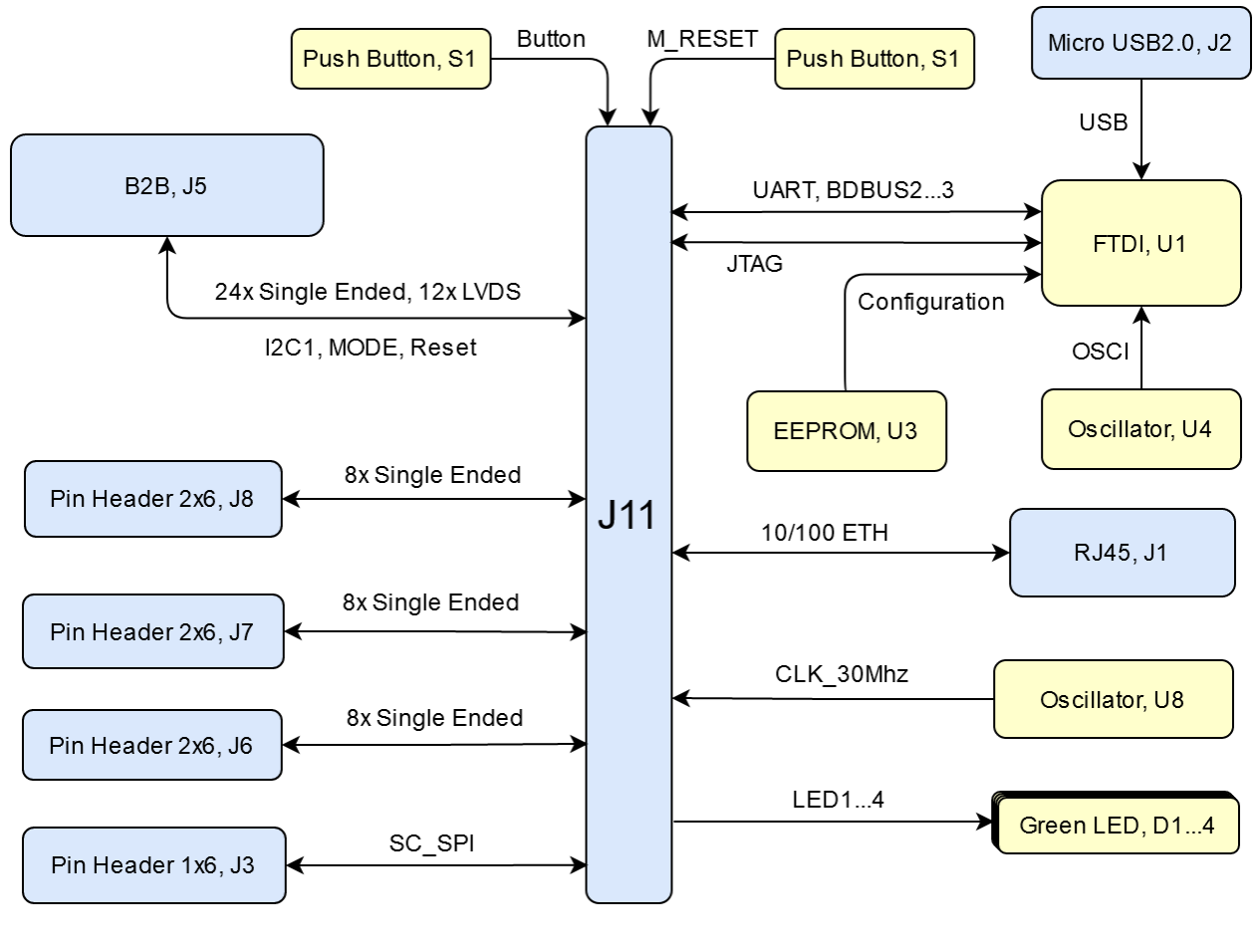


Figure 1: TEMB0005 block diagram

4.3 Main Components

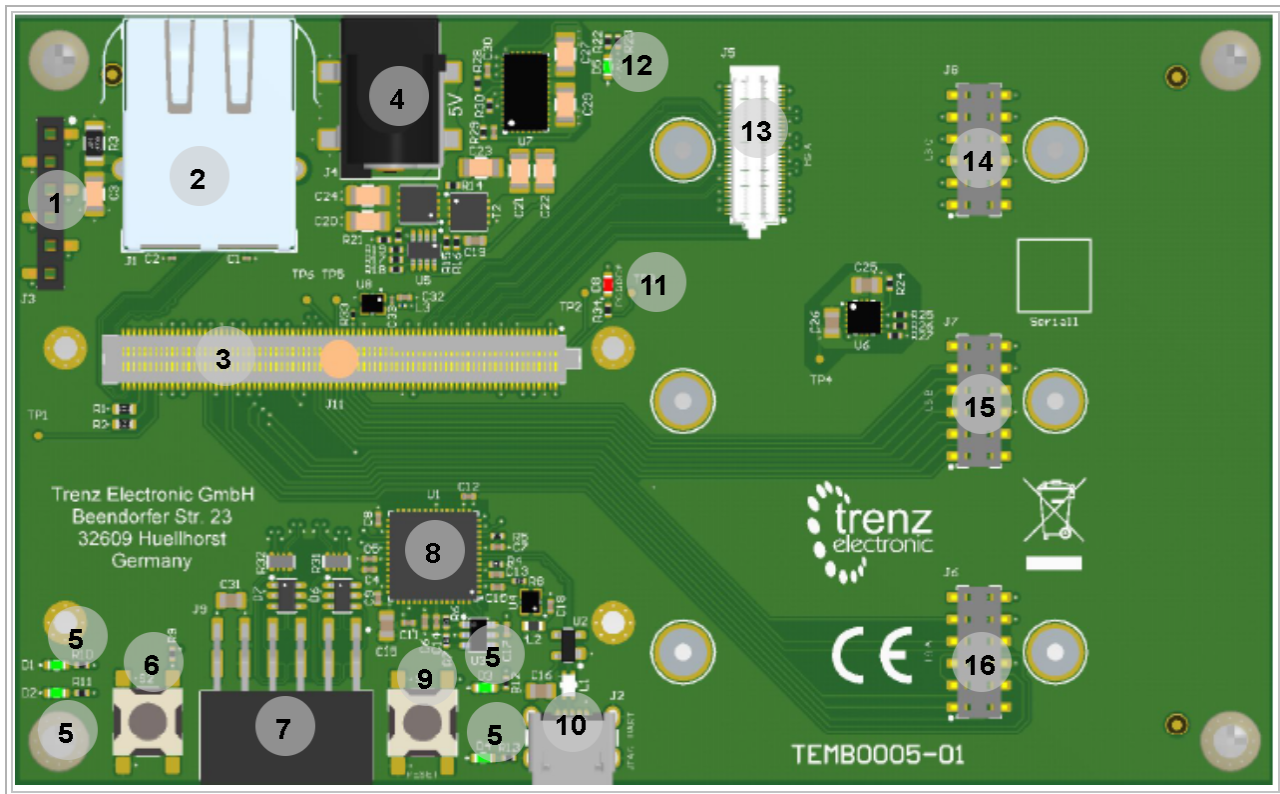


Figure 2: TEMB0005 main components

1. SMD Header 6x1, J3
2. RJ45 LAN Socket, J1
3. B2B Connector, J11
4. Barrel Jack, J4
5. Green LEDs, D1...4
6. User Push Button, S2
7. PMod 2x6 SMD Host Socket, J9
8. FT2232H FTDI, U1
9. Reset Push Button, S1
10. Micro USB2.0 Socket, J2
11. Red LED (PG_DCDC), D8
12. Green LED (5VIN), D5
13. High Speed CRUVI Connectors, J5
14. Low Speed CRUVI Connectors, J8
15. Low Speed CRUVI Connectors, J7
16. Low Speed CRUVI Connectors, J6

4.4 Initial Delivery State

Storage device name	Content	Notes
EEPROM	Programmed	FTDI Configurition

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

4.5 Configuration Signals

Signal	B2B	Connected to	Note
M_RESET	J11- 11	Push Button, S1	Module Reset
EN_VADJ	J11-110	DCDC, U6	pull-down, input from module
SEL_VADJ	J11-108	DCDC, U6	pull-up, input from module. 'low' → 1.8V, 'high' → 2.5V

Table 2: Reset process.

5 Signals, Interfaces and Pins

5.1 Board to Board (B2B) I/Os

The carrier TEMB0005 is equipped with a Samtec (SS4) B2B Connector. More information in the following table.

De sig na tor s	Interface	I/O Signal Count	Connected to	Notes
J1 1	JTAG	4x Single Ended	FTDI, U1	
	MSIOD	24x Single Ended, 12x Differential Pairs	CRUVI B2B, J5	A0...5, B0...5 (N/P)
	MSIO/ GPIO	8x Single Ended	CRUVI B2B, J6	A_X0...7
	MSIO	8x Single Ended	CRUVI B2B, J7	B_X0...7
	MSIO/ GPIO	8x Single Ended	CRUVI B2B, J8	C_X0...7
	LEDs (2x MSIO, 2x MSIO/ GPIO)	4x Single Ended	D1...4	LED1...4
	MSIO	8x Single Ended	Pmod Header, J9	
	Push Button	1x Single Ended	Push Button, S1	M_RESET
	Push Button	1x Single Ended	Push Button, S2	pull-up, User Button
	MSIO/ GPIO/I2C	2x Single Ended	CRUVI B2B J6	I2C

De sig na tor s	Interface	I/O Signal Count	Connected to	Notes
	ETH	2x Differential Pairs 2x Single Ended	RJ45 Socket, J1 RJ45 LEDs, J1	Yellow and Green LEDs
	UART	2x Single Ended	FTDI, U1	UART RX/TX
	FTDI I/O	2x Single Ended	FTDI, U1	BDBUS2-BDBUS3
	CLK	1x Single Ended	Oscillator, U8	30 MHz
	MSIOD	4x Single Ended	CRUVI B2B, J5	RESET, HSIO, HSO, HSI
	IO (3x MSIO, 4x MSIO/ GPIO, 2x MSIO GPIO/I2C)	9x Single Ended	CRUVI B2B, J5	
	Power Signal	1x Single Ended	RED LED, D8	PG_DCDC
	SC_SPI	4x Single Ended	pin header, J3	SC_CLK, SC_SDO, SC_SDI, SC_SS
	GOLDEN	1x Single Ended	Testpoint, TP1	GOLDEN
	JTAGSEL	1x Single Ended	Testpoint, TP2	JTAGSEL

Table 3: General B2B connectors information

5.2 CRUVI B2B Connectors

The TEMB0005 is equipped with three Low Speed Connectors J6...8 and a High Speed Connector J5. These connectors are provided for CRUVI extension cards. More information is provided in the [B2B Connectors](#)(see page 0) section.

Speed	Designators	Schematic	Connected to	Notes
Low	J6	A_X0...1	B2B, J11	alternative GPIO
		A_X2...5	B2B, J11	alternative SPI
		A_X6...7	B2B, J11	alternative I2C0 SDA/SCL
	J7	B_X0...7	B2B, J11	
	J8	C_X0...7	B2B, J11	alternative GPIO
High	J5	A0...A5 (N/P)	B2B, J11	HS I/O
		B0...B5 (N/P)	B2B, J11	HS I/O
		HSIO, HI, HO, RESET	B2B, J11	HS I/O single ended
		SMB_ALERT, SMB_SDA, SMB_SCL, MODE, REFCLK	B2B, J11	
		DI,DO,SCK,SEL	B2B, J11	alternative GPIO

Table 4: CRUVI B2B connectors information

5.3 USB2.0 Socket

There is a USB2.0 Socket, J2 provided in order to use JTAG/UART via FTDI, U1.

Pin	Schematic	Connected to	Notes
ID	N.C	N.C	

Pin	Schematic	Connected to	Notes
D+	DL_P	FTDI, U1	Through Line Filter, L1
D-	DL_N	FTDI, U1	Through Line Filter, L1
Vbus	VBUS	Diode, U2	

Table 5: USB2.0 Socket information

5.4 RJ45 LAN Socket

There is a RJ45 Ethernet LAN Socket, J1 connected to B2B, J11 via 2x channels data receive and transmit.

Pin	Schematic	Connected to	Notes
TD+	ETH1_TX_P	B2B, J11	
TD-	ETH1_TX_N	B2B, J11	
RD+	ETH1_RX_P	B2B, J11	
RD-	ETH1_RX_N	B2B, J11	
Green LED	ETH1_LED0	B2B, J11	Link/Activity indicator
Yellow LED	ETH1_LED1	B2B, J11	Speed indicator

Table 6: RJ45 LAN Socket information

5.5 PMod Header

There is a PMod Header, J9 connected to the B2B, J11 and all signals are protected from invers polarity by two diodes D6, D7.

Schematic	Connected to	Notes
PM0...3 (N/P)	B2B, J11	

Table 7: PMod Header information

5.6 Pin Header

There is a Pin Header 6x1, J3 provided for SPI signals.

Pin	Schematic	Connected to	Notes
1	3.3V	B2B, J11	
2	GND	B2B, J11	
3	SC_SDO	B2B, J11	
4	SC_SDI	B2B, J11	
5	SC_SS	B2B, J11	
6	SC_CLK	B2B, J11	

Table 8: Pin Header connections

5.7 UART

There is an UART channel provided in order to communicate with the module and signals are accessible via B2B, J11 through the FTDI, U1.

U1 Pin	Schematic	Connected to	Notes
BDBUS1	UART1_TXD	B2B, J11	FTDI receiver input
BDBUS0	UART1_RXD	B2B, J11	FTDI transmitter output

Table 9: UART connection

5.8 JTAG Interface

JTAG access is provided through B2B connector J11 connected to the FTDI. For more information please refer to the FTDI section.

JTAG Signal	B2B Connector
TMS	J11-14
TDI	J11-8
TDO	J11-10
TCK	J11-12

JTAG Signal	B2B Connector
JTAGSEL	J11-9

Table 10: JTAG pins connection

5.9 Test Points

Test Point	Signal	Connected to	Notes
TP1	GOLDEN	B2B, J11	
TP2	JTAGSEL	B2B, J11	
TP3	PG_DCDC	B2B, J11	Red LED, D8
TP4	VADJ	Regulator, U6	
TP5	PROBE_B	B2B, J11	
TP6	PROBE_A	B2B, J11	

Table 11: Test Points Information

6 On-board Peripherals

Chip/Interface	Designator	Notes
FTDI(see page 0)	U1	
LEDs(see page 18)	D1...D5	
Push Buttons(see page 17)	S1-S2	
EEPROM(see page 17)	U3	
Oscillator(see page 18)	U4-U8	

Table 12: On board peripherals

6.1 FTDI FT2232H

The FTDI chip (U8) converts signals from USB2 to variety of standard serial and parallel interfaces. Refer to the FTDI [data sheet](#)¹ to get information about the capacity of the FT2232H chip which is used in Multi-Protocol Synchronous Serial Engine (MPPSE) mode for JTAG.

The configuration of FTDI FT2232H chip is pre-programmed on the EEPROM U10.

Pin	Schematic	Connected to	Notes
ADBUS0	TCK	FPGA Bank 1B, U6	JTAG interface
ADBUS1	TDI	FPGA Bank 1B, U6	
ADBUS2	TDO	FPGA Bank 1B, U6	
ADBUS3	TMS	FPGA Bank 1B, U6	
BDBUS0	F_UART_TX	FPGA Bank 1B, U6	UART transmitter output
BDBUS1	F_UART_RX	FPGA Bank 1B, U6	UART receiver input
BDBUS2	BDBUS2	B2B,J11	I/O
BDBUS3	BDBUS3	B2B,J11	I/O
OSCI	OSCI	Oscillator, U4	Clock 12 MHz
EECS	EECS	EEPROM, U3	EEPROM Contains FTDI configuration

¹ http://www.ftdichip.com/Support/Documents/DataSheets/ICs/DS_FT2232H.pdf

Pin	Schematic	Connected to	Notes
EECLK	EECLK	EEPROM, U3	
EEDATA	EEDATA	EEPROM, U3	
DM/DP	D_N/ D_P	Micro USB, J2	USB to UART
nRESET	3.3V	3.3V	

Table 13: FTDI chip interfaces and pins

6.2 EEPROM

There is an EEPROM IC, U3 provided for storing the FTDI (U1) configuration.

Pin	Schematic	Notes
DI/DO	EEDATA	Data
CLK	EECLK	Clock
CS	EECS	Select

Table 14: I2C EEPROM interface MIOs and pins

The I2C address is as the following.

I2C Address	Designator	Notes
0x70	U3	

Table 15: I2C address for EEPROM

6.3 Push Buttons

There are two Push Buttons provided on the TEMB0005 designated as S1, S2. The Push Button S2 is considered to be as user buttons and S1 is provided to reset the module on the carrier.

Designator	Schematic	Connected to	Functionality	Note
S1	M_RESET	B2B, J11	Reset	
S2	Button	BUTTON	User Button	

Table 16: On-board Push Buttons

6.4 LEDs

There are 4 green LEDs provided as user LEDs.

Designator	Color	Connected to	Active Level	Note
D1...D4	Green	B2B, J11	Active High	User LEDS
D5	Green	5VIN	Active High	Power Status LED
D6	Red	PG_DCDC	Active Low	from module

Table 17: On-board LEDs

6.5 Clock Sources

Designator	Description	Frequency	Note
U4	MEMS Oscillator	12 MHz	
U8	MEMS Oscillator	30 MHz	

Table 18: Osillators

7 Power and Power-On Sequence

7.1 Power Supply

Power supply with minimum current capability of 2 A for system startup is recommended.

7.2 Power Consumption

Power Input Pin	Typical Current
5VIN	TBD*

Table 19: Power Consumption

* TBD - To Be Determined

7.3 Power Distribution Dependencies

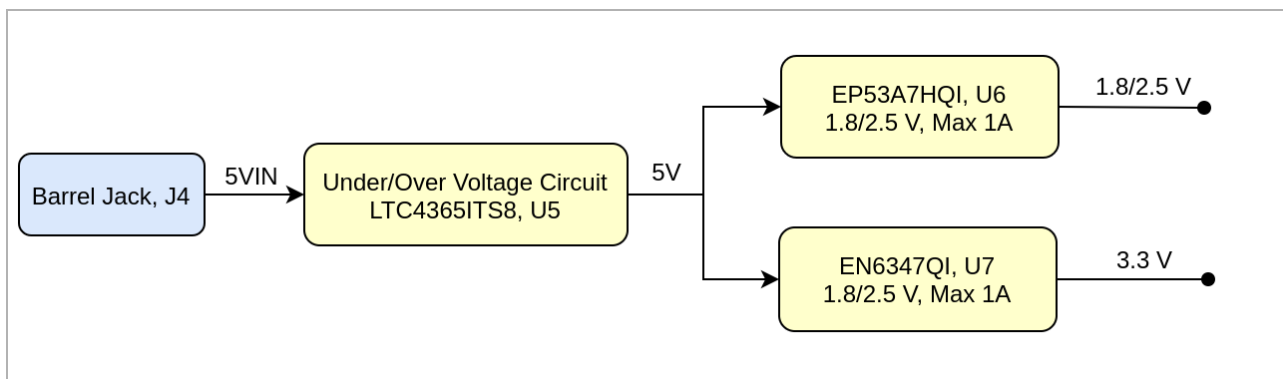


Figure 3: Power Distribution

7.4 Power-On Sequence

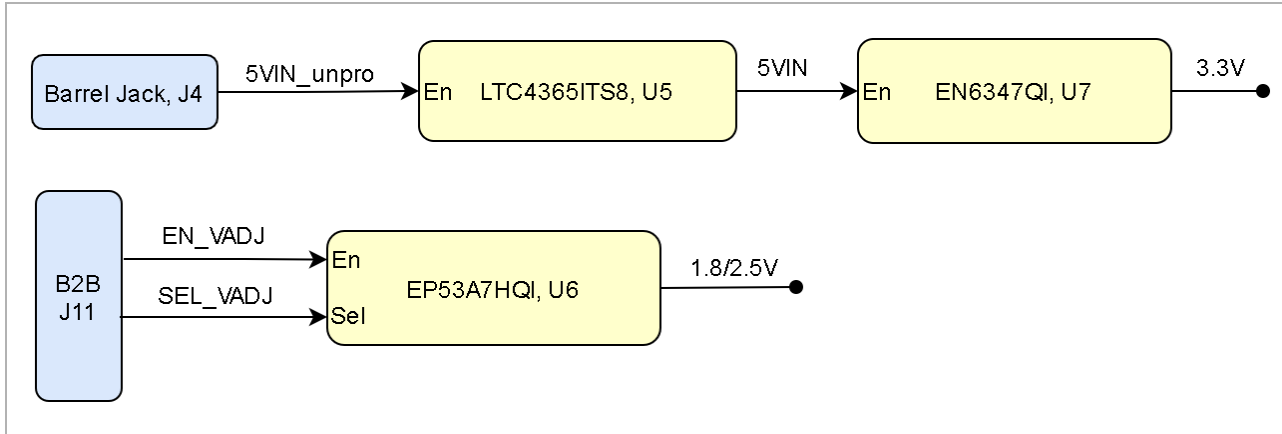


Figure 4: Power Sequence

7.5 Power Rails

Power Rail Name	B2B Connector J11 Pin	CRUVI Connector J5 Pin	B2B Connector J6 Pin	B2B Connector J7 Pin	B2B Connector J8 Pin	Direction	Notes
3.3V	1, 2, 3, 4	-	10	10	10	Output	
VDAJ	22	36	-	-	-	Output	
5VIN	-	-	12	12	12	Output	

Table 20: Module power rails.

8 Board to Board Connectors

3.1 x 5.6 Microsemi SmartFusion2 modules use one Samtec Razor Beam LP Terminal Strip ([ST5](#)²) on the bottom side.

- 1x REF-192552-02 (160-pins)
 - ST5 Mates with SS5

3.1 x 5.6 Microsemi SmartFusion2 carrier use one Samtec Razor Beam LP Socket Strip ([SS5](#)³) on the top side.

- 1x REF192552-01 (160-pins)
 - SS5 Mates with ST5

8.1 Features

- Board-to-Board Connector 160-pins, 80 contacts per row
- Ultrafine .0197" (0.50 mm) pitch
- Narrow body design saves space on board
- Lead style -03.5
- Samtec 28+ Gbps Solution
- Mates with: ST5
- Insulator Material: Liquid Crystal Polymer, schwarz
- Operating Temperature Range: -55°C bis +125°C
- Lead-Free Solderable: Yes
- RoHS Konform: Yes

8.2 Connector Stacking height

When using the standard type on baseboard and module, the mating height is 5 mm.

Other mating heights are possible by using connectors with a different height:

Order number	REF number	Samtec Number	Type	Contribution to stacking height	Comment
27219	REF192552-01	SS5-80-3.50-L-D-K-TR	Baseboard connector	3.5 mm	Standard connector used on carrier
27018	REF-189545-02	SS5-80-3.00-L-D-K-TR	Baseboard connector	3 mm	Assembly option on request

² <https://www.samtec.com/products/st5>

³ <https://www.samtec.com/products/ss5>

Order number	REF number	Samtec Number	Type	Contribution to stacking height	Comment
27220	REF-19255-2-02	ST5-80-1.50-L-D-P-TR	Module connector	1.5 mm	Standard connector used on modules
27017	REF-18954-5-01	ST5-80-1.00-L-D-P-TR	Module connector	1 mm	Assembly option on request

Table 21: Connectors.

The module can be manufactured using other connectors upon request.

8.3 Current Rating

Current rating of Samtec Razor Beam LP Terminal/Socket Strip ST5/SS5 B2B connectors is 1.5 A per pin (1 pin powered per row).

8.4 Connector Speed Ratings

The connector speed rating depends on the stacking height:

Stacking height	Speed rating
4 mm, Single-Ended	13GHz/26Gbps
4 mm, Differential	13.5GHz/27Gbps
5 mm, Single-Ended	13.5GHz/27Gbps
5 mm, Differential	20GHz/40 Gbps

Table 22: Speed rating.

The SS5/ST5 series board-to-board spacing is currently available in 4mm (0.157"), 4.5mm (0.177") and 5mm (0.197") stack heights.

The data in the reports is applicable only to the 4mm and 5mm board-to-board mated connector stack height.

9 CRUVI B2B Connectors

CRUVI modules use on bottom side:

- TMMH-106-04-F-DV-A-M as Low Speed connectors, (12 pins, 6 per row)
- ST4-30-1.50-L-D as High Speed connectors, (60 pins, 30 per row)

CRUVI carrier use on top side:

- CLT-106-02-F-D-A-K as Low Speed connectors , (12 pins, 6 per row)
- SS4-30-3.50-L-D as High Speed connectors, (60 pins, 30 per row)

9.1 Connector Mating height

Mating height of the high speed connectors is 5mm. The low speed connectors mate correctly within a range from 4.78 mm to 5.29 mm.

9.2 Current Rating

Current rating of High Speed B2B connectors is 1.6A per pin (2 pins powered).

Current rating of Low Speed B2B connectors is 4.1A per pin (2 pins powered).

9.3 Speed Rating

There is no data available for the connectors actual used here. Data available for other stacking heights of same connectors is summarized in the following table:

Connector	Speed ratings
ST4/SS4 single ended (4mm stacking height!)	13.5GHz / 27 Gbps
ST4/SS4 differential (4mm stacking height!)	15.5 GHz / 31 Gbps
TMMH/CLT single ended (4.77mm stacking height!)	5.5GHz / 11 Gbps

Table 23: Connector speed ratings

9.4 Operating Temp Range

All connectors are specified for a temp. range of -55 °C to 125 °C.

10 Technical Specifications

10.1 Absolute Maximum Ratings

Symbols	Description	Min	Max	Unit
VIN	Input Supply Voltage	2.5	34	V
T_STG	Storage Temperature	-55	125	°C

Table 24: PS absolute maximum ratings

10.2 Recommended Operating Conditions

Operating temperature range depends also on customer design and cooling solution. Please contact us for options.

Parameter	Min	Max	Units	Reference Document
VIN	4.06	5.58	V	See the carrier datasheets.
T_OPT	0	70	°C	Push button datasheet.

Table 25: Recommended operating conditions.

10.3 Physical Dimensions

- Module size: 115 mm × 70 mm. Please download the assembly diagram for exact numbers.
- Mating height with standard connectors: 4 mm.

PCB thickness: 1.6 mm.

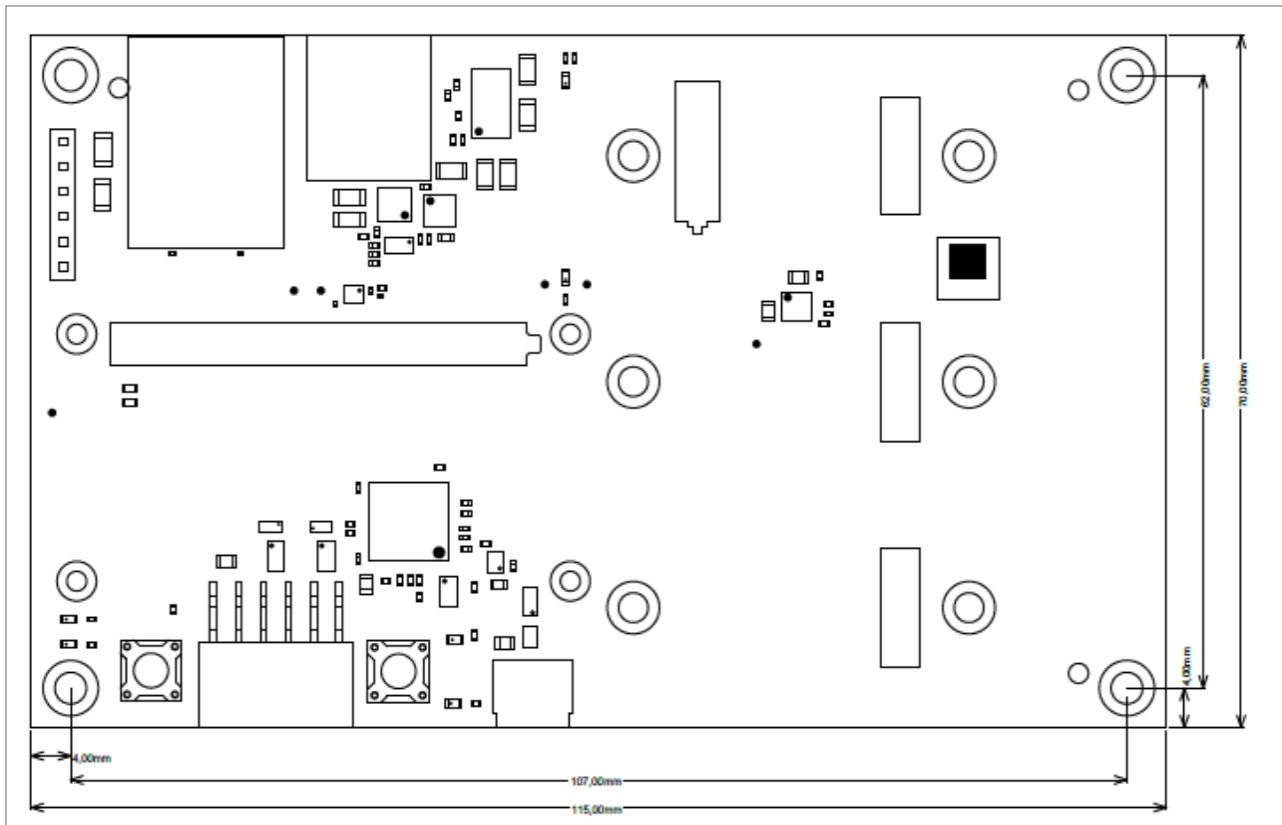


Figure 5: Physical Dimension

11 Currently Offered Variants

Trenz shop TEMB0005 overview page	
English page⁴	German page⁵

Table 26: Trenz Electronic Shop Overview

⁴ <https://shop.trenz-electronic.de/en/search?sSearch=TEMB0005>

⁵ <https://shop.trenz-electronic.de/de/search?sSearch=TEMB0005>

12 Revision History

12.1 Hardware Revision History

Date	Revision	Changes	Documentation Link
2020-05-20	REV01	Initial Release	---

Table 27: Hardware Revision History

Hardware revision number can be found on the PCB board together with the module model number separated by the dash.



Figure 6: Board hardware revision number.

12.2 Document Change History

Date	Revision	Contributor	Description
 2020-11-02	v.33(see page 6)	Martin Rohrmüller ⁶	Initial Release
--	all	Pedram Babakhani ⁷ , Martin Rohrmüller ⁸	--

Table 28: Document change history.

⁶ <https://wiki.trenz-electronic.de/display/~m.rohrmueller>

⁷ <https://wiki.trenz-electronic.de/display/~P.Babakhani>

⁸ <https://wiki.trenz-electronic.de/display/~m.rohrmueller>

13 Disclaimer

13.1 Data Privacy

Please also note our data protection declaration at <https://www.trenz-electronic.de/en/Data-protection-Privacy>

13.2 Document Warranty

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To confront directly with the responsibility toward the environment, the global community and eventually also oneself. Such a resolution should be integral part not only of everybody's life. Also enterprises shall be conscious of their social responsibility and contribute to the preservation of our common living space. That is why Trenz Electronic invests in the protection of our Environment.

13.7 REACH, RoHS and WEEE

REACH

Trenz Electronic is a manufacturer and a distributor of electronic products. It is therefore a so called downstream user in the sense of REACH⁹. The products we supply to you are solely non-chemical products (goods). Moreover and under normal and reasonably foreseeable circumstances of application, the goods supplied to you shall not release any substance. For that, Trenz Electronic is obliged to neither register nor to provide safety data sheet. According to present knowledge and to best of our knowledge, no SVHC (Substances of Very High Concern) on the Candidate List¹⁰ are contained in our products. Furthermore, we will immediately and unsolicited inform our customers in compliance with REACH - Article 33 if any substance present in our goods (above a concentration of 0,1 % weight by weight) will be classified as SVHC by the European Chemicals Agency (ECHA)¹¹.

RoHS

Trenz Electronic GmbH herewith declares that all its products are developed, manufactured and distributed RoHS compliant.

WEEE

Information for users within the European Union in accordance with Directive 2002/96/EC of the European Parliament and of the Council of 27 January 2003 on waste electrical and electronic equipment (WEEE).

Users of electrical and electronic equipment in private households are required not to dispose of waste electrical and electronic equipment as unsorted municipal waste and to collect such waste electrical and electronic equipment separately. By the 13 August 2005, Member States shall have ensured that systems are set up allowing final holders and distributors to return waste electrical and electronic equipment at least free of charge. Member States shall ensure the availability and accessibility of the necessary collection facilities. Separate collection is the precondition to ensure specific treatment and recycling of waste electrical and electronic equipment and is necessary to achieve the chosen level of protection of human health and the environment in the European Union. Consumers have to actively contribute to the success of such collection and the return of waste electrical and electronic equipment. Presence of hazardous substances in electrical and electronic equipment results in potential effects on the environment and human health. The symbol consisting of the crossed-out wheeled bin indicates separate collection for waste electrical and electronic equipment.

Trenz Electronic is registered under WEEE-Reg.-Nr. DE97922676.

 2019-06-07

⁹ <http://guidance.echa.europa.eu/>

¹⁰ <https://echa.europa.eu/candidate-list-table>

¹¹ <http://www.echa.europa.eu/>