

TE0807 TRM

[Download PDF version of this document.](#)

Table of Contents

- [Overview](#)
 - [Key Features](#)
 - [Block Diagram](#)
 - [Main Components](#)
 - [Initial Delivery State](#)
- [Boot Process](#)
- [Signals, Interfaces and Pins](#)
 - [Board to Board \(B2B\) connectors](#)
 - [MGT Lanes](#)
 - [JTAG Interface](#)
 - [Configuration Bank Control Signals](#)
 - [Analog Input](#)
 - [Quad SPI Interface](#)
 - [Default PS MIO Mapping](#)
- [On-board Peripherals](#)
 - [Flash](#)
 - [DDR4 SDRAM](#)
 - [Programmable PLL Clock Generator](#)
 - [Oscillators](#)
 - [MAC Address EEPROMs](#)
 - [On-board LEDs](#)
- [Power and Power-On Sequence](#)
 - [Power Consumption](#)
 - [Power Distribution Dependencies](#)
 - [Power-On Sequence](#)
 - [Operation Conditions of the DC-DC Converter Control Signals](#)
 - [Voltage Monitor Circuit](#)
 - [Power Rails](#)
 - [Bank Voltages](#)
- [Board to Board Connectors](#)
 - [Features](#)
 - [Connector Stacking height](#)
 - [Current Rating](#)
 - [Connector Speed Ratings](#)
 - [Manufacturer Documentation](#)
- [Variants Currently In Production](#)
- [Technical Specifications](#)
 - [Absolute Maximum Ratings](#)
 - [Recommended Operating Conditions](#)
 - [Physical Dimensions](#)
- [Revision History](#)
 - [Hardware Revision History](#)
 - [Document Change History](#)
- [Disclaimer](#)
 - [Data Privacy](#)
 - [Document Warranty](#)
 - [Limitation of Liability](#)
 - [Copyright Notice](#)
 - [Technology Licenses](#)
 - [Environmental Protection](#)
 - [REACH, RoHS and WEEE](#)

Overview

The Trenz Electronic TE0807 is an industrial-grade MPSoC SoM integrating a Xilinx Zynq UltraScale+ MPSoC, up to 8 GBytes of DDR4 SDRAM via 64bit wide data bus, max. 512 MByte Flash memory for configuration and operation, 20 Gigabit transceivers and powerful switch-mode power supplies for all on-board voltages. A large number of configurable I/Os are provided via rugged high-speed stacking connections. All this in a compact 5.2 x 7.6 cm form factor, at the competitive price.

Key Features

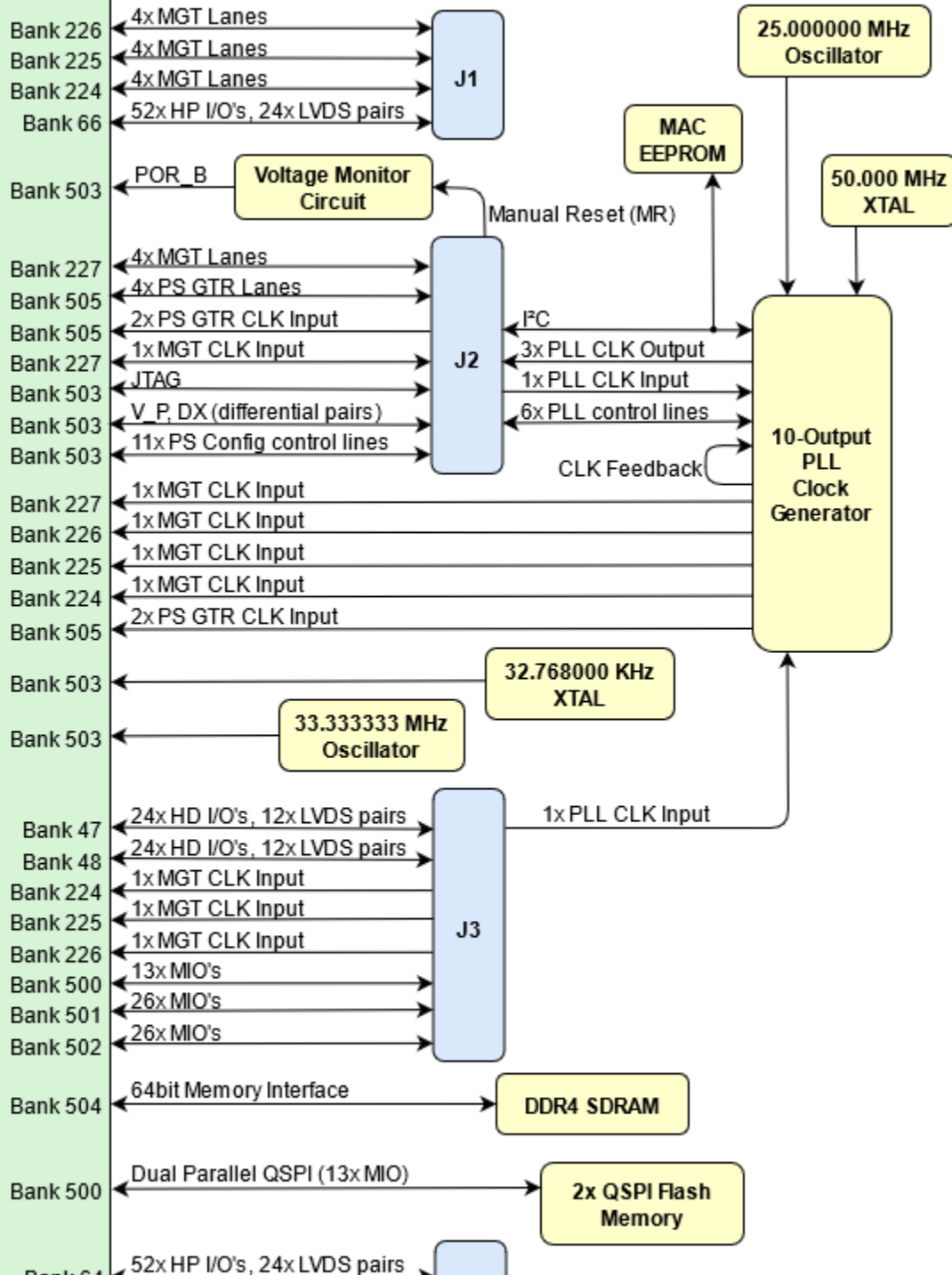
- MPSoC: ZYNQ UltraScale+ ZU7EV 900-pin package
- Memory
 - 64bit DDR4, 8 GByte maximum
 - Dual SPI boot Flash in parallel, 512 MByte maximum
- User I/Os
 - 65 x PS MIOs, 48 x PL HD GPIOs, 156 x PL HP GPIOs (3 banks)
 - Serial transceivers: 4 x GTR + 16 x GTH
 - Transceiver clocks inputs and outputs
 - PLL clock generator inputs and outputs
- Si5345 - 10 output PLL
- All power supplies on board, single 3.3V power source required
 - LPD, FPD, PL separately controlled power domains
- Support for all boot modes (except NAND) and scenarios
- Support for any combination of PS connected peripherals
- Size: 52 x 76 mm, 3 mm mounting holes for skyline heat spreader
- B2B connectors: 4 x 160 pin

Additional assembly options are available for cost or performance optimization upon request.

Block Diagram

TE0807-03

**Xilinx ZYNQ
UltraScale+
MPSoC**



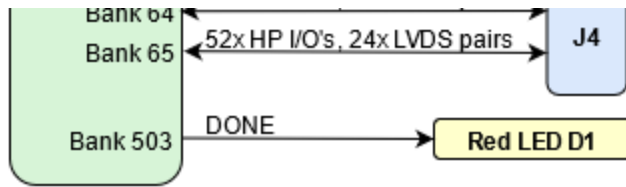


Figure 1: TE0807-03 block diagram

Main Components

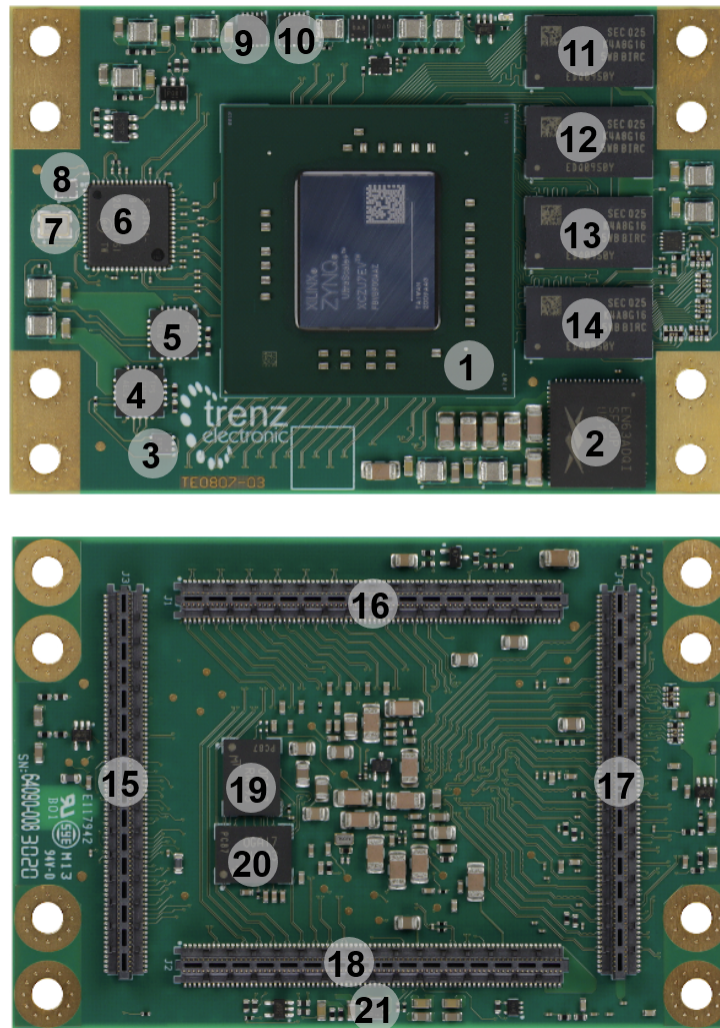


Figure 2: TE0807-03 main components

1. Xilinx ZYNQ UltraScale+ ZU7EV-1FBVB900 MPSoC, U1
2. EN63A0QI 12A PowerSoC DC-DC converter, U4
3. TI TPS72018 LDO @ 1.8V, U6
4. TI TPS74401 LDO @ 0.9V, U14

5. TI TPS74401 LDO @ 1.2V, U28
6. TI TPS72018 LDO @ 1.8V, U6
7. Quarz Crystal @50.000MHz, Y1
8. Low-power programmable oscillator @ 25.000000 MHz (IN0 for U5), U25
9. TI TPS74801 LDO @ 1.8V, U10
10. TI TPS74801 LDO @ 0.9V, U8
11. 8 Gbit (512Mx16) DDR4-2400 SDRAM, U12
12. 8 Gbit (512Mx16) DDR4-2400 SDRAM, U9
13. 8 Gbit (512Mx16) DDR4-2400 SDRAM, U2
14. 8 Gbit (512Mx16) DDR4-2400 SDRAM, U3
15. Ultra fine 0.50 mm pitch, Razor Beam™ LP Slim Terminal Strip with 160 contacts, J3
16. Ultra fine 0.50 mm pitch, Razor Beam™ LP Slim Terminal Strip with 160 contacts, J1
17. Ultra fine 0.50 mm pitch, Razor Beam™ LP Slim Terminal Strip with 160 contacts, J4
18. Ultra fine 0.50 mm pitch, Razor Beam™ LP Slim Terminal Strip with 160 contacts, J2
19. 1.8V, 512 Mbit QSPI flash memory ,U17
20. 1.8V, 512 Mbit QSPI flash memory, U7
21. TI TPS72018 LDO @ 1.8V, U27

Initial Delivery State

Storage Device Name	Content	Notes
SPI Flash OTP Area	Empty, not programmed	Except serial number programmed by flash vendor.
SPI Flash Quad Enable bit	Programmed	-
SPI Flash main array	Not programmed	-
eFUSE USER	Not programmed	-
eFUSE Security	Not programmed	-
Si5345A OTP NVM	Not programmed	-

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

Boot Process

The boot device and mode of the Zynq UltraScale+ MPSoC can be selected via 4 dedicated pins accessible on B2B connector J2:

Boot Mode Pin	B2B Pin
PS_MODE0	J2-109
PS_MODE1	J2-107
PS_MODE2	J2-105
PS_MODE3	J2-103

Table 2: Boot mode pins on B2B connector J2.

Following boot modes are possible on the TE0808 UltraScale+ module by generating the corresponding 4-bit code by the pins PS_MODE0 ... PS_MODE3 (little-endian alignment):

Boot Mode	Mode Pins [3:0]	MIO Location	Description
JTAG	0x0	JTAG	Dedicated PS interface.

QSPI32	0x2	MIO[12:0]	Configured on module with dual QSPI Flash Memory. 32-bit addressing. Supports single and dual parallel configurations. Stack and dual stack is not supported.
SD0	0x3	MIO[25:13]	Supports SD 2.0.
SD1	0x5	MIO[51:38]	Supports SD 2.0.
eMMC_18	0x6	MIO[22:13]	Supports eMMC 4.5 at 1.8V.
USB 0	0x7	MIO[52:63]	Supports USB 2.0 and USB 3.0.
PJTAG_0	0x8	MIO[29:26]	PS JTAG connection 0 option.
SD1-LS	0xE	MIO[51:39]	Supports SD 3.0 with a required SD 3.0 compliant level shifter.

Table 3: Selectable boot modes by dedicated boot mode pins

For functional details see [ug1085 - Zynq UltraScale+ TRM \(Boot Modes Section\)](#).

Signals, Interfaces and Pins

Board to Board (B2B) connectors

The TE0807 MPSoC SoM has four Board to Board (B2B) connectors with 160 contacts per connector.

Each connector has a specific arrangement of the signal pins, which are grouped together in categories related to their functionalities and to their belonging to particular units of the Zynq UltraScale+ MPSoC like I/O banks, interfaces and Gigabit transceivers or to the on-board peripherals.

Following table lists the I/O-bank signals, which are routed from the MPSoC's PL and PS banks as LVDS pairs or single ended I/O's to the B2B connectors.

Bank	Type	B2B Connector	I/O Signal Count	Bank Voltage	Notes
47	HD	J3	24 single-ended I/Os or 12 LVDS pairs	VCCO47	VCCO max. 3.3V
48	HD	J3	24 single-ended I/Os or 12 LVDS pairs	VCCO48	VCCO max. 3.3V
64	HP	J4	52 single-ended I/O's or 24 LVDS pairs	VCCO64	VCCO max. 1.8V
65	HP	J4	52 single-ended I/Os or 24 LVDS pairs	VCCO65	VCCO max. 1.8V
66	HP	J1	52 single-ended I/Os or 24 LVDS pairs	VCCO66	VCCO max. 1.8V
500	MIO	J3	13 I/Os	PS_1V8	User configurable I/Os on B2B
501	MIO	J3	26 I/Os	PS_1V8	User configurable I/Os on B2B
502	MIO	J3	26 I/Os	PS_1V8	User configurable I/Os on B2B

Table 4: B2B connector pin-outs of available PL and PS banks of the TE0807-03 SoM.

All MIO banks are powered from on-module DC-DC power rail. All PL I/O Banks have separate VCCO pins in the B2B connectors, valid VCCO should be supplied from the baseboard.

For detailed information about the B2B pin-out, please refer to the [Pin-out](#) table.

The configuration of the I/O's MIO13 - MIO77 are depending on the base-board peripherals connected to these pins.

MGT Lanes

The Xilinx Zynq UltraScale+ MPSoC device used on the TE0807 module has 20 high-speed data lanes (Xilinx GTH / GTR transceiver). All of them are wired directly to B2B connector. MGT (Multi Gigabit Transceiver) lane consists of one transmit and one receive (TX/RX) differential pairs, four signals total per one MGT lane. Following table lists lane number, MGT bank number, transceiver type, signal schematic name, board-to-board pin connection and FPGA pins connection:

Bank	Type	Lane	Signal Name	B2B Pin	FPGA Pin
224	GTH	0	<ul style="list-style-type: none"> • B224_RX0_P • B224_RX0_N • B224_TX0_P • B224_TX0_N 	<ul style="list-style-type: none"> • J1-69 • J1-71 • J1-68 • J1-70 	<ul style="list-style-type: none"> • MGTHRXP0_224, V2 • MGTHRXN0_224, V1 • MGHTXP0_224, W4 • MGHTXN0_224, W3
		1	<ul style="list-style-type: none"> • B224_RX1_P • B224_RX1_N • B224_TX1_P • B224_TX1_N 	<ul style="list-style-type: none"> • J1-63 • J1-65 • J1-62 • J1-64 	<ul style="list-style-type: none"> • MGTHRXP1_224, U4 • MGTHRXN1_224, U3 • MGHTXP1_224, V6 • MGHTXN1_224, V5
		2	<ul style="list-style-type: none"> • B224_RX2_P • B224_RX2_N • B224_TX2_P • B224_TX2_N 	<ul style="list-style-type: none"> • J1-57 • J1-59 • J1-56 • J1-58 	<ul style="list-style-type: none"> • MGTHRXP2_224, T2 • MGTHRXN2_224, T1 • MGHTXP2_224, T6 • MGHTXN2_224, T5
		3	<ul style="list-style-type: none"> • B224_RX3_P • B224_RX3_N • B224_TX3_P • B224_TX3_N 	<ul style="list-style-type: none"> • J1-51 • J1-53 • J1-50 • J1-52 	<ul style="list-style-type: none"> • MGTHRXP3_224, P2 • MGTHRXN3_224, P1 • MGHTXP3_224, R4 • MGHTXN3_224, R3
225	GTH	0	<ul style="list-style-type: none"> • B225_RX0_P • B225_RX0_N • B225_TX0_P • B225_TX0_N 	<ul style="list-style-type: none"> • J1-45 • J1-47 • J1-44 • J1-46 	<ul style="list-style-type: none"> • MGTHRXP0_225, N4 • MGTHRXN0_225, N3 • MGHTXP0_225, P6 • MGHTXN0_225, P5
		1	<ul style="list-style-type: none"> • B225_RX1_P • B225_RX1_N • B225_TX1_P • B225_TX1_N 	<ul style="list-style-type: none"> • J1-39 • J1-41 • J1-38 • J1-40 	<ul style="list-style-type: none"> • MGTHRXP1_225, M2 • MGTHRXN1_225, M1 • MGHTXP1_225, M6 • MGHTXN1_225, M5
		2	<ul style="list-style-type: none"> • B225_RX2_P • B225_RX2_N • B225_TX2_P • B225_TX2_N 	<ul style="list-style-type: none"> • J1-33 • J1-35 • J1-32 • J1-34 	<ul style="list-style-type: none"> • MGTHRXP2_225, K2 • MGTHRXN2_225, K1 • MGHTXP2_225, L4 • MGHTXN2_225, L3
		3	<ul style="list-style-type: none"> • B225_RX3_P • B225_RX3_N • B225_TX3_P • B225_TX3_N 	<ul style="list-style-type: none"> • J1-27 • J1-29 • J1-26 • J1-28 	<ul style="list-style-type: none"> • MGTHRXP3_225, J4 • MGTHRXN3_225, J3 • MGHTXP3_225, K6 • MGHTXN3_225, K5
226	GTH	0	<ul style="list-style-type: none"> • B226_RX0_P • B226_RX0_N • B226_TX0_P • B226_TX0_N 	<ul style="list-style-type: none"> • J1-21 • J1-23 • J1-20 • J1-22 	<ul style="list-style-type: none"> • MGTHRXP0_226, H2 • MGTHRXN0_226, H1 • MGHTXP0_226, H6 • MGHTXN0_226, H5

		1	<ul style="list-style-type: none"> • B226_RX1_P • B226_RX1_N • B226_TX1_P • B226_TX1_N 	<ul style="list-style-type: none"> • J1-15 • J1-17 • J1-14 • J1-16 	<ul style="list-style-type: none"> • MGTHRXP1_226, G4 • MGTHRXN1_226, G3 • MGHTXP1_226 G8 • MGHTXN1_226, G7
		2	<ul style="list-style-type: none"> • B226_RX2_P • B226_RX2_N • B226_TX2_P • B226_TX2_N 	<ul style="list-style-type: none"> • J1-9 • J1-11 • J1-8 • J1-10 	<ul style="list-style-type: none"> • MGTHRXP2_226, F2 • MGTHRXN2_226, F1 • MGHTXP2_226, F6 • MGHTXN2_226, F5
		3	<ul style="list-style-type: none"> • B226_RX3_P • B226_RX3_N • B226_TX3_P • B226_TX3_N 	<ul style="list-style-type: none"> • J1-3 • J1-5 • J1-2 • J1-4 	<ul style="list-style-type: none"> • MGTHRXP3_226, E4 • MGTHRXN3_226, E3 • MGHTXP3_226, E8 • MGHTXN3_226, E7
227	GTH	0	<ul style="list-style-type: none"> • B227_TX0_P • B227_TX0_N • B227_RX0_P • B227_RX0_N 	<ul style="list-style-type: none"> • J2-45 • J2-43 • J2-48 • J2-46 	<ul style="list-style-type: none"> • MGHTXP0_227, D6 • MGHTXN0_227, D5 • MGTHRXP0_227, D2 • MGTHRXN0_227, D1
		1	<ul style="list-style-type: none"> • B227_TX1_P • B227_TX1_N • B227_RX1_P • B227_RX1_N 	<ul style="list-style-type: none"> • J2-39 • J2-37 • J2-42 • J2-40 	<ul style="list-style-type: none"> • MGHTXP1_227, C8 • MGHTXN1_227, C7 • MGTHRXP1_227, C4 • MGTHRXN1_227, C3
		2	<ul style="list-style-type: none"> • B227_TX2_P • B227_TX2_N • B227_RX2_P • B227_RX2_N 	<ul style="list-style-type: none"> • J2-33 • J2-31 • J2-36 • J2-34 	<ul style="list-style-type: none"> • MGHTXP2_227, B6 • MGHTXN2_227, B5 • MGTHRXP2_227, B2 • MGTHRXN2_227, B1
		3	<ul style="list-style-type: none"> • B227_TX3_P • B227_TX3_N • B227_RX3_P • B227_RX3_N 	<ul style="list-style-type: none"> • J2-27 • J2-25 • J2-30 • J2-28 	<ul style="list-style-type: none"> • MGHTXP3_227, A8 • MGHTXN3_227, A7 • MGTHRXP3_227, A4 • MGTHRXN3_227, A3
505	GTR	0	<ul style="list-style-type: none"> • B505_TX0_P • B505_TX0_N • B505_RX0_P • B505_RX0_N 	<ul style="list-style-type: none"> • J2-69 • J2-67 • J2-72 • J2-70 	<ul style="list-style-type: none"> • PS_MGTRTXP0_505, M27 • PS_MGTRTXN0_505, M28 • PS_MGTRRXP0_505, L29 • PS_MGTRRXN0_505, L30
		1	<ul style="list-style-type: none"> • B505_TX1_P • B505_TX1_N • B505_RX1_P • B505_RX1_N 	<ul style="list-style-type: none"> • J2-63 • J2-61 • J2-66 • J2-64 	<ul style="list-style-type: none"> • PS_MGTRTXP1_505, K27 • PS_MGTRTXN1_505, K28 • PS_MGTRRXP1_505, J29 • PS_MGTRRXN1_505, J30
		2	<ul style="list-style-type: none"> • B505_TX2_P • B505_TX2_N • B505_RX2_P • B505_RX2_N 	<ul style="list-style-type: none"> • J2-57 • J2-55 • J2-60 • J2-58 	<ul style="list-style-type: none"> • PS_MGTRTXP2_505, J25 • PS_MGTRTXN2_505, J26 • PS_MGTRRXP2_505, H27 • PS_MGTRRXN2_505, H28
		3	<ul style="list-style-type: none"> • B505_TX3_P • B505_TX3_N • B505_RX3_P • B505_RX3_N 	<ul style="list-style-type: none"> • J2-51 • J2-49 • J2-54 • J2-52 	<ul style="list-style-type: none"> • PS_MGTRTXP3_505, G25 • PS_MGTRTXN3_505, G26 • PS_MGTRRXP3_505, G29 • PS_MGTRRXN3_505, G30

Table 5: MGT lanes

There are 2 clock sources for the GTH and GTR transceivers. The clock inputs of the MGT transceivers are connected directly to the B2B connectors, so the clock can be provided by the carrier board. The second clock source is provided by the on-board clock generator Si5345A (U5). As there are no capacitive coupling of the data and clock lines that are connected to the B2B connectors, these may be required on the user's PCB depending on the application.

Clock signal	Bank	Source	FPGA Pin	Notes
B224_CLK0_P	224	B2B, J3-62	MGTREFCLK0P_224, R8	Supplied by the carrier board
B224_CLK0_N	224	B2B, J3-60	MGTREFCLK0N_224, R7	Supplied by the carrier board
B224_CLK1_P	224	U5, CLK4_P	MGTREFCLK1P_224, N8	On-board Si5345A
B224_CLK1_N	224	U5, CLK4_N	MGTREFCLK1N_224, N7	On-board Si5345A
B225_CLK0_P	225	B2B, J3-67	MGTREFCLK0P_225, L8	Supplied by the carrier board
B225_CLK0_N	225	B2B, J3-65	MGTREFCLK0N_225, L7	Supplied by the carrier board
B225_CLK1_P	225	U5, CLK3_P	MGTREFCLK1P_225, J8	On-board Si5345A
B225_CLK1_N	225	U5, CLK3_N	MGTREFCLK1N_225, J7	On-board Si5345A
B226_CLK0_P	226	U5, CLK2_P	MGTREFCLK0P_226, H10	On-board Si5345A
B226_CLK0_N	226	U5, CLK2_N	MGTREFCLK0N_226, H9	On-board Si5345A
B226_CLK1_P	226	B2B, J3-61	MGTREFCLK1P_226, F10	Supplied by the carrier board
B226_CLK1_N	226	B2B, J3-59	MGTREFCLK1N_226, F9	Supplied by the carrier board
B227_CLK0_P	227	U5, CLK1_P	MGTREFCLK0P_227, D10	On-board Si5345A
B227_CLK0_N	227	U5, CLK1_N	MGTREFCLK0N_227, D9	On-board Si5345A
B227_CLK1_P	227	B2B, J2-22	MGTREFCLK1P_227, B10	Supplied by the carrier board
B227_CLK1_N	227	B2B, J2-24	MGTREFCLK1N_227, B9	Supplied by the carrier board
B505_CLK0_P	505	B2B, J2-10	PS_MGTREFCLK0P_505, M23	Supplied by the carrier board
B505_CLK0_N	505	B2B, J2-12	PS_MGTREFCLK0N_505, M24	Supplied by the carrier board
B505_CLK1_P	505	B2B, J2-16	PS_MGTREFCLK1P_505, L25	Supplied by the carrier board
B505_CLK1_N	505	B2B, J2-18	PS_MGTREFCLK1N_505, L26	Supplied by the carrier board
B505_CLK2_P	505	U5, CLK5_P	PS_MGTREFCLK2P_505, K23	On-board Si5345A
B505_CLK2_N	505	U5, CLK5_N	PS_MGTREFCLK2N_505, K24	On-board Si5345A
B505_CLK3_P	505	U5, CLK6_P	PS_MGTREFCLK3P_505, H23	On-board Si5345A
B505_CLK3_N	505	U5, CLK6_N	PS_MGTREFCLK3N_505, H24	On-board Si5345A

Table 6: MGT reference clock sources

JTAG Interface

JTAG access is provided through the MPSoC's PS configuration bank 503 with bank voltage PS_1V8.

JTAG Signal	B2B Connector Pin
TCK	J2-120
TDI	J2-122

TDO	J2-124
TMS	J2-126

Table 7: B2B connector pin-out of JTAG interface.

Configuration Bank Control Signals

The Xilinx Zynq UltraScale+ MPSoC's PS configuration bank 503 control signal pins are accessible through B2B connector J2.

For further information about the particular control signals and how to use and evaluate them, refer to the [Xilinx Zynq UltraScale+ MPSoC TRM](#) and [UltraScale Architecture Configuration - User Guide](#).

Signal	B2B Connector Pin	Function
DONE	J2-116	PL configuration completed.
PROG_B	J2-100	PL configuration reset signal.
INIT_B	J2-98	PS is initialized after a power-on reset.
SRST_B	J2-96	System reset.
MODE0 ... MODE3	J2-109/J2-107/J2-105 /J2-103	4-bit boot mode pins. For further information about the boot modes refer to the Xilinx Zynq UltraScale+ MPSoC TRM section 'Boot and Configuration'.
ERR_STATUS / ERR_OUT	J2-86 / J2-88	ERR_OUT signal is asserted for accidental loss of power, an error, or an exception in the MPSoC's Platform Management Unit (PMU). ERR_STATUS indicates a secure lock-down state.
PUDC_B	J2-127	Pull-up during configuration (pulled-up to PL_1V8).

Table 8: B2B connector pin-out of MPSoC's PS configuration bank.

Analog Input

The Xilinx Zynq UltraScale+ MPSoC provides differential pairs for analog input values. The pins are exposed to B2B-connector J2.

Signal	B2B Connector Pin	Function
V_P, V_N	J2-113, J2-115	System Monitor
DX_P, DX_N	J2-119, J2-121	Temperature-sensing diode pins

Table 9: B2B connector pin-out of analog input pins

Quad SPI Interface

Quad SPI Flash memory ICs U7 and U17 are connected to the Zynq MPSoC PS QSPI0 interface via PS MIO bank 500, pins MIO0 ... MIO5 and MIO7 ... MIO12.

MIO	Signal Name	U7 Pin		MIO	Signal Name	U17 Pin
0	SPI Flash CLK	B2		7	SPI Flash CS	C2

1	SPI Flash IO1	D2		8	SPI Flash IO0	D3
2	SPI Flash IO2	C4		9	SPI Flash IO1	D2
3	SPI Flash IO3	D4		10	SPI Flash IO2	C4
4	SPI Flash IO0	D3		11	SPI Flash IO3	D4
5	SPI Flash CS	C2		12	SPI Flash CLK	B2

Table 10: PS MIO pin assignment of the Quad SPI Flash memory ICs.

Default PS MIO Mapping

PS MIO	Function	Connected to
0	SPI0	U7-B2, CLK
1	SPI0	U7-D2, DO/IO1
2	SPI0	U7-C4, WP/IO2
3	SPI0	U7-D4, HOLD/IO3
4	SPI0	U7-D3, DI/IO0
5	SPI0	U7-C2, CS
6	N/A	Not connected
7	SPI1	U17-C2, CS
8	SPI1	U17-D3, DI/IO0
9	SPI1	U17-D2, DO/IO1
10	SPI1	U17-C4, WP/IO2
11	SPI1	U17-D4, HOLD/IO3
12	SPI1	U17-B2, CLK
13 ... 77	user dependent	B2B connector J2

Table 11: TE0807-03 PS MIO mapping

On-board Peripherals

Flash

The TE0807 SoM can be configured with max. 512 MByte Flash memory for configuration and operation.

Name	IC	Designator	PS7	MIO	Notes
------	----	------------	-----	-----	-------

SPI Flash	N25Q512A11G1240E	U7	QSPI0	MIO0 ... MIO5	dual parallel booting possible, 64 MByte memory per Flash IC at standard configuration
SPI Flash	N25Q512A11G1240E	U17	QSPI0	MIO7 ... MIO12	

Table 12: Peripherals connected to the PS MIO pins.

DDR4 SDRAM

The TE0807-03 SoM is equipped with four DDR4 SDRAM chips with a total of up to 8 GByte memory. The SDRAM chips are connected to the Zynq MPSoC's PS DDR controller (bank 504) with a 64bit wide data bus.

Refer to the Xilinx Zynq UltraScale+ datasheet [DS925](#) for more information on whether the specific package of the Zynq UltraScale+ MPSoC supports the maximum data transmission rate of 2400 MByte/s.

Programmable PLL Clock Generator

Following table illustrates on-board Si5345A programmable clock multiplier chip inputs and outputs:

Input	Connected to	Frequency	Notes
IN0	On-board Oscillator (U25)	25.000000 MHz	-
IN1	B2B Connector pins J2-4, J2-6 (differential pair)	User	AC decoupling required on base
IN2	B2B Connector pins J3-66, J3-68 (differential pair)	User	AC decoupling required on base
IN3	OUT9	User	Loop-back from OUT9
XA/XB	Quartz (Y1)	50.000 MHz	-
Output	Connected to	Frequency	Notes
OUT0	B2B Connector pins J2-3, J2-1 (differential pair)	User	Default off
OUT1	B227 CLK0	User	Default off
OUT2	B226 CLK0	User	Default off
OUT3	B225 CLK1	User	Default off
OUT4	B224 CLK1	User	Default off
OUT5	B505 CLK2	User	Default off
OUT6	B505 CLK3	User	Default off
OUT7	B2B Connector pins J2-7, J2-9 (differential pair)	User	Default off
OUT8	B2B Connector pins J2-13, J2-15 (differential pair)	User	Default off
OUT9	IN3 (Loop-back)	User	Default off

Table 13: Programmable PLL clock generator input/output.

The Si5345A programmable clock generator's control interface pins are exposed to B2B connector J2. For further information refer to the Si5345A data sheet.

Signal	B2B Connector Pin	Function
PLL_FINC	J2-81	Frequency increment
PLL_LOLN	J2-85	Loss of lock (active-low)
PLL_SEL0 / PLL_SEL1	J2-93 / J2-87	Manual input switching

PLL_FDEC	J2-94	Frequency decrement
PLL_RST	J2-89	Device reset (active-low)
PLL_SCL / PLL_SDA	J2-90 / J2-92	I ² C interface, external pull-ups needed for SCL / SDA lines I ² C address in current configuration: 1101001b.

Table 14: B2B connector pin-out of Si5345A programmable clock generator.



Si5345 OTP ROM is not programmed by default at delivery, so it is customers responsibility to either configure Si5345 during FSBL or then use SiLabs programmer and program the OTP ROM with customer fixed clock setup.

Si5345 OTP can only be programmed two times, as different user configurations may required different setup TE0808 is normally shipped with blank OTP. For more information refer to [Si5345 at SiLabs](#).

Oscillators

The TE0808-04 SoM is equipped with two on-board oscillators to provide the Zynq's MPSoC's PS configuration bank 503 with reference clock signals.

Clock	Signal Schematic Name	Frequency	Connected to Bank 503 Pin
MEMS Oscillator, U32	PS_CLK	33.333333 MHz	Bank 503 Pin P20
Quartz crystal, Y2	XTALI / XTALO	32.768 kHz	Bank 503 Pin R22/R23
Quartz crystal, Y1	XAXB_P / XAXB_N	50.000 MHz	PLL U5, Pin XA/XB

Table 15: On-board osciallators

MAC Address EEPROMs

There is one Microchip 24AA025E48 serial EEPROMs (U11) present containing a globally unique 48-bit node address, which are compatible with EUI-48 (TM) specification. The device are organized as two blocks of 128 x 8 Kbit memory. One of the blocks stores the 48-bit node address and is write protected, the other block is available for application use. The MAC address EEPROM accessible over I²C bus on B2B connector J2-92 (PLL_SDA) / J2-90 (PLL_SCL).

On-board LEDs

LED	Color	Connected to	Description and Notes
D1	Red	DONE signal (PS Configuration Bank 503)	This LED goes ON when power has been applied to the module and stays ON until MPSoC's programmable logic is configured properly.

Table 16: LED's description.

Power and Power-On Sequence

Power Consumption

The maximum power consumption of a module mainly depends on the design which is running on the FPGA.

Xilinx provide a power estimator excel sheets to calculate power consumption. It's also possible to evaluate the power consumption of the developed design with Vivado. See also Trenz Electronic Wiki [FAQ](#).

Power Input Pin	Typical Current
DCDCIN	TBD*
LP_DCDC	TBD*
PL_DCIN	TBD*
PS_BATT	TBD*

Table 17: Maximum current of power supplies. *to be determined soon with reference design setup.

Power supply with minimum current capability of 3A for system startup is recommended. For the lowest power consumption and highest efficiency of on board DC/DC regulators it is recommended to powering the module from one single 3.3V supply. Except 'PS_BATT', all input power supplies have a nominal value of 3.3V. Although the input power supplies can be powered up in any order, it is recommended to power them up simultaneously.

The TE0807 module equipped with the Xilinx Zynq UltraScale+ MPSoC delivers a heterogeneous multi-processing system with integrated programmable logic and independently operable elements and is designed to meet embedded system power management requirement by advanced power management features. This features allow to offset the power and heat constraints against overall performance and operational efficiency.

This features allowing highly flexible power management are achieved by establishing Power Domains for power isolation. The Zynq UltraScale+ MPSoC has multiple power domains, whereby each power domain requires its own particular external DC-DC converters.

The Processing System contains three Power Domains:

- Battery Power Domain (BBRAM and RTC)
- Full-Power Domain (Application Processing Unit, DDR Controller, Graphics Processing Unit and High-Speed Connectivity)
- Low-Power Domain (Real-Time Processing Unit, Security and Configuration Unit, Platform Management Unit, System Monitor and General Connectivity)

The fourth Power Domain is for the Programmable Logic (PL). If individual Power Domain control is not required, power rails can be shared between domains.

On the TE0807 SoM, following power domains can be powered up individually with power rails available on the B2B connectors:

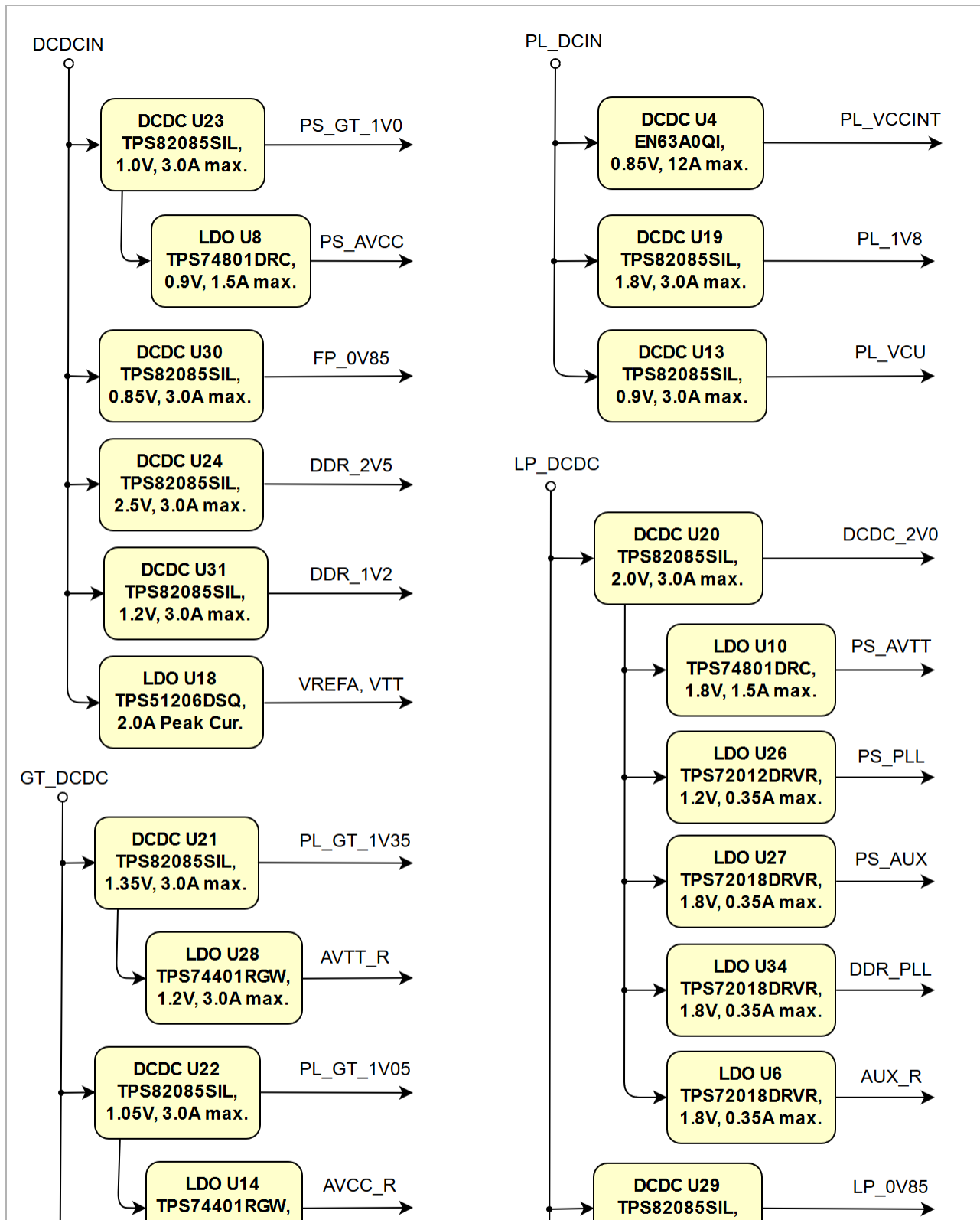
- Full-power domain, supplied by power rail **DCDCIN**
- Low-power domain, supplied by power rail **LP_DCDC**
- Programmable logic, supplied by power rail **PL_DCIN**
- Battery power domain, supplied by power rail **PS_BATT**

Each power domain has its own enable and power good signals. The power rail **GT_DCDC** is needed to generate the voltages for the Multi Gigabit Transceiver units of the Zynq UltraScale+ MPSoC.

Power Distribution Dependencies

The power rails DCDCIN, LP_DCDC, PL_DCIN, PS_BATT have to be powered up on the assigned pins of the B2B connectors as listed on the section "Power Rails". Except 'PS_BATT' (see section "Recommended Operation Conditions"), all power-rails can be powered from 3.3V power sources (also share the same source, if power domain control is not required).

There are following dependencies how the initial voltages of the power rails on the B2B connectors are distributed to the on-board DC-DC converters, which power up further DC-DC converters and the particular on-board voltages:



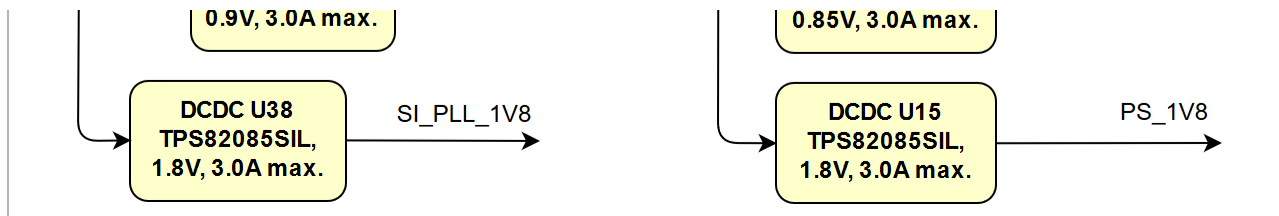


Figure 3: TE0807-03 Power Distribution Diagram

See also Xilinx datasheet DS925 for additional information. User should also check related base board documentation when intending base board design for TE0807 module.

Power-On Sequence

The TE0807 SoM meets the recommended criteria to power up the Xilinx Zynq UltraScale+ MPSoC properly by keeping a specific sequence of enabling the on-board DC-DC converters dedicated to the particular Power Domains and powering up the on-board voltages.

The on-board voltages of the TE0807 SoM will be powered-up in order of a determined sequence by activating the above-mentioned power rails and the Enable-Signals of the DC-DC converters. The on-board voltages will be powered up at three steps.

1. Low-Power Domain (LPD) and on-board Si5345A programmable clock generator supply voltage
2. Programmable Logic (PL) and Full-Power Domain (FPD)
3. GTH, PS GTR transceiver and DDR memory

Hence, those three power instances will be powered up consecutively and the Power-Good-Signals of the previous instance has to be asserted.

Following diagram describes the sequence of enabling the three power instances utilizing the DC-DC converter control signals (Enable, Power-Good), which will power-up in descending order as listed in the blocks of the diagram.

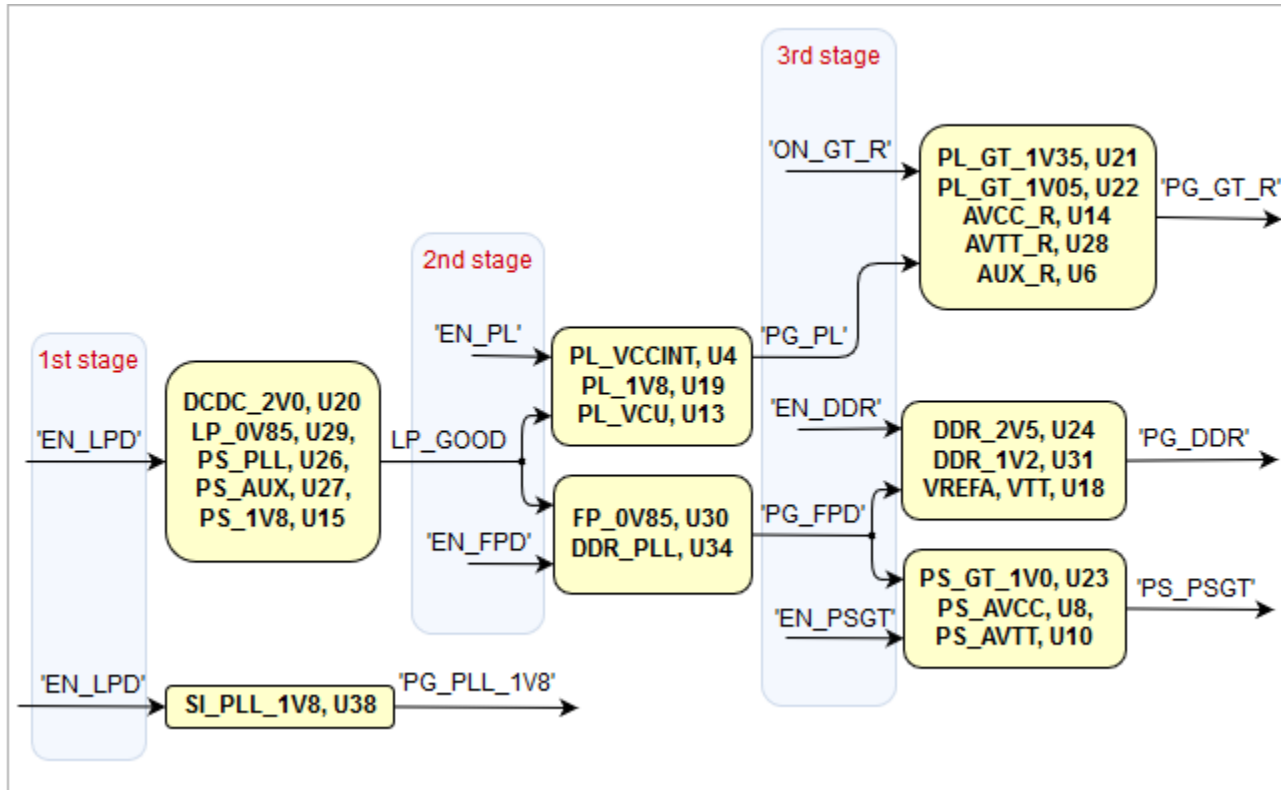


Figure 4: TE0807-03 Power-on Sequence Diagram

Operation Conditions of the DC-DC Converter Control Signals

The control signals have to be asserted on the B2B connector J2, whereby some of the Power-Good signals need external pull-up resistors.

Enable-Signal	B2B Connector Pin	Max. Voltage	Note	Power-Good-Signal	B2B Connector Pin	Pull-up Resistor	Note
EN_LPD	J2-108	6V	TPS82085SIL data sheet	LP_GOOD	J2-106	4K7, pulled up to LP_DCDC	-
EN_FPD	J2-102	DCDCIN	NC7S08P5X data sheet	PG_FPD	J2-110	4K7, pulled up to DCDCIN	-
EN_PL	J2-101	PL_DCIN	left floating for logic high (drive to GND for logic low)	PG_PL	J2-104	4K7, pulled up to PL_DCIN	-
EN_DDR	J2-112	DCDCIN	NC7S08P5X data sheet	PG_DDR	J2-114	4K7, pulled up to DCDCIN	-
EN_PSGT	J2-84	DCDCIN	NC7S08P5X data sheet	PG_PSGT	J2-82	External pull-up needed (max. 5.5V), max. sink current 1 mA	TPS74801 data sheet
EN_GT_R	J2-95	GT_DCDC	NC7S08P5X data sheet	PG_GT_R	J2-91	External pull-up needed (max. 5.5V), max. sink current 1 mA	TPS74401 data sheet
EN_PLL_PWR	J2-77	6V	TPS82085SIL data sheet	PG_PLL_1V8	J2-80	External pull-up needed (max. 5.5V), max. sink current 1 mA	TPS82085SIL data sheet

Table 18: Recommended operation conditions of DC-DC converter control signals.



To avoid any damage to the MPSoC module, check for stabilized on-board voltages in steady state before powering up the MPSoC's I/O bank voltages VCCOx. All I/Os should be tri-stated during power-on sequence.

Core voltages and main supply voltages have to reach stable state and their "Power Good"-signals have to be asserted before other voltages like bank's I/O voltages (VCCOx) can be powered up.

It is important that all PS and PL I/Os are tri-stated at power-on until the "Power Good"-signals are high, meaning that all on-module voltages have become stable and module is properly powered up.

See Xilinx datasheet [DS925](#) for additional information. User should also check related base board documentation when intending base board design for TE0808 SoM.

Voltage Monitor Circuit

The voltages LP_DCDC and LP_0V85 are monitored by the voltage monitor circuit U41, which generates the POR_B reset signal at power-on. A manual reset is also possible by driving the MR-pin (J2-83) to GND. Leave this pin unconnected or connect to VDD (LP_DCDC) when unused.

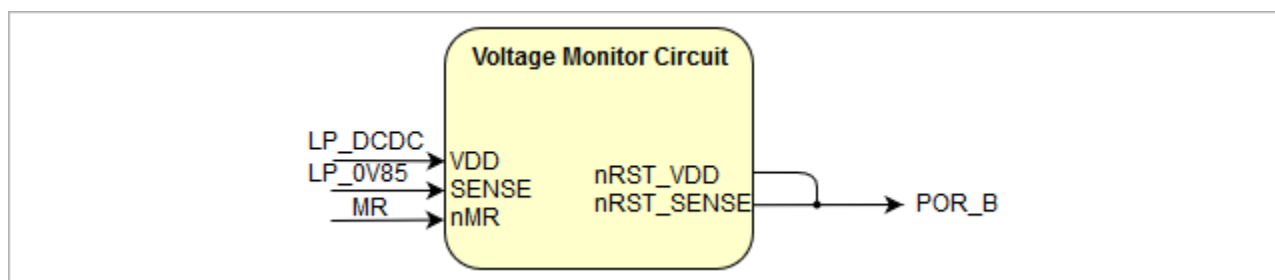


Figure 5: TE0807-02 Voltage Monitor Circuit

Power Rails

Power Rail Name	B2B J1 Pins	B2B J2 Pins	B2B J3 Pins	B2B J4 Pins	Directions	Note
PL_DCIN	151, 153, 155, 157, 159	-	-	-	Input	-
DCDCIN	-	154, 156, 158, 160, 153, 155, 157, 159	-	-	Input	-
LP_DCDC	-	138, 140, 142, 144	-	-	Input	-
PS_BATT	-	125	-	-	Input	-
GT_DCDC	-	-	157, 158, 159, 160	-	Input	-
PLL_3V3	-	-	152	-	Input	U5 (programmable PLL) 3.3V nominal input
SI_PLL_1V8	-	-	151	-	Output	Internal voltage level 1.8V nominal output
PS_1V8	-	99	147, 148	-	Output	Internal voltage level 1.8V nominal output
PL_1V8	91, 121	-	-	-	Output	Internal voltage level 1.8V nominal output
DDR_1V2	-	135	-	-	Output	Internal voltage level 1.2V nominal output
VCCO47	-	-	43, 44	-	Input	-
VCCO48	-	-	15, 16	-	Input	-
VCCO64	-	-	-	58, 106	Input	-

VCCO65	-	-	-	69, 105	Input	-
VCCO66	90, 120	-	-	-	Input	-

Table 19: TE0807-03 power rails

Bank Voltages

Bank	Type	Schematic Name	Voltage	Reference Input Voltage	Voltage Range
47	HD	VCCO47	user	-	1.2V to 3.3V
48	HD	VCCO48	user	-	1.2V to 3.3V
64	HP	VCCO64	user	VREF_64, pin J4-88	1.2V to 1.8V
65	HP	VCCO65	user	VREF_65, pin J4-15	1.2V to 1.8V
66	HP	VCCO66	user	VREF_66, pin J1-108	1.2V to 1.8V
500	MIO	PS_1V8	1.8V	-	-
501	MIO	PS_1V8	1.8V	-	-
502	MIO	PS_1V8	1.8V	-	-
503	CONFIG	PS_1V8	1.8V	-	-

Table 20: TE0807-03 I/O bank voltages

See Xilinx Zynq UltraScale+ datasheet DS925 for the voltage ranges allowed.

Board to Board Connectors

5.2 x 7.6 cm UltraSoM+ modules use four Samtec Razor Beam LP Terminal Strip ([ST5](#)) on the bottom side.

- 4x REF-192552-02 (160-pins)
 - ST5 Mates with SS5

5.2 x 7.6 cm UltraSoM+ carrier use four Samtec Razor Beam LP Socket Strip ([SS5](#)) on the top side.

- 4x REF192552-01 (160-pins)
 - SS5 Mates with ST5

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

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	3.5mm	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
27220	REF-192552-02	ST5-80-1.50-L-D-P-TR	Module connector	1.5 mm	Standard connector used on modules
27017	REF-189545-01	ST5-80-1.00-L-D-P-TR	Module connector	1 mm	Assembly option on request

Connectors.

The module can be manufactured using other connectors upon request.

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).

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

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.

Manufacturer Documentation

File	Modified
PDF File hsc-report-sma_st5-ss5-04mm_web.pdf	30 05, 2017 by Susanne Kunath
PDF File hsc-report-sma_st5-ss5-05mm_web.pdf	30 05, 2017 by Susanne Kunath
PDF File REF-192552-01.pdf	13 11, 2017 by John Hartfiel
PDF File REF-192552-02.pdf	13 11, 2017 by John Hartfiel
PDF File ss5.pdf	13 11, 2017 by John Hartfiel
PDF File ss5-st5.pdf	13 11, 2017 by John Hartfiel
PDF File ss5-xx-x.xx-x-d-k-tr-mkt.pdf	13 11, 2017 by John Hartfiel
PDF File st5.pdf	13 11, 2017 by John Hartfiel
PDF File st5-xx-x.xx-x-d-p-tr-mkt.pdf	13 11, 2017 by John Hartfiel

[Download All](#)

Variants Currently In Production

Trenz shop TE0807 overview page	
English page	German page

Technical Specifications

Absolute Maximum Ratings

Parameter	Min	Max	Unit	Notes / Reference Document
PL_DCIN	-0.3	4	V	TPS82085SIL / EN63A0QI data sheet/ Limit is LP_DCDC over EN/PG
DCDCIN	-0.3	4	V	TPS82085SIL / TPS51206 data sheet/ Limit is LP_DCDC over EN/PG
LP_DCDC	-0.3	4	V	TPS3106K33DBVR data sheet
GT_DCDC	-0.3	4	V	TPS82085SIL data sheet/ Limit is LP_DCDC over EN/PG
PS_BATT	-0.5	2	V	Xilinx DS925 data sheet
PLL_3V3	-0.5	3.8	V	Si5345/44/42 data sheet
VCCO for HD I/O banks	-0.5	3.4	V	Xilinx DS925 data sheet
VCCO for HP I/O banks	-0.5	2	V	Xilinx DS925 data sheet
I/O input voltage for HD I/O banks	-0.55	VCCO + 0.55	V	Xilinx DS925 data sheet
I/O input voltage for HP I/O banks	-0.55	VCCO + 0.55	V	Xilinx DS925 data sheet
PS I/O input voltage (MIO pins)	-0.5	VCCO_PSIO + 0.55	V	Xilinx DS925 data sheet, VCCO_PSIO 1.8V nominally
PS GTR reference clocks absolute input voltage	-0.5	1.1	V	Xilinx document DS925
PS GTR absolute input voltage	-0.5	1.1	V	Xilinx document DS925
MGT clock absolute input voltage	-0.5	1.3	V	Xilinx document DS925
MGT Receiver (RXP/RXN) and transmitter (TXP/TXN) absolute input voltage	-0.5	1.2	V	Xilinx DS925 data sheet
Voltage on input pins of NC7S08P5X 2-Input AND Gate	-0.5	VCC + 0.5	V	NC7S08P5X data sheet, see schematic for VCC
Voltage on input pins (nMR) of TPS3106K33DBVR Voltage Monitor, U41	-0.3	VDD + 0.3	V	TPS3106 data sheet, VDD = LP_DCDC
"Enable"-signals on TPS82085SIL (EN_PLL_PWR, EN_LPD)	-0.3	7	V	TPS82085SIL data sheet
Storage temperature (ambient)	-40	100	°C	ROHM Semiconductor SML-P11 Series data sheet

Table 21: Module absolute maximum ratings



Assembly variants for higher storage temperature range are available on request.

Recommended Operating Conditions

Parameter	Min	Max	Unit	Notes / Reference Document
PL_DCIN	3.3	3.6	V	EN63A0QI / TPS82085SIL data sheet/ Limit is LP_DCDC over EN/PG
DCDCIN	3.3	3.6	V	TPS82085SIL / TPS51206PSQ data sheet/ Limit is LP_DCDC over EN/PG
LP_DCDC	3.3	3.6	V	TPS82085SIL / TPS3106 data sheet
GT_DCDC	3.3	3.6	V	TPS82085SIL data sheet/ Limit is LP_DCDC over EN/PG
PS_BATT	1.2	1.5	V	Xilinx DS925 data sheet
PLL_3V3	3.3	3.47	V	Si5345/44/42 data sheet 3.3V typical
VCCO for HD I/O banks	1.14	3.4	V	Xilinx DS925 data sheet
VCCO for HP I/O banks	0.95	1.9	V	Xilinx DS925 data sheet
I/O input voltage for HD I/O banks.	-0.2	VCCO + 0.2	V	Xilinx DS925 data sheet
I/O input voltage for HP I/O banks	-0.2	VCCO + 0.2	V	Xilinx DS925 data sheet
PS I/O input voltage (MIO pins)	-0.2	VCCO_PSIO + 0.2	V	Xilinx DS925 data sheet, VCCO_PSIO 1.8V nominally
PL bank reference voltage VREF pin	-0.5	2	V	Xilinx DS925 data sheet
Voltage on input pins of NC7S08P5X 2-Input AND Gate	0	VCC	V	NC7S08P5X data sheet, see schematic for VCC
Voltage on input pin 'MR' of TPS3106K33DBVR Voltage Monitor, U41	0	VDD	V	TPS3106 data sheet, VDD = LP_DCDC

Table 22: Recommended operating conditions

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



See Xilinx datasheet DS925 for more information about absolute maximum and recommended operating ratings for the Zynq UltraScale+ chips.

Physical Dimensions

- Module size: 52 mm × 76 mm. Please download the assembly diagram for exact numbers
- Mating height with standard connectors: 5mm
- PCB thickness: 1.6mm
- Highest part on PCB: approx. 3mm. Please download the step model for exact numbers

All dimensions are given in millimeters.

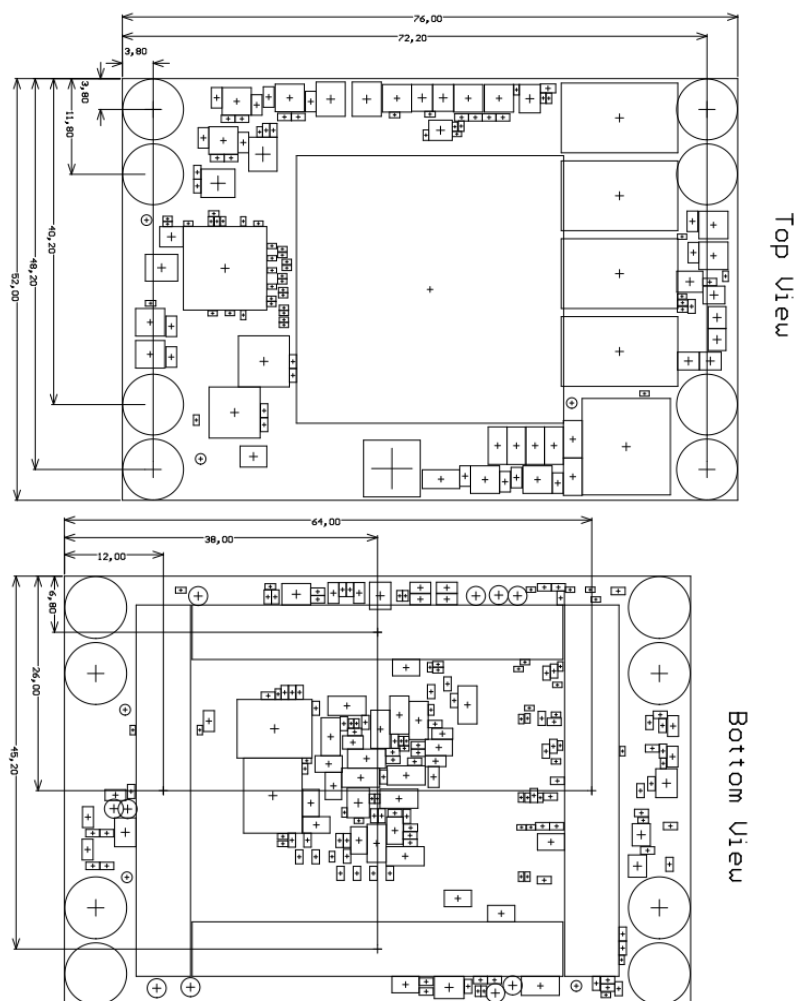


Figure 6: Module physical dimensions drawing

Revision History

Hardware Revision History

Date	Revision	Notes	PCN Link	Documentation Link
2020-06-05	03	current available module revision	PCN-20200511	TE0807-03
-	02	current available module revision	-	TE0807-02
-	01	first production release	-	TE0807-01

Table 23: Hardware revision history table

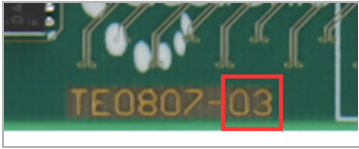


Figure 7: Module hardware revision number

Document Change History

Date	Revision	Contributors	Description
<div>Error rendering macro 'page-info' Ambiguous method overloading for method jdk.proxy279.\$Proxy4022#hasContentLevelPermission. Cannot resolve which method to invoke for [null, class java.lang.String, class com.atlassian.confluence.pages.Page] due to overlapping prototypes between: [interface com.atlassian.confluence.user.ConfluenceUser, class java.lang.String, class com.atlassian.confluence.core.ContentEntityObject] [interface com.atlassian.user.User, class java.lang.String, class com.atlassian.confluence.core.ContentEntityObject]</div>	<div>Error rendering macro 'page-info' Ambiguous method overloading for method jdk.proxy279.\$Proxy4022#hasContentLevelPermission. Cannot resolve which method to invoke for [null, class java.lang.String, class com.atlassian.confluence.pages.Page] due to overlapping prototypes between: [interface com.atlassian.confluence.user.ConfluenceUser, class java.lang.String, class com.atlassian.confluence.core.ContentEntityObject] [interface com.atlassian.user.User, class java.lang.String, class com.atlassian.confluence.core.ContentEntityObject]</div>	<div>Error rendering macro 'page-info' Ambiguous method overloading for method jdk.proxy279.\$Proxy4022#hasContentLevelPermission. Cannot resolve which method to invoke for [null, class java.lang.String, class com.atlassian.confluence.pages.Page] due to overlapping prototypes between: [interface com.atlassian.confluence.user.ConfluenceUser, class java.lang.String, class com.atlassian.confluence.core.ContentEntityObject] [interface com.atlassian.user.User, class java.lang.String, class com.atlassian.confluence.core.ContentEntityObject]</div>	<ul style="list-style-type: none">• Correction on MGT Lanes (column "FPGA Pin" of bank 227 and 505 was incorrect)
2021-09-07	v.28	John Hartfiel	<ul style="list-style-type: none">• Correction on Power section

2021-06-10	v.27	John Hartfiel	<ul style="list-style-type: none"> • correction number IOs in BD
2021-05-17	v.26	John Hartfiel	<ul style="list-style-type: none"> • typo correction in DDR section
2021-05-03	v.25	Martin Rohrmüller	<ul style="list-style-type: none"> • Updated to REV03
2021-03-11	v.24	Antti Lukats	<ul style="list-style-type: none"> • Corrected B2B include macro
2019-06-14	v.22	John Hartfiel	<ul style="list-style-type: none"> • typo correction SI5345 I2C address • typo B2B Pin of CLK signals
2018-08-07	v.20	Ali Naseri	<ul style="list-style-type: none"> • initial document

Table 24: Document change history

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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 [REACH](#). 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 List](#) 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 \(ECHA\)](#).

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.

Error rendering macro 'page-info'

Ambiguous method overloading for method `jdk.proxy279.$Proxy4022#hasContentLevelPermission`. Cannot resolve which method to invoke for `[null, class java.lang.String, class com.atlassian.confluence.pages.Page]` due to overlapping prototypes between: `[interface com.atlassian.confluence.user.ConfluenceUser, class java.lang.String, class com.atlassian.confluence.core.ContentEntityObject]` `[interface com.atlassian.user.User, class java.lang.String, class com.atlassian.confluence.core.ContentEntityObject]`

02 Sept 2017