

# TEM0005 TRM

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## Overview

The Trencz Electronic TEM0005-02 is a low-cost module with Microsemi [SmartFusion2](#) SoC and 32 MByte flash memory for configuration and operation. SmartFusion2 combines a 166 MHz Cortex-M3 MCU with 256 KByte Flash and 80 KByte SRAM as well as 12 kLUT FPGA Core Logic.

Refer to <http://trenz.org/tem0005-info> for the current online version of this manual and other available documentation.

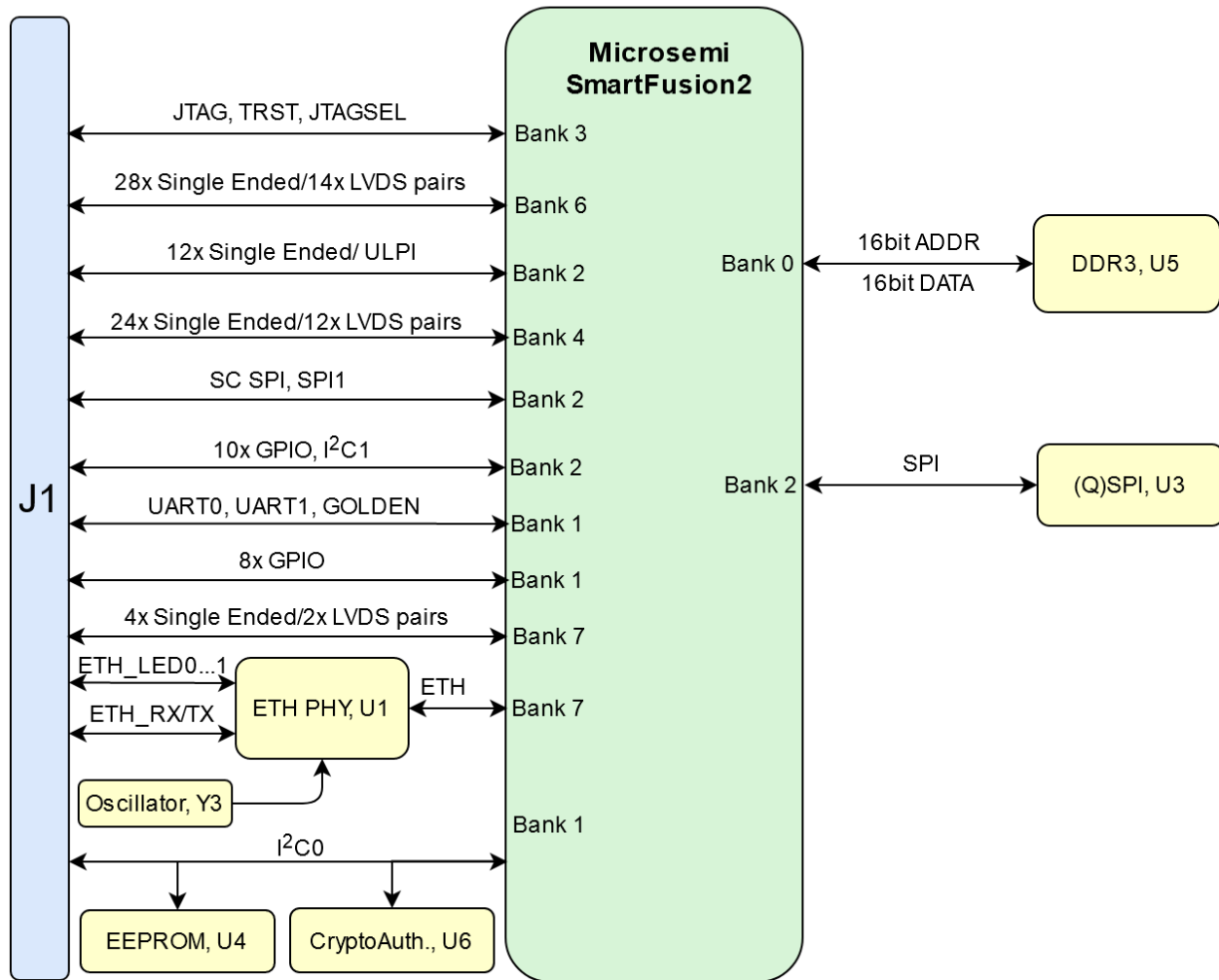
## Key Features

- **SoC/FPGA**
  - Package: VFG400
  - Device: M2S010, M2S050 \*

- Engine: 166Mhz 32Bit ARM Cortex-M3
  - Speed: Standard
  - Temperature: C, I\*
- **RAM/Storage**
  - Low Power DDR3
    - Data width: 16bit
    - Size: def. 2Gb
  - SPI Flash
    - size: 256 M bit
  - 2Kb EEPROM
- **On Board**
  - Crypto Authentication IC
  - Voltage monitor IC
  - 10/100 Mbps PHY Ethernet
- **Interface**
  - Samtec ST5 B2B Connector
- **Power**
  - 3.3V supplied from carrier
- **Dimension**
  - 56 x 31 mm
- **Notes**
  - \* depends on assembly version

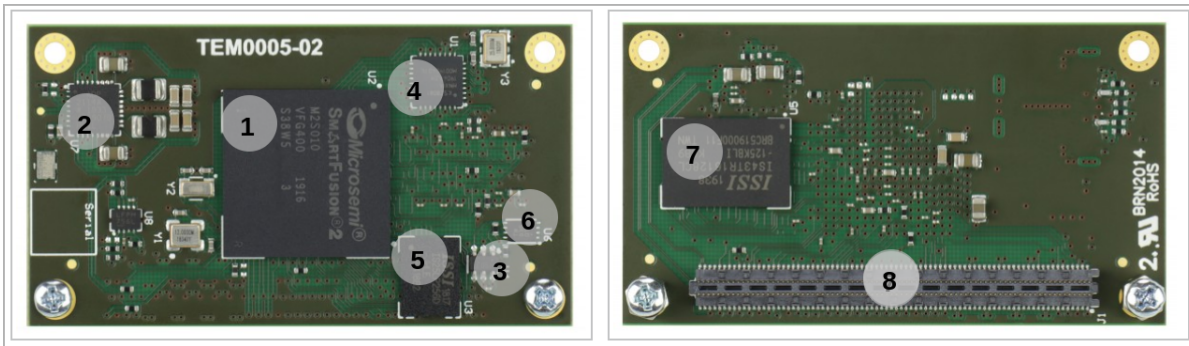
## Block Diagram

## TEM0005



TEM0005 block diagram

## Main Components



TEM0005 main components

1. Microsemi SmartFusion2 SoC, U2
2. Dual DCDC Regulator, U7
3. EEPROM, U4
4. 10/100 Mb Ethernet, U1
5. QSPI Flash, U3
6. Authentication IC, U6
7. DDR3 Memory, U5
8. B2B Connector, J1

## Initial Delivery State

Storage device name	Content	Notes
Quad SPI Flash	Not Programmed	
EEPROM	Not Programmed	
CryptoAuthentication	Not Programmed	

Initial delivery state of programmable devices on the module

## Configuration Signals

Signal	B2B	I/O	Note
RESET	J1-11		Active low reset

Reset process.

## Signals, Interfaces and Pins

### Board to Board (B2B) I/Os

FPGA bank number and number of I/O signals connected to the B2B connector, J1.

FPGA Bank	Interface	I/O Signal Count	Voltage Level	Notes
Bank 1	GPIO	8x Single Ended	3.3V	
	UART	4x Single Ended	3.3V	

Bank 2	I2C	2x Single Ended	3.3V	
	GOLDEN	1x Single Ended	3.3V	
	ULPI/I/O	12x Single Ended	3.3V	
	I2C	2x Single Ended	3.3V	
	GPIO	10x Single Ended	3.3V	
	SC SPI	4x Single Ended	3.3V	
	SPI1	7x Single Ended	3.3V	
Bank 3	JTAG	5x Single Ended	3.3V	
	Reset	1x Single Ended	3.3V	
Bank 4	I/O	24x Single Ended/12 LVDS pairs	3.3V	
Bank 6	I/O	28x Single Ended/14 LVDS pairs	VDDI6	max 2.5V
Bank 7	I/O	4x Single Ended	3.3V	

**General PL I/O to B2B connectors information**

## JTAG Interface

JTAG access to the TEM0005 SoM through B2B connector J1.

JTAG Signal	B2B Connector
TMS	J1-14
TDI	J1-8
TDO	J1-10
TCK	J1-12
TRST	J1-7

**JTAG pins connection**

## Test Points

Test Point	Signal	Connected to	Notes
TP1	CLKOUT	Regulator, U7	

**Test Points Information**

## On-board Peripherals

Chip/Interface	Designator	Notes
QSPI	U3	
DDR3L SDRAM	U5	
EEPROM	U4	

Authentication IC	U6	
Ethernet PHY	U1	
Oscillators	Y3	

#### On board peripherals

## (Quad) SPI Flash Memory

The TEM0005 is equipped with a (Q)SPI flash memory, U3 provided in order to store data and configuration.

Schematic	U3 Pin	Connected to	Notes
SPI0_SS0	nCE	FPGA Bank 2	
SPI0_CLK	SCK	FPGA Bank 2	
SPI0_SDO	SI/IO0	FPGA Bank 2	
SPI0_SDI	SO/IO0	FPGA Bank 2	

#### Quad SPI interface MIOs and pins

## EEPROM

The TEM0005 is equipped with an EEPROM IC, U4. The I<sup>2</sup>C signals are connected to authentication IC as well.

Schematic	U4 Pin	Notes
I2C0_SCL	SCL	
I2C0_SDA	SDA	

#### I2C EEPROM interface MIOs and pins

Pin	I2C Address	Designator	Notes
SCL/SDA	0x70	U4	

#### I2C address for EEPROM

## Authentication IC

There is an Authentication IC ATECC608A provided on TEM0005, The IC is connected to I2C0 bus.

Pin	Schematic	Notes
SCL	I2C0_SCL	Serial Clock
SDA	I2C1_SCL	Serial Data

#### Authentication IC information

Pin	I2C Address	Designator	Notes
SCL/SDA	0xC0	U6	This is the default value, which can be changed, see device datasheet.

#### I2C address for Authentication IC

## DDR3L SDRAM

The TEM0005 SoM has 2 Gb volatile DDR3L SDRAM IC for storing user application code and data.

- Part number: IS43TR16128CL-125KBLI
- Supply voltage: 1.5 V
- Temperature: -40 to 95 °C

## Ethernet Transceiver

On board 10/100 Mbps Ethernet Transceiver U1 is provided on the module TEM0005.

U1 Pin	Signal Name	Connected to	Note
RXM/RXP	ETH1_RX	B2B, J1	
TXM/TXP	ETH1_TX	B2B, J1	
LED0/NWAYEN	ETH1_LED0	B2B, J1	
LED1/SPEED	ETH1_LED1	B2B, J1	
MDIO	ETH1_MDIO	FPGA Bank 7, U2	
MDC	ETH1_MDC	FPGA Bank 7, U2	
REXT	-	GND	
INTRP	ETH1_INTRP	FPGA Bank 7, U2	
XO/XI	-	Crystal Oscillator, Y3	
nRST	ETH1_RST	FPGA Bank 7, U2	
CONFIG0...2	ETH1_COL/CRC/RXDV	FPGA Bank 7, U2	
TXC	ETH1_TXC	FPGA Bank 7, U2	
TXEN	ETH1_TXEN	FPGA Bank 7, U2	
TXD0...3	ETH1_TXD0...3	FPGA Bank 7, U2	
RXD0...3	ETH1_RXD0...3	FPGA Bank 7, U2	
RXC	ETH1_RXC	FPGA Bank 7, U2	
RXCER	ETH1_RXCER	FPGA Bank 7, U2	

Ethernet PHY to Zynq SoC connections

## Clock Sources

Designator	Description	Frequency	Note
Y3	Crystal Oscillator	25 MHz	Connected to ETH PHY

Osillators

## Power and Power-On Sequence

## Power Supply

Power supply with minimum current capability of 1.5 A for system startup is recommended.

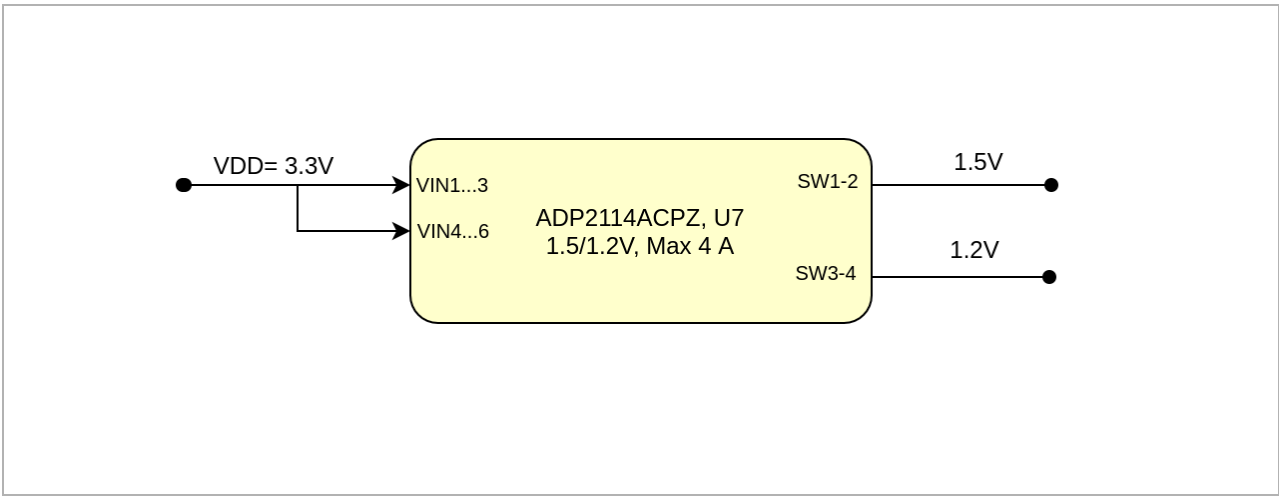
## Power Consumption

Power Input Pin	Typical Current
VIN	TBD*

### Power Consumption

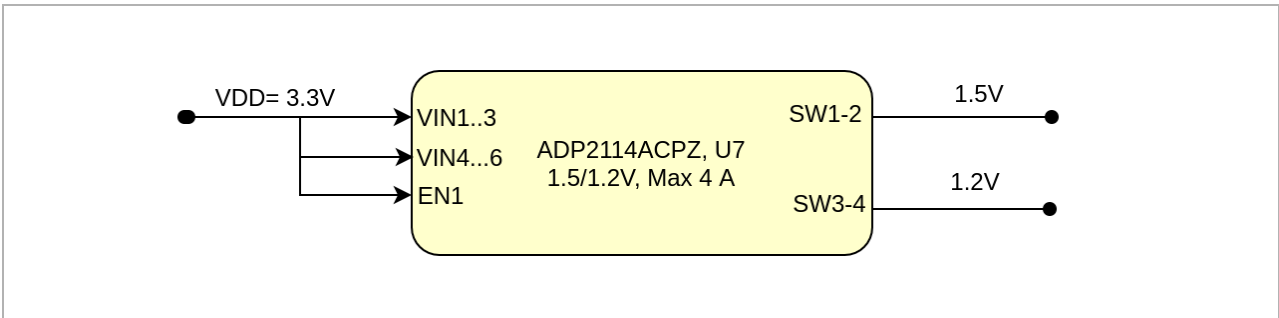
\* TBD - To Be Determined

## Power Distribution Dependencies



Power Distribution

## Power-On Sequence

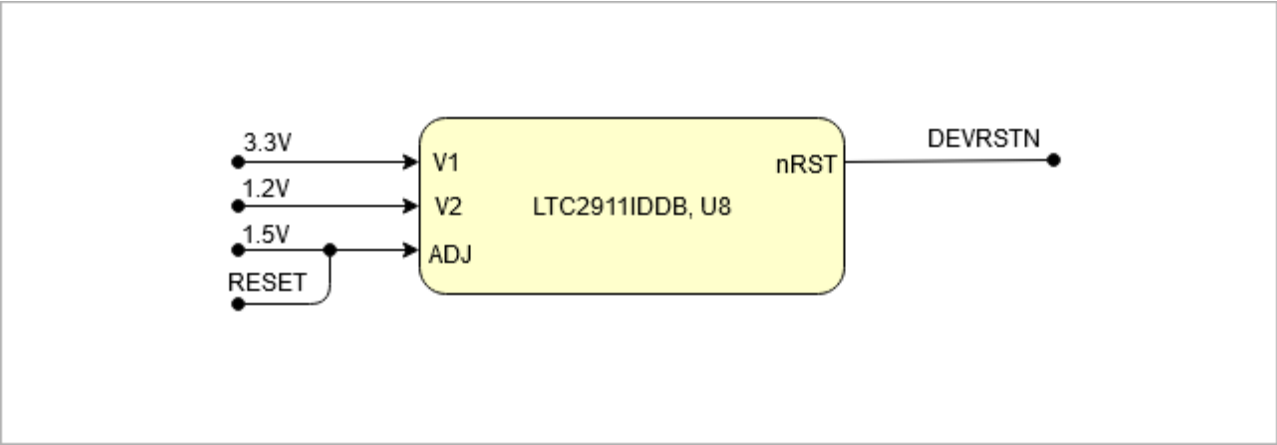


Power Sequence

## Voltage Monitor Circuit

The TEM0005 is equipped with a voltage monitoring IC, U8. Reset Logic Output (nRST) asserts low when any of the V1, V2, or ADJ inputs are below their reset thresholds.





Voltage Monitor Circuit

Power Rails

Power Rail Name	B2B Connector J1 Pin	Direction	Notes
3.3V	1, 2, 3, 4	Input	
VDDI6	22	Input	

Module power rails.

Bank Voltages

Bank	Schematic Name	Voltage	Notes
Bank0	1.5V	1.5V	
Bank1	3.3V	3.3V	
Bank2	3.3V	3.3V	
Bank3	3.3V	3.3V	
Bank4	3.3V	3.3V	
Bank5	3.3V	3.3V	
Bank6	VDDI6	max. 2.5V	supplied by carrier
Bank7	3.3V	3.3V	

Zynq SoC bank voltages.

Board to Board Connectors

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Technical Specifications

## Absolute Maximum Ratings

Symbols	Description	Min	Max	Unit
VIN	Input Supply Voltage	-0.3	3.63	V
STG_T	Storage Temperature	-45	125	°C

PS absolute maximum ratings

## Recommended Operating Conditions

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

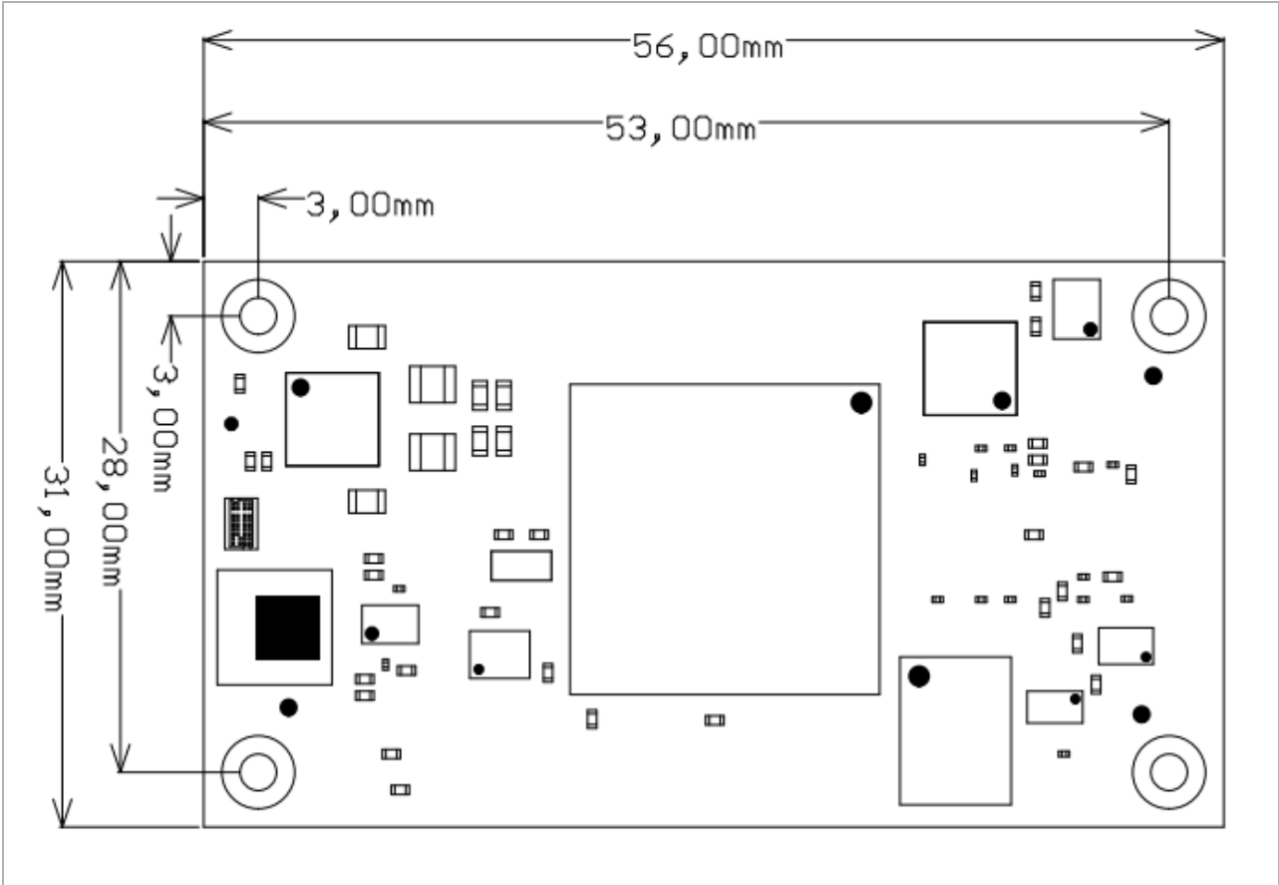
Parameter	Min	Max	Units	Reference Document
VIN	3.15	3.45	V	See the carrier datasheets.
OPT_T	0 /-40	85	°C	See Microsemi Smartfusion2 datasheet. Depends on assembly version.

Recommended operating conditions.

## Physical Dimensions

- Module size: 56 mm x 31 mm. Please download the assembly diagram for exact numbers.
- Mating height with standard connectors: 4 mm.

PCB thickness: 1.6 mm.



Physical Dimension

Currently Offered Variants

Trenz shop TEM0005 overview page	
<a href="#">English page</a>	<a href="#">German page</a>

Trenz Electronic Shop Overview

Revision History

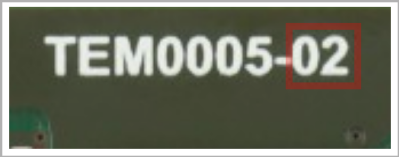
Hardware Revision History

Date	Revision	Changes	Documentation Link
2019-10-01	REV01	<ul style="list-style-type: none"><li>Initial Release</li></ul>	<a href="#">REV01</a>

2020-05-20	REV02	<ul style="list-style-type: none"><li>Support M2S050 -&gt;added R29,R30, C24..C26,C31</li><li>Added resistor R32</li><li>Full upd LIB</li></ul>	REV02
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Hardware Revision History

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



Board hardware revision number.

Document Change History

Date	Revision	Contributor	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"><li>initial Release</li></ul>

--	all	<div><div>Error rendering macro 'page-info'</div><div>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>	• --
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Document change history.

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

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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.

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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]`