Zolertia Orion Ethernet Router Revision A, an Internet of Things IPv6 & IPv4 Edge Router for 2.4-GHz and 863-950MHz IEEE 802.15.4 and 6LoWPAN Applications

1. Device overview

1.1. Features

- Device
  - Two on-board IEEE 802.15.4-compliant transceivers: 2.4GHz and 863-950MHz
  - Ethernet 10BASE-T IPv4/IP64
  - Active POE (Power Over Ethernet), 48VDC 802.3af)
  - Programmable over USB and JTAG
  - On-board RGB LED, user and MCU reset button, with an optional third button for master reset
  - On/Off switch
- Microcontroller
  - CC2538 ARM® Cortex®-M3 with Code Prefetch
  - Up to 32-MHz Clock Speed
  - 512KB Programmable Flash
  - 32KB RAM (16KB with retention in all Power Modes)
  - JTAG Debugging
  - Low-Power
    - Active Mode: 20mA
    - Power Mode 1 (4µs wake-up): 0.6mA
    - Power Mode 2 (sleep timer running and 16KB RAM retention): 1.3µA
    - Power Mode 3 (external interrupt and 16KB RAM retention): 0.4 µA
- Radio
  - ISM 2.4GHz IEEE 802.15.4 Compliant transceiver
    - Receiver sensitivity -97dBm
    - Robustness to interference with ACR 44dB
    - Programmable output power up to 7dBm
    - 250Kbps data rate with DSSS modulation
    - Reception (CPU Idle): 20mA peak
    - Transmission (CPU Idle, @ 0dBm): 24mA peak
  - ISM 863-950MHz IEEE 802.15.4 Compliant transceiver
    - Receiver sensitivity -123dBm @1.2kbps, -109dBm @ 50kbps
    - Blocking 86dB at 10MHz
    - Adjacent channel selectivity: up to 60dB at 12.5KHz offset
    - Programmable output power up to 16dBm
    - Modulation formats: 2-FSK, 2-GFSK, 4-FSK, 4-GFSK, MSK, OOK
    - Data rate up to 1.25Mbps
    - Power down: 0.12 µA, 0.5 µA with Wake-On radio (eWOR)
    - Reception: 19mA, 0.5mA in RX Sniff Mode
    - Transmission (@10-14dBm): 35-46mA
- Security Hardware Acceleration
  - AES-128/256, SHA2 Hardware Encryption Engine
  - ECC-128/256 RSA Hardware Acceleration Engine for secure key exchange
- Layout
  - 40.29 x 73.75 mm
  - Indoor enclosure available

1.2. Description

The Zolertia Ethernet Router allows to connect your smart wireless devices to Internet over IPv4/IPv6. It features two RF interfaces: 2.4GHz and 863-950MHz, compatible with IEEE 802.15.4/6LoWPAN, Thread, ZigBee and other IoT/M2M protocols. The device may be powered over POE (active), or micro USB.

1.3. Applications

- Internet of Things research and development
- Wireless Sensor Network
- Smart Agriculture
- Smart Cities
- Intelligent Lighting System
- Smart Metering

1.4. Development Tools

- Code Composer Studio ™
- IAR Embedded Workbench® for ARM
- SmartRF™ Studio
- SmartRF™ Flash Programmer

- BSL programming over USB (cc2538-bsl)
- Sensniff 6LoWPAN packet sniffer

1.5. Operating Systems & Software

- Contiki OS
- RIOT OS
- OpenWSN
- OpenThread
- 6LBR Border outer (CETIC®)
- Texas Instruments ZigBee Z-Stack
- Texas Instruments CC2538 Foundation Firmware
- Texas Instruments IEEE 802.15.4 MAC software Stack (TIMAC)

2. Revision history

Version	Author	Date	Description
1.0.0	Antonio Liñán Colina	19/12/2016	Initial Release

3. Compliances

- Europe: ETSI EN 300 220, ETSI EN 300 328, ETSI EN 300 440, EN 54-25
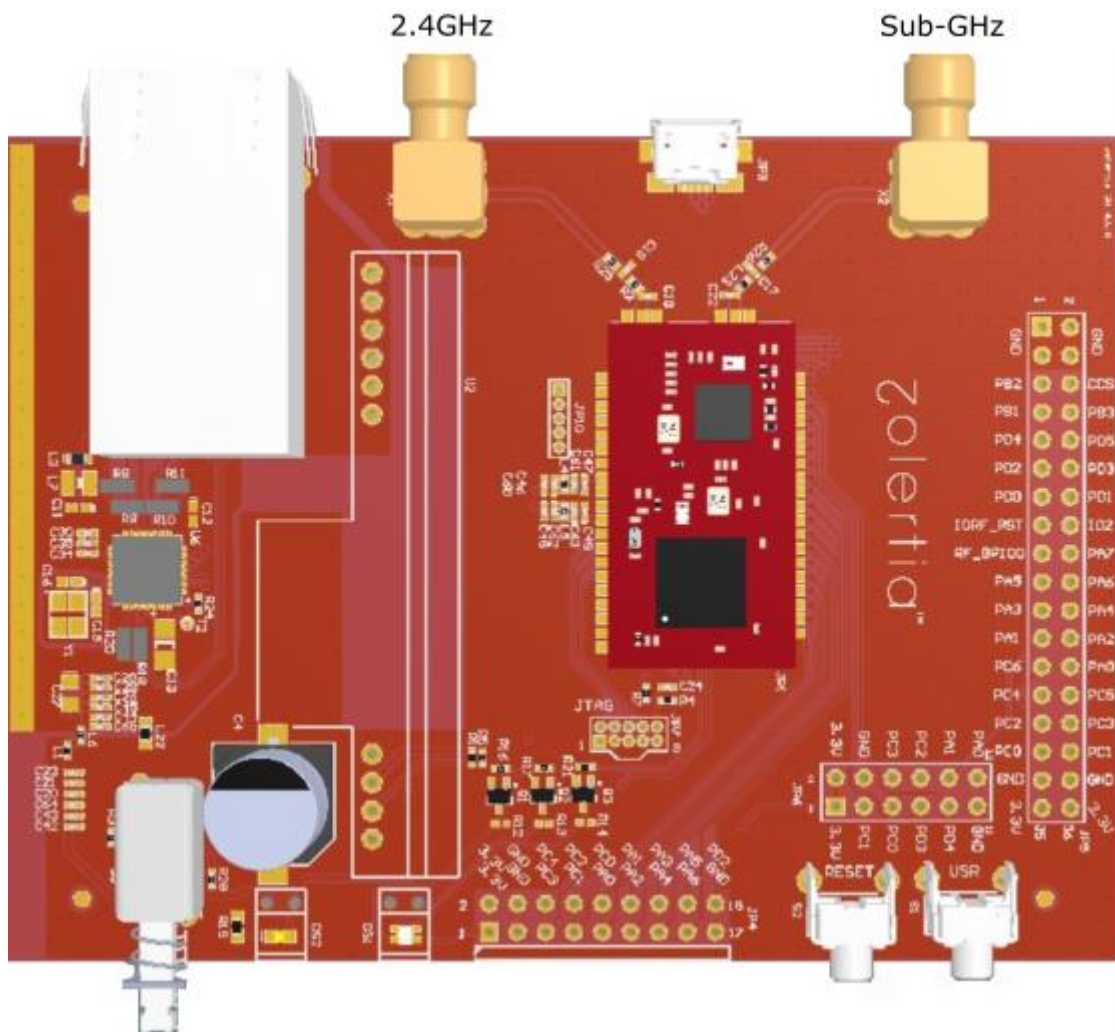- US: FCC CFR47 Part 15, FCC CFR47 Part 90

Certification for CE/FCC 2017 Q1

4. Ordering information and documentation

- Online Purchases: http://zolertia.io/product/hardware/orion-router
- Sales department: sales@zolertia.com
- Website: http://zolertia.io
- Technical resources: https://github.com/Zolertia/Resources

5. Device Information
5.1. Block description and pin-out

The Zolertia Ethernet Router exposes a Power DPDT push button, a RESET button to reboot the CC2538 system-on-chip, and a programable USR button. The RP-SMA connector for a 2.4GHz external antenna is located next to the RJ Ethernet connector, whereas the SMA connector for sub-GHz antenna is located on the opposite side. The micro-USB connector is used for both powering the device over USB (5VDC), and programming/debugging.
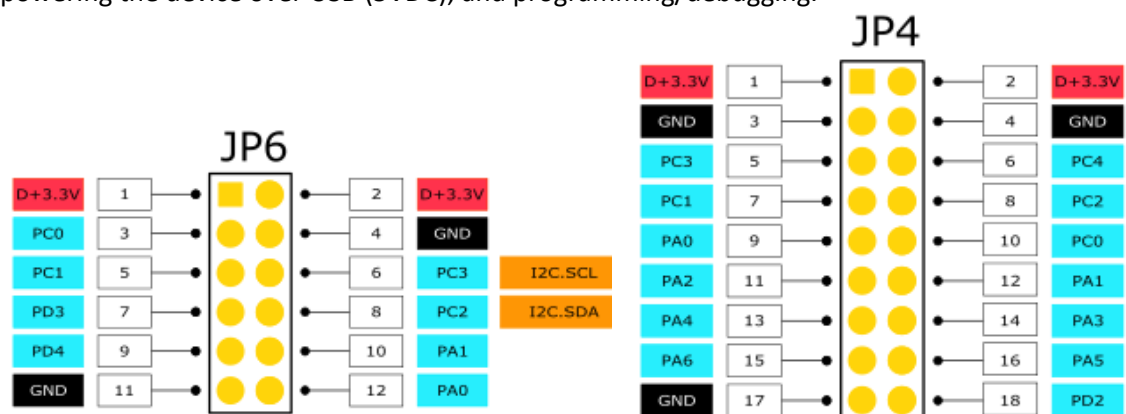
There are additional connectors (not populated as default) with 2.54mm pitch spacing, exposing the CC2538 pins. The JP4 and JP6 connectors exposes pins mostly to interface sensors, actuators and communication buses. The JP6 even-numbered pins are compatible with the I2C default pins used by other platforms such as the Firefly or the RE-Mote).
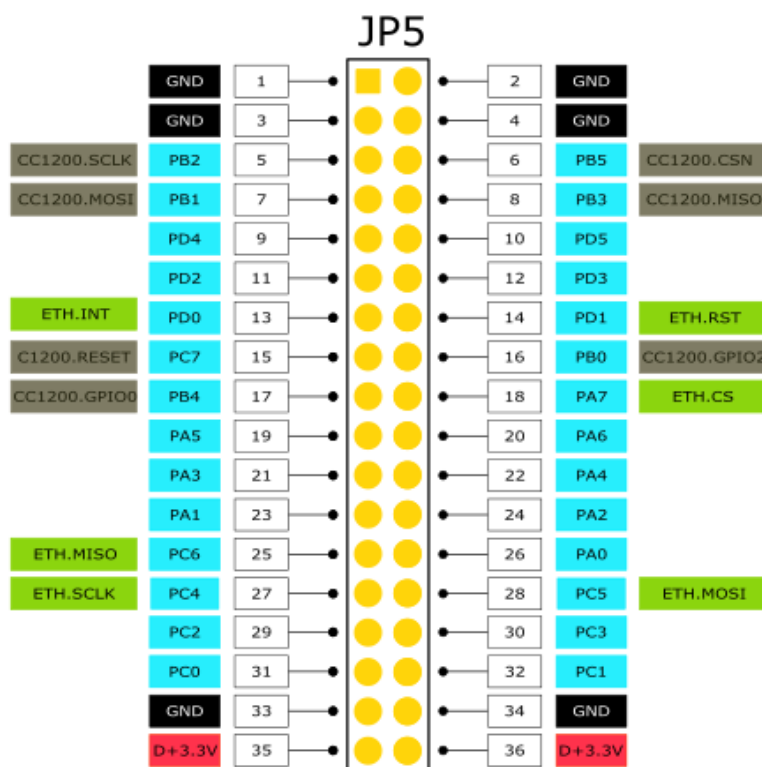
The JP5 exposes the pins of the CC2538 connected to the CC1200 sub-GHz transceiver, and the ENC28J60 Ethernet module.

The female RJ-45 Ethernet support active Power Over Ethernet (POE) 802.3af, up to 48VDC. Using POE allows to carry both data and power over the same cabling, reducing the number of elements required to connect and power the Zolertia Ethernet Router.

A non-populated JTAG connector is also available to further debug the device using an external JTAG tool.

Two on-board LEDs are available over a light-guide. The green LED next to the Power switch shows the device power status (lit when on, else off). The RGB LED next to the JP4 connector is programable by the user.

5.2. JP5 Pin description

Pin	Default name	Pin Type	MC	Description
1	DGND	Ground	N/A	Digital Ground
2	DGND	Ground	N/A	Digital Ground
3	DGND	Ground	N/A	Digital Ground
4	DGND	Ground	N/A	Digital Ground
5	CC1200.CLK	Digital I/O	PB2	CC1200 SPI clock output
6	CC1200.CSN	Digital I/O	PB5	CC1200 SPI Chip Select
7	CC1200.MOSI	Digital I/O	PB1	CC1200 SPI MOSI
8	CC1200.MISO	Digital I/O	PB3	CC1200 SPI MISO
9	GPD4	Digital I/O	PD4	GPIO
10	GPD5	Digital I/O	PD5	GPIO
11	GPD2	Digital I/O	PD2	GPIO

12	GPD3	Digital I/O	PD3	GPIO
13	ETH.INT/GPD0	Digital I/O	PD0	ENC28J60 interrupt pin
14	ETH.RESET/GPD1	Digital I/O	PD1	ENC28J60 reset line
15	CC1200.RESET	Reset	PC7	CC1200 Reset line
16	CC1200.GPIO2	Digital I/O	PB0	CC1200 GPIO2 pin
17	CC1200.GPIO0	Digital I/O	PB4	CC1200 GPIO0 pin
18	ETH.CSN/GPA7	Digital I/O	PA7	ENC28J60 SPI Chip Select
19	ADC1/AIN5/GPA5	Digital I/O	PA5	ADC1 analogue input channel or GPIO
20	ADC4/AIN6/GPA6	Digital I/O	PA6	ADC4 analogue input channel, or AIN6 as external reference for the ADC, or GPIO
21	USER/GPA3	Digital Input	PA3	Programmable User Button (default), to use otherwise disable the BSL bootloader or change backdoor enable pin
22	ADC2/AIN4/GPA4	Digital I/O	PA4	ADC2 analogue input channel or GPIO
23	UART0.TX	Digital I/O	PA1	Connected to the CP2104 USB-to-serial converter
24	ADC3/AIN2/GPA2	Digital I/O	PA2	ADC3 analogue input channel or GPIO
25	ETH.MISO/GPC6	Digital I/O	PC6	ENC28J60 SPI MISO
26	UART0.RX	Digital I/O	PA0	Connected to the CP2104 USB-to-serial converter
27	ETH.SCLK/GPC4	Digital I/O	PC4	ENC28J60 SPI clock output
28	GPC5	Digital I/O	PC5	GPIO 20 mA output capability, no pull-up or pull-down
29	GPC2	Digital I/O	PC2	GPIO 20 mA output capability, no pull-up or pull-down
30	GPC3	Digital I/O	PC3	GPIO 20 mA output capability, no pull-up or pull-down
31	GPC0	Digital I/O	PC0	GPIO 20 mA output capability, no pull-up or pull-down
32	GPC1	Digital I/O	PC1	GPIO 20 mA output capability, no pull-up or pull-down
33	DGND	Ground	N/A	Digital Ground
34	DGND	Ground	N/A	Digital Ground
35	+VDD	Power output	N/A	3.3VDC max output pin
36	+VDD	Power output	N/A	3.3VDC max output pin

5.3. JP6 Pin description

Pin	Default name	Pin Type	MC	Description
1	+VDD	Power output	N/A	3.3VDC max output pin
2	+VDD	Power output	N/A	3.3VDC max output pin
3	GPC0	Digital I/O	PC0	GPIO 20 mA output capability, no pull-up or pull-down
4	DGND	Ground	N/A	Digital Ground
5	GPC1	Digital I/O	PC1	GPIO 20 mA output capability, no pull-up or pull-down
6	GPC3	Digital I/O	PC3	GPIO 20 mA output capability, no pull-up or pull-down
7	GPD3	Digital I/O	PD3	GPIO
8	GPC2	Digital I/O	PC2	GPIO 20 mA output capability, no pull-up or pull-down
9	GPD4	Digital I/O	PD4	GPIO
10	UART0.TX	Digital I/O	PA1	Connected to the CP2104 USB-to-serial converter
11	DGND	Ground	N/A	Digital Ground
12	UART0.RX	Digital I/O	PA0	Connected to the CP2104 USB-to-serial converter

5.4. JP4 Pin description

Pin	Default name	Pin Type	MC	Description
1	+VDD	Power output	N/A	3.3VDC max output pin
2	+VDD	Power output	N/A	3.3VDC max output pin
3	DGND	Ground	N/A	Digital Ground
4	DGND	Ground	N/A	Digital Ground
5	GPC3	Digital I/O	PC3	GPIO 20 mA output capability, no pull-up or pull-down
6	ETH.SCLK/GPC4	Digital I/O	PC4	ENC28J60 SPI clock output
7	GPC1	Digital I/O	PC1	GPIO 20 mA output capability, no pull-up or pull-down
8	GPC2	Digital I/O	PC2	GPIO 20 mA output capability, no pull-up or pull-down
9	UART0.RX	Digital I/O	PA0	Connected to the CP2104 USB-to-serial converter
10	GPC0	Digital I/O	PC0	GPIO 20 mA output capability, no pull-up or pull-down
11	ADC3/AIN2/GPA2	Digital I/O	PA2	ADC3 analogue input channel or GPIO
12	UART0.TX	Digital I/O	PA1	Connected to the CP2104 USB-to-serial converter

13	ADC2/AIN4/GPA4	Digital I/O	PA4	ADC2 analogue input channel or GPIO
14	USER/GPA3	Digital Input	PA3	Programmable User Button (default), to use otherwise disable the BSL bootloader or change backdoor enable pin
15	ADC4/AIN6/GPA6	Digital I/O	PA6	ADC4 analogue input channel, or AIN6 as external reference for the ADC, or GPIO
16	ADC1/AIN5/GPA5	Digital I/O	PA5	ADC1 analogue input channel or GPIO
17	DGND	Ground	N/A	Digital Ground
18	GPD2	Digital I/O	PD2	GPIO

5.5. Connector descriptions

The images below show the back panel (left) and front panel (right). On the back panel, the antenna connectors are available, exposing an SMA connector for the Sub-GHz antenna and a RP-SMA for the 2.4GHz antenna. The micro-USB and RJ-45 (Ethernet) connector are available as well. On the front panel, the Power button (left) allows to turn the device "on/off", and the power status is shown on the ON LED. The Status LED is the user programable LED, and can be configured as required. The Reset (RST) button allows to reboot the CC2538 controller, whereas the programable user button (USR) allows to configure a specific input to the device.

5.6. Parametric and ratings

The Zolertia Orion Ethernet Router can be powered over the Micro USB port (+5VDC), or over the Ethernet connector via the built-in Active POE (Power Over Ethernet - 802.3af) with 48VDC max. All Power Inputs are protected and pose no harm to simultaneously connect any combination at once, but it is recommended to avoid this.

Table 1. Absolute Maximum Ratings

Parameter	Min	Max	Unit
Supply voltage	12 (POE) 5 (USB)	48 (POE) 5.1 (USB)	V
Voltage on any digital pin	-0.3	3.3V	V
Input RF Level	-	10 both RF interfaces	dBm
Storage temperature range	-40	125	°C

Table 2. Recommended Operating Conditions

Parameter	Min	Max	Unit
Operating ambient temperature range	-40	85	°C
Operating supply voltage	3	16 (PS+EXT) 5.1 (USB)	V

5.7. Mechanical information
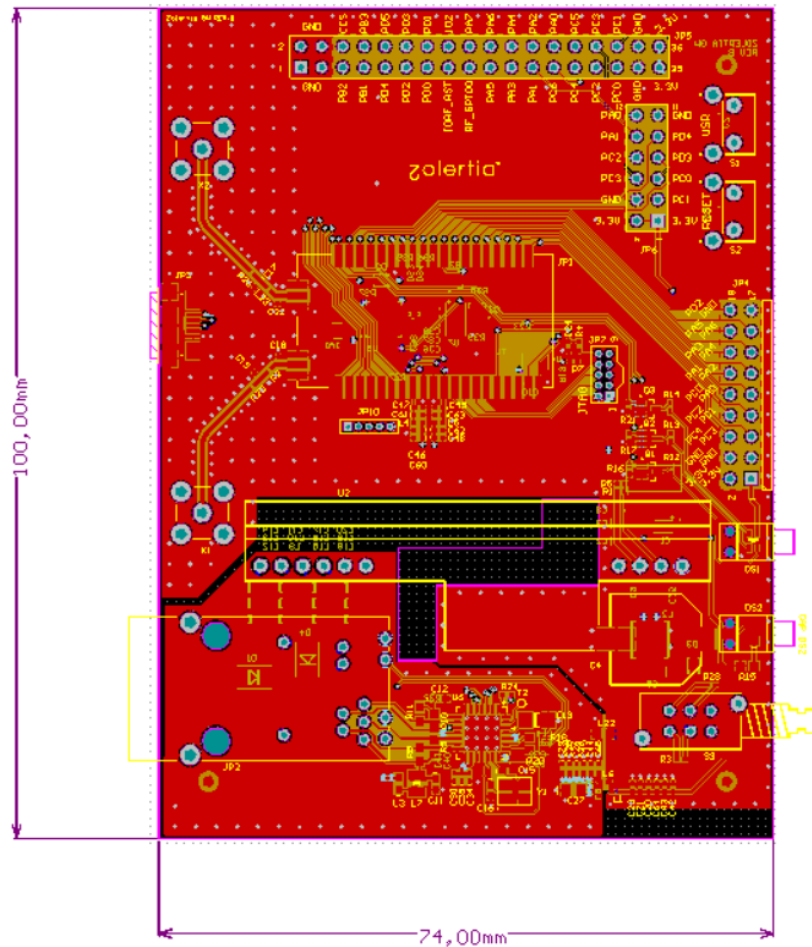
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