6LoWPAN Development Platform

Saker

Manual

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1. General information

The manual belongs to the WEPTECH Saker Gateway and contains texts and pictures on the correct handling of the product. In this section, we give you an overview of general information about the product and the manual.

1.1 Copyright protection

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1.2 Warranty information

Great care was taken in preparing this manual. No guarantee is given for the correctness of the contents of this manual since errors, inspite of all efforts, can never be completely avoided.

1.3 Declaration of conformity

This product is marked with "CE" and complies therefore with the applicable harmonized European standards. Therewith, compliance with all the provisions of this directive of electromagnetic compatibility is ensured.

The judgement of the product as to electromagnetic compatibility was effected on the basis of the following standards: EN13757-4:2013 as well as the R&TTE-directive 1999/5/EG (RDE 2014).

1.4 Disclaimer

The author reserves the right to not be responsible for the topicality, correctness, completeness, or quality of the information provided. Liability claims regarding damage caused by the use of any information provided, including any kind of information which is incomplete or incorrect, will therefore be rejected. Parts of the pages or the complete publication including all offers and information may be extended, changed or partly or completely deleted by the author without separate announcement.

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1.5 Operating limitations

WEPTECH elektronik products are not authorized for use in life support appliances, devices or other systems where malfunction can reasonably be expected to result in significant personal injury to the user, or as a critical component in any life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness. WEPTECH elektronik GmbH customers, using or selling these products for use in such applications, do so at their own risk and agree to fully indemnify WEPTECH elektronik GmbH for any damages resulting from any improper use or sale. Use of WEPTECH elektronik GmbH products commits the user to the terms and conditions set out herein.

2. Software

Find the complete source code and an extensive Readme on the software example in Weptech's fork of the Contiki operating system at

https://github.com/Weptech-elektronik/contiki

The Saker is supported as a platform under /platform/saker. The Readme can be found in /platform/saker/README.md.

3. Board overview

The hardware is built upon the following base components:

- A Texas Instruments CC2538 Cortex®- M3 Microcontroller (1) with 512KB Flash + 32KB RAM. The integrated 2.4GHz low power radio is connected to an Inverted F-Antenna (2) (optional U.FL connector (assembly variant)).
- A Texas Instruments Sub-Ghz Transceiver CC1200 (3) connected to a Monopole PCB Antenna (4) (optional U.FL connector (assembly variant)). The CC1200 is controlled by the CC2538 via SPI.
- A Microchip ENC28J60 10BASE-T Ethernet Controller (5) connected to a RJ45 modular jack. The ENC28J60 is controlled by the CC2538 via SPI (not shared with CC1200).
- A Microchip 24AA02E48 EEPROM providing a (read-only) EUI-48 ("MAC address") for the Ethernet Interface. In addition, this EEPROM provides 128Byte of writeable memory which can be used e.g. for configuration purposes. The EEPROM is controlled by the CC2538 via I2C.
- A FTDI FT234XD USB-to-UART converter (7) providing a virtual COM port to the host system
- Two buttons
- Three LEDs

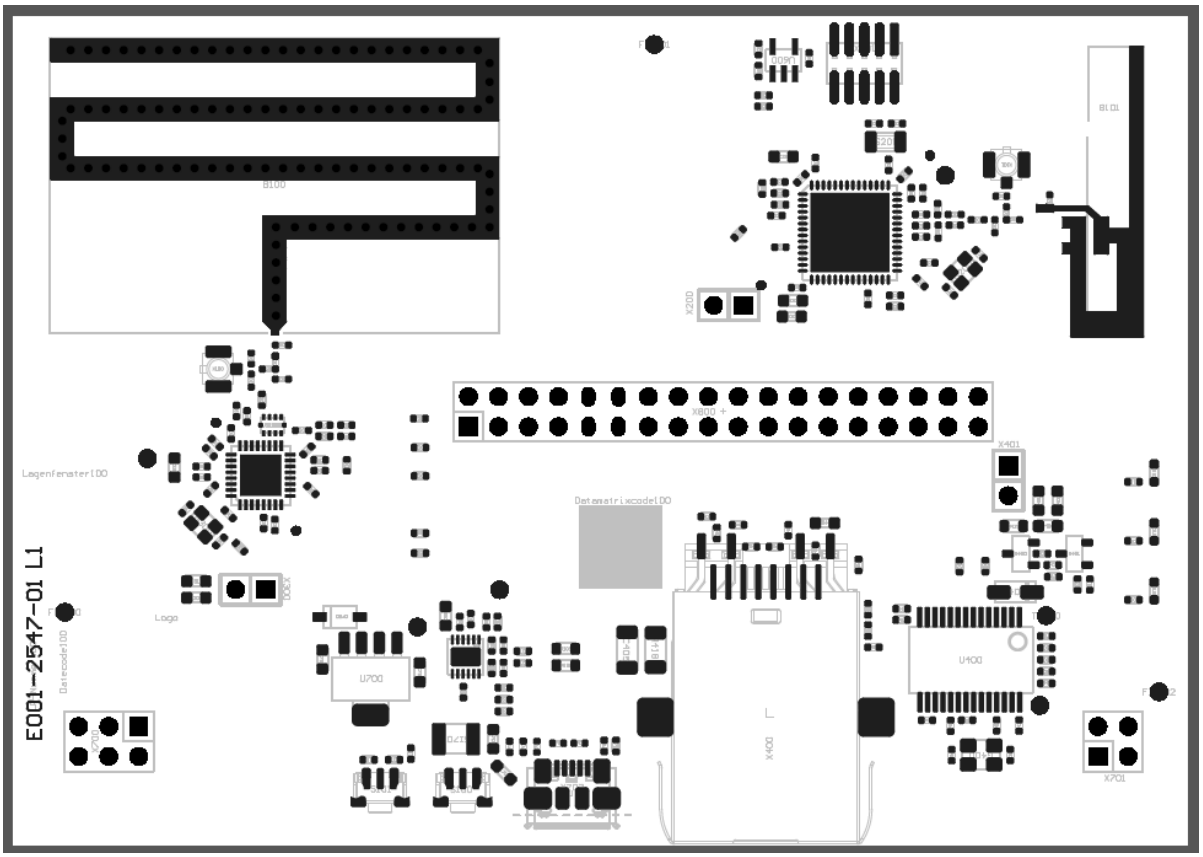

Figure 1 Board Overview

4. Power Supply

The board is powered using 5V via Micro-USB connector. In the default configuration, this jack is also connected to the FTDI USB-to-UART IC.

The maximum current drawn by the board is approximately 220mA at the following conditions:

- CC2538 running at full speed (32MHz)
- Ethernet actively transmitting data
- CC1200 in TX

5. CC2538

5.1 USB Interface

The internal USB interface of the CC2538 is not used. It can be connected to the USB Micro jack if needed by placing to 0R resistors (R101 and R103, SMD 0603) and removing R100 and R102 (SMD 0402). By the removing the latter two resistors, the FTDI FT234XD is separated from the USB bus and can't be used any more.

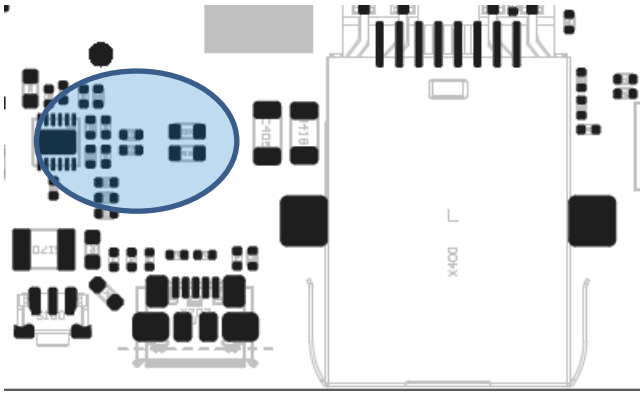

Figure 2 USB selection using two pairs of resistors

5.2 Current measurements

The supply voltage of the CC2538 is provided by means of a solder jumper. By cutting this solder jumper (located on the bottom side of the PCB), the pin header X200 (not assembled) can be used to monitor the current drawn by the CC2538.

5.3 Programming

Programming of the CC2538 can take place either by

- Using the CC2538 bootloader or
- the JTAG interface.

5.3.1 CC2538 Bootloader via USB

Thanks to the FTDI USB-to-UART chip connected to UART0 RX (PA0) and UART0 TX (PA1), a firmware update can take place via USB. If configured accordingly, pressing BTN1 during a system reset will start execution of the bootloader.

BTN1 is connected to PA5 using an external pull-up resistor and pulls PA5 low once pressed. Therefore, the bootloader backdoor configuration (found at address 0x0027FFD7) has to be set as following:

- Bit 4 (Enable): 1 (Enable backdoor function)
- Bit 3 (Level): 0 (Active low level for selected pin)
- Bits 0–2 (Pin Number): 5

5.3.2 JTAG Interface

A 10-pin fine pitch (0.05”) pin header (X201) provides JTAG access to the CC2538. Pin 1 is marked with a triangle (top layer).

Pin	Signal name	Description
1	3V3_CC2538	Voltage supply (Sense)
2	JTAG_TMS	Test Mode Select
3	GND	Ground
4	JTAG_TCK	Test Clock
5	GND	Ground
6	JTAG_TDO	Test Data Out
7	-	
8	JTAG_TDI	Test Data In
9	GND	Ground detect
10	RESET#	System Reset

Table 1 CC2538 X201 JTAG pin out

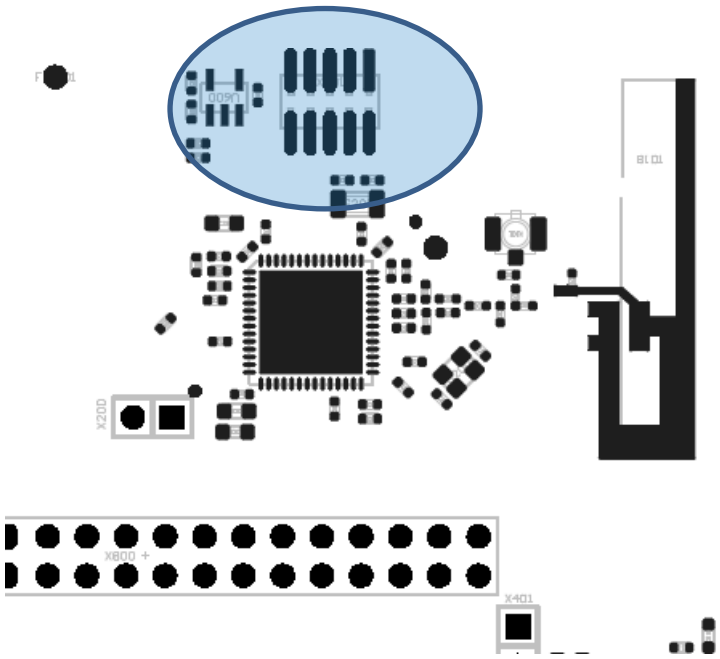

Figure 3 Position of JTAG Connector

CC2538	Direction	Connected via	Peripheral	Comment	Serial Interface	Availabl e
PA0	I	Solder jumper NC	FT234XD TXD	Boot loader UART0 Rx	UART0	
PA1	O	Solder jumper NC	FT234XD TXD	Boot loader UART0 Tx	UART0	
PA2	-	0R not fitted	FT234XD RTS#			X
PA3	-	0R not fitted	FT234XD CTS#			X
PA4	-	0R not fitted	FT234XD CBUS0			X
PA5	I		BTN1	Boot loader backdoor		
PA6	I	10k	CFG_1 (Solder jumper NO)	Configuration purposes		X
PA7	I	10k	CFG_2 (Solder jumper NO)	Configuration purposes		X
PB0	O	Solder jumper NC	CC1200 SCLK		SSI0	
PB1	O	Solder jumper NC	CC1200 CS#			
PB2	I	Solder jumper NC	CC1200 MISO	10k pull down	SSI0	

PB3	I	Solder jumper NC	CC1200 GPIO0			
PB4	O	Solder jumper NC	I2C-EEPROM SCL	2k2 pull up	I2C	
PB5	I/O	Solder jumper NC	I2C-EEPROM SDA	2k2 pull up	I2C	
PB6			X201	JTAG TDI		(X)[1]
PB7			X201	JTAG TDO		(X)[1]
PC0	O	Via 1k5 to USB_P		USB pull up		(X)[2]
PC1	O	330R	LED RED			
PC2	O	330R	LED YELLOW			
PC3	O	330R	LED GREEN			
PC4	O	0R	CC1200 RESET#			(X)[3]
PC5	I	0R not fitted	CC1200 GPIO3			X
PC6	I	Solder jumper NC	CC1200 GPIO2			
PC7	O	Solder jumper NC	CC1200 MOSI		SSI0	
PD0	O	Solder jumper NC	ENC28J60 CS#			
PD1	O	Solder jumper NC	ENC28J60 SCLK		SSI1	
PD2	I	Solder jumper NC	ENC28J60 MISO	10k pull down	SSI1	
PD3	O	Solder jumper NC	ENC28J60 MOSI		SSI1	
PD4	I	0R	ENC28J60 INT#			(X)
PD5	O		ETH ENABLE	ENC28J60 enable via FETs		

Table 2 CC2538 peripheral connections

[1]After programming [2]If internal USB is not used [3]Reset line optional

"Solder Jumper NC" is depicted below. In contrast to the image below "NC" means "normally closed", that means the two copper pads are initially connected and have to be separated e.g. using a cutter knife or scalpel. Afterwards, they can be closed again using a drop of solder.

Figure 4 Solder Jumper NO ("normally open")

6. CC1200

The CC1200 is connected to CC2538 using the following pins:

CC2538 Pin	Signal name	Description	Comment
PB1	CC1200 CS#		Solder jumper NC + pull up (not fitted)
PB0	CC1200 SCLK		Solder jumper NC + pull down (not fitted)
PB2	CC1200 MISO		Solder jumper NC + 100k pull down
PC7	CC1200 MOSI		Solder jumper NC + pull down (not fitted)
PB3	CC1200 GPIO0		Solder jumper NC
PC6	CC1200 GPIO2		Solder jumper NC
PC5	CC1200 GPIO3		Not connected (series resistor, not fitted)
PC4	CC1200 RESET#		0R series resistor + pull up (not fitted)

Table 3 CC2538/CC1200 connections

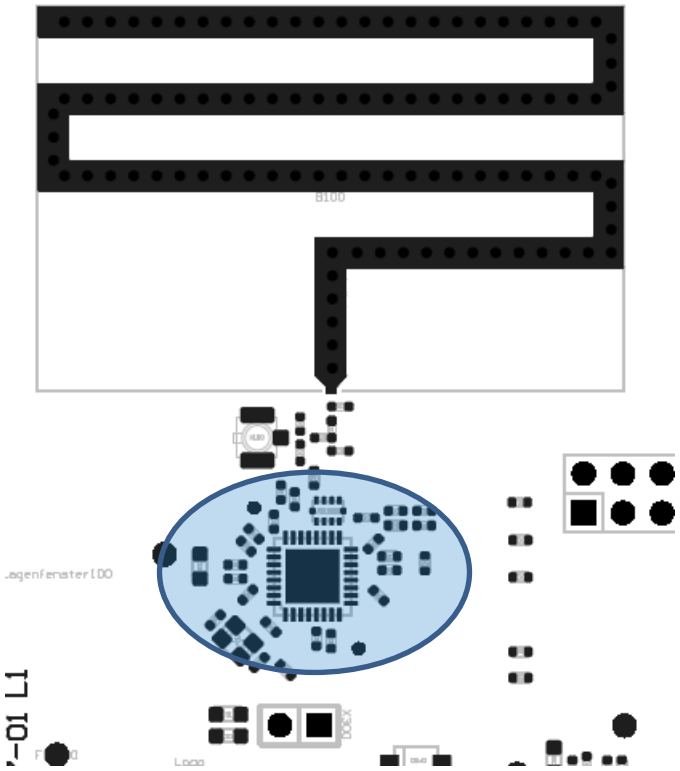

Figure 5 Position of CC1200

6.1 Current measurements

The supply voltage of the CC1200 is provided by means of a solder jumper. By cutting this solder jumper (located on the bottom side of the PCB), the pin header X300 (not assembled) can be used to monitor the current drawn by the CC1200.

7. ENC28J60 Ethernet Controller

CC2538 Pin	Signal name	Description	Comment
PD0	ENC28J60 CS#		Solder jumper NC + 100k pull up
PD1	ENC28J60 SCLK		Solder jumper NC + pull down (not fitted)
PD2	ENC28J60 MISO		Solder jumper NC + 100k pull down
PD3	ENC28J60 MOSI		Solder jumper NC + pull down (not fitted)
PD4	ENC28J60 INT#		0R series resistor
PD5	ETH_ENABLE		Connected to MOSFET circuit

Table 4 CC2538/ENC28J60 connections

7.1 Power-Up

A separate (MOSFET) switch is used to turn on / off the voltage supply for the ENC28J60. Unless the corresponding pin (PD5) is not asserted, nearly no current is drawn by the Ethernet Controller. This

solution was chosen in order to improve compliance with the USB specification and avoid currents above 100mA drawn from the USB port before enumeration has completed.

7.2 Current measurements

The supply voltage of the ENC28J60 is provided by means of a solder jumper. By cutting this solder jumper (located on the bottom side of the PCB), the pin header X401 (not assembled) can be used to monitor the current drawn by the ENC28J60.

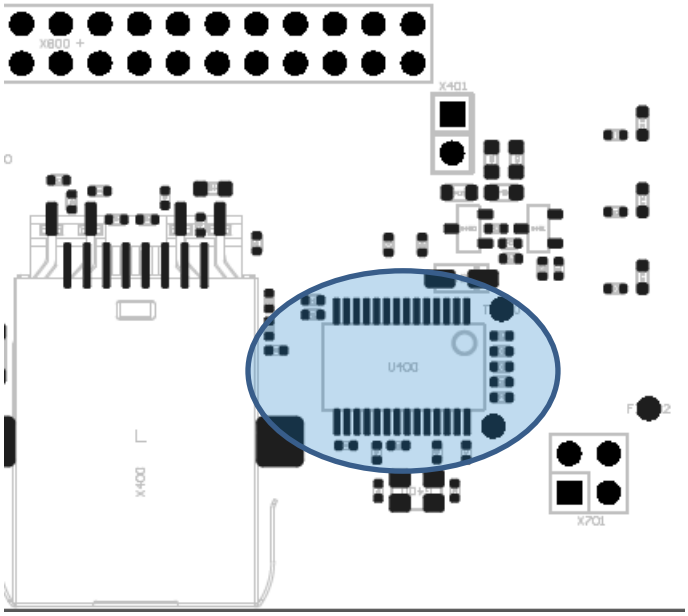

Figure 6 Position of ENC28J60

8. I2C EEPROM

An I2C-EEPROM (Microchip 24AA02E48) provides a EUI-48 identifier which can be used as a MAC-address for the Ethernet Interface. The EEPROM is controlled by the CC2538 via I2C.

Pull up resistors on SDA and SCL are provided allowing a maximum speed of 400kbps.

CC2538 Pin	Signal name	Description	Comment
PB4	I2C SCL		Solder jumper NC, 2k2 pull up
PB5	I2C SDA		Solder jumper NC, 2k2 pull up

Table 5 CC2538/I2C EEPROM connections

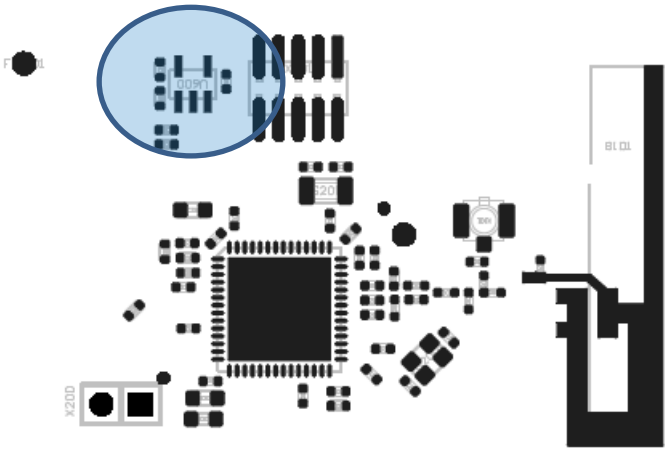

Figure 7 Position of I2C-EEPROM

9. FTDI FT234XD USB-to-Serial converter

The USB-to-Serial converter is connected to the CC2538 using the following pins:

CC2538 Pin	Signal name	Description	Comment
PA0	FT234XD TXD		Solder jumper NC
PA1	FT234XD TXD		Solder jumper NC
PA2	FT234XD RTS#		Not connected (series resistor, not fitted)
PA3	FT234XD CTS#		Not connected (series resistor, not fitted)
PA4	FT234XD CBUS0		Not connected (series resistor, not fitted)

Table 6 CC2538/FT234XD connections

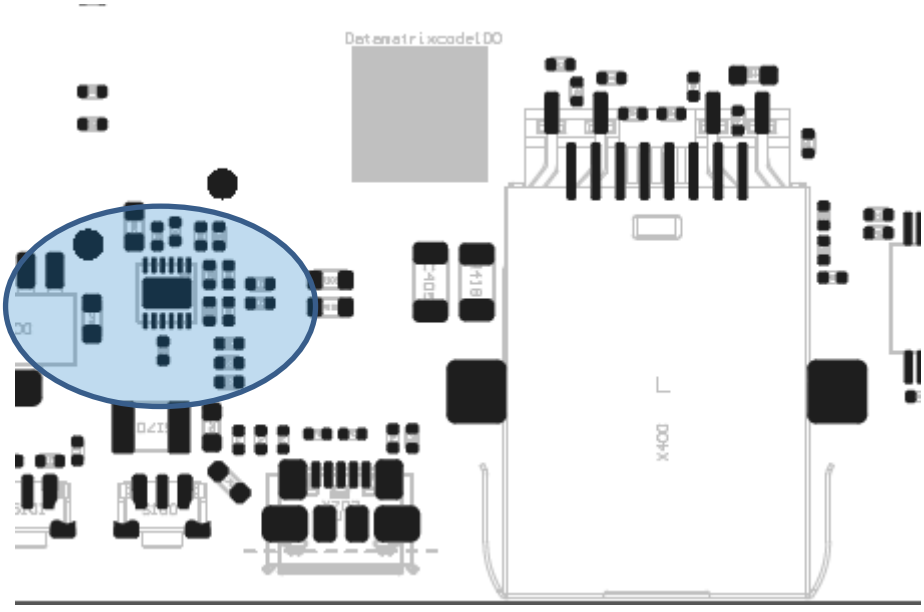

Figure 8 Position of FT234XD

10.Buttons

The board provides two buttons connected to the CC2538:

- Reset (S100)
- BTN1 (S101), connected to PA5

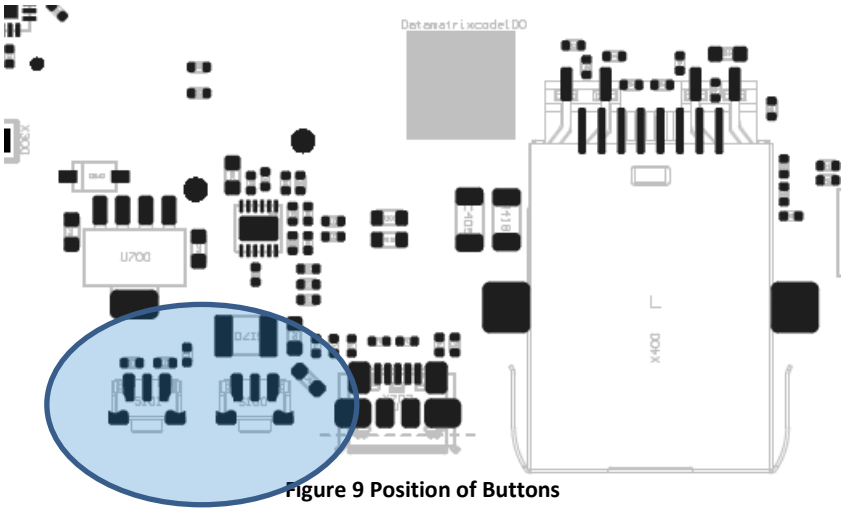

Figure 9 Position of Buttons

10.1 Reset Button (S100)

The reset button is connected to the CC2538 nRESET pin using a 2k2 series resistor and a 1µF capacitor. Once pressed, it forces a low level on the nRESET pin, this will lead to a system reset.

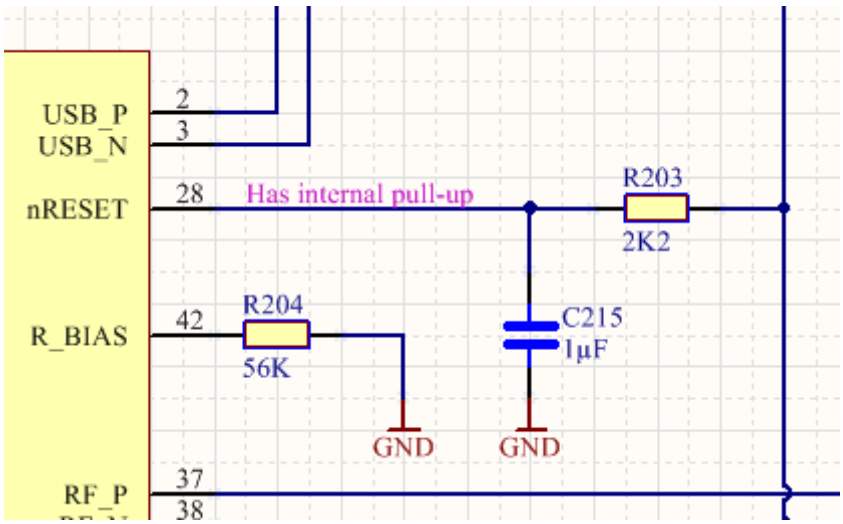

Figure 10 CC2538 Reset Circuit

10.2 General Purpose Button BTN1 (S101)

This button can be used as a general purpose button. It is connected to the CC2538 via PA5 and provides an external pull up resistor. In addition, a debouncing circuit is added.

Once pressed, the button generates an active low level on the CC2538's pin.

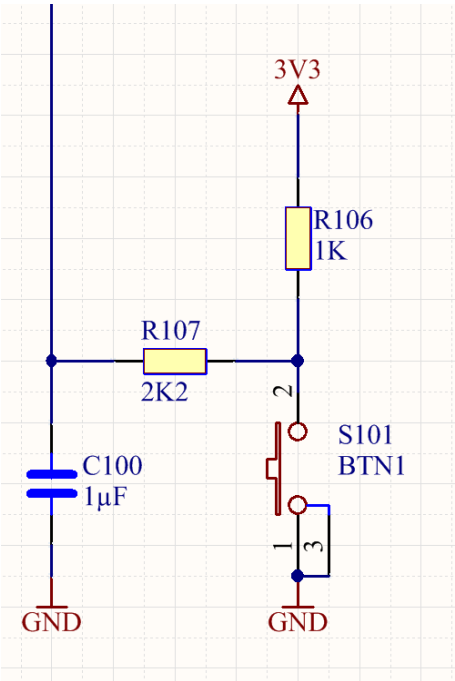

Figure 11 General Purpose Button.

BNT1 can be used to execute the bootloader backdoor if configured accordingly (see 5.3.1).

11. LEDs

Three LEDs are provided for signaling purposes:

- A red LED (D100) connected to the CC2538 using PC1
- A yellow LED (D101) connected to the CC2538 using PC2
- A green LED (D102) connected to the CC2538 using PC3

As the LEDs cathode is directed towards the CC2538, the LEDs are turned on by setting the appropriate pin to a high level.

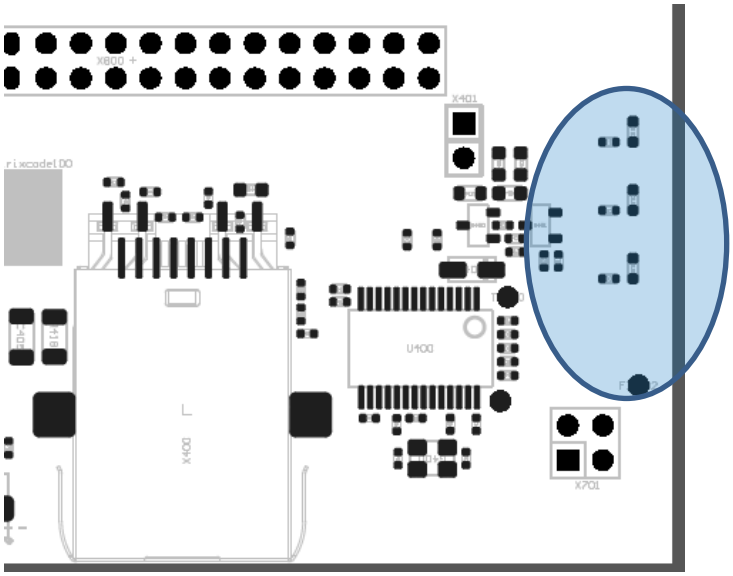

Figure 12 Position of LEDs

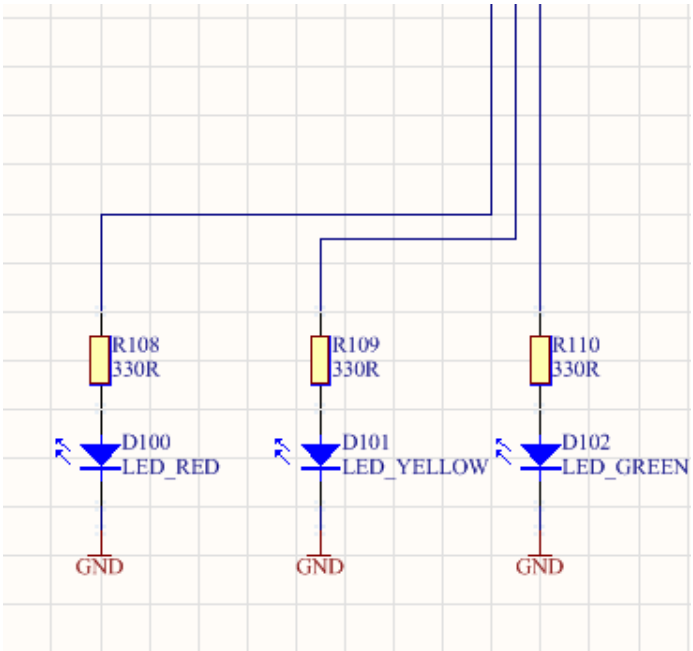

Figure 13 LEDs

12. References

(1) Texas Instruments CC2538 Data Sheet

(2) Texas Instruments Design Note DN007

(3) Texas Instruments CC1200 Data Sheet

(4) Texas Instruments Design Note DN024

(5) Microchip ENC28J60 Data Sheet

(6) Microchip 24AA02E48 Data Sheet

(7) FTDI FT234XD Data Sheet

WEPTECH elektronik GmbH

Ostring 10

D-76829 Landau

http://www.weptech.de

info@weptech.de

Tel: +49 6341 9255-0

Fax: +49 6341 9255-100

Note:

The information, instructions and descriptions in this manual refer to the actual operating and service conditions herein.

For technical questions, safety notes or technical failure, please contact WEPTECH elektronik GmbH.

We reserve the right to technical modifications.