Title:	**EMEDVK9X0X USER MANUAL**
Product Family:	**EM9x0x**
Part Number:	
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DOCUMENT HISTORY

Release	Author	Date	Description
1.0	EM	January 22, 2014	Initial release
1.1	EM	May 09, 2014	Add Raisonance tools

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1 PRESENTATION

The EMEDVK9x0x Evaluation and Development Kit is a versatile tool to assess performance and prototype user applications using the EM9101, EM9201, EM9203, EM9209, and EM9301 transceivers in an easy-to-configure and easy-to-use environment.
The kit consists of the main EMEDVK9x0X board, a target board featuring ST Microelectronics STM32L152 microcontroller with Low Power Cortex-M3 core, and an EM RF transceiver module.
The kit can be used either linked to a PC for evaluation of the 2.4GHz devices using STM32 Integrated Development Environment or with a stand-alone application running on the powerful on-board microcontroller. STM32 development is supported by user friendly Integrated Development Environment (IDE) e.g: Keil MDK or Ride7 for ARM GCC available separately..
A set of demonstration applications and transceiver device dedicated Graphical User Interface are available to asses each of EM Microelectronic's 2.4GHz devices.

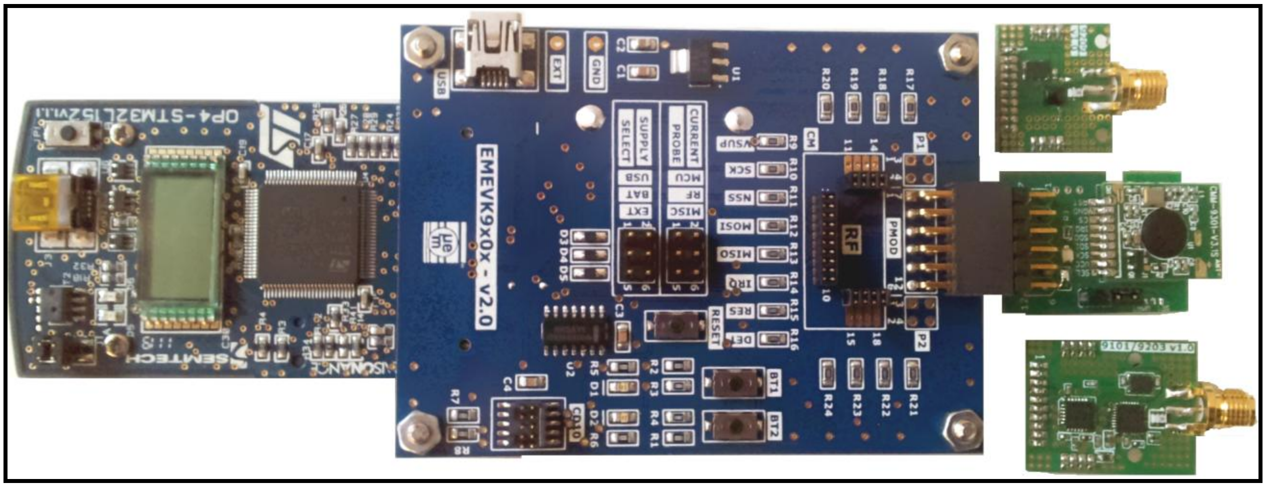


Figure 1: Overall view of the EMEDVK9x0x Kit

The EMEDVK9x0x Kit is based on

- The Central Board EMEDVK9x0xCB
- The Cortex-M3 board EMEDVK9x0xCM3
- One RF Module board EMRF9x0x

The EMEDVK9x0xCB is the Central Board of the EMEDVK9x0x Evaluation and Development Kit. It provides the RF Modules plug-in area, a Cortex-M3 Board plug-in area, buttons and LEDs in addition to numerous test and access points to perform any type of voltage and current measurement. The EMEDVK9x0xCB key's features include:

- Several power sources
- Connector for Cortex M3 board and RF Module board
- Connector for SWD debugger
- On boards LEDs, buttons and test points

The EMEDVK9x0xCM3 microcontroller Board contains the microcontroller, a STM32L152 Low Power Cortex M3 from ST Microelectronics.
The different EM RF modules board can be plugged on the EMEDVK9x0xCB Central board using dedicated 3 row connectors or standard PMOD connector. Each module contains all hardware necessary for RF operation of with their respective devices. Each includes a PCB or

ceramic antenna or SMA connector for RF measurement. Each layout can be used as a reference design for one of the EM 2.4GHz products.

Part number	Description
Complete Evaluation/Development kit	
EMEDVK9201	Complete Evaluation/Development kit for EM9201
EMEDVK9203	Complete Evaluation/Development kit for EM9203
EMEDVK9301	Complete Evaluation/Development kit for EM9301
EMEDVK9209	Complete Evaluation/Development kit for EM9209
EMEDVK9101	Complete Evaluation/Development kit for EM9101
Evaluation/Development kit Central board	
EMEDVK9x0xCB	EMEDVK9x0x Central board
Evaluation/Development kit Microcontroller board	
EMEDVK9x0xCM3	EMEDVK9x0x Cortex M3 Microcontroller board
Evaluation/Development kit RF EM9201 module	
EMRF9201SMA	RF EM9201 Module – SMA connector
EMRF9201SA	RF EM9201 Module – stripped antenna
EMRF9201CA	RF EM9201 Module – chip antenna
Evaluation/Development kit RF EM9203 module	
EMRF9203SMA	RF EM9203 Module – SMA connector
EMRF9203SA	RF EM9203 Module – stripped antenna
EMRF9203CA	RF EM9203 Module – chip antenna
Evaluation/Development kit RF EM9301 module (BLE)	
EMRF9301SMA	RF EM9301 Module – SMA connector
EMRF9301SA	RF EM9301 Module – stripped antenna
EMRF9301CA	RF EM9301 Module – chip antenna
Evaluation/Development kit RF EM9209 module (LORA)	
EMRF9209SMA	RF EM9209 Module – SMA connector
EMRF9209SA	RF EM9209 Module – stripped antenna
EMRF9209CA	RF EM9209 Module – chip antenna
Evaluation/Development kit RF EM9101 module (ZOE)	
EMRF9101SMA	RF EM9101 Module – SMA connector
EMRF9101SA	RF EM9101 Module – stripped antenna
EMRF9101CA	RF EM9101 Module – chip antenna

Table 1: EMEDVK9x0x part number

Contact EM Microelectronic to check tools development availability and ordering part numbers. This table is subject to changes.

2 SETUP

2.1 Board connections

The EMEDVK9x0xCM3 board is plugged into the EMEDVK9x0xCB Central Board (CTB connector on the bottom side of the EMEDVK9x0xCB main board) as shown in the **Error! Reference source not found.**.
The RF Module EMRF9x0x is plugged into the EMEDVK9x0xCB Central board (PMOD connector or CM connector on the top side of the of the EMEDVK9x0xCB Central board) as shown in the Figure 3 and **Error! Reference source not found.**.

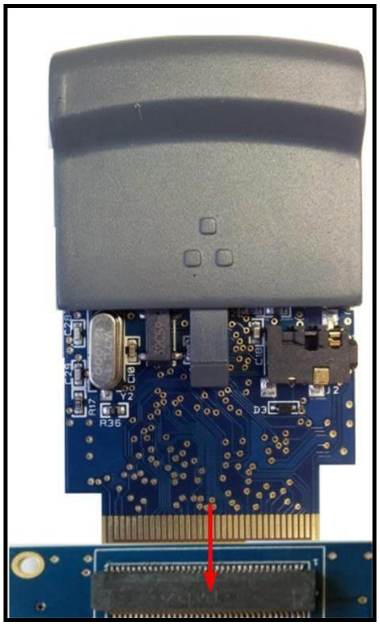


Figure 2: EMEDVK9x0xCM3 connection

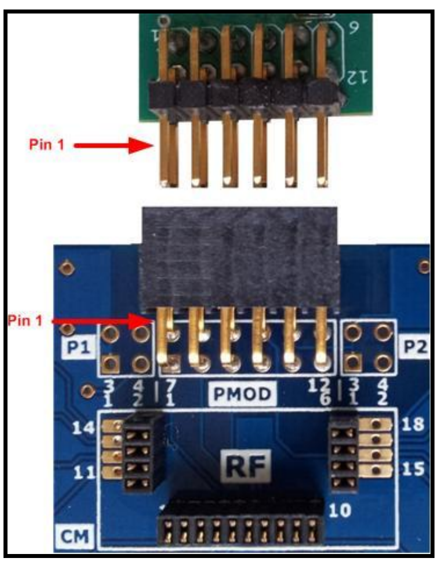


Figure 3 : EMEDVK9x0xRF - PMOD connection

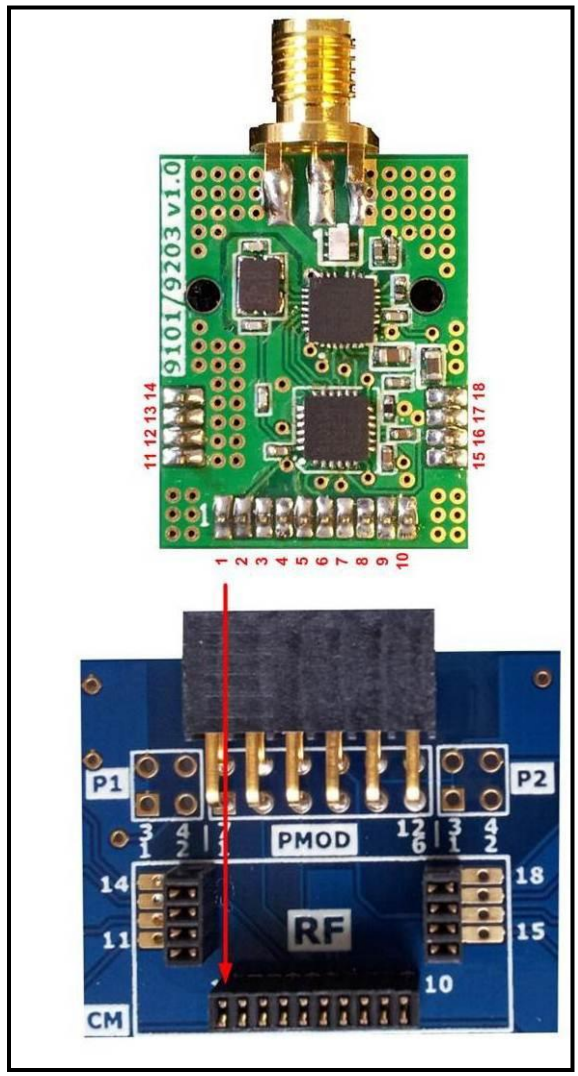


Figure 4: EMEDVK9x0xRF – CM connection

3 Block Diagram

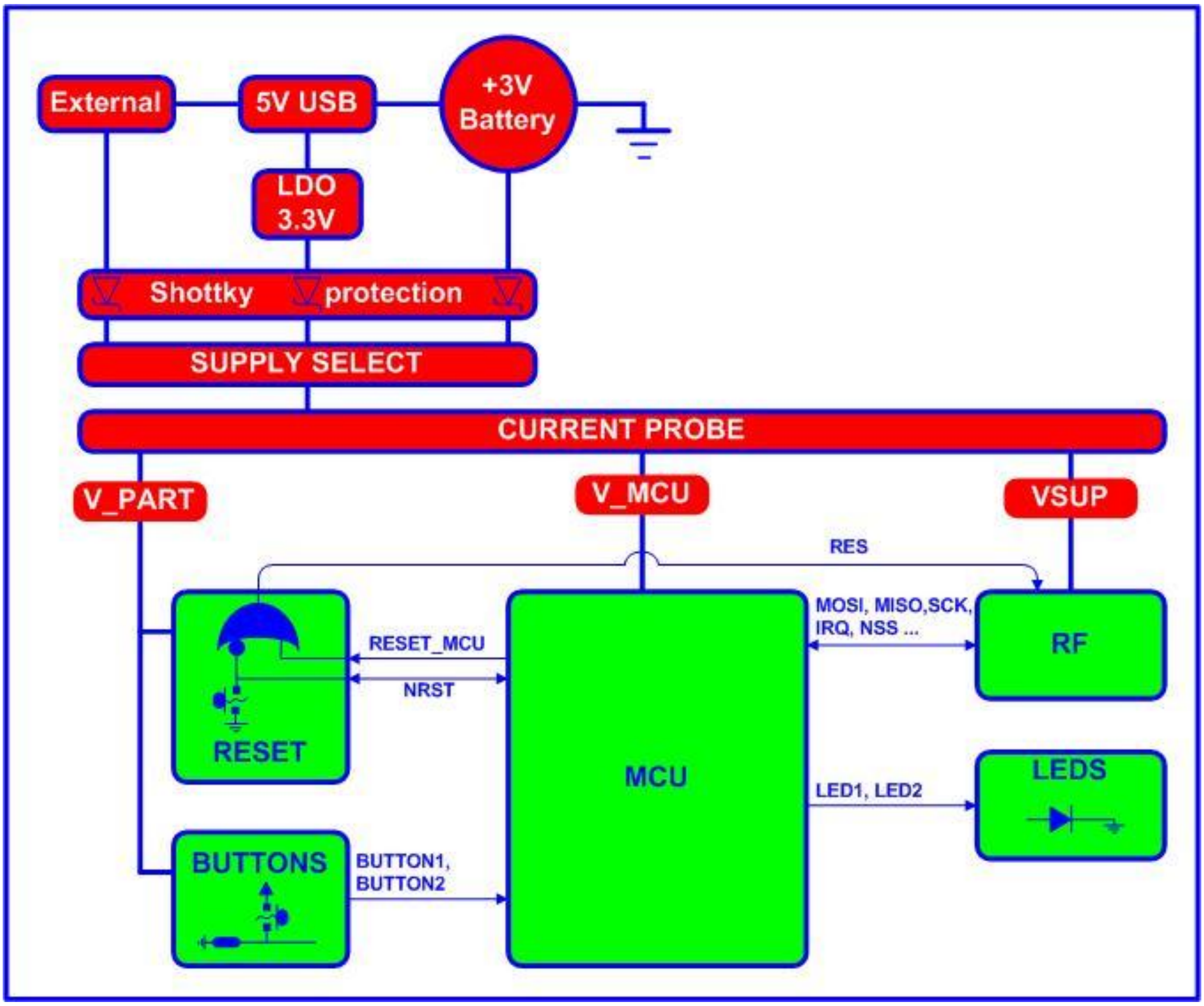


Figure 5: EMEDVK9x0x

3.1 Supply and current probing

The entire kit is powered from the Central board from any one of the 3 sources:

1. USB (USB port available on the Central board is used for power suuply only – no communication)
2. CR2032 coin cell (on the bottom of the board)
3. External power supply (EXT and GND pins)

Several possibilities are offered for current measurement. Independently, the EMRF9x0x, EMEDVK9x0xCM3 board, and complete system current can be measured.

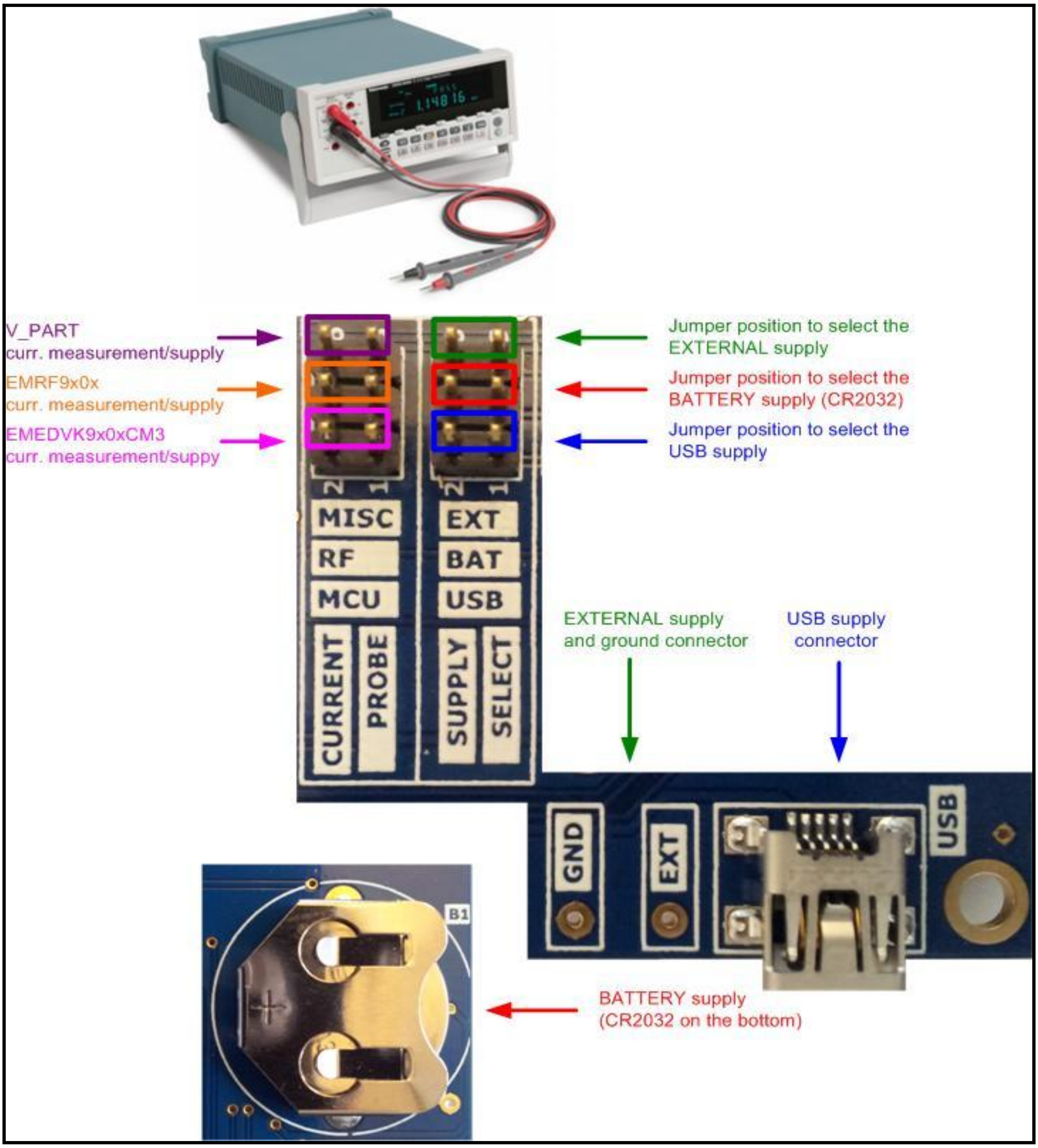


Figure 6: Supply select and current probe jumpers overview

The USB port used to supply power is the port labelled “USB” and located on the EMEDVK9x0xCB Central Board, as shown in Figure 7.
To use USB supply:

- Place a jumper in position 1-2 of the jumper area labelled “Supply select” and removes the jumpers in positions 3-4 and 5-6.
- Connect a mini-USB cable from the “USB” to a PC or +5V USB supply source.

The EMEDVK9x0xCB Central Board features a linear regulator LDO to generate +3.3V.
A CR2032 battery can also be used to supply the system. The battery holder is located on the bottom of the EMEDVK9x0xCB Central Board and labelled “B1” as shown in Figure 7. To use the battery supply:

- Place jumpers in position 3-4 of the jumper area labelled “Supply select” and remove the jumper in positions 1-2 and 5-6.
- Insert a coin cell +3V CR2032 in the battery holder (with the marked face “+” uppermost)

The system can also be powered using an external power supply connected to the pins labelled “GND” and “EXT” on the EMEDVK9x0xCB Central Board, as shown in Figure 7. To use external supply:

- Place jumpers in position 5-6 of the jumper area labelled “Supply select” and remove the jumper in positions 1-2 and 3-4.
- Connect “GND” to your power supply ground and “EXT” to your “+” output power supply.(3.3V is the recommended voltage).

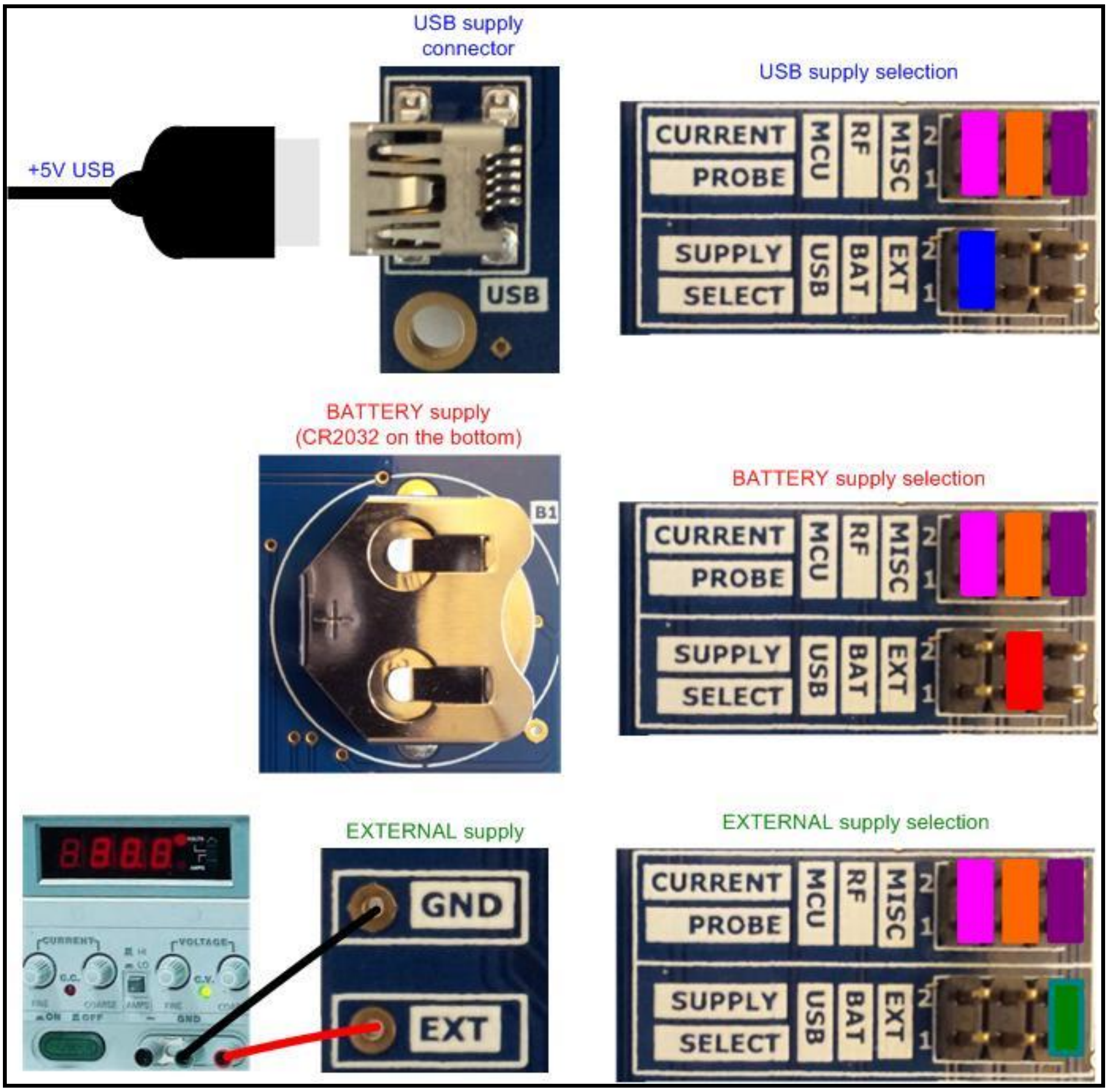


Figure 7: Supply select

The jumpers section "Current Probe" allows current measurement.
Total current consumption can be probed on the "Supply Select" jumper according to the selected power supply.
The current probes shall be connected in place of "Supply Select" jumper position:

- 1-2 in case of USB supply as shown in Figure 8 – (A).
- 3-4 in case of Battery supply.
- 5-6 in case of External supply.

The EMEDVK9x0xCM3 current consumption can be probed in the labelled microcontroller "Current Probe" area in place of the jumper position 1-2 as shown in Figure 8 – (B).
The EMRF9x0x current consumption can be probed in the labelled RF "Current Probe" area in place of the jumper position 3-4 as shown in Figure 8 – (C).
The remaining current consumption can be probed in the labelled MISC "Current Probe" area in place of the jumper position 5-6 as shown in Figure 8 – (D).

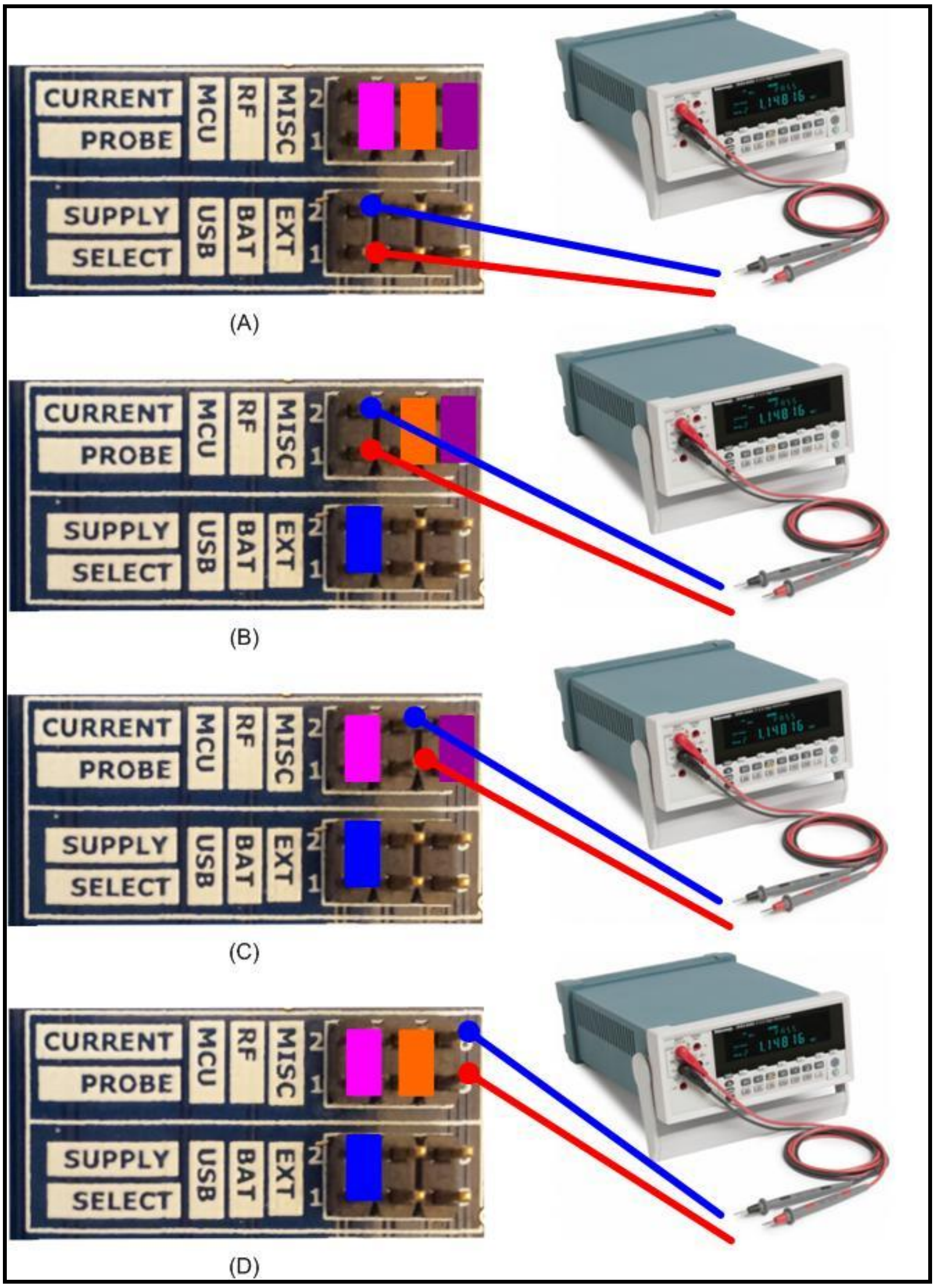


Figure 8: Current probing

4 Features of the EMEDVK9x0xCB board

4.1 CB to CM3 interface

The EMEDVK9x0xCM3 board is connected to EMEDVK9x0xCB Central board thanks to the connector labelled “CTB” located on the bottom of the EMEDVK9x0xCB.

Bold font (PX.d): Microcontroller Cortex M3 pin name (e.g: PD.14 : Port D pin number 14)
Red Font (CM.d): CM connector pin number (e.g: CM.3 : CM connector pin number 3)
Blue Font (P1.d / P2.d): P1/P2 connector pin number (e.g: P2.2 : P2 connector pin number 2)
Green Font (PMOD.d): PMOD connector pin number (e.g: PMOD.4 : PMOD connector pin number 4)

CTB pin	Names & Connections	Description
	SWD Debug	
67	**SWDIO**	SWD data in/out – 100K pull-up
66	**SWDCLK**	SWD clock (100K pull-up)
65	**SWO**	SWD trace data out
64	**NRST**	RESET (main reset - active low)
	Supply	
70	V_MCU	Supply for EMEDVK9x0xCM3
36	VBAT	No connect (from EMEDVK9x0xCM3)
1, 35	GND	Common ground
	Buttons	
46	BUTTON1 | **PD.14**	Button 1 (input - 10K pull-down)
45	BUTTON2 | **PD.15**	Button 2 (input - 10K pull-down)
	Leds	
47	LED2 | **PD.13**	Led 2 (output – serial resistor 100 ohms)
44	LED1 | **PD.12**	Led 1 (output – serial resistor 100 ohms)
	Reset	
56	RESET_MCU | **PA.4**	Reset generated by GPIO microcontroller (output)
	RF Module	
63	CM.16 | PMOD.10 | **PB.6**	Connected by 0 ohm R23
62	CM.17 | P2.1 | **PB.7**	Connected by 0 ohm R22
61	MISO | CM.6 | PMOD.3 | **PB.14**	RF Master In Slave Out - Connected by 0 ohm R13
60	MOSI | CM.5 | PMOD.2 | **PB.15**	RF Master Out Slave In - Connected by 0 ohm R12
59	SCK | CM.3 | PMOD.4 | **PB.13**	RF Serial Clock - Connected by 0 ohm R10
58	IRQ | CM.7 | PMOD.7 | **PB.8**	RF Interrupt – Connected by 0 ohm R14
57	NSS_CS | CM.4 | PMOD.1 | **PD.0**	RF Chip Select – Connected by 0 ohm R11
55	CM.18 | P2.3 | **PA.2**	Connected by 0 ohm R21
54	CM.11 | P1.2 | **PA.3**	Connected by 0 ohm R20
53	CM.12 | P1.4 | **PA.1**	Connected by 0 ohm R19
52	CM.13 | **PD.3**	Connected by 0 ohm R18
50	DETECT | CM.9 | PMOD.9 | **PD.5**	Connected by 0 ohm R16
	Other	
56	**PA.4**	
49	**PD.6**	

Table 2: Microcontroller pins

4.2 PMOD interface for RF module

Bold font (PX.d): Microcontroller Cortex M3 pin name (e.g: PD.14 : Port D pin number 14)
Green Font (PMOD.d): PMOD connector pin number (e.g: PMOD.4 : PMOD connector pin number 4)

PMOD pin	Names & Connections	Description
1	NSS_CS | **PD.0**	RF Chip Select – Connected by 0 ohm R11
2	MOSI | **PB.15**	RF Master Out Slave In - Connected by 0 ohm R12
3	MISO | **PB.14**	RF Master In Slave Out - Connected by 0 ohm R13
4	SCK | **PB.13**	RF Serial Clock - Connected by 0 ohm R10
5	GND	Common ground
6	VSUP	RF Supply - Connected by 0 ohm R9
7	IRQ | **PB.8**	RF Interrupt – Connected by 0 ohm R14
8	RES	RF Reset - Connected by 0 ohm R15
9	DETECT | **PD.5**	RF Detect module - Connected by 0 ohm R16
10	**PB.6**	Connected by 0 ohm R23
11	GND	Common ground
12	VSUP	RF Supply - Connected by 0 ohm R9

Table 3: PMOD pins

4.3 P1 and P2 interface for RF module

Bold font (PX.d): Microcontroller Cortex M3 pin name (e.g: PD.14 : Port D pin number 14)
Blue Font (P1.d / P2.d): P1/P2 connector pin number (e.g: P2.2 : P2 connector pin number 2)

P1 pin	Names & Connections	Description
1	GND	Common ground
2	**PA.3**	Connected by 0 ohm R10
3	GND	Common ground
4	**PA.1**	Connected by 0 ohm R19

Table 4: P1 pins

P2 pin	Names & Connections	Description
1	**PB.7**	Connected by 0 ohm R22
2	GND	Common ground
3	**PA.2**	Connected by 0 ohm R21
4	GND	Common ground

Table 5: P2 pins

4.4 CM interface for RF module

Bold font (PX.d): Microcontroller Cortex M3 pin name (e.g: PD.14 : Port D pin number 14)
Red Font (CM.d): CM connector pin number (e.g: CM.3 : CM connector pin number 3)

CM pin	Names & Connections	Description
1	GND	Common ground
2	VSUP	RF Supply - Connected by 0 ohm R9
3	SCK | **PB.13**	RF Serial Clock - Connected by 0 ohm R10
4	NSS_CS | **PD.0**	RF Chip Select – Connected by 0 ohm R11
5	MOSI | **PB.15**	RF Serial Out Master In - Connected by 0 ohm R12
6	MISO | **PB.14**	RF Master In Serial Out - Connected by 0 ohm R13
7	IRQ | **PB.8**	RF Interrupt – Connected by 0 ohm R14
8	RES	RF Reset - Connected by 0 ohm R15
9	DETECT | **PD.5**	RF Detect module - Connected by 0 ohm R16
10	GND	Common ground
11	**PA.3**	Connected by 0 ohm R10
12	**PA.1**	Connected by 0 ohm R19
13	**PD.3**	Connected by 0 ohm R18
14	GND	Common ground
15	VSUP	Connected by 0 ohm R24
16	**PB.6**	Connected by 0 ohm R23
17	**PB.7**	Connected by 0 ohm R22
18	**PA.2**	Connected by 0 ohm R21

Table 6: CM pins

4.5 Buttons BT1 and BT2

Two push-buttons labelled " BT1" and "BT2" are connected to microcontroller GPIOs.
By default - BT1 (BT2) released - the Button 1 (Button 2) line is providing a weak "0" (external 10 K Pull-down). By pressing BT1 (BT2), the Button1 (Button 2) line will be connected to V_PART.

MCU pin	Names & Connections	Description
	Buttons	
PD.14	BUTTON1	Button 1 line – external 10K pull-down
PD.15	BUTTON2	Button 2 line – external 10K pull-down

Table 7: BT1, BT2 pins

Figure 9: BT1, BT2 push-buttons

4.6 Leds

Two leds LED1 and LED2 (labelled "D1" and "D2") are connected to microcontroller GPIOs.
By driving at "1", the Led 1 (Led 2) line, LED1 (LED2) will light-ON. A 100 ohm serial resistor is connected between the microcontroller GPIO and the LED1 (LED2).

MCU pin	Names & Connections	Description
PD.13	LED2	Led 2 line – serial resistor 100 ohms
PD.12	LED1	Led 1 line – serial resistor 100 ohms

Table 8: LED1, LED2 pins

Figure 10: LED1, LED2 push-buttons

4.7 Reset

The EMEDVK9x0x features a reset button.
The reset button (labelled “RESET”) generates a reset for the microcontroller and RF module.
By default (button RESET released and no other reset condition) the reset is not activated.
The microcontroller NRST line can be driven by:

- The reset button to propagate the reset into the microcontroller. By pressing the button, the NRST line is tied to “0”. By default this NRST line is pulled-up by a weak pull-up inside the Cortex microcontroller (typically 45Kohms).
- The hardware debugger when a debugger is connected to the SWD debug interface (pin 10) and hold the line at “0”.
- The microcontroller when an internal reset condition is raised (e.g: internal watchdog timeout). Refer to Cortex manual for details.

Additionally, a GPIO of the microcontroller is connected to the line called RESET_MCU. The goal is to generate a reset for the RF module from the application. The corresponding line is called RES.
A reset circuit based on logic ALVC family (NAND gates) is used to perform an OR operation between NRST and RESET_MCU. The result of this logical operation (not NRST or RESET_MCU) drives the RES line.

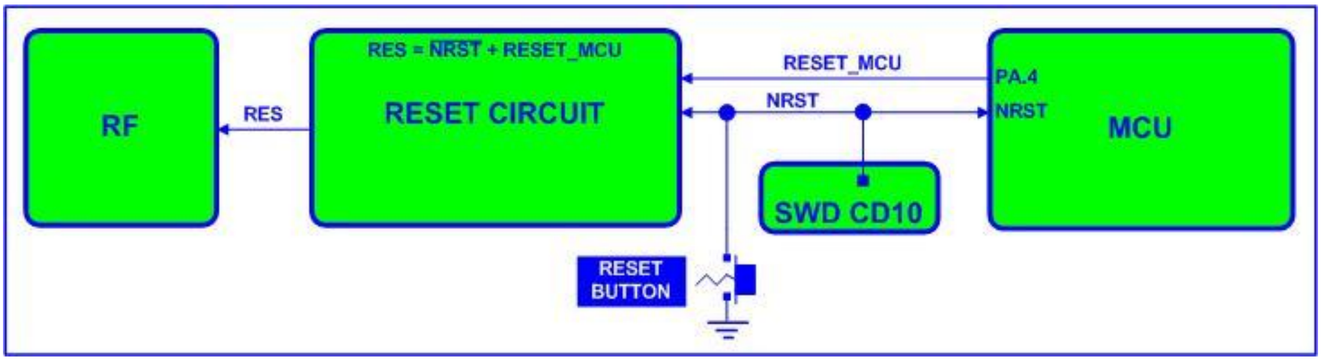


Figure 11: Reset circuit

MCU pin	Names & Connections	Description
NRST	NRST	RESET (main reset - active low)
PA.4	RESET_MCU	Reset generated by GPIO MCU (output)

Table 9: Reset pins

Figure 12: Reset push button

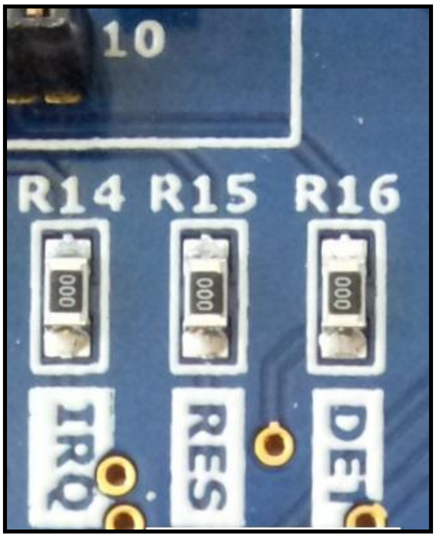


Figure 13: RF Module reset line (labelled "RES

4.8 SWD Debug Connector

The EMEDVK9x0x features a debug connector to program and debug the microcontroller firmware. A Cortex Debug 10-pin connector (0.05" – type Samtec FTSH-105-01) is used. This debug connector is labelled as "CD10". The Cortex Debug connector is supported by ULINK2, ULINKPro.

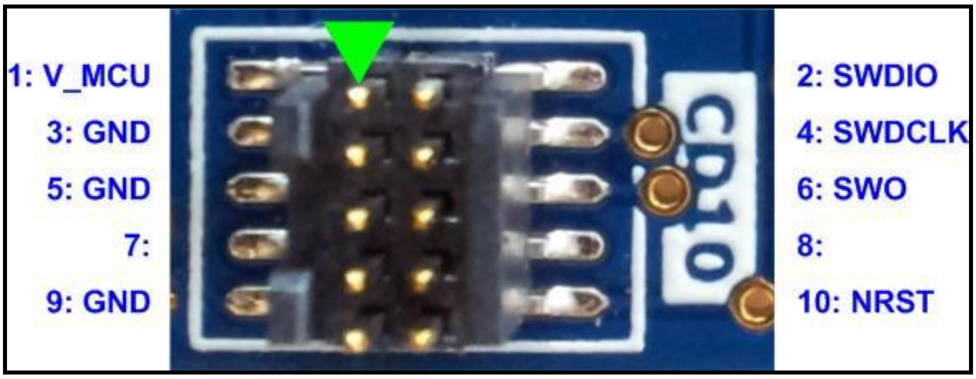


Figure 14: Debug CD10 connector

CD10 pin	Names & Connections	Description
1	**V_MCU**	Supply voltage
2	**SWDIO**	SWD data in/out – 100K pulled-up to V_MCU
3	**GND**	Common ground
4	**SWDCLK**	SWD clock (100K pulled-up to V_MCU)
5	**GND**	Common ground
6	**SWO**	SWD trace data out
7	**N.C**	
8	**N.C**	
9	**GND**	Common ground
10	**NRST**	MCU NRST line (internal pull-up)

Table 10: Debug pin connector

A 10-pin cable from (Samtec part number FFSD-05-D-12.00.01-N) is used to connect CD10 to the debugger.

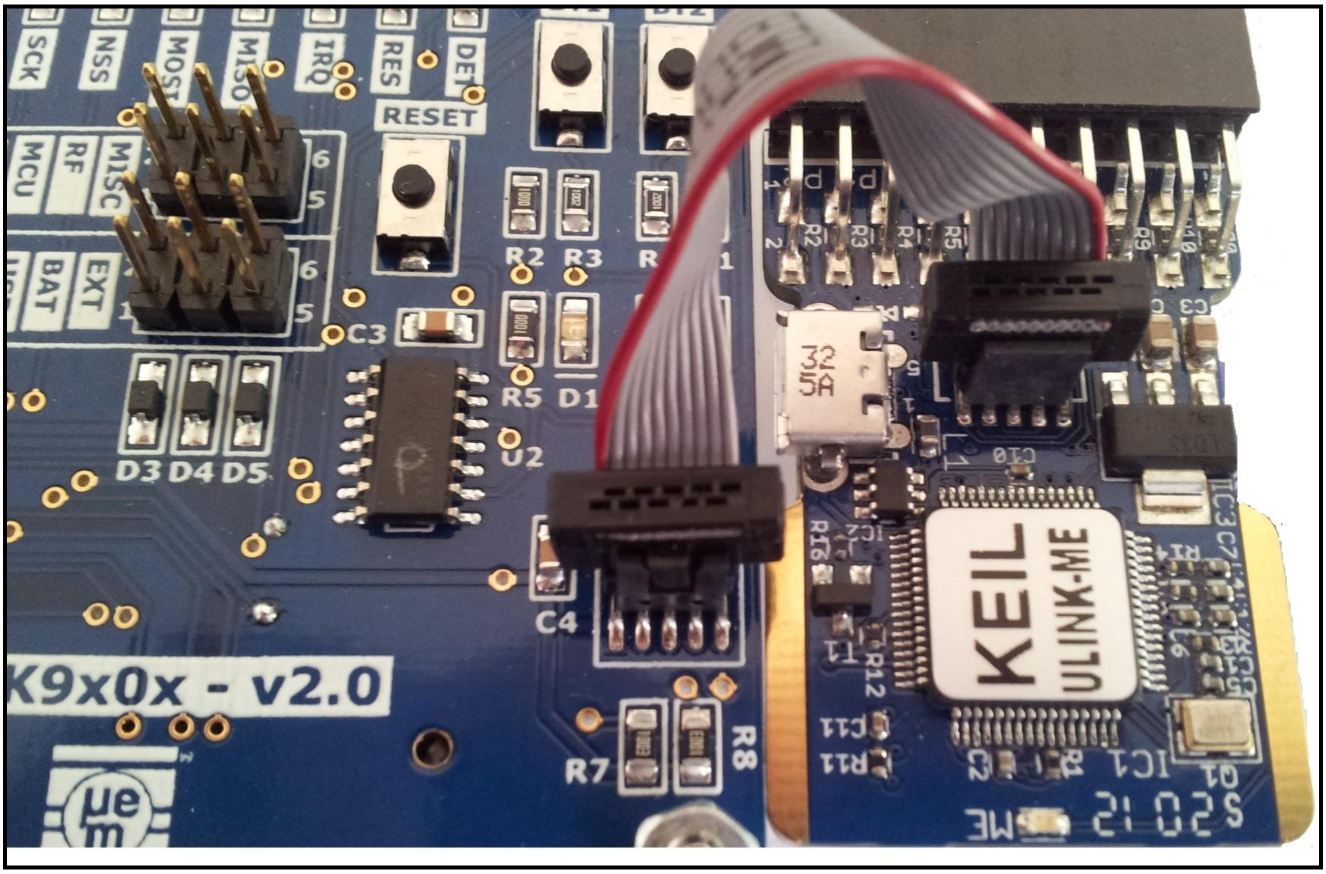


Figure 15: Debugger connection

Some 10-pin to 20-pin JTAG adapters can be used to convert from the 10-pin mini-SWD connector to the standard ARM SWD connector (20-pin). The following connection scheme must be followed:

SWD-10 pin	Name	SWD-20 pin
1	**V_MCU**	1
2	**SWDIO**	7
3,5,9	**GND**	4,6,8,10,12,14,16,18,20
4	**SWDCLK**	9
6	**SWO**	13
7,8	**N.C.**	2,3,5,11,17,19
10	**NRST**	15

Table 11: SWD-10 to SWD-20 connection table

5 Using Raisonance tools Development

The Ride7 platform supports the hardware RLink debugger and Open4 versatile tool. Both tools can be used to program and debug EMEDVK9x0x software.
Open4 (Raisonance name) and EvoPrimer (STM and distributors name) refer to the same hardware.
STD-Rlink (Raisonance name) and STX-RLink (STM and distributors name) refer to the same hardware.
Both hardware provide an adapter (JTAG-SWD v1.2) used to connect the EMEDVK9x0x SWD debug connector. Additonnally to connect this connector a 2x5 pin connector and flex cable are available in your EMEDVK9x0x box.

Part	Reference
2x5 male header (1.27mm) Female-female flex cable (10 pin/1.27mm)	Harwin M50-3500542 Embedded Artists EA-ACC-012

Table 12: Cable and Header reference

From the JTAG-SWD adapter, a male 2x5 pin1.27mm header need to be soldered as described below. By using a 10-pin flex cable (female-female), the connection to the CD10 can be established as shown on Figure 16: JTAG-SWD - header assembly and connection. Figure 17: STX RLink and JTAG-SWD and
Figure 18: Open4 with Open4-RLink-ADP and JTAG-SWD show the two complete Raisonance hardware solutions usable to program your EMEDVK9x0x.

Figure 16: JTAG-SWD - header assembly and connection

Figure 17: STX RLink and JTAG-SWD

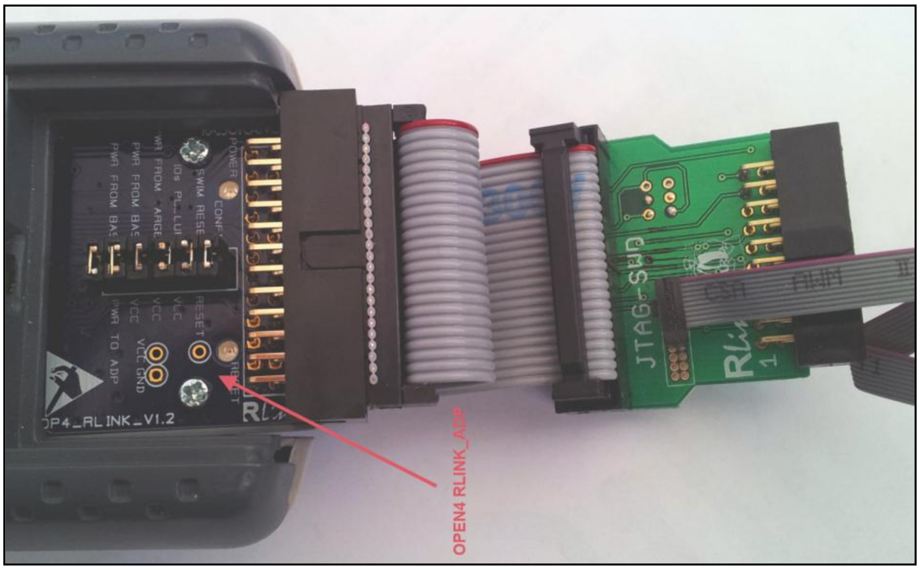


Figure 18: Open4 with Open4-RLink-ADP and JTAG-SWD

5.1 Open4_Rlink_ADP configuration for In-Situ-Programming

When using the Open4, the following jumper Open4_Rlink_ADP configuration need to be used.

Figure 19: Open4-RLink-ADP Jumper configuration

6 Software configuration for SPI module interface

The EM Microelectronic EMEDVK9x0x hardware platform is based on the Cortex-M3 STM32L152 Microcontroller. To configure the communication over SPI between the microcontroller and the EM RF device, the following SPI interface definition, interrupt and reset lines need to be linked to the STM32L152 microcontroller. The following pin assignment is needed.
SPI bus (using Cortex-M3 **SPI2** bus):

- SPI Clk = PortB.13
- SPI Miso = PortB.14
- SPI Mosi = PortB.15
- SPI CSn = PortD.0

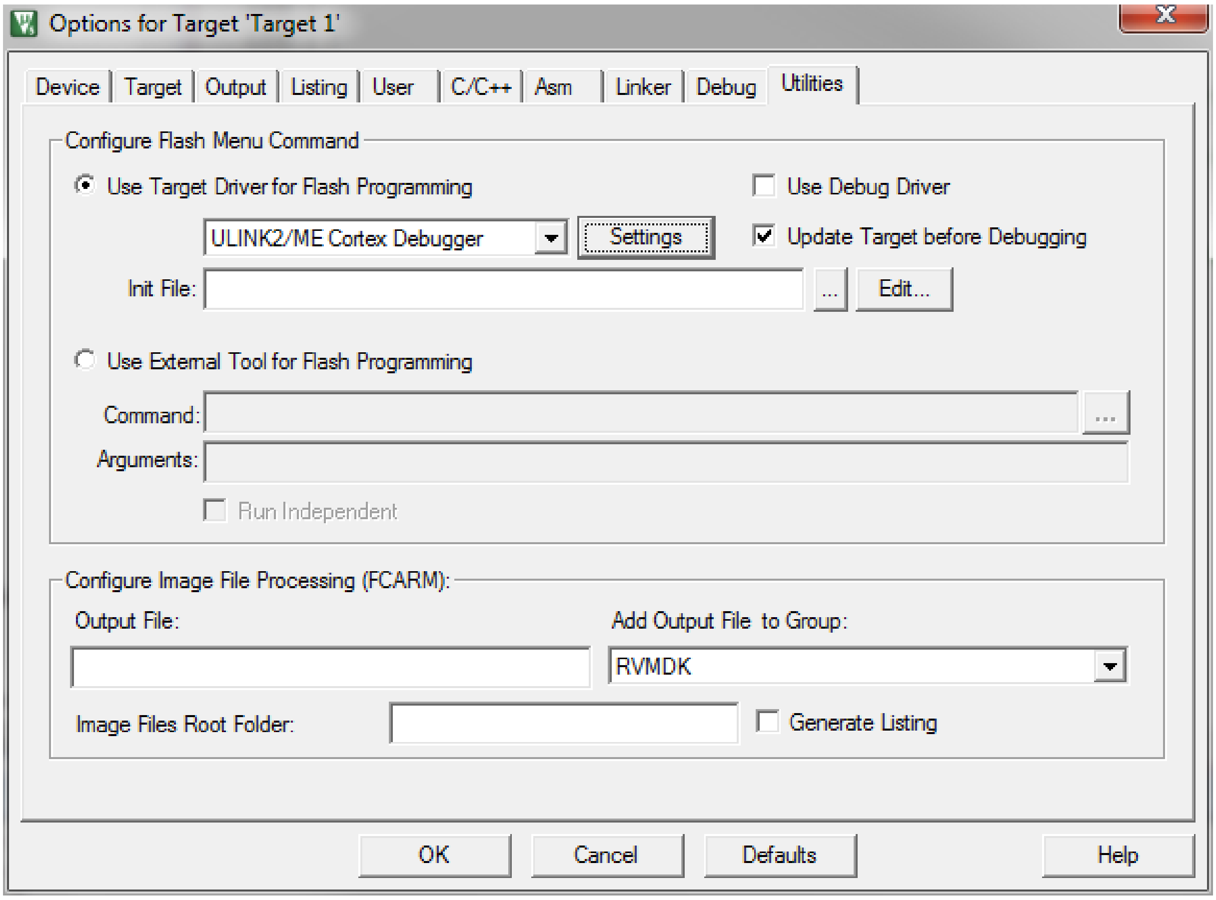
Additionally, two additional pins are required for the RF Module:

- EM9301 Interrupt = PortB.8 (GPIO and external interrupt line need to be assigned)
- EM9301 Reset = PortA.4

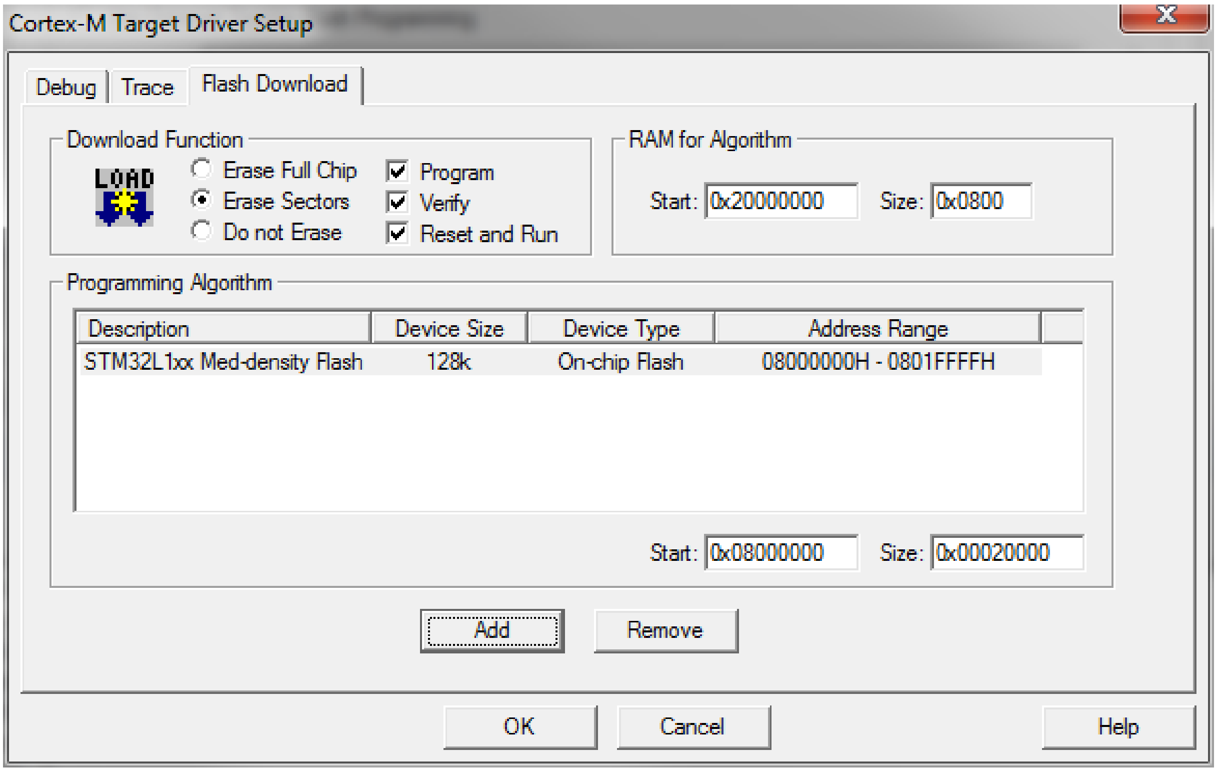
7 Settings – Using Keil and ULINK-ME

The following settings (Keil project / Options for target) should be used for programming and debugging application firmware.

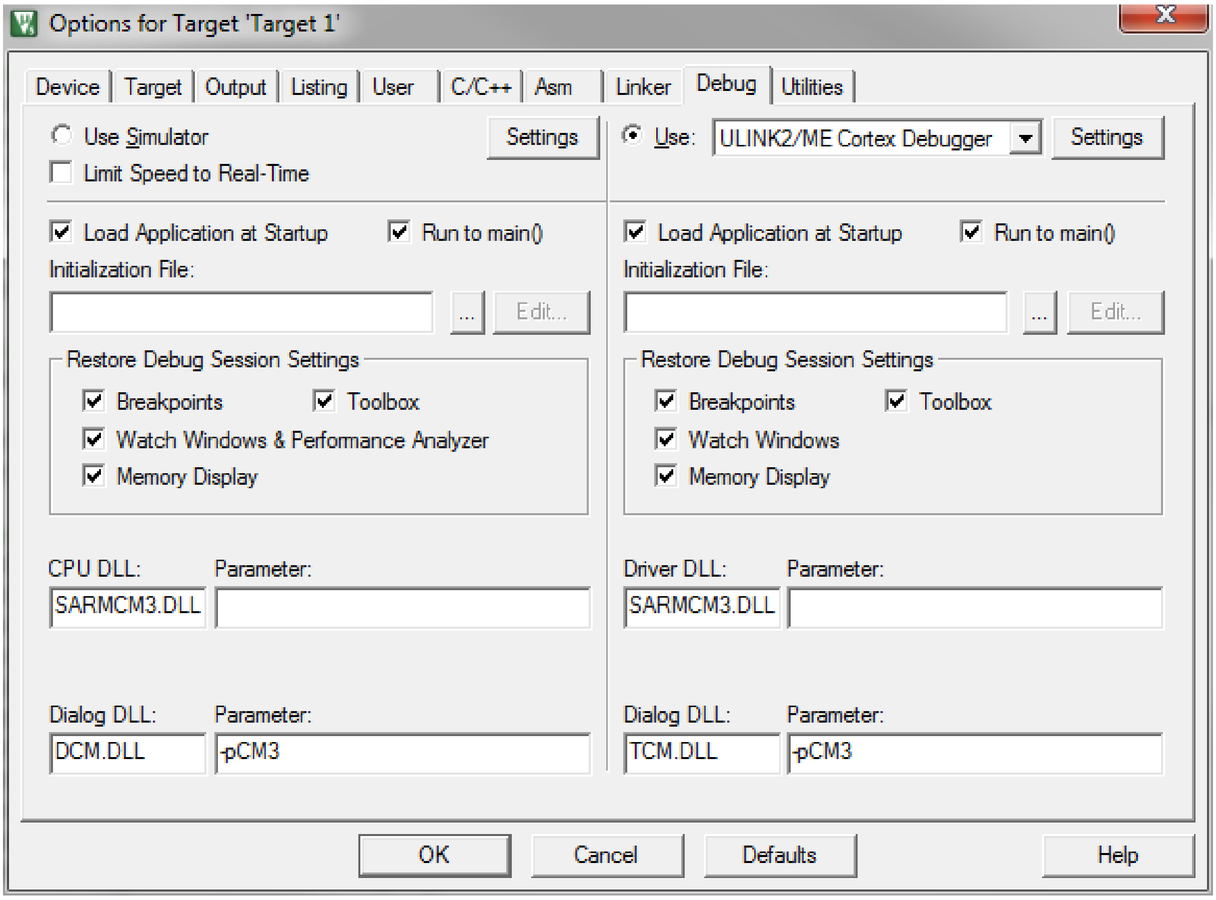
7.1 Target Options / Utilities Menu



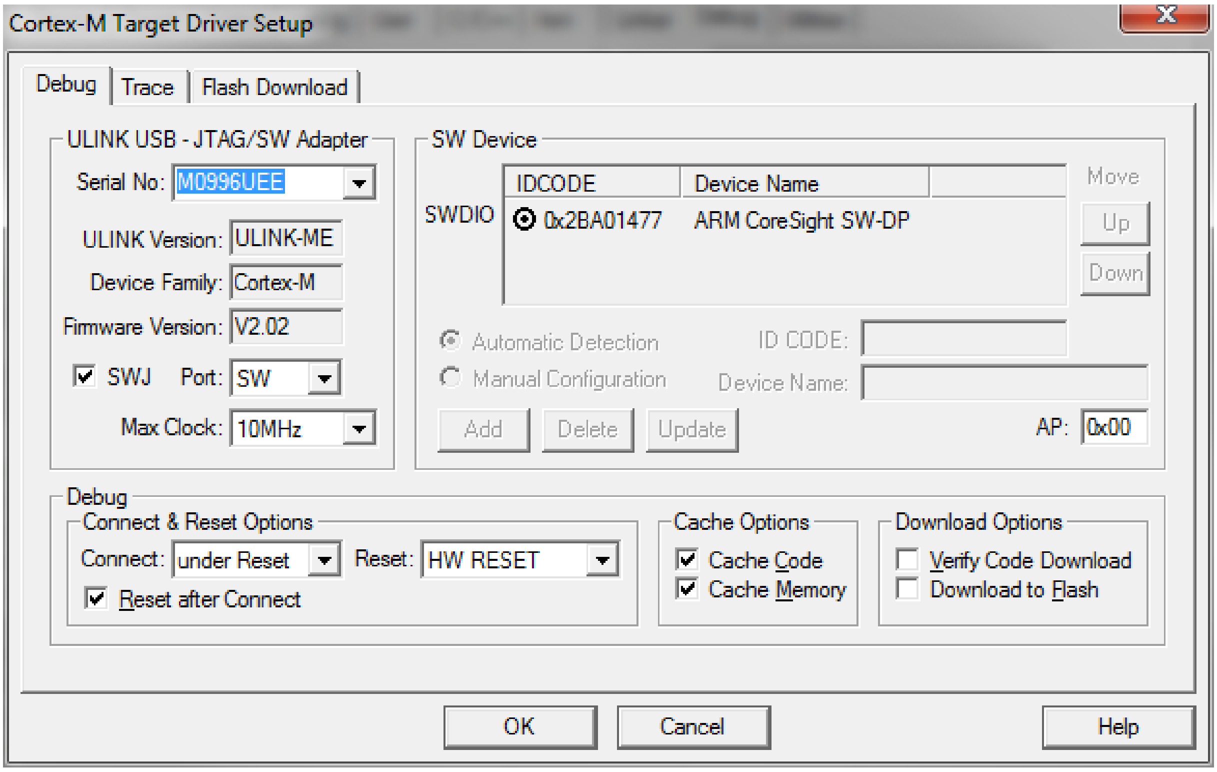
7.2 Target Options / Utilities / Settings Menu



7.3 Target Options / Debug Menu



7.4 Target Options / Debug / Settings Menu



8 Annexes

The Cortex-M3 board EMEDVK9x0xCM3 documentation can be found at:

http://www.stm32circle.com/resources/stm32Lprimer.php