ELARA-II EVALUATION BOARD MANUAL

FOR RADIO MODULES

EV Order Code	Module order code	Marketing Name
2613029237001 2613029237011	2613021137000	Elara-II

VERSION 1.7

JUNE 2, 2021

****

MUST READ

Check for firmware updates

Before using the product make sure you use the most recent firmware version, data sheet and user manual. This is especially important for Wireless Connectivity products that were not purchased directly from Würth Elektronik eiSos. A firmware update on these respective products may be required.

We strongly recommend to include in the customer system design, the possibility for a firmware update of the product.

Revision history

Manual version	HW version	Notes	Date
1.0	2.1	• Initial version	February 2020
1.1	2.1	• Jumper table JP3 updated	March 2020
1.2	2.1	• Jumper table JP3 updated • Chapter 3.5.11 added • Chapter 3.6 added	June 2020
1.3	2.1	• Added Chapter 4: putting into operation. For Chapter 4.1, content was moved from Chapter 2. • Updated product image in Chapter 1	July 2020
1.4	2.1	• Added table 3.2	August 2020
1.5	2.1	• Added Chapter 4.3 : Putting into operation - SPI.	October 2020
1.6	2.1	• Released Thyone-I RF interface and battery operation	November 2020
1.7	2.1	• Updated Chapter 4.2 : Putting into operation - I^2C. • Updated Chapter 4.3 : Putting into operation - SPI.	June 2021

Abbreviations and abstract

Abbreviation	Name	Description
BDS	BeiDou navigation System	Chinese satellite navigation system
COM	Communication	
CS	Chip Select	
CTS	Clear to send	
ESD	Electro Static Discharge	
FTDI	Future Technology Devices International	
Galileo		European satellite navigation system
GLONASS	Global Navigation Satellite System	Russian satellite navigation system
GNSS	Global Navigation Satellite System	
GPS	Global Positioning System	American satellite navigation system
HIGH	High signal level	
I^2C	Inter-Integrated Circuit	
IO	Input Output	
LDO	Low-dropout	Linear voltage regulator
LED	Light Emitting Diode	
LOW	Low signal level	
MISO	Master Input, Slave Output	
MOSI	Master Output, Slave Input	
PC	Personal Computer	
RC	Resistor Capacitor	
RF	Radio frequency	Describes everything relating to the wireless transmission.
RTS	Request to send	
RST	Reset	
SCL	Serial Clock Line	
SCLK	Serial Clock	
SDA	Serial Data Line	
SPI	Serial Peripheral Interface	
SWDCLK	Serial Wire Debug Clock	

Abbreviation	Name	Description
UART	Universal Asynchronous Receiver Transmitter	Universal Asynchronous Receiver Transmitter allows communicating with the module of a specific interface.
USB	Universal Serial Bus	
VCC	Supply voltage	

Contents

1 Supported radio modules 6

2 Functional description 8

3 Development board 9
3.1 Block diagram . . . 9
3.2 Jumpers . . . 10
3.3 Connectors . . . 13
3.3.1 CON1 . . . 14
3.3.2 CON2 . . . 14
3.3.3 CON4 (only for 2613029237011) . . . 14
3.4 Switches and Buttons . . . 15
3.4.1 RESET GNSS button . . . 16
3.4.2 ON/OFF GNSS button . . . 16
3.4.3 RESET_RF button (only for 2613029237011) . . . 16
3.4.4 WAKE-UP_RF button (only for 2613029237011) . . . 16
3.5 Function blocks . . . 17
3.5.1 Power supply . . . 17
3.5.1.1 Bus powered, power supply through USB . . . 17
3.5.1.2 Battery powered, power supply through AAA Battery (only for 2613029237011) . . . 17
3.5.2 JP1 - Current measurement . . . 17
3.5.3 JP2 - UART Communication Interface Selection . . . 17
3.5.4 JP3 - Communication Interface . . . 17
3.5.5 JP4 - Antenna Selection . . . 18
3.5.6 JP5 - Active Antenna Bias . . . 18
3.5.7 JP6 - CTS/RTS Pull Resistors . . . 18
3.5.8 JP7 (only for 2613029237011) . . . 18
3.5.9 JP8 - Power Supply selection . . . 18
3.5.10 UART / USB . . . 18
3.5.11 LED - Elara-II GNSS module . . . 18
3.5.11.1 STATUS GNSS LED . . . 19
3.5.11.2 1PPS GNSS LED . . . 19
3.5.11.3 TX GNSS LED . . . 19
3.5.12 LED - Thyone-I radio module (only for 2613029237011) . . . 19
3.5.12.1 BUSY_RF and RF_ST1 LED . . . 19
3.5.13 Proprietary RF Block . . . 19
3.6 Assembly Information . . . 19
3.6.1 Soldering Recommendation . . . 19
3.6.2 Light sensitivity . . . 20
3.7 Schematic . . . 21
3.8 Layout . . . 24

4 Putting into operation 26
4.1 Putting into operation - UART . . . 26
4.1.1 Putting into operation - UART with Thyone-I proprietary RF module (only for 2613029237011) . . . 28
4.2 Putting into operation - I^2C . . . 30
4.2.1 Hardware Setup - Elara-II . . . 30

4.2.2 Evaluation Board Modification - Elara-II . . . 31
4.3 Putting into operation - SPI . . . 33
4.3.1 Hardware Setup - SPI . . . 33
4.3.2 Evaluation Board Setup - SPI . . . 34

5 Regulatory compliance information 36
5.1 Exemption clause . . . 36

6 Important notes 37
6.1 General customer responsibility . . . 37
6.2 Customer responsibility related to specific, in particular safety-relevant applications . . . 37
6.3 Best care and attention . . . 37
6.4 Customer support for product specifications . . . 37
6.5 Product improvements . . . 38
6.6 Product life cycle . . . 38
6.7 Property rights . . . 38
6.8 General terms and conditions . . . 38

7 Legal notice 39
7.1 Exclusion of liability . . . 39
7.2 Suitability in customer applications . . . 39
7.3 Trademarks . . . 39
7.4 Usage restriction . . . 39

8 License terms 41
8.1 Limited license . . . 41
8.2 Usage and obligations . . . 41
8.3 Ownership . . . 42
8.4 Firmware update(s) . . . 42
8.5 Disclaimer of warranty . . . 42
8.6 Limitation of liability . . . 42
8.7 Applicable law and jurisdiction . . . 43
8.8 Severability clause . . . 43
8.9 Miscellaneous . . . 43

1 Supported radio modules

The evaluation board is exclusively for the Elara-II module:

Order code	Product Name	Description
2613021137000	Elara-II	GNSS module supporting GPS and GLONASS navigation systems

Order code	Description
2613029237001	Elara-II module EV-Kit
2613029237011	Elara-II module EV-Kit with Thyone-I RF interface

Table 1: Compatibility

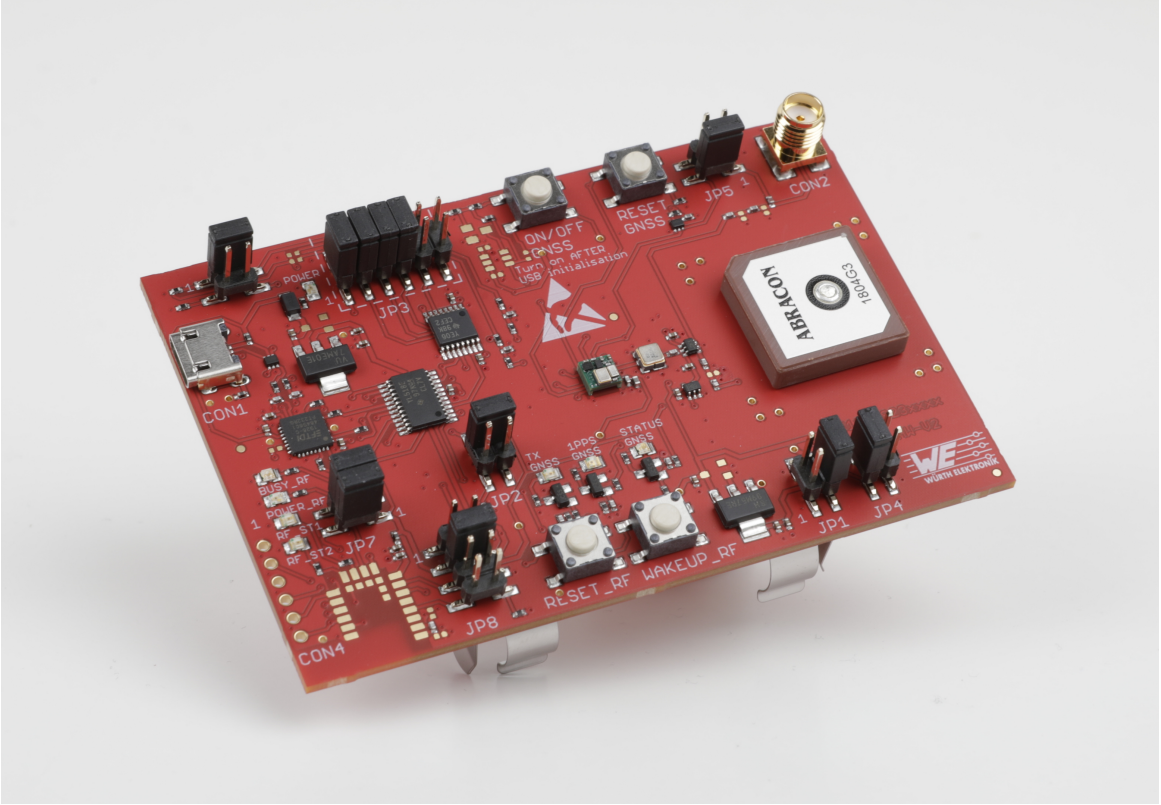


Figure 1: 2613029237001 - product image

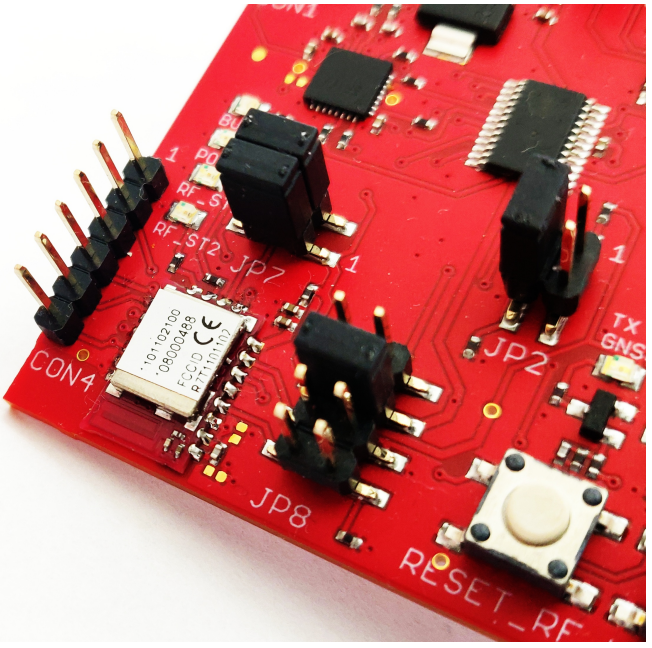


Figure 2: 2613029237011 - detail of the Thyone-I RF interface

Kit Content 2613029237001	Quantity
Evaluation board with Elara-II	1
USB2 A to USB Micro cable	1
External active antenna	1
Packaging: Cardboard Box, ESD bag	1

Table 2: Content Elara-II module EV-Kit

Kit Content 2613029237011	Quantity
Evaluation board with Elara-II and Thyone-I	1
USB2 A to USB Micro cable	1
Thyone-I USB radio stick	1
Packaging: Cardboard Box, ESD bag	1

Table 3: Content Elara-II module EV-Kit with Thyone-I RF interface

Batteries are not included in the evaluation kit

2 Functional description

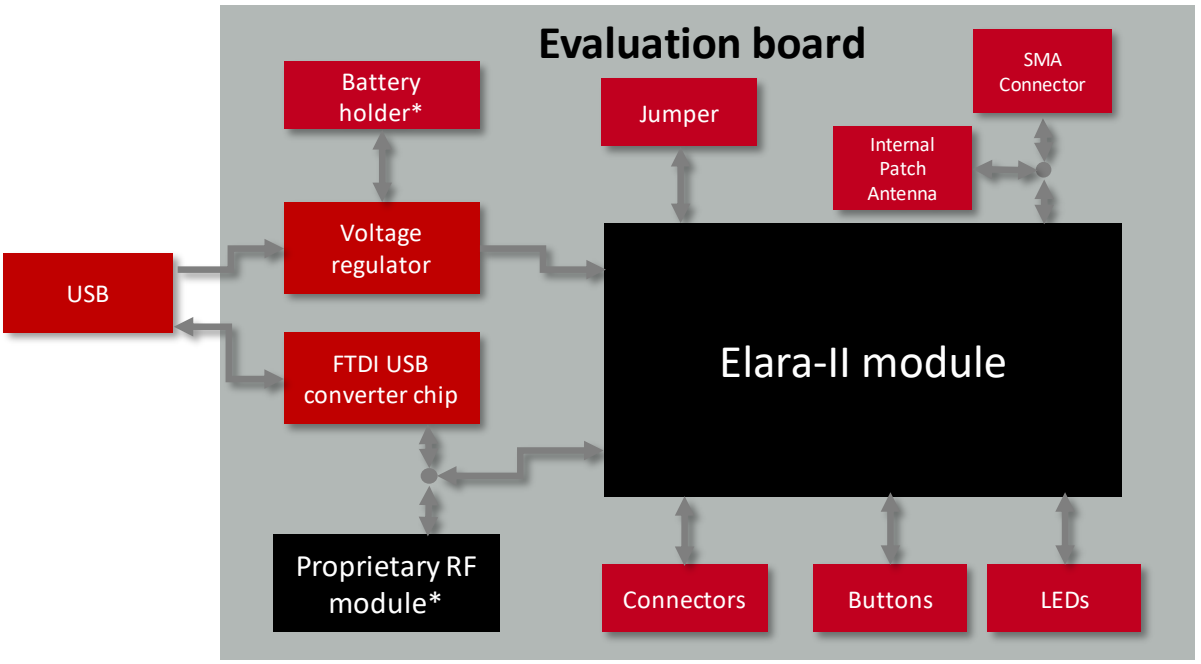
The evaluation board offers the user the possibility to put the compatible GNSS module into operation and to evaluate its features. Furthermore, it represents our reference design for the integration of the compatible GNSS module in an application board.

The evaluation board can be connected to an USB port of a PC. For the connection to a microcontroller system the development board is equipped with a multi-pin connector which gives access to all necessary pins of the GNSS module. Jumpers allow the module to be disconnected from components such as the USB interface which are not required.

In the version with the Thyone-I RF interface (part number 2613029237011), the radio module Thyone-I (on the evaluation board) and the corresponding USB radio stick (available in the evaluation kit) can be used to communicate with the GNSS module through RF link, instead of USB cable. In this setup, batteries can be used to supply the evaluation board, making it completely standalone.

3 Development board

3.1 Block diagram



*only in part number 2613029237011

Figure 3: Block diagram

3.2 Jumpers

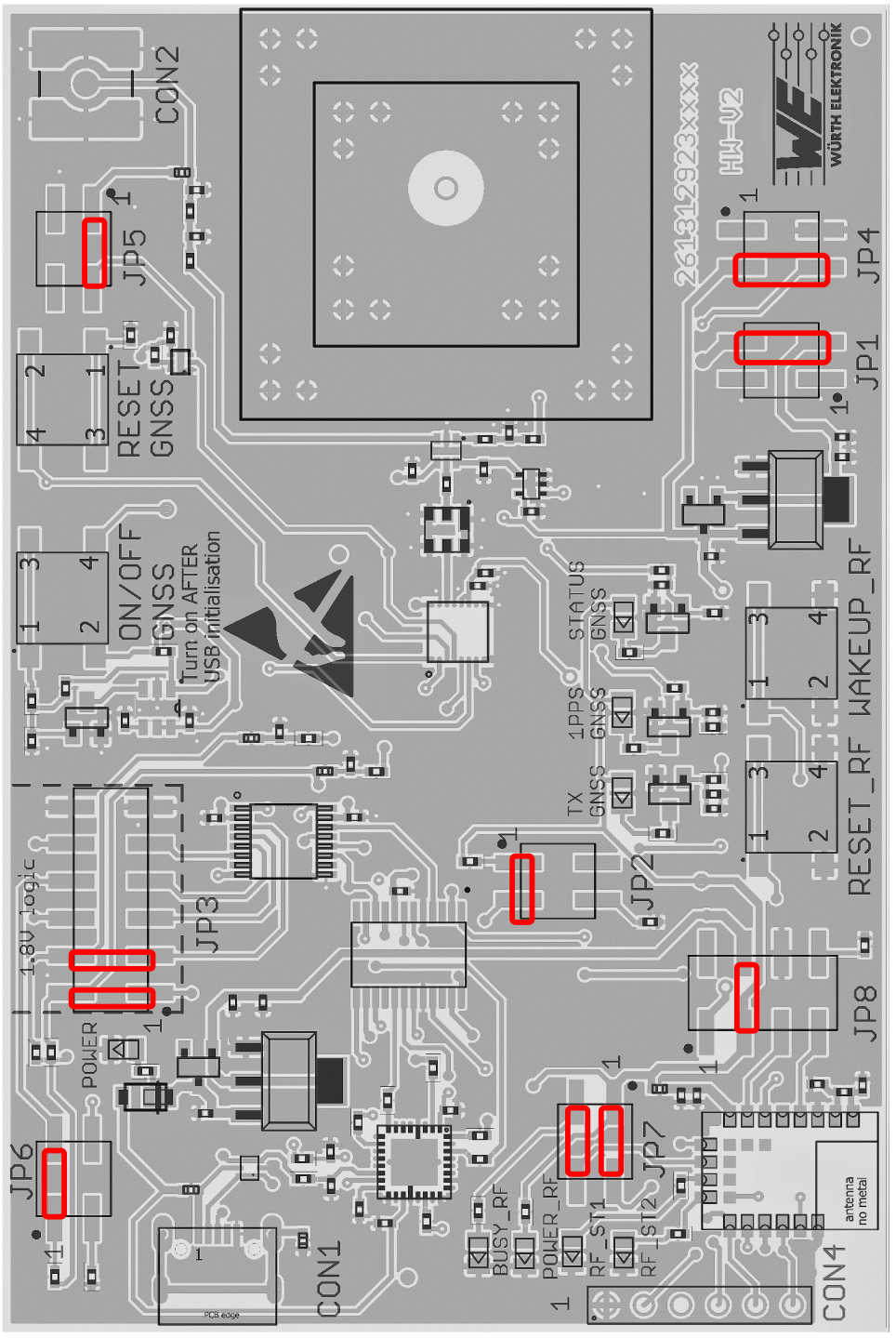


Figure 4: Jumpers - default setting

JP1	Function	Jumper set (default)
1,2	No connection	No
3,4	Power bridge (remove for current measurement)	Yes

JP2	Function	Jumper set (default)
1,3	UART to USB communication	Yes
3,4	UART to proprietary RF communication	No

JP3	Function	Jumper set (default)
1,2	RX UART interface to TX-GNSS module	Yes
3,4	TX UART interface to RX-GNSS module	Yes
5,6	CTS UART interface to RTS-GNSS module	No
7,8	RTS UART interface to CTS-GNSS module	No
9,10	RST-control interface to RST-GNSS module	No
11,12	Ground connection	No

JP4	Function	Jumper set (default)
2,4	Active antenna	No
3,4	Passive antenna	Yes

JP5	Function	Jumper set (default)
1,2	Active antenna bias	Yes
3,4	No connection	No

JP6	Function	Jumper set (default)
1,2	CTS pullup	Yes
3,4	RTS pulldown	No

JP7	Function	Jumper set (default)
1,2	Mode set (only for 2613029237011)	Yes
3,4	Busy LED (only for 2613029237011)	Yes

JP8	Function	Jumper set (default)
1,3	Battery power supply (only for 2613029237011)	No
3,4	3V LDO power supply	Yes
5,6	Pulldown BOOT_RF (only for 2613029237011)	No
7,8	Pulldown SWDCLK_RF (only for 2613029237011)	No

3.3 Connectors

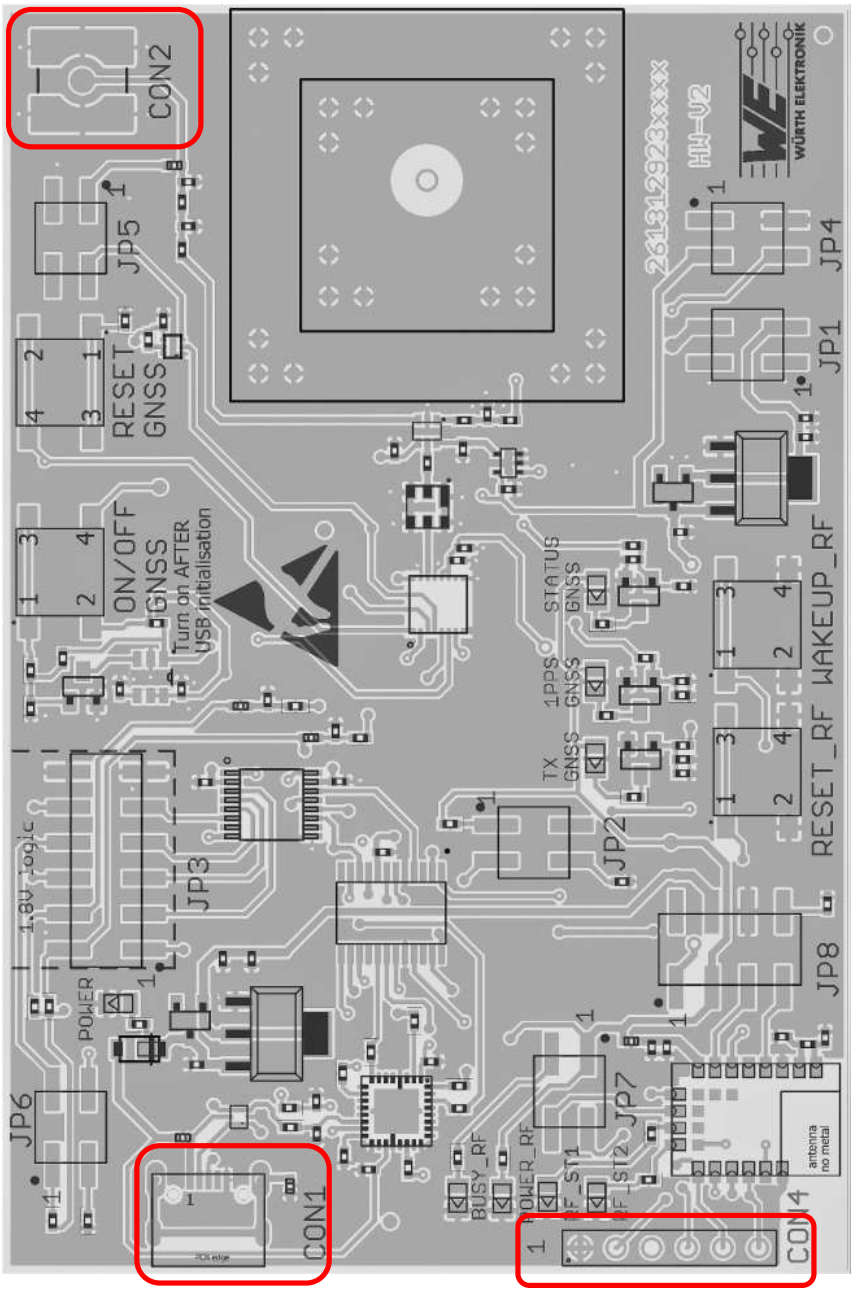


Figure 5: Connectors

Connector	Function
CON1	Micro-USB connector for host connection and VCC bus supply
CON2	SMA connector for external active antenna
CON4	UART interface Thyone-I module (only for 2613029237011)

3.3.1 CON1

Connector CON1 is a micro-USB socket that enables connection to PC via standard micro-USB cable and also provides supply voltage to the board during USB powered operation.

CON1	Function
	Micro-USB connector for host connection and VCC bus supply

3.3.2 CON2

Connector CON2 (SMA Jack) is used to connect an external antenna.



In order use the external active antenna, Jumper JP4 and jumper JP5 has to be set according to the jumper table



In order use the on-board passive antenna, Jumper JP4 has to be set according to jumper table and connector CON2 should be left open

CON2	Function
Inner	RF signal
Outer	GND

3.3.3 CON4 (only for 2613029237011)

Connector CON4 is a standard 2.54mm pin header which is used as the UART interface for the Thyone-I module.

CON4	Function
1	GND
2	RTS_RF signal
3	Not connected
4	RX_RF signal
5	TX_RF signal
6	CTS_RF signal

3.4 Switches and Buttons

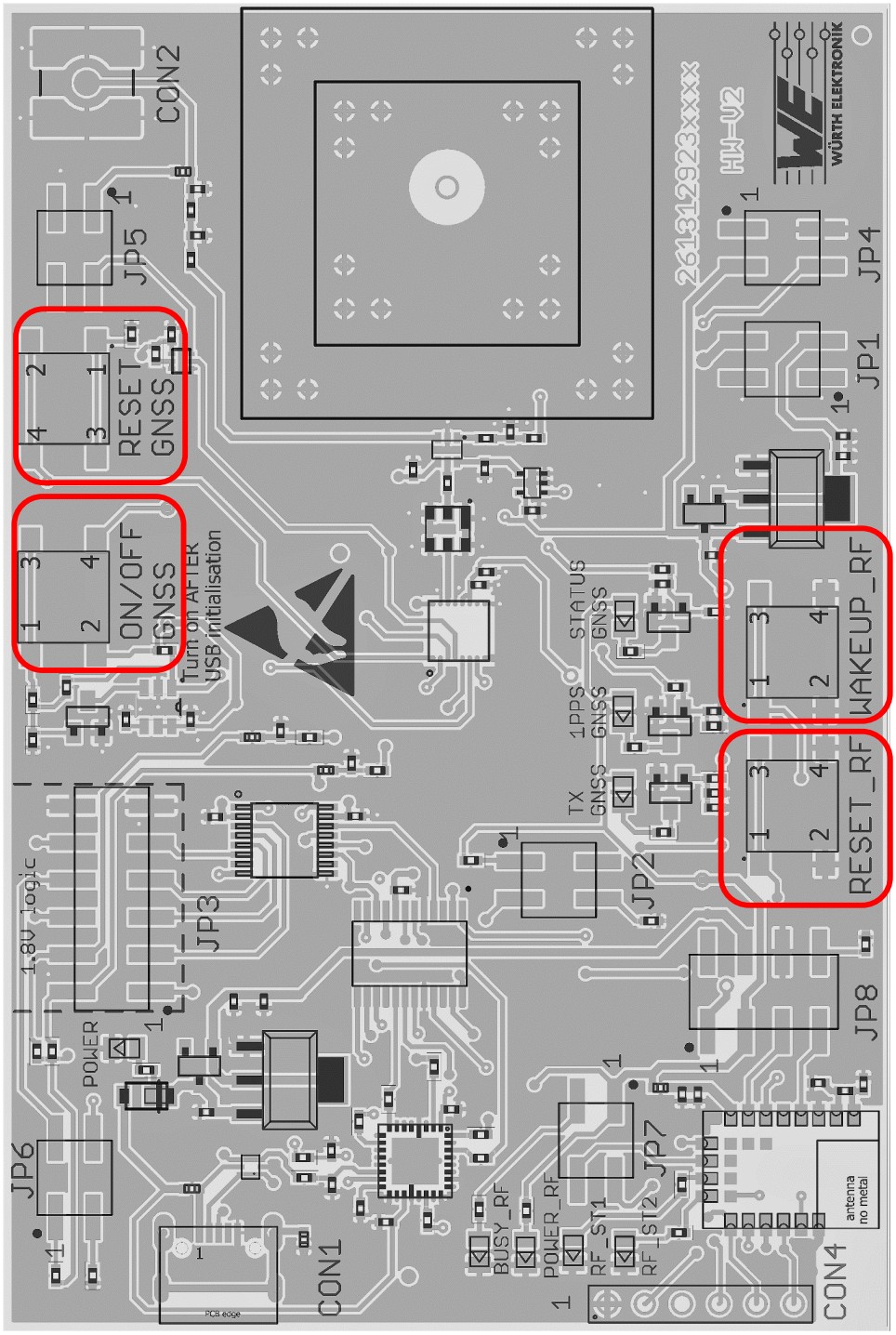


Figure 6: Buttons

3.4.1 RESET GNSS button

Internally the active low reset input of the Elara-II is connected via a RC combination with the power supply to ensure a proper startup of the module. */RESET* pin is connected to this button which provides the possibility for hard reset. Please refer to the module specific manual for detailed information.

In order to have better signal stability and avoid ESD influence on the module a decoupling capacitor of 1nF should be used between the Reset pin signal trace of the GNSS module and Ground, close to the module. This capacitor is not implemented in the evaluation board but recommended for signal stability and to avoid ESD issues.

3.4.2 ON/OFF GNSS button

The ON/OFF button is connected to the GNSS module's *ON_OFF* pin. This gives the user the possibility to switch between the operating modes. Please refer to the module manual for detailed information.

In order to have better signal stability and avoid ESD influence on the module a decoupling capacitor of 1nF should be used between the ON_OFF pin signal trace of the GNSS module and Ground, close to the module. This capacitor is not implemented in the evaluation board but recommended for signal stability and to avoid ESD issues.



After switching on and resetting, the module starts in Hibernate mode.

3.4.3 RESET_RF button (only for 2613029237011)

Internally the active low reset input of the Thyone-I radio module is connected via a RC combination with the power supply to ensure a proper startup of the module. The module provides a */RESET* pin that is connected to this button so the module can be restarted properly. The module provides an internal pull-up resistor. Please refer to the module specific manual for detailed information.

3.4.4 WAKE-UP_RF button (only for 2613029237011)

The Thyone-I radio module uses the wake-up button connected to the *WAKE-UP* pin to exit from sleep mode of the module. Please refer to the module specific manual for detailed information.

3.5 Function blocks

3.5.1 Power supply

3.5.1.1 Bus powered, power supply through USB

The development board can be powered through the micro USB connector. The integrated voltage regulator regulates the connected USB voltage of typ. 5V down to 3V and further a dedicated voltage regulator is used to power the module with the proper voltage supply of 1.8V. If the evaluation board is power sourced the *Power LED* lights up. USB power supply can be selected using the jumper *JP8*. By default the jumper *JP8* is set to USB powered operation.

3.5.1.2 Battery powered, power supply through AAA Battery (only for 2613029237011)

The development board also has optional assembly for battery holders on the bottom to connect two AAA batteries. To power up the board using the AAA batteries *JP8* shall be moved from the default position 3-4 to the new position 1-3.

3.5.2 JP1 - Current measurement

By default, JP1 is set to normal operation. If a current meter is connected in place of the jumper, the power consumption of the radio module can be measured.
If the meter is not attached and the bridge is not set, the module will not receive a supply voltage. However, the *Power LED* may be active, as it is connected prior to the current measurement bridge in order not to distort the module's power consumption.

3.5.3 JP2 - UART Communication Interface Selection

By default, JP2 is bridged for UART communication through USB interface.

In part number 2613029237011, the proprietary RF module provides the possibility to support UART communication through radio, which can be established by setting the JP2 to connect pins 3-4 instead of the default 1-3.

3.5.4 JP3 - Communication Interface

By default, JP3 is bridged between the TX, RX, CTS, RTS, Reset lines of GNSS module to UART communication interface. In this setting only TX and RX connections are absolute necessity for UART communication. CTS, RTS and Reset connections are optional and provide the possibility to control the relevant module pins using UART interface.
Pins 2, 4, 6 and 8 of the JP3 can also be used to connect GNSS module to any other external interface instead of bridging the jumper JP3. In such case, beware of IO level compatibility as these pins have a IO logic level of 1.8V. The host must obey the values stated in the module's manual. Especially the IO level restrictions must be implemented by a host system (i.e. using a level shifter to support the allowed IO levels).

3.5.5 JP4 - Antenna Selection

By default, JP4 is bridged to select the passive patch antenna on the evaluation board, the jumper setup can be modified according to the jumper table to select the SMA connector for external active antenna connection.

3.5.6 JP5 - Active Antenna Bias

By default, JP5 is bridged to bias active antenna connected to SMA connector.

3.5.7 JP6 - CTS/RTS Pull Resistors

By default, JP6 is bridged to provide external pullup on CTS of the GNSS module to support UART communication interface. For detailed information related to the setup of pull resistors please refer to the module Manual.

3.5.8 JP7 (only for 2613029237011)

JP7 is used to set the radio module Thyone-I to normal operation mode and to connect a LED for visualization. By default, both jumpers are set.

3.5.9 JP8 - Power Supply selection

By default, the jumper JP8 is set to USB powered operation.

In part number 2613029237011, the jumper *JP8* can be set to position (1,3) for battery operation.

3.5.10 UART / USB

UART interface of the module can be connected to the USB converter by setting the jumper JP2 and JP3 accordingly. By default, communication takes place through the USB jack. Using the FTDI-driver the PC tool will show a virtual COM-Port which can be used to communicate with the module.



The USB cable length should not exceed 3 meters.

3.5.11 LED - Elara-II GNSS module

There are three LEDs available on the evaluation board dedicated to indicate the status of Elara-II module's functions.

3.5.11.1 STATUS GNSS LED

STATUS GNSS LED is connected to the *WAKE_UP* pin of the Elara-II module. If the LED is in steady ON state, it indicates that the module is in full power mode. If the LED is in steady OFF state, it indicates that the module is in hibernate mode. Please refer to the module manual for detailed information.

3.5.11.2 1PPS GNSS LED

1PPS GNSS LED is connected to the *1PPS* pin of the Elara-II module. *1PPS GNSS LED* is triggered through 1PPS signal pulse once the module obtains 3D position fix. Please refer to the module manual for detailed information.

3.5.11.3 TX GNSS LED

TX GNSS LED is connected to the *TX* pin of the Elara-II module. If the LED is in steady OFF state, it indicates that the module is in hibernate mode. If the LED is in blinking state, it indicates that the module in full power mode and GNSS messages are transmitted by the module. Please refer to the module manual for detailed information.

If the *RESET_GNSS* button on the evaluation board is pressed, the GNSS message transmission is stopped but the *TX GNSS LED* is in steady ON state, this is because of the pull up on TX line by the level shifter used in the evaluation board.

3.5.12 LED - Thyone-I radio module (only for 2613029237011)

3.5.12.1 BUSY_RF and RF_ST1 LED

These LEDs indicate that a radio link between the Thyone-I module on the evaluation board and a partner radio device (e.g. a Thyone-I USB radio stick) is established and data exchange is taking place.

3.5.13 Proprietary RF Block

In part number 2613029237011, the evaluation board is ready to use the proprietary RF-Module *Thyone-I* for UART communication through a radio interface.

3.6 Assembly Information

3.6.1 Soldering Recommendation

For proper assembly of module on the host PCB, the recommended soldering parameters given below shall be followed.

Solder stencil thickness:	max. 100 µm
Solder stencil opening:	80 % to 100 %
Solder stencil type:	Electroformed or Laser cut stencil
Solder paste type:	Type 4.5 to Type 6
Peak reflow temperature:	245 °C

3.6.2 Light sensitivity

Elara-II module is sensitive to light. Exposure to light might result in malfunction. For proper functionality of the module an enclosure against light shall be used. On the evaluation board the module is covered by a silicone encapsulating compound.

3.7 Schematic

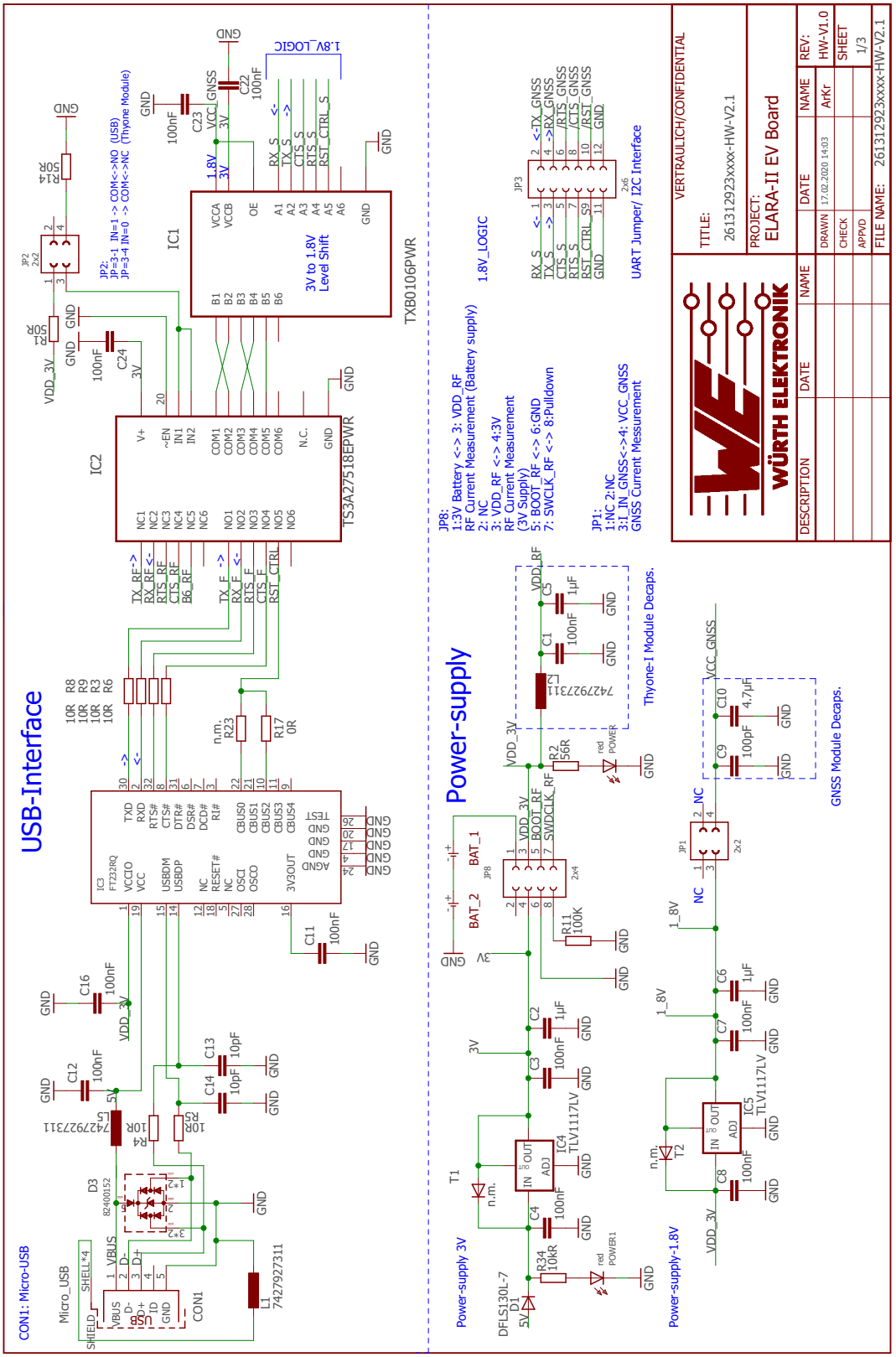


Figure 7: Schematic sheet-1

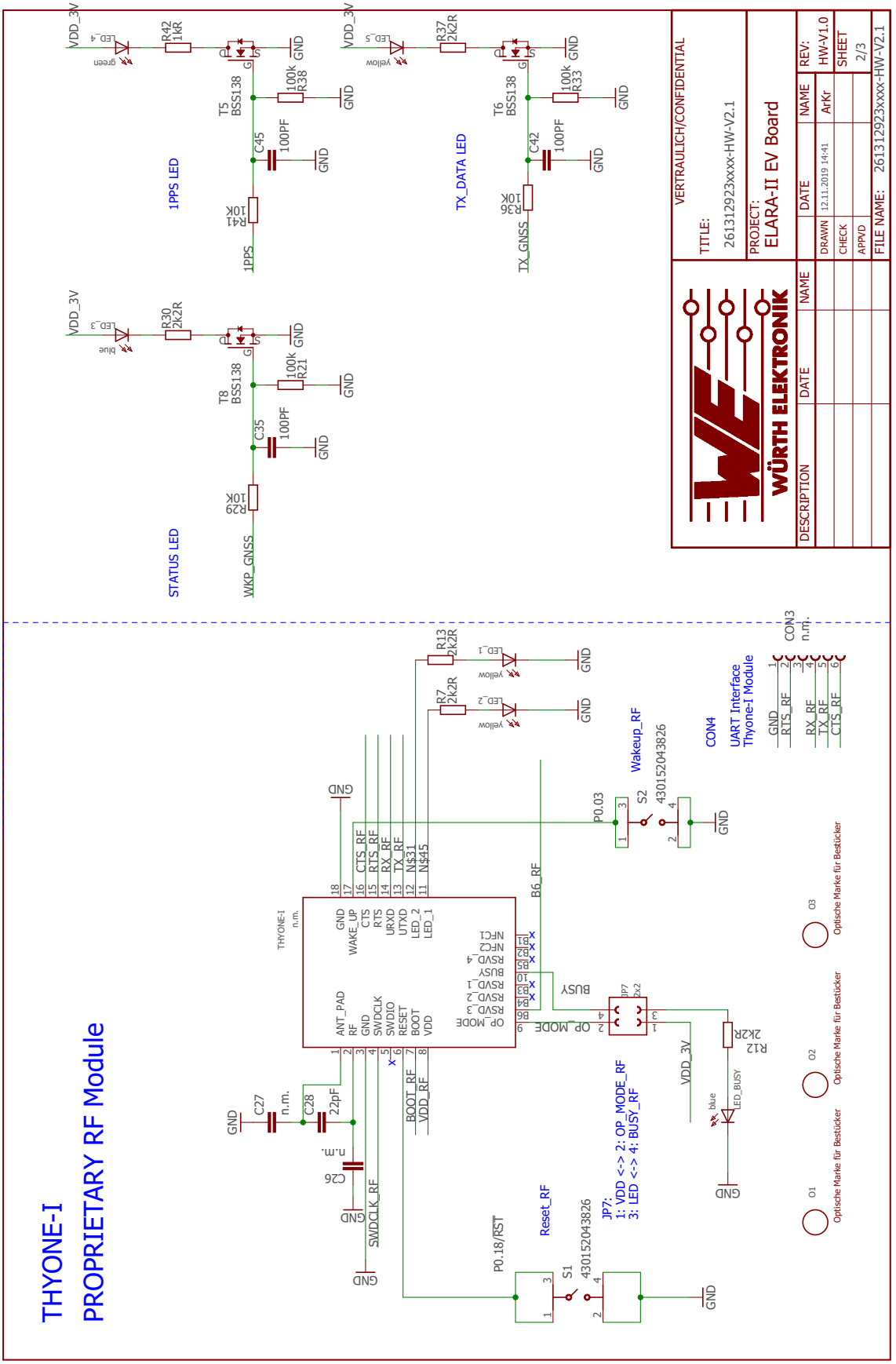


Figure 8: Schematic sheet-2

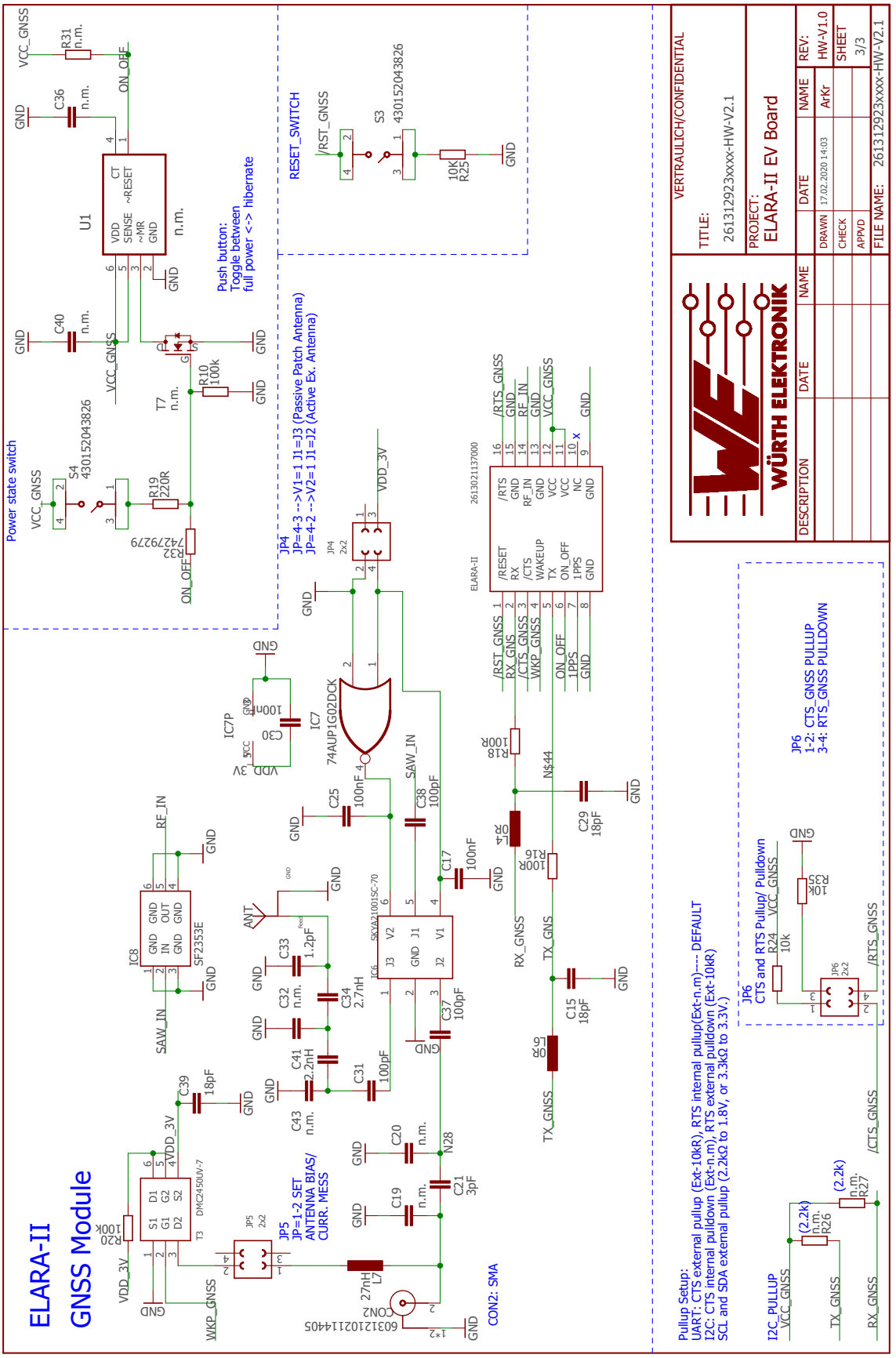


Figure 9: Schematic sheet-3

3.8 Layout

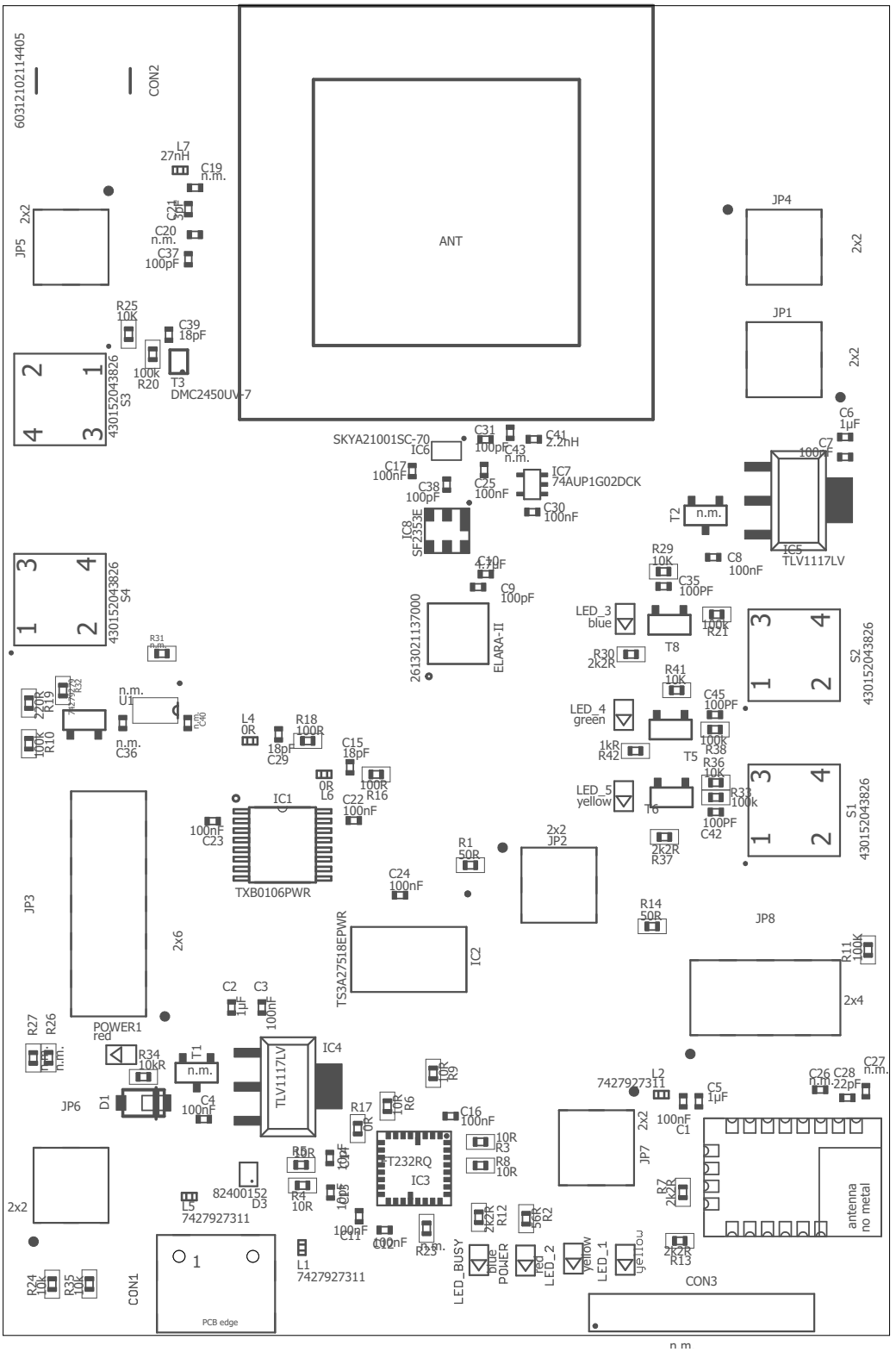


Figure 10: Assembly diagram

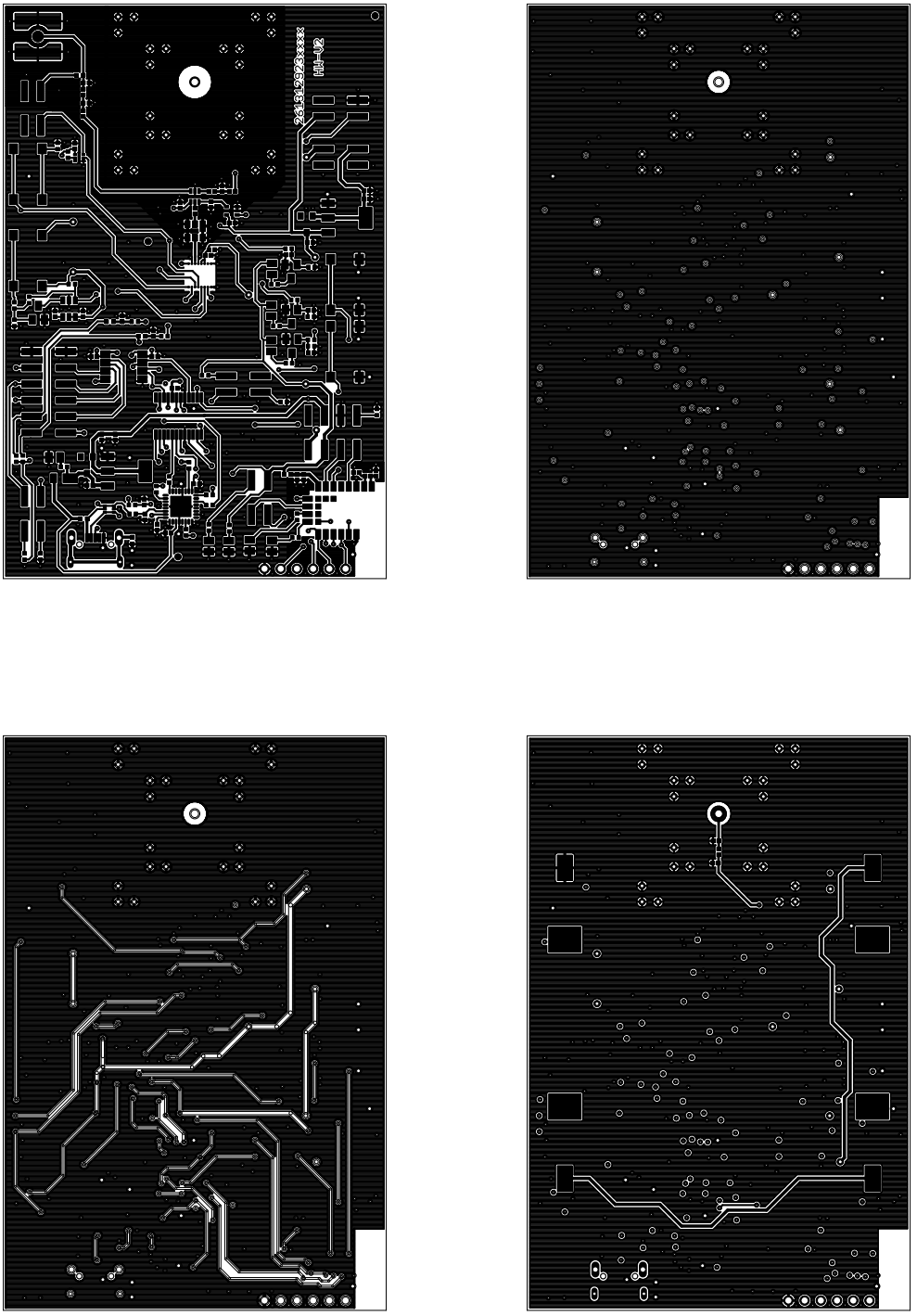


Figure 11: Top,bottom & internal layers

4 Putting into operation

4.1 Putting into operation - UART

Before starting to work with the evaluation board make sure that:

- The jumpers on the EV board are placed on the default locations.
- FTDI driver package is installed on the PC. The latest version of the drivers can be downloaded from *www.ftdichip.com/Drivers/VCP.htm*. Please use the setup executable package or follow the install instructions from FTDI.
- Evaluation board is connected to the PC via USB-cable provided in the evaluation kit.
- Module power supply (VCC) is stable and able to reliably supply the module's static and peak current consumption as specified by the module manual.
- COM port is detected and installed on the PC. The (COM) port name of the evaluation board can be found using the device manager on Windows and the display message (dmesg) on Linux. For example, the evaluation board might appear similar to "COM12" on windows and "/dev/ttyUSB0" on Linux. Once the COM port is detected, USB initialisation is completed.
- Push the ON/OFF GNSS Button to switch the module from hibernate to full power state. Please make sure to do this only after the USB initialisation. Pressing the ON/OFF GNSS Button before USB initialisation, can cause the PC Device Manager to interpret the GNSS module as Microsoft serial ballpoint mouse. In such event, disconnect the board from the PC and repeat the steps.
- WENSS PC-tool can be used to take the evaluation board into operation and communicate with the module. Once connection to the evaluation board is properly estabilshed, flow of messages from the GNSS module should be visible in the PC-tool. Please refer to the PC-Tool manual for detailed information.

Please refer to the module reference manual to get the detailed module specific information.

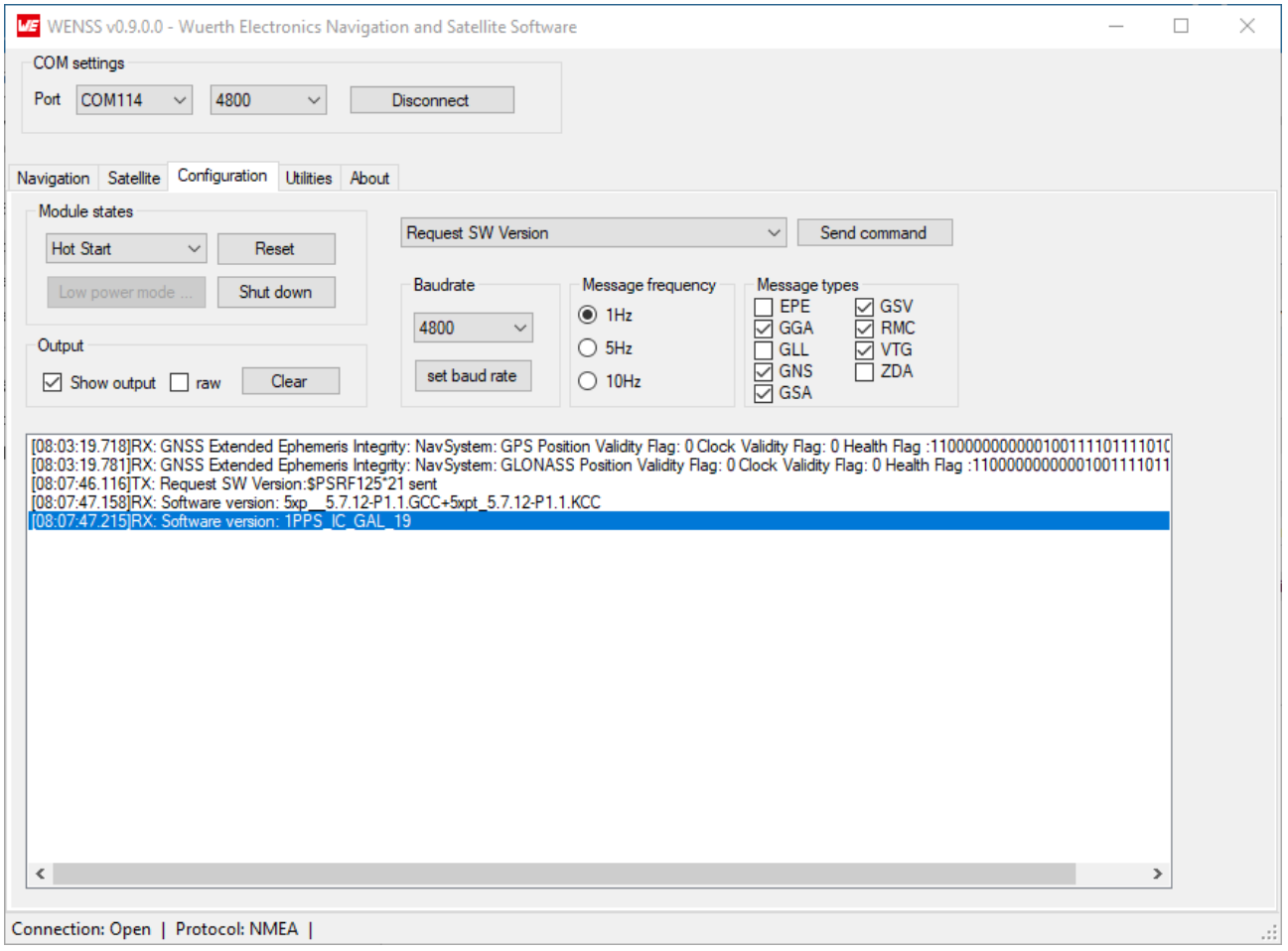


Figure 12: PC-Tool

4.1.1 Putting into operation - UART with Thyone-I proprietary RF module (only for 2613029237011)

The Thyone-I module on the evaluation board, together with the USB radio stick included in the evaluation kit, allows transmission of the messages from the GNSS module via RF link to the host PC. The same RF link can be used to send input commands from the host PC to the GNSS module.

The evaluation board can be used in standalone mode using two AAA batteries.

The Thyone-I module is configured in transparent mode: it sends out the incoming messages without further configuration steps needed.

The configuration with Thyone-I module and USB radio stick is only supported with the GNSS module working with the default baud rate (4800 baud) and default communication protocol (NMEA).

To guarantee a stable RF link, the GNSS EV-board (with the Thyone-I module) and the Thyone-I radio stick shall have a maximum distance of 20 meters. Presence of obstacles can have impact on this distance.

For putting into operation, please execute the following steps and refer to Figure 13.

- Make sure that the jumpers on the EV board are placed on the default locations.
- Switch jumper JP2 to position 3,4 to set the UART communication between Elara-II and Thyone-I (see Chapter 3.2).
- - Option A: for battery operation of the evaluation board, switch jumper JP8 to position 1,3 (see Chapter 3.2).

  - Option B and C: for power supply from PC or power bank, keep JP8 in default position 3,4.
- - Option A: insert two AAA batteries in the battery holder placed on the back side of the evaluation board.

  - Option B: connect the evaluation board to the PC via USB-cable

  - Option C: connect the evaluation board to a power bank via USB-cable
- Connect the Thyone-I USB radio stick to the host PC.
- Make sure that the FTDI driver package is installed on the PC. The latest version of the drivers can be downloaded from *www.ftdichip.com/Drivers/VCP.htm*. Please use the setup executable package or follow the install instructions from FTDI.
- Make sure that the COM port is detected and installed on the PC. The COM port name of the evaluation board can be found using the device manager on Windows and the

display message (dmesg) on Linux. For example, the evaluation board might appear similar to "COM12" on windows and "/dev/ttyUSB0" on Linux. Once the COM port is detected, USB initialisation is completed.

- WENSS PC-tool can be used to take the evaluation board into operation and communicate with the module. Once started:

  - select the correct COM port used by the USB radio stick

  - select baud rate 115200

  - click "connect"

- Press the ON/OFF GNSS Button to switch the module from hibernate to full power state.

- Flow of NMEA messages from the GNSS module should now be visible in the PC-tool (tab "Navigation"). Please refer to the PC-tool manual for detailed information. Two LEDs on the evaluation board (RF_BUSY and RF_ST) and one LED on the USB radio stick should blink, confirming that the RF communication is properly established and that data exchange is taking place.

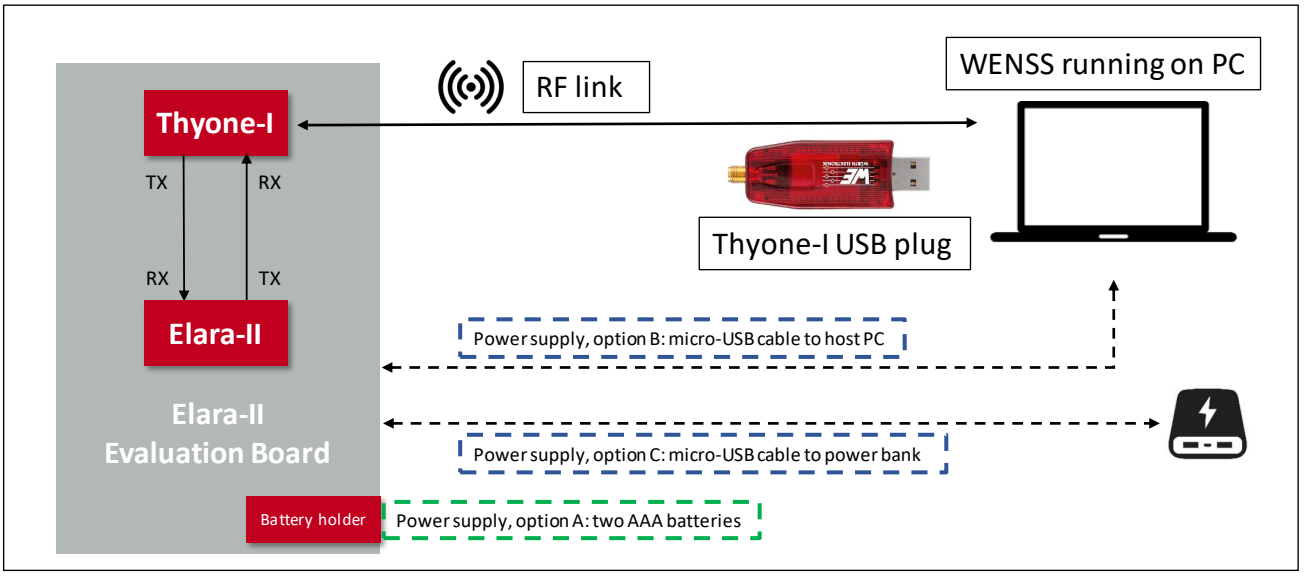


Figure 13: Putting into operation - Thyone-I + Elara-II

4.2 Putting into operation - I²C

The I²C (Inter-IC) bus interface can be selected as the communication interface in the GNSS module through */CTS* and */RTS* pins. During power up, the module recognizes the I²C bus interface through the */CTS* and */RTS* pin connections as per table 4.

Interface	/CTS	/RTS
I²C	Open	External pull-down

Table 4: I²C Interface Setting

By default the evaluation board is implemented with UART interface. To communicate with the module through I²C bus interface, modifications on the evaluation board are required by the user. Details follow in the next sections.

4.2.1 Hardware Setup - Elara-II

I²C hardware setup for Elara-II evaluation board is shown in the figure 14.

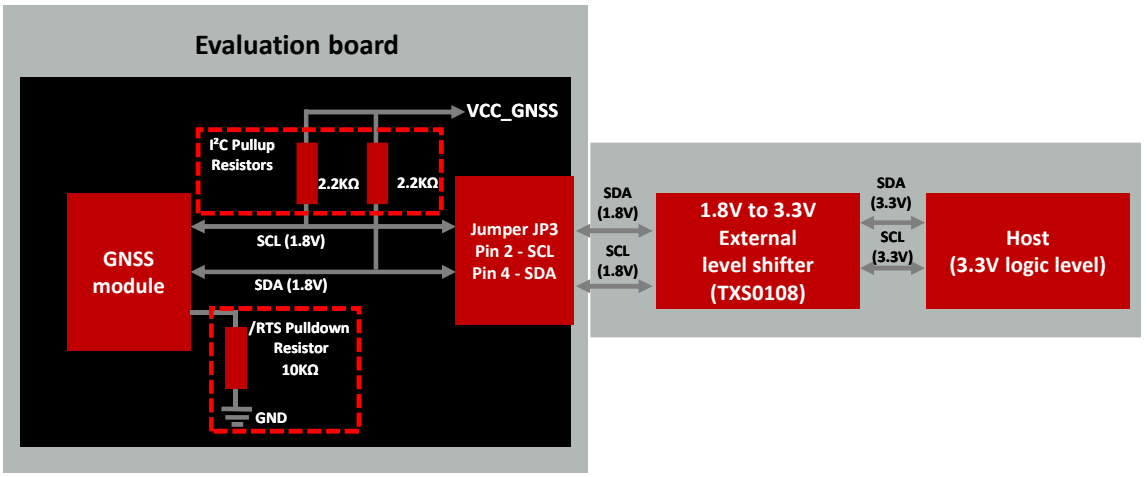


Figure 14: I²C Hardware setup - Elara-II

The block diagram illustrates the pull-up resistors assembly for the SDA and SCL bus lines as well as the pull-down resistor on the */RTS* pin for booting up in I²C interface mode. It also shows that the I²C bus access on evaluation board jumper JP3-2 and JP3-4 can be used to connect the bus to a host.

The I²C bus outputs on jumper JP3 are 1.8V logic levels. Therefore, a suitable level shifter is needed for further logic level translation (i.e. when the host does not support 1.8V logic level). For a logic level translation to 3.3V, the level shifter TXS0108 by Texas Instruments is used in the tested hardware setup. Further information of the level shifter can be found at *https://www.ti.com/product/TXS0108E*.

Please note that the level shifter shall use an open drain circuit and support I²C communication.

4.2.2 Evaluation Board Modification - Elara-II

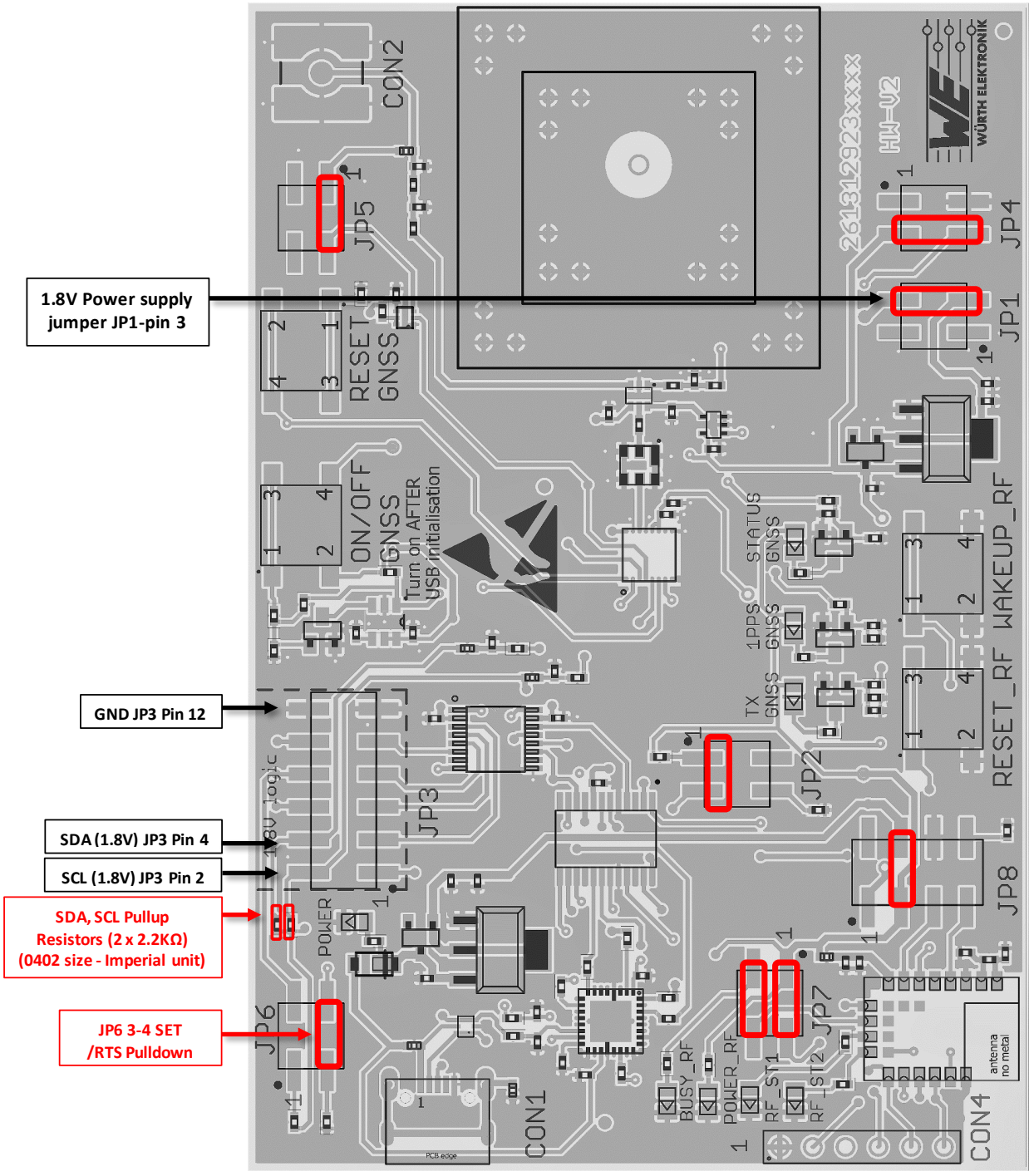


Figure 15: I²C evaluation board modification - Elara-II

Figure 15 illustrates the necessary modification, including correct jumper settings, to be done on the evaluation board for I²C communication.

The following changes must be done:

- Solder 2.2kΩ pull-up resistors on the SDA and SCL bus;
- Connecting 10kΩ pull-down resistor on */RTS* line by switching jumper JP6 from default position (1,2) to (3,4).

Apart from the hardware modifications listed above, jumpers shall be set according to Figure 15.

The I²C bus (1.8V logic level) can be accessed through the jumper JP3.

Jumper JP3 (1.8V logic level)	
I²C SCL	Pin 2
I²C SDA	Pin 4
Ground	Pin 12

Table 5: I²C Jumper JP3 Connection - Elara-II

The 1.8 V reference supply can be accessed through JP1 Pin-3.

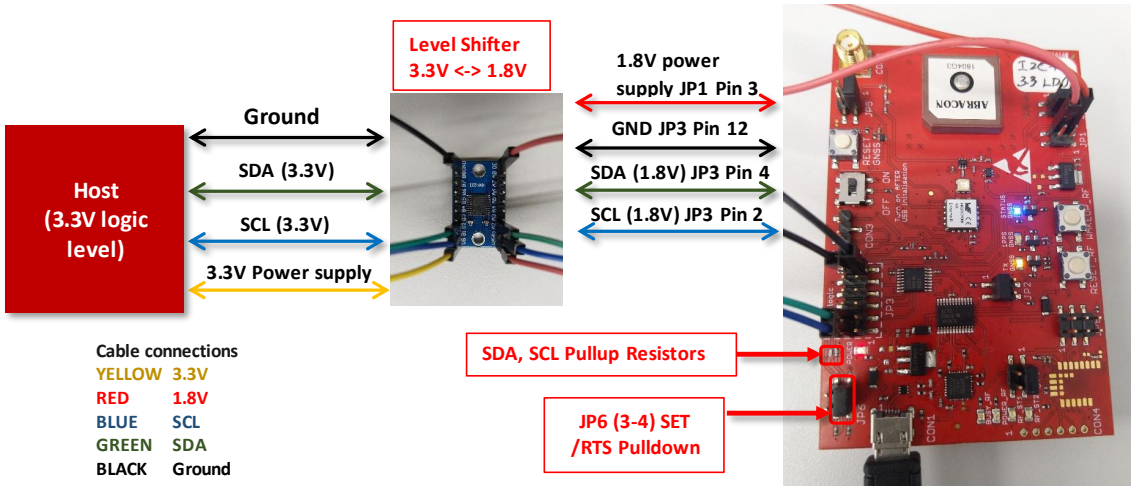


Figure 16: Elara-II- GNSS evaluation board connection to 3.3V Host

For further information about I²C communication with the Elara-II, including an application example with Aardvark and its matching PC software, please refer to our dedicated application note: *Application Note ANR018*.

4.3 Putting into operation - SPI

The SPI bus interface can be selected as the communication interface for the GNSS module through */CTS* and */RTS* pins. Table 6 gives the needed setting during power up for the */CTS* and */RTS* pins to activate the SPI communication.

Interface	/CTS	/RTS
SPI	Open	Open

Table 6: SPI Interface Setting

By default the evaluation board is implemented with UART interface. To communicate with the module through SPI bus interface, defined jumper settings have to be done by the user. Details follow in the next sections.

4.3.1 Hardware Setup - SPI

SPI hardware setup for Elara-II evaluation board is shown in the figure 17 .

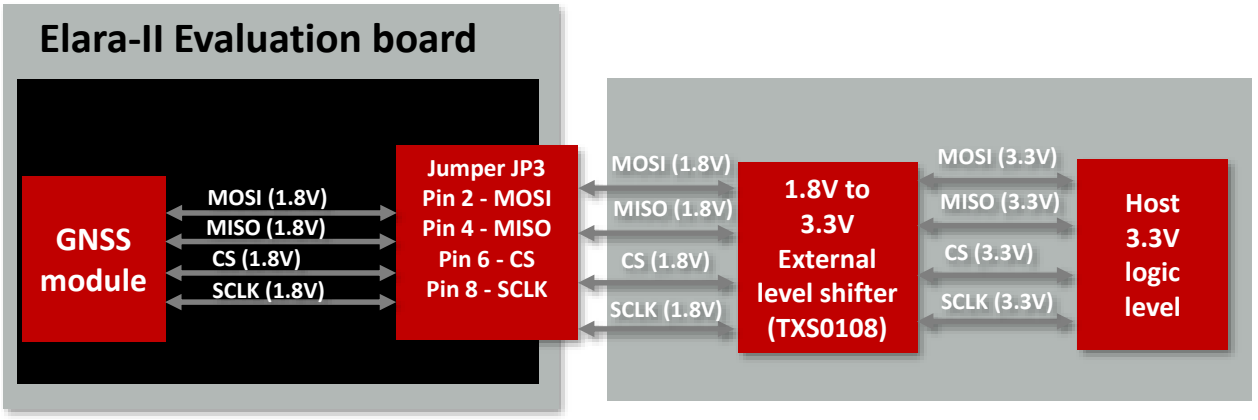


Figure 17: SPI Hardware setup

The block diagram illustrates the SPI bus access on evaluation board jumper JP3 and connection to a host with a logic of 3.3V.

The SPI bus outputs on jumper JP3 are 1.8V logic levels. Therefore, a suitable level shifter is needed for further logic level translation (i.e. when the host does not support 1.8V logic level). For a logic level translation to 3.3V, the level shifter TXS0108 by Texas Instruments is used in the tested hardware setup. Further information of the level shifter can be found at *https://www.ti.com/product/TXS0108E*.

Please note that the level shifter shall use a push-pull circuit and support SPI communication.

4.3.2 Evaluation Board Setup - SPI

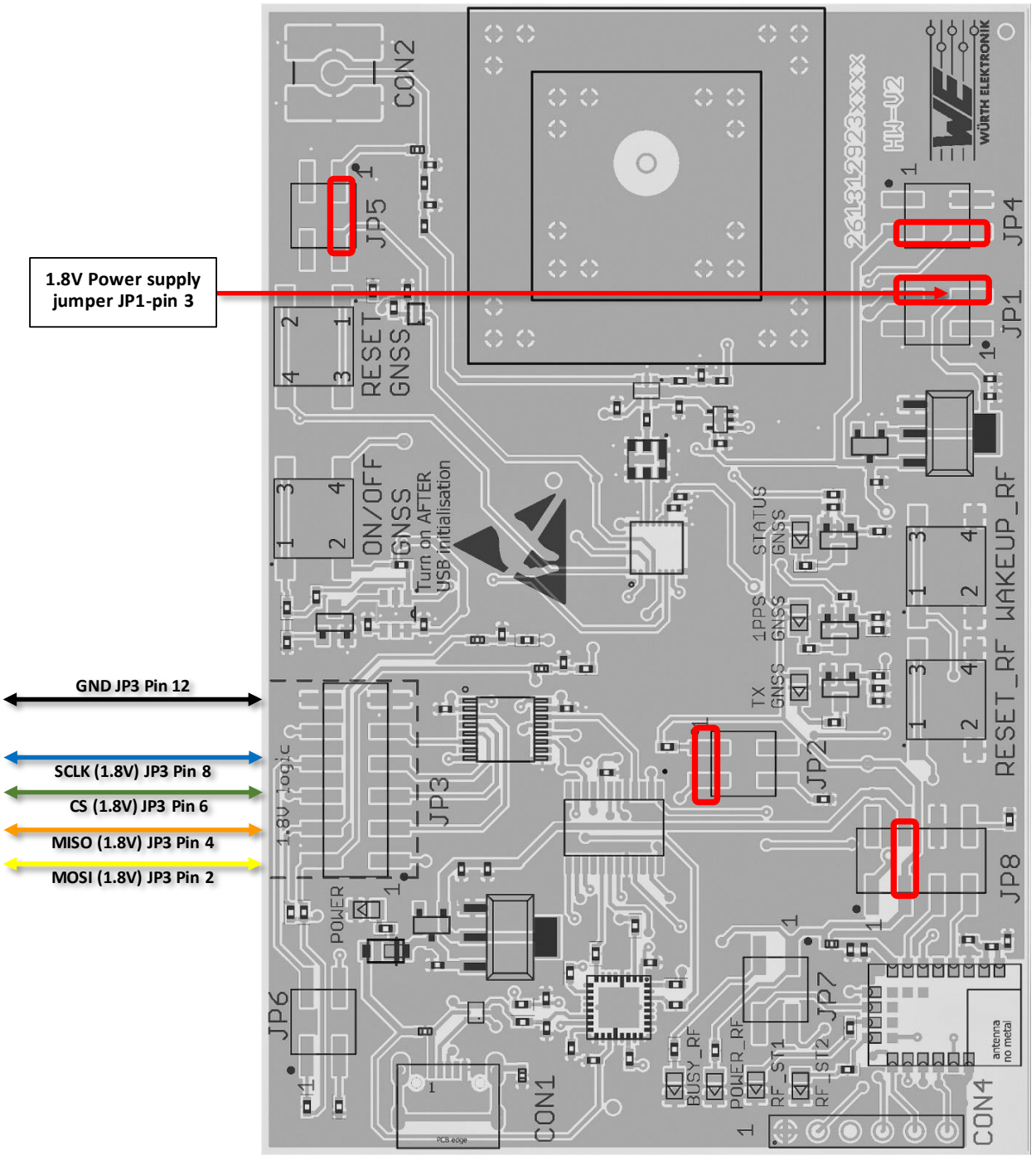


Figure 18: SPI bus access on evaluation board

Figure 18 illustrates the jumper settings and the necessary pins to access the SPI bus on the evaluation board.

The SPI bus (1.8V logic level) can be accessed through the jumper JP3.

Jumper JP3 (1.8V logic level)	
MOSI	Pin 2
MISO	Pin 4
CS	Pin 6
SCLK	Pin 8
Ground	Pin 12

Table 7: SPI Jumper JP3 Connection

During module power up the JP3 pins shall be left open.

The 1.8 V reference supply can be accessed through JP1 Pin-3.

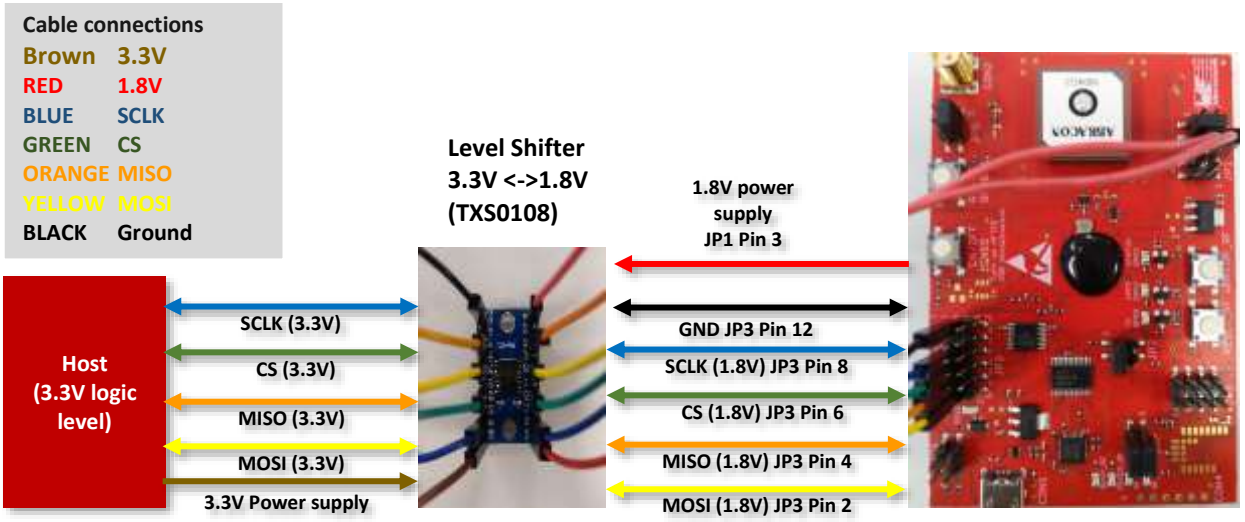


Figure 19: SPI communication setup - Elara-II evaluation board to 3.3V Host

5 Regulatory compliance information

Pursuant to Article 1 (2.) of the EU directive 2014/53/EU, Article 1 (2.) the directive does not apply to equipment listed in Annex I (4.): custom-built evaluation kits designed for professionals to be used solely at research and development facilities for such purposes. The evaluation board itself is not FCC approved for resale; meant for evaluation purposes only.

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List of Figures

1 2613029237001 - product image . . . 6
2 2613029237011 - detail of the Thyone-I RF interface . . . 7
3 Block diagram . . . 9
4 Jumpers - default setting . . . 10
5 Connectors . . . 13
6 Buttons . . . 15
7 Schematic sheet-1 . . . 21
8 Schematic sheet-2 . . . 22
9 Schematic sheet-3 . . . 23
10 Assembly diagram . . . 24
11 Top,bottom & internal layers . . . 25
12 PC-Tool . . . 27
13 Putting into operation - Thyone-I + Elara-II . . . 29
14 I^2C Hardware setup - Elara-II . . . 30
15 I^2C evaluation board modification - Elara-II . . . 31
16 Elara-II- GNSS evaluation board connection to 3.3V Host . . . 32
17 SPI Hardware setup . . . 33
18 SPI bus access on evaluation board . . . 34
19 SPI communication setup - Elara-II evaluation board to 3.3V Host . . . 35

List of Tables

1 Compatibility . . . 6
2 Content Elara-II module EV-Kit . . . 7
3 Content Elara-II module EV-Kit with Thyone-I RF interface . . . 7
4 I^2C Interface Setting . . . 30
5 I^2C Jumper JP3 Connection - Elara-II . . . 32
6 SPI Interface Setting . . . 33
7 SPI Jumper JP3 Connection . . . 35

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74638 Waldenburg
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Tel.: +49 651 99355-0
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www.we-online.com/wireless-connectivity