RF G5 FAST MCP

Installation instructions

& User manual

GOLDTEC
CONTROL SYSTEMS

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Minimum versions:

Dream 2 version 4.110.207

Sapir 2 version 0.202.603

RF Master G5 version 2.14

RF UNIT version 4.15

RTU RF Modular G5 version 4.17

RTU RF ECO G5 version 5.10

RTU RF 4 ANA G5 version 3.12

RTU RF SDI G5 version 3.08

Radio Modem version 1.01

WorkBench version 1.0.0.103

TreeView version 1.0.0.xx

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INTRODUCTION TO THE RF G5 FAST MCP

Talgil Computing and Control Ltd is happy to present the new RF System called **RF G5 Fast MCP**. The RF G5 Fast is a new communication protocol that is supported by the **Dream 2** and **Sapir 2** irrigation controllers. The RF G5 Fast works with the regular RF G5 units by upgrading the firmware version of the Irrigation controller, Master unit, and RTUs.

This quick user guide describes, step by step, how to upgrade a system to work in G5 Fast mode. This process is relevant for new installations or when upgrading an existing project to work in G5 Fast mode.

The RF G5 Fast arrives with advanced properties, advantages, and new features. It Includes new Tools, professional PC software, and smartphone applications for Programming, Monitoring, Analyzing, and Troubleshooting.

The RF G5 Fast is compatible with the WorkBench and TreeView software. It is supported by the Radio Modem and Talgil ToolBox App.

Read on to learn about the RF G5 Fast mode, the Advantages of the new mode, new features, how to program the unit with the Workbench software, how to use the TreeView software for Analyzing, and Troubleshooting, how to use the Radio Modem and Toolbox app and more…

Talgil Computing and Control wishes you success in working with the new product and further down the road.

If you have any questions or need assistance, don’t hesitate to drop us a message or leave a comment. Our team is always here to help.

RF G5 FAST MCP BROCHURE

The advanced Multi-layer communication protocol RF G5 SYSTEM

Following the tradition of the well-known family of **TALGIL's** RF Units, the Multi-layer communication protocol RF G5 Fast system, offers a perfect solution for controlling distributed irrigation systems, when using cable is impossible or undesirable. The new mode, called RF G5 Fast, arrives with a new communication protocol, advanced properties, and new features. Includes new Tools, professional PC software, and smartphone applications for programming, Monitoring, Analyzing, and troubleshooting.

General Features:

- **Low power consumption:** For energy-saving purposes, the outputs activated by the system are pulse-latching.
  - The RTUs are energized by standard Alkaline batteries. ROUTERS, RTU with Analog inputs, SDI, or LIN Cards are energized by solar cells with rechargeable batteries.
- **Frequency:** Automatic selection of the suitable frequency.
  - Automatic selection of the most suitable routing option.
  - Change the frequency Automatically when detecting a problem.
  - License exempt. No licensing is required.
- **Communication:** Supported by the **Dream 2** and **Sapir 2** professional irrigation controllers with a Baud rate of **115200** Bits per second.
  - Supports up to **500 RTUs** in one system.
  - Asynchronous communication- The RF units send data only when there is a change. This feature reduces the traffic in the air and reduces the Duty cycle.
  - Low transmission energy of 10 milliwatts.
  - To assure information integrity, each communication gets a confirmation signal and failure is followed by retries.
  - Bidirectional communication between the RTUs and the Master unit enables activating remote outputs and reading the RTU status, settings, digital inputs, Analog inputs, Flow, accumulation, and more.
  - **OTA**-Upgrading the RTUs firmware version **O**ver **T**he **A**ir.
- **Routing mechanism:** Every unit can be used as a router to help another RTU to join the network. Set up a router by pressing the ROUTER button or remotely by the Radio Modem and ToolBox app.
  - **Distance:** Under good conditions, the distance between two units in the communication chain can reach a distance of 2.5 km.
  - Covering an area of up to 25 km by multiplying up to 10 times routers for others.
  - **RTUs:** Local I/O test mode in RTU Modular, ECO, and I/O 8/4 LIN card.
  - Automatic shutdown of outputs on communication loss and automatic recovery when communication is regained.
  - Onboard LEDs and Sound to describe the RF communication, Hardware, Charging, and Battery status.
  - Reporting RTU low battery voltage.
  - Configurable wakeup signals.
  - Existence of a diagnostic RF sniffer tool/Radio Modem to monitor the Radio signals and Analyze them for troubleshooting.
  - Professional PC software and smartphone application for programming, Monitoring, and troubleshooting.
  - Programmable RF units grant flexibility to meet the requirements in the field.
- **Variety of RF RTU types:** **Modular RTU-** Modular structure allows operation of up to 8 Outputs and Reading up to 8 Digital Inputs or 4 Digital and 1 Analog Input. In addition, a variety of LIN Cards can be connected to the RTU Modular to expand the number of Outputs, Digital Inputs, Analog Input, and SDI values. Moreover, supports special sensors such as Water pH EC and THD.
  - **RTU ECO**- Economic RTU with up to 2 Output/2 Digital Inputs/ 2 Analog inputs.
  - **RTU 4 ANA-** Reads up to 4 standard analog sensors (4-20mA/0-5V) with a 12-bit resolution.
  - **RTU SDI-** reads a maximum of 64 values from up to 10 SDI sensors.
  - **Radio Modem-** Used as a Sniffer for troubleshooting. In addition, used for Programming the RTUs remotely.
  - **Workbench-** Professional PC software for Programming.
  - **TreeView-** Professional PC software for Troubleshooting.
  - **Talgil ToolBox-** Professional smartphone application for Programming. Supported by Android and iOS operating systems.

Upgrading the Dream 2 firmware version to the beta version.

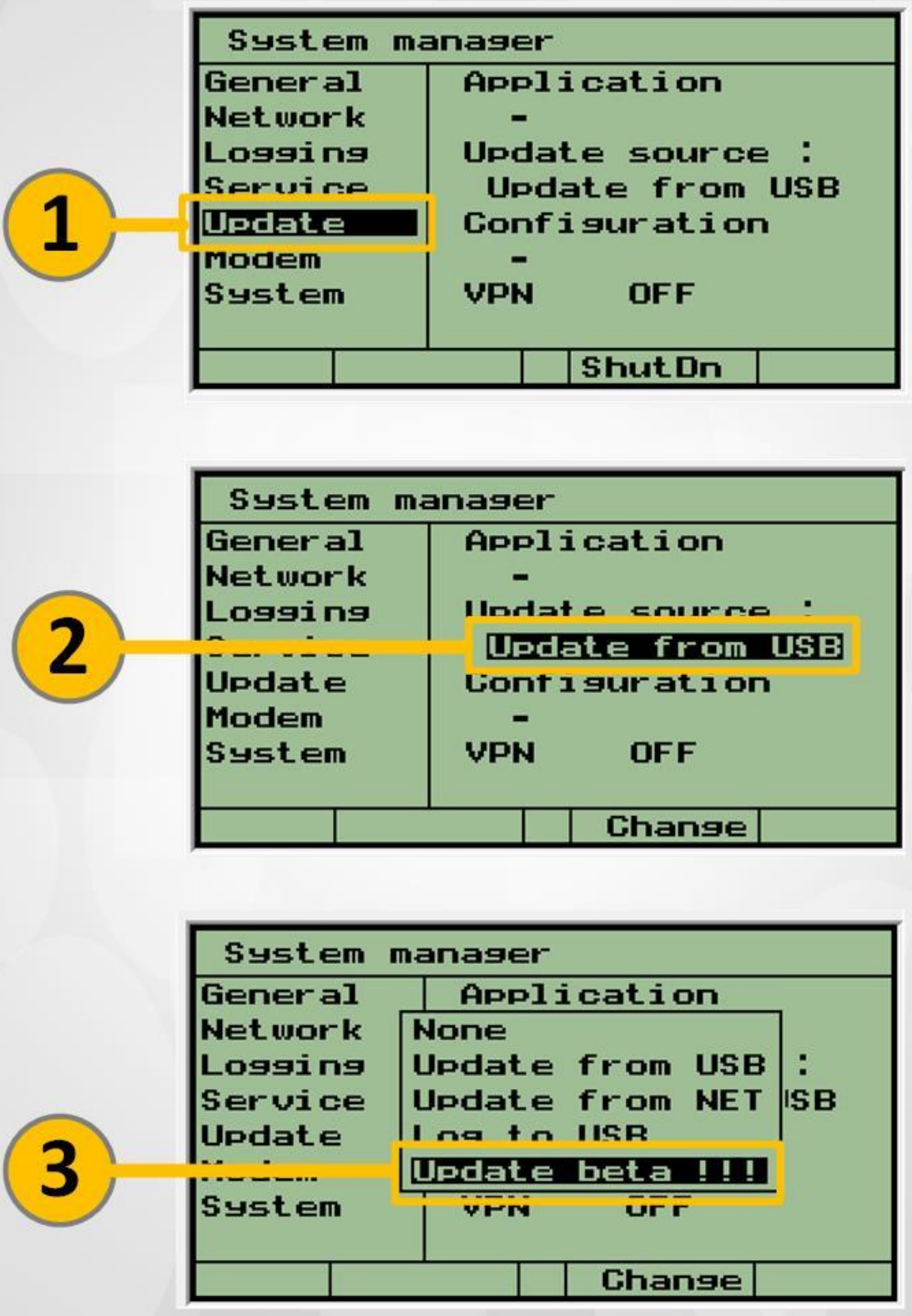


Image 1–System manager/Update screen.

1. DREAM2-UPGRADING THE FIRMWARE VERSION TO THE BETA VERSION.

The **RF G5 Fast mode** is supported by the **Dream 2** version 4.110.907 and up. In **Sapir 2**, it is supported in version 0.202.612 and up. At this point (October 2023), Dream 2 version 4.110.907 is a beta version.

If the controller firmware version is lower than the minimum version, please upgrade the controller firmware version.

To Upgrade the Dream 2 to the beta version, navigate to the **System Manager** screen as described in image 1 and follow the instructions below.

To navigate to the **System Manager** screen, hold the **PageUp** button then press the **PageDown** button.

1. In the **System Manager** screen Select **Update**.
2. Move the cursor to the **Update source** field on the right column.
3. Under **Update source**, select **Update beta!!!**.

The **Dream 2** will download the beta version from the server. When it finishes the download, the **Dream 2** will reset and turn on with the new firmware version.

It is possible to do the firmware version upgrade via a USB flash drive.

2. DREAM 2- SLOW AND FAST COMMUNICATION PORTS.

In the **Dream 2** controller, there are two communication ports called **Remote I/O Slow** (Blue plug) and **Fast** (Orange plug).

By default:

1. The Blue port called **Remote I/O Slow,** is working in the **Slow** mode and supports Interfaces address 1 to 15. The communication baud rate is 9600 bits per second.
2. The orange port called **Remote I/O Fast,** is working in the **Slow** mode and supports Interfaces address 16 and up. The baud rate is 9600 bits per second.

When the Orange port mode is Fast,

1. The Blue port called **Remote I/O Slow,** is working in the **Slow** mode and supports Interfaces address 1 to 15. The baud rate is 9600 bits per second.
2. The orange port called **Remote I/O Fast,** is working in the **Fast** mode and supports Interfaces address 1 to 59. The baud rate is 115200 bits per second.

3. DREAM 2- G5 FAST INTERFACES.

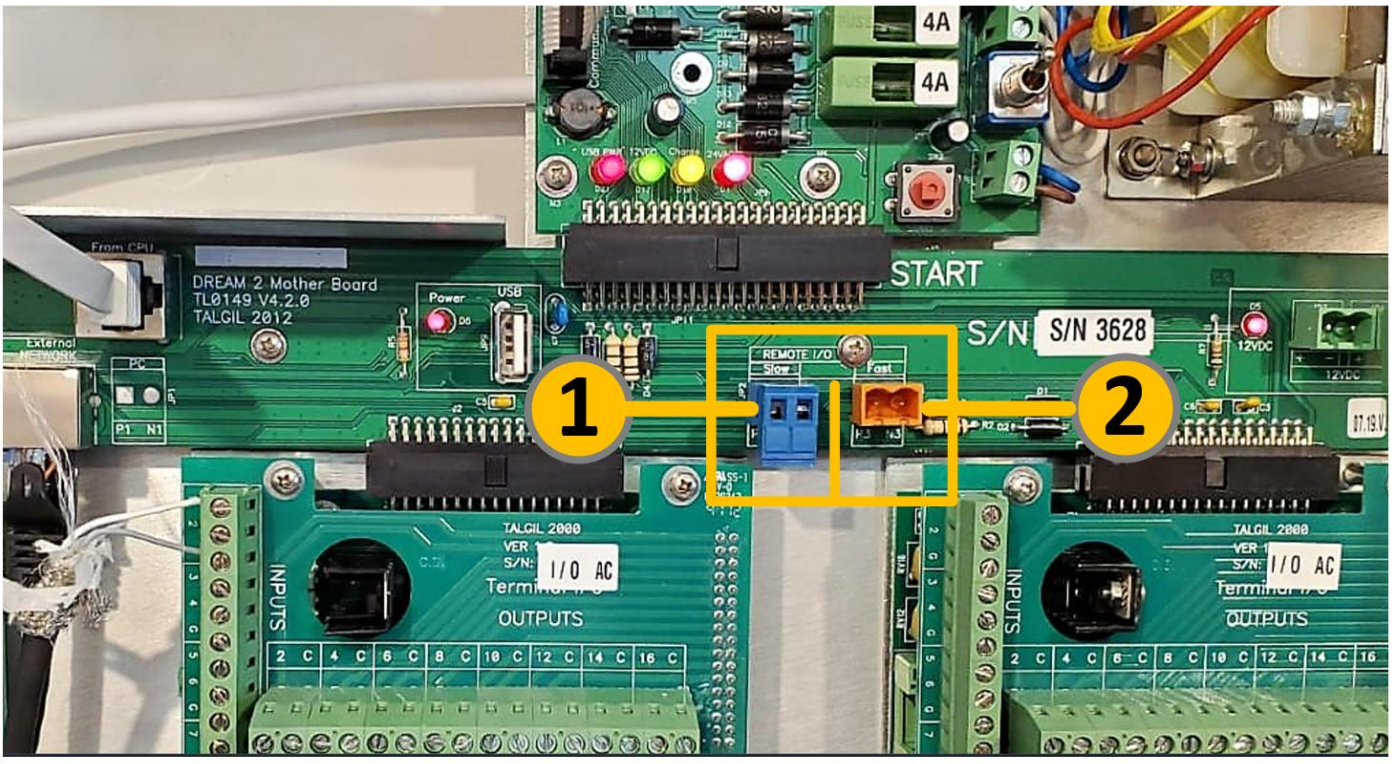


Image 2–Dream 2- REMOTE I/O Slow and Fast.

At this point (October 2023), the Interfaces that support the G5 Fast communication protocol are **Interface AC/DC** and **RF MASTER G5.**

1. By default, the jumper **JP7** on the **Interface AC/DC** is on OLD. When the Jumper is on OLD, the mode is Slow. To change the **Interface AC/DC** mode to work in the Fast mode, put the Jumper JP7 on **NEW**.

❖ At this point (October 2023), Interface AC/DC that is connected directly to the Mother Board can work in the slow mode only. **Only remote Interface AC/DC** that is connected to the **orange port** can work in the Fast mode.

2. By default, the generation of the **RF MASTER G5** is **4**. When the generation is 4, the mode is Slow. To change the **RF MASTER G5** to work in the Fast mode, use the **Workbench PC software** and change the generation to **5**.

Interface AC/DC FAST **MASTER G5 FAST**

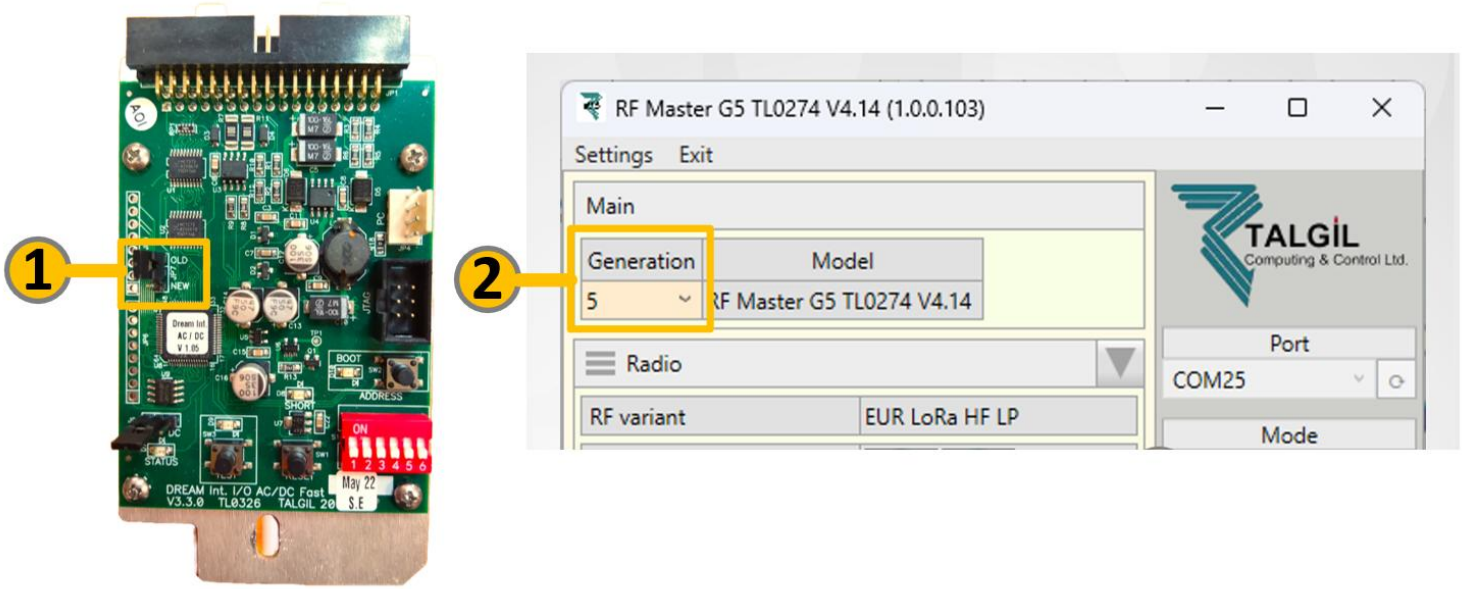


Image 3–FAST Interfaces.

Dream 2-Switching the Orange port to work in Fast mode.

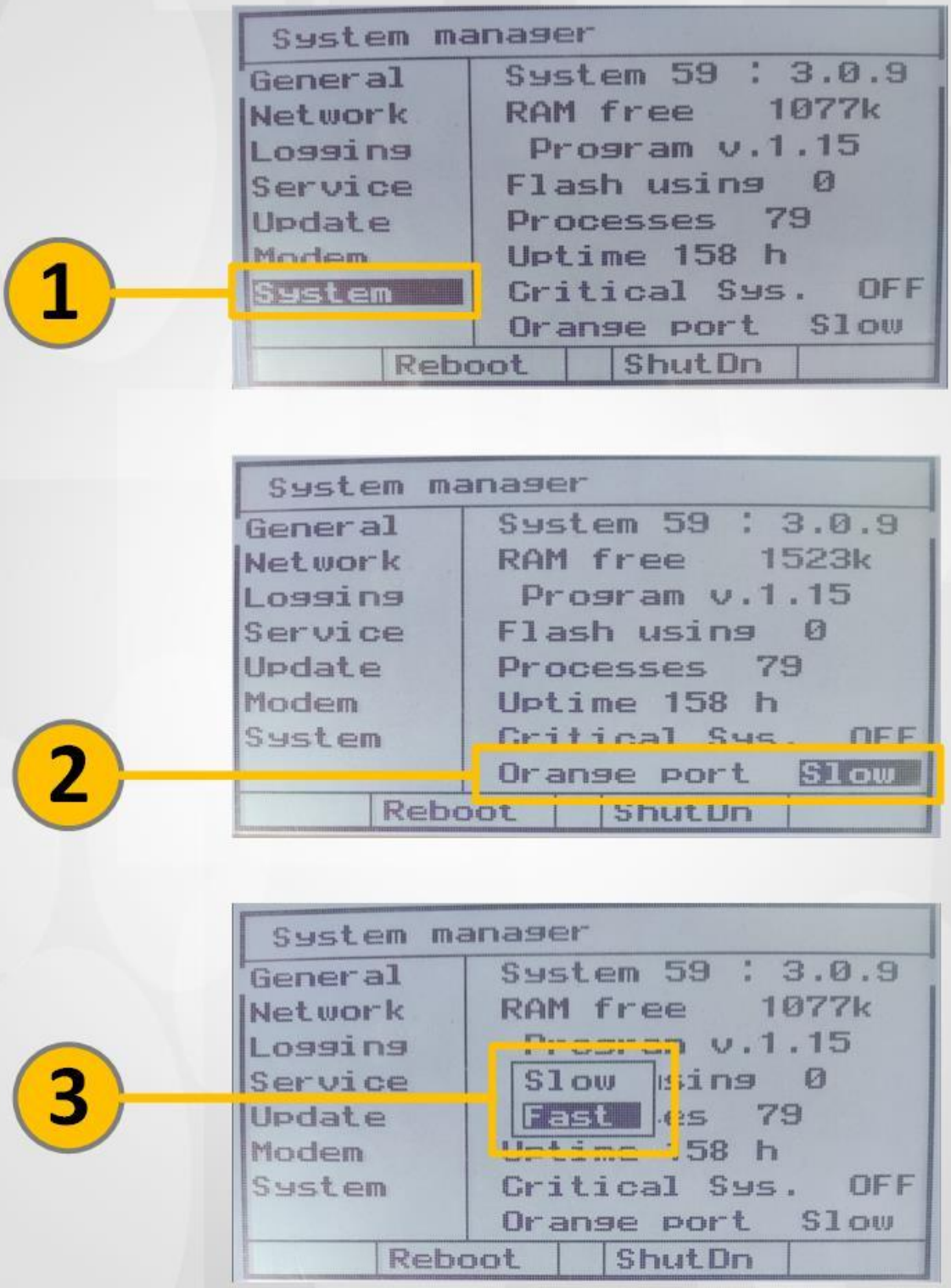


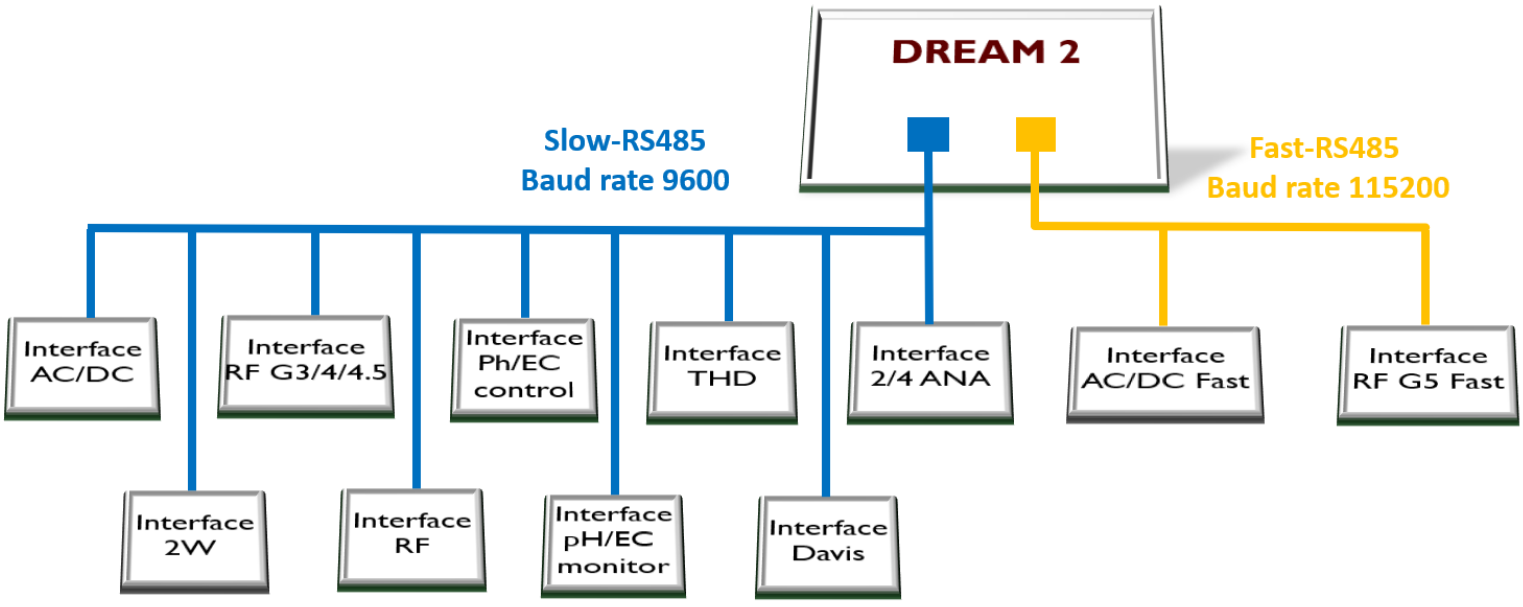
Image 4–System manager screen/System.

4. DREAM 2- SWITCHING THE ORANGE PORT TO WORK IN THE FAST MODE.

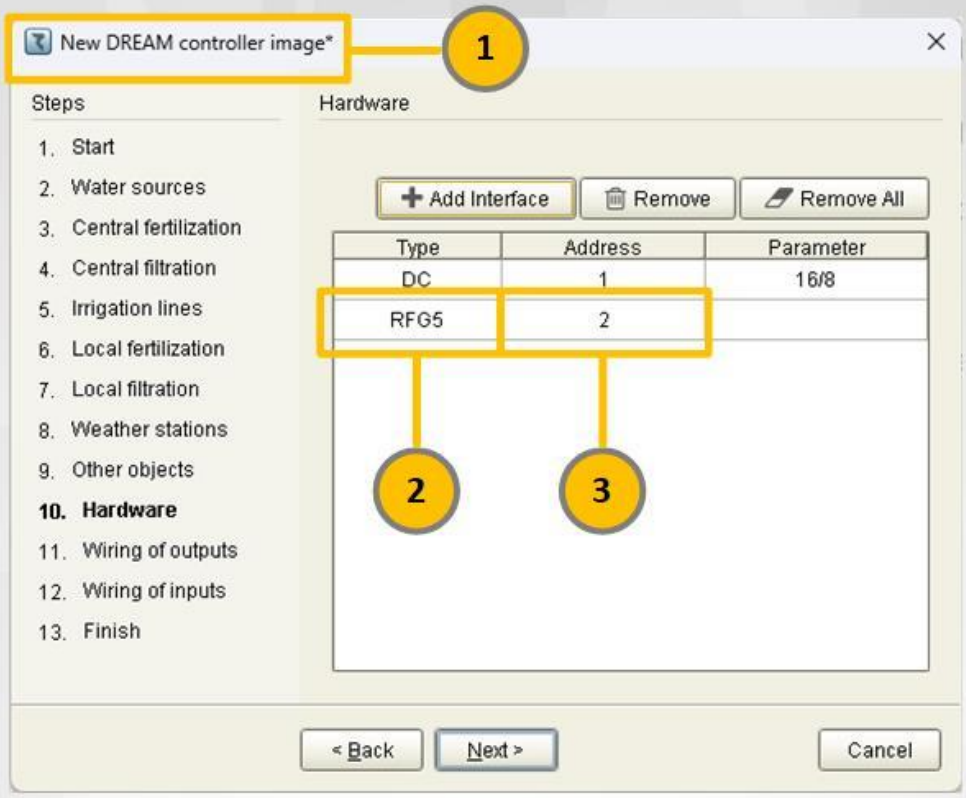
To support **Fast Interfaces** (**RF G5 FAST** or **Remote INTERFACE AC/DC FAST**), change the orange port mode to work in the FAST mode. To change the **orange port** to work in the **FAST** mode, follow the instructions below:

1. Navigate to the **System Manager** screen. select **System** as described in **Image 4**.
2. On the System screen, press F4 (Right) and navigate to the **Orange port**.
3. Press **Enter** and change the orange port to **Fast** mode.

When the orange port is defined to work in the Fast mode, it is not possible to connect Slow and Fast Interface to the same communication port. In this mode, the Blue port supports only Slow Interfaces and the Fast port supports only Fast Interfaces.



Adding Interface RF G5 Fast to the Dream 2/Sapir 2 using the Image maker.



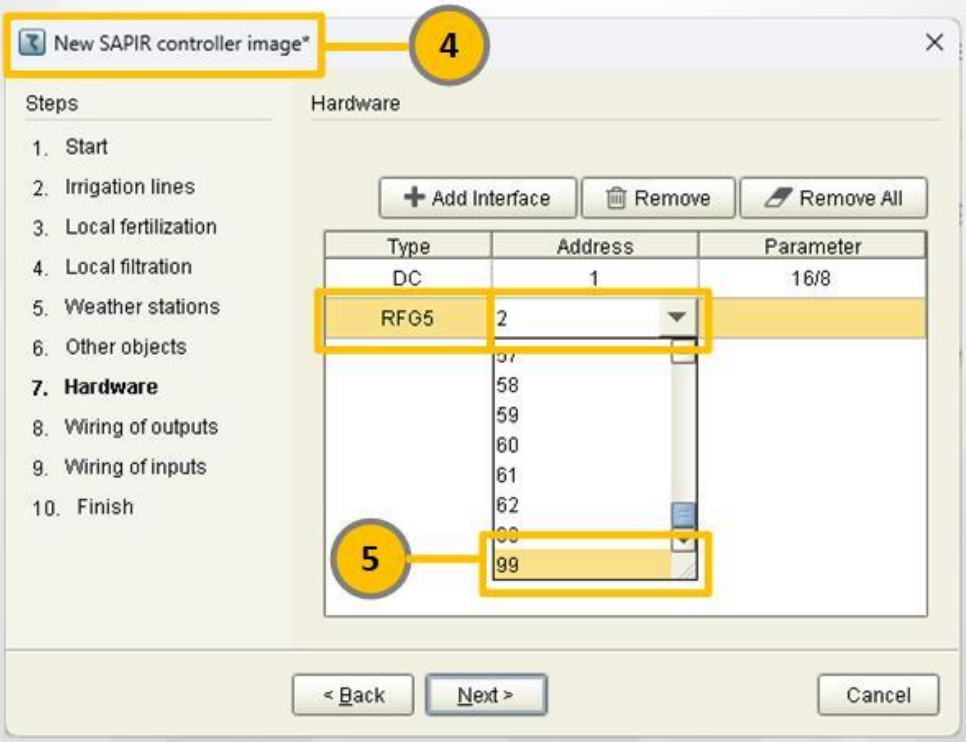


Image 5–The Image maker.

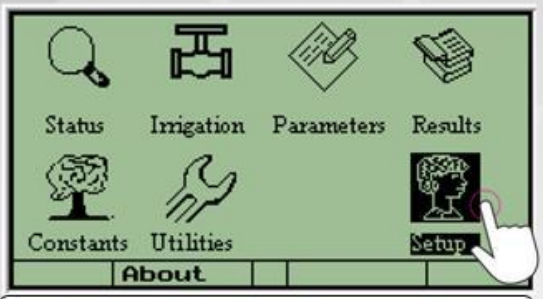
5. ADDING INTERFACE RF G5 FAST USING THE IMAGE MAKER.

1. To add Interface RF G5 Fast to the **Dream 2**, download the configuration of the **Dream 2** controller to the Image maker as described in **Image 5.**
2. To add Interface RF G5 Fast to the Image maker add **Interface RF G5.**
3. Select an available address for the **RF G5 Interface**. In the Dream 2, the address can be 1 to 59.
4. To add Interface RF G5 Fast to the **Sapir 2**, download the configuration of the **Sapir 2** controller to the Image maker**.**
5. When the **RF MASTER G5** does not have dip switches to set the Address (**RF Master for Sapir 2**), use Interface address **99** (Because the address is defined in the firmware version as **Address 99**. It is constant address).

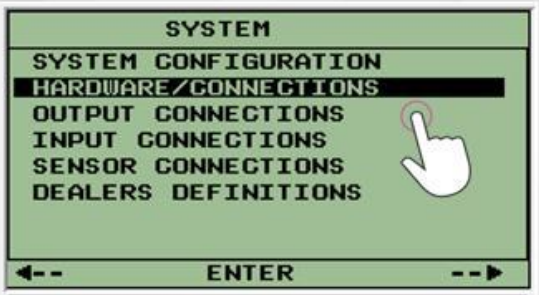
RF MASTER FOR DREAM 2

RF MASTER FOR SAPIR 2

RF G5 – Hardware Definitions on Dream 2.

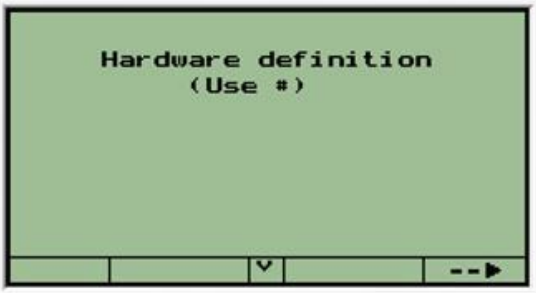


Screenshot 1- Select the SETUP submenu.

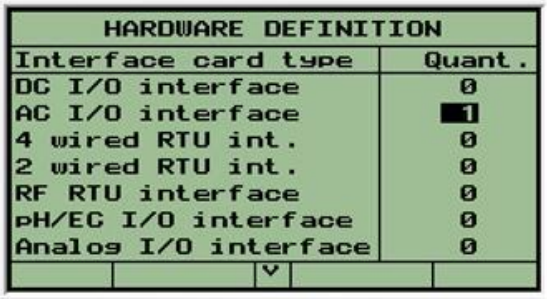


Screenshot 2-
Select HARDWARE/CONNECTIONS.

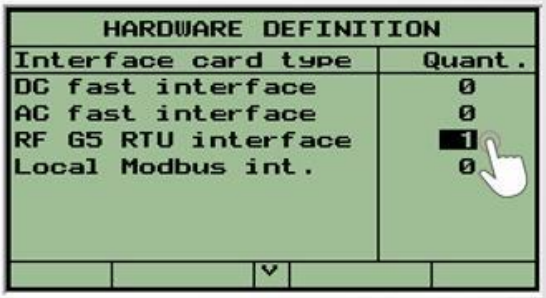
Screenshot 3- Enter the password "247".



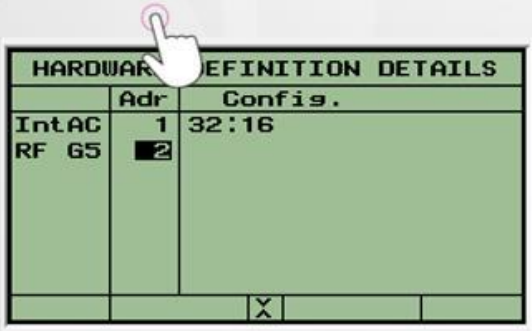
Screenshot 4- Press Page Down.



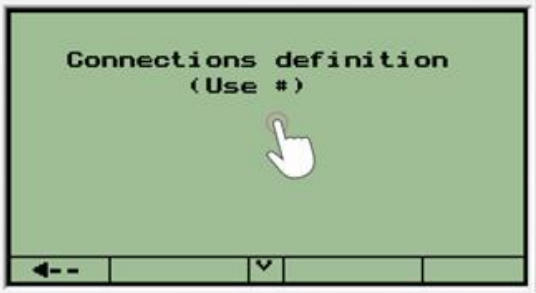
Screenshot 5- Press Page Down.



Screenshot 6- Add 1 RF G5 Interface.



Screenshot 7- Set address to the Interface RF G5. To exit, press Page Down then F4.



Screenshot 8-Set up the Connections of Outputs and Inputs. To exit, press F4.

Image 6 – Hardware Definitions in the Dream 2.

6. ADDING INTERFACE RF G5 FAST USING THE DREAM 2 MMI.

1. To add an **Interface RF G5 Fast** to the **Dream 2** configuration through the Dream 2 MMI, navigate to the **Setup** screen as described in **Image 6**.
2. Select the **Hardware/Connections** option**.**
3. To change the **Hardware Definition**, Enter the password "**247".**
4. At the **Hardware Definition** screen, press **Page Down**.
5. A list of regular Interfaces will appear. To skip, press the **Page Down** button.
6. A list of **Fast Interfaces** will appear. Add 1 **Interface RF G5.** To skip, press the **Page Down** button.
7. Select an available address for the **Interface RF G5.** To skip, press the **Page Down** button**.**
8. The **Hardware definition** screen will appear. To exit, press the **F4** button.
9. The **Connections Definition** screen will appear. To exit, press the **Page Down** button then press the **F4** button.

RF Master G5– Installation.

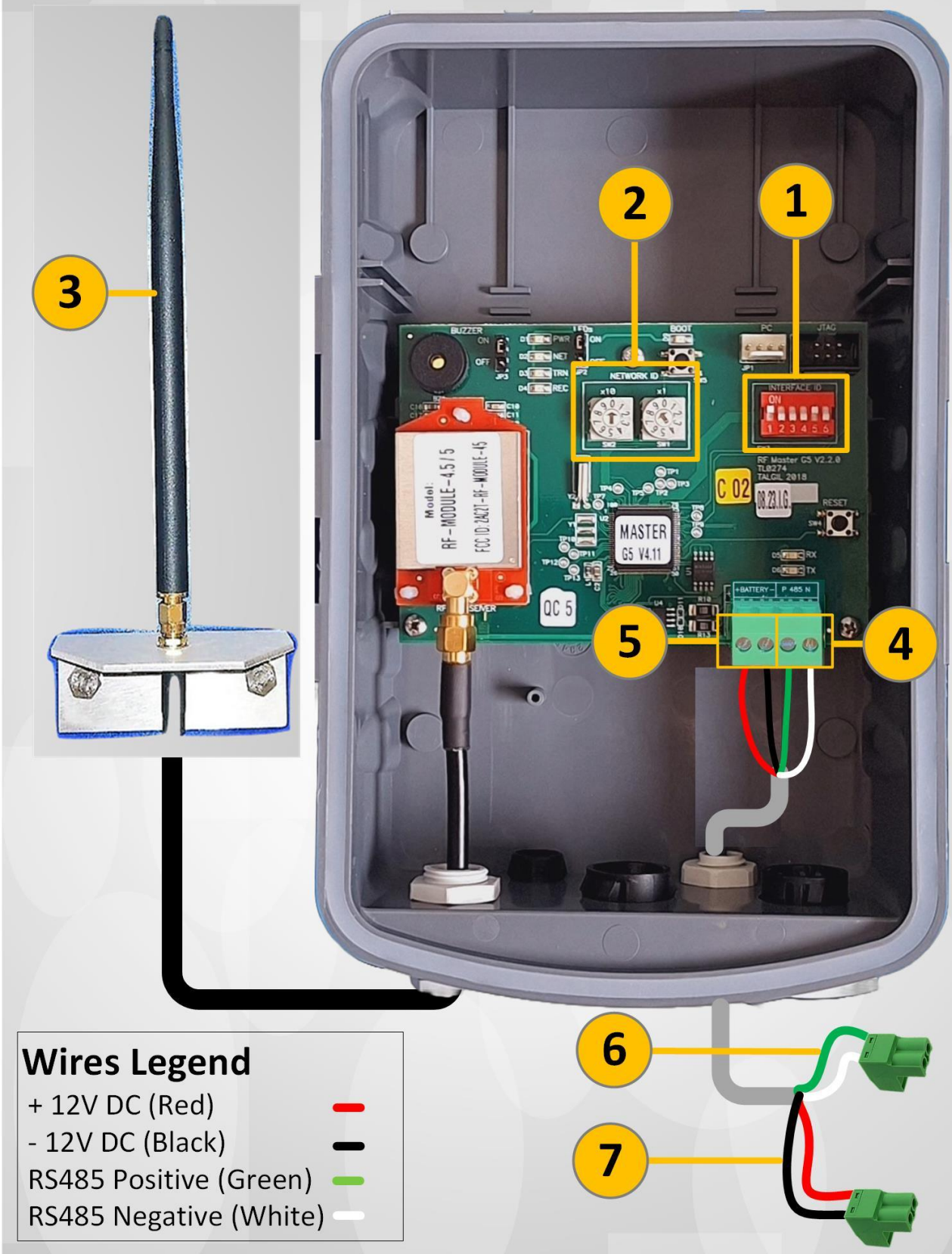


Image 7 – RF Master G5 card.

7. RF MASTER G5- INSTALLATION

1. Use the dip switches block called **INTERFACE ID** to set up the RF Master G5 **INTERFACE ID** as described in **Image 7**. The **INTERFACE ID** should be identical to the RF G5 Interface address as defined in the configuration.
2. Every **RF G5** system must use a unique **NETWORK ID**. Make sure that the **NETWORK ID** is not used by another RF system in this area. Use the **Sniffer** or the **Radio Modem** and **TreeView PC software** to identify other RF Systems in this area. To set up the **NETWORK ID,** use the **NETWORK ID** rotary switches. When using the Rotary switches, the range of the **NETWORK ID** is **1** to **99.**

   There is an option to set up a software **NETWORK ID.** To set up the software **NETWORK ID**, set the **NETWORK ID** Rotary switches to 0 and use the **Workbench PC software** to change the software **NETWORK ID.** The range of the software **NETWORK ID** is **1** to **65535.**
3. To improve the **RF** communication, install the **Antenna** in a high place. Do not install the **Antenna** behind a metal pipe. The Antenna must be installed on a pipe made of non-metallic material. For example, use a PVC pipe to hold the Antenna. Make sure that the **RF G5 MASTER Antenna** has the best **Line of sight** to the most RTUs.
4. Connect the **RS485** two wires to the **RF G5 MASTER.** The **Green** wire should be connected to the **P** (Positive). The **White** wire should be connected to the **N** (Negative).
5. Connect the two wires of the **12V DC** Power supply to the **RF G5 MASTER.**
   The **Red** wire should be connected to the **+ BATTERY** (+12V DC).
   The **Black** wire should be connected to the **– BATTERY** (-12V DC).
6. Connect the **RS485** two wires to the **orange** port in the **Dream 2** called **Remote I/O Fast.**
   The **Green** wire should be connected to the **P** (Positive).
   The **White** wire should be connected to the **N** (Negative).
7. Connect the two wires of the **12V DC** Power supply to the **12V DC** Plug on the **Dream2 Motherboard.** The **Red** wire should be connected to the **+ 12V DC**.
   The **Black** wire should be connected to the **- 12V DC**.

Selecting an available Frequency:

After connecting the power supply plug, the **Master** unit starts to check the frequencies and select automatically the first frequency that is clear and not in use by another RF system in the vicinity. After finding the best frequency to work, the Master will receive TEST packets from the RTUs and start to join the RTUs to the RF system. When detecting that 10% of RTUs are disconnected for 10 minutes, the **RF MASTER G5** skips to another available frequency automatically to improve communication. The RTUs will skip to the new frequency automatically.

Upgrading the firmware version of RF Master G5.

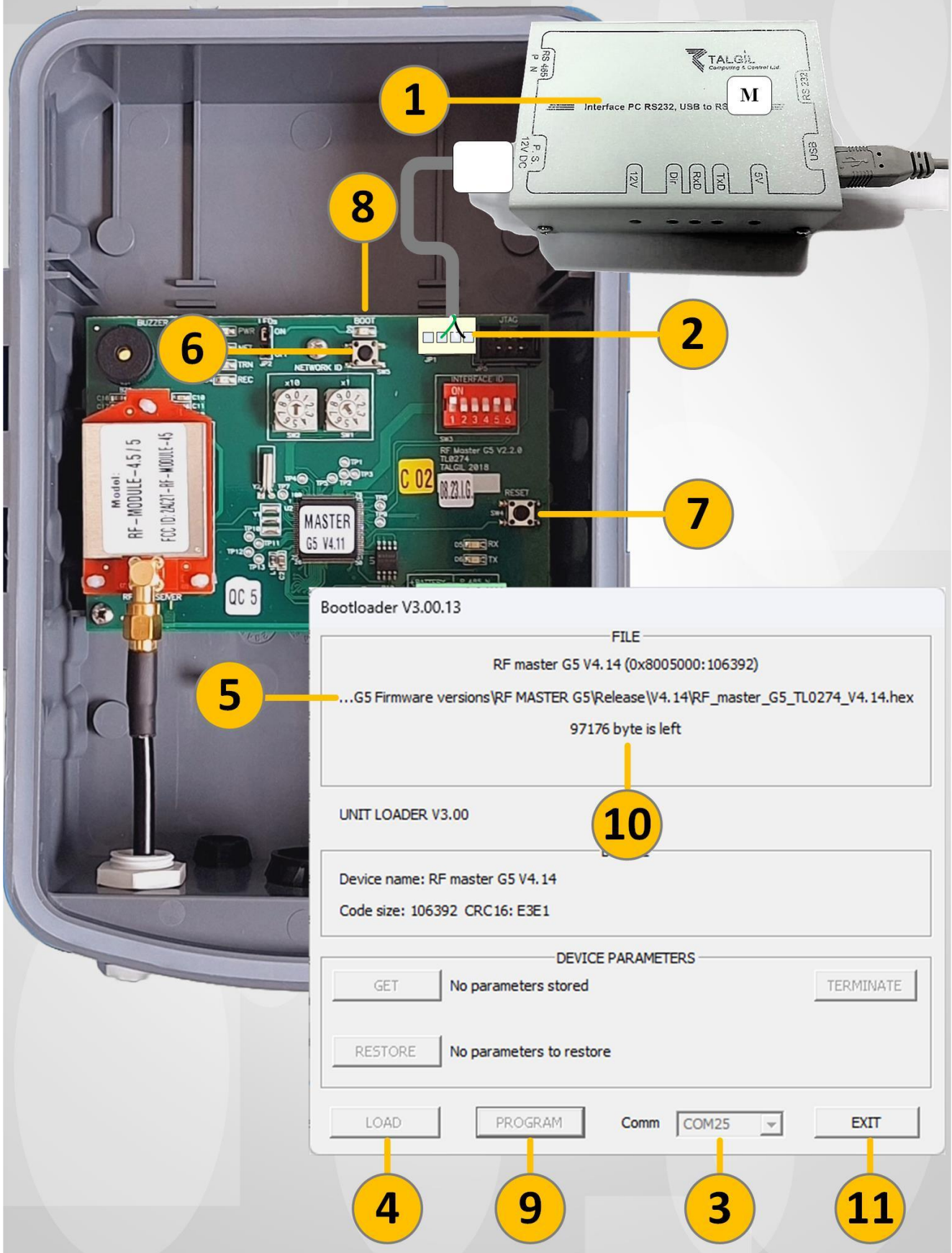


Image 8 – Upgrading the firmware version of RF Master G5.

8. RF MASTER G5- FIRMWARE VERSION UPGRADE.

Make sure that you are using the latest Firmware version of the **RF Master G5**. Use the links below to download the latest firmware version and the **CBoot PC software**. To start the firmware version upgrading process, please follow the instructions below:

1. Connect the **Programmer Device** to your PC.
2. Connect the **Programmer device** cable to the **PC Socket** on the **RF MASTER G5** card as described in **Image 8**.
3. Start the **CBoot** PC software and select the **Communication port.**
   If you do not have the **CBoot** software, download it here:
   https://drive.google.com/drive/folders/17AZoFHJXi4XWkqNSbLTVXLVqKH4EP0tp?usp=sharing
4. Click the **LOAD** button, browse to the **RF MASTER G5** firmware version hex file and select it.
   To download the latest **RF Master G5** version, click here:
   https://drive.google.com/drive/folders/1sKFhwgJQYbp4QdtsRxNsHfZVxiYfyxnt?usp=sharing
5. The pathway to the hex file will appear on the screen.
6. On the **RF MASTER G5** card, press and hold the **BOOT** button.
7. While the **BOOT** button is pressed, press the **RESET** button. Leave the **RESET** button, after 1 second, leave the **BOOT** button. This action will put the **RF MASTER G5 mode** into a **BOOT Mode**.
8. In **BOOT Mode,** the **BOOT** led turns on.
9. To start the upgrading process, click the **PROGRAM** button.
   The upgrading process will start.
10. A progress indicator will appear on the screen**.** At the end of the process, a **Terminated** message will appear.
11. To close the **CBoot** software, click **EXIT.**

9. PREPARING TO PROGRAM THE RF MASTER G5 CARD

1. Connect a **Programmer device** to the **PC**.
2. Connect the **Programmer device** to the **PC socket** on the **RF Master G5 card** as described in **Image 9.**
3. Make sure that the Master's **BOOT LED** is **OFF**.
4. Start the **Workbench PC software**. Make sure that you are using the latest version. To Download the latest version of the WorkBench PC software, click here. (https://drive.google.com/drive/folders/1MyHe8iHkUQBm8AzeVlkPVU-HIq1_kW9N?usp=sharing).
5. Select the **Communication port** from the available communication port list.
6. To update/refresh the available communication port list, click the **Update** button.
7. To start the Serial communication with the **RF Master G5**, Click **Start.**

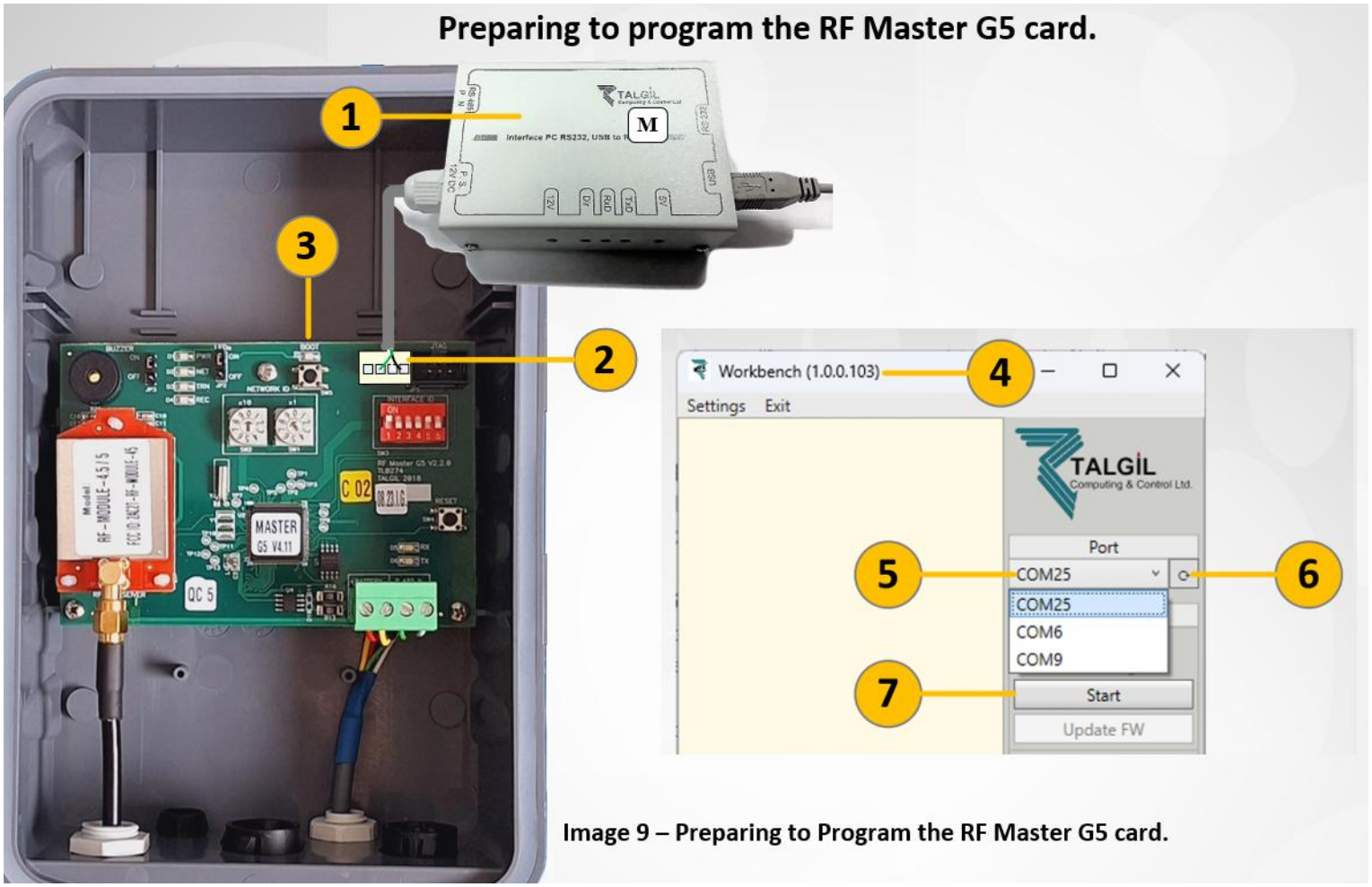


Image 9 – Preparing to Program the RF Master G5 card.

PROGRAMMING THE RF MASTER WITH THE WORKBENCH

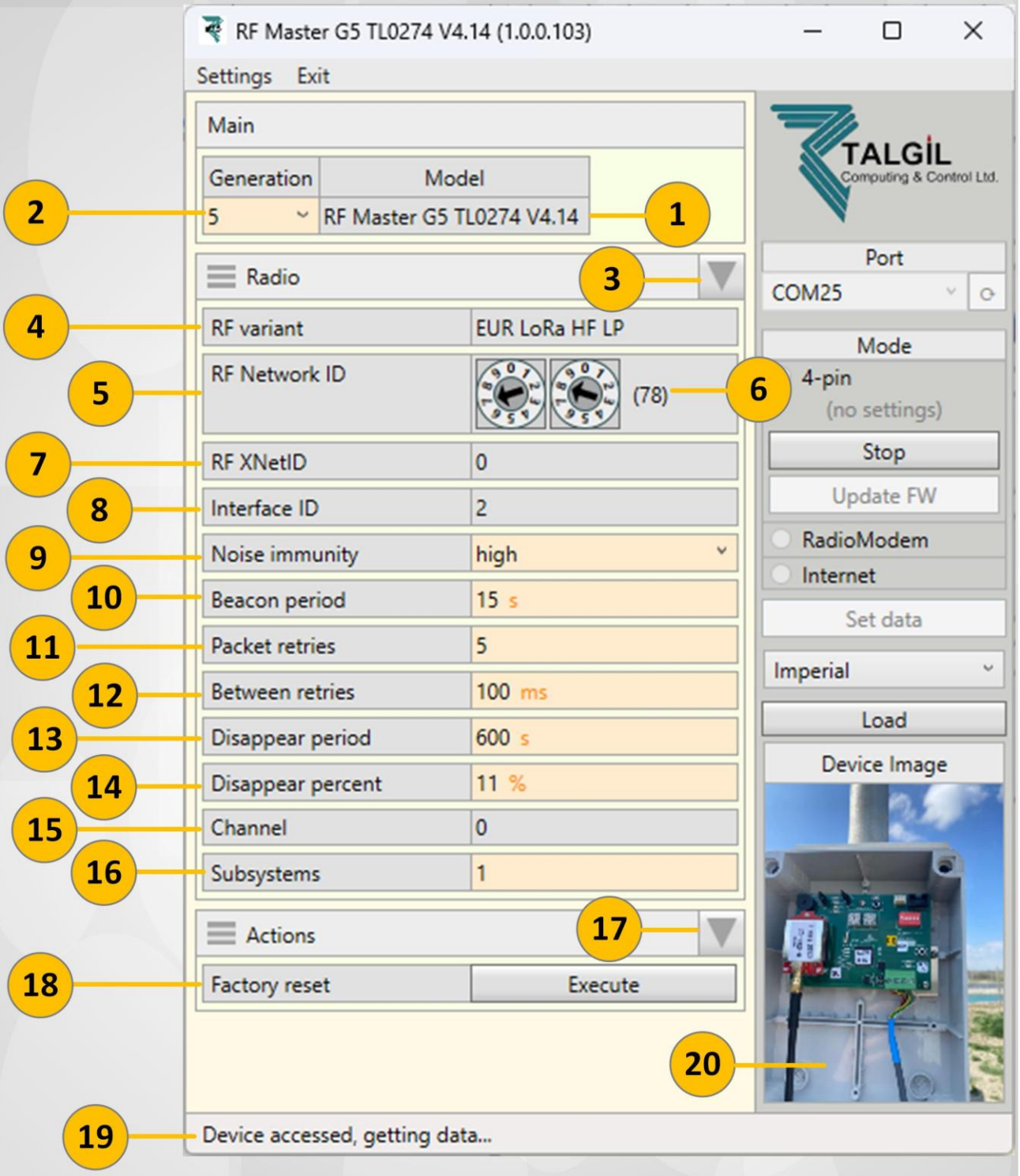


Image 10–The WorkBench PC software.

10. RF MASTER G5-SETTINGS.

After connecting to the **Master unit**, the **Workbench** will show the following settings:

1. **Model-** Describes the RF device type. In this case, it shows **RF Master G5** and his **TL** number. The TL number specifies the Hardware design version.
   In addition, the Master's firmware version appears in this field.
2. **Generation-** The Generation defines the RF communication protocol. **G4** means **REGULAR RF G5**. **G5** means **RF G5 FAST**. The RTUs change their generation automatically according to the Master's generation.
3. **Radio-** Click the **Expand** button to open the Radio window.
4. **RF Variant-** Determines the Country code, Modulation, Frequency, Bandwidth, Baud rate, and Bands. Make sure that you are using the correct Variant according to Table 1. To change the Variant, use the **SerialTool.**
5. **Network ID**- The Master's **Network ID**.
6. Shows the status of the onboard **Network ID** Rotary switches.
7. **RF XNetID**- This parameter defines the **software Network ID**. The **software Network ID** range is **1-65535**. The **software network ID** takes effect when the **Network ID Rotary switches** are set to **"0".**
8. **Interface ID**- Shows the status of the onboard **INTERFACE ID** dip switches.

9. **Noise immunity**-Defines the behavior while sending data to the Radio.
   There are two options. High noise or Low noise. It is recommended to work in High noise.
   Low noise-Low noise means that in a noisy environment, the Master unit will wait for better conditions before transmitting data.
   High noise-In this mode, the Master unit will transmit data in a noisy environment.

10. Beacon Period- The **Beacon** defines the period of time in seconds that the Master unit sends to the RTUs a **command to wake up**. In other words, the Master is the trigger to wake up the RTUs. By default, the Beacon period is 10 seconds. This means that the Master Unit will send a Beacon command to the RTUs every 10 seconds approximately. There are two types of Beacon packets. Beacon packet with an empty list of RTUs, and Beacon packet with a list of RTUs. The Beacon period should be changed according to the quantity of the RTUs (See Table 1).
Read on to see examples and descriptions.

10.1 Beacon 0 (Old mode, Not recommended) When the Beacon period is 0 (zero), the RTUs wake up without a request from the Master. The **Wake-up** period is defined in the RTU. By default, the **Wake-Up** period is **10 seconds**. Every 10 seconds, the RTU sends a Wake-Up packet to the Master. As a result, the Master returns an acknowledgment to the RTU. When the RTU is wake-up, if needed, the Master sends a command to open/close the outputs.
10.2 Beacon packet with an empty list of RTUs: When there is no irrigation (The Irrigation controller does not send a command to open or close the outputs), the Master sends a Beacon

command with an empty list of RTUs. As a result, the RTUs wake up at this time and do not respond to the Beacon command.

For example, look in the log file below, the Master sends a Beacon command. The Beacon period is 9.287 seconds (**PRD=9287)** and no RTUs appear in the list **{}**.
Time=**13:24:46**.915, SQN=79, **BCN** [NACK, RTR, MCP] L=0, SYS=78, **ID=0**, SNET=00000000, **PRD=9287**, **{}**, PWR=127

After 10 seconds approximately, the Master unit sends a new Beacon command:
Time=**13:24:56**.026, SQN=83, **BCN** [NACK, RTR, MCP] L=0, SYS=78, **ID=0**, SNET=00000000, **PRD=9591**, {}, PWR=127

10.3 Beacon packet with a list of RTUs: When there is irrigation (The Irrigation controller sends a command to open or close the outputs), the Master sends a Beacon packet with a list of RTUs that should return to the Master when they wake up. As a result, the RTUs wake up at this time and respond to the Beacon command. When the RTU is wake-up, the Master unit sends the request to open or close the Outputs.

For example, look in the log file below, the Master sends a Beacon command. The Beacon period is 10.634 sec (**PRD=10634)** and a request for **RTU number 2** to return to the Master **{2}**.
Time=11:10:49.485, SQN=123, **BCN** [N, RTR, MCP] L=0, SYS=78, ID=0, SNET=00000000, **PRD=10634, {2},** PWR=127

As a result, **RTU number 2** returns to the Master:
Time=11:10:49.809, SQN=165N L=1, SYS=78, **ID=2**, NET=00000001: {}, RSSI=-85, PWR=-86
When RTU number 2 is wake-up, the Master sends the command oreqx1 (Open output number 1):
Time=11:10:49.810, SQN=117F, MCP] L=0, SYS=78, ID=0, NET=00000001: {[2,0,87]G:w-**oreq=0x1**}, RSSI=127, PWR=127

11. **Packet Retries-** To assure information integrity, each communication gets a confirmation signal and failure is followed by retries. **Packet Retries** define the maximum number of retries that the Master will send when the packets do not reach the destination.
By default, **Packet Retries** is **5.**
12. Between retries- Defines the period of time in milliseconds that the Master unit will wait before sending a retry. By default, the period of time **Between retries** is **100** milliseconds**.**
13. Disappear period- Defines the period of time in seconds that several RTUs are disconnected from the Master. In other words, the period of time that several RTUs have communication errors. By default, the **disappear period** is **600 seconds** (10 minutes). This parameter is used to decide when to skip to another frequency.

14. Disappear percent- Defines the quantity of RTUs (in percent) that are disconnected from the Master. In other words, the quantity of RTUs that have communication errors.
By default, **Disappear percent** is 10% (10 percent). This parameter is used to decide when to skip to another frequency.

Skipping to another frequency:
To ensure that the selected frequency is clear and not in use by another RF system, the Master unit has a special mechanism to detect that several RTUs are disconnected for a long time. When several RTUs (more than **Disappear percent**) are disconnected from the Master unit for a long time (more than **Disappear period**), the Master unit skips to another frequency automatically. To find a new frequency, the Master starts scanning the frequencies and selects the first available frequency. When finding a new frequency, the Master starts to work in this new frequency. As a result, all the RTUs will detect that the Master does not respond to their packets and send **TEST** packets to find the new frequency that the Master uses. When the Master is answering a TEST packet, the RTUs ask to join the Master.

15. Channel- Specifies the RF channel that the Master unit is working on.
16. Subsystems- In old generations (Generation=4), when more than 60 RTUs are connected to the system, the first 60 RTUs are defined in the first Interface ID (Real Interface ID). The next 60 RTUs are defined in the next virtual Interface ID which is subsystem 2 and so on.
The maximum number of subsystems is **5**.
60 RTUs per subsystem multiple in 5 subsystems supports up to 300 RTUs (depends on the Duty cycle). In **RF G5 FAST**, Subsystems 1 supports up to 500 RTUs (depends on the Duty cycle).
When the Duty cycle is **below 15%**, it is **OK**.
When the Duty cycle is **above 15%**, it is recommended to **reduce traffic in the air**.
To reduce the traffic in the air, Increase the Sanity (Change the Sanity to 600 sec), Increase the sampling rate of Analog inputs, reduce the data transmissions of digital inputs (by using dividers), increase the Beacon period, or adding second Master.
For more details, See **Table 2**.
17. Actions screen- To open the Actions screen, click this button.
18. Factory reset- To reset the Master to Factory settings, click Factory reset.
19. Status bar- Showing the Serial communication status while reading the settings.
20. Device image- Image of the Master unit.

Table 1 -List of Countries and their Variants

ID	Country	SW RF variant [LP]	Variant number	SW RF variant [HP]	Variant number	Channels	Number of channels
1	Angola	eur lora hf lp	10			863 - 868MHz	6
2	Argentina	usa lora hf lp	0	usa lora hf hp	1	902 - 928 MHz	17
3	Armenia	eur lora hf lp	10			863 - 868MHz	6
4	Australia &NZL	aus lora hf lp	2	aus lora hf hp	3	915 - 928 MHz	8
	Australia &NZL	eur lora lf lp	18			433.545, 434.295 MHz	2
5	Austria	eur lora hf lp	10			863 - 868MHz	6
6	Azerbaijan	eur lora hf lp	10			863 - 868MHz	6
	Azerbaijan	eur lora lf lp	18			433.545, 434.295 MHz	2
7	Belarus	blr lora hf lp	45	blr lora hf hp	46	864.4 - 868.6 MHz	6
	Belarus	eur lora lf lp	18			433.545, 434.295 MHz	2
8	Brazil	bra lora hf lp	14	bra lora hf hp	15	902-907.5, 915-928 MHz	12
9	Bolivia	aus lora hf lp	2	aus lora hf hp	3	915 - 928 MHz	8
10	Bosnia	eur lora hf lp	10			863-868MHz	6
11	Bulgaria	eur lora hf lp	10			863-868MHz	6
12	Cambodia	khm lora hf lp	25	khm lora hf hp	26	866-869, 923-925 MHz	8
13	Canada	usa lora hf lp	0	usa lora hf hp	1	902 - 928 MHz	17
14	Chile	aus lora hf lp	2	aus lora hf hp	3	915 - 928 MHz	8
15	China	chn lora hf lp	37	chn lora hf hp	38	920.5 -924.5MHz	6
16	Croatia	eur lora hf lp	10			863 - 868MHz	6
17	Colombia	aus lora hf lp	2	aus lora hf hp	3	915 - 928 MHz	8
	Colombia	eur lora lf lp	18			433.545, 434.295 MHz	2
	Costa Rica	eur lora lf lp	18			433.545, 434.295 MHz	2
19	Dominican republic	aus lora hf lp	2	aus lora hf hp	3	915 - 928 MHz	8
20	Ecuador	usa lora hf lp	0	usa lora hf hp	1	902 - 928 MHz	17
21	Egypt	eur lora hf lp	10			863 - 868MHz	6
	Egypt	eur lora lf lp	18			433.545, 434.295 MHz	2
22	EL Salvador	aus lora hf lp	2	aus lora hf hp	3	915 - 928 MHz	8
23	Ethiopia	eur lora hf lp	10			863 - 868MHz	6
24	Georgia	eur lora hf lp	10			863 - 868MHz	6
25	Germany	eur lora hf lp	10			863 - 868MHz	6
26	Greece	eur lora hf lp	10			863 - 868MHz	6
27	Guatemala	aus lora hf lp	2	aus lora hf hp	3	915 - 928 MHz	8
28	Honduras	aus lora hf lp	2	aus lora hf hp	3	915 - 928 MHz	8
29	India			ind lora hf hp	50	865 - 867 MHz	9
31	Israel	isr lora hf lp	12	isr lora hf hp	13	915 - 917 MHz	3
	Israel	isr lora hf lp	52	isr lora hf hp	53	915 - 920 MHz	7
	Israel	eur lora lf lp	18			433.545, 434.295 MHz	2
32	Italia	eur lora hf lp	10			863 - 868MHz	6
33	Ivory Coast	civ lora hf lp	56			868 - 870MHz	3
34	Japan			jpn gfsk hf hp	30	920.5 - 923.5MHz	15
35	Jordan			ind lora hf hp	50	865 - 867 MHz	9
36	Kazakhstan	eur lora lf lp	18			433.545, 434.295 MHz	2
37	Kenya	eur lora lf lp	18			433.545, 434.295 MHz	2

38	Kyrgyzstan	eur lora lf lp	18			433.545, 434.295 MHz	2
39	Laos	khm lora hf lp	25	khm lora hf hp	26	866-869, 923-925 MHz	8
40	Macedonia	eur lora hf lp	10			863 - 868MHz	6
	Macedonia	eur lora lf lp	18			433.545, 434.295 MHz	2
41	Malaysia	mys lora hf lp	41	mys lora hf hp	42	916 - 924 MHz	13
42	Mexico	usa lora hf lp	0	usa lora hf hp	1	902 - 928 MHz	17
43	Moldova	eur lora hf lp	10			863 - 868MHz	6
	Moldova	eur lora lf lp	18			433.545, 434.295 MHz	2
44	Morocco	mar lora hf lp	47	mar lora hf hp	48	869 - 870 MHz	2
45	Myanmar	eur lora lf lp	18			433.545, 434.295 MHz	2
46	Nicaragua	aus lora hf lp	2	aus lora hf hp	3	915 - 928 MHz	8
47	Nigeria	eur lora hf lp	10			863 - 868MHz	6
48	Palestine	isr lora hf lp	12	isr lora hf hp	13	915 - 917 MHz	3
	Palestine	eur lora lf lp	18			433.545, 434.295 MHz	2
49	Panama	usa lora hf lp	0	usa lora hf hp	1	902 - 928 MHz	17
50	Paraguy	aus lora hf lp	2	aus lora hf hp	3	915 - 928 MHz	8
51	Peru	aus lora hf lp	2	aus lora hf hp	3	915 - 928 MHz	8
52	Poland	eur lora hf lp	10			863 - 868MHz	6
53	Portugal	eur lora hf lp	10			863 - 868MHz	6
	Portugal	eur lora lf lp	18			433.545, 434.295 MHz	2
54	Romania	eur lora hf lp	10			863 - 868MHz	6
	Romania	eur lora lf lp	18			433.545, 434.295 MHz	2
55	Russia	rus lora hf lp	20			864.5, 868.95 MHz	2
	Russia	eur lora lf lp	18			433.545, 434.295 MHz	2
56	Scotland	eur lora hf lp	10			863 - 868MHz	6
57	Senegal	eur lora hf lp	10			863 - 868MHz	6
58	Serbia	eur lora hf lp	10			863 - 868MHz	6
59	South Africa	ecc 915 lora hf lp	16	ecc 915 lora hf hp	17	915 - 921 MHz	7
60	Sri Lanka	lka lora hf lp	54	lka lora hf hp	55	868.5, 920 - 924 MHz	7
61	Tanzania	tha lora hf lp	27	tha lora hf hp	28	920 - 925 MHz	6
62	Thailand	tha lora hf lp	27	tha lora hf hp	28	920 - 925 MHz	6
	Thailand	eur lora lf lp	18			433.545, 434.295 MHz	2
63	Turkey	eur lora hf lp	10			863 - 868MHz	6
64	UK	eur lora hf lp	10			863 - 868MHz	6
65	Ukraine	eur lora hf lp	10			863 - 868MHz	6
66	United Arab Emirates	are lora hf lp	43	are lora hf hp	44	863-875.8, 915-921 MHz	30
67	Uruguay	usa lora hf lp	0	usa lora hf hp	1	902 - 928 MHz	17
68	USA	usa lora hf lp	0	usa lora hf hp	1	902 - 928 MHz	17
69	Uzbekistan	eur lora lf lp	18			433.545, 434.295 MHz	2
70	Vietnam	vnm lora hf lp	23			918 - 923 MHz	6
71	Venezuela	ven lora hf lp	51			922 - 928 MHz	

BEACON PERIOD ACCORDING TO THE NUMBER OF RTUS IN THE SYSTEM.

When more than 60 RTUs are connected to the RF system, it will take more time to communicate with the RTUs. As a result, the Duty cycle and the traffic on the Radio will increase. To reduce the traffic, increase the Beacon period.
Use **Table 2** to select the correct **Beacon period** according to the quantity of the RTUs in the System.

G4 (gen=4)							G5 FAST (gen=5)					
ID	Subsystems of	Interface Address in the Image maker	Beacon period of the Master	Wake-Up period of Routers	RTU Address in the RTUs	RTU Address in the Image maker	Subsystems of the Master	Interface Address in the Image maker	Beacon period of the Master	Wake-Up period of Routers	RTU Address in the RTUs	RTU Address in the
1					1	1					1	1
2					2	2					2	2
...	1	1	*10	10	...	...	1	1	10	Auto	...	...
59					59	59					59	59
60					60	60					60	60
61					101	1					61	61
62					102	2					62	62
...	2	2	*15	15	...	...	1	1	15	Auto	...	...
119					159	59					119	119
120					160	60					120	120
121					201	1					121	121
122					202	2					122	122
...	3	3	*20	20	...	...	1	1	20	Auto	...	...
179					259	59					179	179
180					260	60					180	180
181					301	1					181	181
182					302	2					182	182
...	4	4	*30	30	...	...	1	1	30	Auto	...	...
239					359	59					239	239
240					360	60					240	240
241					401	1					241	241
242					402	2					242	242
...	5	5	*35	35	...	...	1	1	35	Auto	...	...
299					459	59					299	299
300					460	60					300	300

Table 2 -Settings of Master and RTUs per the quantity of RTUs

11. RF G5 FAST VS REGULAR RF G5.

The **RF G5 FAST** is a new communication protocol. Several parts are working like the Regular RF G5 system. For example, the Variant of the Master and RTUs remain the same, Routers work as in the regular RF G5 protocol, and more…

The advanced properties, advantages, and new features are described in **Table 3.**

Table 3 -RF G5 FAST VS Regular RF G5

	PROPERTY	REGULAR RF G5	RF G5 FAST
1	Master's Baud rate (Bits per second)	9600	115200
2	Logging the RS 485 communication.	**X**	**V**
3	Maximum number of RTU RF G5 per interface	60	500
4	Maximum number of RTU RF G5 in the RF System	300	500
5	Maximum number of Analog sensors per interface RF	120	500
6	Access to the RTU's settings from the server	**X**	**V** **(Not ready)**
7	Backup/Restore the settings of the RF RTUs	**X**	**V**
8	Maximum number of LIN cards connected to the RTU Modular	1	4
9	Maximum Analog inputs per RTU MODULAR+4 ANA LIN cards	4	17
10	Maximum number of SDI inputs per RTU MODULAR+SDI LIN card	4	64
11	Sending SDI values as Data	**X**	**V**
12	Flow calculation in the RTU	X	**V**
13	Read high flow without pulses divider/Expansion	**X**	**V**
14	Pulses accumulations in the RTU	**X**	**V**
15	8 Outputs / 4 Inputs expansion LIN card	**X**	**V**

12. RTU RF MODULAR G5 FAST.

The RTU RF Modular G5 Fast is the most advanced RF RTU among the RF RTUs. Here is a short description of the RTU Modular and its properties:

Outputs: Modular structure. Operates 0,2,4,6, or 8 12V DC latch Solenoids/Valves.

Digital Inputs (Dry contact): Variety of Inputs card. 8 Digital inputs, 4 Digital inputs, or 4 Digital + 1 Analog input cards.

Analog input: 1 Standard Analog input (4-20mA or 0-5V) with 12 Bits resolution.

THD: Supports SHT15 and SHT31 TH sensors. Returns Air temperature, Relative humidity, and calculated Dew point.

EC PH Monitoring: Returns Water EC, Water PH, and Water temperature.

LIN communication port: The RTU RF Modular G5 FAST supports up to 4 LIN cards.

The LIN cards are **4 ANA LIN**, **SDI LIN**, **EC PH Monitoring LIN**, and **I/O 8/4 LIN**.

In G5 Fast, there is an option to connect several LIN cards in parallel. When connecting several LIN cards of the same type to the RTU Modular, set up a unique address for every LIN card. The RTU Modular detects automatically the LIN card type, and LIN card address, and transmits the LIN card type, address, and the LIN card Data, to the Master unit. The quantity of LIN cards supported by the RTU Modular is described in **Table 4**.

Table 4 - RTU RF MODULAR G5 FAST-MAX LIN CARDS CONNECTED IN PARALLEL

4 DIGITAL + 1ANA	THD	PH/EC Monitor LIN	4 ANA LIN	SDI LIN	I/O 8/4 LIN	Out/Din/Ain/Sin
1	*1	0	0	0	0	8/4/1/0
1	0	*1	0	0	0	8/4/1/0
1	0	0	4	0	0	8/4/17/0
1	0	0	3	1	0	8/4/13/64
1	0	0	3	0	1	16/8/13/0
1	0	0	2	1	1	16/8/9/64
0	0	0	2	1	1	16/12/9/64

Outputs/Digital Inputs/Analog Inputs/SDI Values.

- When a **THD sensor** (SHT15/SHT31) or **PH EC Monitoring LIN** card is connected to the RTU Modular, there is no option to add more LIN cards to the LIN port.
- It is possible to connect only 1 SDI LIN card to the RTU Modular in parallel to other LIN cards.
- It is possible to connect only 1 I/O 8/4 LIN card to the RTU Modular in parallel to other LIN cards.

1. **The maximum** number of **Outputs** is **16** when the I/O 8/4 LIN card and 4 Output cards are connected to the RTU Modular.
2. **The maximum** number of **Digital inputs** is **12** when the I/O 8/4 LIN card and 8 Digital Inputs card are connected to the RTU Modular.
3. **The maximum** number of **Analog inputs** is **17** when 4 units of 4 ANA LIN cards + 4 Digital+1 ANA card are connected to the RTU Modular.
4. **The maximum** number of **SDI values** is **64** when the SDI LIN card is connected to the RTU Modular.

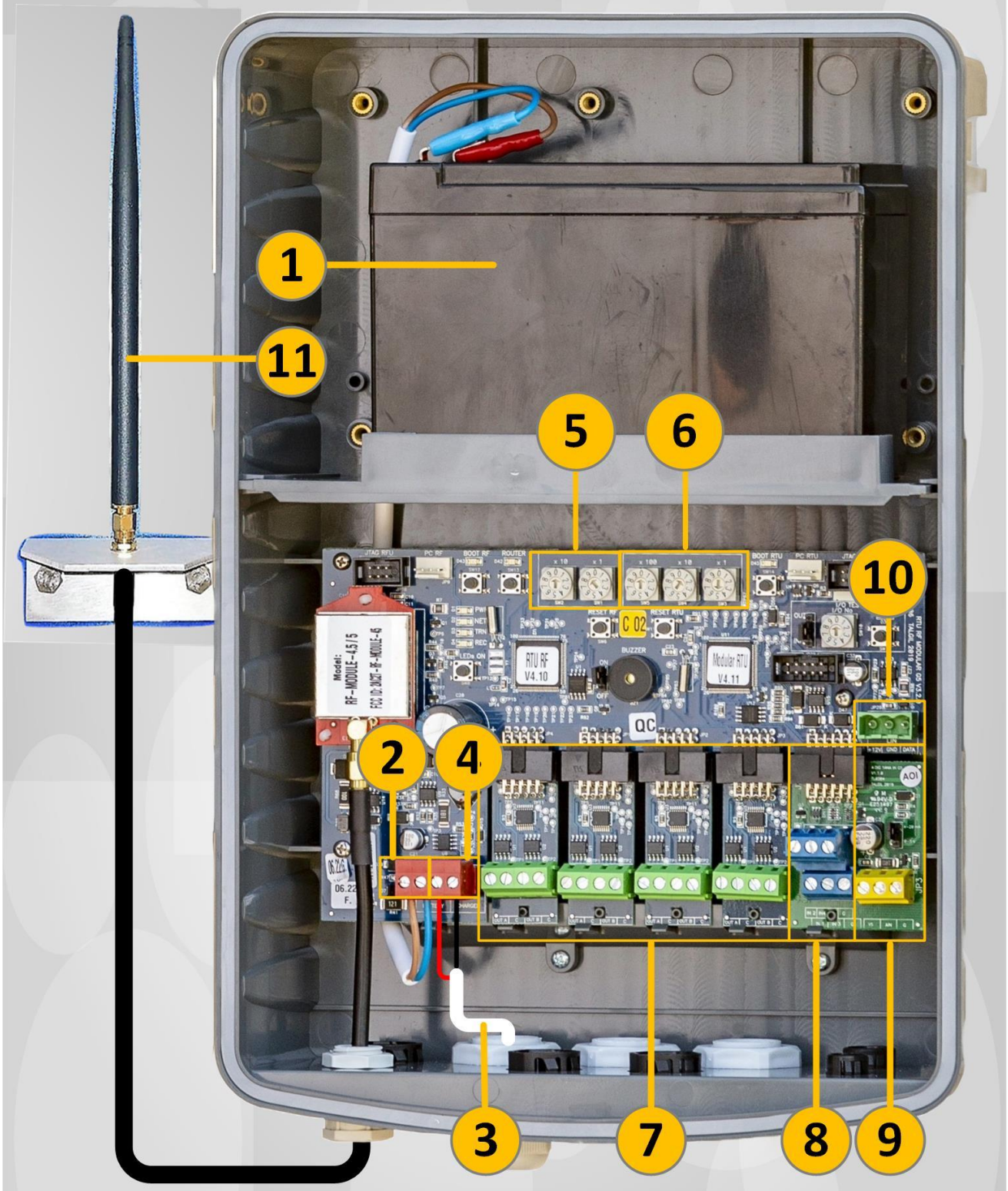


Image 13–RTU Modular Installation instructions.

13. RTU RF MODULAR G5- INSTALLATION

Install the RTU Modular on a wall or a metal pole. For easy access, install the unit at a height of a meter and a half.

1. RTU Modular can be powered by a **6V DC** power supply (four 1.5 Volts Alkaline batteries size D). When the RTU Modular works as a **ROUTER**, reading **Analog sensors**, or any **LIN card** is connected to it, the power supply must be **12 V DC** (Solar panel/Power supply and rechargeable battery).
2. Connect the Rechargeable battery cable to the **BATTERY** input in the power supply plug.
3. To charge the battery, use an **18V DC** charger. It can be a Solar Pannel or 18V DC Power supply.
4. Connect the charger cable to the **CHARGER** input in the power supply plug.
5. Use the **NETWORK ID** rotary switches to set up the **NETWORK ID (SYSTEM NUMBER)** of the **RTU Modular**. It must be identical to the Master's **NETWORK ID**. Make sure that the **Network ID** is not used by another system in the surrounding. Use the **Sniffer** or the **Radio Modem** to see the available **NETWORK ID** in this area. Create a list of your Projects and their **NETWORK IDs**. It will help you to decide what **NETWORK ID** to use in the future. It is possible to set up a software **NETWORK ID.** Use the **Workbench PC software** to set the software **NETWORK ID.**
6. Use the **RTU ID** rotary switches to set up the **ADDRESS** of the **RTU MODULAR**. It is possible to set up a software **RTU ADDRESS.** Use the **Workbench PC software** to set the software **RTU ID.**
7. Connect the solenoids (Or another output device like Valve, Latch Realy, or Pump switching device) to the **Outputs terminal block** (Colored Green).
8. Connect the **Digital Inputs** to the **Digital Inputs** terminals block (Colored Blue). The digital inputs can read a Dry contact pulse such as a Water meter, Fertilization meter, Pressostat (Pressure sensor), DP sensor, Float, or Contact.
9. Connect the **Analog sensor** to the **Analog Input** terminals block (Colored Yellow). The Analog input can read a standard Analog sensor (4-20 milli Ampere or 0-5 Volts)
10. Connect the **LIN cards** to the **LIN** communication port. **12V** is the 12V DC power supply (**Red**). **GND** is the Ground (**Black**), and **DATA** is the LIN communication (**Green**).
    Use the same wiring at the LIN cards.
11. To improve the Radio communication, install the **Antenna** in a high place. The top of the **RF G5 RTU Antenna** must be installed on a pipe made of non-metallic material. Make sure that the Antenna has a Line of sight to the Master or a ROUTER. The maximum distance to the Master or a ROUTER unit is 2.5 km.

RTU RF Modular G5 - OUTPUTS

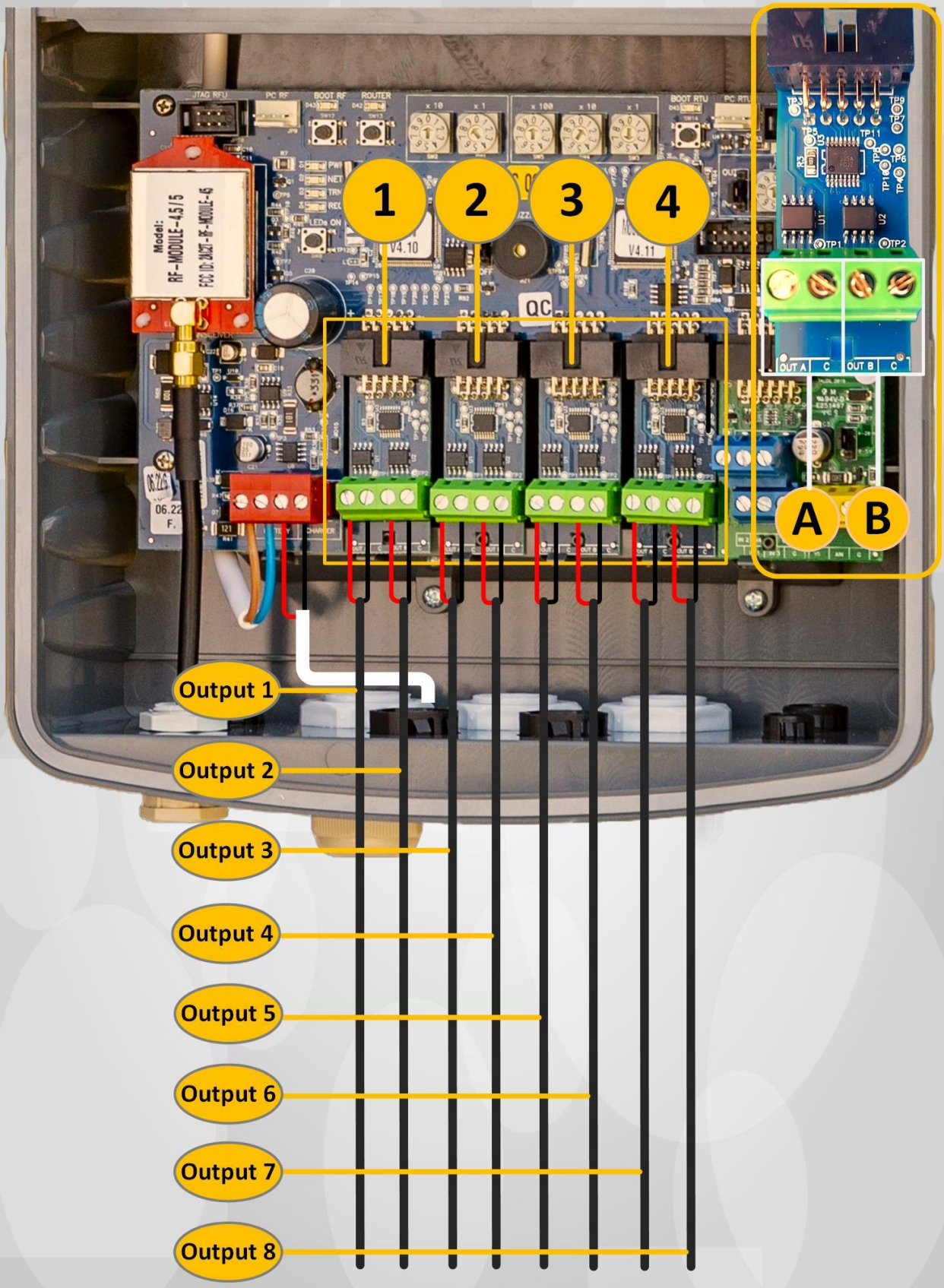


Image 14– RTU Modular Outputs cards.

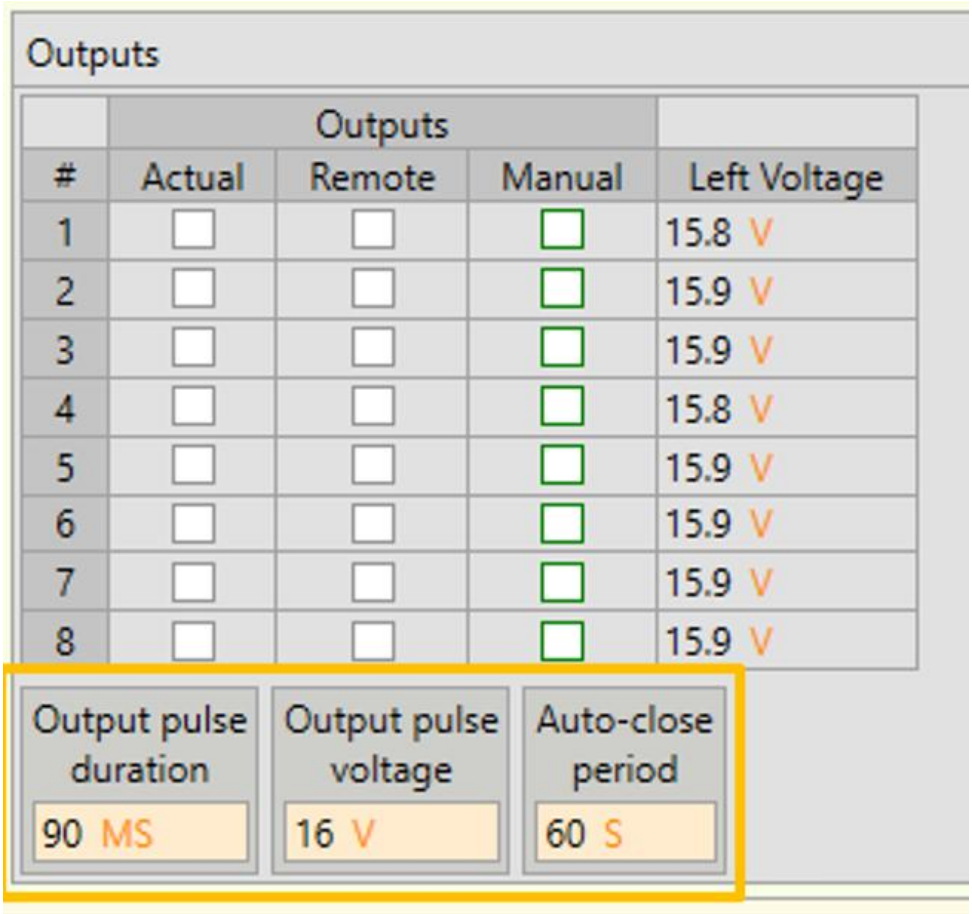
14. RTU RF MODULAR G5 FAST-OUTPUTS.

RTU RF Modular G5 has a modular structure. After powering the RTU Modular, it detects automatically the number of Output cards that are connected to the RTU. The options are:

When no Outputs card is connected: 0 Outputs. Used to read Inputs or as a Router.
When 1 Outputs card is connected: 2 Outputs.
When 2 Outputs cards are connected: 4 Outputs.
When 3 Outputs cards are connected: 6 Outputs.
When 4 Outputs cards are connected: 8 Outputs.

On the Outputs card, there are 4 screws. From left to right, Out A, C Out B, and C. Out A is used for the Odd Outputs (Outputs 1,3,5, and 7). Out B is used for the Even Outputs (Outputs 2,4,6, and 8).

By default, the **Output pulse duration** (pulse period) is **90 milliseconds.**
The **Output pulse voltage** is **16V DC**. It is used for 12V DC latched solenoids, Valves, 12 V DC Latch relays, or Pump switching units. Use the **Workbench PC** software to see the Outputs current status, change the Pulse period, Pulse voltage, and more settings of the Outputs as described in **Chapter 22.**



RTU RF Modular G5-DIGITAL INPUTS

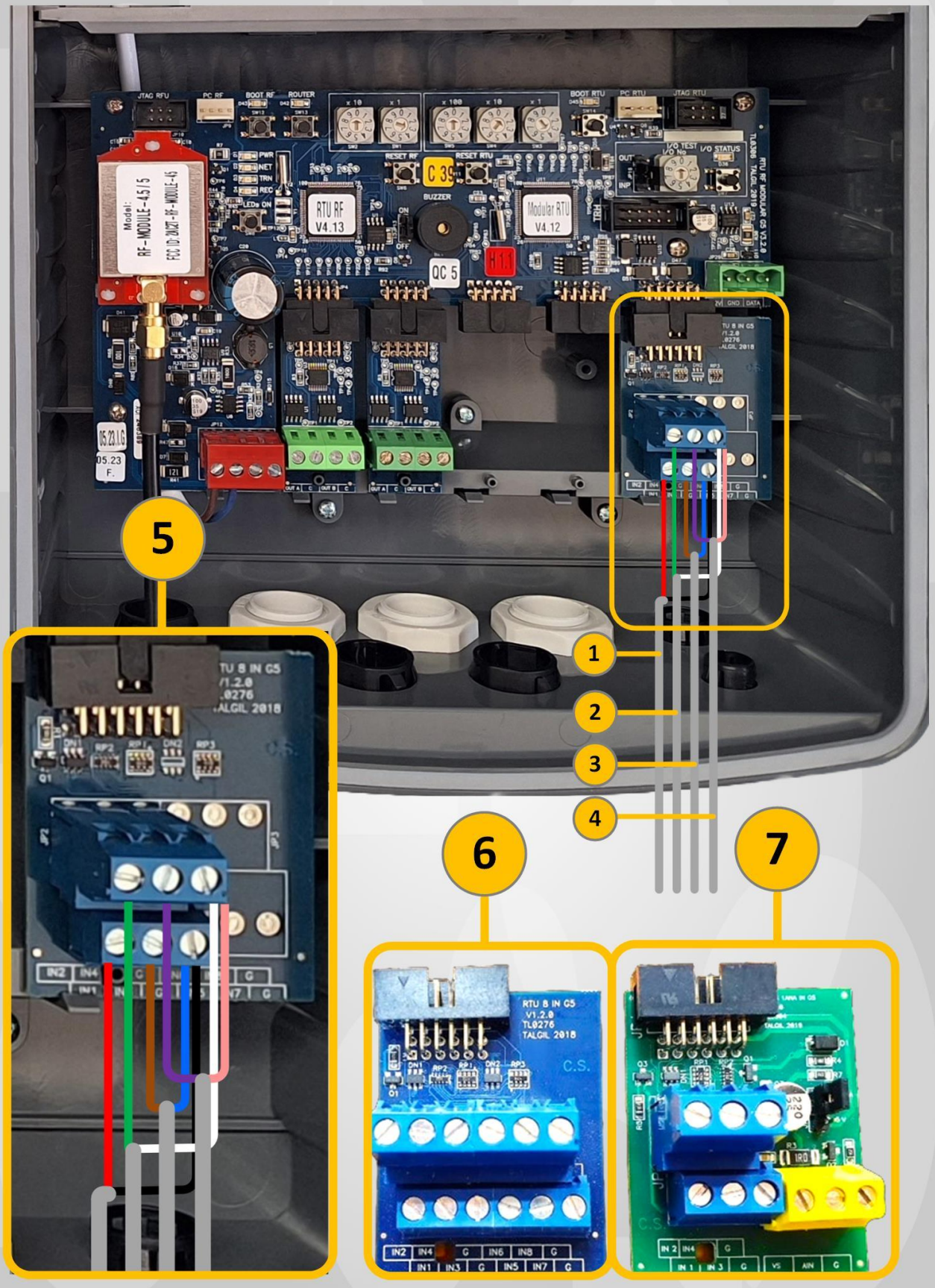


Image 15– RTU Modular digital Inputs card types.

15. RTU RF MODULAR G5 FAST- DIGITAL INPUTS.

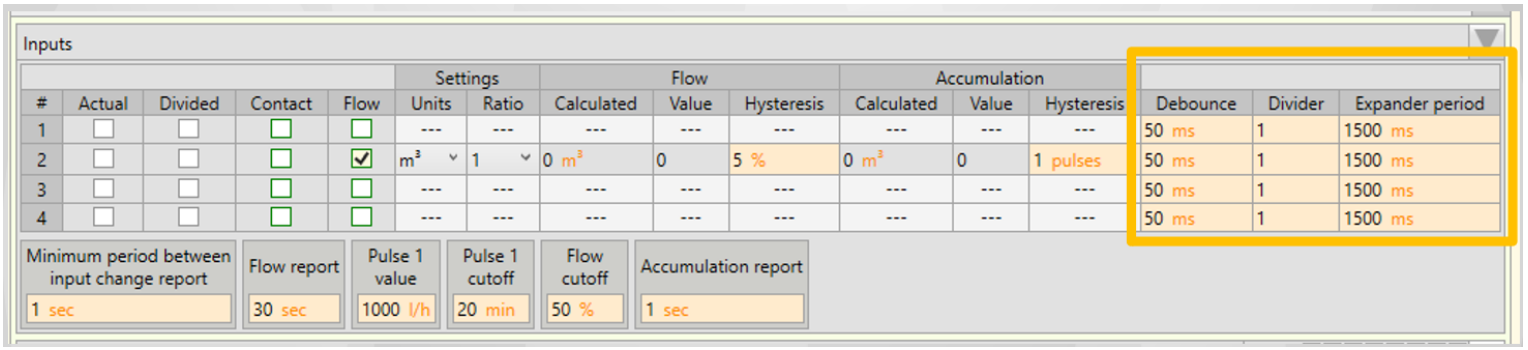
RTU RF Modular G5 has a modular structure. After powering the RTU Modular, it detects automatically if an Input card is connected to the RTU Modular. The options are:

When **no Inputs card** is connected: 0 Inputs. Used to operate Outputs or as a Router. When **4 digital Inputs card** is connected: 4 Digital inputs as described in **Image 15**.
where:

1. Input number 1 (Red wire) is the left screw in the lower terminal block.
2. Input number 2 (Green wire) is the left screw in the higher terminal block.
3. Input number 3 (Brown wire) is the middle screw in the lower terminal block.
4. Input number 4 (Purple wire) is the middle screw in the higher terminal block.
5. The Ground is the right screw in the lower and higher terminal block. It is a common **ground** input for all the Inputs in the Inputs card.
6. When **8 digital Inputs card** is connected: 8 Digital inputs.
7. When **4 digital Inputs + 1 ANA** card is connected: 4 Digital inputs + 1 Analog input.

By default, the Debounce is 100 milliseconds, the Divider is 1, and the Expansion is 1500 milliseconds. The pulse type should be a Dry contact.
In G5 FAST, there are two types of Digital Inputs. The types are **FLOW** and **CONTACT.**
FLOW input calculates the flow rate and sends the value to the Master.
CONTACT input sends the current status of the input (**ON** or **OFF**) to the Master.

Use the **Workbench PC software** to see the Current Status of the Inputs, change the Debounce, Divider, Expansion, and more settings of the Digital Inputs as described in **Chapter 21.**



RTU RF Modular G5-ANALOG INPUTS.

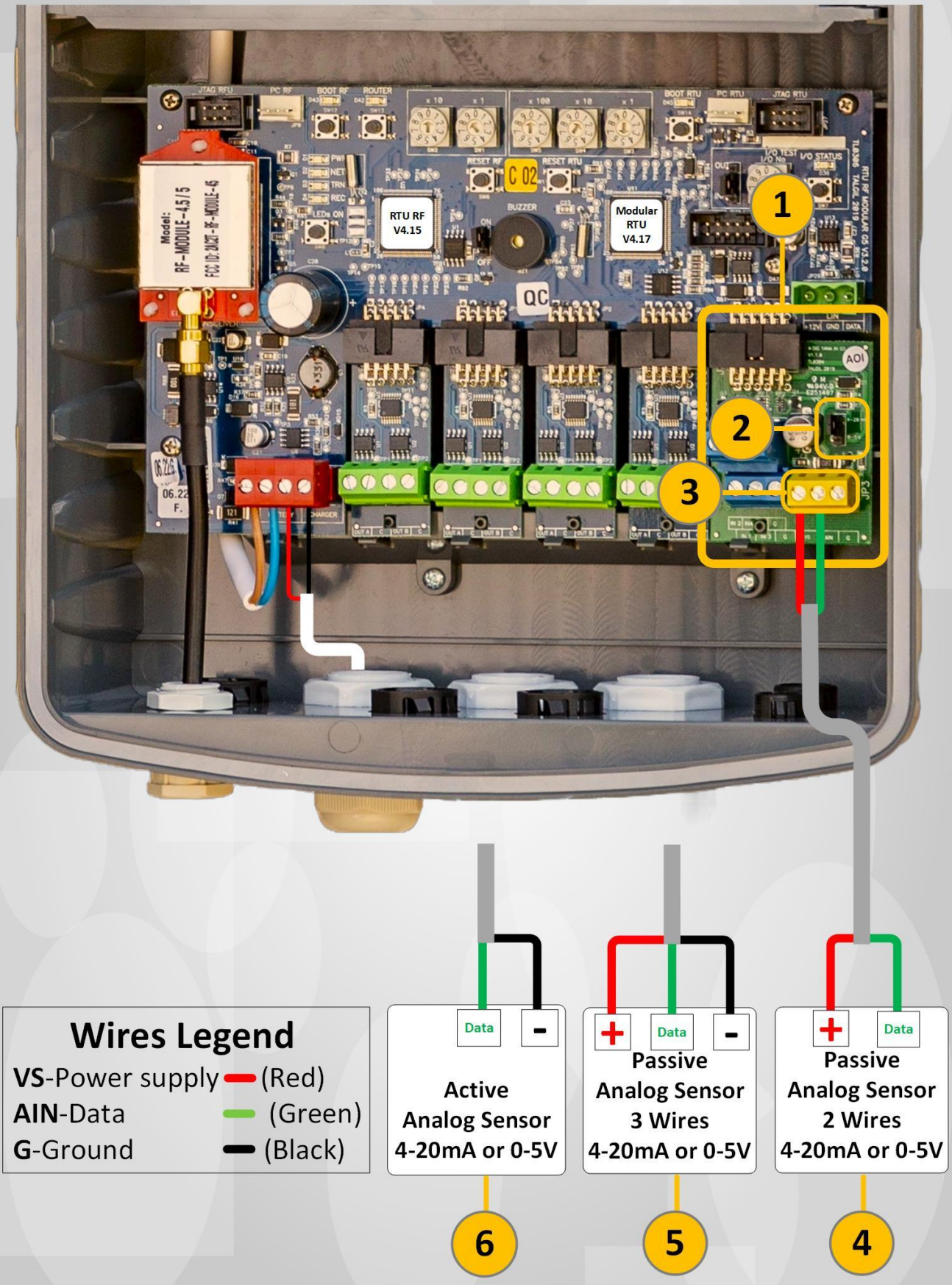


Image 16– RTU Modular G5 Analog input.

16. RTU RF MODULAR G5 FAST-ANALOG INPUTS.

RTU RF MODULAR G5 has a special Input card with **4 Digital** Inputs and **1 Analog** Input. The Analog input type is used for standard Analog sensors 4-20mA or 0-5V. The resolution is 12 Bits. To read the Analog sensor, the power supply must be **12 V DC** (Solar panel/power supply and rechargeable battery). Read on to learn about the Analog sensor wiring and follow the instructions below.

1. Make sure that an Inputs card with Analog input is connected to the RTU RF Modular G5. The Analog input terminal block is colored Yellow.
2. Use the jumper **JP4** to select the Analog input type. When the jumper JP4 is on the **upper 2 pins**, the Analog input type is **4-20mA** (Current).
   When the jumper **JP4** is on the **lower 2 pins**, the Analog input type is **0-5V** (Voltage).
3. Connect the Analog sensor wires to the Analog input terminal block.
   The Analog input terminal block has 3 screws. **VS**, **AIN**, and **G** where **VS** is the **12V DC** power supply, **AIN** is the **Analog data** (Analog Signal), and **G** is the **Ground**.
   Types of Analog Sensors:
   Read the Analog sensor specification document or Datasheet to identify the Analog sensor type, Powering time, wiring, and range. A Passive Analog sensor should be powered before reading the Analog value. It is also called excitation time. On the other hand, an Active Analog sensor should not be powered.
4. To read a Passive analog sensor, If the Analog sensor has 2 wires, connect the Positive wire to **VS** and the negative wire to **AIN**.
5. To read a Passive analog sensor, If the Analog sensor has 3 wires, connect the Powering wire to **VS**, the **DATA** (Signal) wire to **AIN**, and the **Ground** wire to **G**.
6. To read an Active analog sensor, connect the **DATA** (Signal) wire to **AIN**, and the **Ground** wire to **G**.
7. Set up the Analog sensor **Type** and **Range** in the **Constants/Analog sensors screen** according to the Analog sensor **Type and Range.**
8. Use the **Workbench PC software** to see the Current Status of the Analog Inputs, Read the Analog values, change the Sampling rate, Averaging, Power up time, and more settings of the Analog Inputs as described in **Chapter 23.**

RTU RF Modular G5 - THD SENSOR.

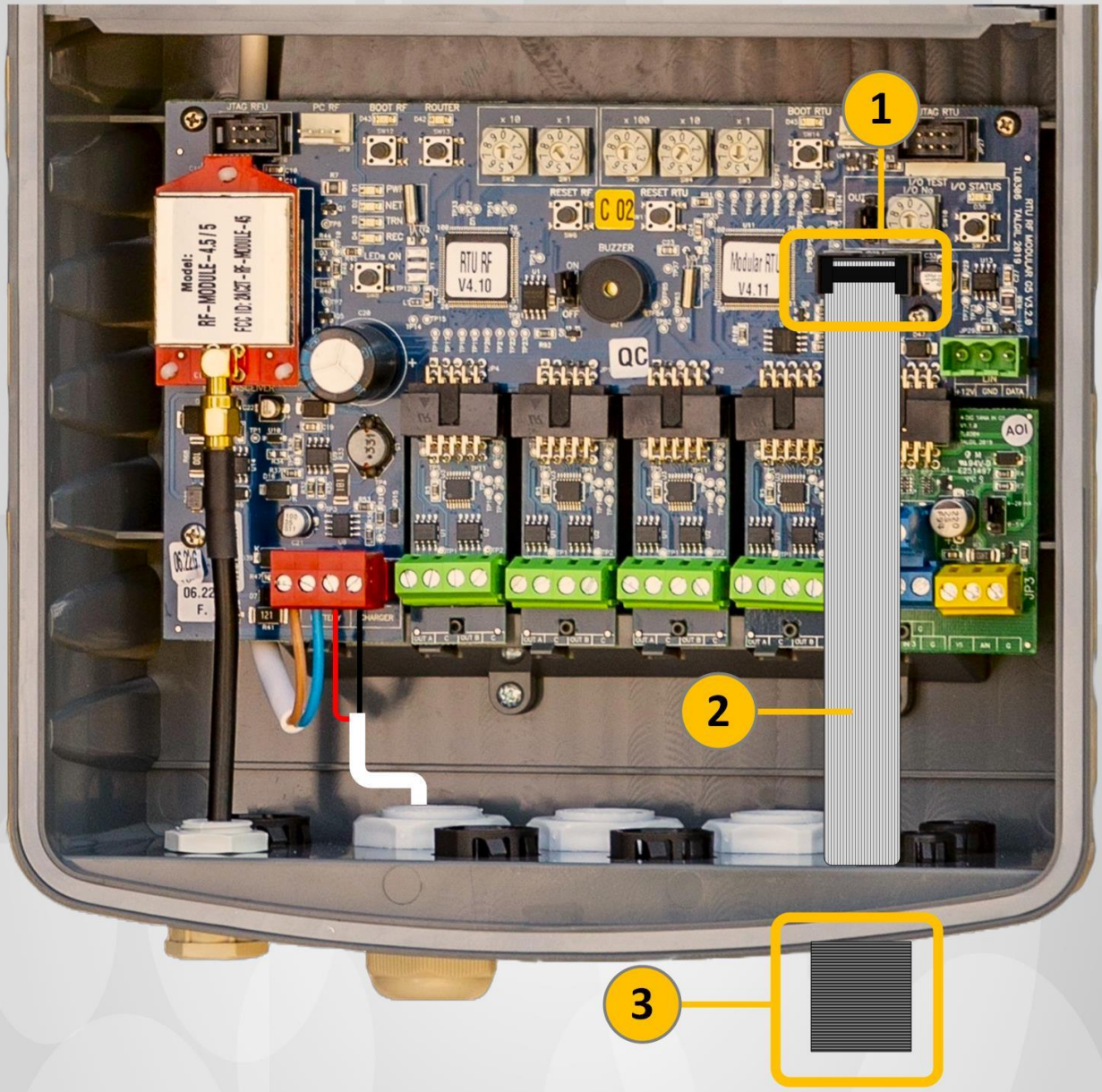


Image 17– RTU Modular G5 and THD sensor

17. RTU RF MODULAR G5 FAST-THD SENSOR.

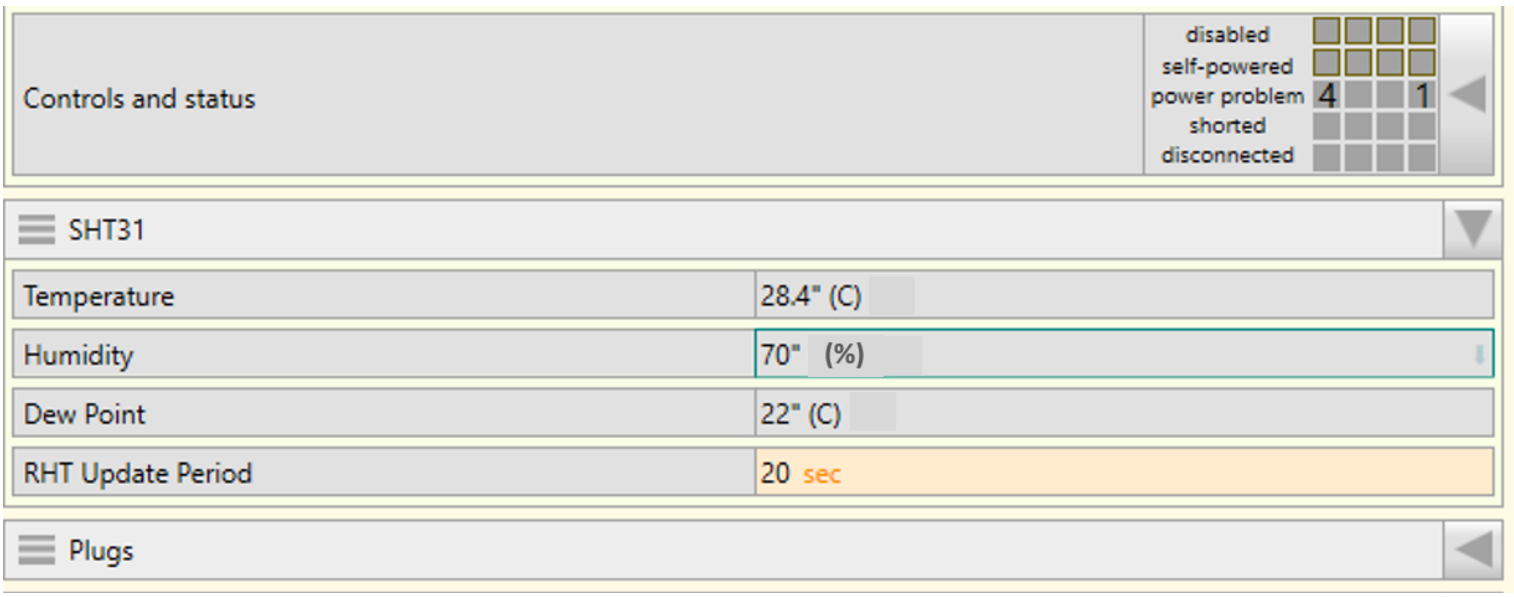
The RTU MODULAR supports the **SHT15** and **SHT31** TH (Temperature and Humidity) sensors. When a TH sensor is connected, the RTU RF Modular G5 returns three values. The values are: Air Temperature (In Celsius), Relative humidity (In percentages), and calculated Dew point. After powering the RTU RF Modular G5, it detects automatically the TH sensor and sends these three values to the Master unit where the **Air Temperature** is in **Analog input number 2**, **Relative Humidity** in **Analog input 3**, and **Dew point** in **Analog input 4**. The Analog sensor's **Type** in the **Constants/Analog sensors screen** should be **External.** It is not necessary **to set the Range** in the **Constants/Analog sensors screen**

* When a TH sensor is connected, it is not possible to connect another LIN card in parallel.

To read the TH sensor, the power supply can be **6V DC** (4 Alkaline batteries 1.5V size D) or **12 V DC** (Solar panel/power supply and rechargeable battery). Read on to learn about the Analog sensor wiring and follow the instructions below.

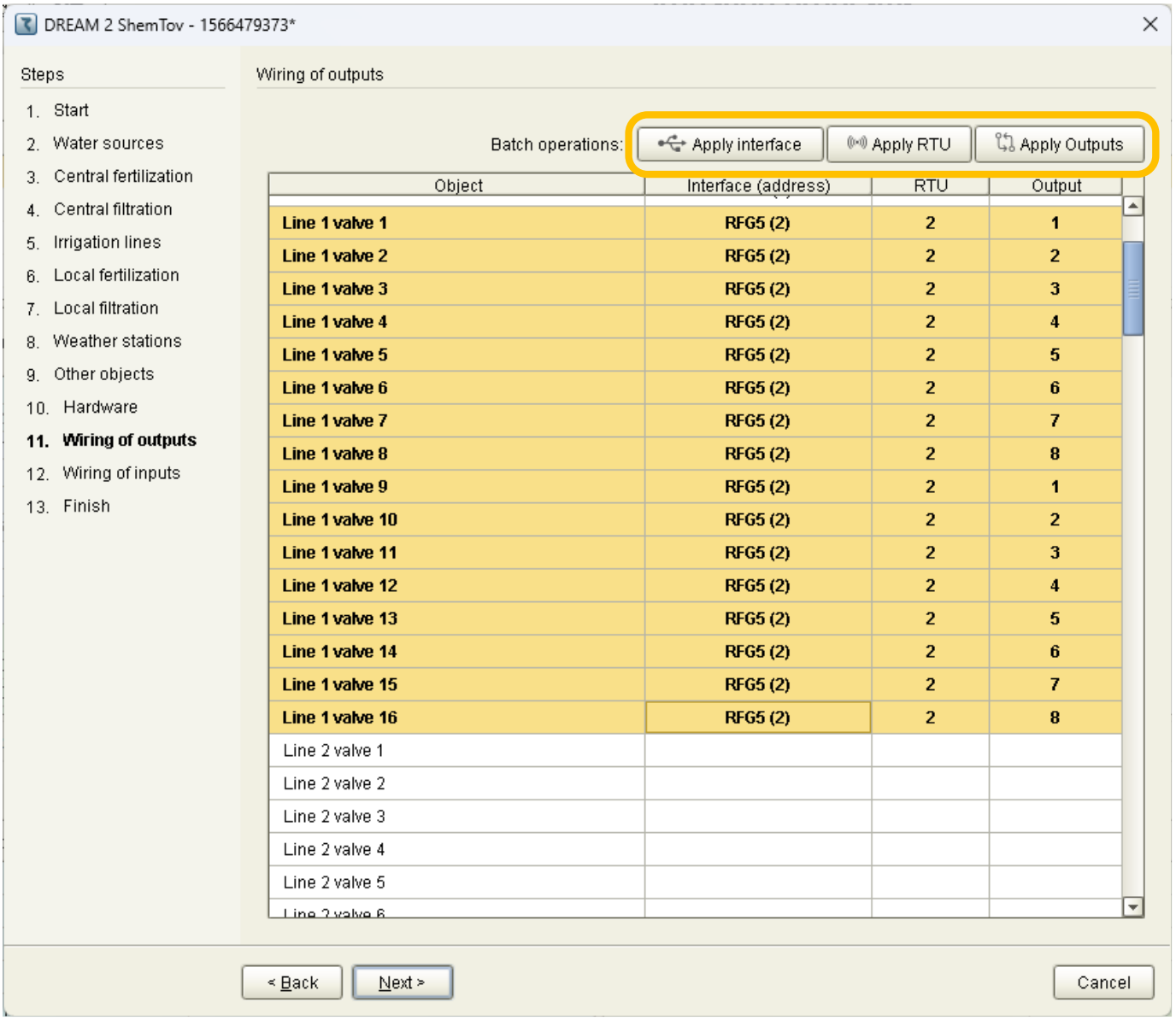
1. Disconnect the power supply plug and insert the **THD** sensor into the **TRH** (Temperature and Relative humidity) socket as described in image 17.
2. The **THD** sensor has a short flat cable. It is not possible to change the flat cable length. Make sure that the cover is not closed on the flat cable.
3. The **THD** sensor should be installed out of the box. Install the **THD** sensor at the bottom of the box to protect it from water. The THD sensor is not intended to measure water humidity. Make sure that the sensor does not come into contact with water. Splashing water directly on the **THD** sensor can damage the **THD** sensor.

Use the **Workbench PC software** to see the current values or to edit the THD sensor sampling rate.



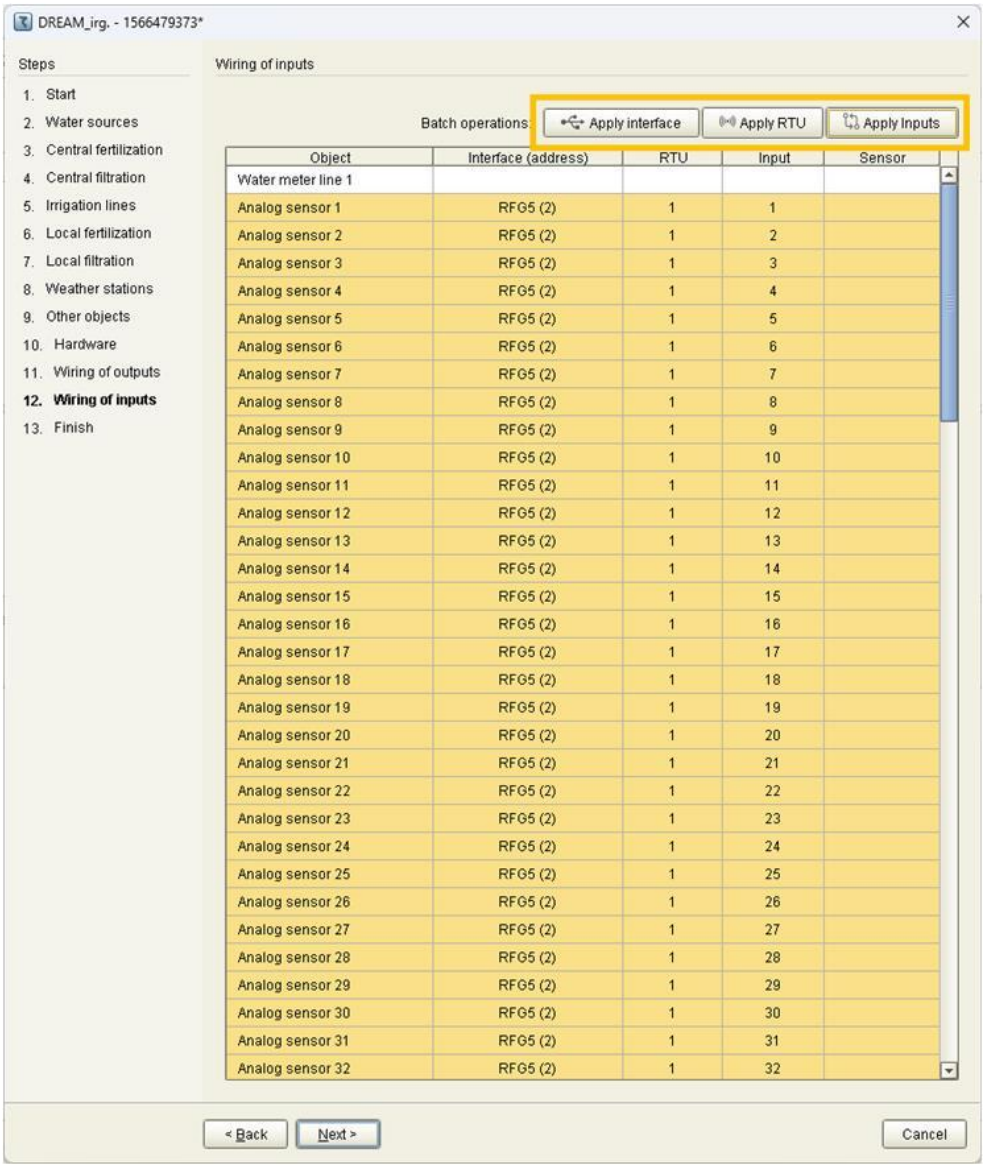
Wiring of Outputs.

Use the **Image Maker** to define the **Interface address**, **RTU Address**, and **Output number**. In G5 Fast, it is possible to operate up to 16 Outputs connected to the **RTU RF Modular** and the **I/O 8/4 LIN card**. To select the **Interface address**, **RTU Address**, or **Output number**, for multiple Outputs, select the column (Interface, RTU, or Output) then click Apply. To define the Wiring of Outputs connected to the **I/O 8/4 LIN plug**, use the Dream MMI.
For more details, see the **I/O 8/4 LIN plug** section.



Wiring of Inputs.

Use the Image Maker to define the **Interface address**, **RTU Address**, and **Digital** or **Analog input**. In G5 Fast, it is possible to read up to 12 Digital inputs, connected to the **RTU RF** Modular and the **I/O 8/4 LIN card**. In addition, it is possible to read up to 17 Analog inputs or 64 values (From up to 10 SDI sensors) per RTU using the **4 ANA LIN** or **SDI LIN cards**. To select the **Interface address**, **RTU Address**, or **Input number**, for multiple Inputs, select the column (Interface, RTU, or Input) then click Apply. To define the Wiring of Inputs connected to an **I/O 8/4 LIN**, **4 ANA LIN**, or **SDI LIN** cards, use the Dream MMI. For more details, see the **I/O 8/4 LIN**, **4 ANA LIN**, or **SDI LIN** sections.



RTU RF Modular G5- FIRMWARE VERSION UPGRADE

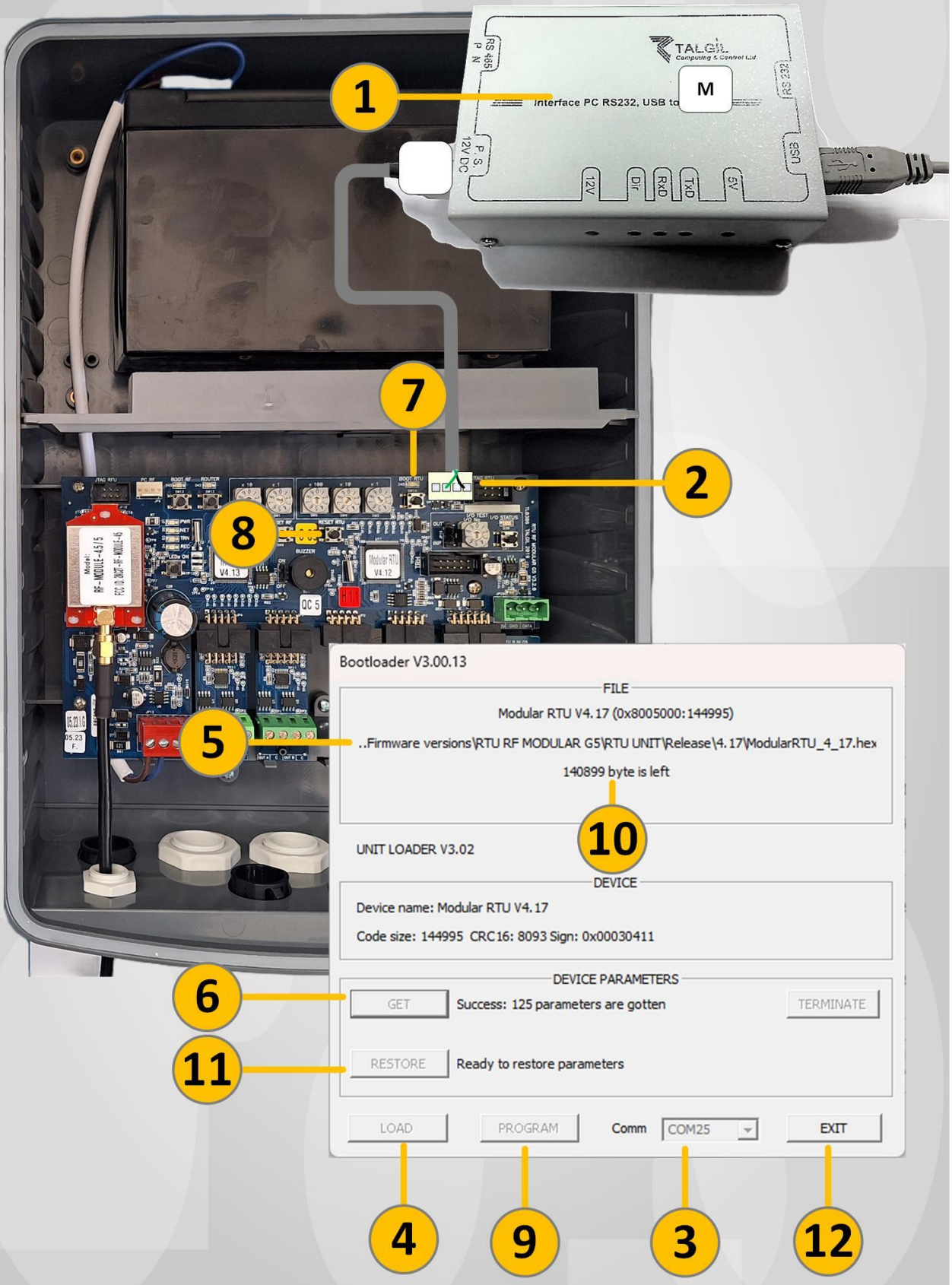


Image 18 – RTU RF Modular G5 firmware version Upgrade.

18. RTU RF MODULAR G5-FIRMWARE VERSION UPGRADE

Make sure that you are using the latest Firmware version of the **RTU RF MODULAR G5**. Use the links below to download the latest firmware version and the **CBoot PC software**. To start the firmware version upgrading process, please follow the instructions below:

1. Connect the **Programmer device** to your **PC**.
2. Connect the **Programmer device** cable to the **PC Socket** on the upper right corner of the **RTU RF MODULAR G5** card as described in **Image 18**.
3. Start the **CBoot** PC software and select the **Communication port.** If you do not have the **CBoot** software, download it here:

https://drive.google.com/drive/folders/17AZoFHJXi4XWkqNSbLTVXLVqKH4EP0tp?usp=sharing

4. Click the **LOAD** button, browse to **RTU RF MODULAR G5** hex file and select it.

To download the latest **RTU RF MODULAR G5** firmware version, click here:

https://drive.google.com/drive/folders/1sKFhwgJQYbp4QdtsRxNsHfZVxiYfyxnt?usp=sharing

5. The pathway to the hex file will appear on the screen.
6. Click the **GET** button to read the settings of the **RTU RF MODULAR G5.** This will save the settings in the **CBoot** PC software. The number of saved parameters will appear.
7. On the **RTU RF MODULAR G5** hardware, press and hold the **BOOT RTU** button.
8. While the **BOOT RTU** button is pressed, press the **RESET RTU** button. Leave the **RESET RTU** button, after 1 second, leave the **BOOT RTU** button. This action will put the **RTU RF MODULAR G5 mode** into a **BOOT Mode**.
   In **BOOT Mode,** the **BOOT RTU** LED turns on.
9. To start the upgrading process, click the **PROGRAM** button. The upgrading process will start.
10. A progress indicator will appear on the screen**.** At the end of the process, a **Terminated** message will appear.
11. After the upgrading process, the **CBoot** PC software will **RESTORE** the saved settings to the **RTU RF MODULAR G5.**
12. To close the **CBoot** PC software, click **EXIT.**

RFU - FIRMWARE VERSION UPGRADE

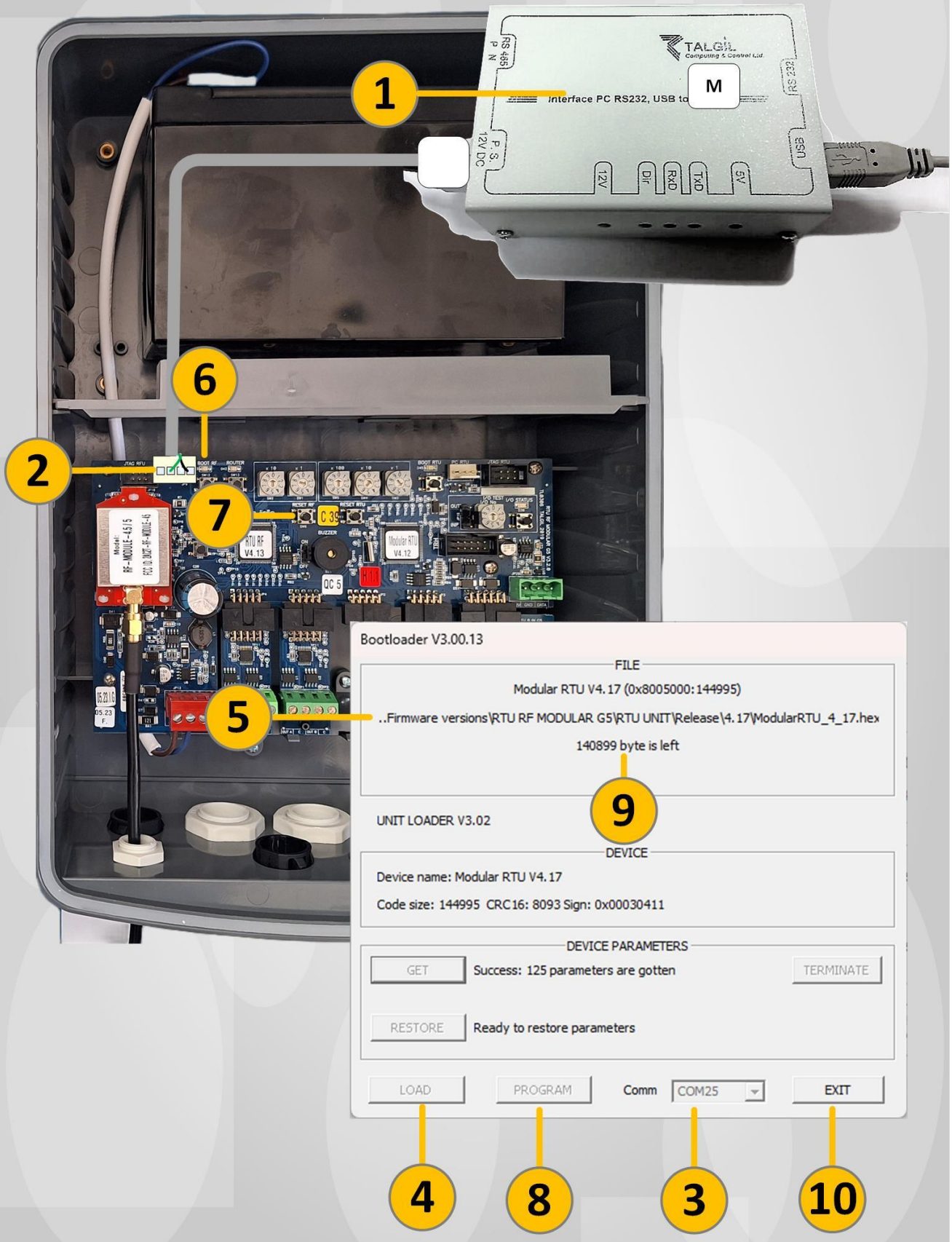


Image 19 – RFU firmware version Upgrade.

19. RFU (RF UNIT) - FIRMWARE VERSION UPGRADE

Make sure that you are using the latest Firmware version of the **RFU (RF UNIT)**. Use the links below to download the latest firmware version and the **CBoot PC software**. To start the firmware version upgrading process, please follow the instructions below:

1. Connect the **Programmer device** to your **PC**.
2. Connect the **Programmer device** cable to the **RF PC Socket** on the upper left corner of the **RTU RF MODULAR G5** card as described in **Image 19**.
3. Start the **CBoot** PC software and select the **Communication port.** If you do not have the **CBoot** software, download it here:

https://drive.google.com/drive/folders/17AZoFHJXi4XWkqNSbLTVXLVqKH4EP0tp?usp=sharing

4. Click the **LOAD** button, browse to the **RFU** hex file, and select it.

To download the latest **RFU** firmware version, click here:

https://drive.google.com/drive/folders/1sKFhwgJQYbp4QdtsRxNsHfZVxiYfyxnt?usp=sharing

5. The pathway to the hex file will appear on the screen.
6. On the **RTU RF MODULAR G5** hardware, press and hold the **BOOT RF** button.
7. While the **BOOT RF** button is pressed, press the **RESET RF** button. Leave the **RESET RF** button, after 1 second, leave the **BOOT RF** button. This action will put the **RFU mode** into a **BOOT Mode**.
   In **BOOT Mode,** the **BOOT RF** LED turns on.
8. To start the upgrading process, click the **PROGRAM** button. The upgrading process will start.
9. A progress indicator will appear on the screen**.** At the end of the process, a **Terminated** message will appear.
10. To close the **CBoot** software, click **EXIT.**

RTU RF MODULAR G5 FAST-MAIN AND RADIO SETTINGS

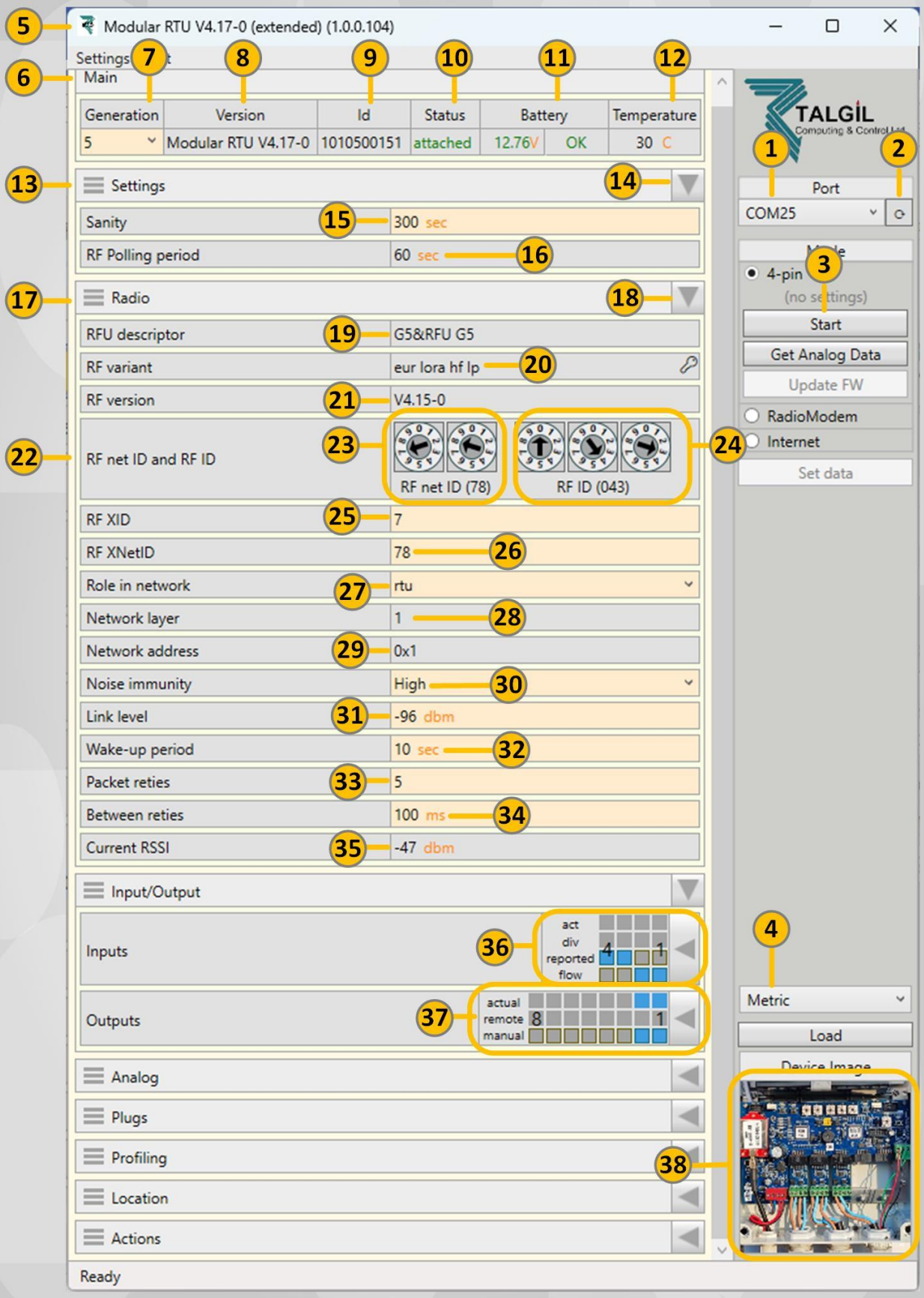


Image 20– Programming the RTU RF MODULAR G5 FAST.

20. RTU RF MODULAR G5 FAST – MAIN AND RADIO SETTINGS

To read or edit the settings of the **RTU RF MODULAR G5 FAST**, connect the **Programmer device** to the **PC** and the **RTU PC** socket as described in **Image 18.**

To Download the latest version of the **Workbench PC software** click here. (https://drive.google.com/drive/folders/1MyHe8iHkUQBm8AzeVlkPVU-HIq1_kW9N?usp=sharing).

1. Start the **Workbench** PC software and select the communication port as described in **Image 20.**
2. To update the communication port list, click the **Update** button.
3. To start the serial communication, click **Start**.
4. Select the **unit's type**. The options are **Metric** or **Imperial**.
5. The RTU type, firmware version, and Workbench version number will appear on the title.
6. **Main window**- The **Main** window includes the Generation**,** RTU type and its firmware version, CPU ID, Connection Status, Battery Voltage and Status, and Temperature.
7. **Generation**-The generation specifies the **RF communication protocol** where **G4** is the **regular** communication protocol and **G5** is the new communication protocol called **G5 FAST.** The generation is read-only. The RTUs (All types) change the generation automatically. The RTUs identify the communication protocol that the Mater is using and change their generation according to the Master.
8. **Version-** The RTU type and the firmware version.
9. **ID-** The CPU ID number for internal use.
10. **Status**-The connection status. When the RTU is connected to the Master, it will show **Attached**. When the RTU is not connected to the Master (RTU communication error), it will show **Not attached.**
11. **Battery-**The Battery voltage and status. When the Battery voltage is above 11.2V when powered by 12V, or above 5V when powered by 6V the Battery status is **OK**. When the Battery voltage is below **11V**(12V power supply), or **4.8V** (6V power supply) the Battery status is **Low battery**.
12. **Temperature-** The measured temperature by onboard temperature sensor on the Hardware for internal use.
13. **Settings window**-Contains general settings of the **RTU** and **RFU** (RF Unit).
14. Use this button to **Show** or **Hide** the **Settings window**.
15. **Sanity-** The Sanity is the rate in seconds that the RTU will send Data to the Master unit although no change was made to the Outputs or the Inputs. The Sanity is helping to update the Master unit and the RTU when information has been lost due to a communication error. For example, imagine that the Master sent a command to open Output 1 in RTU 1 and RTU 1 did

not receive the command several times (although the Master sent 5 retries). As a result, Output 1 remains closed. When RTU 1 connects to the Master unit, he will send a sanity packet to the Master unit. The Master unit will identify that Output 1 is closed and will send a command to open Output 1.

By default, the Sanity is 300 seconds. This means that the RTU will send the Data every 300 seconds to the Master unit. The Data includes Firmware version, CPU ID, configuration ID, and configuration back to identify changes on the settings for restore or backup, status, Connected LIN plugs, Requested output status, Manually Opened outputs, flow rate of **FLOW** inputs, accumulations of **FLOW** inputs, current status of digital inputs, and Analog values.

Here is an example of a Sanity packet that RTU 3 sends to the Master:

Sanity message

AT#SEND,{[0,3,80]G:w-fw=0x3040C,id=1575509480,confid=27,confbck=0,status=0x80,plug:1="sdi"}

AT#SEND,{[0,3,81]G:w-oreq=0x1,oman=0x0,flow:1=0,flow:2=0,flow:3=0,flow:4=0,acc:1=0,acc:2=0}

AT#SEND,{[0,3,82]G:w-acc:3=0,acc:4=0,ana:1="51125"}

16. **RF Polling period**- By default, the RF polling rate is 60 seconds. This means that the RFU will send data to the RTU every 60 seconds. It is used to update the RTU about changes in the RFU. The data includes:

    RTU Address, Wake-up period, connection status, Battery voltage, Battery status, Temperature, RF descriptor, Variant, Noise, Node, Network ID, Link level (RSSI Link), Packets retries, Between retries, Network layer, Network address, Current RSSI, XID, and XnetID. Here is an example of Polling that the RFU sends to RTU 3:

    #STAT,3,10,1,12.14,0,22,G5&RFU G5,4,12,0,isr lora hf lp,H,U,67,-96,5,100,1,3,-53,0,0
17. **Radio window**- contains the settings of the RFU.
18. Use this button to **Show** or **Hide** the **Radio window**.
19. **RFU descriptor**- Describes the generation where **G4&RFU G5** is **generation 4** (Regular G5), and **G5&RFU G5** is **generation 5** (G5 FAST).
20. **RF Variant-** The Variant determines the Country code, Modulation, Frequency, Power, Bandwidth, Baud rate, and Bands. Make sure that you are using the correct Variant according to Table 1.
21. **RF version-** RF unit firmware version.
22. **RF NetID and RF ID-** The **RTU ID** and **NETWORK ID**.
23. **RF NetID Rotary switches-** The current status of the **NETWORK ID** rotary switches. The range is **1** to **99**.
24. **RF ID Rotary switches -** The current status of the **RTU ID** rotary switches. The range is **1** to **500**.
25. **RF XID-**The software **RTU ID.** Takes effect when the **RTU ID** rotary switches are set to 0. The range is **1** to **500**.

26. **RF XNETID-** The software **NETWORK ID.** Takes effect when the **NETWORK ID** rotary switches are set to 0. The range is **1** to **65535**.
27. **Role in Network-** The RTU Role in the Network. The options are **RTU** or **ROUTER**.
    When the RTU is defined to work as a **ROUTER**, the **ROUTER LED** turns **ON**.
28. **Network layer-**The layer of this RTU in the network. The **Master** unit is in **layer 0**. RTUs that communicated **directly** with the Master unit (No Routers in the middle) are in **layer 1**. RTUs that communicated with the Master unit via one Router in the middle, are in **layer 2** and so on.
29. **Network address-** An Address that the Master unit grants to the RTU. It is not the RTU Address but a secondary address for internal use.
30. **Noise immunity-** Defines the behavior in a noisy environment. There are two options.
    High Noise means that RTU will transmit data in a noisy environment.
    Low noise means that RTU will wait for better conditions before transmitting data.
31. **Link level-** Defines the minimum RSSI of the RTU to connect to the Router or the Master unit. When the current RSSI is lower than the Link level, the RTU will try to find another Router to connect to the Master unit by sending TEST packets. Also called RSSI link.
    For example, by default, the **Link level** is **-96**. Imagine that **RTU 1** has **RSSI -80** and **RTU 2** has **RSSI -100**. RTU 1 will not try to find another route. He will stay connected as is.
    On the other hand, RTU 2 will send TEST commands to find another route to improve the RSSI.
32. **Wake-Up period-** Defines when the RTU will wake up to receive data from the Master unit. By default, the Wake-up period is 10 seconds. This means that the RTU will wake up every 10 seconds. When needed, the Master sends a command to open or close the outputs while the RTU is Wake-up. The wake-up period takes effect when the Beacon period of the Master unit is 0. When the Beacon period of the Master unit is not 0, the Master sends a Beacon command to the RTUs to tell the RTUs when they should wake up.
33. **Packets retries-** Defines how many times the RTU will try to send the data when the Router or Master unit does not receive the data. It happens when the Router or Master unit does not respond to the command that the RTU sends (No acknowledged receipt).
34. **Between retries-** Define the delay period before sending a Retry.
35. **Current RSSI-** The Received Signal Strength Indication where a Signal -50 is Very good and a signal -100 is very low.
36. The **current status of Digital Inputs** where gray is open contact and blue is closed contact.
37. The **current status of Ouputs** where gray is closed output and blue is opened output.
38. **Device Image-** Displays the Device image.

RTU RF MODULAR G5 FAST- I/O SETTINGS

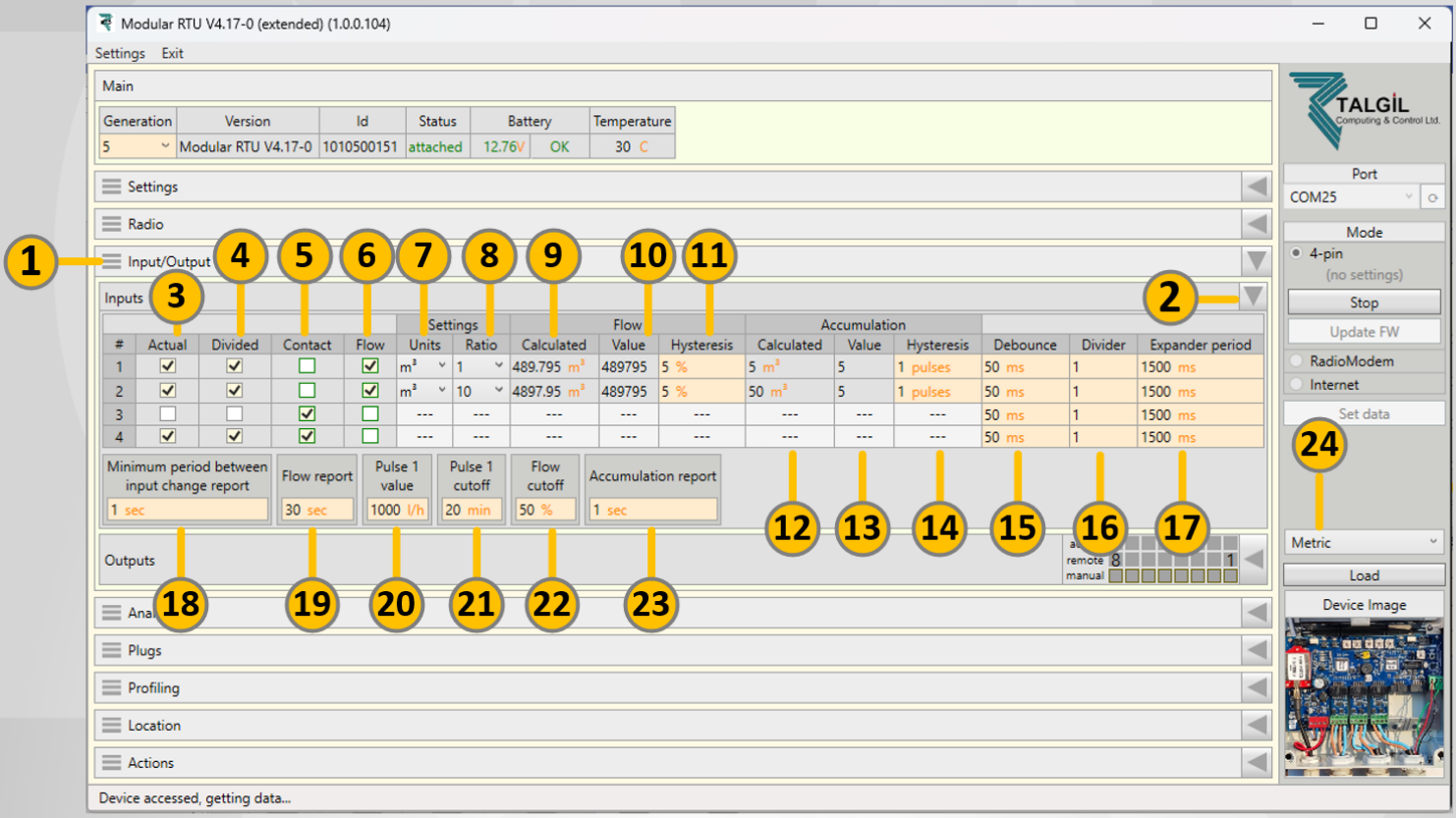


Image 21– Programming the RTU RF MODULAR G5 FAST.

21. RTU RF MODULAR G5 FAST- SETTINGS OF DIGITAL INPUTS

1. **Inputs/Outputs Window**-Includes the settings of Digital inputs and Outputs connected to the RTU Modular.
2. Use this button to **Show** or **Hide** the **Inputs/Outputs window**.
3. **Actual**- The current status of the Digital input. When it is checked, the input is closed.
4. **Divided**- When using a Divider higher than 1, it shows the current status of the Digital input after the Deviation.

Digital inputs type:

in G5 Fast, there are new parameters to define the Digital input type. The options are **CONTACT** and **FLOW**. When a Digital input is defined as **CONTACT**, the RTU will send to the Master the current status of the Input (Opened is 0, Closed is 1). When a Digital input is defined as **FLOW**, the RTU calculates the flow rate and accumulations of this input and sends the Data to the Master. To change the units to Metric or Imperial units, use the button in section 24. The Input type is defined automatically after resetting or changing the image of the Dream 2 or Sapir 2 irrigation controllers. The Dream 2 or Sapir 2 send to the RTUs the parameters **i4send** (CONTACT) and **i4flow** (FLOW) according to the input type in the image. A digital input that is used to read a water meter or fertilization meter must be defined as **FLOW**.

5. **Contact**- A Digital Input type. When a Digital input is defined as **CONTACT**, the RTU will send to the Master the current status of the Input (Opened is 0, Closed is 1).
   For example, RTU 1 sends the status of Digital Inputs 6, 7, and 8 where input 6 is closed and inputs 7 and 8 are opened:
   Time=13:07:00.749, SQN=239, DATA [NACK, ENDU, MU] L=1, SYS=78, ID=1, NET=00000001: {[0,1,15]G:w-fw=0x30411,id=1011286586,ts=0,confid=169,status=0x80,**i:6=1,i:7=0,i:8=0**}, RSSI=-65, PWR=-23
6. **Flow**- A Digital Input type. When a Digital input is defined as **FLOW**, the RTU calculates the flow rate and accumulation of this input and sends the Data to the Master.
   For example, RTU 1 sends the flow rate of Digital Inputs 2 and 3 where the flow rate is 167.053 and 835.526 pulses per hour:
   Time=13:07:00.821, SQN=240, DATA [NACK, ENDU, MU] L=1, SYS=78, ID=1, NET=00000001: {[0,1,16]G:w-oreq=0xB,oman=0x0,**flow:2=167053,flow:3=83526,**acc:2=2009,acc:3=729}, RSSI=-65, PWR=-23
7. **Units-** The RTU does not know the meter's Ratio. The RTU calculates the flow rate as Pulses per hour. To see the correct flow rate, set up the meter's Units (m3, Litters, THG, or Gallons).
   To change the units to Metric or Imperial units, use the button in section 24.
8. **Ratio**- The RTU does not know the meter's Ratio. The RTU calculates the flow rate as Pulses per hour. To see the correct flow rate, set up the meter's Ratio. (0.001,0.01,0.1,1,10,100,1000)
9. **Calculated Flow**- The Calculated flow in Units per Hour or Units per minute**.** The calculation is based on the **Flow Value**, **Units**, and **Ratio.**
10. **Flow Value**- The Calculated Flow in Pulses per Hour. The calculation is not based on the **Units** and **Ratio.**
11. **Flow Hysteresis**- By default, the **Flow Hysteresis** is 5%. It is used to reduce the traffic. Only when the current flow is 5% above or below the previous flow value, the RTU will send the new flow rate to the Master.
12. **Calculated Accumulations**- The Calculated Accumulations since the last reset. Based on the **Accumulation value**, **Units** and **Ratio.**

13. **Accumulation value**- The number of received pulses since the last reset. The RTU does not know the meter's Ratio. To see the accumulations in m3, Litters, THD, or Galons, see section 12 called **Calculated Accumulations**.

    For example, RTU 1 sends the accumulations of Digital Inputs 2 and 3:

    Time=13:07:00.821, SQN=240, DATA [NACK, ENDU, MU] L=1, SYS=78, ID=1, NET=00000001: {[0,1,16]G:w-oreq=0xB,oman=0x0,flow:2=167053,flow:3=83526**,acc:2=2009,acc:3=729**}, RSSI=-65, PWR=-23

14. **Accumulations Hysteresis**- The number of pulses to be accumulated before sending the accumulations value. By default, the **Accumulations Hysteresis** is 1 pulse. This means that the RTU will send to the Master every entire pulse (ON + OFF). For example, if the Unit is m3 and the Ratio is 1 (1 m3 per pulse), the RTU will send to the Master the Total accumulations every m3.

    For example, RTU 1 sends the accumulations of Digital Inputs 2 every entire pulse:

    Time=13:07:00.821, SQN=240, DATA [NACK, ENDU, MU] L=1, SYS=78, ID=1, NET=00000001: {[0,1,16]G:w-oreq=0xB,oman=0x0,flow:2=167053,flow:3=83526**,acc:2=2009**,acc:3=729}, RSSI=-65, PWR=-23

    Time=13:07:04.766, SQN=241, DATA [NACK, ENDU, MU] L=1, SYS=78, ID=1, NET=00000001: {[0,1,17]G:d-**acc:2=2010**}, RSSI=-65, PWR=-23

15. **Debounce**- Defines the minimum pulse width of the incoming pulse. When the incoming pulse width is lower than the Debounce time, the RTU will not read the pulse.
16. **Divider**- When there are several pulses in 1 second, Dream 2 and Sapir 2 controllers cannot read it. They are limited to reading 1 pulse per second. In this case, use a divider to define how many pulses to join together and send one long pulse instead. For example, A digital rain gauge is connected to input 1. The rain gauge can generate 4 pulses per second. The rain gauge generates a pulse every 1 mm. As described above, the Dream 2 and Sapir 2 controllers cannot read it. To solve the problem, use a **Divider 4** to join 4 pulses together and send 1 long pulse to the controller. In Dream 2 or Sapir 2, you need to define that every pulse is **4 mm**.
17. **Expander period**- As described above, the Dream 2 and Sapir 2 controllers cannot read a pulse width lower than 1 second**.** To solve this, by default, the pulse Expansion is 1500 milliseconds. This means that when the incoming pulse width is very short, the RTU will expand the pulse width to 1500 milliseconds. For example, Input 3 gets a closed contact for 110 milliseconds. The RTU expands the pulse to 1500 milliseconds:

    16:48:50.865 Input 3 is **closed**
    16:48:**50.882** AT#SEND,{[0,43,74]G:d-**i:3=1**}
    16:48:50.975 Input 3 is **opened**
    16:48:**52.390** AT#SEND,{[0,43,75]G:d-**i:3=0**}

18. **Minimum period between input change period**- The minimum period time in seconds that the RTU will send the current status of Digital inputs to the Master. By default is 1 second. This means that if a digital input is changed several times during 1 second, the RTU will not send the data to the Master. The incoming pulse can change at a rate of pulse per second.

19. **Flow report-** The time rate that the RTU will send a change in the flow rate to the Master. By default, it is 30 seconds. This means that if the flow rate is changed (5% higher or lower than the previous flow), the RTU will send the change to the Master every 30 seconds. It is used to reduce the traffic.
20. **Pulse 1 value**- To calculate the flow rate, the controller should receive 2 pulses. The **Pulse 1 value** is the Flow rate that will appear after 1 pulse. By default is 1000 liters per hour (1000 liters per hour will appear in the controller as 1 m3 per hour). For example, If the Ratio is 1 m3 per pulse, the Flow rate that will appear after 1 pulse is 1 m3 per hour.
21. **Pulse 1 cutoff**- By default it is 20 minutes. This means that the **Pulse 1 value** will change to 0 when not receiving the second pulse after 20 minutes.
22. **Flow cutoff**- By default it is 50%. This means that when the current flow is lower than 50% than the previous flow, the calculated flow will change to 0.
23. **Accumulations report-** By default is 1 second. This means that when the accumulations change several times in one second, the RTU will not change the accumulation data several times in one second. It is limited to 1 second minimum.
24. Select the **unit's type**. The options are **Metric** or **Imperial**.

RTU RF MODULAR G5 FAST- OUTPUTS SETTINGS

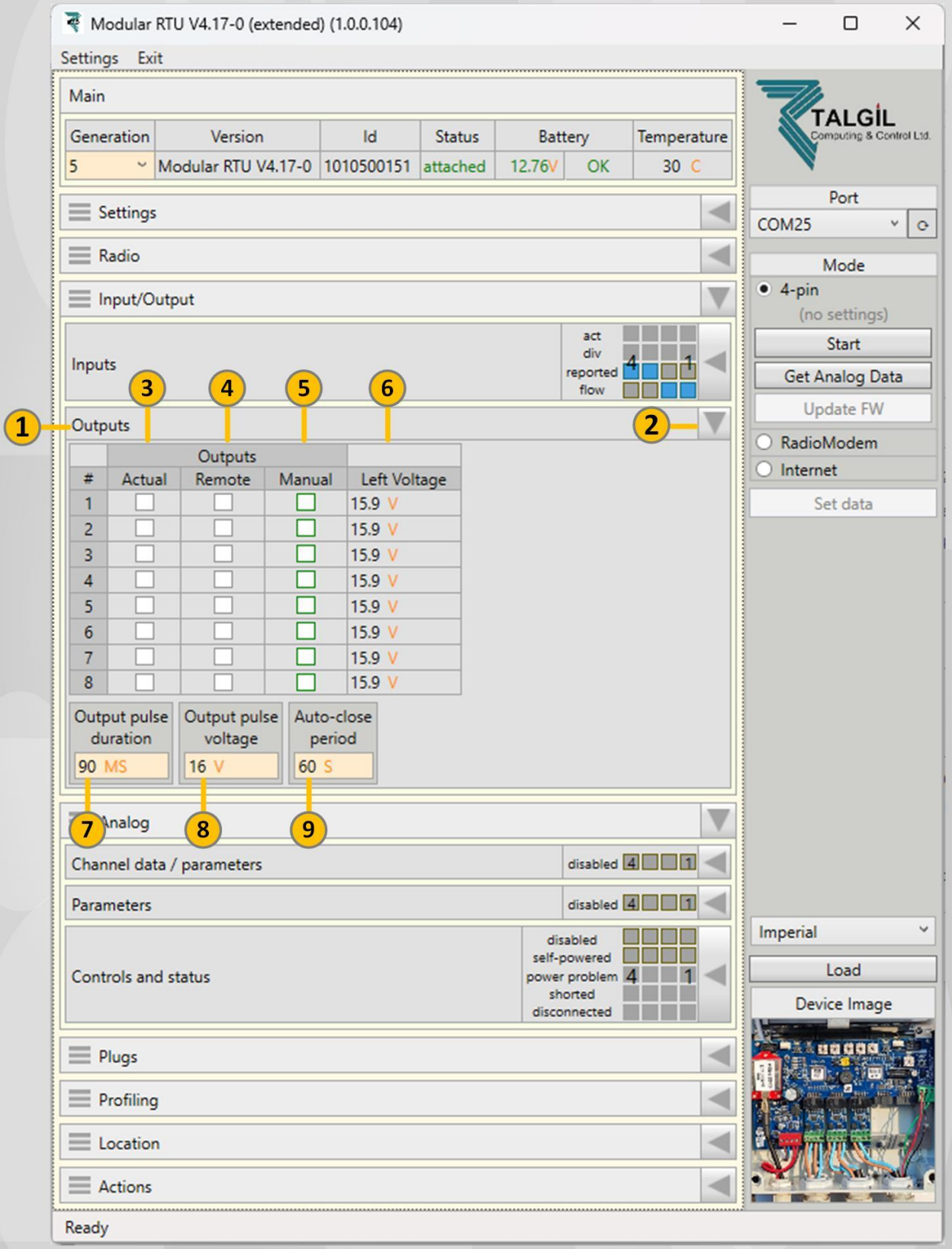
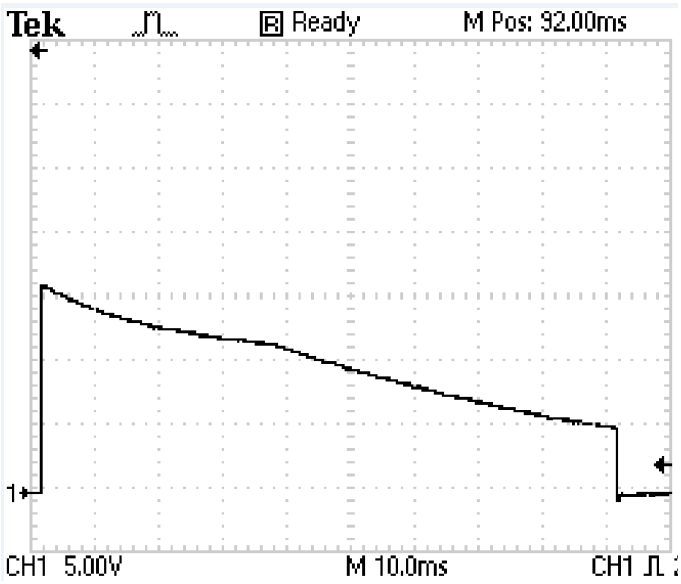


Image 22– Programming the RTU RF MODULAR G5 FAST.

22. RTU RF MODULAR G5 FAST- SETTINGS OF OUTPUTS

1. **Outputs window**- Includes the settings of the Outputs connected to the RTU Modular.
2. Use this button to **Show** or **Hide** the **Outputs window**.
3. **Actual**- The current status of the Outputs. When it is checked, the Output is opened.
4. **Remote-** The current status of the **Outputs** according to the Dream 2 or Sapir 2 controllers.
5. **Manual-** An option to operate the Outputs manually. When checked, the Output will open Manually.
6. **Left voltage-** Measured voltage on the capacitor after operating the Output. It is used to identify if something is connected to the Output.
   After opening or closing the Output:
   when it is close to 16V, it means that nothing is connected to the Output.
   when it is below 5V, it means that a Solenoid or Valve is connected to the Output.
7. **Output pulse duration-** The period of time to energize the Output. By default it is 90 milliseconds.
8. **Output pulse voltage-** The maximum output voltage while energizing the Output. By default, it is 16V DC.



9. **Auto-close period-** When the RTU has communication error for long time, the RTU will close the Outputs automatically. By default, it is 60 seconds.

RTU RF MODULAR G5 FAST- ANALOG INPUTS SETTINGS

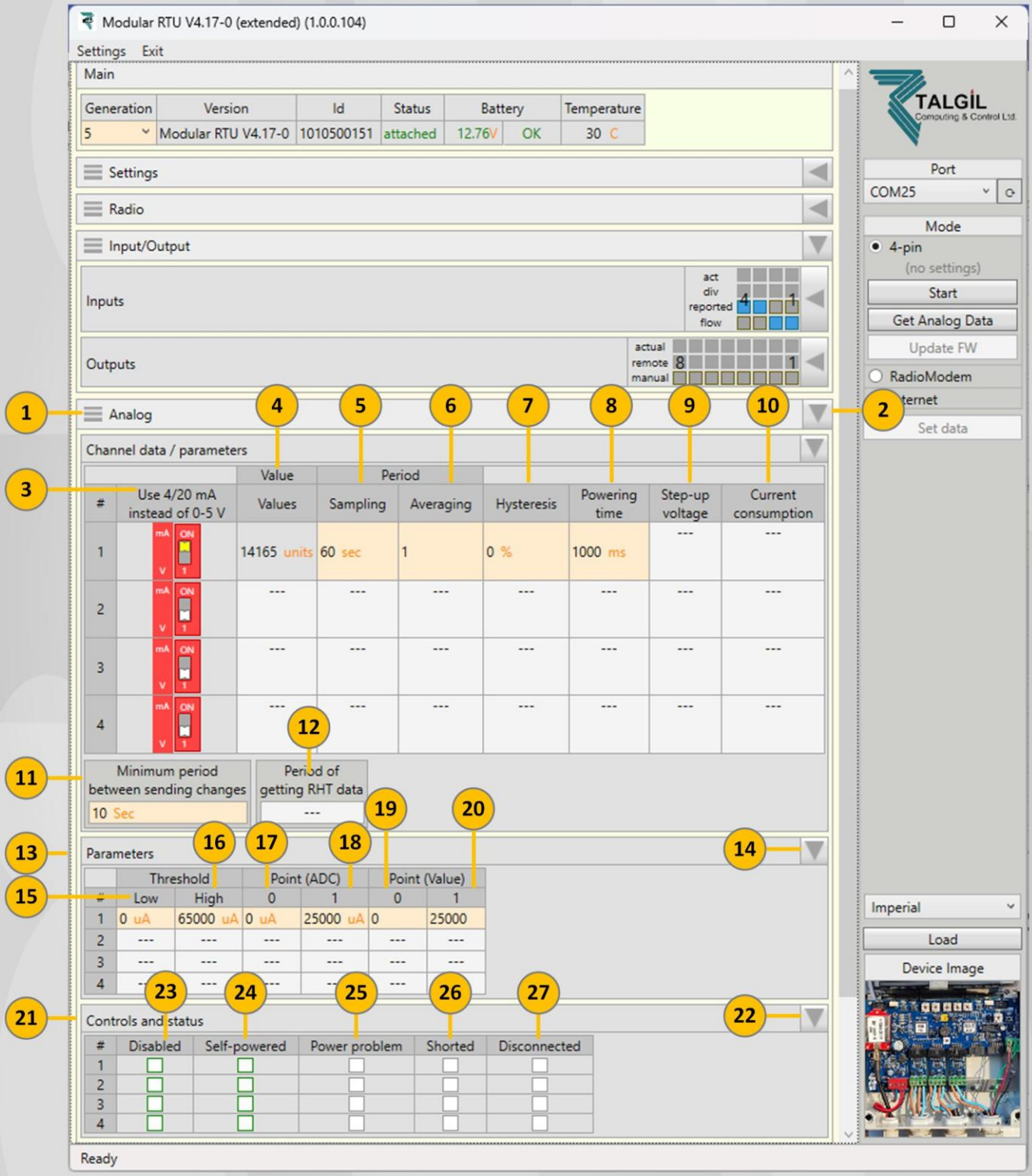


Image 23– Programming the RTU RF MODULAR G5 FAST.

23. RTU RF MODULAR G5 FAST- SETTINGS OF ANALOG INPUTS

1. **Analog window**- Includes the settings of the Analog inputs of the RTU RF Modular G5 FAST.
2. Use this button to **Show** or **Hide** the **Analog window**.
3. **Analog Input Type-** The Analog input type is according to the status of Jumpr **JP4** as described in chapter 16. The types are Voltage (0-5V) or Current (4-20mA).
4. **Value-** The analog value that has been measured in the last analog sampling.
5. **Sampling-** The Analog sampling rate in seconds (How often to read the Analog sensor).
6. **Averaging-** Allows reading the Analog Sensor several times and sending the Average value of the last samplings. For example, the Sampling rate is 10 minutes and Averaging is 10. The RTU will read the Analog input every minute. After 10 sampling (10 minutes) it will send the average of the last 10 readings.
7. **Hysteresis-** By default, the **Hysteresis** is 0%. This means that the RTU will send the Analog values after the Analog sampling. When the Hysteresis is not 0, for example, it is 10%, the RTU will send the Analog values when the new value is 10% higher or lower than the previous Analog value.
8. **Powering time-** Determines the Powering time before the Analog sampling (Also called Excitation time or Response time). This value can be taken from the Analog sensor data sheet or specification document.
9. **Step-up voltage**-Used in the 4 ANA LIN card to set the Powering voltage of the Analog inputs.
10. **Current consumption-** The current consumption of the Analog sensor (When it is powered by the RTU). Available on RTU RF 4 ANA and 4 ANA LIN card.
11. **Minimum Period between sending Changes-**The time rate in seconds to send the Analog values to the Master.
12. **Period of getting RHT data**-
13. **Parameters**- Parameters of the Analog inputs.
14. Use this button to **Show** or **Hide** the **Parameters window**.
15. **Low threshold**- A measured Analog value that is lower than the **Low threshold** will raise a Disconnected Analog sensor.
16. **High threshold**- A measured Analog value that is higher than the **High threshold** will raise a Shorted Analog input.
17. **Low Point ADC**- Minimum ADC value to be sent.
18. **High Point ADC**- Maximum ADC value to be sent.
19. **Low Point Value**- Minimum true value to be sent.
20. **High Point Value** - Maximum true value to be sent.
21. **Control and Status-** Settings and Status of Analog inputs.
22. Use this button to **Show** or **Hide** the **Control and Status window**
23. **Disabled-**When checked the Analog input is disabled.
24. **Self-powered-** When checked, the RTU will not power the Analog sensor. Used for Active Analog sensors (Analog sensors that do not need a power supply).
25. **Power problem**- When it is checked, a Powering problem has been detected.
26. **Shorted**- When it is checked, a shorted Analog sensor has been detected.
27. **Disconnected**- When it is checked, a disconnected Analog sensor has been detected.

PROGRAMMING THE RFU (RF UNIT)

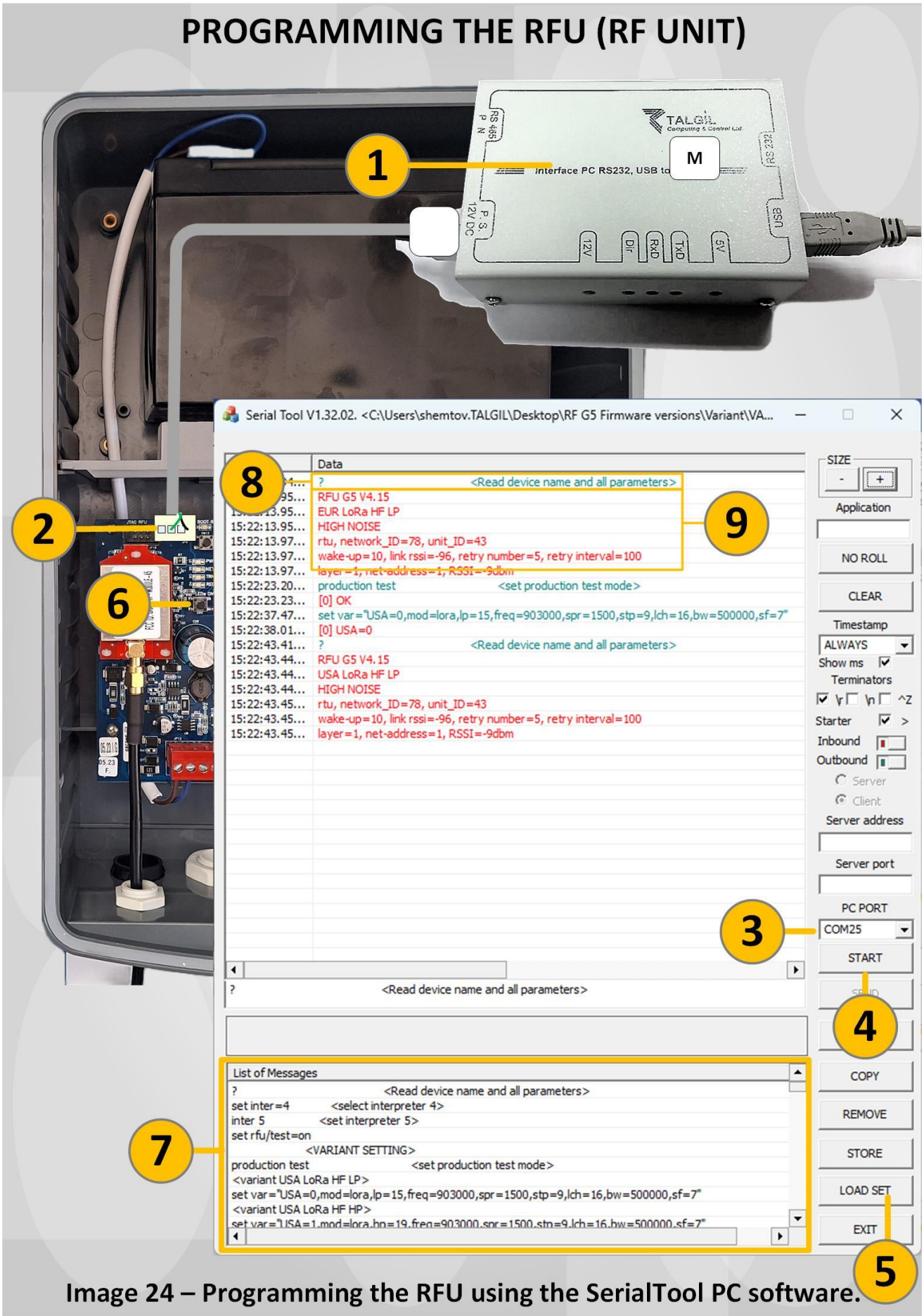


Image 24 – Programming the RFU using the SerialTool PC software.

24. PROGRAMMING THE RFU USING THE SERIALTOOL PC SOFTWARE

To read the setting of the RFU (RF Unit), you can use the Workbench PC software as described in **Chapter 20**. It is not possible to change the Variant through the Workbench PC software. To change the Variant, follow the instructions below:

1. Connect the **Programmer device** to your **PC**.
2. Connect the **Programmer device** cable to the **RF PC Socket** on the upper left corner of the **RTU RF MODULAR G5** card as described in **Image 24**.
3. Start the **SerialTool** PC software and select the **Communication port.** To download the **SerialTool** PC software and the set of commands called **VARIANTS.promptset**, click it here: https://drive.google.com/drive/folders/1LnYjFsgmcl4iGiqDCN0ufBPboZzRdXFb?usp=sharing
4. Click the **START** button **(2).**
5. To write a command manually, write the new command in the **Command text box.** To use a library of existing commands, click the **Load set** button and select the **VARIANTS.promptset** file. The available commands will appear in the **Commands list.**
6. To put the **RFU** in **Programming mode**, press the **LEDs ON** button**.** in **Programming mode**, the **PWR** and **NET** LEDS are working.
7. Select the first command on the **Commands list** and double-click on it. It is called **"?".** This command reads the settings of the **RFU**. The SerialTool saves the logging files in the folder where the SerialTool is located.
8. The command that has been sent will appear on the **Logging window.**
9. The response from the **RFU** will appear on the **Logging window.** The RFU will return the settings. Make sure that you are using the correct Variant according to **Table 1.**
10. To change the Variant, put the **RFU** in **Test mode**. To put the **RFU** in **Test mode**, double-click on the command called **production test**.
11. Select the Variant from the **Commands list** and double-click on it.
    * Pay attention, several Variants have 2 commands to send.
12. To start working with the new Variant, reset the RFU.

To add commands to the **Commands list**, write the new command in the **Command text box** and click the **Store.** To remove a command from the **Commands list**, select the command to remove and click **Remove**. The user can use different colors for the transmitted and received data by using the **Outbound** and **Inbound** buttons**.** The new colors will appear in the **Logging window.** To show the logged time in milliseconds, check the **Show ms** check box**.** To clear the logging list from the **Logging window** click **CLEAR.** To freeze the Logging while the logging is still running, click **NO ROLL.** To change the software size, use the **+** and **–** buttons

RTU RF Modular G5-4 ANA LIN CARD

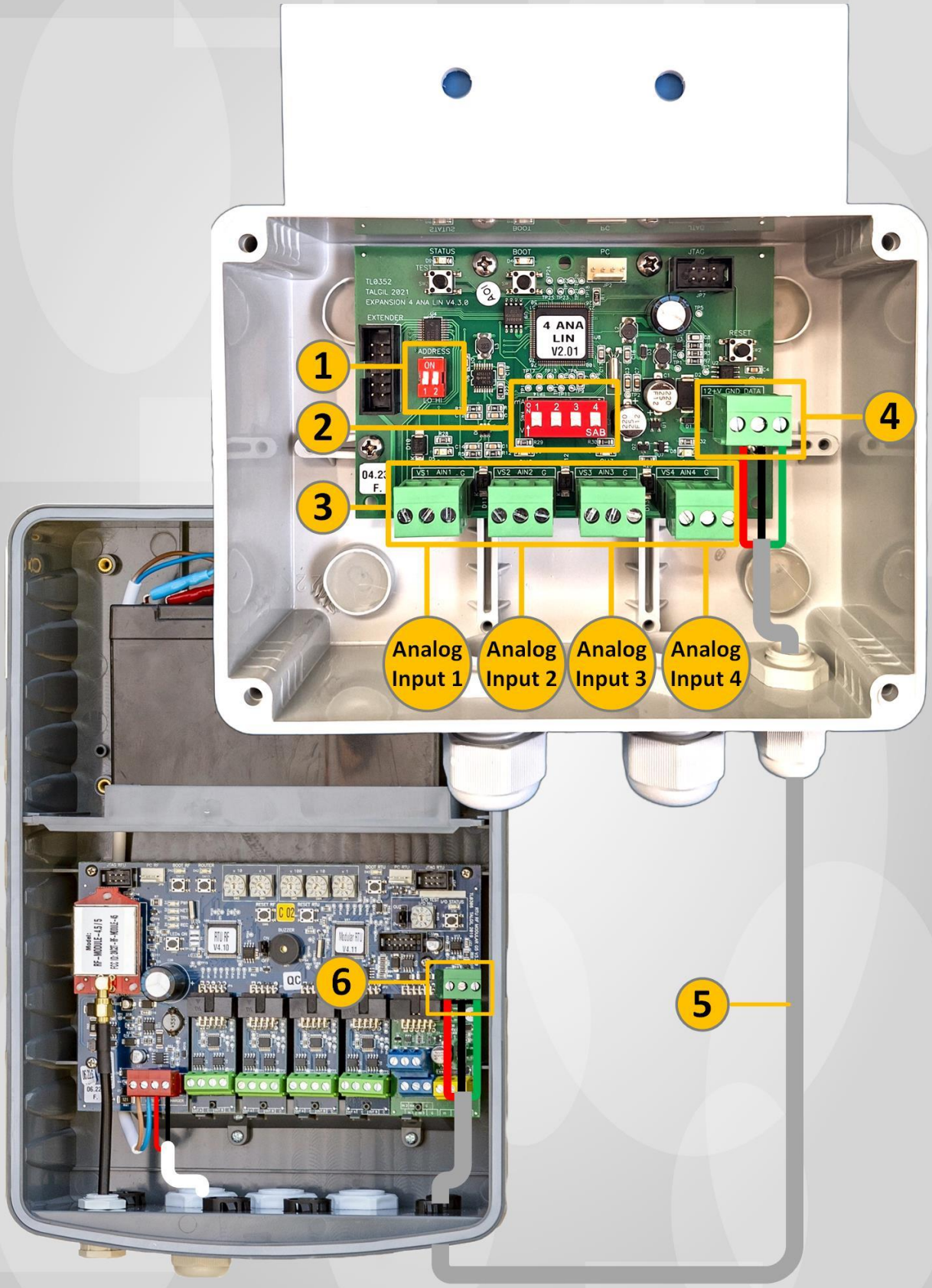


Image 25 – 4 ANA LIN card connected to RTU RF Modular G5.

25. ANA LIN CARD - INSTALLATION

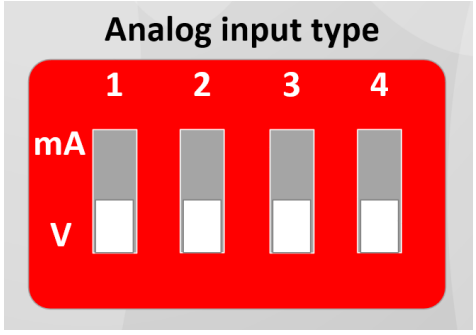
When any LIN card is connected to the RTU RF G5 Modular it must be powered by a **12V DC** power supply. Connect the Rechargeable battery cable to the **BATTERY** input in the power supply plug. To charge the battery, use an 18V DC charger and connect it to the **CHARGE** input in the power supply plug. It can be a **Solar Panel** or an **18V DC Power supply**. The 4 ANA LIN card can read up to 4 Standard Analog sensors, 4-20 milli ampere, or 0-5 Volts with 16 Bits resolution. Use the Workbench PC software to program the 4 ANA LIN card. Set the Sampling rate, Powering time, Averaging, Hysteresis, and more.

To install the 4 ANA LIN CARD, follow the instructions below:

1. Use the two dipswitches called **ADDRESS** to set the 4 ANA LIN card address.
2. Use the 4 dipswitches to set up the Analog input types. When the Dip switch is OFF, the Analog input type is Voltage. When the Dipswitch is ON, the Analog input type is Current. For example, if Analog input 1 is Voltage (0-5V), put the dipswitch 1 on V (turn OFF dipswitch 1). If Analog input 2 is Current (4-20mA), put the dipswitch 2 on mA (turn ON dipswitch 2).
3. Connect the Analog sensor wires to the Analog input terminal block. The Analog input terminal block has 3 screws. **VS**, **AIN**, and **G** where **VS** is the 12V DC power supply, **AIN** is an input for the Analog data (Analog Signal), and **G** is a **Ground**.

   Types of Analog sensors: Read the Analog sensor specification document or Datasheet to identify the Analog sensor type, Powering time, wiring, and the range. A **Passive Analog sensor** should be powered before reading the Analog value. It is also called excitation time. On the other hand, an **Active Analog sensor** should not be powered. To read a **Passive analog sensor**, If the Analog sensor has **2 wires**, connect the Positive wire to **VS** and the negative wire to **AIN**.

   To read a **Passive analog sensor**, If the Analog sensor has **3 wires**, connect the Powering wire to **VS**, the DATA (Signal) wire to **AIN**, and the Ground wire to **G**. To read an **Active analog sensor**, connect the DATA (Signal) wire to **AIN**, and the Ground wire to **G**.
4. Connect the LIN communication cable to the LIN port on the 4 ANA LIN card where **12V** is a 12V DC power supply (**Red**), **GND** is the Ground (**Black**), and **DATA** is the LIN communication (**Green**).
5. The maximum length of the LIN cable is 10 meters.
6. Connect the LIN cable to the LIN port on the RTU Modular.



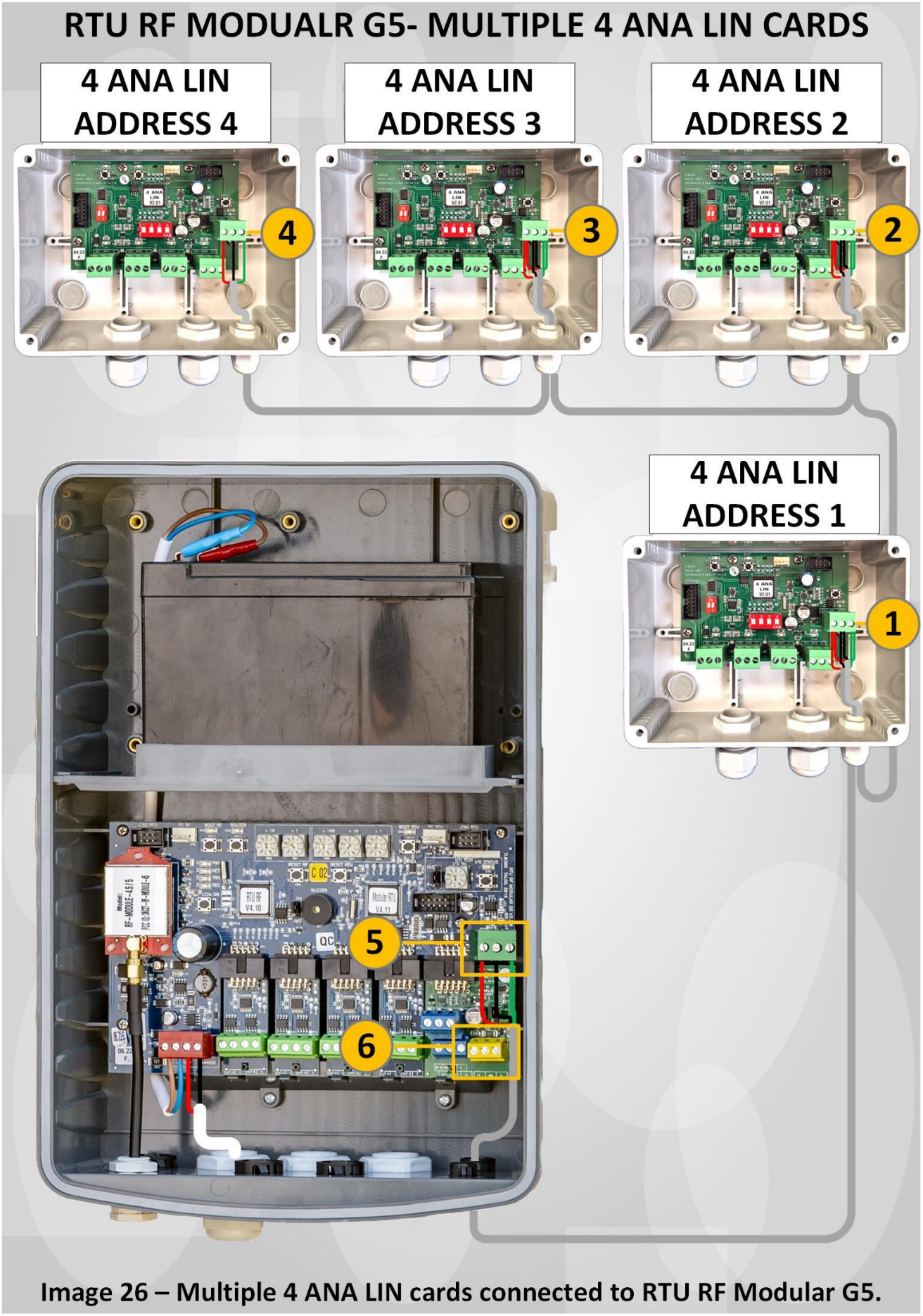


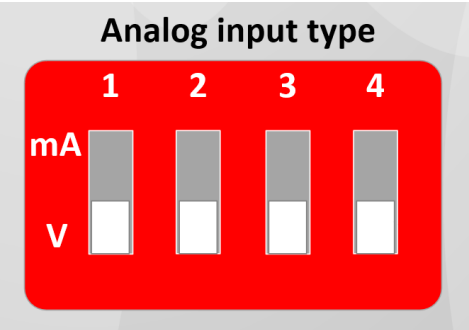
Image 26 – Multiple 4 ANA LIN cards connected to RTU RF Modular G5.

26. RTU RF MODULAR G5 FAST-MULTIPLE 4 ANA LIN CARDS

As described before, it is possible to connect up to 4 LIN cards to the RTU RF Modular G5 Fast. Image 26 describes how to connect 4 cards of 4 ANA LIN to the RTU RF Modular G5 Fast. Every 4 ANA LIN card has 4 Analog Inputs. When 4 cards of 4 ANA LIN are connected to the RTU RF Modular G5 Fast, the number of Analog inputs increases to 16. When **4 Digital + 1 ANA INPUT card** is connected to the RTU RF Modular G5 Fast, the number of Analog inputs increases to 17. Only the 4 ANA LIN card can be used several times in the same RTU (It is not possible to connect more than 1 SDI LIN card or more than 1 I/O 8/4 LIN card to the same RTU).

To install 4 cards of 4 ANA LIN to the RTU RF Modular G5 Fast, follow the instructions below:

1. Connect the LIN communication cable to the LIN port on the first 4 ANA LIN card. **12V** is the 12V DC power supply (**Red**), **GND** is the Ground (**Black**), and **DATA** is the communication (**Green**). Set the LIN address to address 1. Use the 4 Dipswitches to set up the Analog input type and connect the Analog sensors as described in chapter 25.
2. Connect the LIN communication cable to the LIN port on the second 4 ANA LIN card. Set the LIN address to address 2. Use the 4 Dipswitches to set up the Analog input type and connect the Analog sensors as described in **Chapter 25**.
3. Connect the LIN communication cable to the LIN port on the second 4 ANA LIN card. Set the LIN address to address 3. Use the 4 Dipswitches to set up the Analog input type and connect the Analog sensors as described in **Chapter 25**.
4. Connect the LIN communication cable to the LIN port on the second 4 ANA LIN card. Set the LIN address to address 4. Use the 4 Dipswitches to set up the Analog input type and connect the Analog sensors as described in **Chapter 25**.
5. Connect the LIN cable to the LIN port on the RTU Modular. The maximum length of the LIN cable is 10 meters.
6. To install the onboard Analog input of the RTU Modular, follow the instructions in **Chapter 16**.



4 ANA LIN CARD - FIRMWARE VERSION UPGRADE

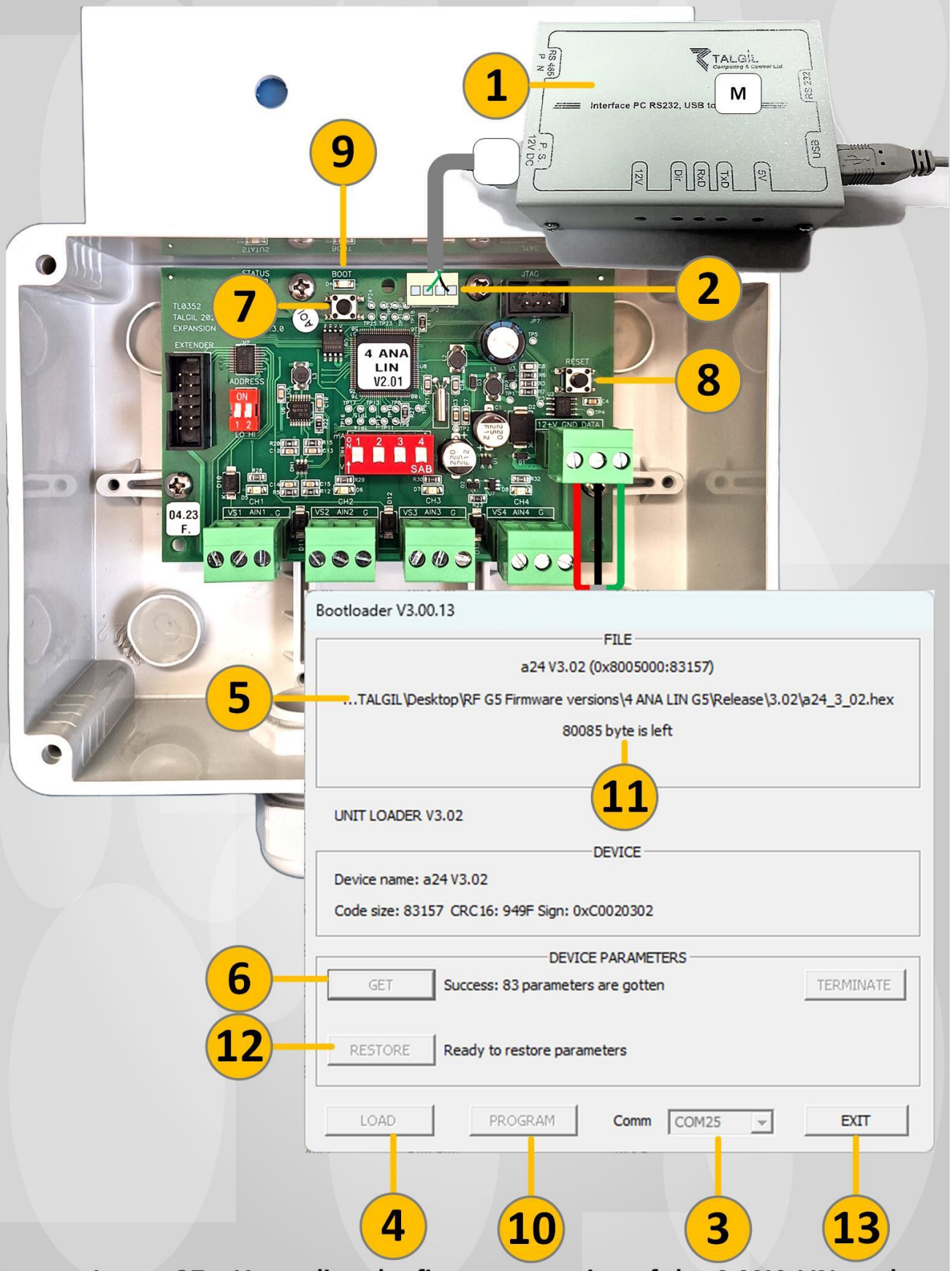


Image 27 – Upgrading the firmware version of the 4 ANA LIN card.

27. UPGRADING THE FIRMWARE VERSION OF THE 4 ANA LIN CARD

Make sure that you are using the latest Firmware version of the **4 ANA LIN CARD**. Use the links below to download the latest firmware version and the **CBoot PC software**. To start the firmware version upgrading process, please follow the instructions below:

1. Connect the **Programmer device** to your PC.
2. Connect the Programmer cable to the **PC Socket** on the **4 ANA LIN CARD** as described in **Image 27**.
3. Start the **CBoot** PC software and select the **Communication port.** If you do not have the **CBoot** PC software, download it here:

https://drive.google.com/drive/folders/17AZoFHJXi4XWkqNSbLTVXLVqKH4EP0tp?usp=sharing

4. Click the **LOAD** button, browse to **4 ANA LIN CARD** hex file and select it.

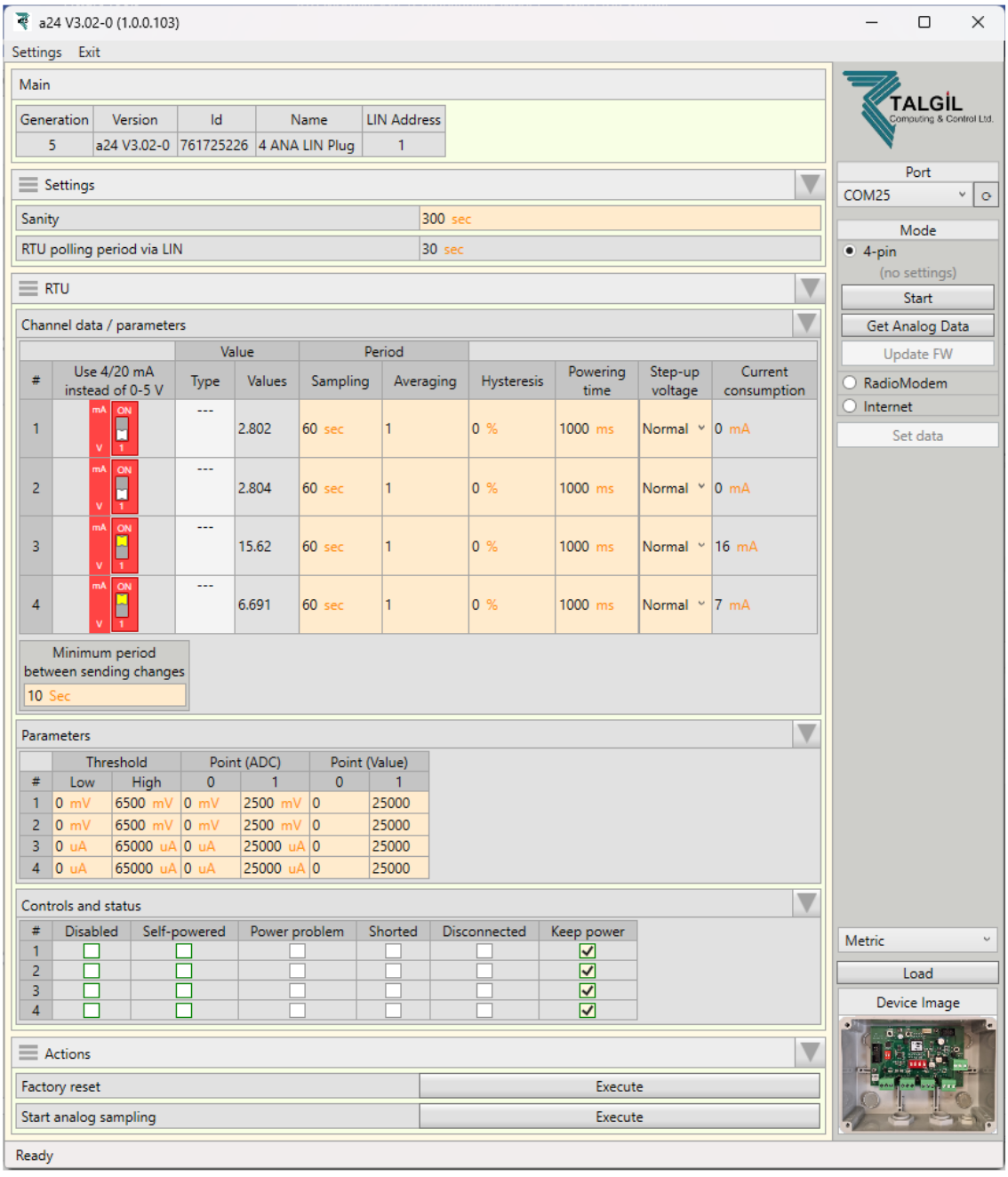
To download the latest **4 ANA LIN CARD** firmware version, click here:

https://drive.google.com/drive/folders/1sKFhwgJQYbp4QdtsRxNsHfZVxiYfyxnt?usp=sharing

5. The pathway to the hex file will appear on the screen.
6. Click the **GET** button to read the settings of the **4 ANA LIN CARD.** This will save the settings in the CBoot software. The number of the saved parameters will appear.
7. On the **4 ANA LIN CARD** hardware, press and hold the **BOOT** button.
8. While the **BOOT** button is pressed, press the **RESET** button. Leave the **RESET** button, after 1 second, leave the **BOOT** button. This action will put the **4 ANA LIN CARD mode** into a **BOOT Mode**.
9. In **BOOT Mode,** the **BOOT** LED is ON.
10. To start the upgrading process, click the **PROGRAM** button. The upgrading process will start.
11. A progress indicator will appear on the screen**.** At the end of the process, a **Terminated** message will appear.
12. After the upgrading process, wait for the settings to be restored. The **CBoot** software will **RESTORE** the settings to the **4 ANA LIN CARD.**
13. To close the **CBoot** software, click **EXIT.**

28. PROGRAMMING THE 4 ANA LIN CARD

The **4 ANA LIN card** can read up to 4 standard Analog sensors. The Analog input types can be Current (4-20 milli Ampere) or Voltage (0-5 Volts). The Resolution is 16 Bits. The 4 ANA LIN card is a programable device. Use the **Workbench** PC software while it is connected to the **4 ANA LIN CARD** to see the measured Analog values, define the Sampling rate, Averaging, Hysteresis, powering time, and Start Analog Sampling now. Read **Chapter 23** to learn about the Workbench and Settings of Analog inputs.

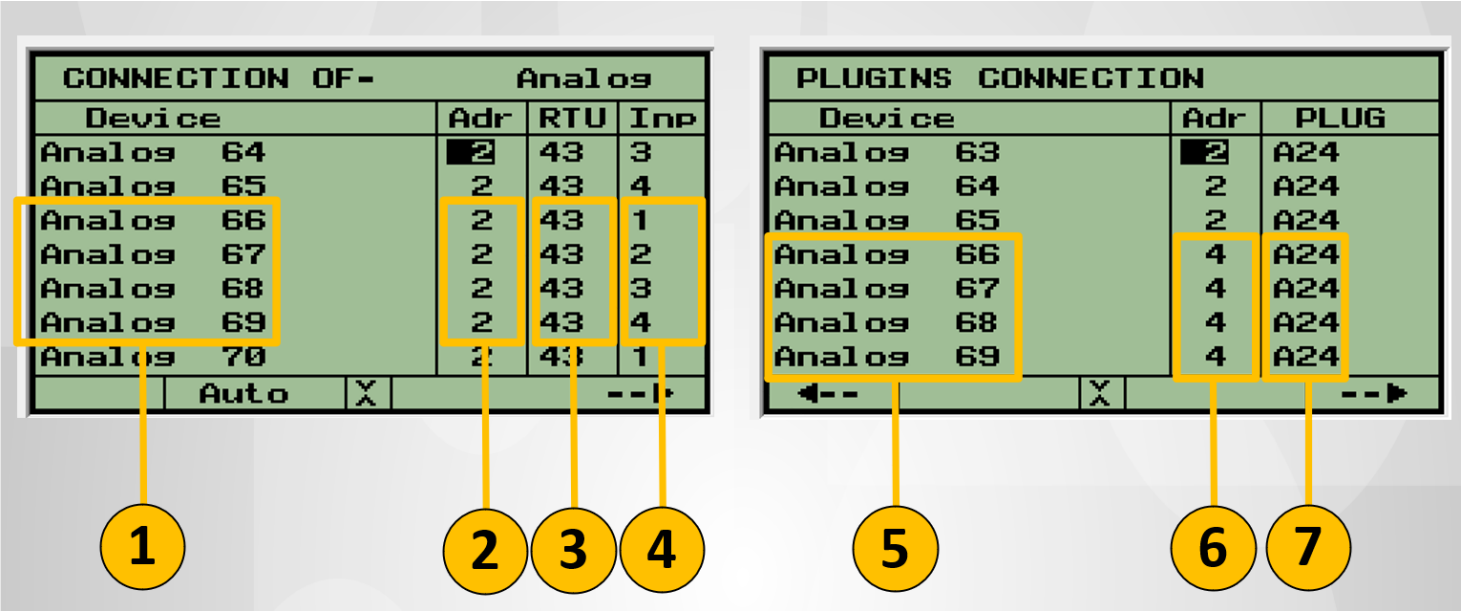


29. ANA LIN CARD - ANALOG INPUTS WIRING IN THE DREAM 2.

At this point, it is not possible to define the LIN card type and LIN card address in the **Image Maker**. Therefore, when a **4 ANA LIN card** is connected to the **RTU RF Modular G5 FAST**, use the **Dream 2** MMI to set up the **LIN card Type**, **LIN card Address,** and **Analog input number** in the **4 ANA LIN card**.

For example, Analog Sensors **66 to 69** are connected to the **4 ANA LIN card**. The **LIN card Address** is **4**. The **4 ANA LIN card** is connected to **RTU RF Modular G5 FAST** where the **RTU Address** is **43**.

1. Go to the **Dream 2/Setup/Hardware connections/Connection of Analog inputs** screen and scroll down to Analog Sensors **66** to **69**.
2. Set up the **INTERFACE RF G5 ADDRESS** (Interface address is **2**).
3. Set up the **RTU RF MODULAR G5 ADDRESS** (Address **43**).
4. Set up the **Analog input** in the **4 ANA LIN Card** (Inputs **1** to **4**).
5. Press the **F4** button to move to the **PLUGINS CONNECTION** screen and scroll down to the Analog Sensors **66** to **69**.
6. Set up the **Address** of the **4 ANA LIN Card** (Address **4**).
7. Set up the **LIN Card Type** (**4 ANA LIN** appears as **A24**).
8. To exit, press the **F4** button.
9. Set up the Analog sensor **Type** and **Range** in the **Constants/Analog sensors screen** according to the Analog sensor's **Type** (Current or Voltage) and **Range.**



RTU RF MODULAR G5 FAST - SDI LIN CARD

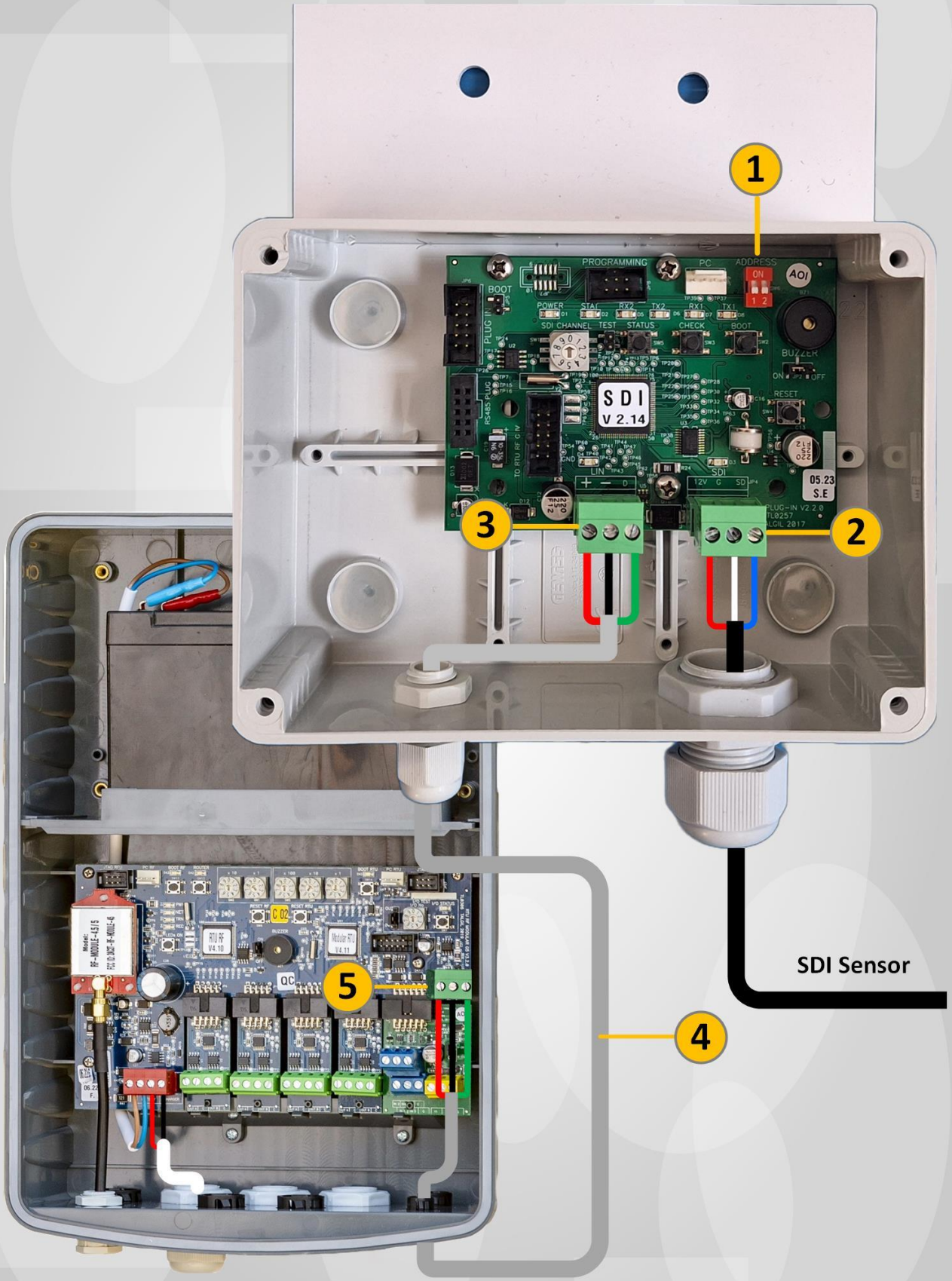


Image 30 – SDI LIN Card connected to the RTU RF Modular G5 Fast.

30. SDI G5 FAST LIN CARD- INSTALLATION

When any **LIN card** is connected to the **RTU RF MODULAR G5 FAST** it must be powered by **12V DC** power supply**.** Connect the Rechargeable battery cable to the **BATTERY** input in the power supply plug. To charge the battery, use an **18V DC** charger and connect it to the **CHARGE** input in the power supply plug. The charger can be a **Solar Panel** or an **18V DC Power supply**. The **SDI G5 FAST LIN CARD** can communicate with up to **10 SDI Sensors**. The maximum number of values to read is **64 values**. Use the **SDI Programmer** PC software to program the **SDI G5 FAST LIN CARD**. Set the SDI card type, Quantity of SDI sensors, SDI sensor models, Sampling rate, SDI Sensor Addresses, and select values to read. In G5 Fast, the values are not converted to Current (4-20mA) but, the Values are transmitted as is.

To install the SDI G5 FASTLIN CARD, follow the instructions below:

1. It is possible to connect only one **SDI G5 FAST LIN CARD** to the **RTU RF MODULAR G5 FAST**.
2. Read the **SDI sensor** Installation Instructions to identify the **SDI sensor model** and the **Wiring**. Connect the **SDI SENSOR** wires according to the Installation instructions guide to the **SDI PLUG**. The **SDI PLUG** has 3 screws. **12V**, **G**, and **SDI** where **12V** is the 12V DC power supply to power the SDI sensors, **G** is the Ground, and **SDI** is the Data.
3. Connect the **LIN communication cable** to the **LIN port** on the **SDI G5 FAST LIN CARD** where **12V** is the 12V DC power supply (**Red**), **GND** is the Ground (**Black**), and **DATA** is the **LIN communication** (**Green**).
4. The maximum length of the LIN cable is 10 meters.
5. Connect the **LIN cable** to the **LIN port** on the **RTU RF MODULAR G5 FAST**.

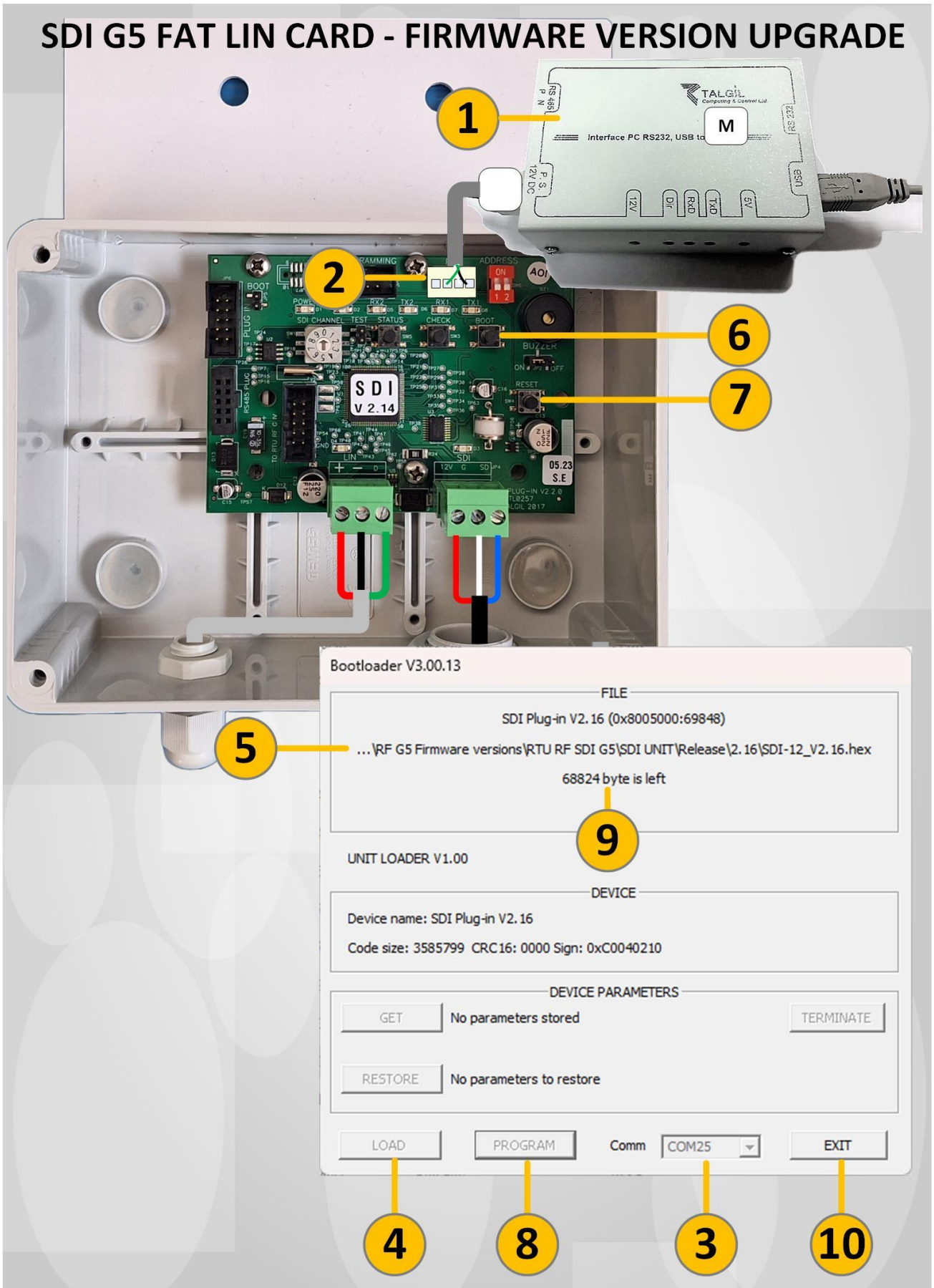


Image 31 – Upgrading the firmware version of the SDI G5 FAST LIN card.

31. SDI G5 FAST LIN CARD - FIRMWARE VERSION UPGRADE

Make sure that you are using the latest Firmware version of the **SDI G5 FAST LIN CARD**. Use the links below to download the latest firmware version and the **CBoot PC software**. To start the firmware version upgrading process, please follow the instructions below:

1. Connect the **Programmer device** to your PC.
2. Connect the Programmer cable to the **PC Socket** on the **SDI G5 FAST LIN CARD** as described in **Image 31**.
3. Start the **CBoot software** and select the **Communication port.** If you do not have the **CBoot** software, download it here:

https://drive.google.com/drive/folders/17AZoFHJXi4XWkqNSbLTVXLVqKH4EP0tp?usp=sharing

4. Click the **LOAD** button, browse to **SDI CARD** hex file, and select it.

To download the latest **SDI CARD** firmware version, click here:
https://drive.google.com/drive/folders/1sKFhwgJQYbp4QdtsRxNsHfZVxiYfyxnt?usp=sharing

5. The pathway to the hex file will appear on the screen.

6. On the **SDI G5 FAST LIN CARD**, press and hold the **BOOT** button.

7. While the **BOOT** button is pressed, press the **RESET** button. Leave the **RESET** button, after 1 second, leave the **BOOT** button. This action will put the **SDI G5 FAST LIN CARD mode** into a **BOOT Mode**. In **BOOT Mode,** the **POWER** and **SDI LEDs** are flashing.

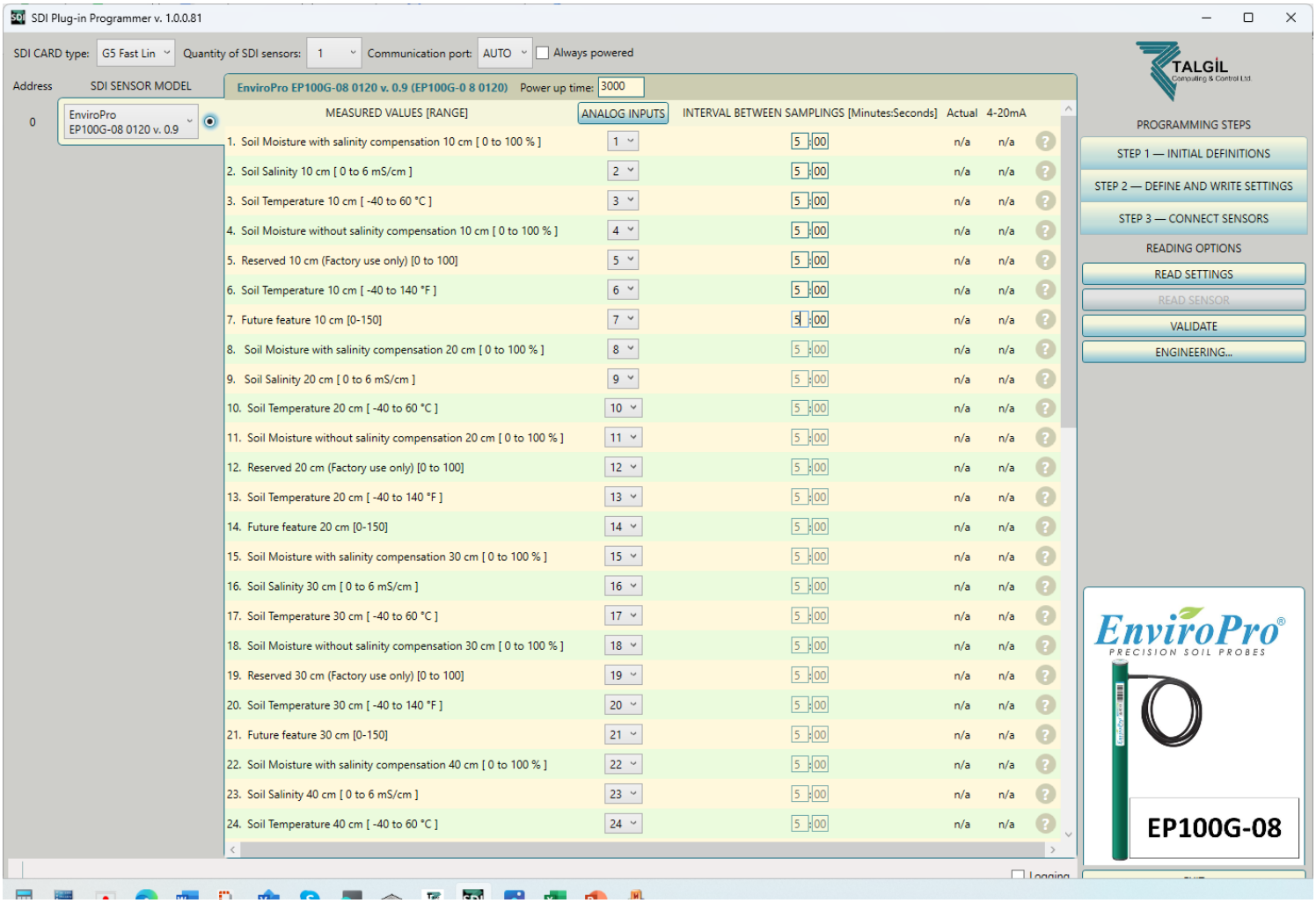
8. To start the upgrading process, click the **PROGRAM** button. The upgrading process will start.

9. A progress indicator will appear on the screen**.**
At the end of the process, a **Terminated** message will appear.

10. To close the **CBoot** software, click **EXIT.**

32. PROGRAMMING THE SDI G5 FAST LIN CARD.

The **SDI G5 FAST LIN CARD** can read up to **64 values** from up to **10 SDI sensors**. The **SDI G5 FAST LIN CARD** is a programable device. Use the **SDI Programmer** PC software to set up the SDI card type, and the SDI sensor model, select values to read, Sampling rate, Set the Sensor's address, to read the measured values, or Start sampling now…

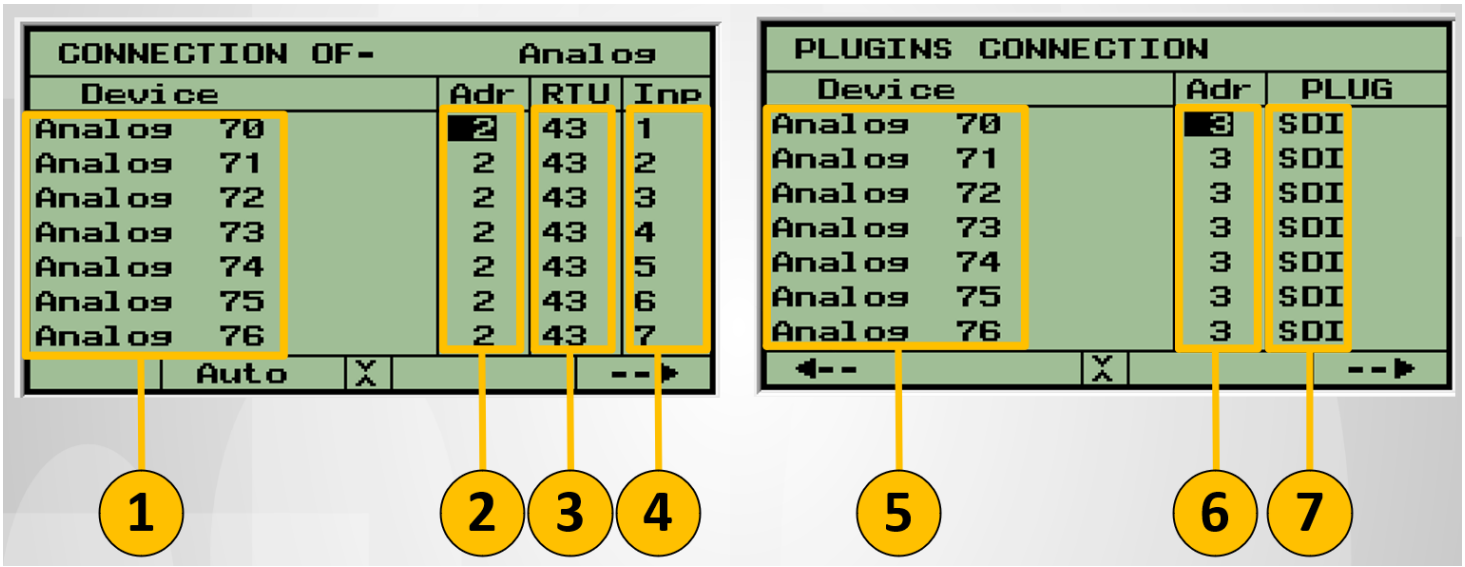


33. SDI G5 FAST LIN CARD – WIRING OF ANALOG INPUTS IN THE DREAM 2.

At this point, it is not possible to define the LIN card type and LIN card address in the **Image Maker**. Therefore, when an **SDI G5 FAST LIN CARD** is connected to the **RTU RF MODULAR G5 FAST**, use the **Dream 2** MMI to set up the **LIN card Type**, **LIN card Address,** and **Analog input number** in the **SDI G5 FAST LIN CARD**.

For example, Analog Sensors **70 to 76** are connected to the **SDI G5 FAST LIN CARD**. The **LIN card Address** is **3**. The **SDI G5 FAST LIN CARD** is connected to **RTU RF Modular G5 FAST.** The RTU **Address** is **43**.

1. Go to the **Dream 2/Setup/Hardware connections/Connection of Analog inputs** screen and scroll down to Analog Sensors **70** to **76**.
2. Set up the **INTERFACE RF G5 ADDRESS**.
3. Set up the **RTU RF MODULAR G5 ADDRESS** (Address **43**).
4. Set up the Analog input number in the **SDI G5 FAST LIN CARD** as defined in the **SDI Programmer** PC software.
5. Press the **F4** button to move to the **PLUGINS CONNECTION** screen and scroll down to Analog Sensors **70** to **76**.
6. Set up the **Address** of the **SDI G5 FAST LIN CARD (**Address **3).**
7. Set up the **LIN Card Type** (SDI).
8. To exit, press the **F4** button.
9. The Analog sensor types in **Constants/Analog sensors** screen should be **SDI** (It is not Current or Voltage).



RTU RF MODULAR G5 FAST – PH EC MONITORING LIN CARD

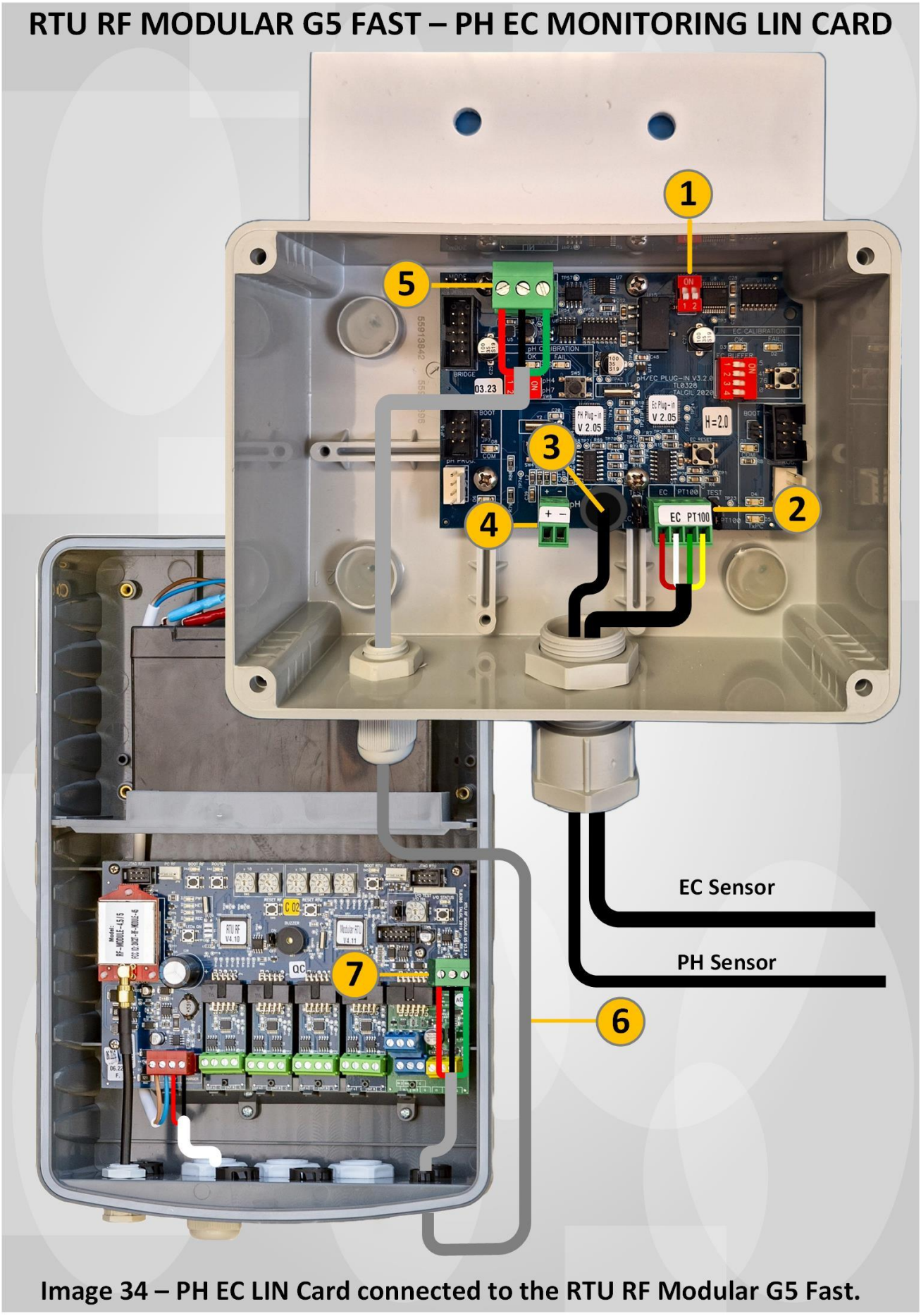


Image 34 – PH EC LIN Card connected to the RTU RF Modular G5 Fast.

34. PH EC MONITORING LIN CARD- INSTALLATION

When the **PH EC MONITORING LIN CARD** is connected to the **RTU RF MODULAR G5 FAST** it must be powered by **12V DC.** Connect the Rechargeable battery cable to the **BATTERY** input in the power supply plug. To charge the battery, use an **18V DC** charger and connect it to the **CHARGE** input in the power supply plug. The charger can be a **Solar Panel** or an **18V DC Power supply**. The **rechargeable battery type** is **12V DC 9Ah**. In G5 Fast, the values are not converted to Voltage (0-5V) but, the Values are transmitted as is. When a **PH EC Monitoring LIN card** is connected, the RTU RF Modular G5 returns three values. The values are Water EC, Water PH, and Water temperature. After powering the RTU RF Modular G5, it detects automatically the **PH EC MONITORING LIN CARD** and sends these three values to the Master unit where the Water EC is in Analog input number 2, Water PH in Analog input 3, and Water temperature in Analog input 4.

When the **PH EC MONITORING LIN CARD** is connected to the RTU Modular, it is not possible to connect another LIN card in parallel.

To install the PH EC LIN CARD, follow the instructions below:

1. It is possible to connect only one **PH EC MONITORING LIN CARD** to the **RTU RF MODULAR G5 FAST**.
2. Connect the **EC sensor** wires to the **EC Plug** as described in image 34.
3. When the **PH sensor** has a coaxial plug, connect the **PH sensors** to the **PH coaxial Plug** on the right.
4. When the PH sensor does not have a coaxial plug, connect the **PH sensor** wires to the **PH Plug** on the left.
5. Connect the **LIN communication cable** to the **LIN port** on the **PH EC MONITORING LIN CARD** where **12V** is the 12V DC power supply (**Red**), **GND** is the Ground (**Black**), and **DATA** is the **LIN communication** (**Green**).
6. The maximum length of the LIN cable is 10 meters.
7. Connect the **LIN cable** to the **LIN port** on the **RTU RF MODULAR G5 FAST**.

PH Calibration:

8. Put the PH Sensor in the **PH 7.00 buffer**. Turn on the **PH 7.00 dipswitch**. To start the calibration, press the **PH Calibration** button.
9. Clean and dry the **PH sensor**, and put it in a **PH 4.00 buffer**. Turn on the **PH 4.00 dipswitch**. To start the calibration, press the **PH Calibration** button. When the calibration process passes successfully, the **OK** (Green) button Turns **ON** for a few seconds.

EC Calibration:

10. Put the **EC Sensor** in the **EC 2.76 buffer**. Turn on the **EC 2.76 dipswitch**. To start the calibration, press the **EC Calibration** button. When the calibration process passes successfully, the **OK** (Green) button Turns **ON** for a few seconds.

Temperature Calibration:

11. Disconnect the **EC sensor**. Put the **EC TEST** and **Temperature TEST** jumpers on the **TEST mode** (put the jumpers on the upper two pins). In **TEST mode**, the **EC** should change to **1.00 mS/cm** and the **Temperature** to **25 C˚**. Turn the 4 EC dipswitches ON. To start the Temperature calibration, press and hold the **EC Calibration** button for **5 seconds**. The Water temperature should change to **23.8 C˚.**

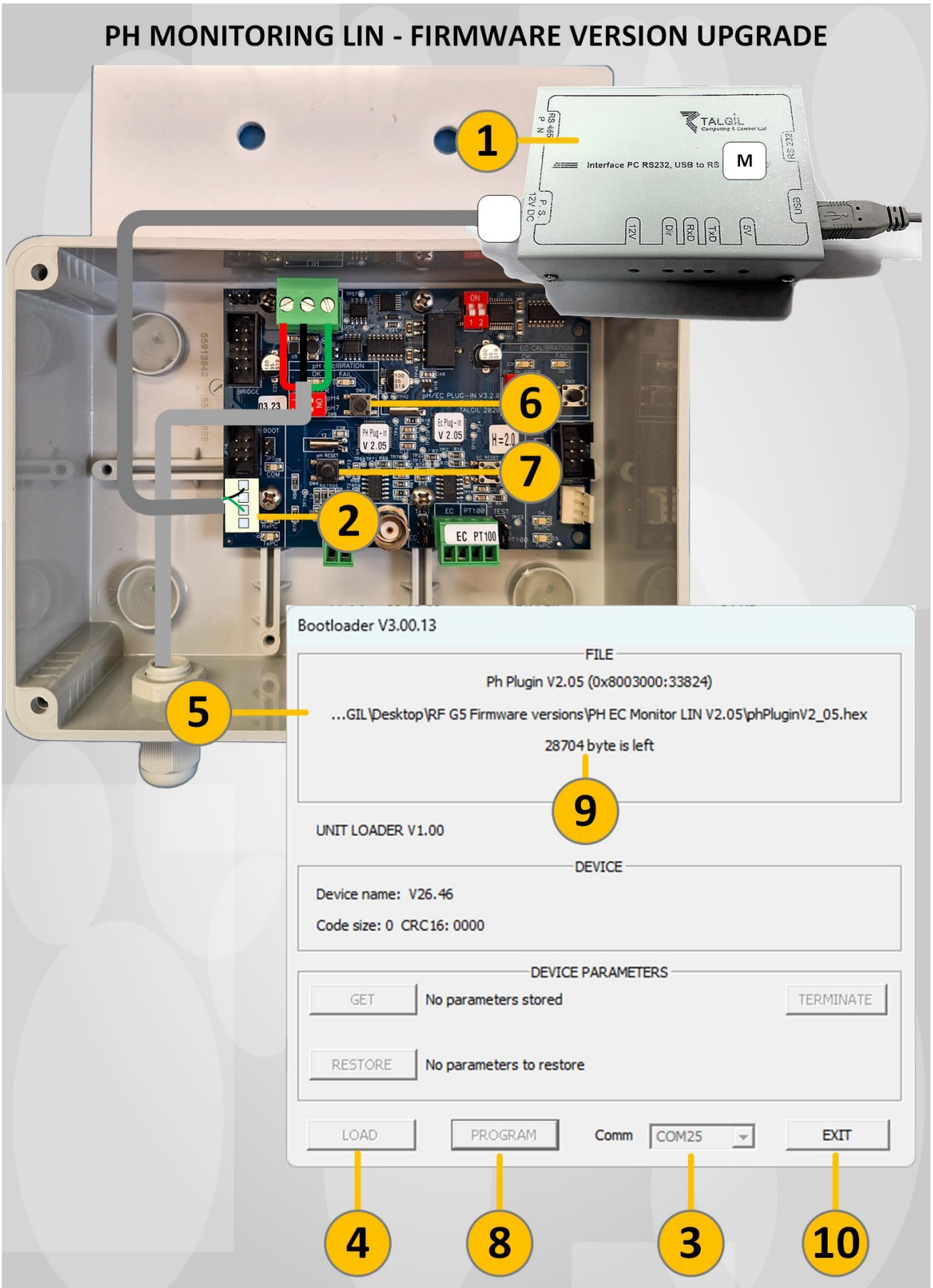


Image 35 – Upgrading the firmware version of the PH Monitoring LIN.

35. UPGRADING THE FIRMWARE VERSION OF THE PH LIN CARD

Make sure that you are using the latest Firmware version of the **PH LIN CARD**. Use the links below to download the latest firmware version and the **CBoot** PC software. To start the firmware version upgrading process, please follow the instructions below:

1. Connect the **Programmer** device to your PC.
2. Connect the Programmer cable to the **PC Socket** on the **PH LIN CARD** as described in **Image 35**.
3. Start the **CBoot** PC software and select the **Communication port.** If you do not have the **CBoot** PC software, download it here:

https://drive.google.com/drive/folders/17AZoFHJXi4XWkqNSbLTVXLVqKH4EP0tp?usp=sharing

4. Click the **LOAD** button, browse to the **PH Plug-In** hex file, and select it.

To download the latest **PH Plug-In** firmware version, click here:

https://drive.google.com/drive/folders/1sKFhwgJQYbp4QdtsRxNsHfZVxiYfyxnt?usp=sharing

5. The pathway to the hex file will appear on the screen.
6. On the **PH LIN CARD**, press and hold the **PH Calibration** button.
7. While the **PH Calibration** button is pressed, press the **PH RESET** button. Leave the **PH RESET** button, after 1 second, leave the **PH Calibration** button. This action will put the **PH LIN CARD mode** into a **BOOT Mode**. In **BOOT Mode,** the **PH OK LED** is **ON**, and the **PH FAIL LED** is flashing.
8. To start the upgrading process, click the **PROGRAM** button. The upgrading process will start.
9. A progress indicator will appear on the screen**.**
   At the end of the process, a **Terminated** message will appear.
10. To close the **CBoot** software, click **EXIT.**

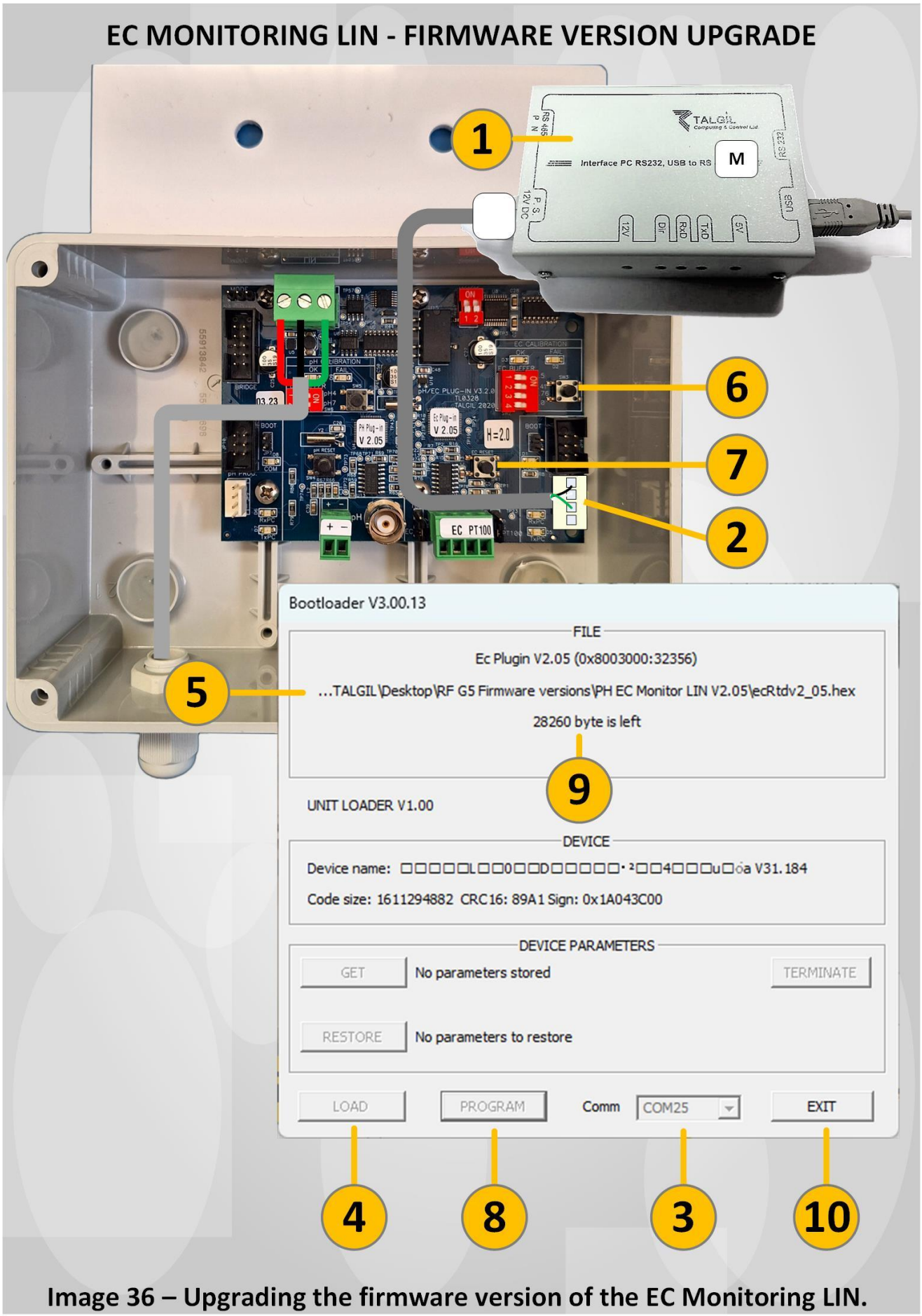


Image 36 – Upgrading the firmware version of the EC Monitoring LIN.

36. UPGRADING THE FIRMWARE VERSION OF THE EC LIN CARD

Make sure that you are using the latest Firmware version of the **EC LIN CARD**. Use the links below to download the latest firmware version and the **CBoot** PC software. To start the firmware version upgrading process, please follow the instructions below:

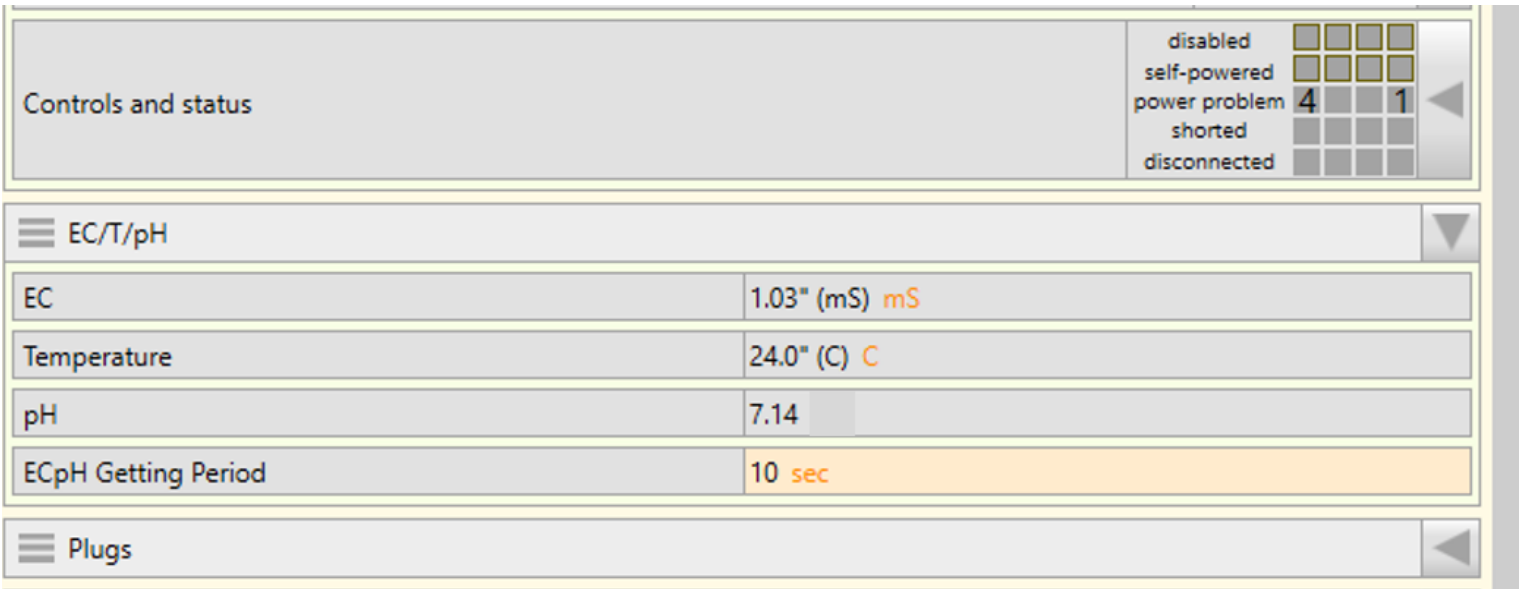
1. Connect the **Programmer** device to your PC.
2. Connect the Programmer cable to the **PC Socket** on the **EC LIN CARD** as described in **Image 36**.
3. Start the **CBoot** PC software and select the **Communication port.** If you do not have the **CBoot** PC software, download it here:
4. https://drive.google.com/drive/folders/17AZoFHJXi4XWkqNSbLTVXLVqKH4EP0tp?usp=sharing
   Click the **LOAD** button, browse to the **EC Plug-In** hex file, and select it.
   To download the latest **EC Plug-In** firmware version, click here:
   https://drive.google.com/drive/folders/1sKFhwgJQYbp4QdtsRxNsHfZVxiYfyxnt?usp=sharing
5. The pathway to the hex file will appear on the screen.
6. On the **EC LIN CARD**, press and hold the **EC Calibration** button.
7. While the **EC Calibration** button is pressed, press the **EC RESET** button. Leave the **EC RESET** button, after 1 second, leave the **EC Calibration** button. This action will put the **EC LIN CARD mode** into **BOOT Mode**. In **BOOT Mode,** the **EC OK LED** is **ON**, and the **EC FAIL LED** is flashing.
8. To start the upgrading process, click the **PROGRAM** button. The upgrading process will start.
9. A progress indicator will appear on the screen.
   At the end of the process, a **Terminated** message will appear.
10. To close the **CBoot** software, click **EXIT.**

37. SETTINGS OF THE PH EC MONITORING LIN CARD.

The **PH EC MONITORING LIN CARD** returns 3 Analog sensors.
The Sensors are **Water EC, Water PH**, and **Water temperature**.
The **Water EC** and **Water temperature** values returned by the **EC sensor**.
These are not standard sensors (Their type is not **4-20mA** or **0-5V**).

Use the Workbench PC software while it is connected to the **RTU RF MODULAR G5.**
The **Workbench** shows the current Analog values and the sampling rate.

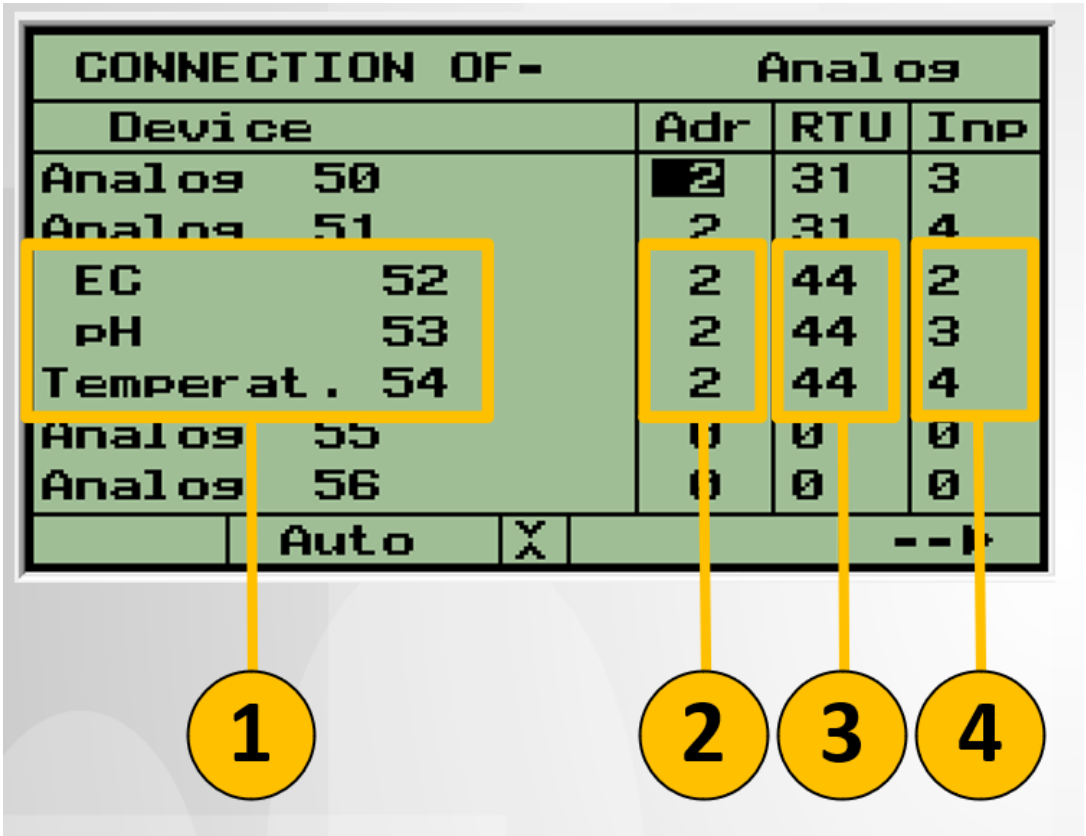
* Pay attention, when the **PH EC Monitoring LIN card** is connected to the RTU Modular, it is not possible to connect another LIN card in parallel!



38. PH EC MONITORING LIN CARD – WIRING OF ANALOG INPUTS IN THE DREAM 2.

When a **PH EC MONITORING LIN CARD** is connected to the **RTU RF MODULAR G5 FAST**, it is not possible to connect other LIN cards in parallel. After powering the RTU Modular, it detects automatically the **PH EC MONITORING LIN CARD** and sends the values to the Master unit. Use the **Image Maker** or the **Dream 2 MMI** to set up the **INTERFACE RF G5 ADDRESS, RTU RF MODULAR ADDRESS**, and **ANALOG INPUT**. The Analog inputs are defined as Analog inputs 2,3, and 4 in the RTU Modular. For example, Analog Sensors **52, 53**, and **54** are used to read the returned values from the **PH EC MONITORING LIN CARD**. The **PH EC MONITORING LIN CARD** is connected to **RTU RF MODULAR G5 FAST.** The RTU **Address** is **44**.

1. Go to the **Dream/Setup/Hardware connections/Connection of Analog inputs** screen and scroll down to Analog Sensors **52** to **54**.
2. Set up the **INTERFACE RF G5 ADDRESS**.
3. Set up the RTU Modular **Address** (Address **44**).
4. Set up the **Analog input number** in the **RTU Modular** where the **Water EC** is in Analog input **2**, **Water PH** is in Analog input **3**, and **Water Temperature** is in Analog input **4**.
5. Do not set the **ADDRESS** of the **PH EC MONITORING LIN CARD**. It should remain **0**.
6. Do not set the **Type** of the **PH EC MONITORING LIN CARD**. It should remain **"-" (None).**
7. The Analog sensor types in the **Constants/Analog sensors** should be **External.**



RTU RF MODULAR G5 FAST- I/O 8/4 LIN CARD

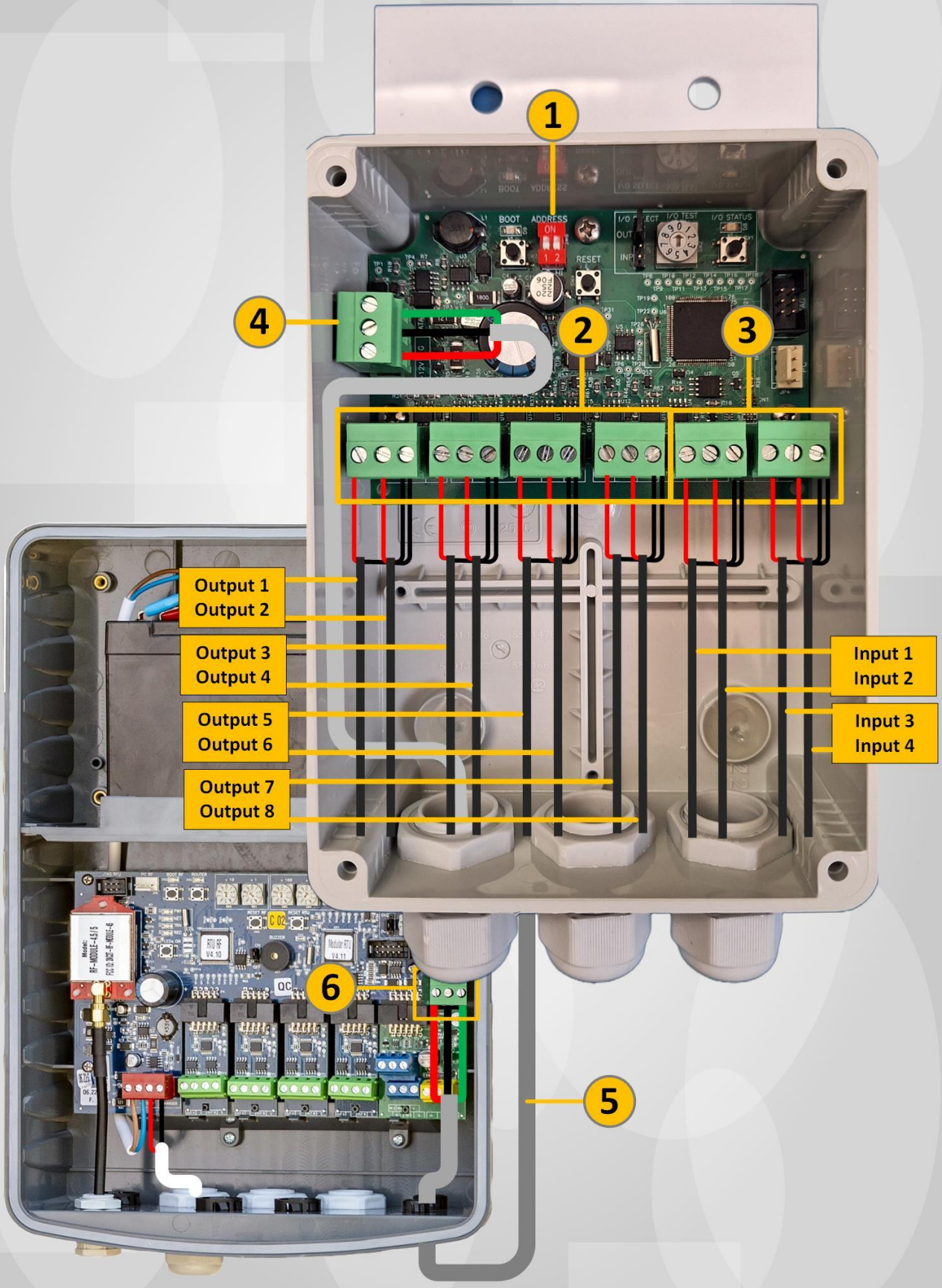


Image 39 – I/O 8/4 LIN card connected to RTU RF Modular G5 FAST.

39. I/O 8/4 LIN CARD- INSTALLATION

When the **I/O 8/4 LIN CARD** is connected to the **RTU RF MODULAR G5 FAST** it must be powered by **12V DC.** Connect the Rechargeable battery cable to the **BATTERY** input in the power supply plug. To charge the battery, use an **18V DC** charger and connect it to the **CHARGE** input in the power supply plug. It can be a **Solar Panel** or an **18V DC** Power supply.

To install the I/O 8/4 LIN CARD, follow the instructions below:

1. Use the two dipswitches called **ADDRESS** to set the **I/O 8/4 LIN CARD Address**.
2. Connect the Output's wires to the Output plugs as described in **Image 39**.
3. Connect the Input's wires to the Input plugs as described in **Image 39**.
4. Connect the LIN communication cable to the **LIN port** on the **I/O 8/4 LIN CARD** where **12V** is a 12V DC power supply (**Red**), **GND** is the Ground (**Black**), and **DATA** is the LIN communication (**Green**).
5. The maximum length of the LIN cable is 10 meters.
6. Connect the **LIN cable** to the **LIN port** on the **RTU RF MODULAR G5 FAST**.

The **I/O 8/4 LIN CARD** has 8 Outputs. The output type is a **12V DC latch**. By default, the Output **pulse duration** (pulse period) is **90 milliseconds**. The Output **Pulse voltage** is **16V DC**.
It is used for 12V DC latched solenoids, Valves, or 12V DC Latch relays.

In addition, it has 4 Digital Inputs (Dry contact). By default, the **Debounce** is **100 milliseconds**, the **Divider** is **1**, and the **Expansion** is **1500** milliseconds. The pulse type is **Dry contact**.

Use the **Workbench** PC software while it is connected to the **I/O 8/4 LIN CARD** to program the card, see the Outputs/Inputs current status, change the Pulse period, Pulse voltage, Debounce, Divider, Expansion, and more settings as described in **Chapters 21** and **22**.

I/O 8/4 LIN CARD – FIRMWARE VERSION UPGRADE

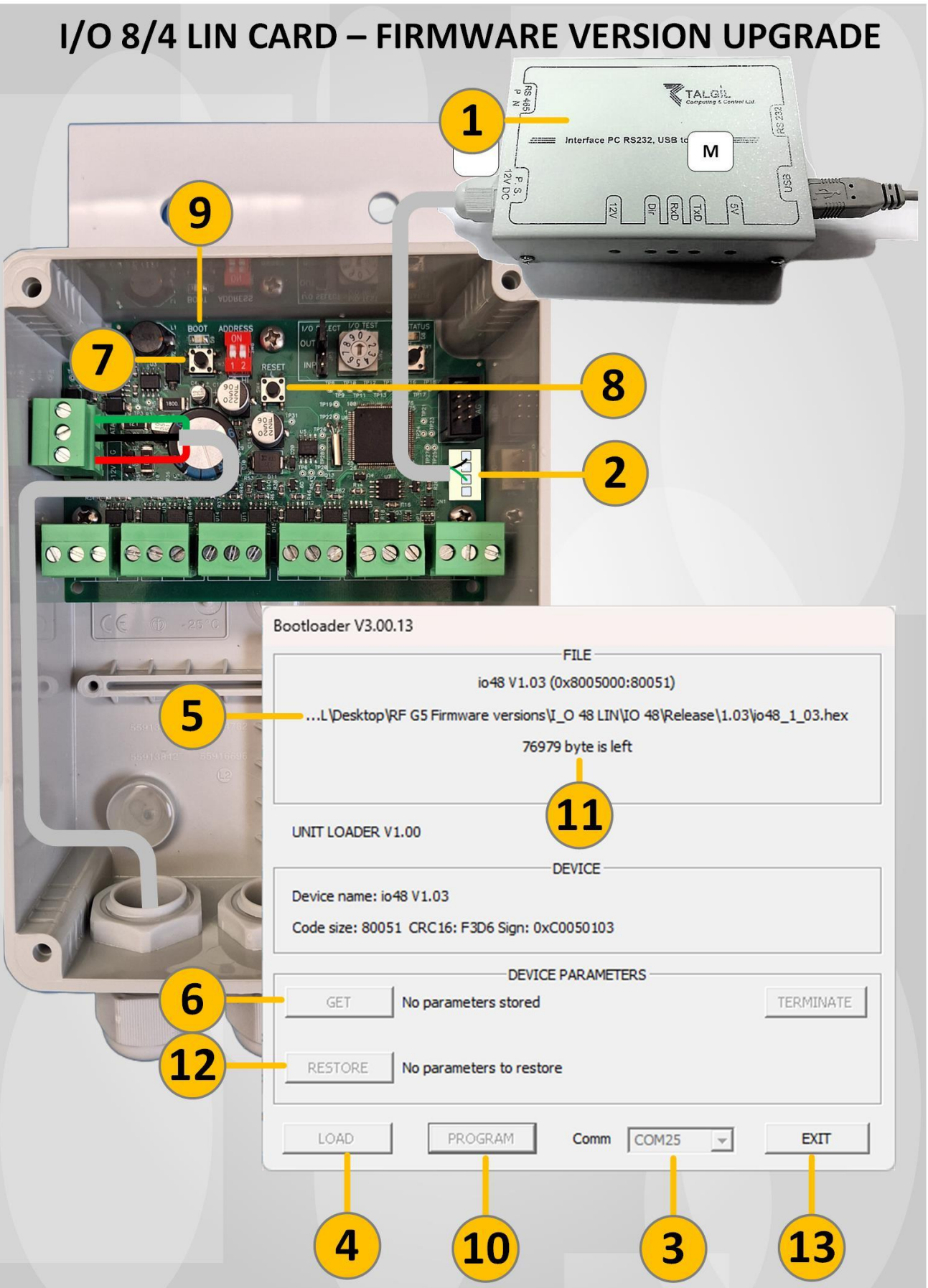


Image 40 – Upgrading the firmware version of the I/O 8/4 LIN card.

40. UPGRADING THE FIRMWARE VERSION OF THE I/O 8/4 LIN CARD

Make sure that you are using the latest Firmware version of the **I/O 8/4 LIN CARD**.
Use the links below to download the latest firmware version and the **CBoot** PC software.

To start the firmware version upgrading process, please follow the instructions below:

1. Connect the **Programmer** device to your PC.
2. Connect the Programmer cable to the **PC Socket** on the **I/O 8/4 LIN CARD** as described in **Image 40**.
3. Start the **CBoot** PC software and select the **Communication port.** If you do not have the **CBoot** PC software, download it here:

https://drive.google.com/drive/folders/17AZoFHJXi4XWkqNSbLTVXLVqKH4EP0tp?usp=sharing

4. Click the **LOAD** button, browse to the **I/O 8/4 LIN CARD** hex file, and select it.

To download the latest **I/O 8/4 LIN card** firmware version, click here:

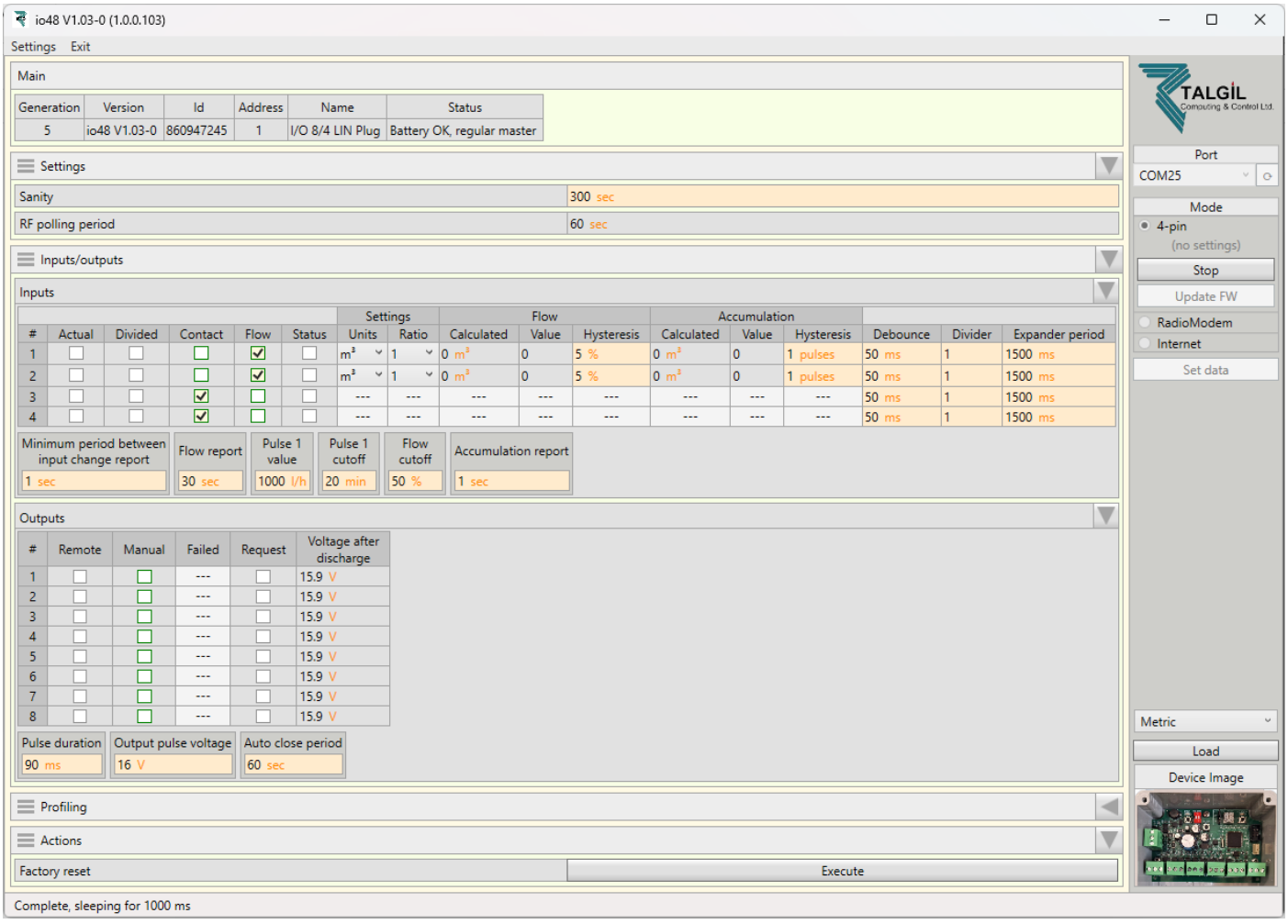
https://drive.google.com/drive/folders/1sKFhwgJQYbp4QdtsRxNsHfZVxiYfyxnt?usp=sharing

5. The pathway to the hex file will appear on the screen.
6. Click the **GET** button to read the settings of the **I/O 8/4 LIN CARD.** This will save the settings in the **CBoot** PC software. The number of the saved parameters will appear.
7. On the **I/O 8/4 LIN CARD** hardware, press and hold the **BOOT** button.
8. While the **BOOT** button is pressed, press the **RESET** button. Leave the **RESET** button, after 1 second, leave the **BOOT** button.
   This action will put the **I/O 8/4 LIN CARD mode** into a **BOOT Mode**.
9. In **BOOT Mode,** the **BOOT** LED is **ON**.
10. To start the upgrading process, click the **PROGRAM** button. The upgrading process will start.
11. A progress indicator will appear on the screen**.**
    At the end of the process, a **Terminated** message will appear.
12. After the upgrading process, wait for the settings to be restored.
    The CBoot software will **RESTORE** the settings to the **I/O 8/4 LIN CARD.**
13. To close the **CBoot** PC software, click **EXIT.**

41. SETTINGS OF THE I/O 8/4 LIN CARD.

The **I/O 8/4 LIN CARD** has 8 Outputs. The output type is a **12V DC latch**. By default, the Output **pulse duration** (pulse period) is **90 milliseconds**. The Output **Pulse voltage** is **16V DC**. It is used for 12V DC latched solenoids, Valves, or 12V DC Latch relays. In addition, it has 4 Digital Inputs (Dry contact). By default, the **Debounce** is **100** milliseconds, the **Divider** is **1**, **Expansion** is **1500** milliseconds. The pulse type is **Dry contact**.

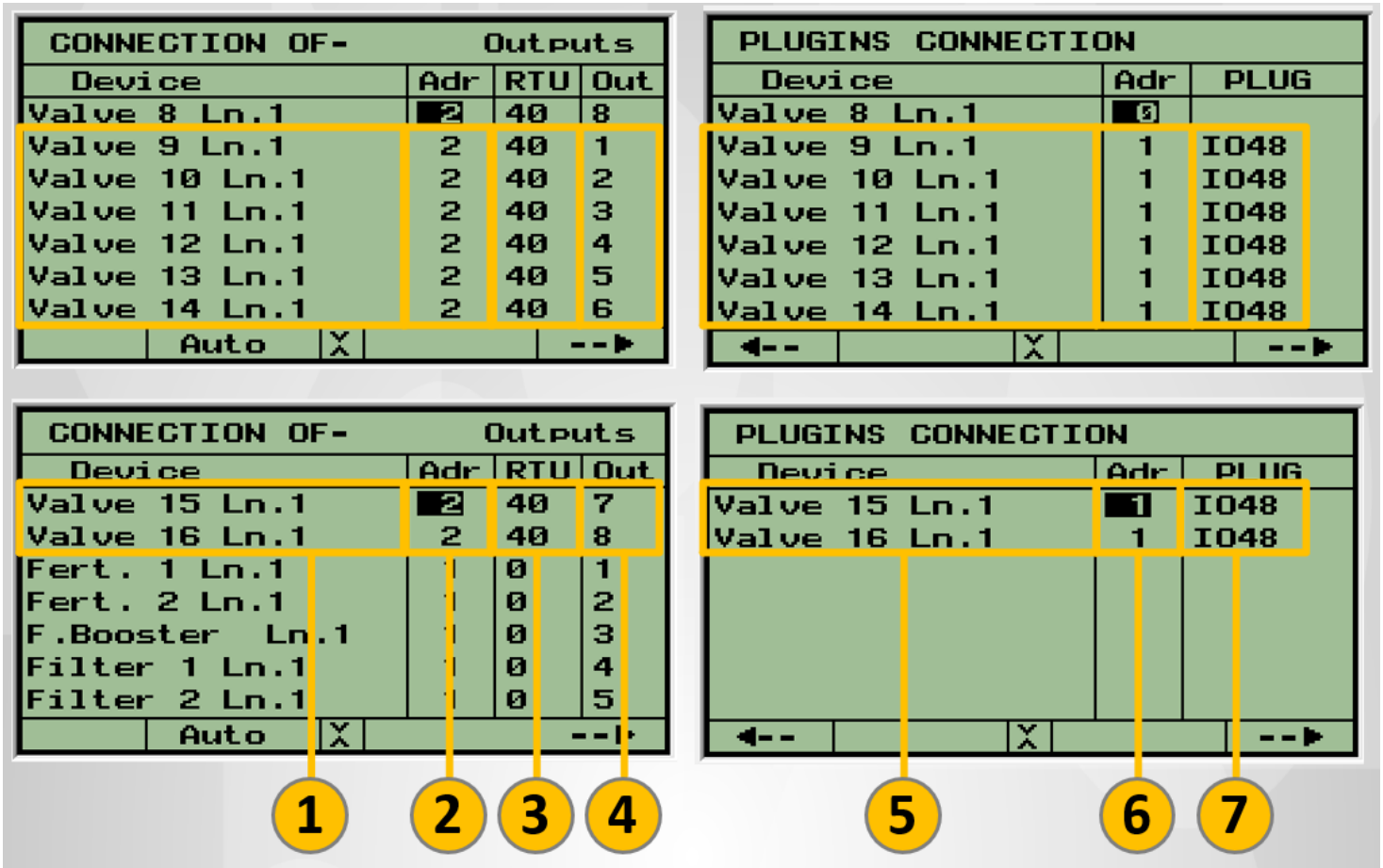
Use the **Workbench** PC software while is it connected to the **I/O 8/4 LIN CARD** to program the card**,** see the Output/Input current status, change the Pulse period, Pulse voltage, Auto close, Debounce, Divider, Expansion, and more settings as described in **Chapters 20-22.**



42. I/O 8/4 LIN CARD - WIRING OF OUTPUTS IN THE DREAM 2.

At this point, it is not possible to define the **LIN card Type** and **LIN card Address** in the **Image Maker**. Therefore, when a **I/O 8/4 LIN CARD** is connected to the **RTU RF MODULAR G5 FAST**, use the **Dream 2** MMI to set up the **LIN card Type**, **LIN card Address**, and **Output number**, in the **I/O 8/4 LIN CARD**. For example, Valves **1.9** to **1.16** are connected to the **I/O 8/4 LIN CARD**. The **LIN card Address** is **1**. The **I/O 8/4 LIN CARD** is connected to the **RTU RF MODULAR G5 FAST.** The RTU **Address** is **40**. To set up the Wiring of the Outputs connected to the **I/O 8/4 LIN CARD**, follow the instructions below:

1. Go to the **Dream 2/Setup/Hardware connections/Connection of Outputs** screen and scroll down to Valves **1.9** to **1.16**.
2. Set up the **INTERFACE RF G5 ADDRESS**.
3. Set up the **RTU RF MODULAR G5 Address** (Address **40**).
4. Set up the Output Number in the **I/O 8/4 LIN CARD**.
5. Press the **F4** button to move to the **PLUGINS CONNECTION** screen and scroll down to Valves **1.9** to **1.16**.
6. Set up the **Address** of the **I/O 8/4 LIN CARD** (Address **1**).
7. Set up the **LIN Card Type** (**I/O 8/4 LIN CARD** is **IO48**).
8. To exit, press the **F4** button.

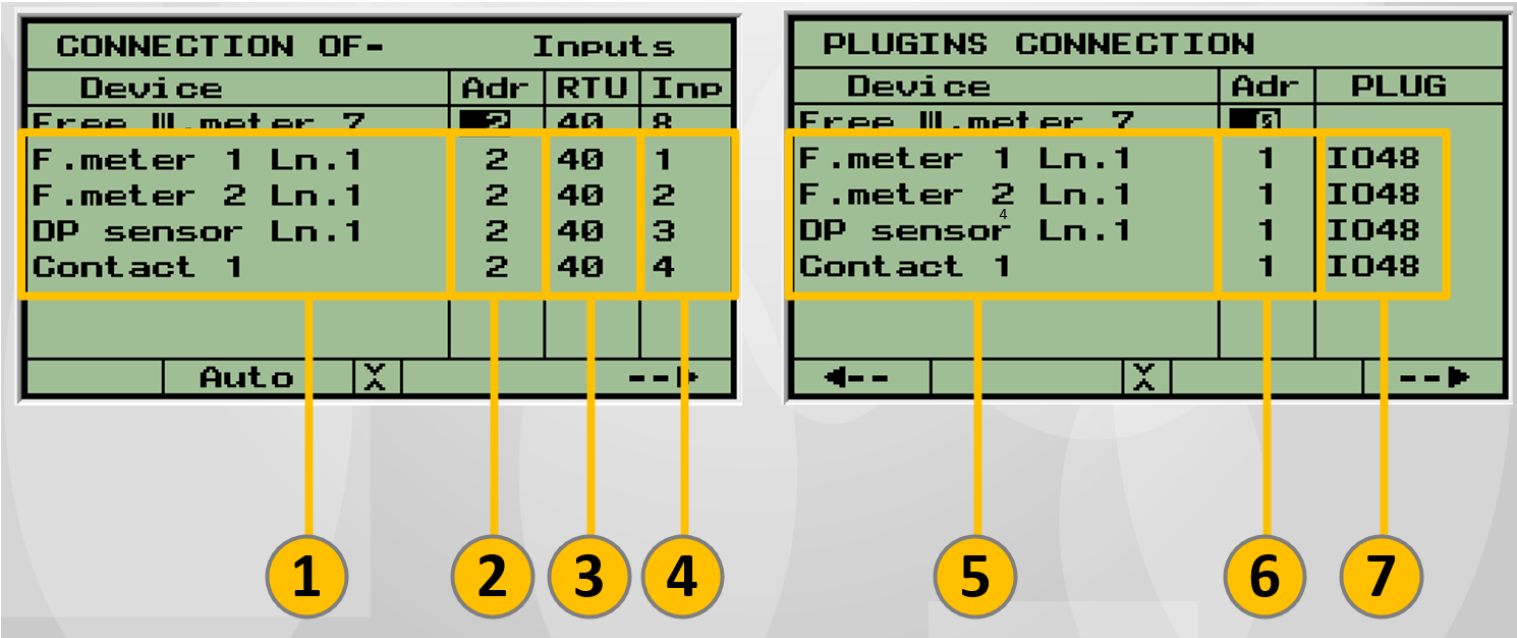


43. I/O 8/4 LIN CARD - WIRING OF DIGITAL INPUTS IN THE DREAM 2.

At this point, it is not possible to define the **LIN card Type** and **LIN card Address** in the **Image Maker**. Therefore, when the **I/O 8/4 LIN CARD** is connected to the **RTU RF MODULAR G5 FAST**, use the **Dream 2** MMI to set up the **LIN card Type**, **LIN card Address**, and **Digital Input number** in the **I/O 8/4 LIN CARD**. For example, Fertilization meters 1 and 2 of Line 1, the DP sensor of Filter site Line 1, and Contact 1 are connected to the **I/O 8/4 LIN CARD**. The **LIN card Address** is **1**. The **I/O 8/4 LIN CARD** is connected to **RTU RF MODULAR G5 FAST.** The RTU Modular **Address** is **40**. To set up the Wiring of Digital inputs connected to THE **I/O 8/4 LIN CARD**, follow the instructions below:

1. Go to the **Dream 2/Setup/Hardware connections/Connection of Inputs** screen and scroll down to Fertilization meters 1 and 2 of Line 1, DP sensor of Filter site Line 1, and Contact 1**.**
2. Set up the **INTERFACE RF G5 ADDRESS**.
3. Set up the **RTU RF MODULAR G5 Address** (Address **40**).
4. Set up the **Input Number** in the **I/O 8/4 LIN CARD**.
5. Press the **F4** button to move to the **PLUGINS CONNECTION** screen and scroll down to Fertilization meters 1 and 2 of Line 1, DP sensor of Filter site Line 1, and Contact 1**.**
6. Set up the **Address** of the **I/O 8/4 LIN CARD**. (**Address 1**).
7. Set up the **LIN Card Type** (**I/O 8/4 LIN card** is **IO48**).
8. To exit, press the **F4** button.

* The digital input type of the Fertilization meters 1 and 2 of Line 1 is **FLOW**.
The digital input type of the DP sensor of Filter site Line 1, and Contact 1 is **CONTACT.**



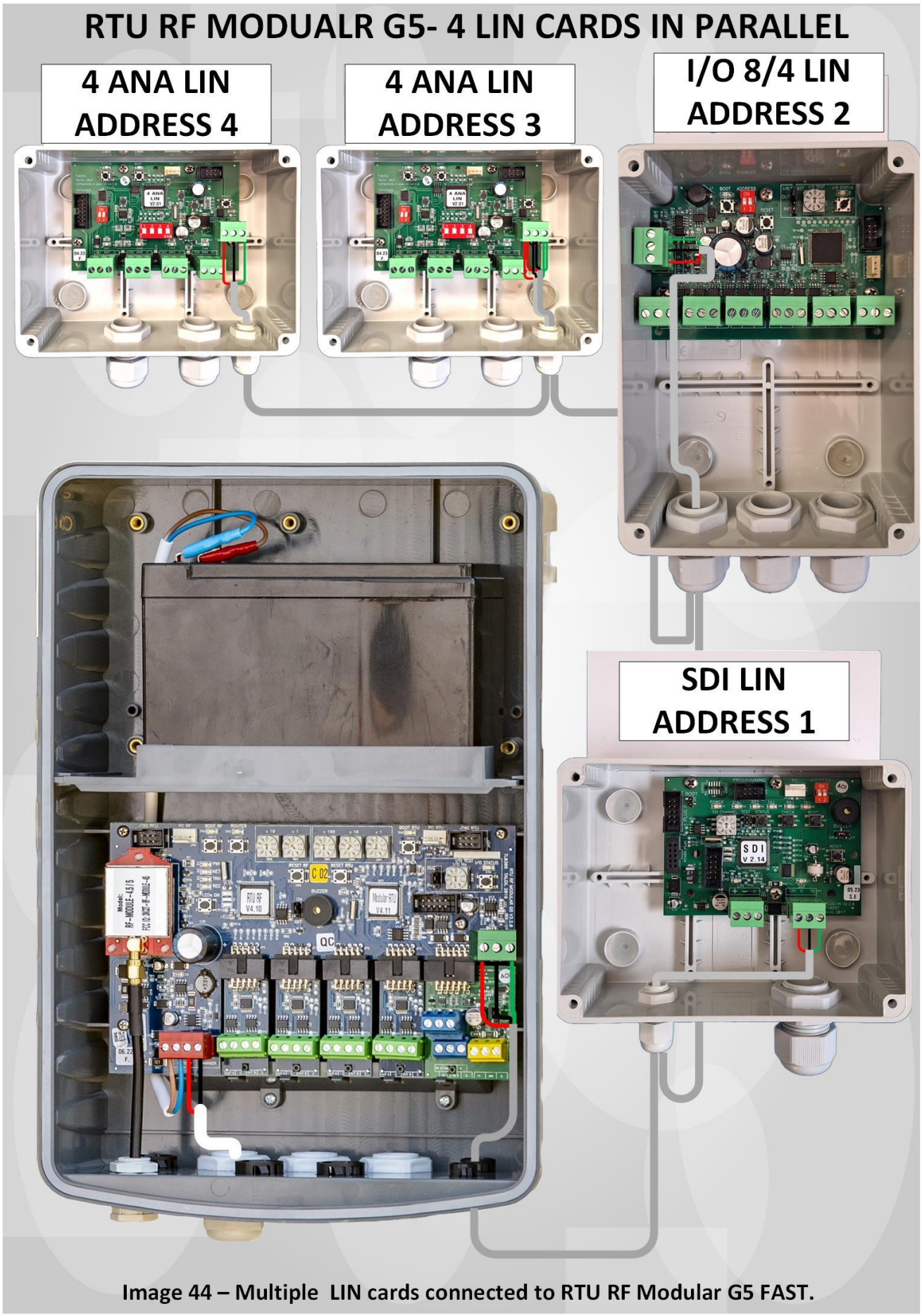
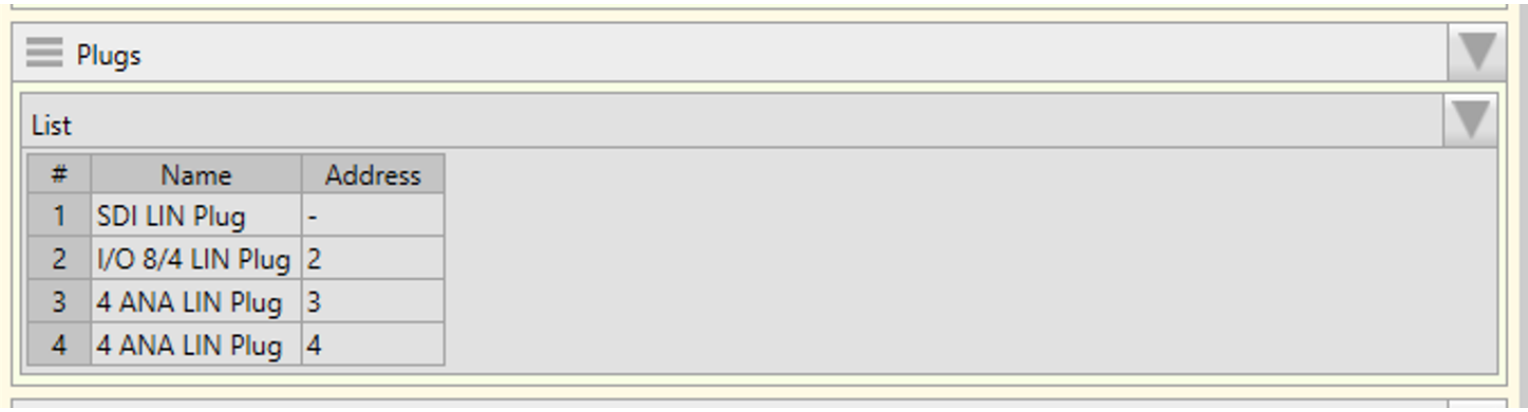


Image 44 – Multiple LIN cards connected to RTU RF Modular G5 FAST.

44. RTU RF MODULAR G5 FAST AND LIN PLUGS AT THE WORKBENCH PC SOFTWARE

Use the **Workbench** PC software while it is connected to the **RTU MODULAR G5 FAST** to see the list of **LIN CARDS** that are connected to the RTU.

To see the list of the **LIN CARDS** that are connected to the **RTU MODULAR G5 FAST**, open the **Plugs window**. The **Workbench** will show a table of detected **LIN cards, LIN card type**, and **LIN address**.



45. RTU RF ECO G5 FAST- PROPERTIES

The **RTU RF ECO G5 FAST** works like the regular RTU RF ECO G5. The difference is only in the communication protocol. Here is a short description of the RTU ECO and its properties:

Versions:
RTU RF ECO G5 0/0 has no Digital Inputs and No Outputs.
Can be used to read Analog sensors or as a ROUTER.
RTU RF ECO G5 1/1 has one Digital Input, one Output, and 2 Analog inputs.
RTU RF ECO G5 2/2 has two Digital Inputs, two Outputs, and 2 Analog inputs.

Outputs:
Operates 12V DC latched Solenoids, Valves, Pump switching units, or 12V DC Latched relays.
By default, the output pulse period is 90 milliseconds. The output pulse voltage is 16V DC.

Digital Inputs (Dry contact): Can read up to 2 Digital Inputs. The pulse type is Dry contact.

Analog inputs: 2 Standard Analog inputs (4-20mA or 0-5V) with 12 Bits resolution.

Power supply: Low power consumption**.**
6V DC: Can be powered by four Alkaline batteries 1.5V size C.
When reading Analog sensors or when the RTU is defined to work as a ROUTER, it must be powered by 12V DC.

12V DC:
Rechargeable battery: 12V DC 1.3Ah.
Charging:
Solar panel 20V DC 2.5W connected to the CHARGE input.
Power supply 18V DC connected to the CHARGE input.
Power supply 14.3V DC connected to the BATTERY input.

RTU RF ECO G5-INSTALLATION

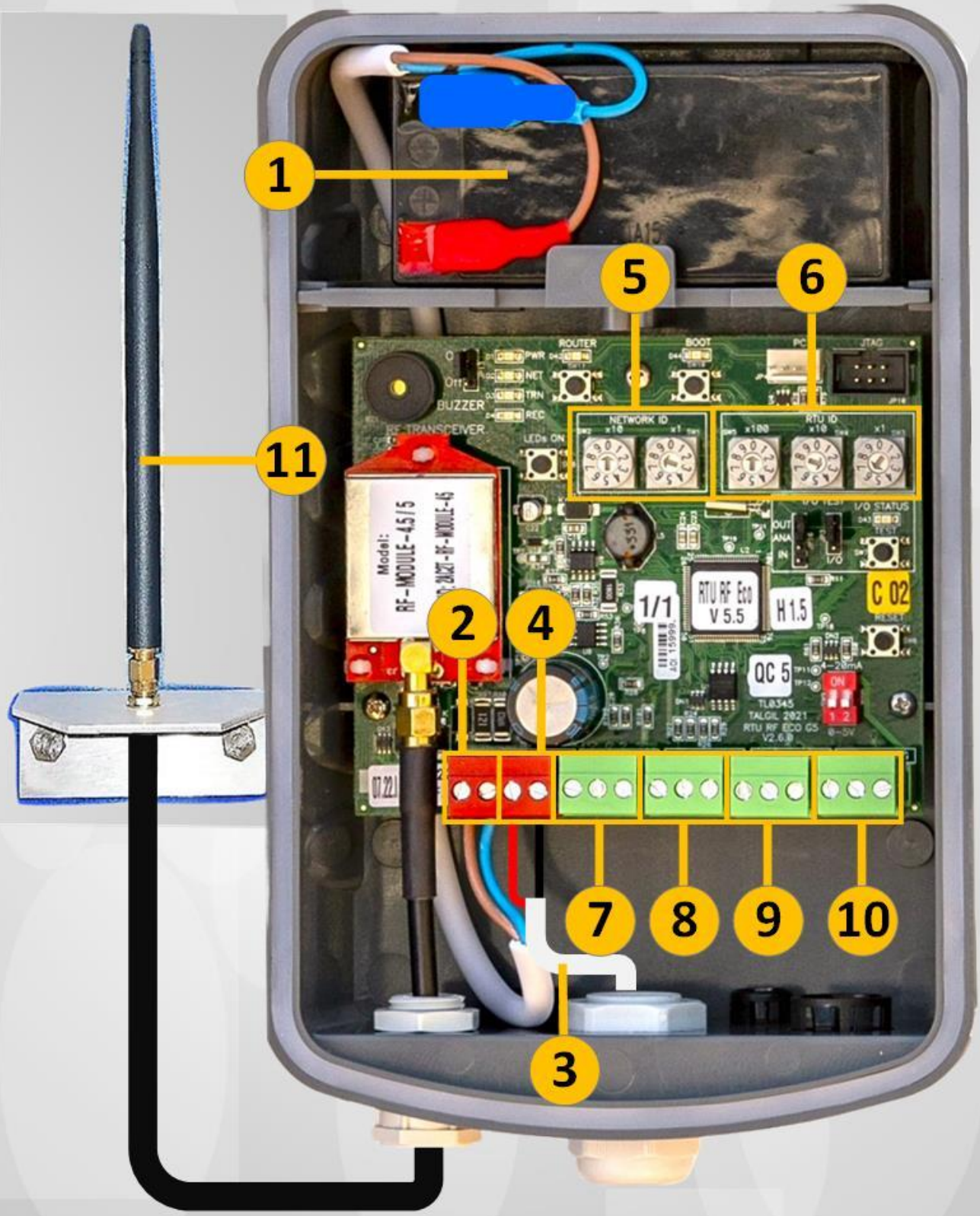


Image 46–RTU RF ECO G5-Installation instructions.

46. RTU RF ECO G5 - INSTALLATION INSTRUCTIONS

Install the RTU RF ECO G5 on a wall or a metal pole. For easy access, install the unit at a height of a meter and a half.

1. RTU RF ECO G5 can be powered by a **6V DC** power supply using four Alkaline batteries 1.5 Volts size C. When the RTU Modular works as a **ROUTER** or reading **Analog sensors**, the power supply must be **12 V DC** (Solar panel/Power supply and rechargeable battery).
2. Connect the 12V DC 1.3Ah Rechargeable battery cable to the **BATTERY** input in the power supply plug as described in **Image 46**.
3. To charge the battery, use an **18V DC** charger. It can be a **20V 2.5W Solar Pannel** or **18V DC Power supply**.
4. Connect the charger cable to the **CHARGER** input in the power supply plug.
5. Use the **NETWORK ID** rotary switches to set up the **NETWORK ID (SYSTEM NUMBER)** of the **RTU RF ECO G5**. It must be identical to the Master's **NETWORK ID**. Make sure that the **Network ID** is not used by another system in the surrounding. Use the **Sniffer** or the **Radio Modem** to see the available **NETWORK ID** in this area. Create a list of your Projects and their **NETWORK IDs**. It will help you to decide what **NETWORK ID** to use in the future. It is possible to set up a software **NETWORK ID.** Use the **Workbench PC software** to set the software **NETWORK ID.**
6. Use the **RTU ID** rotary switches to set up the **ADDRESS** of the **RTU RF ECO G5**. It is possible to set up a software **RTU ADDRESS.** Use the **Workbench PC software** to set the software **RTU ID.**
7. Connect the solenoids (Or another output device like Valve, Latch Realy, or Pump switching device) to the **Outputs terminal block**.
8. Connect the **Digital Inputs** to the **Digital Inputs terminals block**. The digital inputs can read a Dry contact pulse such as a Water meter, Fertilization meter, Pressostat (Pressure sensor), DP sensor, Float, or Contact.
9. Connect the first **Analog sensor** to the **Analog Input 1 terminal block**. The Analog input can read a standard Analog sensor (4-20 milli Ampere or 0-5 Volts).
10. Connect the second **Analog sensor** to the **Analog Input 2 terminals block**.
11. To improve the Radio communication, install the **Antenna** in a high place. The top of the **RTU RF ECO G5 Antenna** must be installed on a pipe made of non-metallic material. Make sure that the Antenna has a Line of sight to the Master or a ROUTER. The maximum distance to the Master or a ROUTER unit is 2.5 km.

RTU RF ECO G5 - OUTPUTS

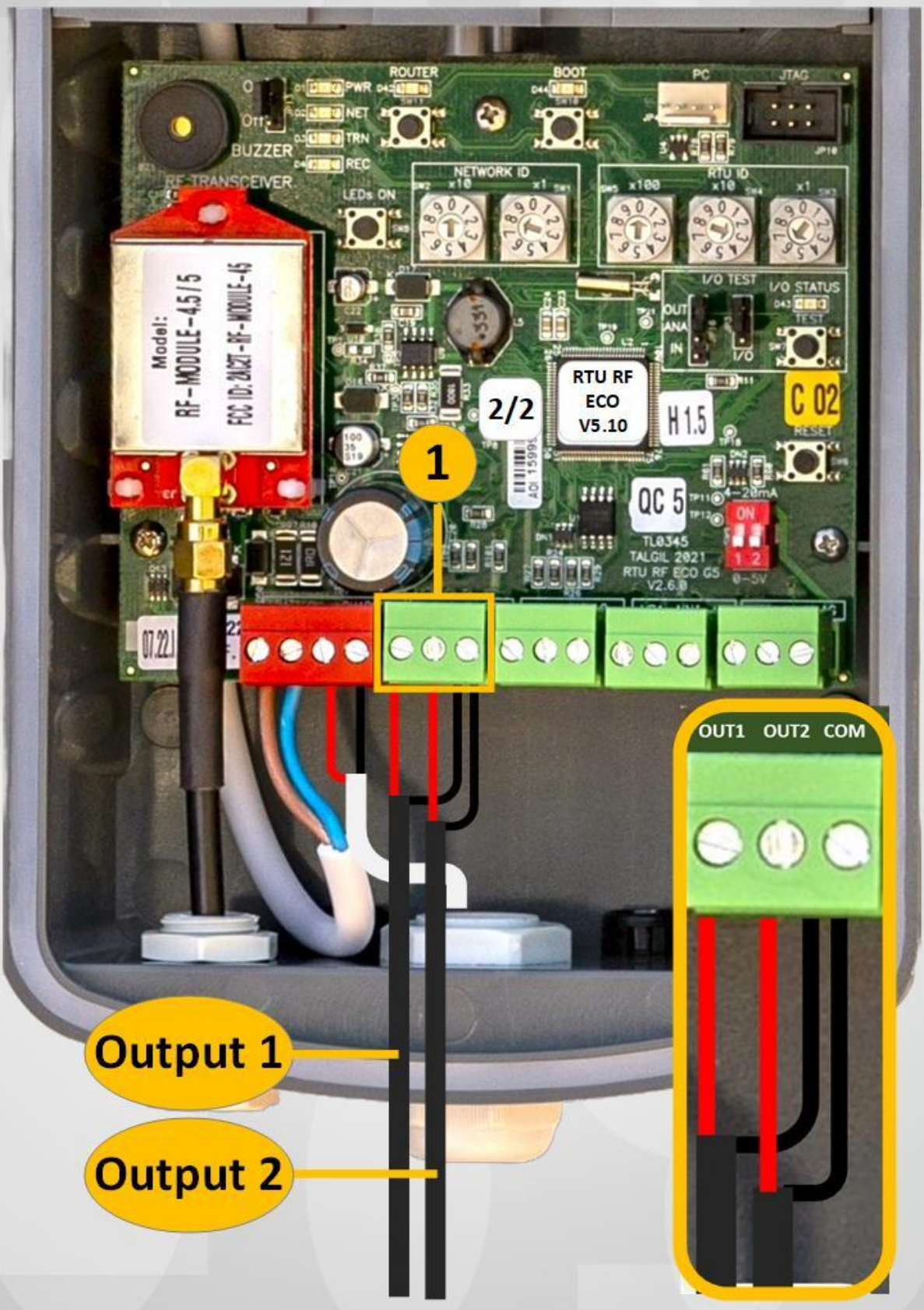


Image 47–RTU RF ECO G5-Outputs wiring.

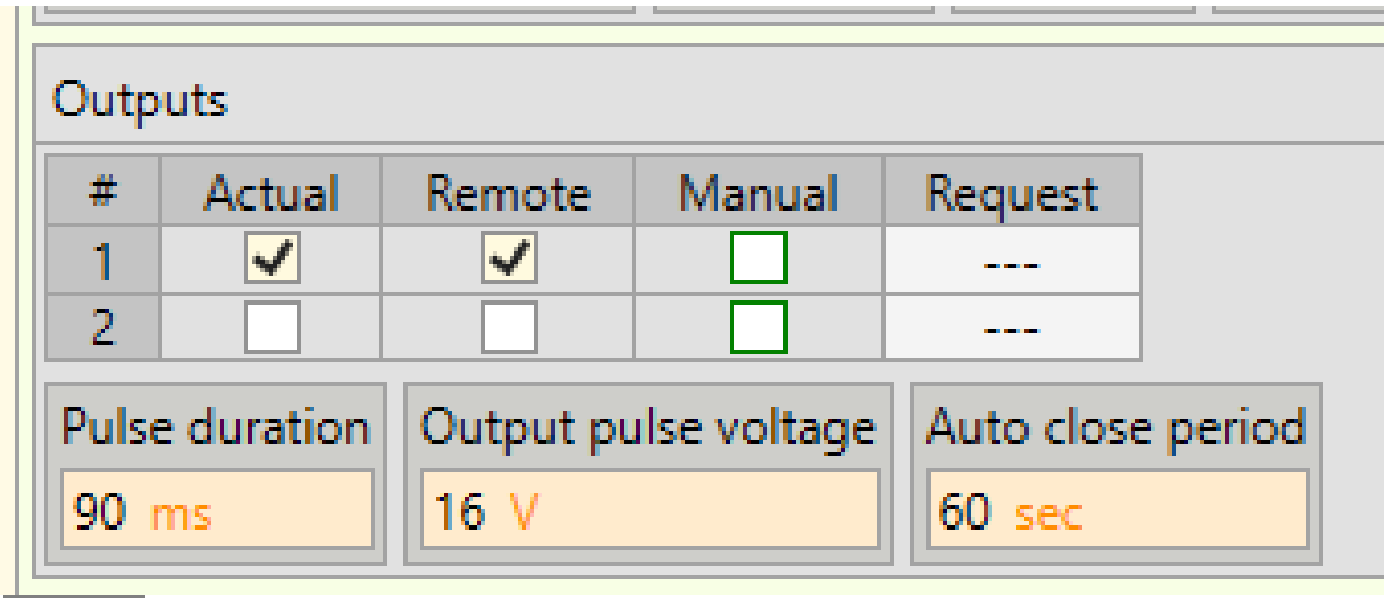
47. RTU RF ECO G5 - OUTPUTS.

There are 3 versions of **RTU RF ECO G5**. **RTU RF ECO G5 0/0** has no Outputs. It can be used to read Analog sensors or as a ROUTER. **RTU RF ECO G5 1/1** has one Output. **RTU RF ECO G5 2/2** has two Outputs.

1. Connect the Solenoids to the **Outputs plug** as described in **Image 47**. There are 3 screws on the **Outputs plug**. From left to right, **Out1**, **Out2**, and **COM** where **Out1** is used for **Output 1**, **Out2** is used for **Output 2**, and **COM** is the common for **Output 1** and **Output 2**.
To change the Output from Normally Open to Normally Close, change the polarity.
By default, the **Output pulse duration** (pulse period) is **90 milliseconds.**
The **Output pulse voltage** is **16V DC**. It is used for 12V DC latched solenoids, Valves, 12 V DC Latch relays, or Pump switching units.

Use the **Workbench PC** software to see the Output current status, change the Pulse period, Pulse voltage, and more settings**.**

Actual- The current status of the Outputs. When it is checked, the Output is opened.
Remote- The current status of the **Outputs** according to the Dream 2 or Sapir 2 controllers. For example, Output 1 is opened remotely by the irrigation controller.
Manual- An option to operate the Outputs manually.
When it is checked, the Output will open Manually.
Output pulse duration- The period to energize the Output.
By default, it is 90 milliseconds.
Output pulse voltage- The maximum output voltage while energizing the Output.
By default, it is 16V DC.



RTU RF ECO G5 – DIGITAL INPUTS

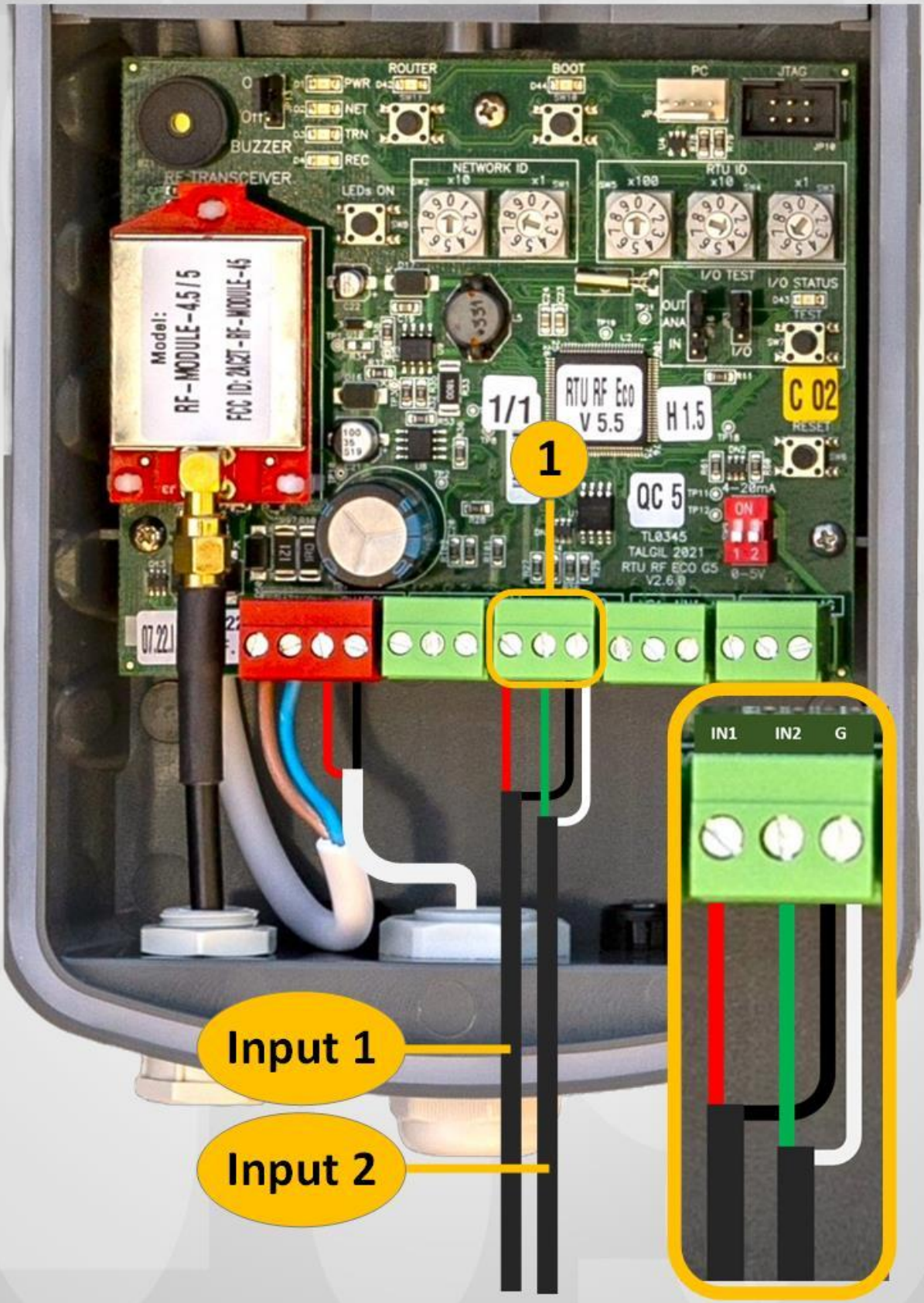


Image 48–RTU RF ECO G5-Digital Inputs wiring.

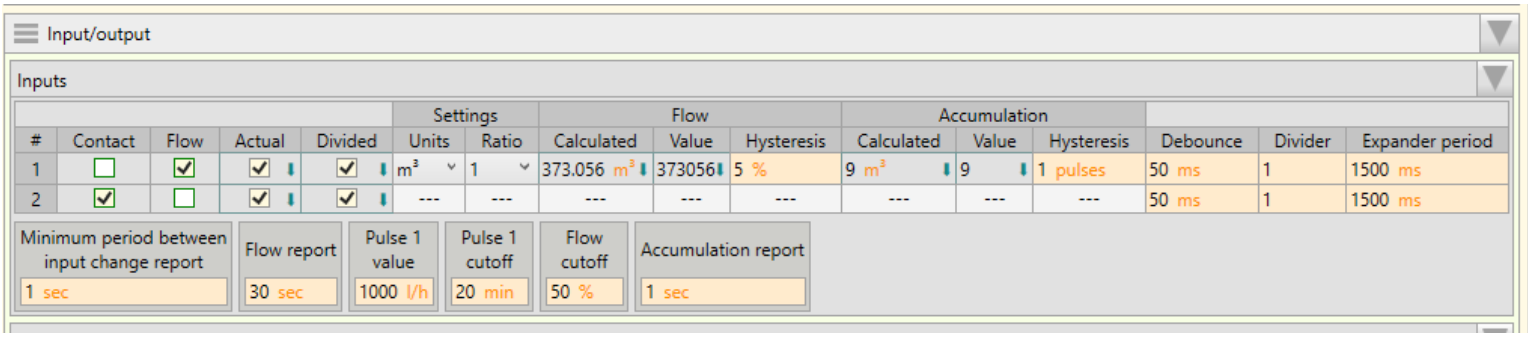
48. RTU RF ECO G5 - DIGITAL INPUTS.

There are 3 versions of **RTU RF ECO G5**. **RTU RF ECO G5 0/0** has no Digital Inputs.
It can be used to read Analog sensors or as a ROUTER.
RTU RF ECO G5 1/1 has one Digital Inputs. **RTU RF ECO G5 2/2** has two Digital Inputs.

1. Connect the Digital inputs to the **Inputs plug** as described in **Image 48**. There are 3 screws on the **Inputs plug**. From left to right, **IN1**, **IN2**, and **G** where **IN1** is used for **Input 1** (Red wire), **IN2** is used for **Input 2** (Green wire), and **G** is the Ground for **Input 1** (Black wire), and **Input 2** (White wire). By default, the Debounce is 100 milliseconds, the Divider is 1, and the Expansion is 1500 milliseconds. The pulse type should be a Dry contact.

In G5 FAST, there are two types of Digital Inputs. The types are **FLOW** and **CONTACT.**
FLOW input is used to read meters and calculate the flow rate and the accumulations. The **RTU RF ECO G5** sends the values to the Master.
CONTACT input is used to read Digital Sensors and sends the current status of the input (**ON** or **OFF**) to the Master.

Use the **Workbench PC software** to see the Current Status of the Inputs, and change the Debounce, Divider, Expansion, and more settings of the Digital Inputs. For more details, see **Chapter 22**.



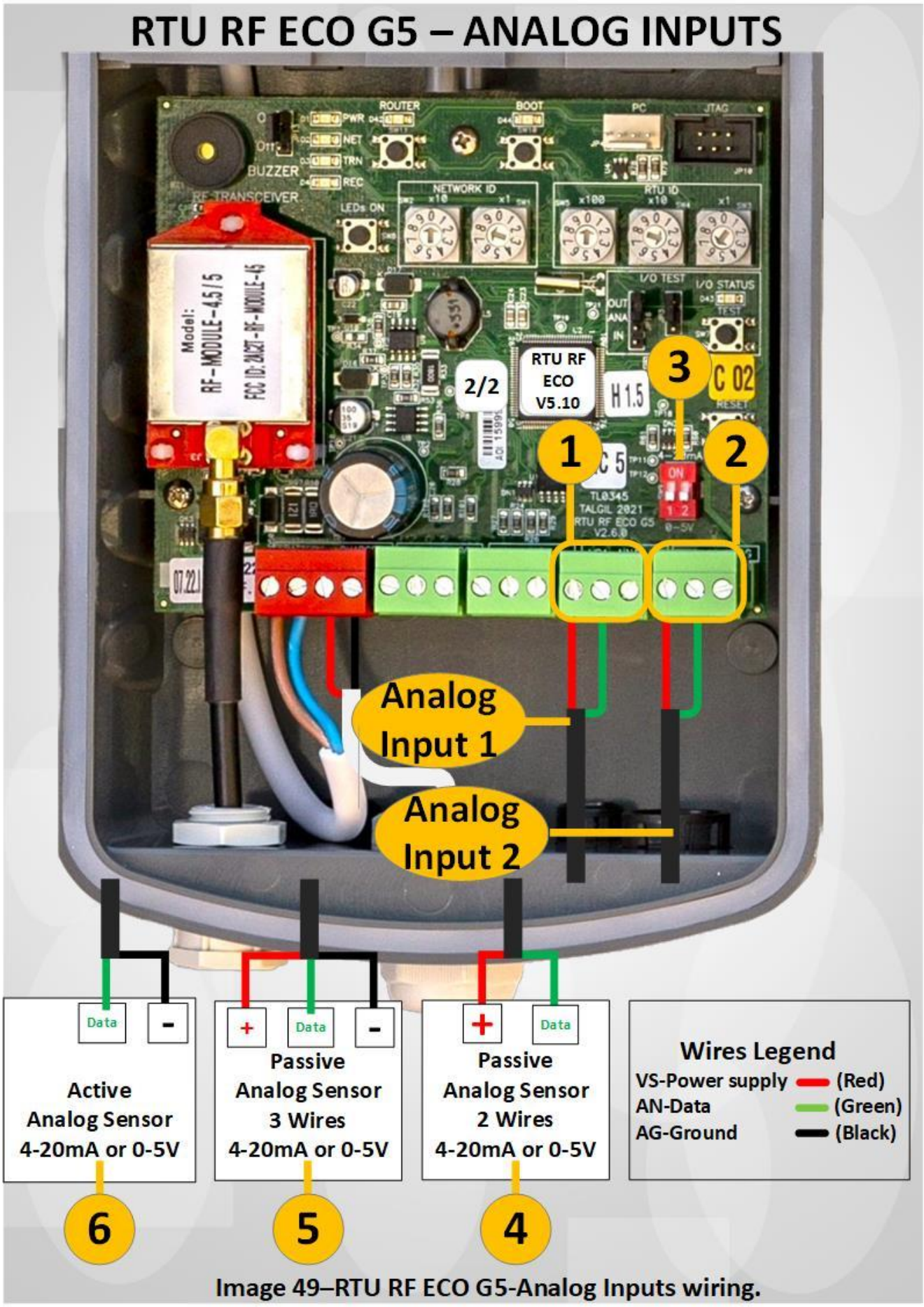


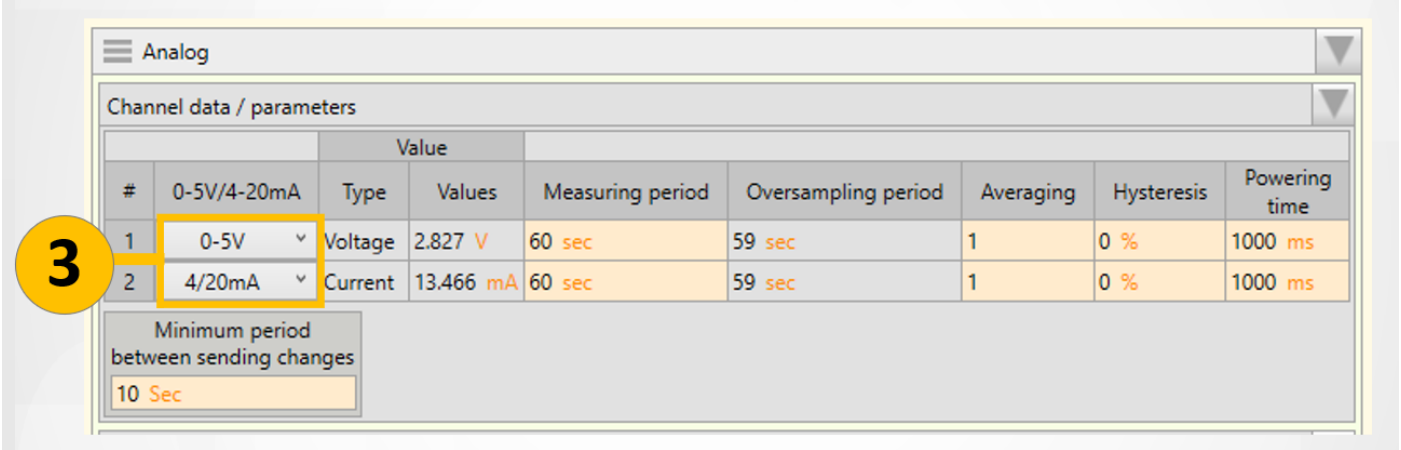
Image 49–RTU RF ECO G5-Analog Inputs wiring.

49. RTU RF ECO G5 - ANALOG INPUTS.

The **RTU RF ECO G5** has 2 Analog inputs. The Analog inputs type is used for standard Analog sensors 4-20mA or 0-5V. The resolution is 12 Bits. To read the Analog sensor, the power supply must be **12 V DC** (Solar panel/power supply and rechargeable battery). Read on to learn about the Analog sensor wiring and follow the instructions below:

1. Connect the first Analog sensor wires to the Analog input 1 terminal block.
   The Analog input terminal block has 3 screws. **VS1**, **AN1**, and **AG** where **VS1** is the **12V DC** power supply, **AN1** is the **Analog data** (Analog Signal), and **AG** is the **Ground**.
2. Connect the second Analog sensor wires to the Analog input 2 terminal block.
   The Analog input terminal block has 3 screws. **VS2**, **AN2**, and **AG** where **VS2** is the **12V DC** power supply, **AN2** is the **Analog data** (Analog Signal), and **AG** is the **Ground**.
3. Use the two Dip switches to select the Analog input type.
   When the Dip switch is ON, the Analog input type is **4-20mA** (Current).
   When the Dip switch is OFF, the Analog input type is **0-5V** (Voltage).
   *The **RTU RF ECO G5** does not update the status of the Analog input type Dipswitches. By default, it will appear in the Workbench PC software as Voltage. **Please connect the Workbench PC Software to the RTU and set the Analog input type.**

   Types of Analog Sensors:
4. Read the Analog sensor specification document or Datasheet to identify the Analog sensor type, Powering time, wiring, and range. A Passive Analog sensor should be powered before reading the Analog value. It is also called excitation time. On the other hand, an Active Analog sensor should not be powered.
5. To read a Passive analog sensor, If the Analog sensor has 2 wires, connect the Positive wire to **VS** and the negative wire to **AN**.
6. To read a Passive analog sensor, If the Analog sensor has 3 wires, connect the Powering wire to **VS**, the **DATA** (Signal) wire to **AN**, and the **Ground** wire to **AG**.
7. To read an Active analog sensor, connect the **DATA** (Signal) wire to **AN**, and the **Ground** wire to **AG**.
8. Set up the Analog sensor **Type** and **Range** in the **Constants/Analog sensors** screen according to the Analog sensor **Type and Range.**
9. Use the **Workbench PC software** to see the Current Status of the Analog Inputs, Read the Analog values, change the Sampling rate, Averaging, Power up time, and more settings of the Analog Inputs as described in **Chapter 23.**



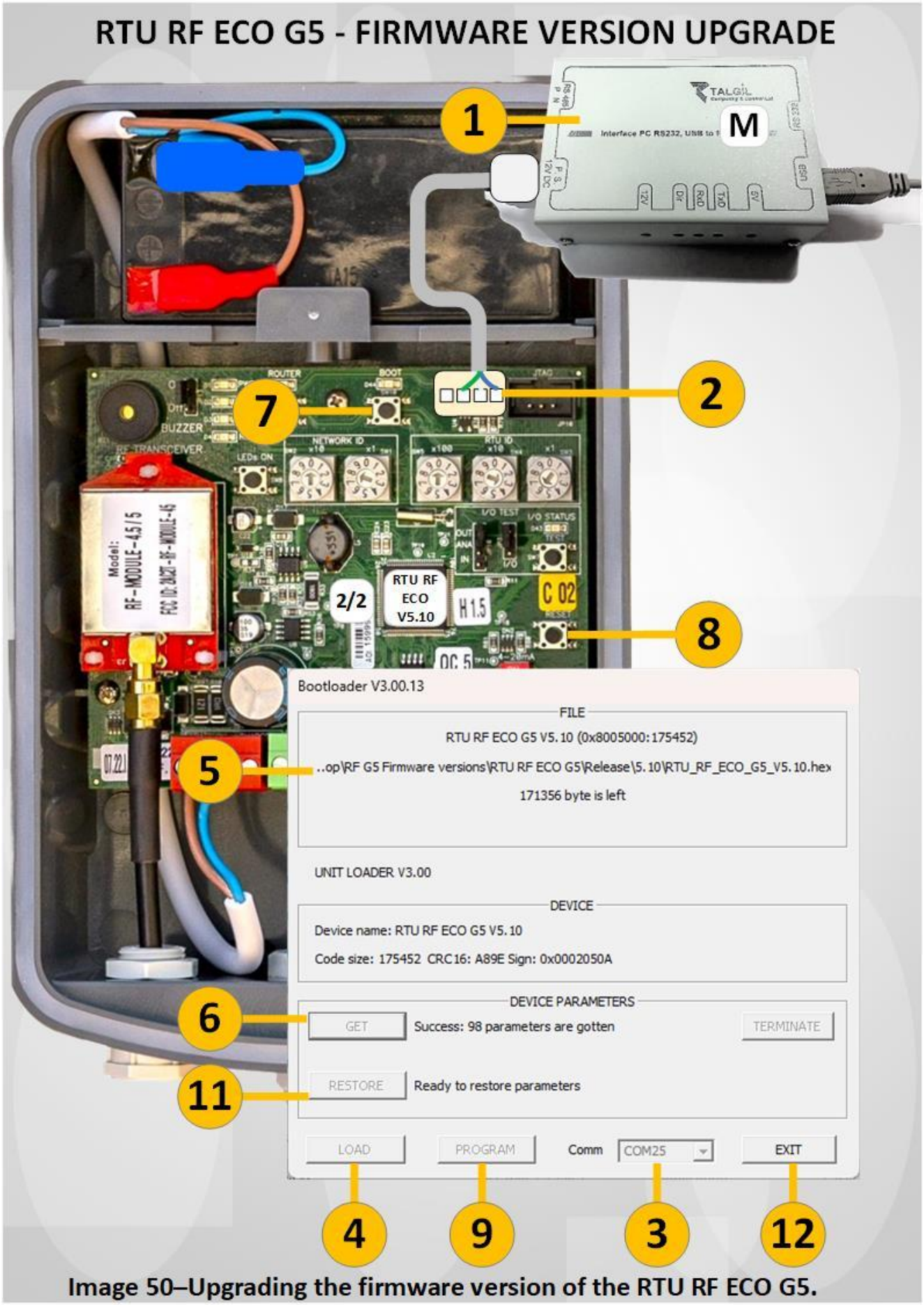


Image 50–Upgrading the firmware version of the RTU RF ECO G5.

50.RTU RF ECO G5 - FIRMWARE VERSION UPGRADE

Make sure that you are using the latest Firmware version of the **RTU RF ECO G5**. Use the links below to download the latest firmware version and the **CBoot** PC software.
To start the firmware version upgrading process, please follow the instructions below:

1. Connect the **Programmer** device to your **PC**.
2. Connect the **Programmer** device cable to the **PC Socket** on the upper right corner of the **RTU RF ECO G5** card as described in **Image 50**.
3. Start the **CBoot** PC software and select the **Communication port.** If you do not have the **CBoot** PC software, download it here:

https://drive.google.com/drive/folders/17AZoFHJXi4XWkqNSbLTVXLVqKH4EP0tp?usp=sharing

4. Click the **LOAD** button, browse to the **RTU RF ECO G5** hex file, and select it.

To download the latest **RTU RF ECO G5** firmware version, click here:
https://drive.google.com/drive/folders/1sKFhwgJQYbp4QdtsRxNsHfZVxiYfyxnt?usp=sharing

5. The pathway to the hex file will appear on the screen.
6. Click the **GET** button to read the settings of the **RTU RF ECO G5.** This will save the settings in the **CBoot** PC software. The number of saved parameters will appear.
7. On the **RTU RF ECO G5** hardware, press and hold the **BOOT** button.
8. While the **BOOT** button is pressed, press the **RESET** button. Leave the **RESET** button, after 1 second, leave the **BOOT** button. This action will put the **RTU RF ECO G5 mode** into a **BOOT Mode**.

In **BOOT Mode,** the **BOOT** LED turns ON.

9. To start the upgrading process, click the **PROGRAM** button. The upgrading process will start.
10. A progress indicator will appear on the screen**.** At the end of the process, a **Terminated** message will appear.
11. After the upgrading process, the **CBoot** PC software will **RESTORE** the saved settings to the **RTU RF ECO G5**.
12. To close the **CBoot** PC software, click **EXIT**.

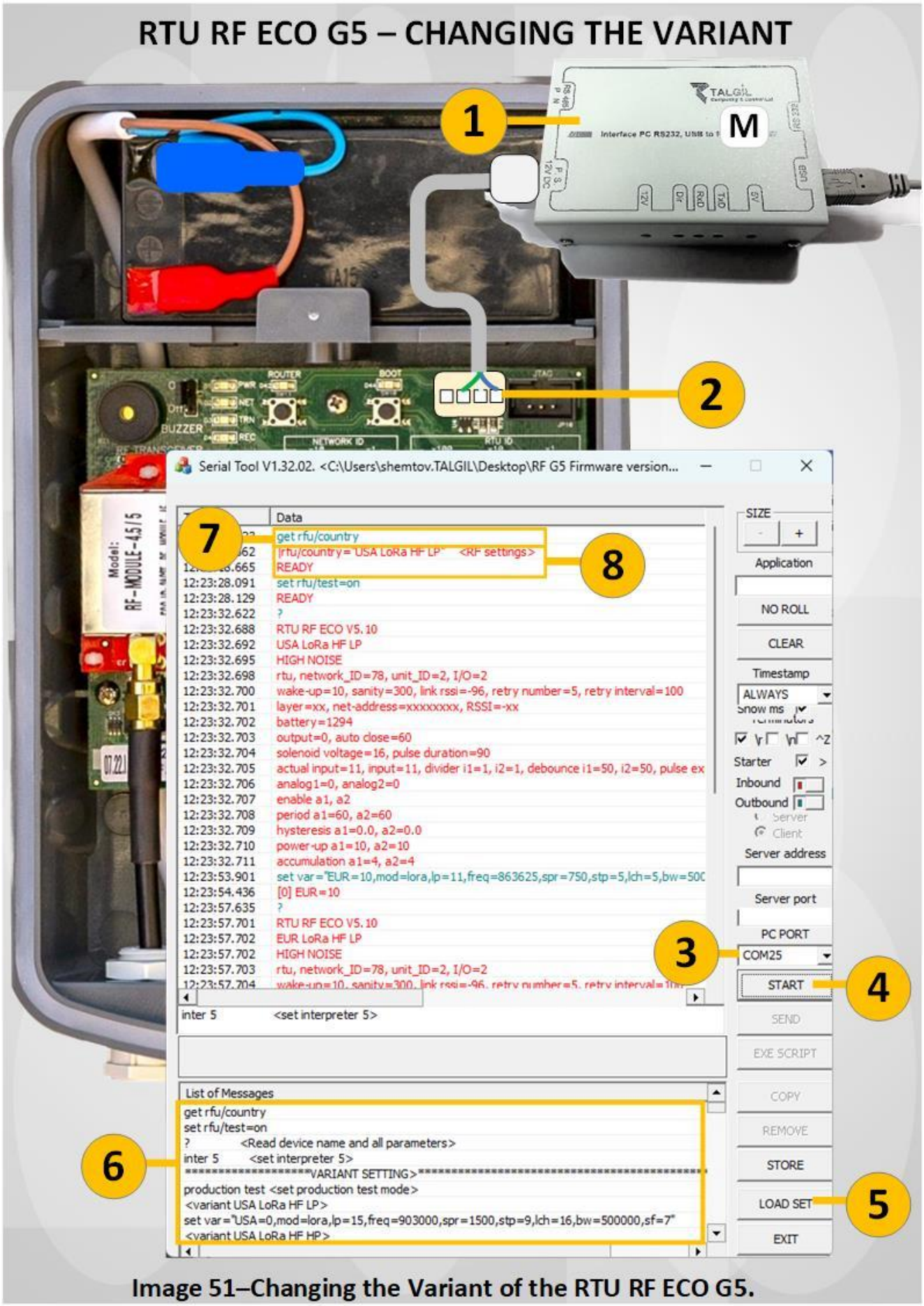


Image 51–Changing the Variant of the RTU RF ECO G5.

51. PROGRAMMING THE RTU RF ECO G5 - SETTINGS

Connect the Programmer device to the **RTU RF ECO G5** as described in **Image 51** and use the **Workbench** PC software to read or edit the setting of the **RTU RF ECO G5**.
Use Chapters 20 to 23 to learn about the Workbench PC software.

52. PROGRAMMING THE RTU RF ECO G5 - VARIANT

It is not possible to change the Variant through the **Workbench** PC software. To change the Variant, follow the instructions below:

1. Connect the **Programmer** device to your **PC**.
2. Connect the **Programmer** device cable to the **PC Socket** on the upper left corner of the **RTU RF ECO G5** card as described in **Image 51**.
3. Start the **SerialTool** PC software and select the **Communication port.** To download the **SerialTool** PC software and the set of commands called **VARIANTS.promptset**, click it here: https://drive.google.com/drive/folders/1LnYjFsgmcl4iGiqDCN0ufBPboZzRdXFb?usp=sharing
4. Click the **START** button **(2).**
5. To write a command manually, write the new command in the **Command text box.** To use a library of existing commands, click the **LOAD SET** button and select the **VARIANTS.promptset** file. The available commands will appear in the **Commands list.**
6. Select the first command on the **Commands list** and double-click on it.
   The command is **get rfu/country**. This command reads the **Variant** of the **RTU RF ECO G5**. The **SerialTool** saves the logging files in the folder where the **SerialTool** is located.
7. The command that has been sent will appear on the **Logging window.**
8. The **RTU RF ECO G5** will return the Variant. The response from the **RTU RF ECO G5** will appear on the **Logging window**. Make sure that you are using the correct **Variant** according to **Table 1.**
9. To change the Variant, put the **RTU RF ECO G5** in **Test mode**. To put the **RTU RF ECO G5** in **Test mode**, double-click on the command called **set rfu/test=on**.
10. Select the Variant from the **Commands list** and double-click on it.
    * Pay attention, several Variants have 2 commands to send.
11. To start working with the new Variant, reset the **RTU RF ECO G5**.

To add commands to the **Commands list**, write the new command in the **Command text box** and click the **Store.** To remove a command from the **Commands list**, select the command to remove and click **Remove**. The user can use different colors for the transmitted and received data by using the **Outbound** and **Inbound** buttons**.** The new colors will appear in the **Logging window.** To show the logged time in milliseconds, check the **Show ms** check box**.** To clear the logging list from the **Logging window** click **CLEAR.** To freeze the Logging while the logging is still running, click **NO ROLL.** To change the software size, use the **+** and **–** buttons

53. LINKS TO DOWNLOAD THE LATEST FIRMWARE VERSIONS AND PC SOFTWARE

RF G5 Released firmware version:
https://drive.google.com/drive/folders/1sKFhwgJQYbp4QdtsRxNsHfZVxiYfyxnt?usp=sharing

Workbench:
https://drive.google.com/drive/folders/1MyHe8iHkUQBm8AzeVlkPVU-HIq1_kW9N?usp=sharing

SDI Programmer:
https://drive.google.com/drive/folders/1OyjAIJ1yalZWu-SgBF6pM4hMou3JJNYg?usp=sharing

TreeView:
https://drive.google.com/drive/folders/1OUWf04dw7EEsFPFOAmfFBZ1EJExaMkrT?usp=sharing

SerialTool:
https://drive.google.com/drive/folders/1LnYjFsgmcl4iGiqDCN0ufBPboZzRdXFb?usp=sharing

CBoot:
https://drive.google.com/drive/folders/17AZoFHJXi4XWkqNSbLTVXLVqKH4EP0tp?usp=sharing

Sapir 2 – Released firmware version:
https://drive.google.com/drive/folders/1japcFXpqcw-FNe2afPSm3sVcaD_h-K_7?usp=sharing