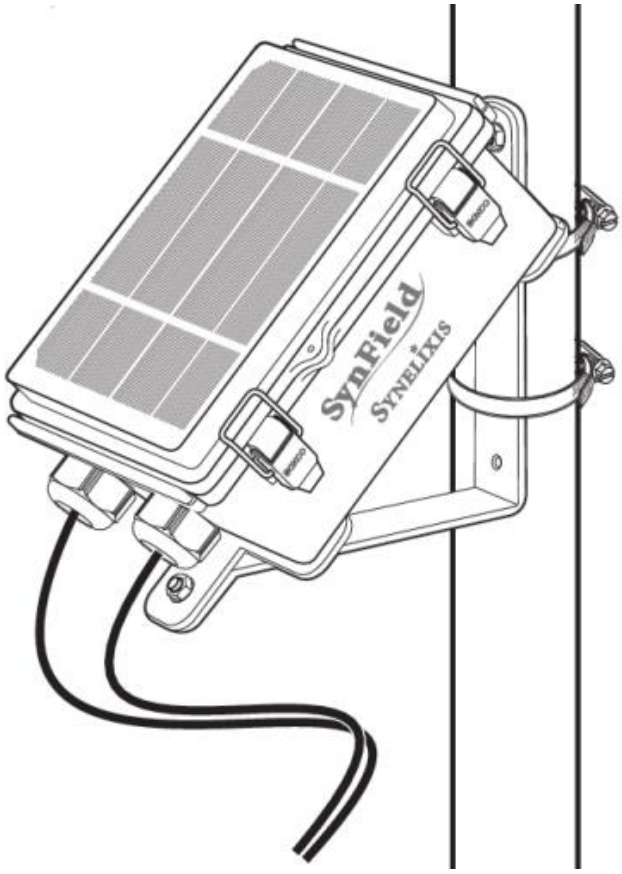
SynField® X5

Monitoring & Remote-Control Node

Technical Guide

Device Version: 2021



Revision v1.2 – March 2022

SYNELIXIS

SynField

Contents

1. General and safety information

Important:

- All documents are provided as-is and are subject to change without notice.
- Never immerse equipment in any liquid.
- Keep equipment within temperature range indicated in recommendation section.
- Do not connect or power equipment using cables that have been damaged.
- Place equipment in an area to which only maintenance personnel can have access (in a restricted access zone).
- In any case keep children away from the equipment.
- If a software failure occurs, contact Synelixis technical support before doing any action by yourself.
- Be careful if you are connected through SynField Control Application for setting up device configuration; if settings are incorrectly altered, it could lose connection to the server and connected sensors.
- If you need to clean the node, wipe it with a dry towel.
- The device is not designed to be placed under dangerous chemical elements, explosive atmospheres with flammable gases, high voltage installations or special installations. Please contact Synelixis technical support to ensure your application is compatible with the device.

Read before use:

The following list shows just some of the actions that produce the most common failures.

Software:

- When updating device firmware, using the SynField Control application, make sure battery voltage is over 3.75V.
- Do not plug/unplug any sensor while updating firmware. The device can become unresponsive.

Hardware:

- Do not submerge SynField Monitoring & Remote-Control Node in liquids.
- Do not place the device in places where it could be exposed to extreme shocks and vibrations.
- Do not expose the device in temperatures below -30 °C or above 60 °C.
- Do not place the device where water can reach the internal parts of the device.

2. Introduction

This guide explains the features related to our **SynField X5 Monitoring & Remote-Control Node**, released in January 2021.

If you are using another version of our products, please use the corresponding guides, available on our website.

2.1 Parts included

The parts included are shown in the following figure and are the following:

- The SynField Node, with international SIM installed. Ready to operate, out-of-the-box.
- Aluminum base (2 parts)
- Stainless-steel screws for fixing the base and the device with the base.
- Metal-clamp (or tire-ups) for attaching the device to a pole.

See the respective “Installation Guide” for details.

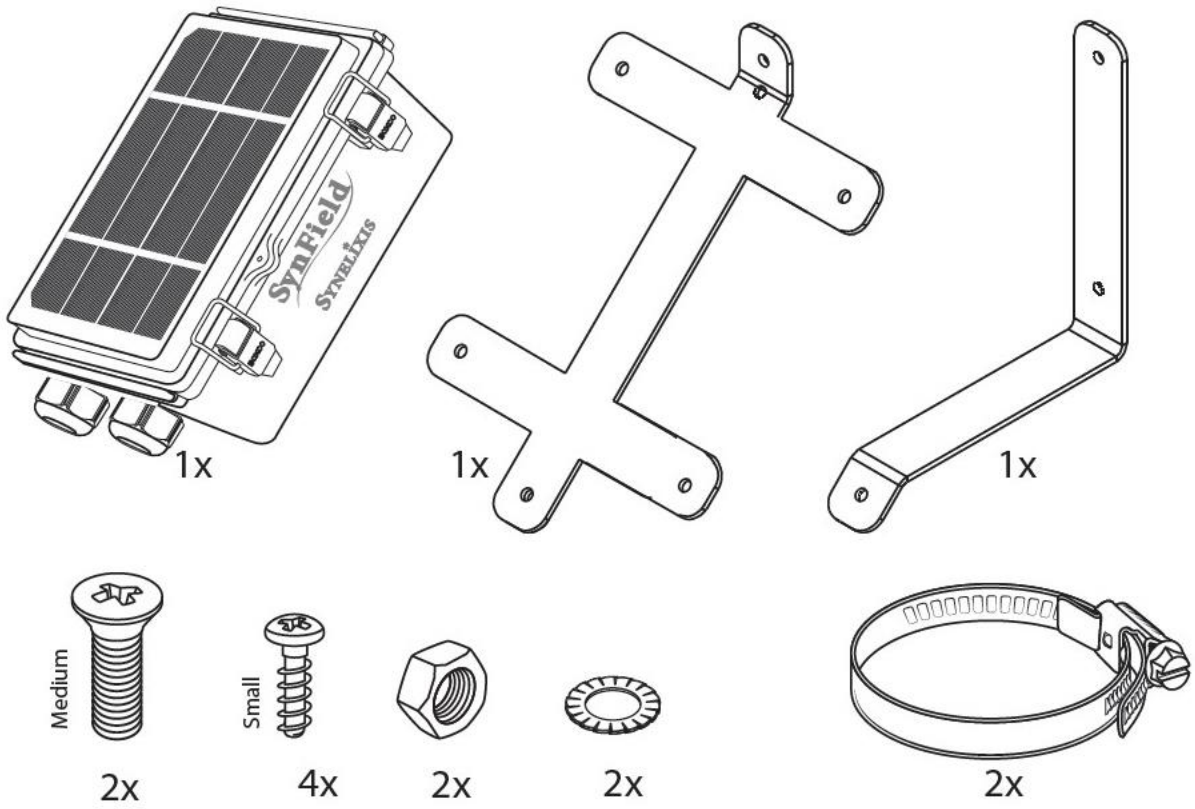


Figure 1. Parts included

3. Description

The SynField ecosystem (Figure 2) is based on the SynField Monitoring & Remote-Control Node, which are able to interface to a variety of sensors and control automation systems (i.e., relays and electrovalves).

The SynField Node periodically collects sensor data and forward them to the SynField cloud server via a cellular or Wi-Fi connection. Moreover, they act as controllers that allow remote control of actuators (i.e., electrovalves and relays). This way they can support smart irrigation applications and automatic control of electrovalves and pumps based on field status and user preferences.

The SynField ecosystem, except the Monitoring & Remote-Control Node, comprises of:

- The **SynField Web portal** (https://app.synfield.gr/), where the user can monitor sensors, control actuators, configure the system, define actuation rules and much more.
- The **SynField Mobile application**[1] through which the user can easily monitor and control the various sensors and actuators.
- The **SynField Control application**[2] through which the user can configure the SynField device.

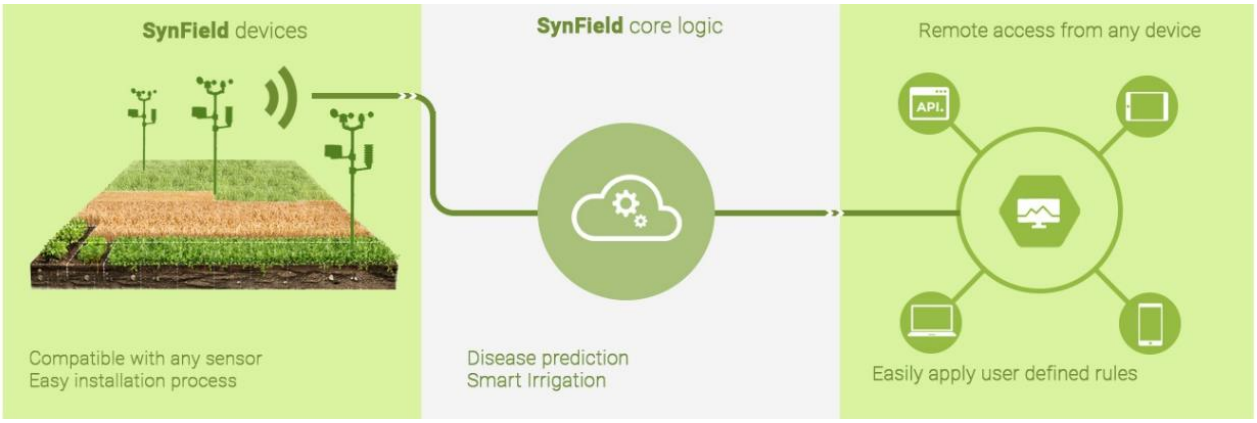


Figure 2. The complete SynField Ecosystem

[1] The SynField application is available for Android devices. Can be downloaded from Google Play store (search for "Synfield" or use the link https://play.google.com/store/apps/details?id=gr.synfield.client.android)

[2] The SynField Control application is available for Android devices. Can be downloaded from Google Play store (search for "SynField Control" or use the link https://play.google.com/store/apps/details?id=com.synelixis.SynControl)

3.1 Features

- Ultra-rugged and durable construction
- Eight sensor ports (any type of analog, pulse, I2C, SDI-12)
- Eight latching actuator ports (any type of solenoid control valves, pumps, latching relays, etc.)
- Wireless connection to SynOdos peripheral node via LoRa RF technology
- Supports a plethora of off-the-self sensors (vendor independent) and actuators (valves, relays).
- Integrated quad-band cellular module, NB-IoT compatible
- Out-of-the-box integrated with the SynField Cloud application, for almost real-time data monitoring
- Almost real-time control of valves, relays and automations using advanced, user-defined rules
- Integrated GPS and barometric pressure sensor
- Configurable via Bluetooth with the SynField Control application (Android OS)
- Simple setup process via the Bluetooth interface
- Firmware update using the control application
- Built-in solar panel or external charger for all kinds of installations
- Rechargeable high capacity (4000mAh) battery
- On board non-volatile memory (8 Mbyte)
- ESD/lightning protection
- Optimized user interface for desktop and mobile devices
- Dedicated application for mobile devices (Android OS) providing a simplified monitor and control interface.

3.2 Specifications

Sensors' Input	
Wireless interconnection	• LoRa RF interface for interconnection with peripheral devices (synOdos)

Sensor input ports	8 sensor input ports, grouped as follows:
	• 4 x fully selectable ports supporting
	  ○ analog: (10bit accuracy), single-ended, differential sensors
	  ○ pulse counters sensors
	• 2 x high accuracy analog ports (16 bits accuracy)
	• 1 x combo port to support the meteorological-sensor-suite combinational sensor (rain-meter, windmeter, wind direction)
	• 1 x digital sensors port (UART, I2C, SDI12)

Power Output to Sensors	Selectable 3.3V or 5V excitation power output to sensors
Sensor Connectors	• 3.5 mm stereo jack for analog, digital and pulse counters • RJ-11 for I2C / SDI12 / UART and Weather Station
Global Position System	• Integrated GPS receiver
GPS position accuracy	• ±3 m, with good sky view
GPS Antenna	• Active patch antenna
On board sensors	• GPS • Barometric • System Temperature • Battery Voltage Level • Charge current
Logging/Reporting interval	• 5 minutes to 24 h • 1 minute to 24 h in case of permanent connection to power supply
Actuators' Output	
Actuator ports	• 8 latching ports (i.e., valves with latching solenoid, latching relay) • Selectable 9V or 12V actuation
Actuation interval	• 5 minutes to 24 h • 1 minute to 24 h in case of permanent connection to power supply
Connectivity	
Cellular Connectivity	Quad-Band GSM/GPRS cellular module, NB-IoT compatible
Cellular coverage	Integrated SIM supporting 150+ countries, with 200+ networks
SIM type	Nano SIM Card
Cellular Antenna	On board chip-antenna
Extra Cellular Antenna	Optional SMA connector for connecting external antenna
Internet downloads	SSL/TLS encrypted

Configuration Interface	Bluetooth 2.1
System Characteristics	
Data storage	8 MB (1-year+ records depending on configuration)
Memory type	On-board, non-volatile flash, full data retention with loss of power
Timekeeping	Synchronize automatically with SynField server
Battery capacity	4000mAH Lithium Polymer battery
Battery charging	Solar energy harvesting or external charger
Solar panel	6V 2.5W solar panel
Solar Panel Type	Monocrystaline, ETFE coated
Environmental	
Operating Temperature	–20°C to +60°C
Operating Humidity	0% to 95% RH
Storage Temperature	–20°C to +80°C
Storage Humidity	0% to 99% RH
Physical Properties	
Enclosure	Weather-, impact-, and UV-resistant polycarbonate
Environmental Rating	IP56, NEMA 4
Enclosure access	Hinged door with latches and eyelets for lock or zip tie
System Conformal Coating	Acrylic conformal coating
Enclosure size	13.5 cm × 19.5 cm × 7.0 cm
Weight	0.85 Kg
CE	The CE Marking identifies this product as complying with all relevant directives in the European Union (EU).

3.3 SynField Connectors & Switches

The SynField X5 node is comprised of a single printed circuit board (PCB) that is housed inside the enclosure. The following figure shows the layout of the device's PCB along with its connectors and switches.

The board includes the following connectors and switches:

- **ON/OFF switch** for powering ON and OFF the device
- **Solar-Panel Connector** for plugging in either the solar or an external 5VDC power-supply
- **Battery connector** for connecting the device battery
- **Sensors' connectors**:
    - connectors 1-4 that support analog (10-bit accuracy), pulse counters and unidirectional serial sensors
    - connectors 5-6 that support analog sensors (16-bit accuracy)
    - connector 7m that supports the meteorological-sensor-suite combinational sensor (rainmeter, windmeter, wind direction)
    - connector 8d for digital sensors (UART, I2C, SDI12)
- **Actuators' connectors** A1-A8 for installing valves and bi-stable relays (with 1 or 2 coils)
- **SIM Card socket** for inserting cellular provider SIM. The device typically comes with pre-installed SIM
- **DIP switch 1**: Configuring connectors 1 to 4 as analog or pulse-counter sensors' ports
- **DIP switch 2:** Configuring the output voltage-level of the digital sensor (connector 8d) to 3.3V or 5V
- **DIP switch 3:** Configuring the output voltage-level of the actuators to 9V or 12V
- **DIP switch 4:** Configuring connectors 5 and 6
- **GPS antenna connector** for installing an active, 3V, GPS antenna (at the back side of the PCB)
- **Cellular antenna connector** for optionally installing an external cellular antenna (typically not used). (at the back side of the PCB)

Board Display

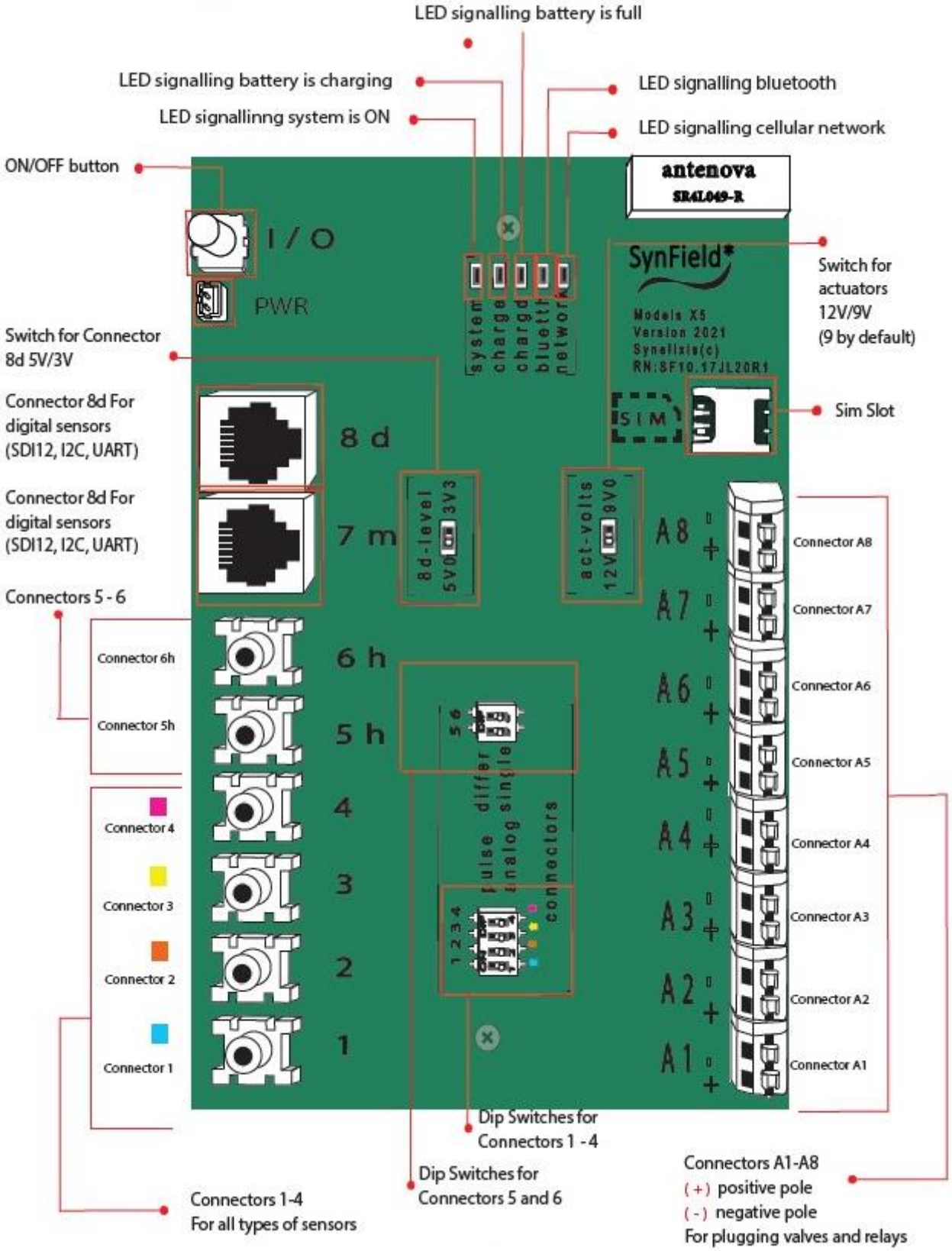


Figure 3 SynField X5 Node printed circuit board

4. Installing the device

After you have unpacked the device and checked that everything stated in the contents list is included, it is recommended to follow the steps described next in order to install and operate the SynField device.

The SynField X5 Node itself comes ready to operate out-of the box. The cellular SIM card is installed and the device is setup to connect to the server. The only steps required are:

- Install sensors and actuators
- Configure sensors and actuators
- Attach aluminum mounting base
- Place the device in its final position (pole, wall, etc.)

The following subsections give additional information on the above processes.

4.1 Installing sensors and actuators

Before starting sensor installation, you need to identify the connector for each sensor. The following table shows the sensor interfaces that each device connector can support.

Connector	*Analog (10 bit)*	*Analog (16 bit)*	*Pulse-counter*	*I2C / SDI12 / UART*	*1-wire serial (DDI)*	*Wind & Rain combo*[3]
1	√		√		√	
2	√		√		√	
3	√		√		√	
4	√		√		√	
5		√				
6		√				
7m						√
8d				√		

Table 1. Device connectors and supported interfaces

The following table shows the interface for the most frequently used sensors. If the sensor is not included in the following table, consult additional sensor documentation or technical support to identify sensor interface.

[3] "Wind & Rain combo" interface is a proprietary interface connector (RJ11 type) that combines a rain-meter, wind-meter and wind direction sensor in a single RJ11 connector

Description		Interface
Wind speed, wind direction and rain meter Davis Vantage Pro 2 sensor suite		Wind & Rain combo
Temperature & relative humidity sensor Sensirion SHT1x/2x/3x		I2C
Soil Moisture sensor Meter Environment 10HS or EC-5		Analog
Soil Electrical conductivity, moisture & temperature sensor Meter Environment 5TE		1-wire serial (DDI)
Industrial air/liquid pressure sensor Various manufacturers and ranges		Analog
Leaf Wetness sensor Meter Environment LWS		Analog
Solar Radiation sensor Davis solar radiation sensor		Analog
PAR/Light Sensor Apogee SQ1xx/SQ2xx		Analog
Liquid pH Sensor Industrial pH sensor & interface circuitry		I2C
Soil volumetric water content, temperature & electrical conductivity sensor Meter Environment Teros-12		DDI

Table 2. Sensors and their interfaces

Actuators are installed in connectors A1 to A8[4]. The device supports latching type actuators[5]. Specifically, it supports:

- All type of electrovalves with latching solenoid. All major manufacturers supply a DC-latching version for their solenoids.
- Latching relays with single or double coils and a coil voltage of 9 or 12 VDC.

[4] Please note that in some places these connectors maybe referred to as connectors 9 to 16 respectively.

[5] The system could also support non-latching actuators in special applications where power is available. Contact technical support for further information.

After you have identified where to connect each sensor/actuator, insert respective cable as shown in the following figure and insert plug in the appropriate connector.

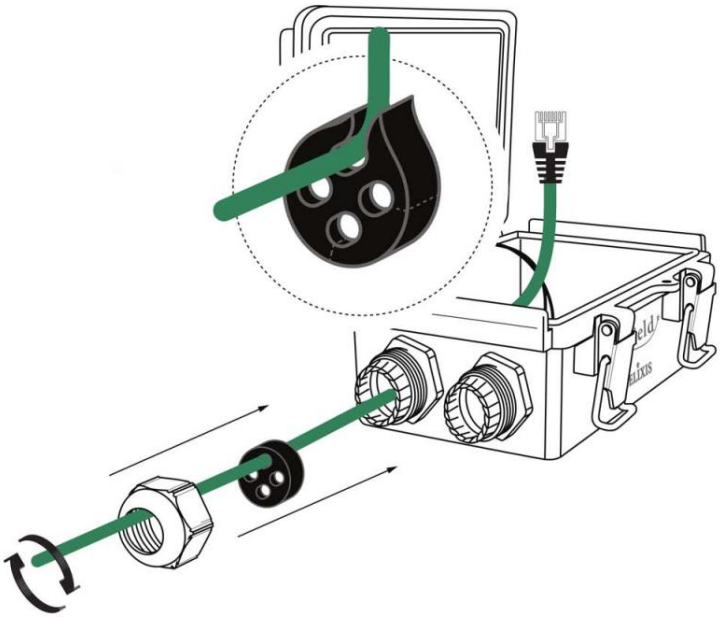


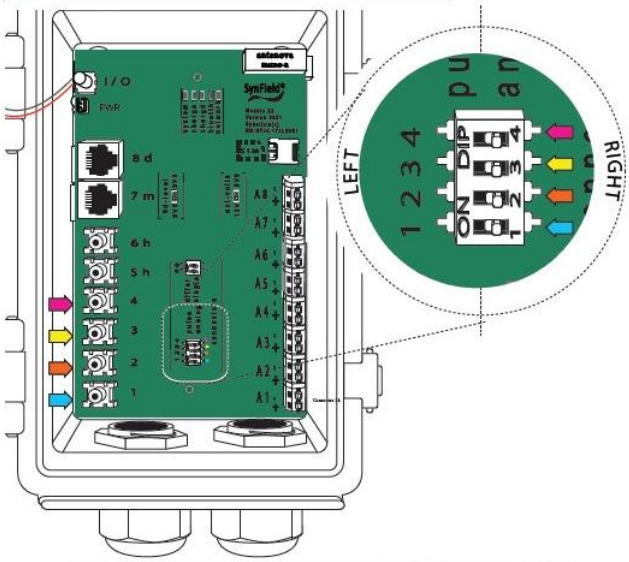
Figure 4. Sensor cable insertion

In the case of actuators, insert the positive cable (red color) in the "**+**" terminal of the connector and the negative cable (black color) in the "**-**" terminal. In the case of a double-coil latching relay, a neutral cable is also present and should be connected in the ground terminal marked as "**GND**".

4.2 Configuring sensors and actuators

Some of the device connectors need to be configured (using DIP switches) according to the type of the installed sensor.

SENSOR TYPE	DIP SWITCH
Pulse counter	Turned to the left
Unidirectional Serial	Turned to the right
Analog (Voltage)	Turned to the right



Specifically, **connectors 1 to 4** need to be configured using a **DIP-switch** (see main board section) whether the attached sensor is of "pulse counter" type or analog. Check the adjacent figure for more information.

The **DIP switch** for connectors 5 and 6 should be in the **single** position (right position).

Connector 8d need to be configured using a **DIP switch**, whether the voltage level of the digital interface is 3.3V or 5V. Typically, the digital interface of supported sensors is 3.3V, so you should leave respective DIP switch unchanged.

Connectors A1 – A8 need to be configured using a **DIP switch**, whether the voltage level of the digital interface is 9V or 12V.

Connectors 5h, 6h 7d do not need any additional configuration.

In addition to configuring the respective connectors, the firmware configuration also needs to be updated accordingly. This is achieved using the SynField Control application. Below, the required steps are briefly presented; more information can be found in the "SynField Control application manual".

- Install SynField Control application from Google Play (search for "SynField Control") and "open" the application
- Press the "CONNECT" button and in parallel power on the SynField device. The application searches for a SynField device in vicinity, after a few seconds the application should locate the SynField device. If the device is connected for the first time with the specific mobile device, a pop-up window comes up asking for a PIN, enter "1234" and press OK. If the pop-up window doesn't come up, check on device notification area (slide top-to-down on device screen).
- After the device is found and the Bluetooth connection is established, the application will try to connect with the SynField device firmware. This should be achieved in the following 5 seconds, if not restart the SynField device and press the "CONNECT" button again. After the device and the control application are fully connected (Bluetooth and firmware), the "CONNECT" button changes to a **green** "CONNECTED" button.
- On the first tab named "CONTROL", press the "CONFIGURE" button. This will take you to the configuration screen where you select the sensor and actuator type for each connector.
- Press the "BACK" button on the bottom left. It will ask you to send the modified configuration to the device, press "SEND". It will then ask you to save the configuration, you can leave that for later.
- On the "MONITOR" tab, press the orange refresh button on the bottom right and check that the sensor values that are read are correct. On each actuator connector, check that the "ACTIVATE/DEACTIVATE" buttons on connectors with actuators perform respective actions.
- When everything is complete, save the configuration. Make sure that in the save dialog, the device serial number is shown, if not press the respective refresh button, you should also press the refresh button underneath so as to update location information (if mobile device has GPS capability). The select a name for the configuration and save. You could then select to forward the configuration (from the extra menu on the top-right) to have it handy later on when you need to enter device information on the SynField portal.
- Before exiting the application, press the "DISCONNECT FIRMWARE" button, this will put the device in back to normal operation. In parallel, various log messages are print in the "LOG" window of the application, while the device will try to connect to the server and send respective sensor data. If a warning/error message is displayed **other than** "Unregistered device" please refer to troubleshoot section and if problem is not solved contact technical support.

4.3 Attach mounting base

Firstly, assemble the mounting base by screwing together the two parts and then screw the mounting base on the back of the device enclosure. The following figure depicts the mounting process. After that, the device is ready to be placed in its final position.

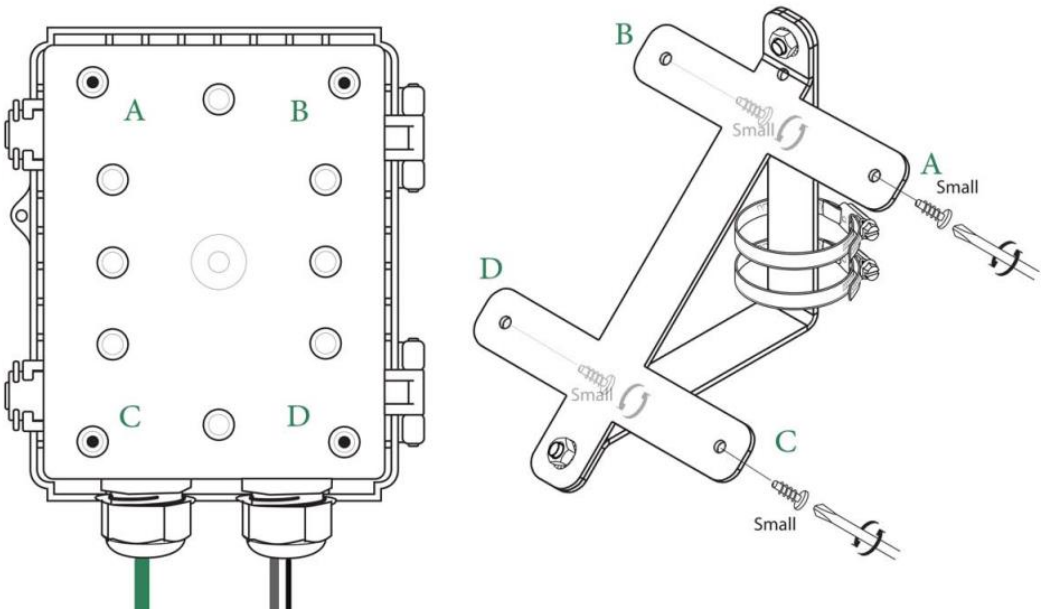


Figure 5. SynField Node and its mounting base

4.4 Placing a SynField device in the field

Select an appropriate location for the device taking into account the following recommendations:

- Select an open area where the device panel will get direct sunlight for at least 3-4 hours a day. Make sure that it will not be shaded by present and future vegetation. Preferably, place the device towards the South to receive as much sunshine as possible.
- Make sure that network signal strength is adequate. You can use the “SIGNAL STRENGTH” button on the SynField Control application to verify signal status.
- If a wind-meter is installed, then the device along the wind sensor should be placed in an open area where the wind is not blocked and/or altered. Make sure that the wind-direction sensor points towards the North.
- If a rain meter is installed, have in mind that debris/vegetation/etc. could block the bottom hole of the rain bucket. In any case, regular inspection and cleaning of the rain bucket is advised. Make sure that the rain bucket is installed vertically; if installed at an angle, its accuracy will be degraded.
- Avoid placing the device at places that are prone to lightning and very strong winds.
- If possible, keep sensor cabling short (i.e., < 10 meters) to avoid induction currents from nearby lightning.

Then fasten metal-straps/tire-ups on the mounting pole **or alternatively** screw the mounting base on a wall or pole. Upon final placement, power on the device and connect using the SynField Control application. Verify again that all sensors and actuators are operating as expected and press “Firmware

disconnect" button and inspect log messages to verify that the device successfully connected to the server and sent measurements. In the end an "Unregistered device" warning message appears; this is regular since our device has not been set up in the SynField web portal. Leave the device powered on and sending.

Finally, on the web portal (https://app.synfield.gr/) login and visit the "Configuration" tab to add the respective device along with its sensors and actuators. This process could be achieved either manually by entering one by one or by importing the configuration file that was saved and forwarded during the sensor configuration process (Section 4.2). If the configuration file was saved but not forwarded, then it could be done by opening the control application and from the extra menu on the top right, select "Load configuration file", select the appropriate file and then forward it (i.e., using email).

5. Troubleshooting

If device does not send any data and is not visible/accessible through the portal, then the first thing is to visit the device, power-off and then back on and try to connect with the SynField Control application to identify the reason of failure. If device manages to connect with the application, then press “Disconnect firmware” button and observe the messages printed into the LOG window.

Problem	Cause	Solution
Device won’t power-on (on-board LED does not light after power button is pressed)	Very-low battery	Make sure battery connector and solar panel/charger connector are firmly in place. Un-press power button and leave device to charge its battery for several hours. Then try again.
Device won’t connect with the SynField Control application	Hidden window / other	If the device is to connect for the first time with the particular mobile device, check during Bluetooth registration process if a “Pairing request” is visible in the mobile notification area. Alternatively, open the mobile Bluetooth configuration page and search for a Bluetooth device named “SynField” and connect from there. If Bluetooth link is established but the application cannot connect with the device firmware, power off the device and then back on and try again. If still cannot connect with the firmware, exit control application, power off the device and try again.
“CPIN” and “Network init error” printed in the LOG window	SIM missing or incorrectly inserted	Make sure SIM is in place and correctly inserted. If problem persists, you could insert SIM in a mobile device and verify that SIM is operational and unlocked.
“Registering to GPRS network” shown for a long time and then Network connect error printed in the LOG window	Poor signal	Try to place the device at a place with better signal quality. You could use the “Check signal” button in the control application to check signal strength. Signal strength value should be at least 2.
Incorrect sensor values	Damaged cable/connector/sensor	Inspect sensor and cabling. Make sure sensor plug is firmly inserted in the connector. Unplug and re-plug. Connect to the device using SynField Control application and in the monitor tab, view the value for the particular sensor. If the problem

		persists, you could try installing the sensor in a different connector.
Device is not adequately charged (battery voltage doesn't manage to reach 4.1V and above).	Dirt/shade on solar panel	Inspect device solar panel and make sure there is not any dirt on the panel or something is shading part of the panel. Clean the panel with a towel. Connect to the device using the SynField Control application and verify charge current. If the device is not fully charged and is charging, then charge current when the sun "hits" the panel should be above 300mA.
Device battery is drained quickly (battery voltage manages to reach 4.1V and above, but when not charging battery voltage drops quickly and till the next morning, battery voltage reaches 3.8V and below).	Aged battery **or** high power consumption	Inspect device and cabling for any visual defects. Disconnect all sensors and see if the problem persists. If the problem persists, it is quite possible that battery is degraded and should be replaced. Contact technical support for spare battery and instructions.

6. After the final installation

6.1 SynField X5 maintenance

- It is recommended to inspect the device externally on a monthly basis.
- Avoid any work that may damage the SynField X5 device and its accessories (above and below ground).
- If a software failure occurs and cannot be resolved following the instructions in section 5, contact Synelixis technical support before doing any action by yourself.
- If you need to clean the node, wipe it with a dry towel.
- Check solar panel and clean if required.
- Check battery voltage (through the portal) regularly for strange battery behavior (i.e. low battery levels: <3.8V).
- Make sure solar panel is facing south and is not shaded by branches/leaves.
- Check sensor cabling for signs of wear.

6.2 Sensor maintenance

For each sensor, please follow the maintenance instructions provided in their own manuals. Especially for the rain meters ensure that the rain bucket is clear of leaves and debris.

7. Contacting Synelixis

If you have question questions about the SynField X5 or encounter problems installing the SynField X5 please contact Synelixis technical support.

Please do not return items for repair without prior authorization.

CONTACT TECHNICAL SUPPORT

+30 210 2511 584

Monday - Friday

10:00 a.m. – 5:00 p.m.

Eastern European Time

support@synfield.gr

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