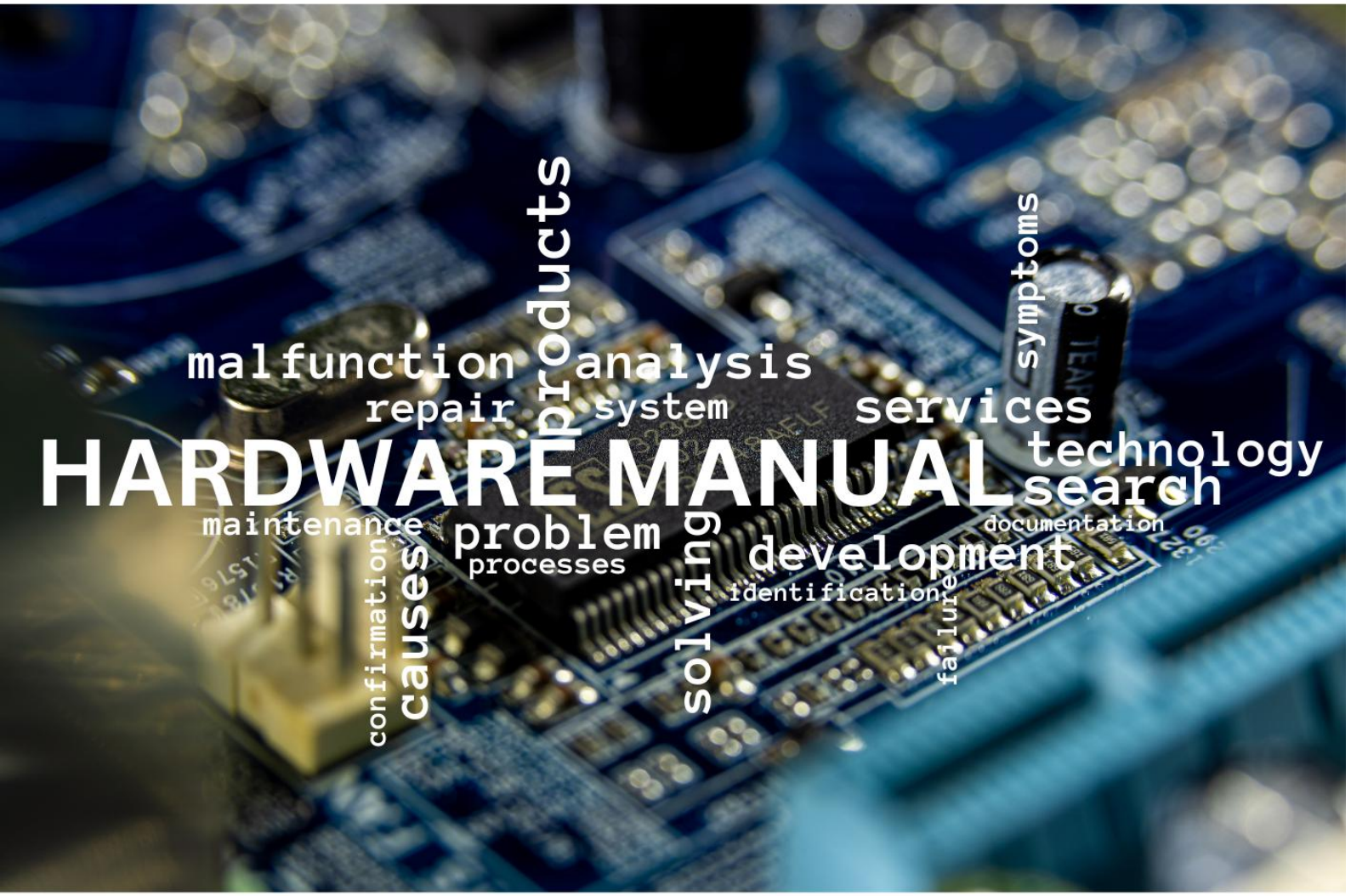
farmsync

Automation Technology



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Contents

Congratulations on purchasing the FARMSYNC™ system.

The FARMSYNC™ system is a family of hardware, software and cloud products designed and developed for the planning, management and monitoring of irrigation and Fertigation.

Intended Audience and How to Use This Manual

This document is the installation-manual of the cables (power & signal) required for the FARMSYNC™ system. **Always keep this manual at hand** while installing to reduce the risks of possible interference due to incorrect cable installation.

Contact for support

Should, in any case you need additional support, contact your FARMSYNC™ local representative.

Installation Support:

- Albert Engelbrecht: 082 562 8353
- Johann Mostert: 082 330 0029

Technical Support:

- Albert Engelbrecht: 082 562 8353
- Johann Mostert: 082 330 0029

Use of symbols in this document

The symbols used in this manual refer to the following:

WARNING

The following text contains instructions aimed at preventing bodily injury or direct damage to the crops, the FARMSYNC™™ system and/or the infrastructure.

CAUTION

The following text contains instructions aimed at preventing unwanted system operation, installation or conditions that, if not followed, might void the warranty.

ATTENTION

The following text contains instructions aimed at enhancing the efficiency of usage of the instructions in the manual.

NOTE

The following text contains instructions aimed at emphasizing certain aspect of the operation of the system or installation.

ELECTRICAL HAZARD

The following text contains instructions aimed at preventing bodily injury or direct damage to the FARMSYNC™™ system and/or the infrastructure in the presence of electricity.

PROTECTIVE EQUIPMENT

The following text contains instructions aimed at preventing damage to health or bodily injury in the presence of fertilizers, acid, or other chemicals.

SAFETY FOOTWEAR

The following text contains instructions aimed at preventing foot injury.

TIP

The following text provides clarification, tips or useful information.

Safety instructions

- All safety regulations must be applied.
- Use only approved accessories specified by FARMSYNC™ for the FARMSYNC™ equipment.
    - Failure to do so may result in the system operating in a dangerously unsafe condition.
- Unauthorized modification of the product will negate the approval rating of the product and the warranty.
    - Protection provided by the equipment can be impaired if the equipment is used in a manner other than that specified by the manufacturer.

WARNING

In agricultural environment - always wear protective footwear.

Electrical Safety Precautions

Electrical installation, maintenance and troubleshooting procedures must be performed by an authorized electrician only.

Overhead Power Lines

WARNING

When installing FARMSYNC™ units care must be taken:

- Ensure there is always clear space from overhead power lines.
- Do not erect any pole and associated FARMSYNC™ unit if power lines are in the vicinity.
- Check with your relevant authority as to the clearances from power lines required in your region.

Batteries

- Use only FARMSYNC™ approved batteries on the FARMSYNC™ equipment.
    - **It is advised that a 20Ah Battery be used due to frequent loadshedding (4-hours)**
- The FARMSYNC™ system uses Lithium acid batteries as a power source. Do not puncture the battery. If a battery is found to be punctured take caution in handling the battery and avoid contact with the corrosive material in the battery.
- All batteries can cause property damage and/or bodily injury, such as burns.
- Prevent contact between the terminals of a battery and objects made of conductive material (jewelry, keys, tools etc.). Failure to do so may cause a short circuit and generate significant heat.
- Exercise care in handling any charged battery, particularly when placing it inside a container (toolbox) amidst metal objects.
- Always dispose of a used battery in a responsible manner - in the intended places for battery recycling. Batteries should never be put in a fire because they could explode.
- It is important not to dispose of large numbers of alkaline batteries in a group. Used batteries are often not completely dead. Grouping used batteries together can bring these live batteries into contact with one another, allowing their charge to be released which could create safety risks.
- **ONLY use TRUE ONLINE UPS**
    - https://www.takealot.com/fsp-champ-2000va-1800w-online-pure-sinewave-ups-bk/PLID54756001

Thunderstorms

- If the area is known to be prone to thunderstorms, FARMSYNC™ stations installed in the fields, may attract lightning discharge, as they are the highest object in the vicinity.
- In such case it is recommended to install a **lightning rod** in the FARMSYNC™ stations vicinity. A lightning rod is a metal rod installed on a pole and grounded.
- The lightning rod should be the highest object in the vicinity in order to properly attract the lightning discharge and direct it safely into the ground.

Working at height

WARNING

Mounting the base unit and routers and erecting poles might require working at height:

To prevent fatalities or major injuries, all safety measures regarding work at height must be observed. Without limiting the foregoing:

- Avoid work at height whenever possible.
- As much work as possible should be done from the ground (whenever possible: mount the unit on the pole, wire it and then erect the fully equipped pole into position).

If work at height cannot be avoided:

- All work at height must be properly planned, supervised, and carried out by competent, trained, and experienced personnel, authorized by the local safety authority.
- Make sure equipment used for work at height is certified by the local standards authority, well maintained, and inspected regularly.
- Avoid standing on fragile surfaces such as shingle or asbestos cement roofs.
- For the entire duration of work at height a person should be present on the ground, constantly keeping eye-contact with the workers at height, ready to assist them when needed.
- When working at height make sure that nobody is standing under you.
- Make sure the surface, scaffold or ladder used are stable and strong enough to support the worker's weight and that of the equipment.
- Always wear a harness and make sure it is correctly anchored to a stable element.
- Always use tools designed for work at height and make sure that they are secured in a basket preventing them from falling.

Environmental conditions

CAUTION

The PRO Controllers should be:

- Placed in a roofed building Protected from direct sunlight
- Kept at an ambient temperature between 10°c and 40°c (50°f and 104°f) Kept at a maximum relative air humidity of 85%
- Properly ventilated
- Protected from dust
- Protected from splashes or direct spraying with water or chemicals
- Installed at least 2-meters away from any VSD Drive
- All Signal cables must be installed at least 1-meter away from Power Cables
- All Signal cables must be screened
- Internet connection MUST be available – not just bars on your cellphone, LTE/3G/4G/5G must be available & let your internet service provider confirm bandwidth in your area

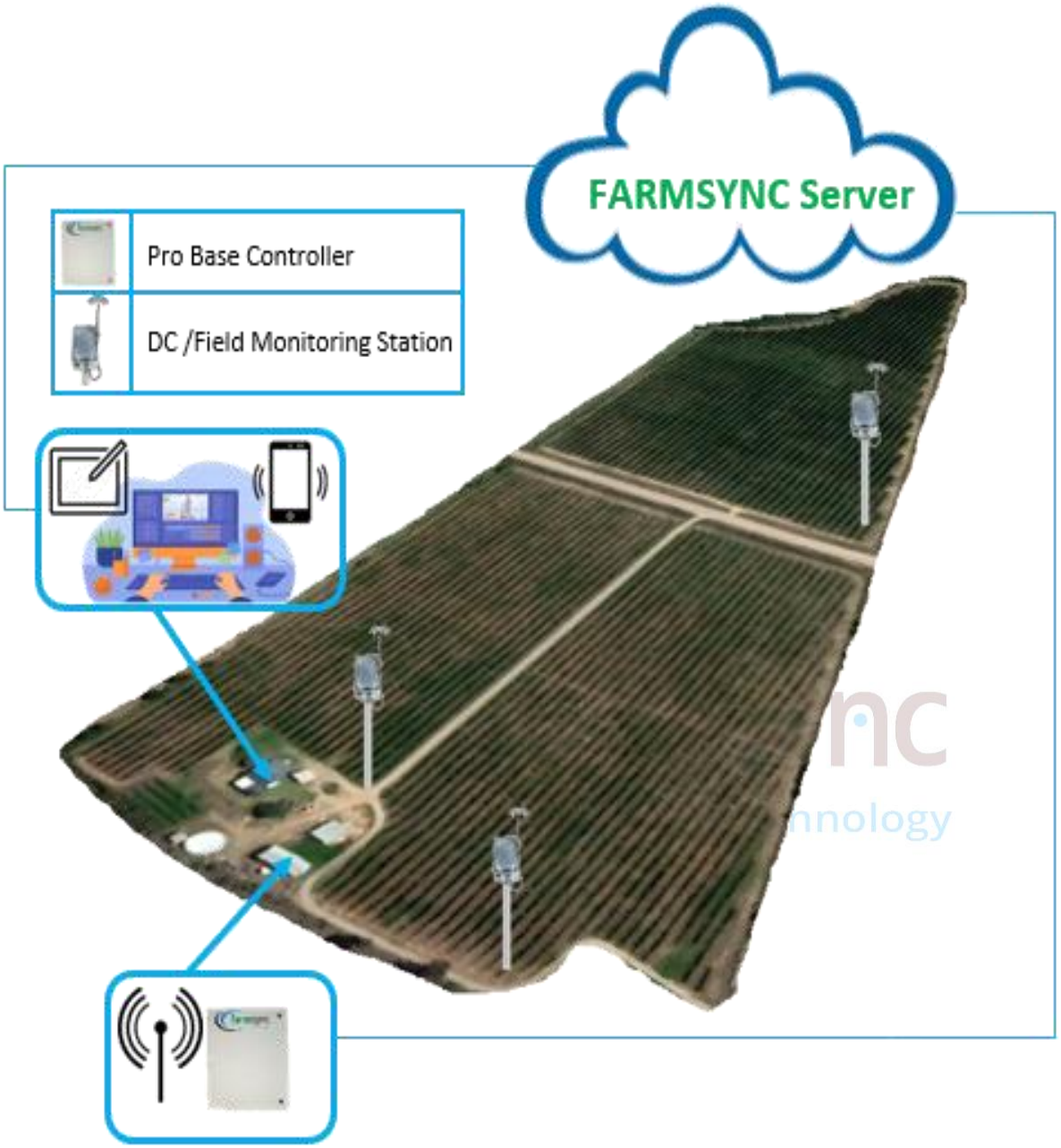
The FARMSYNC™ system is a full solution of hardware, software and cloud products designed and developed for planning and monitoring of crop management with emphasis on irrigation and fertigation.

FARMSYNC™ system is ideal for the following applications:

- Agricultural open field control systems, including small farm to large scale agriculture projects, utilizing drip and sprinklers or any other controllable irrigation system.
- Horticultural crops in nurseries, orchards and vineyards.

General description

Example of a typical farm managed by FARMSYNC™



Features

Just as a heart consists of four chambers, so does the heart of the FARMSYNC™ system contains 4 major elements:

- **Monitoring:** From a wide range of sensors, including 3rd party sensors (e.g. soil, water, fertilizers, climate and weather) and external data sources (e.g. weather services), data is collected & monitored.
- **Controlling:** Easy planning, programming, and executing of all irrigation and fertigation programs based on pre-defined programs, sensor-based triggers.
- **Dosing:** Integration of advanced dosing systems (based on various methods) to ensure the highest level of Fertigation accuracy, while optimizing water.
- **Agronomical Support:** Access to years of irrigation and Fertigation expertise and agronomical know-how of AGRIWIZ experts, to maximize crop quality and yield.

Benefits

Freedom & Flexibility:

The user will have **access** to all relevant monitoring data and **control** capabilities from **any device** (PC or mobile), which will enable the farmer to manage their crops more effectively & efficiently.

Driving efficiencies:

Reducing water, energy & fertigation costs by data integration from all sources combined with control capabilities at the palm of their hands.

- More precise irrigation and fertigation to increase crop yield and quality.
- Saves money on fertilizers.

Peace of Mind:

Reduced risk and constant feedback via Whatsapp & e-mail notifications increases growers' confidence.

- Automated irrigation
- Alarms / Notifications sent straight to your phone
- Remote control (whether it be from your laptop, tablet or cellphone)
- Full reports and events history
- Full training and support

Caution:

It is still advised that separate records are kept of watermeter readings, fert meter readings, levels of tanks etc as reference. This is to counteract possible faults in sensors / hardware & ensure that your system is running efficiently.

Pro Base Controller

1 FARMSYNC™ Main Control Unit (PRO BASE Controllers)

1.1 Placement & Installation of Farmsync Controller

Each Controller comes with a warning label as shown below:

- **Do Not install Controller within 2-Meters of a VSD Drive**
- **Keep all signal cables at least 1-Meter away from power cables**
- **All Signal cables must be screened**
- **Ensure that the Earth has been tested**

Farmsync will not be held liable for faults and / or damages to the Farmsync Controller should this rule not be implemented

It is of the utmost importance that these rules be applied to prevent unnecessary damage & interference between components & cables.

Farmsync uses only the most advanced range of industrial enclosures in the world. With a lifespan of 25+ years, these enclosures are highly corrosion resistant, non-conductive & high in strength.

The Controller requires its own earth connected directly to the Earth connector provided inside the Controller box.

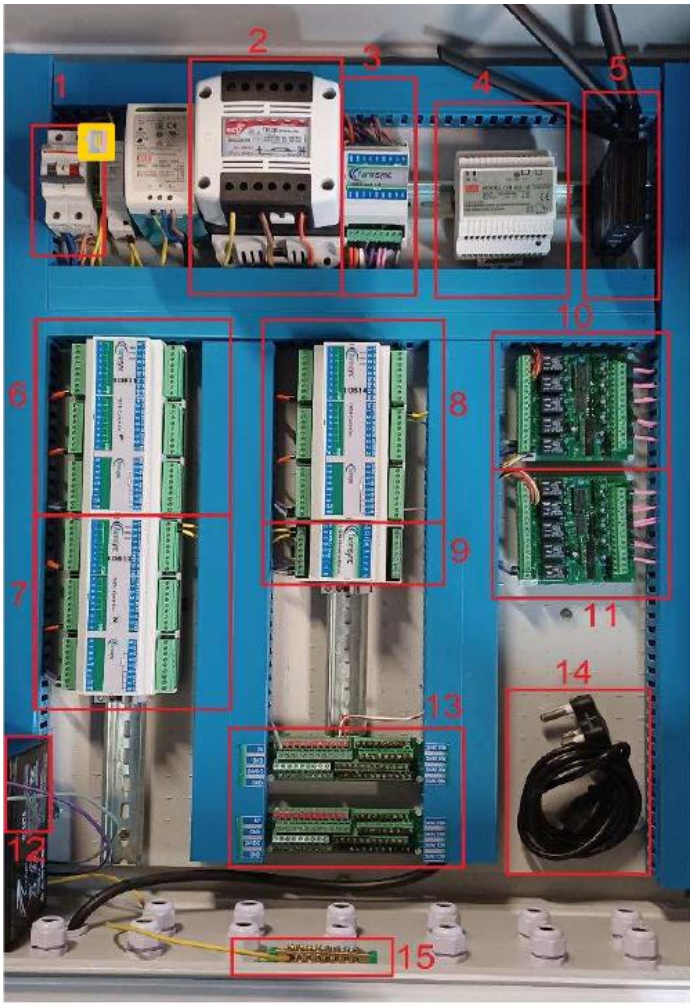
NO Modbus Communications are allowed FOR WEG DRIVES ever.

- **ONLY use TRUE ONLINE UPS**
  - https://www.takealot.com/fsp-champ-2000va-1800w-online-pure-sinewave-ups-bk/PLID54756001

1.2 Features & benefits

- Flame retardant
- Integrated Rain Canopy
- IP Level 66
- Quarter Turn Lock
- Durable GRP Material
- Modular controller for agriculture and horticultural use.
- Fits all farm
- the cloud and the controlled units.
- A Battery is provided for the controller, however, Farmsync cannot guarantee that it will be capable of handling the heavy load that is Eskom's ever-changing loadshedding schedule. The Client must upgrade/replace/add on new batteries as required.

1.3 General description



1) Incoming Power – Breaker
2) 24VAC Transformer for valves
3) Farmsync Power supply board for circuitry
4) Power Supply for Analog valves
5) Industrial Router – Analog Valves
6) Expander Board 1
7) Expander Board 2
8) Main Board
9) Conversion Module
10) Analog output card 1
11) Analog output card 1
12) Backup Battery
13) Terminals
14) Farmsync Power Cord
15) Earth bus bar

1.3.1 Specifications

Power supply	Mains power (230 VAC 50/60Hz)
Touch screen	Optional

1.3.2 Easy expansion

Based on internal, easy to install, I/O expanders.

1.3.2.1 UPS Power

The Expander receives 12VDC input voltage from the UPS.
It supplies the voltage to all expanders and charges the backup battery with 12VDC output voltage.

NOTE: Electric Fence Device can be connected with the controller on the same UPS supply; However, the Electric fence Device and its wiring must stay at least **3 meters** away from the Controller or any signal or power wiring on the controller.

UPS power supply

Parameter	Rating
Input	
Voltage range	100-240VAC

AC current	2A/240VAC
Output	
DC voltage	4.5A/+13.8VDC
Battery Charge	13.8V/2.5A

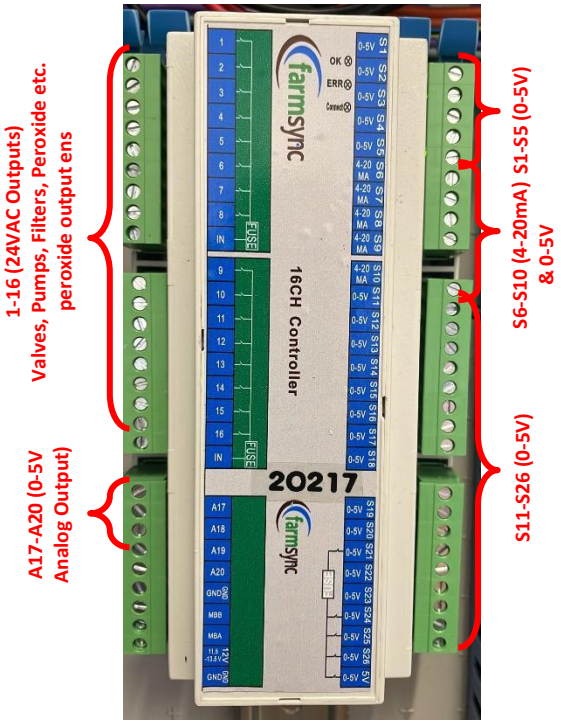
UPS backup battery

Parameter	Rating
Nominal voltage	12V
Nominal capacity	21Ah

1.4 Wiring the Pro Base Controller

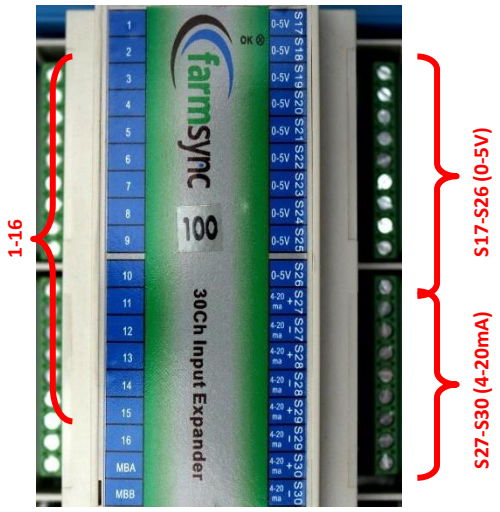
1.4.1 16 Channel Controller

Left Side = Outputs
Right Side = Inputs

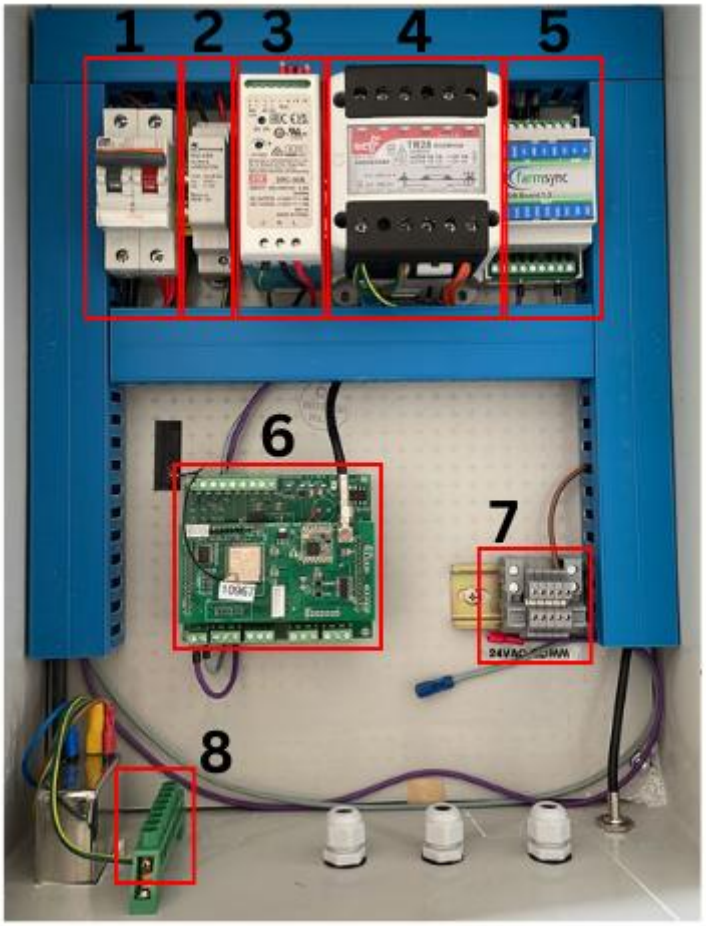


1.4.2 30 Channel Input Controller

Left Side = Digital inputs for watermeters
Right Side = 0-5V / 4-20mA Analog inputs for sensors

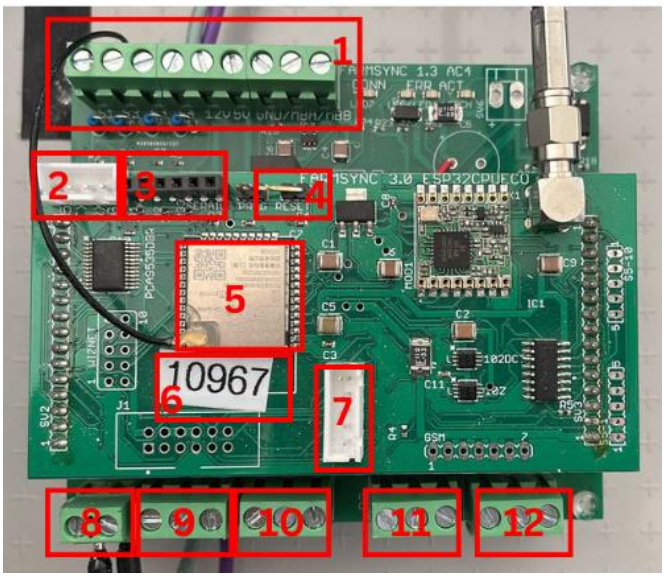


Pump Start Station



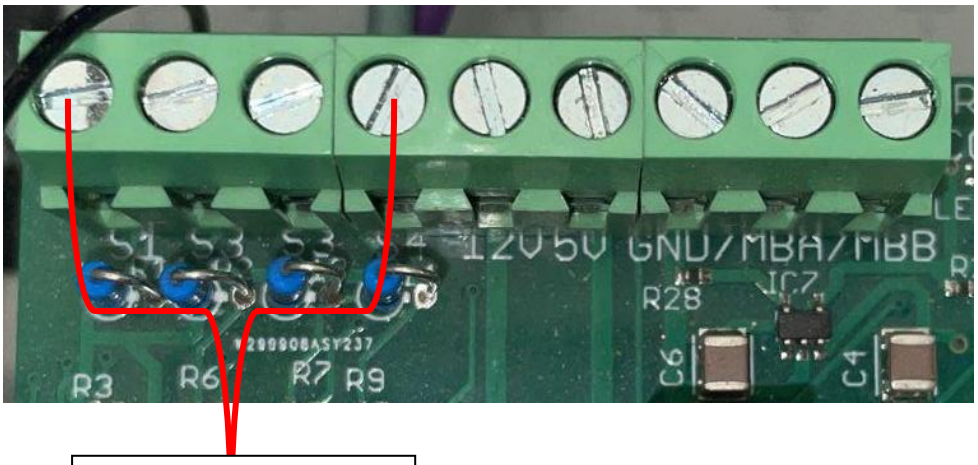
- Incoming Power Breaker
- Surge Arrestor
- PSU / UPS
- 24V AC Transformer for Valves
- Farmsync Power Supply board for circuitry

1.5 Wiring a Pump Start Unit



- Sensor Inputs
- Display Port
- Programming
- Programming - Reset
- CPU (Central Processing Unit)
- Serial Number

1.5.1 Sensor Inputs



With Resistor:
S1 -S4 = 4-20mA
Without Resistor:
S1-S4 = 0-5V

Field (DC) Station

2 FARMSYNC™ Field DC Station

Transmits field data and activates remote system components such as field valves. The Field Station can also be used as a repeater* to extend communication range.

2.1 Features & benefits

- Open unit for any input (sensors) or any output (valves, pumps, dosing)
    - 4- station
    - 8- station
- Enables remote control of field devices.
- Measures field parameters e.g. flow, pressure, soil moisture, plant and weather station.
- Managed by the PRO Controllers via radio using (LoRa) low power radio. **communication of up to 3km** with a clean line of sight (without repeaters).
- Enables over-the-air maintenance and automatic firmware updates.
- Various mounting options - on a wall, a pole or a rod.

*A repeater consumes more energy since it is constantly active. Do not use batteries. If an external power source is not available a solar panel can be used to ensure continuous operation.

2.2 Specifications

Power	Battery operated (3.7V @ 2.6Ah)
Inputs and outputs Integrates digital, analog and serial inputs, with digital outputs	4 to 8 outputs for DC Latch valves
	4 Multifunctional inputs for sensors (e.g. pressure sensor, flow meters etc.)
	2 serial ports for serial communication sensors (RS-232, SDI-12)
Enclosure	Robust UV stabilized enclosure rated to IP65

2.3 Placement & Installation of Farmsync DC Station

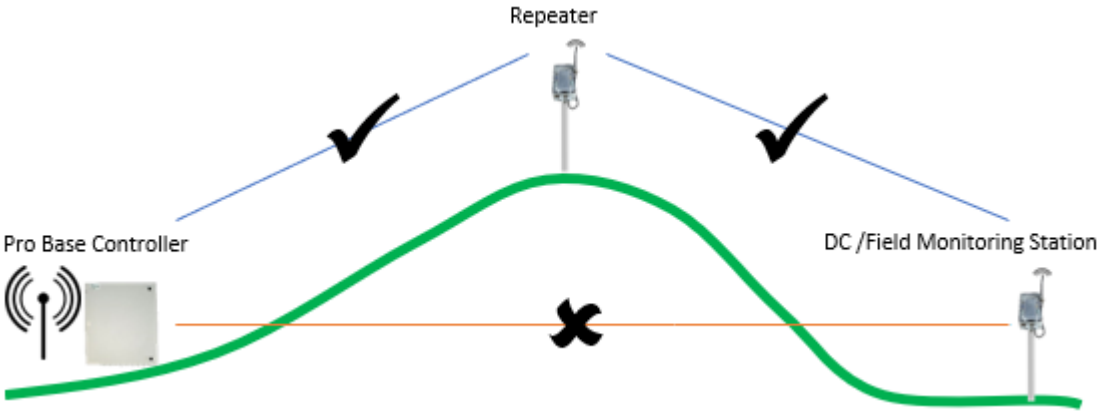
Farmsync field units consist of two categories:

- **DC Stations for valves (Solar Powered)**
    - Above crop – at least 1m
    - Always facing north – ensure that the Solar Panel is always in full **sunlight** & mounted at an angle of between 30° - 45°
    - Only insert battery when Base is online to prevent the battery from draining
    - **Direct** Line of sight with Controller / repeater
    - Do not place behind the wood pole that you mount the station on
- **Field Monitoring Stations for probes/weather stations etc (Solar Powered)**
    - Above crop – at least 1m
    - Always facing north – ensure that the Solar Panel is always in full **sunlight** & mounted at an angle of between 30° - 45°
    - Only insert battery when Base is online to prevent the battery from draining
    - **Direct** Line of sight with Controller / repeater
    - Do not place behind the wood pole that you mount the station on

Do not mount under a roof or on the side of a building / any object that might obstruct the signal path.

Below are some rules that need to be followed when installing each:

Field Units MUST have Line of sight, as shown above SIT ANGLE VAN LINE OF SIGHT BY….



Should no Line of sight be possible, a Repeater can be installed

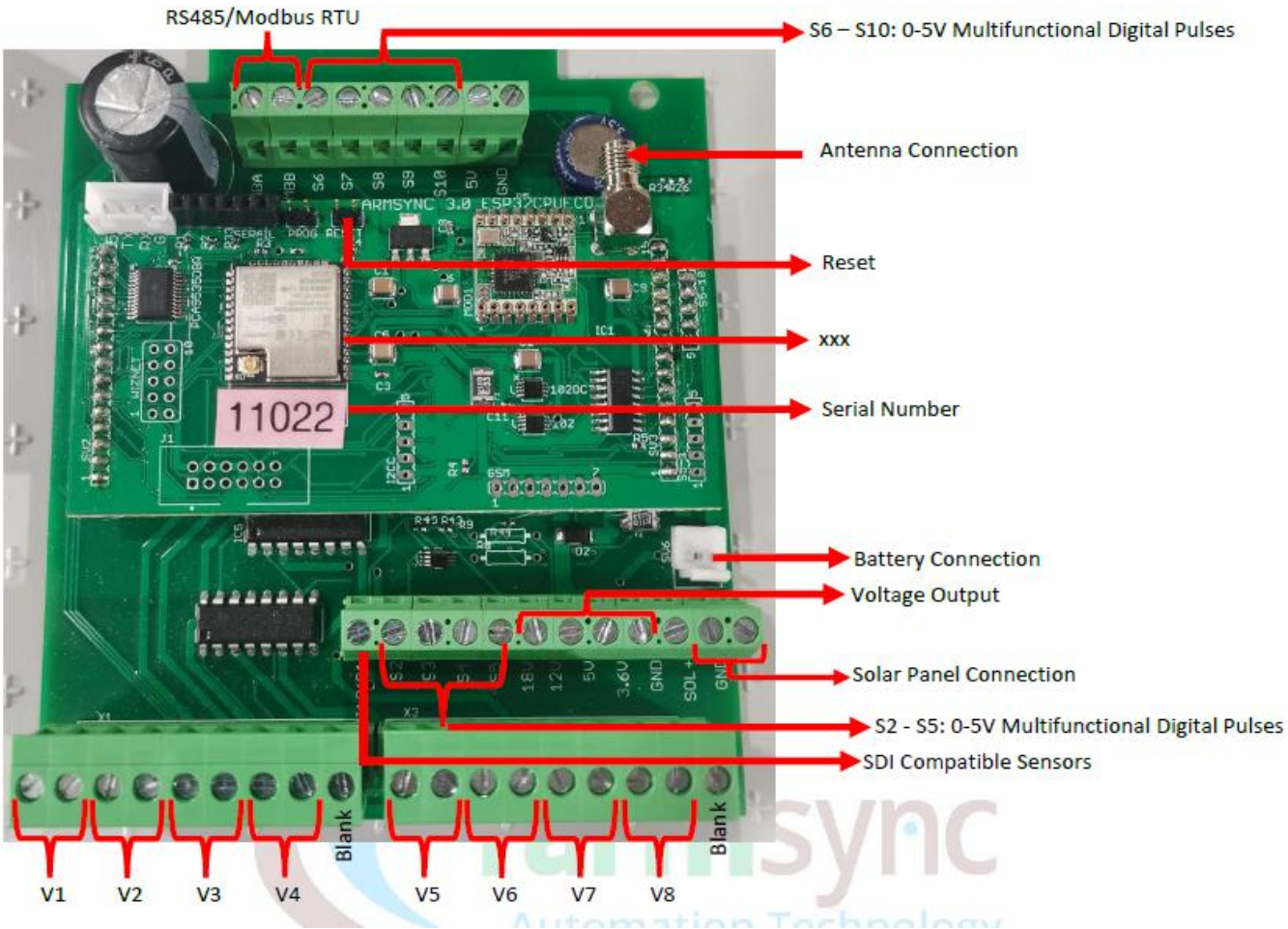
2.3.1 DC Station

DC Controllers are installed to control valves in-field. A signal is received from the Main Controller in the pumphouse, & the valve opens / closes accordingly. These stations are solar powered with an internal battery. It is for this reason that the unit MUST be installed facing North / the sun in order to work optimally.

The Max distance prescribed by Farmsync (with Line of Sight) is 3km from the Main Controller. Should the DC Controller be installed further away, or not have Line of Sight, it is advised that a Repeater be installed to assist with the signal.

Farmsync recommends that these units be installed on a pole above the tree-line to help with Line of Sight, this also assists & protects the units somewhat from tampering.

2.3.1.1 Wiring the DC Station



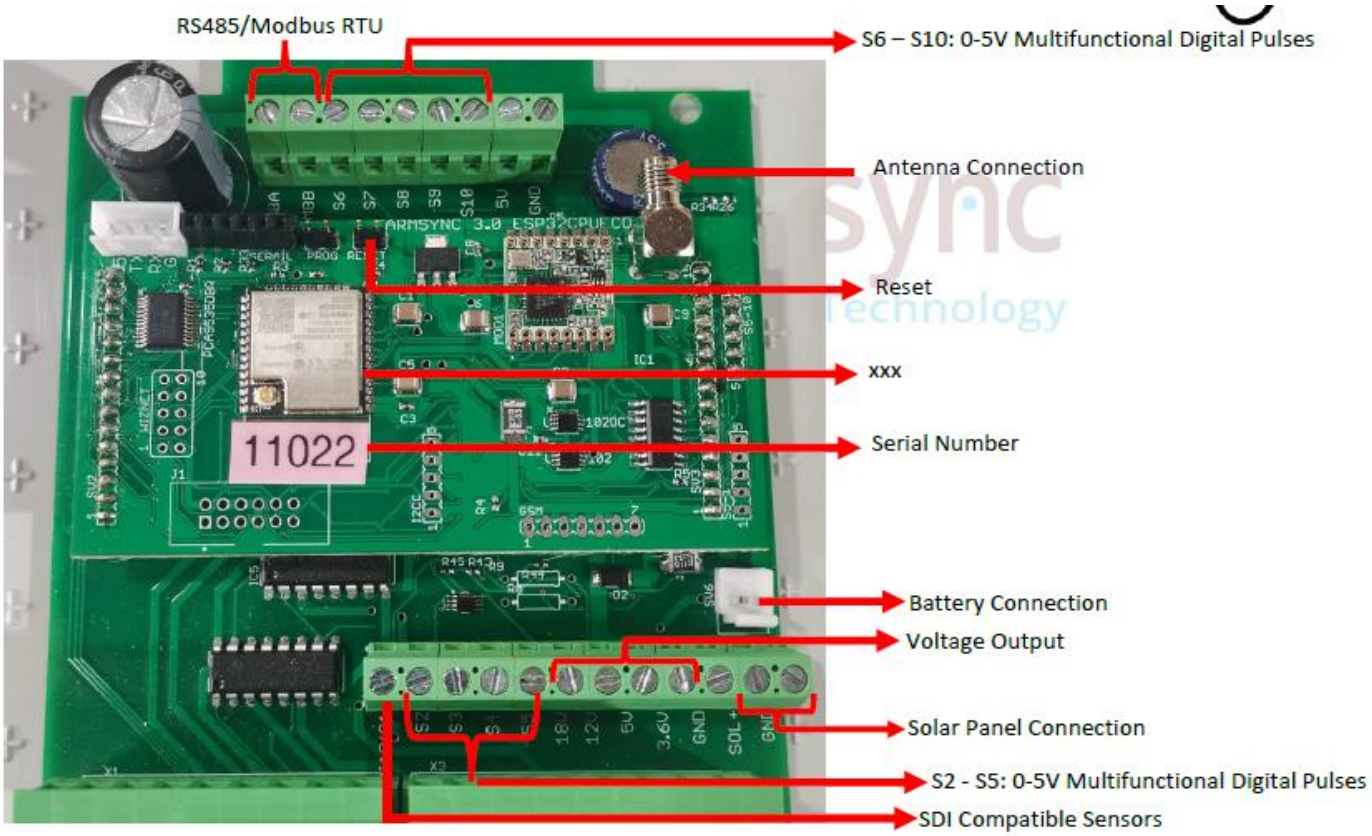
2.3.2 Field Monitoring Station

Field Monitoring Stations are installed to connect, receive & send data from most types of fields sensors in-field.
These stations are solar powered with an internal battery. It is for this reason that the unit MUST be installed facing North / the sun in order to work optimally. These units do however, also need to have Direct Line of Sight with the Main Controller / repeater as indicated above for the data to be sent to the Main Controller effectively.

The Max distance prescribed by Farmsync (with Line of Sight) is 3km from the Main Controller. Should the Field Monitoring Station be installed further away, or not have Line of Sight, it is advised that a Repeater be installed to assist with the signal.

Farmsync recommends that these units be installed on a pole above the tree-line to help with gaining the optimal amount of sun, Line of Sight & this also assists & protects the units somewhat from tampering.

2.3.2.1 Wiring the Field Monitoring Station



How to test a Port:

- Connect 5V directly to the sensor port (NOT SDI12 PORT)
- SensorRaw will jump from 0 to 4096
- All output voltages except for 3.6V will only turn on when the station is reading / refresh on website or reboot

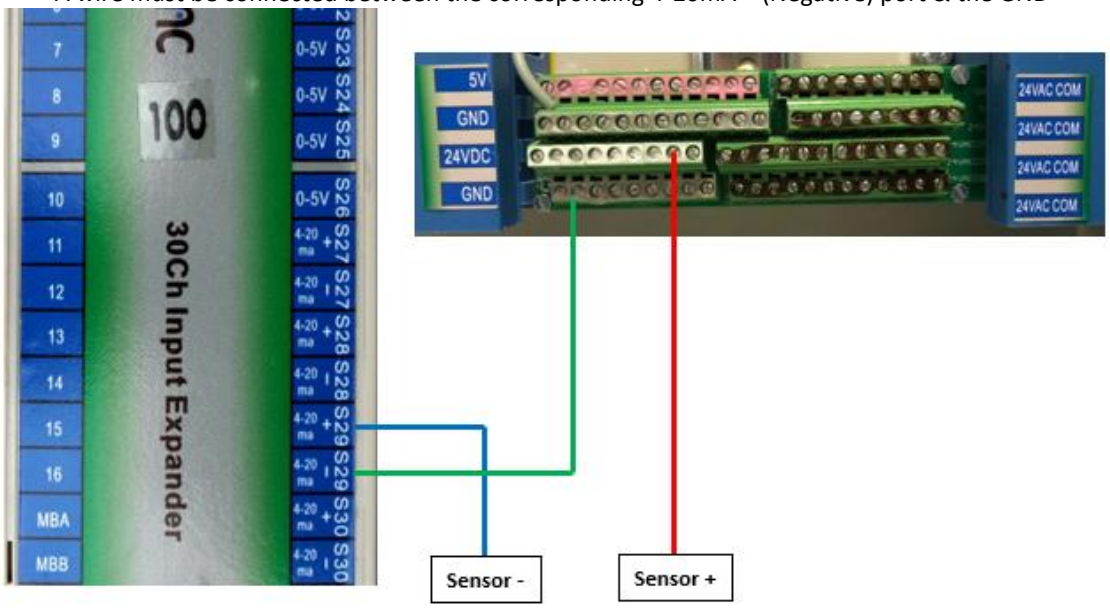
Connection of Sensors

3 Connection of 4-20mA Level Sensor in Main Controller

Level Sensors must receive power directly from the Controller.

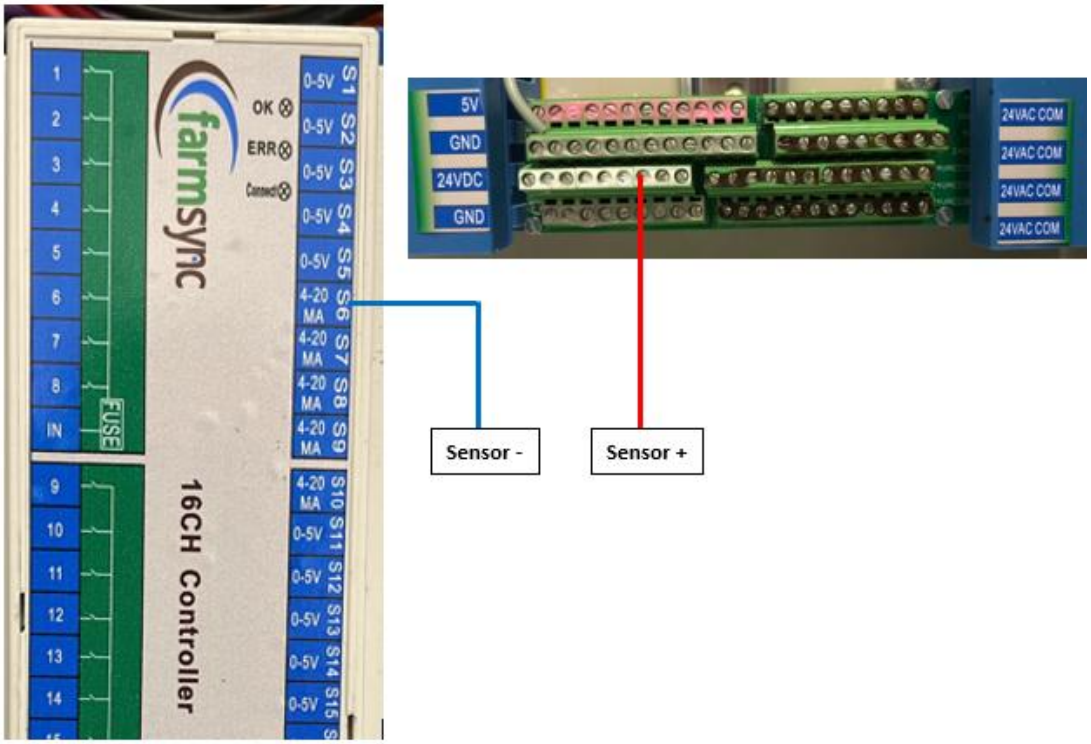
4.1 30CH Controller (Older Models)

- Sensor + (Positive) wire must be connected to 24V**DC**
- Sensor – (Negative) wire must be connected to 4-20mA + (Positive) port
- A wire must be connected between the corresponding 4-20mA – (Negative) port & the GND

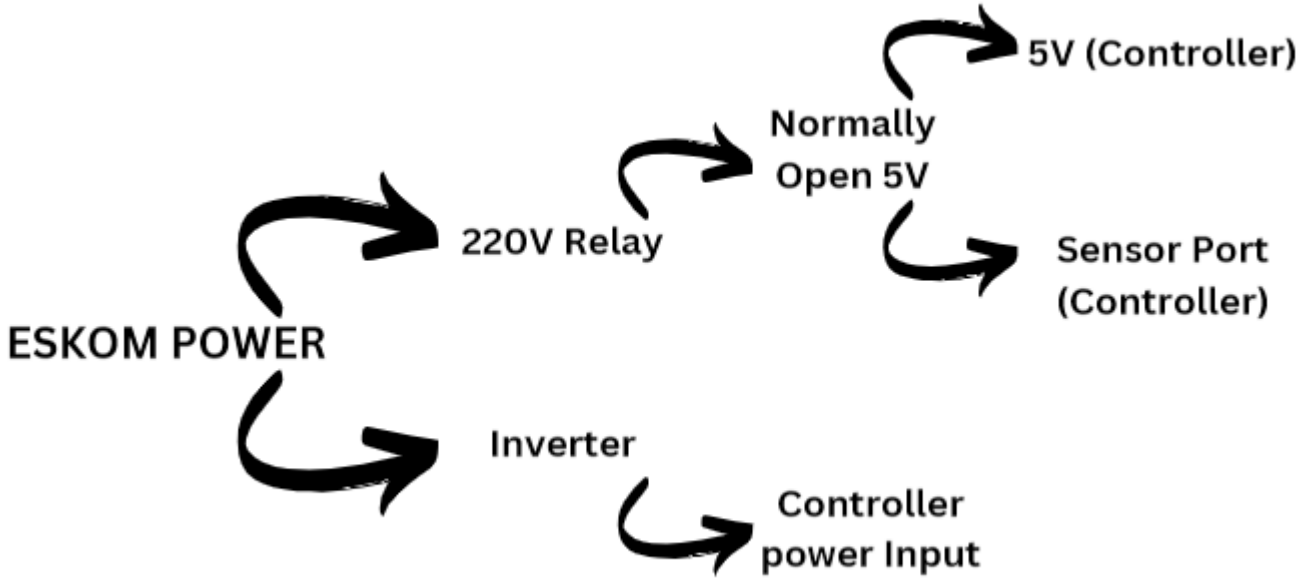


4.2 16CH Controller (New Models)

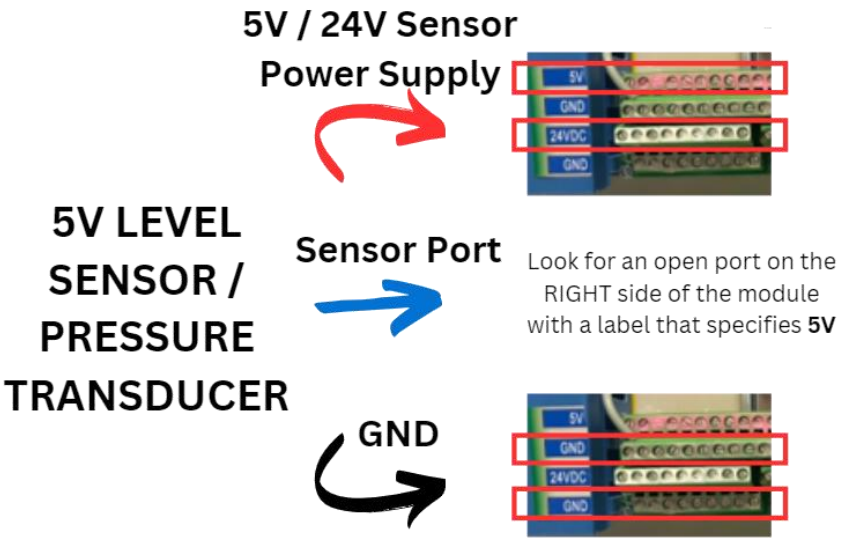
- Sensor + (Positive) wire must be connected to 24V**DC**
- Sensor – (Negative) wire must be connected to 4-20mA + (Positive) port
- A connection between the corresponding 4-20mA – (Negative) port & the GND has already been made during construction of the controller



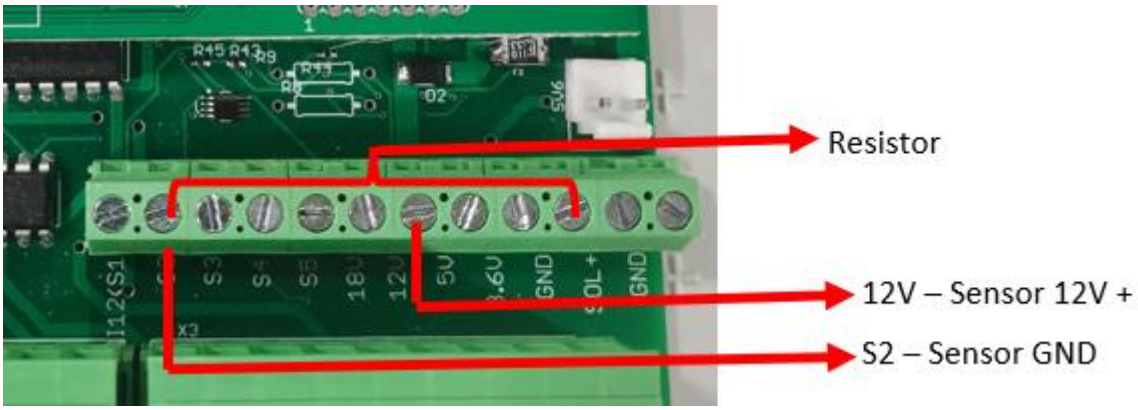
4 Connection of Eskom Sensor in Main Controller



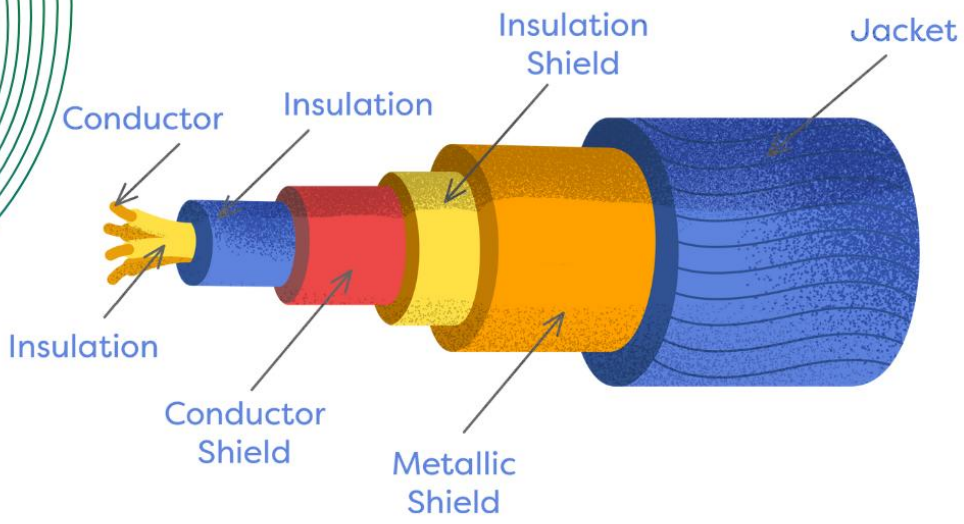
5 Connection of 5V / 12V Sensor in Main Controller



6 How to connect a 4-20mA Sensor to the FM Station



Control Cable Installation



7 Best Practice

Experience has taught Farmsync System developers, technical personnel, and system installers that it is impossible to predict an installation's sensitivity to surges caused by various factors, i.e. power supply's, lightning, inductive current, total harmonic distortion (THD) or electromagnetic interference (EMI)… a certain electrical supply company…

We at Farmsync have a proactive approach towards surges, therefore we have adopted best practice from the planning stage of any system, considering cost and product constrains. **Note: NOTHING CAN PROVIDE 100% PROTECTION AGAINST LIGHTNING STIRKES**
To minimalize THD and EMI, we have used a more reactive approach during the development phase of most of our products.
When installing a Farmsync system, a few basic and good practice steps need to be taken to reduce the risk and effects of surge damage or interference (THD or EMI), & to minimize maintenance cost.

The following will be outlined in this document:
Basic practical installation taking in considerations extra low and low voltage power supply to control devices,
as well as control and monitoring circuits from such devices to extra low voltage auxiliary equipment with the aim to mitigate potential problems.
Note: The document is not intended as a comprehensive guide with regards to power supply, earth networks and protection.
Please refer to SANS 10142[i] regarding protection and safety considerations.
Note: SANS 10142-1:2017 now also applies to external power supply wiring of extra low voltage applications (<50 VAC and <120 VDC) and include agricultural applications among others.[ii]

7.1 Definitions

Power Surge
an unexpected, temporary, uncontrolled increase in current or voltage in an electrical circuit; a voltage spike

The source of a voltage spike could be due to but not limited to the following:

- a fault originating at the supply side (power utility or generator).
- "single phasing" in a 3-phase system,
- a live phase is lost,
- the loss of the neutral conductor,
- under-usage by other users on the grid,
- incorrect or faulty transformer tapping
- lightning
- due to inductive current where the electromagnetic field in one conductor (usually carrying a higher voltage), influence the current / voltage in a second conductor that runs parallel to the first one,
- A poor earth system could create voltage potential difference between two points of an installation and will magnify the potential damage caused by power surges.
- Etc.

Harmonics
In an electric power system, harmonic voltages and currents are a result of non-linear electric loads, typically caused by switch-type power supplies, fluorescent lights, UPS's, VSD's etc.
Worst case scenarios:

- harmonic frequencies in the power grid can be a cause of power quality problems.
- Harmonics in power systems result in increased heating in the equipment and conductors, misfiring in variable speed drives, and torque pulsations in motors. More often however it will only cause interference with (mostly unshielded and economy range) electronics and controllers.
- Reduction of the detrimental effects of harmonics (and other harmful effects caused by electrical equipment) is however required by SANS[iii] and therefore all means possible should be pursued to do so. This includes following best practice cabling guidelines.

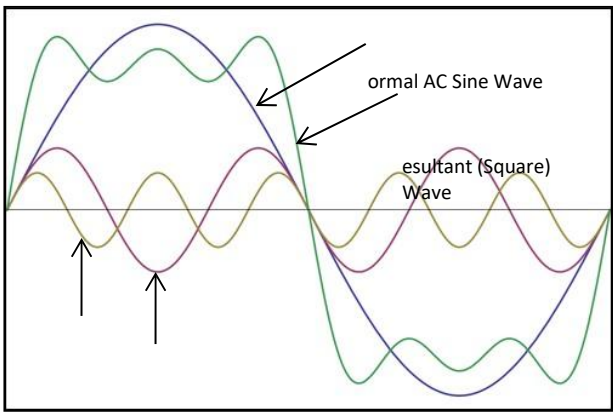


*Figure SEQ Figure * ARABIC 2- Example of the effect of harmonic distortion on an AC Sine Wave.*

According to Wikipedia total harmonic distortion or THD is a common measurement of the level of harmonic distortion present in power systems.
THD can be related to either current harmonics or voltage harmonics, and it is defined as the ratio of total harmonics to the value at fundamental frequency x 100%.
According to international standards a level of <3% is required for medical grade installations and <5% is still seen as acceptable for other less sensitive installations.

NB: All non-linear electrical load generators, including VSDs, will cause some level of harmonic distortion, even if it does operate within the SANS standard related to this phenomenon. Standards pertaining to acceptable levels of THD do however not pertain to just one component in the system, but to the TOTAL installation and is measured at the Point of Common Coupling (PCC).

Factors that influence THD includes, but is not limited to:

- cable diameter and distance,
- quality of earth,
- supply side transformer size,
- quality of power entering your premises etc.

A further complication is that, as with EMI, some 3rd party equipment might be more sensitive than others. This makes it extremely difficult to predict whether relatively expensive counter- measure should be installed from the start – hence our more reactive approach to this.

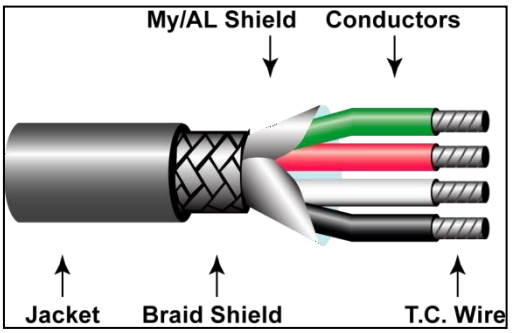
Electromagnetic Interference

Electromagnetic interference (or EMI) is a disruption that affects an electrical circuit because of either electromagnetic induction or externally emitted electromagnetic radiation. EMI is the interference from one electrical or electronic system to another caused by the electromagnetic fields generated by its operation]

7.2 Best Installation Practice

7.2.1 Positioning and Shielding of Electrical Equipment

- Position electrical equipment where it will be readily accessible for installation, maintenance and repair[iv]. The same approach should apply to cabling where possible.
- Do not install potentially sensitive electronic equipment close to (or in the same enclosure as) devices like VSDs that has the potential to generate harmonic distortions or EMI.
- Shield potentially sensitive electronic equipment by installing it in metal enclosures.



7.2.2 Earth System

Ensure that a quality earth network is in place. According to SANS, an earth bonding system of < 0.2 Ohm is required in South Africa[v]. Establishing a high-quality ground / earth system includes, but is not limited to:

- Separation of Earth and Neutral Conductors[vi]. Although these two conductors are for example both joined together on the star side of a supply transformer, the Neutral is a current carrying conductor, while the earth conductor is for protection only and should be left current free[vii] (Figure 2). Using the same conductor for both E and N will reduce the effectiveness of any surge protection installed in the system. Accidental disconnect of the conductor, if a shared conductor is used for E and N, a single phase 110 V or 220 V systems might experience a power increase up to 240 V or 400 V, which will fry your equipment.
    - As an alternative, if separation of E and N is not practical or financially viable, the installation of an isolating transformer could be investigated (e.g. 400:240V).

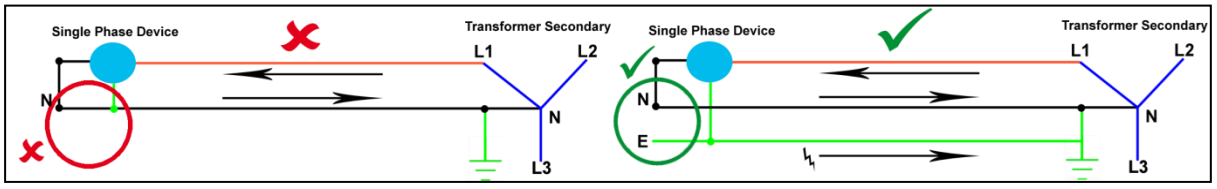


Figure 2 - Separation of Earth and Neutral Conductors

- Use of a copper conductor of at least the same diameter as the live conductors in the power system as the Earth conductor. Using only the armoured shielding of a cable is not enough[viii].
- Installation of earth pegs at the transformer (should be standard) and at each outlet / building on the local low voltage grid. Also ensuring that all these pegs are interconnected and that connections are bonded properly[ix]. In very sensitive installations, it might be advisable to contact an earth expert to do a risk assessment[x] that will include analysing soil samples as to determine how a quality earth network can be established. His findings might result in the use of longer earth pegs, special preparation of the area where the peg is to be installed or the establishment of an earth mat instead of relying on single pegs.

- Establishing a proper ground / earth system is the first step to protect electronic equipment against power surges, harmonics and EMI[xi].

7.2.3 Phase Balance and Surge Protection

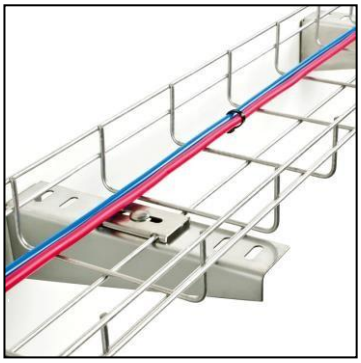
- In a multiphase system, ensure that phases are balanced[xii]. This will potentially reduce the effects of harmonic interference and other harmful phenomena.
- A multi-tier approach should be taken when installing surge arrestors. Some equipment, like a VSD, might come with surge arrestors, but might only be sufficient for secondary protection. Primary protection should already be installed at the distribution enclosure. The decision to install Class I vs Class II protection at this level will likely be influenced by the budget available, but SANS require at least Class II at the distribution board[xiii]. As previously mentioned, the quality of your earth plays a major role in effectiveness of any surge protection devices[xiv].

7.2.4 Wiring Considerations

- Select conductor size according to SANS standards[xv].
- Use braided (double) shielded cables (Figure 3) for your control or signal cables.
- Earth the braided shield on one side at a common point[xvi]. In some cases "Surfix" cable (that has a metal insulation) or installation of normal cables in "Bosal" steel conduit might be sufficient (See Figure 4).
- Standardizing on a combination of braided shield cables installed in steel conduit will be first prize.

- Wiring and Installation of Transducers and other Electronic Sensors:
  - Use a 0.75 mm or smaller diameter cable only (since sensors in general do not carry current, this will be sufficient).
  - Use braided (double) shielded cable (Figure 3) as described above.
  - Although seemingly crude, we have found that installing a simple glass fuse (50 mA) on a 4 – 20 mA sensor cable has the potential to protect the system to a large degree against power surges.
  - Installation of surge arrestors that are specifically designed for 4 – 20 mA sensor circuits are at times even more expensive than the sensor itself, but is an option. Effectiveness of such devices will largely depend on the quality of the earth network.
  - Isolate the transducer or sensor from any metal structures or pipes by means of non-conductive elements. For example, use a PVC or PP bush between your pressure transducer and a metal pipe.
  - Make sure that metal structure or pipe is properly earthed (bonded) as described above.
  - Seal the cable connector with silicone tape around the cable gland as well as the connector side. Silicone spray can also be used on the screw terminals to expel moisture.
- Positioning and fixing of cables[xix]:
  - Separate any signal or control cable from high voltage carrying cables[xx]. This will reduce the risk of EMI, harmonic interference or surges due to conductive current (Figure 4).
  - Recommended distance to keep is 0.5 – 1 m. If possible, try to keep the 1m recommendation. This will likely mean two sets of cable racks are required, one for high voltage and one for control cables.
  - In trenches this is likely not possible. Try to keep the high voltage cables on one side and the control cable on the other side of the trench. The backfill soil will assist with shielding.
  - Signal / Control Cables include: Pressure transducer cables, low voltage switching cables (24VAC), digital

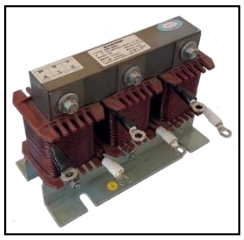
input cables from fertilizer and water meters, CAT5 LAN cables and antenna cables.

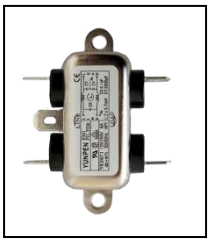


- Make use of cable trays and trunking to lift cables off the floor. Water and fertilizer corrode insulation and leads to short circuits. Avoid clamping cables to pipes or fittings that might in future be replaced[xxi].
- Use UV resistant cables when working outdoors[xxii] and do not install cables on surfaces that can potentially get very hot (corrugated iron sheets for example).
- Avoid cables with single strand cores, rather use cables with multi-stranded cores.
- Use lugs or ferrules where possible to avoid bad contacts[xxiii].
- Avoid joining cables. Rather order a cable of the correct length. If a connection is necessary, solder the wires and install in a watertight epoxy connector. Keep the joint above ground and / or at a workable height for future troubleshooting[xxiv].
- Mark cables at both ends with a durable label to assist installation and future troubleshooting.
- Do not over-tighten terminals, but do check all connections before commissioning and at least every 3 months thereafter.

Additional measures

If interference is still experienced after above measures has been implemented, it might be necessary to install more expensive filters or reactors, for example an AC Input Reactor and/or a DC Reactor will decrease harmonic feedback generated by a VSD into the power grid. An EMI filter installed on the influenced device' power supply might resolve EM related issues and Signal isolators might improve the quality and compatibility of analogue signals. Also see Endnote[xxv].





Endnotes

[i] Since this document is primarily intended for a South African audience, we will refer to SANS standards. Standards do however vary from country to country; therefore refer to the standards applicable in your country where necessary.

[ii] SANS 10142-1:2017, pp. 1, 21, 22, 51.

[iii] SANS 10142-1:2017, p. 70.

[iv] SANS 10142-1:2017, p. 68.

[v] SANS 10142-1:2017, p. 267.

[vi] SANS 10142-1:2017, pp. 76, 169.

[vii] SANS 10142-1:2017, p. 169.

[viii] SANS 10142-1:2017, p. 165.

[ix] SANS 10142-1:2017, pp. 164, 171 – 173.

[x] SANS 10142-1:2017, pp. 160, 328 – 339.

[xi] SANS 10142-1:2017, p. 165.

[xii] SANS 10142-1:2017, p. 76.

[xiii] SANS 10142-1:2017, p. 319.

[xiv] SANS 61643-12 and SANS 10142-1:2017, p. 165, annex I.1.

[xv] SANS 10142-1:2017, pp. 78 – 132, annex O.

[xvi] SANS 10142-1:2017, pp. 74, 77, 164.

[xvii] SANS 10142-1:2017, pp. 133 – 141.

[xviii] SANS 10142-1:2017, pp. 170 – 173.

[xix] SANS 10142-1:2017, pp. 78 – 132.

[xx] SANS 10142-1:2017, pp. 77, 137.

[xxi] SANS 10142-1:2017, p. 137.

[xxii] SANS 10142-1:2017, p. 136.

[xxiii] SANS 10142-1:2017, p. 77.

[xxiv] SANS 10142-1:2017, pp. 136, 137.

[xxv] SANS 10142-1:2017, annex O.