Skyfri

SolarSCADA

Product Description and Installation Guide

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Skyfri SolarSCADA

Product Overview and Installation Guide

V1.3, ©SolarSCADA By G. Linder *3/13/2021*

1 Introduction

The SolarSCADA System is an integrated solar asset monitoring and control platform designed for ease of installation and reliable, high-speed bi-directional data specifically for solar generating assets. A single SolarSCADA system provides a web portal to view sensors orderable in batches as specified by IEC-61724, along with inverter data, power meter data, and the ability to interface with other field devices, including tracker controllers, protective relays, transformer sensors, trip/close contactors, external meters, and auxiliary data systems.

For small sites, all functionality is built into (1) panel. Larger sites simply have multiples of that panel, with one of those being the Site Master. The Site Master panel will have the Computer and Cellular Modem, and is identical in all other ways. In addition to the Panel, SolarSCADA will provide a spreadsheet with all IP Address assignments required for on-field equipment. If special IT needs are required on-site, please tell SolarSCADA up front. Equipment on site will NOT have "public" Internet access unless specifically requested. Feed-Through of Inverter-specific monitoring gateways is available if requested. Some sites will have a separate meter enclosure or in-field panel, depending on wiring considerations. All panels are built using identical components, just ordered in different ways required to meet site expectations.

Each SolarSCADA panel will ship with the following (depending on how ordered). All sensor leads land in the SolarSCADA panel, at labeled terminal blocks on the front of the SSI device, or on provided cage-clamp spring terminal blocks

(1) A pyranometer mounting plate holding both:
    a. Plane of Array and Global Horizontal Pyranometers
    b. In some cases, the All-In-One IEC 61724 compliant Weather Station
(2) A separate bracket for POA Sensors for tracker-installed POA Pyranometer Instruments.
(3) Up to Six high accuracy RTD temperature sensors with pre-terminated cable lengths
(4) Revenue Grade Metering (Via built in CCS® WattNode™, KYZ pulse inputs, or Serial or Ethernet connected external power meter)
(5) Inverter Communications (Via Serial or Ethernet)
(6) Built in Cellular data modem (In Master Panel Only)
(7) UPS system (12 or 24VDC, Battery/Solar/AC combination)
(8) Wide AC Input voltage range (200-600 VAC for 3-phase)
(9) Upload to the SolarSCADA Web Monitoring Portal, and access to such.

This document covers the installation of the SolarSCADA hardware in the field.

2 Electrician Scope

This is what is expected of subs installing SolarSCADA systems in the field. Once complete, further commissioning can be performed remotely with support of on-site electricians, or can be hired out to SolarSCADA. SolarSCADA can provide commissioning training for site personnel.

(1) Mount the SolarSCADA Panel on rack near the equipment to be monitored. Good practice is to install a wire trough or gutter directly under the ADAS panel.
(2) Mount the supplied pyranometer / weather station bracket, along with security camera if ordered.
(3) Mount the tracker pyranometer bracket, if required.
(4) Mount the supplied module temperature sensors (clean the modules first, at least with a paper towel, before sticking them on the back)
(5) Mount the supplied 12 or 24VDC PV modules if the solar option is ordered.
(6) Mount radio equipment if supplied, such that the faces of the antennas face each other.
(7) Install conduit and pull cables as appropriate from all other equipment into the SolarSCADA Panel for all LV cables. Low Voltage (LV) is defined as all cables whose voltage is less than 48VDC. This encompasses all Serial cables, Ethernet Cables, KYZ Pulse cables, and data cables. These cables should be labeled as to their source, and rolled up inside the SolarSCADA panel prior to termination.

    NOTE: **NO COPPER ETHERNET CABLE PULLS LONGE THAN 300 FEET ARE ALLOWED**

    Standard cables could include, but are not limited to, the following:
    a. Cables from Inverters: To be Ethernet or RS-485 depending on inverter brand.
    b. Cables from Switchgear or Metering: This could be Ethernet cable from a relay, or KYZ cables from Utility Metering, or RS-485 / Ethernet to protection relays.
    c. Cable from Tracker controllers, probably Ethernet.
    d. BOM Temp sensor Cable, Weather Station Cable, Pyranometer Cable(s).
    e. Fiber pre-terminated jumper, if required.
(8) Install conduit and terminate all NON LV Cables. This would generally include:
    a. Install and Terminate AC supply Cable for Power Supply and Metering (if used). This would be the 3-phase conductors that lands on the Main Breaker in the SolarSCADA Panel.
    b. For metering systems, all 0.333mV CT metering leads.
    c. For Relaying equipment, if installed in SolarSCADA's equipment, land CT and PT/VT taps on appropriate labeled terminal strips.
(9) If trained to do so, the cables pulled in previous steps can be landed. All SolarSCADA provided cables (steps 1-5) come with pre-labeled cables that land on pre-labeled locations on the SSI module or Ethernet Switch.
(10) If supplied, install the UPS battery.

NOTE: **IF THE SYSTEM WAS NOT SHIPPED WITH SOLAR MODULES, DO NOT INSTALL THE UPS BATTERY UNTIL AC IS ENERGIZED UNLESS DIRECTED BY SOLARSCADA.**

With the PV Module, the UPS / Battery system can operate completely standalone. Without the PV module, the UPS / Battery operates only as a backup power supply for 2-3 days of runtime should AC power be lost.

Upon completion of the final step, the SolarSCADA can be energized via battery and optional PV module. Commissioning can now begin by calling SolarSCADA to begin configuration and testing. At this stage, any devices present and terminated can be made available via the web portal.

For cable termination information, refer the cable cheat-sheet supplied with the equipment. This cheat sheet is included here in Appendix 1: Cable Termination Summary Sheet. Full schematics of a standard panel are included in Appendix 2: SolarSCADA Reference Drawings. Note that there may be different options in your system than shown in the attached drawings, but all systems share common components.

A standard SolarSCADA panel install is shown in Figure 1. This version of the panel shown uses external metering. Wattnode™ meters, if included, would be mounted on the bare DIN rail between the terminal blocks and UPS/Power supply section.

Figure 1: Complete SolarSCADA Panel (External Meters)

3 System Overview

The SolarSCADA Monitoring System ships with (4) key pieces as shown in Figure 2. Larger systems may have multiple similar panels. One of the panels will be the “master panel”, which will contain the Cellular Modem and Computer for the site. Some sites may have multiple masters, depending on requirements.

Figure 2: SolarSCADA Typical Install

1. **The SolarSCADA panel.** All cable terminations for SCADA things end here. This panel contains the computer, cell modem, power supply/battery/ups system, power meter, communications systems, and a place to land all required field terminations.
2. **Weather Station bracket.** This bracket can be mounted on any round or square post less than 1.875” (1 7/8”) Outside Diameter. It can also be mounted to flat surfaces (parapet walls, etc). For tracker equipped systems, a separate version of this bracket is available for mounting on the torque-tube. Cables for attached instrumentation are shipped with this platform, with pre-ordered cable lengths. This bracket can hold up to (3) Pyranometers and (1) Weather Station.
3. **System Solar Module.** These modules plug into the UPS to provide for stand-alone operation. This module supplies power to the built-in UPS controller, at either 12 or 24VDC.
4. **SolarSCADA Module Temp Sensors (MTS).** These are flat surface temperature sensor (not shown) that ship with pre-specified cable lengths for rapid installation.

4 SolarSCADA Panel

The SolarSCADA panel comes configured and integrated with all options for a specific site. Some sites may have multiple panels, depending on layout and size. All panels generally contain the equipment as described in Figure 3. The basic specifications of the SolarSCADA ADAS panels are listed in Table 1. All SolarSCADA systems aim to have (1) panel at each location such features are required, bundling all communications, analog signal processing, grounding, surge arresting, power, metering, and met station functions in a single enclosure.

Table 1: ADAS Panel Basic Specifications

ADAS Panel Basic Specifications	
Panel Size	30" tall x 20" wide x 10" deep
Panel Weight	50 pounds no UPS, 80 pounds with UPS option
Operating Environment	-40 to 85C
Box Style	NEMA 4X, White painted Steel, Hinge mounted at left when installed
Cable Penetrations	Anywhere on bottom of cabinet.
Power Supply Requirements	150 watts max, AC Supply comes from AC sense voltage leads
	AC range is 208 -> 600 VAC. 120VAC options available.
UPS Specs	35AH, 24V or 12V@20A Max for external trip coils, 3-day run time w/ no external load. Solar and HV (1500 VDC Array Powered) options available for full standalone operation.

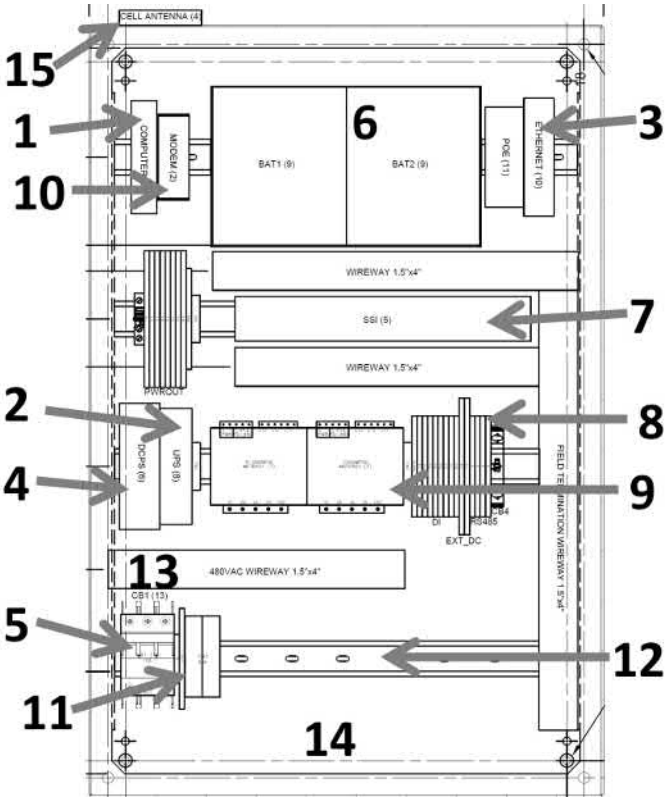


Figure 3: SolarSCADA Panel Internals

The equipment inside the SolarSCADA panel is labeled as shown in Figure 3. Not all equipment will be present in all panels.

1) **Site Computer**: This is a small, embedded, temperature-rated computer that runs the SolarSCADA software, which is built on Mango Automation™ SCADA from RadixIOT™. This computer has (2) Ethernet port. LAN1 is the WAN port, and connects to the built-in cell modem or off-site hardline. This computer can also join a local WiFi if required for data connectivity. LAN2 is the LOCAL network port, and is for all Ethernet devices for the site, which could include inverters, power metering, trackers, or switchgear.
2) **UPS Controller**: This manages SolarSCADA's DC UPS power options. Provides stable power from AC Power Supply, Battery, or Solar Module, if installed. This unit makes use of Anderson Power Pole® in either 15A or 30A sizes for interconnect.
3) **System Ethernet Switches**: Can vary based on order, but usually will be: 5-port copper for a small site, or 8-port with SC Fiber terminations for Fiber-equipped systems. Multiple switches can be included, for systems with DMZ-attached WAN devices or those requiring POE.
4) **AC Power Supply:** SolarSCADA has (2) power supply options: Single phase 120, and 208 -> 600VAC. SolarSCADA ships standard with the 208-600VAC power supply option, which can run from any (2) phases of a 600VAC or less 3-phase service.
5) **Service Disconnect.** Standard 3-phase breaker for isolation. If AC Meter is installed, this shuts down everything, including the meter.

   NOTE: **If this breaker is opened, the system will continue to operate off the battery if installed. For complete power-down, unplug Battery and Solar from the UPS module.**

6) **UPS Battery**: Either (1) or (2) UB12350 12V 25AH AGM batteries. This provides on average 3 full days of runtime. The 24V option will have (2) batteries with a fused jumper. With the solar module option, the system can be operated entirely standalone.
7) **The SSI (SolarSCADA Integrated) Data Interface** provides for inputs for up to (2) pyranometers, (1) weather station, (6) RTD temperature sensors, (8) discrete inputs, (2) KYZ Meter inputs, and (3) relay outputs. It also provides control power circuit breaker for internal components, and surge arrestors for RS-485 cables into the cabinet. Most field wiring lands on the SSI unit.
8) **External Spring Cage Terminal Blocks:** These are for external terminations not standard on the SSI. These could include KYZ pulse inputs, extra serial I/O, or external field power and comms for pyranometers. If external excitation is needed, there will be a low amperage breaker here for 12/24VDC power leaving the enclosure. If (3) Serial Ports are used, they will be here as A, B, C: A is for Internal comms (inside the SCADA Panel), B is for Inverters, and C is for aux equipment. If (2) serial ports are used, A is for metering (if external) and pyranometers, and B is for Inverter RS485 Communications.
9) **Revenue Meter(s):** A CCS® WattNode™ Revenue Grade Meter. If the meter option is ordered, this is the site meter. 0.333mV field-wired CTs land on the top terminal block. The Voltage is measured from the 3-phase control terminal input at the Service Disconnect breaker. Your system may have (2) meters here, one for solar and one for consumption, both

sharing a common voltage reference. Systems with external meters will have the same meter, but in an external box, and attached to the RS-485 A port.

10) **Cellular Data Radio**: The type varies by site.

    NOTE: **FACTORY RESET OF THE CELL MODEM WILL RENDER THE DATA LINK UNUSABLE.**

11) **External Battery Breaker:** If equipped, this breaker provides a high-current direct tap from the battery to low-duty cycle, high current devices, such as motor-operated circuit breakers.
12) **Expansion DIN Rail:** This area is for site-specific expansion. Such options may include extra POE, splice blocks for cable feeds, or supplemental surge protection devices.
13) **480VAC Specific wireway:**

    NOTE: **LV Conductors should NEVER be installed in this area.**

    This wireway is intended to isolate the 200-600VAC meter voltage sense leads. All other wireways are available for LV cable runs.

    NOTE: **The CT Leads provided with SolarSCADA are all 0.333mV CTs, and are assumed "low voltage" for the sake of this ADAS panel. Please install according to local code as required for these types of leads.**

14) **Cable Penetration Area**: This area (about 30" x 10") on the base of the panel is for conduit runs. SolarSCADA generally recommends bottom-entry for conduit when possible.
15) **Cell Antenna:** The cell antenna is permanently affixed to the enclosure. If an external cell antenna is required due to system location, please consult SolarSCADA.
16) **DC Power Distribution:** This area is for DC power distribution inside the panel. For Excitation / DC outside the panel, please use the EXT_DC block off the breaker at location 9, or the high-current breaker at location 11 if required.

    NOTE: **DO NOT TAP EXCITATION VOLTAGE FOR EXTERNAL DEVICES FROM LOCATION 16.**

5 Pyranometer / Weather Station Bracket

The bracket simplifies the installation of weather stations and pyranometers. This unit ships as an assembly from SolarSCADA, with pyranometers and the weather station already mounted if appropriate. The unit is then installed atop any shape of pipe up to 1.875" (1 7/8") in diameter, and is made level by the included mounting screws around the vertical section of the tube.

Components of the environment instrumentation platform are shown in Figure 4. All the cables from the sensors on the platform terminate in the ADAS panel. It is generally assumed that this bracket will mount near the SolarSCADA panel containing the SSI, although the cables can be extended for all sensors up to 100 feet if necessary. For extra remote sensors, such as need to be located in the middle of fields, ask SolarSCADA about the Array Powered and Radio options or the SolarSCADA SPD (Surge Protection Device) which can isolate and condition RS-485 runs and low-power supply voltages for long (>100 feet) cable runs. This bracket can also be used upside down (with the round tube facing down) to support more install opositions.

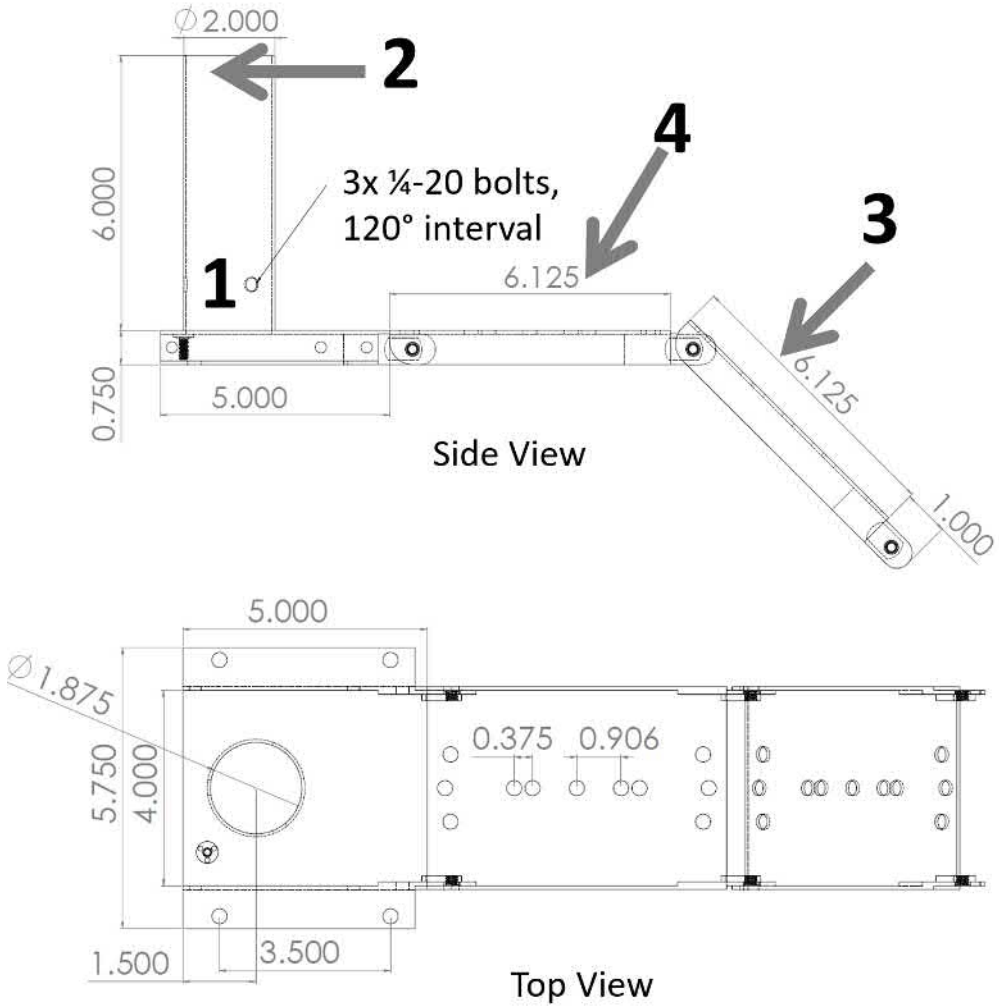


Figure 4: Pyranometer and Weather Station Bracket and Dimensions

(1) **Post mounting**. The bracket is designed to attach to any post, round or square, whose largest dimensions is less than 1.875" (1 7/8") in diameter, and a height as required for the install location. This bracket has bolts all around it to mount to round or square post. Care should be taken to make sure the top surface of the bracket is level for proper pyranometer alignment. Azimuth adjustment is accomplished by rotating the entire bracket around the post.

(2) **Weather Station**. SolarSCADA supports (3) weather stations, the ATMOS-41, ATMOS-22, or ATMOS-14, depending on site requirements. They all mount the same way, but provide different measurements via SDI-12 to the SSI. Communications to the SSI is via SDI-12. The platform and weather station must be level, and the N on the weather station must point NORTH to get accurate wind direction information.

(3) **Plane-Of-Array (POA) pyranometer mounting area**. Upon install, the angle of this should be verified to match the site tilt angle.

NOTE: **If a tilt angle of < 20 Degrees is required, the POA instrument MUST be mounted on a second bracket to avoid shading. SolarSCADA recommends mounting the Weather Station and Pyranometer(s) at separate locations to minimize reflection from the weather station.**

(4) **Global Horizontal Irradiance (GHI)** Pyranometer mounting area as appropriate.

6 SolarSCADA Back of Module (BOM) Flat Surface Temperature Sensors

The SolarSCADA system ships with up to (6) pre-calibrated flat surface RTD-100 temperature sensors. All SolarSCADA back of module temperatures meet accuracy requirements specified in IEC 61742-1. The system uses 3-wire RTDs and internal compensation electronics within the SSI to enable cables lengths in excess of 300 feet. Temperature sensor cables can be cut shorter with no effect on accuracy.

However, **DO NOT SPLICE TEMPERATURE SENSOR CABLE WITHOUT TALKING TO SolarSCADA.** If you want to know why, search how 3-wire Resistance Temperature Detector (RTD) systems work.

The business end of the SolarSCADA BOM temperature sensors is shown in Figure 5. These sensors ship with (2) pieces of industrial 3M™ VHB adhesive, one on the RTD sensor itself, and one on the wire for the RTD about 6" away from the sensor.

Figure 5: SolarSCADA Back of Module Temperature Sensor

In Figure 5, 1 is the temperature sensor itself, and 2 is the wire support adhesive. The sensing element is encapsulated to the back of the module by the VHB adhesive, making a weather proof and permanent seal with the modules.

MAKE SURE THE MODULE MOUNTING LOCATION IS CLEAN AND DRY PRIOR TO MOUNTING. IDEALLY, USE A SURFACE CLEANER OR ALCOHOL SWAB PRIOR TO INSTALL.

The VHB adhesive is permanent and strong, and it sticks to everything, including dust, your shirt, mud, and whatever else is there to stick to.

DO NOT REMOVE THE PROTECTIVE BACKING UNTIL READY TO INSTALL. Otherwise you may get schmoo in the glue, and it won't stick.

Figure 6 (next page) is an example install of (2) sensors). Should you need new adhesive, SolarSCADA uses 3M™ VHB 5952. If you need to apply when the modules are very cold, use 3M™ VHB 4952.

Figure 6: Properly Installed Back of Module (BOM) Temperature Sensors

7 The SSI (SolarSCADA Integrated) Data Interface

The SSI provides all the analog inputs, signal conditioning, and power distribution for the SolarSCADA System. This is also where the SolarSCADA BOM Temperature Sensors, Weather Station, and Pyranometer(s) interface. In addition, the SSI has 8 digital inputs and 3 relay outputs. A picture of the SSI is shown in Figure 7 with ports labeled.

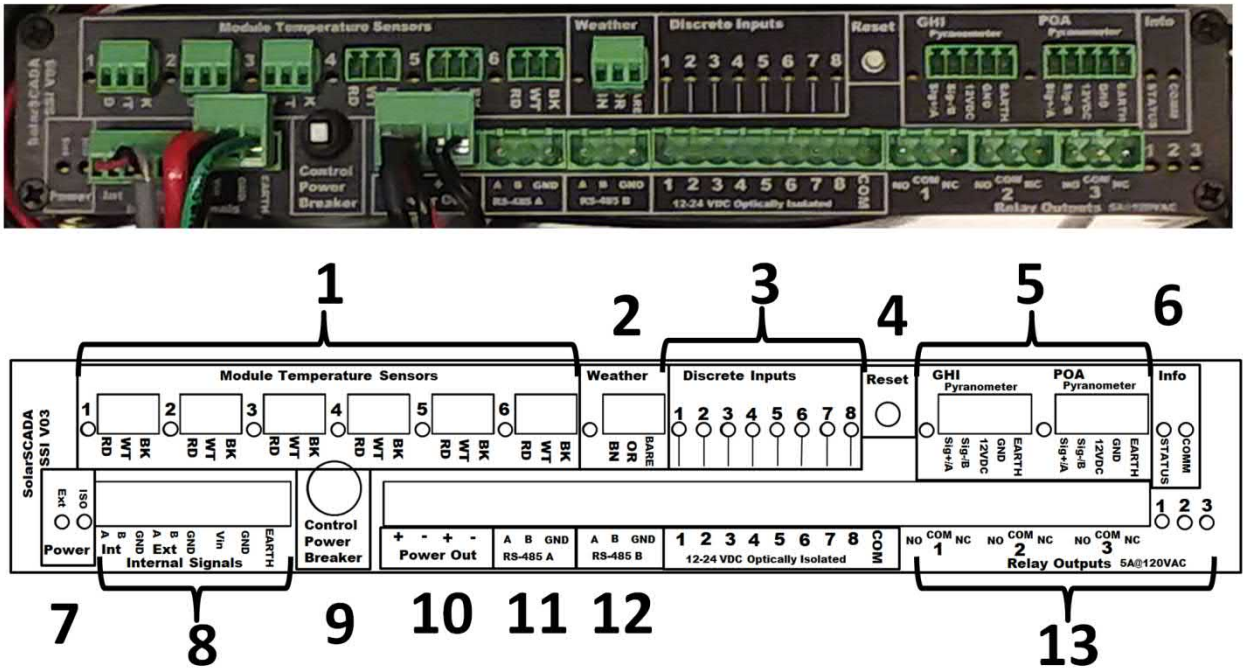


Figure 7: SolarSCADA Integrated (SSI) Interface. Picture (top), Schematic View (lower)

1) **BOM Temperature Sensors**: Terminate the supplied 3-wire RTD Back of Module Temperature (BOM Temp) sensors on these green plug blocks. The colors are labeled at each connector block (Red, White, Black), which aligns with the cable supplied by SolarSCADA. There are (6) connectors, one per temperature sensor. When landing these cables, they can be cut shorter, but **DO NOT SPLICE** unless absolutely necessary. If cables need to be spliced, contact SolarSCADA. RTD sensor temperature accuracy specs can only be met with factory cable. Splicing in other types of cable will cause measurement error. The LED adjacent to each connector will illuminate when the connected temperature sensor is detected.
2) **Weather Station:** This 3-pin block is for the supplied Weather Station. Terminate the weather station's cable here, via the three-conductor cable (brown/orange/shield), as labeled on the front panel. The led adjacent to the connector will turn green when the weather station is detected. This process can take as long as a few minutes, depending on weather station type. Once detected, this light will flash every so often when data is gathered from the weather station.

3) **Discrete Inputs and Indicators:** There are (8) LEDs on the top, which line up over the (8) input pins at the bottom. These LEDs illuminate when the input is active. These are for discrete inputs such as breaker status, transformer alarms, or KYZ pulses. The inputs are 12-24VDC compliant and optically isolated from the rest of the system, but share a common for all inputs (The "COM" terminal). The inputs can be either sinking or sourcing, with the standard recommendation being sourcing: The COM terminal is attached to the wetting voltage positive, and then the input channel is grounded to signal an active state. These channels can be used in two ways:
    - Method one: Eight separate discrete inputs. These can be used for transformer alarms, breaker status, or other relay-interface applications.
    - Method two: KYZ pulse inputs. In this case, channels 5 (Y) 6 (Z) are the RECEIVED KYZ meter inputs, and channels 7 (Y) 8 (Z) are the DELIVERED KYZ meter inputs. K is the return path to DC Ground, and Y and Z go to their corresponding inputs.
    - If KYZ pulse inputs are used, input pins 1-4 are still available for use as discrete inputs. Use of two-wire (K/Z) signaling is supported, but using all (3) means that the SSI is better able to calculate real time power at low energy levels.
4) **Reset Button:** This pushbutton resets the SSI. It causes the SSI to re-initialize, re-detect attached sensors, and clear internal state. This button can be used when sensors are swapped rather than power cycling the enclosure.
5) **Pyranometer Inputs:** The SSI supports nearly all common pyranometer types, configured via switches internal to the unit. SolarSCADA ships Hukseflux SR05-D1A3's configured as RS-485 devices started at address 100 by default. Consult the Appendix 1: Cable Termination Summary Sheet on page 20 for information on proper way terminating pyranometers.
6) **INFO LEDs:** The STATUS light flashes occasionally indicating the SSI is operating. The COM light illuminates when Modbus™ communications requests occur. If the STATUS light is on solid RED, the SSI device has an internal fault.
7) **Power LEDs**: There are (2) power sources inside the SSI. Both need to be lit for proper operation

    EXT "External" power present illuminates when external power is present on the input to the device. This means the SolarSCADA panel is energized.

    ISO "Isolated" power illuminates when the isolated power supply inside the SSI is energized. The internal electronics of the SSI are powered from an isolated power converter, to isolate the main SolarSCADA panel power supply from long cable runs. If the ISO light is extinguished, a surge event may have damaged the internals of the SSI.
8) **Internal Signals:** These are the signals installed by SolarSCADA at the factory. There are (2) RS-485 inputs, and (1) Power supply input. Do not modify these connections unless instructed by SolarSCADA.
9) **Control Power Breaker:** This is a 4A breaker that provides protection for the SSI internal supplies, as well as anything attached to the Power Out pins. This will trip if any of the internal electronics inside the SolarSCADA panel see a fault.

10) **Power Out:** The power out from the Control Power Breaker. This power supply has transient suppression and is meant to power internal panel equipment.

    DO NOT USE POWER OUT FOR POWER OUTSIDE THE SOLARSCADA PANEL. Instead, use the breaker-protected output or battery output breaker.

11) **RS485-A**: The "internal" RS-485 Modbus connector. This Modbus™ link runs at 19200 8-N-1 and is meant for signals inside the SolarSCADA Panel. Generally, this link talks to the SSI, UPS, and Power Meter if installed. This is also used for RS-485 connected Pyranometers. This port has basic TVS protection elements, but is not galvanically isolated.
12) **RS485-B**: The "External" RS-485 Modbus connector. This is the primary RS-485 port for Inverter interfacing for RS-485 equipped inverters. This port is fully configurable by SolarSCADA remotely for baud and settings. This port has basic TVS protection elements, but is not galvanically isolated. When galvanic isolation is needed, such as for long RS-485 from systems not well bonded to ground, SolarSCADA may elect to include additional RS-485 to USB adapters as needed to be used in place of RS485-B.
13) **Relay Outputs:** There are (3) 5A SPDT relays, controllable remotely, with status LEDs being GREEN when the relay is energized. These relays are for remote trip, close, or reset operations requiring remote toggling.

8 Installation Overview

This section covers a basic outline of the installation process of the SolarSCADA system.

8.1 What is In the Box?

SolarSCADA tries to pre-kit and pre-assemble as much as possible. Generally, systems ship in two or three boxes from SolarSCADA via LTL Freight on a single pallet. Some items, notably UPS batteries, get drop-shipped direct to site. The general box assignments are as follows:

Box 1: The SolarSCADA Panel. CT's are sometimes included inside this panel, occupying the battery shelf.

Box 2: The BOM Temperature sensors and their attached cables. This box also may have the Pyranometer(s), Weather station, and Brackets, depending on system size.

Box 3: If the Bom Temp Sensors are long, then Box 3 will have the Pyranometers, weather station, and weather station.

Drop Shipped Items usually include Solar Modules for the UPS (if ordered) and the UPS Batteries.

8.2 Pre-Installation Requirements

The SolarSCADA system requires the following before installation:

1) An appropriately sized AC Breaker (if AC metering is installed in the ADAS panel, or an AC power option is selected), depending on voltage source available (ADAS panel need is max of 150W). The internal breaker on the ADAS panel is a 10A breaker.
2) A solid earth ground.
3) Unistrut or some other racking available to hold up to 80lbs, for the ADAS panel (30" high x 20" wide x 10" deep).
4) A pipe, square rail, or piece of EMT not exceeding 1.875" in diameter of a height appropriate to hold up the weather station equipment, mounted close to ADAS panel area. This mast will also be used for the radio link, if needed.
5) A space to mount the solar module (if ordered). If your site allows it, this module can be mounted over the ADAS panel to act as a sun shield / rain guard.
6) A clean(ish) rag to wipe the backs of the solar modules prior to installing the temperature sensors.

8.3 Basic Installation Steps for Environmental Sensors

The following steps are for a basic (non IEC 61724-1 Class A) site. If you need the system to perform to IEC 61724-1 specifications, special care needs to be provided to levelness, height, and alignment of all sensors. We suggest hiring a SolarSCADA Certified Installer if strict IEC 61724 compliance is required.

1) Mount the ADAS panel. This panel has (4) screw mounting locations inside the panel in the corners. The enclosure ships with the backpan installed, but the backpan can be removed to simplify installation if required.
2) Mount the solar module(s), if needed: This should go at the approximate tilt angle for the site.
3) Erect a mast for the weather station and pyranometers brackets. These should be located to minimize shading as much as possible.
4) Mount the pyranometer bracket on the top of the mast, and level it with the attached screws and your bubble level.
5) Run the supplied cables from the mast to the SolarSCADA panel. Depending on your site, you can run these in conduit, or just zip-tie them down the mast. All SolarSCADA factory supplied cables are UV resistant, 300V rated tray cable.
6) Terminate the cables according to the wire labels referencing Appendix 1: Cable Termination Summary Sheet when needed. Follow the color code on the label on the front of the equipment.
7) Pull the temperature sensor free ends through your conduit. Protect the temperature sensor ends so they don't fall into the mud, as the adhesive needs to be dry when installed. We recommend a plastic bag (or a buddy holding the active ends up) as the cable is pulled through your conduits to the ADAS enclosure.
8) Once the temperature sensor wires are pulled into the ADAS enclosure, use your rag to wipe off the back surface of the module. If you're extra keen, get some kind of alcohol-based wet wipes to make sure there's no schmoo on the module where the sensors will stick.
9) Peel off the red protective covering on the module temperature sensors, and stick them to the back of the module. Once the sensor is installed, peel the protective plastic off the wire support adhesive, and stick that in line with the module temperature sensor.
10) Dress the cables for the module temperature sensors, such that the cable does not pull directly on the adhesive.
11) Terminate the wires inside the ADAS enclosure to the SSI temperature sensor inputs.

8.4 Inverter and Tracker Communications

This section briefly touches on on-site communications items. For SolarSCADA's interface, RS-485 Inverters go into RS-485 "B" port on the SSI, or the supplied "B" spring cage-clamp blocks of supplied. Ethernet connected machines go to any port on the Ethernet switch. Tracker controllers, protective relays, or other equipment goes into any port on the Ethernet switch. Discrete inputs go to the discrete inputs on the SSI or their cage clamps, and KYZ pulses go to the channels on SSI IES as noted in the appendix. Generally, when this stage is done, call SolarSCADA, so we can work through getting the First Device talking. Once that first unit is up and running, SolarSCADA will configure the other devices as they become available, allowing us to point-to-point check the system as it is configured.

8.5 Notes on RS-485 Connected devices

For systems that have RS-485 Serial connected inverters, wire them according to the inverter manufacturer's specifications. Inevitably, this takes some troubleshooting on commissioning for new inverter types, due to vagaries of labeling and termination resistors, among other things.

SolarSCADA will assign Modbus™ unit ID's to equipment that requires it. Generally, we start Inverters at #1, and go up from there. Slower bauds are generally more reliable: SolarSCADA generally suggests 19200 8-N-1 for inverter communications.

In certain cases, isolated RS-485 converters are required for site with long cable runs (> 300 feet) or for sites that have poor grounding between structures (such as cables going between different rooftops or car ports that may not have a solid ground bond between them). SolarSCADA has several options for these systems, and will make suggestions for solutions as needed.

8.6 Notes on Ethernet Connected devices

SolarSCADA will supply Static IP Addresses for equipment installed on SolarSCADA equipped sites. Once SolarSCADA knows what and how many devices are there, a spreadsheet will assign the addresses to be used on the equipment. SolarSCADA can provide IP tunneling and forwarding, as well as "public" internet access via SolarSCADA's cellular gateways if needed. Extra fees may apply for this, depending on requirements and bandwidth used. The SolarSCADA IP System is entirely firewalled via our own static VPN key system.

NO COPPER ETHERNET CABLE SHALL BE LONGER THAN 300 FEET. The technical limit for standard Ethernet cable is 100 meters, or 328 feet. Sometimes it works over longer lengths. For distances over 300 feet, for Ethernet devices, wireless solutions of Fiber should be used. SolarSCADA has a family of Wireless Bridgebox devices, complete with 1500VDC capable array-powered options, to enable system designers to drop sensors wherever needed for optimal data accuracy and system coverage. This can also be used to avoid expensive directional boring, as a static-secured radio link can be much more affordable, and just as reliable, as the situation which results from directional bores, junction boxes, and fiber patch panel termination expenses. If fiber cannot be avoided, SolarSCADA can provide direct bury jumpers as part of our packaged systems for very rapid installation.

FOR THE LOVE OF ALL THAT IS SACRED AND JOYFUL FOR YOUR LIFE:

DO NOT USE ETHERNET CABLE FOR ANYTHING OTHER THAN ETHERNET.

If you need extra cable for something, PLEASE CALL. SolarSCADA stocks all manner of cables that can be used to solve problems. We can turn around cable-orders in the same day in most cases.

This may be a bit pedantic, but, well, I'm tired of getting calls to fix things because someone scotch-locked a Cat 5 cable onto something because the cable was 5' too short, then hiding that in a pull box that's now full of water. We can send you weatherproof / connectorized extension cables for all components of our system. We can also send you field-installable cable ends for extension of all cables, to avoid JBoxes and Scotchlocks ™.

- **Greg Linder, founder of SolarSCADA**

9 Appendix 1: Cable Termination Summary Sheet

SolarSCADA Wire Termination Cheet Sheet					V05 2/25/2021
Pyranometers			SSI Inputs		
Cable			Analog	Digital	
M12 Pin	Color	Function	Pyran.	Pyran.	RS-485A
2	WHT	DATA+	N/C	N/C	A+
5	GRY	DATA-	N/C	N/C	B-
3	BLU	SIG	SIG+/A	N/C	Jumper COM on 485A to BLK GND
1	BRN	PWR	12VDC	12VDC	
4	BLK	GND	GND	GND	
N/C	SHLD	SHLD	EARTH	EARTH	
Module Temp Sensors			SSI Inputs		
M12 Pin	Color	Function	BomTemp Connector		
1	RED	RTD+1	RED		
2	WHT	RTD+2	WHITE		
3	BLK	RTD-	BLACK		
4	SHLD	N/C	N/C		
If Equipped					
Weather Station			SSI Inputs		
M12 Pin	Color	Function	Weather Station Con.		
1	BRN	DATA	BRN	RED	
2	ORG	12VDC	ORG	WHT	
3	BARE	GND	BARE	BLK	
4	BARE		N/C	N/C	
If Equipped			If Extension Cable		

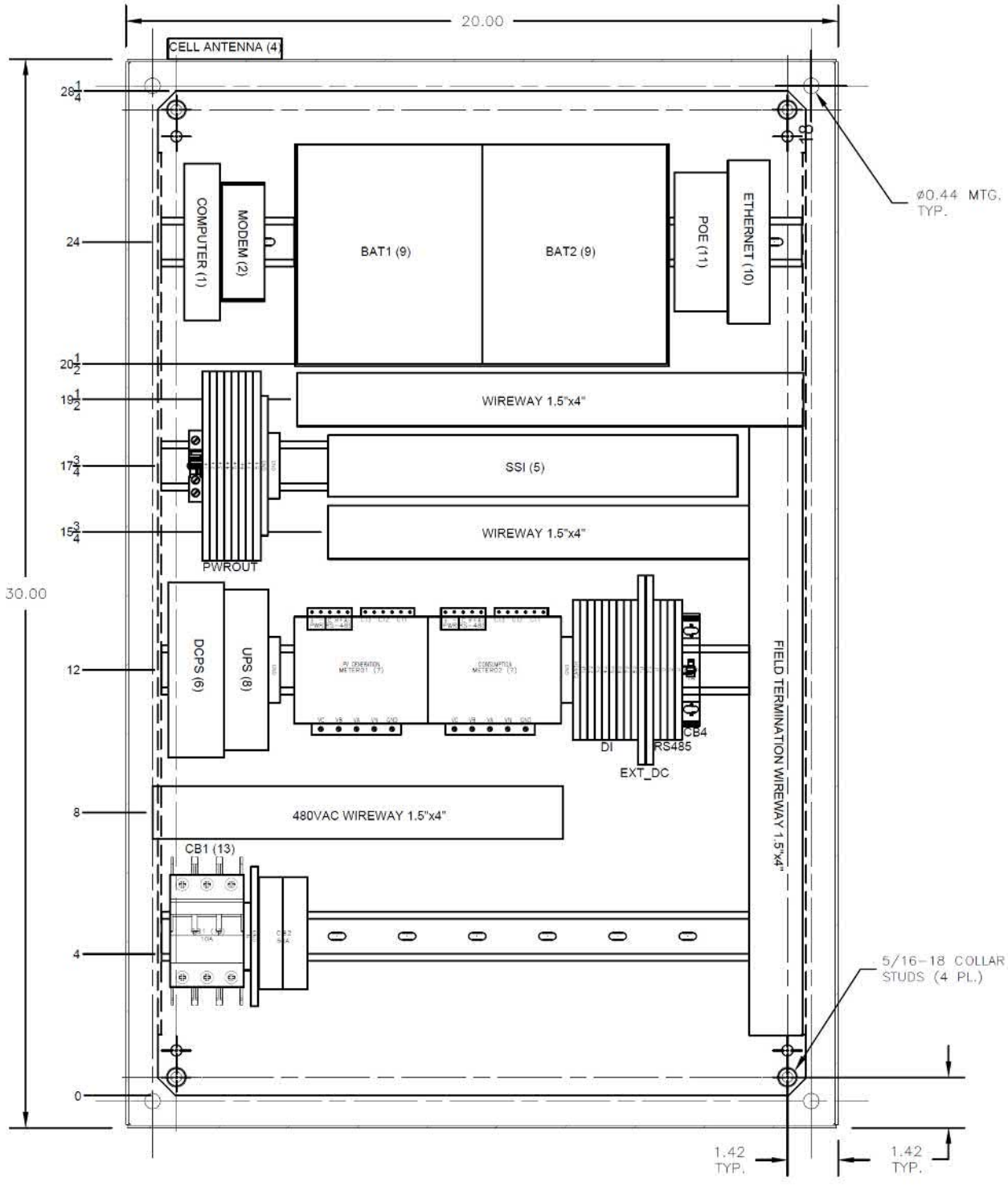
Discrete Inputs	
IES Pin	Function
1	DI 1
2	DI 2
3	DI 3
4	DI 4
5	DI 5
6	DI 6
7	DI 7
8	DI 8
COM	Common
Input Range 12-24 VDC Inputs Optically Isolated	
If COM to +VDC Input to GND = Active	
If COM to GND Input to +VDC = Active	
Power Out can be used for Excitation Power	

KYZ Operation	
IES Pin	Function
1 -- 4	Same as above
5: KYZ "Y" RECEIVED	
6: KYZ "Z" RECEIVED	
7: KYZ "Y" DELIVERED	
8: KYZ "Z" DELIVERED	
COM must be wired for proper wetting of KYZ Output contacts	

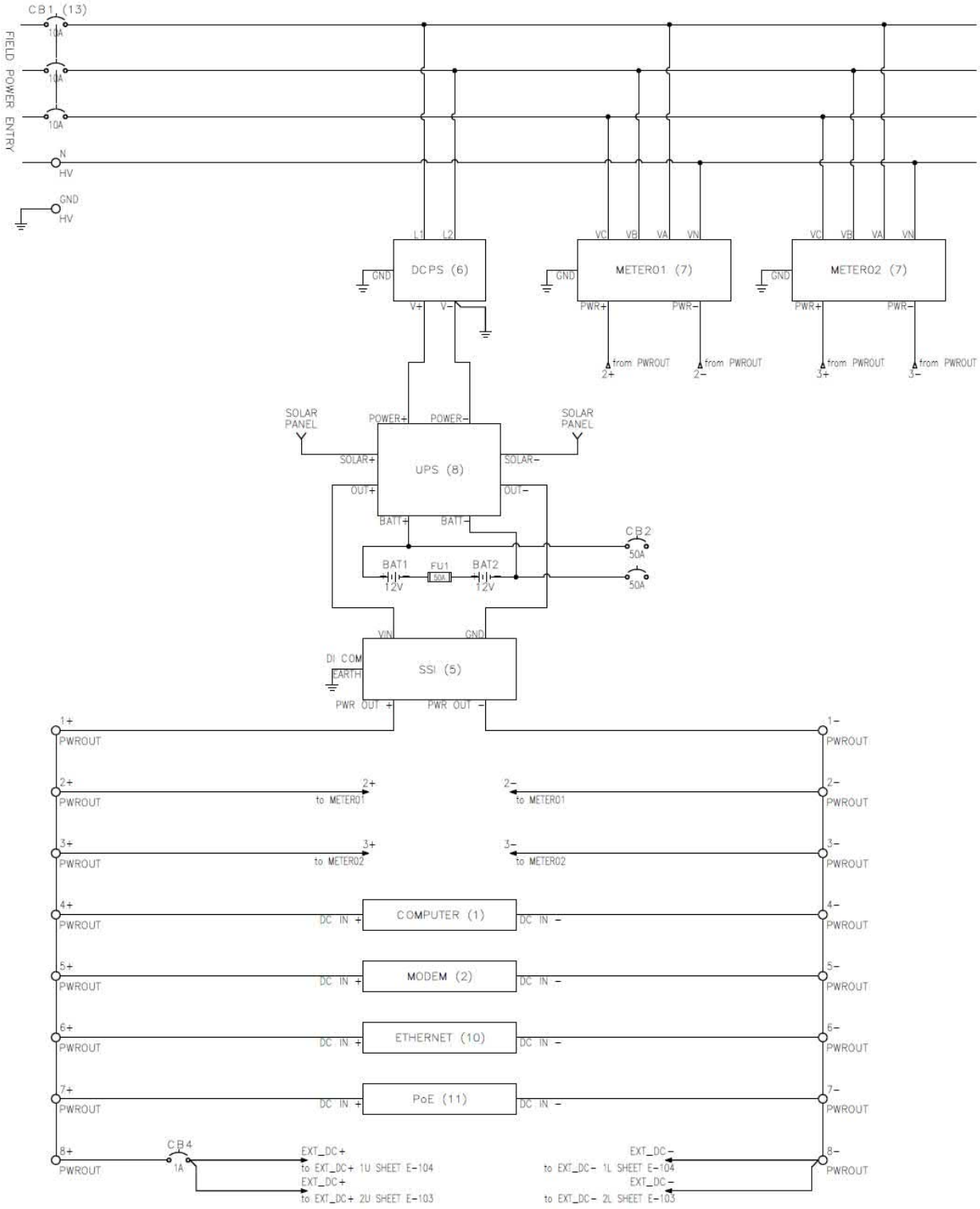
RS-485 Defaults
19200, 8-N-1
Modbus 1,2 = Meters (1 = Solar, 2 = Consumption)
Modbus 100. . . = Pyranometers
Modbus 200 = SSI
Modbus 201 = UPS

10 Appendix 2: SolarSCADA Reference Drawings

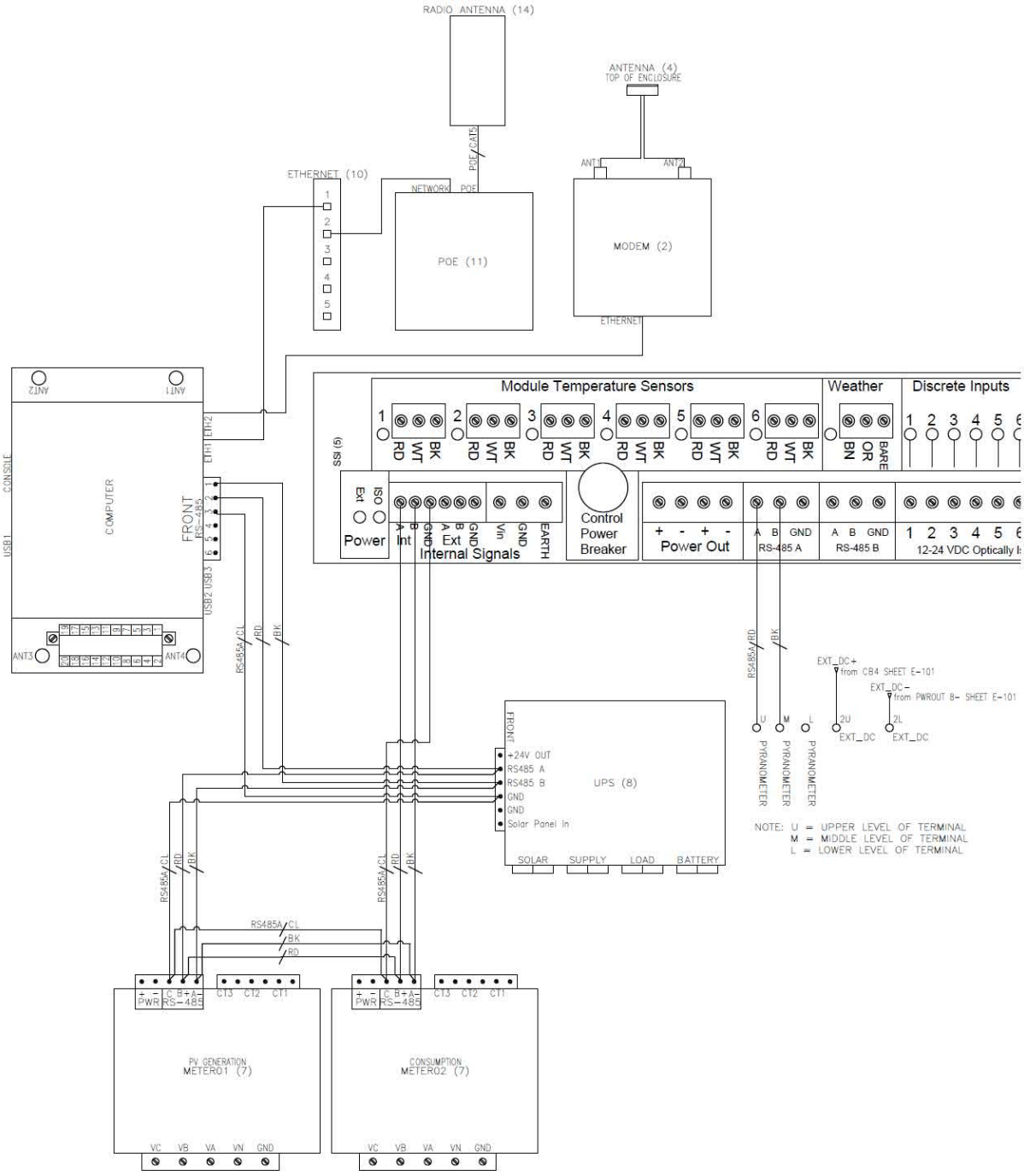
10.1 Physical Layout



10.2 Internal Power Distribution



10.3 Internal Communications



10.4 SSI Terminations / Comms