IntelliSAW IRM-48 Reader

INSTALLATION MANUAL

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WARRANTY

These products are warranted to be free from functional defects in material and workmanship at time of manufacture and to conform at that time to the specifications set forth in the relevant instruction manuals or data sheets, for such products for a period of one year.

Reference IntelliSAW terms and conditions provided at time of purchase for complete warranty details.

IMPORTANT INFORMATION

⚠ This symbol identifies messages in this document related to safety.

⚠ **DANGER**

DANGER indicates an imminently hazardous situation, which, if not avoided, will result in death or serious injury.

Failure to follow the instructions given will result in death or serious injury.

⚠ **WARNING**

WARNING indicates a potentially hazardous situation, which, if not avoided, could result in death or serious injury.

Failure to follow the instructions given can result in death or serious injury

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⚠ **CAUTION**

CAUTION indicates a potentially hazardous situation, which, if not avoided, may result in minor or moderate injury.

Failure to follow these instructions can result in personal injury.

NOTICE

NOTICE alerts you to practices unrelated to personal injury, such as those that can cause property damage.

Failure to follow these instructions can result in property damage.

IMPORTANT

IMPORTANT indicates additional information about making effective use of this product.

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1 INTRODUCING THE IRM-48 READER

The IntelliSAW IRM-48 Reader is a remote monitoring unit that provides temperature, partial discharge (PD), and humidity sensing for predictive condition-based monitoring of electrical power critical assets such as switchgear, circuit breakers, and bus ducts. Multiple IRM Readers can be bussed to a CAM-4 system or existing SCADA system providing immediate data display and alarming.

1.1 MODELS

This manual covers the following models:

- IRM-48-T00: Temperature only monitoring
- IRM-48-TP0: Temperature and PD monitoring
- IRM-48-T0H: Temperature and Humidity monitoring
- IRM-48-TPH: Temperature, PD, and Humidity monitoring

1.2 INSTRUCTIONS FOR USE

The IRM-48 Reader is intended for use in the measurement of Temperature, Humidity, Ambient Temperature, Partial Discharge and Surface Discharge of Low to Medium Voltage air insulated Electrical Equipment. Readers connect Air Interfaces through RF cables for wireless interrogation of SAW temperature sensors and Partial Discharge monitoring, while humidity and ambient temperature sensors are wired to the readers. Interfacing to the IntelliSAW CAM-4 or an existing SCADA, DCS, or historian is easily accomplished with industry standard Modbus RTU (RS485 serial).

⚠ **WARNING**

The Reader is not intended for use in monitoring assets above 40KV

The reader is intended to be installed in Low Voltage compartments of switchgear or in similar types of assets; a unit can also be installed in a weather proof environmental enclosure. The unit is intended for use at a maximum altitude of 5km, between -40°C to +70°C and between 10 - 95% non-condensing relative humidity. The reader has been recognized for meeting UL 61010-1 safety requirements for electrical equipment. Please refer to Specifications and Compliance for complete ratings.

⚠ **WARNING**

The Reader is not intended for installation in asset Medium Voltage or High Voltage Compartments. Only sensors and antennas are intended for installation in medium voltage Compartments.

2 PRODUCT OVERVIEW

2.1 SYSTEM INPUTS AND OUTPUTS

The maximum system inputs and outputs are as follows:

Inputs	Outputs
12 temp sensors	Communications: Modbus RTU
4 air interfaces (PD / temp)	
8 humidity sensors	
Power: 24V to 60V DC (3.5W)	

2.2 LABELING

The Reader has two labels on the bottom of the unit, a Serial ID label and a compliance label, and one main product label on the top.

2.2.1 Serial ID Label

The IRM-48 Serial ID label provides a model number and serial number for the reader.

Figure 1: IRM-48 Model Number and Serial ID Label

2.2.2 Compliance Label

The compliance label provides product certification information.

Figure 2: IRM-48 Compliance Label

2.2.3 Product Label

The top product label provides guidance to the model type, product voltage and power ratings, and connector interfaces.
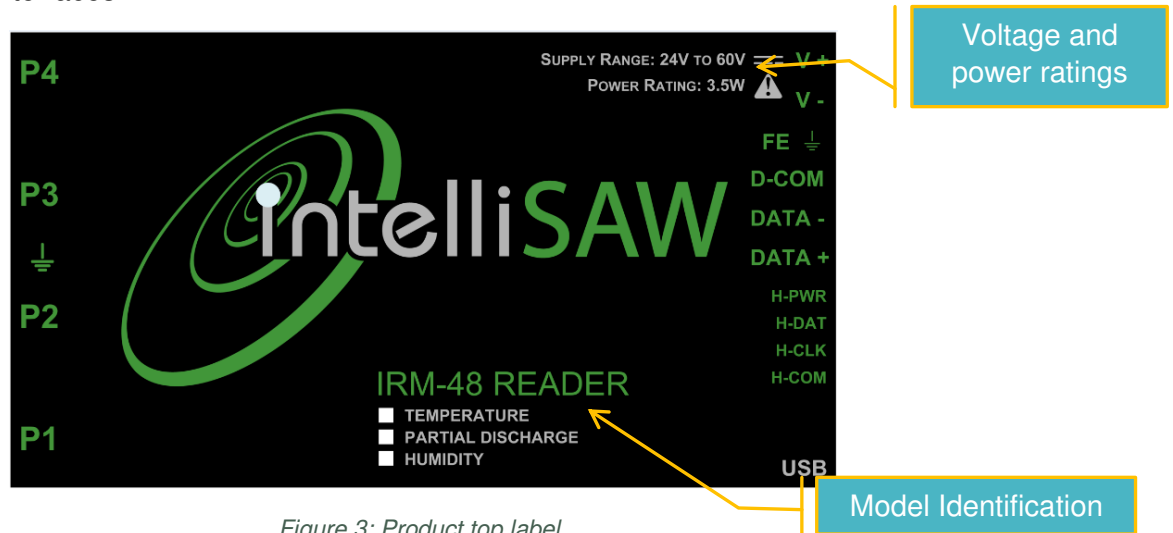
Figure 3: Product top label

Model identification boxes will be red if the option is available in the reader.

2.3 CONNECTORS

The product has up to seven connectors (depending on model):

- (1) USB connector – used for configuration
- (1) Power and Modbus RTU (RS485) connector
- (4) SMA (RF) connectors – used for air interface connections
- (1) Ground lug – chassis Function Earth (FE)
- (1) Humidity connector – available with humidity option

Figure 4: Front and side views of IRM-485 Reader

2.3.1 USB Cable Connector

Interface	Name	Description
USB	USB	USB mini used for unit configuration

2.3.2 Power and Modbus RTU Connector

Pin	Name	Description
V+	Power In +	Input power range from 24 to 60V DC.
V-	Power In -	Input power range from 24 to 60V DC.
FE	Functional Earth	This pin is used for ground and shield connectivity. Should use separate wire from Case Ground.
D-COM	DATA Common	Common input for Modbus RTU (RS485)
DATA-	DATA Negative	Negative Input for Modbus RTU (RS485)
DATA+	DATA Positive	Positive Input for Modbus RTU (RS485)

2.3.3 SMA (RF) Connectors

Pin	Name	Description
P1	RF Port 1	Air Interface Radio Frequency Port 1
P2	RF Port 2	Air Interface Radio Frequency Port 2
P3	RF Port 3	Air Interface Radio Frequency Port 3
P4	RF Port 4	Air Interface Radio Frequency Port 4
Ground	Case Ground	Chassis ground lug connection, required for safety when air interfaces are near energized conductors.

2.3.4 Humidity Sensor Connector

Pin	Name	Description
H-PWR	Humidity Power	Humidity Cable Power Input from Humidity Sensor
H-DAT	Humidity Data	Humidity Cable DATA Input from Humidity Sensor
H-CLK	Humidity Clock	Humidity Cable Clock Input from Humidity Sensor
H-COM	Humidity Common	Humidity Cable Common Input from Humidity Sensor

2.4 POWER / FEEDBACK LED

The product has one power / feedback LED.
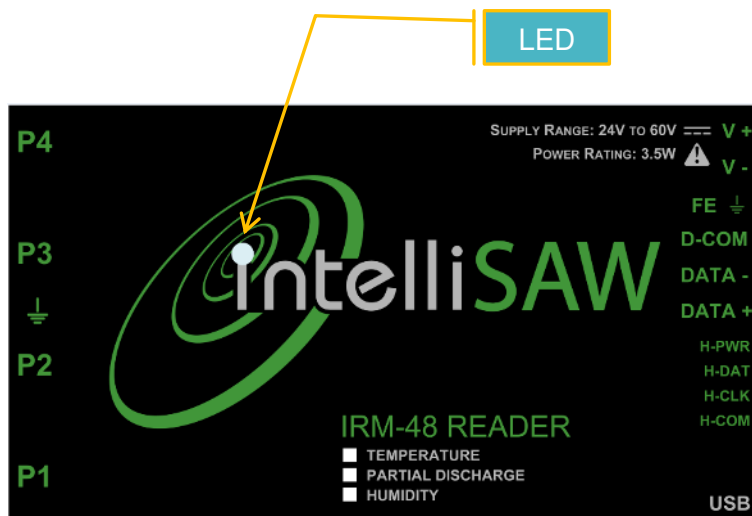
LED States:

- No Illumination: No Power
- Solid Green: Power, no measurements
- Green / Amber toggle: Automated measurements
- Fast flashing Amber: Rebooting

3 INSTALLATION

IMPORTANT

- The installation instructions are only for the IRM-48 Reader.
- It is assumed an Air Interface Antenna, and Sensors have been installed and configured.

⚠ **WARNING**

INSTALLATION AND CONFIGURATION SHOULD BE PERFORMED ONLY BY PERSONNEL WHO ARE TECHNICALLY COMPETENT AND AUTHORIZED TO DO SO. LOCAL REGULATIONS REGARDING ELECTRICAL INSTALLATION AND SAFETY MUST BE OBSERVED.

Failure to follow the instructions given can result in death or serious injury

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⚠ **WARNING**

THE USE OF THIS EQUIPMENT IN A MANNER NOT SPECIFIED IN THIS MANUAL OR BY THE MANUFACTURER MAY IMPAIR PROTECTION OF THE USER AND EQUIPMENT.

Failure to follow the instructions given can result in death or serious injury

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⚠ **CAUTION**

THIS EQUIPMENT IS DESIGNED FOR INSTALLATION IN AN ENCLOSURE THAT PROVIDES ADEQUATE PROTECTION AGAINST ELECTRIC SHOCK.

Failure to follow these instructions can result in personal injury.

3.1 UNPACKING

1. Remove the product from its packing. Retain the packing for future use, to transport the instrument to a different site or to return it to the supplier for repair/testing.
2. Examine the delivered items for damage or defects. If any are found, contact the courier immediately.
3. In the Box:
   a. Reader with a pre-installed din rail mounting clip
   b. Power and Modbus RTU terminal block (6 position 5.08mm Plug)

3.2 DIMENSIONS

The IRM-48 instrument has dimensions of 81 H × 142.5 W x 51.5 mm D (3.19 H × 5.61 W × 2.03 in D).
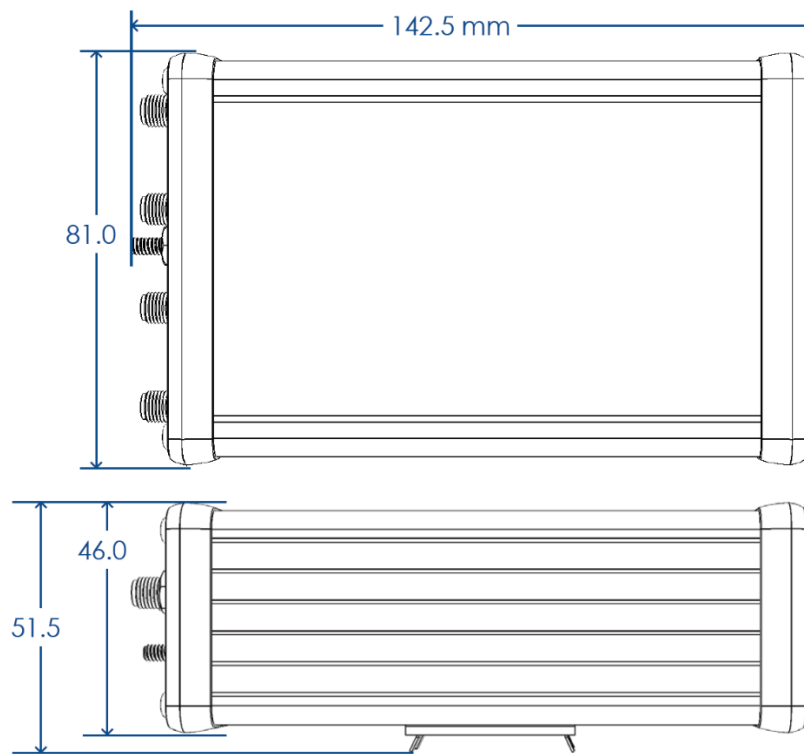
Figure 5: IRM-48 Dimensions (in mm)

3.3 DIN RAIL MOUNTING

⚠ **CAUTION**

ENSURE THE INSIDE OF THE PANEL IS WITHIN THE READER'S OPERATING TEMPERATURE AND THAT THERE IS ADEQUATE AIR FLOW TO PREVENT OVERHEATING.

The IRM-48 Reader is mounted on standard 35 mm din rail. It can be mounted either vertically or horizontal by changing the orientation of the mounting clip.

The din rail mounting clip is located on the back of the IRM-48 Reader and is screwed on to the frame. The clip is normally oriented for vertical installation of the reader on to a din rail. To change the installation mounting orientation, remove the 2 screws holding the mounting clip to the frame of the reader. Once removed, turn the mounting clip 90 degrees in the desired direction and screw on the mounting clip to the two additional tapped holes on the frame of the reader.

Figure 6: Horizontally Installed Din Rail Mounted Reader

Figure 7: Vertically Installed Din Rail Mounted Reader

3.3.1 Installation Location

The IRM-485 Reader is intended for installation in LV compartments of switchgear, other electrical assets, or in weather protected enclosed locations. The Reader is required to be installed within 7m of the Air Interface, the maximum length of the Air Interface Antenna RF cable.

3.3.2 Recommended Spacing

It is recommended to allow up to 5 cm (2 in.) for the IRM-48 Reader connectors. It is best to have the USB connector easily accessible.

4 WIRING

> ⚠️ **WARNING**
>
> SYSTEM WIRING SHOULD BE PERFORMED ONLY BY PERSONNEL WHO ARE TECHNICALLY COMPETENT AND AUTHORIZED TO DO SO. LOCAL REGULATIONS REGARDING ELECTRICAL INSTALLATION AND SAFETY MUST BE OBSERVED.
> **Failure to follow the instructions given can result in death or serious injury**

> ⚠️ **WARNING**
>
> TO AVOID ELECTRICAL SHOCK. AC POWER WIRING MUST NOT BE CONNECTED TO THE SOURCE UNTIL ALL WIRING CONNECTIONS PROCEDURES ARE COMPLETED.
>
> **Failure to follow the instructions given can result in death or serious injury**

> ⚠️ **WARNING**
>
> CHECK THE INFORMATION LABEL ON THE CASE TO DETERMINE THE CORRECT VOLTAGE BEFORE CONNECTING TO A LIVE SUPPLY.
>
> **Failure to follow the instructions given can result in death or serious injury**

> **IMPORTANT**
>
> The wiring diagram below shows all possible combinations. The actual connections required depend upon your system installation.

The Reader terminal connections are illustrated in the figure below. In general, all wiring connections are made to the instrument after it is installed.
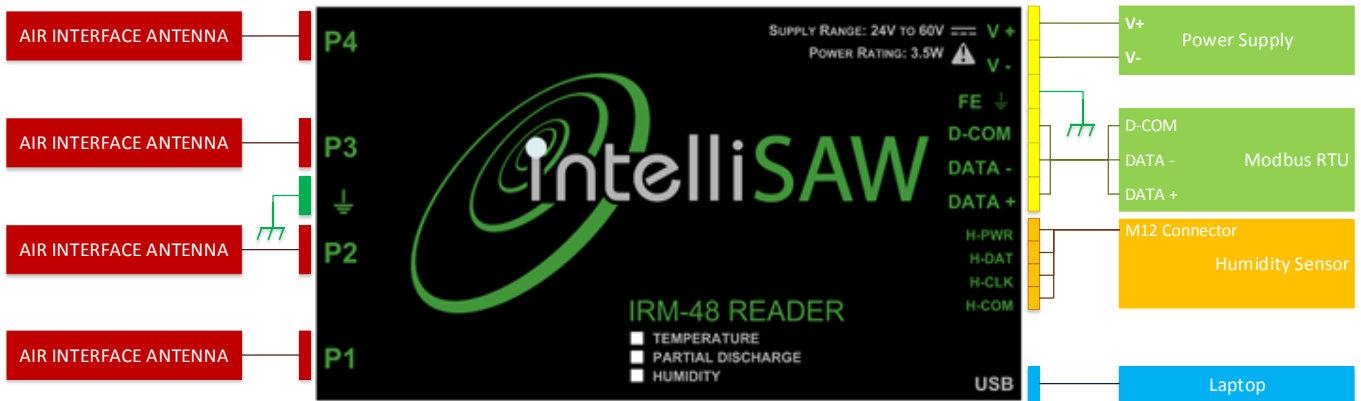
Figure 8: IRM-48 Connections and Common Wiring

4.1 POWER AND MODBUS RTU CONNECTIONS

The IRM-48 Reader uses a single connector for power and Modbus RTU communication. The Connector is a 6 position Male connector. The connector accepts 16-26 AWG wire.

It is recommended that Ferrules be used for all terminating wires.
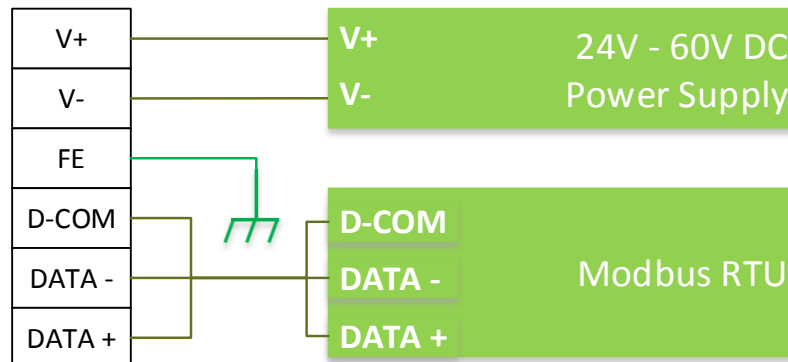
Figure 9: Power and Modbus RTU Connections

4.1.1 Power

The IRM-48 Reader operates at 48VDC nominal power, but can operate between 24 to 60V DC with a total power consumption of 3.5 W. The following block diagram outlines the recommended power wiring for the IRM-48 Reader with a 2-pole circuit breaker and AC/DC power supply. Surge suppression devices can also be installed on the input line and neutral if higher safety rating is required.
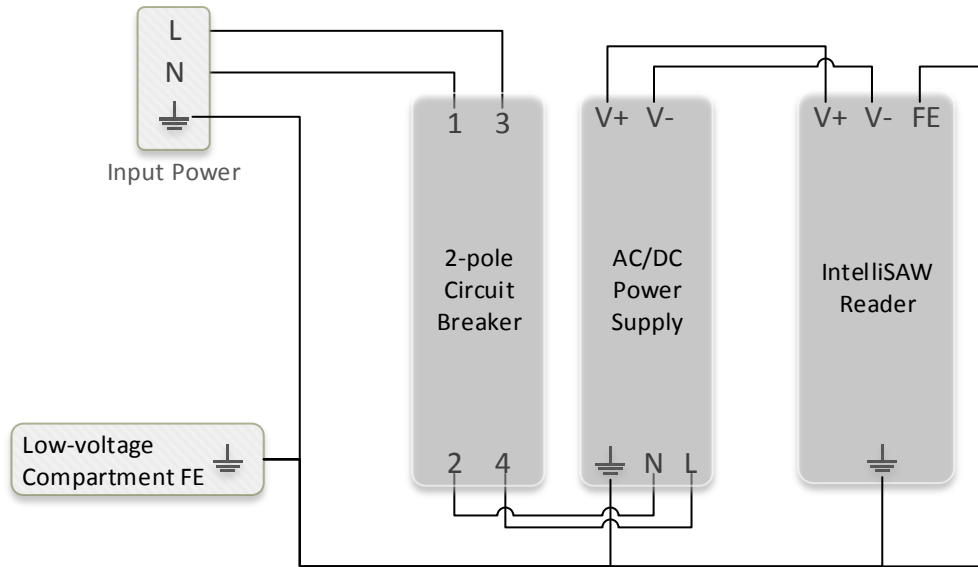
Figure 10: IntelliSAW Reader Recommended Power Wiring

4.1.1.1 Local versus bussed DC power

IntelliSAW recommends the use of a DC power supply in the same low-voltage compartment as the reader. This is the simplest and most flexible option. It is possible to run a DC power bus alongside the RS485 bus, however, this option requires careful consideration of the wire diameter. This method also increases the likelihood of EFT or surge voltages along the DC bus.

4.1.1.2 DC power wire diameter considerations

Power connections are recommended to be a minimum 18 AWG, tin-coated, soft drawn copper per ASTM B8, Class B stranding, 300V rated. Insulation shall be EP (ethylene propylene) or EPCP (ethylene propylene chlorosulfonated polyethylene compound).

If bussed power is being considered, the wire gauge must be selected to prevent excessive voltage drop between the DC power source and the reader that is electrically farthest from the source. The larger wire diameter required could force the use of a custom cable for DC power as the power bus wire cannot be the same gauge as the communications bus (RS485). Most standard RS485 bus installations use wire diameters of about 0.5mm or 24 AWG; this wire size may be too small to properly support DC power to all the readers if there are many readers a bus.

4.1.1.3 Functional Earth wiring

Functional earth (FE) connection should always be installed between the reader's FE terminal, FE post, and the FE connection in the low-voltage compartment. FE at the cable connection shunts transients at the cables, while case ground provides both RF shielding and safety against induced voltages on air interface cables.

IMPORTANT

There are two INDEPENDENT connections that shall be individually wired to the Protective Earth of the installation site such that there is an extremely low impedance between the enclosures; this is best achieved using the shortest possible ground cable.

4.2 COMMUNICATION CONNECTIONS

The IntelliSAW readers are connected in a network using a standard, half-duplex RS485 bus. This is a 3-wire bus, differential signals for data +/- and a common signal return. The common signal is clamped to PE for safety and connects to the line driver through a high resistance to prevent ground loops. The figure below shows the various elements of a network in a switchgear substation.
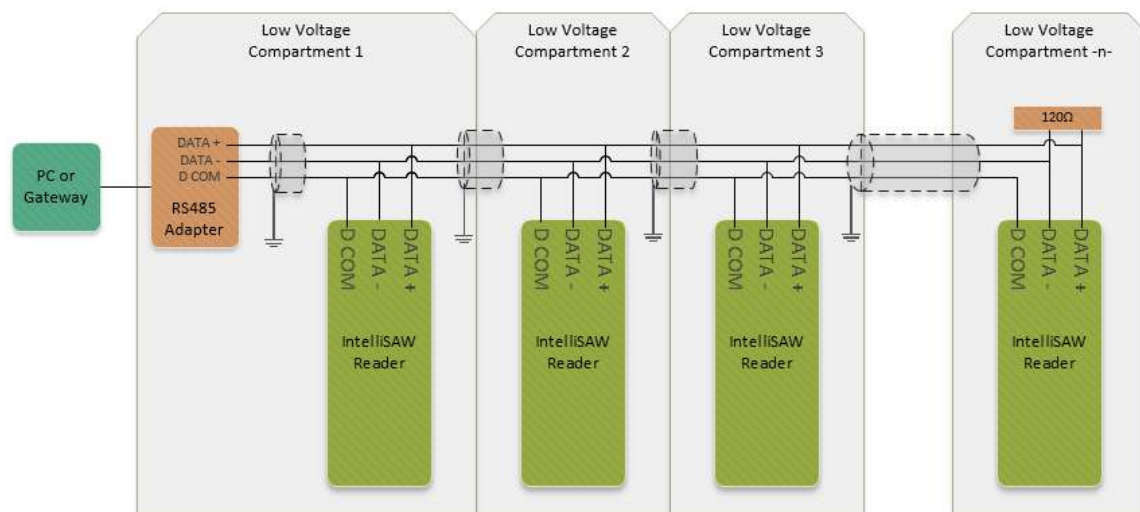
Figure 11: RS485 Data Communication Bus Topology

4.2.1.1 Recommended Cabling

IntelliSAW recommends the use of shielded cable for the RS485 wiring, providing at least one twisted pair, one single line, and a drain wire, although typical cable has two twisted pair. The twisted pair provides DATA+/- signals to each reader while the single line would be for D-COM, providing a low-impedance return for each reader.

4.2.1.2 Bus cable shielding

The drain wire associated with the RS485 bus shielding foil should be connected to the protective earth at the source end (the end of the line segment closest to the bus master) with the destination end left unconnected. This prevents ground loops and induced noise. Each

segment of the bus should be shield-terminated to the protective earth in the cabinet from which it originates.

4.2.1.3 Bus resistive termination

The RS485 bus needs to be terminated at each end with 120 Ω resistors when long stretches of cable are used. This ensures that the bus has the correct impedance. In general, RS485 adapters and bus masters provide the source impedance internally and should be located at one end of the bus.

If the bus length is less than 2% of the maximum (20 meters at 9600 baud), the termination resistor may be omitted, as long as the bus master has termination and failsafe resistors.

4.2.1.4 Bus data rate (baud rate) considerations

The RS485 bus data rate is dependent on the bus cable length and the number of readers on the bus. In industrial environments, slower data communication rates are generally more reliable; IntelliSAW recommends either 19200 baud or 9600 baud for the data rate.

Bus length

Bus cable length has an impact on the overall data rates which can be achieved. A conservative rule for RS485 uses the equation: (baud rate * cable length (m)) $< 10 \times 10^6$. A 9600 baud network would require a bus less of $(10 \times 10^6 \div 9600)$, or 1042 meters (about 3400 feet). This is perfectly adequate for most substation installations.

Number of Readers

As the number of readers increase on the RS485 bus, the baud rate must be adjusted to accommodate the electrical characteristics of the communication protection circuits. The following table is a guide for number of readers versus system baud rate:

Readers	Baud Rate
1	115,200
1 – 8	38,400
1 – 16	19,200
1 – 32	9,600

4.3 HUMIDITY SENSOR CONNECTIONS

The Humidity Sensor Connector is a 4 position male connector. The connector accepts 16-26 AWG wire. It is recommended that Ferrules be used for all terminating wires. The IntelliSAW Humidity sensor is shipped with a cable assembly.

H-PWR
H-DAT
H-CLK
H-COM

M12 Connector — **HUMIDITY SENSOR**
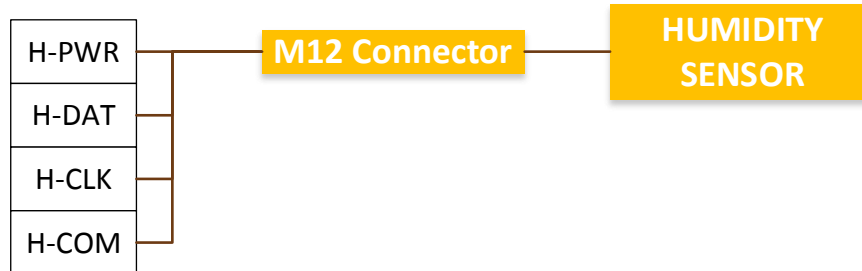
Figure 12: Humidity Connector

4.4 AIR INTERFACE CONNECTIONS

The IRM-48 Reader supports up to 4 Air Interface Antenna connections (P1-P4). The Air Interface Antenna connections on the Reader are female SMA connections. The Air Interface Antenna's connect to the Reader through RF cables with Male SMA Connectors on each end. RF Cables are provided by IntelliSAW when purchasing air interfaces. Only IntelliSAW provided antennas are suitable for the desired performance and for compliance with transmitter authorizations.

5 SENSOR INSTALLATION & SYSTEM CONFIGURATION

5.1 SENSOR INSTALLATION

This manual does not cover specific sensor installation. Please reference the **IntelliSAW Sensor Installation Manual** for more detail.

5.2 SYSTEM CONFIGURATION

The Reader requires system configuration for the associated installed temperature sensors, air interfaces, and humidity sensors. Configuration is performed through the USB port and uses the IntelliSAW Measurement Configuration Software. Details will not be discussed here, please refer to the **Configuration Software User Manual** for detailed instructions.

Figure 13: IntelliSAW System Configuration Software

6 SYSTEM INTEGRATION

The IRM-48 Reader has one RS485 slave communication connection. The Reader can be connected to a CAM-4 unit or an existing SCADA, DCS, or historian system. All IRM-48 readers are slave devices polled by either a Master CAM-4 unit or SCADA system.

The following Modbus information is for Reader Firmware rev.1123 or higher.

For legacy Modbus Register data, please contact IntelISAW support.

6.1 MODBUS COMMANDS

The Reader treats holding and input registers identically; however HOLDING registers are the preferred approach. Modbus-RTU payloads always begin with the address and a function code (FC). The Reader supports the following Modbus function codes, as shown in the following table:

Command	FC	Description
	2	Function code required by CiTect
MBF_READHOLDING	3	Fetch up to 81 of 256 defined registers
MBF_READINPUT	4	Exactly duplicates the MBF_READHOLDING command with the same registers
MBF_PRESETSINGLE	6	Set a single register – do not use in reserved registers
MBF_DIAGNOSTICS	7	Sub-functions supported are 1, 4, 10-14
MBF_FETCH_CEC	11	Return 0x0000 if not busy, 0xFFFF if busy
MBF_PRESETMULTIPLE	16	Set up to registers
MBF_RESET_COMM	19	Reset reader processor if successful.
MBF_RESET_COMM_ISR	7E	<address> <7E> <AA> <55> <crc1> <crc2> resets reader
XMS_XMESSAGE_FC	7F	The remainder of the payload contains a native command.

Modbus-RTU payloads obey the MODICON standard except for special function codes, 7E and 7F. For the 0x7F function code, the payload begins with address and 0x7F followed by an IntelliSAW native protocol command payload.

The MBF_RESET_COMM_ISR command is a special sequence that reboots the processor from within the serial receive interrupt service routine, regardless of protocol, when it is detected from a serial line idle condition.

The MBF_RESET_COMM_ISR command must be properly formatted and successfully parsed. This special sequence offers a means of resetting a reader that is otherwise externally unresponsive.

6.2 MODBUS REGISTERS

Note: table items highlighted in **blue** are not yet implemented.

REGISTER	DESCRIPTION	TYPE	MIN	MAX	SCALE	ERROR CODE
418 [1]	temp 1	signed 16	-500	1675	0.1 C	0x8000
419	temp 2	signed 16	-500	1675	0.1 C	0x8000
420	temp 3	signed 16	-500	1675	0.1 C	0x8000
421	temp 4	signed 16	-500	1675	0.1 C	0x8000
422	temp 5	signed 16	-500	1675	0.1 C	0x8000
423	temp 6	signed 16	-500	1675	0.1 C	0x8000
424	temp 7	signed 16	-500	1675	0.1 C	0x8000
425	temp 8	signed 16	-500	1675	0.1 C	0x8000
426	temp 9	signed 16	-500	1675	0.1 C	0x8000
427	temp 10	signed 16	-500	1675	0.1 C	0x8000
428	temp 11	signed 16	-500	1675	0.1 C	0x8000
429	temp 12	signed 16	-500	1675	0.1 C	0x8000
430	ambient 1	signed 16	-400	1250	0.1 C	0x8000
431	RH 1	unsigned 16[2]	0	1000	0.1% RH	0xFFFF
432	ambient 2	signed 16	-400	1250	0.1 C	0x8000
433	RH 2	unsigned 16	0	1000	0.1% RH	0xFFFF
434	ambient 3	signed 16	-400	1250	0.1 C	0x8000
435	RH 3	unsigned 16	0	1000	0.1% RH	0xFFFF
436	ambient 4	signed 16	-400	1250	0.1 C	0x8000
437	RH 4	unsigned 16	0	1000	0.1% RH	0xFFFF
438	ambient 5	signed 16	-400	1250	0.1 C	0x8000
439	RH 5	unsigned 16	0	1000	0.1% RH	0xFFFF
440	ambient 6	signed 16	-400	1250	0.1 C	0x8000
441	RH 6	unsigned 16	0	1000	0.1% RH	0xFFFF
442	ambient 7	signed 16	-400	1250	0.1 C	0x8000
443	RH 7	unsigned 16	0	1000	0.1% RH	0xFFFF
444	ambient 8	signed 16	-400	1250	0.1 C	0x8000
445	RH 8	unsigned 16	0	1000	0.1% RH	0xFFFF
446	SD1 Total	unsigned 16	0	65534	10 "Q_{uhf}"[3]	0xFFFF
447	SD2 Total	unsigned 16	0	65534	10 "Q_{uhf} "	0xFFFF
448	SD3 Total	unsigned 16	0	65534	10 "Q_{uhf} "	0xFFFF
449	SD4 Total	unsigned 16	0	65534	10 "Q_{uhf} "	0xFFFF
450	PD1 Total	unsigned 16	0	65534	10 "Q_{uhf} "	0xFFFF
451	PD2 Total	unsigned 16	0	65534	10 "Q_{uhf} "	0xFFFF
452	PD3 Total	unsigned 16	0	65534	10 "Q_{uhf} "	0xFFFF
453	PD4 Total	unsigned 16	0	65534	10 "Q_{uhf} "	0xFFFF
454	Data version = 1	unsigned 16	0	65534	na	0xFFFF
455	noise 1	unsigned 16	0	65534	10 "Q_{uhf} "	0xFFFF

[1] Registers start at 0. 418 is 400418 or 0x01A2 in the datagram.
[2] RH may be treated as signed 16 making the error code translate to a small negative number.
[3] Partial discharge and surface discharge are nonlinear, and the scale is approximate.

456	surface 1	unsigned 16	0	65534	10 "Q_{uhf} "	0xFFFF
457	internal 1	unsigned 16	0	65534	10 "Q_{uhf} "	0xFFFF
458	noise 2	unsigned 16	0	65534	10 "Q_{uhf} "	0xFFFF
459	surface 2	unsigned 16	0	65534	10 "Q_{uhf} "	0xFFFF
460	internal 2	unsigned 16	0	65534	10 "Q_{uhf} "	0xFFFF
461	noise 3	unsigned 16	0	65534	10 "Q_{uhf} "	0xFFFF
462	surface 3	unsigned 16	0	65534	10 "Q_{uhf} "	0xFFFF
463	internal 3	unsigned 16	0	65534	10 "Q_{uhf} "	0xFFFF
464	noise 4	unsigned 16	0	65534	10 "Q_{uhf} "	0xFFFF
465	surface 4	unsigned 16	0	65534	10 "Q_{uhf} "	0xFFFF
466	internal 4	unsigned 16	0	65534	10 "Q_{uhf} "	0xFFFF
467	noise 5	unsigned 16	0	65534	10 "Q_{uhf} "	0xFFFF
468	surface 5	unsigned 16	0	65534	10 "Q_{uhf} "	0xFFFF
469	internal 5	unsigned 16	0	65534	10 "Q_{uhf} "	0xFFFF
470	noise 6	unsigned 16	0	65534	10 "Q_{uhf} "	0xFFFF
471	surface 6	unsigned 16	0	65534	10 "Q_{uhf} "	0xFFFF
472	internal 6	unsigned 16	0	65534	10 "Q_{uhf} "	0xFFFF
473	noise 7	unsigned 16	0	65534	10 "Q_{uhf} "	0xFFFF
474	surface 7	unsigned 16	0	65534	10 "Q_{uhf} "	0xFFFF
475	internal 7	unsigned 16	0	65534	10 "Q_{uhf} "	0xFFFF
476	noise 8	unsigned 16	0	65534	10 "Q_{uhf} "	0xFFFF
477	surface 8	unsigned 16	0	65534	10 "Q_{uhf} "	0xFFFF
478	internal 8	unsigned 16	0	65534	10 "Q_{uhf} "	0xFFFF
479	noise 9	unsigned 16	0	65534	10 "Q_{uhf} "	0xFFFF
480	surface 9	unsigned 16	0	65534	10 "Q_{uhf} "	0xFFFF
481	internal 9	unsigned 16	0	65534	10 "Q_{uhf} "	0xFFFF
482	noise 10	unsigned 16	0	65534	10 "Q_{uhf} "	0xFFFF
483	surface 10	unsigned 16	0	65534	10 "Q_{uhf} "	0xFFFF
484	internal 10	unsigned 16	0	65534	10 "Q_{uhf} "	0xFFFF
485	noise 11	unsigned 16	0	65534	10 "Q_{uhf} "	0xFFFF
486	surface 11	unsigned 16	0	65534	10 "Q_{uhf} "	0xFFFF
487	internal 11	unsigned 16	0	65534	10 "Q_{uhf} "	0xFFFF
488	noise 12	unsigned 16	0	65534	10 "Q_{uhf} "	0xFFFF
489	surface 12	unsigned 16	0	65534	10 "Q_{uhf} "	0xFFFF
490	internal 12	unsigned 16	0	65534	10 "Q_{uhf} "	0xFFFF
491	SD1 Num	unsigned 16	0	65534	counts	0xFFFF
492	SD2 Num	unsigned 16	0	65534	counts	0xFFFF
493	SD3 Num	unsigned 16	0	65534	counts	0xFFFF
494	SD4 Num	unsigned 16	0	65534	counts	0xFFFF
495	PD1 Num	unsigned 16	0	65534	counts	0xFFFF
496	PD2 Num	unsigned 16	0	65534	counts	0xFFFF
497	PD3 Num	unsigned 16	0	65534	counts	0xFFFF
498	PD4 Num	unsigned 16	0	65534	counts	0xFFFF

7 SPECIFICATIONS

TEMPERATURE

Operating Frequency	425 to 442 MHz
SAW Sensors	up to 12
Redundancy Model	Up to 4 redundant antennas
RF Transmit Power	Pulsed, -6 to + 10 dBm[4]
RF Receive Sensitivity	-86 dBm
RF Receive Frequency Stability	± 700 Hz
RF Interrogation Distance	Up to 1.75 m (2.5 m with TPD air interface)
RF Interrogation Time	≤ 160 mSec

PARTIAL DISCHARGE

Number of Channels	Up to 4 IntelliSAW CAM Air Interfaces (TPD)
Measurement Method	Ultra-High Frequency (UHF)
Selectable Bands (Center Frequency)	300MHz, 600MHz, or 1200MHz
Measurement Types	Noise Floor, Surface Discharge (Corona), Internal Discharge (PD)
Measurement Scale	nonlinear scale, capability to calibrate to reference source
Sensitivity	100pC Q_{pk} demonstrated in 24kV switchgear, installation dependent.
Response Time	100 mSec

HUMIDITY

Number of Channels	Up to 8 IntelliSAW IH-10 sensors (bussed)
Measurement Types	Relative Humidity, Ambient Temperature

COMMUNICATION INTERFACES

Data Bus Interface	RS485 (half duplex)
Data Bus Baud Rate	4800, 9600, 19200, 38400, 57600, or 115200 baud
Data Protocol	Modbus-RTU device
Response Time	500 mSec or longer timeout recommended. (typically < 100 mSec)
Configuration Interface	USB
Configuration Protocol	IntelliSAW Native

PHYSICAL

Operating Power	48 Vdc typical (24 to 60 Vdc), 3.5W
Dimensions	81 W × 142.5 L × 46 mm H
Weight	0.3 kg (10 oz)
International Protection (IEC 60529)	IP 20
Mounting Style	DIN rail mounted
Operating Conditions	-40°C to +70°C, 10 - 95% RH non-condensing
Elevation	Up to 5000m

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[4] Using administrative settings, levels to -13.5dBm may be attained. FCC modes reduce the maximum power using these settings.

8 PRODUCT CERTIFICATIONS

8.1 COMPLIANCE

UL / cUL 61010-1 Registered	Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 1
IEC61000-6-5	**Level 4 substation EMC/EMI per IEC61000-4-x below**
IEC 61000-4-2	ESD, ±8kV contact & ±15kV air discharge
IEC 61000-4-3	RFI, 10V/m
IEC 61000-4-4	EFT, ±4kV (power, humidity, and RS485)
IEC 61000-4-5	Surge, ±2kV line-line, ±4kV line-PE, Criteria B
IEC 61000-4-6	CRFI, 10Vrms (power, humidity, and RS485)
IEC 61000-4-8	Magnetic immunity, 100V/m, 50 & 60Hz, three axes
IEC 61000-4-9	Pulse magnetic field immunity test, 300A/m
IEC 61000-4-10	Damped oscillatory magnetic field immunity, 30A/m
IEC 61000-4-11	Voltage dips and interrupts, DC power
IEC 61000-4-12	Ring wave immunity
	5kV common mode, 1kV differential (power & signal)
IEC 61000-4-16	Conducted frequency immunity
	30V cont. and 300V/1s diff., common mode to earth (power)
	30V cont. and 300V/1s, common mode to earth (signal)
IEC 61000-4-17	Ripple on DC supply
IEC 60255-5	Dielectric strength, 500Vrms per IEC61010-1 for 24Vdc equipment
IEC 60255-5	Impulse voltage, 806V per IEC61010-1 for 24Vdc equipment
EN 300 220	Conducted spurious and EMI spurious
	(restricted frequency ranges)
EN 55011	Conducted Spurious, Class A

8.2 WIRELESS CERTIFICATIONS

8.2.1 Telecommunication Compliance

All wireless devices require certification to ensure that they adhere to regulations regarding the use of the RF spectrum. Nearly every country requires this type of product certification. IntelliSAW is working with governmental agencies around the world to supply fully compliant products and remove the risk of violating country directives or laws governing wireless device usage. However, certification is dependent on the class of asset into which the equipment is installed.

8.2.2 Approved Antennas

The Reader RF module has been approved to operate with the antenna types listed below with the maximum permissible gain indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

IntelliSAW Part #	Type	Gain
IA-MM-5-y	Monopole (5 cm mast)	-1 dBi
IA-MM-9-y	Monopole (9 cm mast)	+1 dBi
IA-MM-17-y	Monopole (17 cm mast)	+3.2 dBi
IA-MM-TPD-y	Patch inverted F (PIFA)	+3.5 dBi
IA-MM-TMP-y	Patch inverted F (PIFA)	+3.5 dBi

Part Number ("y") indicates cable length and is offered in 3, 5, or 7 meters.

8.2.3 Federal Communications Commission (FCC)

This product contains **FCCID: 2AEAE-ISAW-RF-H0215**

The design of the IRM-48 complies with U.S. Federal Communications Commission (FCC) guidelines respecting safety levels of radio frequency (RF) exposure for fixed location devices.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules when the unit is professional installed in metal enclosures described in the IEEE standard C37.20. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

8.2.3.1 Installation Requirements

The IntelliSAW IRM-48 and approved antennas can be professionally installed in the following installation environments:

1. Metal enclosures described in the IEEE/ANSI Std C37.20, or UL and NEMA specifications derived from Std C37.20, as indicated in KDB 550099.
   a. The Reader is not required to be in such an enclosure since the antenna is wired away from the host.
   b. The Reader firmware shall be configured for ANSI
2. Open air operation
   a. The antenna and reader can operate outside of the metal enclosures when the Reader firmware is configured for Open Air operation.

Changes or modification to the equipment not expressly approved by IntelliSAW could void the user's authority to operate the equipment.

8.2.4 Industry Canada (IC)

This product contains device certified under **IC: 11526A-ISAWRFH0215**

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following conditions:

- This device may not cause harmful interference.
- This device must accept any interference received, including interference that may cause undesired operation.

Changes or modification to the equipment not expressly approved by IntelliSAW could void the user's authority to operate the equipment

Ce produit contient un appareil certifié en vertu IC: 11526A - ISAWRFH0215

Cet appareil se mets en conformité avec les normes CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux conditions suivantes:

- *L'appareil ne produit pas de brouillage malfaisant.*
- *L'appareil doit accepter tout brouillage radioélectrique reçu, y compris le brouillage qui pourrait provoquer le fonctionnement non désiré.*

Les changements ou les modifications apportés à l'équipement qui n'est pas expressément approuvé par IntelliSAW pourraient annuler l'autorité de l'utilisateur à utiliser cet équipement.

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