



VRF180005 Rev. E

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**VRF-2000C Series**  
of Variable Radio Frequency  
Point Level Sensors  
*Integral Electronics with Opti-Sense™ & Cable Probes*



**INSTALLATION,  
OPERATION &  
MAINTENANCE MANUAL**

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# ***SAFETY INFORMATION***

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Before installing the VRF-2000 model, please read these instructions and familiarize yourself with the requirements and functions. If any questions or problems arise during the installation, please contact Bindicator® Applications at 1-800-778-9242.

The VRF-2000 model must only be installed and operated as described in this operating instruction. Please note that other action can cause damage for which Bindicator® does not take responsibility. If the model is not installed correctly or used in approved applications, dangers may arise such as product overflow.

Ensure that all personnel installing, wiring, and calibrating this device are suitably qualified.

Observe all local and national electrical codes for the wiring of this device.

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**8.0**

## 1.0 PRODUCT DESCRIPTION

### 1.1 Function

The VRF-2000 is a line powered (AC or DC) material level sensor that outputs a DPDT relay contact. The electronics and probe are integral. It is a "point level" sensor used to detect the presence or absence of material at a point inside a tank, bin, or other vessel. Material coming in contact with the unit's probe causes its output relay to change state, thereby indicating to the user material presence.

Operation of the VRF-2000 is based upon Bindicator's Opti-Sense™ technology using Variable Radio Frequency (VRF™) which automatically selects the optimal operating frequency (20 KHz to 100 KHz) of the low voltage signal applied to the probe depending on the probe circuit impedance.

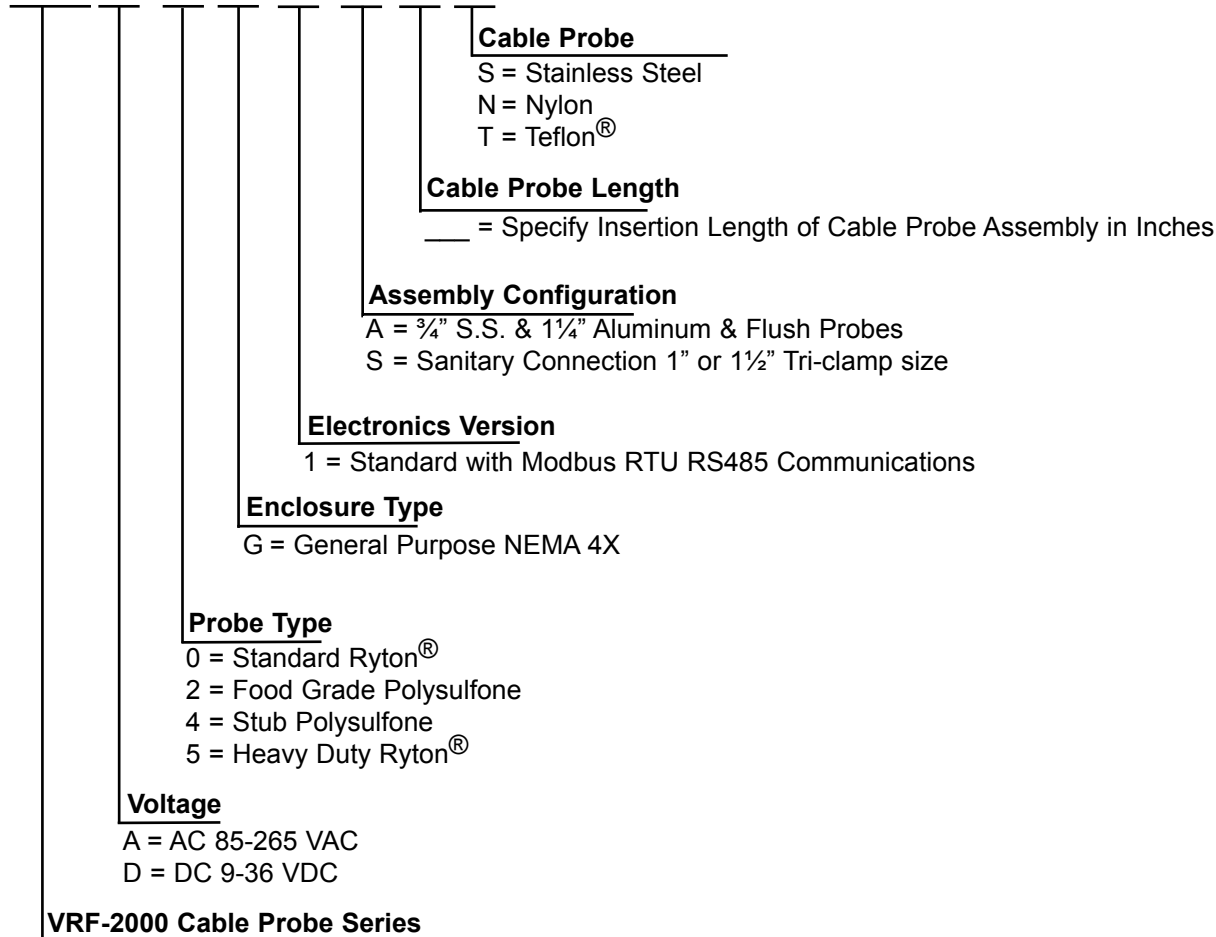
A dual core microprocessor scans the probe circuit and digitally analyzes voltage and current values to characterize the complex impedance seen by the probe. The digital signal processor continuously analyzes the conductance and susceptance of the probe circuit and calculates when to alarm the unit.

### 1.2 Applications

- Point level detection of granulars, powders, liquids, and slurries.
- Measurement of materials with a dielectric constant as low as 1.2.

### 1.3 Model Code Identification

VRF2C



**Note 1:** Maximum length 45 feet (13.71m) or 540 inches (13716mm).

## 1.4 Technical Specifications/Approvals

### Electronics

|                               |  |
|-------------------------------|--|
| <b>Line Voltage:</b>          | AC Models 85 VAC to 265 VAC<br>DC Models 9 VDC to 36 VDC                     |
| <b>Power Consumption:</b>     | 5.5 watts  |
| <b>Output Relay:</b>          | 2 form C (DPDT) 6 amps @ 240 VAC, 6 amps @ 30 VDC,<br>Minimum load 12V/100ma |
| <b>Temperature Range:</b>     | -40° F to 158° F (-40° C to 70° C)   |
| <b>Sensitivity Settings:</b>  | See Section 5.2  |
| <b>Selectable Time Delay:</b> | See Section 5.2  |

### Probes

|  |   |
|--|---|
| <b>Standard Duty:</b>                          | 316 S.S. and Ryton <sup>®</sup> , 150 PSI (10.5 kgs/cm <sup>2</sup> ),<br>-100° F to +450° F (-73° C to +232° C)                              |
| <b>Standard Kynar<sup>®</sup> Coated:</b>      | 316 S.S. and Ryton <sup>®</sup> coated with Kynar <sup>®</sup> , 50 PSI, (3.5 kgs/cm <sup>2</sup> ),<br>-100° F to 250° F (-73° C to +121° C) |
| <b>Food Grade:</b>                             | 316 S.S. and Polysulfone, 150 PSI (10.5 kgs/cm <sup>2</sup> ),<br>-30° F to +300° F (-34° C to +149° C)                                       |
| <b>Stub:</b>                                   | 316 S.S. and Polysulfone, 150 PSI (10.5 kgs/cm <sup>2</sup> ),<br>-30° F to +300° F (-34° C to +149° C)                                       |
| <b>Heavy Duty:</b>                             | 316 S.S. and Ryton <sup>®</sup> , 150 PSI (10.5 kgs/cm <sup>2</sup> ),<br>-100° F to +450° F (-73° C to +232° C)                              |
| <b>Heavy Duty Kynar<sup>®</sup> Coated:</b>    | 316 S.S. and Ryton <sup>®</sup> coated with Kynar <sup>®</sup> , 50 PSI, (3.5 kgs/cm <sup>2</sup> ),<br>-100° F to 250° F (-73° C to +121° C) |
| <b>Flush &amp; Dome Flush:</b>                 | 316 S.S. and Epoxy 50 PSI (3.5 kgs/cm <sup>2</sup> ), -30° F to +200° F (-34° C to +93° C)  |
| <b>Armored Food Grade:</b>                     | 316 S.S. and Food Grade Epoxy, 150 PSI, -30° F to +230° F (-34° C to +110° C)   |
| <b>Jumbo:</b>                                  | 316 S.S. and Epoxy, 50 PSI, (3.5 kgs/cm <sup>2</sup> ), -30° F to +200° F (-34° C to +93° C)  |
| <b>Teflon<sup>®</sup> Jacketed:</b>            | 316 S.S. and FEP Teflon <sup>®</sup> 50 PSI, (3.5 kgs/cm <sup>2</sup> ),<br>-30° F to +250° F (-34° C to +121° C)                             |
| <b>Teflon<sup>®</sup> Jacketed Heavy Duty:</b> | 316 S.S. and FEP Teflon <sup>®</sup> 50 PSI, (3.5 kgs/cm <sup>2</sup> ),<br>-30° F to +250° F (-34° C to +121° C)                             |
| <b>Fly Ash Probe:</b>                          | 316 S.S. and Ryton <sup>®</sup> coated with Kynar <sup>®</sup> , 50 PSI, (3.5 kgs/cm <sup>2</sup> ),<br>-100° F to 250° F (-73° C to +121° C) |

## 1.5 Dimensions

See section 9.0 for appropriate model drawing and applicable housing and probe dimensions.

## 2.0 HANDLING AND STORAGE

### 2.1 Inspection and Handling

The VRF-2000 is individually packed to provide adequate protection during shipping and has been tested and calibrated at the factory. When the unit is received it should be inspected for damage that may have occurred due to mishandling during shipping. If the unit is received damaged, do not dispose of the carton or packing material, and notify the shipping carrier immediately. If you have any problems or questions consult Bindicator<sup>®</sup> Customer Care at 1-800-778-9242.

### 2.2 Storage

After receiving the VRF-2000, care should be taken to avoid damage. If the unit is not scheduled to be installed soon after delivery, the following steps should be taken:

1. After inspection, repackage the unit into its original packaging.
2. Select a clean dry site free of vibration, shock, and impact hazards.

If the VRF<sup>TM</sup> point level unit will be in storage for more than 30 days, it must be stored in a non-condensing atmosphere less than 100% relative humidity. **DO NOT STORE THE UNPOWERED UNIT OUTDOORS FOR A PROLONGED PERIOD.**

## 3.0 MECHANICAL INSTALLATION

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### 3.1 Guidelines

The probe can be mounted on the side of the vessel horizontally, or on the top of the vessel vertically. The probe should be located out of the direct flow of material into the vessel.

### 3.2 Mounting

Consult the applicable dimensional drawing in section 9.0 for mounting information on your model.

## 4.0 ELECTRICAL WIRING

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### 4.1 Guidelines

The VRF<sup>TM</sup> unit is a line powered point level switch with a DPDT isolated relay contact output. Wiring will consist of:

- Grounding
- Input supply line power
- Output relay contacts for signal/control

#### Conduit-Cable Connection

Two threaded 3/4" NPT female conduit openings are provided in the housing for input and output wiring. When only one conduit opening is used for installation, the unused opening must be sealed with a suitable Type 4X/IP66 3/4" - 14 NPT plug with pipe sealant in order to maintain approval requirements.

#### Input Power

The VRF<sup>TM</sup> unit is either an AC or DC input model. Consult section 1.3 model codes, and the nameplate of the unit to determine the proper power supply.

#### Connection Information

See Figures 1 and 2 in section 4.2 for location of input and output wiring.

**IMPORTANT!** Either AC or DC power is to be connected to the power input depending on the model. Consult the nameplate of the unit and section 1.3 to determine what type of power is required. Consult section 1.4 for the allowable voltage ranges.

### 4.2 Connection Information/Wiring Diagram

See Figure 1 for location of input and output terminal blocks. Agency approved insulated barrel type terminals are supplied in the input terminal block to provide additional safety. These terminals must be used in order to maintain approval requirements. See Figure 2 for output contact positions during stages of operation.

**IMPORTANT!** An electrical earth ground connection must be made to the housing input ground screw. See Figure 1 for location. This connection is needed for both electrical safety and proper operation of the unit. This is required for both AC and DC units.

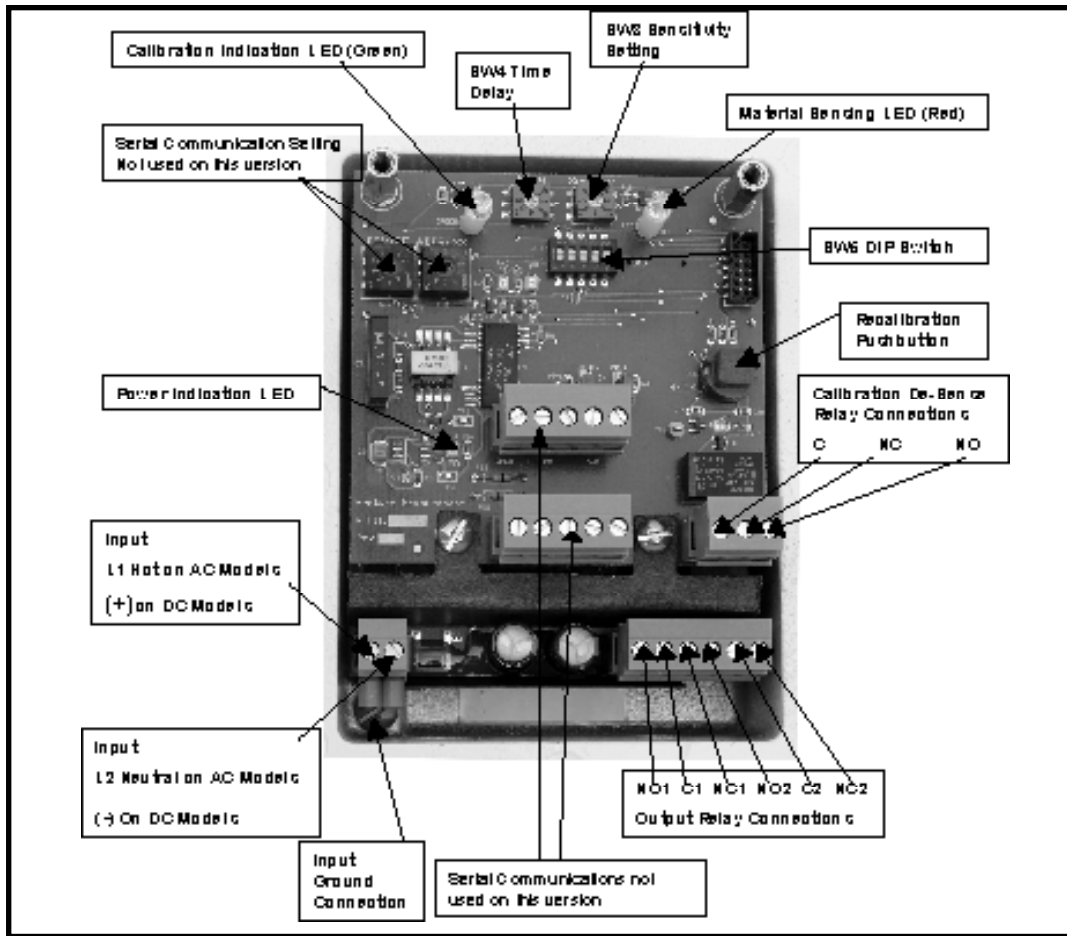


Figure 1. VRF-2000 Electronics

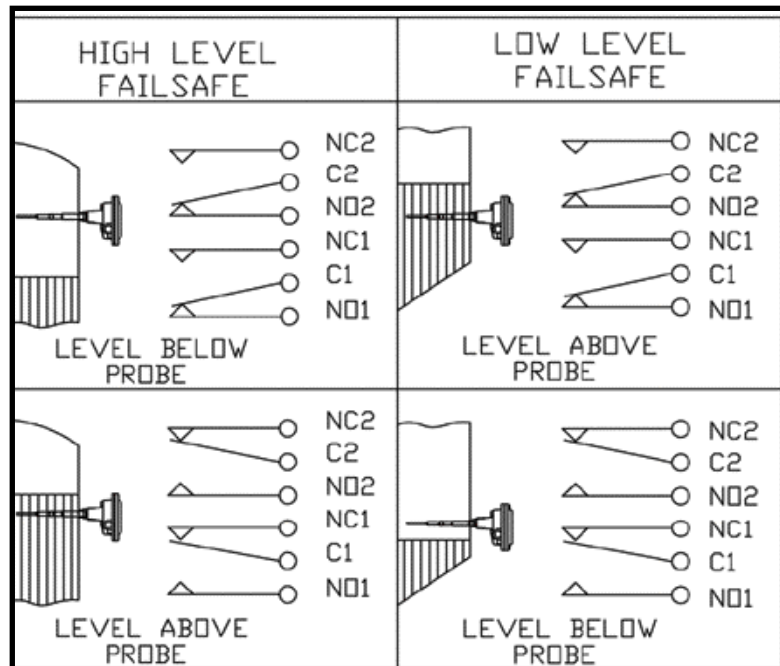


Figure 2. High/Low Level Failsafe

The output relay contacts are labeled in the un-powered alarm state. The relay is energized when the VRF-2000 is not alarmed. This status may be opposite that of other Bindicator® brand units. If the VRF-2000 is replacing an older Model RF-8000 or RF-9000 unit, connections will need to be opposite. If a connection was made to the NC1 terminal of the RF8/9000, connect now to the NO1 terminal of the VRF-2000. C1 and C2 connections remain the same.

## 5.0 SET-UP AND CALIBRATION

### 5.1 Operation

The VRF™ unit will begin operating when powered up. The sensitivity, failsafe, and time delay settings can be made without power applied. Recalibration will require that the unit be powered. Changes to the sensitivity, failsafe, and time delay do not require a recalibration.

### 5.2 Settings and Adjustments

#### Failsafe Selection

The VRF™ is shipped from the manufacturer in the high level failsafe condition. This setting is made on DIP switch SW1, position 5. See Figure 1 in section 4.2.

#### High Level Failsafe Operation

- DIP Switch SW5 position 1 is on.
- If the electrical power fails, the relay turns off. This indicates material as if the tank were full.
- Relay status LED is on when no material is present, and off when material is present.
- Material sensing LED is off when no material is present, and on when material is present.
- NC output contacts are open when no material is present and closed when material is present.
- NO output contacts are closed when no material is present and open when material is present.

#### Low Level Failsafe Operation

- DIP Switch SW5 position 1 is off.
- If the electrical power fails, the relay turns off. This indicates material as if the tank were empty.
- Relay status LED is off when no material is present, and on when material is present.
- Material sensing LED is off when no material is present, and on when material is present.
- NC output contacts are closed when no material is present and open when material is present.
- NO output contacts are open when no material is present and closed when material is present.

#### Sensitivity Setting

The VRF™ is shipped from the manufacturer in the 2pF setting. This setting is made on rotary switch SW3. See Figure 1 in section 4.2.

| Position | Sensitivity |
|----------|-------------|
| 1        | 100, 0.5pF  |
| 2        | 100, 1pF    |
| 3        | 100         |
| 4        | 100         |
| 5        | 100, 2pF    |
| 6        | 100         |
| 7        | 100, 10pF   |
| 8        | 100, 0.5pF  |

#### Time Delay Setting

The VRF™ is shipped from the manufacturer in the minimum time delay setting. This setting is made on DIP switch SW5 positions 2 and 3 to set the mode of delay, and on rotary switch SW4 to set the amount of delay. This setting will delay the time between when the VRF™ unit senses material and the output relay changes state. The delay is only in this direction, regardless of failsafe setting. There will be no delay when the material leaves the probe. See Figure 1 in section 4.2.

| Position | Time Delay |
|----------|------------|
| 1        | 100ms      |
| 2        | 100ms      |
| 3        | 100ms      |
| 4        | 100ms      |
| 5        | 100ms      |
| 6        | 100ms      |
| 7        | 100ms      |
| 8        | 100ms      |

| Position | Time Delay |
|----------|------------|
| 1        | 100ms      |
| 2        | 100ms      |
| 3        | 100ms      |
| 4        | 100ms      |
| 5        | 100ms      |
| 6        | 100ms      |
| 7        | 100ms      |
| 8        | 100ms      |



### Enable Automatic Calibration Feature

The VRF-2000 features EZ-CAL<sup>®</sup> II. This feature consists of three parts. First, is an automatic calibration when the unit is first powered up. This should be done when no material is present at the probe. Second, is an automatic recalibration if the VRF<sup>™</sup> electronics senses that the capacitance of the probe circuit has decreased significantly from what it was when it was last calibrated. Third, is the ability to manually recalibrate by momentarily pushing the recalibration pushbutton. See Figure 1 in section 4.2. The VRF-2000 is shipped from the manufacturer with the automatic calibration/recalibration feature enabled. If only manual pushbutton calibration/recalibration is desired, set SW5 DIP switch position 4 to off.

**Note:** SW5 DIP switch position 5 is not used on this version.

## 6.0 START-UP AND OPERATION

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The VRF-2000 will automatically begin operation when powered up. It should be initially powered after it is installed in the application and with material below the probe. When initially powered up, the VRF-2000 will automatically begin a 3 second calibration operation. The unit will then operate according to the settings made which are described in section 5.2.

If the unit is powered on the bench prior to installation, or moved from one installation to another, recalibration is required. Momentarily press the recalibration pushbutton. See Figure 1 in section 4.2 for location. The green calibration indication LED will go off, and after 3 seconds illuminate to indicate calibration is complete.

## 7.0 MAINTENANCE AND PARTS LIST

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If it should become necessary to replace any parts on the VRF-2000 unit, please contact Bindicator<sup>®</sup> Customer Care Department at 1-800-778-9242. You will need the model number and date code from the nameplate located on the cover of the unit. An engineer will assist you with identifying what replacement parts are available for this model.

## 8.0 TROUBLE SHOOTING

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If problems are experienced with the VRF-2000 unit, check the following:

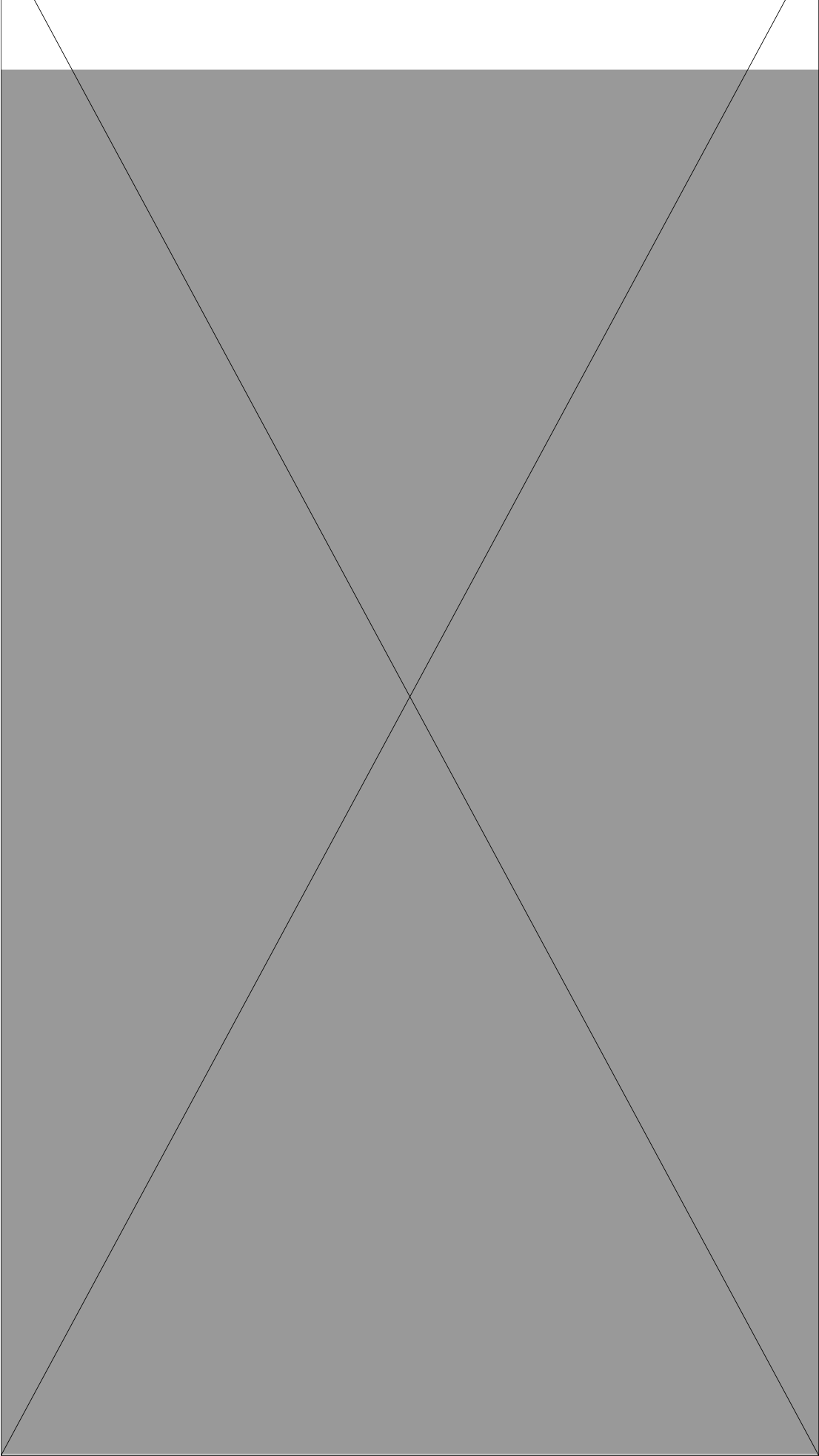
- Check for proper input voltage. If correct, the "Power Indication LED" should be illuminated. See Figure 1 in section 4.2 for location.
- Check that a good electrical earth ground is terminated to the "Input Ground Connection" screw on the housing of the unit.
- Recalibrate the unit as described in section 6.0.

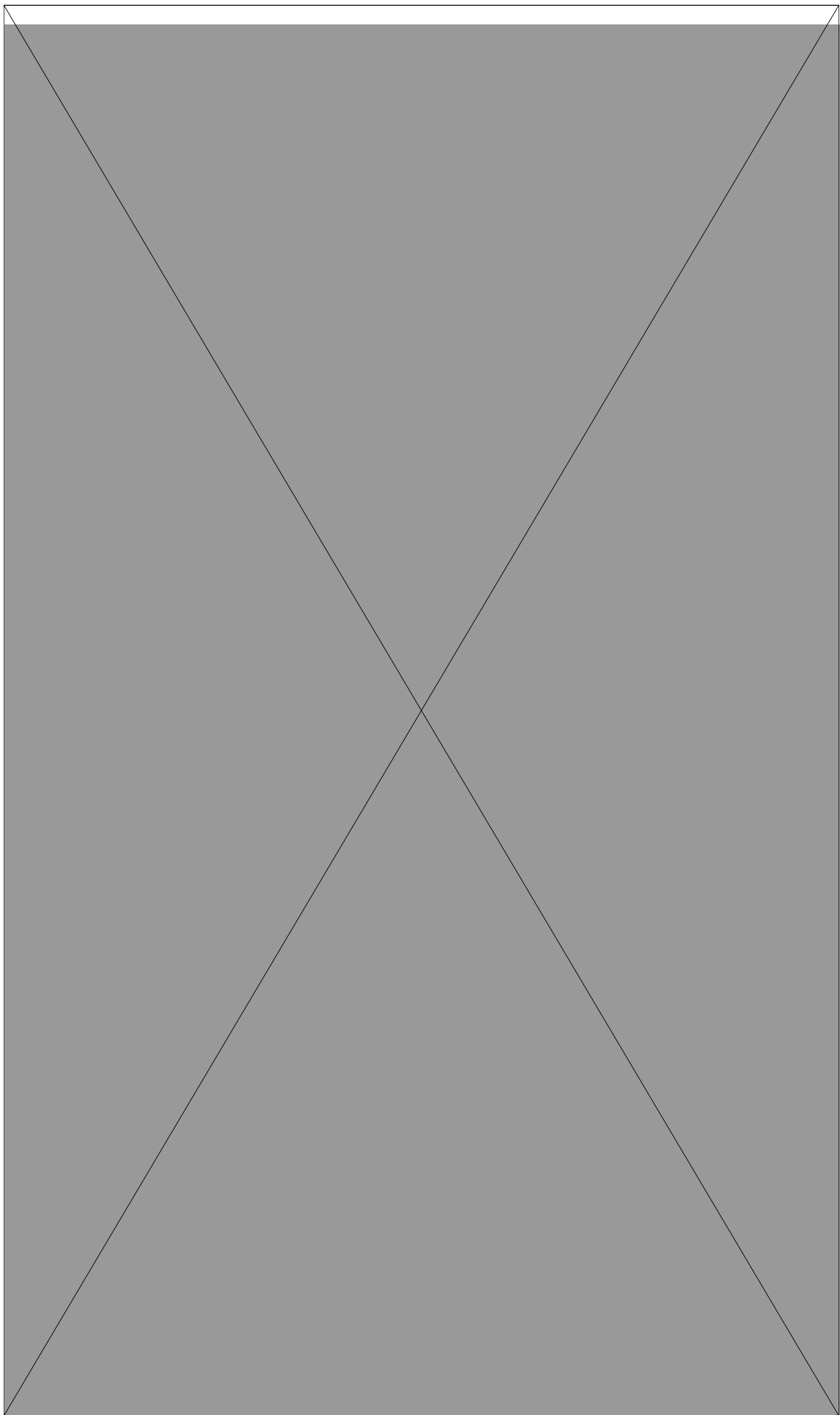
Please contact Bindicator<sup>®</sup> Customer Care Department at 1-800-778-9242 for further assistance.

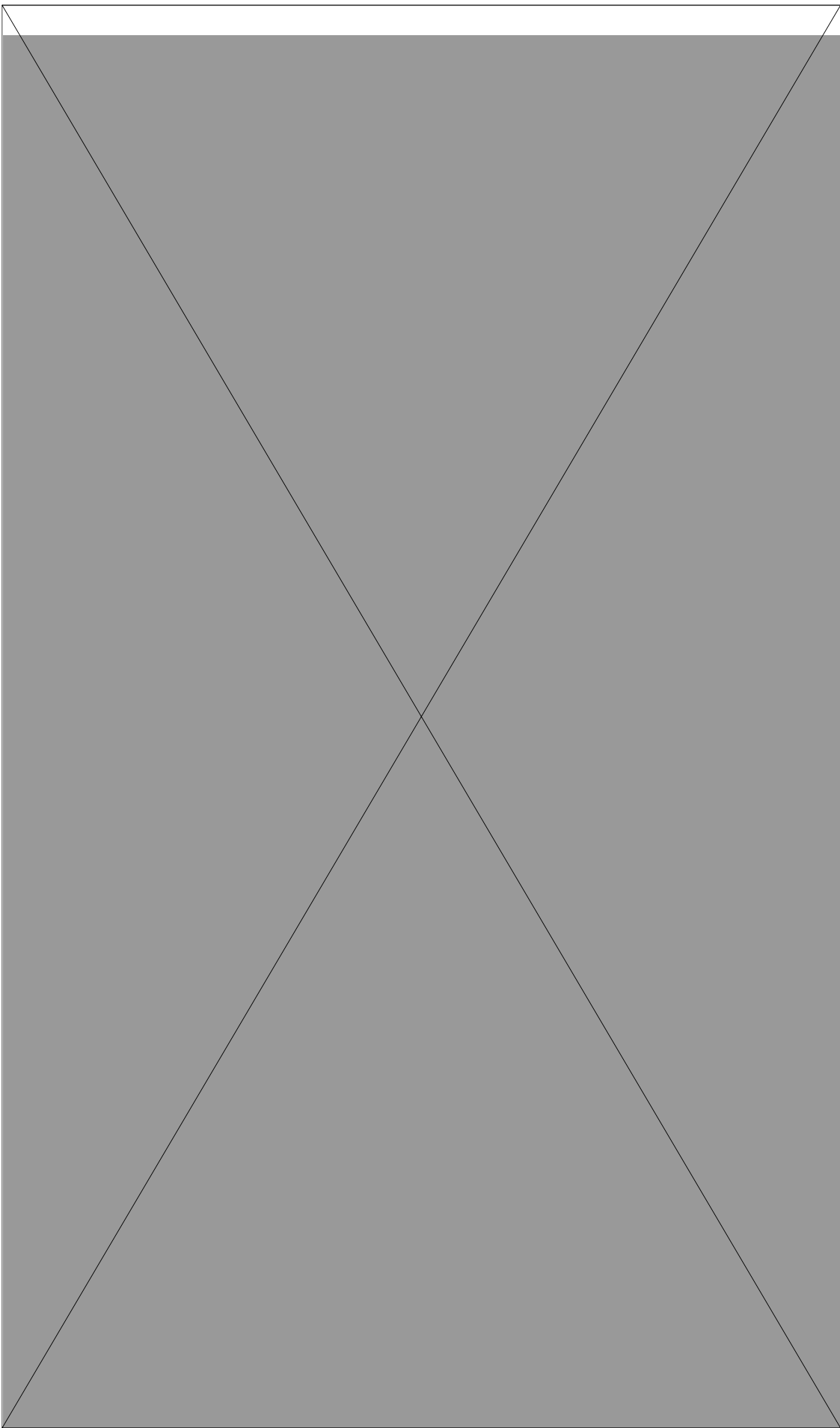
## 9.0 APPENDIX

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| Drawing Description   | Drawing Number | Rev. | Page |
|---|----------------|------|------|
| DIMENSIONAL DRAWING FOR VRF-1000 AND VRF-2000 GP CABLE PROBE      | VRF185002      | A    | 7    |
| WIRING FOR VRF-2000   | VRF185008      | B    | 8    |
| VRF-1000 AND VRF-2000 SANITARY CABLE PROBES (STUB AND FOOD GRADE) | VRF185012      | A    | 9    |







# NOTES

# NOTES

# NOTES



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