MetriCorr

TR-Monitor

Installation Manual

Document: 102618-01

Release date: July 2022

Toerringvej 7 Roedovre 2610 Denmark Tel. +45 9244 8080 info@metricorr.com

Contents

Revision	Date	Comments	Prepared	Review	Approval
1.00	2022-07-05	First release.	RCH	LBT	FGa

1 Introduction

This document describes how to install MetriCorr's TR-Monitor (Transformer Rectifier-Monitor), which comes in a standard DIN-mountable casing for easy installation.
Hereafter referred to as "TRM".

The TRM is designed to monitor various types of Rectifiers for cathodic protection of pipelines and other metal structures.

1. Pipe to reference electrode potential
2. Rectifier output current.
3. Rectifier output voltage.
4. Instant Off Interrupter, that is time synchronized with MetriCorr dataloggers
5. Off-potentials measurements

Similar to MetriCorr's Slimline series of dataloggers, the TRM holds a "MasterLink" for data communication with WEBservice, which is MetriCorr's online remote monitoring system. (CP manage)
Go www.metricor.com for more information and operation instructions for WEBservice.

This "TR-Monitor Installation Manual" can also be downloaded at www.metricorr.com/downloads.

1.1 Terms & abbreviation:

TRM	Transformer Rectifier Monitor, also referred to as "Unit".
T/R	Transformer Rectifier.
PIPE	Refers to buried metallic pipeline or other metal structure.
Rectifier	Transformer Rectifier feeding the pipe/structure with DC-current.
Interrupter	Switch/breaker connected between rectifier and pipe to interrupt the current to the pipe.
Off-potential	Pipe-potential immediately after the cathodic protection current have been cut off. (Interrupted)
WEBservice	MetriCorr's online cathodic protection management sotware, which is also known as "CP*Manage"
MasterLink	Integral part of the TRM, which handles data communication, etc.
Datalogger	Integral part of the TRM, which performs measurements on the sensor inputs.

The TRM terminals are referred to by "TRM" followed by the name of the given terminal in parentheses.

In example: "TRM (Power, Primary, 24V)".

1.2 Accessories

Connectors with screw terminals: 3 pin, 4 pin, 5 pin, 6 pin and 6 pin (wide)
Optional: Combi antenna GSM/LTE + GPS/GNSS

2 Specifications & Basic Functions

2.1 Overview of Basic Functions

POWER

PRIMARY:
Normal power source
(Power supply from mains)

SECONDARY:
Backup power source (Battery)

LAN

RJ45 socket for ether-net

COMMUNICATION

RS232: GND, RX, TX
Serial communication

IN, OUT, SUPPLY:
Software controlled Relay for powering peripheral units.

ANTENNAS

GPS:
Position and Time sync.

GSM/LTE

Mobile network

Status/Control

Control button & LED indicator

See section 3.1 for Blink patterns

INTERRUPTER (Output)

RELAY:
NO: Normally Open
NC: Normally Closed
COM: Mid terminal

Controls external switch/interrupter for the rectifier.

ALARMS (Inputs)

TAMPER: (Tamper LED)
For door switch, etc.
Normal: Switch open, LED: Green
Alarm: Switch closed, LED: Red

POWER: (T/R Power LED)
For T/R Power Failure
Power OK, LED: Green

BATTERY:
For Battery fail signal.
Battery NOT OK, LED: Red

SENSORS (Datalogger inputs)

POTENTIAL:
Voltage measurement between pipe and reference electrode

VOLTAGE:
Voltage measurement for rectifier output.

SHUNT:
Voltage input in the mV range. Connect to an external shunt resistor to measure current.

2.2 Specifications

POWER (Input)

Voltage range:	(Primary & Secondary)	[10V -> 28Vdc]
Standby Supply current:	12V dc supply	16 mA
	24 Vdc supply	12 mA
Current, maximum:	12V dc supply	100 mA, (1.2W)
	24 Vdc supply	45 mA, (1.08W)

LAN

RJ45 socket for LAN/ethernet connection

COMMUNICATION

This 5 pin connector enables power and communication to an external RS232 device.

RS232 interface	GND, RX, TX
Supply In & Out	Software controlled relay for powering peripheral units. Timing can be set in WEBservice.

ANTENNAS

GSM/LTE antenna	2G / 3G / 4G / 5G
GPS antenna	GPS / GNSS

Status/Control

See section 3.1 MasterLink – Control Button & “Status LED”

INTERRUPTER

This relay output controls interruption of cathodic protection current for off-potential measurements. The relay combines a bi-directional Solid State Relay and a mechanical relay for fast response time and true “Normally closed” operation” in case of power down.

Relay specifications:

Type:	Bi-directional Solid State Relay + mechanical failsafe relay
Maximum peak voltage:	± 30 V
Maximum current:	500 mA
Isolation voltage:	

For higher currents (> 500 mA) an external relay can be controlled using this output. See section 4. Installation of TR-Monitor

ALARMS

These 3 inputs are logical HI or LO and galvanically isolated from each other and all other inputs and outputs.

Voltage range:	[0Vto 30V]
HI state minimum voltage:	2.5V
LO state maximum voltage	0.7V

TAMPER: Typically used for door switch
POWER: Typically connected to the rectifiers “Power monitor” output.
BATTERY: Typically connected to an UPS/battery charger/controller that indicates low battery voltage.

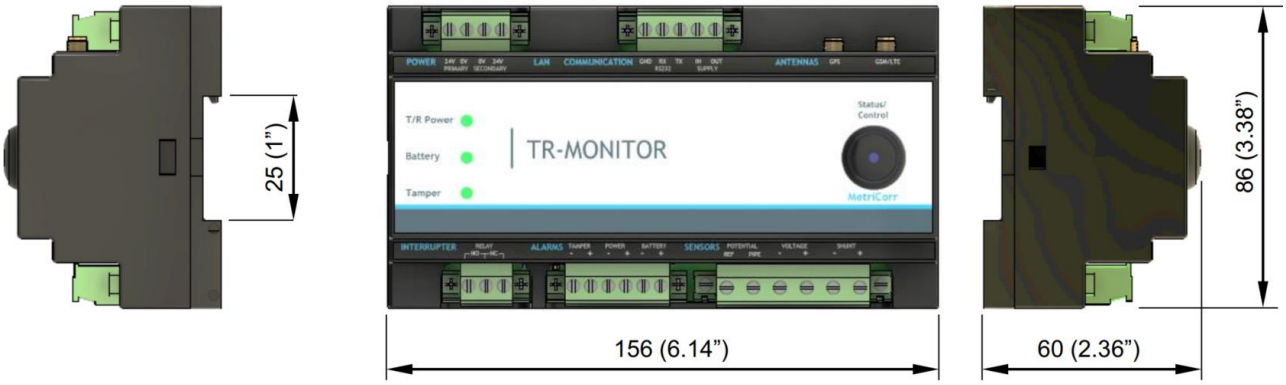
SENSORS (Datalogger inputs)

POTENTIAL (REF input to PIPE input) and **VOLTAGE** ("+" input to "-" input)			
Electrical charac-teristics	Voltage range:	± 100 V_{DC} 100 V_{AC}	
	Input resistance	~ 10 MΩ	(resistive)
	AC to DC rejection	- 80 dB	
	DC voltage resolution:	0.1 mV	
	DC voltage accuracy:	± 1mV ± 0.3%	
	AC Voltage Resolution	0.1 mV	
	AC Voltage Accuracy	± 1mV ± 1%	
Surge Protection	Nominal Discharge Current 8/20 µs	5 kA	15 hits
	Lightning Impulse Current 10/350 µs	1 kA	(Based on energy handling capability)
	4 kV according to EN/ISO 61000-4-5, installation class 4.		
Isolation voltage	1 kV continuously 2.5 kV for 1 second		Isolation voltage to all other inputs

SHUNT ("+" input to "-" input) *Millivolt input for current measurement using an external shunt resistor*			
Shunt selection (Examples)	Recommended DC Voltage range for shunt selection, max	± 200mVdc	
	Rectifier output 100A	125A / 60 mV	Shunt resistance 0.48 mΩ (P_{max} = 6.0W)
	Rectifier output 20A	25A / 150 mV	Shunt resistance 6.0 mΩ (P_{max} = 3.0W)
	Rectifier output 3A	4A / 150 mV	Shunt resistance 37.5 mΩ (P_{max} = 0.45W)
	WEBservice calculates the corresponding current from a user-determined shunt resistance value.		
Electrical charac-teristics	Absolute max. continuous voltage	± 10 V_{DC} 10 V_{AC}	
	Voltage range (peak, incl. AC)	± 1 V	Before clipping
	Input impedance	33 kΩ	(resistive)
	AC to DC rejection	-80 dB	
	DC voltage resolution	0.2 µV	(0.2mA @ 1mΩ, 2µA @ 100mΩ)
	DC voltage accuracy	±1 µV ±0.1% rdg	(1mA ±0.1% rdg @ 1 mΩ, 10µA @ 100mΩ)
	AC Voltage Resolution	0.2 µV	(0.2mA @ 1mΩ, 2µA @ 100mΩ)
	AC Voltage Accuracy	±5 µV ±0.1% rdg	
Surge Protection	Nominal Discharge Current 8/20 µs	10 kA	15 hits
	Lightning Impulse Current 10/350 µs	2.5 kA	(Based on energy handling capability)
	4 kV according to EN/ISO 61000-4-5, installation class 4.		
Isolation voltage	2.5 kV for 1 second	Isolation voltage to all other inputs	

General	
Casing	IP20, DIN-rail mount
Operating temperature range	-40 °C to +85 °C
Dimensions	L: 156mm, W: 60mm H: 86mm

MasterLink	
Storage capacity	+200,000 readings
Logging intervals	10 min → ∞, recommended 1 hour
Communication	LTE Cat. M – 4G/5G with 2G fall back Ethernet RS232 GPS/GNSS Position and Time Synchronization



2.3 LED indicators & Alarm inputs

The three LED indicators on the left side of the front panel indicates the status of the TRM alarm inputs, which can be either logically low or high.

- **"T/R Power"** is dedicated to show the status of the T/R to be monitored. Many T/R's are equipped with a "Power monitor" signal output that can be connected to the TRM (Power) inputs.

- **"Battery"** is dedicated to indicate if the battery is de-charged or defect. Battery powered UPS supplies are often equipped with a status signal output that can be connected to the TRM(Battery) inputs.

- **"Tamper"** is dedicated to i.e. a door-switch to indicate intrusion/access to the TRM-installation.

The three LEDs will light up red or green according to the following table:

Logical Input Level	Low	Unconnected	High
LED Indication			
Power	Green	OFF	OFF
Battery	OFF	OFF	Red
Tamper	Green	Green	Red

If all TRM (ALARM) input terminals are left unconnected, the "T/R Power" and "Battery" LEDs will be turned off and the "Tamper" LED will be green.

3 Data transmission & WEBservice

Measurement data from the sensor inputs can be transmitted by the MasterLink via mobile network or ethernet connection using MetriCorr's WEBservice. https://data-metricorr.com.

MasterLink data communication

1. **Mobile network** wireless LTE/GSM to WEBservice
2. **Ethernet** cable connection to external router/modem

New customers must provide company name and email address to MetriCorr to receive account information (username and password) to login to WEBservice at https://data-metricorr.com.

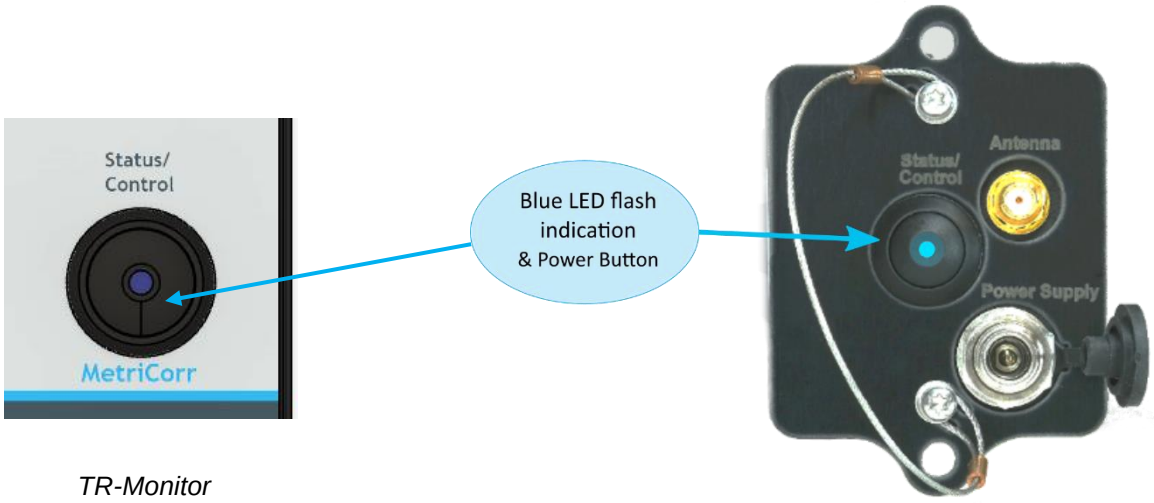
Please contact MetriCorr at support@metricorr.com

It is possible to acquire several logins (username and password) to the same WEBservice account.

To link a new MetriCorr device to an existing account, please send an email to support@metricorr.com with the following information:

- **Account Name** (existing or new) you wish the unit(s) to be assigned to.
- **User email address** (for new users to log in to existing or new accounts**)**
- **MasterLink Serial Number(s)** you wish to link to the account

3.1 MasterLink – Control Button & “Status LED”



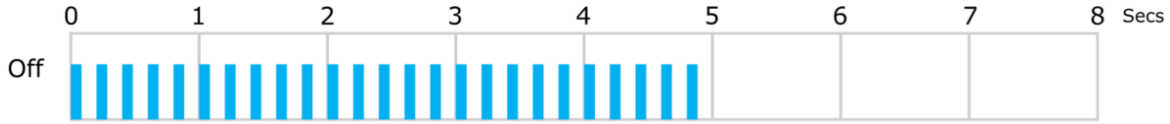
TR-Monitor

Slimline MasterLink/Datalogger

The Blue Status LED indicates the state of the MasterLink.

Pressing the control button shortly (< 0.5s) may result in any of the two LED flash patterns below:

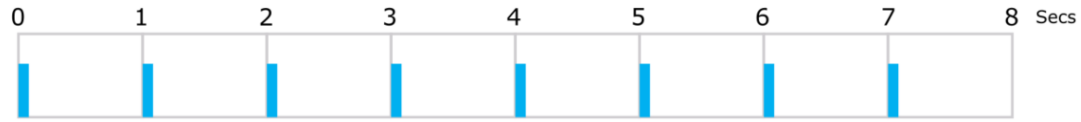
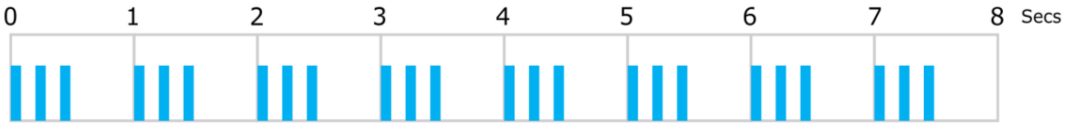
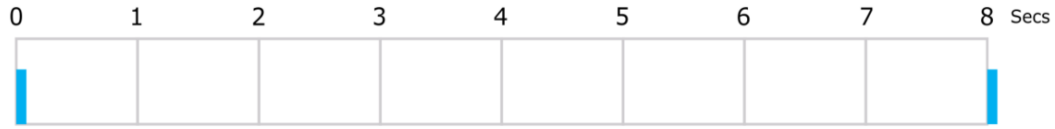
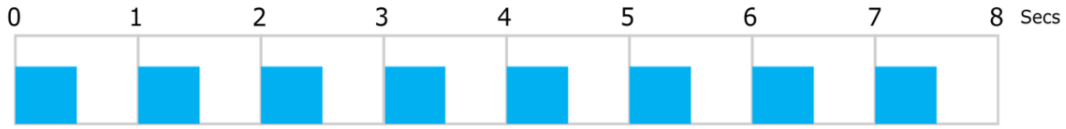
25 short blinks indicates that the unit is turned off. This state is rarely used for other applications than MetriCorr’s VL100/MasterLink with built-in lithium battery.

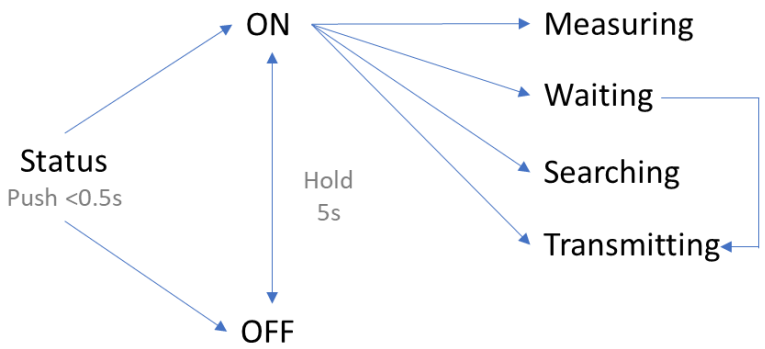


11 blinks indicates that the unit is in “Sleep mode”, which minimizes the current consumption, ideal for battery operated installations.

Pressing the control button for at least 5 sec will turn the unit on or off.

Pressing the control button for at least 1 sec, but less than 5 sec will put the MasterLink in "Searching" mode, indicating that WEBservice or COM port communication is attempted.

<table>
<tr><th></th><th>WEBservice</th><th>COM port (Satellite & standalone)</th></tr>
<tr><td rowspan="2">Searching</td><td>The MasterLink is searcing for a network.</td><td></td></tr>
<tr><td colspan="2">1 short (0.5 ms) flash repeated every second.
 
</td></tr>
<tr><td rowspan="2">Trans-mitting</td><td>The MasterLink is transmitting data to WEBservice</td><td></td></tr>
<tr><td colspan="2">3 short (0.5 ms) consecutive flashes repeated every second.
 
</td></tr>
<tr><td>Sleep mode</td><td colspan="2">After data transmission has been performed, the unit will go into "Sleep mode", indicated by a short blink every 8 second.
 
</td></tr>
<tr><td>Measuring (Dataloggin g)</td><td colspan="2">When the unit is performing measurements, the LED will blink once a second.
 
</td></tr>
</table>



4 Installation of TR-Monitor

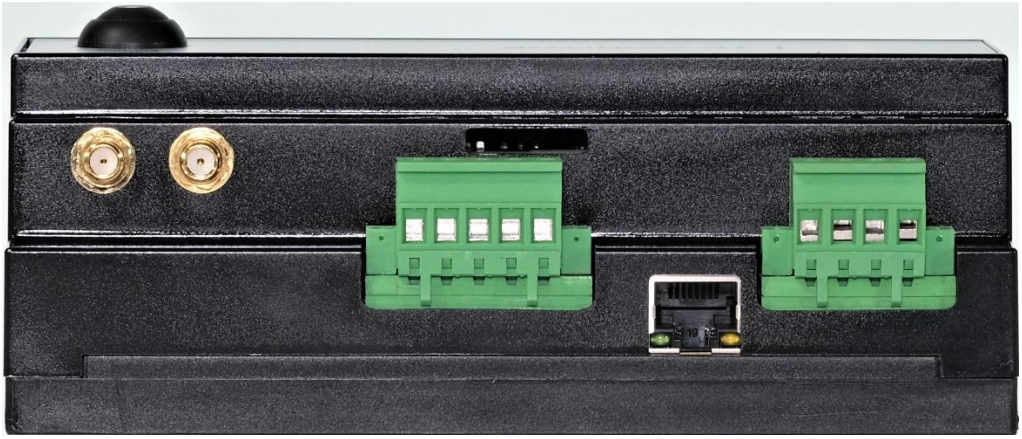
MetriCorr's TRM is designed for easy installation in existing rectifier installations for cathodic protection. This section describes how the TRM is installed in a typical installation of a rectifier for cathodic protection of a pipeline. See the schematic in section 4.1 Schematic example (TRM - existing installation)

For this example, the existing installation consists of the following components:

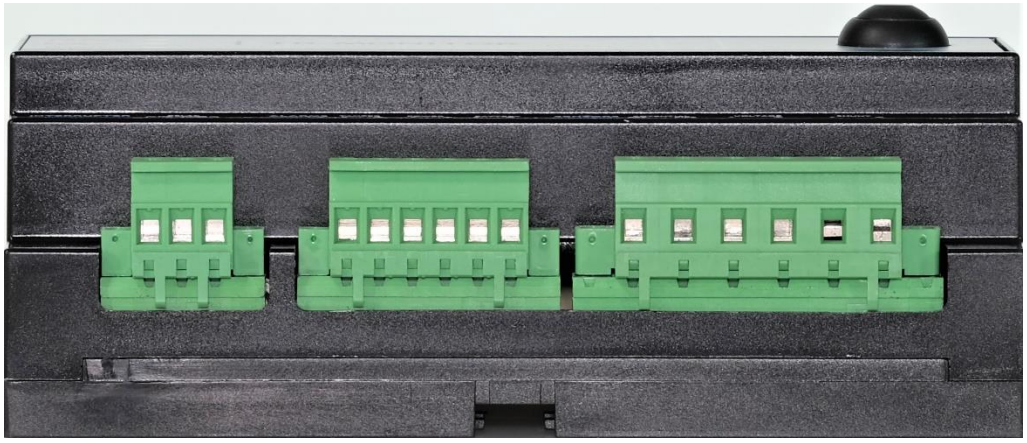
- Rectifier
- Relay / Interrupter (of rectifier current)
- Anode bed
- Reference electrode
- Door Switch (Normally closed)

TRM & peripheral components to be installed:

- TRM (MetriCorr)
- Power supply (12 Vdc or 24 Vdc, minimum 5W)
- Antennas (GSM/LTE and GPS)
- Battery (optional, for backup power in case of power outages)

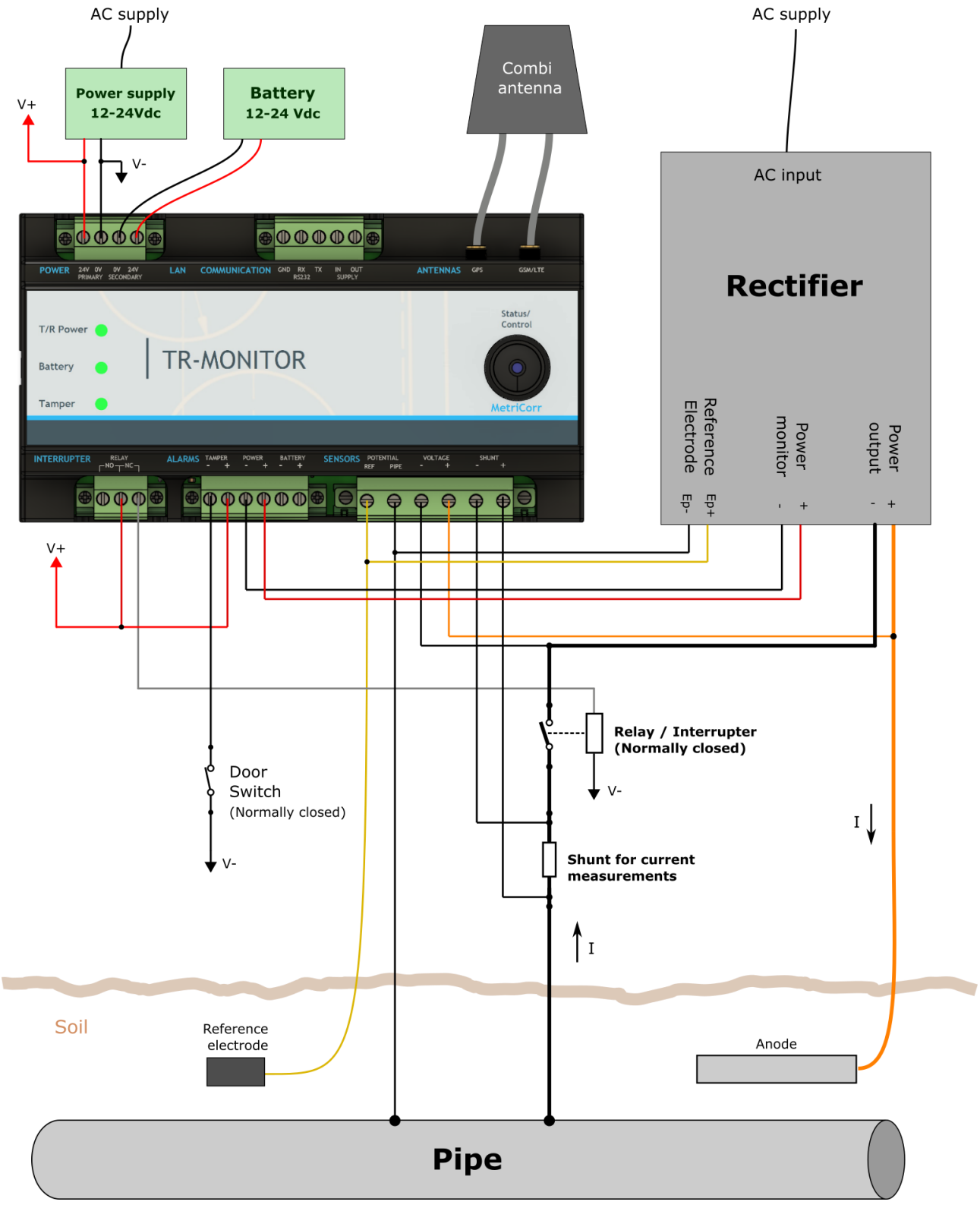


Top view,
MetriCorr
TRM



Bottom view,
MetriCorr
TRM

4.1 Schematic example (TRM - existing installation)



4.2 Installation Instructions

1. Select the shunt to make sure that the maximum voltage across the shunt does not exceed ± 200 mVdc under normal full range operation. (At maximum rectifier output current).

2. Make sure that the control voltage of the installed “Relay / interrupter” match the power supply level, i.e. 24 Vdc.

SENSORS (Datalogger inputs)

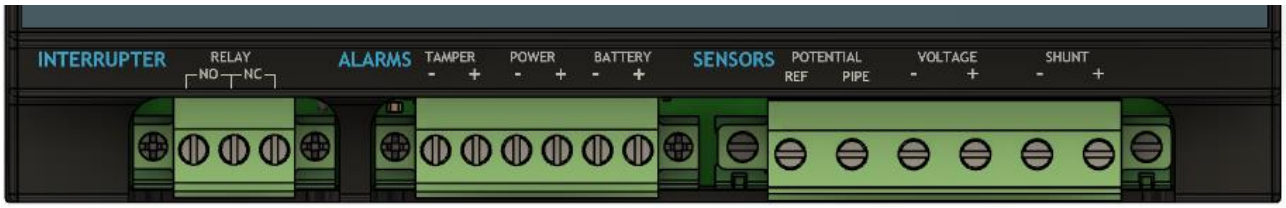
1. Connect the reference electrode to both TRM (POTENTIAL, Ref) and the dedicated input terminals on the rectifier if available.

2. If **two pipe connections** exist, connect the second pipe connection directly to TR-M (PIPE) and the rectifier measurement input as shown on the schematic, section 4.1. (This will minimize the error from the voltage drop across the pipe cable for better measurement and rectifier accuracy).
   If only **one pipe connection** exists, connect TRM (PIPE) to TRM (SHUNT, +) and the rectifier measurement input, so both inputs are connected to the pipe.

3. Connect both TRM (VOLTAGE) terminals to the rectifier output terminals as close to the rectifier output terminals as possible. (To minimize errors due to voltage drop across the cables to anode and pipe.

4. Connect TRM (SHUNT, +) to PIPE.
   Connect TRM (SHUNT, -) to the Relay / interrupter.
   This connection will result in a positive current value in relation to the normal current direction indicated with arrows on the schematic, section 4.1.

5. Connect the control input of the Relay / interrupter (relay coil) to TRM (Relay, NC).
   Connect TRM (Relay, COM), positioned between the NO and NC terminals, to V+. This configuration will ensure that the control input of the Relay / interrupter is at 0V in case of power failure of the TR-M module.



ALARMS

1. Connect the door switch to TRM (TAMPER, -) and V-.
   Connect TRM (TAMPER, +) to V+.
   If there’s no door switch, leave both TAMPER inputs unconnected.

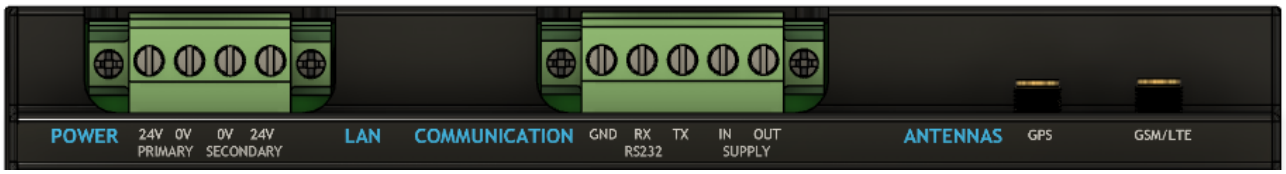
2. Connect TRM (POWER, - and +) to the rectifier power monitor outputs if available. Otherwise leave both TRM(POWER) inputs unconnected.

3. UPS/Battery power supplies are typically equipped with a status output signal that can be connected to the TRM (BATTERY) inputs. (Not shown on the schematic, section 4.1).
   However, this example uses the secondary power input for battery backup supply. Here, the TRM (BATTERY) inputs can be left unconnected.

POWER

1. Connect the DC power supply (12 Vdc to 24 Vdc) to the TRM (POWER, PRIMARY) inputs.
   "24V" is referred to as "V+". "0V" is referred to as "V-".
   MetriCorr recommends that the DC power supply is connected to the same AC supply as the rectifier to enable the TRM to monitor the AC supply to the rectifier.

2. Connect backup battery (or other backup power supply) to the TRM (POWER, SECONDARY) inputs.
   Note! The TR-M module will internally connect to either the primary or secondary input due to the following conditions:
   - Primary input connected if the primary power supply is available.
   - Secondary input connected if the primary power supply is NOT available.



LAN & COMMUNICATION

1. Typically, the MasterLink communicates with WEBservice via the GSM/LTE antenna. As an alternative, a wired LAN-connection or a modem with RS232 interface can also be used to transfer date in example at locations where wireless signals are not available.
   For this example, LAN and COMMUNICATION terminals are left unconnected.

ANTENNAS

1. A GSM/LTE antenna that meets the requirement of the available network in your area must be connected to the TRM (ANTENNAS, GSM/LTE) terminal to establish wireless data connection for the MasterLink.

2. Reception of GPS coordinates and time stamps for synchronization of multiple TR-Monitors for off-potential measurements can be realized in two ways:
    a. A dedicated GPS/GNSS antenna can be connected to the TRM (ANTENNAS, GPS) terminal. This antenna must have unblocked access to the sky to receive data from the required satellites.
    b. If no external antenna is connected to the TRM (ANTENNAS, GPS) terminal, the internal GPS/GNSS antenna on the TRM circuit board can be used. Setup up of the internal GPS/GNSS antenna is done in WEBservice. See www.metricorr.com for further instructions.

Please visit:

www.metricorr.com

LinkedIn

YouTube

MetriCorr

Toerringvej 7
2610 Rodovre
Denmark
Phone: +45 92 80 80
Email: support@metricorr.com