

CONNECTION GUIDE





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Introduction

The LiveWire Mantis[™] is an energized cable monitoring system based on Spread Spectrum Time Domain Reflectometry (SSTDR). It detects, locates, and characterizes faults, static, persistent, or intermittent, to show where and when they occur. This information can then be transmitted wirelessly or over data cables to send alerts, enabling an instant response by maintenance personnel.

This document is a supplement to the Mantis Instruction Manual and is intended to aid in the connections that are necessary to operate the Mantis SSTDR tool.

The Mantis is connected in the system at a substation and used to monitor external cables. The connection guide demonstrates how to connect the Mantis for monitoring. An example of the overall Mantis system in a rail configuration is shown in Figure 1:



Figure 1. Mantis configuration in rail system

System Requirements



T00032-2 Top Assy rev A Mantis Assy - Fibox Enclosure (PWR / USB / RJ Face plate interface)

B) Front panel Interface: 1- PWR connector 2- USB Interface 3- RJ Interface

C) Terminal block Interface for DC / SSTDR lower section 4-Terminal Block: Phoenix 3244012 (2) 5-Terminal Elock: Phoenix 3244216 (2) 6-Terminal End Cap: Phoenix 3024180 (2) 7- Cable Glands: Fibox 3545080 (2)

Figure 2. Mantis unit diagram

Note: The Ethernet connector (RJ45) may be located in different locations on different Mantis models. In some of the images following, the RJ45 is located on the bottom of the Mantis rather than on the faceplate as shown in the above image.

Part Number: LW-MM200

Additional Equipment Required

Additional PC equipment is required for the Windows PC Interface application to set up and control the Mantis and read certain test results and data. See LiveWire Mantis User Manual (Windows PC Interface Version) located at livewireinnovation.com/downloads.

May be required:

Isolation Kit: Application-specific components.

DIN-Rail mount terminal block or similar to facilitate a functional/safe t-junction with isolation kit.

Mantis Connection Overview

An electrical cable system typically consists of three major components (see Figure 3):

- 1. Power source (generator, battery, wall outlet)
- 2. Cable or wire connecting the source to the load (phase-to-phase, phase-to-ground, phase-to-neutral, twisted pair, coaxial)
- 3. Load (motor, lights, trains, sensors, heater, etc.)





The Mantis is a 2-wire tester, much like a volt or ohmmeter. It uses two test leads to connect to two different cables that the Mantis monitors. One test lead of the Mantis unit should be connected using a T-junction at point A in Figure 4 below. The other Mantis test lead should be similarly connected to a t-junction at point B in Figure 4.

In order for the Mantis unit to monitor the entire length of cable or wire, the test leads must be connected to the cable *as close* to the source as possible. Connecting close to the source ensures that the entire length of cable is diagnosed, connection points are easily accessible, and protected from environmental damage. The source may also need to be isolated from the Mantis using an isolation filter from the isolation kit, shown in Figure 5. The isolation kit is optional depending on the application.

An example of the Mantis connection in a simple system is shown in the diagrams below:





Mantis connection with isolation filter (may be required):



Figure 5. Mantis connection to cable system with isolation filter

Connection points at the source may be circuit breakers, fuses, DC/DC transducers, etc. An example of the Mantis connected to a DC/DC transformer is included in the **Connecting the System** section of this guide in Figure 23.

Once the Mantis connection points are determined, it is time to begin Mantis installation.

LiveWire Mantis[™] Installation

Mounting the Unit

Begin by securely mounting the Mantis unit with enough working space to install wires below the Mantis, about 4".

Electrical Connections

There are three physical connections required for the Mantis shown in Figure 6:

- 1. Ethernet (TCP/IP) cable via an RJ45 connector
- 2. DC power, 2-wire, 12-28 VDC.
- 3. 12-28 AWG 2-wire connection (Test Leads) for SSTDR diagnostics



Figure 6. Required Mantis connections

These connectors can be seen in Figure 7 below:



Figure 7. Mantis connectors

Note: The RJ45 Ethernet connector is located on the bottom of the Mantis unit in the following diagrams. This connector may be located on the faceplate as shown above.

The Mantis SSTDR test leads must be connected in a T-junction (see Figure 14 in the SSTDR

Connection section). This can be done in multiple ways depending on the application. In the following section, the T-junction is made using an external DIN-Rail mount to easily connect the isolation kit. The Mantis unit can also be connected using a T-junction without an external mount, depending on the existing system connections.

Ethernet & Power

The Mantis can be connected to Ethernet for internet connectivity (optional) and must be powered by a power source 12-28VDC.

Note: *Power connection maximum voltage is 28VDC. Connecting the Mantis power connections to higher voltages will seriously damage the Mantis unit.*

Connecting Ethernet:

There are two different possible locations of the RJ45 connector.

• Ethernet connects to bottom mounted RJ 45 connector



Figure 8. Ethernet to RJ45 connection

• Ethernet connects to the front plate using an RJ connector.



Figure 9. Ethernet to front plate connection

Connecting Mantis Unit Power:

• The Mantis model shown in Figure 10 has two options for connecting to power. Only one of these options is needed for the Mantis to receive power. Power should not be connected to both options.



Figure 10. Mantis power connection options

- (a) Power through the AC Power Connector
 - Attach the optional AC/DC power adapter accessory to the power connector jack
 - Connect the AC Power adapter to a 120 VAC wall outlet or other AC Power outlet
- (b) Power through the internal Mantis DIN rail to the external DIN rail
 - Pull power through cable glands (Figure 11)



Figure 11. Power through cable glands

- Using a flathead screwdriver, insert driver into Mantis internal DIN rail, shown in Figure 12. Pull flathead screwdriver up to open connector to insert power wires.
- Insert both red (+) and black (-) power wires



Figure 12. Internal DIN rail connection instructions

- Check connectivity by pulling slightly on power wires
- Connect power wires to external power source. Often this is done by first connecting to an external terminal block or equivalent, shown below in Figure 13.



Figure 13. Mantis connections using external terminal block

SSTDR Connection

The SSTDR connection should be connected to point A and point B using two test leads shown in Figure 14 below. Figure 14 illustrates these two wires in the system. The cable or wires from the system (points A and points B) must be connected into the system using a T-junction for each test lead. This can be at the external DIN-rail or at a junction that already connects the cables for diagnosis and the source that can be connected to.



Figure 14. SSTDR connection diagram

An isolation filter may also be required, as seen in Figure 15.



Figure 15. SSTDR connection diagram with isolation filter

The DIN-rail T-junction shown in the **Connecting the System** section effectively makes these connections. Figure 16 illustrates an example of the source and cables to be diagnosed in a typical rail system.



Figure 16. Rail system source and cable example system

A connection to this type of system is illustrated in Figure 17 using T-junctions.





Connection of Mantis / Test Leads to Monitored System

The manner and methods of connecting the test leads from the Mantis to the system or cables to be monitored or diagnosed will vary with and depend on the individual characteristics of each system or cable. Connecting the test leads to the system or cables to be monitored or diagnosed will be the responsibility of and in the sole discretion and control of each system's owner or operator. LiveWire assumes no responsibility for such connections.

First, connect the Mantis SSTDR wires to the internal DIN-Rail in a similar manner as the DIN-Rail power connector and inserting through cable gland, shown in Figure 18.



Figure 18. SSTDR wires through cable gland

Figure 19 below shows the cable to the system (3) connected with the external DIN Rail connector block. The blue test leads between the external DIN Rail connector block and the internal DIN-Rail connector block inside the Mantis are 2000-V rated.



Figure 19. System connection to SSTDR test leads through external DIN rail

The two SSTDR test leads (blue leads) from the DIN-Rail to the Mantis must be stabilized during installation to ensure that test leads do not move during tests. Movement of test leads introduces error in Mantis results. In order to achieve this, it is desirable that the two SSTDR test leads are stabilized by making the two test leads:

- 1. Equal in length
- 2. Close together by:
 - a. Twisting wires together
 - b. Using tie wraps to secure wires together
 - c. Placing wires in close proximity (only for <1ft.)
- 3. For Mantis with AC power connected only: one lead stabilized through the left cable gland with other lead through the right cable gland *Note: If small enough SSTDR test lead wires are used (and of the proper rating) they may be routed through a single cable gland.*

The following section illustrates correct connections followed by incorrect connections for the SSTDR connection.

Correct SSTDR Test Lead Connections

Option A: twisting the test leads between the internal DIN-Rail connector block inside the Mantis and the external terminal block.



Test leads are twisted together to control the impedance.

Option B: Use tie wraps to secure the two test leads together between Mantis and terminal block



Tie wraps holding the two test leads together

Option C: Test leads routed closely together from Mantis to an external terminal block (for < 1 ft. test leads)



Two test leads in close proximity based on length and connections

Option D: Mantis with AC power connected only

When installing the Mantis for higher voltage rated systems (>2kV), it may be required to route each of the two SSTDR connections through two cable glands.



Incorrect SSTDR Test Lead Connections

1. Test leads of different lengths



2. Test leads connected with distance between them





Test leads spread apart in an unpredictable way makes a poor SSTDR connection.

3. Loose test leads or exposed conductors



Source Isolation Filter

In order for the Mantis to be accurate, it must often be isolated from the source. Isolation filters are ferrites placed close to the source on each of the cables, illustrated in Figure 20.



Figure 20. Source isolation filter connection diagram

An example of how this is connected in a rail system is shown in Figure 21 below:



Figure 21. Isolation filter in rail system schematic

The isolation filter is highly specific to each application. An isolation filter commonly used in rail applications is shown in Figure 24 of the **Connecting the System** section of this guide. Advice with respect to isolation equipment is available through LiveWire Innovation, Inc.

In Figure 21, points (3) and (4) are the test leads that connect from the Mantis to the system using a T-junction. In a rail system, this would connect to the positive and negative of the track and the source (in this case, a DC Transducer). An example of the Mantis in a rail system is shown in Figure 22 below.



Figure 22. Mantis connected to rail system

Connecting the System

To connect the system, the test leads, cables to be diagnosed, and source must be connected. This is often done using a T-junction at points A and B, as seen in the schematics, diagrams, and examples. In order to create this T-junction, the external DIN-rail connector block is used in the example shown in Figure 23 below. Figure 24 and Figure 25 illustrates a Mantis connection in a rail system that did not require an external connector block.



Figure 23. Mantis connection to system with DC/DC transformer example

Another example is shown below:



Figure 24. Mantis connection to rail system example

The required T-junctions are clearly illustrated in this kind of set-up in Figure 25:



Figure 25. Mantis connection to rail system T-junctions example

Contact Information

For technical information and customer support, please visit www.livewireinnovation.com or send an email to support@livewireinnovation.com.

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