

Thermo Fisher Scientific™
Ramsey™ Oretronic IV Tramp Metal Detector
User Manual



Thermo Scientific Ramsey Oretronic IV Tramp Metal Detector

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About this Manual

This manual provides the information you need to install, operate, and maintain the TMD IV.

Read this manual before working with the system. For personal and system safety, and for the best product performance, make sure you thoroughly understand the manual before installing, operating, or maintaining this machine.

Important Safety Information

Please note the following important safety information about installing, operating, handling, transporting, maintaining, and disposing of the TMD IV. The following symbols are used on the TMD IV itself and in this manual, and convey the following important safety information.



CAUTION. Risk of electric shock.



All warnings and cautionary text in this manual is marked with this symbol. Please read all cautions and warnings very carefully and fully obey them.

The Difference between a Caution and Warning Message

Two types of safety message are used in this manual, and the distinction between the two is as follows.



CAUTION. Failure to observe may cause minor injury or damage to the equipment.



WARNING. Failure to observe could result in death or serious injury.

General Safety Precautions

Here are the safety precautions you should follow when installing, operating, or maintaining the TMD IV.



CAUTION: The protection provided by the safety elements of this system may be impaired if the equipment is used in a manner other than specified in this manual.



WARNING. User must follow all applicable safety procedures related to this product. High voltages and high temperatures are present within the system enclosure during normal operation.



WARNING. Do not attempt to defeat safety interlocks provided with this product. There are no user-serviceable parts inside the system enclosure. This product must be serviced only by authorized Thermo Fisher Scientific service personnel.



WARNING. Failure to follow safe installation and servicing procedures could result in death or serious injury.

- Make sure only qualified personnel perform installation and maintenance procedures in accordance with the instructions in this manual.

- Allow only qualified electricians to open and work in the electronics cabinet, power-supply cabinet, control cabinet, or switch boxes.
- Covers over the electronics and rotating parts must always remain in place during normal operation. Remove only for maintenance, with the machine's power OFF. Replace all covers before resuming operation.
- During maintenance, a safety tag (not supplied by the factory) must be displayed in the ON/OFF switch areas instructing others not to operate the unit (ANSI:B157.1).



WARNING. High voltage that may be present on leads could cause electrical shock.

- All switches must be OFF when checking input AC electrical connections, removing or inserting printed circuit boards, or attaching voltmeters to the system.
- Use extreme caution when testing in, on, or around the electronics cabinet, PC boards, or modules. There are voltages in excess of 115–230 V in these areas—even with the main door open.



WARNING. Use only the procedures and new parts specifically referenced in this manual to ensure specification performance and certification compliance. Unauthorized procedures or parts can render the instrument dangerous to life, limb, or property.



WARNING. The TMD IV should not be operated at more than the production rate stated on your equipment specification sheet, or used in applications other than those stated in the original order.



WARNING. Do not place or store objects of any kind on the TMD IV.



WARNING. Tampering with and/or removing any safety guards and other safety devices fitted to the TMD IV is *strictly forbidden*. If the existing guards or safety devices are modified, you *must* verify that any changes made comply with the appropriate safety regulations before the TMD IV is used.

Conventions Used in This Manual

Here is a summary of the conventions used in this manual.

- The term “TMD IV” is a general term that refers to Thermo Scientific Ramsey Oretronic IV Tramp Metal Detector.

Introduction

This section introduces the Thermo Scientific™ Ramsey™ Oretronic IV Tramp Metal Detector (TMD IV). It gives an overview of the device's capabilities, provides information on installing, operating and maintaining the device, along with technical specifications and reference drawings.

Overview

The TMD IV detects the presence of tramp metal in bulk material being transported on a conveyor belt. Detected tramp metal can then be removed from the process stream manually or automatically by mechanical means. Removing the tramp metal protects crushers, material handlers, and process equipment from the damage it may cause.

This highly reliable system detects all types of tramp metal that could be found in bulk material on belt conveyors even when it is buried in wet, conductive materials. Tramp metal could include such things as bucket teeth, manganese steel mantles, bore crowns, bar scrap, chains, and tools. The bulk material (or burden) can be product such as iron pellets, minerals, aggregates, coal, or coke.

The TMD IV can be installed on conveyors with speeds up to 1,800 ft/min (9 m/s). In addition, because it is insensitive to materials with high magnetic permeability and electrical conductivity, this detector can be used in applications where conventional metal detectors produce an unacceptable false alarm rate.

The TMD IV control unit includes software that helps ease system setup and calibration. The operator interface provides easy-to-read indicators, and a membrane-switch keypad.

Theory of Operation

The TMD IV operates by generating a pulsed magnetic field (the primary magnetic field) that is radiated from its transmitter coil. This field generates an output signal in the receiver coil (see Figure 1-1).

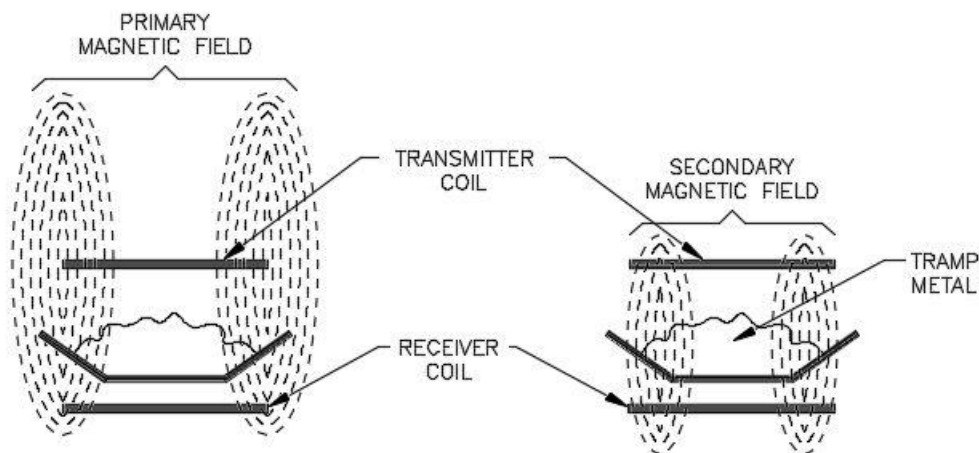


Figure 1-1. Magnetic Fields Generated by the TMD IV

When the pulse is turned off, eddy currents induced in tramp metal produce a secondary magnetic field. This new field also generates an output signal in the receiver coil. The detector measures the effect of this secondary magnetic field only during the time the primary field is inoperative.

The material on the conveyor belt also produces a secondary magnetic field. The two magnetic fields can be distinguished from each other by observing their decay times. The better the conductivity characteristics of the material, the longer the decay time. As the magnetic field decays, the output signal strength decreases (see Figure 1-2).

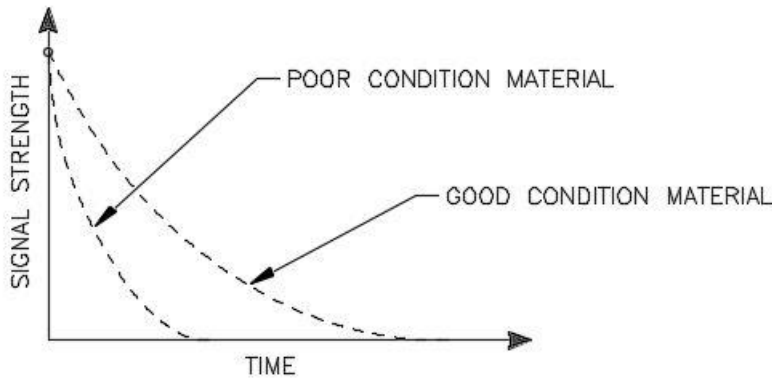


Figure 1-2 How Conductivity Effects Decay Time

Coal, aggregate, and mineral ores have conductivity characteristics considerably poorer than tramp metal, which means their magnetic field decays more quickly (see Figure 1-3).

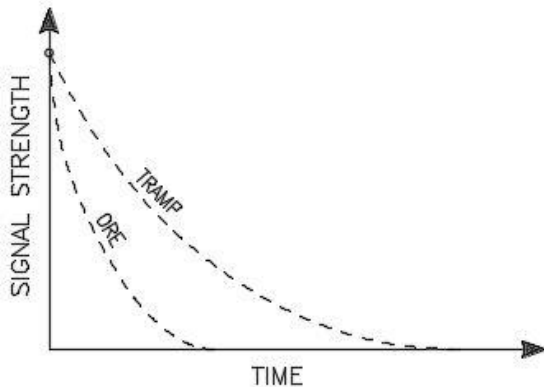


Figure 1-3 Ore/Tramp Metal Decay Time Comparison

The TMD IV is designed to take advantage of the difference in decay time by activating its measurement window (the point at which it reads the output signal) only after the magnetic field from the material on the conveyor has decayed and before the tramp's decay has ended (see Figure 1-4). Using this measurement window timing helps prevent both false trips and passed tramp metal.

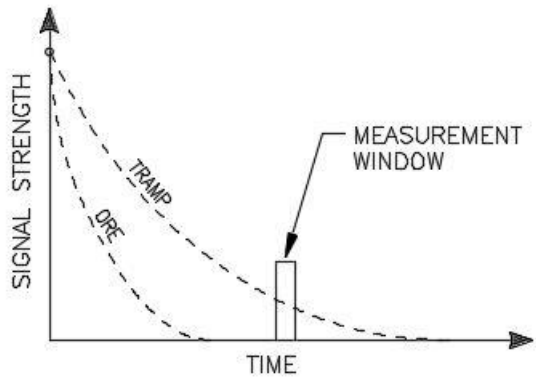


Figure 1-4 Measurement Window Timing

The TMD IV allows you to adjust both the sensitivity of the device to output signals and the location of the measurement window in the decay time. Signal strength is adjusted by a sensitivity factor; the measurement-timing window is adjusted based on a material type code factor (see Figure 1-5).

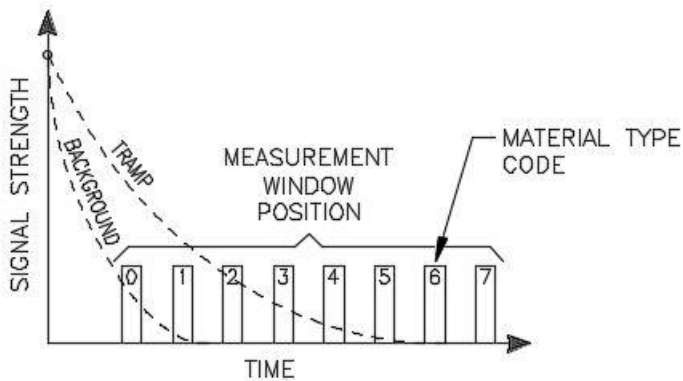


Figure 1-5 Signal Sensitivity/Measurement Timing Adjustment

System Components

The TMD IV comes in two configurations, a dual coil system and an under the belt single coil system. The dual coil TMD IV has a transmitter coil mounted above the belt and a receiver coil mounted under the belt. The under belt single coil TMD IV is physically different but functionally similar to a standard model. On an under belt single coil TMD IV, the transmitter and receiver coils are together in a coil assembly mounted under the belt.

This section describes the major components of a TMD IV system.

Figure 1-6 shows the components and system options for a dual coil TMD IV. Figure 1-7 shows the components and system options for an under belt single coil TMD IV.

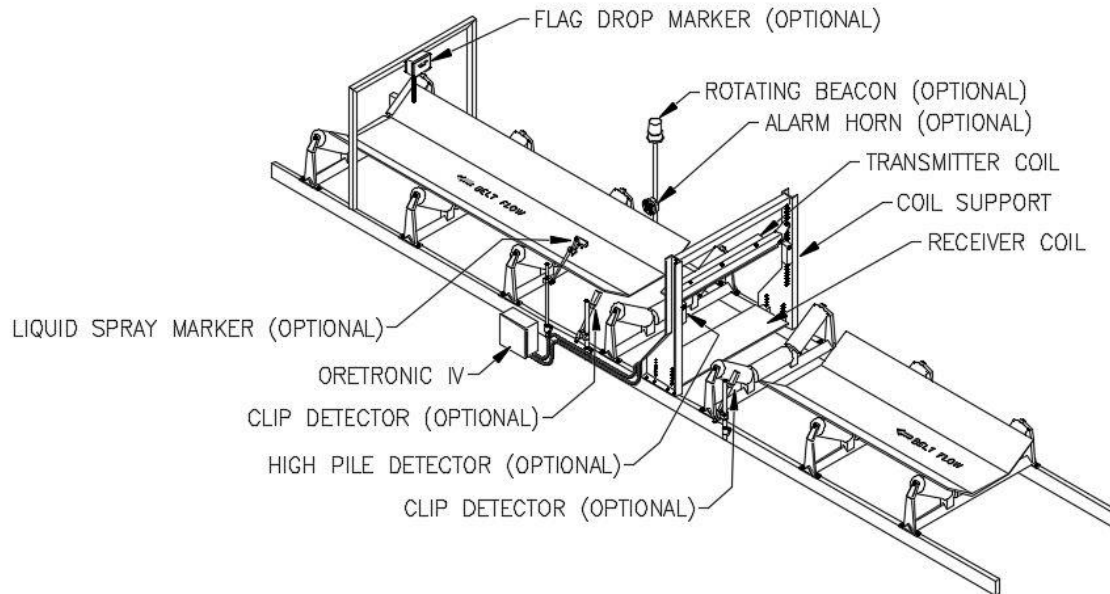


Figure 1-6 TMD IV System Components: Dual Coil

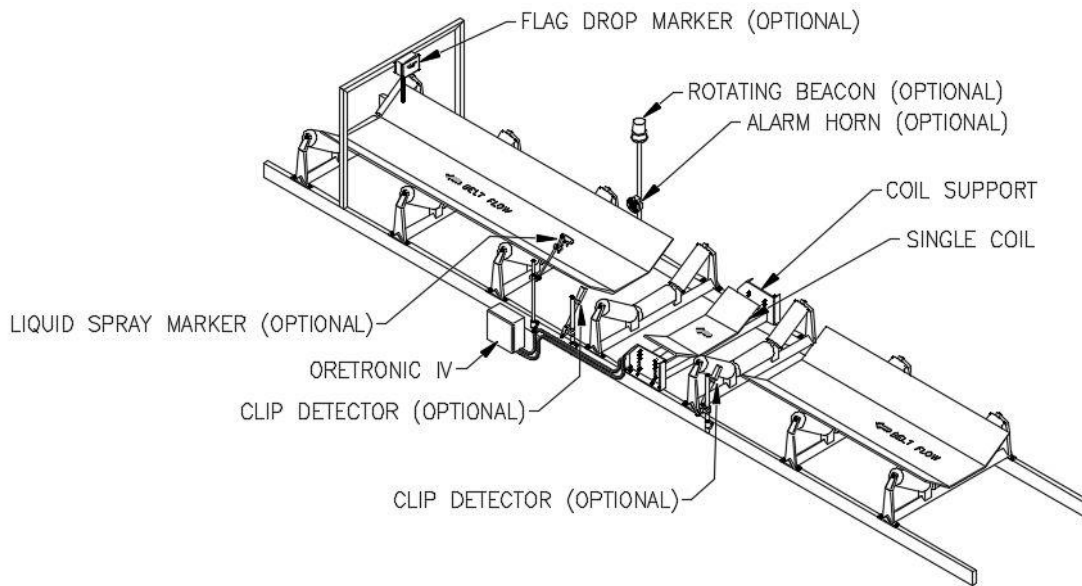


Figure 1-7 TMD IV System Components: Under Belt Single Coil

Support Structure & Coils

The coils (or coil) are mounted on a rugged support structure made of non-conducting fiberglass material. On a dual coil TMD IV, the transmitter coil is swing-mounted above the belt to protect the coil and support from being damaged by oversized material. The receiver coil is mounted under the belt.

On an under belt single coil TMD IV, the transmitter and receiver coils are together in a coil assembly mounted under the belt. The coil support structure does not extend above belt height (see Figure 1-7).

Coils formers are made of impact-resistant polyvinyl chloride (PVC) and are designed to withstand stresses up to 10 times gravity.

The transmitter coil transmits the pulsed electrical energy to the conveyor burden. The receiver coil receives the electrical energy signal from the conveyor burden. Within this signal is the eddy current when tramp metal is present.

Control Unit

The TMD IV control unit (see Figure 1-8) provides excitation for the transmitter coil, accepts receiver coil signals, and annunciates the presence of tramp metal. The circuitry is housed in a NEMA 4X IP66 (P/N 147797) fiberglass enclosure or a NEMA 4 IP66 (P/N 147800) painted mild steel enclosure.

The front panel of the control unit provides the operator interface to the TMD IV system. Within the enclosure, visible through an acrylic window, is a lighted, heated LCD panel with status LEDs and a membrane keypad. Under normal operations, the LCD panel and LEDs will indicate the presence of tramp and the coast count. It is also used for set-up and calibration. An exterior-mounted and weather resistant RESET button provides all of the interaction a user will need during normal operation; if desired, the fiberglass enclosure can be secured with a lock. The software can also be secured though password protection.



Figure 1-8 Oretronic IV-4 and Oretronic IV-6 Control Units

Features and Options

The TMD IV includes a number of standard features and available options that enhance its performance in a conveyor system.

Simplified Operator Interface

The LCD panel and membrane keypad make it easy to enter and change values and to scroll through the displays. The display indicates tramp count and coast count during normal operations and is used during setup and calibration.

LEDs visible from outside the enclosure indicate SETUP, ALARM, NORMAL, and BYPASS conditions, and a bar graph displays signal strength (see Figure 1-9).



Figure 1-9 TMD IV Control Unit Keypad

Increased Detection Sensitivity

With the increase in sensitivity, the TMD IV can detect similar sized tramp at higher belt speeds than its predecessor, or smaller tramp at the same belt speed.

Field Upgradeable Software

System updates can be installed by qualified Thermo Fisher Scientific field engineers and representatives in just a few moments, without removing or re-installing the controller.

Modbus Interface

An RS-485 interface allows the user to communicate with the controller using a standard Modbus terminal or mobile device. Through this interface, virtually all of the major operational characteristics of the controller can be read and, in many cases written.

Synchronization of Transmitter Pulses

When two or more detectors are within 30 feet of each other, the SYNC input feature allows for the synchronization of transmitter pulses. This prevents the detectors from mistaking a transmitter pulse from another detector for a metal signal.

To set up synchronization, one TMD IV is selected to be the “master,” the others are “slaves.” The difference between the master and the slaves is that the master does not have SYNC input turned on; only the slaves do. The SYNC OUT signal on the master is connected to SYNC IN on the slaves. The master sends the SYNC signal before it energizes its’ transmit coil; this prevents the slave units from reading their receive coils and interpreting the output of the master unit as tramp.

Speed Sensor

An optional belt speed sensor can be added for optimal performance with variable speed belts. Speed input provides for accurate belt coast determination and other speed-dependent operations. The speed sensor input is limited to 2.5 KHz.

Clip Detector

An optional belt clip detector is used with conveyor belts having metallic splices or repair clips. The detector marks the splice so the TMD IV can momentarily reduce sensitivity while metal fasteners traverse the detection zone. Larger tramp metal will still be detected.

High Pile Detector

The optional high pile detector is designed to help protect the transmitter coil from damage caused by oversized material on the belt. If the transmitter coil swings away from the support structure because of impact, the display will show hi pile, indicating that the coils may no longer be balanced. If the transmitter coil does not swing back into position in four seconds, the alarm relays of the control are activated.

The high pile detector is available on a dual coil TMD IV only. The under belt single coil model does not have this feature because the transmitter coil is under the belt.

Time Delay Marker

If an optional liquid spray or flag drop marker is used to visually identify the location of tramp metal on the conveyor, a timed delay can be specified that indicates to the TMD IV how long it takes for the detected tramp to move from the coils to the marking device. For variable speed belts, the activation of the marker is coordinated with the measured belt speed. A marker duration variable can also adjust the length of time a spray marker is fired, thereby controlling the length of the mark and conserving marker fluid.

System Requirements

System requirements for incorporating a dual coil TMD IV into a conveyor system can be found on the following Engineering Drawings in Appendix A of this manual:

- Final Assembly, Standard System (D07328C-A001)
- Installation Placement, Standard System (D07328C-A002)

System requirements for incorporating an under-belt single coil TMD IV into a conveyor system can be found on the following Engineering Drawings in Appendix A of this manual:

- Under-Belt Single Coil Final Assembly (D07328C-A101)
- Under Belt Single Coil Installation Placement (D07328C-A102)

Technical Specifications

This section lists the technical specifications for the TMD IV. Specifications apply to both dual coil and under belt single coil models unless otherwise noted.

Requirements	Metrics	Units	Specification
Operating Temperature	Temperature range	Degrees	-50°C to +58°C (-58°F to +136°F) Note: heater req'd below -40°C
Storage Temperature	Temperature range	Degrees	-30°C to +70°C (-22°F to +158°F)
Enclosure rating		IP/NEMA	NEMA 4X IP66 – Fiberglass encl (P/N 147797) NEMA 4 IP66 - Painted Steel encl (P/N 147800)
Humidity		%	10 to 95%, non-condensing
Altitude	Max altitude	m	2000 (6,561ft)
Pollution Degree			Level 2 per IEC 61010-1
Installation Category			II
Inspection speed	Range of material speed	m/sec (FPM)	0.03-9.14m/sec (5-1800 FPM)
Input Voltage		V	98-253 VAC for 4ST and 6ST models 115 VAC for 4LT-115 and 6LT-115 models 230 VAC for 4LT-230 and 6LT-230 models
Input power frequency		Hz	48-62
Pulse Power		A	4 A for Oretronic IV-4 models 6 A for Oretronic IV-6 models

Table 1-1. Technical Specifications

Installing the TMD IV

This section provides information about installing and setting up the TMD IV. It discusses installation considerations, provides procedures for mounting, and wiring, describes the hardware configuration, and provides procedures for determining initial setup parameters for the device.

Overview

The customer is responsible for initial inspection of the equipment and for site preparation. It is essential that the equipment be placed on the production line in accordance with the guidelines set forth in this section.

The customer must ensure that qualified personnel are available to make interconnections with other production equipment and perform work at the installation site. A customer service representative is available to assist with installation and verify operation as well as train personnel assigned to operate and maintain the equipment.

Installation Considerations

Do not connect power to the machine or turn on the unit until you have read and understood this entire section. The precautions and procedures presented in this section must be followed carefully to prevent equipment damage and protect the operator from possible injury.



WARNING. Failure to follow safe installation and servicing procedures could result in death or serious injury.

- Make sure only qualified personnel perform installation and maintenance procedures in accordance with the instructions in this manual.
- Allow only qualified electricians to open and work in the electronics cabinet, power-supply cabinet, control cabinet, or switch boxes.
- Covers over the electronics and rotating parts must always remain in place during normal operation. Remove only for maintenance, with the machine's power OFF. Replace all covers before resuming operation.
- During maintenance, a safety tag (not supplied by the factory) must be displayed in the ON/OFF switch areas instructing others not to operate the unit (ANSI:B157.1).

Mounting Location

The coil support structure and coil(s) must be mounted properly for the TMD IV to function correctly. Large metallic objects near the coil(s) will cause a reduction in signal strength. To prevent loss in signal strength, make sure that no metallic objects such as steel girders, deck plates, skirt boards, return idlers, or metal building walls are within 4 ft (1.2 m) of the receiver coil. Carry idlers and conveyor stringers may be within this distance.

Other considerations for mounting the support structure and coil(s) include:

- The coil support structure must be located so that the conveyor will stop before tramp is discharged.
- Metal deck plates or skirt boards located within 4 ft (1.2 m) either side of the coil support structure must be removed or replaced with non-metallic parts.

- Metal chutes of feed points should be at least 8 ft (2.4 m) away from the coil support structure.
- Magnets must be at least 18 ft (5.5 m) away from the coil support structure.
- Corrugated metal covers located within 4 ft (1.2 m) either side of the coil support structure must be removed or replaced with non-metallic covers.

The control unit enclosure should be mounted in a vibration-free area less than 10 ft (3 m) from the coil(s) and should be protected from excessive heat, cold, or moisture.

See the Final Assembly drawings and the Installation Placement drawings in Appendix A of this manual for additional installation considerations.

Electrical Specifications

- 98-253 VAC for the TMD IV Controller
- 115 VAC or 230 VAC for the 115V and 230V heaters, respectively 0.9A for the standard models and 2.8A for the low temperature models

Customer Supplied Fusing Requirements

- Universal Power Supply: 115 VAC or 230 VAC
- Fusing 4ST System: 115 VAC - 1.0 A, 250 VAC, SB, "Type T"
230 VAC 0.5 A, 250 VAC, SB, "Type T"
- Fusing 6ST System: 115 VAC – 1.5 A, 250 VAC, SB, "Type T"
230 VAC - 0.75 A, 250 VAC, SB, "Type T"
- Fusing 4LT System: 115 VAC - 3.0 A, 250 VAC, SB, "Type T"
230 VAC 2.5 A, 250 VAC, SB, "Type T"
- Fusing 6LT System: 115 VAC – 3.5 A, 250 VAC, SB, "Type T"
230 VAC - 2.75 A, 250 VAC, SB, "Type T"

Output Relay Rating

All of the output relays must be externally fused 5A Max, 250VAC or 30VDC

The following relays provide both NO and NC contacts:

- Alarm Indicator
- Alarm
- Marker output

The following relays are NC only:

- Bypass
- Power OK

Safety Precautions



WARNING. High voltage that may be present on leads could cause electrical shock.

- Disconnect incoming power at mains before beginning any installation or wiring procedures.
- Use extreme caution when testing in, on, or around the electronics, PC boards, or modules. There are voltages in excess of 115V or 230V in these areas.
- Covers over the electronics should always remain in place during operation. Remove only for maintenance procedures with the machine's power OFF. Replace all covers before resuming operation.



WARNING. Use only the procedures and new parts specifically referenced in this manual to ensure specification performance and certification compliance. Unauthorized procedures or parts can render the instrument dangerous to life, limb, or property.



WARNING. All wiring must be done in accordance with the field wiring diagrams, applicable sections of the National Electrical Code, and local electrical codes.



WARNING. Keep hands and clothing away from all moving or rotating parts.



WARNING. This equipment should not be operated at more than the production rate stated on your Equipment Specification sheet or used in applications other than those stated in the original order.

Equipment Handling

The TMD IV coil support structure and coil(s) are normally packaged on a wooden skid and may be lifted with a forklift or crane. Do not lift the equipment using the support structure; use the exterior wooden structure. Use care when lifting this equipment to avoid damage to the coil(s).



WARNING. This equipment may be heavy. Employ a two-person lift for any configurations housed in a metal enclosure.

Inspection and Unpacking

The Tramp Metal Detector has been properly packaged for shipment. Inspect all packages before opening. If there is any evidence of shipping damage, notify the shipping carrier immediately; the carrier may be responsible for the damage. After unpacking, inspect the unit for broken or damaged components.

After unpacking, inspect the unit for broken or damaged components.

Storage

The Tramp Metal Detector and associated equipment can be safely stored, with the cover secured and hole plugs installed, in ambient temperatures between -50°C to +58°C (-58°F to +136°F). The control unit should be protected against moisture.

Installing the TMD IV

This section provides procedures for installing the coil support structure and coils and for mounting and wiring the control unit. The installation procedures are different for dual coil and under belt single coil TMD IVs.

Installing Coil Support Structure & Coils for Dual Coil TMD IV

The coil support structure is shipped from the factory partially assembled. Coils are mounted on the cross members. Refer to Outline, Mounting and Assembly, Coil Stand (D07328C-A003) for assembly information. Refer to Installation Placement (D07328C-A002) for detailed information about positioning the system components.

Note: The coil support structure must be located so that the conveyor will stop before any tramp is discharged. Use the following procedure to assemble and install the coil support structure and coils on your conveyor.

1. Assemble the coil support structure and the coils so that all electrical cables for the transmitter and receiver coils are on the same side of the conveyor.
2. Mount the transmitter coil to allow it to swing in the direction of belt travel at a height above the belt so it will clear normal conveyor loads.
3. The swing arm feature allows high loads to pass without damage. If the transmitter coil is mounted too high, the system's sensitivity is reduced.
4. Set the receiver coil located under the belt 1–2 in. (25–50 mm) below the belt line. The belt must not rub on the receiver coil.
5. Mount the coils across the conveyor on the centerline between the two idlers.
6. Idler spacing at the coil location must be greater than 4 ft (1.2 m). If for mechanical reasons this spacing is not possible, the distance may be reduced by using rubber impact-type idlers.
7. Remove all deck plates, cross bracing, and return idlers located within 4 ft (1.2 m) of the receiver coil.

Installing Coil Support Structure & Coils for Under Belt Single Coil TMD IV

The coil support structure is shipped from the factory partially assembled. The coil is mounted on the cross members. Refer to Under Belt Single Coil Outline and Mounting (D07328C-B101), Under Belt Single Coil, Assembly Stand, (D07328C-A110) for assembly information. Refer to Under Belt Single Coil Installation Placement (D07328C-A102) for detailed information about positioning system components correctly.

Note: The coil support structure must be located so that the conveyor will stop before any tramp is discharged. Use the following procedure to assemble and install the coil support structure and coil on your conveyor:

Assemble the coil support structure.

Set the coil under the belt 1–2 in. (25–50 mm) below the belt line. The belt must not rub on the coil.

Mount the coil across the conveyor on the centerline between the two idlers.

Idler spacing at the coil location must be greater than 4 ft (1.2 m). If for mechanical reasons this spacing is not possible, the distance may be reduced by using rubber impact-type idlers.

Remove any deck plates, cross bracing, and return idlers located within 4 ft (1.2m) of the coil.

Installing System Devices

Optional system devices such as clip or high pile detectors, spray, or flag drop markers, and alarm beacons or horns may need to be assembled and installed on your conveyor.

Refer to the appropriate drawings in Appendix A for information about installing optional system devices for your TMD IV model. The Installation Placement drawings and Final Assembly drawings show where optional devices are to be placed on your conveyor.

Mounting the Control Unit

The TMD IV control comes in a fiberglass enclosure. Figure 2-1 shows the mounting dimensions for the fiberglass enclosure or a painted mild steel enclosure, Figure 2-18 shows the mounting dimensions of the mild steel enclosure.

The control unit should be mounted in a vibration-free area less than 10 ft (3 m) from the coils. Mount the control unit enclosure to a rigid, flat, vertical surface using the 2-position mounting feet on the back of the enclosure (see Figure 2-1A and Figure 2-1B)

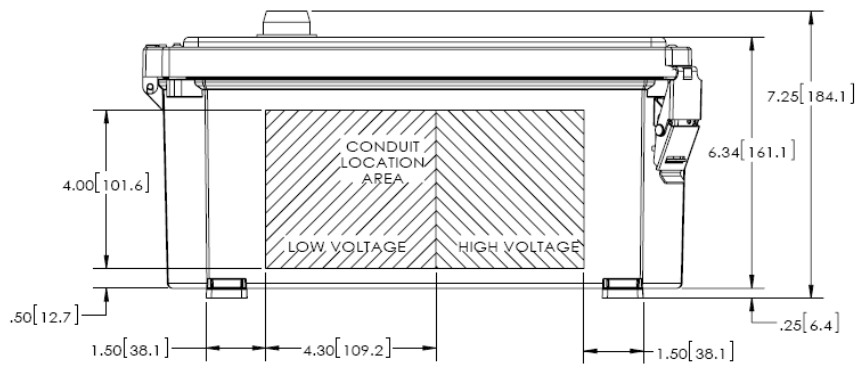
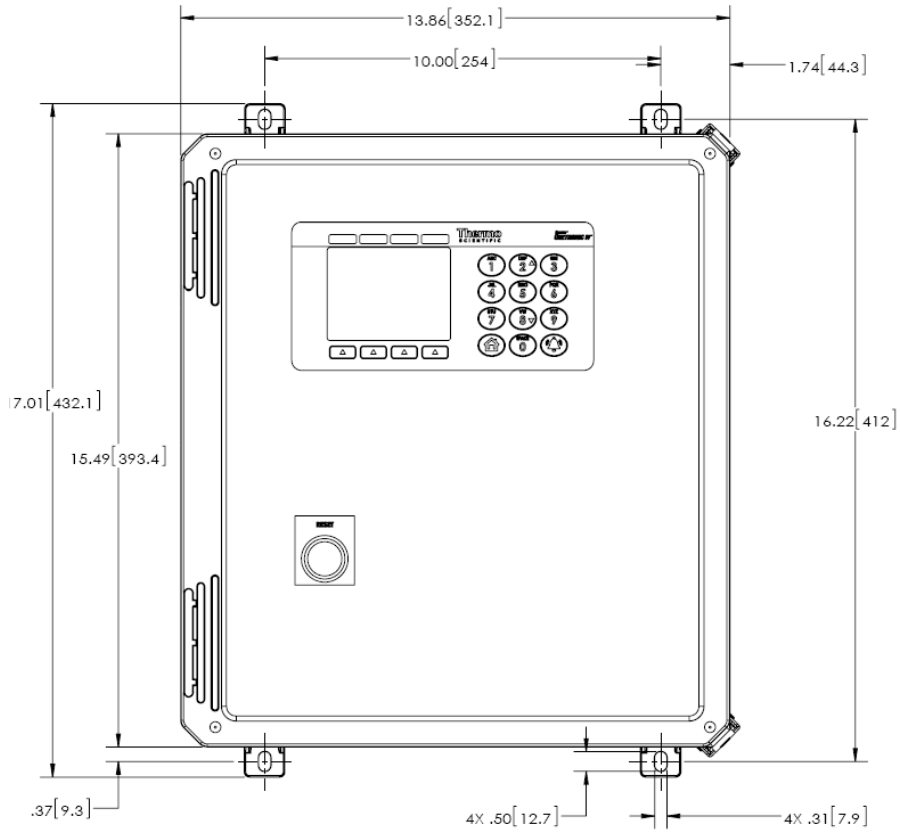


Figure 2-1A Control Unit Mounting, fiberglass enclosure

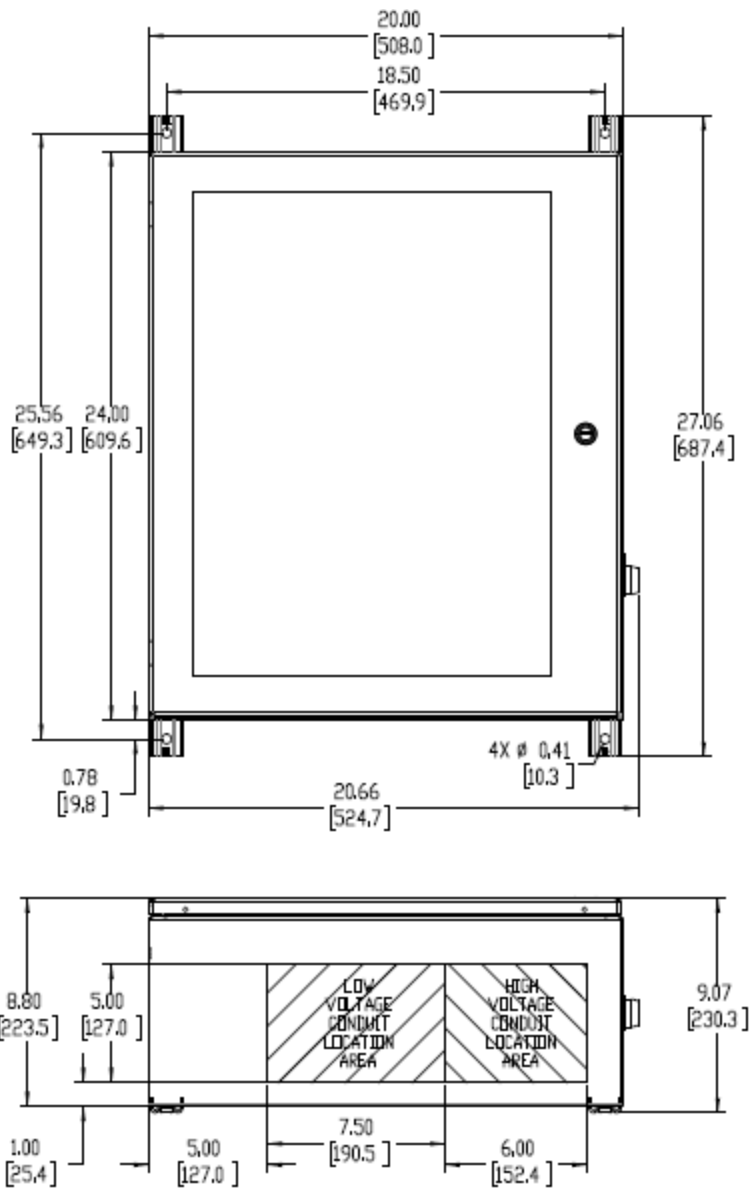


Figure 2-1B Control Unit Mounting, mild steel enclosure



WARNING. Make sure the mounting surface is flat so that the fiberglass enclosure does not twist or warp when mounting bolts are tightened.

Follow this procedure to mount the control unit enclosure.

1. Open the enclosure door.
2. Remove the power cover to allow access to the line power terminals.
3. Bolt the enclosure to a flat, vertical surface using the 2-position mounting feet on the back of the enclosure (see Figure 2-1A or 2-1B).
4. Punch the required conduit holes in the bottom of the enclosure for the power supply cable, coil cables, control wiring, communications cable(s), and any additional signal wires and conduit.
5. Locate the holes in the appropriate areas of the enclosure to separate high (greater than 30 V) and low (less than 30 V) voltages (see Figure 2-1A or 2-1B).

6. Install conduit.

Field Wiring the TMD IV

All wiring, except as noted, is the responsibility of the customer. Follow the field wiring diagram for your system or refer to the Field Wiring Diagram D07468F-E001 to connect system wiring to the CPU board in the control unit.



WARNING. All wiring must be done in accordance with field wiring diagrams, the National Electrical Code, and all local electrical codes. Do not route cables through the same conduit with power cables or any large source of electrical noise.

Critical Wiring Conditions

Be sure to observe the following critical wiring conditions to ensure proper connection of your detector:

- Ensure main power is OFF.
- High voltage (>30 V) and low voltage (< 30 V) cables must be routed through different areas of the control unit enclosure (see Figure 2-1).
- Earth ground all enclosures and conduit. A ground connection between all conduits is required.
- Stranded, rather than solid, wire should be used. This wiring should be long enough, and routed, to allow the chassis to be removed from the front for servicing.
- Connect the shields only where shown.
- Never use a “megger” to check the wiring.
- A readily accessible disconnect device (maximum 20A, minimum 5A) shall be incorporated in the field wiring. This disconnect should be in easy reach of the operator and it must be marked as the disconnecting device for the equipment, see fusing requirements.
- All conduits should enter the bottom of the enclosure. Do not run conduit through the top or sides of the enclosure.

Field Wiring Procedure

Follow all cable number specifications on the Field Wiring Diagram (D07468F-E001) when connecting wiring to the CPU board. Figure 2-2 shows the locations of the terminal blocks.

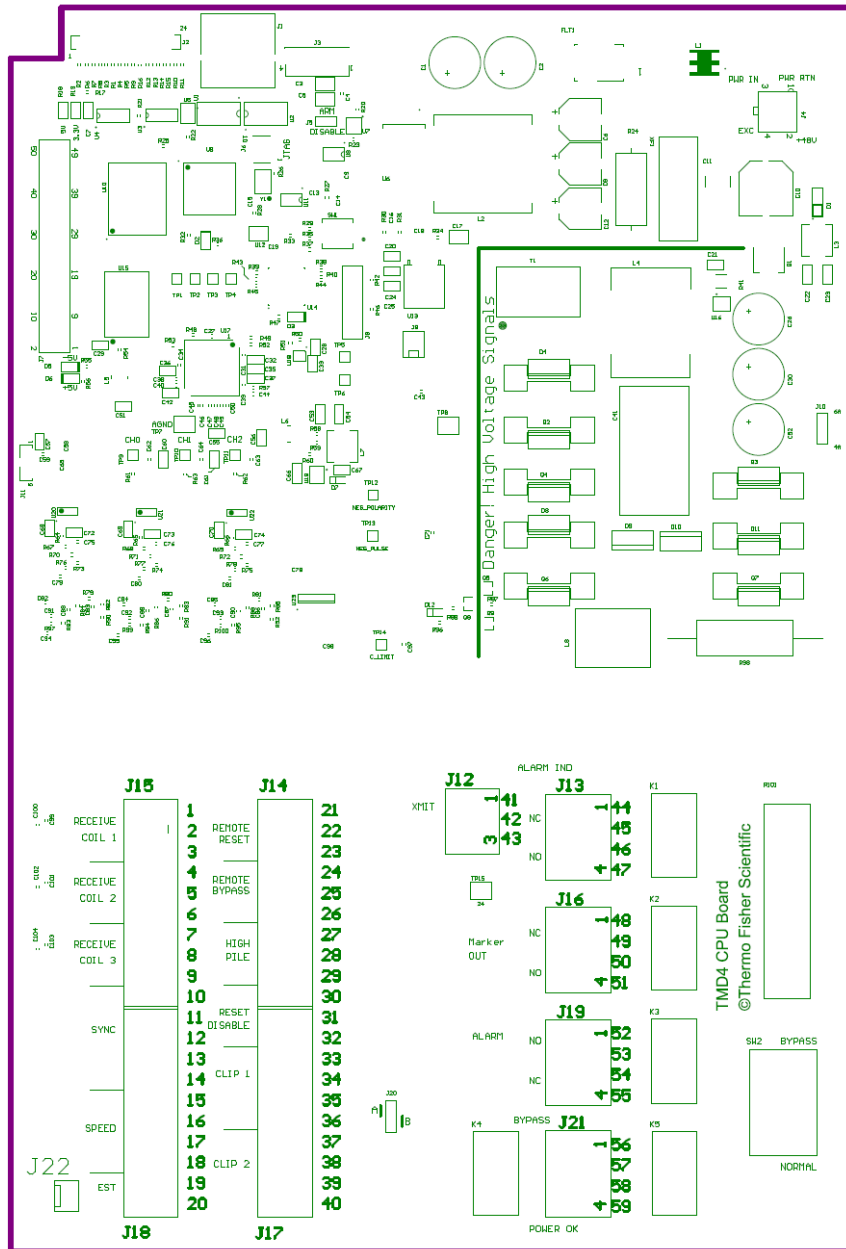


Figure 2-2 Terminal Block Locations on the CPU board

Procedure to Wire the Control Unit

1. Route incoming connections at line voltages above 30 V through a conduit hole in the bottom right of the enclosure so that they are protected by the power cover (see Figure 2-1). Leave enough loose wiring (about 8 in or 20 cm) to allow the board to be moved without having to disconnect wires. Connect all alarm and indicator output wiring to the appropriate terminals (see Figure 2-2).
2. Connect all alarm and indicator output wiring to the appropriate terminals on J-13, J-16, J-19 and J-21.
3. Route incoming connections at voltages below 30 V through a conduit hole on the bottom left of the enclosure (see Figure 2-1).
4. Connect all coil cables, detector wiring, control wiring and communications cables to the appropriate terminals on J-14 through J-21 (see Figure 2-1), in accordance with Field Wiring Diagram in Appendix A.

Connecting Incoming Power



WARNING. Do not apply power until you have read and understand this entire section. Improper connection may result in damage to your detector.

- Verify that the input voltage is correct with a voltmeter before you connect it to the unit. The red tag attached to the machine specifies the correct input voltage for your particular unit.
- Earth ground must be provided to the unit. Do not use conduit to provide this ground.
- Follow your local electrical codes and regulations for minimum wire size and routing.

Follow this procedure to connect incoming power to the control unit.

1. Determine the input power to be supplied to the control unit.
2. Route incoming power wiring through a conduit hole on the bottom right of the enclosure

Use 14 AWG stranded copper wire.

Maintain a gap of at least ½ in. from low voltage wires.

Leave enough loose wiring to allow the board to be moved without having to disconnect wires. (Generally, 8 in or 20 cm is sufficient.)

3. Connect the GROUND wire to the safety ground terminal located on the right inside of the chassis.
4. Wire the LINE (HOT) input power to the terminal labeled “L.”
5. Wire the NEUTRAL input power to the terminal labeled “N.”
6. Replace the power cover.

Note: Make sure the chassis cover is secured before applying power.

Heater Power and Thermostat Setting

If your unit is equipped with a heater, connect the heater’s “pigtail” wiring in parallel with the main power using wire nuts or other certified connectors. Set the thermostat to no higher than +20 C (degrees F).



WARNING. Setting the thermostat higher than body temperature may create a burn hazard.



WARNING. Setting the thermostat excessively high may result in equipment damage.

Initial Power On

After the TMD IV control is mounted and wired and system devices have been installed, turn power on at the mains.

Setting System Options

Before calibrating the TMD IV control, you must configure the system options from the Options screen. The following options are available:

- **Sync Input:** The sync input allows the TMD IV to work in parallel with other TMD IV detectors with coils installed within 30' (10 meters) of each other. One TMD IV will act as the controller, and the other will act as a syncro. In order to avoid interference, the syncro unit will listen to the controller unit and generate its magnetic pulse during the controller's "down time".
- **Bar/Rod Detect:** If long pieces of tramp are to be detected (such as lengths of rebar or pipes), the bar/rod detection algorithm must be enabled. When this option is set to Enabled, an edit field becomes available in the Settings screen for entering the maximum bar length.
- **Clip Detect:** If the conveyor belt has a metallic repair clip installed, a switch can be installed so that, as the clip approaches the coils, the control unit can temporarily reduce sensitivity in order to avoid a false detection without reducing the overall sensitivity of the TMD IV. When this option is set to Enabled, an edit field becomes available in the Settings screen for entering the distance from the clip detection switch to the coils.
- **Speed Sensor:** For belts running at variable speeds, a speed sensor is needed to allow distance values entered for features such as marker distance or clip distance, to be used as functions of the speed sensor input rather than time. If the speed sensor option is enabled, a Speed Sensor Calibration screen becomes available in the Calibration menu.
- **External Communication:** The TMD IV can communicate with external devices through a Modbus interface via an RS-485 physical connection. At this writing, no other interface options are available.
- **Language:** Select the language in which you wish to operate using this selection. The user interface will switch to this language as soon as you press "Accept." Available languages may include English, Spanish, Italian, German, French, and Chinese.
- **Units:** Select metric (meters, meters per second) or English (feet, feet per minute) units for entering or displaying distances or speeds.
- **Line Frequency:** Set the frequency of your AC (line) power in accordance with your site requirements and/or electrician.
- **Password Protection:** This option secures the user interface from tampering. If this option is selected, the device will enter protected mode after 5 minutes of inactivity, and only the Run menu and View menu will be available. The View menu allows a user to bring up the Settings, Options, and Alarm menus in read-only mode and, when Password Protection is set to Enabled, provides an edit control for entering the password, which unlocks the rest of the user interface.

Measuring Belt Speed

In order for the TMD IV to operate properly, the belt speed must be known. This value is used for tuning the detection algorithm and for setting the timing for any clip detection options.

1. Determine the length of the belt, including the return path and any idler/tensioner loops.
2. Identify (or make) a mark on the belt that's large or noticeable enough to spot as the belt is moving at production speeds.
3. Identify a specific point on the conveyor that will act as your starting and ending reference position.

4. Start the belt and, if it's a variable speed belt, set it to a normal operating speed. Allow the speed to "settle down".
5. Time the travel of the marker through at least 5 passes across the reference position, divide the belt length by the total time, and then divide the result by the number of passes.

Calibrating the Speed Sensor

If your system uses a speed sensor, use this procedure to calibrate it. In order to complete this step, you will need to have a measured belt speed (see previous section).

1. Make sure that the speed sensor is enabled in the Options screen (see Figure 2-3). While in the Options screen, make sure that the Units option is set correctly (factory default is Metric).

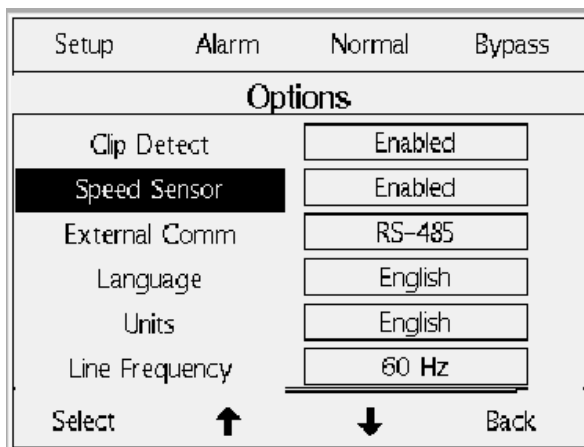


Figure 2-3. Enabling the Speed Sensor Input

2. Navigate through the user interface to the Calibration screen, and select the Speed Calibration screen (see Figure 2-4)

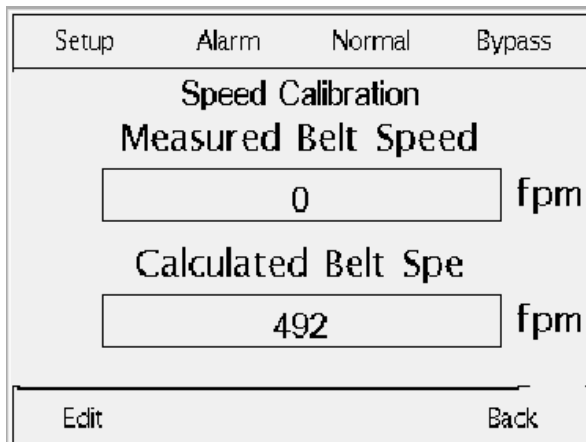


Figure 2-4. Speed Calibration Screen

3. Start the belt without burden, and wait for the speed to "settle down".

4. Using the stopwatch, measure and record the time it takes for the belt to make a full revolution. Record at least five revolutions.
5. Find the average of the recorded intervals, and divide the belt length by this average. If you are using English units, multiply this value by 60 (to get feet per minute, instead of feet per second). This will give you the speed of the belt in the units used to specify the belt length.
6. In the Speed Calibration screen, press Edit, use the numeric keys to enter the belt speed calculated in the previous step, and press Accept. The system will immediately begin using the value entered as the basis of its speed calculations, and Calculated Belt Speed field will immediately change to match the Measured Belt Speed. Note that the Accept key is not visible until the entered value is greater than or equal to the minimum supported speed, and the numeric keys become inoperative when the entered value is greater than the maximum supported speed.

If you make a mistake in entering the speed, use the Cancel button to clear the edit field and start over. To exit the screen without saving, press Cancel (if it's visible) and then press Back.

Calibrating Sensitivity

1. Set Coarse Gain = 6 and Fine Gain = 750.
2. In the Settings menu, set the Speed Filter input to 1800 ft/min.
3. In the Calibration menu, run a Quick Balance.
4. Enter the Fine Sensitivity screen. Pass the tramp metal sample of interest through the **middle** of the aperture by hand. Attempt to pass the tramp at 1 ft/sec or 0.3 m/sec. Record the peak value displayed on the Fine Sensitivity screen. Clear the peak value.
5. Repeat Step 4 four more times yielding five peak values recorded. If possible, try to orient the tramp differently as it traverses the coils for each pass.
6. Take only the **smallest** peak value from the five trials and discard the rest.
7. Use Table 2-1 to determine the scale factor, which will range between 1.0 and .687, based on the belt speed. (Note: Belt is still motionless. This is referring to the speed at which the belt will move during production.)
8. Plug the small peak and the scale factor into the following equation for Fine Sensitivity:

$$\text{Fine Sensitivity} = 1000 - [(Peak_{small}) \times (Scale Factor) \times .80]$$
9. Manually change the Fine Sensitivity to the calculated value. You are now ready to run the belt at full speed.

10. If it is determined that the Fine Sensitivity is too low and therefore not tripping on the tramp of interest, multiply $[(Peak_{small}) \times (Scale Factor) \times .80] \times .90$ and subtract from 1000, which increases sensitivity by 10%. If Fine Sensitivity is too high and the detector is either false tripping or tripping on metal pieces that are too small to need to detect, multiply $[(Peak_{small}) \times (Scale Factor) \times .80] \times 1.10$ and subtract from 1000, which decreases sensitivity by 10%. These tuning steps can be repeated as many times as necessary.

Signal Scaling		
Speed (m/sec)	Speed (ft/min)	Scale Factor
.25	50	1.000
.51	100	0.983
.76	150	0.967
1.02	200	0.951
1.27	250	0.936
1.52	300	0.921
1.78	350	0.907
2.03	400	0.893
2.29	450	0.879
2.54	500	0.866
2.79	550	0.854
3.05	600	0.842
3.30	650	0.830
3.56	700	0.819
3.81	750	0.808
4.06	800	0.798
4.31	850	0.788
4.57	900	0.778

Signal Scaling		
Speed (m/sec)	Speed (ft/min)	Scale Factor
4.82	950	0.769
5.08	1000	0.761
5.33	1050	0.753
5.59	1100	0.745
5.84	1150	0.738
6.10	1200	0.732
6.35	1250	0.725
6.60	1300	0.720
6.86	1350	0.714
7.11	1400	0.709
7.37	1450	0.705
7.62	1500	0.701
7.87	1550	0.698
8.13	1600	0.695
8.38	1650	0.692
8.64	1700	0.690
8.89	1750	0.688
9.14	1800	0.687

Table 2-1 Scaling Factors for Calibrating Fine Sensitivity

Calibrating Clip Sensitivity

If your belt has an optional clip detector and one or more repair clips, the TMD IV can reduce sensitivity in the area of the clip in order to prevent the clip from triggering false detections without reducing sensitivity for the rest of the belt.

In order for the Oretronic to detect the approach of the clip, the clip sensor must be mounted so that the clip will pass directly across its face, and the clip(s) must extend all the way to the edge of the belt.

To calibrate clip sensitivity, the belt must be run empty (so that there is no opportunity for tramp detections to be confused with the clip). Bring up the Clip Coarse detect screen (under Calibration) and press the Learn button. Allow the belt to run for at least 10 full revolutions. The bar graph will indicate the current “background” detection, and an “x” drawn on one of the bars will indicate the maximum detection since the

learn started. After 10 full revolutions, press the Save button; the maximum reading will be used to determine the desensitization. Repeat this process with the Clip Fine Calibration screen.

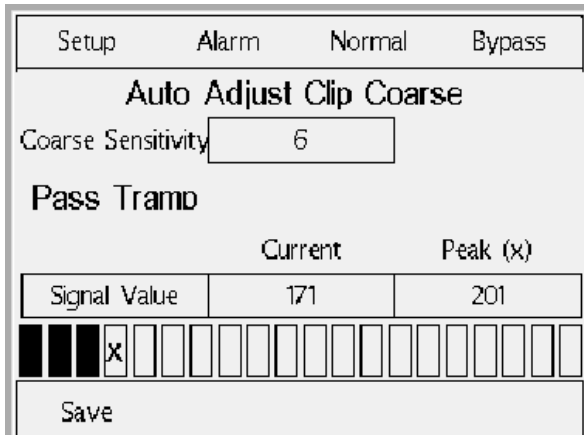


Figure 2-5. Clip Coarse Calibration Screen

If, after running this procedure, the clip(s) continue to trip the TMD IV metal alarm, navigate to the Clip Coarse calibration screen and manually reduce the coarse sensitivity value by 1 (see Figure 2-5). Note that this may allow some tramp to go undetected if it is small enough and is within the vicinity of a clip.

External Communication

With the installation of the optional RS-485 communication card, the Oretronic IV can communicate with external systems using the Modbus RTU protocol. Using this interface, alarm status and other data can be remotely monitored, and the device can be reset.

If this level of control is not needed, it is possible to wire the alarm output and reset switch input directly to remote devices or panels. Refer the field wiring diagram for the location of the Alarm, Bypass, and Remote Reset connectors on the CPU board.

Operating the TMD IV

Overview

This section provides information about setting up and operating the TMD IV. The operator interface, including all keys, indicators, and displays, is described. Procedures for initial setup and calibration are provided.

The operator interface to the TMD IV is a front panel on the control unit. The front panel is composed of an LCD display panel, LED indicators across the top of the display, a row of soft-keys across the bottom of the display, and a membrane keypad with the digits 0-9 and “Home” and “Alarm Reset” keys. Figure 3-1 shows the front panel.

In addition to operating from the operator interface panel, the TMD IV can communicate through the Modbus communications protocol (if the optional Any Bus card is installed).

The TMD IV can operate using either English or Metric units, as selected by the “Units” option. This document uses English units. If you change your units’ selection after the TMD IV is set up and calibrated, you do not need to redo the calibrations and setup using the new units; the TMD IV will convert values.

Several languages are supported by the TMD IV. These include English, German, Spanish, Italian, and Chinese.

This section describes the components of the front panel and how they are used to set up the TMD IV.



Figure 3–1. Tramp Metal Detector Keypad

Operator Interface

The TMD IV normally presents the user with the Run screen (Figure 3-2).

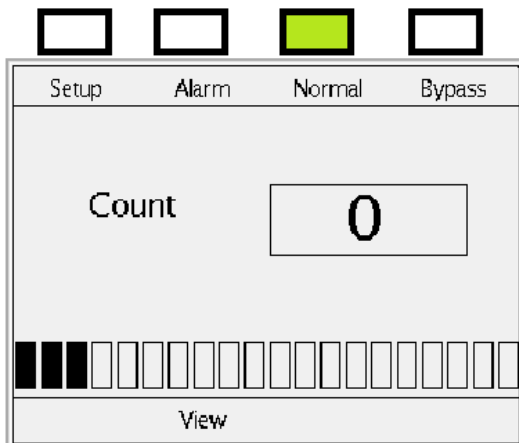


Figure 3–2. Tramp Metal Detector Run Screen

When the TMD IV is in normal Run mode, the NORMAL LED is lit, the display shows the word COUNT, and the counter shows the total count of detected tramp. The horizontal bar graph indicates relative signal strength from tramp metal. The more bars that are displayed, the stronger the signal.

If the TMD IV trips (detects tramp), the ALARM LED lights and the counter shows the coast count, which is the number of pieces of tramp detected since the system tripped (or while the belt was “coasting” to a stop), if any. Pressing the RESET (bell) key sets the coast counter to zero and resets the display to the normal mode (Figure 3-1).

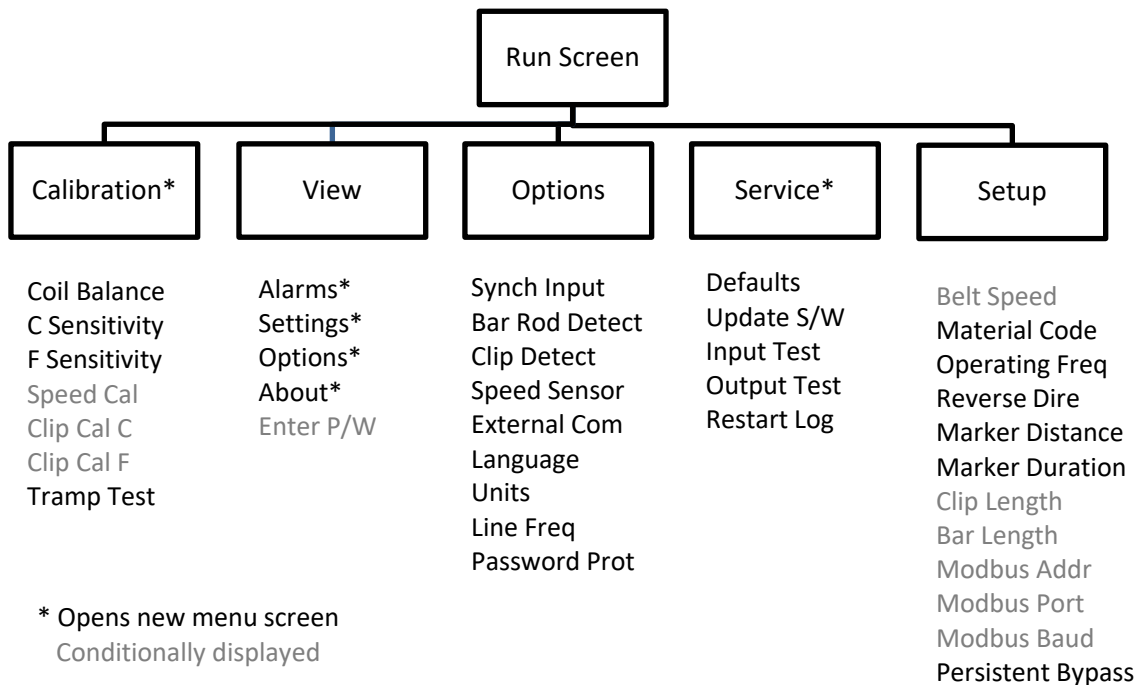


Figure 3–3. TMD IV Menu Tree

The TMD IV operator interface is based on a tree-structure of menus that the user navigates using the soft-keys. From the Run screen, there are 5 lower-level menus that can be accessed through the soft-keys:

- The View menu, which provides visibility to alarms, system settings, system options, and if the password protection option is enabled, a place to log in.
- The Calibration menu (“Calib”), which provides access to lower-level menus for calibrating (balancing) the coils and, if clip detection is enabled, the clip sensitivity. This menu also offers a screen for testing tramp detection without tripping alarms (and shutting down the belt).
- The Options menu, which allows the user to enable or disable all of the TMD IV optional settings.
- The Settings menu, where values can be assigned to the programmable features of the TMD IV.
- A Service menu, intended for field support functions, such as software upgrades or reset to factory defaults.

Front Panel LEDs

A single row of indicator LEDs is arranged across the top of the LCD display.

The NORMAL LED (green) indicates that the TMD IV is in normal Run mode, has not determined a fault or error exists, and has not detected metal since the RESET (bell) key was pressed. It is never on when the ALARM LED is on.

The ALARM LED (red) indicates that metal was detected and the TMD IV has not been reset since the detection. This LED will also be on if a fault or error is present. It is never on when the NORMAL LED is on.

The BYPASS LED (yellow) indicates that the alarm output relay is disabled

Alarm output is also disabled (and the BYPASS LED lit) when the TMD IV is in Calibrate mode. This allows you to set up and calibrate the detector without generating alarms during the process.

BYPASS disables the alarm even if metal is detected and essentially isolates the TMD IV from the rest of the system.

The CALIB LED (red) indicates that the TMD IV is in Setup/Calibrate mode. When it is lit, you can change setup variables or calibrate the detector.

Keypad

The TMD IV has a membrane keypad that’s designed to be rugged, long-lasting, and easy to use even in conditions that require gloves. In normal operation, the only key used is the Reset key, also called the Alarm key, represented by a bell symbol on the keypad. For convenience in operation, an external Reset key is environmentally isolated and mounted on the outside of the enclosure.

The function of the soft-keys along the bottom of the LCD depends on the current screen. The function of the soft-keys is explained further in the following sections

The remaining keys (Home and digits 0-9) are used during calibration or when changing system settings. Pressing the Home key from any one of the sub-menus will return the system immediately to the Run screen. The digit keys are self-explanatory; however the “2” and “8” keys can also be used to navigate through the menus (as an alternative for the up-arrow and down-arrow soft keys).

Options Screen

System options are selected from the Options screen using the soft keys; the up-arrow and down-arrow keys shift focus to the desired option; the currently selected option is displayed as white text on a black background. The “Back” key returns the TMD IV to the Run screen. Figure 3-4a shows the option screen in navigation mode, with the “Sync Input” option selected.

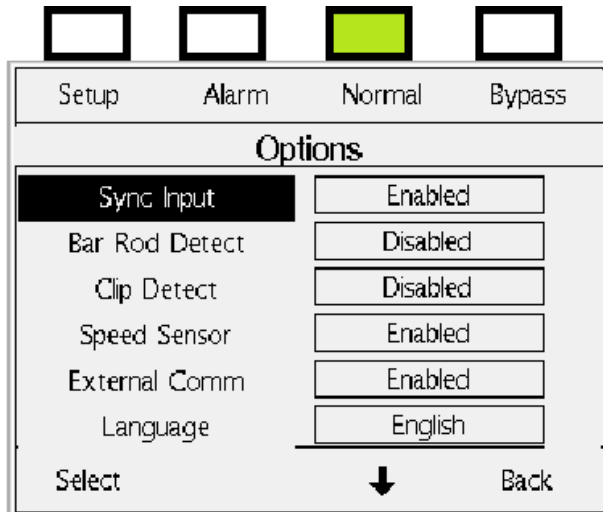


Figure 3-4a. Options Screen, upper section, navigation mode.

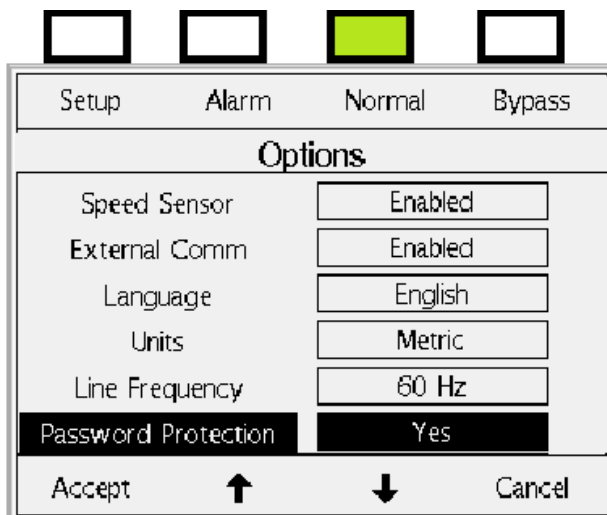


Figure 3-4b. Options Screen, lower section, in selection mode

To change the currently selected option, press the “Select” soft-key; this will change the display of the option value (rightmost column) to white text on a black background, while also changing the “Select” and “Back” soft keys to “Accept” and “Cancel”. To change the options value, use the up and down arrow keys to scroll through the available selections. When the desired value is displayed, press the “Accept” key, and the screen will return to navigation mode. If the Select key was pressed in error, press the “Cancel” key to return to navigation mode with the original value, regardless of the current selection.

The following sections explain the use of each of the options.

Sync Input

Enable SYNC input on the slaves for synchronization of transmitter pulses; required when two detectors are within 30 ft of each other.

Bar/Rod Detect

This option controls the detection of long pieces of tramp (typically rebar or pipe). When this option is enabled, the Bar Length setting is displayed in the Settings menu.

Clip Detect

This option controls the use of a clip detector input, which temporarily desensitizes the detector to allow a section of belt with a belt repair clip or joint to pass the detection area without tripping the metal alarm. When the Clip Detect option is enabled, the Clip Length setting is displayed in the Settings menu.

Speed Sensor

This option controls the use of an external speed sensor. Speed sensor input is used in detection calculations as well as for marker timing and clip desensitization. If the speed sensor input is enabled, the Belt Speed setting is not displayed in the Settings menu, and the Speed Calibration screen becomes available in the Calibration menu.

External Comms

This option controls the use of the Modbus communication protocol. If this option is enabled, the Settings menu displays the Modbus Port, Modbus Address, and Modbus Baud Rate settings.

Language

This option determines the operating language of the TMD IV. Available languages are English, Spanish, German, Italian, and Chinese. After changing language, the TMD IV should be restarted.

Units

This option allows the TMD IV to display distance and speed values in either Metric or English units.

Line Frequency

This option determines the frequency of the input power. It can be set to either 60 or 50 Hz.

Password Protection

This option turns on password protection. When enabled, a Password entry control is displayed in the View menu, and unless the correct password has been entered, the only available soft-key in the Run menu is the View option.

Settings Menu

From the Settings menu, values can be entered for the system parameters. Some of the fields are for numeric entry; others are limited to a set of selection. When navigating between the settings, leftmost soft-key will read “Select” for selection fields and “Edit” for numeric fields.

The numeric entry fields are all range limited. When entering a numeric value, the “Accept” soft-key will be visible only if the value entered is within the allowed range. The decimal point is provided by the control; there is no decimal point on the keypad.

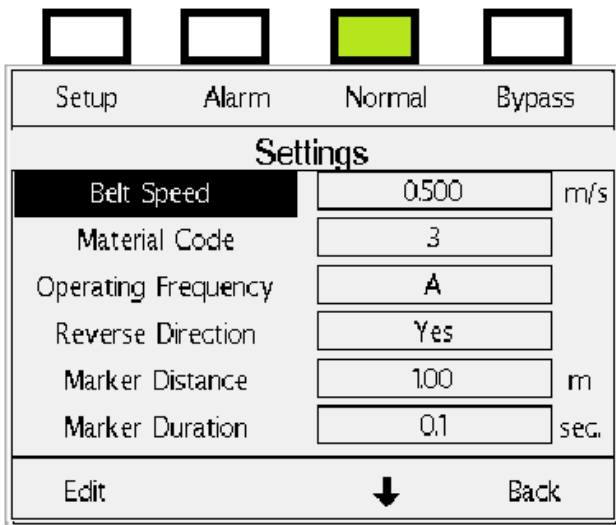


Figure 3–5a. Settings screen, scrolled to top

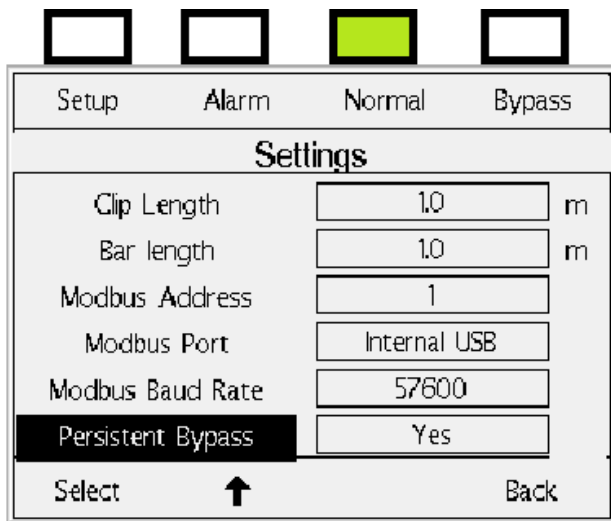


Figure 3–5b. Settings screen, scrolled to bottom

Belt Speed

This setting is only displayed if the Speed Sensor option is disabled. Enter into this control the typical operating speed of the belt. This value will be used to the metal detection capability and marker timing. The allowable range is 5 to 1800 fpm (0.025 to 9.0 m/s).

Material Code

The material code determines the timing of the pulse and detection mechanism described in Figure 1-5, in order to optimize the detection for different materials. The selection range is 1 through 7.

Operating Frequency

This setting changes the scanning frequency (A or B) to improve detection.

Reverse Direction

This setting reverses the direction of the detection algorithm. It does not actually change the direction of the belt.

Marker Distance

Edit this field to define the distance from the coil to the marker device. If there is no speed sensor, the system calculates this distance based on time and the Belt Speed setting. If a speed sensor is installed and enabled, the distance is based on calibrated speed pulses. The allowed range is 4.9 to 328.1 feet (1.5 to 100.0 meters).

Marker Duration

This field determines the length of time that the marker output remains active after a metal detection. For spray markers, this determines the length of the marked portion of the burden. Allowed range is 0.1 to 1.0 seconds.

Clip Length

This field defines the distance that the belt will move while the TMD IV operates under decreased sensitivity after a repair clip or joint is detected. This field is only displayed if the Clip Detect option is enabled. Allowed range is 1 to 30 feet (0.3 to 10.0 meters).

Bar Length

This field is only displayed if the Bar/Rod Detect option is enabled. Enter the maximum expected length of rebar or pipe expected to be among the burden. Pieces longer than this will be seen as “noise” by the TMD IV. Allowed range is 1 to 50 feet (0.3 to 15.24 meters).

Modbus Address

This setting is only displayed if the External Comm. option is enabled. Allowable range is 0 to 255.

Modbus Port

This option is only displayed if the External Comm. option is enabled. Allowable settings are “Internal USB” and “Expansion Card”.

Modbus Baud Rate

Allowable selections are 1200, 2400, 4800, 9600, 19200, 57600. This control is only available if the External Comm. option is enabled.

Persistent Bypass

This option puts the TMD IV into bypass mode for use by field service.

View Menu

The View menu provides read-only versions of the Settings and Options menus, inputs and outputs, and, if Password Protection is enabled, a control for entering the password.

When the Password Protection option is enabled, the TMD IV is in either a secured (“logged in”) or unsecured (“logged out”) mode. In unsecured mode, the View menu is the only screen available from the Run screen.

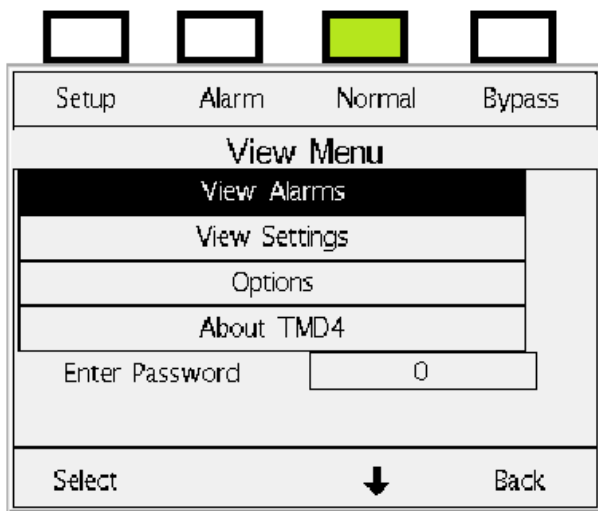


Figure 3–6. View menu with Password entry field visible.

Normal Operation

The screen that you will see upon power-up is the Home (or “Run”) screen. This screen shows the total count of detected tramp (or total trips) since the last factory reset or software update operation. When metal is detected, an additional field is displayed with the label “Coast” which is the number of pieces of tramp detected since the TMD IV tripped (or while the belt was “coasting” to a stop). Pressing the RESET (bell) key or the external Reset button sets the coast counter to zero.

From the home screen, a number of additional screens can be entered, using the “soft keys” along the bottom of the screen. These screens allow the user to change system options, change settings, calibrate the TMD IV, and perform various service operations. In order to select an option, use the up-and-down soft keys to highlight the option, then press the “Select” or “Edit” soft key (if neither soft key is displayed, then the selected value is read-only).

The Select soft key indicates that a limited set of values is defined, the up-and-down soft keys will be used to change the value displayed. The Edit soft key indicates that a value must be entered from the numeric keypad. For Edit fields, an “Accept” key will not be visible if the entered value is outside allowed range.

It’s important to note that no change is actually set until the Accept key is pressed. If the Cancel key is pressed, the display will go back into item selection mode, with the previous value unchanged. HOME keypad key is pressed while in Edit or Select mode, the previous value is unchanged.

Maintenance and Troubleshooting

This section provides information about TMD IV maintenance and troubleshooting. It includes pointers for routine maintenance and suggestions for diagnosing operational problems.

The maintenance information in this section should be sufficient to meet your service needs. If you encounter a problem that requires technical assistance, please call your service representative (refer to Service, Repair and Replacement Parts section of this manual for contact information).

Overview

You can expect the TMD IV system to operate satisfactorily and hold its calibration for months with simple routine maintenance.

Routine Maintenance

Keep the area around the TMD IV free from rocks and material build-up.

The TMD IV system can be washed down with water and meets NEMA Type 4 and IP66 (P/N 147797, 147800) standards. Do not add harsh chemicals, caustics, or disinfectants to the wash down solution.

The control unit enclosure can be wiped clean with a damp cloth, and if necessary, a mild detergent. Never use abrasive cleaners, especially on the display windows. Keep the enclosure door tightly closed to prevent dirt infiltration.

As a preventive measure, check all wires, plugs, and integrated circuits in the control unit to make sure they are tight in their connectors.

The idlers on each side of the TMD IV coil support structure should be greased according to the manufacturer's specifications.

Make sure that the conveyor belt is running true to the conveyor centerline in the detection area to prevent damage to the coil support structure and coil(s).

Troubleshooting

If your TMD IV is not detecting reliably or your calibrations are providing unexpected results, there are several things you can do to determine the cause of the problem.

Always begin with a visual inspection, not only of TMD IV components but also of the conveyor belt, the idlers, and all optional equipment.

If your system operates but is not working as expected, there are adjustments you can make to the TMD IV device setup and calibration settings to make it work better. First, you must determine what is causing the problem and what you can do to correct it.

Visual Inspection

If you are experiencing operational problems with the TMD IV, a quick visual inspection may reveal the source of the problem. Check the following items before proceeding to more specific troubleshooting procedures. Refer to the Operating the TMD IV section of this manual for the correct options settings mentioned below.

- Check power:
 - Make sure that the power switch is turned on
 - Make sure that the power connector block is plugged into the power supply assembly
 - Make sure that the circuit breaker powering the TMD IV is closed.
- Check the connections
 - Make sure all terminations are secure
 - Make sure all TMD IV wiring and installation is correct according to the drawings provided for your system.

Diagnosing and Correcting Problems

If setup and calibration were done with the conveyor belt stopped or running empty, background noise caused by material may be different with the belt running loaded. You should observe the TMD IV for a day or two before changing the device setup or calibration settings.

There are two basic types of problems you could be having with the TMD IV: false tripping or passing tramp undetected. Both of these problems are costly. False trips stop the conveyor and interrupt the process flow. Undetected tramp damages process machinery.

Common reasons for false tripping include:

- Coil Imbalance
- Sensitivity set too high
- Improper bar/rod detection
- Improper clip (belt splice) detection

Common reasons for passing tramp undetected include:

- Sensitivity set too low
- Tramp is too small
- Coil damage
- Detector malfunction

The remainder of this section describes the diagnostic processes for these problems and offers suggestions for correcting them.



WARNING. Failure to follow safe installation and servicing procedures could result in death or serious injury.

- Make sure only qualified personnel perform installation and maintenance procedures in accordance with the instructions in this manual.
- Allow only qualified electricians to open and work in the electronics cabinet, power-supply cabinet, control cabinet, or switch boxes.

- Covers over the electronics and rotating parts must always remain in place during normal operation. Remove only for maintenance, with the machine's power OFF. Replace all covers before resuming operation.
- During maintenance, a safety tag (not supplied by the factory) must be displayed in the ON/OFF switch areas instructing others not to operate the unit (ANSI:B157.1).

False Tripping

False tripping means that something other than the metal the TMD IV is set up to detect is causing it to trip. The most common problem is a sensitivity setting that is too high for the amount of background noise present. This makes it difficult for the TMD IV to distinguish between the signal produced by tramp metal and the background signal. Another common problem is coil imbalance, which can cause the receiver coil to generate output signals when there is no tramp metal passing.

If your TMD IV is false tripping, use the procedures in this section to help determine the cause. The procedures are written for a user familiar with the operator interface. The Operating the TMD IV section of this manual describes the operator interface in detail.

Correct the Coil Imbalance

Coil imbalance can result from the transmitter and receiving coils not being aligned well. It can also result from different amounts of metal in the conveyor structure on each side of the coils.

Use this procedure to balance the coils. Always perform this procedure first, before trying to determine any other cause of false tripping.



WARNING. Keep hands and clothing away from all moving or rotating parts.

1. Stop the conveyor belt
2. Clear the burden off the belt for four feet on each side of the coil structure
Also, check the immediate area around the support structure and on the coils and remove any loose metal objects.
3. Go to the Settings menu from the Run screen.

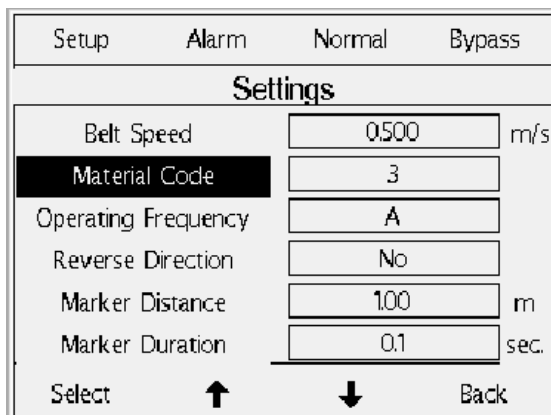


Figure 4-1. Selecting the Material Code

4. Scroll to the Material Code setting, and confirm that the type code is 3. For mineral ores, this value could also be set to 4.
5. Navigate back to the Run screen, select the Calibration menu, and enter the Coarse Sensitivity screen. Record the value as initially displayed, then use the manual option to change the setting to 2.

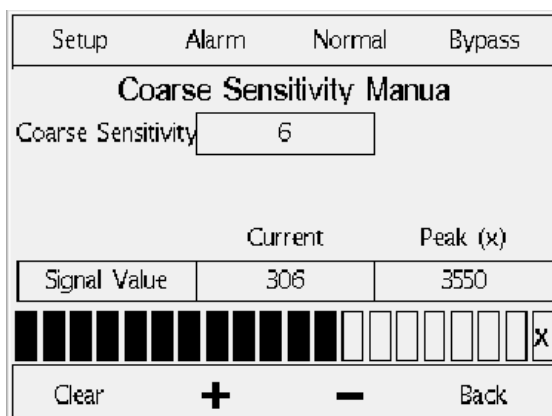


Figure 4-2. Capturing the initial Coarse Sensitivity Setting

6. Navigate to the Coil Balance screen and observe the number of bars displayed. There should be fewer than five bars displayed on either side of the center (the triangular markers). The bars may be going off and changing sides, but if five or more bars are dark, you will need to manually balance the coils.

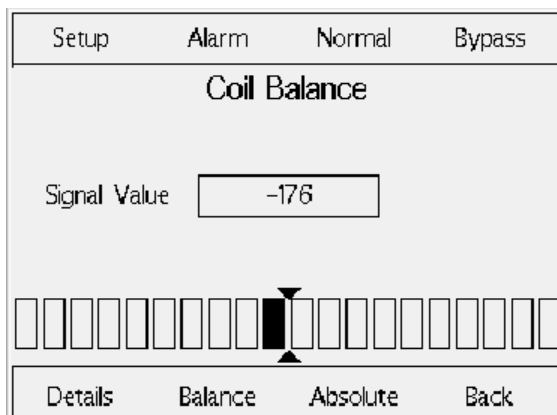


Figure 4-3. Checking coil balance

7. Adjust the coil position for your TMD IV model as follows:
 - For a dual coil TMD IV:
 - Use the adjusting bolts on the swing arm stop to adjust the position of the transmit coil forward or back.
 - As the transmitter coil is moved, the bar graph display will change. Find the position where the minimum number of bars is displayed. If the balance improves significantly, proceed with Step 8 to fine tune the coil balance.
 - If adjusting the transmitter coil does not affect the bar graph significantly, experiment with moving the TMD IV coil frame forward and back to achieve the best position possible. If

moving the frame does not help balance, proceed to section titled “Finding the Source of Mechanical or Electrical Noise”.

For a single coil TMD IV:

- Loosen the plastic bolts that hold the coil to the frame.
 - Move the coil from side to side. The slots in the coil will limit the travel.
 - As the coil is moved, the bar graph will change. Find the position where the minimum number of bars is displayed. Retighten the plastic bolts.
 - If the previous operation improved the balance significantly, proceed to Step 8 in order to fine tune the coil balance.
 - If adjusting the coil did not affect the balance significantly, proceed to the section titled “Finding the Source of Mechanical or Electrical Noise.”
8. Navigate to the Coarse Sensitivity screen and manually set the value to 5. This increases the sensitivity of the TMD IV so you can fine-tune the coil balance.
 9. Navigate back to the Coil Balance screen and observe the bar graph again. The bar graph may be “noisier” than it was in Step 6. This is because the sensitivity is set higher.
 10. Repeat Steps 7 and 8, increasing the coarse sensitivity value each time.
 11. When you are satisfied with the coil balance, navigate to the Coarse Sensitivity screen and manually set the value back to the number recorded in Step 5.

Finding the Source of Mechanical or Electrical Noise

False tripping often occurs from mechanical vibrations that produce background noise. The TMD IV software has signal processing to recognize the difference between a signal from metal passing through the coils and a signal from metal vibrating in the region of the coils. However, severe metal vibrations can sometimes produce the same signal as the metal passing through the coils.

Electrical disturbances from the conveyor belt motor or the wiring from the motor may also produce noise that interferes with TMD IV operations. Even other electrical systems near the TMD IV may be generating the noise.

Follow this procedure to find the source of mechanical or electrical noise.

1. Balance the coils as evenly as possible using the procedure from the section titled “Correcting Coil Imbalance”.
2. Navigate to the fine sensitivity screen and write down the “As found” value, then manually set the value to 950.

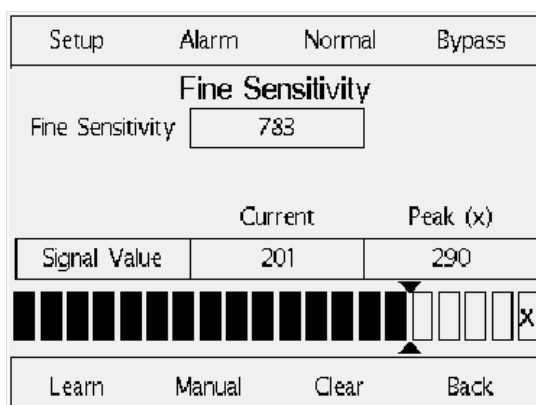


Figure 4-4. Fine Sensitivity Screen

3. Watching the bar graph, manually adjust the sensitivity until 14 or 15 bars are dark (about 70% of full scale). The actual number of bars shown will change continuously; try to get an average of about 70%).



WARNING. Keep hands and clothing away from all moving or rotating parts.

4. Start the conveyor belt. Do not run any burden at this time
5. Observe the bar graph. The number of bars should not change. If the noise level (the number of bars displayed) increases with the conveyor belt running, the noise could be caused by mechanical vibrations or electrical disturbances.
6. With the conveyor still running empty, check the area in the immediate vicinity of the coils for possible sources of mechanical vibration. The larger the size and surface area of the metal, the less the vibration required to cause problems.
 - The coil support structure should not vibrate or sway.
 - The coil(s) should be firmly bolted to the structure and should not vibrate
 - There should be no conveyor idlers or other moving conveyor parts in the area of the coils. The minimum distances for moving components are given in the system installation drawings.
 - There should be no vibrating grates or covers in the area.

If you find a possible source of mechanical vibration, correct the problem and repeat this procedure to verify that it significantly improved the balance.

If the noise level increases when the conveyor is run empty and mechanical vibrations do not appear to be the problem, the problem may be electrical noise from the conveyor motor or electrical wiring from the motor.



WARNING. High voltage that may be present on leads could cause electrical shock.

- All switches must be OFF when checking input AC electrical connections, removing or inserting printed circuit boards, or attaching voltmeters to the system.
 - Use extreme caution when testing in, on, or around the electronics cabinet, PC boards, or modules. There are voltages in excess of 115–230 V in these areas—even with the main door open.
 -
7. Check system wiring and installation to be certain it conforms to the recommended distances specified in the wiring diagram for your system or the Field Wiring Diagram (07468FE001.X1).



WARNING. The coil wiring must be run in a separate conduit from any power wiring.

If the system appears to be installed and wired correctly and there is still a high level of noise when the conveyor is run, other electrical systems may be generating the noise.

8. With the conveyor running empty, turn off other systems near the TMD IV one at a time while observing the bar graph. Turning off the source of the electrical noise will cause the number of bars to decrease, identifying that system as the one causing the problem.
9. If you identify a definite source of the electrical noise, correct the problem.
A typical solution may be re-routing wiring carrying large currents. In some instances, the only practical solution may be relocating the TMD IV to some other less noisy location. If you cannot identify a definite source of the electrical noise, it may be helpful to change the operating frequency of the TMD IV.
10. Navigate to the Settings menu, and change the operating frequency to the other value (A or B).
11. Observe the bar graph on the Home screen. If the number of bars has decreased, this is a better operating frequency for the TMD IV. If the number of bars has not decreased, set the operating frequency back to the original value and continue on.

Adjusting for High Product Noise (Mineral Ores)

With some highly conductive ores, the default measurement window for detecting metal will cause false tripping similar to high electrical noise when the ore is conveyed. The typical indication of this situation is a low noise level when the conveyor is run empty and a higher level when it is run loaded (as indicated by the bar graph).

This noise signal can be overcome by changing the location of the measurement window, which determines the timing of the measurement. Because the magnetic field from mineral ore takes longer to decay, you need to move the measurement window farther out on the time scale so the instrument will not be as sensitive to the signal from the ore. To move the measurement window farther out on the time scale, you increase the material type code number.

Follow this procedure to adjust the sensitivity of the TMD IV for mineral ores

1. Balance the coils as evenly as possible using the procedure from “Correcting Coil Imbalance”. Make sure that the Material code (in the Settings screen) is set to 4.
2. Navigate to the Coarse Sensitivity screen and perform an auto-calibration (“Learn”).

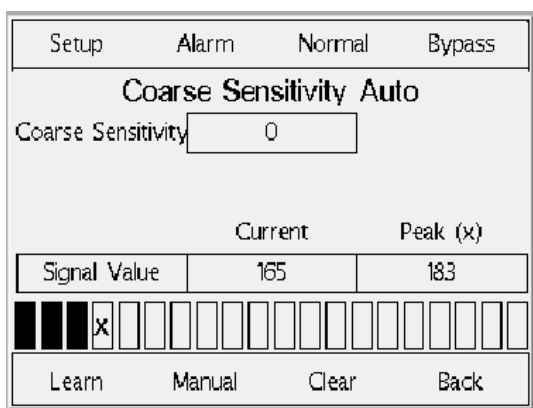


Figure 4-5.

3. Navigate to the Fine Calibration screen, and perform an auto-calibration (Learn). The values for Coarse and Fine Sensitivity will be different from the values obtained using material type code 3. Return to the home screen.



WARNING. Keep hands and clothing away from all moving or rotating parts.

4. Start the conveyor belt and run material through the coils. Observe the noise level on the bar graph on the home screen. The noise level should have decreased (fewer bars darkened). If it did, use this material code. If the noise level increased, the problem is not caused by the type of material conveyed. Go to Step 6.
5. If the noise level from the ore is still too high, navigate to the Settings screen and increase the value of Material code by 1, then repeat Steps 2 through 4. The valid numbers for material type code are 0-7. If you tried using the values 4, 5, 6, and 7 and there was no significant improvement or the noise level increased, the problem may be mechanical or electrical noise or the metal content of the tramp to be detected may be too small for existing system conditions.
6. Navigate back to the Settings screen and set the Material Code back to 3. You may want to try the procedure from section “Finding the Source of Mechanical or Electrical Noise” to see if that may be the problem.

Adjusting for Clip (Belt Splice) Detection

Some false trips may occur from the clips used for belt repair or splicing. The clip detection feature reduces the detection sensitivity of the TMD IV during the interval in which the clip is travelling between the clip detector and the transmit/receive coils. The length of this interval is entered in the Settings screen as “Clip length”. The TMD IV determines the “desensitization time” as a function of the specified clip length and the speed of the belt. For belts operating at variable speed, the correct operation of the clip detection feature therefore depends on the proper calibration of the speed sensor. For fixed-speed belts, the clip detection feature depends on accurately specifying the belt speed in the Setting menu. Before attempting any of the procedures below, you should verify the settings for Clip Detection Enabled, Clip Length, and Speed Sensor enabled/disabled.

Check the installation of the clip detector(s) to make sure they are positioned correctly. (Refer to the appropriate Installation Placement drawing for your system.)

Make sure that you have enabled Clip Detect from the Options screen, that the belt speed is set correctly in the settings screen or, if a speed sensor is installed, that it has been calibrated from the calibration menu.

Also, make sure that the clip length (the distance from the clip detector to 4 in or 10 cm past the downstream side of the transmit coil) is entered correctly on the setting screen, which is designed to prevent the TMD IV from tripping when a clip goes through. Calibrate the system for clip detection and delay as follows:

A false trip on a clip can usually be easily diagnosed. The TMD IV will trip just as or just after a clip has passed. If the conveyor is wired to stop on a trip, the clip will generally be the same distance downstream from the coils each time the trip occurs and the belt is shut down. False tripping from clips is generally caused by one of three conditions:

- The clip detector did not see the clip
- The clip delay is too short
- The clip desensitization isn't set low enough

To determine if the clip sensitivity is too high, navigate to the Clip Coarse Calibration screen (through the Calibration menu). If necessary, set the Clip Coarse Sensitivity to 0 using the manual setting option. Set the Clip Fine Sensitivity to 0 using the same method. Run the belt empty, and if no false detects occur, and nothing else has changed, the problem can be assumed to be with the sensitivity. Re-run the clip calibration procedure and manually reduce the sensitivity until the false trips stop occurring.

If the clip delay is too short, the TMD IV will return to normal sensitivity before the clip has passed through the detection volume, and a false detection will occur. In the Settings screen, set the Clip Length parameter to the maximum (100 meters or 300 feet), and run the belt empty. If no tripping occurs, and no other conditions have been changed, the clip distance was too short. Re-measure the distance from the clip detector to the upstream edge of the receive coil. If the false detects continue to occur on an empty belt, try increasing the clip length in steps of 1 ft (0.3 meters).

To determine if the clip detector is seeing the clip, stop the belt and pass a solid object (a screwdriver will work nicely) in front of the clip detector while watching the Input Test screen (under the Next/Service menu). If the detector is operating correctly, you will see an indication on the inputs screen.

If all of the tests have passed and false detections are still occurring in the vicinity of the clip, check to make sure that the clip is installed so that it triggers the clip detector.

Passing Tramp Undetected

There are a number of reasons why the TMD IV may pass tramp metal undetected. The detector may be incorrectly wired or installed, the material code may be incorrect, the sensitivity may be set too low, the size of the tramp may be too small for the coil size and separation, the coils or junction box may be damaged, or the TMD IV may be malfunctioning.

Tramp may also pass undetected if your system uses clip detection and the size of the clip(s) is large compared to the size of the tramp you are trying to detect. If there should happen to be tramp metal on top of a clip, the TMD IV may not detect the metal because it's letting the clip pass.

If your TMD IV is passing tramp undetected, use the procedures in this section to help determine the cause. The procedures are written with an assumption that the reader is familiar with the TMD IV operator interface. If you are not, please familiarize yourself with the Operating the TMD IV section of this manual before beginning any of these procedures.

Changing Material Code to Adjust Sensitivity

Detecting small-sized tramp metal, especially small stainless steel tramp may require changing the material type code used by the TMD IV. This may not result in a dramatic sensitivity increase because a reduction of 1/2 in tramp size may result in a reduction of only 1/4 to 1/6 of the signal; the signal reduction is a function of size and type.

First, you must determine how well the TMD IV is working with the current material type code (which defaults to 3).

1. Balance the coils using the procedure in Correcting Coil.
2. Under the Calibration menu, bring up the Coil Balance screen and observe the bar graph
3. Increase both Coarse and Fine sensitivity values until the bar graph covers 75% of the screen in the Coil Balance display. This may require a number of cycles of changing and observing.
4. When the bar graph covers 75% of the screen, record the Coarse and Fine sensitivity values.
5. Navigate to the Settings screen, and change the Material Code selection to 1.
6. Balance the coils again using the procedure in Correcting Coil Imbalance.
7. Navigate to Coarse Sensitivity screen in the Calibration menu and enter the value recorded in Step 4.
8. Navigate to the Fine Sensitivity screen in the Calibration menu and enter the value recorded in Step 4.
9. Navigate to the Coil Balance screen in the Calibration menu and observe the bar graph. If the bar graph covers less than 75% of the screen, the TMD IV is operating properly at this material code, and the sensitivity will be greater than it was with the previous material code.

NOTE: The lower the material code, the greater the sensitivity to conductive materials other than tramp metal. In most instances, this will not be a problem; if a problem should occur, refer to the process for Adjusting for High Product Noise (Mineral Ores). If the bar graph covers more than 75% of the screen, the TMD IV may still function properly at this material code setting.

10. Perform an auto-calibration for the coarse and fine metal sensitivity, as described in section "Initial Setup Procedure" and test the system to see if it trips on tramp correctly.
11. If still greater sensitivity is required, repeat this procedure until you have the sensitivity you need.

Testing for Coil or Junction Box Damage

If you suspect that coil or junction box may be causing the TMD IV to operate improperly, follow the procedures in this section to test for damage.

These procedures involve testing wiring on the CPU (and in the junction box, if one is used on your system) using an ohmmeter.



WARNING. Do not attempt to defeat safety interlocks provided with this product. There are no user-serviceable parts inside the system enclosure. This product must be serviced only by authorized Thermo Fisher Scientific service personnel.



WARNING. High voltage that may be present on leads could cause electrical shock.

- All switches must be OFF when checking input AC electrical connections, removing or inserting printed circuit boards, or attaching voltmeters to the system.
- Use extreme caution when testing in, on, or around the electronics cabinet, PC boards, or modules. There are voltages in excess of 115–230 V in these areas—even with the main door open.

Testing the Transmitter Coil

Follow this procedure to test the transmitter coil if your system does not have a junction box.

1. Turn off power to the control unit (main switch)
2. Disconnect the transmitter coil wires from the field terminals marked Transmit.
3. Measure the resistance of the coil.

If the ohmmeter does not show 2-3 ohms, the transmitter coil is bad.

If the transmitter coil resistance is approximately 2-3 ohms, the transmitter coil, its wiring, and its portion of the CPU board is working correctly.

If your system uses a junction box, follow this procedure to test the transmitter coil:

1. Turn off the power to the system control unit (main switch).
2. Disconnect the transmitter coil wires from field terminals 4 and 5.
3. Measure the resistance of the coil.
4. If the transmitter coil resistance is approximately 2-3 ohms, the transmitter coil wires, the transmitter coil, its wiring, and its portion of the CPU board are working correctly.
5. If the Ohmmeter does not show 2-3 ohms, on the transmitter coil, measure the resistance between terminal 24 and 25 at the junction box. If 24-25 at the junction box are 2-5 ohms, the cable from the junction box to the control unit is bad.

Testing the Receiver Coil

Follow this procedure to test the receiver coil if your system does not have a junction box:

1. Turn off power to the control unit (main switch)
2. Disconnect the receiver coil wires from the terminals marked “Coil 1”.
3. Measure the resistance of the coil. IF the resistance is greater than 500 ohms, the receiver coil is bad.
If the receiver coil resistance is approximately 450 to 500 ohms, the receiver coil, its wiring, and its portion of the CPU board is working correctly.

If your system uses a junction box, follow this procedure to test the receiver coil:

1. Turn off power to the control unit (main switch).
2. Disconnect the receiver coil wires from terminals 121 and 222 at the junction box.
3. Measure the resistance of the coil. If the resistance is greater than 500 ohms, the receiver coil is bad.
If the receiver coil resistance is approximately 450 to 500 ohms, the receiver coil, its wiring, and its portion of the CPU board are all working correctly.
4. If the receiver coil resistance is correct, reconnect the wires to the terminals in the junction box.

5. Disconnect the receiver coil wires from field terminals marked Coil 1 on the control unit main board.
6. Measure the resistance of the coil through the junction box. If the receiver coil resistance is greater than 2,500 ohms, the wiring to the junction box or the junction box circuit is bad.

Installing Default Values

Note: if your system has Password Protection turned on, you must log in, in order to execute this procedure. The log-in values is 5414.

From the Home screen, press the “Next” soft-key, select Service. The Service menu will be displayed. From there, select Default Settings. A confirmation screen will be displayed:

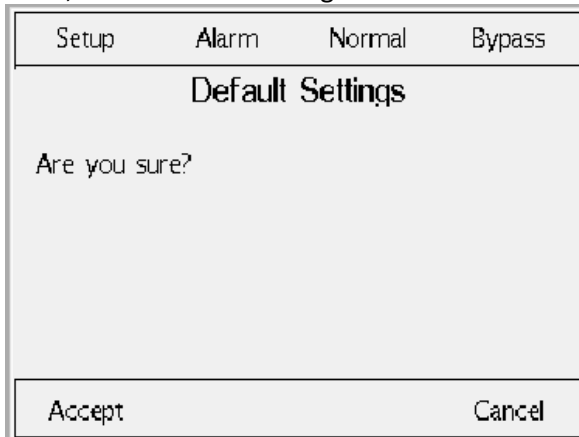


Figure 4-6.

Press the Accept soft-key to continue, otherwise press the Cancel soft-key to go back to the Service menu.

TMD IV Modbus Interface

This section provides information about the Modbus protocol implemented for communication between the TMD IV and an intelligent host or PLC. It deals only with the protocol as used for this particular interface.

Overview of TMD IV Communications

The TMD IV Modbus interface protocol is a subset of the Modicon Modbus protocol. The physical layer uses an asynchronous serial bus topology with an RS-485 physical data medium. Transferred data is 8-bit binary using RTU framing and 16-bit CRC error checking.

Control is restricted to a single master/multiple slave configuration. The host or PLC must act as a Modbus master device. Baud rates supported are: 1200, 2400, 4800, 9600, 19200, and 57600. The default is 57600 bps.

Modbus Message Types Supported by TMD IV

The TMD IV provides normal Modbus responses only for the functions listed below; all other functions and diagnostic requests will return Exception 01 (Illegal Function).

- Function 03 – Read Holding Registers

- Function 06 – Preset Single Register
- Function 16 – Preset Multiple Registers

TMD IV Holding Registers

The TMD IV uses Modbus holding registers (4xxxx designation) to implement the register set. The message function code implicitly defines that the query applies to a holding register. The leading 4 (indicating a holding register) is not sent as part of the register address. Registers are addressed starting at zero: register 1 is addressed as 0.

Table A-1 describes the holding registers that are useful for day-to-day operations. In the table, Type “I” is a signed integer; Type “P” means that data is packed within the bytes. MSB = most significant byte, LSB = least significant byte.

Register Type	Address	Name	Access	Persistent?
Holding	529	Service Code	Get/Set	No
Holding	545	Service Result	Get Only	n/a
Holding	561	Material Code	Get/Set	Yes
Holding	577	Coarse Sensitivity	Get/Set	Yes
Holding	753	Operating Frequency	Get/Set	Yes
Holding	769	Power Line Frequency	Get/Set	Yes
Holding	849	Language	Get/Set	Yes
Holding	865	Units	Get/Set	Yes
Holding	881	Password Protection Enabled	Get/Set	Yes
Holding	897	Password	Get/Set	Yes
Holding	977	Normal Fine Sensitivity	Get/Set	Yes
Holding	993	Marker Distance	Get/Set	Yes
Holding	1009	Marker Duration	Get/Set	Yes
Holding	1025	Nominal Belt Speed	Get/Set	Yes
Holding	1265	Coast Count	Get Only	n/a
Holding	1281	Lifetime Trip Count	Get/Set	Yes
Holding	1361	Speed Sensor Input Enabled	Get/Set	Yes
Holding	1377	Meters Per Speed Pulse	Get/Set	Yes
Holding	1393	Actual Belt Speed	Get Only	n/a
Holding	1425	Clip Fine Sensitivity	Get/Set	Yes
Holding	1441	Clip Length	Get/Set	Yes
Holding	1457	Clip Coarse Sensitivity Delta	Get/Set	No
Holding	1473	Clip Coarse Sensitivity	Get/Set	Yes
Holding	1505	Alarm Status Bit string	Get Only	n/a
Holding	1585	Belt Direction Reversed	Get/Set	n/a
Holding	1601	Clip Detection Enabled	Get/Set	n/a
Holding	1616	Bar Rod Detection Enabled	Get/Set	Yes
Holding	1633	Bar Rod Length	Get/Set	Yes
Holding	1649	Bar Rod Sensitivity	Get/Set	Yes
Holding	1665	Modbus Address	Get/Set	Yes
Holding	1681	Modbus Baud Rate	Get/Set	Yes
Holding	1697	Modbus Parity	Get/Set	Yes
Holding	1713	Modbus Num Stop Bits	Get/Set	Yes
Holding	1729	Sync Input Enabled	Get/Set	Yes
Holding	1777	Welding Noise Filter Enabled	Get/Set	Yes

Table A-1. Holding Registers

Register Details

Service Codes

Base Address: H529 **Data Type:** UINT16
Access: Get/Set **Length:** N/A
Persistent: No

This register is used to invoke various “services” provided by the TMD IV. “Service” is just a fancy name for command. This register has two bit fields. Bits 0:14 are the desired service code. Bit 15 is the toggle bit. Commands are invoked by writing to this register. The command will only be accepted if the toggle bit value is different than the current toggle bit value. The following table gives some examples of how this works.

Current Value	Value Written	Result
0x0000	0x8001	Service 1 (Update Config) is invoked. The toggle bit changed from 0 to 1.
0x8001	0x8001	No action is taken. The toggle bit did not change
0x8001	0x0001	Service 1 (Update Config) is invoked. The toggle bit changed from 1 to 0.
0x0001	0x0002	No action is taken. The toggle bit did not change.

Valid service code values are listed in the following table.

Code	Service	Description
0	No Operation	This service does nothing. It is mainly useful for setting the toggle bit to a known value.
1	Update Config	For each parameter there is a “staging” value and a run-time value. Modbus register writes only change the staging value. The Update Config service causes the run-time settings to be updated in a safe atomic manner. The typical procedure for updating the TMD IV parameters is to write to one or more settings register and then invoke the “Update Config” service.
2	Set Defaults	Restore all parameters to their factory default setting. An Update Config command should be issued immediately after this command to make the new settings active.
3	Quick Balance	Force the balance estimate to rapidly “lock” on the current value of the receive signal. This command is often necessary if something happens that causes a step change in the balance signal. This includes things like changing the material code or the coarse sensitivity.
4	Start Data Capture	This command initiates data capture. Data capture is a feature which allows signals to be captured in real-time and stored in a buffer for later read-out. Data capture will stop automatically when the trigger condition is satisfied or can be stopped manually using the Stop Data Capture service.
5	Stop Data Capture	This command stops data capture. Data capture normally stops automatically when the trigger condition is satisfied.
6	Corrupt Settings File	This command is used for testing. It completely erases the EEPROM used to save parameter values. It restores the EEPROM to its factory state. The embedded software will raise a “Settings File CRC” alarm when the EEPROM is in this state because the check sequences associated with each data item will be incorrect.
7	Reset Alarms	Attempt to clear all active alarms. This command can be used to clear momentary or “latching” alarms like the Metal Detected.

- | | | |
|---|--------------------|--|
| 8 | Clear Restart Info | A count of restarts caused by watchdog reset and unexpected exceptions is maintained in the EEPROM. This command resets this count back to zero. |
| 9 | Software Reset | Reset the hardware and software. When this command is sent the embedded software stops updating the software watchdog. The reset is caused by a watchdog timer expiration. This command can be used to test the software watchdog feature. |

Service Result

Base Address: H545	Data Type: UINT16
Access: Get Only	Length: N/A
Persistent: No	

This register contains an integer code value giving the result of the last service invocation. The encoding is given in the table below.

Value	Meaning
0	Service Succeeded
1	Service Pending
2	Invalid Service Code
3	Other Error

Material Code

Base Address: H561	Type: UINT16
Access: Get/Set	Length: N/A
Persistent: Yes	Min: 0
	Max: 7

This is an integer code value which controls the delay from the end of the excitation pulse to the start of data acquisition. It should be between 0 and 7. The time delay increases with code value.

Coarse Sensitivity

Base Address: H577	Type: UINT16
Access: Get/Set	Length: N/A
Persistent: Yes	Min: 0
	Max: 6

This parameter controls the receive A/D gain. The encoding is shown in the table below.

Value	ADC Gain
0	1
1	2
2	4
3	8
4	16
5	32
6	64

Operating Frequency

Base Address: H753	Type: UINT16
Access: Get/Set	Length: N/A
Persistent: Yes	Min: 0
	Max: 1

This parameter controls the pulse rate. This is an enumerated type with the encoding shown below.

Value	Meaning
0	Use Frequency "A"
1	Use Frequency "B"

There are two different possible pulse rates ("A" and "B"). In certain situations an external signal may get picked up in the receive coils. If this signal is at the wrong frequency it can interfere with the operation of the TMD IV. Switching to a different pulse rate may eliminate this interference. The exact pulse rate used depends on the power line frequency as specified by the table below. The correct power line frequency must be specified using the *Power Line Frequency* parameter.

Operating Frequency	Power Line Frequency	Pulse Rate (Hz)
A	60	900
B	60	660
A	50	960
B	50	650

Power Line Frequency

Base Address: H769	Type: UINT16
Access: Get/Set	Length: N/A
Persistent: Yes	Min: 0
	Max: 1

This parameter specifies the AC power line frequency. The instrument needs this value for certain internal setup calculations. The encoding is given below.

Value	Meaning
0	50 Hz
1	60 Hz

Language

Base Address: H849	Type: UINT16
Access: Get/Set	Length: N/A
Persistent: Yes	Min: 0
	Max: 65535

This item holds the value of the GUI language selection.

Units

Base Address:	H865	Type:	UINT16
Access:	Get/Set	Length:	N/A
Persistent:	Yes	Min:	0
		Max:	1

This item holds the value of the GUI units selection. The encoding is shown below.

Value	Meaning
0	English
1	Metric

Normal Fine Sensitivity

Base Address:	H977	Type:	UINT16
Access:	Get/Set	Length:	N/A
Persistent:	Yes	Min:	0
Units:	Counts	Max:	999
		Default:	250

This parameter gives the detection threshold indirectly. The detection threshold is $1000-F$ where F is the value of this parameter. It has units of signal counts.

Marker Distance

Base Address:	H993	Type:	FLOAT32
Access:	Get/Set	Length:	N/A
Persistent:	Yes	Min:	1.5
Units:	Meters	Max:	100
		Default:	1.5

This parameter specifies the distance in meters from the detector coils to the marker/diverter. If a piece of tramp is detected at belt position X , the marker/diverter will be activated at belt position $X+M$ where M is the value of this parameter.

Marker Duration

Base Address:	H1009	Type:	FLOAT32
Access:	Get/Set	Length:	N/A
Persistent:	Yes	Min:	0.1
Units:	Seconds	Max:	1.0
		Default:	0.1

This parameter specifies length in seconds of the marker/diverter activation pulse.

Nominal Belt Speed

Base Address:	H1009	Type:	FLOAT32
Access:	Get/Set	Length:	N/A
Persistent:	Yes	Min	0.025
Units	meters/sec	Max	9.144
		Default	1.5

This data item specifies the nominal belt speed in meters/second. When there is no speed sensor, the software assumes the belt is moving at this speed and converts distances to times accordingly. In particular the *Marker Distance* data item is converted into a time delay using this value.

Coast Count

Base Address:	H1265	Type:	UINT16
Access:	Get Only	Length:	1
Persistent:	No	Min	0
Units	N/A	Max	9999

A count of the number of times tramp metal was detected since the metal alarm was raised. This is useful in setups where the belt is stopped when tramp is detected. A coast count greater than 1 tells the user that additional tramp came through while the belt was stopping. The additional tramp will be located somewhere between the marked location and the detector.

Lifetime Trip Count

Base Address:	H1281	Type:	UINT16
Access:	Get/Set	Length:	1
Persistent:	Yes	Min	0
Units	N/A	Max	9999

A count of the total number of times tramp metal was detected during the life-time of the detector. This value will not increase beyond 9999.

Speed Sensor Input Enabled

Base Address:	H1361	Type:	UINT16
Access:	Get/Set	Length:	1
Persistent:	Yes	Min	0
Units	N/A	Max	1

A boolean flag which specifies that a speed sensor is present. A speed sensor is a crude belt position feedback device. Each speed sensor pulse corresponds to a certain amount of belt movement. When this flag is set, the detector will use the speed sensor to determine belt speed and position. This will affect marker activation and clip detection. Both of these features have distance type parameters. For instance “marker distance” specifies the belt distance from the detector to the marking device. If there is no speed sensor, the detector assumes the belt is moving at the speed specified by the nominal belt velocity and translates this distance parameter into a time. When the belt is ramping up to speed or stopping this feature does not work correctly. When a speed sensor is present marker control works correctly even during speed ramps.

Meters Per Speed Pulse

Base Address:	H1377	Type:	FLOAT32
Access:	Get/Set	Length:	1
Persistent:	Yes	Min	1E-6
Units	meters/pulse	Max	4E-2

This data item specifies the belt position change in meters corresponding to one speed pulse.

Actual Belt Speed

Base Address:	H1393	Type:	FLOAT32
Access:	Get Only	Length:	1
Persistent:	No	Min	N/A
Units	meters/sec	Max	N/A

This is the measured belt speed (product of the speed sensor rate and the meters per speed pulse).

Clip Fine Sensitivity

Base Address:	H1425	Type:	UINT16
Access:	Get/Set	Length:	N/A
Persistent:	Yes	Min	0
Units	Counts	Max	999
		Default	250

This parameter specifies the fine sensitivity value to use in belt regions marked by a repair clip.

Clip Length

Base Address:	H1425	Type:	FLOAT
Access:	Get/Set	Length:	N/A
Persistent:	Yes	Min	0.3
Units	Meters	Max	9.144
		Default	0.3

This parameter specifies the length of belt repair regions. After the upstream clip detector input goes active the detector will be desensitized until either (a) the belt has moved the distance specified by this parameter or (b) the downstream clip detector input goes active.

Clip Coarse Sensitivity Delta

Base Address:	H1457	Type:	INT16
Access:	Get/Set	Length:	N/A
Persistent:	No	Min:	-6
		Max:	6

This is one of two parameters which specify the coarse sensitivity value to be used in clip regions. A clip region is a region of the conveyor belt marked by a repair clip. In such regions the coarse sensitivity is the sum of this register and the [Clip Coarse Sensitivity](#) register. This register is not persistent. This register is used during

calibration. It allows the effective clip coarse sensitivity to be adjusted without modifying the persistent Clip Coarse Sensitivity register itself. This limits the number of EEPROM writes and helps with EEPROM lifetime.

Clip Coarse Sensitivity

Base Address: H1473	Type: INT16
Access: Get/Set	Length: N/A
Persistent: Yes	Min: 0
	Max: 6

This is one of two parameters which specify the coarse sensitivity value to be used in clip regions. A clip region is a region of the conveyor belt marked by a repair clip. In such regions the coarse sensitivity is the sum of the [Clip Coarse Sensitivity Delta](#) register and this register. This register is persistent. In normal operation the *Clip Coarse Sensitivity Delta* register is zero and the coarse sensitivity value to be used in clip regions is specified by this register.

Alarm Status Bit String

Base Address: H1505	Type: UNT16
Access: Get Only	Length: N/A
Persistent: No	Min: 0
	Max: 65535

This is a status variable with one bit for each alarm condition. If the alarm condition is active the corresponding bit will be set. Multiple alarms can be active at the same time and thus multiple bits may be set at the same time. The alarm corresponding to each bit is given in the table below. The value in the “Mask” column can be used for testing for a particular alarm condition.

Bit	Mask	Alarm Condition
0	0x0001	Metal
1	0x0002	Long Bar
2	0x0004	Coil Driver Short Circuit
3	0x0008	Col Driver Open Circuit
4	0x0010	Coil Driver High Voltage
5	0x0020	Balance Fault
6	0x0040	High Pile
7	0x0080	ADC Overload
8	0x0100	Reset Disable
9	0x0200	DSP Communications
10	0x0400	Settings File CRC
11	0x0800	Firmware CRC

Belt Direction Reversed

Base Address: H1585	Type: UINT16
Access: Get/Set	Length: N/A
Persistent: Yes	Min: 0
	Max: 1

The receive coil is supposed to be mounted in a certain direction with respect to the direction of belt travel. There is a label on the coil assembly showing the correct orientation. In this orientation, tramp travelling through the coils will produce a positive pulse and then a negative pulse. If the receive coils have been mounted incorrectly, set this parameter to have the software compensate for the error.

Clip Detection Enabled

Base Address:	H1601	Type:	UINT16
Access:	Get/Set	Length:	N/A
Persistent:	Yes	Min:	0
		Max:	1

This parameter can be used to enable or disable the clip detection feature. When the feature is disabled the clip detector inputs are ignored.

Bar Rod Detection Enabled

Base Address:	H1617	Type:	UINT16
Access:	Get/Set	Length:	N/A
Persistent:	Yes	Min:	0
		Max:	1

This parameter is a flag which turns the Bar/Rod detection feature on and off.

Bar Rod Length

Base Address:	H1633	Type:	FLOAT
Access:	Get/Set	Length:	N/A
Persistent:	Yes	Min:	1
Units:	Meters	Max:	15.24
		Default:	15.24

The maximum bar length that can be detected by the bar/rod detection feature. The bar/rod detection algorithm will detect bars between 0.46 meters and this length.

Bar Rod Sensitivity

Base Address:	H1649	Type:	UINT16
Access:	Get/Set	Length:	N/A
Persistent:	Yes	Min:	1
Units:	Unit-less	Max:	9

This item specifies the “sensitivity” value for the bar/rod algorithm. The bar/rod detection algorithm has its own signal threshold. The bar/rod threshold is a fraction of the threshold used by the normal detection algorithm. The fraction corresponding to each setting of this parameter is given in the table below.

Value	Fraction
1	1
2	15/16
3	14/16

4	12/16
5	10/16
6	8/16
7	6/16
8	4/16
9	2/16

Modbus Address

Base Address:	H1665	Type:	UINT16
Access:	Get/Set	Length:	1
Persistent:	Yes	Min:	1
Units	N/A	Max:	247

This is the address to be used with the modbus serial communication protocol. This parameter only applies for communications using the comm expansion board. A fixed address of 1 is used for communication using the built-in USB-to-serial converter.

Modbus Baud Rate

Base Address:	H1681	Type:	UINT16
Access:	Get/Set	Length:	1
Persistent:	Yes	Min:	0
Units	N/A	Max:	5

This parameter specifies the baud rate to be used with the Modbus serial communication protocol. The encoding is given below. This parameter only applies for communications using the comm expansion board. A fixed baud rate of 57600 is used for communication using the built-in usb-to-serial converter.

Selection Code	Baud Rate
0	1200
1	2400
2	4800
3	9600
4	19200
5	57600

Modbus Parity

Base Address:	H1697	Type:	UINT16
Access:	Get/Set	Length:	1
Persistent:	Yes	Min:	0
Units	N/A	Max:	2

This parameter specifies the parity to be used for the Modbus serial communication protocol. The encoding is given below. This parameter only applies for communications using the comm expansion board. A fixed value of “None” is used for communication using the built-in USB-to-serial converter.

Selection Code	Parity
0	None
1	Odd
2	Even

Modbus Num Stop Bits

Base Address:	H1713	Type:	UINT16
Access:	Get/Set	Length:	1
Persistent:	Yes	Min:	1
Units	N/A	Max:	2

This parameter specifies the number of stop bits to be used for the Modbus serial communication protocol. This parameter only applies for communications using the comm expansion board. A fixed value of 1 is used for communication using the built-in USB-to-serial converter.

Sync Input Enabled

Base Address:	H1729	Type:	BOOL
Access:	Get/Set	Length:	N/A
Persistent:	Yes	Min:	N/A
Units	N/A	Max:	N/A

A boolean flag related to the external sync feature. This feature allows two detectors located in close proximity to synchronize their pulse generation. This prevents the two detectors from interfering with each other. One detector is configured as the master and the other as the slave. The sync output of the master is fed into the sync input of the slave. The flag should be set to TRUE for the slave unit and FALSE for the master unit.

Welding Noise Filter Enabled

Base Address:	H1777	Type:	BOOL
Access:	Get and Set	Length:	N/A
Persistent:	Yes	Min:	N/A
Units	N/A	Max:	N/A

A boolean flag which enables the welding noise elimination filter. This is a special filter designed to reduce interference from certain types of arc welders. This filter can be very useful in many situations. It is not recommended for use when the fine sensitivity is larger than 970.

Service, Repair & Replacement Parts

This section provides information about service, repair and replacement parts for your TMD IV. It includes the telephone numbers for various departments at Thermo Fisher Scientific. The procedure for ordering replacement parts is also included in this section.

Service and Repair Information

The maintenance information in this manual is designed to meet your service needs. If you should encounter a problem that requires technical assistance, you may call Thermo Fisher Scientific Product Service at (800) 445-3503.

Thermo Fisher Scientific also provides on-site service technicians to assist customers with installation, set up, initial calibration, customer training, maintenance, and repair. Contact the Field Service department at the number given below for current rates and scheduling.

Thermo Fisher Scientific has a repair center located at our plant in Minneapolis, Minnesota. Products that need system checkout or repair can be returned to the plant with the Return Material Authorization (RMA) form. Contact our Repair and Returns department at (800) 445-3503 to get an RMA form and number.

Note: Have your machine model number and serial number available when you call.

Main Switchboard	(763) 783-2500
FAX	(763) 783-2525
Technical Assistance	(800) 445-3503
Field Service	(800) 445-3503
Return Material Authorization & Repair	(800) 445-3503

Parts Ordering Information

For the fastest service when ordering parts, telephone or fax the Thermo Fisher Scientific Parts Department at the numbers given below. Your regional field service representative can also assist you with parts orders, but this may delay shipment of your parts.

The recommended procedure for ordering parts is:

1. Determine the broken or faulty part.
2. Locate the part on the engineering drawings referenced in Appendix A.
3. Find the corresponding part number in the parts list.
4. Before you contact Thermo Fisher Scientific for your parts, make sure you have the following information:
 - Machine model and serial number
 - Purchase Order number
 - Date required
 - Preferred shipping method
 - Part number(s), description, and quantity needed
5. Contact Thermo Fisher Scientific by email, fax, or telephone.

Parts Lists

Replaceable parts for the TMD IV are shown on the engineering drawings referenced in Appendix A. The drawings help you accurately identify the part(s) you need, and the parts lists on the drawings provide part numbers and descriptions.

Contact your local office for a list of spare parts.

Disposal of Hazardous Waste

All soldered printed circuit boards must be disposed of in accordance with your local Hazardous Waste policy.

As an alternative, you may return product supplied by Thermo Fisher Scientific, with an RMA form, freight prepaid for disposal. Contact our Repair and Returns department at (800) 445-3503 to get an RMA number to use on the form.

Contacting Thermo Fisher Scientific

Here's how to contact us for replacement parts or technical support. We are here to help!

Australia

+61 (0) 8 8208-8200
+61 (0) 8 8234-3772 fax
sales.auadl@thermofisher.com

Chile

+56 2 378 5080
+56 2 370 1082 fax
sales.bmh@thermofisher.com

China

+86 8008105118
sales.bulk.us@thermofisher.com

Germany

+49 (0) 208-824930
+49 (0) 208-852310 fax
sales.oberhausen@thermofisher.com

India

+91-22-4157-8800
+91-22-4157-8801 fax

Italy

+39 02-950590-55
sales.mi.ramsey.it@thermofisher.com

Mexico

+52 55 3600 1599
mxnau.sales@thermo.com

South Africa

+27 11 776 0000
+27 11 822 3982 fax

Spain

+34 91-484-5965
+34 91-484-3597 fax

United States

+1 (800) 445-3503
+1 (763) 783-2500
sales.bulk.us@thermofisher.com

Visit our website at:

www.thermofisher.com/bulkweighing

Appendix A –Engineering Drawings

This Appendix contains the engineering drawings for your TMD IV system. The following drawings are included:

- Field Wiring Diagram (D07468F-E001)
- Field Wiring Diagram with Junction Box (D07468F-E002)
- Under Belt Single Coil Assembly Stand (D07328C-A110-XX)
- Under Belt Single Coil Final Assembly (D07328C-A101)
- Under Belt Single Coil Installation Placement (D07328C-A102)
- Final Assembly, Standard System (D07328C-A001)
- Installation Placement, Standard System (D07328C-A002)
- Outline, Mounting and Assembly, Coil Stand (D07328C-A003)
- Outline & Mounting Dimensions, Clip Detector (C07328C-B003)
- Outline & Mounting Dimensions, Flag Drop Marker (B07328C-B004)
- Outline & Mounting Dimensions, Spray Marker (D07344B-B007)
- Outline & Mounting dimensions, Rotating Beacon Assembly(B07328C-B006)
- Outline & Mounting Dimensions, Alarm Horn (B07328C-B005)
- Outline, Mounting and Installation, High Pile Detector(B07328C-B007)
- Outline, Mounting and Installation, TMD IV Control 4A Plastic Enclosure (D07468F-B001)
- Outline, Mounting and Installation, TMD IV Control 6A Metal Enclosure (D07468F-B002)
- Field Wiring Diagram RS-485, TMD IV (D07468F-E003)
- Outline, Mounting and Installation, TMD IV Control 4A/6A Enclosure-Australia Only (D07468V-A001)