

Master Unit		Slave Unit		4..20mA Conf.
GND1	GND2	GND3	GND4	Output, mA
Good	Good	Good	Good	20
Failed	Good	Good	Good	18
Good	Failed	Good	Good	17
Failed	Failed	Good	Good	16
Good	Good	Failed	Good	15
Good	Good	Good	Failed	14
Good	Good	Failed	Failed	13
Failed	Good	Failed	Good	12
Good	Failed	Failed	Good	11
Failed	Failed	Failed	Good	10
Failed	Good	Good	Failed	9
Good	Failed	Good	Failed	8
Failed	Failed	Good	Failed	7
Failed	Good	Failed	Failed	6
Good	Failed	Failed	Failed	5
Failed	Failed	Failed	Failed	4
4	5	7	8	RJ45 Pin
5,6,7,8	1,2,3,4	5,6,7,8	1,2,3,4	Master Unit
				Slave Unit

Limited Warranty

Credence Technologies, Inc. warrants Ground Master monitors to be free from defects in materials and workmanship under normal use and service for a period of one (1) year from date of purchase directly from Credence Technologies, Inc., or from its authorized distributors. This warranty extends only to the original purchaser. This warranty shall not apply to any product or part of it which has been subjected to misuse, neglect, accident or abnormal conditions of operation. Operation with power supply not provided or expressly approved by Credence Technologies voids the warranty. Except to the extent precluded by applicable state law, Credence Technologies will have no liability for any consequential, incidental, or special damages.

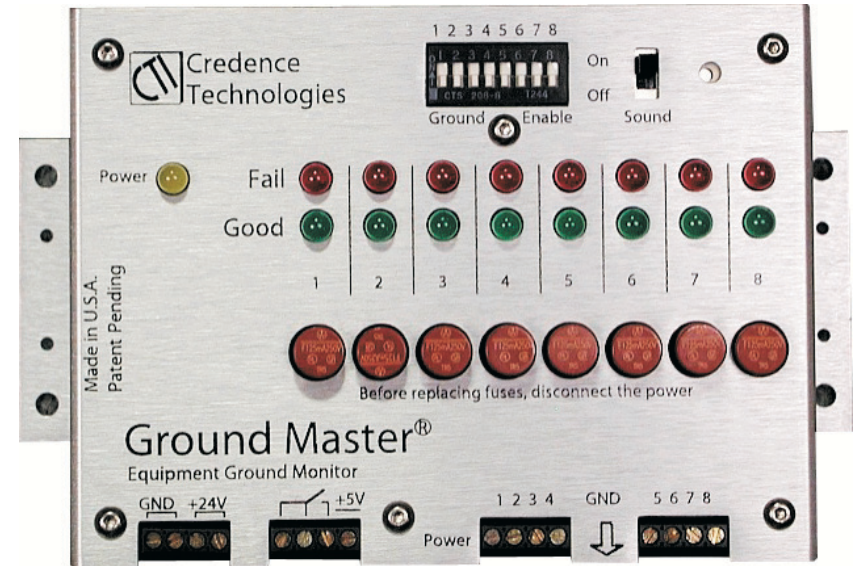
In the event of failure of a product covered by this warranty, Credence Technologies, Inc. will repair a product returned to authorized distributor or, only if it was purchased directly from Credence Technologies, Inc., to the manufacturer; provided the warrantor's examination discloses to the company's satisfaction that the product was defective and is qualified for to a warranty claim. Credence Technologies may, at its option, replace the product or its components with new or factory-refurbished parts or as whole in lieu of repair. With regard to a product returned within one year of its purchase, said repair or replacement will be made without charge. If the failure has been caused by misuse, neglect, accident or abnormal conditions of operation, repairs will be billed at a nominal cost. Warranty does not cover transportation costs.

Ground Master[®]

Equipment Ground Monitors

Models **CTC065**

CTC065RT



User's Guide

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PUB01608



Credence Technologies, Inc.

Welcome to Ground Master®! Now you will know at all times whether your equipment is properly grounded, assuring ESD safety of your process.

Ground Master® is a comprehensive real-time ground monitor that checks connection of your equipment to ground in accordance with ANSI/ESDA S.20.20 standard. It also monitors presence of electromagnetic interference (EMI) on ground, alerting you to possible functionality problems, such as tool lockups, erratic behavior, parametric errors, etc.

Controls and Indicators

Power LED	Indicates that power is provided for operation of Ground Master®
Pass/Fail LEDs	Indicates which ground is being monitored and whether each ground quality is compliant or non-compliant with your requirements
Enable Switches	Enables/disables monitoring of each individual ground connection
Sound On/Off	Enables/disables alarm buzzer
Fuses	Replaceable safety fuses for each individual ground connection
Equipment Terminals	Screw terminals for connection of the individual equipment grounds
Ground Connection	Terminal for connection to reference ground
Power	Jack for power adapter
Output	RJ45 jack for connection to facility monitoring system 4..20mA or MODBUS
Ext.	RJ45 jack for connection to an extension/slave or MODBUS

Operation with Facility Monitoring System

Ground Master provides intelligent information to a facility monitoring system (FMS) or data acquisition system (DAQ) on status of each individual ground it monitors. For FMS interface Ground Master is available with 4..20mA interface (-3) and MODBUS interface (-5).

System Requirements

DAQ or FMS must be able to sample data from each Ground Master monitor often enough in order not to miss intermittent grounding problems and to properly represent them. Credence Technologies can provide you with the portable or stationary data acquisition systems if you don't already have one -- please contact the factory or authorized distributor.

Ground Master provides output signal via its RJ45 connector.

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- ☞ **IMPORTANT: DO NOT PLUG GROUND MASTER INTO YOUR 10/100BASET ETHERNET FACTORY NETWORK!**
 - ☞ **DO NOT PLUG -3 VERSION INTO -5 INTERFACE AND VS. VERSA - THIS MAY CAUSE IRREVERSIBLE DAMAGE TO GROUND MASTER AND YOUR FMS.**
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If a long data cable is used, it is advisable to install ferrite clamp-on chokes on both ends of the cable in order to reduce electromagnetic interference induced on cables. Please contact the factory for proper selection of ferrite filters.

WARNING! FAILURE TO FOLLOW THESE INSTRUCTIONS MAY RESULT IN IRREVERSIBLE DAMAGE TO GROUND MASTER AND MAY HARM PERSONNEL AND EQUIPMENT!

If Ground Master is connected to a Facility Monitoring System (FMS), always verify that there is zero voltage and low resistance between FMS ground and ground at the location where Ground Master is being grounded. If ground conditions are unacceptable, correct them prior to installing Ground Master, otherwise damage to personnel, Ground Master and/or FMS may occur.

Signal Levels

For MODBUS interface contact factory for specific details. For 4..20mA each connection provides information on four grounds -- please see section "Data Output." Each Ground Master has two such groups of grounds -- grounds 1..4 and grounds 5..8. For each group, the table below shows the output current corresponding to the different states of the grounds.

Alarm Limits

Each Ground Master is calibrated to provide alarm when impedance of the equipment to ground goes above the preset limit. This limit is set at the factory and can be changed using the rotary switch on the top of the unit with the small screwdriver.

Setting	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Limit1 (Ohms)	2	3	4	5	6	7	8	9	10	12	14	16	18	20	

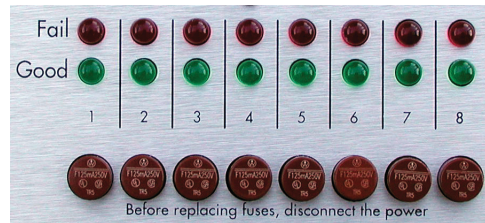
"0" setting is reserved -- do not use it.

Don't forget to account for impedance of wires from Ground Master to your equipment and to ground.

It is tempting to try to comply with the lowest possible impedance limits, such as 1 Ohm. However, very seldom this can be achieved in a realistic factory environment. Even the wires between the monitor and the equipment have finite impedance. Start first with the more achievable levels, such as 10 Ohms, and once it is achieved, reduce the alarm threshold down to the next practical level.

Fuses

If equipment ground is disconnected for whatever reason, or the ground wiring is done improperly, such equipment may be under significant potential, sometimes equal to the voltage on the AC mains (110V or 220V). In order to prevent propagation of this voltage to other equipment via Ground



Master, fuses are implemented for each individual ground connection. In case of excessive voltage on the equipment, appropriate fuse will disconnect the equipment from Ground Master and from the other connected equipment. Ground failure

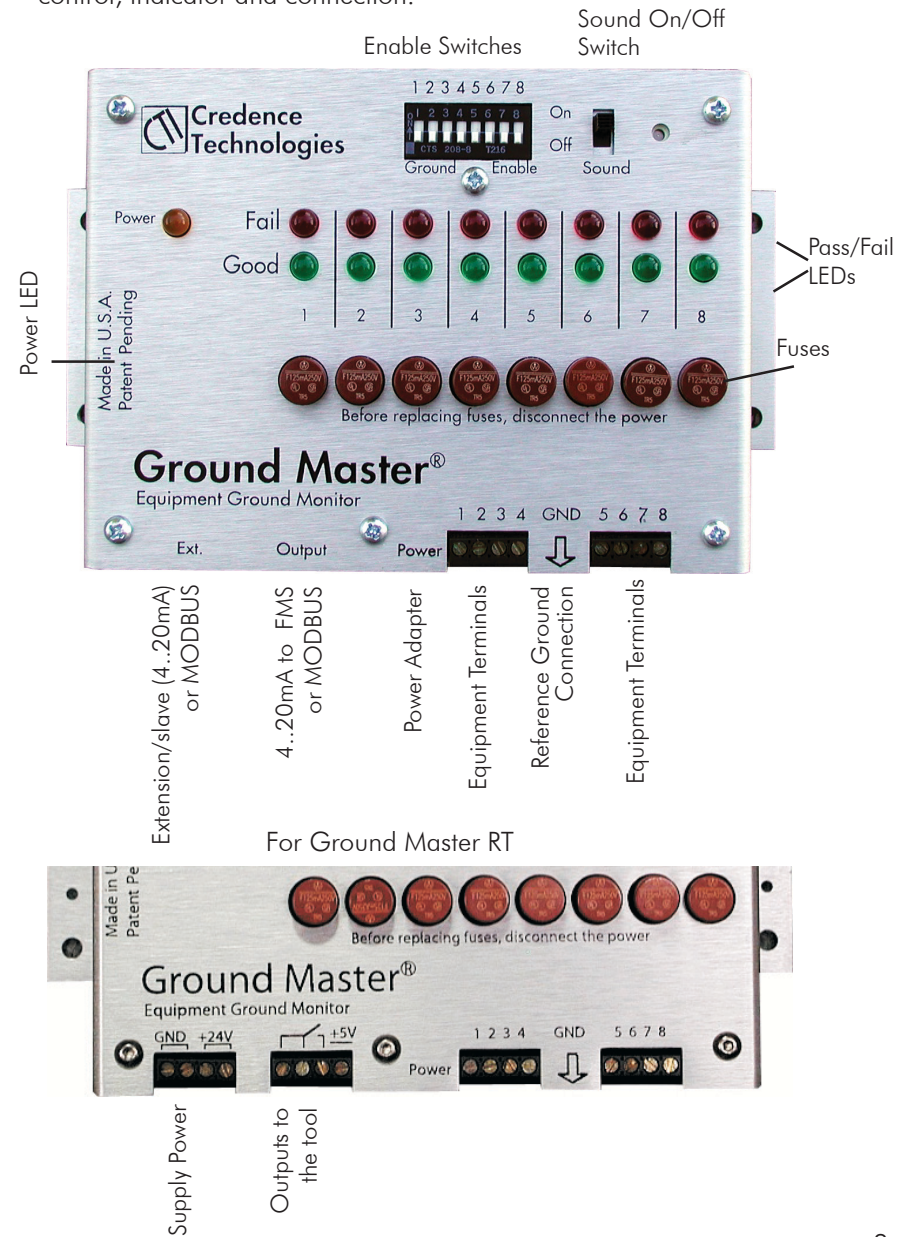
on that particular ground will be immediately indicated.

Before replacing the fuse always investigate the reason for fuse blowing and correct the problem. Fuse should never be blown under normal circumstances.

IMPORTANT: NEVER USE WIRE JUMPERS IN PLACE OF FUSES -- USE ONLY FACTORY-AUTHORIZED FUSES. DISCONNECT POWER BEFORE REPLACEMENT OF FUSES.

Brief Tour of your Ground Master

Please refer to the rest of this User's Guide for detailed explanation of each control, indicator and connection.



Overview

Ground Master® is a continuous monitor of grounding status of equipment. It provides independent ground monitoring of up to 8 tools. Monitoring of ground connection is done in accordance to ANSI/ESDA S.20.20 standard. Specific limits are set to the customer requirements. If no requirements are specified, default ground impedance set at the factory to 10 Ohms.

In addition to monitoring connection to ground, Ground Master offers monitoring of electromagnetic interference (EMI) on the ground wires often present in a factory environment. Such interference causes problems with operation of equipment.

Ground Master provides local indication and alarm of the status of each ground and local alarms. In addition, Ground Master provides intelligent output to a facility monitoring or data acquisition system for factory-wide monitoring.

To extend monitoring to additional 8 points, another Ground Master monitor can be connected to the extension port. Connected units would provide one combined output to a facility monitoring system.

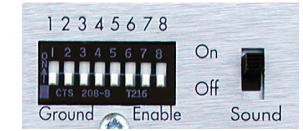
Safety First!

While assuring proper ESD grounding is a purpose of using Ground Master, before connecting equipment to it make sure that equipment itself is properly grounded. Ground Master only MONITORS proper connection to ground. DO NOT ground equipment through Ground Master.

Operation

Monitoring Enable

In order for Ground Master to monitor a particular ground, it must be enabled by turning “on” (sliding up) the appropriate DIP switch. This way you won’t need to use wire jumper to simulate unused connection and will always know the status of every ground connection.

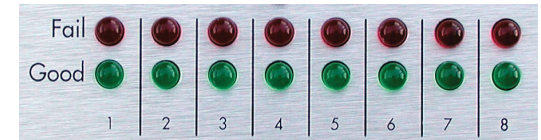


Monitoring Enable Switches

If you are not planning to monitor a particular connection, turn the appropriate switch “off” by sliding it down.

Indication

When ground monitoring is enabled on any particular ground, one of the corresponding LEDs lights on. If the ground connection is within the



Ground Status Indication

specification, the green LED will be lit. If the ground impedance is higher than the limit, the red LED will be on. In case the ground connection impedance is below the alarm limit, but the particular ground has strong EMI signal present, the green LED will be on and the red LED will be blinking.

Summary of LED Indication:

Status	Green LED	Red LED	Sound
Ground impedance passes	On	Off	Off
Ground impedance fails	Off	On	On
Ground impedance passes but strong EMI present	On	Blinks	Off
Ground monitoring disabled	Off	Off	Off

Sound can be turned on/off using the slide switch.

Connecting two Ground Master Units Together

In cases when more than 8 ground connections must be monitored, you can connect two Ground Master units in Master/Slave configuration as shown. This configuration is valid only for Ground Master with 4..20mA outputs. For connecting Ground Masters with MODBUS interface follow MODBUS conventions.

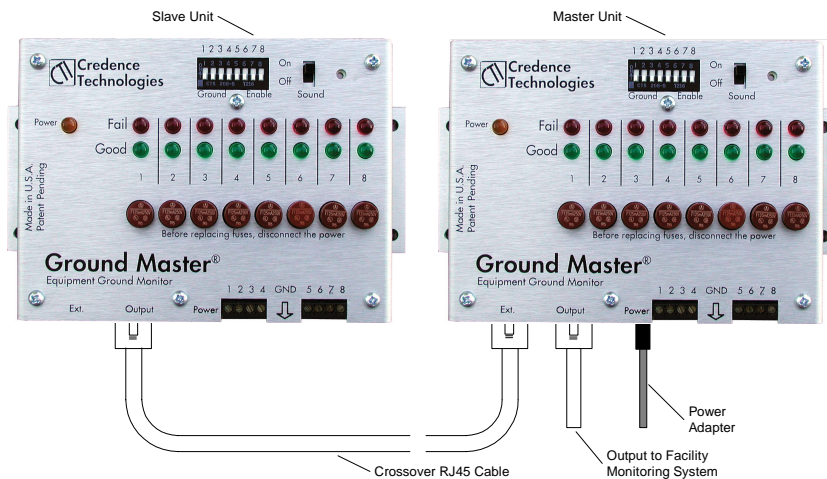
The cable that connects both units must be 100BASE-T4CROSSOVER RJ45 CABLE -- please consult the factory, your computer administrator or computer store. Do not use regular RJ45 cable or regular 10/100 Base T crossover cable. Crossover cables usually have red or orange color of insulation, however do not rely on color only.

The slave Ground Master unit gets its power from the master unit. Do not plug power adapter into the slave unit.

Only one slave unit can be connected to the master unit to monitor up to a total of 16 grounds. Do not connect any other monitors to the slave unit.

100 BASE-T4 crossover cable diagram

Pin#		Pin#
1	<>	3
2	<>	6
3	<>	1
4	<>	7
5	<>	8
6	<>	2
7	<>	4
8	<>	5



Connection of Ground Master monitors in Master/Slave Configuration

Installation and Connections

Placement

Mount Ground Master on a wall or on a side of equipment where its stable placement and access to all connections is assured. DIN-rail mounting is available as well. Place Ground Master so that the length of wires to the monitored equipment is minimized.

Mounting

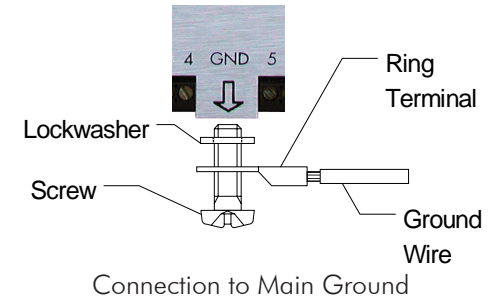
Depending on the mounting option that you have ordered, Ground Master comes with the bracket to mount it on a flat surface. An optional DIN bracket to mount it on a standard DIN rail is available.

Connecting Reference Ground

Ground Master must be connected to proper facility ground using its GND connection. This ground will serve as a reference. Without this connection no monitoring is possible.

Make sure that this reference ground is a true ground and is properly connected to both facility (power) ground and to ESD ground, should such be separately present at your factory.

Crimp 18 AWG (1mm diameter) wire to the supplied ring terminal and connect it to the GND terminal of the unit. Connect the other end of this wire to proper facility ground. Minimize the length of this wire since the impedance of this wire will be a significant factor in measuring ground impedance of all connections. Do not coil extra length of this wire.



Connecting Equipment Grounds

Use 18 AWG (1mm diameter) wires to connect them to the screw terminals of the unit. Connect the other end of the wire to grounded connection of your equipment.

Shorten the wires and do not coil or loop extra wire. The longer the wire, the higher its impedance and the more influence it will make on the monitored parameters.

As a reference, DC resistance of an 18 AWG wire is 0.0128 Ohms/meter or 0.00387 Ohms/ft. This doesn't take into account resistance of the connection nor AC impedance component which could be significant if the wire is coiled.

Connecting Power

Ground Master can be powered in the following ways:

- by a separate power adapter
- via its RJ45 cable from facility monitoring system for Ground Master
- via terminal block for Ground Master RT

IMPORTANT: PROVIDE POWER VIA ONE WAY ONLY.

Ground Master needs 12..24V DC and consumes less than 300 mA

If two Ground Master monitors are connected together (see further in the text), the "slave" monitor gets power from the "master" unit and the current requirements double.

Power Jack: it is a 2.1mm barrel connector, center positive

RJ45 Jack: See pinouts for your configuration.

Power must be reasonably clean of spikes and EMI.

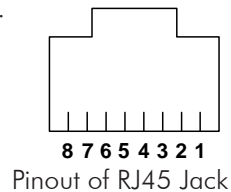
IMPORTANT: Use only the adapter provided by the manufacturer. Operation with power supply not provided by or expressly approved by Credence Technologies voids the warranty.

Data Output (Ground Master)

Ground Master provides intelligent information to facility monitoring or data acquisition system. Ground Master can be ordered in two versions -- 4..20mA or MODBUS. In either configuration Ground Master can be powered by facility monitoring system (FMS) via its data cable.

Pinout of RJ45 Jack for 4..20mA

Pin	Signal
1	+12..24V DC
2	Ground
3	+12..24V DC
4	Output grounds 5..8, master unit
5	Output grounds 1..4, master unit
6	Ground
7	Output grounds 5..8, slave unit when connected
8	Output grounds 1..4, slave unit when connected



Pinout of RJ45 Jack for MODBUS

Pin	Signal
1	Not Connected
2	Not Connected
3	Not Connected
4	TXD1/D1
5	TXD0/D0
6	Not Connected
7	+12..+24V DC
8	Ground

IMPORTANT: 4..20MA AND MODBUS VERSIONS ARE NOT INTERCHANGEABLE -- VERIFY YOUR CONFIGURATION BEFORE CONNECTING GROUND MASTER!

Terminal Block Outputs (Ground Master RT)

Ground Master RT enables automatic shutdown of the tools, provides signal to many types of tower alarm light, as well as provides logic signal for use in similar circumstances. Three basic configurations are recommended: Dry Contact, 24V Output and 5V Output (see to the right).

Dry relay contacts are closed when Ground Master is plugged in and all monitored grounds are within acceptable limits. If any of the grounds fails or if power to Ground Master fails, contact will become open. If you connect inductive load, such as relay coil, to the relay contacts, a protective diode must be utilized.

Logic level is CMOS and TTL compatible. Output is normally +5V and becomes logic "0" when any of the grounds fails.

