

DIGITAL 2T-48VDC-xx -48Vdc-to- 120Vac Power Inverter

Owner's Guide

Part Number: EK-48VDC-OG. B01

February 1998

**Digital Equipment Corporation
Maynard, Massachusetts**

March 1997
February 1998

Digital Equipment Corporation makes no representations that the use of its products in the manner described in this publication will not infringe on existing or future patent rights, nor do the descriptions contained in this publication imply the granting of licenses to make, use, or sell equipment or software in accordance with the description.

Possession, use, or copying of the software described in this publication is authorized only pursuant to a valid written license from DIGITAL or an authorized sublicensor.

FCC NOTICE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.

Any changes or modifications made to this equipment may void the user's authority to operate this equipment.

Operation of this equipment in a residential area may cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

© Digital Equipment Corporation 1997, 1998. All rights reserved.

The following are trademarks of Digital Equipment Corporation: DIGITAL and the DIGITAL logo.

Table of Contents

1 Introduction

- 1.1 General..... 1-1
- 1.2 Controls and Indicators..... 1-3
 - 1.2.1 Inverter Alarm Module 1-4
 - 1.2.2 Inverter Control Module 1-5
 - 1.2.3 Inverter Power Module 1-5
 - 1.2.4 Rear Panel 1-6

2 Installation

- 2.1 Introduction..... 2-1
- 2.2 Site Preparation for Field Installation..... 2-2
- 2.3 Unpacking the Shipment..... 2-3
- 2.4 Installing the 2T-48VDC-xx Power Inverter 2-4
- 2.5 Normal Power Up..... 2-6
- 2.6 Tests and Verification..... 2-7
 - 2.6.1 Power Inverter Functionality Test 2-7
 - 2.6.2 Inverter Control Module Test (N+1 Only)..... 2-8
 - 2.6.3 Power Inverter Load Test (Optional)..... 2-9
- 2.7 Installing a Redundant (N+1) Inverter Control Module..... 2-10
- 2.8 Installing a Redundant (N+1) Inverter Power Module..... 2-10
- 2.9 Connecting External Alarm Circuits 2-11

3 Troubleshooting

- 3.1 Introduction..... 3-1

4 Removal and Replacement

- 4.1 Introduction..... 4-1
- 4.2 Front Cover 4-1
- 4.3 2T-48VDC-xx Chassis..... 4-2
- 4.4 Inverter Alarm Module 4-4
- 4.5 Inverter Control Module 4-5
 - 4.5.1 Redundant (N+1) Power Inverter 4-5
 - 4.5.2 Nonredundant Power Inverter 4-5
- 4.6 Inverter Power Module 4-6
 - 4.6.1 Redundant (N+1) Power Inverter 4-6
 - 4.6.2 Nonredundant Power Inverter 4-6

A Hardware Specifications

Electromagnetic Compatibility	A-2
Safety	A-2

B Field Replaceable Units

Figures

Figure 1-1 2T-48VDC-xx Power Inverter Block Diagram.....	1-2
Figure 1-2 Front View	1-3
Figure 1-3 Rear Panel.....	1-6
Figure 2-1 Alarm Connector.....	2-11

Tables

Table 1-1 Inverter Alarm Module LEDs	1-4
Table 1-2 Inverter Power Module LEDs	1-5
Table 2-1 Mounting Hardware.....	2-3
Table 2-2 Alarm Connector Pinout	2-12
Table 3-1 Troubleshooting Table.....	3-2
Table A-1 2T-48VDC-xx Specifications.....	A-1
Table B-1 2T-48VDC-xx FRUs	B-1

Preface

Overview

This guide provides the information necessary to install the 2T-48VDC-xx -48Vdc-to-120Vac power inverter in a 48.26-cm (19-in.) English RETMA cabinet. It also provides information on operating and troubleshooting the 2T-48VDC-xx -48Vdc-to-120Vac power inverter, and removing and replacing field replaceable units (FRUs).

Intended Audience

This guide is intended for anyone who has purchased the 2T-48VDC-xx -48Vdc-to-120Vac power inverter, either already installed in a cabinet or as a field installation.

Personnel should be experienced and trained in installing computer and related equipment.

How to Use This Guide

Read all of this guide *before* installing the 2T-48VDC-xx -48Vdc-to-120Vac power inverter.

Before installation review the warranty. The terms of the warranty agreement with DIGITAL may require that a qualified DIGITAL Customer Services representative install the system. Contact your local DIGITAL representative if you have any questions.

Organization

This guide is organized as follows:

Chapter 1, Introduction – Provides an overview of the 2T-48VDC-xx -48Vdc-to-120Vac power inverter and a description of the front and rear panel controls, components, and indicators.

Chapter 2, Installation – Provides site preparation, unpacking, installation, testing, and verification information.

Chapter 3, Troubleshooting – Provides troubleshooting information.

Chapter 4, Removal and Replacement – Provides removal and replacement procedures for the chassis, inverter alarm module, inverter control module, and the inverter power module.

Appendix A, Specifications – Provides the physical, environmental, and electrical specifications for the 2T-48VDC-xx power inverter.

Appendix B, Field Replaceable Units (FRUs) – Lists all of the FRUs and their part numbers for the 2T-48VDC-xx power inverter.

Conventions

This guide uses the following conventions:

Convention	Meaning
Note	A note calls the reader's attention to any item of information that may be of special importance.
Caution	A caution contains information essential to avoid damage to the equipment.
Warning	A warning contains information essential to the safety of personnel.

The following symbols appear on the chassis. Please review their definitions below:



This Dangerous Voltage warning symbol indicates risk of electrical shock and indicates hazards from dangerous voltage.



This Attention symbol is used to alert the reader about specific safety conditions, and to instruct the reader to read separate instructional material.

Reader's Comments

DIGITAL welcomes your comments on this or any other manual. You can send your comments to DIGITAL the following way:

- Mail:
Digital Equipment Corporation
Shared Engineering Services
PKO3-2/21J
129 Parker Street
Maynard, MA 01754-2199

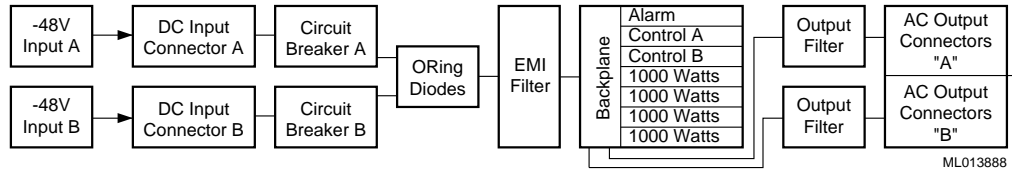
1.1 General

The 2T-48VDC-xx -48Vdc-to-120Vac power inverter is designed for a Telco central office (restricted area) environment and converts a -48 Vdc input into a true sine wave 120 Vac 60Hz output. The 2T-48VDC-xx power inverter is fed by dual -48 Vdc inputs that are internally OR'd together, filtered, and passed to the inverter. The 2T-48VDC-xx power inverter is a modular system which can be assembled in different combinations. The building blocks of the power inverter are:

- **Inverter Power Module** – Each inverter power module is a 1000 watt power inverter. All of the inverter power modules are connected to a common output bus and have built-in current (load) sharing. They require and receive drive signals from an inverter control module. Up to four inverter power modules can be installed in the 2T-48VDC-xx power inverter.
- **Inverter Control Module** – The inverter control module generates all of the signals necessary to operate up to four inverter power modules. The module itself does not generate any AC output power nor does any power flow through it. A second inverter control module can be installed to create a redundant (N+1) set of control signals to form the basis of a completely redundant power inverter system.
- **Inverter Alarm Module** – The inverter alarm module provides alarm output signals to the user via LEDs on the front panel and to a 25-pin D-subminiature connector on the rear panel for external monitoring of the alarm signals. The inverter alarm module also contains the INV On/Off toggle switch and the AC POWER (output) circuit breaker.

Figure 1-1 shows a detailed block diagram of the 2T-48VDC-xx power inverter.

Figure 1-1 2T-48VDC-xx Power Inverter Block Diagram



The 2T-48VDC-xx power inverter is available in six different models. Three of the available models are redundant (N+1) and three of the available models are nonredundant. The following table lists the models and a description of each model.

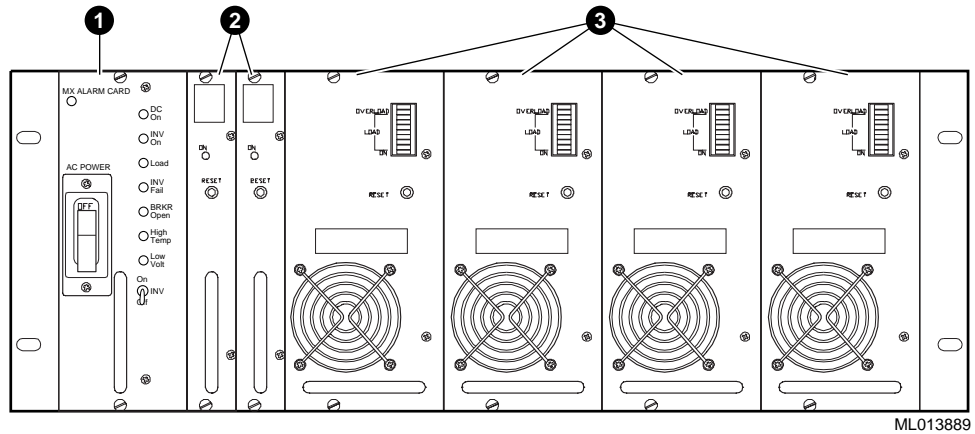
Model Number	Description
2T-48VDC-AA	3 kW (N+1) power inverter with one inverter alarm module, two inverter control modules, and four inverter power modules.
2T-48VDC-AB	2 kW (N+1) power inverter with one inverter alarm module, two inverter control modules, and three inverter power modules.
2T-48VDC-AC	1 kW (N+1) power inverter with one inverter alarm module, two inverter control modules, and two inverter power modules.
2T-48VDC-BA	3 kW power inverter with one inverter alarm module, one inverter control module, and three inverter power modules.
2T-48VDC-BB	2 kW power inverter with one inverter alarm module, one inverter control module, and two inverter power modules.
2T-48VDC-BC	1 kW power inverter with one inverter alarm module, one inverter control module, and one inverter power modules.

1.2 Controls and Indicators

The controls and indicators for the 2T-48VDC-xx power inverter are found on the inverter alarm module, inverter control module(s), and inverter power module(s) that are plugged into the front of the chassis and on the rear panel of the chassis. The following sections describe the controls and indicators on the inverter alarm module, inverter control module, inverter power module, and the rear panel.

Figure 1-2 shows the front of the 2T-48VDC-xx power inverter chassis.

Figure 1-2 Front View



- ❶ Inverter Alarm Module
- ❷ Inverter Control Modules
- ❸ Inverter Power Modules

1.2.1 Inverter Alarm Module

The front panel of the inverter alarm module contains two switches and seven LEDs (see Figure 1-2).

The two switches are:

- INV On/Off toggle switch – Used to apply -48 Vdc power to the inverter power module(s).
- AC POWER circuit breaker (CB1) – Used to apply the AC output of the inverter power modules to the output connectors on the rear panel.

The seven LEDs and the function of each are listed in Table 1-1.

Table 1-1 Inverter Alarm Module LEDs

LED Name/Color	Function
DC On (Green)	<p>Lit when the INV On/Off is in the On position, and -48 Vdc is available at the -48 Vdc input A terminal block (TB1) and the -48 Vdc input A circuit breaker (CB1) is in the closed position or -48 Vdc is available at the -48 Vdc input B terminal block (TB2) and the -48 Vdc input B circuit breaker (CB2) is in the closed position.</p> <p>If not lit, either the INV On/Off switch is in the Off position, -48 Vdc is not available at TB1 or CB1 is in the open position, or -48 Vdc is not available at TB2 or CB2 is in the open position..</p>
INV On (Green)	<p>Lit when the INV On/Off switch is in the On position and the power inverter is operating within specified limits.</p> <p>Not lit when the INV On/Off switch is in the Off position, an inverter power module fails, an inverter control module fails, an overload has occurred, or an over temperature has occurred.</p>
Load (Green)	<p>Lit when the AC POWER circuit breaker (CB1) on the alarm module is in the closed position.</p> <p>Not lit when the AC POWER circuit breaker (CB1) on the alarm module is in the open position.</p>
INV Fail (Red)	<p>Lit when an inverter power module fails, an inverter control module fails, an overload has occurred, or an over temperature has occurred.</p> <p>Not lit when the power inverter is functioning normally.</p>
BRKR Open (Red)	<p>Lit when the AC POWER circuit breaker (CB1) is in the open position.</p> <p>Not lit when the AC POWER circuit breaker (CB1) is in the closed position.</p>
High Temp (Yellow)	<p>Lit when an over temperature condition exists.</p> <p>Not lit when the temperature is within normal operating range.</p>
Low Volt (Yellow)	<p>Lit when the -48 Vdc input drops below -43 Vdc.</p> <p>Not lit when the -48 Vdc input is above -43 Vdc.</p> <p>Note: The inverter will automatically power down if the -48 Vdc input drops to -42 Vdc or less and will automatically power back on when the -48 Vdc input rises to -47 Vdc or greater.</p> <p>The inverter can also be manually powered back on after a low voltage power down by cycling the INV On/Off toggle switch after the -48 Vdc input rises to -43 Vdc or greater.</p>

1.2.2 Inverter Control Module

The front panel of the inverter control module contains one switch and one LED (see Figure 1-2). The function of the switch and LED are as follows:

- **On LED (Green)** – Lit when the inverter control module is providing control signals to the inverter power module(s). In a redundant (N+1) power inverter with two inverter control modules, this LED will be lit on the control module that is providing control signals (master control module) and not lit on the one that is in standby mode (slave control module).
- **Reset switch** – Used to reset an inverter control module that is not functioning properly. In a redundant (N+1) power inverter with two inverter control modules, this switch is used to switch control from the master control module to the slave control module. By pressing the Reset switch on the slave control module, the On LED on the slave control module will light and it will become the master control module while the On LED on the original master control module will go off and it will become the slave control module.

Note

If a master control module fails during normal operation on a redundant (N+1) power inverter with two control modules, control automatically switches to the slave control module.

1.2.3 Inverter Power Module

The front panel of the inverter power module contains one switch and a ten-segment LED (see Figure 1-2).

The Reset switch is used to reset the inverter power module if it is tripped accidentally.

The ten-segment LED is divided into three parts. These LEDs are described in Table 1-2.

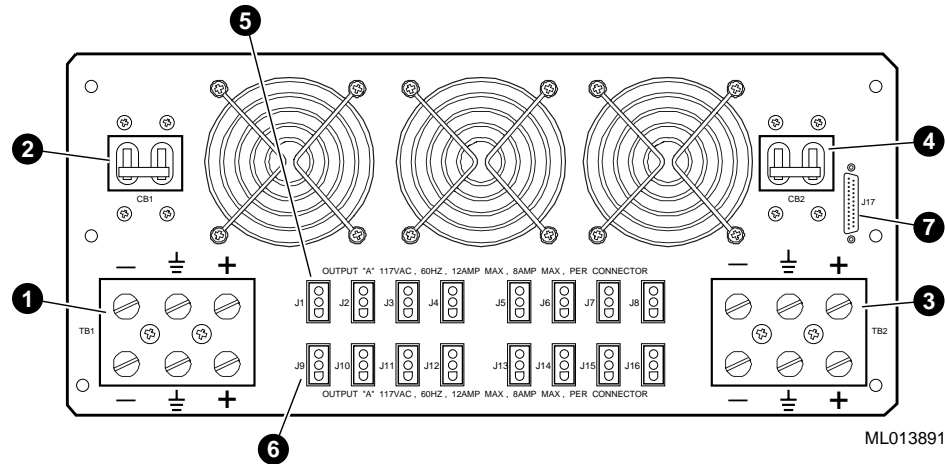
Table 1-2 Inverter Power Module LEDs

LED	LED Segments	Color	Function
On	1 (bottom segment)	Green	Lit when DC power is applied to the inverter power module and the module is functioning normally.
Load	2, 3, 4, 5	Green	Lit to indicate relative output power.
	6, 7, 8	Yellow	Lit to indicate relative output power.
Overload	9, 10	Red	Lit to indicate that output power has exceeded the inverter power module's rated output power.

1.2.4 Rear Panel

The rear panel of the 2T-48VDC-xx power inverter, shown in Figure 1-3, contains two -48 Vdc input terminal blocks, two -48 Vdc input circuit breakers, sixteen AC output connectors, and a 25-pin D-subminiature external alarm connector.

Figure 1-3 Rear Panel



The components on the rear panel are listed and described below.

- ❶ -48 Vdc Input A Terminal Block (TB1) – Contains the positive, negative, and ground connectors for connecting the -48 Vdc battery power to the power inverter’s -48 Vdc input A.
- ❷ -48 Vdc Input A Circuit Breaker (CB1) – Connects and disconnects the -48 Vdc input A battery power to and from the power inverter.
- ❸ -48 Vdc Input B Terminal Block (TB2) – Contains the positive, negative, and ground connectors for connecting the -48 Vdc battery power to the power inverter’s -48 Vdc input B.
- ❹ -48 Vdc Input B Circuit Breaker (CB2) – Connects and disconnects the -48 Vdc input B battery power to and from the power inverter.
- ❺ AC Output A Connectors – Eight 3-pin Molex connectors that provide 120 Vac, 60 HZ output power. Each connector is rated for 8 Amps maximum with a 12 Amp maximum rating for the eight connector row.
- ❻ AC Output B Connectors – Eight 3-pin Molex connectors that provide 120 Vac, 60 HZ output power. Each connector is rated for 8 Amps maximum with a 12 Amp maximum rating for the eight connector row.
- ❼ External Alarm Connector (J17) – 25-pin D-subminiature connector for connecting alarms to the customer’s alarm panel sensing equipment.

WARNING

The terminal block protective covers must be in place on TB1 and TB2 before applying -48 Vdc power to the power inverter.

2.1 Introduction

This chapter covers the following topics:

- Site Preparation for Field Installation
- Unpacking the Shipment
- Installing the 2T-48VDC-xx Power Inverter
- Normal Power Up
- Tests and Verification
- Installing a Redundant (N+1) Inverter Control Module
- Installing a Redundant (N+1) Inverter Power Module
- Connecting External Alarm Circuits

WARNING

A qualified electrician is required for connecting and disconnecting the -48 Vdc input wiring on terminal blocks TB1 and TB2 on the rear of the chassis.

WARNING

Only a qualified service person should install the 2T-48VDC-xx power inverter. A qualified service person should have the technical training and experience necessary to be aware of the hazards to which they are exposed in performing a task and the measures that should be taken to minimize the danger to themselves or other persons.

Note

The 2T-48VDC-xx power inverter should only be installed in restricted areas.

WARNING

To ensure that the 2T-48VDC-xx power inverter remains safe after installation, grounding is required when the -48 Vdc power is connected to terminal blocks TB1 and TB2.

2.2 Site Preparation for Field Installation

The cabinet that the 2T-48VDC-xx power inverter is to be installed in should be located in an area that provides sufficient clearance for ventilation and servicing. A clearance of 91.44 cm (36.0 in.) at both the front and rear of the cabinet is required for service.

Ensure that the specifications and conditions listed in Appendix A have been met.

Caution

Do not impede airflow by obstructing the front and rear of the cabinet. Exceeding internal thermal limits can affect equipment reliability.

If the 2T-48VDC-xx power inverter is to be installed in an existing cabinet that contains other systems, perform the following procedure before installing the power inverter:

1. Power down all of the systems in the existing cabinet.
2. Remove any AC power controllers or AC power distribution units that may already be installed in the existing cabinet.
3. Reposition the systems in the existing cabinet so that 22.2 cm (8.75 in.) of space is available in the bottom of the cabinet for installing the power inverter.

2.3 Unpacking the Shipment

The 2T-48VDC-xx power inverter shipment may include more than one carton. Check the packing list to ensure that all items listed have been received.

If the shipment is damaged or if any items are missing, notify the delivery agent and contact the DIGITAL sales representative.

Save all shipping cartons in case the equipment needs to be moved to a new location, or needs to be returned for repair.

WARNING

The 2T-48VDC-xx chassis weighs approximately 32.7 kg (72 lb.). Use sufficient personnel, or proper lifting equipment, when lifting or moving this chassis.

Table 2-1 lists the mounting hardware included with the power inverter for installation in an English RETMA cabinet.

Table 2-1 Mounting Hardware

Description	Part Number	Quantity
Right mounting slide	74-51875-01	1
Left mounting slide	74-51875-02	1
Right rear slide bracket	74-51093-01	1
Left rear slide bracket	74-51093-02	1
U-nut, 10-32 x 0.615L	90-07786-00	4
Screw, 10-32 hex-head	90-09988-05	14
Kepnut, 10-32	90-06565-00	4
Screw, 10-32 pan-head	90-09228-10	4
Flat washer	90-06664-00	8

2.4 Installing the 2T-48VDC-xx Power Inverter

The 2T-48VDC-xx power inverter requires 22.2 cm (8.75 in.) of vertical space or 15 contiguous holes in a 48.26-cm (19-in.) English RETMA cabinet.

Note

Due to the weight, DIGITAL recommends that the 2T-48VDC-xx power inverter be installed in the bottom of the cabinet.

To determine the installation area, perform the following steps at the front and rear cabinet rails.

1. Find two holes at the bottom of the cabinet rail that have a 1.27 cm (0.50 in.) space between them.
2. Make a mark between these holes. This is the starting point of the installation area.
3. Count up 15 holes from this mark and make a mark above the 15th hole. The area between these two marks is the installation area.

After marking the installation area on both front cabinet rails and both rear cabinet rails, use the following procedure to install the 2T-48VDC-xx power inverter.

1. Find the right mounting slide and the right rear slide bracket.
2. Attach the right rear slide bracket to the inside rear of the right mounting slide using two 10-32 pan-head screws, two flat washers, and two 10-32 kepnuts, but *do not* tighten the screws at this time. The right rear slide bracket must be loose enough to adjust later.

Ensure that the flange on the right rear slide bracket is facing the same direction as the flange on the front of the right mounting slide.

3. Find the left mounting slide and the left rear slide bracket.
4. Attach the left rear slide bracket to the inside rear of the left mounting slide using two 10-32 pan-head screws, two flat washers, and two 10-32 kepnuts, but *do not* tighten the screws at this time. The left rear slide bracket must be loose enough to adjust later.

Ensure that the flange on the left rear slide bracket is facing the same direction as the flange on the front of the left mounting slide.

5. Install a U-nut over the 4th and 7th holes of the installation area on the rear rails by sliding the U-nut over the edge of the rail and aligning it with the hole. Ensure that the threaded half of the U-nuts are toward the inside of the cabinet.
6. Place the front flange of the right mounting slide on the inside of the right front rail and align the 2nd and 4th holes from the bottom of the flange with the 3rd and 10th holes of the installation area on the right front rail.
7. Secure the right mounting slide to the right front rail by installing two 10-32 hex-head screws and two flat washers in the 3rd and 10th holes of the installation area on the right front rail.

8. Adjust the right rear slide bracket to fit on the outside of the right rear rail and align the two right rear slide bracket holes with the 4th and 7th holes of the installation area on the right rear rail.
9. Secure the right rear slide bracket to the right rear rail by installing two 10-32 hex-head screws in the 4th and 7th holes of the installation area on the right rear rail.
10. Tighten the two 10-32 pan-head screws and two 10-32 kepnuts that secure the right rear slide bracket to the inside rear of the right mounting slide.
11. Place the front flange of the left mounting slide on the inside of the left front rail and align the 2nd and 4th holes from the bottom of the flange with the 3rd and 10th holes of the installation area on the left front rail.
12. Secure the left mounting slide to the left front rail by installing two 10-32 hex-head screws and two flat washers in the 3rd and 10th holes of the installation area on the left front rail.
13. Adjust the left rear slide bracket to fit on the outside of the left rear rail and align the two left rear slide bracket holes with the 4th and 7th holes of the installation area on the left rear rail.
14. Secure the left rear slide bracket to the left rear rail by installing two 10-32 hex-head screws in the 4th and 7th holes of the installation area on the left rear rail.
15. Tighten the two 10-32 pan-head screws and two 10-32 kepnuts that secure the left rear slide bracket to the inside rear of the left mounting slide.

WARNING

The 2T-48VDC-xx chassis weighs approximately 32.7 kg (72 lb.). Use sufficient personnel, or proper lifting equipment, when lifting or moving this chassis.

16. Lift the 2T-48VDC-xx chassis until the slide retainers on the sides of the chassis are just above the mounting slides, and then move the chassis back into the cabinet and onto the mounting slides.
17. Secure the 2T-48VDC-xx chassis to the front cabinet rails by installing a 10-32 hex-head screw in the center hole of the left and right chassis mounting flange.
18. Ensure that the -48 Vdc input A circuit breaker (CB1) and the -48 Vdc input B circuit breaker (CB2) on the rear panel of the power inverter are on the Off position.
19. Ensure that the AC POWER circuit breaker (CB1) on the front of the inverter alarm module is in the Off position.
20. Ensure that the INV On/Off switch on the front of the inverter alarm module is in the Off position.

Note

DIGITAL recommends that separate -48 Vdc battery power sources be connected to both -48 Vdc input terminal blocks on the rear panel to ensure that the power inverter will still function if one of the battery power sources is lost.

Caution

The polarity of the battery leads is critical to avoid damage to the power inverter. Check batteries and battery cables for correct polarity and voltage before connecting them to the power inverter.

21. Have a qualified electrician connect the -48 Vdc battery cables to the positive, negative, and ground terminals on the -48 Vdc input A terminal block (TB1). The terminals can accept 14 to 2/0 gauge wire. It is recommended that a minimum of 6 gauge wire be used. Torque the terminal screws to 40 to 45 inch-pounds.
22. Have a qualified electrician connect the -48 Vdc battery cables to the positive, negative, and ground terminals on the -48 Vdc input B terminal block (TB2). The terminals can accept 14 to 2/0 gauge wire. It is recommended that a minimum of 6 gauge wire be used. Torque the terminal screws to 40 to 45 inch-pounds.

WARNING

The terminal block protective covers must be in place on TB1 and TB2 before applying -48 Vdc power to the power inverter.

23. Connect the AC power cords from the systems in the cabinet to the AC output A connectors (top row) and the AC output B (bottom row) connectors on the rear panel of the power inverter. These power cords should be connect so that there is an approximately equal load on the AC output A connectors and the AC output B connectors.

2.5 Normal Power Up

The following procedure provides a normal power up sequence for the 2T-48VDC-xx power inverter.

1. Place the -48 Vdc input A circuit breaker (CB1) and the -48 Vdc input B circuit breaker (CB2) to the closed (on) position.
2. Place the INV On/Off switch on the inverter alarm module to the On position.
3. Verify that the DC On LED, the BRKR Open LED, and the INV On LED on the inverter alarm module are lit.
4. Verify that the On LED on the inverter control module is lit. On redundant power inverters, the On LED is lit on one of the inverter control modules (master control module) and not lit on the other inverter control module (slave control module).
5. Verify that the bottom segment of the ten-segment LED on all inverter power modules is lit.

6. Place the AC POWER circuit breaker (CB1) on the inverter alarm module to the closed position.
7. Verify that the DC On LED, the INV On LED, and the Load LED on the inverter alarm module are lit. The BRKR Open LED should not be lit.
8. Verify that the On LED on the inverter control module is lit. On redundant power inverters, the On LED is lit on one of the inverter control modules (master control module) and not lit on the other inverter control module (slave control module).
9. Verify that the three ac fans are functioning properly.
10. Using a DVM, measure the AC output at an unused AC output A and AC output B connector on the rear panel. The AC output should be between 111 Vac and 122 Vac.

WARNING

Use caution when measuring the ac output voltage to prevent electrical shock.

11. Verify that multiple segments of the ten-segment LED on all inverter power modules are lit. The number of segments lit depends on the load on the power inverter. All of the inverter power modules should have approximately the same number of segments lit since they share the load.

2.6 Tests and Verification

This section describes three tests that can be performed on the 2T-48VDC-xx power inverter to test and verify proper operation.

2.6.1 Power Inverter Functionality Test

The power inverter functionality test is used to verify that the power inverter is operating properly before any loads are connected.

Before performing this test, ensure that all systems connected to the power inverter are properly powered down, the AC POWER circuit breaker (CB1) on the inverter alarm module is in the open (off) position, the INV On/Off switch on the inverter alarm module is in the Off position, the -48 Vdc input A circuit breaker (CB1) on the rear panel is in the open position, and the -48 Vdc input B circuit breaker (CB2) on the rear panel is in the open position.

Perform the following procedure to verify that the power inverter is operating properly.

1. Place the -48 Vdc input A circuit breaker (CB1) and the -48 Vdc input B circuit breaker (CB2) to the closed (on) position.
2. Place the INV On/Off switch on the inverter alarm module to the On position.
3. Verify that the DC On LED, the BRKR Open LED, and the INV On LED on the inverter alarm module are lit.
4. Verify that the On LED on the inverter control module is lit. On redundant power inverters, the On LED is lit on one of the inverter control modules (master control module) and not lit on the other inverter control module (slave control module).
5. Verify that the bottom segment of the ten-segment LED on all inverter power modules is lit.

6. Place the AC POWER circuit breaker (CB1) on the inverter alarm module to the closed position.
7. Verify that the DC On LED, the INV On LED, and the Load LED on the inverter alarm module are lit. The BRKR Open LED should not be lit.
8. Verify that the On LED on the inverter control module is lit. On redundant power inverters, the On LED is lit on one of the inverter control modules (master control module) and not lit on the other inverter control module (slave control module).
9. Verify that the three ac fans are functioning properly.
10. Using a DVM, measure the AC output at an unused AC output A and AC output B connector on the rear panel. The AC output should be between 111 Vac and 122 Vac.

2.6.2 Inverter Control Module Test (N+1 Only)

The inverter control module test can only be performed on redundant (N+1) power inverters. The redundant (N+1) power inverters contain two inverter control modules. One inverter control module is the master control module and the second inverter control module is the slave control module and is in a standby mode. This test verifies that both inverter control modules are capable of being the master control module and generating the control signals necessary to operate the inverter power modules.

When the 2T-48VDC-xx power inverter is initially powered on, either inverter control module 1 (the left inverter control module) or inverter control module 2 (the right inverter control module) can come up as the master control module and have the On LED lit. The other inverter control module is the slave control module and is in a standby mode. The On LED on the slave control module will *not* be lit.

Perform the following procedure to verify that either inverter control module is capable of being the master control module and generating the control signals necessary to operate the inverter power modules.

1. Push the Reset switch on the slave control module (the inverter control module with the On LED not lit). This resets the module and causes control to be transferred to this inverter control module.
2. Verify that the On LED on this inverter control module (the new master control module) is lit and the On LED on the original master control module (the new slave control module) is not lit.
3. Repeat steps 1 and 2 to switch control back to the original master control module.
4. When the master/slave functionality for both inverter control modules has been verified, set inverter control module 1 (the left inverter control module) to the master mode (On LED is lit) by pushing the Reset switch on inverter control module 1.

2.6.3 Power Inverter Load Test (Optional)

The 2T-48VDC-xx power inverter is factory tested to ensure that it is capable of supplying the full rated power. The output power ratings of the six models are listed below.

Model	Description	Output Power
2T-48VDC-AA	3 kW, (N+1)	3000 watts
2T-48VDC-AB	2 kW, (N+1)	2000 watts
2T-48VDC-AC	1 kW, (N+1)	1000 watts
2T-48VDC-BA	3 kW	3000 watts
2T-48VDC-BB	2 kW	2000 watts
2T-48VDC-BC	1 kW	1000 watts

Perform the following procedure to verify that the power inverter is capable of supplying the full rated power.

1. Connect multiple system or equipment power cords to the AC output A and AC output B connectors on the rear panel.

Caution

Do not exceed the maximum current rating of 12 Amps/row or 8 Amps/connector.

2. Refer to Section 2.5 and power up the 2T-48VDC-XX power inverter.
3. One at a time, turn on the systems or equipment connected to the power inverter AC output connectors. Verify that as each system is turned on, the number of lit segments in the inverter power module(s) ten-segment LED increases.
4. Continue turning on connected systems or equipment until the lower eight segments in the inverter power module(s) ten-segment LED are lit.
5. Verify that the power inverter is operating properly with no indication of failure (high temperature, audibly noisy inverter power modules, unstable power output, etc.).

2.7 Installing a Redundant (N+1) Inverter Control Module

A second inverter control module can be installed in a nonredundant power inverter to create a redundant (N+1) set of control signals so that if one inverter control module fails, the second one takes over control to ensure continued power inverter operation.

Perform the following procedure to install a second inverter control module.

Note

The second inverter control module can be installed without interrupting the power inverter operation or having to power down the power inverter, however, it is recommended that the power inverter be powered down before removing or installing modules or blank filler plates.

1. Remove the two screws that secure the blank inverter control module plate to the front of the 2T-48VDC-xx chassis and remove the blank plate.
2. Align the inverter control module being installed with the tracks inside the chassis.
3. Slide the inverter control module into the chassis and apply pressure until the inverter control module is properly seated.
4. Install the two screws to secure the inverter control module to the front of the 2T-48VDC-xx chassis.

Caution

Do not overtighten these screws or damage to the threads can occur. Tighten to 4 to 6 inch-pounds.

5. Refer to Section 2.6.2 and perform the inverter control module test to verify that both inverter control modules are capable of becoming the master control module and generating the control signals necessary to operate the inverter power modules.

2.8 Installing a Redundant (N+1) Inverter Power Module

An extra inverter power module can be installed in a nonredundant power inverter to create a redundant (N+1) power inverter so that if one inverter power module fails, the extra inverter power module takes over the load sharing to ensure continued power inverter operation.

Perform the following procedure to install a second inverter power module.

Note

The extra inverter power module can be installed without interrupting the power inverter operation or having to power down the power inverter, however, it is recommended that the power inverter be powered down before removing or installing modules or blank filler plates.

1. Remove the two screws that secure the blank inverter power module plate to the front of the 2T-48VDC-xx chassis and remove the blank plate.

2. Align the inverter power module being installed with the tracks inside the chassis.
3. Slide the inverter power module into the chassis and apply pressure until the inverter power module is properly seated.
4. Install the two screws to secure the inverter power module to the front of the 2T-48VDC-xx chassis.

Caution

Do not overtighten these screws or damage to the threads can occur. Tighten to 4 to 6 inch-pounds.

5. Verify that multiple segments of the ten-segment LED on all inverter power modules are lit. The number of segments lit depends on the load on the power inverter. All of the inverter power modules should have approximately the same number of segments lit since they share the load.

2.9 Connecting External Alarm Circuits

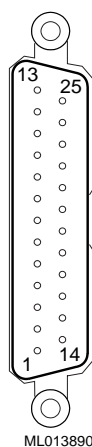
The 2T-48VDC-xx power inverter has a 25-pin D-subminiature connector on the rear panel for external monitoring of the alarm signals. This connector provides external contact closures for alarms that are generated by the inverter alarm module. The customer can wire these alarm outputs to their alarm panel sensing equipment as desired.

The alarm outputs available on this connector and a description of them are listed below.

Minor Alarm	Indicates an inverter control module or an inverter power module failure or an over temperature condition.
Major Alarm	Indicates an open AC POWER circuit breaker (CB1) on the inverter alarm module, a loss of AC output power, or failure of both control modules.
Inverter Fail Alarm	Indicates an inverter control module failure, an inverter power module failure, or a chassis failure (AC output failure).
DC Fail Alarm	Indicates a loss of DC input power.
AC Fail Alarm	Indicates an AC output power failure.

Figure 2-1 shows a diagram of the 25-pin D-subminiature connector.

Figure 2-1 Alarm Connector



Installation

Table 2-2 contains the alarms, the pin numbers, and the usage of the pins on the external alarm connector on the rear panel.

Table 2-2 Alarm Connector Pinout

Alarm	Pin Numbers	Usage
Minor	1	NC
	2	C
	3	NO
Major	4	NC
	5	C
	6	NO
Inverter Fail	7	NC
	8	C
	9	NO
	10	Reserved
	11	Reserved
DC Fail	12	Reserved
	13	NC
	14	C
AC Fail	15	NO
	16	NC
	17	C
	18	NO
	19	Not used
	20	Not used
	21	Not used
	22	Not used
	23	Not used
	24	Not used
	25	Not used

NC = Normally Closed

C = Common

NO = Normally Open

See Appendix A for additional relay contact specifications.

3.1 Introduction

This chapter contains basic troubleshooting information for the 2T-48VDC-xx power inverter.

When a problem occurs with the power inverter, inspect the following items before checking the internal components.

1. Ensure that the inverter alarm module, the inverter control module(s), and the inverter power module(s) are properly seated in the front of the chassis.
2. Ensure that -48 Vdc is present at the -48 Vdc input A and input B terminal blocks (TB1 and TB2) on the rear panel.
3. Ensure that the -48 Vdc input A and input B circuit breakers (CB1 and CB2) on the rear panel are in the closed position.
4. Ensure that the INV On/Off switch on the inverter alarm module is in the On position.
5. Ensure that the AC POWER circuit breaker (CB1) on the inverter alarm module is in the closed position.

If the problem still exists after checking the above items, check the LEDs on the inverter alarm module, the inverter control module(s), and the inverter power module(s) for problem indications (see Section 1.2).

Note

The 2T-48VDC-xx power inverter should only be installed in restricted areas.

Table 3-1 described the LED and alarm contact closure status for the listed conditions in a fully redundant (N+1) power inverter system.

Table 3-1 Troubleshooting Table

Condition	LEDs										Alarms				
	CM1	CM2	Pwr Mods	Low Volt	DC On	INV On	Load	INV Fail	BRKR Open	High Temp	INV Fail	DC Fail	AC Fail	Minor	Major
Single CM fail	Off	On	x	x	x	x	x	x	x	x	On	x	x	On	Off
Dual CM fail	Off	Off	x	x	x	Off	x	On	x	x	On	x	On	Off	On
No AC out or AC out of limits	x	x	x	x	x	Off	x	On	x	x	On	x	On	Off	On
PM fail	x	x	Off	x	x	x	x	x	x	x	On	x	x	On	Off
CM overtemp	Off	On	x	x	x	x	x	x	x	On	x	x	x	On	Off
PM overtemp	x	x	Off	x	x	x	x	x	x	On	x	x	x	On	Off
DC input under voltage	x	x	x	On	x	x	x	x	x	x	x	x	x	On	x
AC power breaker open	x	x	x	x	x	x	Off	x	On	x	x	x	x	Off	On
DC input available	x	x	x	x	On	x	x	x	x	x	x	Off	x	Off	Off
Normal	On	Off	On	Off	On	On	On	Off	Off	Off	Off	Off	Off	Off	Off

Key:

- On = The LED is on or the relay is energized (NC contacts are open and NO contacts are closed)
- Off = The LED is off or the relay is not energized (NC contacts are closed and NO contacts are open)
- x = N/A

CM = Control module

PM = Power module

CM1 = The left control module

CM2 = The right control module

Pwr Mods = The bottom LED segment on each power module indicates "On". If the module fails this LED segment will be out even though the rest of the segments may be lit.

Breaker open is detected by a contact on the breaker.

Only one alarm, major or minor, can be on at a time unless no alarm condition exists, and then both are off.

Removal and Replacement

4.1 Introduction

This chapter contains the removal and replacement procedures for the components that are unique to the 2T-48VDC-xx power inverter.

The following removal and replacement procedures are included:

- Front Cover
- 2T-48VDC-xx Chassis
- Inverter Alarm Module
- Inverter Control Module
- Inverter Power Module

Note

The 2T-48VDC-xx power inverter should only be installed in restricted areas.

4.2 Front Cover

Remove the front cover by removing the four 10-32 hex-head screws that secure it to the front rails.

Replace the front cover by aligning it with the front of the chassis and securing it to the front rails with four 10-32 hex-head screws.

4.3 2T-48VDC-xx Chassis

Perform the following procedure to remove the 2T-48VDC-xx chassis from the cabinet.

WARNING

Observe all Tag Out rules when removing and replacing the chassis.

1. Remove the front cover (see Section 4.2).
2. Properly power down all systems that are connected to the power inverter.
3. Place the AC POWER circuit breaker (CB1) on the inverter alarm module to the open position.
4. Place the INV On/Off switch on the inverter alarm module to the Off position.
5. Place the -48 Vdc input A circuit breaker (CB1) and the -48 Vdc input B circuit breaker (CB2) on the rear panel to the open position.
6. Disconnect all of the AC power cords that are connected to the AC output connectors on the rear panel.
7. Have a qualified electrician disconnect the -48 Vdc battery cables to the positive, negative, and ground terminals on the -48 Vdc input A terminal block (TB1) and the -48 Vdc input B terminal block (TB2).

WARNING

The terminal block protective covers must be replaced on TB1 and TB2 after reconnecting the battery cables and before applying -48 Vdc power to the power inverter.

8. Remove the two screws that secure the inverter alarm module to the front of the power inverter chassis and slide the module part way out of the chassis.

Caution

When replacing the module, do not overtighten these screws or damage to the threads can occur. Tighten to 4 to 6 inch-pounds.

9. Remove the nut that secures the ground wire to the inside front panel of the inverter alarm module and slide the module completely out of the chassis.

WARNING

This ground wire must be reconnected to the inside front panel of the inverter alarm module when it is reinstalled.

10. Remove the two screws that secure the inverter control module(s) to the front of the power inverter chassis and slide the module(s) completely out of the chassis.

Caution

When replacing the module(s), do not overtighten these screws or damage to the threads can occur. Tighten to 4 to 6 inch-pounds.

11. Remove the two screws that secure the inverter power module(s) to the front of the power inverter chassis and slide the module(s) completely out of the chassis.

Caution

When replacing the module(s), do not overtighten these screws or damage to the threads can occur. Tighten to 4 to 6 inch-pounds.

12. Remove the 10-32 hex-head screw in the center hole of the left and right chassis mounting flange that secures the chassis to the front cabinet rails.

WARNING

The 2T-48VDC-xx chassis weighs approximately 18.1 kg (40 lb.) with all modules removed. Use sufficient personnel, or proper lifting equipment, when lifting or moving this chassis.

13. Slide the 2T-48VDC-xx chassis forward off of the mounting slides until it is out of the cabinet.

To replace the 2T-48VDC-xx chassis in the cabinet, reverse steps 1 through 13.

4.4 Inverter Alarm Module

Perform the following procedure to remove the inverter alarm module from the power inverter.

1. Remove the front cover (see Section 4.2).
2. Properly power down all systems that are connected to the power inverter.
3. Place the AC POWER circuit breaker (CB1) on the inverter alarm module to the open position.
4. Place the INV On/Off switch on the inverter alarm module to the Off position.
5. Place the -48 Vdc input A circuit breaker (CB1) and the -48 Vdc input B circuit breaker (CB2) on the rear panel to the open position.
6. Remove the two screws that secure the inverter alarm module to the front of the power inverter chassis and slide the module part way out of the chassis.

Caution

When replacing the module, do not overtighten these screws or damage to the threads can occur. Tighten to 4 to 6 inch-pounds.

7. Remove the nut that secures the ground wire to the inside front panel of the inverter alarm module and slide the module completely out of the chassis.

To replace the inverter alarm module, reverse steps 1 through 7.

4.5 Inverter Control Module

There are two procedures for removing and replacing the inverter control module in the 2T-48VDC-xx power inverter. In a redundant (N+1) power inverter, an inverter control module can be removed and replaced without removing power from the power inverter. In a nonredundant power inverter, power has to be removed from the power inverter before removing and replacing the inverter control module. The following sections provide the procedures for removing and replacing the inverter control module in a redundant (N+1) and a nonredundant power inverter.

4.5.1 Redundant (N+1) Power Inverter

Perform the following procedure to remove the inverter control module from a redundant (N+1) power inverter.

1. Remove the front cover (see Section 4.2).
2. Remove the two screws that secure the inverter control module to the front of the power inverter chassis.

Caution

When replacing the module, do not overtighten these screws or damage to the threads can occur. Tighten to 4 to 6 inch-pounds.

3. Grasp the handle on the front of the module and slide the module out of the chassis.

To replace the inverter control module, reverse steps 1 through 3.

4.5.2 Nonredundant Power Inverter

Perform the following procedure to remove the inverter control module from a nonredundant power inverter.

1. Remove the front cover (see Section 4.2).
2. Properly power down all systems that are connected to the power inverter.
3. Place the AC POWER circuit breaker (CB1) on the inverter alarm module to the open position.
4. Place the INV On/Off switch on the inverter alarm module to the Off position.
5. Place the -48 Vdc input A circuit breaker (CB1) and the -48 Vdc input B circuit breaker (CB2) on the rear panel to the open position.
6. Remove the two screws that secure the inverter control module to the front of the power inverter chassis.

Caution

When replacing the module, do not overtighten these screws or damage to the threads can occur. Tighten to 4 to 6 inch-pounds.

7. Grasp the handle on the front of the module and slide the module out of the chassis.

To replace the inverter control module, reverse steps 1 through 7.

4.6 Inverter Power Module

There are two procedures for removing and replacing the inverter power module in the 2T-48VDC-xx power inverter. In a redundant (N+1) power inverter, an inverter power module can be removed and replaced without removing power from the power inverter. In a nonredundant power inverter, power has to be removed from the power inverter before removing and replacing the inverter power module. The following sections provide the procedures for removing and replacing the inverter power module in a redundant (N+1) and a nonredundant power inverter.

4.6.1 Redundant (N+1) Power Inverter

Perform the following procedure to remove the inverter power module from a redundant (N+1) power inverter.

1. Remove the front cover (see Section 4.2).
2. Remove the two screws that secure the inverter power module to the front of the power inverter chassis.

Caution

When replacing the module, do not overtighten these screws or damage to the threads can occur. Tighten to 4 to 6 inch-pounds.

3. Grasp the handle on the front of the module and slide the module out of the chassis.

To replace the inverter power module, reverse steps 1 through 3.

4.6.2 Nonredundant Power Inverter

Perform the following procedure to remove the inverter power module from a nonredundant power inverter.

1. Remove the front cover (see Section 4.2).
2. Properly power down all systems that are connected to the power inverter.
3. Place the AC POWER circuit breaker (CB1) on the inverter alarm module to the open position.
4. Place the INV On/Off switch on the inverter alarm module to the Off position.
5. Place the -48 Vdc input A circuit breaker (CB1) and the -48 Vdc input B circuit breaker (CB2) on the rear panel to the open position.
6. Remove the two screws that secure the inverter power module to the front of the power inverter chassis.

Caution

When replacing the module, do not overtighten these screws or damage to the threads can occur. Tighten to 4 to 6 inch-pounds.

7. Grasp the handle on the front of the module and slide the module out of the chassis.

To replace the inverter power module, reverse steps 1 through 7.

Hardware Specifications

Table A-1 contains the physical, environmental, and electrical specifications for the 2T-48VDC-xx power inverter.

Table A-1 2T-48VDC-xx Specifications

Physical Characteristics	
Chassis	
Weight	32.7 kg (72 lb.)
Length	60 cm (23 in.)
Width	48.26 cm (19.0 in.)
Height	22.2 cm (8.75 in.)
	17.8 cm (7.0 in.) chassis
	4.4 cm (1.75 in) cooling space
Environmental Requirements	
Operating Temperature	-25°C to 40°C (-25°F to 104°F) at full power. Derated above 40°C (104°F)
Humidity	5% to 95% noncondensing
Altitude	60 m to 3050 m (-200 ft to 10,000 ft)
Cooling	
Power modules:	Thermostatically controlled forced air, each module
ORing diodes:	Redundant forced air cooling fans
Electrical Requirements	
Input Voltage Range	
Minimum voltage:	43.0 Vdc
Nominal voltage:	48.0 Vdc
Maximum voltage:	60.0 Vdc
Input Power for 3000 W AC output	43.0 Vdc @ 89 Amp
	48.0 Vdc @ 80 Amp
	60.0 Vdc @ 64 Amp
Typical Efficiency	
At full power output:	80%
At 1/3 power output:	82%
Output Voltage	117 Vac +/- 5%
Output Current	25.0 Amps in a 3000 Watt (N+1) redundant configuration.
Dielectric Withstand	500 Vdc

Hardware Specifications

Table A-1 (Cont.) 2T-48VDC-xx Specifications

Electrical Requirements (Cont.)	
Protection Circuitry	
Over Voltage:	Inverter shutoff at maximum input voltage.
Under Voltage:	Inverter shutoff at minimum input voltage (-42 Vdc).
Thermal:	Inverter shutoff at 105°C (221°F) internal temperature. Inverter warning buzzer at 100°C (212°F) internal temperature.
Output Short:	Inverter shutoff. Circuit breaker protected.
Output Overload:	Inverter shutoff. Circuit breaker protected.
Input:	ORing diode isolation between the A and B inputs. Inputs protected by circuit breakers.
Input Terminal Blocks	
Fitting Type:	Compression fittings
Wire Size:	14 to 2/0 gauge
Torque Specification:	40 to 45 inch-pounds
Alarm Connector Relay Contacts	
Contact Type:	Dry relay contacts, form C
Max. Switching Voltage:	220 Vdc, 250 Vac
Max. Switching Current:	2 Amp
Max. Carrying Current:	2 Amp
Min. Contact Ratings:	100 mVdc, 100 µA
Initial Contact Resistance:	50 mΩ, typical

Electromagnetic Compatibility

The 2T-48VDC-xx power inverter meets the following standards:

- EN55022: 1993 Class A - Emissions
- EN50082-1 1992 Light Industrial - Immunity
- IEC 1000-4-2 Electrostatic Discharge
- IEC 1000-4-3 Radio Frequency Susceptibility
- IEC 1000-4-4 Electrical Fast Transient
- IEC 1000-4-5 Power Line Transient
- Bellcore TR - EOP000063 2 June, 1986 Conducted Emissions
- CFR 47 Part 15 FCC Rules and Regulations, Radio Frequency Devices

Safety

- UL Recognized to UL 1950
- UL Recognized to CSA 95
- UL Reviewed to IEC 950

Field Replaceable Units

The major field replaceable units (FRUs) and their part numbers for the 2T-48VDC-xx power inverter are listed in Table B-1.

Table B-1 2T-48VDC-xx FRUs

Part Description	Part Number
2T-48VDC-xx Chassis Assembly	70-33089-01
Inverter Alarm Module	30-48117-02
Inverter Control Module	30-48117-03
Inverter Power Module (1000 W)	30-48117-04
Inverter Power Module Blank Panel	74-52125-01
Inverter Control Module Blank Panel	74-52125-03

The point source for returns and repairs of inverter components is:

Digital Equipment Corporation
c/o Metz Electronics Corporation
O'Shea Industrial Park
Laconia, N.H. 03246
Phone: 603-524-8806