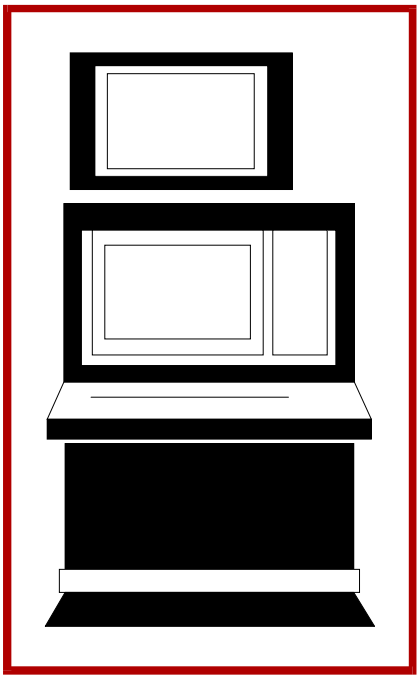
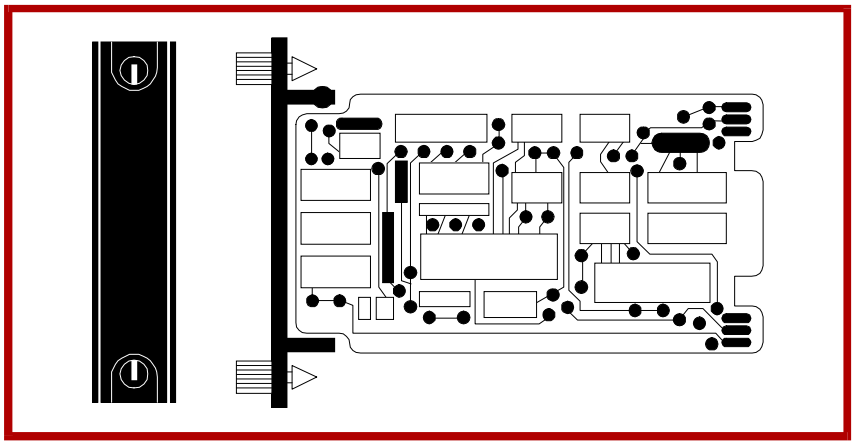
Bailey® infi 90®

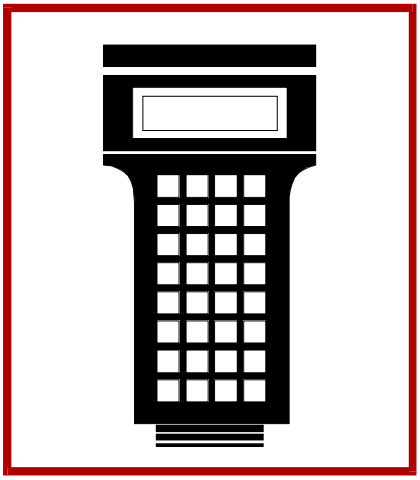
E96-508

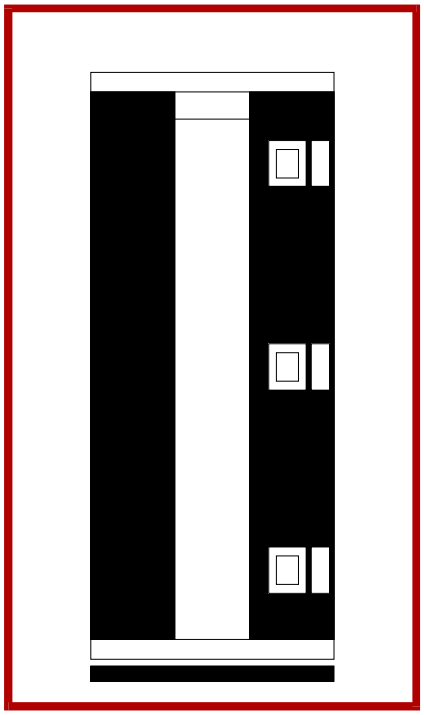
Instruction

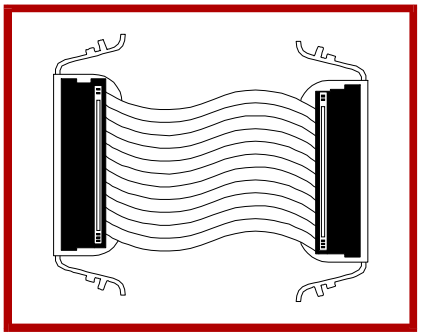
DC Modular Power System

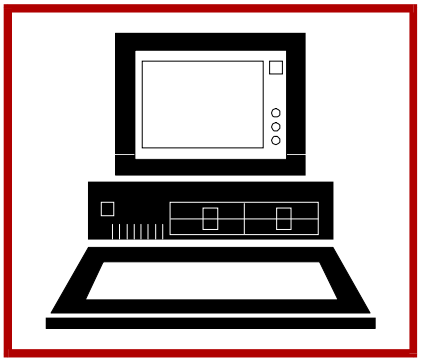












Bailey® Process Control and Automation Solutions from Elsag Bailey Group

WARNING notices as used in this instruction apply to hazards or unsafe practices that could result in personal injury or death.

CAUTION notices apply to hazards or unsafe practices that could result in property damage.

NOTES highlight procedures and contain information that assists the operator in understanding the information contained in this instruction.

WARNING

INSTRUCTION MANUALS

DO NOT INSTALL, MAINTAIN, OR OPERATE THIS EQUIPMENT WITHOUT READING, UNDERSTANDING, AND FOLLOWING THE PROPER **Elsag Bailey** INSTRUCTIONS AND MANUALS; OTHERWISE, INJURY OR DAMAGE MAY RESULT.

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MOST ELECTRONIC EQUIPMENT IS INFLUENCED BY RADIO FREQUENCY INTERFERENCE (RFI). CAUTION SHOULD BE EXERCISED WITH REGARD TO THE USE OF PORTABLE COMMUNICATIONS EQUIPMENT IN THE AREA AROUND SUCH EQUIPMENT. PRUDENT PRACTICE DICTATES THAT SIGNS SHOULD BE POSTED IN THE VICINITY OF THE EQUIPMENT CAUTIONING AGAINST THE USE OF PORTABLE COMMUNICATIONS EQUIPMENT.

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MAINTENANCE MUST BE PERFORMED ONLY BY QUALIFIED PERSONNEL AND ONLY AFTER SECURING EQUIPMENT CONTROLLED BY THIS PRODUCT. ADJUSTING OR REMOVING THIS PRODUCT WHILE IT IS IN THE SYSTEM MAY UPSET THE PROCESS BEING CONTROLLED. SOME PROCESS UPSETS MAY CAUSE INJURY OR DAMAGE.

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MANUELS D'OPÉRATION

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PERTURBATIONS DU PROCÉDÉ

L'ENTRETIEN DOIT ÊTRE ASSURÉ PAR UNE PERSONNE QUALIFIÉE EN CONSIDÉRANT L'ASPECT SÉCURITAIRE DES ÉQUIPEMENTS CONTRÔLÉS PAR CE PRODUIT. L'AJUSTEMENT ET/OU L'EXTRACTION DE CE PRODUIT PEUT OCCASIONNER DES À-COUPS AU PROCÉDÉ CONTRÔLE LORSQU'IL EST INSÉRÉ DANS UNE SYSTÈME ACTIF. CES À-COUPS PEUVENT ÉGALEMENT OCCASIONNER DES BLESSURES OU DES DOMMAGES MATÉREILS.

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Preface

The 24/48 VDC Modular Power System supplies system and I/O power to the INFI 90® system. This manual explains how the 24/48 VDC Modular Power System operates through supportive text, diagrams and flowcharts. It provides introductory material and specific instructions for installation, operation, troubleshooting and maintenance of the system based on the following:

- IECAB01 or IECAB03 system cabinets.
- IEPDS01 or IEPDS02 system power modules.
- IEPDF01 or IEPDF02 field power modules.
- IEPEP04 power entry panel.
- IEMMU01 or IEMMU02 module mounting unit.
- IEPMU01 or IEPMU02 power mounting unit.

This manual also provides information about module current consumption so the modular power system can be sized for your application. This instruction covers only the 24/48 VDC Modular Power System. For information on the AC modular power system refer to the ***AC Modular Power System*** manual.

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List of Effective Pages

Total number of pages in this instruction is 79, consisting of the following:

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iii through ix	Original
1-1 through 1-7	Original
2-1 through 2-7	Original
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4-1 through 4-3	Original
5-1 through 5-5	Original
6-1 through 6-7	Original
7-1 through 7-6	Original
8-1	Original
A-1 through A-2	Original
B-1 through B-10	Original
C-1 through C-3	Original
D-1 through D-3	Original
Index-1	Original

When an update is received, insert the latest changed pages and dispose of the superseded pages.

NOTE: On an update page, the changed text or table is indicated by a vertical bar in the outer margin of the page adjacent to the changed area. A changed figure is indicated by a vertical bar in the outer margin next to the figure caption. The date the update was prepared will appear beside the page number.

Safety Summary

GENERAL WARNINGS

Equipment Environment
All components, whether in transportation, operation or storage, must be in a noncorrosive environment.

Electrical Shock Hazard During Maintenance
Disconnect power or take precautions to insure that contact with energized parts is avoided when servicing.

Special Handling
This module uses electrostatic sensitive devices.

SPECIFIC WARNINGS

Verify the main power and power entry panel circuit breakers are turned off before starting installation, retrofit, upgrade, or wiring procedures. Failure to do so could result in severe or fatal shock. Do not turn the power on until the installation, retrofit, upgrade, or wiring procedures are complete. (p. 3-4, 3-11, 7-5)

Do not remove the plastic covers on the module mounting unit backplane. These covers protect against accidental contact with DC voltage. Severe or fatal shock could result. (p. 3-10)

There are exposed DC connections inside the cabinet. These exposed electrical connections present a shock hazard that can cause injury or death. (p. 6-1)

Never clean electrical parts or components with the power on. Doing so exposes you to a fatal electrical shock hazard. (p. 6-1)

If input or output circuits are a shock hazard after disconnecting system power at the power entry panel, then the door of the cabinet containing these externally powered circuits must be marked with a warning stating that multiple power sources exist. (p. 6-1)

Wear eye protection whenever working with cleaning solvents. When removing solvents from printed circuit boards using compressed air, injury to the eyes could result from splashing solvent as it is blown off the printed circuit board. (p. 6-1)

Handle the module by surfaces other than the heat sink. The heat sink may be hot and may cause severe burns. (p. 7-4)

Allow five seconds for the line filter capacitors to discharge before handling the module after removal. Failure to do so could result in severe or fatal shock. (p. 7-4)

Sommaire de Sécurité

AVERTISSEMENT D'ORDRE GENERAL	**Environment de l'Equipement** Nes pas soumettre les composantes a une atmosphere corrosive lors du transport, de l'entreposage ou de l'utilisation. **Risques de Chocs Electriques lor de l'Entretien** S'assurer de debrancher l'alimentation ou de prende les precautions necessaires a eviter tout contact avec des composants sours tension lors de l'entretien. **Precautions de Manutention** Ce module contient des composantes sensibles aux decharges electro-statiques.

AVERTISSEMENT D'ORDRE SPECIFIQUE	Assurez-vous que le disjoncteur d'alimentation principal et le disjoncteur de panneau d'entrée des alimentations sont éteints avant de procéder à l'installation, à la mise à jour, à l'extension ou au câblage, dans le but d'éviter les chocs sérieux et même mortels. Ne rétablissez pas l'alimentation tant que ces procédures ne sont pas terminées. (p. 3-4, 3-11, 7-5) Ne retirez pas les couvercles de plastique situés sur le panneau arrière du châssis de montage des modules. Ces couvercles constituent une protection contre les contacts accidentels avec la tension c.c., qui risquent de provoquer des chocs sérieux et même mortels. (p. 3-10) Cette armoire comporte des connexions c.c. dénudées. Ces connexions électriques présentent un danger d'électrocution pouvant entraîner des blessures ou la mort. (p. 6-1) Il ne faut jamais nettoyer des pièces ou des composants électriques lorsqu'ils sont sous tension. Ceci présente un risque d'électrocution fatale. (p. 6-1) Si des circuits d'entrée ou de sortie sont alimentés à partir de sources externes, ils présentent un risque de choc électrique même lorsque l'alimentation du système est débranchée du panneau d'entrée l'alimentation. Le cas échéant, un avertissement signalant la présence de sources d'alimentation multiples doit être apposé sur la porte de l'armoire. (p. 6-1) Portez toujours des lunettes de protection lorsque vous utilisez des solvants de nettoyage. L'air comprimé servant à enlever le solvant des cartes de circuits imprimés provoque des élaboussures qui risquent d'atteindre les yeux. (p. 6-1)

AVERTISSEMENT D'ORDRE SPECIFIQUE	Le module diot être manipulé à l'aide de surfaces autres que le dissipatour thermique. Ce dernier resque d'être chaud et de provoquer des brûlures sérieuses. (p. 7-4) Aprés avoir retiré le module, laissez les condensateurs de filtres antiparasites se décharger pendant cinq secondes avant de manipuler celui-ci, afin d'éviter les chocs sérieux et même mortels. (p. 7-4)

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SECTION 1 - INTRODUCTION

OVERVIEW

The INFI 90 DC input power system provides 5 VDC, ±15 VDC, and 24 VDC to power process control modules and field termination devices. The DC input power system uses a 24 VDC or 48 VDC input as the system supply voltage.

The system consists of the power entry panel (PEP), fan assembly, power modules and their mounting unit, bus bars and associated wiring. The power modules provide scalable power for logic and I/O functions through N+1 redundancy. In this type of redundancy, power modules equally share output. If any power module fails, the remaining power modules adjust their outputs to meet the total system load. Therefore, redundancy can be provided by one extra power module beyond the minimum number required to power the system.

INTENDED USER

The user should have a background in electricity and electronics and be able to recognize shock hazards. Personnel working with the DC modular power system must also be familiar with electronic process control instrumentation and how to use measuring instruments such as digital multimeters.

HARDWARE DESCRIPTION

Power Entry Panel

The IEPEP04 Power Entry Panel supplies DC line power to the system cabinet. The IEPEP04 panel transfers redundant power to the system cabinet and monitors system status. It contains the DC transfer module and the bus monitor module which perform these functions. The DC transfer module monitors line voltage inputs to the system cabinet, provides automatic DC line transfer (for redundant DC lines) and generates a power fail interrupt (PFI) signal. The bus monitor module monitors the power system and provides status and user alarm outputs.

Fan Assembly

The fan assembly provides air flow cooling for the power modules and process control modules in the system cabinet. The IEFAN03 fan assembly is used in 24 VDC powered systems and the IEFAN05 fan assembly is used in 48 VDC powered systems.

Power Modules

There are four power modules: the IEPDS01 System Power Module and IEPDF01 Field Power Module require 24 VDC inputs, the IEPDS02 System Power Module and IEPDF02 Field Power Module require 48 VDC inputs. The IEPDS01 and IEPDS02 modules provide 5 VDC, ±15 VDC and 24 VDC outputs. The IEPDF01 and IEPDF02 modules provide only 24 VDC output for field powered devices.

Module Mounting Unit

The IEMMU01 Module Mounting Unit provides the housing, power connections and signal conductors for power supply and process control modules. The IEMMU02 Module Mounting Unit has the same functionality as the IEMMU01 Module Mounting Unit, but it is a front-mounted unit. Its primary use is in smaller system cabinets like the MINI 90™ system.

Power Mounting Unit

The power mounting unit (PMU) segregates power modules from INFI 90 process modules. It provides housing and power connections for IEPDS01 or IEPDS02 and IEPDF01 or IEPDF02 power modules. The PMU is capable of supporting up to 12 power modules (provided that its output current capacity of 100 amps is not exceeded).

There are two PMU models. The IEPMU01 Power Mounting Unit is a rear mount unit, the IEPMU02 Power Mounting Unit is a front mount unit. Both PMU units mount in an INFI 90 or Network 90 ® system cabinets.

FEATURES

The modular power system requires less cabinet space than conventional systems, yet it offers features found on larger power supply systems.

- The DC modular power system accepts redundant 24 VDC input or redundant 48 VDC input. The DC transfer card in the power entry panel automatically transfers the input source if one source fails.

- Power modules provide scalable power for logic and I/O functions through N+1 redundancy. With N+1 redundancy, power modules equally share total power output. If any module fails, the others adjust their output to meet the total system load.

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® Network 90 is a registered trademark of Elsag Bailey Process Automation.

- Modular design permits removal and installation of power modules while under power, without interrupting power to the INFI 90 system.

INSTRUCTION CONTENT

This manual provides introductory, installation, operation, calibration, troubleshooting and maintenance information. Read and understand this document before placing the power system into service. A summary of section content follows:

Introduction — An overview of the system, description of hardware, glossary of unique terms, reference documentation, and physical and electrical specifications.

Description and Operation — A block diagram to explain how key parts of the system operate.

Installation — Handling, inspection, how to set up, install, wire and safety considerations.

Operating Procedures — Power module start-up, how to use, individual controls.

Troubleshooting — Error indications, corrective actions, problem determination and verification.

Maintenance — Provides a preventive maintenance schedule and covers maintenance procedures.

Repair/Replacement Procedures — Procedures for power system repair and replacement.

Support Services — How to order replacement parts, obtain additional documentation and training.

Appendices — A quick reference guide of switch and jumper settings, module power requirements, wiring diagrams and power system sizing procedures and tables.

HOW TO USE THIS MANUAL

Read this manual in sequence. To get the best use of this manual, read it from cover to cover, then go back to specific sections.

1. Complete the steps in Section 3.
2. Read Section 4 thoroughly before powering up the system.
3. Refer to Section 5 if operating problems occur.

4. Read Section 7 if system repairs are needed.

5. Use Section 8 for a replacement parts list and warranty information.

6. Refer to the appendices for power system sizing information, and wiring diagrams.

GLOSSARY OF TERMS AND ABBREVIATIONS

Table 1-1 is a glossary of terms and abbreviations unique to Bailey Controls Company products.

Table 1-1. Glossary of Terms and Abbreviations

Term	Definition
BMM	Bus monitor module.
DTM	DC transfer module.
I/O Expander Bus	Parallel communication bus between the control and I/O modules.
MMU	Module mounting unit. A card cage that provides electrical and communication support for INFI 90/Network 90 modules.
PEP	Power entry panel.
PFI	Power fail interrupt. Signal generated by the PEP if loss of DC or out-of-tolerance input.
PMU	Power mounting unit.
Termination Module	Provides input/output connection between plant equipment and the INFI 90/ Network 90 modules.
Termination Unit	Provides input/output connection between plant equipment and the INFI 90/ Network 90 modules.

NOMENCLATURE

Table 1-2 lists nomenclature associated with the DC modular power system. Refer to Table 7-1 for DC modular power system part numbers.

Table 1-2. Nomenclature

Description	Nomenclature
INFI 90 System Cabinet	
With MMUs (DC input bus bar)	IECAB01
With PMU and MMUs (no DC input bus bar)	IECAB03
Fan Assembly	
24 VDC input	IEFAN03
48 VDC input	IEFAN05
Module mounting unit	
Rear mount	IEMMU01
Front mount	IEMMU02

Table 1-2. Nomenclature (continued)

Description	Nomenclature
24 VDC input field power module 48 VDC input field power module	IEPDF01 IEPDF02
24 VDC input system power module 48 VDC input system power module	IEPDS01 IEPDS02
DC power entry panel with redundant DC feed and circuit breakers	IEPEP04
Power mounting unit Rear mount Front mount	 IEPMU01 IEPMU02

NOTE: The DC transfer module and bus monitor module have part numbers (refer to Table 7-1).

REFERENCE DOCUMENTS

Table 1-3 lists other Bailey documents containing information relevant to the DC modular power system.

Table 1-3. Reference Documents

Number	Document Title
I-E96-500	Site Planning and Preparation

SPECIFICATIONS

Table 1-4 lists DC modular power system specifications.

Table 1-4. Specifications

<table>
<tr><th>Property</th><th>Characteristic/Value</th></tr>
<tr><td colspan="2">IEPDS01/02, IEPDF01/02 Power Modules</td></tr>
<tr><td>Module input requirements</td><td>
<table>
<tr><th rowspan="2">Module</th><th colspan="3">Voltage (VDC)</th><th rowspan="2">Current (A) Max</th><th rowspan="2">Power (W) Nom</th></tr>
<tr><th>Min</th><th>Nom</th><th>Max</th></tr>
<tr><td>IEPDF01</td><td>21</td><td>24</td><td>30</td><td>6.5</td><td>102</td></tr>
<tr><td>IEPDF02</td><td>42</td><td>48</td><td>60</td><td>3.25</td><td>102</td></tr>
<tr><td>IEPDS01</td><td>21</td><td>24</td><td>30</td><td>7.6</td><td>117</td></tr>
<tr><td>IEPDS02</td><td>42</td><td>48</td><td>60</td><td>3.8</td><td>117</td></tr>
</table>
NOTE: Inrush current increases from 0 A to steady state in 3 seconds typically.
</td></tr>
<tr><td>Module outputs</td><td>
<table>
<tr><th>Module</th><th>Voltage (VDC)</th><th>Current (A)</th><th>Power (W)</th><th>Tolerance (%)</th></tr>
<tr><td>IEPDF01/02</td><td>25.5</td><td>4.0</td><td>102.0</td><td>+6/-0</td></tr>
<tr><td rowspan="4">IEPDS01/02</td><td>5.1</td><td>10.0</td><td>51.0</td><td>±3.0</td></tr>
<tr><td>-15.0</td><td>0.5</td><td>7.5</td><td>±2.3</td></tr>
<tr><td>+15.0</td><td>0.5</td><td>7.5</td><td>±2.3</td></tr>
<tr><td>25.5</td><td>4.0</td><td>102.0</td><td>+6/-0</td></tr>
</table>
NOTE: Total 5 VDC and 24 VDC power output per module should not exceed 102 watts.
</td></tr>
</table>

Table 1-4. Specifications (continued)

<table>
<tr><th>Property</th><th>Characteristic/Value</th></tr>
<tr><td colspan="2">IEPDS01/02, IEPDF01/02 Power Modules (continued)</td></tr>
<tr><td>Line regulation</td><td>0.5%</td></tr>
<tr><td>Hold up time</td><td>≥6 msecs (output fully loaded)</td></tr>
<tr><td>Heat dissipation</td><td>120 BTU per hr</td></tr>
<tr><td colspan="2">IEPEP04 Power Entry Panel Characteristics</td></tr>
<tr><td>Input voltage</td><td>21 VDC (min.) to 30 VDC (max.) for 24 VDC input
42 VDC (min.) to 60 VDC (max.) for 48 VDC input</td></tr>
<tr><td>Ripple voltage</td><td>The input voltage range includes RMS ripple voltage.</td></tr>
<tr><td>Maximum input current</td><td>60 A for 24 VDC input
30 A for 48 VDC input</td></tr>
<tr><td>Maximum input interruption</td><td>6 msecs</td></tr>
<tr><td>Maximum input line surge</td><td>36 V for 24 VDC input (not to exceed 5 msecs)
65 V for 48 VDC input (not to exceed 5 msecs)</td></tr>
<tr><td>Redundant DC transfer time</td><td>7 msecs typical</td></tr>
<tr><td>Voltage monitor inputs</td><td>
<table>
<tr><th>Bus</th><th>Valtage (VDC)</th><th>Trip Point, Typical (VDC)</th></tr>
<tr><td rowspan="4">DC MPS bus</td><td>5</td><td>4.76</td></tr>
<tr><td>15</td><td>14.3</td></tr>
<tr><td>-15</td><td>-14.3</td></tr>
<tr><td>24</td><td>24.5</td></tr>
<tr><td rowspan="3">Auxiliary bus</td><td>24</td><td>21.8</td></tr>
<tr><td>48</td><td>43.7</td></tr>
<tr><td>125</td><td>114</td></tr>
</table>
</td></tr>
<tr><td>Power system alarm output</td><td>Open to alarm, 24 VDC maximum, 120 mA
(inductive loads require diode suppression)</td></tr>
<tr><td>Bus voltage alarm output</td><td>Open to alarm, 24 VDC maximum, 120 mA
(inductive loads require diode suppression)</td></tr>
<tr><td>Status signal inputs</td><td>Normally open (NO) or normally closed (NC) jumper selectable on BMM module, low ≤0.8 VDC, high ≥3.1 VDC</td></tr>
<tr><td colspan="2">General</td></tr>
<tr><td>Electromagnetic/radio frequency interference</td><td>Values not available at this time. Keep cabinet doors closed. Do not use communication equipment any closer than 2 m from the cabinet.</td></tr>
<tr><td>Mounting</td><td>Power supply modules occupy one slot in the INFI 90 module mounting unit (MMU) or power mounting unit (PMU). Fastens to MMU or PMU with two half-turn latches on the faceplate.</td></tr>
<tr><td>Physical dimensions</td><td>
<table>
<tr><th rowspan="3">Device</th><th colspan="6">Dimensions</th></tr>
<tr><th colspan="2">Height</th><th colspan="2">Width</th><th colspan="2">Depth</th></tr>
<tr><th>mm</th><th>in.</th><th>mm</th><th>in.</th><th>mm</th><th>in.</th></tr>
<tr><td>IEFAN03/05</td><td>44.4</td><td>1.75</td><td>482.6</td><td>19</td><td>330.2</td><td>13</td></tr>
<tr><td>IEMMU01/02</td><td>177.8</td><td>7</td><td>482.6</td><td>19</td><td>317.5</td><td>12.5</td></tr>
<tr><td>IEPEP04</td><td>175.2</td><td>6.9</td><td>482.6</td><td>19</td><td>685.8</td><td>27</td></tr>
<tr><td>IEPMU01/02</td><td>177.8</td><td>7</td><td>482.6</td><td>19</td><td>317.5</td><td>12.5</td></tr>
</table>
</td></tr>
</table>

Table 1-4. Specifications (continued)

Property	Characteristic/Value
Environmental	
Ambient temperature	0° to 55°C (32° to 131°F)
Maximum module ambient temperature	70°C (158°F)
Humidity	5% to 90%, up to 55°C (131°F) noncondensing 0% to 45%, above 55°C (131°F) noncondensing
Atmospheric	Sea level to 3 km (1.86 mi)
Air quality	Noncorrosive
Certification	CSA certified as process control equipment in an ordinary (nonhazardous) environment.

SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.

SECTION 2 - DESCRIPTION AND OPERATION

INTRODUCTION

This section uses block diagrams and supportive text to explain how the main functional blocks of the power system operate. Figures 2-1 and 2-2 show overall system architecture using a module mounting unit and systems using a power mounting unit. Additional diagrams show circuit details for the DC transfer module, bus monitor module and power module.

POWER DISTRIBUTION

Bus bars distribute DC input and regulated DC output power throughout the cabinet. The input power bus bar has three separate conductor layers. The system power bus bar has eight separate conductor layers. Bus bars reduce hand wiring and improve reliability.

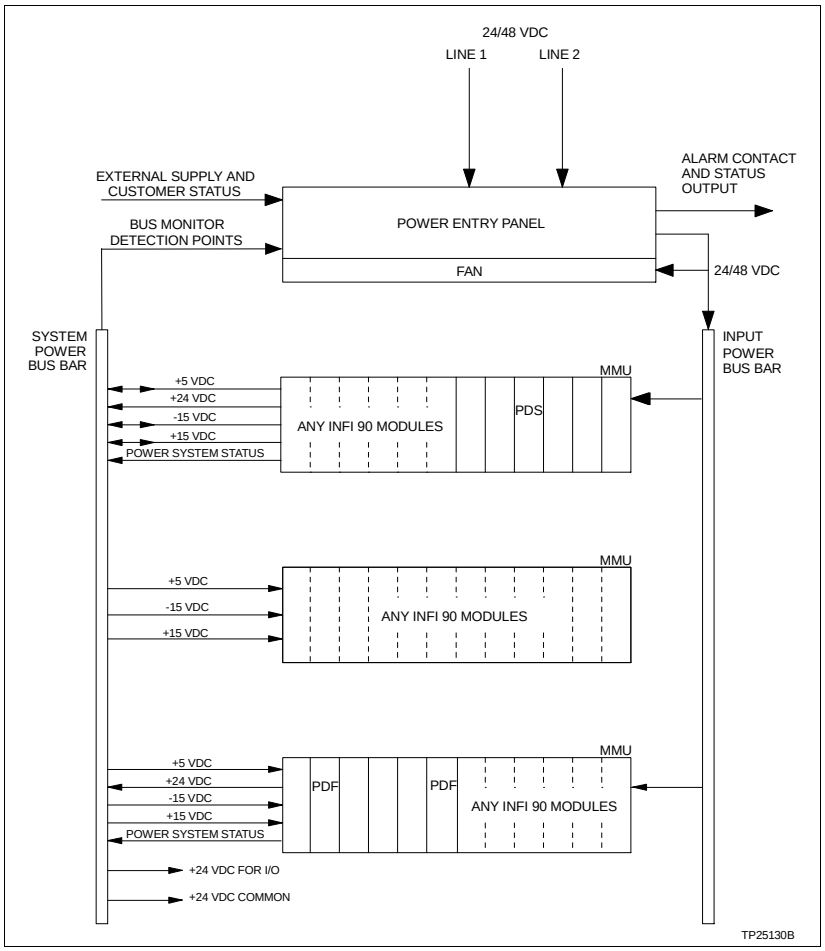

Figure 2-1. Block Diagram of Modular Power System with Module Mounting Unit

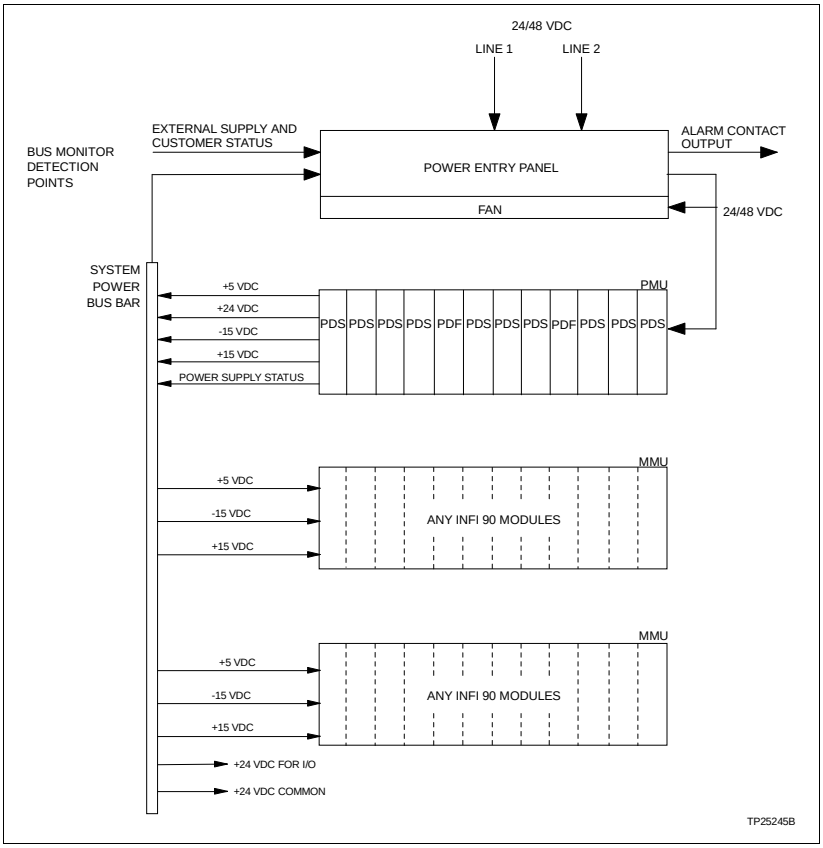

Figure 2-2. Block Diagram of Modular Power System with Power Mounting Unit

The input power bus bar distributes DC power from the power entry panel (PEP) to the module mounting unit (MMU) backplanes. The bus bar has quick connect tabs to connect cables from the power entry panel and the module mounting unit. IECAB03 cabinets have power mounting units (PMU) and do not have input power bus bars. A cable distributes power directly from the PEP panel to the PMU card cage (see Figure 2-2).

The eight-layer system power bus bar distributes regulated DC voltages, power supply status and power fail interrupt (PFI) signals. This bus bar also has quick connect tabs.

High-current, multi-conductor flat cables connect regulated voltage outputs and status signals from the MMU backplane to the system power bus bar. A cable from the power entry panel to the system power bus bar allows the system to monitor bus voltages and status signals. Extra tabs are available at the bottom of the system power bus bar for connecting 24 VDC I/O power to field termination units or to other cabinets. Tabs are also available to connect DC common and I/O common to the system common bus bar at the bottom of the cabinet.

POWER ENTRY PANEL

The IEPEP04 Power Entry Panel connects single or redundant 24/48 VDC line power to an INFI 90 system cabinet. It also distributes power to the power modules and fan assembly. This version has circuit breakers for each power line input. Two modules reside in the PEP panel. They are the DC transfer module and bus monitor module.

DC Transfer Module

The DC transfer module monitors both power inputs and its own circuitry. If a power input is lost or faulty, the module automatically transfers to the redundant input. The DC transfer module generates a power fail interrupt signal if both lines are lost or below the low voltage threshold. It sends this signal to the bus monitor module. The bus monitor module sends the PFI signal to the appropriate process control modules, thereby interrupting their operation. Visible through the front panel are three LEDs. The red and green LED at the top shows whether the module is operating normally (green) or not (red). The two other LEDs (line 1 and line 2) provide DC input status (green = good, red = bad).

Bus Monitor Module

The bus monitor module monitors the regulated bus voltages (5 VDC, ±15 VDC, and 24 VDC) and power module status from the system power bus bar. A cable connection between the bus bar and the J2 connector on the PEP panel provides the path. The bus monitor module can also monitor two additional external power supply voltages at the PEP terminal blocks. User-configured jumpers allow the module to monitor either 24 VDC, 48 VDC or 125 VDC for up to two auxiliary power supplies. There are two inputs for monitoring system status signals.

Jumpers are used to configure input status signals (low true or high true). Also the status input one may be configured as an additional PFI signal (low true). Two red and green LEDs on the module faceplate provide status information. The topmost LED shows whether the module is operating properly (green) or not (red). The system status LED is red when voltages are low or other inputs are bad. The status signal goes to the communication system hardware, which is the bus interface module for plant loop systems, and the network interface slave for INFI-NET® systems. On the communication loop, any INFI 90 operator interface can access the signal.

There are two alarms: PWR SYS ALARM and BUS VOLT ALARM. The PWR SYS ALARM becomes active when a power system problem occurs. The BUS VOLT ALARM becomes active

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when any bus voltage (5 VDC, ±15 VDC, or 24 VDC) falls out of tolerance.

The bus monitor module also generates a power fail interrupt signal if it receives a PFI from the DC transfer module, status input one, or if the five VDC bus voltage is low (if selected). It distributes this signal to process control modules in the INFI 90 system cabinet.

FAN ASSEMBLY

The IEFAN03 and IEFAN05 Fan Assemblies contain six fans that mount in one chassis. Its purpose is to keep the power supplies and modules cool. The fans draw cooling air up through the module mounting assemblies and force it through exhaust vents (when present) in the top of the cabinet door.

MODULE MOUNTING UNIT

The IEMMU01 and IEMMU02 Module Mounting Units provide mounting for the power modules and process control modules. Two five-conductor flat cables link the power fail interrupt and power module status signals, 5 VDC, ±15 VDC, and 24 VDC, MCOM and I/O COM from the system power bus bar to the MMU card cage. A three-wire cable from the power input bus bar to the MMU backplane supplies the power modules with DC input power.

Cables are required to connect the communication buses between multiple MMU card cages. The module bus uses a three-wire, twisted cable, while the I/O expander bus uses a flat, 40 conductor ribbon cable.

POWER MOUNTING UNIT

The power mounting unit (IEPMU01 and IEPMU02) mounts and segregates power modules from INFI 90 process modules. Each PMU is open on the top and bottom for air flow. There are 12 pairs of guides for mounting power modules, two side plates and the backplane. The backplane uses bus bars rather than traces for heavier currents.

POWER MODULES

The DC system power modules receive input power at the MMU or PMU backplane. The IEPDS01 DC System Power Module requires 24 VDC input power. The IEPDS02 DC System Power Module requires 48 VDC input power. DC-to-DC converters convert the primary input voltage to secondary regulated voltages of 5 VDC, ±15 VDC and 24 VDC. These voltages are available at the system bus bar for distribution to process control modules. See Figures 2-3 and 2-4.

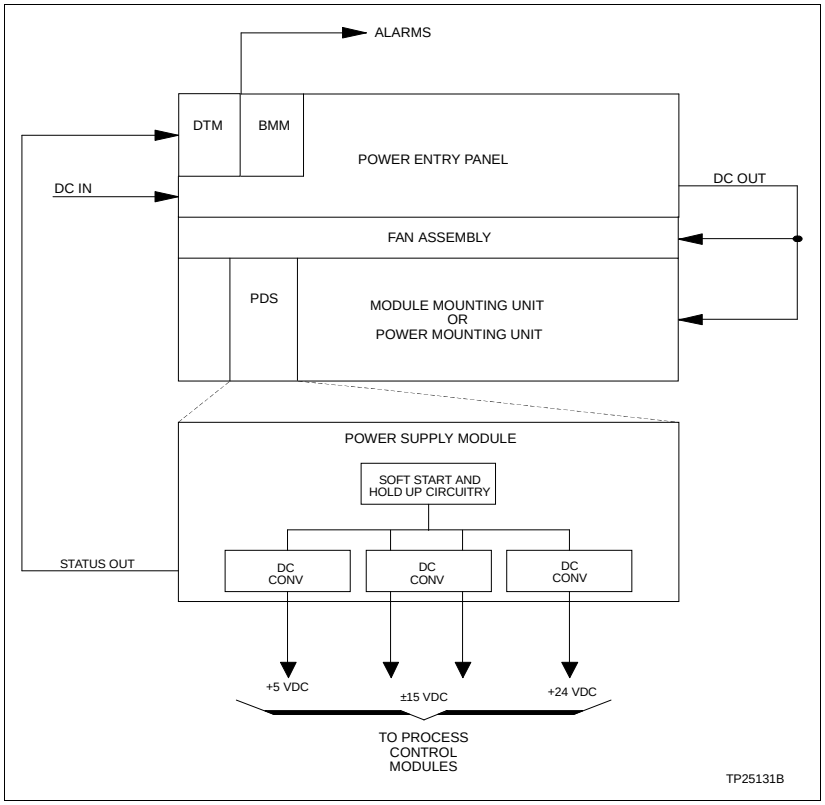

Figure 2-3. Block Diagram, Power Distribution to the PDS

All output voltages are preset at the factory. In an N+1 redundant environment, proper operation of each module output is based on this preset voltage. If a bus requires more current, the module automatically compensates.

NOTE: The factory preset voltages are not field-adjustable.

The IEPDF01 and IEPDF02 DC Field Power Modules are functionally the same as the IEPDS01 or IEPDS02 modules except that they provide only 24 VDC. The DC field power module provides power to field termination devices when separate termination cabinets are used, or when it is desirable to separate the I/O power supplies from the module power supplies.

STATUS SIGNALS

The block diagram in Figure 2-5 shows the flow of status signals through the system. The following text explains status signal flow.

Power System Status

The bus monitor module logically ANDs all status lines (DC line, bus voltages, external power inputs, external user status inputs and power module status). Internal bus monitor

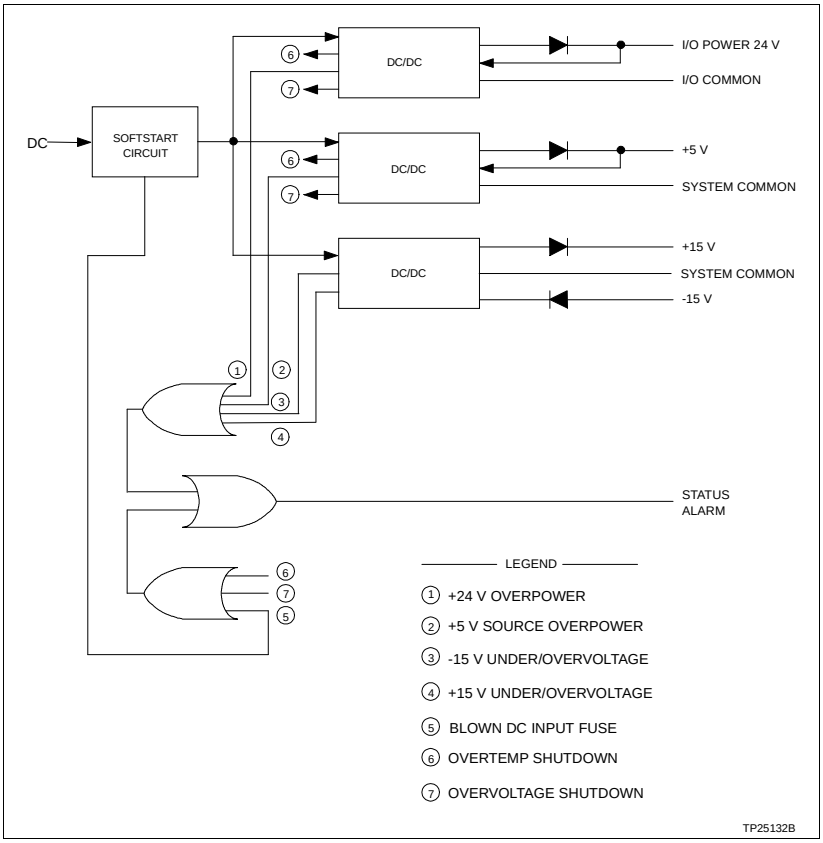

Figure 2-4. Block Diagram, PDS Module Converter and Status Circuitry

circuitry determines if any status line is bad. If any status is bad, the bus monitor module generates a low-true output signal to the communication system hardware, which is the bus interface module (BIM) for plant loop systems and the network interface slave (NIS) for INFI-NET systems.

Bus Voltage Status

The BMM module logically ANDs the DC bus voltage status lines and outputs the result to an isolated customer alarm output. If any bus output voltage signal falls out of specification, a bus voltage alarm is generated.

POWER MODULE STATUS

The power modules generate their own status signals. These signals travel through the system power bus bar to the bus monitor module. The bus monitor module then combines this signal with the other status signals. If it or any other signal is bad, a power system status alarm is generated.

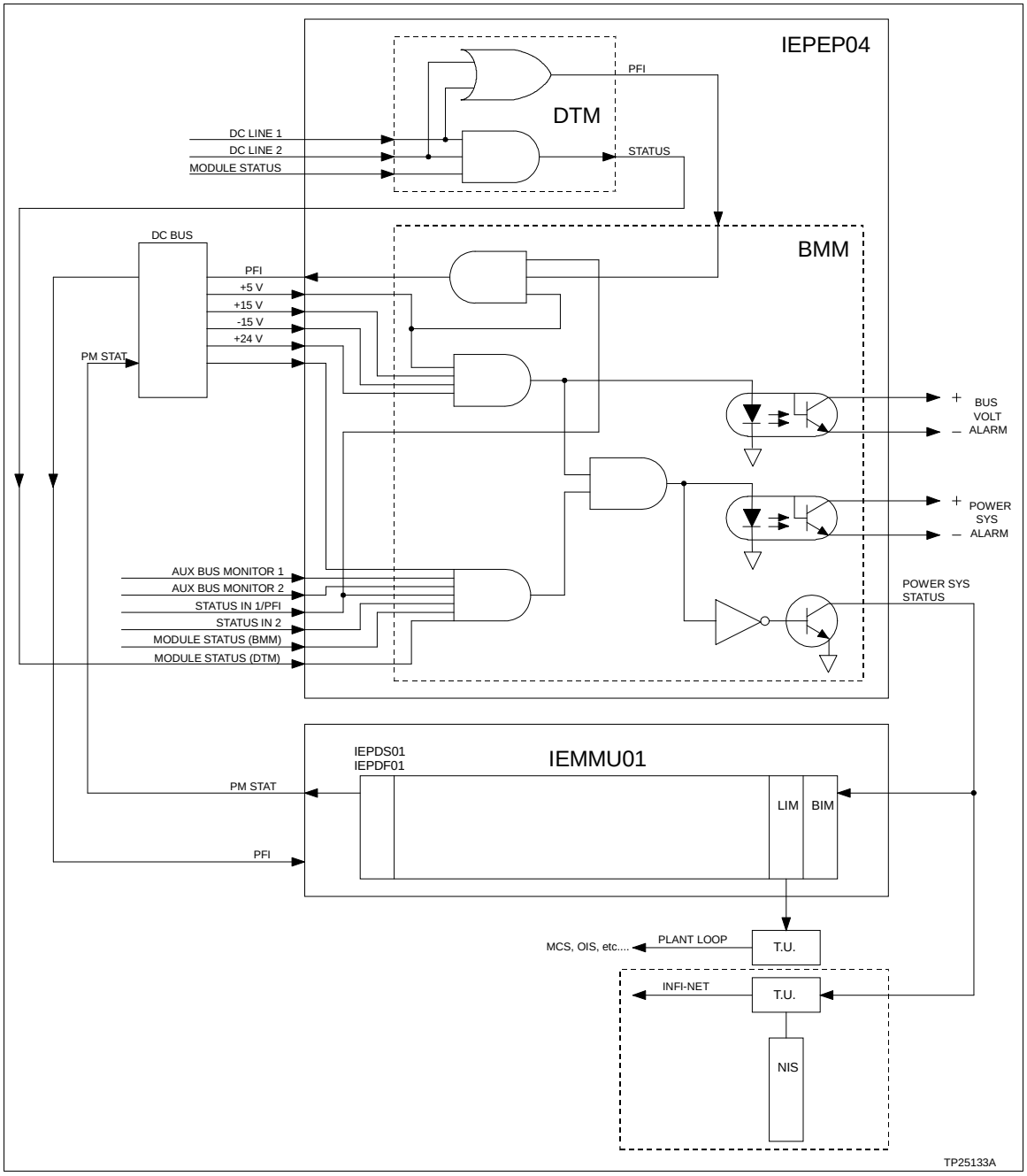

Figure 2-5. Status Signal Circuit Diagram

USER ALARM OUTPUTS

There are two user alarm outputs (normally closed): bus voltage and power system status alarm. The bus voltage alarm activates (opens) if any bus voltage goes low or is lost. The power system status alarm activates (opens) for any bad status. These outputs are optically isolated and can drive relays or annunciator panels that require no more than 120 milliamps.

SECTION 3 - INSTALLATION

INTRODUCTION

Completely install and prepare (i.e., attach wiring to terminal blocks, etc.) the hardware before applying power. This section explains hardware preparation in detail.

> **NOTE:** Normally, the cabinet is fully wired and ready to go upon receipt. The following information is provided in the event that you need to repair, replace, wire, or add to the modular power system.

UNPACKING AND INSPECTION

The power modules are in separate packages from the rest of the power system. Handle these modules per the steps in ***Special Handling*** and ***General Handling***.

Special Handling

The power supply module, DC transfer module and bus monitor module use devices susceptible to electrostatic discharge. Follow these handling procedures:

> **NOTE:** Always use Bailey Controls field static kit (part number 1948385_1 - consisting of two wrist straps, ground cord assembly, alligator clip, and static dissipative work surface) when working with the modules. The kit grounds a technician and the static dissipative work surface to the same ground point to prevent damage to the modules by electrostatic discharge.

1. ***Use Static Shielding Bag.*** Keep the modules in the static shielding bag until you are ready to install them in the system. Save the bag for future use.

2. ***Ground Bag before Opening.*** Before opening a bag containing an assembly with semiconductor devices, touch it to the equipment housing or a ground to equalize charges.

3. ***Avoid Touching Circuitry.*** Handle assemblies by the edges; avoid touching the circuitry.

4. ***Avoid Partial Connection of Semiconductor Device.*** Verify that all devices connected to the modules are properly grounded before using them.

5. ***Ground Test Equipment.***

6. ***Use an Antistatic Field Service Vacuum.*** Remove dust from the module if necessary.

7. ***Use a Grounded Wrist Strap.*** Connect the wrist strap to the appropriate grounding plug on the power entry panel. The grounding plug on the power entry panel must be effectively connected to the earth grounding electrode system through the AC safety ground.

8. ***Do Not Use Lead Pencils to Set Dipswitches.*** To avoid contamination of dipswitch contacts that can result in unnecessary circuit board malfunction, do not use a lead pencil to set a dipswitch.

General Handling

1. Examine the hardware immediately to verify that it has not been damaged in transit.

2. Notify the nearest Bailey Controls sales office of any such damage.

3. File a claim for any damage with the transportation company that handled the shipment.

4. Use the original packing material and container to store the hardware.

5. Store the hardware in an environment of good air quality, free from temperature and moisture extremes.

SYSTEM INSTALLATION

The following factors should be considered when determining the installation location of the system cabinet:

- The humidity of the location must not go above 95 percent noncondensing at 55 degrees Celsius (131 degrees Fahrenheit).
- The floor of the location must be able to bear a load of 362.9 kilograms (800 pounds).
- There should be a 914.4-millimeter (three-feet) clearance both front and back for opening cabinet doors.
- A power source for 24 VDC, 60 amp service or 48 VDC, 30 amp service must be available for fully loaded cabinets (no more than eight modular power supplies). Power sources for 24 VDC systems that supply cabinets having less than eight power modules should have a service that can supply 7.6 amps per module. Power sources for 48 VDC systems that supply less than fully loaded cabinets, should have a service that can supply 3.8 amps per power module.

Refer to the ***Site Planning and Preparation*** instruction for additional information. The standard cabinet configuration is

the power entry panel at the top, with the fan assembly placed between the power entry panel and the module mounting units. See Figure 3-1.

IEPEP04 POWER ENTRY PANEL WIRING

The appendices at the back of this manual show complete wiring diagrams of the modular power system. Figures C-1 and C-2 show the IEPEP04 system cabinet wiring diagram.

NOTE: Plug your wrist strap ground cord into the WRIST STRAP GND receptacle on the power entry panel when working with the system.

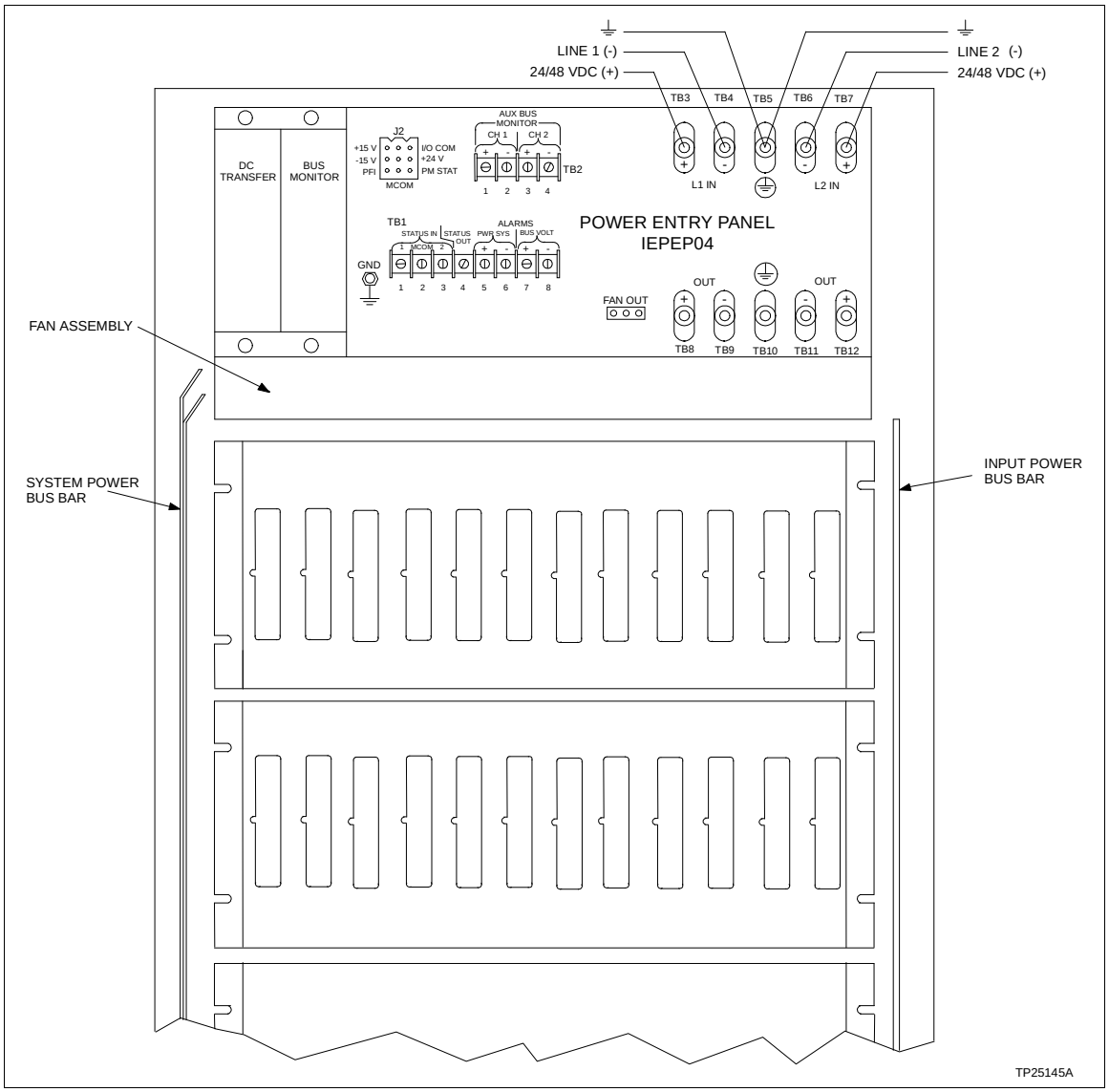

Figure 3-1. System Cabinet (Rear View)

WARNING	**Verify the main power and power entry panel circuit breakers are turned off before starting installation, retrofit, upgrade, or wiring procedures. Failure to do so could result in severe or fatal shock. Do not turn the power on until the installation, retrofit, upgrade, or wiring procedures are complete.**
AVERTISSEMENT	**Assurez-vous que le disjoncteur d'alimentation principal et le disjoncteur de panneau d'entrée des alimentations sont éteints avant de procéder à l'installation, à la mise à jour, à l'extension ou au câblage, dans le but d'éviter les chocs sérieux et même mortels. Ne rétablissez pas l'alimentation tant que ces procédures ne sont pas terminées.**

1. Place circuit breakers CB1 and CB2 (Figure 3-2) on the front of the panel to the OFF position before connecting DC power input wiring.

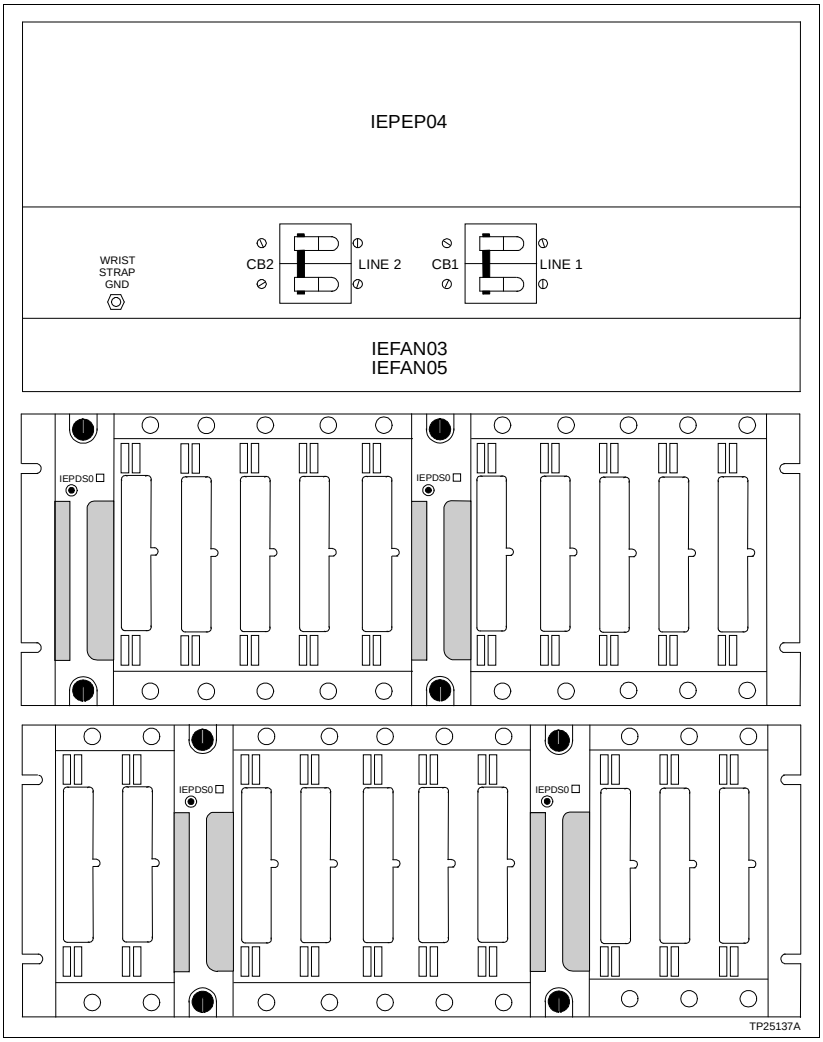

Figure 3-2. Circuit Breakers CB1/CB2

2. Connect 24 VDC or 48 VDC primary (L1) input power to TB3 (+), TB4 (-) and TB5 (GND) (Figure C-1).

3. Connect the secondary (L2) DC power input (if used) to TB5 (GND), TB6 (-) and TB7 (+). Both inputs must be the same nominal voltage level. If only 1 DC power input is being used, proceed with Step 4. If not, skip to Step 5.

4. Connect TB3 to TB7 and TB4 to TB6. Use 6 AWG wire. Note that this step avoids false status information because it connects line 1 and line 2 inputs together.

5. Connect cable 6637813_1 from J2 on the power entry panel to the system power bus bar. This provides connections to sample the DC output bus voltages, monitor the power module status signal and to output a power fail interrupt signal. See the wiring diagrams at the end of this manual (Figure C-1) for correct system power bus bar connections.

6. Connect cable 6639443_1 from TB8, TB9, TB10, TB11 and TB12 on the panel to the input power bus bar for distribution of DC power to the module mounting unit (Figure C-1).

7. Connect cable 6637818_2 from the input power bus bar to each module mounting unit backplane (Figure C-1).

8. Connect the fan assembly power cable to connector J1 labeled FAN OUT on the panel (Figure C-1).

9. Connect a wire equivalent to power wiring but not less than 6 AWG from the TB10 (GND) stud of the panel to the cabinet frame for DC input safety grounding (Figure C-1).

10. There are 2 extra voltage monitor inputs available to monitor customer external power supply voltages (see Figure C-1). Use terminal block TB2 labeled AUX BUS MONITOR for this purpose. Attach one input to terminals 1(+) and 2(-) labeled CH1. Connect the other input to terminals 3(+) and 4(-) labeled CH2. Inputs can be 24 VDC, 48 VDC or 125 VDC. Set jumpers J1 and J2 for the desired voltage. Refer to Table 3-2.

11. Wire the status inputs to terminal block TB1, terminals 1 (STATUS IN 1), 2 (COM) and 3 (STATUS IN 2). Insure that the inputs are open collector or contact type referenced to DC common (terminal COM). The alarm inputs must have the current carrying capability to sink at least 1 mA. If the system uses Plant Loop, do Step 12. If not, go to Step 13.

12. Connect cable 6634205_1 from TB1 terminal 4 STATUS OUT to the P3 card edge connector of the bus interface module (BIM). Doing so enables the BIM to send the status message to

the loop interface module (LIM) and to the Plant Loop. If redundant BIMs are used, connect cable 6634205_1 from each BIM to TB1 terminal 4 STATUS OUT. Go to Step 16.

13. Connect an 18 AWG wire from TB1 terminal 4 STATUS OUT to TB1 terminal 8 on the NTCL01 termination unit.

14. If redundant network interface slave modules are being used with the NTCL01 termination unit:

    a. Put two 18 AWG wires on a lug. Attach the lug to TB1 terminal 4 STATUS OUT.

    b. Attach the primary wire to TB1 terminal 8; the secondary to TB3 terminal 8.

15. If redundant network interface slave modules are being used with the NICL01 termination module:

    a. Put two 18 AWG wires on a lug. Attach the lug to TB1 terminal 4 STATUS OUT.

    b. Attach the primary wire to TB2 terminal 4; the secondary to TB2 terminal 5.

16. Use 18 AWG wire if connecting TB1 terminals 5, 6, 7 and 8 to alarms. Terminals 5(+) and 6(-) are labeled PWR SYS. These are the output connections for the power system alarm. Terminals 7(+) and 8(-) labeled BUS VOLT are the bus voltage alarm annunciators.

NOTE: Wire your system per the color codes in the wiring diagrams of Appendix C.

DC Transfer Module

Before installing the DC transfer module, set jumper J13 for 24 VDC or 48 VDC operation. Refer to Table 3-1 for jumper assignments. Figure 3-3 shows the DC transfer module board layout. Set jumpers J1 through J4 for the desired overvoltage or undervoltage detection (see Table 3-1).

NOTE: Both the DC transfer and bus monitor modules mount from the rear of the system cabinet. The DC transfer module mounts in the leftmost slot; the bus monitor module mounts in the rightmost slot. The board edge connectors are keyed to prevent mounting in the wrong slots.

To mount the module:

1. Grasp the sides of the faceplate.

2. Line up the circuit board edges with the card guides in its power entry panel mounting slot (see Figure 3-2).

Figure 3-3. DC Transfer Module Board Layout

Table 3-1. DC Transfer Module Jumper Settings

Jumper	Setting	Function
J1	1-4 2-4	**Line 1 input:** 24 VDC high detect 48 VDC high detect
J2	1-4 2-4	**Line 1 input:** 24 VDC low detect 48 VDC low detect
J3	1-4 2-4	**Line 2 input:** 24 VDC high detect 48 VDC high detect
J4	1-4 2-4	**Line 2 input:** 24 VDC low detect 48 VDC low detect
J13	2-3 1-2	**Input power source:** 24 VDC 48 VDC

NOTE: Short pins with a jumper to enable function.

3. Slide the module into the slot until its faceplate is flush with the power entry panel.

4. Turn the 2 thumbscrews 1/2-turn to lock the module in place.

Bus Monitor Module

Before mounting the bus monitor module, set jumpers J1 through J7. Refer to Table 3-2 for switch settings. Refer to

Table 3-3 for jumper definitions. See Figure 3-4 for the bus monitor module circuit board layout.

Table 3-2. Bus Monitor Module Switch (S1) Setting

Pole				Function
1	2	3	4	
0 1				Monitor 5, 15 and ±15 VDC enabled Monitor 5, 15 and ±15 VDC disabled
	0 1			Monitor system 24 VDC enabled Monitor system 24 VDC disabled
		0 1		Monitor external power supply CH1 enabled Monitor external power supply CH1 disabled
			0 1	Monitor external power supply CH2 enabled Monitor external power supply CH2 disabled

NOTE: 0 = CLOSED (ON), 1 = OPEN (OFF).

1. Unused monitor inputs must be disabled. Do not enable all switches at once. Doing so will cause a bad status signal. Figure 3-4 shows the factory settings of switch S1.

Table 3-3. Bus Monitor Module Jumper Settings

Jumper	Setting[1]	Function
J1		**Auxiliary bus monitor channel 1:**
	1-2	Selects 24 VDC external power
	2-4	Selects 48 VDC external power
	2-3	Selects 125 VDC external power
J2		**Auxiliary bus monitor channel 2:**
	1-2	Selects 24 VDC external power
	2-4	Selects 48 VDC external power
	2-3	Selects 125 VDC external power
J3	2-3	Not used, must install jumper in this position
J4		**Auxiliary status input 1:**
	1-2	Normally open (NO) status input
	2-3	Normally closed (NC) status input
	3-4	PFI input (NO)
J5		**Auxiliary status input 2:**
	1-2	Normally open (NO) status input
	2-3	Normally closed (NC) status input
J6[2]		**Input power isolation:**
	1-2	Do not isolate input power
	2-3	Isolate input power
J7	2-3	Not used, must install jumper in this position
J8[2]		**Input/output common isolation:**
	1-2	Isolate input common from output common
	2-3	Do not isolate input common from output common

NOTES:

1. Short pins with a jumper to enable function.
2. Jumpers J8 and J6 must be set so that they correspond (i.e.,both set for isolation or no isolation).

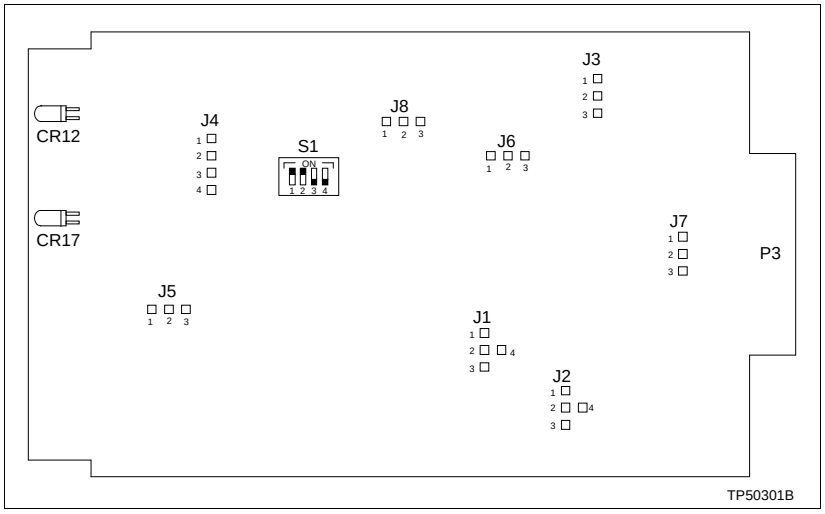

Figure 3-4. Bus Monitor Module Board Layout

Fan Assembly

The fan assembly (Figure 3-1) mounts directly beneath the power entry panel and above the first module mounting unit. Attach the fan power cable to the FANOUT connector on the power entry panel.

Power Modules

Power modules (Figure 3-5) mount directly in the module mounting unit (MMU). Any slot except the rightmost (slot 12) can be used. Install the modules as explained in Steps 1 through 5 and as shown in Figure 3-6. This installation scheme provides the best heat dissipation and power distribu-

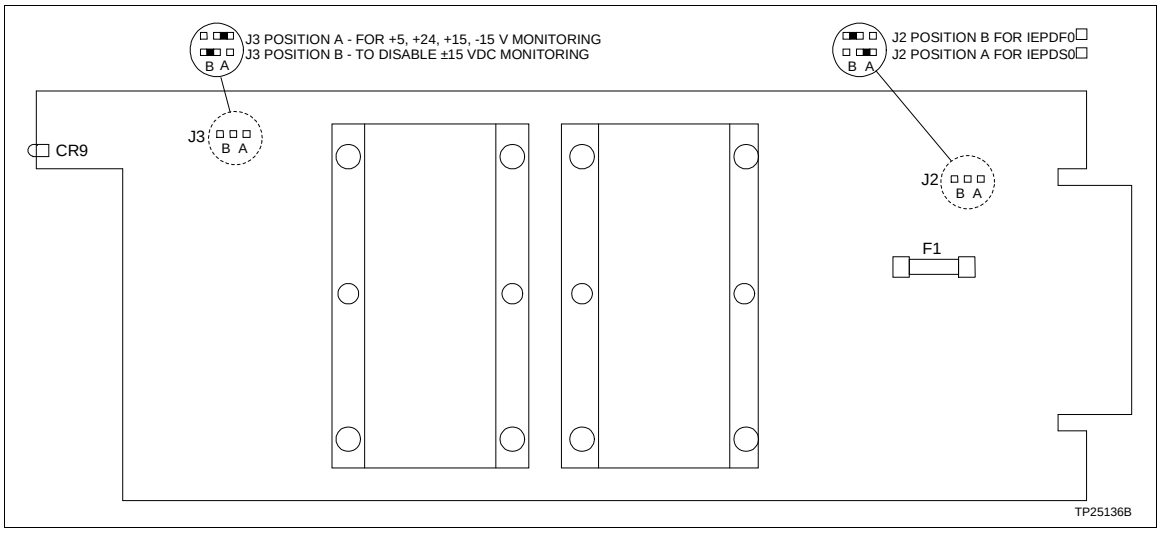

Figure 3-5. Power Module Board Layout

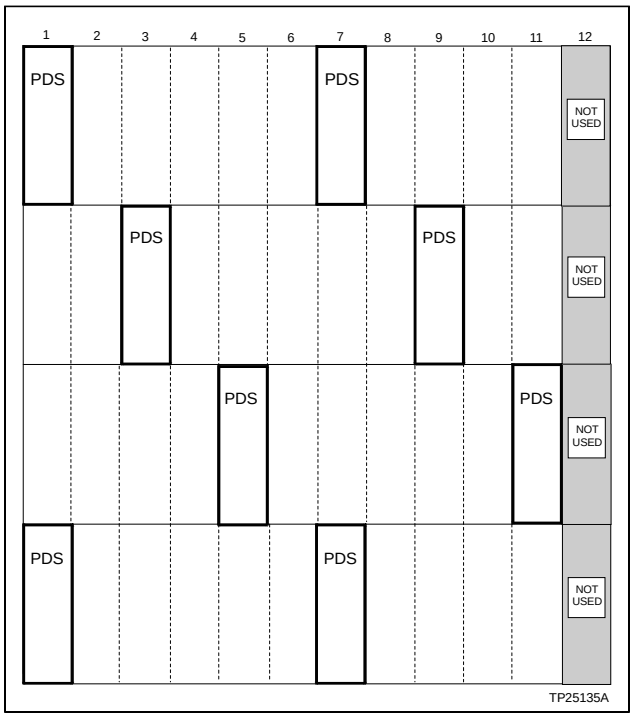

Figure 3-6. Recommended Power Module Layout

tion. For optimum heat dissipation and power distribution, do not exceed more than two IEPDS01 and IEPDS02 modules in any module mounting unit. Install at least one IEPDS01 and IEPDS02 module in the module mounting unit with the largest load (i.e., an MMU card cage containing several multi-function processor modules).

NOTE: The power mounting unit can hold a maximum of 12 power modules mounted side by side. However the total five VDC current load on the power mounting unit cannot exceed 100 amps. The total 24 VDC current load on the power mounting unit cannot exceed 60 amps.

WARNING	**Do not remove the plastic covers on the module mounting unit backplane. These covers protect against accidental contact with DC voltage. Severe or fatal shock could result.**
AVERTISSEMENT	**Ne retirez pas les couvercles de plastique situés sur le panneau arrière du châssis de montage des modules. Ces couvercles constituent une protection contre les contacts accidentels avec la tension c.c., qui risquent de provoquer des chocs sérieux et même mortels.**

Before handling the power modules:

- Verify that all devices connected to the module are properly grounded before using them.

- Avoid touching the circuitry when handling the module.
- Always use grounding straps (field static kits) when working with the modules.

To install the power modules:

1. Refer to Figure 3-5 to set jumper J2 for module type and J3 for bus voltage monitoring.

2. Grasp the module faceplate handle and align the top and bottom edges of the circuit board with the guides in the module mounting unit or power mounting unit.

3. Hold the module by the faceplate handle and slide it into its mounting slot. Push on the module faceplate until the rear edge connector is firmly seated in the backplane connector.

4. Firmly push on the module handle as you use a blade screwdriver to push and turn the 2 latching screws 1/2-turn clockwise to lock the module in place.

To remove the module, refer to ***POWER MODULE REPLACEMENT*** in Section 7 of this manual.

IEPMU01/02 POWER MOUNTING UNIT INSTALLATION

WARNING	**Verify the main power and power entry panel circuit breakers are turned off before starting installation, retrofit, upgrade, or wiring procedures. Failure to do so could result in severe or fatal shock. Do not turn the power on until the installation, retrofit, upgrade, or wiring procedures are complete.**
AVERTISSEMENT	**Assurez-vous que le disjoncteur d'alimentation principal et le disjoncteur de panneau d'entrée des alimentations sont éteints avant de procéder à l'installation, à la mise à jour, à l'extension ou au câblage, dans le but d'éviter les chocs sérieux et même mortels. Ne rétablissez pas l'alimentation tant que ces procédures ne sont pas terminées.**

Required Tools

You will need these tools to install the power mounting unit:

- 16-inch flat screwdriver.
- 7/16-inch nut driver.
- Pliers.
- Volt/ohmmeter.
- Heat gun.

Installing the PMU in the INFI 90 Cabinet

NOTE: Install the IEPMU01 mounting unit from the rear of the cabinet, the IEPMU02 mounting unit from the front.

1. Mount the power mounting unit directly beneath the fan assembly.

2. Secure both sides of the power mounting unit to the cabinet mounting rails.

3. Proceed to ***Wiring Instructions***.

Wiring Instructions

NOTE: All wiring is done in the rear of the cabinet. Wires are color-coded. This procedure and Figure C-2 apply to INFI 90 cabinets only.

1. Attach the DC input wire harness (part number 6639443_2) to TB8, TB9, TB10, TB11 and TB12 on the power entry panel (PEP) (see Figure C-2 for wire assignments) to the 2 DC input terminals on the right side of the PMU as follows:

   Black to top conductive strip on right hand side of PMU (DC Com).

   Red to second conductive strip on right hand side of PMU (24/48 V).

   Green/yellow to top screw of terminal block P3 (ground) on right hand side of PMU.

2. Before installing the 0 AWG (part number 206632285_45 or 6632285_47) braided wire, shape it into a [form to avoid overstressing the PMU bus bar terminals. On the left side of the PMU at the third conductive strip (from the top), attach one end of the first 0 AWG wire assembly (part number 6632285_47).

3. Attach the other end to the MCOM tab at the top of the system power bus bar. See Figure C-2.

4. Slide heat shrink tubing over PMU connection. See Figure 3-7. Insure that connections are properly covered, then use heat gun to shrink the tubing into place.

5. On the left side of the PMU at the fourth conductive strip (from the top), attach one end of the second 0 AWG wire assembly (part number 6632285_45).

6. Attach the other end to the 5 VDC tab at the top of the system power bus bar. See Figure C-2.

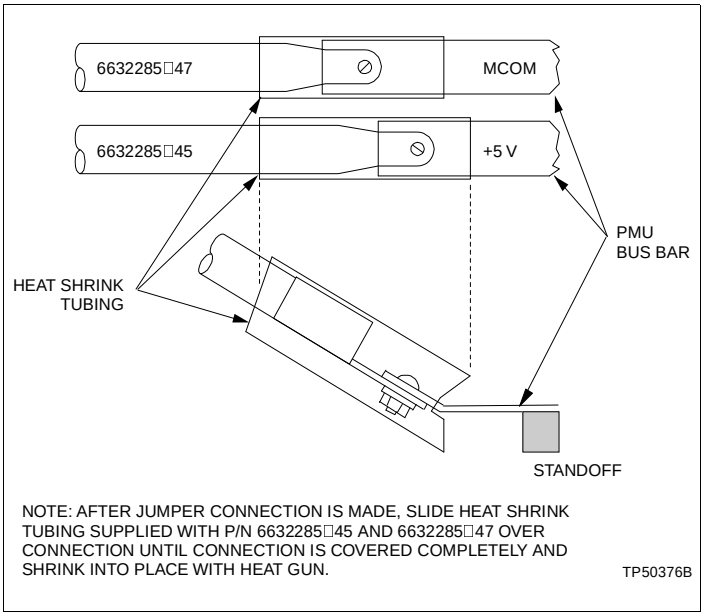

Figure 3-7. Heat Shrink Tubing for 5 VDC Connection

7. Slide heat shrink tubing over PMU connection (see Figure 3-7). Insure that connections are properly covered, then use heat gun to shrink the tubing into place.

8. Attach one end of the 6 AWG wire assembly (part number 6632885_48) to the fifth conductive strip (from the top) on the left side of the PMU.

9. Attach the other end of 6 AWG wire assembly to the system power bus bar I/O COM tab located at the top of the bus bar.

10. Slide heat shrink tubing over PMU connection (see Figure 3-8). Insure that connections are properly covered, then use heat gun to shrink the tubing into place.

11. On the left side of the PMU at the sixth conductive strip (from the top) attach one end of 6 AWG wire assembly (part number 6632885_48).

12. Attach the other end of 6 AWG wire assembly to system power bus bar 24 VDC tab located at the top of the bus bar.

13. Slide heat shrink tubing over PMU connection (see Figure 3-8). Insure that connections are properly covered, then use heat gun to shrink the tubing into place.

NOTE: If system bus bar (Bailey part number 1948506_8) is revision C or older, it will not have tabs at the top for 24 VDC connections. Use the 10 AWG wires supplied with the PMU to connect to the system power bus bar fastons identified as 24 V and I/O COM.

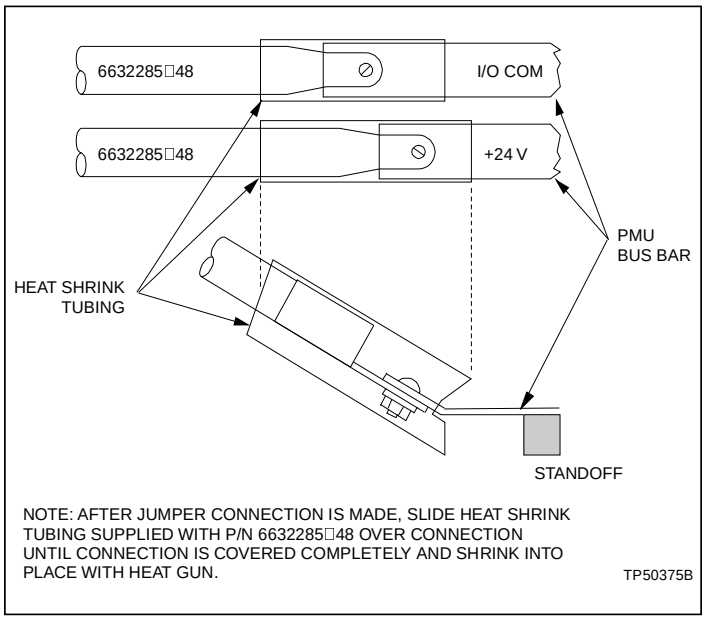

Figure 3-8. Heat Shrink Tubing for 24 VDC Connection

14. Attach one spade lug end of 10 AWG wire assembly (part number 206632285_46) to PMU +15 VDC. Attach the other spade lug end to system power bus bar +15 VDC.

15. Attach one spade lug end of 10 AWG wire assembly (part number 206632285_46) to PMU -15 VDC. Attach the other spade lug end to system power bus bar -15 VDC.

16. Attach one spade lug end of 18 AWG wire assembly (part number 20663228_49) to PMU STATUS. Attach the other spade lug end to system power bus bar status.

17. Attach spade lugs of cable assembly (part number 6637813_1) for signal connections from IEPEP04 connector J2 to the system power bus bar appropriately.

18. Verify that the circuit breakers on the PEP are in the OFF position.

19. Unplug all process and slave modules from the MMU backplane.

20. Verify that all wiring connections are complete before turning on the source power.

21. Use a voltmeter to measure 24 VDC or 48 VDC power at TB3 and TB7.

22. Turn PEP circuit breakers on.

> **NOTE:** Before doing step 23, verify that switch and jumper settings on the power modules are correct. Refer to Section 3 for settings.

23. Install the required number (calculated from ***SIZING THE MODULAR POWER SYSTEM*** in Appendix B) of PDS (or PDF) modules in the PMU one at a time. Slide 1 power module along the guides until it is seated. Turn the 2 latching screws until they lock. Verify that the status LED turns green on each power module. If it does not, refer to Section 5.

24. Do not install the process modules at this time. Refer to ***RECOMMENDED START-UP PROCEDURES*** in Section 4, Steps 5 through 8.

SECTION 4 - OPERATING PROCEDURES

INTRODUCTION

This section covers what must be known to operate the modular power system. The first part of this section provides a step-by-step approach to start-up. The remainder of this section explains the faceplate LED on the DC transfer, bus monitor and power modules, and other general operating information.

NOTE: The modular power system requires no user calibration; all components are factory calibrated.

LED INDICATORS

When the modular power system is operating, observe the status LEDs. The following paragraphs explain how to interpret these LEDs. Also, refer to Table 4-1.

Table 4-1. LED Conditions

Module	LED/Color	Condition
DTM	Status - Green Red	Normal Module has failed
	Line 1 - Green Red	Line 1 input is good Line 1 input has failed or is out of tolerance
	Line 2 - Green Red	Line 2 input is good Line 2 input has failed or is out of tolerance
BMM	Status - Green Red	Normal Module has failed
	System - Green Status - Red	Normal Bad power system status
PDS/PDF	Status - Green Blinking Green Red	Normal 5 VDC or 24 VDC overload 15 VDC overload, failure or over temperature

DC Transfer Module

The DC transfer module (DTM) has three LEDs, module status, line one and line two. All LEDs are red and green. When the system is receiving power and operating normally, the module status LED is green, as are the line one and two status LEDs. The only time the module status LED turns red is if the module fails. A failure means that the internally generated supply voltages or references have fallen below the minimum acceptable level. In a redundant supply line configuration, a failure in the primary input turns line one LED red; a failure in the secondary input turns line two LED red.

Bus Monitor Module

The bus monitor module (BMM) has two LEDs: module status and system status. The module status LED is green when the module is operating properly. It turns red if the module fails. A failure means that the internally generated supply voltages or references have fallen below the minimum acceptable level. The system status LED is green when everything in the system is satisfactory. If for some reason a bus voltage fails or falls out of tolerance, one of the DC inputs fails, external status, auxiliary power supply inputs are low, or the DTM module fails, the LED turns red.

Power Module

The power module has one LED, module status. This LED is green when the module is operating normally. It blinks green if the five VDC or 24 VDC circuits overload. It turns red if the 15 VDC circuits overload, if one or more outputs fail, or if module temperature goes beyond acceptable levels.

DC TRANSFER MODULE/BUS MONITOR MODULE REMOVAL DURING OPERATION

The DC transfer module and bus monitor module can be removed while the system is in operation.

> **NOTE:** If power from the operational line is lost and the DTM module is out of the system the entire power system will go down. Likewise, the power system status is not available to the user while the BMM module is out of the system.

RECOMMENDED START-UP PROCEDURES

Follow this procedure to apply power to the system.

1. Verify that all connections are secure.

2. Insure that all unused DC bus bar receptacles are covered with insulated receptacles.

3. Install the power modules only (refer Section 3 for details).

4. Turn power on.

5. Measure the bus voltages at the test jacks of the bus monitor module (5 VDC and ±15 VDC are with respect to MOD COM; 24 VDC with respect to I/O COM). Refer to Table 4-2 for the unloaded DC bus voltage requirements.

6. When the bus voltages are at acceptable levels, start adding process control modules.

Table 4-2. Typical Unloaded DC Bus Output Voltage Requirements

5 VDC		24 VDC		+15 VDC		-15 VDC	
Min	Max	Min	Max	Min	Max	Min	Max
5.1	5.25	25.5	27	15	15.75	-15	-15.75

7. Continue adding process control modules until the system cabinet is filled.

8. Measure the voltages when the system cabinet is filled and verify that they are within the acceptable levels in Step 5. Refer to Table 1-4 for power module outputs under load.

> **NOTE:** A red status light at this point may indicate an overload condition or defective module. If this happens, replace the suspect power module. If the condition still exists, add power modules to meet the system current requirements. Use the procedures in Appendix B to size the power system.

9. For optimum cooling, put blank faceplate (Bailey Controls part number 6636586_1) in any unused slots.

SECTION 5 - TROUBLESHOOTING

INTRODUCTION

The flowchart in Figure 5-1 represents basic troubleshooting procedures. They are not intended to be all encompassing. For step-by-step details, refer to the supportive text.

TROUBLESHOOTING DC MODULAR POWER SYSTEMS

Most power system problems cause a bad status flag at the operator interface. This appears as an **S** on the system status display of an operator interface station or management command system. Additionally, LED indicators on the bus monitor and DC transfer modules become red. The LED on the power supply module will blink green when the five VDC or 24 VDC circuits overload. It turns red if the 15 VDC circuits overload, if one or more outputs fail, or if module temperature goes beyond acceptable levels. Additionally, user alarm outputs are activated if a low bus voltage or other power system problem occurs.

Follow the steps below if bad status is detected:

1. Check the LED indicators on the DC transfer and bus monitor modules.

2. If the DC transfer module status LED is red, the module has failed and must be replaced. A defective DC transfer module may cause the bus monitor module to show bad status.

> **NOTE:** Refer to Section 7 for details on module removal and replacement.

3. If the bus monitor module status LED is red, the module has failed and must be replaced.

4. If both module LEDs are green, check the line 1 and line 2 LEDs on the DC transfer module.

5. If either of these LEDs is red, this means a loss of DC input power, or bad quality.

6. Verify that the circuit breakers are in the ON position.

7. If circuit breakers are on and the line LEDs are still red, the power entry panel has failed. Replace the power entry panel.

8. If all DC transfer module LEDs are green, look at the bus monitor module LEDs.

9. If bus monitor module status LED is red, the module has failed and must be replaced. If it is green, proceed.

10. If the system status LED is red, measure the bus voltages at the test jacks (on the module front panel).

11. If the measurements made in Step 10 are good, look at the power supply module status LEDs. If one or more are blinking green or red, an overload condition may exist.

12. Install additional power supply modules.

13. Check power supply modules that had blinking green or red LEDs. If they are still blinking green or red, they have failed. Install a good power module, then remove the faulty module.

14. If the system status LED is red, bus voltages are good and there are no red or blinking green LEDs on the power supply modules, the problem is in the external inputs being monitored by the bus monitor module.

15. If user external power supply voltages are being monitored at the AUX bus monitor inputs to the power entry panel, verify the jumper settings on the bus monitor module are correctly set for the voltage levels being monitored (refer to Table 3-3 for jumper settings).

16. If switch settings are okay, measure the voltages between TB2-1 and TB2-2 or TB2-3 and TB2-4 on the power entry panel. Voltages should be:

Greater than 22.2 VDC if set for 24 VDC

Greater than 44.2 VDC if set for 48 VDC

If the voltages are correct, there is a problem in one of the auxiliary status inputs (STATUS IN) at terminal block TB1 on the power entry panel.

17. Measure the voltage from terminal 1 and terminal 3 with respect to terminal 2 of TB1. The voltage measured at these terminals will depend on how J4 and J5 are set on the bus monitor module. If J4 and J5 are set for normally open (NO) status input and the voltage measures greater than 0.7 VDC, the input status is bad. If J4 and J5 are set for normally closed (NC) status input and the voltage measures less than 3.5 VDC, the input status is bad. To verify the external device causing the bad status, remove the suspect input wire. The SYSTEM STATUS LED should turn green if the external device was pulling the input low or high.

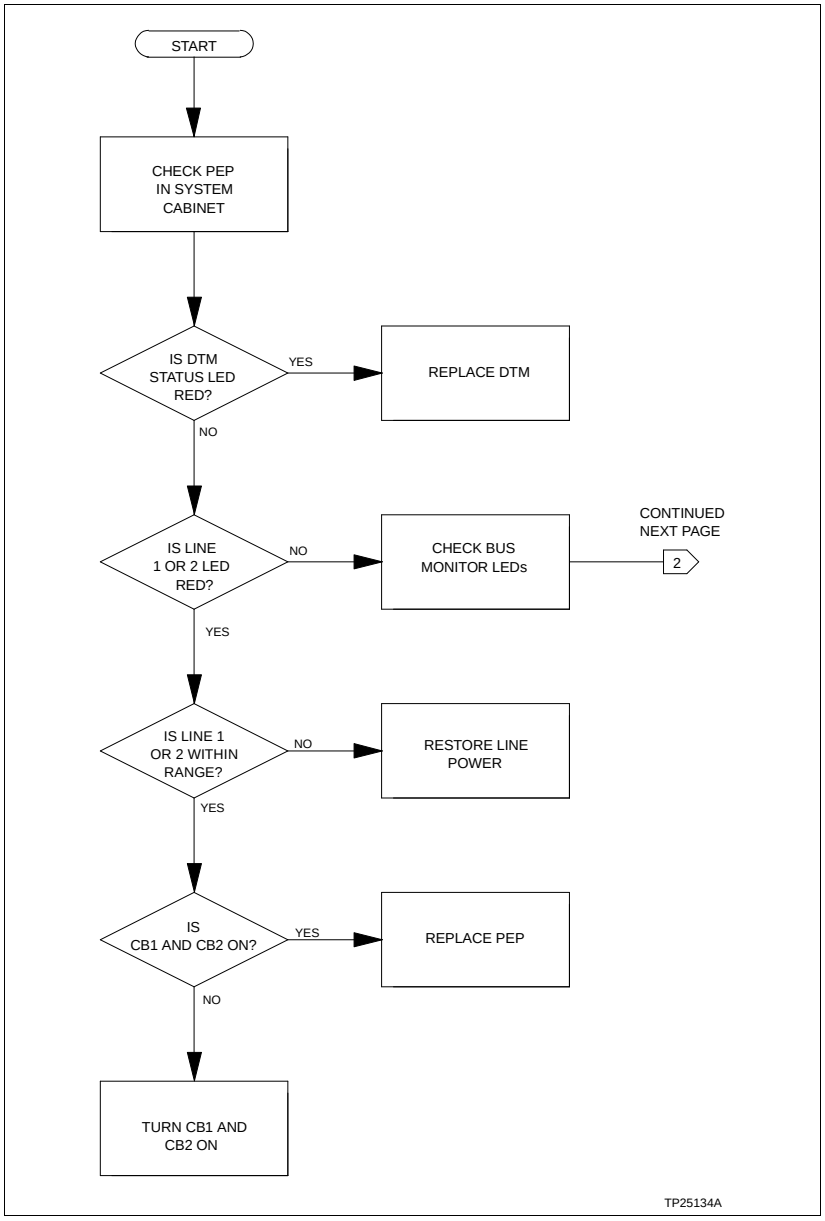

Figure 5-1. Troubleshooting Flowchart, DC Modular Power Systems

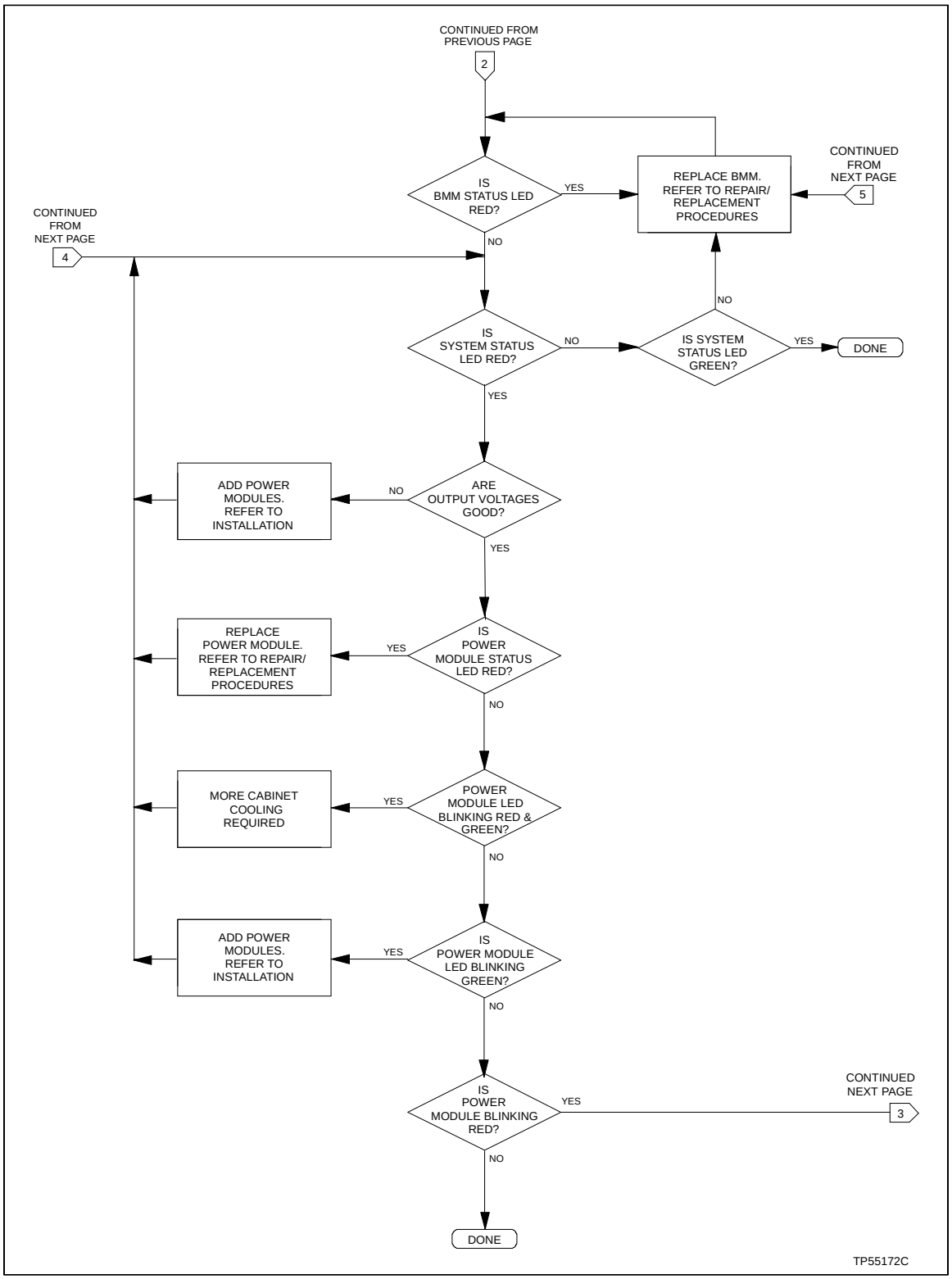

Figure 5-1. Troubleshooting Flowchart, DC Modular Power Systems (continued)

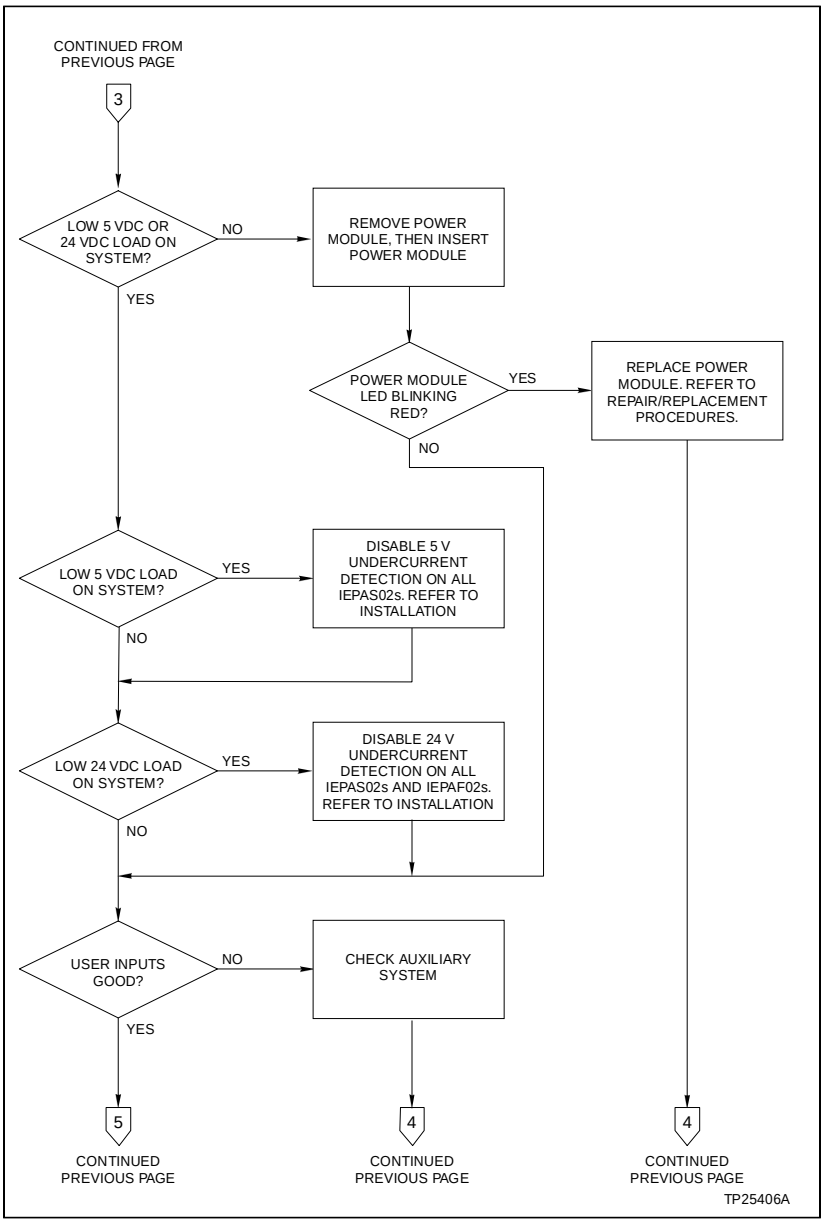

Figure 5-1. Troubleshooting Flowchart, DC Modular Power Systems (continued)

SECTION 6 - MAINTENANCE

INTRODUCTION

WARNING	**There are exposed DC connections inside the cabinet. These exposed electrical connections present a shock hazard that can cause injury or death.**
AVERTISSEMENT	**Cette armoire comporte des connexions c.c. dénudées. Ces connexions électriques présentent un danger d'électrocution pouvant entraîner des blessures ou la mort.**

WARNING	**Never clean electrical parts or components with the power on. Doing so exposes you to a fatal electrical shock hazard.**
AVERTISSEMENT	**Il ne faut jamais nettoyer des pièces ou des composants électriques lorsqu'ils sont sous tension. Ceci présente un risque d'électrocution fatale.**

WARNING	**If input or output circuits are a shock hazard after disconnecting system power at the power entry panel, then the door of the cabinet containing these externally powered circuits must be marked with a warning stating that multiple power sources exist.**
AVERTISSEMENT	**Si des circuits d'entrée ou de sortie sont alimentés à partir de sources externes, ils présentent un risque de choc électrique même lorsque l'alimentation du système est débranchée du panneau d'entrée l'alimentation. Le cas échéant, un avertissement signalant la présence de sources d'alimentation multiples doit être apposé sur la porte de l'armoire.**

WARNING	**Wear eye protection whenever working with cleaning solvents. When removing solvents from printed circuit boards using compressed air, injury to the eyes could result from splashing solvent as it is blown off the printed circuit board.**
AVERTISSEMENT	**Portez toujours des lunettes de protection lorsque vous utilisez des solvants de nettoyage. L'air comprimé servant à enlever le solvant des cartes de circuits imprimés provoque des élaboussures qui risquent d'atteindre les yeux.**

This section contains a modular power system preventive maintenance schedule and procedures. Doing the preventive maintenance procedures as scheduled maintains good, dependable modular power system operation.

This section presents procedures that the customer should be able to perform on site. These preventive maintenance procedures should be used as a guideline to assist in establishing good preventive maintenance practices. Select the minimum steps required to meet the cleaning needs of your system.

Personnel performing preventive maintenance should meet the following qualifications.

- Maintenance personnel should be qualified electrical technicians or engineers that know the proper use of test equipment such as digital multimeters.

- Maintenance personnel should be familiar with the INFI 90 modular power system, have experience working with process control systems, and know what precautions to take when working on live DC systems.

PREVENTIVE MAINTENANCE SCHEDULE

Table 6-1 is the preventive maintenance schedule and check list for the modular power system. The table lists the preventive maintenance tasks in groups according to their specified maintenance interval. Some tasks in Table 6-1 are self explanatory. Instructions for tasks that require further explanation are covered under ***PREVENTIVE MAINTENANCE PROCEDURES***.

NOTE: The preventive maintenance schedule list is for general purposes only. Your application may require special attention.

Table 6-1. Preventive Maintenance Schedule

Preventive Maintenance Task	Frequency
Check the cabinet air filters. Clean or replace them as necessary. Check the air filter more frequently in excessively dirty environments. Refer to procedure.	3 months
Check cabinet for dust. Clean as necessary using an antistatic vacuum.	
Check all signal, power and ground connections within the cabinet and verify that they are secure. Refer to procedure.	
Check modular power supply outputs. Refer to procedure.	6 months
Do a visual inspection of the fan assembly. Verify that all fans are rotating and replace if necessary.	
Check the quality of the plant power and grounding system. Follow the power and grounding system verification procedures in the INFI 90 site preparation and planning instruction.	12 months
Inspect all control, I/O, and power modules, giving particular attention to power supply contacts and heat sinks. Clean as necessary. Refer to procedure.	
Inspect and check the power entry panel. In high vibration environments inspection may be necessary at shorter intervals. Refer to procedure.	2 years
Complete all checks and inspections in this table. Replacement tasks should be done at the scheduled frequency.	Shutdown

EQUIPMENT REQUIRED

Listed are tools and equipment required for the maintenance procedures.

- Antistatic vacuum.
- Digital multimeter.
- Flathead torque screwdriver (Newton-meters (inch-pounds)).
- Four-inch flathead screwdriver.
- 16-inch flathead screwdriver.
- Isopropyl alcohol (99.5 percent electronic grade).
- Foam tipped swab.
- Eberhard Faber (400A) pink pearl eraser.
- Fiberglass burnishing brush.
- Lint-free cloths.
- Small needle nose pliers.

PREVENTIVE MAINTENANCE PROCEDURES

This section covers tasks from Table 6-1 (preventive maintenance schedule) that require specific instructions or further explanation. The tasks and instructions covered are:

- Cabinet air filter cleaning or replacement.
- How to check signal, power and ground connections.
- Checking modular power supply outputs.
- The power entry panel preventive maintenance procedure.
- Specific instructions on cleaning printed circuit boards and edge connectors.

Refer to Section 7 for instructions on how to replace the fan assembly.

Cabinet Filter Cleaning/Replacement

The cabinet air filter mounts over the lower air vent, inside the cabinet front door. To replace the air filter:

1. Use a flathead screwdriver to remove 1 screw securing the mounting plate at the top of the air filter mounting bracket.

2. Pull the mounting bracket (and air filter) off the cabinet door.

3. Remove the air filter from its mounting bracket.

4. Either clean or replace the air filter. To clean the filter:

   a. If the air filter stays dry and relatively clean, use compressed air to blow dust and dirt free from the filter.

   b. Clean dirty filter in water and a mild detergent (i.e., dish washing soap). Agitate the filter or squeeze the soapy water through the filter to remove built-up dirt.

   c. When the filter is clean, rinse the filter thoroughly with water.

   d. Air dry the filter before replacing it.

5. Wipe any dust or dirt from the mounting bracket.

6. Return the dry filter to its mounting bracket.

7. Place the mounting bracket into position on cabinet door and tighten the screw that holds the mounting plate over the air filter mounting bracket.

Checking Connections

NOTE: Power to the cabinet should be off while performing this preventive maintenance task.

Check all signal wiring, power and ground connections within the cabinet to verify their integrity. When checking connections, always turn a screw, nut or other fastening device in the direction to tighten only. If the connection is loose, it will be tightened. If the connection is tight, the tightening action will verify that it is secure. There must not be any motion done to loosen the connection.

1. Check and verify that all positive and negative input, and grounding conductor connections on the power entry panel are secure.

2. Check and verify that all other power connections within the cabinet, including bus bars and connections to the power supplies are secure.

3. Check and verify that all field wiring connections to the termination units or termination modules are secure.

Checking Power Module Outputs

There are test jacks on the bus monitor module for checking bus voltages on IEPEP04 power entry panel systems. Appendix C contains complete modular power system wiring diagrams.

1. Verify all power module status LEDs are green.

2. If any of the status LEDs are not green, go to Section 5 to troubleshoot and correct the problem before proceeding.

3. Measure the bus voltages at the test jacks on the bus monitor module. This test should be done with the system loaded.

4. Use a digital voltmeter to measure 5 VDC and ±15 VDC with respect to DC common.

5. Measure 24 VDC with respect to I/O common using a voltmeter.

6. The measured voltages should be within the specifications under module voltage requirements in Table 1-4.

7. If the module bus voltages are not within specification, verify that the system is properly sized. Refer to Appendix B for the power system sizing procedure.

Power Entry Panel Inspection and Check

This procedure applies to IEPEP04 power entry panel. The system must be shut down to perform this maintenance task.

NOTE: Removal of the power entry panel may require two people.

1. Turn off power at the external circuit breakers that feed power to the power entry panel.

2. Use the 4-inch screwdriver to disconnect all wires and cables from the rear of the power entry panel. Label the wires according to their terminal assignments.

3. Use the 16-inch flathead screwdriver to remove the 4 screws (2 on each side) that hold the power entry panel in position.

4. Remove the power entry panel by sliding it out the back of the cabinet.

5. Remove the top cover from the power entry panel by removing the 3 screws securing it at the rear of the power entry panel.

6. Check the tightness of all power wiring screws within the power entry panel. Torque all No. 6 screws to 0.90 Nm (8 in-lbs). Torque all No. 8 screws to 1.58 Nm (14 in-lbs).

7. Inspect and clean the power entry panel, DC transfer module and bus monitor module.

8. Replace the power entry panel top cover and install the power entry panel.

9. Connect all wires and cables removed from the power entry panel.

Printed Circuit Board Cleaning

There are several circuit board cleaning procedures in this section. These procedures cover circuit board cleaning and washing, cleaning edge connectors and circuit board laminate between edge connectors. Use the procedures that meet the needs of each circuit board. Remove all dust, dirt, oil, corrosion or any other contaminant from the circuit board.

Do all cleaning and handling of the printed circuit boards at static safe work stations. Always observe the steps under ***Special Handling*** in Section 3 of this instruction when handling printed circuit boards.

GENERAL CLEANING AND WASHING

If the printed circuit board needs minor cleaning:

Remove dust and residue from the printed circuit board surface using clean, dry, filtered compressed air or an antistatic field service vacuum cleaner.

To wash the printed circuit board:

1. Clean the printed circuit board by spraying or wiping it with isopropyl alcohol (99.5% electronic grade). Use a foam tipped swab to wipe the circuit board.

2. Remove excess solvent by using compressed air to blow it free of the circuit board.

EDGE CONNECTOR CLEANING

To clean edge connector contacts:

1. Use a solvent mixture of 80% isopropyl alcohol (99.5% electronic grade) and 20% distilled water.

2. Soak a lint-free cloth with the solvent mixture.

3. Work the cloth back and forth parallel to the edge connector contacts.

4. Repeat with a clean cloth that is soaked with the solvent mixture.

5. Dry the edge connector contact area by wiping with a clean lint-free cloth.

To clean tarnished or deeply stained edge connector contacts:

1. Use an Eberhard Faber (400A) pink pearl eraser, or equivalent to remove tarnish or stains. Fiberglass or nylon burnishing brushes may be used also.

2. Minimize ESD by using the 80/20 isopropyl alcohol and water solution during burnishing.

3. Do not use excessive force while burnishing. Use only enough force to shine the contact surface. Inspect the edge connector after cleaning to assure no loss of contact surface.

4. Wipe clean with a lint-free cloth.

SECTION 7 - REPAIR/REPLACEMENT PROCEDURES

INTRODUCTION

Although the modular power system is designed to give long, trouble-free service, some components may need to be replaced periodically. This section explains the procedures for replacement and lists recommended spare parts.

SPARE PARTS

Table 7-1 lists a description and Bailey part number of spare parts that can be kept on-site. It is impractical to specify a recommended quantity of spare parts because Bailey Controls custom designs every system. Contact Bailey Controls Company if you need help determining the quantity of spare parts to keep on hand for your particular system.

Table 7-1. Spare Parts Numbers and Description

Nomenclature/ Part Number	Description	Remarks
194776_12001 194776_15001	Fuse 2 A slo blo Fuse 5 A slo blo	Used in IEFAN05 (48 VDC) Used in IEFAN03 (24 VDC)
1948502_0340	Cable	Connects I/O expander bus from MMU to MMU
1948529_1	Insulated quick connect receptacle	For covering unused tabs on bus bars
1948714_11002	Fuse 10 A/125 V fast-act	Used in IEPDS01, IEPDF01
1948714_15001	Fuse 5 A/125 V fast-act	Used in IEPDS02, IEPDF02
6637827_1	DC transfer module	Used in IEPEP04
6637830C1[1]	Bus monitor module	Used in IEPEP04
IEFAN03 IEFAN05	Fan	24 VDC input 48 VDC input
IEPDF01 IEPDF02	DC field power module	24 VDC input 48 VDC input
IEPDS01 IEPDS02	DC system power module	24 VDC input 48 VDC input
IEPEP04	Power entry panel	Redundant 24/48 VDC inputs with circuit breakers

NOTE:
1. The bus monitor module must be revision level C or higher to work with the IEPEP04 power entry panel.

DC TRANSFER MODULE REPLACEMENT

NOTE: The DC transfer module can be removed under power. After the DC transfer module is removed, the system will maintain the last transfer state. No input power transfer will be possible until a functional DC transfer module is restored to the system.

To replace the DC transfer module:

1. Turn the 2 latching thrumbscrews on the faceplate and release the DC transfer module.

2. Grasp the module by the faceplate and pull the module out of its mounting slot.

3. Set jumpers J1 through J4 and J13 to match the jumper settings on the DC transfer module just removed.

4. Insert the replacement DC transfer module. Grasp it by the faceplate. Align the top and bottom edges of the circuit board with the guides in the panel.

5. Hold the module by the faceplate and slide it into the slot; push until the rear edges are firmly seated in the backplane connectors.

6. Turn the 2 latching screws ½-turn to lock the module in place.

BUS MONITOR MODULE REPLACEMENT

NOTE: The bus monitor module can be removed under power. Replace with another bus monitor module as soon as possible.

To replace the bus monitor module:

1. Turn the 2 latching thrumbscrews on the faceplate and release the bus monitor module.

2. Grasp the module by the faceplate and pull the module out of its mounting slot.

3. Set jumpers J1 through J7 to match the jumper settings on the bus monitor module just removed.

4. Align the top and bottom edges of the replacement bus monitor circuit board with the guides in the panel.

5. Hold the module by the faceplate and slide it into the slot; push until the rear edges are firmly seated in the backplane connectors.

6. Turn the 2 latching screws ½-turn to lock the module in place.

FAN ASSEMBLY REPLACEMENT

Fuse

To replace a fan assembly fuse:

1. Unplug fan assembly.

2. Remove fuseholder cover.

3. Remove fuse from fuseholder.

4. Replace with identically rated fuse (e.g., 5 A slow blo fuse for IEFAN03 (24 VDC) or 2 A slow blo fuse for IEFAN05 (48 VDC)).

Fan Assembly

To replace the fan assembly:

1. Unplug fan assembly.

2. Remove the 4 screws that attach the assembly to the cabinet frame.

3. Gently slide the assembly out. Be careful not to disturb other cabinet wiring.

4. Verify that replacement assembly is the same rating as the one just removed.

5. Slide replacement assembly in.

6. Secure with the 4 screws.

7. Plug power cord into power entry panel.

8. Do a visual inspection of the fan assembly and verify that all fans are rotating.

POWER MODULE REPLACEMENT

The DC power modules can be removed under power. Always insert a replacement power module before removing a power module.

Power Module

To replace a power module:

1. Set the jumper settings on the replacement power module.

2. Grasp the replacement module by its faceplate handle.

3. Align the top and bottom edges of the circuit board with the guides of its slot in the power mounting unit or module mounting unit.

4. Hold the module by the faceplate handle and slide it into the slot; push until the rear edges are firmly seated in the backplane connectors.

5. Firmly press the module handle while using a flathead screwdriver to push and turn the 2 concentric screws ½-turn clockwise to lock the module in place.

6. Verify the status LED turns green.

7. Use a flathead screwdriver to turn the 2 concentric screws ½-turn in either direction on the power module being replaced.

WARNING	**Handle the module by surfaces other than the heat sink. The heat sink may be hot and may cause severe burns.**
AVERTISSEMENT	**Le module diot être manipulé à l'aide de surfaces autres que le dissipatour thermique. Ce dernier resque d'être chaud et de provoquer des brûlures sérieuses.**

WARNING	**Allow five seconds for the line filter capacitors to discharge before handling the module after removal. Failure to do so could result in severe or fatal shock.**
AVERTISSEMENT	**Aprés avoir retiré le module, laissez les condensateurs de filtres antiparasites se décharger pendant cinq secondes avant de manipuler celui-ci, afin d'éviter les chocs sérieux et même mortels.**

8. Grasp the faceplate handle and partially pull out the module.

9. Allow at least 5 seconds for the line filter capacitors to discharge then remove it completely from power mounting unit or module mounting unit.

Fuse

Do the steps under ***POWER MODULE REPLACEMENT*** to remove the power module from its mounting unit. To replace the power module fuse:

1. Lay the module on an antistatic mat.

2. Locate fuse F1 (at the rear of the module by P1 edge connector). See Figure 3-5.

3. Use a fuse removal tool to extract fuse F1.

4. Insert a new 10 A, 125 V fast-acting fuse for 24 VDC input, or a 5 A, 125 V fast-acting fuse for 48 VDC input.

5. To install the power module after changing its fuse, repeat the steps under ***POWER MODULE REPLACEMENT***.

POWER ENTRY PANEL REPLACEMENT

WARNING	**Verify the main power and power entry panel circuit breakers are turned off before starting installation, retrofit, upgrade, or wiring procedures. Failure to do so could result in severe or fatal shock. Do not turn the power on until the installation, retrofit, upgrade, or wiring procedures are complete.**
AVERTISSEMENT	**Assurez-vous que le disjoncteur d'alimentation principal et le disjoncteur de panneau d'entrée des alimentatoins sont éteints avant de procéder à l'installation, à la mise jour, à l'extension ou au câblage, dans le but d'éviter les chocs sérieux et même mortels. Ne rétablissez pas l'alimentation tant que ces procédures ne sont pas terminées.**

If the power entry panel needs replacement, follow these steps:

1. Turn off power to the cabinet at the DC power source.

2. Open the rear door of the cabinet to gain access to the rear of the power entry panel.

3. Remove all wiring from the power entry panel. Label the wires as you remove them.

4. From the rear of the cabinet, use a 16-inch flathead screwdriver to remove the 4 mounting screws.

5. Pull the power entry panel out of the cabinet.

6. From the rear of the cabinet, insert the replacement power entry panel in the same mounting space.

7. Secure the power entry panel in the cabinet with the 4 mounting screws.

8. With power entry panel circuit breakers off, connect the wiring that was removed in Step 3. Appendix C contains power entry panel wiring diagrams.

9. Set the jumpers on the DC transfer module for the desired operation.

10. Set the jumpers and dipswitch on the bus monitor module for the desired operation.

11. Turn on the power to the power entry panel at the DC source.

12. Turn on the power to the cabinet at the power entry panel circuit breakers and check for proper operation.

SECTION 8 - SUPPORT SUERVICES

INTRODUCTION

Bailey Controls is ready to help in the use and repair of its products. Contact your nearest sales office to make requests for sales, applications, installation, repair, overhaul and maintenance contract services.

REPLACEMENT PARTS AND ORDERING INFORMATION

When making repairs at your facility, order replacement parts from a Bailey sales office. Provide this information:

1. Part description, part number and quantity.

2. Model and serial numbers (if applicable).

3. Bailey Controls instruction manual number, page number and reference figure that identifies the part.

When you order standard parts, use Bailey Controls part numbers and descriptions (refer to Table 7-1). Order parts without commercial descriptions from the nearest Bailey Controls sales office.

TRAINING

Bailey Controls has a modern training facility that provides service and repair instruction. On-site training is also available. Contact a Bailey Controls sales office for specific information and scheduling.

TECHNICAL DOCUMENTATION

Obtain additional copies of this manual from the nearest Bailey sales office at a reasonable charge.

APPENDIX A - QUICK REFERENCE MATERIAL

INTRODUCTION

Use Table A-1 as a quick reference to check switch and jumper settings on the, IEPDF01, IEPDF02, IEPDS01 and IEPDS02 modules, bus monitor module, and DC transfer module. Figures 3-3, 3-4, and 3-5 show DC transfer module, bus monitor module, and power module board layout.

Table A-1. Switch and Jumper Setting Reference Guide

Device	Dipswitch Settings	Jumper Position	Function
Bus monitor module	S1-0011		Factory default setting, 5 VDC, ±15 VDC, and 24 VDC monitoring enabled. External power monitoring disabled.
		J1 1-2 2-4 2-3	**Auxiliary bus monitor, channel 1:** Selects 24 VDC external power Selects 48 VDC external power Selects 125 VDC external power
		J2 1-2 2-4 2-3	**Auxiliary bus monitor, channel 2:** Selects 24 VDC external power Selects 48 VDC external power Selects 125 VDC external power
		J3 2-3	Jumper must be installed in this position
		J4 1-2 2-3 3-4	**Auxiliary status input 1:** Normally open status input Normally closed status input PFI (NO)
		J5 1-2 2-3	**Auxiliary status input 2:** Normally open status input Normally closed input
		J6 1-2 2-3	**Input power isolation:** Do not isolate input power Isolate input power
		J7 2-3	Jumper must be installed in this position
		J8 [1] 1-2 2-3	**Input common isolation:** Isolate input common from output common Do not isolate input common from output common
DC transfer module		**J1** 1-4 2-4	**Input power, line 1:** 24 VDC high detect 48 VDC high detect
		J2 1-4 2-4	**Input power, line 1:** 24 VDC low detect 48 VDC low detect

Table A-1. Switch and Jumper Setting Reference Guide (continued)

Device	Dipswitch Settings	Jumper Position	Function
DC transfer module (cont.)		**J3** 1-4 2-4	**Input power, line 2:** 24 VDC high detect 48 VDC high detect
		J4 1-4 2-4	**Input power, line 2:** 24 VDC low detect 48 VDC low detect
		J13 1-2 2-3	**Input power source:** 48 VDC 24 VDC
All power modules		**J2** A B	 Enable 5 VDC, ±15 VDC, and 24 VDC monitoring Disable ±15 VDC monitoring
		J3 A B	 IEPDS01/02 power module IEPDF01/02 power module

NOTE:

1. Jumpers J6 and J8 must have corresponding settings (i.e., both set for isolation or no isolation).

APPENDIX B - MODULE POWER REQUIREMENTS

INTRODUCTION

This section lists the power requirements of INFI 90 modules, and termination unit and modules. Use this information to calculate the 5 VDC, ±15 VDC and 24 VDC module current requirements for each INFI 90 cabinet. The procedure for calculating current requirements includes a worksheet for calculating system powered I/O current requirements.

After you calculate the current requirements for each cabinet, calculate the number of modular power supplies needed for each cabinet by following the instructions under ***SIZING THE MODULAR POWER SYSTEM***. Appendix D provides tables that allow you to bypass the power system sizing calculations in this section. Finally, there is a procedure to verify that the total current draw of the power cabinet is within the power entry panel specifications.

CALCULATING CURRENT REQUIREMENTS

Tables B-1 and B-2 contain a list of all INFI 90 modules, termination units and modules and their operating current requirements. Use Table B-3 to calculate system powered I/O current requirements. To use the information in these tables:

> **NOTE:** Current consumption values listed in the tables apply to one module. Multiply the value of current consumption per module by the number of those modules in the cabinet. For example, if a cabinet contains four IMASI02 modules, the total 5 VDC current consumption of these modules is 4 x 85 mA = 340 mA.

1. Make a list of modules contained in the cabinet you are sizing for modular power supplies.

2. Calculate the 5 VDC current requirement for each cabinet.

   a. Refer to Table B-1 for the 5 VDC current requirement of each module.

   b. Total the 5 VDC current requirement per cabinet.

3. Calculate the +15 VDC current requirement for each cabinet.

   a. Refer to Table B-1 for the +15 VDC current requirement of each module.

   b. Total the +15 VDC current requirement per cabinet.

4. Calculate the -15 VDC current requirement for each cabinet.

   a. Refer to Table B-1 for the -15 VDC current requirement of each module.

   b. Total the -15 VDC current requirement per cabinet.

5. Calculate the 24 VDC current requirement.

   a. Refer to Table B-1 for the 24 VDC current requirement for each module.

   b. Table B-2 lists 24 VDC current requirements of termination units and termination modules.

   c. Total the 24 VDC current requirement per cabinet.

6. Add the current requirement of any system powered I/O using 24 VDC to the total from Step 5c. The procedure under ***CALCULATING I/O CURRENT REQUIREMENTS*** gives an overview of how to calculate the system powered I/O current requirement.

Table B-1. DC Current Consumption for INFI 90 Modules

INFI 90 Modules	No. of Modules/ Cabinet	Current Consumption per Module (mA)							
		5 V	Total 5 V	+15 V	Total +15 V	-15 V	Total -15 V	24 V	Total 24 V
IISAC01		0		0		0		530	
IMAMM03		725		125		30		0	
IMAOM01		1045		0		0		0	
IMASI02		95		30		25		0	
IMASI03		330		140		40		0	
IMASM01		120		85		45		0	
IMASM02 IMASM03		400		80		40		6	
IMASM04		550		45		30		0	
IMASO01		530		220		225		50	
IMCIS02		300		30		25		7	
IMCOM03 IMCOM04		660		55		50		7	
IMCPM01		0		0		0		0	
IMCPM02		825		0		0		0	
IMDSI02		60		0		0		0	
IMDSM04		1500		0		0		65	
IMDSM05		600		0		0		0	
Page total									

Table B-1. DC Current Consumption for INFI 90 Modules (continued)

INFI 90 Modules	No. of Modules/ Cabinet	Current Consumption per Module (mA)							
		5 V	Total 5 V	+15 V	Total +15 V	-15 V	Total -15 V	24 V	Total 24 V
IMDSO01 IMDSO02 IMDSO03		150		0		0		0	
IMDSO04		165		0		0		0	
IMFBS01		100		30		20		0	
IMFCS01		220		7		10		0	
IMHSS01 IMHSS02		180		80		70		20	
IMLMM02		660		0		0		0	
IMMFC03		4200		40		20		0	
IMMFC04		1400		0		0		0	
IMMFC05		1000		0		0		0	
IMMFP01 IMMFP02		2000		0		0		0	
IMMFP03		2000		0		0		0	
IMMPC01		4200		40		20		0	
IMMPI01		415		0		0		0	
IMMPI02		700		0		0		0	
IMQRC01		660		55		50		7	
IMQRS01 IMQRS02		300		30		25		7	
IMRIO02		1600		20		90		0	
IMSPM01		1330		30		25		0	
INBIM01 INBIM02 INBTM01		1100		0		0		0	
INICT01		4200		40		20		0	
INICT03		1958		0		0		0	
INIIT01		4200		40		20		0	
INIIT02 INIIT03		2000		0		0		0	
INIPT01		4200		40		20		0	
INLIM03		2200		90		90		0	
INNIS01		900		5		200		0	
INNPM01		2000		0		0		0	
Page total									

Table B-1. DC Current Consumption for INFI 90 Modules (continued)

INFI 90 Modules	No. of Modules/ Cabinet	Current Consumption per Module (mA)							
		5 V	Total 5 V	+15 V	Total +15 V	-15 V	Total -15 V	24 V	Total 24 V
INPCT01/ INPPT01		4200		40		20		0	
INPTM01		1100		0		0		0	
INSIM01		1500		30		25		0	
NCTM01		1500		0		0		0	
NDCS03		0		0		0		510	
NDIS01		0		0		0		360	
NDLS02		0		0		0		320	
NLIS01		900		5		200		0	
NLSM01 NLSM02		4200		40		20		0	
NMFC01 NMFC02		4600		40		20			
NSBM01		1000		0		0		0	
NSSM01		4200		40		20		0	
Page total									
Cabinet total									

Table B-2. 24 VDC Current Consumption of Termination Units and Modules

Termination Unit/ Module	TU/TMs Using System Power per Cabinet	24 VDC Current Consumption per TU/TM (mA)	24 VDC TU/TM Current Consumption per Cabinet
NTCL01, NICL01		40	
NTDO02		90	
NTFB01		65	
NTMF01, NIMF01, NIMF02		130	
NTMP01, NIMP01, NIMP02		230	
NTRL03, NIRL01, NIRL02, NIRL03		130	
NTRL02		190	
Total			

CALCULATING I/O CURRENT REQUIREMENTS

The total current requirements of system powered analog inputs, analog outputs, digital inputs, and digital outputs make up the system powered I/O current requirements. Fill in column two of Table B-3, then multiply it by column three (quantity of inputs or outputs times the current per input or

Table B-3. System Powered I/O Current Consumption

Type of Input/Output	Number of Inputs/ Outputs	Current Consumption per Input/Output (mA)	Total Current Consumption for System Power I/O
Analog outputs		20	
Analog inputs		20	
Digital inputs		5	
Digital outputs		See note	
Total I/O current consumption			

NOTE: Use the typical current requirements of your particular digital outputs.

output). For digital outputs, specify the current requirements for the digital outputs in your system. Complete the calculation to determine the current requirements by filling in all five rows as necessary then totaling the current requirements in column four.

SIZING THE MODULAR POWER SYSTEM

The following text and equations explain how to calculate the number of power supply modules needed for a particular system.

Overall power requirements for 5 VDC, ±15 VDC, and 24 VDC power are calculated by adding the individual module current requirements. Refer to product specifications for current requirements of modules not listed.

The combined 5 VDC and 24 VDC current output of any PDS module should not exceed 102 watts (see Figure B-1). Use the following procedure when sizing the modular power system to assure that the PDS module operates within its power range.

For Systems with IEPDS01 or IEPDS02 Power Modules Only

Let:

A = total 5 VDC current requirements for system cabinet

B = total 24 VDC current requirements for associated I/O

C = total +15 VDC current requirements for system cabinet

D = total -15 VDC current requirements for system cabinet

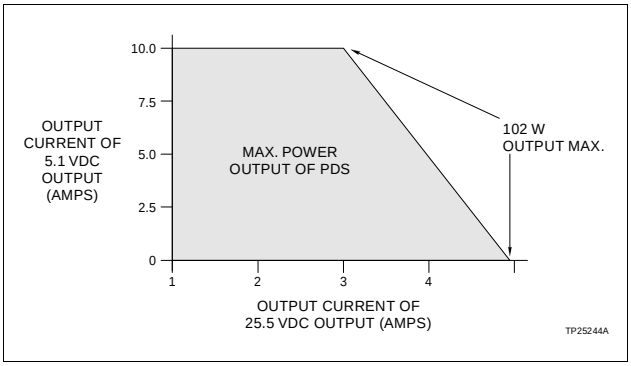

Figure B-1. Power Output of One IEPDS01/02 Module

Q1 = number of PDS power modules needed to meet 5 and 24 VDC current requirements

Q2 = number of PDS power modules needed to meet +15 VDC current requirements

Q3 = number of PDS power modules needed to meet -15 VDC current requirements

QS = the largest value of Q1, Q2 or Q3

QS(N) = number of PDS power modules needed to power the system

QS(N+1) = number of modules needed for N+1 redundancy, add 1 to the value of QS(N)

The following equations should be used when sizing systems having only PDS supplies.

If $B \geq A/5$ then $Q1 = (A/20) + (B/4)$

If $B < A/5$ then $Q1 = A/10$

$Q2 = C/0.5$

$Q3 = D/0.5$

QS = largest value of Q1, Q2 and Q3

QS(N) = value of QS rounded to the next highest integer = number of PDS power modules required

QS(N+1) = if using N+1 redundancy, add 1 to the value of QS(N)

NOTE: The tables in Appendix D contain calculated values of Q1, Q2 and Q3 for various load combinations. These tables enable you to size the modular power system without doing the sizing calculations.

System Calculation Example Using IEPDS01 or IEPDS02 Power Modules Only

Assume that the current requirements for a set of modules residing in a system cabinet have been calculated.

Additionally, the current requirements for 24 VDC I/O power were calculated. The results are:

A = 26.5 amps (5 VDC cabinet requirement)

B = 3.1 amps (24 VDC I/O power requirement)

C = 0.9 amps (+15 VDC cabinet requirement)

D = 0.4 amps (-15 VDC cabinet requirement)

Substitute these values into the equations and solve for Q.

Q1 = (26.5/10) because B = 3.1 which is less than A/5 = 26.5/5 = 5.3
Q1 = 2.65

Q2 = 0.9/0.5
Q2 = 1.8

Q3 = 0.4/0.5
Q3 = 0.8

QS = Largest value of Q1, Q2 and Q3
QS = 2.65

Round the value of QS to the next highest integer. This is the number of PDS power modules required to power the system.

QS(N) = 3 PDS modules

With N+1 redundancy

QS(N+1) = QS(N) + 1 = 4 PDS modules

For Systems Using Both IEPDS01 and IEPDF01, or IEPDS02 and IEPDF02 Power Modules

Let:

A = total 5 VDC current requirements for system cabinet

B = total 24 VDC current requirements for associated I/O

C = total +15 VDC current requirements for system cabinet

D = total -15 VDC current requirement for system cabinet

Q1 = number of PDS power modules needed to meet 5 VDC requirements

Q2 = number of PDS power modules needed to meet +15 VDC current requirements

Q3 = number of PDS power modules needed to meet -15 VDC current requirements

Q4 = number of PDF power modules needed to meet 24 VDC current requirements

QS = the largest value of Q1, Q2 and Q3

QS(N) = number of PDS power modules needed to power the system

QF = calculated number of PDF power modules needed to meet associated I/O current requirements

QF(N) = number of PDF power modules needed to meet associated I/O current requirements

QS(N+1) = number of modules needed for N+1 redudancy, add 1 to the value of QS(N)

The following equations should be used when sizing systems having both PDS and PDF supplies.

$Q1 = \sqrt{A \times B/80 + A^2/1600} + A/40$
If (Q1 - A/10) < 0 then use Q1 = A/10

Q2 = C/0.5

Q3 = D/0.5

QS = largest of Q1, Q2 and Q3

QS(N) = value of QS rounded to the next highest integer = number of PDS modules required

If Q1 = 0 then use QF = B/4

$QF = B \times [5/(20 - A/QS(N))] - QS(N)$

If Q1 = 0 then use QF = B/4

QF(N) = value of QF rounded to the nest highest integer = number of PDF modules required

QS(N+1) = if using N+1 redundancy, add 1 to the value of QS(N)

NOTE: The tables in Appendix D contain calculated values of Q1, Q2, Q3 and QF for various load combinations. These tables enable you to size the modular power system without doing the sizing calculations.

System Calculation Example Using IEPDS01 and IEPDF01, or IEPDS02 and IEPDF02 Power Modules

Assume that the current requirements for a set of modules residing in a system cabinet has been calculated.

Additionally, the current requirements for 24 VDC I/O power was:

A = 26.5 amps (5 VDC cabinet requirement)

B = 12 amps (24 VDC associated I/O requirement)

C = 0.9 amps (+15 VDC cabinet requirement)

D = 0.4 amps (-15 VDC cabinet requirement)

Substitute these values into the equation and solve for Q.

$$Q1 = \sqrt{(26.5 \times 12)/80 + 26.5^2/1600} + 26.5/40$$
$$Q1 = 2.76$$

Q2 = 0.9/0.5
Q2 = 1.8

Q3 = 0.4/0.5
Q3 = 0.8

QS = Largest of Q1, Q2 and Q3
QS = 2.76

Round the value of QS to the next highest integer. This is the number of PDS power modules required for system.

QS(N) = 3 PDS modules

Calculate the value of QF

QF = 12 x[5/(20 - 26.5/3)] - 3
QF = 2.37

Round the value of QF to the next highest integer. This is the number of PDF power modules required to power associated I/O current requirements.

QF(N) = 3 PDF modules

With N+1 redundancy

$$QS(N+1) = QS(N) + 1 = 4 \text{ PDS modules}$$

Power module placement is important. For optimum cooling, power modules should not be stacked at one end of the module mounting unit. See Figure 3-6 for an example of how the power modules should be positioned in the IEMMU01 and IEMMU02 module mounting units.

> **NOTE:** Place a maximum of two power supply modules in any module mounting unit, a maximum of 12 modules in any power mounting unit.

MAXIMUM POWER ENTRY PANEL CURRENT DRAW

Add the current draw of all the power modules within the cabinet to the fan assembly current draw to determine the maximum current draw on the power entry panel. The current draw of each power module is:

- IEPDF01 module, 6.5 amps.
- IEPDF02 module, 3.25 amps.
- IEPDS01 module, 7.6 amps.
- IEPDS02 module, 3.8 amps.

The current draw for each fan assembly is:

- IEFAN03 fan assembly, 1.50 amps.
- IEFAN05 fan assembly, 1.32 amps.

The current draw on the power entry panel should be within its specified limit. The current draw limit on the IEPEP04 Power Entry Panel is:

- 60 amps for 24 VDC systems.
- 30 amps for 48 VDC systems.

APPENDIX C - WIRING DIAGRAMS

INTRODUCTION

Appendix C contains system cabinet wiring diagrams for the IEMMU01 and IEMMU02 Module Mounting Unit and the IEPMU01 and IEPMU02 Power Mounting Unit. Figure C-1 shows the IEPEP04 system cabinet wiring diagram for the module mounting unit. Figure C-2 shows the IEPEP04 system cabinet wiring diagram for the power mounting unit.

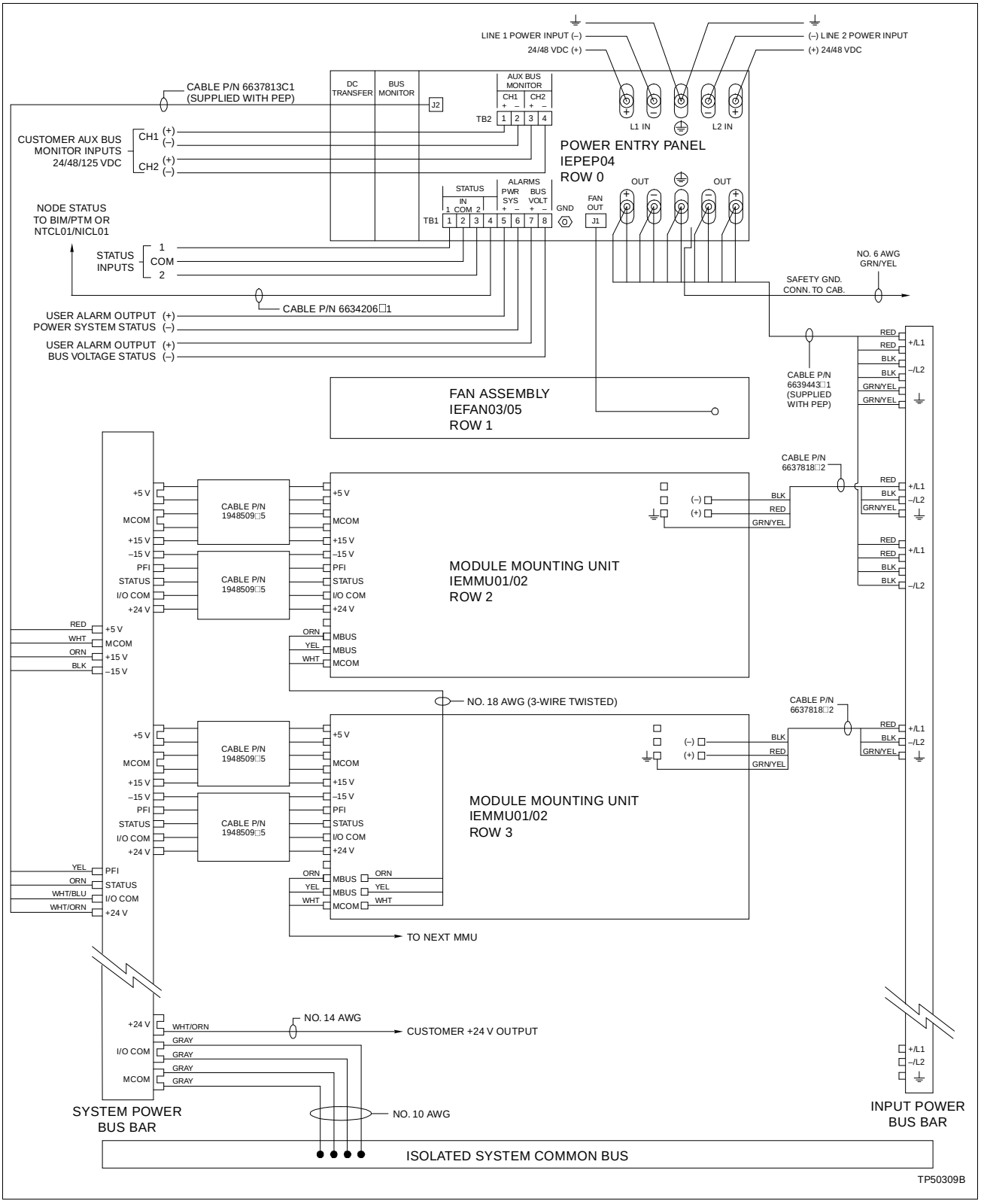

Figure C-1. IEPEP04 System Cabinet Wiring Diagram (Module Mounting Unit)

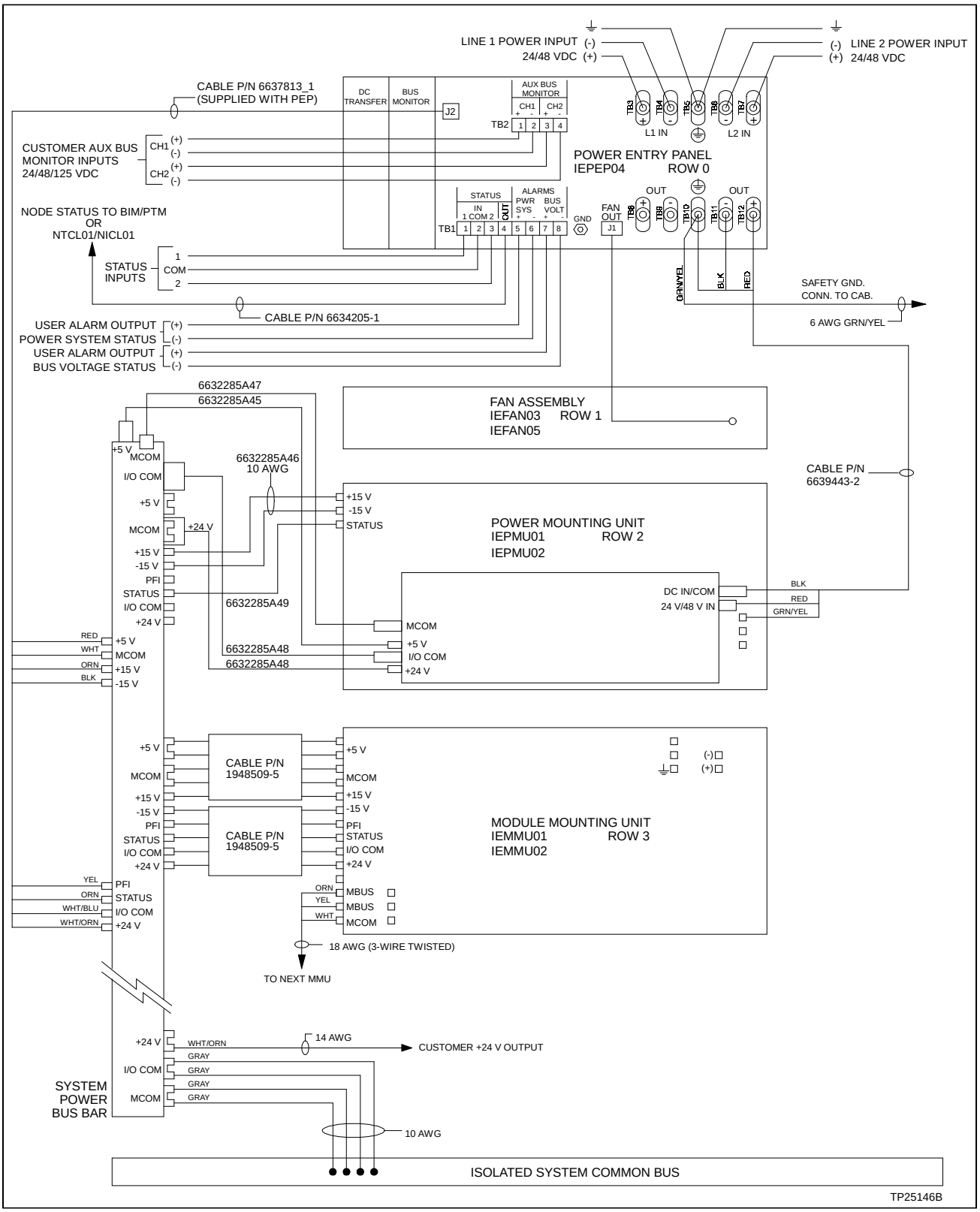

Figure C-2. IEPEP04 System Cabinet Wiring Diagram (Power Mounting Unit)

APPENDIX D - MODULAR POWER SYSTEM SIZING TABLES

INTRODUCTION

The tables in this appendix enable you to size the modular power system and bypass the calculations required by the sizing procedure in Appendix B. Use Table D-1 to size power systems that have only IEPDS01 and IEPDS02 modules. To use the tables, first determine the current requirements for the cabinet (refer to Appendix B). Shown in the table are values for A (5 VDC current requirement for the cabinet) and B (24 VDC current requirement for the cabinet). The box intersected by the requirements of A and B shows the number of PDS modules needed.

Table D-1. Q1 for Systems Using IEPDS01/02 Modules Only

A	B															
	0	**2**	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**	**20**	**22**	**24**	**26**	**28**	**30**
0	0	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8
5	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8
10	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8
15	2	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9
20	2	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9
25	3	3	3	3	4	4	5	5	6	6	7	7	8	8	9	9
30	3	3	3	3	4	4	5	5	6	6	7	7	8	8	9	9
35	4	4	4	4	4	5	5	6	6	7	7	8	8	9	9	10
40	4	4	4	4	4	5	5	6	6	7	7	8	8	9	9	10
45	5	5	5	5	5	5	6	6	7	7	8	8	9	9	10	10
50	5	5	5	5	5	5	6	6	7	7	8	8	9	9	10	10
55	6	6	6	6	6	6	6	7	7	8	8	9	9	10	10	11
60	6	6	6	6	6	6	6	7	7	8	8	9	9	10	10	11
65	7	7	7	7	7	7	7	7	8	8	9	9	10	10	11	11
70	7	7	7	7	7	7	7	7	8	8	9	9	10	10	11	11
75	8	8	8	8	8	8	8	8	8	9	9	10	10	11	11	12
80	8	8	8	8	8	8	8	8	8	9	9	10	10	11	11	12
85	9	9	9	9	9	9	9	9	9	9	10	10	11	11	12	12
90	9	9	9	9	9	9	9	9	9	9	10	10	11	11	12	12
95	10	10	10	10	10	10	10	10	10	10	10	11	11	12	12	13
100	10	10	10	10	10	10	10	10	10	10	10	11	11	12	12	13

Use Table D-2 to size systems that use both the IEPDS01 and IEPDS02 and IEPDF01 and IEPDF02 modules. Table D-2 lists two values (Q1 and QF) for the 5 VDC and 24 VDC (A and B) current requirements. The value of Q1 indicates how many PDS modules are needed to meet system requirements. The value of QF indicates how many PDF modules are needed to meet system requirements.

Table D-2. Q1 and QF for Systems Using IEPDS01/02 and IEPDF01/02 Modules

A		B															
		0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
0	Q1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	QF	0	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8
5	Q1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2
	QF	0	0	1	1	2	2	3	3	4	4	5	5	6	6	7	7
10	Q1	1	1	1	2	2	2	2	2	2	2	2	2	2	3	3	3
	QF	0	0	1	0	1	2	2	3	4	4	5	6	6	5	6	6
15	Q1	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3
	QF	0	0	0	1	2	2	3	2	3	3	4	5	5	6	7	7
20	Q1	2	2	2	2	2	3	3	3	3	3	3	3	3	4	4	4
	QF	0	0	0	1	2	1	2	3	3	4	5	6	6	5	6	6
25	Q1	3	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4
	QF	0	0	0	0	1	2	3	3	4	3	4	4	5	6	7	7
30	Q1	3	3	3	3	3	3	3	4	4	4	4	4	4	4	5	5
	QF	0	0	0	0	1	2	3	2	3	4	4	5	6	7	5	6
35	Q1	4	4	4	4	4	4	4	4	4	4	4	5	5	5	5	5
	QF	0	0	0	0	0	1	2	3	4	4	5	4	5	5	6	7
40	Q1	4	4	4	4	4	4	4	4	4	5	5	5	5	5	5	5
	QF	0	0	0	0	0	1	2	3	4	3	4	5	5	6	7	8
45	Q1	5	5	5	5	5	5	5	5	5	5	5	5	5	6	6	6
	QF	0	0	0	0	0	0	1	2	3	4	5	5	6	5	6	6
50	Q1	5	5	5	5	5	5	5	5	5	5	5	6	6	6	6	6
	QF	0	0	0	0	0	0	1	2	3	4	5	4	5	6	6	7
55	Q1	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	7
	QF	0	0	0	0	0	0	0	1	2	3	4	5	6	6	7	6
60	Q1	6	6	6	6	6	6	6	6	6	6	6	6	6	7	7	7
	QF	0	0	0	0	0	0	0	1	2	3	4	5	6	5	6	7
65	Q1	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
	QF	0	0	0	0	0	0	0	0	1	2	3	4	5	6	7	7
70	Q1	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	8
	QF	0	0	0	0	0	0	0	0	1	2	3	4	5	6	7	6
75	Q1	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
	QF	0	0	0	0	0	0	0	0	0	1	2	3	4	5	6	7

Table D-2. Q1 and QF for Systems Using IEPDS01/02 and IEPDF01/02 Modules (continued)

A		B															
		0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
80	Q1	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
	QF	0	0	0	0	0	0	0	0	0	1	2	3	4	5	6	7
85	Q1	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
	QF	0	0	0	0	0	0	0	0	0	0	1	2	3	4	5	6
90	Q1	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
	QF	0	0	0	0	0	0	0	0	0	0	1	2	3	4	5	6
95	Q1	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
	QF	0	0	0	0	0	0	0	0	0	0	0	1	2	3	4	5
100	Q1	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
	QF	0	0	0	0	0	0	0	0	0	0	0	1	2	3	4	5

Use Table D-3 to determine the value of Q2 using C (the +15 VDC current requirements for the cabinet) and Q3 using D (the -15 VDC current requirements for the cabinet).

Table D-3. Q2 or Q3 for All Power Systems

Q2 or Q3	C or D												
	0	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
	0	1	2	3	4	5	6	7	8	9	10	11	12

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