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# **UDC3300**

# **Universal Digital**

# **Limit Controller**

**51-52-25-101**

**1/01**

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# About This Document













## Abstract

This Product Manual is divided into 9 sections numbered 1 through 9. These sections contain all the information you need to configure, operate, monitor, and troubleshoot your controller.

To find information quickly, use the comprehensive Table of Contents in the front of the manual and the Index located in the back of the manual.

# Symbol Definitions

The following table lists those symbols that may be used in this document to denote certain conditions.

Symbol	Definition
	This <b>DANGER</b> symbol indicates an imminently hazardous situation, which, if not avoided, <b>will result in death or serious injury</b> .
	This <b>WARNING</b> symbol indicates a potentially hazardous situation, which, if not avoided, <b>could result in death or serious injury</b> .
	This <b>CAUTION</b> symbol may be present on Control Product instrumentation and literature. If present on a product, the user must consult the appropriate part of the accompanying product literature for more information.
	This <b>CAUTION</b> symbol indicates a potentially hazardous situation, which, if not avoided, <b>may result in property damage</b> .
	<b>WARNING</b> <b>PERSONAL INJURY:</b> Risk of electrical shock. This symbol warns the user of a potential shock hazard where HAZARDOUS LIVE voltages greater than 30 Vrms, 42.4 Vpeak, or 60 Vdc may be accessible. <b>Failure to comply with these instructions could result in death or serious injury.</b>
	ATTENTION, Electrostatic Discharge (ESD) hazards. Observe precautions for handling electrostatic sensitive devices
	Protective Earth (PE) terminal. Provided for connection of the protective earth (green or green/yellow) supply system conductor.
	Functional earth terminal. Used for non-safety purposes such as noise immunity improvement. NOTE: This connection shall be bonded to protective earth at the source of supply in accordance with national local electrical code requirements.
	Earth Ground. Functional earth connection. NOTE: This connection shall be bonded to Protective earth at the source of supply in accordance with national and local electrical code requirements.
	Chassis Ground. Identifies a connection to the chassis or frame of the equipment shall be bonded to Protective Earth at the source of supply in accordance with national and local electrical code requirements.
	Earth Ground. Functional earth connection. NOTE: This connection shall be bonded to Protective earth at the source of supply in accordance with national and local electrical code requirements.
	Chassis Ground. Identifies a connection to the chassis or frame of the equipment shall be bonded to Protective Earth at the source of supply in accordance with national and local electrical code requirements.

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# Acronyms

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DMCS .....	Distributed Manufacturing Control System
EMI .....	Electromagnetic interference
HID .....	High intensity discharge
IEEE .....	Institute of Electrical and Electronics Engineers
MOVs .....	Metal Oxide Varistors
NC .....	Normally closed
NO .....	Normally open
RC .....	Resistance-capacitance
RFI .....	Radio frequency interference
RH .....	Relative Humidity
RS422 .....	Communications Protocol
RTD .....	Resistance Thermometer Device
SCRs .....	Silicon controlled rectifiers
UDC .....	Universal Digital Controller



# Parameters

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A1S1 HL.....	Alarm 1, Setpoint 1 State
A1S1 VAL.....	Alarm 1, Setpoint 1
A1S1TYPE .....	Alarm 1, Setpoint 1 Type
A1S2 HL.....	Alarm 1, Setpoint 2 State
A1S2 VAL.....	Alarm 1, Setpoint 2
A1S2TYPE .....	Alarm 1, Setpoint 2 Type
A2S1 HL.....	Alarm 2, Setpoint 1 State
A2S1 VAL.....	Alarm 2, Setpoint 1
A2S1TYPE .....	Alarm 2, Setpoint 1
A2S2 HL.....	Alarm 2, Setpoint 2 State
A2S2 VAL.....	Alarm 2, Setpoint 2
A2S2TYPE .....	Alarm 2, Setpoint 2 Type
AL HYST .....	Alarm Hysteresis
BAUD .....	Baud Rate
BIAS IN1 .....	Input 1 Bias
CAL TEST .....	Calibration test failure
Com ADDR .....	Communications Station Address
ComSTATE .....	Communications Option State
CONFTEST.....	Configuration test failure
DUPLEX.....	Duplex Operation
E E FAIL.....	Unable to write to non-volatile memory
EMSSIV.....	Emissivity
EXT RSET.....	External Reset (Digital Input 1)
FACT CRC.....	Factory Calibration Cyclic Redundancy test
FAILSAFE .....	Controller in Failsafe
FILTER 1.....	Input 1 Filter
IN1 HI.....	Input 1 High Range Value
IN1 LO.....	Input 1 Low Range Value
IN1 TYPE .....	Input 1 Actuation Type
INP1 RNG .....	Input 1 Out of Range
INP1FAIL.....	Two consecutive failures of Input 1 integration
LO or HI.....	Type of Limit Control
LOOPBACK .....	Local Loop Back
PARITY .....	Parity
POWER UP.....	Power-up Logic
PV LIMIT .....	PV Out of Range
PWR FREQ.....	Power Line Frequency
RAM TEST .....	RAM test failed
SHEDTIME.....	Shed Time
SP HILIM.....	High Setpoint Limit
SP LOLIM.....	Low Setpoint Limit
UNITS .....	Communication Units
XMITTER .....	Transmitter Characterization

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# Section 1 – Overview

## 1.1 Introduction

---

**Function**

The UDC3300 Universal Digital Limit Controller is a microprocessor-based stand-alone controller. It combines the highest degree of functionality and operating simplicity offered in a 1/4 DIN size controller.

With a typical accuracy of  $\pm 0.20\%$  of span, the UDC3300 is an ideal controller for limiting temperature and other process variables in numerous heating and cooling applications, in metal working, food, and pharmaceuticals, and testing and environmental work.

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**Easy to read displays**

The dedicated vacuum fluorescent displays with English prompts make the operator interface easy to read, understand and operate. Programmed sequences of displays assure quick and accurate entry of all configurable parameters.

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**Easy to operate**

Simple keystrokes let you select input and range configuration, set the operating parameters that meet your process control needs now, and change them later to meet new ones.

The tactile keyboard provides positive operator feedback. Self diagnostics, fault tolerant design and keyboard security provide maximum assurance of trouble-free operation.

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**Latching relays**

This limit controller has a latching output relay which is de-energized whenever the PV goes above (high limit) or below (low limit) a selected setpoint value. When the limit is exceeded (high or low), the lower display alternately indicates “the limit control setpoint value” and the word “limit.”

---

**Reset of relay**

Reset of the latching output relay is made through a [RESET] key on the front of the controller or an external switch (if the option is present).

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**Alarm relay**

Two additional non-latching alarm relays with two setpoints each alert you to critical process conditions.

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## 1.1 Introduction, Continued

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### Mount anywhere

The UDC is industrial control equipment that must be panel mounted. The wiring terminals must be enclosed within the panel. The UDC is environmentally hardened and, when suitably enclosed, can be mounted virtually anywhere in plant or factory; on the wall, in a panel, or even on the process machine. It withstands ambient temperatures up to 55 °C (133 °F) and resists the effects of vibration and mechanical shock.

---

### CE Conformity (Europe)

This product is in conformity with the protection requirements of the following European Council Directives: **73/23/EEC**, the Low Voltage Directive, and **89/336/EEC**, the EMC Directive. Conformity of this product with any other “CE Mark” Directive(s) shall not be assumed.

Deviation from the installation conditions specified in this manual, and the special conditions for CE conformity in Section 2.1, may invalidate this product’s conformity with the Low Voltage and EMC Directives.

### ATTENTION

The emission limits of EN 50081-2 are designed to provide reasonable protection against harmful interference when this equipment is operated in an industrial environment. Operation of this equipment in a residential area may cause harmful interference. This equipment generates, uses, and can radiate radio frequency energy and may cause interference to radio and television reception when the equipment is used closer than 30 meters (98 feet) to the antenna(e). In special cases, when highly susceptible apparatus is used in close proximity, the user may have to employ additional mitigating measures to further reduce the electromagnetic emissions of this equipment.

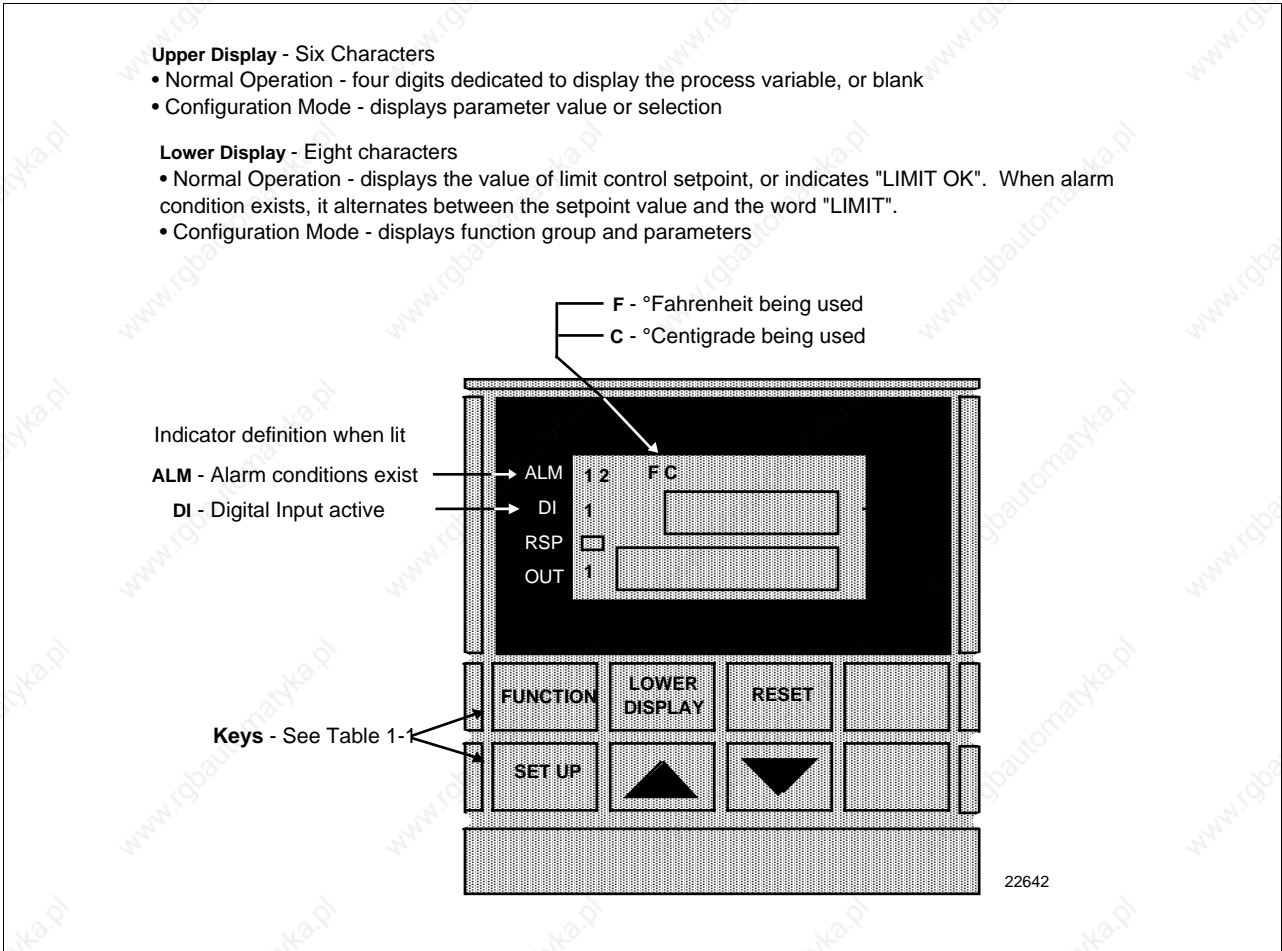
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# 1.2 Operator Interface

## Displays and indicators

Figure 1-1 shows the operator interface and defines the displays and indicators. The function of the keys is shown in Table 1-1.

Figure 1-1 Operator Interface Displays and Indicators










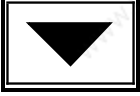
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## 1.2 Operator Interface, Continued

### Function of keys

Table 1-1 shows each key on the operator interface and defines its function.

Table 1-1 Function of Keys

Key	Function
	<ul style="list-style-type: none"> <li>Places the controller in the Configuration Set Up group select mode. Sequentially displays Set Up groups and allows the [FUNCTION] key to display individual functions in each Set Up group.</li> </ul>
	<ul style="list-style-type: none"> <li>Used in conjunction with the [SET UP] key to select the individual functions of a selected Configuration Set Up group.</li> <li>Used during field calibration procedure.</li> </ul>
	<ul style="list-style-type: none"> <li>Selects one of the following display modes when no limit conditions exist:               <ul style="list-style-type: none"> <li>#1 Upper Display = the value of the process variable Lower Display = the value of the Limit Control Setpoint</li> <li>#2 Upper Display = (blank) except during Limit conditions Lower Display = the value of the Limit Control Setpoint</li> <li>#3 Upper Display = (blank) except during Limit conditions Lower Display = LIMIT OK</li> </ul> </li> <li>Pressing [LOWER DISPLAY] key while a limit condition exists, shows the following in the lower display:               <ul style="list-style-type: none"> <li>TIME XX.YY = Limit action duration in hours and minutes</li> <li>PK_XXXXX = Peak PV Value—The highest PV value reached for a High Limit Controller, or the lowest PV value reached for a Low Limit Controller.</li> </ul> </li> </ul>
	<ul style="list-style-type: none"> <li>Resets the latching output relay. Relay cannot be reset while a limit condition exists.</li> </ul>
	The upper blank key is not used.
	<p>The lower blank key restores an original value.</p> <ul style="list-style-type: none"> <li>When you are using the [FUNCTION] key and [s] [t] keys to change a parameter value of selection and you decide you want to keep the original value that was displayed, press the lower blank key, before entry, to recall the original value.</li> </ul>
	<ul style="list-style-type: none"> <li>Increases the setpoint, output, or configuration values displayed.</li> </ul>
	<ul style="list-style-type: none"> <li>Decreases the setpoint, output, or configuration values displayed.</li> </ul>

## Section 2 – Installation

### 2.1 Overview

#### Introduction

Installation of the UDC3300 Limit Controller consists of mounting and wiring the controller according to the instructions given in this section.

Read the pre-installation information, check the model number interpretation and become familiar with your model selections, then proceed with installation.

#### What's in this section?

This section contains the following information:

	Topic	See Page
2.1	Overview	5
2.2	Model Number Interpretation	7
2.3	Mounting	8
	Physical Considerations	8
	Overall Dimensions	8
	Mounting Procedure	9
2.4	Wiring	10
	Taking Electrical Noise Precautions	10
	Permissible Wire Bundling	10
	Identify Your Wiring Requirements	11
	Control Alarm Circuit Wiring	11
	Wiring the Controller	11
2.5	Wiring Diagrams	12
	Composite Wiring Diagram	12
	AC Line Voltage	13
	Input #1	14
	Output and Alarm Wiring	15
	Digital Inputs	16
	Communications	17
	RS422/485	17
	DMCS	18

#### Pre-installation information

If the controller has not been removed from its shipping carton, inspect the carton for damage and remove the controller. Inspect the unit for any obvious shipping damage and report any damage due to transit to the carrier.

Make sure the carton with the controller includes

- a bag containing mounting hardware and
- a bag containing input resistors.

Check that the model number shown on the inside of the case agrees with what you have ordered.

*Continued on next page*

## 2.1 Overview, Continued

### CE Conformity special conditions (Europe)

Shielded twisted pair cables are required for all Analog I/O, Process Variable, RTD, Thermocouple, dc millivolt, low level signal, 4-20 mA, Digital I/O, and computer interface circuits.

### Operating limits

We recommend that you review and adhere to the operating limits listed in Table 2-1 when you install your controller.

Table 2-1 Operating Limits

Condition	Specifications
Ambient Temperature	32 to 131°F (0 to 55°C)
Relative Humidity	5 to 90 % RH at 40°C (104°F)
Vibration Frequency Acceleration	0 to 200 Hz 0.6 g
Mechanical Shock Acceleration Duration	5 g 30 ms
Power 90 to 264 Vac  24 Vac/dc	90 to 264 Vac 50/60 Hz (CSA models rated to 250 V maximum)  20 to 27 Vac 50/60 Hz 20 to 27 Vdc 0 Hz
Power Consumption	18 VA maximum (90 to 264 Vac) 12 VA maximum (24 Vac/dc)
Frequency (For Vac)	48 to 52 Hz 58 to 62 Hz

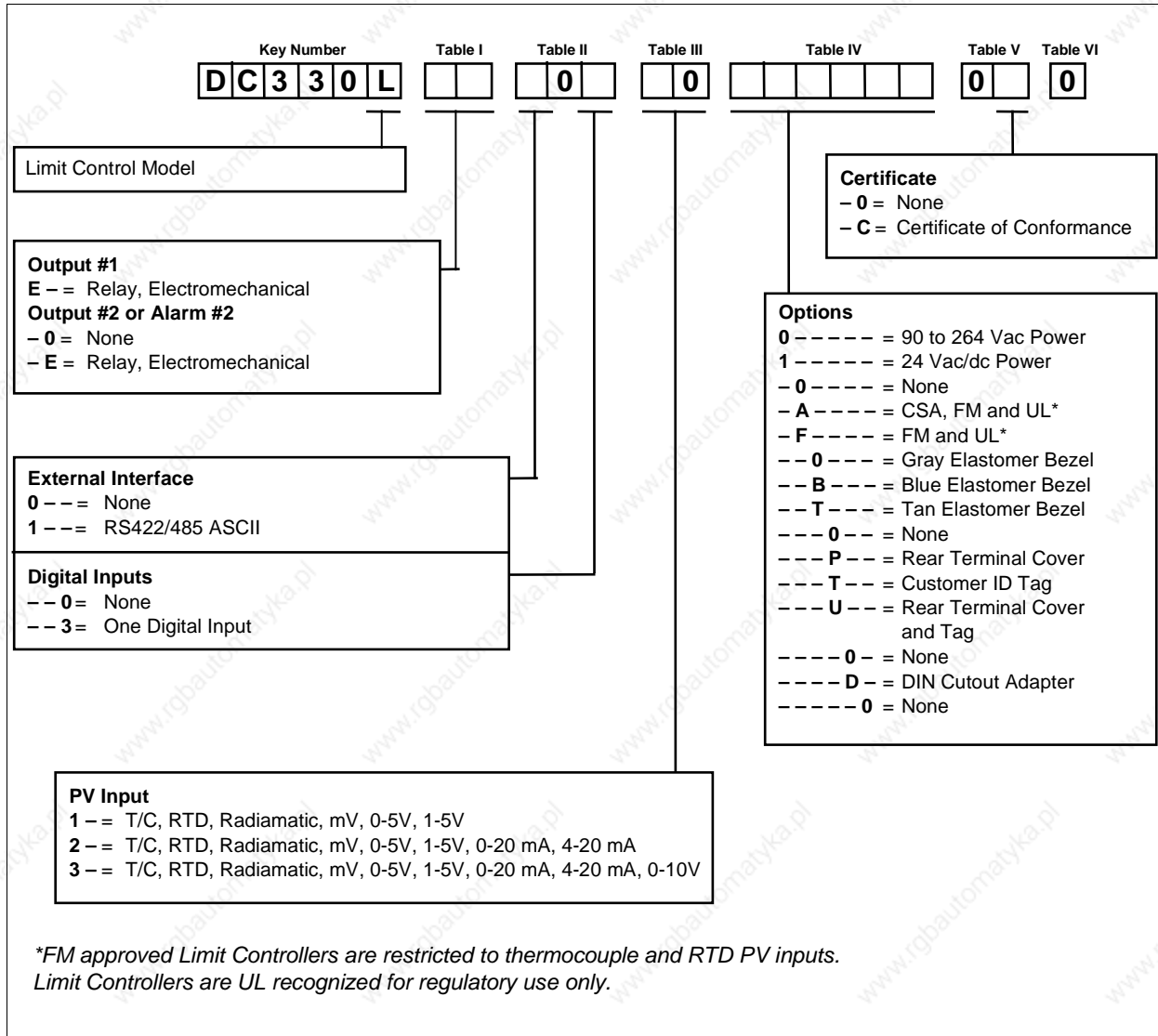


## 2.2 Model Number Interpretation

### Model number

The model number interpretation is shown in Figure 2-1. Write the model number into the spaces provided and compare it to the model number interpretation. This information will also be useful when you wire your controller.

Figure 2-1 Model Number Interpretation



## 2.3 Mounting

### Physical considerations

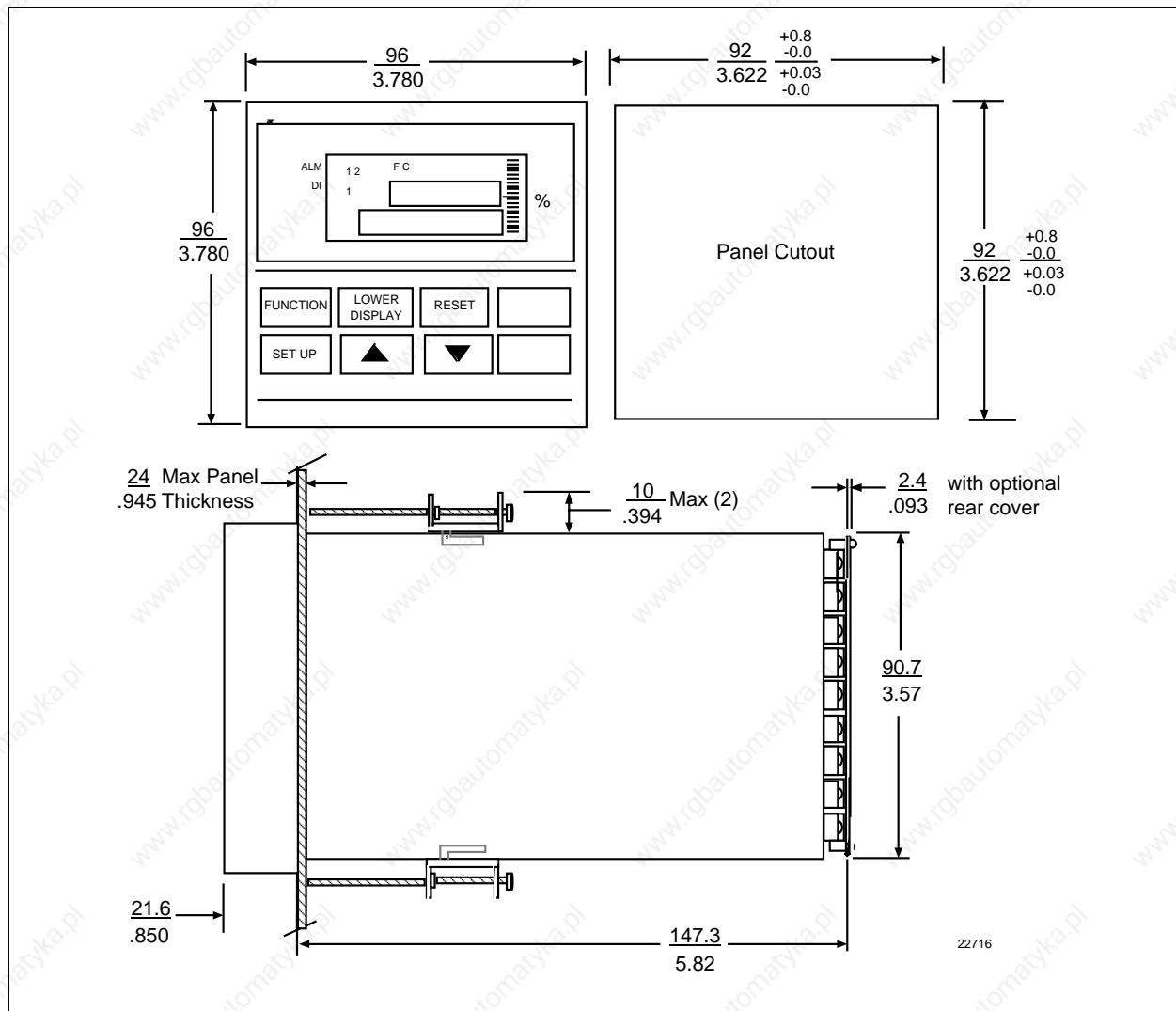
The controller can be mounted on either a vertical or tilted panel using the mounting kit supplied. Adequate access space must be available at the back of the panel for installation and servicing activities.

The overall dimensions and panel cutout requirements for mounting the controller are shown in Figure 2-2.

### Overall dimensions

Figure 2-2 shows the overall dimensions for mounting the controller.

Figure 2-2 Dimensions



Continued on next page

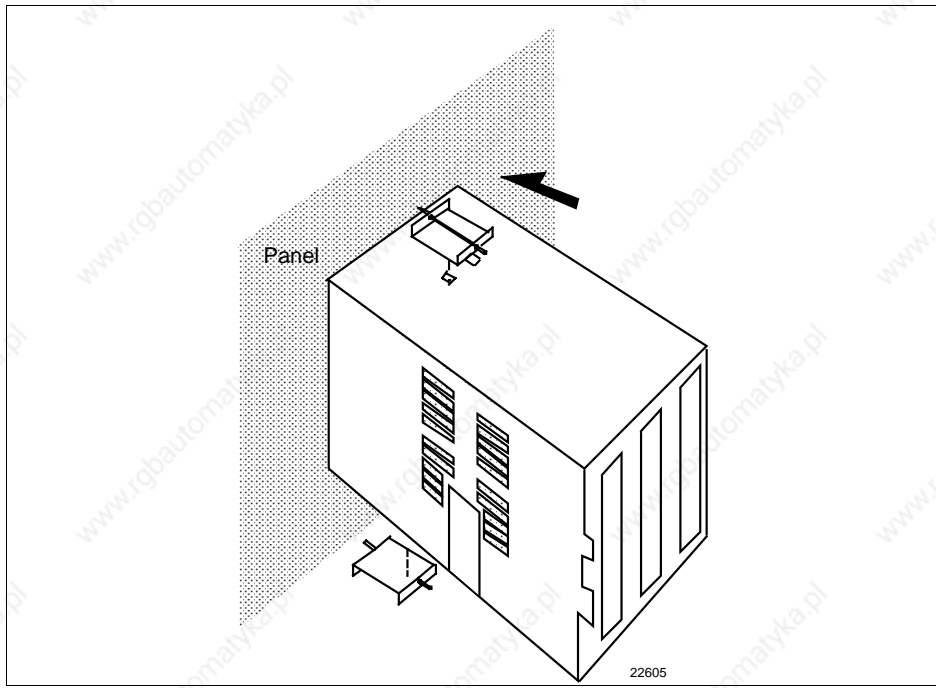
## 2.3 Mounting, Continued

### Mounting method

Before mounting the controller, refer to the nameplate on the inside of the case and make a note of the model number. It will help later when selecting the proper wiring configuration.

Figure 2-3 shows you the mounting method for the UDC3300 Limit controller.

Figure 2-3 Mounting Method



### Mounting procedure

Refer to Figure 2-3 and follow the procedure below to mount the controller.

Step	Action
1	Mark and cut out the controller hole in the panel according to the dimension information in Figure 2-2.
2	Remove the screw cover and loosen the screw on the front of the controller. Pull the chassis out of the case.
3	Orient the case properly and slide it through the panel hole from the front.
4	Remove the mounting kit from the shipping container, and install the kit as follows: <ul style="list-style-type: none"><li>• Install the screws into the threaded holes of the clips.</li><li>• Insert the prongs of the clips into the two holes in the top and bottom of the case.</li><li>• Tighten both screws to secure the case against the panel.</li><li>• Carefully slide the chassis assembly into the case, press to close and tighten the screw. Replace the screw cover.</li></ul>

## 2.4 Wiring

### Electrical considerations



The controller is considered “rack and panel mounted equipment” per EN 61010-1, Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use, Part 1: General Requirements. Conformity with 72/23/EEC, the Low Voltage Directive requires the user to provide adequate protection against a shock hazard. The user shall install this controller in an enclosure that limits OPERATOR access to the rear terminals.

### Controller grounding

PROTECTIVE BONDING (grounding) of this controller and the enclosure in which it is installed shall be in accordance with National and local electrical codes. To minimize electrical noise and transients that may adversely affect the system, supplementary bonding of the controller enclosure to a local ground, using a No. 12 (4 mm<sup>2</sup>) copper conductor, is recommended.

### Taking electrical noise precautions

Electrical noise is composed of unabated electrical signals which produce undesirable effects in measurements and control circuits.

Digital equipment is especially sensitive to the effects of electrical noise. Your controller has built-in circuits to reduce the effect of electrical noise from various sources. If there is a need to further reduce these effects:

- Separate External Wiring - separate connecting wires into bundles (see Table 2-2) and route the individual bundles through separate conduits or metal trays.
- Use Suppression Devices - for additional noise protection, you may want to add suppression devices at the external source. Appropriate suppression devices are commercially available.

**NOTE**

For additional noise information, refer to *Section 9*.

### Permissible wire bundling

Table 2-2 shows which wire functions should be bundled together.

**NOTE**

*For installation where high EMI/RFI noise cannot be avoided, we recommend you use shielded twisted pair wires for the signals in bundle 2.*

Table 2-2 Permissible Wiring Bundling

Bundle No.	Wire Functions
1	<ul style="list-style-type: none"><li>• Line power wiring</li><li>• Earth ground wiring</li><li>• Control relay output wiring</li><li>• Line voltage alarm wiring</li></ul>
2	Analog signal wire, such as: <ul style="list-style-type: none"><li>• Input signal wire (thermocouple, 4 to 20 mA, etc.)</li><li>• Digital input signals</li><li>• Communications</li></ul>
3	<ul style="list-style-type: none"><li>• Low voltage alarm relay output wiring</li><li>• Low voltage wiring to solid state type control circuits</li></ul>

*Continued on next page*

## 2.4 Wiring, Continued

### Alarm circuit wiring

The insulation of wires connected to the Alarm terminals shall be rated for the highest voltage involved. Extra Low Voltage (ELV) wiring (input, current output, and low voltage Alarm circuits) shall be separated from HAZARDOUS LIVE (>30 Vac, 42.4 Vpeak, or 60 Vdc) wiring per Table 2-2.

### Identify your wiring requirements

To determine the appropriate diagrams for wiring your controller, refer to the model number interpretation in this section. The model number of the controller can be found on the inside of the case.

### Wiring the controller

Using the information contained in the model number, select the appropriate wiring diagrams from the figures listed below and wire the controller accordingly.

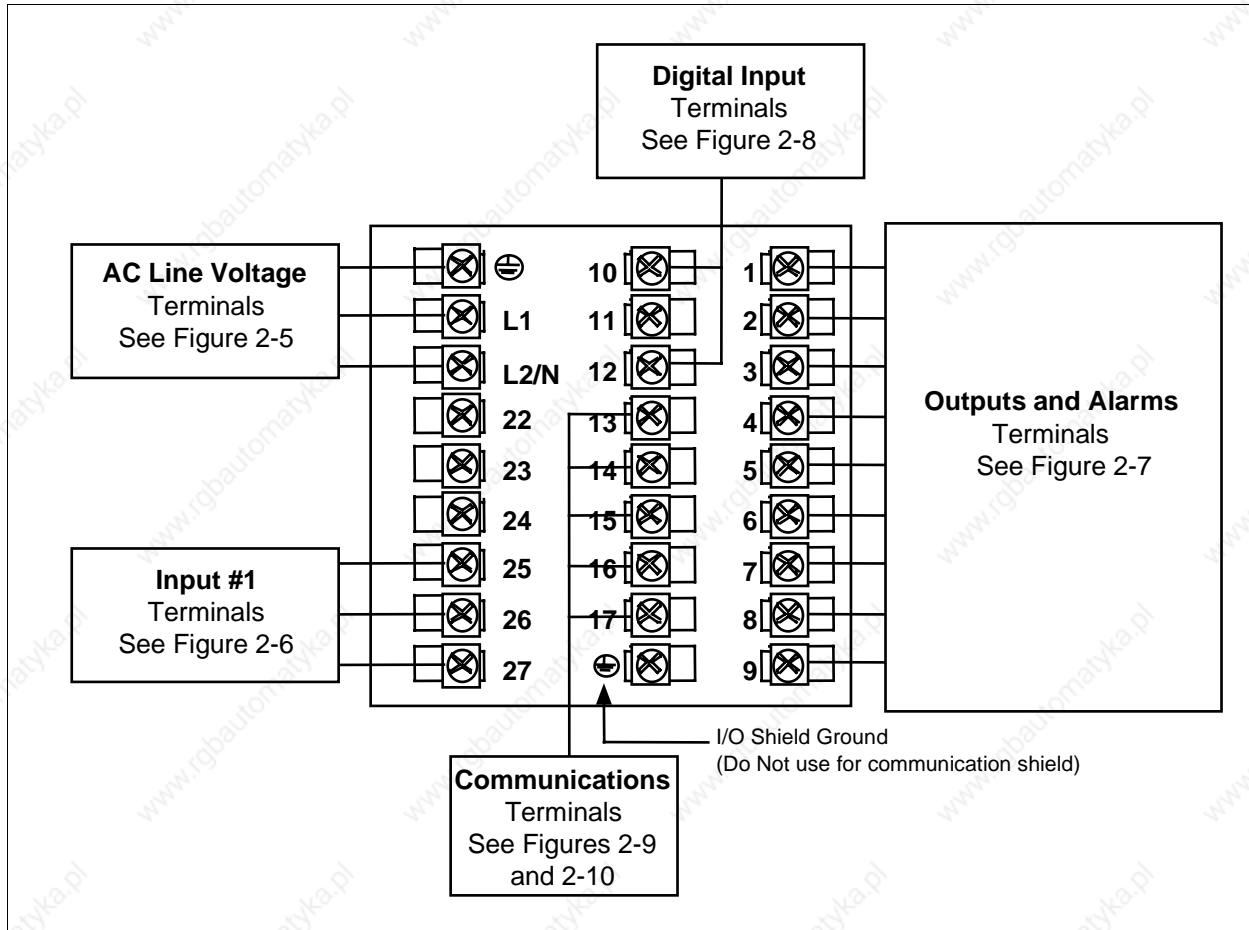
Wiring Requirements	Figure
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Line Power 90–264 Vac or 24 Vac/dc	2-5
Input #1 Wiring	2-6
Output and Alarm Wiring	2-7
Digital Inputs Wiring	2-8
Communications Wiring <ul style="list-style-type: none"><li>• RS422</li><li>• DMCS</li></ul>	2-9 2-10

## 2.5 Wiring Diagrams

### Composite wiring diagram

Figure 2-4 is a composite wiring diagram of the UDC3300 Limit controller. It identifies the terminal designations and their functions. Refer to the individual diagrams listed to wire the controller according to your requirements.

Figure 2-4 Composite Wiring Diagram



*Continued on next page*

## 2.5 Wiring Diagrams, Continued

### Line voltage wiring

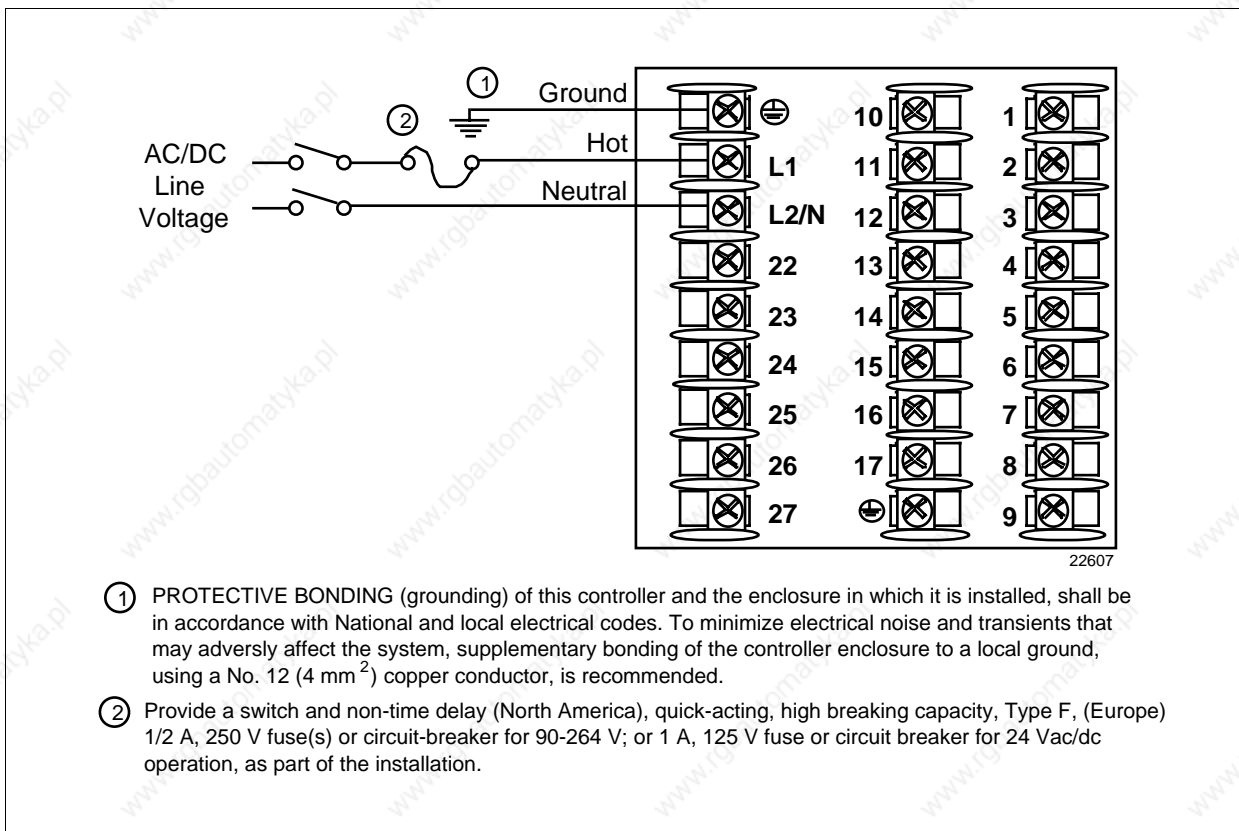
This equipment is suitable for connection to 90-264 Vac or 24 Vac/dc, 50/60 Hz, power supply mains. It is the user's responsibility to provide a switch and non-time delay (North America), quick-acting, high breaking capacity, Type F, (Europe) 1/2 A, 250 V fuse(s) or circuit-breaker for 90-264 V; or 1 A, 125 V fuse or circuit breaker for 24Vac/dc operation, as part of the installation. The switch or circuit-breaker should be located close to the controller, *within easy reach of the operator*. The switch or circuit-breaker should be marked as the disconnecting device for the controller. (4mm<sup>2</sup>).

**CAUTION** Applying 90-264 Vac to a controller rated for 24Vac/dc will severely damage the controller and is a fire and smoke hazard.

When applying power to multiple instruments, make sure that sufficient current is supplied. Otherwise, the instruments may not start up normally due to the voltage drop caused by the in-rush current.

Figure 2-5 shows the wiring connections for line voltage.

Figure 2-5 Line Voltage Wiring

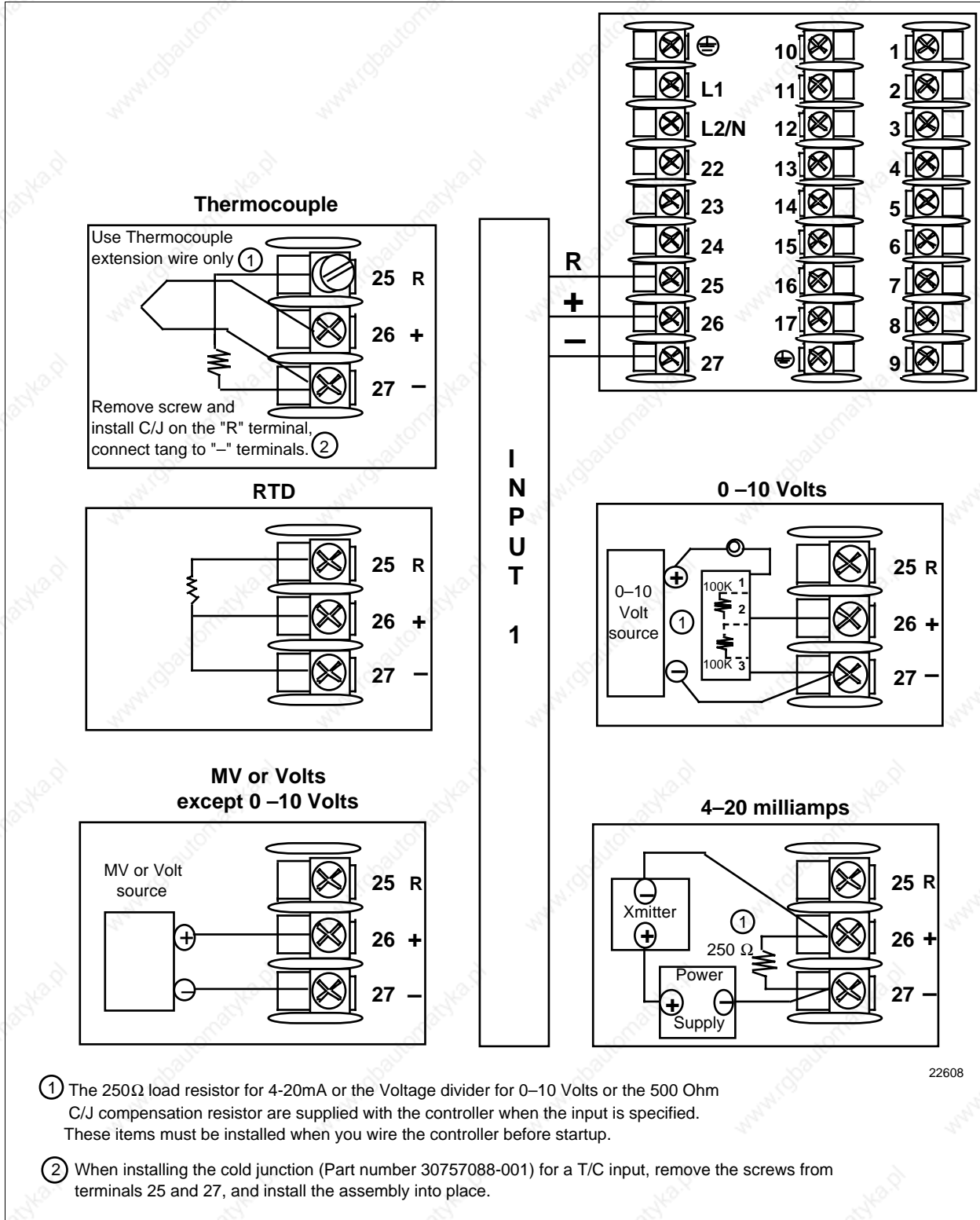


Continued on next page

## 2.5 Wiring Diagrams, Continued

**Input #1 connections** Figure 2-6 shows the wiring connections for Input #1.

Figure 2-6 Input #1 Connections



22608

- ① The 250 $\Omega$  load resistor for 4-20mA or the Voltage divider for 0-10 Volts or the 500 Ohm C/J compensation resistor are supplied with the controller when the input is specified. These items must be installed when you wire the controller before startup.
- ② When installing the cold junction (Part number 30757088-001) for a T/C input, remove the screws from terminals 25 and 27, and install the assembly into place.

Continued on next page

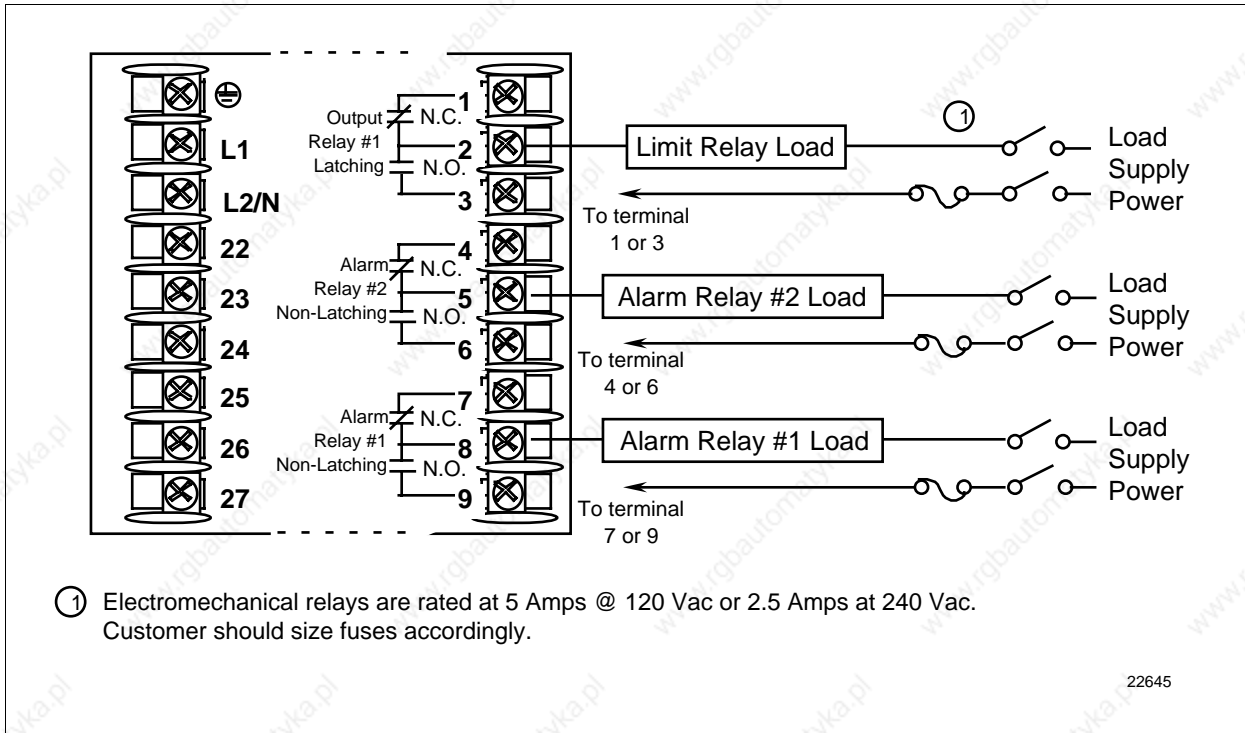


## 2.5 Wiring Diagrams, Continued

### Output and alarm wiring diagram

Figure 2-7 shows the Output and Alarm wiring connections for Limit controllers.

Figure 2-7 Output and Alarm Wiring



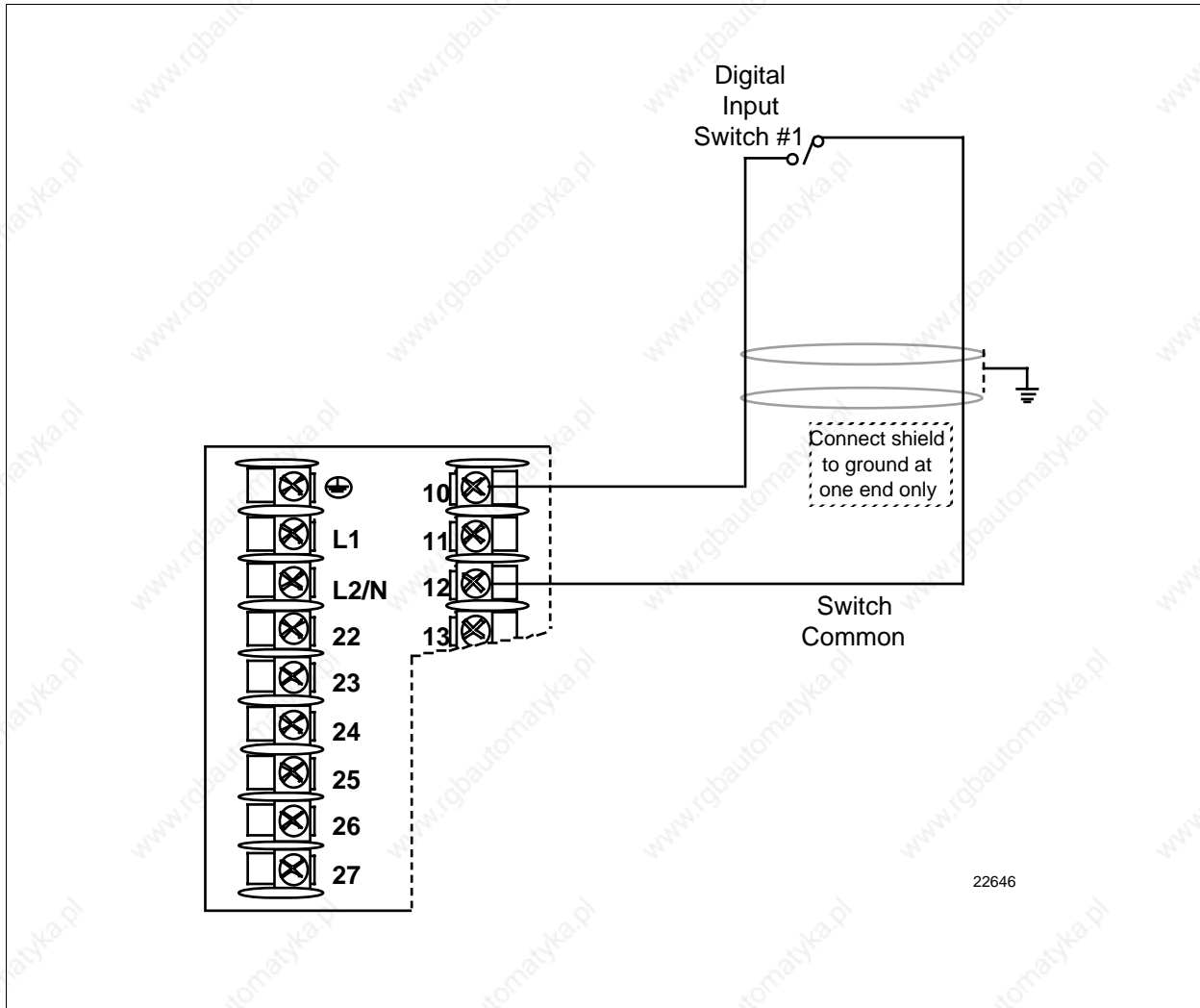
Continued on next page

## 2.5 Wiring Diagrams, Continued

### Digital input connections

Figure 2-8 shows the wiring connections for the Digital Input option. This input is used for external reset of the latching relay.

Figure 2-8 Digital Input Connections



*Continued on next page*

## 2.5 Wiring Diagrams, Continued

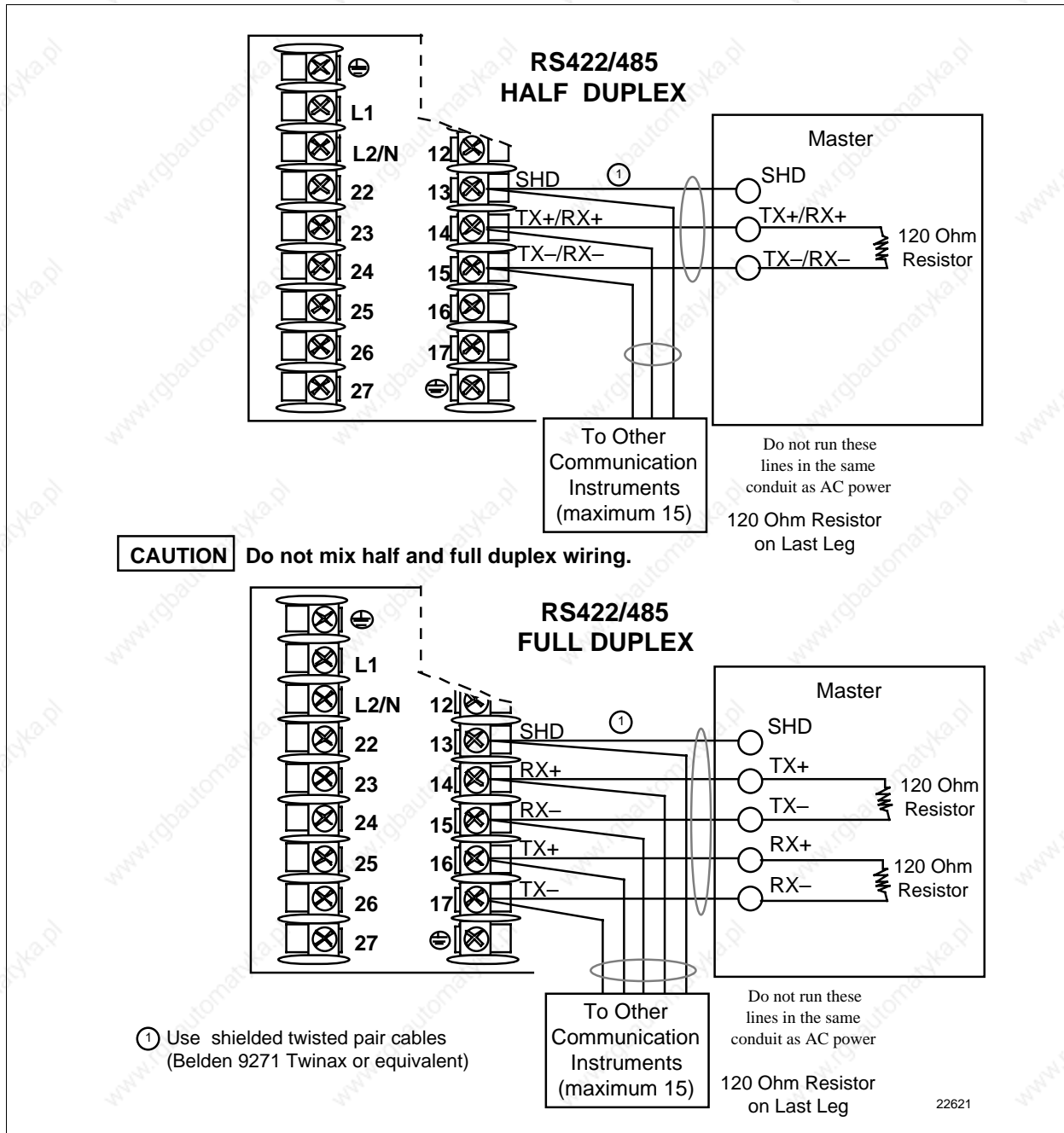
### Communications option connections

There are two types of Communications option available:

- RS422/485—Figure 2-9
- DMCS—Figure 2-10.

Figure 2-9 shows the wiring connections for the RS422/485 Communications Option.

Figure 2-9 RS422/485 Communications Option Connections



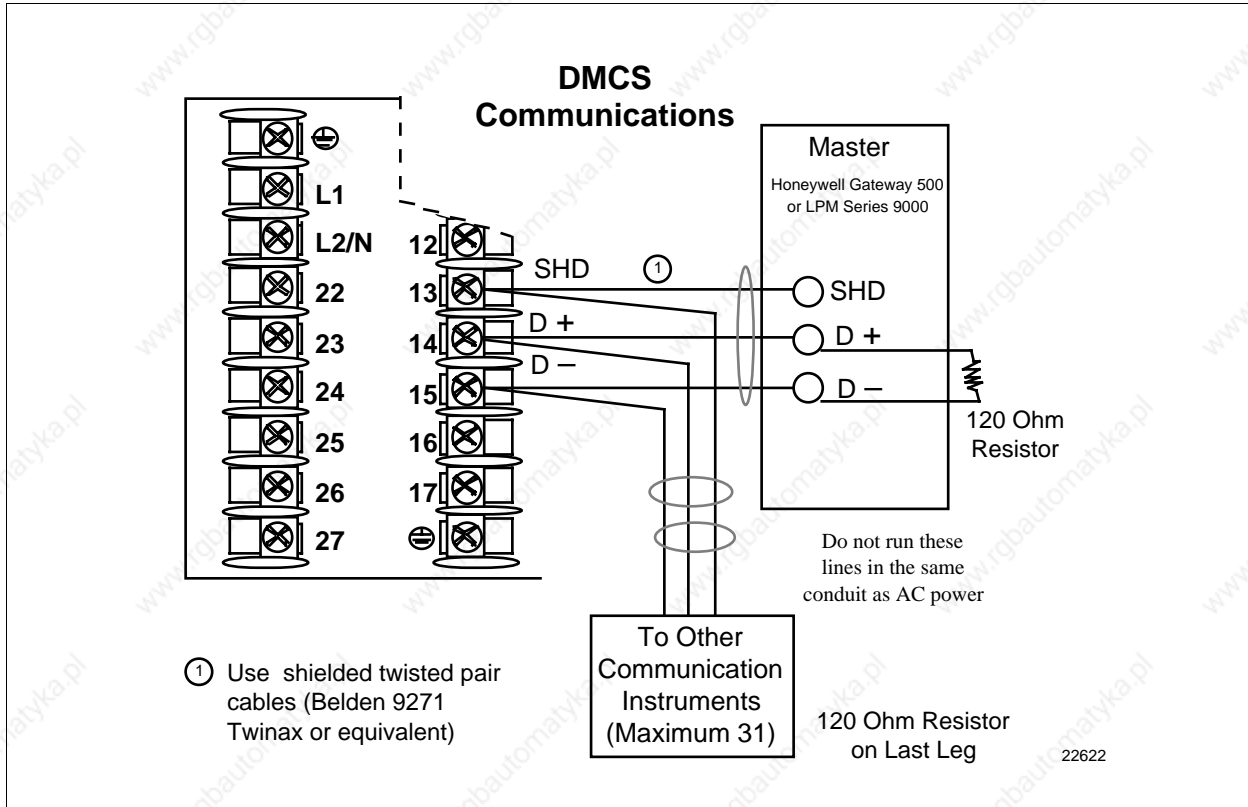
Continued on next page

## 2.5 Wiring Diagrams, Continued

### Communications option connections (continued)

Figure 2-10 shows the wiring connections for the DMCS Communications Option.

Figure 2-10 DMCS Communications Option Connections



## Section 3 – Configuration

### 3.1 Overview

#### Introduction

Configuration is a dedicated operation where you use straightforward keystroke sequences to select and establish (configure) pertinent control data best suited for your application.

#### What's in this section?

The table below lists the topics that are covered in this section.

	Topic	See Page
3.1	Overview	19
3.2	Prompt Hierarchy	20
3.3	How to Get Started	21
3.4	Configuration Tips	22
3.5	Configuration Procedure	23
3.6	Lockout Setup Groups	25
3.7	Limit Set up Group	26
3.8	Input 1 Setup Group	27
3.9	Communications Setup Group	29
3.10	Alarms Setup Group	30
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3.13	Configuration Record Sheet	32

#### Prompts

To assist you in the configuration process, there are prompts that appear in the upper and lower displays. These prompts let you know what group of configuration data (Set Up prompts) you are working with and also, the specific parameters (Function prompts) associated with each group.

Figure 3-1 shows you an overview of the prompt hierarchy. As you will see, the configuration data is divided into 5 main Set Up groups plus prompts for calibration and prompts that show the status of the continuous background tests that are being performed.

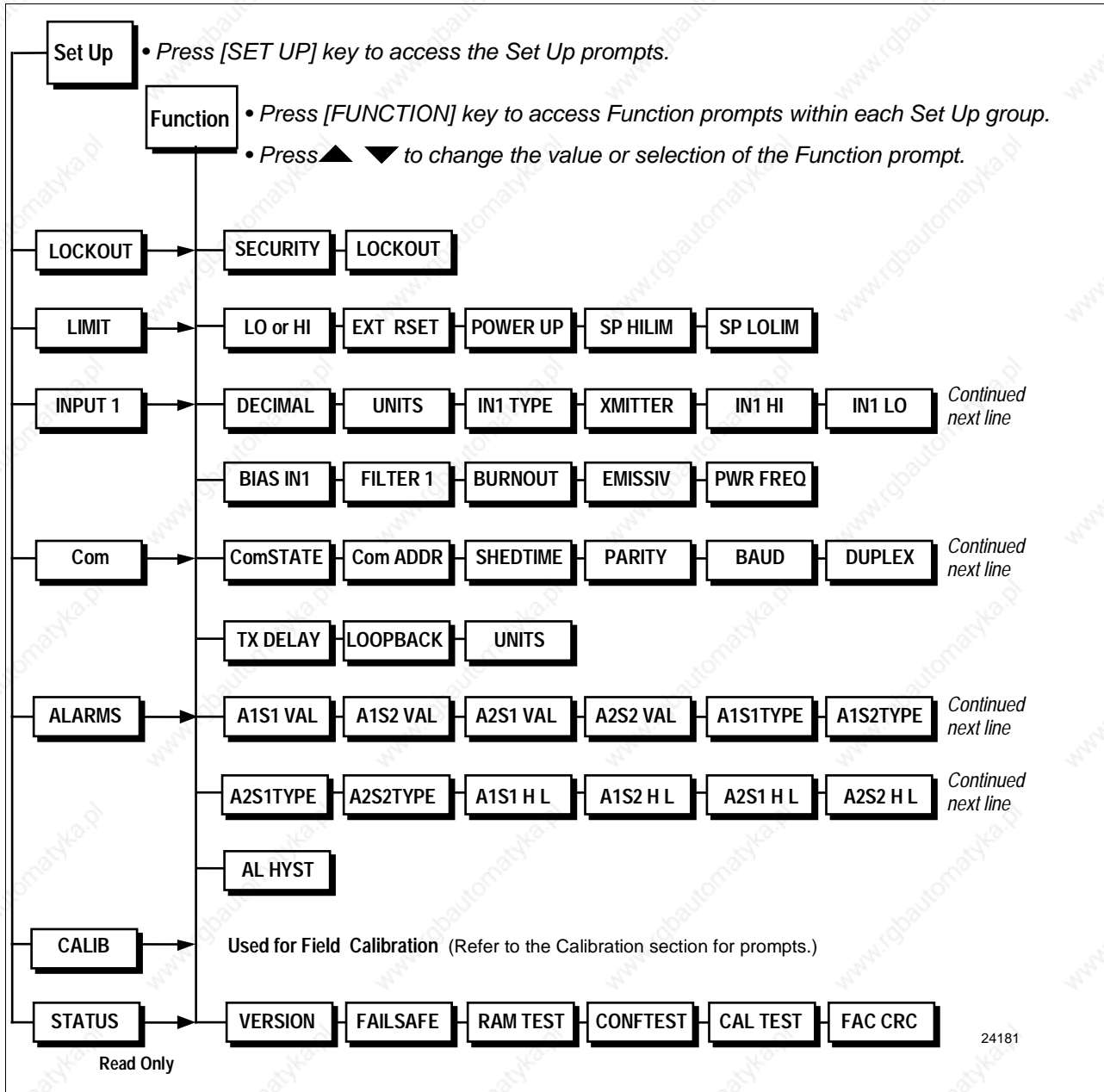
*Continued on next page*

## 3.2 Configuration Prompts

**Diagram: prompt hierarchy**

Figure 3-1 shows an overview of the UDC3300 Set Up prompts and their associated Function prompts. *Read from left to right.*

Figure 3-1 Overview of UDC3300 Prompt Hierarchy



## 3.3 How To Get Started

### Read the configuration tips

Read “*Configuration Tips*” shown on the next page. These tips will help you to easily and quickly accomplish the tasks at which you will be working when you configure your controller.

---

### Read configuration procedure

Read “*Configuration Procedure*”. This procedure tells you how to access the Set Up groups, and the Function parameters within each of these groups that are shown in the Prompt Hierarchy in Figure 3-1.

---

### Set Up groups

The Set Up groups and Function parameters are listed in the order of their appearance. The list includes the name of the prompt, the range of setting or selections available, and the factory setting.

---

### Parameter explanations or definitions

If you need a detailed explanation of any prompt listed, refer to *Section 4 - Configuration Parameter Definitions*.

This section lists the Set Up and function prompts, the selection or range of settings that you can make for each, plus a detailed explanation or definition of each parameter.

---

### Configuration record sheet

Located on the last page of this section is a “*Configuration Record Sheet*”. When you make your configuration selections, record them on this sheet. Then you will have a record of how the controller was configured.

---

## 3.4 Configuration Tips

### Introduction

Listed below in Table 3-1 are a few tips that will help you enter the configuration data more quickly.

Table 3-1 Configuration Tips

Function	Tip
<b>Displaying Groups</b>	Use the [SET UP] key to display the Set Up groups. The group titles are listed in this section in the order that they appear in the controller.
<b>Displaying Functions</b>	Use the [FUNCTION] key to display the individual parameters under each group. The prompts are listed in the order of their appearance in each group.
<b>Scrolling</b>	<p>To get to a Set Up group prompt more quickly, hold the [SET UP] key in. To get to a Function prompt more quickly, hold the [FUNCTION] key in. The display will scroll through the parameters.</p> <p><b>ATTENTION</b> The prompting scrolls at a rate of 2/3 seconds when the [SET UP] or [FUNCTION] key is held in. Also, [s] or [t] keys will move Group prompts forward and backward at a rate twice as fast.</p>
<b>Changing values quickly</b>	When changing the value of a parameter, you can adjust a more significant digit in the upper display by holding in one key [s] or [t], and pressing the other [s] or [t] at the same time. The adjustment will move one digit to the left. Press the key again and you will move one more digit to the left.
<b>Restoring to the original value</b>	When you change the value or selection of a parameter while in Set Up mode and decide not to enter it, press the lower blank key once, the original value or selection will be recalled.
<b>Exiting SET UP mode</b>	To exit Set Up mode, press the [LOWER DISPLAY] key. This returns the display to the same state it was in immediately preceding entry into the Set Up mode.
<b>Timing out from Set Up mode</b>	If you are in Set Up mode and do not press any keys for one minute, the controller will time out and revert to the mode and display that was being used prior to entry into Set Up mode.
<b>Key Error</b>	<p>When a key is pressed and the prompt "KEY ERROR" appears in the lower display, it will be for one of the following reasons:</p> <ul style="list-style-type: none"> <li>• parameter not available</li> <li>• not in Set Up mode, press [SET UP] key first</li> <li>• key malfunction, do keyboard test (operation)</li> </ul>



## 3.5 Configuration Procedure

### Introduction

Each of the Set Up groups and their functions are pre-configured at the factory.

The factory settings are shown in the Set Up group tables that follow this procedure.

If you want to change any of these selections or values, follow the procedure in Table 3-2. This procedure tells you the keys to press to get to any Set Up group and any associated Function parameter prompt.

### Procedure

Follow the procedure listed in Table 3-2 to access the Set Up groups and Function prompts.

**ATTENTION** The prompting scrolls at a rate of 2/3 seconds when the [SET UP] or [FUNCTION] key is held in. Also, [s] [t] keys will move group prompts forward or backward at a rate of 1/3 seconds.

Table 3-2 Configuration Procedure







Step	Operation	Press	Result
1	Select Set Up mode	<b>SET UP</b>	<p>Upper Display  <input type="text" value="SET UP"/> Lets you know you are in the configuration mode and a Set Up group title is being displayed in the lower display.</p> <p>Lower Display  <input type="text" value="LOCKOUT"/> This is the first Set Up group title.</p>
2	Select any Set Up group	<b>SET UP</b>	<p>Successive presses of the [SET UP] key will sequentially display the other Set Up group titles shown in the prompt hierarchy in Figure 3-1.</p> <p>You can also use the [s] [t] keys to scan the Set Up groups in both directions.</p> <p>Stop at the Set Up group title which describes the group of parameters you want to configure. Then proceed to the next step.</p>
3	Select a Function Parameter	<b>FUNCTION</b>	<p>Upper Display  <input type="text" value="0"/></p> <p>Lower Display  <input type="text" value="SECURITY"/> Shows the first Function prompt within that Set Up group.</p> <p>Example displays show Set Up group "Lockout", Function prompt "Security" and the code selected.</p>

*Continued on next page*

## 3.5 Configuration Procedure, Continued

### Procedure, continued

Table 3-2 Configuration Procedure, Continued

Step	Operation	Press	Result
4	Select other Function Parameters		Successive presses of the [FUNCTION] key will sequentially display the other function prompts of the Set Up group you have selected.  Stop at the function prompt that you want to change, then proceed to the next step.
5	Change the value or selection	 or 	These keys will increment or decrement the value or selection that appears for the function prompt you have selected.  See "Configuration Tips" for instructions to increase or decrease value quickly.  Change the value or selection to meet your needs.  If the display flashes, you are trying to make an unacceptable entry.
6	Enter the value or selection	 or 	This key selects another Function prompt.  This key selects another Set Up group.  The value or selection you have made will be entered into memory after another key is pressed.
7	Exit Configuration		This exits configuration mode and returns the controller to the same state it was in immediately preceding entry into the Set Up mode. It stores any changes you have made.

## 3.6 Lockout Set Up Group

### Introduction

The Lockout group provides three levels of keyboard security to protect configuration and calibration data. To further secure this data, there is a security code that can be entered which will permit changes to the lockout configuration.

### Set this group last

DO NOT configure this group until all other configuration is complete.

### Function prompts

Table 3-3 lists the function prompts in the “LOCKOUT” Set Up group.

Table 3-3 Lockout Group Function Prompts

Function Prompt Lower Display	Function Name	Selections or Range of Setting Upper Display	Factory Setting
<b>SECURITY</b>	Security Code	0 to 4095	0
<b>LOCKOUT</b>	Configuration Lockout	NONE CALIB +CONF MAX	NONE

## 3.7 Limit Set Up Group

### Introduction

Limit control provides a latching output relay which is de-energized whenever the PV goes above (high limit) or below (low limit) a selected setpoint value. Reset is through the [RESET] key on the front of the controller or an optional external switch (Digital Input #1).

### Function prompts

Table 3-4 lists the function prompts in the “LIMIT” Set Up group.

Table 3-4 Limit Group Function Prompts

Function Prompt Lower Display	Function Name	Selections or Range of Setting Upper Display	Factory Setting
<b>LO or HI</b>	Type of Limit Control	LO LIM HI LIM	HI LIM
<b>EXT RSET</b>	External Reset (Digital Input 1)	DISABL ENABLE EXONLY	DISABL
<b>POWER UP</b>	Power-up Logic	NORMAL RESET	NORMAL
<b>SP HILIM</b>	High Setpoint Limit	0 to 100% of Span in engineering units  <b>ATTENTION</b> This value should never be set higher than the temperature limit of the oven or furnace being controlled.	1000
<b>SP LOLIM</b>	Low Setpoint Limit	0 to 100% of Span in engineering units	0

## 3.8 Input 1 Parameters Set Up Group

### Introduction

This data deals with various parameters required to configure Input 1.

### Function prompts

Table 3-5 lists all the function prompts in the “INPUT 1” Set Up group.

Table 3-5 Input 1 Group Function Prompts

Function Prompt Lower Display	Function Name	Selections or Range of Setting Upper Display	Factory Setting
<b>DECIMAL</b>	Decimal Point Location	XXXX None XXX.X One XX.XX Two	XXXX
<b>UNITS</b>	Temperature Units	DEG F DEG C NONE	NONE
<b>IN1 TYPE</b>	Input 1 Actuation Type	B TC      T TC L E TC H      W TC H E TC L      W TC L J TC H      100 PT J TC L      100 LO K TC H      200 PT K TC L      500 PT NNM H      RAD RH NNM L      RAD RI NM90 H      0-20mA* NM90 L      4-20mA* NIC TC      0-10mV* R TC      0-50mV* S TC      0-5 V* T TC H      1-5 V* 0-10V*  *not available for FM models	0-10mV (K TC H for FM only)
<b>XMITTER</b> <i>(not available for FM models)</i>	Transmitter Characterization	B TC      S TC E TC H      T TC H E TC L      T TC L J TC H      W TC H J TC L      W TC L K TC H      100 PT K TC L      100 LO NNM H      200 PT NNM L      500 PT NM90 H      RAD RH NM90 L      RAD RI NIC TC      LINEAR R TC      SQROOT	LINEAR
<b>IN1 HI</b>	Input 1 High Range Value (Linear Inputs and Radiamatic RI only)	-999. to 9999. in engineering units	1000 (2400 for FM only)
<b>IN1 LO</b>	Input 1 Low Range Value (Linear Inputs and Radiamatic RI only)	-999. to 9999. in engineering units	0

Continued on next page

## 3.8 Input 1 Group, Continued

Function prompts,  
continued

Table 3-5 lists all the function prompts in the “INPUT 1” Set Up group.

Table 3-5 Input 1 Group Function Prompts, Continued

Function Prompt Lower Display	Function Name	Selections or Range of Setting Upper Display	Factory Setting
<b>BIAS IN1</b>	Input 1 Bias	<i>FM</i> : -10.0 to +10.0 <i>Non-FM</i> : -999. to 9999.	0
<b>FILTER 1</b>	Input 1 Filter	0 to 120 seconds	0
<b>BURNOUT</b>	Burnout Protection	Burnout is fixed.  <i>For non-linear inputs:</i> High Limit Control = Upscale Low Limit Control = Downscale	UPSCALE for FM
<b>EMISSIV</b>	Emissivity	0.01 to 1.00	0
<b>PWR FREQ</b>	Power Line Frequency	60 Hz 50 Hz	60 Hz

## 3.9 Communications Set Up Group

### Introduction

This data deals with the Communications option that is available with your controller. This option allows the controller to be connected to a host computer via a RS422/485 or DMCS bus.

**ATTENTION** FM-approved Limit controllers with Communications option are limited to READ ONLY (monitoring only) functionality.

If your controller does not have the Communications option, the prompts will not appear.

### Function prompts

Table 3-6 lists all the function prompts in the “Com” Set Up group.

Table 3-6 Com Group Function Prompts

Function Prompt <small>Lower Display</small>	Function Name	Selections or Range of Setting <small>Upper Display</small>	Factory Setting
<b>ComSTATE</b>	Communications Option State	DISABL DMCS RS422	DISABL
<b>Com ADDR</b>	Communications Station Address	1 to 99	0
<b>SHEDTIME</b>	Shed Time	1 to 255 sample periods	0
<b>PARITY</b> (RS422/485 Only)	Parity	ODD EVEN	ODD
<b>BAUD</b> (RS422/485 Only)	Baud Rate	300      4800 600      9600 1200     19200 2400	300
<b>DUPLEX</b> (RS422/485 Only)	Duplex Operation	HALF FULL	HALF
<b>TX DELAY</b> (RS422/485 Only)	Transmission Delay	1 to 500 milliseconds	1
<b>LOOPBACK</b>	Local Loop Back	DISABL ENABLE	DISABL
<b>UNITS</b>	Communication Units	PERCNT ENG	ENG

## 3.10 Alarms Set Up Group

### Introduction

This data deals with the Alarms function that is available with your controller.

There are two alarms available. Each alarm has two setpoints. You can configure each of these two setpoints to alarm on one of nine events and you can configure each setpoint to alarm High or Low.

You can also configure the two setpoints to alarm on the same event and to alarm both high and low, if desired.

### Function prompts

Table 3-7 lists all the function prompts in the “ALARMS” Set Up group.

Table 3-7 Alarms Group Function Prompts

Function Prompt Lower Display	Function Name	Selections or Range of Setting Upper Display	Factory Setting
<b>A1S1 VAL</b>	Alarm 1, Setpoint 1 Value	Value in Engineering Units	90
<b>A1S2 VAL</b>	Alarm 1, Setpoint 2 Value	Value in Engineering Units	10
<b>A2S1 VAL</b>	Alarm 2, Setpoint 1 Value	Value in Engineering Units	95
<b>A2S2 VAL</b>	Alarm 2, Setpoint 2 Value	Value in Engineering Units	5
<b>A1S1TYPE</b>	Alarm 1, Setpoint 1 Type	NONE PV (Input 1) DEV (Deviation) SHED (Communications)	NONE
<b>A1S2TYPE</b>	Alarm 1, Setpoint 2 Type	Same as A1S1TYPE	NONE
<b>A2S1TYPE</b>	Alarm 2, Setpoint 1 Type	Same as A1S1TYPE	NONE
<b>A2S2TYPE</b>	Alarm 2, Setpoint 2 Type	Same as A1S1TYPE	NONE
<b>A1S1 H L</b>	Alarm 1, Setpoint 1 State	LO H I	HI
<b>A1S2 H L</b>	Alarm 1, Setpoint 2 State	LO H I	LO
<b>A2S1 H L</b>	Alarm 2, Setpoint 1 State	LO H I	HI
<b>A2S2 H L</b>	Alarm 2, Setpoint 2 State	LO H I	LO
<b>AL HYST</b>	Alarm Hysteresis	0.0 to 5.0% of Span or 100% Output, as appropriate	0.1



## 3.11 Calib Group

---

### Calibration data

The prompts used here are for field calibration purposes.  
Refer to *Section 6 – Calibration* in this manual for complete information and instructions.

---

## 3.12 Status Group

---

### Status Test Data

The prompts used here are read only.  
They are used to determine the reason for a controller failure.  
Refer to *Section 7 – Troubleshooting* in this manual for complete information.

---

### 3.13 Configuration Record Sheet

Keep a record

Enter the value or selection for each prompt on this sheet so you will have a record of how your controller was configured.

Group Prompt	Function Prompt	Value or Selection	Factory Setting	Group Prompt	Function Prompt	Value or Selection	Factory Setting	
<b>LOCKOUT</b>	SECURITY	_____	0000	<b>Com</b>	ComSTATE	_____	Disabl	
	LOCKOUT	_____	None		Com ADDR	_____	0	
<b>LIMIT</b>	LO or HI	_____	HI		SHEDTIME	_____	0	
	EXT RSET	_____	Disabl		PARITY	_____	Odd	
	POWER UP	_____	Normal		BAUD	_____	300	
	SP HILIM	_____	1000		DUPLEX	_____	Half	
	SP LOLIM	_____	0		TX DELAY	_____	1	
<b>INPUT 1</b>	DECIMAL	_____	XXXX		<b>ALARMS</b>	LOOPBACK	_____	Disabl
	UNITS	_____	None			UNITS	_____	Percent
	IN1 TYPE	_____	0-10mV			A1S1 VAL	_____	90
	XMITTER	_____	Linear	A1S2 VAL		_____	10	
	IN1 HI	_____	1000	A2S1 VAL		_____	95	
	IN1 LO	_____	0	A2S2 VAL		_____	5	
	BIAS IN1	_____	0	A1S1TYPE		_____	None	
	FILTER 1	_____	0	A1S2TYPE		_____	None	
	BURNOUT	_____	None	A2S1TYPE		_____	None	
	EMISSIV	_____	0	A2S2TYPE		_____	None	
PWR FREQ	_____	60Hz	A1S1 H L	_____	H I			
				A1S2 H L	_____	LO		
				A2S1 H L	_____	H I		
				A2S2 H L	_____	LO		
				AL HYST	_____	0.1		

#### FM Models only

Group Prompt	Function Prompt	Value or Selection	Factory Setting	Group Prompt	Function Prompt	Value or Selection	Factory Setting	
<b>LOCKOUT</b>	SECURITY	_____	0000	<b>Com</b>	ComSTATE	_____	Disabl	
	LOCKOUT	_____	None		Com ADDR	_____	0	
<b>LIMIT</b>	LO or HI	_____	HI		SHEDTIME	_____	0	
	EXT RSET	_____	Disabl		PARITY	_____	Odd	
	POWER UP	_____	Normal		BAUD	_____	300	
	SP HILIM	_____	1000		DUPLEX	_____	Half	
	SP LOLIM	_____	0		TX DELAY	_____	1	
<b>INPUT 1</b>	DECIMAL	_____	XXXX		<b>ALARMS</b>	LOOPBACK	_____	Disabl
	UNITS	_____	None			UNITS	_____	Percent
	IN1 TYPE	_____	K TC H			A1S1 VAL	_____	90
	IN1 HI	_____	2400	A1S2 VAL		_____	10	
	IN1 LO	_____	0	A2S1 VAL		_____	95	
	BIAS IN1	_____	0	A2S2 VAL		_____	5	
	FILTER 1	_____	0	A1S1TYPE		_____	None	
	BURNOUT	_____	Upscale	A1S2TYPE		_____	None	
	EMISSIV	_____	0	A2S1TYPE		_____	None	
	PWR FREQ	_____	60Hz	A2S2TYPE		_____	None	
				A1S1 H L	_____	H I		
				A1S2 H L	_____	LO		
				A2S1 H L	_____	H I		
				A2S2 H L	_____	LO		
				AL HYST	_____	0.1		

# Section 4 – Configuration Prompt Definitions

## 4.1 Overview

### Introduction

This section provides information for all the user configurable parameters listed in the configuration section. If you aren't familiar with these parameters, this section gives you the parameter prompt, the selection or range of setting that you can make, and a definition of how each parameter setting affects controller performance. It will also refer you to any other prompts that might be affected by your selection.

### What's in this section?

The table below lists the topics that are covered in this section. They are listed in the order of their appearance in the controller.

	<b>Contents</b>	<b>See Page</b>
4.1	Overview	33
4.2	Lockout Data Set Up Group	34
4.3	Limit Data Set Up Group	35
4.4	Input 1 Set Up Group	36
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## 4.2 Lockout Data Set Up Group

### Introduction

The Lockout group provides three levels of keyboard security to protect configuration and calibration data. To further secure the data, there is a security code that can be entered which will permit changes to the lockout configuration.

### Lockout group prompts

Table 4-1 lists all the function prompts in the “LOCKOUT” Set Up group and their definitions.

Table 4-1 Lockout Group Prompt Definitions

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
<b>SECURITY</b>	0-4095	<p><b>SECURITY CODE</b>—A security code may or may not be used to protect configuration or keyboard Lockout selection. In order to enable this feature, a code (up to four-digits) between 1 and 4095 must be entered, then the keyboard level lockout cannot be changed until you select this number (or 1000 as an override). After selecting this number here, be sure to copy and keep it in a secure location.</p> <p>NOTE: The Security Code is for keyboard entry only and is not available via communications.</p> <p>Can only be changed if “LOCKOUT” selection is “NONE.”</p>
<b>LOCKOUT</b>	<p>NONE</p> <p>CALIB</p> <p>+CONF</p> <p>MAX</p>	<p><b>LOCKOUT</b> applies to one of the functional groups: Configuration or Calibration. DO NOT CONFIGURE UNTIL ALL CONFIGURATION IS COMPLETE.</p> <p>No Lockout—all groups read/write.</p> <p><b>CALIB</b>—All are available for read/write except for the Calibration group.</p> <p><b>+CONF</b>—All groups are read only.</p> <p><b>MAX</b>—Only Lockout group is available. No other parameters are viewable.</p>

## 4.3 Limit Data Set Up Group

### Introduction

Limit control provides a latching output relay which is de-energized whenever the PV goes above (high limit) or below (low limit) a selected setpoint value. Reset is through the [RESET] key on the front of the controller or an optional external switch (Digital Input 1).

### Limit group prompts

Table 4-2 lists all the function prompts in the “LIMIT” Set Up group and their definitions.

Table 4-2 Limit Group Prompt Definitions

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
LO or HI	LO LIM  HI LIM	<b>LOW LIMIT CONTROL</b> —The latching output relay de-energizes when the PV goes below the configured setpoint. It cannot be reset until the PV rises above the configured setpoint.  <b>HIGH LIMIT CONTROL</b> —The latching output relay de-energizes when the PV goes above the configured setpoint. It cannot be reset until the PV drops below the configured setpoint.
EXT RSET	DISABL ENABLE EXONLY	<b>EXTERNAL RESET</b> —Only available with the Digital Input option. Allows the controller to be reset from a remote location by contact closure of a momentary-type switch.  DISABL = External reset is not active.  ENABLE = Enables external reset when Digital Input option is included in the controller.  EXONLY = Enables external reset and disables the keyboard [RESET] key.
POWER UP	NORMAL RESET	<b>POWER UP LOGIC</b> —What condition do you want the controller to be in at power up.  RESET = Latching relay will have to be reset.  NORMAL = Controller will operate in the same mode as before power was removed.
SP HILIM	0 to 100% of span input in engineering units with decimal place	<b>SETPOINT HIGH LIMIT</b> —This selection prevents the setpoint from going above the value selected here. The setting must be equal or less than the upper range of input 1.
SP LOLIM	0 to 100% of span input in engineering units with decimal place	<b>SETPOINT LOW LIMIT</b> —This selection prevents the setpoint from going below the value selected here. The setting must be equal or greater than the lower range of input 1.

## 4.4 Input 1 Parameters Set Up Group

### Introduction

These are the parameters required for input 1; temperature units, decimal location, actuation, transmitter characterization, high and low range values in engineering units, filter, burnout, emissivity, and power line frequency.

**Input 1 group prompts** Table 4-3 lists all the function prompts in the “INPUT 1” Set Up group and their definitions.

Table 4-3 Input 1 Group Definitions

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
DECIMAL	XXXX XXX.X XX.XX	<p><b>DECIMAL POINT LOCATION</b>—This selection determines where the decimal point appears in the display.</p> <p>None One Place Two Places</p> <p>NOTE: Auto-ranging will occur when one decimal position has been selected and the value increases above 999.9 but auto-ranging <i>will not</i> similarly occur when two decimal positions are selected.</p>
UNITS	DEG F DEG C NONE	<p><b>TEMPERATURE UNITS</b>—This selection will be indicated on the annunciator. What display of temperature do you want.</p> <p>Degrees Fahrenheit Degrees Celsius None</p>

*Continued on next page*

## 4.4 Input 1 Parameters Set Up Group, Continued

### Input 1 group prompts, continued

Table 4-3 Input 1 Group Definitions, Continued

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
<b>IN1 TYPE</b>		<b>INPUT 1 ACTUATION TYPE</b> —This selection determines what actuation you are going to use for input one.
B TC	B TC	B thermocouple 0 to 3300°F -18 to 1816°C
E TC H	E TC H	E thermocouple high -454 to 1832°F -270 to 1000°C
E TC L	E TC L	E thermocouple low -200 to 1100°F -129 to 593°C
J TC H	J TC H	J thermocouple high 0 to 1600°F -18 to 871°C
J TC L	J TC L	J thermocouple low 20 to 770°F -7 to 410°C
K TC H	K TC H	K thermocouple high 0 to 2400°F -18 to 1316°C
K TC L	K TC L	K thermocouple low -20 to 1000°F -29 to 538°C
NNM H	NNM NiNiMo thermocouple high	32 to 2500°F 0 to 1371°C
NNM L	NNM NiNiMo thermocouple low	32 to 1260°F 0 to 682°C
NM90 H	NiMo-NiCo thermocouple high	32 to 2500°F 0 to 1371°C
NM90 L	NiMo-NiCo thermocouple low	32 to 1260°F 0 to 682°C
NIC TC	NIC Nicrosil-Nisil thermocouple	0 to 2372°F -18 to 1300°C
R TC	R thermocouple	0 to 3100°F -18 to 1704°C
S TC	S thermocouple	0 to 3100°F -18 to 1704°C
T TC H	T thermocouple high	-300 to 700°F -184 to 371°C
T TC L	T thermocouple low	-200 to 500°F -129 to 260°C
W TC H	W5W26 thermocouple high	0 to 4200°F -18 to 2315°C
W TC L	W5W26 thermocouple low	0 to 2240°F -18 to 1227°C
100 PT	100 Ohm-RTD	-300 to 1200°F -184 to 649°C
100 LO	100 Ohm RTD low	-300 to 300°F -184 to 149°C
200 PT	200 Ohm RTD	-300 to 1200°F -184 to 649°C
500 PT	500 Ohm-RTD	-300 to 1200°F -184 to 649°C
RAD RH	Radiamatic (Type RH)	0 to 3400°F -18 to 1871°C
RAD RI	Radiamatic (Type RI)	
0-20mA	0 to 20 Milliamps*	
4-20mA	4 to 20 Milliamps*	
0-10mV	0 to 10 Millivolts*	
0-50mV	0 to 50 Millivolts*	
0-5 V	0 to 5 Volts*	
1-5 V	1 to 5 Volts*	
0-10 V	0 to 10 Volts*	
		<i>*not available for FM models</i>

Continued on next page

## 4.4 Input 1 Parameters Set Up Group, Continued

### Input 1 group prompts, continued

Table 4-3 Input 1 Group Definitions, Continued

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
<b>XMITTER</b> <i>(not available for FM models)</i>	B TC E TC H E TC L J TC H J TC L K TC H K TC L NNM H NNM L NM90 H NM90 L NIC TC R TC S TC T TC H T TC L W TC H W TC L 100 PT 100 LO 200 PT 500 PT RAD RH RAD RI LINEAR SQROOT	<b>TRANSMITTER CHARACTERIZATION</b> —This selection lets you instruct the controller to characterize a linear input to represent a non-linear one.  NOTE: Prompt only appears when a linear actuation is selected at prompt 'IN1 TYPE'.  FOR EXAMPLE: If input 1 is a 4 to 20 mA signal, but the signal represents a type "K" thermocouple; select "K TC H" and the controller will characterize the 4 to 20 mA signal so that it is treated as a type "K" thermocouple input (high range).  B Type Thermocouple E Type Thermocouple High E Type Thermocouple Low J Type Thermocouple High J Type Thermocouple Low K Type Thermocouple High K Type Thermocouple Low NNM NiNiMo Type Thermocouple High NNM NiNiMo Type Thermocouple Low NiMo-NiCo Type Thermocouple High NiMo-NiCo Type Thermocouple Low NIC Nicrosil Nisil Thermocouple R Type Thermocouple S Type Thermocouple T Type Thermocouple High T Type Thermocouple Low W5W26 Type Thermocouple High W5W26 Type Thermocouple Low 100 Ohm-RTD 100 Ohm RTD low 200 Ohm-RTD 500 Ohm-RTD Radamatic (Type RH) Radamatic (Type RI) Linear Range Extracts Square Root

*Continued on next page*



## 4.4 Input 1 Parameters Set Up Group, Continued

### Input 1 group prompts, continued

Table 4-3 Input 1 Group Definitions, Continued

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
<b>IN1 HI</b>	–999. to 9999. in Engineering units	<p><b>INPUT 1 HIGH RANGE VALUE</b> in engineering units is displayed for all inputs but can only be configured for Radiamatic RI, linear, or square root transmitter characterization.</p> <p>Scale the #1 input signal to the display value you want for 100%.</p> <p>EXAMPLE:                      Actuation (Input) = 4 to 20 mA                      Alarms Set Up GroupžXE "Alarms Set Up Group" \i ž TC "3.10 .ii.Alarms Set Up Group" \i 4 ;</p> <p>Introduction“This                      The control setpoint will be limited by the range of units selected here.</p>
<b>IN1 LO</b>	–999. to 9999. in Engineering units	<p><b>INPUT 1 LOW RANGE VALUE</b> in engineering units is displayed for all inputs but can only be configured for Radiamatic RI, linear, or square root transmitter characterization. Scale the #1 input signal to the display value you want for 0%. See example given in IN1 HI. The control setpoint for Input 1 will be limited by the range of units selected here.</p>
<b>BIAS IN1</b>	<i>Non-FM:</i> –999. to 9999. <i>FM:</i> –10.0 to +10.0	<p><b>BIAS ON INPUT 1</b>—Bias is used to compensate the input for drift of an input value due to deterioration of a sensor, or some other cause.</p> <p>Select the bias value you want on input one.</p>
<b>FILTER 1</b>	0 to 120 seconds No filter = 0	<p><b>FILTER FOR INPUT ONE</b>—A software digital filter is provided for input 1 to smooth the input signal. You can configure the first order lag time constant from 1 to 120 seconds.</p> <p>If you do not want filtering, enter 0.</p>
<b>BURNOUT</b>	Burnout is preset based on the type of model.	<p><b>BURNOUT PROTECTION (SENSOR BREAK)</b> provides most input types with upscale or downscale protection if the input fails.</p> <p><b>NO BURNOUT</b> applies to linear inputs.</p> <p><b>HIGH LIMIT CONTROLLERS</b> have upscale burnout.</p> <p><b>LOW LIMIT CONTROLLERS</b> have downscale burnout.</p>
<b>EMISSIV</b>	0.01 to 1.00	<p><b>EMISSIVITY</b> is a correction factor applied to the Radiamatic input signal that is the ratio of the actual energy emitted from the target to the energy which would be emitted if the target were a perfect radiator. Available only for “Radiamatic” inputs.</p>
<b>PWR FREQ</b>	60 Hz 50 Hz	<p><b>POWER LINE FREQUENCY</b>—select whether your controller is operating at 60 Hz or 50 Hz.</p> <p><b>60 HERTZ</b> <b>50 HERTZ</b></p>

## 4.5 Communications Set Up Group

### Introduction

This option allows the controller to be connected to a host computer via a RS422/485 or DMCS bus. Fifteen units can be configured over this link. The controller looks for messages from the computer at regular intervals. If these messages are not received within the configured shed time, the controller will SHED from the communications link and return to stand alone operation. The device address, parity, and baud rate are configurable.

**ATTENTION** FM-approved Limit controllers with Communications option are limited to READ ONLY (monitoring only) functionality.

### Communications group prompts

Table 4-4 lists all the function prompts in the “COMMUNICATIONS” Set Up group and their definitions.

Table 4-4 Communications Group Definitions

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
<b>ComSTATE</b>	RS422 DMCS DISABL	<b>COMMUNICATIONS SELECTION</b> <b>RS422</b> —Allows RS422/485 communication prompts. <b>DMCS</b> —Allows DMCS communication prompts. <b>DISABL</b> —Disables the communications option.
<b>Com ADDR</b>	1 to 99 (RS422) 1 to 99 (DMCS)	<b>COMMUNICATION STATION ADDRESS</b> —This is a number that is assigned to a controller that is to be used with the communications option.
<b>SHEDTIME</b>	0 to 255	<b>SHED TIME</b> —The number that represents how many sample periods there will be before the controller sheds from communications. Each period equals 1/3 seconds or 0 = No shed.
<b>PARITY</b> (RS422/485 only)	ODD EVEN	<b>PARITY</b> pertains to the use of a self-checking code employing binary digits in which the total number of ONE's (or ZERO's) in each permissible code expression is either ODD or EVEN.  <b>ODD PARITY</b> <b>EVEN PARITY</b>
<b>BAUD</b> (RS422/485 only)	300 600 1200 2400 4800 9600 19200	<b>BAUD RATE</b> is the transmission speed in bits per second.  <b>300 BAUD</b> <b>600 BAUD</b> <b>1200 BAUD</b> <b>2400 BAUD</b> <b>4800 BAUD</b> <b>9600 BAUD</b> <b>19200 BAUD</b>

*Continued on next page*

## 4.5 Communications Set Up Group, Continued

### Communications group prompts, continued

Table 4-4 Communications Group Definitions, Continued

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
<b>DUPLEX</b> (RS422/485 only)	HALF FULL	<b>DUPLEX</b> —Transmission Type <b>HALF DUPLEX</b> —Two wires <b>FULL DUPLEX</b> —Four wires
<b>TX DELAY</b> (RS422/485 only)	1 to 500 milliseconds	<b>TX DELAY</b> —Configurable response-delay timer allows you to force the UDC to delay its response for a time period of from 1 to 500 milliseconds compatible with the host system hardware/software.
<b>LOOPBACK</b>	ENABLE  DISABL	<b>LOCAL LOOPBACK</b> tests the communications hardware. <b>ENABLE</b> —Allows loopback test. The UDC goes into Loopback mode in which it sends and receives its own message. The UDC displays “PASS” or “FAIL” in the upper display and “LOOPTEST” in the lower display as long as the test is running. The UDC will go into manual mode. The test will run until the operator disables it here. <b>DISABLE</b> —disables the Loopback test.
<b>UNITS</b>	PERCNT ENG	<b>COMMUNICATION UNITS</b> —This selection determines how the controller values are expressed during communications. <b>PERCENT OF SPAN ENGINEERING UNITS</b>

## 4.6 Alarms Set Up Group

### Introduction

An alarm is an indication that an event that you have configured (for example—Process Variable) has exceeded one or more alarm limits. There are two alarms available. Each alarm has two setpoints. You can configure each of these two setpoints to alarm on various controller parameters. There are two alarm output selections, High and Low. You can configure each setpoint to alarm either High or Low. These are called single alarms. You can also configure the two setpoints to alarm on the same event and to alarm both high and low. A single adjustable Hysteresis of 0.0% to 5.0% is configurable for the alarm setpoint.

### Alarms group prompts

Table 4-5 lists all the function prompts in the “ALARMS” Set Up group and their definitions.

Table 4-5 Alarms Group Definitions

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
A1S1 VAL	Value in Engineering Units	<b>ALARM 1 SETPOINT 1 VALUE</b> —This is the value at which you want the alarm type chosen in Prompt "A1S1TYPE" to actuate. The value depends on what the setpoint has been configured to represent. NO setpoint is required for Communications SHED.
A1S2 VAL	Value in Engineering Units	<b>ALARM 1 SETPOINT 2 VALUE</b> —This is the value at which you want the alarm type chosen in Prompt "A1S2TYPE" to actuate.  The details are the same as “A1S1 VAL”.
A2S1 VAL	Value in Engineering Units	<b>ALARM 2 SETPOINT 1 VALUE</b> —This is the value at which you want the alarm type chosen in Prompt “A2S1TYPE” to actuate.  The details are the same as “A1S1 VAL”.
A2S2 VAL	Value in Engineering Units	<b>ALARM 2 SETPOINT 2 VALUE</b> —This is the value at which you want the alarm type chosen in Prompt “A2S2TYPE” to actuate.  The details are the same as “A1S1 VAL”.
A1S1TYPE	NONE PV DEV SHED	<b>ALARM 1 SETPOINT 1 TYPE</b> —Select what you want Setpoint 1 of Alarm 1 to represent. It can represent the Deviation or Input 1, and if you have a model with communications, you can configure the controller to alarm on SHED.  <b>NO ALARM INPUT 1 DEVIATION SHED FROM COMMUNICATIONS</b>

*Continued on next page*

## 4.6 Alarms Set Up Group, Continued

### Alarms group prompts, continued

Table 4-5 Alarms Group Definitions, Continued

Lower Display Prompt	Upper Display Range of Setting or Selection	Parameter Definition
<b>A1S2TYPE</b>	Same as A1S1 TYPE	<b>ALARM 1 SETPOINT 2 TYPE</b> —Select what you want Setpoint 2 of Alarm 1 to represent. The selections are the same as A1S1TYPE.
<b>A2S1TYPE</b>	Same as A1S1 TYPE	<b>ALARM 2 SETPOINT 1 TYPE</b> —Select what you want Setpoint 1 of Alarm 2 to represent. The selections are the same as A1S1TYPE.
<b>A2S2TYPE</b>	Same as A1S1 TYPE	<b>ALARM 2 SETPOINT 2 TYPE</b> —Select what you want Setpoint 2 of Alarm 2 to represent. The selections are the same as A1S1TYPE.
<b>A1S1 H L</b>	H I LO	<b>ALARM 1 SETPOINT 1 STATE</b> —Select whether you want the alarm type chosen in Prompt "A1S1TYPE" to alarm High or Low .  <b>HI ALARM</b> <b>LO ALARM</b>
<b>A1S2 H L</b>	H I LO	<b>ALARM 1 SETPOINT 2 STATE</b> —Select whether you want the alarm type chosen in Prompt "A1S2TYPE" to alarm High or Low .  <b>HI ALARM</b> <b>LO ALARM</b>
<b>A2S1 H L</b>	H I LO	<b>ALARM 2 SETPOINT 1 STATE</b> —Select whether you want the alarm type chosen in Prompt "A2S1TYPE" to alarm HIGH or LOW.  <b>HI ALARM</b> <b>LO ALARM</b>
<b>A2S2 H L</b>	H I LO	<b>ALARM 2 SET POINT 2 STATE</b> —Select whether you want the alarm type chosen in Prompt "A2S2TYPE" to alarm HIGH or LOW.  <b>HI ALARM</b> <b>LO ALARM</b>
<b>AL HYST</b>	0.0 to 5.0% of span or full output as appropriate	<b>ALARM HYSTERESIS</b> —A single adjustable hysteresis is provided on alarms such that when the alarm is OFF it activates at exactly the alarm setpoint; when the alarm is ON, it will not deactivate until the variable is 0.0% to 5.0% away from the alarm setpoint.  Configure the hysteresis of the alarms based on INPUT signals as a % of input range span.

## 4.7 Calibration Data

---

### Introduction

The prompts used here are for field calibration purposes. Refer to *Section 6 – Calibration* in this manual for complete information.

---

## 4.8 Status Test Data

---

### Introduction

The prompts used here are for determining the reason for a controller failure. Refer to the *Section 7 – Troubleshooting* in this manual for complete information.

---

# Section 5 – Operation

## 5.1 Overview

### Introduction

This section gives you all the information necessary to monitor and operate your controller. Review the Operator Interface shown in “Monitoring” to make sure you are familiar with the indicator definitions. The key functions are listed in *Section 1 — Overview*.

### What's in this section?

This section contains the following topics:

	Topic	See Page
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	Diagnostic Tests	46
	Troubleshooting	46
	Display and Key Check	47
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		48
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	Selecting a Setpoint Value	50
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	Digital Input Option	51
	How to Reset the Latching Relay	51
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	Introduction	54
	Displaying or Changing the Alarm Setpoints	54
5.7	Restarting After a Power Loss	55

## 5.2 How to Power Up the Controller

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### Apply power

When power is applied, the controller will run three diagnostic tests. All the displays will light and then the controller will go into automatic mode.

---

### Diagnostic tests

Table 5-1 lists the three diagnostic tests.

Table 5-1 Power Up Diagnostic Tests

Prompt on Lower Display	Condition
RAM TEST	Check RAM
CONFTEST	Check Non-volatile memory
CAL TEST	Check Calibration

---

### Test failures

If one or more of these tests fail, the controller will go to the Failsafe Mode, and “FAILSAFE” will flash in the lower display.

---

### Troubleshooting

Refer to “STATUS TESTS” in *Section 7 — Troubleshooting* to identify and correct the problem.

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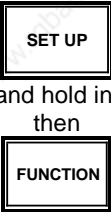


## 5.2 How to Power Up the Controller, Continued

### Check the displays and keys

Use the procedure in Table 5-2 to run the display and key test.

Table 5-2 Procedure for Testing the Displays and Keys

Press	Result																						
<div style="text-align: center;">  <p>and hold in, then</p> <p>at the same time</p> </div>	<p>The controller will run a display test. All the displays will light for 8 seconds, then the displays will look like this:</p> <div style="text-align: center;"> <p>Upper Display</p> <div style="border: 1px solid black; padding: 2px; display: inline-block;">keys</div> <p>Lower Display</p> <div style="border: 1px solid black; padding: 2px; display: inline-block;">try all</div> </div>																						
<p>Press each key to see if it works</p>	<p>When the key is pressed, the lower display will indicate the name of the key pressed.</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Key Pressed</th> <th>Lower Display</th> </tr> </thead> <tbody> <tr> <td>FUNCTION</td> <td>FUNCTION</td> </tr> <tr> <td>LOWER DISPLAY</td> <td>LWR DISP</td> </tr> <tr> <td>SET UP</td> <td>SET UP</td> </tr> <tr> <td>▲</td> <td>INCRMENT</td> </tr> <tr> <td>▼</td> <td>DECRMENT</td> </tr> <tr> <td>RESET</td> <td>RESET</td> </tr> <tr> <td>▲ + ▼</td> <td>INCRDECR</td> </tr> <tr> <td>FUNCTION+SETUP</td> <td>FUNC SU</td> </tr> <tr> <td>UPPER BLANK KEY</td> <td>UNUSED</td> </tr> <tr> <td>LOWER BLANK KEY</td> <td>RESTORE</td> </tr> </tbody> </table>	Key Pressed	Lower Display	FUNCTION	FUNCTION	LOWER DISPLAY	LWR DISP	SET UP	SET UP	▲	INCRMENT	▼	DECRMENT	RESET	RESET	▲ + ▼	INCRDECR	FUNCTION+SETUP	FUNC SU	UPPER BLANK KEY	UNUSED	LOWER BLANK KEY	RESTORE
Key Pressed	Lower Display																						
FUNCTION	FUNCTION																						
LOWER DISPLAY	LWR DISP																						
SET UP	SET UP																						
▲	INCRMENT																						
▼	DECRMENT																						
RESET	RESET																						
▲ + ▼	INCRDECR																						
FUNCTION+SETUP	FUNC SU																						
UPPER BLANK KEY	UNUSED																						
LOWER BLANK KEY	RESTORE																						

If no key is pressed for 20 seconds, the test will time out and the controller will go into control mode.

If any test fails, go to “Controller Failure Symptoms” in *Section 7 — Troubleshooting*.

### Key error

When a key is pressed and the prompt “KEY ERROR” appears in the lower display, it will be for one of the following reasons:

- parameter not available,
- not in Set Up mode, press [SET UP] key first,
- key malfunction, do keyboard test.

## 5.3 Enter a Security Code

### Introduction

The LOCKOUT feature in the UDC3300 is used to inhibit changes (via keyboard) of certain functions or parameters by unauthorized personnel. There are different levels of LOCKOUT depending on the level of security required. These levels are:

NONE  
CALIB  
+CONF  
MAX

See *Section 4 — Configuration Definitions* for details.

### Security code numbers

The level of keyboard lockout may be changed in the Set Up mode. However, knowledge of a security code number (1 to 4095) may be required to change from one level of lockout to another.

When a controller leaves the factory, it has a security code of 0 which permits changing from one lockout level to another without entering any other code number.


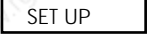






### Procedure

If you require the use of a security code, select a number from 1 to 4095 and enter it when the lockout level is configured as “NONE”. Thereafter, that selected number must be used to change the lockout level from something other than “NONE”.

**CAUTION** Write the number on the Configuration Record Sheet in the configuration section so you will have a permanent record; or, in case of a problem, refer to the keyboard failure troubleshooting section.

Use the procedure in Table 5-3 to enter a security code.

Table 5-3 Procedure for Entering a Security Code

Step	Press	Action
1		Until you see Upper Display  Lower Display 
2		Until you see Upper Display  Lower Display 
3	 or 	to enter a four digit number in the upper display (1 to 4095) This will be your security code.

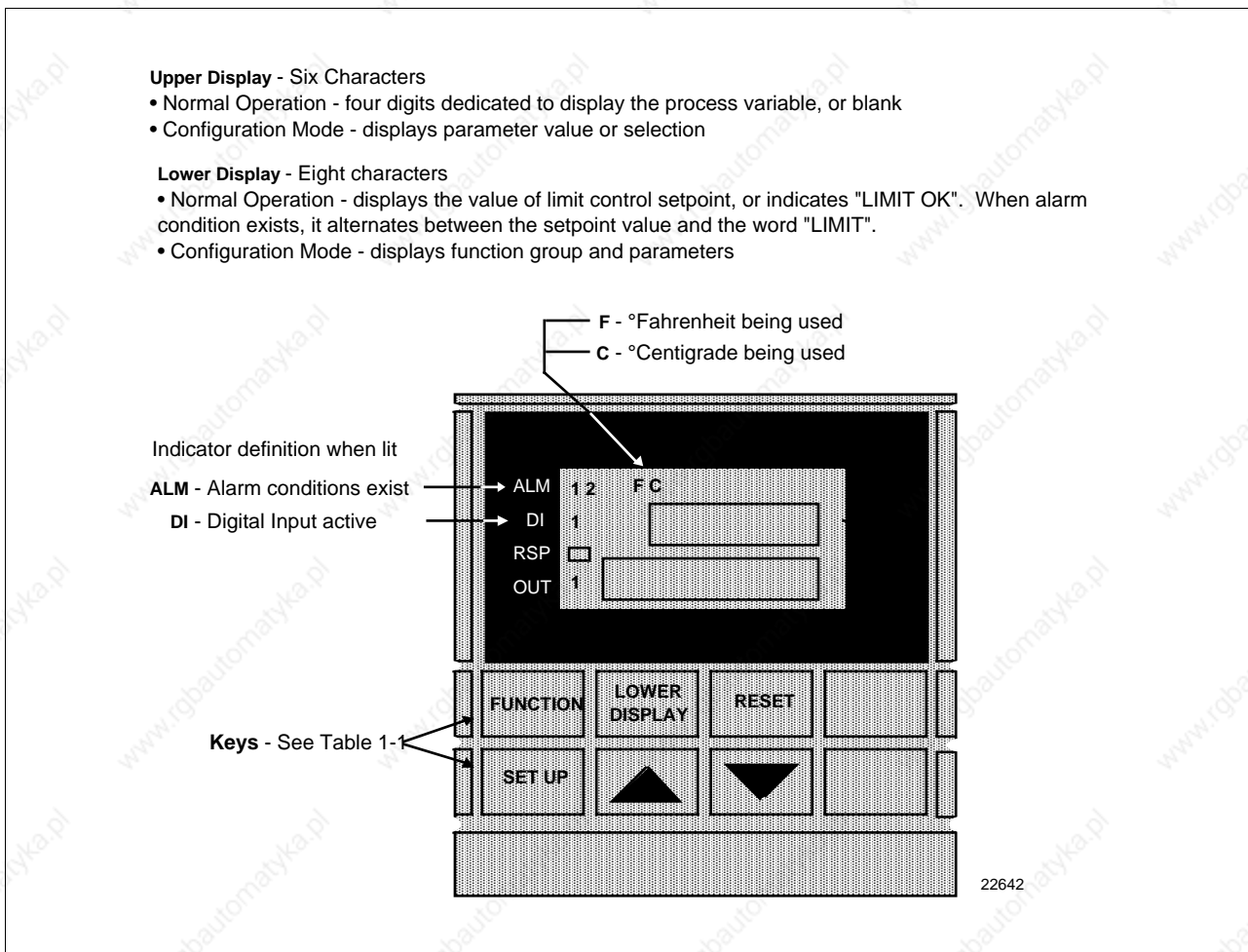
## 5.4 How to Operate Your Limit Controller

### Overview

The indicators and displays on the operator interface let you see what is happening to your process and how the controller is responding.

Figure 5-1 is a view of the operator interface. A description of the displays and indicators is included.

Figure 5-1 Operator Interface



**Decimal point position** In each display, when no decimal place is configured, the right-most character is blank.

When a single decimal position has been configured and values greater than 1000 are displayed, the right-most character is blank but the decimal point will be lit.

*Continued on next page*

## 5.4 How to Operate Your Limit Controller, Continued

### Operating principles

The UDC3300 Limit Controller accepts signals from such sources as thermocouples (T/Cs), Resistance Temperature Detectors (RTDs), milliamps, millivolts, and volts dc. The equivalent PV signal is compared with the limit setpoint and any error (difference) de-energizes a limit output relay. When de-energized, the output relay locks out and remains in this state until the PV input signal drops below the high limit setpoint or rises above the low limit setpoint, and the controller is reset manually from the front of the controller or through an optional external switch.

### Setting a display mode

When an alarm condition exists, there are three display modes from which to choose:

Press [LOWER DISPLAY] key to successively select one of the following three modes.

#### DISPLAY MODE #1

Upper Display = the value of the PV

Lower Display = the limit control setpoint value

#### DISPLAY MODE #2

Upper Display = (blank)

Lower Display = the limit control setpoint value

#### DISPLAY MODE #3

Upper Display = (blank)

Lower Display = LIMIT OK

### Viewing limit action duration or peak PV value

When an alarm condition exists, you can view the parameters listed in Table 5-4.

Table 5-4 Limit Action Duration or Peak PV Value

To View	Press	Lower Display Shows
Limit Action Duration	LOWER DISPLAY	the limit action duration in hours:minutes as "TIME XX.XX".
Peak PV Value	LOWER DISPLAY	the highest PV value reached for a high limit controller, or the lowest PV value reached for a low limit controller as "PK XXXX".



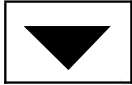
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## 5.4 How to Operate Your Limit Controller, Continued

### Selecting a setpoint value

Use the procedure in Table 5-5 to change the setpoint value in the lower display.

Table 5-5 Change a Setpoint Value Procedure

Step	Press	Action
1		until you have selected display mode #1 or #2.
2	 or 	This changes the value of the limit controller setpoint.  NOTE: To change setpoint values quickly, you can adjust a more significant digit in the lower display by holding in one key [s] or [t] and pressing the other [s] or [t] at the same time. The adjustment will move one digit to the left. Press the key again and you will move another digit to the left.

### High or low limit indication

When the High or Low limit setpoint is exceeded the lower display alternately indicates “the limit control setpoint value” and the word “LIMIT.” This will continue until you reset the latching relay.

### Non-latching relay alarm conditions

The alarm is active if alarm setpoint 1 or alarm setpoint 2 is exceeded. The alarm goes inactive when the value goes into the allowed region by more than the hysteresis.

### Digital input option

The digital input option detects the state of external contacts. On contact closure, the limit controller will be reset if the option has been enabled at prompt “EXT RSET” in Set Up group “Limit.” (See Sections 3 and 4 for explanation.)

### How to reset the latching relay

The latching relay cannot be reset until the PV input signal drops below the high limit setpoint or rises above the low limit setpoint.

Press the [RESET] key or make contact closure of an external switch if the digital input option is present.

## 5.5 How to Monitor Your Limit Controller

### Diagnostic error messages

The UDC3300 performs background tests to verify data and memory integrity. If there is a malfunction, an error message will be displayed. In the case of more than one simultaneous malfunctions, only the one with the highest priority will appear on the lower display.

A list of error messages is contained in Table 5-6.

If any of these error messages occur, refer to *Section 7 — Troubleshooting* for information to correct the failure.

Table 5-6 Error Messages

Prompt	Description
<b>EE FAIL</b>	Unable to write to non-volatile memory
<b>FAILSAFE</b>	Failsafe
<b>INP1FAIL</b>	Two consecutive failures of input 1 integration
<b>INP1 RNG</b>	Input 1 out-of-range Linear: $\pm 10\%$ out-of-range Characterized: $\pm 1\%$ out-of-range
<b>PV LIMIT</b>	PV $\pm 10\%$ out-of-range

*Continued on next page*

## 5.5 How to Monitor Your Limit Controller, Continued

---

### RS422 communications

Refer to the separate manual shipped with this controller.

---

### DMCS communications (also refer to Gateway manual — Section 10)

#### *Changing Parameters from the Keyboard*

The following occurs when parameters are changed from the keyboard:

#### LOCAL SETPOINT

When the local setpoint is changed, its new value will be entered into non-volatile memory as soon as another key is pressed (other than raise/lower). If no other key is pressed, the new setpoint is automatically entered into non-volatile memory ONE-HALF MINUTE following the last change. Obviously, if someone turns power off a unit within one-half minute following a setpoint change and during which there was no further keyboard activity, the new setpoint will not be remembered when power is restored.

#### OTHER THAN SETPOINT

When any parameter, other than setpoint, is changed, its new value will be entered into non-volatile memory as soon as another key (other than raise/lower) is pressed. If no other key is pressed, the new parameter is automatically entered into non-volatile memory at one minute following the last change. Obviously, if someone turns the power off a unit within one minute following a parameter change (other than setpoint) and during which there was no further keyboard activity, the new parameter value will not be remembered when power is restored.

#### MONITORING DMCS COMMUNICATIONS

When a Limit Controller (non-FM models only) goes into “slave” mode, the LED indicator for RSP goes “ON” indicating “SLAVE” mode. Also, the ▲▼ keys do not work. You cannot make any adjustments to the configurable parameters.

---

## 5.6 Alarm Setpoints

### Introduction

An alarm consists of a relay contact and an operator interface indication. The alarm is de-energized if Setpoint 1 or Setpoint 2 is exceeded. The alarm is energized when the monitored value goes into the allowed region by more than the hysteresis.




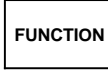


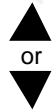

The relay contacts can be wired for normally open (NO) or normally closed (NC) at the rear terminals. See *Section 2 — Installation* for details.

There are four alarm setpoints, two for each alarm. The type and state (High or Low) is selected during configuration. See *Section 3 — Configuration* for details.

### Procedure for displaying and changing the alarm setpoints

The procedure for displaying and changing the alarm setpoints is listed in Table 5-7.

Table 5-7 Procedure for Displaying or Changing the Alarm Setpoints

Step	Operation	Press	Action
1	Access the Alarm Set Up group		Until you see: Upper Display  Lower Display 
2	Access the Alarm Setpoint Values		until you see the desired alarm setpoint and its value. The specific prompts are shown below. Upper Display  ← The alarm setpoint value Lower Display 
			to change any alarm setpoint value you select in the upper display.
3	Return to normal operation		



## 5.7 Restarting After Power Loss

---

### Power-up logic

Configurable power-up logic lets you select the latching output relay to require “reset” or to provide normal operation at power-up.

If the power to the controller fails and power is reapplied, the controller goes through power-up tests then starts in one of the following configurable conditions:

---

### Display indications

*If you have configured:*

UPPER DISPLAY = RESET  
LOWER DISPLAY = POWER UP

- The lower display will alternately blink the limit setpoint value and the word “LIMIT.” This will require reset via the [RESET] key or external switch to obtain normal operation.

*If you have configured:*

UPPER DISPLAY = NORMAL  
LOWER DISPLAY = POWER UP

- The displays and controller will function normally; i.e., no reset of latching relay is required unless a limit has been exceeded. If the limit was latched when power went down, the unit will be in limit at power-up.

Refer to the Configuration section under Set Up prompt “LIMIT” and make your selection at Function prompt “POWER UP.”

---

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# Section 6 – Input Calibration

## 6.1 Overview

### Introduction

This section describes the field calibration procedures for Input 1.

Every UDC3300 Limit controller contains all input actuation ranges fully factory calibrated and ready for configuration to range by the user.

However, these procedures can be implemented if the factory calibration of the desired range is not within specifications.

Note that the field calibration will be lost if a change in input type configuration is implemented at a later time. The original factory calibration data remains available for later use after a field calibration is done.

### What's in this section

This section contains the following topics:

	Topic	See Page
6.1	Overview	57
6.2	Minimum and maximum range values	58
6.3	Preliminary Information <ul style="list-style-type: none"><li>• Disconnect the field wiring</li><li>• Equipment needed</li></ul>	59 59 60
6.4	Input 1 Set Up Wiring <ul style="list-style-type: none"><li>• Thermocouple inputs using an ice bath</li><li>• Thermocouple inputs using a precision resistor</li><li>• RTD (Resistance Thermometer Device) inputs</li><li>• Radiamatic, Millivolts, or Volts except 0-10 Volts inputs</li><li>• 0 to 10 Volts input</li><li>• 4-20 Milliamps input</li></ul>	61 61 62 63 64 65 66
6.5	Input 1 Calibration Procedure	67



## WARNING—SHOCK HAZARD



**INPUT CALIBRATION MAY REQUIRE ACCESS TO HAZARDOUS LIVE CIRCUITS, AND SHOULD ONLY BE PERFORMED BY QUALIFIED SERVICE PERSONNEL. MORE THAN ONE SWITCH MAY BE REQUIRED TO DE-ENERGIZE UNIT BEFORE CALIBRATION.**

## 6.2 Minimum and Maximum Range Values

### Select the range values

You should calibrate the controller for the minimum (0%) and maximum (100%) range values of your particular sensor.

Select the Voltage or Resistance equivalent for 0% and 100% range values from Table 6-1. Use these values when calibrating your controller.

Table 6-1 Voltage and Resistance Equivalents for 0% and 100% Range Values

Sensor Type	PV Input Range		Range Values	
	° F	° C	0%	100%
<b>Thermocouples</b>				
<b>B</b>	0 to 3300	-18 to 1816	-0.100 mV	13.769 mV
<b>E</b>	-454 to 1832	-270 to 1000	-9.835 mV	76.373 mV
<b>E (low)</b>	-200 to 1100	-129 to 593	-6.472 mV	44.455 mV
<b>J</b>	0 to 1600	-18 to 871	-0.886 mV	50.060 mV
<b>J (low)</b>	20 to 770	-7 to 410	-0.334 mV	22.400 mV
<b>K</b>	0 to 2400	-18 to 1816	-0.692 mV	52.952 mV
<b>K (low)</b>	-20 to 1000	-29 to 538	-1.114 mV	22.255 mV
<b>NiNiMoly (NNM68)</b>	32 to 2500	0 to 1371	0.000 mV	71.330 mV
<b>NiNiMoly (low)</b>	32 to 1260	0 to 682	0.000 mV	31.820 mV
<b>NiMo-NiCo (NM90)</b>	32 to 2500	0 to 1371	0.000 mV	71.773 mV
<b>NiMo-NiCo (low)</b>	32 to 1260	0 to 682	0.000 mV	31.825 mV
<b>Nicrosil Nisil (Nic)</b>	0 to 2372	-18 to 1300	-0.461 mV	47.513 mV
<b>R</b>	0 to 3100	-18 to 1704	-0.090 mV	20.281 mV
<b>S</b>	0 to 3100	-18 to 1704	-0.092 mV	17.998 mV
<b>T</b>	-300 to 700	-184 to 371	-5.341 mV	19.097 mV
<b>T (low)</b>	-200 to 500	-129 to 260	-4.149 mV	12.574 mV
<b>W5W26</b>	0 to 4200	-18 to 2315	-0.234 mV	37.075 mV
<b>W5W26 (low)</b>	0 to 2240	-18 to 1227	-0.234 mV	22.283 mV
<b>Honeywell Radiamatic</b>				
<b>Type RH</b>	0 to 3400	-18 to 1871	0.00 mV	57.12 mV
<b>Type RI</b>	0 to 3200	-18 to 1760	0.00 mV	60.08 mV
<b>RTD</b>				
<b>(IEC Alpha=0.00385)</b>				
<b>100 ohms</b>	-300 to 1200	-184 to 649	25.18 ohms	274.96 ohms
<b>100 ohms (low)</b>	-300 to 300	-184 to 149	25.18 ohms	156.90 ohms
<b>200 ohms</b>	-300 to 1200	-184 to 649	50.36 ohms	549.92 ohms
<b>500 ohms</b>	-300 to 1200	-184 to 649	125.90 ohms	1374.80 ohms
<b>Linear</b>				
<b>Milliamps</b>	4 to 20 mA* 0 to 20 mA*		4.00 mA 0.00 mA	20.00 mA 20.00 mA
<b>Millivolts</b>	0 to 10 mV* 0 to 50 mV*		0.00 mV 0.00 mV	10.00 mV 50.00 mV
<b>Volts</b>	1 to 5 Volts* 0 to 5 Volts* 0 to 10 Volts*		1.00 Volts 0.00 Volts 0.00 Volts	5.00 Volts 5.00 Volts 10.00 Volts

\* not available for FM models

## 6.3 Preliminary Information

### Calibration steps

Use the following steps when calibrating an input.

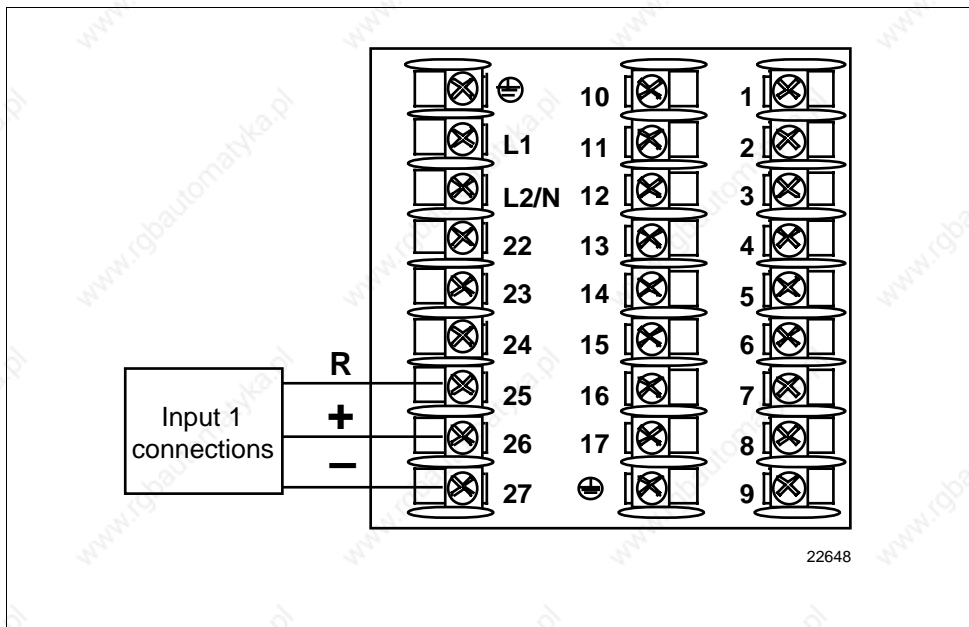
Step	Action
1	Find the minimum and maximum range values for your PV input range from Table 6-1.
2	Disconnect the field wiring and find out what equipment you will need to calibrate. DO NOT remove external resistor assemblies (if present).
3	Wire the calibrating device to your controller according to the Set Up wiring instructions for your particular input.
4	Follow the calibration procedure given for Input #1 after the controller has warmed up for a minimum of 15 minutes.

### Disconnect the field wiring

Tag and disconnect any field wiring connected to the input terminals on the rear of the controller.

Figure 6-1 shows the wiring terminal designations for Input #1.

Figure 6-1 Input #1 Wiring Terminals



Continued on next page

## 6.3 Preliminary Information, Continued

### Equipment needed

Table 6-2 lists the equipment you will need to calibrate the specific types of inputs that are listed in the table. You will need a screwdriver to connect these devices to your controller.

Table 6-2 Equipment Needed

Type of Input	Equipment Needed
<i>Thermocouple Inputs (Ice Bath)</i>	<ul style="list-style-type: none"> <li>• A calibrating device with <math>\pm 0.02\%</math> accuracy for use as a signal source such as a millivolt source.</li> <li>• Thermocouple extension wire that corresponds with the type of thermocouple that will be used with the controller input.</li> <li>• Two insulated copper leads for connecting the thermocouple extension wire from the ice baths to the precision calibrator.</li> <li>• Two containers of crushed ice.</li> </ul>
<i>Thermocouple Inputs (Precision Resistor)</i>	<ul style="list-style-type: none"> <li>• A calibrating device with <math>\pm 0.02\%</math> accuracy for use as a signal source such as a millivolt source.</li> <li>• Two insulated copper leads for connecting the calibrator to the controller.</li> <li>• A precision 500 ohm resistor <math>\pm 0.1\%</math> connected across input #1 terminals 25 (R) and 27 (-).</li> </ul>
<i>RTD (Resistance Thermometer Device)</i>	<ul style="list-style-type: none"> <li>• A decade box, with <math>\pm 0.02\%</math> accuracy, capable of providing stepped resistance values over a minimum range of 0 to 1400 ohms with a resolution of 0.1 ohm.</li> <li>• Three insulated copper leads for connecting the decade box to the controller.</li> </ul>
<i>Milliampere, Millivolt, Volts, and Radiomatic</i>	<ul style="list-style-type: none"> <li>• A calibrating device with <math>\pm 0.02\%</math> accuracy for use as a signal source.</li> <li>• Two insulated copper leads for connecting the calibrator to the controller.</li> <li>• Place current source at zero before switching ON.</li> <li>• Do not switch current sources OFF/ON while connected to the UDC3300 input.</li> </ul>

## 6.4 Input #1 Set Up Wiring

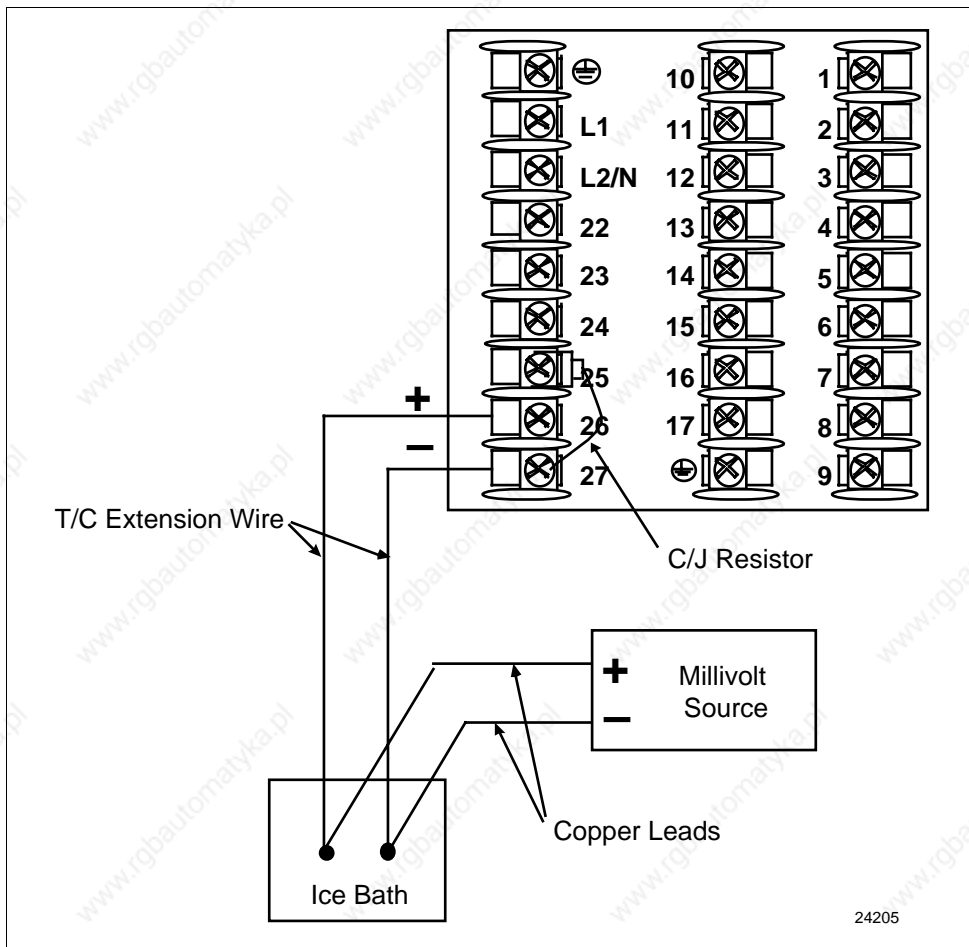
### Thermocouple inputs using an ice bath

Refer to Figure 6-2 and wire the controller according to the procedure given in Table 6-3.

Table 6-3 Set Up Wiring Procedure for Thermocouple Inputs Using An Ice Bath

Step	Action
1	Connect the copper leads to the calibrator.
2	Connect a length of thermocouple extension wire to the end of each copper lead and insert the junction points into the ice bath.
3	Connect the thermocouple extension wires to the terminals for Input #1. See Figure 6-2.
4	Connect a cold junction resistor to terminals 25 and 27 for Input #1. See Figure 6-2.

Figure 6-2 Wiring Connections for Thermocouple Inputs Using an Ice Bath



Continued on next page

## 6.4 Input #1 Set Up Wiring, Continued

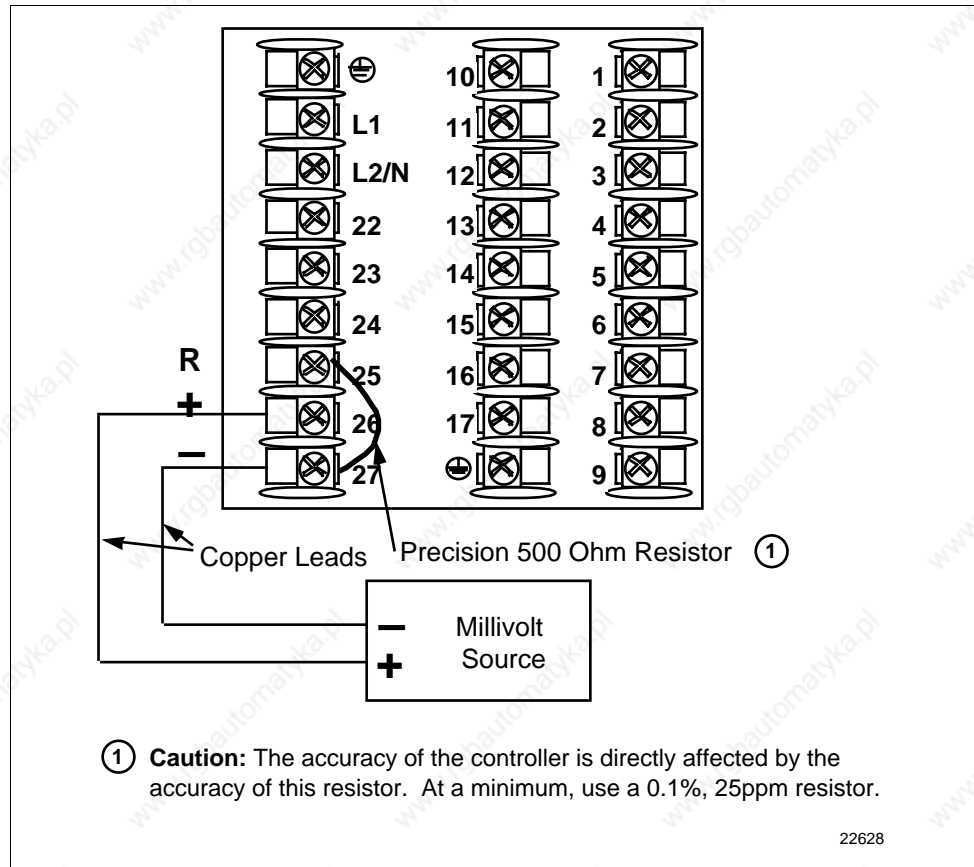
### Thermocouple inputs using a precision resistor

Refer to Figure 6-3 and wire the controller according to the procedure given in Table 6-4.

Table 6-4 Set Up Wiring Procedure for Thermocouple Inputs Using a Precision Resistor

Step	Action
1	Connect the copper leads to the calibrator.
2	Disconnect the cold junction resistor.
3	Install a 500-ohm precision resistor across terminal 25 (R) and terminal 27 (-). See Figure 6-3.
4	Subtract the millivolt value for 77°F (25°C) from the zero and span value for your range (see Table 6-1 for zero and span values) and use the adjusted value when calibrating.

Figure 6-3 Wiring Connections for Thermocouple Inputs Using a Precision Resistor



Continued on next page

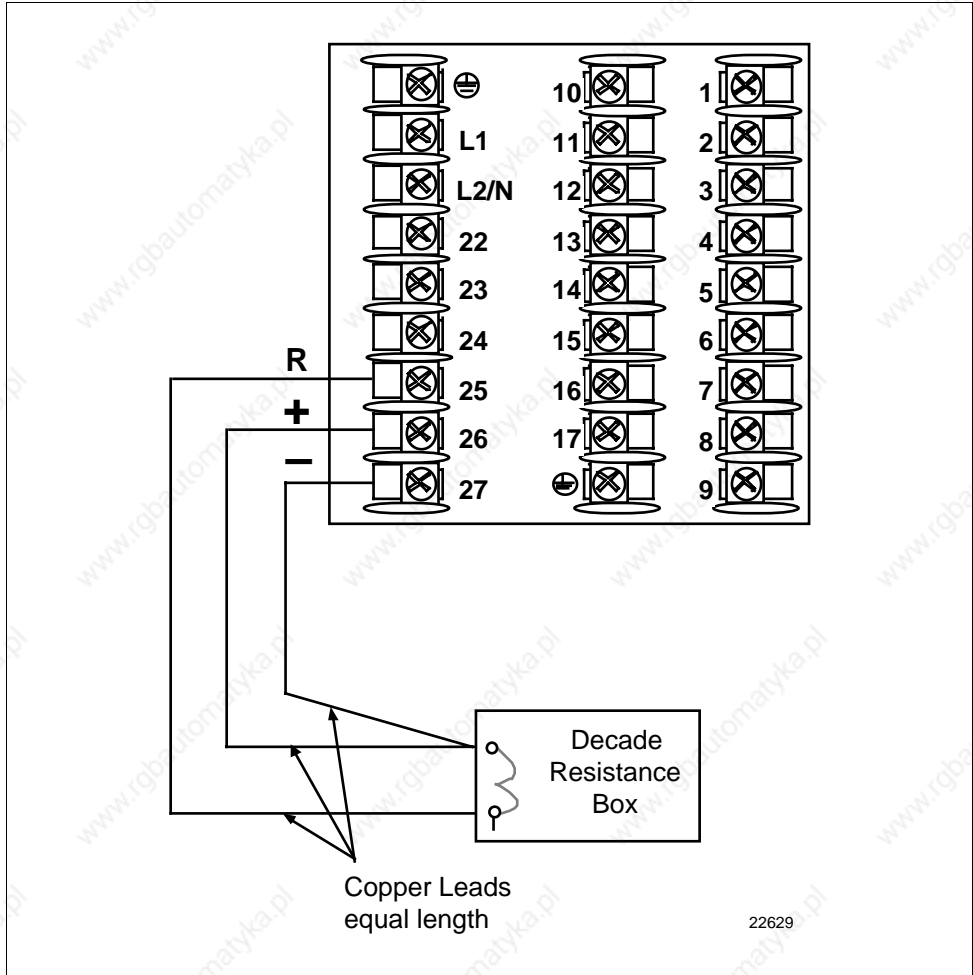


## 6.4 Input #1 Set Up Wiring, Continued

### RTD inputs

Use the copper leads and connect the calibrator to the rear terminals of Input #1. See Figure 6-4.

Figure 6-4 Wiring Connections for RTD (Resistance Thermometer Device)



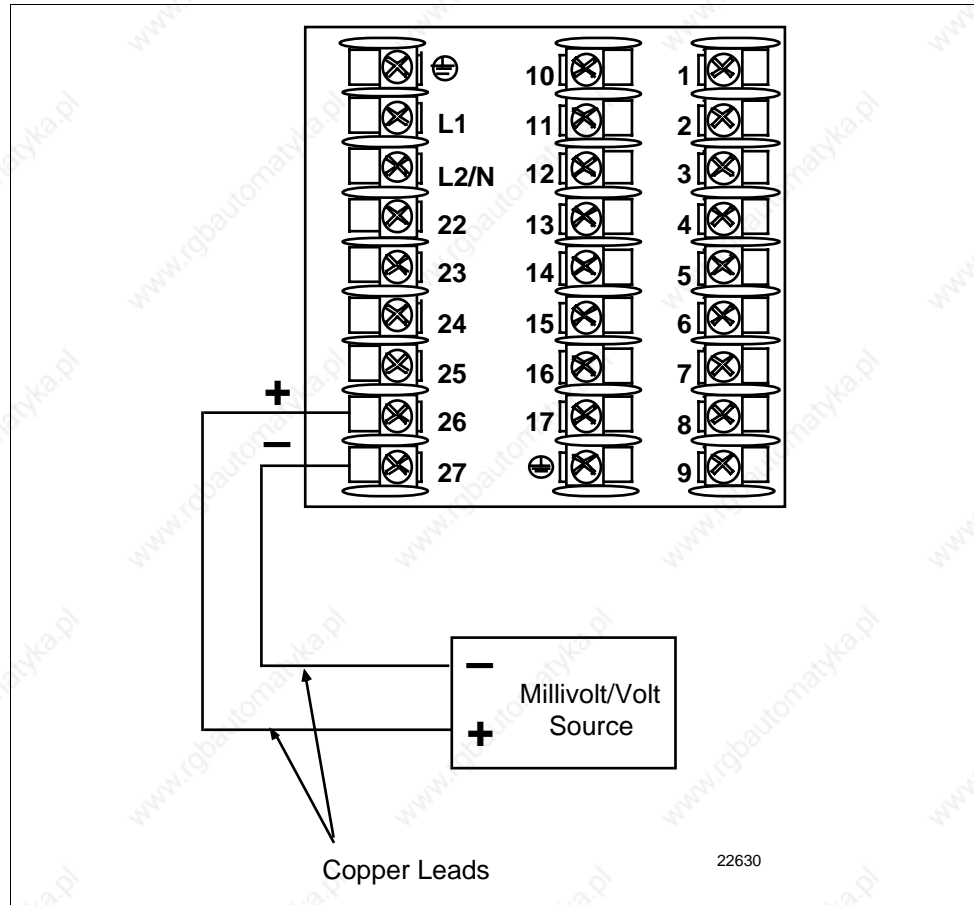
*Continued on next page*

## 6.4 Input #1 Set Up Wiring, Continued

**Radiamatic, millivolts, or volts (except 0 to 10 volts) inputs**

Use the copper leads and connect the calibrator to the rear terminals of Input #1. See Figure 6-5.

Figure 6-5 Wiring Connections for Radiamatic, Millivolts, or Volts (except 0 to 10 Volts)



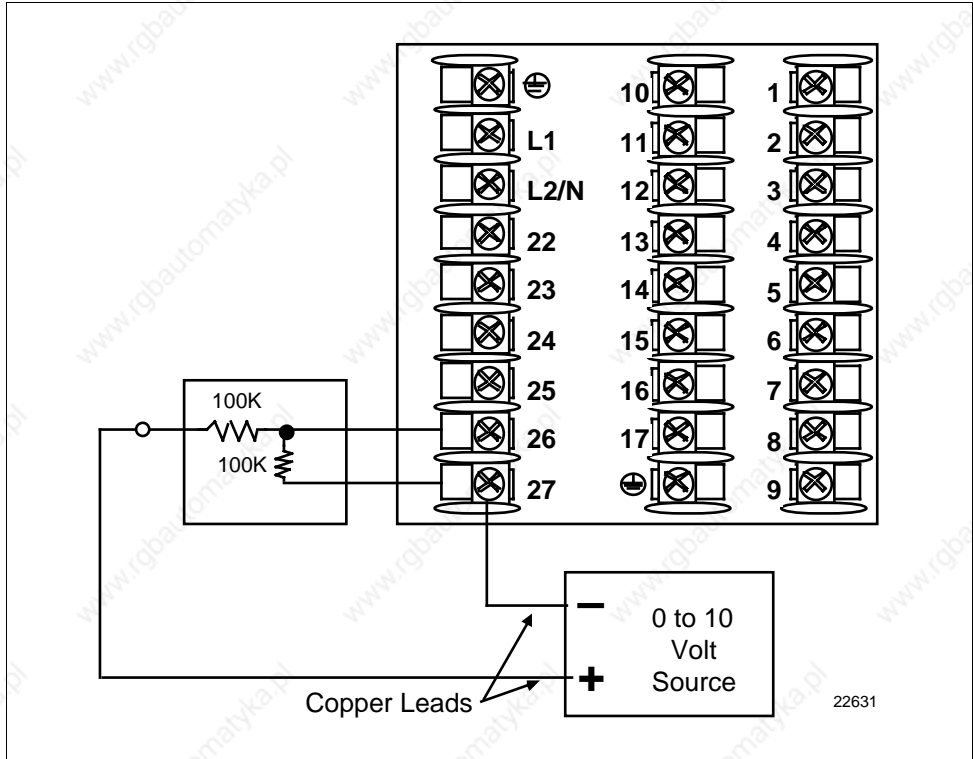
*Continued on next page*

## 6.4 Input #1 Set Up Wiring, Continued

### 0 to 10 volt inputs

Use the copper leads and connect the calibrator to the rear terminals of Input #1. See Figure 6-6.

Figure 6-6 Wiring Connections for 0 to 10 Volt Inputs



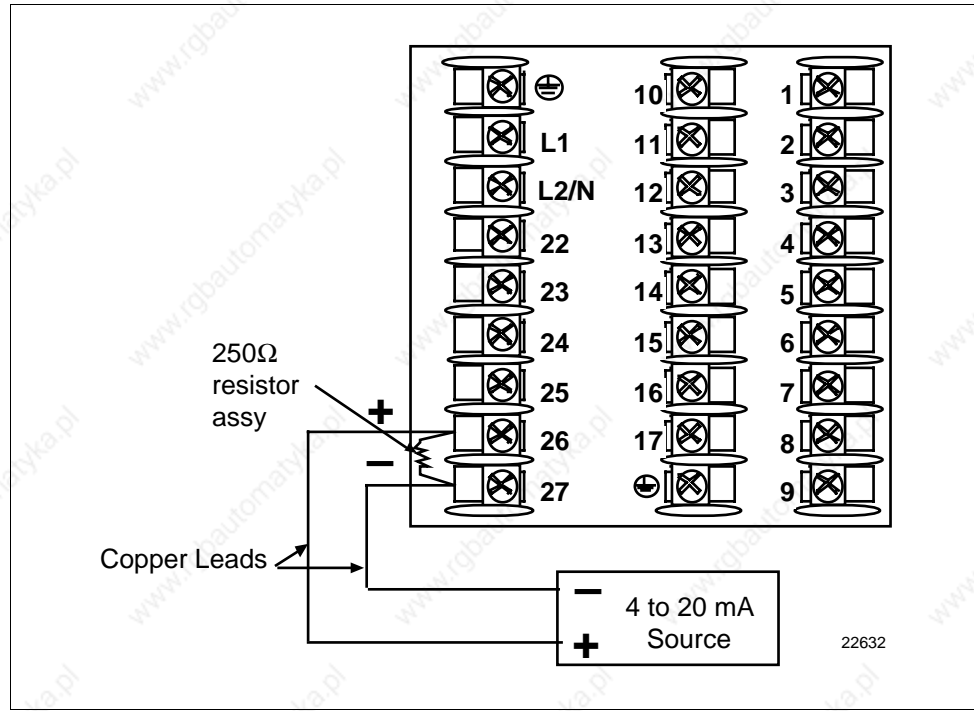
*Continued on next page*

## 6.4 Input #1 Set Up Wiring, Continued

### 4 to 20 mA inputs

Use the copper leads and connect the calibrator to the rear terminals of Input #1. See Figure 6-7.

Figure 6-7 Wiring Connections for 4 to 20 mA Inputs



## 6.5 Input #1 Calibration Procedure

### Introduction













Apply power and allow the controller to warm up for 15 minutes before you calibrate. Read “*Set Up Wiring*” before beginning the procedure. Make sure you have “LOCKOUT” set to “NONE.” See *Section 3 – Configuration*.

**CAUTION** For linear inputs, avoid step changes in inputs. Vary smoothly from initial value to final 100% value.

### Procedure

The Calibration procedure for Input #1 is listed in Table 6-5.

Table 6-5 Input #1 Calibration Procedure

Step	Description	Press	Action
1	Enter Calibration Mode	 until you see	Upper Display   Lower Display 
			You will see: Upper Display   Lower Display 
			The calibration sequence is enabled and you will see: Upper Display   Lower Display   At the completion of the sequence, the selection automatically reverts to disable.
2	Calibrate 0%		You will see: Upper Display   Lower Display   Adjust your calibration device to an output signal equal to the 0% range value for your particular input sensor. See Table 6-1 for Voltage or Resistance equivalents. Wait 15 seconds, then go to the next step.

*Continued on next page*

## 6.5 Input #1 Calibration Procedure, Continued

### Procedure, continued

Table 6-5 Input #1 Calibration Procedure, Continued

Step	Description	Press	Action						
3	Calibrate 100%	<b>FUNCTION</b>	<p>You will see:</p> <p>Upper Display  <input type="text" value="APPLY"/></p> <p>Lower Display  <input type="text" value="IN1 SPAN"/></p> <p>Adjust your calibration device to an output signal equal to the 100% range value for your particular input sensor. See Table 6-1 for Voltage or Resistance equivalents. Wait 15 seconds, and</p> <table border="1"> <thead> <tr> <th>If...</th> <th>Then...</th> </tr> </thead> <tbody> <tr> <td>you are calibrating a Thermocouple input</td> <td>Go to step 4</td> </tr> <tr> <td>you are calibrating other than a Thermocouple input</td> <td>Go to step 5</td> </tr> </tbody> </table>	If...	Then...	you are calibrating a Thermocouple input	Go to step 4	you are calibrating other than a Thermocouple input	Go to step 5
If...	Then...								
you are calibrating a Thermocouple input	Go to step 4								
you are calibrating other than a Thermocouple input	Go to step 5								
4	<p>Check the Cold Junction Temperature</p> <p><b>ATTENTION</b>                      The accuracy of the controller is directly affected by the accuracy of this value. Change this value only if the zero and span calibration procedures did not bring the controller within the specified accuracy requirements.</p>	<b>FUNCTION</b>	<p>The calculations for zero and span are now stored and you will see:</p> <p>Upper Display  <input type="text" value=""/> ← The cold junction temperature at the rear terminals</p> <p>Lower Display  <input type="text" value="C-J TEMP"/></p> <p>The value in the upper display is in the tenths of a degree. It is the current reading of the temperature as measured at the thermocouple terminals and recognized by the controller. You can change this value, if it is in error, using the s or t key.</p> <p><b>ATTENTION</b> When calibrating T/C inputs using a precision resistor, calibrate the cold junction as 77°F(25°C).</p>						
5	Exit the Calibration Mode	<b>FUNCTION</b>	The controller will store the calibration constants and exit calibration mode.						

# Section 7 – Troubleshooting / Service

## 7.1 Overview

### Introduction

Instrument performance can be adversely affected by installation and application problems as well as hardware problems. We recommend that you investigate the problems in the following order:

- Installation related problems
- Application related problems
- Hardware and software related problems

and use the information presented in this section to solve them.

If a replacement of any part is required, follow the procedures listed under “Replacement Procedures”.



### **WARNING—SHOCK HAZARD**



**INPUT CALIBRATION MAY REQUIRE ACCESS TO HAZARDOUS LIVE CIRCUITS, AND SHOULD ONLY BE PERFORMED BY QUALIFIED SERVICE PERSONNEL. MORE THAN ONE SWITCH MAY BE REQUIRED TO DE-ENERGIZE UNIT BEFORE CALIBRATION.**

### What's in this section?

The following topics are covered in this section.

	Topic	See Page
7.1	Overview	69
7.2	Troubleshooting Aids	71
7.3	Power-up Tests	73
7.4	Status Tests	74
7.5	Background Tests	76
7.6	Controller Failure Symptoms	78
7.7	Troubleshooting Procedures	79
7.8	Parts Replacement Procedures	83
7.9	Maintenance (Cleaning)	92

*Continued on next page*

## 7.1 Overview, Continued

---

### Installation related problems

Read the Installation section in this manual to make sure the UDC3300 has been properly installed. The installation section provides information on protection against electrical noise, connecting external equipment to the controller, and shielding and routing external wiring.

**ATTENTION** System noise induced into the controller will result in diagnostic error messages recurring. If the diagnostic error messages can be cleared, it indicates a “soft” failure and is probably noise related.

If system noise is suspected, completely isolate the controller from all field wiring. Use calibration sources to simulate PV and check all controller functions; i.e. Inputs, Alarms, etc.

---

### Application related problems

Review the application of the controller; then, if necessary, direct your questions to the local sales office.

---

### Hardware and software related problems

Use the troubleshooting error message prompts and controller failure symptoms to identify typical failures which may occur in the controller. Follow the troubleshooting procedures to correct them.

---



## 7.2 Troubleshooting Aids

### Overall error messages

An error message can occur

- at power-up
- during continuous background tests while in normal operation
- when the Status Tests are requested

Table 7-1 lists all the error message prompts that you could see, the reason for the failure, and under what test group the prompt could appear.

Refer to Tables 7-3 (Power-up), 7-5 (Status), and 7-6 (Background) for the particular test group indicated.

Table 7-1 Error Message Prompts

Error Message (lower display)	Reason for Failure	Test Group	Refer to Table
<b>CAL TEST</b>	Calibration test failure	Power-up or Status	7-3 7-5
<b>CONFTEST</b>	Configuration test failure	Power-up or Status	7-3 7-5
<b>E E FAIL</b>	Unable to write to non-volatile memory	Background	7-6
<b>FACT CRC</b>	Factory Calibration Cyclic Redundancy test	Status	7-5
<b>FAILSAFE</b>	Controller in Failsafe	Power-up, Background, or Status	7-3 7-5 7-6
<b>INP1FAIL</b>	Two consecutive failures of Input 1 integration	Background	7-6
<b>INP1 RNG</b>	Input 1 Out of Range	Background	7-6
<b>PV LIMIT</b>	PV Out of Range	Background	7-6
<b>RAM TEST</b>	RAM test failed	Power-up or Status	7-3 7-5

*Continued on next page*

## 7.2 Troubleshooting Aids, Continued

### Controller failure symptoms

Other failures may occur that deal with the Power, Latching Output Relay, or Non-Latching Alarm Relays. Refer to the controller failure symptom in Table 7-7 to determine what is wrong and the troubleshooting procedures to use to correct the problem.





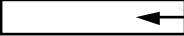
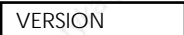
### Check Installation

If a set of symptoms still persists, refer to *Section 2 — Installation* and ensure proper installation and proper use of the controller in the system.

### Determining the software version

Table 7-2 lists the procedure for identifying the software version number.

Table 7-2 Procedure for Identifying the Software Version

Step	Operation	Press	Action
1	Select STATUS Set Up Group		Until you see: Upper Display  Lower Display 
2	Read the software version		Until you see: Upper Display  ← Software version Number Lower Display   Please give this number to the Customer Support person. It will indicate which version of UDC3300 you have and help them determine a solution to your problem.

## 7.3 Power-up Tests

### What happens at power-up

When the controller is powered-up, three tests are run by the UDC3300 software to ensure memory integrity.

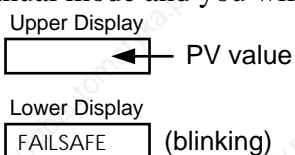
As the tests are run, the displays will appear as shown in Table 7-3.

Table 7-3 Power-up Tests

Lower Display	Upper Display
RAM TEST	PASS or FAIL
CONFTEST	PASS or FAIL
CAL TEST	PASS or FAIL

### Test failures

If any of these three tests fail, “FAILED” will appear momentarily in the upper display, then a display test is run, after which the controller will go into manual mode and you will see:



Refer to “*Status Tests*” to determine which tests have failed and how to correct them.

## 7.4 Status Tests

### Introduction

When required, the results of these tests can be checked to determine the reason the controller has gone to “Failsafe”.

### How to check the status tests

The procedure in Table 7-4 tells you how to display the results of the status tests. Table 7-5 lists the tests, the reason for the failure, and how to correct the problem.

Table 7-4 Procedure for Displaying the Status Tests Results

Step	Operation	Press	Action
1	Select STATUS Set Up Group	<input type="button" value="SET UP"/>	Until you see: Upper Display <input type="button" value="READ"/>  Lower Display <input type="button" value="STATUS"/>
2	Read the status tests results	<input type="button" value="FUNCTION"/>	Until you see: Upper Display <input type="button" value="NO or YES"/> YES indicates a failure  Lower Display <input type="button" value="FAILSAFE"/>  Successive presses of the [FUNCTION] key will display the results of the status tests in the following order: RAM TEST CONF TEST CAL TEST FACT CRC  Identify the problem and correct the failure as shown in Table 7-5.

*Continued on next page*

## 7.4 Status Tests, Continued

### Status Tests

Table 7-5 lists the Status tests, the reason for their failure, and how to correct the failure.

Table 7-5 Status Tests

Test (Lower Display)	Definition	Upper Display	Reason for Failure	How to Correct the Failure
<b>FAILSAFE</b>	Failsafe Fault	NO	No Failure	
		YES	Burnout configured for none and input fails. –RAM TEST failed –CONFTEST failed –CALTEST failed	1. Step through the rest of the STATUS check to identify the particular failure.  Also see Table 7-6, Background tests.
<b>RAM TEST</b>	RAM Test Run at Power-up	PASS	No Failure	RAM test passed.
		FAIL	RAM Failure	1. Power cycle to see if the error clears.
<b>CONF TEST</b>	Configuration Checksum	PASS	No Failure	Configuration checksum passed.
		FAIL	Configuration data is in error.	1. Step through STATUS tests – the controller will recalculate the checksum.  2. Check all configuration prompts for accuracy. See <i>Section 3 - Configuration</i> .
<b>CAL TEST</b>	Working Calibration	PASS	No Failure	Working calibration checksum passed.
		FAIL	The working calibration constants in the controller are in error.	1. If the controller has not been field calibrated, see <i>Section 3 - Configuration</i> and change the input to a different type. Enter it, loop through the status tests, then return the input type to the original one.  2. If the controller has been field calibrated, recalibrate the controller.
<b>FACT CRC</b>	Factory Calibration Test	PASS	No Failure	Factory calibration cyclic redundancy test passed.
		FAIL	Factory set input constants have been changed due to the change in input type.	1. Cycle through Status to clear the error. 2. Check the calibration. Make sure 0 and 100% are correct values. 3. Recalibrate if step 1 is unsatisfactory. Refer to <i>Section 6 - Input Calibration</i> .

## 7.5 Background Tests

### Introduction

The UDC3300 performs on-going background tests to verify data and memory integrity. If there is a malfunction, an error message will be displayed (blinking) in the lower display.

### Background tests

In the case of more than one simultaneous malfunction, only the one with the highest priority will appear in the lower display. Table 7-6 lists these background tests, the reason for their failure, and how to correct the problem.

Table 7-6 Background Tests

Lower Display	Reason for Failure	How to Correct the Problem
<b>EE FAIL</b>	Unable to write to non-volatile memory. Anytime you change a parameter and it is not accepted, you will see EE FAIL.	<ol style="list-style-type: none"> <li>1. Check the accuracy of the parameter and re-enter.</li> <li>2. Try to change something in configuration.</li> <li>3. Run through STATUS tests to re-write to EEPROM.</li> </ol>
<b>FAILSAFE</b>	<p>This error message shows whenever the controller goes into a failsafe mode of operation. This will happen if:</p> <ul style="list-style-type: none"> <li>• RAM test failed</li> <li>• Configuration test failed</li> <li>• Calibration test failed</li> <li>• Burnout configured for none and the input failed.</li> </ul>	<ol style="list-style-type: none"> <li>1. Run through STATUS check to determine the reason for the failure.</li> <li>2. Press the [SET UP] key until STATUS appears in the lower display.</li> <li>3. Press the [FUNCTION] key to see what tests pass or fail, then run through the STATUS codes a second time to see if the error cleared. Correct according to the recommendations given in Table 7-5.</li> </ol>
<b>INP1FAIL</b>	Two consecutive failures of input 1 integration. i.e., cannot make analog to digital conversion.	<ol style="list-style-type: none"> <li>1. Make sure the actuation is configured correctly. See <i>Section 3 — Configuration</i>.</li> <li>2. Make sure the input is correct.</li> <li>3. Check for gross overranging.</li> <li>4. Restore the factory calibration: <ol style="list-style-type: none"> <li>a. Disconnect the wiring from and place a jumper across terminals 26 and 27. The controller should read room temperature if it is configured for a thermocouple input.</li> <li>b. If it does not read room temperature, see <i>Section 3 – Configuration</i> and change the IN1TYP prompt in the INPUT 1 group to another type of thermocouple.</li> <li>c. After the change, press [FUNCTION] key, then the [LOWER DISPLAY] key. The limit controller should read the correct room temperature. If it does not, the unit has an input failure.</li> <li>d. Repeat step b. This time switch the IN1TYP back to the originally selected thermocouple.</li> <li>e. Repeat step c. The controller is restored with factory calibration.</li> <li>f. Remove the jumper and reconnect the thermocouple.</li> </ol> </li> <li>5. Replace the cold junction assembly.</li> </ol>

Table continued on next page

## 7.5 Background Tests, Continued

### Background tests, continued

Table 7-6 Background Tests, Continued

Lower Display	Reason for Failure	How to Correct the Problem
<b>INP1 RNG</b>	<p>Input 1 out of range. The process input is outside the range limits.</p> <p>If you have a linear input and the range goes outside the range limits, the controller will switch to Limit mode.</p>	<ol style="list-style-type: none"> <li>1. Make sure the range and actuation are configured properly.</li> <li>2. Check the input source.</li> <li>3. Restore the factory calibration:               <ol style="list-style-type: none"> <li>a. Disconnect the wiring from and place a jumper across terminals 26 and 27. The controller should read room temperature if it is configured for a thermocouple input.</li> <li>b. If it does not read room temperature, see <i>Section 3 – Configuration</i> and change the IN1TYP prompt in the INPUT 1 group to another type of thermocouple.</li> <li>c. After the change, press [FUNCTION] key, then the [LOWER DISPLAY] key. The limit controller should read the correct room temperature. If it does not, the unit has an input failure.</li> <li>d. Repeat step b. This time switch the IN1TYP back to the originally selected thermocouple.</li> <li>e. Repeat step c. The controller is restored with factory calibration.</li> <li>f. Remove the jumper and reconnect the thermocouple.</li> </ol> </li> <li>4. Field calibrate. See <i>Section 6 — Input Calibration</i>.</li> </ol>
<b>PV LIMIT</b>	<p>PV out of range.  <math>PV = INP1 + INP1 \text{ BIAS}</math></p>	<ol style="list-style-type: none"> <li>1. Make sure the input signal is correct.</li> <li>2. Make sure the Bias setting is correct</li> <li>3. Recheck the calibration. Use Bias of 0.0.</li> </ol>

## 7.6 Controller Failure Symptoms

### Introduction

In addition to the error message prompts, there are failure symptoms that can be identified by noting how the controller displays and indicators are reacting.

### Symptoms

Compare your symptoms with those shown in Table 7-7 and refer to the troubleshooting procedure indicated to correct the problem.

Table 7-7 Controller Failure Symptoms

Upper Display	Lower Display	Controller Output	Probable Cause	Troubleshooting Procedure
Blank	Blank	None	Power Failure	1
OK	Lower Display disagrees with Latching Output Relay function	Latching Output Relay function disagrees with Lower Display	Latching Output Relay	2
OK	OK	External Alarm function does not operate properly	Malfuction in alarm output	3
Display does not function when a key is pressed			Keyboard Malfuction	4
Controller fails to go into "Slave" operation during communications			Communications Failure	5

### Other symptoms

If a set of symptoms or prompts other than the one you started with appears while troubleshooting, re-evaluate the symptoms. This may lead to a different troubleshooting procedure.

If the symptom still persists, refer to the installation section in this manual to ensure proper installation and proper use of the controller in your system.



## 7.7 Troubleshooting Procedures

### Introduction

The troubleshooting procedures are listed in numerical order as they appear in Table 7-7. Each procedure lists what to do if you have that particular failure and how to do it or where to find the data needed to accomplish the task.



### **WARNING—SHOCK HAZARD**



**TROUBLESHOOTING MAY REQUIRE ACCESS TO HAZARDOUS LIVE CIRCUITS, AND SHOULD ONLY BE PERFORMED BY QUALIFIED SERVICE PERSONNEL. MORE THAN ONE SWITCH MAY BE REQUIRED TO DE-ENERGIZE UNIT BEFORE SERVICING.**

### Equipment needed

You will need the following equipment in order to troubleshoot the symptoms listed in the tables that follow:

- DC Milliammeter – mAdc
- Calibration sources – T/c, mV, Volt, etc.
- Voltmeter

### Procedure #1

Table 7-8 explains how to troubleshoot power failure symptoms.

Table 7-8 Troubleshooting Power Failure Symptoms

Step	What to do	How to do it
1	Check the AC line voltage.	Use a Voltmeter to measure the AC voltage across terminals L1 and L2 on the rear terminal panel of the controller.  Check the earth ground connection.
2	Make sure the chassis plugs into the rear of the case properly.	Withdraw the chassis and visually inspect the controller board and the inside of the case.
3	Check the system for Brown-outs, heavy load switching, etc., and conformance to installation instructions.	Refer to <i>Section 2 - Installation</i> .

*Continued on next page*

## 7.7 Troubleshooting Procedures, Continued

### Procedure #2

Table 7-9 explains how to troubleshoot Latching Output Relay failure symptoms.

Table 7-9 Troubleshooting Latching Output Relay Failure

Step	What to do	How to do it
1	Make sure all the configurable data for the Limit controller is correct.	See the Configuration section in this manual to check the configuration data and to reconfigure, if necessary.
2	Check that the latching relay actuates properly.	Move the setpoint above or below the PV value, depending on the type of limit control. Listen for the click of the relay as the setpoint moves above or below the PV.

### Procedure #3

Table 7-10 explains how to troubleshoot Alarm Relay Output failure.

Table 7-10 Troubleshooting Alarm Relay Output Failure

Step	What to do	How to do it
1	Check the alarm configuration data. If it is correct, check the field wiring.	Reconfigure if necessary. Refer to <i>Section 3 – Configuration</i> for details.
2	Check that the applicable alarm relay actuates properly depending on what you have set at prompt “ALARM TYPE”. If it does, check the field wiring.	Place the controller in manual mode. Vary the input to raise and lower the PV around the setpoint. Listen for a click from the relay as the PV moves in either direction and note that the proper ALM1 or ALM2 is lit.
3	Check the field wiring.	Make sure the NO or NC contact wiring is correct on the alarm output terminals. Refer to <i>Section 2 – Installation</i> for details.

*Continued on next page*

## 7.7 Troubleshooting Procedures, Continued

### Procedure #4

Table 7-11 explains how to troubleshoot a Keyboard failure.

Table 7-11 Troubleshooting a Keyboard Failure

Step	What to do	How to do it
1	Make sure the keyboard is connected properly to the MCU/output and power/input boards.	Withdraw the chassis from the case and visually inspect the connection.
2	Controller Keyboard or specific keys may be "LOCKED OUT" via the security code.	Use your 4 digit security code number to change the lockout level. Refer to <i>Section 3 – Configuration</i> .  <b>ATTENTION</b> Using "1000" as a security code number will override the 4-digit code previously entered.
3	Run the keyboard test.	Press the [SET UP] key and hold in, then press the [FUNCTION] key at the same time. The controller will run a display test. Then you will see: Upper Display <div style="border: 1px solid black; padding: 2px; display: inline-block;">KEYS</div> Lower Display <div style="border: 1px solid black; padding: 2px; display: inline-block;">TRY ALL</div> Press each key. If it works, the key name will appear in the lower display.
4	Replace the display/keyboard if any keys are shorted out.	Refer to " <i>Replacement Procedures</i> " in this section.

*Continued on next page*

## 7.7 Troubleshooting Procedures, Continued

### Procedure #5

Table 7-12 explains how to troubleshoot a Communications failure.

Table 7-12 Troubleshooting a Communications Failure

Step	What to do	How to do it
1	Check the field wiring and termination resistor.	Refer to the Installation section of either the RS422/485 Manual or the Gateway Manual depending on the protocol used.
2	Make sure the Communications Printed Wiring Board is installed properly in the controller.	Withdraw the chassis from the case and inspect the board. See the exploded view (Figure 8-1) for location of the board. Return the chassis to the case.
3	Determine if the Communications board is faulty by running a LOCAL LOOPBACK TEST.  If the test fails, replace the board.	<p>Run the Local Loopback Test.</p> <p>Press [SET UP] until you see:</p> <p>Upper Display  <input type="text" value="SET UP"/></p> <p>Lower Display  <input type="text" value="COM"/></p> <p>Press [FUNCTION] until you see:</p> <p>Upper Display  <input type="text" value="DISABL"/></p> <p>Lower Display  <input type="text" value="LOOPBACK"/></p> <p>Press s or t, you will see:</p> <p>Upper Display  <input type="text" value="ENABLE"/></p> <p>Lower Display  <input type="text" value="LOOPBACK"/></p> <p>The test will run until the operator disables it here.</p>

## 7.8 Parts Replacement Procedures

---

### Introduction

These procedures tell you how to access and replace the following printed wiring boards in your controller.

- Display/Keyboard
  - MCU/Output
  - Power/Input
  - Digital Input
  - DMCS Communications
  - RS422/485 Communications
- 

### Equipment needed

To accomplish the procedures that follow, you will need the following equipment:

- Phillips Head Screwdriver
  - Flat Bladed Screwdriver
  - Small Pliers
- 

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## 7.8 Parts Replacement Procedures, Continued

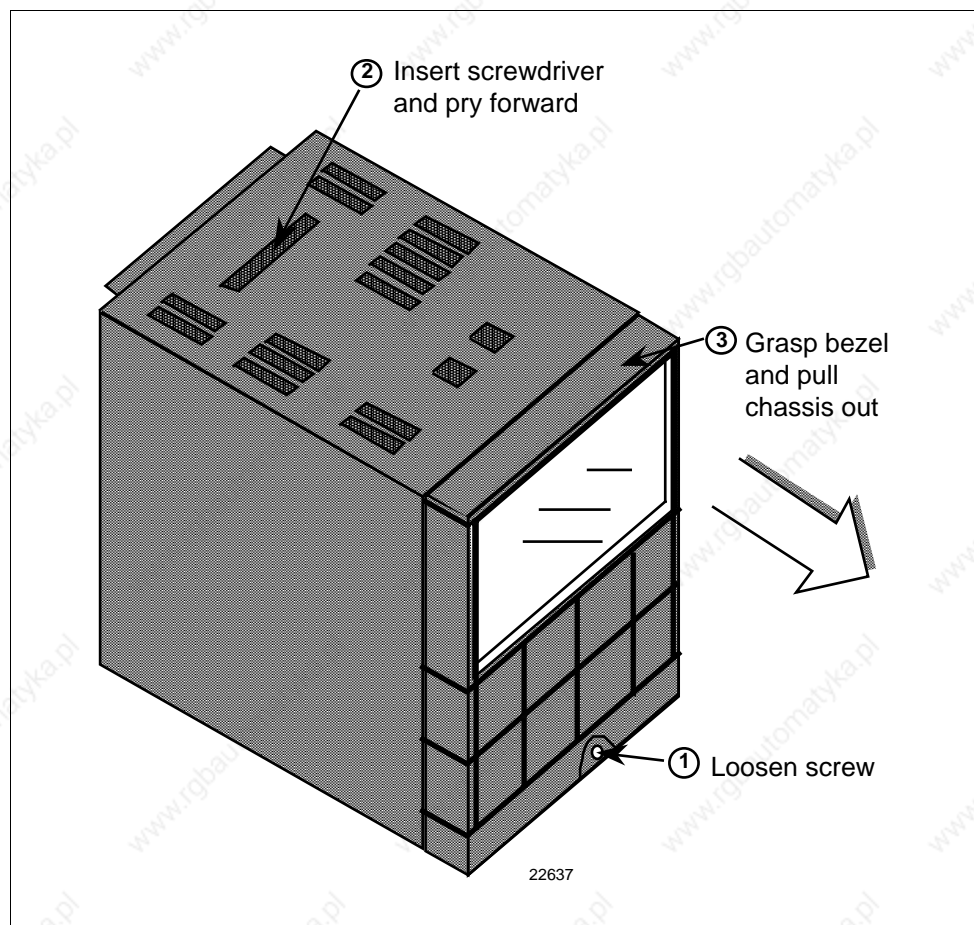
### How to remove the chassis

Refer to Figure 7-1 for steps and follow the procedure listed in Table 7-13.

Table 7-13 How to Remove the Chassis

Step	Action
1	Loosen the screw on the front face.
2	Insert a flat-bladed screwdriver into the hole on the top of the case as shown in Figure 7-1 and pry chassis forward slightly until the chassis connectors separate from the back of the case.
3	Grasp the bezel and pull the chassis out of the case.

Figure 7-1 Chassis Removal



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## 7.8 Parts Replacement Procedures, Continued

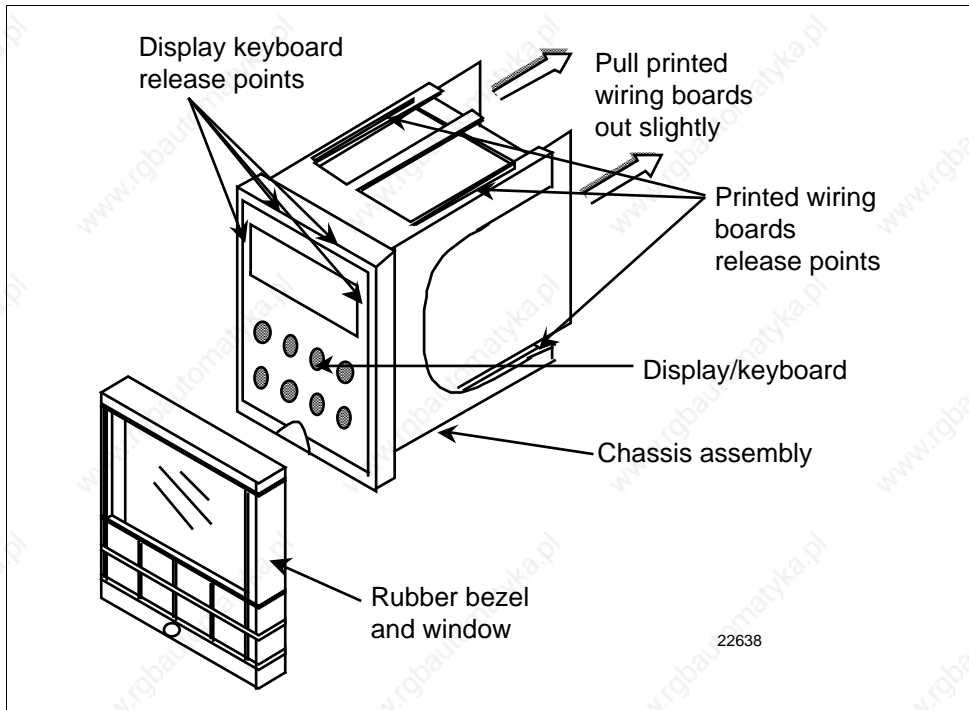
### How to replace the display/keyboard assembly

Refer to Figure 7-2 and follow the procedure listed in Table 7-14.

Table 7-14 Display/Keyboard Assembly Replacement Procedure

Step	Action
1	Remove the chassis from the case as shown in Figure 7-1.
2	Peel the rubber bezel and display window off the chassis assembly.
3	Separate the chassis frame at the four release points shown in Figure 7-2 and wiggle each printed wiring board out of its socket on the display/keyboard assembly. Pull out slightly.
4	Insert a small flat-bladed screwdriver into each of the display/keyboard release points (Figure 7-2) and pry out the board.
5	Install the new board, bottom end in first, and push in the top until it clicks into place.
6	Reinstall the printed wiring boards into the rear of the display board making sure that the boards click into their release points.
7	Replace the bezel and window assembly.
8	Reinstall chassis into case. Press in hard, then tighten the screw.

Figure 7-2 Display/Keyboard Replacement



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## 7.8 Parts Replacement Procedures, Continued

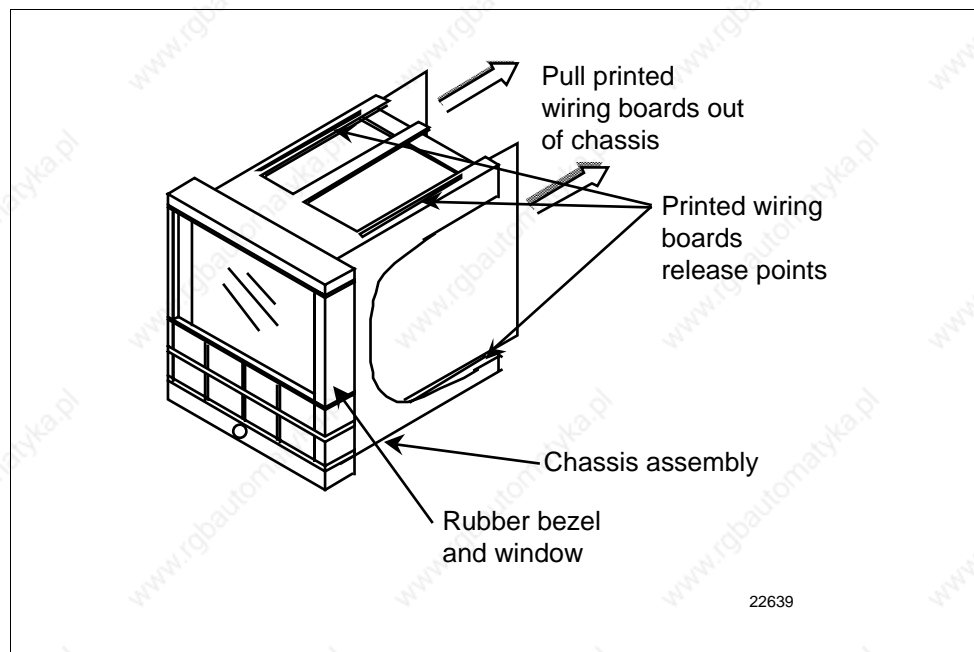
### How to remove the printed wiring boards from the chassis

To remove the printed wiring boards from the chassis, refer to Figure 7-3 and follow the procedure in Table 7-15.

Table 7-15 Printed Wiring Board Removal from Chassis

Step	Action
1	Remove the chassis from the case as shown in Figure 7-1.
2	Separate the chassis frame at the release points shown in Figure 7-3 and wiggle each printed wiring board out of its socket on the display/keyboard assembly. Pull both boards out of the chassis assembly.

Figure 7-3 Removing the Printed Wiring Boards



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## 7.8 Parts Replacement Procedures, Continued

### Printed wiring board identification

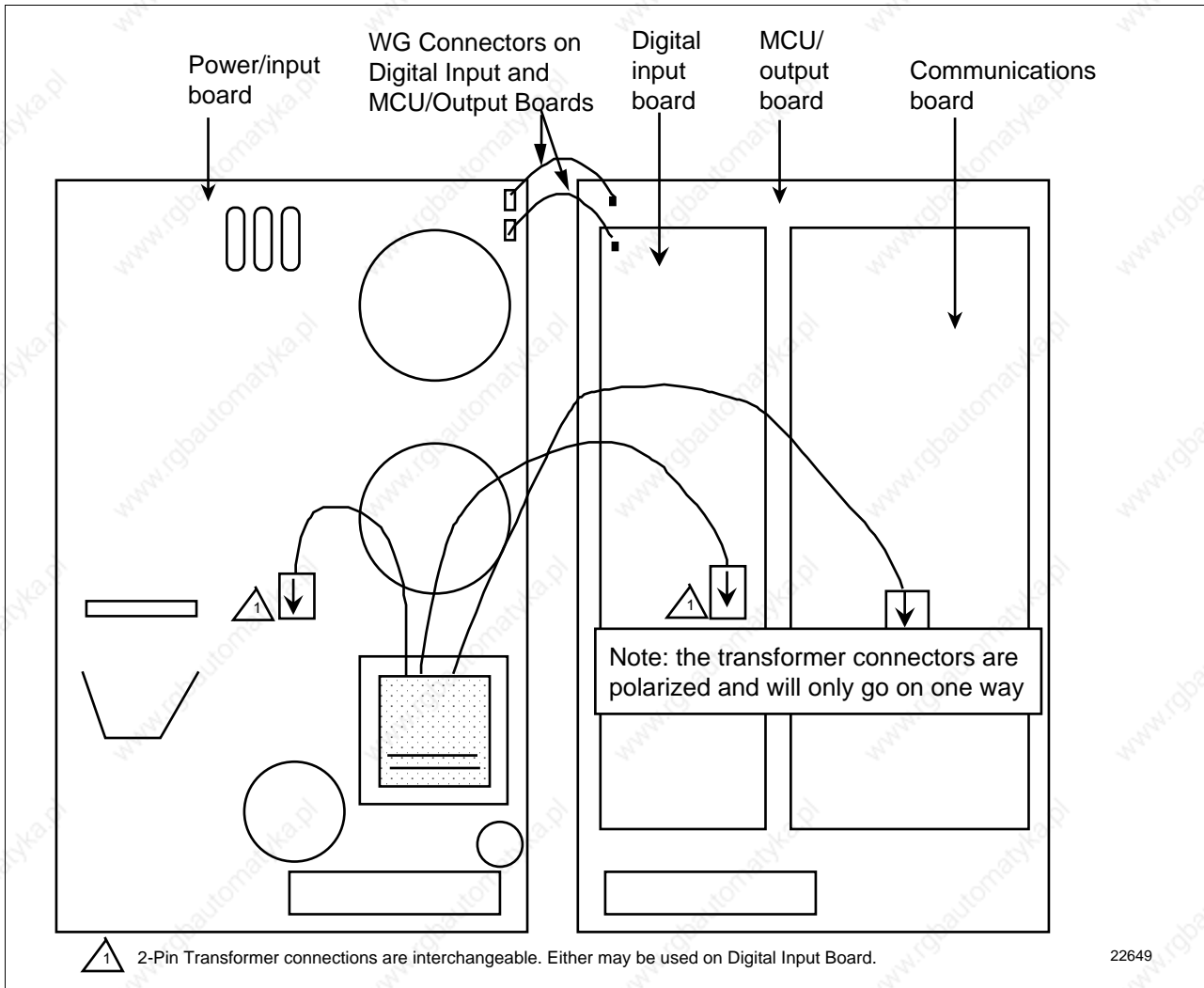
Figure 7-4 identifies each of the printed wiring boards that can be replaced. Refer to this drawing when following the replacement procedures for each of the boards, since you have to remove all of them from the chassis to replace the one you want.

In order to lay boards flat, remove the transformer lead from the Communications board and from the Digital Input board.

Refer to the specific procedure table to remove the desired board.

- Power Input Board — Table 7-16
- Digital Input Board — Table 7-17
- Communications Board — Table 7-18
- Limit MCU Board — Table 7-19

Figure 7-4 Printed Wiring Board Identification



*Continued on next page*

## 7.8 Parts Replacement Procedures, Continued

### Power input board

Follow the procedure listed in Table 7-16 to replace the Power Input board—P/N 51309404-502 (90 to 264 Vac) or 51309404-501 (24 Vac/dc).

Table 7-16 Power Input Board Replacement Procedure

Step	Action
1	Remove the chassis from the case. See Figure 7-1.
2	Remove the printed wiring boards from the chassis. See Figure 7-3.
3	Lay the boards flat and identify the Power Input board. See Figure 7-4.
4	Remove the transformer connections to the Digital Input board and Communications board, if present.
5	Replace the Power Input board.
6	Reinstall the transformer connections to Digital Input board and Communications board, if present.
7	Slide the printed wiring boards back into the chassis. Make sure the connections to the display/keyboard assembly are made and that the release points on the chassis snap into place on the printed wiring boards.
8	Reinstall the chassis into the case. Push in hard, then tighten screw.

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## 7.8 Parts Replacement Procedures, Continued

### Digital input board

Follow the procedure listed in Table 7-17 to replace the Digital Input board—P/N 30756696-501.

Table 7-17 Digital Input Board Replacement Procedure

Step	Action
1	Remove the chassis from the case. See Figure 7-1.
2	Remove the printed wiring boards from the chassis. See Figure 7-3.
3	Lay the boards flat and identify the Digital Input board. See Figure 7-4.
4	Remove the transformer plug from connector J9.
5	Locate the three mounting posts under the MCU/Output board that attach the Digital Input board to the MCU/Output board.
6	Use small pliers and squeeze the ends of each post together and push it up through the board. Remove the Digital Input board.
7	Orient the new Digital Input board onto the MCU/Output board and push the mounting posts down through the MCU/Output board until they click into place.
8	Replace the transformer plug onto connector J9.
9	Slide the printed wiring boards back into the chassis. Make sure the connections to the display/keyboard assembly are made and that the release points on the chassis snap into place on the printed wiring boards.
10	Reinstall the chassis into the case. Push in hard, then tighten the screw.

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## 7.8 Parts Replacement Procedures, Continued

### Communications board

Follow the procedure listed in Table 7-18 to replace the following boards:

- DMCS Communications Board—P/N 30756690-501
- RS422/485 Communications Board—P/N 30756693-501

Table 7-18 Communications Board Replacement Procedure

Step	Action
1	Remove the chassis from the case. See Figure 7-1.
2	Remove the printed wiring boards from the chassis. See Figure 7-3.
3	Lay the boards flat and identify the Communications board. See Figure 7-4.
4	Remove the transformer plug from connector J8.
5	Locate the three mounting posts under the MCU/Output board that attach the Communications board to the MCU/Output board.
6	Use small pliers and squeeze the ends of each post together and push it up through the board. Remove the Communications board.
7	Orient the new Communications board onto the MCU/Output board and push the mounting posts down through the MCU/Output board until they click into place.
8	Replace the transformer plug onto connector J8.
9	Slide the printed wiring boards back into the chassis. Make sure the connections to the keyboard assembly are made and that the release points on the chassis snap into place on the printed wiring boards.
10	Reinstall the chassis into the case. Push in hard, then tighten the screw.

*Continued on next page*

## 7.8 Parts Replacement Procedures, Continued

### MCU/output board

Follow the procedure listed in Table 7-19 to replace the following MCU/output boards:

- Relay Output—P/N 51309401-506

Table 7-19 MCU/Output Board Replacement Procedure

Step	Action
1	Remove the chassis from the case. See Figure 7-1.
2	Remove the printed wiring boards from the chassis. See Figure 7-3.
3	Lay the boards flat and identify the MCU/Output board. See Figure 7-4.
4	Each option board is held onto the MCU/Output board with three posts. Locate these posts under the MCU/Output board.
5	Use small pliers and squeeze the ends of each post together and push it up through the board. Remove the option boards present.
6	Remove the transformer connections to the Digital Input board and the Communications board, if present.
7	Remove the Digital Input Board, if present. See Table 7-17.
8	Remove the Communications board, if present. See Table 7-18.
9	Replace the MCU/Output board.
10	Reinstall the Digital Input board, if present, onto the new MCU/Output board.
11	Reinstall the Communications board, if present, onto the new MCU/Output board.
12	Reinstall the transformer connectors to the Digital Input board and Communications board, if present.
13	Slide the printed wiring boards back into the chassis. Make sure the connections to the display/keyboard assembly are made and that the release points on the chassis snap into place on the printed wiring boards.
14	Reinstall the chassis into the case. Push in hard, then tighten the screw.

## 7.9 Maintenance

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### Cleaning

If you find it necessary to clean the elastomer bezel, use a 50% alcohol solution or mild soapy water.

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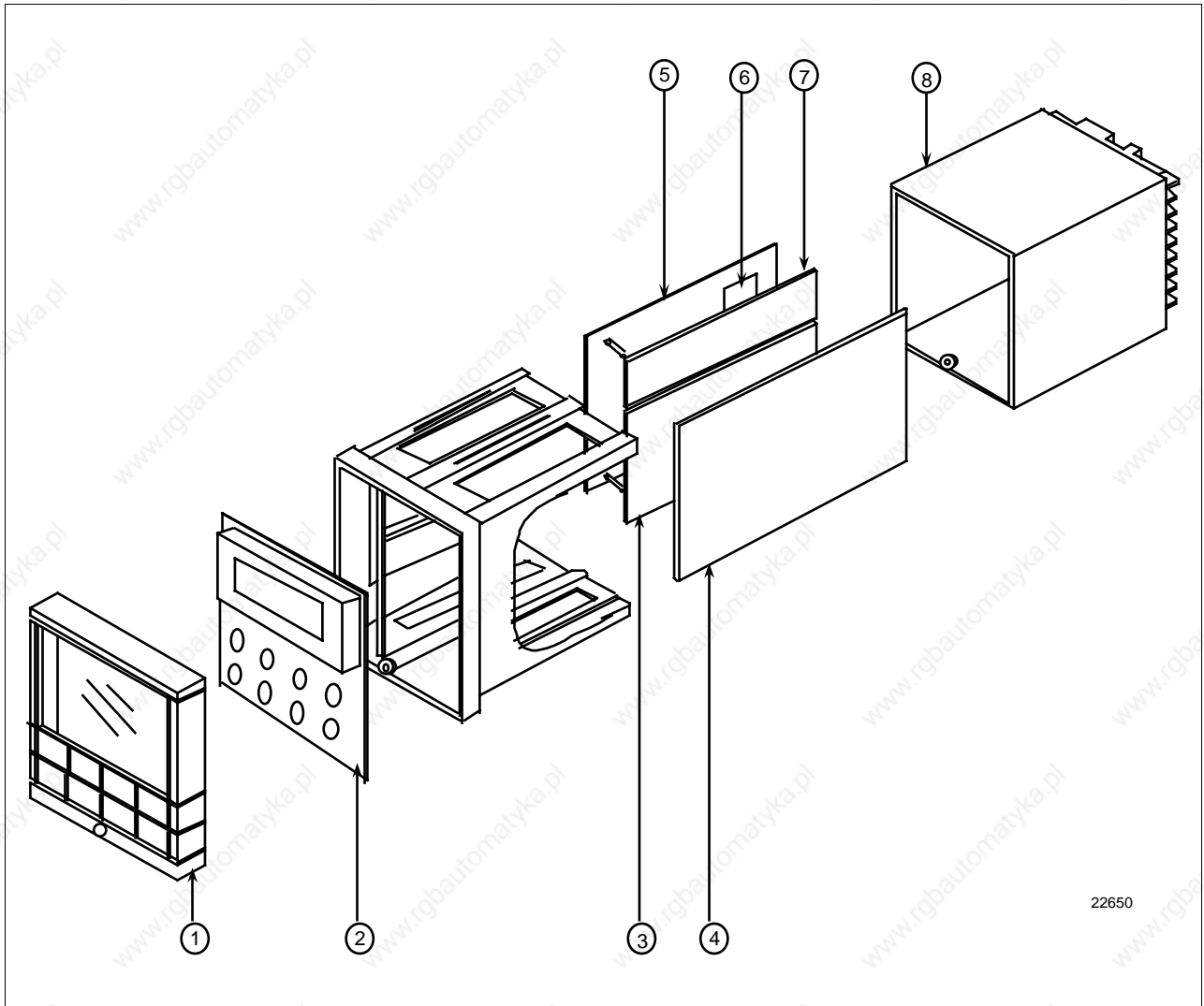
## Section 8 – Parts List

### 8.1 Exploded View

#### Introduction

Figure 8-1 is an exploded view of the UDC3300 Limit Controller. Each part is labeled with a key number. The part numbers are listed by key number in Table 8-1. There is a list of parts not shown in Table 8-2.

Figure 8-1 UDC3300 Exploded View



*Continued on next page*

## 8.1 Exploded View, Continued

### Parts identification

Table 8-1 lists the part numbers for the key numbers shown in the exploded view.

Table 8-1 Parts Identification

Key Number	Part Number	Description	Quantity
1	30756667-502	Bezel Assembly—Gray	1
2	30756672-501	Display/Keyboard Printed Wiring Assembly	1
3	30756690-501 30756693-501	DMCS Communications PWB RS422/485 Communications PWB	1
4	51309404-502 51309404-501	Power/Input Printed Wiring Board 90 to 264 Vac 24 Vac/dc	1
5	51309401-506	Limit Control MCU/Output Printed Wiring Board	1
6	30755306-501	Relay, Electromechanical	2
7	30756696-501	Digital Input Printed Wiring Board	1
8	30756721-501	Case Assembly	1

## 8.2 Parts Not Shown

### Parts not shown

Table 8-2 lists the part numbers of the parts not shown in the exploded view.

Table 8-2 Parts Not Shown

Part Number	Description	Quantity
30731996-506	4-20 mA Resistor Assembly, 250 ohms	1
30754465-501	0-10 Volt Input Resistor Assembly, 100K Pair	1
30752481-501 30752481-502	Varistor, 120V Varistor, 240V	1
30755050-001	Mounting Kit	1
30756764-002	Rear Cover Kit	1
30755223-002 30755223-003	DIN Adapter Kit, Blue DIN Adapter Kit, Gray	1
30757088-501	Cold Junction Resistor	1
30756683-001	NEMA 3 Gasket (panel to case)	
30757215-001	NEMA 4 Front Face Kit	1
30757069-001	Bezel Cover	1



# Section 9 - Appendix A

## How to Apply Digital Instrumentation in Severe Electrical Noise Environments

### 9.1 Overview

#### Guideline overview

Products that incorporate digital technology provide recognized performance advantages over conventional analog instrumentation used for process control. These advantages can result in better product uniformity and greater overall efficiency when used correctly.

There are, however, certain guidelines regarding installation and wiring which must be carefully followed in order to achieve this performance. In addition to the traditional precaution of the separation of signal and power wiring in separate conduits, other measures must be taken to minimize the effects of electromagnetic interference (EMI) and radio frequency interference (RFI) on the operation of the equipment. Otherwise, if high level, short duration, noise spikes are permitted to enter the digital equipment, the noise can be transferred into the system's logic networks and can be misinterpreted as signal data, resulting in erroneous system operation and other unpredictable responses.

#### What's in this section

This section contains the following information:

	Topic	See Page
9.1	Overview	95
9.2	Potential Noise Sources	96
9.3	Prevention Methods	97
9.4	Recommended Wiring Practices	98
9.5	Power Source Considerations	100
9.6	Noise Suppression at the Source	101

## 9.2 Potential Noise Sources

---

### Overview

Noise can enter electronic equipment via three methods of coupling, namely:

- Capacitive (or electrostatic)
  - Inductive (or magnetic)
  - Impedance.
- 

### Capacitive and inductive coupling

Capacitive and inductive coupling have the same essential effect — they couple current or voltage, without any actual connection of the two circuits. Impedance coupling requires a connection between the two circuits. Typical noise-generating sources that could affect electronic equipment through capacitive and inductive coupling include:

- Relay coils
  - Solenoids
  - AC power wires — particularly at or above 100 Vac
  - Current carrying cables
  - Thyristor field exciters
  - Radio frequency transmissions.
- 

### Impedance coupled noise

Impedance-coupled noise may enter by way of the lines used to power the digital equipment or by way of improper grounding. Most power lines, at typical industrial locations, are far from noise-free. The noise on them can be generated in many ways, but are nearly always associated with switching circuits of some nature.

These include:

- Large relays
  - Contactors
  - Motor starters
  - Business and industrial machines
  - Power tools
  - HID (high intensity discharge) lights
  - Silicon controlled rectifiers (SCRs) that are phase-angled fired.
-

## 9.3 Prevention Methods

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### Introduction

There are three ways to prevent electrical noise from interfering with the operation of the electronic digital equipment.

- Built-in noise rejection
  - Separation of signal and power lines
  - Noise suppression at source
- 

### Built-in noise rejection

The first method is to design the digital equipment with a high degree of noise rejection built-in. This includes housing the equipment in a case that will provide shielding, liberal use of noise rejection filters and opto-isolators, and the use of noise suppressors on potential noise sources within the equipment itself. This, of course, is the responsibility of the manufacturer who usually performs extensive laboratory and field testing of newly designed digital equipment to insure the adequacy of its immunity to noise. As a minimum requirement, the equipment should be able to pass the tests outlined in the IEEE Standard 472-1974 (*Surge Withstand Capacity Tests*).

---

### Signal and power line separation

The second method is to prevent noise from getting on the signal and power lines that are connected to the equipment. This is achieved by proper separation and shielding of those lines. In some cases, separate power lines or special power line regulation or filtering may be required for satisfactory electronic digital equipment operation. It is the responsibility of the installer to follow good wiring practices.

---

### Suppression at the source

The third prevention method is to suppress the noise at its source. This is the most effective but also the most difficult because it is not easy to identify all of the potential noise sources in a typical industrial installation. Therefore, “suppression” is usually a last resort for those extreme situations where the other methods are insufficient by themselves. See *Noise Suppression at Source* which follows.

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## 9.4 Recommended Wiring Practices

### General rules

- All wiring must conform to local codes and practices.
- Wires carrying similar types of signals (Table 9-1) may be bundled together, but bundles with different types of signals must be kept separated to prevent inductive or capacitive coupling.

### Wire bundling

Table 9-1 shows what wiring should be bundled together to prevent inductive or capacitive coupling.

Table 9-1 External Wiring

Wire Function		Bundle No.	Are Shielded Twisted Wires Recommended?
No.	Type		
1 2 3	HIGH VOLTAGE Line Power Earth Ground Line Voltage Digital I/O	1	NO
4 5	ANALOG I/O Process Variable RTD Thermocouple dc Millivolts Low level (<100V) 4-20 mA dc 1-5 Vdc	2	YES
6 7	DIGITAL I/O Low Voltage (<100V) Computer Interface	3	YES

*Continued on next page*

## 9.4 Recommended Wiring Practices, Continued

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### Additional rules

Please observe these additional rules for wire bundling:

- For distances over five (5) feet, and when shielding is recommended, use a separate metal tray or conduit for each bundle. Where conduits or trays are not practical, use twisted wires with a metal overbraid and provide physical separation of at least one foot.
  - Tray covers must be in continuous contact with the side rails of the trays.
  - When unlike signal levels must cross, either in trays or conduits, they should cross at a 90-degree angle and at a maximum spacing. Where it is not possible to provide spacing, a grounded steel barrier or grid should be placed between the unlike levels at the crossover points.
  - Trays containing low level wiring should have solid bottoms and sides. Tray covers must be used for complete shielding. Tray cover contact with side rails must be positive and continuous to avoid high reluctance air gaps, which impair shielding. Trays for low level cables should be metal and solidly grounded.
  - Wires containing low level signals should not be routed near any of the following:
    - Contactors
    - Motors
    - Generators
    - Radio transmitters
    - Wires carrying high current that is being switched on and off.
  - Use a 12-gage (or heavier) insulated stranded wire for the ground connection. Attach it firmly to a proven good earth ground such as a metal stake driven into the ground.
  - All shields should be grounded at one end only — preferably the instrument end.
-

## 9.5 Power Source Considerations

### Operate within limits

The AC power for the digital electronic equipment must be within the voltage and frequency limits specified for that equipment. Attempts to operate outside the specified limits will result in no performance. For those installations where the supply voltage will not stay within the specified limits, a ferroresonant transformer, for voltage resolution, should be used.

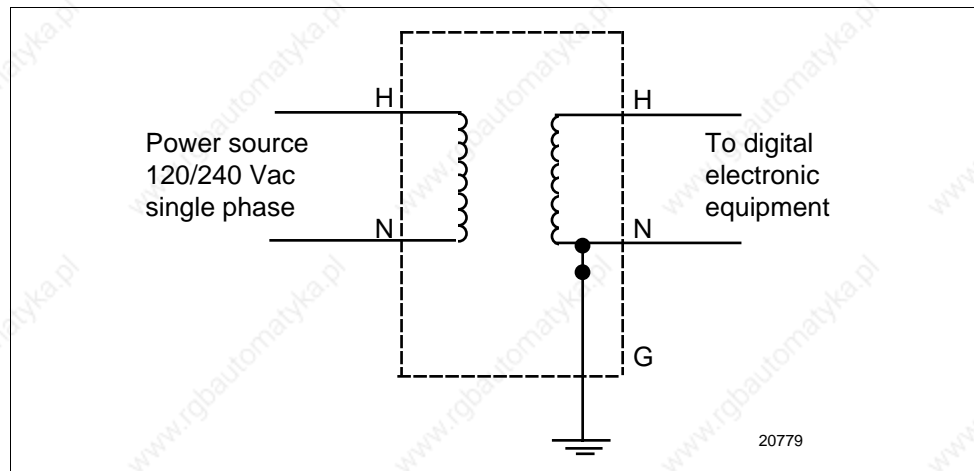
### Independent AC source

For protection against noise, the AC source for the digital electronic equipment should be independent of all other loads especially when switching loads are involved. For example, it should not provide power for air-conditioning, convenience outlets, lighting, motors, or similar noise-generating devices. To obtain electrical isolation (see Figure 9-1) a separate transformer is required to supply power to the digital equipment. For additional noise and transient rejection, shielded primary and secondary windings may be required. And, if necessary, power line filters may be added to attenuate noise signals that have a higher frequency than the power line frequency.

### Transformer for digital equipment

Figure 9-1 is an illustration of a separate transformer required to supply power to digital equipment.

Figure 9-1 Transformer for Digital Equipment



## 9.6 Noise Suppression at the Source

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### Introduction

Generally speaking, when good wiring practices are used with well-designed digital electronic equipment, no further noise protection is necessary. However, in some severe electrical environments, the magnitude of the electrical noise is so great that it must be suppressed at the source. In most control cabinets, the main sources of noise are motor starters, contactors, relays, and switching gear. For this reason, many manufacturers of these devices supply “surge suppressors” which mount directly on the noise source, (for example, on the coil of a control relay or motor starter).

For those devices that do not have accessory “surge suppressors,” resistance-capacitance (RC) circuits and/or voltage limiters such as metal varistors may be added when and where needed. This can be broken down into two categories, namely inductive loads (for example, a relay switch in series with a relay coil) and contacts.

---

### Inductive coils

Metal Oxide Varistors (MOVs) are recommended for transient suppression in inductive coils. An MOV is connected in parallel with the coil and is as close as physically possible to the coil (see Figure 9-2). MOV devices (listed in Table 9-2) are recommended for general purpose applications.

Table 9-2 lists part numbers for recommended MOV devices.

Table 9-2 MOV Devices

Part Number	30732481-001	30732481-002
Maximum AC	130V	275V
Energy Pulse Rating	10 Joules	15 Joules
Supplier (General Electric)	V130LA10A	V275LA15A

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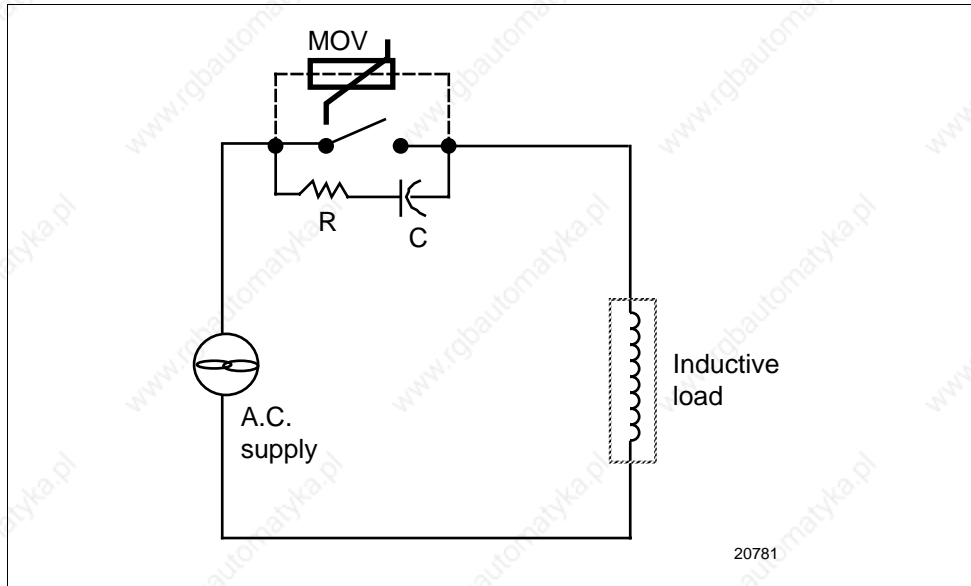
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## 9.6 Noise Suppression at the Source, Continued

### Inductive coils, continued

Figure 9-2 is an illustration of transient suppression in inductive coils.

Figure 9-2 Transient Suppression in Inductive Coils



Additional protection may be provided by adding an RC circuit in parallel with the MOV. This consists of a 220-ohm resistor in series with a 0.5 microfarad, 1000V capacitor. The power rating of the resistor will depend on the voltage rating of the coil (see Table 9-3).

Table 9-3 Coil Voltage vs Resistor Voltage Rating

Coil Voltage	Resistor Voltage Rating
115V	1/4 Watt
230V	1 Watt
460V	3 Watt
550V	5 Watt

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## 9.6 Noise Suppression at the Source, Continued

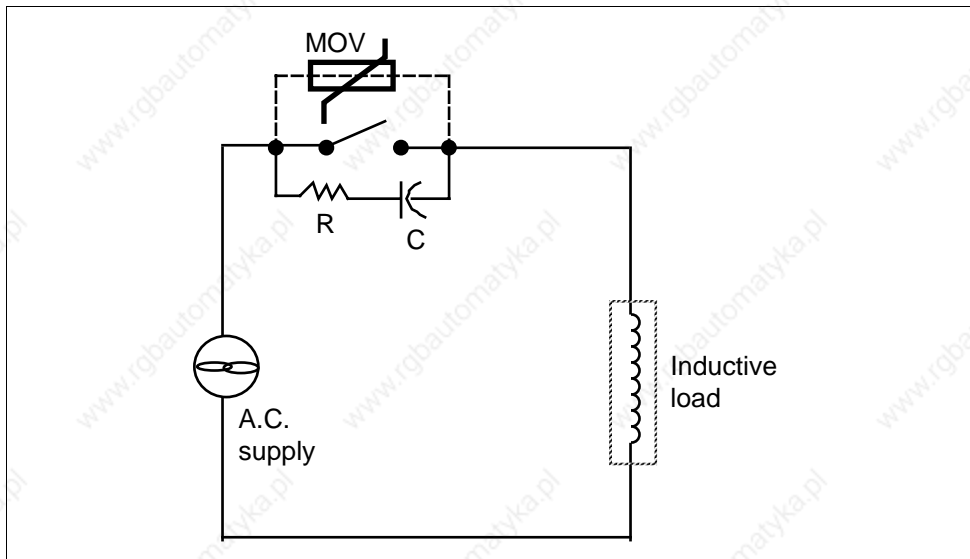
### Contacts

When a contact interrupts an inductive load, a certain amount of energy is stored in the load. An MOV or RC circuit in parallel with the load provides a place where this energy may be dissipated. However, if there is no MOV or RC circuit, the energy may create a visible electrical arc across the open contacts. This, in turn, results in electrical noise as well as damage to the contacts.

One way to eliminate this arc is to connect a resistor and capacitor across the contacts (see Figure 9-3). A combination of 47 ohms and 0.1 microfarads (1000 Vdc) is recommended for circuits up to 3 amps and 300 Vac. For voltages above 2000 Vac, an MOV across the contact may be added for extra protection.

Figure 9-3 is an illustration of a resistor and capacitor connected across a contact to eliminate electrical noise.

Figure 9-3 Contact Noise Suppression



For large load currents, a rule of thumb is to size the capacitor so that the number of microfarads equals the number of amperes in the load current, and the resistor has the same resistance value as the load. The objective is to eliminate the visible arc.

Either discreet resistors and capacitors or packaged RC networks may be used. An RC network (47 ohms and 0.1 microfarad) is available as part number 30371852-001. Similar RC networks are available from Electrocube Inc. (part number RG1782-3) and from Industrial Condenser Corporation.

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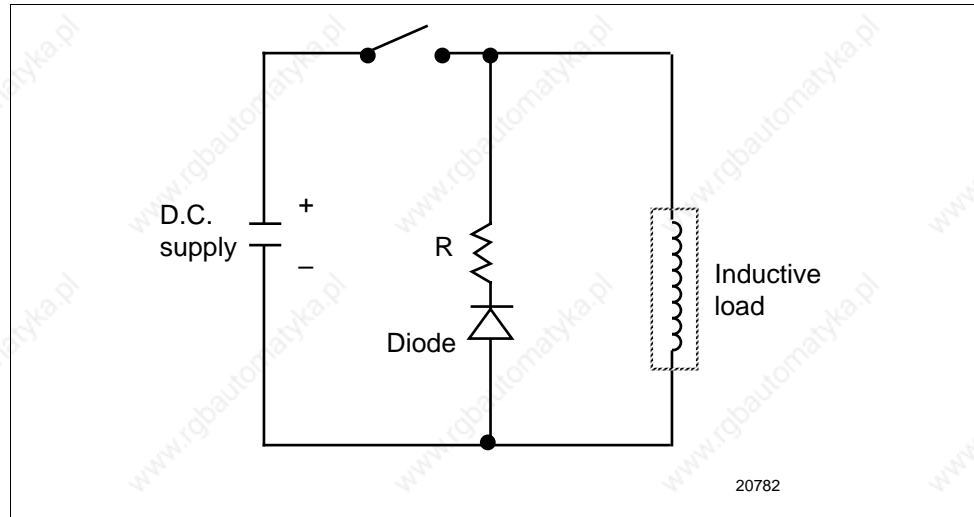
## 9.6 Noise Suppression at the Source, Continued

### Contacts, continued

In DC circuits, the power dissipation under steady state condition can be eliminated by placing a diode (in series with a resistor) in parallel with the load (see Figure 9-4). The value of R should be less than or equal to the DC resistance of the inductive load.

Figure 9-4 is an illustration of DC load noise suppression.

Figure 9-4 DC Load Noise Suppression



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