

**NuDAQ<sup>®</sup>**

**ACL-7225B**

**16 Relay & 16 Isolated DI Card**

**User' s Guide**



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# How to Use This Guide

This manual is designed to help you use the ACL-7225. It describes how to operate the ACL-7225 card to meet your application requirements. It is divided into three chapters:

- Chapter 1, "Introduction," gives an overview of the product features, applications, and specifications.
- Chapter 2, "Installation," describes how to install the ACL-7225. The layout of ACL-7225 is shown, the DIP switch setting for base address, and jumpers setting for input configuration are specified.
- Chapter 3, "Registers Format," describes the registers format and how to program the digital input and output channels on the ACL-7225.





# Introduction

The ACL-7225 - 16-CH Relay Actuator and Isolated D/I card is a compact size ISA Bus card for industrial applications.

This card provides 16 relay actuators and 16 opto-isolated digital input channels. You can use 16 on-board relays to control power switches or ON/OFF control devices. Each relay is matched with one red LED to reflect its ON/OFF status.

The 16 opto-isolated D/I channels are used to collect digital input data. It is very essential to use isolated input to prevent the ground loop problems. Each input channel is jumper selectable to either AC or DC input control voltage. The isolation voltage is guaranteed at 1,000V, so that common-mode voltages and voltage spikes that often occurs in industrial environments are safety isolated from the PC and the ACL-7225.

The digital I/O is via two 37 pin D-type connectors that project through the computer case at the rear of the board.

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## 1.1 Features

The ACL-7225 Relay Actuator and D/I Card provides the following advanced features:

- 16 relay actuator outputs
- 16 opto-isolated AC or DC polarity-free digital inputs
- LEDs to indicated the energized relays
- Inputs jumpers selectable for AC\_Filter/ Non-AC\_Filter
- 1,000 V fully isolation
- On-board relay driving circuits
- 37-pin D-type female connector

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## 1.2 Applications

- Industrial ON/OFF control
- Energy management
- External high power relay driving, signal switching
- Laboratory automation
- Industrial automation
- Switch contact status sensing, limit switch monitoring

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## 1.3 Specifications

### Relay Outputs

- **Relay Type:** Double-Pole-Double-Throw (DPDT)
- **Number of Relays:** 16
  - ♣ R0~R4 and R8~R12 are in Form C
  - ♣ R5~R7 and R13~R15 are in Form A
- **Contact Rating:** 120VAC/ 0.5A or 24VDC 1A
- **Contact Type:** Bifurcated
- **Contact Resistance:** 100M $\Omega$  Max.
- **Relay ON/OFF Time:** 5 msec. typical
- **Coil Voltage:** +12V @33mA for each relay

### Isolated Inputs

- **Opto-Isolator:** PC-814
- **Number of Input Channels:** 16
- **Input Signal Type:** AC (don't care polarity) or DC
- **Input Voltage:** 5~24V<sub>DC</sub> or AC 50 ~1,000 Hz
- **Input Resistors:** 1.2 K $\Omega$
- **Isolation Voltage:** 1,000V channel-to-channel and channel-to-ground
- **Response Time:** 20  $\mu$ sec without AC Filter, 2.2 ms with AC Filter

### Power Consumption

- **+5V<sub>DC</sub>:** 310 mA typical
- **+12V<sub>DC</sub>:** 550 mA maximum, all relays are energized

### General Specifications

- **I/O Connectors:** One 37-pin Female D-type connector, one 40-pin header, an accessory is provided to convert the 40-pin header into 37-pin D-type connector
- **Compatible Bus:** IBM PC-AT Bus
- **Operating Temperature:** 0° C ~ 50°C
- **Storage Temperature:** -20° C ~ 80°C
- **Humidity:** 5 ~ 90%, non-condensing
- **Dimension:** 177mm(L) X 122mm(W)

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## 1.4 Software Supporting

The ACL-7225 is programmed using simple 8-bit I/O port commands. Users can use high level language, such as BASIC, C, or PASCAL, or low-level language, such as assembly to program the board. For the programming under Windows or LabView, please contact your dealer to purchase ACLS-DLL1 or ACLD-LVIEW.

### **ACLS-DLL1**

For easily program the board under Windows environment, we also provide ACLS-DLL1, which include the DLL for Windows 95/98/NT. With ACLS-DLL1, you can use compilers such as VB, VC/C++, or Delphi.

### **ACLS-LVIEW**

For easily link the ACL-7225 with LabView of National Instrument. ACLS-LVIEW includes the Vis of the ACL-7225 under for Windows 3.1/95/98 and NT.

# 2

## Installation

This chapter describes how to install the ACL-7225. The following procedures show the installation procedures:

1. Check what you have
2. Check the PCB and check the location of jumper and switch
3. Setup the jumpers according to the operation theorem
4. Installation the DOS software library if necessary

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### 2.1 What You Have

In addition to this *User's Manual*, the package includes the following items:

- ACL-7225 Relay Actuator & Isolated D/I Card
- Two DB-37 male connectors assembly
- 40-pin to DB-37 converter flat cable
- ADLINK CD

If any of these items is missing or damaged, contact the dealer from whom you purchased the product. Save the shipping materials and carton in case you want to ship or store the product in the future.

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## 2.2 Unpacking

Your ACL-7225 card contains sensitive electronic components that can be easily damaged by static electricity.

The card should be done on a grounded anti-static mat. The operator should be wearing an anti-static wristband, grounded at the same point as the anti-static mat.

Inspect the card module carton for obvious damage. Shipping and handling may cause damage to your module. Be sure there are no shipping and handling damages on the module before processing.

After opening the card module carton, extract the system module and place it only on a grounded anti-static surface component side up.

Again inspect the module for damage. Press down on all the socketed IC's to make sure that they are properly seated. Do this only with the module place on a firm flat surface.

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**Note : DO NOT APPLY POWER TO THE CARD IF IT HAS BEEN DAMAGED.**

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**You are now ready to install your ACL-7225.**

## 2.3 PCB Layout

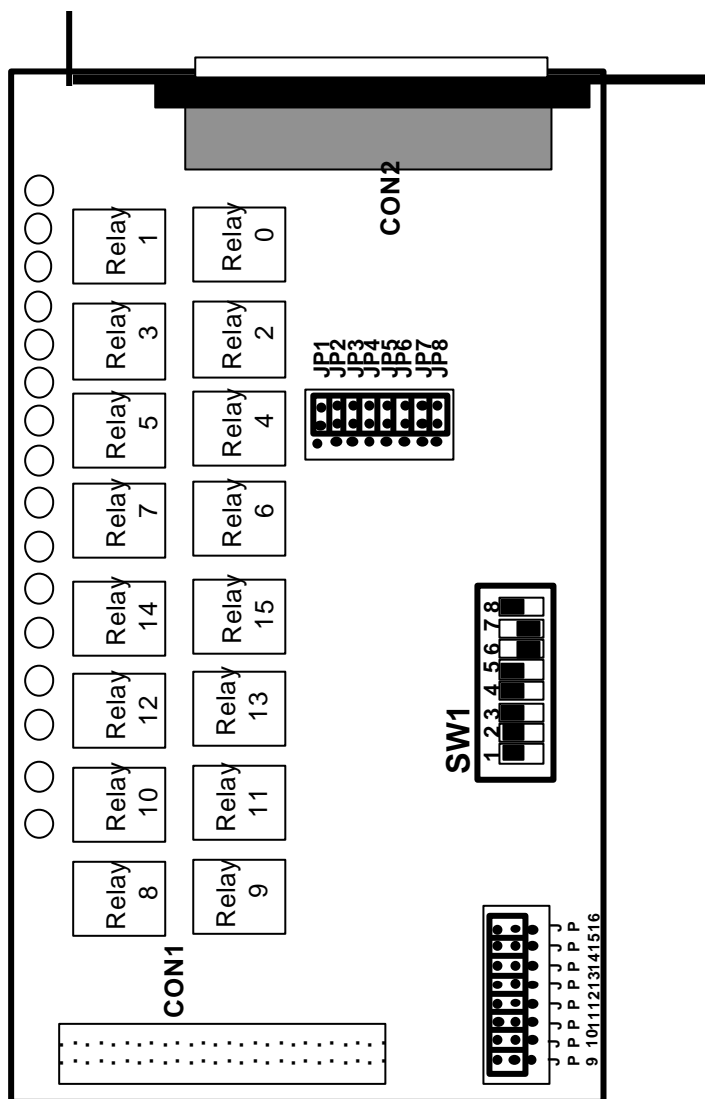


Figure 2.1

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## 2.4 Jumper and DIP Switch Description

You can change the ACL-7225's input signals and base address by setting jumpers and DIP switches on the card. The card's jumpers and switches are preset at the factory. Under normal circumstances, you should not need to change the jumper settings.

A jumper switch is closed (sometimes referred to as shorted) with the plastic cap inserted over two pins of the jumper. A jumper is open with the plastic cap inserted over one or no pin(s) of the jumper.

---

## 2.5 Base Address Setting

The ACL-7225 occupies eight consecutive address locations in I/O address space. Actually, only 4 consecutive address locations are used. The base address of the ACL-7225 is restricted by the following conditions.

1. The base address must be within the range 200hex to 3FFhex.
2. The base address should not conflict with any PC reserved I/O address. see Appendix A.

The ACL-7225's I/O port base address is selectable by an 6 position DIP switch SW1 ( refer to Figure 2.1). The default base address is set as Hex 300, which is shown as following figure 2.2. All the possible combinations of SW1 switch configuration are listed in the table 2.1 below.

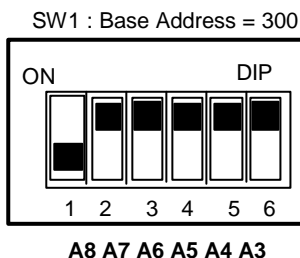


Figure 2.2 Default Base Address Setting



I/O Port Address (Hex)	1 A8	2 A7	3 A6	4 A5	5 A4	6 A3
200-207	ON (0)	ON (0)	ON (0)	ON (0)	ON (0)	ON (0)
208-20F	ON (0)	ON (0)	ON (0)	ON (0)	ON (0)	OFF (1)
:						
2F8-2FF	ON (0)	OFF (1)	OFF (1)	OFF (1)	OFF (1)	OFF (1)
(*) 300-308	OFF (1)	ON (0)	ON (0)	ON (0)	ON (0)	ON (0)
308-30F	OFF (1)	ON (0)	ON (0)	ON (0)	ON (0)	OFF (1)
:	:	:	:	:	:	:
3F8-3FF	OFF (1)	OFF (1)	OFF (1)	OFF (1)	OFF (1)	OFF (1)

(\*) : default setting

ON = 0 ; OFF = 1.

A9, ..., A3 are corresponding to PC Bus address lines

A9 is fixed as 1, and A2, A1 and A0 are fixed by 0 with hardware

How to Define a Base Address for the ACL-7225 ?

The DIP1 to DIP7 in the switch SW1 are one to one corresponding to the PC bus address line A3 to A8. A9 is always set as 1, and A0, A1 and A2 are always 0. If you want to change the base address, you can only change the values of A9 to A3 ( shadow area of below diagram). Following is an example, which shows you how to define the base address as **Hex 300**.

Base Address : **Hex 300**

<b>3</b>			<b>0</b>					<b>0</b>			
<b>1</b>	<b>1</b>		<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>		<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
A9	A8		A7	A6	A5	A4		A3	A2	A1	A0

Table 2.1 Address Switch Setting Table

## 2.4 Input Signal Type Selection

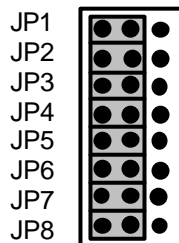
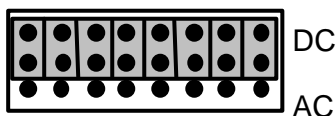
The ACL-7225's input signal can be selected either **AC input** or **DC input** signal. There are 16 jumpers (JP1...JP8 and JP9...JP16) associated with each digital input channel for configuring the channel as AC or DC input. The digital input channels and their corresponding jumpers is shown in the following Table 2.3.

JUMPER	INPUT SIGNAL	JUMPER	INPUT SIGNAL
JP1	DI0	JP9	DI8
JP2	DI1	JP10	DI9
JP3	DI2	JP11	DI10
JP4	DI3	JP12	DI11
JP5	DI4	JP13	DI12
JP6	DI5	JP14	DI13
JP7	DI6	JP15	DI14
JP8	DI7	JP16	DI15

Table 2.3 Input Signal Type Selection Table

The default setting of the input signal selection is DC type, which is shown as following diagrams:

J J J J J J J J  
P P P P P P P P  
9 10 11 12 13 14 15 16



DC AC

Input Signal Selection	AC Input	DC Input (Default)
Jumper JP1 ~ JP16	AC position	DC position

---

## 2.3 Connector Pin Assignments

The ACL-7225 card comes equipped with two I/O connectors CON1 and CON2. The CON1 is an on-board 40-pin connector, and CON2 is a 37 pin D-type connector accessible from the rear panel of the card, and . The pin assignment of these connectors is described by Figure 2.4 and Figure 2.5, respectively.

### Legend :

- 1. **DIA $n$**  -digital input A of channel  $n$
- 2. **DIB $n$**  -digital input B of channel  $n$
- 3. **NC $n$**  -normal close pin of relay  $n$
- 4. **NO $n$**  -normal open pin of relay  $n$
- 5. **COM $n$**  -common pin of relay  $n$
- 6. **GND** -ground
- 7. **NC** -Not Connected

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**Note :** Isolated Digital Input is polarity-free, so you can connect the digital inputs signal on input A and input B points and do not care the polarity.

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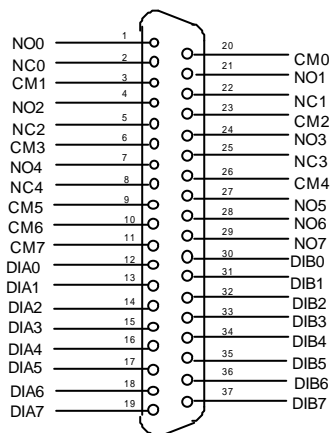


Fig 2.4 Pin Assignment of 37-pin CON2 connector

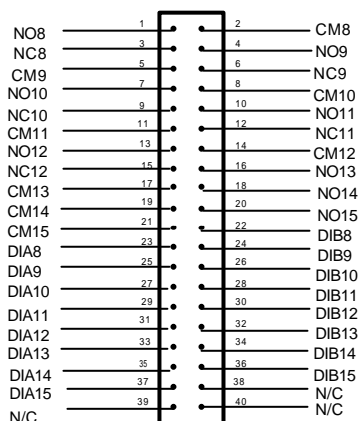
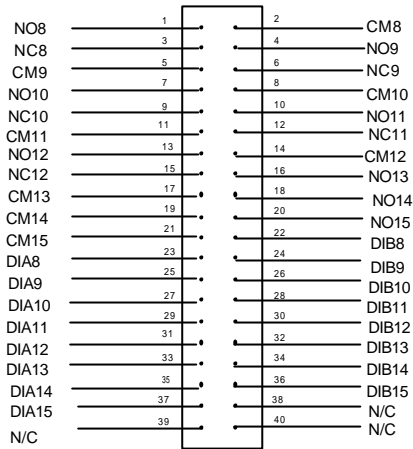
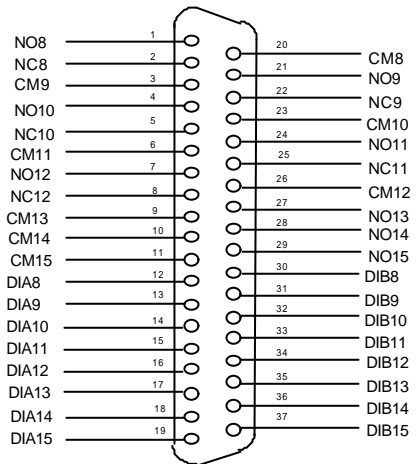
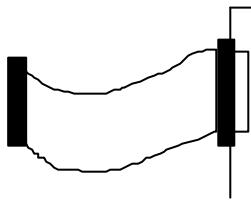


Fig 2.5 Pin Assignment of 40-pin CON1 connector

A cable connector to convert the CON1 40-pin header to 37-pin male D-type connector is enclosed with the ACL-7225. The mapping between the 40-pin header and 37-pin D-type connector are shown on next page.



40-pin Ribbon



37-pin D-sub

Figure 2.6 Conversion Diagram from 40-pin to 37-pin connector

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## 2.4 DOS Software Library Installation

This section describes the DOS software library, which is free supplied. The function prototypes and some useful constants are defined in the header files in LIB directory. The DOS library software includes a utility program, C language library, and some demonstration programs, which can help you reduce the programming work. Please refer to the ACLS-DLL1 function reference manual, which included in ADLINK CD. The DOS functions are compatible with ACLS-DLL1 functions except without “**W**” prefix in function names.

To program in Windows environment, please use ACLS-DLL1, however, it needs license.

To install the DOS library software and utilities, please follow the following installation procedures:

1. Put *ADLINK CD* into the appropriate CD-ROM drive.
2. Type the following commands to change to the card' s directory (X indicates the CD-ROM drive):  
`X:\>CD \NuDAQISA\7225`
3. Execute the setup batch program to install the software:  
`X:\NuDAQISA\7225>SETUP`

## Registers Format

The registers format of ACL-7225 is described in this chapter.

### 3.1 Registers Map

The ACL-7225 requires 8 consecutive addresses (only 4 are used) in the PC I/O address space. The following table (Table 3.1) shows the location of each register and driver relative to the base address, and its description.

Location	FUNCTION DESCRIPTION	R/W Attribute
Base + 0	Relay Outputs (R0~R7)	Read/Write
Base + 1	Relay Outputs (R8~R15)	Read/Write
Base + 2	Isolated Inputs (DI0 ~DI7)	Read Only
Base + 3	Isolated Inputs (DI8 ~DI15)	Read Only
Base + 4	Not Used	-
Base + 5	Not Used	-
Base + 6	Not Used	-
Base + 7	Not Used	-

Table 3.1 I/O Registers Map

### 3.2 Relay Output Registers

The ACL-7225 provides 16 relay output channels, and they are arranged into two groups. First group relays(R0 ~R7) are controlled via the register Base + 0, and the second group relays ( R8~R15) are controlled via the register Base + 1. The ON/OFF status of each relay is controlled by its corresponding one bit of register, i.e. the control bit is low (0) status, it turns the relay OFF, and high status (1) will energized the relay.

The readback capability is also support in the ACL-7225, i.e. you can read back each relay's status through the relay output registers.

The relationships between the bit of relay output register and its corresponding relays are shown as below.

**Data Format:**

**Realy Output Register: (Base + 0)**

Bit	7	6	5	4	3	2	1	0
	RO7	RO6	RO5	RO4	RO3	RO2	RO1	RO0

**Realy Output Register: (Base + 1)**

Bit	7	6	5	4	3	2	1	0
	RO15	RO14	RO13	RO12	RO11	RO10	RO9	RO8

**RO : Relay Output**

---

### 3.3 Isolated Input Registers

There are 16 non-polarity isolated inputs are provided in the ACL-7225. These inputs are also divided into two groups. Each group is controlled by one input register. The register can be read only.

**Data Format:**

**Isolated Input Register: (Base + 2)**

Bit	7	6	5	4	3	2	1	0
	DI7	DI6	DI5	DI4	DI3	DI2	DI1	DI0

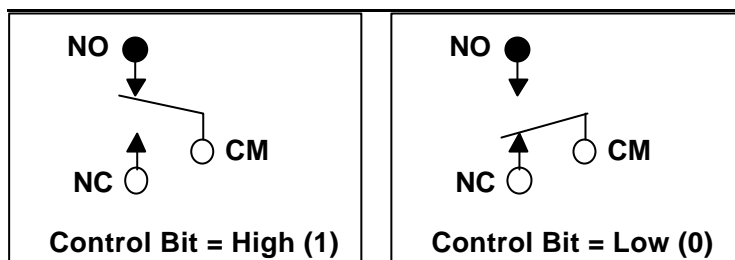
**Isolated Input Register: (Base + 3)**

Bit	7	6	5	4	3	2	1	0
	DI15	DI14	DI13	DI12	DI11	DI10	DI9	DI8

### 3.4 Relay Output

The ACL-7225 contains two types of relays: Form C and Form A. The relay R0 ~ R4 and R9 ~ R12 are form C relays, and R5 ~ R7 and R13 ~ R15 are form A type. The difference between these two types of relay are :

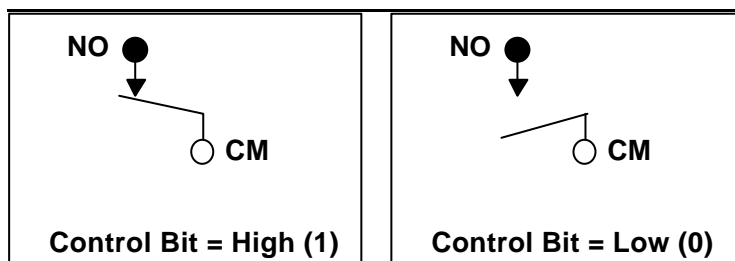
#### 1. Form C Relays: (R0 ~ R4 and R9 ~ R12)



Form C relay has three contacts: NC ( Normal Close), NO ( Normal Open), and CM( Common). The COM post, located at the middle, can make contact either NO post or NC post. When the control bit is high (1), the CM post and NO post are contacted. If the control bit is low (0), the CM post and NC post make contact.

In normal power-up and reset, the relay is in **low** status.

#### 2. Form A Relays: (R5 ~ R7 and R13 ~ R15)



Form A relay only has two contacts : NC ( Normal Close) and CM( Common). The CM post can make contact either NO post or not contact NO post. When the control bit is high (1), the CM post and NO post are contacted. If the control bit is low (0), the CM post and NO post does not make contact. Under normal power-up and reset, the relay is in **low** status.



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## 3.6 Programming Examples

The ACL-7225's registers can be accessed through direct I/O instructions, such as **inport** and **outport** instructions in Borland C/C++ language. You can write (outport) control word to relay output register to turn the relay's ON/OFF. Also, you can read (inport) back the signal of relay status or isolated input signals.

### 1. Read operation

A read operation on BASE+2 will read in the value ( status) of the first 8 corresponding digital input channels.

#### For example:

To get the status of these channels using the BASIC language,  
value = INP(BASE+2)

In C Language

```
value = inp( BASE + 2 );
```

### 2. Write operation

A write operation on BASE+0 will set the desired status on the first 8 corresponding relay output channels.

#### For example:

##### In Basic Language:

```
OUT BASE,abc
```

In C Language :

```
outp( BASE, abc );
```

the value of **abc** should be between 0 and 255 . The status of the relay output can be monitored by reading back registers

#### In Basic:

```
STATUS = INP(BASE)
```

In C Language:

```
status = inp( base );
```

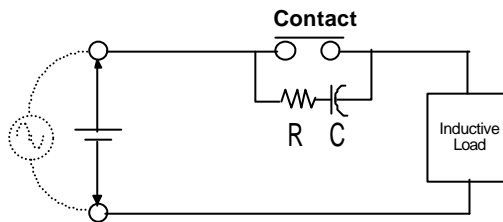
# Appendix A. Realy Contact Protection Circuits

The contacts are the most important elements of relay constructions, Contact performance conspicuously influenced by contact material, and voltage and current values applied to the contacts.

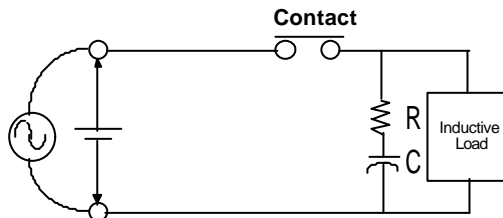
Another important issue is contact protection, a right contact protection circuit can suppress the counter emf to a low level. However, note that incorrect use will result in an adverse effect. Typical contact protection circuits are given below :

## 1. RC Circuit

This circuit is suitable for DC application. If the load is a timer, leakage current flows through the RC circuit causing faulting operation.



The below circuit is suitable for both AC and DC applications. If the load is a relay or solenoid, the release time lengthens. Effective when connected to both contacts if the power supply voltage is 24V or 48V and the voltage cross the load is 100 to 200V.



### Device Selection:

As a guide in selecting R and C,

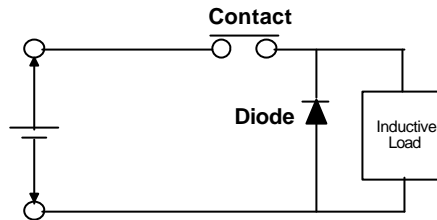
R: 0.5 to 1  $\Omega$  per 1V contact voltage

C : 0.5 to 1  $\mu$ F per 1A contact current

Value vary depending on the properties of the capacity C acts to suppress the discharge the moment the contacts open. Resistor R acts to limit the current when the power is turned on the next time. Test to confirm. Use a capacitor with a breakdown voltage of 200 to 300V. Use AC type capacitors( non-polarized) for AC circuits.

## 2. Diode Circuit

This circuit is suitable for DC application. The diode connected in parallel causes the energy stored in the coil to flow to the coil in the form of current and dissipates it as joule heat at the resistance component of the inductive load. This circuit further delays the release time compared to the RC circuit.

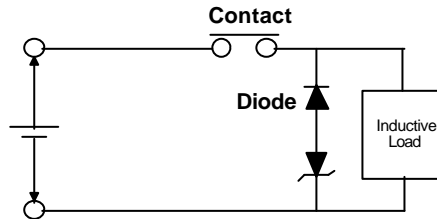


### Device Selection

Use a diode with a reverse breakdown voltage at least 10 times the circuit voltage and a forward current at least as large as the load current. In electronic circuits where the circuit voltages reverse breakdown voltage of above 2 to 3 times the power supply voltage.

## 3. Diode & Zener diode Circuit

This circuit is also suitable for DC application. Effective when the release time in the diode circuit is too long.

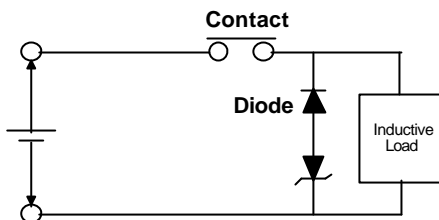


### Device Selection

Use a zener diode with a zener voltage about the same as the power supply voltage.

#### 4. Varistor Circuit

This circuit is also suitable for both AC & DC applications. Using the stable voltage characteristics of the varistor, this circuit prevents excessively high voltages from being applied across the contacts. This circuit also slightly delays the release time. Effective when connected to both contacts of the power supply voltage is 24 or 48V and the voltage across the load is 100 to 200 V.



# Product Warranty/Service

Seller warrants that equipment furnished will be free from defects in material and workmanship for a period of one year from the confirmed date of purchase of the original buyer and that upon written notice of any such defect, Seller will, at its option, repair or replace the defective item under the terms of this warranty, subject to the provisions and specific exclusions listed herein.

This warranty shall not apply to equipment that has been previously repaired or altered outside our plant in any way as to, in the judgment of the manufacturer, affect its reliability. Nor will it apply if the equipment has been used in a manner exceeding its specifications or if the serial number has been removed.

Seller does not assume any liability for consequential damages as a result from our products uses, and in any event our liability shall not exceed the original selling price of the equipment.

The equipment warranty shall constitute the sole and exclusive remedy of any Buyer of Seller' s equipment and the sole and exclusive liability of the Seller, its successors or assigns, in connection with equipment purchased and in lieu of all other warranties expressed implied or statutory, including, but not limited to, any implied warranty of merchant ability or fitness and all other obligations or liabilities of seller, its successors or assigns.

The equipment must be returned postage-prepaid. Package it securely and insure it. You will be charged for parts and labor if you lack proof of date of purchase, or if the warranty period is expired.