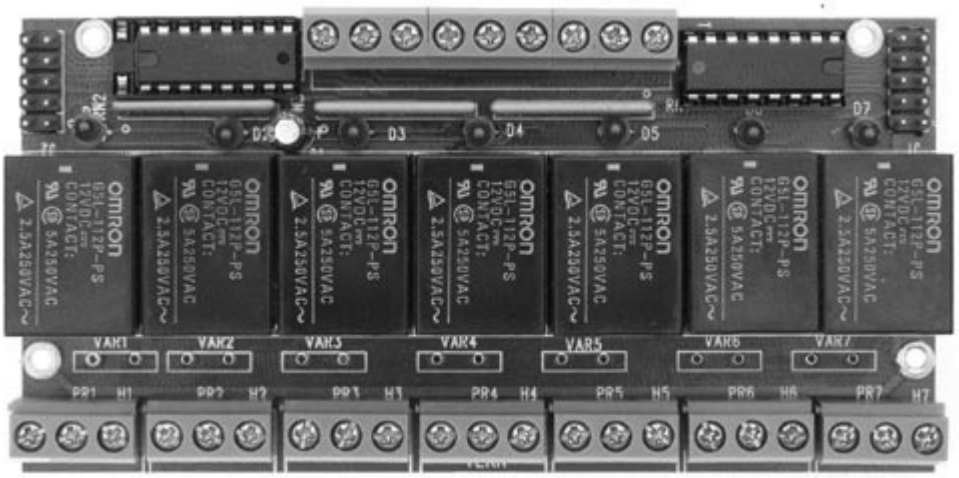
Relay7™

Seven power relays and seven high voltage drivers for industrial applications



Technical Manual

TERN INC.
1724 Picasso Avenue, Suite A, Davis, CA 95616, USA
Tel: 530-758-0180 Fax: 530-758-0181

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1724 Picasso Avenue, Suite A, Davis, CA 95616, USA
Tel: 530-758-0180 Fax: 530-758-0181
Internet Email: tern@netcom.com ***http://www.tern.com***

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Chapter 1: Introduction

1.1 Functional Description

In many industrial applications, 12V or 24V control signals are required; however, most embedded controllers provide TTL level (0-5V) input or output only. The Relay7 (R7) board is designed to support signal conversion of high voltage (up to 30V) digital signals and TTL level digital signals.

The Relay7 offers seven power relays. Each power relay provides Normal Close, Normal Open, and COM contacts, rated 10A @ 35V. Seven red LED indicators are installed to indicate the power relay status. The user may install MOVs to protect relay contacts.

An additional seven I/O channels with high voltage drivers are also on board. These seven high voltage I/O channels are hardware-configurable as 0V to 30V inputs or as 0V to 30V outputs at the screw terminals, T1.

1.2 Features

- Dimensions: 4.4 x 2.2 x 0.8 inches
- Temperature: -40°C to +80°C
- Power supply input voltage: +12 V unregulated DC
- Seven mechanical power relays with Normal Open, Normal Close, and Common contacts rated at least 5A @ 250V.
- Seven channels of high voltage (0V to 30V) inputs or outputs.

A functional block diagram of the Relay7 is shown below in Figure 1.1.

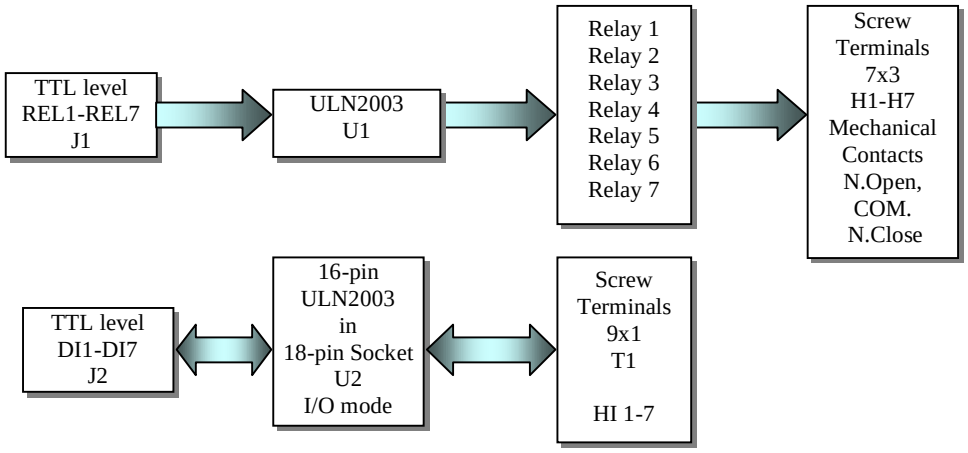


Figure 1.1 Relay7 functional block diagram

1.3 Physical Description

Figure 1.2 shows the physical layout of the Relay7. Dimensions are given in inches.

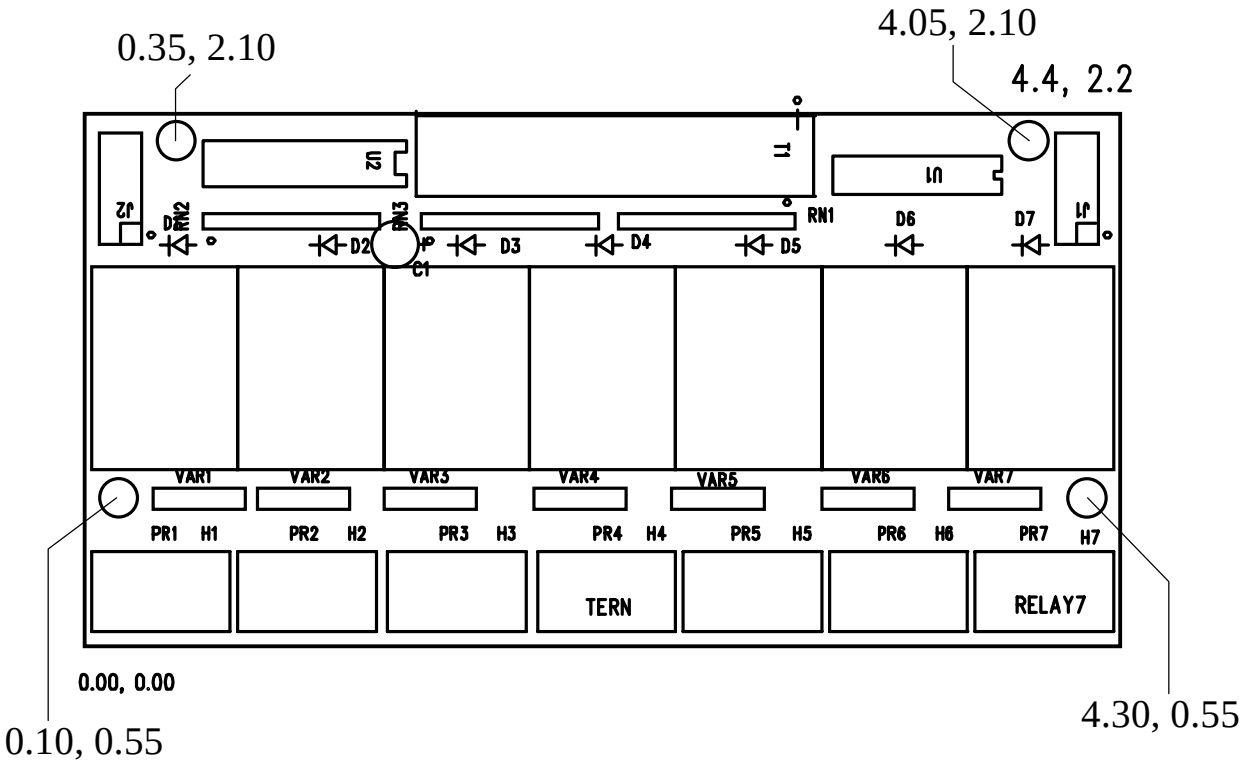


Figure 1.2 Layout of the Relay7

Chapter 2: Hardware

For many industrial applications, contact switch signals need to be 12V or 24V. In order to be useful, a control signal may have to drive a solenoid coil or a mechanical relay at 12V or 24V DC.

Most microcontrollers provide TTL-level digital control signals only. The Relay7 is designed to provide a buffer interface between TTL digital signals and the industrial control environment.

ULN2003 is a high voltage, high current Darlington transistor array, consisting of seven silicon NPN Darlington pairs on a common monolithic substrate. All channels feature open-collector outputs for sinking 350 mA at 50V, and integral protection diodes for driving inductive loads. Peak inrush currents of up to 600 mA sinking are allowed. The outputs may be paralleled to achieve high-load capability, although each driver has a maximum continuous collector current rating of 350 mA at 50V. The maximum power dissipation allowed is 2.20 W per chip at 25 degrees Celsius (ºC).

The common substrate G is routed to GND. All currents sinking in return through the J2 GND pin. A heavy gauge (20) wire must be used to connect the T1 GND pin to the external power supply ground return.

K provides a connection to the protection diodes. K should be tied to the highest voltage in the external load system. It is connected to +12V at U2 pin 1 and T1 pin 9. ULN2003 is a sinking driver, not a sourcing driver.

Please refer to the Relay7 schematic “RELAY7.SCH” (found at the end of this manual) for the following discussion.

2.1 Power Relays

The Relay7 provides seven mechanical power relays. The Normal Open, Normal Close, and Common pins of each power relay are connected to the terminal blocks (T1) with heavy traces that support at least 5A current. The relays are driven by seven solenoid drivers (U1, ULN2003) that are controlled by seven TTL control signals, REL1-7. They are routed to a 5x2-pin dual row pin header, J1. The user can drive a relay via the J1 header with an input voltage of 0V to turn the relay off, or a positive voltage ranging from +3V to +30V to turn the relay on.

For mechanical relay contact protection, you may install MOVs on the pads labeled “VARx”.

2.2 High-voltage I/Os

An additional seven high voltage drivers are installed in the U2 socket to provide seven high voltage inputs or outputs.

The 16-pin ULN2003 chip is installed in the 18-pin U2 socket. This allows you to configure the chip to operate in either input mode or output mode.

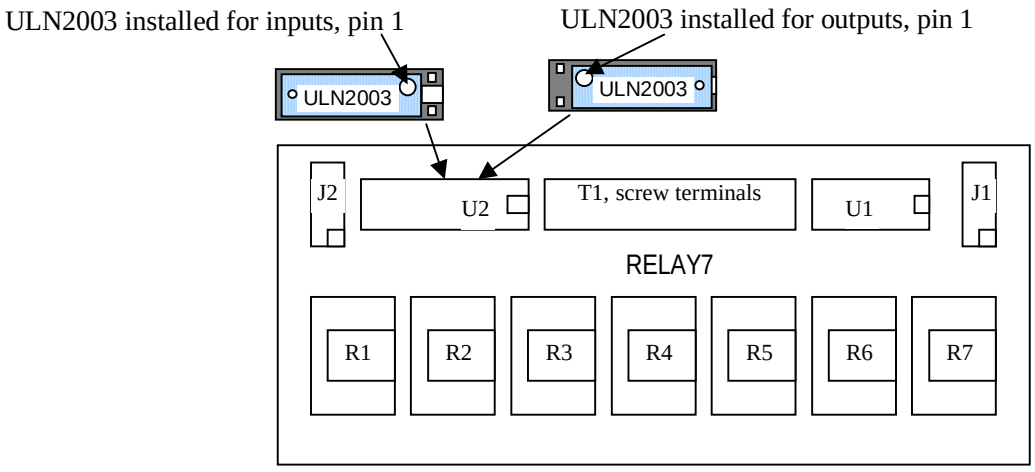


Figure 2.1 Installation of user-configurable Darlington Transistor Array in U2.

The ULN2003 is installed as a solenoid driver output by factory default. When the ULN2003 is installed as a solenoid driver output, pins 1 to 8 of the chip are next to the power relays, and the other side of the chip (pins 9 to 16) is next to the outside edge of the board, leaving pins 9 and 10 of the socket empty.

For using the ULN2003 as output, see Figure 2.2.

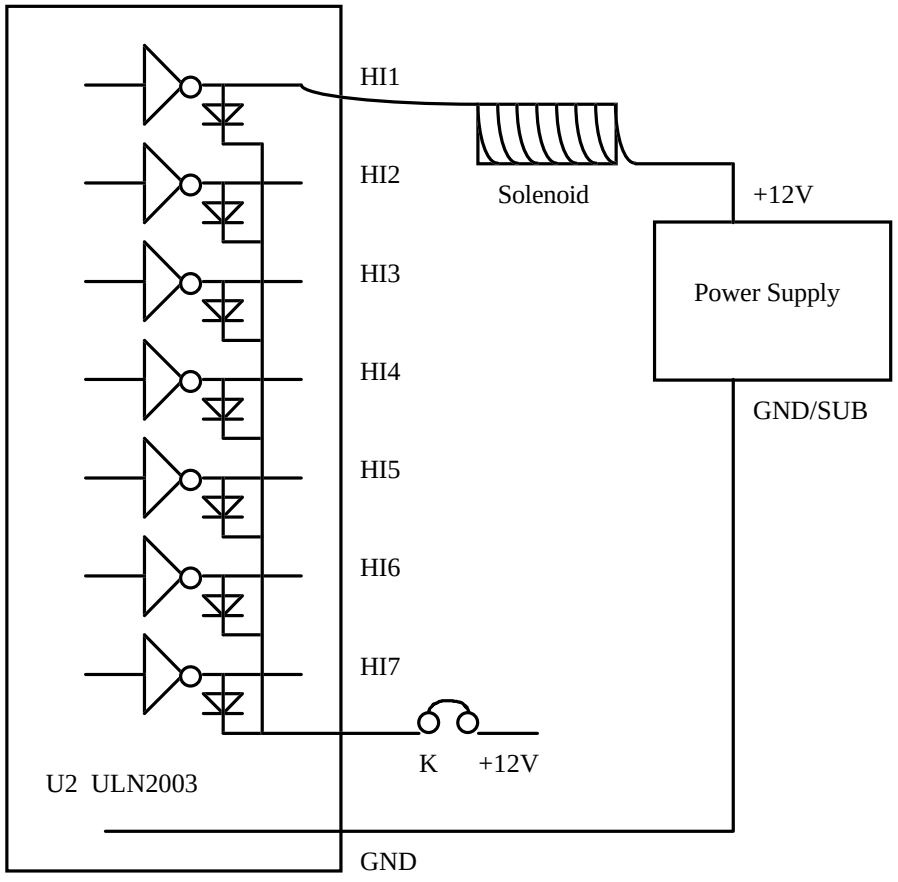


Figure 2.2 Using ULN2003 as output: drive inductive load with high voltage/current drivers

If you wish to use high voltage inputs, you must take the ULN2003 chip out of the socket, turn it 180 degrees, and line it up in the U2 socket with pins 9 and 10, thus leaving pins 1 and 18 of the U2 socket empty.

The maximum input voltage is 30V. You may install a pull-up resistor network in RN3. A valid input low voltage is less than 0.8V, and the input high voltage must be higher than 3V and less than 30V.

For using ULN2003 as input, see Figure 2.3.

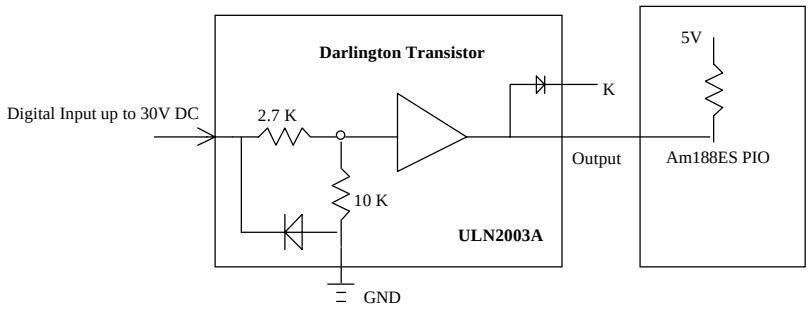
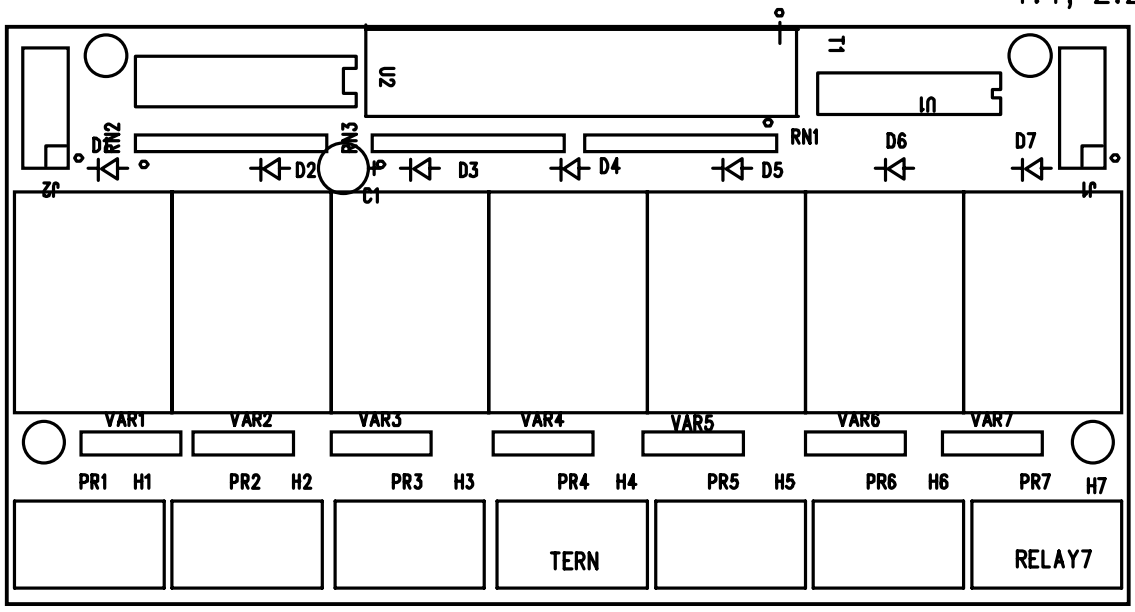


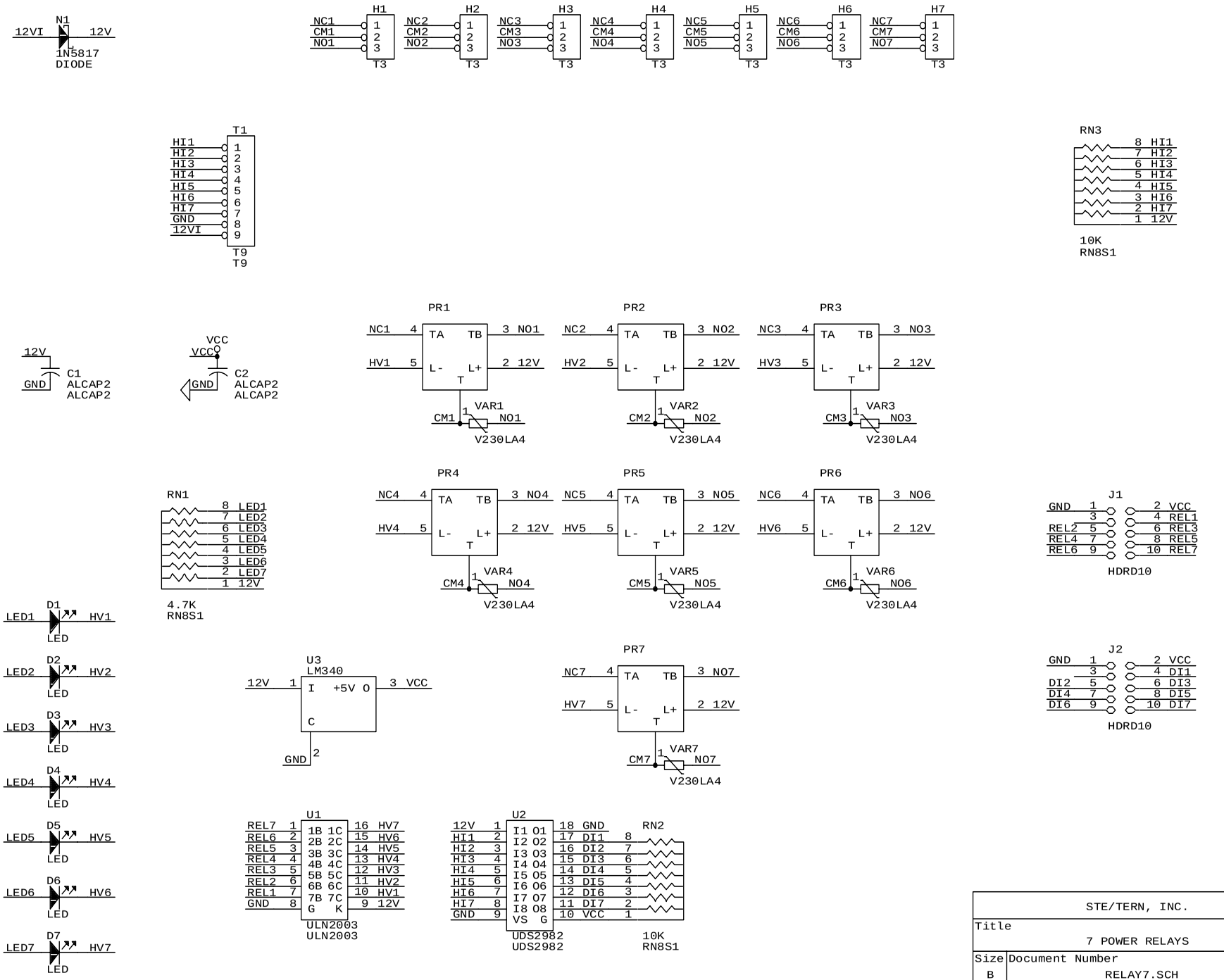
Figure 2.3 Darlington Transistors can be used as Protective High Voltage Inputs.

Relay7™ Layout

4.4, 2.2



0.00, 0.00


N1
12VI
12V
1N5817
DIODE
H1
NC1
CM1
NO1
T3
H2
NC2
CM2
NO2
H3
NC3
CM3
NO3
H4
NC4
CM4
NO4
H5
NC5
CM5
NO5
H6
NC6
CM6
NO6
H7
NC7
CM7
NO7
T1
HI1
HI2
HI3
HI4
HI5
HI6
HI7
GND
12VI
T9
RN3
8 HI1
7 HI2
6 HI3
5 HI4
4 HI5
3 HI6
2 HI7
1 12V
10K
RN8S1
12V
GND
C1
ALCAP2
VCC
C2
PR1
NC1
TA
TB
3 NO1
HV1
L-
L+
2 12V
VAR1
CM1
NO1
V230LA4
PR2
NC2
3 NO2
HV2
VAR2
CM2
NO2
PR3
NC3
3 NO3
HV3
VAR3
CM3
NO3
RN1
8 LED1
7 LED2
6 LED3
5 LED4
4 LED5
3 LED6
2 LED7
1 12V
4.7K
RN8S1
PR4
NC4
3 NO4
HV4
VAR4
CM4
NO4
PR5
NC5
3 NO5
HV5
VAR5
CM5
NO5
PR6
NC6
3 NO6
HV6
VAR6
CM6
NO6
J1
GND 1
2 VCC
3
4 REL1
REL2 5
6 REL3
REL4 7
8 REL5
REL6 9
10 REL7
HDRD10
D1
LED1
HV1
LED
D2
LED2
HV2
D3
LED3
HV3
D4
LED4
HV4
D5
LED5
HV5
D6
LED6
HV6
D7
LED7
HV7
U3
LM340
12V 1
I +5V O
3 VCC
C
GND 2
PR7
NC7
3 NO7
HV7
VAR7
CM7
NO7
J2
GND 1
2 VCC
3
4 DI1
DI2 5
6 DI3
DI4 7
8 DI5
DI6 9
10 DI7
HDRD10
U1
REL7 1
1B 1C
16 HV7
REL6 2
2B 2C
15 HV6
REL5 3
3B 3C
14 HV5
REL4 4
4B 4C
13 HV4
REL3 5
5B 5C
12 HV3
REL2 6
6B 6C
11 HV2
REL1 7
7B 7C
10 HV1
GND 8
G K
9 12V
ULN2003
U2
12V 1
I1 O1
18 GND
HI1 2
I2 O2
17 DI1 8
HI2 3
I3 O3
16 DI2 7
HI3 4
I4 O4
15 DI3 6
HI4 5
I5 O5
14 DI4 5
HI5 6
I6 O6
13 DI5 4
HI6 7
I7 O7
12 DI6 3
HI7 8
I8 O8
11 DI7 2
GND 9
VS G
10 VCC 1
UDS2982
RN2
10K
RN8S1
STE/TERN, INC.
Title
7 POWER RELAYS
Size
B
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RELAY7.SCH
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