Relay Cards (SR9500 Series)

Smart Star Modular C-Programmable Control System

User's Manual

010215 - A

Digital I/O Cards User's Manual

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TABLE OF CONTENTS

1. RELAY CARDS

Chapter 1 describes the features of the relay card, one of the I/O cards designed for the Smart Star embedded control system. The Smart Star embedded control system is described in complete detail in the ***Smart Star User's Manual***.

The Smart Star is a modular and expandable embedded control system whose configuration of I/O, A/D converter, D/A converter, and relay cards can be tailored to a large variety of demanding real-time control and data acquisition applications.

The typical Smart Star system consists of a rugged backplane with a power supply, a CPU card, and one or more I/O cards. The CPU card plugs into a designated slot on the backplane chassis, which has seven additional slots available for I/O cards to be used in any combination. A high-performance Rabbit 2000 microprocessor on the CPU card operates at 25.8 MHz to provide fast data processing.

1.1 Relay Card Features

Two models of relay cards are available, as shown in Table 1.

Table 1. Smart Star Relay Cards

I/O Card	Model	Features
Relay	SR9500	5 SPST relays and 1 SPDT relay, each protected with onboard snubbers
	SR9510	8 SPDT relays (no snubbers)

The SR9500 relay cards are suitable for switching all kinds of loads up to 30 V DC at 1 A or 48 V AC at 0.5 A. The SR9510 handles similar loads, but is restricted to noninductive loads unless you add snubbers to the system that is interfacing with the Smart Star.

Appendix A provides detailed specifications.

1.2 Installing Relay Cards

1. Orient the backplane with the CPU card already installed and facing towards you as shown in Figure 1.

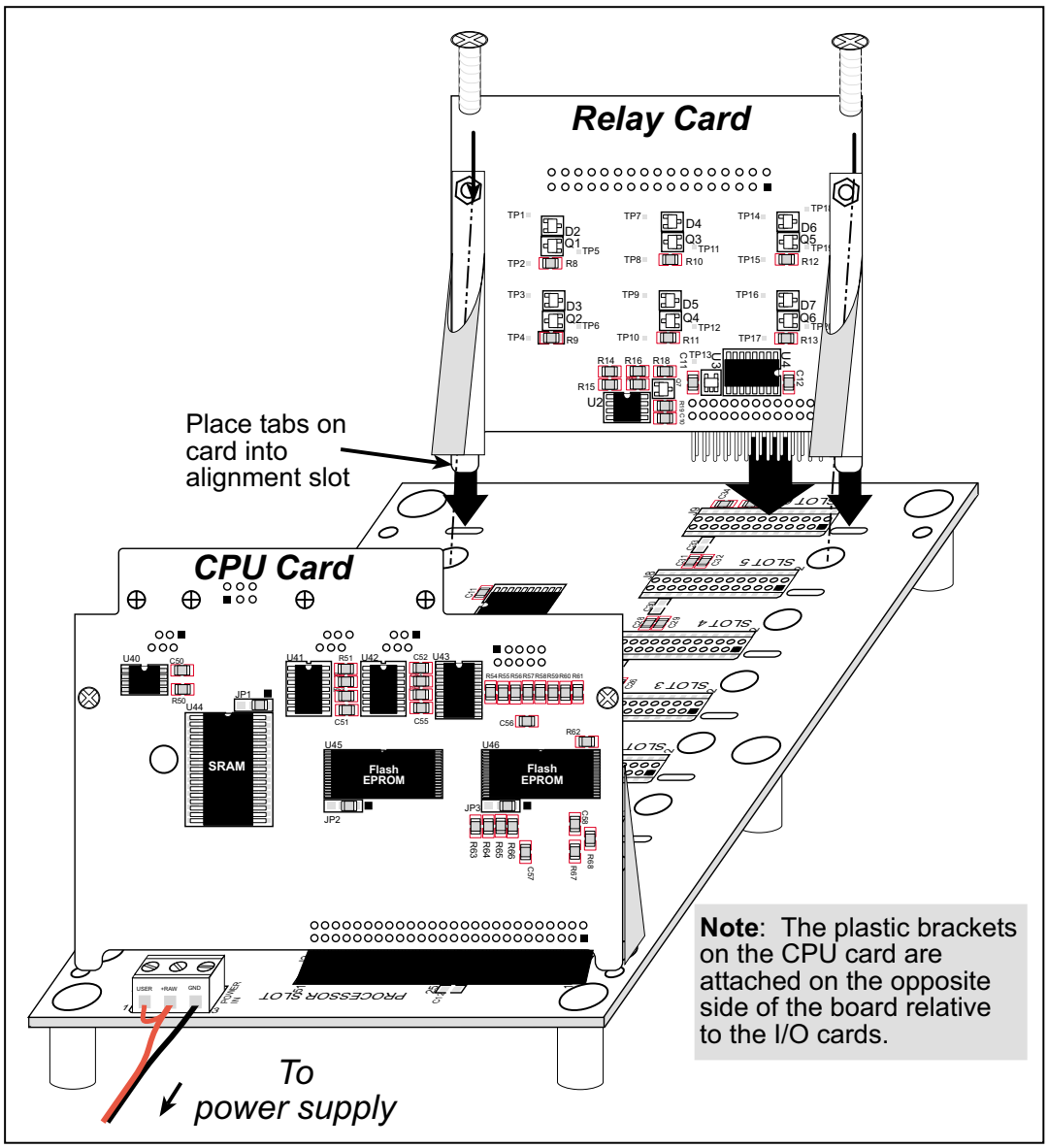


Figure 1. Installing Relay Cards on the Backplane

2. Position the relay card above the backplane over any unused slot position (**SLOT 0** to **SLOT 6**) as shown in Figure 1. Note the slot number and the type of I/O card since Dynamic C addresses the I/O cards by slot number.
3. Carefully insert the relay card header into the slot on the backplane and line up the tabs on the card with the slots on the backplane as shown in Figure 1.
4. Use the two 4-40 screws supplied with the relay card to ensure that the plastic brackets anchor the relay card firmly on the backplane. Tighten the screws as needed.

1.3 User Interface

Depending on the model of relay card (see Table 1), the relays on the relay card will be configured as SPDT or SPST with or without snubbers. Figure 2 shows these relay configurations.

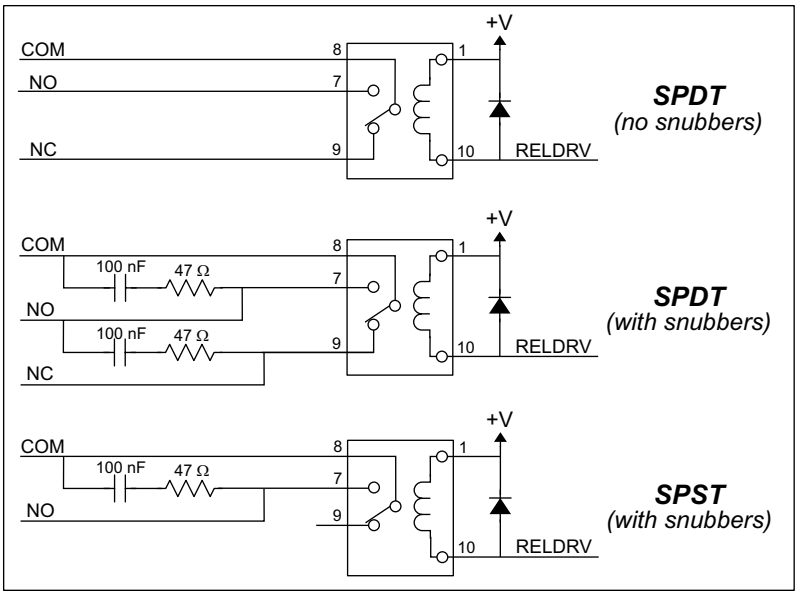


Figure 2. Relay Configurations

The diode protects the coil power supply (and the Smart Star backplane) from inductive spikes caused by energizing/de-energizing the coil, and the resistor-capacitor snubbers protect the relay contacts against voltage spikes induced by inductive loads.

Figure 3 shows the complete pinout for the user interface on header J1. Note that pin 1 is indicated by a small arrow on the ribbon cable connector.

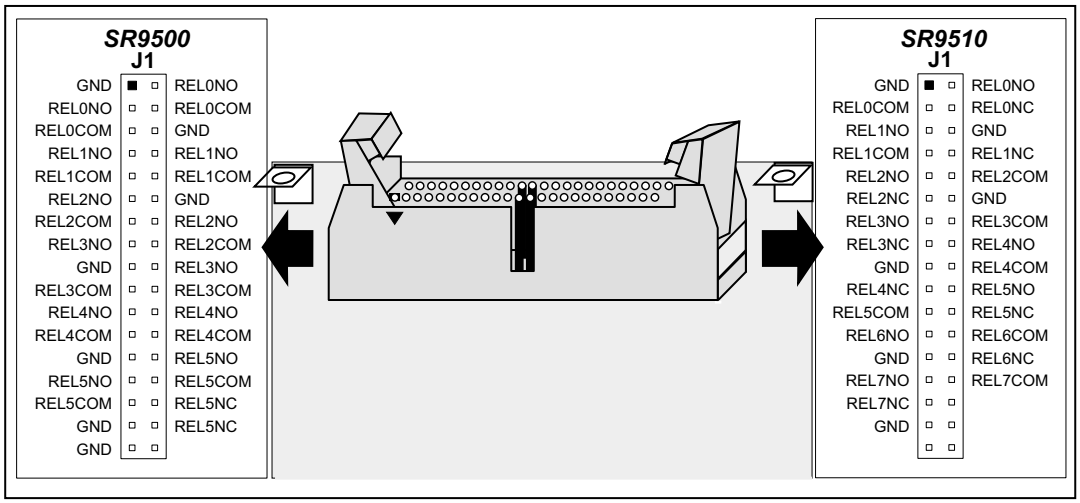


Figure 3. Relay Card User Interface Pinout

1.4 User Connections

Connections to the relay cards are made via a ribbon cable connector or optional field wiring terminals that are either pluggable or have screw terminals. Table 2 lists the Z-World part numbers for the FWTs.

Table 2. Guide to FWT Selection

FWT Description	I/O Cards	Z-World Part Number	
		Pluggable Terminals	Screw Terminals
			
FWT18R	Relay (SR9500)	101-0422	101-0426
FWT27	Relay (SR9510)	101-0420	101-0424

Appendix B, "Field Wiring Terminals," provides further information on FWTs, including their dimensions and pinouts.

1.5 Power Distribution

Figure 4 shows the power distribution on the relay card.

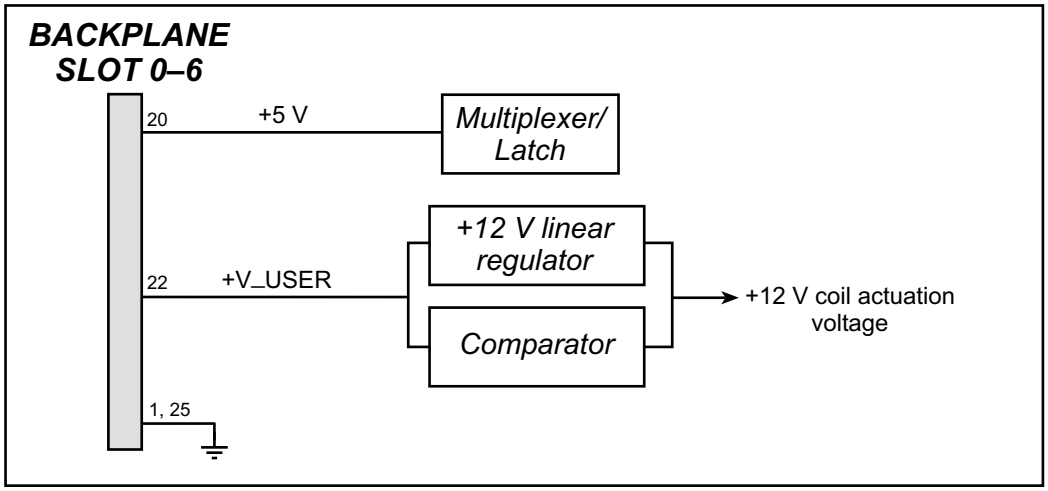


Figure 4. Relay Card Power Distribution

The relay coil actuation voltage is 12 V, and so **+V_USER** should be 12 V to 30 V DC. The **+V_USER** supply passes through a linear regulator and comparator, which are in parallel. The comparator is set for approximately +13.9 V, and as long as **+V_USER** is more than +13.9 V, the +12 V from the linear regulator will provide the coil actuation voltage. Should **+V_USER** be less than +13.9 V, the comparator will supply **+V_USER** directly to provide the coil actuation voltage.

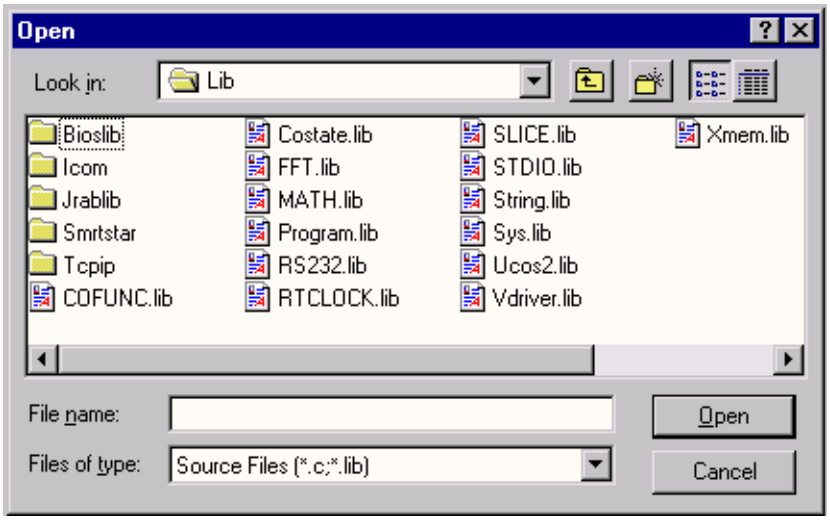
2. SOFTWARE

Dynamic C Premier is an integrated development system for writing embedded software. It runs on an IBM-compatible PC and is designed for use with Z-World controllers and other controllers based on the Rabbit microprocessor.

Chapter 2 provides the libraries, function calls, and sample programs related to the Smart Star relay cards.

2.1 Dynamic C Libraries

With Dynamic C running, click **File** > **Open**, and select **Lib**. The following list of Dynamic C libraries and library directories will be displayed.



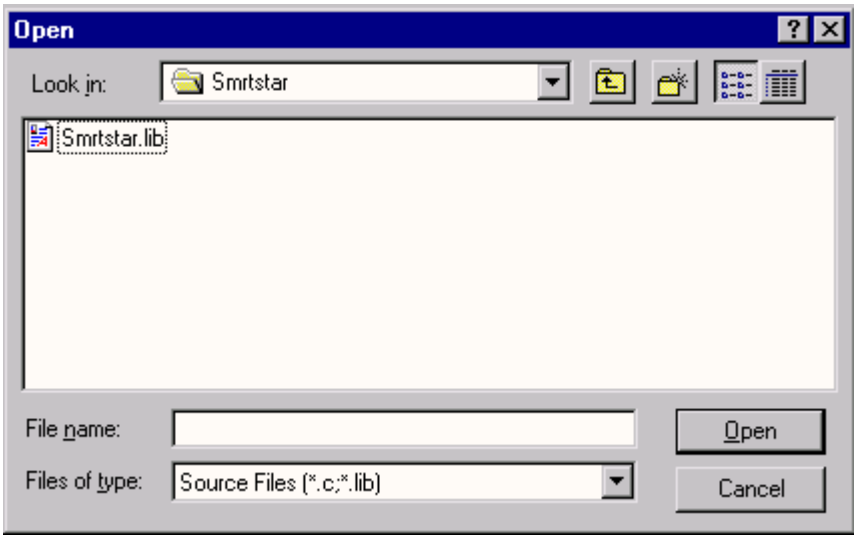
One library directory is specific to the Smart Star.

- **SMRTSTAR**—libraries associated with features specific to the Smart Star control system.

Other functions applicable to all devices based on the Rabbit 2000 microprocessor are described in the ***Dynamic C Premier User's Manual***.

2.1.1 Library Directories

The **SMRTSTAR** directory contains libraries required to operate the Smart Star control system.



- **SMRTSTAR.LIB**—This library supports all the functions needed by the Smart Star systems including digital I/O cards, relay cards, D/A converter and A/D converter cards, and serial communication.

Functions dealing with the relay cards are described in this manual. Functions relevant to the other I/O cards are described in the manual specific to the I/O card. Functions dealing with the backplane and the CPU card are described in the ***Smart Start (SR9000) User's Manual***.

2.2 Smart Star Relay Card Function APIs

```
void relayOut(int relay, int value);
```

Sets the state of a relay.

Parameter

`relay` is the relay to set. **`relay`** should be passed as

```
relay = (slotnumber * 128) + (relaynumber)
```

or

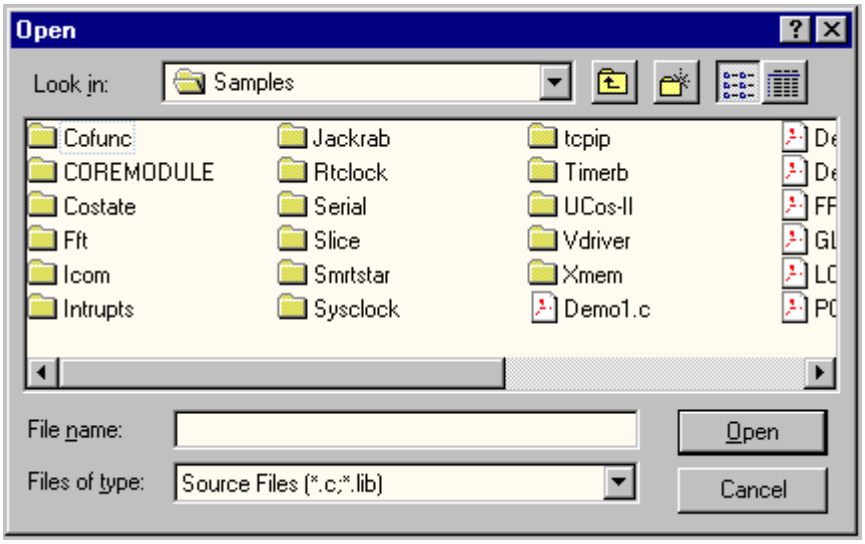
```
relay = ChanAddr(slotnumber, relaynumber)
```

where **`slotnumber`** is 0–6, and **`relaynumber`** is 0–5 (SR9500) or 0–7 (SR9510), depending on the model of relay card.

`value` is the value to set the relay to, 0 or 1 (off or on).

2.3 Sample Programs

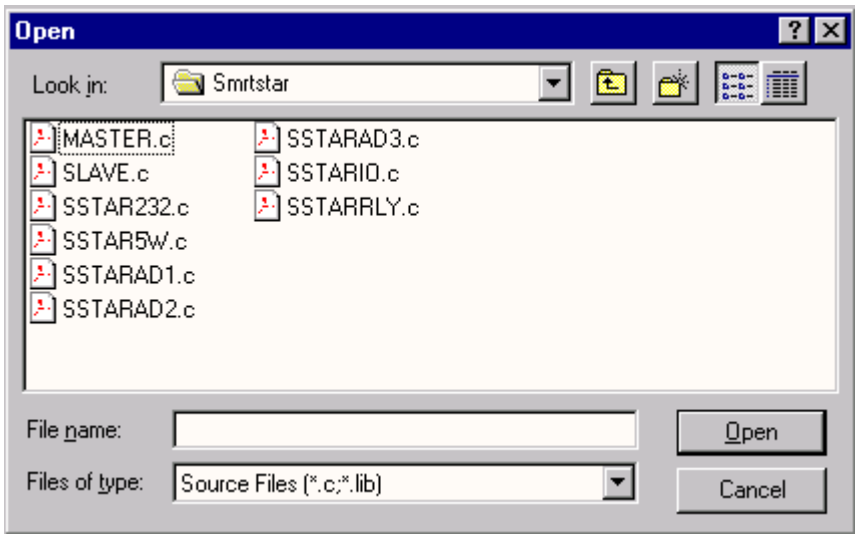
Sample programs are provided in the Dynamic C **Samples** folder, which is shown below.



The various folders contain specific sample programs that illustrate the use of the corresponding Dynamic C libraries. For example, the sample program **PONG.C** demonstrates the output to the **STDIO** window.

The **SMRTSTAR** folder provides sample programs specific to the Smart Star control system. Each sample program has comments that describe the purpose and function of the program. Follow the instructions at the beginning of the sample program.

Let's take a look at sample programs for the relay card in the **SMRTSTAR** folder.



- **SSTARRLY.C**—Demonstrates turning a relay on the relay card on and off.

2.4 Using Dynamic C

To run a sample program, open it with the **File** menu (if it is not still open), compile it using the **Compile** menu, and then run it by selecting **Run** in the **Run** menu. The CPU card must be in Program Mode (see Section 3.1, "Switching Between Program Mode and Run Mode," in the ***Smart Start (SR9000) User's Manual***) and must be connected to a PC using the programming cable as described in Section 2.3, "Programming Cable Connections," in the ***Smart Start (SR9000) User's Manual***.

More complete information on Dynamic C is provided in the ***Dynamic C Premier User's Manual***.

APPENDIX A.
RELAY CARD SPECIFICATIONS

Appendix A provides the specifications for the Smart Star relay card.

A.1 Electrical and Mechanical Specifications

Figure A-1 shows the mechanical dimensions for the relay card.

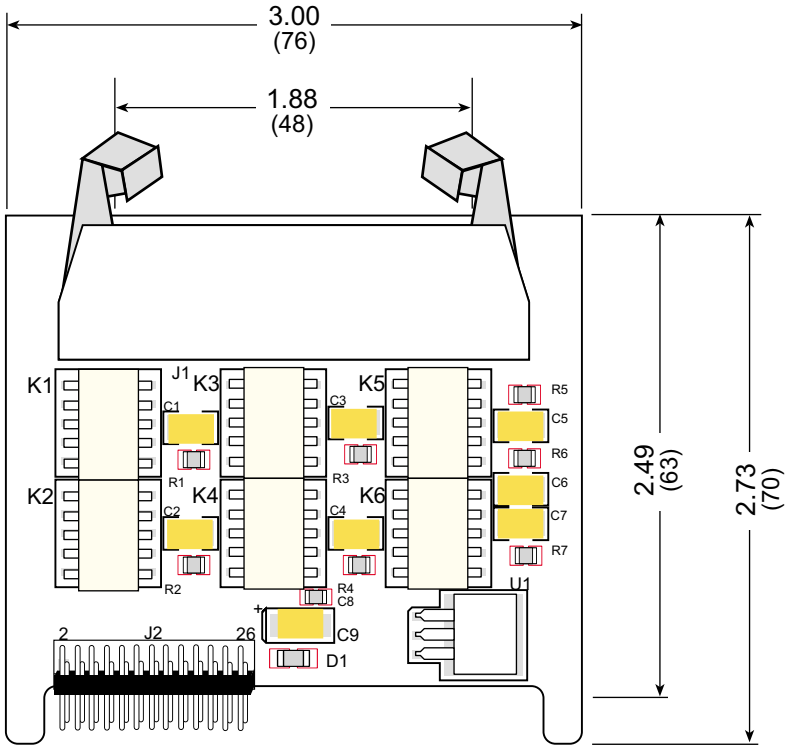


Figure A-1. Relay Card Dimensions

All diagram and graphic measurements are in inches followed by millimeters enclosed in parentheses.

Table A-1 lists the electrical, mechanical, and environmental specifications for the relay card.

Table A-1. Relay Card Specifications

Parameter	Specification
Board Size	2.73" × 3.00" × 0.44" (70 mm × 76 mm × 11 mm)
Connectors	one 2 × 17 latch/eject ribbon connector, 0.1 inch pitch
Operating Temperature	–40°C to +70°C
Humidity	5% to 95%, noncondensing
Power Requirements	5 V DC at 10 mA from backplane (+5 V supply) 12 V to 30 V DC, 10 mA at 24 V DC, **+RAW/+V_USER** from backplane
Relay Switching Contacts	30 V DC at 1 A or 48 V AC at 0.5 A
Relays	SR9500: 1 SPDT, 5 SPST (N.O., COM) with snubbers SR9510: 8 SPDT (N.O., N.C., COM), no snubbers

APPENDIX B. FIELD WIRING TERMINALS

Appendix B explains how to prepare the connector on an I/O card to accept a field wiring terminal, and how to secure the field wiring terminal to the I/O card. The dimensions for the field wiring terminals are included.

B.1 Selecting and Installing a Field Wiring Terminal

Connections to the I/O cards are made via a ribbon cable connector or optional field wiring terminals that are either pluggable or have screw terminals. Three different Field Wiring Terminals (FWTs) are available. Table B-1 lists the I/O cards and the Z-World part numbers for the corresponding FWTs.

Table B-1. Guide to FWT Selection

FWT Description	I/O Cards	Z-World Part Number	
		Pluggable Terminals 	Screw Terminals 
FWT27	Digital I/O (SR9200 series) Relay (SR9510)	101-0420	101-0424
FWT18	A/D Converter (SR9300 series) D/A Converter (SR9400 series)	101-0421	101-0425
FWT18R	Relay (SR9500)	101-0422	101-0426

The pinouts on the two models of relay card are different, and so you must be careful to select the correct FWT for the relay card you have. Figure B-1 shows the two types of FWTs for the relay cards.

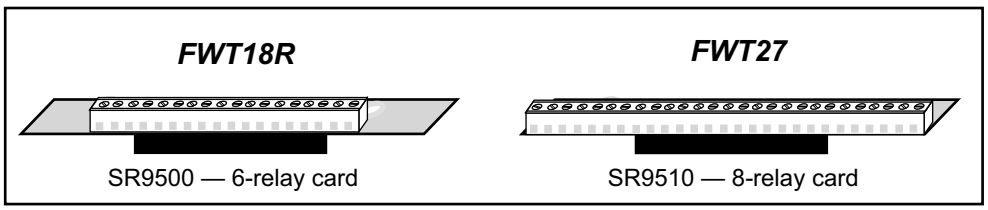


Figure B-1. Relay Card FWTs

Before you can install the FWT you selected for your I/O card, you must remove the tabs from the connector on the I/O card. To do so, move the tab inwards as shown in Figure B-2. Then insert a screwdriver into the space below the tab on the side of the connector and gently nudge the tab up and out. If you are careful, the tab will remain intact to be saved and snapped back in place for future use.

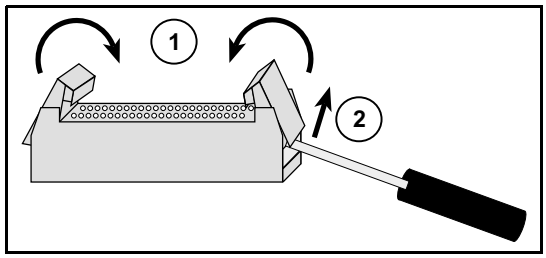


Figure B-2. Remove Tabs from Connector on I/O Card

Plug the FWT connector into the connector on the relay card. Be sure to position the pluggable or screw connectors so that the edge of the FWT they are on faces outwards from the relay card as shown in Figure B-3. Position the mylar insulator above the FWT as shown in Figure B-3 to protect the header pins on the printed circuit board, and secure the FWT using the two 4-40 × ¼ screws supplied.

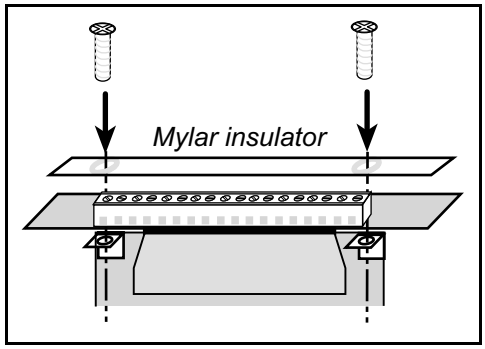


Figure B-3. Secure FWT to I/O Card

B.2 Dimensions

Figure B-4 shows the FWT dimensions.

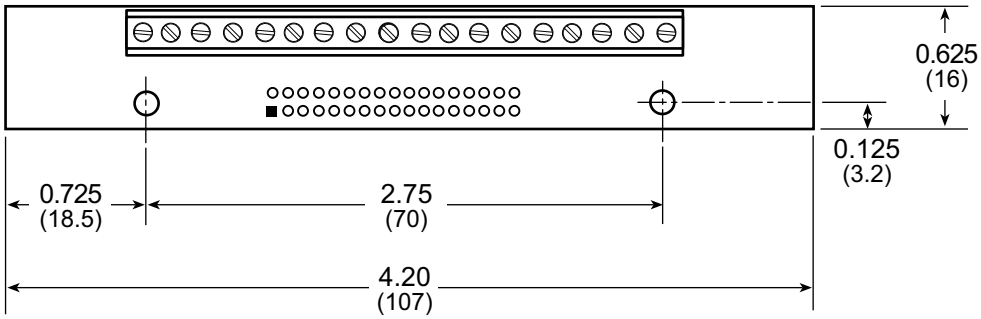


Figure B-4. FWT Dimensions

The dimensions of both FWTs are the same.

All diagram and graphic measurements are in inches followed by millimeters enclosed in parentheses.

B.3 Pinouts

Figure B-4 shows the pinout for the FWTs used on the relay cards.

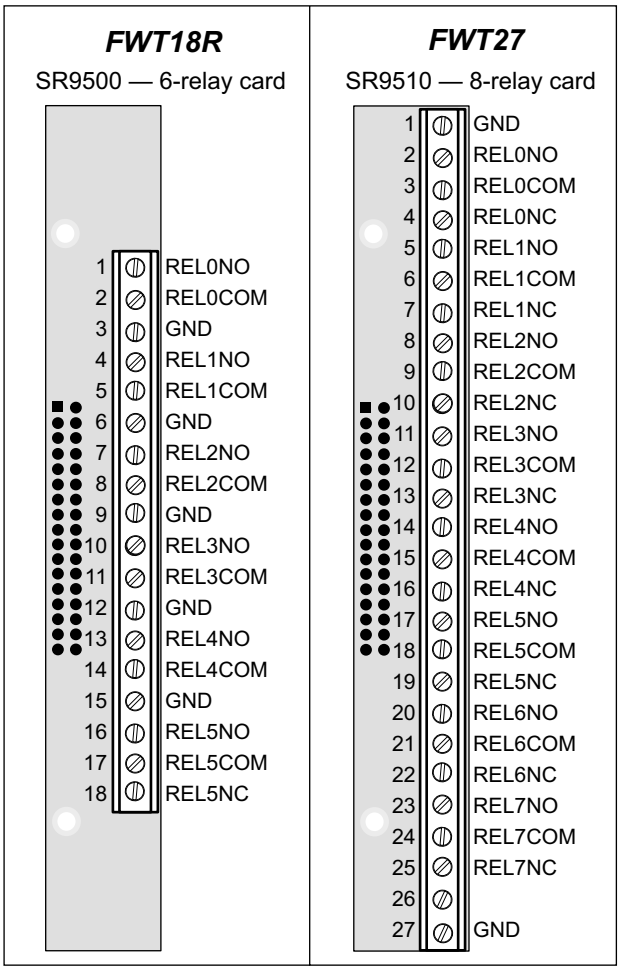


Figure B-4. FWT Pinouts for Relay Cards

APPENDIX C.
SMART STAR SLOT ADDRESS LAYOUT

Appendix C provides information about the register addresses for the various I/O card slots on the backplane. The information in this appendix will be of interest to more advanced users.

The slots on the Smart Star backplane are accessed as external registers via the Rabbit 2000's assembly **IOE** prefix or via standard Rabbit BIOS functions. More convenient functions specific to the Smart Star control system have been written to provide more flexibility; for example, there is now a provision for the automatic update of shadow registers for each slot and for each register.

The Smart Star design routes four address bits to each slot, providing 16 register addresses for each slot. These bits are passed through as bits 0–3 of the register address. The slot number itself is assigned to bits 6–8 of the address. In addition, the backplane design requires that bits 13 and 14 be high and that bit 9 be low. The simplest way to enforce this is to use a base address of 0x6000. Table C-1 provides the address layout for accessing the Smart Star backplane slots, where S*n* is the binary representation of the slot number (0–6), R*n* is the binary representation of the register numbers (0–15), and *X* means the value does not matter.

Table C-1. Smart Star External Register Address Bitmap

A15	A14	A13	A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1	A0
0	1	1	0	*X*	*X*	0	S2	S1	S0	*X*	*X*	R3	R2	R1	R0

This bit mapping of the external register address provides the register addresses for each slot as listed in Table C-2.

Table C-2. Slot External Register Addresses

Slot Number	Address Range
0	0x6000–0x600F
1	0x6040–0x604F
2	0x6080–0x608F
3	0x60C0–0x60CF
4	0x6100–0x610F
5	0x6140–0x614F
6	0x6180–0x618F

C.1 Relay Card Channel Layout

The relay card layout is complemented by the standard Z-World method of minimizing chip layout while adding channel arrangement flexibility. In particular, the nibble-wise layout of the relay channels requires fewer chips if fewer channels are desired. This is a common feature on Z-World products and should not surprise most users. The relay channel layout is straightforward.

Table C-3. Relay Card Channel Mapping

Local Board Address	SR9500 Relay Channels	SR9510 Relay Channels
0x00	REL0	REL0
0x01	REL1	REL1
0x02	REL2	REL2
0x03	REL3	REL3
0x04	REL4	REL4
0x05	REL5	REL5
0x06	—	REL6
0x07	—	REL7

INDEX

SCHEMATICS

090-0098 6-Relay Card (SR9500) Schematic

090-0108 8-Relay Card (SR9510) Schematic

090-0103 FWT27 Schematic

090-0106 FWT18R Schematic

REVISION HISTORY			REVISION APPROVAL			
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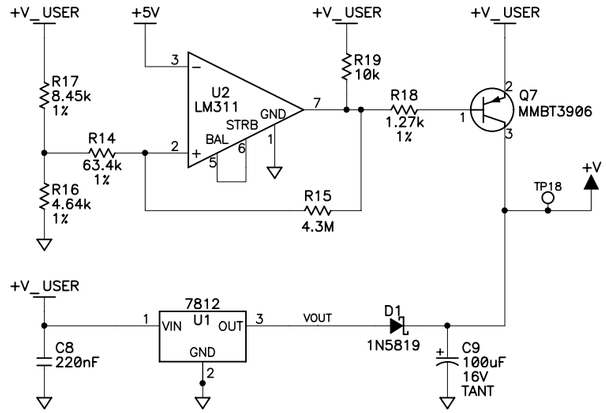


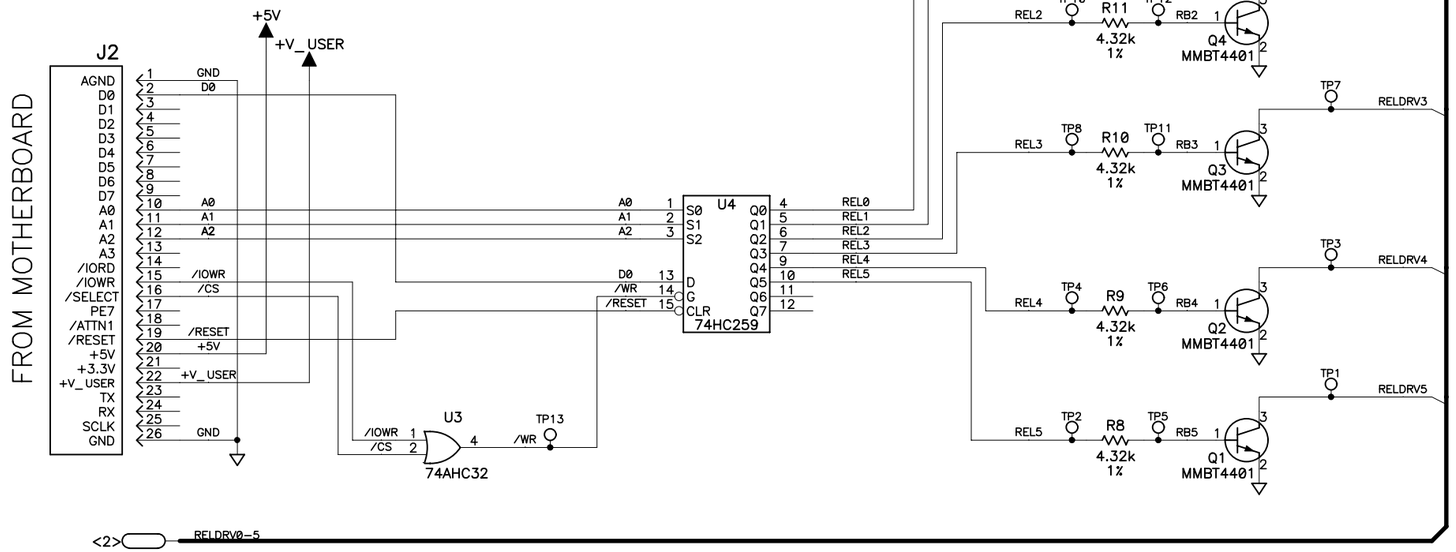
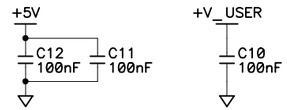


TABLE A

REF DES	DEVICE	DEVICE VOLTAGE INFORMATION					DEVICE: FILTER CAP REF DES(s)
		AGND	GND	+5V	+V_USER	NO CONNECTS	
U1	7812						
U2	LM311		4		8		C10
U3	74AHC32		3	5			C11
U4	74HC259		8	16			C12



NOTES: UNLESS OTHERWISE SPECIFIED;
1. ALL RESISTOR VALUES ARE IN OHMS, 1/10W, 5%
2. ALL CAPACITORS ARE 50VDC OR HIGHER.
3. THE ORIGINATION SOURCE OF A VOLTAGE IS REPRESENTED BY (VCC), AND ALL REFERENCES TO THAT VOLTAGE ARE REPRESENTED BY (VCC).

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PROJECT ENGINEER:	
ENGINEERING MANAGER:	
SIGNATURES	DATE

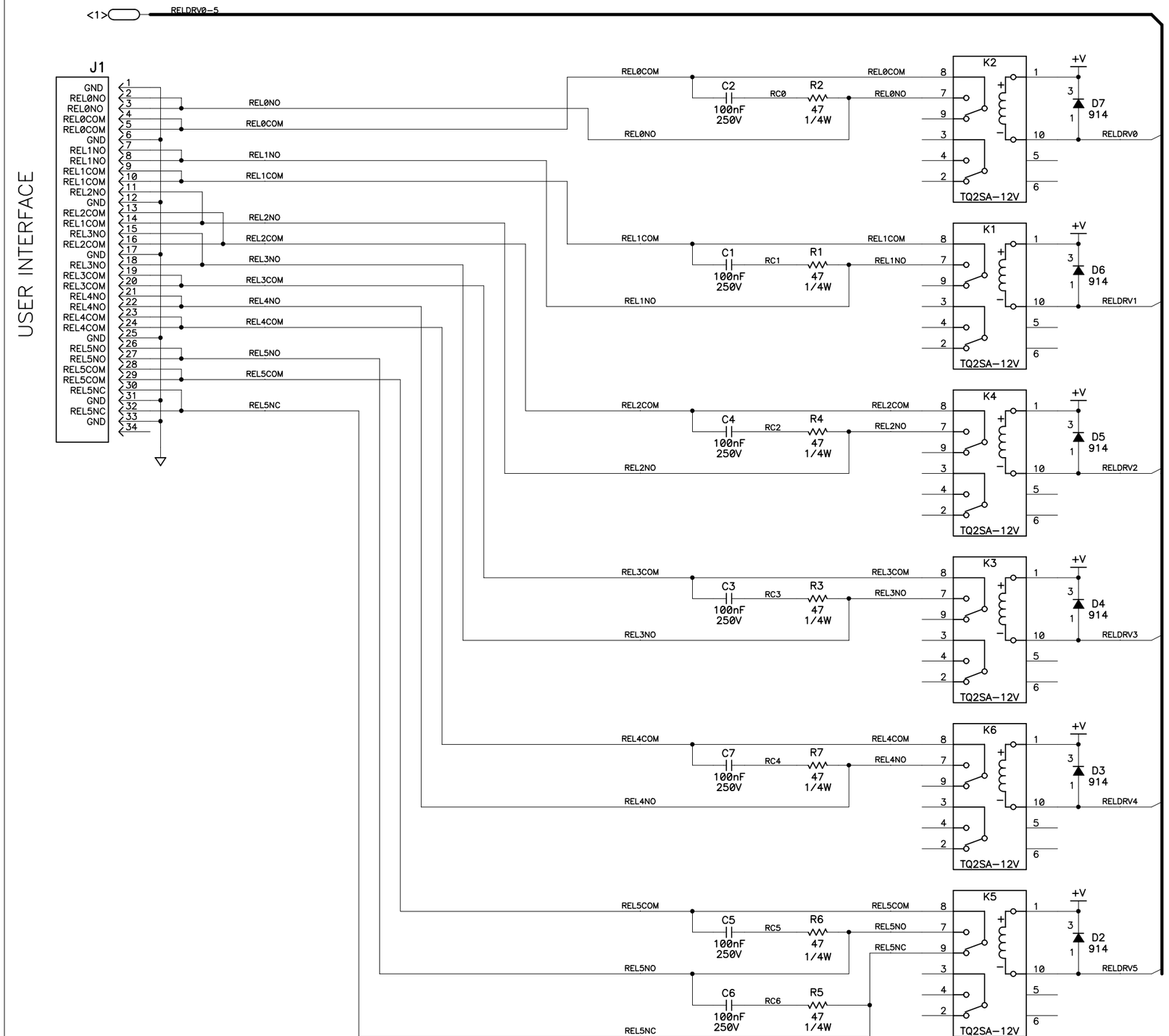
TITLE

SCHEMATIC DIAGRAM SR9500 SERIES RELAY BOARD

Z-WORLD
2900 SPAFFORD ST.
DAVIS, CA 95616
530 - 757 - 4616

SIZE **B** | DWG NO. 090-0098

SCALE **NONE** | RELEASE DATE | SHEET 1 OF 2



26SEP00

SIZE	DWG NO.	
B	090-0098	
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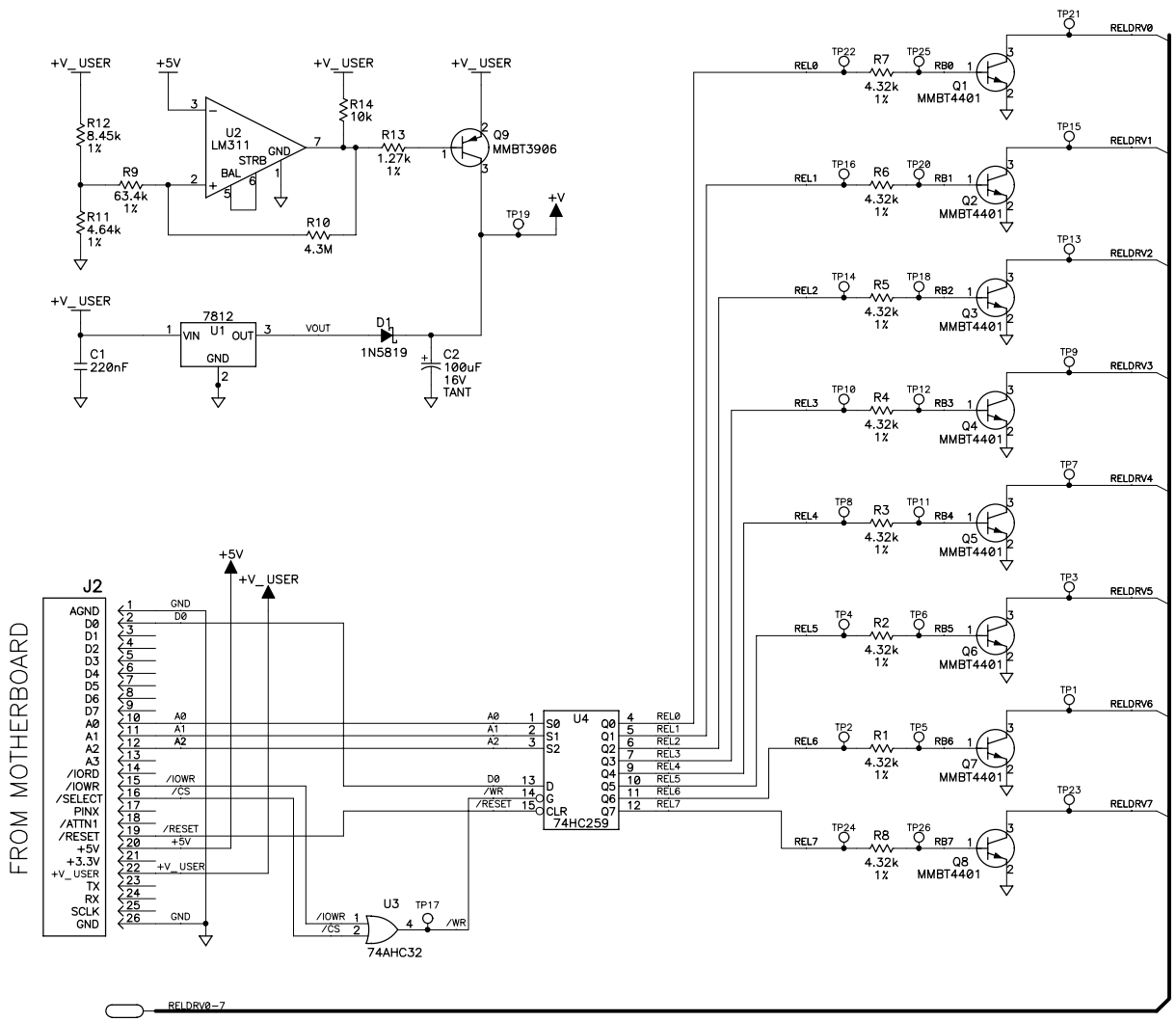

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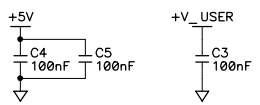
A	E11266	INITIAL RELEASE A/W @ REV-A				

TABLE A

REF DES	DEVICE	DEVICE VOLTAGE INFORMATION					DEVICE: FILTER CAP REF DES(s)
		AGND	GND	+5V	+V_USER	NO CONNECTS	
U1	7812						
U2	LM311		4		8		C10
U3	74AHC32		3	5			C11
U4	74HC259		8	16			C12



NOTES: UNLESS OTHERWISE SPECIFIED;
1. ALL RESISTOR VALUES ARE IN OHMS, 1/10W, 5%
2. ALL CAPACITORS ARE 50VDC OR HIGHER.
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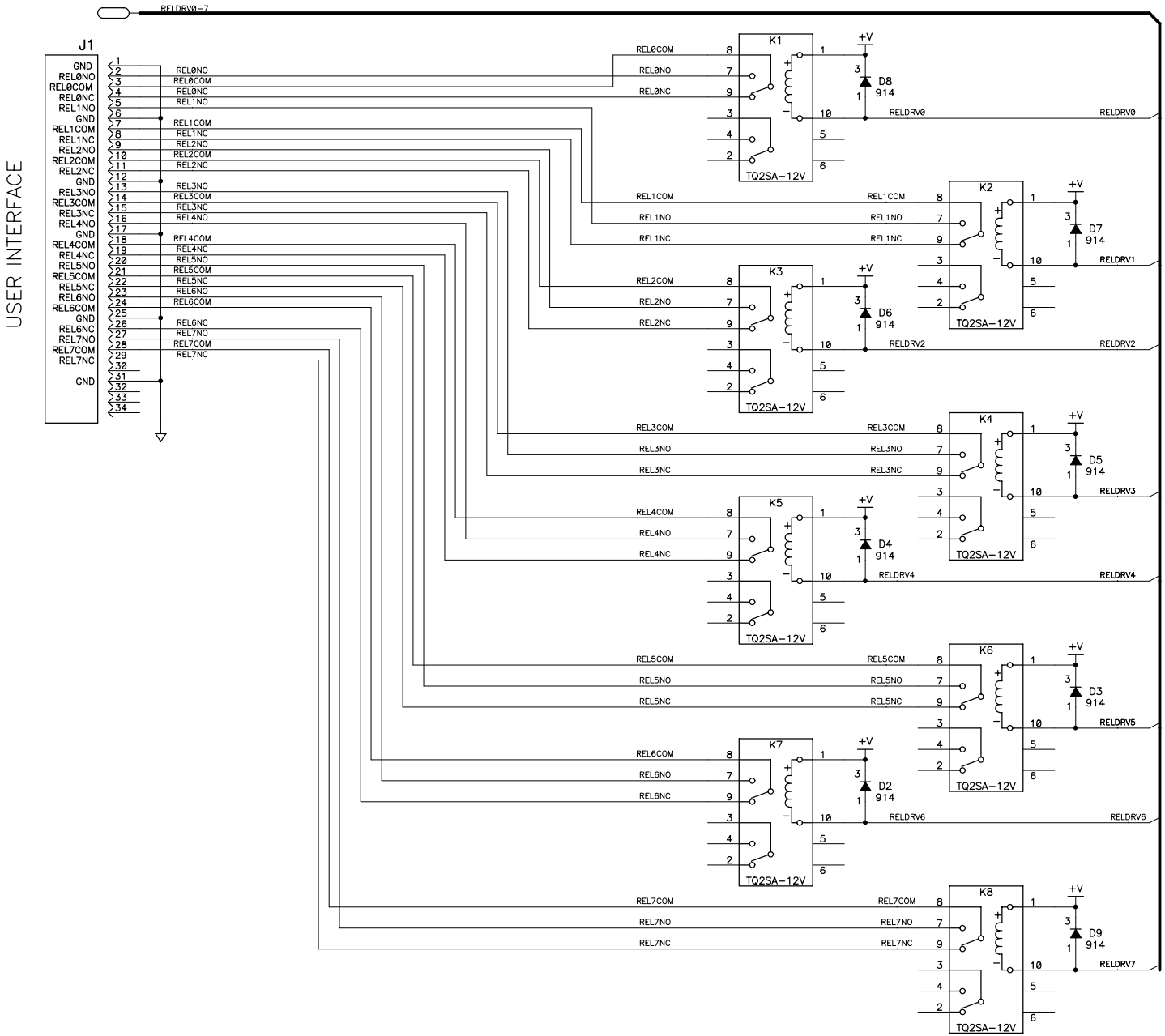
APPROVALS: INITIAL RELEASE	
PROJECT ENGINEER:	
ENGINEERING MANAGER:	
SIGNATURES	DATE

TITLE
SCHEMATIC DIAGRAM SIGNAL RELAY-8 BOARD

Z-WORLD
2900 SPAFFORD ST.
DAVIS, CA 95616
530 - 757 - 4616

SIZE B | DWG NO. 090-0108

SCALE NONE | RELEASE DATE TBD | SHEET 1 OF 2



23JUN00

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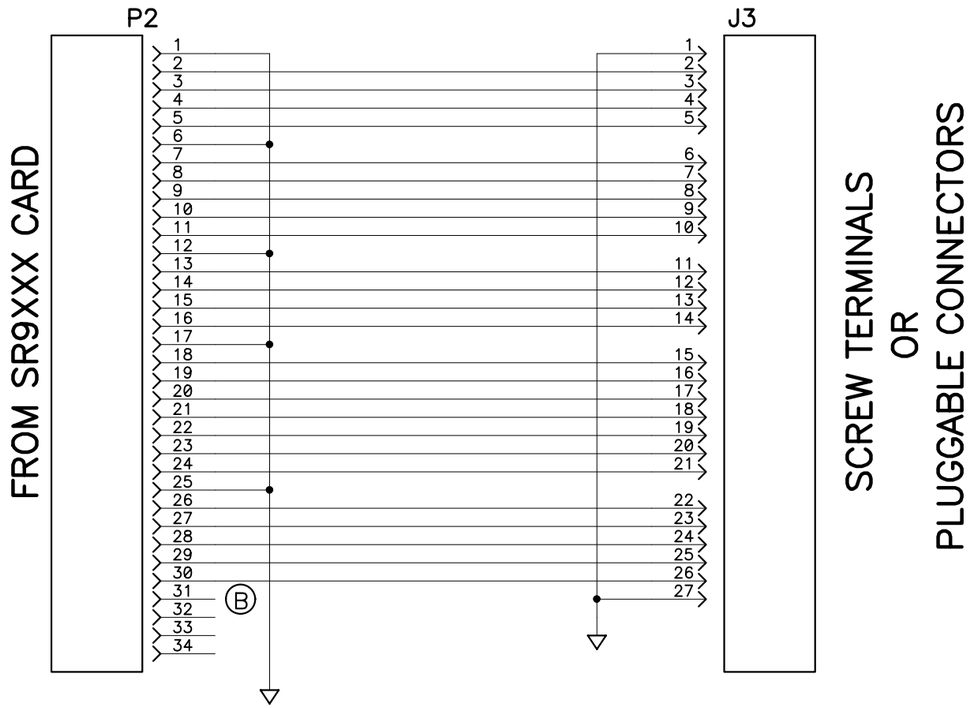

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APPROVALS: INITIAL RELEASE	
PROJECT ENGINEER:	
ENGINEERING MANAGER:	
SIGNATURES	**DATE**

TITLE SCHEMATIC DIAGRAM
SR9XXX SERIES
27 POSITION
FIELD WIRING TERMINAL

Z-WORLD
2900 SPAFFORD ST.
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REVISION HISTORY			REVISION APPROVAL			
REV	ECO	DESCRIPTION	PROJECT ENGINEER	APPROVAL DATE	DOCUMENT CONTROL	APPROVAL DATE
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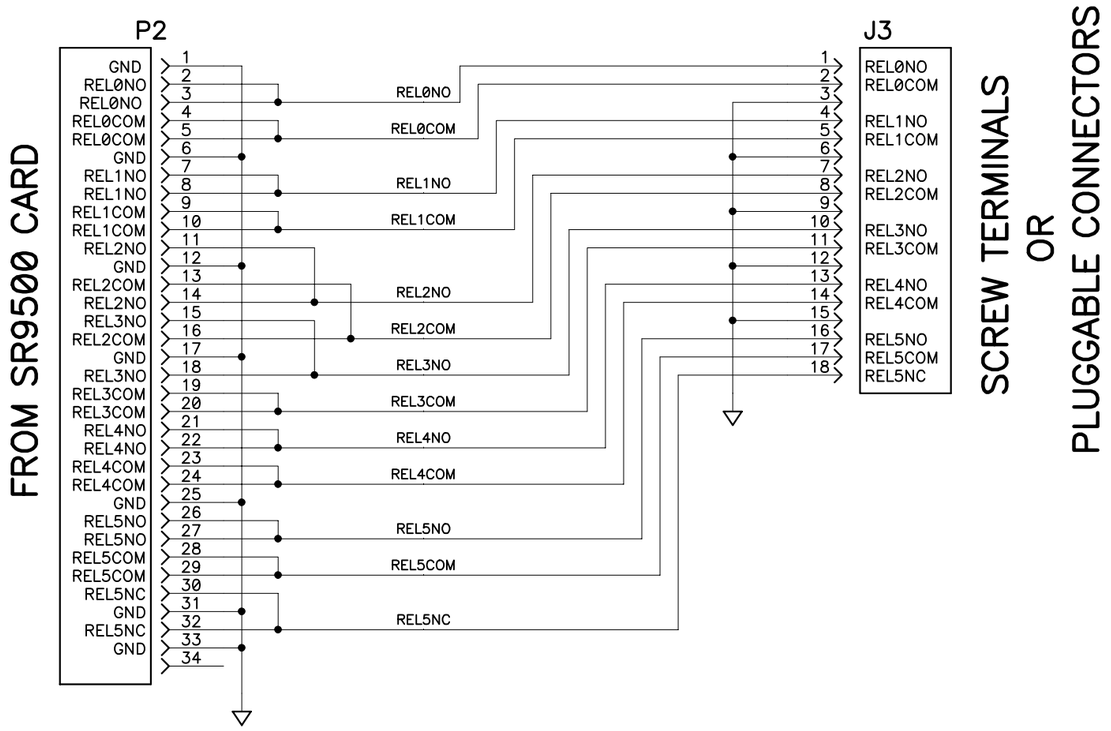

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DRAWING CONTENT:	
DRAWN BY: (INITIAL RELEASE) KEITH HOEK	24MAY00
REVISED BY: KEITH HOEK	26SEP00
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PROJECT ENGINEER:	
ENGINEERING MANAGER:	
SIGNATURES	**DATE**

TITLE SCHEMATIC DIAGRAM
SR9500 SERIES
ONLY 18 POSITION
FIELD WIRING TERMINAL

Z-WORLD
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