TECHNICAL MANUAL

FOR

MODEL 6664C

LOW THERMAL QUAD SCANNER

NOTICE

The Model 6664C is manufactured for Guildline Instruments Limited by Data Proof and retains the specifications and functionality of the Data Proof Model 164B.

TM6664C-C-00
26 April, 2011

WARRANTY AND SERVICE

CERTIFICATION: Data Proof certifies that this product was tested and inspected and found to meet its published specifications when it was shipped from the factory.

WARRANTY: This product is warranted against defects in materials and workmanship for a period of one year from date of shipment. During the warranty period, Data Proof will, at its option, either repair or replace products that prove to be defective.

SERVICE: For warranty service or repair, this product must be returned to the factory. The buyer shall prepay shipping charges to Data Proof and Data Proof shall pay surface shipping to the buyer. Permission must be obtained from the factory for warranty repair returns.

LIMITATIONS: The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by the buyer, or unauthorized modifications or misuse.

Neither Data Proof nor any of its employees shall be liable for any direct or indirect, special, incidental or consequential damages arising out of the use of this product.
No other warranty is expressed or implied.

SAFETY PRECAUTIONS

This product has been designed and tested in accordance with IEC1010-1/EN61010-1 including amendment 1(1995) for insulation category II use. Use of this equipment in a manner not specified could result in personal injury.

AC POWER SOURCE: This product is intended to operate from an ac power source that will apply not more than 264 V ac between either of the supply conductors and ground.

POWER CORD: Use only the power cord and connector appropriate for the voltage and plug configuration in your country. The cord must contain a safety ground conductor and be connected to a plug that has a connection to earth ground. Use only a power cord that is in good condition.

SIGNAL INPUT POWER: Signals applied to the input or output terminals must be limited to levels deemed safe by the IEC/EN specifications. When applied voltages are above 30 volts, the current source must limit the current to not more than 2 milliamps.

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1. INTRODUCTION

1.1. DESCRIPTION

The Guildline Low Thermal Scanner, with extremely low thermal offsets, is ideal for automating precision measurements to sub-ppm accuracy. This versatile scanner has two pairs of output lines that make it suitable for a wide variety of uses. It can be used for comparing voltage reference standards, as well as four-terminal measurements on resistance devices.

Special care has been taken to minimize thermal offsets. The switches used are latching relays requiring only a few millisecond pulses to actuate. Several systems are used to protect the devices connected to the scanner from being damaged by operator error or scanner failure. It can be operated from the front panel or by commands sent over the General Purpose Interface Bus.

The 6664C has been designed in a modular fashion in banks of 8 channels. It is possible to have either 16 channels or 8 channels installed. A cover plate is installed on the front and rear of the 8 channel models covering the channels 9 through 16. This allows for the 8 channel model to be factory upgraded to 16 at any time.

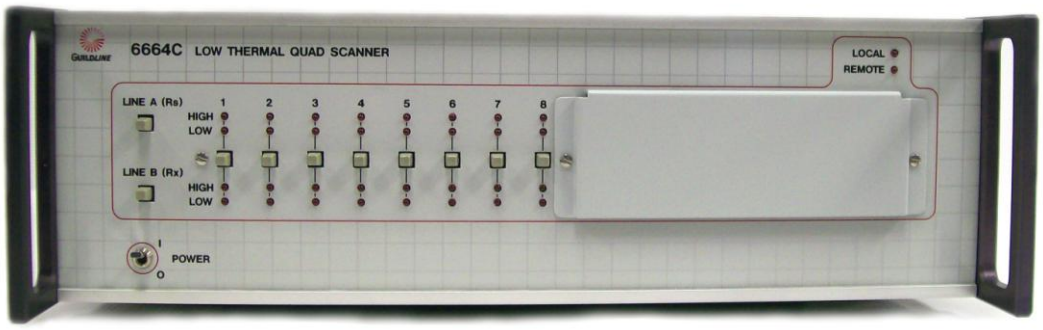


Figure 1-1 Low Thermal Scanner Guildline Model 6664C

1.2. SPECIFICATIONS

NUMBER OF INPUTS
8 or 16 for Model 6664C

THERMOELECTRIC POTENTIALS **
20 nanovolts typical, 50 nanovolts maximum

SYSTEMATIC ERROR CONTRIBUTION FOR VOLTAGE COMPARISON **
Standard deviation less than 20 nanovolts

ENVIRONMENTAL LIMITS
Operating: 10^{o} C to 40^{o} C up to 80% relative humidity
Storage: -20^{o} C to 65^{o} C up to 95% relative humidity

** Note: Specifications apply only if temperature is stable within 1^{o}C, free of drafts and the relative humidity is below 70%. Warm the scanner up for 2 hours min. Measurement using the NIST 4x4 design with inputs properly shorted. (See NIST Technical Note 430.)

SCANNER CONTROL
Local, using front panel push-buttons
Remote, via IEEE-488 bus (interface included)

RELAY CONTACT RATINGS
Life: greater than 10,000,000 cycles at low levels
Current: 2 amps maximum at 10 volts
Voltage switched: 100 volts maximum at 1 milliamp
Voltage non-switched*: 1000 volts max. (for terminal inputs)

*CAUTION - reduce voltage before actuating relays.
NOTE: when applied voltage is above 30 volts, the current source must limit the current to less than 2 milliamps to meet IEC 1010-1/EN61010-1 safety requirements.

SIZE
Length: 420 mm (16.5 in.)
Width: 451 mm (17.7 in.)
Height:133 mm (5.2 in.)

WEIGHT
16 channel scanner: 10 kg (23 lb.)

LINE POWER
100V, 115V-127V, 220V-230V, 240V all ±10%; 50-60 Hz

1.3. REAR PANEL CONNECTIONS

SCANNER INPUTS
Low thermal binding posts. Tellurium copper, gold flashed per MIL-G-45204.

OUTPUT LINES
Two low thermal four-terminal binding posts
Rs (Line A)
Rx (Line B)

INTERFACE BUS
24 pin IEEE-488 connector, CINCH No. 57-20240

REFERENCE STANDARD PROTECTION
Screw terminals connected to open collector TTL logic circuit. Terminal goes low (0 volts) when any relay is closed, and goes high (5 volts through 10k ohm) when all relays are open. This line can be connected in parallel with other scanners cascaded in a large system to protect standards from being shorted together. Two systems are provided, one for line A and one for line B.

1.4. REFERENCE STANDARD PROTECTION SYSTEMS

Three systems are used to help protect standards from being damaged due to scanner failure or operator error. These systems are described briefly below. See Theory of Operation Section for complete description.

a. The relays are driven from a decoder so that only one output circuit can be activated for any possible input combination.

b. Contacts on each relay are connected in series so that all input lines must be open before power is available to close a relay.

c. Two push-buttons must be depressed at the same time to actuate any relay, which requires two hands to operate.

2. INSTALLATION

2.1. INITIAL INSPECTION

This instrument was carefully inspected both mechanically and electrically before shipment. It should be free of mars and scratches and in perfect electrical order upon receipt.

Unpack the instrument and retain the shipping container until the instrument has been inspected for damage in shipment. If in-shipment damage is observed, notify the carrier and obtain authorization for repairs before returning the instrument to the factory.

2.2. POWER REQUIREMENTS

The instrument is shipped with a either three-wire line cord or external power pack. Both configurations must be connected to a grounded 50 to 60 Hz ac power source. This product will operate at between 100V and 240V all ±10%.

WARNING: BEFORE SWITCHING ON THIS INSTRUMENT, THE PROTECTIVE TERMINAL OF THIS INSTRUMENT MUST BE CONNECTED TO A PROTECTIVE EARTH CONTACT. THE POWER LINE CORD SUPPLIED WILL PROVIDE THE PROTECTIVE GROUNDING WHEN INSERTED INTO A SOCKET OUTLET PROVIDED WITH AN EARTH CONTACT. THE PROTECTIVE ACTION MUST NOT BE NEGATED BY THE USE OF AN EXTENSION CORD OR ADAPTOR WITHOUT A PROTECTIVE GROUNDING CONDUCTOR.

2.3. LOCATION

To insure optimum performance, the scanner should be installed in an area having reasonably constant temperature, no strong electrostatic or magnetic fields, and a minimum amount of vibration. The unit should not be located near heating or cooling vents or in direct sunlight. Such locations can cause sudden temperature changes resulting in generation of thermal errors in the measurements. A cloth can be placed over the binding posts on the rear panel (and at the connections to your devices) to shield it from drafts to further reduce thermal errors.

3. OPERATION

3.1. FRONT PANEL CONTROLS AND INDICATORS

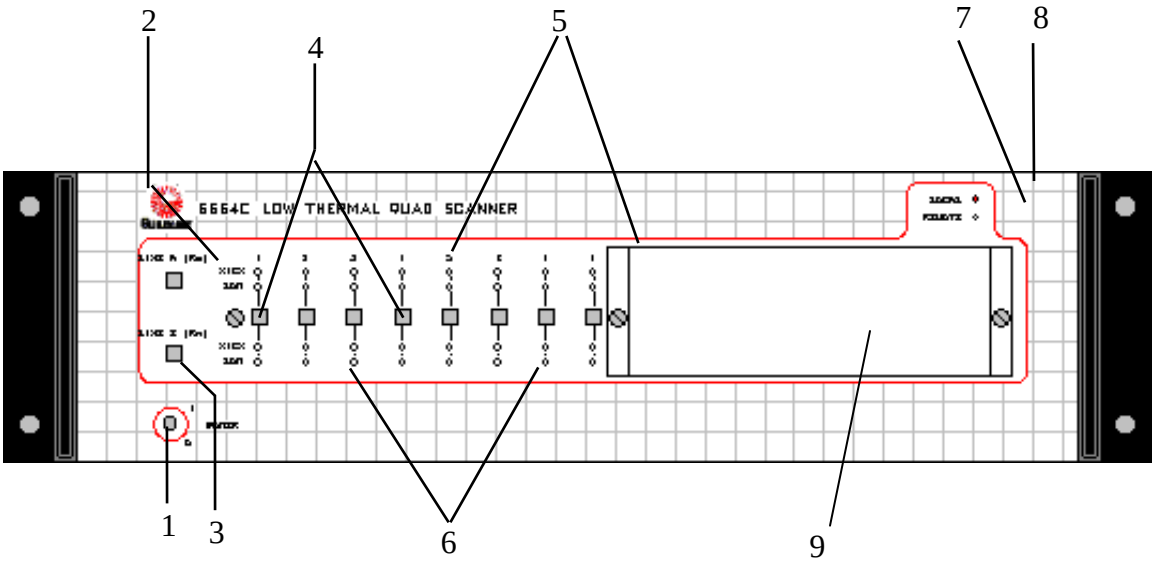


Figure 3-1 Front Panel Guildline Model 6664C

1. Line POWER on/off switch
2. LINE A push-button - when depressed will cause any relay on the A line to be cleared.
3. LINE B push-button - when depressed will cause any relay on the B line to be cleared.
4. Numbered relay control push-buttons - when depressed at the same time that either the A LINE or the B LINE push-button is depressed will cause the corresponding relay to close.
5. LINE A lights - indicates which LINE A relay is closed.
6. LINE B lights - indicates which LINE B relay is closed.
7. REMOTE light - is illuminated when the scanner is in bus control. The front panel push-buttons are inoperative.
8. LOCAL Light - is illuminated when the scanner is in front panel (local) control.
9. Cover Plate (installed over unused channels 9 – 16 for 8 channel option)

3.2. REAR PANEL CONNECTIONS

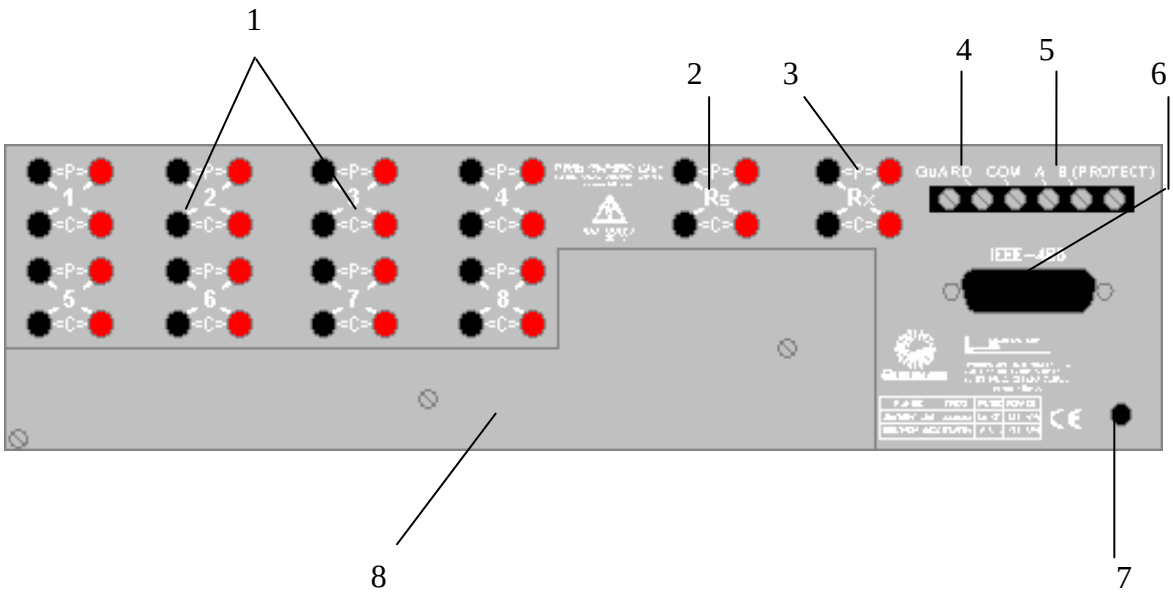


Figure 3-2 Rear Panel Guildline Model 6664C

1. SCANNER INPUTS - Terminal inputs,
   Connect red terminals to one side of units under test and black terminals to the opposite side of the units under test. Numbers correspond to front panel relay numbers.
2. LINE A OUTPUTS - Connect to potential and current terminals of the reference resistor.
3. LINE B OUTPUTS - Connect to potential and current terminals of the unknown resistor.
4. GUARD - Connected to chassis at relay isothermal box.
5. PROTECT CIRCUIT - Connect to same terminals on other scanners. Provides protection for standards in a multiple scanner system. See Section 3.9 for details.
6. INTERFACE BUS - IEEE-488 bus connector used to connect scanner to controller.
7. 5V DC POWER INPUT - from external power supply.
8. Cover Plate (installed over unused channels 9 – 16 for 8 channel option)

3.3. FRONT PANEL OPERATION

The scanner must be in local mode (LOCAL light on) to operate from the front panel. To connect one of the channel inputs to LINE A proceed as follows:

a. Press and hold down the LINE A push-button. This will cause any previously closed relay on the A LINE to be cleared.

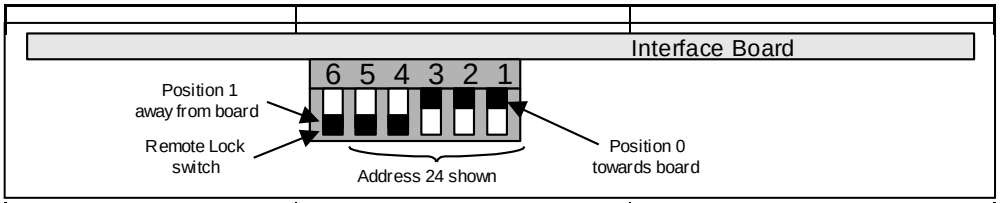
b. Press the numbered push-button corresponding to the input to be connected. This will cause the relay to actuate connecting the input line to the A output and also turn on the appropriate light.

c. To actuate a LINE B relay repeat the above process except hold down the LINE B push-button.

NOTE: The push-buttons can be depressed in either order and the end result will be the same; that is, any previously closed relay will be opened and the desired relay will be closed. The important thing is that two push-buttons must be pressed for any relay to close.

3.4. ADDRESS SELECTION

The IEEE-488 bus address of the scanner is selected by the "DIP" switches located on the interface board under the top cover. The five switches labelled 1 through 5 are used to select a unique address. The scanner normally leaves the factory with the switches set to a bus address of 5. When two scanners are ordered, addresses are set to 5 and 6. Switch No. 6 is used to lock the scanner in remote only. The following table lists the address codes and corresponding switch settings:



ASCII Code Character		Address Switches					5 Bit Decimal Code	
Listen	Talk	A5	A4	A3	A2	A1		
SP	@	0	0	0	0	0	00	
!	A	0	0	0	0	1	01	
"	B	0	0	0	1	0	02	
#	C	0	0	0	1	1	03	
$	D	0	0	1	0	0	04	
%	E	0	0	1	0	1	05	← FACTORY SETTING
&	F	0	0	1	1	0	06	
`	G	0	0	1	1	1	07	
(	H	0	1	0	0	0	08	
)	I	0	1	0	0	1	09	
*	J	0	1	0	1	0	10	
+	K	0	1	0	1	1	11	
`	L	0	1	1	0	0	12	
–	M	0	1	1	0	1	13	
.	N	0	1	1	1	0	14	
/	O	0	1	1	1	1	15	
0	P	1	0	0	0	0	16	
1	Q	1	0	0	0	1	17	
2	R	1	0	0	1	0	18	
3	S	1	0	0	1	1	19	
4	T	1	0	1	0	0	20	
5	U	1	0	1	0	1	21	
6	V	1	0	1	1	0	22	
7	W	1	0	1	1	1	23	
8	X	1	1	0	0	0	24	
9	Y	1	1	0	0	1	25	
:	Z	1	1	0	1	0	26	
;	{	1	1	0	1	1	27	
<	\	1	1	1	0	0	28	
=	}	1	1	1	0	1	29	
>	~	1	1	1	1	0	30	

Table 3-1: Bus Address

3.5. OPERATION FROM INTERFACE BUS

The interface circuit is designed to accept coded data sent over the bus to actuate the relays. To operate with the bus the scanner must be set to a usable address and must be connected to the controller using a 24 pin IEEE-488 cable (not supplied).

The scanner was set at the factory for bus address 5, while all the examples that follow assume 24 as the address. The address can be easily changed if necessary by means of a "DIP" switch on the interface board located under the top cover. Refer to paragraph 3.4 for the procedure to change the bus address.

To actuate a relay the bus interface must first receive the correct address, then a three character ASCII codes designating the relay, and then a carriage return/line feed. For example using an HTBasic computer, the statement:

```
OUTPUT 724;"A01"
```

Would cause any relay on LINE A to be cleared, and then relay number 1 to be closed. In this example

7 is the controller IO address,
24 is the scanner address and
A01 is the code for relay 1 on line A

To clear both lines use the following HTBasic commands:

```
OUTPUT 724;"A00"
WAIT .2
OUTPUT 724;"B00"
```

Note that each actuation must be a separately addressed statement. For example, the following is not valid:

```
OUTPUT 724;"A00","B00"  —NOT VALID—
```

Note also that a delay of at least 200 milliseconds must occur between any two actuations to allow the relays to complete their operation.

Programming languages such as LabVIEW® that do not automatically add a carriage return/ line feed at the end of the command will require a CR/LF or simply a fourth alphanumeric character to be added to the command when addressing the scanner. The following examples use a space as the fourth character or the CR/LF.

```
IBWRT "A01 "
```

3.6. SAMPLE PROGRAMS

The following program will exercise the scanner relays 1 through 16 and leave both lines clear. This program is for HTBasic computers with the scanner address set to 724.

```
10    ! SCANNER TEST
20    DIM Relay$[32]
30    Relay$="0102030405060708091011121314151 6"
40    FOR I = 1 TO 16
50    OUTPUT 724;"A"&Relay$[2*I-1,2*I]      ! CLOSES A RELAY
60    WAIT .2
70    OUTPUT 724;"B"&Relay$[2*I-1,2*I]      ! CLOSES B RELAY
80    WAIT .2
90    NEXT I
100   OUTPUT 724;"A00"                      ! CLEARS LINE A
110   WAIT .2
120    OUTPUT 724;"B00"                     ! CLEARS LINE B
130   END
```

Note: A Wait of at least 200 milliseconds is required between relay actuations to allow time for the relay circuits to actuate.

The second program example has exactly the same result as the first program listed above but uses string output statements. The formatted output statement is used to assure the first character that the scanner sees (after the address) is the line code and the next two characters are the relay code.

```
10    ! SCANNER TEST
30    FOR I = 1 TO 16
40    OUTPUT Code$ USING "A,ZZ";"A",I       ! SETS CODE
50     OUTPUT 724; Code$                    ! CLOSES A RELAY
60    WAIT .2
70     OUTPUT Code$ USING "A,ZZ";"B",I      ! SETS CODE
80    OUTPUT 724; Code$                     ! CLOSES B RELAY
90    WAIT .2
100   NEXT I
110   PRINT "A00"                           ! CLEARS A RELAY
120   WAIT .2
130   PRINT "B00"                           ! CLEARS B RELAY
140   END
```

3.7. REMOTE LOCK

The push-buttons can be locked out when it is desired to prevent tampering from the front panel. Position No. 6 of the "DIP" switch located on the Interface printed circuit board is used to lock the scanner in remote only. If the switch is the "O" position (towards the PC board) the REMOTE light will be on and the front panel push-buttons will not operate. The scanner can only be actuated by the bus in the usual manner. The scanner address must still be used in the output command to actuate the relays.

3.8. STANDARD PROTECTION FOR MULTIPLE SCANNERS

The protection feature can be extended to multiple scanners in a large system by means of the rear panel PROTECT terminals. The protection circuit prevents more than one relay on either the A Line or the B Line from being closed at the same time that prevents standards from being shorted together. Each relay has a contact that closes when the relay is in the open position. These contacts must all be closed (relays open) for the logic circuit to allow a close pulse to be sent out. This protection can be extended to more than one scanner in a large system by connecting the PROTECT terminals together. Both the A and B PROTECT terminals are connected to an open collector TTL gate on the control board. When all relays are open the terminal will be high (5 volts through 10k ohm), and when any relay is closed the terminal will be low (near 0 volts). Connecting either terminal to COM will prevent any relay on that line from being activated.

To extend this protection feature when two or more scanners are used in a system, connect all PROTECT A terminals together, all PROTECT B terminals together, and all PROTECT COM terminals together.

4. THEORY OF OPERATION

4.1. INTRODUCTION

Data Proof Low Thermal Scanners with extremely low thermal offsets are ideal for automating precision measurements to sub-ppm accuracy. This versatile scanner has two pairs of output lines that make it suitable for a wide variety of uses. It can be used for comparing voltage reference standards, as well as four-terminal measurements on resistance devices.

The devices that make this scanner possible are sensitive latching relays. The major problem with conventional relays is the thermal offset voltage caused by the heat generated by the current in the relay coil. With this latching relay a short pulse of only 10 milliseconds is all that is required to toggle the contacts from one side to the other. Thus the heat generated is negligible.

4.2. LOW THERMAL DESIGN

Special care has been taken to minimize thermal offsets. The switches used are latching relays requiring only a short pulse to actuate, and thus no self-heating occurs.

Switching assemblies with eight relays to a PC board are housed in a heavy machined aluminium box. This isothermal enclosure helps to maintain a uniform temperature at each of the relay contacts.

The printed circuit edge connectors carry only the relay coil and panel light circuits. All the channel input lines are soldered to the relay boards directly to prevent the thermal and noise voltages caused by connectors.

4.3. LOGIC CIRCUITS

The scanner is designed to allow easy operation from both the IEEE-488 Bus and the front panel. The information from the bus is in binary form sent serially, one ASCII character at a time. This serial format is changed to a parallel format by means of a decoder ROM on the interface board as can be seen in Figure 4.1.

To allow the system to operate from the front panel, the push-button data is converted to a form identical to binary data from the bus interface circuit. A selector at this point switches between bus and push-button operation. A 6-to-64 line decoder after the selector converts the 6-bit parallel data to a single line output which actuates one of the relay coil drivers.

4.4. PROTECTION FOR DEVICES CONNECTED TO THE SCANNER

Some devices such as standard cells can be damaged if two relays on the same output line are closed at the same time. The Data Proof scanners have three methods to protected devices connected to the scanner inputs.

Two of the three protection schemes can be seen in Figure 4.1. The first one is in the logic itself. The data at the selector is in six bit binary. Thus only one of the 64 relays can be activated for any possible combination of the six input lines. If a failure should occur in the bus interface, encoder or selector circuits, or if an incorrect message is sent over the bus, no devices will be damaged because only one relay can be closed.

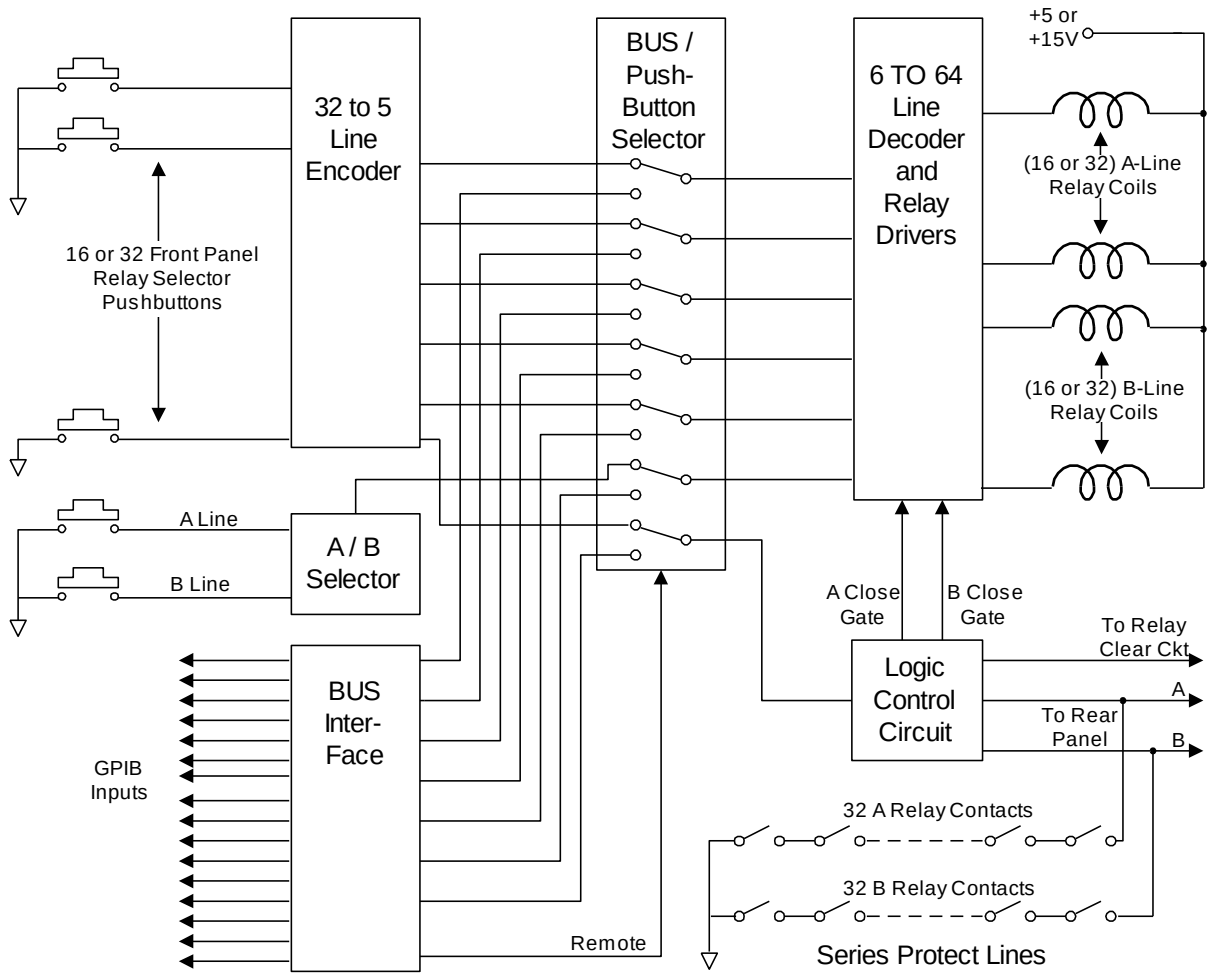


Figure 4-1: Functional Diagram of Scanner

The second method for protection is the 'close gate' lines to the decoder circuits. The control circuit will allow these gates to open only if the series protection line is complete to ground. One of the contacts on each relay is connected in series, and will complete the series protection circuit only if all the relays on the line are in the clear position. Thus, no relay on the A line can be closed if any other relay on the A line is already closed; and similarly no B line relay can be closed if any other relay on the B line is already closed. These series protection lines are brought out to terminals on the rear panel. Thus if more than one scanner is used in a large system and these terminals are connected together, all units in the system will be protected.

The third protection mechanism to protect devices from damage is not shown on the diagram but is part of the control logic circuit. This is the requirement that two push-buttons on the front panel must be pressed at the same time for any relay to actuate. These would be either the A or B line button and any of the 16 relay selector push-buttons. This is to help prevent accidental operation. It takes two hands to operate the scanner from the front panel.

5. MAINTENANCE AND TROUBLE SHOOTING

5.1. PERIODIC MAINTENANCE

There are no adjustments or controls in the scanner. Each relay should be operated at least a 10 times in a given month to ensure they do not become stuck in a fixed position and that the contacts are kept clean.

5.2. UNSTABLE READINGS

The most common cause for unstable readings is poor connections between the units being measured and the scanner inputs. Loose connections or leads that are oxidized or unclean will cause unstable readings. The leads should be shiny and can be restored by lightly sanding with fine sandpaper and/or cleaning with isopropyl alcohol. Periodic cleaning of the leads and tightening connections may improve your readings. Ideally gold flashed copper banana jacks should be used for connection to scanner terminals for best contact quality and reliability.

Scanner channels that are used less than once a month may develop a film on the relay contacts. The relay contacts are wiped clean each time they are used; however, if a relay is not used for a while the film may not be wiped clean with only one closing of the relay. Infrequently used relays should be switched on and off a few times before use. This can be done from the front panel or by using the Relay Exercise routine in the BridgeWorks software program.

5.3. RELAY FAILURES

Relay failure is just about the only cause of scanner malfunction. All relays are carefully adjusted and very thoroughly screened. Improved relay drive circuits have minimized but not yet completely eliminated these failures. The channel indicator light staying on or off can identify a bad relay that will not open or close.

Note: If one relay hangs up on the closed position, no other relays in the line can be closed. The protect circuit prevents more than one relay on a line from closing. See section 4.5 for protect circuit.

5.4. LOCATING THE RELAY CHANNELS

When the cover of the isothermal box is removed, the relay boards can be seen. Each board holds four A-line relays and four B-line relays. Refer to figure 5.1. The A-line relays are along the top of the board and the B-line relays are at the bottom. The first relay is at the end of the board closest to the rear panel. Channels one through four can be located on the board closest to the power transformer. The next board has channels five through eight and so on.

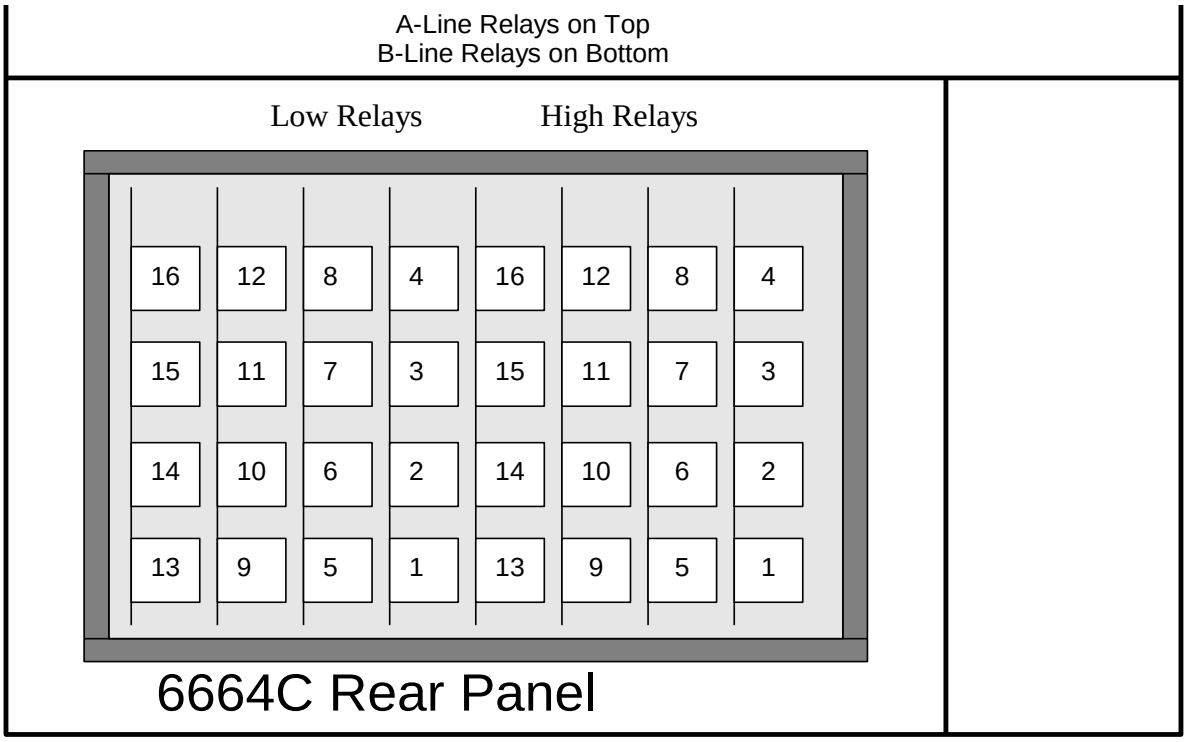


Figure 5-1 Relay Locations (Top View)

6. CIRCUIT DIAGRAMS AND REPLACEMENT PARTS LIST

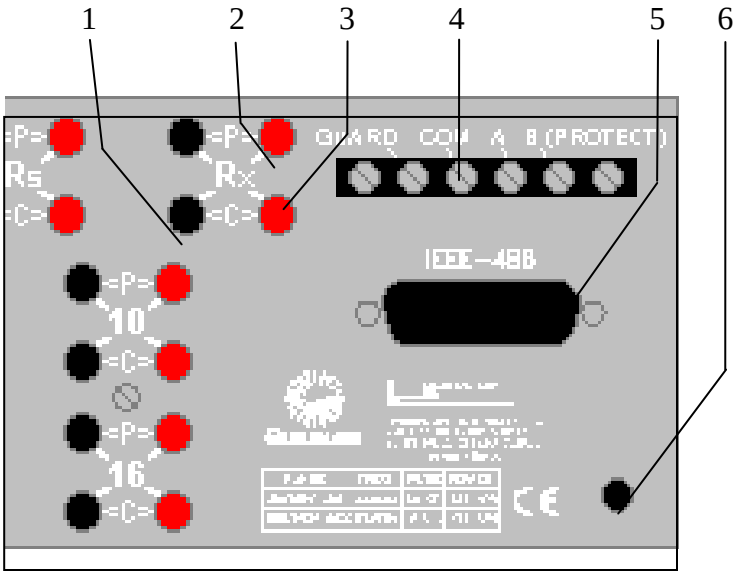
6.1. INTRODUCTION

This section contains circuit diagrams and information for ordering replacement parts. For each circuit board there is a circuit diagram, a component location diagram and a parts list. There is also a list of general parts that are located on the chassis and the rear panel.

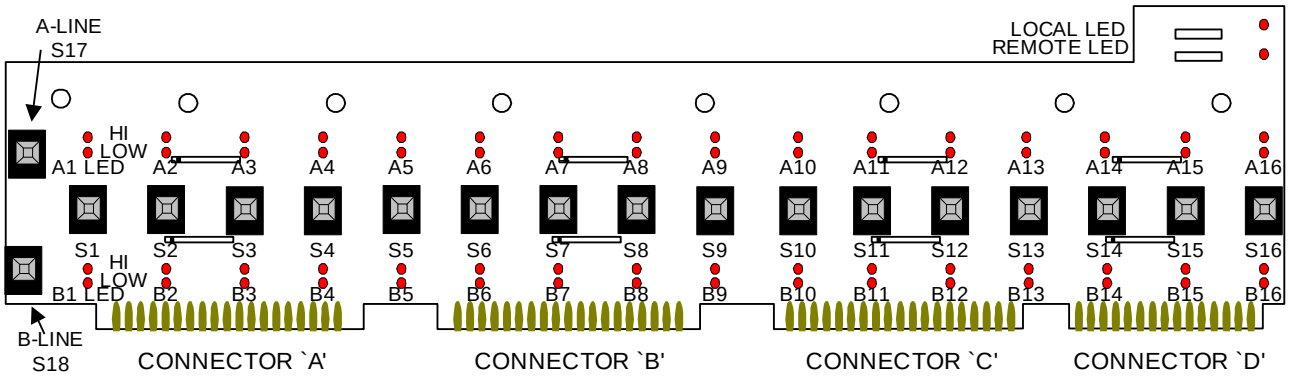
6.2. ORDERING INFORMATION

To obtain parts directly from the factory, send an order to the address shown on page 7.1 of this manual. Identify parts by their part number as shown on the following pages. Include the instrument model and serial numbers as well as the part description.

6.3. CIRCUIT DIAGRAMS AND PARTS LISTS



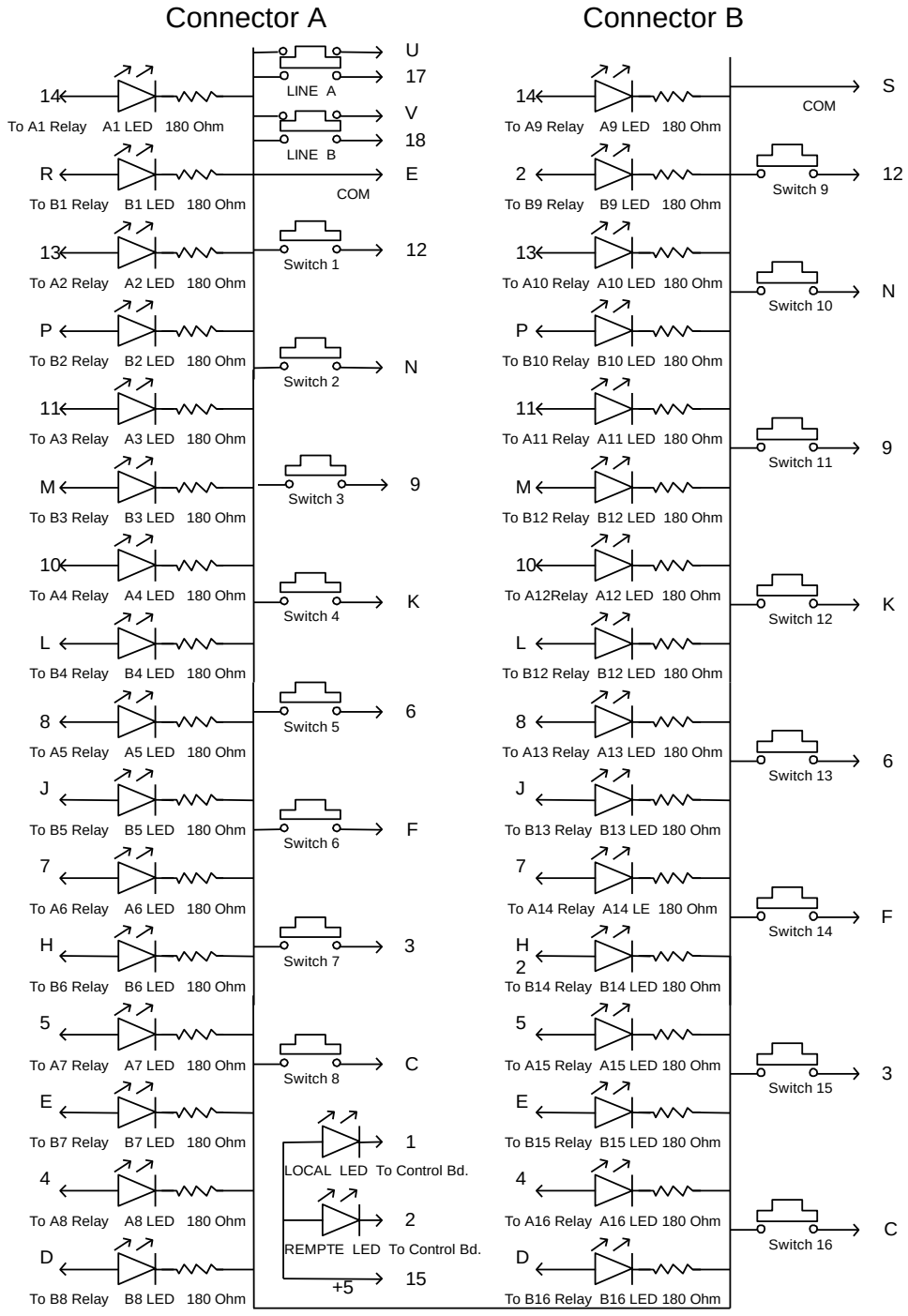
REAR PANEL PARTS LIST		
LOCATOR NUMBER	DP PART NUMBER	PARTS DESCRIPTION
6	50-17	POWER JACK CONNECTOR
1	51-01	LOW THERMAL BINDING POST, BLACK (Tellurium copper gold flashed)
2	51-02	LOW THERMAL BINDING POST, RED (Tellurium copper gold flashed)
3	51-03	BINDING POST MOUNTING BASE
4	51-04	TERMINAL BLOCK , 4 CONDUCTOR
5	50-11	IEEE-488 BUS CONNECTOR
MOTHER BOARD (NOT SHOWN)		
	320-000	Mother Board
	50-04	PC CONNECTOR, 15 PIN
	50-05	PC CONNECTOR, 18 PIN
	50-06	PC CONNECTOR, 22 PIN
	50-09	PC CONNECTOR, 30 PIN
	51-04	FLAT CABLE CONNECTOR, 24 PIN
	81-14	FLAT CABLE, 28 AWG, 24 COND

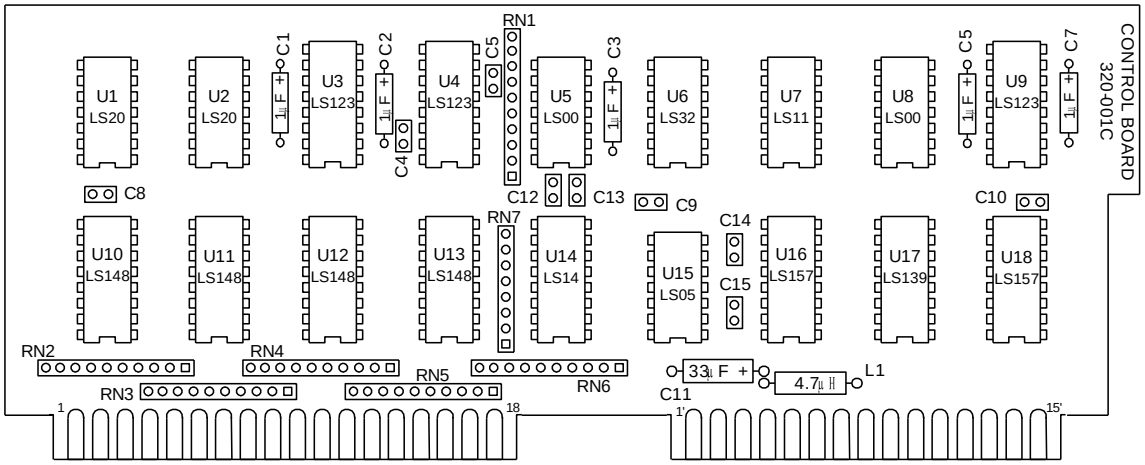


MODEL 164B, 6664B

SWITCH BOARDS (ALL) PARTS LIST		
CIRCUIT DESIG.	DP PART NUMBER	PARTS DESCRIPTION
all LED's	23-01	LIGHT EMITTING DIODE, Red
SWITCHES	31-02	SWITCH, Pushbutton, SPDT
R1,R2	68-05	RESISTOR NETWORK, 9x180 ohm, Cermet SIP
R3,R4	69-03	RESISTOR, FXD, 1Kohm, .0125W, 1% Met film

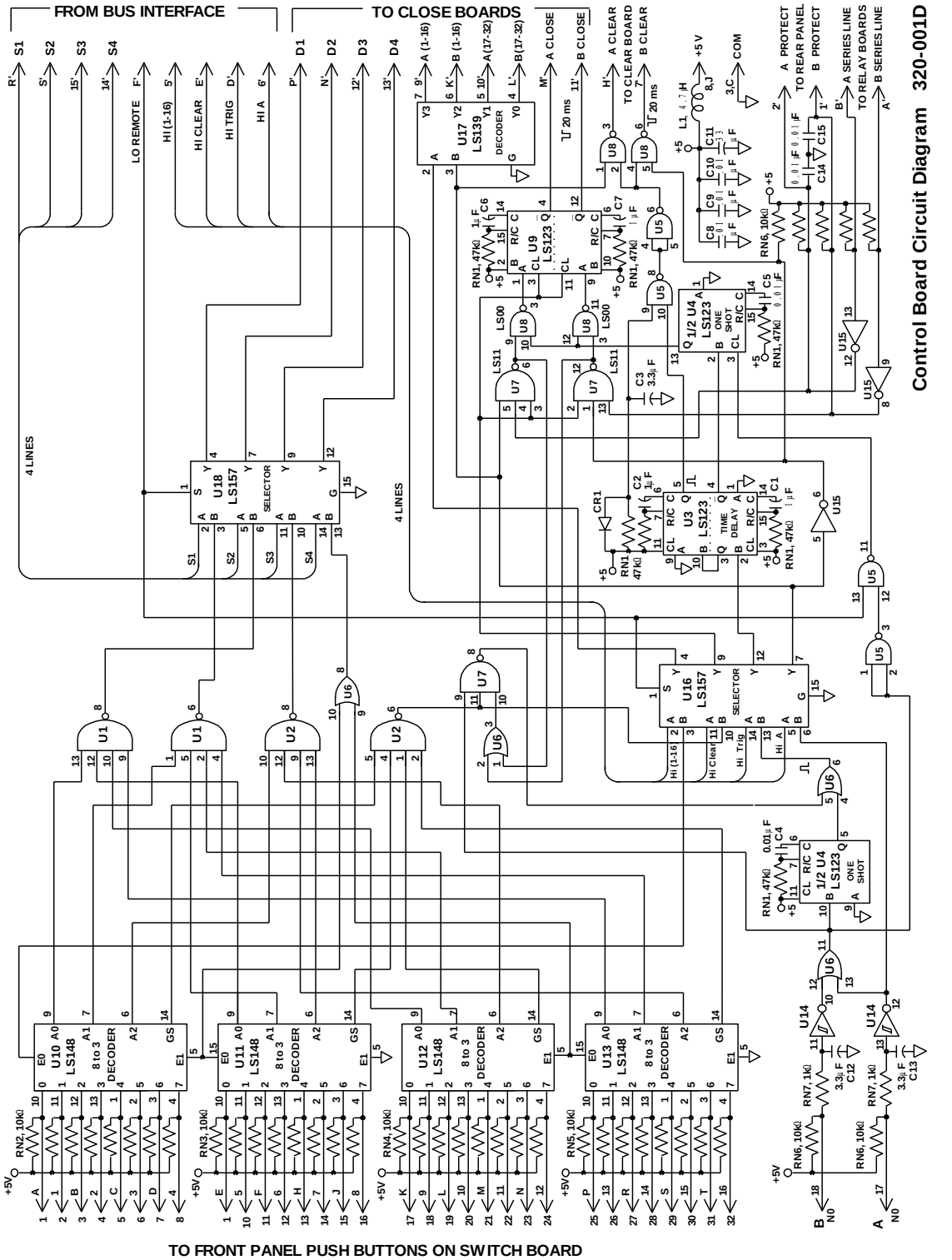
6664C FRONT PANEL CIRCUIT DIAGRAM

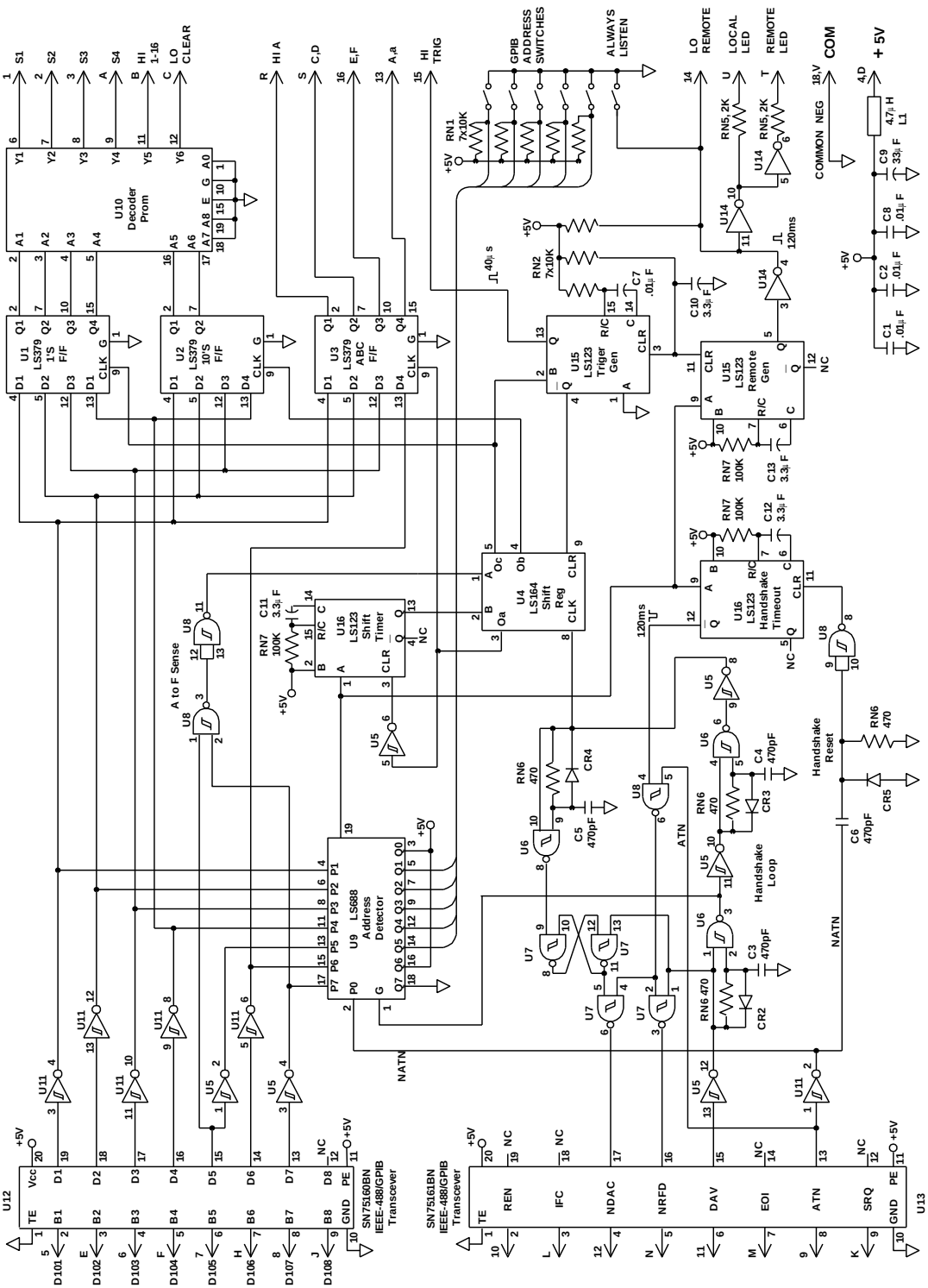


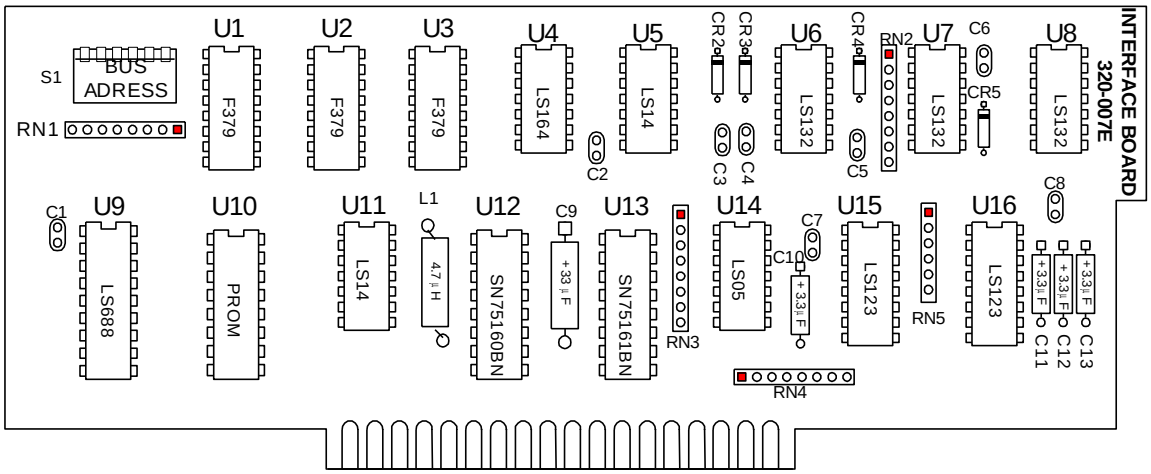


CONTROL BOARD COMPONENT LOCATIONS

CONTROL BOARD CIRCUIT PARTS LIST		
CIRCUIT DESIGN.	DP PART NUMBER	PARTS DESCRIPTION
C4,5,8-10,12-15	16-02	CAPACITOR, FXD, .01 uFd 50VDC, 10%, Monolithic
C1,2,3,6,7	18-01	CAPACITOR, FXD, 1 uFd 15VDC, 10%, Electrolytic
C11	18-04	CAPACITOR, FXD, 33 uFd 10VDC, 10%, Electrolytic
L1	46-01	INDUCTOR,FXD,4.7uH
RN1	68-06	RESISTOR, NETWORK, 9x47Kohm, 2% Cermet, SIP
RN2,3,4,5,6	68-03	RESISTOR, NETWORK,9x10Kohm, 2% Cermet, SIP
RN7	68-10	RESISTOR, NETWORK,4x1Kohm, 2% Cermet, SIP
U1,2	20-06	IC,DUAL 4-Input NAND Gate, 74LS20
U3,4,9	20-10	IC,DUAL Monostable MULTIVIBRATOR, 74LS123
U5,8	20-02	IC,QUAD 2-Input NAND Gate, 74LS00
U6	20-07	IC,QUAD 2-Input OR Gate, 74LS32
U7	20-04	IC,TRIPLE 3-Input AND Gate, 74LS11
U10-13	20-13	IC,8-TO-3 Line ENCODER, 74LS148
U14	20-05	IC,HEX Schmitt Trigger INVENTOR,, LS14
U15	20-03	IC,HEX INVENTOR, 74LS05
U16,18	20-15	IC,QUAD 2-Input DATA SELECTOR, 74LS157
U17	20-12	IC,2-TO-4 Line DECODER, 74LS139

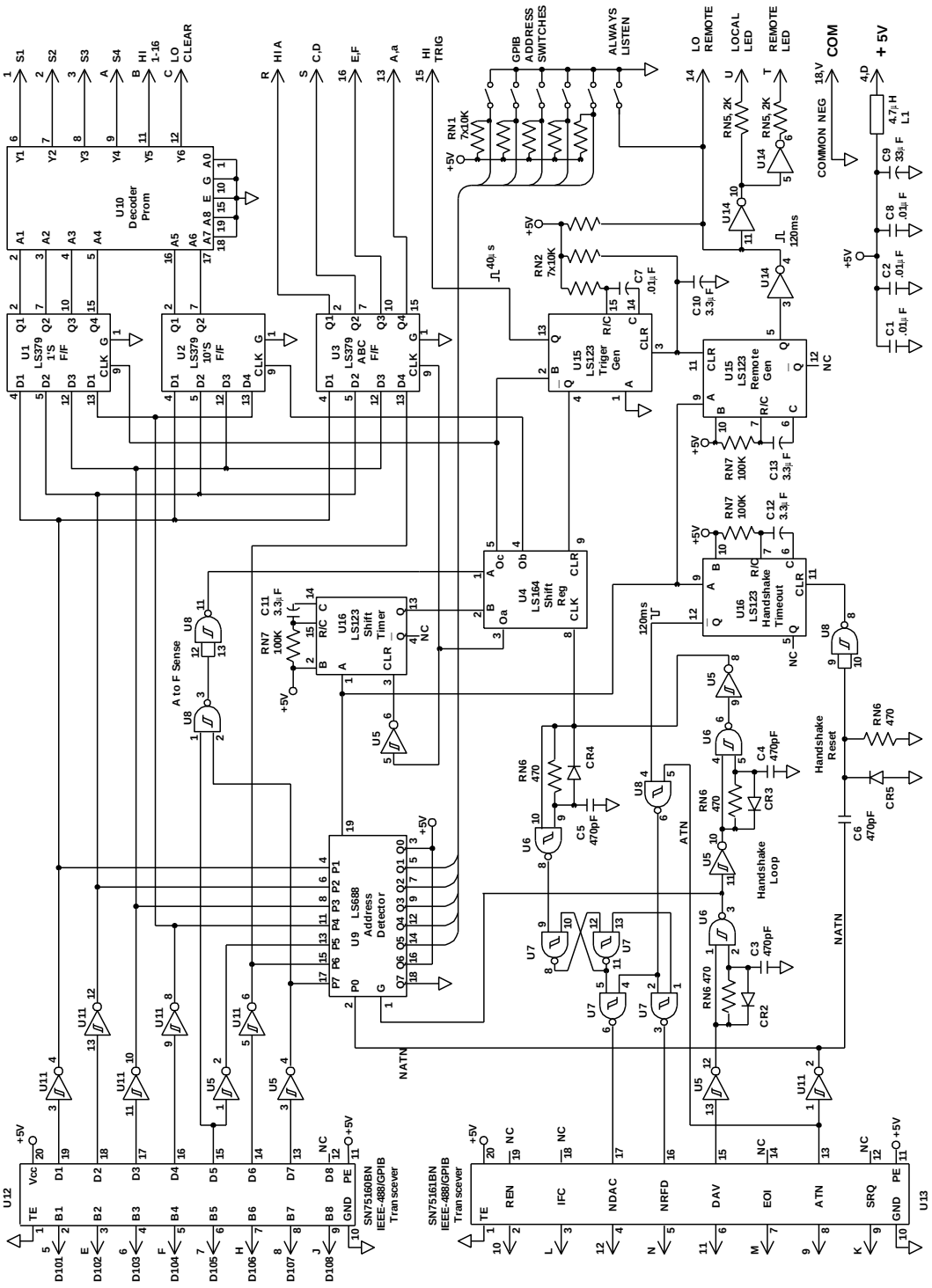

FROM BUS INTERFACE
TO CLOSE BOARDS
Control Board Circuit Diagram 320-001D
TO FRONT PANEL PUSH BUTTONS ON SWITCH BOARD


GPIB Interface Board Curcuit Diagram 320A-007E
U10 Decoder Prom
U1 LS379 1'S F/F
U2 LS379 10'S F/F
U3 LS379 ABC F/F
U15 LS123 Triger Gen
U15 LS123 Remote Gen
U16 LS123 Handshake Timeout
U16 LS123 Shift Timer
U4 LS164 Shift Reg
U9 LS688 Address Detector
SN75161BN IEEE-488/GPIB Transcever
SN75160BN IEEE-488/GPIB Transcever
GPIB ADDRESS SWITCHES
ALWAYS LISTEN
LO REMOTE
LOCAL LED
REMOTE LED
COM
+ 5V
A to F Sense
Handshake Reset
Handshake Loop
NATN
ATN
120ms
40μs

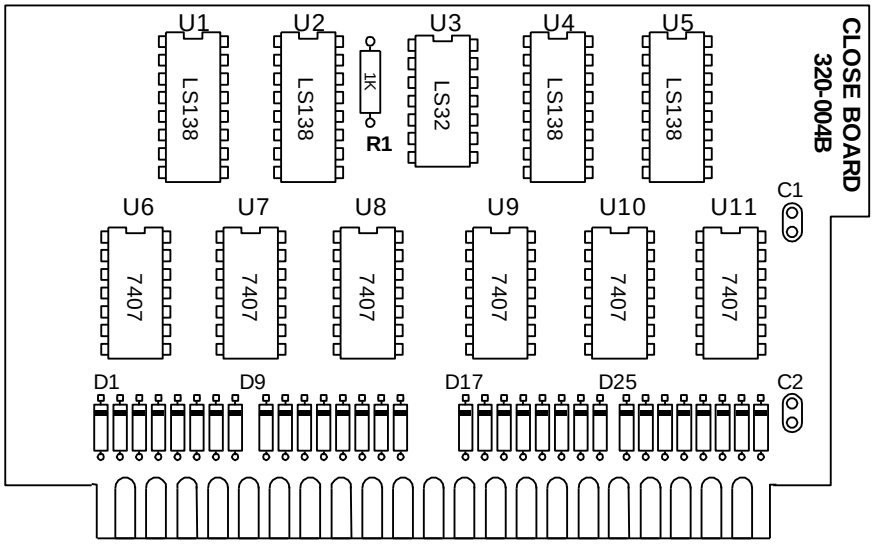


INTERFACE BOARD COMPONENT LOCATIONS

INTERFACE BOARD CIRCUIT PARTS LIST		
CIRCUIT DESIGN.	DP PART NUMBER	PARTS DESCRIPTION
C3,4,5,6	16-01	CAPACITOR, FXD, 470 pf 50VDC, 5%, Monolithic
C1,2,7,8	16-02	CAPACITOR, FXD, .01 uFd 50VDC, 10%, Monolithic
C9	18-04	CAPACITOR, FXD, .33 uFd 10VDC, 10%, Tantalum
C10-13	18-02	CAPACITOR, FXD, 3.3 uFd 15 VDC, 10%, Tantalum
CR2-5	22-01	DIODE, 50VPIV, 200mA, 1N4150
L1	46-01	INDUCTOR,FXD,4.7uH
RN1,3	68-02	RESISTOR, NETWORK,7x10Kohm, 2% Cermet,SIP
RN2	68-11	RESISTOR, NETWORK,4x470Kohm, 2% Cermet,SIP
RN4	68-12	RESISTOR, NETWORK,4x2.2Kohm, 2% Cermet,SIP
RN5	68-08	RESISTOR, NETWORK,5x100Kohm, 2% Cermet,SIP
S1	31-05	SWITCH,SIP,6 Position
U1-3	20-18	IC,QUAD D-Type FLIP-FLOP, LS379
U4	20-16	IC,8-BIT SHIFT REGISTER, LS164
U5,11	20-05	IC,HEX Schmitt Trigger INVENTOR,, LS14
U6,7,8	20-11	IC,QUAD 2-Input Schmitt Trig NAND, 74LS132
U9	20-19	IC,8-BIT MAGNITUDE COMPARATOR, LS688
U10	20-20	MEMORY CIRCUIT, 512x8,Programed
U11	20-23	TRANSCEVER, IEEE-488, SN75160BN
U12	20-24	TRANSCEVER, IEEE-488, SN75161BN
U14	20-03	IC,HEX INVENTOR, Open Col. Output, LS05
U15,16	20-10	IC,DUAL Monostable MULTIVIBRATOR, LS123



GPIB Interface Board Curcuit Diagram 320A-007E

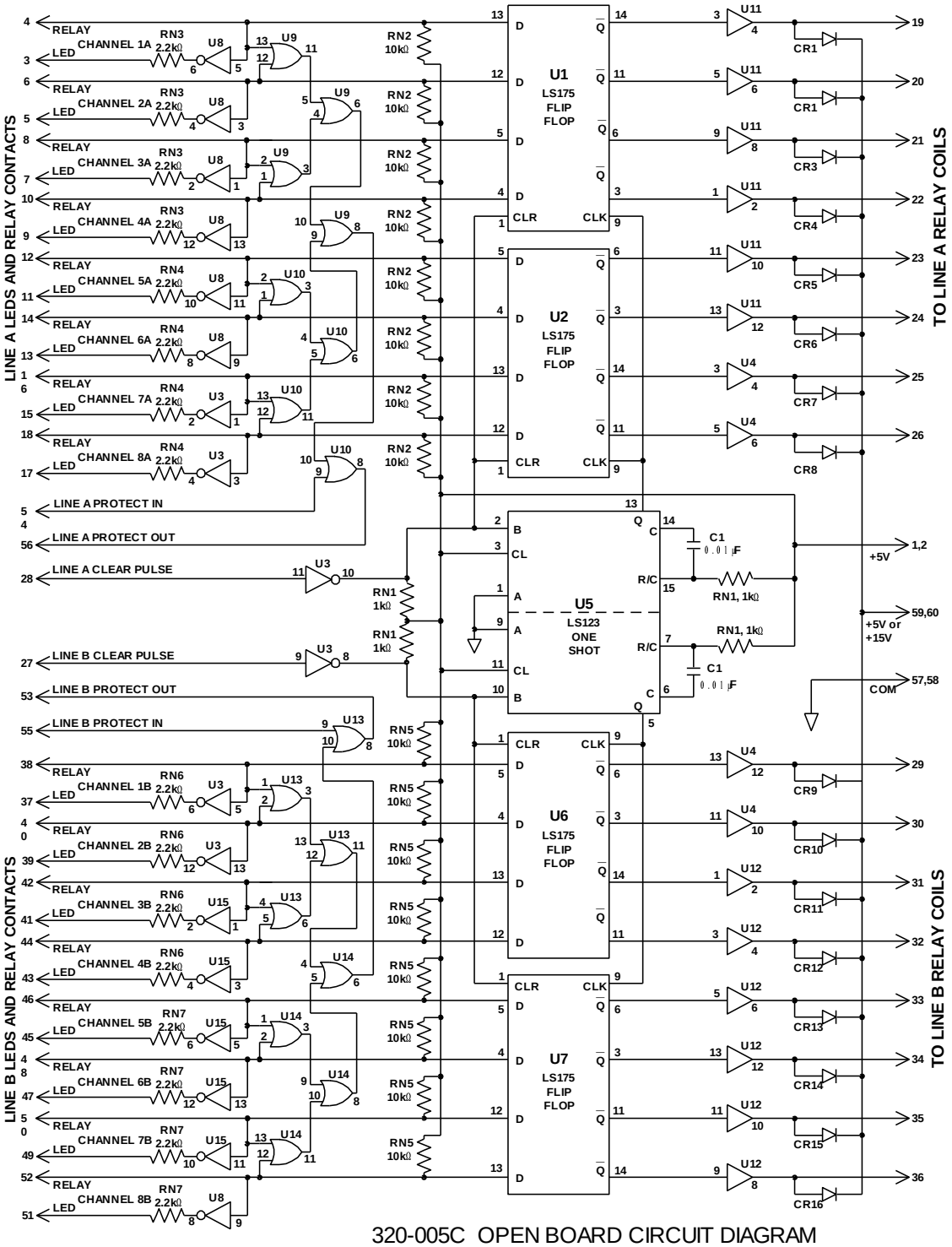


CLOSE BOARD COMPONENT LOCATIONS

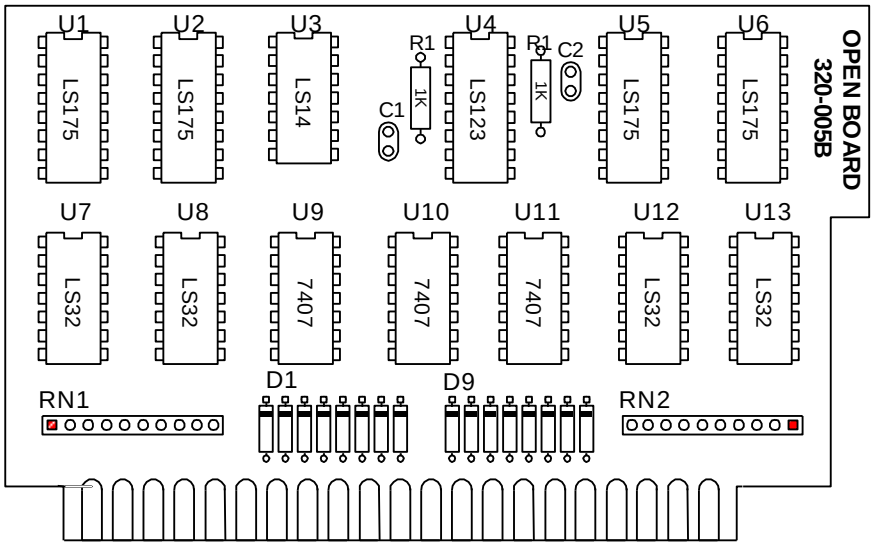
Notes: Two close boards are used in Model 6664C
Diodes (CR1-CR32) not used with +5V relays

CLOSE CIRCUIT PARTS LIST

CIRCUIT DESIG.	DP PART NUMBER	PARTS DESCRIPTION
C1,C2	16-02	CAPACITOR, FXD, .01 uFd 50VDC, 10%, Monolithic
R1	69-03	RESISTOR, FXD, 1Kohm, .0125W, 1% Met film
CR1-CR32	22-01	DIODE, 50VPIV, 200mA, 1N4150
U1,2,4,5	20-22	3-TO-8 LINE DECODER, 74LS138N
U3	20-07	QUAD 2-Input OR gate, 74LS32N
U6-U11	20-01	Hex BUFFER, Open Collector, 7407



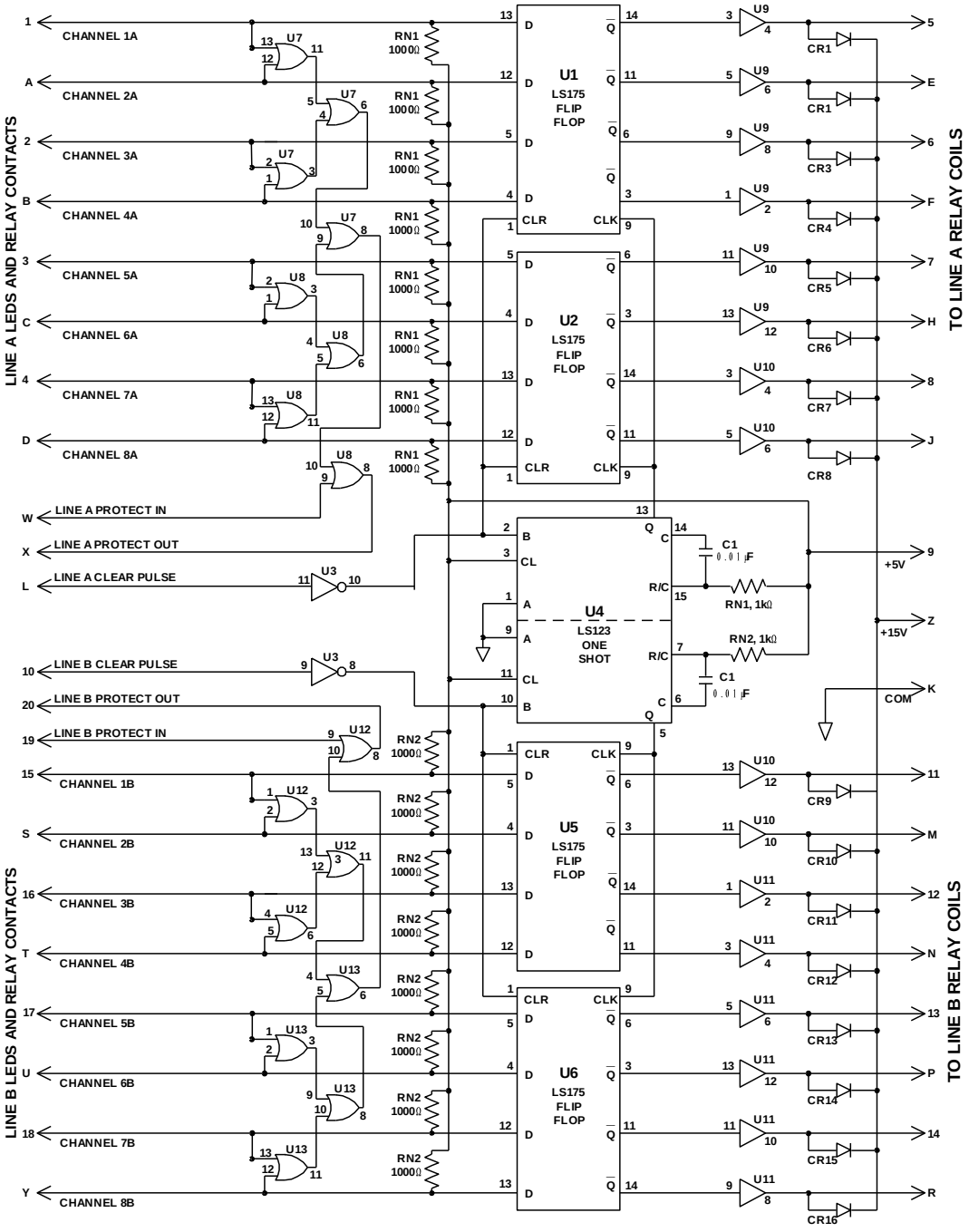
320-005C OPEN BOARD CIRCUIT DIAGRAM



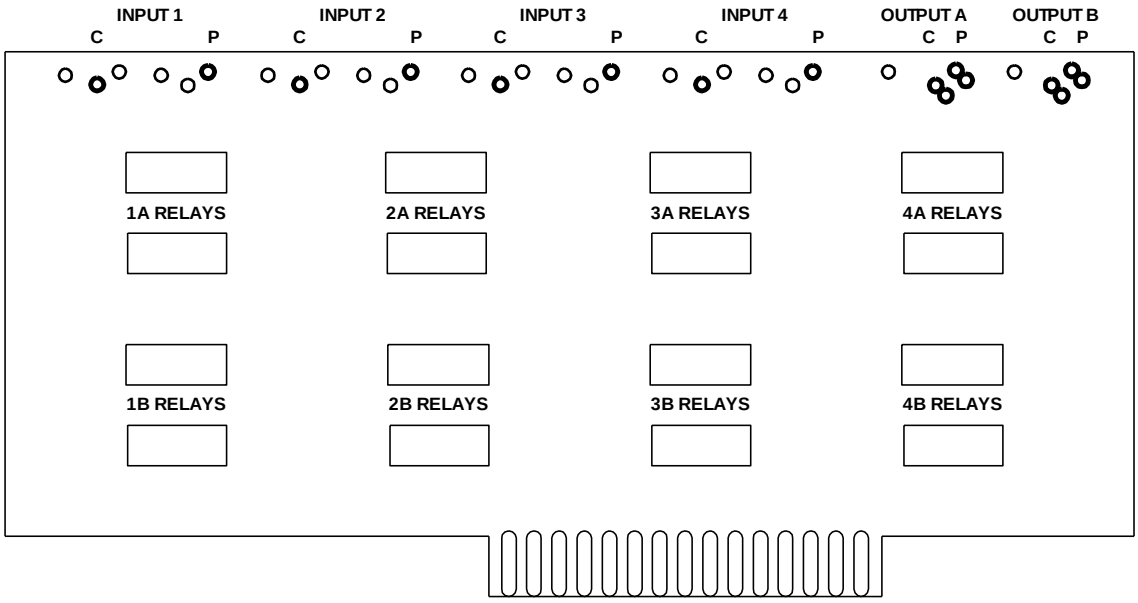
OPEN BOARD COMPONENT LOCATIONS

Notes: Four Open Boards ar used in Model 6664C
Diodes (D1-D16) not used with +5V relays

OPEN CIRCUIT PARTS LIST (Rev. B)		
CIRCUIT DESIG.	DP PART NUMBER	PARTS DESCRIPTION
C1,C2	16-02	CAPACITOR, FXD, .01 uFd 50VDC, 10%, Monolithic
RN1,RN2	68-01	RESISTOR NETWORK, 9x1 Kohm, Cermet SIP
R1,R2	69-03	RESISTOR, FXD, 1Kohm, .0125W, 1% Met film
D1-D16	22-01	DIODE, 50VPIV, 200mA, 1N4150
U1,2,5,6	20-21	Quad D-TYPE FLIP-FLOP, 74LS175N
U3	20-05	Hex INVERTOR, 74LS14N
U4	20-10	MONOSTABLE MULTIVIBRATOR, 74LS123N
U7,8,12,13	20-07	QUAD 2-Input OR gate, 74LS32N
U9,10,11	20-01	Hex BUFFER, Open Collector, 7407



OPEN BOARD CIRCUIT DIAGRAM 320-005B

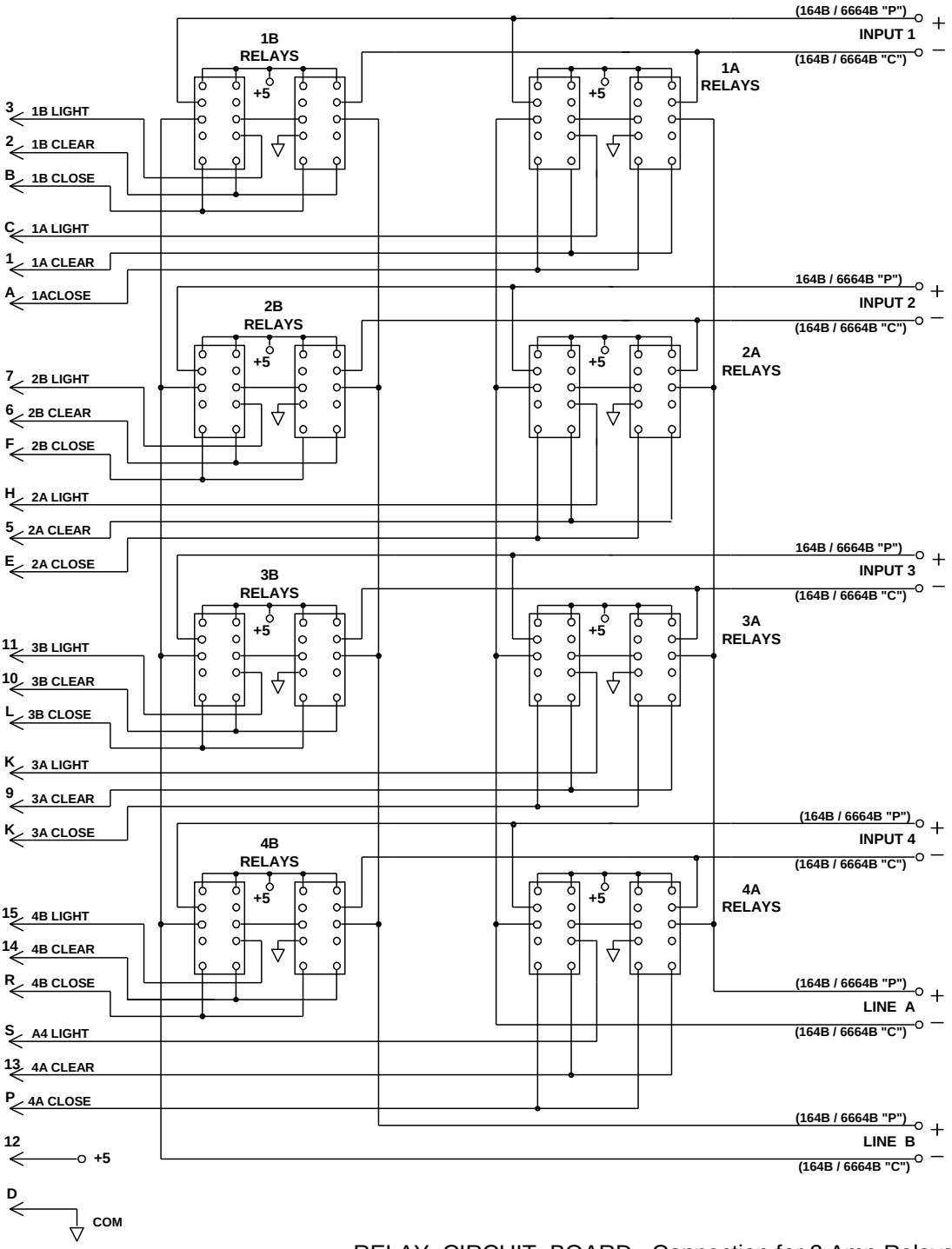


2 AMP RELAY BOARD COMPONENT LOCATIONS

Notes:

1. Each Board holds latching relays for four channels of low thermal inputs.
2. Four or eight boards are used depending on the model
3. These boards are located under the top of the isothermal box.

2 AMP RELAY BOARD PARTS LIST		
CIRCUIT DIAGRAM	DP PART NUMBER	PARTS DESCRIPTION
All PARTS	49-04	RELAY, LATCHING 2 AMP, 5 VOLT



RELAY CIRCUIT BOARD, Connection for 2 Amp Relays

7. DECLARATION OF CONFORMITY

(according to ISO/IEC Guide and EN 54014)

Manufacturer's Name: Data Proof
Manufacturer's Address: 2562 Lafayette Street.
Santa Clara, CA 95050

Declares, the product

Product Names: Low Thermal Scanner
Low Thermal Quad Scanner
Low Thermal Guarded Scanner

Model Numbers: 6664C

Product Options: All Options

Conforms to the following Product Specifications

EMC: EN50081-1 (1992)/EN55022 Class B
EN50082-2 (1992) / IEC 801-2 (1984)
EN50082-2 (1992) / IEC 801-3 (1984)
EN50082-2 (1992) / IEC 801-4 (1988)

SAFETY: EN 61010-1:1993/1995

Supplementary Information: The Product herewith complies with the requirements of the EMC Directive 89 / 336 / EEC.

Santa Clara, California

James A. Marshall, President
January 10, 1996 & May 15, 1997

Note: The declaration of conformity applies only to scanners with the CE Mark on the rear panel.