RELAY BUF–Term (RBUF–Term)

Rev. 1.1

CIRCUIT CELLAR INC.

4 Park Street ● Vernon, CT 06066

TECHNICAL MANUAL

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6/95

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Table of Contents

1. Introduction

The Relay BUF-Term (RBUF-Term) board was specifically designed to buffer the digital inputs and outputs of the HCS180 and HCS2-DX boards from "real world" signals. The supervisory controller (SC) board's digital I/O lines can only interface with signals in the 0 to +5 V range. Unless you are interfacing with other equipment which operates in this range, the 0 to +5 volt input and output levels of the SC will need to be buffered.

The RBUF-Term's sixteen inputs can withstand signal levels of ±30 Vdc. Its outputs are eight relays with absolute maximum, non-inductive, ratings of 3A at 300 Vac/150 Vdc or 600 VA/100W. The maximum inductive load is 1/8 Hp at 120 Vac. Each relay offers connections for normally open and normally closed operation.

The RBUF-Term connects to the 8255 parallel peripheral interface port (J4) of the SC through a 26-pin ribbon cable. The inputs and outputs to be buffered are connected to these boards through a series of screw terminal blocks which can accept up to #14 wire.

2. The RBUF-Term Buffer Terminator Board

2.1 Getting Started with the RBUF-Term

If you're like most people, you don't have the patience to read the entire manual before setting the system up to see it work. In order to satisfy your impatience, we've provided quick set up instructions so you can get your system working in just a few minutes. When you're ready to install the system for real, read the remainder of this section before proceeding.

Just a note of warning: **Do not** make any connections other than the ones we suggest below until after you've read the rest of the manual. Failure to heed this warning may result in damage to one or more HCS II components or to your own equipment. Such damage is **not** covered under any kind of warranty.

2.2 RBUF-Term Quick Setup

The minimal setup we assume here is an SC and an RBUF-Term. If you have purchased kits, all of these must be assembled and tested according to their respective manuals before proceeding. You should also have a push button with a normally open output and an ohm meter or continuity tester.

- Verify that all the jumpers are installed on the SC in their factory default positions. Likewise, make sure the jumpers are set on the RBUF-Term as shown on page 10.

- Connect the 26-pin ribbon cable between J26 on the RBUF-Term board and J4 on the SC. Pay close attention to the location of pin 1 when plugging the cable into each board.

- Connect the push button to the screw terminals labeled A0 on the RBUF-Term board.

- Connect the ohm meter or the continuity tester to the NO and COM terminals on connector J17. The ohm meter should indicate an open connection. If you are using a continuity tester, the light should be off.

- Make sure your power supply is off and connect it to the power terminals on the SC (J12). The positive side should go to the pin labeled V+ while ground should go to the pin labeled Gnd.

- If your HCS2-DX board has R8 installed or if you are using the HCS180 then you must use a 5 V power supply. Powering the SC with a voltage greater than 5 V **will** damage it. **Damage caused by an incorrect power supply voltage is not covered under warranty.**

- Similarly, connect the 12 V power supply to the power terminals on the RBUF-Term (J27: +12V and GND).

- Connect a serial cable between J2 on the SC and COM1 on a PC-compatible. Be sure pin 1 on the serial cable matches the pin 1 location on the connector on the board. J2 is a 16-pin Berg-type header so an adapter will be needed. Circuit Cellar offers such an adapter as part number DB25S-160 or you may construct your own.

- Double check ALL power connections to ensure nothing is wired backwards (especially the power connections).

- Finally turn the power supply on. The LED on the SC will stay off until a program has been downloaded to it.

Type the sample program shown below into a plain text file on your PC using a text editor or a word processor in text-only mode. In some word processors, you must make a special effort to request that the program save your file as plain ASCII text. Call the file EVENTS.HCS. Be sure your word processor does not add any extra control characters or formatting commands.

```
!
! Sample XPRESS control program
!
CONFIG SC = SC1
! or CONFIG SC = HCS180 if you are using XPRESS ver. 3.0

 DEFINE Switch     = Input(0)
DEFINE Relay      = Output(0)

BEGIN

IF Switch=ON THEN
     Relay = ON
END

IF Switch=OFF THEN
     Relay = OFF
END
```

The program simply watches the input and closes the relay when the switch is closed, then opens it when the switch is opened.

When you're done creating the file, exit the text editor and type COMPILE. The XPRESS compiler will check your program for proper syntax and will create a binary equivalent called EVENTS.BIN. If COMPILE finds any typing errors, fix them and compile the program again.

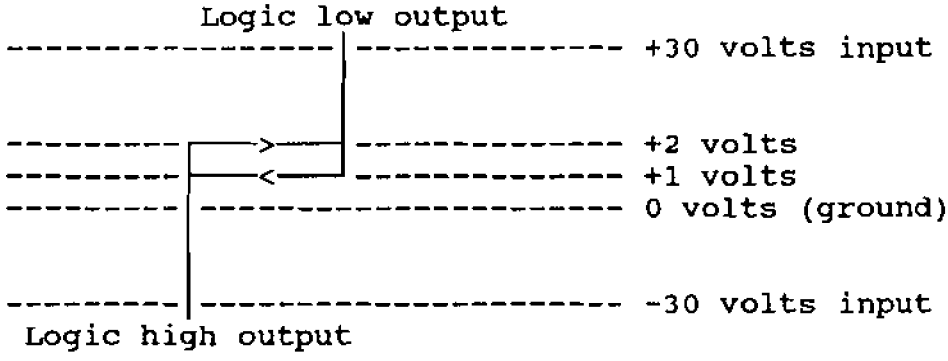
After a successful compile, type HOST to enter the host program. You should get a screen full of windows that display various system status information. If you are using XPRESS 2.1 or earlier, press the "T" key to set the SC's time and date. Then press the "L" key to load your compiled program into the supervisory controller. If you are using XPRESS 3.0, select the "C"ommand menu and the "T"ime command. Then select the "F"ile menu and the "L"oad command. When HOST tells you the load is successful, your program is running and should respond to your sensor or push button as described above.

If HOST tells you that the SC isn't responding to either the T or L command, there is probably a problem with the serial connection between your PC and the SC. Double check all connections.

Your HCS II is now operational. Feel free to experiment by modifying the sample program for other behaviors. Be sure to recompile the program each time you make a change. When you're ready to begin installing the system for real, read the rest of this manual before making any more connections.

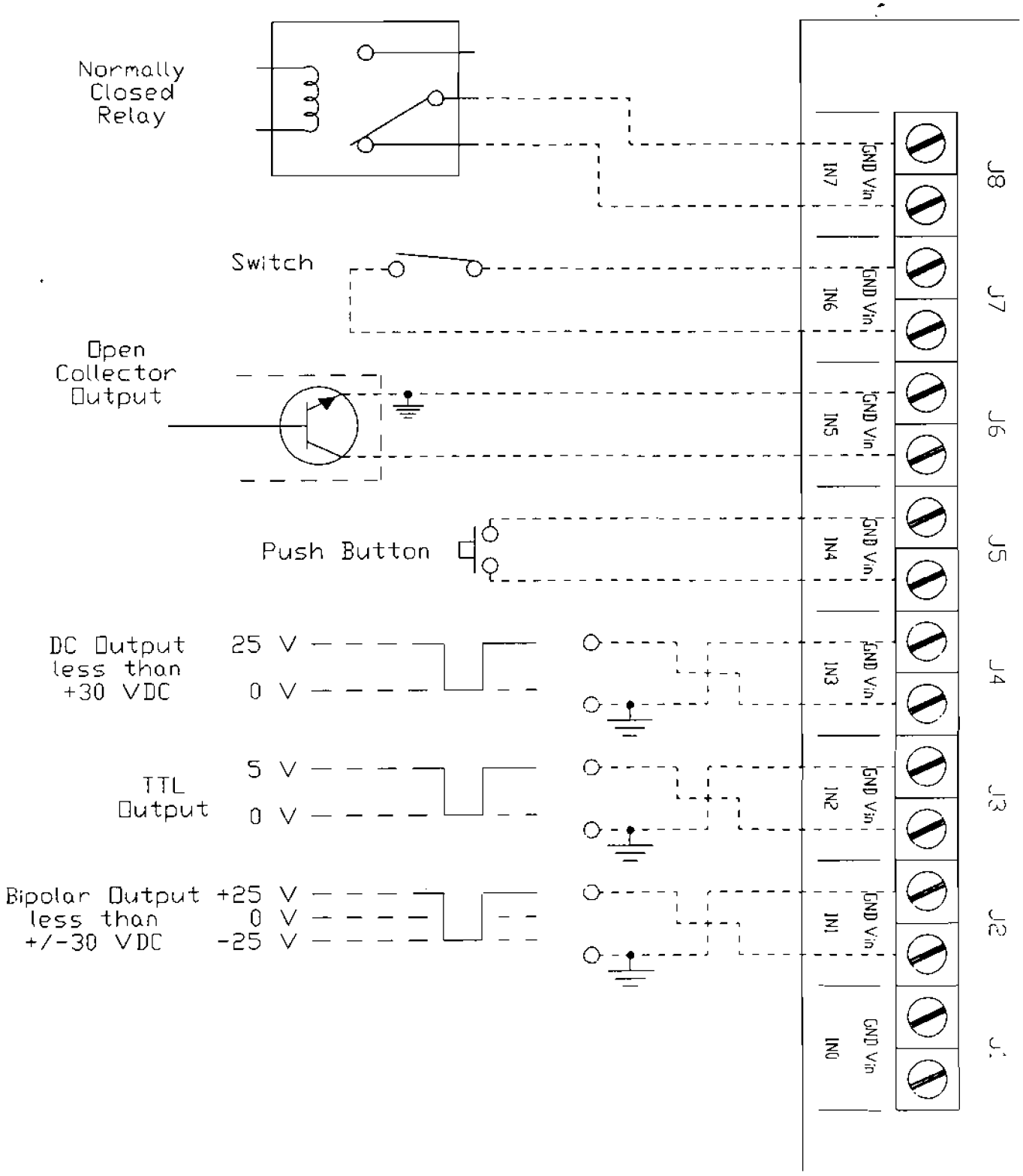
3. RBUF-Term Input Connections

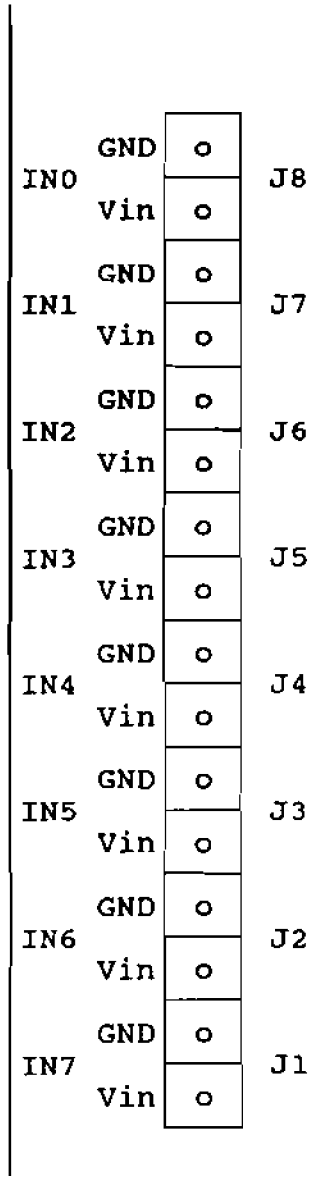
The RBUF-Term uses 1489 input inverters to manage its inputs. These inputs can handle levels as high as ±30 volts. The inverter output will switch to a logic high level, as seen by the SC, when the input signal drops from above +2 volts down to below +1 volt. The output will switch to a logic low level when the input rises from below +1 volt to above +2 volts. This hysteresis provides about 1 volt of noise immunity. All the inputs have a 2-7 kΩ input impedance. **It is important to remember that these inputs are inverted when writing your XPRESS code. See the XPRESS manual for information on writing code for inverted inputs and outputs.**



Ports A and B are designated as the input ports. The input connectors J8-J1 are premapped by the SC as local inputs 0-7 while connectors J16-J9 are premapped as local inputs 8-15. Every input has a complementary ground pin. Each input also has an LED associated with it to show when the channel is active. Pull-up resistors are provided for the input lines to guarantee that open inputs will present a logic low to the supervisory controller.

3.1 Sample Input Connections





This is typical for both input ports.

3.2 RBUF-Term Input Terminals

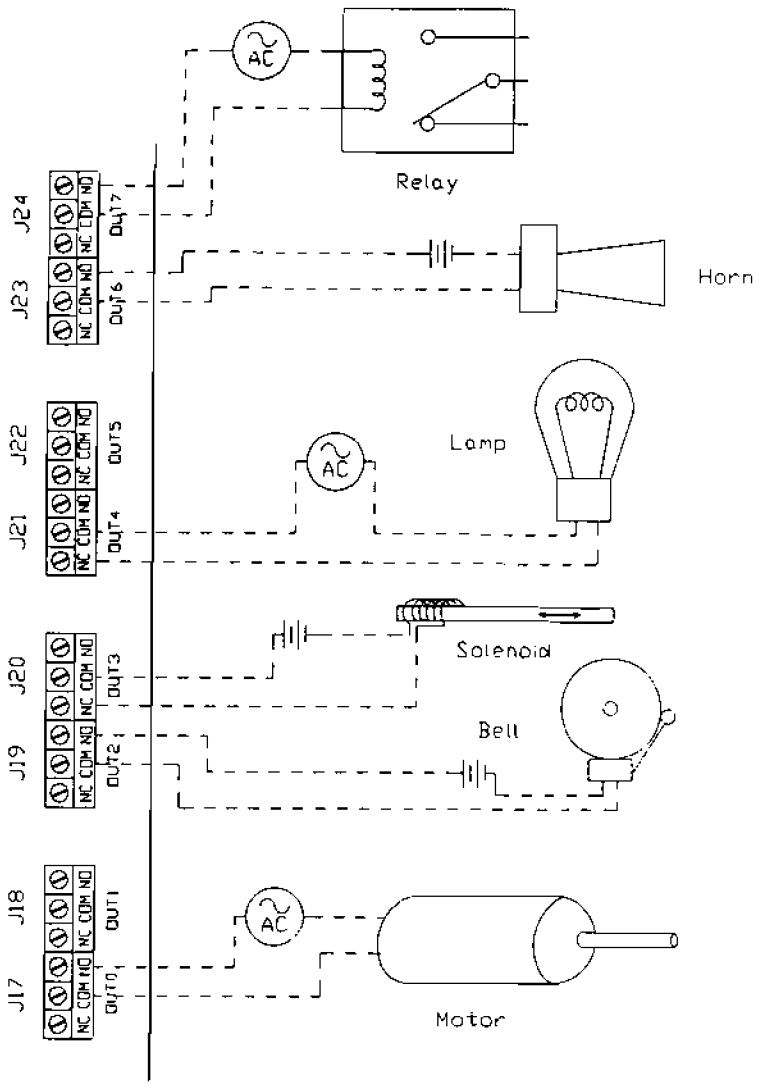
4. RBUF-Term Output Connections

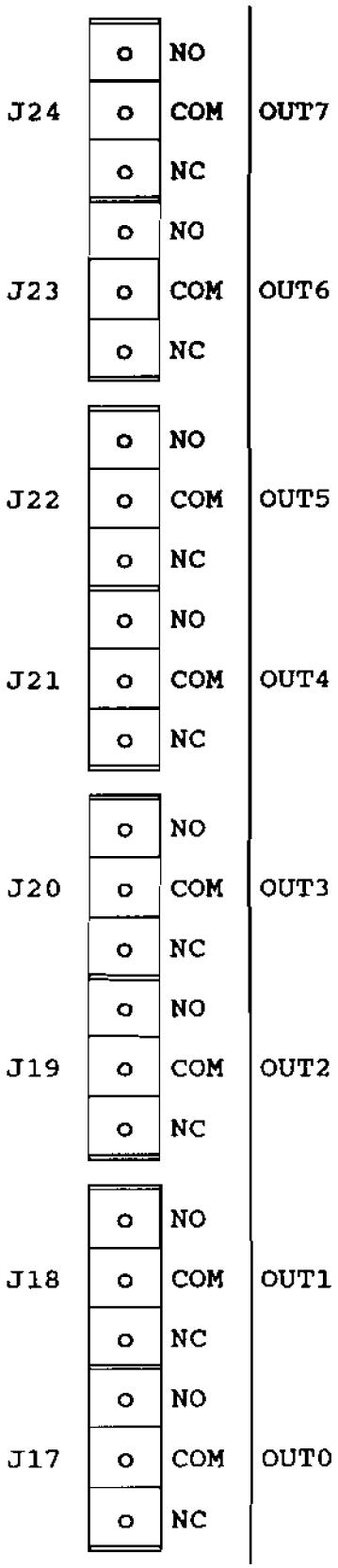
The RBUF-Term uses relay outputs to control higher voltage and current levels than the SC's 8255 PPI allows. The adsolute maximum, non-inductive, ratings of the relays are 3A at 300 Vac/150 Vdc or 600 VA/100W. The maximum inductive load is 1/8 hp at 120 Vac.

The outputs can be used to drive lamps, relays, solenoids, buzz ers, or other typical low-voltage devices. To control higher voltage and/or current devices, use these signals to operate a larger relay located external to the system.

The outputs of port C are connected to terminals J17-J24. These connectors are premapped by the supervisory controller as local outputs 0-7. To use these outputs, connect the device to be controlled, in series with its power source, across the normally open (NO) or normally closed (NC) terminal and the common (COM) terminal. When a logic high (1, XPRESS OUTPUT(x) = ON) is sent to the output, the NC and COM terminals are connected. When a logic low (0, XPRESS OUTPUT(x) = OFF) is sent to the output, the relay is energized and the NO and COM terminals are connected.

15.1 Sample Output Connections

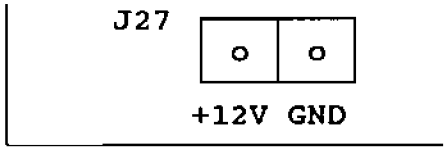




4.2 RBUF-Term Output Terminals

5. Power Supply Connections

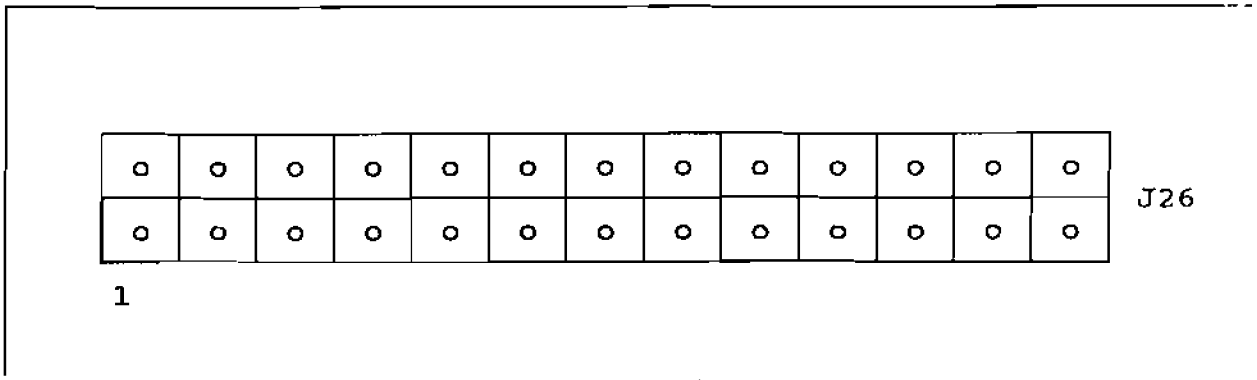
The RBUF-Term operates on 12 VDC. This voltage is connected to the board through the J27 screw terminal block. A linear voltage regulator reduces this to +5 VDC for use by some of the devices on the board.



Power Connection J27

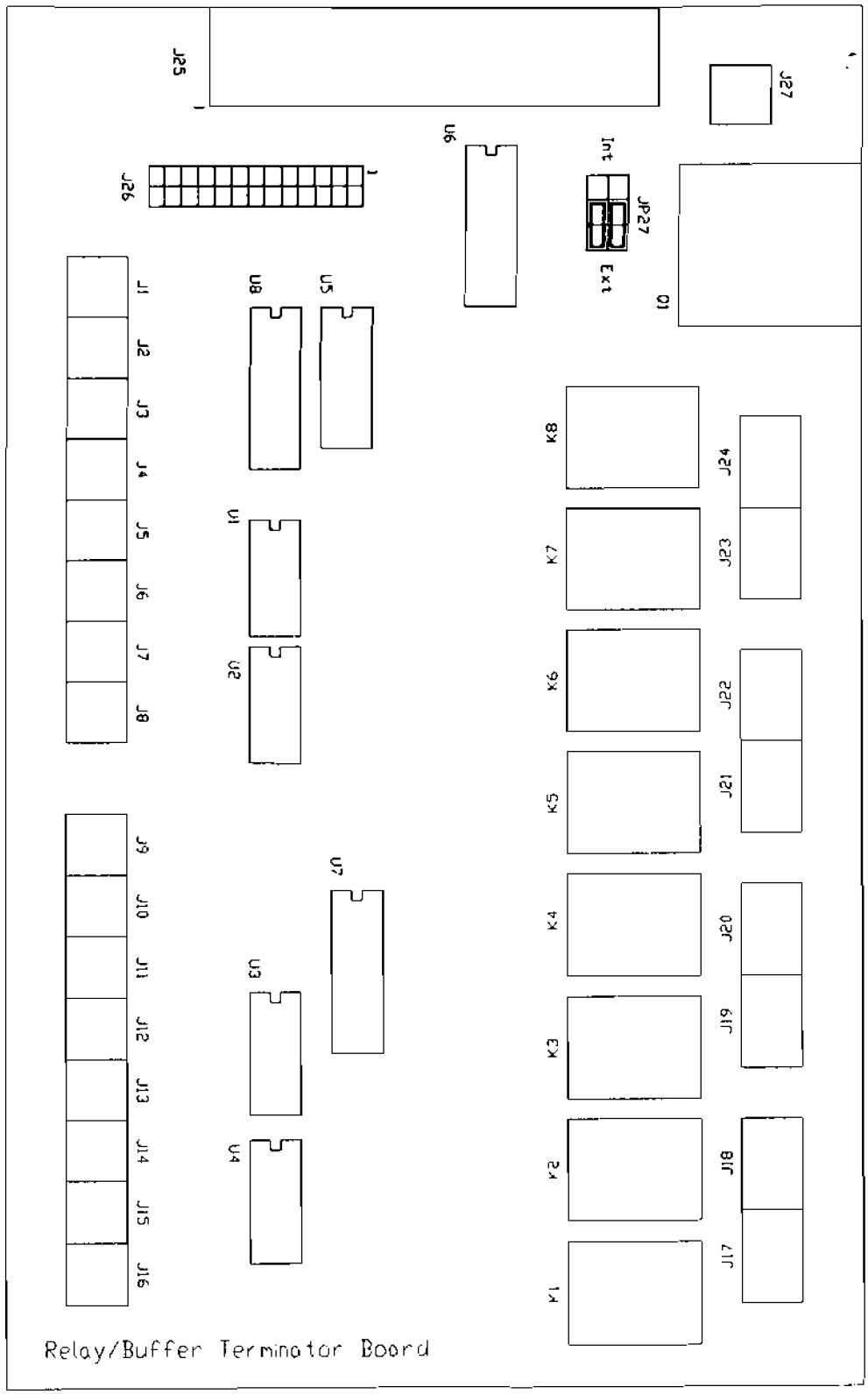
6. Control Bus Connections

The SC sets up its on-board 8255 for 16 TTL inputs and 8 TTL outputs. These signals are available on J4 the 2x26 square-pin header on the HCS2-DX and HCS180 boards. A short 26 conductor ribbon cable is used to connect J4 to the RBUF-Term's connector J26.



Control Bus Connector J26

7. Default Jumper Settings



8. Parts List for the RBUF-Term

DESIGNATION	PART#	DESCRIPTION
Printed Circuit Board		
RBUF-Term PCB		
Integrated Circuits		
U1-U4	1489	QUAD High voltage input level shifter
U5	ULN2803	OCTAL Open-collector latch
U6-U8	74LS240	
Resistors		
SIP1, SIP3	470 Ω	10-pin 9-common end resistor network
SIP2, SIP4	1 kΩ	10-pin 9-common end resistor network
SIP5		
SIP6, SIP7	10 kΩ	10-pin 9-common end resistor network
Capacitors		
C1, C2	100 μF	Electrolytic
C3-C10	0.1 μF	Monolithic
Semiconductors		
LED1-LED24	TIL220	Visible LED
Q1	LM7805	5.0 volt linear regulator
Connectors		
J1-J24, J27	1x2	Screw Terminal Blocks
	(Note: J1-J16 each position takes one 1x2 block, J17-J24 each position takes three 1x2 block.)	
J25	2x25	Shrouded Square-Pin Header **(Not used)**
J26	2x13	Square-Pin Header
JP27	2x3	Square-Pin Header
Sockets		
SK1-SK4	14-Pin	0.3 inch IC-Socket
SK5	18-Pin	0.3 inch IC-Socket
SK6-SK8	20-Pin	0.3 inch IC-Socket
Miscellaneous		
K1-K8		Relay, 12V, DPDT
SJ1,SJ2		Shorting Jumpers
Cable1		26-conductor ribbon cable
HS1		Heatsink and #4 hardware

9. RBUF-Term Assembly Instructions

Tools required for assembly:

Low-wattage or temperature-controlled soldering iron
Rosin-core solder (DO NOT use acid core!)
Lead cutters
Screwdriver

Additional tools to ease assembly:

Needle-nose pliers
Lead bender
Solvent for removing rosin (flux)

Tools for troubleshooting (and their use):

Oscilloscope	Viewing AC/DC signals
Logic probe	Indicating logic levels (activity)
Continuity checker	Determining shorted or open traces
Volt/ohm meter	Checking power supply, logic levels, or continuity

9.1. ( ) PCB Inspection

Before beginning assembly of the RBUF-Term board, you should inspect the PCB for shorted or open traces. This will increase your assembly time slightly but it is well worth the effort compared to the time it can take to track down a problem after the board has been assembled. The easiest way to do this is to hold the board up to a light. You should then be able to see all the traces clearly. Examine each trace for breaks or shorts to other traces. If you find what looks to be a short, use the schematic to verify that the traces should not be connected. A continuity checker or a VOM can then be used to determine if the short is truly there. The continuity checker or VOM can also be used to test for a break in a trace. You should also check for continuity between the Gnd and V+ pads of T1. These two points should **NOT** be shorted together.

9.2. ( ) Parts Inspection

The next step is to familiarize yourself with the parts to be installed in the kit. All Circuit Cellar kits are thoroughly inspected so they should be complete and accurate. Check to make sure you have the correct parts needed and the correct amount of each part.

> **Note: The side of the board with the silkscreen outline is the component side and the opposite side is the solder side. All components should be mounted on the component side and all soldering should be done on the solder side of the board.**

9.3. ( ) IC Sockets

All the DIP sockets have a notch in one end to indicate the location of pin 1. This notch must match the outline shown on the silkscreen. Insert all of the sockets into the board making sure that they are oriented correctly and that all the pins protrude through the board. If the sockets you are using have straight solder tails rather than retention type, you may wish to tack down one pin and then the pin on the opposite corner to hold the socket in place. Once the socket is tacked in place, you can verify that the socket is flush to the board and that all the pins are protruding through the holes. Check off each socket on the list below after they have been inserted and verified.

( )	SK1-SK4	14 pin DIP
( )	SK5	18 pin DIP
( )	SK6-SK8	20 pin DIP

Solder all the socket pins to the board. The spacing between the pins is tight, so care must be used when soldering so that no solder bridges are formed.

9.4. ( ) Capacitors

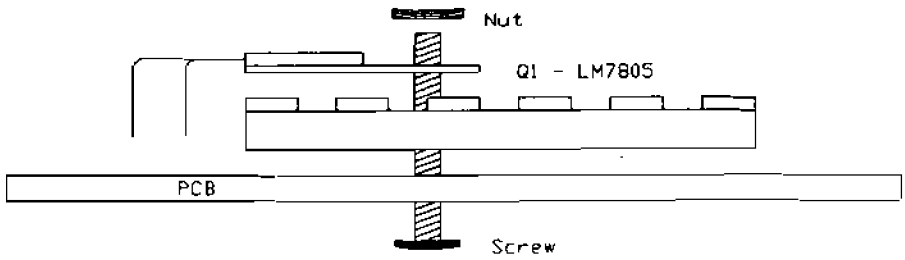
Capacitors C1 and C2 are polarized and must be installed with this in mind. These capacitors will have one lead marked with a stripe and a "+" or "-" symbol to denote whether it is positive or negative. The remaining capacitors are not polarized and may be installed either way. Insert the capacitors, noting polarity where appropriate, and bend the leads over to keep the parts from falling out. Verify that each part is in its correct location and that it is oriented correctly. Check off each capacitor on the list below after it has been installed and verified.

( )	C1, C2	100 µF, Electrolytic (polarized)
( )	C3-C10	0.1 µF, 0.10" (104)

Solder each capacitor to the board and clip the excess leads.

9.5. ( ) Voltage Regulator and LEDs

Q1 is a 7805 in a TO-220 style case. This device is installed with a heat sink (HS1). When installing Q1, place the heat sink on the board, with the fins up, and lay Q2 on top of the heat sink. At this point you can judge how the leads need to be bent. Bend the leads, insert Q2 into the board on top of the large heat sink. Next, secure the assembly with the screw and nut. Note that the nut should be installed on the component side of the board. The drawing below shows how these components should be placed.



The LEDs have a flat side or notch on their bases to identify the cathode. This flat side or notch should line up with the flat side of the outline on the silkscreen. Verify that each part is installed in the correct location and with the proper orientation. Check off each device on the list below after it has been installed and verified.

( )	Q1	LM7805 Voltage Regulator (TO-220)
( )	HS1	Heat Sink
( )	HS2	Heat Sink
( )	Screw	
( )	Nut	
( )	LED1-LED24	LED, Red, TIL220
	POWER	

Solder each device to the board and clip the excess leads.

9.6. ( ) Resistor Networks

The resistor networks (SIPs) have pin one marked with a dot and have writing on the same side of the component as the dot. The SIPs should be installed so that pin 1 goes into the hole with a square solder pad. Insert the parts into the board and bend the leads over to prevent them from falling out. Verify that each part is installed in the proper location and is oriented correctly. Check off each device on the list below after it has been installed and verified.

( )	SIP1, SIP3	470 Ω SIP, 9 Element, 10 pins
( )	SIP2, SIP4, SIP5	1 kΩ SIP, 9 Element, 10 pins
( )	SIP6, SIP7	10 kΩ SIP, 9 Element, 10 pins

Solder the SIPs to the board.

9.7. ( ) Pin Headers

The pin headers do not have long leads which can be used to hold the parts in place while soldering. Because of this, the headers should be held in place by hand and pins on opposite corners tacked on using a small dab of solder on the solder side of the board. Note that the headers are constructed with shorter pins on one side of the base. It is these shorter pins that should be inserted into the board. Insert the headers and tack them in place. Verify that all the headers are straight and in their proper locations. Check off each device on the list below after it has been installed and verified.

( )	J25	2x25 Shrouded Square-Pin Header
( )	J26	2x13 Square-Pin Header
( )	JP27	2x3 Square-Pin Header

Solder all of the connector pins to the board.

9.8. ( ) Screw Terminal Blocks

The terminal blocks should be tacked in place like the pin headers and should have their open sides facing out of the board. Terminal blocks J1-J8 should be combined into one connector by sliding them together before installation. J9-J16 should be similarly combined. The output screw terminals are joined in sets of three (J17-J18 = three 2-position terminal blocks). Tack all the terminal blocks to the board. Verify that all the parts are oriented correctly and that they all fit properly on the board. Check off the parts below after they have been installed and verified.

( )	J1-J24, J27	Screw Terminal Block, 2 Position Side Loading, 5mm

Solder all the terminal blocks to the board.

9.9. ( ) Relays

Each relay has five pins in an asymmetrical formation. Because of this the relays should only fit into the board one way. Since these pins are short you will need to tack down at least two of the pins to hold the relay in place. Verify that all the relays are oriented correctly and that all the pins protrude through the board. Check off the parts below after they have been installed and verified.

( ) K1-K8 Relay, 12V, DPDT

Solder all the relays to the board.

9.10. ( ) Cleaning & Final Inspection

At this point all the components (except for the ICs) should be installed and soldered to the board. To facilitate the final inspection, we recommend that the board be cleaned with flux remover. Once the board is clean, verify once again that the components are in their proper location and oriented correctly. You should also inspect the solder side of the board to make sure that all the leads have been soldered and trimmed. Look also for any solder bridges and shorted leads.

9.11. ( ) Voltage Check

Before inserting any ICs or applying power to the board it is a good idea to check for shorts between the power supply input and ground. Use a VOM to check the resistance between the two pins of T1. If you obtain a very low resistance reading, there may be a short and the board should be inspected again to find the cause. If the board passes this test, connect a power supply with an output of 12 VDC to terminal block T1. If you see smoke or hear popping sounds, disconnect the power supply immediately. Check the board for shorts and polarized capacitors that were inserted backwards. Correct any problems you find and try the test again. If everything appears normal when power is applied, use the power table (located on the last schematic page) to confirm that power is available to all the ICs.

9.12. ( ) Final Test

The next step is to install the ICs, jumpers, and battery. Make sure the power supply has been disconnected from the board before installing the ICs. Use the power table and the silkscreen as references for installing the ICs. Note that the ICs may be marked with a notch or a dot to show the location of pin 1. Use the attached jumper diagram as a reference for installing the jumpers. Inspect the board to be sure that all the ICs and jumpers are firmly seated and correctly oriented. You should also watch for any pins that may have bent under the device or over the edge of the socket.

At this point you should connect your power supply to the board and apply power. If you don't see smoke and don't hear any strange noises coming from your board, the odds are in your favor that your RBUF-Term is in good health.

For the final test see section 2.1 Getting Started with the RBUF-Term. Follow the instructions in that section to run an operation test on the board.

10. Troubleshooting

If, after several attempts you cannot get the RBUF-Term to operate properly, try the following:

- Check your power supply and SC connections.

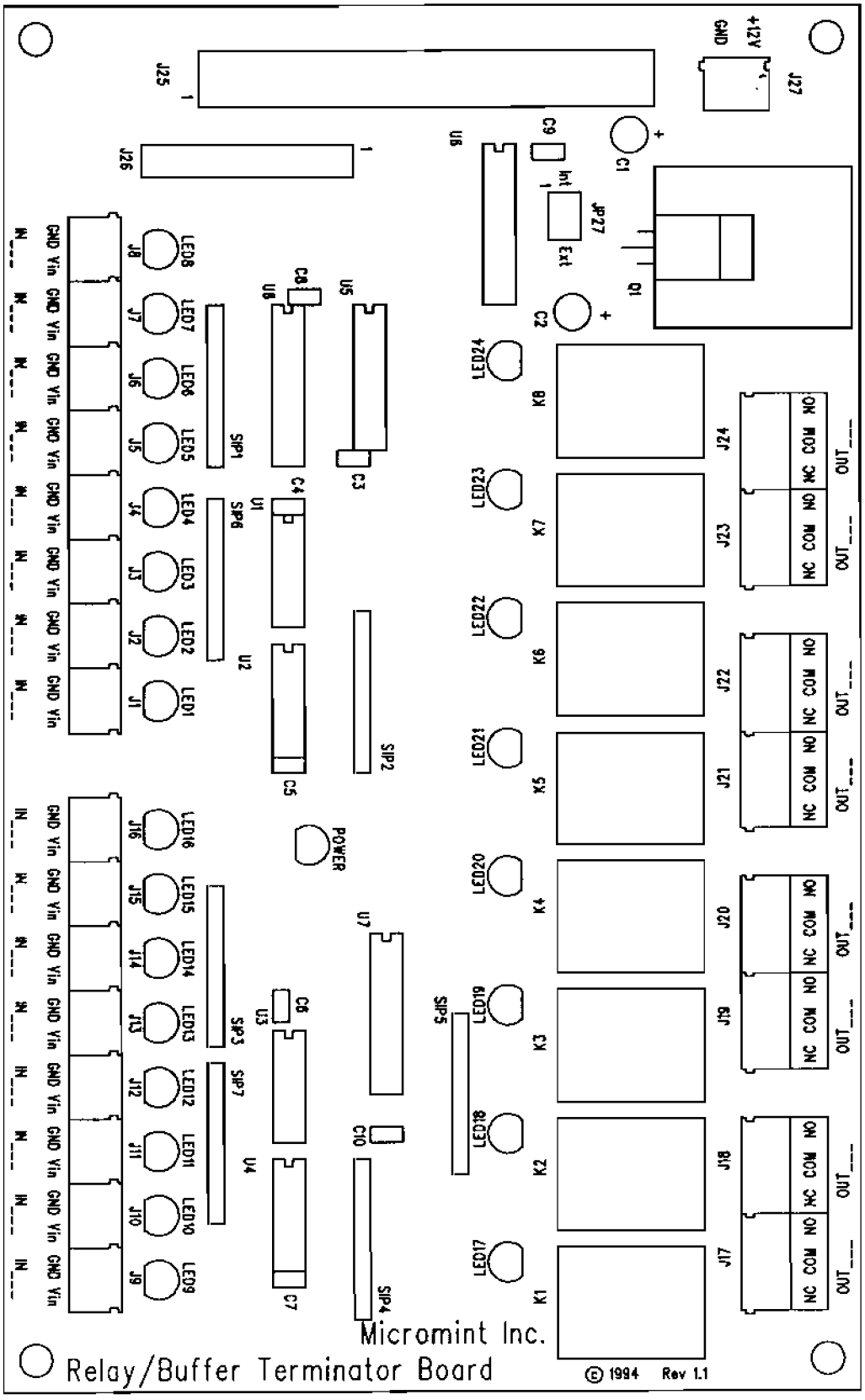
- Check all the control lines with an oscilloscope. You should see signals that are steady or cycling between two voltages. Any line that stays at a solid ground or 5 volts may be shorted to the power lines. Any line that jumps between more than two voltage levels may be shorted to another line.

- Inspect all of your solder joints again, checking for missed pins, solder bridges, and poor solder joints. A solder joint should be smooth and shiny. If a joint looks dull or somewhat crystalline, resolder the joint. A large number of inoperable boards can be fixed simply by correcting soldering mistakes.

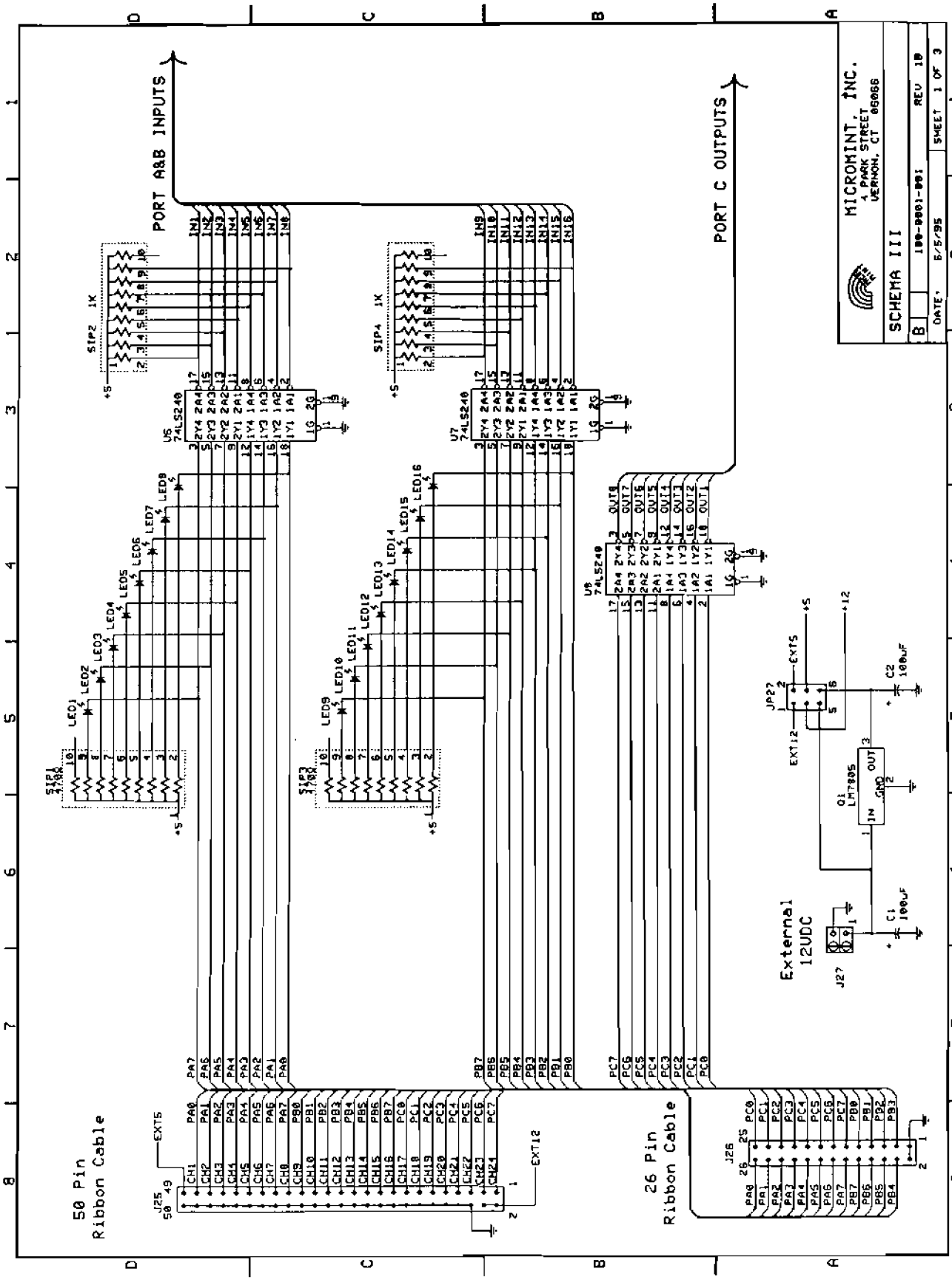
If you have purchased the kit version from Circuit Cellar and are unable to get your board working, we do offer a repair service. For a flat fee of $75.00 we will, at our discretion, repair or replace the board. Please note that we can only offer this service for kits which have been assembled with our parts. Therefore, this offer does not apply to boards assembled using parts procured from sources other than Circuit Cellar.

If you wish to take advantage of this service, please contact Circuit Cellar at (203) 875-2751 to obtain an RMA number. The board, a completed copy of the RMA sheet found at the back of this manual, and a check or money order may then be sent postage-paid to us. Please note the RMA number on the outside of the package so that it will be directed to the correct department.

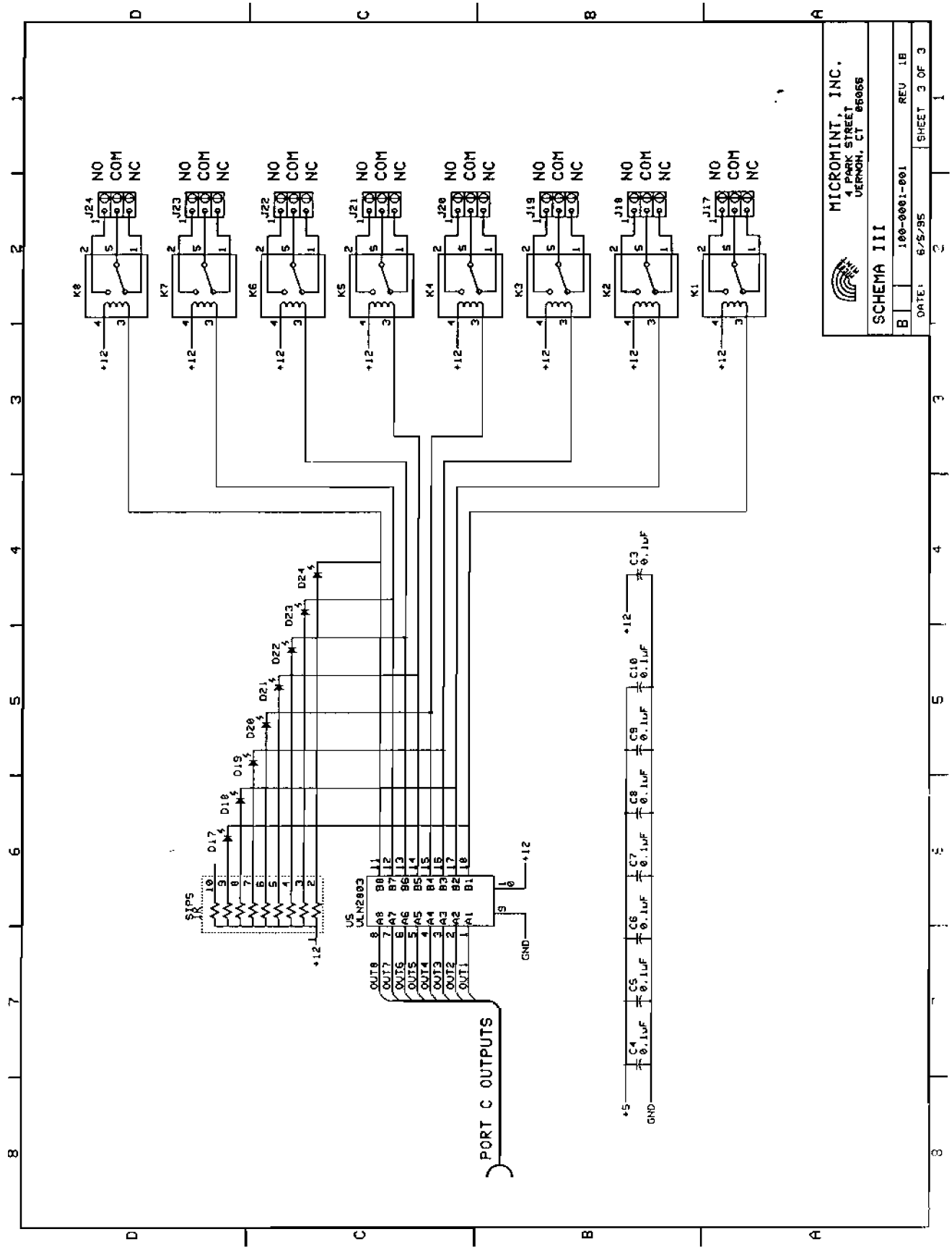
11. RBUF-Term Silkscreen



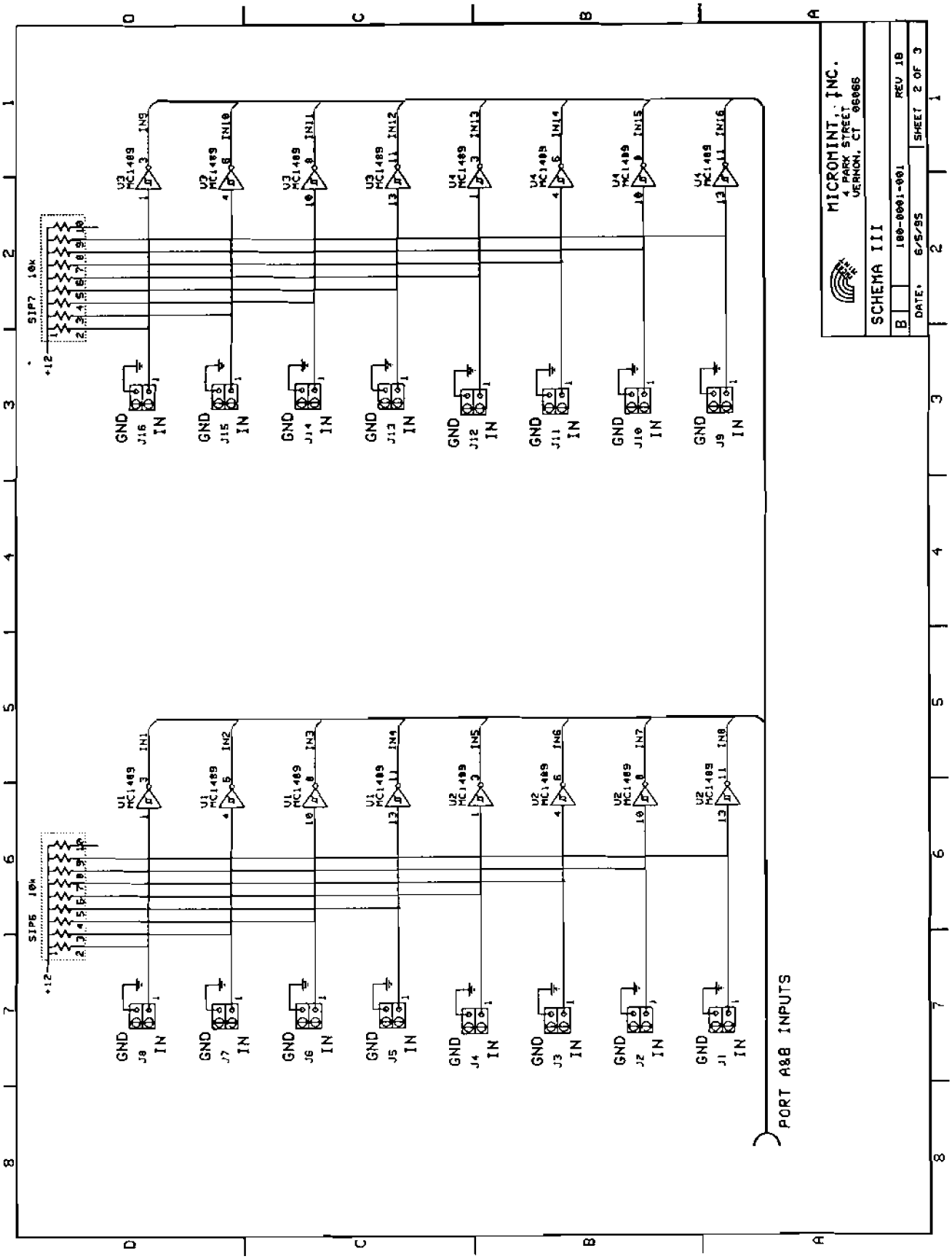
12. RBUF-Term Schematic



12. RBUF-Term Schematic



12. RBUF-Term Schematic



CIRCUIT CELLAR, INC. MERCHANDISE RETURN FORM

IN THE EVENT THAT YOU NEED TO RETURN AN ITEM TO US, PLEASE TAKE THE FOLLOWING STEPS:

1. Call CCI and obtain an RMA number.

2. Complete the form below and return it with the merchandise. Include a copy of your original invoice.

3. Should you need a replacement item shipped immediately, contact a CCI customer service rep. at **(860) 8751-2751.**

4. Ship the merchandise (pre-paid) to the address below. Using the original packaging, safely repack with all original accessories included.

PLEASE COMPLETE THIS FORM AND RETURN WITH THE MERCHANDISE AND A COPY OF THE ORIGINAL INVOICE:

RMA# _____

Date _____ Invoice # _____ P.O.# _____ Daytime Phone _____

Customer # _____ Account Name _____

Contact Name _____

METHOD OF PAYMENT:

☐ Check ☐ Charge ☐ Company Purchase Order (please attach copy)

Credit Card # _____ Expiration Date _____

Signature of Cardholder _____ Purchase Order # _____

ITEM(S) RETURNED	REASON(S)

(Use additional paper to be as explicit as possible on your reason(s) for return)

What action would you like us to take? (Repair or Replace item, Refund or Credit your account):

Is Shipping Data on Invoice correct? Yes _____ No _____

If not, please provide correct information: _____

To help us serve you better, use this space for your comments regarding Circuit Cellar Inc.'s service, support, product quality, etc. Thank you.

Ship to: CIRCUIT CELLAR, INC. • 4 PARK STREET • VERNON, CT 06066

CONDITIONS OF SALE AND PRODUCT WARRANTY

Circuit Cellar Inc. and the Buyer agree to the following terms and conditions of Sale and Purchase:

1. Circuit Cellar Inc. extends the following warranty: a factory manufactured circuit board or assembly carries with it a one-year warranty covering both parts and labor. Any unit which is found to have a defect in materials or workmanship will, at the discretion of Circuit Cellar Inc., be repaired or replaced.

2. A minimum inspection fee must be prepaid for the repair of units that are no longer under warranty. Call Circuit Cellar Inc. for a current list of fees.

3. NO WARRANTY is extended on USER ASSEMBLED systems or kits. However, assembled kits will be inspected and repaired with charges based on the current minimum one hour charge. Circuit Cellar Inc. retains the right to refuse to repair any USER ASSEMBLED item. This right is at the sole discretion of Circuit Cellar Inc. However, in the event that repair charges would exceed a reasonable amount, the user may be consulted for a determination. Repairs on user assembled items must be POSTPAID. Return authorzation must be obtained prior to any return.

4. Circuit Cellar Inc. will not be responsible for the repair or replacement of any unit damaged by user modification, negligence, abuse, mishandling, or improper installation.

5. Circuit Cellar Inc. is not responsible to the Buyer for any, or claim of, special or consequential damages.

6. All units returned for repair must first receive prior authorization from Circuit Cellar Inc. A return authorization number may be obtained by phone or letter. Please retain a record of this number, since most subsequent correspondence will refer to this authorization. Under no circumstances should any product be returned to Circuit Cellar Inc. without such authorization, and Circuit Cellar Inc. assumes no responsibility for returns unaccompanied by an authorization number. All returns must be shipped postpaid and ought to be insured. Circuit Cellar Inc. is not responsible for losses or damage during shipment. Repaired units will be returned postage and insurance paid.

7. Circuit Cellar Inc. reserves the right to alter any feature or specification at any time. This right extends to fees, charges, and any other conditions or warranties contained herein.