

The Circuit Cellar RS-485 Repeater

Overview

The RS-485 repeater enhances the capabilities of RS-485 networks by increasing the maximum cabling length and providing isolation for multiple terminations. The repeater is jumper programmable for data rates of 1200-115 kbps and word sizes of 9-12 bits allowing it to be used in a variety of applications. By using the repeater, networks are no longer limited to runs of 4000 feet, since each repeater can extend the network by an additional 4000 feet. The repeater makes complex star networks more manageable and reliable by using isolation to help alleviate the problems of multiple terminations. The RS-485 repeater also features two LEDs to show data direction.

Assembly Instructions

Parts List

Location	Description	Quantity	Notes
C1, C2	10 μ F, 16V, Tantalum Cap.	2	
C3, C4	0.1 μ F, 50V, 0.10", Monolithic Cap.	2	Marked 104
C5, C6	15pF Monolithic Cap.	2	Marked 150
D1	1 N4001 Diode	1	
TVS1-TV56	Surge suppressor	6	
R1, R2	330W, 1/4W, 5% Resistor	2	
R3	0W, (use a piece of cutoff lead)	1	
SIP1	10kf2.9 Element SIP	1	
JP1, JP2	2x3 Header	2	
Y1	14.31818 Low Profile Crystal	1	
	Insulator for Crystal	1	
Q1	MC7805 Voltage Regulator	1	
SK1	18 pin DIP Socket	1	
SK2, SK3	8 pin DIP Socket	2	
T1-T3	2 Position Terminal Block	3	
U1	PIC16C54	1	
U2, U3	75176	2	
LED1, LED2	TIL220 Red LED	2	
PCB	RS-485 Repeater	1	
	Shorting Jumper	5	

Equipment Needed for Assembly

- Low-wattage soldering iron
- Rosin core solder (NOT acid core)
- Small wire cutters
- Needle nose pliers
- Multimeter (for test procedure)
- Lead bending jig (optional)
- Flux removing solution

Assembly and Test

1. () Check the parts list to become acquainted with the components and to verify that you have all that are needed. You should also read the remaining assembly instructions prior to assembling the board to become

familiar with the order of parts installation. Finally, check the box next to each step after the step is completed and verified. A little extra time spent now eliminates or greatly reduces any troubleshooting time you may need later.

Note that the side of the board with the silkscreen (part outlines and identifying marks) is the component side. The opposite side is the solder side. All parts are installed on the component side and soldered on the solder side.

2. () Locate resistors R1 and R2 and their locations on the board.. Bend all the resistors on 0.4" centers. Insert the resistors into the board and bend each lead slightly to prevent the resistor from falling out. After the resistors are installed, verify that they are in the correct locations, and solder the leads to the board. Inspect the solder joints for defects and then clip the excess leads. Keep one of the leads you have just clipped off. This will be used for R3.
3. Note that R3 is not shown on board. Please refer to the print out of the silkscreen to find its location. R3 is located between R1 and Y1. Bend the lead on a 0.4" center and insert it into the board. Bend the leads slightly to keep it from falling out. Verify that the wire is in the correct location and solder it to the board. Inspect the solder joints for defects and then clip the excess leads.
4. () Locate diode D1 and its location on the board. Bend the leads of the part on 0.4" center. The diode must be installed so that the stripe on its body aligns with the stripe on the silkscreen. Insert the diode into the board and bend the leads slightly to prevent it from falling out. After the diode is installed, verify that it is located and oriented correctly and solder the leads to the board. Inspect the solder joints for defects and then clip the excess leads.
5. () Locate capacitors C1 and C2 and their locations on the board. Note that the capacitors have a stripe and/or plus symbol on the body next to one of the leads to denote the positive lead. Insert the positive lead of the capacitor into the hole with the square solder pad and bend the leads slightly. Verify that the capacitors are installed correctly and solder each lead. Inspect the solder joints for defects and clip the excess leads.
6. () Locate capacitors C3-C6 and their locations on the board. These capacitors are not polarized and may be installed either way in the board. Insert the capacitors into the board and bend each lead slightly. Verify that the capacitors are installed correctly and solder the leads to the board. Inspect the solder joints for defects and clip the excess leads.
7. () Locate headers JP1 and JP2 and their locations on the board. Insert the headers into the board and tack solder two corner pins to the board. Inspect the headers and make sure they are flat against the board. Once the headers are positioned correctly, solder the remaining pins to the board. Make sure to go back and completely solder the pins which were tacked to the board. Inspect the solder joints for defects.
8. () Locate surge suppressors TVS1-TVS6 and their locations on the board. Bend the leads of the parts on 0.6" centers. Insert the devices in the board, verify that they are installed correctly, and solder the leads to the board. Inspect the solder joints for defects and clip the excess leads.
9. () Located LEDs LED1 and LED2 and their locations on the board. Note that the LEDs and the outlines on the board both have a flat edge. Insert the LEDs into the board so that flat edges align, verify that they are installed correctly, and solder the leads to the board. Inspect the solder joints for defects and clip the excess leads.
10. () Locate the resistor network SIP1 and its location on the board. Note that the device has one pin marked with a dot. Insert the device in the board so that the pin with the dot goes into the hole with the square solder pad. Verify that the part is installed correctly and solder the leads to the board. Inspect the solder joints for defects.
11. () Locate sockets SK1-SK3 and their locations on the board. Note that the sockets and the outlines on the board have a notch in one end. Install the sockets in the board so that the notches are aligned and solder the leads to the solder side of the board. Inspect the joints for defects.
12. () Locate the voltage regulator Q1 and its location on the board. The device is installed laying down with the flat side against the board so its leads must be bent before it can be installed. The outside leads should be bent at the point the leads narrow. The inside lead should be bent slightly closer to the end. Insert the devices and bend the leads slightly. Verify that the device is installed correctly and solder the leads to the board. Inspect the solder joints for defects and clip the excess leads.

13. () Locate the 2 position terminal blocks T1-T3 and their locations on the board. Insert the blocks in the board so that the openings are facing the edge of the board. Verify that the blocks are flat against the board, solder the pins, and inspect the solder joints for defects.
14. () This concludes the assembly of the board. At this point its a good idea to clean the board with flux remover. This will get rid of any flux and dirt that has seeped on to the socket pins and make it easier to inspect your work.
15. () After cleaning the board you should inspect it once again for defective solder joints, misplaced components, and other errors.
16. () To test the board you will need a multimeter, 9-15V DC power supply, and the power table (Table 1) below. The ICs should NOT be installed at this time. Connect the power supply to T2 and be sure to observe the polarity marked on the board. The repeater is reverse power protected but you will not obtain the correct test results if the supply is connected incorrectly. Use the meter to test for +5V at the locations shown. If you do not see +5V at all the locations, go back and inspect your work again.

Part	+5V	Gnd
U1	4, 14	3,5
U2	8	2, 5
U3	8	2, 5

Table 1

17. Once the board has passed the voltage test, you may insert the ICs. Notice that the ICs have a notch or dot at one end. This signifies the location of pin 1 and must be aligned with the notch on the socket. Applying power to an incorrectly installed IC may damage the IC. ICs damaged in this way are not covered under the warranty.
18. This completes the testing of the RS-485 Repeater. The next sections describe configuring and using the board.

Configuring the RS-485

In order to use the RS-485 Repeater five (5) jumpers must be installed to set the baud rate and number of bits per word. Jumper JP2 is used to set the baud rate while JP1 sets the number of bits per word. Figure 1 and tables 2 & 3 below show the locations and settings for the jumpers.

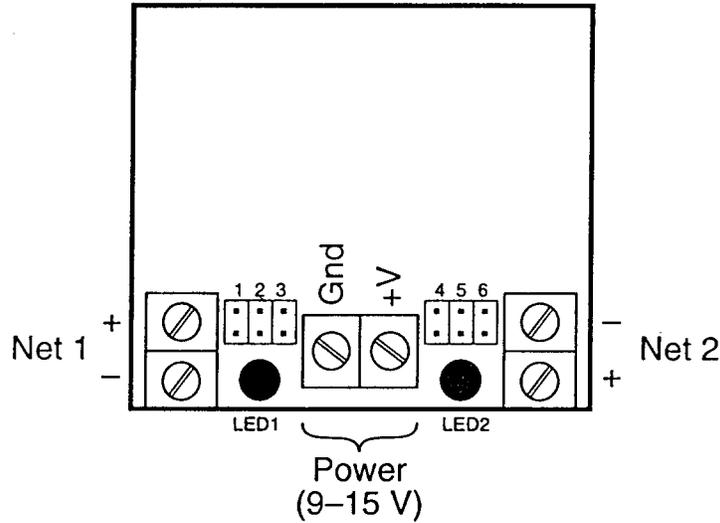


Figure 1

JP2 Settings			
Baud Rate	1	2	3
115200	X	X	X
57600	-	X	X
38400	X	-	X
19200	-	-	X
9600	X	X	-
4800	-	X	-
2400	X	-	-
1200	-	-	-

X = jumper installed
 - = no jumper

Table 2

JP1 Settings			
Word Size (Bits)	4	5	6
9	X	X	-
10	-	X	-
11	X	-	-
12	-	-	-

X = jumper installed
 - = no jumper

Table 3

Power Connection

A 9-15 Vdc power supply must be used to power the RS-485 repeater. The power supply is connected to screw terminal block T2 (see fig. 1). Note that the polarity of the terminals is marked on the board. Connecting the power supply incorrectly will not damage the board but it will not work until the connection is corrected.

Network Connections

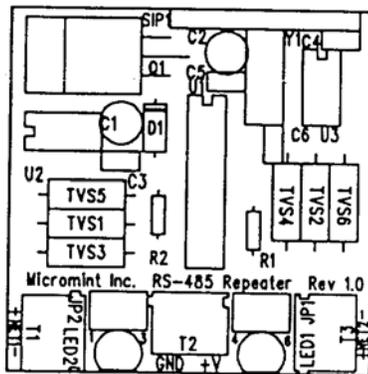
Network connections are made using screw terminal blocks T1 and T3 (see fig. 1). Please note that the polarity for the terminals is marked on the board. You must observe the correct polarity of the network wires when connecting them to the repeater.

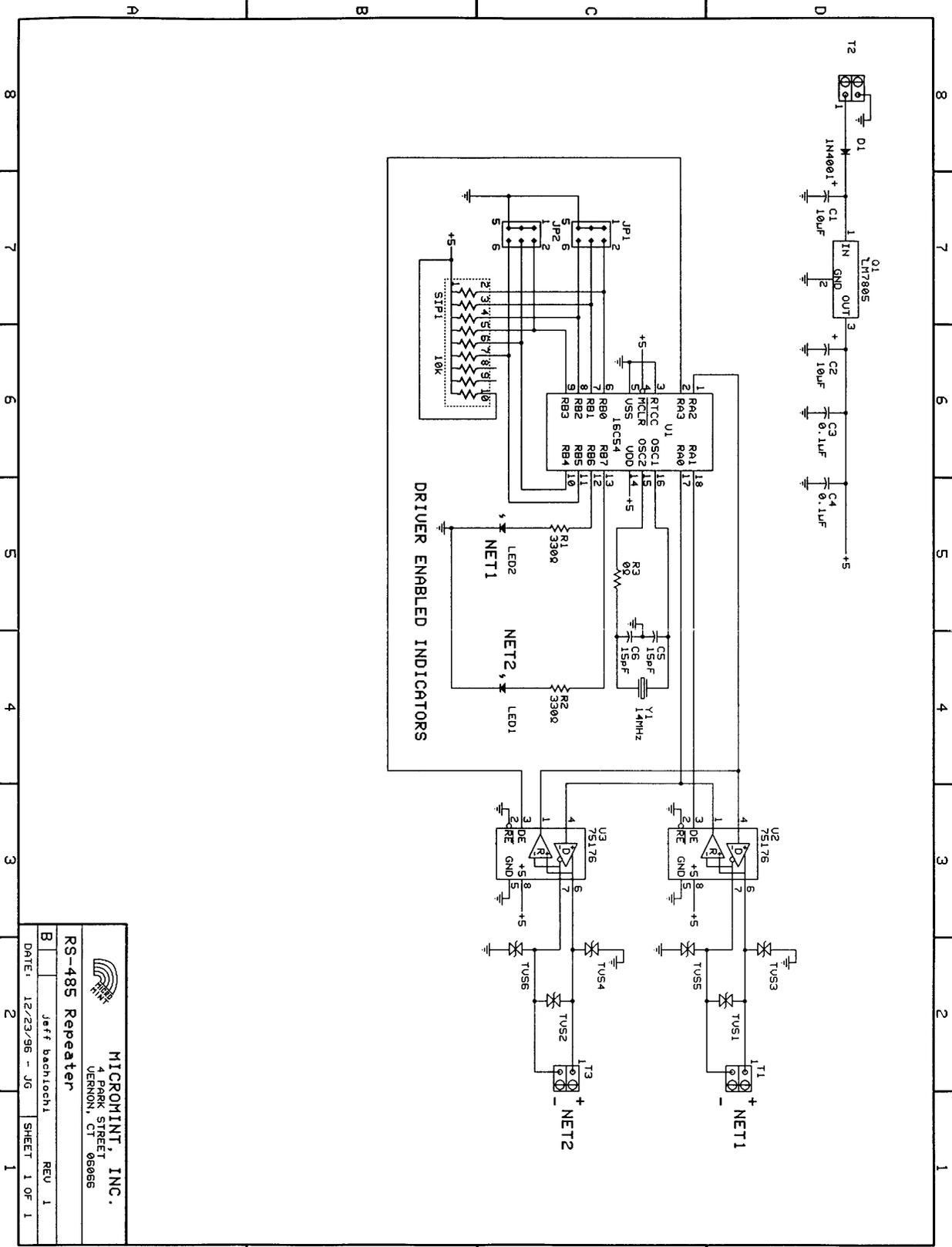
LEDs

Two LEDs are provided on the board to show the direction the data is flowing. When data is received at the Net 2 terminal block, LED1 is turned on and the data is transmitted out the Net 1 terminal block. When data is received at the Net 1 terminal block, LED2 is turned on and the data is transmitted out the Net 2 terminal block.

Data In	Data Out	LED1	LED2
Net 1	Net 2	Off	On
Net 2	Net 1	On	Off

Table 4






MICROMINT, INC.
 4 PARK STREET
 VERNON, CT 06065

RS-485 Repeater
 Jeff bachlochl
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