REALISTIC®

Service Manual

26-1145

RS-232-C INTERFACE

FOR TRS-80

Catalog Number 26-1145

NOTE: This Service Manual is to be used together with the User's Manual, which contains complete operating instructions plus circuit description.

CUSTOM MANUFACTURED FOR RADIO SHACK TC A DIVISION OF TANDY CORPORATION

RS-232 CHECK OUT

(for details see the next section)

I. POWER SUPPLY

A. +5V in
Check for excessive high frequency noise.

B. +12V presence
Is it noisy?

C. −12V presence
Is it noisy?

II. DECODING (Software Section)

Run DECODE
Check for low going strobes on outputs of A1.

III. RUN SWITCH (Refer to Software Section)

Toggle switches
Should get single display for each switch toggled, etc.

IV. Set switches for 7-bit word

Run LOOP

A. Check for proper display

B. Check FR & FT of BRG for clean square wave, no jitter

V. Run IN OUT

Pass or fail
If fail, check U3-1489 and U2 or

VI. Run CATCH-PITCH

Check for Baud rate passing 110 → 9600
Failing baud rates
BRG bad or wrong or inaccurate crystal

RS-232-C CHECK OUT AND TROUBLESHOOTING GUIDE

Power Supply

Three voltage levels are required by the RS-232-C Interface: +5V, +12V, and −12V. 5V is available at the internal expansion bus. The +12 and −12V is generated from the 5V supply by the Aztec voltage converter. This device chops the DC into a high frequency pulsing DC, steps it up to a higher voltage, rectifies, and filters it, and generates + & −12V. Notice that the input and +12V output have pi filters. These suppress high frequency voltage spikes that the converter may put on these lines.

When checking the power supply be sure that 5V is present at the internal expansion bus. Be aware that the 5V and ground pads are beside each other on this bus and that misalignment of the connector and board may cause a short which would fold back the supply on the E. I.

A lack of 5V input to the converter (while it is present at the connector) probably indicates a bad solder connection to L1. Incomplete removal of the insulation at the solder joint on coils L1 and L2 may be a frequent cause of power supply trouble. Check for the presence of both 12V sources at U6, U12, and U10. Either 12V source could be shorted and leave the other operating.

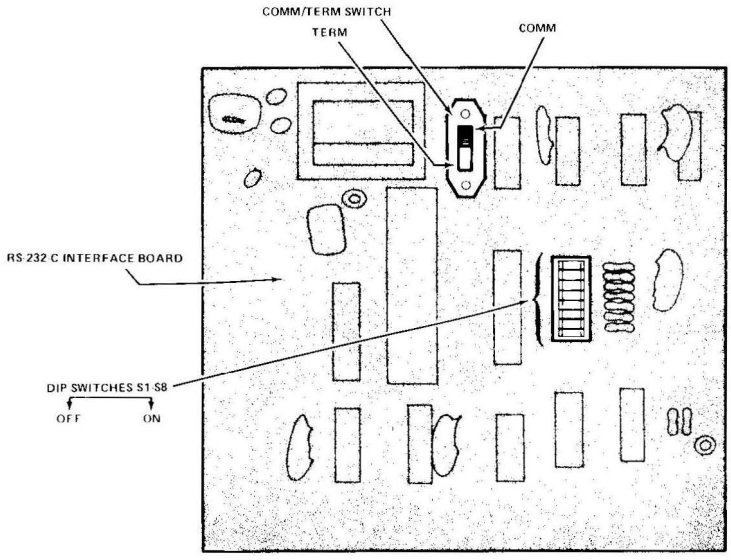
Excessive high-frequency noise may exist on the +12V supply or the 5V input if there is a fault with the pi-filter. An open filter capacitor or shorted turns in a coil could be responsible. Or the converter may generate more noise than the filter can suppress. Noise should not exceed 50 mVp-p. When checking this with a scope, it is advisable to fabricate a probe ground no greater than 1 inch in length to avoid picking up induced noise.

Decoding

If you are able to determine that one or more functions of the Interface are not operating properly you may suspect the decoder, U1. Run DECODE and refer to the explanation of this test. If you are not getting any outputs, check all inputs. There should be no 'tri-state' type of signal on any inputs to the interface. Any signals that look that way are probably shorted at the connector, so check out the pin's neighbors. U1 pins 2 & 14 should also show negative-going pulses. If all is well with the decoder, check the destination point of each output to ensure that there are no open etches. If some of the outputs are working and others are inactive and high, all combinations of inputs may not be present.

Sense Switches

There are two programs which test Sense Switch operation. COMSTAT displays the option selected by the sense switches, and SWITCH displays the switch number on the Monitor when it is actuated. **Note that the pin out of the dip switch on the schematic diagram is not in straight numerical order.** Failure of the correct option(s) to be displayed indicates trouble with the Sense Switches, the pull-up resistors or U7. Pin-pointing a bad Sense Switch or associated circuitry might best be accomplished by using the SWITCH program. Since the operation of one switch causes its numbers to be displayed on one line of the Monitor, shorts between switches will be indicated by two (or more) switch numbers being displayed on the same line. No display when a switch is operated indicates a faulty switch, pull-up resistor or U7. You can check U7 pins 1 & 19 (enable) for negative going pulses, 67mS apart, while SWITCH is running. If all the above checks out, look at the outputs of U7 while operating the associated switch. Good outputs will leave you with the conclusion that something is wrong at the connector. This can be verified by running another program and looking for a failure associated with the suspected data line.

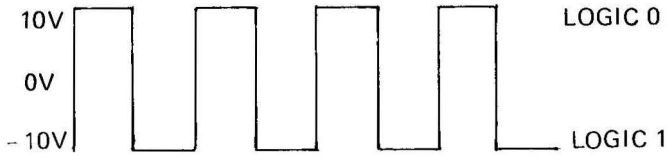


Transmission Test

Refer to the LOOP BACK DATA TEST in the software description. With LOOP running you can check out clock signals at pins 3 & 17 of U10. Remember that this signal is 16 times the baud rate so adjust the scope sweep accordingly. The clock should be a picture-perfect square wave at all baud rates. Although it is possible to set the transmit and receive clocks to different frequencies, this program insures that both clocks will always be the same. If a difference in frequency should occur, a bad U10 could be the cause, but it's more likely that one or more of the data lines are open or shorted together.

If characters are not displayed, check to make sure that the loop between pin 2 & 3 (pins 18 & 22 on the edge connector) is good. LOOP monitors the UART pin 19, Data Received and pin 22, Transmitter Holding Register Empty. Pin 19 should exhibit high going pulses and pin 22 low going pulses. If these seem to be stuck at 5V or ground, that may be the problem. Check U5 outputs and its enable if necessary. Transmitted data must also be enabled by a high level signal at U12 pin 9. This signal originates at U11 pin 6 where it was latched with the DECODE program, and pin 7 should not appear to be grounded or a low floating level.

U12, a 1488, converts the TTL level transmitted data into the RS-232-C signal level. A TTL logic level 1 is about 4.6V. The RS-232 logic level 1 is less than −3V. A TTL logic level 0 is about 0.4V. The RS-232 logic level 0 is higher than +3V. The actual levels using the 1488 converter will be approximately 10 to 12V for a logical 0 and −10 to −12V for a logical 1. If you look at U12 pin 8 with the scope set on 5V/division and the reference trace centered while LOOP is running, you should get a trace like this:



You will not be able to get a stable display because the data pattern is rapidly changing, but you will be able to see the 20V p-p voltage swing. This signal is coming right back to the interface to U4 pin 4, a 1489, which reconverts the signal to TTL logic levels and outputs it at pin 6.

Signal Level Conversion

The operation of U3 and U12 is checked by the program INOUT. These are the same circuits described at the end of the transmission test and you can expect to see the same levels there. If one of the four tests fails, the program will stop and you can troubleshoot this circuit with stable signals applied. Keep in mind the 'reversed' logic levels when compared with the voltage levels of the RS-232 signals. The one input NAND gate used for the symbols of both the 1488 & 1489 indicate this inversion of logic level to voltage level.

If the test fails, the truth table will point you in the right direction. If U12 inputs are wrong, check U11 pin 3, 4, & 9. If all converter inputs and outputs are good, U2 may be malfunctioning. U2 must also have active enable inputs, pins 1 & 5, which can be checked with the DECODE program. If U12 pins 6 & 11 are correct, but the inputs to U3 are wrong, there is a problem on the test fixture.

Transmission Rate Test

The test program PITCH and CATCH checks for accurate rate of data transmission. Refer to the software section for instructions. Besides being a baud rate test, these programs will provide a fairly thorough test of the entire RS-232-C interface. The only exception is the Sense Switches. If this test fails at any baud rate, it would be best to use the other Diagnostic programs to locate the trouble.

RS-232-C
TEST SOFTWARE DESCRIPTION

This section describes the use of functional test and diagnostic programs for the Radio Shack RS-232-C interface board. A test station will require two of each of the following: TRS-80 Level II, Expansion Interface, and Disk Drive. One known good RS-232 interface will also be required in addition to the Interface under test. All test software is provided on disk. Two of the programs require the use of a special test fixture to be plugged into the E.I. connector and a third test requires a special transmission line described under BAUD RATE TEST. **A Schematic of the Special Test Fixture is provided at the back of this service manual.**

1. **Sense Switch operational test.** File name is SWITCH. When this test is started, the number of the same switch toggled will be displayed on the Monitor as S1 through S8. Note that the position of the switch is not indicated, only its operation from one position to another. Switches that are changed simultaneously will be displayed on the same line of the Monitor. Succeeding switch operation will be displayed on following lines. To exit this test, press the X key.

2. **Sense Switch configuration test.** File name is COMSTAT. When this program is called, a display of the options selected with the Sense Switches is tabulated in the following format:

BAUD RATE	110	(One of the 8 supported baud rates)
WORD LENGTH	8	(5, 6, 7, or 8)
STOP BITS	1	(1 or 2)
PARITY	EVEN	(ODD, or NO PARITY)

   To select and display different options, first set the Sense Switches to the desired configuration and then recall COMSTAT. Note that COMSTAT only displays the options selected; it does not actually reconfigure the interface.

3. **Decoder Test.** File name is DECODE. When this program is started the following prompt is displayed:

   DECODER TEST – CHECK FOR LOW GOING STROBES ON OUTPUTS OF U1.

   At this time, all eight outputs of U1 will have low-going pulses separated by approximately 1.6 mS. Pin 1 of U1 will have groups of four positive-going pulses separated by 0.6 mS. Pin 15 will be a negative-going version of Pin 1. This test allows for a quick check of all enable signals of the RS-232 interface. Pressing the X key will abort the test.

4. **Handshake latch test.** File name is INOUT. This test requires the special test fixture to be plugged into the RS-232 interface connector. An external 5V supply is required for this fixture. When this program is called, a truth table is displayed in the following format:

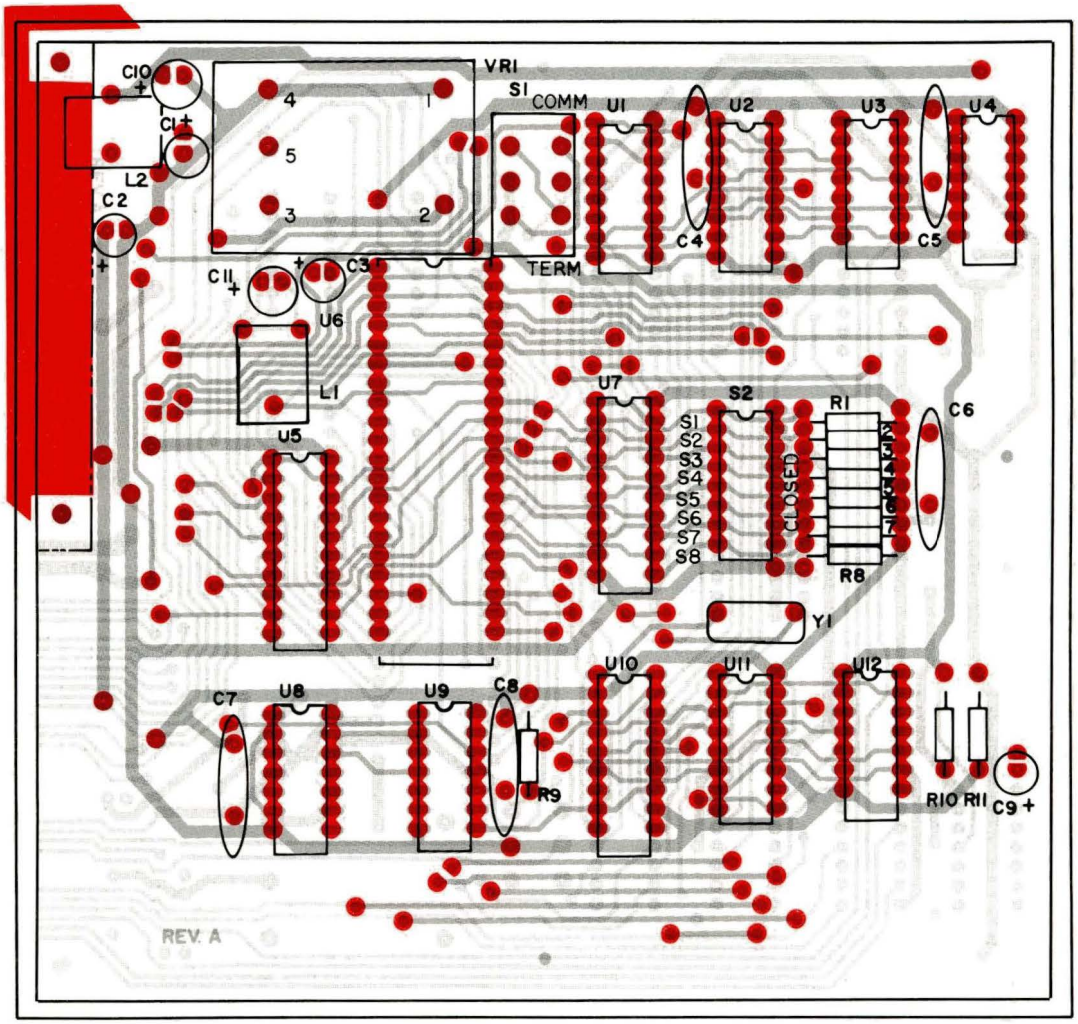
OUTPUTS		***INPUTS***			
DTR	RTS	CTS	DSR	CD	RI
Ø	Ø	1	1	1	Ø
Ø	1	1	1	Ø	1
1	Ø	1	Ø	1	1
1	1	Ø	1	1	1

   PASSES/FAILS TEST

   The output columns, DTR and RTS, should contain a binary count from Ø to 3. The diagonal row of zeros in the input section of the table is typical of the correct output. Pass or fail will also be indicated below the table. If an input should fail, the display will stop after the line containing the error is displayed. This gives you an opportunity to troubleshoot the board while failing conditions are still present. To continue the program, press the space bar.

5. **Loop Back data test.** File name is LOOP. This test requires the special test fixture or a jumper wire on pins 2 & 3 of the RS-232 connector (pins 18 & 22 on the E.I. board). When the program is started it first configures the RS-232 interface according to the options selected by the Sense Switches. Then it begins with a space and displays all 65 ASCII characters on one line of the Monitor, continuing until the entire screen has been filled. Upon filling the screen, the program clears the screen and re-reads the Sense Switches. If the switches were changed while the screen was filling, the interface will be reconfigured to reflect the new selection of options. In this way a "quick and dirty" check of baud rate may be made by observing the Monitor. Also note that if the Sense Switches are selecting the 5-bit word option, only 32 characters will be displayed, twice on each line. This program runs until the X key is pressed.

6. **Baud rate test.** File names are PITCH and CATCH. These programs test the data rate of transmission/reception. Two complete systems are required. They are connected between the RS-232 ports with a 3-wire cable at pins 2, 3 & 7. S1 (the DPDT switch) on the interfaces must be in opposite positions. Load the CATCH program first, in either computer. It will listen to the line until data arrives. Now load PITCH into the other computer. A line of characters will be displayed as they are sent to the "catcher". Then the catcher will send the line back to the pitcher and display them as they are sent. If the baud rates are correct, the prompt: 110 BAUD PASSES will be displayed. The "pitcher" and "catcher" will continue until they have tested all baud rates.



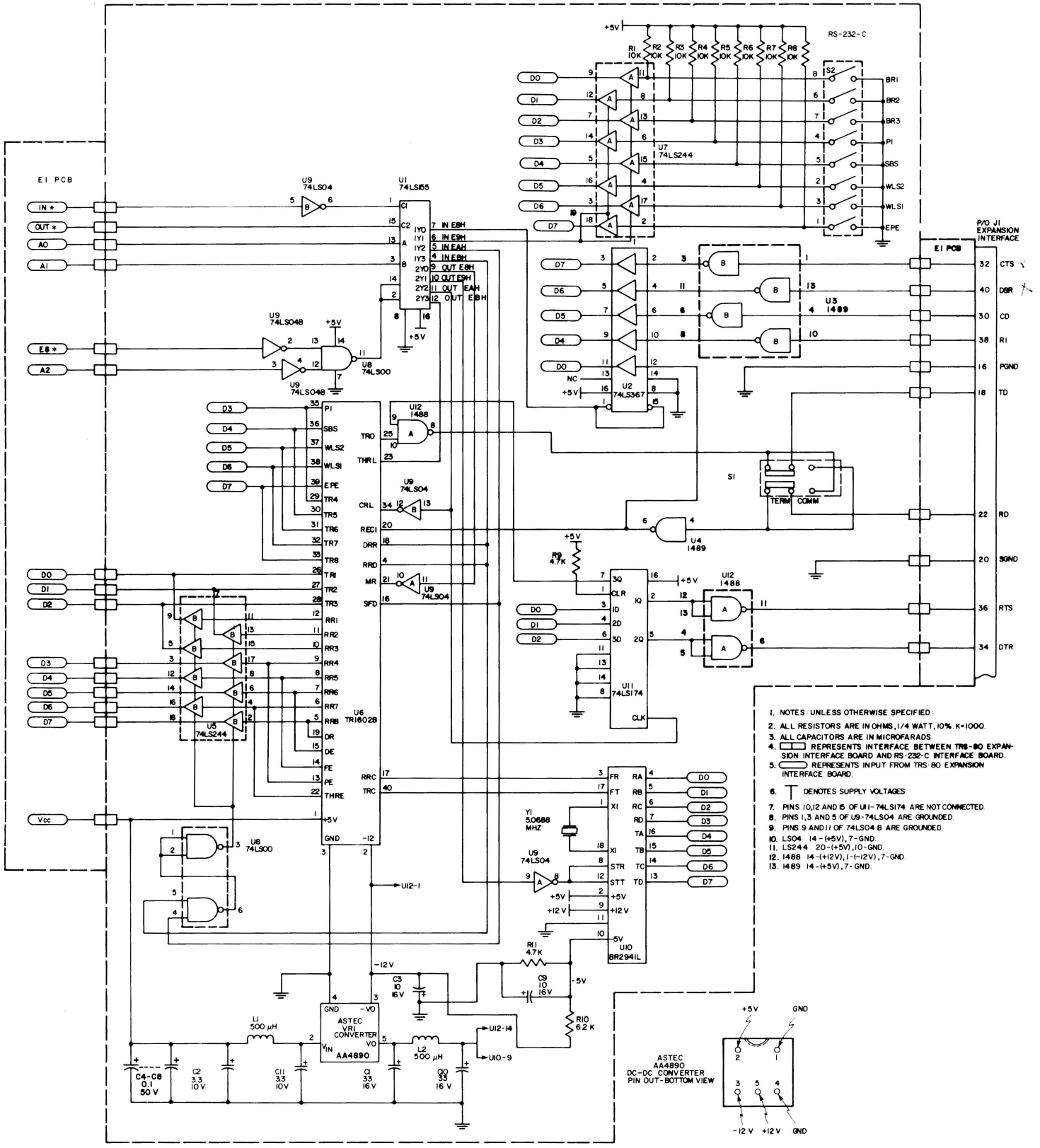
PRINTED CIRCUIT BOARD (Top View)

NOTE: Red indicates printed-through holes.
Light gray indicates foil area on top.
Darker gray indicates foil area on bottom.

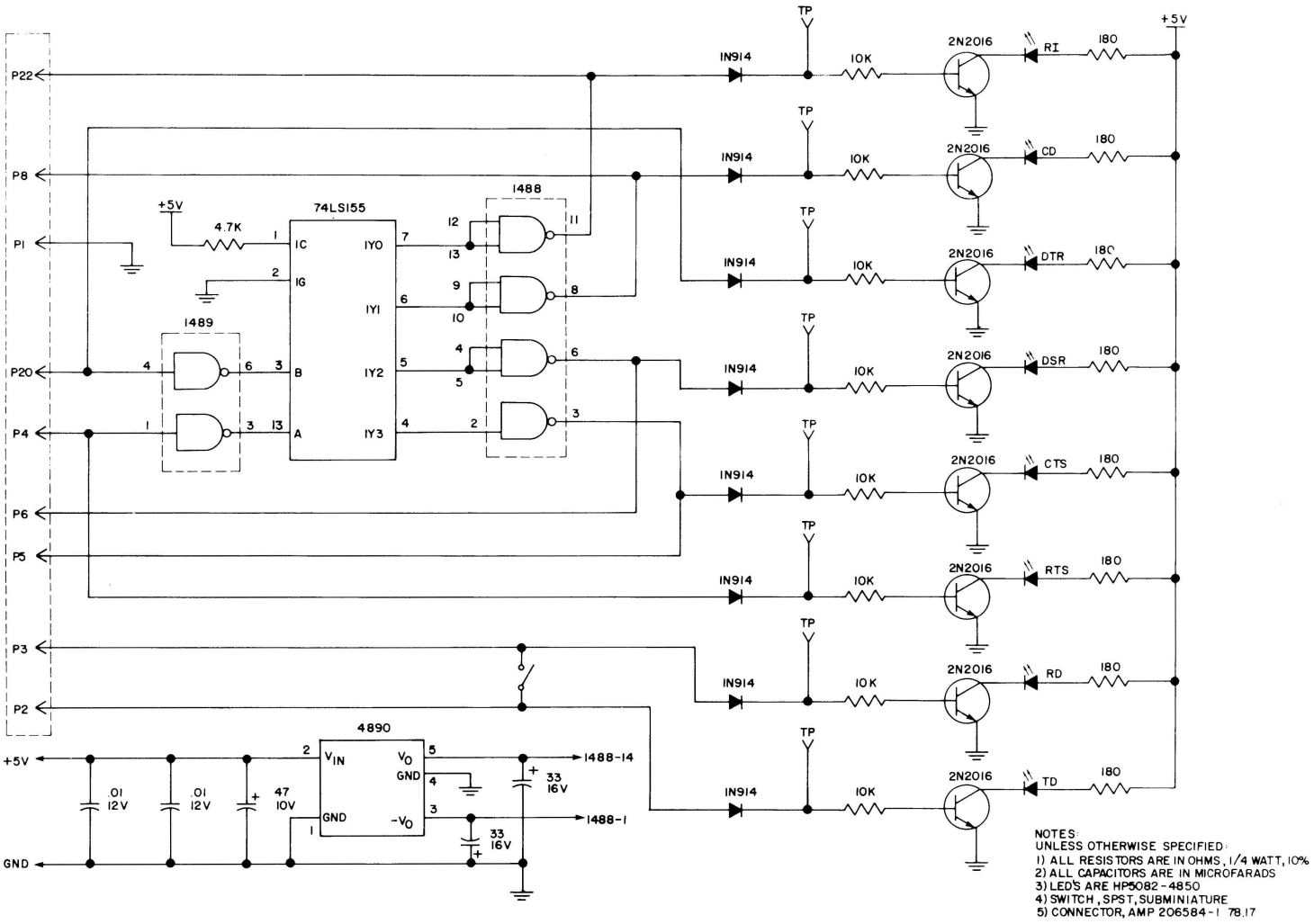
PARTS LIST

Symbol	Description	Part Number
	CABLE	
	RS-232-C, 40 Conductor-to-25 Conductor	
	CAPACITORS	
C1	33 μF, 16 V, Tantalum	8336331
C2	3.3 μF, 10 V, Tantalum	8335331
C3	10 μF, 16 V, Electrolytic	8326101
C4	0.1 μF, 50 V, Ceramic Disc	8304104
C5	0.1 μF, 50 V, Ceramic Disc	8304104
C6	0.1 μF, 50 V, Ceramic Disc	8304104
C7	0.1 μF, 50 V, Ceramic Disc	8304104
C8	0.1 μF, 50 V, Ceramic Disc	8304104
C9	10 μF, 16 V, Electrolytic	8326101
C10	33 μF, 16 V, Tantalum	8336331
C11	3.3 μF, 10 V, Tantalum	8335331
	CHOKES	
L1	500 μH, 0.1 Ω	8419001
L2	500 μH, 0.1 Ω	8419001
	RESISTORS	
R1	10 K, 1/4 W, 5%, Fixed	8207310
R2	10 K, 1/4 W, 5%, Fixed	8207310
R3	10 K, 1/4 W, 5%, Fixed	8207310
R4	10 K, 1/4 W, 5%, Fixed	8207310
R5	10 K, 1/4 W, 5%, Fixed	8207310
R6	10 K, 1/4 W, 5%, Fixed	8207310
R7	10 K, 1/4 W, 5%, Fixed	8207310
R8	10 K, 1/4 W, 5%, Fixed	8207310
R9	4.7 K, 1/4 W, 5%, Fixed	8207247
R10	6.2 K, 1/4 W, 5%, Fixed	8207262
R11	4.7 K, 1/4 W, 5%, Fixed	8207247

Symbol	Description	Part Number
	SWITCHES	
S1	Slide, DPDT	8489005
S2	SPST – 8 Position	8489004
	INTEGRATED CIRCUITS	
U1	74LS155, Dual 2-Line to 4-Line Decoder	8020155
U2	74LS367, Tri-State HEX Buffer	8020367
U3	1489, EIA to TTL Converter	8050189
U4	1489, EIA to TTL Converter	8050189
U5	74LS244, Octal Tri-State Buffer	8020244
U6	TR1602, Universal Asynchronous Receiver/Transmitter	8045602
U7	74LS244, Octal Tri-State Buffer	8020244
U8	74LS00, Quad 2-Input NAND Gate	8020000
U9	74LS04, HEX, Inverter	8020004
U10	BR2941L, Dual Baud Rate Generator	8045941
U11	74LS174, HEX, D Flip-Flop	8020174
U12	1488, TTL to EIA Converter	8050188
	CONVERTER	
VR1	DC-to-DC Converter	8090003
	CRYSTAL	
Y1	5.0688 MHz	8409003
	MISCELLANEOUS	
	Tape, RS-232-C System, TERM	8791012



SCHEMATIC DIAGRAM



TEST FIXTURE, RS-232C

This Schematic is provided to show a simple test fixture which can be constructed to aid in troubleshooting and checking out an RS-232-C.

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