Serial Interface for TV II

To connect TV Typewriter II to a telephone or other two-wire system or to a magnetic-tape memory you need an adequate modem. Here's how to build one

ED COLLE

FOR THE TV TYPEWRITER II TO COMMUNICATE via a two-wire system, a phone line or a magnetic-tape data storage system, the parallel ASCII data must be broken down into sequential one-bit-at-a-time form both when coming out of the keyboard and going into the terminal. The serial interface or UART (*U*niversal *A*synchronous *R*eceiver/*T*ransmitter) provides this conversion from the parallel form into a series of properly timed one's and zero's including not only the serial data, but the start, stop and parity bits as well. The reverse is true during the receive mode. The baud rate or speed at which the serial data is transmitted or received can be selected from 110, 150, 300, 600 or 1200 baud with a single-pole rotary switch. There is a provision for "echo off" where the data is transmitted to the receiver, but is not put up on the screen until it is transmitted back by the receiver and displayed by the terminal; or "echo on" where the data is transmitted and simultaneously put up on the screen and is not echoed back by the receiver.

The input/output connections are type RS-232 compatible which will attach directly to most couplers and data sets, however, to record on or playback from magnetic tape it will be necessary to build some kind of FSK encoder/decoder system to get the digital data on and off the tape since this is not provided by the interface. Data to be transmitted can either be provided by the screen-read board or the keyboard. The interface normally monitors the keyboard, however, a "ready to send" command from the screen board locks out the keyboard and allows the screen-read board to transmit its data.

The entire circuit is built on a 3⅜" × 9½" circuit board that is plugged onto the main board at connector strips J1 and J2 just behind the cursor and screen-read boards. Switch connections to the serial interface board are provided by a 12-pin connector (J1) while the keyboard is plugged into another 12-pin connector (J2) rather than J9 of the main terminal board as is done if the interface board is not used.

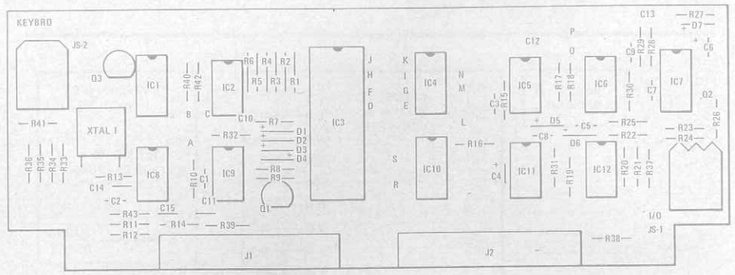


FIG. 2—COMPONENT PLACEMENT diagram.

SPECIFICATIONS

Receive Format:	E1A RS-232 and TTL compatible with a mark equal to + 1.5 to — 25 volts and a space equal to + 3 to + 25 volts. The range from + 1.5 to + 3 is the hysteresis region.
Input Impedance:	1800 ohms
Transmit Format:	E1A RS-232 with a mark equal to — 4.7 volts and a space equal to + 4.7 volts (2000-ohm load)
Baud Rates	
Standard:	110 baud
Optional:	110, 150, 300, 600, 1200—selectable
Stop Bits:	Automatic selection of 2 stop-bits for 110 baud and 1 stop-bit for 150, 300, 600 and 1200 baud
Parity	
7 bit:	odd, even, none
8 bit:	no parity (bit 8 programmable to a 0 or 1)

PARTS LIST

Serial Interface Board—110 baud
All resistors are ¼-watt, 10%, unless noted

R1-R7, R16, R24—22,000 ohms
R8, R15, R17, R20-R22, R29, R31, R37, R39, R42—1000 ohms
R9, R27—47,000 ohms
R18, R38—12,000 ohms
R19—2000 ohms
R23—3900 ohms
R25—27 ohms
R26—2700 ohms
R28—5600 ohms
R30—330 ohms
C3—470 pF capacitor
C4, C6—33 μF, 25 volt electrolytic
C5—.01 μF capacitor
C7—100 pF capacitor
C8—.001 μF capacitor
C9—330 pF capacitor
C10-C13—0.1 μF capacitor
D1-D7—1N4148 silicon diode
Q1—2N5210 silicon transistor
Q2—PNP general purpose transistor, gain = 100, maximum V_{ce} = 40 volts
IC2—7493 counter
IC3—S1883 UART
IC4, IC10—74157 data selector
IC5—74132 quad NAND gate
IC6—7400 quad NAND gate
IC7—74123 dual one-shot
IC9—7474 dual type-D flip-flop
IC11—7404 hex inverter
IC12—7403 quad open collector NAND gate

PARTS LIST

150, 300, 600, 1200 baud option
All resistors are ¼-watt, 10%, unless noted

R10—180 ohms
R11, R13—1800 ohms
R12, R14—470 ohms
R32-R36, R40, R41—1000 ohms
R43—2700 ohms
C1, C14—300 pF capacitor
C2—50 pF capacitor
C15—.005 μF capacitor
Q3—2N5210 silicon transistor
IC1—7497 rate multiplier
IC8—7404 hex inverter
XTAL 1—307.200 kHz series resonant crystal

The following items are available from Southwest Technical Products Corp., 219 West Rhapsody, San Antonio, TX 78216.

CT-S Serial Interface Kit $39.95
S1-b Serial Interface Circuit $11.75
Other add-ons for TVT-II include:
Screen Read Board Kit $17.50
(September 1975 issue)
Manual Cursor Kit $11.50
(November 1975 issue)

How it works

The serial interface circuit has been designed around a single UART chip that actually does most of the work. The other circuitry on the interface board interfaces the chip itself to the circuitry on the main terminal board. The schematic diagram appears in Fig. 1.

During the transmit mode, both the outputs from the keyboard and the screen-read board are fed into data selectors IC4 and IC10. These data selectors select either one of the two sets of inputs with the input from the screen-read board taking priority. Normally the keyboard is selected as the input. However, if the screen-read board starts to send data, the incoming low-to-high transition at J2 pin-13 triggers IC7-a, a retriggerable 350 ms one-shot. This selects the screen-read inputs and locks out the keyboard by driving pin 1 of IC4 and IC10 low. It also blocks any data from being received during a screen read operation if the jumper from S to R is installed by forcing pin 8 of IC9-a low. This gates the "output data available" line into the "reset data available" line of the UART chip. Since the keyboard and receiver are disabled for at least 350 ms after

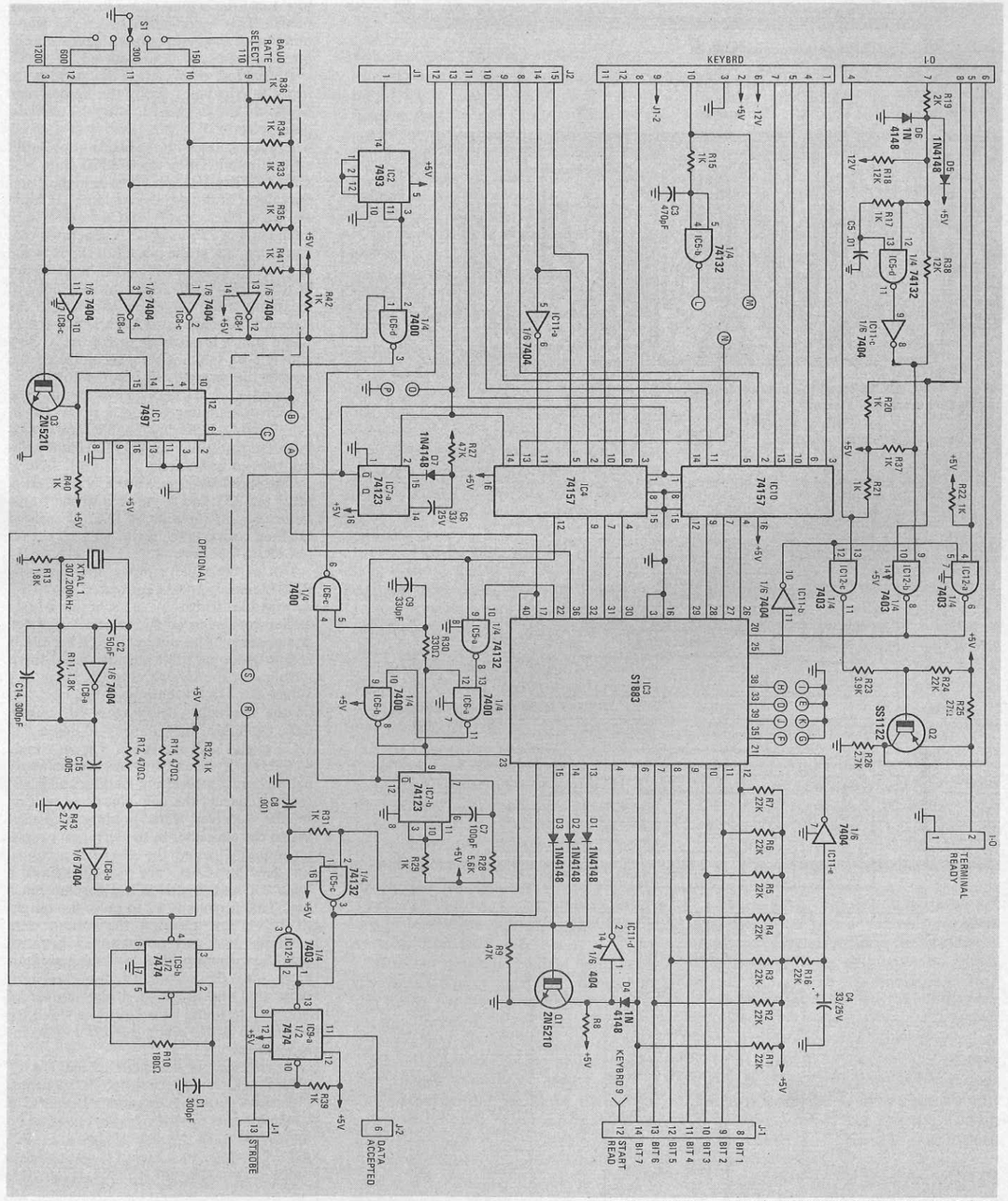


FIG. 1—SERIAL INTERFACE OPTION for TV Typewriter II.

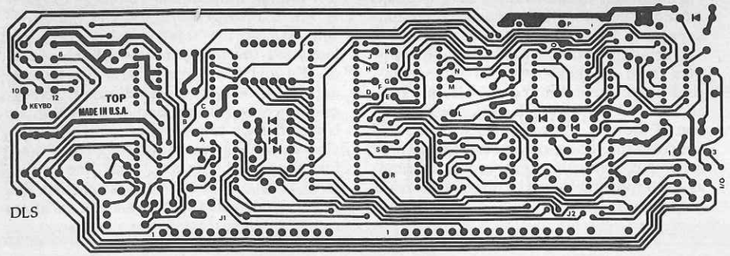


FIG. 3—FOIL PATTERN of component side of double sided board shown ½ size.

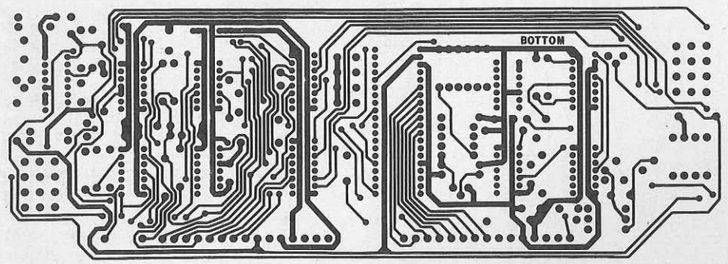
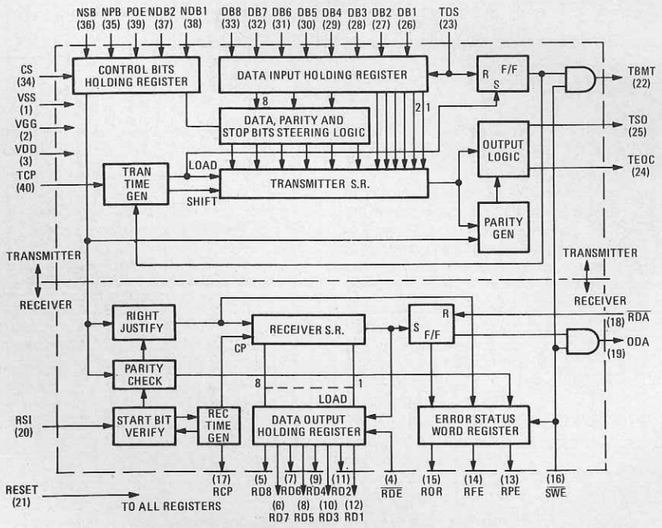


FIG. 4—FOIL PATTERN of foil side of double sided board shown ½ size.



each character is dumped during a screen-read operation, there may be problems with a computer sending a return message too soon after the screen-read operation is completed, especially when using high baud rates. In these situations, you may not want to lock out the receiver during a screen-read transmission and can omit the jumper between points S and R. You must be sure, however, that the TV Typewriter II is not in the echo mode and that the computer does not attempt to send data to it until the screen dump has been completed. This is indicated by an "!" transmission if the auto-stop function on the screen read-board is being used.

Regardless of whether the data to be transmitted comes from the screen-read board or the keyboard, it exits from the data selector IC4 pin-12 to IC5-a pin 9 where it is gated with the transmitter buffer empty output from the UART chip, IC3 pin 22. When IC3 pin 22 goes high, it sets the output of the AND gate latch (IC6 pin 11) high. Each time this (IC6-a and IC6-b) latch is set, a 250-ns pulse is generated that loads the data at the output of the IC4 and IC10 data selectors into the input buffer of the UART chip. At the trailing edge of the same pulse, a pulse is supplied to the screen read board until it resets and forces IC6-a pin 9 low which resets the (IC6-a and IC6-b) latch. This reset pulse that is sent to the screen-read board allows it to find and store its next character until the UART transmitter buffer is ready for it. This double buffering enables the transmitter to transmit at up to 1200 baud without gaps or hesitations.

The serial data leaves the UART chip, (IC3 pin 25) and is gated with the transmitter on/off input at IC12-c. Transistor Q2 then converts the serial TTL level output to RS-232 format.

During the receive mode, the incoming RS-232 serial data is converted into TTL compatible levels by a Schmitt trigger circuit consisting of IC5-d and its related components. The output at IC11-c pin 8 is then gated and fed into the serial input terminal of the UART chip (IC3 pin 20.) When the UART chip sees the stop bits of the character being received, output data available line changes to logic "1" (IC3 pin 19). If IC9-a pin 8 is at a logic "1" level, it means the terminal already has a character awaiting loading and is not ready to accept the new character waiting in the receiver data holding registers. When the character in the terminal's register is finally loaded, the character accepted line feeding IC9-a (pin 11) changes to a logic "0" and toggles IC9-a forcing pin 8 low. This permits IC12 to pulse the output of IC5-c low clearing the output data available line and generating a negative going keypress strobe to load the new character into the terminal's data registers. Note that the keypress strobe jumper of the main terminal board must be wired for a negative strobe when the serial interface is being used.

If an error is detected by the UART chip, it drives one of three IC3 outputs high. IC3 pin 14 changes to a logic "1" if a stop bit does not follow after the start bit and the correct number of data bits. IC3 pin 13 changes to a logic "1" if there is a parity error received. IC3 pin 15 changes

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R-E's Service Clinic

Horizontal oscillators

Oddball symptoms

by JACK DARR
SERVICE EDITOR

THE RECENT SERVICE CLINIC ABOUT horizontal oscillator circuits got quite a bit of mail. Mainly requests for more information on this circuit. So, here it is. Let's look at some of the oddball symptoms you will find. With a little cool, logical thinking, you can get a handle on any of them.

OK, here's one; an oldie. When the antenna signal is applied to the receiver, the horizontal oscillator runs and you get a raster. Horizontal hold isn't too good. Turn to a dead channel or remove the antenna signal and out goes the raster and high voltage! Or, just the opposite. Raster off-channel, no raster with an antenna signal. (*Not* to be confused with an AGC blackout. If this happens, you do have high-voltage, but the tube is cut-off.) Weird, eh? Not too. The problem is in the *horizontal AFC*.

Why? Because the *only* difference between the two conditions is the presence or absence of the horizontal *sync*. In the first case, the horizontal oscillator will run when there is sync, but won't run without it. In the opposite case, the oscillator will run if the sync is not present; when the sync appears, this throws the oscillator so far off that it dies!

The major cause of this is a defective AFC diode unit. Sometimes due to a bad part in the anti-hunt circuit, etc., but mostly the diodes. To check, kill the AFC and see if this will keep the oscillator running, on- and off-channel.

In one really wild case, in an old Philco, the horizontal sync wasn't too bad but the vertical sync was terrible. After checking out the vertical circuits, I finally found that the ground-side of the *horizontal* AFC diode was shorted! This was pulling down the amplitude of the composite sync and upsetting the vertical oscillator first.

Another puzzler (unless you know it's there) comes up in sets using only the boost for the plate voltage supply of the horizontal oscillator. Figure 1 shows a typical example, an Admiral T2H-1A chassis. The complaint is often "no raster" or "narrow raster".

The horizontal oscillator plate voltage will be well below normal. Here, note that there is no direct path from the horizontal oscillator supply back to the B+. Oh, no? There is, if you'll trace it out. When the set is turned on, the DC voltage appears immediately, since solid-state diodes are used in the DC power supply, However, the damper tube must warm up enough to conduct current before any DC voltage shows up on the oscillator.

Without any output signal from the horizontal output stage, only the B+ voltage appears on the damper cathode.

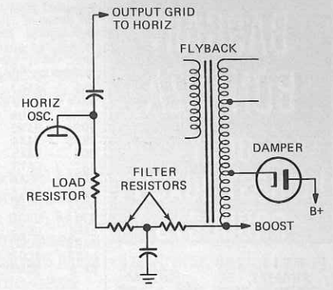

FIG 1

This is connected to the oscillator plate through two resistors. There will be enough voltage to *start* the oscillator. Once it starts running, it drives the horizontal output stage, producing a flyback pulse. This pulse is rectified by the damper tube, producing a much higher voltage, and everything starts to work.

If you have this kind of trouble, check the *boost* voltage. The boost capacitor is returned to ground instead of to B+. It develops about +340 volts DC. If you measure only the B+ voltage of about +135 volts, you have no boost at all. A good check for this is to drive the horizontal output with a substitute drive signal.

If the boost voltage and high-voltage appears, then you have some problem in those resistors feeding the horizontal oscillator. If you still have no boost, check things like the boost capacitor, the horizontal winding of the deflection yoke, and the damper and horizontal output tubes. In one odd variation of this, I found 0 V DC on the damper cathode. This turned out to be an open cathode connection inside the damper tube! You should see the B+ voltage here before the horizontal output tube starts to work.

In another queer case, in an RCA CTC-53, the raster and high-voltage

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to a logic "1" if there is a condition where the receiver is being sent characters faster than it can accept them. If any one of these three error conditions occurs, transistor Q1 turns on and presents a "?" to the terminal as an error indication for the character(s) for which the error was received.

The standard baud rate for the unit is 110 baud and is derived from the 15,840 Hz phase-locked oscillator on the main board that is brought in through pin 1 of J1. The 15,840 clock frequency is divided-by-nine by IC2 to produce 1760 Hz required by the UART chip for 110 baud. For higher baud rates, a crystal oscillator with a 307.200 kHz crystal is required as well as IC1 and IC8. Inverters IC8-a and IC8-b form an oscillator with a frequency of 307.200 kHz that is fed to flip-flop IC9-b pin 4 where it is divided by two and in turn fed to a programmable divider, IC1 pin 9. By selecting correct inputs of this integrated circuit, the correct output frequency neccesary for each baud rate can be easily set. A five position rotary switch can be attached at jack J1 that grounds the selected baud rate line providing easy selection of either 110, 150, 300, 600 or 1200 baud. The 110-baud input inverter (IC8-f) also drives the stop bit select line of the UART chip, IC3 pin 36, to select the correct number of stop bits for 110 baud operation.

A terminal ready signal is provided at J1 pin 2 to tell external devices when the terminal is powered up, however, this output is a sense line only and should not be loaded when anything sourcing or sinking a current of more than 5 mA.

A power-up reset is provided by IC11-e to clear the registers inside the UART chip when power is applied to the terminal.

Construction

It is not very difficult to assemble the unit, just be sure to orient all of the integrated circuits, diodes, electrolytic capacitors, transistors, and connectors as shown in Fig. 2. Note that the connectors are notched and must be installed exactly as shown in the drawing. The foil pattern of the component side of the double sided printed circuit board is shown in Fig. 3, while the foil pattern of the foil side of the board is shown in Fig. 4. If you use the 150, 300, 600 or 1200 baud option, install the parts used for the crystal controlled oscillator and its related circuitry. Also attach a jumper between points A and C on the interface board. The various baud rates are selected by grounding the appropriate pin of connector J1. If you are not using the optional baud rates and wish to use the standard 110 baud then attach a jumper between points A and B instead of A and C on the interface board.

Without the screen-read board inserted on the TV Typewriter II main terminal board it will be necessary to jumper point O to P on the interface board. With the screen-read board installed on the main terminal board, omit the jumper.

If you want to guarantee that the receiver remains off during a screen-read dump, you will probably want to jumper point S to R on the interface board. If high baud rates are used and/or the turnaround time from whatever feeds the terminal is fast you may have to omit this jumper. If so, you must be sure the terminal is not in the echo mode and that whatever feeds the receiver of the terminal doesn't transmit during the time a screen-dump operation takes place.

It is also necessary to program the interface board for the correct parity and number of bits to be handled. The transmit and receive formats are identical and are programed with jumpers as follows:

Odd parity, no bit 8—jumper J to K and jumper I to H
Even parity, no bit 8—jumper I to H
No parity, no bit 8—jumper G to F and jumper I to H
No parity, bit 8 = 1—jumper G to F
No parity, bit 8 = 0—jumper G to F and jumper E to D

The appropriate keypressed strobe jumper should be installed. If your keyboard's strobe is positive going and narrow or if it is negative going and the data is held for at least 100 nanoseconds after the trailing edge of the strobe pulse, solder a jumper wire between pads L and N. Almost all keyboards will work in this configuration. Jumpering pad M to N instead is used for positive edge level triggering where the pulse is clean and there is no ringing. The board must not be wired for a positive keypressed strobe (M to N) if the screen-read board is used.

Before plugging the interface board into the main terminal board, be sure to insert the indexing key in J2 pin 2 to prevent the board from being plugged in backwards. Then orient the interface board so its component side is toward the center of the main terminal board and plug it into connectors J1 and J2.

Input/output and control lines for the interface are accessed thru connector J1. J1 pin 7 is the RS-232 compatible input and J1 pin 6 is the RS-232 compatible output. Pin 2 of J1 is a terminal ready status line that is high when power is applied to the terminal. You must be sure not to draw more than 5 mA from this pin when sensing this line. J1 pin 5, pin 4 and pin 8 control the receiver off, transmitter off and echo off, respectively. Grounding the respective control line shuts off the selected function and J1 pin 1 is ground. Note that when the serial interface board is used, the keyboard must be plugged into jack J2 on the interface rather than the J9 connector on the main terminal board on the chassis.

Checkout and use

The easiest way to check the unit out is to operate it in the echo mode and the receiver and transmitter switched off. This should display everything that is typed on the screen where it can be seen and checked. Since this mode uses both the transmit and receive circuitry, it is a good way to check everything on the interface for proper operation. If you have any problems, remove power and check carefully for assembly errors. If you find it necessary to troubleshoot the circuit, you will need an oscilloscope, a good background in digital theory and a thorough knowledge of how the unit operates. **R-E**