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HI-FI – STEREO SPECTACULAR

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tering. But this isn't really such a big worry, because when a set of new transistors are installed, the amplifier is off and the filter capacitor is not charged. If a short exists, then as the equipment is turned on the fuse will trip long before the filter capacitor has time to charge. (The typical technician gets around this problem by using a Variac and an ammeter in series with the equipment load. The line voltage is increased and the ammeter is carefully monitored. A sudden rise in the current as the voltage is increased indicates a short. As quick as possible the technician switches the Variac off, but often he is too late and the damage is permanent.) In over 1½ years of service, the fuse has "saved" many replacement transistors from biting the dust. In most cases, devices that are normally on and develop shorts will be protected from damage.

The electronic fuse is not only restricted to high current (3 amp RMS) operation, it also may be used to protect low-current devices such as portable phonographs and low-power (5-15 watt) audio amplifiers. For example, to protect the components of a 120-volt, 12-watt amplifier, first calculate the current level that will trip the fuse. This is found from the equation:

$$I_{RMS} = P_{max}/120 \text{ volts}$$

For the example cited above; $I_{RMS} = 12/120 = 100$ mA. Now adjust the fuse to limit at this current by calculating the proper resistance of R9 (see Fig. 2):

$$R9 = 1/I_{RMS} \; (R9 \leq 10 \text{ ohms})$$

For our example, $R9 = 1/.1 = 10$ ohms. To check the power rating for R9, use the formula:

$$P = 1.96/R9$$

The power consumption of R9 is: $P = 1.96/10 = .196$ watts. Thus R9 should be a ¼ watt resistor.

A DEFEAT switch on the front panel of the Electronic Fuse is used to override normal operation and apply line current directly to the equipment. This is useful when you are making a test and can't tolerate the 5-volt drop across the fuse or when you expect large current surges and don't want the fuse to limit.

Circuit description

When the Electronic Fuse isn't in the current-limit mode, current flows from the AC line, through the equipment load, the full-wave bridge rectifier, 3 stage Darlington and back to the AC line (see Fig. 2). Diodes D1 through D4 make up the bridge rectifier and conduct on alternate cycles of the 60-Hz line voltage. This produces a 120-Hz pulsating DC voltage that is applied across the collector and emitter of the Darlington circuit. Resistor R9, in the emitter leg of the final stage of the Darlington (Q3) develops a voltage waveform that follows the instantaneous load current.

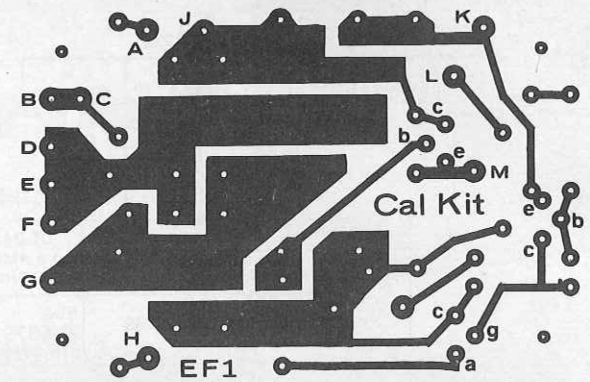


FIG. 5—FOIL PATTERN of printed circuit board.

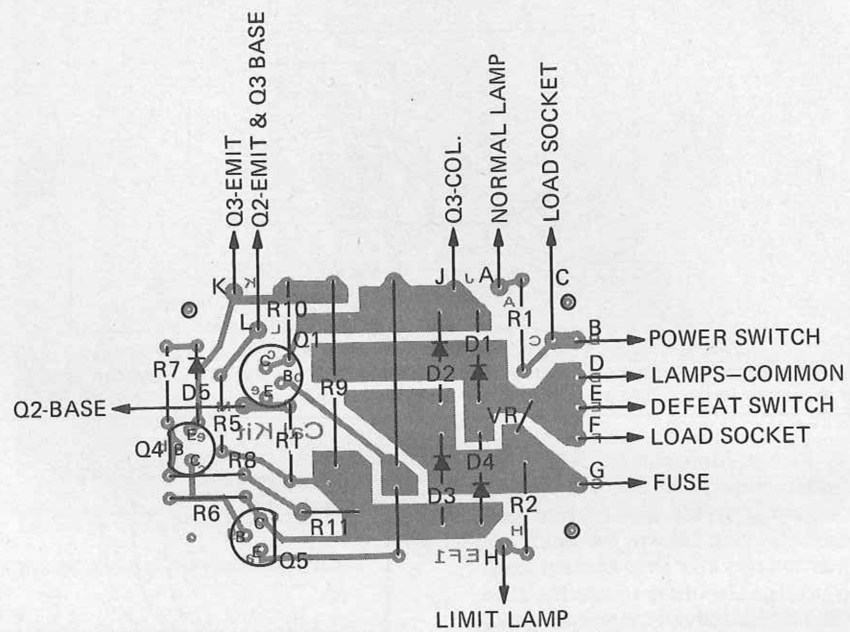


FIG. 6—COMPONENT PLACEMENT diagram for the Electronic fuse.

Transistor Q4 and its associated components make up a temperature-compensated inverter amplifier that senses when the voltage across R9 reaches the trip-point of the fuse and triggers SCR Q5. When the SCR conducts, the base voltage of Q1 is lowered, thus turning it off. This in turn shuts off Q2 and Q3. The voltage across R10 produces positive feedback that turns Q1, Q2, and Q3 off in under 10 microseconds.

Any inductive spike or transient due to the fast switching speeds is absorbed by varistor VR1. A varistor is similar in operation to two back-to-back Zener power diodes and produces excellent low-cost protection for the switching transistors. Trimmer R11 is used to adjust the trip point of the fuse by adjusting the threshold voltage of the temperature-compensated inverter amplifier. This stage may appear rather strange at first. What is odd is that V_{cc} for Q4 is developed from the same signal used to trigger Q4. The overall operation of Q4 is such that it functions like a diode with an adjustable offset. The transfer function of Q4 shows this more clearly (see Fig. 3).

The voltage waveforms of the Electronic Fuse shows what happens as the fuse goes from normal operation to the current-limiting condition. The voltage waveforms are shown in Fig. 4.

Construction

There are a number of ways to construct the circuit—Vector board, point-to-point wiring, etc. However, a printed circuit board (see Fig. 5) will allow the varistor and diodes to be heat-sinked by the copper foil. A finished board is available from the supplier shown in the parts list. The component placement for the printed-circuit board is shown in Fig. 6.

The diodes should be heat-sinked at 60° centigrade per watt and the varistor at 40° centigrade per watt. Mount the 5-watt resistors, R9 and R3, as far from transistors Q4 and Q5 as possible. Power transistors Q2 and Q3 are mounted on a sheet of 4 × 4 × ⅛"

(continued on page 91)

ASCII to BAUDOT

Build this converter to connect your TV Typewriter or Mark-8 Minicomputer to a teletypewriter for a hard-copy print-out

ROGER L. SMITH

MANY HAM RADIO OPERATORS HAVE PUT THE older model Teletype[R] and Kleinschmidt page printers to work for print-out (they call it RTTY). With the present increase of digital equipment in the homes of other electronic enthusiasts, the use of these older machines for "hard-copy" print-out has spread. The Kleinschmidt models TT100 and TT117 and Teletype models 32, 28, 26, 19, 15, etc., are presently available at prices from $20 up which puts them within reach of anyone.

Hobbyists have built micro-computers and TV Typewriters for their home use and many now want a printer of some type. Many Ham radio operators already own an older Teletype and have now added a TV Typewriter. However, they are faced with one big problem—the older printers operate from the 5-level BAUDOT code while newer equipment uses the ASCII code! So how can you hook an ASCII coded device to a BAUDOT machine? Microcomputer owners can write a program to handle the problem in software, but the conversion is not so simple for those without a computer. In addition, even the computer owners would like a conversion device to save them programming routines. For this reason, the circuit described here was made compatible with the Mark-8 Minicomputer (**Radio-Electronics**, July 1974) as well as both TV Typewriters (**Radio-Electronics**, Sept. 1973 and Feb. 1975), and most Ham gear.

Some of the ROM (*R*ead-*O*nly *M*emory) manufacturers explain how to convert from BAUDOT to ASCII by using a ROM and several NAND gates. Converting from ASCII to BAUDOT however, is much more complicated. The complication arises because the BAUDOT machines have two special function keys not required on ASCII equipment. These are the FIGURES key that shifts the mechanism to the upper case characters, and the LETTERS key that shifts the machine back to the lower case. Without these keys, the 5-bit code would be capable of handling only 32 characters and functions. Perhaps now you can see what would happen if ASCII encoded characters were fed to a BAUDOT machine. Your print-out would have to be all letters or all figures and punctuation since there would be no way to shift the machine.

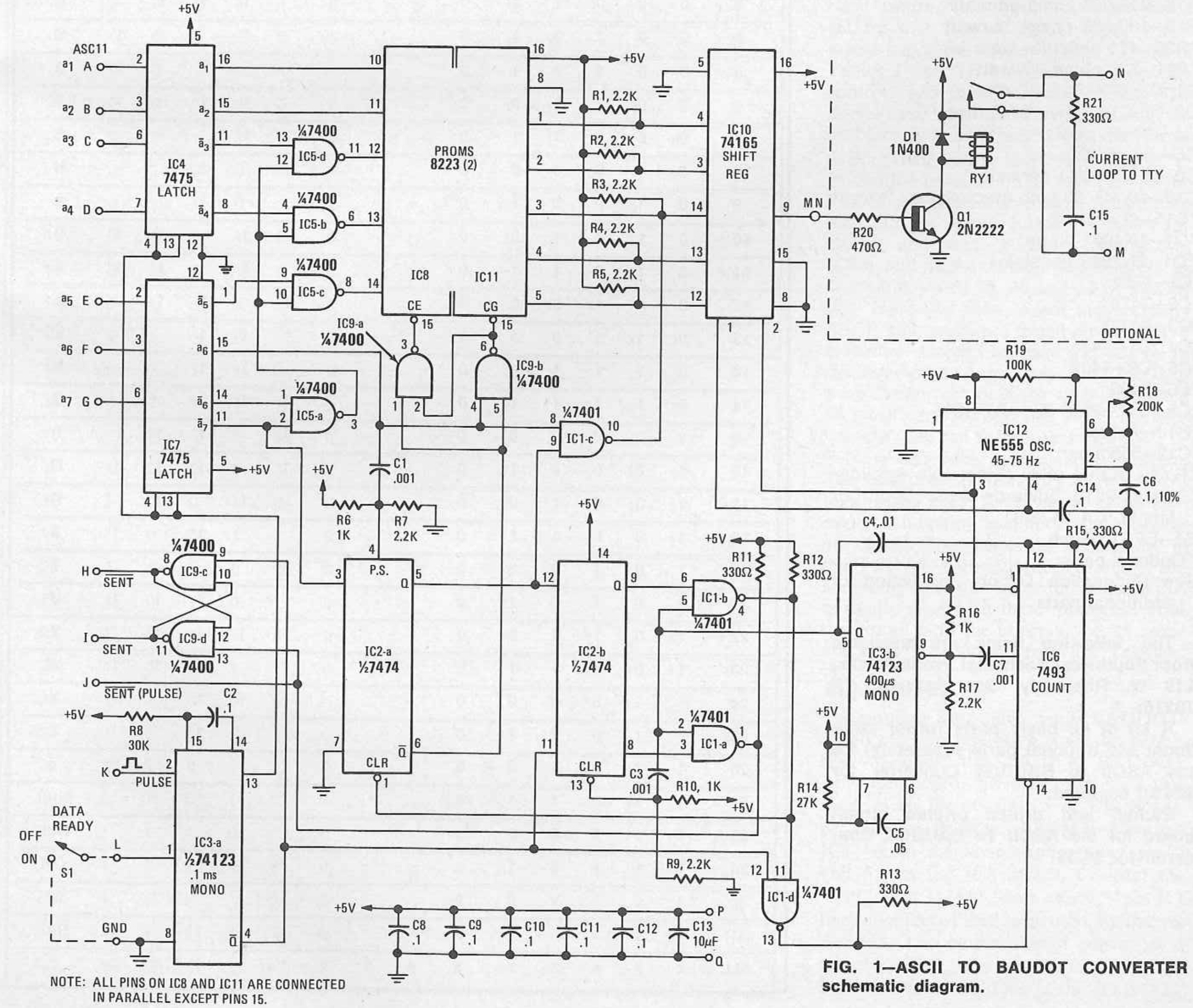


FIG. 1—ASCII TO BAUDOT CONVERTER schematic diagram.

One solution to the problem would be to look at each incoming ASCII character, determine whether it is upper or lower case, generate the correct shift character (FIGURES or LETTERS), and then generate the correct BAUDOT encoded character. As you can see, if you typed a whole page of letters, it would take twice as long as normal for the machine to type this page because each character would be preceded by a shift character.

A better solution is to detect when there is a *change* in the incoming ASCII characters (from one level to the other) and generate the proper shift character *only* when there is a change. The first circuit described here does just that and, of course it converts the ASCII character to Baudot thru the use of a special PROM (actually 2 PROM's for reasons of economy). You will have to program your own PROM's because ASCII to BAUDOT ROM's are not available.

ASCII to BAUDOT converter

Nearly all BAUDOT-encoded machines will operate at speeds from 60 to 100 words-per-minute (a word is 6.1 characters). This represents a transmission time of 163 to 100 milliseconds per character. This means our output oscillator which determines the transmission speed (IC12 in Fig. 1) must be tuned to match the machine speed to some frequency between 45 Hz. and 75 Hz. (more on this adjustment later). We can't set the ASCII input rate at 60 or 100 words-per-minute because occasionally one of the BAUDOT output characters will be one of the shifts not present in the ASCII input code. The solution is to use a "handshake" arrangement where the BAUDOT machine tells the ASCII device when it is ready to accept another character. This assumes the BAUDOT machine is the slower of the two.

The schematic diagram of the ASCII to BAUDOT converter is shown in Fig. 1. Monostable multivibrator IC3-a is enabled when switch S1 is placed in the ON position. Next, the input ASCII data is received along with a "data ready" pulse. The "data ready" pulse generates a 1-ms pulse from IC3-a pin 4 that stores the ASCII character in IC4 and IC7.

If bit-6 or bit-7 of the ASCII character are different than these bits of the previous character, then flip-flop IC2-a is set. This disables the outputs of the PROM's (IC8 and IC11) causing them to go high (BAUDOT 11111). If input ASCII bit-6 was a "0" (indicating a LETTER character), then gate IC1-c is disabled and all BAUDOT output bits are "1". If input ASCII bit-6 was a "1" (indicating a FIGURE), then IC1-c is enabled and BAUDOT bit-3 becomes a "0". Therefore, we have generated either the BAUDOT LETTER shift-character (11111) or the FIGURE shift-character (11011).

After the BAUDOT shift character has been generated, the output of IC3-a will return to a logic "1", storing the contents of flip-flop IC2-a into IC2-b and setting a single flip-flop in IC6 (pin 12 goes high). Counter IC6 contains three additional flip-flops connected to count from 0 thru 7, which is used to count the BAUDOT output shift-register clock pulses and stop oscillator IC12 after 7½ bits have been shifted out. When IC6 pin-12 goes high, shift-register IC10 changes from the "load" to the "shift" mode and oscillator IC12 clocks IC10 and IC6.

After the BAUDOT shift-character has been clocked out, single-shot IC3-b is triggered by counter IC6. Single-shot IC3-b clears IC6 to "0", stopping oscillator IC12 and returning shift-register IC10 to the "load" mode. Flip-flop IC2-a is cleared by single-shot IC3-b via gate IC1-b which enables PROM's IC8 or IC11. At the end of the 400-μs pulse from IC3-b, gates IC1-b and IC1-d set the single flip-flop in IC6 and the BAUDOT character from IC8 or IC11 is clocked out of the shift register IC10. At the end of the character output, IC3-b generates another 400-μs pulse that passes thru gate IC1-a generating the "sent" signal for the next character. Note that three different "sent" signals are available. If the input device is a computer, this "sent" signal could serve as the "interrupt" signal.

If the next character received at the input is also a LETTER (or FIGURE as the case might be), then flip-flop IC2-a will not be set and the only character sent to the output shift register IC10 will be the BAUDOT-coded character generated by the PROM's. The only time two BAUDOT characters (a shift and a print character) are transmitted for one ASCII input character is when the input changes from a LETTER to a FIGURE or vice versa. Therefore, if you printed nothing but LETTERS, the BAUDOT and ASCII devices would operate at the same number of characters-per-second.

Now that we have the circuit operating properly, all that remains is to determine the truth tables for the PROM's. If we did not require use of control functions (carriage return, line feed, bell), we could get by with a 6-bit ASCII input which would match the 6 input PROM's (refer to Tables 1 and 2). However, we need the controls and therefore, the 7th bit. The easiest way (fewest IC's) to handle the problem is to add $\overline{\text{NAND}}$ gate $\overline{\text{IC5-a}}$ to detect when both bits $\overline{a6}$ and $\overline{a7}$ are "1" (a control function) and then change the PROM address to an unused location to read out the stored BAUDOT codes for CR, LF and BELL. NAND gates IC5-b, IC5-c and IC5-d change the address as desired to words 29, 30 and 31 of PROM IC8. Note that these words are normally ASCII characters not found on BAUDOT machines. Hopefully, they will not be in the received message. Two 8223 PROM's were chosen not only for their combined 64 word capacity and *low price*, but also because they can field-programmed.

Now let's look at the output section. The output of shift register IC10 (pin 9) is normally high, so transistor Q1 is normally conducting and the relay contacts are closed. This means the magnet coil in the Teletype is energized, provided it has some source of power for the 20 to 60 mA normally used with these machines. Thus the circuit is in the normal "mark" mode and there is no output from the Teletype.

Adjustments

Assuming you have your BAUDOT-coded machine operating properly, here is how to adjust the ASCII to BAUDOT converter board. First, be sure your machine is set for 60, 66, 75 or 100 words-per-minute. Remove PROM's IC8 and IC11 from the board and ground pin 5 (bit 5) on the IC8 socket. Connect the "sent" (pin I) and "data ready" (pin K) lines together. Place switch S1 to the ON position. The output should consist of a start bit ("0"), four mark bits ("1"), and a space ("0") bit. This is the BAUDOT

PARTS LIST
ASCII TO BAUDOT CONVERTER

R1—R5, R7, R17—2200 ohms, ¼ watt
R6, R10, R16—1000 ohms, ¼ watt
R8—30,000 ohms, ¼ watt
R11, R12, R13, R14—330 ohms, ¼ watt
R14—27,000 ohms, ¼ watt
R18—200,000 ohms, trimmer
R19—100,000 ohms, ¼ watt
*R20—470 ohms, ½ watt
*R21—330 ohms, ½ watt
C1, C3, C7—.001 μF, disc
C2, C8-C12, C14—.1 μF, disc
C4—.01 μF, disc
C5—.05 μF, disc
C6—.1 μF, 10%, ceramic
C13—10 μF, 25 volt, electrolytic
*C15—.1 μF, disc
*D1—1N4001 diode
*Q1—2N2222 transistor
IC1—7401
IC2—7474
IC3—74123
IC4, IC7—7475
IC5, IC9—7400
IC6—7493
IC8, IC11—8223 32 × 8 PROM
IC10—74165
IC12—555 timer
*RY1—1A5AH relay (Electronic Applications, 2213 Edwards Ave., South El Monte, CA 91733)
S1—SPST switch
*Optional parts
See Connection Details for listing of additional parts

The following items are available from Southwest Technical Products Co., 219 W. Rhapsody, San Antonio, TX 78216:

A kit of all basic parts (order additional and optional parts separately) for the ASCII to BAUDOT Converter for $24.50 postpaid.

Etched and drilled printed circuit board for the ASCII To BAUDOT Converter for $4.35.

TABLE I
TRUTH TABLE FOR 8223 PROM—TO BE USED AS IC8
Check that the symbols given here agree with your machine

WORD	INPUTS						OUTPUTS								SYMBOL
	A_4	A_3	A_2	A_1	A_0	ENABLE	B_7	B_6	B_5	B_4	B_3	B_2	B_1	B_0	
0	0	0	0	0	0	0									Null
1	0	0	0	0	1	0							1	1	A
2	0	0	0	1	0	0				1	1			1	B
3	0	0	0	1	1	0					1	1	1		C
4	0	0	1	0	0	0					1			1	D
5	0	0	1	0	1	0								1	E
6	0	0	1	1	0	0					1	1		1	F
7	0	0	1	1	1	0				1	1		1		G
8	0	1	0	0	0	0				1		1			H
9	0	1	0	0	1	0						1	1		I
10	0	1	0	1	0	0					1		1	1	J
11	0	1	0	1	1	0					1	1	1	1	K
12	0	1	1	0	0	0				1			1		L
13	0	1	1	0	1	0				1	1	1			M
14	0	1	1	1	0	0					1	1			N
15	0	1	1	1	1	0				1	1				O
16	1	0	0	0	0	0				1		1	1		P
17	1	0	0	0	1	0				1		1	1	1	Q
18	1	0	0	1	0	0					1		1		R
19	1	0	0	1	1	0						1		1	S
20	1	0	1	0	0	0				1					T
21	1	0	1	0	1	0						1	1	1	U
22	1	0	1	1	0	0				1	1	1	1		V
23	1	0	1	1	1	0				1			1	1	W
24	1	1	0	0	0	0				1	1	1		1	X
25	1	1	0	0	1	0				1		1		1	Y
26	1	1	0	1	0	0				1				1	Z
27	1	1	0	1	1	0									Null
28	1	1	1	0	0	0									Null
29	1	1	1	0	1	0					1				CR
30	1	1	1	1	0	0							1		LF
31	1	1	1	1	1	0						1		1	Bell
ALL	x	x	x	x	x	1	1	1	1	1	1	1	1	1	

TABLE II
TRUTH TABLE FOR 8223 PROM—TO BE USED AS IC11
Check that the symbols given here agree with your machine

WORD	INPUTS						OUTPUTS								SYMBOL
	A_4	A_3	A_2	A_1	A_0	ENABLE	B_7	B_6	B_5	B_4	B_3	B_2	B_1	B_0	
0	0	0	0	0	0	0						1			Space
1	0	0	0	0	1	0					1	1		1	!
2	0	0	0	1	0	0				1				1	"
3	0	0	0	1	1	0				1		1			#
4	0	0	1	0	0	0					1			1	$
5	0	0	1	0	1	0									Null
6	0	0	1	1	0	0				1	1		1		&
7	0	0	1	1	1	0					1		1	1	'
8	0	1	0	0	0	0					1	1	1	1	(
9	0	1	0	0	1	0				1			1		)
10	0	1	0	1	0	0									Null
11	0	1	0	1	1	0									Null
12	0	1	1	0	0	0					1	1			,
13	0	1	1	0	1	0							1	1	-
14	0	1	1	1	0	0				1	1	1			.
15	0	1	1	1	1	0				1	1	1		1	/
16	1	0	0	0	0	0				1		1	1		0
17	1	0	0	0	1	0				1		1	1	1	1
18	1	0	0	1	0	0				1			1	1	2
19	1	0	0	1	1	0								1	3
20	1	0	1	0	0	0					1		1		4
21	1	0	1	0	1	0				1					5
22	1	0	1	1	0	0				1		1		1	6
23	1	0	1	1	1	0						1	1	1	7
24	1	1	0	0	0	0						1	1		8
25	1	1	0	0	1	0				1	1				9
26	1	1	0	1	0	0					1	1	1		:
27	1	1	0	1	1	0				1	1	1	1		;
28	1	1	1	0	0	0									Null
29	1	1	1	0	1	0									Null
30	1	1	1	1	0	0									Null
31	1	1	1	1	1	0				1	1			1	?
ALL	x	x	x	x	x	1	1	1	1	1	1	1	1	1	

CONNECTION OF ASCII TO BAUDOT CONVERTER

TV Typewriter I

*Add a new 2524 IC to the Memory board. Piggyback the new 2524 on top of IC4 by first bending pins 2 and 6 straight out from the new IC. Pinch the remaining pins together slightly (1 toward 8, 4 toward 5 etc.), so the IC will make physical contact with IC4's pins and only pins 4 & 8 will need soldering (just a very light touch). Tack on a 2.2K resistor from pin 6 to common of R1 through R5 (+5V) and a 6.8K from pin 2 to bus on pin 4 (−5V). Add jumper wires from pin 6 of IC to pin 2 on PC board and from pin 2 of IC to pin 46 of board.

*Also on the memory board, cut the foil to pin 52 of the board and add a SPST switch (see Fig. 3-a).

On the Timing board, cut the foil connection to pin 23. The REPEAT switch now becomes the TRANSMIT-NORMAL switch.

Add Molex pins to required pins on edge of board and add jumpers as shown in Fig. 3-a.

Add a 74123 dual monostable, resistors and capacitors (see Fig. 3-a) at the spare IC location at the top of the board. Connect the output from pin 5 to pin K on the board.

Put TV Typewriter I in "Memory Protect" mode when transmitting out.

TV Typewriter II (CT-1024)

You must use the Screen Read (CT-E) and Cursor boards.

*Add a 2102 IC to the memory board. Piggyback the IC to one of the other 2102's connecting all but pins 11 & 12 in parallel. Connect pin 11 of 2102 IC to P7-10 and pin 12 of 2102 IC to P8-14. On Main board, add a pin to J8-14 and cut a break in foil between J8-14 and IC36-5. Also, add a wire from J7-10 to J4-4.

*Cut a break in foil coming from IC36 pin 3 (between IC36 and IC37 on top of board). Connect a SPST switch to each end of cut foil. This will be the STORE switch.

Add a Molex connector (09-52-3151) to board (see Fig. 3-b) and pins to J2. Add jumpers and capacitor and resistor as shown in Fig. 3-b.

When operating, close switch S1 (connected to L), put SCREEN READ switch to ON and pulse pin J9-9.

Mark 8 Minicomputer

Connect output port bits 0 through 6 to pins A through G.

Connect output latch (or bit-8 or a "flag" bit) to pin K.

Connect pin I to Interrupt input, or use "timed" software.

Ham radio connections

Connections will vary, but check to see that power is properly connected (+5V) to pin P, GND. to pin Q.

*Do not incorporate this step if you can set the margin on your teletype for 32 spaces and have automatic CR and LF.

TABLE III

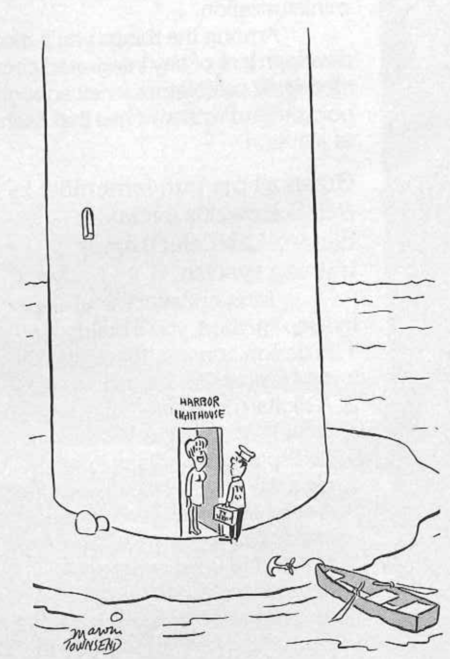
SYMBOL	ASCII bits 7 6 5 4 3 2 1	BAUDOT 5 4 3 2 1	SYMBOL	ASCII bits 7 6 5 4 3 2 1	BAUDOT 5 4 3 2 1
@	1 0 0 0 0 0 0		Space	0 1 0 0 0 0 0	0 0 1 0 0
A	1 0 0 0 0 0 1	0 0 0 1 1	!	0 1 0 0 0 0 1	0 1 1 0 1
B	1 0 0 0 0 1 0	1 1 0 0 1	"	0 1 0 0 0 1 0	1 0 0 0 1
C	1 0 0 0 0 1 1	0 1 1 1 0	#	0 1 0 0 0 1 1	1 0 1 0 0
D	1 0 0 0 1 0 0	0 1 0 0 1	$	0 1 0 0 1 0 0	0 1 0 0 1
E	1 0 0 0 1 0 1	0 0 0 0 1	%	0 1 0 0 1 0 1	
F	1 0 0 0 1 1 0	0 1 1 0 1	&	0 1 0 0 1 1 0	1 1 0 1 0
G	1 0 0 0 1 1 1	1 1 0 1 0	'	0 1 0 0 1 1 1	0 1 0 1 1
H	1 0 0 1 0 0 0	1 0 1 0 0	(	0 1 0 1 0 0 0	0 1 1 1 1
I	1 0 0 1 0 0 1	0 0 1 1 0	)	0 1 0 1 0 0 1	1 0 0 1 0
J	1 0 0 1 0 1 0	0 1 0 1 1	*	0 1 0 1 0 1 0	
K	1 0 0 1 0 1 1	0 1 1 1 1	+	0 1 0 1 0 1 1	
L	1 0 0 1 1 0 0	1 0 0 1 0	,	0 1 0 1 1 0 0	0 1 1 0 0
M	1 0 0 1 1 0 1	1 1 1 0 0	-	0 1 0 1 1 0 1	0 0 0 1 1
N	1 0 0 1 1 1 0	0 1 1 0 0	.	0 1 0 1 1 1 0	1 1 1 0 0
O	1 0 0 1 1 1 1	1 1 0 0 0	/	0 1 0 1 1 1 1	1 1 1 0 1
P	1 0 1 0 0 0 0	1 0 1 1 0	0	0 1 1 0 0 0 0	1 0 1 1 0
Q	1 0 1 0 0 0 1	1 0 1 1 1	1	0 1 1 0 0 0 1	1 0 1 1 1
R	1 0 1 0 0 1 0	0 1 0 1 0	2	0 1 1 0 0 1 0	1 0 0 1 1
S	1 0 1 0 0 1 1	0 0 1 0 1	3	0 1 1 0 0 1 1	0 0 0 0 1
T	1 0 1 0 1 0 0	1 0 0 0 0	4	0 1 1 0 1 0 0	0 1 0 1 0
U	1 0 1 0 1 0 1	0 0 1 1 1	5	0 1 1 0 1 0 1	1 0 0 0 0
V	1 0 1 0 1 1 0	1 1 1 1 0	6	0 1 1 0 1 1 0	1 0 1 0 1
W	1 0 1 0 1 1 1	1 0 0 1 1	7	0 1 1 0 1 1 1	0 0 1 1 1
X	1 0 1 1 0 0 0	1 1 1 0 1	8	0 1 1 1 0 0 0	0 0 1 1 0
Y	1 0 1 1 0 0 1	1 0 1 0 1	9	0 1 1 1 0 0 1	1 1 0 0 0
Z	1 0 1 1 0 1 0	1 0 0 0 1	:	0 1 1 1 0 1 0	0 1 1 1 0
[	1 0 1 1 0 1 1		;	0 1 1 1 0 1 1	1 1 1 1 0
\	1 0 1 1 1 0 0		<	0 1 1 1 1 0 0	
]	1 0 1 1 1 0 1		=	0 1 1 1 1 0 1	
^	1 0 1 1 1 1 0		>	0 1 1 1 1 1 0	
_	1 0 1 1 1 1 1		?	0 1 1 1 1 1 1	1 1 0 0 1
CR	0 0 0 1 1 0 1	0 1 0 0 0	Letter		1 1 1 1 1
LF	0 0 0 1 0 1 0	0 0 0 1 0	Figure		1 1 0 1 1
Bell	0 0 0 0 1 1 1	0 0 1 0 1			

letter "K" or "(" depending on the shift position. The 200K trimmer (R18) between pins 6 & 7 of IC12 should be set to within 20 K ohms of its minimum position and then slowly increased in value (slows down oscillator) until the machine prints out a "K" or "(". Keep on turning until you get a "Q" or a "1", then back off to a point midway between the misprints.

Of course, if you have a calibrated scope or frequency counter, you can use that to adjust the oscillator. The frequencies are 45.5, 50, 57 or 74 Hz (60, 66, 75 or 100 words-per-minute, respectively). Once you get the oscillator tuned properly, remove the grounds from IC8, replace the PROMS, hook up the ASCII device and you're in business. Refer Fig. 3 on page 00 for hookup of your particular device along with PC board patterns for this unit.

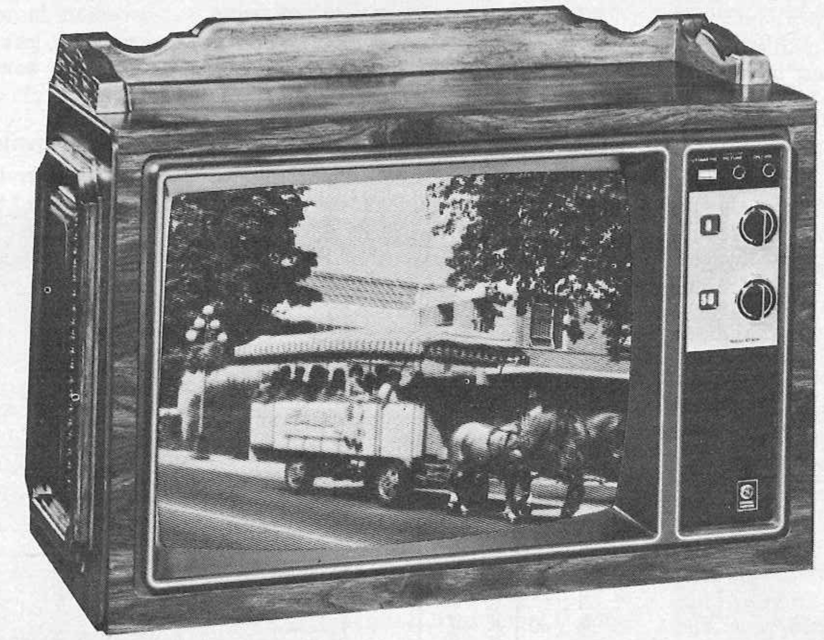
It is a good idea any time you begin to use your conversion board and machine for print-out to start the transmission with a "space" (treated as a FIGURE on this board) followed by a letter. This puts the machine in the proper mode. Also, with the TV Typewriter, it will put the memory in the "protect" mode. Note that since you are now storing the control characters (CR, LF and BELL), that these will appear on the TV screen as letters. Control character CR will be a "M", LF will be a "J" and BELL will be a "G". *If your machine can be set up for automatic* CR *and* LF, *you may be able to avoid storing them.*

Coming: In a future issue of **Radio-Electronics** we will present construction plans for a BAUDOT to ASCII converter circuit. This converter will enable you to use your BAUDOT Teletype (or Kleinschmidt, or Creed) machine as an input device. If you are a Ham operator, you can connect your receiver to your TV Typewriter. This will enable you to receive and display BAUDOT RTTY transmissions on your TV Typewriter. **R-E**



"The jokes on me! I forgot to plug it back in after I cleaned behind it."

Evaluating Color TV Receivers



Here are a few tips on evaluating a color television receiver's overall performance and localizing the possible trouble-causing circuits

STAN PRENTISS

WHEN WE CAN SAY NICE THINGS ABOUT a color television receiver manufacturer and also offer some good tips on color TV evaluation with this manufacturer's newest TV receiver, then it's double pleasure indeed. The set we'll use is a brand new 1976 19YC series having G-E's special Quadline™ (in-line) black matrix color picture tube, 4 dynamic and 4 static convergence controls, 7 simple pullout modules, and 5 standardized integrated circuits.

EIA's resolution pattern

For studio use, closed circuit applications, and general "eye-ball" evaluations, the EIA (RETMA) Resolution Chart (Fig. 1) is excellent—as far as it goes. For instance, you can readily look at all 10 shades of gray (gray scale) and determine the horizontal and vertical resolution on either 400-line or 800-line scales. There are also outer circles for determining corner resolution. With these you can count up to 600 lines and evaluate such critical factors as streaking, ringing, interlace, shading, scan linearity and aspect ratio. The only problem with this pattern is that it is set up for black and white and the monochrome portion of color projections, but has nothing to do with color. In addition, unless you have some means of getting it to your television receiver, it's useless.

True, if you believe you have a receiver that's flat to 4 MHz, then the number of distinct lines divided by the horizontal resolution factor will tell you the frequency: $F = 200 \text{ lines}/80 = 2.5 \text{ MHz}$—with 80 being the horizontal resolution factor. Very good, but with no transmitter or broadcaster handy, how can you see the pattern? Obviously, you can't, and here is where a somewhat different but readily available method will help anyone evaluate the luminance and chroma sections of any color set in literally minutes. And all the equipment you'll need is a good triggered sweep oscilloscope and a clean color bar generator.

The VITS signal

VITS stands for *V*ertical *I*nterval *T*est *S*ignal (Fig. 2) and is used by broadcasters as a gain check at certain frequencies, amplitude vs. frequency response, black or white compression and differential phase/gain (staircase). It is also used to check the frequency response below 3 MHz and group envelope delay (2T sine^2 pulse), amplitude-frequency response errors above 3 MHz (12T sine^2 pulse), white level, sync compression or expansion, and a check on ringing (window signal). The multiburst portion of the VITS signal is transmitted on line 17, field 1 of the vertical signal (262.5 lines). Color bars can be shown on line 17, field 2 while a composite VITS may be transmitted in field 1, line 18. All three patterns are shown in Fig. 2.

NTSC color bar signal

An aid in evaluating television receivers is the NTSC color pattern that's visible in the early morning before programming begins. This is a locally generated station signal, that amounts to six color-bars (Fig. 3). The pattern begins with yellow and progresses through cyan, green, magenta, red and blue with −I and +Q following burst and cyan. This signal is displayed on your oscilloscope at whatever level the receiver's video detector demodulates the composite video waveform. Individual details of the waveform are shown in Fig. 3 with the relative amplitude levels. The oscilloscope display (Fig. 4) shows superimposed fields for color bars and I and Q signals between horizontal blanking and burst. The signal is used at the studio transmitter for