FC-179-SS

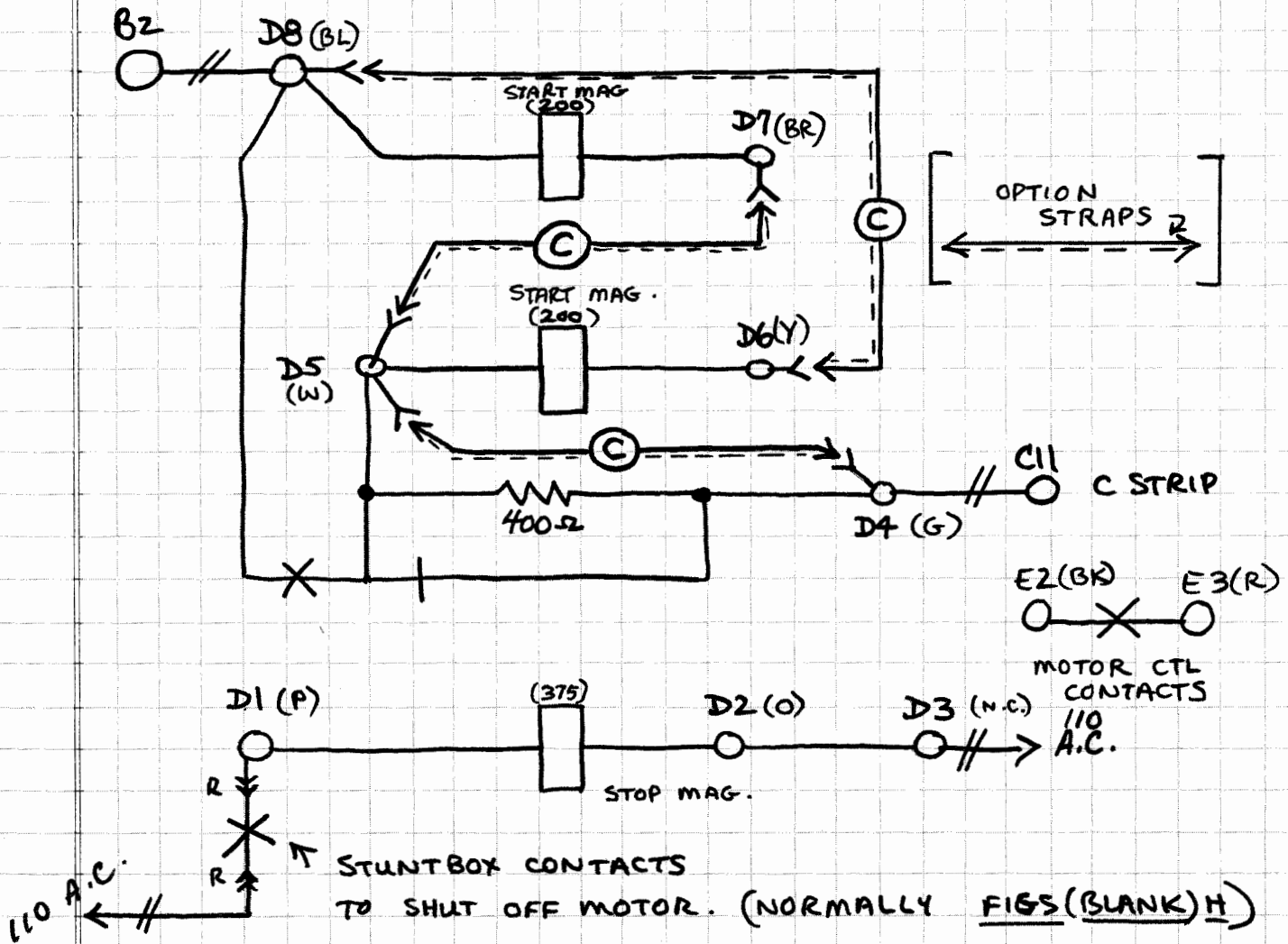
PREPARED BY WA2HWJ PG. 1

DATE 11-2-72 LONG ISLAND LIGHTING COMPANY W. O. NO.

SUBJECT LESU MOTOR CONTROL (TOWER) ACCT. NO.

ELECTRIC MOTOR CONTROL

153251



STRAPS

	60 ma.	20 ma.
	D7 - D5	D6 - D7 (D)
(C)	D4 - D5	
	D6 - D8	

28 SEQUENCE SELECTOR

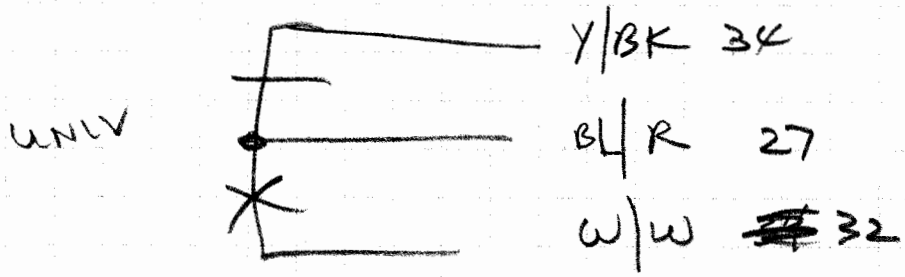
3/6/04

TSC KM KG CM CG
CDC NK
BCST BC

1	R	26	W/BR	
2	G	27	BL/R	COMM UNIV.
3	BK	28	–	
4	W/G — CDC	29	–	
5	W/Y —	30	–	
6	W/BL	31	–	
7	W/V	32	W + W	
8	W/R	33	–	
9	W/SL	34	Y/BK	
10	W/BK - CR/LF Sel +	35	–	
11	SL - ~~CDC~~ TSC			
12	—			
13	BR			
14	BL			
15	Y — F/H/L			
16	–			
17	–			
18	–			
19	–			
20	–			
21	–			
22	–			
23	OR			
24	–			
25	Y/GN			

32 - SW COMMON

NORM OPEN +

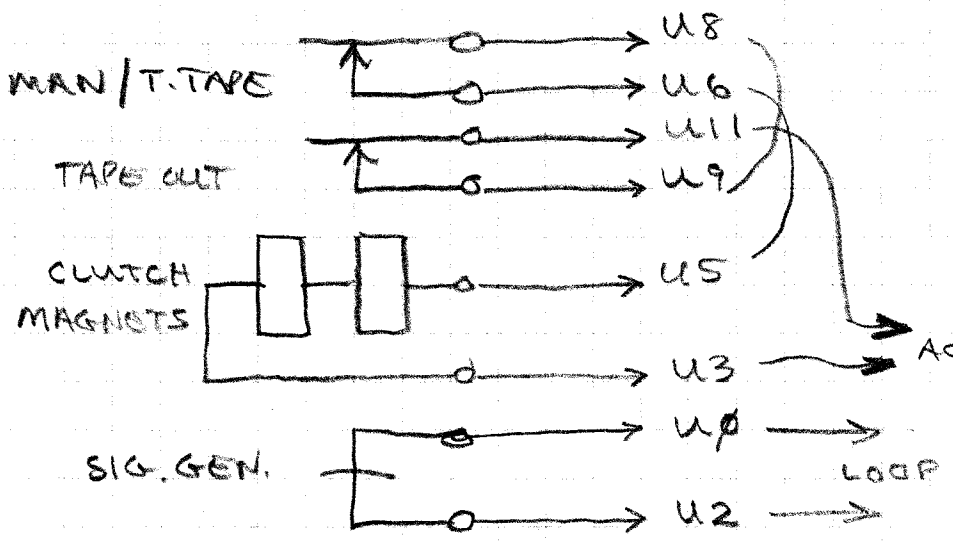


TSC 10 OPEN AT ~~F/H/L~~ CR/LF
CLOSE AT F/H/L

CDC 4-5 close @ NK then open at next character decoded after CR/LF

040405

LXD connection



AC C149 - C150

KEYBOARD	C9 - C10
LOOP RELAY	C7 - C8
DC-	C21 - C22

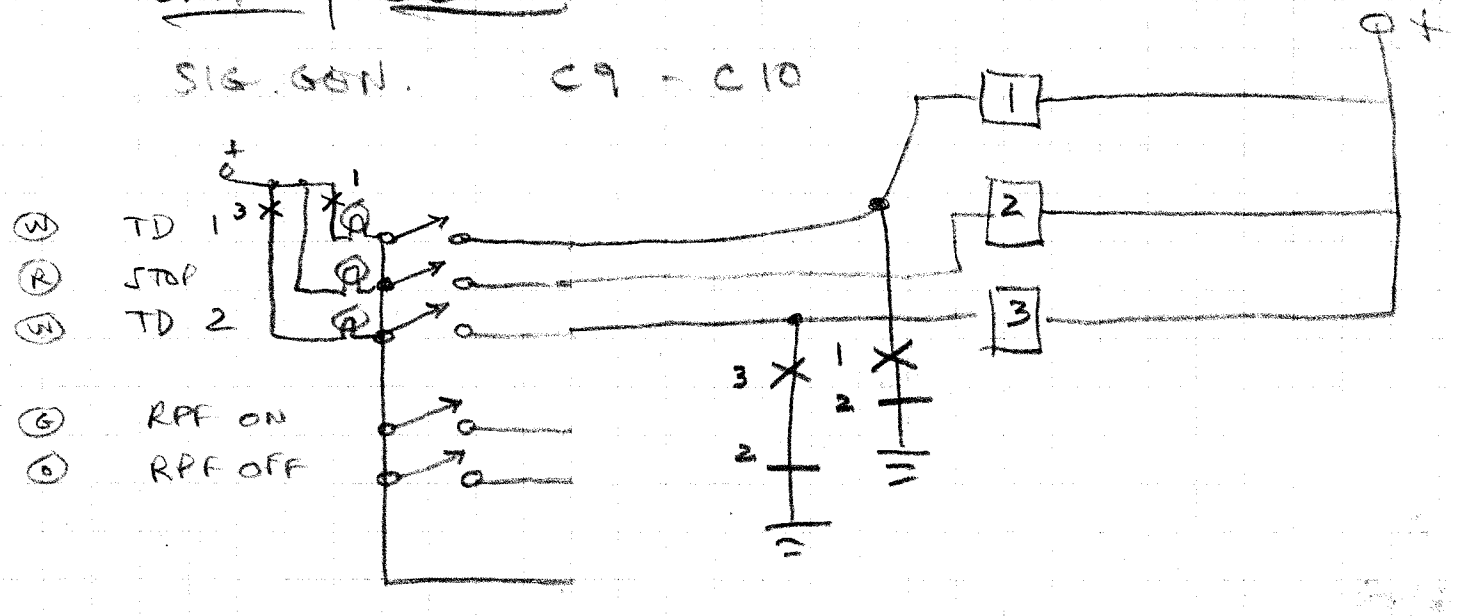
JUMPERS

8 to 9
5 to 6
AC 3 + 11
LOOP 0 + 2

276H 2K/5W parallel.

LAK / LESU

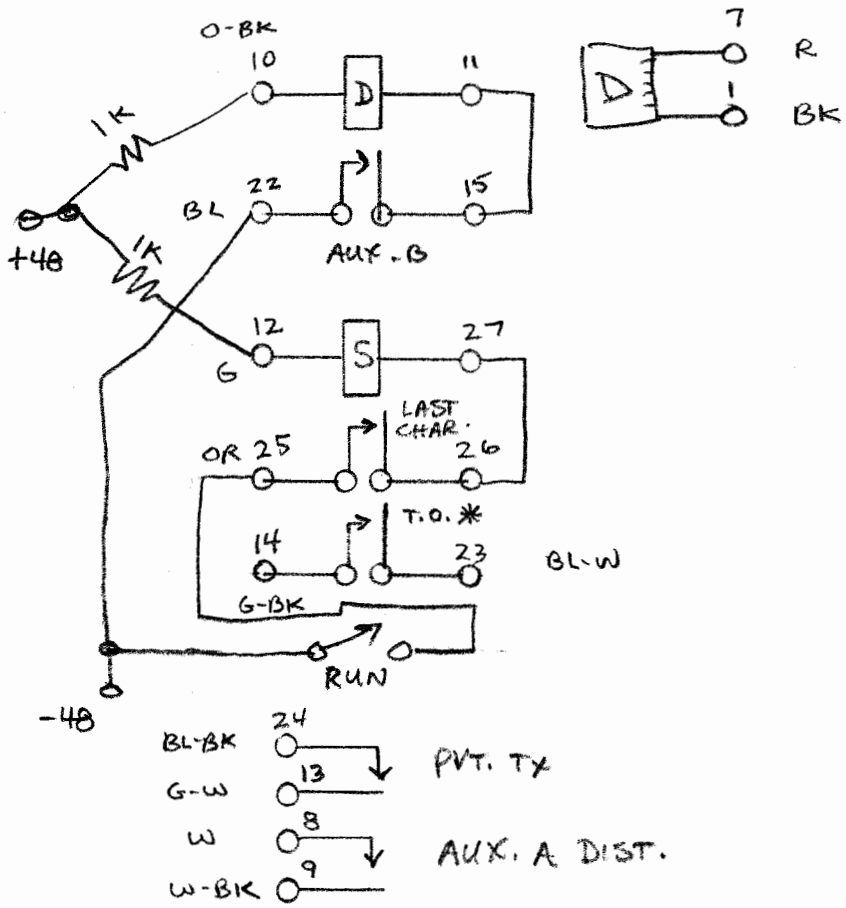
SIG. GEN. C9 - C10



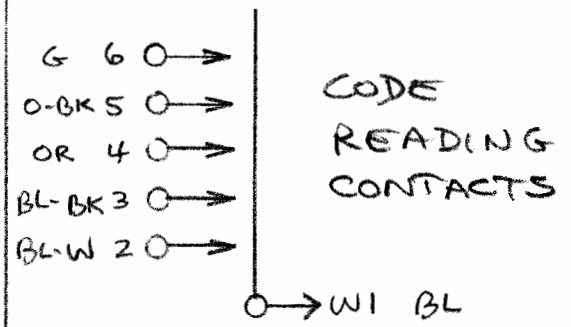
MODEL 28 R-T

CONTROL UNIT
112505

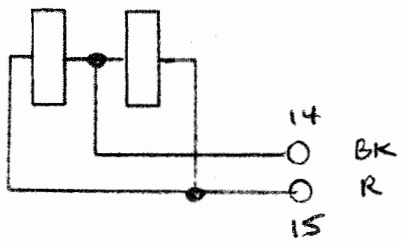
LAXD

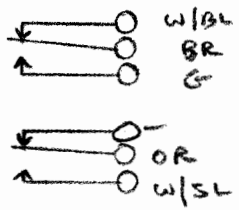


LPR3ARC



SEL. MAGS





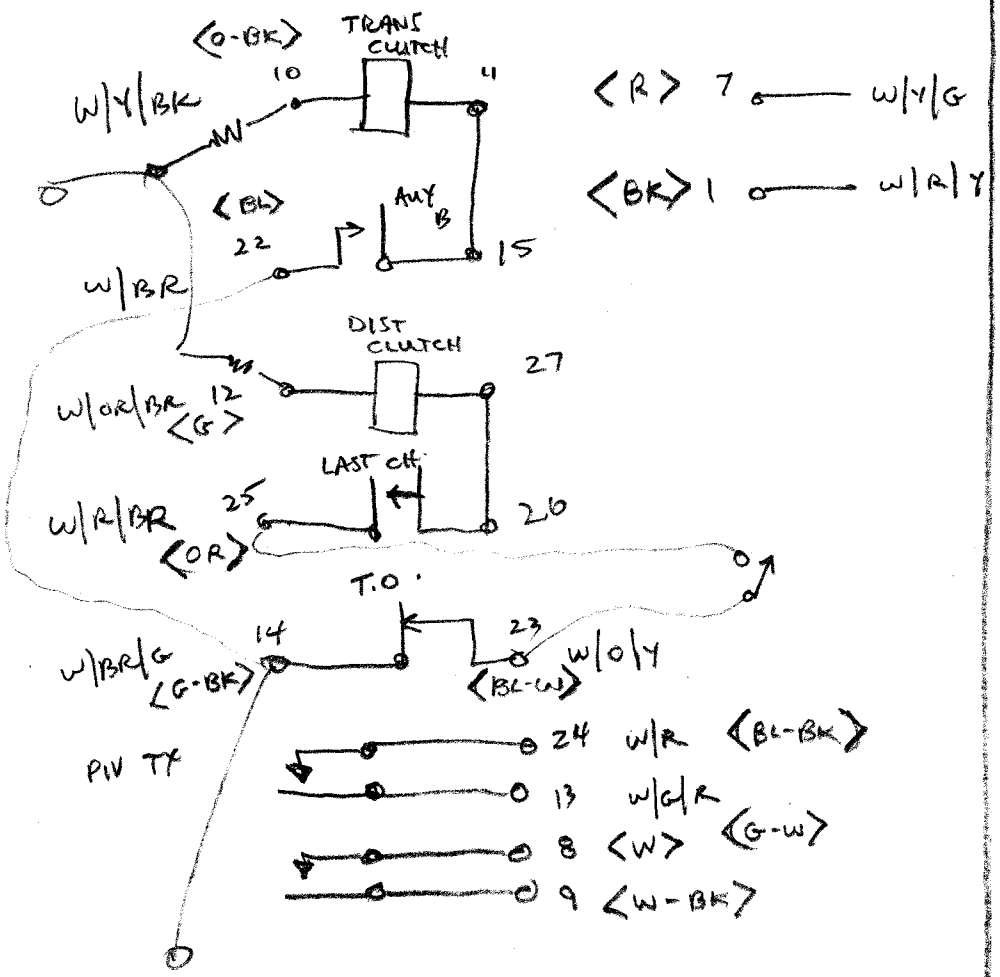
11-19-05

* T.O. SWITCH N/C, MOMENTARY OPEN.

28 RT

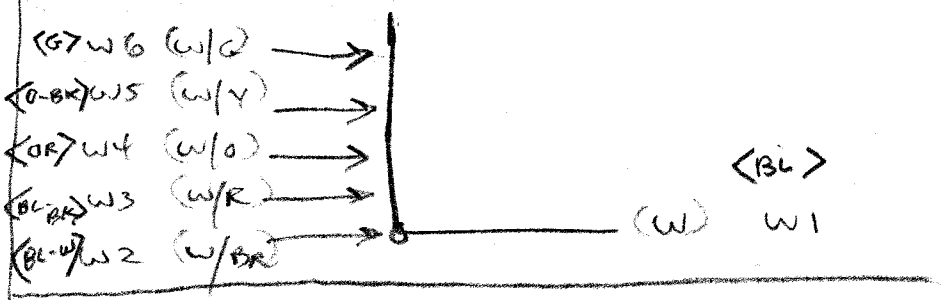
#1473

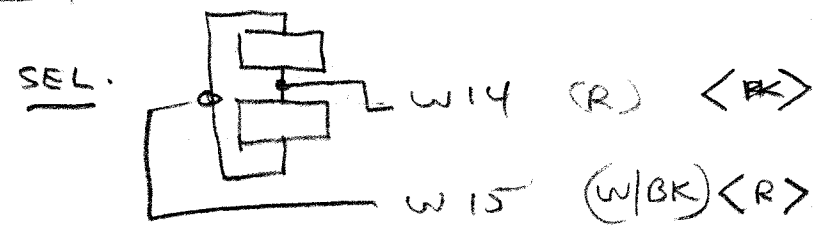
LAYD

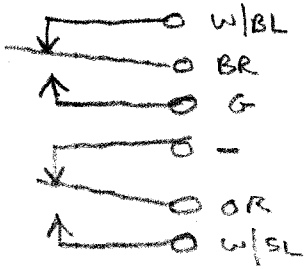


REPERF

LPR3ARC

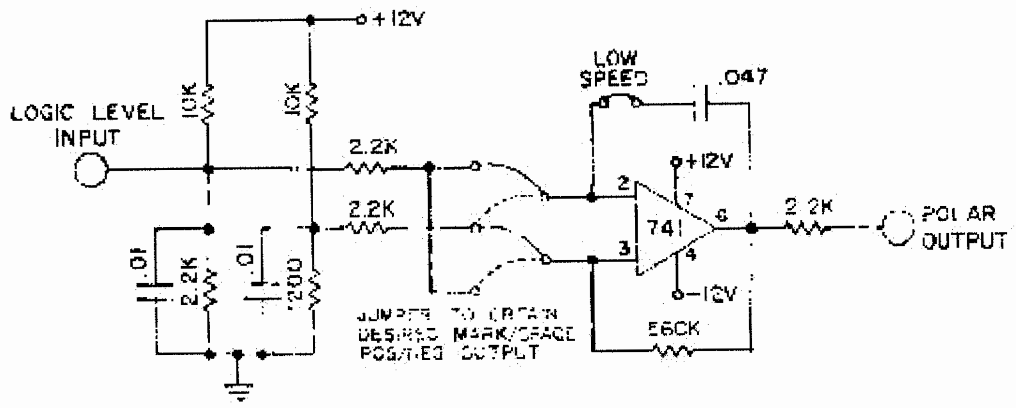






11-14-05

RENIRE 11-19-05



LOGIC TO POLAR INTERFACE

USED ON DI-30 AND DI-70 INTERFACE BOARDS

Dave WW8S

Dovetron

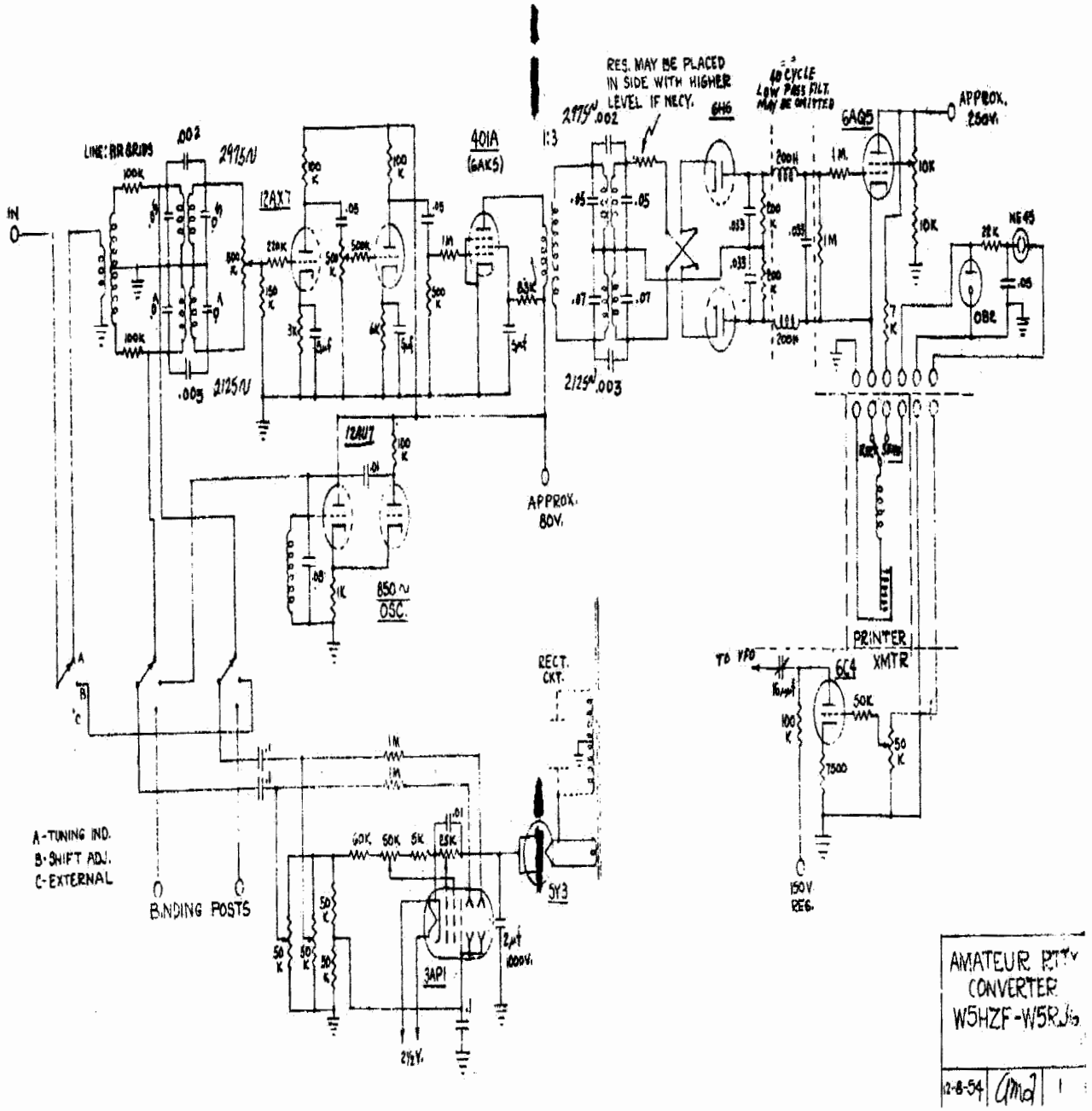
C49 C51

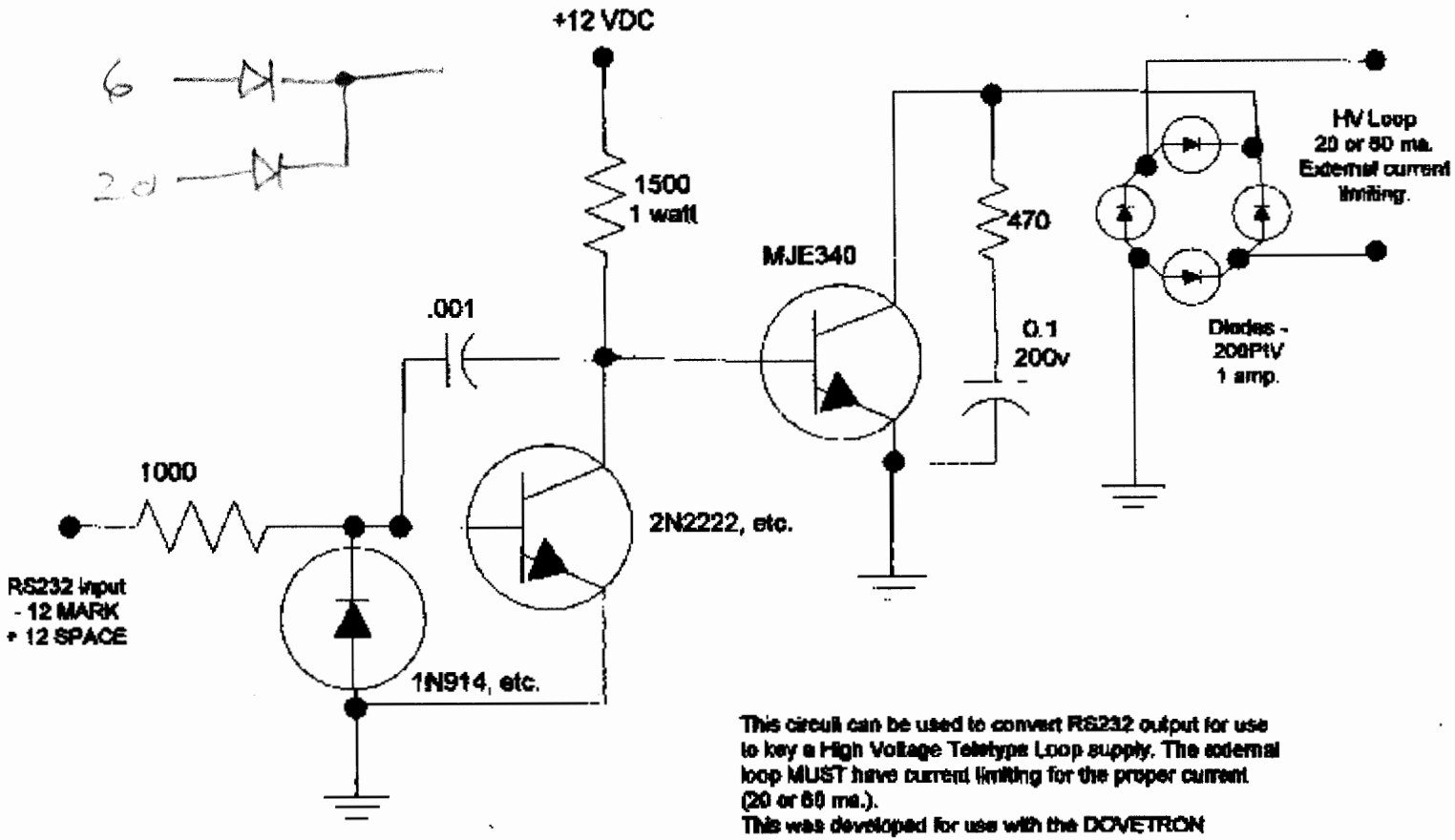
long 50 wire

241 + 2 4/2

W5HFZ-W5RJG
RTTY Converter

Here is the diagram of the converter which Arlan and I worked out. Believe there is room for improvement from the standpoint of selective fading. Have been thinking of including the Gates circuit, from the output of the discriminator transformer on throught the ouput tube. The values shown for the tuned circuits give a band-pass that is a good compromise. My tuned circuits use larger capacitors, 0.2 and 0.15 mfd. to get narrower response, and I have a five position switch with taps on the coils in both the input and discriminator filters (on the high tone only) to take care of the signals that do not have the correct shift. The tapped portions of the coil consist of five turns between each switch point. The capacitors remain the same. Of course you could change them instead of the tapped coils.





NOTE: Parts are not critical. The MJE340 can be replaced with a TIP48 or similar HV power transistor.
The +12VDC is supplied by the Dovetron.

This circuit can be used to convert RS232 output for use to key a High Voltage Teletype Loop supply. The external loop MUST have current limiting for the proper current (20 or 60 ma.).
This was developed for use with the DOVETRON "Tempest" RTTY Terminal Units.

WA2HWJ - June 2002

THE MAINLINE

UT-4

FIFO BUFFER

IRVIN N.HOFF, W6FFC, March 1975

INTRODUCTION:
The Mainline UT-2 was described in May 1975 RTTY JOURNAL issue. It is essentially a regenerative repeater utilizing the UART chip. With a second clock it can be used as an up (or down) converter, both for transmit and for receive. If used as a down converter, the input speed cannot exceed the maximum character rate of the output speed, otherwise it would over-run with loss of characters.

The Mainline UT-4 adds buffer storage, virtually eliminating over-run possibilities with hand typing. It also offers visual display of buffer quantity. An integral delay system offers the operator the ability to select an output rate that gives a steady, uniform transmission speed. The system effectively brings the computer age to the typical RTTY enthusiast.

BASIC DESIGN PHILOSOPHY:
Most RTTY operators hand type approximately 40-45 WPM. Even so, the techanical limitations on the keyboard of the machine sometimes prevent the operator from typing as well as the other guy might. The idea behind the Mainline UT-4 was to allow the operator to type as fast as he cares to, in as jerky a manner as he likes, while selecting an output that keeps characters backed into the buffer memory enabling a continuous and steady output speed. This makes it possible for the operator to type easy words rapidly and yet slow down on those that are more difficult without affecting the output speed at all. Those who have heard such a system being used are instantly aware that "something is different". The effect is similar to that of a slow-running tape distributor, yet no tape is being used.

ADVANTAGES:
When the operator can select his own output speed, it usually allows him to make fewer errors than when he is trying to approach machine speed. The system allows him to use 100 WPM gears if he is really a fast typist or otherwise has found the mechanical limitations of the 60 speed gears detrimental to his typing style. Even with 60 speeds gears, the machine can receive 100 WPM hand typing with no loss of characters if the person typing is not averaging over approximately 64 wpm. The operator can also transmit at 100 WPM with his machine geared for 60 WPM, although his maximum actual output speed would be that of the printer itself, or about 60 wpm, due to keyboard limitations. This would allow for the first time a reasonable intermix of various speeds with printers geared for one specific speed. A number of other interesting possibilities come to mind - - with the optional Transmitter Distributor (TD) control system, a person can send a CQ tape at the same speed he plans to hand-type during the QSO -- this in itself offers a most interesting phenomena of advertising in advance what the other person could expect from your typing. Of course the output speed could be run quite slowly to conserve paper if a lengthy CQ were needed. These are some of the more obvious possibilities available.

FUTURE POSSIBILITIES:
The Mainline UT-4 was deliberately kept about as simple as it could be and still operate within the basic design philosophy. A wide variety of interesting additional features could be added. For instance, a

"diddle generator" that would automatically insert letters characters (or 'figures' if in upper-case) if the buffer storage became empty. This would fake machine speed regardless of what the operator was doing. An "anti-diddle" unit could be added that would ignore all superfluous letters (or figures) characters not actually needed to put the machine in upper or lower case. A feature could be added that would allow the operator to flip one switch and continuously repeat whatever was currently in the FIFO storage, up to the 80 character limit -- for instance you could type a line of CQ and your callsign then just sit back and watch it type that same line again and again - - when you turned that switch back to normal position you could continue typing on the next line while it was finishing the present line, making no interruption of the transmission at all.

Other interesting applications will certainly be developed by operators using the device.

SOLID-STATE KEYBOARDS
Computer-type keyboards are usually 4-row "ASCII" encoded. Many of these are showing up on the surplus market at prices that interest many RTTY operators. It is only a matter of time until amateurs will be allowed to use the 8-level ASCII code, but in the meantime, it is possible to use these keyboards with Baudot output. Cole Ellsworth W6OXP has been developing such a system to use with the UT-4. In this case he converts from ASCII-to-Baudot and then stores the Baudot characters in the FIFO memory. This enables him to run the input speed to the UART at anything he likes that is commensurate with the full-N rollover capability of the ASCII keyboard. A report on his work should appear before long.

The Hal Communications dual-mode 2010 keyboard may be easily used with the UT-4. The keyboard would be placed on the 100 WPM speed and then the built-in character counter would accurately show when to CR-LF regardless of your typing speed. The status indicator on the UT-4 would show if you needed to adjust the output rate or not.

MEMORY SIZE:
The FIFO units used in the UT-4 are the Fairchild 3351 type. These are 40 characters by 9 bits wide. They will be suitable in future years for use with 8- level ASCII keyboards. Two of these units are shown in the schematic, but additional units could easily be added between the two shown, in a similar manner. The status indicator is wire for up to 128 characters, so a third FIFO could be added with virtually no other changes.

CURRENT REQUIREMENTS:
Approximately 600-650 mils of current at 5V will be needed if the XB-6 with dual output clocks is added to the UT-4. The voltage should be adjusted for as close to 5.0 volts as is convenient. The limits are 4.5 to 5.5. volts for proper operation. Approximately 10 mils of -12V is needed for each FIFO, making a total of about 25-28 mils needed, including the UART.

THE RECEIVE-TRANSMIT SWITCH:
If a DPDT toggle switch is used for S-3, the second pole may be wired to turn the transmitter on or off, giving a "1- switch transmit control". The transistor connected to the standby line keeps the motor on during transmit should the operator be using normal autostart.

METER POSITION:
The status indicator should be placed as near the operator's normal line of vision during typing, as possible. This may well indicate it would not go on the same cabinet that contained the rest of the unit, but perhaps in a small enclosure placed directly to the side of the teleprinter. The larger the meter movement the easier it is to just glance at the quantity of characters currently in memory. Lamps of

course can easily be added to the output of the unit to show empty, full, partially full or whatever you like.

THE PRE-LOAD SWITCH:
The S-5 switch (pre-load) allows the operator to type ahead and fill the buffer if in transmit mode. During receive, the switch will stop the output to the printer and store the characters in the FIFO while the operator quickly changes the roll of paper. An optional switch (S-8) called the "repeat switch" may be added that would allow continuous repeat of whatever was pre-typed, such as "RYRYRYRY" or "THE QUICK BROWN FOX" or "CQ CQ CQ", etc. This would be a DPDT switch. The wiper arm of one pole would go to pin 10 of IC-1d, the normally closed contact to the wire presently shown hooked to that pin, and the other normally open contact to plus 5 volts. The wiper arm of the second half of the switch would hook to pin 2 of IC-la and the 4700 ohm pull-up resistor would hook to that same pin. The normally closed contact would connect to the end of tne 8200 ohm resistor presently shown hooked to pin 2. The normally open contact would hook to pin 9 of IC-1d. The following routine would then be used:

- 1. S-3 to transmit
- 2. S-5 to pre-type
- 3. S-8 to normal
- 4. Type in the line you wish to repeat
- 5. S-8 to repeat
- 6. S-5 to normal

When step 6 has been completed, the text starts to be transmitted. It will also now appear on the local printer copy. When you wish to terminate the repeated line, just return the repeat switch S-8 to normal, the local copy immediately stops although the buffer will continue to output until empty - - and you can again type into the buffer getting local copy on the printer. This is one of the many optional things that can be added to the UT-4.

CAUTION: This S-8 switch would only be useful if the input Baud rate and output Baud rates are the same!

THE SPACE SWITCH:
Closing S-7 (space switch) causes the output of the AFSK or FSK to go to steady space tone. This is needed to set the shift properly. A full-shift compatible C.W. ident device can also be added at this point if desired.

NO IC-3:
There is no IC-3 in the UT-4. That is used in the UT-2, and since it is some what different in the UT-4, it is called IC-4 instead to avoid confusion. Therefore you will not find an IC-3.

HOOKING TO THE ST-6:
The interface between the ST-6 and the UT-2 will be similar to that for the UT-4. The UT-2 schematic in the February 1975 RTTY JOURNAL must be used to observe these connections.

HOOKING TO THE ST-5:
If the ST-5 is used a similar hookup to that of the ST-6 would be incorporated, except do not hook the standby line to the NPN transistor unless it is another MJE-340 - - the standby line on the ST-6 is approximately plus 12 volts and is regular loop voltage on the ST-5. If that point is connected, the S-8 switch mentioned in the pre-load section would not allow local copy in the repeat mode.

CIRCUIT DESCRIPTION:
An incoming signal goes through the slicer (mark positive) and is inverted in the transistor to a mark low. It then goes into pin 5 or IC-1b, and is again inverted to a mark high on the output. The UART is then triggered with this signal. At the completion of a character, the data appears on the output lines (all 8 are shown connected for eventual 8-level ASCII use). The data available flag U-19 goes high, initiating the transfer of the character into the FIFO storage buffer. This U-19 "high" triggers the first one-shot of the 74221 IC-11. The "not Q" output is used to reset the data available flip-flop U-18 via IC-4c andlC-4b. The "Q" output is used to strobe the character into the FIFO registers. At this time the character is automatically transferred through the FIFO and the data available flag F-12 goes high indicating a character has been removed. The same pulse that reset the data available flip-flop (U-18) via 4c and 4b also pulses the up-counter (pin 5 of IC-9) showing on the status indicator that a character has been received. The 4- input NAND gate 5a is now activated putting an immediate low to both the IC-6 and to IC-7d. Since we are in receive, we shall ignore IC-6 at present as its output is inhibited by a low at pin 12 of IC-7c. Therefore IC-7d goes low, tripping the IC-8a flip-flop. This in turn strobes the character into the transmit side of the FIFO via U-23. It also operates the other section of the flip-flop one clock pulse later, which in turn resets the first section while operating the down-counter, showing the character has been removed. At the same time the output strobe of the FIFO is reset, putting a low on the data available line, turning off IC-5a. While the character was being transferred into the FIFO, U-22 went temporarily low showing a transfer was in progress, and while the character was actually being outputted through the transmit section, U-24 went low. As all of these are connected to IC-5a, it would not be possible for another character to be sent to the transmit section of the UART no matter how fast the characters would be stored into the FIFO. Only when all inputs to 5a go high can another character be processed.

On transmit, IC-7c is activated instead of IC-7d, and now the dual one-shot delay IC-6 enters the picture, delaying the pulse to 1C-7a. for a period adjustable by the 50K delay pot. With the 5 Mfd. capacitor chosen, and outputting at 45.45 Baud, the output speed may be varied from approximately 30-64 wpm, at the operator's selection. A larger capacitor may be used to slow the output further if desired, although 30 wpm is already quite slow for all but a beginner on RTTY.

The pre-load switch utilizes a "bounceless" arrangement as the logic chosen only needs about 15-20 nanoseconds to activate.

REQUIRED STOP-PULSE:
You can experiment with switch S-4 and see if you prefer incoming signals to have a stop pulse or copy them as long as the UART thinks it received a valid start pulse. Many operators think they prefer to leave this switch closed, but a few like the required stop pulse. You have the option of doing which one you prefer on the UT-4.

ONE MEASUREMENT:
When in mark, measure the voltage at pin 2 of IC-la. It should be less than plus 0.4 volts - - if not change the 8200 ohm resistor to a value that gives approximately zero volts when the FSK line is connected.

THE AUTO RESET:
When the FIFO has had characters and then becomes empty, the voltage at F-12 goes low and stays low, activating the auto reset at pin 2 of IC-l1. This in turn triggers the output of the memory clear 4-in put NAND gate IC-5b, resetting the status indicator to zero. The purpose of this system is to make certain the status indicator shows zero at any time the FIFO is empty. This guards against occasional possible meter errors due to RF glitches, etc. Again pulses as short as 15-2O nano- seconds can activate the up-down counters (IC-9 and IC-l0) so this acts as a back-up device.

THE D/A CONVERTER:
The interesting feature about the IC - 12 chip is its ability to take binary input counts from the 74193's and change them into a linear output current. To set the status indicator (0-1 ma. meter), you would just hit the pre-load switch and allow the unit to copy until the FIFOs were obviously full. The 2500 ohm pot would then be adjusted to indicate full scale and you are finished. Thereafter the meter would indicate the amount of characters in the FIFO. With an empty FIFO, the meter might not show exactly zero due to a very small residual current at that time. The mechanical zero on the meter face could be used for this purpose. The D/A (digital to analog) converter is shown connected for up to 128 characters. As it is an "8-bit converter" it could be wired to accommodate up to 256 characters with individual increments.

OPTIONAL D/A CONVERTER:
The optional D/A converter uses fixed-value resistors. They are considerably cheaper than the $6 Motorola D/A chip and some builders have expressed an interest in saving the money. The 25 ohm pot adjusts the meter for zero with empty buffer, and the 50 ohm pot adjusts the meter when the buffer is obviously full.

T.D. CONTROL:
The T.D. must run at the same gearing the printer has. If the printer is set for 100 WPM, the T.D. must be also, in order to get local copy. The input to this system is hooked to the up-down counters so that when the FIFO gets almost full the T.D. is shut off until the FIFO units are empty at which time it automatically starts up again. This keeps the FIFO from over running. Since you will be outputting while the T.D. is running, it will take longer for it to cycle on and off than might first be expected. Switch S-21 gives an interesting use of the T.D. -- when in normal the T.D. can run at 8.0 unit code output due to the ungrounding of the UART's U-36 pin. If the S-21 is in "slow" position, then the output of the UART is the same speed as that used during hand typing - - for the first time you can use the T.D. to call CQ at the same speed you intend to hand type! You can close the S-21 switch and immediately speed the output up to normal output rate. If you use only a 60 wpm printer and 60 wpm T.D. there is no necessity in ungrounding U-36 as the T.D. would then run its usual 7.42 output speed. The U-36 arrangement was added primarily for using 100 wpm T.D. units where the output speed would then be that of the UART itself.

TROUBLE-SHOOTING:
While receiving, a voltmeter or scope (D.C. type) could be used -- the output of the slicer at point AA is about plus 11 on mark and about minus 11 on space. Pin 5 of IC-lb should then go low (about 0.2 volts approximately) on mark and around 4-5 volts on space. Pin 20 on the UART should go high (4-5 volts) on mark and low (around 0.2-0.5 volts) on space. If the clock speed is normal at pin U-17, the data pins U-8 through U-12 should alternate at least occasionally, depending upon what characters are being received. If they do, then the UART is no doubt working correctly. The output of many of the other points of interest is so short duration it may be all but impossible to see if they work normally or not. For instance the output at pin l2 of lC-6 and IC-l1 is on the order of 1.5 microseconds. A meter would not show this and it would take a rather fast, triggered scope to see it as well. Unless you are fairly adept at checking logic circuits, there would be a distinct advantage in buying brand new components from a reputable dealer. Apparently some of the surplus places selling IC's for low cost do not bother to even test the items to make sure they are not shorted or defective. The more expensive IC's at least should be mounted in Molex pins so they could be readily removed if needed.

P.C. BOARDS:
An unusual amount of interest has al ready been generated in the Mainline UT 4. Most of those active on the west coast autostart net (3612.500 KHz.) are already using this device. Two of the fellows participating on that net have PC. boards available. One source is Clyde Keenari K7WTQ in Lakebay, Wash. The other source is Jim Page WA7ARI who is calling his firm EDI, for Electronic Development,

Inc. He plans to not only offer boards that are drilled, plated through (requiring no jumpers), but also hopes to have available a complete kit of all parts needed. Check the classified ads in this and future issues. No other source of boards is expected to be available.

THE RM-200:
Howard Nurse W6LLO was the first amateur known by the author to use the UART/FIFO combination. He is a very competent independent design engineer. After hearing his unit some time ago, the author urged him to produce it for amateur use. This has been delayed somewhat because of other more pressing business matters, but the RM-200 represents a much more sophisticated device than the UT-4. It uses 5 PC boards and among other features offers a diddle generator, an anti-diddle unit to remove superfluous letters (or figures) characters, interrupt inputs and other unique features. Howard hopes to soon publish further details on the unit.

ACKNOWLEDGEMENTS:
A large number of people have been interested in this project from the beginning. It Is difficult to try to give credit where it is due without overlooking or slighting someone. Several people stand out in particular: Howard Nurse W6LLO whose comments, suggestions and advice have been most helpful. Steve Klingler WA5GRE/5 whose beautiful drawings appear in this issue. Clyde Keenan K7WTQ whose work with the reproduction of those drawings was greatly appreciated. Cole Ellsworth W6OXP who made the original work by the author available to over 100 interested enthusiasts. Pete Bertelli who has made it convenient to obtain the integrated circuit chips needed. Barry Simpson WA7HJR who built the first unit after the prototype was completed. Karl Hatfield W6BXR who was first to try the T.D. control section. Peter Morley K6SRG whose support and Xerox machine have been most helpful. Many others have contributed comments and suggestions and include W1HAB, K2SMN, K4CZ, KL7HOH, K5UAR, WASIAT, K4EID, WA5NYY and WA7RQV. This has certainly been an interesting undertaking and the enthusiasm and co-operation of all those mentioned could hardly have existed on any other mode of amateur operation.

SUMMARY:
The Mainline UT-4 was designed to allow the operator to type at a keyboard speed comfortable to him whether 60, 75 or 100 wpm, and to adjust the output speed for the Baud rate being used so that some characters would remain in the buffer allowing even and steady output speed. In addition the unit allows up/down conversion regardless of printer speed as well as improved reception and transmission at minimum distortion. It helps any printer to receive and transmit equal to the very best units available.

(Last Minute Addition)
(This addition was developed too late to incorporate into the main drawing.)

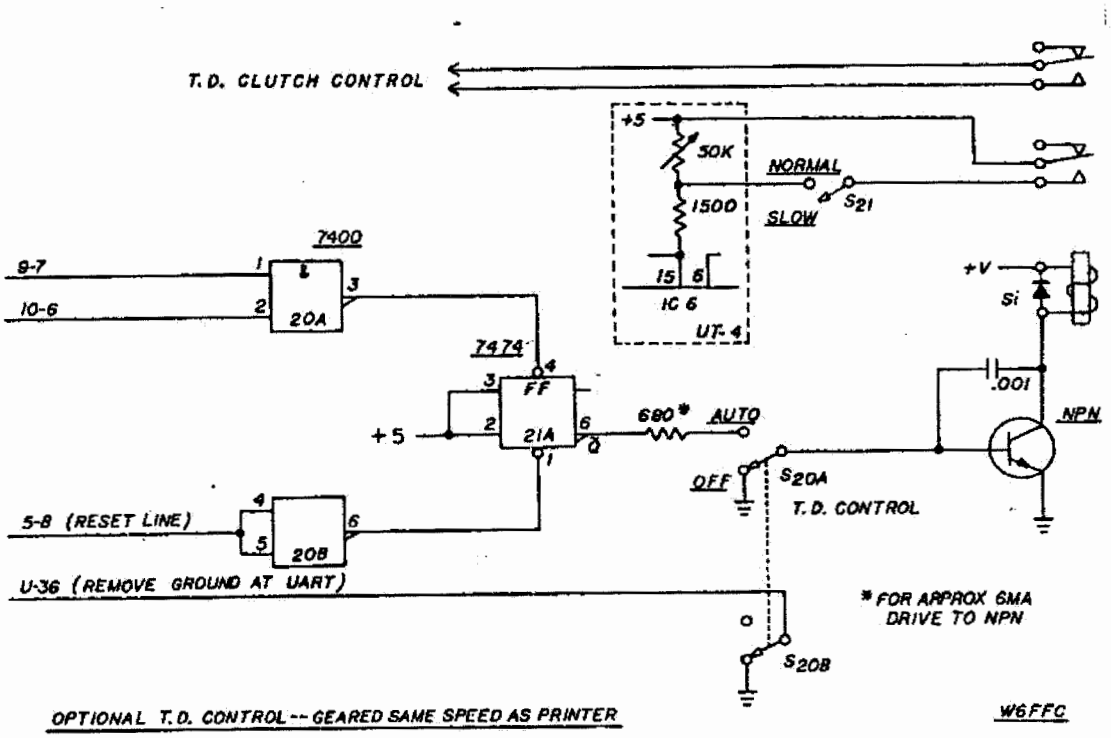
If the up-down counters are on zero and a false count is received, the counters try to "go around" to 255 counts. This would be 127 counts on the configuration used on the UT-4 so the meter would try to pin at full-scale. Although this rarely has ocurred a simple solution has been developed that prevents this happening.

First remove pin 12 of IC-5b from plus 5 volts. Next install a 4700 ohm resistor from this now vacant pin to plus 5 volts. Also connect this same pin l2 to the output (pin 3) of IC-4d. Connect the two input pins (1 and 2) of IC-4d together and attach to pin 7 of IC-10. (That's all.)

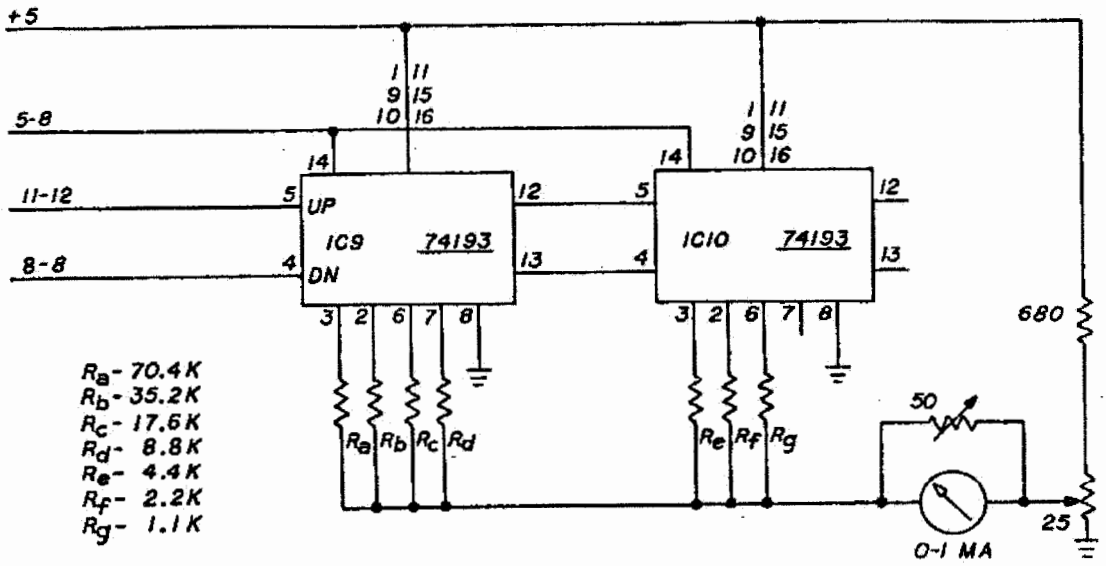
Explanation. If the counters ever attempt to "go around" on a false. down count, this system will reset their clear lines to zero automatically. (This addition is incorporated in the P.C. boards previously mentioned.)

Schematics

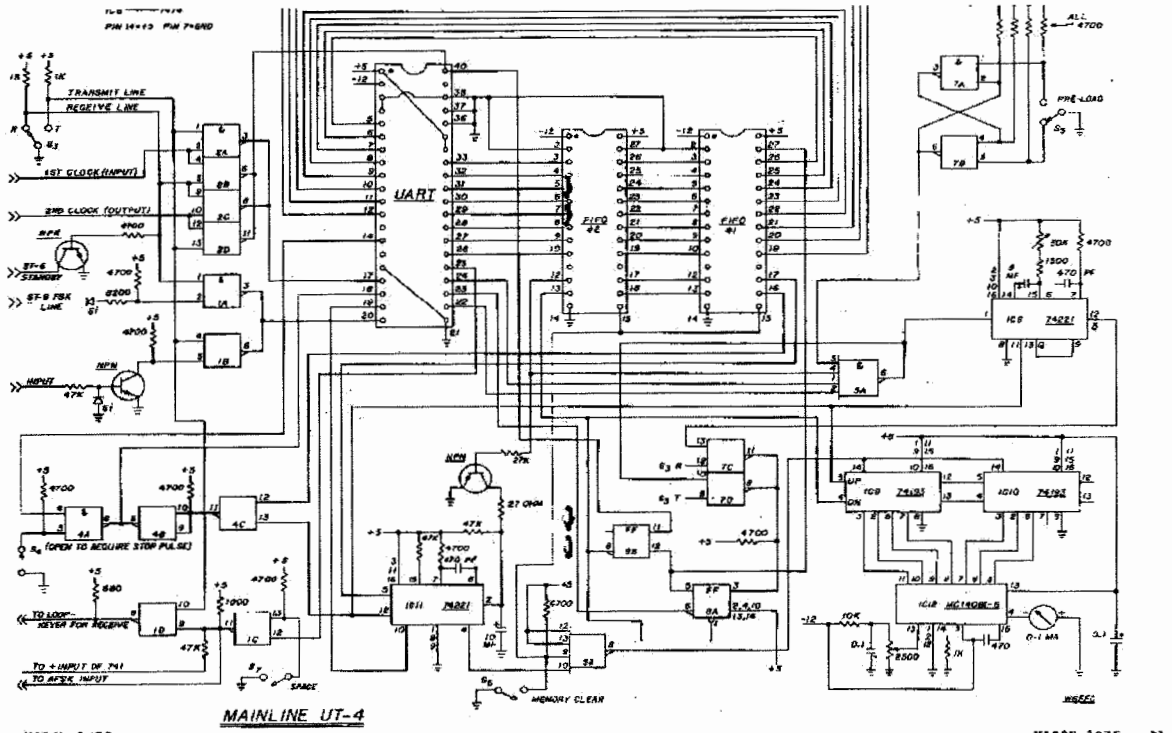
NOTE: Use your right mouse button on your browser, click on the schematic to save them and view them on your full sized monitor or to print them. Each diagram is much larger than what your screen will allow.



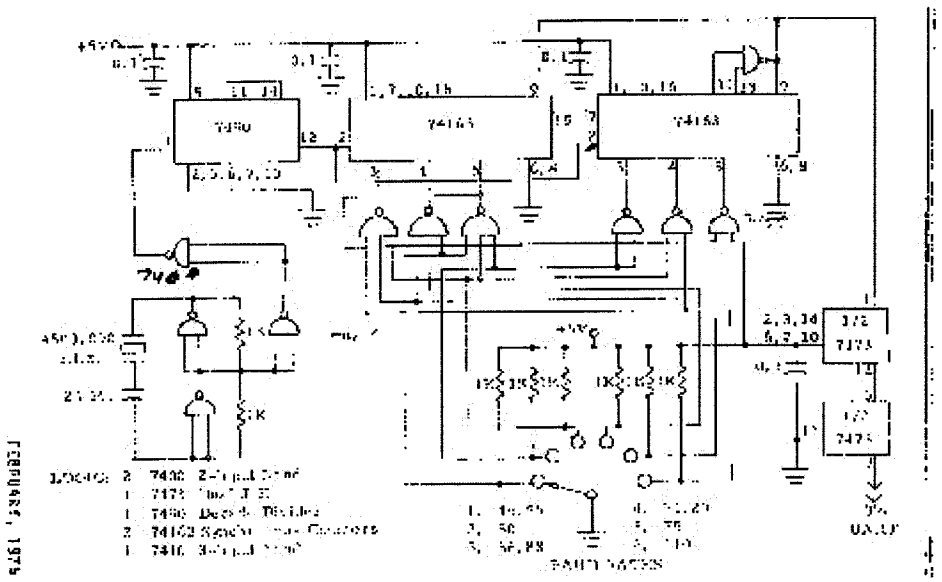
Optional T.D Control -- Geared Same Speed as Printer



Optional D/A Converter



Mainline UT-4 Schematic

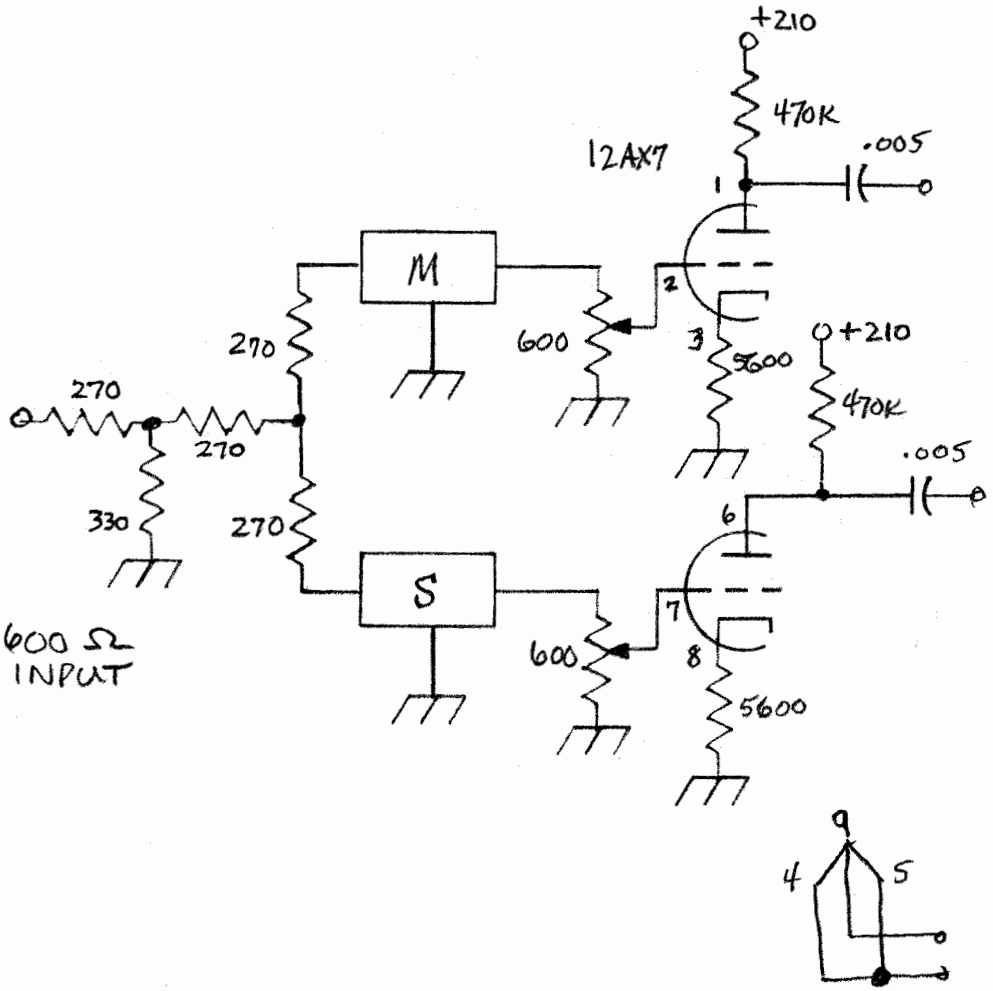


Mainline XB-6 UART Clock

George Hutchison
W7KSJ
(Webmaster)

WWW.RTTY.COM

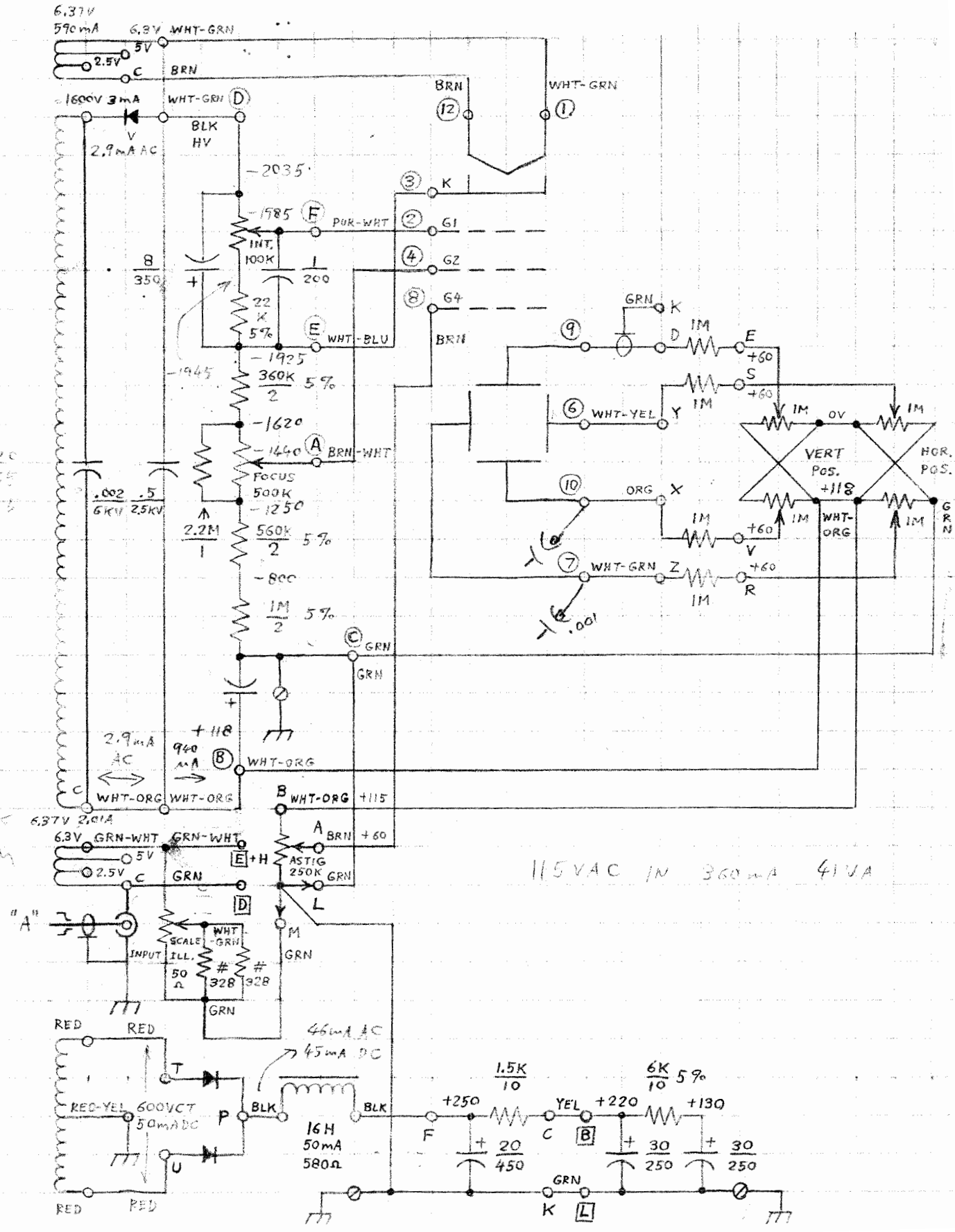
William Bytheway
AA6ED
(Co-Webmaster)

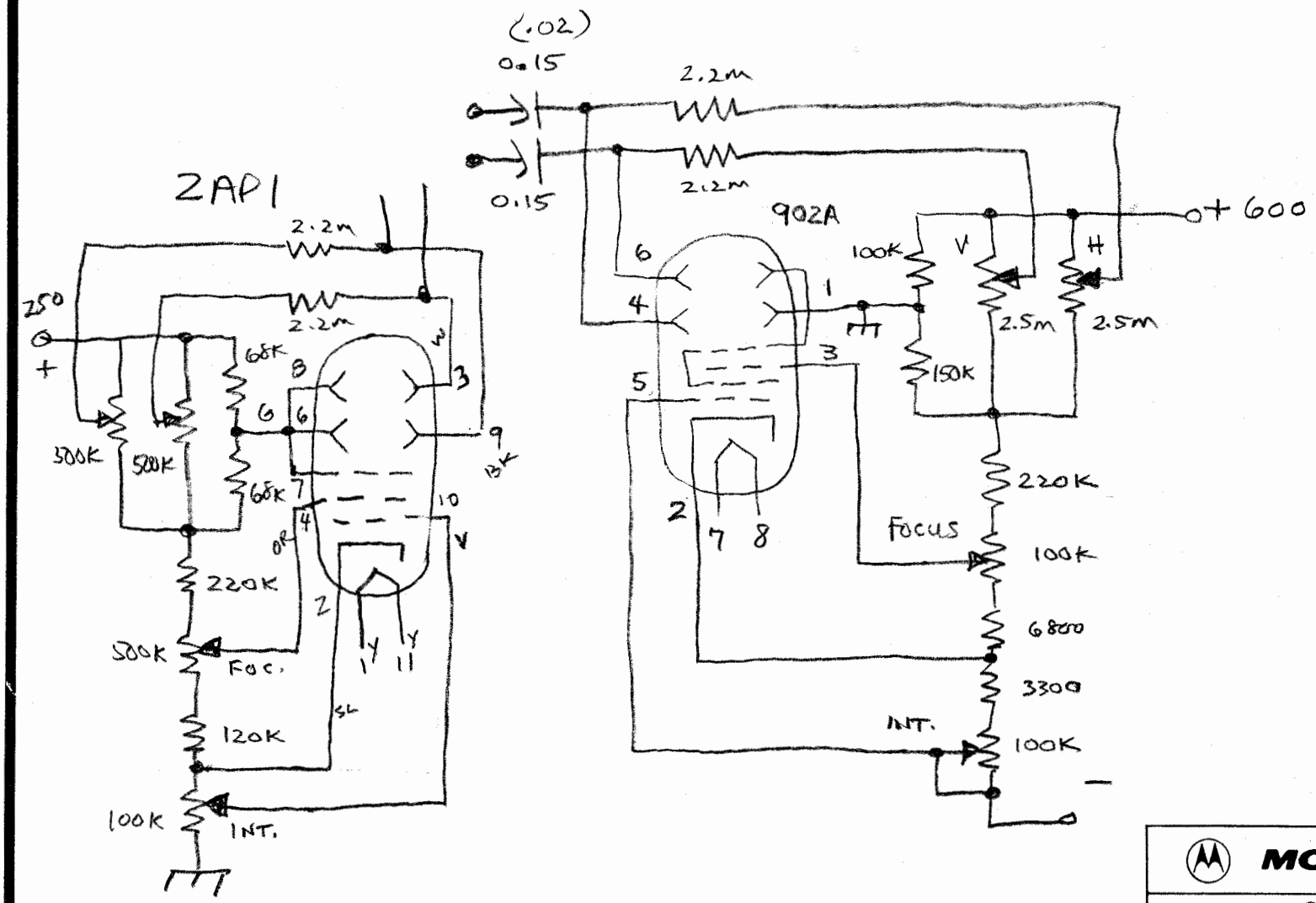


MOTOROLA INC.	
MAINLINE TT/L A.M. INPUT	
BY:	DATE: 6/19/03
NO:	PAGE OF

3818-70(A)

3-INCH Scope w/ bezel





MOTOROLA INC.	
RTTY TUNING SCOPE	
BY: JH	DATE: 10-4-03
NO: 001	PAGE 1 OF 1

3818-70(A)

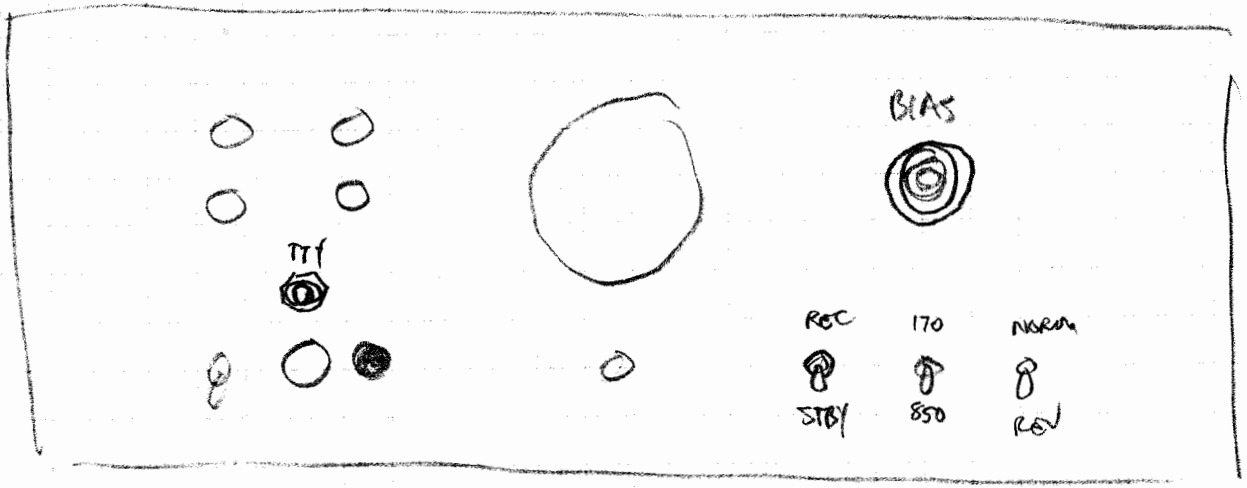
E I·R

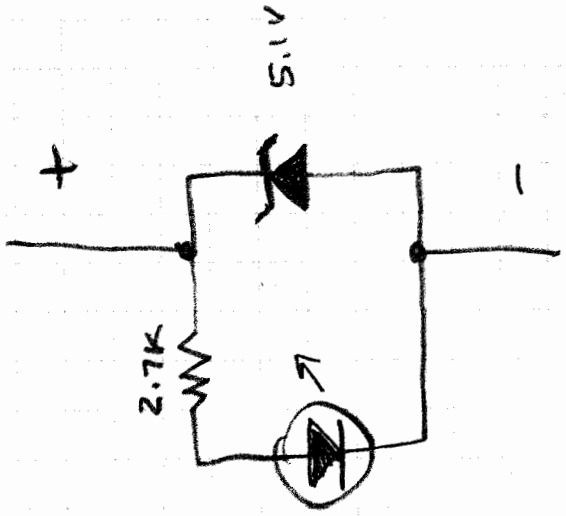
I | R

ER = I

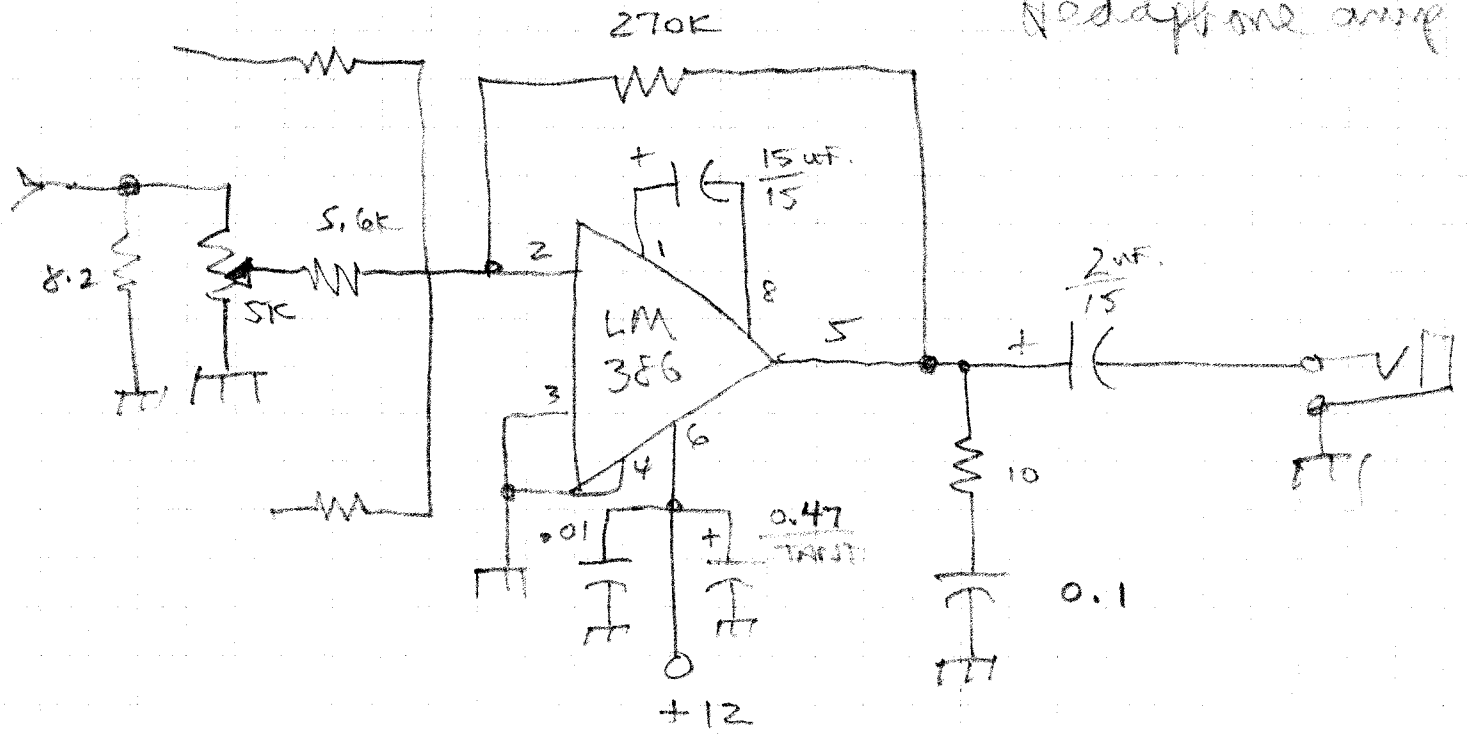
250Ω

130



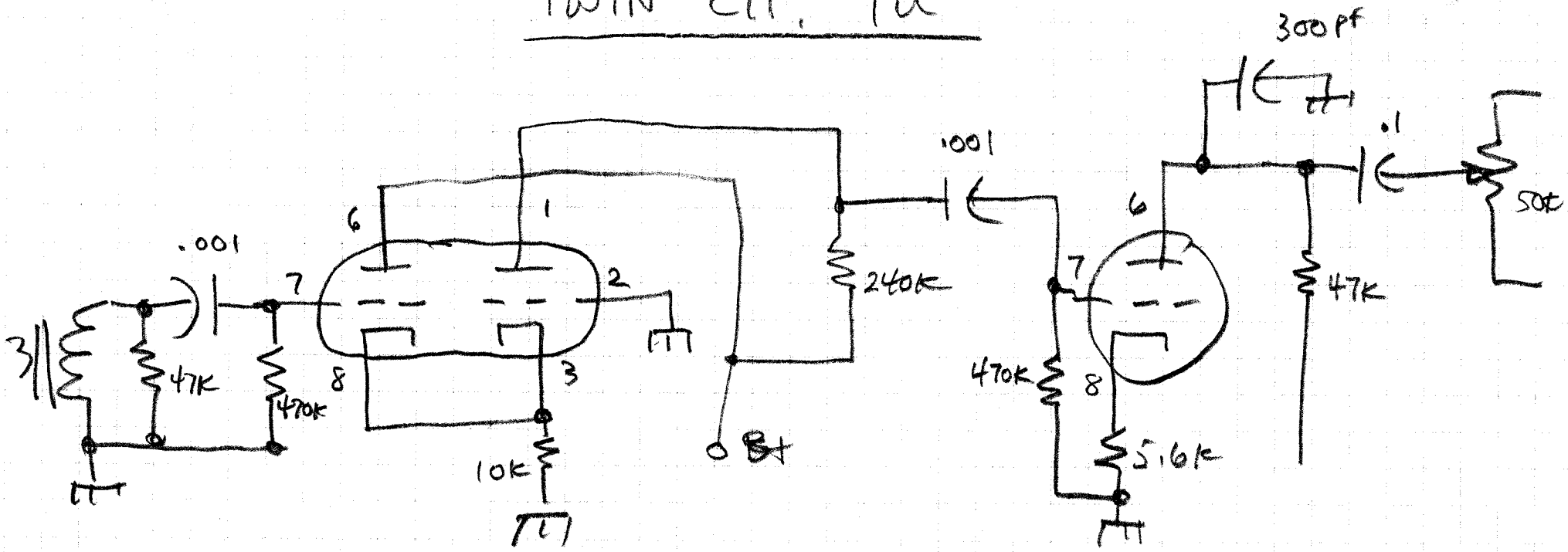


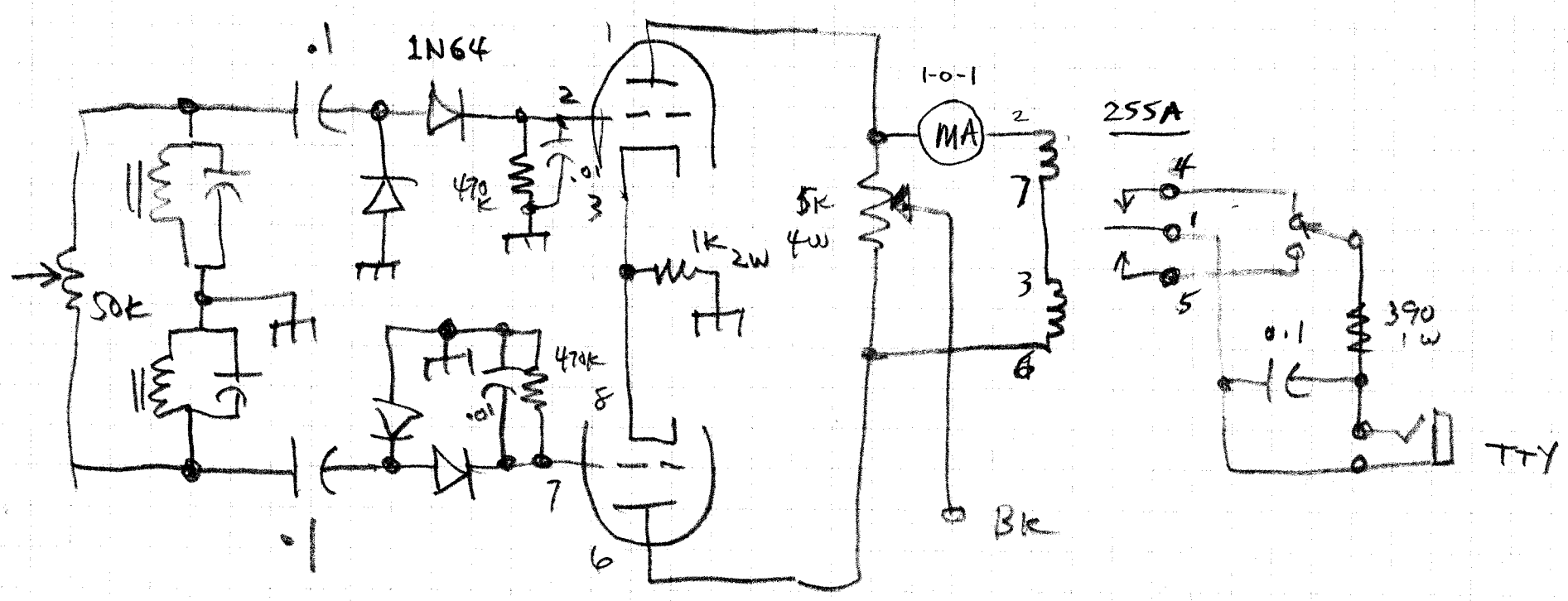
Headphone amp.

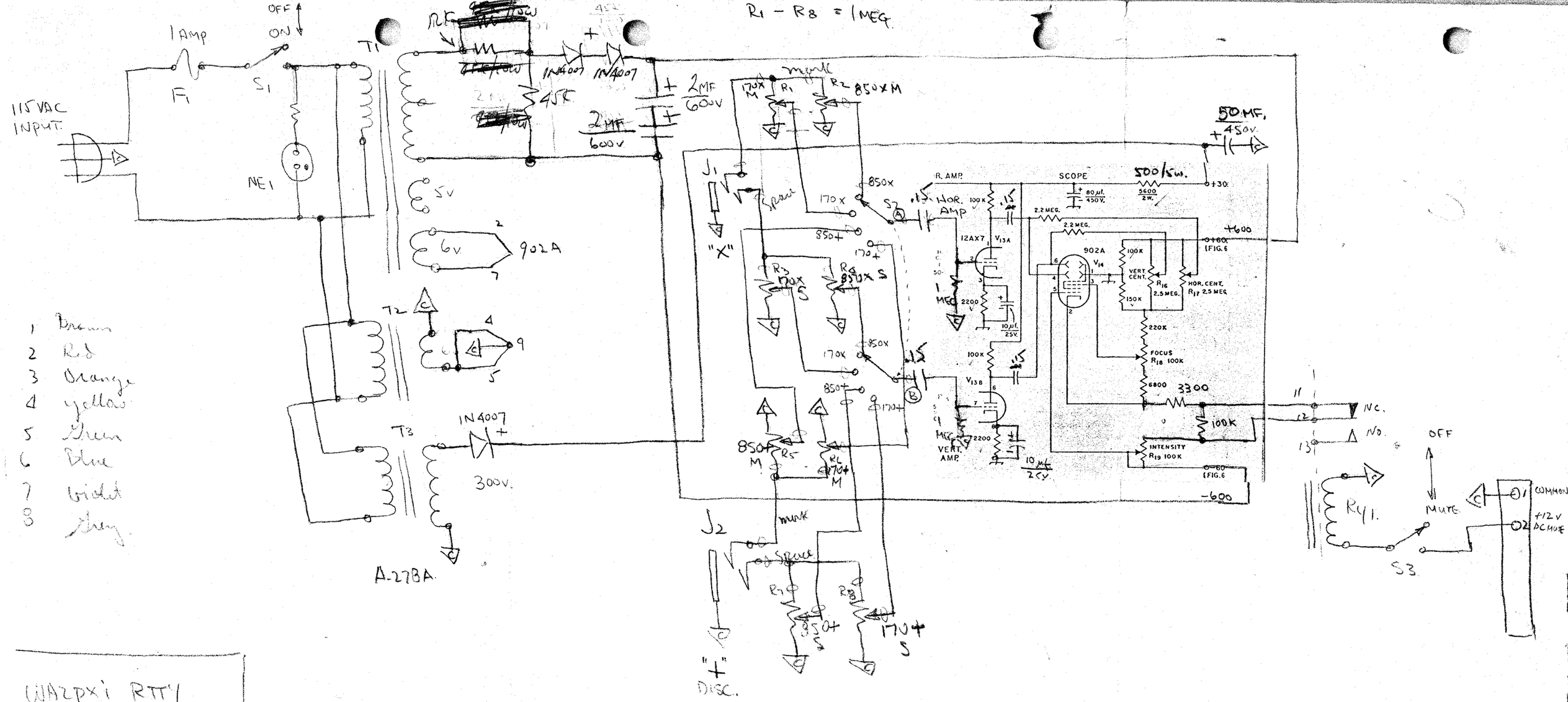


1985 ARRL P. 28-11

TWIN CIT. TX

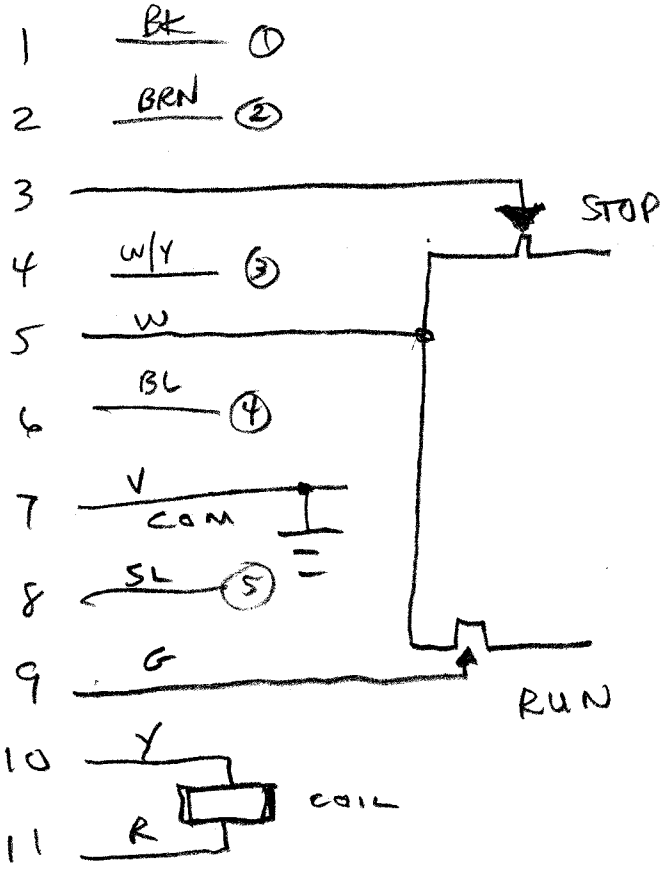

300 pf
.001
.1
50K
47K
240K
470K
5.6K
10K
B+
6
7
8
1
2
3

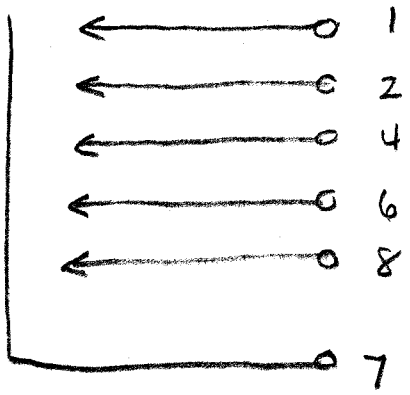

.1
1N64
470K
.01
1K 2W
5K 4W
1-0-1
MA
255A
50K
390 1W
TTY
Bk
1
2
3
4
5
6
7
8



WA2PXI RTTY TUNING INDICATOR

"Rms 7-20-70





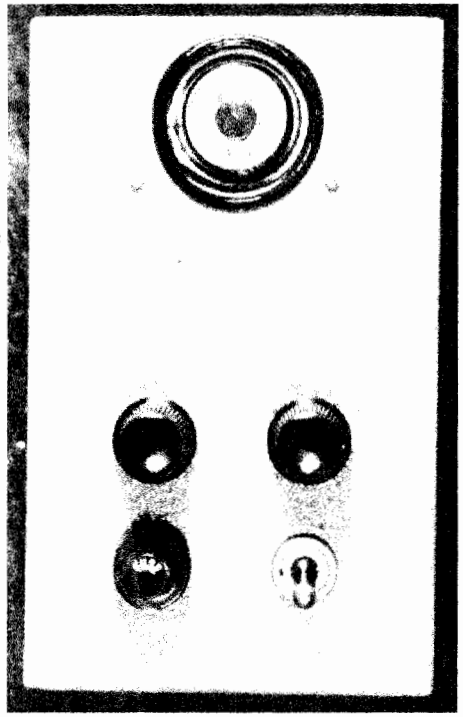
11- PIN CONN.

MOTOROLA INC.	
TDMS CODER	
BY:	DATE: 9/1/03
NO:	PAGE OF

3818-70(A)

Alltronics Teletypewriter Model - A Receiving Converter

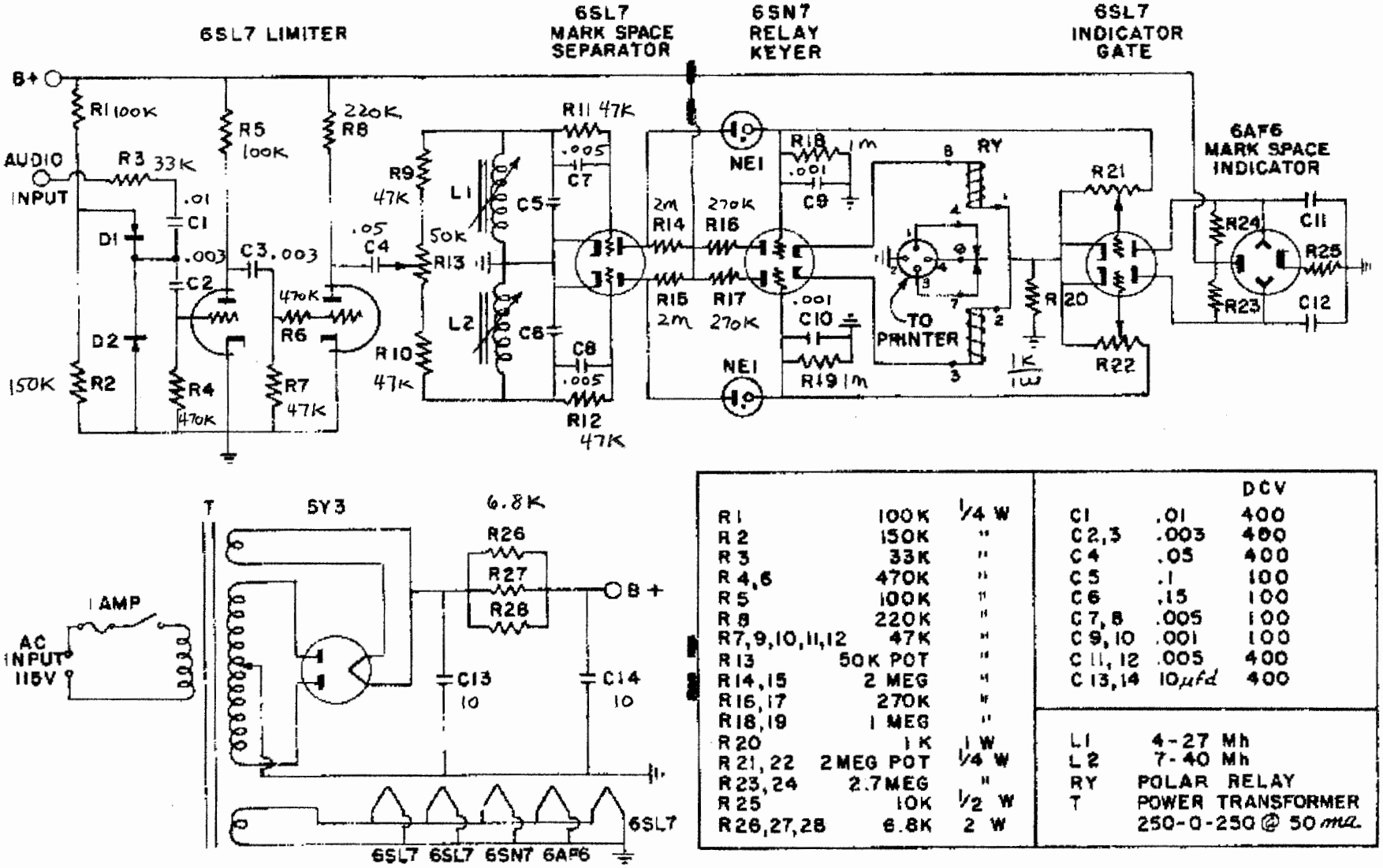
1. The Alltronics "Mark-Space" Receiving Converter plugs into the phone jack of any radio receiver and converts mark and space Teletypewriter signals into pulses suitable for the operation of a polar relay. The polar relay makes and breaks the 110 v. d. c. supply to the selecting magnets within the Teletypewriter printer.
2. The Mark-Space Receiving Converter has a built in 110 v. a. c. power supply, to supply the filament and plate voltages for its operation.
3. A dual unit 6AF6 Tuning Eye is used for more accurate receiver tuning.
4. A 6SLT amplifier increases the sensitivity of the tuning eye.
5. Two potentiometers mounted on the panel control tuning eye adjustments.
6. There are two octal sockets on the back of the chassis, one of which may be used to plug in an octal base midget polar relay. The other socket is for input from the associated radio receiver, and for connections to polar relays other than the type furnished by us.
7. All resistors and capacitors, except the power supply filter capacitor which is the octal base plug-in type, are mounted on two terminal boards. These terminal boards are mounted vertically on opposite sides of the chassis base. Wiring to the terminal boards is colorcoded and cabled.
8. Tube line-up: 6SL7 limiter, 6SL7 detector, 6SN7 current amplifier, 6AF6 (lual tuning eye, 6SL7 tuning eye amplifier, 5Y3GET rectifier, two NE-2 neon.
9. Panel size 4x6 inches, depth of the cabinet 8 inches.
10. Cabinet finish: Gray crackle.



Kit price with tubes $59.50. Wired and tested $89.50, F.O.B. Boston.

Polar relay 88.50.

ALLTRONICS TELEWRITER CONVERTER MODEL "A"

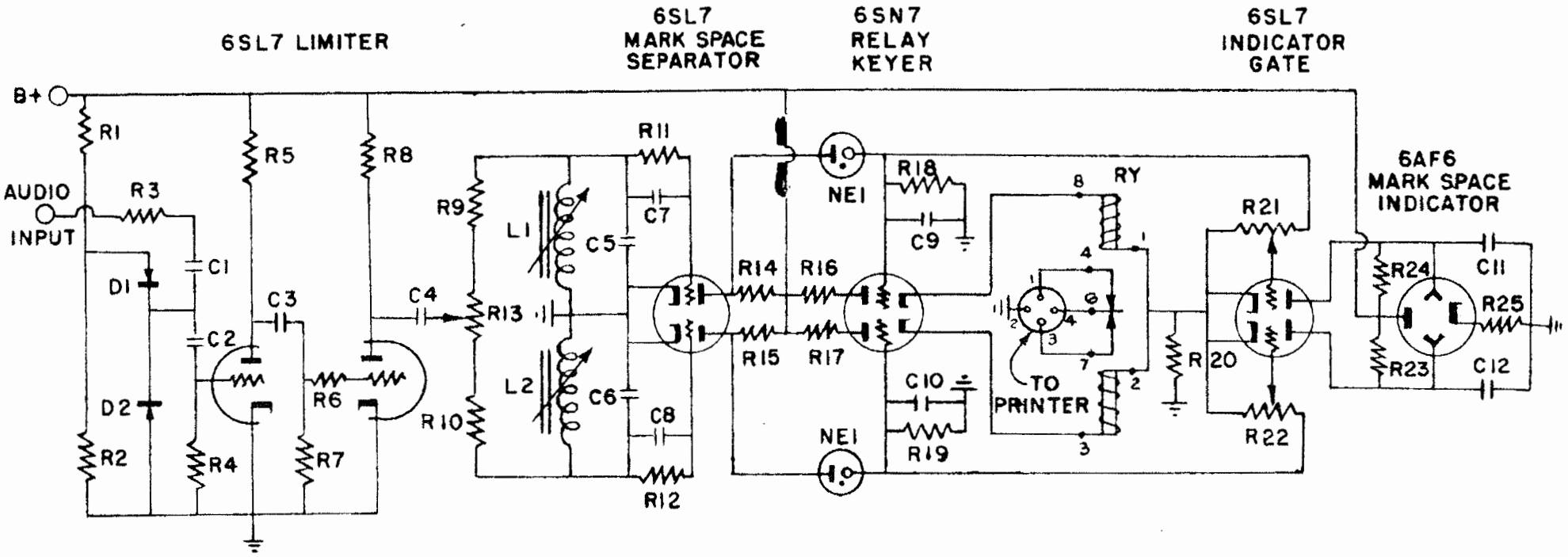


R1	100K	1/4 W
R2	150K	"
R3	33K	"
R4,6	470K	"
R5	100K	"
R8	220K	"
R7,9,10,11,12	47K	"
R13	50K POT	"
R14,15	2 MEG	"
R16,17	270K	"
R18,19	1 MEG	"
R20	1K	1 W
R21,22	2 MEG POT	1/4 W
R23,24	2.7 MEG	"
R25	10K	1/2 W
R26,27,28	6.8K	2 W

		DCV
C1	.01	400
C2,3	.003	400
C4	.05	400
C5	.1	100
C6	.15	100
C7,8	.005	100
C9,10	.001	100
C11,12	.005	400
C13,14	10 μfd	400

L1	4-27 Mh
L2	7-40 Mh
RY	POLAR RELAY
T	POWER TRANSFORMER 250-0-250 @ 50 ma.

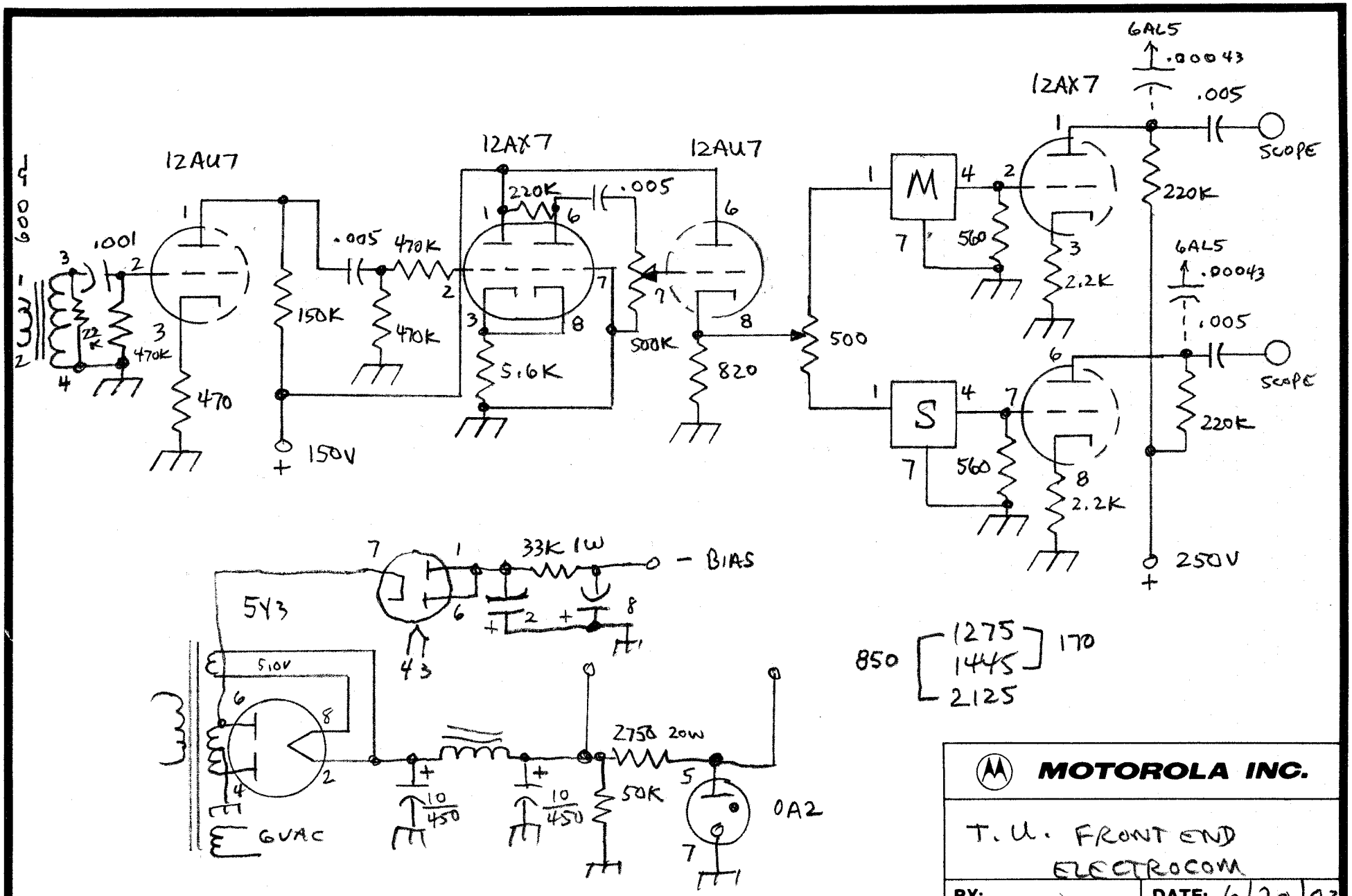
ALLTRONICS TELEWRITER CONVERTER MODEL "A"



R1	100K	1/4 W
R2	150K	"
R3	33K	"
R4,6	470K	"
R5	100K	"
R8	220K	"
R7,9,10,11,12	47K	"
R13	50K POT	"
R14,15	2 MEG	"
R16,17	270K	"
R18,19	1 MEG	"
R20	1K	1 W
R21,22	2MEG POT	1/4 W
R23,24	2.7MEG	"
R25	10K	1/2 W
R26,27,28	6.8K	2 W

		DCV
C1	.01	400
C2,3	.003	400
C4	.05	400
C5	.1	100
C6	.15	100
C7,8	.005	100
C9,10	.001	100
C11,12	.005	400
C13,14	10 μfd	400

L1	4-27 Mh
L2	7-40 Mh
RY	POLAR RELAY
T	POWER TRANSFORMER 250-0-250 @ 50 ma

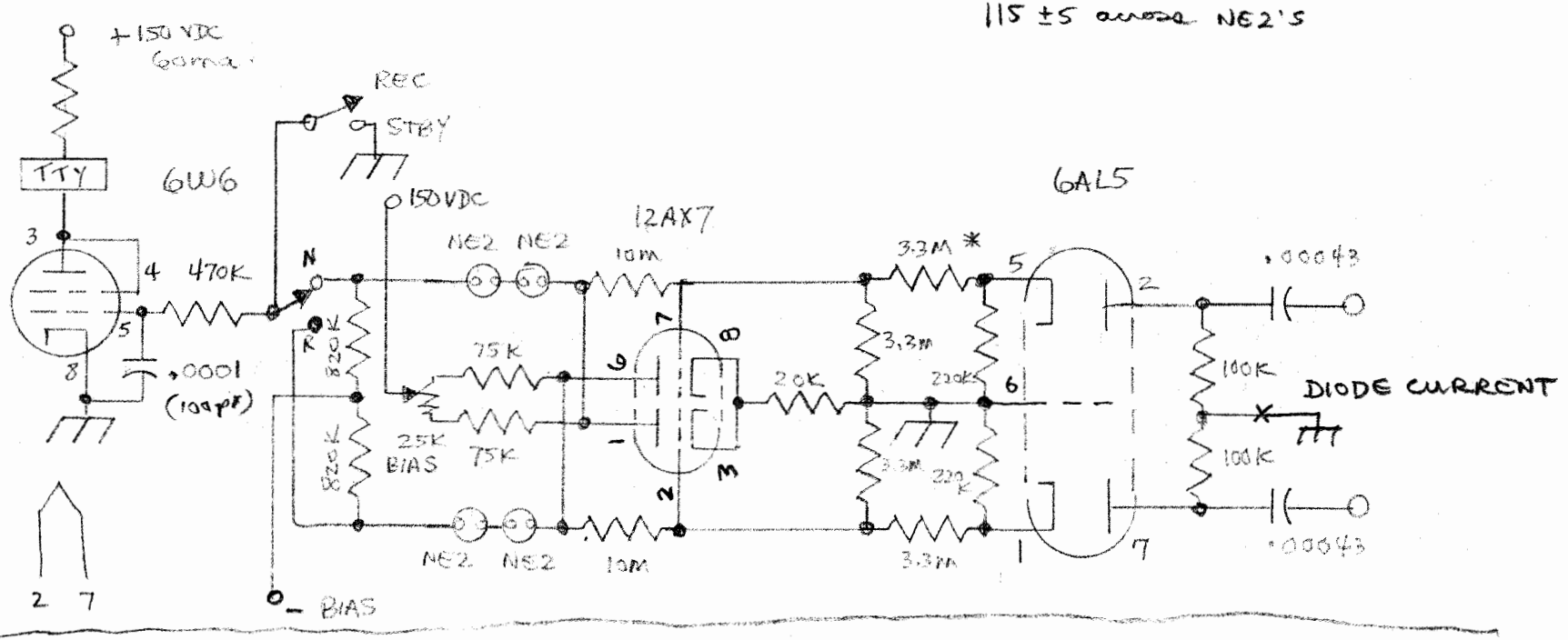


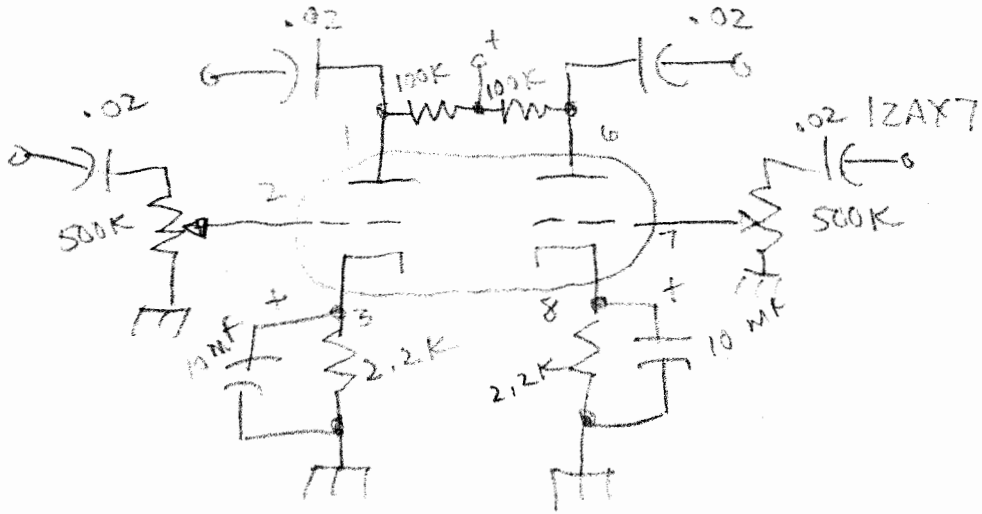
MOTOROLA INC.

T. U. FRONT END
ELECTROCOM

BY:	DATE: 6/20/03
NO:	PAGE OF

3818-70(A)





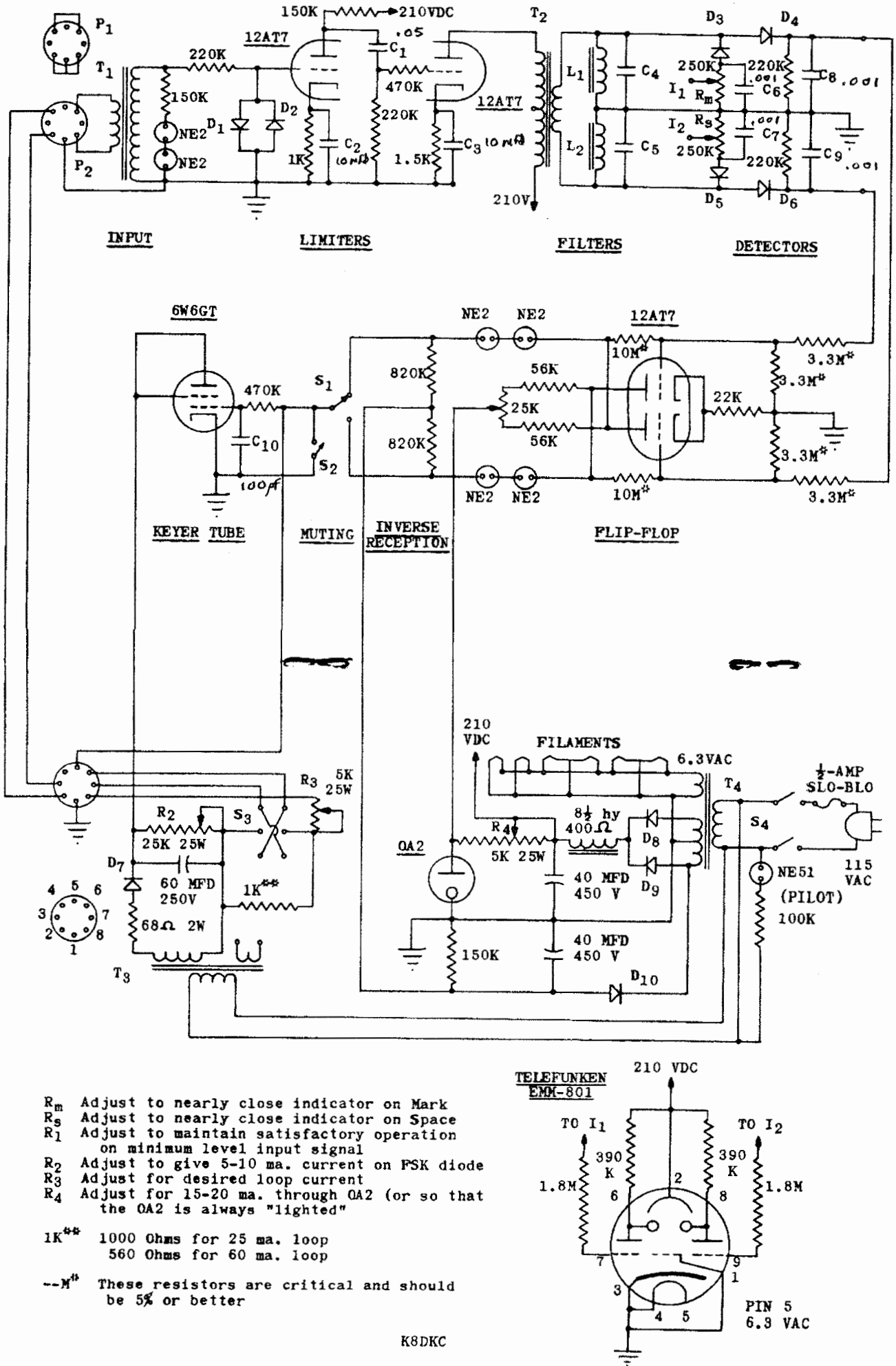
Scope Amp.

* 3.0M to 3.9M

MOTOROLA INC.	
BY:	DATE:
NO:	PAGE OF

3818-70(A)

CIRCUIT DIAGRAM FOR THE MAINLINE RADIOTELETYPE RECEIVING CONVERTER



R_m Adjust to nearly close indicator on Mark
R_s Adjust to nearly close indicator on Space
R_1 Adjust to maintain satisfactory operation on minimum level input signal
R_2 Adjust to give 5-10 ma. current on FSK diode
R_3 Adjust for desired loop current
R_4 Adjust for 15-20 ma. through OA2 (or so that the OA2 is always "lighted"

1K** 1000 Ohms for 25 ma. loop
560 Ohms for 60 ma. loop

--M* These resistors are critical and should be 5% or better

K8DKC

TELEFUNKEN EMM-801

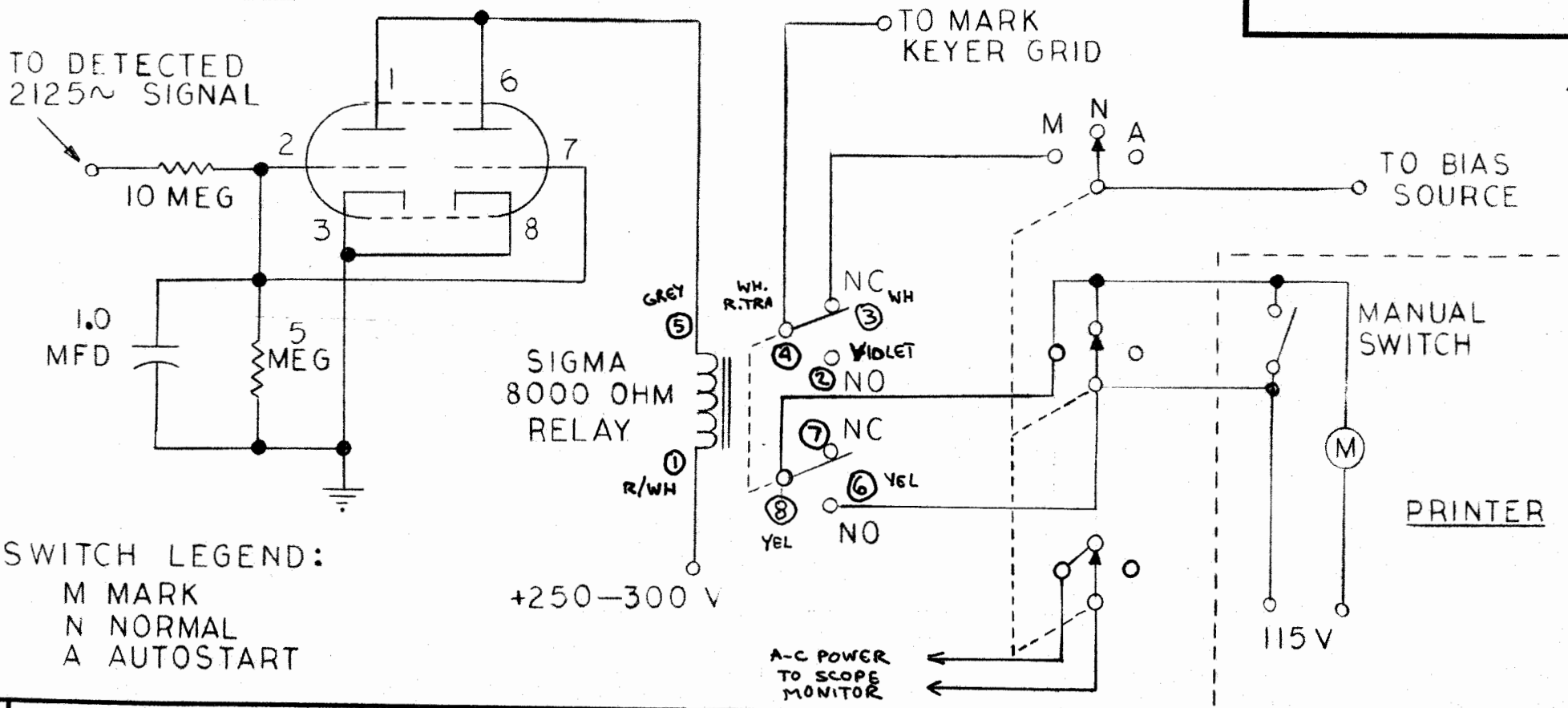
FORM 2981 REV. 2-58

DWG SIZE
A

UNLESS OTHERWISE SPECIFIED

ALL FINISHED DIMENSIONS ± .010
ALL FORGING DIMENSIONS ± .030
ALL CASTING DIMENSIONS ± .030

12AT7



SWITCH LEGEND:
M MARK
N NORMAL
A AUTOSTART

NF	REVISIONS			
	SYM	DESCRIPTION	DATE	APPROVAL
		ADD A/C SW. CIR.	8-10-60	

NEXT ASSY	USED ON

FINAL PROTECTIVE FINISH

MATERIAL

ORIGINAL DATE OF DWG
8-5-60

DFMN

SCHEMATIC

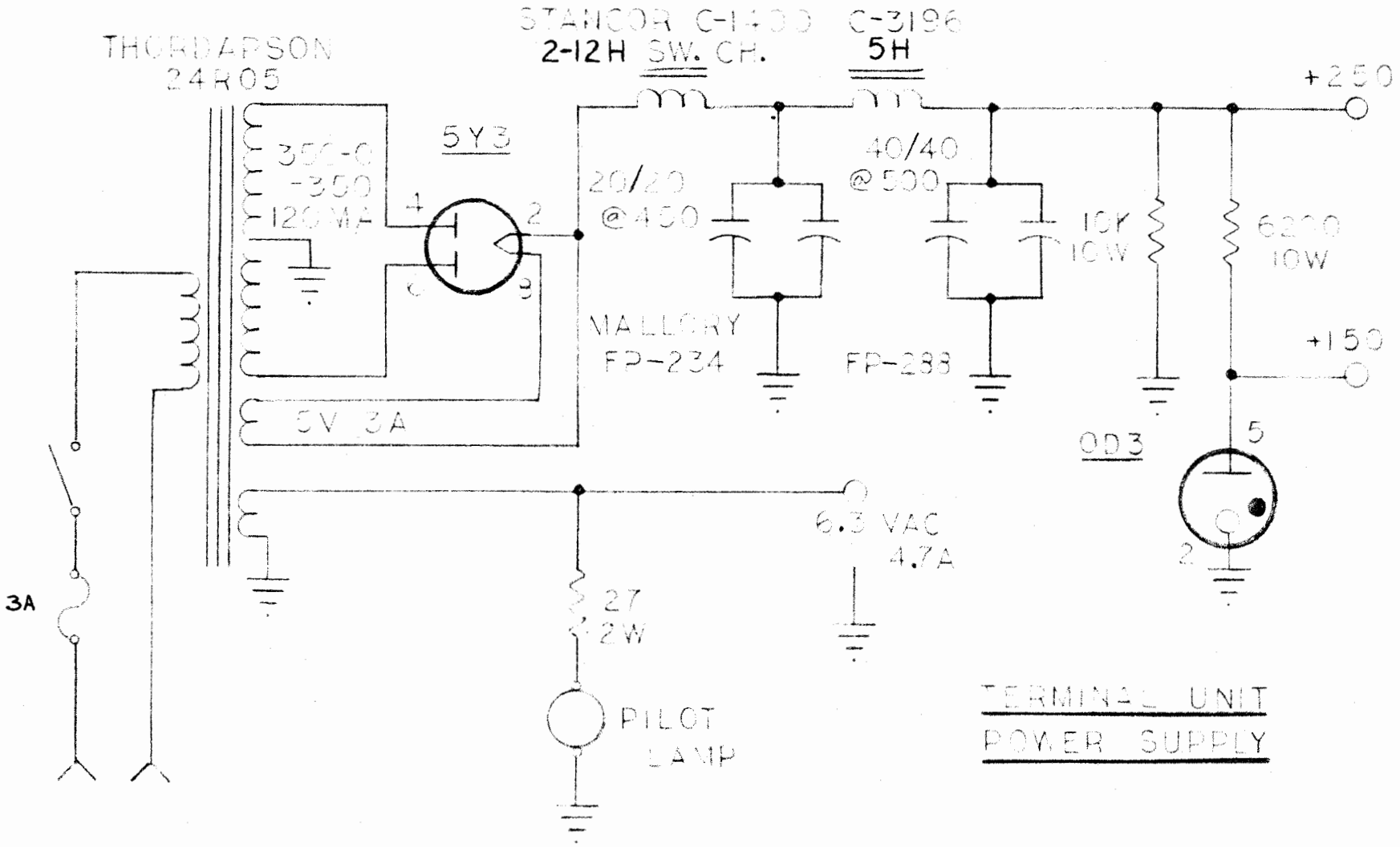
AUTOSTART AND MARK-HOLD

SCALE | UNIT WT

CHRYSLER CORP.
MISSILE OPERATIONS

DWG SIZE	
A	EL-1145968
	SHEET

PEERLESS BLUE PRINT CO. 2M-6-57


THORDARSON
24R05
STANCOR C-1400 C-3196
2-12H SW. CH.
5H
+250
350-0
-350
120MA
5Y3
1
2
3
20/20
@450
40/40
@500
10K
10W
6200
10W
MALLORY
FP-234
FP-288
+150
5V 3A
0D3
5
2
6.3 VAC
4.7A
3A
27
2W
PILOT
LAMP
TERMINAL UNIT
POWER SUPPLY

DWG SIZE A

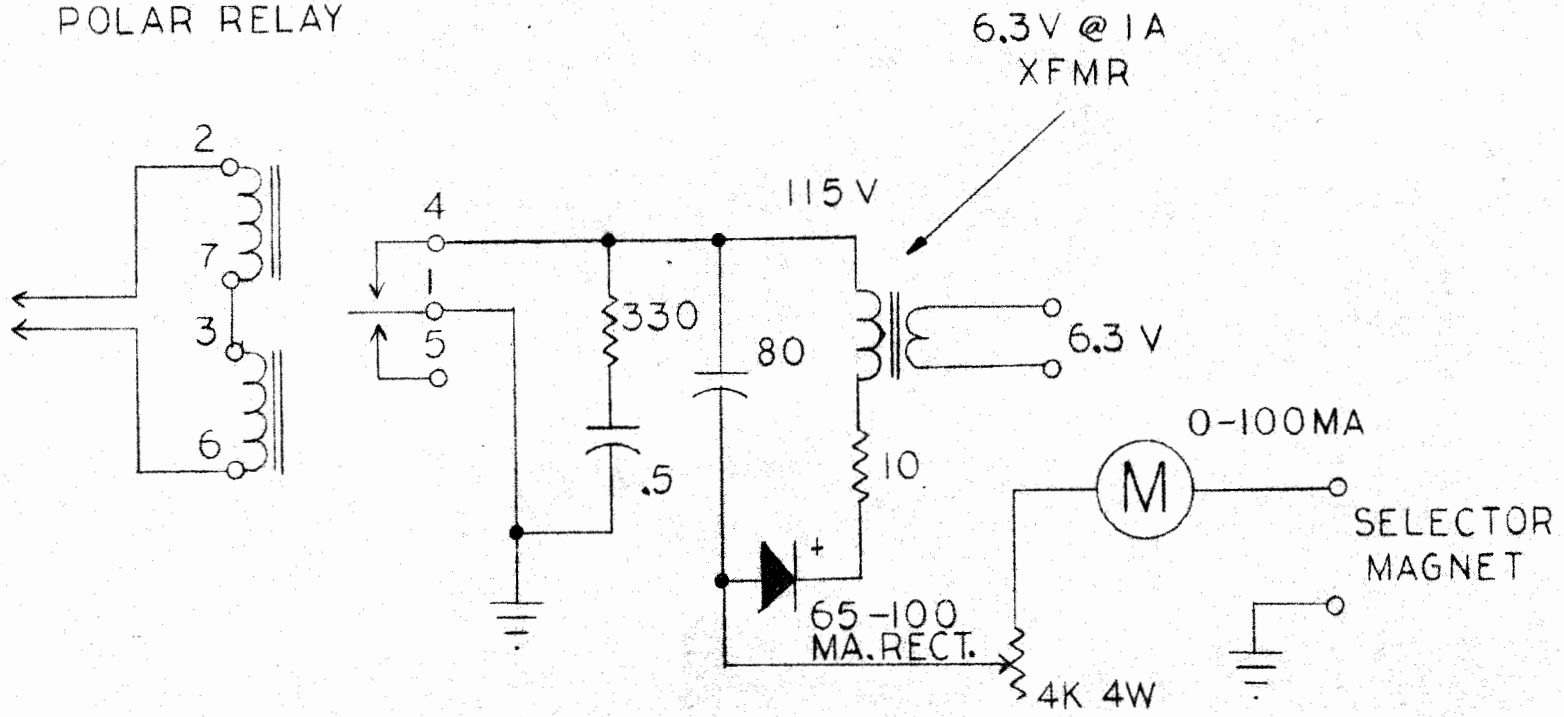
UNLESS OTHERWISE SPECIFIED

ALL FINISHED DIMENSIONS ± .010

ALL FORGING DIMENSIONS ± .030

ALL CASTING DIMENSIONS ± .030

POLAR RELAY



MF	REVISIONS			
	SYM	DESCRIPTION	DATE	APPROVAL

NEXT ASSY	USED ON

FINAL PROTECTIVE FINISH

MATERIAL

ORIGINAL DATE OF DWG 1-13-60

DFMN

POWER SUPPLY

POLAR RELAY

SCALE | UNIT WT

CHRYSLER CORP.
ENGINEERING DIV.
MISSILE BRANCH

DWG SIZE A

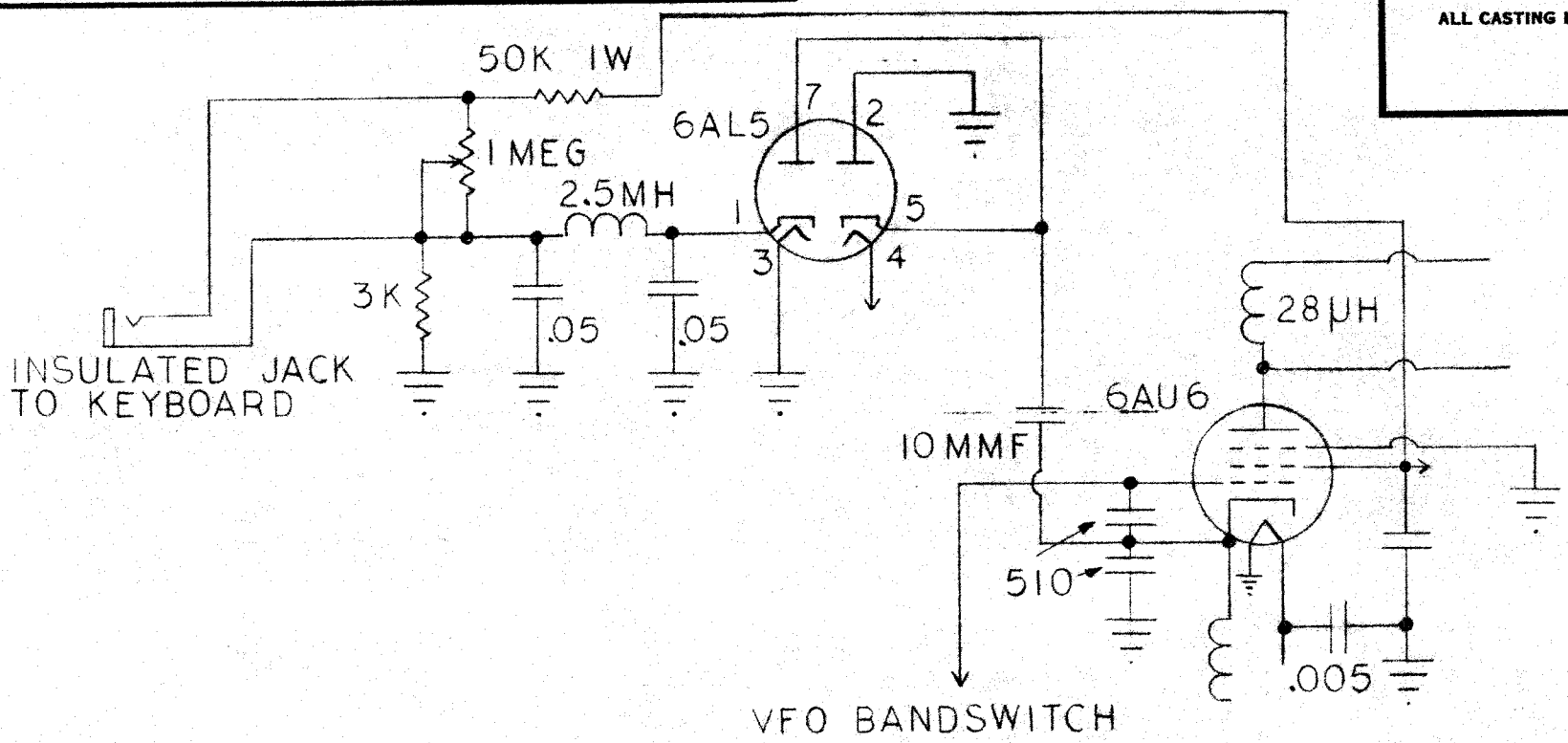
EL-1145962

SHEET

DWG SIZE	
A	

UNLESS OTHERWISE SPECIFIED

ALL FINISHED DIMENSIONS ± .010
ALL FORGING DIMENSIONS ± .030
ALL CASTING DIMENSIONS ± .030



MF	REVISIONS			
	SYM	DESCRIPTION	DATE	APPROVAL

NEXT ASSY	USED ON

FINAL PROTECTIVE FINISH

MATERIAL

ORIGINAL DATE OF DWG
1-13-60

DFMN

SCHEMATIC

FSK KEYER

SCALE | UNIT WT

CHRYSLER CORP.
ENGINEERING DIV.
MISSILE BRANCH

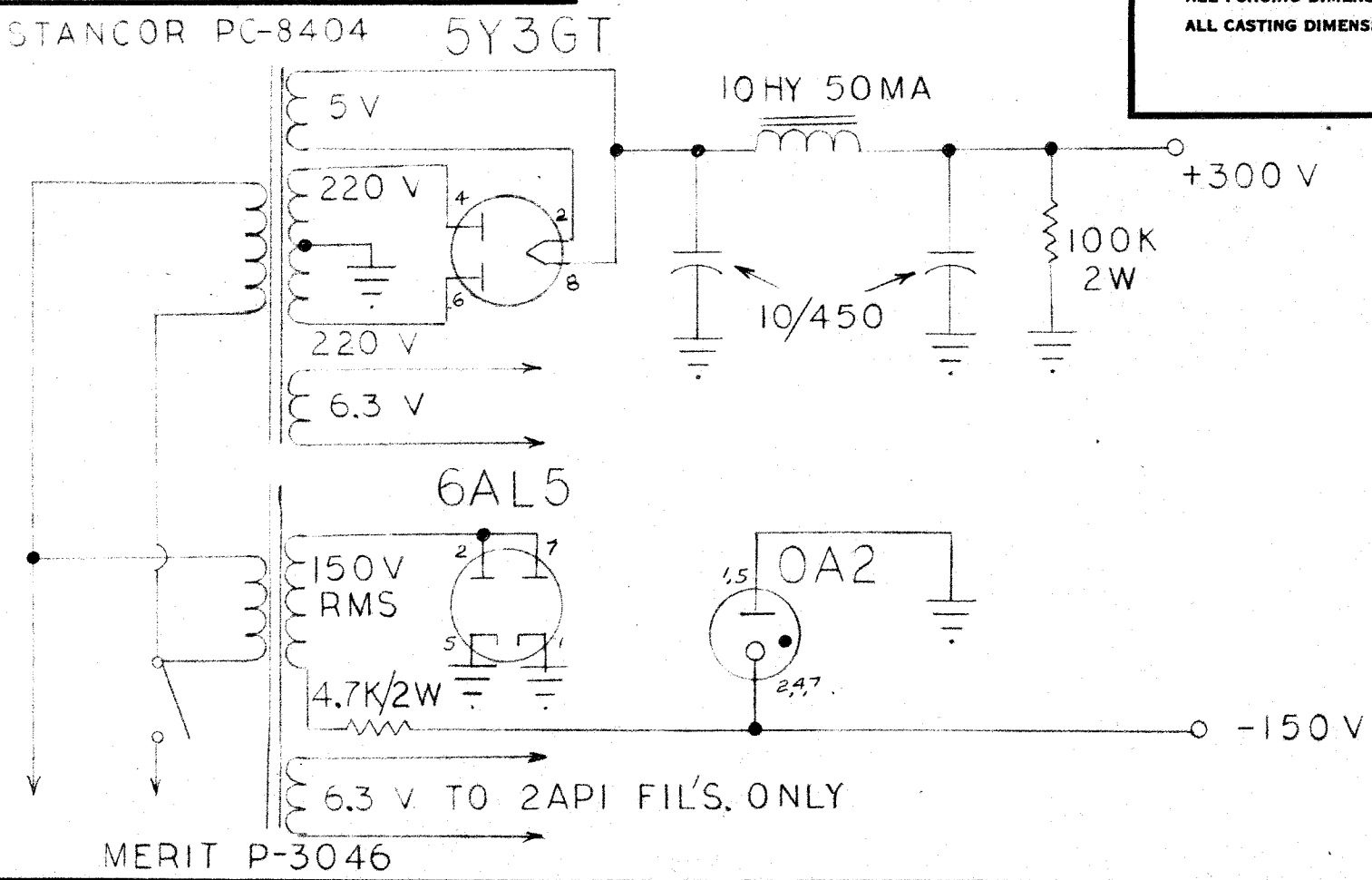
DWG SIZE	
A	EL-1145961
	SHEET

FORM 3381 REV. 12-54

PEERLESS BLUE 1M 7-55

DWG SIZE A

UNLESS OTHERWISE SPECIFIED
ALL FINISHED DIMENSIONS ± .010
ALL FORGING DIMENSIONS ± .030
ALL CASTING DIMENSIONS ± .030



MF	REVISIONS			
	SYM	DESCRIPTION	DATE	APPROVAL

NEXT ASSY	USED ON
EL-1145960	

FINAL PROTECTIVE FINISH

MATERIAL

ORIGINAL DATE OF DWG
1-19-60

DFMN

POWER SUPPLY

P/O FSK TUNING INDICATOR

SCALE | UNIT WT

CHRYSLER CORP.
ENGINEERING DIV.
MISSILE BRANCH

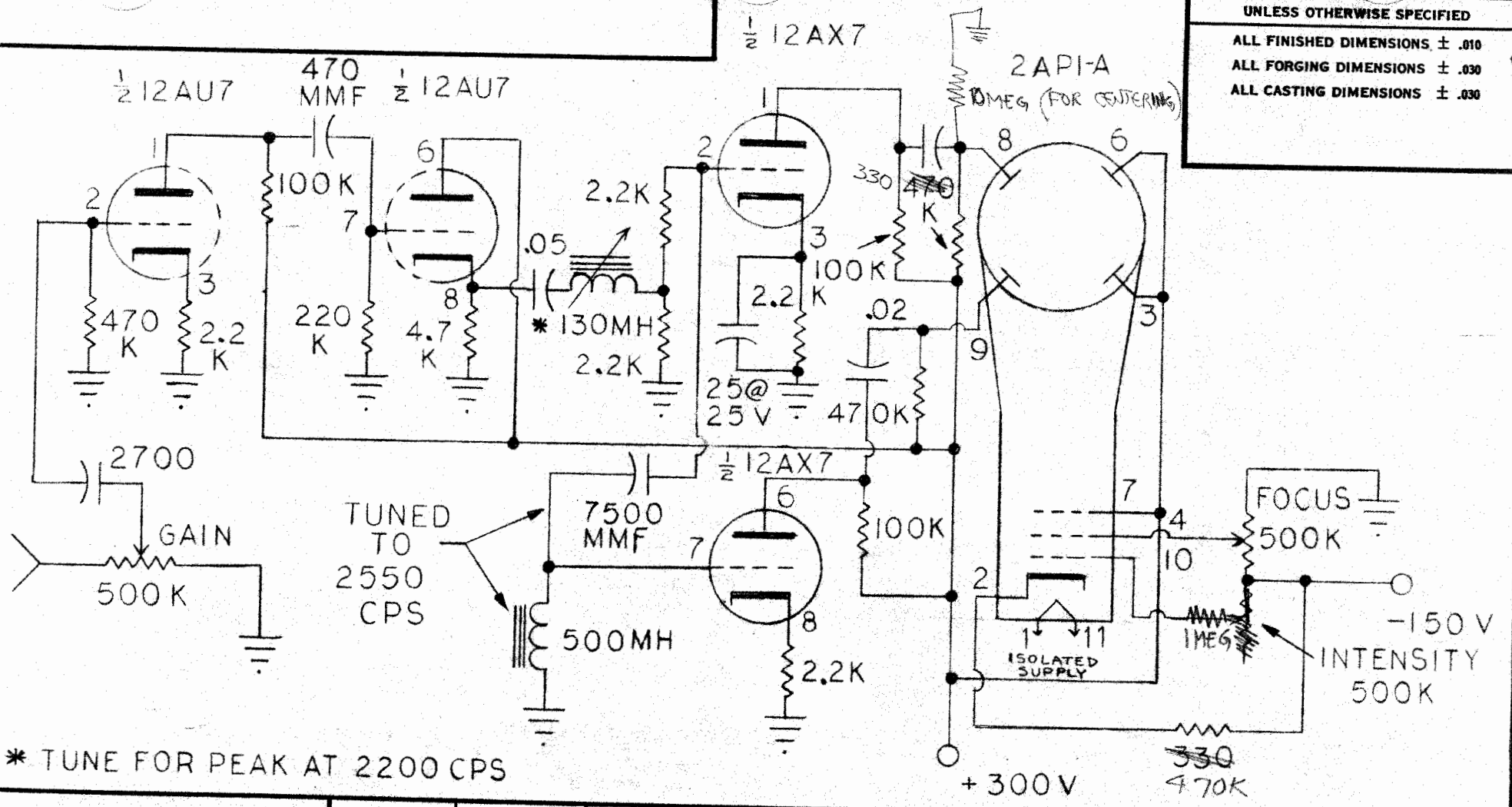
DWG SIZE A

EL-1145959

SHEET

DWG SIZE A

UNLESS OTHERWISE SPECIFIED
ALL FINISHED DIMENSIONS ± .010
ALL FORGING DIMENSIONS ± .030
ALL CASTING DIMENSIONS ± .030



MF	REVISIONS			
	SYM	DESCRIPTION	DATE	APPROVAL

NEXT ASSY	USED ON

FINAL PROTECTIVE FINISH

MATERIAL

ORIGINAL DATE OF DWG
1-13-60

DFMN

INDICATOR

FSK TUNING

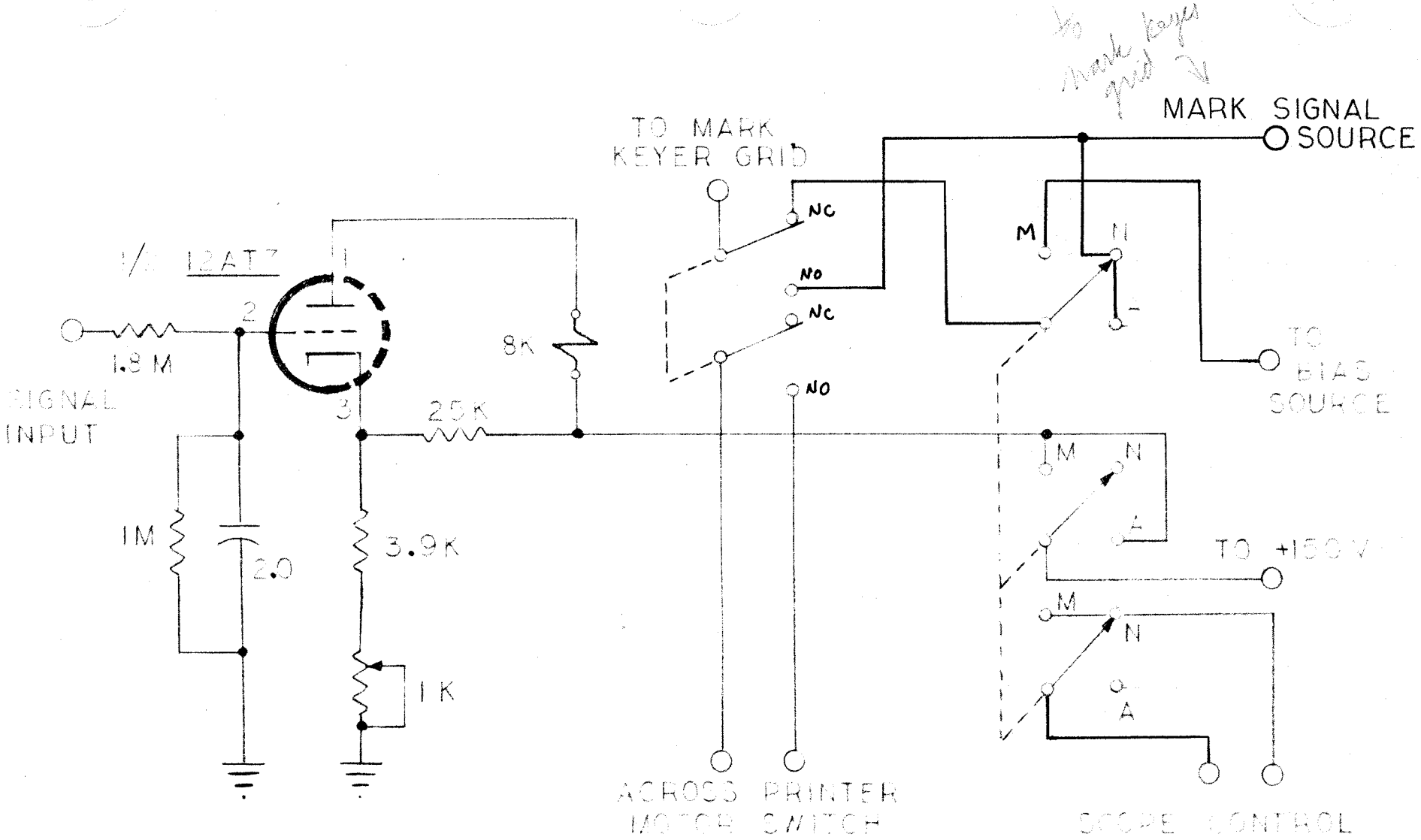
SCALE | UNIT WT

CHRYSLER CORP.
ENGINEERING DIV.
MISSILE BRANCH

DWG SIZE A

EL-1145960

SHEET



SWITCH LEGEND

M MARK LOCK
N NORMAL
A AUTOSTART

MARK LOCK & AUTOSTART

FORM 2321 REV. 12-54

DWG SIZE A

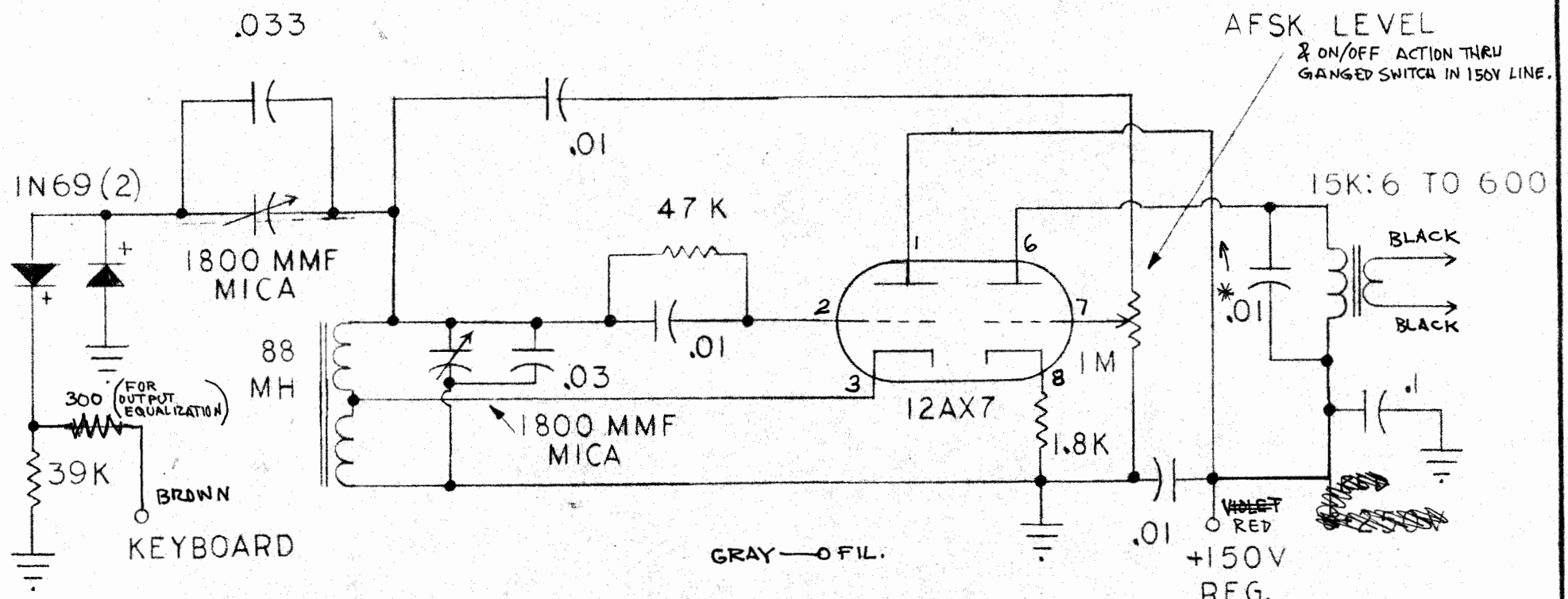
UNLESS OTHERWISE SPECIFIED

ALL FINISHED DIMENSIONS ± .010

ALL FORGING DIMENSIONS ± .030

ALL CASTING DIMENSIONS ± .030

* ADJUST VALUE FOR EQUAL OUTPUT AMPLITUDE OF THE TONES.



MF	REVISIONS			
	SYM	DESCRIPTION	DATE	APPROVAL

NEXT ASSY	USED ON

FINAL PROTECTIVE FINISH

MATERIAL

ORIGINAL DATE OF DWG 1-12-60

DFMN

SCALE

UNIT WT

SCHEMATIC

AFSK OSCILLATOR

CHRYSLER CORP.

ENGINEERING DIV.

MISSILE BRANCH

DWG SIZE A

EL-1145963

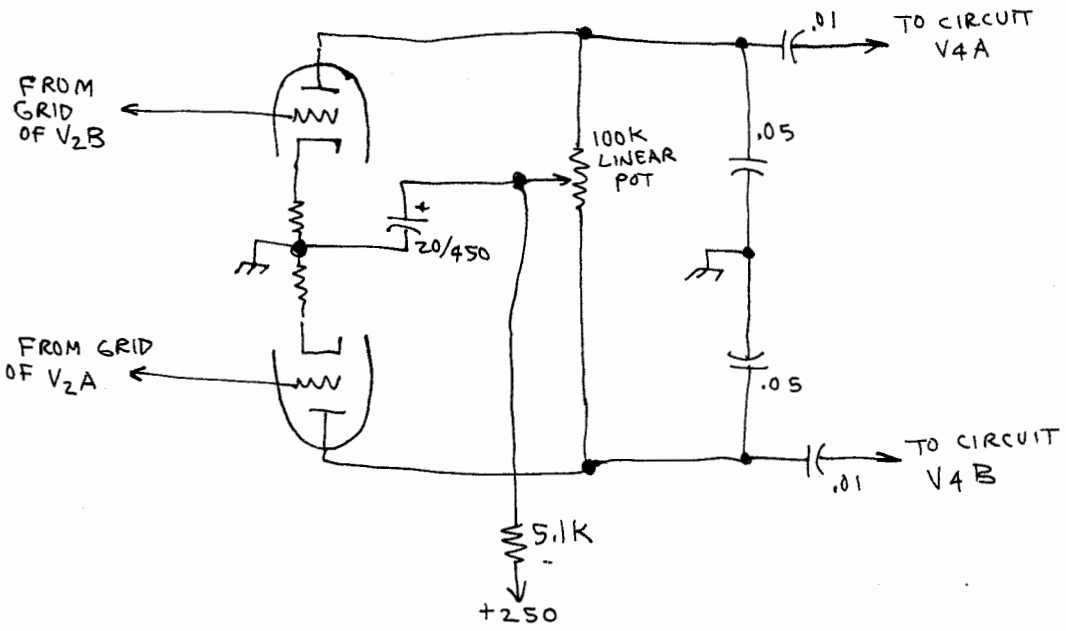
SHEET

PEERLESS BLUE 1M 7-55

SOME NOTES ON IMPROVING THE W2JAV TU

(1)

12AX7 (V_3A,B)



THIS CIRCUIT MINIMIZES PERFORMANCE IMBALANCE BETWEEN HALVES OF V_3. RESULT: BETTER COPY.

FROM: K4GRY, SEPT '63 "73" MAGAZINE

Operation Slow-Down - Part I

or

How To Convert 75 Speed Tape Gear To 60 Speed For RTTY

COURTESY RTTY SOCIETY OF MICHIGAN

By W8MCE - Walt Konrad

If you have recently become the proud owner of a Model 14 Typing Reperferator and "gate" transmitter the following information may prove useful in getting it on the air. As can be gleaned from the title the first project is to obtain gears as required for the units to operate at 60 words per minute. Contact Ray Morrison W9GRW and obtain the following parts:

1. If you have a 14 ROTR - Receive Only Typing Reperferator
   or a 14 KTR - Keyboard Typing Reperferator

   Pinion - 78510 (7 TEETH)
   Gear - 78509 (30 TEETH) approx. $5.00

   Pinion is for the motor shaft.
   Gear is for the main shaft.
   How to change 'em comes later.

   This unit does not punch holes out completely because it would be difficult to type on holes Hi! It uses 11/16" tape.

2. Order the following only if you have a mounting base which originally contained a motor driving, a jack shaft, which in turn drives 3 "gates"; or if you wish to build a short jack shaft to drive a single gate. See drawing #7 for the original base. One jack shaft gear (circled on drawing) was furnished with your gate. More to come!!

   MXB-16 - Multiple Xmitting Base

   Gear - 112690 (50 TEETH)
   Pinion - 112691 (11 TEETH) approx. $10.00 set

   (This will convert the base to an MXB-12)

3. If you received only a "gate" with an extra gear, the following is a special direct drive set. These can only be used with an 1800RPM motor. (See 4 below)

   Gear - 118296 - replaces gear on gate
   Pinion - 118297 - motor shaft — approx. $15.00

   Remember only (2) or (3) above not both!!!

4. Motors - Syncronous - 1800rpm - approximately $15.00

5. If neither 2 or 3 above suit you, you can home-brew a drive for the gate using any available motor and a couple of pulleys that give you a shaft speed on the gate of 368RPM. Credit W8QMI.

After you have acquired the necessary parts, here's what to do with 'em. Starting with the:

Typing Reperferator (it's easiest)

Drawing #1 shows a partial wiring sketch, the unit I received did not have the relay wired in. Out of all this all I wanted was the selector magnets, so I removed the Jones plug and its cable and connected the phone type plug with the black shell to terms 24 and 25. This brings out the selector on that cord, then connect the red shell plug and cord to terms 32 and 34. This brings out the tape feed-out magnet. Drawing #2 shows the terminal blocks and numbering.

Check the strapping of the small terminal block behind the selector, drawing 2A, if your T.U. output is 20 milliamp wire for series operation, if your T.U. has 60 milliamp output wire for parallel operation.

The tape feed out magnet resistance is 1020 ohms and requires about 15 mils D.C. for its operation.

Next step - change gears. Take the typing unit (the part with the type basket, motor, etc.) off the base by removing the two large knurled head machine screws on the left front and right rear of the typing unit.

Next remove the range finder (that's the part on top with the 0-120 scale and the adjustable pointer) by taking out its two mounting screws - the armature for the tape feed out magnet (with the small wooden knob) falls off at the same time, save the spring.

Remove the large headed screw marked LEFT HAND THREAD that you find under the range finder. With a turning motion remove the selector cam and washer and felt disk above it. Drawing 4 is an exploded view of the main shaft assembly (keep it handy).

Next, stand the typing unit up on its left side and start to operate. On drawing 4, remove the Handle. On drawing 5, remove the screw, washer and bushing that holds the punch bail, also the spring. Let this part swing down out of the way. Back on drawing 4, remove the upper and lower bearing caps. The main shaft should now be free. Carefully pull up and out on the main shaft (watch out for all the washers and springs at the top end). With the shaft out remove the keyed nut (can't remember if its left hand or not so be careful) and all the parts down to the driven gear. Notice that the friction dish that fits inside the gear has a stud on the lower side that fits in only one of the three holes in the gear. Remove the gear and replace it with the 78509 gear.

Then reassemble the main shaft before you forget where all of those pieces go. A liberal soaking of the felts with light machine oil won't do any harm while you at it.

Before reinstalling the main shaft, replace the pinion on the motor shaft with the 78510 pinion.

Put the main shaft back in and replace the bearing caps (do not tighten yet). Working from the top replace the selector cam and all the washers and felts that go with it. Tighten the left hand threaded retaining nut at the top of the shaft.

Rotate the main shaft by hand (clockwise looking at the top of the shaft) and check to be sure that the selector cams are centered on the cam followers as you rotate the shaft. Position the shaft up or down till you meet this requirement.

Holding the main shaft, turn the motor by hand to check for backlash - there should be between 5 and 10° - loosen the motor mounting screws and reposition the motor to meet this requirement.

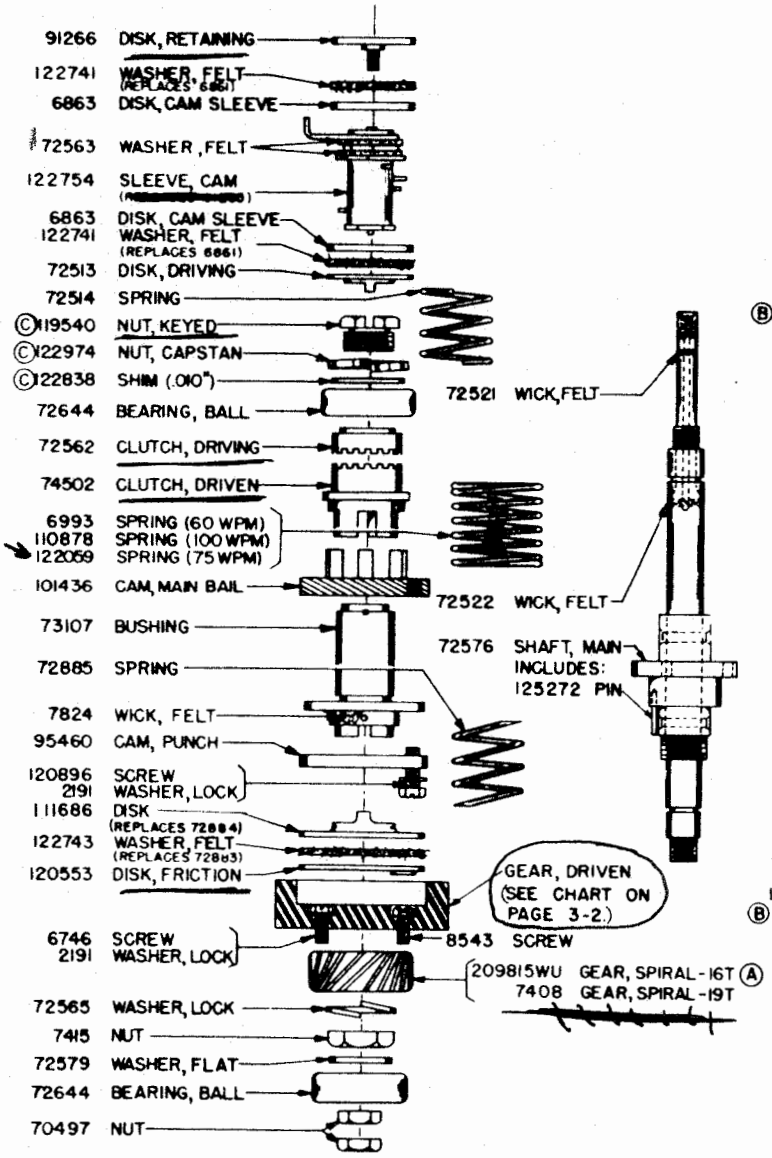
Check to see that there is about .010 clearance between the driving and driven clutch on the main shaft when the clutch is fully disengaged. Adjust by repositioning the clutch lever up or down.

Reassemble the punch bail, complete with spring, handle and range finder. Make sure that the pointed extension on the tape feed out armature fits between the bell crank and the frame of the range finder drawing #6.

Replace the typing unit on the base, connect A.C. power, T.U. output and if luck is with you, you should be in business.

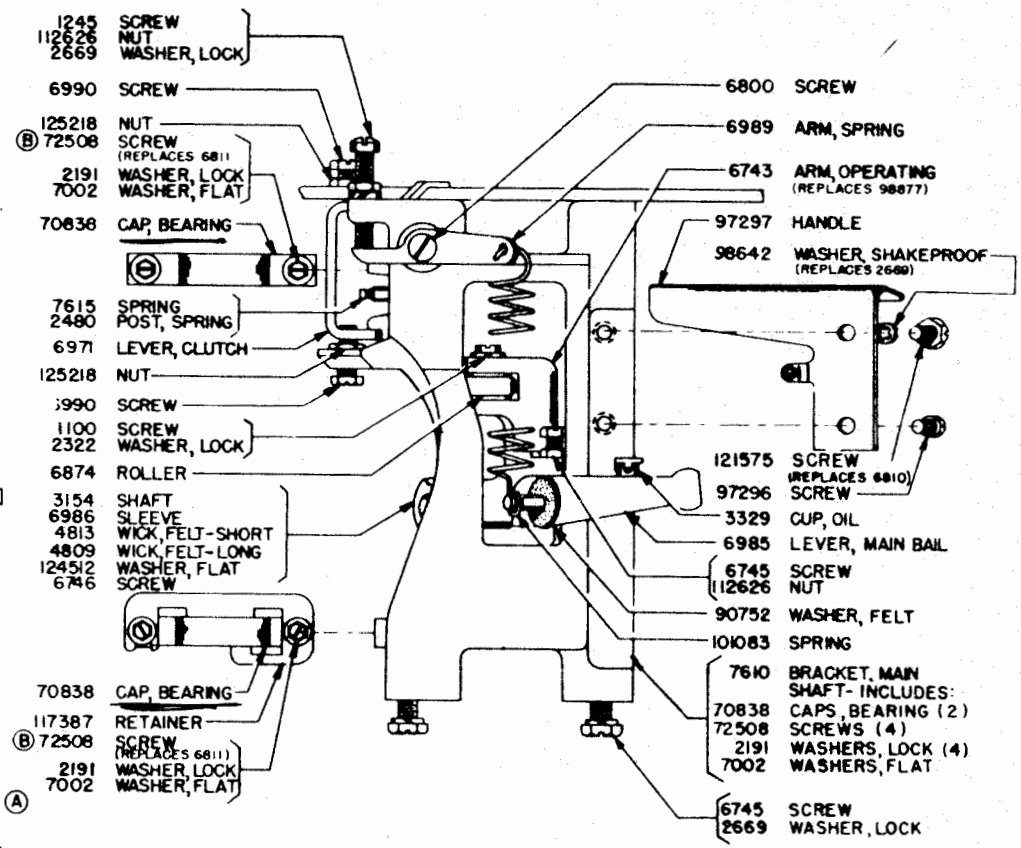
While receiving copy, loosen the knurled head screw holding the pointer on the range finder, move it toward zero till you find a point where the copy just begins to "junk". Then find the upper limit in the same manner - near the top of the scale. The spread between these two points is the range of the machine. Set the pointer and lock it at the middle of this range. For example, if the lower limit is 30, upper limit 90, set the pointer on 60.

More on variations for the reperf and how to get the Transmitter Distributor going in the next installment coming soon.



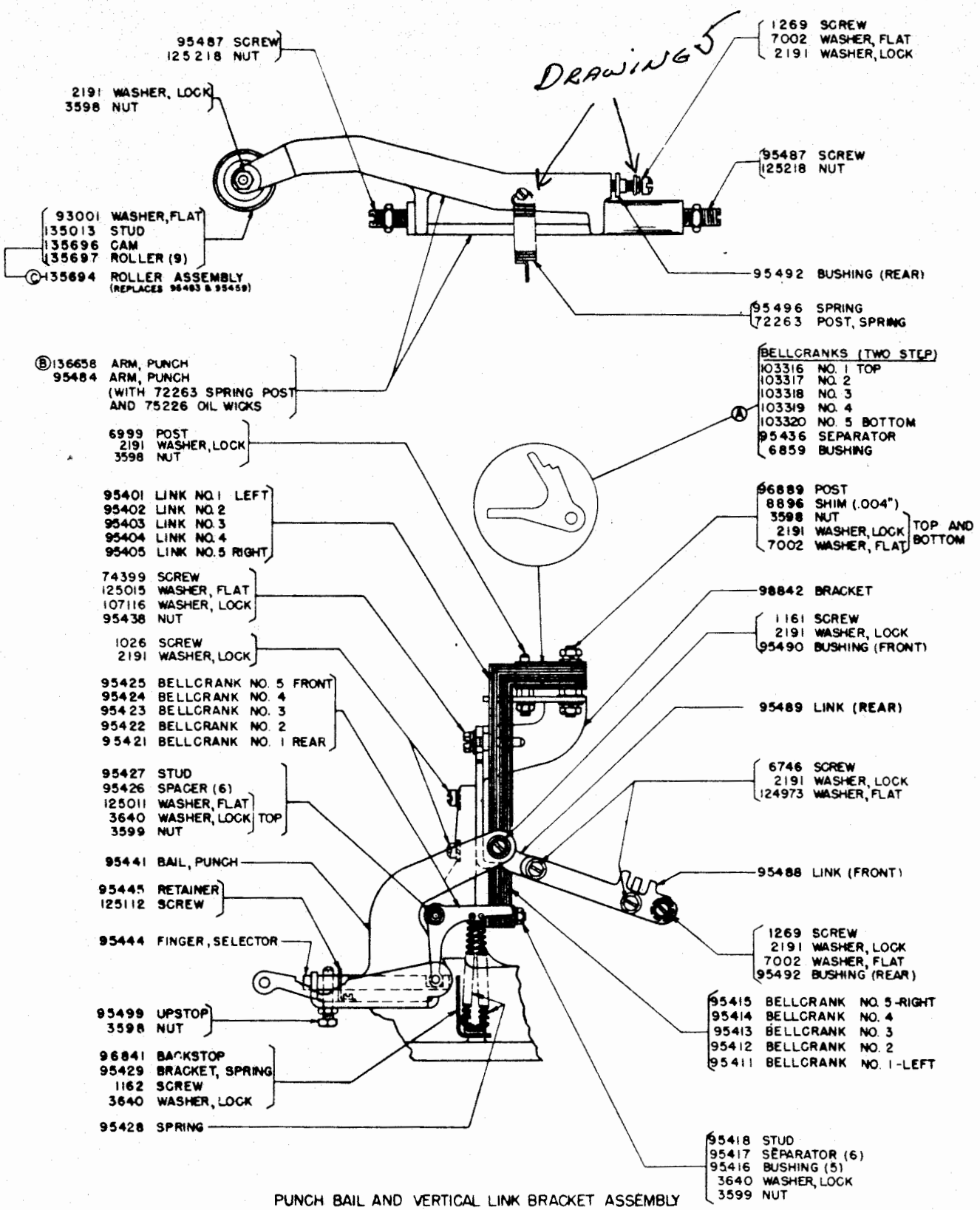
MAIN SHAFT ASSEMBLY

USE SAME SPRING



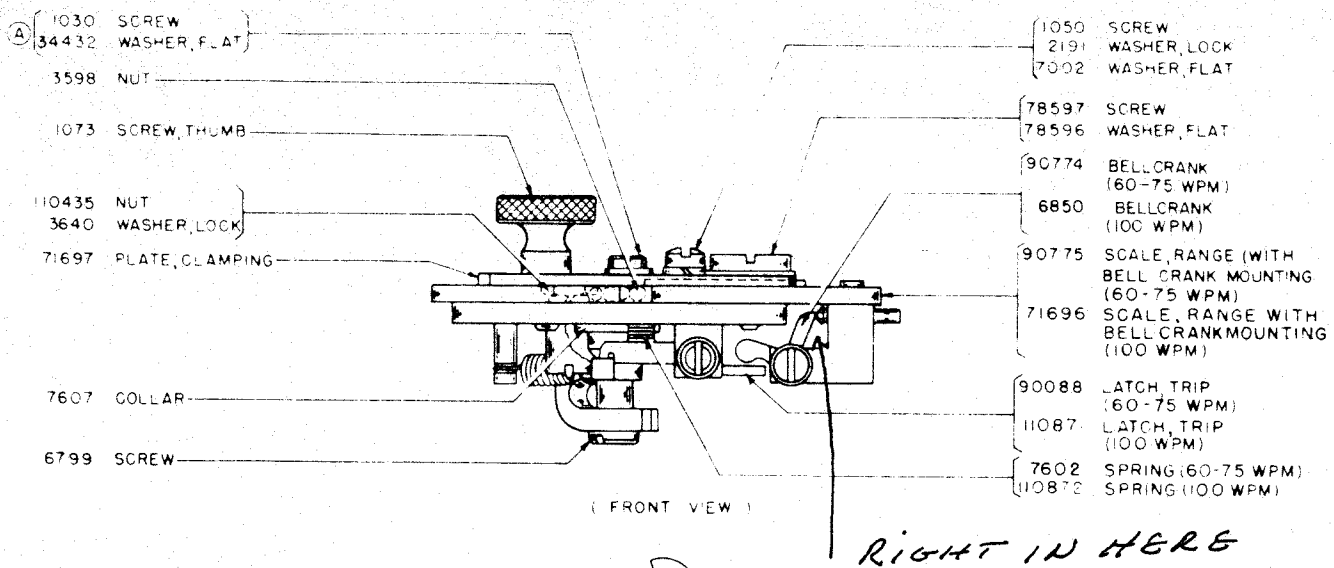
MAIN SHAFT BRACKET ASSEMBLY

DRAWING 4



PUNCH BAIL AND VERTICAL LINK BRACKET ASSEMBLY

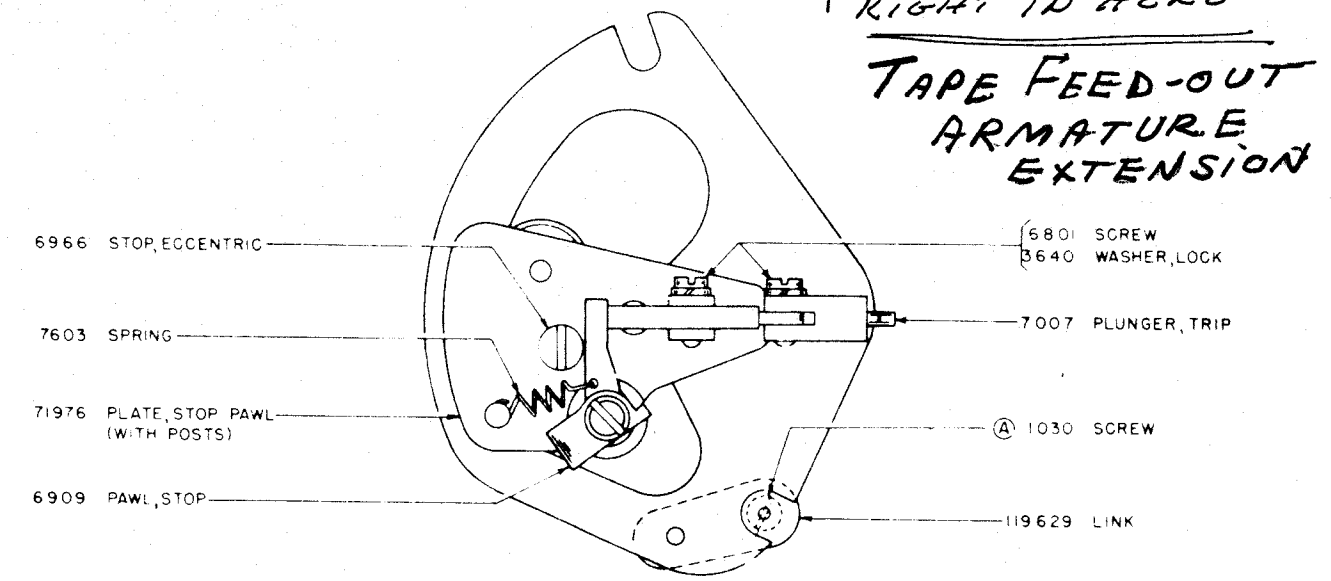
Ⓐ Ⓑ & Ⓒ FOR EXPLANATION SEE PAGE 7-2



(FRONT VIEW)

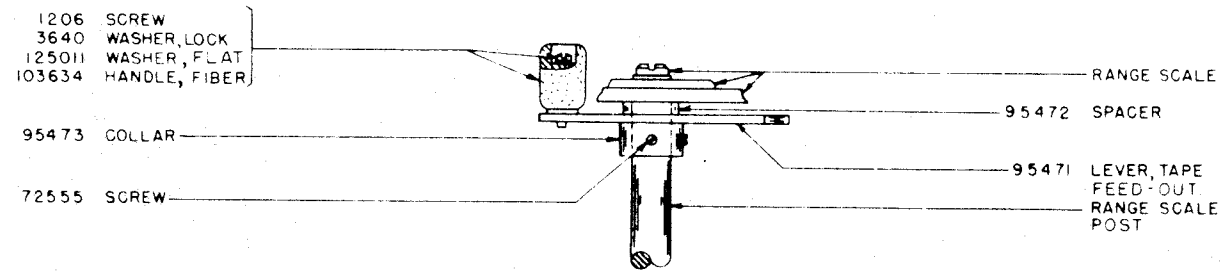
RIGHT IN HERE

TAPE FEED-OUT ARMATURE EXTENSION



(BOTTOM VIEW)

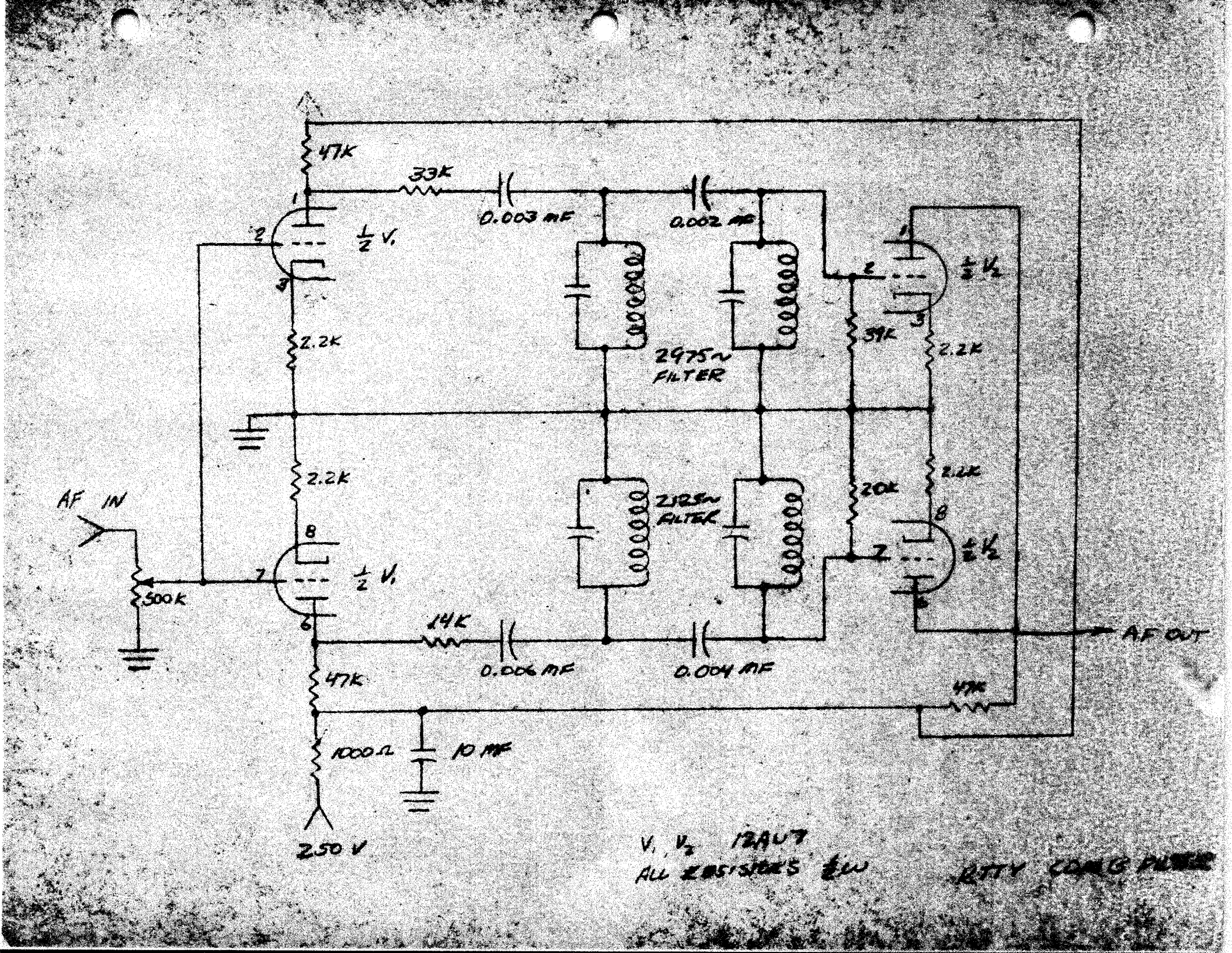
90760 RANGE SCALE ASSEMBLY (60-75 WPM)
119284 RANGE SCALE ASSEMBLY (100 WPM)
EXCLUDES PARTS MARKED Ⓐ



TAPE FEED-OUT HANDLE

DRAWING 6

ORIGINAL


47K
33K
0.003 MF
0.002 MF
½ V1
2.2K
2975~ FILTER
2125~ FILTER
AF IN
500K
14K
0.006 MF
0.004 MF
47K
1000Ω
10 MF
250 V
39K
20K
AF OUT
V1, V2 12AU7
ALL RESISTORS ½W
RTTY COMB FILTER

Operation Locomotion

or

Some Hints on Firing-Up the MXD13 Gate Unit

COURTESY RTTY SOCIETY OF MICHIGAN

By W8DTY - Ed Bruening

This paper briefly covers the basic mechanical and electrical steps to get the gate to operate. The wiring and switch arrangement is up to you.

1. Parts Needed

One Series Governed A-C motor, type 5BA65AA29
One D-83178 Compound Reduction Unit Assembly (Gear Box)
One 1-mfd, 400VDC capacitor
One 250 ohm resistor

2. Where to get 'em

The first two items may be obtained from:

N. Silverstine & Co.,
6532 E. McNichols Ave.,
Detroit 12, Michigan

Motor - $2.69
Gear Box - $3.88

The "resistor" is really the resistor assembly found in the base of the typing-reperforator. (Two 500 ohm resistors in parallel). The capacitor you will have to furnish----

3. Motor Conversion

A. Remove the rear speed-adjusting-bracket by taking out the 2 retaining screws as shown in figure (1).
B. Remove the lamp and switch bracket and all associated wires, (figure 1).
C. Remove wires from the terminal block and treat as shown in figure (2). Note that the leads needed to run the motor through the governor contacts are the ones going to the 2 terminals on the left of the block as you face the shaft end of the motor.
D. Add the load resistor and capacitor as shown in figure (2). How and where the capacitor and the resistor bracket are mounted depends on the extent to which you want to "dress-up" the completed T-D. See figures (7) and (11).

4. About the Gear Box

Read Carefully Before Working on the Gear Box !!

A. Remove all the gears, starting with the one that drives the large fiber gear. Be careful so that none of the gear teeth are marred or damaged.

Note (1): Keep the fiber gear on the steel hub. (More about this later).
Note (2): Set aside the small steel gear that meshes with the fiber gear. You will need it too. See figure (3).

B. The remaining gears and the gear box are not used in this conversion. Don't feel too bad about it because you still get the needed gears at a substantial savings.

C. Remove the steel hub from the fiber gear and modify it as shown in figure (4). After modification, mount it on the fiber gear again as shown in figure (5).

D. Place the gear on the gate shaft as shown in figure (5). Place the hub on the shaft so that there is no interference between it and the gate. There should be about 3/8ths of an inch clearance between the gate and the face of the gear.

E. Remove the small steel gear from its shaft if you have not done so already. File a flat area into the teeth on the beveled end as shown in figures (6a, 6b, and 6c). Besure to remove all burrs from the inside surface after drilling the hole shown in figures (6b and 6c) .

F. Drill and tap the motor shaft as shown in figure (6d). Mount the steel gear on the shaft as shown. in figure (7a).

G. Mount the motor and gate to any solid base (7b). Take care that the gears are properly aligned. See that the fiber gear teeth will not hit the locking screw of the small gear.

Note: During operation there should be no appreciable noise produced by the gears if they are lined up right. Any grating noises or "singing" indicates excessive and unnecessary wear on the fiber gear. After proper alignment, apply a small amount of grease to the gear teeth. (use some from the gear box).

5. Concerning the Gate

(a schematic diagram of the Gate is shown in figure 10)

A. Rearrange the leads on the terminal block inside the gate until the r-f filter components (2 capacitors, one coil) are out of the keying contact circuit completely. A resistance check between the larger wires and the pins on the plug as shown in figure (10) will help. No wires need be taped or cut. (See figure 12).

B. The coils shown as going to pins (1) and (5) in figure (10) are those of the tape-advance relay. When 60 ma is applied to this relay and it is connected in series with the tape-advance switch circuit, the following operation is obtained:

At the end of a tape, the transmitting contacts will lock closed on "mark". You will note that there are seven sets of transmitting contacts. From left to right they are, the "tape-out" contacts, the five "intelligence" contacts and the "stop" contacts. The "tape-out" contacts will remain closed during the absense of the tape in the gate.

The motor will run, but the shaft clutch will be disengaged. So.....insert more punched tape and momentarily press down on the lever on top of the gate. This will unlock the tape-advance mechanism.

C. If you wish, the shaft clutch can be left permanently engaged by removing the relay armature spring found down near the bottom of the gate below the shaft. If this is done, the motor must be turned off while inserting tape in the gate. After the motor is turned on, the lever on top of the gate must be depressed again for an instant as described above. In any case, choose the method of operation that is most convenient for your own shack and conditions.

6. Timing

A. Place a small light colored mark or dot on one face of the fiber gear near the teeth. When the fiber gear speed is 360 rpm there will be about 5 to 6 images of the mark formed on one half of the gear. A neon lamp operated on 60 cycle current used to illuminate the gear face will give this effect. (6 x 60 = 360) See figure (8).

B. The motor speed is varied through the use of the small wheel on the governor assembly as shown in figure (9). Turn the motor on and check the fiber gear speed with a neon lamp. If the images appear to rotate in one direction the speed is "off". Stop the motor. Turn the speed correction wheel with your fingers. Turn on the motor and note if the images have slowed down or are moving faster.

6. Timing, continued

Turn off the motor and re-adjust the speed control wheel again. Repeat the above steps until the images are as stationary as possible. At that point the fiber gear will be turning at 360 rpm. In all probability, the motor as you will receive it, will be running slightly faster than the speed needed for this application.

The correct speed for the fiber gear and the gate shaft is 368 rpm for 60 wpm operation. By making small adjustments with the speed control wheel, you should reach a point where perfect copy of any tape will be obtained on a printer or reperforator (60 wpm) keyed by the gate.

7. Assembly

Figures (7) and (11) indicate one possible way to assemble the various components. For correct operation using the motor specified in this paper, the gate and motor must be operated more or less in-line as shown in the above illustrations.

Note: The gate and motor assembly need not be completely enclosed as shown in figure (11). However, a reasonable amount of protection should be given to the gate to protect its "innards" from dust and dirt.

- Addition -

An alternate method of timing the gate for 60 wpm has been suggested by W8ERM. In this procedure, it is necessary to have a punched tape that contains at least 100 characters or operations. (A continuous loop will do).

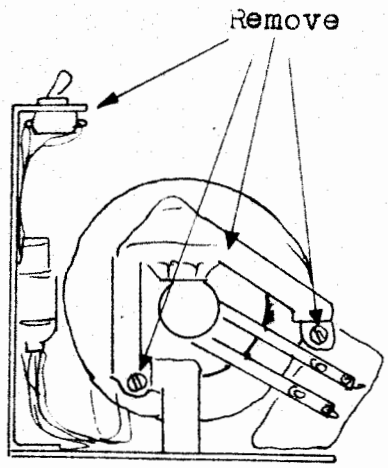
A. Mark the tape at the beginning and end of 92 operations (92 sprocket feed holes).

B. Insert the tape in the gate. Place it so the first marked-off letter or operation is lined up with the "feeler" pins.

C. Turn on the motor. (Speed adjustments will be made exactly as outlined in the first section on Timing).

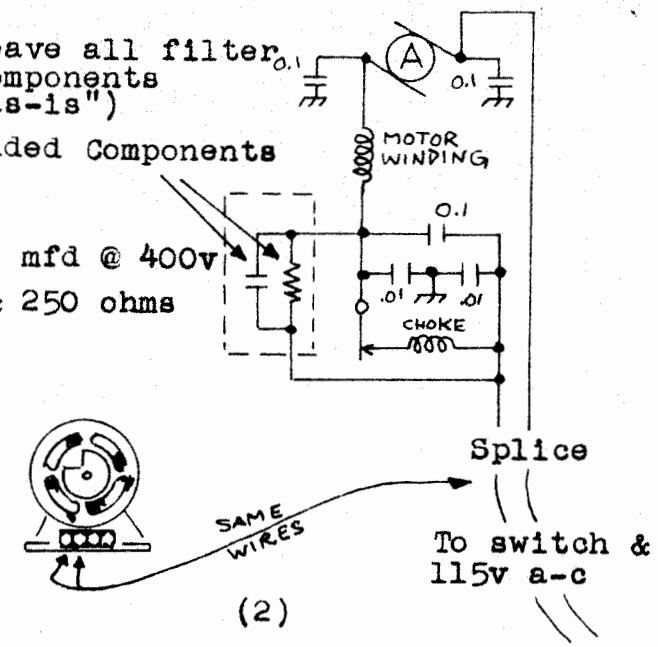
D. Depress the relay armature with a finger or energize the relay with about 60 mA of current. This will engage the tape sensing and feed mechanisms.

E. Time the tape movement with a clock or watch which has a sweep second hand. The 92 characters should be fed through the gate in exactly 15 seconds for operation at 60 wpm.

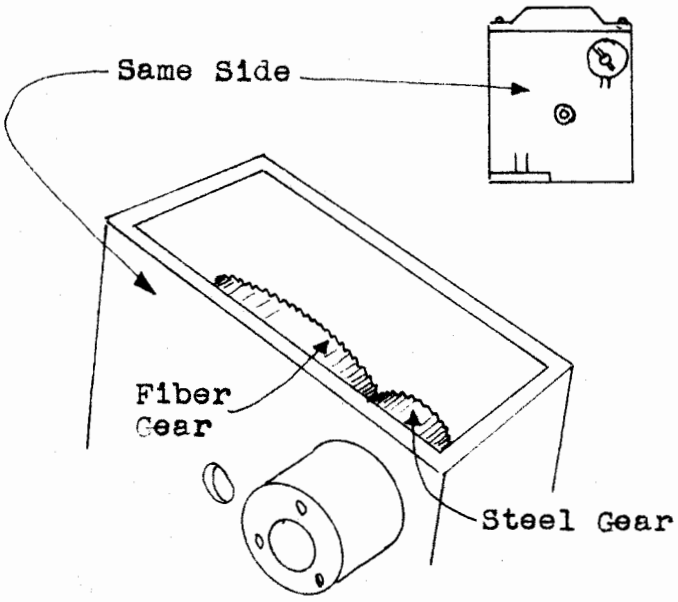


Rear view of motor Assembly

(1)

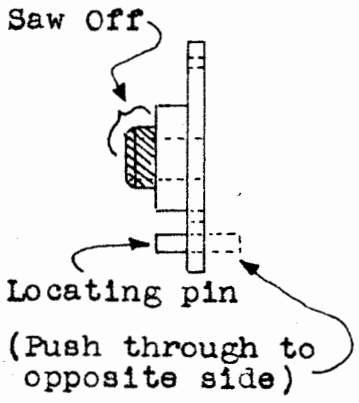


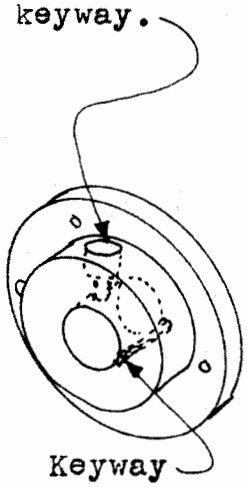
(2)



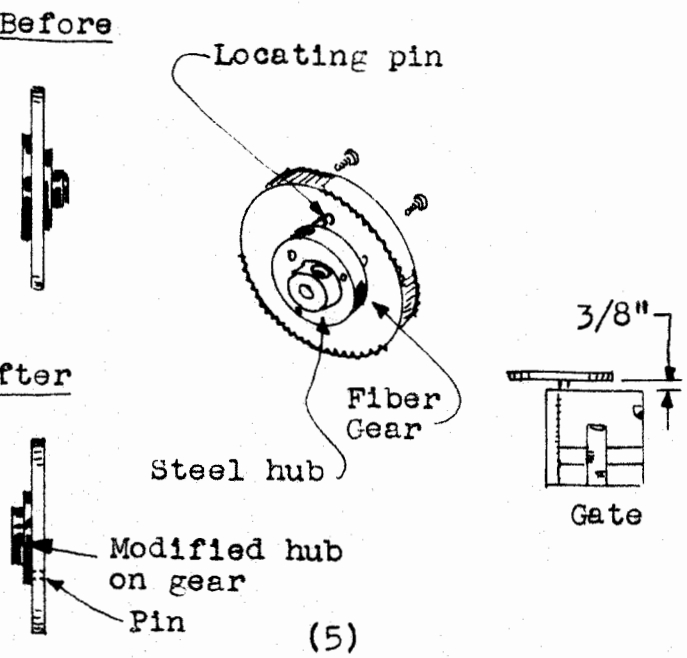
(3)

Drill hole for #6 screw & c'bore. Go deep enough so that screw in hub supplied with gate will almost go completely through the shaft. Drill at a right-angle to the keyway.

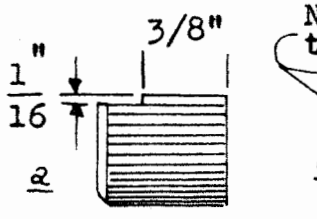


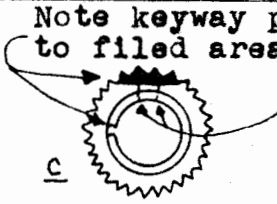


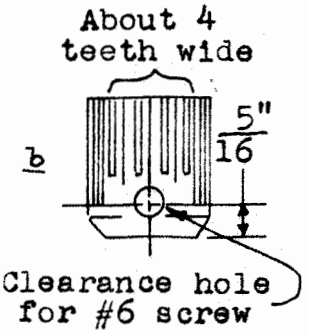
(4)

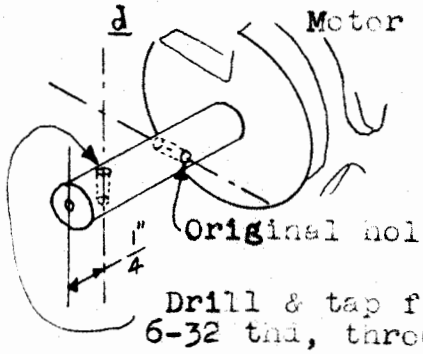


(5)

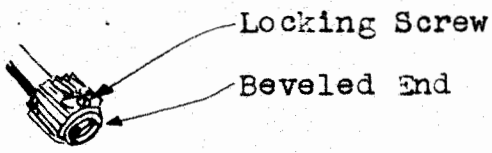






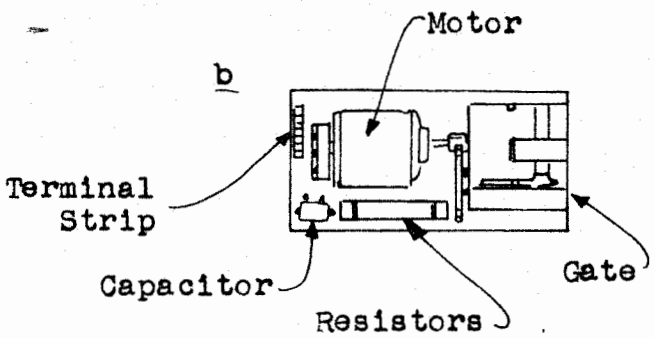


(6)

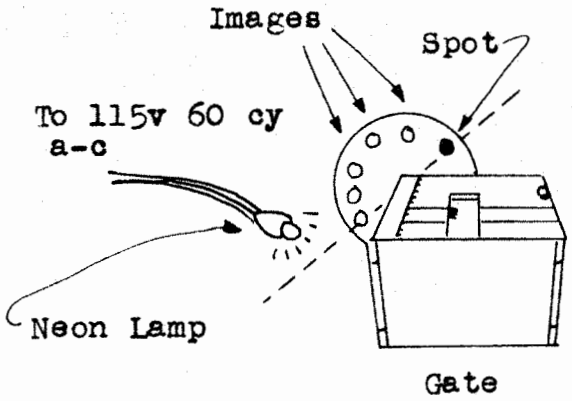


a

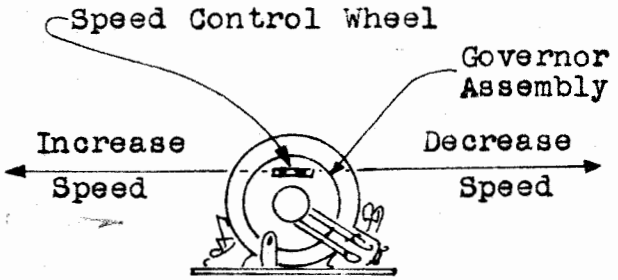
b



(7)

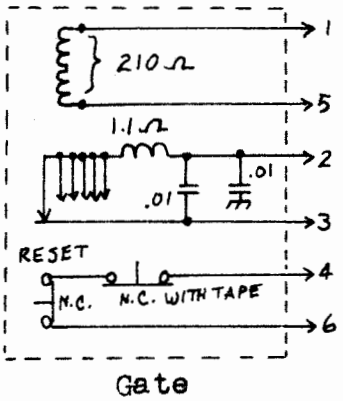


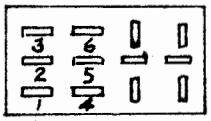
(8)



Rear View of Motor (Governor End)

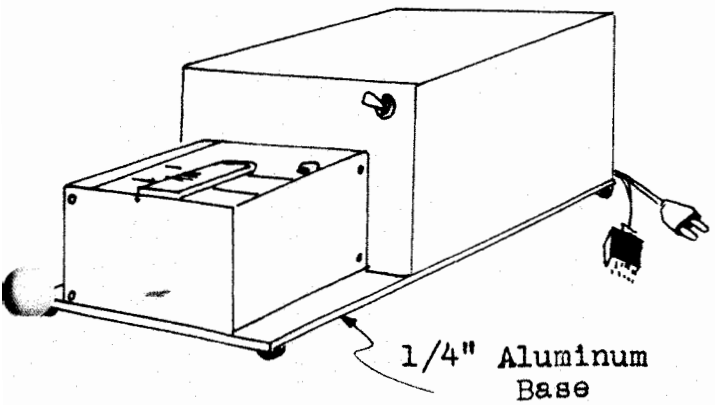
(9)





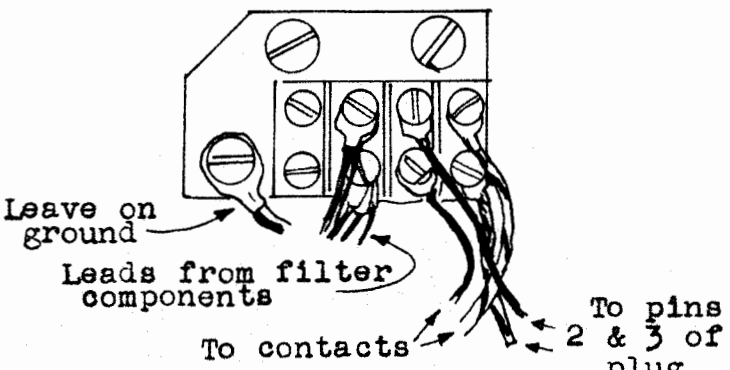
Schematic Diagram & Pin Connections

(10)



(11)

Internal Terminal Board, Gate Unit



Check out with an ohmmeter.
(Rotate Shaft)

(12)

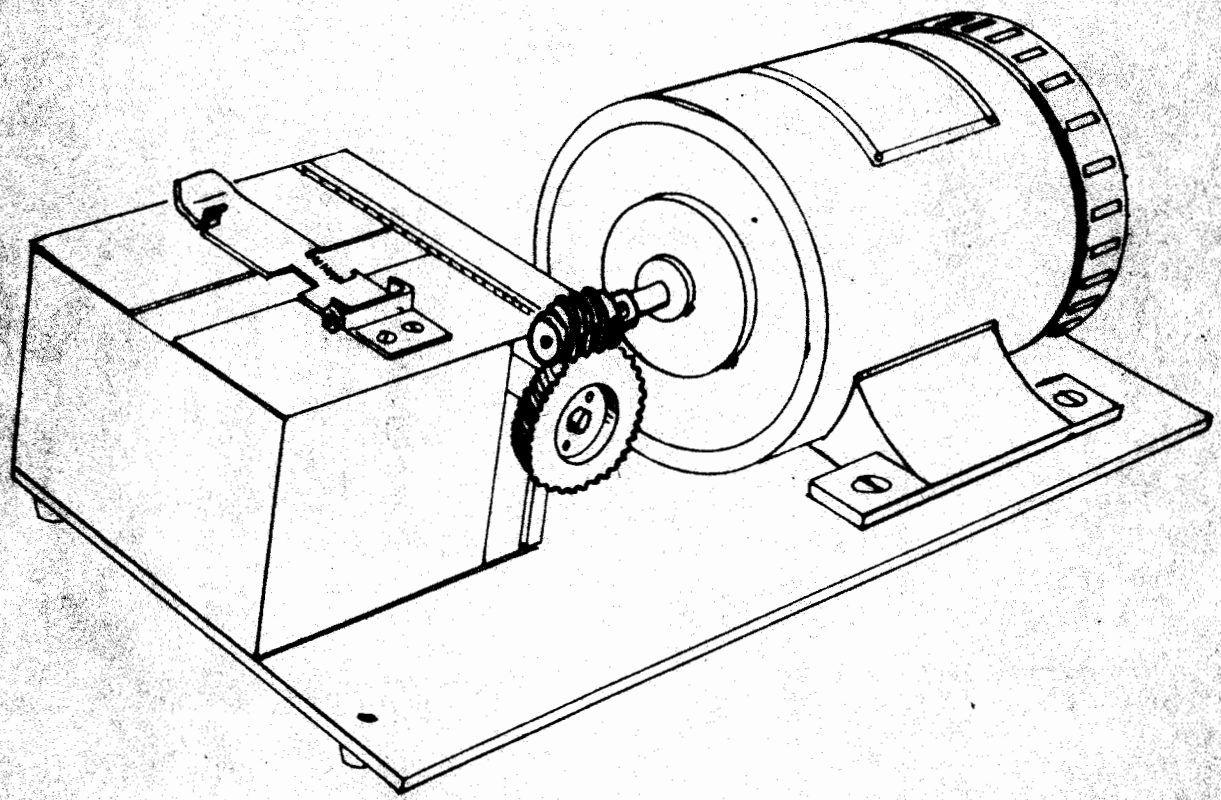
A Method of Activating a "Gate" Tape Transmitter

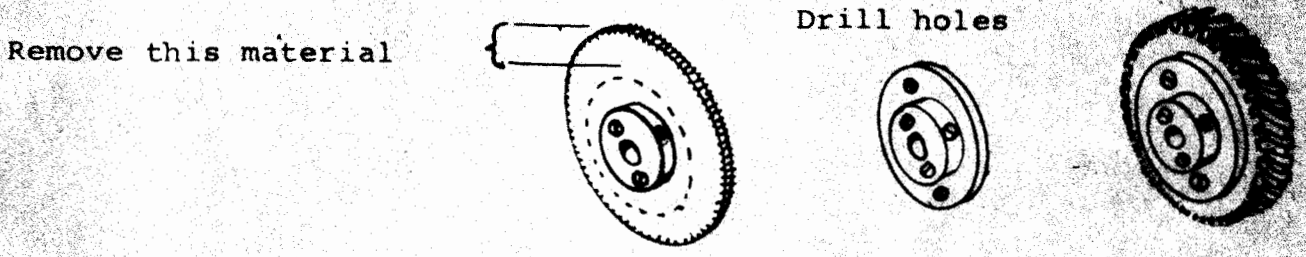
by Ed Bruening W8DTY

Parts required: One 1800 RPM synchronous motor;
One set of 60 WPM gears (model 14TD type).

Order gears from: Mr. John Reiser, K8YFV $6.00
31054 Beechnut Avenue
Wayne, Michigan

How to do it: Turn down the original metal gear of the gate so that its circumference clears the toothed area of the new fiber gear. Drill two holes 180° apart in the old gear to mount it to the fiber one. Screw the metal and fiber gears together and remount on the gate shaft. Assemble gate and motor on mounting plate as shown.





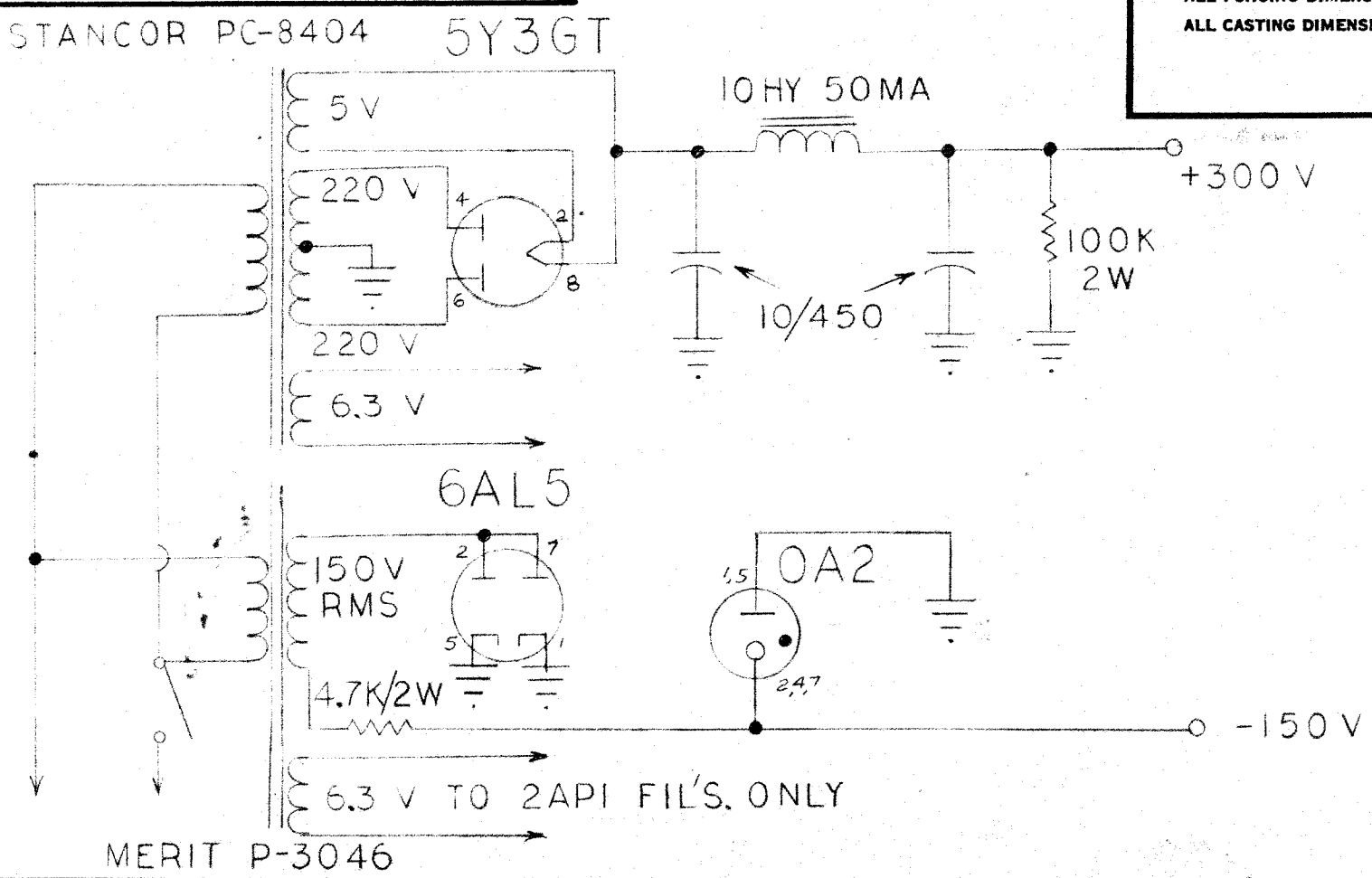
DWG SIZE A

UNLESS OTHERWISE SPECIFIED

ALL FINISHED DIMENSIONS ± .010

ALL FORGING DIMENSIONS ± .030

ALL CASTING DIMENSIONS ± .030



M/F	SYM	DESCRIPTION	DATE	APPROVAL

REVISIONS

NEXT ASSY	USED ON
EL-1145960	

FINAL PROTECTIVE FINISH

MATERIAL

ORIGINAL DATE OF DWG: 1-19-60

DFMN

POWER SUPPLY

P/O FSK TUNING INDICATOR

SCALE | UNIT WT

CHRYSLER CORP.
ENGINEERING DIV.
MISSILE BRANCH

DWG SIZE A

EL-1145959

SHEET

PEERLESS BLUE 1M 7-55

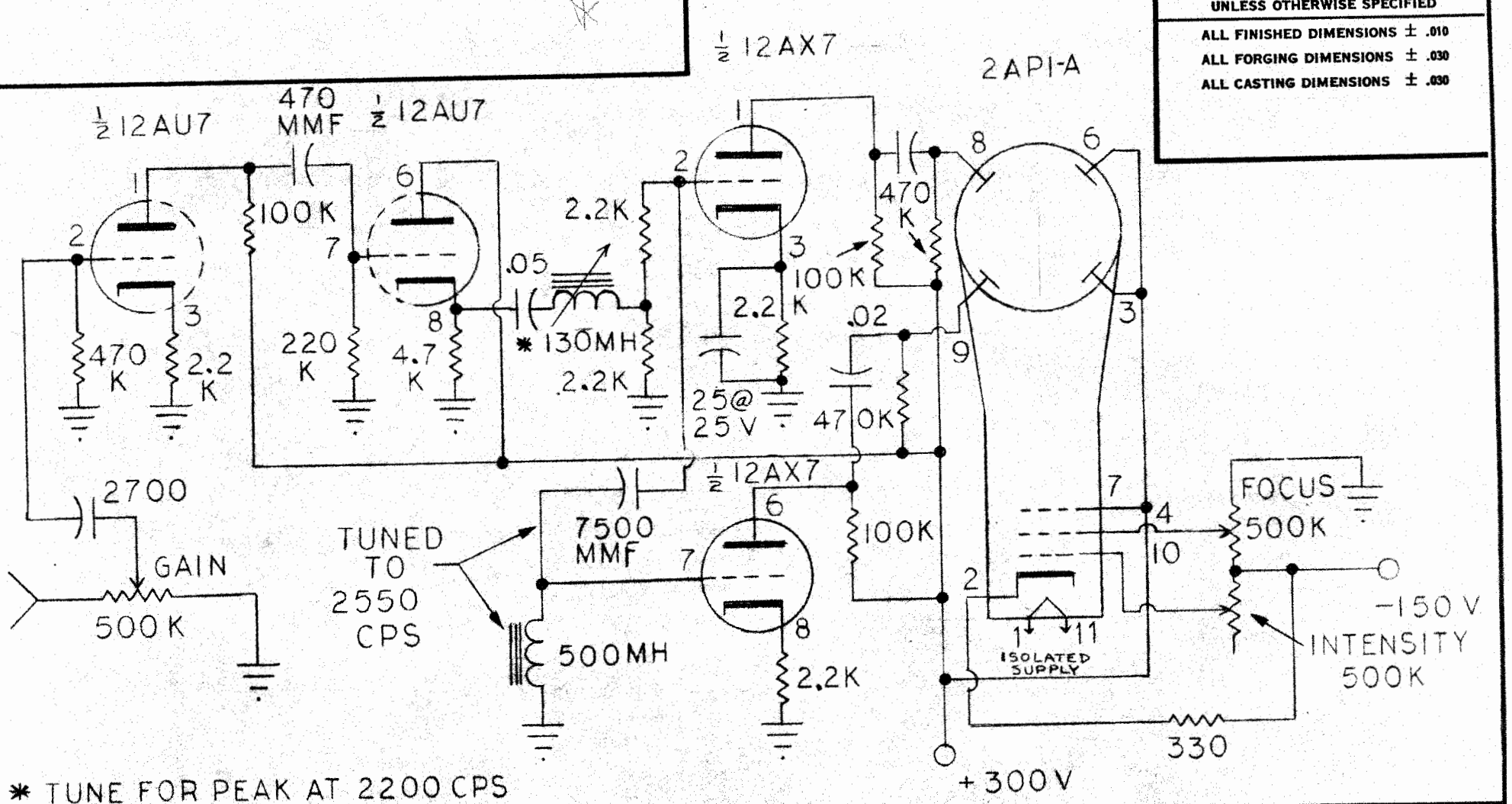
DWG SIZE A

UNLESS OTHERWISE SPECIFIED

ALL FINISHED DIMENSIONS ± .010

ALL FORGING DIMENSIONS ± .030

ALL CASTING DIMENSIONS ± .030



MF	REVISIONS			
	SYM	DESCRIPTION	DATE	APPROVAL

NEXT ASSY	USED ON

FINAL PROTECTIVE FINISH

MATERIAL

ORIGINAL DATE OF DWG 1-13-60

DFMN

INDICATOR

FSK TUNING

SCALE

UNIT WT

CHRYSLER CORP.

ENGINEERING DIV.

MISSILE BRANCH

DWG SIZE A

EL-1145960

SHEET

PEERLESS BLUE 1M 7-55

FORM 3381 REV. 12-54

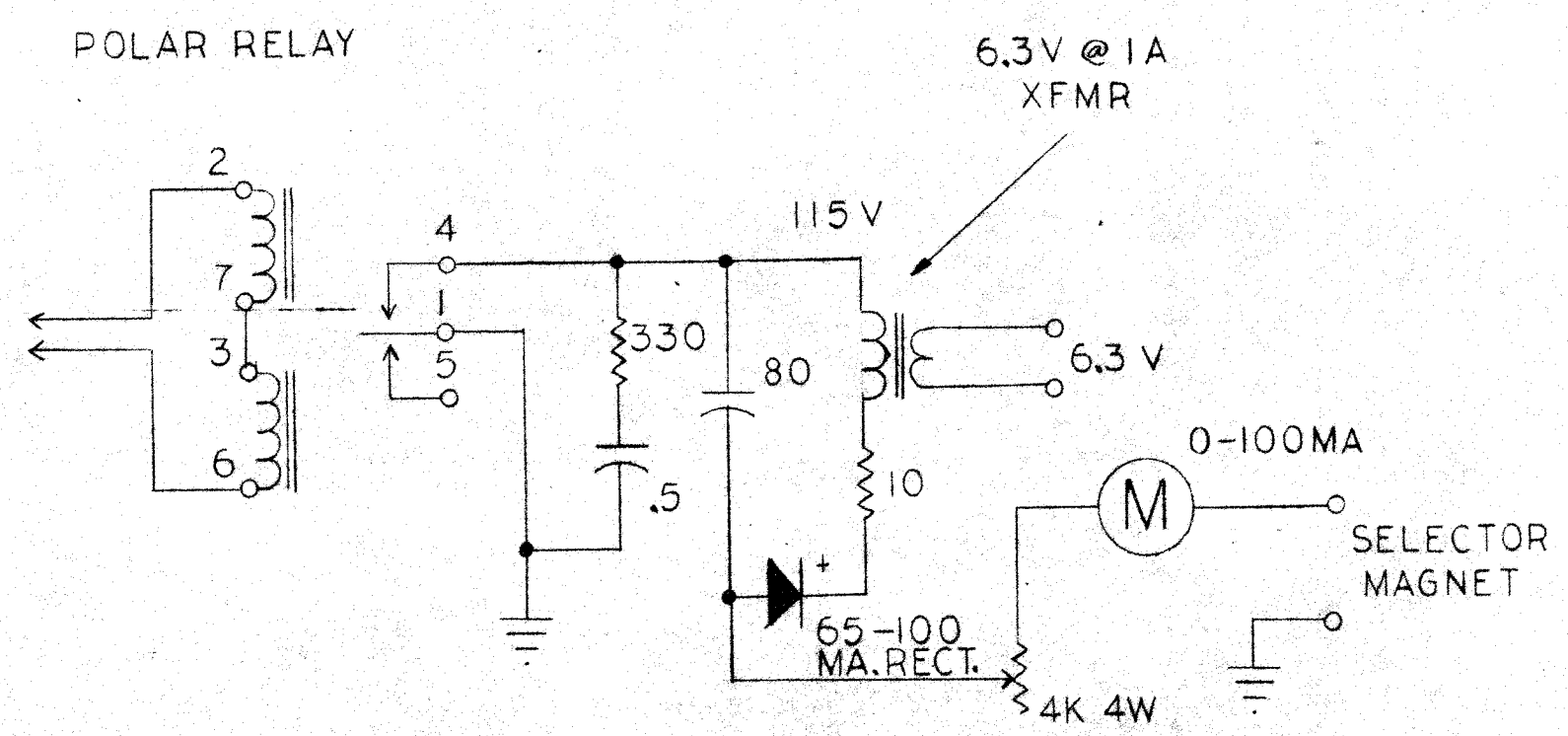
DWG SIZE	
A	

UNLESS OTHERWISE SPECIFIED

ALL FINISHED DIMENSIONS ± .010

ALL FORGING DIMENSIONS ± .030

ALL CASTING DIMENSIONS ± .030



MF

REVISIONS

SYM	DESCRIPTION	DATE	APPROVAL

NEXT ASSY	USED ON

FINAL PROTECTIVE FINISH

MATERIAL

ORIGINAL DATE OF DWG
1-13-60

DFMN

POWER SUPPLY

POLAR RELAY

SCALE | UNIT WT

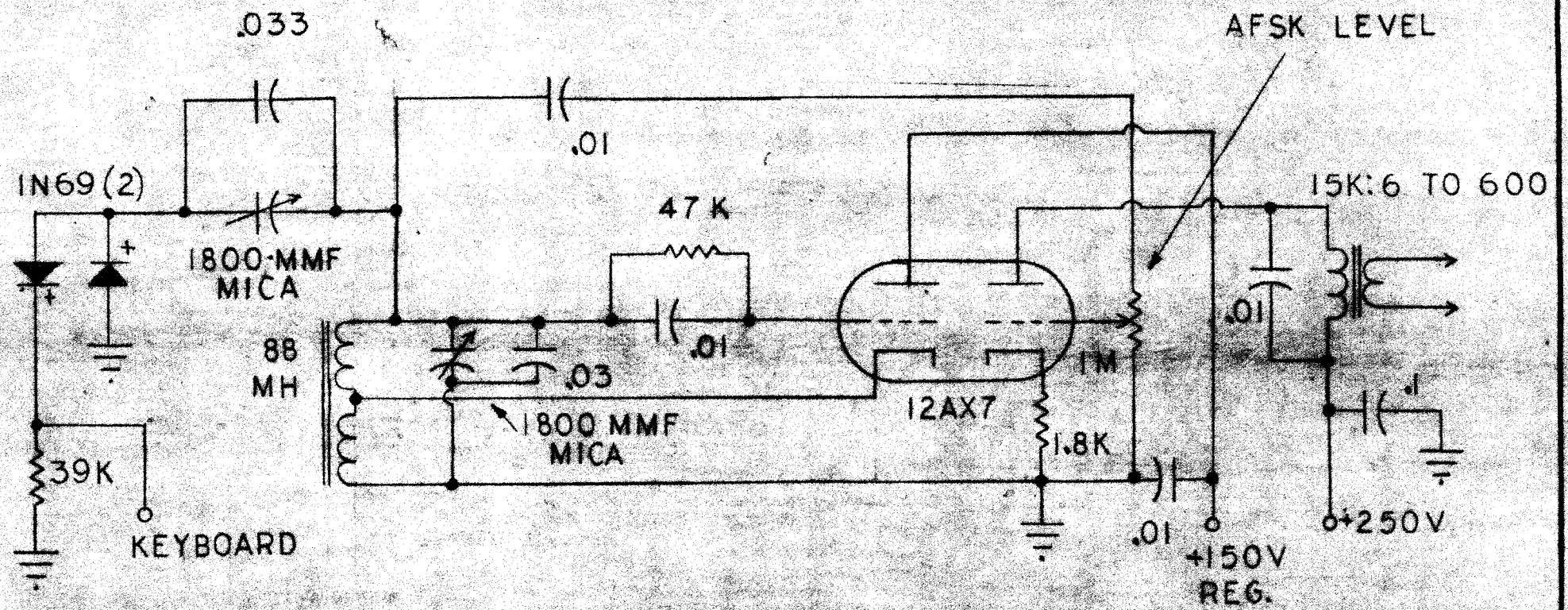
CHRYSLER CORP.
ENGINEERING DIV.
MISSILE BRANCH

DWG SIZE	
A	EL-1145962
	SHEET

PEERLESS BLUE 1M 7-55

DWG SIZE A

UNLESS OTHERWISE SPECIFIED
ALL FINISHED DIMENSIONS ± .010
ALL FORGING DIMENSIONS ± .030
ALL CASTING DIMENSIONS ± .030



NO.	REVISIONS			
	SYM	DESCRIPTION	DATE	APPROVAL

NEXT ASSY | USED ON

FINAL PROTECTIVE FINISH

MATERIAL

ORIGINAL DATE OF DWG 1-12-60

DRAWN

SCHEMATIC

AFSK OSCILLATOR

SCALE | UNIT WT

CHRYSLER CORP.
ENGINEERING DIV.
MISSILE BRANCH

DWG SIZE A

EL-1145963

SHEET

FORM 2387 REV. 15-64

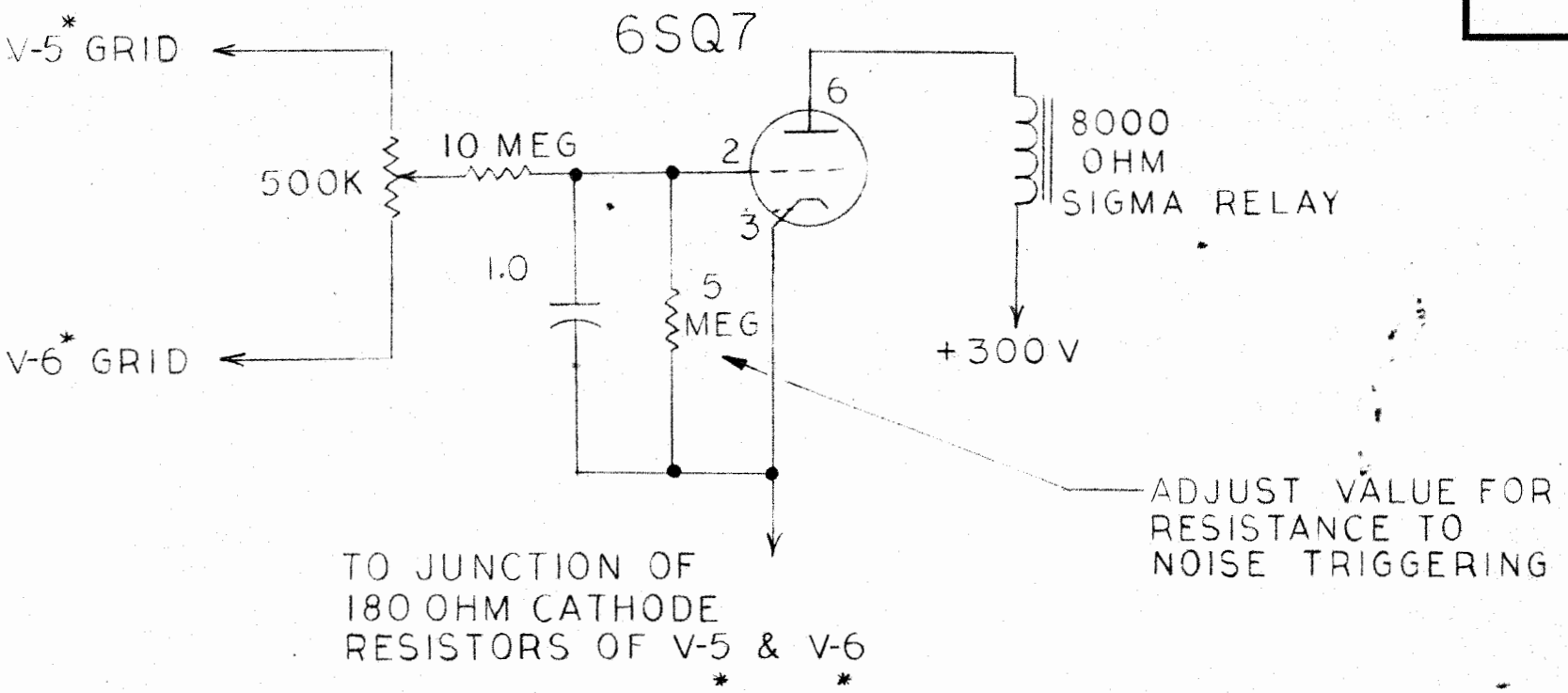
DWG SIZE A

UNLESS OTHERWISE SPECIFIED

ALL FINISHED DIMENSIONS ± .010

ALL FORGING DIMENSIONS ± .030

ALL CASTING DIMENSIONS ± .030



*W2JAV TERMINAL UNIT (APR-58/CQ)

MF	REVISIONS			
	SYM	DESCRIPTION	DATE	APPROVAL

NEXT ASSY	USED ON

FINAL PROTECTIVE FINISH

MATERIAL

ORIGINAL DATE OF DWG 1-19-60

DFMN

AUTOSTART

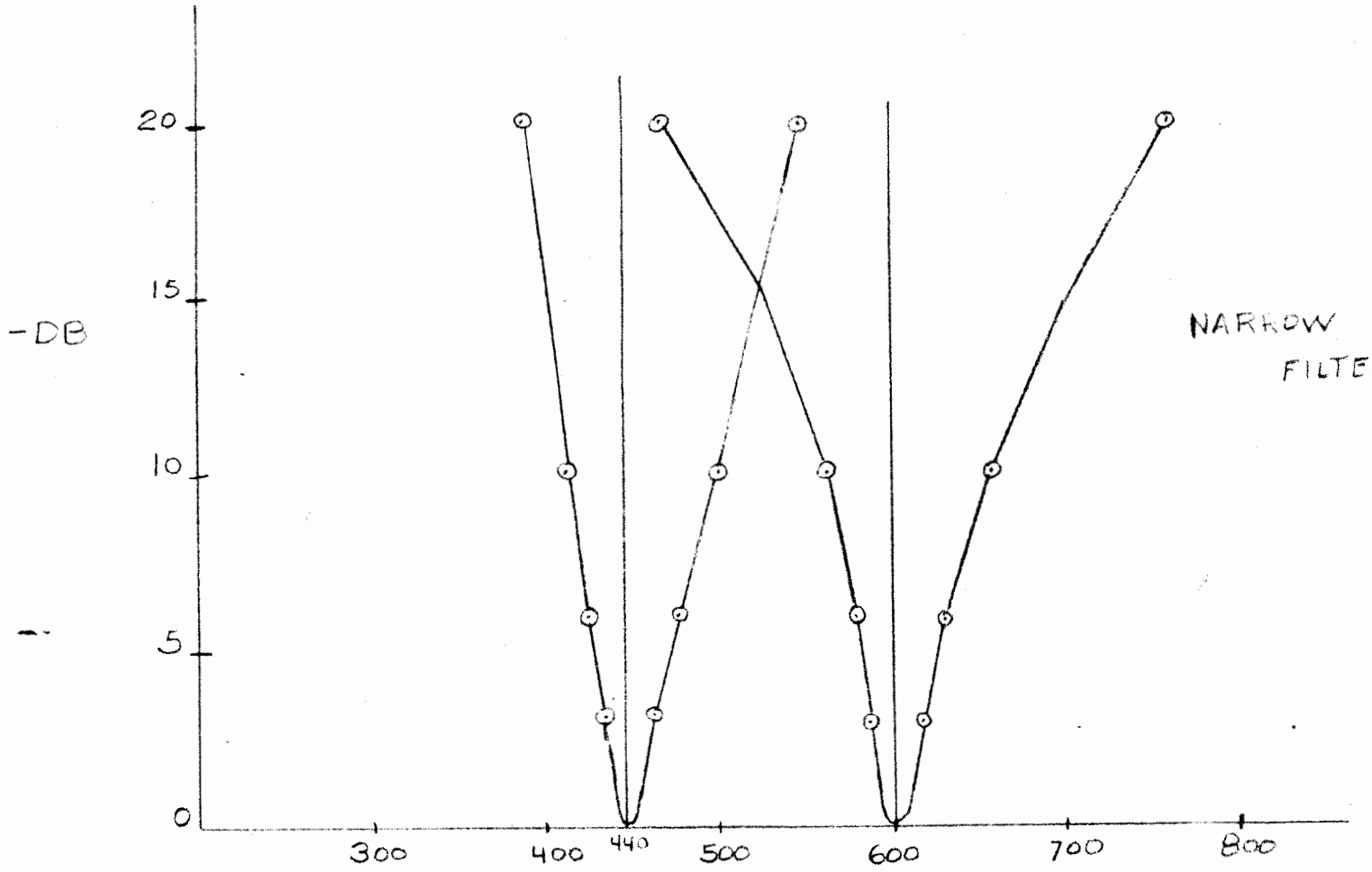
SCALE | UNIT WT

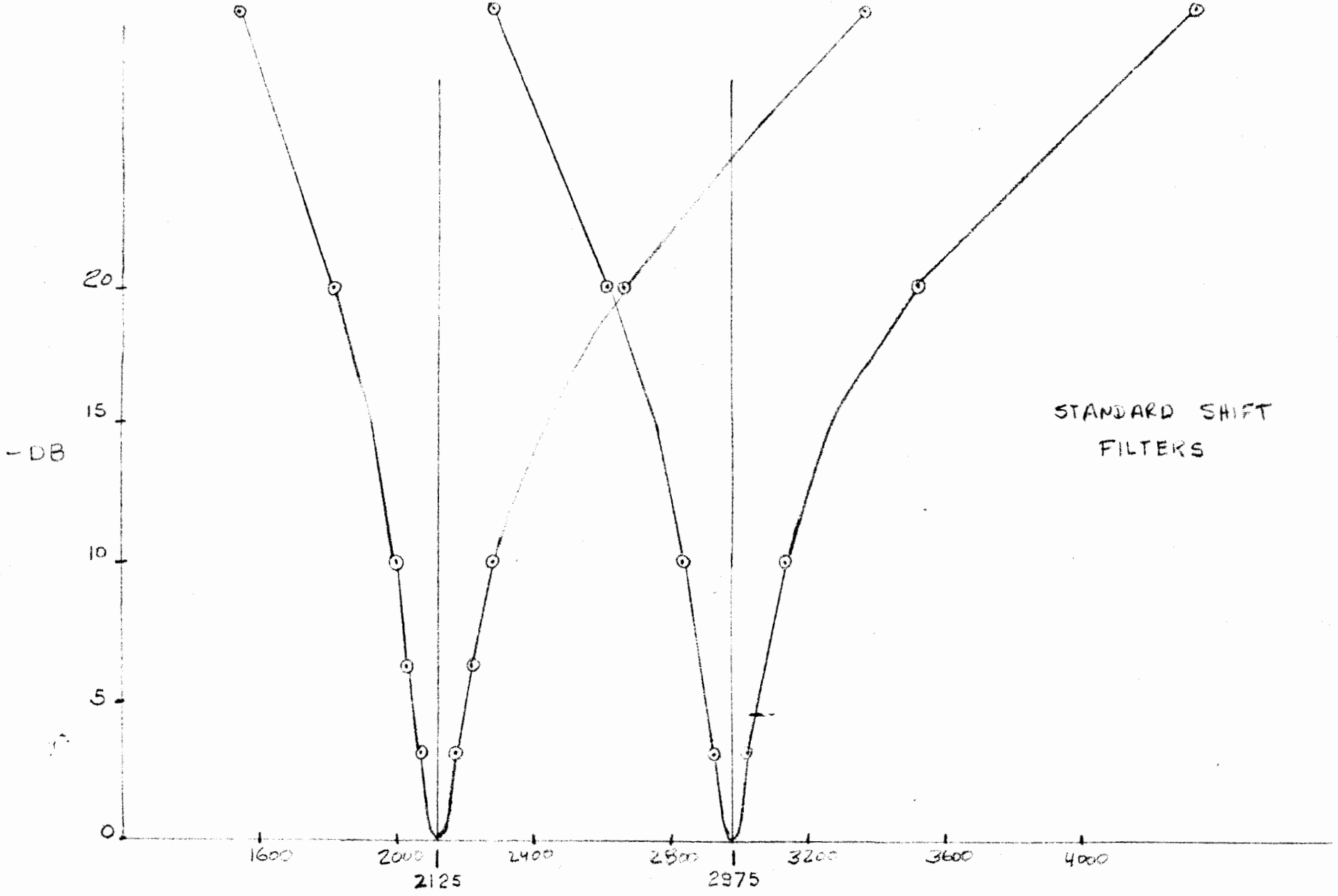
CHRYSLER CORP.
ENGINEERING DIV.
MISSILE BRANCH

DWG SIZE A

EL-1145964

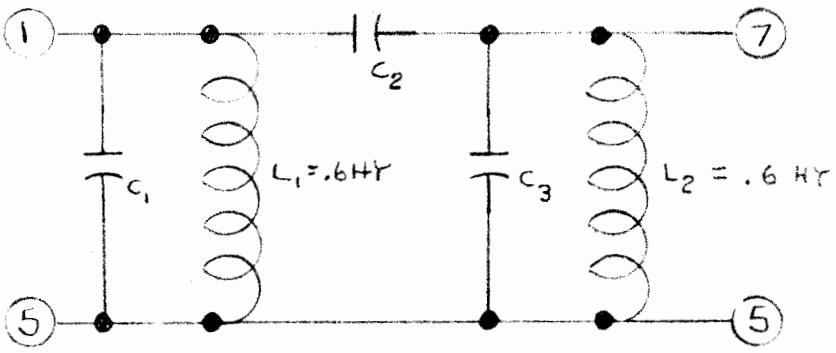
SHEET


20
15
10
5
0
-DB
300
400
440
500
600
700
800
NARROW SHIFT
FILTERS
FREQUENCY - CYCLES

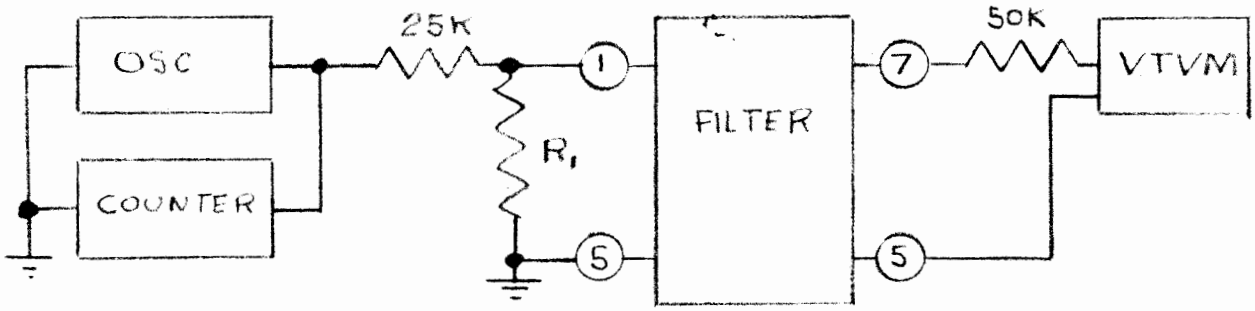

20
15
10
5
0
-DB
1600
2000
2125
2400
2800
2975
3200
3600
4000
STANDARD SHIFT
FILTERS
FREQUENCY - CYCLES

2 OF 3
9/31/60

BANDPASS FILTER DESIGN



TERMINAL NUMBERS REFER TO PINS ON OCTAL SOCKET



R_1 = 47K FOR SPACE
R_1 = 22K FOR MARK

MARK		SPACE	
2125 ~	BW = 100~	2975 ~	BW = 100~
C_1 = .01 mfd C_2 = .00144 mfd C_3 = .0096 mfd critical		C_1 = .0056 mfd C_2 = 250 pf C_3 = .0055 mfd non-critical	
440	BW = 30~	600 ~	BW = 30~
C_1 = .23 mfd C_2 = .0155 mfd C_3 = .242 mfd critical		C_1 = .1 mfd C_2 = .047 mfd C_3 = .1122 mfd non-critical	

FORM 2382 REV. 2-58

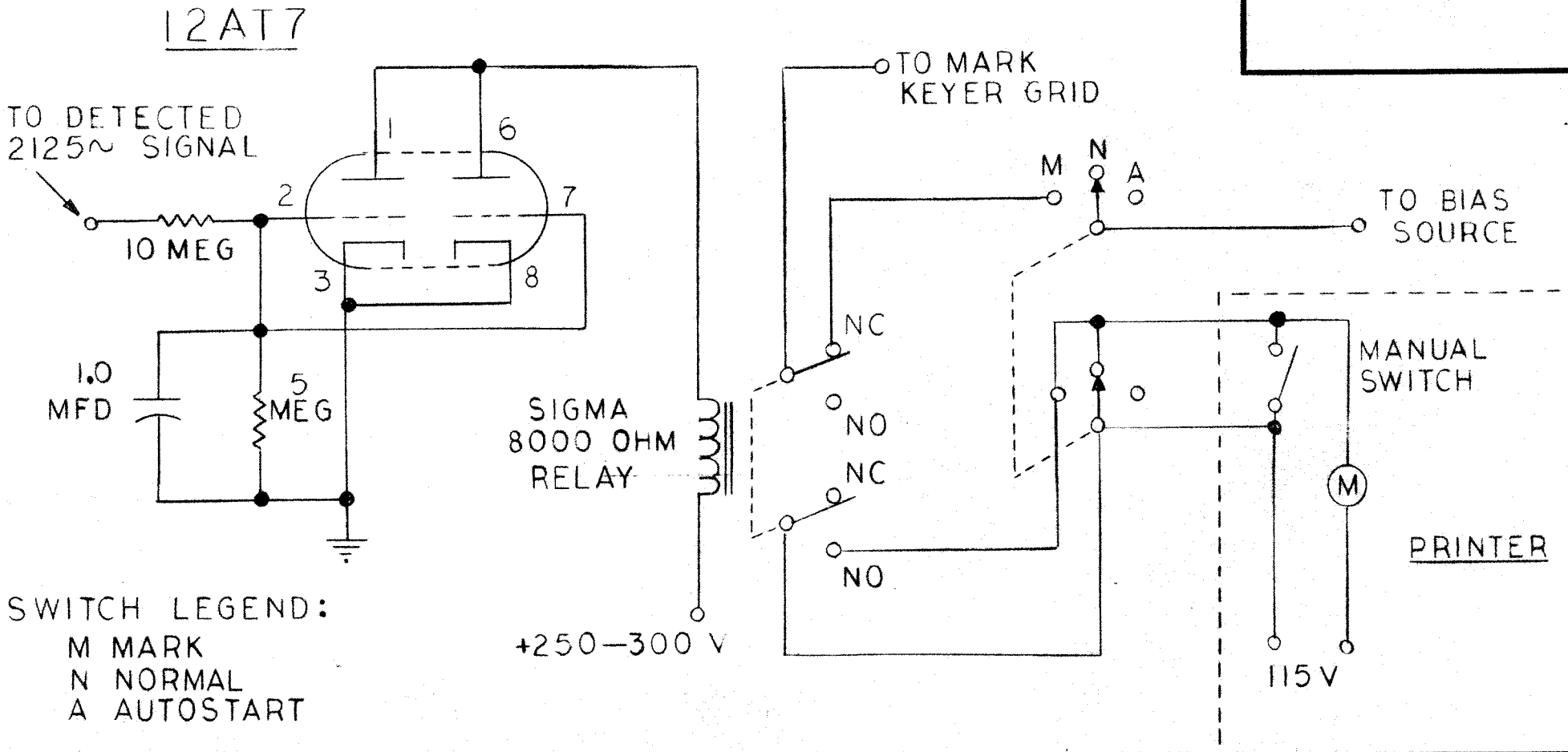
DWG SIZE	
A	

UNLESS OTHERWISE SPECIFIED

ALL FINISHED DIMENSIONS ± .010

ALL FORGING DIMENSIONS ± .030

ALL CASTING DIMENSIONS ± .030



MF	REVISIONS			
	SYM	DESCRIPTION	DATE	APPROVAL

NEXT ASSY	USED ON

FINAL PROTECTIVE FINISH

MATERIAL

ORIGINAL DATE OF DWG
8-5-60

DFMN

SCHEMATIC

AUTOSTART AND MARK-HOLD

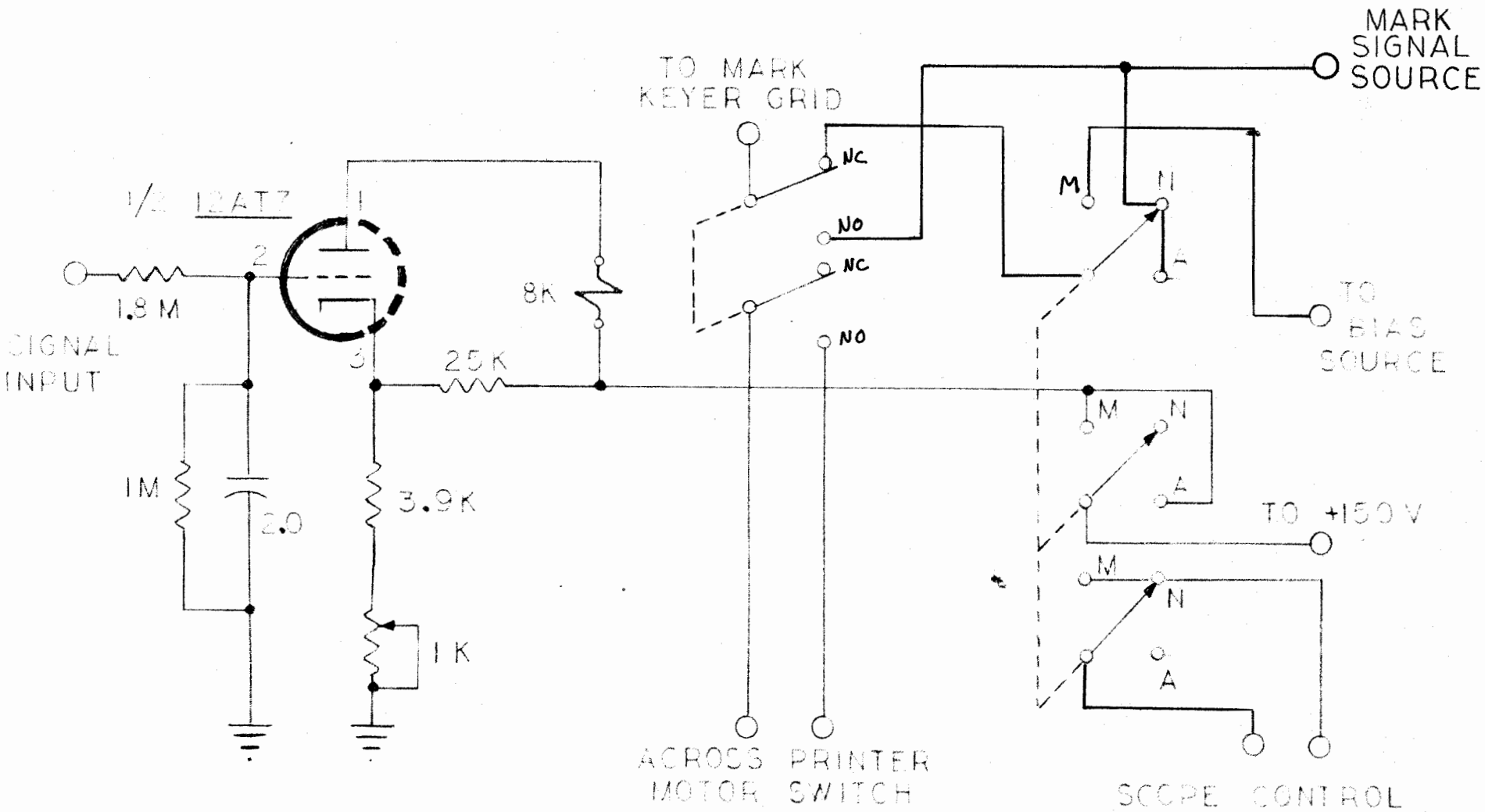
SCALE | UNIT WT

CHRYSLER CORP.

MISSILE OPERATIONS

DWG SIZE	
A	EL-1145968
	SHEET

PEERLESS BLUE PRINT CO. 2M-8-57



SWITCH LEGEND

M MARK LOCK
N NORMAL
A AUTOSTART

MARK LOCK & AUTOSTART

FORM 3387 REV. 12-54

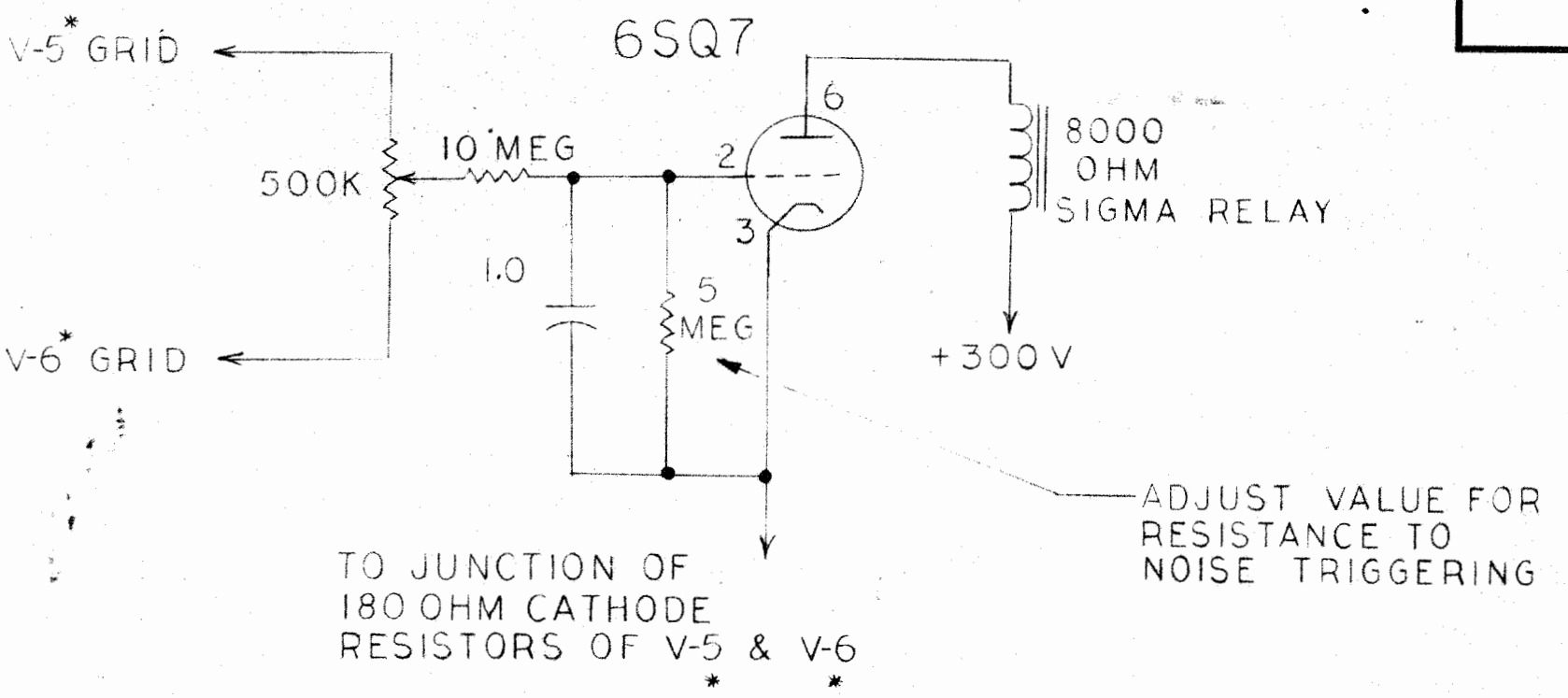
DWG SIZE A

UNLESS OTHERWISE SPECIFIED

ALL FINISHED DIMENSIONS ± .010

ALL FORGING DIMENSIONS ± .030

ALL CASTING DIMENSIONS ± .030



*W2JAV TERMINAL UNIT (APR-58/CQ)

MF

REVISIONS

SYM	DESCRIPTION	DATE	APPROVAL

NEXT ASSY	USED ON

FINAL PROTECTIVE FINISH

MATERIAL

ORIGINAL DATE OF DWG
1-19-60

DFMN Gaitz

AUTOSTART

SCALE

UNIT WT

CHRYSLER CORP.
ENGINEERING DIV.
MISSILE BRANCH

DWG SIZE A

EL-1145964

SHEET

PEERLESS BLUE 1M 7-55

Jack

From: "David Ross" <ross@hypertools.com>
To: <greenkeys@mailman.qth.net>
Sent: Tuesday, February 04, 2003 4:24 PM
Subject: Re: [GreenKeys] Re: M20-RO

RTTY folks -

There is precious little teletype MUX stuff on HF lately, most all data traffic has migrated up to satellites. Lately is it just a fast bitstream sent via satellite, no need for audio tones at all...

A common teletype MUX format in the 1960s & 1970s had 16 tone pairs in a 3 KC audio passband. The scheme was intended to accommodate 16 simultaneous 75 baud bitstreams. Each tone pair used 85 CPS shift, center freqs were 170 CPS apart and started at 425 CPS - tones are like this:

382.5 & 467.5
552.5 & 637.5
772.5 & 807.5
892.5 & 977.5
1062.5 & 1147.5
1232.5 & 1317.5
1402.5 & 1487.5
1572.5 & 1657.5
1742.5 & 1827.5
1912.5 & 1997.5
2082.5 & 2167.5
2252.5 & 2337.5
2422.5 & 2507.5
2592.5 & 2677.5
2762.5 & 2847.5
2932.5 & 3017.5

1260 CF.
1217.5
1302.5

In the '60s, both Collins & TMC built HF radios with filters compatible with this format - the radios used special IF filters with well-defined widths & passband flatness & group delay.
Varying delays across the filter's passband were critical, since one optional MUX configuration had the 16 separate channels set up as 8 dual-diversity channels. Between two diversity channels analog voting was used, and the scheme worked best if the incoming sigs were exactly in sync.

The CCITT spec that defines this old-timey MUX format also specifies four sidebands called A2, A1, B1, & B2 - if you see a radio with sidebands named like this then it probably uses these fancy superflat filters...

- A2 is the LSB of a suppressed carrier 6.29 KCs

37718 110 BAUD RECEIVE FILTER UNIT

ASSOCIATED INFORMATION

EAS-37718 — Equipment Assembly Schematic Diagram

1. TECHNICAL SUMMARY

General

Application:

Provides a bandpass filter, discriminator, and a low-pass filter for the selection and demodulation of desired frequencies for an associated receive unit. The filter unit is available in 18 options, 37718-01 through 37718-18, which differ only in the specific channel midband frequency of each option. Used initially in 25A systems.

Installation:

Plugs into an equipment shelf. All external electrical connections are made through a round, 11-pin connector at the rear of the unit.

Dimensions:

Height	4-13/16 inches
Width	1-3/4 inches
Depth	8-7/8 inches
Weight (Approx.)	4 pounds

Operational Characteristics

Channel Midband Frequencies:

37718-01	425 Hz	37718-10	1955 Hz
-02	595 Hz	-11	2125 Hz
-03	765 Hz	-12	2295 Hz
-04	935 Hz	-13	2465 Hz
-05	1105 Hz	-14	2635 Hz
-06	1275 Hz	-15	2805 Hz
-07	1445 Hz	-16	2975 Hz
-08	1615 Hz	-17	3145 Hz
-09	1785 Hz	-18	3315 Hz

Channel Spacing . . . . . 170 Hz

Mark-Space Frequency Shift . . . . . 85 Hz, centered on the channel midband frequency

Bandpass Input Impedance . . . . . 600 ohms

Bandpass Output Impedance . . . . . 1200 ohms

Discriminator Input Impedance . . . . . 200 ohms

Discriminator Output Impedance . . . . . 1000 ohms

Environmental Conditions (Operating)

Ambient Temperature Range: . . . . . 0° to 55° C (32° to 131° F)

Maximum Relative Humidity: 95%

Maximum Altitude: . . . . . 15,000 feet

2. PHYSICAL DESCRIPTION

2.01 The 37718 110 Baud Receive Filter Unit is enclosed in a hermetically sealed case which plugs into an equipment shelf. The front of the case contains five terminals, A through E. A BIAS ADJ potentiometer having a screwdriver adjustment and two DISC OUT jacks, + and —, are mounted on a bracket in front of the filter case. A round, 11-pin plug for making all external electrical connections is located on the rear of the case.

3. ELECTRICAL DESCRIPTION

3.01 The 37718 110 Baud Receive Filter Unit consists of two main sections, a bandpass filter and a discriminator. It is used in conjunction with a receive unit to form the receive portion of a 110-baud data transmission channel. The bandpass filter, which is tuned to the channel midband frequency, is connected between the voice-frequency receive line and the input to the channel

receiver. This filter will pass data signals at a rate of up to 110 bauds. Space and mark signals, which are 42.5 Hz above and below the midband, respectively, represent these data signals; they are passed by the filter to the receive channel limiter stages. Adjacent channel signals are attenuated approximately 45 dB. Response characteristics are shown in Figure 1.

3.02 The discriminator stage of the filter unit contains two detectors and a low-pass filter. From the limiter stage output of the associated receive unit, the discriminator produces a dc voltage which drives the data amplifier in the receive unit. Each detector contains a series-resonant circuit, one side of which is tuned slightly above the space frequency and the other slightly below the mark frequency. The full-wave rectifier in each detector produces a dc output voltage whenever a signal of the correct frequency is applied to that particular detector. The two rectifiers are connected in opposition so that the dc voltage at the moveable contact of BIAS ADJ potentiometer R1 is either positive for space signals or negative for mark signals with respect to the common rectifier connection.

3.03 The BIAS ADJ potentiometer is adjusted for zero distortion while mark and space signals of equal duration are applied to the discriminator. Undesired carrier and detector signal products are removed from the discriminator output pulses by the low-pass filter. The output from the filter is then applied to a zero-crossing detector in the output keyer of the receive unit.

Reason for reissue: Issue 2 — Format updated and technical summary expanded. Equalizer reference deleted.

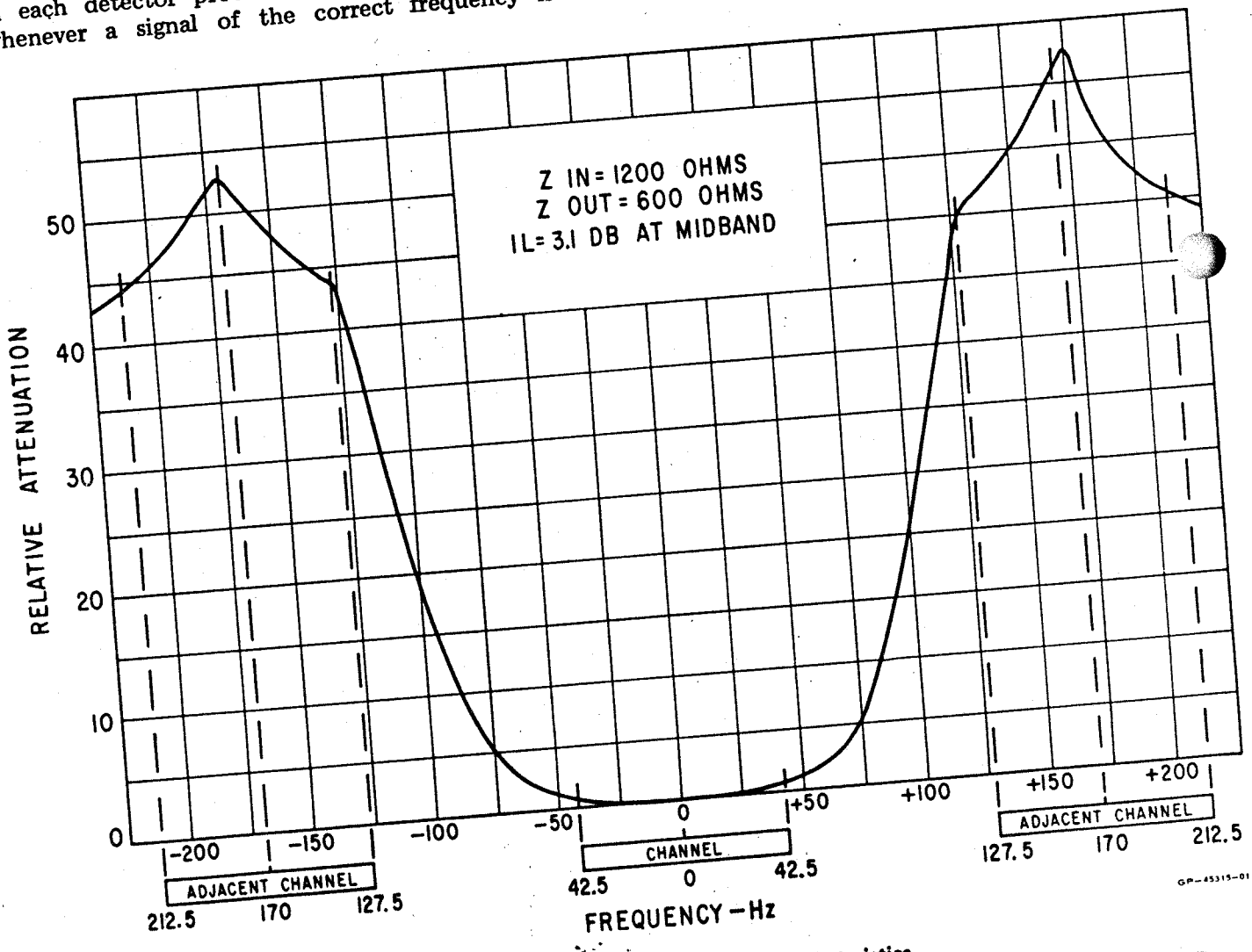


Figure 1. Typical Attenuation—Frequency Characteristics.

37717 75 BAUD RECEIVE FILTER UNIT

ASSOCIATED INFORMATION

EAS-37717	Equipment Assembly Schematic Diagram

1. TECHNICAL SUMMARY

General

Application:

Provides a bandpass filter, discriminator and low-pass filter to select desired frequencies for use in an associated channel receive unit. Initially used in 25A systems.

Installation:

Plugs into an equipment shelf. All external electrical connections are made through contacts at the rear of the unit.

Dimensions:

Height	4-13/16 inches
Width	1-3/4 inches
Depth	8-7/8 inches
Weight (Approx.)	4 pounds

Operating Characteristics

Channel Midband Frequencies:

37717-01	420 Hz	37717-14	1980 Hz
-02	540 Hz	-15	2100 Hz
-03	660 Hz	-16	2220 Hz
-04	780 Hz	-17	2340 Hz
-05	900 Hz	-18	2460 Hz
-06	1020 Hz	-19	2580 Hz
-07	1140 Hz	-20	2700 Hz
-08	1260 Hz	-21	2820 Hz
-09	1380 Hz	-22	2940 Hz
-10	1500 Hz	-23	3060 Hz
-11	1620 Hz	-24	3180 Hz
-12	1740 Hz	-25	3300 Hz
-13	1860 Hz		

MARK - SPACE Frequency Shift: 60 Hz, centered on midband frequency.

Bandpass Filter Characteristics: See Figure 1.

Impedances:

Bandpass Input	600 ohms
Bandpass Output	1200 ohms
Discriminator Input	200 ohms
Discriminator Output	1000 ohms

Environmental Conditions

Ambient Temperature Range: 0° to 55° C (32° to 131° F)

Maximum Relative Humidity: 95%

Maximum Altitude: 15,000 feet

2. PHYSICAL DESCRIPTION

2.01 The 37717 Receive Filter Unit is contained in a hermetically-sealed case which plugs into an equipment shelf. On the front of the case is a pair of discriminator output (DISCR OUT) test pin-jacks and a bias adjustment (BIAS ADJ) potentiometer. A round 11-pin plug at the rear of the case provides connections to the shelf.

3. ELECTRICAL DESCRIPTION

3.01 The 37717 unit consists of a bandpass filter and a discriminator, and operates in conjunction with a receive unit to comprise the receive portion of a 75-baud telegraph transmission channel. The bandpass filter is tuned to the channel midband frequency and is connected between the receive v-f line and the input to the channel receiver. This filter will pass telegraph signals at a rate of up to 75 baud. SPACE and MARK frequencies, which are respectively 30 Hz above and below the midband, represent these telegraph signals and are passed by the filter to the receive channel limiter stages. Adjacent channel signals are attenuated approximately 40 dB. Response characteristics are shown in Figure 1.

3.02 The discriminator section of the filter unit contains two detectors and a low-pass filter. The discriminator produces, from the limiter stage output, a d-c voltage which drives the telegraph amplifier in the channel receiver. Each detector contains a series-resonant circuit, one being tuned to slightly above the SPACE frequency and the other being tuned to slightly below the MARK frequency. The full-wave rectifier in each detector produces a d-c output voltage whenever a signal of the correct frequency is applied to that particular detector. The two rectifiers are connected in opposition so that the d-c voltage at the moveable contact of the BIAS ADJ potentiometer is, with respect to the common rectifier connection, either positive for SPACE signals or negative for MARK signals. The BIAS ADJ potentiometer is adjusted for zero distortion while applying MARK and SPACE signals of equal duration to the discriminator. Undesired carrier and detector signal products are removed from the discriminator output pulses by the pi-section low-pass filter. This filter consists of the three capacitors and the inductor in the rectifier output circuit. The output from the filter unit is then applied to a zero-crossing detector in the output keyer of the receive unit.

Reason for reissue: Issue 2 - Reference to the equalizer section deleted. Text clarified. Format revised.

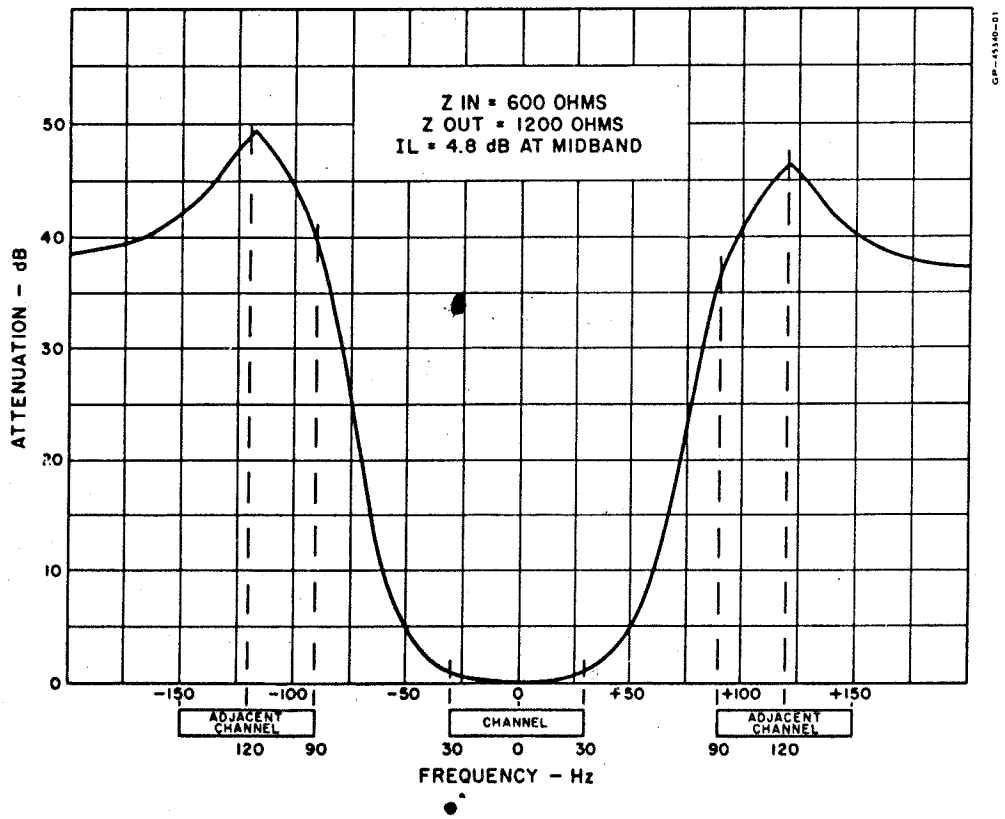


Figure 1. Typical Attenuation-Frequency Characteristics

37712 RECEIVE FILTER UNIT

ASSOCIATED INFORMATION

EAS-37712	Equipment Assembly Schematic Diagram

1. TECHNICAL SUMMARY

General

Application:

Operating in conjunction with an associated receive unit, provides a bandpass filter, discriminator, low-pass filter, and an equalizer for selecting and demodulating the desired channel signal. Initially used in 25A systems.

Installation:

Plugs into an equipment shelf. All external electrical connections are made through a plug at the rear of the unit.

Dimensions:

Height	4-13/16 inches
Width	1-3/4 inches
Depth	8-7/8 inches
Weight (Approx.)	4 pounds

Operating Characteristics

Channel Midband Frequencies:	37712-01	1190 Hz
	-02	1530 Hz
	-03	1870 Hz
	-04	2210 Hz
	-05	2380 Hz
	-06	2550 Hz
	-07	2890 Hz
	-08	3230 Hz

Mark - Space Frequency Shift: 170 Hz, centered on the channel midband frequency.

Bandpass Filter Characteristics: See Figure 1.

Impedances:

Bandpass Filter Input	600 ohms
Bandpass Filter Output	1200 ohms
Discriminator Input	200 ohms
Discriminator Output	1000 ohms

Controls and Adjustments

BIAS ADJ (R1): Potentiometer used to equalize the pulse duration of the received Mark and Space signals.

Test Points

DISCR OUT (J2, J3): Two pin-jack test points used to monitor the discriminator output signal.

Environmental Conditions

Ambient Temperature Range:	0° to 50° C (32° to 122° F)
Maximum Relative Humidity:	95%
Maximum Altitude:	15,000 feet

2. PHYSICAL DESCRIPTION

2.01 The 37712 Receive Filter Unit is contained in a hermetically sealed case, which plugs into an equipment shelf. On the front of the case is a pair of discriminator output (DISCR OUT) test pin-jacks and a bias adjustment (BIAS ADJ) potentiometer. A round, 11-pin plug on the rear of the case provides electrical connection with the shelf.

3. ELECTRICAL DESCRIPTION

3.01 The 37712 Receive Filter Unit consists of two main sections, a bandpass filter and a discriminator. The bandpass filter is tuned to the

channel midband frequency and is connected between the v-f receive line and the input to the receive channel of a 25A Data Transmission System. This filter will pass data signals at a rate of up to 200 baud. Space and Mark frequencies, which are respectively 85 Hz above and below the midband, represent these data signals and are passed by the filter to the receive channel limiter stages. Adjacent channel signals are attenuated approximately 45 dB. Response characteristics are shown in Figure 1.

3.02 The discriminator section of the filter unit contains two detectors, a low-pass filter, and a delay equalizer. The discriminator produces, from the limiter stage output, a d-c voltage which drives the data amplifier in the receive channel. Each detector contains a series resonant circuit, one being tuned to slightly above the Space frequency and the other being tuned to slightly below the Mark frequency. The full-wave rectifier in each detector produces a d-c output voltage whenever a signal of the correct frequency is applied to that particular detector. The two rectifiers are connected in opposition so that the d-c voltage at the moveable contact of the BIAS ADJ potentiometer is, with respect to the common rectifier connection, either positive for Space signals or negative for Mark signals. The BIAS ADJ potentiometer is adjusted for zero distortion while applying Mark and Space signals, of equal duration, to the discriminator. Undesired carrier and detector signal products are removed from the discriminator output pulses by the low-pass filter. The delay equalizer corrects for any phase distortion that may occur in the transmission facility. The output from the equalizer is then applied to a zero-voltage reference detector in the output keyer of the receive unit.

Reason for reissue: Issue 2 - TECHNICAL SUMMARY section clarified and expanded. Minor editorial corrections.

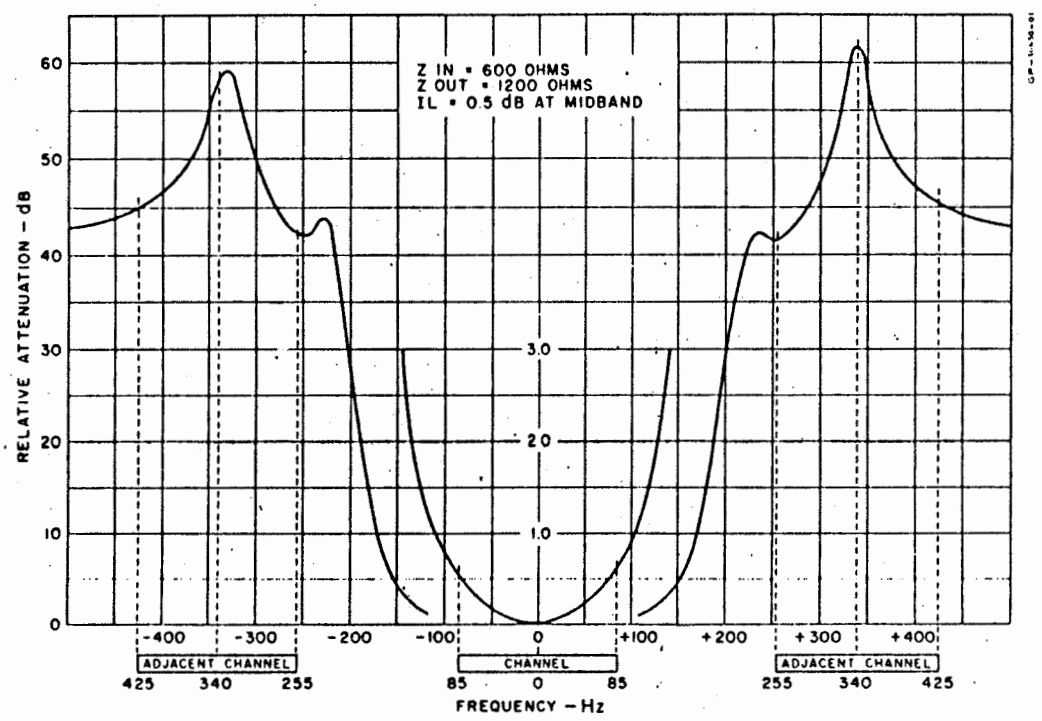


Figure 1. Typical 37712 Filter Attenuation-Frequency Characteristics

designed so that up to thirteen subsets, at a single location, may be paralleled on the VF line without mismatching the line. The filter unit case contains the input bandpass filter, which determines the specific channel operating frequency, and the discriminator network for the voice-frequency (FSK) to direct-current conversion within the signal path. The filter unit is fully described in the publication furnished for the selected filter. The following paragraphs describe the subset circuits on a section-by-section basis.

Amplifier

3.07 Transistors Q1 and Q3 amplify the incoming signal to a level capable of driving the limiter stage. Transistor Q1 is a Class A amplifier, the output of which is applied to Q3 and to the input of the supervisory circuit. At low input signal level, the Q3 output waveform resembles that of the input. As the input signal increases, Q3 produces a square wave output. Limiting occurs when negative-going pulses drive Q3 into saturation. Positive-going pulses tend to drive the stage into cut off, but are clipped by diode CR6. Clipping prevents Q3 from cutting off and, thereby, maintains symmetry in alternate half-cycles of the output waveform.

Limiter

3.08 The limiter removes, from the received signal, amplitude variations which cause distortion in the receive channel output data. Transistors Q5 and Q6 operate Class B in a push-pull configuration and supply a square-wave output to the discriminator. The output amplitude is approximately 6 volts, peak-to-peak, and is established by breakdown diode CR9. As a result of the push-pull circuit operation, alternate half cycles of the limiter output remain symmetric and their reference remains at zero if the input level varies. The limiter output response curve is shown in Figure 1. The limiter output is applied to the discriminator which converts the MARK and SPACE frequencies into polar-form, DC pulses. A MARK or low-frequency input signal produces a voltage across discriminator net output pins 3 and 4 (37717 unit) which is, respectively, negative and positive. This polarity reverses for a SPACE or high-frequency input.

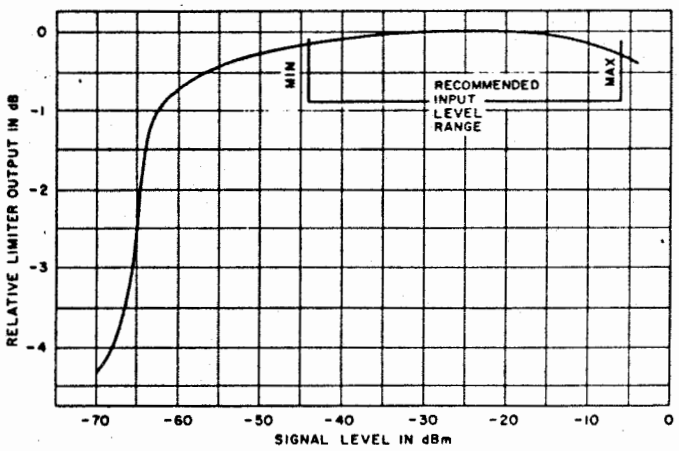


Figure 1. Typical Limiter Response, Output-Input Level Variations

Output Keyer

3.09 The discriminator output signals are amplified by the output keyer circuit which drives telegraph receiving equipment in the receive loop. The keyer consists of a zero-voltage reference detector, a voltage amplifier and a single-ended current drive stage. Signals from the discriminator are polar and have an amplitude of about 1 volt, peak-to-peak. Output signals to the receive loop are neutral with an open-circuit condition for SPACE and loop current flow (60 mA) for MARK. All keyer stages are direct-coupled to permit amplification of steady MARK and SPACE signals.

3.10 Transistor Q8 operates as the zero-voltage reference detector and provides a square-wave output to the Q9 voltage amplifier. Breakdown diode CR13, in conjunction with factory-selected resistor R28, establishes the bias for Q8. This sets the reference, or slicing, level of Q8 and a slight change in signal level from the discriminator (MARK or SPACE output) will drive Q8 into either saturation or into cut off. Diode CR12 is temperature sensitive and is used to maintain the zero reference point throughout the ambient temperature operating range of the unit. Assuming a MARK signal input to the subset, the voltage developed at output pin 4 of the discriminator is positive with respect to pin 3. This places a positive-going pulse on the base of Q8, saturating Q8. Transistor Q8 turns Q9 on and, in turn, Q10

saturates. Transistor Q10, thus, has closed the receive loop and MARK current from the subset power supply flows through the loop. A SPACE input signal to the subset causes a reverse action, with Q10 cutting off and opening the loop. Capacitor C16, at the collector of Q10, suppresses the reverse-current spike that tends to develop, due to the collapsing field of the telegraph equipment receiving magnet, when the loop changes from the MARK to SPACE condition. This protects Q10. This arrangement will handle the inductive spike from a maximum of two receiving machines.

3.11 The loop circuit within the subset includes a loop test or patch jack (J2) and a loop current adjustment potentiometer (R42), both in series with the loop, and a loop keying lamp (DS2). The keying lamp is arranged between the collector of Q10 and the negative side of the power supply so that it will light when Q10 is cut off. This represents a SPACE condition of the loop. Should the loop jack be used to extend the receive loop to the external telegraph receiving equipment, a jumper must be used between loop terminals 4 and 5 of terminal board TB1. This jumper is required to complete the loop.

3.12 The external control lead, from terminal 6 of TB1, connects with the collector of keyer transistor Q9. An external ground applied to this lead will turn Q10 on and clamp the receive loop in a MARK HOLD condition.

Power Supply Section

3.13 The subset power supply section makes use of a full-wave diode-bridge rectifier, and provides −20-volt direct current and +100-volt direct current, both with respect to ground. The 115-VAC input is fused and connected with the primary winding of isolation transformer T1. The T1 secondary is connected across the bridge rectifier composed of diodes CR1 through CR4. Capacitor C1 provides filter action for the supply. Breakdown diode CR5 and resistor R2 act as a tapped voltage divider across the supply output and establish the ground reference point. Diode CR5 also regulates the −20-volt output.

3.14 The −20-volt power is used to operate the circuits within the subset and these circuits have their return path to the ground reference point of the supply. The 120-volt telegraph battery for the receive loop is obtained across the supply (+100 volts to −20 volts), therefore, the external loop circuit must be isolated from ground. This voltage may be measured between the junction of C16 and R41 and the junction of R38 and R40, within the output keyer section of the subset.

Supervisory Circuit

3.15 Transistors Q2, Q4 and Q7 form the supervisory circuit of the subset. This circuit monitors the receive signal and, if the receive line level falls to −43 dBm ±3 dB (at the line side of the receive bandpass filter), supplies a clamp output to the output keyer. This level is just above the point where limiting action of the limiter section starts decreasing. The supervisory circuit also provides an alarm indication of unusable signal level by lighting the subset carrier alarm lamp (DS1).

3.16 The input to the supervisory circuit is taken from the collector of Q1. This signal is further amplified by a linear feedback amplifier composed of Q2 and Q4. The gain of the amplifier is set by factory-selected resistor R16 for the proper operate level of the clamp circuit. This resistor is located in the feedback loop from Q4 to Q2. The Q4 output drives a voltage doubler circuit made up of diodes CR7 and CR8 and capacitors C11 and C13. For normal signal level conditions, the negative output of the doubler circuit back-biases Q7 and holds it cut off. If the input signal falls to the clamp level, the doubler output will not be sufficient to hold Q7 off and it will saturate. This completes the alarm lamp circuit from the positive to negative side of the power supply and applies a negative clamp voltage on the lead to the output keyer.

3.17 The negative clamp voltage from the supervisory circuit is applied, through strap terminals 19 and 18 of the output keyer, to the base of Q8. This voltage is of sufficient magnitude to override the discriminator output and cuts off Q8. In turn, this cuts off both Q9 and Q10 and places a SPACE HOLD clamp condition on the receive loop. For certain applications, keyer strap terminal 19 may be strapped to terminal 20 instead of 18. This will place the low-signal, negative clamp voltage on the collector of Q8 and will cause a MARK HOLD clamp condition on the loop.

Reason for reissue: Issue 2 — Revised Interface levels in TECHNICAL SUMMARY.
Issue 3 — Output Keyer circuit description revised. Minor editorial corrections.

48873 RECEIVE SUBSET

ASSOCIATED INFORMATION

EAS-48873 — Equipment Assembly Schematic Diagram

1. TECHNICAL SUMMARY

General

Application:

In conjunction with a plug-in receive filter unit, provides receiving and supervisory equipment for termination of a single VF telegraph channel. Contains a power supply, line matching and loop current adjusting facilities, and a visual supervisory indication function. Initially used in 25A systems.

Installation:

May be placed on any flat, horizontal surface measuring 6 inches wide by 10 inches deep, minimum, or may be mounted on a subset shelf. The subset cabinet is equipped with four rubber feet.

Dimensions:

Height (Overall)	6 inches
Width	6 inches
Depth	10 inches
Weight (Approx.)	13 pounds (with receive filter unit)

Interface Characteristics

Line Impedance (Primary of Transformer T3)	600 ohms, balanced
Input Level Range (From Rec Line)	−5 to −40 dBm (with 37717 Receive Filter Unit), −21 or −29 dBm nominal
Input Frequency Range	300 to 7750 Hz
Output Loop Operation	60 mA, nominal, Neutral (120 volts), Telegraph battery supplied by subset.
Output Telegraph Rate	Up to 200 b/s. Specific rate determined by receive filter characteristics.
Line Level for Supervisory Clamp	−43 dBm ±3 dB (with 37717 Receive Filter Unit)

Controls and Adjustments

LOOP CUR (R42)	A potentiometer used for setting loop current at 60 mA.

Lamps and Jacks

CARRIER ALARM (DS1)	A red lamp which lights if the input carrier signal drops below the minimum acceptable receive level.
KEYING (DS2)	An amber lamp which indicates channel keying. (Lamp is lit during the open or SPACE condition.)
LOOP (J2)	Type 218A Telephone Jack (single tip-sleeve, break contact on tip).

Power Requirements

115 VAC, 60 Hz	13.5 watts, maximum

Environmental Conditions

Ambient Temperature Range	0° to 55°C (32° to 131°F)
Maximum Relative Humidity	95%
Maximum Altitude	15,000 feet

2. PHYSICAL DESCRIPTION

2.01 The 48873 subset consists of a dark gray, textured metal cabinet that forms a housing for a channel receive and supervisory section, a power supply section and a separate receive filter unit. The filter unit is equipped on a plug-in basis, slides into the lefthand cabinet position and mates with cabinet electrical receptacle J1. The wired-in receiver and supervisory printed-circuit card occupies the center portion of the cabinet. The righthand side of the cabinet is fitted with a front panel.

2.02 The cabinet front panel contains the loop current adjusting control, carrier alarm and keying lamps, the loop jack and the power supply input fuse. An inner compartment, behind this panel, contains the fixed loop resistor, line matching transformer and power supply components. A second inner compartment extends along the rear of the cabinet and contains subset wiring. A terminal block, TB1, at the rear of the cabinet provides for external line, loop, ground and control lead connections. A line cord, for supplying 115-volt alternating current to the power supply, is also located at the rear of the cabinet.

2.03 A removable cabinet front cover, held in place by two screws, protects the internal equipment. A cut-out in the cover allows observation of the carrier alarm and keying lamps, and provides access to the loop current control and to the loop jack. The cover must be removed for access to the fuse or for replacement of the filter unit. A card holder is furnished on the front of the cover for channel designation information. In certain instances, the front side of the front cover is silk-screened with a special system designation.

2.04 The subset cabinet top, as well as the front cover, may be removed for subset maintenance. The cabinet top is held in place by four screws. Removal of both items provides easy access to the circuit card, power supply, etc.

2.05 The cabinet is equipped, both top and bottom, with ventilation grills. These grills, combined with the cabinet-to-desk or shelf separation provided by the rubber cabinet feet, allow unimpeded convection air cooling of the equipment within the cabinet.

3. ELECTRICAL DESCRIPTION

General

3.01 The single-channel 48873 subset converts frequency-shift input signals, from the voice-frequency receive line, into binary output pulses which drive telegraph loop equipment. The output is a MARK, or "one" data level, when the input signal frequency is below the midband reference frequency and a SPACE, or "zero" data level, when the input is above midband. The total MARK—SPACE shift is determined by the receiver filter characteristic.

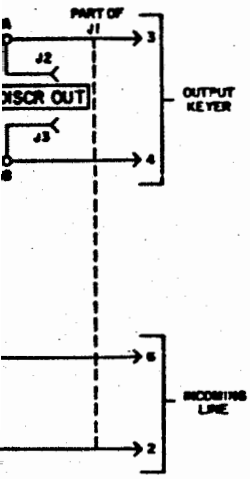
3.02 Channel frequency is established by means of the receive filter unit, used as part of the 48873 subset, and is determined by the filter family selected and by the filter unit midband frequency option used.

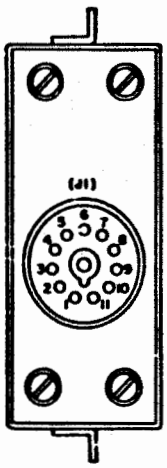
3.03 The subset output circuit provides 60 mA neutral (current flow with MARK, open circuit for SPACE) loop operation with a supply voltage of 120 volts; telegraph battery is supplied by the subset. The external loop circuit must be kept isolated with respect to ground.

3.04 An associated supervisory circuit, within the subset, monitors the received signal and clamps the receive loop in either the SPACE or MARK condition (as determined by a strapping option) if the received signal falls below the minimum acceptable level. This clamp action prevents erratic operation of the receive loop equipment and is released by an increase in signal level. SPACE HOLD or open circuit state clamping is normally used in application of the 48873 subset.

3.05 The receive subset contains a built-in power supply, operating from an alternating-current source of 115 volts, which provides regulated —20-volt power for the channel circuitry of the receiver and the 120-volt telegraph battery for the loop.

3.06 The subset signal path consists of an input section, amplifier and limiter section, discriminator, and an output keyer. The input section includes a balanced-to-unbalanced receive line matching transformer (T3) and a selected receive filter unit. The matching transformer has been





VIEW B-B

TABLE A [1] [6]

TYPE NO.	FUNCTION	FREQ
37712-01	PROVIDES BANDPASS FILTER, DISCRIMINATOR, LOW PASS FILTER, AND EQUALIZER TO SELECT DESIRED FREQUENCIES AND FOR USE WITH 37713 RECEIVE UNIT.	1190CPS
37712-02	PROVIDES SAME FUNCTION	1530CPS
37712-03	PROVIDES SAME FUNCTION	1870CPS
37712-04	PROVIDES SAME FUNCTION	2210CPS
37712-05	PROVIDES SAME FUNCTION	2380CPS
37712-06	PROVIDES SAME FUNCTION	2550CPS
37712-07	PROVIDES SAME FUNCTION	2890CPS
37712-08	PROVIDES SAME FUNCTION	3230CPS

A & M ONLY

SYM	DESCRIPTION
	SHADED AREA DENOTES CIRCUITRY NOT RECOMMENDED FOR FIELD SERVICE
( )	DENOTES REFERENCE INFORMATION NOT MARKED ON EQUIPMENT
>—	FEMALE CONNECTOR
→|	MALE CONNECTOR
□	NUMBER IN SQUARE REFERS TO RESPECTIVE NOTE

LEGEND

EAS-37712-MI

L-90

NO.	DESCRIPTION	DATE	APPD
1	ORIGINAL		
2 CLASS B	ECA-19726 POTENTIOMETER R1 VALUE WAS 1/3W. FACE PLATE REARRANGED.	6-17-64 PJV	
3	ECA 25182, CLASS B OPTIONAL RESISTOR R1, 1000 OHM, 178-12690-58 & R4, 2610 OHM, 161-02614-00 ADDED. TABLE OF REPLACEABLE PARTS REMOVED.	8-23-66 GMB	
3	ECA 30111, CLASS E NOTE 6 ADDED. IN TABLE A, -03 OPTION WAS SHOWN AS 1370 CPS, IN ERROR.	2-15-68 SWD	DJK
3A	CDN 43194, CLASS D EQPT CLASSIFICATION CHANGED TO A&M.	4-17-72 JA	GRT

JB	GOS	CJH	RHF
6-17-63	RJH	GLS	RNL

LENKURT ELECTRIC

37712
200 BAUD
RECEIVE FILTER UNIT

3A

EAS-37712-MI 01

FIG. 1 [1] [2]

37712
200 BAUD
RECEIVE FILTER UNIT

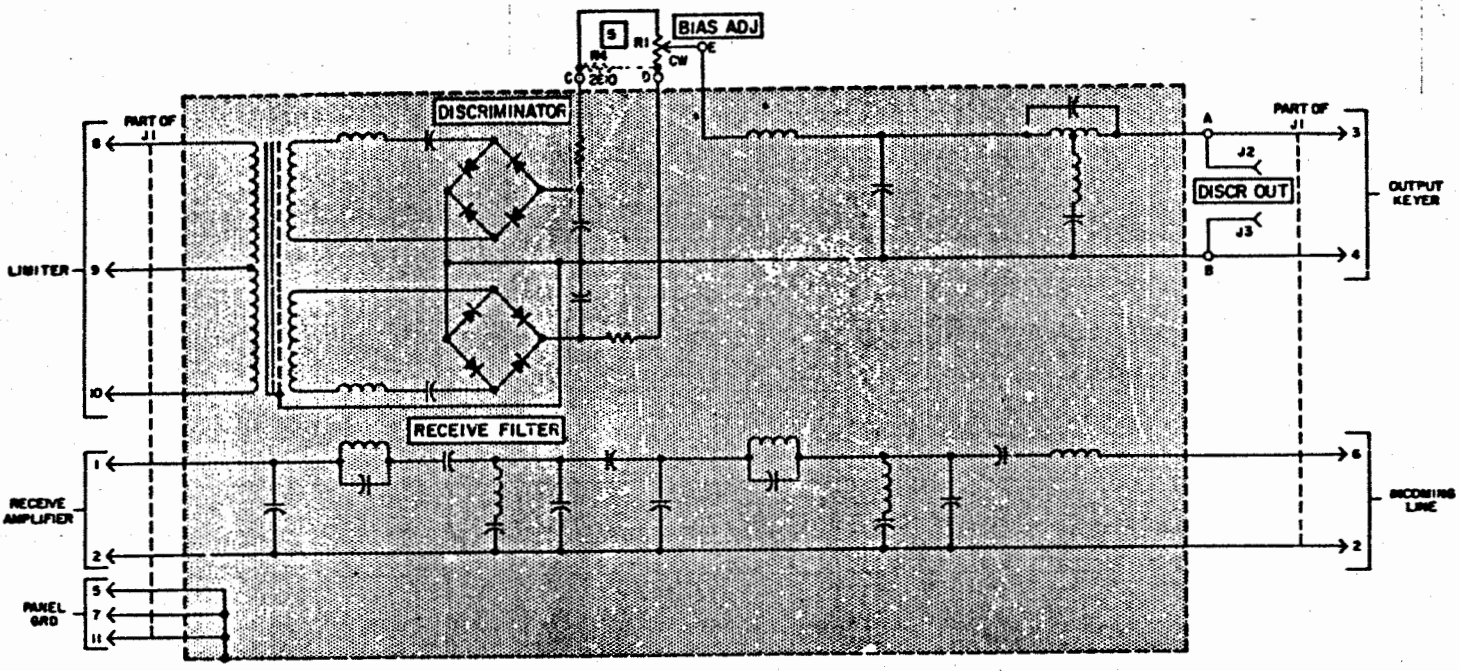
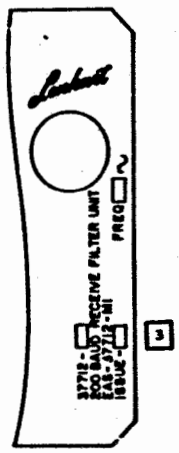
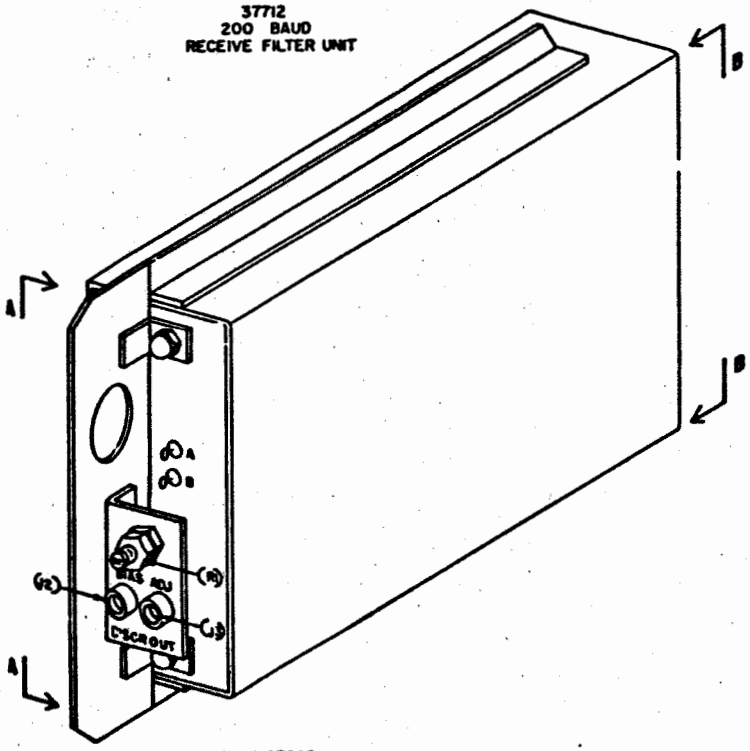


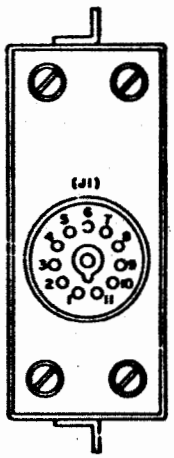
FIG. 2 [4]

37712
200 BAUD
RECEIVE FILTER UNIT



VIEW A-A





VIEW B-B

NOTES:

1. EQUIPMENT
   EQUIPMENT FURNISHED IN ACCORDANCE WITH TABLE A.

2. FUNCTIONAL MARKING
   INFORMATION IN RECTANGULAR BOX REPRESENTS FUNCTIONAL MARKING ON THE EQUIPMENT.

3. [illegible]UE NUMBER
   UE NUMBER MARKED ON EQUIPMENT AGREES WITH EAS DRAWING ISSUE NUMBER AT TIME OF MANUFACTURE.

4. WARRANTY MARKING
   THE WARRANTY MARKING WILL NORMALLY APPEAR ON THE SIDE OF THE UNIT. E.G., (WARTY 0563) REFERS TO THE START OF WARRANTY PERIOD, MAY, 1963.

5. BIAS ADJUST RESISTORS
   RESISTOR R1 VALUE AND STOCK NUMBER FOR USE ON 37712-01 AND -02 IS 1000 OHM, 178-12690-58. RESISTOR R1 VALUE AND STOCK NUMBER FOR USE ON 37712-03 THRU -08 IS 500 OHM, 178-12690-48. RESISTOR R4 VALUE AND STOCK NUMBER FOR USE ON 37712-02 ONLY IS 2610 OHM, 161-02614-00.

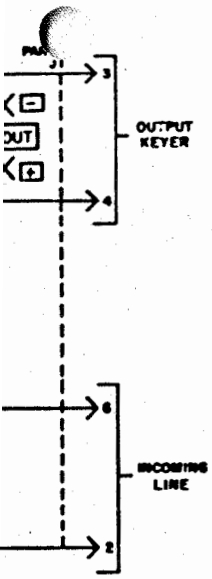
6. CHANNEL SPACING
   THE CHANNEL SPACING BETWEEN THE -04 FILTER AND -05 FILTER AND BETWEEN THE -05 FILTER AND -06 FILTER IS ONLY 170 Hz. THEREFORE, NEITHER THE -04 FILTER NOR THE -06 FILTER SHOULD BE USED IN THE -05 FILTER.

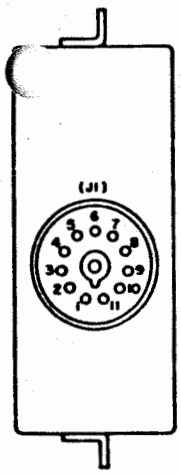
L-M90

SYM	ZONE	DESCRIPTION	DATE	APPROVED
1		ECA 29583, CLASS E FIG. 1, TERMINALS 5 & 7 WERE SHOWN CONNECTED TO FILTER HOUSING AND DESIGNATED PANEL GROUND IN ERROR.	12-26 67 BJL	DH
2		ECA 31149, CLASS D MECHANICAL CHANGE IN THE DESIGN OF THE FILTER.	6-20 68 SB	MLA

TABLE A

EQUIP	FUNCTION	CENTER FREQ CPS
37718-01	PROVIDES BANDPASS FILTER, DISCRIMINATOR, LOW PASS FILTER, TO SELECT DESIRED FREQUENCIES AND FOR USE WITH 25A RECEIVE UNIT.	425
37718-02	PROVIDES SAME FUNCTION	595
37718-03	PROVIDES SAME FUNCTION	765
37718-04	PROVIDES SAME FUNCTION	935
37718-05	PROVIDES SAME FUNCTION	1105
37718-06	PROVIDES SAME FUNCTION	1275
37718-07	PROVIDES SAME FUNCTION	1445
37718-08	PROVIDES SAME FUNCTION	1615
37718-09	PROVIDES SAME FUNCTION	1785
37718-10	PROVIDES SAME FUNCTION	1955
37718-11	PROVIDES SAME FUNCTION	2125
37718-12	PROVIDES SAME FUNCTION	2295
37718-13	PROVIDES SAME FUNCTION	2465
37718-14	PROVIDES SAME FUNCTION	2633
37718-15	PROVIDES SAME FUNCTION	2805
37718-16	PROVIDES SAME FUNCTION	2973
37718-17	PROVIDES SAME FUNCTION	3145
37718-18	PROVIDES SAME FUNCTION	3315





VIEW B-B

NOTES:

1. EQUIPMENT
   EQUIPMENT FURNISHED IN ACCORDANCE WITH TABLE A.
2. FUNCTIONAL MARKING
   INFORMATION IN RECTANGULAR BOX REPRESENTS FUNCTIONAL MARKING ON THE EQUIPMENT.
3. ISSUE NUMBER
   ISSUE NUMBER MARKED ON EQUIPMENT AGREES WITH EAS DRAWING ISSUE NUMBER AT TIME OF MANUFACTURE.
4. WARRANTY MARKING
   THE WARRANTY MARKING WILL NORMALLY APPEAR ON THE SIDE OF THE UNIT. E.G. (WARRANTY 1264) REFERS TO THE START OF WARRANTY PERIOD, DECEMBER, 1964.

EAS-37718
1

TABLE B

ITEM	DESIG	COMPONENT STOCK NUMBER
REPLACEABLE COMPONENTS		
WHEN ORDERING COMPONENTS, SPECIFY UNIT TYPE NUMBER, COMPONENT DESIGNATION, AND COMPONENT STOCK NO.		
1	C1	178-12690-48

	SHADED AREA DENOTES CIRCUITRY NOT RECOMMENDED FOR FIELD SERVICE
□	NUMBER OR LETTER IN SQUARE REFERS TO RELATED NOTE OR TABLE
( )	DENOTES REFERENCE INFORMATION NOT MARKED ON EQUIPMENT
SYM	DESCRIPTION
LEGEND	

25A
INITIAL USE

		DATE
ENGINEER	D. HUGHES	10-28-64
DRAFTSMAN	V. EDWARDS	10-28-64
CHECKED		
DFTG:	ELJ	12-30-64
APPL:	GOS	12-30-64
APPROVED		
STDS:	CHK	12-30-64
APPL:	RHF	12-30-64
DWG RLS DATE		12-31-64

DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED:
TOLERANCES:
FRACTIONS ± DECIMALS ± ANGLES ±
MATERIAL: FINISH:

LENKURT ELECTRIC CO., INC.
SAN CARLOS, CALIFORNIA

37718 MODEL 1
110 BAUD
RECEIVE FILTER UNIT

CODE IDENT NO.	SIZE	
	D	EAS-37718-M1
SCALE	DWG ISSUE 2	SHEET 1 OF 1

FIG. 1

37718
110 BAUD
RECEIVE FILTER UNIT

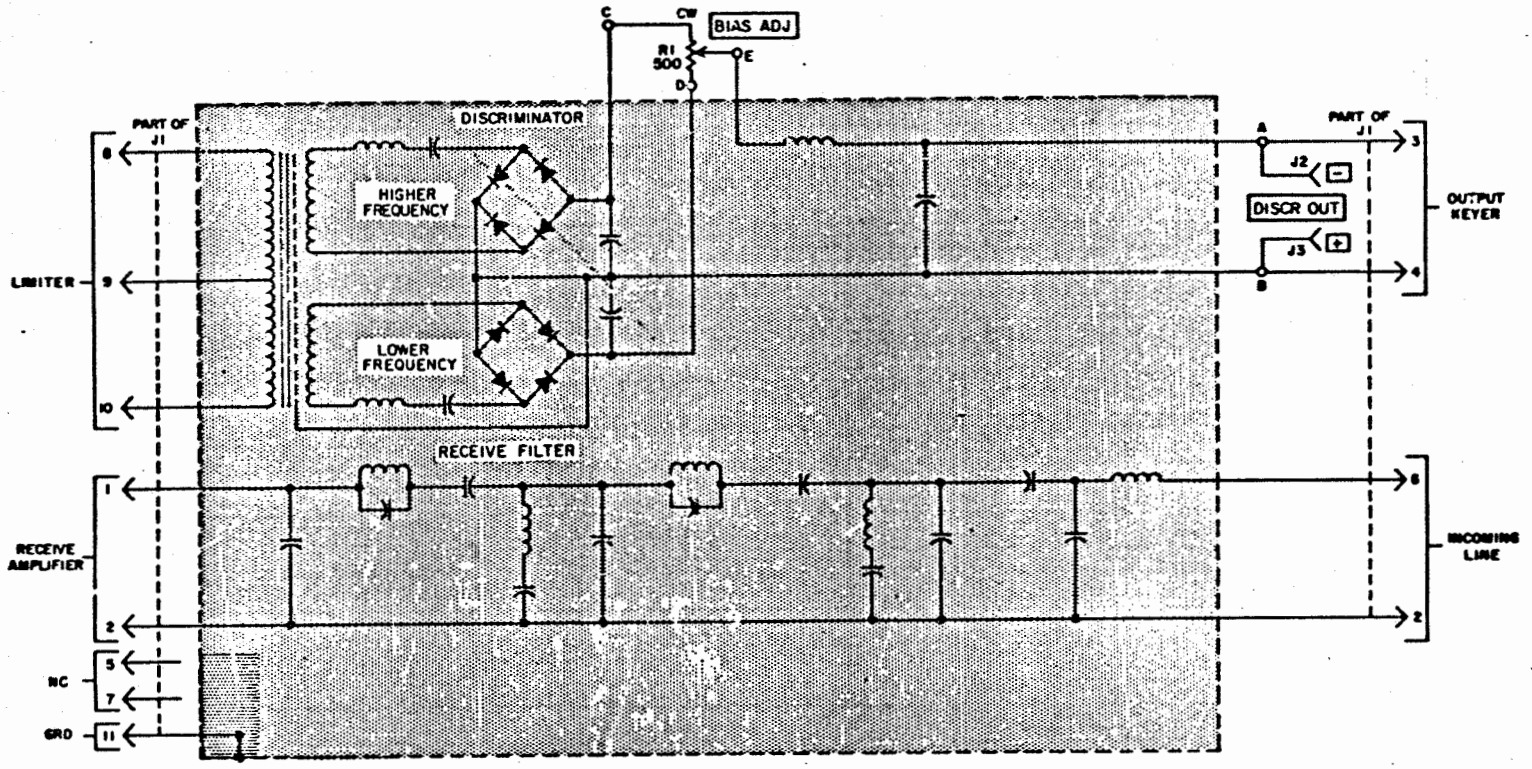
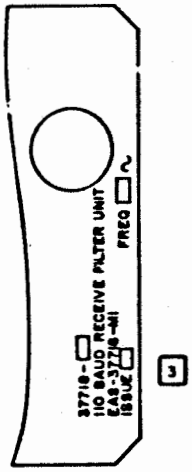
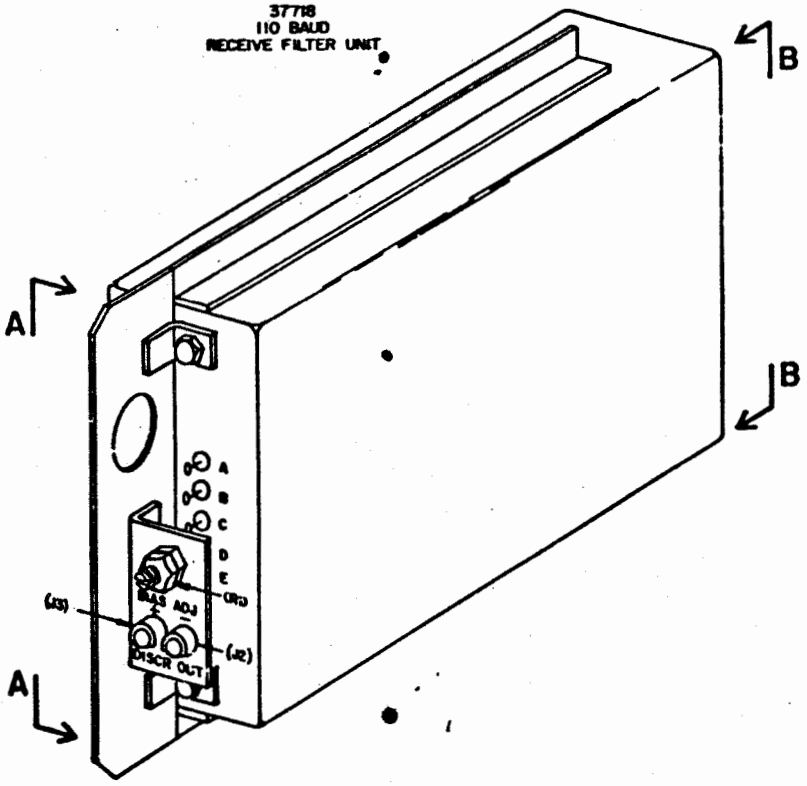


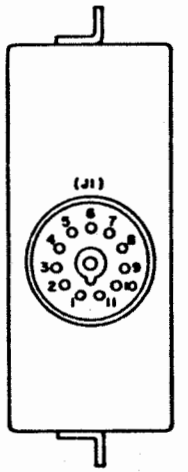
FIG. 2

37718
110 BAUD
RECEIVE FILTER UNIT



VIEW A-A





VIEW B-B

TABLE B

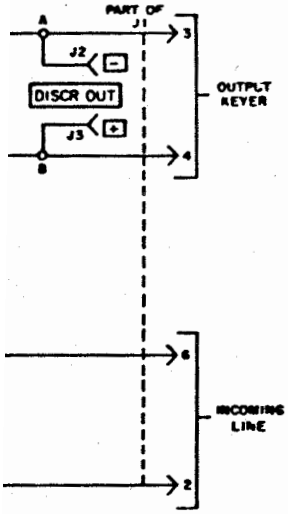
REPLACEABLE COMPONE		
ITEM	DESIG	COMPONENT STOCK NUMBER
WHEN ORDERING COMPONE SPECIFY UNIT TYPE NUMBE COMPONENT DESIGNATION, AND COMPONENT STOCK NO		
1	BASIC	
	R1	178-12690-4

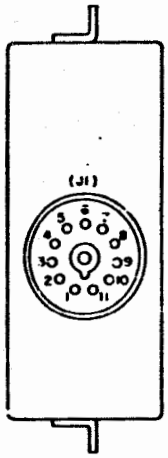
DISTR L-MSC

REVISIONS				
SYM	ZONE	DESCRIPTION	DATE	APPROVE
2		ECA 23971, CLASS B NOTE 5 ADDED. IN FIG. 1 & TABLE B, R2, R3 & R4 ADDED. IN TABLE A, OPTION -21 FREQ READ "2800". IN FIG. 1, PNL GRD LEADS 5 & 7 FROM P1 DELETED.	7-19 66 JEJ	
2		ECA 29583, CLASS E FIG. 1, TERMINALS 5 & 7 WERE DESIGNATED PANEL GROUND IN ERROR.	12-26 67 BJL	CH
3		ECA 31149, CLASS D MECHANICAL CHANGE IN THE DESIGN OF THE FILTER.	6-20 68 SB	MLA

TABLE A

EQUIP	FUNCTION	CENTER FREQ CPS
37717-01	PROVIDES BANDPASS FILTER, DISCRIMINATOR, LOW PASS FILTER, TO SELECT DESIRED FREQUENCIES AND FOR USE WITH 25A RECEIVE UNIT	420
37717-02	PROVIDES SAME FUNCTION	540
37717-03	PROVIDES SAME FUNCTION	660
37717-04	PROVIDES SAME FUNCTION	780
37717-05	PROVIDES SAME FUNCTION	900
37717-06	PROVIDES SAME FUNCTION	1020
37717-07	PROVIDES SAME FUNCTION	1140
37717-08	PROVIDES SAME FUNCTION	1260
37717-09	PROVIDES SAME FUNCTION	1380
37717-10	PROVIDES SAME FUNCTION	1500
37717-11	PROVIDES SAME FUNCTION	1620
37717-12	PROVIDES SAME FUNCTION	1740
37717-13	PROVIDES SAME FUNCTION	1860
37717-14	PROVIDES SAME FUNCTION	1980
37717-15	PROVIDES SAME FUNCTION	2100
37717-16	PROVIDES SAME FUNCTION	2220
37717-17	PROVIDES SAME FUNCTION	2340
37717-18	PROVIDES SAME FUNCTION	2460
37717-19	PROVIDES SAME FUNCTION	2580
37717-20	PROVIDES SAME FUNCTION	2700
37717-21	PROVIDES SAME FUNCTION	2820
37717-22	PROVIDES SAME FUNCTION	2940
37717-23	PROVIDES SAME FUNCTION	3060
37717-24	PROVIDES SAME FUNCTION	3180
37717-25	PROVIDES SAME FUNCTION	3300





VIEW B-B

NOTES:

1. EQUIPMENT
   EQUIPMENT FURNISHED IN ACCORDANCE WITH TABLE A.
2. FUNCTIONAL MARKING
   INFORMATION IN RECTANGULAR BOX REPRESENTS FUNCTIONAL MARKING ON THE EQUIPMENT.
3. ISSUE NUMBER
   ISSUE NUMBER MARKED ON EQUIPMENT AGREES WITH EAS DRAWING ISSUE NUMBER AT TIME OF MANUFACTURE.
4. WARRANTY MARKING
   THE WARRANTY MARKING WILL NORMALLY APPEAR ON THE SIDE OF THE UNIT. E.G. (MMYY DASH) REFERS TO THE START OF WARRANTY PERIOD, JUNE, 1965
5. OPTIONAL RESISTORS
   RESISTORS R2, R3 AND R4 ARE USED IN OPTIONS -09 THRU -25 ONLY.

EAS-37717

TABLE B

REPLACEABLE COMPONENTS		
ITEM	DESIG	COMPONENT STOCK NUMBER
WHEN ORDERING COMPONENTS, SPECIFY UNIT TYPE NUMBER, COMPONENT DESIGNATION, AND COMPONENT STOCK NO.		
1	BASIC	
	R1	178-12690-48
	R2	161-01214-00
	R3,R4	161-03832-00

5

LEGEND	
SYM	DESCRIPTION
	SHADED AREA DENOTES CIRCUITRY NOT RECOMMENDED FOR FIELD SERVICE
□	NUMBER OR LETTER IN SQUARE REFERS TO RELATED NOTE OR TABLE
( )	DENOTES REFERENCE INFORMATION NOT MARKED ON EQUIPMENT

	25A
	INITIAL USE
ENGINEER D.HUGHES	DATE 2-25-65
DRAFTSMAN T.A.L.WOLD	2-25-65
CHECKED	
DFTG: E.J	5-3-65
APPL.: G.O.S	5-20-65
APPROVED	
STDS: C.H.K	5-24-65
APP.: R.H.F	5-24-65
DWG RLS DATE	6-11-65

DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED
TOLERANCES:
FRACTIONS ± DECIMALS ± ANGLES ±
MATERIAL: FINISH:

LENKURT ELECTRIC CO., INC.
SAN CARLOS, CALIFORNIA

37717 MODEL 1
75 BAUD
RECEIVE FILTER UNIT

CODE IDENT NO.	SIZE	
	D	EAS-37717-MI
SCALE	DWG ISSUE 3	SHEET 1 OF 1

FIG. 1

37717
75 BAUD
RECEIVE FILTER UNIT

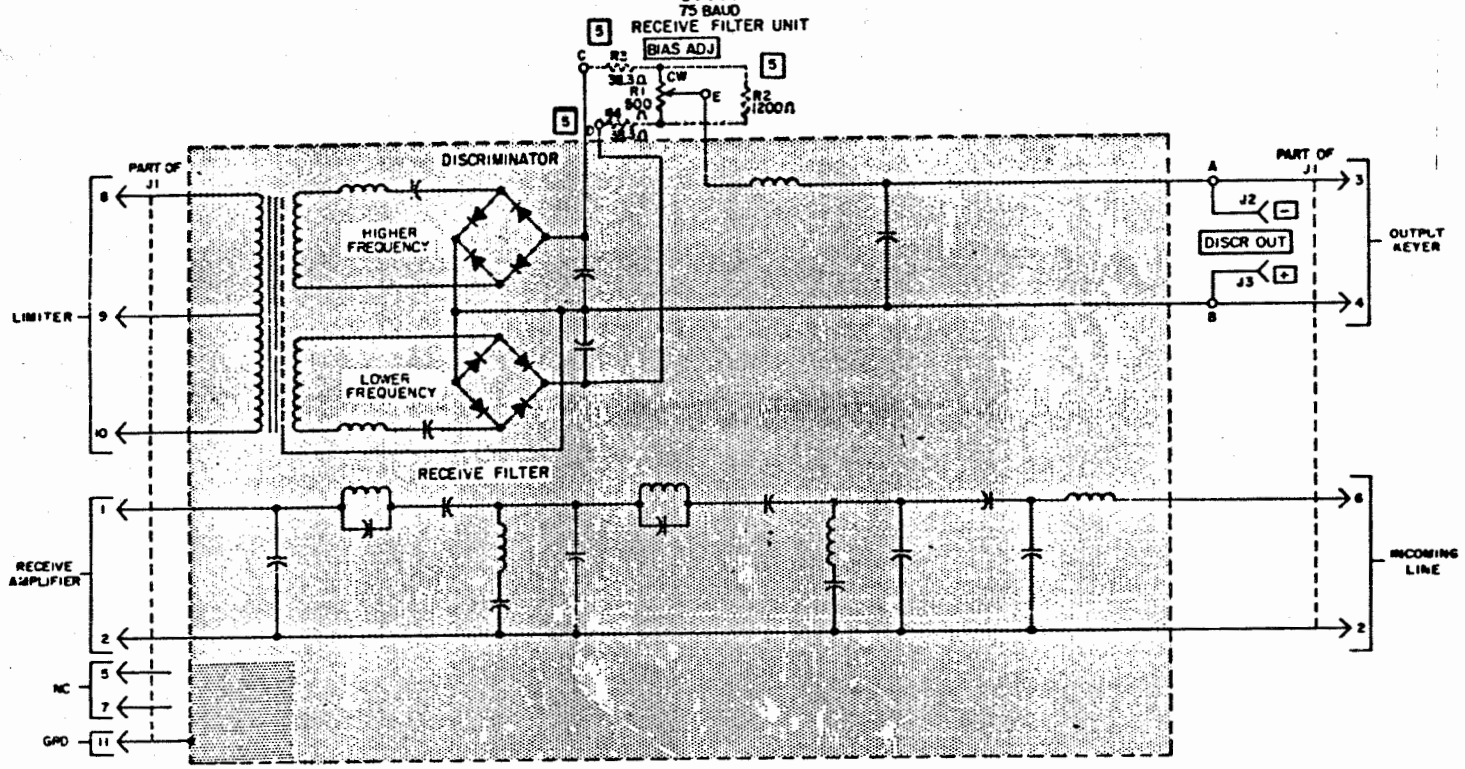
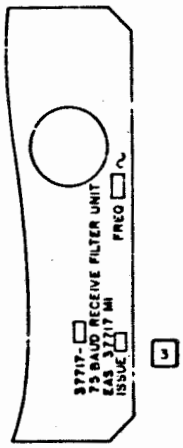
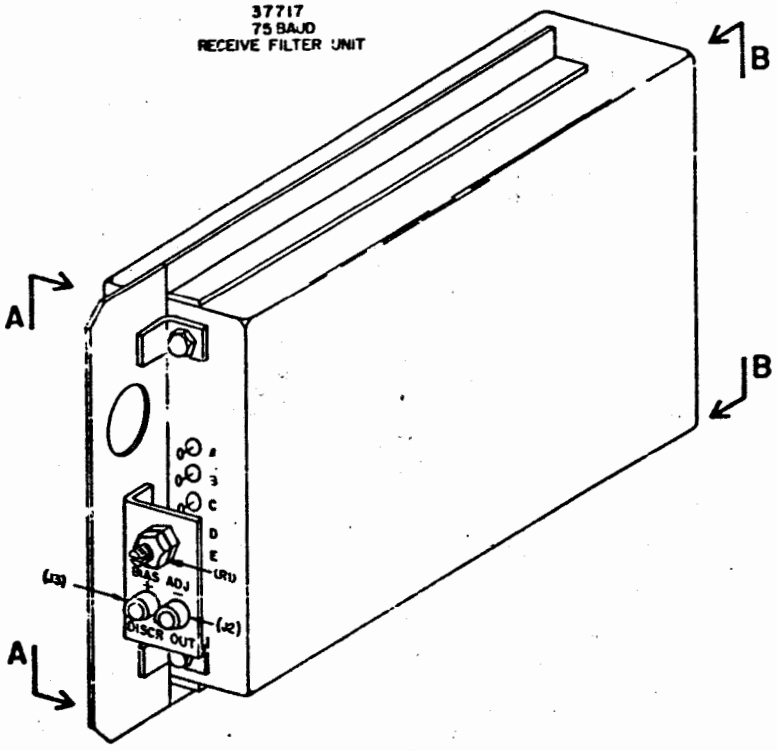


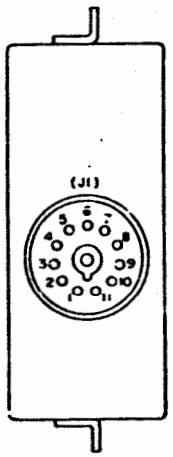
FIG. 2

37717
75 BAUD
RECEIVE FILTER UNIT



VIEW A-A





VIEW B-B

TABLE B

ITEM	DESIG	COMPONENT STOCK NUMBER
REPLACEABLE COMPONENTS		
WHEN ORDERING COMPONENTS, SPECIFY UNIT TYPE NUMBER, COMPONENT DESIGNATION, AND COMPONENT STOCK NO.		
1	BASIC	
	R1	178-12690-48
	R2	161-01214-00
	R3, R4	161-03832-00

FIG. 1
48873
RECEIVE SUBSET

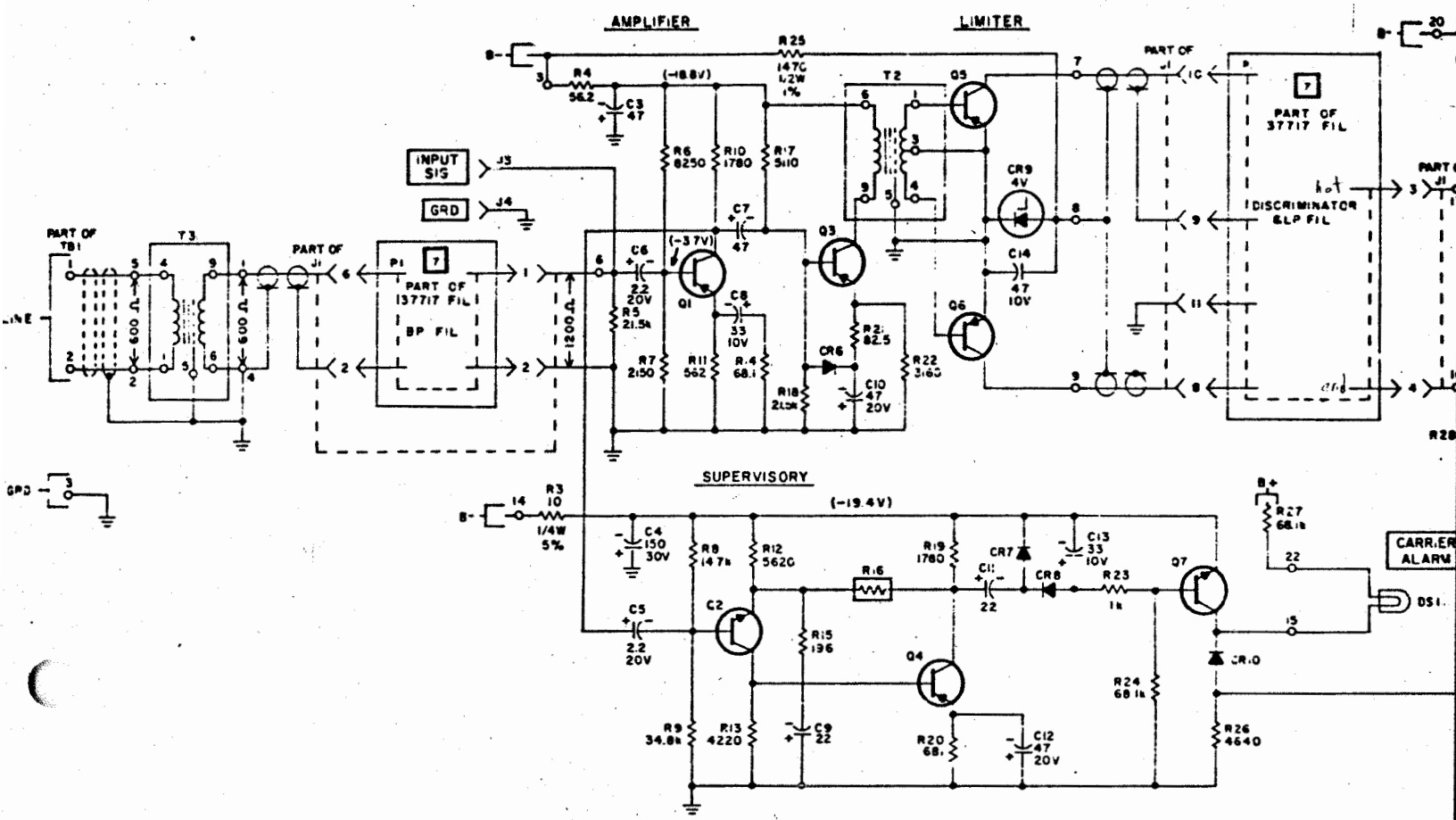


FIG. 2

DETAIL A
TRANSISTOR LEAD IDENTIFICATION

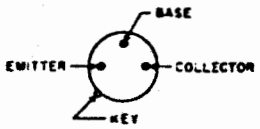


FIG. 2
48873-01 THRU-04

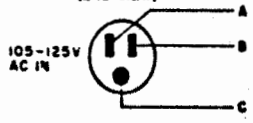


TABLE A

EQUIP	FUNCTION
48873-01	WHEN USED WITH A PLUG-IN RECEIVE FILTER, THIS PANEL COMPRISES A COMPLETE RECEIVE TELEGRAPH SUBSET AND SUPPLIED WITH AN AC POWER CORD AND STANDARD THREE PRONG PLUG AND 6 FO POWER CORD.
48873-02	PROVIDES SAME FUNCTIONS AS 48873-0 EXCEPT THAT THE SUBSET IS SUPPLIED WITH A STANDARD THREE PRONG AC PLUG WITH A 6 FOOT POWER CORD AND A FRONT COVER HAVING SPECIAL MARKING.
48873-03	PROVIDES SAME FUNCTION AS 48873-01 EXCEPT THAT SUBSET IS SUPPLIED WIT A FRONT COVER HAVING SPECIAL MARKI AND 2 FOOT POWER CORD.
48873-04	PROVIDES SAME FUNCTION AS 48873-01 EXCEPT THAT SUBSET IS SUPPLIED WIT FRONT COVER HAVING SPECIAL MARKING

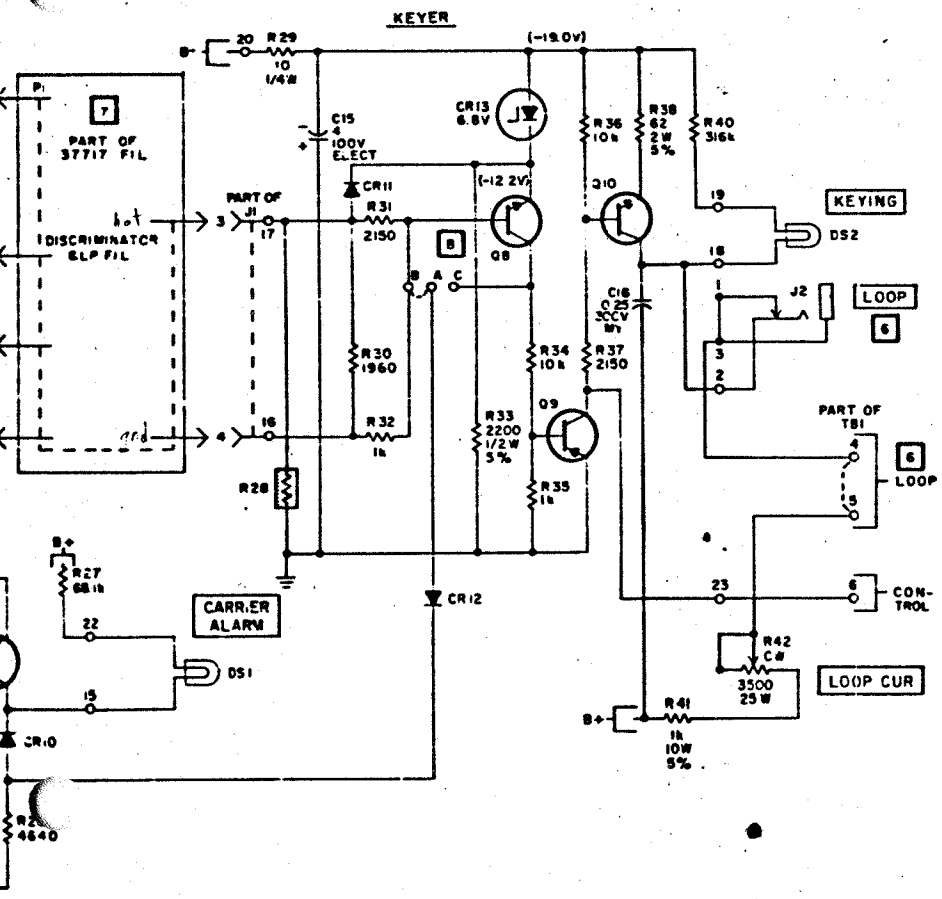
TABLE B

CLAMP OPTIONS	
CLAMPED STATE	STRAP
REC LOOP MARK HOLD	A-C
REC LOOP SPACE HOLD	A-B *

* EQUIPMENT FACTORY STRAPPED FOR SPACE HOLD UNLESS OTHERWISE SPECIFIED.

DISTR L-M9D

REVISIONS				
SYM	ZONE	DESCRIPTION	DATE	APPROVED
1		ECA 28698, CLASS D ADDED NOTES 22 & 23. IN TABLE C, Q7,Q10 WAS 174-25566-20 IN ERROR.	8-23-67 JEJ	
2		ECA 28343 CLASS B REPLACED R39 & C14 SERIES WITH C16 AND REVERSED LEADS TO J2 IN FIG 1 IN TABLE C. C16 ADDED. CR14 STOCK NO 174-14809-10 AND R39 1K, 1/2 W STOCK NO 161-01004-02 DELETED. Q10 STOCK NO WAS 174-25566-50	9-7 67 GWB	
3		ECA 29013, CLASS A IN FIG 1 & TABLE C, F1 WAS 1/4A 175-14721-33.	9-27-67 BC	DH
3		ECA 29309, CLASS E IN FIG. 1, CR3 & CR4 WERE SHOWN IN REVERSED POLARITY IN ERROR. IN TABLE C, CR10 STOCK NO. WAS 174-14809-10 IN ERROR.	11-7 67 SB	DH
4		ECA 31-75, CLASS D IN FIG 20, PROTECTIVE COVER BOARD ADDED.	7-8 68 SB	MLA
5		ECA 32633, CLASS C IN TABLE A, -04 OPTION ADDED. IN TABLE C, ITEM 5 ADDED.	1-14 69 JR	DJK
6		ECA 33164, CLASS C IN TABLE C, P2 FOR OPTION -03 WAS 135-24539-02; COVER FOR OPTION -04 WAS 024-49002-03 IN ERROR.	2-20 69 BB	DJK
7		ECA 36759, CLASS B, IN TABLE C, Q10 WAS 174-25566-63.	5-25-70 BW	JMS
8		CDN 47518, CLASS D IN FIG. 2 & TABLE A 48873-02 STANDARD THREE PRONG PLUG WAS A POLARIZED TWO PRONG AC PLUG. IN TABLE C DESIGNATION P2 STOCK NO. 135-24529-02 WAS 135-49290-01. FIG. 3 DELETED	6-25 73 JA	MDG
9		CDN 49177, CLASS D IN TABLE C, CR11 WAS 174-14809-53.	12-20 73	GRT



DETAIL A

NSISTOR LEAD IDENTIFICATION

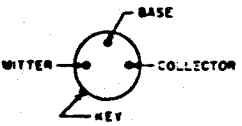


TABLE A

FUNCTION	ITEM
USED WITH A PLUG-IN RECEIVE ER, THIS PANEL COMPRISES A COM- E RECEIVE TELEGRAPH SUBSET AND IS PLIED WITH AN AC POWER CORD AND DARD THREE PRONG PLUG AND 6 FOOT R CORD.	1,2
IDES SAME FUNCTIONS AS 48873-01 PT THAT THE SUBSET IS SUPPLIED A STANDARD THREE PRONG AC PLUG A 6 FOOT POWER CORD AND A FRONT R HAVING SPECIAL MARKING.	1,2
IDES SAME FUNCTION AS 48873-01 PT THAT SUBSET IS SUPPLIED WITH NT COVER HAVING SPECIAL MARKING R 2 FOOT POWER CORD.	1,4
IDES SAME FUNCTION AS 48873-01 PT THAT SUBSET IS SUPPLIED WITH A T COVER HAVING SPECIAL MARKING.	1,5

NOTES:

1. EQUIPMENT
   EQUIPMENT FURNISHED IN ACCORDANCE WITH TABLE A. ITEM NUMBERS IN TABLE A REFER TO ITEM NUMBERS IN TABLE C.
2. RESISTORS
   ALL RESISTANCE VALUES SHOWN IN OHMS. K DENOTES THOUSAND. ALL RESISTORS ARE 1/8 WATT, 1% UNLESS OTHERWISE INDICATED.
3. CAPACITORS
   ALL CAPACITANCE SHOWN IN MICROFARADS UNLESS OTHERWISE NOTED. ALL CAPACITORS ARE TANTALYTIC WITH A WORKING VOLTAGE OF 35V UNLESS OTHERWISE INDICATED. MY DENOTES MYLAR
4. FUNCTIONAL MARKING
   INFORMATION IN RECTANGULAR BOX REPRESENTS FUNCTIONAL MARKING ON THE EQUIPMENT.
5. VOLTAGES
   ALL VOLTAGES INDICATED ARE REFERENCED TO GROUND.
6. EQUIPMENT CONNECTION LOOP
   PROVIDE JUMPER 4-5 ON TB1 WHEN EQUIPMENT IS CONNECTED TO "LOOP" JACK J2. EQUIPMENT CONNECTED TO LOOP MUST BE ISOLATED FROM GROUND.
7. ASSOCIATED DRAWING
   REFER TO EAS-37717 FOR FILTER CIRCUITRY.

EAS-4887 1

NC	NO CONNECTION
	SHADED AREA DENOTES CIRCUITRY NOT RECOMMENDED FOR FIELD SERVICING
( )	DENOTES REFERENCE INFORMATION NOT MARKED ON EQUIPMENT
□	NUMBER OR LETTER IN SQUARE REFERS TO RELATED NOTE OR TABLE
SYM	DESCRIPTION

LEGEND

INITIAL USE: 25A	
ENGINEER D STOSCHER	3-7-67
DRAFTSMAN R. HARRIS	5-2-67
CHECKED	
DFTG: ELJ	5-16-67
APPL: DH	5-16-67
APPROVED	
STDS: CHK	5-16-67
APPL: R&H	5-16-67
DRAWING RELEASE DATE	5-18-67

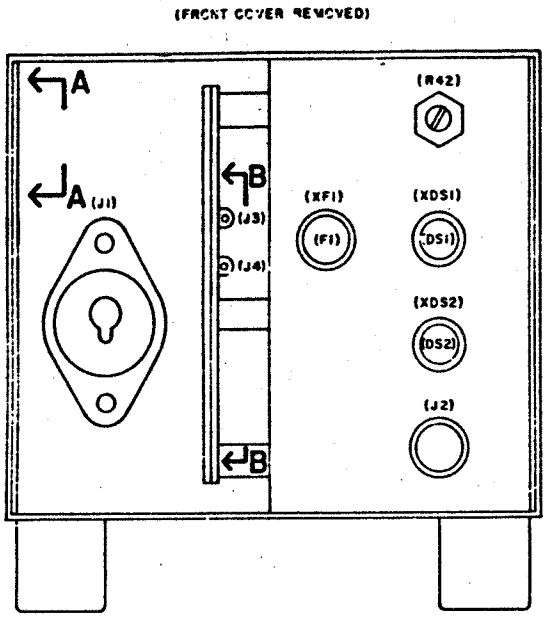
DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED:
TOLERANCES:
FRACTIONS ± DECIMALS ± ANGLES ±
MATERIAL: FINISH:

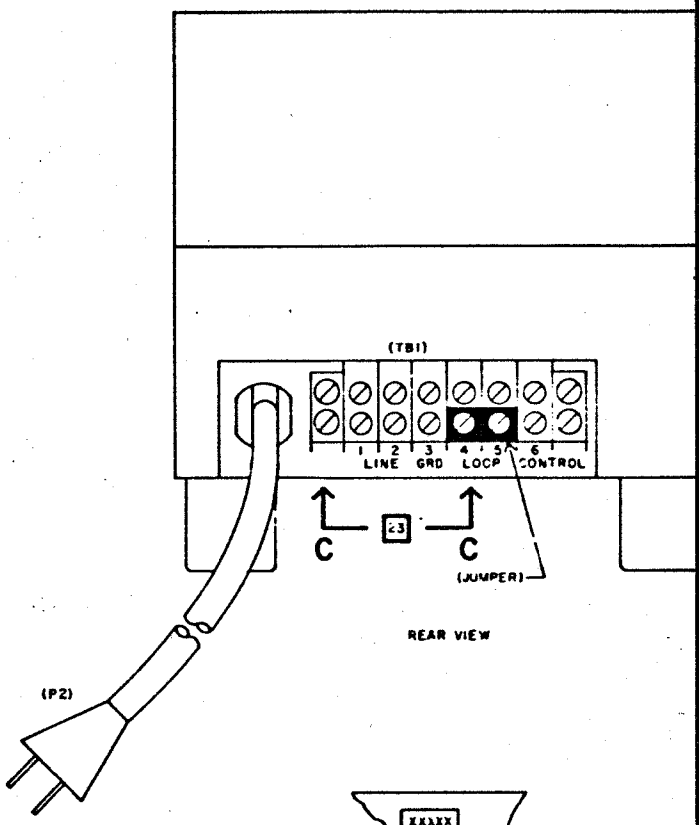
LENKURT ELECTRIC CO., INC.

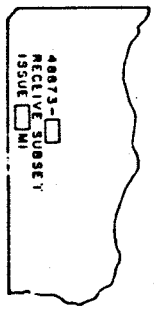
48873 MODEL 1
RECEIVE SUBSET

CODE IDENT NO.	SIZE	
	D	EAS-48873-M1
SCALE	DWG ISSUE 9	SHEET 1 OF 2

FIG. 20
48873
RECEIVE SUBSET

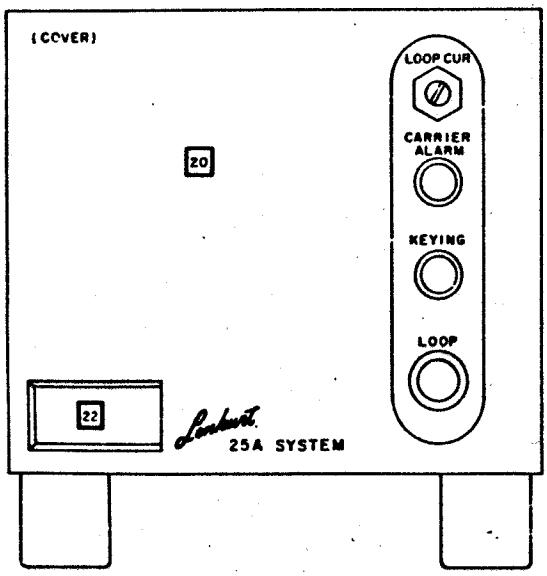




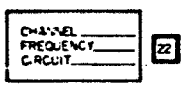


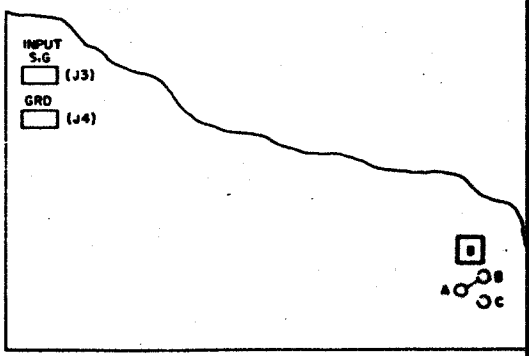
VIEW A-A

VIEW C-C



DETAIL B
MJF-1174





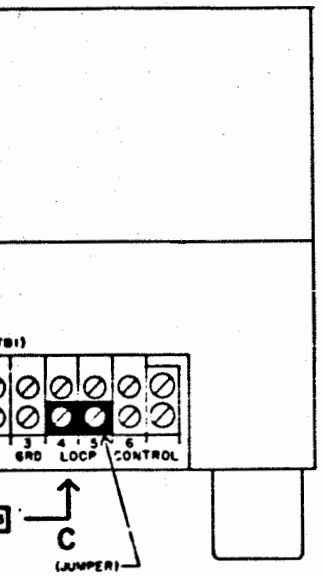
VIEW B-B

DISTR	REVISIONS				
L-M9D	SYM	ZONE	DESCRIPTION	DATE	APPROVED

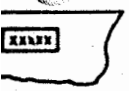
TABLE C

ITEM	DESIG	COMPONENT STOCK NUMBER
WHEN ORDERING COMPONENTS, SPECIFY UNIT TYPE NUMBER, COMPONENT DESIGNATION, AND COMPONENT STOCK NO.		
1	BASIC	
	C1	159-20839-01
	C2,C4	159-10922-28
	C3	159-25922-37
	C5,C6	159-25922-16
	C7	159-25922-31
	C8,C13	159-25922-10
	C9,C11	159-25922-35
	C10,C12	159-25922-24
	C14	159-25922-05
	C15	159-23614-05
	C16	056-14250-35
	CR1-CR4	174-19529-12
	CR5	174-22826-21
	CR6	174-14809-35
	CR7,CR8, CR12	174-14809-53
	CR9	174-14809-38
	CR10	174-19529-10
	CR11	174-14809-41
	CR13	174-14809-28
	DS1,DS2	184-29639-02
	F1	175-14721-04
	J1	138-15914-02
	J2	139-10665-01
	J3	139-46051-01
	J4	139-46051-02
	LENS (RED)	138-47484-01
	LENS (AMBER)	138-47484-04
	Q1,Q3,Q4	174-25566-24
	Q2	174-25566-34
	Q5,Q6	174-25566-06
	Q7	174-25566-50
	Q8	174-25566-21
	Q9	174-25566-62
	Q10	174-25566-76
	R1	162-05002-47
	R2	162-01754-49
	R3,R29	160-01002-41
	R4	161-05622-00
	R5,R18	161-02155-02
	R6	161-08254-00
	R7,R31, R37	161-02154-00
	R8	161-01475-00
	R9	161-03485-00
	R10	161-01784-00
	R11	161-05623-00
	R12	161-05624-00

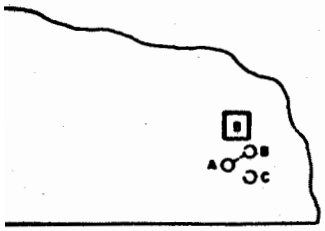
1	BASIC (CONT)	
	R13	161-04224-00
	R14	161-06812-00
	R15	161-01963-00
	R17	161-05114-00
	R18	161-02155-00
	R19	161-01784-00
	R20	161-06813-00
	R21	161-08252-00
	R22	161-03164-00
	R23,R32, R35	161-01004-00
	R24,R27	161-06815-00
	R25	161-01474-02
	R26	161-04644-00
	R30	161-01964-00
	R33	160-02204-42
	R34,R36	161-01005-00
	R38	160-06202-44
	R40	161-03166-00
	R41	162-01004-47
	R42	178-12614-11
	T1	080-08012-02
	T2	080-00306-21
	T3	080-04081-21
	TB1	137-28241-06
	XDS1,XDS2	138-47484-05
	XF1	137-95990-01
	JUMPER	137-49295-01
2		-01 OPTION
	P2	135-24539-02
	COVER	024-49002-01
3		-02 OPTION
	P2	135-24539-02
	COVER	024-49002-02
4		-03 OPTION
	P2	035-52038-01
	COVER	024-49002-03
5		-04 OPTION
	P2	135-24539-02
	COVER	024-49002-04



REAR VIEW



W C-C



EW B-B

NOTES

20. SPECIAL MARKING
48873-02, -03 & -04, HAVE SPECIAL MARKING IN THIS AREA.

21. WARRANTY MARKING
THE WARRANTY MARKING NORMALLY APPEARS ON THE REAR OF THE UNIT. E.G. (WRNTY 0467) REFERS TO THE START OF THE WARRANTY PERIOD, APRIL, 1967.

22. OPERATIONAL ASSIGNMENT
CHANNEL, FREQUENCY AND CIRCUIT ASSIGNMENT PER NJF 1174. SEE DETAIL B.

23. SUBSET IDENTIFICATION
-02 VERSION HAS SPECIAL IDENTIFICATION DECAL AFFIXED IN THIS AREA.

EAS-48873
2

DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED:
TOLERANCES:
FRACTIONS ± DECIMALS ± ANGLES ±

INITIAL USE: 25A		MATERIAL:	FINISH:
ENGINEER D. STOSCHER	DATE 3-7-67	LENKURT ELECTRIC CO., INC.	
DRAFTSMAN D. PRATT	4-10-67		
CHECKED		48873 MODEL 1 RECEIVE SUBSET	
DFTG: ELJ	5-16-67		
APPL: DH	5-16-67		
APPROVED			
STDS: CHK	5-16-67		
APPL: RAH	5-16-67		
DRAWING RELEASE DATE	5-18-67	CODE IDENT NO.	SIZE D EAS-48873-MI
		SCALE	DWG ISSUE 9 SHEET 2 OF 2

Dear Mr. Lundquist,

I saw your plea in 73 Magazine for info on the Lenkurt 25A demodulator. Enclosed is some info on it.

You will probably have a hard time using it on the ham bands because most of the plug-in filters are 60 Hz shift. There are a large variety of filters and 3 or 4 shifts available on the used equipment market, but they are expensive.

These demodulators are used by AP and UPI wire services in radio stations and newspapers. They send many data streams down the phone lines, using frequency division multiplexing, hence the many filter center frequencies and shifts. You just plug in the one for the service you bought.

You might try putting a ttl or cmos divide-by-2 circuit after your limiter. This would cut the shift in half, but also the audio frequencies received. Sounds like a lot of work. Oh, well...

Hope you can use this info.

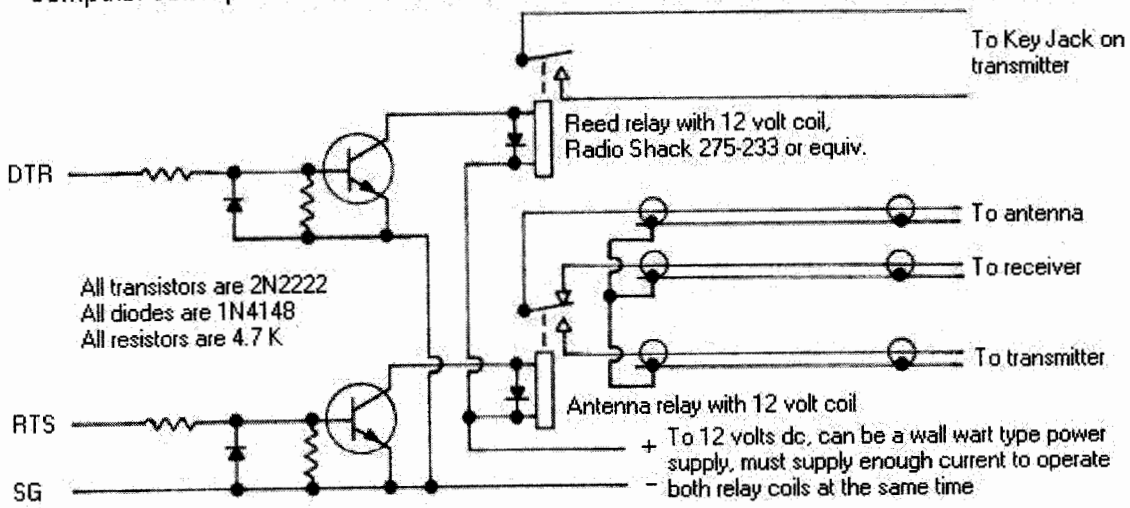
yours,

Rick Strehlow

Rick Strehlow KAØCSG
1130 SE 9½ Avenue
Rochester, MN 55901

P.S. I sent a copy of the data to WA3AJR, 73 RTTY Loop.

Computer serial port interface for the GLOWBUG transmitter when using CwType software



Signal Name	DB-25 Pins	DB-9 Pins
DTR	20	4
SG	7	5
RTS	4	7

Drawn by KG4HSY

"TTY232-TAP" RS-232 to Teletype Current Loop Interface (90-701-A)
==========

Dec 2000, Gil Smith, gil@vauxelectronics

Also see: "TTY232" Teletype Loop Supply and RS-232 Interface (90-700-A)

Contents:
=========

Description:

This gizmo allows an RS-232 port to tap into an externally-powered (and current-limited) teletype current loop. It is for a half-duplex single send/receive loop, using 20 to 60 mA (150V max). Auto loop polarity is provided by a bridge. The RS-232 interface is self-powered, deriving operating voltages from RTS, DTR, and/or TXD lines. The RTS and DTR lines also drive open-collector transistors, for auxilliary functions such as keying a radio. These lines are not isolated, but the TTY loop is fully opto-isolated.

This is a small pc board (0.6" x 1.5") which fits into a DB9-to-DB9 adapter housin It uses surface-mount parts in sot-23 (dual-diodes, transistors) and 1206 (resistors/caps) packages, and it uses both sides of the board. The optos, bridge, and drive transistor are through-hole parts. It can be built for about $15.

It will plug directly into a PC's 232 port -- you can solder a 1/4" phone plug/cable directly to the pcb, or put a second DB9 on the other end for a cleaner finish, and access to the buffered RTS and DTR lines as well.

Assembly:

Inspect the board for shorts/opens before starting (not likely, but it is a prototy Note that square pads denote negative pins (caps, diodes...), or pin-1 (ICs, connec Use a low-wattage soldering iron with a small tip. Use a rosin-core solder -- ther need to clean the board with chem-spray (you could goop up the connectors inside). smallest to the largest parts (resistors, caps, chips...).

You need tweezers, a good light, and a steady hand for the surface-mount parts. Be a good mood (or you might smash things), and don't drink coffee if it makes you jit Tin one pad of a part on the board, then pick up the part with tweezers, hold it in position over the pads, melt the solder on the pre-tinned pad and drop the part into place (holding it until the solder solidifies). Then solder the other pin(s) of the part. Finally, reflow the solder on the first pad.

The DB-9 connectors push over the ends of the board, and are soldered into place.

OOPS! I forgot to add clamp diodes across the base-emitter of Q2 and Q3. Tack a 1N4148 on each (anode to emitter, cathode to base). Yeah, it looks cheesy. The transistors will likely be fine, but it's bad practice to reverse bias that muc I'll fix this on the next rev (if there is one); I might add a second bridge for full-duplex as well.

Techno-poop:

A small amount of power can be drawn from an RS-232 port for running a peripheral device -- for example, a mouse powers its circuitry this way. Both positive and negative voltage rails may be derived from a serial port, even regulated to drive a microcontroller, etc.

This TTY232-TAP circuit only needs to obtain positive and negative voltage rails for sending 232 levels back to the computer on the RXD line, which is directly switched using an optocoupler from the current loop. The TXD line from the PC directly drives another optocoupler, with no intervening circuitry. For this circuit, power demands from the serial port are low.

The RS-232 spec defines that a port driver should put out +/-5V to +/-15V into a 3 Kohm load. A 232 port on a typical desktop PC may provide +/-12V outputs, while a laptop may only provide +/-5V outputs on its 232 port. RS-232 drivers typically source/sink 5 to 15 mA, but the low end of the spec (5V into 3K) is only 1.6 mA, so parasitic circuits should stay below that.

The RS-232 spec defines that a port receiver should be able to detect +/-3V minimum. Most RS-232 interface chips have a fail-safe input that allows an open or grounded input to be presumed negative. This allows a nice hack, since you can now use ground for mark instead of a negative supply, and drive the space to 3V or 5V logic-levels. This has some handy uses, allowing a logic gate to drive a 232 port directly (short-distance, non-production applications).

While +/-5V is the minimum driver range allowed by the spec, a non-compliant driver could use a range from ground to +3V as the absolute minimum needed in special cases. Signal levels are defined as:

TXD and RXD lines:	Mark = Logic '1' = negative (<= -5V)
	Space = Logic '0' = positive (>= +5V)
Control lines:	Active = Logic '1' = positive (>= +5V)
	Inactive = Logic '0' = negative (<= -5V)

There are three lines driven by the computer, that can be used to derive voltage rails: TXD, RTS, and DTR. The TXD line is marking when no data is being sent, so it is at a negative voltage (typically -5 to -12V). When data is transmitted, the TXD line drives positive for space. The RTS and DTR lines, if driven active by the host, will drive positive.

TTY232-TAP uses diodes to OR all three lines (in both positive and negative directions), and small filter caps -- this provides derived V-POS/V-NEG rails. The board may be powered several ways:

1) The best way to power the board is to drive RTS and DTR to opposite levels. A typical mouse driver sets RTS active (positive), and DTR inactive (negative). This provides stable V-POS/V-NEG rails.

2) The next best case will be when the positive rail is driven by either RTS or DTR active, and the negative rail is derived from filtered TXD (which will be quite negative if it is mostly marking). If TXD is busy sending data, the negative rail will float up towards ground. Having a perfect negative rail is not particularly necessary, since most receivers will accept even ground as the negative mark. Sending data with a lot of spaces may cause the V-NEG rail to rise higher than desired. This can be improved by adding extra stop bits or inter-character delays to increase the marking time, allowing the V-NEG cap C2 to charge more. Another variation is to constantly toggle either RTS or DTR for charging both rails, perhaps changing the level between transmitted characters.

3) The least-desirable case is when only TXD is connected, and it will need to charge both rails. Since it is normally marking, the V-NEG rail

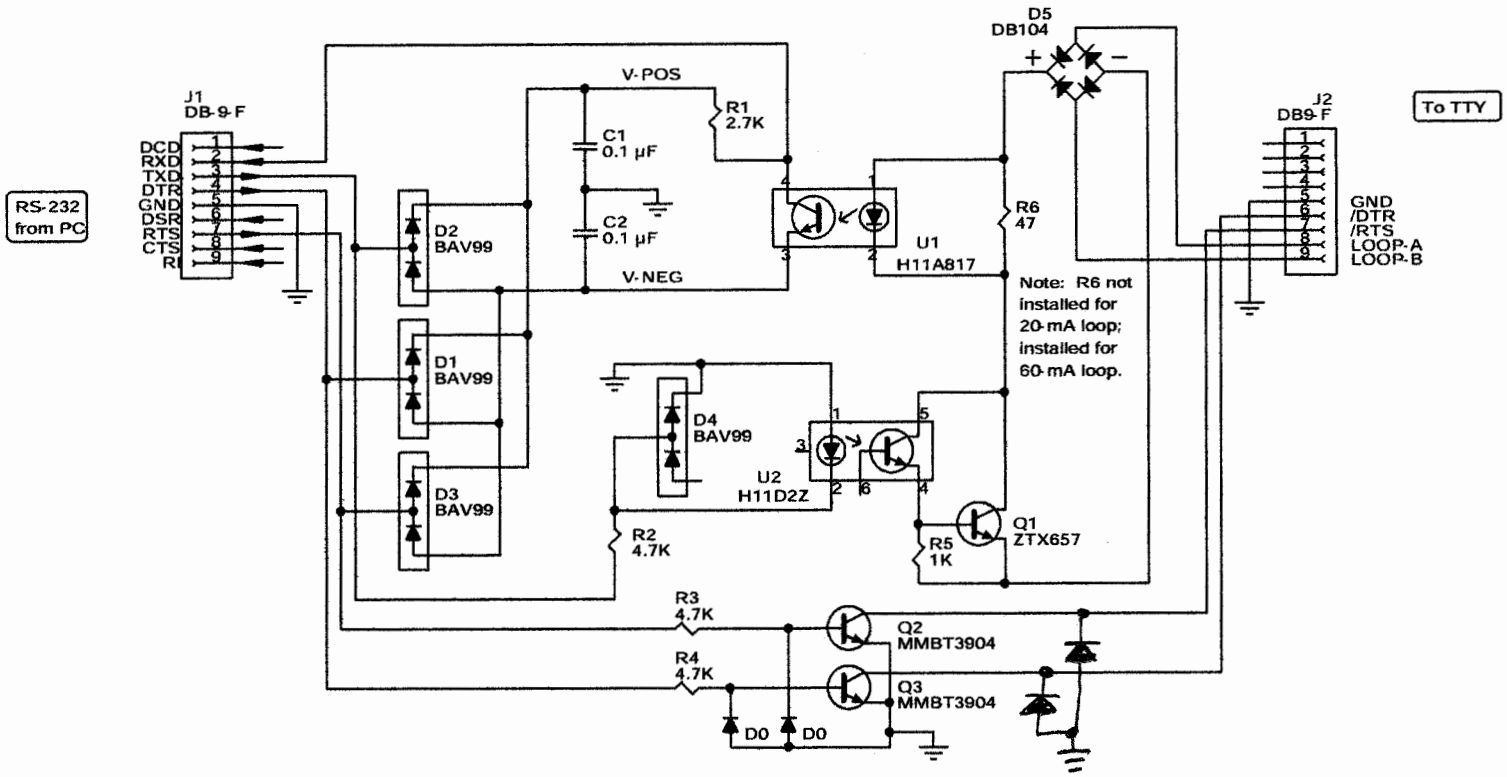
will likely be fine. But to get the V-POS rail lifted, the host will need to send some data to charge up the positive cap. This means a dummy header string before sending data blocks.

The RTS and DTR lines also drive open-collector transistors, for auxilliary functions such as keying a radio. When the RTS or DTR line is active (positive) the associated transistor will pull to ground and sink up to about 50 mA (40V max). If you are driving a relay (or other inductive load), be sure to add a freewheel diode across the coil (anode to transistor, cathode to v+) to protect the transistor from the di/dt spike.

Parts List:
==========

Mouser Electronics	www.mouser.com	800-346-6873
DigiKey	www.digi-key.com	800-344-4539
Jameco	www.jameco.com	800-831-4242

Ref	Desc	Source	Order Number	Qty
	pcb	gil	90-701-A	1
case	DB9 to DB9 housing	Mouser	157-4001	1
C1,2	cap, cer, 1 uF, 1206	DigiKey	PCC1882CT	2
D1,2,3,4	diode, dual, sot-23	DigiKey	BAV99ZTXCT	4
D5	bridge-rect, 400V/1A	DigiKey	DB104MS	1
J1	jack, DB9-F, solder-cup	DigiKey	209F	1
R1	res, 2.7K, 1206	DigiKey	P2.7KECT	1
R2,3,4	res, 4.7K, 1206	DigiKey	P4.7KECT	3
R5	res, 1K, 1206	DigiKey	P1.0KECT	1
R6	res, 47, 1206	DigiKey	P47ECT	1
Q1	xstr, npn, 300V, 0.5A	DigiKey	ZTX657	1
Q2,3	xstr, npn, sot-23	DigiKey	MMBT3904DICT	2
U1	optoisolator, 300V	DigiKey	H11D2ZQT	1
U2	optoisolator, 35V	DigiKey	H11A817QT	1



TTY232-TAP -- RS-232 to Teletype Current-Loop Interface

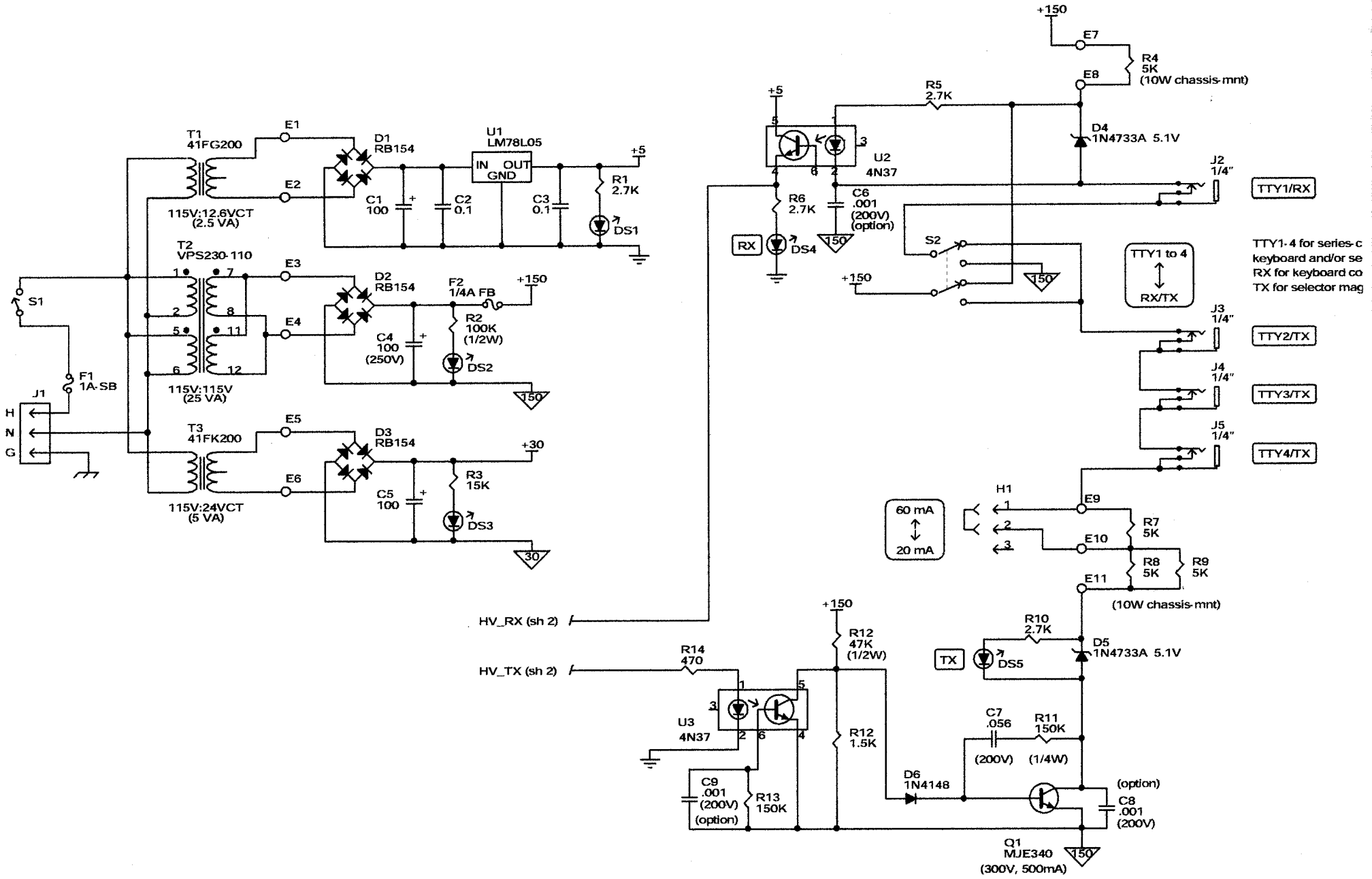
Allows RS-232 port to tap into externally-powered (and current-limited) TTY current loop. For half-duplex single loop using 20-60 mA (150V max). Auto-Loop-Polarity provided by bridge D5. Self-powered RS-232 interface, derives V-POS and V-NEG rails from RTS, DTR, and/or TXD lines. Note: laptops may have low-voltage/low-current 232 ports compared to desktop PCs. Best results are obtained when RTS and DTR are driven to opposite voltage levels by PC (one active=positive, one inactive=negative), resulting in stable V-POS and V-NEG rails. If RTS and DTR are both active (positive), V-NEG rail is derived from filtered TXD, which is normally marking (negative). V-NEG rail will rise when data is transmitted -- if it rises above -3V (RS-232 min spec), filter cap C2 may need to be increased, and/or inter-character delays (or extra stop bits) may be needed, to increase TXD's marking time for charging C2. The RS-232 spec calls for the negative level to be less than -3V, but most 232 receivers will accept as negative a level all the way up to ground. If only TXD is connected (no RTS or DTR), V-POS rail is also derived from TXD during transmission -- a break (line spacing) or header string of dummy characters may be needed to charge C1. Tested to 9600 baud with 20-mA/30V loop, and 4800 baud with 60-mA/150V loop.

Open-collector RTS and DTR lines are available for uses such as. keying a radio transmitter. Setting RTS or DTR active (positive) will activate Q2 or Q3. Set the other line inactive (negative) to provide V-NEG; V-POS wil be provided by TXD.

OOPS: Forgot diodes on B-E of Q2 and Q3 to clamp neg level. Add these on next rev, and maybe a second bridge for full duplex.

12-13-00, Gil Smith, gil@vauxelectronics.com

Vaux Electronics, Inc.		
Title 95-701-A TTY232-TAP .PIC		
Size A	Document Number	Rev A
Date: 12/21/00 Thu	Sheet 1 of 1	

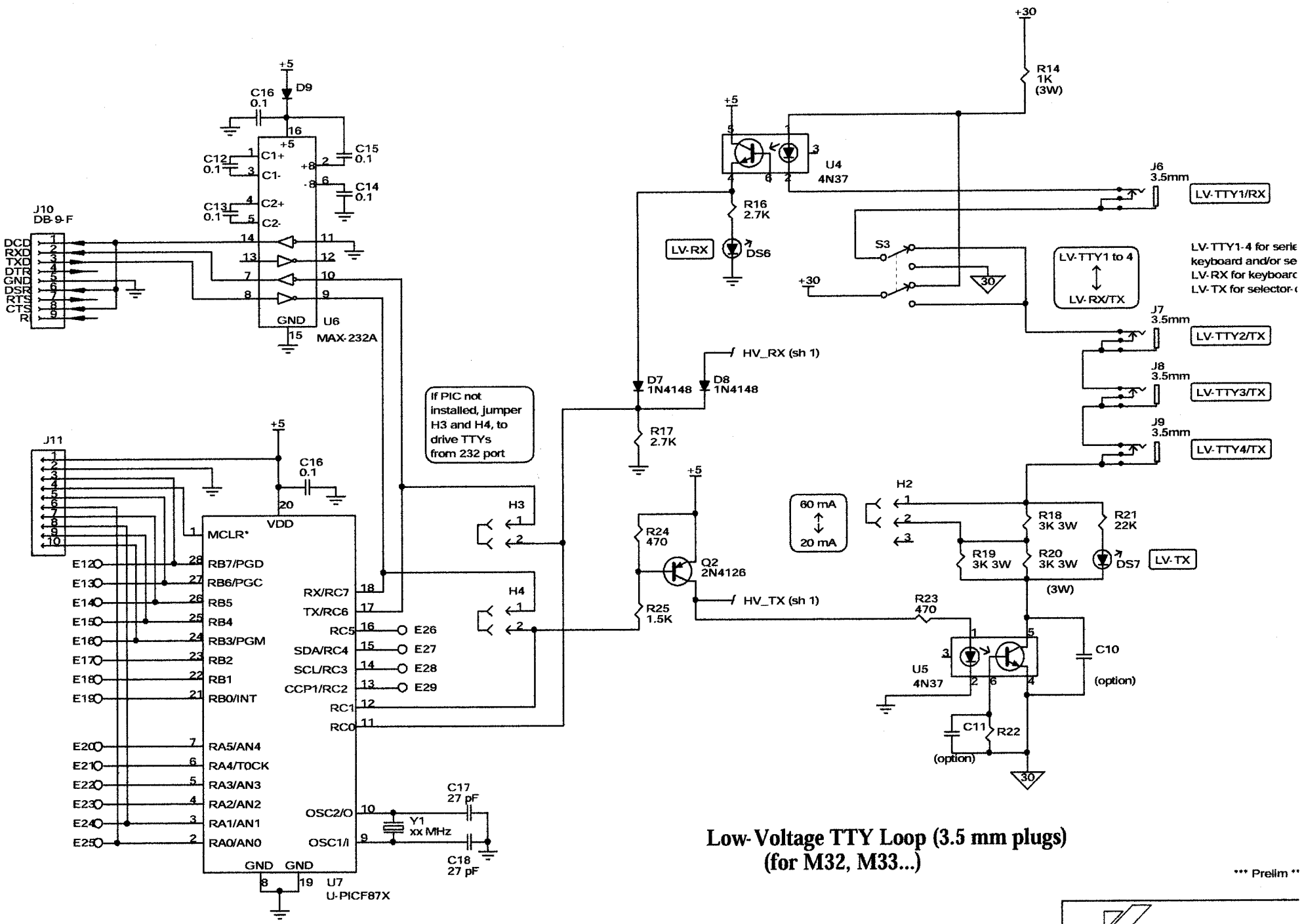


High-Voltage TTY Loop (1/4" plugs)

(for M15, M28...)

*** Prelim

Vaux Electronics, Inc.	
Title 95-700-A_TTY1_1-OF-2.PIC	
Size B	Document Number
Date: 11/08/00 Wed	

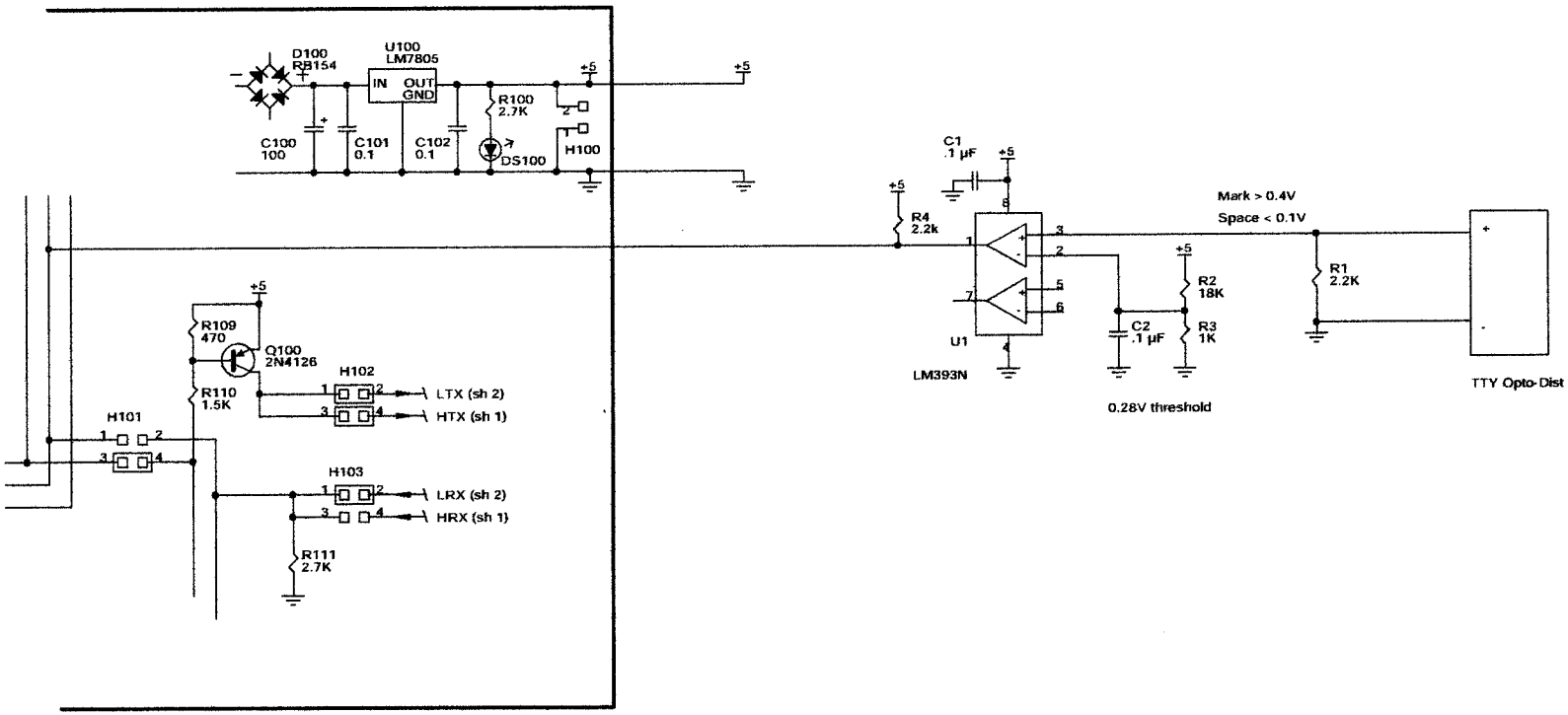


Ascii to Baudot Converter (optional)

Low-Voltage TTY Loop (3.5 mm plugs) (for M32, M33...)

*** Prelim **

Vaux Electronics, Inc.	
Title 95-700-A_TTY1_2-OF-2.PIC	
Size B	Document Number



TTY-232 board connections -- Remove jumper from H101-1 to H101-2

Vaux Electronics, Inc.		
Title BUZBEE-1 .PIC		
Size B	Document Number	Rev
Date: 1/10/01 Wed		Sheet

"TTY232" Teletype Loop Supply and RS-232 Interface (90-700-A)
==========

Dec 2000, Gil Smith, gil@vauxelectronics

Also see: "TTY232-TAP" RS-232 to Teletype Current Loop Interface (90-701-A)

Contents:
=========

Description:

This gadget provides eveything you need for connecting teletype machines together in a local loop, and also connecting to a computer via an RS-232 serial port. It provides tty loop power (and current-limiting), and full safety isolation.

You can use the box simply as a loop supply for connecting multiple TTYs together, but when you connect a computer's 232-serial (com) port to the interface's 232 port a program on the computer can then talk to the tty gear. For example, using Bill Bytheway's RTTYArt program (bytheway@foxinternet.net), you can "read" the data from a paper-tape when you run the tape through a TD in the loop -- you can then sa the tape data as a disk file. The program can also "send" a disk file out to a tty printer (like an M15 or M28) to print the file out, or to a punch to create a paper

Bill's program is primarily designed for reading and writing "art" files -- drawing and pictures created using the characters of the printer. He has created an archiv of art files, and created the RTTYArt program to let people read their art tapes fc contribution to the archive. Printing an art file is also a great way to test a printer, and demo it to others.

A terminal program (dos), which allows manual typing, is available courtesy of Dave (www.hypertools.com/ttysim.zip). It can also talk to the computer's serial port for direct baudot communication down to 45-baud (60 wpm).

For Linux boxes, Guido Kueppers (nc-drkugu@netcologne.de) has written awk scripts f direct baudot to a tty serial port.

This unit can be built for about $94 if fully populated. You can also build it for you don't build all sections, substitute cheaper chassis/ac-line-cord/switches, etc The board is 4.3 x 4.8 inches, and the chassis is 5 x 10 x 3 inches.

Features:

1) High-Voltage (150V) loop supply, 60- or 20-mA loop operation, and four insulate 1/4" jacks for one to four TTYs (M15, M28...). A switch configures the four ja series for a local loop of keyboard-contacts and/or selector magnets for variou (half-duplex use), or allows one jack to be TTY-TX and the other three to be TT (full-duplex when using the 232 port).

2) Low-Voltage (30V) loop supply, 20-mA loop operation, and three insulated 3.5mm for one to three TTYs (M32, M33...). The LV loop only operates at 20-mils, and

only in half-duplex.

3) RS-232 interface using fully opto-isolated connections to both HV and LV loops. transmit signal from the computer is sent to both loops (you may disable 232TX loop with a jumper). The computer receive signal is jumper-selectable for moni either the HV or LV loop. HV loop may operate in full-duplex or half-duplex mc LV loop is half-duplex only.

4) Socket for optional PIC microcontroller -- may be used to provide ascii-to-baud conversion, baud-rate conversion, auto-line-feed insertion, detection of comman sequences, digital or analog i/o, control of an X10 powerline interface (TW523 PL513) for load control...stuff like that. There are many 28-pin PICs that fit socket (cheap to pricey). There is also an optional serial eeprom socket (I2C) with PICs lacking internal eeprom. If PIC is not installed (which will be the since it is not programmed yet), jumpers connect the 232 port directly to the t interface -- Bill's RTTYArt program can then talk directly to any of the machin

5) An RS-485 network interface may be used in addition to the 232 interface. This a 4000-foot max distance over a twisted-pair line, for a master-slave half-dupl Since 485 is a half-duplex net, the PIC is needed to control RX/TX direction of 485 chip (RX of the chip is TTY transmit). Or, the 485 chip could be jumpered only receive from the line, for TTY TX-only use over a long cable.

6) Connector for an X10 powerline interface module, can allow the PIC to send X10 over the AC wiring to switch TTY motors on/off automatically, and even control around your house if you'd like. It can also listen to the powerline for X10 c (eg: from RF remotes) and do other stuff when certain commands are received.

Most people won't care about the micro, eeprom, rs-485, X10, or even the LV loop fc M32/33 machines. That stuff simply does not need to be installed. But the board i flexible, so you can build it the way you need it.

Assembly:

Inspect the board for shorts/opens before starting (not likely, but it is a prototy Note that square pads denote negative pins (caps, diodes...), or pin-1 (ICs, connec Use a low-wattage soldering iron with a small tip. Use a rosin-core solder -- ther need to clean the board with chem-spray (you could goop up the connectors inside). smallest to the largest parts (resistors, caps, chips...). Put sockets on the chip you'd like. Before you start soldering a part, make sure all leads are sticking th the board. If you need to take something out, clip it off leaving as much lead as then use tweezers to pull each lead out as you heat the pad, then use solderwick tc solder from each hole. If solder does not easily wick from the hole, drill it out instead -- too much heat will lift pads/traces. Clip leads one at a time so as to stress pads/traces. Open a nice cabernet, but have a two-glass limit.

OOPS: I forgot to ground U101-11 -- this is for forced handshake lines back to th which likely will be ignored by the PC anyway, but jumper U101-11 to U101-1

OOPS: DS102 has the pads backwards -- install as per assembly drawing.

OOPS: Square pads showed up as round in a couple of places -- not sure why, since they were correct in the cad file. Assembly drawing shows proper orientati

Lay the board in the bottom of the chassis and mark mounting holes. After you dril holes for the mounting standoffs, it will take a bit of measuring and marking to lc front/rear panel holes, using the mounting hole locations as a reference. Note tha distance between mounting holes and connector centers is in 0.1" increments, to mak bit easier to measure and mark the holes.

Also drill the mounting holes for the power resistors. I mounted them in the right the chassis, bolted to the bottom. They still run a bit hotter than I'd like, so I

it might be better to mount them on the inside of the right side panel, and bolt th
a heatsink mounted on the outside of the right side. I'll look for an appropriate

Position the transformers in the chassis (leaving space for the switch and AC jack)
mark/drill these holes as well. You will need a nibbler to cut the rectangular hol
the switch and AC jack. If you would like the LEDs on the front panel (instead of
on the board), drill holes for the mounting rings as well, and solder the LEDs to s
lengths of twisted wire. Jazz sax seems to help with the assembly -- I'd recommend
Redmond or Grover Washington.

For labelling, I like Avery clear laser labels which are available at an office sup
They are available in various peel-off label sizes, or as a full sheet. Just print
text/graphics you want onto the label stock, and cut apart with scissors. You can
apply using an xacto knife. If you are not using the full-sheet stuff, print to pa
to make sure you are not printing on a label cut line. Leave the chassis natural a
or paint it a light color to use these labels. They may even make clear inkjet stc
have not seen any though), which would let you print color labels. You could also
old dry-transfer stuff, sealing it with a mist of matte fixative from an art supply

Disclaimer:

This thing has nasty voltages inside. You'll have more fun if you don't kill yours
Yes, I got bit already. I had the scope ground on the 150V ground, and unplugged a
tty cable, finding the sleeve in the process. Even though the loops are normally
floating (which would have prevented the previous incident), the phone jacks are in
and the chassis is grounded, you should turn everything off before changing tty cab

It might be a good idea to wear glasses when you work on this, just in case you hav
backwards, or something else blows up. I had a tiny sliver of solder, left from dr
a plugged hole, which found its way across 150V, of course -- popped like a frickin
firecracker.

Testing:

Before wiring the board into the chassis, you should use a meter to check for short
across the transformer input pads, and across the 150VDC, 30VDC, and 5VDC supplies.
Check that the three ground planes are isolated from each other (check this after
assembled in chassis also). You should have the AC line ground wired to a ground
lug on the chassis, and to the E7 pad on the pcb, which connects the 5V and 232 int
to earth ground (this is also grounded via the mounting standoffs, provided they ar
The HV and LV loops are completely floating.

For testing the 5V section, you can clip your scope/meter ground to the tab of the
regulator. You might want to add ground tabs to the 150V and 30V grounds -- bend a
of wire into a small circle, and solder the two overlapping ends onto an open spot
the ground plane.

When you turn power on, all seven leds should be on. Carefully measure the 150VDC,
30VDC, and 5VDC supplies. You can plug an ammeter into each loop to measure loop
currents. For the HV loop, set H201 to both 60- and 20-mA positions; for the LV l
the current should be 20-mA.

First check the HV loop. Connect a PC to the 232 port, and run the RTTYArt program
(select proper com port and connect), or the TTYSim program (must be COM1). Select
the baud rate of the TTY you will test (eg: 60-wpm/45-baud). Set H201 for 60- or 2
and set H103 to the HRX position.

With S200 in the TTY1-4 (Half-Duplex) position, plug a TTY (M15/28...) into any of
four front jacks (if it has a single cable), or into any two of the four front jack
(if it has black and red TX/RX cables). Turn on the TTY232 box and the TTY. When
you type on the TTY, it should also print (half-duplex), and the char should show u

on the PC screen. When you type on the PC, it should print on the TTY, and also ec back to the PC. Note: I did not get this echoed char at first, until I disconnect the snubber. The snubber keeps the inductive transient down (a voltage spike on th switching transistor collector, when it turns off), but screws up the loop sense circuit. I'll look into different snubber values that are a bit softer.

For a full-duplex TTY, switch S200 to the TX/RX (Full-Duplex) position, and plug th TTY's black plug into the TTY1/TX jack, and the TTY's red plug into one of the othe three jacks. Turn on the TTY232 box and the TTY. When you type on the TTY, it shc not print, but the char should show up on the PC screen. When you type on the PC, should print on the TTY, but not echo back to the PC.

Now check the LV loop. Connect a PC to the 232 port, and run the RTTYArt program (select proper com port and connect), or the TTYSim program (must be COM1). Select the baud rate of the TTY you will test (eg: 110-baud ascii). Set H103 to the LRX p

Plug a TTY (M32/33) into any of the three rear jacks (if it has a single cable), or any two of the three jacks (if it has TX/RX cables). Turn on the TTY232 box and th When you type on the TTY, it should also print (half-duplex), and the char should s on the PC screen. When you type on the PC, it should print on the TTY, and also ec back to the PC.

You should burn the unit in for a while, with no TTYs connected, and the cover on. For maximum power dissipation, set H201 for 60-mA, and switch S200 to the TX/RX (Full-Duplex) position. Put in on concrete, away from combustibles, preferrably while you are around as well. Check after it has been running for about an hour to see how hot things are getting. Unplug the unit, wait a minute for things to discharge, and then feel everything. If anything is too hot to touch constantly, it may need to be checked. I think the HV loop power resistors could use a finned external heatsink, but eveything else seems fine on my unit. I'd burn it in for a few days at least.

Techno-poop:

This board came about since I wanted to connect my computer to my M15 or M28 (which a high-voltage loop), or to connect to an M33 (which needs a low-voltage loop). The high-voltage (HV) loop has a 150V loop supply, drop resistors to set 60- or 20- loop current (as needed), and insulated 1/4" jacks so you can plug your tty gear in the loop. The low-voltage loop has a 30V loop supply, a drop resistor to set 20-mi loop current, and insulated 3.5mm jacks. The HV loop includes a snubber suggested Jim Haynes (Bob Weitbrecht's RC from collector to base).

The two loops are independent and may be used at the same time, but equipment on th HV loop cannot talk to the LV loop, and vice-versa. I used standard 1/4" phone plu the HV loop, and non-standard 3.5mm (1/8") phone plugs for the LV loop, to prevent a low-voltage machine by mistake.

The 232 port is opto-isolated to both loops, and all power supplies are transformer from the AC line. The HV and LV loops are floating; the 5V logic and 232 circuitr is connected to chassis (earth) ground for safety. The 232 transmit line drives a that opens/closes the loop to "send" characters to the machines in the loop. There sense circuit that feeds the loop status (open/closed) to the 232 receive line.

The chassis houses the circuit board, the three small power transformers, an AC lin jack, four insulated 1/4" phone jacks for HV TTYs, a Full/Half-Duplex switch for th HV loop, three 3.5mm phone jacks for LV TTYs, a DB-9F connector for the 232 port (u a straight-through M-F cable to PC), and a 6P6C modular jack for an X10 interface m and/or RS-485 twisted-pair.

In Full-Duplex mode, the keyboard (or tape-reader) contacts are sensed, and the cha are sent to the 232 port RX line only. Characters from the 232 port TX line are se to printers (and/or punches).

In Half-Duplex mode, typed characters will echo locally on the tty (as well as all other ttys in the loop). Characters sent from the 232 TX line are also echoed on t RX line.

According to Don Robert House, the common color conventions for 1/4" TTY phone plug are red for receive (RX), and black, brown, or green for send (TX). Polarity convention is negative battery for telegraph transmission (since positive battery causes electrolysis in copper cables). Therefore the signal line is negative, and ground is positive. The 1/4" jack convention is tip-negative, sleeve-positive. Th polarity should be of no concern on a short local loop, but I tried to keep histori accuracy when possible.

Don also noted that of the five level (Baudot/ITA2) teletype machines, about 85% us 60-milliamp selector magnets, 14% used 20-mil, and 1% used 10-mil (US Weather Burea Note that 60-mil machines are in reality 62.5 milliamps by design, and that 130VDC considered the optimum loop voltage. The minimum acceptable loop voltage for these system is said to be around 110 to 120VDC, and the upper end around the NEC safety limit of 199VDC. This design uses 150VDC, since it is readily available using a 115-115V transformer. However, some folks have pointed out that they have successf used loop supplies as low as 24VDC, with short 60-mil loops, or even 12VDC using short 20-mil loops. I was able to get a 60-mil machine running with 18VDC in the l

You could put adjustable power resistors in the loops if you wish to set the loop c exactly. You could even mount ammeters in the chassis and wire them into the loop(The circuit values I used (transformers/resistors) give approximately 20 mA and 60 (not 62.5). Note that the loop supplies are not regulated (will vary with AC line transformer windings are not always exact (the 24VAC xfrm seemed a bit higher than it should be), and voltage drops of devices plugged into the loop change the loop c somewhat (current will drop a bit with each new device connected). However, I susp that TTYs have quite a bit of margin of acceptable current range, and that the fixe values are fine for all but the most discriminating folks. If you do change to an adjustable power resistor, just be sure to use one that is rated at the appropriate wattage, and mounted to dissipate the heat. My rule of thumb for power dissipation is that I should be able to touch a power part and not need to remove my finger (dc get a shock when you do this). If it's too hot to touch, change the design.

Quite a few folks pointed out the rationale for the high-voltage loops. First, the higher voltage will keep some of the dust and oil burned off of the keyboard and TD contacts to help keep them clean. Second, the high DC loop supply voltage is neede to overcome the effect of the selector magnet inductance, which impedes the rise in current when going from SPACE to MARK. Using a high voltage in series with a large resistor (to obtain 60- or 20-mils) minimizes the effect of the inductance, permitting the current to rise rapidly, thus preventing deterioration of the receiving selector margin. The circuit will act faster and give less distortion if higher voltage is used. It was suggested to compare the usable range finder settings using different loop supply voltages -- you would expect to find a much greater range with a higher-voltage loop.

I checked into the math: the inductance of the selector coils is significant, and coil voltage is proportional to L*di/dt. But it's technically the loop resistance, not the loop supply voltage, that sets the current waveform in the coil. Of course to use a larger R, you need to use a larger V, to get the 60 or 20 mA needed.

For a series circuit with a voltage source V, resistor R, and inductor L, when initial current (t=0) is zero, the current for t>0 is:

$$i(t) = (V/R) - (V/R)\, e^{-t/T}$$

where the time constant T = L/R. The first term (V/R) is the drop across the resistor, which will be a constant 60 mA (or 20), by design. The second exponential term affects the leading edge of the waveform, but note

that the V/R scaling magnitude is again a constant (0.06 or 0.02) and not actually dependent on V. It is the T= L/R in the exponent that sets the rise time of the waveform, larger R resulting in faster rise times.

Optional/Future Crapola:

I layed this board out for a 28-pin PIC, with the new flash F87x parts in mind. An PIC would have been a good size, except none are yet available with the usart (the F628 will be nice, but are not shipping yet). I want to use the usart for the 232 (yes, I have bit-banged 232 on lots of other pics, but I don't wanna anymore). The parts with usart that I had in mind for this board are:

PIC	CODE	DATA	EEPROM	QTY-1 (DigiKey)	
16C62B	2K	128	-	$4.70	OTP
16C63A	4K	192	-	$5.78	OTP
16C66	8K	368	-	$8.38	OTP
16F872	2K	128	64	$4.98	FLASH/ISP
16F873	4K	192	128	$8.68	FLASH/ISP
16F876	8K	368	256	$9.38	FLASH/ISP

The pricing is for 20 MHz parts, that I plan to run at 16 MHz. I put a 10-pin heac board for In-System-Programming (ISP) of the flash parts. Standard Flash parts may reprogrammed, but need a programmer box -- these ISP flash parts allow code to be c the chip is in the board. The One-Time-Programmable (OTP) parts also need an exter programmer, and are throw-away if code needs to be changed (but are cheaper for vol There are UV-erasable/reprogrammable versions of the OTP parts, but they cost more the ISP parts.

My intent for the pic code, is to use the usart for the 232/485 port, and bit-bang tty interface. Possible code features:

- force pass-through (bypass mode -- simply connect 232 to ttys)
  (switch-selection using pic pin?)
- ascii-to-baudot conversion (switch-selection using pic pin?)
- buffer 232 data at higher speed (19200 or 9600), to various tty baud rates
- automatic CR/CR/LF/LTRS insertion at end-of-line (eg: at 72nd char)
  (Alan Hobbs pointed out that the European standard is 69 chars, so make it prog
- enable or disable unshift on space
- detection of local command sequences for changing pic operating mode...
  (not passed to tty -- eg: change tty baud rate, number of eol chars...)
- commands to send break, open or close tty line (eg: for external motor control de
- store programmable params in eeprom
- digital i/o (switches, lights, relays...)
- analog i/o (measure loop current w/ isolated sensor...)
- control an X10 powerline interface (connector avail for TW523 or PL513)
  (eg: automatically turn tty motors on/off)

The 6P6C modular connector is for an X10 powerline interface module (a two-way TW-5 a one-way PL-513). X10 commands are carrier-current modulated on the AC powerline, and the interface module provides an opto-isolated means for connecting to the line X10 capability can allow the PIC to send X10 commands to switch TTY motors on and c automatically, using X10 appliance modules. The pic could sense a character and th power up the ttys (or even a specific tty). You could just send a null, or id char wait a few seconds, then send the text -- or maybe the pic could buffer the text. The pic would power the tty(s) down after a minute or so of inactivity.
Could also be used to provide 232-control of lights in the house, detect X10 commands from other devices like RF remotes, etc. It's another future project, but I have done X10 pic code in the past, and it's not too bad. X10 stuff is not high-rel, but it's cheap, and available in 115V/60Hz and 220V/50Hz versions.

Applicatons:

Some ideas for connecting TTYs to a computer have been bouncing around on greenkeys in the past -- with the appropriate bits of software, you could do some interesting

a) run a simple baudot terminal program, like TTYSIM

b) read/punch tapes to/from computer files, using the RTTYArt program

c) with an ascii-to-baudot converter PIC in the interface, you could make a tty look like a standard pc printer (many applications could print)

d) hook to your email program and have certain email (eg: greenkeys) that automatically prints on your tty

e) have your computer periodically check for news of your choice (via internet), and print it out on your tty

f) have your computer periodically check the local weather (via internet), and print it out on your tty

g) have your computer periodically check certain stock prices (via internet), and print it out on your tty (or, better yet, print it out on an old stock ticker)

h) or how about an internet "chat" room, where your machine is connected in real-time as the i/o for the chat. This is the internet version of global rtty, with no fading, and no distance limitations!

Parts List:

Full build: Basic (41.92) + RS-232 (9.27) + HV-Iface (34.06) + LV-Iface (8.75) = $

Some cheaper parts may be substituted (chassis, switches...), or you can build only portion of the circuit.

Mouser Electronics	www.mouser.com	800-346-6873
DigiKey	www.digi-key.com	800-344-4539
Jameco	www.jameco.com	800-831-4242

Basic Stuff:

Ref	Desc	Source	Order Number	Qty
	pcb	gil	90-700-A	1
J1	AC jack/fuseholder	Mouser	161-0717-1-187	1
F1	fuse, 1/2A SB, 5x20 mm	Mouser	5765-18500	1
S1	switch, rocker	Mouser	107-DS850K-00	1
chassis	LMB 5x10x3 cap box	Mouser	537-5103	1
cover	LMB 5x10 cover	Mouser	537-5103C	1
feet	bumper, adhesive	Mouser	517-SJ-5012BK	4
pcb mounts	standoff, 4-40, 0.5"	Mouser	534-2203	4
4-40 screws, locks, nuts, as needed (pcb and transformers).				
2-56 screws, locks, nuts, as needed (chassis resistors).				
ground lug for chassis ground				
power cord	AC line cord	Mouser	173-63101	1

RS-232 Interface and 5V supply:

Ref	Desc	Source	Order Number	Qty
C100	cap, 100uF, 25V 63V	Mouser	140-XRL25V100	1
C101/C102/103	cap, cer, .1 uF	Mouser	21RZ310	3
C104/105/106/107	cap, 10uF, 50V	Mouser	140-XRL50V10	4
D100	bridge-rect, 400V/1.5A	Mouser	583-RB154	1
D101/102/103	diode, 1N4148	Mouser	625-1N4148	3
DS100	led, T1, grn	Mouser	604-L934GD	1
J101	jack, DB-9F	Mouser	152-3409	1
		or Jameco	104951 (0.55)	
Q100	xstr, pnp, 2N4126	Mouser	625-2N4126	1
R100/111	res, 2.7K, 1/8W	Mouser	299-2.7K	2
R101/104/105	res, 4.7K, 1/8W	Mouser	299-4.7K	3
R103/106/107/108	res, 120, 1/8W	Mouser	299-120	4
R109	res, 470, 1/8W	Mouser	299-470	1
R110	res, 1.5K, 1/8W	Mouser	299-1.5K	1
T100	xfrm, 12.6VCT, 2.5VA	Mouser	41FG200	1
U100	reg, 5V, LM7805CT	Mouser	511-L7805ACV	1
U101	RS232 iface, MAX232	DigiKey	TC232CPE	1
		or Digikey	MAX232CPE (3.31)	
		or Digikey	MAX232ACPE (4.88)	

High-Voltage (150V) Loop Supply and 20/60-mA Interface (M15, M28...):

Ref	Desc	Source	Order Number	Qty
C200	cap, elect, 100uF/200V	Mouser	140-XRL250V100	1
		or DigiKey	P5338	
C202	cap, film, .05uF/200V	Mouser	140-PF2D503K	1
D200	bridge-rect, 400V/1.5A	Mouser	583-RB154	1
D201/202	zener, 5.1V, 1W	Mouser	625-1N4733A	2
D203	diode, 1N4148	Mouser	625-1N4148	1
DS200/202	led, T1, grn	Mouser	604-L934GD	2
DS201	led, T1, yel	Mouser	604-L934YD	1
J200/201/202/203	jack, phone, mono/sw, 1/4"	Mouser	550-10284	4
Q200	xstr, npn, 300V, 0.5A	Mouser	511-MJE340	1
R200	res, 100K, 1/2W	Mouser	293-100K	1
R201/204/205/206	res, chassis, 5K, 10W	Mouser	284-HS10-5K	4
R202/212	res, 470, 1/8W	Mouser	299-470	2
R203/207	res, 2.7K, 1/8W	Mouser	299-2.7K	2
R208	res, 150K, 1/4W	Mouser	291-150K	1
R209	res, 47K, 1W	Mouser	294-47K	1
R210	res, 1.5K, 1/8W	Mouser	299-1.5K	1
R211	res, 100K, 1/8W	Mouser	299-100K	1
S200	switch, DPDT, tog	Mouser	10TF160	1
T200	xfrm, 115V-dual, 25VA	Mouser	553-VPS230110	1
U200/201	optoisolator	Mouser	512-4N37	2

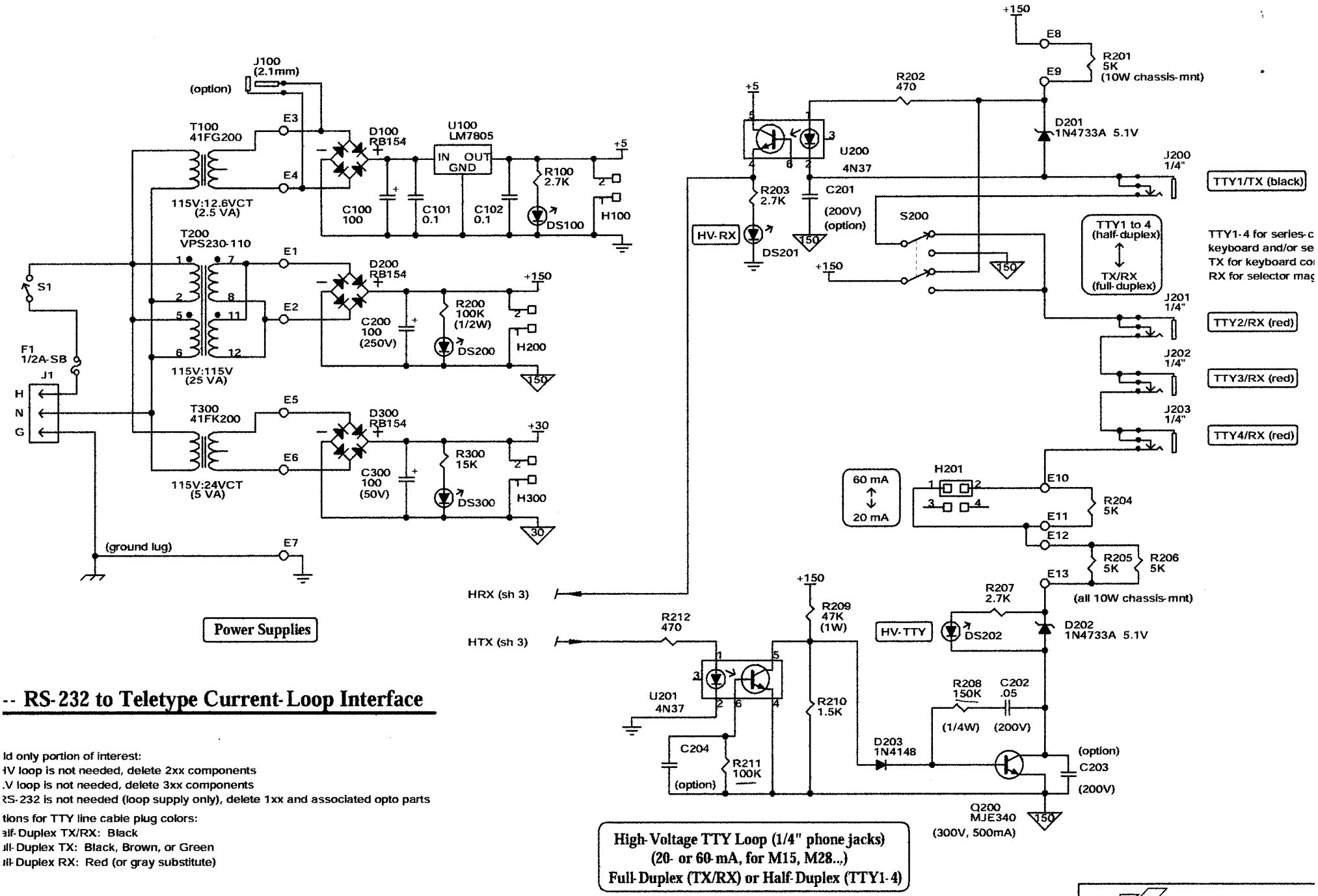
Low-Voltage (30V) Loop Supply and 20-mA Interface (M32, M33...):

Ref	Desc	Source	Order Number	Qty
C300	cap, 100uF, 63V	Mouser	140-XRL63V100	1
D300	bridge-rect, 400V/1.5A	Mouser	583-RB154	1
DS300/302	led, T1, grn	Mouser	604-L934GD	2
DS301	led, T1, yel	Mouser	604-L934YD	1

J300/301/302	jack, phone, mono/sw, 3.5mm	Mouser	16PJ528	3
Q300	xstr, npn, 2N4124	Mouser	625-2N4124	1
R300	res, 15K, 1/8W	Mouser	299-15K	1
R301	res, 2.7K, 1/8W	Mouser	299-2.7K	1
R302	res, 1.5K, 1W	Mouser	294-1.5K	1
R303	res, 22K, 1/8W	Mouser	299-22K	1
R304	res, 10K, 1/8W	Mouser	299-10K	1
R305	res, 1K, 1/8W	Mouser	299-1K	1
R306	res, 100K, 1/8W	Mouser	299-100K	1
R307	res, 470, 1/8W	Mouser	299-470	1
T300	xfrm, 24VCT, 5VA	Mouser	41FK200	1
U300/301	optoisolator	Mouser	512-4N37	2

Optional stuff:

✓C108	cap, cer, .1 uF	Mouser	21RZ310	1
✓C109/C110	cap, cer, npo, 27 pF	Mouser	140-50N2-270J	2
J100	power jack, 2.1mm coaxial	Mouser	16PJ031	1
J102	jack, modular, 6P6C	Mouser	154-UL623-6PCB	1
✓R102/112/113	res, 4.7K, 1/8W	Mouser	299-4.7K	3
U102	RS-485 iface, MAX485CPA (or LTC485CN8)	DigiKey	MAX485CPA	1
U103	uC, PIC16F876 (or other)	DigiKey	PIC16F876-20/SP	1
U104	eeprom, 24Cxx			
✓Y100	xtal, 16 MHz	Mouser	559-FOX160-20	1
C201/203/204	cap, film, .001uF/200V	Mouser	140-PF2D102K	0-3
C301/302	cap, cer, .001uF			
6-pin IC socket		Mouser	571-3902611	4
8-pin IC socket		Mouser	571-3902612	2
16-pin IC socket		Mouser	571-3902614	1
28-pin IC socket (0.3")		Mouser	571-23825713	1
Led panel-mounting ring for T1 led		Mouser	606-CMP100	0-7
header jumpers		Mouser	151-8010	x
header strip (dual-row)				
Cable for LV TTY (black 3.5mm phone plug/cord)		Mouser	172-2106	1+
Cable for serial port (DB9-F to DB9-M), 6ft		Jameco	25700	1
Cable for serial port (DB9-F to DB9-M), 10ft		Jameco	148515	1



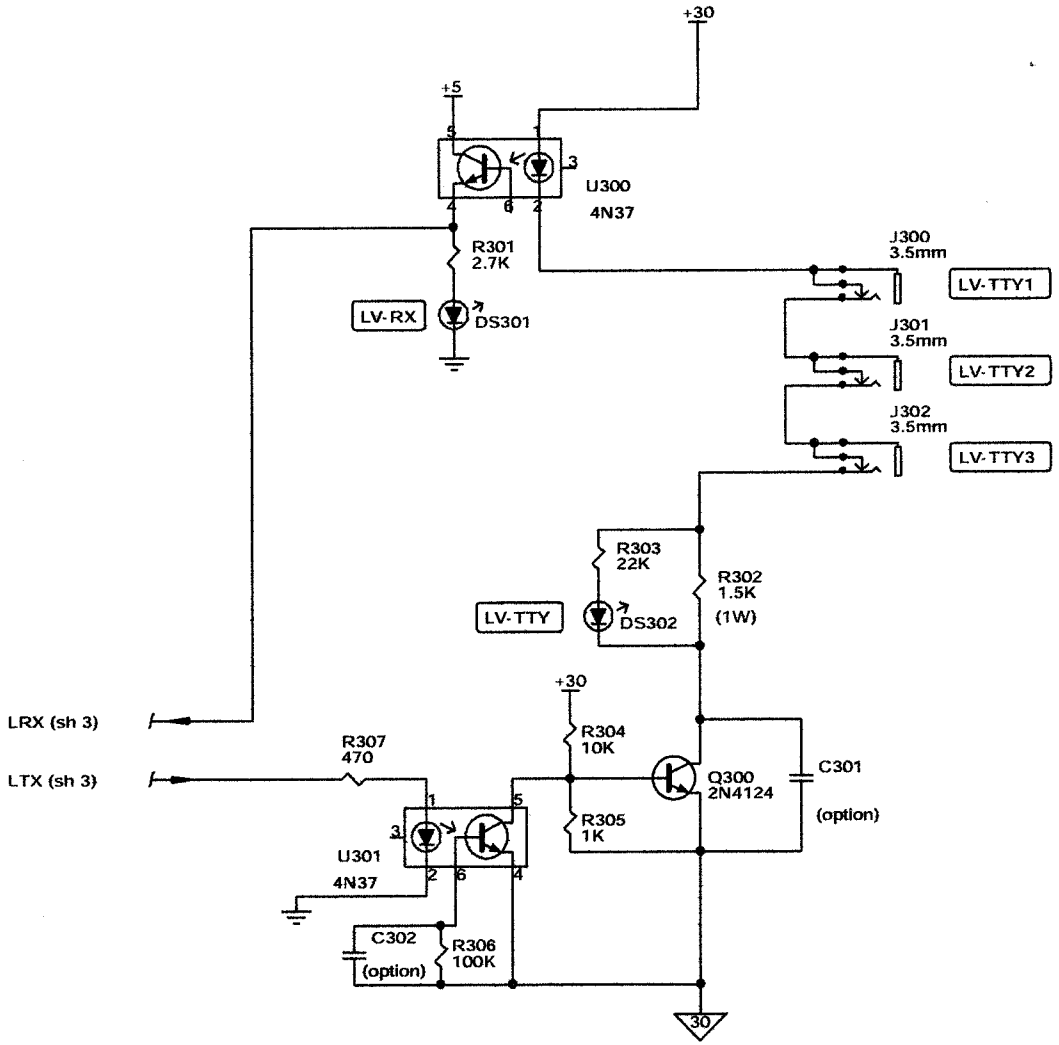
-- RS-232 to Teletype Current-Loop Interface

ld only portion of interest:
HV loop is not needed, delete 2xx components
.V loop is not needed, delete 3xx components
RS-232 is not needed (loop supply only), delete 1xx and associated opto parts

tions for TTY line cable plug colors:
alf-Duplex TX/RX: Black
ull-Duplex TX: Black, Brown, or Green
ull-Duplex RX: Red (or gray substitute)

Vaux Electronics, Inc.

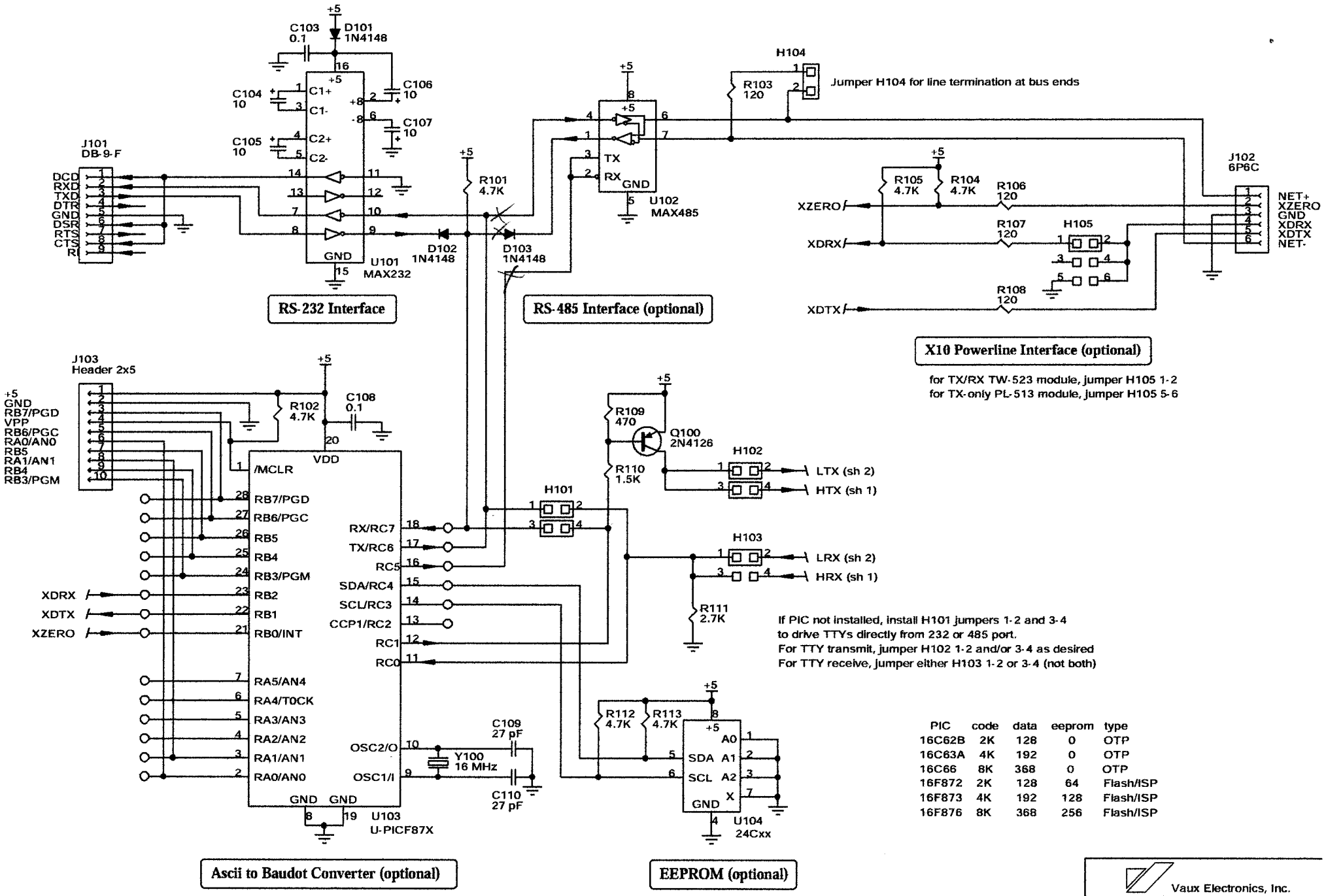
Title 95-700-A TTY232 1-OF-3 .PIC	
Size B	Document Number
Date: 12/21/00 Thu	S



Low-Voltage TTY Loop (3.5 mm phone jacks)
(20-mA only, for M32, M33...)
Half-Duplex only (LV-TTY1-3)

Vaux Electronics, Inc.	
Title 95-700-A TTY232 2-OF-3 .PIC	
Size B	Document Number

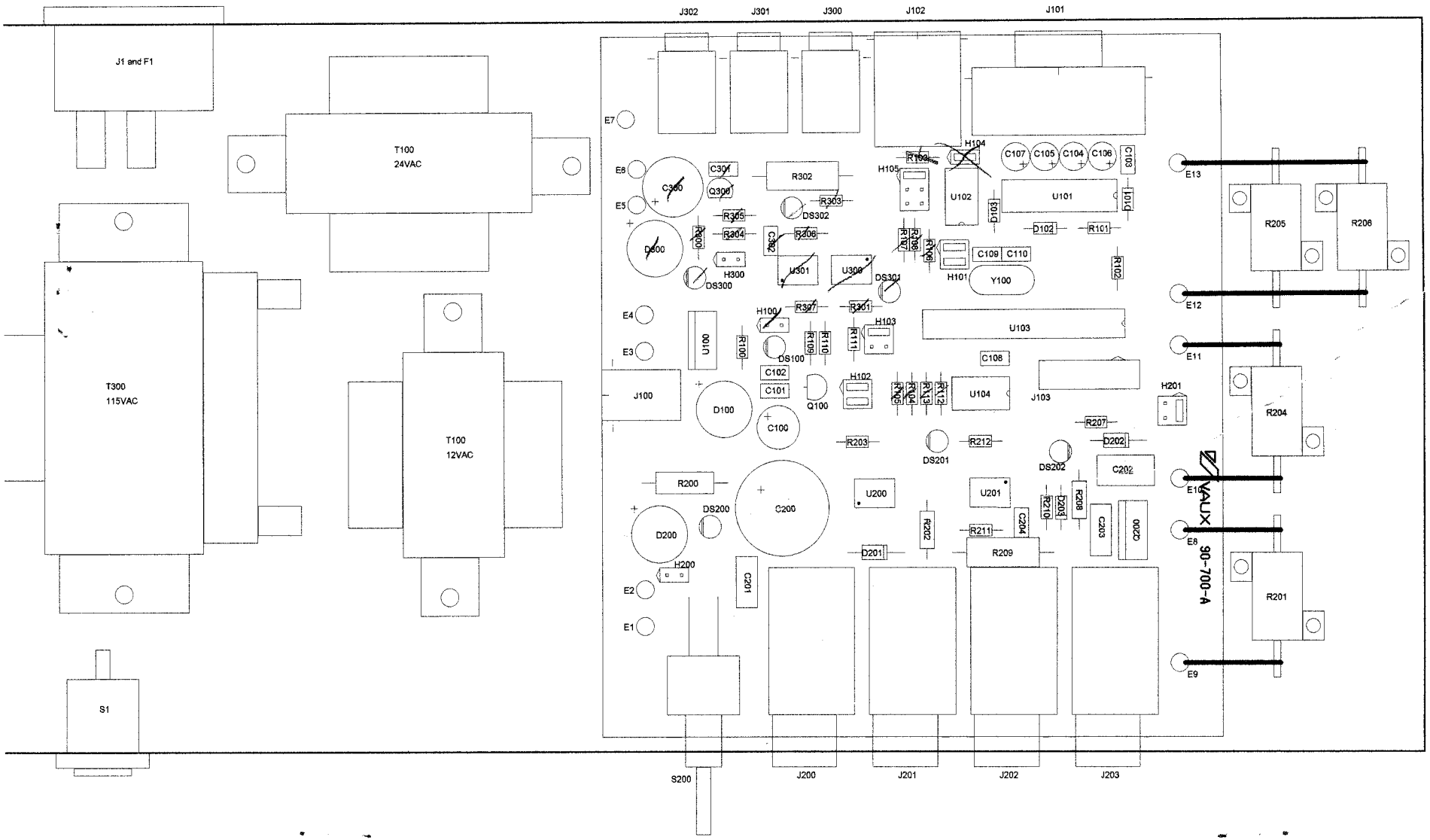
Note: MARK is -3V or less on U101-8, +5V on U101-9, ground on Q100-C, and current flow in TTY loops.

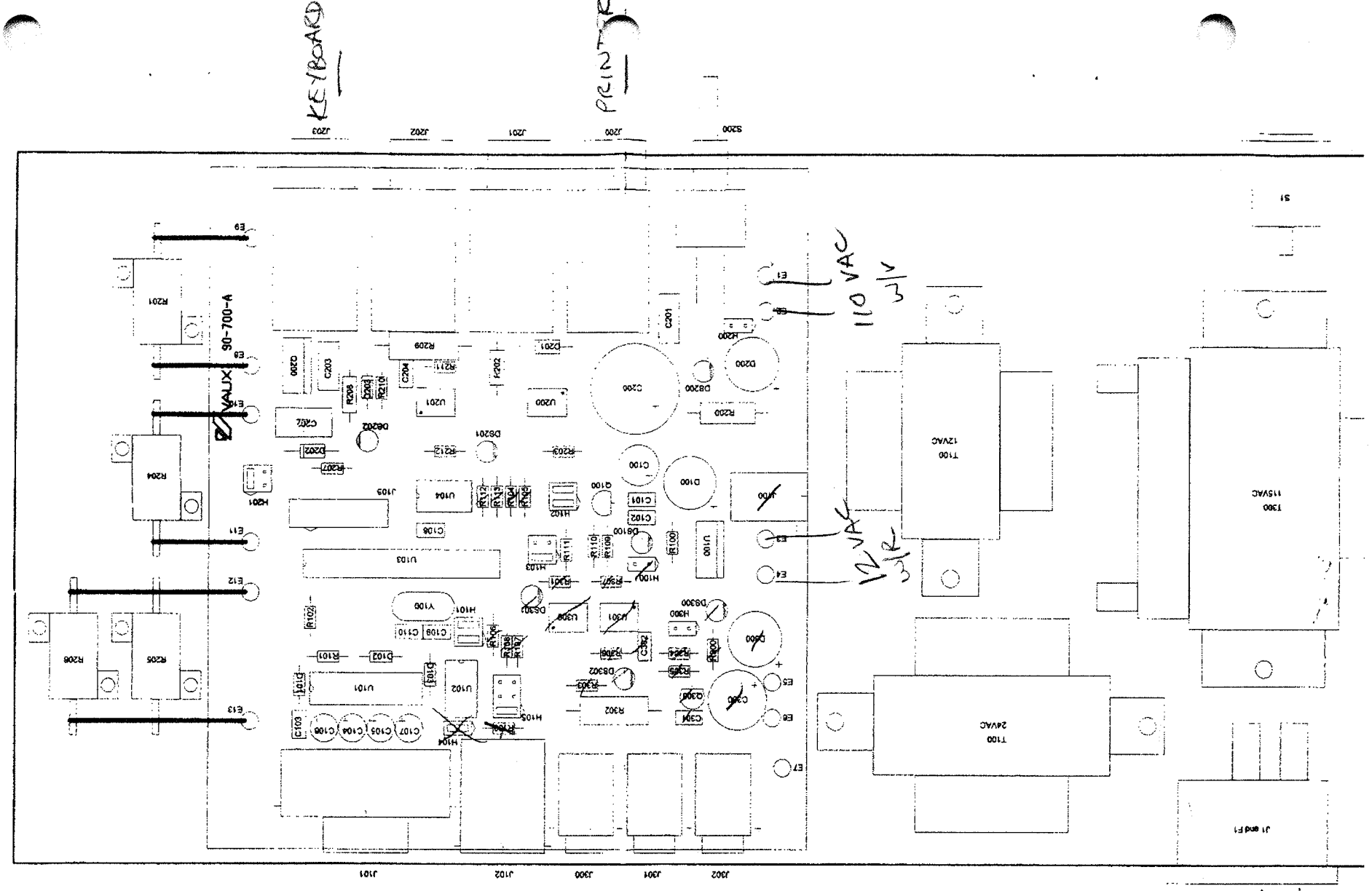


PIC	code	data	eeprom	type
16C62B	2K	128	0	OTP
16C63A	4K	192	0	OTP
16C66	8K	368	0	OTP
16F872	2K	128	64	Flash/ISP
16F873	4K	192	128	Flash/ISP
16F876	8K	368	256	Flash/ISP

Vaux Electronics, Inc.

Title 95-700-A TTY232 3-OF-3 .PIC	
Size B	Document Number
Date: 12/21/00 Thu	


J1 and F1
T100
24VAC
T300
115VAC
T100
12VAC
S1
J302
J301
J300
J102
J101
E7
E8
E5
E4
E3
E2
E1
E13
E12
E11
E10
E8
E9
C300
Q300
R302
R303
DS302
R305
R304
R306
C302
D300
H300
DS300
U301
U300
DS301
H100
R307
R301
H103
U100
R100
R109
R110
R111
DS100
C102
C101
J100
D100
Q100
H102
C100
U103
C108
J103
U104
R105
R104
R113
R112
H201
R207
D202
DS202
C202
R203
DS201
R212
R200
DS200
C200
U200
U201
R208
R210
R203
C204
C203
Q200
D200
H200
C201
R202
R211
R209
D201
H104
R103
C107
C105
C104
C106
C103
U102
U101
D103
D101
D102
R101
R102
R108
R106
R107
C109
C110
H101
Y100
R205
R206
R204
R201
J200
J201
J202
J203
S200
VAUX
90-700-A



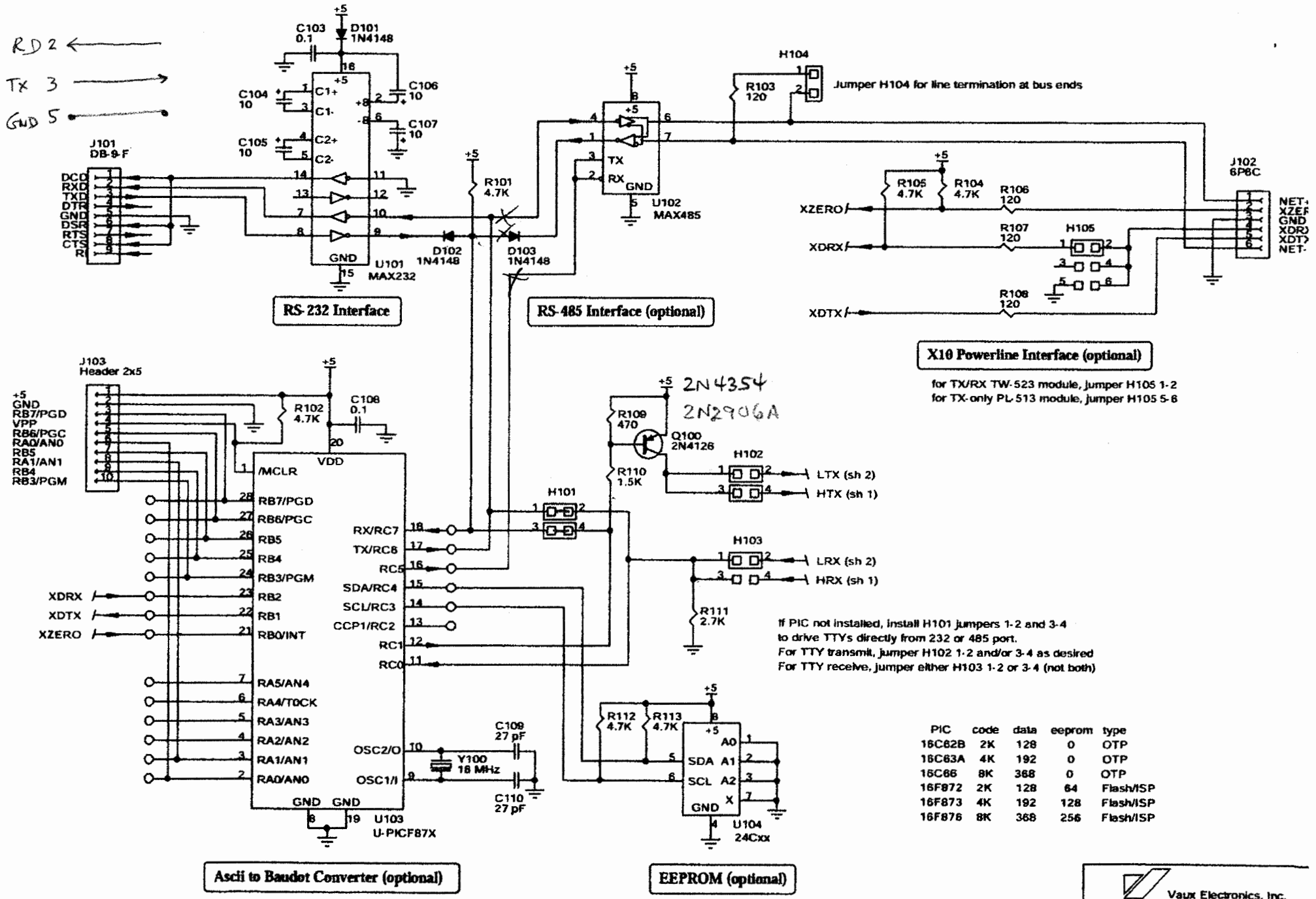
1500 + 700

MAX 232

PC			CHIP
Tx → 2	3 →	W/BL	8
RD ← 3	2 ←	W/OR	7
GND 7 →	5 GND	BL/W	

1/27/02

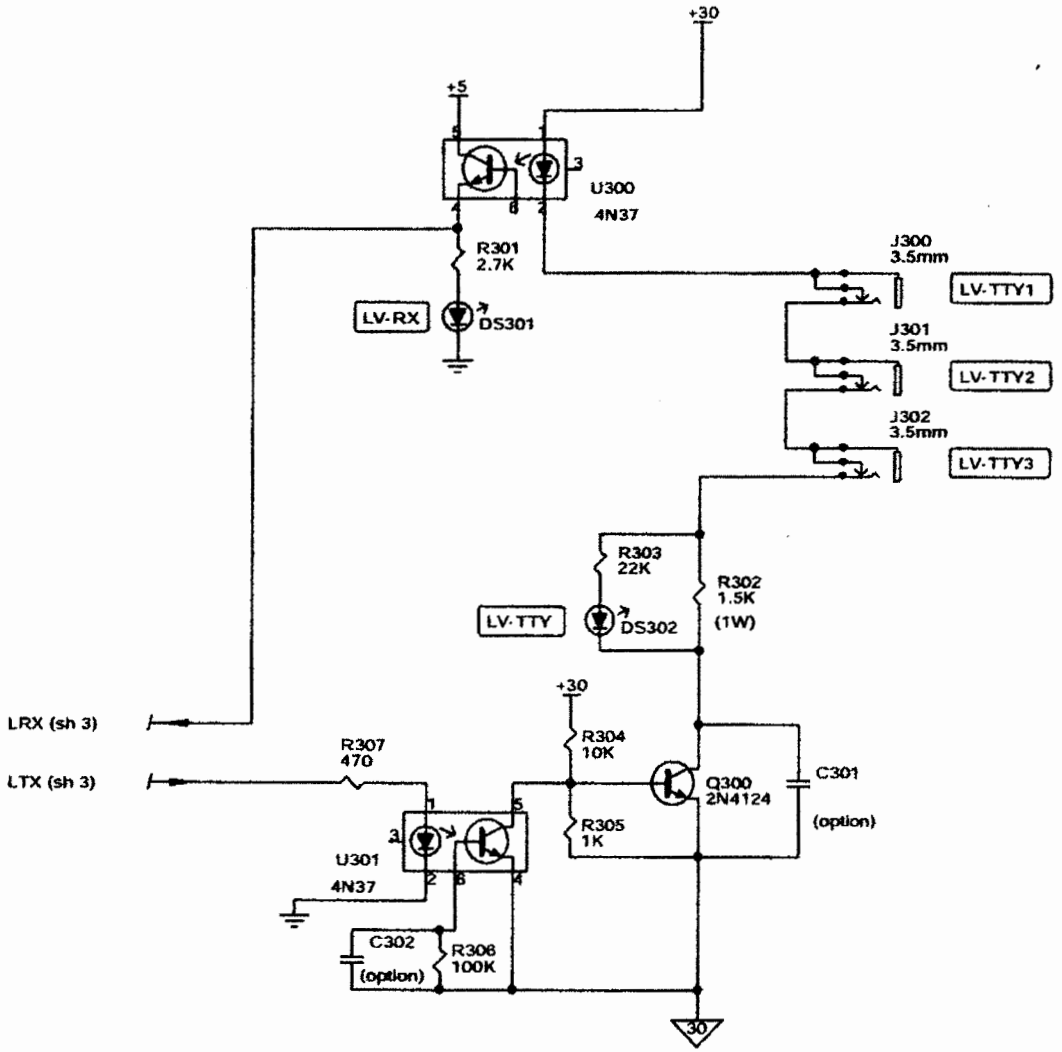
Note: MARK is -3V or less on U101-8, +5V on U101-9, ground on Q100-C, and current flow in TTY loops.



PIC	code	data	eeprom	type
16C62B	2K	128	0	OTP
16C63A	4K	192	0	OTP
16C66	8K	368	0	OTP
16F872	2K	128	64	Flash/ISP
16F873	4K	192	128	Flash/ISP
16F876	8K	368	256	Flash/ISP

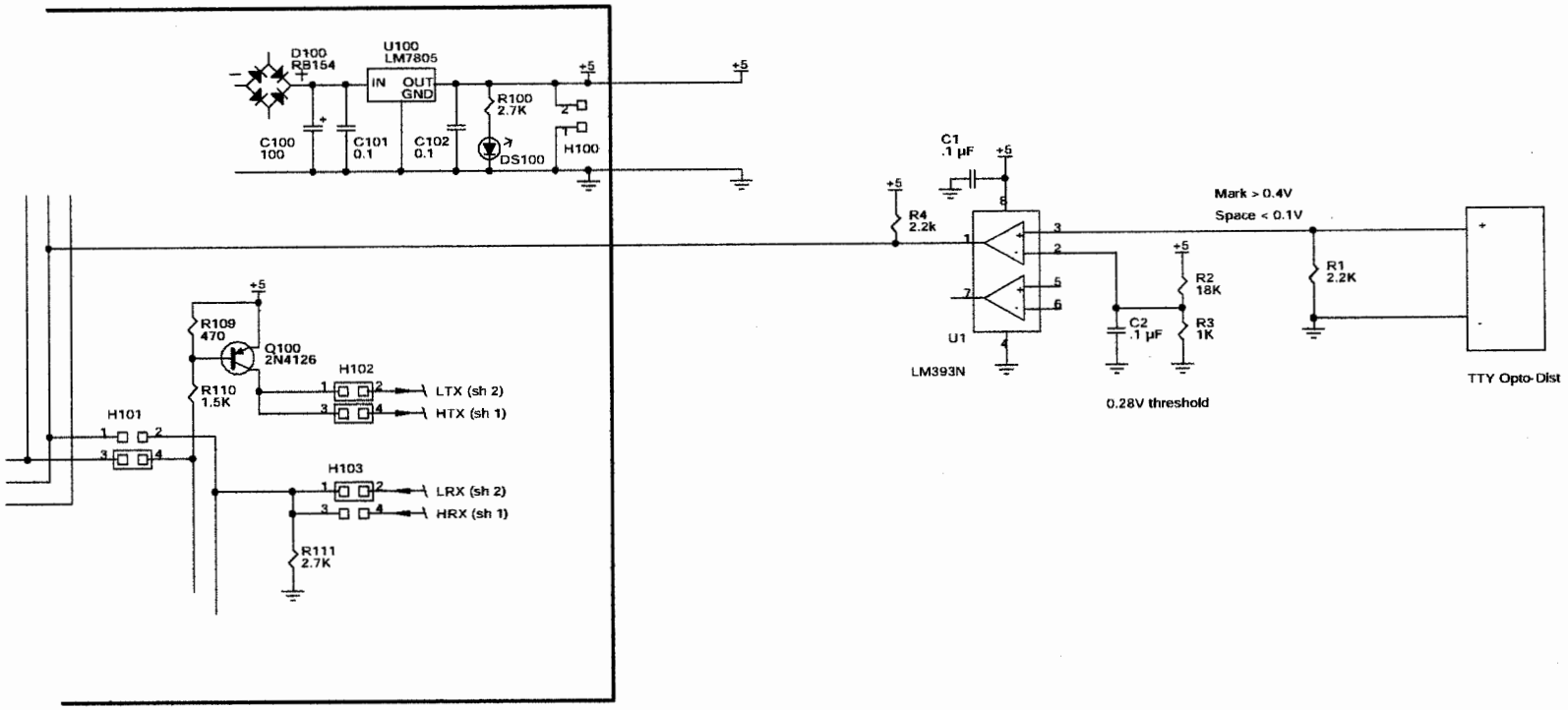
Vaux Electronics, Inc.

Title 95-700-A TTY232 3-OF-3 .PIC	
Size B	Document Number



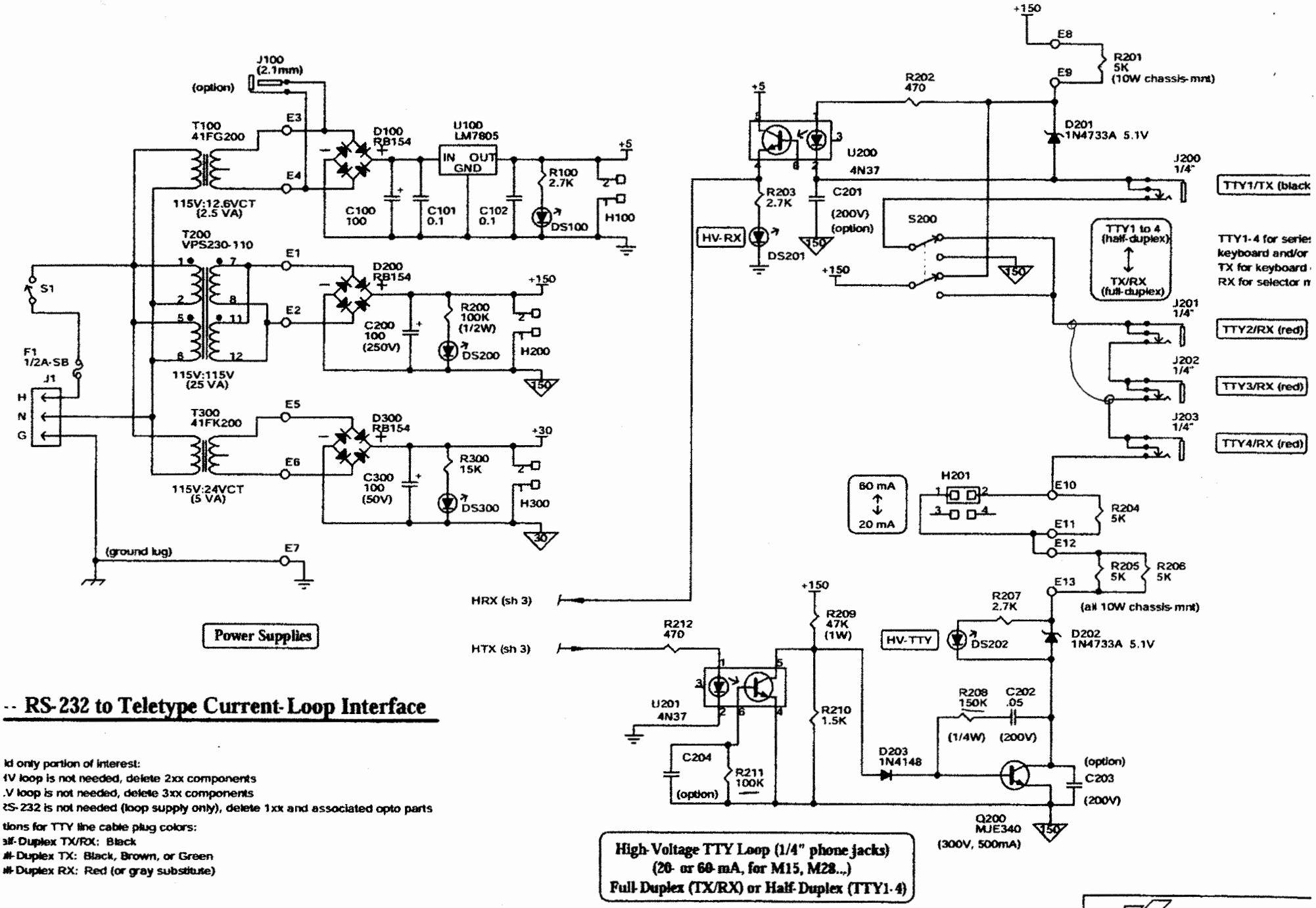
Low-Voltage TTY Loop (3.5 mm phone jacks)
(20-mA only, for M32, M33...)
Half-Duplex only (LV-TTY1-3)

Vaux Electronics, Inc.	
Title 95-700-A TTY232 2-OF-3 .PIC	
Size B	Document Number
Date: 12/21/00 Thu	



TTY-232 board connections -- Remove jumper from H101-1 to H101-2

Vaux Electronics, Inc.		
Title BUZBEE-1 .PIC		
Size B	Document Number	Rev
Date: 1/10/01 Wed		Sheet



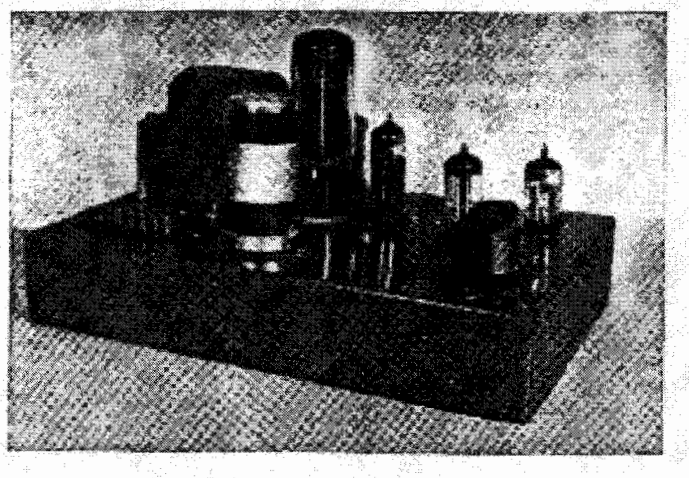
-- RS-232 to Teletype Current-Loop Interface

ld only portion of interest:
tV loop is not needed, delete 2xx components
.V loop is not needed, delete 3xx components
2S-232 is not needed (loop supply only), delete 1xx and associated opto parts

tions for TTY line cable plug colors:
alf-Duplex TX/RX: Black
ll-Duplex TX: Black, Brown, or Green
ll-Duplex RX: Red (or gray substitute)

Vaux Electronics, Inc.

Title 95-700-A TTY232 1-OF-3 .PIC	
Size B	Document Number



A Filterless Terminal Unit for FSK

Above: Any convenient layout can be used for the filterless terminal unit for teletype reception, since there are no critical points in the placement of parts. In K6PYB's unit all external connections are brought in through the multiconductor plug receptacle on top of the chassis at the left.

THE AMATEUR and the commercial company have different problems to overcome in their receiving and transmitting equipment, even though they may be using the same mode of transmission. The commercial company can spend large sums of money for expensive filters and the equipment needed to adjust them. It also has no problem with frequency instability, for most all commercial equipment (receiving and transmitting) is crystal controlled.

On the other hand, most hams who roll their own are interested in low-cost, simple-to-construct-and-adjust equipment. Since the average amateur station is not fully crystal controlled, or does not have extremely stable equipment, the operator is incessantly bothered by frequency drift.

The teletype terminal unit to be described is no more difficult to construct or adjust than a simple audio amplifier or modulator. It contains no *LC* filters and, for this reason, it will keep the printer printing even though the audio tones may drift within the range 500 to 7000 cycles.

BY BARRY M. KAUFMAN,* K6PYB

Inexpensive Circuitry With Wide Drift Tolerance

Here is a teletype converter that is simple to build and will work either with conventional f.s.k. or a.f.s.k. Using a counter-type frequency detector, it responds to the frequency difference in f.s.k. signals and its operation is substantially independent of the actual audio-frequency tones.

Referring to Fig. 1, the audio output of the receiver is fed to a step-up transformer, T_1, the primary of which should be suitable for the output impedance of the receiver while the secondary should have as high an impedance as possible. In my case, I used an 8- to 20,000-ohm transformer, which gave a voltage step-up of 50. This is more voltage gain than could be obtained from the average single-triode amplifier.

The secondary of T_1 feeds the first stage of a two-stage limiting amplifier which is biased for symmetrical clipping at low signal levels. A relatively good square wave is obtained at the plate of the second limiter when the voltage at the secondary of T_1 is 1.5 volts or more. This means that if the peaks of a fading signal give a one-watt receiver output the signal could fade as much as 40 db. and still produce a constant-amplitude square wave from the limiters.

Counter Circuit

The heart of this terminal unit is the pulse-counting detector, which is used to convert the constant-amplitude square-wave audio tones into a d.c. voltage which is proportional to the incoming audio frequency. This detector is well known for its excellent linearity over very wide frequency deviations, and is used in many commercial f.m. modulation monitors and in audio-frequency meters.

For those who are not familiar with the detector, a brief description of its operation is necessary. Referring to Fig. 2A, when the incoming square wave goes in the negative direc-

*925 Durlston Road, Redwood City, Calif.

tion D_2 will conduct, charging C in such a direction that point "X" is negative with respect to point "Y." At this time, the voltage at the junction of the diodes, "Y," will still be essentially zero because D_2 is practically a short circuit when conducting. When the square wave goes in the positive direction, D_2 will stop conducting and the charge on C will appear across R through diode D_1. For linear operation (average d.c. output proportional to input frequency) the RC time constant is chosen to be short, compared with the period of the highest frequency that will be used (Figs. 2B and 2C). The charge across C is rapidly dissipated through R, causing a spike of d.c. which has a width and shape that is virtually independent of the audio frequency, within the linear range of the system. Under these conditions the average d.c. across R is a function of the audio frequency only, as can be seen from Figs. 2D and 2E.

The RC network that follows the pulse-counting detector in Fig. 1 is a low-pass filter used for getting rid of the spikes of audio frequency, which are not wanted since the desired output from the detector is simply an average d.c. voltage that varies between two levels at the keying rate of the incoming teletype signal.

Keying Circuit

The 0.5-μf. capacitor between the low-pass filter and the input circuit of the next stage is for the purpose of eliminating the steady d.c. from the pulse-counting detector. As long as the audio tones are in a linear portion of the detector's curve, the difference in d.c. voltage between mark and space will be the same (for the same frequency difference) irrespective of the actual audio tones. The mark-space difference voltage

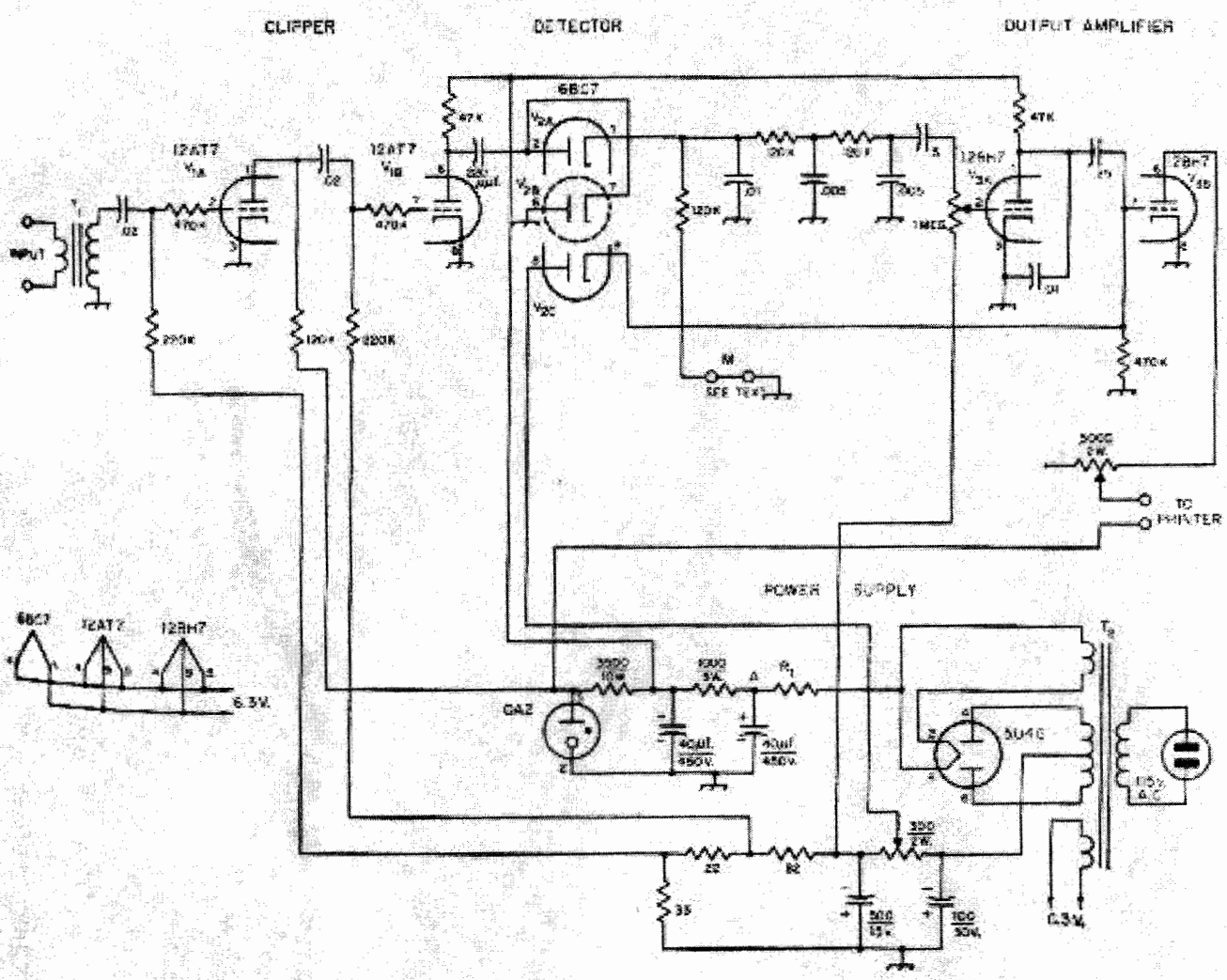


Fig. 1 — Circuit of the filterless terminal unit and power supply. Unless otherwise indicated, capacitances are in μf., resistances are in ohms, resistors are ½ watt. Capacitors with polarities indicated are electrolytic, others may be paper or ceramic as convenient.

R_1 — To drop voltage to 250 to 275 volts d.c. at point "A"; resistance required, if any, depends on output voltage of power transformer used.

T_1 — Audio transformer, approx. 50:1 ratio, secondary to primary (10,000:4 ohm output transformer suitable).

T_2 — Power transformer, to deliver at least 250 to 275 volts d.c. at approx. 40 ma.; 6.3-volt 2-amp. and 5-volt 3-amp. filament windings.

will depend only on the transmitted frequency shift. It is this difference that is wanted and not the steady d.c. The 0.5-μf. capacitor and the 1-megohm potentiometer at the grid of the 12BH7 stage have a long enough time constant to pass fairly flat-topped squared keying pulses.

The 1-megohm potentiometer is used to adjust the unit for different amounts of shift. If you want to copy a narrow shift, you just turn up the pot until the signal will run the printer.

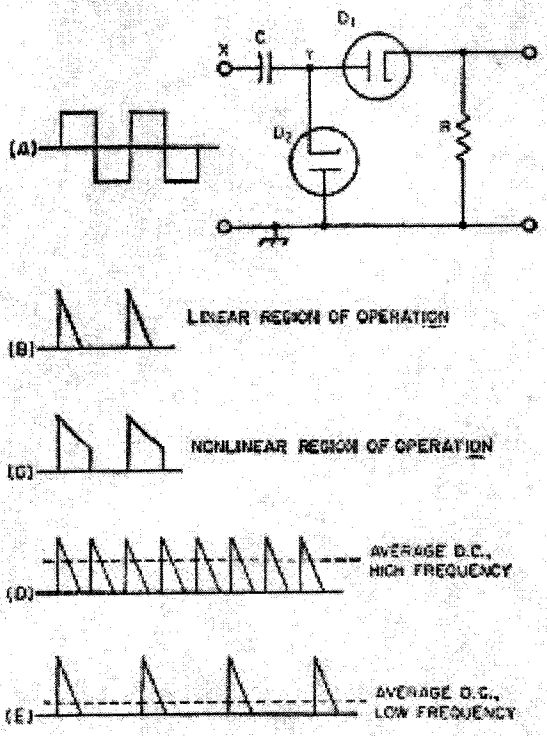


Fig. 2 — The basic frequency-counter circuit and method of operation.

The first half, V_{3A}, of the 12BH7 is a conventional amplifier using fixed bias. The keying pulses are coupled to the second half, V_{3B}, of the 12BH7 through the 0.25-μf. capacitor. This capacitor, in combination with the grid-to-cathode diode effect of the second half of the 12BH7, forms a d.c. restorer which automatically sets "mark" as zero bias. The third diode (V_{3C}) of the 6BC7, the one connected between the 300-ohm pot and the grid of the keyer tube, is simply a clipper that rejuvenates the keying pulses that were slightly distorted by the low-pass filter and the coupling capacitors.

The plate of the keyer tube feeds the printer through a 5000-ohm variable resistor that adjusts the current flowing through the selector magnets.

The power supply is completely conventional, except for the fact that fixed bias is developed for all tubes in the unit. R_1 is chosen so there will be 250 to 275 volts at point "A" while the terminal unit is operating. This allows freedom in the selection of a power transformer.

Adjustment

The adjustment of the unit is simple. Hook up the printer in series with a milliammeter. With the 1-megohm pot turned down all the way, adjust the 5000-ohm resistor for 30 ma., then short-circuit the clipper diode (V_{3C}) that goes to the grid of the second half of the 12BH7, and adjust the 300-ohm pot for zero reading on the milliammeter. The terminal unit is now completely adjusted and ready for use.

The unit is set up to print on space-high signals. A reversing switch could be put in to reverse both diodes of the pulse counting detector for mark-high reception, but it is just as easy to turn the receiver b.f.o. to the other side of zero beat.

If a 0-100 or 0-50 microammeter with a variable shunt across it is connected at "M," Fig. 1, the unit can be used simultaneously as an audio-frequency meter. The meter can be calibrated from WWV, or some other accurate source. This method of measurement should prove accurate enough for general use between 500 and 4000 cycles. The lower limit is set by the diode's contact bias, while the upper limit is set by the linearity of the pulse counter.

Summary

Summing up, the features of this terminal unit are:

1) It is very simple to construct and adjust.

2) No expensive or hard-to-get filters are incorporated in the design.

3) It is very tolerant of large frequency drifts in transmitting and receiving equipment. For this reason, it can be used on nets where a lot of hams are not right on the net frequency.

4) It can be used simultaneously as a terminal unit and as an audio-frequency meter.

5) It can copy any shift from around 200 cycles to over 5000 cycles.

6) Since this is an audio unit, all its features hold for the reception of v.h.f. audio shift, as well as the r.f. shift used at lower frequencies.

7) There is no need for an oscilloscope to aid in tuning in a signal, since tuning is completely noncritical.

Along with the sweet must come the bitter and along with the good features of this terminal unit must come its bad point. It cannot compete with filter-type terminal units so far as digging down into noise, heterodynes, and general mud for the desired signal is concerned. The pulse-counting detector is a wide-band device, and wide band width means susceptibility to noise and heterodyne interference. A simple device such as this must have a wide band width for tolerating large frequency drifts.

However, all is not lost. First of all the device, as is, will give good copy on medium to strong signals that are relatively free of strong heterodynes. For those who like to dig down into the mud, I suggest that a band-pass filter be used between the receiver and the terminal unit. Alternatively, the selectivity of a receiver having a steep-sided band-pass i.f., such as a mechanical filter, could be used.

More on the Filterless Terminal Unit for F.S.K.

Modification for 60-Ma. Printer Magnets

BY HAROLD E. DAVIS,* W8MTI

EVERY so often something is in style, goes out of style and returns again, like a cycle. One such thing is the filterless terminal unit described by K6PYB in July 1958, *QST*. More correctly designated a "converter," this unit filled the need for someone who had a Model 26 teletype printer and wanted to get copy without a complicated receiving RTTY converter using tuned filters. In 1958 many of the up-to-date RTTYers were using Model 26s, and receiving units such as the W2PAT RTTY converter in the *Handbook* were used to make copy.

After building several types of RTTY converters, I came to the conclusion that there just isn't one type that will fill all needs. Converters using TV-width coils gave fair selectivity, filterless types gave little if any selectivity, and toroid-filter types gave good selectivity. But on the other hand, toroid-filter types require quite accurate tones and frequencies, width-coil types are more tolerant of the incoming tones, while the filterless type is capable of good results from any number of tone combinations that would be unusable in a filter type. Where a.f.s.k. is used, as on 6 or 2 meters, this often is a very important consideration since we don't all have accu standards for setting the shift from mark space, or to the exact frequencies of the m tone or the space tone. It is for this main rea in addition to some minor ones, that the aut has just completed his fifth K6PYB filter unit.

The theory and operation of the unit are fu covered in the original article by K6PYB, s the reader is urged to review that article.

In the past few years, more and more hams a using later-model RTTY machines and much this newer equipment requires 60 ma. for prop operation. While many articles on RTTY co verters do not include information on the keyi current available, the K6PYB article does, and number of RTTYers have not built this un because it was clearly stated to adjust the curren to 30 ma. This just isn't enough for most Mode 15 printers and most Model 14 tape gear.

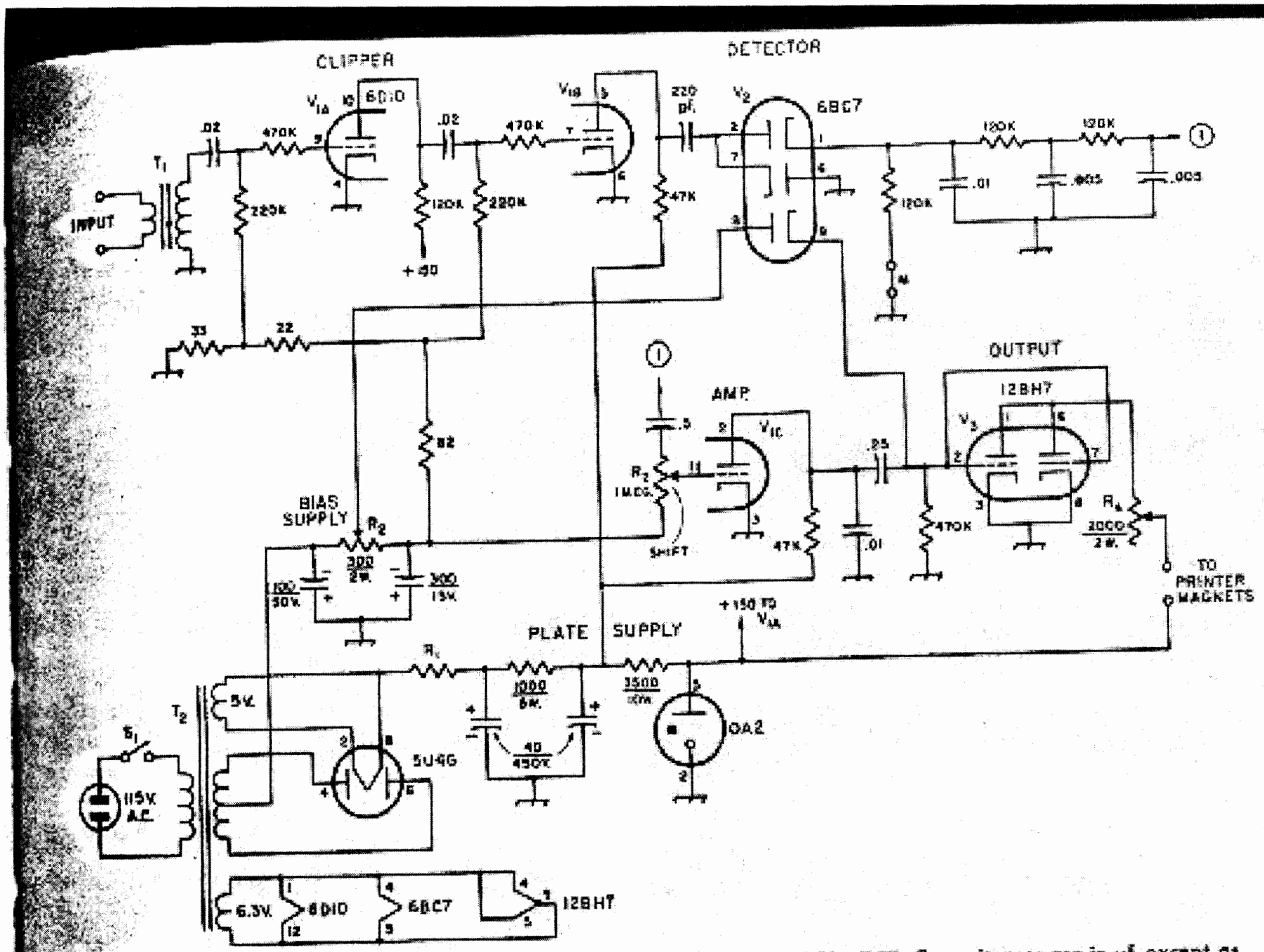
I felt that if the unit would key a 60-ma. cir cuit it would be just the ticket for both MAR h.f. net f.s.k. operation, where stations vary little as to frequency, and v.h.f. operation wit a.f.s.k., where many of the fellows are usin something other than the standard 2125/2975 c.p.s. tones and 850-c.p.s. shift. Another con sideration is that with mechanical-filter receiver better receiver response can be obtained o frequencies lower than the 2125 and 2975 c.p.s used for the large majority of converters fo RTTY.

Perhaps the most important change from the original unit is the use of a heavier power trans former, so the 60 ma. in the keying circuit would not impose a serious overload on the B supply. As one half of the 12BH7 would key a 30-ma circuit nicely, it figured that two halves in paral lel ought to key a 60-ma. circuit. In order to avoid installing another tube, socket and heater wiring, a newer type tube was used in place of the original 12AT7. This tube, the General Electric 6D10 Compactron, is the equivalent of three halves of a 12AT7. As shown in Fig. 1, the 6D10 replaces the entire 12AT7 and the first half of the 12BH7 of the original circuit. This allows parallel operation of the 12BH7 sections. The only other change was the current-regulation rheostat in the plate line of the 12BH7. The original circuit had a 5000-ohm unit, but in the modified converter a 2000-ohm resistor was used.

The power transformer used in the modified model, rated at 225 v.d.c. at 110 ma., allowed a maximum current of 50 ma. to flow in the selector magnet winding. Resistor R_1 of the original circuit was not used, since the voltage was already slightly lower than that recommended by K6PYB in the original article. A salvaged TV power transformer would most likely deliver higher voltage. In case the transformer used supplies more than 250–275 volts at the high-side terminal of the input capacitor, the use of the series resistor, R_1, is recommended.

If occasional operation is intended where a current of only 30 ma. is required, it is recommended that a 5-watt rheostat be used in place

* 4781 Baldwin St., Onondaga, Michigan.



...unit described in July 1958, QST. Capacitances are in μf. except as

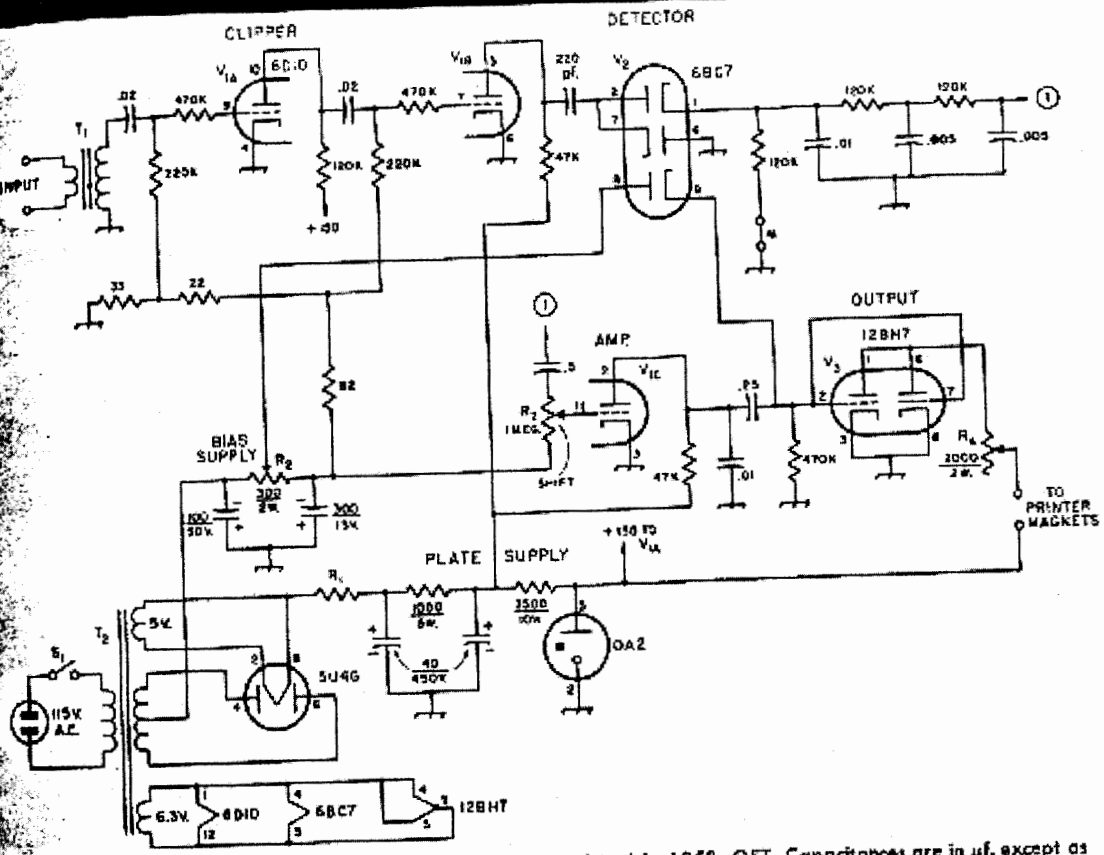


Fig. 1—Modified circuit of the K6PYB terminal unit described in July 1958, QST. Capacitances are in μf. except as specified otherwise. Resistances are in ohms (K = 1000), resistors are ½ watt except as specified.

M—Terminals for microammeter.
R_1—To drop plate voltage to 250; see text.
R_2—Wire-wound control (clipping adjustment).
R_3—1-megohm control.
R_4—Wire-wound control (printer-magnet current adjustment).
S_1—S.p.s.t. toggle.
T_1—Audio transformer, approx. 50 to 1 turns ratio (output transformer, 10,000 to 4 ohms, suitable).
T_2—Power transformer, to deliver 250–275 volts d.c. at approximately 75 ma.; 6.3 volts at 1.5 amp. or more; 5 volts, 3 amp.

of the 2-watt one and that the value be 5000 ohms. Also, a single-pole, single-throw switch should be used to lift one of the cathodes of the 12BH7 from ground.

The operation and adjustment of the modified unit are the same as for the original converter, with the exception of adjusting for 60 ma. instead of 30 ma.

QST

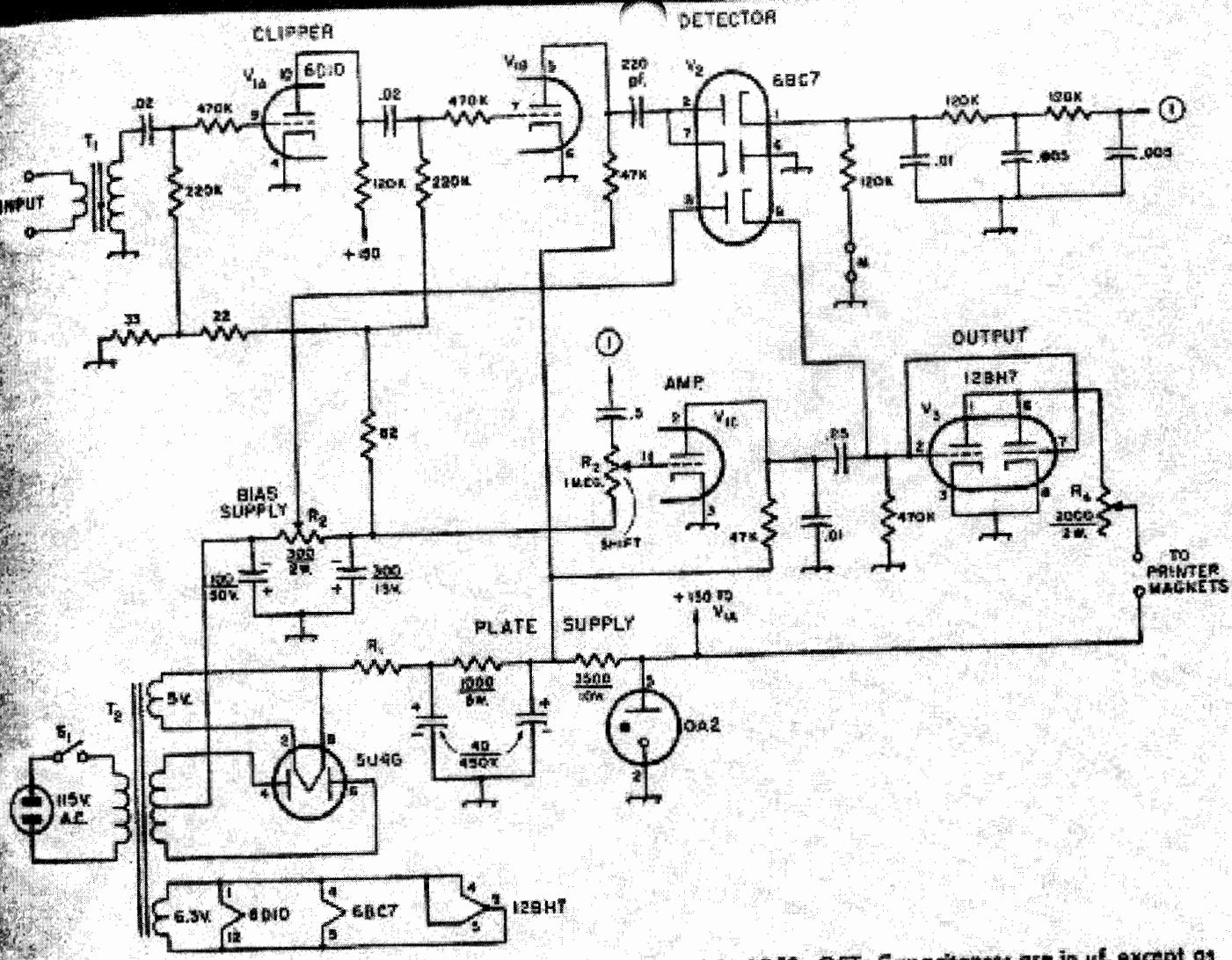
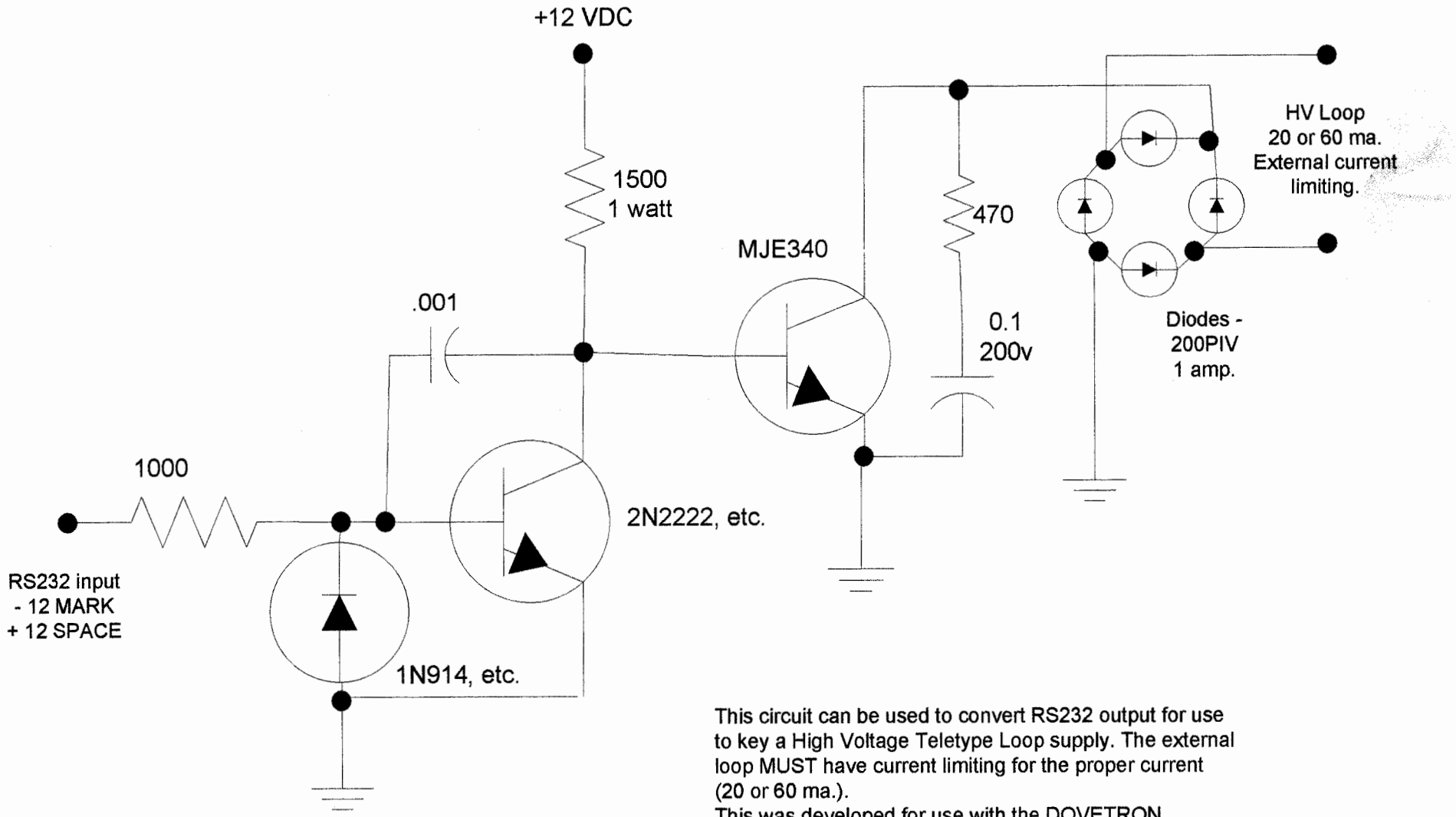


Fig. 1—Modified circuit of the K6PYB terminal unit described in July 1958, QST. Capacitances are in μf. except as specified otherwise. Resistances are in ohms (K = 1000); resistors are ½ watt except as specified.

M—Terminals for microammeter.
R_1—To drop plate voltage to 250; see text.
R_2—Wire-wound control (clipping adjustment).
R_3—1-megohm control.
R_4—Wire-wound control (printer-magnet current adjustment).
S_1—S.p.s.t. toggle.
T_1—Audio transformer, approx. 50 to 1 turns ratio (output transformer, 10,000 to 4 ohms, suitable).
T_2—Power transformer, to deliver 250–275 volts d.c. at approximately 75 ma.; 6.3 volts at 1.5 amp. or more; 5 volts, 3 amp.

of the 2-watt one and that the value be 5000 ohms. Also, a single-pole, single-throw switch should be used to lift one of the cathodes of the 12BH7 from ground.

The operation and adjustment of the modified unit are the same as for the original converter, with the exception of adjusting for 60 ma. instead of 30 ma. QST



This circuit can be used to convert RS232 output for use to key a High Voltage Teletype Loop supply. The external loop MUST have current limiting for the proper current (20 or 60 ma.).
This was developed for use with the DOVETRON "Tempest" RTTY Terminal Units.

WA2HWJ - June 2002

NOTE: Parts are not critical. The MJE340 can be replaced with a TIP48 or similar HV power transistor.
The +12VDC is supplied by the Dovetron.

UPDATED ST-5 MAINLINE DEMODULATOR

by IRVIN H. HOFF, W6FFC, May 1973

The Mainline ST-5 was originally Introduced in the RTTY JOURNAL in May, 1970. It has rapidly become one of the most popular demodulators for RTTY. As back issues have been un available for some time, the original article is being reprinted.

For those interested in 100 speed, change the 0.068 capacitor on the input to the slicer to a 0.039. A 741 may be used for the slicer if desired, in which case the 220 pf, 0.005 Mfd., and 1.5K components are left off, as the 741 is internally compensated. Regulated voltage has been added, as shown.

Keep in mind also that prices quoted were current at the time the article was originally written. Both Hal Communications and PEMCO, and possibly others, offer boards, components, kits and ready-to-use ST-5 units.

Many newcomers to RTTY have complained that a current yet simple de modulator hasn't been published for them to build. The W2PAT unit in the ARRL handbook is nearly 15 years old. In 1964 an attempt was made to replace the W2PAT design with a modestly priced updated unit, the TT/L-1. This design. together with the subsequent TT/L-2 is now the standard of the serious RTTY enthusiast. However, the original goal was missed by a country mile, since the TT/L-2 costs over $160 just for parts and has l4 tubes.

The ST-3 was a successful solid- state design that introduced integrated linear operational amplifiers to RTTY. It was still moderately complex, however, and fell short of the goal to supply the beginner with something that could be built in a few hours.

THE ST-5 DEMODULATOR

While developing a unit based primarily on ICs to replace the TT/L-2, a very simple modulator with great potential was developed: the ST-5. As with any simple circuit, the cost of the power supply is out of proportion with the rest of the unit. At 1970 prices the ST-5 costs only $14.50 less loop supply and a plus-minus 12-volt supply ($11).

The total cost of $33 is not overly impressive until you realize this unit can, if desired, be used as a building block for the more exotic ST-6. Almost every component used here can be used in that unit. The ST-5 is a basis from which the beginner can expand - it's not just a collection of parts that will find no further use when he is ready to broaden his horizons to more sophisticated equipment.

FEATURES

The ST-5 uses two operational amplifiers (Fig. 1 shown at end of this article). One is an audio limiter, and the other is a trigger stage to drive the keyer. It has a 175-volt loop supply of the same type used in the TT/L, which provides plus-minus voltages for keying a transmitter and also features narrow-shift cw identification. Finally, the ST-5 has a symmetrical plus-minus 12-volt power supply.

LIMITER
The 709C op amp has over 90-dB gain and is good to over 10 MHz. It makes an ideal limiter. The zener diodes on the input don't assist in the limiting; they merely protect the 709C against damage in the event of excessive audio input (hardly likely but worth the protection). The limiter puts out square waves and is so powerful it starts working on input signals as low as 200 mV. The 25k pot merely balances the small offset input voltage for maximum gain. This voltage varies slightly from one unit to another, so a control pot was added rather than a fixed resistor, which many units use.

DISCRIMINATOR/DETECTOR
It's difficult to use the same value inductor with different capacitors and expect to obtain two similar filters of equal characteristics. To get similar band-width, voltage output, noise response, etc., some loading is necessary. Most simple demodulators merely balance the voltage or ignore all the problems completely. Without belaboring the point, it's not a simple job to get all these factors to balance suitably; but it is possible, and the Mainline units all have filters that have been designed with care.

The ST-5 offers a choice of the 2125-2975 mark and space tones (considered standard), or the 1275-2125 low tones necessary in some modern receivers. (Actually nearly all these receivers respond beautifully to 2975 tones and higher, but a new BFO crystal is needed.) The best results come from the 2125-2975 tones, since the two frequencies are only about 28% apart while the 1275-2125 tones are 40% apart. thus it's a more difficult job to separate the harmonics and achieve proper filter design.

The detector features full-wave rectification for most efficient filtering of the DC ripple remaining after the audio has been rectified. A simple RC low-pass filter removes the remaining audio component.

SLICER
The slicer takes the small voltages from the filters and changes them to roughly +10 volts for mark and -10 volts for space, regardless of the original amplitude. This in reality is a DC limiter, as a signal as small as a 100 uv DC or so will cause the unit to saturate completely, either plus or minus, depending upon the polarity of the applied signal voltage. The unit has so much gain that at the cross-over point, a change at the audio input as small as one or two Hz will cause this trigger stage to flip from +10 to -10 volts. This is another way of saying shifts as low as 3-4 Hz could be copied on the ST-5 if tuned in properly.

KEYER STAGE
A 250-volt Motorola 20W transistor selling for $1.06 is used. The normal loop-supply current for TTY machines is 60 mA. This transistor has a large amplification factor and acts like an on-off switch. When on, the power consumed in the transistor is only 0.012 W; so in the ST-5 there's no way you could ever damage that transistor.

An RC network in the 2N5655 collector takes care of the back EMF developed by the inductance of the selector magnets in the printer during the transition from space to mark. The transistor is biased off during space. A diode in the base circuit keeps this negative voltage below the point at which the base-emitter junction would be reverse biased.

STANDBY SWITCH
When S1 is closed, the unit is placed in mark. When S1 Is opened, the printer can follow whatever is fed into the limiter from the receiver.

As explained previously, the unit has so much gain that a signal as small as 3-4 Hz can be copied if tuned correctly; this is called straddle tuning. However, for 170-Hz shift you may wish to add a switch that changes the space filter to the new frequency. Fig. 2 shows the way this would be accomplished if using the normal 2125-2975 tones, and Fig. 3 shows the circuit for the low tones of 1275-2125. This is merely an expedient and doesn't result in proper filter balance, but it provides good 170-shift reception with the switch closed, or normal 850-shift reception with it open.

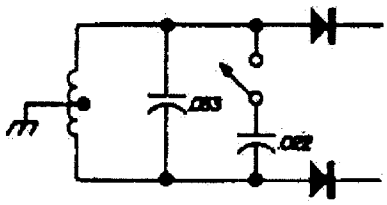


Fig. 2. Switching circuit for adding 170 shift to space filter for 2125-2575 tones.

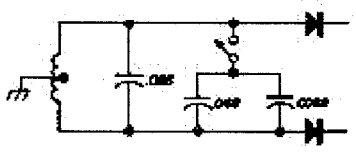
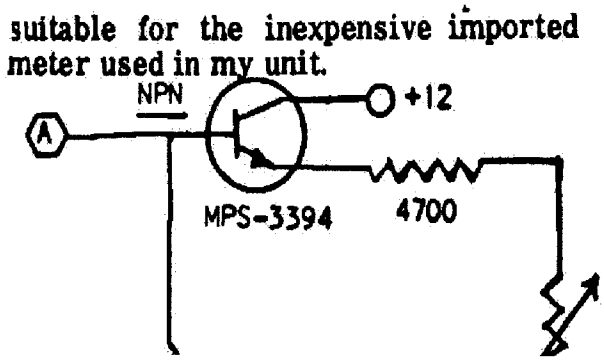


Fig. 3. Switching circuit for adding 170 shift to space filter for 1275-2125 tones.

TUNING INDICATOR

Provisions are provided for connections to the vertical and horizontal amplifiers of a scope (Fig.1 shown at the end of this article). It is customary to connect the mark signal to the horizontal amplifier and space signal to the vertical amplifier, although many reverse this method.

Most people prefer a scope indication, but an excellent tuning indicator is provided at point A (Fig. 1). A voltmeter connected to this point will give equal voltage indication for mark or space. With RTTY signals the meter should stand still. If it doesn't, retune the receiver until it does. If straddle tuning a signal, the meter may read less than normal, although it won't move. This is normal and merely indicates the shift being copied is not the correct shift for the filters you're using.



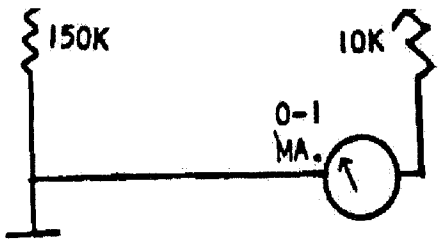


Figure 4: Optional Tuning Indicator

Fig. 4 also shows how a 0-1 mA meter may be added. An inexpensive NPN transistor is used, such as the MPS-3394, although any NPN transistor would be satisfactory here. The capacitor merely dampens the meter so it doesn't flip around too violently. If your meter is too damped, remove the capacitor or try a smaller value. This was installation in the transmitter. The components can be mounted on a small terminal strip and placed near the VFO tube under a convenient mounting screw which also serves as a ground return. The trimmer is connected to the cathode of the VFO tube and the tube replaced in its socket; thus, no changes of any type are made to the transmitter and its resale value is not affected. There should be room for several keyers if you wish to have the convenience of both 170 and 850 shift.

THE TRANSMITTER KEYER

Fig. 5 shows a typical FSK keyer for installation in the transmitter. The components can be mounted on a small terminal strip and placed near the VFO tube under a convenient mounting screw which also serves as a ground return. The trimmer is connected to the cathode of the VFO tube and the tube replaced in its socket; thus, no changes of any type are made to the transmitter and it's resale value is not affected. There should be room for several keyers if you wish to have the convenience of both 170 and 850 shift.

Although a 3-12 pF trimmer is shown in Fig. 5, some. transmitters only require a 1.5-7 pF trimmer. It is suggested that you do not substitute for the 1N270 diode as it is superior to most other types in this application.

If your signal is reported as "up side down," reverse the 1N270 diode. If you do not obtain sufficient CW shift with this connection (conduct on mark), the 500-ohm CW-shift pot should be connected to the opposite side of the 8.2k resistor at the junction of the two 15k resistors (Fig. 1).

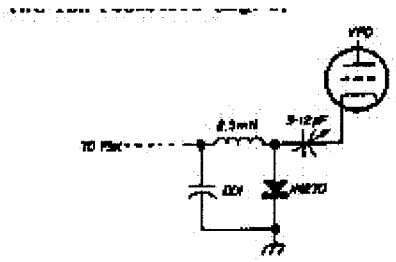


fig. 5. To add FSK to literally any transmitter, connect a 2-12 pF trimmer to the cathode pin of the VFO tube.

COMPONENTS

The 709C op amps are supplied by various manufacturers including Signetics, Fairchild, and

Motorola. Prices are constantly being reduced as de vices become available from more com panies. When I first started working on a super deluxe demodulator in the fall of 1967, I paid over $10 each. Now they're too cheap not to use. The Motorola unit can be purchased through most distributors, including Allied and Newark. The Fairchild unit can be mail ordered from the firms below. Specify the TO-S can, as this is easier to work with than the dual in-line 14-pin type (same cost).

The diodes marked G in fig. 1 are 1N270 germanium at 32 cents each. Those marked SIL are most any silicon type, such as the 1N2069. The one in the loop supply should, however, be a minimum of 400 volts PIV. Fifty-volt PIV is suitable everywhere else.

The 88-mH toroids are available from various sources for about 4O cents each. They're wired in series for 88 mH, and the junction of the two windings is grounded.

If you have an accurate means of determining the frequency, you can tune the filters by removing turns of wire from each of the two sections con currently to keep the turns ratio in the two windings the same. One turn from each of the two windings will increase the frequency about 6 Hz at the 2125 frequency, for example.

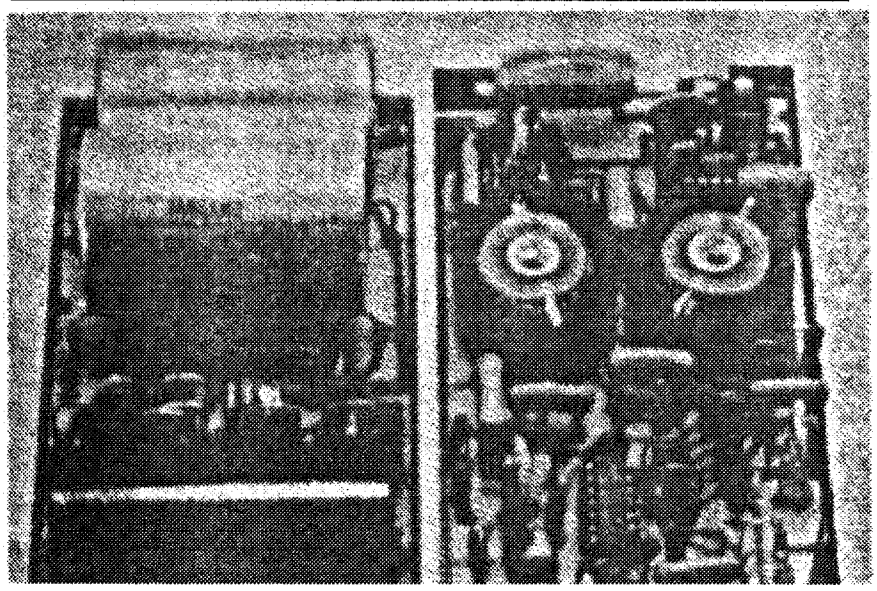
Use Mylar capacitors, such as the Sprague Orange Drop. Twenty-five-volt capacitors are adequate, but you'll probably wind up getting 200V types. They are only 15-21 cents each.

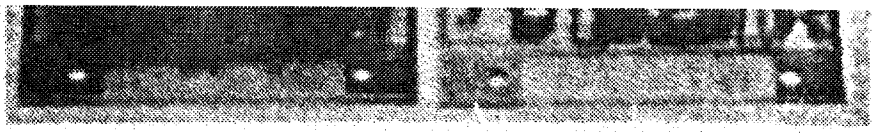
The pots can be the inexpensive 39 cent Mallory PC board MTC types. Other power transformers may be used, but the Triad F-4OX is an excellent buy.

PRINTED-CIRCUIT BOARD

The printed circuit boards shown in the ST-5 in the photographs hold all of the components except the two transformers and the control switches. This greatly enhances construction, and at the same time makes it possible for nearly anybody to build an extremely nice looking unit. The printed circuit board includes one section for the power supply and another for everything else. The board may be split down the middle and the two sections mounted back-to-back as I did in my unit, or the board may be left intact and used with a more shallow chassis.

Photo of boards from HAL Comm.





ADJUSTMENT

With no input signal, or with the input grounded, adjust the pot on the limiter for zero volts DC at pin 6. If this isn't possible, you'd better write me and explain thoroughly, as you probably ruined the op amp somehow. By the way, unless. you get too much voltage on pins 2 or 3, like the full power supply voltage, or get the plus-minus hooked up backwards, it's very difficult to ruin these things. By following even the most elementary construction practices, you'll have no problems with the 709C.

After balancing the limiter for zero volts output, connect the receiver and tune to maximum mark and note the indication on your tuning indicator (Fig 4.) or on a voltmeter connected to point A. Tune to space on the receiver and again note the reading. if the indications are not the same, adjust the 5k pot on the limiter output until they are. You have now finished all the adjustments and they should require no further attention at any time unless you switch to 170 shift, for instance. In this event you may or may not want to reset the filter balance pot. I suggest you leave it for the 850 setting and take what you get on the 170-switch position, as this is a somewhat artificial method of getting good 170-shift reception.

When transmitting be certain to first close the standby switch or you can get feedback, which will produce errors similar to those you would get when using a microphone if you didn't turn off the speaker.

OTHER OP AMPS

The 709C is to other op amps what the Ford V-8 was to other automobiles. It not only led the way; it's still in use. The 709C was (and is) one of the cheapest ICs of its type available. One would gain very little and stand to lose a lot by trying to substitute other units. The 741 and 748, for example, have a bit more gain, higher input voltages, and require no frequency compensation. Their biggest disadvantage here is that they're not at all suited as audio amplifiers. At 2 kHz they have only 30-40 dB gain and make a poor audio limiter compared with the 709C. So unless you know what you're doing, stick to the 709C.

*Hamilton Electro Sales, 340 East Middlefield Road, Mountain View, Calif. 94040 and G.S. Marshall Co., 732 North Pastoria Avenue, Sunnyvale, Calif. 94086 (also carries Signetics). If buying Motorola version, ask for the MC 1709CG. Texas Instruments 709 op amps are $1.50 each (or 7 for $10) from HAL Devices, Box 365H, Urbana, Illinois 61801; ask for SN72709L.

MARK-SPACE INDICATOR LAMPS

Adequate indicator lamps to show mark or space are shown in the partial drawing of the loop supply. Any type of low-current neons should be suitable. Their use does enhance tuning in a signal and they help to indicate if a station is upside down or not.

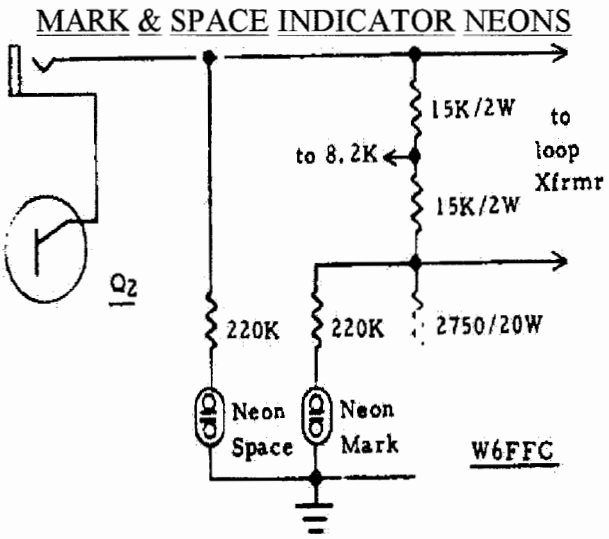
NORMAL-REVERSE SWITCH

No normal-reverse switch has been added to the ST-5. While possible to incorporate one, (see the ST-5 schematic) it seems hardly necessary. At my station, I do not recall having heard more than 1-2 stations "upside down" in the past year. Using the other sideband on the receiver normally accomplishes the same thing as a reversing switch.

THE ST-5 AND 170 SHIFT:
At the time the ST-5 was originally designed, a majority of stations were on 850 shift. These days, only a few stations use 850 shift on H.F.; nearly every body having switched to 170 shift. If you wish to optimize the ST-5 for 170, you would want to use the following component values: (ST-5 b.)

170 Shift Values

- R12 6800
- R14 6800
- R15 lOOK



THE POWER SUPPLY
Several transformers are suitable for the loop supply such as the Stancor PA-8421, or the Triad N51-X. Almost any transformer rated for 24 volts C.T. will be suitable for the power supply, if rated at least 200 mills. (The relay will take about 100-150 mills, depending upon brand.)

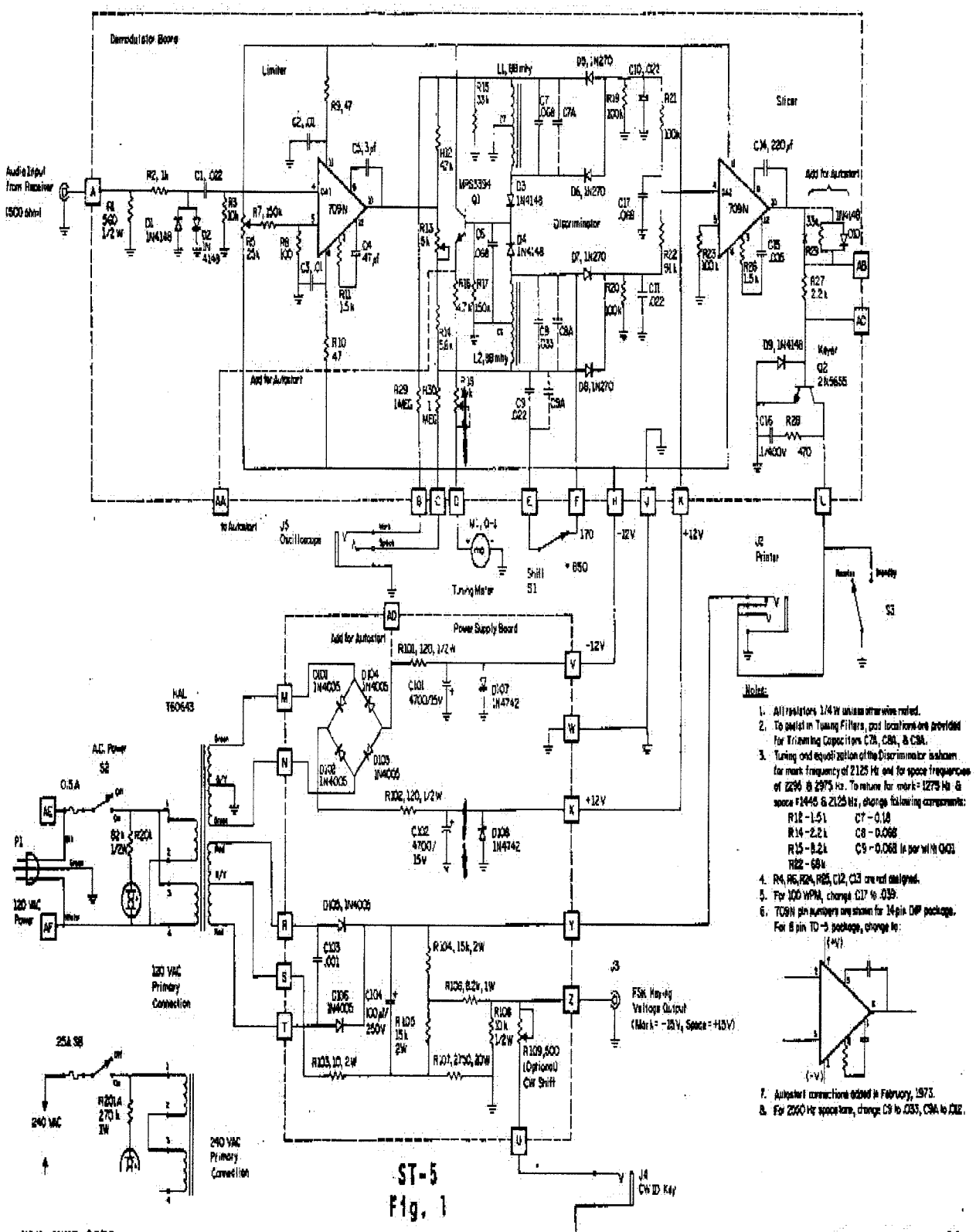
Hal Communications has a special transformer made exclusively for them by Stancor which combines both the loop and power windings. This saves not only space but money.

CONCLUSION
The ST-5 was designed as a simple but highly effective RTTY demodulator using the best of currently available concepts. It should be a very popular unit for some years to come, as it's impossible to imagine at this time how any additional performance could be made available, it's already ridiculous to talk in terms of 90 + dB amplification. Only a completely different concept of RTTY processing could outdate the ST-5, and that seems quite unlikely to occur until we all get computer terminals in the shack.

REFERENCES
1. RTTY, November, 1964; also QST, August, 1965.

2. RTTY Journal, September, 1967; also QST, May, June, 1969.

3. RTTY Journal, September, 1968; also QST, April, 1970.



Notes:

1. All resistors 1/4 W unless otherwise noted.
2. To assist in Tuning Filters, pad locations are provided for Trimming Capacitors C7A, C8A, & C9A.
3. Tuning and equalization of the Discriminator is shown for mark frequency of 2125 Hz and for space frequencies of 2296 & 2975 Hz. To retune for mark = 1275 Hz & space 1445 & 2125 Hz, change following components:
   R12 - 1.5 k — C7 - 0.1 µ
   R14 - 2.2 k — C8 - 0.068 µ
   R15 - 8.2 k — C9 - 0.068 µ in parallel with C401
   R22 - 68 k
4. R4, R6, R24, R25, C12, C13 are not designed.
5. For 100 WPM, change C17 to .039.
6. 709N pin numbers are shown for 14-pin DIP package. For 8 pin TO-5 package, change to:

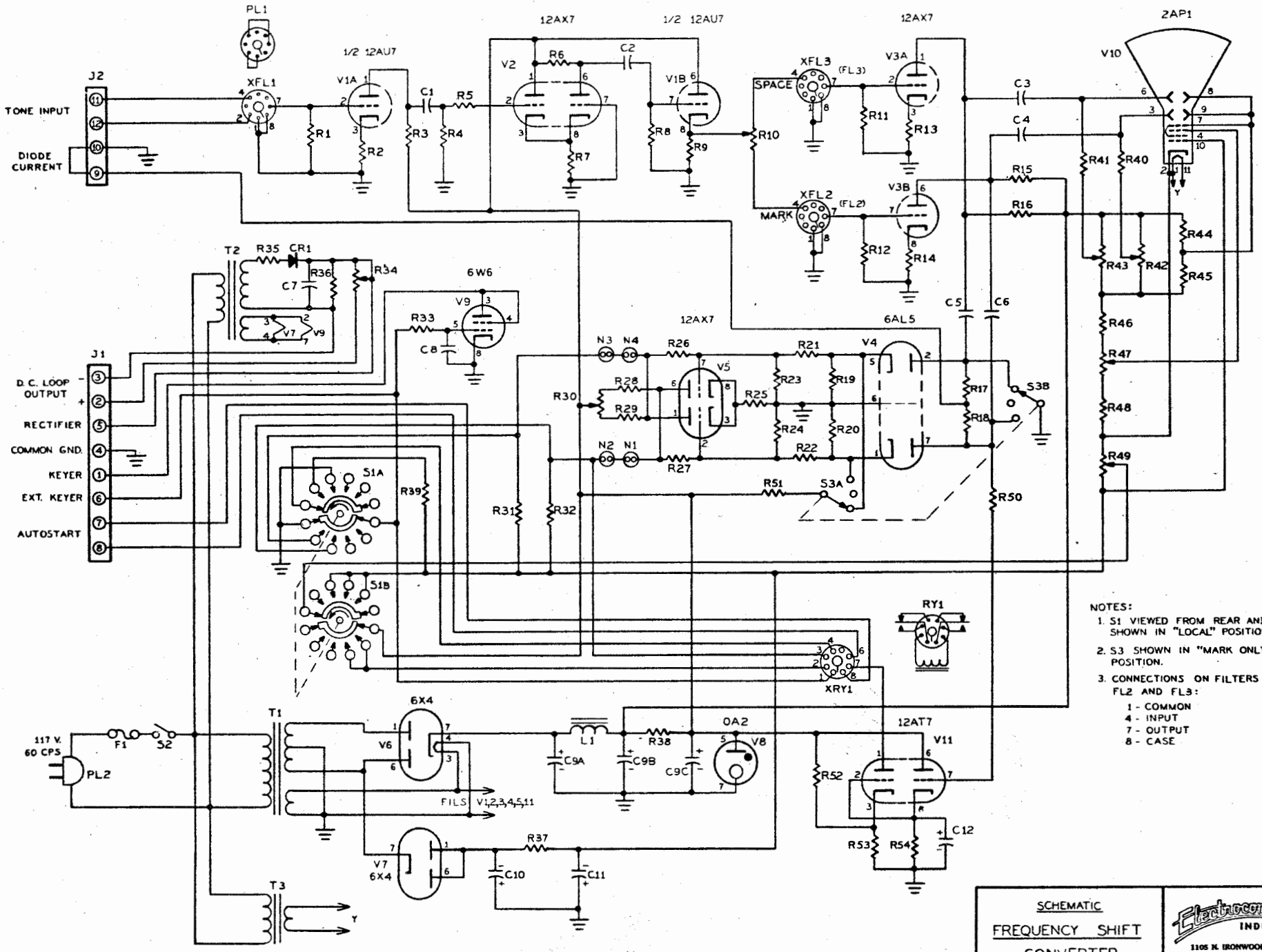
7. Autostart connections added in February, 1973.
8. For 2550 Hz spacing, change C9 to .033, C9A to .02.

Figure 1 - ST-5 Original Schematic Diagram


George Hutchison
W7KSJ
(Webmaster)

WWW.RTTY.COM

William Bytheway
AA6ED
(Co-Webmaster)

SCHEMATIC

FREQUENCY SHIFT CONVERTER

MODEL FSC-250

Electrocom INDUSTRIES

1105 N. IRONWOOD DRIVE
SOUTH BEND, INDIANA

250001

REV D

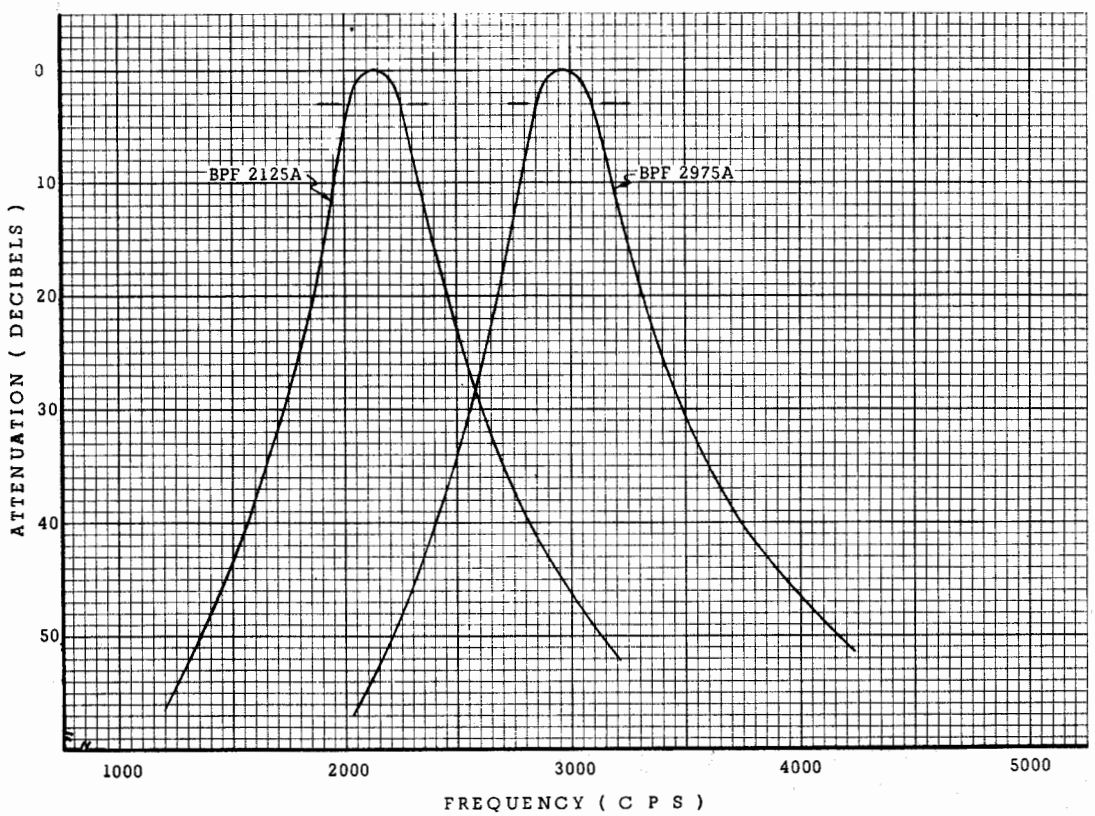
DATE 11-2-59

Electrocom INDUSTRIES

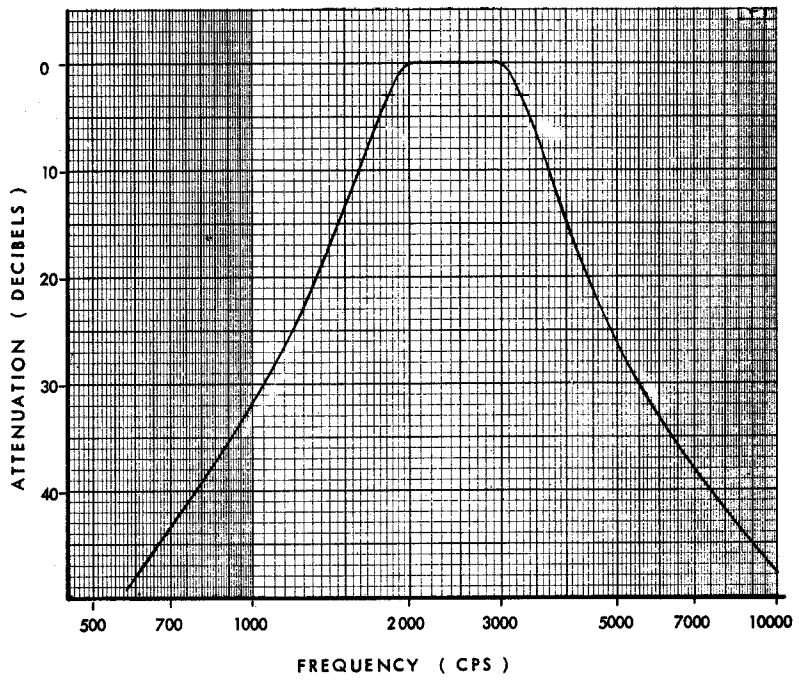
Communications Products and Systems

FILTER CHARACTERISTICS

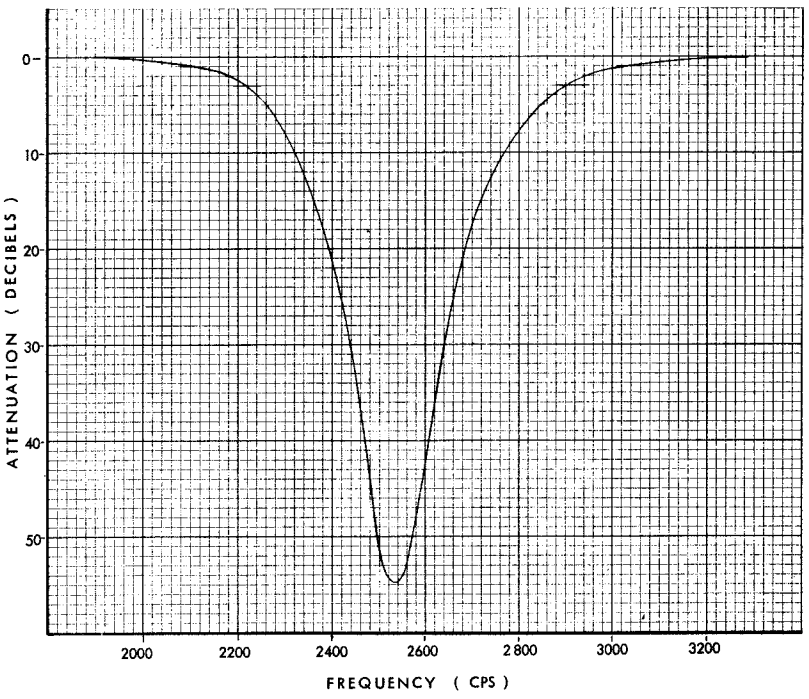
Various filters are manufactured by Electrocom Industries for use with the model FSC-250 Frequency Shift Converter or similar equipment. Typical response characteristics for four standard filters are shown below. Filters BPF 2125**A** and BPF 2975A are channel filters for receiving 850 cps shift. Similar filters for other shifts are also available. Filters BPF 2455J and BSF 2229J are input filters designed to give improved performance under conditions of heavy interference. BPF 2455J is for use with receivers having moderate selectivity and serves to attenuate unwanted signals outside of the required passband of the RTTY signals. The notch filter, BSF 2229J, is for use with selective receivers (such as those using a 1.5 kc. mechanical filter) in order to give additional interference rejection to unwanted signals which may occur between the mark and space frequencies. The above filters may be plugged directly into the sockets provided in the FSC-250. They are of 600 ohm input and output impedance. Filters having other characteristics are available on special order.



Characteristic of filters BPF 2125A & BPF 2975A



Characteristic of filter BPF 2455J



Characteristic of filter BSF 2229J

Electrocom INDUSTRIES

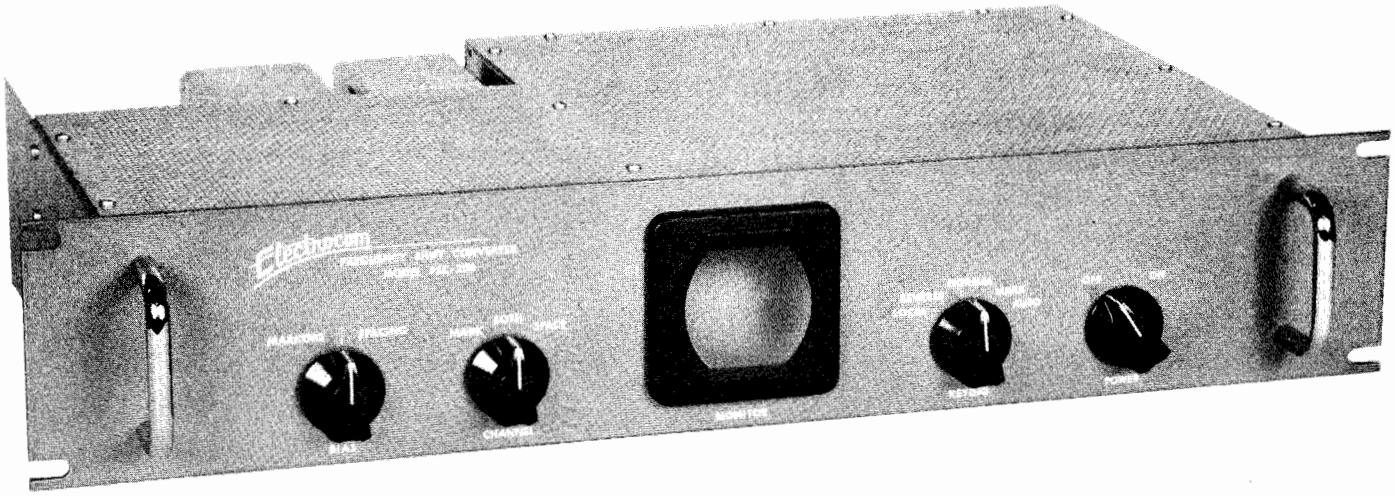
1105 NORTH IRONWOOD DRIVE, SOUTH BEND 15, INDIANA

Telephone CEntral 4-3829

Electrocom INDUSTRIES

Communications Products and Systems

FREQUENCY SHIFT CONVERTER MODEL FSC-250



A highly versatile, complete radio-teleprinter terminal unit providing outstanding performance for AMATEUR, CIVIL DEFENSE, and COMMERCIAL APPLICATIONS

FEATURES:

- Incorporates selective filters for maximum interference rejection
- Plug-in filters allow optimum performance for any frequency shift
- Scope tuning indicator for rapid, accurate receiver tuning
- Audio filter system—may be used for FSK and AFSK operation
- Electronic polar operation—no relay required
- Mark-space "bias" adjustment aids in correcting distorted incoming signals
- Self contained "loop" power supply variable from 20 to 70 milliamperes
- Mark only or space only operation available in event of intereference to one channel
- Built in "autostart" operation
- Quality construction throughout—uses hermetically sealed filters and quality components for reliability

DESCRIPTION:

The Electrocom Model FSC-250 is a completely self-contained frequency shift terminal unit designed to convert audio tones to keyed direct current suitable for operating teleprinters. The unit is complete with filters, scope monitor, and DC power supply for operating the teleprinter selector magnets. Upon connection of the FSC-250 to the audio output of a communications receiver and to the teleprinter, the system is ready for operation. Terminals are provided on the rear panel for operation of a Frequency Shift Keyer for transmitter keying, motor control of automatically started printers, and additional loop keyers if desired.

An effective limiter, selective filters, and electronic polar keying provide outstanding performance during periods of fading and interference. A "bias" control is also provided to aid in correcting distorted incoming signals and thus allow maximum keying range of the teleprinter. A selector switch enables the FSC-250 to be used for local loop operation, normal or reverse keying, mark lock, and unattended autostart operation.

The built in scope monitor and precision tuned filters not only allow for rapid tuning of the receiver, but also provide a convenient monitor for frequency shift adjustment of associated transmitting equipment.

A high degree of equipment reliability is provided by the use of quality components and hermetically sealed plug-in filters. The entire assembly including filters and power supplies is attractively packaged on a standard 19 inch rack panel only 3½ inches high.

SPECIFICATIONS:

INPUT: 600 ohm, unbalanced to ground

SENSITIVITY: 100 mv. rms for limiting

SHIFT: 850 cps with filters supplied*

FILTERS: 600 ohm plug-in units with 3 db. bandwidth of 250 cps. Mark-space channel attenuation greater than 40 db.

TUNING INDICATOR (MONITOR): 2 inch CRT

OUTPUT: DC continuously variable from 20 to 70 ma. into 500 ohm loop

MAXIMUM KEYING SPEED: 200 WPM

CASE: Aluminum with clear irridite finish

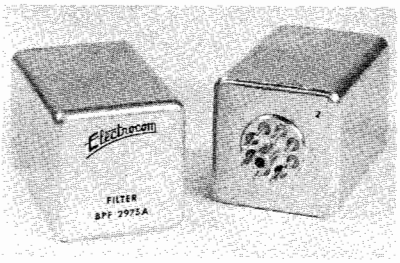
OVERALL DIMENSIONS BEHIND PANEL: 3½ by 17 by 10½ inches deep

PANEL: Grey hammertone, white figures

WEIGHT: 14 pounds

POWER: 110-125 volts, 60 cps, 75 watts maximum

*OPTIONAL FILTERS AVAILABLE:



Various input filters are available depending upon the selectivity characteristics of the associated communications receiver.

Additional hermetically sealed mark and space filters are available for optimum performance on shifts other than 850 cps.

CONTROLS:

Front panel:

BIAS—Marking to Spacing

CHANNEL—Mark, Both, Space

KEYING—Local, Reverse, Normal, Mark, Auto

POWER—Off, On

Rear panel:

Loop Current Adjust

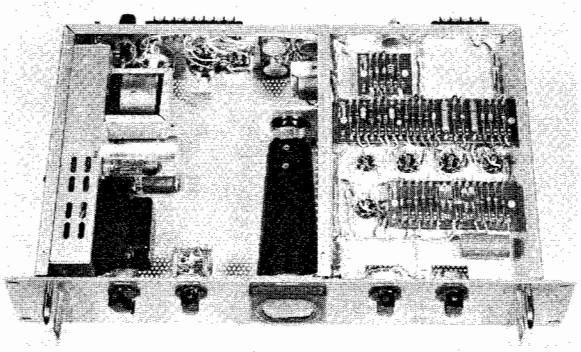
Horizontal, Vertical, Intensity, and Focus for monitor scope

Channel Balance

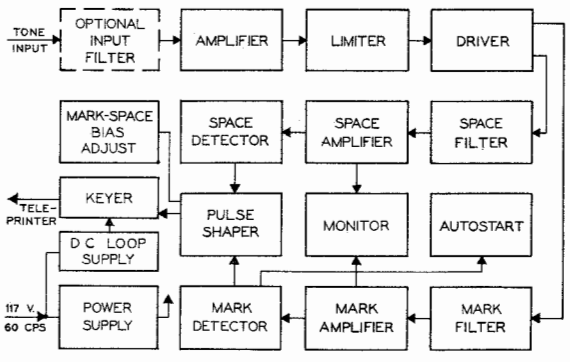
TUBES:

1 12AU7 Input amplifier, driver
1 12AX7 Limiter
1 12AX7 Mark-space amplifier
1 6AL5 Detector
1 12AX7 Pulse shaper
1 6W6GT Loop keyer
1 2AP1 Monitor
2 6X4 Rectifiers
1 0A2 Voltage regulator
1 12AT7 Autostart control

BOTTOM VIEW (Cover Removed)



BLOCK DIAGRAM OF FSC-250



PRICE: $325.00 FOB South Bend, Indiana

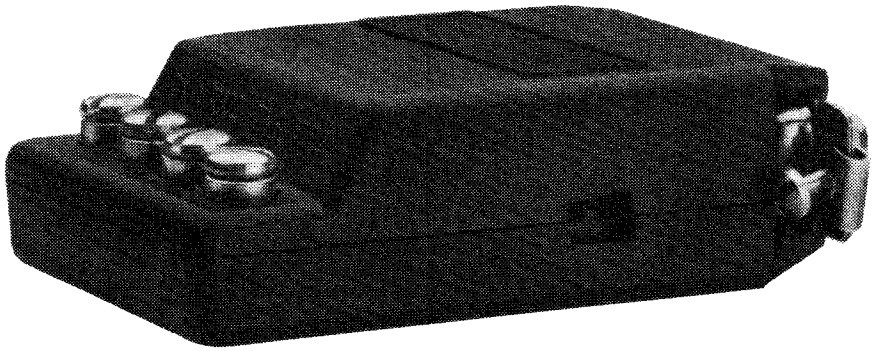
Electrocom INDUSTRIES

1105 NORTH IRONWOOD DRIVE, SOUTH BEND 15, INDIANA

Telephone CEntral 4-3829

CL412F-587
CL412M

RS-232↔CURRENT LOOP INTERFACE CONVERTER (101-4Q)



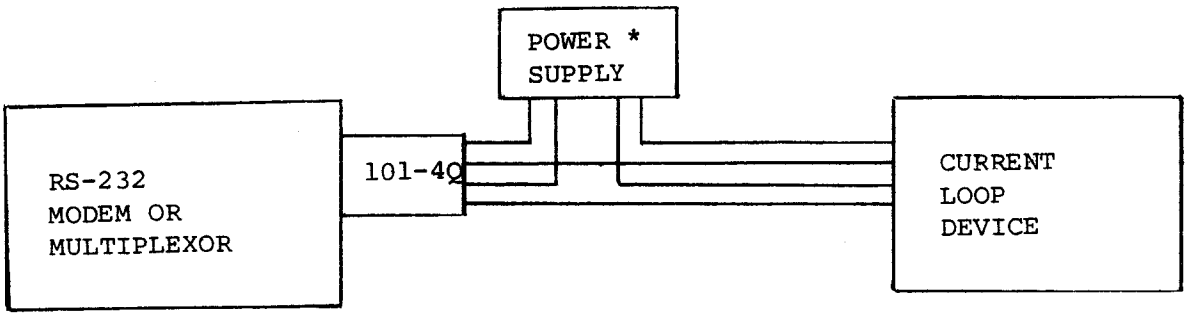
- SMALL, INTERFACE POWERED EIA RS-232/20 mA CURRENT LOOP CONVERTER UNIT FOR INSTALLATIONS WITH LIMITED SPACE
- DCE/DTE SWITCH FOR SIMPLE CONFIGURATION
- OPTICALLY ISOLATED FOR RS-232 SIGNAL PROTECTION
- SEPARATE CURRENT LOOP POWER SUPPLY AVAILABLE

SPECIFICATIONS:
POWER — UNIT OPERATING POWER: PROVIDED BY EIA INTERFACE: PIN 6 WHEN CONFIGURED FOR CONNECTION TO DCE, PIN 20 WHEN CONFIGURED FOR CONNECTION TO DTE
CURRENT LOOP POWER — PROVIDED EXTERNAL (20 mA, 24 VDC MAX.)
SIZE — 0.6"H x 1.6"W x 2.8"D WEIGHT — 3 OZ.
ENCLOSURE — HIGH-IMPACT PLASTIC
INTERFACE — RS-232/V.24, DCE OR DTE (SWITCH-SELECTABLE); 20 mA CURRENT LOOP
CONNECTORS — RS-232: (1) DB25P (MALE), CL412M
(1) DB25S (FEMALE), CL412F
CURRENT LOOP: (1) FOUR-POSITION SCREW TERMINAL STRIP
MODE OF LINE OPERATION — PASSIVE, 20 mA CURRENT LOOP

1.Ø GENERAL

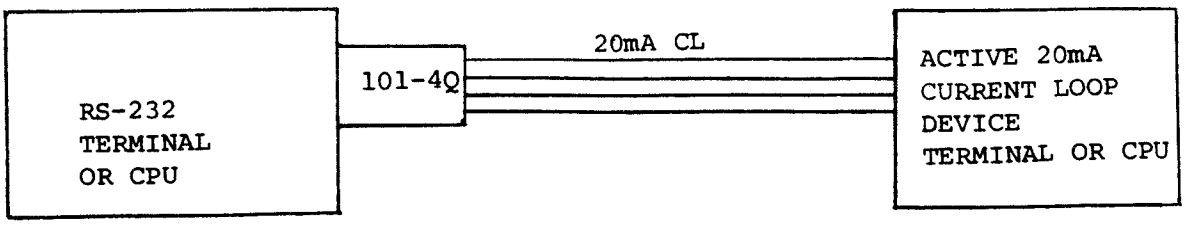
The EIA <--> Current Loop adapter (1Ø1-4Q) is intended for use in interfacing terminals with RS-232C ports to neutral current loops. The 1Ø1-4Q allows data transmission by current flow rather than by vooltage level as defined by EIA - RS-232. Current flowing (closed loop) represents a MARK signal and no current flowing represents a SPACE signal. The 1Ø1-4Q functions as a passive device in neutral current loop environments operating at a maximum current of 2ØmA and a maximum loop voltage of 24 VDC. Operating power for the 1Ø1-4Q is derived from pin 6 when the DCE/DTE switch is in the DCE position, and derived from pin 2Ø when the DCE/DTE switch is set on DTE.

Figure 1A 101-4Q Application
(101-4Q configured for attachment to DCE device; External Power Supply)



* Power may come from an active device in loop in which case power supply is not necessary, as shown below.

Figure 1B 101-4Q Application
(101-4Q configured for attachment to DTE device; active current loop device in loop)



2.Ø INSTALLATION

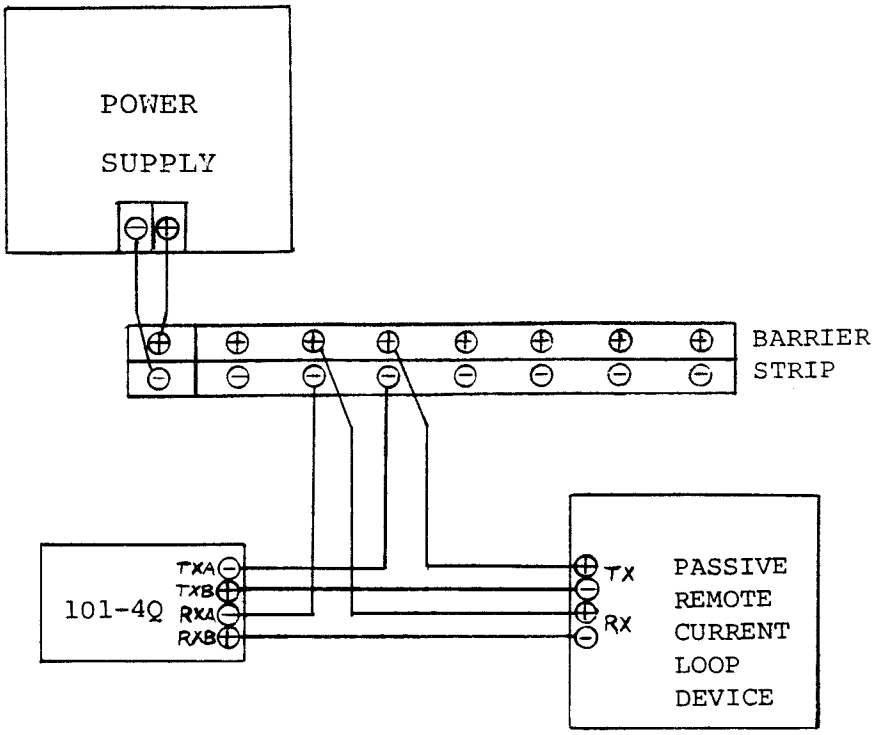
The 1Ø1-4Q is easily installed by completing the current loop between the adapter, power supply, and other devices in the loop. Each loop, transmit and receive, must be independently connected for full duplex operation, and must be connected in a complete circuit observing polarity markings on adapter and power supply.

Use figure 2a when using an external power supply. Reference figure 2b when an active device is in loop.
NOTE: The 1Ø1-4Q terminals are labeled on the case as follows:

TXA - Transmit Negative
TXB - Transmit Positive
RXA - Receive Negative
RXB - Receive Positive

Figure 2-1 101-4Q Installation

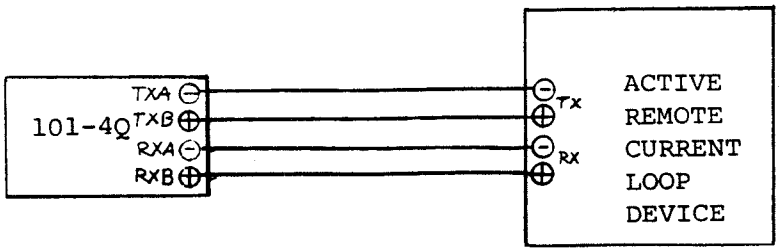
2A Installation with External Power Supply



NOTE

The above drawing shows the 101-4Q used in conjunction with a power supply and a barrier strip. The barrier strip must isolate + and - pairs for proper operation of more than one loop per power supply.

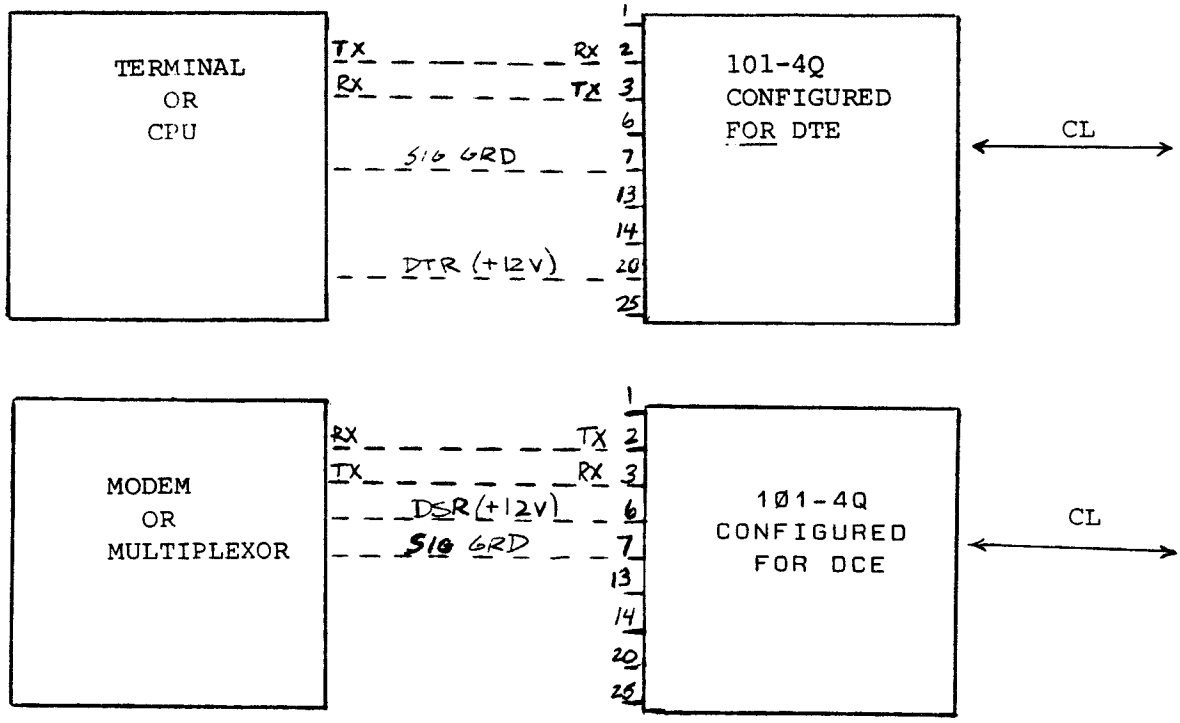
2B Installation with Active Device in Loop



3.Ø RS-232 INTERFACE

The 1Ø1-4Q has an RS-232C connector configurable for attachment to either DCE or DTE devices. When the switch on the 1Ø1-4Q is set to "DCE", the unit is configured for attachment to a DCE device (modem or multiplexor); the "DTE" setting configures the 1Ø1-4Q for attachment to a terminal or CPU.

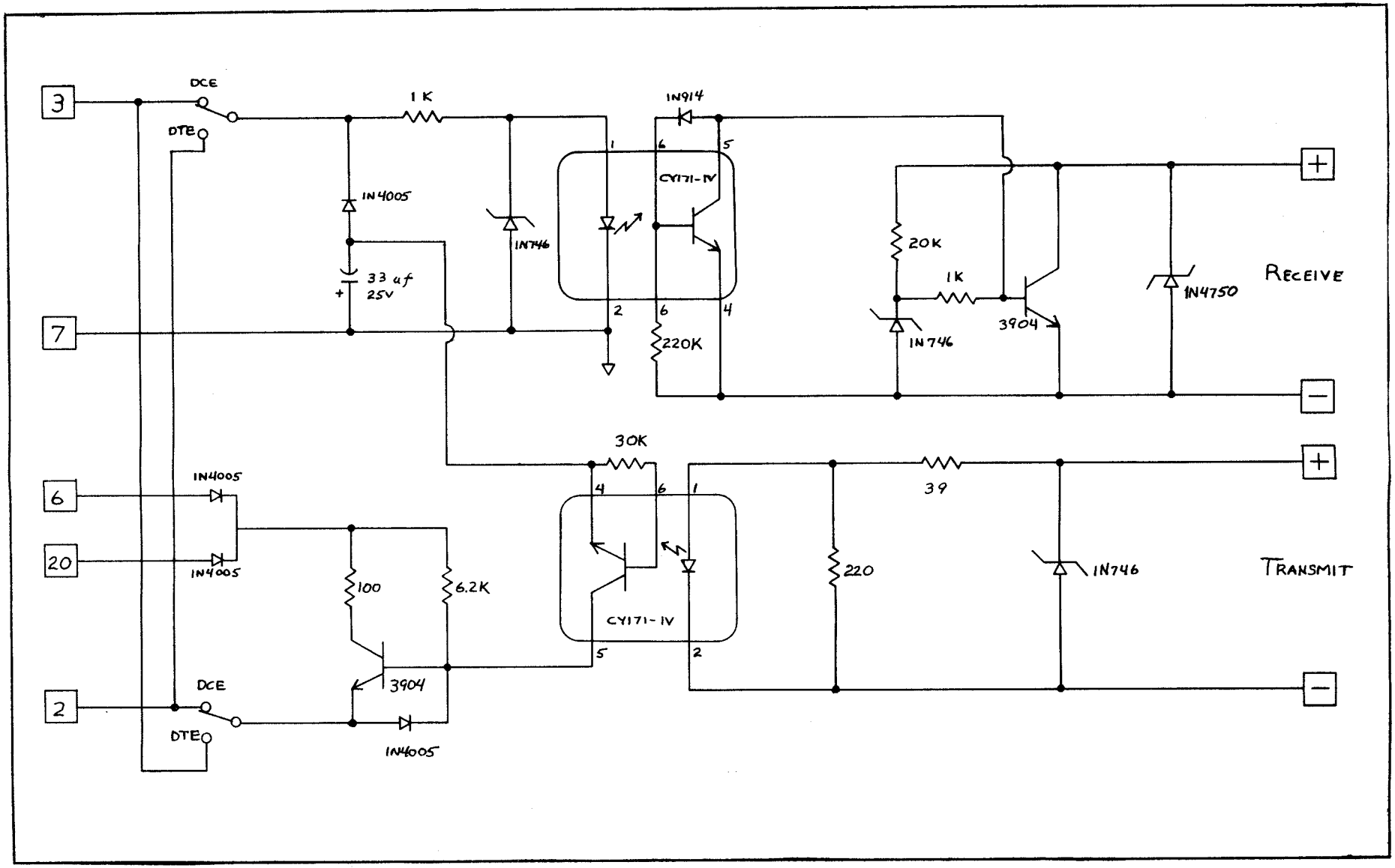
RS-232 INTERFACE



Current Loop Reverse Polarity Protection

Transmit: A diode is incorporated across the transmit current loop pair so that if they are inadvertently reversed, current will flow in the circuit but the transmit switch is protected.

Receive: A diode is incorporated across the receive current loop pair so that inadvertent reversal will cause loop current to flow, but the receiver will not detect current and will indicate a continuous "spacing" condition to the attached device.



SCHEMATIC OF EIA/CURRENT LOOP INTERFACE 101-4Q

serial converter for 8-level teleprinters

This converter translates Baudot to ASCII and ASCII to Baudot using readily available ICs — recommended for the experienced amateur only

At the outset I'd like to stress that this is a project for the experienced amateur with the technical know-how to connect the converter described to appropriate points in his demodulator or fsk circuit.

The heart of the converter is the universal asynchronous receiver/transmitter (UAR/T), a 40-pin IC that contains both an independent, 8-bit asynchronous, digital-data receiver, and an 8-bit asynchronous, digital-data transmitter. The UAR/T has been described earlier in *ham radio*.[1,2]

Parts layout and wiring of the converter is quite a task in itself. Sockets are mandatory for the ICs as some are MOS devices, which are sensitive to ungrounded soldering irons. Fairly heavy bus wire is necessary for ground (common) and +5-volt leads. Also, liberal use of 0.01-μF ceramic disc capacitors (not shown in the schematic) is required to bypass +5, and −12 volt circuits.

All NAND gates used as inverters can be replaced by hex inverters to reduce component count. Type 74121s can be replaced by 74123s except where both A inputs are used.

Those readers interested only in receiving RTTY with an 8-level machine can save much time and money by deleting the connections (except for grounds and clock inputs) to the much more complex ASCII-to-Baudot section, which is shown below the dashed lines of both UAR/Ts in **fig. 1**.

The cost for the complete converter should be well below $100; possibly around $50. The 8223 proms can be replaced with 82S23s, which are currently on the market for about $3 each. The UAR/T ICs can be replaced with the GI AY-5-1013A, which is less expensive, about $6.50. The 3351 fifo devices can be obtained for about $14 through W6KS, as mentioned in the *RTTY Journal*. The other chips are standard devices and are available for about 50 cents or so.

Baudot-to-ASCII/ASCII-to-Baudot converters have been described in other publications but were not directly compatible with RTTY, which is a serial system, and didn't take advantage of the UAR/Ts.

circuit description

The converter schematic is shown in **fig. 1**. The serial 5-bit Baudot signal at TTL level enters U1 at pin 20 and appears in parallel form at pins 8 through 12. ICs U2, U3 sense whether letters or figures have been sent and set R/S flip-flop U4 to enable either U5 or U6, which translate the 5-bit Baudot code to 7-bit ASCII code; this translation appears at U6 pins 1 through 7. (The no. 8 bit is a parity bit, which is used with computers, and is unnecessary for amateur RTTY. I have modified my model 35ASR so that the no. 8 bit is always a zero.)

Output from U6 is applied to UAR/T U7 and appears in serial form at pin 25, which is connected through driver Q1 to a 4N33 opto-isolator, U8. Another 4N33, U9, is connected in series with U8, whose output with that of U8 is inserted into the loop of a model 33 or 35 ASR. This circuit keeps modifications of the ASCII machine to a minimum.

The signal originating from either the keyboard or tape reader of the ASCI machine is connected to the input of the second 4N33, U9, and its output serially feeds into U7-20. This data appears in parallel form at U7 pins 12 through 19.

Because there are no *LTRS* or *FIGS* in the ASCII code, these characters must be generated. For this reason the 6th and 7th ASCII bit, which appear at pins 7 and 6 respectively to U7, are sensed by 7474 flip-flop U10. In combination with 7474 flip-flop U11, U10 will disable the 8223 proms U12, U13 temporarily.

By Eric Kirchner, VE3CTP, Ontario Science Center, Don Mills, Ontario, Canada

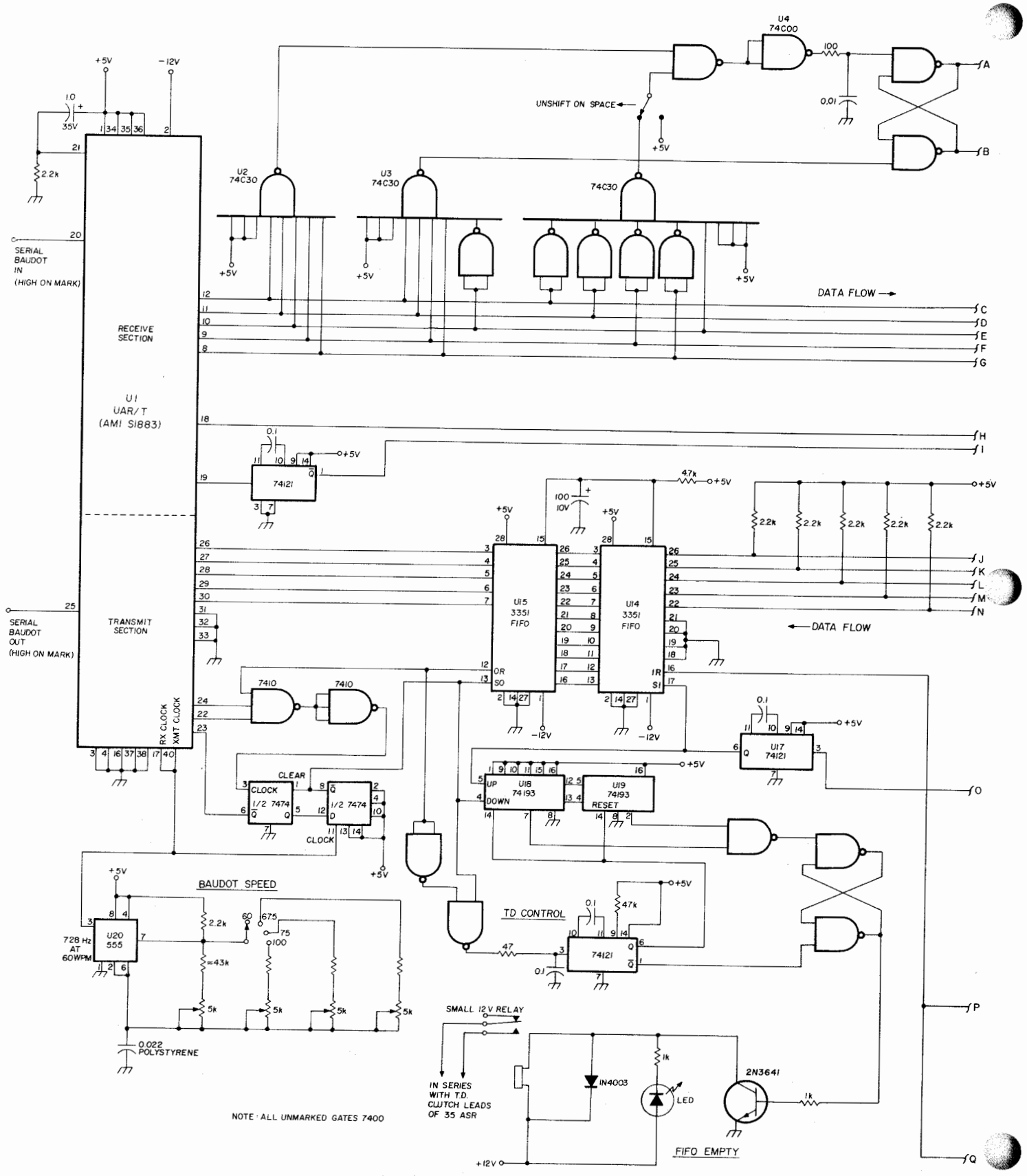


fig. 1. Schematic of the serial Baudot-to-ASCII-to-Baudot converter for model 33 and 35 ASR machines.

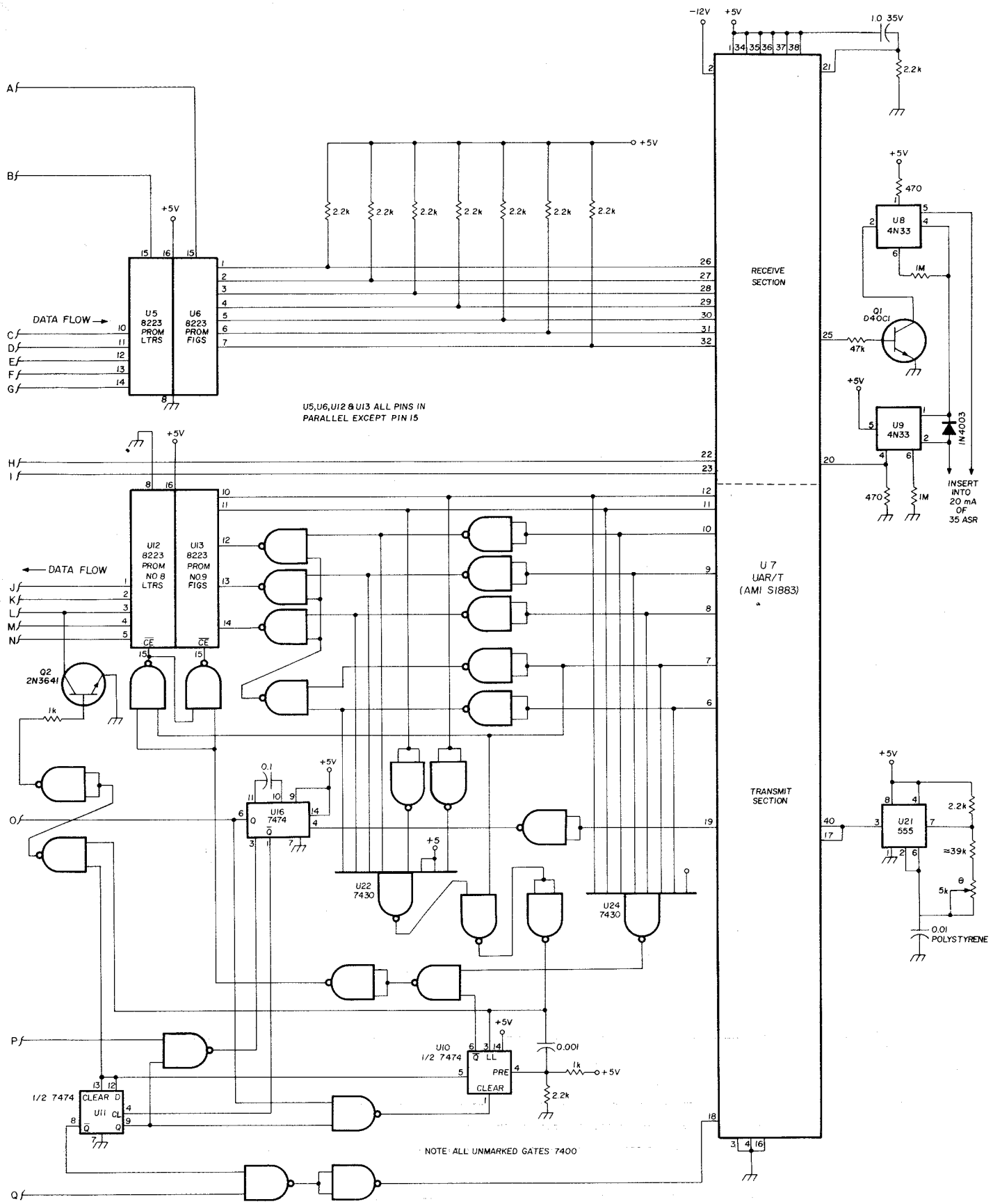

-12V
+5V
1.0 35V
2.2k
RECEIVE SECTION
U5 8223 PROM LTRS
U6 8223 PROM FIGS
DATA FLOW
U5,U6,U12 & U13 ALL PINS IN PARALLEL EXCEPT PIN 15
U8 4N33
470
1M
Q1 D40C1
47k
U9 4N33
IN4003
INSERT INTO 20 mA OF 35 ASR
U12 8223 PROM NO 8 LTRS
U13 8223 PROM NO 9 FIGS
Q2 2N3641
1k
U7 UAR/T (AMI S1883)
TRANSMIT SECTION
U16 7474
U22 7430
U24 7430
U21 555
2.2k
≈39k
5k
0.01 POLYSTYRENE
U10 1/2 7474
U11 1/2 7474
0.001
NOTE: ALL UNMARKED GATES 7400

table 1. Program for 8223 prom, Baudot-to-ASCII letters (U5).

Word	A 4 3 2 1 0	Symbol	B 0 1 2 3 4 5 6 7
0	0 0 0 0 0	Blank	0 0 0 0 0 0 0 0
1	1 0 0 0 0	T	0 0 1 0 1 0 1 0
2	0 1 0 0 0	CR	1 0 1 1 0 0 0 0
3	1 1 0 0 0	O	1 1 1 1 0 0 1 0
4	0 0 1 0 0	Space	0 0 0 0 0 1 0 0
5	1 0 1 0 0	H	0 0 0 1 0 0 1 0
6	0 1 1 0 0	N	0 1 1 1 0 0 1 0
7	1 1 1 0 0	M	1 0 1 1 0 0 1 0
8	0 0 0 1 0	LF	0 1 0 1 0 0 0 0
9	1 0 0 1 0	L	0 0 1 1 0 0 1 0
10	0 1 0 1 0	R	0 1 0 0 1 0 1 0
11	1 1 0 1 0	G	1 1 1 0 0 0 1 0
12	0 0 1 1 0	I	1 0 0 1 0 0 1 0
13	1 0 1 1 0	P	0 0 0 0 1 0 1 0
14	0 1 1 1 0	C	1 1 0 0 0 0 1 0
15	1 1 1 1 0	V	0 1 1 0 1 0 1 0
16	0 0 0 0 1	E	1 0 1 0 0 0 1 0
17	1 0 0 0 1	Z	0 1 0 1 1 0 1 0
18	0 1 0 0 1	D	0 0 1 0 0 0 1 0
19	1 1 0 0 1	B	0 1 0 0 0 0 1 0
20	0 0 1 0 1	S	1 1 0 0 1 0 1 0
21	1 0 1 0 1	Y	1 0 0 1 1 0 1 0
22	0 1 1 0 1	F	0 1 1 0 0 0 1 0
23	1 1 1 0 1	X	0 0 0 1 1 0 1 0
24	0 0 0 1 1	A	1 0 0 0 0 0 1 0
25	1 0 0 1 1	W	1 1 1 0 1 0 1 0
26	0 1 0 1 1	J	0 1 0 1 0 0 1 0
27	1 1 0 1 1	FIGS	0 0 0 1 1 0 0 0
28	0 0 1 1 1	U	1 0 1 0 1 0 1 0
29	1 0 1 1 1	Q	1 0 0 0 1 0 1 0
30	0 1 1 1 1	K	1 1 0 1 0 0 1 0
31	1 1 1 1 1	LTRS(delete)	1 1 1 1 1 1 1 0

table 2. Program for 8223 prom, Baudot-to-ASCII figures (U6).

Word	A 4 3 2 1 0	Symbol	B 0 1 2 3 4 5 6 7
0	0 0 0 0 0	Blank	0 0 0 0 0 0 0 0
1	1 0 0 0 0	5	1 0 1 0 1 1 0 0
2	0 1 0 0 0	CR	1 0 1 1 0 0 0 0
3	1 1 0 0 0	9	1 0 0 1 1 1 0 0
4	0 0 1 0 0	Space	0 0 0 0 0 1 0 0
5	1 0 1 0 0	#	1 1 0 0 0 1 0 0
6	0 1 1 0 0	,	0 0 1 1 0 1 0 0
7	1 1 1 0 0	.	0 1 1 1 0 1 0 0
8	0 0 0 1 0	LF	0 1 0 1 0 0 0 0
9	1 0 0 1 0	)	1 0 0 1 0 1 0 0
10	0 1 0 1 0	4	0 0 1 0 1 1 0 0
11	1 1 0 1 0	&	0 1 1 0 0 1 0 0
12	0 0 1 1 0	8	0 0 0 1 1 1 0 0
13	1 0 1 1 0	Ø	0 0 0 0 1 1 0 0
14	0 1 1 1 0	:	0 1 0 1 1 1 0 0
15	1 1 1 1 0	;	1 1 0 1 1 1 0 0
16	0 0 0 0 1	3	1 1 0 0 1 1 0 0
17	1 0 0 0 1	"	0 1 0 0 0 1 0 0
18	0 1 0 0 1	$	0 0 1 0 0 1 0 0
19	1 1 0 0 1	?	1 1 1 1 1 1 0 0
20	0 0 1 0 1	Bell	1 1 1 0 0 0 0 0
21	1 0 1 0 1	6	0 1 1 0 1 1 0 0
22	0 1 1 0 1	!	1 0 0 0 0 1 0 0
23	1 1 1 0 1	/	1 1 1 1 0 1 0 0
24	0 0 0 1 1	-	1 0 1 1 0 1 0 0
25	1 0 0 1 1	2	0 1 0 0 1 1 0 0
26	0 1 0 1 1	1	1 1 1 0 0 1 0 0
27	1 1 0 1 1	FIGS	0 0 0 1 1 0 0 0
28	0 0 1 1 1	7	1 1 1 0 1 1 0 0
29	1 0 1 1 1	8	1 0 0 0 1 1 0 0
30	0 1 1 1 1	(	0 0 0 1 0 1 0 0
31	1 1 1 1 1	LTRS	1 1 1 1 1 1 1 0

If a *LTRS* character must be inserted into the text, transistor Q2, a 2N3641, will be nonconducting so that all bits on the left-hand side of proms U12, U13 will be high, signifying the *LTRS* code. If a *FIGS* character must be inserted into text, Q2 will conduct, making the center bit a zero, which signifies the *FIGS* code.

The ASCII bits are applied to the address lines of 8223 proms U12, U13. Here the ASCII code is translated into the corresponding Baudot code; this data is fed into the two 3351 fifos, U14 and U15. A "data available" pulse at U7-19, delayed by the two 74121 one-shots (U16, U17), appears at the "shift-in" pin of U14 (pin 17). The Baudot characters are thus loaded into the fifo memory.

The fifo memories are necessary because the information from the ASCII machine is fed in at 100 wpm, while the Baudot output from UAR/T U1 is at 60 wpm. When typing, the ASCII speed will exceed 60 wpm only occasionally. However, when the ASCII tape reader runs, the memory will eventually become fully loaded. Because the two fifos can store only 80 characters, the tape reader control circuit, consisting of up-down counter U18, U19, will interrupt current to the tape-reader clutch, holding it until the fifo memory is again empty.

The parallel data at fifo U15 output is applied to UAR/T U1 and appears in serial form at TTL level at U1-25. This signal can be used to key an afsk generator, as described below.

The 555 clocks, U20, U21, will be stable if high-grade components are used. Crystal stability is nice but unncecessary. Precise resistance values have not been given as they may differ from case-to-case, but they can be easily determined with a frequency counter.

Because the equivalent Baudot character for the ASCII space signal is contained in the ASCII-to-Baudot *FIGS* prom, a space signal between words is always preceded and followed by a *LTRS* and *FIGS* signal. This is undesirable because two extra characters will be sent, which are unnecessary. This problem can be resolved by TTL IC U22 which steers U10 (**fig. 1**).

Note that when using the converter with an fsk demoodulator it may be necessary to insert a level changer, inverter, or both between the demodulator and U1-20. The data must enter this point at TTL level. The *Baudot speed* switch (**fig. 1**) allows you to copy signals at speeds other than the amateur speed of 60 wpm.

Pin numbers for the gates in **fig. 1** (type 7400s) have not been given as a new layout will be made for the final version. Except for the proms, the ICs in the Baudot to ASCII section are CMOS devices. These happened to be available, so they were used. The cir-

table 3. Program for 8223 prom, ASCII-to-Baudot letters (U13).

Word	A 4 3 2 1 0	Symbol	B 0 1 2 3 4 5 6 7
0	0 0 0 0 0	Null	0 0 0 0 0 0 0 0
1	0 0 0 0 1	A	1 1 0 0 0 0 0 0
2	0 0 0 1 0	B	1 0 0 1 1 0 0 0
3	0 0 0 1 1	C	0 1 1 1 0 0 0 0
4	0 0 1 0 0	D	1 0 0 1 0 0 0 0
5	0 0 1 0 1	E	1 0 0 0 0 0 0 0
6	0 0 1 1 0	F	1 0 1 1 0 0 0 0
7	0 0 1 1 1	G	0 1 0 1 1 0 0 0
8	0 1 0 0 0	H	0 0 1 0 1 0 0 0
9	0 1 0 0 1	I	0 1 1 0 0 0 0 0
10	0 1 0 1 0	J	1 1 0 1 0 0 0 0
11	0 1 0 1 1	K	1 1 1 1 0 0 0 0
12	0 1 1 0 0	L	0 1 0 0 1 0 0 0
13	0 1 1 0 0	M	0 0 1 1 1 0 0 0
14	0 1 1 1 0	N	0 0 1 1 0 0 0 0
15	0 1 1 1 1	O	0 0 0 1 1 0 0 0
16	1 0 0 0 0	P	0 1 1 0 1 0 0 0
17	1 0 0 0 1	Q	1 1 1 0 1 0 0 0
18	1 0 0 1 0	R	0 1 0 1 0 0 0 0
19	1 0 0 1 1	S	1 0 1 0 0 0 0 0
20	1 0 1 0 0	T	0 0 0 0 1 0 0 0
21	1 0 1 0 1	U	1 1 1 0 0 0 0 0
22	1 0 1 1 0	V	0 1 1 1 1 0 0 0
23	1 0 1 1 1	W	1 1 0 0 1 0 0 0
24	1 1 0 0 0	X	1 0 1 1 1 0 0 0
25	1 1 0 0 1	Y	1 0 1 0 1 0 0 0
26	1 1 0 1 0	Z	1 0 0 0 1 0 0 0
27	1 1 0 1 1	Null	0 0 0 0 0 0 0 0
28	1 1 1 0 0	Null	0 0 0 0 0 0 0 0
29	1 1 1 0 1	CR	0 0 0 1 0 0 0 0
30	1 1 1 1 0	LF	0 1 0 0 0 0 0 0
31	1 1 1 1 1	Null	0 0 0 0 0 0 0 0

table 4. Program for 8223 prom, ASCII-to-Baudot letters (U12).

Word	A 4 3 2 1 0	Symbol	B 0 1 2 3 4 5 6 7
0	0 0 0 0 0	Space	0 0 1 0 0 0 0 0
1	0 0 0 0 1	!	1 0 1 1 0 0 0 0
2	0 0 0 1 0	"	1 0 0 0 1 0 0 0
3	0 0 0 1 1	#	0 0 1 0 1 0 0 0
4	0 0 1 0 0	$	1 0 0 1 0 0 0 0
5	0 0 1 0 1	Null	0 0 0 0 0 0 0 0
6	0 0 1 1 0	&	0 1 0 1 1 0 0 0
7	0 0 1 1 1	'	1 1 0 1 0 0 0 0
8	0 1 0 0 0	(	1 1 1 1 0 0 0 0
9	0 1 0 0 1	)	0 1 0 0 1 0 0 0
10	0 1 0 1 0	Null	0 0 0 0 0 0 0 0
11	0 1 0 1 1	Null	0 0 0 0 0 0 0 0
12	0 1 1 0 0	,	0 0 1 1 0 0 0 0
13	0 1 1 0 1	-	1 1 0 0 0 0 0 0
14	0 1 1 1 0	.	0 0 1 1 1 0 0 0
15	0 1 1 1 1	/	1 0 1 1 1 0 0 0
16	1 0 0 0 0	Ø	0 1 1 0 1 0 0 0
17	1 0 0 0 1	1	1 1 1 0 1 0 0 0
18	1 0 0 1 0	2	1 1 0 0 1 0 0 0
19	1 0 0 1 1	3	1 0 0 0 0 0 0 0
20	1 0 1 0 0	4	0 1 0 1 0 0 0 0
21	1 0 1 0 1	5	0 0 0 0 1 0 0 0
22	1 0 1 1 0	6	1 0 1 0 1 0 0 0
23	1 0 1 1 1	7	1 1 1 0 0 1 0 0
24	1 1 0 0 0	8	0 1 1 0 0 0 0 0
25	1 1 0 0 1	9	0 0 0 1 1 0 0 0
26	1 1 0 1 0	:	0 1 1 1 0 0 0 0
27	1 1 0 1 1	;	0 1 1 1 1 0 0 0
28	1 1 1 0 0	Null	0 0 0 0 0 0 0 0
29	1 1 1 0 1	Null	0 0 0 0 0 0 0 %
30	1 1 1 1 0	Null	0 0 0 0 0 0 0 0
31	1 1 1 1 1	LTRS	1 0 0 1 1 0 0 0

cuit should work just as well with TTL devices. **Fig. 2** shows socket connections for the devices.

The circuit in **fig. 3** makes programming a cinch as the burn-out time is automatically determined by the 74121 one-shot, U1. The time is fixed at 150 milliseconds. Programming must be done carefully, while you're wide awake, or mistakes are bound to occur! The +15 and +5-volt leads must be connected to a regulated power supply that provides at least 1 ampere. Proceed as follows:

1. With the power supply shut off, insert the 8223 to be programmed into its socket.

2. Set S2B to *BURN*.

3. Set address switches S3-S7 and output switch S8 according to the program pattern for the first bit.

4. Switch on the power supply and depress S1.

5. Set S3-S7 and S8 to the next bit and depress S1. Continue this procedure, bit-by-bit, until the entire pattern is programmed into the chip. You can test the programming by setting S2 to *TEST*. Go through the entire pattern again, using switches S3-S7 and S8. The LED will illuminate for a 1 and remain dark for a zero. If the test yields the desired pattern your 8223 is ready for use.

Four 8223s are necessary for the Baudot-to-ASCII conversion and vice versa. For more information on the makeup of the programming pattern, see reference 3. An article describing a memory for automatic CW identificaton using an 8223 prom can be found in reference 4.

In **tables 1-4** you'll find one program for each of the four proms used in the code converter. The *A* column determines the prom address line switch positions, while the *B* column determines the switch positions of the prom outputs.

example

To program the letter *Y* into the prom that translates Baudot to ASCII letters (**table 1**), proceed as follows:

1. Set switches S2A-B to *TEST* and set the prom output line-selector switch, S8, to *B0*.

2. Look up the letter *Y* on the program (**table 1**).

3. Set the address line switches, S3-S7 (**fig. 3**) according to the information in the table: *A4* = high; *A3* = low; *A2* = high; *A1* = low; and *A0* = high — i.e., 10101. (Low is ground and high is +5 volts.)

4. Set switches 2A-B to *BURN*.

5. Set the prom output line switch to *B0* (a 1 in this case), then depress switches S1A-B.

6. Advance the output line selector switch to *B3*, picking up another 1.

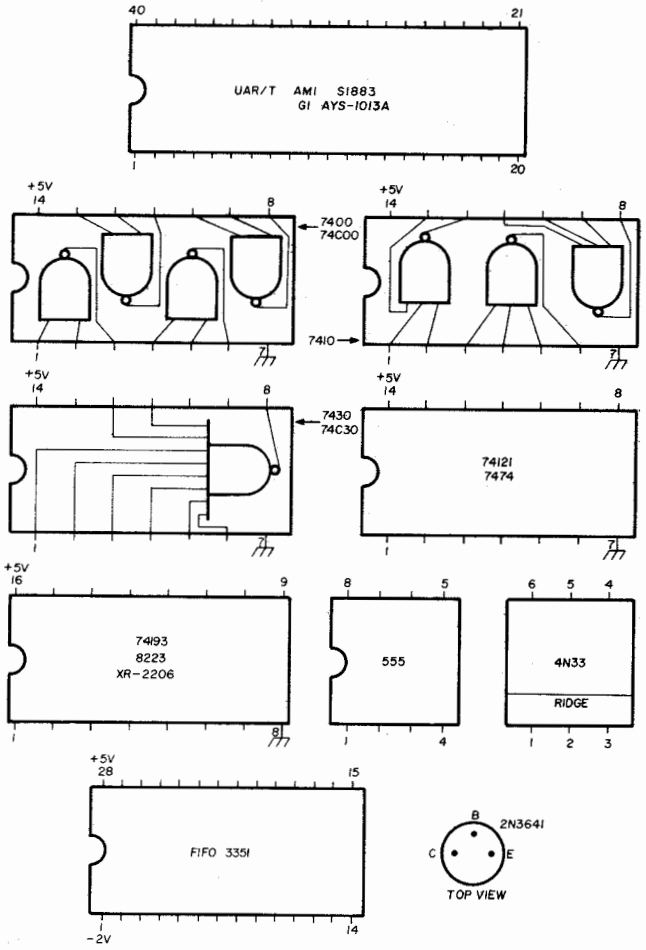


fig. 2. Socket connections (top view) for the devices used in the converter.

7. Press switches S1A-B again.

8. Repeat the procedure at *B4* and *B6*, picking up a 1 in each case.

9. Set switches S2A-B to *TEST*. With S8 in *B0*, *B3*, *B4*, and *B6* positions, the LED should light, indicating a 1; in positions *B1*, *B2*, *B5*, and *B7* it should remain dark, indicating a low, or zero. Should one of the prom fuses refuse to open at the first attempt at testing, try burning it repeatedly.

Start the programming from the top of the table and work down,. When you have one prom fully programmed, go through the check procedure with switches S2A-B in the *TEST* position to verify that the fuses have opened according to the program in use. If the prom checks out okay, mark it for identification.

Type 82S23 proms are presently offered on the surplus market at a reasonable price. These can also be used, but to program these devices the 390-ohm ½-watt resistor at the top contact of S2A (**fig. 3**) must be changed to 4.7 ohms ½-watt, and the +15-volt supply must be increased to 16 volts.

In reference 5, I pointed out the importance of phase-continuous frequency shift to prevent transients, which can cause interference on adjacent channels. I described a rather commplex circuit of an afsk generator that featured phase continuity of the sine-wave output when keyed.

In the meantime integrated circuits have appeared on the market especially designed for waveform generation. One of these, the EXAR XR-2206 CP, is particularly interesting for RTTY. Pin 9 of this IC can be directly connected to pin 25 of U1, **fig. 1**, of the Baudot-to-ASCII/ASCII-to-Baudot converter. The output at pin 2 of the XR-2206 can then be used to modulate an ssb transmitter or transceiver with a phase-continuous afsk signal.

The afsk circuit (**fig. 4**) is extremely simple. The sine-wave frequency is determined by the value of C1 and the total resistance connected to either pin 7 or 8 of the XR-2206. When pin 9 is high pin 7 is active; when pin 9 is low pin 8 is active.

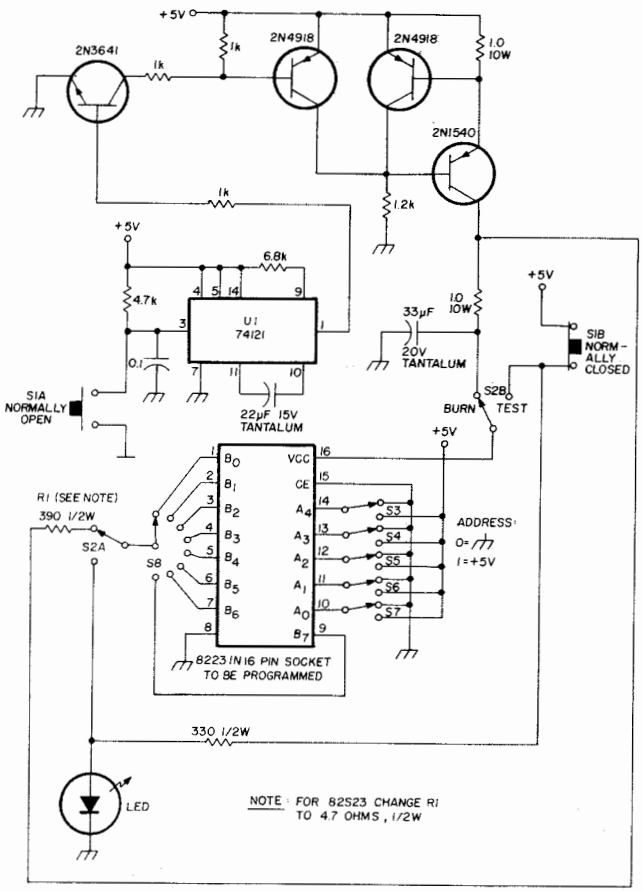


fig. 3. Circuit for programming the 8223 proms.

For excellent frequency stability, C1 should be a polystyrene (Phillips 295 AA/C 8K2) or a Mylar capacitor. The frequency-determining resistors should be carbon film; or better yet, metal film types.

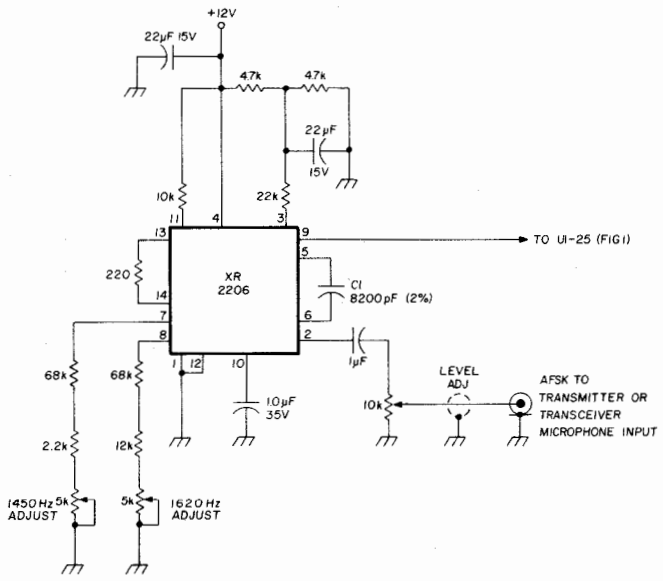


fig. 4. AFSK generator. Phase-continuous frequency shift is featured to prevent out-of-band transients. Sine-wave frequency is determined by C1 and the total resistance connected to either pin 7 or 8 of the XR2206.

The afsk-generator audio frequencies of 1620 and 1450 Hz were chosen to put the second harmonic outside the passband of modern ssb equipment and to eliminate the need for special carrier-frequency crystals in such equipment.

The overall converter system can be tested by feeding data from a Baudot keyboard or tape reader to U1-20 (**fig. 1**). As the output and input of U7 are a closed loop through the two 4N33 optoisolators, U8 and U9, the data is fed back to U1, and its output at pin 25 can be used to operate the printer magnets of the Baudot machine through a suitable driver. In this case, the Baudot data is converted to ASCII, then back to Baudot. The only character not translated from ASCII to Baudot is the bell signal. With additional gates this could be accomplished, but I felt that the additional complexity was unjustified.

acknowledgement

I'd like to thank my friend, Paul Hudson, VE3CWA, for suggestions in preparing this article.

references

1. J. A. Titus, "The UAR/T and How it Works," *ham radio*, February, 1976, page 58.
2. P. E. Field et al, "Microcomputer Interfacing: a Software UAR/T," *ham radio*, November, 1976, page 60.
3. R. D. Pascoe, "How to Program Read-Only Memories," *Popular Electronics*, July, 1975, page 27.
4. L. Nurse, W6LLO, "CW Memory for RTTY Identification," *ham radio*, January, 1974, page 6.
5. E. Kirchner, VE3CTP, "Continuous-Phase Audio-Shift Keyer for RTTY," *ham radio*, October, 1973, page 10.

ham radio

SECTION 4

PRINCIPLES OF OPERATION

1. INTRODUCTION.

This section contains the principles of operation Teletypewriter Set AN/TGC-14(V). Paragraph 2 describes the overall functioning of the equipment in its three modes of operation; paragraph 4-3 describes the electrical and mechanical theory of each functional section of the teletypewriter set.

2. OVERALL FUNCTIONAL DESCRIPTION.

a. GENERAL. — Figure 4-1 is a simplified block diagram showing the functional arrangement of the major assemblies of the teletypewriter set. For operation on a-c primary power, a-c service cable 1A5, a-c signal line power supply 1A4, and a-c line sensor 1A3 are employed. For d-c operation, these assemblies are replaced by d-c service cable 1A8, d-c signal line power supply 1A7, and d-c line sensor 1A6.

b. OVERALL OPERATION. — Electrical chassis 1A1 serves to route the incoming and outgoing signals and to distribute primary power to the appropriate assemblies. For operation on either type of input power, the purpose of the a-c or d-c signal line power supply is to furnish a d-c signal line current source with a floating ground. For the transmission of intelligence, Keyboard TT-318/UG (1A9) functions as a switching device for the output of the signal line power supply. This output may be of either positive or negative polarity, since the teletypewriter set is not polar-sensitive. Depressing a key or the space bar establishes a mechanical code which is converted into a coded motion of pulsing contacts. The output of these contacts is a coded pulse train which is routed through the electrical chassis to either the line sensor or to the send line.

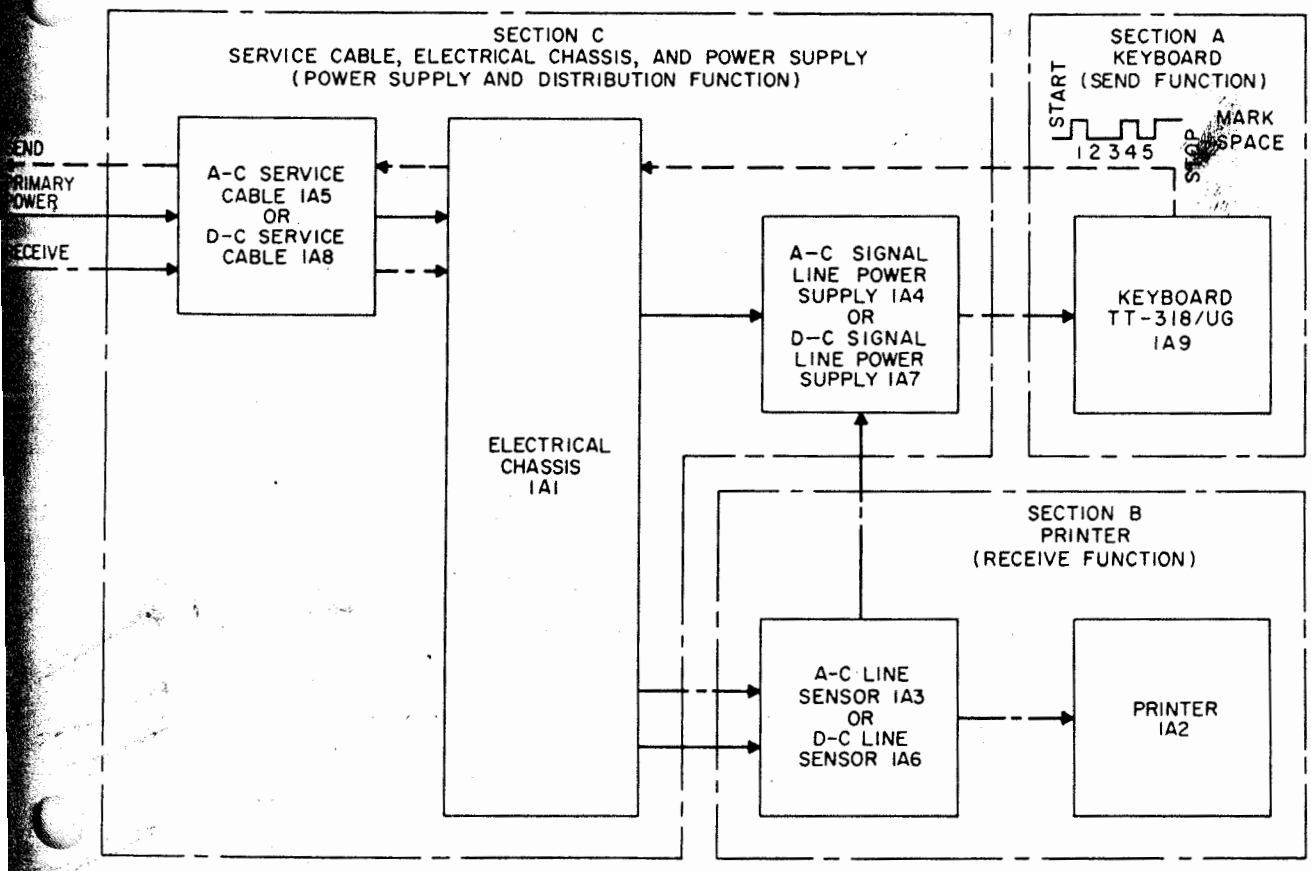


Figure 4-1. Teletypewriter Set AN/TGC-14(V), Functional Sections

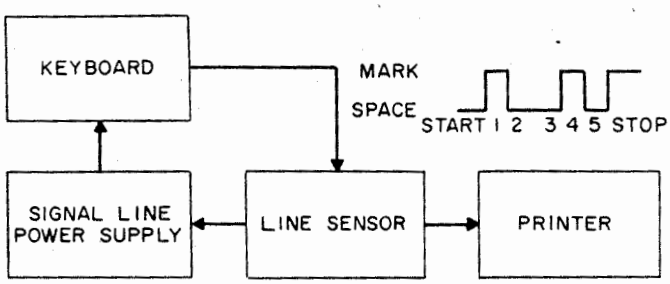


Figure 4-2. Off-Line Local Mode, Functional Block Diagram

The coded pulse train shown in figure 4-2 represents the letter D. This letter has a signal code combination of space (no-current) pulses on start, 2, 3, and 5 and mark (current) pulses on 1, 4, and stop. For further information on the signal code combinations, refer to figure 1-2.

Upon receipt of a signal, the line sensor functions as an electronic switch and switches the start pulse, the five intelligence pulses and the stop pulse in sequence to a magnetic selector in printer 1A2. The magnetic selector converts the intelligence pulses into mechanical functions to operate a system of clutches on the printer mainshaft. These clutches operate cams and linkages to perform all mechanical and printing functions to reproduce the received intelligence.

When the pulse train ceases, a steady mark pulse will remain while the signal is applied to the equipment and the signal loop remains closed. Under this steady mark condition, the printer does not perform any mechanical functions and operates in a closed condition. However, if the signal loop is opened and a steady space condition exists, the printer will run open and will appear to be performing, except for printing.

The following paragraphs describe the overall operation of the teletypewriter set in each of three modes of operation.

c. OFF-LINE LOCAL MODE. — In off-line local mode (figure 4-2), the teletypewriter set functions as an electric typewriter and requires no connection to external equipment. The signal line power supply, keyboard, and line sensor of the local machine are connected in series to form a closed signal loop. The signal line power supply furnishes d-c current for the signal loop.

d. HALF-DUPLEX MODE (SIMPLEX). — In half-duplex mode (figure 4-3), the functional units of both sending and receiving teletypewriter sets are all connected in series. The same signal loop is used for both machines, making it impossible to send and receive simultaneously. Figure 4-3 shows only two machines, but additional teletypewriter sets may be connected into the signal loop provided line current requirements do not exceed the capabilities of the signal line power supply.

When the local operator is sending, d-c current flows through the signal loop which includes the input resistance of the remote line sensor, the closed and inactive remote keyboard pulsing contacts, the local line sensor, and the signal line power supply. Both the local and remote printer

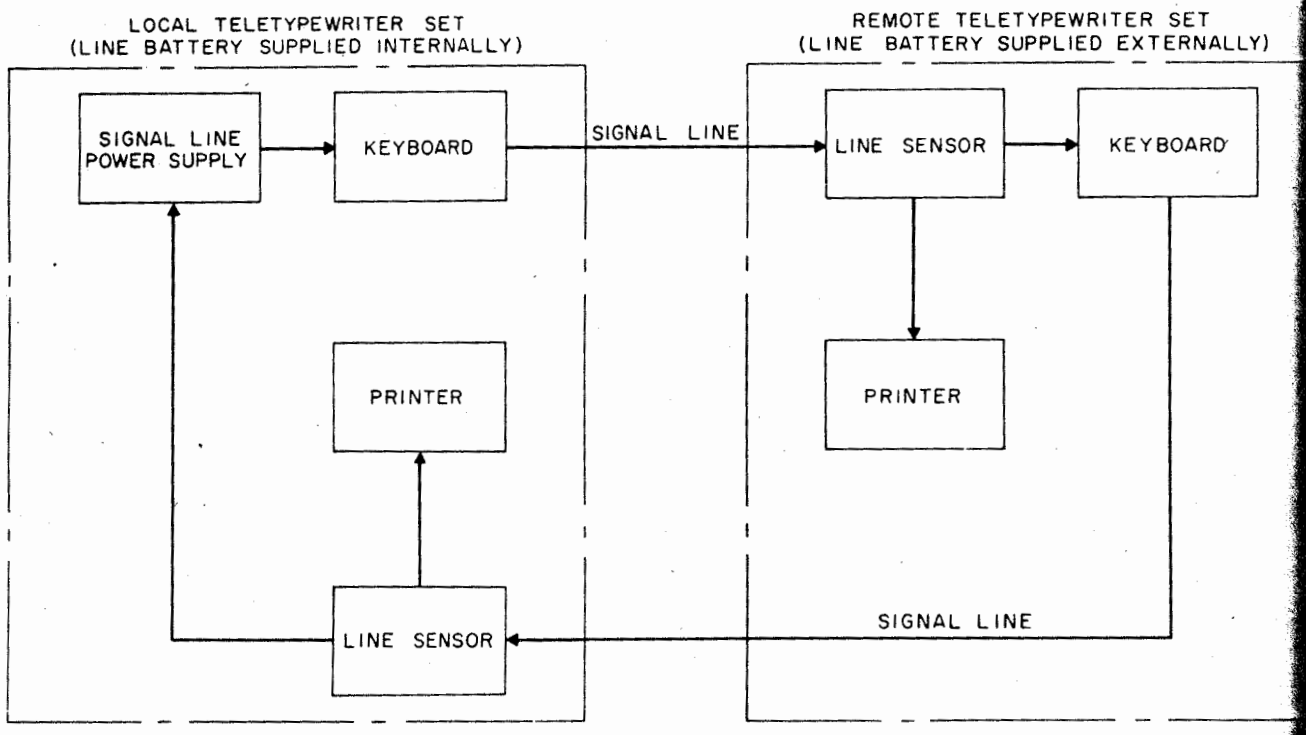


Figure 4-3. Half-Duplex Mode, Functional Block Diagram

ill print a copy of the message. A similar signal op is followed when the remote operator is sending. ach keyboard has a BREAK switch connected in eries with the signal loop. This switch is normally sed to signal the remote operator to stop sending. the BREAK switch is used, the signal loop will be pened. Both machines will then run open, as indi- ted by an interruption in printed copy. In addition the BREAK switch, each keyboard has a SEND• EC-REC switch. With the switch in the SEND•REC osition, the keyboard pulsing contacts are connected series with the signal loop and permit either send- or receiving. With the switch in the REC posi- on, the keyboard pulsing contacts and the BREAK itch function are both shorted out, resulting in a losed signal loop. Under this condition, the tele- pewriter set will function as a receive-only printer.

e. FULL-DUPLEX MODE. — Full-duplex mode eration (figure 4-4) requires two separate signals ops and permits simultaneous sending and receiv- g. Since each keyboard is operated independently its printer, no home copy of the message is avail- le. Operation of the equipment in sending and re- ving is essentially the same as operation in half- plex mode except that the depression of a BREAK itch will open only one signal loop.

3. FUNCTIONAL SECTIONS.

a. INTRODUCTION. — The operation of the indi- ual functional sections forming the teletypewriter set is described in the following paragraphs. The arrangement of these descriptions approximates the signal path through the equipment: signal line power supply, keyboard, line sensor, and printer. To allow ease of reference, however, each assembly is described independently.

b. A-C SIGNAL LINE POWER SUPPLY 1A4. — A-c signal line power supply 1A4 (figure 4-5) functions as a source of d-c signal line current for the operation of the local keyboard or as an external signal line current source for other equipment requiring currents not exceeding 100 milliamperes at 26 vdc and a floating ground. The input to the power supply is 115 vac, either 60 or 400 cps, single-phase. The power supply consists of a power transformer capable of operating on either 60 or 400 cps, a conventional full-wave bridge rectifier, and a resistance-capacitance filter network. With the exception of transformer T1, the components are mounted on a printed-circuit board. Power transformer T1 is a step-down transformer applying 33 vac across the rectifier formed by diodes CR1 through CR4. After filtering, the output voltage across bleeder resistor R2 is 26 vdc at 100 milliamperes of load current. The negative side of the power supply is returned through the outside signal loop (when used) through LINE ADJUST control 1A1R2. This control is used to adjust the signal line current.

c. D-C SIGNAL LINE POWER SUPPLY 1A7. — D-c signal line power supply 1A7 (figure 4-6) converts 26 vdc, negative ground to 26 vdc, floating ground at 100 milliamperes load current. The

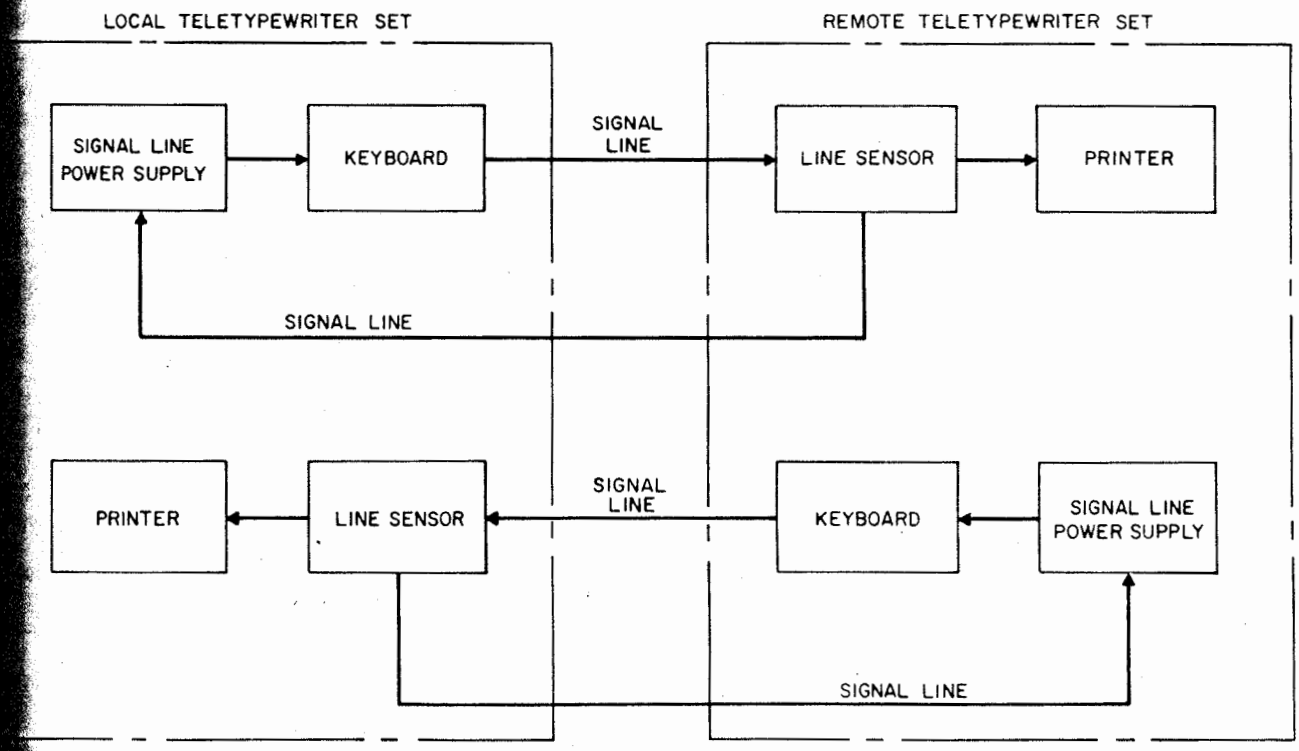


Figure 4-4. Full-Duplex Mode, Functional Block Diagram

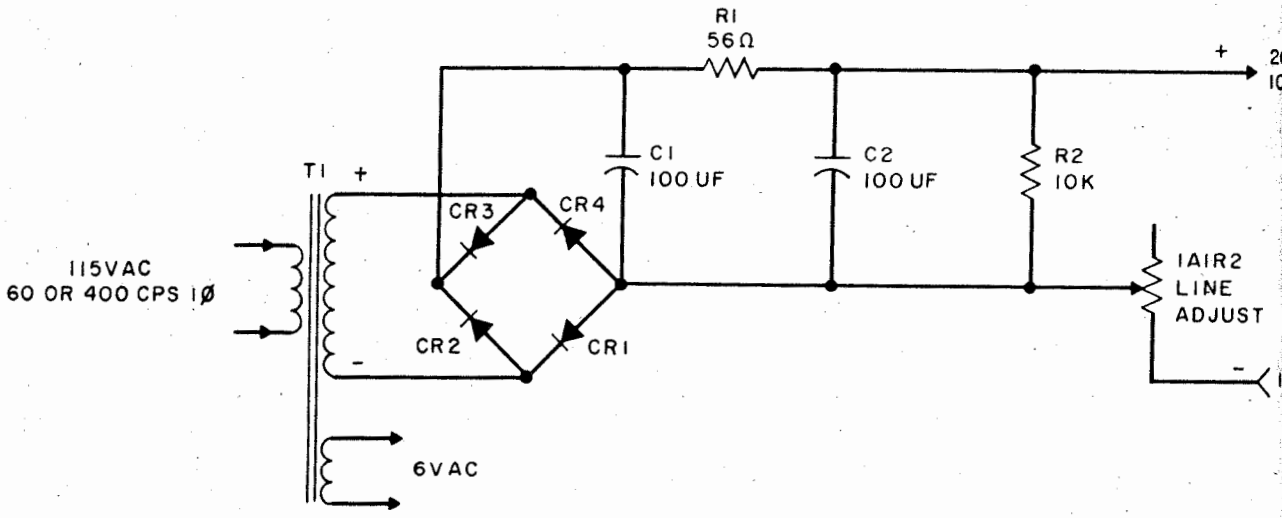


Figure 4-5. A-c Signal Line Power Supply 1A4, Simplified Schematic Diagram

unit is a multivibrator type of transistor switching circuit operating at a frequency of approximately 2000 cps. Through switching action, it converts the d-c input voltage to 2000 cps ac, which is then rectified by a full-wave bridge rectifier.

The transistorized d-c switching circuit resembles a blocking oscillator but is a multivibrator. The collectors of two PNP transistors are connected to center-tapped transformer primary winding A, and the base of each transistor is connected to center-tapped transformer feedback winding B. The emitters are common and are held at a negative bias with respect to the base by diode CR5. Due to the feedback winding, one transistor will be conducting with the other transistor cut off and will remain in this state as long as collector current through half of primary winding A continues to rise. When the transformer core becomes saturated and can no longer supply a drive signal to the conducting transistor, the two transistors switch state. The conducting transistor is cut off, and the other transistor is driven into conduction. This change of state is continuous and repetitive, producing an essentially square waveform at the collectors.

For a detailed analysis, assume that the base of Q2 is driven positive momentarily. A positive signal on the base of Q2 will decrease the collector current flowing through the lower half of transformer winding A and cause the voltage at the collector to approximate the supply voltage (-26 vdc). Through the transformer feedback winding which is on the same core as the primary winding, a negative-going pulse will be applied to the base of transistor Q1. Since this negative voltage acts to increase the forward bias between the base and emitter of Q1, the collector current will increase and the voltage at the collector of Q1 will be less negative. The developed signal will drive the base of Q2 more positive, thereby aiding the initial positive signal in cutting off the transistor. This condition will continue with the current through Q1 increasing until Q2 is completely cut off or until the transformer reaches the saturation point. Whe this point is reached, the base of transistor Q1 will no longer receive a negative pulse from the feedbac winding and the current through Q1 will start decreasing. This will develop a negative pulse on the collector of Q1, which when applied to the base of transistor Q2, will drive Q2 into conduction. As a result, the base of Q1 will receive a positive pulse driving it to cutoff. In this fashion, switching cont is passed back and forth between Q1 and Q2. Frequency of oscillation is determined by the inductanc of the transformer and the supply voltage. The 200 cps voltage developed by the switching transistors applied through the secondary winding of transform T1 to diodes CR1 through CR4, which constitute a full-wave rectifier. Since the frequency of the pow supply voltage is 2000 cps, only a single capacitor required for filtering. Diode CR5 prevents any polarity reversal on the input from damaging the transistors.

d. KEYBOARD TT-318/UG(1A9).

(1) MECHANICAL FUNCTIONS. — Keyboard TT-318/UG(1A9) (figure 4-7) consists of a keyboard drive gear (coupled to the printer motor), a drive shaft which rotates continuously as long as the moti power is applied, a clutch mechanism coupled to a of five code pulsing cams, code pulsing contacts, a a set of five code bars which set up the mechanical code appropriate to the selected character or functi

The clutch, which is mounted on the drive shaft (figure 4-7), consists of two housings, a cage, four rollers, two bias compression springs, and two spacers. The housings and the cage are connected by four rivets and two spacers so that the housings are rigidly connected and the cage is free to rotate approximately 20 degrees around the drive shaft in relation to the housings. Bias compression springs between the cage and the spacers separating the housings bias the housings in the direction of clutch travel. The four rollers pass through the four slots in the cage and both housings. The slots in the cage fit snugly around the rollers and permit the rollers

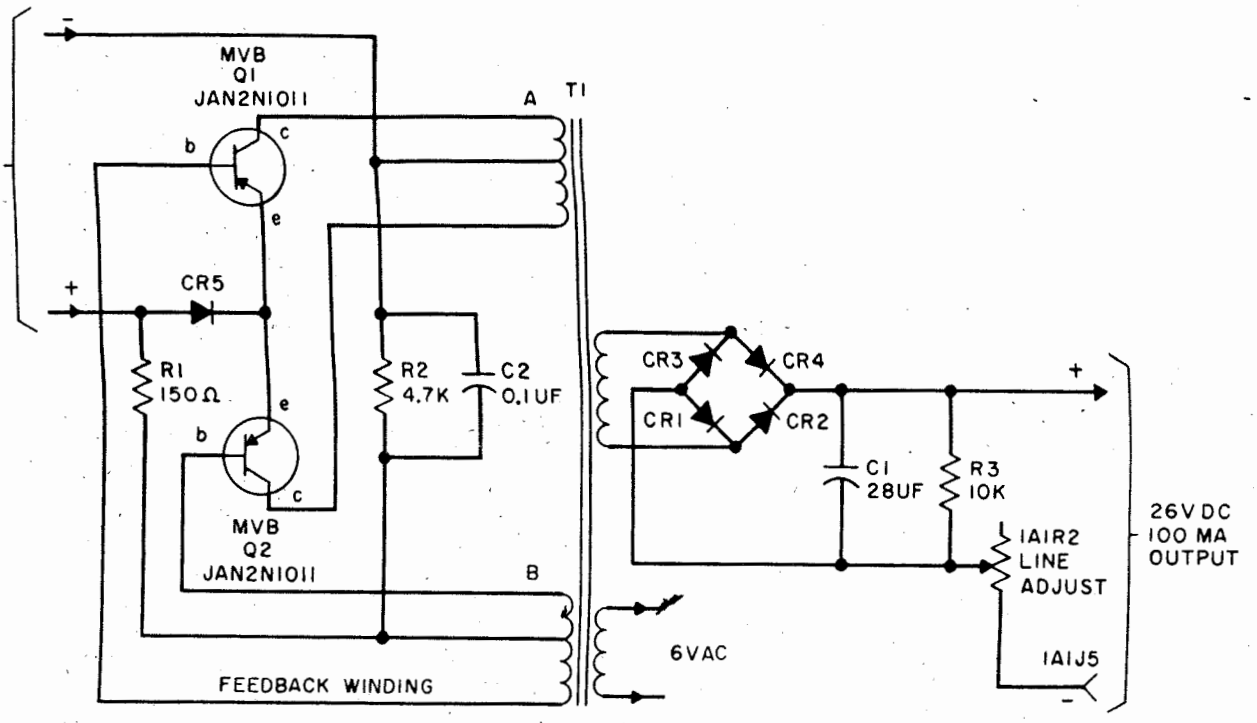


Figure 4-6. D-c Signal Line Power Supply 1A7, Simplified Schematic Diagram

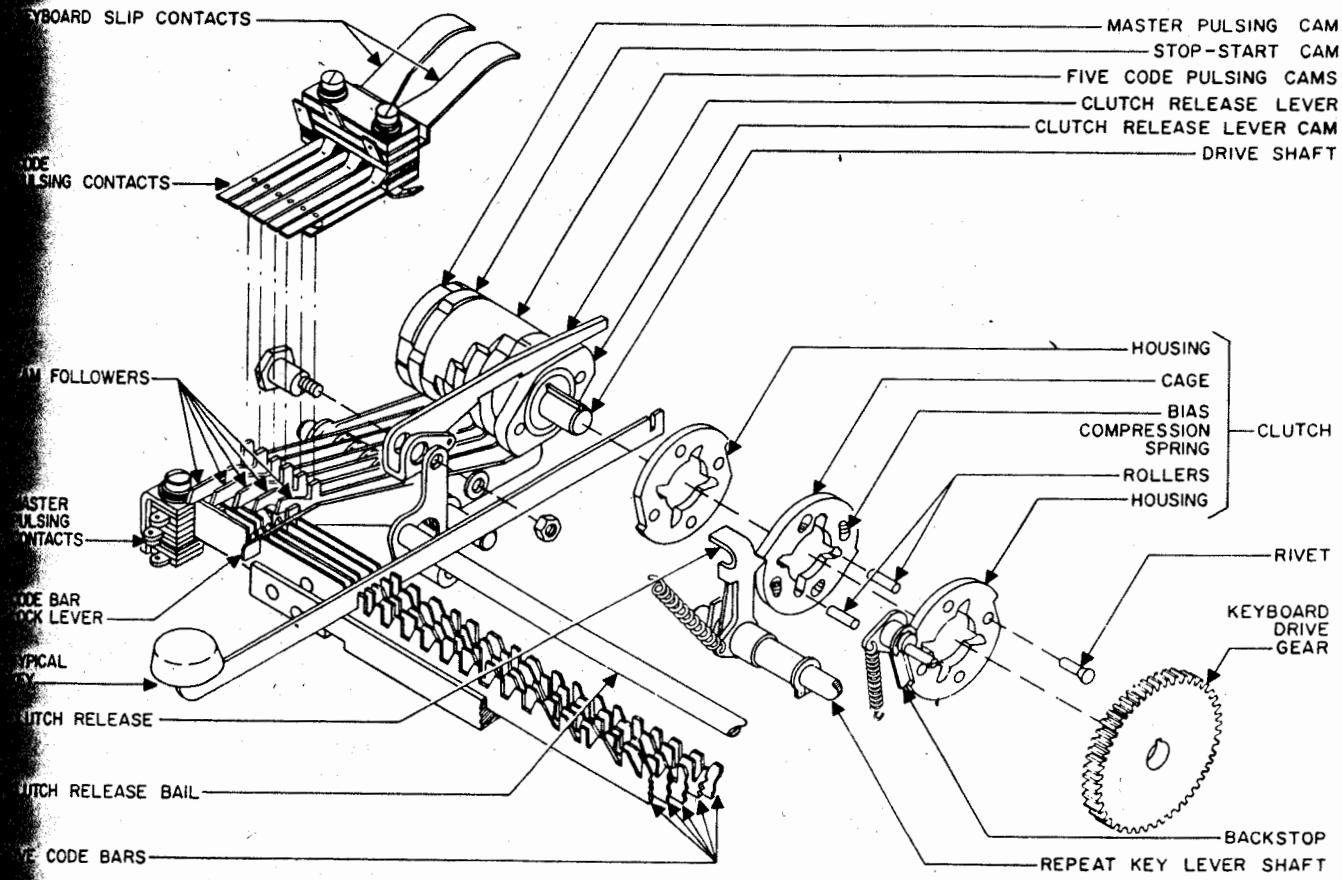


Figure 4-7. Keyboard TT-318/UG (1A9), Mechanical Diagram

to travel the length of the slots. The ends of the slots in the housings contain close-fitting sloped surfaces which, when the clutch is engaged, restrict the motion of the rollers in such a manner as to force the rollers against the drive shaft.

When the clutch release disengages the stop tab on the cage, the cage is moved forward by the bias compression springs. This motion cams the rollers down on the drive shaft and the clutch rotates with the drive shaft. This initial camming action is reinforced by the jamming action exerted on the rollers by the sloped surfaces in the housing slots. The clutch will rotate 180 degrees until one of the cage stop tabs engages the clutch release. At this point, the forward motion of the cage will be stopped and the camming and jamming action of the rollers against the drive shaft will cease, resulting in the clutch being disengaged.

At the instant the cage is halted by the clutch release, the bias compression springs will tend to push the housings backward, thus reestablishing the camming effect. If unrestrained, this backward motion will result in the clutch chattering. Consequently, backstops are provided to prevent any backward motion of the clutch.

Depressing a keyboard key or space bar moves the five separate code bars (figure 4-7) according to the alignment of a particular set of Baudot-code slots into which the key drops and moves the clutch release bail downward. As the clutch release bail moves, it pulls the clutch release toward the front of the keyboard. The clutch release, which is engaged with the cutout in the clutch release lever, is then moved away from the stop tab on the cage, allowing the clutch to become engaged and to begin rotating the pulsing cam nest. The clutch release lever cam rotates and raises the clutch release lever. This movement pulls the spring connected between the clutch release lever and the clutch release, thereby holding the finger close to the surface of the cage as the cage rotates.

During this time, motive power is also applied to the five code pulsing cams, the stop-start cam, and the master pulsing cam. The first motion of the cams releases the code bar lock lever, which falls into one of two adjacent slots in each code bar, locking the code bars in place during the character or function generating cycle. The five-level code set up by the code bars is converted into a pulse train by five code pulsing cams, five cam followers, and five sets of code pulsing contacts. The stop-start cam actuating another set of pulsing contacts through a cam follower, signals the beginning and end of the character transmitting cycle.

The code pulsing contacts are connected in series with the signal loop through the keyboard slip contacts. When the stop-start cam follower moves downward, the associated stop-start pulsing contacts are closed resulting in a steady mark condition. Rotation of the stop-start cam at the beginning of the character cycle causes the stop-start cam follower to open the code pulsing contacts and transmit a start or space pulse. Rotation of the five code pulsing cams acts on the associated cam followers which actuate the five code pulsing contacts. Some of the code bars extend under the cam follower extensions and may stop the extension from dropping, depending upon the positioning of a code bar under the cam follower. When a code bar does not restrict the downward motion of a cam follower, the associated set of code pulsing contacts is closed and transmits a mark pulse. The blocking of a cam follower by a code bar holds the set of code pulsing contacts open, causing a space pulse to be transmitted. The cam follower normally holds the pulsing contacts open except when the cam follower drops into the cam for a mark pulse.

Under normal conditions, the six sets of code pulsing contacts (stop-start pulses and five intelligence pulses) would require careful adjustment as the result of switching high signal line current. To remedy this, a set of master pulsing contacts is provided. These contacts comprise a single-pole, double-throw switch which is alternately switched from one side to the other by the master pulsing cam follower and master pulsing cam. When the switch is in the first position, the code pulsing contacts used for transmitting the stop-start, 2, and 4 pulses are connected in the circuit; in the other switch position, the pulsing contacts used for transmitting pulses 1, 3, and 5 are switched into the circuit. The gap through which the master pulsing contacts oscillate is adjusted to obtain the effect of simultaneously switching one circuit out and the other circuit in. In this manner, the six individual code pulsing contacts handle a minimum amount of current with the master pulsing contacts switching the greater amount, since the six individual pulse contacts close early and open late. The effect of this arrangement is to have six code pulsing contacts determine the presence or absence of a code pulse while the master pulsing contacts oscillate between the stop-start, 2, and 4 circuit and the 1, 3, and 5 circuit, accurately timing the duration of pulses in each circuit.

As the 180 degrees of clutch rotation ends, the code bar lock lever is moved out of the code bar slots by the clutch release lever cam and the clutch is disengaged by the stop tab on the cage engaging the clutch release. If the REP (repeat) key is depressed, the clutch release will be held back from engaging the cage by the action of the repeat key lever shaft. As a result, the clutch will remain engaged and apply motive power to the code pulsing cams, retransmitting the last code combination set up on the code bars. This cycle will be repeated continuously as long as the repeat key is held down.

(2) ELECTRICAL FUNCTIONS. (See figure 4-8.) — The keyboard circuit is shown with conta

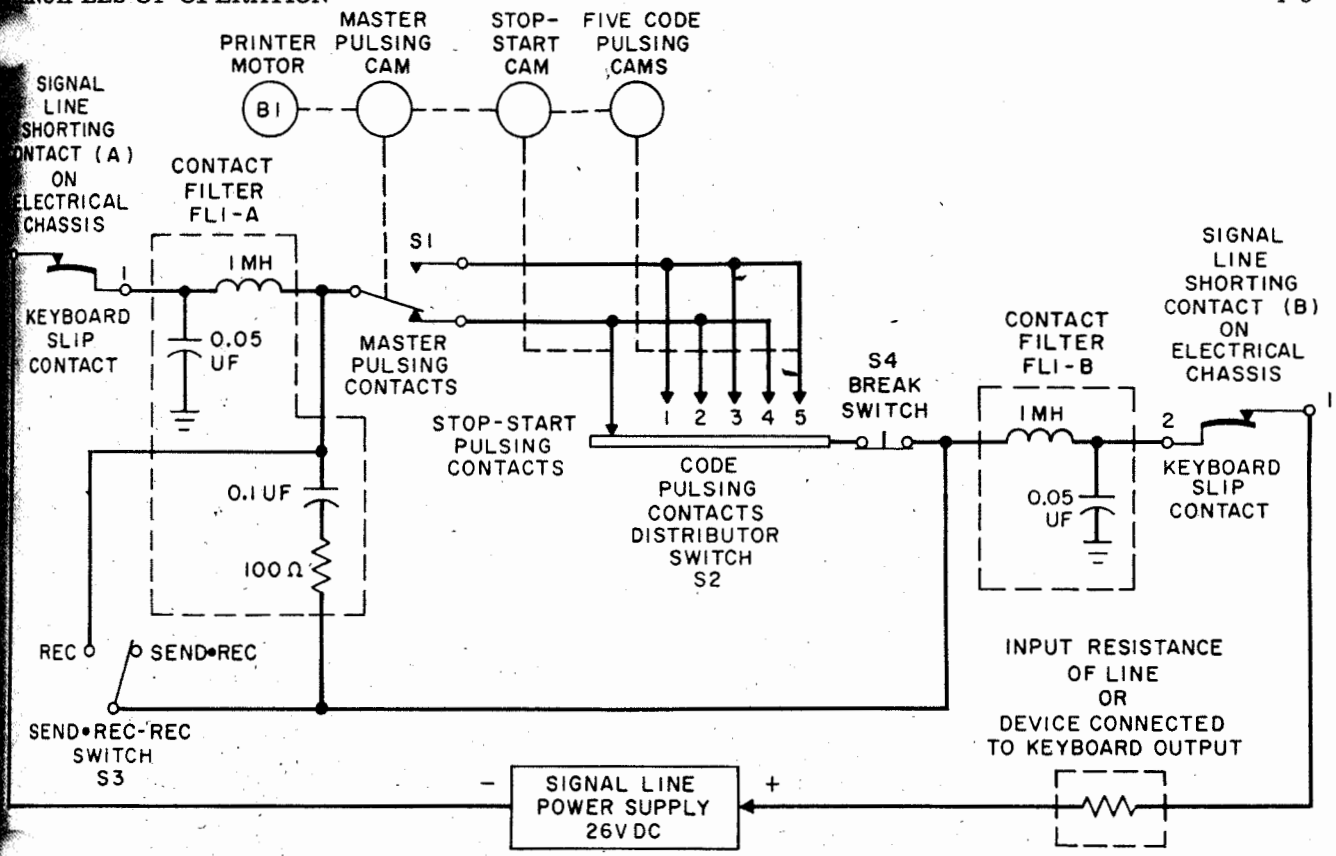


Figure 4-8. Keyboard TT-318/UG(1A9), Simplified Schematic Diagram

ilter FL1 separated into two filter sections. In addition, the keyboard slip contacts and the chassis-mounted signal line shorting contacts are also shown separated. As shown in figure 6-85, the keyboard slip contacts and the automatic signal line shorting contacts are so constructed as to close the signal loop when the keyboard is not in the operating position, thus preventing the loop from remaining open.

In this circuit, the signal loop is completed from the negative side of the signal line power supply, through signal line shorting contact (A), keyboard slip contact, contact filter FL1-A, master pulsing contacts S1, distributor switch S2, BREAK switch S4, line filter FL1-B, keyboard slip contact, signal line shorting contact (B), and through the input resistance of the line or load device back to the signal line power supply. Although the signal line power supply is connected as shown for developing a current that flows in the direction shown, it may be connected so that current flows in the opposite direction, dependent upon the option patching arrangement.

The contact filter is used to suppress arcing across the switching contacts and to minimize interference with nearby radio equipment. The master g contacts are used to switch current between t of pulsing contacts that develops stop-start, , and 4 pulses, and the set of contacts for 1, 3, and pulses. The BREAK switch is connected in series with the switching circuit and if depressed will open the signal loop, interrupting transmission. The SEND•REC-REC switch is connected across the master pulsing contacts, code pulsing contacts, and the BREAK switch. When this switch is in the SEND•REC position, the operator may either send or receive, since the code pulsing contacts are in the circuit to be used as required. In the REC position, the pulsing contacts and the BREAK switch are shorted out, resulting in a closed signal loop, effectively shorting out the output of the keyboard.

e. LINE SENSORS 1A3 and 1A6. — The teletypewriter set may be operated with either a-c line sensor 1A3 or d-c line sensor 1A6. Each line sensor comprises a direct-coupled, transistorized electronic switch and differs from the other only in the type of internal power supply employed. A-c line sensor 1A3 uses an internal power supply identical in all respects to the circuit described in paragraph 4-3b for a-c power supply 1A4. The power supply used in d-c line sensor 1A6 is identical to d-c power supply 1A7. Both line sensors are of the printed-circuit type. The circuit discussions that follow are applicable to both line sensors.

(1) BLOCK DIAGRAM DISCUSSION. (See figure 4-9.) — The line sensor consists of a semiconductor diode bridge to orient the polarity of the signal to a transistor functioning as a switch, a space coil power amplifier transistor to energize the space solenoid coils on the magnetic selector, and a mark coil power amplifier transistor to energize the mark

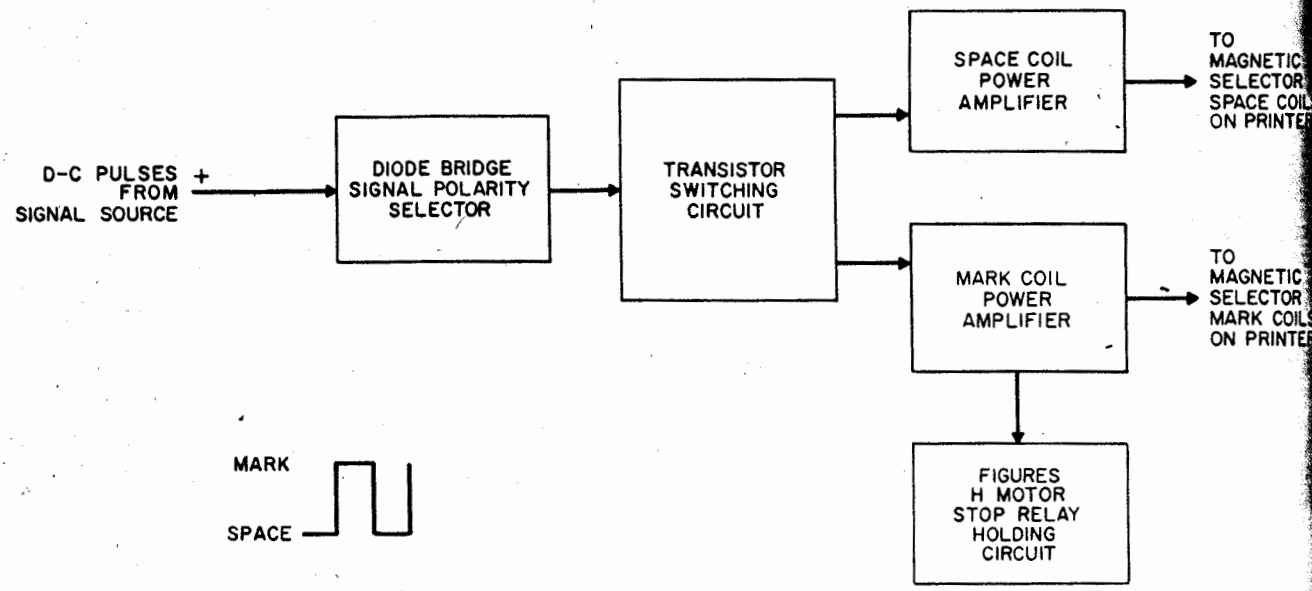


Figure 4-9. Line Sensor 1A3 and 1A6, Functional Block Diagram

solenoid coils on the magnetic selector and to act as a holding circuit for the figures H motor stop function.

The semiconductor diode bridge receives d-c pulses (either positive or negative polarity) from a signal source connected in the signal loop and orients the pulse polarity such that only negative pulses appear at the base of a PNP transistor functioning as a switch in controlling current to the space and mark power amplifier transistors. During a spacing condition (absence of a signal), the space coil transistor conducts, energizing the magnetic selector space coils in the printer; during a marking condition (presence of signal), the mark coil transistor conducts and energizes the magnetic selector mark coils. (The magnetic selector is mounted on the printer and has the function of converting the control current into the mechanical motions required for selecting various printing functions.) The mark transistor also sets up a holding circuit for a relay when the STOP key is depressed.

(2) SIMPLIFIED SCHEMATIC DIAGRAM DISCUSSION. (See figure 4-10.) — Figure 4-10 illustrates the line sensor circuit condition when receiving the letter R. The letter R pulse train consists of spacing pulses (absence of signal and no current) on start, 1, 3, and 5 and marking pulses (presence of signal and current) on 2, 4, and stop.

Current flow from the signal line power supply is through diode CR3, through the emitter and base circuit of transistor Q1, through diode CR2, and through the keyboard back to the negative side of the power supply. Diodes CR1 and CR4 present an open circuit to current flow. If the signal polarity is reversed (positive mark pulses), current will flow through the keyboard and diode CR1, through the emitter and base circuit of transistor Q1, and through diode CR back to the signal line power supply.

The base input circuit of transistor Q1 contains shorting strip which can be positioned to shunt eithe 100-ohm resistor R1 across the input circuit for the 20 to 80-ma input current range or 5600-ohm resistor R2 for the 1 to 5-ma range. Resistors R1 and R shunt portions of the signal current, thereby reduci the input resistance of the circuit. When the shorti strip is positioned for the high range (20 to 80 ma), the line sensor has an input resistance of 125 ohms 60 ma. When positioned for the low range (1 to 5 m the input resistance is 2500 ohms at 5 ma. (This shorting strip is accessible when the line sensor metal cover is removed.) To avoid transistor damage through application of excessive signal current, zener diode CR5 will effectively shunt any excessive signal current and voltage level above 12 volts. In addition, this zener diode protects transistor Q1 against any transients or spikes caused by radio or other interference.

After the input signal is attenuated, it is applied as forward base bias to transistor Q1. The collecto of this transistor is coupled to the base of power amplifier Q3 through resistor R5. The emitter is directly coupled to the base of power amplifier Q2. T base of transistor Q1 normally is held at cutoff by t positive voltage (reverse bias) received through resistor R3 and the attenuator network. With a mark signal applied (negative pulse), the negative signal current is sufficient to drive the transistor into saturation. The large collector current flowing throug resistor R4 causes the negative voltage at the junction of resistors R4 and R5 to decrease (become mo positive), resulting in a more positive voltage applie to the base of power amplifier Q3. Since this voltag is applied as reverse base bias, power amplifier Q3 which is normally held near cutoff by reverse base

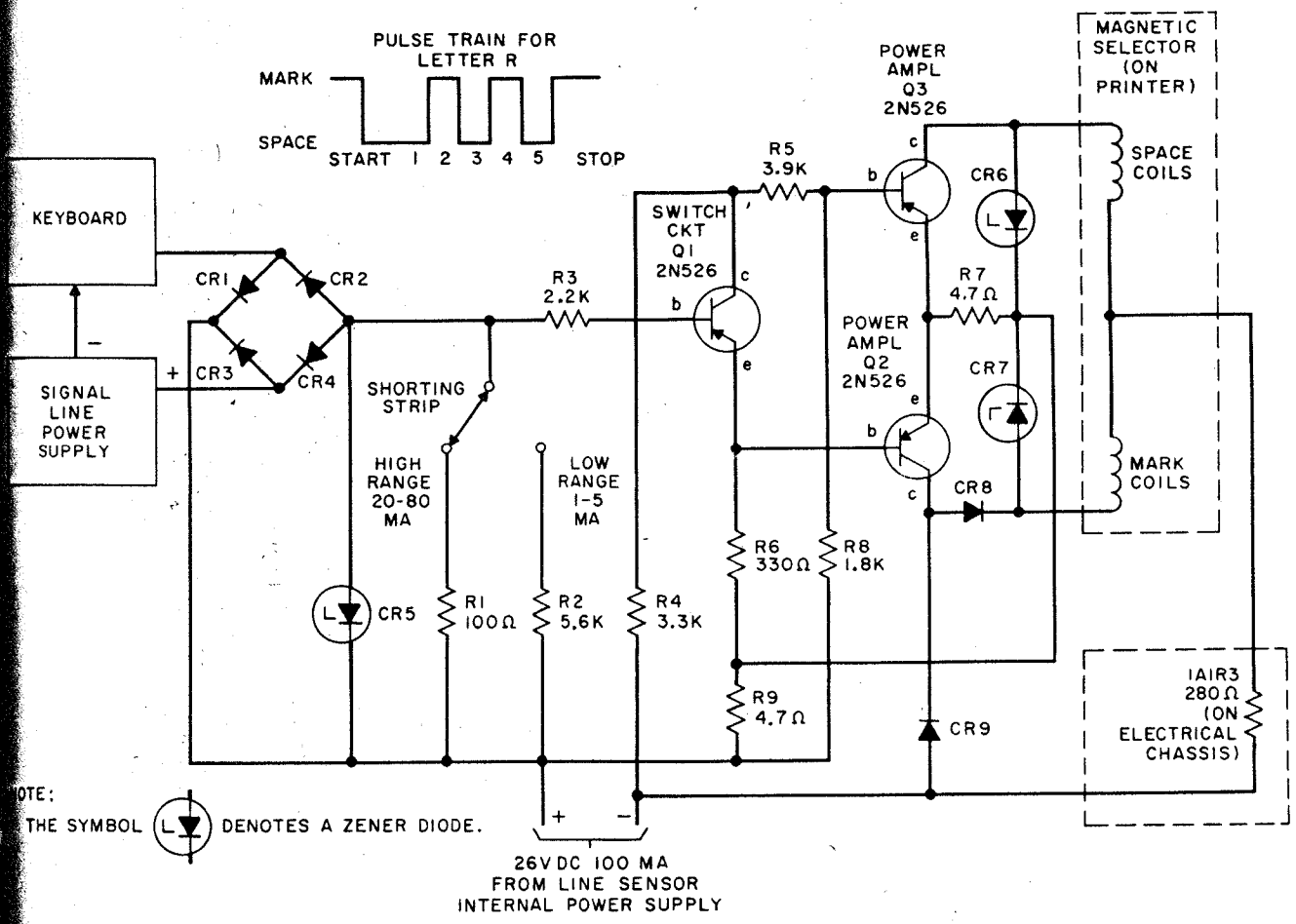


Figure 4-10. Line Sensor 1A3 and 1A6, Simplified Schematic Diagram

ias through resistor R8, will be cut off. The large urrent flowing through the emitter of conducting ransistor Q1 develops a negative pulse across re- istor R6, which causes current to flow in the base f power amplifier Q2. Power amplifier Q2, which s normally cut off by reverse base bias through re- istors R6 and R9, is driven into saturation and en- rgizes the mark coils of the magnetic selector for very mark signal of the input pulse train. When eceiving the letter R, the mark coils will be ener- ized on marking pulses 2, 4, and stop.

When space pulses are present, no input signal xists; this condition is the same as opening the sig- al loop. Consequently, no input signal is applied to he line sensor and transistor Q1 is cut off by the ombination of reverse base bias and the high emitter ias through resistor R9. As a result, the collector f transistor Q1 approaches the negative supply volt- ge level of approximately 26 vdc. This negative oltage causes current to flow in the base of power mplifier Q3 and drives it into saturation, energizing he magnetic selector space coils. When receiving he letter R, the space coils will be energized on tart, 1, 3, and 5 pulses. During a space condition, ower amplifier Q2 is cut off by reverse base bias esistors R6, R7, and R9. Zener diodes CR6 and CR7 prevent inductively produced pulses exceeding a level of -25 volts from appearing on the collectors of power amplifiers Q2 and Q3.

(3) LINE SENSOR MOTOR STOP FUNCTION. (See figure 4-11.) — Power amplifier Q2 is used to set up a relay-holding circuit when the figures H motor stop function is used. During normal teletypewriter set operation, the printer motor supplies motive power to the printer and keyboard and runs continuously. If standby operation is required, the printer motor may be made inoperative until either the remote or local keyboard operator presses the BREAK button.

Stopping the printer motor is accomplished by first striking the FIGS key and then the STOP key. Through operation of the magnetic selector and other mechanisms in the printer, this action closes motor stop switch 1A2A1S1 and energizes motor stop relay 1A1K1. Energizing this relay closes relay contacts 2 and 7 and opens contacts 3 and 5, removing primary power from the printer motor. However, motor stop switch 1A2A1S1 remains closed momentarily and another method must be used to hold the motor stop relay energized. This holding circuit is accomplished through the conduction of mark power amplifier Q2 during a

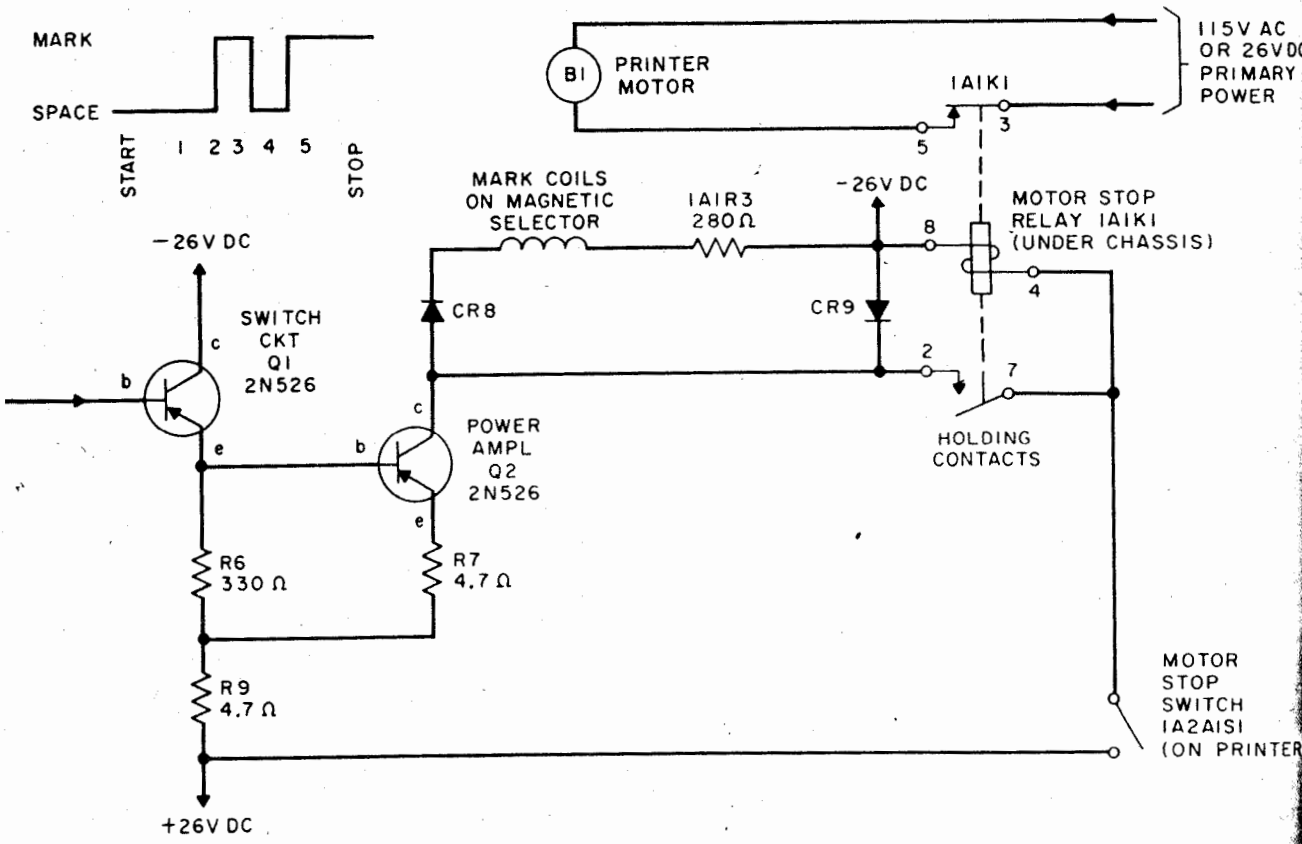


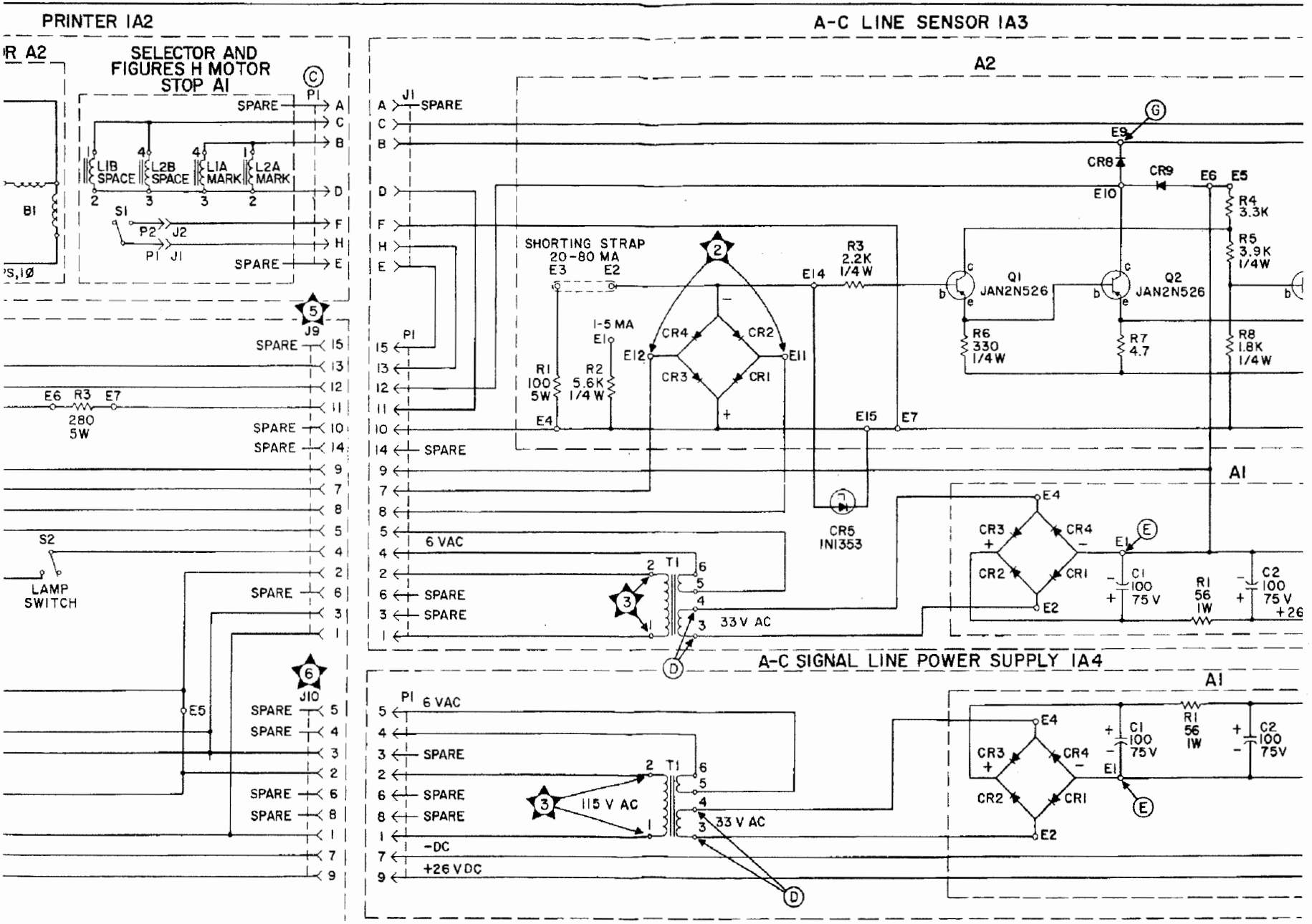
Figure 4-11. Line Sensor 1A3 and 1A6, Motor Stop Function, Simplified Schematic Diagram

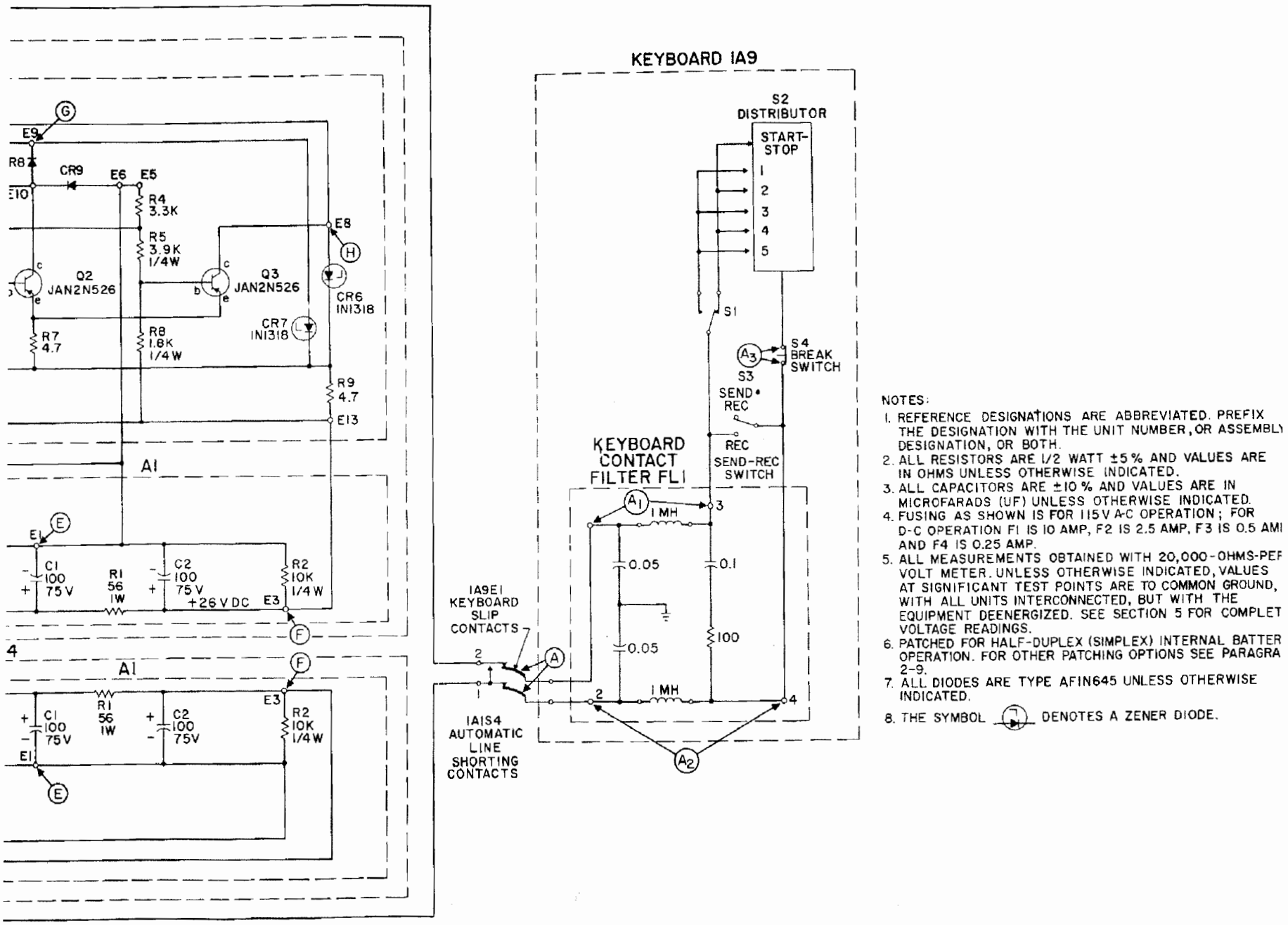
steady marking condition or on a stop pulse. The incoming pulse train for figures H consists of space pulses on start, 1, 2, and 4 and mark pulses on 3, 5, and stop. When mark pulses occur, power amplifier Q2 conducts to energize the mark coils on the magnetic selector and to provide a voltage source which keeps the motor stop relay energized after the motor stop switch opens. Assuming that motor stop switch 1A2A1S1 has opened, removing voltage from one side of relay coil 1A1K1, the relay is held energized by the circuit which is completed from negative 26 vdc through the relay coil, holding contacts, power amplifier Q2, resistors R7 and R9, and positive 26 vdc. The collector of power amplifier Q2 draws current through two circuits in parallel; one circuit includes the relay coil and holding contacts, and the other circuit includes 1A1R3, the mark coils, and diode CR8.

At the instant a start pulse appears (first break in the signal loop), power amplifier Q2 cuts off and the holding circuit is broken. Motor stop relay 1A1K2 is deenergized, closing contacts 3 and 5 to apply primary power to the printer motor.

f. PRINTER 1A2. — A magnetic selector incorporated in the printer receives d-c current impulses from the line sensor (space and mark pulses) and converts these pulses into the mechanical motions required to couple various clutches to a continuously rotating mainshaft. The magnetic selector starts the character printing cycle and all other functions with the start pulse and then translates each of the five telligence pulses to start all mechanical functions the printer. Upon reception of a stop pulse, the m netic selector stops the function or character. Fi ure 4-12 provides a general concept of how all me chanical functions in the printer are selected. The functions will first be discussed on a block diagra basis, and then each functional system will be sep ately described in detail.

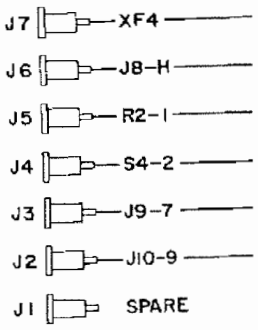
(1) BLOCK DIAGRAM DISCUSSION. (See figure 4-12.) — The magnetic selector first rece a d-c impulse representing start (space). This pu energizes a set of solenoid coils which attract an mature in such a manner that the start clutch rele arm releases the start clutch mounted on the print mainshaft. The mainshaft consists of two section a selector mainshaft and a function mainshaft. T two shaft sections are coupled together and rotate one shaft. All mechanical functions begin on the selector mainshaft. When released by the start c release arm, the start clutch engages the selecto mainshaft for 180 degrees rotation. The clutch d engages the selector mainshaft when the cage sto tab is blocked by the start clutch release latch. a steady mark signal (stop pulse), operation of th start clutch release arm is blocked by the magne selector armature and the start clutch is held stat ary by the start clutch release latch. Release ti of the start clutch and subsequent sampling of the telligence pulses is manually controlled by a ran dial geared to the start clutch.

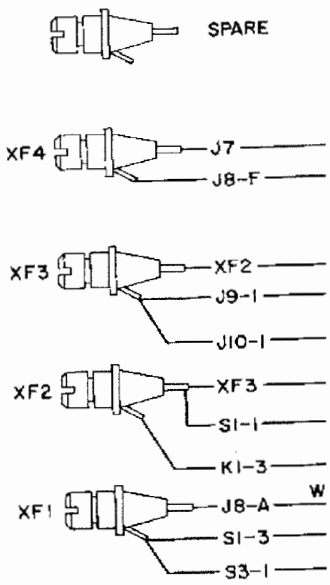

PRINTER IA2
SELECTOR AND FIGURES H MOTOR STOP AI
LIB SPACE
L2B SPACE
LIA MARK
L2A MARK
SPARE
B1
S1
P1
J1
P2
J2
J9
J10
S2
LAMP SWITCH
E5
E6 R3 E7
280 5W
A-C LINE SENSOR IA3
A2
SHORTING STRAP 20-80 MA
E3 E2
R1 100 5W
R2 5.6K 1/4 W
1-5 MA
E1
E4
E12
E11
CR1
CR2
CR3
CR4
R3 2.2K 1/4W
E14
E15
E7
E9
E10
CR8
CR9
E6
E5
Q1 JAN2N526
Q2 JAN2N526
R4 3.3K
R5 3.9K 1/4W
R6 330 1/4W
R7 4.7
R8 1.8K 1/4W
CR5 IN1353
6 VAC
33 V AC
T1
A1
C1 100 75 V
C2 100 75V
R1 56 1W
+26
A-C SIGNAL LINE POWER SUPPLY IA4
115 V AC
-DC
+26 V DC

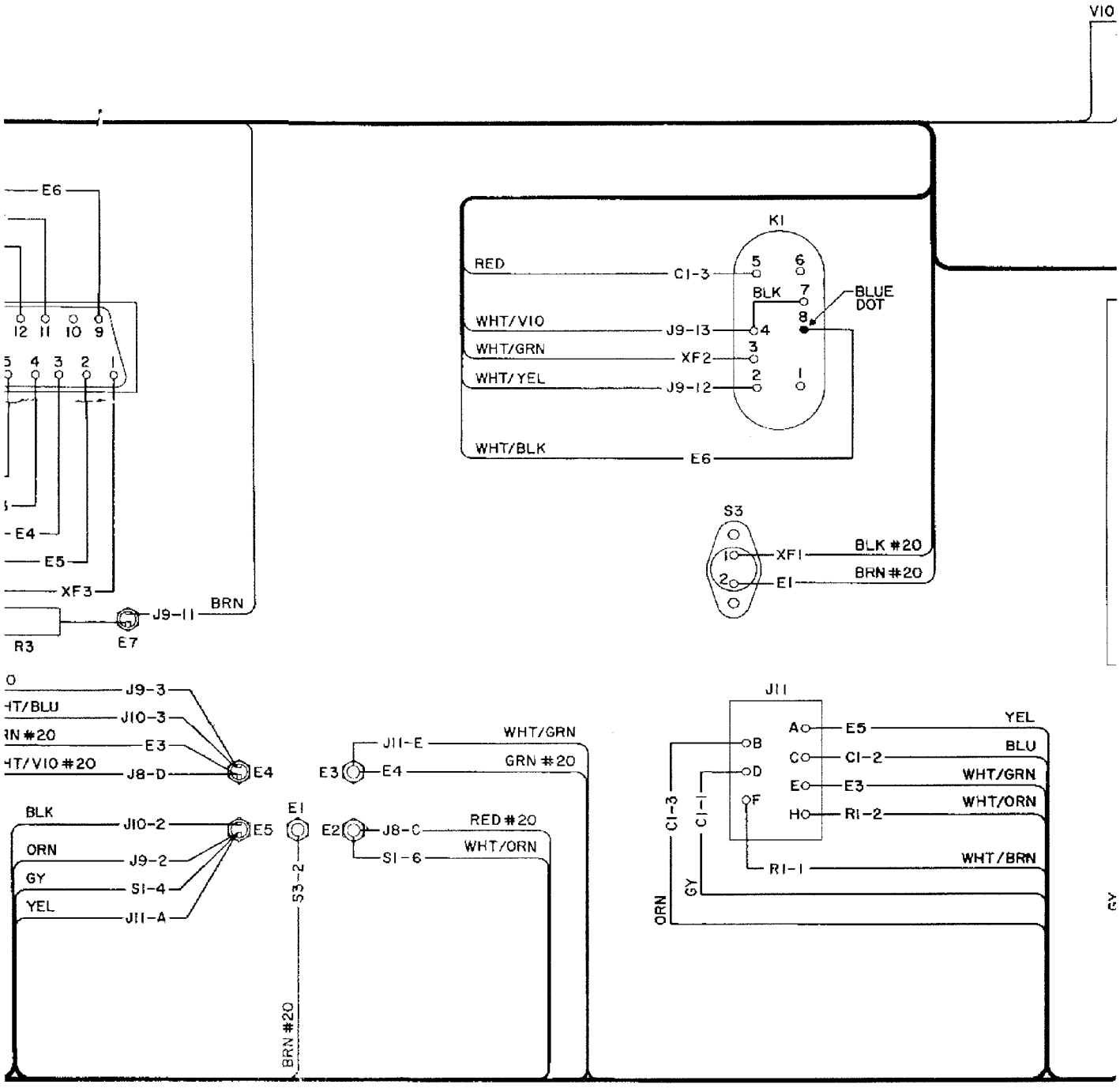


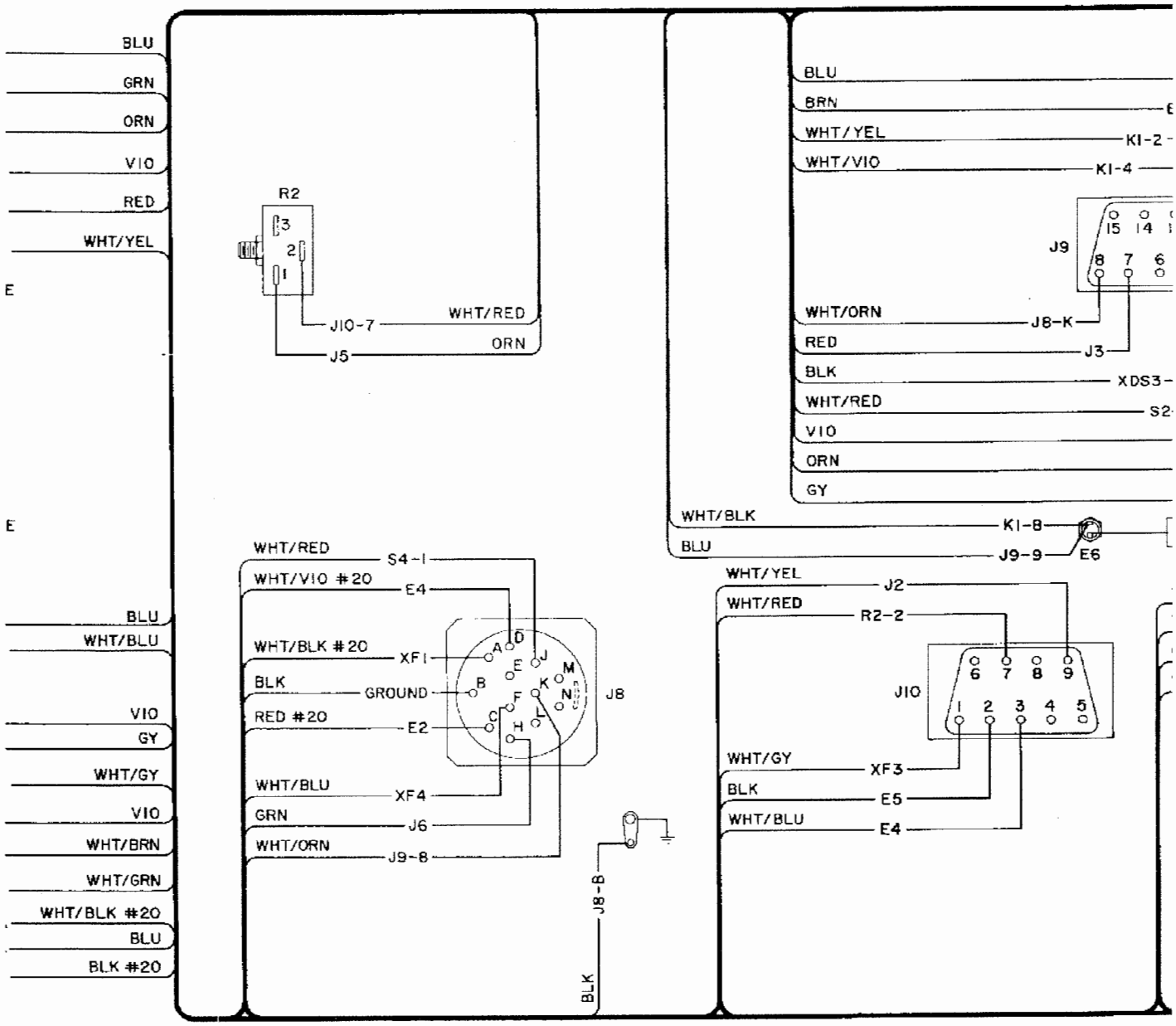
NOTES:

1. REFERENCE DESIGNATIONS ARE ABBREVIATED. PREFIX THE DESIGNATION WITH THE UNIT NUMBER, OR ASSEMBLY DESIGNATION, OR BOTH.
2. ALL RESISTORS ARE 1/2 WATT ±5% AND VALUES ARE IN OHMS UNLESS OTHERWISE INDICATED.
3. ALL CAPACITORS ARE ±10% AND VALUES ARE IN MICROFARADS (UF) UNLESS OTHERWISE INDICATED.
4. FUSING AS SHOWN IS FOR 115 V A-C OPERATION; FOR D-C OPERATION F1 IS 10 AMP, F2 IS 2.5 AMP, F3 IS 0.5 AMP AND F4 IS 0.25 AMP.
5. ALL MEASUREMENTS OBTAINED WITH 20,000-OHMS-PER-VOLT METER. UNLESS OTHERWISE INDICATED, VALUES AT SIGNIFICANT TEST POINTS ARE TO COMMON GROUND, WITH ALL UNITS INTERCONNECTED, BUT WITH THE EQUIPMENT DEENERGIZED. SEE SECTION 5 FOR COMPLETE VOLTAGE READINGS.
6. PATCHED FOR HALF-DUPLEX (SIMPLEX) INTERNAL BATTERY OPERATION. FOR OTHER PATCHING OPTIONS SEE PARAGRAPH 2-9.
7. ALL DIODES ARE TYPE AFIN645 UNLESS OTHERWISE INDICATED.
8. THE SYMBOL DENOTES A ZENER DIODE.


J7
XF4
J6
J8-H
J5
R2-1
J4
S4-2
J3
J9-7
J2
J10-9
J1
SPARE


SPARE
XF4
J7
J8-F
XF3
XF2
J9-1
J10-1
XF2
XF3
S1-1
K1-3
XF1
J8-A
W
S1-3
S3-1


VIO
E6
12 11 10 9
5 4 3 2 1
E4
E5
XF3
J9-11
BRN
R3
E7
K1
RED
C1-3
5
6
BLK
7
BLUE DOT
8
WHT/VIO
J9-13
4
WHT/GRN
XF2
3
WHT/YEL
J9-12
2
1
WHT/BLK
E6
S3
1
XF1
BLK #20
2
E1
BRN #20
O
J9-3
HT/BLU
J10-3
RN #20
E3
HT/VIO #20
J8-D
E4
J11-E
WHT/GRN
E3
E4
GRN #20
BLK
J10-2
E5
E1
E2
J8-C
RED #20
ORN
J9-2
SI-6
WHT/ORN
GY
SI-4
YEL
J11-A
S3-2
BRN #20
J11
A
E5
YEL
B
C
C1-2
BLU
D
E
E3
WHT/GRN
F
H
R1-2
WHT/ORN
R1-1
WHT/BRN
C1-3
C1-1
ORN
GY
GY


BLU
GRN
ORN
VIO
RED
WHT/YEL
E
E
BLU
WHT/BLU
VIO
GY
WHT/GY
VIO
WHT/BRN
WHT/GRN
WHT/BLK #20
BLU
BLK #20
R2
3
2
1
J10-7
WHT/RED
J5
ORN
WHT/RED
S4-1
WHT/VIO #20
E4
WHT/BLK #20
XF1
BLK
GROUND
RED #20
E2
WHT/BLU
XF4
GRN
J6
WHT/ORN
J9-8
J8
J8-B
BLK
BLU
BRN
WHT/YEL
K1-2
WHT/VIO
K1-4
J9
15 14
8 7 6
WHT/ORN
J8-K
RED
J3
BLK
XDS3-
WHT/RED
S2
VIO
ORN
GY
WHT/BLK
K1-8
BLU
J9-9
E6
WHT/YEL
J2
WHT/RED
R2-2
J10
6 7 8 9
1 2 3 4 5
WHT/GY
XF3
BLK
E5
WHT/BLU
E4

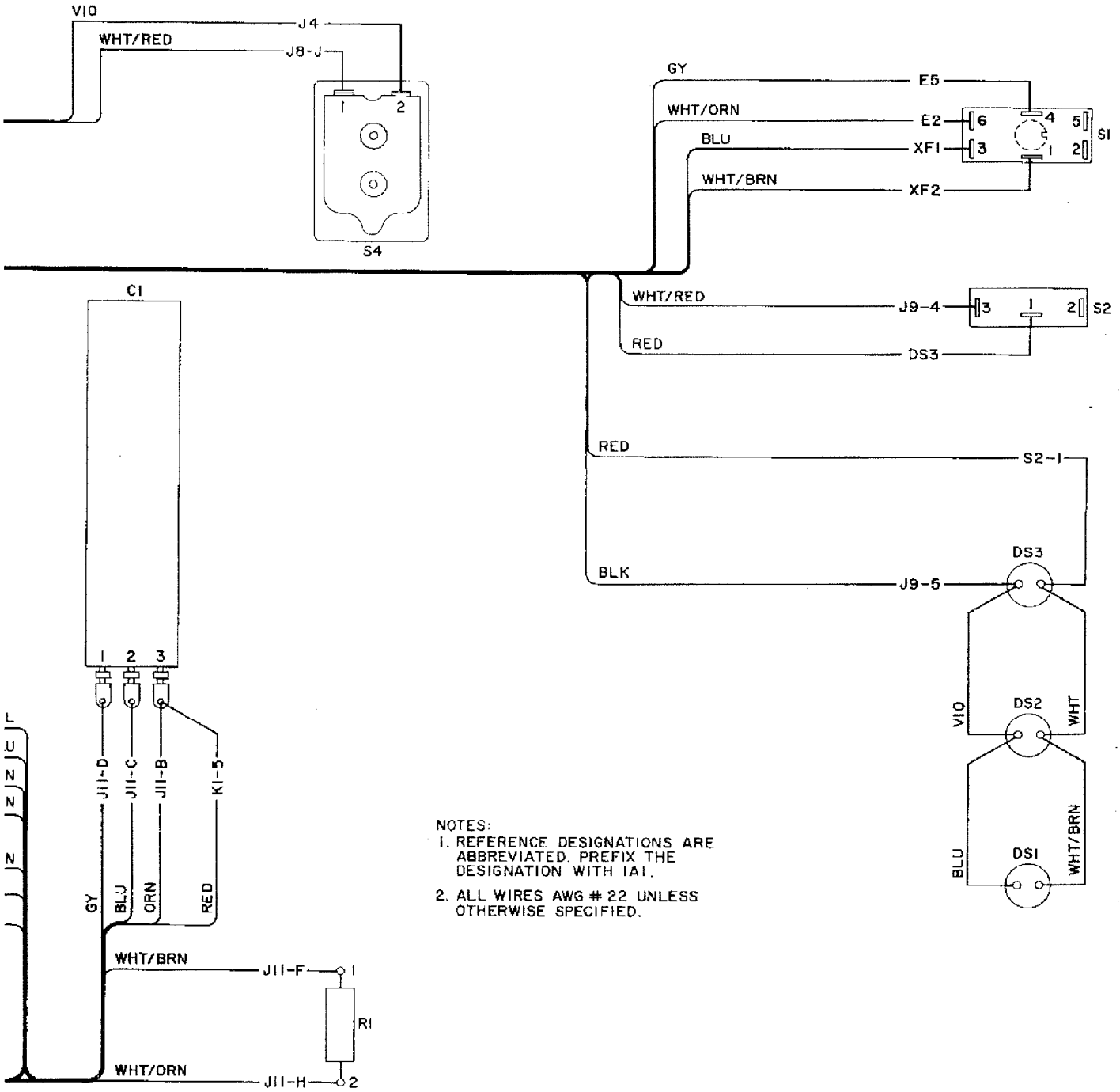
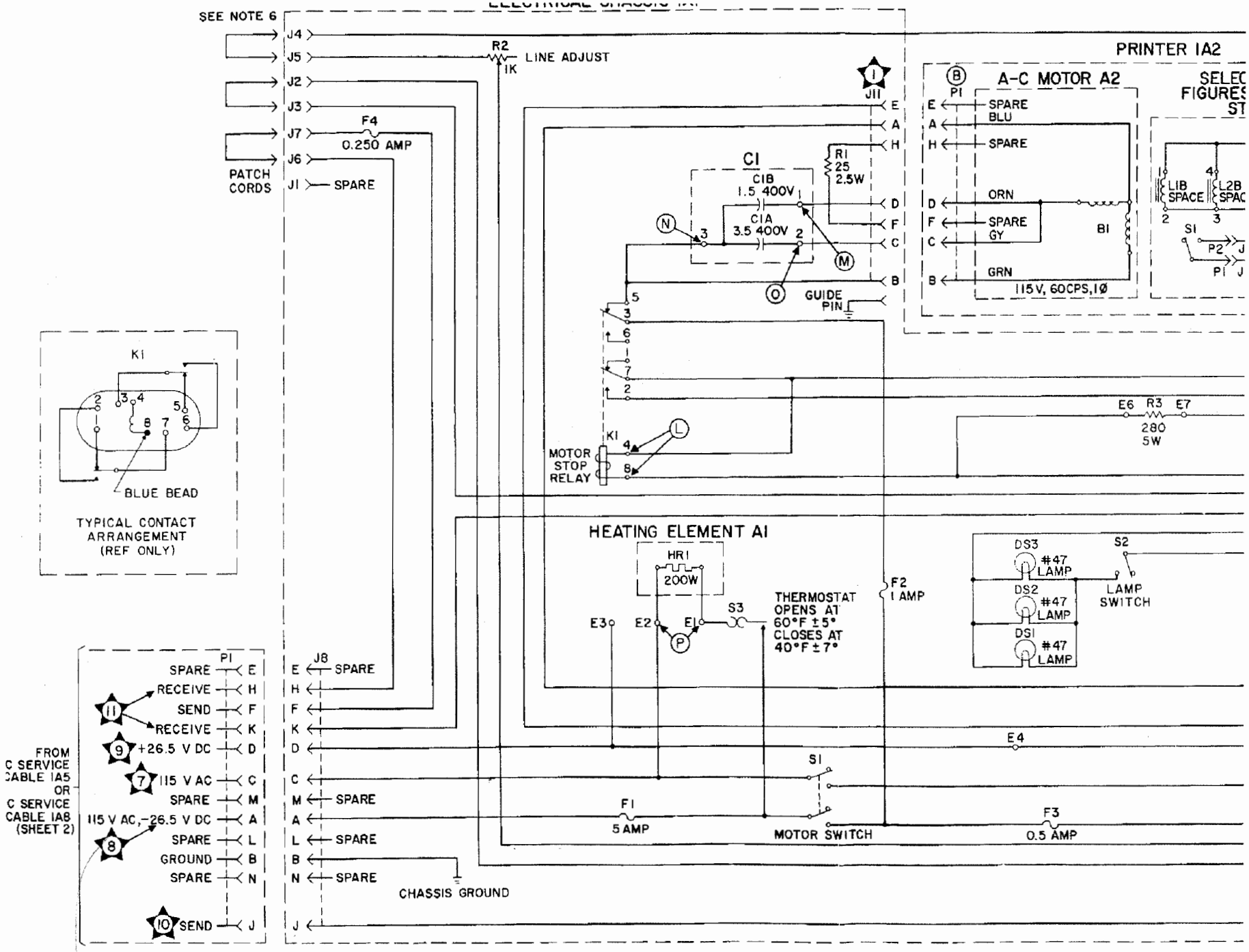
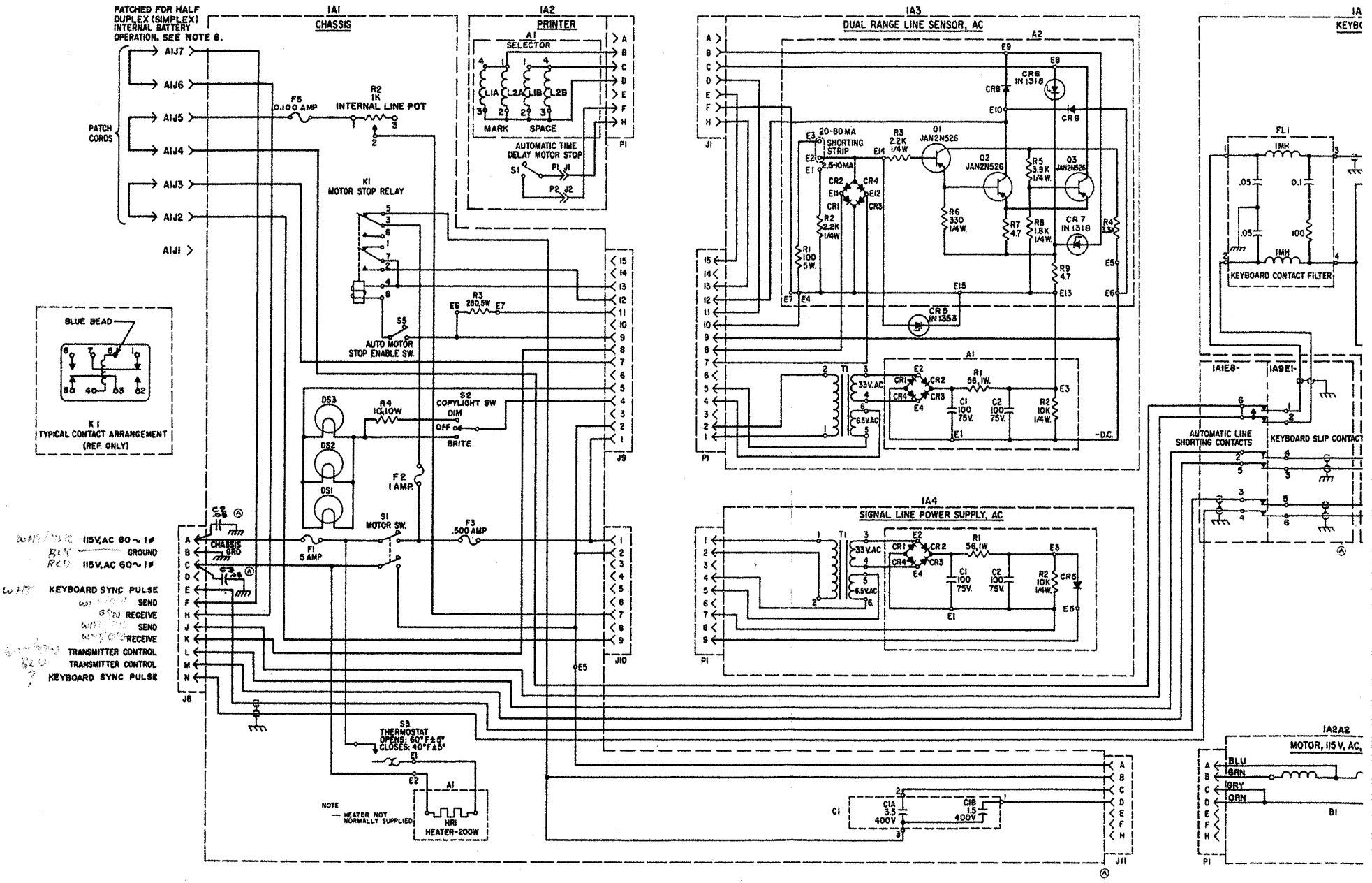
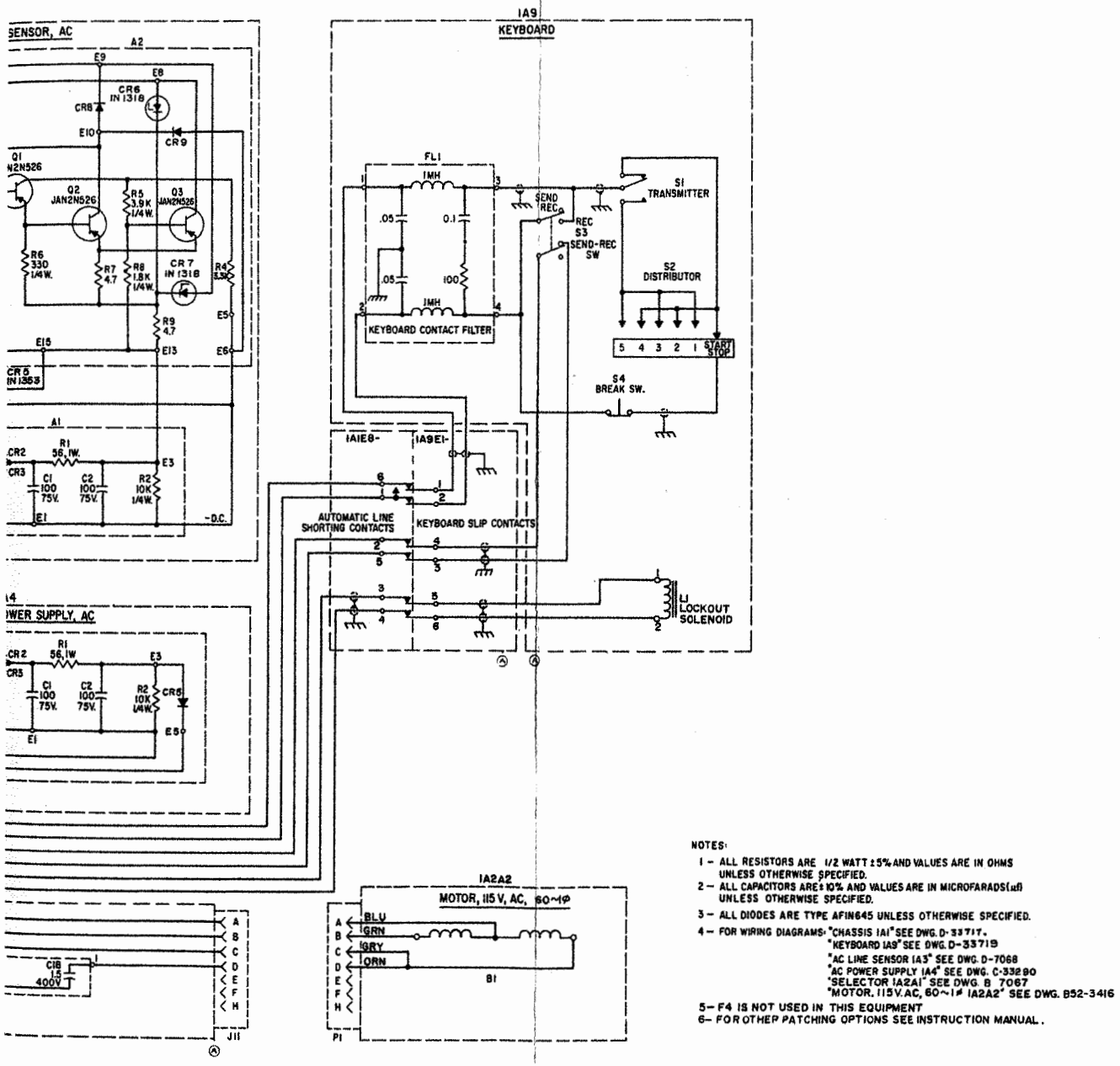


Figure 6-86. Teletypewriter Set AN/TGC-14(V), Electrical Chassis 1A1, Wiring Diagram


SEE NOTE 6
J4
J5
J2
J3
J7
J6
J1
PATCH CORDS
SPARE
R2
1K
LINE ADJUST
F4
0.250 AMP
PRINTER 1A2
A-C MOTOR A2
P1
SPARE BLU
SPARE
ORN
SPARE GY
GRN
BI
115 V, 60CPS, 1Ø
LIB SPACE
L2B SPAC
S1
P2
P1
J11
E
A
H
D
F
C
B
C1
C1B 1.5 400V
C1A 3.5 400V
R1 25 2.5W
N
M
O
GUIDE PIN
5
3
6
7
2
K1
4
8
MOTOR STOP RELAY
L
E6
R3
E7
280 5W
K1
BLUE BEAD
TYPICAL CONTACT ARRANGEMENT (REF ONLY)
HEATING ELEMENT A1
HR1
200W
E3
E2
E1
P
S3
THERMOSTAT OPENS AT 60°F ± 5° CLOSES AT 40°F ± 7°
F2
1 AMP
DS3
#47 LAMP
DS2
#47 LAMP
DS1
#47 LAMP
S2
LAMP SWITCH
E4
S1
F1
5 AMP
MOTOR SWITCH
F3
0.5 AMP
CHASSIS GROUND
J8
P1
SPARE
RECEIVE
SEND
RECEIVE
+26.5 V DC
115 V AC
SPARE
115 V AC, −26.5 V DC
SPARE
GROUND
SPARE
SEND
FROM C SERVICE CABLE 1A5 OR C SERVICE CABLE 1A8 (SHEET 2)


PATCHED FOR HALF DUPLEX (SIMPLEX) INTERNAL BATTERY OPERATION. SEE NOTE 6.
1A1 CHASSIS
1A2 PRINTER
A1 SELECTOR
MARK
SPACE
AUTOMATIC TIME DELAY MOTOR STOP
1A3 DUAL RANGE LINE SENSOR, AC
1A4 SIGNAL LINE POWER SUPPLY, AC
1A2A2 MOTOR, 115 V, AC,
KEYBOARD CONTACT FILTER
AUTOMATIC LINE SHORTING CONTACTS
KEYBOARD SLIP CONTACT
PATCH CORDS
A1J7
A1J6
A1J5
A1J4
A1J3
A1J2
A1J1
F5 0.100 AMP
R2 1K INTERNAL LINE POT
K1 MOTOR STOP RELAY
S5 AUTO MOTOR STOP ENABLE SW.
R3 280,5W
BLUE BEAD
K1 TYPICAL CONTACT ARRANGEMENT (REF. ONLY)
DS3
DS2
DS1
R4 10,10W
S2 COPYLIGHT SW
DIM
OFF
BRITE
F2 1 AMP.
S1 MOTOR SW.
F3 .500 AMP
F1 5 AMP
CHASSIS GND
115V,AC 60~1ø
GROUND
115V,AC 60~1ø
KEYBOARD SYNC PULSE
SEND
RECEIVE
SEND
RECEIVE
TRANSMITTER CONTROL
TRANSMITTER CONTROL
KEYBOARD SYNC PULSE
S3 THERMOSTAT OPENS: 60°F±5° CLOSES: 40°F±5°
HR1 HEATER-200W
NOTE — HEATER NOT NORMALLY SUPPLIED
20-80 MA SHORTING STRIP
2.5-10MA
Q1 JAN2N526
Q2 JAN2N526
Q3 JAN2N526
CR6 IN1318
CR7 IN1318
CR8
CR9
CR5 IN1353
R1 100 5W.
R2 2.2K 1/4W
R3 2.2K 1/4W
R4 3.3K
R5 3.9K 1/4W.
R6 330 1/4W.
R7 4.7
R8 1.8K 1/4W.
R9 4.7
T1
33V.AC
6.5V.AC
C1 100 75V.
C2 100 75V.
R1 56, 1W.
R2 10K 1/4W.
C1A 3.5 400V
C1B 1.5 400V
FL1
1MH
.05
.1
100
B1
BLU
GRN
GRY
ORN



NOTES:

1 – ALL RESISTORS ARE 1/2 WATT ±5% AND VALUES ARE IN OHMS UNLESS OTHERWISE SPECIFIED.

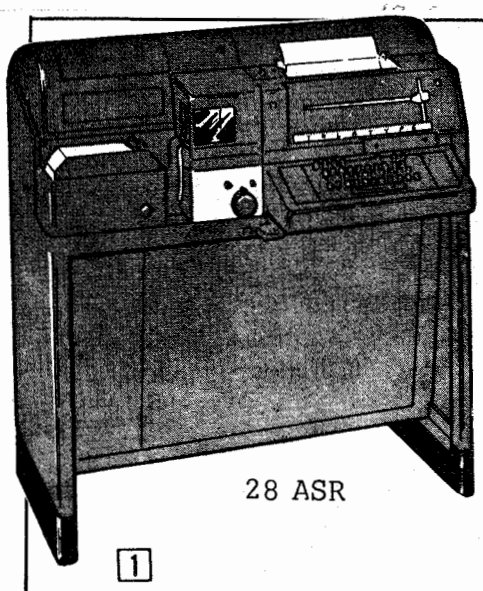
2 – ALL CAPACITORS ARE ±10% AND VALUES ARE IN MICROFARADS(μf) UNLESS OTHERWISE SPECIFIED.

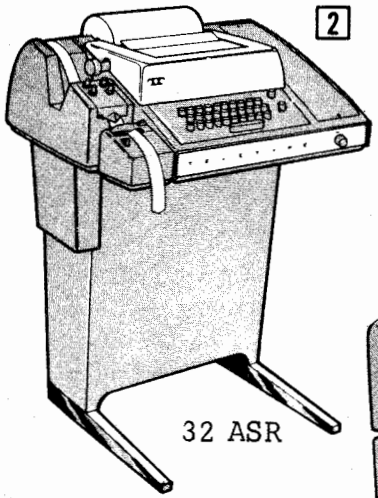
3 – ALL DIODES ARE TYPE AFIN645 UNLESS OTHERWISE SPECIFIED.

4 – FOR WIRING DIAGRAMS: "CHASSIS 1A1" SEE DWG. D-33717.
"KEYBOARD 1A9" SEE DWG. D-33715
"AC LINE SENSOR 1A3" SEE DWG. D-7068
"AC POWER SUPPLY 1A4" SEE DWG. C-33290
"SELECTOR 1A2A1" SEE DWG. B 7067
"MOTOR, 115 V. AC, 60~1Φ 1A2A2" SEE DWG. B52-3416

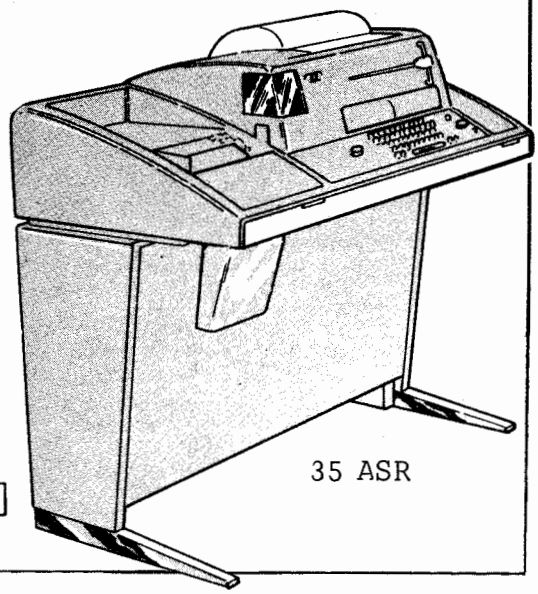
5 – F4 IS NOT USED IN THIS EQUIPMENT

6 – FOR OTHER PATCHING OPTIONS SEE INSTRUCTION MANUAL.


28 ASR
1


2
32 ASR

Many other configurations are available from North Supply.


35 ASR
3

Teletypewriters

Model 28 Teletypewriters

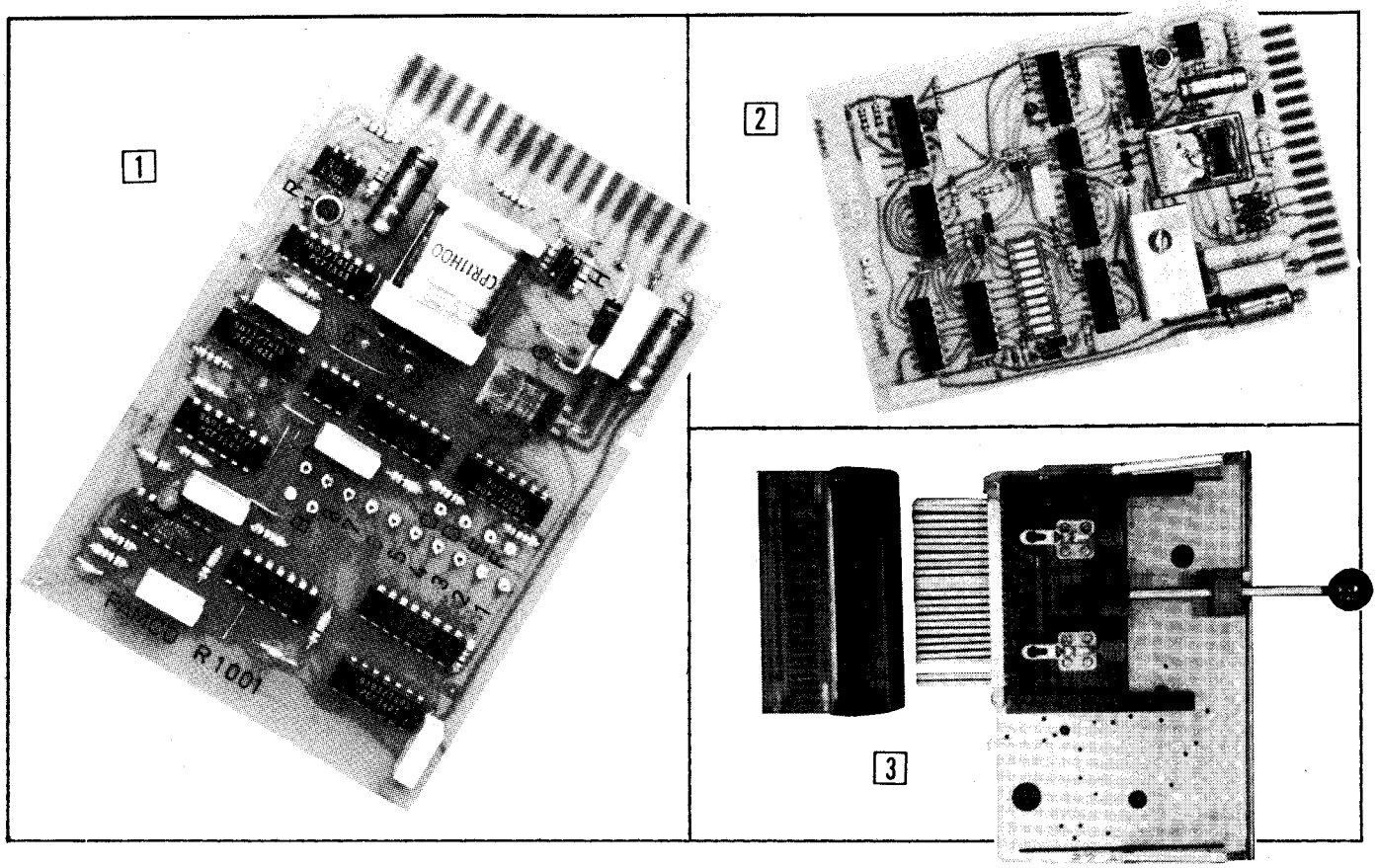
1 The 28 series is a heavy duty line of teletypewriters that use a five-level code for message transmission and reception. Operates at up to100 wpm in half or full duplex transmission mode with direct current signal line interface. Model 28 printers can use inexpensive rolled typewriter paper or multiple-copy business forms and include a stunt box to activate non-printing function. Many configurations are available, including receive-only, keyboard send-receive, automatic send-receive, receive-only typing reperforator and send-receive typing reperforator. Contact North Supply for complete pricing and configuration information. Federal Communications Corp.

Model 32 Data Terminals

2 A low-cost, standard duty line of data terminals, the Model 32 series uses a five-level code for data transmission and reception, operates in half or full duplex at up to 10 characters per second and uses inexpensive teletypewriter paper or multiple-copy business forms. The interface is DC current. Terminals are available for operation on either 60 Hz or 50 Hz power frequencies. An option answer-back provides station identification. This series features three or four-row keyboards and offers a variety of character sets. Contact North Supply for pricing information for the receive-only, keyboard send-receive and automatic send-receive terminals. Federal Communications Corp.

Model 35 Data Terminals

3 A versatile, heavy-duty line of data terminals, the Model 35 series uses an eight-level code for data transmission and reception, operates in half or full duplex at up to 10 characters per second and uses inexpensive teletypewriter paper or multiple-copy business forms. Features a four-row keyboard and a stunt box which activates non-printing functions. One terminal arrangement provides for DC current interface or customer installed EIA voltage interface. Another provides a built-in modem for manual original/manual answer or manual original/automatic answer. Options include even parity code generation, answer back for station identification, horizontal and vertical tabulation & automatic punch and reader control. Contact North Supply for complete pricing and configuration information. Federal Communications Corp.



Toll Restrictor, R1001

[1] The R1001 is a rotary dial pulse, programmable toll restrictor for key systems or single line applications, and is designed to plug into any standard 1A2 key system line card panel. No wiring changes to the line card panel are required. Restricted and non-restricted stations can operate on the same line; restricted calls can be diverted to auxiliary trunking or intercept equipment. A ground disable lead is provided for class of service marking. Pamco Electronics Inc.

435802—R1001 Toll Restrictor $96.00 Ea.

Toll Restrictor, R1002

[2] The R1002 is a rotary dial pulse, D.I.P. switch programmable, "1" or "0" in the first digit or when the total number of digits exceeds seven, toll call restrictor designed for PABX trunk, key system and central office applications. It will mount in any standard 1A2 enclosure using the standard line card pin assignment with no wiring changes required. Restricted calls can be diverted to intercept equipment. A ground disable lead is provided for class of service marking. Operates on ground start or loop start trunks or lines. Pamco Electronics Inc.

435801—R1002 Toll Restrictor $98.00 Ea.

XY Bank Cleaner

[3] This bank cleaner is comprised of three units: a multi-finger brush, a holding tool and a brush cleaner. The brush is made of 24 fingers with a special, fibrous materila that wraps around the bank rods. The tool holds the multi-fingered brush on a sliding plate for an effortless forward and back motion to scrub the rods in one bank position at one time. The brush cleaner is a reservoir for the cleaning fluid with a comb arrangement to clean the brush. Shuinn & Associates.

740144—100-731 Bank Cleaning Tool ..... $219.95 Ea.
740145—100-732 Multifinger Cleaning Tool ..... $29.95 Ea.
740146—100-733 Wiper Cleaning Brush ..... $1.00 Ea.
740147—100-734 Reservoir/Brush Cleaning Comb..... $22.00 Ea.

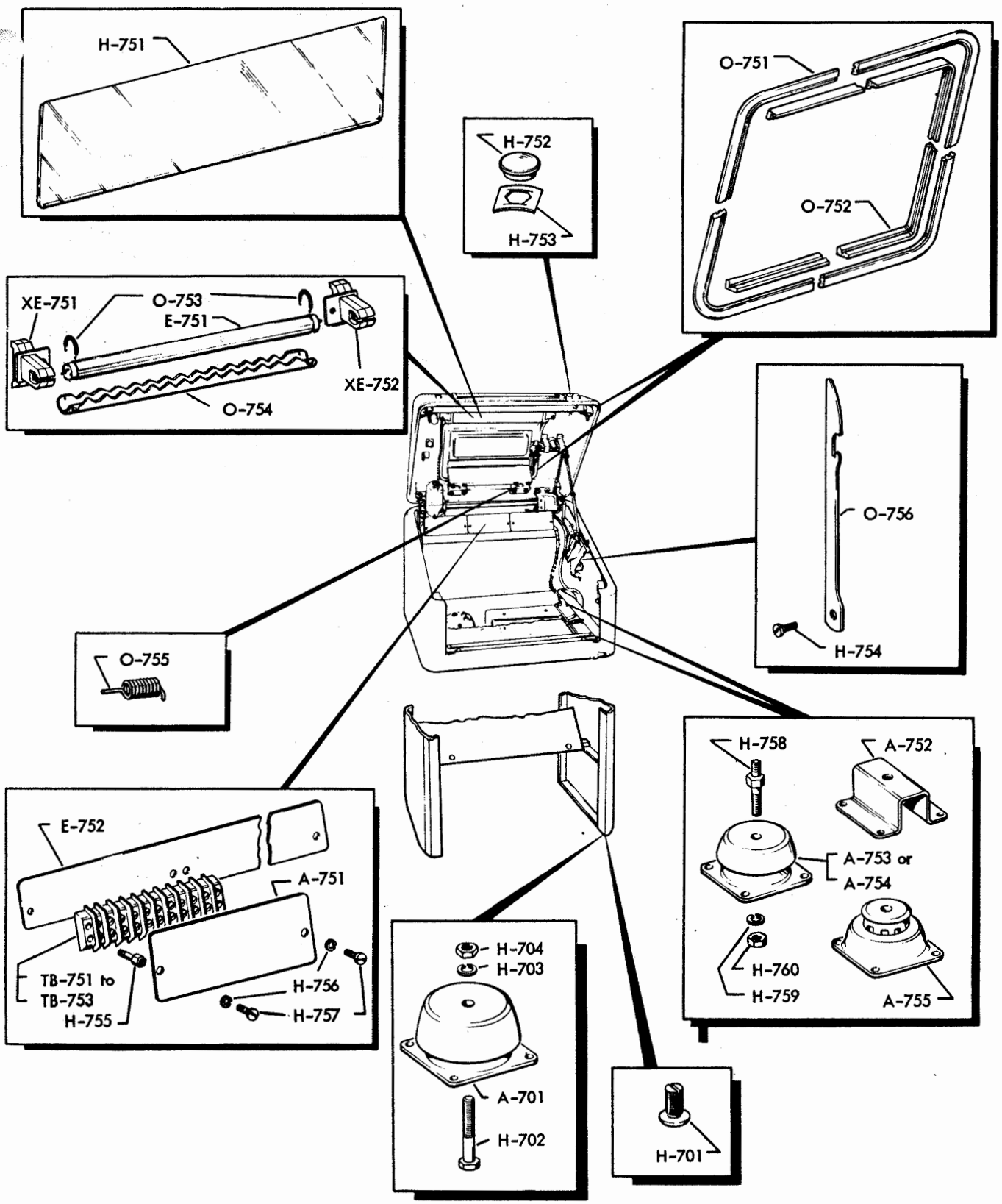


Figure 7-109. Cabinet

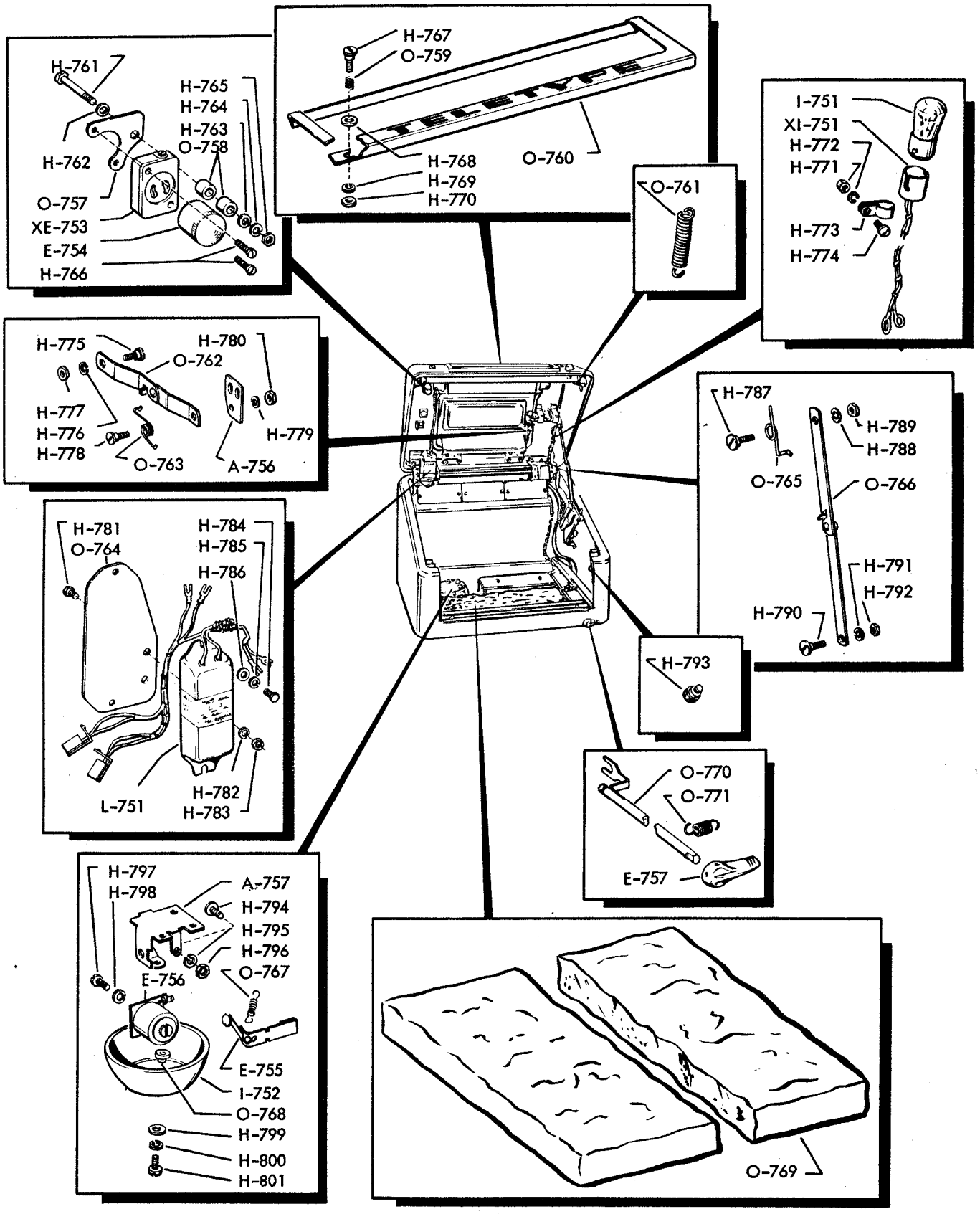


Figure 7-110. Cabinet

44. Front-panel and Motor-governor Controls and Devices (contd)

Control or device	Location	Purpose and use
LINE FUSE (⅛ amp).	Bottom of panel, at right of center.	Protects signal line circuit from power surges and overloads. To remove and replace fuse, proceed as directed for MOTOR FUSE above. *Caution:* Always be sure to use a ⅛-amp replacement LINE FUSE. Avoid accidental interchange with the 2-amp MOTOR FUSE, which is almost identical in appearance.
Motor-governor-adjustment worm	Extends from front (center) of motor and governor assembly (fig. 4).	Sets spring tension on movable governor contact. Used to adjust motor speed to 3,600 rpm by adjusting tension for automatic open circuit at governor contacts when motor speed exceeds appropriate critical rate. Turn clockwise to increase motor speed. Turn counterclockwise to decrease motor speed.

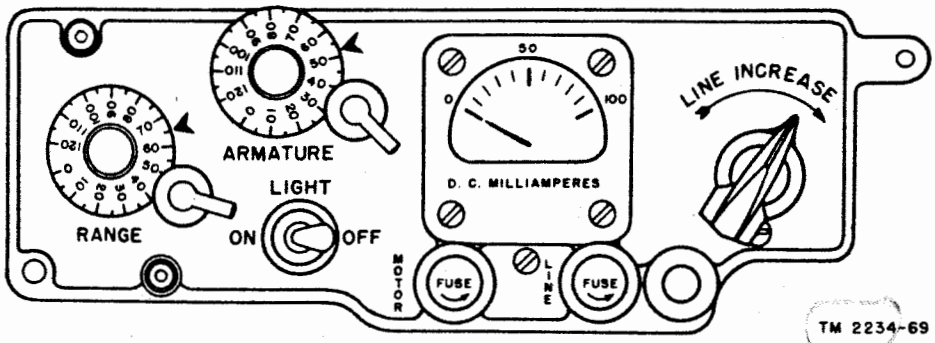


Figure 23. Panel controls and operating devices.

TT-4/TG

45. Other Teletypewriter Controls and Operating Devices (figs. 4, 5, 24, 29, and 30)

The following table lists and explains teletypewriter controls and operating devices not directly associated with the keyboard, control panel, or motor governor. This category includes such items as the manual CAR RET knob, the platen and ribbon controls, and the VOICE FREQ LINE-D C LINE toggle switch. All are located beneath the dust cover except the platen knob and the dust cover operating devices. For controls and operating devices directly associated with the keyboard, see paragraph 43. For controls and operating devices directly associated with the front panel or motor governor, see paragraph 44.

Control or device	Location	Purpose and use
VOICE FREQ LINE-D C LINE toggle switch.	Left-hand side of teletypewriter (fig. 4).	Adjusts wiring connections to selector magnet for 20-ma or 60-ma incoming signals, as appropriate. Set at VOICF FREQ LINE for 20-ma incoming signals (at teletypewriter REC terminals). Set at D C LINE for 60-ma incoming signals (at teletypewriter REC terminals).
Platen (printing roller).	Top of teletypewriter (fig. 4).	Forms solid backing for the portion of recording paper being printed. Also serves to move paper up when LINE FEED key (par. 43) is struck, or up or down when platen knob is turned. It is equivalent to platen on typewriter.
Platen knob.	Left-hand end of platen (fig. 4).	Turns platen to move recording paper up (line-by-line) when manually turned counterclockwise. Turns platen to move recording paper down (line-by-line) when manually turned clockwise. Also can be moved laterally to permit removal and replacement of teletypewriter dust cover. It is equivalent to platen knob on typewriter.
Pressure-roller-release lever (paper-straightener lever).	Right-hand end of platen (figs. 4, 29, and 30).	When operated (fig. 30), releases pressure rollers from platen to permit straightening of paper. This lever is equivalent to pressure-roller-release (paper-straightener) lever on typewriter.

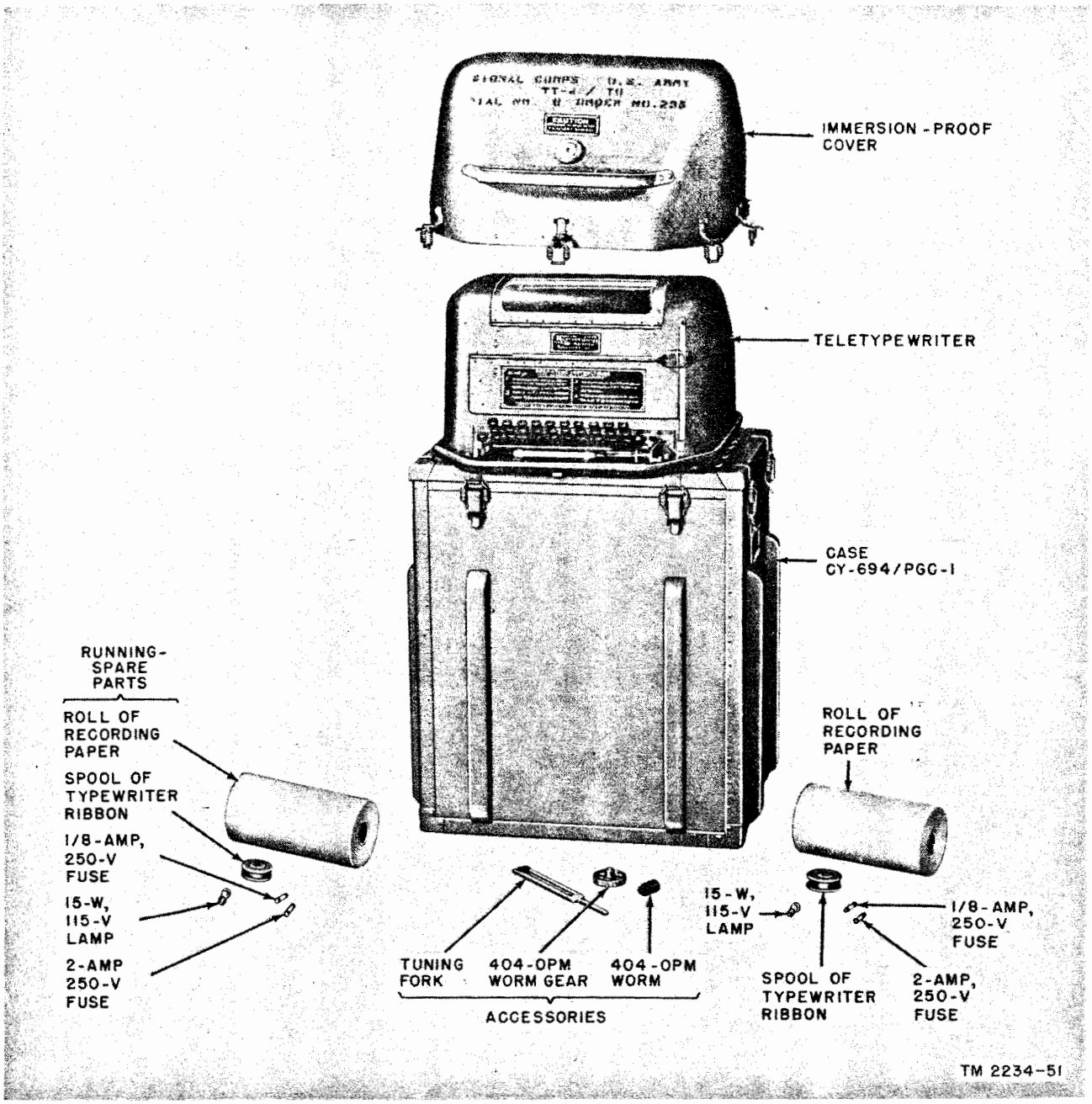


Figure 3. Teletypewriter TT-4/TG, components.

The immersion-proof cover fits over the dust cover and is clamped, watertight, to the base. Hooks are provided on the base so that the teletypewriter can be roped to a standard packboard when the machine is used in the field. The immersion-proof cover can be removed without removing the base from the packboard; thus, the teletypewriter can be connected to line and power source (or power sources), and can be operated, without being removed from the packboard.

5. Groups of Parts of Teletypewriter Unit

The teletypewriter unit consists of six main groups of parts: the keyboard-transmitter subassembly (figs. 4 and 5), the papershaft group (fig. 5), the platen subassembly (fig. 4), the type-bar carriage subassembly (fig. 4), the motor and governor subassembly (figs. 4 and 5), and the base frame subassembly. These groups are described in paragraphs 6 through 11.

and small door open; width—20-1/2 inches; depth—18-1/2 inches.

Manufacture discontinued. Replaced by the 28E teletypewriter cabinet.

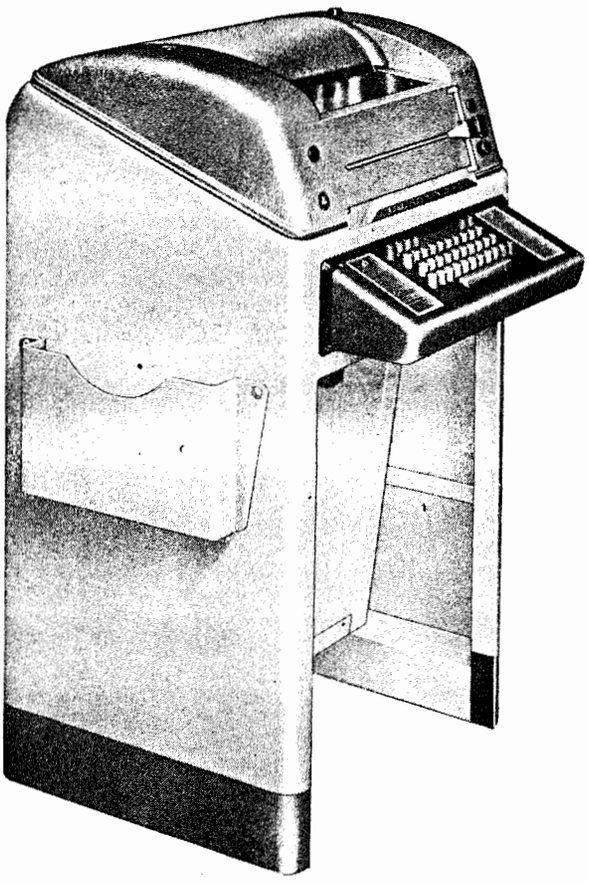
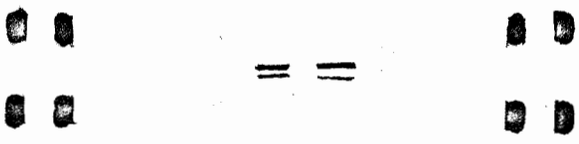


Fig. 4



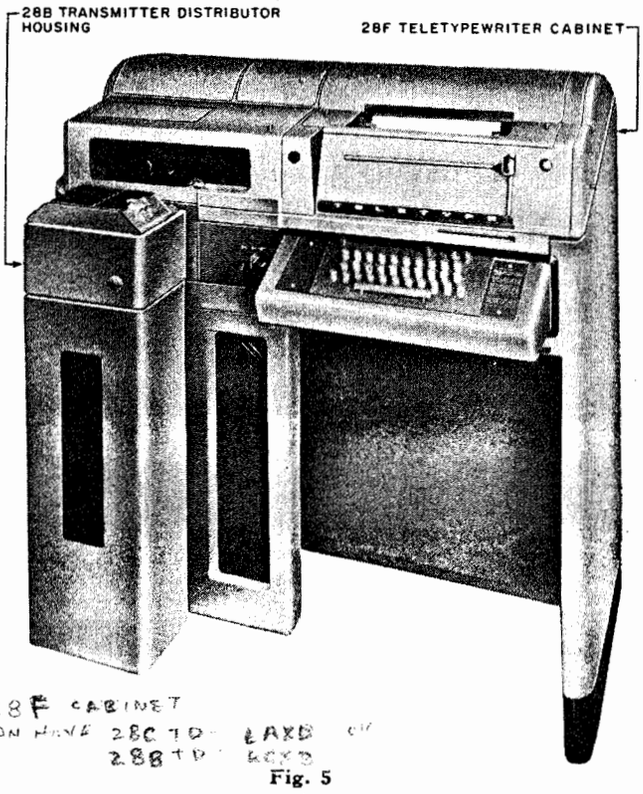


Fig. 5

3.04 **28D** Teletypewriter Cabinet:** This cabinet supersedes the 28B teletypewriter cabinet and differs from it in that it uses an ac power supply and is equipped with a transformer and two 6-volt copylights in parallel.

3.05 **28E** Teletypewriter Cabinet:** This cabinet is the same as the upper portion of the 28D teletypewriter cabinet.

3.06 **28F** Teletypewriter Cabinet:** This cabinet is a part of a 28 automatic send-receive set which includes a pivoted transmitter-distributor or a pivoted and fixed transmitter-

Table I—Mercury Relay Characteristics

Type	*Fig.*	*Windings*	*Ohms*	*Operate* (ma)	*Release* (ma)
275A	A	Single	2500	10.1	4.5
275B	A	Single	4000	8.1	3.6
275C	B	Pri.	700	32.0	14.2
		Sec.	3300	12.9	—
275D	A	Single	700	20.0	8.9
275E	A	Single	2	315.0	140.0
275F	F	Pri.	120	55.0	24.5
		Sec.	125	80.0	—
276A	A	Single	90	16.0	1.3
276B	A	Single	4000	3.0	0.2
276C	A	Single	4000	—	—
276D	A	Single	4000	1.5	—1.5
276E	A	Single	4000	—	—
276F	A	Single	1000	5.6	0.4
276G	C	Pri.	700	14.2	2.8
		Sec.	3300	5.7	—
276H	A	Single	90	32.0	15.0
276J	A	Single	4000	4.7	1.7
276K	D	Single	4000	—	—
276L	E	Pri.	1020	14.0	5.9
		Sec.	970	16.0	—
276M	A	Single	4000	5.9	2.8
276N	C	Pri.	700	6.0	—6.0
		Sec.	3300	2.4	—2.4
276R	G	Pri.	100	13.0	—13.0
		Sec.	1100	4.5	—
276S	A	Single	34	90.0	—
276T	B	Pri.	2500	6.7	0.5
		Sec.	2500	7.8	—

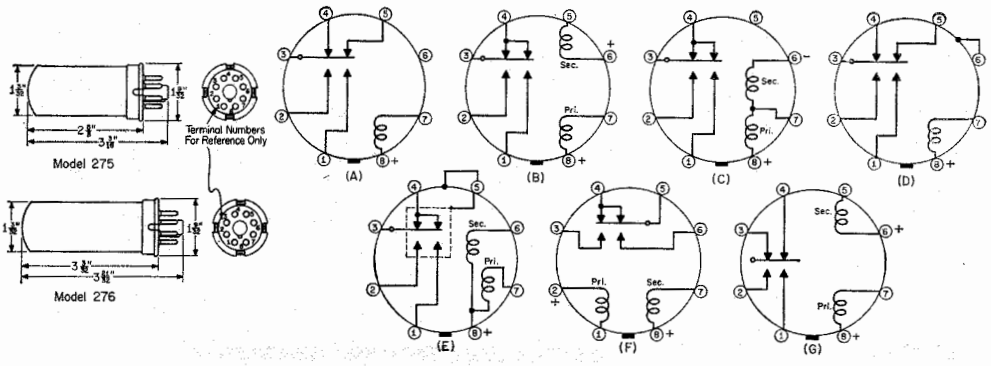
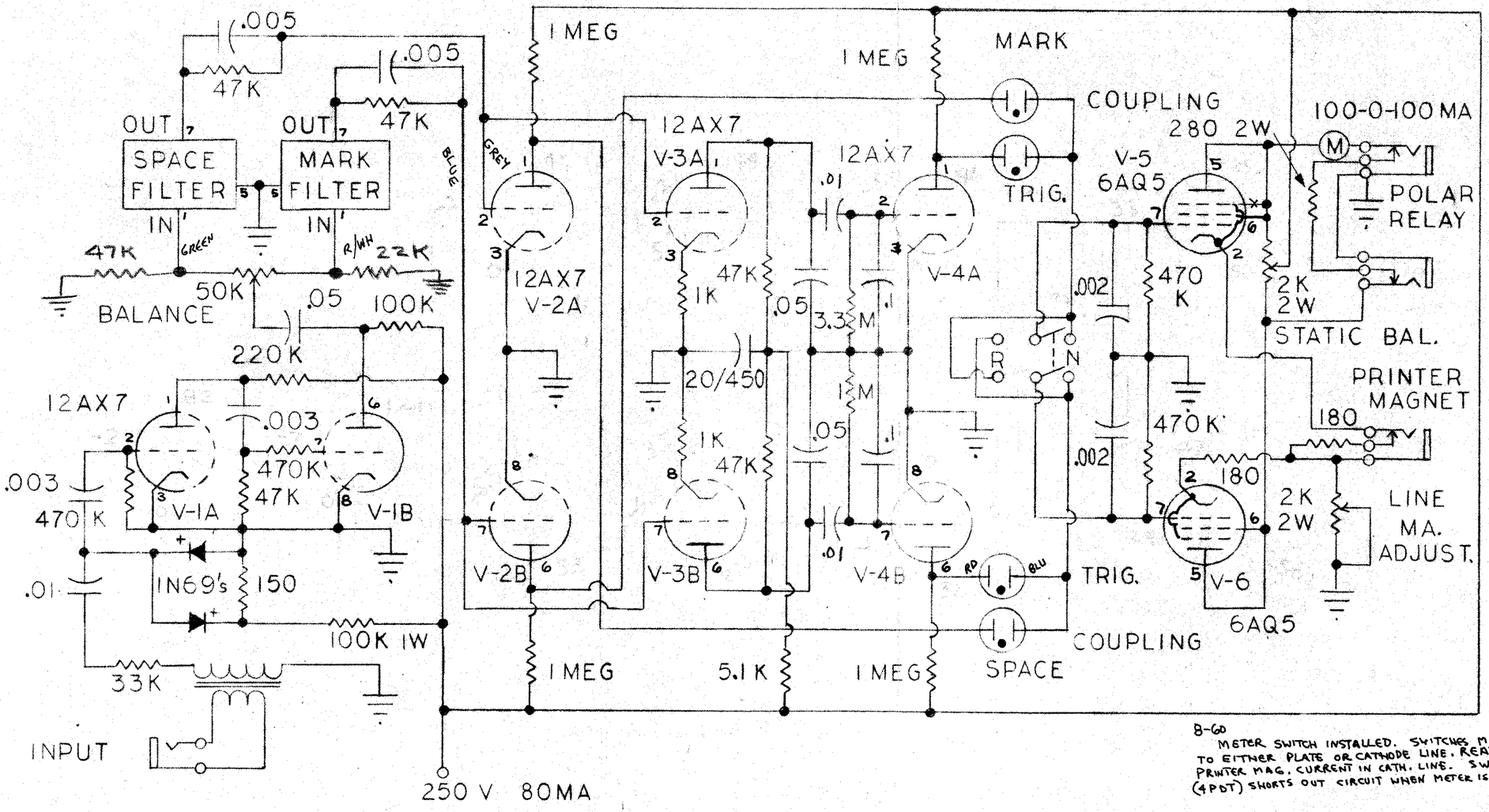


Fig. 1—Western Electric 275 and 276 mercury relays, outlines and connections.

B	REVISION		
MF	ZONE	SYM	DESCRIPTION



8-60
METER SWITCH INSTALLED. SWITCHES METER TO EITHER PLATE OR CATHODE LINE. READS PRINTER MAG. CURRENT IN CATH. LINE. SWITCH, (4 POT) SHORTS OUT CIRCUIT WHEN METER IS SWITCHED.

		PHYSICAL PROPERTIES			UNLESS OTHERWISE SPECIFIED	ORIGINAL DATE OF DWG
		Y P			ALL FINISHED DIMENSIONS ± .01	1-12-60
		T S		FINAL PROTECTIVE FINISH	ALL FORGING DIMENSIONS ± .03	
		EL 2			ALL CASTING DIMENSIONS ± .03	
		R A			ALL SHEET METAL DIM'S ± .03	
EXT ASSY	USED ON	B H		MATERIAL	EQUIVALENT COMMERCIAL MATERIAL DESIGNATION	
APPLICATION					W2JAV APR-58/CQ	
DO DO NOT APPLY PART NO.		R H				

SCHEMATIC DIAGRAM

FSK TERMINAL UNIT

SCALE | UNIT WT

TUBE PIN VOLTAGE CHART

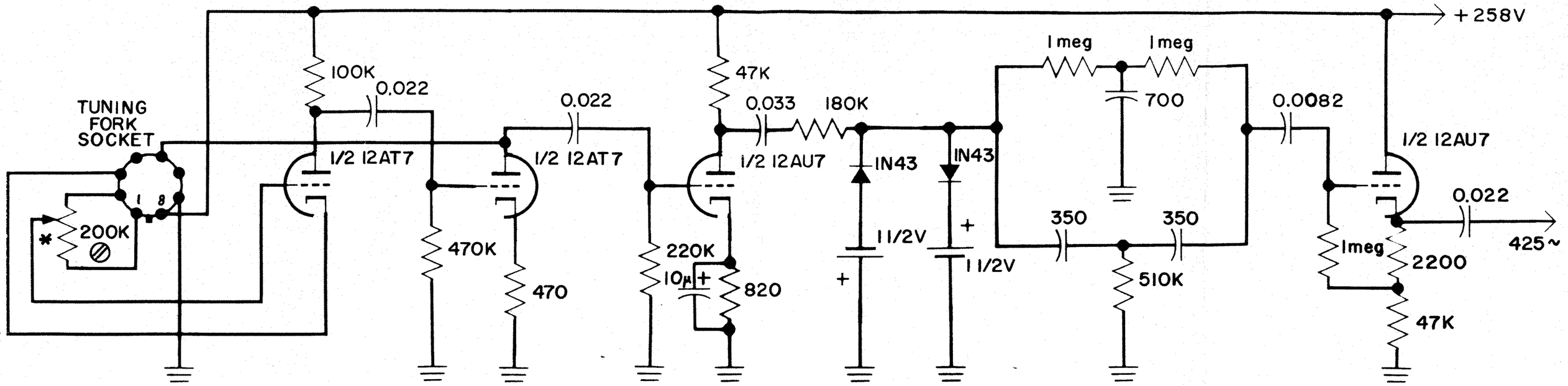
PIN	TUBE V-1	V-2	V-3	V-4	V-5	V-6
1	82	40	194	46 *	N-C	N-C
2	-2	-2	-2	-1.5	50	47
3	0	0	5	0	0	6.3AC
4	6.3AC	6.3AC	6.3AC	6.3AC	6.3AC	0
5	6.3AC	6.3AC	6.3AC	6.3AC	250	250
6	121	59	210	32*	250	250
7	-7	-6.5	-6.5	-1.5	33	24
8	0	0	3.5	0		
9	0	0	0	0		

MEASURED WITH 2125N SIG. PRESENT

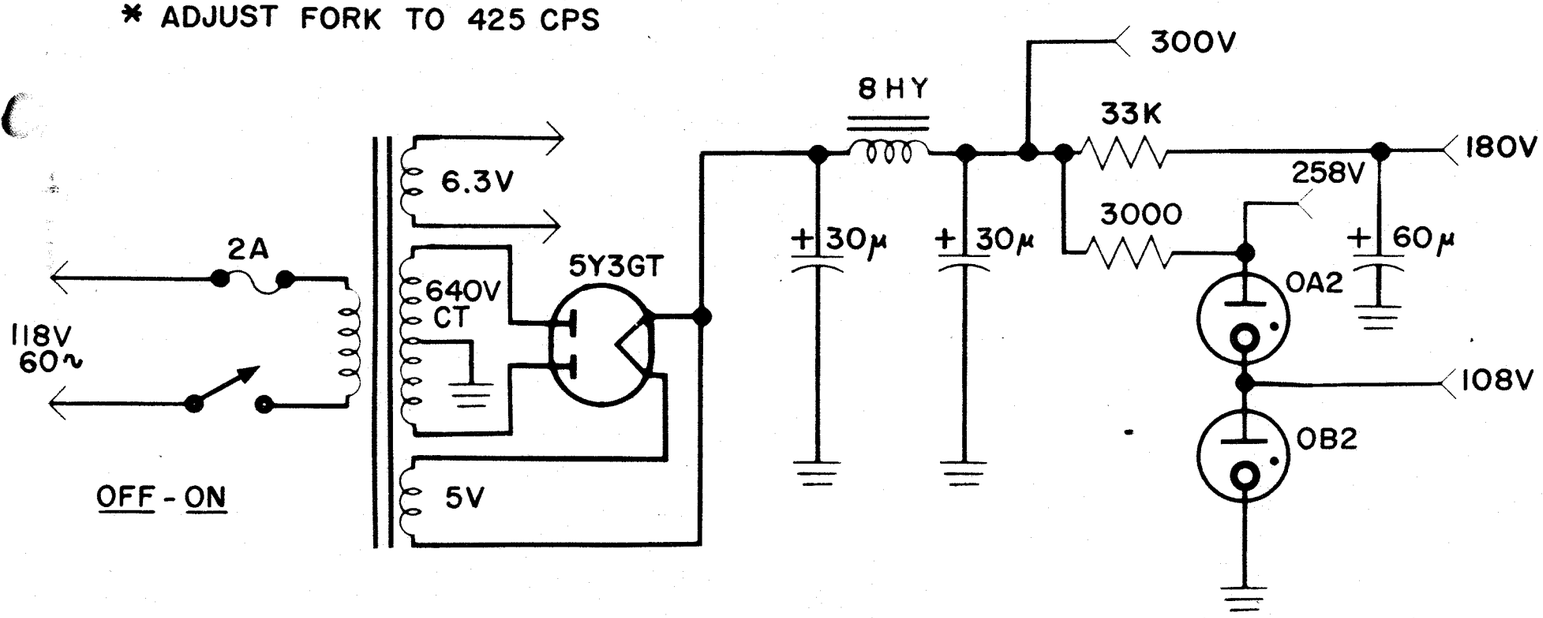
* WILL PEAK *HOLD AT 75-100V WITH TT SIGNAL PRESENT.

FSK TERMINAL UNIT

FSK TERMINAL UNIT



* ADJUST FORK TO 425 CPS

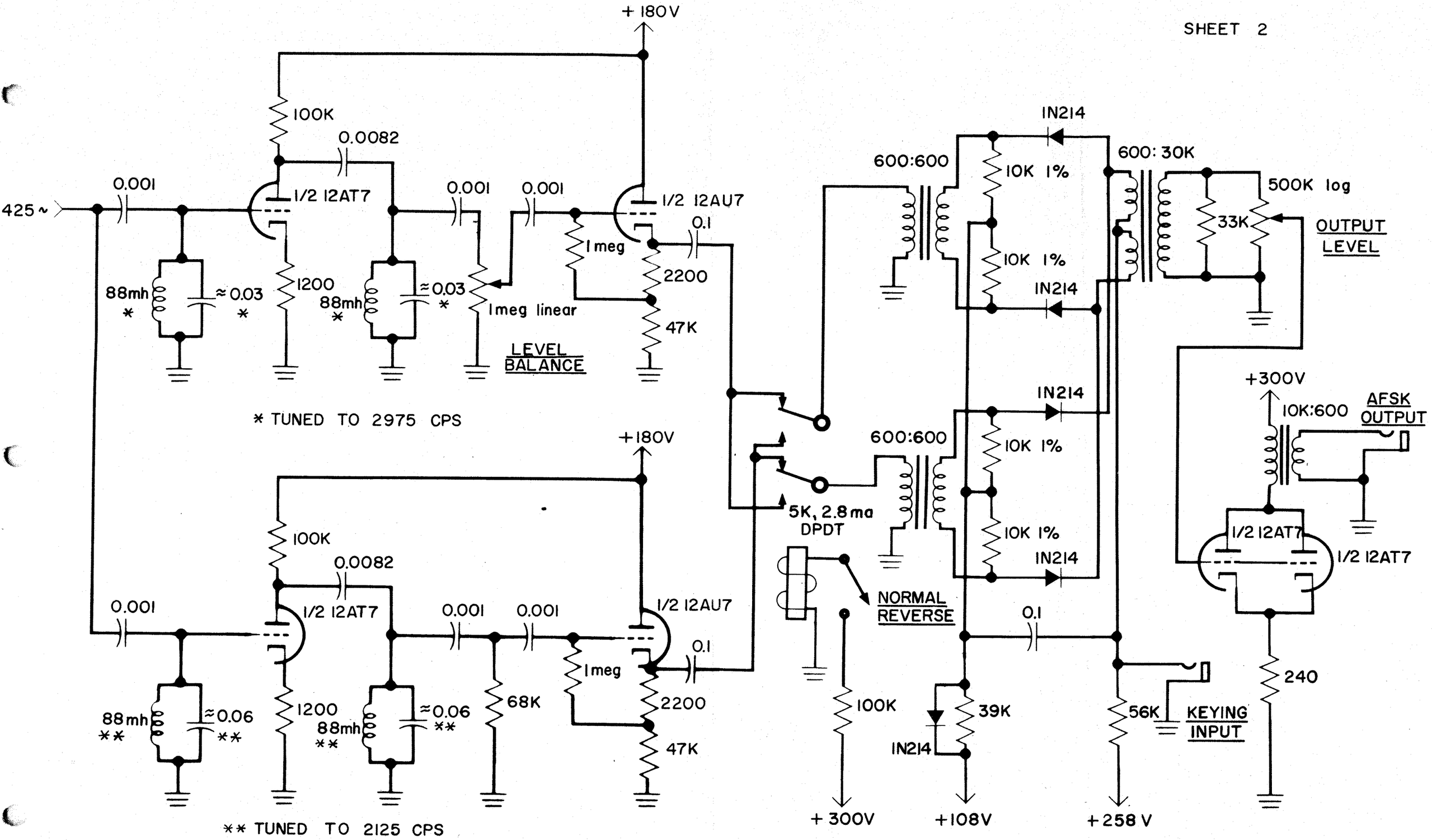


PRECISION AFSK KEYER

- 425 CPS TUNING FORK CONTROL
- 2125 CPS NORMAL MARK
- 2975 CPS NORMAL SPACE
- 600 OHM OUTPUT, 0-10 VOLTS NOMINAL
- KEY WITH BARE CONTACTS ONLY (NO EXTERNAL DC, NO REACTANCE)
- ADJUST OUTPUT LEVEL ON 2125 CPS SIGNAL
- ADJUST LEVEL BALANCE ON 2975 CPS SIGNAL

2/18/63

R. F. DeHaan


+180V
100K
0.0082
0.001
425~
1/2 12AT7
0.001
0.001
1/2 12AU7
0.1
1meg
2200
47K
88mh
≈0.03
*
1200
88mh
≈0.03
*
1meg linear
LEVEL BALANCE
* TUNED TO 2975 CPS
+180V
100K
0.0082
0.001
1/2 12AT7
0.001
0.001
1/2 12AU7
0.1
1meg
2200
47K
88mh
≈0.06
**
1200
88mh
≈0.06
**
68K
** TUNED TO 2125 CPS
5K, 2.8ma DPDT
NORMAL REVERSE
100K
+300V
600:600
IN214
10K 1%
10K 1%
IN214
600:30K
500K log
33K
OUTPUT LEVEL
600:600
IN214
10K 1%
10K 1%
IN214
39K
IN214
+108V
0.1
56K
KEYING INPUT
+258V
+300V
10K:600
AFSK OUTPUT
1/2 12AT7
1/2 12AT7
240