

ST-5AS

AUTO START

**INSTRUCTION
MANUAL**



**HAL COMMUNICATIONS CORP.
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QUALITY COMMUNICATIONS EQUIPMENT

ST-5AS

AUTO START

WARRANTY

HAL Communications Corp. warrants that the components supplied in the ST-5 Autostart kit shall be free of defects under normal use and service for a period of one year. Should any defects occur within the warranty period, notify HAL Communications Corp. promptly. The warranty period is measured from the date of the original invoice to the postmark date of your notification letter.

This warranty applies only to parts supplied in the kit, and does not apply to any components which, in the judgement of HAL Communications Corp., were damaged by incorrect use or construction on the part of the kit builder.

This warranty is and shall be in lieu of all other warranties whether expressed or implied, and of all other obligations or liabilities on the part of HAL Communications Corp. resulting from the installation or use of this kit.

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1. INTRODUCTION

The ST-5AS kit is designed to supplement the ST-5 RTTY Demodulator by providing a simple and reliable autostart and motor-control system. The autostart circuitry is patterned after the proven ST-6 circuits, utilizing one operational amplifier and two PNP transistors. It features a mark-hold and motor power control. Adding the autostart system to a standard ST-5 requires only a few simple modifications to the demodulator. All power required for the operation of the ST-5AS is obtained from the ST-5.

2. SPECIFICATIONS

<u>Input control voltage required to "trip" autostart</u>	2.50V to 4.20V (adjustable)
<u>Autostart Bandwidth (when used with ST-5)</u>	850 shift 275 Hz Min. 170 shift 275 Hz Min.
<u>Autostart Response Time</u>	2 to 4 seconds
<u>Motor Control Time</u>	30 ± 10 seconds
<u>Relay Contacts</u>	10 amperes @ 120 VAC
<u>Power Requirements</u>	+12V regulated, 5 ma -12V regulated, 10 ma -12 to -15V unregulated, 115 ma

3. CONSTRUCTION AND INSTALLATION

Installing the ST-5AS is simply a matter of assembling the circuit board, and connecting it to the ST-5 demodulator, and to the printer motor.

Although it is easiest to build the autostart and the demodulator at the same time, the autostart can be added to the ST-5 later with a minimum of effort.

While it may be possible to use the ST-5AS with other demodulators, it may be necessary to modify the demodulator or the autostart itself. HAL Communications Corp. does not warrant either parts or circuit performance when the autostart is used with demodulators other than the ST-5, nor can it provide interface data for other demodulators.

Assembling the Circuit Board

The ST-5AS kit is extremely simple to construct. All components of the autostart, with the exception of the relay, switches, and connectors, are mounted on the circuit board.

Referring to the ST-5AS layout drawing, insert the components in their proper positions on the board. Note the polarities of the diodes and electrolytic capacitors; C2 and C3 are mounted with their positive ends grounded. Be sure that OA-1 is oriented correctly before soldering. All components except R1, R9, C3, Q1, Q2, and D5 are placed horizontally on the circuit board. The switches, relay, and 120 VAC printer motor connector should be mounted at convenient locations on the cabinet.

Modifying the ST-5

The relatively simple modifications required to the ST-5 are indicated in the ST-5 schematic (Figure 3) and partial pictorial diagrams (Figures 4A, 4B, 4C). The principle modification is the addition of a 33K resistor (R29) in parallel with a 1N4148 diode (D10) in the signal path from the slicer(709N) to the keyer transistor (2N5655). On HAL ST-5 circuit boards purchased after April 1, 1973, extra holes have been provided, as indicated in Figure 4B. Note that the path must be broken at the point marked X...X. On earlier ST-5 circuit boards, it will be necessary to add an assembly consisting of resistors R27, R29, and Diode D10 in the circuit board location formerly occupied by R27. Construction of the assembly and correct connection points are indicated in Figure 4A. New holes may be drilled, or the components may be soldered on the back of the printed circuit board.

The receive-standby switch in the ST-5 is changed to a DPDT type to provide manual control of the printer motor. One pole is wired the same as the original switch. The other pole is wired to the autostart relay as shown in Figure 1.

The rest of the installation involves running wires from points AA, AB, AC, AD, AE, and AF on the ST-5 board to the corresponding points on the autostart board indicated in the ST-5AS schematic (Figure 1). Note that the AC power for the motor is not fused in the demodulator--fusing should be provided at the machine itself.

The ST-5 demodulator and ST-5AS autostart are furnished with a grounded, three-wire power cord and socket. Do not defeat the grounding; use it --it may save

your life. Be particularly sure that the machine frame is also well grounded. Defeating the power line ground voids all HAL Communications Corp. warranties.

4. USING THE ST-5 WITH AUTOSTART

With the autostart feature switched off, the ST-5 will operate exactly as if the autostart circuits were not present. The receiver is tuned to a RTTY signal and is adjusted so that the tuning meter deflects upscale and changes very little as the incoming signal shifts between mark and space. If the standby switch is set to the receive position, printing will start as soon as the signal is correctly tuned.

To use the autostart, throw the autostart switch to the "on" position. The printer will be locked in the mark-hold condition when no signal is present or when the incoming signal is improperly tuned. Tuning is the same as without autostart; however, printing will not begin until three or four seconds after correct tuning is achieved. The motor, if off, will then be switched on and the keyer stage will be released from the mark-hold state. When the incoming signal is lost or becomes mistuned, the keyer will switch back to mark-hold. The printer motor will remain on for about 30 seconds, allowing time to retune the receiver or search for a different signal.

With a little practice, it will become easy to tune the receiver with the autostart active. The autostart will prevent the printer from running open or printing garble during tuning.

Because it employs a broadband, linear discriminator, the basic ST-5 is very tolerant of improper tuning and of signals with incorrect frequency shifts. The autostart bandwidth, however, is fairly narrow (about 275 Hz), so it is more important to tune carefully when using autostart. Signals with

shifts which do not closely match those of the ST-5 discriminators may not trip the autostart circuit. These signals may be printed by switching the autostart off.

5. THEORY OF OPERATION

The ST-5AS uses the meter signal of the ST-5 to sense the presence or absence of RTTY signals. The meter signal is derived by detecting a portion of the mark and space outputs of the discriminator, as shown in the ST-5 schematic (Figure 3). The ST-5 detector diodes D3 and D4 produce a positive voltage output for either mark or space at the base of transistor Q1. The resulting positive voltage at the emitter of Q1 (point AA) is therefore proportional to the match in frequency between the input signal and the discriminator filters.

If an RTTY signal of correct shift is tuned in, the voltage at point AA will increase to approximately 0.9 volts and will be the same for both mark and space. If the signal is not correctly tuned, however, or is not an RTTY signal, the voltage will fluctuate rapidly as the input frequency changes from mark to space. If the received RTTY signal has a frequency shift different from the demodulator discriminators, the voltage at AA (and hence the meter indication) can be made to remain constant as the input signal shifts between mark and space by "straddle tuning". However, the amplitude of the meter voltage will not be as great as when the input signal and the discriminators are matched.

The "plus-plus" signal from point AA in the ST-5 is supplied to point 1 of the autostart circuit, as shown in the ST-5AS schematic diagram (Figure 1). The operational amplifier, OA-1, senses the difference in potential between a 0.7 volt reference source (formed by diode D2 and biasing resistor R3) and the "plus-plus" signal, which is reduced in amplitude and integrated by

resistors R1, R10, R2, and C1. The "plus-plus" voltage required to exceed the 0.7 volt reference (that is, the "trip point") is adjustable over a small range by resistor R1; further adjustment can be made by changing R2 or R10. The turn-on time of the autostart is nominally three to four seconds and can be adjusted by changing the value of C1 and/or R1 and R10. The autostart can be defeated by closing switch S1, which shorts out bias diode D2.

When an RTTY signal is present, the voltage on pin 2 of OA-1 exceeds the reference voltage applied to pin 3 (0.7 volt), and the output of OA-1 (pin 6) quickly changes from plus 10 to minus 10 volts ($\pm 1v$). This negative signal rapidly charges C2 through diode D3, turning on transistors Q1 and Q2, the relay, and therefore, the motor. In this condition, diode D4 is reverse biased and the keyer stage of the ST-5 is allowed to function.

If the RTTY signal disappears, the "plus-plus" voltage drops below 0.7 volt and, after a time delay determined by C1, the output of OA-1 returns to +10 volts. Diode D4 immediately conducts and forces the keyer stage of the ST-5 into a "mark-hold" condition, thus preventing the printing of garble from noise. Also, Diode D3 is reverse-biased and C2 starts discharging through R6. After approximately 30 seconds, the voltage across C2 has decreased sufficiently that Q1, Q2, the relay, and the motor all turn off. Manual control of the motor is also provided by adding a pole to the ST-5's receive-standby switch.

6. TROUBLESHOOTING

In case the ST-5AS does not work correctly, carefully recheck the wiring of the circuit board and all interconnections to the ST-5 board and the relay. Often a friend can find wiring errors the builder has repeatedly overlooked.

If the wiring is correct and the problem persists, measure the voltages at the points listed in the following table. The voltages listed are approximate and minor deviations are acceptable. A 20,000 ohms-per-volt multimeter is adequate for all measurements except those at pin 3 of the operational amplifier (OA-1) and the base of Q-1. At these points, use a meter having an input impedance of 10 megohms or more (such as a VTVM or FETVM). Measure the voltages under two conditions: first, with no signal applied, and then with a 2125 Hz mark tone fed to the ST-5 input. Adjust the mark tone frequency for a maximum indication on the tuning meter.

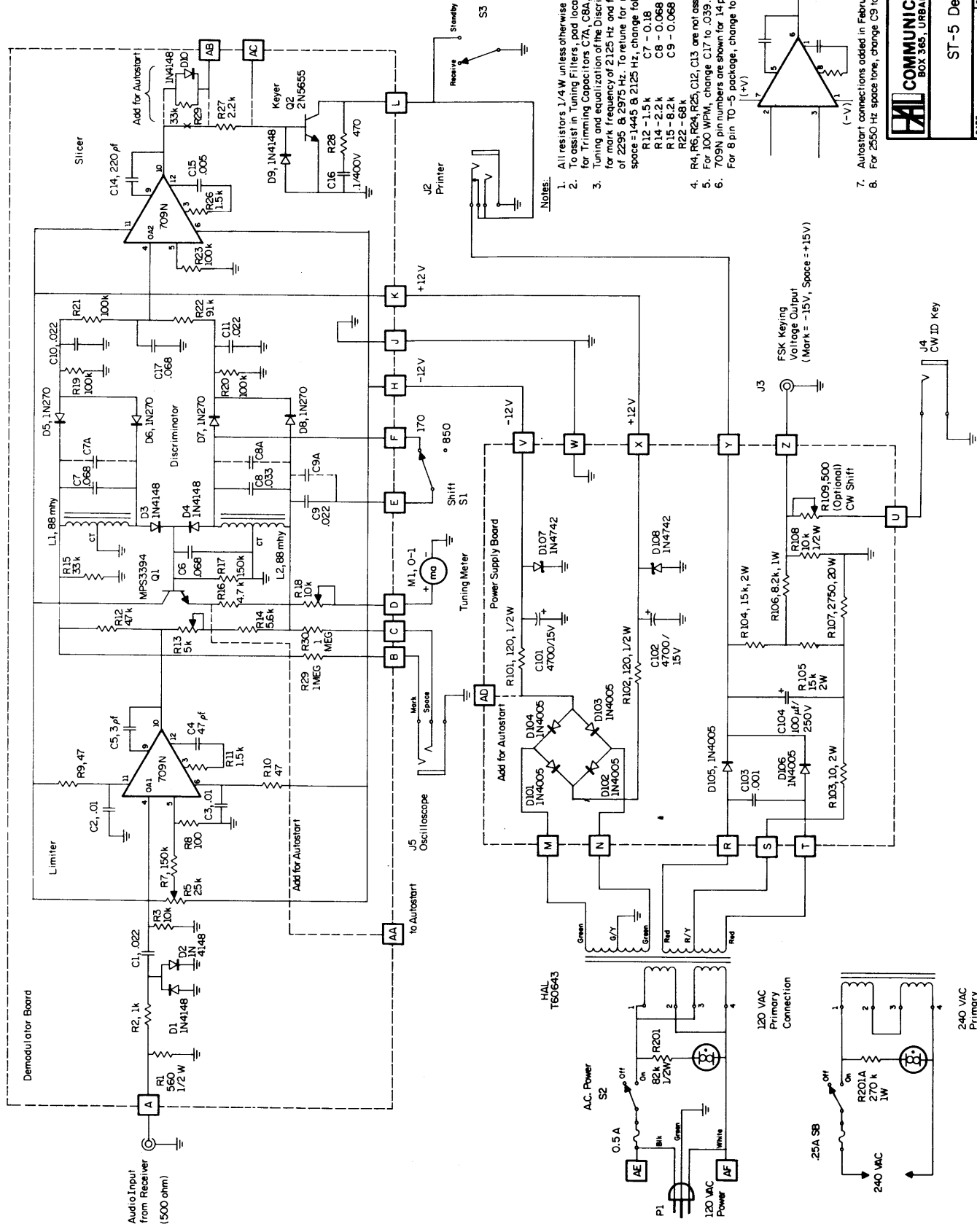
ST-5 INPUT	NO SIGNAL	MARK SIGNAL
CKT. BD. No. 1	0V	+7.0V
" " " 2	+11.5 ("+12")	+11.5 ("+12")
" " " 3	+0.62*	+0.62*
" " " 4	+10.0	+10.0
" " " 5	-12.3 ("-12")	-12.3 ("-12")
" " " 6	-20.0	-0.08
" " " 7	0 (GND)	0 (GND)
" " " 8	-20.0	-12.3
" " " 9	-20.0	-17.2
OA-1, pin 2	0	+0.95
" " 3	+0.62	+0.62
" " 6	+10.6	-10.0
Q1 base	-0.4	-8.0
Q1 emitter	0	-9.2

*S1 in "Auto-On" position

If checking these voltages does not lead to a solution of the problem, please write the factory, fully explaining the difficulties and measurements made.

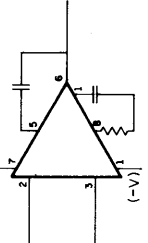
7. DIAGRAMS

The schematics and parts layout drawings are shown on the following pages.



Notes:

- All resistors 1/4W unless otherwise noted.
- To assist in Tuning Filters, pad locations are provided for Trimming Capacitors C7A, C8A, & C9A.
- Tuning and equalization of the Discriminator is shown for mark frequency of 2125 Hz and for space frequencies of 2295 & 2575 Hz. To retune for mark = 1275 Hz & space = 1445 & 2125 Hz, change following components:
 R12 - 1.5 k
 C7 - 0.18
 R14 - 2.2 k
 C8 - 0.068
 R15 - 8.2 k
 R22 - 88 k
 R12 - 1.5 k
 C7 - 0.18
 R14 - 2.2 k
 C8 - 0.068
 R15 - 8.2 k
 R22 - 88 k
- R4, R6, R24, R25, C12, C13 are not assigned.
- For 100 WPM, change C17 to .039.
- For 709N pin numbers are shown for 14 pin DIP package. For 8 pin TO-5 package, change to:

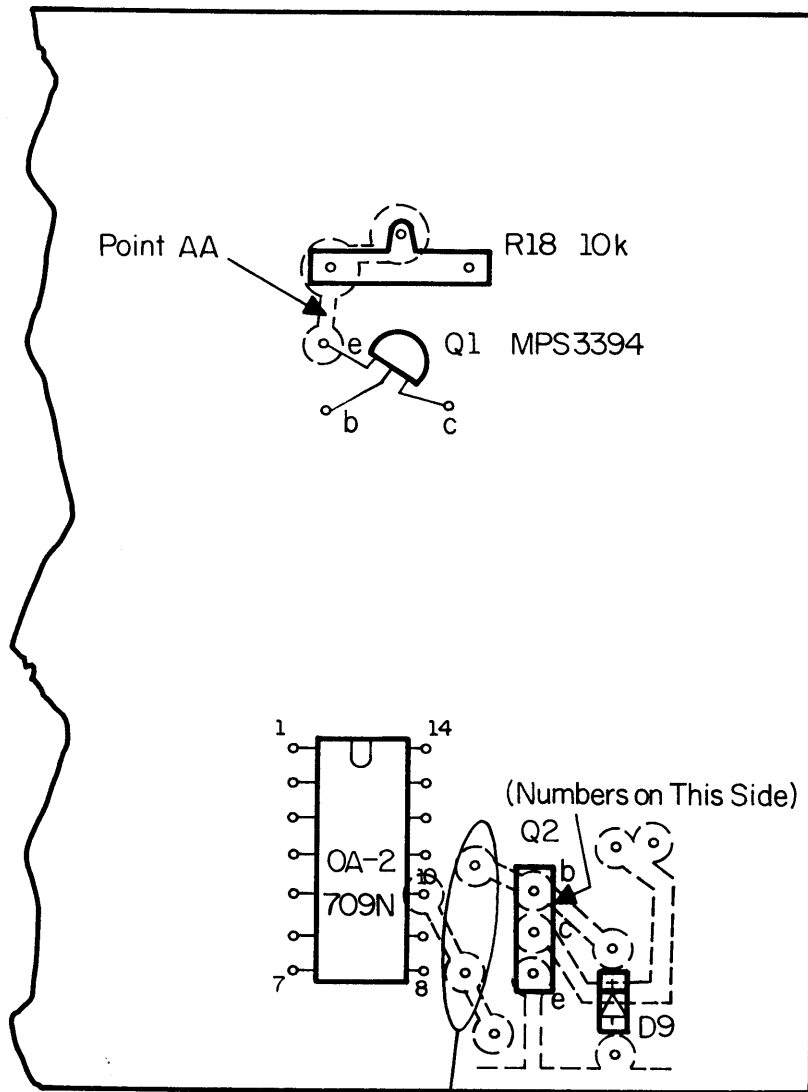


- Autostart connections added in February, 1973.
- For 2500 Hz space tone, change C9 to .033, C9A to .012.

COMMUNICATIONS CORP.
 BOX 365, URBANA, ILLINOIS, 61801

ST-5 Demodulator

DATE: July 19, 1972 SCALE: _____
 APPROVED: G. W. H. No. ST-5, S



Replace R27 (2.2k) with this assembly:

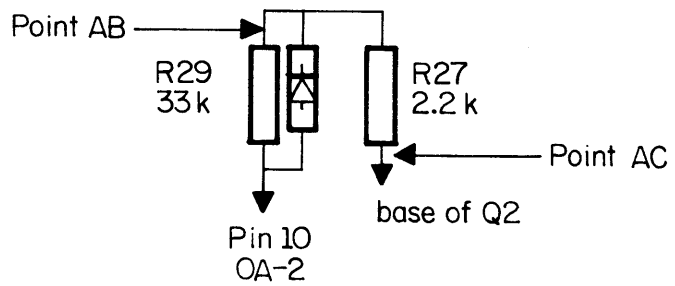


Fig. 4a Modifications Required on Early ST-5 Kits

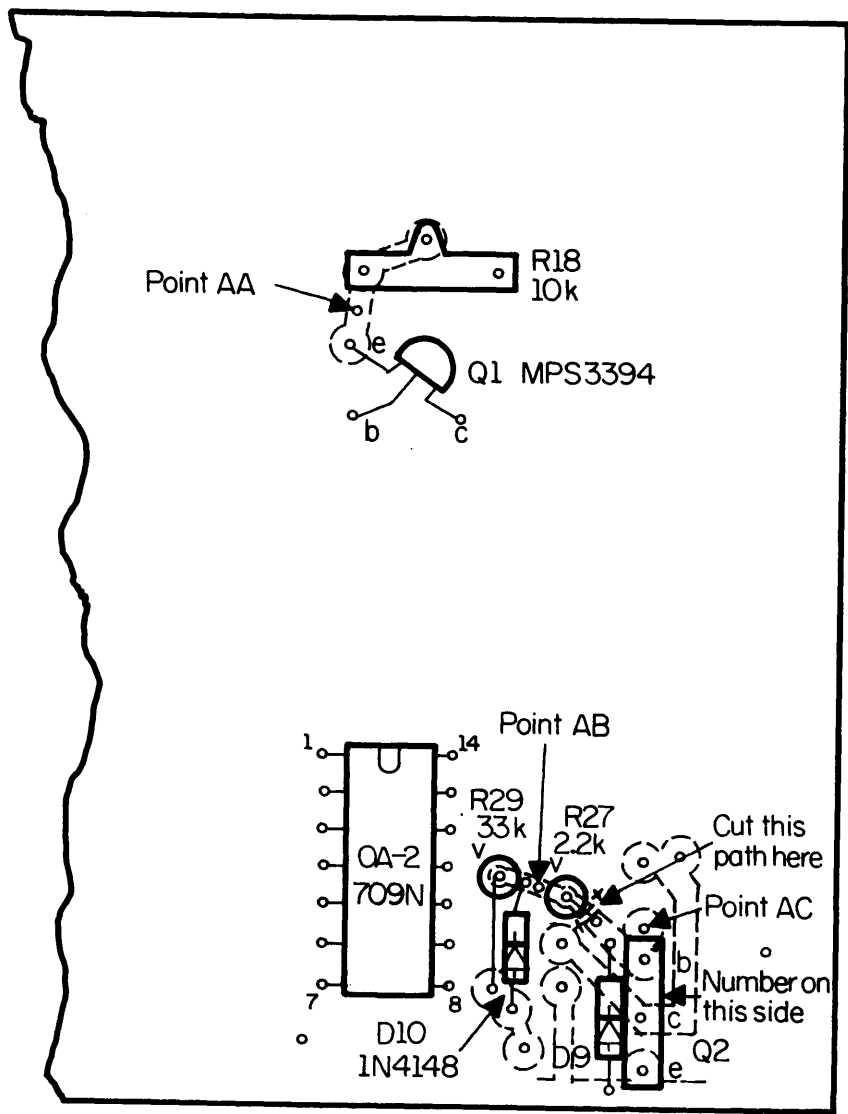


Fig. 4b Modifications Required on Current ST-5 Kits

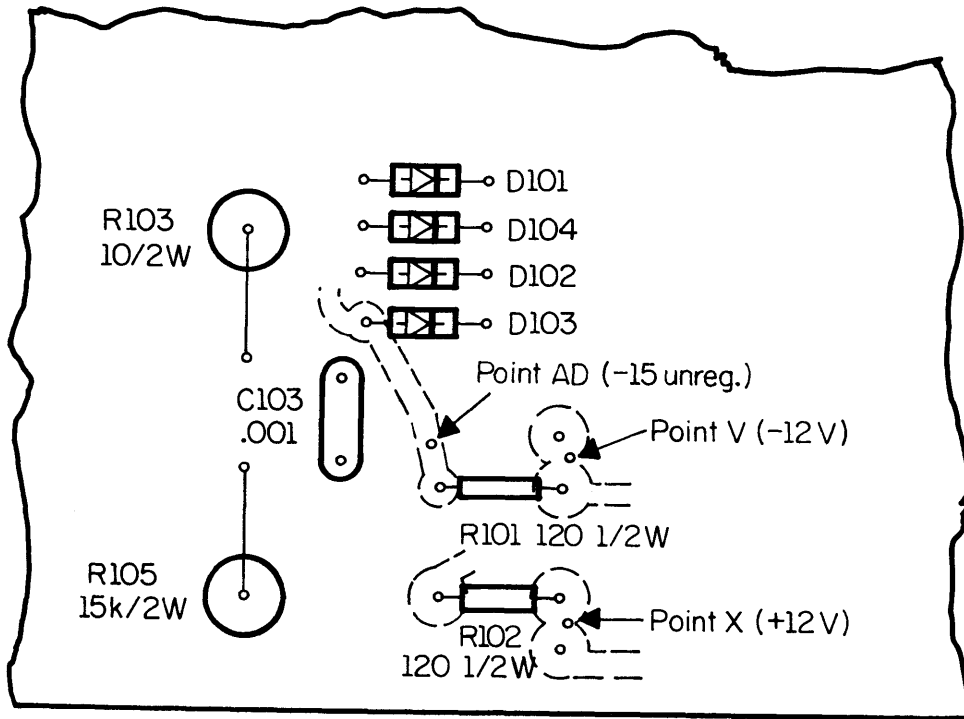


Fig.4c Connection Points on ST-5 Power Supply

8. PARTS LIST

Resistors

- 1 - 47 ohm, 1 watt
- 1 - 1K, $\frac{1}{4}$ w
- 1 - 2.2K, $\frac{1}{4}$ w
- 1 - 10K, $\frac{1}{4}$ w
- 2 - 33K, $\frac{1}{4}$ w
- 1 - 91K, $\frac{1}{4}$ w
- 1 - 100K, $\frac{1}{4}$ w
- 1 - 220K, $\frac{1}{4}$ w
- 1 - 1 meg, $\frac{1}{4}$ w
- 1 - 250K trimpot

Capacitors

- 2 - 22uf/16V
- 1 - 1000uf/25V

Semiconductors

- 6 - 1N4148 diodes (one for ST-5 modification)
- 1 - MPS3703
- 1 - MJE370
- 1 - 741N Integrated Circuit

Miscellaneous

- 1 - Circuit board
- 1 - 12VDC relay
- 1 - SPST toggle switch
- 1 - DPDT toggle switch
- 1 - 120VAC receptacle
- 1 - manual
- 1 - Length, hook-up wire
- 2 - Angle brackets
- 4 - 6-32x $\frac{1}{4}$ screws
- 5 - 6-32 nuts
- 5 - #6 lockwashers