



Flesher Corporation

TU-170A OPERATORS MANUAL

900 082

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For 90 days from the date of original retail purchase, any kit or wired unit that fails to perform in accordance with the specifications accompanying it, when properly used and when connected with equipment with which it is compatible, will be repaired or replaced in a reasonable time without charge. J. A. Fleisher Company, Inc., does not warrant compatibility of its products with any particular radio or TTY equipment; connection of a J. A. Fleisher Company, Inc. kit or wired unit to equipment with which it is not compatible shall be deemed unreasonable use of the product. The determination of the compatibility of a J. A. Fleisher Company, Inc. product with any such radio or TTY equipment and the determination of what, if any, components to use in completing such connection and insuring such compatibility are and shall remain the sole responsibilities of the purchaser.

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There is no other express warranty
on this kit or wired unit.

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Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

WARRANTY DOES NOT COVER DAMAGE RESULTING FROM IMPROPER ASSEMBLY OF KITS.

UNPACKING AND CARE
MOTOROLA

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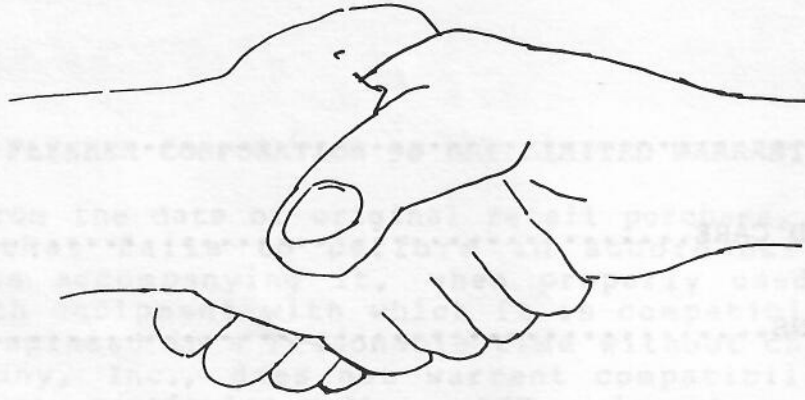
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INTRODUCTION



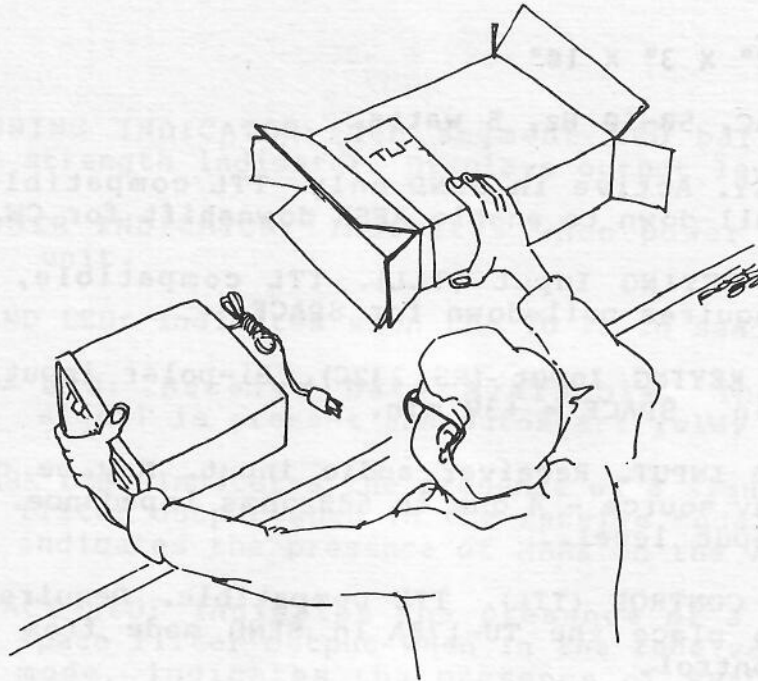
C O N G R A T U L A T I O N S

on your purchase of an Flesher Corporation professional quality TU-170A RTTY terminal unit. Your investment in Flesher Corporation RTTY products is an investment in operating pleasure for years to come. Each Flesher Corporation product is backed up by years of engineering experience and technological innovation, assuring you a high degree of reliability you expect in professional electronic equipment.

The TU-170A is a result of customer input and over a year of development. The combination of this input, professional engineering and quality components make the TU-170A a highly reliable and versatile RTTY terminal unit. We welcome you to the growing family of Flesher Corporation product owners.

To be sure of obtaining the best possible performance from your new Flesher Corporation TU-170A, read this operating manual carefully to become thoroughly familiar with the various features and controls before connecting it into your system.

UNPACKING AND CARE



- * Carefully remove all items from the container and check for damage.
- * Before discarding any of the packing material, examine the container carefully for items you may have overlooked. It will be to your advantage to save original carton and fillers. They will prove valuable in preventing damage should you ever have to transport or ship the unit.
- * Do not attempt installation without first reading the OPERATING INSTRUCTIONS and CONNECTION ILLUSTRATIONS.
- * The TU-170A must not be exposed to excessive moisture, or direct sources of heat.
- * All wiring should be made as short in length as possible.
- * Be sure the system is grounded with a good earth or water pipe ground to provide some protection against voltage surges and built-up static charges. Ground leads should be as short as possible.
- * To clean the cabinet, use a mild glass cleaner and soft cloth. Care should be taken when cleaning the front panel or rear panel. Markings could be damaged with excessive pressure and with certain cleaners.
- * In extended non-use periods, it is recommended that the appliance power cord be unplugged from the outlet.

TU-170A SPECIFICATIONS

- SIZE:** 7 1/2" X 3" X 10"
- POWER:** 120VAC, 50-60 Hz, 5 watts.
- INPUTS:** CW KEY. Active in SEND only. TTL compatible. Requires pull-down to enable AFSK downshift for CW ID.
- AFSK KEYING Input (TTL). TTL compatible, MARK high. Requires pull-down for SPACE.
- AFSK KEYING Input (RS 232C). Bi-polar input. MARK = -3V min., SPACE = +3V min.
- AUDIO INPUT. Receiver audio input. May be connected to any source - 4 ohm to 600 ohms impedance. 100 mv min. input level.
- SEND CONTROL (TTL). TTL compatible. Requires pull-down to place the TU-170A in SEND mode from an external control.
- OUTPUTS:** KEYING OUTPUT (TTL). TTL compatible demodulator output. MARK high.
- KEYING OUTPUT (RS 232C). Bi-polar demodulator output. MARK = -6V min., SPACE = +6V min. into a 3K ohm load.
- SCOPE OUTPUTS. High impedance (50K ohms) MARK and SPACE filter outputs, phase corrected for accurate "+" scope tuning display.
- AFSK AUDIO OUTPUT. Adjustable level (0 to 2 volts RMS), 600 ohm impedance.
- FSK OUTPUT. Bi-polar output. MARK = -6V min., SPACE = +6V min. into a 3K ohm load.
- AUXILIARY POWER (autostart). 5 amp relay contact output with standard U.S. 120 VAC power receptacle on the rear chassis.
- AUXILIARY SEND/RECEIVE switch contacts. Single pole, single throw auxiliary contacts from front panel SEND/RECEIVE switch.
- RDA OUTPUT. Receive Data Available. TTL compatible output with active pull-down. Indicates presence of received signal in receive mode. Locked ON (pulled down) during SEND.

TU-170A SPECIFICATIONS

- DISPLAYS:** **TUNING INDICATOR:** Ten segment LED bar graph signal strength indicator. Displays output level of filters.
- POWER INDICATOR:** Indicates when power is applied to unit.
- SEND LED:** Indicates when the TU is in send mode.
- RDA LED:** Receive Data Available. Indicates when signal is present and autostart relay is on.
- MARK LED:** Indicates the presence of a signal at the mark filter output when in the receive mode. In send mode, indicates the presence of MARK on the AFSK input.
- SPACE LED:** Indicates the presence of a signal at the space filter output when in the receive mode. In send mode, indicates the presence of SPACE on the AFSK input.
- AUXILIARY INPUT/OUTPUT CONNECTOR P2:** Auxiliary connector for optional loop power supply. TTL compatible keying input and output connections and +12 volts and ground.

TU-170A CIRCUIT DESCRIPTION

ACTIVE FILTER

Each of the TU-170A active filters consists of three stages of two pole active bandpass filters. Each stage is a low gain, low Q stage which, when cascaded with the other two stages, results in a very stable, high Q filter.

On all filters except the filters tuned for 2295 Hz (HI-TONES) or 1445 Hz (LO-TONES), R1 is the input resistor. R2, R3, R4, C1 and C2 are not used. The first stage of the active filter consists of the first half of IC1, the second stage the other half of IC1, and the final stage, the first half of IC2. Each stage is tuned independently with a trimmer potentiometer. The second half of IC2 is used as a voltage level comparator. The output of the comparator switches the bias voltage for the gate of the field effect transistor Q1, which switches the audio output from the third active filter stage to the output connection of the filter board. Q1 transistor is switched off when the output "pin 7" of IC2 is approximately minus 10 volts. Q1 switches on when the output of IC2 changes to plus 10 volts. Pin 7 of IC2 is at the minus 10 volt potential when the inverting input (pin 6) is a higher voltage level than the non-inverting input (pin 5).

On the ACTIVE FILTER board tuned to 2295 Hz or 1445 Hz, an additional phase shift network is formed by resistors R2, R3, R4 and capacitors C1 and C2. This phase shift network provides additional delay of the signal passing through the filter to provide proper phase relationship between the mark and space signals to give a proper plus shaped oscilloscope pattern which may be used for tuning.

Frequency select diodes 0 through 7 are used to select the output frequency of audio frequency shift keyer (AFSK).

DEMODULATOR

The TU-170A DEMODULATOR consists of a discriminator stage, low pass filter stage, signal balance restorer circuit, slicer circuit and a mark hold circuit.

The discriminator circuit consists of diodes D1 and D2, and resistors R1, R2 and R15. The output from the discriminator is a pulsating DC voltage of the polarity determined by which of the filter signals (mark or space) is dominant.

The discriminator is connected to the input of the low pass filter at the junction of C1, R3 and R16. C2 and IC1 complete the low pass filter circuit.

The output of the low pass filter is connected to the signal balance restorer circuit. The circuit supplies an output voltage to R8 which is summed with the output of the low pass filter through

TU-170A CIRCUIT DESCRIPTION

R6 to offset any signal level difference between the mark and space filter outputs, the space output from the low pass filter is negative and the mark output is positive. This signal is connected to two precision rectifier stages, one being a positive rectifier and the other being a negative rectifier. The output from each rectifier charges capacitors C3 and C4 respectively and is summed through R4 and R5. Any difference in the level of the mark and space voltages at the output of the low pass filter then appears as a non-zero output from the summing resistors R4 and R5. This error voltage is amplified by IC1 part 'C' and summed with the original output voltage of the low pass filter at the inverting input of IC2, stage 'A'. The output from the signal balance restorer provides a bias voltage which will center the output levels of the low pass filter at the input of the slicer.

The slicer stage, IC2 stage 'A', is a positive feed back or hysteresis type slicer. As such, it has a dead band which is determined by the ratio R9 and R10 resistors, and will only change state when the input voltage exceeds the hysteresis level. This circuit prevents low level signal fluctuation from generating erroneous output signals.

The MARK HOLD circuit returns the TU output to the mark state any time a space signal is longer than any normal space pulse width should be. On the TU demodulator this is set at approximately 150 MS. The output of the slicer for a space signal is a positive going voltage. This positive going transition, coupled through C5, raises the voltage across R12 to approximately +12 volts and then decays towards zero as capacitor C5 charges. The initial positive going signal is greater than the voltage level set by voltage divider R13 and R14 on the non-inverting input of IC2. This causes the output of IC2 to go positive. As C5 charges through R12, the voltage at the non-inverting input of IC2 decays towards zero and as this decaying voltage crosses the threshold level set by voltage divider resistors R13 and R14, the output of IC2 switches negative. Under normal conditions, the length of time that the output of the slicer is positive is less than the length of time required for C5 to charge through R12. Therefore the mark hold circuit will have no noticeable effect on the output signal. Only when the space signal from slicer output exists for longer than the decay time determined by C5 and R12 will the mark hold circuit take effect.

AUDIO FREQUENCY SHIFT KEYER (AFSK)

The TU-170A AUDIO FREQUENCY SHIFT KEYER is a crystal controlled oscillator, programmable frequency divider, and band pass filter which provides a sinusoidal audio frequency output in the range from 2000 to 3000 Hz (HI-TONES).

The time base for the TU-170A AUDIO FREQUENCY SHIFT KEYER is a 5.508 Mhz crystal connected to a CMOS 4069 inverter. The output of the oscillator is connected directly to the input of the first

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CIRCUIT DESCRIPTION

programmable divider, IC2. The output of IC2 is connected to the second programmable frequency stage IC3. Together IC2 and IC3 provide frequency division by any integer number between 2 and 256. The output from the programmable dividers IC2 and IC3 is connected to a divide by sixteen divider, IC4. IC4 is enabled or disabled by an external connection. By this method the output of the AUDIO FREQUENCY SHIFT KEYER is turned on and off. The output of IC4 is a symmetric square wave which is connected to the input of the low pass filter IC5. This low pass filter is designed to have a relative flat response in the range from 2000 to 3000 Hz (HITONES).

MAIN CIRCUIT BOARD LOGIC

The MAIN CIRCUIT BOARD logic consists of the input and output circuits necessary to interface the various plug in circuit boards with the front panel controls and the "outside world".

INPUTS

KEY-N input switches the AFSK to the downshift CW ID frequency when the TU is in the transmit mode. KEY-N input is a TTL compatible input connected to an inverter transistor Q3. Q3 provides isolation from the outside world and the CMOS inverter IC3 (pin 2). The output of the inverter enables the CW ID frequency select diodes on the AFSK circuit board. The output of the inverter also connects to AND gates IC2 (pin 5 and pin 8). These two gates disable the mark and space frequency control. KEY-N must be pulled "LO" to downshift.

AFSKIN-TTL input signal causes the AFSK to switch between mark and space frequencies when the TU is in the transmit mode. This input must be high for a mark frequency output and low for a space frequency output. AFSKIN-TTL signal connects to inverter transistor Q4 which provides isolation between the outside world and the CMOS inverter IC1. The output of IC1 (pin 14) is wired OR'ed with the output of IC1 pin 15 which is the bi-polar serial input for the AFSK. (AFSKIN-RS) This signal also connects to inverter IC1 (pin 1). Reverse shift of a send signal is accomplished by selecting either the input signal of IC1 (pin 1) or the output signal of the same stage (pin 16) "SEND REVERSE" switch. The output of this switch connects to IC2 (pin 6) and provides the frequency switching control for mark and space frequencies. AFSKIN-TTL is TTL compatible.

AFSKIN-RS input also provides the determination of the mark or space output frequencies when the TU is in the transmit mode. This signal is connected through IC1 pin 2 and is wired OR'ed with the AFSKIN-TTL signal. AFSK-RS input requires a bi-polar input signal.

SEND-N controls the operating mode of the TU. When SEND-N line is left open or held at plus five volts the TU is in the receive mode. When SEND-N is pulled down or to a low TTL level, the TU is

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switched to the send mode. This signal disables the outputs of all the active filters by changing the bias level of the enable filter line through R37 and R38. The enable filter signal is at a positive voltage level in receive mode, and a negative voltage level in the transmit mode. SEND-N also is connected to inverter transistor Q8 which serves as isolation between the outside world and the CMOS circuits. The collector of Q8 is connected to inverter IC3 which enables the AFSK and to the inputs of gates IC2 (pin 2) and IC2 (pin 12). When enabled, these gates allow the mark and space LED's on the TU front panel to indicate the status of the AFSK input signal. The mark and space LED's are turned on by IC1 (pin 10) and IC1 (pin 11). The output of Q8 is low when in the send mode. This enables both the selected space filter select diodes and the mark filter select diodes through diodes D6 and D7 respectively. The AFSK input signal provides the final determination of which frequency is selected.

RECEIVE AUDIO input signal is the signal from the receiver audio output circuit which contains the audio frequency shifted TTY signal. This signal must be tuned so that the mark frequency is at 2125 Hz (HI-TONES) or 1275 Hz (LO-TONES) and the space signal 2295 Hz (HI-TONES) or 1445 Hz (LO-TONES) respectively. Minimum audio input level is 100 mv.

OUTPUT SIGNALS

RDA (RECEIVE DATA AVAILABLE) output indicates the presence of an output signal from the mark filter. Diode D17 rectifies the mark audio output. The signal is summed and filtered by C4. This voltage level is then compared to the reference level set by R28 and R29 at IC5 (pin 3). This reference voltage is approximately + 4 volts so that when the peak output of the filter exceeds 4 volts peak the output of IC5 (pin 1) will go to approximately negative 10 volts. This causes C5 to discharge through R44 and D20 and as soon as the decaying voltage drops below approximately 6 to 7 volts negative, the output of IC5 (pin 7) switches positive. This positive output drives the input of IC3 (pin 7) which pulls RDA output low. IC3 (pin7) also turns on the RDA LED on the front panel through R33. If the audio output level of the filters drops below the threshold voltage set by R28 and R29, the output of IC5 (pin 1) will go to approximately +10 volts. This positive voltage will charge capacitor C5 through R30. When the voltage level of IC5 exceeds approximately 8 volts, the output of IC5 (pin 7) returns to the negative state and the RDA output goes to a TTL high level state. The comparator circuit is forced to the RDA 'ON' state by D9 when the TU is in the transmit mode, and is disabled when the front panel STANDBY switch is depressed.

DMOUT-TTL output is derived from the demodulator circuit board output which drives Q5 through D3 and R16 to a low state when a space output is present from the demodulator. DMOUT-TTL is pulled to a high TTL level by the voltage divider combination of the SIP and R15 when a mark signal is present at the demodulator output.

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DMOUT-RS signal is the demodulator output signal passed through current limiting resistor R10. This is a bi-polar signal, mark = -10 volts and space = +10 volts (no load).

SCOPE MARK output is a monitor output from the 2125 Hz (HI-TONES) or 1275 Hz (LO-TONES) mark filter through current limiting resistor R8.

SCOPE SPACE output is the audio output from the selected space filter through current limiting resistor R7.

OTHER CIRCUITS

MARK LED on the front panel is turned on by two different circuits depending on whether the TU is in transmit or receive mode. In the receive mode the MARK LED is driven by the audio output from the mark filter rectified through D5 which drives IC1 (pin 5). Since this input is a pulsating DC audio voltage, the output of IC1 (pin 12) will also be a pulsating voltage. The pulsation rate is too high to be noticed by the eye and the LED will appear to be fully on. Current is limited through the LED by resistor R20. In the transmit mode the MARK LED is controlled by the condition of the AFSK input signal which is gated through IC2 (pin 3). This input drives the inverter IC1 (pin 6). The output of IC1 (pin 11) turns on the MARK LED through R18 and R20 current limiting resistors.

SPACE LED is controlled in a similar manner to the MARK LED.

RECEIVE AUDIO AMPLIFIER is a two stage amplifier consisting of Q1 and Q2. The audio input signal is coupled to Q1 through C1 and resistor R1. The voltage divider consisting of R2 and R3 provides base bias for the base of transistor Q1. Q2 is an emitter follower which drives the signal level clipping diodes D1 and D2. The clipped audio signal drives all active filter inputs.....

TU-170A OPERATING INSTRUCTIONS

FRONT PANEL SWITCH FUNCTIONS

POWER: Alternate action switch, turns power line on.

STAND-BY: Alternate action switch. Locks the demodulator output in the MARK state, and turns on the Autostart power output. Autostart power will remain on for approximately 5 seconds after normal mode is restored.

SEND/REC: Alternate action switch:

RECEIVE: Enables filters and places the demodulator output on the TTL and RS 232 output lines.

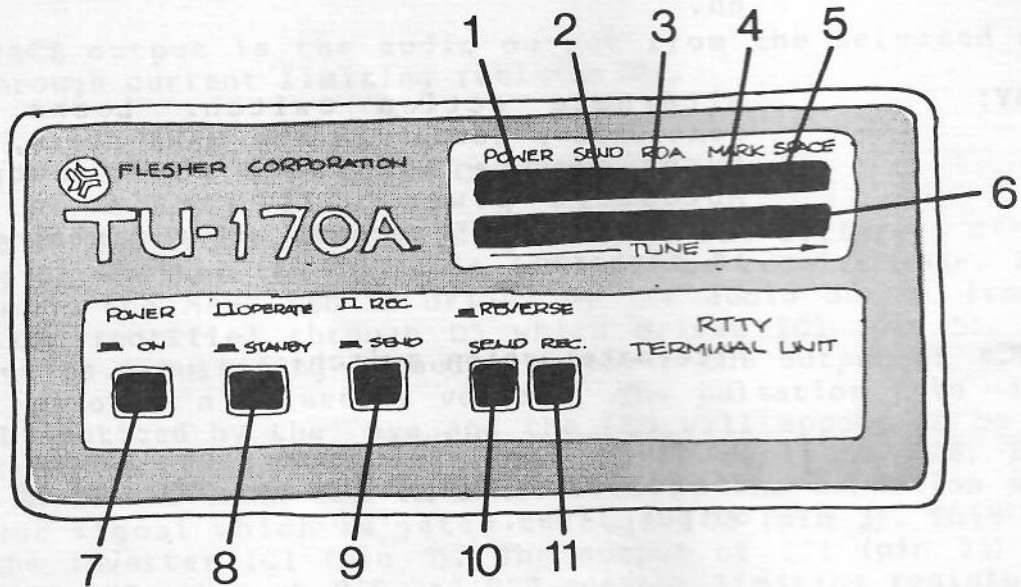
SEND: Locks the demodulator outputs in the MARK condition. Enables the AFSK audio output and closes the auxiliary switch contacts.

REVERSE SHIFT: Alternate action switches:

RECEIVE: Reverses the MARK and SPACE assignments of the audio frequencies.

SEND: Reverses the output frequency assignments to MARK and SPACE AFSK inputs.

TU-170A OPERATING INSTRUCTIONS

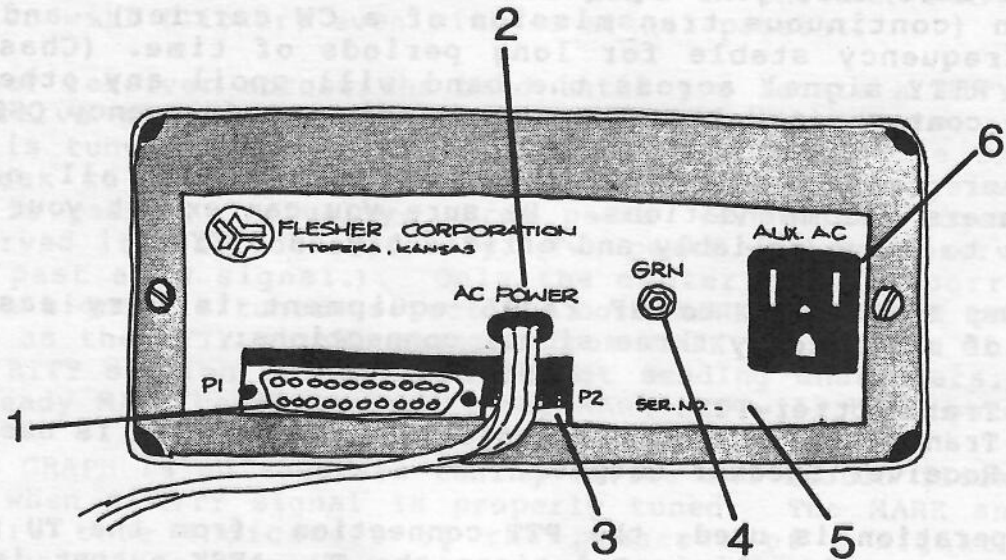


FRONT PANEL

I N D I C A T O R S A N D S W I T C H E S

- | | | |
|---------------------|----------------------|----------------------|
| (1) POWER INDICATOR | (5) SPACE INDICATOR | (9) SEND/RECEIVE |
| (2) SEND INDICATOR | (6) TUNING INDICATOR | (10) REVERSE SEND |
| (3) RDA INDICATOR | (7) POWER | (11) REVERSE RECEIVE |
| (4) MARK INDICATOR | (8) OPERATE/STANDBY | |

TU-170A CONNECTION ILLUSTRATIONS



REAR CHASSIS PANEL

- | | | |
|-------------------|---------------------|-----------------------------|
| (1) P1 CONNECTOR | (3) P2 CONNECTOR | (5) SERIAL NO. (WIRED UNIT) |
| (2) AC POWER CORD | (4) GROUND TERMINAL | (6) AUXILIARY AC |

TU-170A OPERATING INSTRUCTIONS

Some years back, operating RTTY on HF was a lot of work. Today, the TU-170A eliminates most of the work, reduces most of the installation time, and makes operating more enjoyable.

Many brands of HF radio equipment have improved stability and reliability for operating RTTY mode; however, there are some hints a new operator to RTTY should be aware of.

First, be sure that your equipment is rated to handle 'key down' operation (continuous transmission of a CW carrier), and will remain frequency stable for long periods of time. (Chasing a drifting RTTY signal across the band will spoil any otherwise enjoyable contact as well as aggravate adjacent frequency QSO's.)

Check your radio equipment manuals and observe all of the manufacturers recommendations. Be sure you can expect your radio equipment to serve reliably and efficiently on RTTY.

Connecting a TU-170A to HF radio equipment is very easy and consists of making only three signal connections:

- 1) Transmitter PTT
- 2) Transmitter Microphone Audio Input (when AFSK is used)
- 3) Receiver Speaker Output.

If VOX operation is used, the PTT connection from the TU to the transmitter can be eliminated since the TU AFSK output is only enabled in the transmit mode.

If your transmitter has FSK capability and you wish to use it, an FSK connection replaces the Transmitter Microphone Audio Input connection.

Lower side band is normally used for RTTY on the HF bands with "MARK" low and "SPACE" high. (If you use FSK, most newer equipment automatically limits the power output and switches to lower side band in this mode.) If AFSK is used, be sure to consult your operating manual so that the transmitter continuous power rating is not exceeded.

VHF and UHF RTTY equipment is connected the same as HF equipment except FSK is not normally used and AFSK is required. Again, consult your operating manual so you don't exceed the transmitter continuous power rating. (Some HF rigs are rated for continuous operation at full power.)

RECEIVING RTTY: Once you have made the proper connections to your equipment, receiving RTTY with the TU-170A is very easy; First, set all of the front panel switches on the TU to their 'OUT'

TU-170A OPERATING INSTRUCTIONS

position. Turn on your radio equipment and the TU and allow a proper warm up period for stabilization. (Most VHF and UHF equipment is crystal controlled and solid state and does not require warm up.)

When power is applied to the TU, the 'POWER' indicator LED will illuminate and the 'RDA' LED will turn on momentarily and then turn off. Set the receiver audio level control at a normal listening level and notice that the first few LED's on the BAR GRAPH tuning indicator will flicker, even with no signal present.

Tune your receiver across the band until you locate a RTTY signal and observe the BAR GRAPH, MARK and SPACE indicators. As the signal is tuned through 2125 to 2295 Hz (HI-TONES), the BAR GRAPH will peak to nearly full scale and then fall off again as the signal is passed. Actually, three peaks very close together can be observed if you look carefully. (Two peaks will be observed when tuning past a CW signal.) Only the center peak is correct and when the signal is tuned correctly, both MARK and SPACE LED's will flicker as the RTTY signal changes from MARK to SPACE. Of course, if the RTTY station being tuned is not sending characters, but is in a steady MARK condition, only the MARK LED will be lighted.

The BAR GRAPH is an accurate tuning device and should flicker very little when a RTTY signal is properly tuned. The MARK and SPACE LED's are true indicators of the presence of a signal in the respective filter channel (with a lot of QRM, both can be on at the same time, or in the absence of any signal, both will be off). Only when a signal is properly tuned and of the proper shift will the MARK and SPACE indicators blink in complementary fashion. When a signal is detected in the MARK channel filter, the 'RDA' LED will be turned on and the autostart relay will be energized.

If a signal appears to be tuned correctly but 'garbage' is printed, the station may be sending up-side-down (upper sideband), or at a different speed than your printing device. Try using the "Reverse Shift" on your TU-170A (are YOU set for lower sideband?) or select a different printer speed on your printing device. You will soon learn the sound of a properly tuned, 170 Hz RTTY signal.

SENDING RTTY with the TU-170A can be done using a variety of equipment such as a mechanical machine, computer, or a dedicated terminal. The TU will be placed in the transmit mode either by pressing the transmit switch on the TU or placing a ground on the 'SEND-N' remote transmit connection. The PTT output of the TU can be used to control the transmitter if the send/receive switch on the TU is used.

If AFSK mode is used, and your transmitter has VOX capability, then the PTT connection to the transmitter can be eliminated since the TU AFSK output is active only during transmit and will key the

TU-170A OPERATING INSTRUCTIONS

VOX circuit. When the TU is in transmit mode (regardless of how it is selected), the 'SEND' LED will light and the MARK/SPACE indicators will blink indicating keying from the keyboard device.

OPERATE/STANDY: The Operate/Standby switch is handy in some cases where you do not want an incoming signal to key your printing device (eg; during CW ID while copying a picture). For normal operation, this switch must remain in the 'OUT' position.

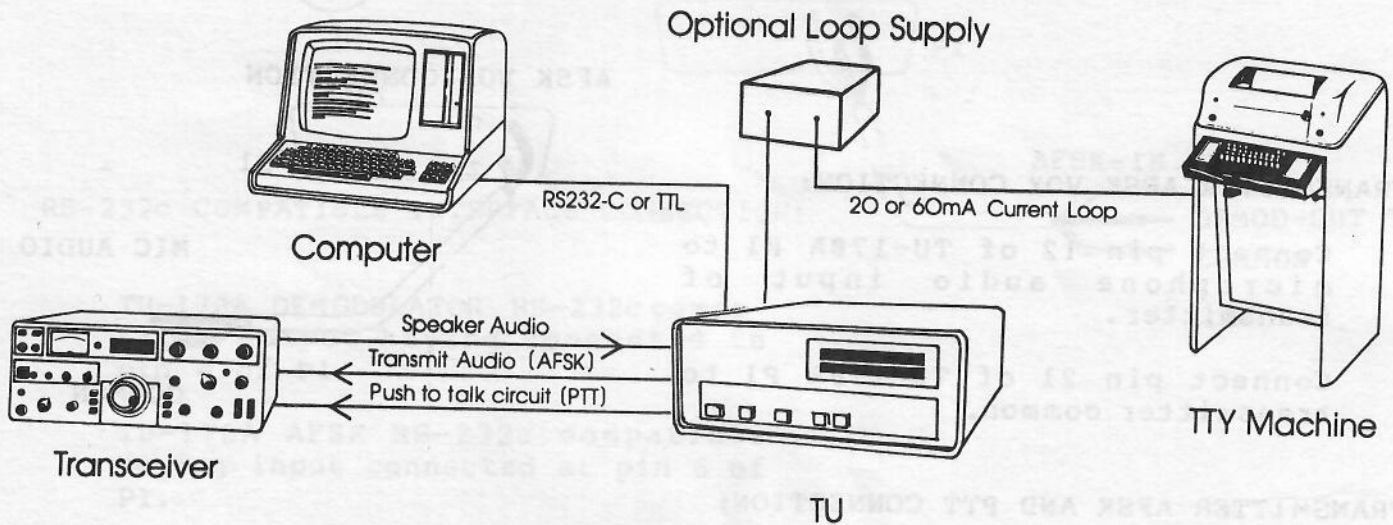
REVERSE SHIFT is handy in those cases when you wish to copy or send to a station which is 'up-side-down'. The separate send and receive switches provide the capability to cope with any combination of send and/or receive reverse shifts which might arise so that communication is possible with those stations which (knowingly or unknowingly) are 'up-side-down'. There are no rules concerning which sideband or which MARK and SPACE convention must be used, so if you want to be different and have an up-side-down QSO, you have all the controls to do so. In any case, this feature can be handy in unusual conditions.

The TU-170A MARK frequency is always 2125 Hz (HI-TONES) or 1275 Hz (LO-TONES) and the SPACE frequency is 170 Hz above MARK. The AFSK will only transmit tones to match the installed filter boards since the filter boards contain the frequency selection circuits for the AFSK.

The TU-170A will receive up to and including 300 baud when using HI-TONES, but sacrifices this speed if you have selected LO-TONES.

TU-170A CONNECTION ILLUSTRATIONS

The following illustrations may not meet your exact wiring needs, but are intended to show typical connections. Flesher Corporation does not provide connection drawings for specific equipment because of the wide variety of equipment available today. The Flesher Corporation warranty does not cover damage resulting from improper connection of the TU-170A to other equipment, and makes no claim that the TU-170A is compatible with specific equipment. It is the user's responsibility to determine the compatibility of the TU-170A with other equipment. Refer to the TU-170A specifications and the specifications of the equipment to which it will be connected.



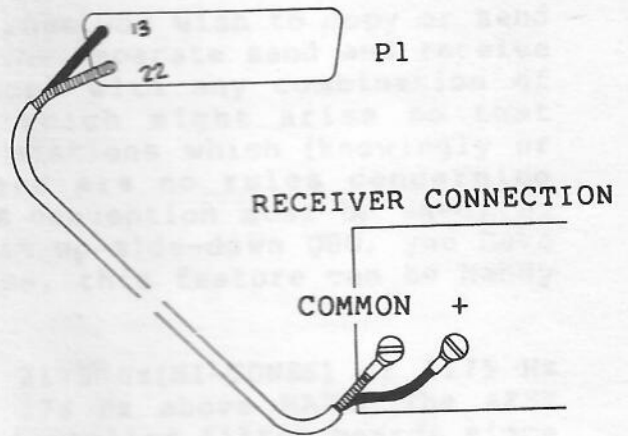
TU-170A CONNECTION ILLUSTRATIONS

Make sure that the POWER SWITCH is in the OFF position and the unit unplugged before making any installation or connections.

RECEIVER CONNECTION:

Connect pin 13 of TU-170A P1 to the receiver speaker plus terminal.

Connect Pin 22 of TU-170A P1 to the receiver speaker common terminal. Any output impedance from 4 ohms to 500 ohms will work.

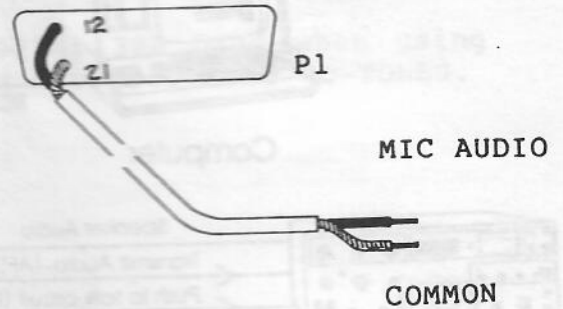


TRANSMITTER AFSK VOX CONNECTION:

Connect pin 12 of TU-170A P1 to microphone audio input of transmitter.

Connect pin 21 of TU-170A P1 to transmitter common.

AFSK VOX CONNECTION



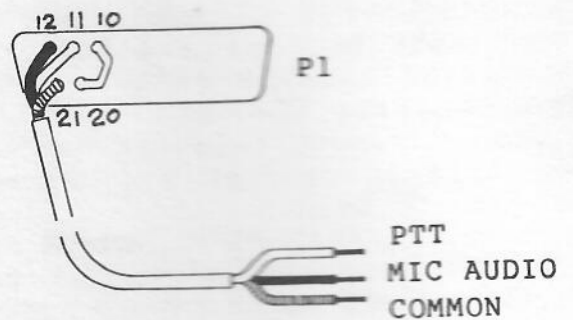
TRANSMITTER AFSK AND PTT CONNECTION:

Connect pin 12 of TU-170A P1 to microphone audio input of transmitter.

Connect pin 11 of TU-170A P1 to transmitter PTT.

Connect pin 21 of TU-170A P1 to the transmitter common.

Solder a jumper between pins 10 and 20 of TU-170A P1.

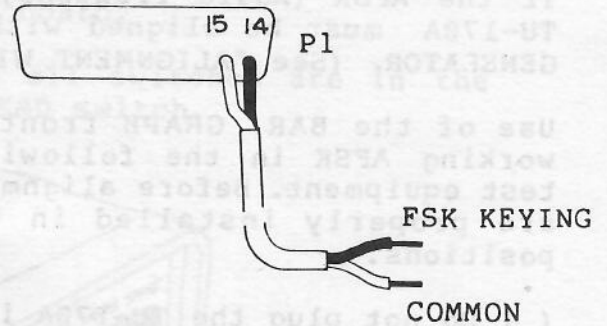


TU-170A CONNECTION ILLUSTRATIONS

TRANSMITTER FSK CONNECTION:

Connect pin 14 of TU-170A P1 to FSK keying input of transmitter.

Connect pin 15 of TU-170A P1 to transmitter common.

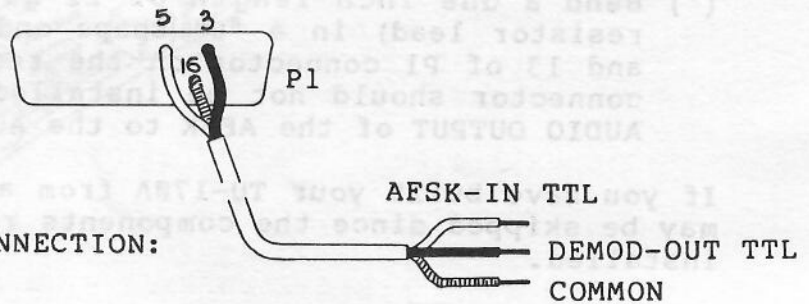


TTL COMPATIBLE INTERFACE CONNECTION:

TU-170A DEMODULATOR TTL compatible keying output connected at pin 3 of P1.

TU-170A AFSK TTL compatible keying input connected at pin 5 of P1.

TU-170A common at pin 16 of P1.

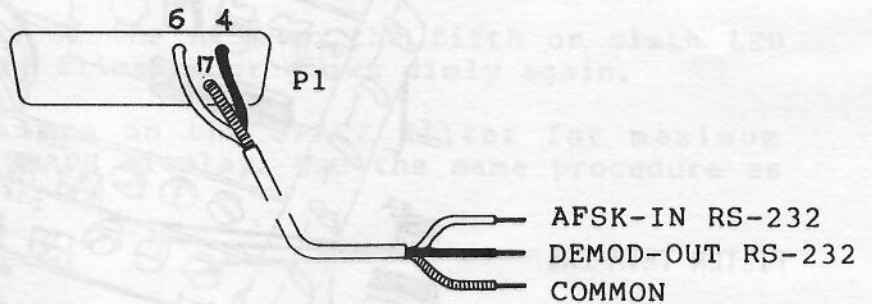


RS-232c COMPATIBLE INTERFACE CONNECTION:

TU-170A DEMODULATOR RS-232c compatible output keying connected to pin 4 of P1.

TU-170A AFSK RS-232c compatible keying input connected at pin 6 of P1.

TU-170A common connected at pin 17 of P1.



TU-170A ALIGNMENT

WITHOUT TEST EQUIPMENT, but WITH AFSK INSTALLED

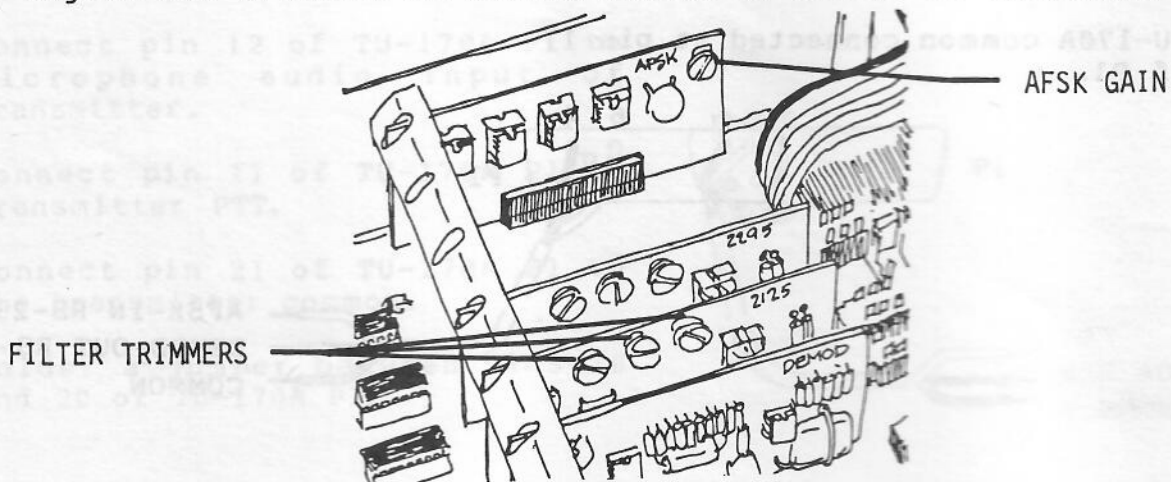
If the AFSK (Audio Frequency Shift Keyer) is not installed, the TU-170A must be aligned with a calibrated sine wave AUDIO SIGNAL GENERATOR. (See "ALIGNMENT WITH TEST EQUIPMENT".)

Use of the BAR GRAPH front panel display and an installed and working AFSK in the following procedure eliminates the need for test equipment. Before alignment, check to make sure all the boards are properly installed in their sockets and are in the proper positions.

- () Do not plug the TU-170A into AC power until instructed.
- () Remove the TU-170A inner-chassis from outer cover by removing the two 8-32 X 3/8" screws on each side of the cabinet rear.
- () Remove the circuit board support bracket fastened by two 6-32 X 1/4" flat head screws on either side.
- () Bend a one inch length of 22 gauge bare wire (or a trimmed resistor lead) in a "U" shape and insert this wire in pins 12 and 13 of P1 connector on the rear of the chassis (the mating connector should not be installed). This jumper connects the AUDIO OUTPUT of the AFSK to the AUDIO INPUT of the DEMODULATOR.

If you have built your TU-170A from a kit, the following two steps may be skipped since the components referred to will not have been installed.

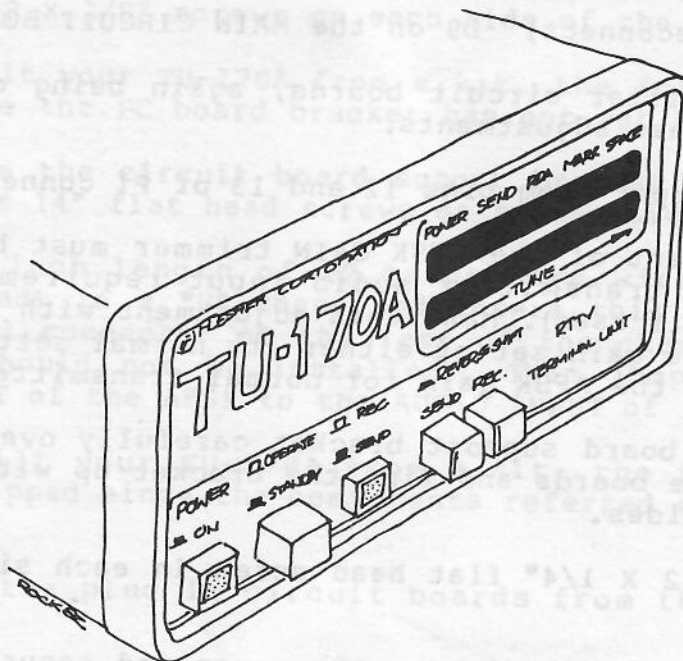
- (x) () Disconnect one lead of D9 on the MAIN CIRCUIT BOARD.
- (x) () Disconnect one lead of D1 on each FILTER board to be aligned.
- () Adjust AFSK gain trimmer to center of rotation.
- () Adjust all trimmers on FILTER BOARDS to center of rotation.



TU-170A ALIGNMENT

WITHOUT TEST EQUIPMENT, but WITH AFSK INSTALLED

- () Apply power to the TU-170A. Be sure the unit does not sit on a metal bench or on metal objects which may short out the circuits on the bottom of the circuit board.
- () Set the front panel controls so that all switches are in the 'OUT' position except POWER and the SEND switch.



- () Adjust the AFSK gain trimmer so the fifth or sixth LED of the BAR GRAPH display flickers or glows dimly.
- () Adjust the three trimmers on the MARK filter for maximum indication on the BAR GRAPH display. You may have to reduce the AFSK gain while peaking the trimmers on the filters, to keep the signal strength indicator from exceeding full scale.
- () Select REVERSE SEND on front panel switch.
- () Adjust the gain trimmer of the AFSK so the fifth or sixth LED of the BAR GRAPH display flickers or glows dimly again.
- () Adjust the three trimmers on the SPACE filter for maximum indication on the BAR GRAPH display. Use the same procedure as before.

TU-170A ALIGNMENT

WITHOUT TEST EQUIPMENT, but WITH AFSK INSTALLED

- () Turn the TU-170A off and unplug it from AC power.
- () Remove the filter circuit boards, being careful not to move the trimmer positions.
- () Install (or reconnect) D1 on the filter boards.
- () Install (or reconnect) D9 on the MAIN CIRCUIT BOARD.
- () Replace the filter circuit boards, again being careful not to move the trimmer adjustments.
- () Remove the jumper from pins 12 and 13 of P1 connector.
- () Final adjustment of the AFSK GAIN trimmer must be made according to your transmitter audio input requirements (and VOX requirements if used). Make this adjustment with your transmitter microphone gain set at either its normal setting or at mid-range. Adjust the AFSK gain for normal transmitter output.
- () Position the board support bracket carefully over the top rear corners of the boards and line the bracket up with the holes on the chassis sides.
- () Install a 6-32 X 1/4" flat head screw in each side and tighten both screws.
- () Install inner-chassis into outer cover and secure with the two 8-32 X 3/8" screws on each side of rear chassis sides.

TU-170A ALIGNMENT

WITH AFSK AND A VOLTMETER

EQUIPMENT REQUIRED: AC VOLTMETER

Before alignment, check to make sure all the boards are properly installed in their sockets and are in the proper positions.

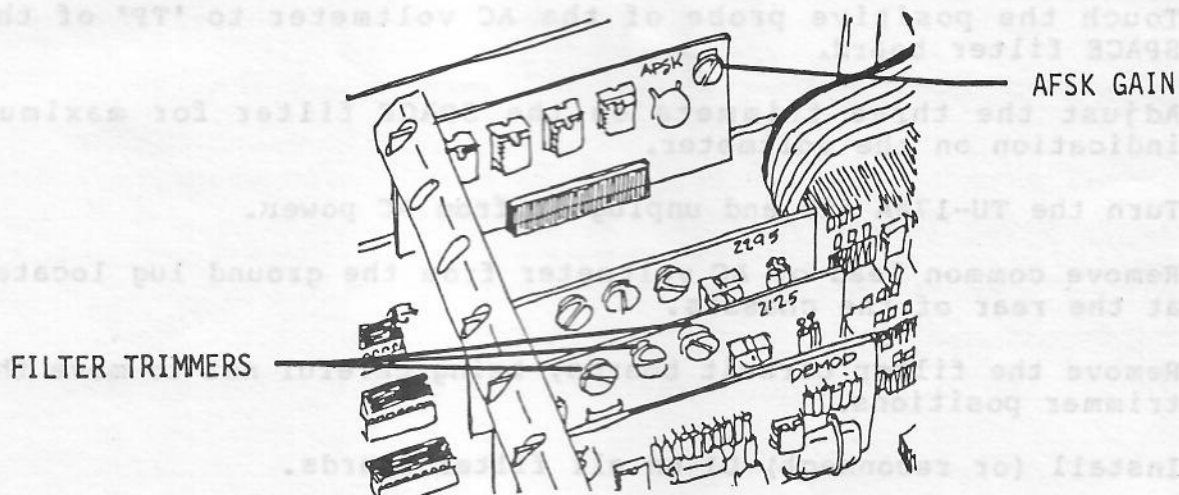
- () Do not plug the TU-170A into AC power until instructed.
- () Remove the TU-170A inner-chassis from outer cover by removing the two 8-32 X 3/8" screws on each side of the cabinet rear.

If you have built your TU-170A from a kit, the following step may be skipped since the PC board bracket has not yet been installed.

- (X) () Remove the circuit board support bracket fastened by two 6-32 X 14" flat head screws on either side.
- () Bend a one inch length of 22 gauge bare wire (or a trimmed resistor lead) in a "U" shape and insert this wire in pins 12 and 13 of P1 connector on the rear of the chassis (the mating connector should not be installed). This jumper connects the AUDIO OUTPUT of the AFSK to the AUDIO INPUT of the DEMODULATOR.

If you have built your TU-170A from a kit, the following three steps may be skipped since the components referred to will not have been installed.

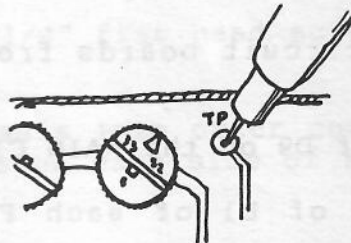
- (X) () Remove the plug in circuit boards from the MAIN CIRCUIT BOARD.
- (X) () Disconnect one lead of D9 on the MAIN CIRCUIT BOARD.
- (X) () Disconnect one lead of D1 of each FILTER BOARD to be aligned.
- () Adjust AFSK gain trimmer to center of rotation.
- () Adjust all trimmers on the FILTER BOARDS to center of rotation.



TU-170A ALIGNMENT

WITH AFSK AND A VOLTMETER

- () Adjust AC volt meter for approximately 20 VAC.
- () Attach the common lead of the volt meter to the ground lugs located at the rear of the chassis.
- () Apply power to the TU-170A. Be sure the unit does not sit on a metal bench or on metal objects which may short out the circuits on the bottom circuit board.
- () Set the front panel controls so that all switches are in the 'OUT' position except the POWER and SEND switches.
- () Touch the positive probe of the AC voltmeter to 'TP' of the MARK filter board.
- () If necessary, start with a low scale on the voltmeter and then graduate to a higher scale to obtain a good visual reading.
- () Adjust the three trimmers on the MARK filter for maximum indication on the voltmeter.
- () Select REVERSE SEND on the front panel switch.



- () Touch the positive probe of the AC voltmeter to 'TP' of the SPACE filter board.
- () Adjust the three trimmers on the SPACE filter for maximum indication on the voltmeter.
- () Turn the TU-170A off and unplug it from AC power.
- () Remove common lead of AC voltmeter from the ground lug located at the rear of the chassis.
- () Remove the filter circuit boards, being careful not to move the trimmer positions.
- () Install (or reconnect) D1 on all filter boards.

TU-170A ALIGNMENT

WITH AFSK AND A VOLTMETER

- () Install (or reconnect) D9 on the MAIN CIRCUIT BOARD.
- () Replace the filter circuit boards, again being careful not to move the trimmer adjustments.
- () Remove the jumper from pins 12 and 13 of P1 connector.
- () Final adjustment of the AFSK GAIN trimmer must be made according to your transmitter audio input requirements (and VOX requirements if used). Make this adjustment with your transmitter microphone gain set at either its normal setting or at mid-range. Adjust the AFSK gain for normal transmitter output.
- () Position the board support bracket carefully over the top rear corners of the board and line the bracket up with the holes on the chassis sides.
- () Install a 6-32 X 1/4" flat head screw in each side and tighten both screws.
- () Install the inner-chassis into outer cover and secure with the two 8-32 X 3/8" screws on each side of the rear chassis sides.

TU-170A ALIGNMENT

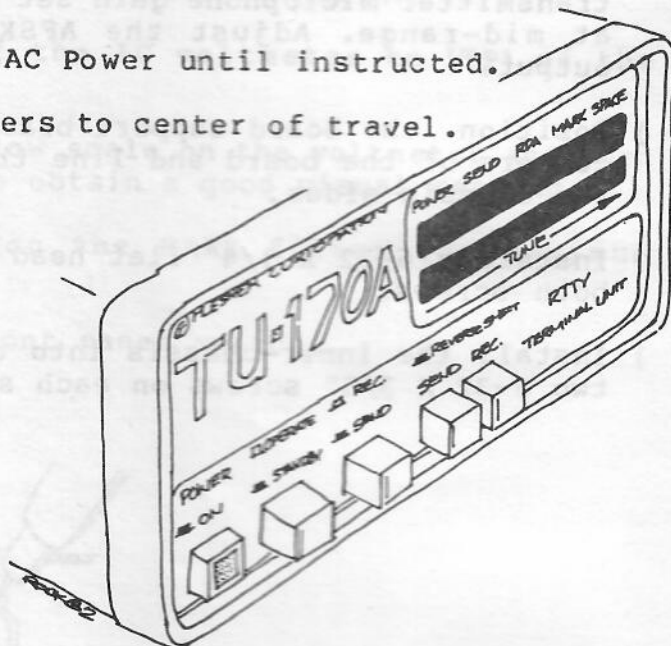
WITH TEST EQUIPMENT

EQUIPMENT REQUIRED: Calibrated sine wave AUDIO SIGNAL GENERATOR,
OPTIONAL EQUIPMENT: AC VOLTMETER or OSCILLOSCOPE

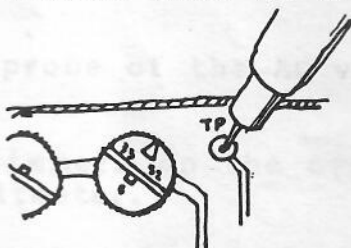
Before alignment, check to make sure all the boards are properly installed in their sockets and are in the proper positions.

The BAR GRAPH display is referred to in the following tuning instructions, but an AC voltmeter or oscilloscope can be used for tuning by connecting the instrument common lead to chassis ground and the probe lead to the test point of each filter board marked "TP".

- () Do not plug the TU-170A into AC Power until instructed.
- () Adjust all filter board trimmers to center of travel.
- () Set the front panel controls so that all switches are in the 'OUT' position except POWER.



- () Connect the common lead of the sine wave Audio Signal Generator to the chassis ground lug.
- () Connect the output of the Audio Signal Generator to pin 13 of P1 using a scrap resistor lead or a piece of 22 gauge bare wire.

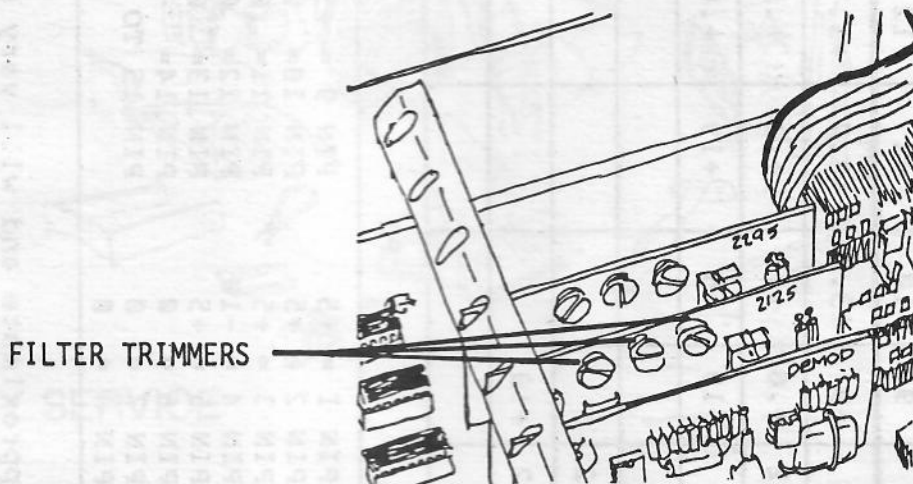


- () Apply power to the TU-170A. Be sure the unit does not sit on a metal bench or on metal objects which may short out the circuits on the bottom of the circuit board.
- () Adjust the Audio Signal Generator for 2125 Hz (for HI-TONES).

TU-170A ALIGNMENT

WITH TEST EQUIPMENT

- () Adjust the gain of the Audio Signal Generator so the fifth or sixth LED on the BAR GRAPH tuning indicator flickers or glows dimly.
- () Adjust the three trimmers on the 2125 Hz (MARK) filter for maximum indication on the BAR GRAPH display. You may have to reduce the Audio Signal Generator gain while peaking the trimmers on the filters to keep the signal strength indicator from exceeding full scale.



- () Adjust the Audio Signal Generator for 2295 Hz (HI-TONES SPACE).
- () Adjust the three trimmers on the 2295 Hz filter for maximum indication on the BAR GRAPH display. Use same procedure as before.
- () When all filters have been tuned, position the board support bracket over the top rear corners of the plug-in boards and line the bracket up with the holes on the chassis sides.
- () Install a 6-32 X 1/4" flat head screw in each side and tighten both screws.
- () Install inner-chassis into outer cover and secure with the two 8-32 X 3/8" screws on each side of rear chassis sides.

SWITCH CONDITIONS: POWER = ON OPERATE/STANDBY = OPERATE REC./SEND = REC.
 REVERSE SHIFTS = OFF

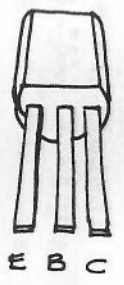
PINS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
IC1	+9	0	0	0	0	0	0	0	+9	+3.7	+3.7	+3.7	+3.7	+9	+9	+6
IC2	+9	+1	+1	+1	+12	+6	0	+12	+6	+1	+1	+1	+6	+12		
IC3	+1	+1	+1	+1	+4.5	0	0	0	+19	+5	+19	+6	+12	+6	+12	+6
IC4	-12	0	-3	-12	-12	-10	+12	0								
IC5	+12	0	+3.6	-12	-6.8	+12	-10	+12								
IC6	-20	-12	0	0	-5	0	0	+12	+19							
IC7	+19	0	+5													

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VOLTAGE CHART

TRANSISTOR	EMITTER	BASE	COLLECTOR
Q1	+0.9	+1.6	+6.5
Q2	+5.8	+6.5	+12
Q3	0	.7	+1
Q4	0	.7	+1
Q5	0	0	+5
Q6	0	+0.7	0

P1		P2
PIN 1 = +5	PIN 9 = +5	PIN 1 = +5
PIN 2 = +5	PIN 10 = 0	PIN 2 = +12
PIN 3 = +5	PIN 11 = 0	PIN 3 = +5
PIN 4 = -10	PIN 12 = 0	PIN 4 = 0
PIN 5 = +5	PIN 13 = 0	
PIN 6 = 0	PIN 14 = -10	
PIN 7 = 0	PIN 15 TO 25 = GROUND	
PIN 8 = 0		



ALL TRANSISTORS

All voltages are approximate and will vary somewhat from unit to unit.

IF YOU HAVE TROUBLE...



FACTORY SERVICE

Occasionally it may become necessary to have your TU-170A repaired. If difficulties arise, first check the fuse, then consult the VOLTAGE CHART and schematic to determine if the problem is of a minor nature and can be repaired by yourself. If you need help, you may call CUSTOMER SERVICE DEPARTMENT (913-234-0198) to determine if it will be necessary to ship it to us for repair.

If service is required, ship the unit postage prepaid to:

Flesher Corporation
P.O. Box 976
Topeka, Kansas 66601

Or UPS prepaid to: 507 Jackson St.
Topeka, Kansas 66603

Your TU-170A should be packaged carefully using the original packing material if possible.

The package should include a letter with complete description of the problem.

Insure the unit for the full value and be sure to obtain a receipt from the carrier.

TU-170A
MAIN CIRCUIT BOARD
PARTS LIST

ITEM	P.N.	DESCRIPTION
R1	100 710	330 ohm resistor 1/4 watt 5% ORG-ORG-BRN
R2	101 110	15K ohm resistor 1/4 watt 5% BRN-GRN-ORG
R3	100 910	2.2K ohm resistor 1/4 watt 5% RED-RED-RED
R4	100 910	2.2K ohm resistor 1/4 watt 5% RED-RED-RED
R5	100 710	330 ohm resistor 1/4 watt 5% ORG-ORG-BRN
R6	100 830	1K ohm resistor 1/4 watt 5% BRN-BLK-RED
R7	101 230	47K ohm resistor 1/4 watt 5% YEL-VIO-ORG
R8	101 230	47K ohm resistor 1/4 watt 5% YEL-VIO-ORG
R9	100 990	4.7K ohm resistor 1/4 watt 5% YEL-VIO-RED
R10	100 830	1K ohm resistor 1/4 watt 5% BRN-BLK-RED
R11	100 930	2.7K ohm resistor 1/4 watt 5% RED-VIO-RED
R12	100 930	2.7K ohm resistor 1/4 watt 5% RED-VIO-RED
R13	100 930	2.7K ohm resistor 1/4 watt 5% RED-VIO-RED
R14	100 930	2.7K ohm resistor 1/4 watt 5% RED-VIO-RED
R15	100 950	3.3K ohm resistor 1/4 watt 5% ORG-ORG-RED
R16	101 070	10K ohm resistor 1/4 watt 5% BRN-BLK-ORG
R17	100 930	2.7K ohm resistor 1/4 watt 5% RED-VIO-RED
R18	100 690	270 ohm resistor 1/4 watt 5% RED-VIO-BRN
R19	100 690	270 ohm resistor 1/4 watt 5% RED-VIO-BRN
R20	100 590	100 ohm resistor 1/4 watt 5% BRN-BLK-BRN
R21	100 590	100 ohm resistor 1/4 watt 5% BRN-BLK-BRN
R22	100 990	4.7K ohm resistor 1/4 watt 5% YEL-VIO-RED
R23	100 990	4.7K ohm resistor 1/4 watt 5% YEL-VIO-RED
R24	100 990	4.7K ohm resistor 1/4 watt 5% YEL-VIO-RED
R25	100 990	4.7K ohm resistor 1/4 watt 5% YEL-VIO-RED
R26	101 070	10K ohm resistor 1/4 watt 5% BRN-BLK-ORG
R27	100 790	680 ohm resistor 1/4 watt 5% BLU-GRY-BRN
R28	101 410	300K ohm resistor 1/4 watt 5% ORG-BLK-YEL
R29	101 310	100K ohm resistor 1/4 watt 5% BRN-BLK-YEL
R30	101 450	390K ohm resistor 1/4 watt 5% ORG-WHT-YEL
R31	101 310	100K ohm resistor 1/4 watt 5% BRN-BLK-YEL
R32	101 390	220K ohm resistor 1/4 watt 5% RED-RED-YEL
R33	100 730	390 ohm resistor 1/4 watt 5% ORG-WHT-BRN
R34	100 830	1K ohm resistor 1/4 watt 5% BRN-BLK-RED
R35	101 390	220K ohm resistor 1/4 watt 5% RED-RED-YEL
R36	101 310	100K ohm resistor 1/4 watt 5% BRN-BLK-YEL
R37	101 310	100K ohm resistor 1/4 watt 5% BRN-BLK-YEL
R38	101 450	390K ohm resistor 1/4 watt 5% ORG-WHT-YEL
R39	100 990	4.7K ohm resistor 1/4 watt 5% YEL-VIO-RED
R40	100 930	2.7K ohm resistor 1/4 watt 5% RED-VIO-RED
R41	100 930	2.7K ohm resistor 1/4 watt 5% RED-VIO-RED
R42	101 070	10K ohm resistor 1/4 watt 5% BRN-BLK-ORG
R43	100 950	3.3K ohm resistor 1/4 watt 5% ORG-ORG-RED
R44	101 110	15K ohm resistor 1/4 watt 5% BRN-GRN-ORG
R45	100 990	4.7K ohm resistor 1/4 watt 5% YEL-VIO-RED
R46	101 310	100K ohm resistor 1/4 watt 5% BRN-BLK-YEL
R47	101 390	220K ohm resistor 1/4 watt 5% RED-RED-YEL
R48	100 830	1K ohm resistor 1/4 watt 5% BRN-BLK-RED
SIP	107 008	Resistor Array, 4.7K x 9 (1)

TU-170A
MAIN CIRCUIT BOARD
PARTS LIST

<u>ITEM</u>	<u>P.N.</u>	<u>DESCRIPTION</u>
C1	110 230	Capacitor .1uf 12V disc (104Z)
C2	111 131	Capacitor 4.7uf 35V Electrolytic
C3	110 230	Capacitor .1uf 12V disc (104Z)
C4	111 101	Capacitor 1.0uf 50V Electrolytic
C5	111 131	Capacitor 4.7uf 35V Electrolytic
C6	111 256	Capacitor 470uf 25V Electrolytic
C7	111 235	Capacitor 220uf 25V Electrolytic
C8	110 205	Capacitor .01uf 1000V Disc
C9	110 205	Capacitor .01uf 1000V Disc
C10	111 131	Capacitor 4.7uf 35V Electrolytic
C11	111 131	Capacitor 4.7uf 35V Electrolytic
C12	110 230	Capacitor .1uf 12V disc (104Z)
C13	110 199	Capacitor .01uf 100V disc (103Z)
C14	"	" " " "
C15	"	" " " "
C16	"	" " " "
C17	"	" " " "
C18	"	" " " "
C19	"	" " " "
C20	"	" " " "
C21	"	" " " "
C22	"	" " " "
C23	"	" " " "
C24	"	" " " "
C25	"	" " " "
C26	"	" " " "
C27	"	" " " "
D1	120 005	Diode, 1N4148
D2	"	" " " "
D3	"	" " " "
D4	"	" " " "
D5	"	" " " "
D6	"	" " " "
D7	"	" " " "
D8	"	" " " "
D9	"	" " " "
D10	"	" " " "
D11	"	" " " "
D12	120 050	Diode, 1N4003, Rectifier
D13	"	" " " "
D14	"	" " " "
D15	"	" " " "
D16	120 005	Diode, 1N4148
D17	120 005	DIODE, 1N4148
D18	"	" " " "
D19	"	" " " "
D20	"	" " " "

**TU-170A
MAIN CIRCUIT BOARD
PARTS LIST**

<u>ITEM</u>	<u>P.N.</u>	<u>DESCRIPTION</u>
IC1	125 150	IC, MC1416
IC2	125 012	IC, 4081, CMOS
IC3	125 150	IC, MC1416
IC4	125 078	IC, 1741
IC5	125 022	IC, MC1458CPI
IC6	125 179	IC, NE5553U, Regulator
IC7	125 000	IC, 7805, Regulator, 5V
Q1	120 027	Transistor, 2N4123
Q2	"	" "
Q3	"	" "
Q4	"	" "
Q5	"	" "
Q6	"	" "
T1	130 001	Transformer
	140 332	Fuse (1)
	140 331	Clip, fuse mounting (2)
	140 376	Switch set (1)
P1	140 334	Connector, PC mount, DB25
	137 180	Connector, PC mount, 15 pin male (4)
	140 330	Relay
P2	137 127	Header, right angle, 4 pin
	140 101	Socket, IC, 16 pin (2)
	140 100	Socket, IC, 14 pin (1)
	140 191	Socket, IC, 8 pin (2)
	145 079	Screw, Nylon, 4-40 x 3/8 (2)
	145 086	Screw, Nylon, 4-40 x 1 1/4 (2)
	145 049	Nut, Nylon, 4-40 (4)
	335 103A	Circuit Board
	140 335	Connector, DB25 male

TU-170A DISPLAY PARTS LIST

<u>ITEM</u>	<u>P.N.</u>	<u>DESCRIPTION</u>	
	335 104	Circuit board	(1)
	170 070	Display module, National LM3914	(1)
	137 188	Connector, 12 pin, Molex male	(1)
	170 068	Cable, flat, 8 conductor	(1)
R1	100 710	Resistor, 330 ohm, 1/4W, 5%	ORG-ORG-BRN
R2	100 830	Resistor, 1K ohm, 1/4W, 5%	BRN-BLK-RED
POWER	120 097	LED, RED, Litronix LD32C	
SEND	" "	" " " "	
RDA	" "	" " " "	
MARK	" "	" " " "	
SPACE	" "	" " " "	

TU-170A CHASSIS PARTS LIST

<u>ITEM</u>	<u>P.N.</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>
	150 497	Cover, chassis	(1)
	150 498	Chassis, internal	(1)
	140 495	Chassis, front panel	(1)
	150 496	Extrusion	(1)
	150 494	Bracket, PC support	(1)
	150 658	Legend, front panel	(1)
	137 019	Outlet, grounded AC	(1)
	140 058	Cord, power, AC	(1)
	145 216	Screw, 4-40 X 1/4" LG, FH, Slotted	(7)
	145 045	" " 6-32 X 1/4" " " "	(2)
	145 023	" " 6-32 X 1/4" Binder head	(6)
	145 043	" " 6-32 X 1/2" Binder head	(1)
	145 015	Nut, 6-32	(2)
	145 017	Lock washer, Int. star #6	(1)
	145 039	Screw, 8-32 X 3/8 Binder head	(2)
	145 079	Screw, 4-40 X 3/8 Nylon	(2)
	145 049	Nut, 4-40, Nylon	(4)
	140 344	Lug, Int. star, ground	(2)
	140 046	Strain relief	(1)
	150 505	Feet, rubber	(4)
	145 018	Washer, #6 flat	(2)
	145 086	Screw, 4-40 X 1 1/4 Nylon	(2)
	137 127	Socket, 1/4" dia, 1/2" deep	(2)
	140 101	Socket, 1/4" dia, 1/2" deep	(2)
	140 100	Socket, 1/4" dia, 1/2" deep	(2)
	140 103	Socket, 1/4" dia, 1/2" deep	(2)
	145 075	Screw, Nylon, 4-40 X 3/8 (2)	(2)
	145 080	Screw, Nylon, 4-40 X 1 1/4	(1)
	145 040	Nut, Nylon, 4-40 (4)	(4)
	140 102A	Circuit board	(1)
	140 102	Connector, 2025 pins	(1)

TU-170A DEMODULATOR BOARD PARTS LIST

<u>ITEM</u>	<u>P.N.</u>	<u>DESCRIPTION</u>	
	335 100	Circuit board	
IC1	125 148	IC, 4741, quad Op Amp	
IC2	125 022	IC, MC1458CP, dual Op Amp	
D1	120 005	Diode, 1N4148, silicon, fast switching	
D2	" "	" " " " " "	
D3	" "	" " " " " "	
D4	" "	" " " " " "	
D5	" "	" " " " " "	
D6	" "	" " " " " "	
D7	" "	" " " " " "	
C1	110 236	Capacitor, .15uf, mylar	
C2	110 143	" 220pf, disc	
C3	111 121	" 3.3uf, 25V, Electrolytic, Axial	
C4	" "	" " " " " "	
C5	110 243	" .22uf, mylar, (224K)	
C6	110 199	" .01uf, 100V, disc	
C7	" "	" " " " " "	
R1	101 310	Resistor, 100K, 1/4W, 5%	(BRN-BLK-YEL)
R2	" "	" " " " " "	(BRN-BLK-YEL)
R3	101 250	" 56K " " "	(GRN-BLU-ORG)
R4	101 190	" 33K " " "	(ORG-ORG-ORG)
R5	" "	" " " " " "	(ORG-ORG-ORG)
R6	" "	" " " " " "	(ORG-ORG-ORG)
R7	101 110	" 15K " " "	(BRN-GRN-ORG)
R8	101 190	" 33K " " "	(ORG-ORG-ORG)
R9	" "	" " " " " "	(ORG-ORG-ORG)
R10	100 910	" 2.2K " " "	(RED-RED-RED)
R11	" "	" " " " " "	(RED-RED-RED)
R12	101 470	" 470K " " "	(YEL-VIO-YEL)
R13	101 190	" 33K " " "	(ORG-ORG-ORG)
R14	100 990	" 4.7K " " "	(YEL-VIO-RED)
R15	101 110	" 15K " " "	(BRN-GRN-ORG)
R16	101 450	" 390K " " "	(ORG-WHT-YEL)
	137 175	Connector, 15 pin, female	
	140 100	Socket, IC, 14 pin	
	140 191	Socket, IC, 8 pin	

TU-170A UNIVERSAL FILTER PARTS LIST

<u>ITEM</u>	<u>P.N.</u>	<u>DESCRIPTION</u>
	335 099A	Circuit board (1)
IC1	125 022	IC, MC1458CP, Dual Op Amp
IC2	125 022	IC, MC1458CP, Dual Op Amp
Q1	120 039	Transistor, MPF111, FET
P1	106 041	Pot, 500 ohm, PC mount
P2	106 041	Pot, 500 ohm, PC mount
P3	106 041	Pot, 500 ohm, PC mount
D1	120 005	Diode, 1N4148, silicon, fast switching
	120 005	Diode, 1N4148 (for freq select) (5)
**C1	110 198	Capacitor, .01uf, mylar, (2A103JT)
* C1	110 181	Capacitor, .005uf, mylar (2A502JT)
* C2	110 181	" " " " " "
C3	" "	" " " " " "
C4	" "	" " " " " "
C5	" "	" " " " " "
C6	" "	" " " " " "
C7	" "	" " " " " "
C8	" "	" " " " " "
C9	110 199	Capacitor, .01uf, 100V, disc
C10	110 199	Capacitor, .01uf, 100V, disc
	137 175	Connector, edge, 15 pin, female (1)
	140 191	Socket, IC, 8 pin (2)

*NOTE: These capacitors are only used in the 2295 Hz (HI-TONES) or 1445 Hz (LO-TONES) filter board. Other filter boards do not require C1 and C2, and none should be installed. LO-TONES option parts not included.

**NOTE: This cap (.01uf) is supplied with the LO-TONES option only and takes the place of C1 through C8 when LO-TONE boards are assembled.

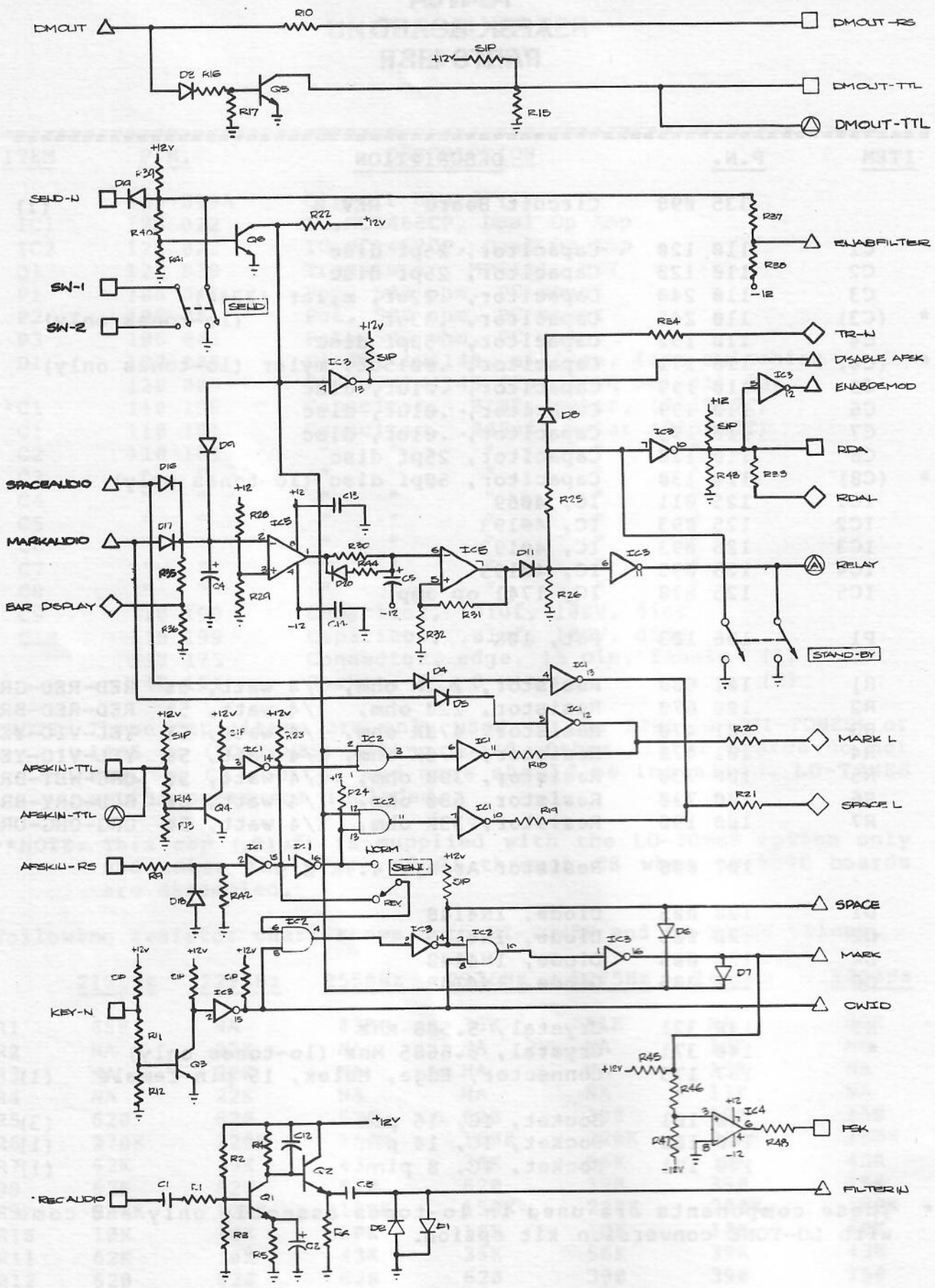
Following resistor chart shows both HI-TONES and LO-TONES values.

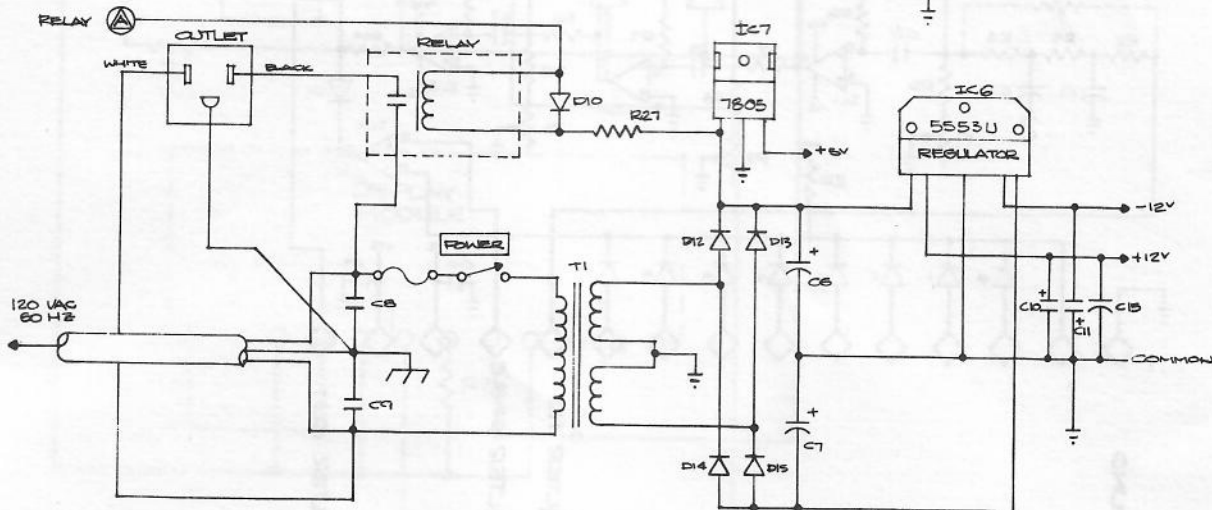
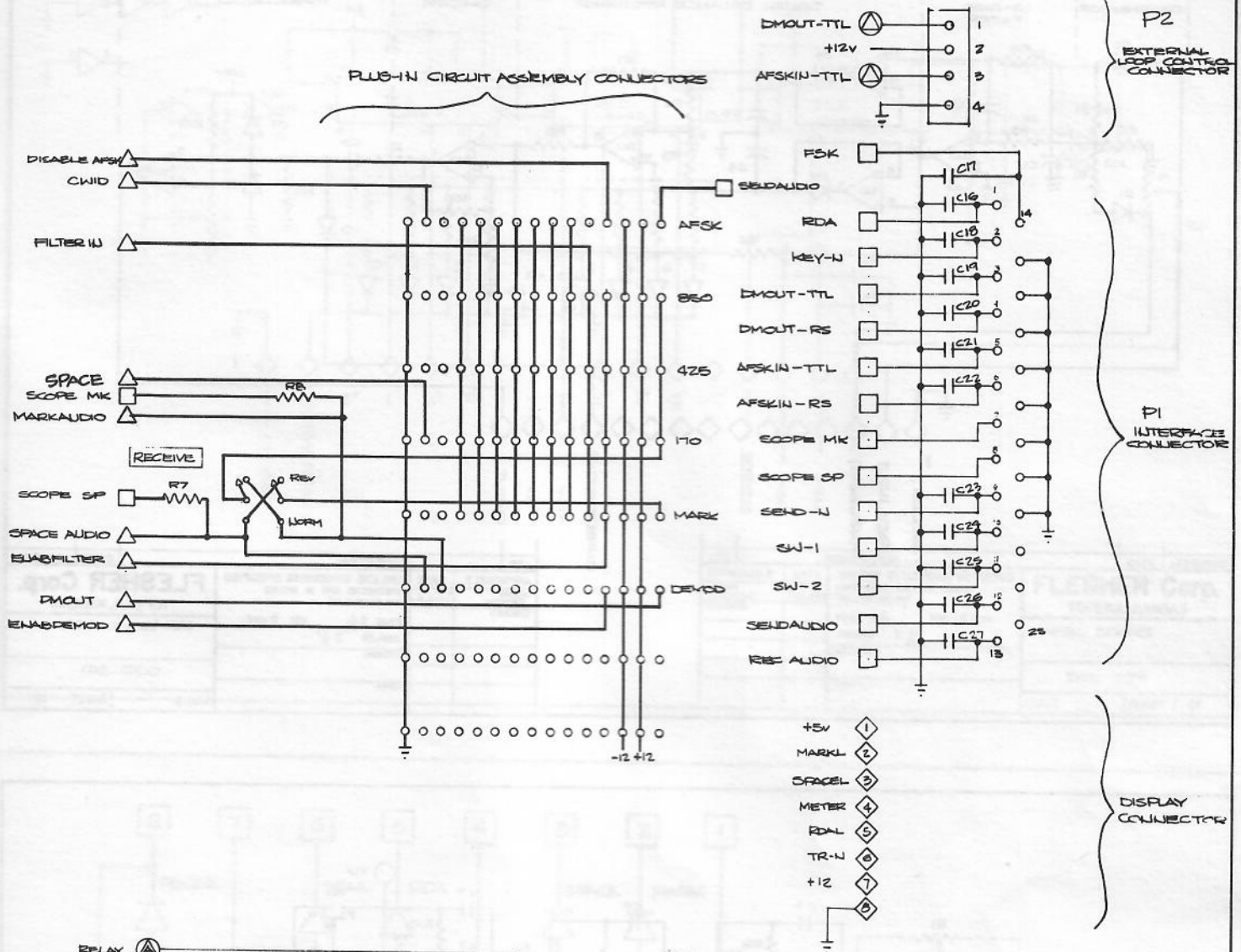
	<u>2125Hz</u>	<u>2295Hz</u>	<u>2550Hz</u>	<u>2975Hz</u>	<u>1275Hz</u>	<u>1445Hz</u>	<u>1700Hz</u>
R1	68K	NA	43K	36K	51K	NA	43K
R2	NA	22K	NA	NA	NA	13K	NA
R3	NA	22K	NA	NA	NA	13K	NA
R4	NA	22K	NA	NA	NA	13K	NA
R5	620	620	620	620	390	390	150
R6	270K	220K	180K	150K	220K	200K	180K
R7	62K	33K	43K	36K	56K	39K	43K
R8	620	620	620	620	390	390	150
R9	270K	220K	180K	150K	220K	200K	180K
R10	10K	10K	10K	10K	10K	10K	10K
R11	62K	30K	43K	36K	56K	39K	43K
R12	620	620	620	620	390	390	150
R13	220K	200K	180K	270K	220K	200K	180K
R14	470K	470K	470K	470K	470K	470K	470K

TU-170A
AFSK BOARD
PARTS LIST

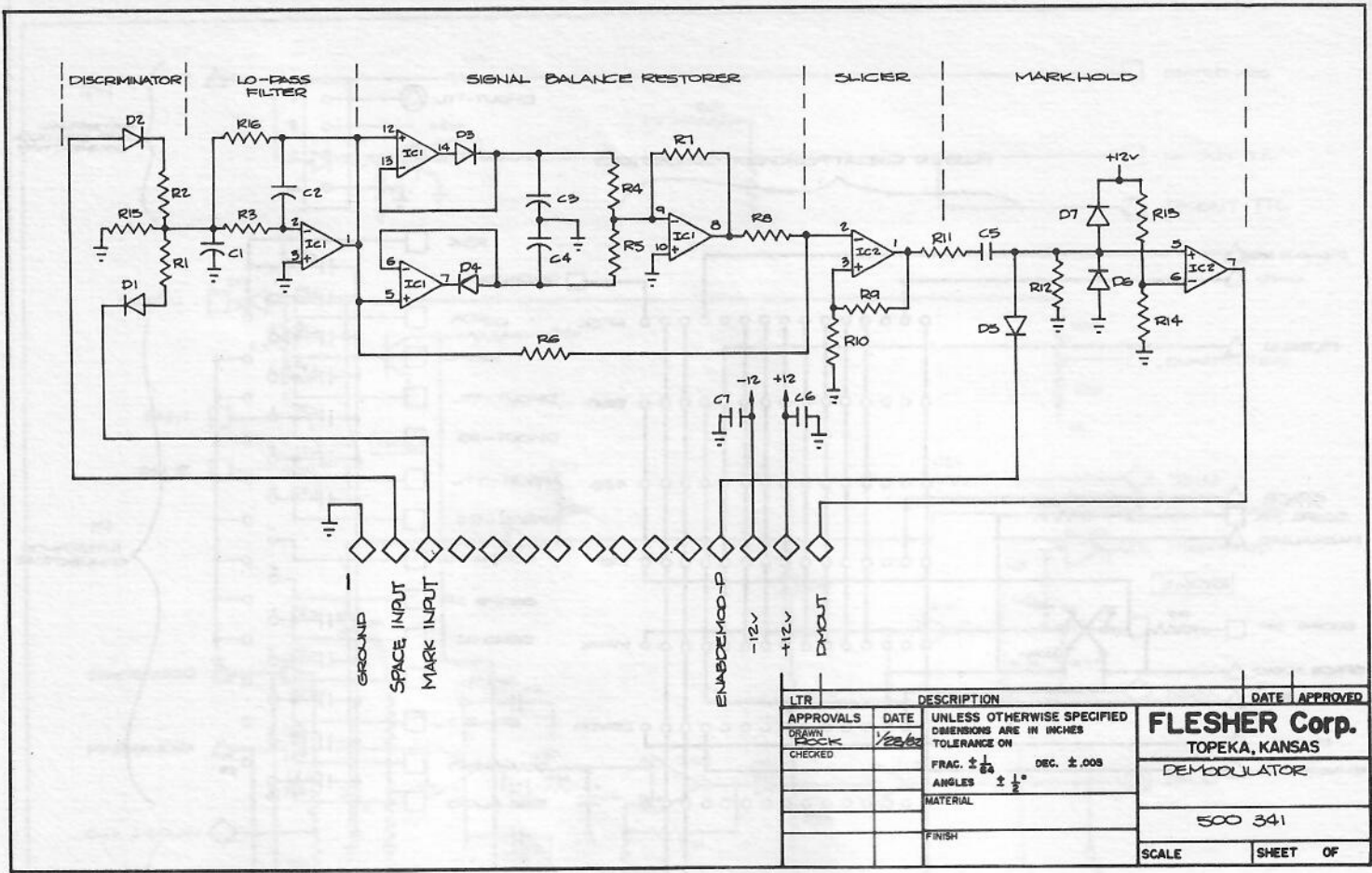
<u>ITEM</u>	<u>P.N.</u>	<u>DESCRIPTION</u>	
	335 098	Circuit Board	REV B (1)
C1	110 120	Capacitor, 25pf disc	
C2	110 120	Capacitor, 25pf disc	
C3	110 240	Capacitor, .22uf, mylar (224K)	
* (C3)	110 245	Capacitor, .33uf	(lo-tones only)
C4	110 152	Capacitor, 750pf disc	
* (C4)	110 171	Capacitor, .0015uf, mylar	(lo-tones only)
C5	110 199	Capacitor, .01uf, disc	
C6	110 199	Capacitor, .01uf, disc	
C7	110 199	Capacitor, .01uf, disc	
C8	110 120	Capacitor, 25pf disc	
* (C8)	110 130	Capacitor, 50pf disc	(lo-tones only)
IC1	125 011	IC, 4069	
IC2	125 093	IC, 40193	
IC3	125 093	IC, 40193	
IC4	125 093	IC, 40193	
IC5	125 078	IC, 1741 op amp	
P1	106 103	Pot, 10K	
R1	101 600	Resistor, 2.2M ohm, 1/4 watt, 5%	RED-RED-GRN
R2	100 670	Resistor, 220 ohm, 1/4 watt, 5%	RED-RED-BRN
R3	101 470	Resistor, 470K ohm, 1/4 watt, 5%	YEL-VIO-YEL
R4	101 470	Resistor, 470K ohm, 1/4 watt, 5%	YEL-VIO-YEL
R5	100 730	Resistor, 390 ohm, 1/4 watt, 5%	ORG-WHT-BRN
R6	100 790	Resistor, 680 ohm, 1/4 watt, 5%	BLU-GRY-BRN
R7	100 190	Resistor, 33K ohm, 1/4 watt, 5%	ORG-ORG-ORG
	107 008	Resistor Array, 4.7K X 9	
D1	120 005	Diode, 1N4148	
D2	120 005	Diode, 1N4148	
D4	120 005	Diode, 1N4148	
D6	120 005	Diode, 1N4148	
XT	140 321	Crystal, 5.508 Mhz	
* *	140 371	Crystal, 3.6685 Mhz	(lo-tones only)
	137 175	Connector, Edge, Molex, 15 pin female	(1)
	140 101	Socket, IC, 16 pin	(3)
	140 100	Socket, IC, 14 pin	(1)
	140 191	Socket, IC, 8 pin	(1)

* These components are used in lo-tones assembly only and come with LO-TONE conversion kit option.

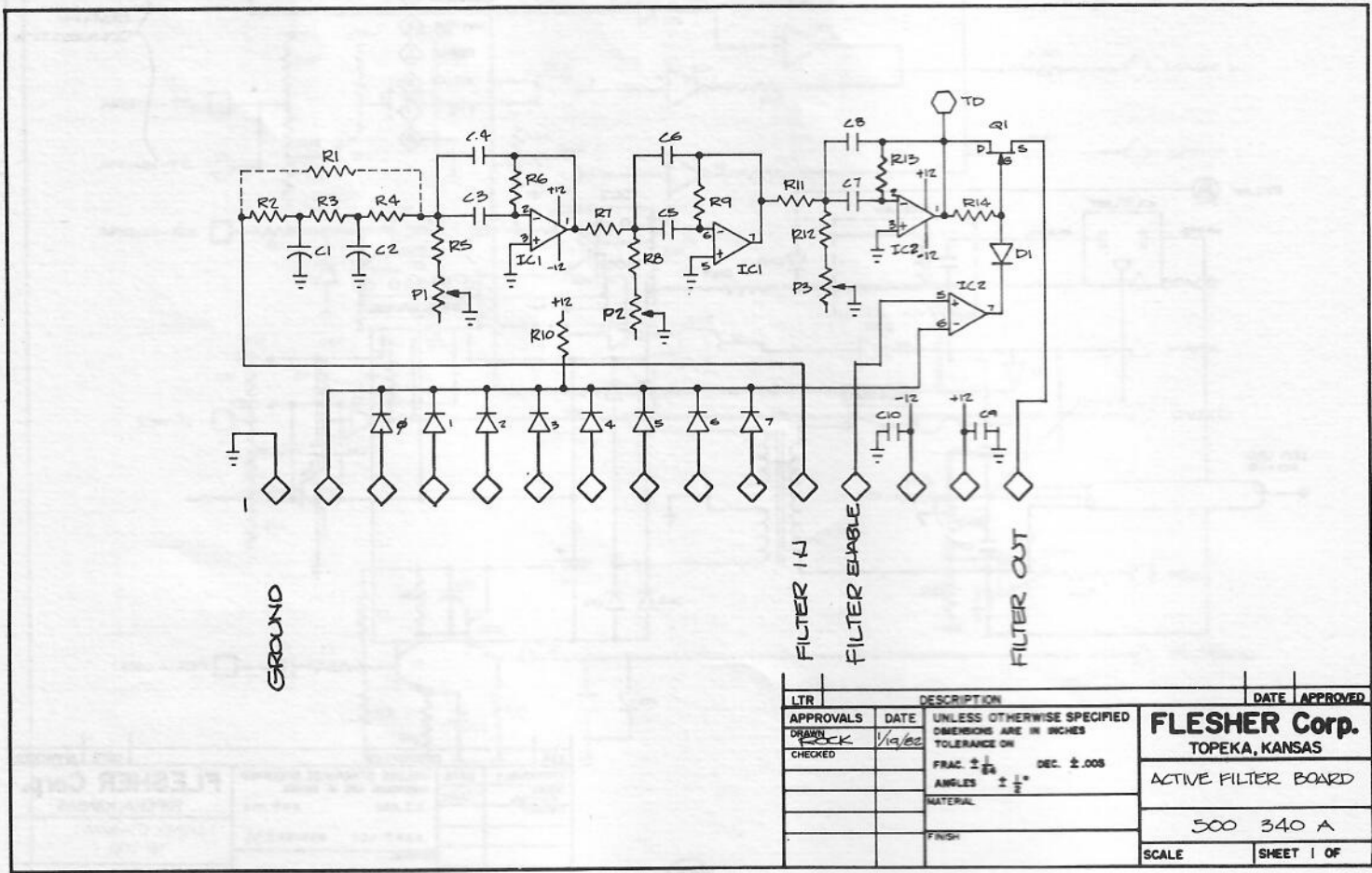




LTR	DATE	DESCRIPTION	DATE	APPROVED
APPROVALS	DATE	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	FLESHER Corp. TOPEKA, KANSAS WIRING DIAGRAM TB-200 500 346 A. SCALE SHEET OF	
DRAWN	1/5/62	.XXX±.030 .XXX±.015		
CHECKED		.XXX±.005 ANGLES±1/2		
		MATERIAL		
		FINISH		



LTR	DESCRIPTION	DATE	APPROVED
APPROVALS	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCE ON	DATE	
DRAWN	FRAC. $\pm \frac{1}{64}$	1/28/60	
CHECKED	DEC. $\pm .008$		
	ANGLES $\pm \frac{1}{2}^\circ$		
	MATERIAL		
	FINISH		
			FLESHER Corp.
			TOPEKA, KANSAS
			DEMODULATOR
			500 341
SCALE			SHEET OF



LTR	DESCRIPTION	DATE	APPROVED
APPROVALS	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCE ON	DATE	
DRAWN	FRAC. $\pm \frac{1}{64}$	1/9/60	
CHECKED	DEC. $\pm .008$		
	ANGLES $\pm \frac{1}{2}^\circ$		
	MATERIAL		
	FINISH		
			FLESHER Corp.
			TOPEKA, KANSAS
			ACTIVE FILTER BOARD
			500 340 A
SCALE			SHEET 1 OF

