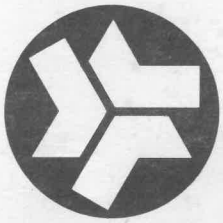

# Flesher Corporation

# TU-470
# OPERATORS MANUAL

## YOUR FLESHER CORPORATION 90 DAY LIMITED WARRANTY

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. Flesher Company, Inc., does not warrant compatibility of its products with any particular radio or TTY equipment; connection of a J. A. Flesher 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. Flesher 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. This warranty does not cover damage resulting from improper assembly of kits.

## WARRANTY SERVICE

For warranty service, return the product postage prepaid to J. A. Flesher Company, Inc., P.O. Box 976, Topeka, Kansas 66601 or prepaid UPS to 507 Jackson, Topeka, Kansas 66603. The returned product should be accompanied by a statement of problem and proof of the date of purchase.

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

UNLESS PROHIBITED BY LAW, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS IS LIMITED TO THE 90-DAY DURATION OF THE WRITTEN EXPRESS WARRANTY.

**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.**

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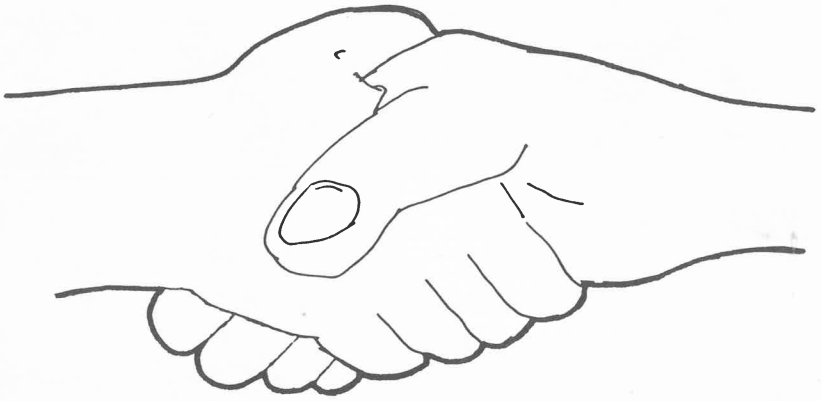
Joe Elliot

# INTRODUCTION



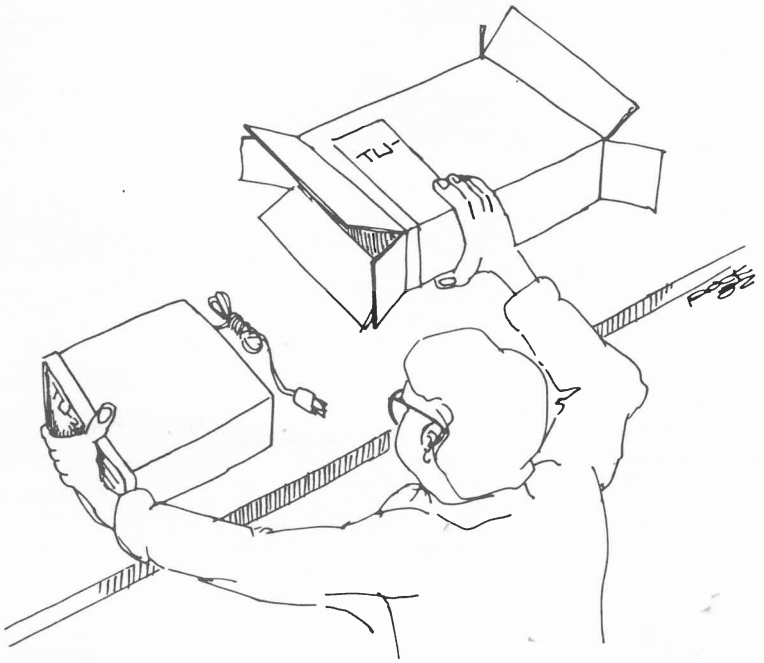
**C O N G R A T U L A T I O N S**

on your purchase of an Flesher Corporation professional quality TU-47Ø 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 by years of engineering experience and technological innovation, assuring a high degree of reliability you expect in professional electronic equipment.

The TU-47Ø 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-47Ø 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-47Ø, 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-470 must not be exposed to excessive moisture, or direct sources of heat.

* All interconnecting wiring should be made as short in length as possible.

* Be sure all equipment system is grounded to 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.

# SPECIFICATIONS

**SIZE:** 7 1/2" X 3" X 10"

**POWER:** 120VAC, 50-60 Hz, 5 watts.

**INPUTS:**

**KEY-N** Active in SEND only. TTL compatible. Requires pull-down to enable AFSK downshift for CW ID.

**AFSKIN-TTL** Input (TLL). TTL compatible, MARK high. Requires pull-down for SPACE.

**AFSKIN-RS** Input (RS 232C). Bi-polar input. MARK= -3V min., SPACE = +3V min.

**RECAUDIO** Receiver audio input. May be connected to any source - 4 ohm to 600 ohms impedance. 100 mv min. input level.

**SEND-N**(TTL). TTL compatible. Requires active pull-down to place the TU-470 in SEND mode from an external control.

**SEND-P** (RS 232C). RS 232C compatible. Requires active pull-up to place the TU-470 in SEND mode from an external control. REC= -3V min., XMIT= +3V min..

**OUTPUTS:**

**DMOUT-TTL** (TTL). TTL compatible demodulator keying output. MARK high.

**DMOUT-RS** (RS 232C). Bi-polar demodulator output. MARK = -6V min., SPACE = +6V min. into a 3K ohm load.

**XMIT-P.** Positive keying for PTT or CW. Toggled by SEND-N or SEND-P inputs.

**XMIT-N.** Negative keying for PTT or CW. Toggled by SEND-N or SEND-P inputs.

**SCOPE MK.** High impedance (50K ohms) MARK filter output, phase corrected for accurate "+" scope tuning display.

**SCOPE SP.** High impedance (50K ohms) SPACE filter output, phase corrected for accurate "+" scope tuning display.

**SENDAUDIO.** AFSK audio output adjustable level (0 to 2 volts RMS), 600 ohm impedance.

**FSK.** Bi-polar output. MARK = -6V min., SPACE = +6V min. into a 3K ohm load.

# SPECIFICATIONS

**OUTPUTS CONTINUED:**

**AUXILIARY POWER** (autostart). 5 amp relay contact output with standard U.S. 120 VAC power receptacle on the rear chassis.

**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.

**LOOP OUTPUT** (S2). 100V 60 miliamphere loop when J1 jumper is installed, 20 miliamphere loop without jumper in place.

**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 INDICATOR:** Indicates when the TU is in send mode.

**RDA INDICATOR:** (Receive Data Available) Indicates when signal is present and autostart relay is on.

**MARK INDICATOR:** Indicates the presence of a signal at the MARK filter output when in RTTY receive mode and the CW filter output when in CW receive mode. In RTTY send mode, indicates the presence of MARK on the AFSK control input.

**SPACE INDICATOR:** Indicates the presence of a signal at the space filter output when in RTTY receive mode. In send mode, indicates the presence of SPACE on the AFSK control input.

**CW DEMODULATOR:**

Center frequency ..... 750 Hz.

-3 db band width .....70 Hz

-20 db band width.....250 Hz

**170 Hz PRESELECTOR FILTER:**

-3 db band width.....350 Hz

-20 db band width.....665 Hz

# CIRCUIT DESCRIPTION

## ACTIVE FILTER

Each of the TU-47Ø 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 1Ø volts. Q1 switches on when the output of IC2 changes to plus 1Ø volts. Pin 7 of IC2 is at the minus 1Ø 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 Ø through 7 are used to select the output frequency of audio frequency shift keyer (AFSK).

## DEMODULATOR

The TU-47Ø 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 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-470 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).

# CIRCUIT DESCRIPTION

The time base for the TU-470 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 programmable divider, IC2. The output of IC2 is conected 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 (HI-TONES).

## MAIN CIRCUIT BOARD LOGIC

The MAIN CIRCUIT BOARD logic consists of the input and output circuits neccessary 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 Q8. Q8 provides isolation from the outside world and the CMOS inverter U3 (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 U2 (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 Q7 which provides isolation between the outside world and the CMOS inverter U1. The output of U1 (pin 14) is wired OR'ed with the output of U1 pin 15 which is the bi-polar serial input for the AFSK. (AFSKIN-RS) This signal also connects to inverter U1 (pin 1). Reverse shift of a send signal is accomplished by selecting either the input signal of U1 (pin 1) or the output signal of the same stage (pin 16) "SEND REVERSE" switch. The output of this switch connects to U2 (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 U1 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 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 R58 and R59. The enable filter signal is at a positive voltage level in receive mode, and a negative voltage level in the transmit mode. SEND-N is also connected to inverter transistor Q14 which serves as isolation between the outside world and the CMOS circuits. The collector of Q14 is connected to inverter U3 which enables the AFSK and to the inputs of gates U2 (pin 2) and U2 (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 U1 (pin 10) and U1 (pin 11). The collector of Q14 is low when in the send mode which enables both the selected space filter frequency select diodes and the mark filter frequency select diodes through diodes D6 and D7 respectively. The AFSK input control signal provides the final determination of which frequency is selected. Q14 collector is also connected to U3 (pin 4) which keys the BI-POLAR circuit for XMIT-P and XMIT-N outputs. This serves as level shifting for transmitter control when using TTL levels to control PTT or CW key input lines of the transmitter.

**SEND-P** controls the operating mode of the TU exactly like SEND-N except the polarity is reversed for transmitt & receive. When SEND-P line is open or held low (+1.0V > SEND-P > -12V) the TU is in the receive mode. When SEND-P is pulled high, (+3.0V < SEND-P < +12V) the TU is switched to the send mode. This input is compatible with RS 232C keying.

**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, 2550 or 2975 Hz (HI-TONES) or 1445, 1700 or 2125 Hz (LO-TONES) respectively. Minimum audio input level is 100 mv.

# CIRCUIT DESCRIPTION

## OUTPUT SIGNALS

**RDA** (RECEIVE DATA AVAILABLE) output indicates the presence of an output signal from the mark filter. Diode CR23 rectifies the mark audio output. The signal is summed and filtered by C26. This voltage level is then compared to the reference level set by R1 and R66 at U4 (pin 13). This reference voltage is approximately + 4 volts so that when the peak output of the filter exceeds 4 volts peak the output of U4 (pin 14) will go to approximately negative 10 volts. This causes C29 to discharge through R50 and CR21 and as soon as the decaying voltage drops below approximately 6 to 7 volts negative, the output of U4 (pin 1) switches positive. This positive output drives the input of U3 (pin 7) which pulls RDA output low. U3 (pin7) also turns on the RDA LED on the front panel through R42. If the audio output level of the filters drops below the threshold voltage set by R66, the output of U4 (pin 14) will go to approximately +10 volts. This positive voltage will charge capacitor C29 through R47. When the voltage level of U4 exceeds approximately 8 volts, the output of U4 (pin 14) returns to the negative state and the RDA output goes to a TTL nigh level state. The comparator circuit is forced to the RDA 'ON' state by CR27 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 Q9 through R23 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 R28 when a mark signal is present at the demodulator output.

**DMOUT-RS** signal is the demodulator output signal passed through current limiting resistor R20. 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 R41.

**SCOPE SPACE** output is the audio output from the selected space filter through current limiting resistor R40.

**XMIT-P** output is keyed from three different sources; the front panel SEND/RECEIVE switch, the SEND-N input and the SEND-P input. When any of the three sources are keyed, the output of inverter U3 (pin 13) drives Q6 base through R14. Q6 collector then pulls high to drive the bases of Q3 and Q5 through R12. When driven, Q5 will pull to ground a positive transmitter PTT or CW keying voltage.

# CIRCUIT DESCRIPTION

OUTPUTS CONTINUED:

**XMIT-N** output is keyed from the same sources as XMIT-P. Q3 acts as an inverter to drive Q4 which will pull to ground a negative transmitter PTT or CW keying voltage.

## 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 CR13 which drives U1 (pin 5). Since this input is a pulsating DC audio voltage, the output of U1 (pin 12) will also be a pulsating voltage. The pulsation rate is too high to be noticed by tne eye and the LED will appear to be fully on. Current is limited through the LED by resistor R38. In the transmit mode the MARK LED is controlled by the condition of the AFSK input signal which is gated through U2 (pin 3). This input drives the inverter U1 (pin 6). The output of U1 (pin 11) turns on the MARK LED through R37 and R38 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 C4 and resistor R8. The voltage divider consisting of R6 and R7 provides base bias for the base of transistor Q2. Q1 is an emitter follower which drives the signal level clipping diodes CR1 and CR2. The clipped audio signal drives all active filter inputs.

**LOOP SUPPLY** current is regulated at either 20 or 60 milliamperes determined by jumper J1. With J1 jumpered the loop will output 60 milliamperes. With J1 open the loop output will be 20 milliampere. Loop connections are made on the output jack S2.

When the TU is idle or in the mark condition, the RTTY demodulator output is negative which turns off Q9. Q9 collector is pulled high by the SIP resistor which drives base of Q11 through R28. This causes Q11 to turn on, driving the base of the loop keying transistor, Q12. When Q12 is turned on, zener diode CR6 regulates the base voltage of Q12 at 5.1 volts below the 90 volt supply voltage. Q12 conducts current (a loop load must be connected) until the voltage drop across Q12 emitter resistor is approximately 4.4 volts below the supply voltage. (Loop current is then approximately 4.4 divided by the emitter resistor value.) This 4.4 volt drop also drives the base of Q10 which monitors the loop status and keys the AFSK keying input.

# 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. **CAUTION: Avoid prolonged standby operation to prevent over-heating when loop is used.**

**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 activates XMIT-P and XMIT-N outputs.

**RTTY/CW:** Alternate action switch:

RTTY: Enables RTTY demodulator and filters for normal RTTY operation.

CW: Enables the CW demodulator and filter for normal CW receive operation.

**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.

# OPERATING INSTRUCTIONS

**FILTER WIDE/NAR.:** Alternate action switch:

When the switch is push-in, the 17Ø Hz band-pass preselector is activated while 17Ø Hz frequency is selected. **If CW mode is selected, this filter should be disabled.**

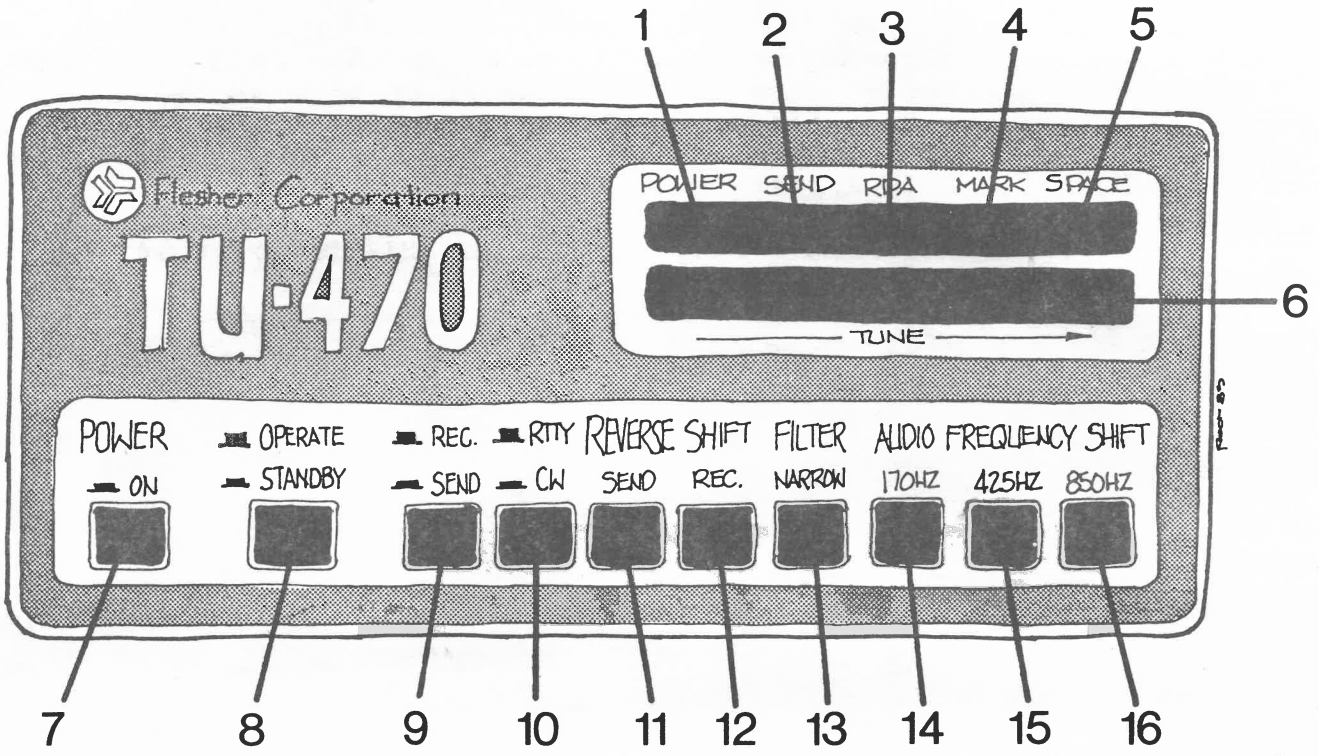
**FREQUENCY SHIFT:** Interlocking switches:

17Ø Hz - Selects 2295 Hz (HI-TONES) or 1445 Hz (LO-TONES)

425 Hz - Selects 255Ø Hz (HI-TONES) or 17ØØ Hz (LO-TONES)

85Ø Hz - Selects 2975 Hz (HI-TONES) or 2125 Hz (LO-TONES)

# OPERATING INSTRUCTIONS

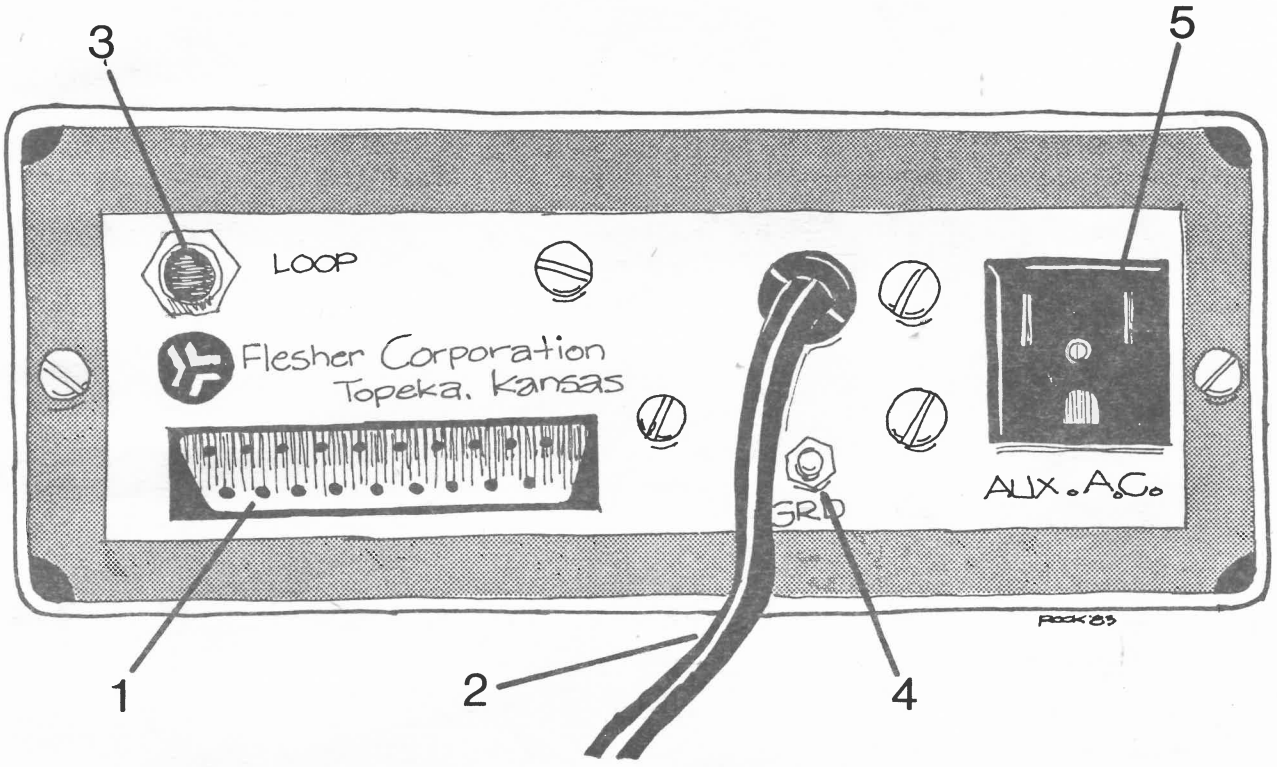



**FRONT PANEL**

**INDICATORS AND SWITCHES**

(1) POWER INDICATOR
(2) SEND INDICATOR
(3) RDA INDICATOR
(4) MARK INDICATOR
(5) SPACE INDICATOR
(6) TUNING INDICATOR
(7) POWER
(8) OPERATE/STANDBY
(9) SEND/RECEIVE
(10) RTTY/CW
(11) REVERSE SEND
(12) REVERSE RECEIVE
(13) PRE-FILTER
(14) 170 HZ SELECT
(15) 425 HZ SELECT
(16) 850 HZ SELECT

# OPERATING INSTRUCTIONS




**REAR CHASSIS PANEL**

(1) S1 CONNECTOR (3) S2 LOOP JACK (5) AUXILIARY AC

(2) AC POWER CORD (4) GROUND TERMINAL

# OPERATING INSTRUCTIONS

Some years back, operating RTTY on HF was a lot of work. Today, the TU-470 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-470 to HF radio equipment is very easy and consists of making only three signal connections:

1) Transmitter PTT
2) Transmitter Microphone Audio Input.
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 continous 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-470 is very easy; First, set all of the front panel switches on the TU to their

'OUT' 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 170 Hz shift), 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 absense 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 and your frequency shift select is correct 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-470 (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 or other shifts you will normally use.

**SENDING RTTY** with the TU-470 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 by the remote transmit connections 'SEND-N' or 'SEND-P'. The BI-POLAR PTT output (XMIT-N or XMIT-P) of the TU can be used to control the transmitter if the send/receive switch is on or by using the remote PTT keying inputs.

# OPERATING INSTRUCTIONS

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 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.

**RTTY/CW:** This switch allows you to switch in either the RTTY demodulator using RTTY filters or the CW demodulator using a 750 Hz three stage filter. Both positions share the same keying outputs (DMOUT-TTL and DMOUT-RS). The 'SEND-N' or 'SEND-P' remote keying lines can isolate TTL or RS 232C keying lines used from computers to key high voltage CW keying inputs of transmitter which in turn key the BI-POLAR keying outputs (XMIT-N or XMIT-P) of the TU-470.

**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.

**FILTER WIDE/NAR:** When this switch is pushed in, the 170 Hz preselector filter will be activated. This is a narrow input filter for the 170 Hz position only, it serves no other selected frequency shift and is disabled when other frequency shifts are selected. When the switched is in the 'OUT' position, the audio is direct to the frequency select filters. **The preselector filter is not recomended for 300 baud ASCII reception and should not be activated when CW is selected.**

The TU-470 MARK frequency is always 2125 Hz (HI-TONES) or 1275 Hz (LO-TONES) and the SPACE frequency selected 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-470 will receive up to and including 300 baud when using HI-TONES, but sacrifices this speed if you have selected LO-TONES.

# OPERATING INSTRUCTIONS

**CW:** Operating the CW Demodulator is easy. Simply select "CW" on the front panel selector switch and set all other switches to normal receive positions. Tune in the CW station while watching the Bar Graph tuning indicator. When the tuning indicator reaches a peak and the MARK LED is flashing with the keyed tone, the CW signal is properly tuned. **If the indicators fail to acknowlege the CW signal, check to see if the NARROW 170 Hz FILTER is activated, this filter will not allow 750 Hz to pass throught it.**

A BI-POLAR keying output is provided to key the transmitter CW or PTT circuits. Either positive or negative keying voltages may be pulled to ground by XMIT-P OR XMIT-N respectively. It is suggested that VOX operation be used for the RTTY mode and XMIT-P or XMIT-N outputs be used to key the CW keying input of the transmitter. It is common for most transmitters to permit both circuits to be keyed simultaneously, responding to the appropriate circuit depending on whether the mode switch is in CW or LSB. When the transmitter is in the CW mode, audio through the microphone input is disabled and, when in the LSB mode, the CW Key input is disabled. This is a convenient feature for those using computers who desire to make use of both RTTY and CW programs. It is not necessary to change interconnections when going from one mode to the other.

If problems are encountered, check the interface wiring first. Many problems can be traced to improper connections between the TU and the computer or transceiver. Check for a pulsing signal at the outputs (S1 pins 3 & 4) with a CW signal tuned in. If keying is present, check the connections to the computer and make sure the program is running correctly.

**RDA THRESHOLD:** The RDA threshold control (R66) sets the signal level at which the RDA circuit (and the autostart relay) recognizes a signal in the band pass of the mark filter. It is adjusted through the access hole on the right side of the cabinet.

To set the threshold, first turn R66 fully clockwise. Set an audio signal generator set to the mark frequency (2125 Hz) and adjust the signal level so that the bargraph shows about 1/2 to 3/4 of full scale. (Alternately, you may use your receiver tuned so that a steady carrier is in the mark filter channel. Adjust the receiver volume control for 1/2 to 3/4 full scale on the bargraph.)

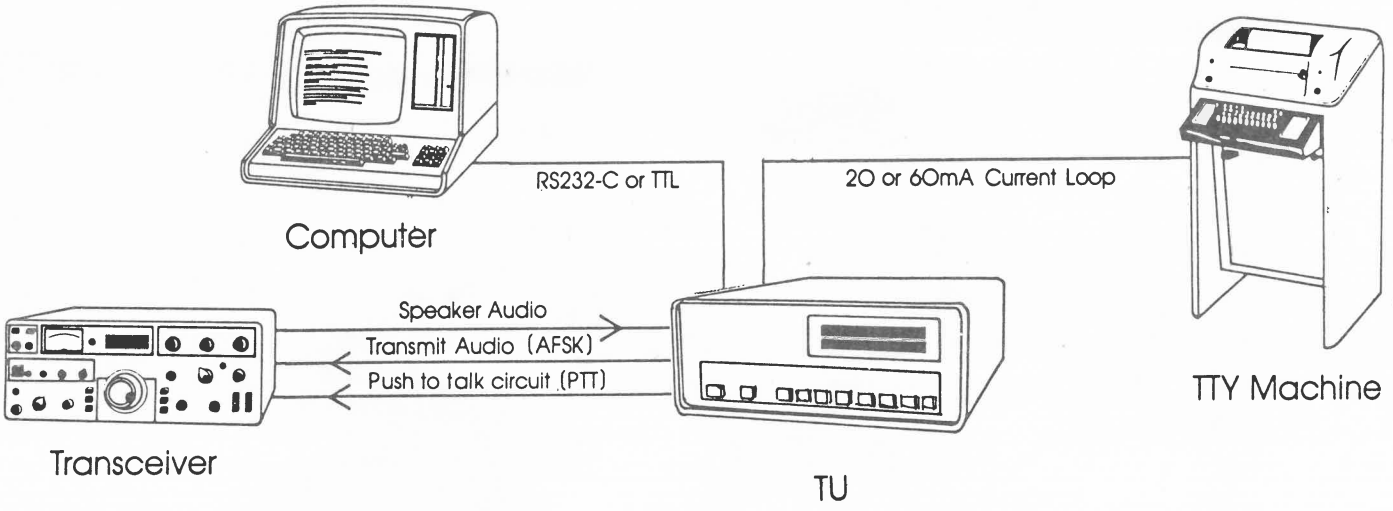
If the RDA indicator on the front panel is lighted, wait about 5 seconds until it turns off. Slowly turn R66 counter-clockwise until the RDA indicator turns on. After this adjustment has been made, it should be reset only if different RDA sensitivity is desired. (Clockwise for less sensitivity, counter-clockwise for greater sensitivity.)

# CONNECTION ILLUSTRATIONS

********** IMPORTANCE NOTICE **********

**If you plan on using a computer and do not need the use of the LOOP SUPPLY, it would be advisable to disable the LOOP SUPPLY by lifting CR7 and CR8. After this is done, install a 4.7K, 1/4 Watt, 5% (YEL-VIO-RED) resistor in the resistor position marked with 'RX' between R2Ø and R25. If both an external machine and a computer is connected at the same time, no change is needed as long as the loop is closed. In any case, if the loop is not used it will be necessary to either short the loop plug to ground or disable the loop circuit entirely.**

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. Tne Flesher Corporation warranty does not cover damage resulting from improper connection of the TU-47Ø to other equipment, and makes no claim that the TU-47Ø is compatible with specific equipment. It is the user's responsibility to determine the compatibility of the TU-47Ø with other equipment. Refer to the TU-47Ø specifications and the specifications of the equipment to which it will be connected.



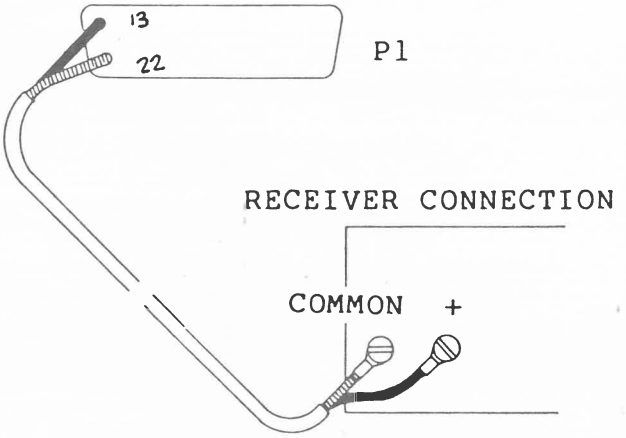
# CONNECTION ILLUSTRATIONS

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 the TU-470 DB25 MALE CONNECTOR to the receiver speaker plus terminal.

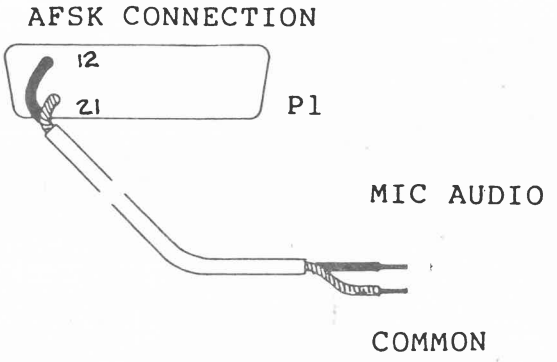
Connect Pin 22 of the TU-470 DB25 MALE CONECTOR to the receiver speaker common terminal. Any output impedance from 4 ohms to 600 ohms will work.




**TRANSMITTER AFSK CONNECTION:**

Connect pin 12 of the TU-470 DB25 MALE CONNECTOR to transmitter microphone audio input.

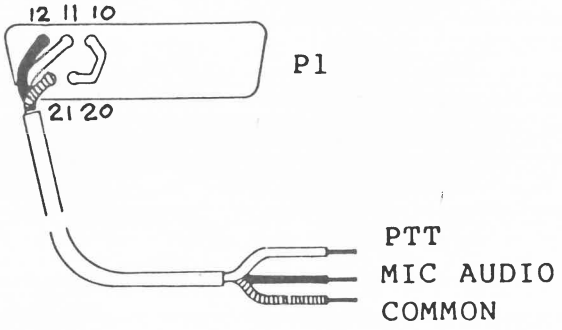
Connect pin 21 of the TU-470A DB25 MALE CONNECTOR to transmitter common.




**TRANSMITTER PTT CONNECTION:**
(Not required if VOX operation is used.)

Connect pin 10 of the TU-470 DB25 MALE CONNECTOR to the transmitter PTT. **NOTE:** If transmitter PTT input requires that a negative voltage pulled to ground, then connect pin 11 of the TU-470 DB25 MALE CONNECTOR to the transmitter PTT circuit.

Connect pin 21 of TU-470 DB25 MALE CONNECTOR to the transmitter common.

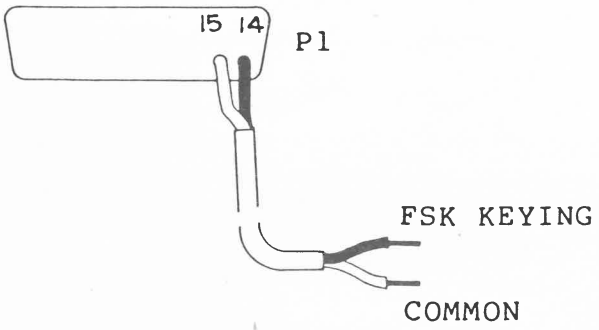


# CONNECTION ILLUSTRATIONS

**TRANSMITTER FSK CONNECTION:**

Connect pin 14 of TU-470 DB25 MALE CONNECTOR to FSK keying input of transmitter.

Connect pin 15 of TU-470 DB25 MALE CONNECTOR to transmitter common.



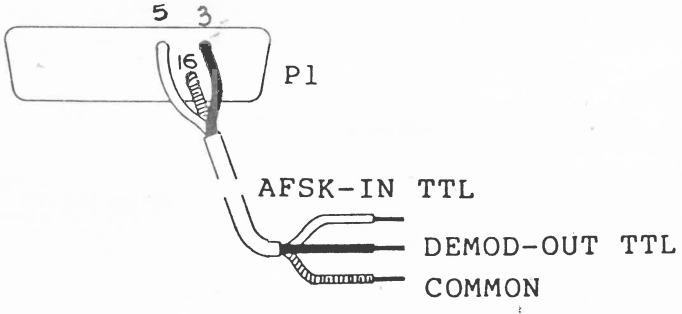

**TTL COMPATIBLE INTERFACE CONNECTION:**

TU-470 DEMODULATOR TTL compatible keying output for RTTY and CW-connect to pin 3 of the DB25 MALE CONNECTOR.

TU-470 AFSK TTL compatible keying input-connect to pin 5 of the DB25 MALE CONNECTOR.

TU-470 SEND-N TTL compatible remote transmit-connect to pin 9 of the DB25 MALE CONNECTOR.

TU-470 common-conect to pin 16 of the DB25 MALE CONNECTOR.



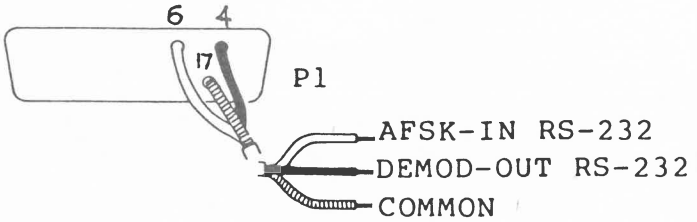

**RS-232c COMPATIBLE INTERFACE CONNECTION:**

TU-470 DEMODULATOR RS-232c compatible output keying for RTTY and CW-connect to pin 4 of the DB25 MALE CONNECTOR.

TU-470 AFSK RS-232c compatible keying input-connect to pin 6 of the DB25 MALE CONNECTOR.

TU-470 SEND-P RS-232c remote transmit-connect to pin 25 of the DB25 MALE CONNECTOR.

TU-470 common-connect to pin 17 of the DB25 MALE CONNECTOR.



# RTTY FILTER
# ALIGNMENT PROCEDURE

With a working AFSK circuit board installed in the TU-470, the BAR GRAPH display on the front panel may be used in the following procedure to eliminate the need for test equipment during alignment. If the AFSK is not used, a calibrated audio signal generator must be used (inject the signal at pin 13 of the S1 connector instead of installing the jumper in step 3, below). Before alignment, be sure all the boards are properly installed in their sockets and are in the proper positions.

1( ) Do not plug the TU-470 into AC power until instructed.

2( ) Remove the TU-470 inner-chassis from outer cover by removing the two 8-32 X 3/8" screws on each side of the cabinet rear.

3( ) 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 S1 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.

An AC voltmeter (10 volts RMS full scale) or a 'scope may be used in place of the BAR GRAPH display for the alignment procedure. If either a meter or 'scope is used, skip the next three steps.

(x) ( ) Remove the circuit board support bracket fastened by two 6-32 X 1/4" binder head screws on either side.

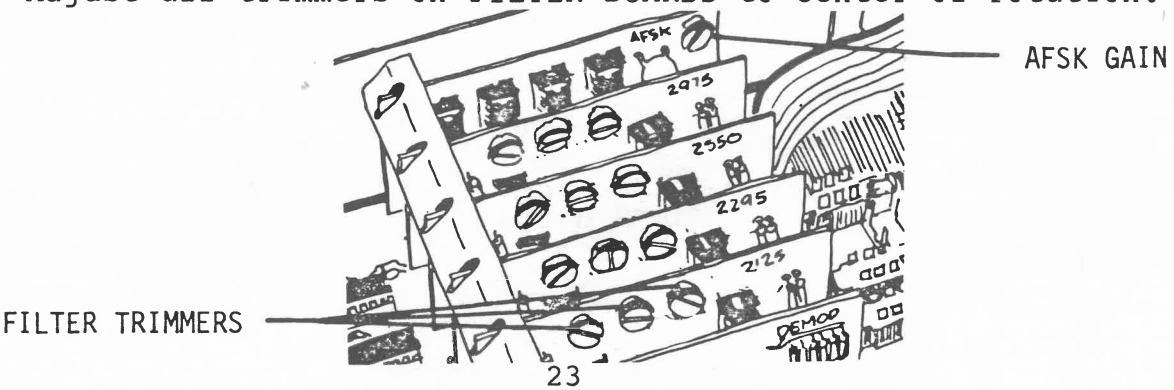
(x) ( ) Disconnect one lead of CR27 on the MAIN CIRCUIT BOARD.

(x) ( ) Remove each filter board and disconnect one lead (either lead) of D1 on each FILTER board to be aligned. (DO NOT CONFUSE D1 WITH FREQUENCY SELECT DIODE #1.)

In the following steps, align each filter by connecting the positive meter or 'scope probe to 'TP' of each filter board as it is being tuned. If test equipment is not used, use the bar graph display as described in the instructions.

( ) Adjust AFSK gain trimmer to center of rotation.

( ) Adjust all trimmers on FILTER BOARDS to center of rotation.

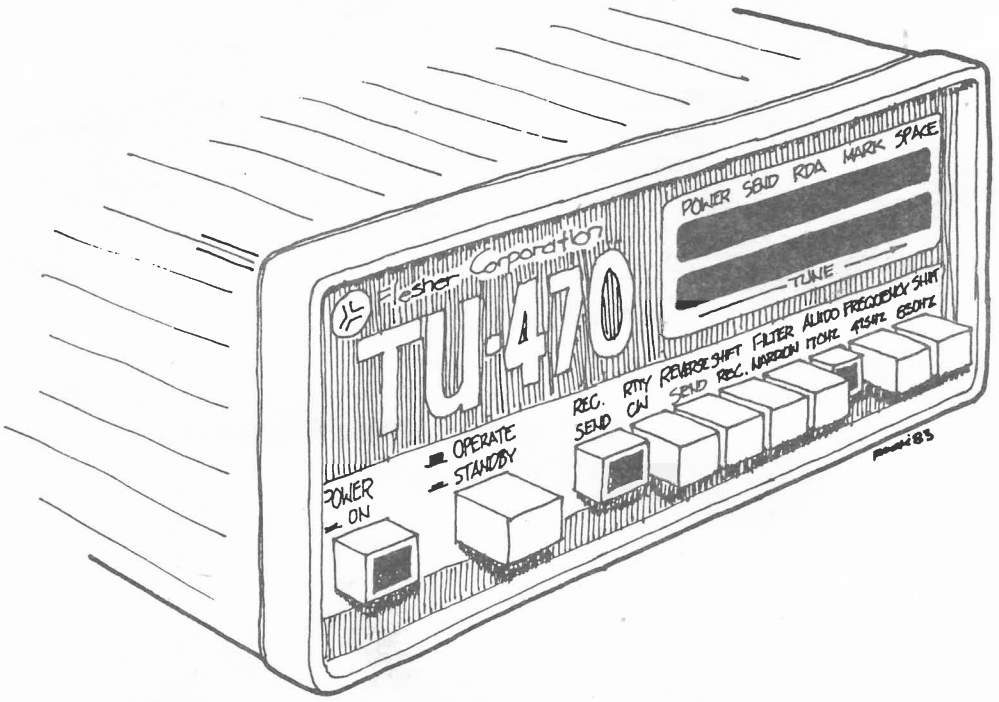


# RTTY FILTER
# ALIGNMENT PROCEDURE

( ) Carefully re-install all filter boards.

( ) Apply power to the TU-47Ø. 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, SEND and the 17Ø Hz Frequency Select 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.

( ) Replace D1 and 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 2295 Hz filter for maximum indication on the BAR GRAPH display. Use the same procedure as before. The 255Ø Hz filter may restrict indication level.

( ) Replace D1 and select 425 Hz on the front panel.

# RTTY FILTER
# ALIGNMENT PROCEDURE

( ) Adjust the gain trimmer of the AFSK so no more than the fifth or sixth LED of the BAR GRAPH disply flickers or glows dimly again.

( ) Adjust the three trimmers on the 2550 Hz filter for maximum indication on the BAR GRAPH disply. Use the same procedure as before.

( ) Replace D1 and select 850 Hz on the front panel.

( ) Adjust the gain trimmer of the AFSK so no more than the fifth or sixth LED of the BAR GRAPH display flickers or glows dimly again.

( ) Adjust the three trimmers on the 2975 Hz filter for maximum indication on the BAR GRAPH display. Use the same procedure as before.

( ) Turn the TU-470 off and unplug it from AC power.

If a meter or 'scope has been used to tune the filters, skip the next four steps.

(x) ( ) Remove the filter circuit boards, being careful not to move the trimmer potentiometer adjustments.

(x) ( ) Install (or reconnect) D1 on each filter board.

(x) ( ) Install (or reconnect) CR27 on the MAIN CIRCUIT BOARD.

(x) ( ) Replace tne filter circuit boards, again being careful not to move the trimmer potentiometer adjustments.

( ) Remove the jumper from pins 12 and 13 of S1 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 and when completed, remove AC plug from power source.

( ) 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" binder 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.

# PS-170A
# ALIGNMENT PROCEDURE

( ) Install the PS-170A in PRESELECTOR position of the TU MAIN CIRCUIT BOARD. Make sure it is positioned correctly.

( ) Set the four tuning potentiometers on the PS-170A to mid range.

( ) Connect AC to the TU and apply power with the power switch on the front panel.

( ) Push the FILTER switch to the 'IN' position.

**If a calibrated signal generator is not available, the required frequencies can be obtained from the AFSK by jumpering certain Freqency Select Diode positions of the filter board installed in the 2125 Hz filter position. If the AFSK is to be used as a signal source for tuning the filters, perform the next three steps. Otherwise, skip the next three steps.**

( ) Bend a one inch length of 22 gauge bare wire (or trimmed resistor lead) in a "U" shape and insert this wire in pins 12 and 13 of S1 connector.

( ) The POWER, SEND, 170 Hz FREQUENCY SHIFT and 170 Hz filter switches should be depressed.

( ) The following chart shows the Frequency select diode positions which must be jumpered on the 2125 Hz filter to get the AFSK to generate the required tones. Tack solder jumpers across the indicated diode positions for easy removal and to prevent damage to the foil. (All diodes must be removed from the 8 diode positions when using the 2125 Hz filter board for this purpose.)

| | |
|---|---|
| **2495** Hz = 1,2,4,5,6 | **1979** Hz = 1,4,6 |
| **2310** Hz = 0,1,3,5,6 | **2100** Hz = 2,3,4,6 |

Use these frequencies for tuning as they are called out in the next steps.

**Tuning of the four filters is critical. The signal source frequencies must be within +5 Hz for proper opertion of the filter and the trimmer potentiometers must be adjusted carefully.**

( ) Connect an audio signal generator sine wave output set at 2495 Hz to pin 13 of S1 connector on the MAIN CIRCUIT BOARD. **(If the AFSK is used for a signal source, the jumper previously put between pins 12 and 13 on S1 makes the signal connection.)**

# PS-170A
# ALIGNMENT PROCEDURE

( ) Adjust the signal generator output level (or the AFSK output level, if the AFSK is used as a signal source) for mid scale indication on the bar graph tuning display on front panel of the TU. (Alternately, and more accurately, an AC volt meter or a scope may be used instead of the bar graph display by connecting to the test point labeled TP on the PS-170A board.)

( ) Peak P1 potentiometer for maximum signal on the bar graph tuning display or at TP. The signal generator output level may have to be reduced to keep from over-driving the bar graph tuning indicator.

( ) Set the signal generator to 1979 Hz and peak P2.

( ) Set the signal generator to 2310 Hz and peak P3.

( ) Set the signal generator to 2100 Hz and peak P4.

( ) Disconnect the audio signal generator (or remove the jumper on S1 connector) and connect the receiver audio. Tune to a RTTY signal and make sure the TU is performing normally.

# CW DEMODULATOR ALIGNMENT PROCEDURE

( ) Install CW Demodulator in position CW DEMOD of TU MAIN CIRCUIT BOARD. Make sure it is positioned correctly.

( ) Set the three tuning potentiometers on the CW Demodulator board to mid range.

( ) Connect AC to the TU and apply power with power switch on front panel.

( ) Set CW/RTTY switch to CW with all others in normal receive condition.

**If an audio sine wave signal generator is not available, skip the next three steps.**

( ) Connect an audio sine wave signal generator set at 750 Hz to pin 13 of S1 connector on TU MAIN CIRCUIT BOARD. Adjust the signal generator output level for mid-range indication on the bar graph tuning display on front panel of TU.

( ) Peak each potentiometer for maximum signal on the bar graph tuning display. The signal generator output level may have to be reduced to keep from over-driving the bar graph tuning indicator. An AC volt meter set for approximately 20 VAC may be used instead of the bar graph by connecting it to the test point (TP) on the CW demodulator board.

( ) Disconnect the audio signal generator and connect the receiver audio. When tuned to a CW signal, the bar graph will advance and the MARK LED will blink. Check for keying on the TTL and RS-232C outputs. When satisfied that the CW Demodulator is operating properly, reassemble the TU in its cabinet.

**If a calibrated signal generator is not available, the following method will tune the filter very close to 750 Hz without using calibrated test equipment.**

( ) Adjust each of the three trimmer potentiometers to center of rotation. This will tune each stage fairly close to 750 Hz.

( ) Use your receiver crystal calibrator or a steady carrier tuned on your receiver to supply an audio tone to the TU-470. Adjust the receiver tuning dial so that the BAR GRAPH DISPLAY indicates peak signal strength (this will be approximately 750 Hz).

( ) Adjust each of the three trimmer potentiometers for maximum indication on the BAR GRAPH DISPLAY.

# TU-470 VOLTAGE CHART

**SWITCH CONDITIONS: POWER = ON  OPERATE/STANDBY = OPERATE  REC./SEND = REC.**
**REVERSE SHIFTS = OFF  ALL PLUG IN BOARDS REMOVED**

| PINS | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| U1 | +9 | Ø | Ø | Ø | Ø | Ø | Ø | Ø | +9 | +3.7 | +3.7 | +3.7 | +3.7 | +9 | +9 | +.6 |
| U2 | +9 | +.1 | +.1 | +.1 | +12 | +.6 | Ø | +12 | +.6 | +.1 | +.1 | +.1 | +.6 | +12 | | |
| U3 | +.1 | +.1 | +.1 | +.1 | +11 | Ø | Ø | Ø | +19 | +5 | +19 | +.6 | +12 | +.6 | +12 | +.6 |
| U4 | -10 | +11 | -7 | +12 | -4 | Ø | -10 | Ø | Ø | Ø | -12 | +2 | Ø | | | |

CHECK REGULATOR OUTPUTS (U5,U6,U7) AS MARKED DIRECTLY IN FRONT OF U6

| TRANSISTOR | EMITTER | BASE | COLLECTOR |
|---|---|---|---|
| Q1 | +5.8 | +6.5 | +12 |
| Q2 | +.8 | +1.5 | +6.5 |
| Q3 | Ø | - .7 | Ø |
| Q4 | Ø | Ø | Ø |
| Q5 | Ø | - .7 | Ø |
| Q6 | +12 | +12 | -.7 |
| Q7 | Ø | + .7 | Ø |
| Q8 | Ø | + .7 | Ø |
| Q9 | Ø | Ø | +4.3 |
| Q10 | +100 | + 96 | +96 |
| Q11 | Ø | Ø | +100 |
| Q12 | +100 | +100 | Ø |
| Q13 | Ø | + .7 | Ø |
| Q14 | Ø | + .7 | Ø |
| Q15 | Ø | Ø | + .6 |

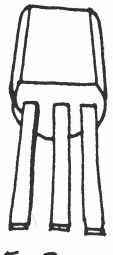
**All voltages are approximate and will vary somewhat from unit to unit.**

**S1**

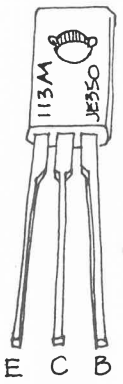
PIN 1 = +5
PIN 2 = +5
PIN 3 = +5
PIN 4 = Ø
PIN 5 = +5
PIN 6 = Ø
PIN 7 = Ø
PIN 8 = Ø
PIN 9 = +6
PIN 10= Ø
PIN 11= Ø
PIN 12= Ø
PIN 13= Ø
PIN 14= -10
PIN 15 TO 22 = GROUND

**TRANSISTOR IDENTIFICATION**

Q1-Q11, Q13-15




Q12




VOLTAGE CHART

# IF YOU HAVE TROUBLE. . .

**FLESHER CORPORATION FACTORY SERVICE**

Occasionally it may become necessary to have your TU-47Ø 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-Ø198) 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

C.O.D. will not be accepted for repair service.

Your TU-47Ø 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.

# MAIN BOARD
# PARTS LIST

500-434

| ITEM | PART NO. | DESCRIPTION | QTY. |
|---|---|---|---|
| | 335 124A | Circuit board | (1) |
| U1,U3 | 125 150 | IC, MC1416 | |
| U2 | 125 012 | IC, 4081, CMOS | |
| U4 | 125 148 | IC, 4741, Quad OP AMP | |
| U5 | 125 001 | IC, MC7812CT, Regulator (+12V) | |
| U6 | 125 002 | IC, MC7912CT, Regulator (-12V) | |
| U7 | 125 000 | IC, MC7805CT, Regulator (+5V) | |
| Q1,Q2,Q7, Q8,Q9,Q13, Q14,Q15 | 120 027 | Transistor, 2N4123, NPN | |
| Q3,Q6 | 120 029 | Transistor, 2N4125, PNP | |
| Q4 | 120 091 | Transistor, MPS L51, PNP | |
| Q5 | 120 090 | Transistor, MPS L01, NPN | |
| Q10 | 120 045 | Transistor, MPS A92, PNP | |
| Q11 | 120 043 | Transistor, MPS A42, NPN | |
| Q12 | 120 087 | Transistor, MJE 350, PNP | |
| CR1-CR5, CR13-CR27 | 120 005 | Diode, 1N4148 | |
| CR6 | 120 007 | Diode, 1N751, Zener | |
| CR7-CR12 | 120 192 | Diode, 1N4004, Rectifier | |
| C1,C2,C4,31 | 110 230 | Capacitor, .1uf, 12V disc (104Z) | |
| C3,C28,C29,C30 | 111 131 | Capacitor, 4.7uf, 35V, electrolytic | |
| C5-C17,C21, C22,C23 | 110 199 | Capacitor, .01uf, disc, 100V (103Z) | |
| C18 | 111 212 | Capacitor, 47uf, 160V, electrolytic | |
| C19,C20 | 110 183 | Capacitor, .005uf, 1600V, disc | |
| C32 | 110 206 | Capacitor, .01uf, 1600V, disc | |
| C24 | 111 235 | Capacitor, 220uf, 25V, electrolytic | |
| C25 | 111 256 | Capacitor, 470uf, 25V, electrolytic | |
| C26,C27 | 111 101 | Capacitor, 1.0uf, 50V, electrolytic | |
| R1,R6,R50 | 101 110 | Resistor, 15K ohm (BRN-GRN-ORG) | |
| R2,R3,R20, R25,R53 | 100 830 | Resistor, 1K ohm (BRN-BLK-RED) | |
| R4,R7 | 100 910 | Resistor, 2.2K ohm (RED-RED-RED) | |
| R5,R8 | 100 710 | Resistor, 330 ohm (ORG-ORG-BRN) | |
| R9,R10,R12, R15,R16,R34,R43, R44,R61,R64,R65 | 100 990 | Resistor, 4.7K ohm (YEL-VIO-RED) | |
| R11,R14,R23,R31 | 101 070 | Resistor, 10K ohm (BRN-BLK-ORG) | |
| R13,R18,R19, R21,R22,R24,R26, R28,R29,R30,R55 | 100 930 | Resistor, 2.7K ohm (RED-VIO-RED) | |
| R17 | 100 950 | Resistor, 3.3K ohm (ORG-ORG-RED) | |
| R27 | 101 250 | Resistor, 56K ohm (GRN-BLU-ORG) | |
| R32 | 101 591 | Resistor, 100 ohm 1/2W (BRN-BLK-BRN) | |
| R33 | 101 126 | Resistor, 18K ohm 1/2W (BRN-GRY-ORG) | |
| R35 | 100 673 | Resistor, 220 ohm 1/2W (RED-RED-BRN) | |
| R36,R37 | 100 690 | Resistor, 270 ohm (RED-VIO-BRN) | |
| R38,R39 | 100 590 | Resistor, 100 ohm (BRN-BLK-BRN) | |

# MAIN BOARD PARTS LIST

500-434

CONTINUED

| ITEM | PART NO. | DESCRIPTION | QTY. |
|---|---|---|---|
| R40,R41 | 101 230 | Resistor, 47K ohm (YEL-VIO-ORG) | |
| R42 | 100 730 | Resistor, 390 ohm (ORG-WHT-BRN) | |
| R45,R48,R54, R56,R58,R60 | 101 310 | Resistor, 100K ohm (BRN-BLK-YEL) | |
| R46,R49,R52 | 101 390 | Resistor, 220K ohm (RED-RED-YEL) | |
| R47 | 101 450 | Resistor, 390K ohm (ORG-WHT-YEL) | |
| R51 | 100 790 | Resistor, 680 ohm (BLU-GRY-BRN) | |
| R57,R59 | 101 400 | Resistor, 270K ohm (RED-VIO-YEL) | |
| R62,R63 | 101 730 | Resistor, 8.2 megohm (GRY-RED-GRN) | |
| RX | 100 990 | Resistor, 4.7K ohm (YEL-VIO-RED) | |
| R66 | 106 100 | Pot, 10K, PC Mount | |
| SIP | 107 008 | Resistor Array, 4.7K X 9 | (1) |
| T1 | 130 031 | Transformer | (1) |
| S1 | 140 334 | Connector, PC mount, DB25 | |
| | 137 180 | Connector, PC MTG, 15 pin male | (8) |
| | 140 330 | Relay | (1) |
| | 140 381 | Switch set | (1) |
| | 140 012 | Insulator | (2) |
| | 140 101 | Socket, IC, 16 pin | (2) |
| | 140 100 | Socket, IC, 14 pin | (2) |
| | 145 048 | Screw, Nylon, 4-40 X 1 3/8" | (2) |
| | 145 079 | Screw, Nylon, 4-40 X 3/8" | (2) |
| | 145 049 | Nut, Nylon | (4) |

NOTE: ALL RESISTORS ARE 1/4 WATT, 5% UNLESS OTHERWISE STATED.

# DISPLAY BOARD PARTS LIST

500-347

| ITEM | PART NO. | DESCRIPTION | QTY. |
|---|---|---|---|
| | 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 (ORG-ORG-BRN) | |
| R2 | 100 830 | Resistor, 1K ohm (BRN-BLK-RED) | |
| POWER | 120 097 | LED, RED, Litronix LD32C | |
| SEND | " " | " " " " | |
| RDA | " " | " " " " | |
| MARK | " " | " " " " | |
| SPACE | " " | " " " " | |

NOTE: ALL RESISTORS ARE 1/4 WATT, 5% UNLESS OTHERWISE STATED.

# CHASSIS PARTS LIST

500-436

| ITEM | PART NO. | DESCRIPTION | QTY. |
|---|---|---|---|
| | 150 497 | Cover, chassis | (1) |
| | 150 662 | Chassis, internal | (1) |
| | 150 663 | Chassis, front panel | (1) |
| | 150 496 | Extrusion | (1) |
| | 150 494 | Bracket, PC support | (1) |
| | 150 661 | Legend, front panel | (1) |
| | 140 057 | Fuse holder | (1) |
| F1 | 140 090 | Fuse, MDL-3 | (1) |
| | 137 019 | Outlet, grounded AC | (1) |
| S2 | 137 018 | Jack, 2 conductor, 1/4", w/mtg nut | (1) |
| | 137 017 | Plug, 2 conductor 1/4" | |
| | 140 382 | Cord, power, AC, 3 cond | (1) |
| | 145 216 | Screw, 4-40 X 1/4" LG, FH, Slotted | (7) |
| | 145 014 | " " 6-32 X 3/8" Binder head | (11) |
| | 145 043 | " " 6-32 X 1/2" Binder head | (1) |
| | 145 015 | Nut, 6-32 | (5) |
| | 145 017 | Lock washer, Int. star #6 | (3) |
| | 145 039 | Screw, 8-32 X 3/8" Binder head | (2) |
| | 140 344 | Lug, Int. star, ground lug #6 | (3) |
| | 140 383 | Strain relief | (1) |
| | 150 505 | Feet, rubber | (4) |
| | 145 018 | Washer, #6 flat | (2) |

# DEMODULATOR BOARD PARTS LIST

500-341

| ITEM | PART NO. | DESCRIPTION | QTY. |
|---|---|---|---|
| | 335 100 | Circuit board | (1) |
| IC1 | 125 148 | IC, 4741, quad Op Amp | |
| IC2 | 125 022 | IC, MC1458CP, dual Op Amp | |
| D1-D7 | 120 005 | Diode, 1N4148, silicon, fast switching | |
| C1 | 110 236 | Capacitor, .15uf, mylar | |
| C2 | 110 143 | " 220pf, disc | |
| C3,C4 | 111 121 | " 3.3uf, 25V, Electrolytic, Axial | |
| C5 | 110 240 | " .22uf, mylar, (224K) | |
| C6,C7 | 110 199 | " .01uf, 100V, disc | |
| R1,R2 | 101 310 | Resistor, 100K ohm (BRN-BLK-YEL) | |
| R3 | 101 250 | " 56K ohm (GRN-BLU-ORG) | |
| R4,R5,R6,R8,R9, R13 | 101 190 | " 33K ohm (ORG-ORG-ORG) | |
| R7,R15 | 101 110 | " 15K ohm (BRN-GRN-ORG) | |
| R10,R11 | 100 910 | " 2.2K ohm (RED-RED-RED) | |
| R12 | 101 470 | " 470K ohm (YEL-VIO-YEL) | |
| R14 | 100 990 | " 4.7K ohm (YEL-VIO-RED) | |
| R16 | 101 450 | " 390K ohm (ORG-WHT-YEL) | |
| | 137 175 | Connector, 15 pin, female | |

# DEMODULATOR BOARD PARTS LIST

500-341

| ITEM | PART NO. | DESCRIPTION | QTY. |
|---|---|---|---|
| | 140 100 | Socket, IC, 14 pin | |
| | 140 191 | Socket, IC, 8 pin | |

NOTE: ALL RESISTORS ARE 1/4 WATT, 5% UNLESS OTHERWISE STATED.

# AFSK BOARD PARTS LIST

500-363

| ITEM | PART NO. | DESCRIPTION | QTY. |
|---|---|---|---|
| | 335 098 | Circuit Board REV B | (1) |
| C1,C2,C8 | 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,C6,C7 | 110 199 | Capacitor, .01uf, disc | |
| *(C8) | 110 130 | Capacitor, 50pf disc (lo-tones only) | |
| IC1 | 125 011 | IC, 4069 | |
| IC2,IC3,IC4 | 125 093 | IC, 40193 | |
| IC5 | 125 078 | IC, 1741 op amp | |
| P1 | 106 103 | Pot, 10K | |
| R1 | 101 600 | Resistor, 2.2M ohm (RED-RED-GRN) | |
| R2 | 100 670 | Resistor, 220 ohm (RED-RED-BRN) | |
| R3,R4 | 101 470 | Resistor, 470K ohm (YEL-VIO-YEL) | |
| R5 | 100 730 | Resistor, 390 ohm (ORG-WHT-BRN) | |
| R6 | 100 790 | Resistor, 680 ohm (BLU-GRY-BRN) | |
| R7 | 100 190 | Resistor, 33K ohm (ORG-ORG-ORG) | |
| | 107 008 | Resistor Array, 4.7K X 9 | |
| D1,D2,D4,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 fem | (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.

# UNIVERSAL FILTER
# PARTS LIST

**500-340**
**500-358**
**500-422**
**500-423**

| ITEM | PART NO. | DESCRIPTION | QTY. |
|---|---|---|---|
| | 335 099A | Circuit board | (1) |
| IC1,IC2 | 125 022 | IC,MC1458CP, Dual Op Amp | |
| Q1 | 120 039 | Transistor, MPF111, FET | |
| P1,P2,P3 | 106 041 | Pot, 500 ohm, PC mount | |
| D1 | 120 005 | Diode, 1N4148, silicon, fast switching | |
| **C1(-C8) | 110 198 | Capacitor, .01uf, mylar, (2A103JT) | |
| * C1-C8 C2 | 110 181 | Capacitor, .005uf, mylar (2A502JT) | |
| C9,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.

FREQUENCY SELECT DIODES are all 1N4148 (P.N. 120 005) and will vary in the amount each board takes depending on the frequency the filter is to be set at. (SEE FREQUENCY SELECT DIODE CHART.)

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

| | 2125Hz | 2295Hz | 2550Hz | 2975Hz | 1275Hz | 1445Hz | 1700Hz |
|---|---|---|---|---|---|---|---|
| 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 | 270K | 220K | 180K | 150K | 220K | 200K | 180K |
| R14 | 470K | 470K | 470K | 470K | 470K | 470K | 470K |

# CW DEMODULATOR PARTS LIST

500-439

| ITEM | PART NO. | DESCRIPTION | QTY. |
|---|---|---|---|
| | 335 117 | Circuit board | (1) |
| IC1,IC2,IC3 | 125 022 | IC, MC1458CPI, Dual Op Amp | |
| Q1 | 120 039 | Transistor, MPF111, FET | |
| P1,P2,P3 | 106 041 | Pot, 500 ohm, PC mount | |
| D1,D2 | 120 005 | Diode, 1N4148, silicon, fast switching | |
| C1-C6 | 110 198 | Capacitor, .01uf, Mylar (2A103JT) | |
| C7 | 110 181 | Capacitor, .005uf, Mylar (2A502JT) | |
| C8 | 110 236 | Capacitor, .15uf, Mylar (2A154K) | |
| C9,C10 | 110 199 | Capacitor, .01uf, disc (103M) | |
| R1 | 101 260 | Resistor, 62K ohm | (BLU-RED-ORG) |
| R2,R5,R8 | 100 870 | " " 1.5K ohm | (BRN-GRN-RED) |
| R3,R6,R9 | 101 395 | " " 240K ohm | (RED-YEL-YEL) |
| R4,R7 | 101 250 | " " 56K ohm | (GRN-BLU-ORG) |
| R10,R19 | 101 310 | " " 100K ohm | (BRN-BLK-YEL) |
| R11 | 101 190 | " " 33K ohm | (ORG-ORG-ORG) |
| R12,R16 | 101 070 | " " 10K ohm | (BRN-BLK-ORG) |
| R13 | 101 450 | " " 390K ohm | (ORG-WHT-YEL) |
| R14 | 101 150 | " " 22K ohm | (RED-RED-ORG) |
| R15 | 101 470 | " " 470K ohm | (YEL-VIO-YEL) |
| R17,R18 | 100 910 | " " 2.2K ohm | (RED-RED-RED) |
| | 140 191 | Socket, IC, 8 pin | (3) |
| | 137 175 | Connector, 15 pin, female | (1) |

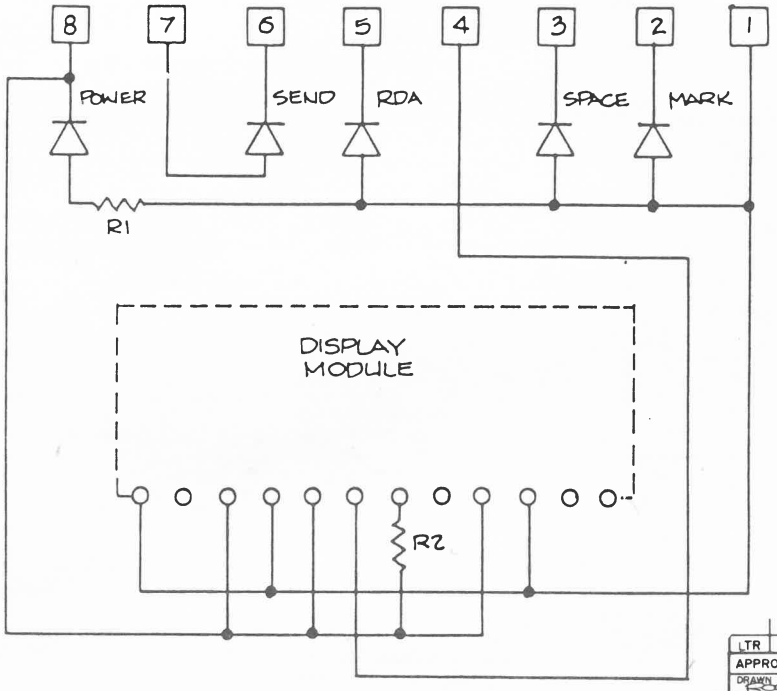
# PS-170A PRESELECTOR PARTS LIST

500-438

| ITEM | PART NO. | DESCRIPTION | QTY. |
|---|---|---|---|
| | 335 123 | Circuit board | (1) |
| | 137 175 | Connector, edge, 15 pin female | (1) |
| | 140 191 | Socket, IC, 8 pin | (2) |
| | 150 297 | Bracket, mounting | (2) |
| IC1,IC2 | 125 022 | IC, MC1458CPI, dual op amp | |
| P1-P4 | 106 041 | Potentiometer, 500 ohm | (4) |
| C1-C8 | 110 181 | Capacitor, 5000 pf (2AR02JT) | (8) |
| C9-C10 | 110 199 | Capacitor, .01uf disc (103Z) | (2) |
| R1 | 101 260 | Resistor, 62K ohm | (BLU-RED-ORG) |
| R2,R5,R8,R11 | 100 690 | Resistor, 220 ohm | (RED-RED-BRN) |
| R3,R9 | 101 440 | Resistor, 360K ohm | (ORG-BLU-YEL) |
| R4,R7,R10 | 101 310 | Resistor, 100K ohm | (BRN-BLK-YEL) |
| R6,R12 | 101 450 | Resistor, 390K ohm | (ORG-WHT-YEL) |

NOTE: ALL RESISTORS 1/4 WATT, 5% UNLESS STATED STATED.

| | | | |
|---|---|---|---|
| MISC | 145 335 | Connector, DB25, Male, W/Cover | (1) |




| LTR | DESCRIPTION | DATE | APPROVED |
|---|---|---|---|
| | | | |

| APPROVALS | DATE |
|---|---|
| DRAWN ROCK | 1/19/82 |
| CHECKED | |

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCE ON
FRAC. ± 1/64 DEC. ± .008
ANGLES ± 1/2°
MATERIAL
FINISH

**FLESHER Corp.**
TOPEKA, KANSAS

DISPLAY MODULE

500 347 A

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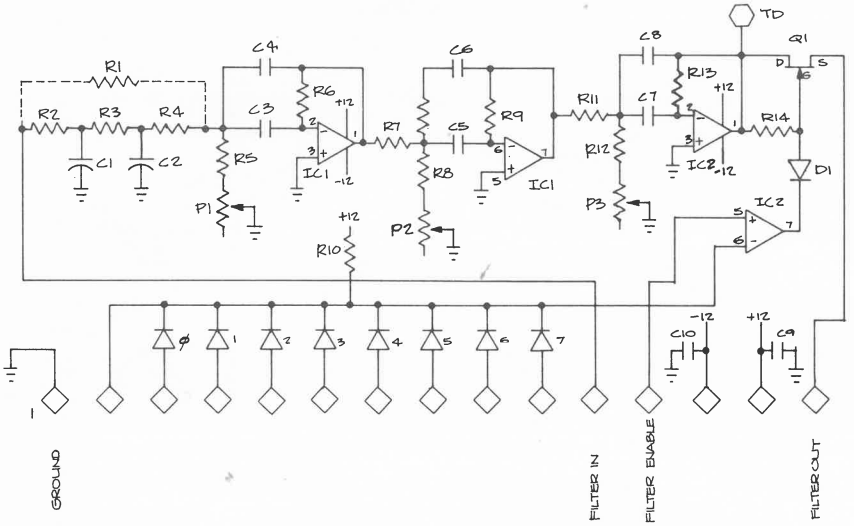


| LTR | DESCRIPTION | DATE | APPROVED |
|---|---|---|---|
| | | | |

| APPROVALS | DATE |
|---|---|
| DRAWN ROCK | 1/19/82 |
| CHECKED | |

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCE ON
FRAC. ± 1/64 DEC. ± .003
ANGLES ± 1/2°
MATERIAL
FINISH

**FLESHER Corp.**
TOPEKA, KANSAS

ACTIVE FILTER BOARD

500 340 A

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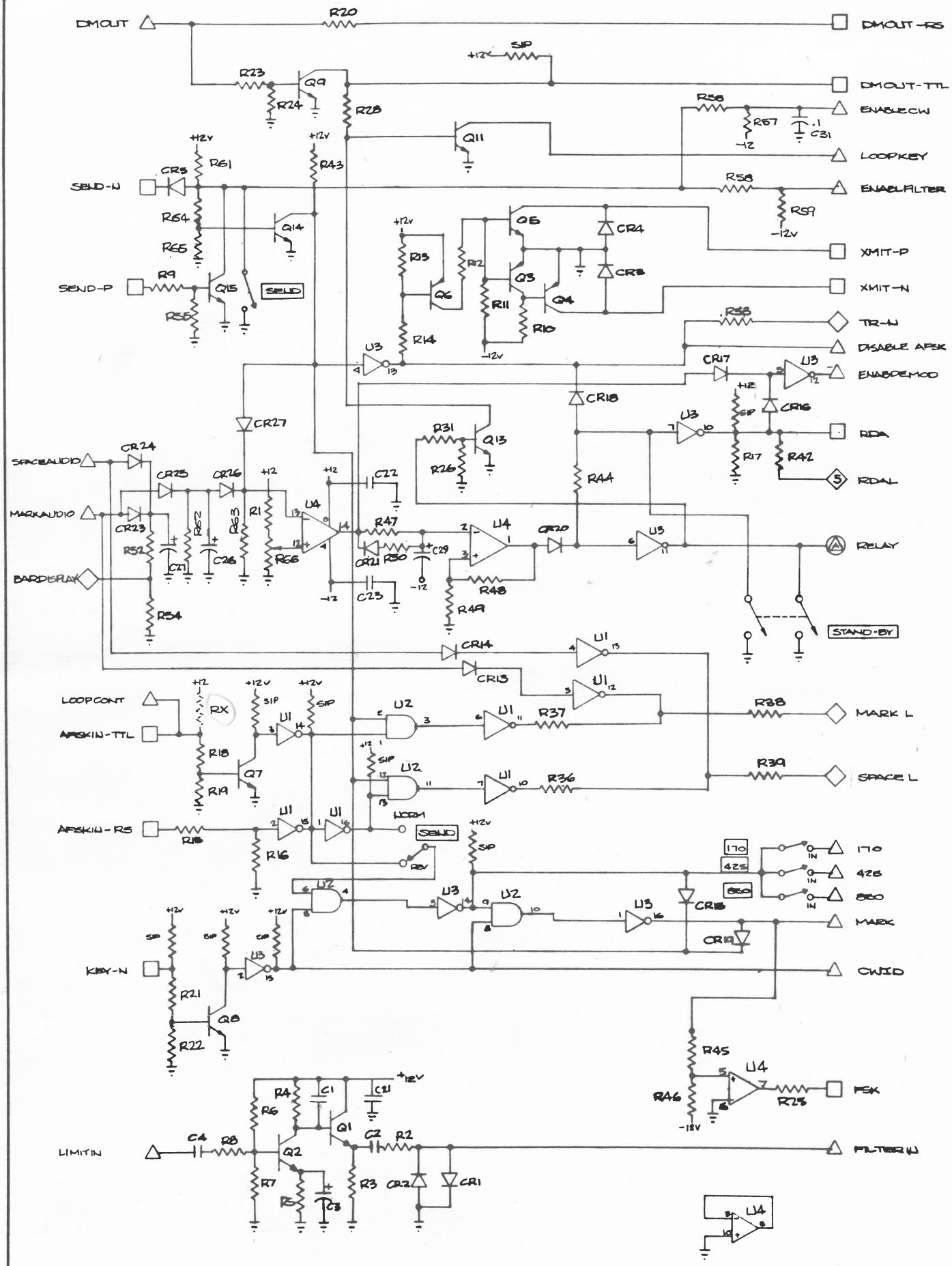
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SIP
+12V
R23
Q9
R24
R28
DMOUT-TTL
R58
R67
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C31
-12
ENABLECW
Q11
LOOPKEY
+12V
R61
R43
CR3
SEND-N
R58
ENABLFILTER
R59
-12V
R64
Q14
R65
+12V
R13
Q6
R12
Q5
Q4
R11
R10
CR4
CR8
XMIT-P
XMIT-N
SEND-P
R9
Q15
SEND
R66
R14
-12V
R55
TR-N
DISABLE AFSK
U3
CR17
U3
ENABDEMOD
CR18
CR27
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SIP
CR16
U3
RDA
R31
Q13
R26
R17
R42
RDAL
R44
CR24
SPACEAUDIO
CR25
CR26
+12
C22
MARKAUDIO
CR23
R52
C21
R62
C26
R63
R1
U4
R66
R47
U4
CR20
U5
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BARDSRAK
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R50
C29
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R48
R49
R54
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CR13
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+12V
SIP
+12V
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U2
U1
R38
MARK L
AFSKIN-TTL
R37
R18
Q7
R19
+12
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FSK
-12V
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C21
R6
Q1
C4
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C2
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R3
CR2
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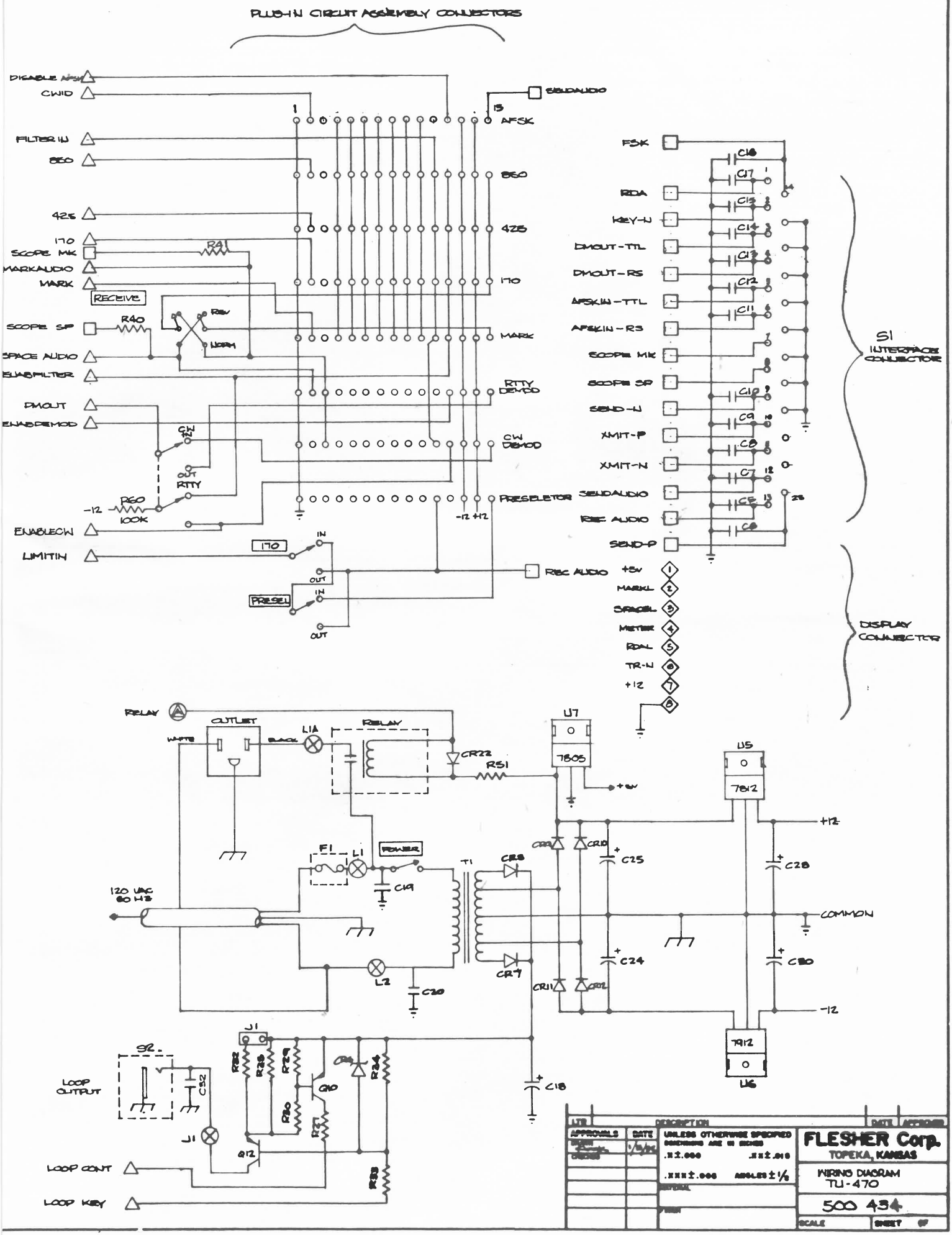
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CWID
FILTER IN
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425
170
SCOPE MK
MARKAUDIO
MARK
RECEIVE
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SPACE AUDIO
SUBFILTER
DMOUT
ENABDEMOD
ENABLECW
LIMITIN
SENDAUDIO
AFSK
850
425
170
MARK
RTTY DEMOD
CW DEMOD
PRESELECTOR
R41
R40
R60
100K
-12
+12
REC AUDIO
PRESEL
FSK
RDA
KEY-N
DMOUT-TTL
DMOUT-RS
AFSKIN-TTL
AFSKIN-RS
SCOPE MK
SCOPE SP
SEND-N
XMIT-P
XMIT-N
SENDAUDIO
REC AUDIO
SEND-P
S1
INTERFACE CONNECTOR
+5V
MARKL
SPACEL
METER
RDAL
TR-N
+12
DISPLAY CONNECTOR
RELAY
OUTLET
WHITE
BLACK
L1A
RELAY
CR22
R51
U7
7805
+5V
U5
7812
+12
F1
L1
POWER
C19
T1
CR8
CR9
CR10
C25
C28
120 VAC 60 HZ
COMMON
L2
C20
CR7
CR11
CR12
C24
C30
-12
7912
U6
C18
J1
S2
LOOP OUTPUT
C32
J1
R32
R33
R35
R30
R31
Q10
Q12
CR6
R34
R36
LOOP CONT
LOOP KEY
LTR
DESCRIPTION
DATE
APPROVALS
DATE
UNLESS OTHERWISE SPECIFIED
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FLESHER Corp.
TOPEKA, KANSAS
WIRING DIAGRAM
TU-470
500 434
SCALE
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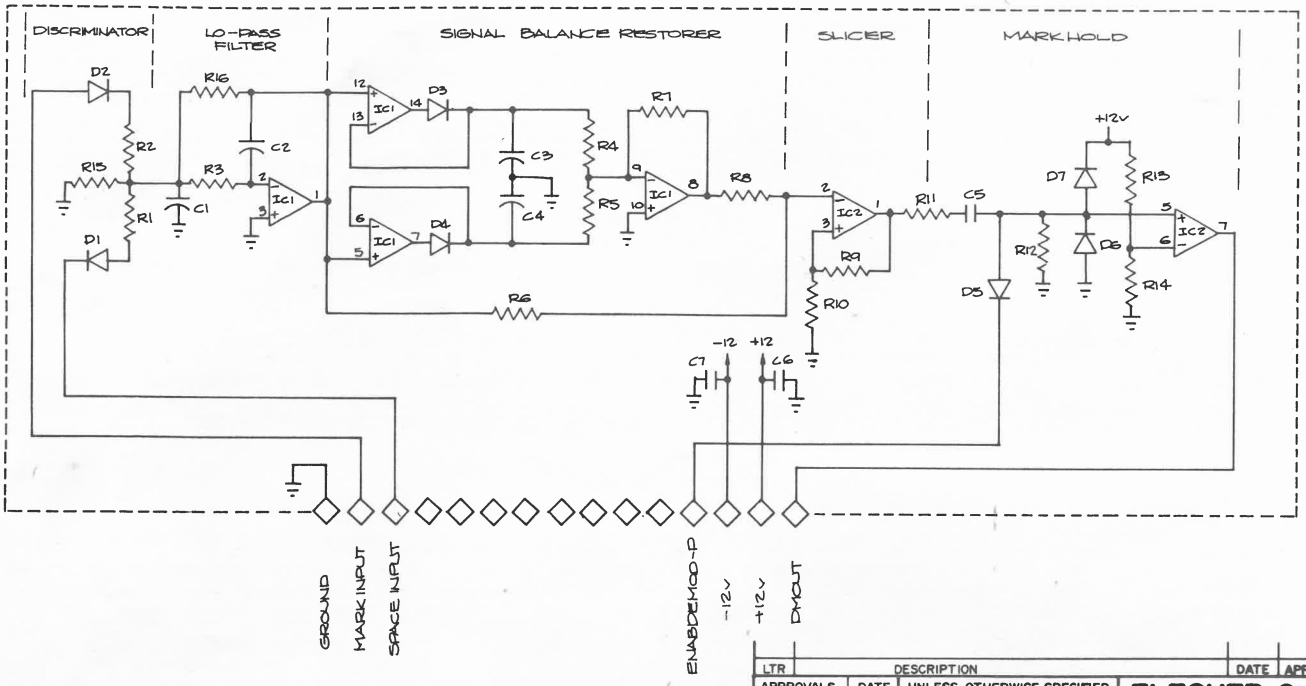


| LTR | DESCRIPTION | DATE | APPROVED |
|---|---|---|---|

| APPROVALS | DATE | UNLESS OTHERWISE SPECIFIED |
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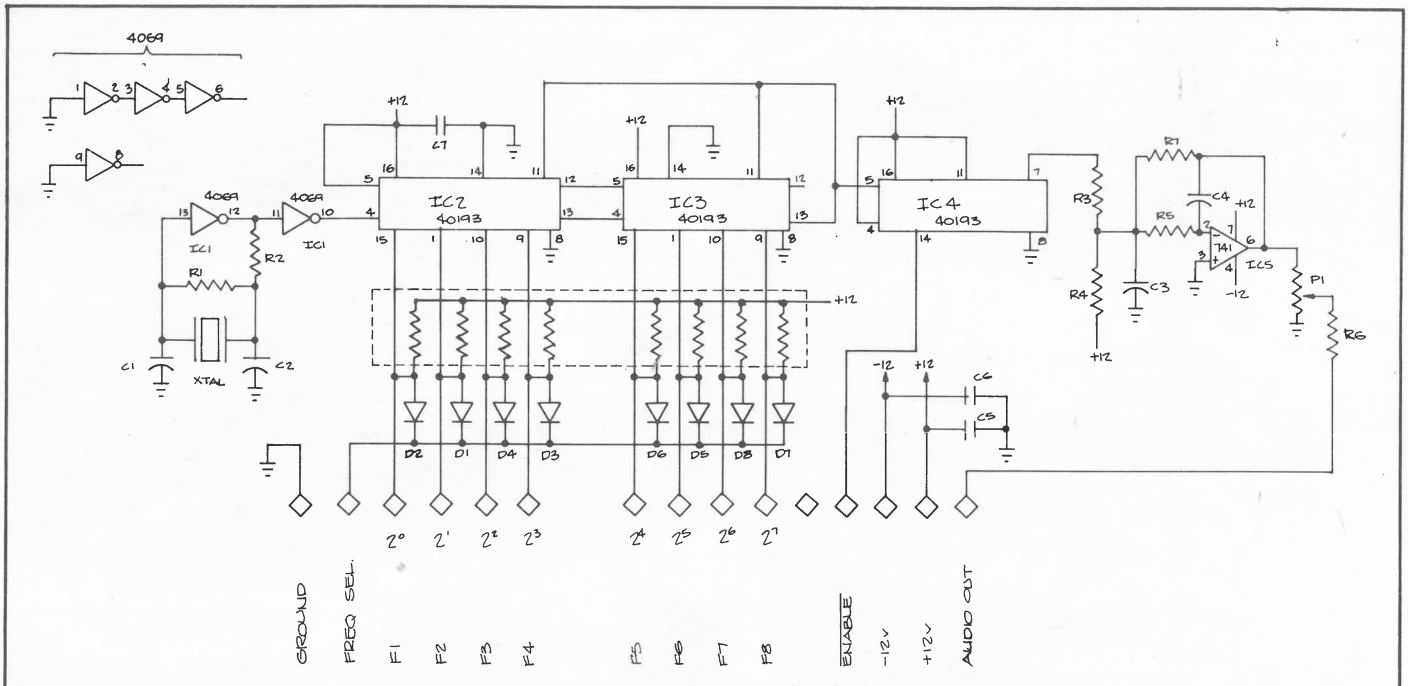
| DRAWN Rock | 1/28/82 | DIMENSIONS ARE IN INCHES |
| CHECKED | | TOLERANCE ON |
| | | FRAC. ± 1/64 DEC. ± .005 |
| | | ANGLES ± 1/2° |
| | | MATERIAL |
| | | FINISH |

**FLESHER Corp.**
TOPEKA, KANSAS

DEMODULATOR

500 341

SCALE | SHEET OF




| LTR | DESCRIPTION | DATE | APPROVED |
|---|---|---|---|

| APPROVALS | DATE | UNLESS OTHERWISE SPECIFIED |
|---|---|---|
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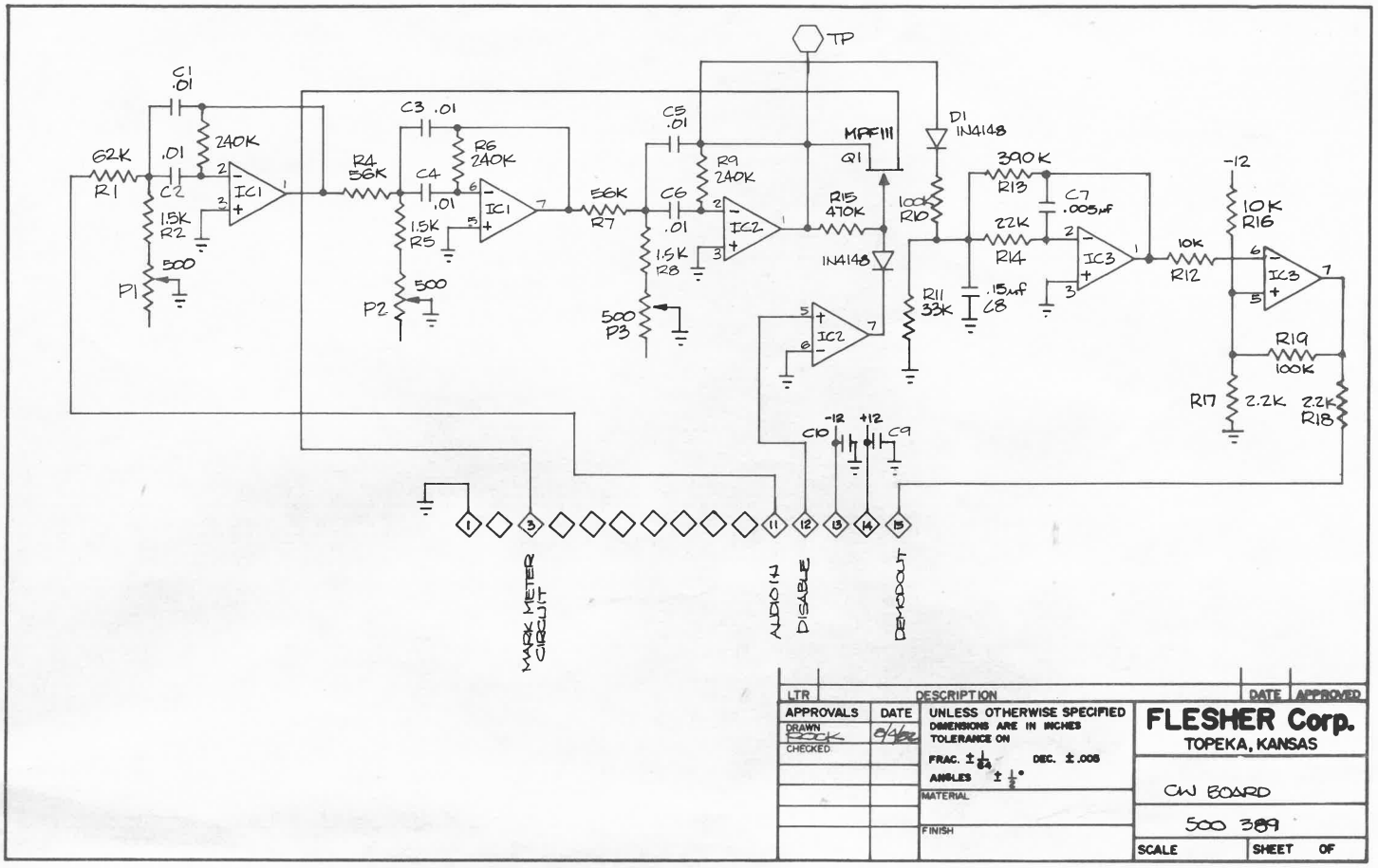
| CHECKED | | TOLERANCE ON |
| | | FRAC. ± 1/64 DEC. ± .005 |
| | | ANGLES ± 1/2° |
| | | MATERIAL |
| | | FINISH |

**FLESHER Corp.**
TOPEKA, KANSAS

AFSK BOARD

500 339

SCALE | SHEET 1 OF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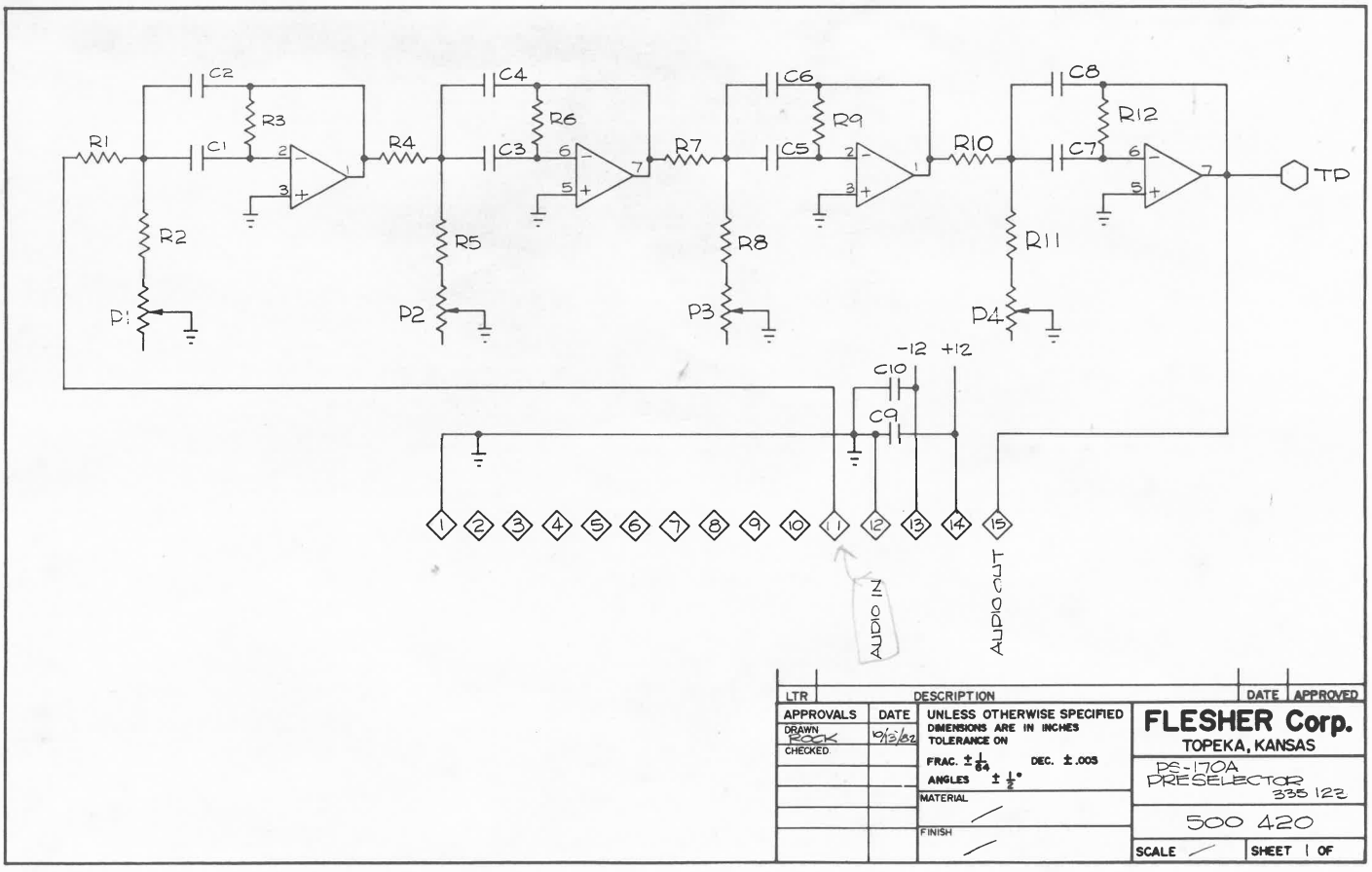
62K R1
.01 C2
240K
1.5K R2
500 P1
IC1
C3 .01
R4 56K
C4 .01
R6 240K
1.5K R5
500 P2
IC1
56K R7
C5 .01
C6 .01
1.5K R8
500 P3
R9 240K
IC2
MPF111 Q1
IN4148
R15 470K
100K R10
D1 IN4148
390K R13
C7 .005μf
22K R14
.15μf C8
R11 33K
IC3
-12
10K R16
10K R12
IC3
R19 100K
R17 2.2K
22K R18
IC2
C10 -12
+12 C9
1 3 11 12 13 14 15
MARK METER CIRCUIT
AUDIO IN
DISABLE
DEMODOUT
LTR DESCRIPTION DATE APPROVED
APPROVALS DRAWN ROCK DATE 9/13/82 CHECKED
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCE ON FRAC. ± 1/64 DEC. ± .005 ANGLES ± 1/2°
MATERIAL
FINISH
FLESHER Corp. TOPEKA, KANSAS
CW BOARD
500 389
SCALE SHEET OF


C2 R3 C1 R1
R4
C4 R6 C3
R7
C6 R9 C5
R10
C8 R12 C7
TP
R2 P1
R5 P2
R8 P3
R11 P4
-12 +12
C10 C9
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
AUDIO IN
AUDIO OUT
LTR DESCRIPTION DATE APPROVED
APPROVALS DRAWN ROCK DATE 9/13/82 CHECKED
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCE ON FRAC. ± 1/64 DEC. ± .005 ANGLES ± 1/2°
MATERIAL
FINISH
FLESHER Corp. TOPEKA, KANSAS
PS-170A PRESELECTOR 338 122
500 420
SCALE SHEET 1 OF