FOR COMPLETE APPRECIATION OF THE FSK-1000, READ THE MANUAL FIRST.

OPERATING MANUAL

IRL

FSK-1000 DEMODULATOR

CONTENTS

WARNING: The FSK 1000 has 110 or 220 volt AC and 170 volt DC voltages present on the circuit board and at some rear panel connectors. Persons unfamiliar with or unqualified to service or operate equipment of this type should refer to a qualified electronics technician.

LIMITED WARRANTY

This iRL product is warranteed against defects in workmanship or materials for a period of ninety (90) days from the date of purchase. Within this period, iRL will repair defective units without charge for parts or labor. This warranty does not cover transportation or shipping costs; nor does it cover equipment subjected to misuse or accidental damage. In no event, shall iRL be liable for losses incurred by the buyer in connection with the use of this equipment.

I. SPECIFICATIONS

MODE:	limiterless (am) or hard limiting (fm)
SHIFT:	continuously tunable, 50 to 1000 hertz
TONES:	low 1275 to 2275 hertz high 2125 to 3125 hertz (optional)
AUDIO INPUT:	600 ohm, unbalanced minimum signal, 1 mv. maximum signal, 17 volts (continuous)
OUTPUTS:	60 ma. 170 volt loop supply (adjustable) RS 232 compatible "Data Out" AFSK Out (on units with FSK-1020 keyer) PTT "push to talk" switch output (open collector)
KEYBOARD INPUT:	Serial input for RS 232 signals, "dry" contacts, or TTL levels. (mark= low voltage or closed contact, space=high voltage or open contact) maximum voltage, +12v
AUTOSTART:	Dual mode (mark or FSK). Selectable 1 second or 4 second attack time. Printer drop-out in approximately 20 seconds.
POWER MAINS:	117 VAC 50 or 60 hertz, optional 220 VAC
DIMENSIONS:	5.22 inches high x 11.37 inches wide x 10 inches deep
WARRANTY:	90 days against parts and workmanship

iRL
700 TAYLOR RD
COLUMBUS, OH 43230
614-864-2464

ATTENTION PLEASE

YOUR FSK-1000 IS BETTER THAN EVER!

The FSK-1000 has undergone some slight changes as the "second edition" comes off the line.

We have added some additional features making the FSK-1000 a better value than ever. Your current Operator's Manual will serve you well if you will please note some differences listed below.

1.) There has been an addition of a front panel mounted Threshold control, which is the small knob located just below the Input Level and ΔF controls. This control serves as an "RTTY Squelch" control and also sets the threshold for the autostart. Full sensitivity of the FSK-1000 occurs when this control is rotated fully counterclockwise.

2.) There is a new jack mounted on the rear panel directly below the "Audio In" jack. This is a "Remote T/R" jack. Shorting the center conductor to ground will place the FSK-1000 in a "hard" transmit mode. That is, the AFSK keyer will output a constant Mark and the PTT output will be enabled. This jack provides the operator with the means for connecting a remote SPST switch some distance from the FSK-1000 for transmitting and receiving without the Keyboard Activated Switch circuitry dropping out.

3.) The Tuning meters remain active in the Local mode.

4.) The Key-In jack is now a phono type jack which simply requires the grounding of the center conductor.

5.) The Key-In sends out a narrow shift (85 hz.) signal for CW ID.

6.) The keyboard or tape distributor (TD) of a mechanical teleprinter may be connected in series with the LOOP OUT and they will key the Keyboard Activated Switch and AFSK keyer. The Serial-In will NOT accept voltages over ±12 volts.

II. INTRODUCTION AND BACKGROUND

Amateur radio has experienced tremendous growth in recent years and radioteleprinter (RTTY) communications is one of the fastest growing aspects of the amateur radio service. The overall growth of the amateur ranks has been exciting in that it has been accompanied by significant technological advances which have provided hams with more sophisticated equipment and alternative modes of communication than ever before; however, with this growth has come an ever increasing congestion of powerful signals on the HF bands which makes solid communication over long distances heavily dependent upon highly selective receiving equipment that is capable of rejecting strong adjacent channel interference.

Although ideal demodulator characteristics, based on modern communication theory, have been described in the RTTY literature for years, the actual demodulators available to commercial and amateur radio operators have usually fallen considerably short of these ideals because a variety of technological or cost limitations often conspire to force compromises upon the actual design.

In the past, demodulators designed for commercial or government use have not had to deal with the problem of severe crowding ("QRM"), that is unique to amateur and MARS frequencies. Consequently, designer's concerns over selectivity were not addressed to the present day ham bands.

A concensus of the RTTY literature seems to suggest that the following are highly desirable features for an FSK demodulator.

(a) Limiterless operation; necessitating stable, independent bandpass filters for each channel, wide dynamic range, and some form of decision level correction for optimum performance.

(b) Matched characteristics of the bandpass filters for proper transient responses and noise cancellation.

(c) Selectable bandwidth to accommodate different QRM conditions or higher baud rates such as is encountered with the use of 100 baud ASCII code instead of 45.45 Baudot code.

(d) Tunable shifts, thereby accommodating signals whose shifts are slightly off or completely nonstandard.

Many demodulators, including phase locked loop types, use hard limiting front ends -- a technique which eliminates the requirements of (a) above and a host of other circuitry. The result is usually a simplified, easy-to-use demodulator which will function quite nicely on strong signals which are "in the clear" and not suffering from selective fading. Appropriately, limiter-type demodulators are fine for clear-channel signals such as one encounters on VHF or many commercial frequencies.

The price paid for using a limiter is that the ultimate selectivity of the demodulator is not as good as a limiterless design can attain, and the unit is subject to capture by the strongest input, be it the desired information or QRM. Also, selective fading (a relatively common occurrence on the HF bands) can cause the limiter to be captured by atmospheric noise (QRN) or QRM and produce printing errors.

The serious HF operator needs a limiterless demodulator, such as the FSK-1000.

The simultaneous achievement of items (b), (c) and (d) above has been one of the greatest challenges facing demodulator designers. The advent of active filters made it possible to mass produce highly selective filters with identical bandwidths and gains for any two specific frequencies; however, as with their passive forerunners, these filters did not allow independent tuning of parameters. Consequently, if the designer tried to change the filters' center frequency to achieve item (d), this adversely affected the filter's bandwidth and gain. Similarly, if he tried to change only the bandwidth to achieve item (c), he would simultaneously and unintentionally shift the center frequency and gain beyond acceptable limits. The cascading of more than one filter stage to achieve steeper skirt selectivity only intensified the existing problem.

One approach to satisfying (b) and (d) is to use two matched filters whose parameters are fixed. The incoming signals are then combined with a beat frequency oscillator in a mixer stage which shifts the incoming tones down to the fixed filter's center frequency. Thus, item (d) is achieved not by tuning the filter across the spectrum, but by changing the frequency of the oscillator.

There are two immediate drawbacks to this approach. First, the mixer stage produces sum and difference tones which can result in audio image interference which allows strong adjacent channel QRM to foul the desired signal. The effect can be to reduce the ultimate selectivity of the unit, in spite of using selective filters. The second drawback is that this approach ignores item (c) altogether.

The FSK-1000 meets all four of the listed criteria through the use of a limiterless design, and a modern, sixth order active filter arrangement which permits independent adjustment of the filter parameters to achieve (b), (c) and (d) without trading off the ultimate selectivity.

The FSK-1000 was designed from inception to function as a limiterless ("linear" or "AM") demodulator, eliminating errors which result from FM-type capture problems associated with hard limiting or "FM" demodulators. In the past, some demodulators have offered an "AM" mode which, while switching out the hard limiting front end, did not provide the operator with a positive indication that true linear operation was being achieved. Depending on the output levels of the receiver, internal gains of the demodulator and dynamic range, it was often the case that high level received signals were being "soft" limited ("clipped") by operational amplifier stages driven into saturation. As a result, it was quite possible that many operators who thought they were operating in a limiterless mode, were actually suffering errors resulting from a type of limiter action.

The FSK-1000 is equipped with a front panel input level control and a dynamic range indicator LED which gives positive indication to the operator when the linear range is exceeded. This permits adjustment for true limiterless operation, "controlled clipping" or hard limiting if desired.

It is a common phenomenon on the HF bands for the mark and space tones of an FSK signal to exhibit independent fading, as if coming from two separate sources. This selective fading results from multipath propagation and can momentarily cause one of the tones to take a deep fade or disappear entirely. Selective fading can spell disaster for hard limiting demodulators since, in the absence of the desired tone, QRM or QRN will "capture" the limiter and produce a random output.

It takes a limiterless demodulator with some form of decision level correction to copy correctly with only one tone present. The FSK-1000 has automatic decision level correction which does not require the operator to switch correction in or out manually.

The FSK-1000 offers three switch-selectable standard shifts of 170, 425, and 850 Hz, while the front panel ΔF tuning allows continuous shift coverage from 50 to 1000 Hz in three ranges. The active filters in the FSK-1000 are computer designed for matched characteristics and optimum response at the standard shifts. The shift adjustments are made by actually tuning a multi-pole bandpass filter of constant bandwidth, rather than using audio frequency mixers in a heterodyning process. This assures complete freedom from audio images, spurious responses, or other problems associated with mixing techniques.

Selectable bandwidth filters for each tone allows the operator to select either 100 Hz "wide" channel filters for normal operation up to 110 baud, or 55 Hz ultra-narrow channel filters, designed specifically to slice through the tough QRM on the crowded HF amateur bands. The two bandpass filters utilize twenty FET operational amplifiers in a stable, modern topology.

The result is a demodulator which not only provides the HF operator with superior selectivity, but also maintains the flexibility one expects from a "deluxe" demodulator.

III. CONTROL AND INPUT/OUTPUT DESCRIPTIONS

FRONT PANEL CONTROLS

ON/OFF: The ON/OFF switch applies power to the FSK-1000, including the AUTOSTART a.c. outlet on the rear panel.

INPUT LEVEL: This control is adjusted while observing the LIMIT LED to select the optimum signal level for copying FSK signals. It has a full clockwise switch detent for the hard limiting mode and an auxiliary "pull" switch for use with the FSK-1040 video option or for any extra function the user may wish.

NORMAL/REV: In the NORMAL position (out), the mark frequency is the lower of the two tones. The REV position (in) reverses the incoming information so that the higher tone is used as the mark. (This switch also reverses the function of the MARK/FSK/SPACE switch.)

SHIFT, 850-425-170: These interlocking pushbuttons are used in conjunction with the ΔF control to select the desired shift range. With the ΔF set to its zero position and the 170 button depressed, the demodulator is set for 170 Hz operation. Rotation of the ΔF control permits adjustment of shift from 50 Hz to 270 Hz by tuning the space filter. With the 425 pushbutton depressed and the ΔF centered at zero, the demodulator is set for 425 Hz operation. Rotation of the ΔF control now permits adjustment of shift over the range of 260 to 640 Hz. Similarly, in the 850 shift position, the range of adjustment is from 590 Hz to 1000 Hz shift. The FSK-1000 equipped with the optional "high tones" has "170", "425", and "850" ΔF ranges of 50-250, 235-550, and 540-1000 Hz respectively.

WIDE/NARROW: With the switch in the WIDE position (out), the bandwidth of the tone channels is 100 Hz nominal. With the switch in the NARROW position (in), the bandwidth is 55 Hz nominal.

LINE/LOCAL:	With the switch in the LINE position (out), the demodulator is in its normal mode for receive and transmit operation. With the switch in the LOCAL position, (in), the audio input to the demodulator is grounded, and the optional FSK-1020 AFSK keyer is disabled. Also, the PTT ("push-to-talk") is disabled so that the operator may type on his keyboard and observe local copy without keying his transmitter.
LIMIT:	This LED illuminates when the audio input level has reached the point where limiting begins in the demodulator. This indicator enables the operator to adjust for the optimum signal level in the limiterless or "linear" range.
TUNING METERS:	These meters indicate the relative signal strengths of the two-tone channels and are viewed by the operator when tuning in an RTTY station. The MARK TUNING meter indicates the strength of the lower FSK tone, while the SPACE TUNING meter indicates the strength of the higher tone. If the reverse button (REV) is pushed, then the signal displays are reversed.
MARK/FSK/SPACE:	This three position toggle switch is normally set to the middle position which is for full FSK operation. Throwing the switch up to the MARK position removes the signal from the sapce channel completely to allow for mark-only copy. Setting the switch down to the SPACE position, removes the signal from the mark channel to allow for space-only operation. The NORMAL/REV switch reverses the operation of this switch.
AUTOSTART: ON/OFF:	With this switch in the OFF position (out), the autostart function is disabled and power is constantly applied to the rear panel auto-start power outlet, controlled by the power ON/OFF switch. With the switch in the ON position (in), the autostart function is enabled.
AUTOSTART: FSK/MARK:	With the switch in the FSK position (out), the autostart responds to FSK signals (both tones must be shifting) which are above the autostart threshold, and will not trigger on a constant tone in either channel. With the switch in the MARK position (in), the auto-start will trigger on a mark tone signal and shifting FSK tones are not required.

AUTOSTART: FAST/SLOW: With the switch in the FAST position (out), the attack time is approximately one second. With the switch in the SLOW position (in), the attack time is approximately four seconds. The attack times may be changed by installation of new resistors on the circuit board.

REAR PANEL JACKS

AUDIO IN: This phono jack receives audio from the receiver. The input impedance is nominally 600 ohms, unbalanced. Although some receivers provide 500 - 600 ohm outputs, a common practice is to simply connect across the receiver's speaker terminals.

SERIAL IN: This phono jack input is for connection of a serial output keyboard or tape reader. The keyboard output may consist of "dry contacts" (such as from a mechanical keyboard <u>without</u> loop current), or RS-232 voltages (mark = -12V max, space = +12V max) or TTL levels (mark = 0V, space = +5V). THIS JACK DOES NOT ACCEPT HIGH VOLTAGE (greater than ± 12V) LOOP SUPPLIES. This input does, however, drive the 170 volt LOOP OUTPUT in the FSK-1000, so that local copy can be observed on a mechanical teleprinter even though the keyboard is not actually in the high voltage loop. This was done so that a variety of keyboard inputs such as RS-232) could be converted to a high voltage loop output. Dry contacts should be closed for mark and open for space. IF THE SERIAL IN IS NOT TO BE USED, THEN A SHORTING-TYPE PHONO PLUG JUMPER IS REQUIRED IN THIS JACK. Otherwise, the demodulator will not function.

+170 POLARIZED LOOP: This one-quarter-inch three-conductor phone jack provides a high voltage, 60 mA polarized loop current output for driving mechanical teleprinters. The output information is either the demodulated receiver audio or that information which is inputted to the SERIAL IN jack. The tip of the three-conductor phone plug is (+) and the ring (center conductor) of the plug is the (-). The main barrel of the plug is chassis ground and may be used for connecting a shield, if a shielded, twisted pair loop cable is used. The loop current may be adjusted for 20 mA operation. This may be accomplished by adjusting the slide on the large power resistor (R301) at the left rear of the circuit board. The slide should be moved upwards to lower the current. The loop current should be measured by an ammeter placed in series with the loop. POWER SHOULD BE REMOVED BEFORE ADJUSTING THE SLIDE. THE SLIDE IS CONNECTED TO 170 VOLTS DC AND PRESENTS A SHOCK HAZARD. A two-conductor phone plug will not function in this jack. The three-conductor jack was used to lessen the likelihood of electrical shock at the LOOP OUT.

DATA OUT: This phono jack provides a RS 232 compatible output (mark =-11V nom., space = +11V nom.). The output information is either the demodulated receiver audio or the information inputted to the SERIAL IN jack. Thus, this jack outputs the same information as the LOOP OUT and may be used simultaneously with the loop out. For instance, the DATA OUT jack may be used to drive a computer or video character generator while the LOOP OUT drives a tape punch or "hard copy" terminal. The DATA OUT jack may be strapped for TTL compatible outputs (mark = 0V, space = 5V, or mark = +5V, space = 0V).

mark low
space high

PTT OUT: This phono jack is for use with the "push-to-talk" lines of many transmitters. The output consists of an open-collector transistor output which is driven "on" (pulled low) by the keyboard activated switch in the FSK-1000. Upon depressing a character on the keyboard (or closing a hand key connected to KEY IN), the transistor turns on, effectively grounding the PTT line. The transistor has a rated maximum of 40 volts and 60 mA. Users should determine if the push-to-talk voltage in their transmitter exceeds this rating. If so, an external relay may be required to isolate this output. This jack may not be required if the transmitter has provision for VOX operation, in which case the audio tones from the AUDIO OUT would key the transmitter. This jack is totally disabled when the FSK-1000 is in the LOCAL mode.

SCOPE OUT MARK, SCOPE OUT SPACE: These two phono jacks provide access to the bandpass filter outputs (output impedance is approximately 100K) for use with an external oscilloscope tuning indicator. The maximum output voltage is 12 volts. Adventurous operators are encouraged to connect the outputs to a stereo amplifier for driving ~~stereo headphones for use as an audio tuning indiciator or highly selective CW filter. (An attenuator would probably be~~ required at the input of the amplifier since the SCOPE outputs are high level.)

KEYBOARD PARALLEL: This 25-pin subminiature "D" connector is for units which have the FSK-1040 Video option and is for connection of a parallel ASCII keyboard. A parallel keyboard connected to an FSK-1000 with FSK-1040 enables the operator to send either ASCII or BAUDOT codes from the same keyboard. This connector is for a parallel output keyboard (with strobe) and should not be confused with RS-232 type connectors which are for serial interfaces.

VIDEO OUT: This phono jack output is for use with FSK-1000 demodulators which have the FSK-1040 video option installed. It provides standard composite video for driving video monitors.

KEY IN: This one-quarter-inch three-conductor phone jack is for connection of a standard hand key, for full-shift CW identification or manual tests of the mark and space outputs. Normally, when receiving, the key contacts should be open. Closing the key activates the keyboard activated switch and causes a space to be sent. When the key is opened again the demodulator goes to the mark condition until the keyboard switch "times out" (approximately three seconds). The key should be connected to the tip and ring of a three conductor phone jack.

AFSK OUT: This phono jack is for units which have the optional FSK-1020 AFSK keyer installed. The output consists of audio tones for driving the microphone input of a transmitter. The keyer is enabled by the keyboard activated siwtch and shifts in accordance with the information inputted to the SERIAL IN. The keyer is completely disabled when the demodulator is in the LOCAL position.

CODE: BAUDOT/ASCII: This switch is for demodulators with the FSK-1040 video option installed. It permits the video monitor to display ASCII or BAUDOT information, and for stations equipped with a parallel ASCII keyboard. It permits the sending of either BAUDOT or ASCII from the keyboard. (The baud rates are selected by the front panel "push/pull" switch located on the INPUT LEVEL control.

The circuit board is easily accessible by removing the two screws at the top of the rear panel and sliding the top out.

IV. OPERATING AND INTERCONNECTION SUGGESTIONS

INTERCONNECTIONS

The FSK-1000 is somewhat different than most demodulators. In certain circumstances, particularly when QRM is a problem, the FSK-1000 is capable of providing significantly improved copy over that of many demodulators.

With this potential for improved performance, however, goes a requirement for improved operator skills.

The operator is encouraged to experiment with various combinations of control settings on his receiver and demodulator in order to "get the feel" of what the unit can do. Also, the operator should read some of the RTTY literature available from various radio publishing houses, to acquaint himself with the general requirements of an RTTY station. Such things as filter bandwidths, BFO or passband settings, signal speeds and keying techniques are dealt with extensively in these handbooks, as well as suggestions for station interconnections and explanations of many RTTY terms.

Just as the chain is only as strong as its weakest link, an RTTY station requires a good, stable, properly adjusted receiver and transmitter, a good antenna, a reliable teleprinter, and most importantly, an operator who is knowledgeable about how the whole system "plays" together.

The basic receive setup is shown in Figure IV-1 and is quite simple. Please note that normally, a shorting plug is required in the SERIAL IN when nothing is connected to it. If an RS-232 output level (or TTL level with appropriate straps) is required, the output should be taken from the DATA OUT jack. The basic transmit connections are shown in Figure IV-2 and include connections for demodulators with the FSK-1020 AFSK keyer option installed. For demodulators without a keyer, there is nothing connected to the AUDIO OUT jack, and transmitter keying must be effected through other means. The operator should consult his transmitter operating manual to determine the type of connector and pin connections necessary to input the signal from the AUDIO OUT jack and the PTT OUT jack.

OPERATION

For initial operation of the FSK-1000, the controls should be set to the following positions.

INPUT LEVEL:	Full counterclockwise (minimum)
ON/OFF:	ON
MARK/FSK/SPACE:	FSK (center position)
NORMAL/REV:	NORMAL
ΔF:	Zero (12 o'clock position)
SHIFT:	To anticipated shift; 170, 425, or 850
WIDE/NARROW:	WIDE
AUTOSTART ON/OFF:	OFF (out)
AUTOSTART FAST/SLOW	FAST (out)
AUTOSTART/FSK/MARK:	FSK (out)
LINE/LOCAL:	LINE

Tune the receiver until an FSK signal is heard and adjust the receive audio level for a comfortable listening volume. Next, slowly rotate the INPUT LEVEL control clockwise until a point is reached where the LIMIT indicator light begins to turn ON. (It may "blink" on and off with receiver static if you are set right at the threshold).

The LIMIT indicator lights to signal the operator that the input level is exceeding the limiterless (or linear) range and that limiting of the signal is beginning to take place.

Now, reduce the INPUT LEVEL control slightly just to the point where the LIMIT indicator goes off. At this point the operator has the maximum input level possible for limiterless operation.

Next, tune the receiver up and down SLOWLY through the RTTY frequency until a noticeable peak is observed on BOTH tuning meters. This peak is quite sharp, so tune carefully. If the demodulator is set for the correct shift, both meters will peak simultaneously at about 75 percent of full scale when the signal is properly tuned in. Intelligent copy should now be observed on the teleprinter. If not, it may be that the received tones are reversed (the low tone is the space, and the high tone is the mark).

If this is the case, the situation can be corrected by setting the NORMAL/REV switch to REV (in).

During the course of printing, the RTTY signal may be heard or seen to fade momentarily. It is not usually necessary to readjust the INPUT LEVEL control for this signal as the FSK-1000 is capable of copying signals which barely deflect the meters at all. Also, if the INPUT LEVEL control is increased during a momentary fade, limiting may occur when the signal returns to its previous strength. Normally, "soft clipping" as indicated by sporadic "blinks" of the LIMIT indicator is of little concern. Remember too, that the input level may be adjusted by either the INPUT LEVEL control or the receiver's audio gain control.

Full limiting operation is achieved by rotating the input level control to the full ~~clockwise~~ position until it "clicks" into the switch detent. Although the unit is designed primarily for limiterless operation, the limiter mode works well on good signals which are "in the clear" and makes tuning somewhat easier, because of the fact that the tuning meters give maximum deflection on almost all signals.

limit full

For copying stations in the midst of strong adjacent channel interference (QRM), limiterless operation is a must and the LIMIT indicator should be completely OFF. Also, copy may be significantly improved by switching the WIDE/NARROW pushbutton to the NARROW position.

len. to - copy

The NARROW filters are extremely sharp and require that the operator exercise extreme care in tuning. Slight mistuning due to operator judgement or a drifting signal can have adverse effects on performance. The NARROW position is generally recommended for use with 60 word-per-minute BAUDOT code (45.45 baud); however, it may prove beneficial in circumstances where QRM is interfering with good signals up to 110 baud.

On a crowded band, a situation may occur where a strong CW station or off-frequency RTTY station may be transmitting "on top" of either the mark or the space frequency. The only recourse for the operator in this situation is to switch the MARK/FSK/SPACE toggle switch up or down to see if copy can be obtained from one tone only. One-tone-only copying is not possible when limiting is occurring. Also, since in this mode, the operator has literally "thrown out" half of the signal, it generally takes a better than average signal-to-noise ratio in the remaining channel to produce copy. For RTTY work on the HF bands, there is rarely a case for using anything other than the FSK mode. The one-tone modes are included, however, so that the serious operator immersed in a battle with QRM, will not have to throw up his hands in defeat until all possible techniques have been attempted.

Mark-only operation can be advantageous on VHF FM, if the FSK-1000 is equipped with the standard "low tones" and the operator wishes to receive information sent via "high tones". The procedure would be as follows:

1. Set the SHIFT for 850 Hz. This would normally mean that the mark channel is set for 1275 Hz and the space channel for 2125 Hz.

2. Set the NORMAL REV switch to REV for reverse operation. This then places the 2125 Hz signal in the mark channel.

3. Set the MARK/FSK/SPACE switch for SPACE (down). This eliminates noise from the 1275 Hz filter, which is not used in this case.

4. Be sure the INPUT LEVEL control and receiver audio are adjusted for limiterless operation.

TRANSMITTING

A serial keyboard (or tape reader, computer output, etc.) will activate the keyboard activated switch circuitry immediately upon the transmission of a character. The serial input overrides the audio input and causes the character to be generated at the LOOP OUT and the DATA OUT jacks. At the same time, the PTT jack goes to ground and the AFSK keyer (if installed) is enabled. Since most transmitters or transceivers require several milliseconds to change over to transmit, the first RTTY character may be lost. Therefore, it is usually a good idea to send one or two "LTRS" characters (or tap the "space" bar) to begin a transmission. Once typing (or tape reading) has ceased, the keyboard activated switch will drop back to the receive mode after approximately three seconds.

Full-shift manual keying may be accomplished with a standard hand key connected to the KEY IN input. The normal condition of the key should be open. Closing the key will operate the keyboard activated switch, sending the higher tone with the key closed and the lower tone with the key open.

With the LINE/LOCAL switch set to LOCAL, the AFSK keyer and PTT OUT are not enabled by the keyboard activated switch.

AUTOSTART OPERATION

The FSK-1000 AUTOSTART may be used to turn a teleprinter or other station accessory "on" automatically by means of the switched AC outlet located on the rear panel. For normal autostart operation the AUTOSTART pushbuttons should be set as follows.

1. AUTOSTART ON/OFF: ON (in)
2. AUTOSTART FAST/SLOW: FAST (out)
3. AUTOSTART FSK/MARK: FSK (out)

In this mode of operation, it takes an FSK signal which deflects both tuning meters past half-scale for approximately one second. The INPUT LEVEL control should be adjusted so that in the absence of a desired RTTY signal, the meters tend to stay below half-scale. The FSK-1000 requires a frequency-shifting signal in both channels and both channels must be above half-scale. Consequently, the autostart rejects constant CW tones of any amplitude and most random QRM. Once the autostart has turned on, it will stay on until 20 seconds after the RTTY signal has either disappeared or fallen below the threshold.

Although the threshold (approximately mid-scale) is factory adjusted, the user may adjust the threshold by means of a screwdriver adjustable potentiometer, accessible at the rear of the panel. Clockwise rotation of this pot lowers the autostart threshold to less than half-scale, and counterclockwise rotation increases the threshold to above half-scale. The operator is encouraged to experiment with various INPUT LEVEL settings, and attack times to achieve the desired autostart response before attempting to adjust the threshold pot.

Selecting AUTOSTART: SLOW (in) changes the attack time from one second to four seconds. Selecting AUTOSTART: MARK (in) means that a mark signal alone which is above the threshold will turn on the autostart.

SERVICE

If difficulty is experienced with the operation or interconnection of your demodulator, iRL Engineers are available for limited technical consultation by telephone or correspondence, at no extra charge. For repair work performed outside of the iRL limited warranty, iRL charges a fee of Fifteen Dollars ($15.00) per hour plus the cost of any parts which may be required. (Most minor repairs to demodulators are accomplished in one hour or less.)

iRL does not pay shipping charges, and will ship United Parcel Service C.O.D., unless specifically instructed otherwise.

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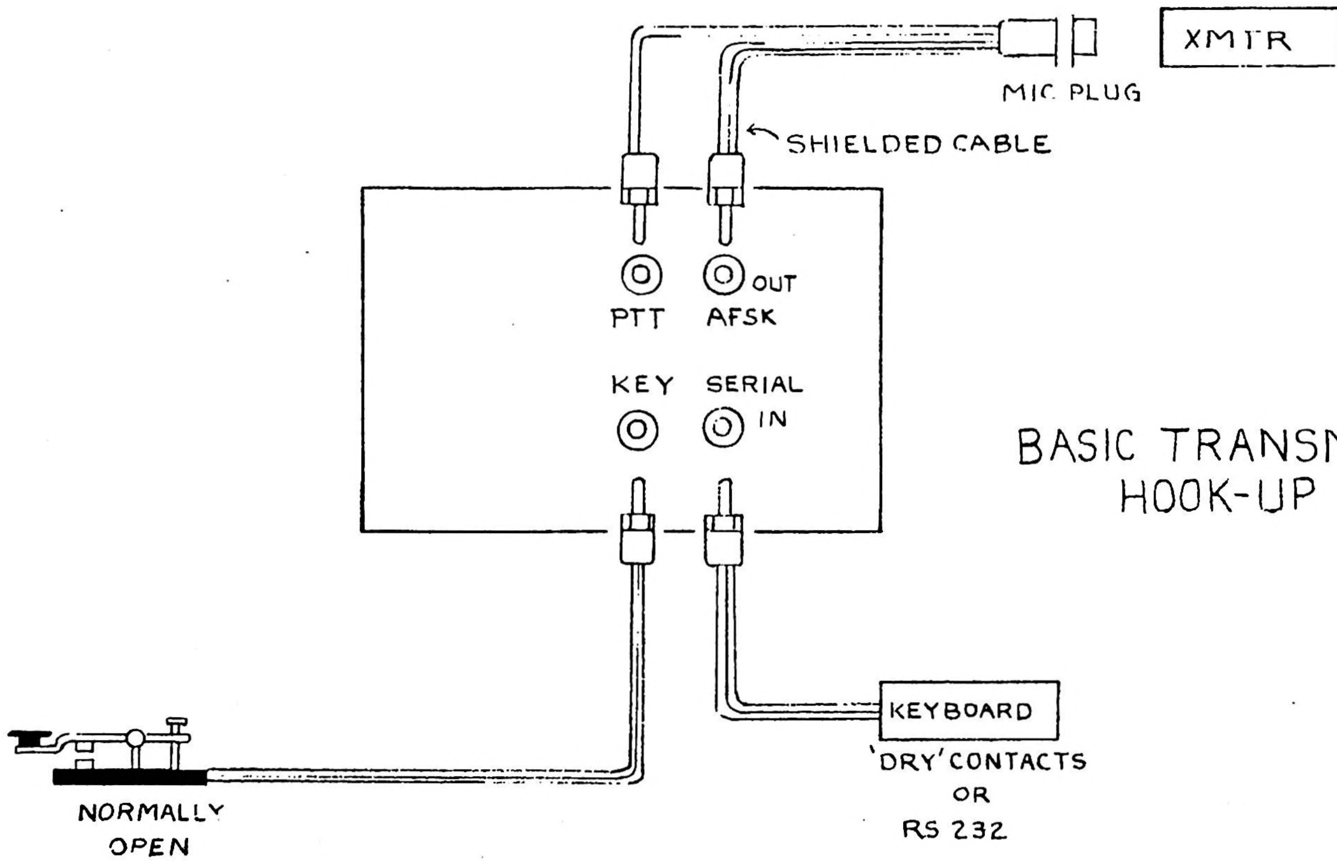


BASIC TRANSMIT
HOOK-UP

FIGURE IV-2

V. CIRCUIT DESCRIPTION

Audio taken from the receiver speaker output or 500-ohm audio output is applied to the input amplifier where the signal level can be attenuated or increased by adjustment of the INPUT LEVEL potentiometer. The LIMIT level detector circuitry samples the output of the input amplifier and the LIMIT indicator lights when this output approaches the saturation point. The limit detector circuitry consists of U23B configured as a comparator and U23A as a unity gain, noninverting amplifier. Transistor Q1 drives the front panel LIMIT LED. LINE/LOCAL switch, S-9, shorts the output of the input amplifier in the LOCAL position to prevent audio signals from producing copy at the output. Center-off toggle switch, S-10, (MARK/FSK/SPACE) selects for mark only, space only, or FSK inputs by appropriate grounding of the undesired channel.

The bandpass filters are sixth order transitional Butterworth-Thomson filters. From the schematic, it can be seen that each filter consists of three identical filter sections arranged in a modified cascade form known in the literature as a multiple resonator topology. The individual filters sections are of the bi-quad type and are well known for stability, constant bandwidths, high Q's and ease of tuning.

Switch S-5 (WIDE/NARROW) changes the feedback between sections to select the narrow bandwidth. The filters have a gain of unit.

The SCOPE outputs are taken directly off the bandpass filter outputs, isolated by a 100K resistor.

The outputs of the bandpass filters are envelope-detected by passing the signals through precision rectifiers followed by low-pass filters. The low-pass filtering is that of a fourth order Bessel-type which rolls off at 50 Hz.

The output of the low-pass is applied to the main summer (U19) where it is combined with signals from the decision level correction circuitry.

The keyboard activated switch injects data from the SERIAL IN into the data stream here, through use of FET Q6. A DC offset nulling pot is also summed into U19A to compensate for operational amplifier offsets.

The decision level correction circuitry (DLCC), automatically biases the main summer so that the input decision level, about which the summer's output is driven either positive or negative, is always centered halfway between the peak mark and space amplitudes. It is this circuitry which enables the FSK-1000 to copy RTTY signals when only one tone is present or where selective fading of the tones occur.

The tuning meters are drived by voltage followers U15A and U16A which receive their inputs from the DLCC circuitry.

The output of the main summer is applied to U19B, configured as an inverting comparator with about 24 millivolts of hysteresis. The output of the comparator then drives the high voltage loop supply and the DATA OUT driver. The loop current is adjusted by the large slide potentiometer, R301 for 60 mA operation. CAUTION: THE LOOP SUPPLY POT SHOULD NEVER BE ADJUSTED WITH THE POWER APPLIED TO THE DEMODULATOR, SINCE THE 170 VOLTS PRESENT ON ITS TERMINALS PRESENTS A SHOCK HAZARD TO THE INDIVIDUAL. Even after power is removed, time should be allowed (approximately ten seconds) for the 180-volt capacitor to discharge.

The SERIAL IN drives U24B, which is normally wired as a high impedance comparator, whose reference voltage is determined by the voltage divider R137, R138. Keying signals are then routed to the FSK-1020 AFSK keyer via the shift-select pushbuttons and a dual-in line header with ribbon cable.

Autostart voltages are "picked off" at the DLCC stage. When capacitors C54 and C55 both charge to voltages greater than the reference set by the AUTOSTART threshold adjust, then the output of U20 "snaps" high, charging C58 which ultimately causes the autostart to function.

Autostart attack times are determined by R123 (FAST) and R122 (SLOW). The autostart dropout time is determined by C56 and R114.

FSK 1000A PARTS LIST

RESISTORS

R1	620
R2	4.99K
R3	4.99K
R4	4.99K
R5	620½W
R6	105K
R7	6.49K
R8	20.0K
R9	105K
R10	1.69K(3.57K)*
R11	1.30K(1.96K)
R12	845 (1.30K)
R13	80.6K
R14	317K
R15	10.0K
R16	10.0K
R17	10.0K
R18	13.3K
R19	105K
R20	1.69K(3.57K)
R21	1.30K(1.96K)
R22	845 (1.30K)
R23	105K
R24	317K
R25	10.0K
R26	10.0K
R27	10.0K
R28	13.0K
R29	105K
R30	1.69K(3.57K)
R31	1.30K(1.96K)
R32	845 (1.30K)
R33	317K
R34	317K
R35	10.0K
R36	10.0K
R37	10.0K
R38	24.9K
R39	105K
R40	105K
R41	10.0K
R42	4.99K
R43	10.0K
R44	10.0K
R45	4.99K
R46	105K
R47	6.49K
R48	20.0K
R49	105K
R50	2.15K(5.90K)
R51	80.6K
R52	317K
R53	10.0K
R54	10.0K
R55	10.0K
R56	13.3K
R57	105K
R58	2.15K(5.90K)
R59	105K
R60	317K
R61	10,0K
R62	10.0K
R63	10.0K
R64	13.0K
R65	105K
R66	2.15K(5.90K)
R67	317K
R68	317K
R69	10.0K
R70	10.0K
R71	10.0K
R72	24.9K
R73	10.0K
R74	4.99K
R75	10.0K
R76	10.0K
R77	4.99K
R78	1.96K
R79	10.0K
R80	48.7K
R81	61.9K
R82	105K
R83	154K
R84	36.5K
R85	46.4
R86	56.2K
R87	105K
R88	10.0K
R89	Deleted
R90	10.0K
R91	Deleted
R92	317K
R93	154K
R94	317K
R95	Deleted
R96	46.4K
R97	2MEG
R98	10.0K
R99	Deleted
R100	46.4K
R101	20.0K
R102	20.0K
R103	20.0K
R104	46.4K
R105	20.0K
R106	5.90K
R107	20.0K
R108	10.0K
R109	105K
R110	10.0K
R111	6.49K
R112	10.0K
R113	Deleted
R114	317K
R115	10.0K
R116	20.0K
R117	20.0K
R118	Deleted
R119	Deleted
R120	10.0K
R121	562
R122	499K
R123	71.5K
R124	562
R125	20.0K
R126	10.0K
R127	10.0K
R128	562½W
R129	332
R130	100K½W
R131	10.0K
R132	10.0K
R133	1.96K
R134	Deleted
R135	10.0K
R136	317K
R137	10.0K
R138	56.2K
R139	154K
R140	10.0K
R141	317K
R142	105K
R143	4.99K
R144	4.99K
R145	1.30K
R145A	1.00K
R146	10.0K
R147	4.99K
R148	4.99K
R149	20.0K
R150	1.00K
R151	10.0K
R152	562
R153	562
R154	10MEG
R155	4.99K
R156	46.4K
R157	46.4K
R158	105K
R159	4.99K
R160	3.57K
R161	4.99K
R162	317K
R163	36.2K
R164	100K½W
R165	10.0K
R166	10MEG

CAPACITORS

C1	.1uF
C2	.1uF
C3	.015uF
C4	.015uF
C5	.015uF
C6	.015uF
C7	.015uF
C8	.015uF
C9	.015uF
C10	.015uF
C11	.015uF
C12	.015uF
C13	.015uF
C14	.015uF
C15	.047uF
C16	.015uF
C17	.1uF
C18	.015uF

(Polarized)

C19	.1uF 25WVDC
C50	4700uF 25WVDC
C51	4700uF 25WVDC
C52	100uF 250WVDC
C53 THRU C62	10uF225WVDC

* ( ) These symbols designate resistors used in low tone FSK 1000.

POTENTIOMETERS

R401 1MEG
R402 500 (2K)
R403 100K

TRIMMERS

R200 500 (2K)
R201 500 (2K)
R202 500
R203 500 (2K)
R204 500 (2K)
R205 500
R206 500 (2K)
R207 500 (2K)
R208 500
R209 500 (2K)
R210 500 (2K)
R211 500 (2K)
R212 2K
R213 DELETED
R214 2K
R215 2K

DIODES

D1 THRU D33 1N4148
Z1 1N750 4.7V

BRIDGE RECTIFIER

BR1 MDA104A
BR2 MDA104A

INTEGRATED CIRCUITS

U1 THRU U12 TL082, LF353 or MC34002
U13 THRU U25 MC1458, TL082 or MC34002

TRANSISTORS

Q1,Q3,Q5,Q7 2N2222
Q2 (FET) 2N5458

REGULATORS

VR1 MC7812CT
VR2 MC7912CT

RELAY

K1 28H113AE

FSK 1020A PARTS LIST

RESISTORS

R1 1K
R2 100K
R3 100K
R4 100K
R5 100K
R6 100K
R7 100K
R8 100K
R9 100K
R10 100K
R11 100K
R12 100K
R13 1.5MEG
R14 100K
R15 100K
R16 Deleted
R17 8.06K
R18 Jumper
R19 1.5MEG
R20 4.99K
R21 4.99K
R22 4.99K
R23 15.8K
R24 11.8K
R25 11.8K
R26 11.0K
R27 1.96K
R28 10.0K
R29 1.96K
R30 9.35K
R31 1.47K
R32 7.68K
R33 Deleted
R34 5.62K
R35 1.00K
R36 10.0K

TRIMMERS

R100 Deleted
R101 2K
R102 2K
R103 2K
R104 2K
R105 500
R106 500
R107 2K

CAPACITORS

C1 .015uF
C2 .033uF
C3 .0047uF
C4 .015uF
C5 .015uF
C6 .001uF
C7 .1uF

DIODES

D1 THRU D6 1N4148

INTEGRATED CIRCUITS

A1 CD4066BE
A2 CD4066BE
A3 MC1458P
A4 MC1458P
A5 MC1458P
A6 MC1458P

FSK 1000A PARTS LIST

RESISTORS

R1 620
R2 4.99K
R3 4.99K
R4 4.99K
R5 4.99K
R6 620½W
R7 105K
R8 6.49K
R9 20.0K
R10 105K
R11 1.69K(3.57K)*
R12 1.30K(1.96K)
R13 845 (1.30K)
R14 80.6K
R15 317K
R16 10.0K
R17 10.0K
R18 10.0K
R19 13.3K
R20 105K
R21 1.69K(3.57K)
R22 1.30K(1.96K)
R23 845 (1.30K)
R24 105K
R25 317K
R26 10.0K
R27 10.0K
R28 10.0K
R29 13.0K
R30 105K
R31 1.69K(3.57K)
R32 1.30K(1.96K)
R33 845 (1.30K)
R34 317K
R35 317K
R36 10.0K
R37 10.0K
R38 10.0K
R39 24.9K
R40 105K
R41 105K
R42 10.0K
R43 4.99K
R44 10.0K
R45 10.0K
R46 4.99K
R47 105K
R48 6.49K
R49 20.0K
105K

R50 2.15K(5.90K)
R51 80.6K
R52 317K
R53 10.0K
R54 10.0K
R55 10.0K
R56 13.3K
R57 105K
R58 2.15K(5.90K)
R59 105K
R60 317K
R61 10.0K
R62 10.0K
R63 10.0K
R64 13.0K
R65 105K
R66 2.15K(5.90K)
R67 317K
R68 317K
R69 10.0K
R70 10.0K
R71 10.0K
R72 24.9K
R73 10.0K
R74 4.99K
R75 10.0K
R76 10.0K
R77 4.99K
R78 1.96K
R79 10.0K
R80 48.7K
R81 61.9K
R82 105K
R83 154K
R84 36.5K
R85 46.4
R86 56.2K
R87 105K
R88 10.0K
R89 Deleted
R90 10.0K
R91 Deleted
R92 317K
R93 154K
R94 317K
R95 Deleted
R96 46.4K
R97 2MEG
R98 10.0K
R99 Deleted

R100 46.4K
R101 20.0K
R102 20.0K
R103 20.0K
R104 46.4K
R105 20.0K
R106 5.90K
R107 20.0K
R108 10.0K
R109 105K
R110 10.0K
R111 6.49K
R112 10.0K
R113 Deleted
R114 317K
R115 10.0K
R116 20.0K
R117 20.0K
R118 Deleted
R119 Deleted
R120 10.0K
R121 562
R122 499K
R123 71.5K
R124 562
R125 20.0K
R126 10.0K
R127 10.0K
R128 562½W
R129 332
R130 100K½W
R131 10.0K
R132 10.0K
R133 1.96K
R134 Deleted
R135 10.0K
R136 317K
R137 10.0K
R138 56.2K
R139 154K
R140 10.0K
R141 317K
R142 105K
R143 4.99K
R144 4.99K
R145 1.30K
R145A 1.00K
R146 10.0K
R147 4.99K
R148 4.99K
R149 20.0K

R150 1.00K
R151 10.0K
R152 562
R153 562
R154 10MEG
R155 4.99K
R156 46.4K
R157 46.4K
R158 105K
R159 4.99K
R160 3.57K
R161 4.99K
R162 317K
R163 36.2K
R164 100K½W
R165 10.0K
R166 10MEG

CAPACITORS

C1 .1uF
C2 .1uF
C3 .015uF
C4 .015uF
C5 .015uF
C6 .015uF
C7 .015uF
C8 .015uF
C9 .015uF
C10 .015uF
C11 .015uF
C12 .015uF
C13 .015uF
C14 .015uF
C15 .047uF
C16 .015uF
C17 .1uF
C18 .015uF
(Polarized)
C19 .1uF 25WVDC
C50 4700uF 25WVDC
C51 4700uF 25WVDC
C52 100uF 250WVDC
C53 THRU C62
10uF225WVDC

POTENTIOMETERS

R401 1MEG
R402 500 (2K)
R403 100K

TRIMMERS

R200 500 (2K)
R201 500 (2K)
R202 500
R203 500 (2K)
R204 500 (2K)
R205 500
R206 500 (2K)
R207 500 (2K)
R208 500
R209 500 (2K)
R210 500 (2K)
R211 500 (2K)
R212 2K
R213 DELETED
R214 2K
R215 2K

DIODES

D1 THRU D33 1N4148
Z1 1N750 4.7V

BRIDGE RECTIFIER

BR1 MDA104A
BR2 MDA104A

INTEGRATED CIRCUITS

U1 THRU U12 TL082, LF353 or MC34002
U13 THRU U25 MC1458, TL082 or MC34002

TRANSISTORS

Q1,Q3,Q5,Q7 2N2222
Q2 (FET) 2N5458

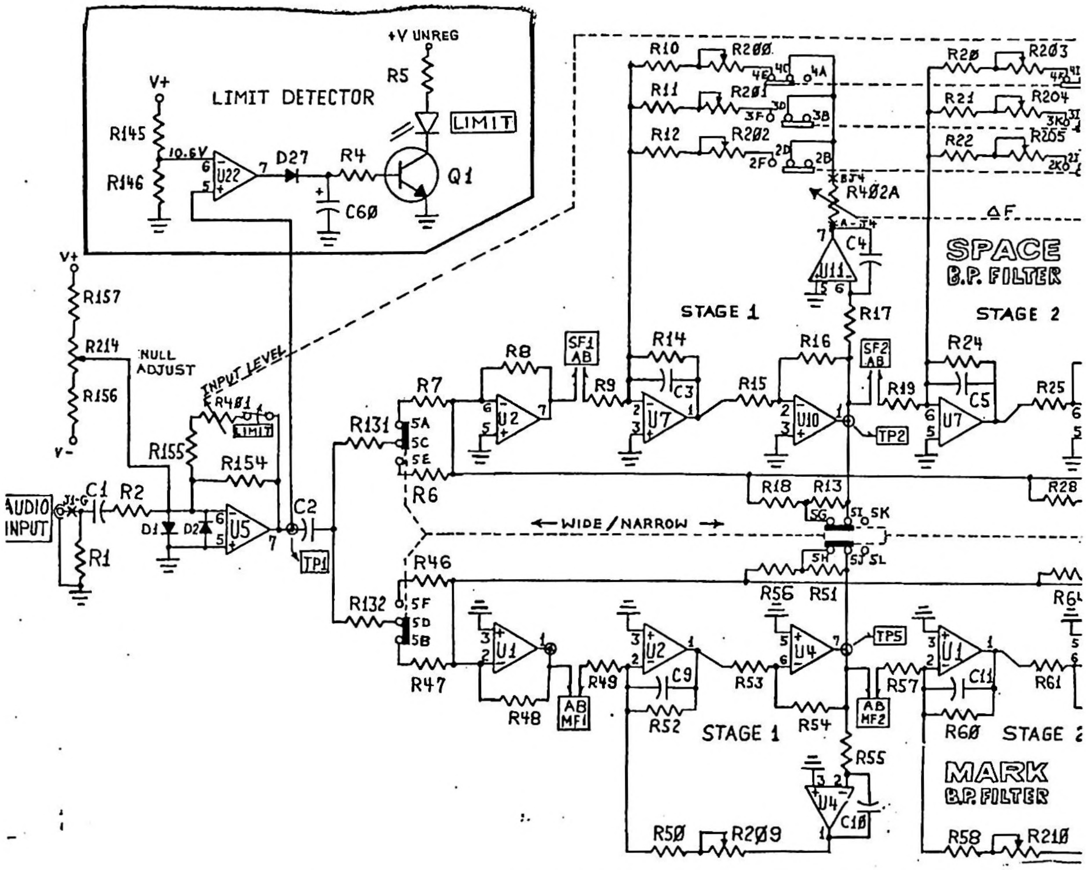
REGULATORS

VR1 MC7812CT
VR2 MC7912CT

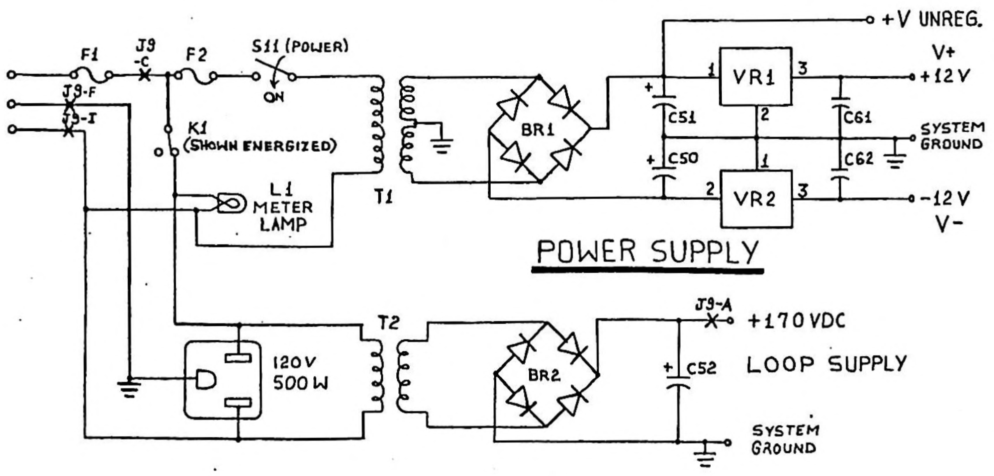
RELAY

K1 28H113AE

* ( ) These symbols designate resistors used in low tone FSK 1000.



FSK-1000



RESIST

R1	6
R2	4
R3	4
R4	4
R5	6
R6	1
R7	6
R8	2
R9	1
R10	1
R11	1
R12	8
R13	8
R14	3
R15	1
R16	1
R17	1
R18	1
R19	1
R20	1
R21	1
R22	8
R23	1
R24	3
R25	1
R26	1
R27	1
R28	1
R29	1
R30	1
R31	1
R32	8
R33	3
R34	3
R35	1
R36	1
R37	1
R38	2
R39	1
R40	1
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R42	4
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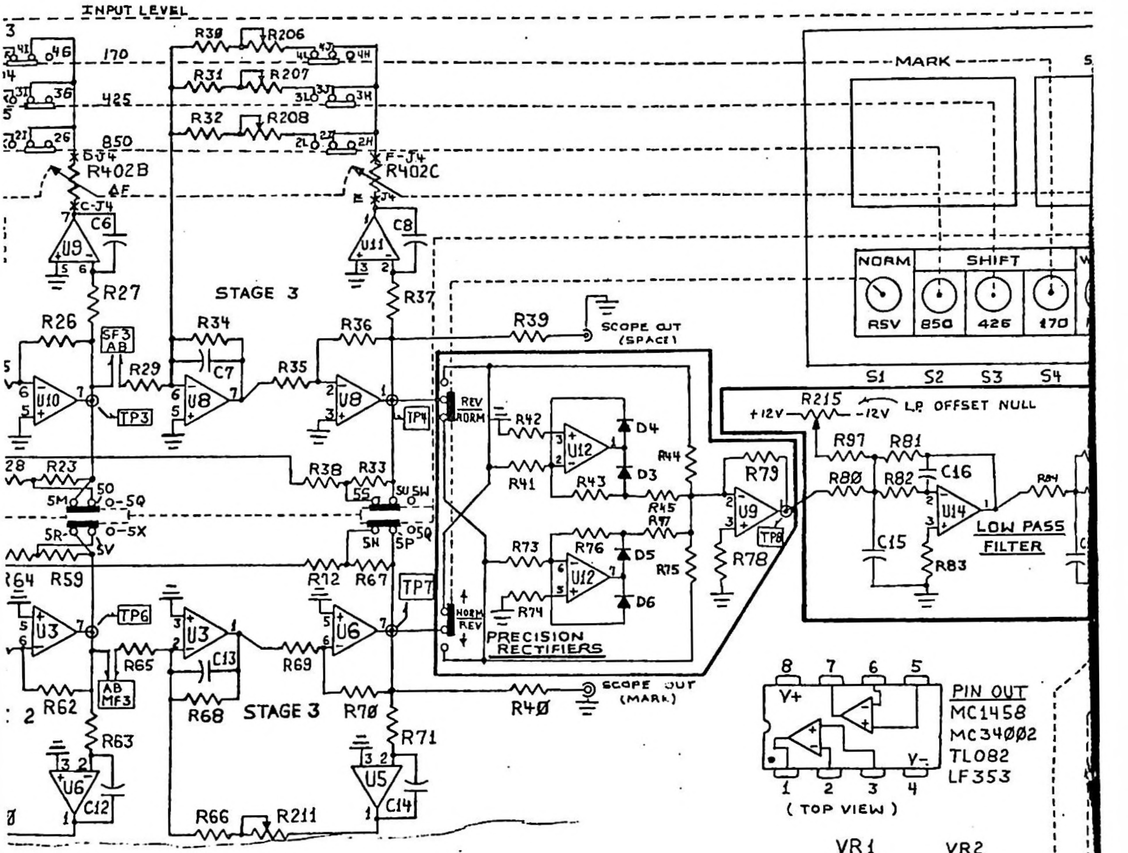
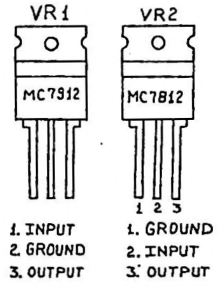
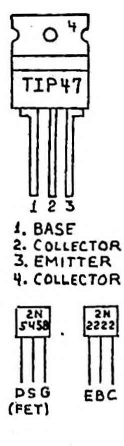
R45	4
R46	1
R47	6
R48	2
R49	1







FSK 1000A PARTS LIST

ISTORS

620
4.99K
4.99K
4.99K
620¼W
105K
6.49K
20.0K
105K
1.69K(3.57K)*
1.30K(1.96K)
845 (1.30K)
80.6K
317K
10.0K
10.0K
10.0K
13.3K
105K
1.69K(3.57K)
1.30K(1.96K)
845 (1.30K)
105K
317K
10.0K
10.0K
10.0K
13.0K
105K
1.69K(3.57K)
1.30K(1.96K)
845 (1.30K)
317K
317K
10.0K
10.0K
10.0K
24.9K
105K
105K
10.0K
4.99K
10.0K
10.0K
4.99K
105K
6.49K
20.0K
105K

R50 2.15K(5.90K)
R51 80.6K
R52 317K
R53 10.0K
R54 10.0K
R55 10.0K
R56 13.3K
R57 105K
R58 2.15K(5.90K)
R59 105K
R60 317K
R61 10.0K
R62 10.0K
R63 10.0K
R64 13.0K
R65 105K
R66 2.15K(5.90K)
R67 317K
R68 317K
R69 10.0K
R70 10.0K
R71 10.0K
R72 24.9K
R73 10.0K
R74 4.99K
R75 10.0K
R76 10.0K
R77 4.99K
R78 1.96K
R79 10.0K
R80 48.7K
R81 61.9K
R82 105K
R83 154K
R84 36.5K
R85 46.4
R86 56.2K
R87 105K
R88 10.0K
R89 Deleted
R90 10.0K
R91 Deleted
R92 317K
R93 154K
R94 317K
R95 Deleted
R96 46.4K
R97 2MEG
R98 10.0K
R99 Deleted

R100 46.4K
R101 20.0K
R102 20.0K
R103 20.0K
R104 46.4K
R105 20.0K
R106 5.90K
R107 20.0K
R108 10.0K
R109 105K
R110 10.0K
R111 6.49K
R112 10.0K
R113 Deleted
R114 317K
R115 10.0K
R116 20.0K
R117 20.0K
R118 Deleted
R119 Deleted
R120 10.0K
R121 562
R122 499K
R123 71.5K
R124 562
R125 20.0K
R126 10.0K
R127 10.0K
R128 562¼W
R129 332
R130 100K¼W
R131 10.0K
R132 10.0K
R133 1.96K
R134 Deleted
R135 10.0K
R136 317K
R137 10.0K
R138 56.2K
R139 154K
R140 10.0K
R141 317K
R142 105K
R143 4.99K
R144 4.99K
R145 1.30K
R145A 1.00K
R146 10.0K
R147 4.99K
R148 4.99K
R149 20.0K

R150 1.00K
R151 10.0K
R152 562
R153 562
R154 10MEG
R155 4.99K
R156 46.4K
R157 46.4K
R158 105K
R159 4.99K
R160 3.57K
R161 4.99K
R162 317K
R163 36.2K
R164 100K¼W
R165 10.0K
R166 10MEG

CAPACITORS

C1 .1uF
C2 .1uF
C3 .015uF
C4 .015uF
C5 .015uF
C6 .015uF
C7 .015uF
C8 .015uF
C9 .015uF
C10 .015uF
C11 .015uF
C12 .015uF
C13 .015uF
C14 .015uF
C15 .047uF
C16 .015uF
C17 .1uF
C18 .015uF
(Polarized)
C19 .1uF 25WVDC
C50 4700uF 25WVDC
C51 4700uF 25WVDC
C52 100uF 250WVDC
C53 THRU C62
10uF225WVDC

POTENTIOMETERS

R401 1MEG
R402 500 (2K)
R403 100K

TRIMMERS

R200 500 (2K)
R201 500 (2K)
R202 500
R203 500 (2K)
R204 500 (2K)
R205 500
R206 500 (2K)
R207 500 (2K)
R208 500
R209 500 (2K)
R210 500 (2K)
R211 500 (2K)
R212 2K
R213 DELETED
R214 2K
R215 2K

DIODES

D1 THRU D33 1N4148
Z1 1N750 4.7V

BRIDGE RECTIFIER

BR1 MDA104A
BR2 MDA104A

INTEGRATED CIRCUITS

U1 THRU U12 TL082, LF353 or MC34002
U13 THRU U25 MC1458, TL082 or MC34002

TRANSISTORS

Q1,Q3,Q5,Q7 2N2222
Q2 (FET) 2N5458

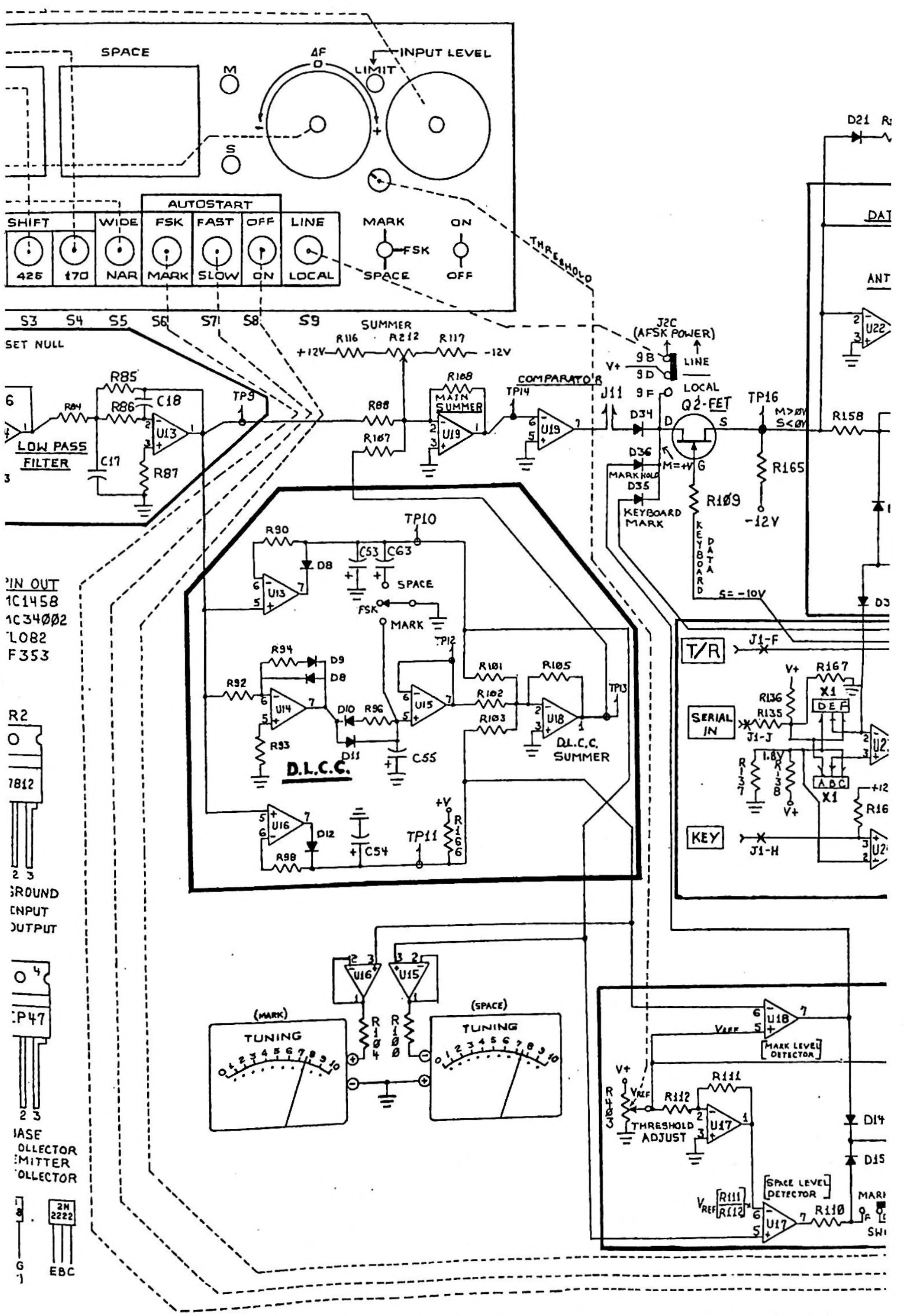
REGULATORS

VR1 MC7812CT
VR2 MC7912CT

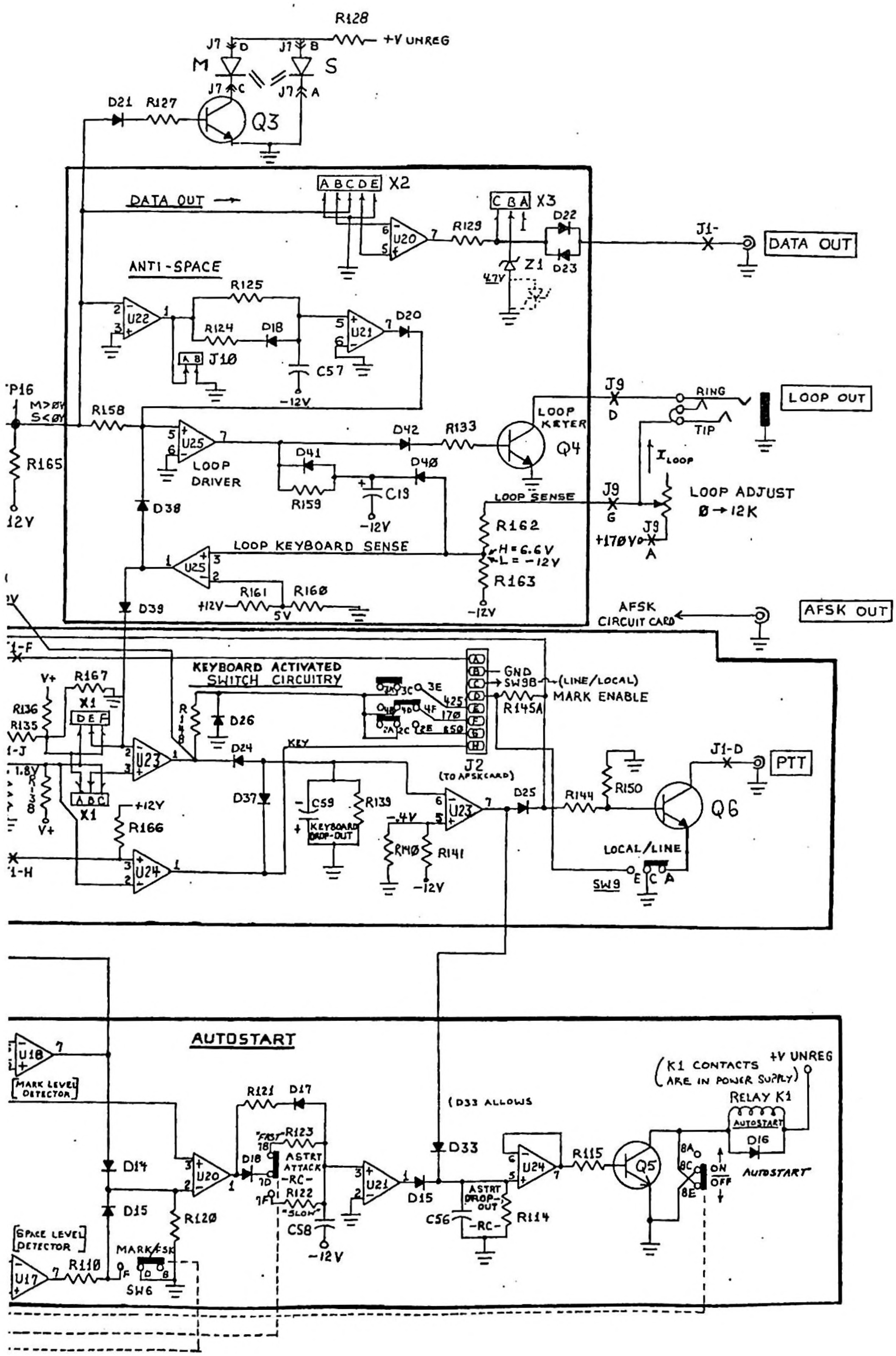
RELAY

K1 28H113AE

( ) These symbols designate resistors used in low tone FSK 1000.



SPACE
M
S
ΔF
INPUT LEVEL
LIMIT
AUTOSTART
SHIFT
WIDE
FSK
FAST
OFF
LINE
MARK
ON
425
170
NAR
MARK
SLOW
ON
LOCAL
SPACE
OFF
THRESHOLD
S3 S4 S5 S6 S7 S8 S9
SET NULL
SUMMER
R116 R212 R117
+12V -12V
J2C (AFSK POWER)
LINE
LOCAL
COMPARATOR
MAIN SUMMER
LOW PASS FILTER
R85 R86 R84 C18 C17 R87 U13 TP9
R88 R167 R108 U19 TP14 J11 D34 D36 D35
Q2-FET
TP16
M>0V S<0V
R158 R165 R109 -12V
MARK HOLD
KEYBOARD MARK
KEYBOARD DATA
S = -10V
D21
DATA
ANT
U22
PIN OUT
MC1458
MC34002
TL082
LF353
R2
7812
GROUND
INPUT
OUTPUT
TIP47
BASE
COLLECTOR
EMITTER
COLLECTOR
2N2222
EBC
TP10
R90 D8 C53 C63 SPACE
FSK MARK
R94 D9 D8 R92 U14 D10 R96 U15 TP12
R101 R102 R103 R105 U18 TP13
D.L.C.C. SUMMER
R93 D11 C55
D.L.C.C.
U16 D12 R98 C54 TP11 R166 +V
T/R J1-F
SERIAL IN
R136 R135 R167 J1-J X1 DEF ABC R137 R138 1.8V V+
KEY J1-H R16 +12
U16 U15
(MARK) TUNING
(SPACE) TUNING
R104 R100
U18 VREF MARK LEVEL DETECTOR
V+ R403 THRESHOLD ADJUST R111 R112 U17
D14 D15
SPACE LEVEL DETECTOR
VREF R111/R112 U17 R110
MARK SH



R128
+V UNREG
M
S
D21
R127
Q3
DATA OUT
X2
X3
R129
U20
D22
D23
Z1
J1-
DATA OUT
ANTI-SPACE
R125
R124
D18
U22
U21
D20
J10
C57
-12V
TP16
M>0V S<0V
R158
R165
LOOP KEYER
J9
RING
TIP
LOOP OUT
U25
LOOP DRIVER
D42
R133
Q4
D41
D40
R159
C13
LOOP SENSE
R162
LOOP ADJUST
0→12K
+170V
D38
LOOP KEYBOARD SENSE
H=6.6V
L=-12V
R163
R161
R160
D39
AFSK CIRCUIT CARD
AFSK OUT
KEYBOARD ACTIVATED SWITCH CIRCUITRY
R167
X1
R136
R135
U23
D26
D24
KEY
GND
SW9B
(LINE/LOCAL)
R145A
MARK ENABLE
J2
(TO AFSK CARD)
D37
C59
R139
KEYBOARD DROP-OUT
R166
U24
R140
R141
D25
R144
R150
Q6
J1-D
PTT
LOCAL/LINE
SW9
AUTOSTART
U18
MARK LEVEL DETECTOR
R121
D17
R123
"FAST"
ASTRT ATTACK -RC-
R122
"SLOW"
C58
-12V
(D33 ALLOWS
D33
D14
D15
R120
U20
D18
U21
D15
ASTRT DROP-OUT -RC-
C56
R114
U24
R115
Q5
(K1 CONTACTS ARE IN POWER SUPPLY)
+V UNREG
RELAY K1
AUTOSTART
D16
ON
OFF
SPACE LEVEL DETECTOR
U17
R110
MARK/FSK
SW6