



DATA TECHNOLOGY ASSOCIATES, INC.

P.O. BOX 431912

MIAMI, FLORIDA 33143

DT-500

TELETYPE DEMODULATOR

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Data Technology Associates, Inc. reserves the right to discontinue products or to change specifications at any time without incurring any obligation to incorporate new features in products previously sold.

T H A N K Y O U

We wish to take this opportunity to thank you for your order and to tell you a little about our company and how we feel about this product. If you are pleased with it, please tell others. If not, please tell us.

The DT-500 is the second of Data Technology's "D-LINE", a modular approach to data communications. Featuring modern components and packaging, a standard circuit board size, common power supply and input/output characteristics, and adaptability to a wide variety of applications, the D-LINE is expected to receive wide acceptance among RTTY enthusiasts and that exploding number of microprocessor hobbyists who are learning the benefits to be gained from combining computers and communications.

Data Technology Associates, Inc., is an infant corporation but the systems concepts on which we are based have been carefully developed over a four-year period. Because of our infancy we have not yet made available kits or ready-made units, nor have we printed a complete manual which would be used with these. We have attempted, however, to provide more quality data with this printed circuit board offering than is typical from other suppliers. We have also tried to provide you with the finest G-10 epoxy board available. Computer processed, drilled and cut to insure quality and uniformity, these boards are double-sided with plated through holes and reflowed solder plating, not tin so often found on the boards of other suppliers. We invite your inspection of our product and its comparison with those of other suppliers. We value your constructive comment and suggestion.

It is not possible to lay out a circuit board that exactly matches the parts in your junk box. We at Data Technology Associates have laid out this board for modern circuit board components, readily available from large electronic suppliers. In cases where several manufacturers make suitable components, we have not listed specific part numbers. To help you with this parts task, we are presently attempting to make quantity purchases of many of the components necessary so that we can make available mini-kits. As soon as all of the required components can be ordered and stocked, we plan to offer a complete kit for the DT-500.

We then submit this circuit board and data package as our second offering. With your support we shall take this beginning and grow to other products. In those endeavors we pledge to do our utmost to provide a quality product at a reasonable price.

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I M P O R T A N T

N O T I C E

The edge connector pin numbers for the DT-500 board for which this manual is provided are different from those referred to in the March 1976 issue of Ham Radio magazine which described the DT-500. This new circuit board was developed in order to provide direct pin compatability between the DT-600 and DT-500. For your use in interpolating between the information given in the article and the data enclosed, we have prepared a conversion chart to cross reference the magazine article pin numbers with the edge connector numbers actually found on the DT-500 board.

Magazine Article Pin Numbers	Correct Pin Numbers	Function	
W	3	Audio Input	DT600 3
Z	2	Ground	2
X	6	Scope (Mark)	6
Y	7	Scope (Space)	7
K	13	Data Output	13
M	12	Loop Keying	12
L	15	Print/Non-Print (Data Flag)	15
D	18	Standby	18
E	17	Autostart Normal/Fast	17
H	20	Motor Automatic/On	20
C	21	Motor Control Relay	21
R	10	Tuning Meter	10
T	8	+12 Volts	8
A	22	Ground	22
P	5	-12 Volts	5
N	19	Autostart Normal/Off	19

4 11 } Blank
9 14 } DT500
16 }

4 - 709 I/p thru 470K } limit errors
9 - 709 o/p } opt

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The first of the parts that may not be available at the local electronic supply store are the potentiometers, 2-5K and 2-10K units. We now have these in stock and can supply them (the four required for the board) for a price of \$2.00 postpaid in the continental United States (Florida residents add 4% sales tax). Please let us know if you would like to take advantage of this offer.

SECTION I

INTRODUCTION

1.1 PURPOSE OF EQUIPMENT

The DT-500 RTTY Demodulator is an austere version of the popular DT-600. Designed specifically for use on VHF or where strong steady signal conditions prevail, the DT-500 retains the superior interface and controllability characteristics of the DT-600 on a board that is directly pin interchangeable with the DT-600. Accepting audio signals from a communications receiver, the DT-500 demodulates these signals and uses the resultant output for keying a standard 20 ma. or 60 ma. teletype loop or one or more TTL logic level devices. In addition, the DT-500 provides a proven autoprint system which discriminates against voice and C.W. signals. Full TTL logic interface and controllability are provided to facilitate easy interconnection with a wide variety of control and signaling devices.

Using single circuit board construction, the DT-500 is designed to provide excellent performance and features with minimum parts count.

1.2 PHYSICAL DESCRIPTION

The DT-500 RTTY Demodulator is contained on a single 4.50" by 6.50" (11.43 cm. by 16.51 cm.), double-sided plug-in circuit board suitable for mounting in a wide variety of enclosures.

1.3 ELECTRICAL SPECIFICATIONS (Amateur Standard)

Input

Impedance	Unbalanced	500-600 Ohms
Input Signal Level		0.2 to 10.0 Volts
Frequency Shift		170 or 850 Hz

Discriminator Filters

850 Hz Shift	MARK	2125 Hz
	SPACE	2975 Hz
170 Hz Shift	MARK	2125 Hz
	SPACE	2295 Hz

Autostart Characteristics

Turn-On Time	NORMAL	3-5 Seconds
	FAST	1-2 Seconds
Mark-Hold Lock-up Time		1 Second
Motor Turn-Off Time		30 Seconds (nominal)

Outputs

Mark/Space Data

Standard 20 ma. or 60 ma. Teletype Loop Keyer (external current limiter)

Open-Collector NPN Transistor (Pulls down (ON) on MARK, up (OFF) on SPACE)

Autostart (Autoprint)

Open-Collector NPN Motor Control Relay Driver Transistor

Data Flag

Open-Collector NPN Transistor (Pulls down (ON) when no data, up (OFF) when data is present)

Power Requirements

+12 Volts DC at 32 ma. (Does NOT include motor relay current which does not have to be regulated.)

-12 Volts DC at 14 ma.

External Loop Supply, 70 to 180 volts at 20 ma. or 60 ma.

SECTION II

THEORY OF OPERATION

2.1 PURPOSE

For those who are not proficient in solid state electronics, we offer this "simplistic" description of the operation of the DT-500 RTTY Demodulator. This Section is designed to supplement rather than replace the higher level theory of operation presented in the March 1976 Ham Radio article. For this reason, this will not be a technically precise description. All voltage indications are approximations provided to help the non-professional builder understand the DT-500.

Should there be a problem with the DT-500, this section should be valuable in helping to isolate and correct the problem.

The DT-500 consists of several simple interconnected modules. It is possible to isolate and independently test these modules, a feature which eases the task of corrective maintenance.

2.2 LIMITER

The Limiter circuit consists of U-1, R-1 thru R-9, and C-1 thru C-6. A single 709 op amp is used as U-1 in an open-loop configuration for maximum gain. For this purpose the 709 is superior to the 741 but requires decoupling from the DC power busses, frequency compensation, and latch-up protection. The principle purpose of the Limiter circuit is to accept a wide range of input signal levels from the receiver and amplify them to the point of amplifier saturation. This provides hard limiting on the output of U-1 at approximately plus/minus 10 volts for about an 80-90 DB swing in the input signal level. This constant level output helps the Discriminator/Detector do its job and provides for reliable autostart operation.

2.3 DISCRIMINATOR/DETECTOR

The plus/minus 10 volt square wave output of the Limiter (U-1) is applied through A.C. equilization components R-12 through R-15 to the MARK and SPACE discriminator filters. By grounding the center-tap of the two 88 MHz inductors (L-1 and L-2), two full-wave rectifier (detector) circuits consisting of D-5/D-6 and D-7/D-8 are possible. This results in a very efficient detection system. The MARK detector is configured for a negative voltage output while the SPACE detector is set for a positive output. These voltage outputs are summed and applied to pin 2 of U-2. Since pin 3 of U-2 is referenced to ground, the output of U-2 inverts the plus/minus outputs of the detector.

A scope cross pattern which is easier to use for tuning purposes than the tuning meter can be obtained by connecting card edge Pin 6 to the horizontal amplifier input and Pin 7 to the vertical amplifier input with the internal oscilloscope time base turned off.

The functions of D-3, D-4 and C-7 are described in the Autostart section description.

2.4 SLICER/KEYER

Although two independent circuits, the Slicer and Keyer are treated together since they work in direct conjunction with each other. The Slicer circuit consists of U-2 and R-20. The Keyer consists of Q-1, Q-2, R-21 thru R-23, and D-9 thru D-12.

The polar (plus/minus) voltages presented at the output of the Detector circuit are low level and are not appropriate for the uniform and expeditious turn-on/turn-off action desired for keying a teletype loop.

The Slicer, because of its high gain, will provide a plus/minus 10 volt swing on its output with only a 1 or 2 millivolt swing on its input. This output turns both Q-1 and Q-2 ON when positive and OFF when negative. D-10 is used to connect the positive voltage outputs of the Standby and Autostart circuits into the Keyer circuit to force Q-1 and Q-2 ON (MARK-HOLD) regardless of the output of the Slicer. Notice, however, that Q-1 is effected by this MARK-HOLD voltage only if it is connected at the junction of D-9 and R-23 (C to 2) instead of to the output of U-2 (C to 1). Because of this feature, Q-1 (the TTL logic level output) is ideal for providing MARK/SPACE data to selective calling and similiar station control equipment.

2.5 STANDBY CIRCUIT

The Standby Circuit consists of Q-4, D-14 thru D-16, R-26 thru R-28, and D-18. The purpose of the Standby circuit, when card edge connector Pin 18 is pulled down or grounded, is two-fold:

- a. The demodulator is forced into a MARK-HOLD condition.
- b. The motor is held on, regardless of whether or not a signal is present.

Let's discuss how these actions take place. As the circuit appears on the schematic with no connection to Pin 18, Q-4 is turned ON (saturated - its collector voltage is only a few tenths of a volt. This turn-on path is +12 volts through R-26, D-15 and the base-emitter junction of Q-4). Since the collector of Q-4 is LOW, no current flows through D-16 to place the unit in MARK-HOLD.

On the other hand, when Pin 18 is pulled down, Q-4 is turned off and its collector voltage rises to +12 volts. This voltage applied through D-16 turns on Q-2 (MARK-HOLD condition) and Q-3 (DATA FLAG OFF -- No data present). Also, the pull down on Pin 18 pulls pin 3 of U-4 (via D-18) low (and less positive than the fixed positive bias voltage on pin 2 of U-4). The output of U-4 then goes negative, turning off Q-5 and forcing the output of U-5 positive thereby holding the Motor Control Relay (K-1) ON. Refer to the Autostart Circuit description in Section 2.6 for more detail on this action.

2.6 AUTOSTART CIRCUIT

The Autostart Circuit consists of U-3, U-4, R-29 thru R-40, C-14, C-15, and D-17 thru D-19.

Whether there is noise, non-RTTY signals, weak or off-frequency signals, or strong, precisely tuned RTTY signals at the input of the demodulator, the relative signal strength captured in the Discriminator MARK and SPACE filters is rectified by D-3 and D-4, filtered by C-7, and presented through R-29 to the Autostart Section. The magnitude of this voltage is lowest with noise (zero with no signal input -- receiver off) and highest when strong perfectly-tuned signals are present. Notice that signals in either the MARK or SPACE channel will produce a positive voltage output.

This output is fed to pin 2 of U-3 where it is compared with a fixed but settable positive bias threshold voltage on pin 3. This bias voltage is really the autostart sensitivity setting and is adjustable by R-32 between approximately 2.2 volts and 3.3 volts.

Before a valid RTTY signal is tuned, the voltage on pin 3 of U-3 is more positive than the voltage impressed on pin 2 by the incoming signal. The output of U-3 is then approximately +10 volts which, you will find when reading the next section on the Motor Control circuit, turns the Motor Control Relay OFF.

When a signal appears on the input, pin 2 of U-3 is then more positive than pin 3 and the output of U-3 swings to approximately -10 volts, thus removing the source of charging voltage to C-14 (and C-15). C-14 (and C-15) then begin to discharge through the series combination of R-36 and R-37. This RC time constant circuit determines the autostart turn-on time. Notice, then, the subtle difference between autostart sensitivity and turn-on time. Basically, sensitivity regulates WHEN the autostart will begin to react and the RC time constant regulates HOW LONG it will take. Such time constant circuits take longer when the resistance or capacitance is increased, shorter when they are decreased. In the NORMAL AUTOSTART mode, when card edge Pin 17 is grounded, we have 22 uf (or 18 uf -- see Parts List for more info). In the FAST AUTOSTART mode we have only 3.9 uf (4.7 uf in series with 22 uf), and thus a shorter turn-on time.

From the initial charge of approximately +9.3 volts (+10 volt output of U-3 less the drop across D-17) on C-14 (and C-15), approximately 3-6 seconds (1-2 seconds in the FAST AUTOSTART mode) is required to discharge down to approximately +3.6 volts. At that time, because of the voltage divider arrangement of R-36 and R-37, the voltage on pin 3 of U-4 drops below the fixed bias voltage of +2.2 volts on pin 2 and the output of U-4 swings negative. As indicated in the Motor Control section to follow, this turns the Motor Control Relay on.

We can force the autostart turn-on in two ways. Notice in the above paragraph that the voltage on pin 3 of U-4 went lower than that on pin 2 for motor turn-on. By physically pulling pin 3 down using card edge connector Pin 19 (FORCE ON) or Pin 18 (STANDBY) via D-18, the motor will be forced on.

2.7 MOTOR CONTROL

The Motor Control circuit consists of U-5, Q-5, Q-6, C-16, R-41 thru R-46, and D-20 thru D-22.

No Signal Condition (Steady State)

When no valid signal is present on the input of the demodulator, the output of U-4 is positive and Q-5 is turned on (collector voltage is a few tenths of a volt). Capacitor C-16 is discharged and the voltage on pin 2 of U-5 is more positive (approximately +2.2 volts fixed bias) than that on pin 3. The voltage at the output of U-5 is negative. Therefore Q-6, the motor control relay driver transistor, is OFF.

Valid Signal

After a few seconds of valid signal, the output of U-4 becomes negative which turns Q-5 off. As soon as Q-5 turns off, C-16 quickly charges to approximately +11.3 volts through R-42. With pin 3 of U-5 at approximately +11.3 volts (and more positive than the +2.2 volts fixed bias on pin 2), the output of U-5 is positive and Q-6, the motor control relay driver transistor, is ON.

Loss of Signal

The important part of the motor control circuit occurs when the signal disappears and the output of U-4 goes positive. Q-5 is immediately turned on and its collector voltage drops to a few tenths of a volt thereby removing the charging voltage source to C-16. The delay in motor turn-off is then determined by the length of time it takes C-16 to discharge through R-43 from approximately +11.3 volts down to just below the +2.2 volt fixed bias on pin 2 of U-5. With 18 uf for C-16 and 1 Meg for R-43 this takes about 30 seconds. The time can be shortened by reducing either component value, preferably the capacitance. Once pin 3 is less positive than pin 2, the output of U-5 swings negative and the motor control relay turns off.

Forced Turn-Off

One excellent feature of the DT-500 is available at card edge connector Pin 20 (which is connected to the collector of Q-5). A switch, transistor collector, or open-collector TTL package pull-down on Pin 20 will force the control circuit to time out (30 seconds) and turn the motor off regardless of whether a signal is present or not. This feature is especially useful for selective calling and similar applications.

SECTION III

CONSTRUCTION TIPS

3.1 THE DT-500 CIRCUIT BOARD

Extra time spent in the careful selection and soldering of components to the circuit board will be time well-spent. These two actions are most important in insuring a product which will work the first time and deliver many years of trouble-free service.

For the purpose of discussions herein, we will refer to either the component side of the circuit board or to the foil side, even though foil patterns are present on both sides of the board. All components mount on the component side where the card edge pins are numbered 1 through 22. The components are soldered in place on the foil side, where the pins are numbered from A through Z. The holes in the board are plated through with approximately .001" of metal thereby connecting the foil on opposite sides of the board together. For this reason, soldering is necessary only on the foil side of the board.

All foil surfaces have been solder plated for ease in soldering. For this reason, less heat should be necessary. Solder plating is superior to the tin plating so often found on hobbist boards since tin plating tends to oxidize after a few days. This oxidation must be removed if a good solder bond is to be obtained either by burnishing before soldering or by the application of excessive heat during the soldering process.

3.1.1 SOLDERING HINTS

Most people are aware of the dangers of overheating when soldering solid state components. In this regard, a few recommendations are in order:

- A. Use a 20-50 watt pencil iron (rather than a soldering gun or high wattage iron). If such an iron is not available and you intend to do a lot of building, it may be advisable to invest in one.
- B. Use only rosin core solder with a tin-lead content of either 60:40 or 50:50. (60:40 is the preferred composition ratio).
- C. When soldering integrated circuits (IC's), pots, transistors or diodes, allow pins to cool before soldering another pin on that device as the heat tends to be cumulative. Actually, this habit is not a bad one for ANY component. Clip-on heat sinks are worthwhile if available. The idea in any case is to get on, solder a good joint, and "get off".
- D. It is also possible to change resistance values, damage capacitors, or even damage the circuit board itself if too much heat is applied. Circuit board damage is VERY prevalent when unsoldering. Therefore, use care and patience in soldering (or unsoldering) all connections, not just in the fragile areas.
- E. If you do make a mistake, removal of components is generally easier using "Solder-Wick" (a G. C. Electronics product) than with most desoldering tools.

3.1.2 LOADING THE BOARD

NOTE - Refer to the component layout pictorial, Figure 3-1, for component placement.

Resistors:

Recommend solder the resistors on the board first. Be careful to place all resistors in their proper locations as it is a lot easier to be right the first time than to move them once they have been soldered in place. This is, of course, true of all components.

Although not necessary, a neater appearance will be obtained if all resistors are oriented in the same direction; i.e., banded end of all resistors either to the left or upward as appropriate. This also helps in reading the color codes.

Note that the resistors used in the discriminator are different for 170 Hz shift and 850 Hz shift. The following chart, identical to that on the large DT-500 schematic, is provided for convenience.

Resistor	2125/2295	2125/2975
R12	6.8K	4.7K
R14	6.8K	6.8K
R15	100K	33K

Here is a ready reference for the color codes of all resistors used in the construction of the DT-500 board:

Resistance	Color Code
47	YELLOW-VIOLET-BLACK
100	BROWN-BLACK-BROWN
470	YELLOW-VIOLET-BROWN
560	GREEN-BLUE-BROWN
620	BLUE-RED-BROWN
1K	BROWN-BLACK-RED
1.5K	BROWN-GREEN-RED
2.2K	RED-RED-RED
4.7K	YELLOW-VIOLET-RED
5.6K	GREEN-BLUE-RED
6.8K	BLUE-GREY-RED
10K	BROWN-BLACK-ORANGE
33K	ORANGE-ORANGE-ORANGE
39K	ORANGE-WHITE-ORANGE
68K	BLUE-GREY-ORANGE
75K	VIOLET-GREEN-ORANGE
91K	WHITE-BROWN-ORANGE
100K	BROWN-BLACK-YELLOW
120K	BROWN-RED-YELLOW
150K	BROWN-GREEN-YELLOW
1 MEG	BROWN-BLACK-GREEN

Diodes:

Once the resistors have been mounted, mount all diodes making sure to observe polarity. Also, be sure to place silicon and germanium diodes in their proper places. Below are shown some equivalent diode markings:

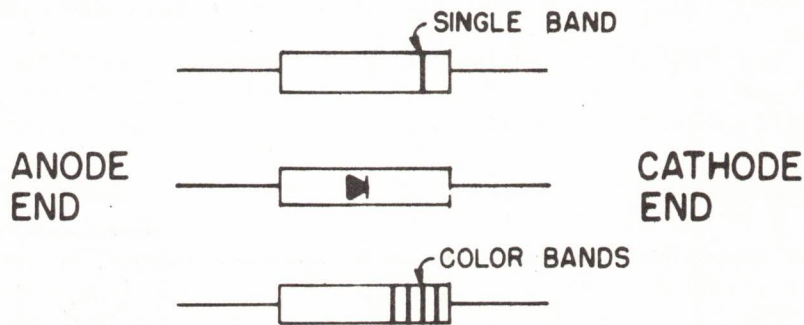


FIGURE 3-2

NOTE - There is no place on the board for D-31 since that mounts directly across the Motor Control Relay, K-1.

Potentiometers:

Next, mount the two 5K and two 10K potentiometers on the board. DO NOT OVERHEAT.

Transistors:

All useable transistors, especially Q2, may not have the metal case with tab to indicate the emitter lead as shown on the layout drawing. In any case, be very careful to mount all transistors with their emitter, base and collector leads oriented as shown on the component layout.

Operational Amplifiers:

Orient the leads of U-1, the 709, as shown on the component layout. Note that the tab is above pin 8 of the OP AMP.

Mount the 741 mini-dip packages as shown.

Capacitors:

Mount all capacitors except C-8 and C-9 on the board. These capacitors will be mounted after the discriminator filters are tuned. Be sure to observe polarity, especially with the tantalum capacitors.

We recommend the use of 18 ufd for C-14 and C-16 vice 22 ufd indicated on the schematic and in the article.

Toroids or Pot Cores:

The toroidal or pot core inductors will not be mounted at this time. They will be mounted after the filters are tuned.

3.2 FILTER TUNING TEST SET-UP

Figure 3-3 depicts the recommended test set-up for filter tuning. The resistor is necessary to isolate the tuned circuit from the low output impedance of the audio signal generator. Although not critical, a resistor of approximately 100K ohms is recommended for this purpose.

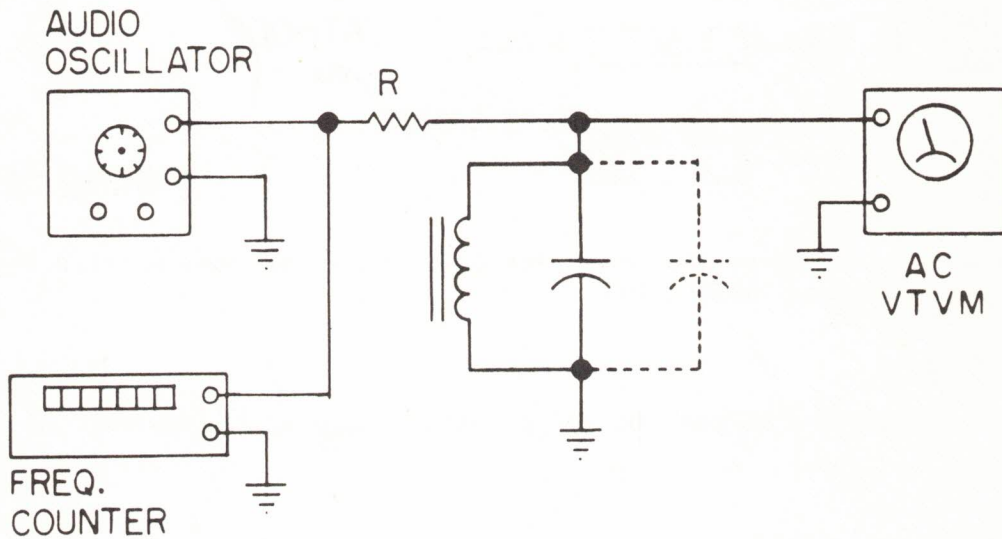


FIGURE 3-3

The general procedure is to tune the audio oscillator until a peak is obtained on the AC VTVM. When this peak is obtained, the frequency counter will indicate the resonant frequency of the filter circuit.

If the resonant frequency is too low, it can be raised by either decreasing the capacitance or carefully removing turns from the toroid.

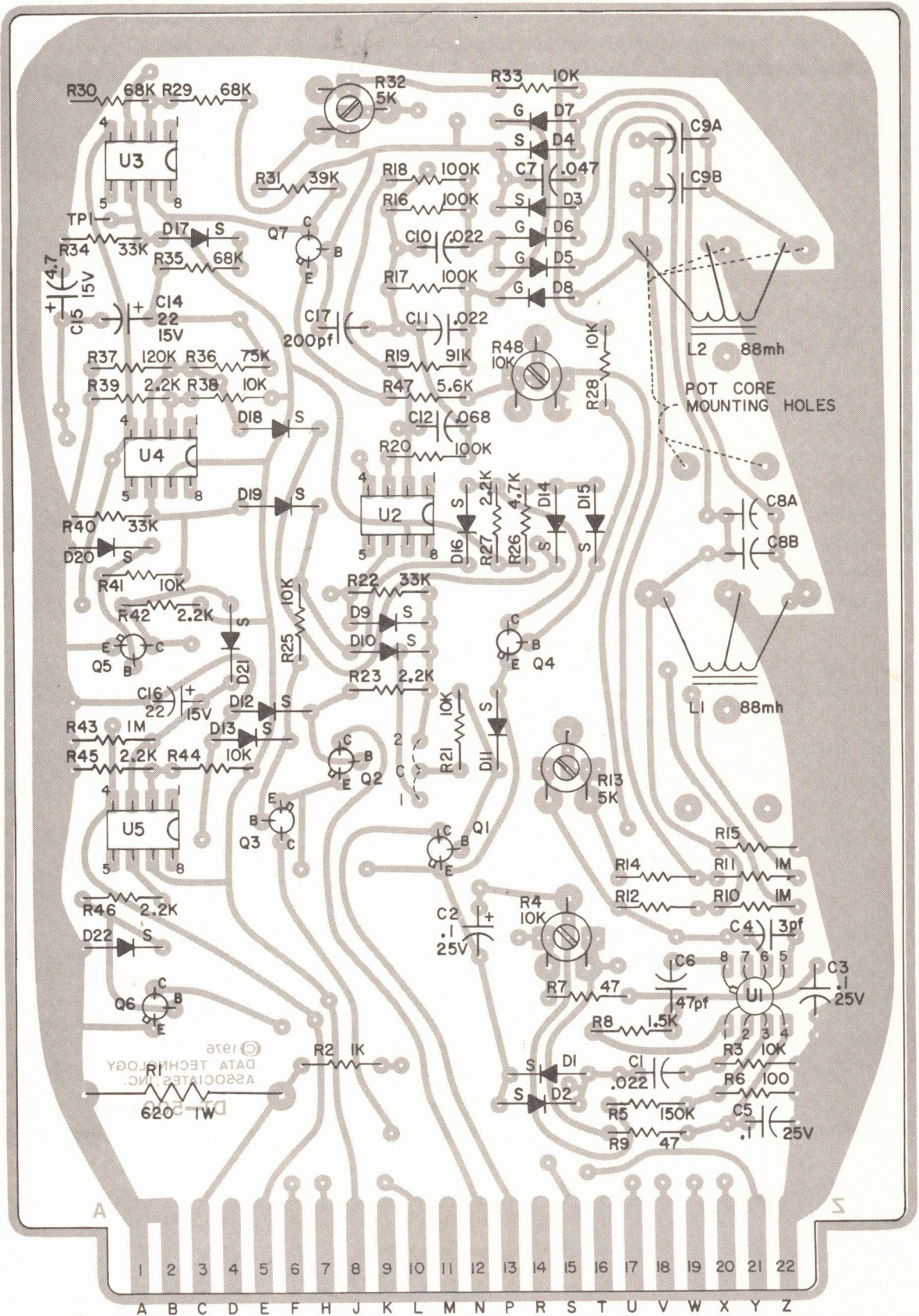
NOTE - Capacitors typically used will be 10% or 20% tolerance and a significant change in the resonant frequency will be obtained by substituting other capacitors, if available, of the same marked value. It is recommended that you pick the capacitor which provides resonance closest to the resonant frequency on the low side; i.e., right on or just below the desired resonant frequency.

Additional tuning details are provided during the specific tuning procedures listed in the following paragraphs.

3.3 FILTER TUNING PROCEDURE

Careful attention should be paid to the tuning of the DT-500 Discriminator filter circuits, as these will greatly affect the performance of the unit. A frequency counter is highly desirable for this purpose as it will significantly simplify the task of proper filter alignment.

DT-500



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- NOTES**
1. VIEW FROM COMPONENT SIDE
 2. FOIL ON COMPONENT SIDE NOT SHOWN

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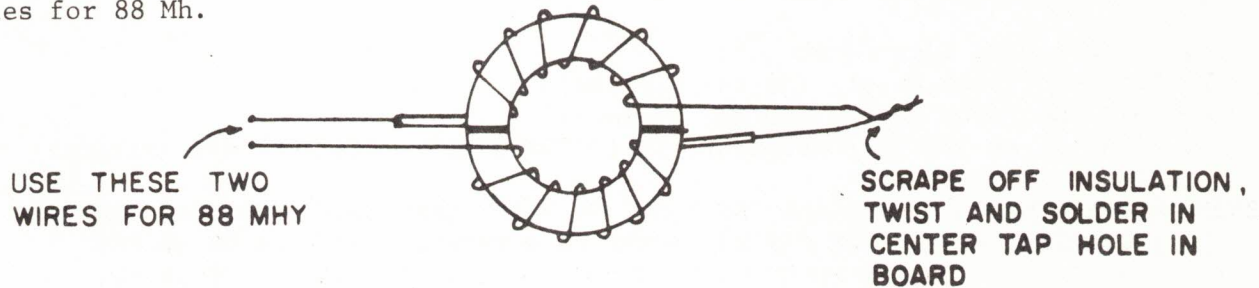
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Note - Only mylar, polystyrene, metalized polycarbonate or mica capacitors (in increasing order of preference from a stability standpoint) are recommended for use in the filter circuits.

CAUTION - WHEN USING TOROIDS ON THE DT-500 BOARD, MAKE SURE TO PLACE A PIECE OF INSULATING MATERIAL BETWEEN THE TOROID AND THE FOIL UNDERNEATH.

3.3.1 Discriminator Filter Tuning (Toroidal Inductors)

a. Refer to Figure 3-4 and connect two toroids with their windings in series for 88 Mh.



SERIES TOROID CONNECTION FOR 88 MHY

FIGURE 3-4

MARK Filter (L-1 and C-8)

b. Using the first of these toroids, connect as shown in Figure 3-3 with a .068 uf capacitor.

c. Tune this combination for 2135 Hz (10 Hz higher than the 2125 Hz MARK frequency to allow for circuit interaction when the filters are mounted on the board and for a small amount of capacitor aging).

Note - When removing turns from the Discriminator toroids, remove the same number of turns from each winding. One turn removed from both windings will raise the resonant frequency approximately 6 Hz.

CAUTION - TUNE IN SMALL STEPS, PARTICULARILY WHEN REMOVING TURNS.

d. Once tuned, refer to the component layout pictorial (Figure 3-1) and mount these components on the board.

SPACE Filter (L-2 and C-9)

e. Again refer to Figure 3-3 and connect the second toroid with a .056 uf capacitor for 170 Hz shift or a .033 uf capacitor for 850 Hz shift.

f. Repeat steps c. and d. above, tuning this combination for 2305 Hz (narrow shift) or 2985 Hz (wide shift) as applicable.

SECTION IV

CHECKOUT AND ALIGNMENT

4.0 Once the printed circuit board has been completed, including filter tuning in Section III, you are ready for initial checkout and alignment. It is not necessary to have the ultimate enclosure completed to perform the steps outlined in this Section. However, the following items are necessary:

- a. 22-Pin Card Edge Connector
- b. +12 VDC Power Supply (50 ma. minimum)
- c. -12 VDC Power Supply (50 ma. minimum)
- d. One 1/4 or 1/2 Watt Resistor, 1K to 10K Ohms (resistance not critical)

WARNING - USE CAUTION DURING ALL TESTS NOT TO SHORT CARD EDGE CONNECTOR PINS TOGETHER OR LAY THE CIRCUIT BOARD ON A METALLIC SURFACE OR OBJECT AS CIRCUIT SHORTS COULD CAUSE DAMAGE TO CIRCUIT BOARD COMPONENTS.

4.1 Checkout Procedure

Referring to Figure 4-1, temporarily connect the power supplies, audio input, tuning meter, and the above mentioned resistor to the card edge connector. Plug the circuit board into the connector using care to match the card edge pin numbers to the socket pin numbers.

The following steps will ascertain whether or not the unit is basically functional before proceeding to the alignment procedure. If problems arise, refer to the Theory of Operation and Troubleshooting sections of this documentation package for assistance in isolating the problem.

- a. Set all 4 potentiometers to the center of their available tuning range.
- b. Connect an audio oscillator capable of the MARK and SPACE frequencies (2125/2295 Hz or 2125/2975 Hz) to the audio input, Pin 3.
- c. Carefully connect the positive lead of a DC voltmeter (12 VDC full scale minimum) to Pin 12 of the socket (Q2 collector). (Insure that the test resistor was connected to this same pin during the set-up phase.) Connect the negative lead of the voltmeter to ground.
- d. Turn on the power supplies. TURN OFF IMMEDIATELY IN CASE OF SMOKE!!!
- e. With no audio input, Pin 12 should read somewhat less than 1.0 volt (0.2v to 0.9v typical depending upon transistor type).
- f. Set the audio oscillator to SPACE (2295 Hz or 2975 Hz as appropriate). A few seconds after application of the audio the voltage on Pin 12 should read approximately +12 volts.

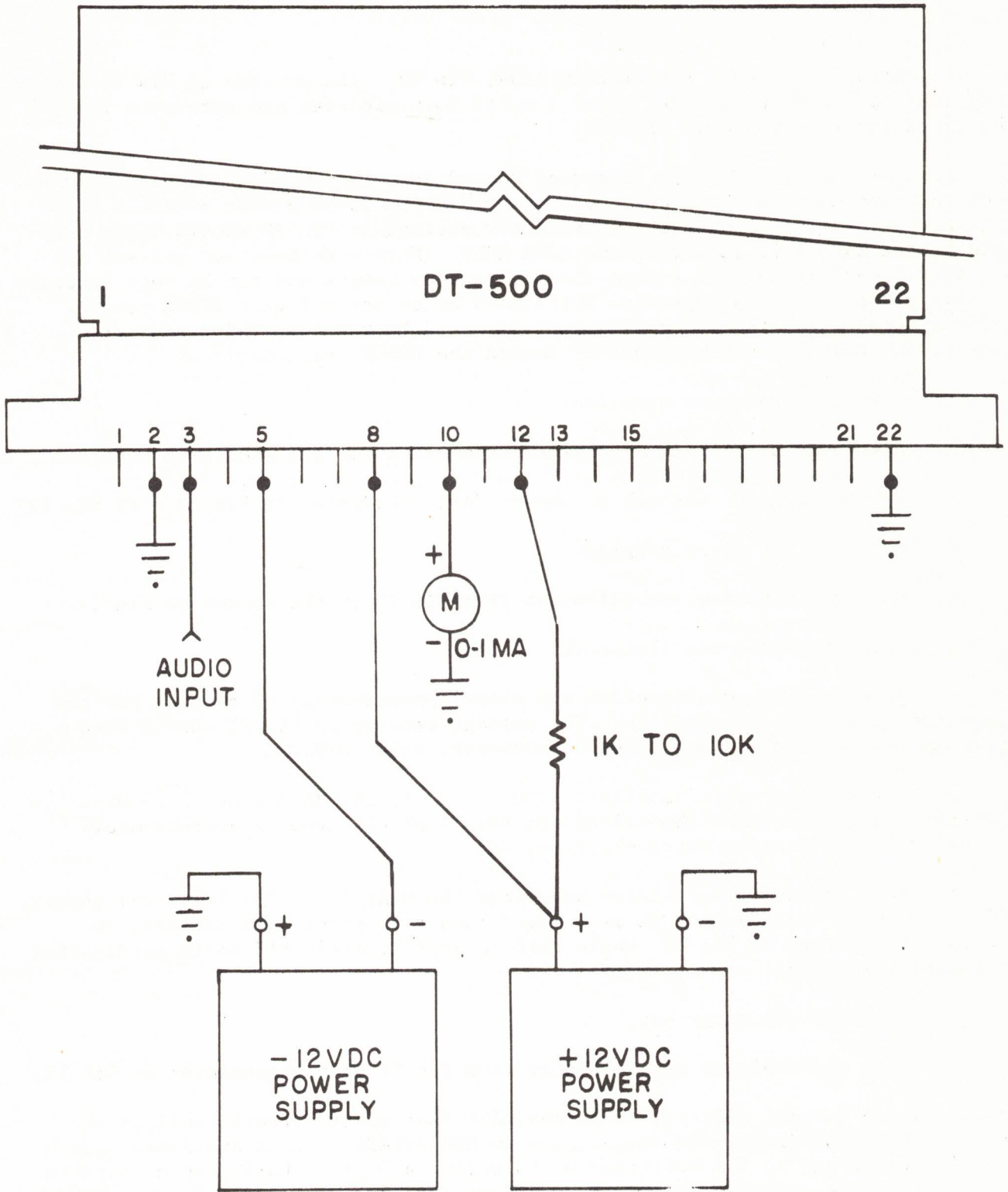


FIGURE 4-1

g. Carefully ground the Standby line, Pin 18. The voltage on Pin 12 should snap down to the MARK voltage (under 1 volt) when grounded and return to +12 VDC shortly after the ground is removed.

h. Vary the audio input frequency up and down slowly plus and minus 100 Hz. Once the frequency is moved off the SPACE frequency 30-50 Hz for a narrow shift unit or 60-80 Hz for a wide shift unit, the voltage at Pin 12 should again drop down to the MARK voltage indicating MARK HOLD. (Note - we have not yet set the autostart sensitivity pots so the above frequency ranges may not be very accurate at this point). The voltage will shift back up to the +12 volt SPACE reading a few seconds after the audio frequency is moved back within the autostart sensitivity range each time you tune toward the SPACE frequency.

i. Turn off the power supplies.

j. Move the resistor and voltmeter from Pin 12 of the socket to Pin 13.

k. Repeat steps d. through g. above. (All references to Pin 13 vice Pin 12)

l. Turn off the power supplies.

m. Move the resistor and voltmeter from Pin 13 of the socket to Pin 21.

n. Turn the audio oscillator OFF.

o. Turn on the power supplies and allow approximately 40 seconds for the autostart circuitry to stabilize. The voltage reading on Pin 21 should then be approximately +12 volts (analogous to autostart relay OFF).

p. Turn on the audio oscillator and set it to the MARK tone (2125 Hz). After 3-6 seconds of MARK the voltage on Pin 21 should drop to approximately 0.7 volts DC (indicating autostart relay ON).

q. Tune the audio oscillator away from the MARK (2125 Hz) frequency approx. 100 Hz (suggest setting 2000 Hz as a round number). After approximately 30 seconds the voltage on Pin 21 should rise to approximately +12 volts (indicating autostart relay OFF).

r. Turn off the power supplies.

s. Move the resistor and voltmeter from Pin 21 of the connector to Pin 15.

Note - Pin 15 is best referred to as the DATA FLAG as it directly follows the MARK HOLD circuit and indicates when MARK/SPACE data is available. Pin 3 corresponds to the collector of Q3 which is ON (TTL LOW) when no data is available and OFF (TTL HIGH) when data is available.

t. Turn the audio oscillator off.

u. Turn on the power supplies and allow approximately 10 seconds for the circuitry to stabilize.

v. The voltage on Pin 15 should be approximately +0.7 VDC, indicating NO DATA or NON-PRINT.

w. Turn on the audio oscillator and set the MARK frequency (2125 Hz). Approximately 3-6 seconds after setting MARK, Pin 15 should rise to approximately +12 VDC. Tune the oscillator off frequency (away from the MARK and SPACE frequencies by at least 100 Hz) or turn the oscillator off. Pin 15 should drop almost immediately to approximately +0.7 VDC.

x. Turn off the power supplies. Disconnect the voltmeter and resistor from Pin 15. Turn off the audio oscillator.

This completes the initial checkout procedure.

Note - In a few cases it may be necessary to do a preliminary alignment before the unit will respond properly to all of the above checkout procedure.

4.2 Alignment Procedure

CAUTION - Use care in placing the voltmeter test lead on the various test points and pins in the following alignment procedure as it is easy to short pins and components together causing damage.

a. Turn on the power supplies

b. Making sure that the audio oscillator is off or disconnected, ground the audio input lead (connects to Pin 3 as shown in Figure 4-1).

Note - a zero center DC voltmeter is best for the following alignment procedure but any DC voltmeter can be used as an alternate.

c. Set the positive meter lead to pin 6 of U-1 (the Limiter), (Refer to the component layout for location). Ground the negative lead of the voltmeter.

d. It will not be possible to zero the meter reading as the Limiter (U-1) output being measured at TP1 will shift rapidly from positive to negative and vice versa. The idea is to set the DC Balance Pot, R-4, as close to the crossover point as possible.

e. Unground the audio input lead, turn on the audio oscillator, and set to the MARK frequency (2125 Hz).

f. Place the positive lead of the DC voltmeter to the junction of D-3 and D-4.

g. Carefully adjust the audio oscillator for a peak on the 0-1 ma. meter. (It may be necessary to adjust the meter potentiometer (R-48) for a convenient meter reading --- 1/2 to 2/3 scale is recommended at peak).

h. Note the meter reading. The idea here is to switch between the MARK and SPACE frequencies (peaking on the 0-1 ma. meter each time), and adjust the AC Balance Pot (R-13) for equal readings on the DC voltmeter.

i. Using the positive lead of the DC voltmeter, carefully measure and record the voltage on Pin 2 of U-3.

j. Carefully tune the MARK frequency for a peak on the 0-1 ma. meter.

k. Adjust the Autostart Sensitivity Pot (R-32) so that the voltage on Pin 3 of U-3 is 1/2 volt (0.5 volt) LOWER than the voltage noted and recorded in step i. above. This procedure is equivalent but simpler than the frequency offset method described in the March 1976 Ham Radio magazine article.

Note - If this recommended autostart sensitivity setting is not in accordance with your personal tastes after you have placed the DT-500 in operation, R-32 can be adjusted to some other setting at that time.

Many of you who use the DT-500 for VHF operation may find, because of the absence of interference and noise on such frequencies, that you wish to operate the DT-500 always in the FAST AUTOSTART mode to provide for faster turn-on.

l. Turn off the power supplies.

The DT-500 is now ready for mounting in a suitable enclosure.

DT-500 RTTY DEMODULATOR

PARTS LIST

SECTION 1 - LISTING BY PART NUMBER

THIS LIST FOR P.C. CARD ONLY

RESISTORS:

R-1	620 OHM, 1 WATT, 10%	
R-2	1K OHM, 1/4 WATT, 10%	
R-3	10K OHM, 1/4 WATT, 10%	
R-4	10K OHM POTENTIOMETER, P.C. MOUNT (PIHER PT-10V)	
R-5	150K OHM, 1/4 WATT, 10%	
R-6	100 OHM, 1/4 WATT, 10%	
R-7	47 OHM, 1/4 WATT, 10%	
R-8	1.5K OHM, 1/4 WATT, 10%	
R-9	47 OHM, 1/4 WATT, 10%	
R-10	1 MEG OHM, 1/4 WATT, 10%	
R-11	1 MEG OHM, 1/4 WATT, 10%	
R-12	6.8K OHM, 1/4 WATT, 10%	(170 Shift)
	4.7K OHM, 1/4 WATT, 10%	(850 Shift)
R-13	5K OHM POTENTIOMETER, P.C. MOUNT (PIHER PT-10V)	
R-14	6.8K OHM, 1/4 WATT, 10%	(170 & 850 Shift)
R-15	100K OHM, 1/4 WATT, 10%	(170 Shift)
	33K OHM, 1/4 WATT, 10%	(850 Shift)
R-16	100K OHM, 1/4 WATT, 10%	
R-17	100K OHM, 1/4 WATT, 10%	
R-18	100K OHM, 1/4 WATT, 10%	
R-19	91K OHM, 1/4 WATT, 10%	
R-20	100K OHM, 1/4 WATT, 10%	
R-21	10K OHM, 1/4 WATT, 10%	
R-22	33K OHM, 1/4 WATT, 10%	
R-23	2.2K OHM, 1/4 WATT, 10%	
R-24	470 OHM, 1/2 WATT, 10%	(Mounted off P.C. card)
R-25	10K OHM, 1/4 WATT, 10%	
R-26	4.7K OHM, 1/4 WATT, 10%	
R-27	2.2K OHM, 1/4 WATT, 10%	
R-28	10K OHM, 1/4 WATT, 10%	
R-29	68K OHM, 1/4 WATT, 10%	
R-30	68K OHM, 1/4 WATT, 10%	
R-31	39K OHM, 1/4 WATT, 10%	
R-32	5K OHM POTENTIOMETER, P.C. MOUNT (PIHER PT-10V)	
R-33	10K OHM, 1/4 WATT, 10%	
R-34	33K OHM, 1/4 WATT, 10%	
R-35	68K OHM, 1/4 WATT, 10%	
R-36	75K OHM, 1/4 WATT, 10%	
R-37	120K OHM, 1/4 WATT, 10%	
R-38	10K OHM, 1/4 WATT, 10%	
R-39	2.2K OHM, 1/4 WATT, 10%	
R-40	33K OHM, 1/4 WATT, 10%	
R-41	10K OHM, 1/4 WATT, 10%	
R-42	2.2K OHM, 1/4 WATT, 10%	
R-43	1 MEG OHM, 1/4 WATT, 10%	
R-44	10K OHM, 1/4 WATT, 10%	
R-45	2.2K OHM, 1/4 WATT, 10%	
R-46	2.2K OHM, 1/4 WATT, 10%	
R-47	5.6K OHM, 1/4 WATT, 10%	
R-48	10K OHM POTENTIOMETER, P.C. MOUNT (PIHER PT-10V)	

CAPACITORS:

C-1 ✓	.022 UFD	25-100V MYLAR OR DISC CERAMIC
C-2	.1 UFD	DISC CERAMIC
C-3	.1 UFD	DISC CERAMIC
C-4	3 PF	DISC CERAMIC (3.3 PF Acceptable)
C-5	.1 UFD	DISC CERAMIC
C-6	47 PF	DISC CERAMIC
C-7	.047 UFD	DISC CERAMIC
C-8 ✓	.068 UFD	25-100V MYLAR OR POLYSTYRENE (170 & 850 Shift)
C-9 ✓	.056 UFD	25-100V MYLAR OR POLYSTYRENE (170 Shift)
	.033 UFD	25-100V MYLAR OR POLYSTYRENE (850 Shift)
C-10 ✓	.022 UFD	25-100V MYLAR OR DISC CERAMIC
C-11 ✓	.022 UFD	25-100V MYLAR OR DISC CERAMIC
C-12 ✓	.068 UFD	25-100V MYLAR OR DISC CERAMIC
C-13	.1 UFD	400V MYLAR (Mounted off P.C. Board)
C-14 ✓	22 UFD	15V TANTALUM ----- See Note 1
C-15 ✓	4.7 UFD	15V TANTALUM
C-16	22 UFD	15V TANTALUM ----- See Note 1
C-17	200 PF	DISC CERAMIC

DIODES:

D-1 thru D-4	Any small silicon diode, 50 PIV or higher (e.g., 1N914)
D-5 thru D-8	1N270 germanium diode
D-9 thru D-22	Any small silicon diode, 50 PIV or higher (e.g., 1N914)

D-23	Silicon rectifier, 50 PIV or higher (e.g., 1N4001, 1N4002) (Mounted across relay K-1, NOT on the P.C. board.)
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OPERATIONAL AMPLIFIERS:

U-1	709 (TO-99 Package)
U-2 thru U-5	741 (Mini-Dip Package)

TRANSISTORS:

Q-1	2N3904, 2N2222, or equiv. silicon NPN
Q-2	2N5656, MJE-340, MPS-A42, G.E. D44R4/D44R5, T.I. TIP48/49/50/63/64 or equiv. H.V. silicon NPN
Q-3 thru Q-7	2N3904, 2N2222, or equiv. silicon NPN

MISCELLANEOUS:

L-1 and L-2	88 MHY C.T. Toroids or Pot Cores
-------------	----------------------------------

Note 1 - Recommend use of 18 UF instead of 22 UF for C-14 and C-16 as these values provide a little nicer time constants for autostart turn on and turn off.

DT-500 RTTY DEMODULATOR

PARTS LIST

SECTION 2 - LISTING BY COMPONENT VALUE

FIXED RESISTORS, 1/4 WATT, 10%:

QTY	VALUE	PART NUMBER(S)
2	47	R-7, R-9
1	100	R-6
1	1K	R-2
1	1.5K	R-8
6	2.2K	R-23, R-27, R-39, R-42, R-45, R-46
2	4.7K	R-12 (850 Shift only), R-26
1	5.6K	R-47
2	6.8K	R-12 (170 Shift only), R-14 (170 & 850 Shift)
8	10K	R-3, R-21, R-25, R-28, R-33, R-38, R-41, R-44
4	33K	R-15 (850 Shift only), R-22, R-34, R-40
1	39K	R-31
3	68K	R-29, R-30, R-35
1	75K	R-36
1	91K	R-19
5	100K	R-15 (170 Shift only), R-16, R-17, R-18, R-20
1	120K	R-37
1	150K	R-5
3	1 MEG	R-10, R-11, R-43

FIXED RESISTORS, 1/2 WATT, 10%:

1	470	R-24
---	-----	------

FIXED RESISTORS, 1 WATT, 10%:

1	620	R-1
---	-----	-----

POTENTIOMETERS, PIHER MODEL PT-10V OR EQUIV. FOR P.C. MOUNTING:

2	5K	R-13, R-32
2	10K	R-4, R-48

CAPACITORS, 25-100V MYLAR OR POLYSTYRENE (170 Shift: 2125 Hz & 2295 Hz):

1	.056 UFD	C-9
1	.068 UFD	C-8

CAPACITORS, 25-100V MYLAR OR POLYSTYRENE (850 Shift: 2125 Hz & 2975 Hz):

1	.033 UFD	C-9
1	.068 UFD	C-8

CAPACITORS, 25-100V MYLAR OR DISC CERAMIC

3	.022 UFD	C-1, C-10, C-11
1	.068 UFD	C-12

CAPACITORS, DISC CERAMIC

1	3 PF	C-4 (3.3 PF Acceptable)
1	47 PF	C-6
1	200 PF	C-17
1	.047 UFD	C-7
3	.1 UFD	C-2, C-3, C-5

CAPACITORS, 400V MYLAR:

1	.1 UFD	C-13 (Mounted off P.C. board)
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CAPACITORS, 15V TANTALUM:

①	4.7 UFD	C-15
②	22 UFD	C-14, C-16 ----- See Note 1

DIODES:

17	Silicon, 50 PIV or higher, small size, 1N914 or equiv. D-1 thru D-4, D-9 thru D-22
4	1N270 Germanium D-5 thru D-8

RECTIFIERS:

1	Silicon, 50 PIV or higher, small size, 1N4001/1N4002 or equiv.
---	--

OPERATIONAL AMPLIFIERS:

1	709 (TO-99 Package)
4	741 (Mini-Dip Package)

TRANSISTORS:

6	2N3904, 2N2222 or equiv. silicon NPN Q-1, Q-3 thru Q-7
1	2N5656, MJE-340, MPS-A42, G.E. D44R4/D44R6, T.I. TIP48/49/50/63/64 or equiv. H.V. silicon NPN Q-2

MISCELLANEOUS:

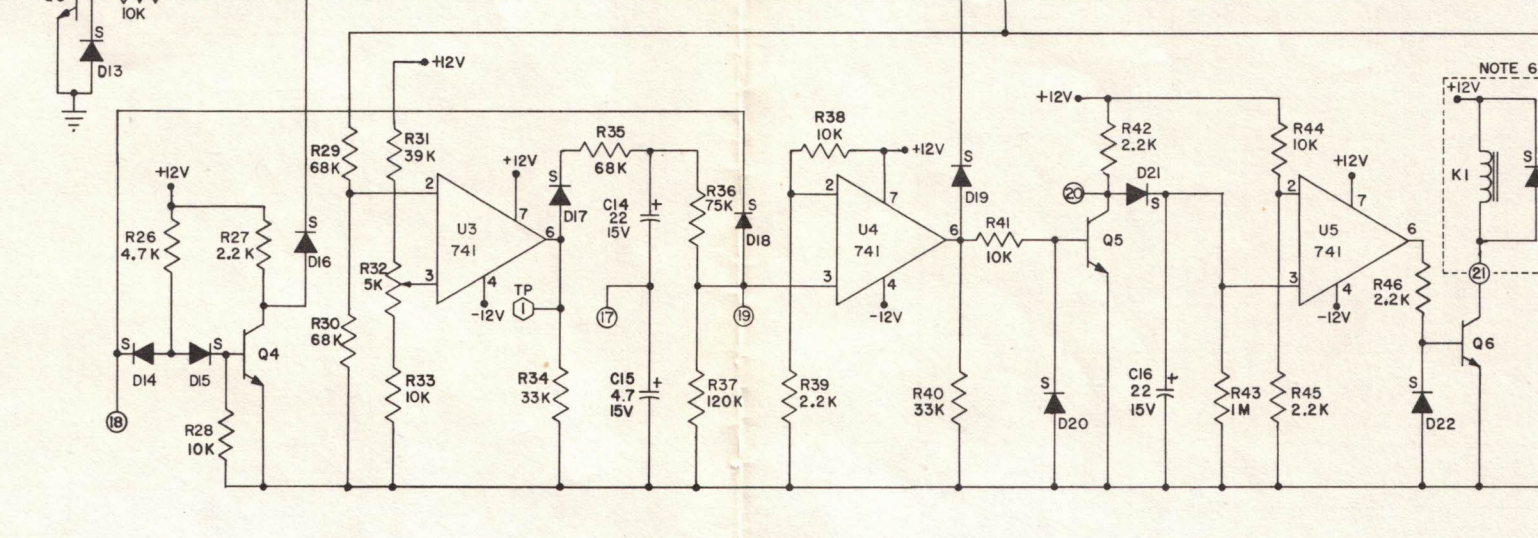
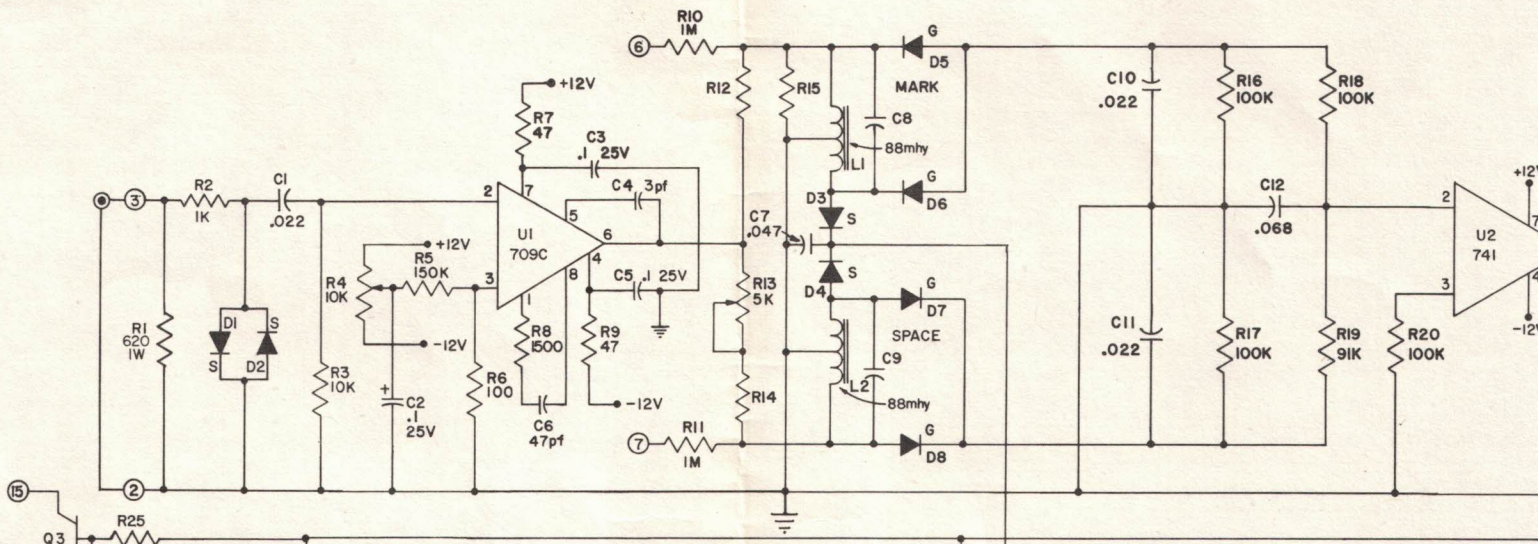
2	88 MHY C.T. Toroids or Pot Cores
1	12 VDC Relay, 10 Amp contacts, P&B KA11DG or equiv.
1	0-1 MA Meter

Note 1 - Recommend use of 18 UF instead of 22 UF for C-14 and C-16 as these values provide a little nicer time constants for autostart turn on and turn off.

LIMITER

DISCR./DETECTOR

SLICER



STANDBY

AUTOSTART

MOTOR CONTROL

NOTES

1. DIODES MARKED "G" ARE GERMANIUM IN270
2. DIODES MARKED "S" ARE SILICON 50PVP UNLESS NOTED
3. RESISTORS 1/4 WATT UNLESS NOTED
4. CAPACITORS IN MFD. UNLESS NOTED
5. TRANSISTORS/OP AMPS:
 U-1 709C
 U-2 THRU 5 741
 Q1, Q3-7 2N3904, 2N2222 OR EQUIV.
 Q2 2N5656, MJE340 OR EQUIV.
6. COMPONENTS SHOWN ENCLOSED IN DASHED LINES ARE LOCATED OFF THE BOARD.

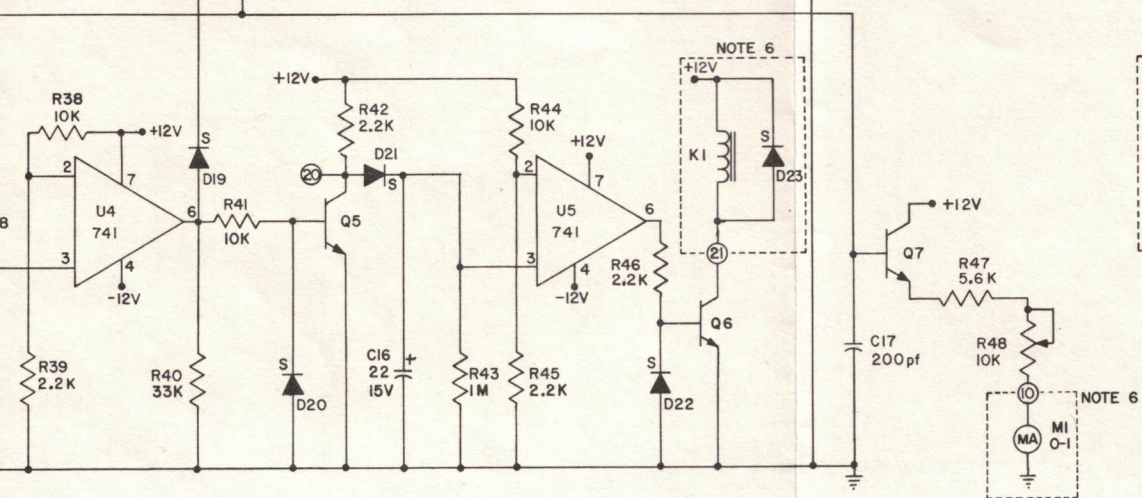
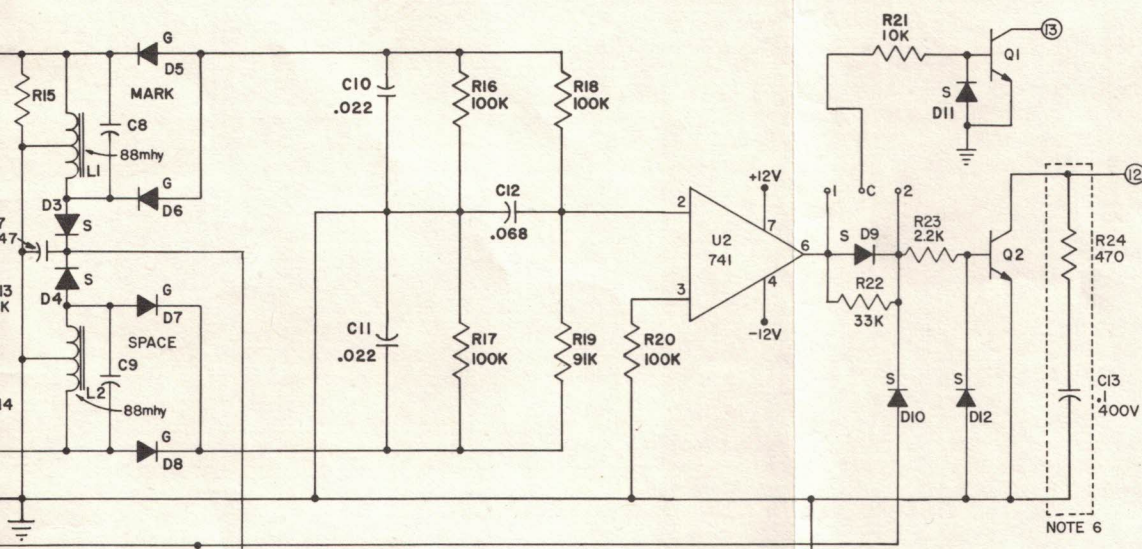
DISCRIMINATOR VALUES

	2125/2295	2125/2975
R12	6.8K	4.7K
R14	6.8K	6.8K
R15	100K	33K
C8	.068	.068
C9	.056	.033

DISCR./DETECTOR

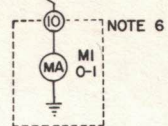
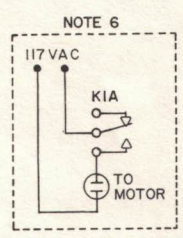
SLICER

KEYER



MOTOR CONTROL

TUNING METER



VALUES

75

MARCH 15, 1976

DT-500
TELETYPE DEMODULATOR



DATA TECHNOLOGY ASSOCIATES, INC.
P.O. BOX 431912
MIAMI, FLORIDA 33143