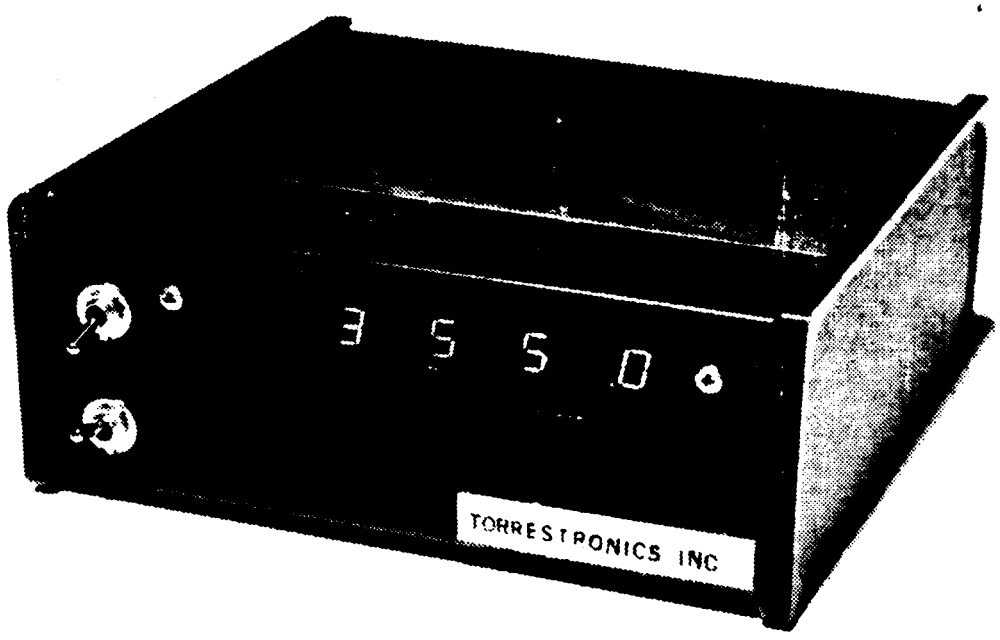
PRICE: $5.00

TORRESTRONICS, INC.

UNIVERSAL DIGITAL FREQUENCY READOUT



ASSEMBLY AND OPERATING MANUAL FOR THE TK-1

TORRESTRONICS, INC.
4850 Hollywreath Court
Dayton, Ohio 45424

INTRODUCTION:

Congratulations! You are now the proud owner of a Universal Digital Frequency Readout unit. This unit was specially designed to give you many years of trouble-free service; no cuts in the quality of components were made, and the power supply is rated for twice the load of the TK-1. If your unit is in Kit form, please follow the instructions very carefully both for the assembly work and for operating your unit.

The printed circuit boards used in our products are of the highest possible quality; except for the oscillator board, the main logic board and the display board have plated through holes. The boards(all) are then reflowed with solder; such action makes soldering to the board a pleasure since the solder flows very easy. The boards are 1/16 inch thick and made of FR4(epoxy glass, similar to the Military grade of G-10). Paper-based boards were not used because they warp under high humidity conditions.

If you purchased the WTK-1, wired and tested version of the TK-1, your unit was calibrated at the factory by a high caliber standard. Mating the unit to any receiver or transceiver should be done using RF type shielded cable(RG-174 or similar) since in some receivers, frequencies up to 40 MHZ. are transmitted through such cable. DO NOT use audio/microphone cable normally available at different Electronic stores for conneoting speakers or similar items; this type of cable has a very high capacitance thus at high frequencies represents a short for RF signals. Another side effect, if you use audio cable is higher susceptibility for picking up stray R.F. from your transmitter or linear amplifier.

The Digital Frequency Readout unit is intended to augment your present receiver or transceiver; it is not going to give you a more stable receiver. With the readout, you should be able to see or appreciate the present accuracy of the receiver; you will also be able to tune more accurately since most receivers do not have 100 HZ. resolution dials.

We have tried to give you in this manual most of the information available for this product; some of it will be of your interest, and some will help you out in case of difficulties or troubleshooting. If for any reason, you do not find the answer to your problem in this manual, please let us know and we will try to give you all the help needed to solve your problem. These units are fabricated by Hams for fellow Hams so your interests are well represented. Enjoy it.

Al. Torres, KP4AQI
President

REVISION 4-SEPT 83

PARTS LIST:

The following items are the parts/components used in the TK-1 unit. Parts marked * are critical components and should not be replaced with equivalent or similar parts.

R-01	2.0 Kohms	R-14	10 Ohms	D-01	1N4148 diode(1-32)
R-02	15 Kohms	R-15	10 Ohms	DPL1	MAN 72 Display
R-03	22 Kohms	R-16	10 Ohms	DPL2	MAN 72
R-04	510 Ohms			DPL3	MAN 72
R-05	1.0 Kohms			DPL4	MAN 52 or MAN 82
R-06	2.0 Kohms			FWB	50 PIV, 1 A. Bridge Rect.
R-07	10 Ohms			RG	LM-309K regulator(5 VDC)
R-08	470 Ohms			T-01	12.6 VAC @ 1.2 A transformer
R-09	22 Ohms			F-01	½ A. fuse.
R-10	2.0 Kohms			S-01	SPDT Toggle switch S-03
R-11	1.0 Kohms			S-02	SPDT Toggle switch
R-12	1.0 Kohms			XTAL	2.4576 MHZ. Crystal
R-13	10 Ohms			DIP1	8 Pos. DIP switch
C-01	180 pf. Silver Mica, 500 VDC.			DIP2	8 Pos. DIP switch
C-02	0.01 uf. disc. cap.			DIP3	8 Pos. DIP switch
C-03	100 pf.disc. cap.(*)			DIP4	8 Pos. DIP switch
C-04	47 pf. disc. cap.			Phono Sockets(2)	
C-05	6-40 pf. ceramic trimmer cap.			L-type Connectors(4)	
C-06	470 or 1000 uf. cap. 25 VDC.			PC Boards(3)	
C-07	4.7 to 25 uf. elec. cap.			Window Material, Gray P-2060	
C-08	47 pf. cap. disc.			DIP Sockets, 14 Pins (8)	
C-09	0.01 uf. disc. cap.			DIP Sockets, 16 Pins (5)	
Q-1	2N918 RF transistor, metal.			Terminal Stand, 5 lugs	
Q-2	2N918 RF transistor, metal			Line Cord and Retainer	
Q-3	2N3904 Switch. trans., plax.			Fuse Holder	
U-01	CD 4060 Counter, RCA only(*)			TO-3 Socket	
U-02	74LS00 only LS or L type (*)			Ten-Tec JW-6 Encl.	
U-03	74LS93 counter			L-Brackets(2); 4-40 X 1/4" (4)	
U-04	74LS190 counter			4 X 40 X 1" (2)	
U-05	74LS190 counter			4 X 40 X 1½"	
U-06	74LS190 counter			4 X 40 X ½"	
U-07	74LS190 counter			4 X 40 Nuts(4)	
U-08	9374 LED dec., driv. Latch.			6 X 32 X ¾"(3)	
U-09	9374			6 X 32 X ½"	
U-10	9374			6 X 32 Nuts(4)	
U-11	9374			6 X 1/2 Sheet metal	
U-12	74LS00 gates			Internal Washers(10)	
U-13	74LS93 counter				
Wire, Cable(2 Conductor) 24"				1/2" Spacers(2)	
Instruction Manual				1/4" Spacers(2)	
Mating Instructions(WTK-1,TK-1 only)				5/8" Spacer	

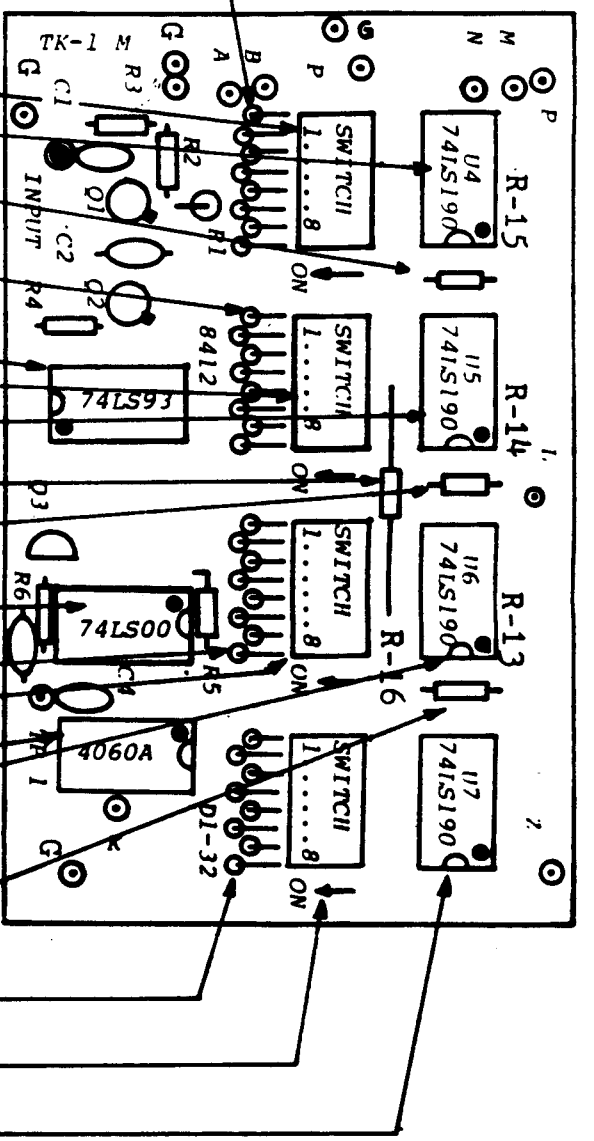
Check to make sure all these components are in your Kit(TK-1). If missing components, write to Torrestronics identifying omitted part(s). The MAN 72 LED Displays come in a package of three(3); these devices are matched for uniform intensity.

Not supplied: Solder, tools and small pieces of hook-up wire. Not supplied also mating RF shielded cable to connect the Readout to your receiver or transceiver.

ASSEMBLY OF THE MAIN BOARD

Notes: 1. When installing diodes to the board(D1 to D32), position the the cathode end as shown in Figure 1. The cathode end is marked with a black band or a wide color band.
2. When installing DIP 8 Position switches, make sure that the "ON" marking with the arrow is facing toward the diodes.
3. Install DIP sockets so that the notched or dotted end are as shown on the board layout.

( ) Connect eight(8) diodes(1N4148).
( ) Install one DIP switch.
( ) Connect a 16 Pins DIP socket.
( ) 10 ohms resistor(Brown-Black-Black).
( ) Eight(8) diodes(1N4148).
( ) 14 Pins DIP socket.
( ) DIP switch.
( ) 16 Pins DIP socket.
( ) 10 ohms resistor(Brown-Black-Black).
( ) 10 ohms resistor.
( ) 14 Pins DIP socket.
( ) Eight(8) diodes(1N4148).
( ) DIP switch.
( ) 16 Pins DIP socket.
( ) 16 Pins DIP socket.
( ) 10 ohms resistor(Brown-Black-Black).
( ) Eight(8) diodes(1N4148).
( ) DIP switch.
( ) 16 Pins DIP socket.



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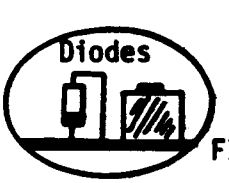


FIG 1

ASSEMBLY OF THE MAIN BOARD

( ) Cut a 6" length of the 2 conductor cable. Connect the red to M, black to N on the foil side of the board.

( ) 22Kohm resistor(Red-Red-Orange).

( ) 15Kohm resistor(Brown-Green-Orange).

( ) 180 pf. Silver mica capacitor.

( ) 2N918 Transistor(position tab as shown).

( ) 2 Kohm resistor(Red-Black-Red).

( ) 0.01 uf. disc. cap.(labeled "103").

( ) 2N918 Transistor.

( ) 510 ohms resistor(Green-Brown-Brown).

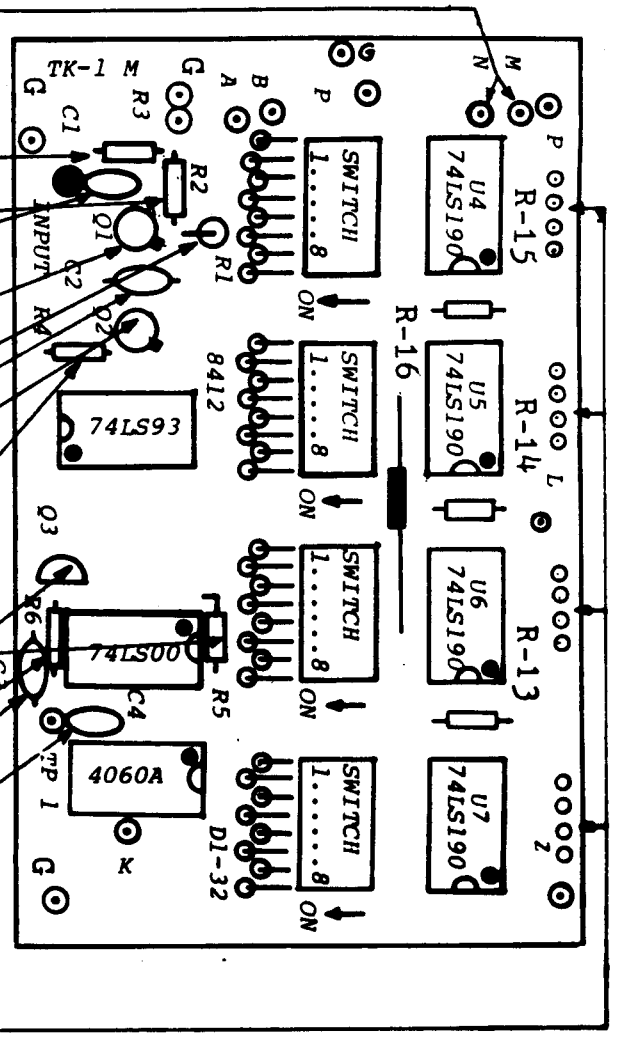
( ) 1 Kohms resistor(Brown-Black-Red).

( ) 2N3904 Transistor(position Flat part as shown).

( ) 2 Kohms resistor(Red-Black-Red).

( ) 100 pf disc. capacitor.

( ) 47 pf. disc. capacitor.



( ) L-type connectors(connectors are mounted on the non-component side of the board, see Figure 2).

( ) Cut the supplied wire into one 8" length, one 5" length, and one 4" length. Strip 3/4" of the outer insulation from each end and strip 1/4" from each lead.

( ) Connect the 8" long wire to the non-component side of the board, Red to A and black to B.

( ) Connect the 5" long wire to the non-component side of the board, Red to P, and Black to G.

( ) Connect the 4" long wire to the non-component side of the board, Red to input(black dot) and Black to G.

( ) Install all ICs; be sure to position the notched or dotted part as shown.

( ) Temporary set aside this board.

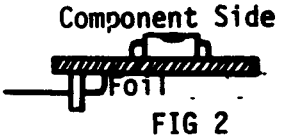


FIG 2

ASSEMBLY OF THE OSCILLATOR BOARD

Note: Some of the components on this board are extremely fragile; please handle such parts as the Crystal and the Ceramic Trimmer capacitor with care.

( ) 10 ohms resistor(Brown-Black-Black).

( ) Test point ; 10 ohm resistor vertical with loop.

( ) 3" wire from the foil side(#).

( ) 22 ohms resistor(Red-Red-Black).

( ) 14 Pins DIP socket.

( ) 4" RF shielded cable(coax, RG-174); center conductor to K and shield to border ground.

( ) 2Kohms resistor(Red-Black-Red).

( ) 0.01 uf. disc. capacitor("103").

( ) 47 pf. disc. capacitor.

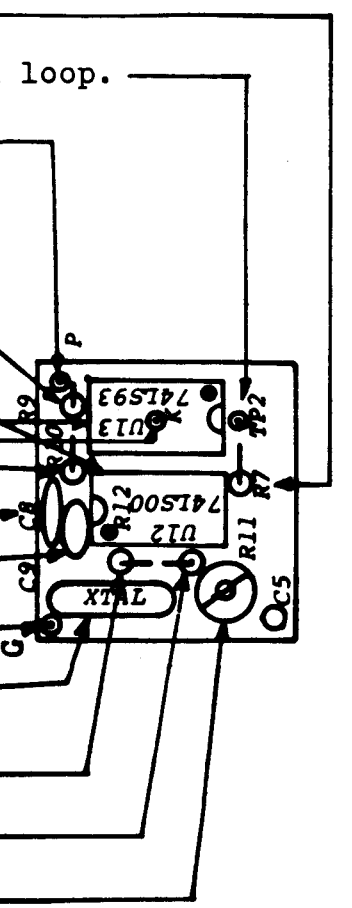
( ) 2" wire from foil side(#).

( ) Crystal; 2.4576 MHZ.

( ) 1 Kohms resistor(Brown-Black-Red).

( ) 1 Kohms resistor(Brown-Black-Red).

( ) 6-40 pf. ceramic trimmer capacitor.



( ) Install all Integrated circuits; be sure to position notched or dotted end as shown.

( ) Temporarily set this board aside.

(#) Indicates that such item is not supplied with the TK-1 Kit.

ASSEMBLY OF THE DISPLAY BOARD

Note: Display drivers(9374) are mounted directly to the Board; these integrated circuits dissipate some power through the printed circuit foil. Do not mount with DIP sockets.

( ) 9374 Display Driver; make sure to follow correct orientation...notched end should be as shown.

( ) Jumper(#); any wire.

( ) 6" wire from foil side(#).

( ) 470 ohm resistor(yellow-violet-brown) Should be mounted from the foil side.

( ) 14 Pins DIP socket.

( ) 2" wire from the foil side(#).

( ) 14 Pins DIP socket.

( ) 9374 Display Driver.

( ) 14 Pins DIP socket.

( ) 2" wire from the foil side(#).

( ) 9374 Display Driver.

( ) 14 Pins DIP socket.

( ) 9374 Display Driver.

( ) 2" wire from the foil side(#).

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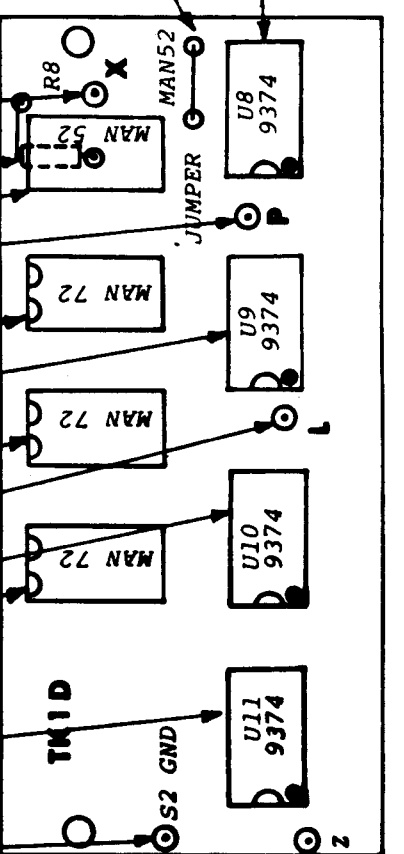


( ) Insert the MAN 72(Green) display into the 100 HZ. position digit; the socket under which the 470 ohm resistor was mounted. The Decimal point is on the bottom left of the digit when properly oriented.

( ) Insert the MAN 72(Red) Displays into the remaining sockets; the decimal point is on the bottom left of the digit when properly oriented.

Substitution: The MAN 52(Green) displays are sometimes substituted with MAN 82(Yellow) displays. The difference between both LED displays is very minimal since the Green display is a green-yellowish color and the Yellow display is a yellow-green in color; electrically they are identical.

(#) Indicates such item is not supplied with the Kit(TK-1).

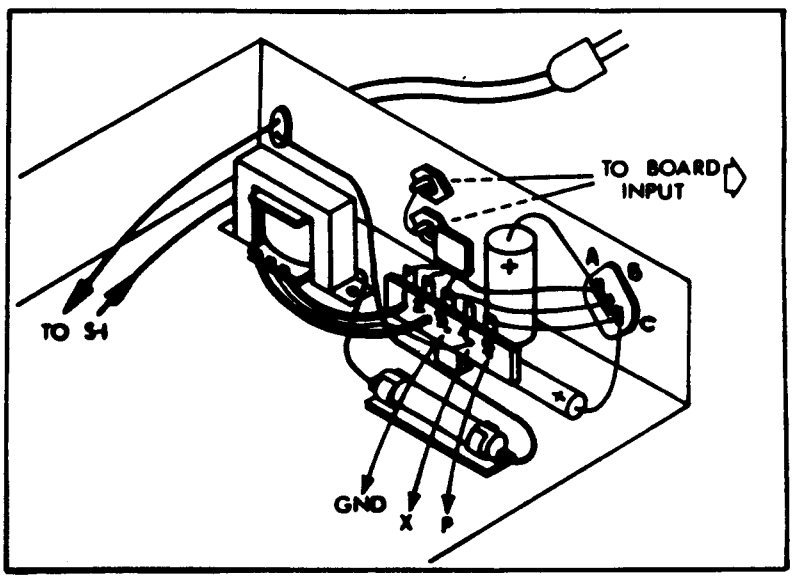
ASSEMBLY OF THE POWER SUPPLY

Notes: 1. When mounting mechanical components to the chassis, please be careful not to scratch the outside of the enclosure.
2. Pay close attention to the wiring and soldering of items associated with the primary voltage levels(105-125 VAC). Make sure such connections are not shorted to chassis.
3. The LM-309K regulator is replaceable with an LM-340-5K

( ) Mount two(2) phono sockets to the rear of the chassis, plain washer on the outside of the enclosure. Make sure that you tilt up the ground lug.

( ) Mount two(2) toggle switches to the front of the chassis. Note that you must remove the alignment tit from the large washer and place on the outside of the chassis under the front nut. Use the rear nut and washer to adjust the switch for a flush front look.

( ) Attach jumper wire connecting the phono sockets in parallel; ground to ground and center to center.



( ) Prewire the transformer by attaching an 8" wire to one side of the transformer primary(only two lugs on this side) and a 5" wire to the other primary lug. The 8" wire is connected to the lug facing the zip cord input power wires.

( ) Connect to the transformer secondary lugs(three on this side), three(3) 4 1/2" wires. Be sure to bend all transformer lugs up and in toward the transformer winding.

( ) Using two(2) 6-32 X 1/4" screws, mount transformer to the enclosure, with the secondary winding facing the front of the enclosure(see pictorial drawing).

( ) Mount the 5 lug terminal stand using a 6-32 X 1/4" screw. Place terminal stand to the front side of the screw, away from the inside back panel(see pictorial drawing).

( ) Mount transistor socket(TO-3) and the LM-309K regulator to the rear panel using two(2) 6 X 1/2" sheet metal screws. No silicon or conductive grease is necessary.

( ) Attach center wire from the transformer secondary to lug 4 of the 5 lug terminal stand. Count from left to right with the transformer being on the left.

POWER SUPPLY ASSEMBLY
Continued from Previous page.

( ) Connect the other two secondary wires to terminals 1 and 2 of the terminal stand(Again count from left to right). Do not solder these wires to the terminal stand.

( ) Mount a 25 uf. capacitor(C-7) between terminals 3 and 5. The negative(-) of the capacitor to lug 3 and the positive(+) is passed through terminal 5 and looped up to point "C" on the transistor socket(you can also take the positive lead of the capacitor and go to point "C" on the transistor socket and then connect to lug 5, thus reversing the order). Solder connections to lug 5 and point "C".

( ) Mount the 470 uf to 1000 uf electrolytic capacitor(C-6) between terminal lug 3 and point "A" on the transistor socket. Slip the negative capacitor lead through lug 3 and pass it up to point "B" on the transistor socket. Align capacitor vertically behind lug 3 against rear of the enclosure and form the positive lead so that it is below the top of the enclosure and solder to point "A" on the transistor socket.

( ) Mount FWB rectifier. Form positive lead around to the back of the bridge and along the back so that it projects to the right as viewed from the front of the enclosure. Attach AC inputs of the bridge(center two leads) to the terminal stand, lug 1 and 2 respectively and the negative bridge lead to lug 3. The positive bridge lead is connected to point "A" on the transistor socket. Solder all connecting and all lugs on the terminal stand.

( ) Mount fuse holder using a 6-32 X 3/8 screw.

( ) Using the 5" lead attached to the primary of the transformer, connect it to the fuse holder. Use the fuse holder lug facing the transformer(see pictorial drawing).

( ) Connect the 8" wire from the primary(T-1) to the lower lug of the bottom switch on the front panel and solder.

( ) Measure 7" from the end of the line cord and attach a line cord retainer and mount to the chassis.

( ) Separate the line cord inside the chassis and connect one wire to the lower switch on the front panel; use the center lug and solder. The other wire from the line cord is connected to the right side of the fuse holder and solder.

( ) Check all wiring and solder joints; double check.

( ) Insert fuse and plug to 120 VAC. With the power switch in the on position, measure using any voltmeter approximately 5 to 7 VDC between lug 3 and 4 and 5 VDC between lug 3 and 5. Voltage on lug 4 could be up to 9 VDC depending on the voltmeter(this is unfiltered full wave DC).

( ) Power supply is complete.

FINAL ASSEMBLY

( ) Connect the Display Board to the Main Board by soldering the L-type connectors. Both boards should be touching.
( ) Connect the wire from "P" hole on the display board to the "P" hole on the Main Board. This wire was soldered to the Display on the previous assembly.
( ) Connect the "Z" wire of the Display Board to the "Z" hole of the Main Board.
( ) Connect the "L" wire of the Display Board to the "L" hole of the Main Board.
( ) The remainder wire connected to "X" will be used at a later step.

( ) Connect the Oscillator Board to the Main Board. This board will be mounted to the Main Board using spacers above the Main Board; the Oscillator Board will be located on the side of the Main Board facing the fuse block(corner hole on Main Board).
( ) Connect the shielded cable, center conductor to hole marked "K" on the Main Board. Connect the shield to the hole marked "G" on the Main Board.
( ) Connect the 2" wire from "G" on the Oscillator Board to the hole marked "G" on the Main Board. This is a double hole located adjacent to the Main Board marking(TK-1 M).
( ) The 3" wire connected to "P" in the Oscillator Board will be connected at a later step.

( ) Slide the three boards inside the enclosure.
( ) Using 4 X 40 X 1" screws, 1/2" spacers, internal washers and 4-40 nuts, mount the Display Board to the chassis. The Window is mounted between the inside of the enclosure front panel and the spacers. Sequentially, the screw through the front chassis, the window, the spacer, the Display Board, the internal washer and the 4-40 nut.
( ) Using a 4-40 X 1/2" screw, a 1/4" spacer, an internal washer and a 4-40 nut, mount the Main Board to the chassis. Use the corner of the Main Board located to the transformer. Sequentially, the screw through the bottom of the chassis, the spacer, the Main Board, the washer and the nut.
( ) Mount the Oscillator Board using a 4-40 X 1-1/4" screw, 1/4" spacers, 3/8" spacer and a 4-40 nut. Sequentially, the screw through the bottom of the chassis, the 1/4" spacer, the Main Board, the 3/8" spacer, the 1/4" spacer, the Oscillator Board and the nut. The 3/8" spacer and 1/4" spacer combination is sometimes replaced with a 5/8" spacer. Make sure that the nut on top of the Oscillator Board is not touching the C-5 trimmer otherwise the oscillator will not oscillate. Double check.
( ) Connect the Red of the two conducted 8" cable to the bottom lug of the Top toggle switch(controling F_A or F_B). Connect the Black wire to the top lug of the same switch. The center lug of the switch is connected to the point marked "S2 GND" on the Display Board. This could be a bare piece of wire, about 1 to 2 inches in length.
( ) Connect the wire coming from hole "X" on the Display Board to the terminal stand, lug 4

( ) Connect the two conductor cable, Red to lug 5 of the terminal stand and Black to lug 3. This cable is connected to points marked "P" and "G" on the Main Board.
( ) Connect the input wires from the Main Board to the phono sockets. Note that the two phono sockets are connected in parallel.

( ) Connect the wire marked "P" from the Oscillator Board(#) 3" in length to lug 5 of the terminal stand.
( ) Perform the following tests:

- ( ) Set all the DIP switches to the "ON" position.
- ( ) Connect the unit to the 120 VAC source.
- ( ) Turn power switch to the "ON" position.
- ( ) The Display should indicate all zeros (000.0). If not check for cold solder joints between the Display Board and the Main Board.
- ( ) Turn the Power switch to the "OFF" position; now go to "ON" position and make sure that you get all zeros. If not, the oscillator is not working; refer to the section about trouble shooting.
- ( ) Any oscillations on the Display indicates that capacitor C-3 is out of tolerance provided that an RCA CD 4060 was used; if not then you must use a greater capacitive value for C-3. NEVER make C-3 greater than 150 pf.

( ) Mount a toggle switch to the back panel by first cutting the tit of the alignment washer. The alignment washer goes on the outside of the chassis. Solder the wires(red and black) coming from the main board, M & N to the bottom and center lug. Order of color is not important.

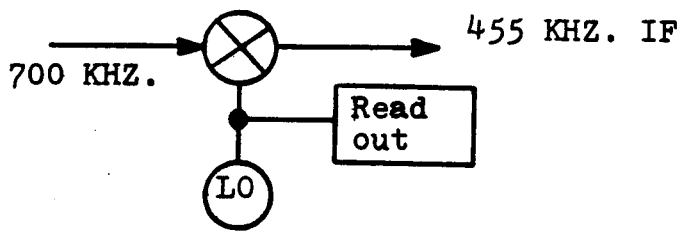
( ) The lid to the chassis is assembled using the L brackets. Use a 4-40 x 1/4 screw, an internal lock washer and a 4-40 nut to mount this bracket to the chassis. Screw is inserted from the bottom or outside of the chassis. Make sure the bracket is flush with the chassis border. You must mount two of these brackets; do not use the threaded side of the bracket against the chassis. The lid is mounted with two 4-40 x 1/4 screws to the threaded part of the L bracket.

( ) The TK-1 is now fully assembled; refer to the calibration procedure located on page 18 of this manual. Relax, so far so good!

OPERATING PRINCIPLES

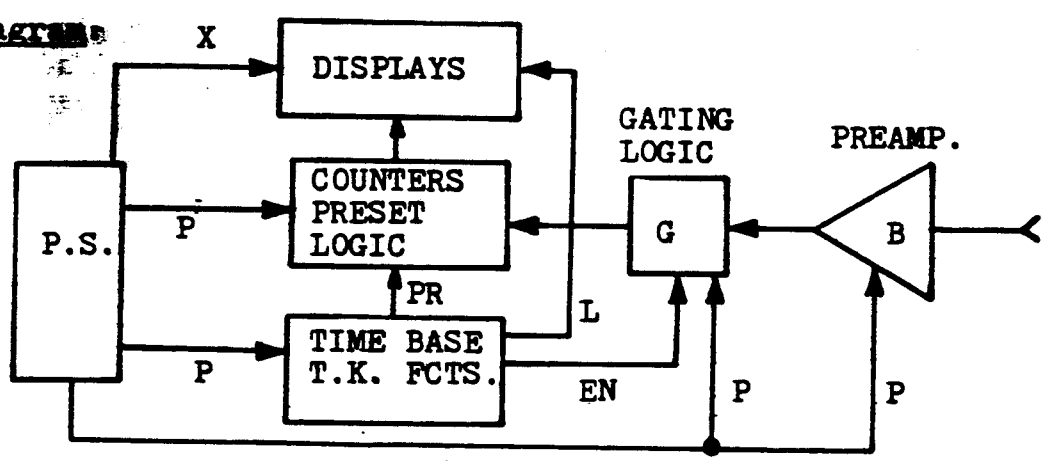
The Readout is designed to operate with any receiver or transceiver IF or Oscillator frequency between 100 KHZ. and 50 MHZ. with a particular sensitivity given for that operating frequency range. Outside the limits, the unit will operate but the given sensitivity will be degraded proportionally.
The concept of being able to program this unit consists of starting the Readout count, in most cases, at numbers other than zero(all frequency counters start their count at zero). By programming the initial count point you can essentially do subtraction or addition, which can be related to your heterodyne. Example: If your input to a heterodyne receiver is 700 KHZ(like WLW Cincinnati), and your receiver IF is fixed at 455 KHZ., then it is obvious that your Local Oscillator(LO) should be:

700 KHZ. minus 455 KHZ. = 245 KHZ.(LO)
700 KHZ. plus 455 KHZ. = 1155 KHZ. (LO)



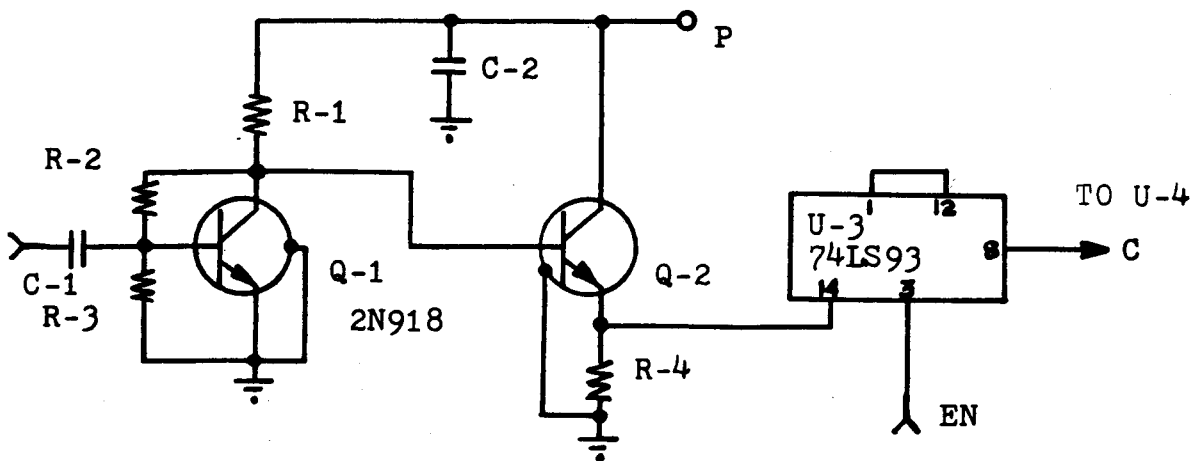
If you were to use a regular frequency counter to read your LO, the displayed number would not correspond to the dial frequency. But suppose that on the above example we start our count at 545 instead of zero, then after counting 1155 KHZ. we would have 1700.0 KHZ. but since the Readout(TK-1) drops the megahertz reading, the display will show 700.0 KHZ. which is the input frequency and the dial frequency. So by starting our count at the compliment of the IF(455 KHZ.) which is 545.0 we can display the right input frequency. Simple? You bet; no mixing, no additional heterodynes, no multi-cable connections to your receiver.
The only limitation of this concept is that the oscillator(LO) or variable IF must be a linear relationship of the incoming frequency and that such oscillator should not have a tuning range greater than 1 MHZ. It doesn't make any difference where it is in the frequency domain as long as it is less or equal to 1 MHZ. wide. This simple concept is applicable to any super heterodyne receiver/ transceiver type(98% of all receivers are of this type).

Block Diagram



Preamplifier/Buffer:

The Preamp to the TK-1 is a two transistor circuit providing gain and isolation, with proper matching between the input signal and the first TTL counter input(74LS93). The configuration is a common emitter amplifier succeeded by a simple emitter follower giving a pair gain of 25 to 30 DB. The transistors used are NPN type 2N918 with Gain-Bandwidth products of about 600 MHZ. The sensitivity of this preamp. when used with the other components of the TK-1 is better than 25 mV-RMS. at 50 MHZ.; at 4.3 MHZ. the sensitivity is 5 mV-RMS. Input impedance to the circuit is approximately 35 Kohms capacitive coupled. Dynamic range at 4.3 MHZ. is 1000:1 (3.0 V-pp) and at 50 MHZ. it is 300:1(500 mV-pp). The configuration of the circuit is shown below with the Gating logic(first counter).



PREAMP/BUFFER INPUT CIRCUIT & GATING LOGIC

Gating Logic(Enable Control):

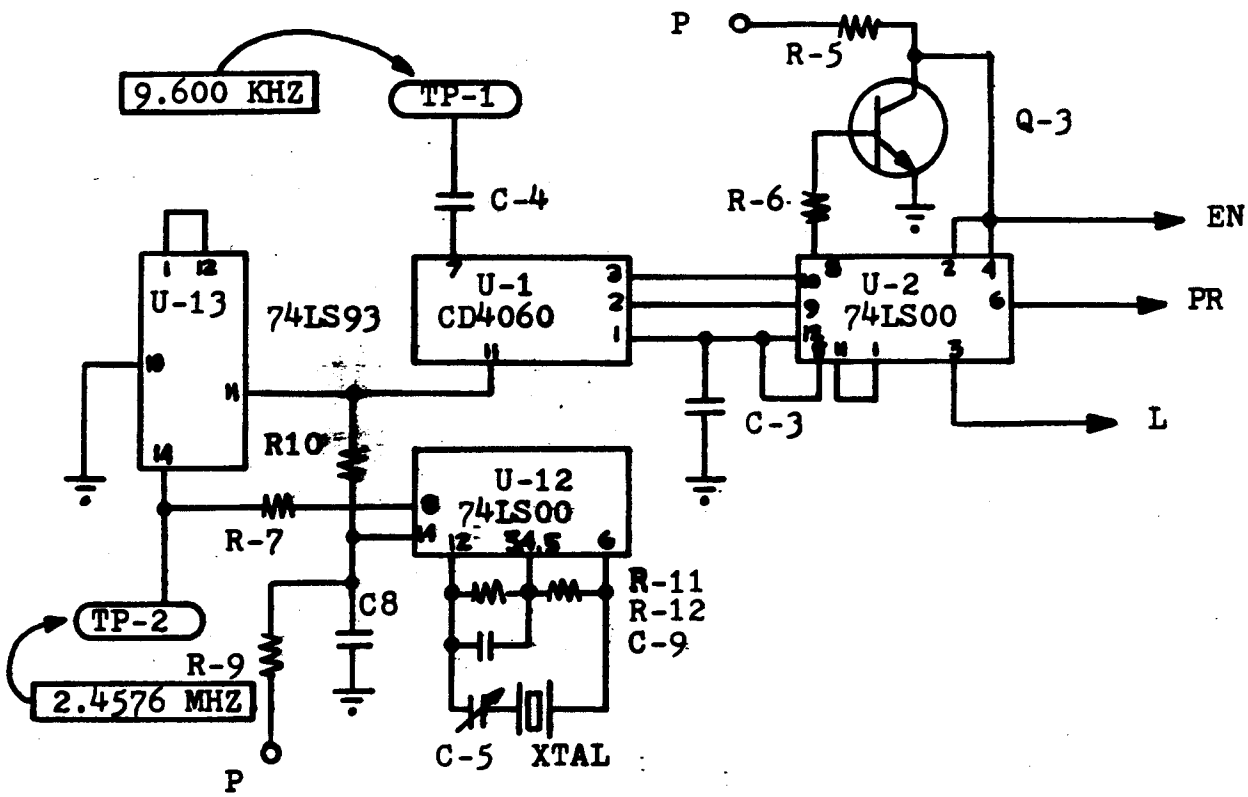
The Gating Logic consists of a pre-divider, 74LS93(U3), which is used as a divide by 8 of the input frequency. This pre-divider and gate is used to reduce last digit flicker(100 HZ. digit). Usually one finds a divide by 10 in other designs however any divider starting with a divide by 2 will reduce last digit flicker proportionally. In our case and because of the Time Base selected, a divide by 8 was used.

Time Base and Time Keeping Functions:

The Time Base consists of an IC-Quartz Crystal Oscillator, a divide by 16 IC (U-13) both in Low Power Schottky TTL, a divide by $_2$14 counter (U-1) C-Mos IC. Thus the crystal frequency is divided by a total of 2 to the 18 or 262,144.
To prepare the three Time Keeping Functions required for the operation of the TK-1, that is, preset(PR), count(EN) and latch(L) another IC is required. The signals generated by U-1 are given to a 74LS00 (U-2), which are 2^{12}, 2^{13} and 2^{14}; U-2 then generates a 3:4 counting duty cycle and the crystal frequency is computed by the following equation:

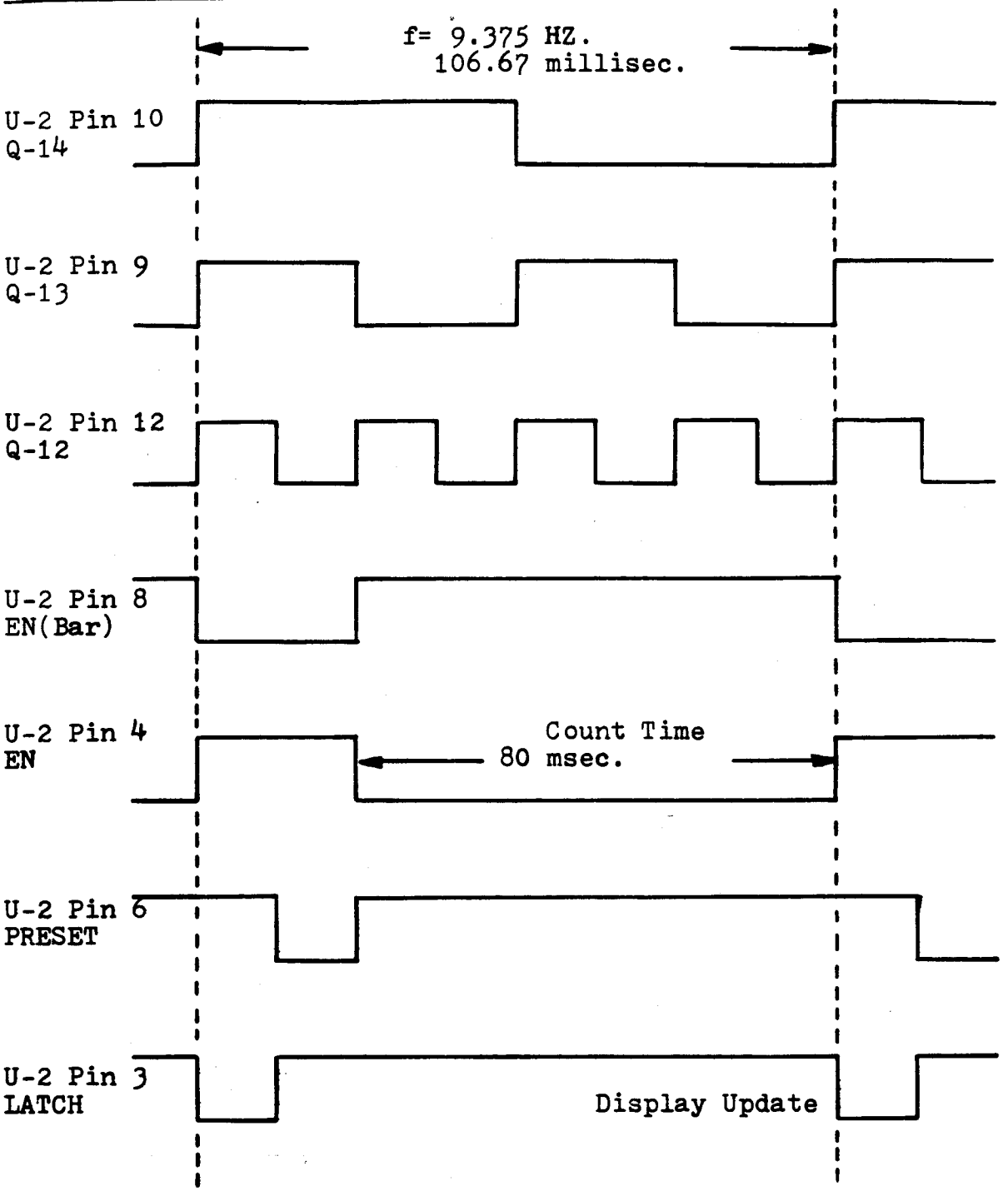
$$F_{xtal} = 1/n(3/4)(100)(2^{18})$$

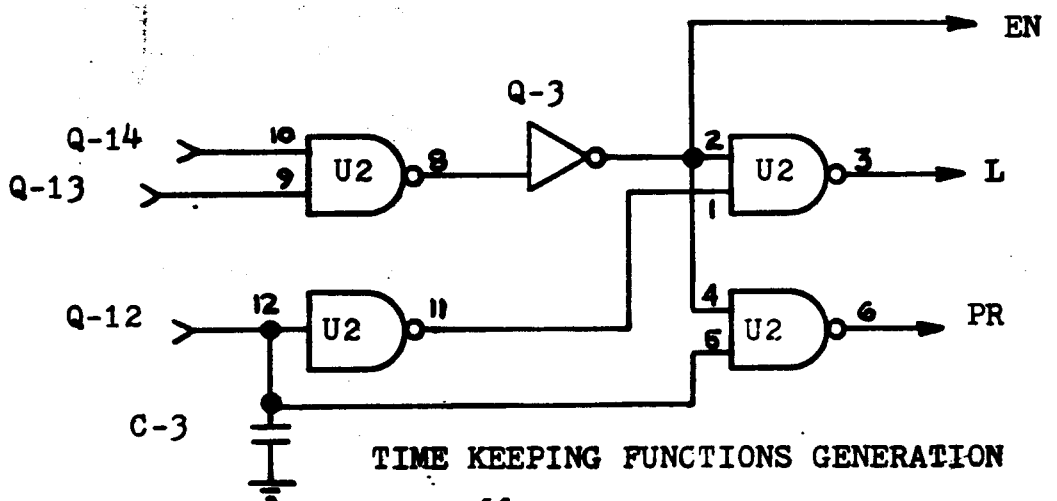
with n being the predivider number, 3/4 indicates the counting duty cycle, 100 is the resolution in Hertz and 2 to the 18 is the Osc. division factor. With n=8, the Oscillator frequency is 2.457600 MHZ. and the up date rate is 9.4 times per second; using other values of n will generate different crystal frequencies and different up date rates. With a 9.4 times per second up date, the display is fast enough to follow the tuning of any dial, thus not lagging in indication. The crystal selected has a temperature-frequency deviation of 0.01% for a 0 to 70 degree C change; since the time base is in a non-ventilated enclosure, temperature rise inside the box is 22 C above ambient, thus after the first hour the unit will drift 25 HZ. on the average. This 25 HZ. deviation would translate to an absolute freq. deviation on the 15 M band of 210 HZ. The units are normally calibrated one hour after initial turned "ON"; after such calibration the unit should be accurate to within 12 HZ.
The crystal frequency is adjusted by C-5(6-40 pf trimmer); this small trimmer allows the frequency to be adjusted 3 KHZ from the center frequency of 2.457600 MHZ. Capacitor C-9(47 pf. disc) prevents the oscillator from frequency"hopping" into the harmonics of the crystal. Using U-12 as the main oscillator(74LS00) and consecutive gates as buffers, the signal is divided by 16 by the U-13 counter(74LS93). A Test Point(TP-2) is located at the input of the U-13 counter to allow calibration of the oscillator. The output of U-13 at 153.6 KHZ. then goes to U-1(CD 4060), a 14 stage ripple-carry binary counter/divider where the input is divided by as much as 16,384 to develop the Time Keeping functions. These signals, except for the Gating(EN) signal are taken directly out of U-2(74LS00); the EN signal is inverted so it must go to Q-3(2N3904) for the proper signal conditioning. The Time Keeping Functions are shown in the Timing Diagram. The circuit is shown below:



CRYSTAL OSCILLATOR & TIME KEEPING FUNCTIONS

TIMING DIAGRAM:





TIME KEEPING FUNCTIONS GENERATION

Counters and Presetting Logic:

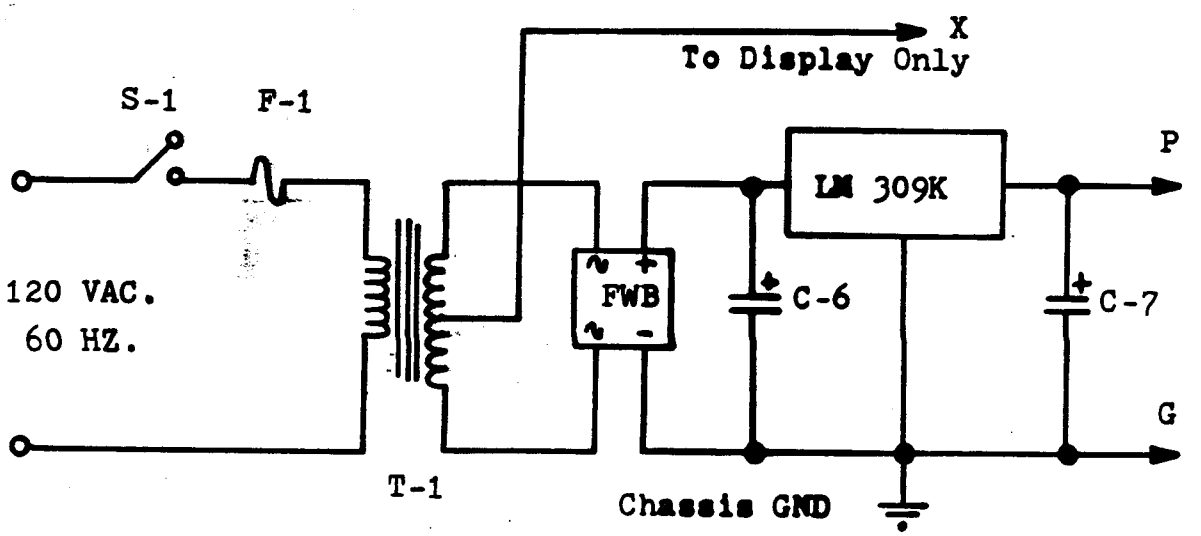
This is the heart of the digital Readout. Four(4) counters 74LS190 are connected in series to form a four decade ripple up/down counter. For the Presetting logic, 32 diodes and four(4) DIP 8 position switches are used to preset any two IF frequencies, which can then be selected by a front panel switch. The counter outputs (DCBA) are connected to four(4) Fairchild 9374 which contain latches and are also LED drivers not requiring limiting resistors.

Displays:

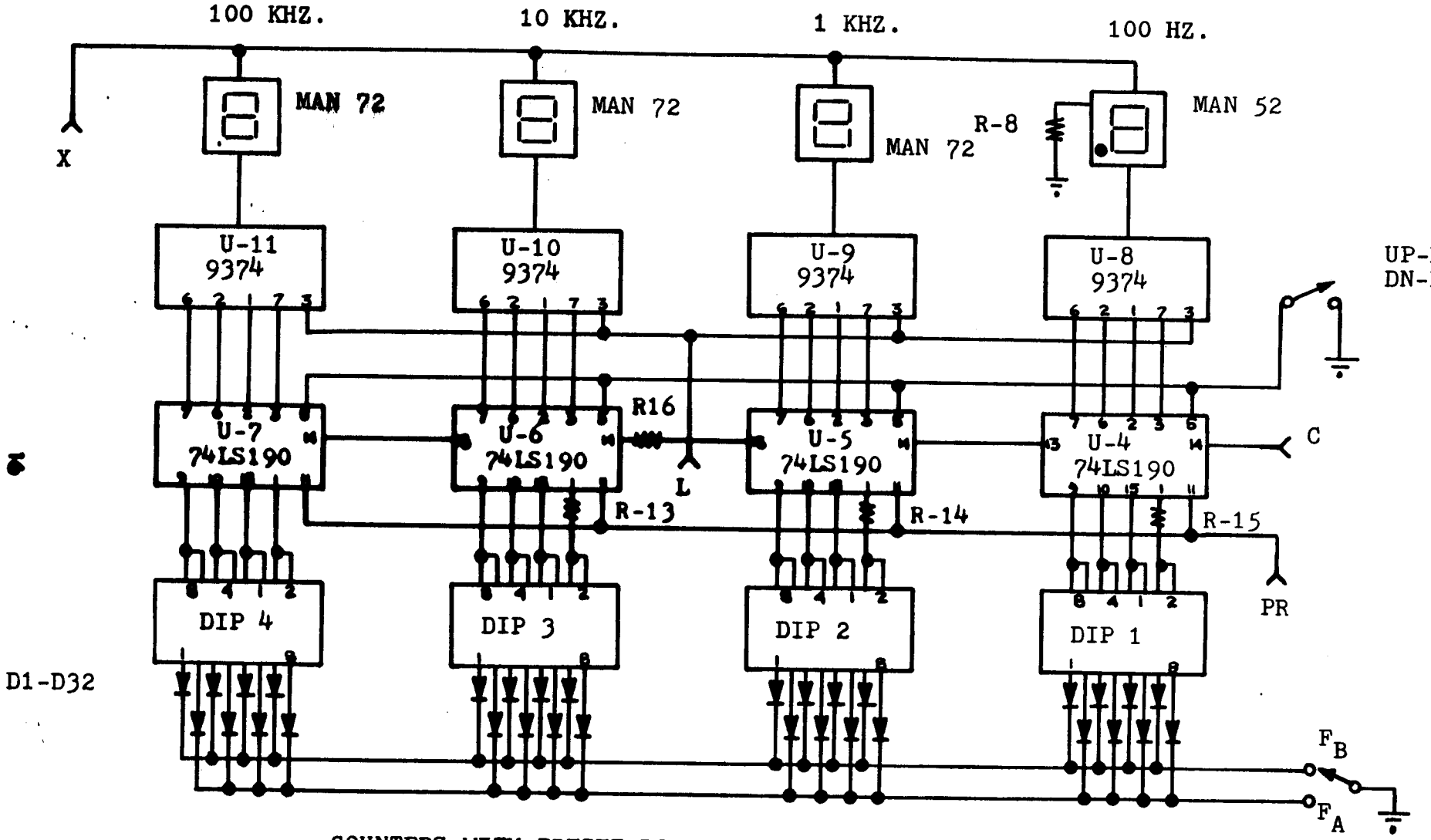
The Displays are standard MAN 72(Red) and MAN 52(Green) or MAN 82 (Yellow). Three of the red displays are used and the different color, is used to indicate the 100 HZ. output. All of the displays are electrically the same pin configuration and as such they can be interchanged. The display drivers(9374) are soldered to the PC Board to aid them in the heat sinking process since they run warm to hot; such performance is normal.

Power Supply:

The power supply consists of a 12.6 VAC @ 1.2 A transformer with centertap, a full wave bridge rectifier(FWB), a filter capacitor and a 5 VDC regulator. The logic on the main board and the oscillator are provided with regulated 5.0 VDC; the displays are supplied with 5 VDC of rectified full wave unfiltered DC which is obtained by using only two diodes of the FWB and being obtained from the center tap of the transformer. The 1/2 A. fuse protects both supplies. The maximum DC current load is 600 mA. when all digits are set to eights(888.8). Schematic Diagram for the Power Supply is shown below:



POWER SUPPLY CIRCUIT

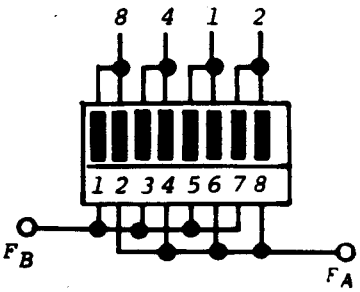


COUNTERS WITH PRESET LOGIC AND DISPLAYS

PROGRAMMING THE TK-1

You will find that programming the TK-1 is as simple as addition or subtraction. The four DIP switches(one for every digit) control the starting point for the counters so that after the dynamic count, the indicated numbers correspond to the dial frequency. By turning switch 1 or 2 of any DIP switch to the off position, will generate the digit "8" depending if the front panel switch is at F_A or F_B.

Please refer to Table 1. If all switches are in the "off" position, the displays will be blanked. All switches in the "on" position will display zeros. The front control switch permits you to program two separate number(which could correspond to two different receivers). Example: Assume you have a Drake R-4C receiver. Set your switches to read 000.0. Connect the TK-1 to the INJ. OUTPUT of the receiver and set your dial to 14.000 MHZ. Your display should be reading 645.0. To make your display read 000.0, disconnect the R-4C from the TK-1 and program 355.0(This is the difference from 000.0 and 645.0) Connect your receiver and it should read 000.0 Now go to 14010.0 MHZ; if your display does not read 010.0 your are counting in the opposite direction. The direction of count is controlled by the toggle switch located in the back panel of the TK-1. When the switch is in the up position the unit counts UP; down and the count is DOWN.



"OFF" SWITCH NUMBER

F_A	F_B	DISPLAYED
-	-	0
6	5	1
8	7	2
6,8	5,7	3
4	3	4
4,6	3,5	5
4,8	3,7	6
4,8,6	3,7,5	7
2	1	8
2,6	1,5	9
2,8	1,7	-
2,8,6	1,7,5	E
2,4	1,3	H
2,4,6	1,3,5	L
2,4,8	1,3,7	P
2,4,6,8	1,3,5,7	Blank

SUMMARIZED PROCEDURE

1. Set Receiver(Transceiver) to the beginning of any band i.e. 7.000 MHZ.
2. Set the TK-1 Displays to read 000.0
3. Connect receiver to TK-1 and read displayed number(645.0 for Drake R-4C).
4. Subtract this number from 000.0 and program the difference with the DIP switches(355).
5. Your receiver should follow the indicated numbers on the readout, if not check for the direction of count.
6. Programming is done; Display will follow dial.

MODIFIED BCD CODING

As shown in Table 1, the DIP switches are weighted with a modified BCD code. The configuration is 8-4-1-2; DIP switch position 1 & 2 are worth 8 units, position 3 & 4, worth 4 units, position 5 & 6, are worth 1 unit, and position 7 & 8, are worth 2 units. Table 1 gives you all possible combinations; note that F_A controls all the even numbers and F_B the odd numbers on the DIP switch.

CALIBRATION PROCEDURE

Note: Before calibrating the TK-1, set the unit to all zeros(000.0) and place the enclosure lid on the cabinet. After 45 minutes, then proceed to perform the calibration. The TK-1 having a Crystal time base must be calibrated every year to make sure that the crystal aging effects are not compromising your Display accuracy.

Approach With Test Equipment:

a. Connect a high accuracy frequency counter to Test Point Two(TP-2). Such unit should have at least a 10 HZ. resolution at 2.5 MHZ.; preference is made to units having a 1 HZ. resolution or better.

b. Adjust the C-5 trimmer capacitor with a tuning tool to read on the frequency counter standard a frequency of 2.457600 MHZ.

c. If the resolution of the frequency counter is not good enough at 2.4576 MHZ. the same counter could be connected to Test Point One (TP-1) and adjustment to C-5 should be made until a reading of 9.6000 KHZ. is obtained.

d. Calibration is complete.

Approach Without Test Equipment:

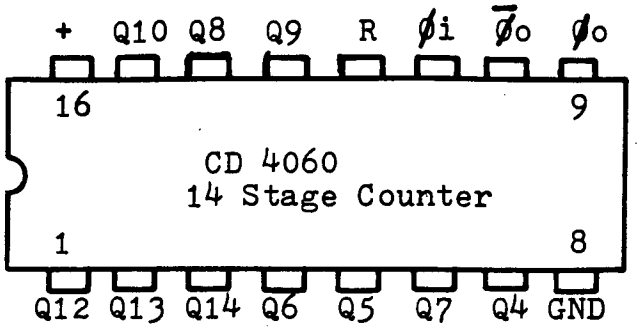
a. Program the TK-1 for your receiver and make sure the TK-1 is operating with your receiver.

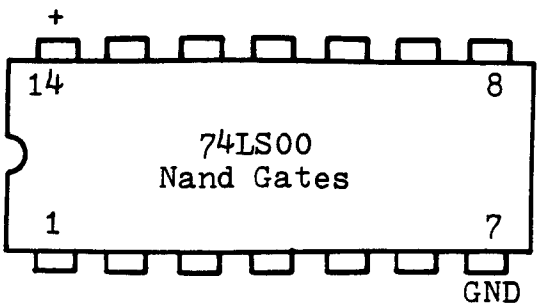
b. From Test Point One(TP-1), connect a small piece of wire to the antenna input of your receiver(any hook up wire is acceptable). Tune the receiver, preferably on one of the higher frequency bands, to one of the harmonics, which should be audible as a heterodyne every 9.6 KHZ intervals.

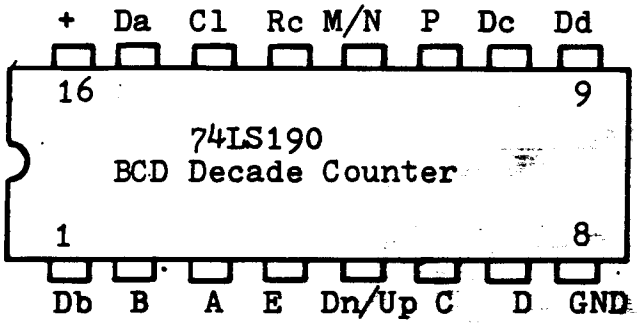
c. With the TK-1 in operation we locate a beatnote; suppose we are on the 15 M band and the beatnote is at 21,390.5(Readout will show 390.5). We now divide this number by 9.6 and obtain 2228.18; since this number(which is a harmonic of our basic 9.6 KHZ.) contains a fraction (.18), we do not have the Time Base properly set. By adjusting C-5, the same process is repeated until the fraction is eliminated.

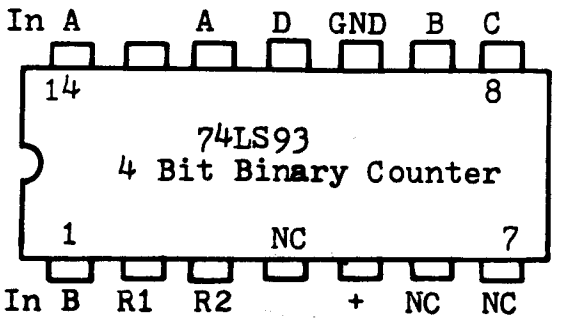
d. If you can tune WWV, set your receiver to such frequency and zero beat by increasing the audio level until no sound is heard; your TK-1 should be reading 000.0 since WWV is at 5.0000 MHZ, 10.0000 MHZ or 15.0000 MHZ. If the TK-1 is not reading zeros, adjust C-5 until you do. Caution: In some receivers not capable of tuning AM, if the zero beat method is used, this frequency will be off by 1.5 KHZ depending if you were tuning USB or LSB. By using USB you must subtract 1.500 KHZ.; if you use LSB you must add 1.5 KHZ. to obtain the correct frequency.

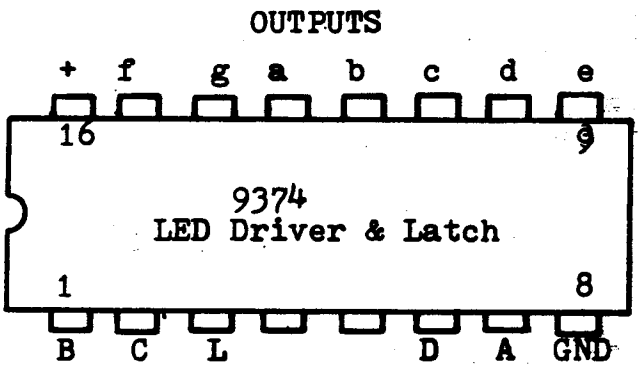
COMPONENT IDENTIFICATION

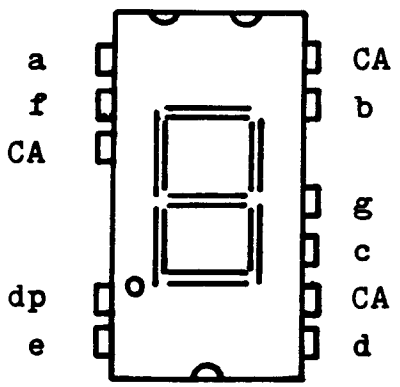






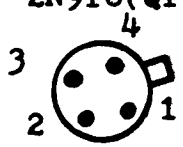






MAN 72, 52 and 82
COMMON ANODE LHDP

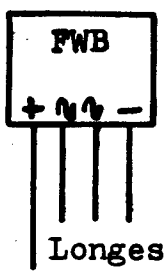
2N918(Q1,2)



1. Emitter
2. Base
3. Collector
4. Case

2N3904(Q3)

1. Collector
2. Base
3. Emitter



Longest is Positive

GENERAL SPECIFICATIONS

The Specifications given reflect the absolute performance of the TK-1. You will find that parameters which most other manufacturers omit are given for the TK-1(like Dynamic Range).

Frequency Range(RF Input): 100 KHZ. to 50 MHZ.at specified Sensitivity.
25 KHZ. to 65 MHZ. at reduced Sensitivity.

Sensitivity: Better than 5 mV.-RMS at 4.3 MHZ.
25 mV.-RMS at 50 MHZ.

Dynamic Range(Input): Better than 1000:1 @ 4.3 MHZ.
300:1 @ 50 MHZ.

Input Impedance: 35 K ohms typical, capacitive coupled.

Maximum DC Input: 300 VDC @ 47 Degree C.

Time Base: 2.457600 MHZ., 0.005%. Maximum Frequency Deviation for a temperature change of 0 to 70 C., 0.01%. Typical Temperature drift from 25 C to 47 C (22 C rise inside enclosure) for the first hour is 25 HZ.; Frequency deviation thereafter 2 HZ.

Absolute Readout Accuracy: 0-60 Minutes: 25 HZ. at 3.5 MHZ.
75 HZ. at 7.0 MHZ.
150 HZ. at 14 MHZ.
200 HZ. at 21 MHZ.
300 HZ. at 28 MHZ.

After 60 Minutes: 2 HZ. at 3.5 MHZ.
6 HZ. at 7.0 MHZ.
10 HZ. at 14 MHZ.
14 HZ. at 21 MHZ.
18 HZ. at 28 MHZ.

Time Base Setability: 3.0 KHZ. from center Frequency, capacitor trimmed.

Gate Interval: 80 milliseconds.

Up-Date Frequency: 9.375 HZ. (106 milliseconds).

Display Format: Four 7 Segment LED readouts, 0.3" high; 100 KHZ., 10 KHZ 1 KHZ. in Red. 100 HZ. in Green or Yellow.

Power Requirements: 105-130 VAC. 60 HZ. at 66 ma., 8 W. typical. Optiona Power Supply: 210-260 VAC. 50-60 HZ.

Operating Temperature: 0 to 70 C or 32 to 158 F.

Dimensions: 6 1/4" wide, 2 1/4" high, 5 3/4" deep.

Weight: 2.6 lbs. (1.18 Kilos).

Calibration: Performed after the first 60 minutes of operation.

Calibration Cycle: Yearly to reduce Quartz crystal aging effects.

Birdies: None in the Ham Bands up to 30 MHZ.

Input Connections: Two phono sockets connected in parallel.

Front Panel Controls: Power Switch and Programming Selection Switch.

TROUBLE-SHOOTING CHART:

Note: All measurements were made using an 11 Megohm VTVM; TK-1 displays were set to read all zeros(000.0) and M & N were connected. VTVM was set on the zero to 15 VDC scale; all measurements should be plus or minus 10% except for the point marked with "osc" which could depend on the damping effects of your meter.

		74LS00(U2)	74LS93(U3)	74LS190	CD4060	9374
PIN	1	2.2 V	0.1 V	0.2 V	2.5 V	0.2 V
	2	1.3 V osc.	0.6 V osc.	0.2 V	2.5 V osc.	0.2 V
	3	3.7 V osc.	0.3 V osc.	0.2 V	2.5 V osc.	3.7 V osc.
	4	1.3 V osc.	0	0	2.5 V	4.4 V
	5	2.5 V	5.0 V	0	2.5 V	1.3 V
	6	3.7 V osc.	0	0.2 V	2.5 V	0.2 V
	7	0	0	0.2 V	2.5 V	0.2 V
	8	2.5 V osc.	0.1 V	0	0	0
	9	2.5 V osc.	0.1 V	0.2 V	2.6 V	3.0 V
	10	2.5 V osc.	0	0.2 V	2.4 V	3.0 V
	11	2.2 V	0.1 V	3.7 V osc.	2.4 V	3.0 V
	12	2.5 V	0.1 V	0.2 V	0	3.0 V
	13	0.8 V	0	4.4 V	2.5 V	3.0 V
	14	5.0 V	0.6 V	4.4 V	2.5 V	3.6 V
	15			0.2 V	2.5 V	3.0 V
	16			5.0 V	5.0 V	5.0 V

	Q1(2N918)	Q2(2N918)	Q3(2N3904)	POWER SUPPLY(Terminal Stand)
C	1.3 V	5.0 V	1.3 V osc.	Lug 1: 12.6 VAC T-1 Sec.
B	0.7 V	1.3 V	0.6 V osc.	Lug 2: 12.6 VAC T-1 Sec.
E	GND	0.6 V	GND	Lug 3: GND
				Lug 4: 4.8 VDC "X" Displays
				Lug 5: 5.0 VDC "P" Logic

Problem:	Problem Area:
Display fast flicker, all digits.	C-3 out of tolerance, Bad CD 4060.
Numbers not presetable with the DIP switches.	Oscillator not working.
Unit fails to count.	Transistor Q-1 or bad U-3(74LS93).
Erratic count(rolling).	Not enough input signal.
"P" voltage greater than 5 VDC.	Bad regulator LM 309K/340-5K.

Note: The highest percentage(98%) of all the repair work done by Torrestronics on TK-1 or PTK-1, the main cause of problems are lack of solder(cold solder joints) or too much solder(solder bridges on PC Board). Please check you solder job before jumping to conclusions. If bad components are to be removed from the PC board, do not use a solder sucker(not effective on plated through holes); use a solder wick to do such job. Do not use a soldering iron greater than 47 Watts; too much heat will lift the foil of the PC board.

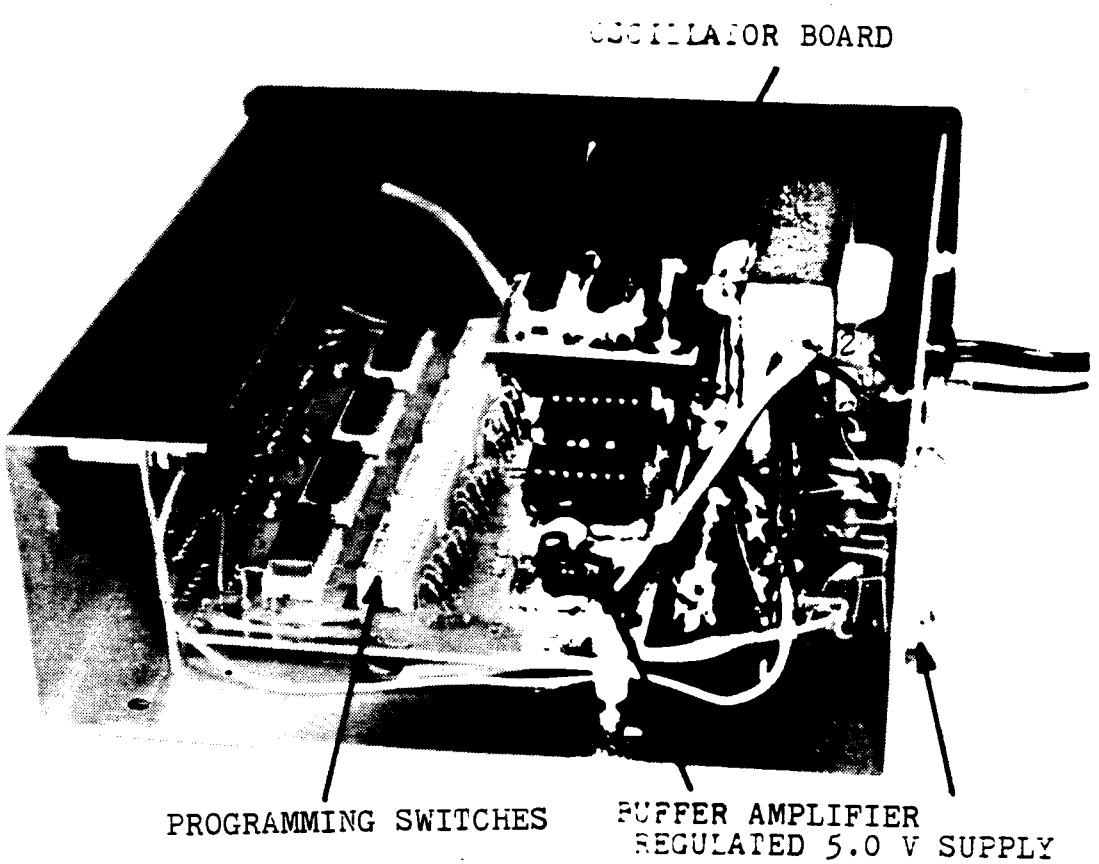
BIRDIES AND INTERFERENCE

Like any digital system, the utilization of pulsed signals could lead to the generation of interference. Special precautions were taken into the design of the TK-1 to reduce interference, like the Display is not multiplexed(multiplexed displays generate noise) and the oscillator "P" line is decoupled using a low pass filter(R9 & C8). Yet some level of noise will be generated, most probably outside the Amateur Band frequency domain. By the utilization of Fourier Theory, we can accurately predict the spectral location of such interference but the intensity at such location is a variable of the receiver sensitivity, selectivity, and LO mixing process used for such particular receiver. The following list indicates the potential frequencies that could generate birdies.

2.45760 MHZ.	17.2030 MHZ.
4.91520 MHZ.	19.6600 MHZ.
7.37280 MHZ.	22.1180 MHZ.
9.83040 MHZ.	24.5760 MHZ.
12.28800 MHZ.	27.0330 MHZ.
14.74500 MHZ.	29.4910 MHZ.

PICTORIAL VIEW OF THE TK-1:

Note: The oscillator board was mounted next to the transformer(T-1) for photographic purposes.



CONSUMER PROTECTION PLAN LIMITED WARRANTY

We offer the following protection plan to the original purchaser or any user of the Torrestronics Universal Digital Frequency Readout unit within the period covered. This is a "Limited Warranty" as defined in the Consumer Warranty and Federal Trade Commission Improvement Act.

RESPONSIBILITY OF TORRESTRONICS

WTK-1: Wired and Tested units will be repaired free of charge for a period of twelve(12) months. This warranty will cover defective parts or workmanship upon receipt of the defective unit prepaid to Torrestronics, Attn: Customer Service. A transportation charge of $5.00 will be required on all warranty work.

TK-1 and PTK-1: All parts and/or components on the kits or special kits will be replaced free of charge for the first 90 days after proof of purchase date. Do not send bad or defective components back to Torrestronics.

We do not cover installation of the WTK-1, TK-1 or PTK-1 to any receiver or transceiver. We only cover materials used by Torrestronics. Any other service or cost are to be covered by separate agreement between the owner and Torrestronics. Damage due to misapplication, misuse, abuse and negligence is not covered.

RESPONSIBILITY OF OWNER

Reading this manual and the trouble shooting section is a must. To request service, ship unit properly packaged to Torrestronics, Inc. Attention Customer Service. Enclose a letter stating carefully the nature of the problem. Do not send Operating Manual or mating instructions; please make reference to the Invoice number(on the yellow copy). Make a check or money order for the amount of $5.00 to cover transportation expenses. Do not bring the unit back to the dealer or any authorized Torrestronics distributor. Average service time is in the vicinity of two(2) weeks but most warranty service is performed within 2 days of receipt of unit.

Torrestronics, Inc. is a family owned corporation, registered in the State of Ohio. We take great pride in the good performance of our products; if for any reason you are not satisfied with the purchased product, please send it back and we will cheerfully refund your money(provided that the unit is not damaged).