SYNTHESIZER II

A 2 Meter Frequency Synthesizer

5011204
$4.00

SYNTHESIZER KIT
(7010370)

1807

SYNTHESIZER W/T
(7010371)

Vhf engineering
DIVISION OF BROWNIAN ELECTRONICS CORP.
320 WATER ST. / BINGHAMTON, N.Y. 13901 / Phone 607-723-9574

SYNTHESIZER II

The Synthesizer II is a two meter frequency synthesizer designed to operate with most of the popular two meter transceivers available today.

SPECIFICATIONS

FREQUENCY RANGE	140 - 149.995 MHz
FREQUENCY INCREMENTS	5 Khz
TRANSMIT OUTPUT	6 - 8 - 12 MHz
RECEIVE OUTPUT	45 MHz
INPUT VOLTAGE	11-18 VDC
INPUT CURRENT	.900 Amps
FREQUENCY STABILITY	.001 %
LOCK-UP TIME (worst case)	150 Milliseconds
SIZE	8" long X $5\frac{1}{2}$" wide X $2\frac{1}{4}$" high
WEIGHT	$1\frac{1}{2}$ lbs.

LIMITED WARRANTY

Factory wired units are warranted for one year. The unit must be returned to the factory postpaid with a note describing difficulty and date of purchase, include a check to cover return postage. Our liability under warranty is limited to repair, adjustment or replacement of units proven to be defective. No further warranty is expressed or implied. Units modified or obviously misused will not be covered by the warranty.

The parts in kits built according to our instructions carry the original manufacturers' warranty. Defective parts must be returned for credit. Units built from kits may be returned to the factory for repair and alignment for a nominal charge, plus parts and shipping.

INDEX

SYN II ASSEMBLY

GENERAL

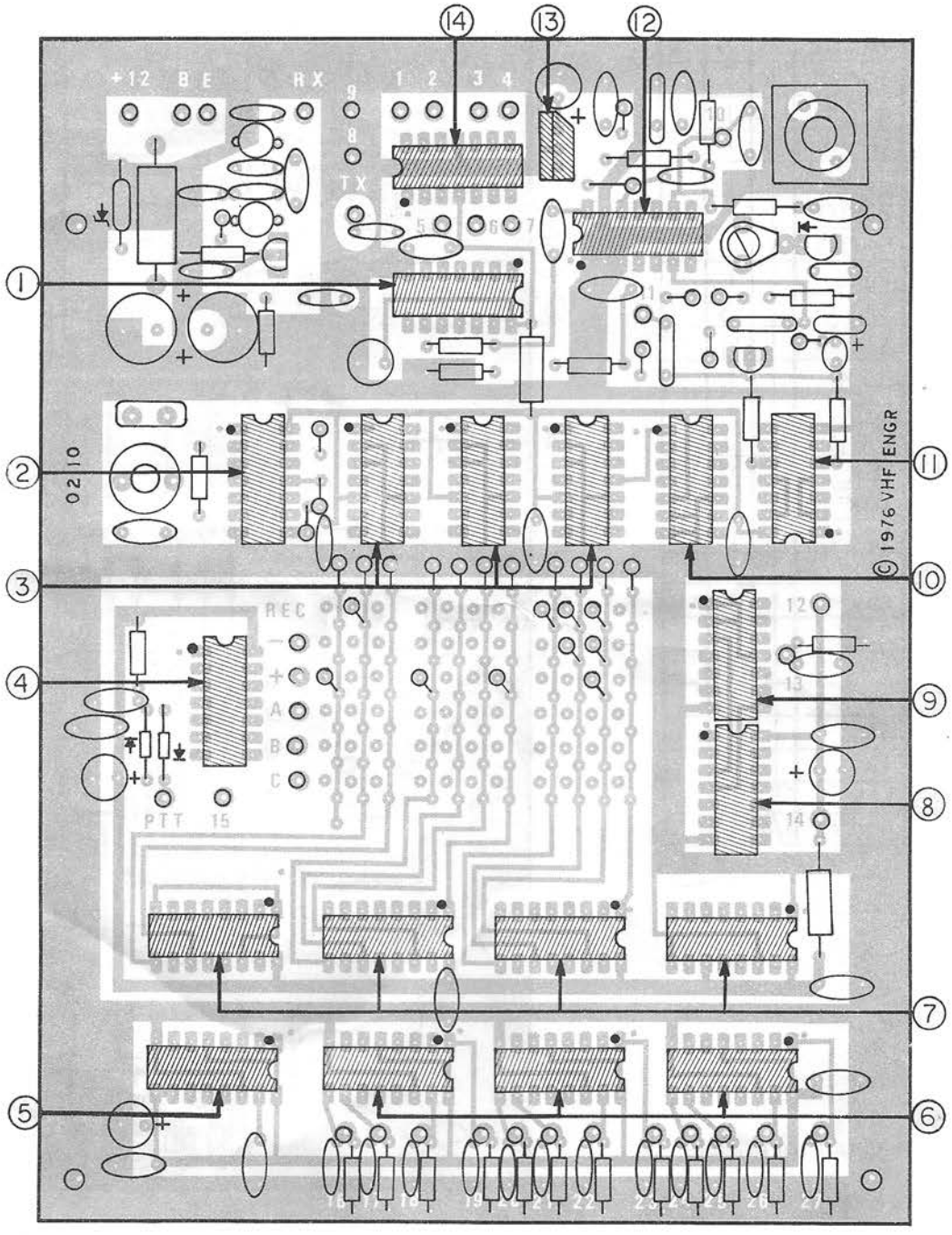
The SYN II is easily assembled using the following instructions. The assembly is broken down into six fundamental procedures.

1. Circuit board assembly
2. Main chassis assembly
3. Wire back panel of main chassis
4. Mount and wire circuit board to back panel
5. Wire control switches
6. Wiring and mounting of control switches

CIRCUIT BOARD ASSEMBLY

The following four pages should be used as a reference in circuit board assembly. Each page shows the board layout and a list of parts to be installed on the board. Parts should be installed and soldered on an item by item basis, checking off each item when completed. In some cases, more than one quantity is indicated under a particular item. Be sure to install all the required quantities in the places indicated. Use a small 25-40 watt pencil type soldering iron. Solder only to the bottom of the board. Since plated-through holes are used throughout, it is not necessary to solder components to the top of the board. Use solder sparingly. Excess solder solder may cause solder bridges or short circuits.

ITEM	VALUE	QTY	CHK
1	7400	1	
2	7400	1	
3	7493	3	
4	74128	1	
5	74193	1	
6	74192	3	
7	7485	4	
8	7474	1	
9	7400	1	
10	7492	1	
11	MC4044	1	
12	LM3086	1	
13	LM341P	1	
14	74H73	1	



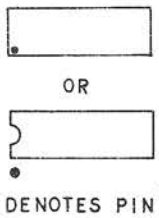


fig. 1

ITEM	VALUE	WATT	QTY	CHK
1	100Ω	1	1	
2	470Ω	1/4	1	
3	1K		1	
4	220Ω		1	
5	220Ω		1	
6	560Ω		1	
7	2.2K		1	
8	330Ω		13	
9	330Ω		11	
10	2.2K		1	
11	4.7K		1	
12	2.2K		2	
13	15K		1	
14	10K		1	
15	4.7K		1	
16	10K		1	
17	15K		1	
18	2.2K		2	
19	100Ω		1	
20	1K		1	
21	47K		1	
22	1K		2	
23	1.8K		1	
24	100Ω	1/4	1	

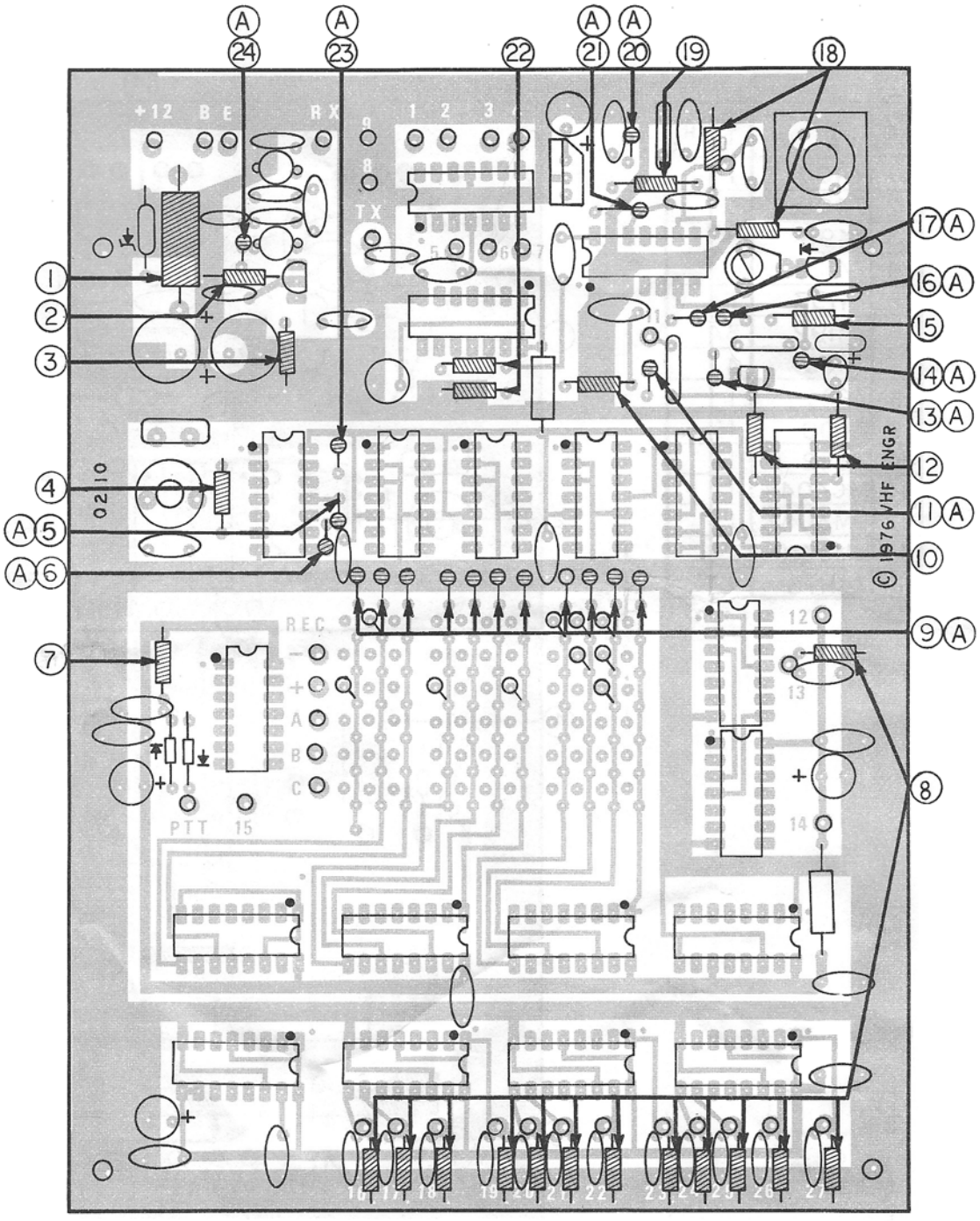
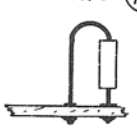
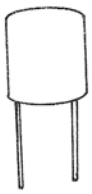


fig. 2

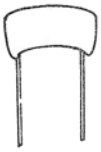
DETAIL (A)



MOUNT
IN THIS MANNER

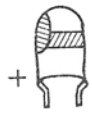


MYLAR



SILVER
MICA

DETAIL (A)



ITEM	VALUE	QTY	CHK
1	.005	2	
2	100MFD 16V	2	
3	20 PF VAR.	1	
4	15 PF SM	1	
5	.01	6	
6	47MFD 16V	3	
7	.001	13	
8	.01	4	
9	.001	1	
10	.1 MYLAR	2	
11	1MFD TAN.	1	
12	.05 MYLAR	2	
13	.01	1	
14	40 PF VAR.	1	
15	100 PF SM	2	
16	.01	1	
17	820 PF SM	1	
18	.01	1	
19	.001	2	
20	47MF 16V	2	
21	.01	1	
22	.001	1	
23	47 PF	1	
24	2.2 PF	1	
25	100PF	1	
26	27 PF	1	
27	22PF	1	

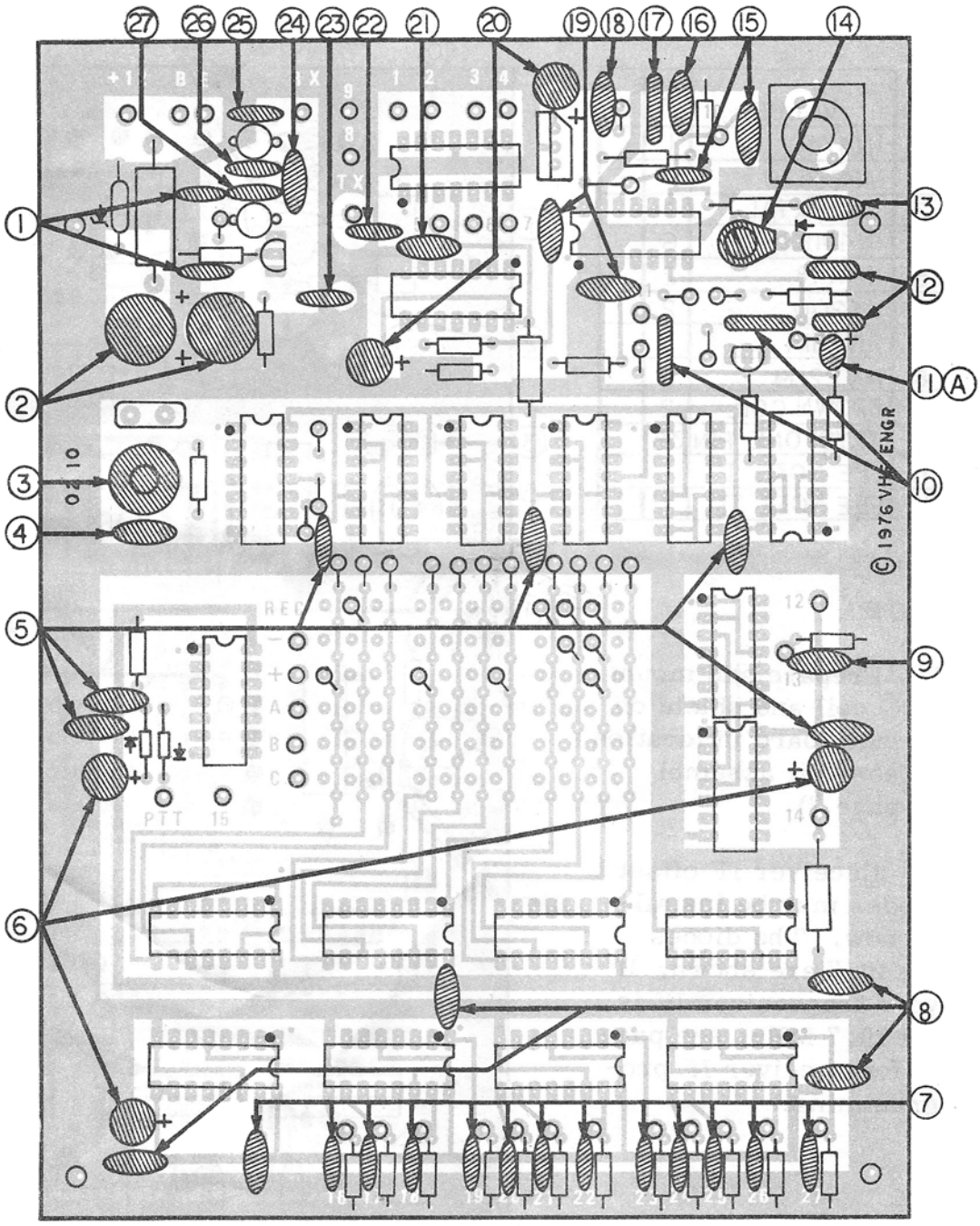


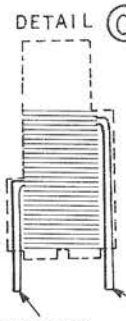
fig. 3

DETAIL (A)

MOUNT
IN THIS MANNER

(B)
SEE COIL ASSY
NEXT PAGE

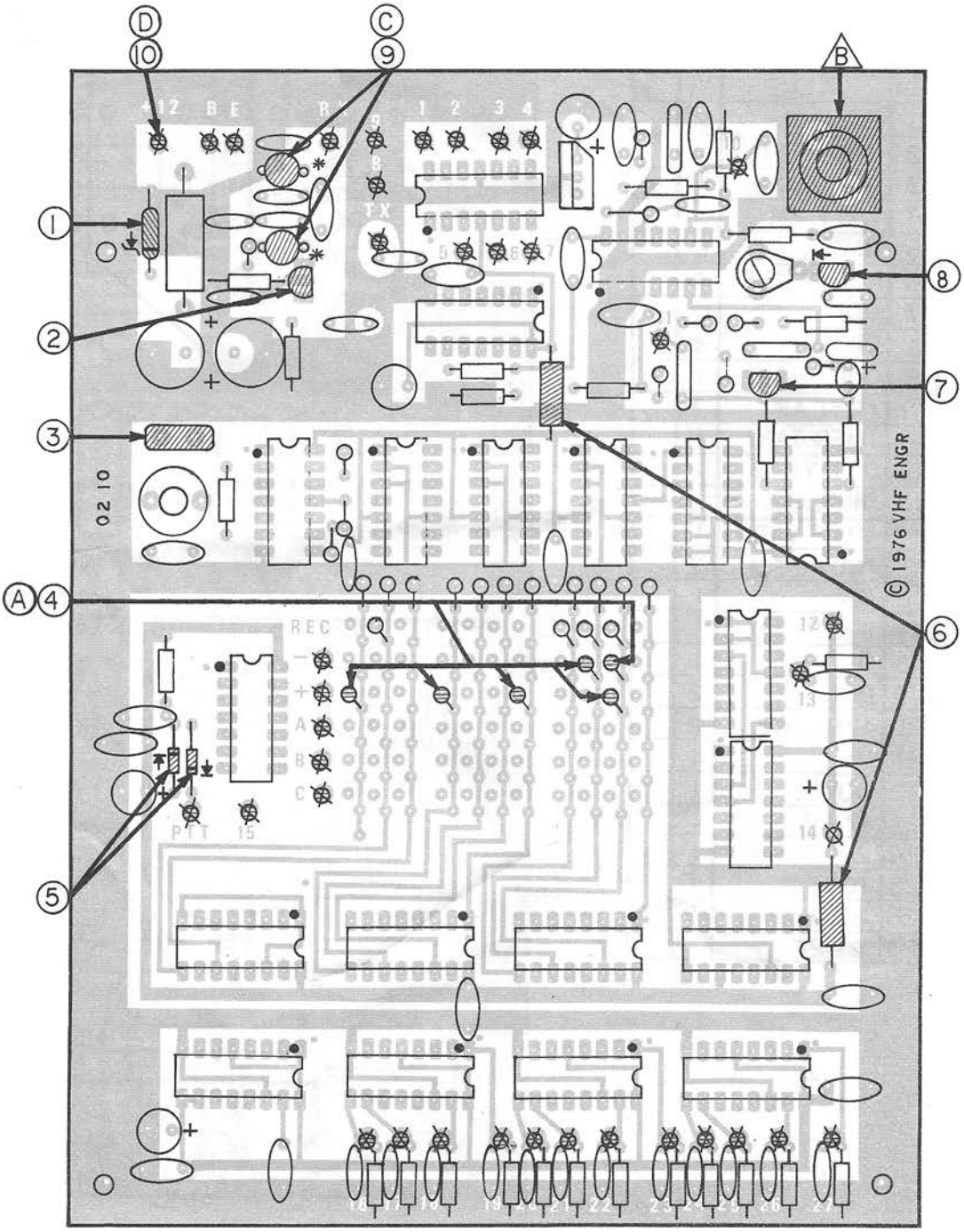
DETAIL (C)



*DENOTES TOP

(D)
DENOTES
KEYSTONE PIN
38 PLACES

ITEM	VALUE	QTY	CHK
1	IN4740	1	
2	MPS6539	1	
3	10.24 XTAL	1	
4	IN4148	6	
5	IN4148	2	
6	VK200	2	
7	2N6514	1	
8	MV2209	2	
9	BROWN COIL	2	
10	KEYSTONE PIN	38	
11	SEE NOTE I		
12	SEE NOTE II		



NOTE:

I. Prepare and mount VCO coil and shield on circuit board in location B (see coil assembly on page 7).

II. Receiver IF offset diodes may be installed now. The diodes for 10.7 are shown. If your transceiver IF is not 10.7 MHz, see page 15 for receiver IF programming.

fig. 4

COIL ASSEMBLY

The VCO coil (L-1) is wound in a single layer on the plastic form provided. Insert about one inch of the #24 enamel covered wire through one of the holes in the coil form base. Wind the full 24 turns, starting at the base. Bring the wire around another half turn, and insert its end through the hole opposite the starting end (see Figure 5). Pull the wire tight. Scrape the insulation of the wires below the base. Install and solder the coil into the circuit board.

Wet the rubber grommet and install in the top of the coil shield. Slide the coil shield down over the coil form, aligning the tabs with the holes in the circuit board. A slight twisting motion will aid in getting the grommet started over the coil form. Solder the coil form tabs and run a solder bead between the can and top printed circuit ground foil. Install the coil slug with a .75 inch hex alignment tool.

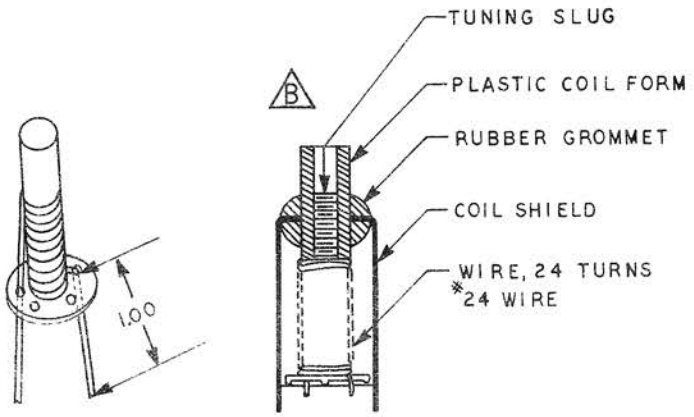


fig. 5

MAIN CHASSIS ASSEMBLY

First, mount the 2N6576 transistor as follows: Slip an insulating washer onto its pins, making sure the mounting holes line up properly. Place the transistor in the holes provided on the back panel as shown. The mounting holes should line up with the pins centered in their respective holes. While holding the transistor in place, slip the transistor socket onto its pins, making sure the insulated shoulders line up with the mounting holes. Fasten the assembly into place with two #6 self taping screws. Mount the LM309K using the same procedure.

Mount the jacks, feed through, and board mounting hardware as shown. Screw the 4-40 screws into the threaded spaces and tighten. Be sure to use the lock washers provided. Install the 4 rubber feet - one in each corner as shown. Install identification label on bottom of chassis.

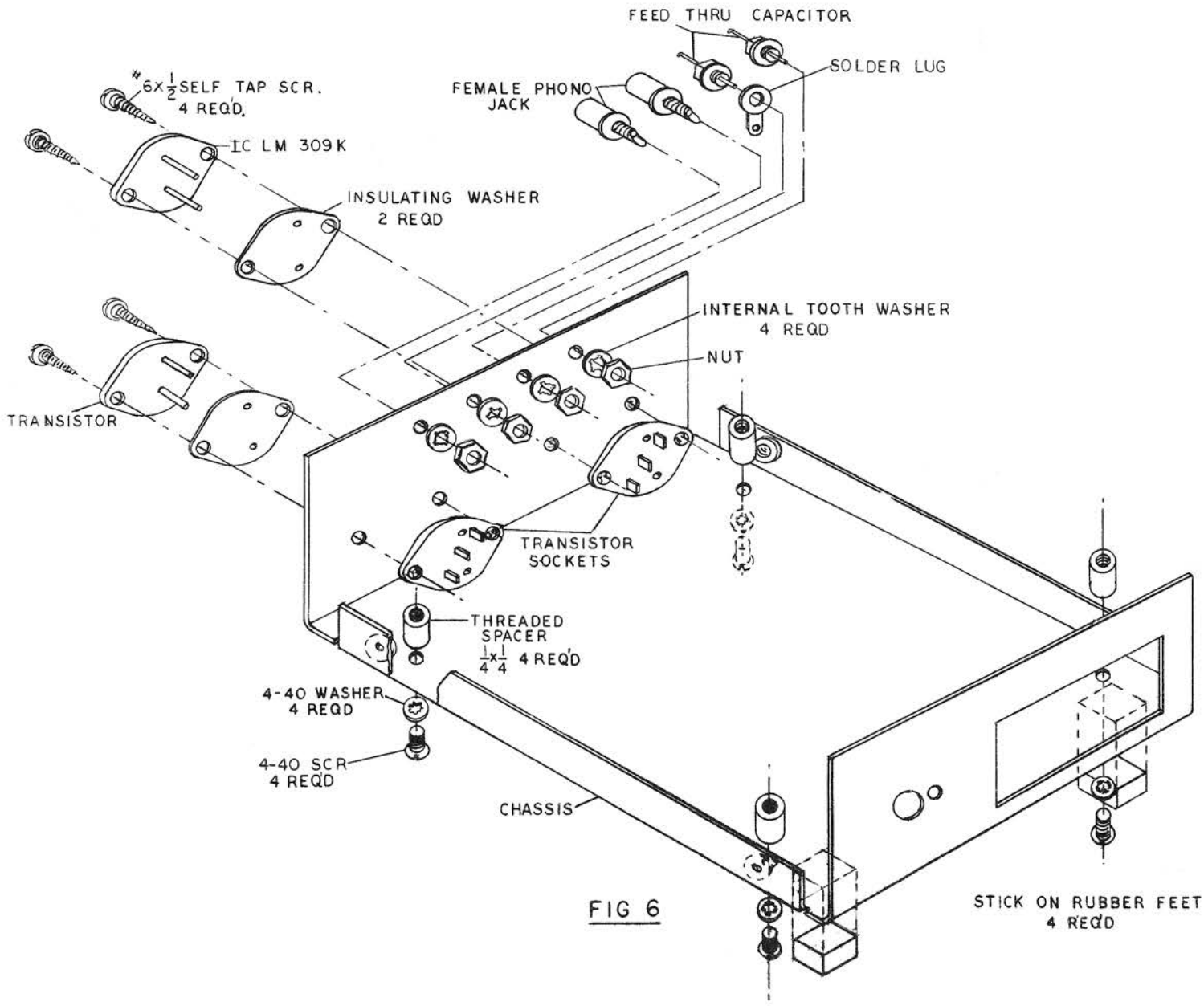


FIG 6

MAIN CHASSIS WIRING

a.) Cut and strip the lengths of wire as shown in Figure 7 below.

b.) Solder the wires to the transistor sockets and connectors as shown.

c.) Mount and solder the .1 on the LM309K socket as shown.

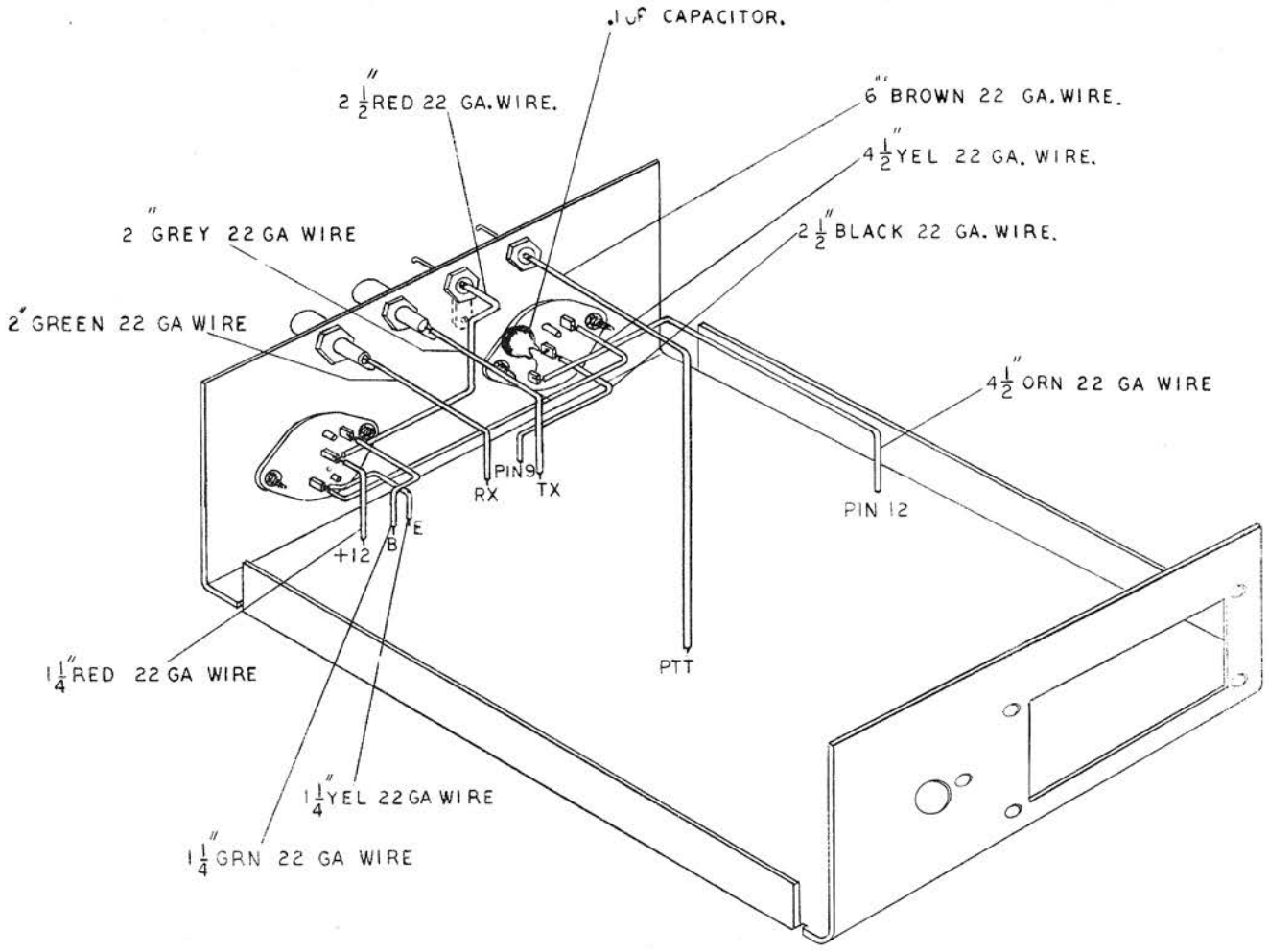


FIG 7

P. C. BOARD INSTALLATION

a.) Mount the PC board using the 4-40 hardware as shown in Figure 7 below.

b.) Solder each wire from the rear panel to its connecting pin as shown in Figure 6 using the following procedure: Strip the insulation back about 1/4 inch on each wire and tin the bare end. Heat the side of the connecting pin and fill the hole with solder. Slip the wire into the end of the pin while applying heat. This will insure a solid connection.

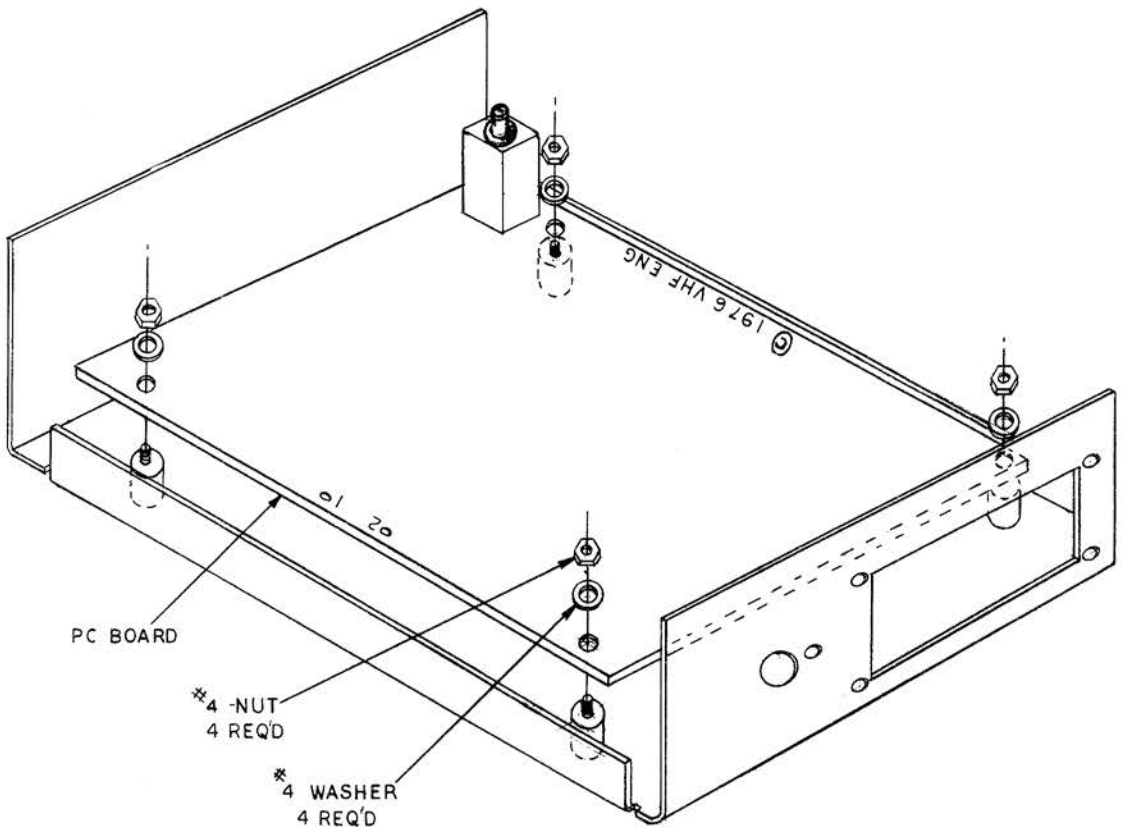


FIG. 8

CONTROL SWITCH WIRING

a.) Lay the 20 conductor cable on a flat surface. Using a sharp knife, separate the conductors on one end for 1 inch. Separate the conductors on the other end for 2 inches. Strip the insulation from each conductor about 1/4 inch. Pre-tin the end of each conductor. Locate the yellow and green wire nearest the black end wire. Pull these wires apart their full length to separate the cable into one 6 conductor and one 14 conductor. See Figure 8.

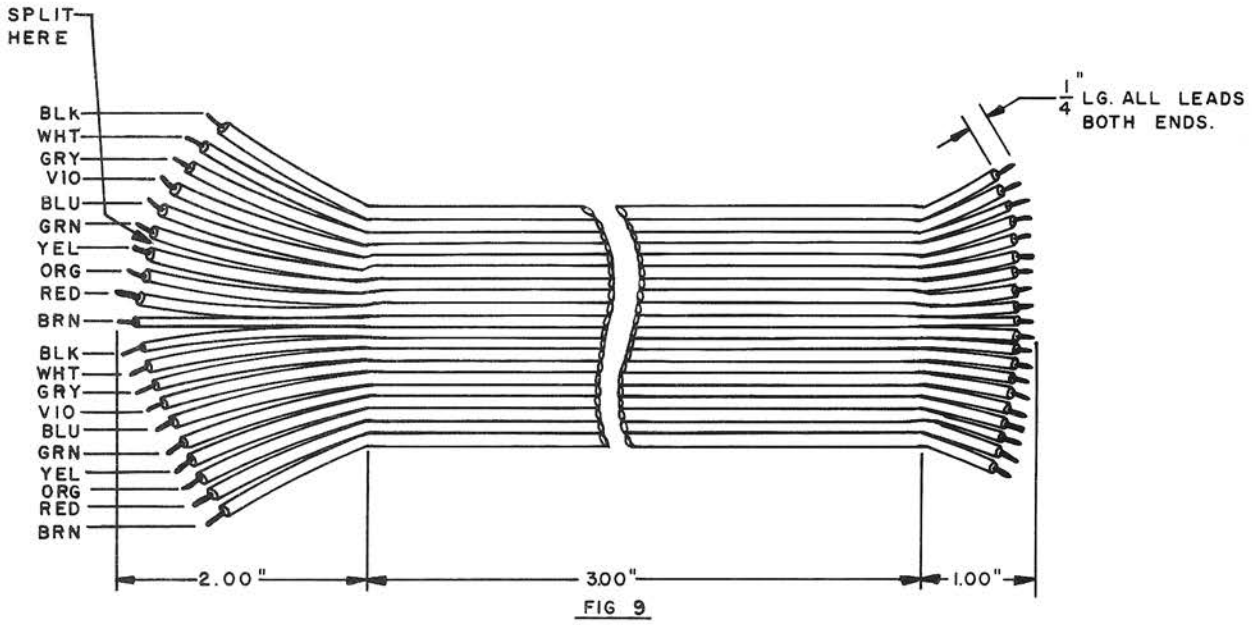


FIG 9

b.) Place the switch face down on a work surface so that the digits 14 are to the right. Slide a $1\frac{1}{4}$" piece of bare #20 wire through the center common hole of all four decodes and solder each connection.

c.) Wire the end of the 14 conductor ribbon cable separated one inch to the thumb wheel switch. Solder one wire at a time using the following sequence (refer to Figure 10):

1 - MHz Section

8 - Brown
4 - Red
1 - Orange
2 - Yellow

2 - 100 Khz Section

8 - Green
4 - Blue
1 - Violet
2 - Grey

3 - 10 Khz Section

8 - White
4 - Black
1 - Brown
2 - Red

4 - 5 Khz Section

Bottom Connection - Orange

Solder yellow wire to the common #20 bare wire previously installed (Note: one connection on the 5 Khz switch between the orange and yellow wire not used).

d.) Wire the end of the 6 conductor ribbon cable separated one inch to the offset waffer switch. Solder one wire at a time using the following sequence (refer to Figure 10):

Common - Black
1 - no connection
2 - White
3 - Grey
4 - Violet
5 - Blue
6 - Green

e.) Orientate the chassis on the work bench as shown in Figure 10. Place the prewired thumb wheel switch in front of the chassis face down, with the number 14 to your right. Bring the ribbon cable over the top of the front panel and solder the leads to the circuit board as follows:

16	- Brown	23	- Grey
17	- Red	24	- White
18	- Orange	25	- Black
19	- Yellow	26	- Brown
20	- Green	27	- Red
21	- Blue	13	- Orange
22	- Violet	14	- Yellow

f.) Place the thumb wheel switch into the front panel, allowing the ribbon cable to form a loop behind the switch. Secure the switch with the four black 4-40 phillips head screws, four #4 lock washers, and four 4-40 nuts.

g.) Place the offset switch in the front panel as shown. Secure with a 3/8 lock washer and nut.

h.) Solder the offset switch wires to the main circuit board as follows:

15	-	Black
C	-	Green
B	-	Blue
A	-	Violet
+	-	Grey
-	-	White

i.) Install offset selector knob. Turn knob full clockwise. Realign knob to position C if necessary.

THIS COMPLETES THE WIRING OF THE SYN II. REFER TO PROGRAMMING AND ALIGNMENT BEFORE INSTALLING COVER.

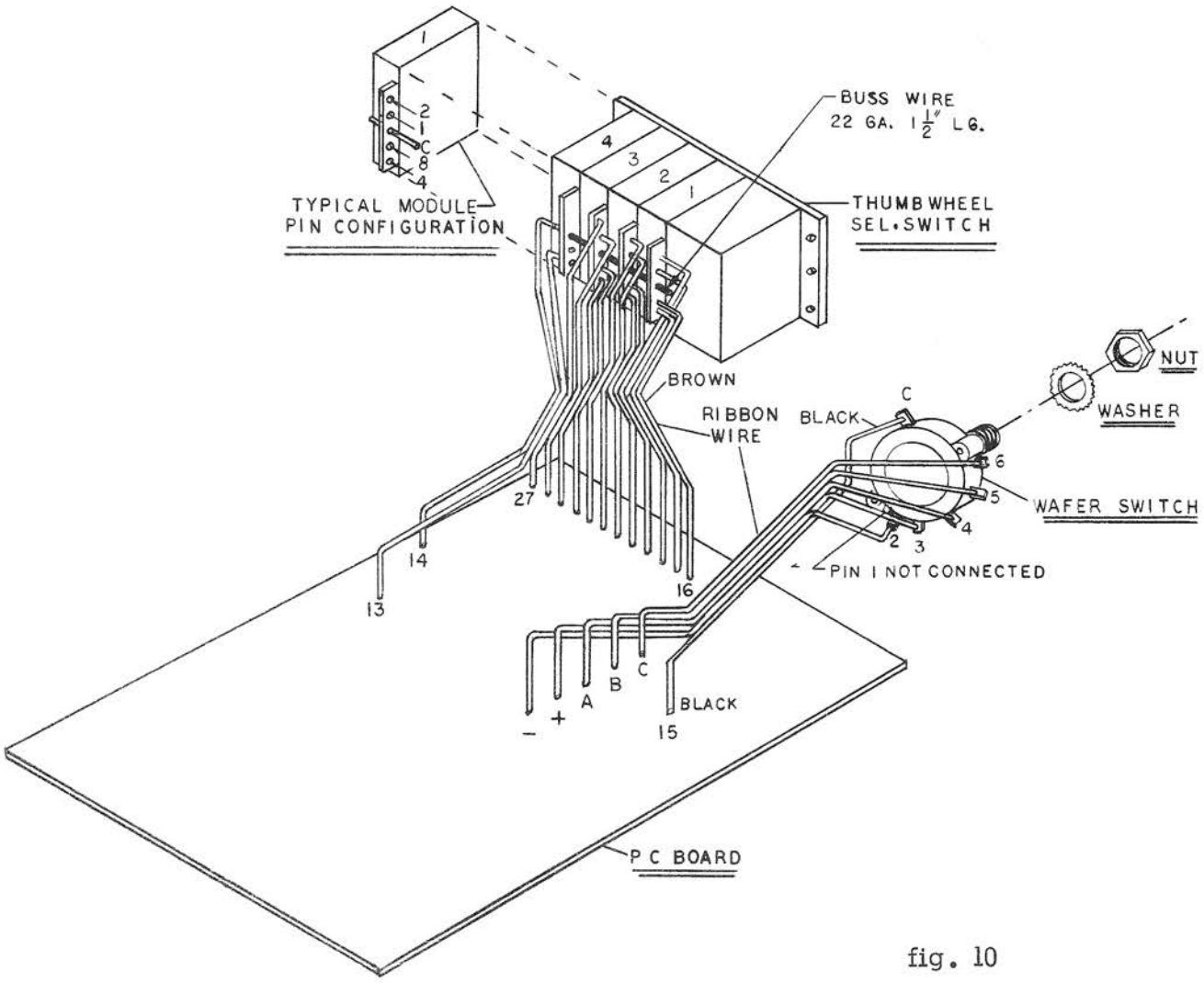


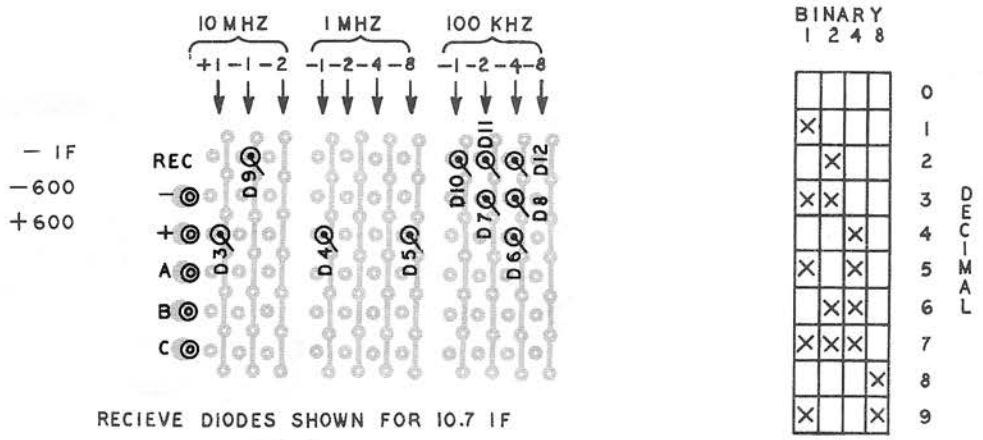
fig. 10

PROGRAMMING

A. General

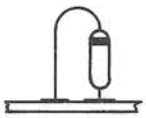
All offsets are programmed by soldering diodes into a matrix located in the center of the circuit board. Programming is in standard BCD notation. BCD notation uses the binary numbers 1, 2, 4, and 8 to form 0 through 9 (see figure 8B).

Facing the front of the SYN II, you will note that there are 11 columns of holes grouped three on the left, four in the middle and four on the right. They correspond to 10 MHz, 1 MHz and 100 Khz respectively (see figure 11). Also, note that there are six rows of holes labeled REC, -, +, A, B, and C. These correspond to the receive, -600, +600, A, B, and C offsets.



RECIEVE DIODES SHOWN FOR 10.7 IF

FIG 11



MOUNT DIODES AS SHOWN

Note that the first group of three columns are labeled +1, -1, and -2. This allows only four conditions in the 10 MHz section. A +10 MHz, -10 MHz, -20 MHz and -30 MHz. The second and third group of four columns are labeled -1, -2, -4, and -8. This allows any number from 0 - 9 to be subtracted in the 1 MHz and 100 Khz sections.

The +10 MHz is used when a transmitter offset above the receive frequency is required. Any plus offset between 100 Khz and 10 MHz (in even 100 Khz increments) can be obtained by first adding 10 MHz and subtracting the difference between the required offset and 10 MHz in the other columns. For example, +600 Khz is 9.4 MHz less than 10 MHz. Therefore, a diode is required in the +10 MHz column, a diode in the -1 and -8 MHz columns for -9 MHz; and a diode in the -4 100 Khz column for -400 Khz.

Transmit offsets below the receive frequency are programmed by installing diodes in the proper columns. For example, -600 Khz requires a diode to be installed in the -2 and -4 100 Khz columns.

B. Diode Installation

Diodes may be installed from top of board. The SYN II double sided plated through holes allows diodes to be installed and removed from the top of the board. Bend the leads as shown in figure 8. Cut the leads to approximately 1/8" long. Place the diode in the proper set of holes and solder the top lead into place with a small tipped iron. Reheat the solder junction and lift the body of the diode about 1/16" off the circuit board. This will allow ample room to solder the anode to the circuit board.

To remove a diode, heat the junction of its lead and circuit board with a hot iron and pull the lead out with a pair of needle nose. Next, heat the junction of the bottom lead and pull the diode out of the board.

Receiver

The receiver IF frequency is programmed along the back row of the matrix labeled REC. Install the required diodes to match the IF frequency of your transceiver. The most popular IF for 10.7 is shown on the parts layout. Diode positions for IF's other than 10.7 are determined as shown in the following examples.

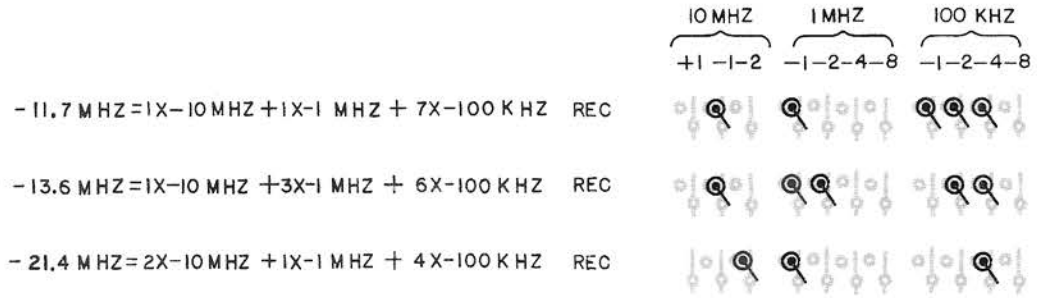


FIG 12

Transmit Offsets

The standard +-600 Khz offsets are wired during assembly. Nonstandard offsets may be added at any time by installing diodes in the proper location. See examples below.

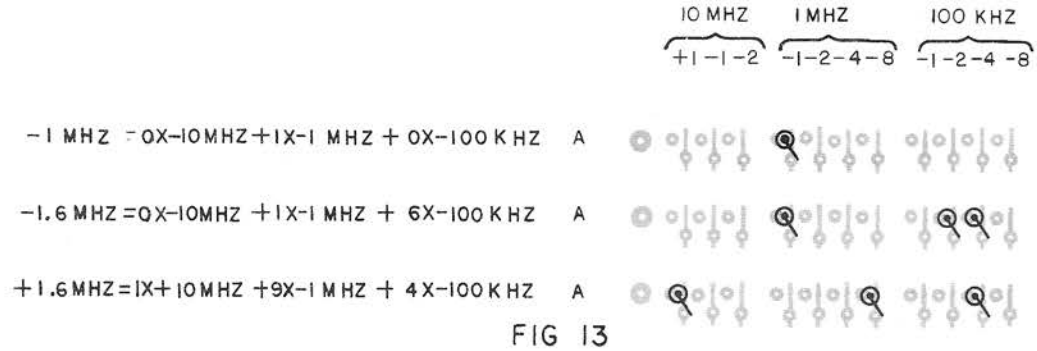


FIG 13

C. Transmitter

Transmit outputs of 6, 8, or 12 MHz are selected by jumper wires connected to the pins located around IC-20. Select the frequency range to match your transceiver and install the required jumpers. Use 12 MHz for the VHF Engineering TX144.

TRANSMITTER OUTPUT CONNECTIONS	
6 MHZ	CONNECT (1-15) (4-6)
8 MHZ	" " (3-5)(4-6)(7-15)
12MHZ	" " (2-8)(4-6)(7-15)

FIG 14

ALIGNMENT

A. VCO

Set front panel offset switch to simplex. Set frequency thumb wheel switch to 146.500. Ground PTT terminal on back panel.

1.) Connect the positive lead of a VOM to pin 11 and the negative lead to ground. Apply power and adjust L-1 for a reading of 3 volts. If the reading does not vary while adjusting L-1, the loop is not locked. Refer to trouble shooting section.

2.) When 3 volts are obtained above, remove the ground from the PTT terminal. Adjust C-43 with an insulated alignment tool for a reading of 3 volts.

3.) Repeat steps 1 and 2 until three volts are maintained with the PTT open or shorted.

B. MASTER OSCILLATOR

The master oscillator can be aligned using two methods. The first method is to align C-29 for the correct frequency while transmitting. The second method is to connect a frequency counter to pin 6 of IC12 and adjust C-29 for a reading of 10.24 MHz.

C. RECEIVER OUTPUT FILTER

Connect an RF probe or wide band scope to the RX output jack. Align L-2 and L-3 for maximum output. For best results, realign L-1 and L-2 with the SYN II connected to transceiver for maximum sensitivity.

INSTALLATION

The SYN II synthesizer is easily interfaced to most of the 2 meter transceivers available on the market today. It may be programmed for any IF frequency offset between 100 Khz and 30 MHz in even 100 Khz sets. Standard plus and minus 600 Khz transmit offsets are provided, plus three additional user programmed offsets between plus 10 MHz and minus 30 MHz. The transmit output can be programmed to 6, 8, or 12 MHz.

Before installing the SYN II, it must be programmed to match your transceiver. The following information must be obtained from your transceiver instruction book:

A. Receiver IF frequency _____MH

B. Receiver crystal range:_____MH

C. Transmit crystal range:_____MH

D. Type of modulation: phase_____ , direct FM_____

GENERAL

The SYN II receiver and transmitter outputs are connected to the transceiver oscillator circuits. These connections must be made with 50 ohm coaxal cable. Cable lengths up to 30 feet may be used. One end of the cable should have an RCA phono plug on it. The other end may be directly wired to the transceiver. It may be necessary to drill a hole in the back of the transceiver for the cables.

RECEIVER

The receiver IF offset must be programmed to match the IF frequency of your transceiver (see receiver programming). The receive output of the SYN II is in the 45 MHz range. If your transceiver uses crystals in the 15 MHz range, the SYN II may still be used without modification. In most cases where the receiver uses 15 MHz crystals, the oscillator triples to 45 MHz. When using the SYN II, the oscillator is used as a 45 MHz buffer without modifications.

Refer to the schematic to your transceiver. Determine if the crystal switch is between the crystal and base of the oscillator or between the crystal and ground.

If the switch is located between the crystals and the oscillator, remove the crystal in position one. Connect the RX cable to the switch side of position one's crystal socket through the network as shown in figure 15A. The other crystal positions can be used as before. Power to the SYN II should be removed when using the crystal positions to prevent interferance.

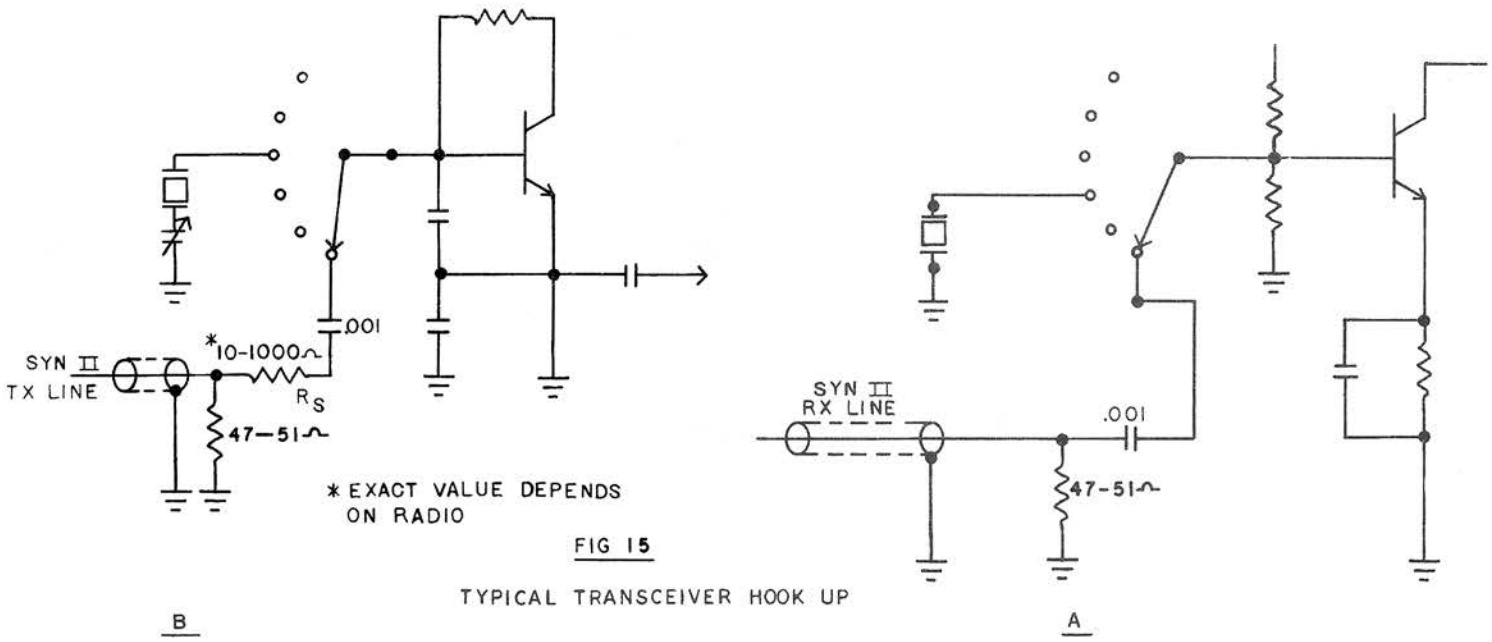


FIG 15

TYPICAL TRANSCEIVER HOOK UP

If the switch is on the ground side of the crystal, remove all receive crystals. Connect the RX cable to the oscillator side of any crystal socket through the network shown in figure 15B. In this case, the other crystal positions may not be used.

Be sure to solder the coax shield to an adjacent chassis or circuit board ground.

TRANSMIT

The output of the SYN II must be programmed to match the crystal range of your transceiver (see transmit programming). The transmit output of the SYN II is connected to the position one transmit crystal socket using the network shown in figure 15B. The other crystal positions can be used as before. The transmitter oscillator circuit is operated as a buffer. The series resistor adjusts the drive level. The resistor value is selected by experimentation. Its value will most likely be between 10 ohms and 1000 ohms. If Rs is too large, the transmitter will suffer from low output. If Rs is too small, the transmitter will have distorted audio. Start with a 100 ohm resistor and increase or decrease as necessary for proper operation.

DIRECT FM

If your transceiver uses direct FM of the crystal oscillator rather than phase modulation (Note: the VHF Engineering TX144 uses direct FM), then the SYN II should be modulated directly. This is accomplished by connecting the output from the transmitter modulator (this is usually the ARM of the deviation control) to the SYN II as shown in figure 16.

A network consisting of 3 resistors and a capacitor is connected between test point 10 and the TX terminal of the SYN II. In the transceiver, a 10K resistor is connected between the ARM of the deviation control and the center conductor of the coax. This technique permits the use of a single cable for SYN II RF and transmitter audio. The value of Rp may be adjusted to raise or lower the deviation range.

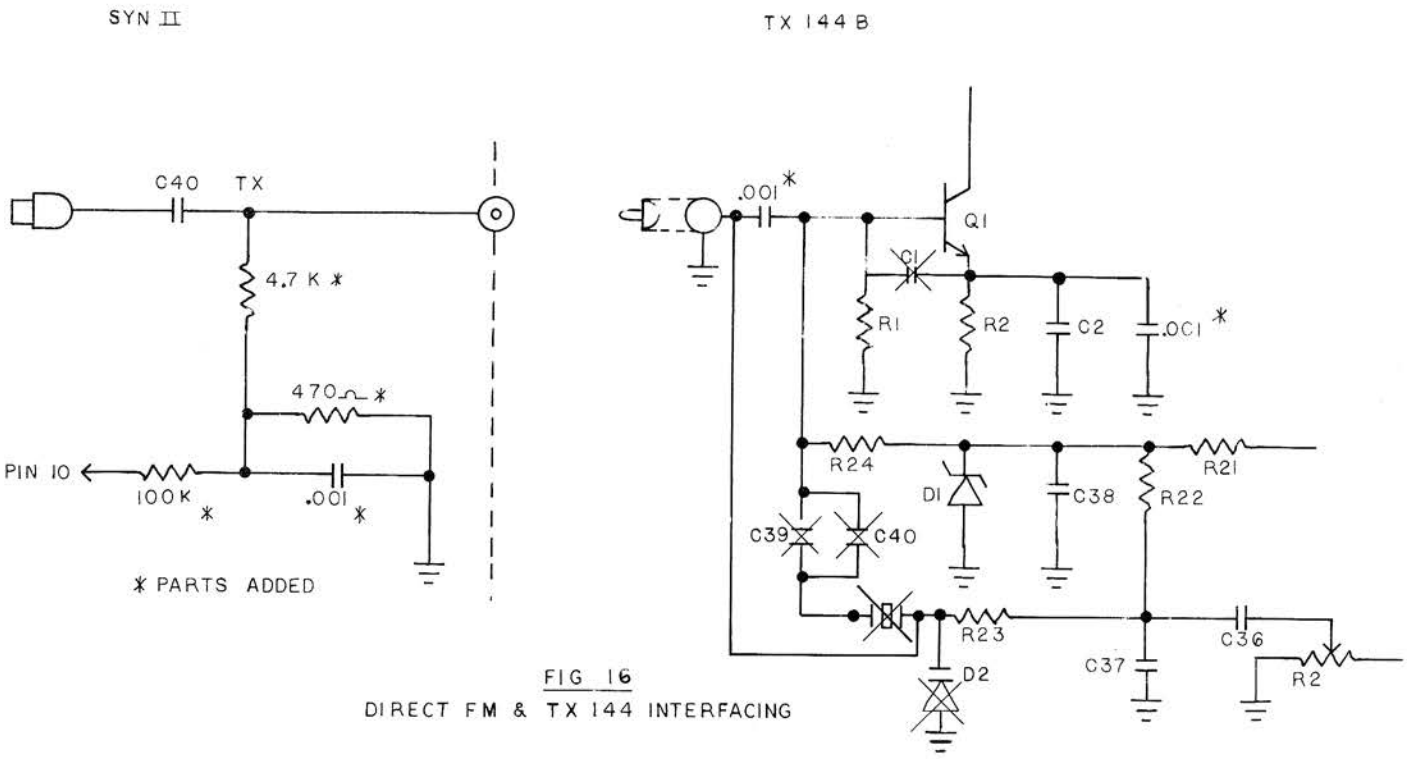


FIG 16
DIRECT FM & TX 144 INTERFACING

POWER

The DC power can be taken off the switched side of the transceiver's on/off switch. This will insure the SYN II is off when the transceiver is turned off.

PTT

In most cases, the SYN II PTT is connected directly to the transceiver mike PTT. Limiting and clamping diodes within the SYN II permit the unit to be used with PTT lines found in most rigs. The PTT line must go to ground on transmit. If the PTT line does not go to ground on transmit or operates off of AC, a relay will be needed for interfacing.

OPERATION

The SYN II has two controls on the front panel. The frequency thumb wheel and the offset switch. The receive frequency is always dialed in on the thumb wheel. The transmit frequency is equal to the dial frequency plus or minus the offset frequency. When the offset switch is in the simplex position, the transmit frequency is equal to the receive frequency.

For example, to work a 146.16/146.76 repeater, the thumb wheel dial would be set to 146.76 and the offset switch set to -600 Khz. To work reverse repeater, the thumb wheel dial would be set to 146.16 and the offset switch set to +600 Khz.

CIRCUIT DESCRIPTION

GENERAL

The SYN II synthesizer operates over a frequency range of 140.0 to 149.955 MHz with 5 Khz steps and is designed to be compatable with most of the popular 2 meter transceivers available today. Most of these available units are transmit crystals in the 6, 8, or 12 MHz range, and receive crystals in the 15 or 45 MHz range. One of the unique features of this unit is that it can be adapted to any IF frequency between 100 Khz and 30 MHz by simple diode programming. Repeater offsets of -600 Khz, +600 Khz and 3 user programmable offsets between +30 and +10 MHz are provided.

A VCO frequency of 22-25 MHz was chosen because it is easily divided to produce outputs of 6, 8, 12 MHz and is within the limits of commonly available logic. Since the actual operating frequency of the VCO is 1/6 of the transceivers output frequency, the reference frequency must be 1/6 of the output increments. Therefore, a reference frequency of 833.3 Hz is required for the 5 Khz increments.

VCO AND OUTPUT CIRCUITRY

The VCO is a modified Colpits oscillator whose frequency is determined mainly by L1 and voltage variable capacitor D14. The oscillator is designed so that by changing the voltage on D14 over a range of 1-4 volts, the frequency will vary from 25 to 22 MHz (note: as the voltage is increased, the frequency decreases). For improved stability, the bias voltage applied to the base of the oscillator and D14 is supplied by a separate 5 volt regulator, IC-21. The VCO output is buffered and converted to TTL logic by IC-19D and IC-18D. IC-20 is programmed by jumpers to provide output for the transmitter in the 6, 8, or 12 MHz range. IC18B is a buffer and line driver for the TX output.

In the receiver mode, capacitor C-43 is switched into the circuit to lower the operating range to compensate for receiver IF frequency offset. The output of the VCO is doubled to the 45 MHz range in Q-1 and connected to the RX terminal through a 2 pole LC filter. The transmitter output is disabled during receive mode. This is accomplished by turning off IC-20 with a ground from pin 15.

MASTER OSCILLATOR

The master oscillator consists of a crystal control oscillator using a 7400 IC and a 10.240 MHz crystal. The 10.240 MHz signal is divided by 12,288 in IC's 13 through 16 to produce a reference frequency of 833.3 Hz. This reference frequency goes to pin 1 of the phase detector, IC-17.

PHASE DETECTOR

The frequency/phase detector is used to compare the reference frequency with the output of the programmable divider. If the frequencies are not identical,

the frequency/phase detector produces an error voltage to raise or lower the frequency of the VCO so that the output from the programmable divider is equal to that of the reference. IC-20 is the frequency/phase detector. The error voltage output is fed to D-14 through a low pass filter consisting of Q2 and IC-19B and associated circuitry.

DIVIDE BY N COUNTER

The divide by N counter consists of IC1 through IC4. This counter is designed to divide by 14,000 through 14,999 corresponding to output frequencies of 140.00 MHz to 149.99 MHz in 10 Khz increments. The 5 Khz increments are provided by the additional divide by 2 counter in IC-10A.

The output of the divide by N counter is compared to a predetermined number, the programmable offset, in IC5 - 8. When the count equals the preset number, a reset pulse generated by IC5 is applied to pin 12 of IC-10B through IC-11B. This causes IC-10B pin 9 to go low, presetting the divide by N counters to the numbers set in the BCD switches. The next VCO pulse resets IC-10B allowing the divide by N to start its count down cycle. IC-10B toggles once for every count down cycle. The output pulse on pin 8 of IC-10B is equal to the VCO frequency divided by the number programmed on the switches minus the pre-programmed offset selected. This pulse is fed to pin 3 of the phase comparator. This effectively subtracts the pre-programmed number from the number set in the switches to produce receive and repeater offsets. The preset pulse lasts for two VCO cycles. This insures proper preset time for the counters. The resulting two count error is compensated by the -2 permanently programmed into IC8.

The output pulse on pin 8 of IC-10B is also fed back to IC-10A through IC-11D. When the 5 Khz switch is set to 5, a negative pulse from IC-11D presets IC-10A. This causes one VCO cycle to be swallowed for every count down cycle. This causes the VCO to move up the equivalent of 5 Khz.

CONTROL

In the receive mode, the PTT line is held high through R13 causing the transmit line to be low through IC-9AB and the receive line to be high through IC-9CD. The high on the receive line program IC-5-7 through the diode matrix to the receive offset frequency. In the transmit mode, the transceiver PTT line provides a ground causing the transmit line to go high and the receive line to go low. The transmit line is applied to the selectable offset switch. Depending on the position of the switch, a zero offset for simplex, -600 Khz, +600 Khz or 3 user programmable offsets are selected.

POWER SUPPLY

The 10-18V input voltage is preregulated to +9 volts by Q3 and associated circuitry. IC-22 provides 5 volts regulated for all logic. IC-21 provides separate regulation and isolation for the VCO.

TROUBLE SHOOTING

This guide is designed to provide a logical trouble shooting procedure. All problems and possible solutions are beyond the scope of this manual. You may phone or write our Service Department for additional servicing information. A listing of the results of the following test will aid us in solving your particular problem.

1.) Measure the voltage on pin "E".
   a.) 8.5 - 9 volts is normal
   b.) Less than 8 volts - check Q-3, D-13 and R-45

2.) Measure voltage on pin 12.
   a.) 5 - 5.5 volts is normal
   b.) 0 volts - check IC-22, or for possible short circuit on p.c. board

3.) Measure voltage on pin 11.
   a.) A voltage between 2-4 volts that varies with setting of thumb wheel switch and L-1 is normal.
   b.) 0 voltage - check IC-21, R-36 and for possible solder bridge.
   c.) More than 4.5 volts indicates loss of reference on pin 1 of IC-17 or VCO too high in frequency (see 4 below).
   d.) Less than 1.5 volts indicates loss of divide by N output or VCO is too low in frequency or inoperative (see 5 and 6 below).

4.) The reference chain may be checked at the following test points with a frequency counter or scope. No reading indicates a bad IC or possible solder short in that circuit.

IC16	-	Pin 8	833.3 Hz
IC15	-	Pin 11	5 Khz
IC14	-	Pin 11	40 Khz
IC13	-	Pin 11	640 Khz
IC12	-	Pin 16	10.24 MHz

5.) The VCO and buffers may be checked at the following test points with a frequency counter or scope. A reading of 20-28 MHz, depending on adjustment settings, is normal. No reading indicates a bad IC or possible solder short in that circuit.

IC11	-	Pin 3
IC18	-	Pin 3
IC19	-	Pin 14

6.) The divide by N (IC1-4) requires a logic 1 (2-5 volts) on pin 11 to count down. Normally, there is a .04 Microseconds negative pulse at a 833.3 Hz rate. This pulse may be too narrow to activate your counter or scope. The divide by N may be checked with a frequency counter or scope at the following test points:

IC10	-	Pin 5	11-13 MHz
IC4	-	Pin 7	1.1-1.3 MHz
IC3	-	Pin 13	110-130 Khz
IC2	-	Pin 13	11-13 Khz
IC1	-	Pin 13	.8-1.3 Khz*

*Will equal 833.3 Hz when loop is locked

7.) The following voltages may be helpful in servicing the active filter and VCO section.

IC19	-	Pin 4	Less than .3 volts on transmit
		Pin 4	More than .6 volts on receive
		Pin 7	1-4 (.6 volts less than pin 11)
		Pin 8	4.9-5.2 volts
		Pin 9	4.9-5.2 volts
		Pin 10	4-5 volts
		Pin 11	8-9 volts
		Pin 14	2.5-4 volts

8.) PC board may be lifted off chassis for service as follows:

a.) Remove thumb wheel and offset switches from front panel.
b.) Remove the four nuts holding board in place.
c.) Lift circuit board out of chassis for access to bottom of board.

SEMICONDUCTORS

IC1	74193	(1040130)	IC12	7400	(1040010)
IC2	74192	(1040120)	IC13	7493	(1040090)
IC3	74192	(1040120)	IC14	7493	(1040090)
IC4	74192	(1040120)	IC15	7493	(1040090)
IC5	7485	(1040060)	IC16	7492	(1040080)
IC6	7485	(1040060)	IC17	MC4044	(1050130)
IC7	7485	(1040060)	IC18	7400	(1040010)
IC8	7485	(1040060)	IC19	LM3086	(1050100)
IC9	74128	(1040150)	IC20	74H73	(1040030)
IC10	7474	(1040040)	IC21	LM341P	(1050021)
IC11	7400	(1040010)	IC22	LM309K	(1050060)
D1-D12	1N4148	(1010049)	Q1	MPS6539	(1020160)
	+5 for optional Matrix Wiring		Q2	2N6514	(1020150)
			Q3	2N6576	(1020170)
D13	1N4740 10V Zener	(1010060)			
D14	MV2209	(1010080)			

RESISTORS

R1	330	(2020170)	R26	560	(2020210)
R2			R27	220	(2020145)
R3			R28	220	(2020145)
R4			R29	1.8K	(2020255)
R5			R30	2.2K	(2020260)
R6			R31	2.2K	(2020260)
R7			R32	1K	(2020230)
R8			R33	1K	(2020230)
R9			R34	1K	(2020230)
R10			R35	2.2K	(2020260)
R11			R36	4.7K	(2020290)
R12	330	(2020170)	R37	15K	(2020350)
R13	2.2K	(2020260)	R38	10K	(2020330)
R14	330	(2020170)	R39	15K	(2020350)
R15			R40	10K	(2020330)
R16			R41	4.7K	(2020290)
R17			R42	470	(2020440)
R18			R43	47K	(2020390)
R19			R44	2.2K	(2020260)
R20			R45	100 1 watt	(2020110)
R21			R46	100	(2020100)
R22			R47	100	(2020100)
R23			R48	1K	(2020230)
R24			R49	2.2K	(2020260)
R25	330	(2020170)			

* Unless otherwise noted, all are 1/4 watt 10%

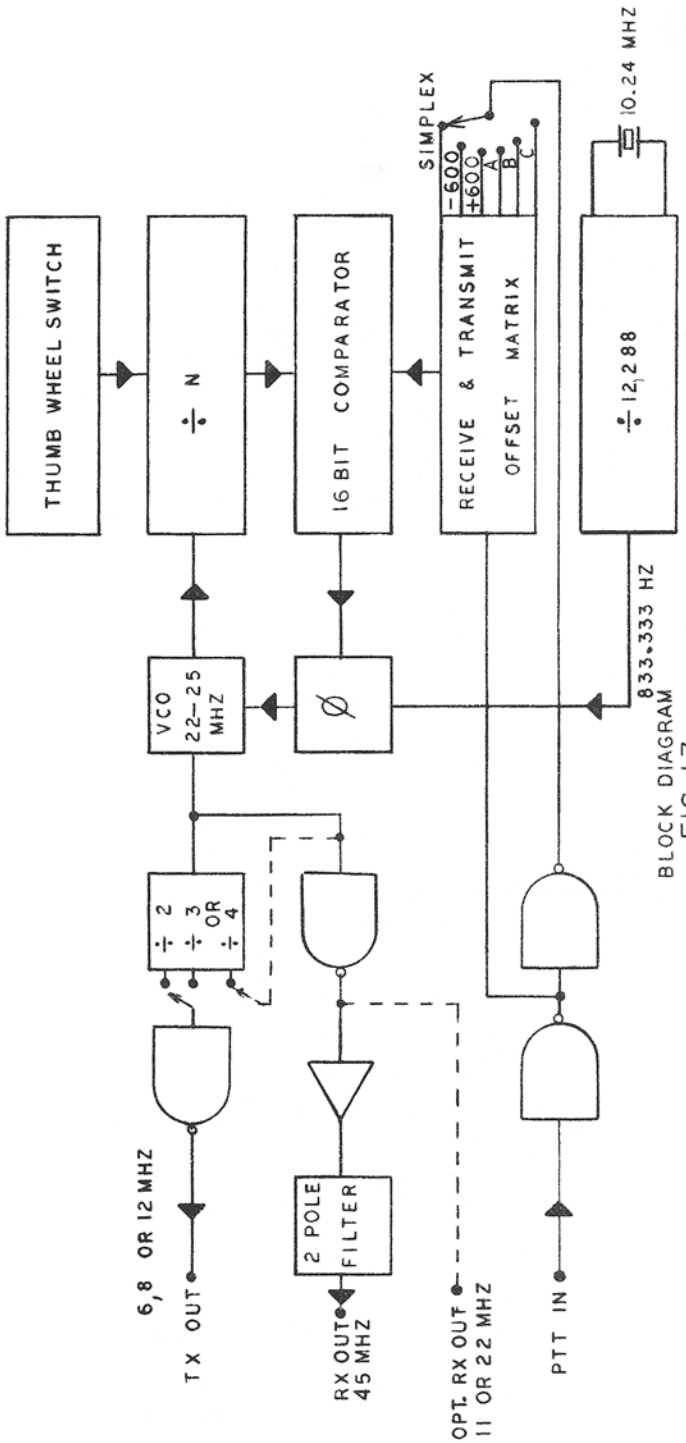
ADDITIONAL

Chokes		
RFC1	VK200	(2040090)
RFC2	VK200	(2040090)
L2	Brown Coil	(2030075)
L3	Brown Coil	(2030075)
L1	Coil Form	(2030100)
	Shield	(2030090)
	Grommet	(4070080)
	Slug	(2030110)

1	Thumb Wheel Switch w/hardware	(3010075)
1	6 pos. switch w/hardware	(3010065)
1	10.24MHz crystal	(2310240)
1	case & cover (4030790)	(4030800)
1	knob	(4050425)
	Keystone Pins	(4060130)
	Misc Mounting Hardware	
1	PC Board	(4040210)
1	Manual	(5011204)

CAPACITORS

C1	.01	(2010410)
C2	.001	(2010370)
C3		
C4		
C5		
C6		
C7		
C8		
C9		
C10		
C11		
C12		
C13		
C14	.001	(2010370)
C15	47MFD 16V	(2010530)
C16	.01	(2010410)
C17	.01	(2010410)
C18	.01	(2010410)
C19	47MFD 16V	(2010530)
C20	47MFD 16V	(2010530)
C21	.01	(2010410)
C22	.01	(2010410)
C23	.01	(2010410)
C24	.001	(2010370)
C25	15pf SM	(2010140)
C26	.01	(2010410)
C27	.01	(2010410)
C28	.01	(2010410)
C29	20pf Var.	(2010650)
C30	100MFD 16V	(2010540)
C31	100MFD 16V	(2010540)
C32	47MFD 16V	(2010530)
C33	.1 Mylar	(2010450)
C34	1MFD Tan.	(2010460)
C35	.005	(2010390)
C36	47pf	(2010190)
C37	.001	(2010370)
C38	.1 Mylar	(2010450)
C39	.05 Mylar	(2010432)
C40	.001	(2010370)
C41	.01	(2010410)
C42	.001	(2010370)
C43	40pf Var.	(2010670)
C44	.05 Mylar	(2010432)
C45	.005	(2010390)
C46	22pf	(2010120)
C47	2.2pf	(2010030)
C48	.01	(2010410)
C49	27pf	(2010150)
C50	100pf	(2010250)
C51	47MFD 16	(2010530)
C52	.01	(2010410)
C53	820pf SM	(2010350)
C54	.01	(2010410)
C55	100pf SM	(2010255)
C56	100pf SM	(2010255)
C57	.001 FT	(2010365)
C58	.001 FT	(2010365)
C59	.1	(2010440)



BLOCK DIAGRAM
FIG 17

NOTES

1. WORKS ON ANY I.F. BETWEEN 100 KHZ AND 30 MHZ.

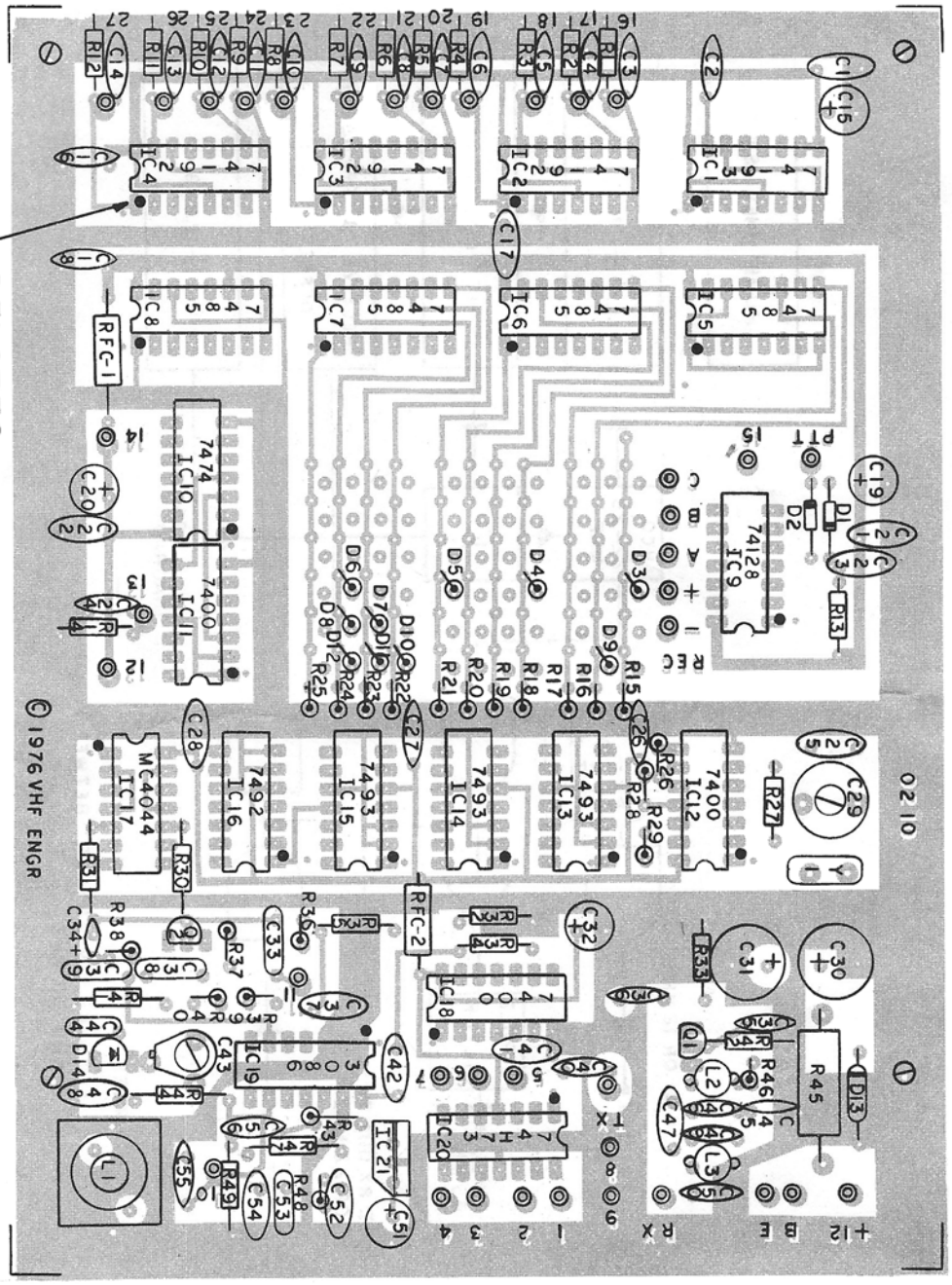


FIG 18

VHF ENGINEERING DIVISION of Brownian Electronics Corp.
320 Water Street, PO Box 1921, Binghamton, N.Y. 13902

SYN II ERRATA SHEET

PLEASE MAKE THE FOLLOWING CHANGES AND ADDITIONS TO THE SYN II MANUAL:

1.) Page 3, Item 2
Change to 74LS00

2.) Page 6, Item 6
NOTE: VK200 is the 2½ turn choke on ferrite bead.

3.) Page 6, Item 8
Change MV2209 quantity to 1.

4.) Page 11, last sentence, first paragraph
Should read as follows: See figure 9.

5.) Page 16, Figure 14
Transmitter output connections under 12 MHz: change (2-8) jumper to (5-8).
Add Note: There will be two wires to pin 15.

6.) Page 16, last sentence
Should read as follows: Realign L-2 and L-3.

7.) Schematic
Transmitter output connections under 12 MHz: change (2-8) jumper to (5-8).

8.) Schematic
Change IC-12 to 74LS00

5 KHZ SWITCH

10 KHZ SWITCH

100 KHZ SWITCH

1 MHZ SWITCH

IC-4 74192

IC-3 74192

IC-2 74192

IC-1 74193

IC-8 7485

IC-7 7485

IC-6 7485

IC-5 7485

IC-12 7400

IC-13 7493

IC-14 7493

IC-15 7493

IC-16 7492

IC-17 MC4044

IC-21 341P

IC-20 74H73

IC-22 LM 309K

Y1 (10.240)

C29 20p

C25 15p

R27 220Ω

R29 1.8K

R28 220Ω

R26 560

Q2 6514

Q1 MPS6539

2N6576 Q3

D13 R45 100 1W

D1 IN 914 OR IN4148

D2 IN 914 OR IN4148

PTT

REC.

SIMPLEX

-600

+600

A

B

C

N.C.

+5V

+12

+12V

TX

RX

L1

L2

L3

RFC1

RFC2

TRANSMITTER OUTPUT CONNECTIONS

6 MHZ	CONNECT (1-15) (4-6)
8 MHZ	" " (3-5)(4-6)(7-15)
12 MHZ	" " (2-8)(4-6)(7-15)

NOTES:

1 ALL CAPACITORS IN MFD UNLESS NOTED.
2 ALL RESISTORS ARE ¼ W. UNLESS NOTED.
3 LOGIC POWER & GROUND CONNECTORS NOT SHOWN.

DR		TOLERANCE UNLESS OTHERWISE SHOWN 2 PLACE ± .02 3 PLACE ± .005 FRACTIONS ± 1/64	VHF ENGINEERING DIVISION OF BROWNIAN ELECTRONICS CORP. BINGHAMTON, N. Y.
DR CHK			
DESIGN CHK		FINISH:	
SHEET 1 OF 1	SIZE K	MATL:	SCHEMATIC SYN II
NEXT ASSY	USED ON		SCALE: DWG NO. 10174