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**Cobra 40X Service Manual Addendum**

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**ADDENDUM**

**TO**

**SERVICE MANUAL**  
**SERVICE MANUAL**

**MODEL 40X**

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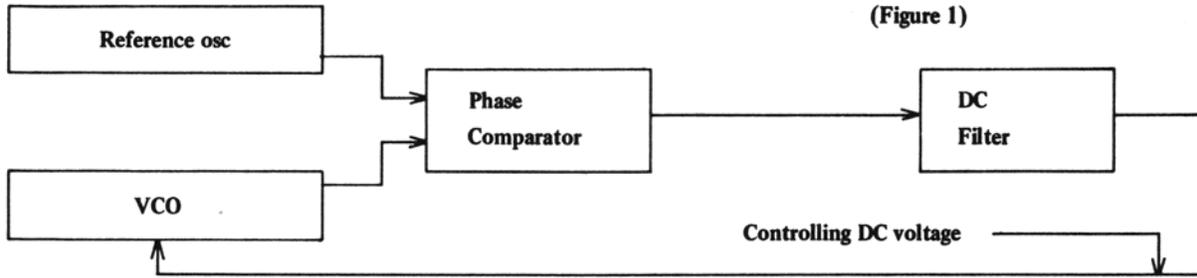
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# OPERATING THEORY OF PLL FREQUENCY SYNTHESIZER

## 1. Fundamental theory of PLL Circuitry

The purpose of PLL (Phase Locked Loop) circuit is to generate multiple number programable frequencies from a signal reference frequency with quartz crystal accuracy.

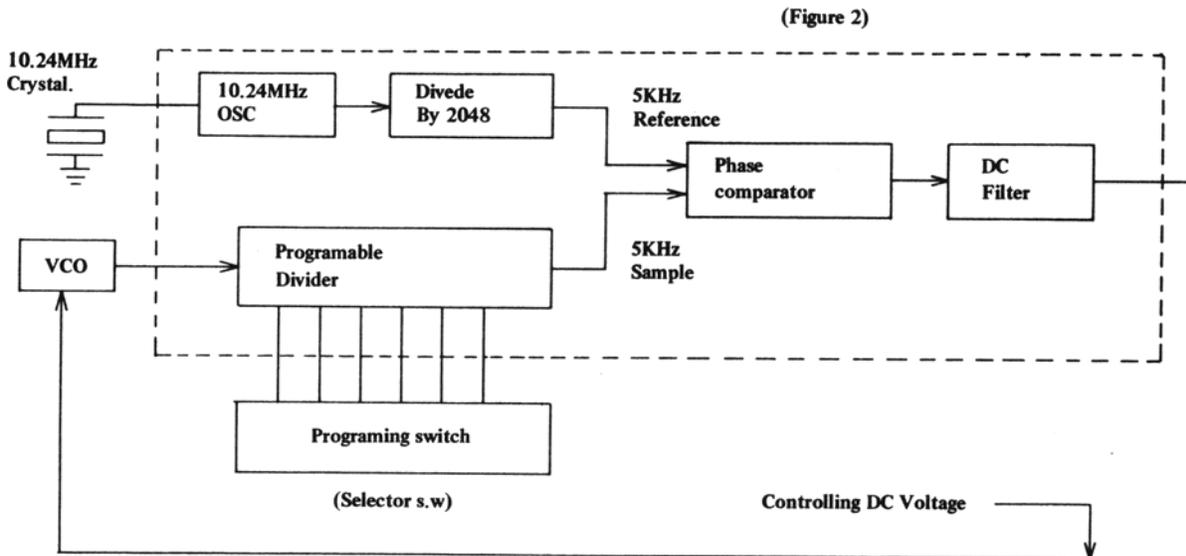
A basic PLL circuitry consists of reference oscillator, VCO, phase comparator and DC filter (low pass filter).



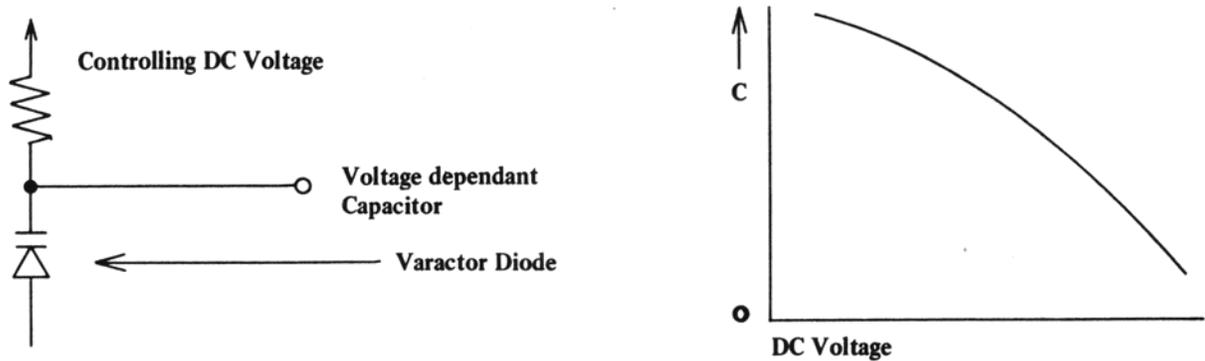
With the above circuit the VCO (Voltage Controlled Oscillator) Frequency is effectively locked to the reference oscillator, and its accuracy is as good as the reference oscillator.

Since the CB radio's adjacent channel spacing is 10KHz (or multiple of 5KHz), our purpose should be to produce multiple of programable frequencies that are spaced apart by 10KHz.

Therefore the basic PLL circuitry is expanded as follow:



The most important part of VCO circuitry is a voltage controlled variable capacitor called varicap or varactor diode whose capacitance depends on DC voltage applied to its cathode.



The varactor diode is responsible for setting VCO frequency, and once set it regulates the VCO frequency against the reference.

The VCO frequencies are chosen in 16 to 17MHz range as shown on table 1.

To obtain transmit signal the VCO is mixed with 10.24MHz. As an example for channel 1:  
 $10.24 + 16.725 = 26.965\text{MHz}$

For receiver mode the VCO is used as a first local oscillator  
channel 1:

$$26.965 - 16.27 = 10.695\text{MHz}$$

The above first IF of 10.695MHz is mixed again with 10.24MHz crystal oscillator frequency which serves as the second local oscillator.

$$10.695 - 10.24 = 0.455\text{MHz}$$

As can be seen above the VCO frequency shifts from 16.725 to 16.27MHz when changed from transmit to receive for the same channel 1.

The shift is accomplished by "read only memory" incorporated inside the PLL IC-1 between the selector switch and the VCO divider (programmable).

When transmit logic signal is applied to the IC-1 through pin 19, the programmable divider will divide incoming VCO frequency by 3345 to produce 5KHz sampling signal.

$$16725 \div 3345 = 5\text{KHz}$$

For the receiver mode the programable divider will automatically change to divide the VCO frequency by 3245.

$$16270 \div 3254 = 5\text{KHz}$$

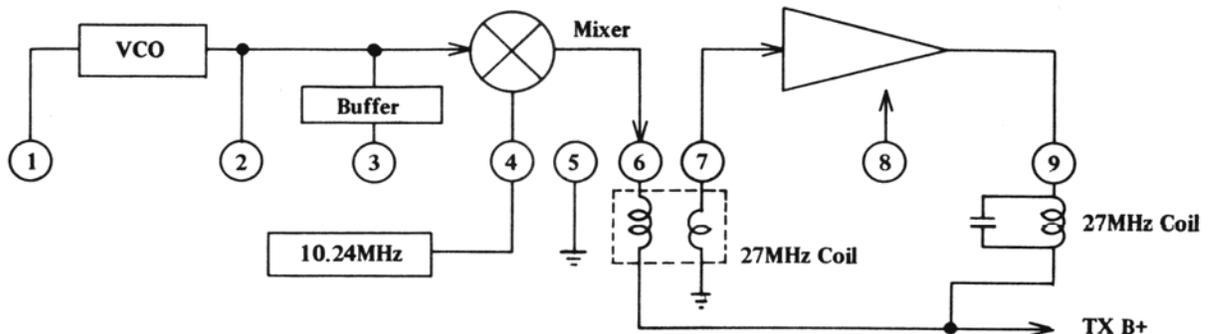
Note that the reference frequency of 5KHz is obtained by dividing the 10.24MHz by 2048 times. (5KHz reference is used instead of 10KHz for division convenience).

See table 1 for transmit/receive mode VCO frequencies.

## 2. Transmitter Circuit

IC-1 (PLL LSI), VCO section of IC-203 (pin 1, 2 and 3) are operational regardless of the receive or transmit mode. When the radio is set to the transmit mode, mixer/amplifier section of IC-3 (pin 4, 6, 7 and 9), Q206, Q301, Q302 and Q303 are activated. The VCO frequency selected by the channel selector switch is mixed with 10.24MHz to generate desired transmit frequency. The mixing is done by a balanced mixer circuit located inside the IC3.

Equivalent Circuit of IC203



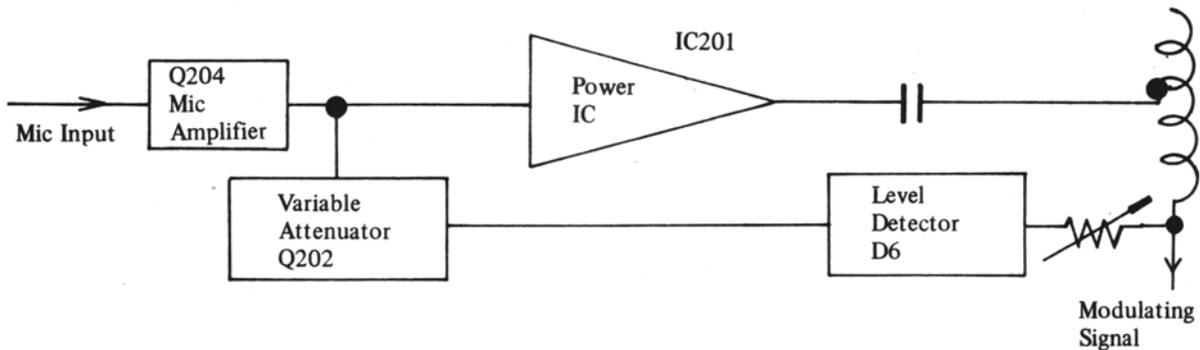
The resulting transmit frequency from pin 9 of IC203 is filtered by L301 and L302. Q301 is an amplifier/switch circuit. When VCO frequency is out of "Lock" condition pin 14 of IC202 pulls down bias voltage of Q301 to ground disabling Q301 from passing possible illegal frequencies.

Q302 is a RF power driver circuit and Q303 is the final RF power amplifier.

A modulation audio signal is applied to the collectors of Q302 and Q303 through a audio power transformer T201.

The audio signal (mic input) applied by a single power IC201.

The modulation limiting is accomplished by a automatic level control circuit which is as follow :



L305 and C350 are series resonator, and L306, L307, C340, C344 and C345 make up pie-low pass filter.

C335 is factory selected and limits the RF output power level to within the FCC limit of 4 watts.

### 3. Receiver Circuit

In the receiver mode of operation, Q206 transistor is turned off. Also bias voltage is applied to Q105 and a proper bias and AGC voltage is established to Q101, Q102, Q103, and Q105.

Q101 is a 27MHz RF input amplifier and any excessive input signal is limited by diodes D101 and D105. The amplified 27MHz is mixed with VCO frequency selected by channel switch. For channel 1 VCO is set at 16.27MHz. The resulting first IF is  $26.965 - 16.27 = 10.695\text{MHz}$ .

Q102 and Q103 is the first converter, and the 10.695MHz is sharply filtered by L103 and a ceramic filter CF-1. The first IF is again mixed with a second local oscillator of 10.24MHz.  $10.695 - 10.24 = 0.455\text{MHz}$ .

Q104 is the second converter and the 455KHz. Second IF is filtered by a razor sharp ceramic filter of CF-2 coupled with L105.

Q105 is a first 455KHz amplifier, and the Q106 being the last amplifier.

D108 is a detector diode which produces audio signal as well as a negative DC voltage for AGC action.

The negative voltage also provides forward biasing to the cathode of ANL clipping diode of D110. The biasing voltage has a time constant determined by R128 and C124.

Therefore any sharp negative going pulse from D108 will back bias A110 and be clipped.

## ALIGNMENT EQUIPMENT FOR CB TRANSCEIVER

### 1. Test Voltage

DC 13.8V  $\pm$  5%, unless otherwise specified.

### 2. Test Equipment

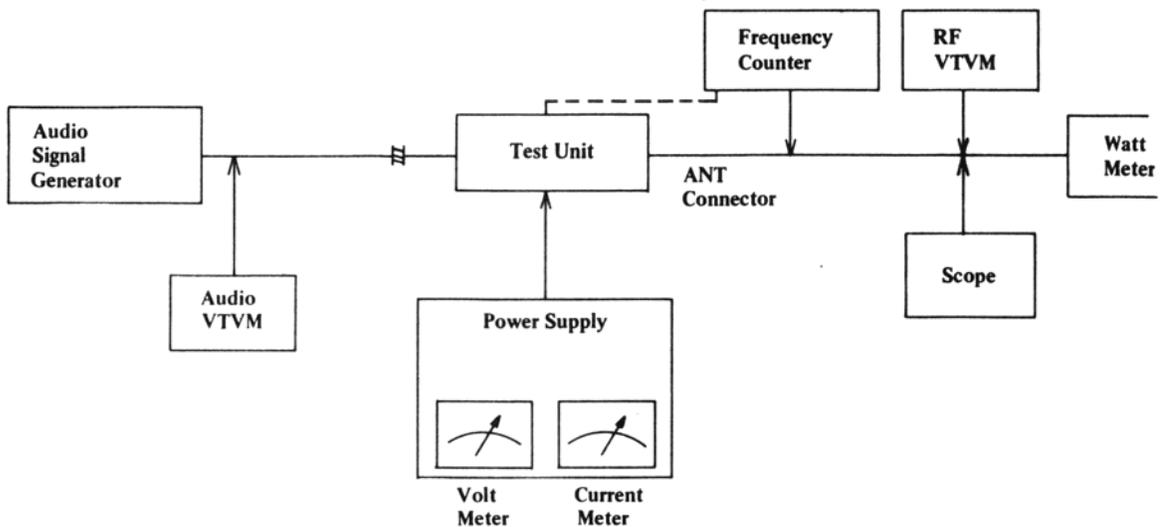
All Test equipment should be properly calibrated.

1. Audio signal generator, 10Hz-20KHz.
2. VTVM 1mV measurable
3. DC ampere meter, 2A
4. Regulated power supply, DC 0-20V, 2A or higher
5. Frequency counter, 0-40MHz, high input impedance type
6. RF VTVM probe type
7. Oscilloscope, 30MHz, high input impedance
8. RF watt meter, thermo-couple type, 50 ohm, 5W
9. Standard signal generator, 100KHz-50MHz, 50 ohm unvalanced
10. Speaker dummy resistor, 8 ohm 5W
11. Circuit tester, DC, 20K ohm/V

### 3. Transmitter Alignment

#### 3-1 Test Setup

Refer to the diagram shown below.



### Transmitter Alignment Set Up

Note:

- a. When connecting audio cable to the microphone input circuit, always use a shield cable.
- b. When making alignment for RF power output, always use the supplied DC cable.

#### PLL Circuit alignment

- a. 10.24MHz Oscillator check

Connect a frequency counter to the pin 12 and check to see 10.240000MHz  $\pm$  100Hz.

When a defective crystal is replaced, and if the frequency is higher than by 100Hz the C304 should be increased. If the frequency is lower, the C304 should be reduced in capacitance.

With a factory supplied crystal C304 value of 47 pfd should be sufficient but on some sets minor value selection may be necessary.

### b. VCO alignment

1. Set the Radio to channel 40 and in transmit mode. (make certain 50 ohm dummy load or wattmeter is connected to antenna terminal)
2. Connect a circuit tester between TPI and ground.
3. Adjust L203 to obtain 5.0V DC.
4. Set the Radio to channel 1 and in receive mode.
5. Check to see the TPI DC voltage dropping to a level between 0.3 to 1.0 volt DC. As long as the DC level stays between 5.0V DC for Transmit at channel 40 and 0.3 to 1.0V DC for receive at channel 1, the VCO is set properly.

The magnitude of the TPI voltage swing is determined by C312 at factory.

The optimum value of C312 was found to be around 60 pfd.

C312 with value larger than 60 pfd will reduced the voltage swing magnitude and vice versa for smaller value. If the lower value drops only to 1.5V DC, then the C312 of 60 pfd should be reduced to increase the range.

But this shouldn't be necessary when factory supplied parts are used for D303 (varactor diode) and L203 (VCO tuning coil).

### 3-2 RF Amplifier Stage Alignment

1. Reduce power supply voltage to 9.0V.
2. Place the channel selector in channel 19, and connect the oscilloscope to the antenna connector through a suitable connection pad.
3. Adjust L204, L301, L302 and L303 for maximum amplitude of the scope display.
4. Increase the power supply voltage to 13.8V, then adjust L306 until the watt meter indicates 3.8W.
5. Measure the transmit power output at all channels, and make sure the power output difference between any channels is less than 0.3W.
6. Measure the transmit frequency at all channels, and make sure the frequency is within  $\pm 800\text{Hz}$  from the assigned channel center frequencies.

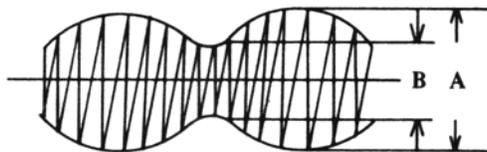
### 3-3 Transmit Frequency Check

1. Set the radio into transmit mode with no modulation.
2. Connect the frequency counter to the antenna load or to the tab provided at the wattmeter.

The frequency should be within  $\pm 800\text{Hz}$  from each channel center frequency as tabulated in the frequency table attached.

### 3-4 Modulation Sensitivity Alignment

1. Set the unit to transmit mode of operation.  
Feed 1 KHz, 30mV signal to the microphone input circuit, and adjust RV201 so that 100% modulation is obtained.



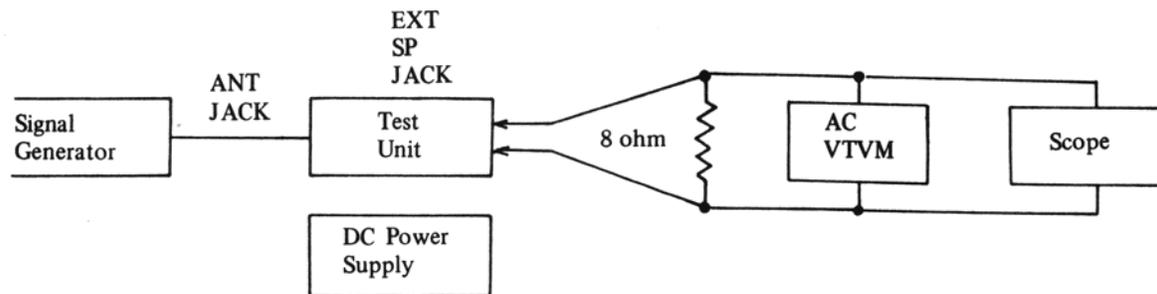
$$\text{Modulation ratio} = \frac{A-B}{A+B} \times 100(\%)$$

2. Next, reduce the signal input level to 3mV, and make sure the modulation is higher than 60%.

#### 4. Receiver Circuit Alignment

##### Test Setup

Refer to the diagram shown below.



**RECEIVER ALIGNMENT SETUP**

##### Sensitivity Alignment

1. Set the signal generator to provide 27.185MHz, 1KHz 30% modulation. Place the channel selector in channel 19 position.
2. Adjust L101, L102, L108 and L103 for maximum audio output across the 8 ohm dummy load resistor.

This alignment should be performed by gradually decreasing the signal output signal to a minimum level required for tuning to avoid inaccurate alignment due to AGC action.

##### Squelch Circuit Alignment

1. Set the signal generator to provide 50dB, 1KHz, 30%mod. antenna input.
2. Rotate the squelch control in full clockwise direction.
3. Temporarily adjust RV101 for maximum audio output, and note the audio output level. Then adjust RV101 so that the audio output level decreases by 6dB.
4. Next, reduce the antenna input signal level to 43-48dB and make sure the audio output decreases to zero.
5. Reduce antenna signal input level to zero, and adjust the SQ control until the noise output decreases to just disappear.

Frequency Chart

(Table 1)

| CH NO | CHANNEL FREQ (MHz) | CRYSTAL OSC | VCO    |       |
|-------|--------------------|-------------|--------|-------|
|       |                    |             | TX     | RX    |
| 1     | 26.965             | 10.24       | 16.725 | 16.27 |
| 2     | 26.975             | "           | 16.735 | 16.28 |
| 3     | 26.985             | "           | 16.745 | 16.29 |
| 4     | 27.005             | "           | 16.765 | 16.31 |
| 5     | 27.015             | "           | 16.775 | 16.32 |
| 6     | 27.025             | "           | 16.785 | 16.33 |
| 7     | 27.035             | "           | 16.795 | 16.34 |
| 8     | 27.055             | "           | 16.815 | 16.36 |
| 9     | 27.065             | "           | 16.825 | 16.37 |
| 10    | 27.075             | "           | 16.835 | 16.38 |
| 11    | 27.085             | "           | 16.845 | 16.39 |
| 12    | 27.105             | "           | 16.865 | 16.41 |
| 13    | 27.115             | "           | 16.875 | 16.42 |
| 14    | 27.125             | "           | 16.885 | 16.43 |
| 15    | 27.135             | "           | 16.895 | 16.44 |
| 16    | 27.155             | "           | 16.915 | 16.46 |
| 17    | 27.165             | "           | 16.925 | 16.47 |
| 18    | 27.175             | "           | 16.935 | 16.48 |
| 19    | 27.185             | "           | 16.945 | 16.49 |
| 20    | 27.205             | "           | 16.965 | 16.51 |
| 21    | 27.215             | "           | 16.975 | 16.52 |
| 22    | 27.225             | "           | 16.985 | 16.53 |
| 23    | 27.255             | "           | 17.015 | 16.56 |
| 24    | 27.235             | "           | 16.995 | 16.54 |
| 25    | 27.245             | "           | 17.005 | 16.55 |
| 26    | 27.265             | "           | 17.025 | 16.57 |
| 27    | 27.275             | "           | 17.035 | 16.58 |
| 28    | 27.285             | "           | 17.045 | 16.59 |
| 29    | 27.295             | "           | 17.055 | 16.60 |
| 30    | 27.305             | "           | 17.065 | 16.61 |
| 31    | 27.315             | "           | 17.075 | 16.62 |
| 32    | 27.325             | "           | 17.085 | 16.63 |
| 33    | 27.335             | "           | 17.095 | 16.64 |
| 34    | 27.345             | "           | 17.105 | 16.65 |
| 35    | 27.355             | "           | 17.115 | 16.66 |
| 36    | 27.365             | "           | 17.125 | 16.67 |
| 37    | 27.375             | "           | 17.135 | 16.68 |
| 38    | 27.385             | "           | 17.145 | 16.69 |
| 39    | 27.395             | "           | 17.155 | 16.70 |
| 40    | 27.405             | "           | 17.165 | 16.71 |

## PARTS LIST FOR COBRA MODEL 40X

| Reference No.  | Manufacturer's Part Number | DYNASCAN Part Number | Reference No.       | Manufacturer's Part Number | DYNASCAN Part Number |
|--|----------------------------|----------------------|---------------------|----------------------------|----------------------|
| R104,108   | 0111019GR                  | 182-029-9-001        | C344                | 263310775                  | 023-081-9-001        |
| Q201,202,203   | 01120020C                  | 176-128-9-001        | C303,338            | 264700775                  | 023-065-9-006        |
| Q101,107,301   | 01120030C                  | 176-115-9-001        | C302                | 265600775                  | 023-065-9-005        |
| Q109,206   | 01120060T                  | 177-049-9-001        | C133                | 268090775                  | 023-081-9-002        |
| Q205   | 01120070T                  | 176-115-9-004        | CH301               | 31000819B                  | 042-041-9-001        |
| Q106   | 01120080H                  | 176-125-9-001        | T201                | 31001928D                  | 061-057-9-001        |
|  | 011103100                  | 176-028-9-003        | RFC305              | 33100100H                  | 047-008-9-001        |
| Q105   | 01120080I                  | 176-115-9-002        | RFC304              | 33100100V                  | 047-008-9-002        |
|  | 011103100                  | 176-028-9-003        | RFC307              | 331091000                  | 041-134-9-007        |
| Q110,204   | 01120100T                  | 176-132-9-001        | RFC202,204,205      | 331092000                  | 041-134-9-006        |
| Q303   | 01130040E                  | 172-062-9-001        | RFC301,302,303      | 332201000                  | 041-134-9-002        |
|  | 011600400                  | 172-024-9-002        | RFC201              | 332500050                  | 041-134-9-001        |
| Q302   | 01130070E                  | 176-120-9-001        | RFC306              | 334540050                  | 046-039-9-001        |
|  | 011600100                  | 172-059-9-001        | RFC309              | 335042000                  | 041-134-9-008        |
| Q102,103   | 01170010B                  | 182-138-9-001        | RFC308              | 336890050                  | 041-134-9-004        |
| IC201  | 021100300                  | 307-272-9-001        | L108                | 340003100                  | 047-008-9-003        |
| IC202  | 021300400                  | 307-272-9-002        | L101                | 34000510B                  | 046-039-9-002        |
| IC203  | 021401200                  | 307-272-9-003        | L102                | 34000610A                  | 046-039-9-003        |
| D102,105,108,111,112,206   | 030000600                  | 150-001-9-005        | L104,204            | 34000710A                  | 046-039-9-004        |
|  | 030000700                  | 150-016-9-001        | L103                | 34000710B                  | 047-008-9-004        |
| D302   | 030000800                  | 152-114-9-001        | L105                | 340008100                  | 046-039-9-005        |
| D101,103,104,106,107,109,<br>110,201,202,203,204,301,<br>304,305,401,402,403,404,<br>405,406,407,408,409,410,<br>411,412 | 030005200                  | 151-035-9-001        | L106                | 340009100                  | 046-039-9-006        |
|  | 030001100                  | 151-093-9-001        | L107                | 340010100                  | 046-039-9-007        |
|  | 030001200                  | 151-028-9-007        | L107                | 340010100                  | 046-039-9-007        |
|  | 030001300                  | 151-108-9-001        | L301                | 34001210A                  | 046-039-9-008        |
| D205,306   | 030001500                  | 151-050-9-001        | L302                | 340013100                  | 046-039-9-009        |
|  | 030001400                  | 151-082-9-001        | L303                | 340014100                  | 046-039-9-010        |
| D303   | 030002100                  | 154-009-9-001        | L304                | 340015100                  | 046-039-9-011        |
|  | 030002000                  | 154-008-9-001        | L307                | 34001600B                  | 046-039-9-012        |
| D307   | 030003000                  | 158-045-9-001        | L305                | 34001710B                  | 046-039-9-013        |
|  | 030004100                  | 238-019-9-001        | L306                | 340018100                  | 046-039-9-014        |
| X201   | 042500200                  | 132-036-9-001        | L203                | 340035100                  | 046-039-9-015        |
| CF2  | 052600500                  | 140-006-9-001        | PCB 40 Connector    | 410212060                  | 302-670-9-001        |
| CF1  | 052600800                  | 140-006-9-002        | PCB Rotary          | 41320701A                  | 302-672-9-001        |
| R318   | 1410001JS                  | 011-001-5-100        | PCB LED Display     | 41420702A                  | 302-673-9-001        |
| R231   | 1415002JS                  | 011-002-5-150        | PCB LED Lamp        | 414207030                  | 302-674-9-001        |
| VR104  | 15103201B                  | 008-436-9-001        | Microphone Assembly | 501020150                  | 561-002-9-001        |
| VR103,105  | 15503201B                  | 008-457-9-001        | Cover Upper         | 711120580                  | 253-112-9-001        |
| VR102  | 15503211A                  | 008-436-9-002        | Cover Bottom        | 712120660                  | 252-045-9-001        |
| RV101,201  | 1810308KH                  | 008-407-9-004        | Bracket 4P Mtg.     | 722140880                  | 250-104-9-001        |
| C114   | 224710770                  | 025-182-9-001        | Name Plate          | 784142840                  | 600-110-9-001        |
| C332,350   | 261010775                  | 023-065-9-004        | Escutcheon,         | 800110390                  | 380-461-9-001        |
| C345   | 261810775                  | 023-065-9-003        | Lens (Red)          | 811140300                  | 753-013-9-001        |
| C340   | 262710775                  | 023-065-9-002        | Knob (Channel)      | 821130010                  | 751-209-9-001        |
|  |                            |                      | Knob (Control)      | 82213007B                  | 751-234-9-003        |
|  |                            |                      | Earphone Jack       | 861140170                  | 773-126-9-001        |
|  |                            |                      | Meter               | 865130010                  | 320-118-9-001        |
|  |                            |                      | Speaker 3" 8 ohm 2W | 865130070                  | 580-136-9-001        |
|  |                            |                      | Rotary SW. 40 Ch    | 866130020                  | 083-274-9-001        |
|  |                            |                      | Push Sw.            | 866140100                  | 088-071-9-001        |
|  |                            |                      | Slide Sw.           | 866140200                  | 084-117-9-001        |
|  |                            |                      | Power Cord Assembly | 871130010                  | 420-040-9-001        |
|  |                            |                      | Schematic           | 933141470                  | 499-240-9-001        |