ADDENDUM

TO

SERVICE MANUAL

SERVICE MANUAL

MODEL 40X

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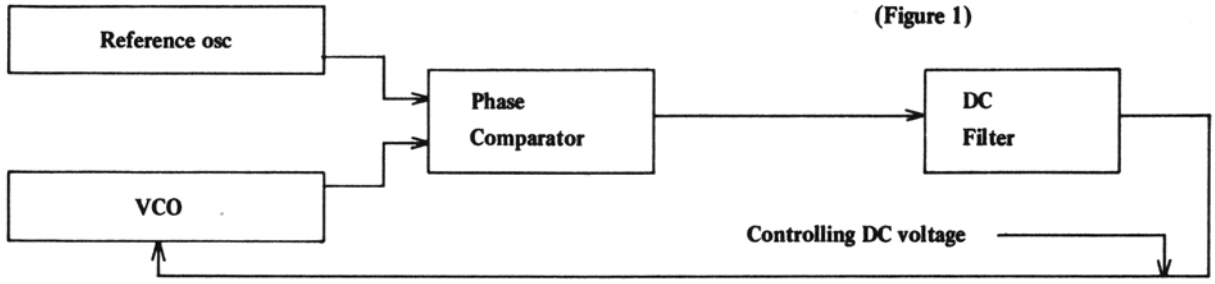
MODEL 40X

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).

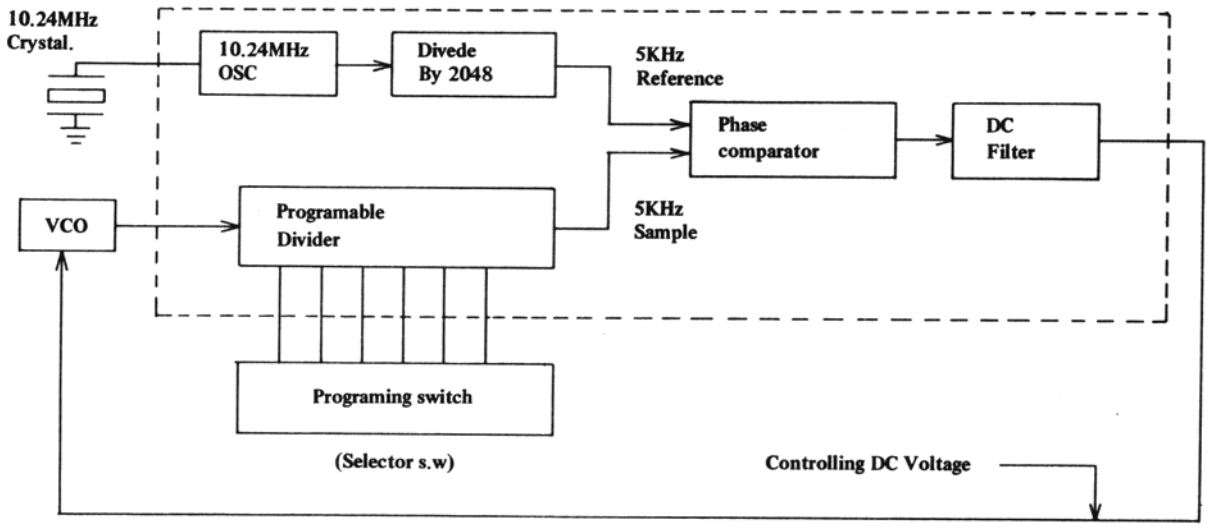
(Figure 1)



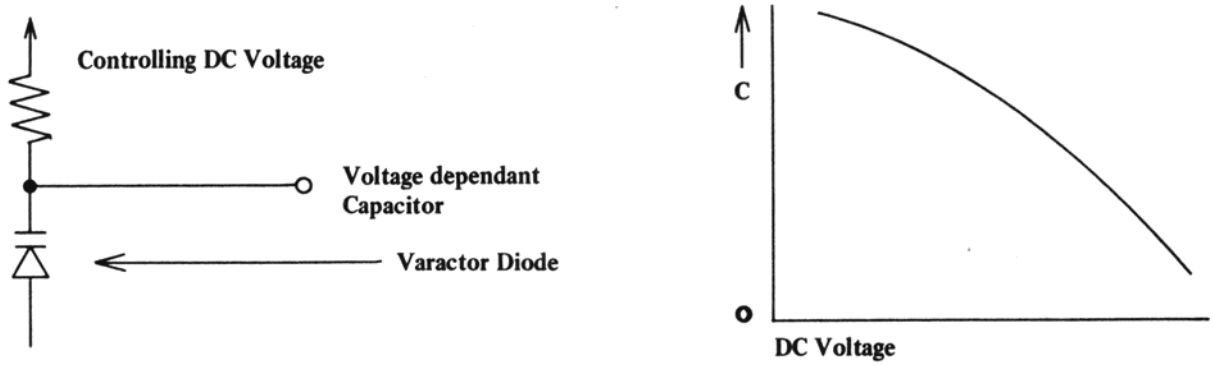
With the above circuit the VCO (Voltage Controlled Oscillator) Frequency is effectively locked to the reference oscillator, and its accuracy is as good as the reference oscillator.
Since the CB radio's adjacent channel spacing is 10KHz (or multiple of 5KHz), our purpose should be to preoduce multiple of programable frequencies that are spaced apart by 10KHz.

Therefore the basic PLL circuitry is espanded as follow:

(Figure 2)



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.



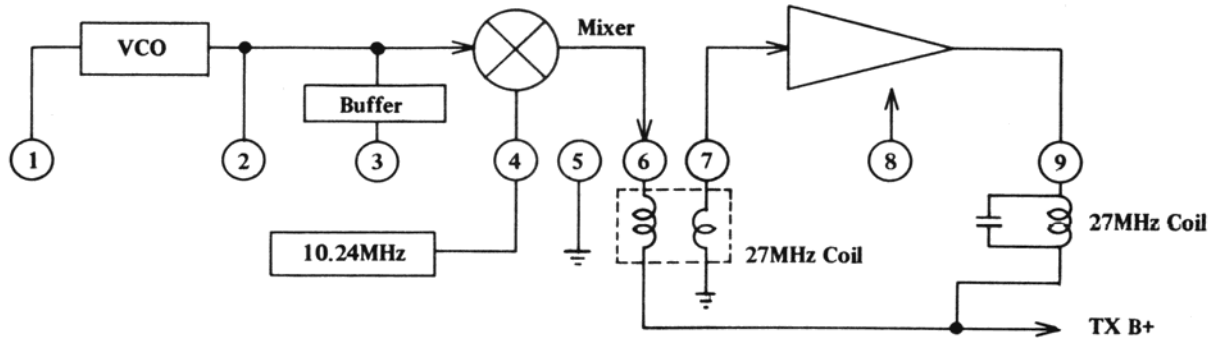
The varactor diode is responsible for setting VCO frequency, and once set it regulates the VCO frequency against the reference.
The VCO frequencies are chosen in 16 to 17MHz range as shown on table 1.
To obtain transmit signal the VCO is mixed with 10.24MHz. As an example for channel 1:
10.24 + 16.725 = 26.965MHz
For receiver mode the VCO is used as a first local oscillator
channel 1:

26.965 – 16.27 = 10.695MHz
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 = 0.455MHz
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 (programable).
When transmit logic signal is applied to the IC-1 through pin 19, the programable divider will divide incoming VCO frequency by 3345 to produce 5KHz sampling signal.
16725 ÷ 3345 = 5KHz
For the receiver mode the programable divider will automatically change to divide the VCO frequency by 3245.
16270 ÷ 3254 = 5KHz
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

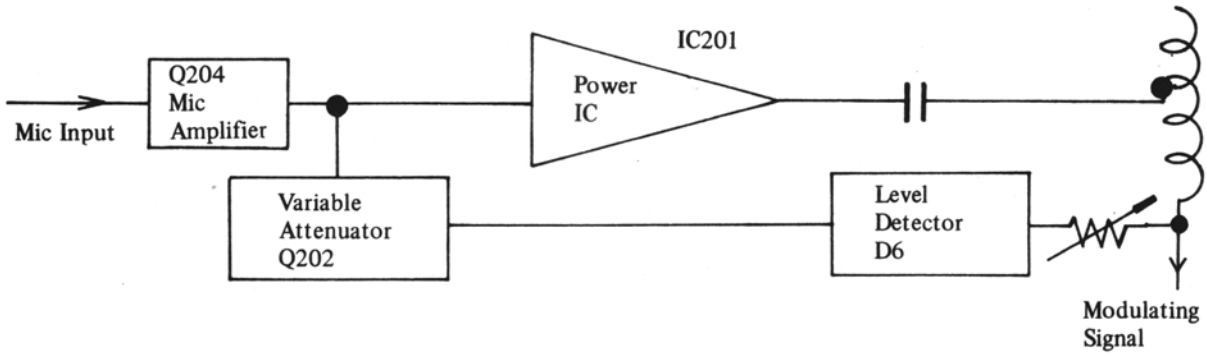
IC-1 (PLL LSI), VCO section of IC-203 (pin 1, 2 and 3) are operational regardless of the receive or transmit mode. When the radio is set to the transmit mode, mixer/amplifier section of IC-3 (pin 4, 6, 7 and 9), Q206, Q301, Q302 and Q303 are activated. The VCO frequency selected by the channel selector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

Equivalant 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) applified by a single power IC201.
The modulation limiting is accomplished by a automatic livel 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 dildes 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 = 10.695MHz.
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 = 0.455MHz.
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 constance determined by R128 and C124.
Therefor 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 ± 5%, unless otherwise specified.

2. Test Equipment

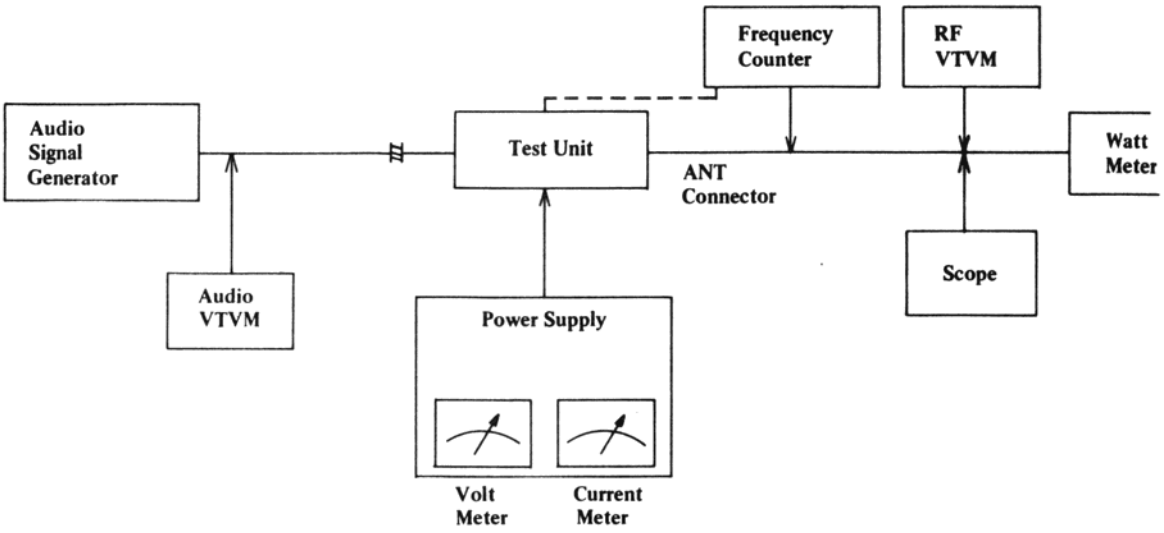
All Test equipment should be properly callibrated.

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 ± 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 foung 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

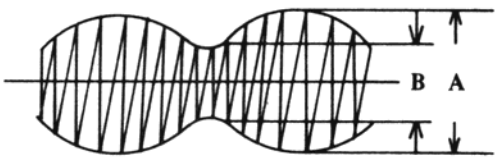
1. Reduce power supply voltage to 9.0V.
2. Place the channel selector in channel 19, and connect the oscilloscop to the antenna connector through a suitable connection pad.
3. Adjust L204, L301, L302 and L303 for maximum amplitude of the scope display.
4. Increase the power supply voltage to 13.8V, then 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 ±800Hz 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 ±800Hz 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 1KHz, 30mV signal to the microphone input circuit, and adjust RV201 so that 100% modulation is obtained.



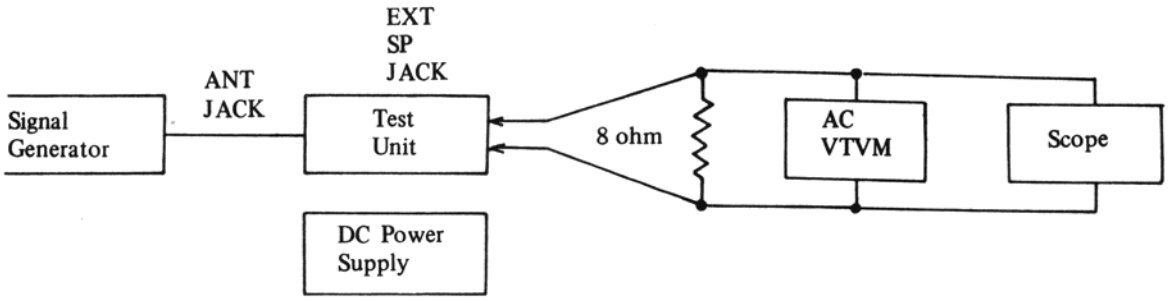
$$\text{Modulation ratio} = \frac{A-B}{A+B} \times 100(\%)$$

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. Temperarily 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
R104,108	0111019GR	182-029-9-001
Q201,202,203	01120020C	176-128-9-001
Q101,107,301	01120030C	176-115-9-001
Q109,206	01120060T	177-049-9-001
Q205	01120070T	176-115-9-004
Q106	01120080H	176-125-9-001
	011103100	176-028-9-003
Q105	01120080I	176-115-9-002
	011103100	176-028-9-003
Q110,204	01120100T	176-132-9-001
Q303	01130040E	172-062-9-001
	011600400	172-024-9-002
Q302	01130070E	176-120-9-001
	011600100	172-059-9-001
Q102,103	01170010B	182-138-9-001
IC201	021100300	307-272-9-001
IC202	021300400	307-272-9-002
IC203	021401200	307-272-9-003
D102,105,108,111,112,206	030000600	150-001-9-005
	030000700	150-016-9-001
D302	030000800	152-114-9-001
D101,103,104,106,107,109, 110,201,202,203,204,301, 304,305,401,402,403,404, 405,406,407,408,409,410, 411,412	030005200	151-035-9-001
	030001100	151-093-9-001
	030001200	151-028-9-007
	030001300	151-108-9-001
D205,306	030001500	151-050-9-001
	030001400	151-082-9-001
D303	030002100	154-009-9-001
	030002000	154-008-9-001
D307	030003000	158-045-9-001
	030004100	238-019-9-001
X201	042500200	132-036-9-001
CF2	052600500	140-006-9-001
CF1	052600800	140-006-9-002
R318	1410001JS	011-001-5-100
R231	1415002JS	011-002-5-150
VR104	15103201B	008-436-9-001
VR103,105	15503201B	008-457-9-001
VR102	15503211A	008-436-9-002
RV101,201	1810308KH	008-407-9-004
C114	224710770	025-182-9-001
C332,350	261010775	023-065-9-004
C345	261810775	023-065-9-003
C340	262710775	023-065-9-002

Reference No.	Manufacturer's Part Number	DYNASCAN Part Number
C344	263310775	023-081-9-001
C303,338	264700775	023-065-9-006
C302	265600775	023-065-9-005
C133	268090775	023-081-9-002
CH301	31000819B	042-041-9-001
T201	31001928D	061-057-9-001
RFC305	33100100H	047-008-9-001
RFC304	33100100V	047-008-9-002
RFC307	331091000	041-134-9-007
RFC202,204,205	331092000	041-134-9-006
RFC301,302,303	332201000	041-134-9-002
RFC201	332500050	041-134-9-001
RFC306	334540050	046-039-9-001
RFC309	335042000	041-134-9-008
RFC308	336890050	041-134-9-004
L108	340003100	047-008-9-003
L101	34000510B	046-039-9-002
L102	34000610A	046-039-9-003
L104,204	34000710A	046-039-9-004
L103	34000710B	047-008-9-004
L105	340008100	046-039-9-005
L106	340009100	046-039-9-006
L107	340010100	046-039-9-007
L301	34001210A	046-039-9-008
L302	340013100	046-039-9-009
L303	340014100	046-039-9-010
L304	340015100	046-039-9-011
L307	34001600B	046-039-9-012
L305	34001710B	046-039-9-013
L306	340018100	046-039-9-014
L203	340035100	046-039-9-015
PCB 40 Connector	410212060	302-670-9-001
PCB Rotary	41320701A	302-672-9-001
PCB LED Display	41420702A	302-673-9-001
PCB LED Lamp	414207030	302-674-9-001
Microphone Assembly	501020150	561-002-9-001
Cover Upper	711120580	253-112-9-001
Cover Bottom	712120660	252-045-9-001
Bracket 4P Mtg.	722140880	250-104-9-001
Name Plate	784142840	600-110-9-001
Escutcheon,	800110390	380-461-9-001
Lens (Red)	811140300	753-013-9-001
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