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SERVICE MANUAL

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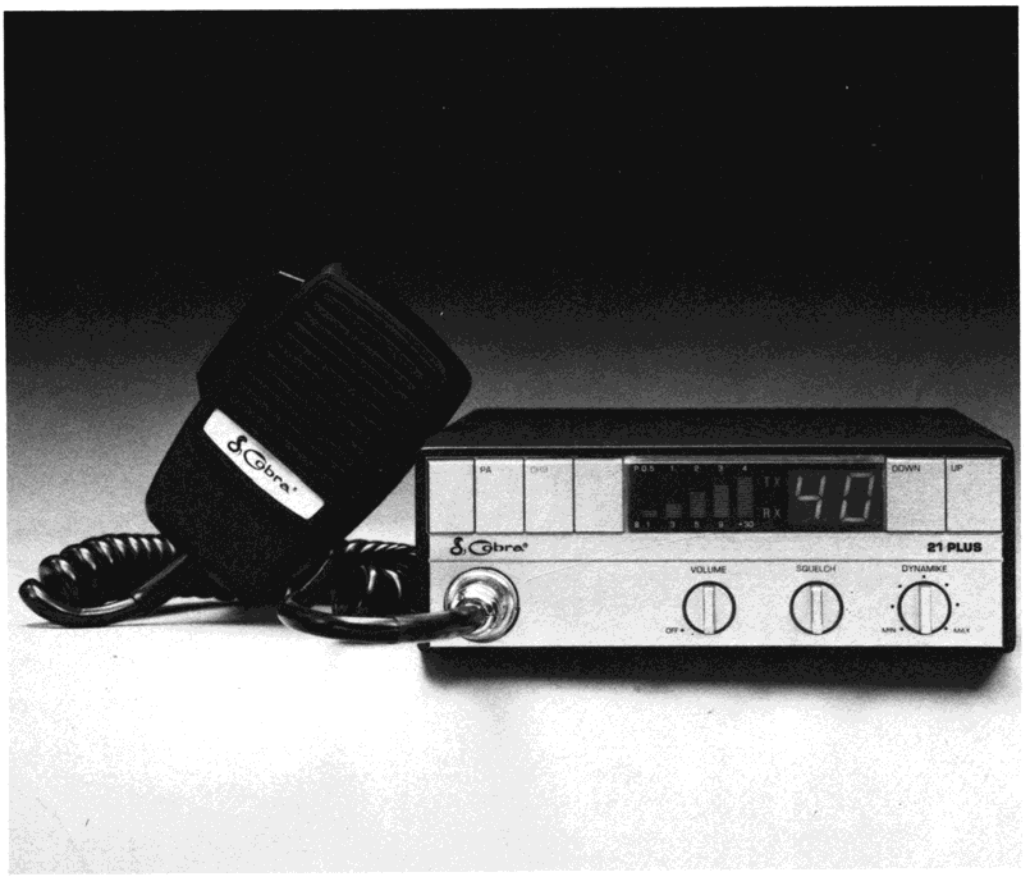
MODEL 21 PLUS



COBRA "21 Plus" Mobile CB Radio with Electronic Tuning, "Channel Saver," LED Bar Graph Meter, "DynaMike," and Instant Emergency Channel 9 Tuning

Cobra®
CONSUMER ELECTRONICS GROUP
DYNASCAN CORPORATION

6500 West Cortland Street • Chicago, Illinois 60635
(312) 889-8870 TELEX: 244-332

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NOTES

SPECIFICATIONS

GENERAL

Channels	40.
Frequency Range	26.965 to 27.405 MHz.
Frequency Control	Phase-Locked Loop (PLL) synthesizer.
Frequency Tolerance	0.005%
Operating Temp. Range	−30°C to +50°C.
Microphone	Plug-in type; dynamic.
Input Voltage	13.8 V DC nom. Positive or negative ground.
Current Drain	Transmit: AM full mod., 1.5 A. (maximum). Receive: (Squelched, 0.3 A; full audio output 1.2 A. (nominal). Channel Saver: Unit off 25 mA.
Size	8½"D × 6¼"W × 2⅛"H. (216 mm×159 mm×56 mm)
Weight	3 lbs., 14 oz.
Antenna Connector	UHF, SO-239.
Semiconductors	30 transistors, 30 diodes, 6 integrated circuits, 11 LEDs.
Meter	Indicates relative power output and received signal strength.

TRANSMITTER

Power Output	4 watts.
Modulation	High-and low-level Class B amplitude.
Frequency	300 to 2500 Hz.
Output Impedance	50 ohms, unbalanced.

RECEIVER

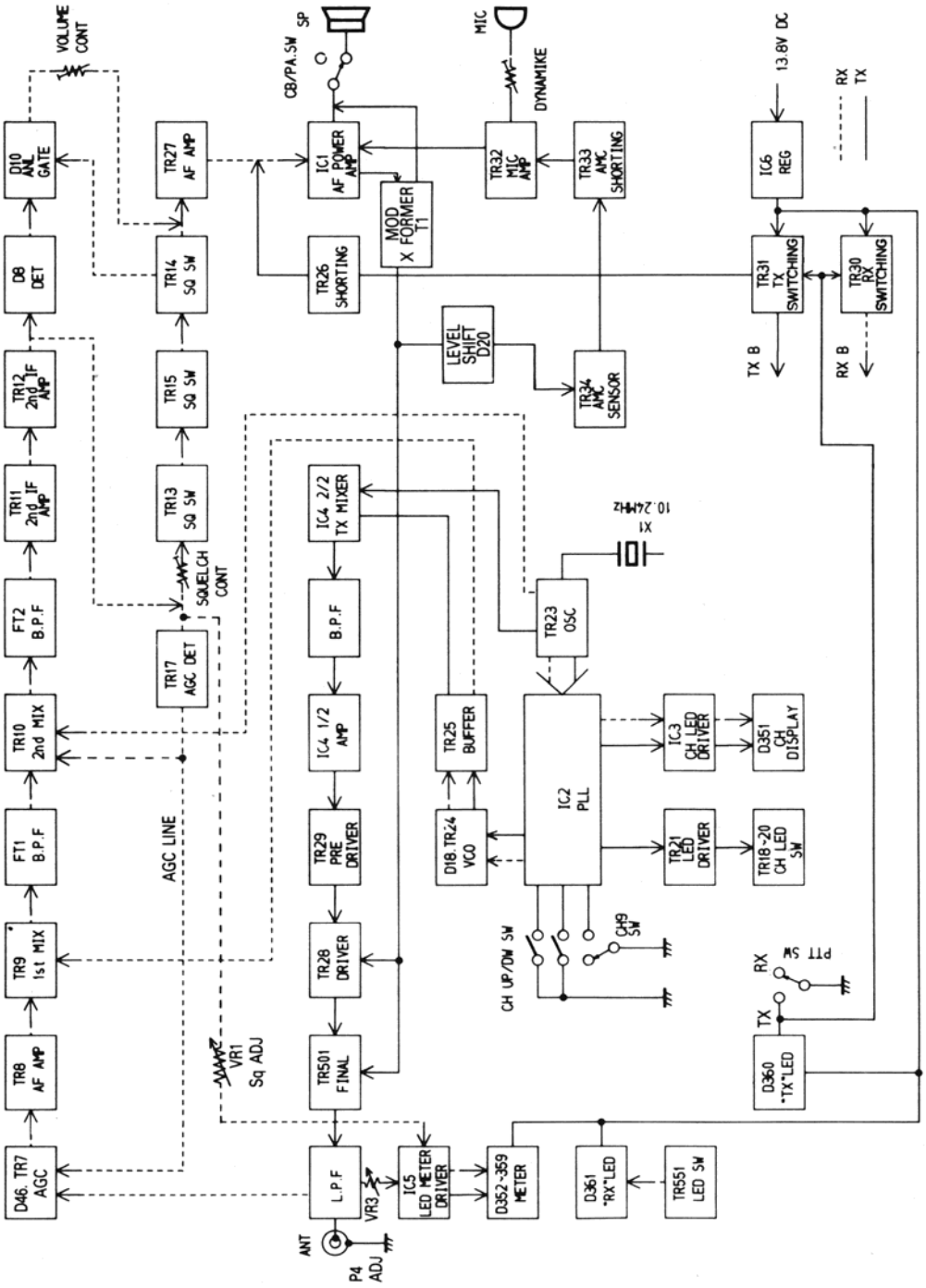
Sensitivity	Less than 1 μV for 10 dB (S+N)/N.
Selectivity	6 dB @ 7 KHz, 60 dB @ 10 KHz.
Image Rejection	80 dB, typical.
Adjacent Ch. Rejection	60 dB, typical.
IF Frequencies	Double conversion, 1st: 10.695 MHz. 2nd: 455 KHz.
Automatic Gain Control (AGC)	Less than 10 dB change in audio output for inputs from 10 to 50,000 microvolts.
Squelch	Adjustable; threshold less than 1 μV.
Audio Output Power	4 watts.
Frequency Response	300–3000 Hz.
Distortion	Less than 7% @ 3 watts @ 1000 Hz.
Built-in Speaker	8 ohms, round.
External Speaker	8 ohms; disables internal speaker when connected.

PA SYSTEM

Power Output	4 watts into external speaker.
External Speaker for PA	8 ohms; a separate jack is provided.

(SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE)

BLOCK DIAGRAM
21 PLUS

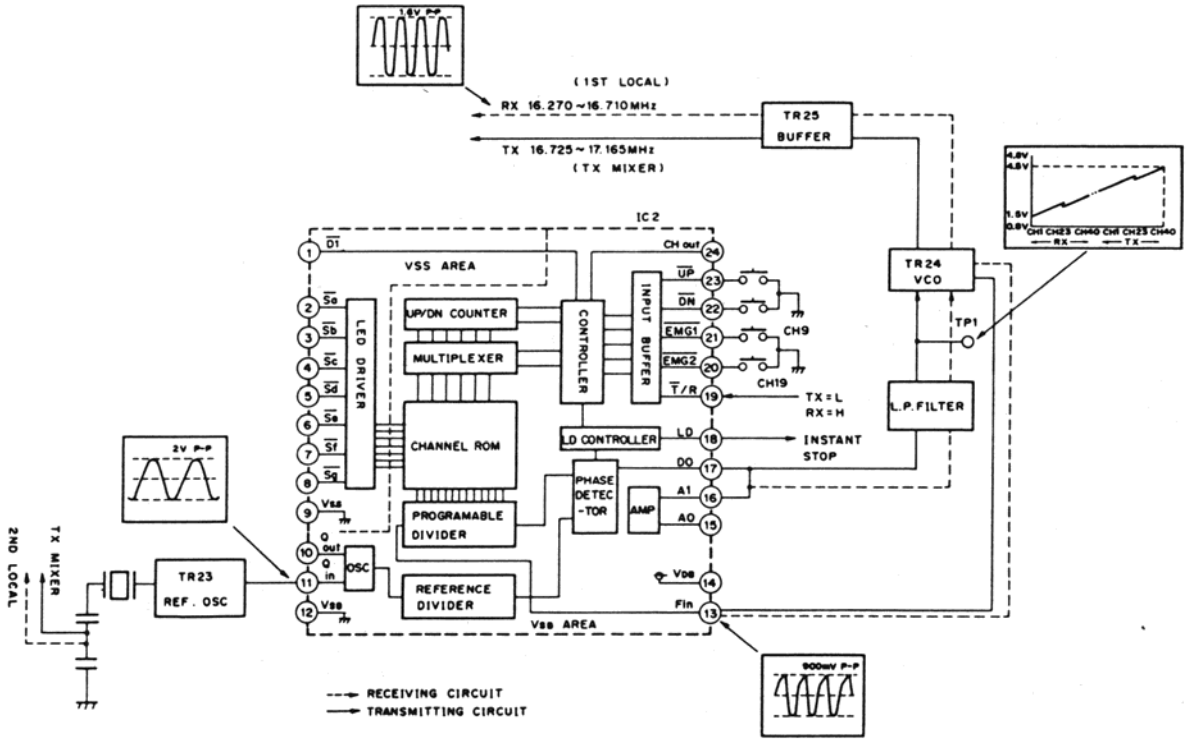


CIRCUIT DESCRIPTIONS

1. PHASE LOCK LOOP

The PLL circuit shown below precisely controls the transmit frequency for each channel and generates a precise 1st local mixer frequency for the selected channel of the receiver. The 7 major parts are the Voltage Controlled Oscillator (VCO), 1/N Divider, a Phase Detector, a Low Pass Filter, a Reference Oscillator (10.24 MHz), 1/2048 Divider and a Channel ROM (Read Only Memory).

PLL CIRCUIT



The VCO is an oscillator which controls oscillation frequency in accordance with input voltage change. The VCO output is mixed with a signal in the transmitter or receiver circuitry. A portion of the VCO frequency is fed to IC2 (1/N divider).

"N" for the 1/N divider is determined by the Channel Up/Down switch whose output is selected by a Channel ROM.

As shown in the frequency chart, N is different between transmit and receive modes, since only one crystal is used with this PLL circuitry.

The output from the 1/N divider is fed to the Phase Detector. The frequency from the reference OSC, 10.24 MHz, is divided to 5 kHz, by the 1/2048 divider and applied to another input of the Phase Detector.

The Phase Detector compares the phase difference between these two input signals (both 5 kHz), generating an error voltage (DO), which acts on the VCO to bring the two frequencies exactly in-phase. When this condition occurs, the PLL circuit is locked.

A Low Pass Filter integrates the output of the Phase Detector which controls the VCO frequency. The program divider 1/N changes the frequency of the VCO (Fvco) in 10 kHz increments. For Example Channel No. 1 transmit divide Ratio "N" is programmed to 3345.

Therefore Fvco = 5×3345 = 16.725 (MHz).

Fvco is determined the same way for all other channels as shown in table A.

Channel Selection Program
The Up/Down channel switches change the input voltage at either pin #22 or pin #23 of IC2 to select the desired channel. The divide ratio of the programmable frequency divider in IC2 is then determined through a code converter and the state of the transmit/receive mode switch (T/R) in IC2. The PTT switch determines the state of T/R in IC2 by changing the voltage at pin #19 from HIGH (receive) to LOW (transmit). The change between the two modes produces a 455 kHz change in VCO frequency.

Transmitter Output Frequency
The transmitter local oscillator of 10.24 MHz is produced by TR23 and crystal X1. The transmitter mixer IC4 mixes the local oscillator frequency 10.24 MHz, which is fed into pin #4 of IC4 and PLL Local Oscillator frequency (Fvco) produced by TR24/D18, which is fed into pin #1 of IC4. The sum of these two frequencies determines the transmitter carrier frequency (Ft). Ft=Fvco+10.24 (MHz)

Receiver IF/Mixers
The 1st IF/Mixer TR9 receives the PLL local oscillator (Fvco) and receiver RF frequency (Fr) to produce 10.695 MHz.

1ST IF=Fr−VCO=10.695 MHz.

The 2nd IF/Mixer (TR10) receives the 1st IF frequency (10.695 MHz) and local oscillator frequency (10.24 MHz) to produce the 2ND IF frequency, 455 kHz.

2ND IF=10.695−10.24=455 (kHz).

2. CIRCUIT FOR PREVENTION OF UNAUTHORIZED FREQUENCY EMISSION

This Transceiver has a built-in circuit which prevents transmission of unauthorized frequencies during the time the PLL circuit is not locked.

When the PLL circuit is not locked or the program data input is not for channels 1−40, Pin 18 in IC2 produces a low level digital control signal. This signal is fed to Pin 7 of IC4 transmitter mixer through D31 diode. When this signal is at low level, IC4 is disabled; and no RF signals are fed to the next stages.

IC2 is designed internally to operate only with valid data required for channels 1−40, thereby eliminating the RF signal output, and preventing any unauthorized frequencies.

TABLE A: FREQUENCY CHART OF Fvco AND DIVIDE RATIO N

Antenna Frequency (MHz)	Channel Number	For transmit (Pin 19 of IC2=L)		For Receive (Pin 19 of IC2=H)	
		Divide Ratio (N)	VCO Frequency (MHz)	Divide Ratio (N)	VCO Frequency (MHz)
26.965	1	3345	16.725	3254	16.270
26.975	2	3347	16.735	3256	16.280
26.985	3	3349	16.745	3258	16.290
27.005	4	3353	16.765	3262	16.310
27.015	5	3355	16.775	3264	16.320
27.025	6	3357	16.785	3266	16.330
27.035	7	3359	16.795	3268	16.340
27.055	8	3363	16.815	3272	16.360
27.065	9	3365	16.825	3274	16.370
27.075	10	3367	16.835	3276	16.380
27.085	11	3369	16.845	3278	16.390
27.105	12	3373	16.865	3282	16.410
27.115	13	3375	16.875	3284	16.420
27.125	14	3377	16.885	3286	16.430
27.135	15	3379	16.895	3288	16.440
27.155	16	3383	16.915	3292	16.460
27.165	17	3385	16.925	3294	16.470
27.175	18	3387	16.935	3296	16.480
27.185	19	3389	16.945	3298	16.490
27.205	20	3393	16.965	3302	16.510
27.215	21	3395	16.975	3304	16.520
27.225	22	3397	16.985	3306	16.530
27.255	23	3403	17.015	3312	16.560
27.235	24	3399	16.995	3308	16.540
27.245	25	3401	17.005	3310	16.550
27.265	26	3405	17.025	3314	16.570
27.275	27	3407	17.035	3316	16.580
27.285	28	3409	17.045	3318	16.590
27.295	29	3411	17.055	3320	16.600
27.305	30	3413	17.065	3322	16.610
27.315	31	3415	17.075	3324	16.620
27.325	32	3417	17.085	3326	16.630
27.335	33	3419	17.095	3328	16.640
27.345	34	3421	17.105	3330	16.650
27.355	35	3423	17.115	3332	16.660
27.365	36	3425	17.125	3334	16.670
27.575	37	3427	17.135	3336	16.680
27.385	38	3429	17.145	3338	16.690
27.395	39	3431	17.155	3340	16.700
27.405	40	3433	17.165	3342	16.710

3. RX OPERATIONS (Refer to block and schematic diagrams)

In the receive mode, switching transistor TR30 is turned ON to supply B+ voltage to the receiver section. TR33 is turned ON to mute the mic input. The transmit B+ switching transistor TR31 is OFF disabling the transmitter mixer IC4 and TR26 RX Audio mute transistor. The TX predriver TR29 is turned OFF by applying a B+ voltage to its emitter. The 2nd IF Amp TR12 modulated signal output is demodulated by detector diode D8. The recovered audio is amplified by TR27, fed to the power amp IC1 and then to the speaker. The output of TR12 also drives or controls the output levels of the AGC detector TR17 and the squelch circuit. When a Low RF signal is received by the antenna, the output of the AGC line is low and TR7 and diode D46 are OFF allowing maximum RF signal to reach TR8 and maximum IF gain of TR10. When the RF signal strength increases, the AGC line voltage increases and causes current to flow through TR7 and D46. This attenuates the RF input signal level to TR8, and decreases the gain of TR10, thereby preventing overload distortion and cross modulation deterioration. TR12 drives diode D9, producing a negative voltage at C31 to offset the squelch preset level and turn OFF TR13. Current flows through TR15 causing TR14 to turn "OFF" and unsquelch the output. Automatic Noise Limiting (ANL) is performed by diode D10.

4. TX OPERATION (Refer to block and schematic diagrams)

In transmit mode, switching transistor TR31 is turned ON to supply Bias voltages to TX mixer IC4 and to turn "ON" TR26 to mute receive output. TR30 is turned "OFF" allowing TR29 to turn ON and TR33 (AMC) to operate. The mic input signal is amplified by TR32 and fed to IC1 to drive the modulation Xformer T1 secondary which causes the TX stages B+ voltage to vary with mic signal amplitude. Automatic modulation control (AMC) is accomplished by level shift diode D20, TR33 and TR34. When mic input signal increases above a critical level, D20 conducts current causing TR34 to turn on TR33 which attenuates the mic input level, controlling the modulation level.

5. PA OPERATION

In PA standby mode the receiver is "ON" and incoming signals can be monitored on the PA spekaer. TX predriver TR29 B+ is disconnected to disable the transmitter. When the PTT switch is ON, TR30 is turned OFF disabling the receiver. TR31 is turned ON driving TR26 in saturation to mute the RX Audio pre-amp TR26. Mic signal is amplified by TR32 and fed to input of IC1 which drives the PA speaker.

6. CHANNEL 9 CIRCUIT

When the CH 9 switch is ON, Pin 21 of IC2 is set low to activate channel 9 only.

ALIGNMENT PROCEDURE

1. PLL SECTION ALIGNMENT

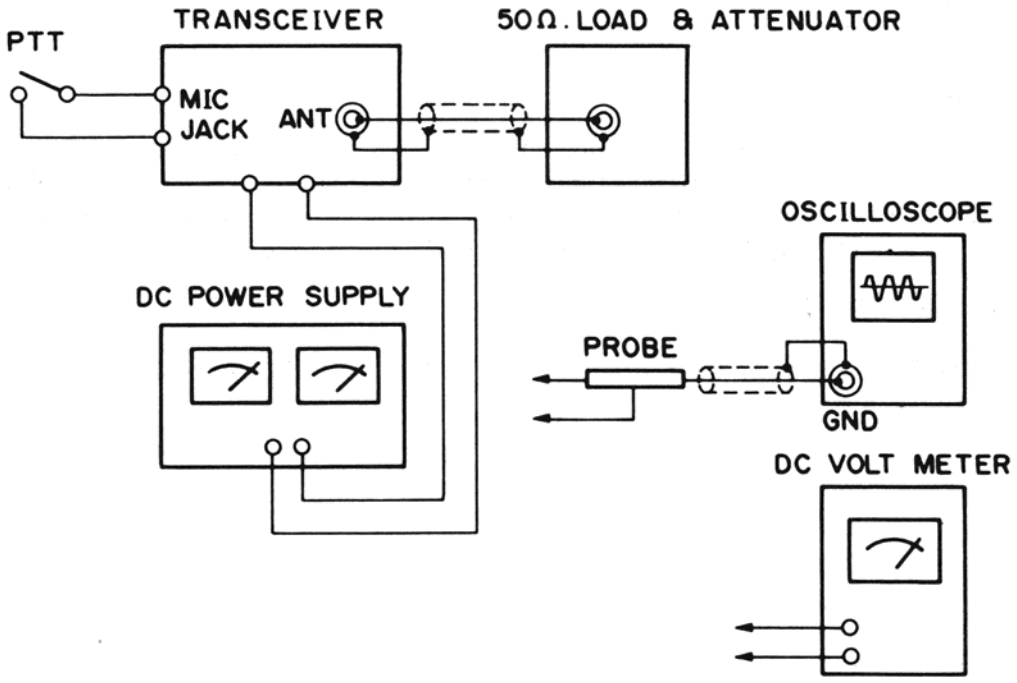
1.1 Test Equipment Required

DC Power Supply (13.8 V)
DC Voltmeter
Oscilloscope
Dummy Load (50 ohm) & Attenuator

1.2 Alignment Procedures

STEP	PRESET TO	ADJUSTMENT	REMARKS
1	CH : 40 Mode : TX	L8	Connect DC Voltmeter to TP1. Adjust for 4.5 V. After alignment, lock the core of L8 with paraffin.
2	CH : 19 Mode : RX	L9	Connect Oscilloscope probe to TP2. Adjust for maximum reading on Oscilloscope.

1.3 Test Equipment Connection



2. TRANSMITTER SECTION ALIGNMENT

2.1 Test Equipment Required

DC Power Supply (13.8 V)
AF Generator (Audio Frequency Oscillator)
Oscilloscope
RF Power Meter
Dummy Load (50 ohm) & Attenuator

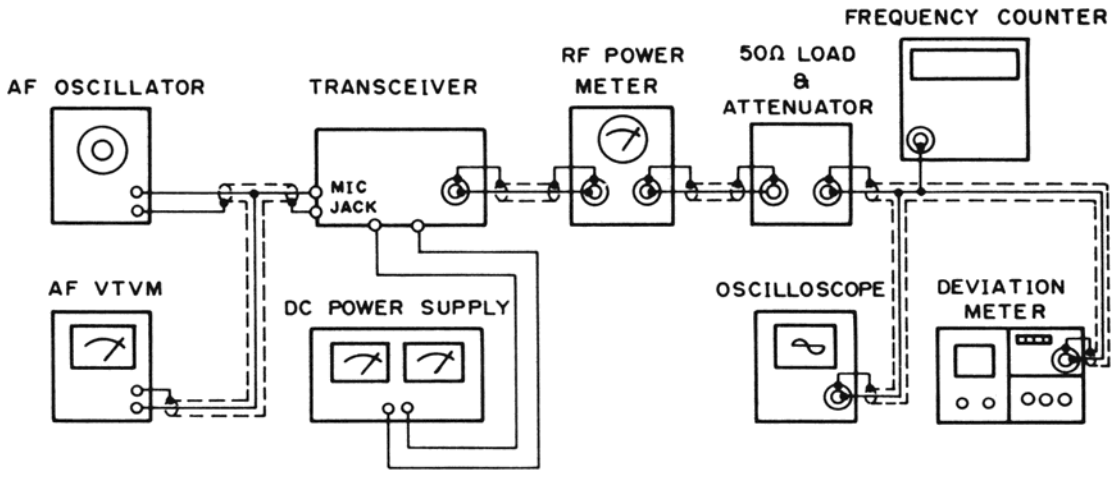
2.2 Preset to

a) CH 9 : OFF
b) PA : OFF
c) DYNAMIKE : Maximum (full clockwise)

2.3 Alignment Procedures

STEP	PRESET TO	ADJUSTMENT	REMARKS
1	CH : 19 No mod.	L16, L17 and L18	Connect Oscilloscpoe probe to TP3. Adjust coils for maximum reading.
2	CH : 19 No mod.	L15 and L12	Connect RF Power Meter to Antenna Jack (J501). Adjust coils for maximum reading.
3	CH : 19 No mod.	L12	Adjust for 4.OW on RF Power Meter. After adjustment, lock L12 with paraffin.
4	CH : 19 No mod.	VR3	1. Reduce DC voltage to obtain 3.1 W on RF power meter. 2. Adjust VR3 to the point at which 5th LED just lights.

2.4 Test Equipment Connection



3. RECEIVER SECTION ALIGNMENT

3.1 Test Equipment Required

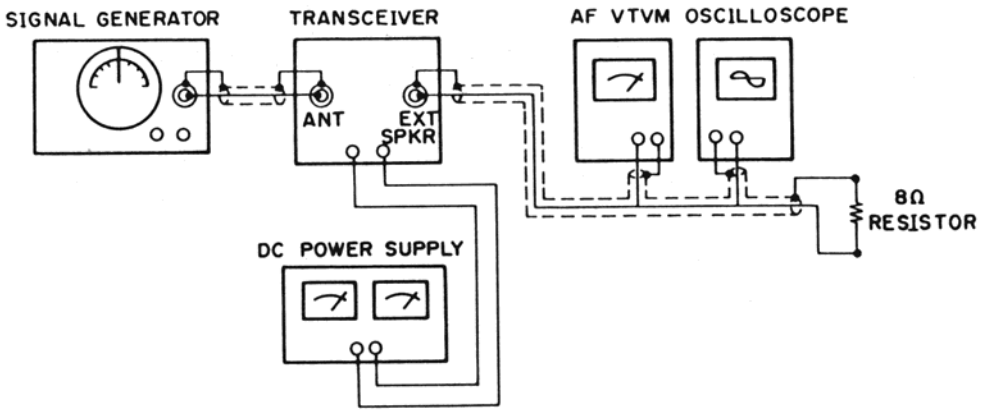
DC Power Supply (13.8 V)
S.S.G. (Standard Signal Generator, with Attenuator)
AF Voltmeter
Oscilloscope
Dummy Load (8 ohm)

3.2 Preset to

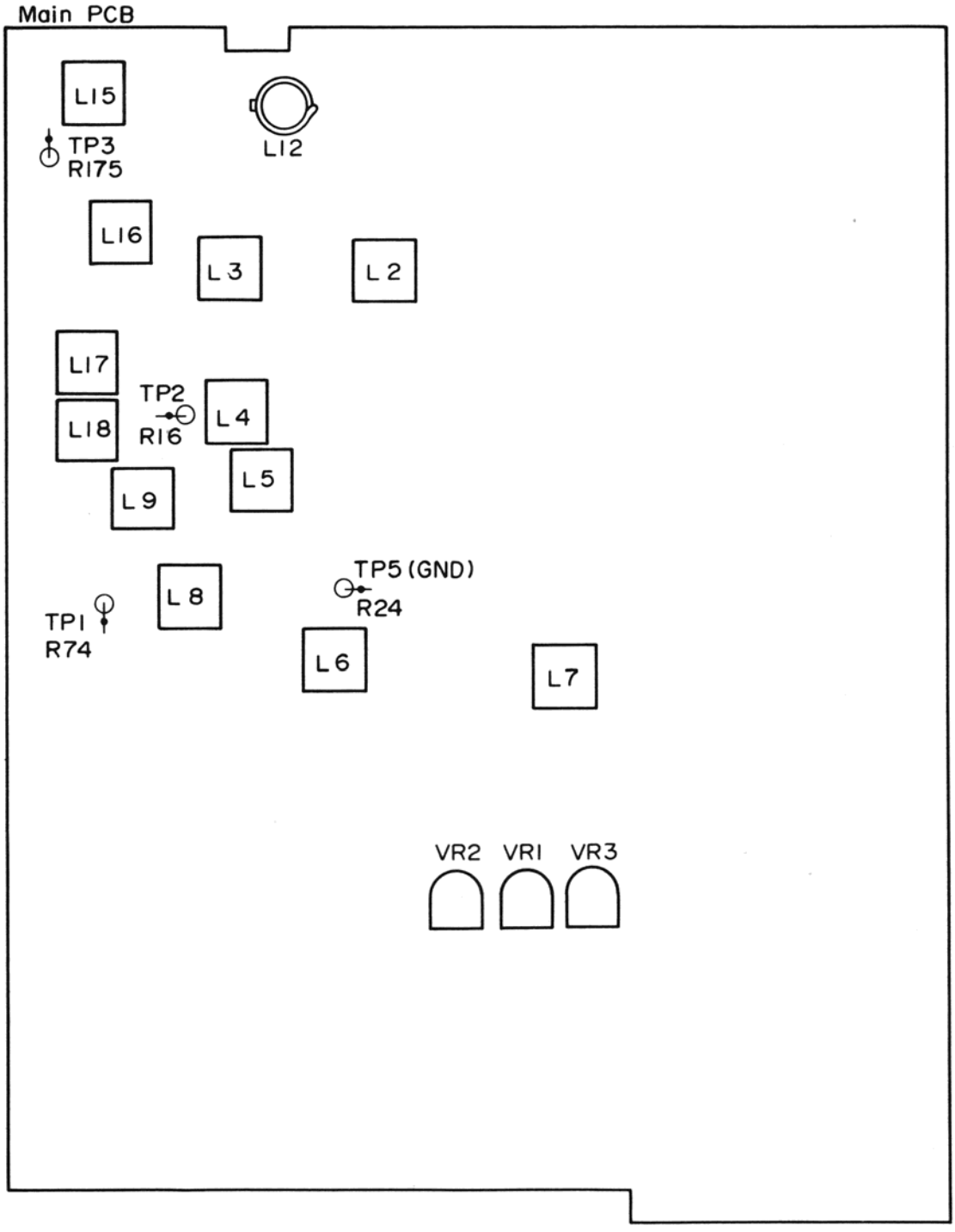
a) CH 9 : OFF
b) PA : OFF
c) NB : OFF
d) SQUELCH : Minimum (full counterclockwise)
e) RF GAIN : Maximum (full clockwise)
f) S.S.G. : 27.185 MHz (19 CH)
modulation 1 kHz 30%

3.2 Alignment Procedure

STEP	PRESET TO	ADJUSTMENT	REMARKS
1	CH : 19 VOLUME : Max. S.S.G. : Mod. on	L2, L3, L4, L5, L6 & L7	Connect S.S.G. to Antenna Jack(J501). Connect AF Voltmeter and Oscilloscope to EXT SP Jack (J3). Adjust coils for maximum reading. During this alignment, decrease RF signal level as required to obtain 2 V on AF VTVM.
2	CH : 19 S.S.G. : 100 μV No mod.	VR1	Adjust so S9 of Transceivers LED Meter illuminates.
3	CH : 19 VOLUME : Max. SQUELCH : Max. S.S.G. : 1 mV Mod. on @ 30%	VR2	Connect AF Voltmeter and Oscilloscope to EXT SP Jack (J3). Adjust so that the AF signal will just appear on Oscilloscope.



ALIGNMENT POINTS



TROUBLESHOOTING HINTS

UNIT WILL NOT TURN ON

1. Blown fuse.
2. Defective Power Switch.
3. Defect in Power Supply Circuit.

NO SOUND RECEIVED

1. Defective external speaker jack.
2. Bad contact in the microphone jack.
3. Bad PTT switch in the microphone.
4. Unlocked PLL circuit or improper alignment.
5. Defect in squelch circuit.
6. Defective PA switch.

NO TRANSMISSION

1. Defective microphone jack.
2. Defective PTT switch on microphone.
3. Unlocked PLL circuit or improper alignment.
4. Defective PA switch.

NO TX MODULATION

1. Defective microphone and/or circuit.
2. Defect in modulation circuit.

FOR MORE HINTS, SEE BELOW

NO TRANSMISSION

Connect current meter in series with power cable.
Check current reading for transmit mode:

A. If current reads more than 1 amp (but less than 2 A.), the final output transistor is OK. Check for bad contacts or short circuits between PC Board and Antenna Connector. A current reading of less than 0.5 A indicates no drive to Final Transistor. Check drive or early RF stages.

B. Defective PLL?
Check voltage at Pin 18 of IC2. If less than 5 V, PLL is unlocked. If more than 5 V, PLL is OK.

C. Short Circuit in Transmitter Circuit?
Voltage on Pin 1 of IC6 should be less than 7 V in TX mode, and should increase to more than 7 V in RX mode.

D. If voltage reading is more than 7 V on TR31 collector, it is OK. If voltage of more than 2 V is measured at the D21 anode, check microphone circuit.

E. If RF voltage (27 MHz) is more than 1.5 V P-P at TP3, previous stages are OK.

F. No voltage readings at TR28 and TR501 collector: check D19 or T-1

G. No Channel LED light: If one particular segment does not light, the LED is defective. If LED does not light in any channel position, check IC3.

CHANNEL UP/DOWN SWITCH INOPERATIVE
If channel does not go up or down when Channel Up/Down Switch is pressed, check IC2 and connection of Channel Up/Down Switch.

CHANNEL LED DOES NOT LIGHT
If one particular channel does not light, check molex, LED, or Channel Up/Down Switch. If no channel lights, check IC3 or molex.

NO TX MODULATION
If receiver operates correctly, but there is no TX modulation, the problem should be in TR32, TR33, TR34, or a short circuit in the microphone circuit. Audio power IC1 is used both for TX and RX modes.

NO RECEPTION
Before troubleshooting, check Squelch Control full CCW, RF Gain Control full CW, and microphone connected.

A) Connect Signal Generator to antenna. Check that Signal Strength Meter (S meter) LEDs light.

S meter LEDs light:
Antenna is OK through IF stage; check circuit through ANL, Squelch and Audio amplifier. If Detector circuit is normal, negative voltage should be present at anode of D8 diode during S meter illumination.

S meter LEDs do not light:
To check PLL:
1. 16 MHz frequency should be present at TP2 (0.9 V P-P or more).
2. The frequencies shown in the frequency chart should be correct when the Channel Up-Down Switch is changed from CH 1 through CH 40.
3. 10.24 MHz frequency should be present at C51 (0.4 V P-P or more). If PLL is OK, check circuit through TR8, TR9, TR10, TR11 and TR12.

B) Check Audio stage for operation: Connect Speaker to PA Speaker Jack, and set PA-CB switch to PA. If there is an audible click when PTT switch is pressed, Audio stage is OK. If there is no audible click, IC1 Audio Amplifier is defective, or T-1 transformer is bad. (Transformer DC resistance should be approximately 0.5 ohm for both primary and secondary windings.)

C) Defective Audio Power IC?
If voltage at Pin 6 is 7 V (VCC/2), IC1 is OK.

D) Squelch constantly "on".
If voltage at the base of TR15 is 0 V, TR13 is defective. If reading is less than 0.7 V, check TR15 circuit and/or Squelch control ground conenction for cold solder.

PLL CIRCUIT TROUBLESHOOTING HINTS