MAINTENANCE MANUAL
EXCITER/POWER AMPLIFIER
CAH-281
FOR
MLSH040
TWO-WAY MOBILE RADIO COMBINATIONS

TABLE OF CONTENTS

DESCRIPTION

Exciter/PA Board CAH-281 (A803) for the MLS VHF mobile radio combination provides 40 Watts of RF power in the 150.8 to 174 MHz frequency range and mounts in the back and bottom of the radio frame assembly as shown in Figure 1 - Exciter/PA Location. This Exciter/PA Board consists of an exciter circuit, a power amplifier circuit, antenna relay K1, a low-pass filter, Automatic Power Control circuitry (APC), a voltage regulator and a 9-Volt transmitter switch circuit (refer to Figure 2 - Block Diagram).

The exciter circuit consists of transistors TR101 and TR103 plus and attenuator at the input and a low-pass filter circuit at the output.

The power amplifier circuit consists of an attenuator circuit at the input, DRIVER POWER module HC1 (M57719-37A), PA transistor TR1 and a low-pass filter on the output. The output of the PA connects through ANTENNA SWITCH K1 to the input of the low-pass filter. The ANTENNA SWITCH (relay K1) is also part of circuit board A803.

The APC circuitry consists of 9-Volt SWITCH transistor TR104, POWER DETECTOR CIRCUIT capacitor CD1 and resistor R9, THERMAL DETECT CIRCUIT transistors TR3 and TR4, DC DRIVER transistor TR5, DC PASS transistor TR6 and SMOOTHER transistor TR2.

The transmit switch circuitry consists of 9-Volt regulator IC101 and EX9V SWITCH transistor TR104.

CIRCUIT ANALYSIS

9-Volt Regulator

The 9-Volt regulator operates from the switched A+ (13.6 volts) line. The regulator circuit consists of 9-Volt regulator IC101 and EX9-volt Switch transistor TR104. Switches are controlled by the $\overline{\text{TX}}$ $\overline{\text{ENBL}}$ lead from System Control & Synthesizer Board A801 (refer to Maintenance Manual LBI-31767).

When the $\overline{\text{TX}}$ $\overline{\text{ENBL}}$ lead is activated ($\overline{\text{DPTT}}$ keyed), transistor switch TR104 turns on and applies the regulated output of IC101 to exciter amplifier transistors TR101 and TR103.

Exciter

The exciter input from the synthesizer circuit is coupled through an attenuator circuit (resistors R101-R103) which provides approximately 3 dB attenuation. This attenuated input is coupled to the input of two RF amplifier stages transistor TR101 and TR103 to provide 400 milliwatts drive to DRIVER POWER MODULE HC1.

40-Watt PA

The 40-Watt PA uses 3 dB attenuator (resistors R1-R3), DRIVER POWER MODULE HC1 and PA transistor TR1 to provide the 40-Watts of RF power output.

DRIVER POWER MODULE HC1 contains two broadband amplifiers. The Automatic Power Control (APC) circuit supplies voltage to the first amplifier. Continuous 13.6 Volts is supplied to the second amplifier. The output of the HC1 is coupled through SMOOTHER transistor TR2 through a 50-ohm impedance matching network consisting of capacitors C8 through C17, capacitor C24, inductors L2 and L3, resistor R22 and a stripline (printed wire pattern) to the base of Class C amplifier TR1.

The PA output is matched to antenna connector J2 through antenna relay K1 and low-pass filter (inductors L8-L10, capacitors C35-C39 and capacitor C42). The continuous 13.6 volt A+ source voltage is applied to transistor TR1 through inductors L4 and L5.

Antenna Relay

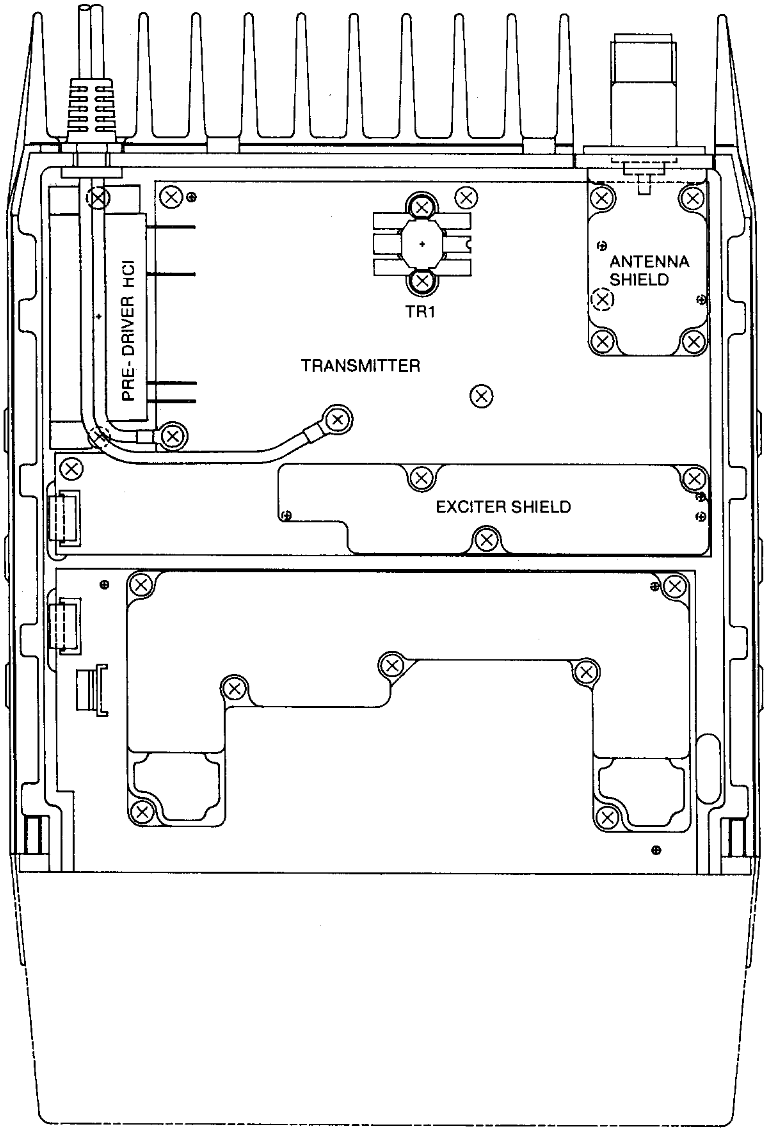
Antenna Relay K1 is controlled by the delayed PTT ($\overline{\text{DPTT}}$) output of the System Control/Synthesizer Board. When the $\overline{\text{DPTT}}$ output goes low, Antenna Relay K1 picks up and couples the PA output through the low-pass filter to Antenna Connector J2.

APC Circuits

Automatic Power Control (APC) circuit protects the transmitter PA from damage due to excessive output power, reflected power or temperature. The output power control circuit allows the RF output power to be set at the rated output by power adjust control RV1. If the output power of the PA increases, the detected voltage and the base input of transistor TR3 in the Thermal Detect circuit increases and the collector voltage decreases. This causes the DC Driver transistor TR5 to conduct less. Transistor TR5 conducting less increases the base voltage on PNP DC Pass transistor TR6, causing it to conduct less. This results in less voltage being applied to the first amplifier stage in the POWER DRIVER MODULE HC1, reducing the power output of the driver/PA in proportion to the increase in output power detected by the circuit.

To protect the PA against badly mismatched loads, a reverse power (VSWR) detector consisting of diode CD10, transistors TR3, TR5 and DC Pass transistor TR6 detect reverse (reflected) power. When sufficient power is detected by CD10, to cause TR3 to conduct, the voltage at the collector of TR6 decreases, causing the driver/PA module to lower the output power, protecting the PA. The reverse power level is set by resistor R20.

The PA is protected against temperature increases by thermal detector circuit consisting of resistor R18 and transistors TR3, TR4, TR5 and TR6. As the temperature increases resistance to ground of thermal detector R18 increases. This causes TR6 to conduct less, causing a decrease in the PA output until the temperature is reduced. The temperature level is set by resistor R14 located in the collector circuit of transistor TR4.



RC-5419A

Figure 1 - Exciter/PA Location (Bottom View)

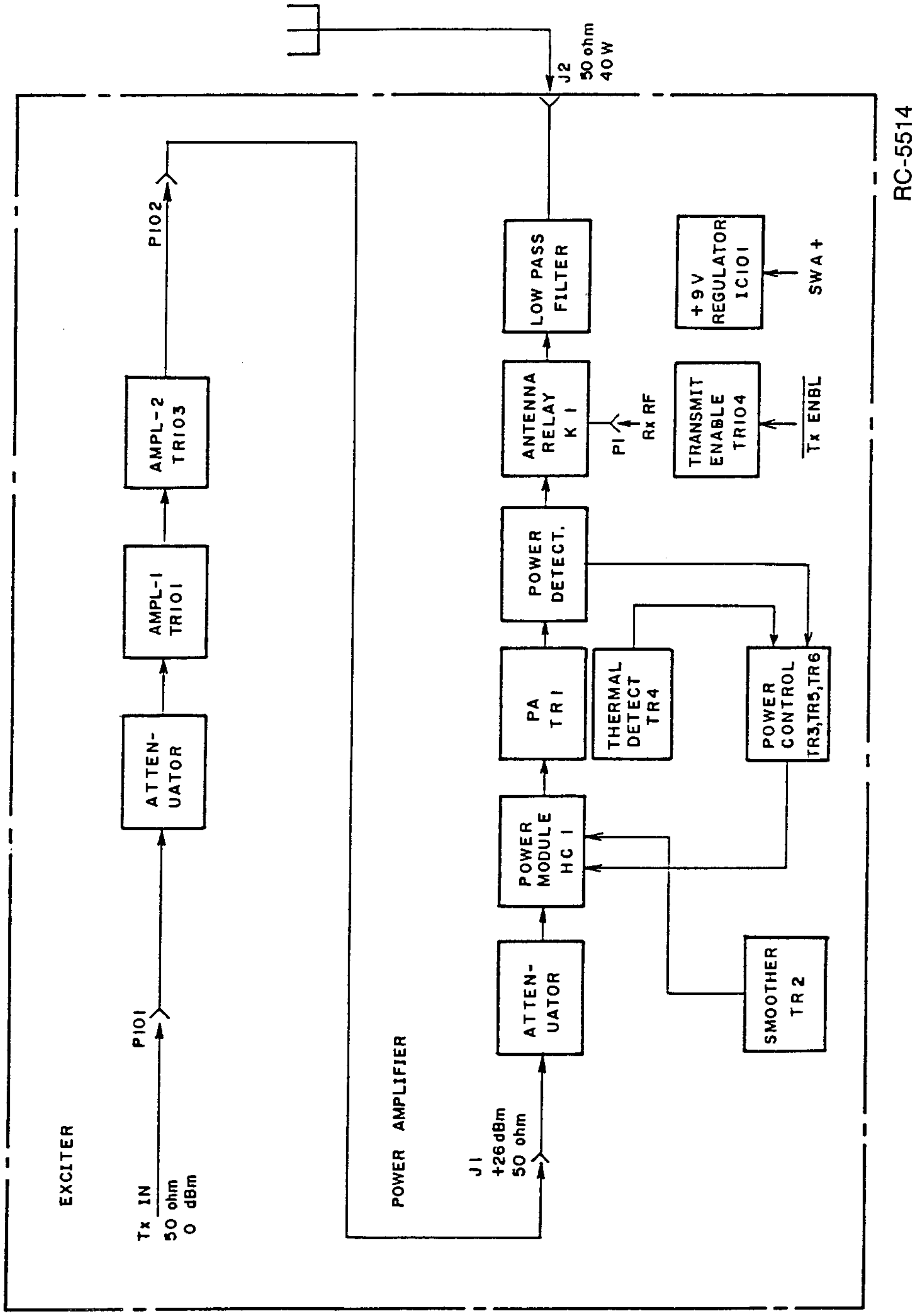


Figure 2 - Block Diagram

GENERAL ELECTRIC COMPANY• MOBILE COMMUNICATIONS DIVISION
WORLD HEADQUARTERS • LYNCHBURG, VIRGINIA 24502 U.S.A.

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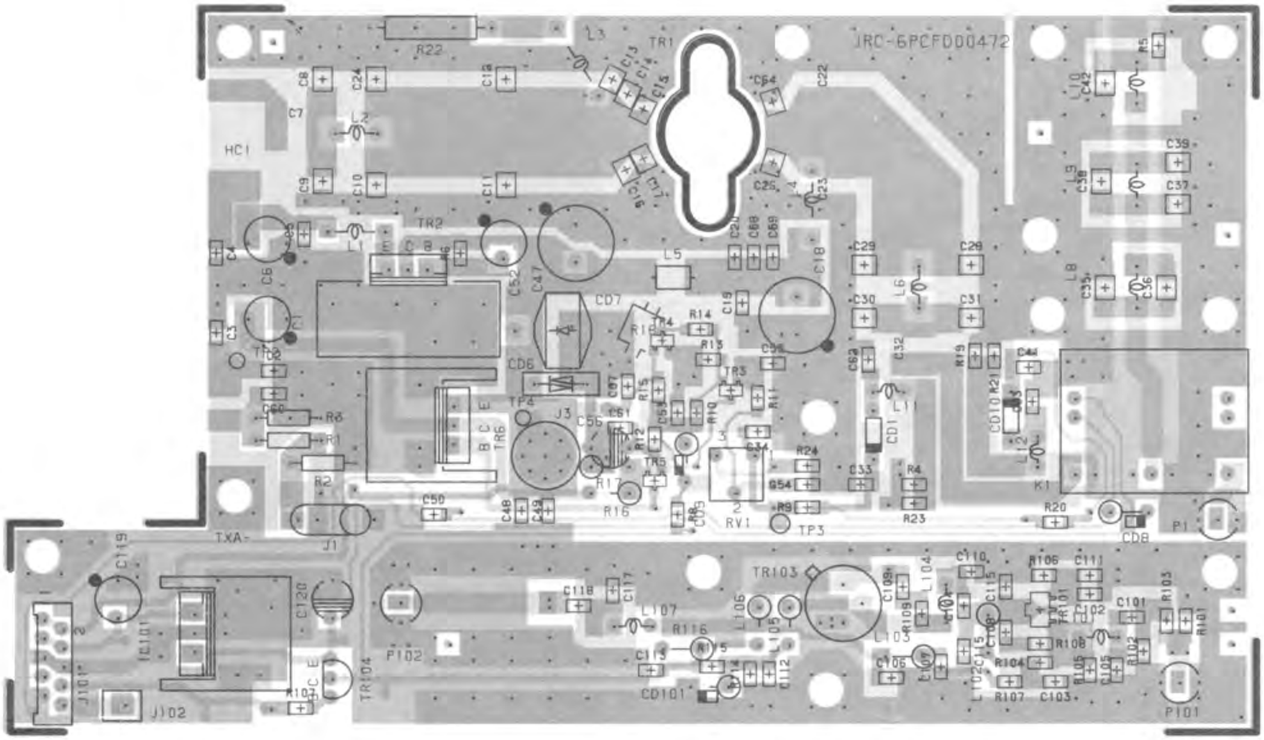
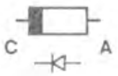


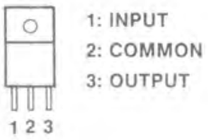
LEAD IDENTIFICATION FOR TR104 (TOP VIEW)

LEAD IDENTIFICATION FOR DIODES (TOP VIEW)



LEAD IDENTIFICATION FOR RV1, RV2 (TOP VIEW)

LEAD IDENTIFICATION FOR IC101 (TOP VIEW)



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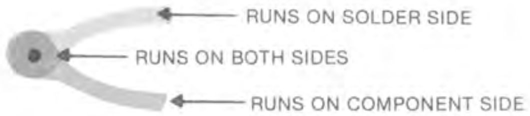
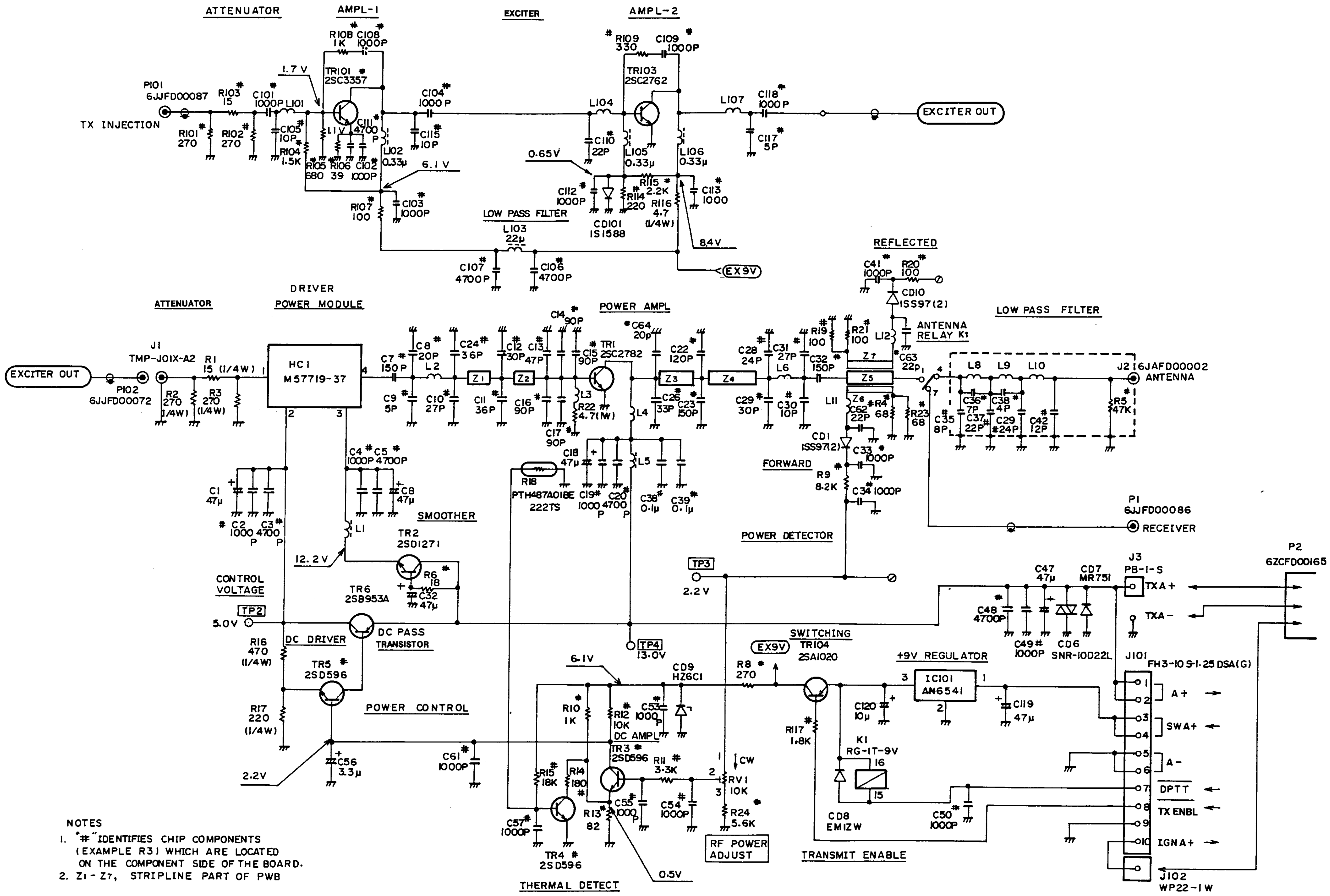


OUTLINE DIAGRAM

Exciter/PA Board

Issue 2



NOTES

1. "#" IDENTIFIES CHIP COMPONENTS (EXAMPLE R3) WHICH ARE LOCATED ON THE COMPONENT SIDE OF THE BOARD.
2. Z1 - Z7, STRIPLINE PART OF PWB

ALL RESISTORS ARE 1/8 WATT UNLESS OTHERWISE SPECIFIED.
RESISTOR VALUES IN Ω UNLESS FOLLOWED BY MULTIPLIER K OR M.
CAPACITOR VALUES IN F UNLESS FOLLOWED BY MULTIPLIER µ, OR P
INDUCTANCE VALUES IN H UNLESS FOLLOWED BY MULTIPLIER m OR µ.

RC-5454A

SCHEMATIC DIAGRAM
150-174MHz TRANSMITTER
DDOO - CAH - 281

PARTS LIST

EXCITER/PA BOARD
JRC/CAH-281

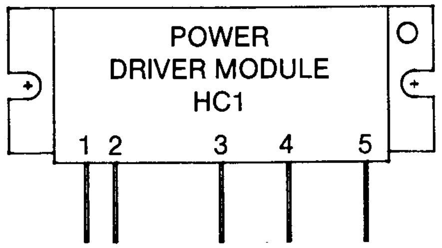
ISSUE 2

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C1	JRC/5CEAA01817	Electrolytic: 47 uF ±20%, 50 VDCW.
C2	JRC/5CAAD00782	Ceramic: 1000 pF ±5%, 50 VDCW, temp coef +350 -1000 PPM.
C3	JRC/5CAAD01297	Ceramic: 4700 pF ±5%, 50 VDCW, temp coef ±10%.
C4	JRC/5CAAD00782	Ceramic: 1000 pF ±5%, 50 VDCW, temp coef +350 -1000 PPM.
C5	JRC/5CAAD01297	Ceramic: 4700 pF ±5%, 50 VDCW, temp coef ±10%.
C6	JRC/5CEAA01817	Electrolytic: 47 uF ±20%, 50 VDCW.
C7	JRC/5CMAB01471	Mica: 150 pF ±5%, 500 VDCW, temp coef 0 ±100 PPM.
C8	JRC/5CMAB01465	Mica: 20 pF ±0.5 pF, 500 VDCW, temp coef 0 ±200 PPM.
C9	JRC/5CMAB01113	Mica: 5 pF ±0.25 pF, 500 VDCW, temp coef 0 ±200 PPM.
C10	JRC/5CMAB01095	Mica: 27 pF ±0.5 pF, 500 VDCW, temp coef 0 ±200 PPM.
C11	JRC/5CMAB01174	Mica: 36 pF ±0.5 pF, 500 VDCW, temp coef 0 ±200 PPM.
C12	JRC/5CMAB01492	Mica: 30 pF ±0.5 pF, 500 VDCW, temp coef 0 ±200 PPM.
C13	JRC/5CMAB01226	Mica: 47 pF ±0.5 pF, 500 VDCW, temp coef 0 ±200 PPM.
C14 thru C17	JRC/5CMAB01283	Mica: 90 pF ±5%, 500 VDCW, temp coef 0 ±200 PPM.
C18	JRC/5CEAA00439	Electrolytic: 47 uF, ±20%, 40 VDCW.
C19	JRC/5CAAD00782	Ceramic: 1000 pF ±5%, 50 VDCW, temp coef +350 -1000 PPM.
C20	JRC/5CAAD01297	Ceramic: 4700 pF ±5%, 50 VDCW, temp coef ±10%.
C22	JRC/5CMAB01439	Mica: 120 pF ±5%, 500 VDCW, temp coef 0 ±100 PPM.
C23	JRC/5CMAB01471	Mica: 150 pF ±5%, 500 VDCW, temp coef 0 ±100 PPM.
C24	JRC/5CMAB01442	Mica: 36 pF ±5%, 500 VDCW, temp coef 0 ±200 PPM.
C26	JRC/5CMAB01211	Mica: 33 pF ±0.5 pF, 500 VDCW, temp coef 0 ±200 PPM.
C28	JRC/5CMAB01227	Mica: 24 pF ±0.5 pF, 500 VDCW, temp coef 0 ±200 PPM.
C29	JRC/5CMAB01492	Mica: 30 pF ±0.5 pF, 500 VDCW, temp coef 0 ±200 PPM.
C30	JRC/5CMAB01121	Mica: 10 pF ±0.25 pF, 500 VDCW, temp coef 0 ±200 PPM.
C31	JRC/5CMAB01095	Mica: 27 pF ±0.5 pF, 500 VDCW, temp coef 0 ±200 PPM.
C32	JRC/5CMAB01471	Mica: 150 pF ±5%, 500 VDCW, temp coef 0 ±100 PPM.
C33 and C34	JRC/5CAAD00782	Ceramic: 1000 pF ±5%, 50 VDCW, temp coef +350 -1000 PPM.
C35	JRC/5CMAB01114	Mica: 8 pF ±0.25 pF, 500 VDCW, temp coef 0 ±200 PPM.
C36	JRC/5CMAB01129	Mica: 7 pF ±0.25 pF, 500 VDCW, temp coef 0 ±200 PPM.
C37	JRC/5CMAB01172	Mica: 22 pF ±0.5 pF, 500 VDCW, temp coef 0 ±200 PPM.
C38	JRC/5CMAB01397	Mica: 4 pF ±0.25 pF, 500 VDCW, temp coef 0 ±200 PPM.
C39	JRC/5CMAB01227	Mica: 24 pF ±0.5 pF, 500 VDCW, temp coef 0 ±200 PPM.
C41	JRC/5CAAD00782	Ceramic: 1000 pF ±5%, 50 VDCW, temp coef +350 -1000 PPM.
C42	JRC/5CMAB01125	Mica: 12 pF ±0.25 pF, 500 VDCW, temp coef 0 ±200 PPM.
C47	JRC/5CEAA00439	Electrolytic: 47 uF ±20%, 40 VDCW.
C48	JRC/5CAAD01297	Ceramic: 4700 pF ±5%, 50 VDCW, temp coef ±10%.
C49 and C50	JRC/5CAAD00782	Ceramic: 1000 pF ±5%, 50 VDCW, temp coef +350 -1000 PPM.
C52	JRC/5CEAA01817	Electrolytic: 47 uF ±20%, 50 VDCW.
C53 thru C55	JRC/5CAAD00782	Ceramic: 1000 pF ±5%, 50 VDCW, temp coef +350 -1000 PPM.
C56	JRC/5CSAC01180	Tantalum: 3.3 uF ±20%, 25 VDCW.
C57	JRC/5CAAD00782	Ceramic: 1000 pF ±5%, 50 VDCW, temp coef +350 -1000 PPM.
C58 and C59	JRC/5CAAD01056	Ceramic: 0.1 uF +80 -20%, 50 VDCW, temp coef +30 -80%.
C61	JRC/5CAAD00782	Ceramic: 1000 pF ±5%, 50 VDCW, temp coef +350 -1000 PPM.
C62 and C63	JRC/5CAAD00869	Ceramic: 22 pF ±5%, 50 VDCW, temp coef 0 ±60 PPM.
C64	JRC/5CMAB01465	Mica: 20 pF, 500 VDCW, temp coef 0 ±200 PPM.
C101 thru C104	JRC/5CAAD00782	Ceramic: 1000 pF ±5%, 50 VDCW, temp coef +350 -1000 PPM.
C105	JRC/5CAAD00862	Ceramic: 10 pF ±5%, 50 VDCW, temp coef 0 ±60 PPM.
C106 and C107	JRC/5CAAD01297	Ceramic: 4700 pF ±5%, 50 VDCW, temp coef ±10%.
C108 and C109	JRC/5CAAD00782	Ceramic: 1000 pF ±5%, 50 VDCW, temp coef +350 -1000 PPM.
C110	JRC/5CAAD00869	Ceramic: 22 pF ±5%, 50 VDCW, temp coef 0 ±60 PPM.
C111	JRC/5CAAD01297	Ceramic: 4700 pF ±5%, 50 VDCW, temp coef ±10%.
C112 and C113	JRC/5CAAD00782	Ceramic: 1000 pF ±5%, 50 VDCW, temp coef +350 -1000 PPM.
C115	JRC/5CAAD00785	Ceramic: 10 pF ±0.5 pF, 50 VDCW, temp coef 0 ±60 PPM.
C117	JRC/5CAAD00800	Ceramic: 5 pF ±0.25 pF, 500 VDCW, temp coef 0 ±60 PPM.
C118	JRC/5CAAD00782	Ceramic: 1000 pF ±5%, 50 VDCW, temp coef +350 -1000 PPM.
C119	JRC/5CEAA01817	Electrolytic: 47 uF ±20%, 50 VDCW.
C120	JRC/5CSAC00912	Tantalum: 10 uF ±20%, 35 VDCW.
		- - - - - - - - - - - DIODES - - - - - - - - - -
CD1	JRC/5TXAA00313	Silicon (Schottky Barrier): sim to NEC 1SS97.
CD6	JRC/5TZAA00045	Ceramic Varistor: Limit voltage 38 to 135V; sim to Sanken SNR-10D22L.
CD7	JRC/5TXAM00019	Silicon: fwd current 3A, 200 PIV; sim to Motorola MR751.
CD8	JRC/5TXAN00142	Silicon: 200V 1A, sim to Sanken EM1Z.
CD9	JRC/5TXAE00166	Zener: 500 mW, 6V; sim to Hitachi HZ6C1.
CD10	JRC/5TXAA00313	Silicon (Schottky Barrier): sim to NEC 1SS97.
CD101	JRC/5TXAD00040	Silicon: sim to Toshiba 1S1588.
		- - - - - - - - - HYBRID CIRCUIT - - - - - - - -
HC1	JRC/5DDAB00236	RF Power Amplifier.
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - -
IC101	JRC/5DAAR00021	Linear, Positive Voltage Regulator; sim to Matsushita AN6541.
		- - - - - - - - - - - JACKS - - - - - - - - - - -
J1	JRC/5JWCL00045	Connector, RF: TMP-J01X-A2.
J2	JRC/6JAFD00002	Connector, RF: H-6JAFD00002.
J3	JRC/5JTCW00060	Connector, power source: PB-1-S L=10.
J101	JRC/5JWBS00178	Connector, 10 pins: FH3-10S-1.25DSA(G)
J102	JRC/5JDAS00001	Connector: WP22-1W.
		- - - - - - - - - - - RELAYS - - - - - - - - - -
K1	JRC/5KLAD00626	Relay 9 VDC: RGIT-9V.
		- - - - - - - - - - - COILS - - - - - - - - - - -
L1	JRC/6LAFD01129	Coil, RF.
L2	JRC/6LALD00011	Coil, RF.
L3	JRC/6LALD00012	Coil, RF.
L4	JRC/6LALD00013	Coil, RF.
L5	JRC/6LALD00016	Coil, RF.
L5-1	JRC/5MZAL00002	Ferrite: sim to Nihon Ferrite QM2010P3.5-5-1.3H.
L6	JRC/6LALD00014	Coil, RF.
L8	JRC/6LAFD01213	Coil, RF.
L9 and L10	JRC/6LAFD01214	Coil, RF.
L11	JRC/6LALD00015	Coil, RF.
L12	JRC/6LALD00021	Coil, RF.
L101	JRC/6LAFD01202	Coil, RF.
L102	JRC/5LCAC00228	Choke coil: 0.33 uH ±10%.
L103	JRC/5LCAC00281	Choke coil: 22 uH ±10%.
L104	JRC/6LAFD01204	Coil, RF.
L105 and L106	JRC/5LCAC00228	Choke coil: 0.33 uH ±10%.
L107	JRC/6LAFD01205	Coil, RF.
		- - - - - - - - - - - PLUGS - - - - - - - - - - -
P1	JRC/6JJFD00086	Connector, RF.
P2	JRC/6ZCFD00165	Power Cable.
P101	JRC/6JJFD00087	Connector, RF.
P102	JRC/6JJFD00072	Connector, RF.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	JRC/5RDAA01186	Carbon film: 15 ohms ±5%, 300 VDCW, 1/4 W.
R2 and R3	JRC/5RDAA01161	Carbon film: 270 ohms ±5%, 300 VDCW, 1/4 W.
R4	JRC/5REAG00621	Metal film: 68 ohms ±5%, 200 VDCW, 1/8 W.
R5	JRC/5REAG00578	Metal film: 47K ohms ±5%, 200 VDCW, 1/8 W.
R6	JRC/5REAG00990	Metal film: 18 ohms ±5%, 200 VDCW, 1/8 W.
R7	JRC/5REAG00576	Metal film: 10K ohms ±5%, 200 VDCW, 1/8 W.
R8	JRC/5REAG00622	Metal film: 270 ohms ±5%, 200 VDCW, 1/8 W.
R9	JRC/5REAG00584	Metal film: 8.2K ohms ±5%, 200 VDCW, 1/8 W.
R10	JRC/5REAG00572	Metal film: 1K ohms ±5%, 200 VDCW, 1/8 W.
R11	JRC/5REAG00589	Metal film: 3.3K ohms ±5%, 200 VDCW, 1/8 W.
R12	JRC/5REAG00576	Metal film: 10K ohms ±5%, 200 VDCW, 1/8 W.
R13	JRC/5REAG00792	Metal film: 82 ohms ±5%, 200 VDCW, 1/8 W.
R14	JRC/5REAG00908	Metal film: 180 ohms ±5%, 200 VDCW, 1/8 W.
R15	JRC/5REAG00682	Metal film: 18K ohms ±5%, 200 VDCW, 1/8 W.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

SYMBOL	GE PART NO.	DESCRIPTION
R16	JRC/5RDAA01541	Carbon film: 470 ohms ±5%, 300 VDCW, 1/4 W.
R17	JRC/5RDAA01543	Carbon film: 220 ohms ±5%, 300 VDCW, 1/4 W.
R18	JRC/5RXAE00028	Resistor: sim to Murata PTH487A01BE222TS.
R19 thru R21	JRC/5REAG00586	Metal film: 100 ohms ±5%, 200 VDCW, 1/8 W.
R22	JRC/5REAG00412	Metal film: 4.7 ohms ±5%, 350 VDCW, 1 W.
R23	JRC/5REAG00621	Metal film: 68 ohms ±5%, 200 VDCW, 1/8 W.
R24	JRC/5REAG00625	Metal film: 5.6K ohms ±5%, 200 VDCW, 1/8 W.
R101 and R102	JRC/5REAG00622	Metal film: 270 ohms ±5%, 200 VDCW, 1/8 W.
R103	JRC/5REAG00618	Metal film: 15 ohms ±5%, 200 VDCW, 1/8 W.
R104	JRC/5REAG00574	Metal film: 1.5K ohms ±5%, 200 VDCW, 1/8 W.
R105	JRC/5REAG00591	Metal film: 680 ohms ±5%, 200 VDCW, 1/8 W.
R106	JRC/5REAG00999	Metal film: 39 ohms ±5%, 200 VDCW, 1/8 W.
R107	JRC/5REAG00586	Metal film: 100 ohms ±5%, 200 VDCW, 1/8 W.
R108	JRC/5REAG00572	Metal film: 1K ohms ±5%, 200 VDCW, 1/8 W.
R109	JRC/5REAG00597	Metal film: 330 ohms ±5%, 200 VDCW, 1/8 W.
R114	JRC/5REAG00594	Metal film: 220 ohms ±5%, 200 VDCW, 1/8 W.
R115	JRC/5REAG00575	Metal film: 2.2K ohms ±5%, 200 VDCW, 1/8 W.
R116	JRC/5RDAA01289	Carbon film: 4.7 ohms ±5%, 300 VDCW, 1/4 W.
R117	JRC/5REAG00582	Metal film: 1.8K ohms ±5%, 200 VDCW, 1/8 W.
RV1	JRC/5RVAB00279	Variable: 10K ohms ±30%, 0.1 W.
		- - - - - - - - - - - TRANSISTORS - - - - - - - - - -
TR1	JRC/5TCAF00510	Silicon, NPN: sim to Toshiba 2SC2782.
TR2	JRC/5TDAR00012	Silicon, NPN: sim to Matsushita 2SD1271Q.
TR3	JRC/5TDAB00055	Silicon, NPN: sim to NEC 2SD596-T2 DV3.
TR4	JRC/5TDAB00054	Silicon, NPN: sim to NEC 2SD596-T1 DV3.
TR5	JRC/5TDAB00055	Silicon, NPN: sim to NEC 2SD596-T2 DV3.
TR6	JRC/5TBAR00001	Silicon, PNP: sim to Matsushita 2SB953A.
TR101	JRC/5TCAB00280	Silicon, NPN: sim to NEC 2SC3357.
TR103	JRC/5TCAB00202	Silicon, NPN: sim to NEC 2SC2762.
TR103-1	JRC/5ZKAJ00010	Heatsink: sim to Nihon koukuu densh: TXBZP-032-037.
TR104	JRC/5TAAG00093	Silicon, PNP: sim to Toshiba 2SA1020-Y.

IC DATA



RC-5455

ADDENDUM NO 1 TO LBI-31765A
(PCML)

PARTS LIST CHANGES

The prefix of Service Parts replacement part numbers listed in the various Parts Lists included in this maintenance manual have been changed from "JRC/" to "B19/". All other characters remain the same as displayed. When this manual is next reprinted, all replacement parts lists will show only the "B19/" prefix.

When ordering replacement parts listed in this manual from the GE Mobile Communications Service Parts Operation, please use only the "B19/" prefix. The "B19/" prefix will be the only one shown in any future SERVICE PARTS PRICE LIST.

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