MAINTENANCE MANUAL
EXCITER/POWER AMPLIFIER
CAH-283
FOR
MLS8030
TWO-WAY MOBILE RADIO COMBINATIONS

TABLE OF CONTENTS

DESCRIPTION

Exciter/PA Board CAH-283 (A803) for the MLS 800 MHz mobile radio combinations provides 30 Watts of RF power in the 806.013 to 825.9875 MHz and 851.0125 to 870.9875 MHz frequency ranges 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, power control circuitry and a voltage regulator and transmitter switch circuit (refer to Figure 2 - Block Diagram).

The exciter circuit consists of HC1, HC2, HC3, a low-pass filter, a band-pass filter and four attenuator circuits.

The power amplifier circuit consists of an attenuator circuit at the input, DRIVER circuit HC4 (M57792), 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 power control circuitry consists of 9-Volt SWITCH transistor TR6, IC1, POWer DOWN SWITCH transistor TR5, DC amplifier transistor TR2, POWER CONTROL transistor TR3 and SMOOTHER (BUFFER) transistor TR4.

The transmit switch circuitry consists of 9-Volt regulator IC2 and EX9V SWITCH transistor TR6.

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 IC2 and Ex 9-volt Switch transistor TR6. Switches are controlled by the $\overline{\text{TX ENBL}}$ lead from System Control & Synthesizer board A801 (refer to Maintenance Manual LBI-31755).

When the $\overline{\text{TX ENBL}}$ lead is activated (PTT keyed) Transistor Switch TR6 turns on and applies the regulated ouput of IC2 to exciter amplifier HCs HC1 through HC3 and power control circuit.

Exciter

The exciter input (806/2-871/6 MHz) low-pass filter circuit (C15, C16, C17, L4) and attenuator circuit (R1, R2, R3). This attenuated input is coupled to the input of doubler HC1. The output of doubler HC1 is coupled to amplifier HC2 through two attenuator circuits (R6, R7, R8, R9, R10, R11) and band-pass filter FL1. The output power of HC2 is coupled to DRIVER module HC2 through an attenuator circuit. This exciter provides an RF input of 400 mW to Driver module HC4.

30-Watt PA

The 30-Watt PA uses DRIVER module HC4 and PA transistor TR1 to provide the

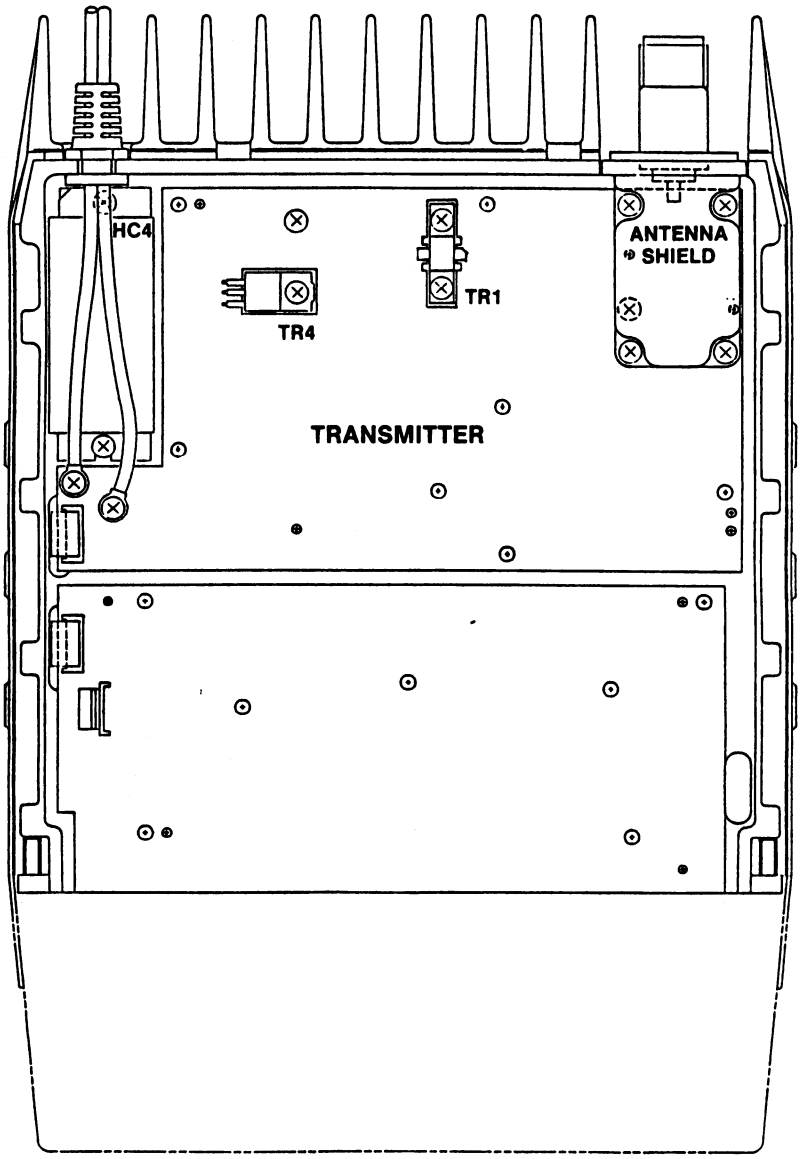

Figure 1 - Exciter/PA Location (Bottom View)

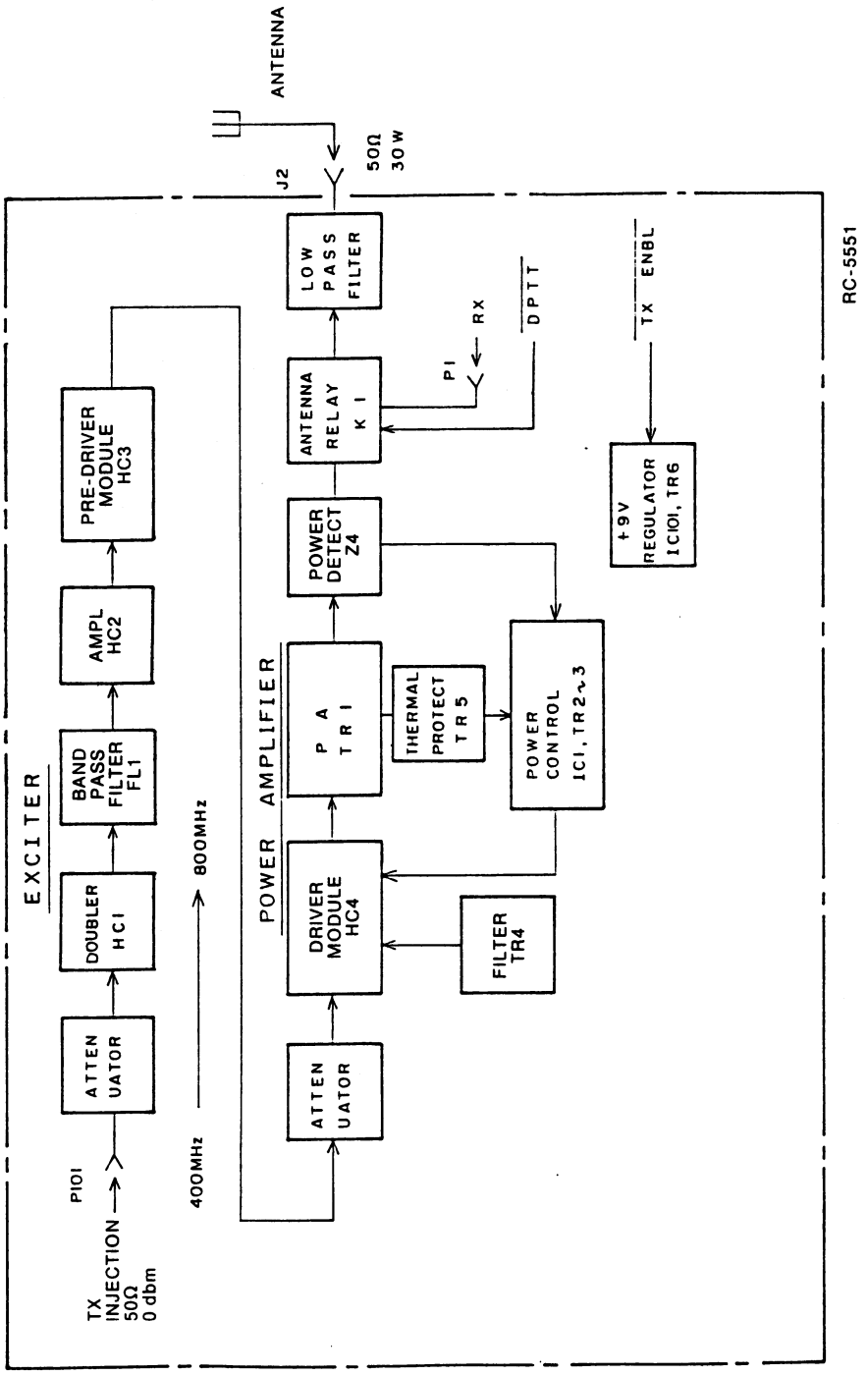

Figure 2 - Block Diagram

30-Watts of RF power output. The DRIVER module (HC4) contains three broadband amplifiers. The Auto Power Control circuit supplies voltage to the first amplifier. Continuous 13.6 Volts is supplied to the second and third amplifiers. The output of the DRIVER module is coupled through a 50-ohm impedance matching network consisting of capacitors C32, C33, CV1 and a 50-ohm stripline (printed circuit pattern) to the emitter of Class C final PA amplifier transistor TR1.

The output of TR1 is taken from the collector and coupled to the low-pass filter through a 50-ohm impedance matching network consisting of capacitor C34, C35, C36, and a 24-ohm stripline. The PA output is matched to antenna connector J2 through antenna relay K1 (ANTENNA SWITCH) and the low-pass filter consisting of capacitors C42 through C48. Continuous 13.6 volts A+ source voltage is applied to transistor TR1 through inductors L12 and L13.

Antenna Relay

Antenna relay K1 is controlled by the delayed PTT ($\overline{\text{DPTT}}$) output of the System Control 1/Synthesizer Board. When the $\overline{\text{DPTT}}$ output goes low, antenna relay K1 couples the PA output through the low-pass filter to the antenna connector J2.

APC Circuits

Auto 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 ADJ variable resistor RV1.

If the output power of the PA increases, the detected voltage and the voltage of OP AMP IC1-2 increases. The output voltage of OP AMP IC1-1 decreases. This causes transistor TR2 to conduct less. Transistor TR2 conducting less increases the base voltage on PNP pass transistor TR3, causing it to conduct less. This results in less voltage being applied to the first amplifier stage in the DRIVER module (HC4) reducing the power output of the exciter/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 circuit consisting of diode CD2, OP AMP IC1 and transistor TR2 and pass transistor TR3, detect reverse (reflected) power. When sufficient power is detected by CD2 to cause IC1 to conduct, the voltage at the output of IC1 decreases, causing the Driver module to lower the output power, protecting the PA. The reverse power level is set by resistor R51 connected in series with diode CD2.

The PA is protected against temperature increases by a thermal detector circuit consisting of R39, TR2, TR3, TR5 and IC1. As temperature increases, the resistance to ground of thermal detector R39 increases. This causes IC1 to conduct less, causing a decrease in the PA output until the temperature level is reduced. The temperature level is set by resistor R40.

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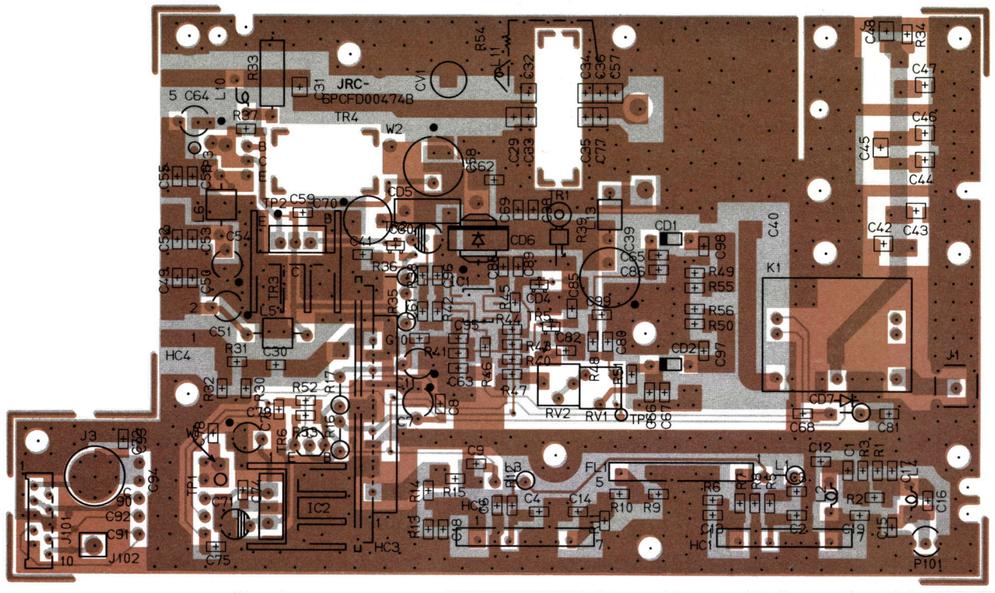
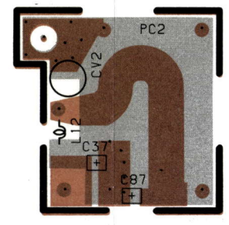
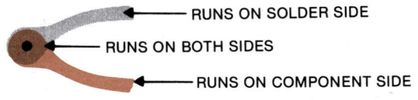
COMPONENT SIDE

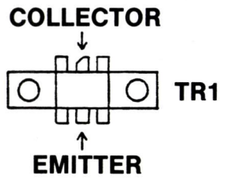


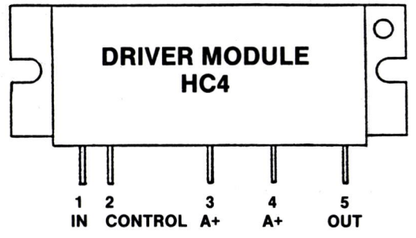
Z3





LEAD IDENTIFICATION



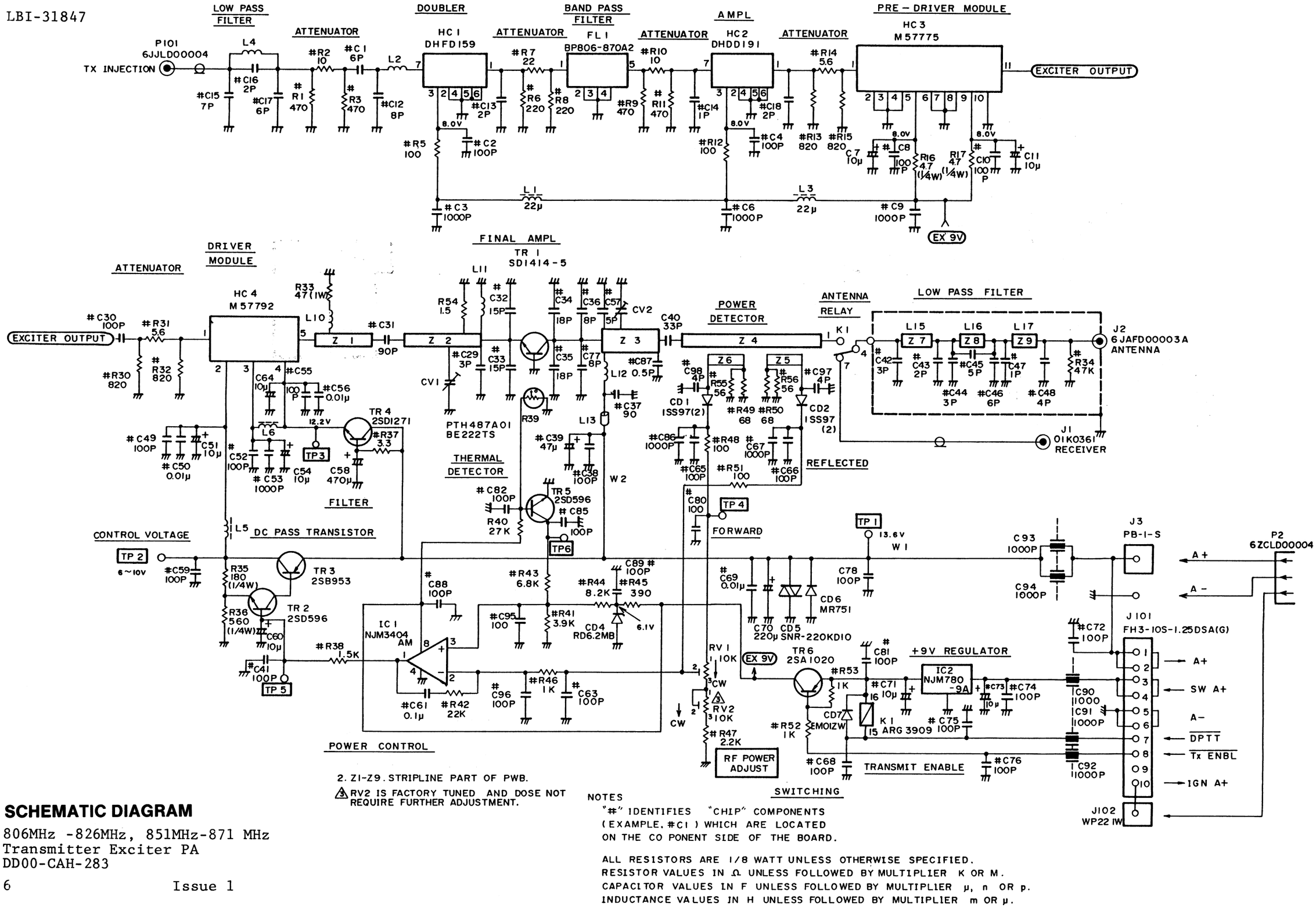


RC-5534

OUTLINE DIAGRAM

Exciter/PA Board
DD00-CAH-283

Issue 1



SCHEMATIC DIAGRAM

806MHz -826MHz, 851MHz-871 MHz
Transmitter Exciter PA
DD00-CAH-283

2. Z1-Z9. STRIPLINE PART OF PWB.

⚠3 RV2 IS FACTORY TUNED AND DOSE NOT REQUIRE FURTHER ADJUSTMENT.

NOTES

"#" IDENTIFIES "CHIP" COMPONENTS (EXAMPLE, #C1) WHICH ARE LOCATED ON THE CO PONENT SIDE OF THE BOARD.

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, n OR p.
INDUCTANCE VALUES IN H UNLESS FOLLOWED BY MULTIPLIER m OR μ.

PARTS LIST

MLS 800 MHz EXCITER/PA BOARD
CAH-283

ISSUE 1

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1	B19/5CAAD00899	Ceramic: 6 pF ±0.25 pF, 50 VDCW, temp coef 0 ±60 PPM.
C2	B19/5CAAD00780	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±60 PPM.
C3	B19/5CAAD00782	Ceramic: 1000 pF ±5%, 50 VDCW, temp coef +350 -1000 PPM.
C4	B19/5CAAD00780	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±60 PPM.
C6	B19/5CAAD00782	Ceramic: 1000 pF ±5%, 50 VDCW, temp coef +350 -1000 PPM.
C7	B19/5CEAA01864	Electrolytic: 10 uF ±20%, 25 VDCW.
C8	B19/5CAAD00780	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±60 PPM.
C9	B19/5CAAD00782	Ceramic: 1000 pF ±5%, 50 VDCW, temp coef +350 -1000 PPM.
C10	B19/5CAAD00780	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±60 PPM.
C11	B19/5CEAA01864	Electrolytic: 10 uF ±20%, 25 VDCW.
C12	B19/5CAAD00994	Ceramic: 8 pF ±0.25 pF, 50 VDCW, temp coef 0 ±60 PPM.
C13	B19/5CAAD00798	Ceramic: 2 pF ±0.25 pF, 50 VDCW, temp coef 0 ±60 PPM.
C14	B19/5CAAD00795	Ceramic: 1 pF ±0.25 pF, 50 VDCW, temp coef 0 ±60 PPM.
C15	B19/5CAAD00977	Ceramic: 7 pF ±0.5 pF, 50 VDCW, temp coef 0 ±60 PPM.
C16	B19/5CAAD00798	Ceramic: 2 pF ±0.25 pF, 50 VDCW, temp coef 0 ±60 PPM.
C17	B19/5CAAD00899	Ceramic: 6 pF ±0.25 pF, 50 VDCW, temp coef 0 ±60 PPM.
C18	B19/5CAAD00798	Ceramic: 2 pF ±0.25 pF, 50 VDCW, temp coef 0 ±60 PPM.
C29	B19/5CMAB01124	Mica: 3 pF ±0.25 pF, 500 VDCW.
C30	B19/5CAAD00780	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±60 PPM.
C31	B19/5CMAB01283	Mica: 90 pF ±5%, 500 VDCW.
C32 and C33	B19/5CMAB01109	Mica: 15 pF ±0.5 pF, 500 VDCW.
C34 and C35	B19/5CMAB01205	Mica: 18 pF ±0.5 pF, 500 VDCW.
C36	B19/5CMAB01114	Mica: 8 pF ±0.25 pF, 500 VDCW.
C37	B19/5CMAB01283	Mica: 90 pF ±5%, 500 VDCW.
C38	B19/5CAAD00780	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±60 PPM.
C39	B19/5CEAA00439	Electrolytic: 47 uF ±20%, 40 VDCW.
C40	B19/5CAAH00015	Mica: 33 pF ±5%, 500 VDCW.
C41	B19/5CAAD00780	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±60 PPM.
C42	B19/5CMAB01124	Mica: 3 pF ±0.25 pF, 500 VDCW.
C43	B19/5CMAB01170	Mica: 2 pF ±0.25 pF, 500 VDCW.
C44	B19/5CMAB01124	Mica: 3 pF ±0.25 pF, 500 VDCW.
C45	B19/5CMAB01113	Mica: 5 pF ±0.25 pF, 500 VDCW.
C46	B19/5CMAB01171	Mica: 6 pF ±0.25 pF, 500 VDCW.
C47	B19/5CMAB01169	Mica: 1 pF ±0.25 pF, 500 VDCW.
C48	B19/5CMAB01397	Mica: 4 pF ±0.25 pF, 500 VDCW.
C49	B19/5CAAD00780	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±60 PPM.
C50	B19/5CAAD00789	Ceramic: 0.01 uF ±10%, 50 VDCW, temp coef ±10%.
C51	B19/5CEAA01864	Electrolytic: 10 uF ±20%, 25 VDCW.
C52	B19/5CAAD00780	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±60 PPM.
C53	B19/5CAAD00789	Ceramic: 0.01 uF ±10%, 50 VDCW, temp coef ±10%.
C54	B19/5CEAA01864	Electrolytic: 10 uF ±20%, 25 VDCW.
C55	B19/5CAAD00780	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±60 PPM.
C56	B19/5CAAD00789	Ceramic: 0.01 uF ±10%, 50 VDCW, temp coef ±10%.
C57	B19/5CMAB01113	Mica: 5 pF ±0.25 pF, 500 VDCW.
C58	B19/5CEAA01756	Electrolytic: 470 uF ±20%, 25 VDCW.
C59	B19/5CAAD00780	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±60 PPM.
C60	B19/5CSAC00912	Tantalum: 10 uF ±20%, 35 VDCW.
C61	B19/5CAAD01056	Ceramic: 0.1 uF +80 -20%, 50 VDCW, temp coef +30 -80%.
C63	B19/5CAAD00780	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±60 PPM.
C64	B19/5CEAA01864	Electrolytic: 10 uF ±20%, 25 VDCW.
C65 and C66	B19/5CAAD00780	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±60 PPM.
C67	B19/5CAAD00782	Ceramic: 1000 pF ±5%, 50 VDCW, temp coef +350 -1000 PPM.
C68	B19/5CAAD00780	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±60 PPM.
C69	B19/5CAAD00789	Ceramic: 0.01 uF ±10%, 50 VDCW, temp coef ±10%.
C70	B19/5CEAA01786	Electrolytic: 220 uF ±20%, 25 VDCW.
C71	B19/5CSAC00912	Tantalum: 10 uF ±20%, 35 VDCW.
C72	B19/5CAAD00780	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±60 PPM.
C73	B19/5CEAA01864	Electrolytic: 10 uF ±20%, 25 VDCW.
C74 thru C76	B19/5CAAD00780	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±60 PPM.
C77	B19/5CMAB01114	Mica: 8 pF ±0.25 pF, 500 VDCW.
C78	B19/5CAAD00780	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±60 PPM.
C80 thru C82	B19/5CAAD00780	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±60 PPM.
C85	B19/5CAAD00780	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±60 PPM.
C86	B19/5CAAD00782	Ceramic: 1000 pF ±5%, 50 VDCW, temp coef +350 -1000 PPM.
C87	B19/5CMAB01122	Mica: 0.5 pF ±0.25 pF, 500 VDCW.
C88 and C89	B19/5CAAD00780	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±60 PPM.
C90 thru C94	B19/5CBAB02093	Ceramic, feed thru type: 1000 pF -0 +200%, 50 VDCW.
C95 and C96	B19/5CAAD00780	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±60 PPM.
C97 and C98	B19/5CAAD00801	Ceramic: 4 pF ±0.25 pF, 50 VDCW, temp coef 0 ±60 PPM.
CV1 and CV2	B19/5CVAC00070	Variable: max 4 pF.
		- - - - - - - - - - DIODES - - - - - - - - - -
CD1 and CD2	B19/5TXAA00313	Silicon, (Schottky Barrier): sim to NEC 1SS97(2)
CD4	B19/5TXAA00655	Zener 7.5V: sim to NEC RD7.5M.
CD5	B19/5TZAA00104	Ceramic Varistor: sim to SANKEN SNR-220KD10.
CD6	B19/5TXAM00019	Silicon, fwd current 3A 200 PIV: sim to MOTOROLA MR751.
CD7	B19/5TXAN00068	Silicon: 200V 1A, sim to SANKEN EM01Z.
		- - - - - - - - - - FILTERS - - - - - - - - - -
FL-1	B19/5NLAT00017	RF B.P.F.: Pass Band 806 to 870 MHz.
		- - - - - - - - - HYBRID CIRCUIT - - - - - - - - -
HC1	B19/6DHFD00159	RF Doubler Amplifier: sim to JRC DHFD159.
HC2	B19/6DHDD00191	Linear, RF Amplifier: sim to JRC DHDD191.
HC3	B19/5DHAA00020	RF Power Amplifier: sim to MITSUBISHI M57775.
HC4	B19/5DDAB00273	RF Power Amplifier: sim to MITSUBISHI M57792-21.
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - - -
IC1	B19/5DAAN00202	Linear, Dual OP AMP: sim to NJRC NJM3404AM.
IC2	B19/5DAAN00069	Linear, Positive Voltage Regulator: sim to NJRC NJM7809A.
		- - - - - - - - - - JACKS - - - - - - - - - -
J1	B19/5JJBL00025	Connector, RF.
J2	B19/6JAPD00003	Connector, RF: N type.
J3	B19/5JTCW00028	Connector.
J101	B19/5JWBS00178	Connector: 10 pins.
J102	B19/5JDAS00001	Connector.
		- - - - - - - - - - RELAYS - - - - - - - - - -
K1	B19/5KLAD00657	Relay, 9 VDC: sim to MATSUSHITA ARG3909.
		- - - - - - - - - - COILS - - - - - - - - - -
L1	B19/5LCAC00281	Choke Coil: 22 uH; sim to TDK TP0206-220K.
L2	B19/6LALD00021	Coil, RF.
L3	B19/5LCAC00281	Choke Coil: 22 uH; sim to TDK TP0206-220K.
L4	B19/6LALD00021	Coil, RF.
L5 and L6	B19/6LAFD01129	Choke Coil.
L10	B19/6LALD00022	Coil, RF.
L11	B19/6LALD00023	Coil, RF.
L12	B19/6LALD00024	Coil, RF.
L13	B19/6LALD00025	Coil, RF.
		- - - - - - - - - - CABLES - - - - - - - - - -
P2	B19/6ZCLD00004	Power Cable.
P101	B19/6JJLD00004	Coaxial Cable.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	B19/5RDAC02257	Metal film: 470 ohms ±5%, 200 VDCW, 1/8 W.
R2	B19/5RDAC02141	Metal film: 10 ohms ±5%, 200 VDCW, 1/8 W.
R3	B19/5RDAC02257	Metal film: 470 ohms ±5%, 200 VDCW, 1/8 W.
R5	B19/5RDAC02137	Metal film: 100 ohms ±5%, 200 VDCW, 1/8 W.
R6	B19/5RDAC02159	Metal film: 220 ohms ±5%, 200 VDCW, 1/8 W.
R7	B19/5RDAC02210	Metal film: 22 ohms ±5%, 200 VDCW, 1/8 W.
R8	B19/5RDAC02159	Metal film: 220 ohms ±5%, 200 VDCW, 1/8 W.
R9	B19/5RDAC02257	Metal film: 470 ohms ±5%, 200 VDCW, 1/8 W.
R10	B19/5RDAC02141	Metal film: 10 ohms ±5%, 200 VDCW, 1/8 W.
R11	B19/5RDAC02257	Metal film: 470 ohms ±5%, 200 VDCW, 1/8 W.
R12	B19/5RDAC02137	Metal film: 100 ohms ±5%, 200 VDCW, 1/8 W.
R13	B19/5RDAC02142	Metal film: 820 ohms ±5%, 200 VDCW, 1/8 W.
R14	B19/5RDAC02204	Metal film: 5.6 ohms ±5%, 200 VDCW, 1/8 W.
R15	B19/5RDAC02142	Metal film: 820 ohms ±5%, 200 VDCW, 1/8 W.
R16 and R17	B19/5RDAA01550	Metal film: 4.7 ohms ±5%, 300 VDCW, 1/4 W.
R30	B19/5RDAC02142	Metal film: 820 ohms ±5%, 200 VDCW, 1/8 W.
R31	B19/5RDAC02204	Metal film: 5.6 ohms ±5%, 200 VDCW, 1/8 W.
R32	B19/5RDAC02142	Metal film: 820 ohms ±5%, 200 VDCW, 1/8 W.
R33	B19/5REAG02152	Metal film: 47 ohms ±5%, 1 W.
R34	B19/5RDAC02134	Metal film: 47K ohms ±5%, 200 VDCW, 1/8 W.
R35	B19/5RDAA01628	Metal film: 180 ohms ±5%, 300 VDCW, 1/4 W.
R36	B19/5RDAA01589	Metal film: 560 ohms ±5%, 300 VDCW, 1/4 W.
R37	B19/5RDAC02553	Metal film: 3.3 ohms ±5%, 200 VDCW, 1/8 W.
R38	B19/5RDAC02133	Metal film: 1.5K ohms ±5%, 200 VDCW, 1/8 W.
R39	B19/5RXAE00028	Posistor.
R40	B19/5RDAC02263	Metal film: 27K ohms ±5%, 200 VDCW, 1/8 W.
R41	B19/5RDAC02435	Metal film: 3.9K ohms ±5%, 200 VDCW, 1/8 W.
R42	B19/5RDAC02148	Metal film: 22K ohms ±5%, 200 VDCW, 1/8 W.
R43	B19/5RDAC02157	Metal film: 6.8K ohms ±5%, 200 VDCW, 1/8 W.
R44	B19/5RDAC02158	Metal film: 8.2K ohms ±5%, 200 VDCW, 1/8 W.
R45	B19/5RDAC02443	Metal film: 390 ohms ±5%, 200 VDCW, 1/8 W.
R46	B19/5RDAC02132	Metal film: 1K ohms ±5%, 200 VDCW, 1/8 W.
R47	B19/5RDAC02124	Metal film: 2.2K ohms ±5%, 200 VDCW, 1/8 W.
R48	B19/5RDAC02137	Metal film: 100 ohms ±5%, 200 VDCW, 1/8 W.
R49 and R50	B19/5RDAC02127	Metal film: 68 ohms ±5%, 200 VDCW, 1/8 W.
R51	B19/5RDAC02137	Metal film: 100 ohms ±5%, 200 VDCW, 1/8 W.
R52 and R53	B19/5RDAC02132	Metal film: 1K ohms ±5%, 200 VDCW, 1/8 W.
R54	B19/5REAG00008	Metal film: 1.5 ohms ±5%, 1 W.
R55 and R56	B19/5RDAC02143	Metal film: 56 ohms ±5%, 200 VDCW, 1/8 W.
RV1	B19/5RVAB00279	Variable: 10K ohms ±30%, 0.1 W.
RV2	B19/5RMAB00053	Variable: 10K ohms.
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
TR1	B19/5TDAU00001	Silicon, NPN: (800 MHz Amplifier); sim to THOMSON SD1414-5.
TR2	B19/5TDAB00054	Silicon, NPN: sim to NEC 2SD596.
TR3	B19/5TBAR00002	Silicon, PNP: sim to MATSUSHITA 2SB953A.
TR4	B19/5TDAR00012	Silicon, NPN: sim to MATSUSHITA 2SD1271Q.
TR5	B19/5TDAB00054	Silicon, NPN: sim to NEC 2SD596.
TR6	B19/5TAAG00093	Silicon, PNP: sim to TOSHIBA 2SA1020-Y.
		- - - - - - - - - - WIRE - - - - - - - - - -
W1	B19/6LALD00026	Wire.
W2	B19/6LALD00027	Wire.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES