MAINTENANCE MANUAL
RECEIVER BOARD B19/CMA-367

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DESCRIPTION

The FMD 16^{PLUS} Receiver board (CMA-367) is designed for operation in the 851 to 870 MHz frequency range. The board is mounted at the bottom front of the radio frame assembly as shown in Figure 1.

Regulated 8.0 volts is provided to operate all receiver stages except the audio PA IC, which operates from the switched A+ (13.6 volts) supply.

The receiver has Intermediate Frequencies (IF) of 82.2 MHz and 455 MHz. Adjacent channel selectivity is obtained by using two band-pass filters: an 82.2 MHz crystal filter and a 455 kHz ceramic filter.

All of the receiver circuitry except the synthesizer, audio preamp, and audio PA are mounted on the receiver (RX) board (refer to Figure 2). The receiver consists of:

- A front end and mixer
- An 82.2 MHz first IF, a 455 kHz second IF, and an FM detector
- Audio PA
- TX/RX Injection

CIRCUIT ANALYSIS

RECEIVER FRONT END

An rf signal from the antenna is coupled through the low-pass filter, antenna switch, and rf band-pass filter FL401 to the input of RF amplifier TR401. The output of TR401 is coupled through rf band-pass filter FL402 to the input of first mixer TR402. Front end selectivity is provided by the rf band-pass filters (FL401 & FL402).

TX/RX INJECTION

RF injection (384.4 to 435.0 MHz) from the synthesizer VCO is applied to doubler TR403 through Tx/Rx INJECTION connector J403. The input level at J403 will be between 0.5 and 1.0 milliwatts. Doubler TR403 multiplies the Tx/Rx injection frequency by two to provide an Rx injection frequency and Tx injection frequency. The output of doubler TR403 is coupled to the input of amplifier IC401 and TR404. The output of amplifier IC401 is filtered by a dielectric filter (FL403). This filter is tuned to pass frequencies in the 768.8-787.8 MHz band-pass range.

The output of amplifier TR404 is filtered by a band-pass filter (FL404). This filter is tuned to pass frequencies in the 806-870 MHz band-pass range.

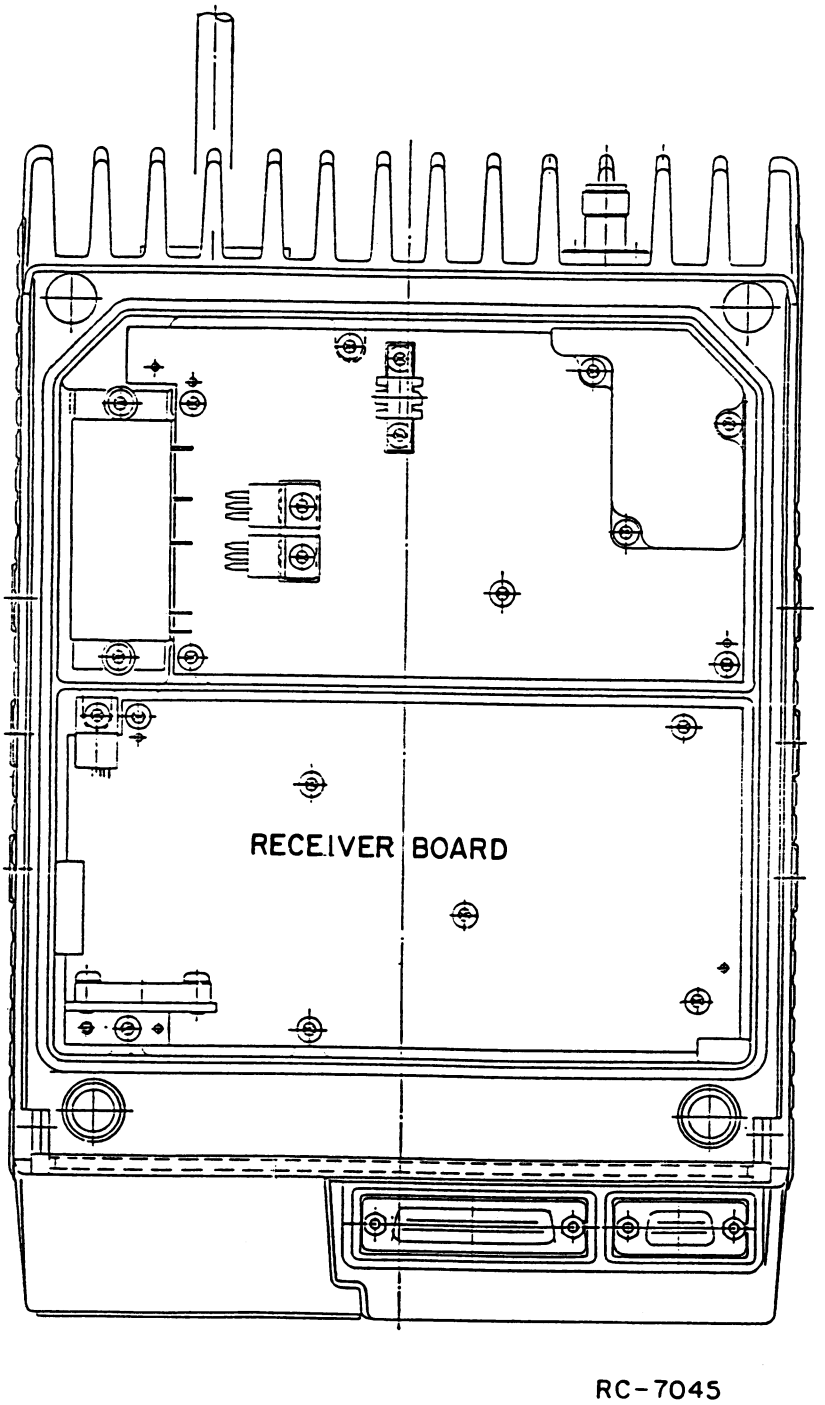


FIGURE 1 - RECEIVER BOARD LOCATION

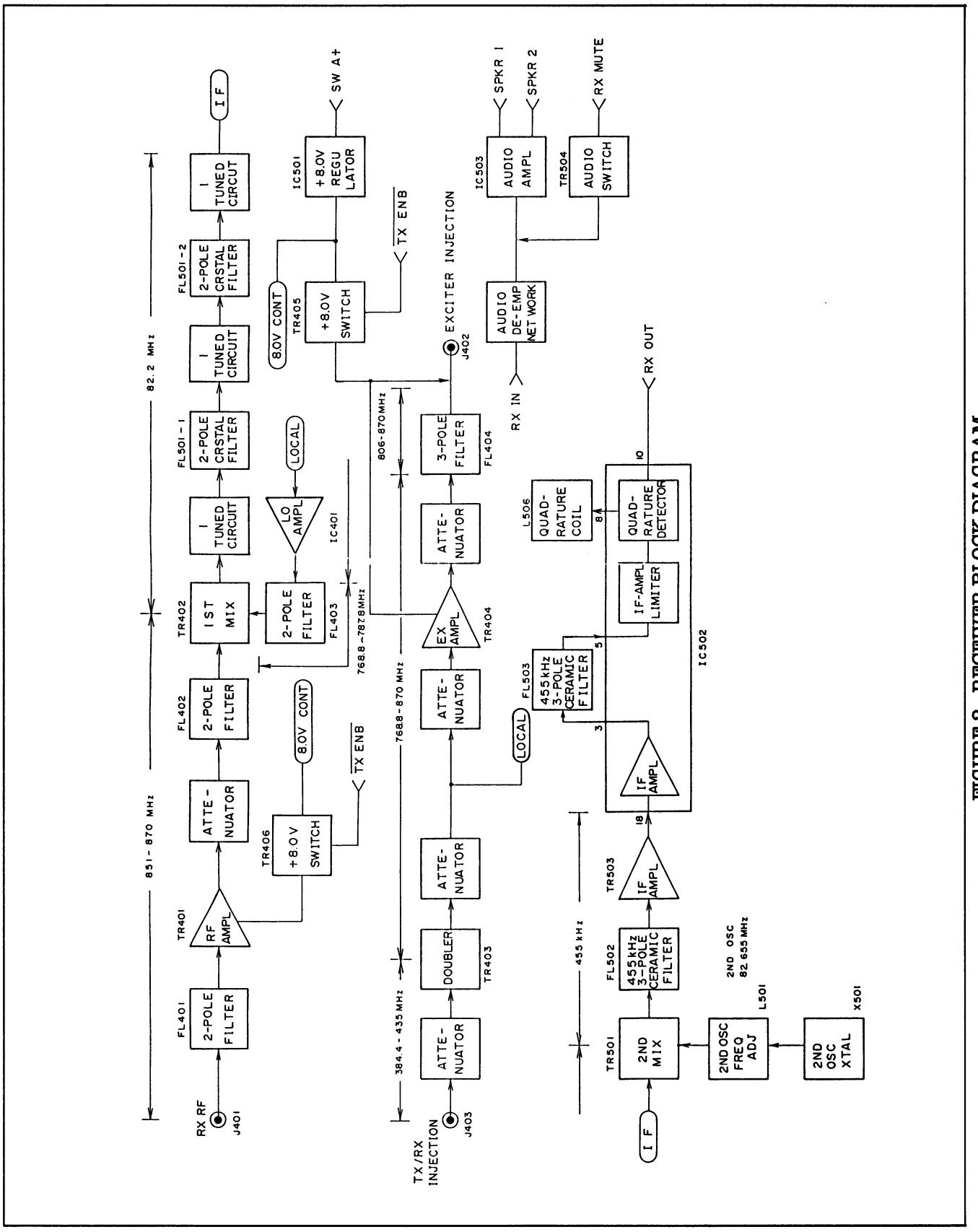


FIGURE 2 - RECEIVER BLOCK DIAGRAM

FIRST MIXER

The first mixer uses a transistor (TR402) as the active device. This transistor mixer provides high power gain and an output relatively free of intermodulation products.

In the mixer stage, rf from the front-end dielectric filter is applied to one input of the mixer. Injection voltage from the multiplier stages is applied to the other input of the mixer. The 82.2 MHz mixer first IF output signal is coupled from the output of TR402 through an impedance matching network (L501 and C501) to a four-pole crystal filter consisting of FL501-1 and FL501-2.

FIRST IF

The highly selective crystal filters FL501-1 and FL501-2 provide the first portion of the receiver IF selectivity. The output to the filters is coupled through an impedance-matching network consisting of inductor L503, capacitors C504 and C507 and resistor R502 to the second mixer TR501.

SECOND MIXER

Second mixer TR501 and associated circuitry provide the second oscillator and second mixer.

The 82.2 MHz IF input is applied to TR501 base and mixed with an 82.655 MHz frequency supplied by crystal oscillator X501. Inductor L505 sets the frequency of X501.

SECOND IF AND DETECTOR

The output of the second mixer is coupled to the four-pole ceramic filter FL502, which provides the 455 kHz selectivity. The output of the ceramic filter is coupled to the base of IF amplifier transistor TR503. This transistor provides limiting for the 455 kHz IF signal (1.4 Vp-p) to prevent high level overloading of IC502 (Limited/FM Detector, Noise Amplifier).

IC502 and associated circuitry provide an IF amplifier and FM detector. The 455 kHz IF input is applied to pin 18.

The 455 kHz IF signal is amplified and applied to four-pole ceramic filter FL503, which provides the 455 kHz selectivity. The output of the 455 kHz filter is re-applied to IC502-5. The second IF signal is amplified and limited. Inductor L506 shifts the IF signal by 90° and applies it to the internal FM detector. The FM detector compares the shifted IF signal to the internal IF signal to recover the audio modulation. The audio output of IC502 is applied to the System Control board (A801).

AUDIO CIRCUITS

Received audio (RX OUT) from the FM detector is applied to the input of audio pre-amplifier IC601-6 on the System Control board A80. The audio is then applied to audio gate IC603-13 and pre-amplifier IC601-6 to the volume control and squelch control of IC605. The audio output from the volume control IC is applied to the de-emphasis network R529 to R531, capacitor C535, C538. This enables audio amplifier IC503 which provides up to four watts of audio output power input to a 16-ohm speaker.

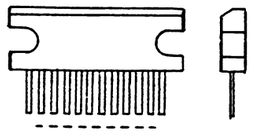
PARTS LIST

FMD RECEIVER BOARD
B19/CMA-367
ISSUE 1

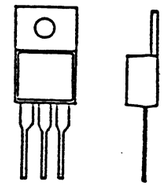
SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C401	B19/5CAAD00853	Ceramic: 3 pF ±0.25 pF, 50 VDCW, temp coef 0 ±30 PPM.
C402 thru C409	B19/5CAAD00839	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C412	B19/5CAAD00853	Ceramic: 3 pF ±0.25 pF, 50 VDCW, temp coef 0 ±30 PPM.
C413	B19/5CAAD01154	Ceramic: 1000 pF ±10%, 50 VDCW, temp coef +350 -1000 PPM.
C414	B19/5CAAD00839	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C415	B19/5CAAD01154	Ceramic: 1000 pF ±10%, 50 VDCW, temp coef +350 -1000 PPM.
C416	B19/5CAAD00963	Ceramic: 18 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C417	B19/5CAAD00951	Ceramic: 7 pF ±0.5 pF, 50 VDCW, temp coef 0 ±30 PPM.
C419	B19/5CAAD00839	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C420	B19/5CAAD00853	Ceramic: 3 pF ±0.25 pF, 50 VDCW, temp coef 0 ±30 PPM.
C422 and C423	B19/5CAAD00839	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C424	B19/5CAAD00961	Ceramic: 4 pF ±0.25 pF, 50 VDCW, temp coef 0 ±30 PPM.
C426 and C427	B19/5CAAD00839	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C428	B19/5CAAD00961	Ceramic: 4 pF ±0.25 pF, 50 VDCW, temp coef 0 ±30 PPM.
C429 thru C432	B19/5CAAD00839	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C433	B19/5CAAD01154	Ceramic: 1000 pF ±10, 50 VDCW, temp coef +350 -1000 PPM.
C434 thru C436	B19/5CAAD00839	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C501	B19/5CAAD00961	Ceramic: 4 pF ±0.25 pF, 50 VDCW, temp coef 0 ±30 PPM.
C502	B19/5CAAD01115	Ceramic: 0.01 uF ±10, 50 VDCW, temp coef 0 ±10%.
C503	B19/5CAAD00961	Ceramic: 4 pF ±0.25 pF, 50 VDCW, temp coef 0 ±30 PPM.
C504	B19/5CAAD00853	Ceramic: 3 pF ±0.25 pF, 50 VDCW, temp coef 0 ±30 PPM.
C505	B19/5CRAR00072	Polyester film: 0.1 uF, ±10, 50 VDCW.
C506 thru C508	B19/5CAAD01115	Ceramic: 0.01 uF ±5%, 50 VDCW, temp coef 0 ±10%.
C509	B19/5CRAR00072	Polyester film: 0.1 uF, ±10%, 50 VDCW.
C510	B19/5CAAD00852	Ceramic: 1 pF ±0.25 pF, 50 VDCW, temp coef 0 ±30 PPM.
C511	B19/5CAAD01115	Ceramic: 0.01 uF ±10%, 50 VDCW, temp coef 0 ±10%
C512	B19/5CAAD01154	Ceramic: 1000 pF ±10%, 50 VDCW, temp coef +350 -1000 PPM.
C513	B19/5CAAD00948	Ceramic: 33 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C514 and C515	B19/5CAAD00950	Ceramic: 15 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM
C516	B19/5CRAR00072	Polyester film: 0.1 uF, ±10%, 50 VDCW.
C517 and C518	B19/5CAAD01115	Ceramic: 0.01 uF ±10%, 50 VDCW, temp coef 0 ±10%
C519 and C521	B19/5CRAR00072	Polyester film: 0.1 uF, ±10%, 50 VDCW.
C522	B19/5CAAD00854	Ceramic: 47 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM
C523	B19/5CAAD01154	Ceramic 1000 pF ±10%, 50 VDCW, temp coef +350 -1000 PPM.
C524 thru C526	B19/5CRAR00072	Polyester film: 0.1 uF ±10%, 50 VDCW.
C527 thru C530	B19/5CSAP00067	Electrolytic: 100 uF ±20%, 16 VDCW.
C531	B19/5CEAD00877	Electrolytic: 47 uF ±20%, 16 VDCW.
C532	B19/5CRAR00072	Polyester film: 0.1 uF ±10%, 50 VDCW.
C534	B19/5CEAD00877	Electrolytic: 47 uF ±20%, 16 VDCW.
C535	B19/5CAAD01115	Ceramic: 0.01 uF ±10%, 50 VDCW, temp coef 0 ±10%
C536 and C537	B19/5CRAR00072	Polyester film: 0.1 uF ±10%, 50 VDCW.
C538	B19/5CAAD01471	Ceramic: 0.015 uF ±10%, 50 VDCW, temp coef ±10%.
		- - - - - - - - - - DIODES - - - - - - - - - -
CD401	B19/5TXAD00290	Silicon, fast recovery (2 diodes in cathode common) sim to TOSHIDA 1SS184.
		- - - - - - - - - - FILTERS - - - - - - - - - -
FL401 and FL402	B19/5NRAB00015	Dielectric RF filter.
FL403	B19/5NRAB00016	Dielectric RF filter.
FL404	B19/5NLAT00017	RF filter; BPF 806-870 MHz.
FL501	B19/6XHAA00780	Crystal filter; f=82.2MH : XPJ7-2.
FL502	B19/5NRAA00053	Ceramic filter: 455 KHz; sim to MURATA CFU455E2.
FL503	B19/5NRAA00041	Ceramic filter: 455 KHz; sim to MURATA CFU455B2.
		- - - - - - - - - INTEGRATED CIRCUITS - - - - - - -
IC401	B19/5DAAA00183	Linear, RF Amplifier; sim to NEC uPC1656C.
IC501	B19/5DAAN00029	Linear, Positive Voltage Regulator; sim to NJRC NJM78M08A.
IC502	B19/5DDAS00074	Linear, IF Amplifier & Detector; sim to MOTOROLA MC3359P.
IC503	B19/5DAAA00233	Linear, Audio Amplifier; sim to NEC uPC1230H2.
		- - - - - - - - - - CONNECTORS - - - - - - - - - -
J401 thru J403	B19/5JDAK00009	Connector, RF; sim to TAIKO TMP-J01X-V2.
J501	B19/5JWAV00117	Connector; 9 pin; sim to SMK CMP1509-0180.
J502	B19/5JWAV00120	Connector; 2 pin; sim to SMK W-P5102#51.
		- - - - - - - - - - COILS - - - - - - - - - -
L501 thru L503	B19/6LADD00553	Coil, RF: sim to MIDORI 6LADD00553.
L504	B19/5LCAA00280	Coil, RF: sim to TAIYO-YUDEN LAL03VBR22M.
L505	B19/6LADD00554	Coil, RF: sim to MIDORI 6LADD00554.
L506	B19/6LAFD00877	Coil, RF: sim to TOKO 6LAFD00877.
		- - - - - - - - - - PLUGS - - - - - - - - - -
P401	B19/6PCLD00057	
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R401	B19/5RDAC02462	Metal film: 3.3K ohms ±5%, 100 VDCW, 1/10W.
R402	B19/5RDAC02474	Metal film: 1.5K ohms ±5%, 100 VDCW, 1/10W.
R403 and R404	B19/5RDAC02137	Metal film: 100 ohms ±5%, 200 VDCW, 1/8W.
R405 and R406	B19/5RDAC02469	Metal film: 220 ohms ±5%, 100 VDCW, 1/10W.
R407	B19/5RDAC02465	Metal film: 22 ohms ±5%, 100 VDCW, 1/10W.
R408	B19/5RDAC02474	Metal film: 1.5K ohms ±5%, 100 VDCW, 1/10W.
R409	B19/5RDAC02469	Metal film: 220 ohms ±5%, 100 VDCW, 1/10W.
R410	B19/5RDAC02137	Metal film: 100 ohms ±5%, 200 VDCW, 1/8W.
R411	B19/5RDAC02451	Metal film: 2.2K ohms ±5%, 100 VDCW, 1/10W.
R412	B19/5RDAC02137	Metal film: 100 ohms ±5%, 200 VDCW, 1/8W.
R415	B19/5RDAC02581	Metal film: 0 ohms, 1/10W.
R416	B19/5RDAC02478	Metal film: 4.7K ohms ±5%, 100 VDCW, 1/10W.
R417	B19/5RDAC02474	Metal film: 1.5K ohms ±5%, 100 VDCW, 1/10W.
R418	B19/5RDAC02127	Metal film: 68 ohms ±5%, 200 VDCW, 1/8W.
R419	B19/5RDAC02137	Metal film: 100 ohms ±5%, 200 VDCW, 1/8W.
R420 and R421	B19/5RDAC02471	Metal film: 470 ohms ±5%, 100 VDCW, 1/10W.
R422	B19/5RDAC02612	Metal film: 12 ohms ±5%, 100 VDCW, 1/10W.
R423	B19/5RDAC02458	Metal film: 6.8K ohms ±5%, 100 VDCW, 1/10W.
R424	B19/5RDAC02542	Metal film: 820 ohms ±5%, 100 VDCW, 1/10W.
R425 and R426	B19/5RDAC02201	Metal film: 4.7 ohms ±5%, 200 VDCW, 1/8W.
R427	B19/5RDAC02579	Metal film: 56 ohms ±5%, 100 VDCW, 1/10W.
R428	B19/5RDAC02137	Metal film: 100 ohms ±5%, 200 VDCW, 1/8W.
R434	B19/5RDAC02446	Metal film: 1K ohms ±5%, 100 VDCW, 1/10W.
R435	B19/5RDAC02451	Metal film: 2.2K ohms ±5%, 100 VDCW, 1/10W.
R436 and R437	B19/5RDAC02471	Metal film: 470 ohms ±5%, 100 VDCW, 1/10W.
R438	B19/5RDAC02612	Metal film: 12 ohms ±5%, 100 VDCW, 1/10W.
R439	B19/5RDAC02451	Metal film: 2.2K ohms ±5%, 100 VDCW, 1/10W.
R501 and R502	B19/5RDAC02458	Metal film: 6.8K ohms ±5%, 100 VDCWl, 1/10W.
R503	B19/5RDAC02481	Metal film: 15K ohms ±5%, 100 VDCW, 1/10W.
R504	B19/5RDAC02478	Metal film: 4.7K ohms ±5%, 100 VDCW, 1/10W.
R505	B19/5RDAC02446	Metal film: 1K ohms ±5%, 100 VDCW, 1/10W.
R506	B19/5RDAC02137	Metal film: 100 ohms ±5%, 200 VDCW, 1/8W.
R507	B19/5RDAC02466	Metal film: 33 ohms ±5%, 100 VDCW, 1/10W.
R508	B19/5RDAC02137	Metal film: 100 ohms ±5%, 100 VDCW, 1/8W.
R509	B19/5RDAC02478	Metal film: 4.7K ohms ±5%, 100 VDCW, 1/10W.
R510	B19/5RDAC02446	Metal film: 1K ohms ±5%, 100 VDCW, 1/10W.
R511	B19/5RDAC02445	Metal film: 10K ohms ±5%, 100 VDCW, 1/10W.
R512	B19/5RDAC02451	Metal film: 2.2K ohms ±5%, 100 VDCW, 1/10W.
R513	B19/5RDAC02474	Metal film: 1.5K ohms ±5%, 100 VDCW, 1/10W.
R514	B19/5RDAC02478	Metal film: 4.7K ohms ±5%, 100 VDCW, 1/10W.
R515	B19/5RDAC02445	Metal film: 10K ohms ±5%, 100 VDCW, 1/10W.
R516	B19/5RDAC02462	Metal film: 3.3K ohms ±5%, 100 VDCW, 1/10W.
R517	B19/5RDAC02451	Metal film: 2.2K ohms ±5%, 100 VDCW, 1/10W.
R518	B19/5RDAC02469	Metal film: 220 ohms ±5%, 100 VDCW, 1/10W.
R519	B19/5RDAC02137	Metal film: 100 ohms ±5%, 200 VDCW, 1/8W.
R520	B19/5RDAC02439	Metal film: 47K ohms ±5%, 100 VDCW, 1/10W.
R521 and R522	B19/5RDAC02478	Metal film: 4.7K ohms ±5%, 100 VDCW, 1/10W.
R523	B19/5RDAC02446	Metal film: 1K ohms ±5%, 100 VDCW, 1/10W.
R524 thru R527	B19/5RDAC02223	Metal film: 2.2 ohms ±5%, 200 VDCW, 1/8W.
R528	B19/5RDAC02468	Metal film: 150 ohms ±5%, 100 VDCW, 1/10W.
R529	B19/5RDAC02458	Metal film: 6.8K ohms ±5%, 100 VDCW, 1/10W.
R530	B19/5RDAC02445	Metal film: 10K ohms ±5%, 100 VDCW, 1/10W.
R531	B19/5RDAC02485	Metal film: 68K ohms ±5%, 100 VDCW, 1/10W.
R532	B19/5RDAC02461	Metal film: 1M ohms ±5%, 100 VDCW, 1/10W.
R533	B19/5RDAC02451	Metal film: 2.2K ohms ±5%, 100 VDCW, 1/10W.
		- - - - - - - - - - TRANSISTORS - - - - - - - - -
TR401	B19/5TCAF00555	Silicon, NPN: sim to TOSHIBA 2SC3606.
TR402 and TR403	B19/5TCAB00288	Silicon, NPN: sim to NEC 2SC3356.
TR404	B19/5TCAB00287	Silicon, NPN: sim to NEC 2SC3357.
TR405	B19/5TAAG00093	Silicon, NPN: sim to TOSHIBA 2SA1020-Y.
TR406	B19/5TDAB00054	Silicon, NPN: sim to NEC 2SD596.
TR501 and TR502	B19/5TAAA00109	Silicon, NPN: sim to HITACHI 2SC2620B.
TR503 and TR504	B19/5TDAB00054	Silicon, NPN: sim to NEC 2SD596.
		- - - - - - - - - - CRYSTAL - - - - - - - - - -
X501	B19/6XHAA00782	Crystal; F=82.655 MHz: XPJ7-3.
		- - - - - - - - - - SOCKETS - - - - - - - - - -
XS501-1 and XS501-2	B19/52JDP00001	Crystal Socket; sim to HAKUTO 75315-001.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

IC503

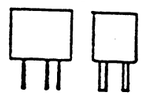


IC501



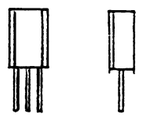
1=INPUT
2=COLLECTOR
3=BASE

FL502, FL503



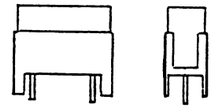
1=INPUT
2=GND
3=OUTPUT

TR405

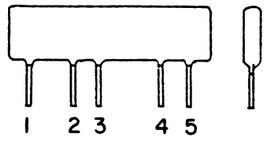


1=EMITTER
2=COLLECTOR
3=BASE

FL401-FL403

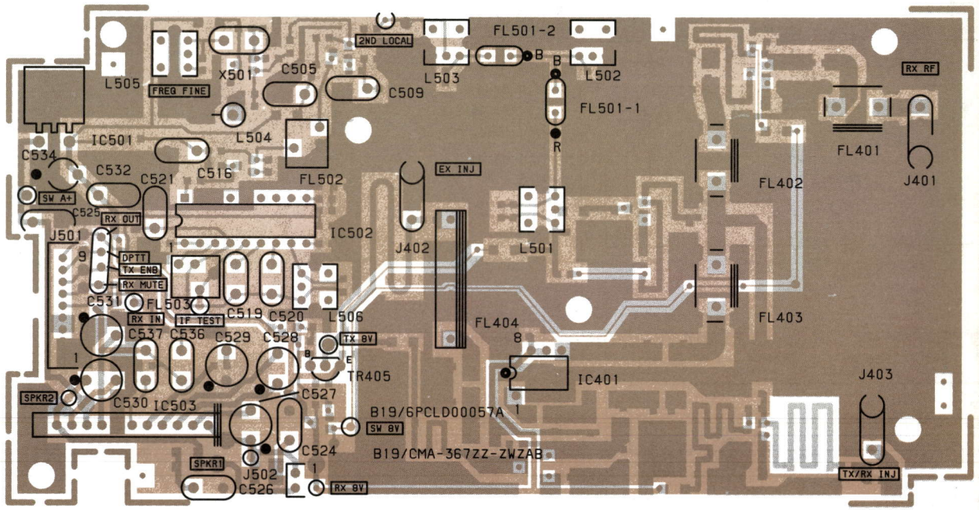


FL404



RC-7047

IC DATA



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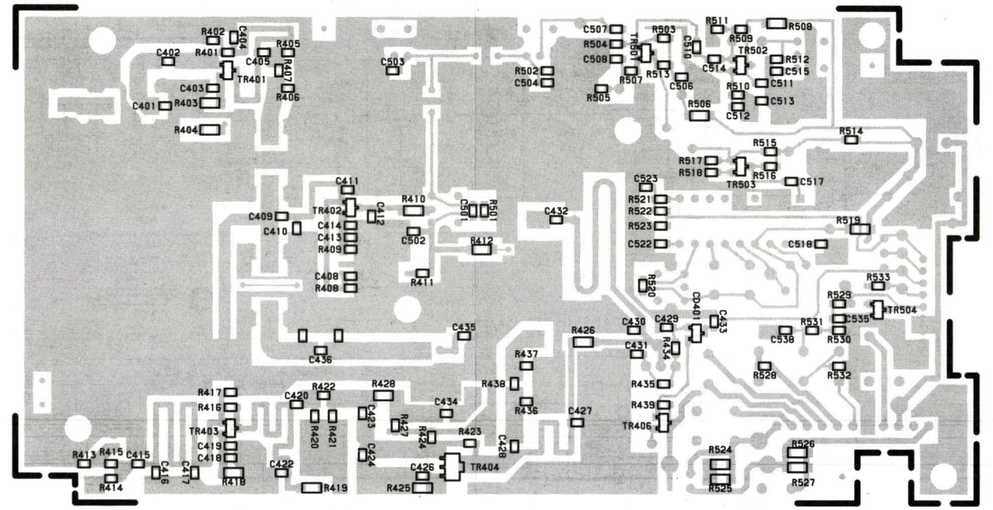
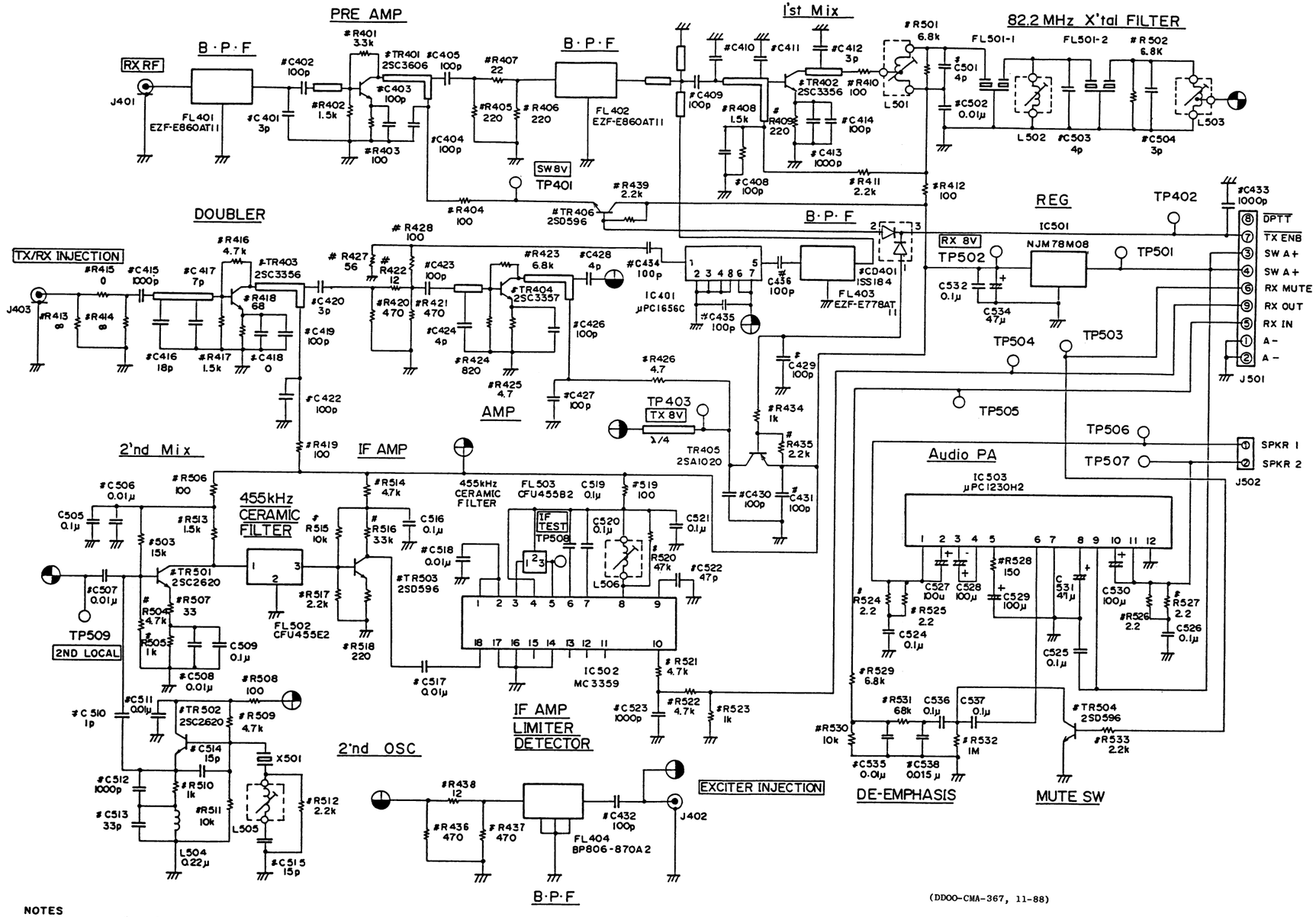


RUNS ON SOLDER SIDE

RUNS ON BOTH SIDES

RUNS ON COMPONENT SIDE

RECEIVER OUTLINE DIAGRAM



(DDOO-CMA-367, 11-88)

NOTES

"#" IDENTIFIES "CHIP" COMPONENTS WHICH ARE LOCATED ON THE SOLDER SIDE OF THE BOARD.

1. RESISTOR VALUES IN Ω UNLESS FOLLOWED BY MULTIPLIER k.

2. CAPACITOR VALUES IN F UNLESS FOLLOWED BY MULTIPLIER µ OR p.

RECEIVER SCHEMATIC DIAGRAM