

# MAINTENANCE MANUAL **RECEIVER BOARD B19/CMA-407**

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## **DESCRIPTION**

The FMD DACS<sup>™</sup> Receiver board (CMA-407) 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 kHz. 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**

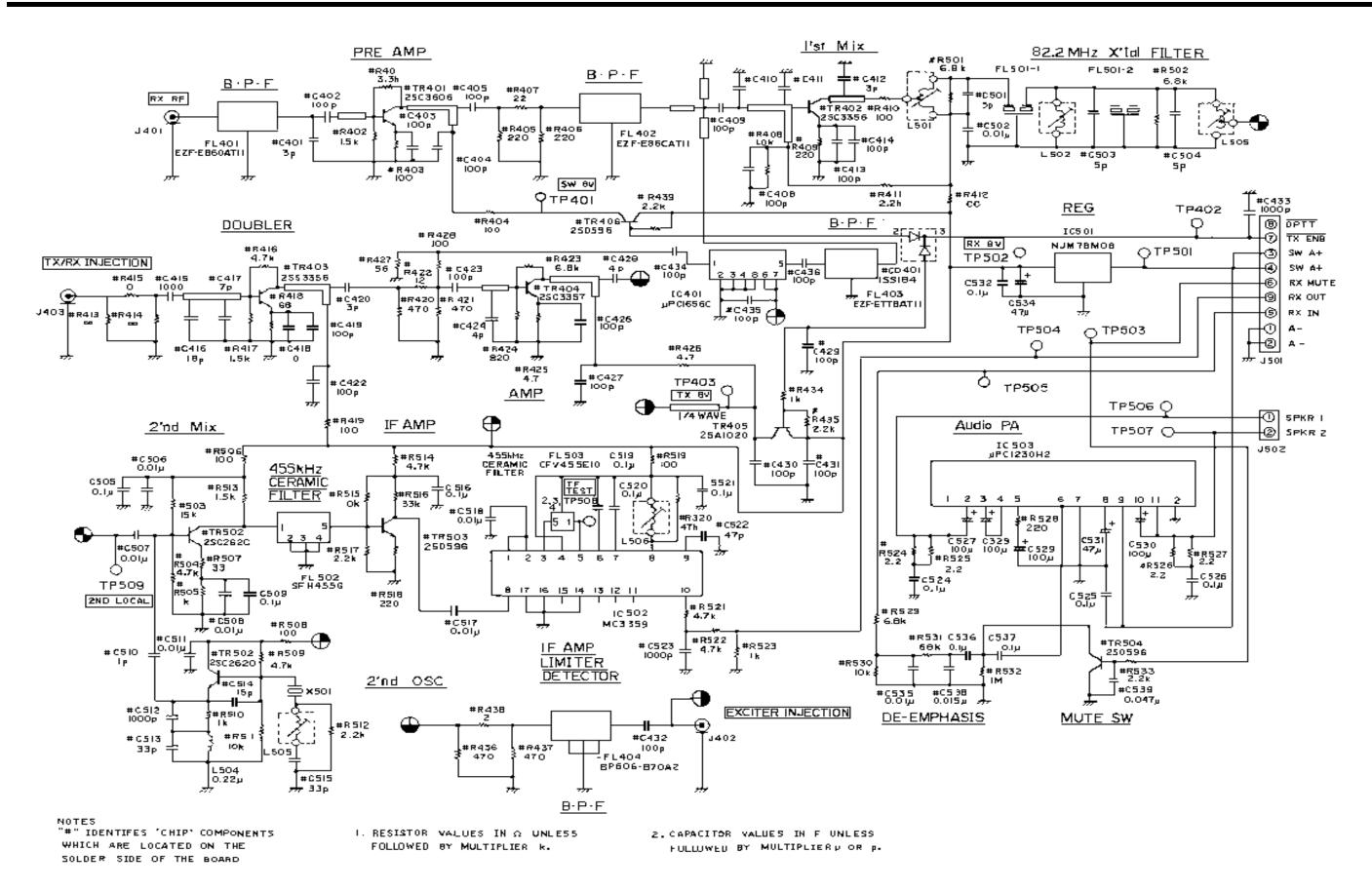
RF injection (384.4 to 435.0 MHz) from the synthesizer VCO is applied to doubler TR403 through TX/RX INJEC-TION connector J403. The input level at J403 will be between 0.5 and 1.0 milliwatts. Doubler TR403 multiplies the TX/RX injection frequency by two to provide an RX injection frequency and TX injection 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.



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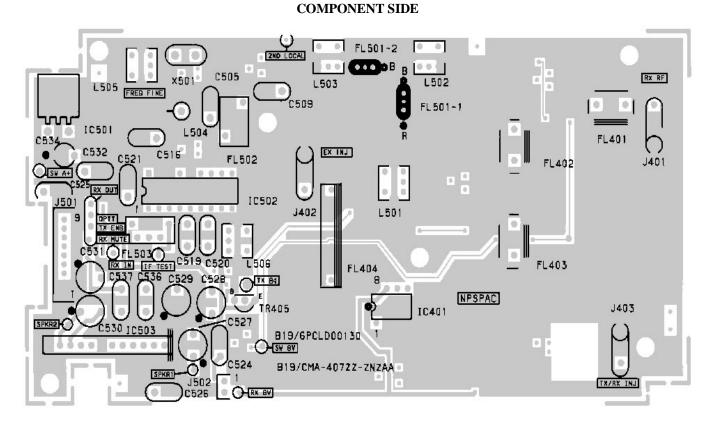


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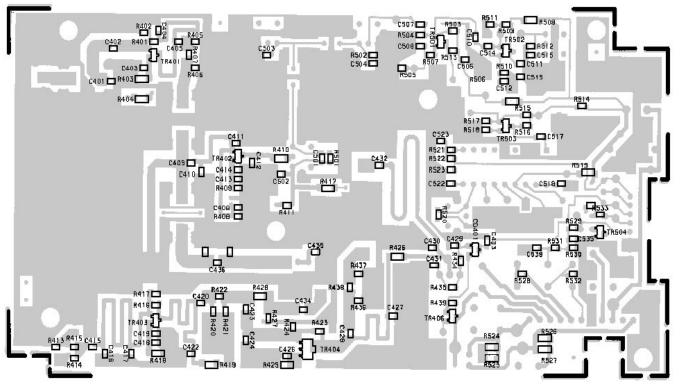
#### LBI-38402

#### OUTLINE DIAGRAM

IC DATA

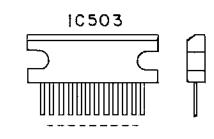


**CHIP COMPONENT SIDE** 



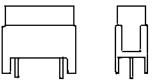
**RECEIVER BOARD B19/CMA-407** 

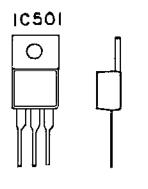
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FL502		FL503		
$ \begin{array}{c}  \\  \\  \\  \\  \\  \\  \\  \\  \\  \\  \\  \\  \\ $				
l=INPUT 2=GND 3=GND 4=GND 5=OUTPUT		1=OUTPUT 2=GND 3=GND 4=GND 5=INPUT		

FL401-FL403

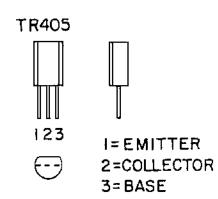


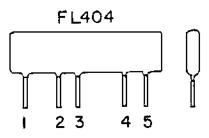


 123
 I=INPUT

 2=COLLECTOR

 3=BASE





PARTS	LIST
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FMD RECEIVER BOARD 819/CMA-407 IBEVE 1

SYMBOL	GE PART NO.	DESCRIPTION
		CAPACITORS
C401	H19/5CAAD00853	Céramic: 3 pF ±0.25 pF, 50 VDCW, temp coaf 0 +30 PPM.
C402 Lbru C409	B19/5CAA000839	Ceramic: 100 pF +54, 50 VDCH, temp coef 0 ±30 PPN.
C412	B19/5CAA000853	Ceramic: $3 pP \pm 0.25 pF$ , 50 VDCM, temp coef 0 $\pm 30$ PPM.
C4⊥3	B19/5CRAD01154	Ceranic: 1000 pP ±10%, 50 V0CM, temp coef +350 -1000 PPM.
0414	B19/5CAAD00839	Ceramic: 100 pF ±5%, 50 VDGW, temp coef û + 30 PPM
C415	B19/5CAAD01154	Сенция́с: 1000 рF +10%, 50 VDCW, temp coef; +350 -1000 рРМ.
C416	B19/5CAAD00963	Cettanic: 10 pt <u>1</u> 5%, 50 VDCN, temp coef 0 <u>1</u> 30 PPK.
C417	B19/5CAAD00951	Coramic: 7 pF ±0.5 pF, 50 VDCM4, temp coef 0 ±30 PPH.
642.9	819/SCAAD00839	Ceramic: 100 pF 45%, 50 VBCM, tong coef 0 +30
C420	B19/5CAAnnoa53	PPM. Ceramic: 3 pr ±0.25 pF, 50 VDCH, temp coef 0 ±
0422	B19/5C/A1#00839	30 РРК. Ceramic: 100 pP <u>+</u> 5%, 50 VDCN, temp coef 0 <u>6</u> 30
and C423		PPM.
0424	B19/5CAADDD961	Ceramic: 4 pF ±0.25 pF, 50 VDCN, temp coet 0 ± 30 PPH.
C426 and U427	B)9/5caad00039	Cecamic: 100 pF +5%, 50 VDCW, temp coef 0 ±30 ყული.
C428	R19/5CAAD00961	Сагитіп: 4 рF +0.25 рF, 50 VDQQ, temp coof 0 + 30 грм.
0429 thru 0432	B19/5CAND00839	Ceramiu: 100 pr <u>1</u> 5%, 50 VDCW, temp coet 0 <u>1</u> 30 PPM.
C433	B19/5CARD01154	Селитіс: 3000 р¥ 410, 50 VDCN, temp coef 4350 -1000 РРМ.
n434 thru 0436	B19/SCAADD0839	Ceramic: 100 pF <u>+</u> 5%, 50 VIXCN, temp coef 0 630 РРМ.
C501	B19/5CAAD00961	Ceramic: 4 pF <u>1</u> 0.25 pP, 50 VDCW, temp coef o <u>+</u> 30 PPM.
C502	819/SCAADOLLIS	Ceramic: 0.01 uF ±10, 50 VDCM, tomp coef 0 +10%.
0593	B19/5CAAD00961	Ceramic: 4 pP <u>1</u> 0.25 pP, 50 Vлсм, temp opef 0 <u>е</u> 30 PPM.
(504	829/SCAADOOB53	Ceramic: 3 pF ±0.25 pF, 50 VDCW, tamp coef 0 +30 rpM.
C505	B19/5CRAR00072	Polyestor film: 0.1 uF, +1D, 50 VDCW.
0.506 thru	B19/5CRAD01115	Ceramic: 0.01 uF ±5%, 50 VDCM, temp coef D (10%.
C508	819/5CRAR00072	
C509 C510	81975CRAR00072 81975CRAR000852	Polyester film: 0.1 uP, ±10%, 50 VDCM. Cetamic: 1 pF ±0.25 pF, 50 VDCM, temp come 0 +
C911	D19/5/11001117	30 PPM.
C512	019/5CAAD01115 819/5CAAD01154	Ceramic: 0.01 uP ±10%, 50 VDCR, temp coef 0 ±10% Ceramic: 1000 pF ±10%, 50 VDCN, temp coef +350
		-1000 PPM.
C\$13	B19/508A000948	Сесилиіс: 33 р9 +5%, 50 VDCM, Lemp coef 0 <u>+</u> 30 РРМ.
C514 and C515	B19/SCRADD0950	Ceramic: 15 pP ±5%, 50 VDCM, temp coef 0 ±30 PPM
0516	B19/SCRARDDD72	∀o]yester film: 0.1 uP, ±10%, 50 V⊅cR.

SYMBOL	GE PART NO.	DESCRIPTION
0517 and 0518	B19/SCAAD01115	Свтатік: 0.01 uF ±10%, 50 VDCN, temp cuef 0 ±10%.
C519 and C521	819/5CRAR00072	Polyestor film: 0.1 wF, +LO%, SG VDCM.
C522	B19/5CAR000854	Caramic: 47 pF ±5%, 50 VDCW, temp so # 0 ±30 PPM
C523	819/SCAAD01154	Cerant 1000 pF ±104, 50 YDCM, temp coef +350 -1000 P2M.
C524 theu C526	B19/SCRAR00072	Polyester film: 0.1 uP <u>+</u> 10%, 50 VDCW.
C527 theu (530	B19/5C5A¥00067	Electrolytic: 100 uF ±20%, 16 VDCW.
C531	819/5CEAD00877	Blectrolytic: 47 dF <u>+</u> 20%, 16 VDCN.
C532	B19/SCRAR00072	Polyenter film: 0.1 uP ±10%, 50 VDON.
C534	819/5CEAD00877	Elactrolytic: 47 uF +20%, 16 VDCW,
C535	B19/5CAAD01115	Ceramíc: 0.01 uř <u>*</u> 10%, 50 VDCW, temp coef 0 <u>(</u> 10%
C536 and C537	B19/5CRAR00072	Polyester film: 0.1 uF <u>+</u> 104, 50 ¥DCW,
C\$38	B19/5C8A001471	Ceramic: 0.015 uF +10%, 50 VECW, temp conf +10%,
C539	B19/SCAA001072	Ceramic: 0.047 uP +B0 -20%, 50 VDCM, temp coef
		422 - 229.
		0100gs
60401	819/STXX000290	Silicon, fast recovery (2 diodes in esthode common) sim to TOSHIDE ISSSIG4.
		FILTER
61401 and FL402	B19/58888800015	Dielectric RF filter.
PL403	B19/5N82800016	Dielectric RF filter.
FL4D4	B19/5N&AT00017	RF filter; BPF 606-870 MRz.
FL501	B19/6XHAA007BD	Crystal filter; f=82.2MH : MFJ7-2.
F1.302	B19/5NRAA00251	Ceramic filter: 455 XHz; sim to HURATA SFN4556.
FL503	819/5NRAA00144	Ceramic filter: 455 KHz; sim to HURATA CF9455ElD.
		· · · · · · · · · INTEGRATED CIRCUITS
IC401	819/5DAAAD0183	Linear, RF Amplifier; sim to NEC uBC1686C.
10501	B19/5DAAN00029	Linear, Positive Voltago Kegulalor; sim to NJRC NJN78M088.
10502	B19/5008800074	Linear, IF Amplifler & Detector; sim to MOTOROLA MC3359P
FG503	B19/5DAAA00233	binear, Audio Amplifier; sim Lo MEC uPC1230H2.
		CONNECTORS
3401 thru 3403	B19/5JDAX00009	Connector, RF; sim to TAIKO YMF-JOlk-v2.
J501	B19/3JWAV00117	Connector; 9 pin; sim to SMR CMP1509-0180.
<i>3</i> 502	819/5JWAY00120	Connector: 2 pin: nim to SMX W-PS102\$51.
L501 Եհեպ L503	619/5LAAL00003	Coll, RP,
L504	819/51CAA00280	Coll, RF: sim to TAIYO-YUDEN LALD3VBR22M.
L505	B19/SLAALDDOOS	Coil, RF.
L506	B19/5LAAL00004	Coil, RF. Coil, RF.
	51 97 5 Design 00004	
P401	B19/6PCLD00D57	
R401,	B19/SRDAC02462	Netai film: 3.3K ohma ±5%, 100 VDCN, 1/100.
R402	B19/5RDA(02474	Metal Eilm: 1.5K ohmay <u>*</u> 5%, 100 VDCN, 1/109.

SYMBOL	GE PART NO.	DESCRIPTION	SYMBOL	GE PART NO.	DESCRIPTION
			N529	819/5RDAC02458	Кесаl film: 6.8К оңим <u>4</u> 5%, 1,00 урож, 1,/10м.
R403 and	B19/ \$RDAC02137	Metal Gilm: 100 ohms ±5%, 200 VDCW, 1/8W.	R530	B19/5RDAQ02445	Hetal film: 10X ohma (5%, LOD VOCW, L/10W,
R404 R405	B19/5RDAC02469	Metal tilm: 220 ohms <u>+</u> 5%, 100 VDCN, 1/1DW.	R531.	819/5RDAC02485	Retal film: 68% otumn ±5%, 100 VDCW, 1/10W.
and R406	BIS, SKERGOLAUS	HELET FINE. THE BRINK THE, 100 THER, 1910W.	R532	B19/5RDAC02461	Hetal film: NH ohme +5%, 100 VDCN, 1/10W.
R407	B19/5RDA002465	Hetal film: 22 ohum ±5%, 0.00 V00%, 1/10%.	8533	H19/5KPAC02451	MeLal film: 2.2K nhms ±5%, 100 VDCM, 1/10R.
R408	B19/5RDAC02474	Netal film: 1.5K ohms +5%, LOD VDCM, 1/10M.			
<b>R4</b> 09	B19/ 5RDA002469	Metal film: 220 ohms <u>+</u> 5%, 100 vDCN, 1/10w.	<b>WR401</b>	H19/STCAF00555	Silicop, KPM: sim to TOSNIBA 2803606.
R410	B19/5RDAC02137	Netal film: 100 ohms ±5%, 200 VDCH, 1/6W.	7R402	B19/5TCA800288	Silicon, NPN: sim to NEC 2503356.
R411	B19/5RDAC02451	Metal Film: 2.2% ohms +5%, 100 V00%, 1/100%.	тк403		
R412 R415	B19/5RDAC02137 B19/58DAC02581	Netal film: 100 ohms <u>+</u> 5%, 200 VDCN, 1/6W. Netal film: 0 ohma, 1/10M.	TR404	B19/5TCAB00287	Silicon, NPN: sim to NEC 2803357.
R416	B19/ 5RDAC02478	Netal film: 4,7K ohms t5%, 100 VOCW, 1/10W.	TR405	519/JTAAG00093	Silicon, NPM: sim to TOSHIBA 25A1020-Y.
R417	819/5R0AC02474	Metal Eilm: 1.5K ohms <u>±</u> 5%, 100 vDCW, 1/10W.	TR 406 TR 501	B19/STDAB00054 B19/STAAAD0109	Silicon, NPN: sim to NET 180596.
<b>\$41</b> 8	819/ SRDAC02127	Netal Eilm: 68 ohms +59, 200 VDCH, 1/8W.	and TR5D2	BIS/ STRARDOLOS	Silinen, NEW: sim to HITACKI 2802620B.
R419	B19/5RDAC02137	Netal Eilm:" 100 ohms ±5%, 200 00000, 1/BW.	<b>TR</b> 503	419/5TDAB00054	Silinon, MPN: sim to NEC 280596.
к420 and R421	B19/5RDAC02471	Netal film: 47D ohms $\pm 5\%$ , 100 VDCW, 1/10W.	and 18504		
R422	B19/5NDAC02612	Netal film: 12 ohms +5%, 100 VDCH, 1/10W.			CRYSTAL
R423	B19/5RDAC02458	Metal Cilm: 5.8K ohms <u>*</u> 5%, 100 VDCW, 1/10W.	x501	819/6XEAA00782	Crystal; 2482.655 MHz: XPJ7-1.
R424	01.9/5RDA002542	Netal film: 620 ohme <u>f</u> 5%, 100 VDCW, 1/10W.			
R425 and R475	B19/5RDAC02201	Neta( film: 4.7 ohms <u>(</u> 5%, 200 VDCW, 1/8W.	X8501-1 and Kボ501-2	B19/5800F00001	Crystal Socket; sim to <u>HANUTO 75315-001</u> .
R427	B19/5RDAC02579	Netal Kilm: 56 ohms $\pm 5\%$ , 100 VOCH, 1/10M.			
R428	B19/5RDAC02137	Netal film: 100 ohms +5%, 200 VDCW, 1/8W.			
R434 R435	B19/5RDAC02446	Metal film: 1K olume ±5%, 100 VDCM, 1/10W.			
R436	B19/5RDAC02451 B19/5RDAC02471	Metal film: 2.2K ohma +5%, 100 VDCR, 1/10%. Netal film: `47D ohma ±5%, 10D VDCW, 1/10%.			
and R <b>4</b> 37	-				
R498 R439	B19/5RDAC02612	Netal film: 12 chms (38, 100 VDCM, 1/1DW.			
R433 R501	B19/5RDAC02451 B19/5RDAC02458	Metal Eilm: 2.28 ohma <u>+</u> 5%, 100 урск, 1/10м. Metal film: 6.88 ohma <u>+</u> 5%, 100 урск1, 1/10м.			
and R502	B1.9/5RDAG02481				
R503 K504	B19/5RDAC02481 B19/5RDAC02478	Netal film: 15K planes $\pm$ 5%, 100 VDCW, 1/10W. Netal Rilm: 4.7K planes $\pm$ 5%, 100 VDCW, 1/10W.			
R505	B19/5RDAC02446	Netal film: 1K ohms 15%, 100 VDCH, 1/2DW.			
<b>R</b> 506	B19/5RDAC02137	Metal Eilm: 100 ohms ±5%, 200 VDCW, 1/8%.			
<b>R</b> 507	B19/5RDAC02466	Netal film: 33 ohnus <u>+</u> 5%, 100 VDCH, 1/1DW.			
R509	B19/5RDAC02137	Metal bilm: 10D ohms <u>+</u> 5%, 10D VDCW, 1/8W.			
<b>R</b> 5D9	619/5RDAC02478	Netal film: 4.7K ohms <u>F</u> 5%, 1DD VDCW, 1/1DW.			
K510	B19/SRDACD2446	Netal Film: 1K ohms ±5%, 100 VDCM, 1/100.			
R511 R512	819/5RDACD2445 819/5RDAC02451	Notal film: IOK ohms +5%, 100 VDCW, 1/10W.			
R512 R513	B19/5RDAC02431 B19/5RDAC02474	Netal film: 2.2K ohms $\pm$ 54, 100 VDGW, 1/10M. Netal film: 1.5K ohms $\pm$ 58, 100 VDGW, 1/10M,			
R514	B19/5RDAC02478	Netal film: 4.7K ohms <u>+</u> 5%, 100 VDCW, 1/10W,			
R515	B19/5RDAC02445	Hetal film: 10% ohms +5%, 100 VDCW, 1/10%.			
R516	819/5RDAC02462	Netal film: 3.3K ohms ±5%, 100 VDGH, 1/20N,			
R517	B19/5RDAC02451	Kotal film: 2.2K ohms +5%, 100 VDCN, 1/3DW.			
R518	B19/5RDAC02469	Metal film: 220 ohms ±5%, 100 VDCW, 1/10W.			
R519	B19/5RDAC02137	Metal film: 100 ohns +5%, 200 VDCN, 1/8W.			
R52D R521	B19/5RDAC02439 B19/5RDAC02478	Netal film: 47K obms <u>+</u> 5%, LOO VDCM, 1/10M, Metal film: 4.7K obms <u>+</u> 5%, 100 VDCM, 1/10M.			
40d R522					
£523	B19/SRDAC02446	Metal film: IK ohme +5%, 100 VDCW, 1/10W.			
R524 thru R527	B19/5RDAC02223	Metal film: 2.2 ohous <u>+</u> 54, 200 VDCH, 1/8M.			
R528	B19/5RDAC02469	Meta) film: 220 obma <u>1</u> 54, 100 VDCW, 1/10k,			

\*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.

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## LBI-38402

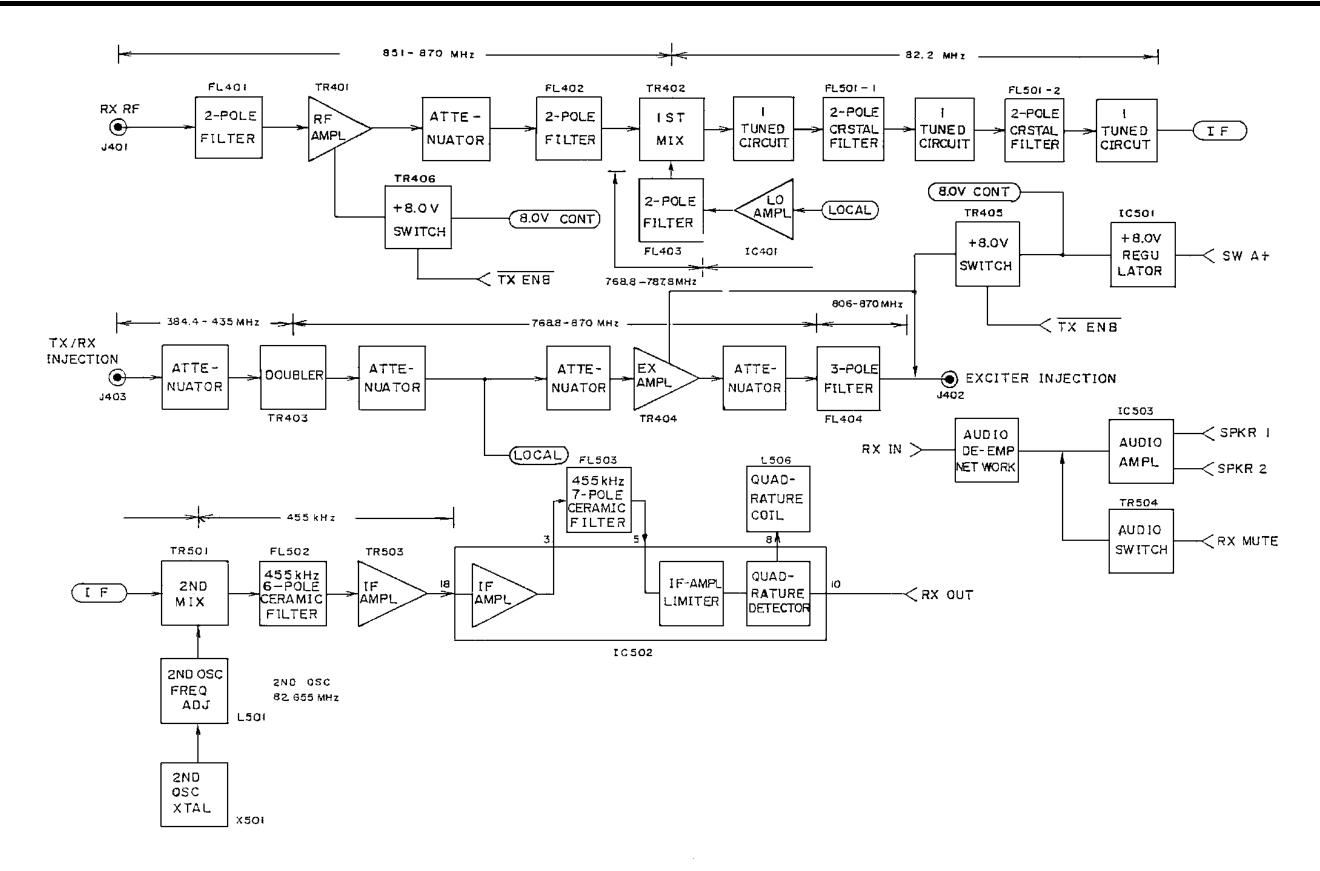


Figure 2 - Receiver Block Diagram

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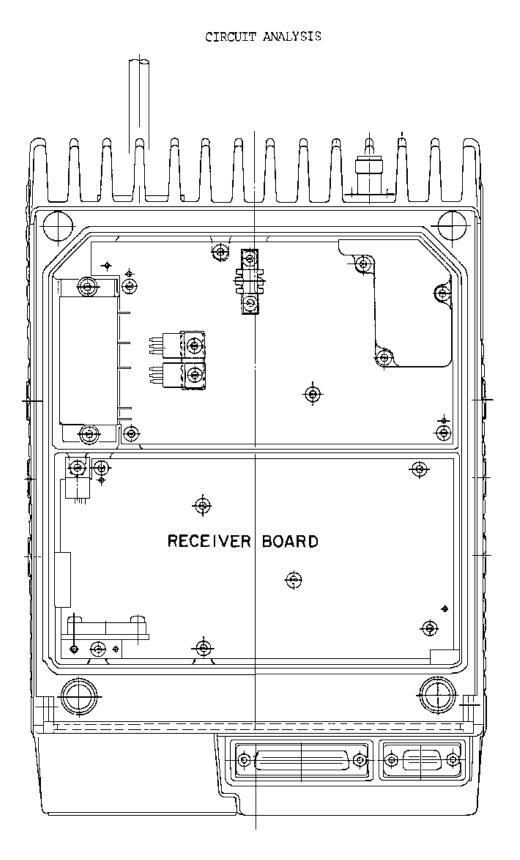


Figure 1 - Receiver Board Location

## 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.

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#### **SECOND IF AND DETECTOR**

The output of the second mixer is coupled to the six-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 sevenpole 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 A801. 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 deemphasis 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.