BENISON

JB-4

FM TRANSCEIVERS

Service Manual

SPECIFICATIONS

GENERAL

Frequency Range	245.0000~245.9875
Working Temperate	－10℃~＋55℃
Power Supply Requirement	DC 7.2V
Operate Mode	Simplex or Semi-duplex
Current Consumption	≤1.6A(transmit 4W)
Sensitivity Adjust	2~20mV
Antenna impedance	50 Ω

TRANSMITTER

Frequency Stability	±5ppm
Output Power	≤5W
Max Frequency Deviation	≤±5KHz
Audio Distortion	≤10%
Adjacent Channel Power	≤-65dB
Occupied Bandwidth	≤16KHz

RECEIVER

RF Sensitivity :	≤0.2μV
Audio Frequency Response	300~3000Hz
Audio Output	≥0.5w
Audio Distortion	≤10%

All stated specifications are subject to change without notice or obligation.

CIRCUIT DESCRIPTION

1. Frequency configuration

The receiver utilizes double conversion. The first IF is 38.85MHz and the second IF is 450kHz. The first local oscillator signal is supplied from the PLL circuit. The PLL circuit in the transmitter generates the ecessary frequencies. Fig. 1 shows the frequencies.

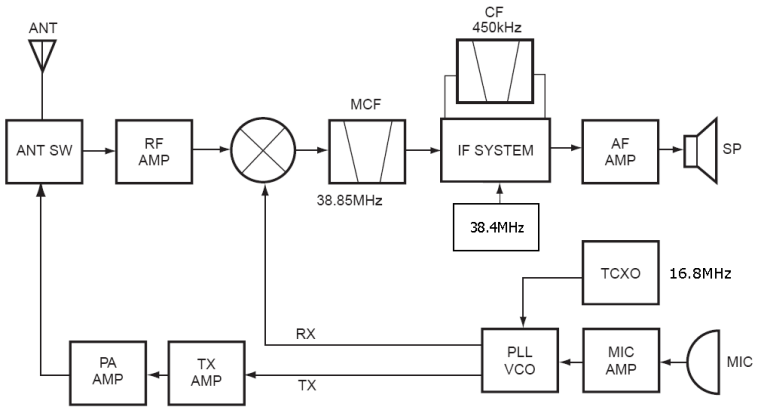


Fig. 1 Frequency configuration

2. Receiver

The freauency configuration of the receiver is shown in Fig.2.

1) Front - end RF amplifier

An incoming signal from the antenna is applied to an RF amplifier (T201) after passing through a transmit/receive switch circuit (D101 ,D102,D103) and a 3-pole LC filter(L203,L204).After the signal is amplified (T201), the signal is filtered by a band pass filter (a 3-pole LC filter) (L217,L218,L221) to eliminate unwanted signals before it is passed to the first mixer. The voltage of these diodes are controlled by to track the MPU(U811) center frequency of the band pass filter. (See Fig. 2)

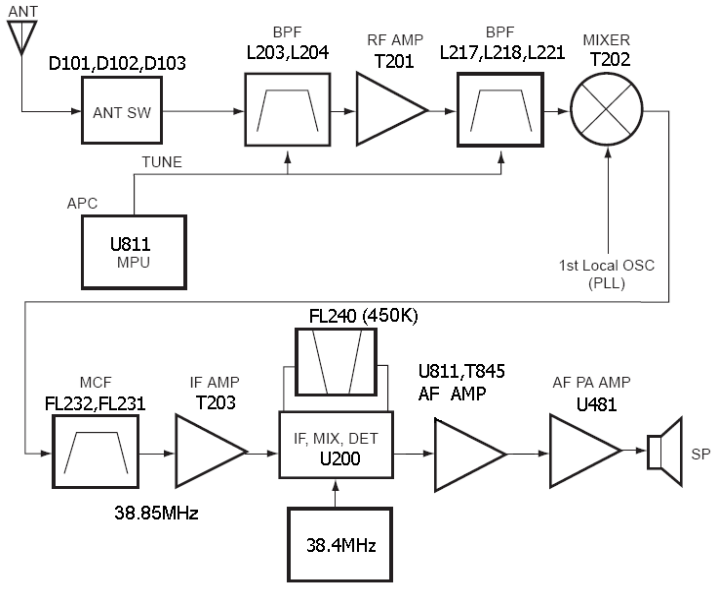


Fig. 2 Receiver section configuration

2) First Mixer

The signal from the RF amplifier is heterodyned with the first local oscillator signal from the PLL frequency synthesizer circuit at the first mixer (T202) to create a 38.85MHz first intermediate frequency (1st IF) signal. The first IF signal is then fed through crystal filters (FL231,FL232) to further remove spurious signals.

3) IF amplifier

The first IF signal is amplified by T203, and then enters U200 (FM processing IC). The signal is heterodyned again with a second local oscillator signal within U200 to create a 450kHz second IF signal. The second IF signal is then fed through a 450kHz ceramic filter (FL240) to further eliminate unwanted signals before it is amplified and FM detected in FL240.

4) AF amplifier

The recovered AF signal obtained from U200 goes to the microprocessor(U811). The processed AF signal passes through an AF volume control and is amplified to a sufficient level to drive a loud speaker by an AF power amplifier (U481).

5) Squelch

Part of the AF signal from the IC enters the FM IC again,and the noise component is amplified and rectified by a filter and an amplifier to produce a DC voltage corresponding to the noise level. The DC signal from the FM IC goes to the analog port of the microprocessor (U811). U811 determines whether to output sounds from the speaker by checking whether the input voltage is higher or lower than the preset value.To output sounds from the speaker, U811 sends a high signal to the AF Power lines and turns U481 on through T471,T472.

6) Receive signaling

QT/DQT

The output signal from FM IC (U200) enters the microprocessor(U811) .U811 determines whether the QT or DQT matches the preset value, and controls the AF Power and the speaker output sounds according to the squelch results

3. PLL frequency synthesizer

The PLL circuit generates the first local oscillator signal for reception and the RF signal for transmission.

1) PLL

The frequency step of the PLL circuit is 5 and 6.25kHz and so on. A 16.8MHz reference oscillator signal is divided at U301 by a fixed counter to produce the 5 or 6.25kHz reference frequency. The voltage controlled oscillator (VCO) output signal is buffer amplified by T373, then divided in U301 by a programmable counter . The divided signal is compared in phase with the 5 or 6.25kHz reference signal in the phase comparator in U301. The output signal from the phase comparator is filtrered through a low-pass filter and passed to the VCO to control the oscillator frequency.

2) VCO

The operating frequency is generated by T331 in transmit mode and T357 in receive mode. The oscillator frequency is controlled by applying the VCO control voltage, obtained from the phase comparator, to the varactor diodes (D331 and D332 in transmit mode and D350 and D351 in receive mode). The TC/RC pin is set low in receive mode causing T192 off, and turn T291 on . The TC/RC pin is set hight in transmit mode causing T291 off,and T192,T191 on.

3) UNLOCK DETECTOR

If a pulse signal appears at the LD pin of U301, an unlock condition occurs, and the DC voltage obtained from D309, and C306 causes the voltage applied to the PLL-LD pin of the microprocessor to go low. When the microprocessor detects this condition, the transmitter is disabled, ignoring the push-totalk switch input signal. (See Fig.3)

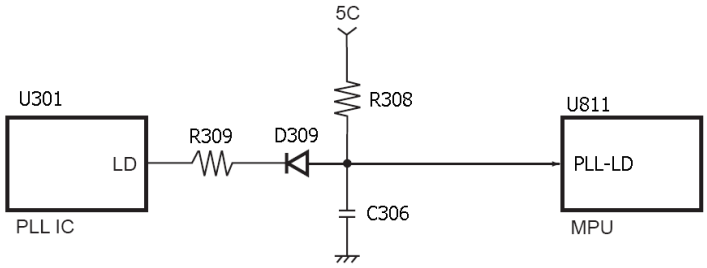


Fig. 3 Unlock detector circuit

4. Transmitter

1)Microphone Amplifier

The signal from the microphone passes through U411.When encoding DTMF,it is turned OFF for muting the microphone input signal by T414.The signal passes through the Audio processor(U411) for the maximum deviation adjustment,and goes to the VCO modulation input.

2)Drive and Final Amplifier

The signal from the T/R switch(D100) is amplified by the pre-drive(T101.T102) and drive amplifier(T105) to 50mW.The output of the drive amplifier is amplified by the RF power amplifier(T107) to 4.0W(1W when the power is low).the RF power amplifier consists of two MOS FET stages.The output of the RF power amplifier consists of two MOS FET stages. The output of the RF power amplifier is then passed through the harmonic filter (LPF) and antenna switch (D101,D102)and applied to the antenna terminal.

5. Power supply

There are four 5V power supplies for the microprocessor: 5M,5C,5R,and 5T,5M for microprocessor is always output while the power is on.5M for microprocessor is always output while the power is on.5M is always output,but turns off when the power is turned off to prevent malfunction of the microprocessor.

5C is a common 5V and is output when SAVE is not set to OFF.

5R is 5V for reception and output during reception.

5T is 5V for transmission and output during transmission.

6.Control Circuit

The control circuit consists of a microprocessor (U811) and its peripheral circuits.it controls the TX-RX unit.U811 mainly performs the following:

(1) Switching between transmission and reception by the PTT signal input.
(2) Reading system,group,frequency,and program data from the memory circuit.
(3) Sending frequency program data to the PLL.
(4) Controlling squelch on/off by the DC voltage from the squelch circuit.
(5) Controlling the audio mute circuit by the decode data input.
(6) Transmitting tone and encode data.

1)Memory Circuit

Memory circuit consists of the CPU (U811) and an EEPROM(U821).An EEPROM has a capacity of 32k bits that contains the transceiver control program for the CPU and data such as Transceiver channels and operation features

2)Low Battery Warning

The battery voltage is checked using by the microprocessor.

(1) The red LED blinks when the battery voltage falls below 6.2V.

(2) A Warning tone generates when the red LED blinking. (See Fig.4)

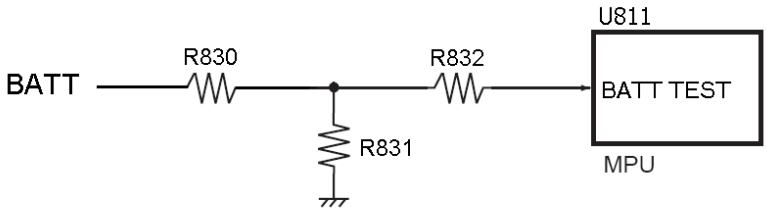


Fig. 4 Low battery warning

ADJUSTMENT

Required Test Equipment

The following items are required to adjust radio parameters:

1. Regulated power supply

Supply voltage: 5-14V DC

Current: 3A or more

2. Digital multimeter

Voltage range: FS = Approx. 20V

Current: 10A or more

Input resistance: High impedance

3. Oscilloscope

Measurable frequency: Audio frequency

4. Audio dummy load

Impedance: 8 ohm

Dissipation: 1W or more

Jack: 3.5mm

5. SSG

Output frequency: 200MHz or more

Output level: -20dBu/0.1uV -120dBu/1V

Modulation: FM

6. Spectrum Analyzer

Measuring range: Up to 2GHz or more

7. Power meter

Measurable frequency: Up to 200MHz

Impedance: 50, unbalanced

Measuring range: 0.1W -10W

8. Audio volmeter

Measurable frequency: Up to 100kHz

Sensitivity: 1mV to 10V

9. Audio generator

Output frequency: 67Hz to 10kHz

Output impedance: 600, unbalanced

10.Distortion meter/SINAD meter

Measurable frequency: 1kHz

Input level: Up to 40dB

Distortion: 1% - 100%

11.Frequency counter

Measurable frequency: Up to 200MHz

Measurable stability: Approx. +/-0.1ppm

12.Linear detector

Measurable frequency: Up to 200MHz

Characteristics: Flat

CN: 60dB or more

Note

Standard modulation: 1kHz +/-2.5kHz/DEV

Reference sensitivity: 12dB SINAD

Specified audio output leve: 200mW at 8

Designator	Component	Designator	Component
C100	470P	C200	5P
C102	470P	C201	8P
C104	7P	C202	4P
C106	470P	C203	2P
C107	470P	C204	10P
C111	8P	C205	4P
C112	470P	C206	4P
C113	102P	C207	470P
C114	470P	C208	470P
C115	104P	C210	470P
C118	47P	C211	470P
C119	102P	C212	470P
C123	102P	C213	8P
C125	470P	C214	470P
C128	103P	C216	4P
C129	470P	C217	10P
C131	104P	C218	1P
C132	470P	C219	3P
C133	20P	C220	470P
C135	7P	C221	3P
C136	5P	C223	103P
C138	100P	C224	6P
C142	3P	C225	15P
C143	470P	C226	103P
C144	2P	C227	470P
C145	470P	C228	4P
C147	4P	C229	5P
C148	1P	C231	104P
C149	1P	C232	103P
C150	5P	C233	8P
C151	1.5P	C234	2P
C153	3P	C235	103P
C154	1P	C236	104P
C155	1.5P	C241	100P
C164	103P	C242	18P
C167	470P	C243	104P
C168	470P	C244	220P
C170	100P	C245	220P
C173	102P	C246	10P
C177	102P	C247	470P
C180	103P	C248	103P
C181	104P	C251	103P
C191	103P	C252	103P
C192	470P	C253	104P
C193	104P	C254	27P
C194	470P	C256	104P
C195	104P	C257	104P
C196	470P	C261	104P

Designator	Component	Designator	Component
C262	104P	C392	103P
C281	473P	C400	102P
C282	104P	C401	100P
C284	221P	C412	104P
C291	103P	C413	470P
C292	103P	C417	104P
C293	470P	C418	273P
C294	470P	C419	222P
C302	104P	C420	223P
C305	102P	C421	102P
C306	104P	C422	223P
C307	104P	C423	104P
C308	101P	C424	100P
C309	101P	C435	470P
C310	101P	C441	473P
C311	101P	C442	332P
C316	5P	C443	680P
C317	5P	C444	104P
C324	102P	C445	473P
C326	103P	C446	470P
C331	100P	C447	820P
C332	100P	C448	332P
C337	10P	C451	103P
C338	0.5P	C471	105P
C339	5P	C472	103P
C340	15P	C473	103P
C341	5P	C474	104P
C342	0.5P	C475	103P
C343	102P	C476	104P
C344	103P	C481	473P
C345	470P	C482	100P
C350	102P	C483	473P
C351	100P	C484	221P
C355	8P	C485	100P
C357	39P	C491	104P
C358	15P	C492	100P
C359	5P	C493	104P
C360	0.5P	C494	104P
C361	103P	C515	223P
C362	470P	C521	223P
C363	470P	C523	223P
C371	102P	C546	104P
C372	6P	C547	103P
C373	22P	C548	104P
C376	102P	C549	104P
C377	7P	C811	102P
C378	102P	C812	102P
C391	470P	C817	104P

Designator	Component	Designator	Component
C818	104P	D332	HVC350
C820	103P	D337	HVC350
C821	104P	D350	HVC350
C822	103P	D351	HVC350
C824	104P	D361	MA2S11
C825	22P	D416	DAN222
C826	22P	D417	1SS372
C827	103P	D493	1SS372
C831	102P	D813	RED
C832	101P	D814	GREEN
C833	101P	D901	1SR154-400
C834	101P	E126	1uF
C835	101P	E173	6.8uF
C836	101P	E232	10uF
C837	101P	E248	10uF
C838	101P	E281	10uF
C839	101P	E301	4.7uF
C840	104P	E302	4.7uF
C841	103P	E319	0.1uF
C842	392P	E320	1uF
C843	104P	E321	0.1uF
C844	333P	E324	22uF
C845	103P	E362	10uF
C846	332P	E380	4.7uF
C847	105P	E401	4.7uF
C848	680P	E417	2.2uF
C849	103P	E423	4.7uF
C901	105P	E452	223P
C902	102P	E471	10uF
C903	103P	E482	10uF
C908	103P	E483	100uF
C909	470P	E514	4.7uF
C910	103P	E908	10uF
CR240	38.4MHz	E910	10uF
CR255	C24	FL231	38.85MHz
CR340	16.8MHz	FL232	38.85MHz
CR825	32.768KHz	FL240	450K
D100	HSC277	JK402	3.5mm
D101	HVU131	JK481	2.5mm
D102	HSC277	JP400	JP3
D103	HSC277	JP811	JP16
D200	HSC277	L102	18nH
D201	HVC350B	L103	101T
D202	HVC350B	L105	101T
D203	HVC350B	L107	15nH
D309	PMSD4148	L110	4T
D331	HVC350	L111	4T

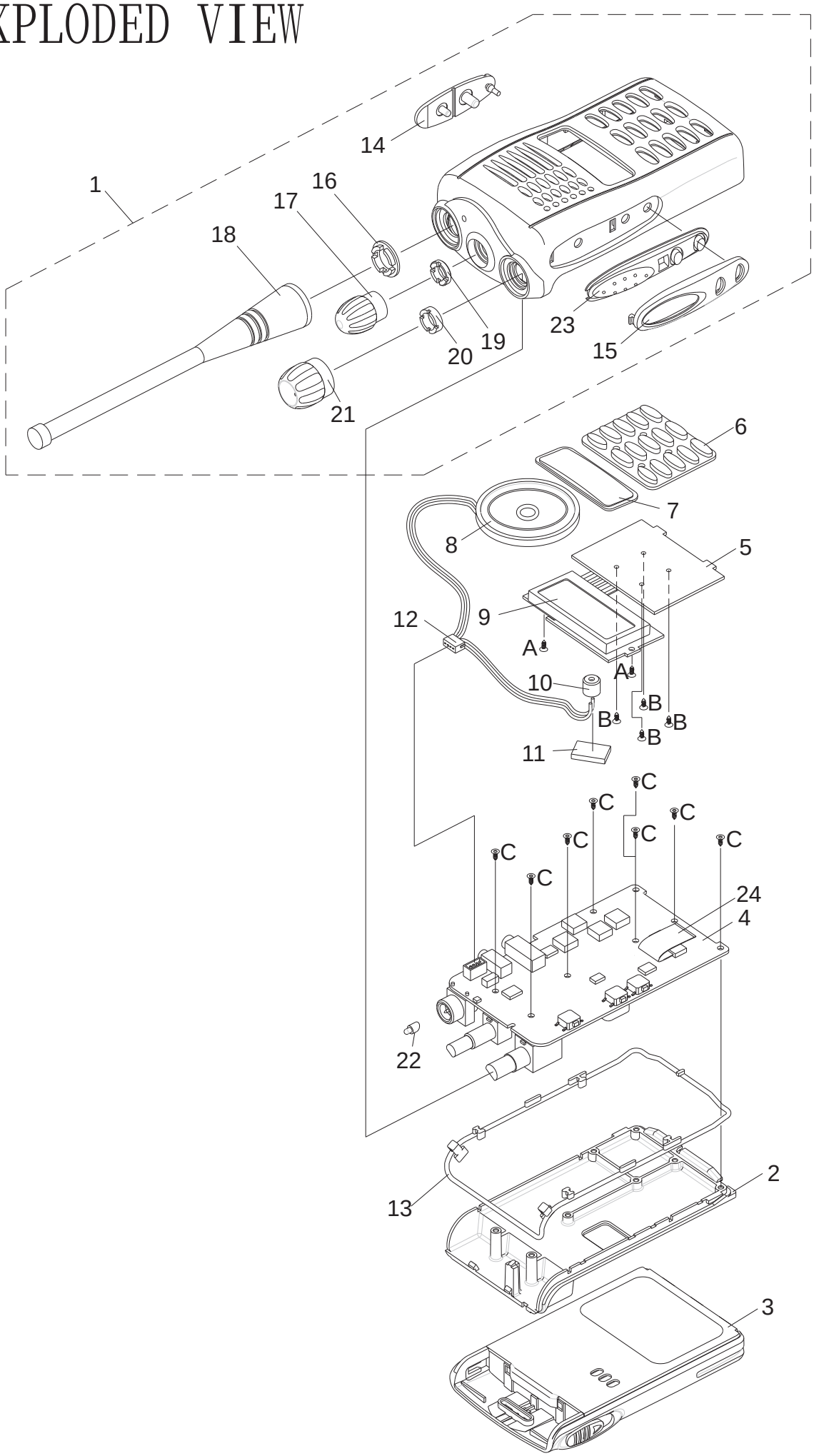
Designator	Component	Designator	Component
L112	4T	R104	1K5
L113	4T	R105	680Ω
L114	1uH	R106	22Ω
L118	1uH	R107	680Ω
L119	2.2nH	R111	10Ω
L126	101T	R113	47Ω
L128	8T	R114	47K
L139	220nH	R115	120K
L201	3T	R123	0Ω
L202	3T	R125	47K
L203	3T	R126	47K
L204	3T	R128	47Ω
L213	39nH	R133	0Ω
L214	18nH	R139	270Ω
L217	3T	R143	270Ω
L218	3T	R147	0Ω
L221	3T	R160	0.33Ω
L224	15nH	R161	0.33Ω
L225	560nH	R162	0.33Ω
L226	330nH	R165	150K(F)
L323	100nH	R166	150K(F)
L324	100nH	R167	150k(F)
L325	101T	R168	150K(F)
L331	6.8uH	R169	150K(F)
L332	6.8uH	R170	150K(F)
L340	6.8nH	R171	10K
L350	6.8uH	R175	220K
L351	6.8uH	R176	47K
L355	8.2nH	R178	1M
L363	101T	R179	10K
L371	100nH	R180	68K
L373	82nH	R181	47K
L412	101T	R182	18K
L481	101T	R191	47K
L821	301T	R192	1K
L840	101T	R200	0Ω
L900	0Ω	R201	0Ω
L901	100nH	R203	100K
MIC401	MIC	R204	100K
PR301	1K	R205	0Ω
PR811	1K	R206	100K
PR812	47K	R210	100K
PR813	47K	R211	220Ω
PR814	1K	R212	220K
R100	3K3	R213	0Ω
R101	47K	R214	3K3
R102	680Ω	R215	100Ω
R103	22Ω	R220	100K

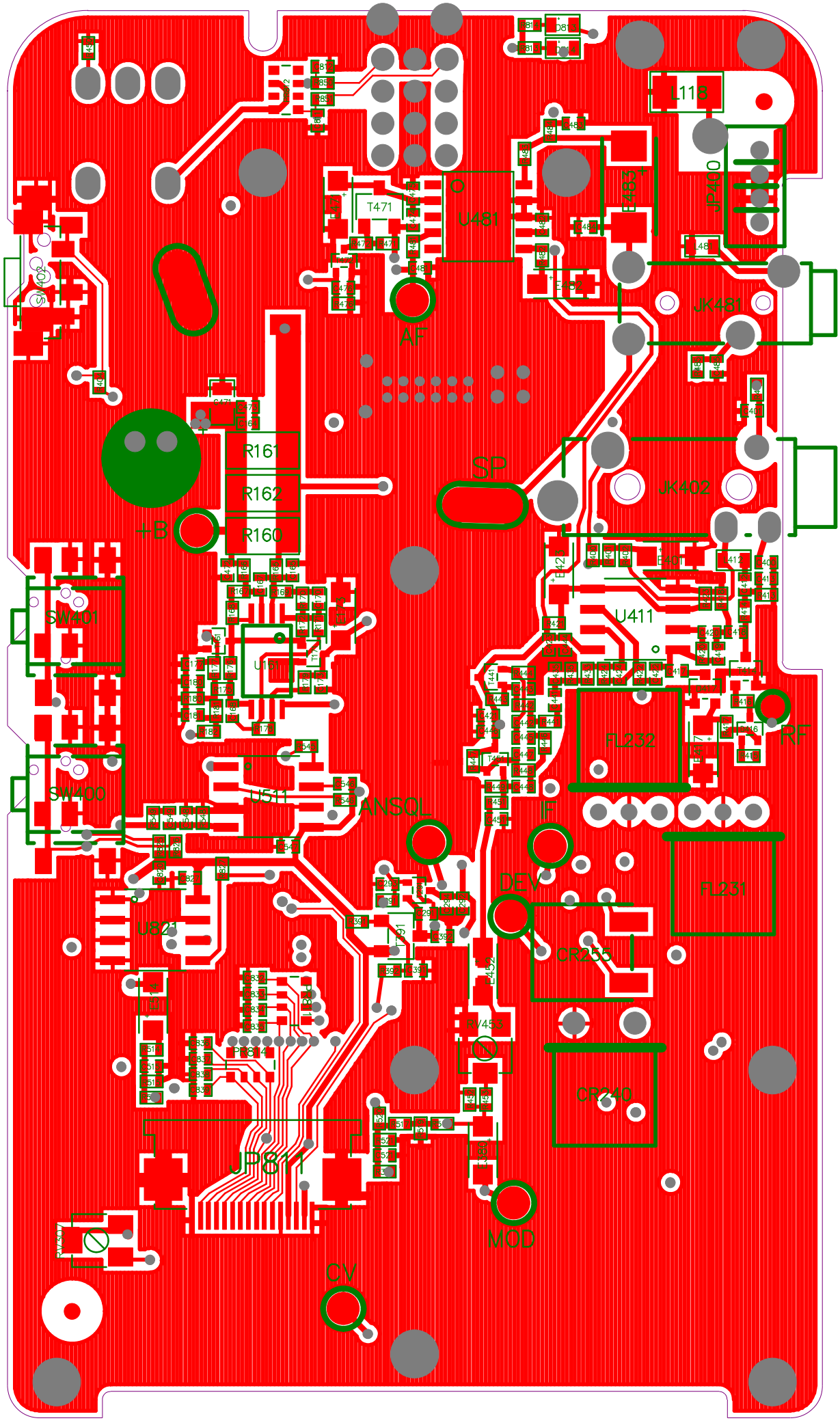
Designator	Component	Designator	Component
R221	0Ω	R361	4K7
R222	1K	R370	680Ω
R223	220Ω	R371	120K
R224	1K	R372	5K6
R225	2K2	R373	3K3
R226	470Ω	R374	100Ω
R227	47Ω	R375	1K
R235	470Ω	R376	220Ω
R236	2K7	R377	3K3
R237	680K	R391	4K7
R243	180K	R392	1K
R244	3.3K	R400	100Ω
R245	180K	R401	100Ω
R247	3K3	R402	4K7
R249	10Ω	R403	100Ω
R253	100K	R404	1K2
R255	1K5	R413	100K
R256	1K	R414	0Ω
R281	4K7	R415	10K
R282	4K7	R416	820Ω
R283	4K7	R417	1K
R284	220K	R418	18K
R291	1K	R420	750K
R292	10K	R421	22K
R300	2K2	R422	1K5
R301	22K	R423	30K
R304	22K	R424	51K
R305	22K	R433	1K8
R306	33K	R435	4K7
R307	150Ω	R441	33K
R308	4K7	R442	33K
R309	1K	R443	1M8
R317	0Ω	R444	10K
R318	560Ω	R446	33K
R319	560Ω	R447	1M8
R320	6K8	R448	33K
R321	0Ω	R449	10K
R322	2K2	R450	10Ω
R324	22K	R451	3K3
R326	100K	R452	5K1
R339	10K	R453	22K
R341	150Ω	R471	10K
R344	100K	R472	2K2
R346	1K	R476	10K
R349	15K	R481	2K2
R350	100K	R482	150Ω
R357	10K	R483	0Ω
R359	270Ω	R484	10Ω

Designator	Component	Designator	Component
R485	1K	SP401	SP
R491	4K7	SW400	CALL
R492	100K	SW401	MONI
R493	0Ω	SW402	PTT
R494	1M	SW811	RD840G
R514	1K	SW812	RD82-TD2
R515	47K	T101	2SC4226
R516	22K	T102	2SC3357
R517	47K	T105	2SK3078
R518	10K	T107	2SK3476
R519	4K7	T161	DTC114EE
R520	10K	T171	DTC114EE
R522	56K	T191	2SB624
R545	10K	T192	DTA114EE
R546	330K	T201	3SK299
R548	1K	T202	3SK299
R549	4K7	T203	2SC4649
R813	560Ω	T204	DTA114EE
R814	560Ω	T291	DTA114EE
R815	4K7	T331	2SC4228(40)
R817	4K7	T343	2SJ243
R818	4K7	T344	UMC4
R820	0Ω	T357	2SC4228(40)
R821	0Ω	T361	2SC4617(S)
R822	15K	T372	2SC3356
R823	82K	T373	2SC3356
R824	100K	T391	2SB624
R825	10K	T414	MRF497
R826	10K	T441	2SC4617
R827	10K	T451	2SC4617
R830	150K	T471	2SB624
R831	150K	T472	DTC114EE
R832	47K	T813	DTC114EE
R841	82K	T814	DTC114EE
R842	68K	T815	DTA114EE
R843	100K	T822	2SB624
R845	1M8	T845	2SC4617
R846	33K	U161	NJM2904V
R847	2K2	U200	TA31136F
R848	10K	U301	LMX2332ATM
R850	1K	U411	LM4558
R851	1K	U481	TA7368
R901	0Ω	U511	AUDIO
R924	47K	U811	U-TMP87P805BU
R925	10K	U821	24C32
RV307	50K	U909	5A
RV453	100K	VR411	RD91

JN0304		JN0205	
Designator	**Component**	**Designator**	**Component**
C710	100P	C720	104P
C711	100P	C724	103P
C712	100P	C725	103P
C713	100P	E720	10uF
C714	100P	L720	101T
C715	100P	L721	101T
C716	100P	R720	1K
D717	PMSD4118	R721	6K8
D718	PMSD4118	R722	330Ω
R710	510Ω	R723	330Ω
R711	510Ω	R724	560Ω
R712	510Ω	R725	560Ω
R713	510Ω	T720	DTC114EE
R714	510Ω	T721	DTC114EE
T713	DTC114EE		

EXPLODED VIEW




L118
JP401
E483
U431
T471
SW402
AF
JK431
JK402
SP
R161
R162
R160
+B
SW401
U411
U151
SW400
U511
ANSQL
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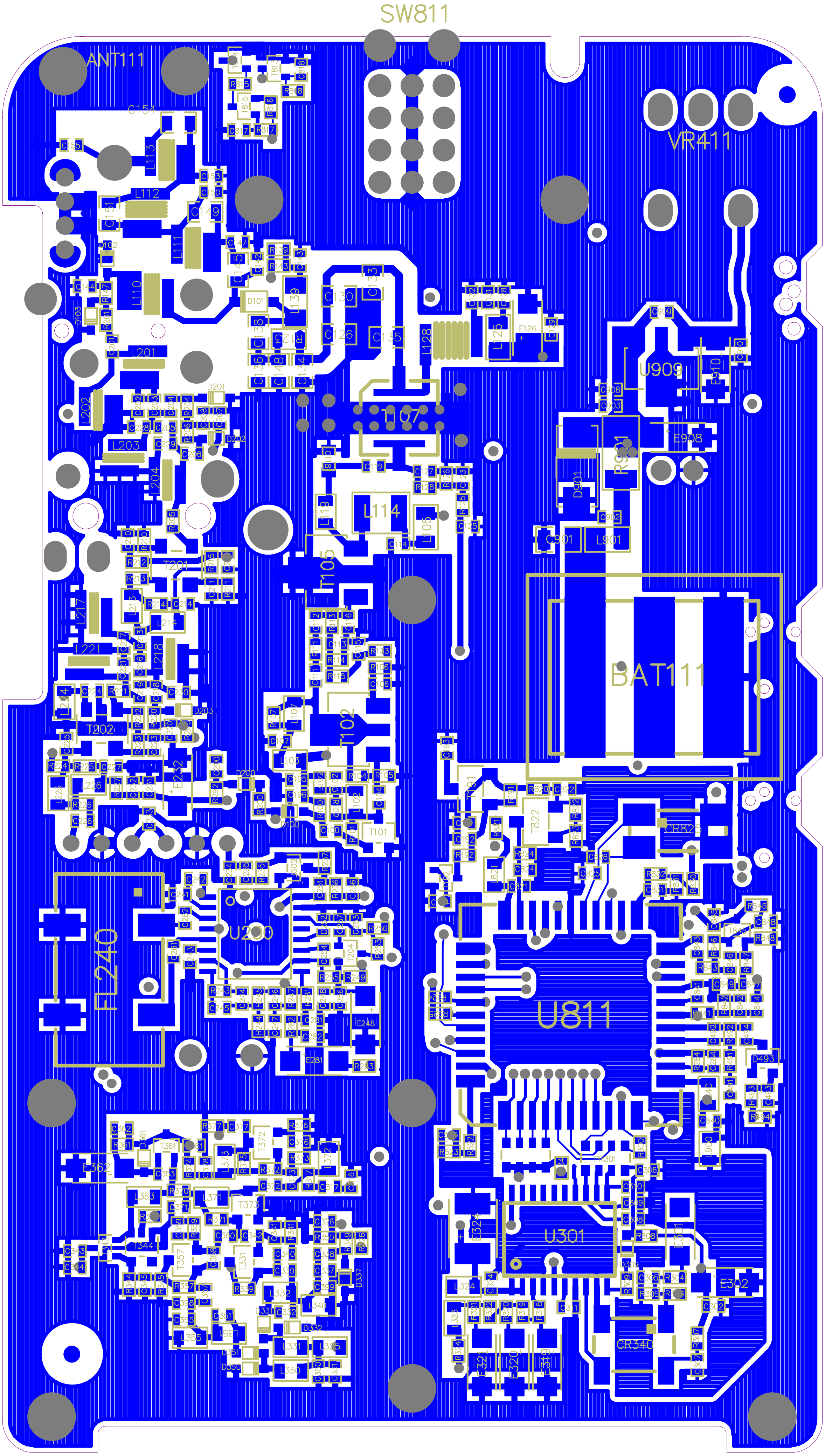
DEV
FL232
RF
FL231
CR255
CR240
U821
RV453
JP811
MOD
CV
RV501


SW811
ANT111
VR411
L113
L112
L111
L110
L201
L203
L204
T201
T202
L114
T105
T107
T102
BAT111
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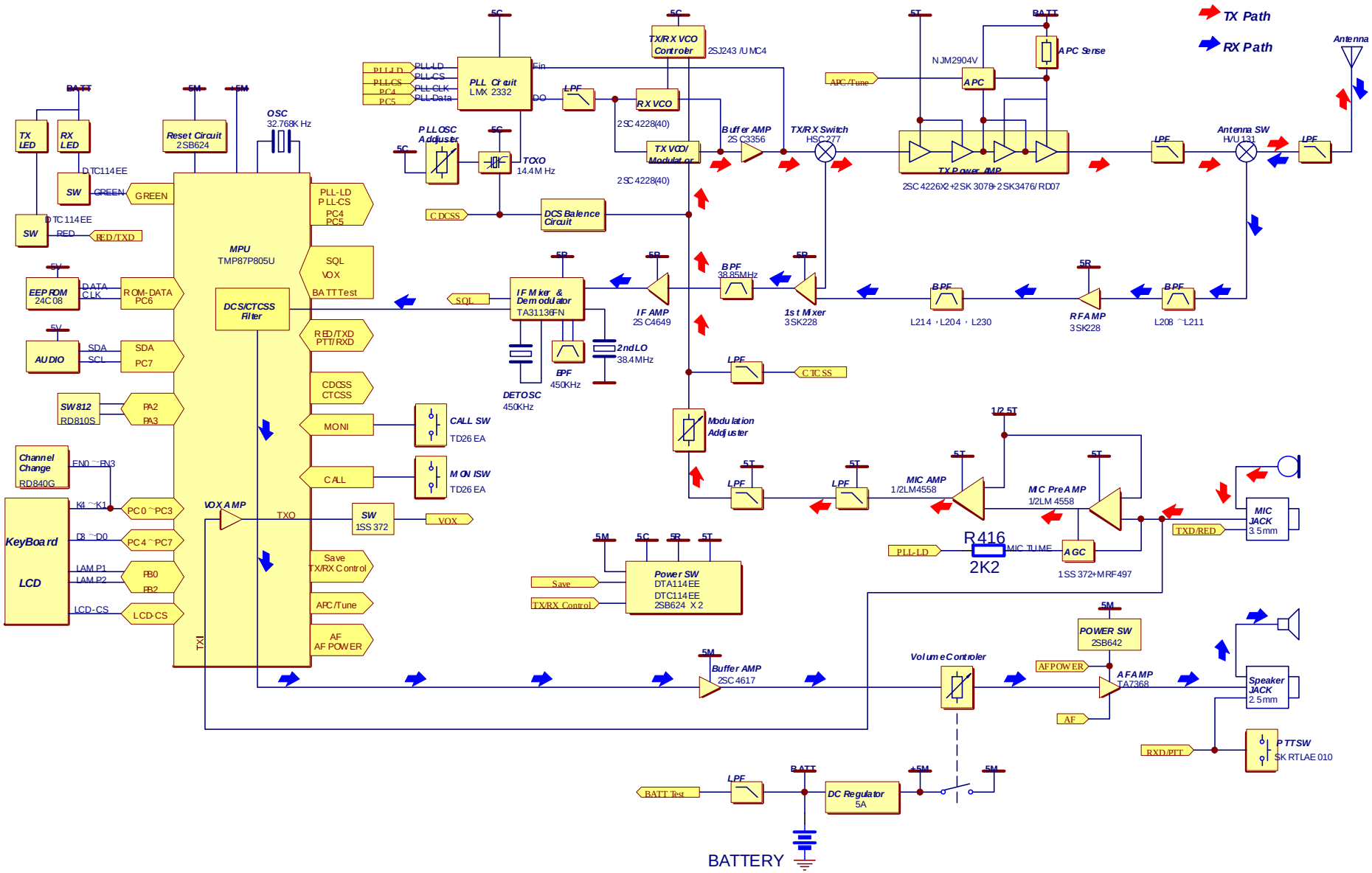
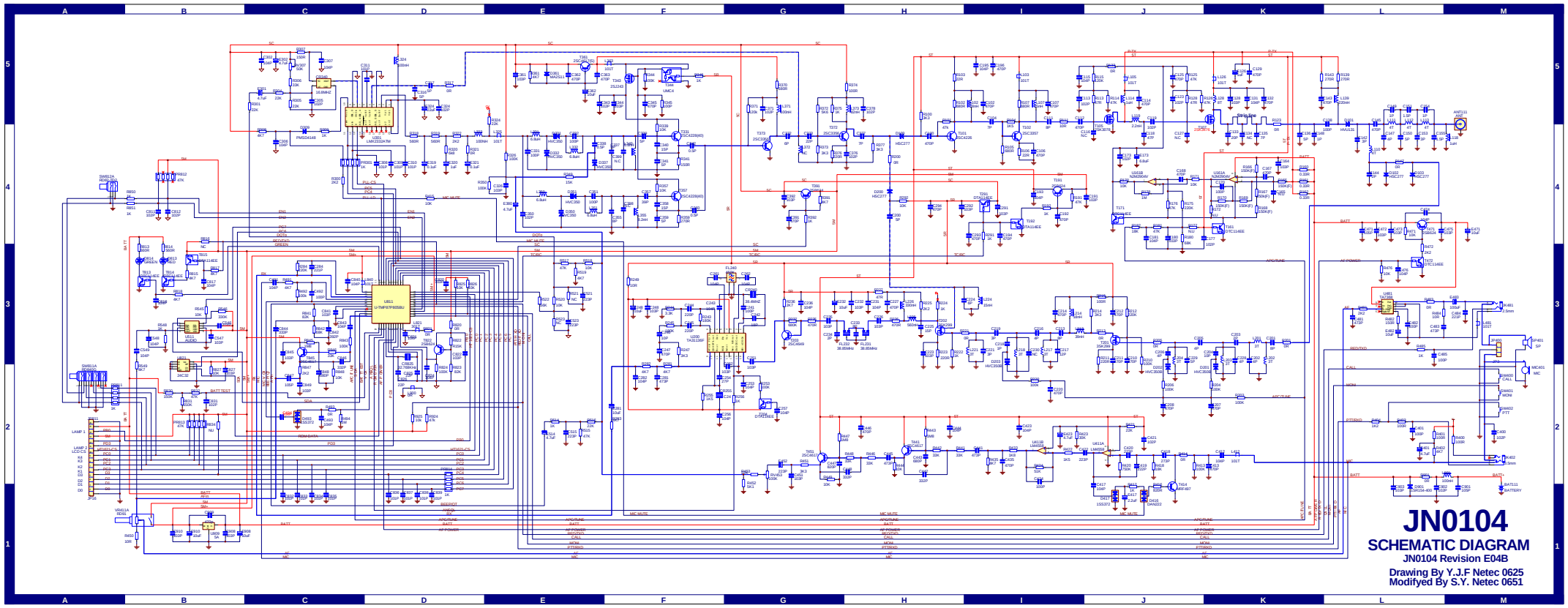
U200
U811
T822
CR822
L362
U301
E302
CR340


TX Path
RX Path
MPU
TMP87P805U
PLL Circuit
LMX 2332
TX/RX VCO Controller
2SJ243 /UMC4
RX VCO
2SC4228(40)
TX VCO/ Modulator
2SC4228(40)
TCXO
14.4MHz
Buffer AMP
2SC3356
TX/RX Switch
HSC277
TX Power AMP
2SC4226X2+2SK3078+2SK3476/RD07
APC
NJM2904V
APC Sense
Antenna
Antenna SW
HVU131
IF Mixer & Demodulator
TA31136FN
IF AMP
2SC4649
1st Mixer
3SK228
RF AMP
3SK228
2nd LO
38.4MHz
DETOSC
450KHz
BPF
450KHz
BPF
38.85MHz
DCS Balence Circuit
Modulation Adjuster
MIC AMP
1/2LM4558
MIC PreAMP
1/2LM 4558
AGC
1SS372+MRF497
MIC JACK
3.5mm
R416
2K2
MIC TUNE
VOX AMP
VOX
CALL SW
TD26 EA
MONI SW
TD26 EA
SW
1SS372
Power SW
DTA114EE
DTC114EE
2SB624 X2
Buffer AMP
2SC4617
Volume Controler
POWER SW
2SB642
AF AMP
TA7368
Speaker JACK
2.5mm
PTT SW
SKRTLAE010
DC Regulator
5A
BATTERY
Reset Circuit
2SB624
OSC
32.768KHz
PLL Circuit
LMX 2332
EEPROM
24C08
AUDIO
Channel Change
RD840G
KeyBoard
LCD
SW812
RD810S
DCS/CTCSS Filter
Save TX/RX Control
APC/Tune
AF
AF POWER
TXO
TXI
CTCSS
CDCSS
SQL
VOX
BATT Test
PLL-LD
PLL-CS
PLL-CLK
PLL-Data
TX LED
RX LED
SW
GREEN
RED/TXD
SDA
SCL
ROM-DATA
PC6
PC7
PA2
PA3
PC0~PC3
PC4~PC7
FB0
FB2
LCD-CS
K4~K1
D8~D0
LAM P1
LAM P2
EN0~EN3
BATT
+5M
5M
5C
5R
5T
5V
1/2 5T



JN0104

SCHEMATIC DIAGRAM

JN0104 Revision E04B

Drawing By Y.J.F Netec 0625

Modifyed By S.Y. Netec 0651