


BENISON

JB7

VHF FM TRANSCEIVERS

Service Manual

SPECIFICATIONS

GENERAL

Frequency Range	245.0000 245.9875
Working Temperature	-10°C +55°C
Power Supply Requirement	DC 7.2V
Current Consumption	≤1.6A(transmit 4W)
Sensitivity Adjust	2 20mV
Antenna impedance	50 Ω

TRANSMITTER

Frequency Stability	5ppm
Output Power	3W(High),1W(Low)
Maximum Frequency Deviation	≤ 2.5KHz
Intermodulation Response Rejection	70dB
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 450 Hz. The first local oscillator signal is supplied from the PLL circuit. The PLL circuit in the transmitter generates the necessary frequencies. Figure 1 shows the frequencies.

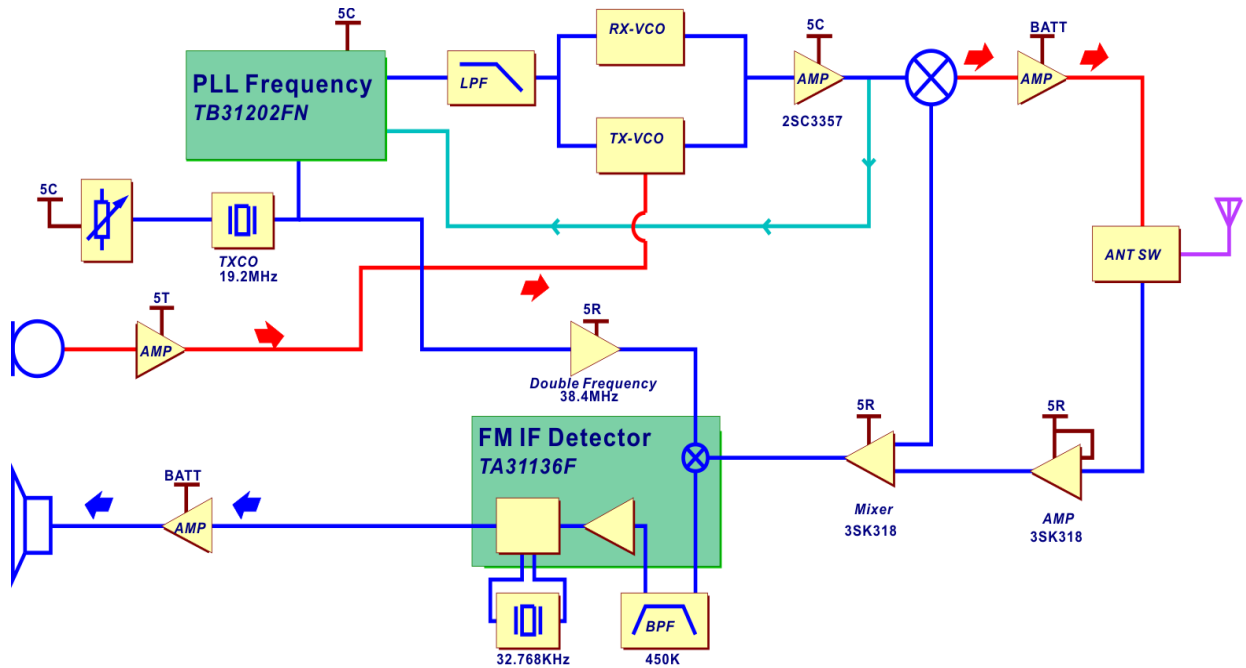


Fig.1

2. Receiver

The frequency configuration of the receiver is shown in Figure 2.

1) Front - end RF amplifier

An incoming signal from the antenna is applied to an RF amplifier (T226) after passing through a transmit/receive switch circuit (D154, D211, D212) and a 3-pole LC filter (L214, C215). After the signal is amplified (T226), the signal is filtered by a band pass filter (a 3-pole LC filter) (L230, C230, L235, L235) to eliminate unwanted signals before it is passed to the first mixer. The voltages of these diodes are controlled to track the MPU (U811) center frequency of the band pass filter. (See Figure 2)

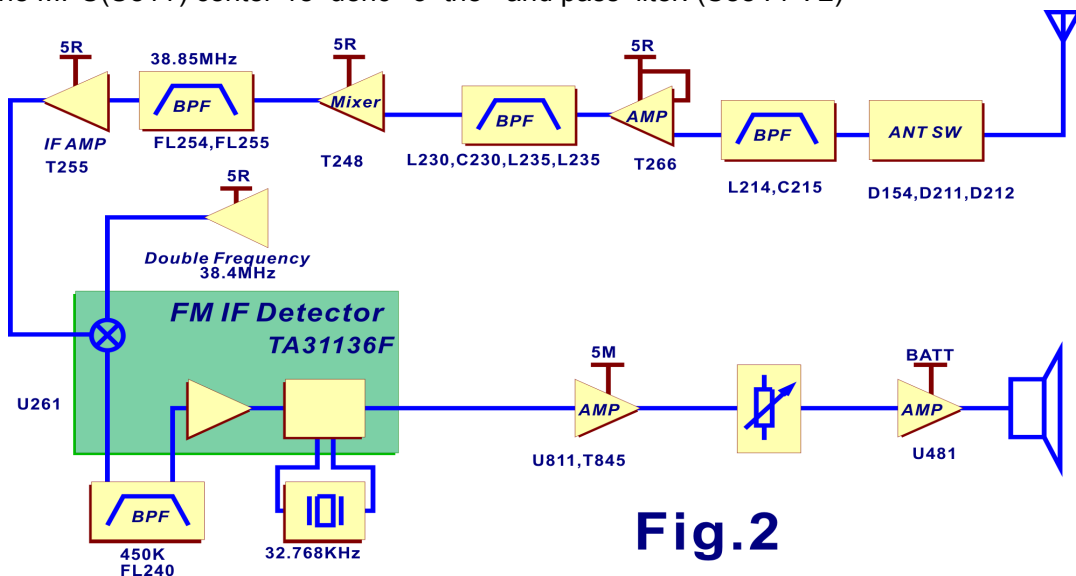


Fig.2

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 (T248) to create a 38.85MHz first intermediate frequency (1st IF) signal. The first IF signal is then fed through crystal filters (FL254 FL255) to further remove spurious signals.

3) IF amplifier

The first IF signal is amplified by T255 and then enters U261 (FM processing IC). The signal is heterodyned again with a second local oscillator signal within U261 to create a 450 Hz second IF signal. The second IF signal is then fed through a 450 Hz ceramic filter (FL263) to further eliminate unwanted signals before it is amplified and FM detected in FL240.

4) AF amplifier

The recovered AF signal obtained from U261 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 loudspeaker through 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 when 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 (U261) 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 reference step of the PLL circuit is 5 and 6.25 Hz and so on. A 19.2MHz reference oscillator signal is divided at U311 by a divided counter to produce the 5 or 6.25 Hz reference frequency. The voltage controlled oscillator (VCO) output signal is further amplified by T340 then divided in U311 by a programmable counter. The divided signal is compared in phase with the 5 or 6.25 Hz reference signal in the phase comparator in U311. The output signal from the phase comparator is filtered through a low-pass filter and passed to the VCO to control the oscillator frequency.

2) VCO

The operating frequency is generated by T340 in transmit mode and T341 in receive mode. The oscillator frequency is controlled by the VCO control voltage obtained from the phase comparator to the varactor diodes (D330 and D331 in transmit mode and D340 and D341 in receive mode). The TC/RC pin is set low in receive mode causing T345 to conduct and turn T337 on. The TC/RC pin is set high in transmit mode causing T337 to conduct and turn T192 T191 on.

3) UNLOCK DETECTOR

If a pulse signal appears at the LD pin of U311 an unlock condition occurs and the DC voltage obtained from D309 and C311 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 in order the push-total switch input signal. (See Fig.3)

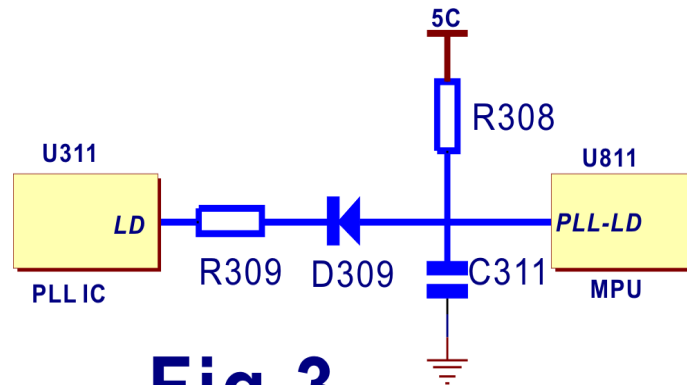


Fig.3

4. Transmitter

1)Microphone Amplifier

The signal from the microphone passes through U511. The signal passes through the Audio processor (U511) or the maximum deviation adjustment and goes to the VCO modulation input.

2)Drive and Final Amplifier

The signal from the T/R switch (D154 and D155) is amplified by the pre-driver (T112, T120) and driver amplifier (T133) to 50mW. The output of the driver amplifier is amplified by the RF power amplifier (T145) to 3.0W (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 (D154, D155) and applied to the antenna terminal.

5. Power supply

There are four 5V power supplies for the microprocessor: 5M, 5C, 5R, and 5T. 5M or microprocessor is always output while the power is on. 5M or 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 register and program data from the memory circuit.
- (3) Sending register program data to the PLL.
- (4) Controlling speech on/off by the DC voltage from the speech 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(U831).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 the microprocessor.

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

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

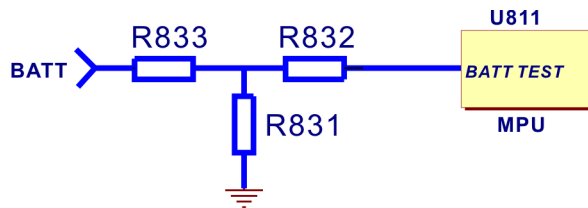


Fig.4

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 Appro. 20V

Current 10A or more

Input resistance High impedance

3. Oscilloscope

Measurement range Audio range

4. Audio dummy load

Impedance 8 ohm

Dissipation 1W or more

Jack 3.5mm

5. SSG

Output range 200MHz or more

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

Modulation FM

6. Spectrum Analyzer

Measurement range Up to 2GHz or more

7. Power meter

Measurement range Up to 200MHz

Impedance 50 unbalanced

Measurement range 0.1W -10W

8. Audio voltmeter

Measurement range Up to 100KHz

Sensitivity 1mV to 10V

9. Audio generator

Output range 67Hz to 10KHz

Output impedance 600 unbalanced

10. Distortion meter/SINAD meter

Measurement frequency 1 Hz

Input level Up to 40dB

Distortion 1% - 100%

11. Frequency counter

Measurement frequency Up to 200MHz

Measurement stability Approx. +/-0.1ppm

12. Linear detector

Measurement frequency Up to 200MHz

Characteristics Flat

CN 60dB or more

Note

Standard modulation 1 Hz +/-2.5 Hz/DEV

Reference sensitivity 12dB SINAD

Specified audio output level 200mW at 8

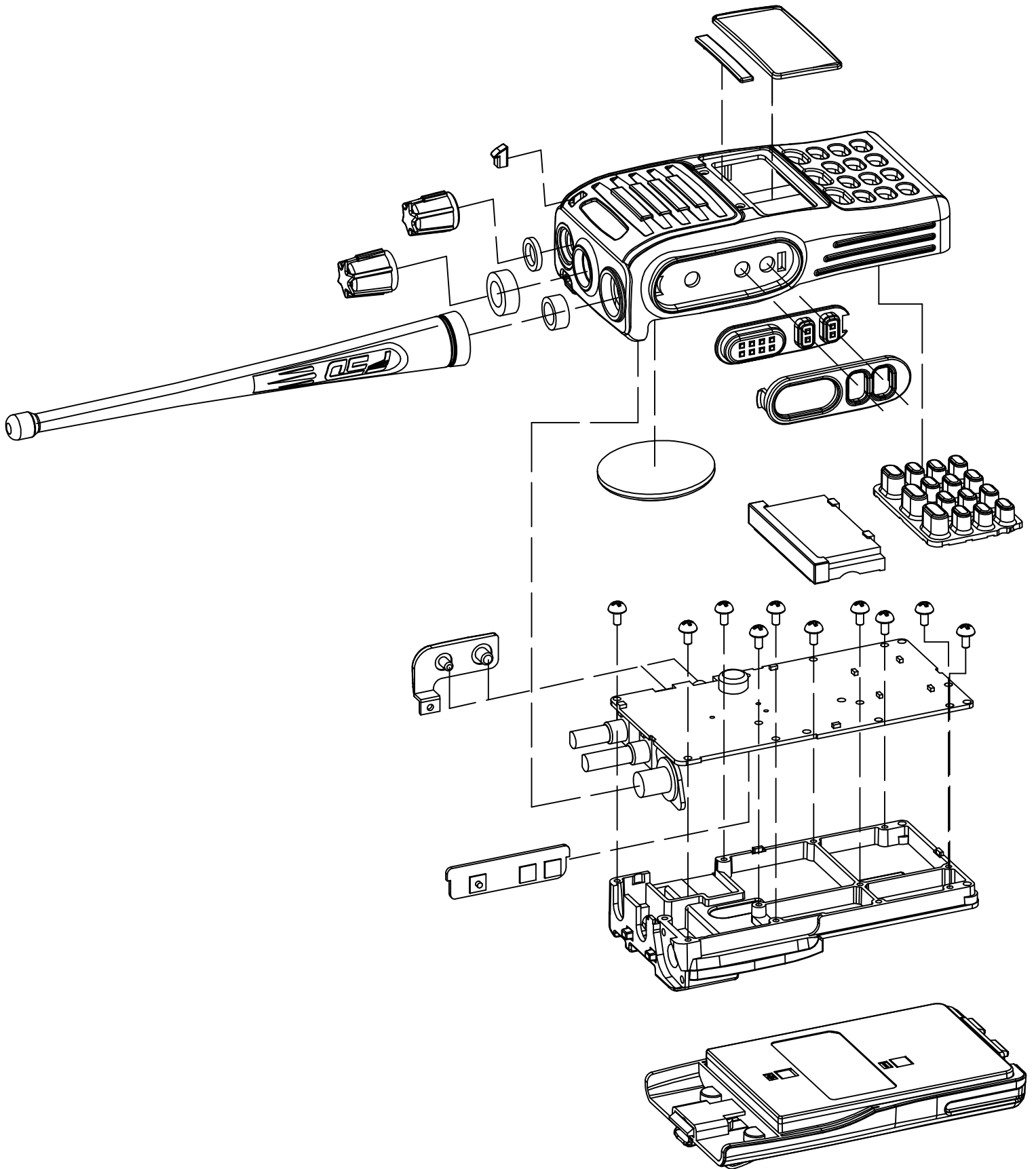
Name/Footprint	Comment	Designators						Quantity
1206 Chip Resistors								
Res (1206)	0R	R901						1
0603 Chip Resistors								
Res (0603)	4K7	R337	R340					2
0402 Chip Capacitors								
Res (0402)	0R	R483	R493					2
Res (0402)	100K	R131	R141	R177	R180	R222	R224	17
		R232	R250	R251	R273	R330	R331	
		R492	R517	R824	R842	R845		
Res (0402)	100R	R227	R248	R338	R344	R370	R374	10
		R400	R401	R403	R814			
Res (0402)	10K	R112	R172	R174	R176	R179	R242	25
		R301	R304	R342	R414	R418	R453	
		R471	R476	R481	R514	R516	R518	
		R520	R522	R711	R830	R848	R913	
		R925						
Res (0402)	10R	R125	R277	R411	R484			4
Res (0402)	120K	R371						1
Res (0402)	150K	R221	R249	R252	R284	R831	R833	6
Res (0402)	150R	R332	R341	R384	R482			4
Res (0402)	15K	R410	R460	R822				3
Res (0402)	180K	R266						1
Res (0402)	1K	R105	R205	R272	R302	R309	R346	11
		R360	R375	R485	R826	R827		
Res (0402)	1K2	R267	R404					2
Res (0402)	1K5	R275						1
Res (0402)	1M	R494						1
Res (0402)	220K	R223	R843					2
Res (0402)	22K	R305	R325	R419				3
Res (0402)	22R	R113						1
Res (0402)	270R	R154						1
Res (0402)	2K2	R300	R323	R324	R402	R472	R911	7
		R912						
Res (0402)	2K7	R257						1
Res (0402)	330K	R361	R417					2
Res (0402)	33K	R385	R841	R846				3
Res (0402)	39K	R413						1
Res (0402)	3K3	R111	R175	R269	R373	R378		5
Res (0402)	470R	R247	R255					2
Res (0402)	47K	R106	R133	R142	R303	R452	R515	10
		R828	R829	R832	R924			
Res (0402)	47R	R132	R143	R225	R253	R377		5

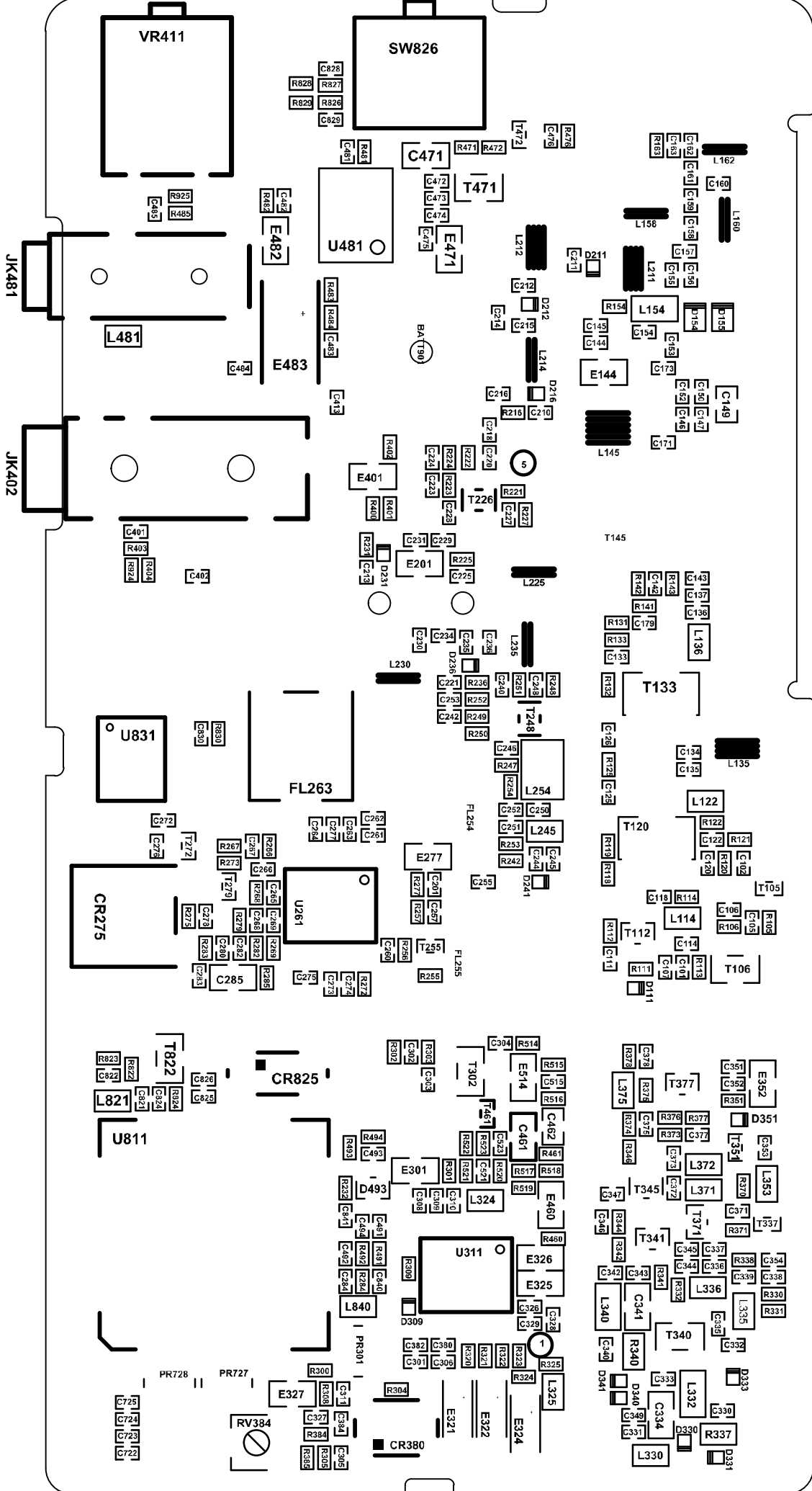
Res (0402)	4K7	R282	R283	R285	R308	R351	R491	11
		R519	R815	R855	R857	R858		
Res (0402)	560R	R320	R321	R853	R854			4
Res (0402)	56K	R268	R412					2
Res (0402)	5K1	R847						1
Res (0402)	5K6	R376						1
Res (0402)	680K	R256						1
Res (0402)	680R	R114	R416					2
Res (0402)	6K8	R322						1
Res (0402)	820R	R427						1
Res (0402)	82K	R163	R178	R823				3
1208 Chip Resistor Packs								
Res-Pac (1206)	1K	PR301	PR727					2
Res-Pac (1206)	47K	PR72						1
1208 Chip Variable Resistors								
Var-Res (1208)	100K	RV180	RV453					2
Var-Res (1208)	50K	RV38						1
0402 Chip Capacitors								
Cap (0402)	0P5	C171	C173	C332	C337	C345		5
Cap (0402)	0R	C218						1
Cap (0402)	100P	C278	C301	C306	C308	C309	C310	15
		C366	C381	C401	C482	C492	C722	
		C723	C724	C725				
Cap (0402)	102P	C133	C137	C142	C172	C174	C175	18
		C179	C251	C305	C326	C347	C353	
		C354	C371	C375	C402	C831	C902	
Cap (0402)	103P	C106	C134	C145	C178	C201	C206	27
		C207	C248	C252	C277	C303	C304	
		C338	C339	C351	C451	C472	C473	
		C475	C711	C822	C830	C841	C845	
		C903	C908	C910				
Cap (0402)	104P	C101	C107	C177	C253	C257	C263	30
		C264	C265	C272	C273	C274	C276	
		C311	C327	C331	C349	C384	C413	
		C416	C474	C476	C491	C493	C494	
		C821	C824	C840	C843	C857	C858	
Cap (0402)	105P	C847						1
Cap (0402)	10P	C163	C211	C244	C246	C268	C336	7
		C361						
Cap (0402)	15P	C155	C157	C343	C373			4
Cap (0402)	1P	C158	C229	C234				3
Cap (0402)	20P	C111						1
Cap (0402)	220P	C266	C267	C284	C417	C484	C485	7
		C849						

Cap(0402)	22P	C159	C825	C826				3
Cap(0402)	27P	C275						1
Cap(0402)	2P	C214	C335	C364				3
Cap(0402)	30P	C363	C365					2
Cap(0402)	332P	C846						1
Cap(0402)	333P	C844						1
Cap(0402)	33P	C330	C340					2
Cap(0402)	392P	C842						1
Cap(0402)	39P	C125	C161	L136				3
Cap(0402)	3P	C160	C235					2
Cap(0402)	470P	C105	C114	C126	C135	C144	C153	24
		C154	C156	C205	C220	C223	C224	
		C225	C227	C240	C242	C250	C260	
		C269	C302	C346	C352	C362	C909	
Cap(0402)	472P	C283	C415	C481				3
Cap(0402)	473P	C280	C282	C414	C483			4
Cap(0402)	47P	C360						1
Cap(0402)	4P	C215						1
Cap(0402)	56P	C150						1
Cap(0402)	5P	C342	C344	C342	C344			2
Cap(0402)	680P	C848						1
Cap(0402)	6P	C162	C228	C230	C245	C372		5
Cap(0402)	7P	C118	C329	C333	C378			4
Cap(0402)	8P	C255						1
Cap(0603)	223P	C462						1
Cap(0603)	2T	C149						1
Cap(0805)	105P	C471	C901					2
Cap(0805)	10uF	C285	E201	E277	E325	E326	E352	11
		E471	E482	E711	E908	E910		
Cap(0805)	1uF	E144						1
Cap(0805)	2.2uF	E452						1
Cap(0805)	2P	C334						1
Cap(0805)	3P	C341						1
Cap(0805)	4.7uF	E179	E301	E327	E401	E460	E514	6
Polarizedcapacitors								
Pol-Cap(6032)	100uF	E483						1
Pol-Cap(3216)	0.1uF	E321	E324					2
Pol-Cap(3216)	1uF	E322						1
Inductance								
Ind(1009)	1uH	L254						1
Ind(0805)	100nH*	L332						1
Ind(0805)	150nH	L340						1
Ind(0805)	220nH	L154						1
Ind(0603)	100nH	L324	L371					2

Ind(0603)	2.2uH	L336	C136					2
Ind(0603)	33nH	L114						1
Ind(0603)	39P	L136						1
Ind(0603)	47nH	L245	L372					2
Ind(0603)	560nH	L362	L364					2
Ind(0603)	82nH	L375						1
Ind(0603)	6.8uH	L330						1
Ind(0603)	47nH	L214	L230	L235				3
Ind(0603)	47nH	L225						1
Ind(0805)	101T	L901						1
Ind(0603)	101T	L325	L353	L481	L840			4
Ind(0603)	301T	L821						1
Coil-Ind	4T	L158	L160	L162				3
Coil-Ind	6T	L135	L211	L212				3
Coil-Ind	8T	L145						1
Diode								
Diode(USM)	1SS372	D493						1
Diode(USM)	3J	D171	D173					2
Diode(USC)	UD	D154						1
Diode(SMA)	1SR154-	D902						1
Diode(ESM)	DAN222	D427						1
Diode(ESC)	HSC277	D111	D211	D212	D241			4
Diode(ESC)	MA2S11	D351						1
Diode(ESC)	PMSD4148	D309						1
SwitchingDiode								
Diode(ESC)	C376	D330	D331	D340	D341			4
Diode(ESC)	H376	D333						1
Light Emitting Diode								
LED(0603)	GREEN	D854						1
LED(0603)	LED	D813	D814	D815	D816	D817	D818	6
LED(0603)	RED	D853						1
Transistors								
Tra(TSQ)	3SK318	T226	T248					2
Tra(USV)	UMC4	T345						1
Tra(USM)	2SC4226	T112	T341	T361				3
Tra(USM)	2SC4226	T371	T377					2
Tra(USM)	MRF497	T425						1
Tra(TSM)	2SB624	T106	T302	T471	T822			4
Tra(ESM)	2SC4617	T845						1
Tra(ESM)	2SC4617(S	T351						1
Tra(ESM)	2SC4649	T255						1
Tra(ESM)	DTA114EE	T178	T206	T272	T855			4
Tra(ESM)	DTC114EE	T105	T472	T814	T853	T854		5
Tra(ESM)	2SC4617	T340						1

FET (ESM)	2SJ243	T337						1
FET (5N1A)	RQA009	T145						1
Integrated Circuits								
IC (SSOP16)	TA31136F	U261						1
IC (SSOP16)	TB31202	U311						1
IC (SSOP10)	TA7368	U481						1
IC (SSOP8)	NJM2904V	U511						1
IC (SOT89)	5A	U909						1
IC (SOP8)	24C32	U831						1
IC (QFP44)	TMP87P805	U811						1
IC (LQFP48)	HT1621B	U711						1
CrystalFilters								
Filters	38.85MHz	FL254	FL255					2
Filters	450G	FL26						1
CrystalOscillator								
Oscillator	32.768KHz	CR82						1
CeramicOscillator								
Oscillator	C24	CR27						1
TCXO								
TCXO	19.2MHZ	CR38						1
Orthers								
LCD	GD-4481	LCD7						1
ANT	ANT	ANT1						1
BATTERY	BATTERY	BATT						1
Knob	RD91	VR41						1
Knob	RD81-T02	SW82						1
SP-JACK	2.5mm	JK48						1
SP	SP	SP40						1
MIC-JACK	3.5mm	JK40						1
MIC	MIC	MIC4						1





VR411

SW826

R828
R827
R826
R825
C828
C827
C826
C825

C471

T471

U481

E482

L481

E483

BA(T)90

D212

L212

D216

L214

D216

L216

R218

C216

R218

C218

R218

C218

R218

C218

R218

C218

R218

C218

R218

C218

R218

C218

R218

C218

R218

C218

R218

C218

R218

C218

R218

C218

R218

C218

R218

C218

R218

C218

R218

L162

C160

L180

L158

L211

R154

L154

D154

C154

R154

C154

R154

C154

R154

C154

R154

C154

R154

C154

R154

C154

R154

C154

R154

C154

R154

C154

R154

C154

R154

C154

R154

C154

R154

C154

R154

C154

R154

C154

R154

C154

R154

C154

R154

T145

R143

C143

R143

C143

R143

C143

R143

C143

R143

C143

R143

C143

R143

C143

R143

C143

R143

C143

R143

C143

R143

C143

R143

C143

R143

C143

R143

C143

R143

C143

R143

L136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

C136

R136

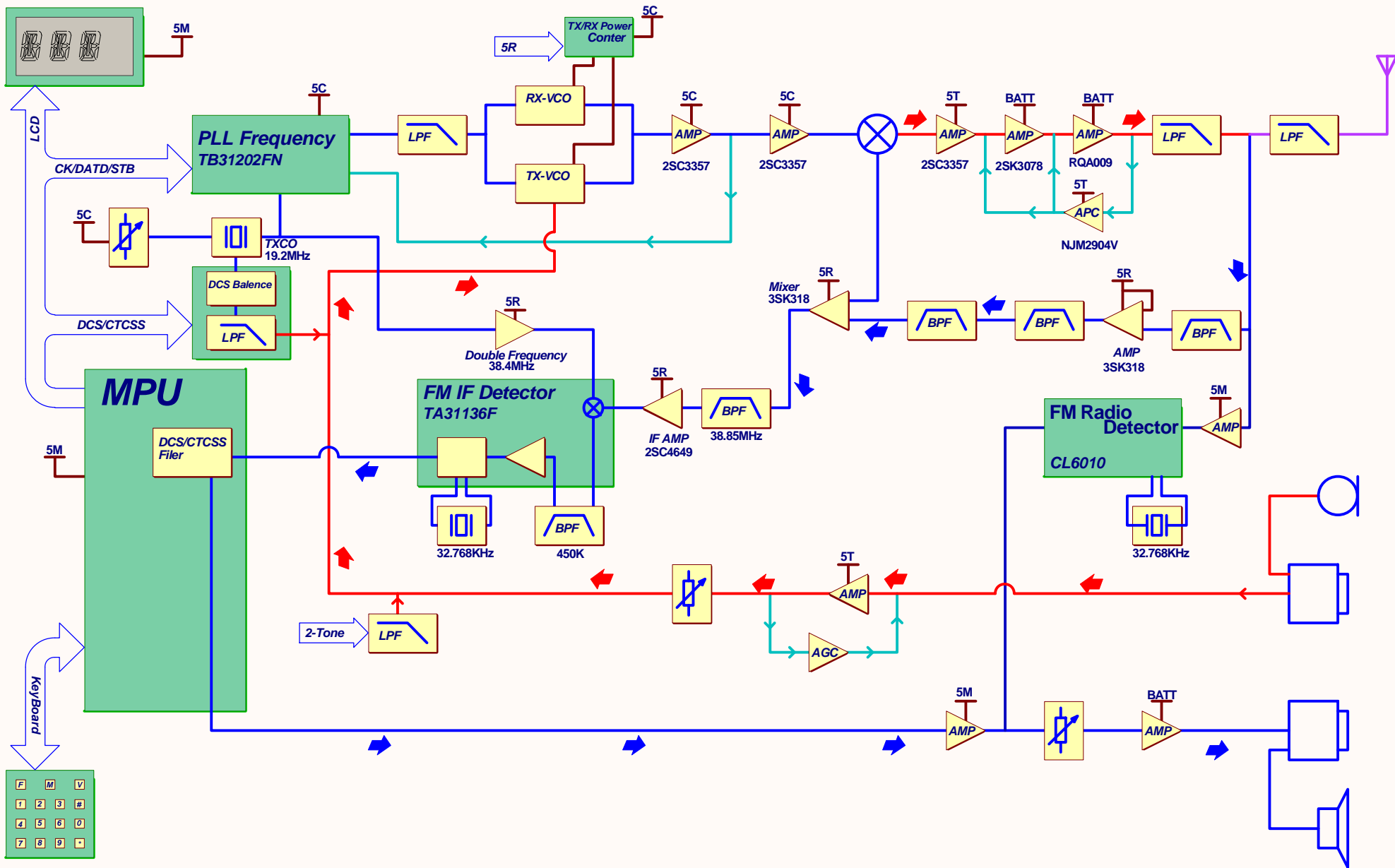
C136

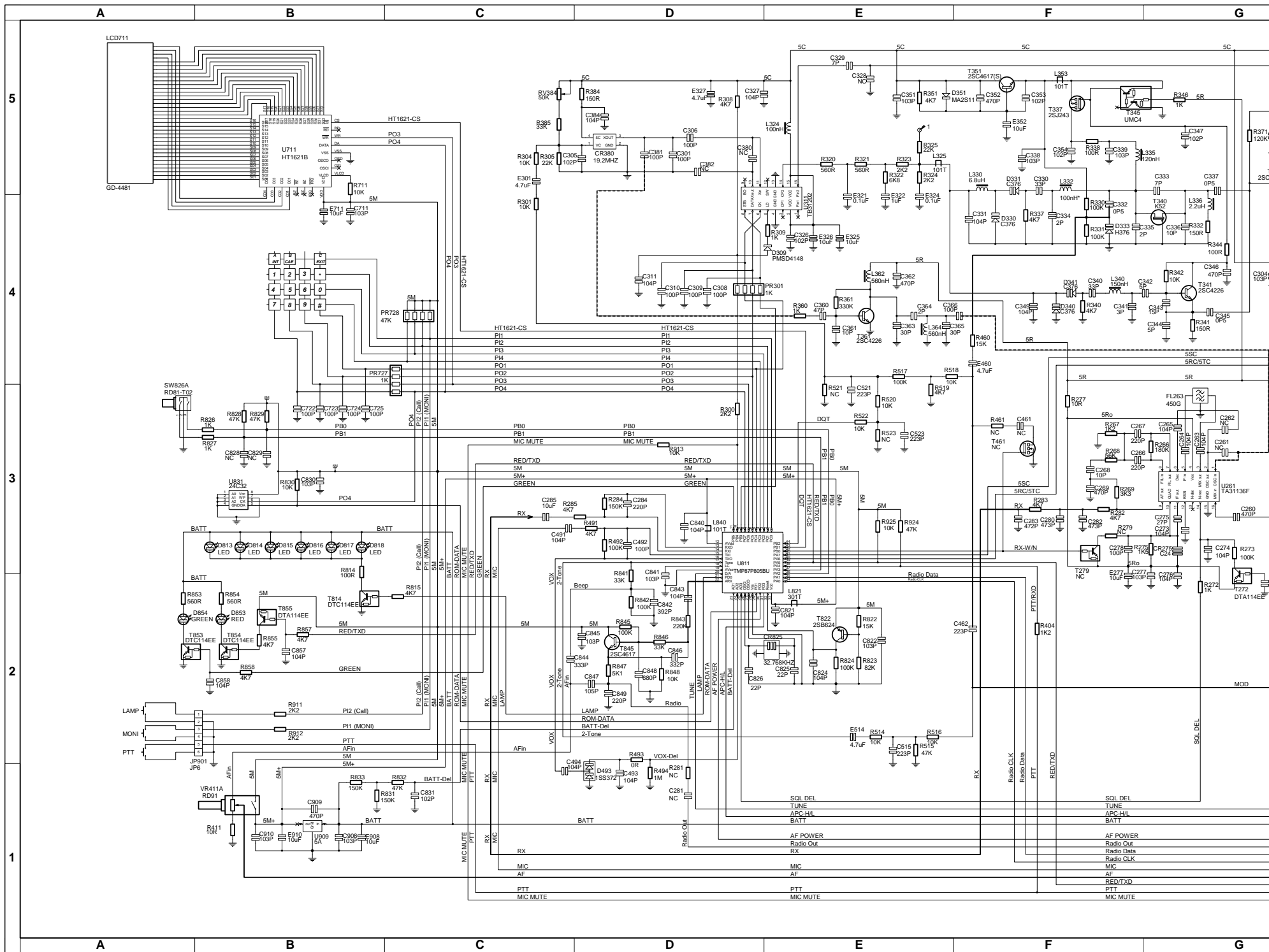
R136

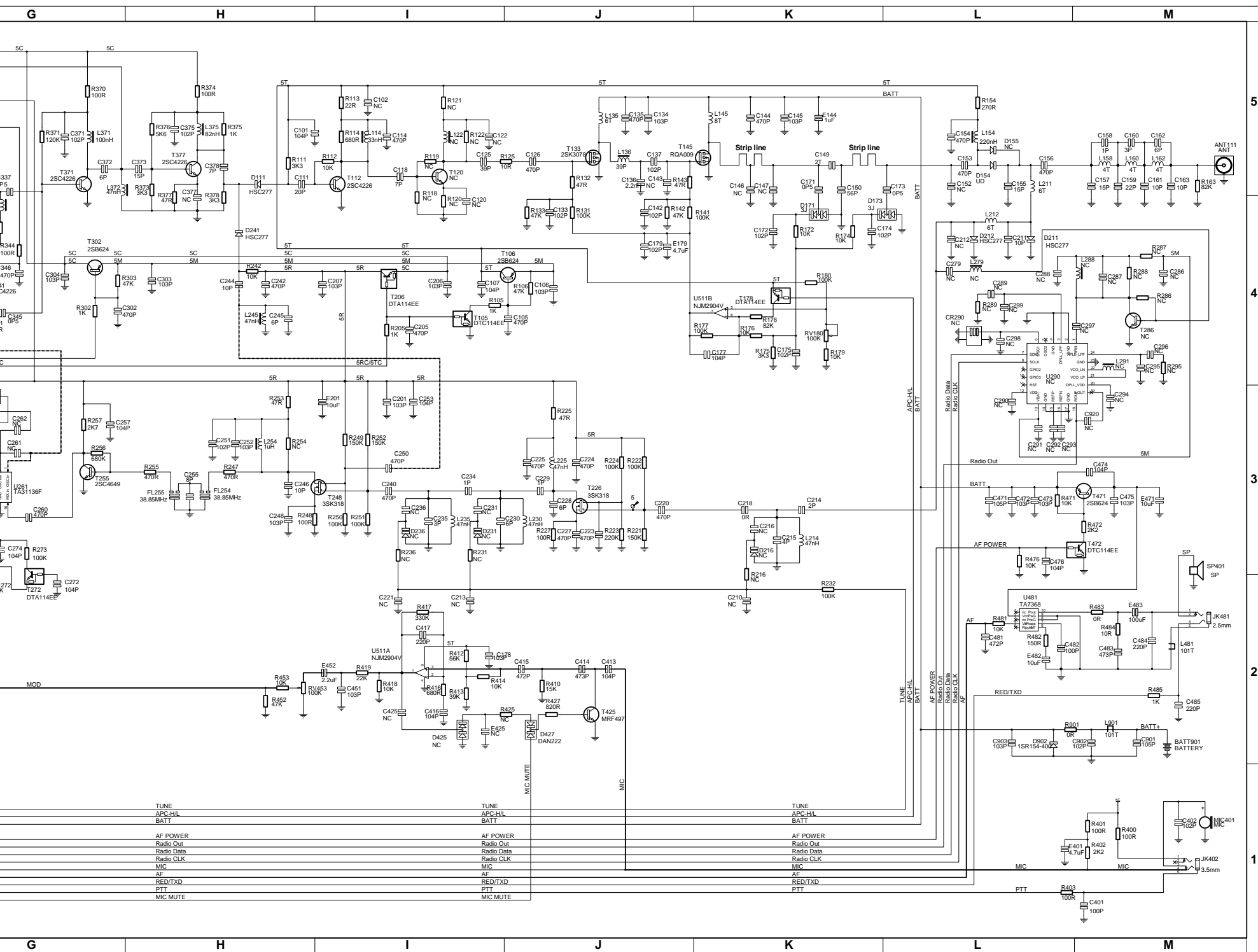
C136

R136

C136







5

4

3

2

1