

# Ningbo Zhonghai Electrical Appliances Co.,Ltd

## Circuit Description (MODEL WT1003)

### RF

#### I.) TX Path

1. The antenna port has given GMRS/FRS transmitted power and  $-119\text{dBm}$  sensitivity respectively.
2. There are matching network with TX/RX path switching between the antenna port and PA, it consist of LC component and pin diode to match the PA to antenna with band pass filtering and isolating TX/RX path.
3. The path switching is consisting of D609, D508 , the transmitted power will flow once the dc bias is given to these two diodes and there will have 20 dB isolation between TX and RX path.
4. C539, C501, and L518 cct as matching network (MN) to match output of PA to be 50 ohm.
5. There have a driver Q601 before the power input to PA from U301 BK48XX, the power input to driver and PA is  $0\text{dBm}$  and  $+18\text{dBm}$  respectively.
6. L621, L609, L610 and L505 are inductor in order to reduce the power dissipation as high power flowing along this path.
7. There is a new IC U301(BK48XX) integrates high performance, FM transmitter,PLL,VCO
8. 21.7MHz TCXO crystal X301 with direct compensation circuit to give  $+-2.5\text{ppm}$  over  $-30\text{C}$  to  $+55\text{C}$ .
9. IC200 cct as voltage regulator to give stable voltage supply to 2.8V path.

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## **II.) RX Path**

1. L502 C572//L571 C542 and L500 were used to match the antenna to 50 ohm .
2. The Q518 is for the LNA.
3. Q511 cct as switch to turn on the RX path in RX mode in order to save the power consumption .
4. The U301 (BK48XX) integrate the IF limiter, demodulator, mixer .
5. Noise detector is used for signal detection which is built with the internal op-amp of U301 (BK48XX) and the level is controlled 5~12dB SINAD

## **III.) WX RX Path**

1. L502 L711 C701 D701 and C7130 were used to match the antenna to 50 ohm .
2. The Q701 is for the LNA.
3. Q704 cct as switch to turn on the RX path in RX mode in order to save the power consumption .
4. The U301 (BK48XX) integrate the IF limiter, demodulator, mixer .
5. Noise detector is used for signal detection which is built with the internal op-amp of U301 (BK48XX) and the level is controlled 5~12dB SINAD

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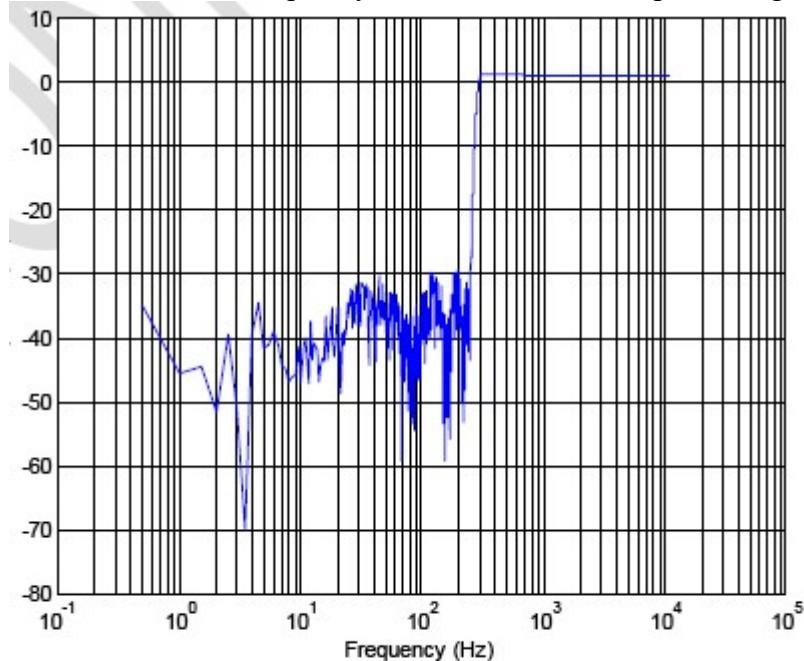
## BASEBAND

### (III.) TX Path

#### 1. Mic

The internal/external mic transfers the sound pressure into electrical signal. About 5mV at 1KHz, when the mic is placed 3 to 4 cm from the lips. This signal will send to the mic amplifier to increase the signal level for U301(BK48XX)

2. The U301(BK48XX) has 300Hz High Pass filter to avoid interference to Sub-audible signal which has 30dB attenuation for frequency below 250hz with respect to signal at 1 Khz.



**Figure 9. Frequency Response of 300Hz High Pass Filter**

#### 3. Pre-emphasis

Pre-emphasis is implemented with the U301(BK48XX) limiter to produce a frequency response of 6dB/octave. This circuit also limits the maximum deviation at 2.5KHz to meet the specification (standard deviation  $\sim 1.5$ kHz, maximum deviation  $\sim 2.5$ kHz).

#### 4. Low Pass Filter

The U301(BK48XX) has Low pass filter with typical 2.55Khz corner for 12.5Khz channel spacing. which has 50dB attenuation for frequency above 3.5Khz with respect to signal at 1 Khz.

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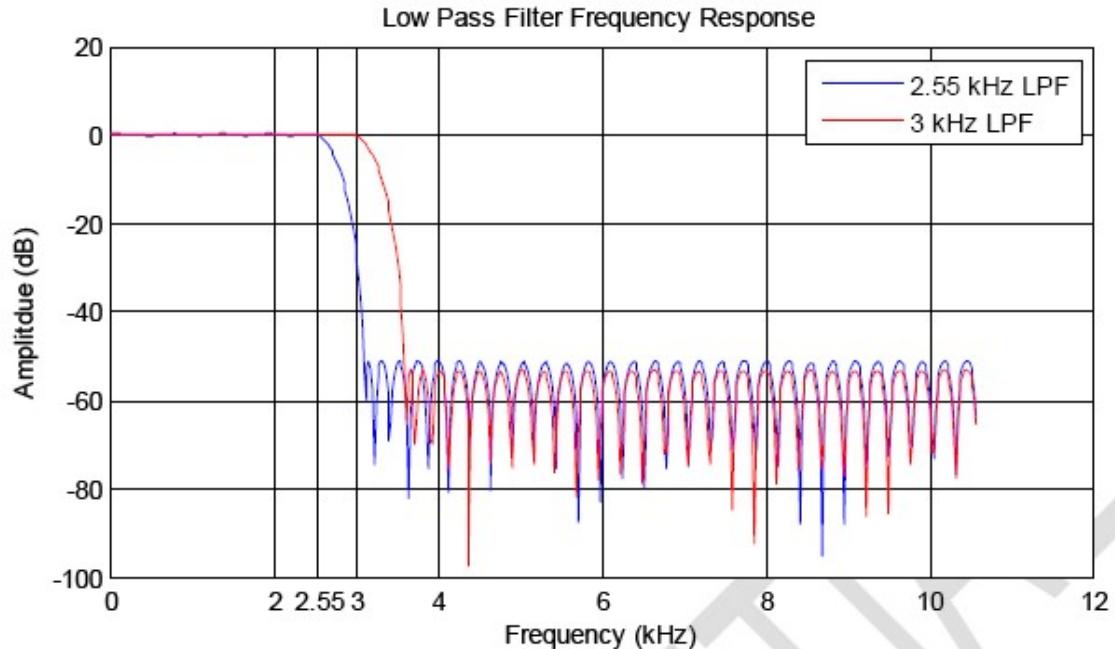


Figure 10. Frequency Response of Low Pass Filter

## (IV.) RX Path

### 1. De-emphasis

The de-emphasis is implemented with the U301(BK48XX).

### 2. Volume Control

8 Level for U301(BK48XX) control.

### 3. Speaker Amplifier

The speaker amplifier IC105 amplifies the expander signal and outputs to the speaker. The speaker amplifier biases as a multi feedback HPF with 2-pole. The roll off is about 300Hz and the gain is about 35dB. The speaker amplifier can be muted by CPU through PIN 1 (High UNMUTE, Low MUTE). The maximum power output is about 800mW.

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## V) Weather Band RX Path

1. The Q701 is for the LNA .

## VI) CTCSS / CDCSS

The U301(BK48XX) generated CTCSS / CDCSS codes.

### VI-1) CTCSS CODES (Frequency tolerance per TIA 603 B 3.4.12)

CODE	FREQ (Hz)	CODE	FREQ (Hz)
1	67.0	20	131.8
2	71.9	21	136.5
3	74.4	22	141.3
4	77.0	23	146.2
5	79.7	24	151.4
6	82.5	25	156.7
7	85.4	26	162.2
8	88.5	27	167.9
9	91.5	28	173.8
10	94.8	29	179.9
11	97.4	30	186.2
12	100.0	31	192.8
13	103.5	32	203.5
14	107.2	33	210.7
15	110.9	34	218.1
16	114.8	35	225.7
17	118.8	36	233.6
18	123.0	37	241.8
19	127.3	38	250.3

### VI-2) CDCSS CODES (Frequency tolerance per TIA 603 B 1.3.5.8)

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Code No.	Octal Code	Bit Pattern		Code No.	Octal Code	Bit Pattern	
		MSB	LSB			MSB	LSB
39	023	11101100011100000010011		81	315	11011000110100011001101	
40	025	11010110111100000010101		82	331	0100011110100011011001	
41	026	11001011101100000010110		83	343	01010010111100011100011	
42	031	10100011111000000011001		84	346	01110101001100011100110	
43	032	10111110101100000011010		85	351	00011101011100011101001	
44	043	101101101101000000100011		86	364	11010000101100011110100	
45	047	0001111101100000100111		87	365	01011110000100011110101	
46	051	111110010101000000101001		88	371	00101011000100011111001	
47	054	110111101001000000101100		89	411	11101110110100100001001	
48	065	101110100011000000110101		90	412	11110011100100100001010	
49	071	110011110011000000111001		91	413	01111101001100100001011	
50	072	110100100111000000111010		92	423	10010111001100100010011	
51	073	010111001101000000111011		93	431	11011000101100100011001	
52	074	111010001111000000111100		94	432	110000101111100100011010	
53	114	01101011110100001001100		95	445	11110111000100100100101	
54	115	11100101011100001001101		96	464	0100111110100100110100	
55	116	11111000001100001001110		97	465	11000001011100100110101	
56	125	00001111011100001010101		98	466	11011100001100100110110	
57	131	01111010011100001011001		99	503	01111000110100101000011	
58	132	01100111001100001011010		100	506	01011111000100101000110	
59	134	01011101101100001011100		101	516	10000011011100101001110	
60	143	01101111010100001100011		102	532	00011100011100101011010	
61	152	00111101100100001101010		103	546	00110011110100101100110	
62	155	10001001101100001101101		104	565	00011000111100101110101	
63	156	10010100111100001101110		105	606	10111011001100110000110	
64	162	11010111100100001110010		106	612	11001110001100110001010	
65	165	01100011101100001110101		107	624	00011110101100110010100	
66	172	00001011111100001111010		108	627	00000011111100110010111	
67	174	00110001011100001111100		109	631	11100101000100110011001	
68	205	11011101001100010000101		110	632	11111000010100110011010	
69	223	11010001110100010010011		111	654	10011000011100110101100	
70	226	11110110000100010010110		112	662	01001000111100110110010	
71	243	10001011011100010100011		113	664	01110010011100110110100	
72	244	00111111010100010100100		114	703	01000101011100111000011	
73	245	10110001111100010100101		115	712	00010111101100111001010	
74	251	11000100111100010101001		116	723	01110011000100111010011	

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75	261	0010111011100010110001	117	731	00111100100100111011001
76	263	10111101000100010110011	118	732	00100001110100111011010
77	265	10000111100100010110101	119	734	00011011010100111011100
78	271	11110010100100010111001	120	743	00101001101100111100011
79	306	0001100111100011000110	121	754	0100000111100111101100
80	311	01110001101100011001001			

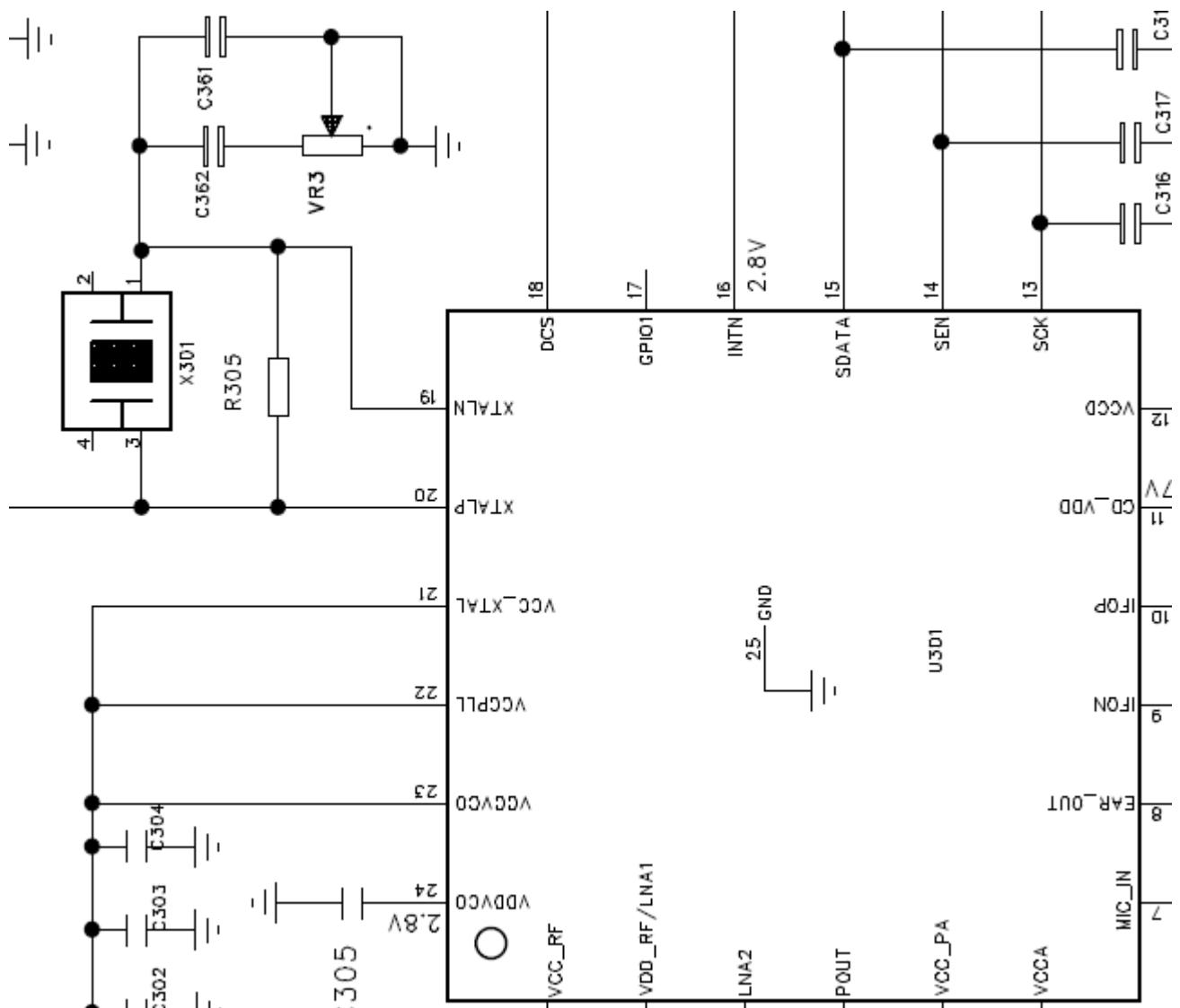
## RF Characteristics

<b>Frequency Range:</b>	462.5500 MHz to 462.7250 MHz
	467.5625 MHz to 467.7125 MHz
<b>Rated Output Power:</b>	29.5 dBm ( $\pm 0.5$ dB)
<b>Modulation Type:</b>	FM
<b>Channel Separation:</b>	12.5 KHz
<b>Number of Channels:</b>	22
<b>Antenna Type:</b>	Integral Antenna
<b>Antenna Gain:</b>	2 dBi

Channel Lists					
Channel	Frequency	Channel	Frequency	Channel	Frequency
1	462.5625 MHz	8	467.5625 MHz	15	462.5500 MHz
2	462.5875 MHz	9	467.5875 MHz	16	462.5750 MHz
3	462.6125 MHz	10	467.6125 MHz	17	462.6000 MHz
4	462.6375 MHz	11	467.6375 MHz	18	462.6250 MHz
5	462.6625 MHz	12	467.6625 MHz	19	462.6500 MHz
6	462.6875 MHz	13	467.6875 MHz	20	462.6750 MHz
7	462.7125 MHz	14	467.7125 MHz	21	462.7000 MHz
				22	462.7250 MHz

## Frequency stabilizing circuit:

The X301 21.7 MHz temperature compensated crystal is provided by the U301 to make the emission frequency stable.

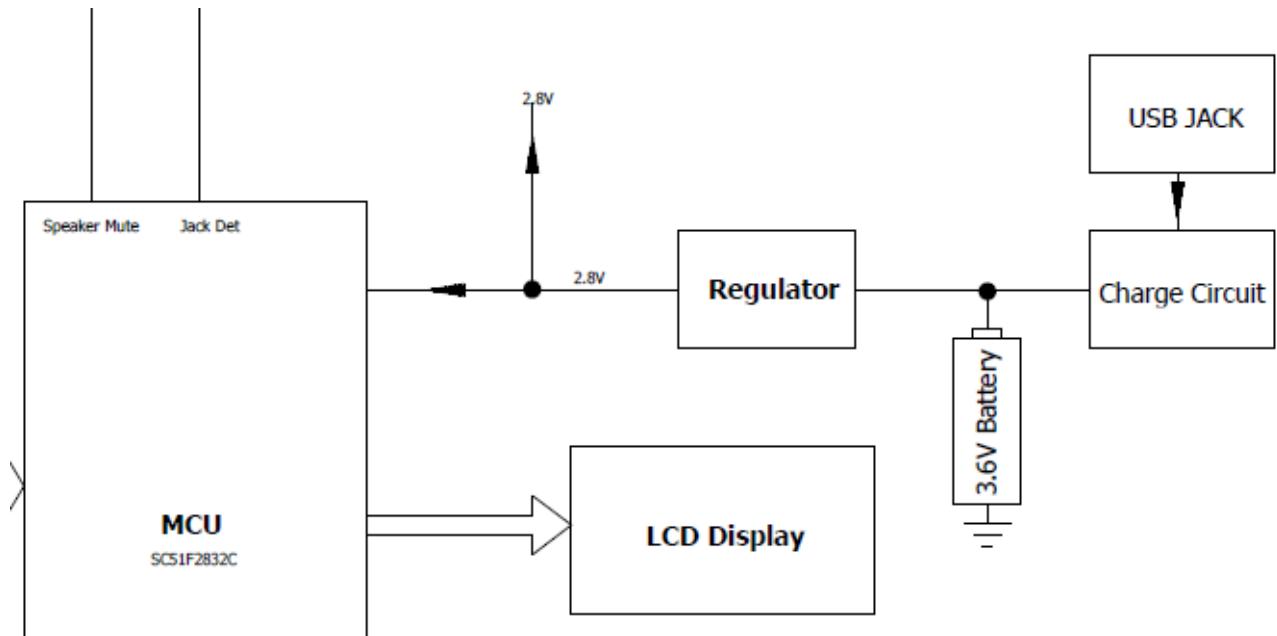


## Antenna:

The antenna must be designed such that the electric field of the emitted waves is vertically polarized when the unit is operated in the normal orientation.

## Power management:

The entire circuit is powered by a battery (normal voltage is 3.6V), and the battery can also be charged through the USB 5.0V interface. Then the voltage is stabilized at 2.8V through the power adjustment circuit (IC 200) and provided to the U1, U301 and PA.



U301 is a fully integrated RF transceiver chip, with internal PLL / VCO / transmitter modulation.(Transmit modulation is fully provided by BK4813 U301 system) When you press the PTT key, U301 receives emission control instructions from MCU.

Walkie-talkie is in the emission mode. Transmit switch, RF PA and VTX signals are on. Release the TALK to stop transmitting. Voice signal from MIC goes to the U301 to generate the modulated PA-OUT. And then it goes through amplification stages Q511 and Q518 before suppressed by the low pass filter to get rid of RF harmonics.

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