1.describe

C9613is a hand tuneFM/AM/SWMulti-band debugging-free single radio chip. The chip monolithically integrates frequency synthesizer, RF front-end,MPXdecoder, etc., can realize all receiver functions from wireless input to audio output, eliminating the need to correct traditionalpvc, Zhongzhou's complex peripheral circuits, omitting the complicated production process of debugging and correction.

C9613The chip integrates a high-performance low-IF digital audioDSP, making the chip have excellent sound quality under various receiving conditions.

C9613The chip hasAFCfunction, making it excellent performance and flexibility.C9613chip can be read from2.0Varrive3.6VWide supply voltage range operation.

## 1.1.feature

- monolithic integrationFM/AM/SWradio receiver
- Very low power consumption
    - FMmode consumes less current than32mA,
    - AMmode consumes less current than
- 28mA global supportFM/AM/SWband
    - AMband520-1710KHz
    - FMband87-108MHz
    - supportFMsingle band64-108MHz
    - SWband3.2MHz-23.00MHz
- Integrated digital low-IF tuner
    - Image Reject Downconverter
    - high performanceA/Dconverter

- Fully Integrated Digital Frequency Synthesizer
    - Fully integrated on-chipRF VCO
    - Fully integrated on-chip loop filter
- Support manualPVRSearch
- support32.768KHzcrystal oscillator
- Automatic frequency control (AFC)
- Supports Digital Automatic Gain Control (AGC)
- Digital Adaptive Noise Cancellation
    - Mono audio output
- FM/AMSelection of frequency bands in various regions
- support9short wave mode
- Support any shortwave frequency band selection
- Package Type:SOP16 (RoHS)

1.2.Application field

- desktop or portable radio
- CD/DVDPlayer
- Mini stereo
- entertainment system
- toys or gifts.

2.Functional block diagram
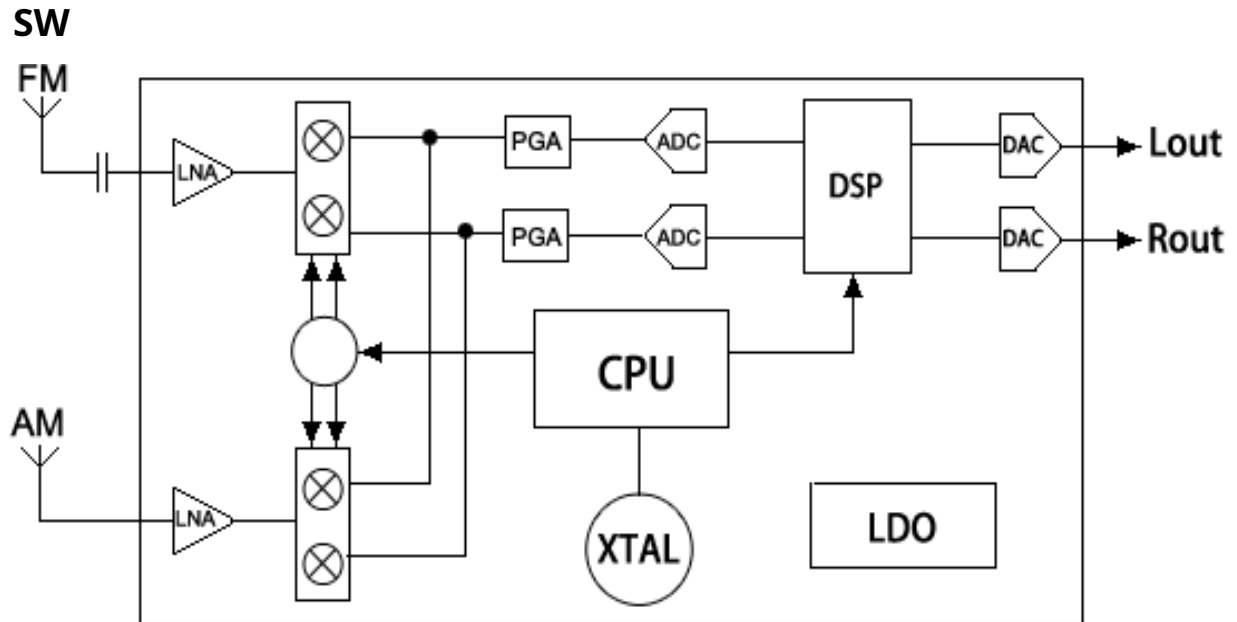
picture1.   C9613Functional block diagram

3.Functional description

3.1.overview

C9613It is a highly integrated single-chip full-bandFM/AM/SWReceiver chip, which can realize flexible and diverse radio reception schemes, greatly reduces the peripheral components of the chip, and reduces the application cost.BOMAnd cost, more convenient factory production.

3.2. FMtake over

C9613The chip adopts a low-IF architecture, which avoids problems such as image suppression caused by direct frequency conversion, and effectively reduces the cost and complexity of applications.C9613The chip integrates support for single-band (64 to 108MHz)ofFMLNA (FM_LNA), quadrature image reject mixer, programmable gain amplifier (PGA), high-resolution analog-to-digital converters, audioDSPand high-fidelity digital-to-analog converters (DAC).

FM_LNAWillRFThe signal is amplified and converted to a differential signal; the quadrature image reject mixer willFM_LNAdifferenceRFThe signal is down-converted to a low-intermediate frequency signal, and the image suppression function is completed at the same time;PGAAmplifies the IF signal output from the quadrature image reject mixer, then passes ADCWillPGAThe output low-IF analog signal is converted into a digital signal and sent to the audioDSPFollow up.

audioDSPComplete channel selection,FMdemodulation,MPXDecoding and audio signal output.

3.3. AMtake over

C9613The chip adopts digital low-IF architecture, supporting frequency range from520kHzarrive1710 kHzthe globalAMband.C9613 chipAMReception requires minimal external components and requires no manual tuning. The digital low-IF architecture makesC9613chip throughout the AMThe band has high-precision filtering, excellent selectivity and excellent signal-to-noise ratio. andFMReceiving is similar to,C9613chipAMReceiving optimizes the receiving sensitivity and the ability to suppress strong interference signals, making weak signal stations easier to receive. To provide maximum flexibility,C9613The chip supports a wide range of ferrite coil magnets.C9613The chip can also support a loop antenna with a transformer to increase the effective inductance.

3.4. SWtake over

C9613The chip supports from3.20MHzarrive23.00 MHzscope9a shortwave band. It also supports arbitrary selection of frequency within the frequency range; C9613The shortwave receiver of the chip has the characteristics of few external discrete components and no need for factory adjustment.C9613The chip also supports the use ofFMThe antenna receives shortwave signals.

3.5.frequency synthesizer

The local oscillator signal generated by the frequency synthesizer is input to the quadrature mixer to beRFThe signal is down-converted to a low-IF signal with a fixed frequency. The frequency of the reference clock of the frequency synthesizer is32.768 KHz(+-10ppm).

4.electrical characteristics

(surface1.   working conditions)

parameter	symbol	Test Conditions	minimum value	typical value	maximum value	unit
voltage	AVDD	Relative to GND	2.0	3.3	3.6	V
ambient temperature	Ta		- 15		+85	°C

(surface2.   DC characteristics)

parameter		symbol	Test Conditions	minimum value	typical value	maximum value	unit
Current consumption	FM Model	I_{FM}			32		mA
	AM Model	I_{AM}			28		mA
	SW Model	I_{SW}			28		mA

(surface3.   FMelectrical index)

(VDD = 3.0V, Ta = 0 to 45°C)

project	Test Conditions	typical value	unit
Frequency Coverage Range (FMFrequency Range)	Low	87	MHz
	High	108	MHz
Sensitivity For 30dB S/N (30decibel sensitivity)	90 MHz	9	dB
	98 MHz	9	dB
	106 MHz	9	dB
S/N Ratio 60dB Input (SNR)	98 MHz	54	dB
3dB Limiting Sensitivity (clipping sensitivity)	98 MHz	14	dB
AFC Holding Range (automatic frequency control)	98 MHz	+ - 50	KHz
AM Suppression 60dB Input (AM suppression)	98 MHz	45	dB
Distortion 60db Input (Distortion)	98 MHz	0.5	%
Overload THD.75 KHz Dev. (overload capacity)	98 MHz	0.3	%
Power Output 10% THD(MOD=75KHz) (power output)	98 MHz	175	mVrms
Max.Power Output (MOD=75KHz) (maximum power output)	98 MHz	175	mVrms
No Signal Current (no signal current)		13	uA
Current Drain Current at OutPut (Maximum current)		35	mA
Modulation Hum.(100dB) (modulated hum)		1.5	mV
Frequency Response 1mV Input with	High	5	KHz
1KHz=0dB (-6dB) (Frequency response)	Low	80	Hz
Level Difference Mono/Stereo(mono/stereo difference)	98 MHz	0	dB
Sens. For Stereo Indicator On (Lighting sensitivity)	98 MHz	twenty two	dB
Channel Balance (channel error)	98 MHz	0.2	dB
Separation 1KHz (separation)	98 MHz	50	dB

NOTE:
    1. Frequency is 87~108 MHz.
    2. V_{EMF} = 1mV.
    3. FMOD = 1 kHz, MONO, and L = R unless noted otherwise.
    4. Δf = 22.5 kHz.
    5. |f2 – f1| > 2 MHz, f0 = 2 x f1 – f2.
    6. BAF = 300 Hz to 15 kHz, A-weighted.
    7. At LOUT and ROUT pins.
    8. f = 75kHz.

(surface4.   AMelectrical index)

(VDD = 3.0V, Ta = 0 to 45°C)

project	Test Conditions	typical value	unit
Frequency Coverage Range(AMFrequency Range)	Low	520	KHz
	High	1710	KHz
Sensitivity For 20dB S/N (20decibel sensitivity)	600KHz	83	dB/m
	1000KHz	83	dB/m
	1400KHz	83	dB/m
S/N Ratio (5mV/m) (SNR)	1000KHz	40	dB/m
AGC -10dB (100mV/m) (automatic gain control)	1000KHz	50	dB/m
Selectivity ±9KHz (optional)	1000KHz	18	dB/m
Band width (-6dB) (bandwidth)	1000KHz	12	KHz
Power Output 10% THD(power output) (Mod=80%)	1000KHz	170	mVrms
Max. Power Output (maximum power output) (Mod=80%)	1000KHz	170	mVrms
Distortion 30% MOD.74dB INPUT (Distortion)	1000KHz	0.5	%
Frequency Response -6dB Frequency	Low	2.8	KHz
response5mV/m Input 1KHz=0dB	High	80	Hz
Min. Volume Output (minimum noise output)		0.2	mV
Modulation Hum.(100dB) (modulated hum)		4	mV
No Signal Current (no signal current)		10	uA
Current Drain Current at MAX. Output (Maximum current)		twenty three	mA
NOTE: 1. Volume = maximum, for all tests. Tested at RF = 520 kHz. 2. FMOD = 1 kHz, 30% modulation, 2 kHz channel filter. 3. BAF = 300 Hz to 15 kHz, A-weighted. 4. VIN = 5mVrms. 5. Stray capacitance on antenna and board must be < 10 pF to achieve full tuning range at higher inductance levels.			

(surface5.   SWelectrical index)

(VDD = 3.0V, Ta = 0 to 45°C)

project	Test Conditions	typical value	unit
Frequency Coverage Range (SWFrequency Range)	Low	9.0	MHz
	High	twenty two	MHz
Sensitivity For 20dB S/N (20decibel sensitivity)	9.5MHz	13	dB
	15MHz	13	dB
	20 MHz	13	dB
S/N Ratio 74dB Input (SNR)	15MHz	> 35	dB
AGC -10dB (100mV/m) automatic gain control	15MHz	40	dB
Selectivity ± 9KHz selectivity	15MHz	±10	dB
Bandwidth (-6dB) bandwidth	15MHz	3-6	KHz
Power Output 10% THD power output (Mod=80%)	15MHz	50 ~ 100	mVrms
Max. Power Output Maximum power output (Mod=80%)	15MHz	50 ~ 100	mVrms
Distortion 30% MOD.74dB INPUT distortion	15MHz	< 1	%
Modulation Hum. (100dB) Modulation Hum		< 5	mv
Max Volume output Maximum Noise Output		30	mv
Min. Volume Output Minimum Noise Output		0.5	mv
Frequency Response -6dB Frequency response	High	2.8	KHz
5mV/m Input 1KHz=0dB	Low	80	Hz
Osc Fallout Voltage Stop voltage		2.2	V
No Signal Current no signal current		< 20	uA
Current Drain Current at MAX. Output Maximum current		20~30	uA
Spurious Frequency Rejection Ratio adjacent frequency rejection ratio		9~18	dB
NOTE:			

5.Chip pin description
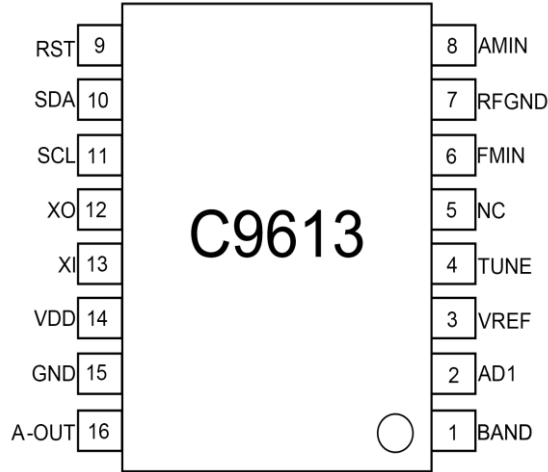
(surface7.   CA9610chip pin description)

| Pin	Pin Name	Description
1	BAND	state detection
2	AD1	country / region,SWfrequency selection
3	VREF	voltage detection
4	TUNE	frequency tuning
5	NC	NC
6	FMIN	FM RFenter
7	RFGND	High frequency
8	AMIN	AM RFenter
9	RST	Reset
10	IIC-SDA	IICCommunication Clock Interface
11	IIC-SCL	IICCommunication data interface
12	XTALO	Crystal Oscillator Output
13	XTALI	Crystal Oscillator Input
14	VDD	ICpower supply
15	GND	ICground wire
16	A-OUT	Audio output

6. C9613Chip pin setting

6.1 BAND and AM/FMSetting of lead legs

(surface8.　　AM/FMband selection)

BAND	AM/FM	band selection
1	1	AM
1	0	FM

6.2 AD1lead set
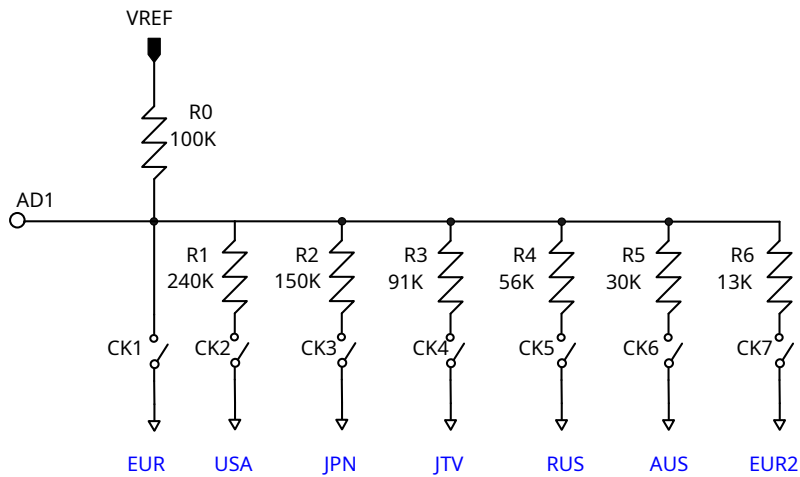
(surface9.　　Country frequency range selection)

country or region	switch	resistance
EUR	CK1	0R
USA	CK2	240K
JPN	CK3	150K
JTV	CK4	91K
RUS	CK5	56K
AUS	CK6	30K
EUR2	CK7	13K

Remarks: The above are reference parameters, all accurate parameters shall be subject to the actual circuit!

(surface10.   Frequency range selection table for each region)

radio area	country / region	Manual frequency width limit value	
EUR	Europe / Korea / Taiwan	AM Lower:	522 KHz;
		AM Upper:	1620KHz
	Europe, Korea and Taiwan	FM Lower:	87.0MHz;
		FM Upper :	108.0MHz
USA	USA , Canada & Latin America	AM Lower:	520 KHz;
		AM Upper:	1710 KHz
	United States, Canada and Latin and South American countries	FM Lower:	87.0 MHz;
		FM Upper :	108.0MHz
JPN	Japan (without TV-Band)	AM Lower:	522 KHz;
		AM Upper:	1710 KHz
	Japan (noTVfrequency band)	FM Lower:	76.0 MHz;
		FM Upper :	95.0MHz
JTV	Japan (with TV-Band TV1, TV2 & TV3)	AM Lower:	522 KHz;
		AM Upper:	1710KHz
	Japan (withTVfrequency band-TV1, TV2 & TV3)	FM Lower:	76.0 MHz;
		FM Upper :	108.0MHz
RUS	Russia	AM Lower:	522 KHz;
		AM Upper:	1620KHz
	Russia	FM Lower:	64.0 MHz;
		FM Upper :	108.0MHz
AUS	Australia, New Zealand & S. Africa	AM Lower:	531 KHz;
		AM Upper:	1602KHz
	Australia, New Zealand and South Africa	FM Lower:	87.5 MHz;
		FM Upper :	108.0MHz
EUR2	UNUSED (Global)	AM Lower:	522 KHz;
		AM Upper:	1620KHz
		FM Lower:	87.5 MHz;
		FM Upper :	108.0MHz

6.3 AD1 SWFrequency range selection

VCC

100K

AD1

SW9 SW8 SW7 SW6 SW5 SW4 SW3 SW2 SW1

NC 1.2M(1%) 510K(1%) 360K(1%) 180K(1%) 120K(1%) 75K(1%) 43K(1%) 20K(1%)

GND
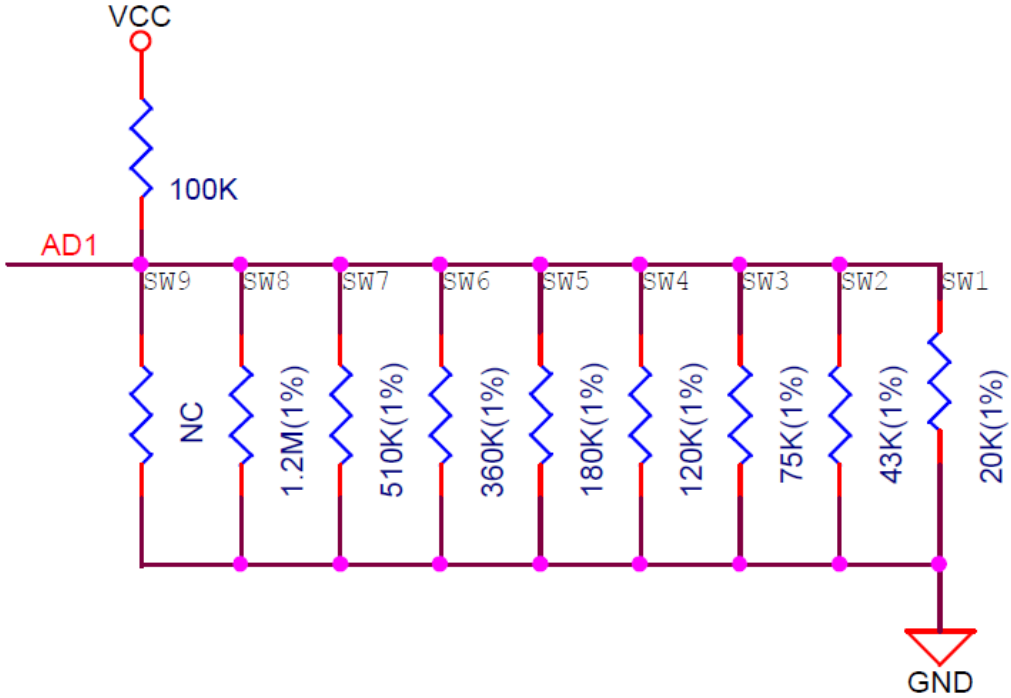
C9613default1-9Shortwave frequency range			
SW1	3.20 - 5.50 MHz	SW6	13.00 - 14.50 MHz
SW2	5.60 - 6.50 MHz	SW7	14.60 - 15.90 MHz
SW3	6.60 - 8.00 MHz	SW8	17.00 - 19.00 MHz
SW4	8.50 - 10.00 MHz	SW9	21.00 - 23.00 MHz
SW5	11.00 - 12.50 MHz		

Remarks: Customers can pass (24c02)The frequency range can be selected at will;
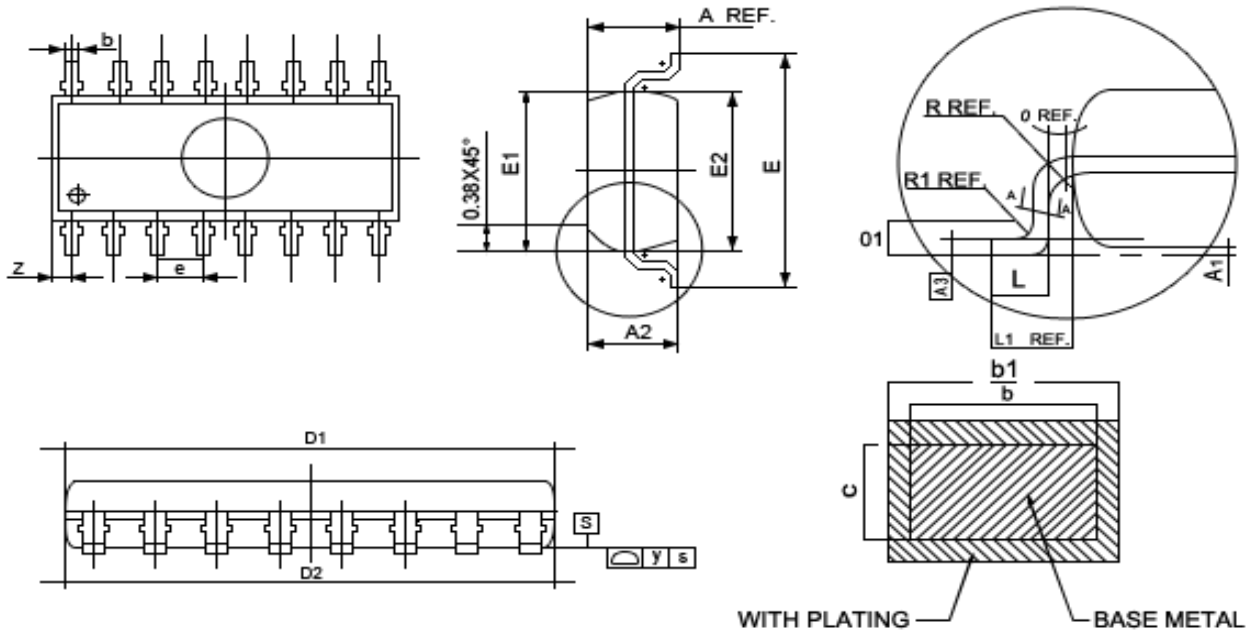
7. AM/FM/SWTypical Application Circuit
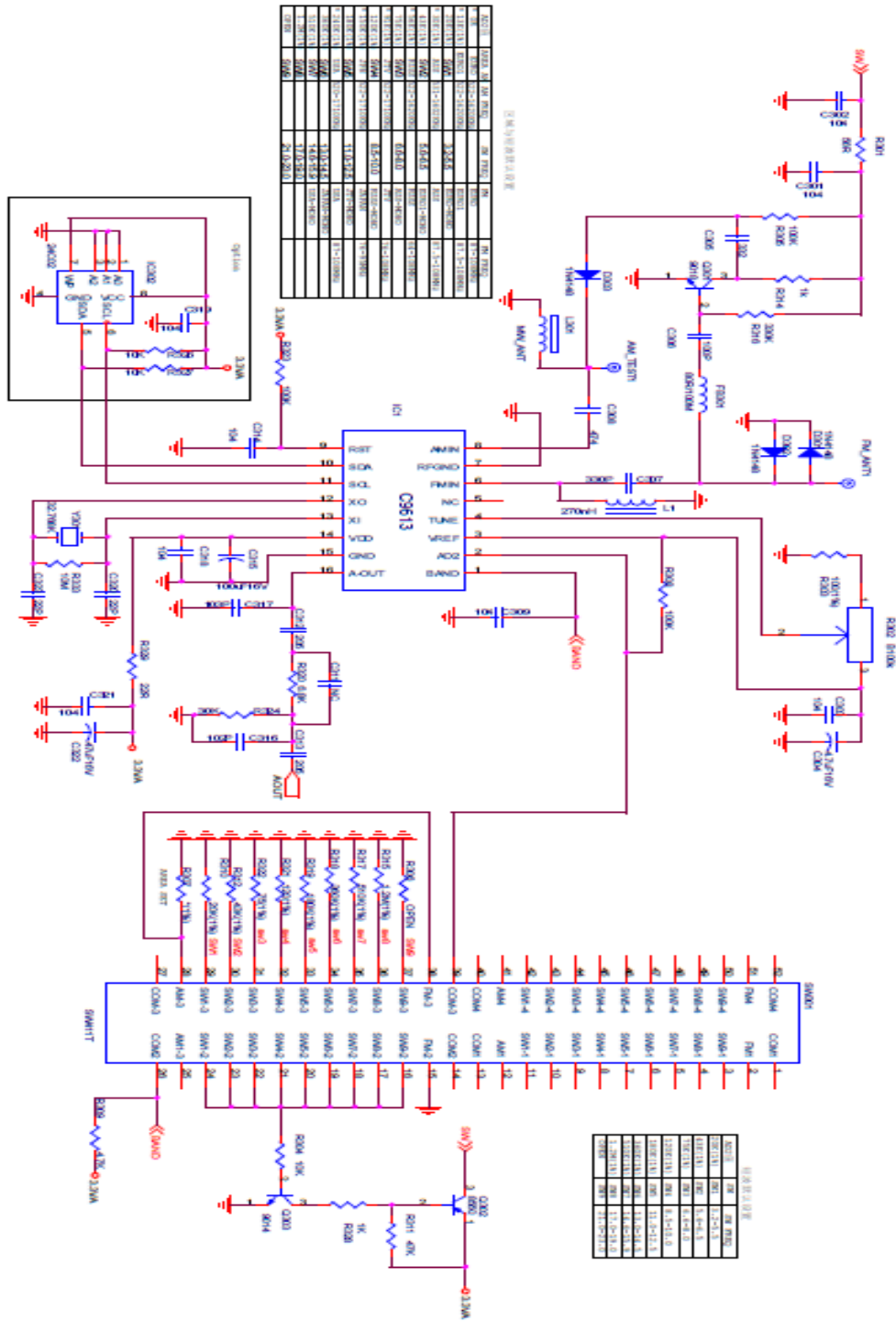
(picture11.   Typical Application Schematic)

Remarks: The above demonstration circuit isC9613For the reference design circuit of the chip, our company reserves the right to modify the circuit;

Timing, please ask our engineering staff for the latest information;

8.encapsulation

Package size:SOP16

Symbol	Min	Nom	Max
A	1.500	1.600	1.700
A1	0.100	0.150	0.200
A2	1.400	1.450	1.500
A3	--------	0.223	--------
b	0.356	0.406	0.456
b1	0.366	0.426	0.486
c	--------	0.203	--------
D1	9.700	9.900	10.10
D2	9.750	9.950	10.15
E	5.900	6.000	6.100
E1	3.800	3.900	4.000
E2	3.850	3.950	4.050
e	--------	1.270	--------
L	0.600	0.660	0.700
L1	0.950	1.050	1.150
R	--------	0.200	-------
R1	--------	0.300	-------
θ	0	--------	8°
θ 1	0	--------	10°
y	--------	--------	0.1
Z	--------	0.505	------

(图3.　SOP-16封装尺寸)

Note:
　　1. All dimension are in mm;
　　2. Dim D1/D2 & E1/E2 does not include plastic flash;
　　flash: Plastic residual around body edge after dejuk/singulation.
　　3.　Dim b does not include dambar protrusion/intrusion.
　　4.　Plating thickness 0.005-0.015 mm.

(picture12.　SOP-16package size)