Monolithic Dial-tuned AM/FM Receiver Radio-on-a-Chip™

KT0922M

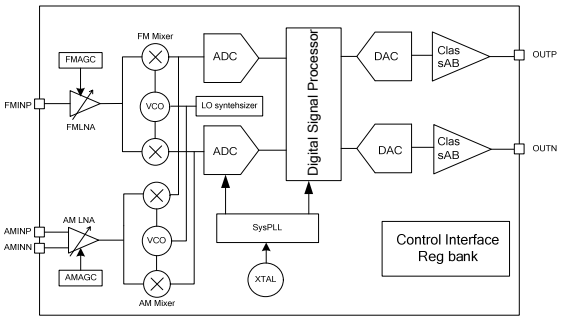
▪ Features

Single-chip AM/FM radio solution
Built-in MCU
Support analog mechanical tuning
Worldwide FM/AM band support
Maximum three FM bands with configurable frequency range within 32MHz-110MHz
Configurable AM frequency range within 500KHz - 1710KHz

High Sensitivity
1.6uVEMF for FM
16uVEMF for AM
High Fidelity
SNR (FM/AM): 60dB/55dB
THD: 0.3%
Low Supply Current
25mA (operating)
<15uA (standby)
Integrated tuning indicator
Programmable sensitivity and hysteresis threshold
Low supply voltage
2.2V to 3.6V, can be supplied with 2 AAA batteries
Integrated low power crystal oscillator
Support 32.768KHz and 38KHz crystal
Arbitrary reference clock supported
From 30KHz to 40MHz with 1Hz step
Small form factor SSOP16L package
RoHS Compliant

▪ Applications

Desktop and portable radio, boom box, clock radio, MP3 speaker, campus radio and other applications with mechanical tuning.



KT0922M System Diagram

▪ Description

The KT0922M is KT Micro's latest generation of proprietary fully integrated mono AM/FM receiver chip supporting mechanical tuning without MCU. By having two differential outputs for mono signal, it simplifies the PCB design and lower BOM cost.

Thanks to its advanced architecture, KT0922M offers an excellent user listening experience with high sensitivity, high signal-to-noise ratio, low distortion and low sensitivity to interference.

KT0922M provides direct and simple interface to support mechanical tuning. A pre-programmed low cost EEPROM can be used to configure the radio settings to differentiate product designs and accommodate standards in various regions. No external MCU is required.

Thanks to its high integration level and efficient user interface design, KT0922M lowers the system cost, simplifies design and improves product reliability and manufacturability. KT0922M can operate with two AAA batteries, making it ideal for low-power portable radio.

Rev. 1.1

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1. Electrical Specification

Table 1: Operation Condition

Parameter	Symbol	Operating Condition	Min	Typ	Max	Units
Power Supply	AVDD	Relative to AVSS	2.1	3.3	3.6	V
Ambient Temperature	Ta		-30	25	70	℃

Table 2: DC Characteristics

Parameter		Symbol	Test/Operating Condition	Min	Typ	Max	Units
Current Consumption	FM Mode	I_{FM}		-	24	-	mA
	AM Mode	I_{AM}			26		mA
Standby Current		I_{APD}			15		μA

Table 3: FM Receiver Characteristics

(Unless otherwise noted Ta = -30~70℃, VDD= 2.1V to 3.6V)

Parameter	Symbol	Test/Operating Condition	Min	Typ	Max	Units
FM Frequency Range	F_{rx}		32		110	MHz
Sensitivity[1,2,3]	Sen	(S+N)/N=26dB		1.6	2	uVemf
Input referred 3rd Order Intermodulation Production[4,5]	IIP3			85		dBuVEMF
Adjacent Channel Selectivity		±200KHz	35		51	dB
Alternate Channel Selectivity		±400KHz	50		70	dB
Image Rejection Radio				35		dB
AM suppression				50		dB
RCLK frequency			30	32.768	40,000	KHz
RCLK frequency Range[8]			-100		100	ppm
Audio Output Voltage[1,2,3,4]		32ohm load	-	96	-	mV_{RMS}
Audio Band Limits[1,2,4]		±3dB	30		15k	Hz
Audio Mono S/N[1,2,3,4]			55	60		dB
Audio THD[1,2,4,6]				0.3		%
De-emphasis Time Constant		DE=0		75		μs
		DE=1		50		μs
Audio Common Mode Voltage				0.85		V
Audio Output Load Resistance	R_L	Single-ended		32		Ω
Seek/Tune Time					50	ms
Power-up Time					600	ms

Notes:
1. FMOD=1KHz, 75us de-emphasis
2. MONO=1
3. △F=22.5KHz
4. V_{EMF}=1mV, Frx=32MHz~110MHz
5. AGCD=1
6. △F=75KHz
7. VOLUME<4:0>=11111
8. The supported RCLK frequency is not continuous. Please refer to application notes.

Table 4: AM Receiver Characteristics

(Unless otherwise noted Ta = -30~70℃, VDD= 2.1V to 3.6V)

Parameter	Symbol	Test/Operating Condition	Min	Typ	Max	Units
AM Frequency Range	F_{rx}		500		1710	KHz
Sensitivity[1,2]	Sen	(S+N)/N=26dB		15		uVemf
Audio Output Voltage[1,2,3,4]		32ohm load		96		mV_{RMS}
Audio Mono S/N[1,2,3,4]				55		dB
Audio THD[1,2,4,6]				0.3	0.6	%
Antenna inductance	L		250	300	350	uH

Notes:
1. FMOD=1KHz
2. Modulation index is 30%
3. V_{EMF}=1mV, Frx=500KHz~1710KHz
4. VOLUME<4:0>=11111

2. Pin List

Table 5: Pin list

Pin Num	Pin Name	Description
1	VOL	Volume adjustment
2	CH	Channel adjustment
3	OUTP	Positive audio output.
4	OUTN	Negative audio output.
5	AVSS	Analog ground.
6	AVDD	Power supply
7	XI/RCLK	Crystal input/Reference clock input
8	XO	Crystal output
9	AMINN	AM RF negative input.
10	AMINP	AM RF positive input.
11	RFINP	FM RF input
12	RFGND	RF ground.
13	DVSS	Digital ground.
14	TUNING	Tuning indicator.
15	AM_FM	AM/FM switching control.
16	SPAN	Band switching control pin.

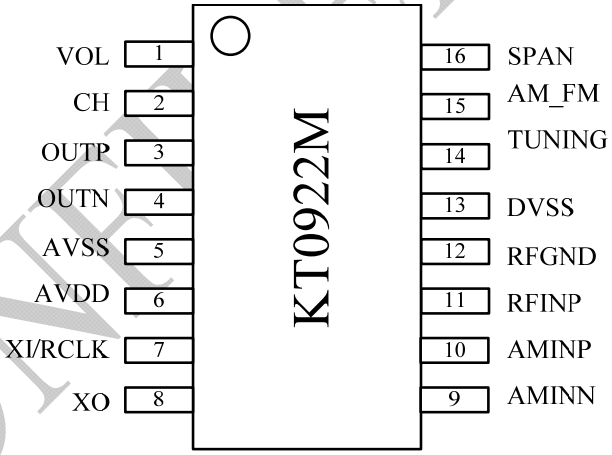


Figure 1: KT0922M Pin assignment (Top view)

3. Function Description

3.1. Overview

KT0922M offers a true single-chip, full-band FM/AM and versatile radio solution by minimizing the external components and offering a variety of configurations.

3.2. FM Receiver

The FM receiver is based on the architecture of KT Micro's latest generation FM receiver chips in mass production. There are no external filters or frequency-tuning devices thanks to a proprietary digital low-IF architecture consisting of a fully-integrated LNA, an automatic gain control (AGC), a set of high-performance ADCs, high-quality analog and digital filters, and an on-chip low-noise self-tuning VCO. The on-chip high-fidelity Class-AB driver further eliminates the need for external audio amplifiers and can drive stereo headphones directly.

3.3. AM Receiver

The AM Receiver employs a similar digital low IF architecture and shares many circuits with the FM receiver. The AM receiver supports arbitrary frequency range from 500KHz to 1710KHz. The AM channel spacing can be set to 1KHz, 9KHz or 10KHz to address applications in different regions. The bandwidth of the channel filter can be set to 1KHz to 5KHz to suit various requirements by setting register FLT_SEL<2:0>.

The AM receiver in KT0922M can provide accurate and automatic antenna tuning without manual alignment within the frequency range of 500KHz to 1710KHz. It supports 300uH ferrite loop antenna with +/- 25% tolerance.

3.4. Softmute

There is a Soft Mute feature that is enabled by setting FM_DSFTMUTE to 0 in FM mode and AM_DSFTMUTE to 0 in AM mode. In this mode, the audio volume is gradually attenuated when the signal reception is bad (i.e. when the RSSI is below a certain level as defined by FM_SFTMUTE_LOWTH<2:0> and AM_SFTMUTE_LOWTH<2:0>, respectively.) The attenuation attack rate can be configured through SFTMUTER<1:0>. The target volume can be configured through VOLUMET<2:0>. The volume will be recovery from VOLUMET<2:0> with a decay rate determined also by SFTMUTER<1:0> once the signal quality is good enough (i.e. when the RSSI is higher than a certain level as defined by FM_SFTMUTE_HIGHTH<2:0> and AM_SFTMUTE_HIGTH<2:0>, respectively.) SNR value can also be used as the judgment threshold by setting SFTMUTE_MD to 1.

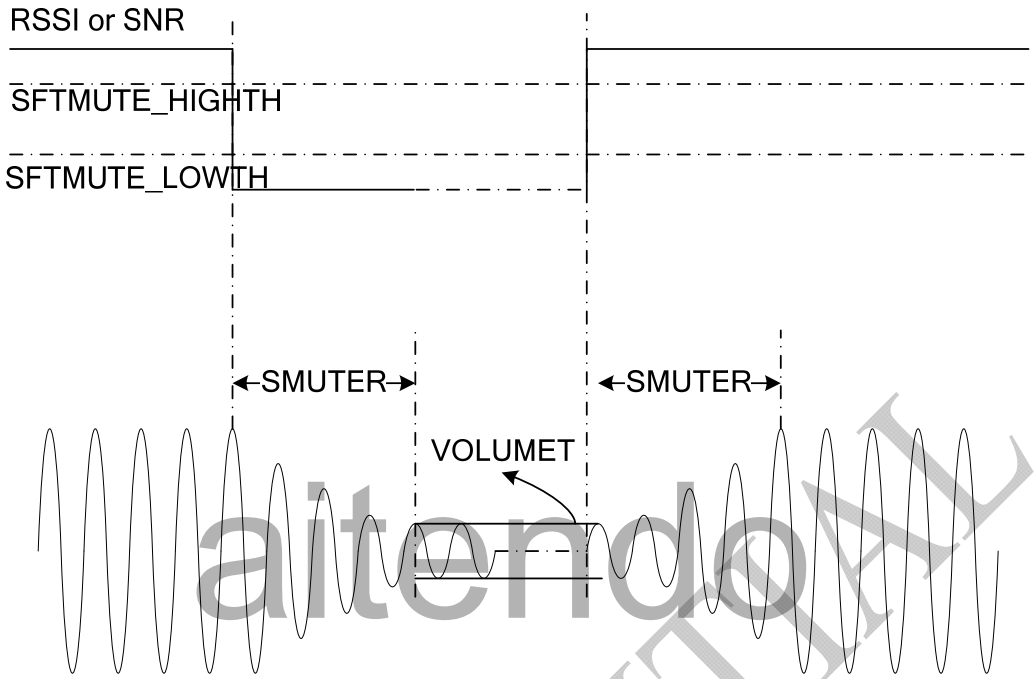


Figure 2 Softmute

3.5. Operation Bands

KT0922M supports wide FM bands and AM bands.
The FM receiver covers frequencies from 32MHz to 110MHz and groups them into 3 bands. The frequency range of each FM band can be set by FMi_LOW_CHAN<11:0> and FMi_CHAN_NUM11:0>, where i=1, 2, 3. The number of selected bands can be set by through FM_BAND_NUM<1:0> bits. Furthermore, if FM_BAND_NUM<1:0> is set to 00, all three FM bands are disabled and only AM band is usable. KT0922M supports 3 different channel steps for FM band, 50KHz, 100KHz and 200KHz, which are specified in register FMiSPACE<1:0>, where i=2, 1, 0.
The frequency range of the AM band can be set by AM_LOW_CHAN<14:0> and AM_CHAN_NUM<11:0> and the channel step is set to 1KHz, 9KHz or 10KHz specified by AM_SPACE<1:0>.
The same as FM band, the AM band can also be disabled by setting AM_BAND_NUM to 0.

3.6. Crystal and Reference clock

KT0922M integrate a low power crystal oscillator in it and supports various crystals whose frequency is lower than 100 KHz.
On the other side, a TCRC (True Continuous Reference Clock) technique is realized in KT0922M to support arbitrary reference clock from 30 KHz to 40MHz with 1Hz step and 3V voltage tolerance.

3.7. Dial Mode for Channel Control and Volume Control

KT0922M supports a unique Dial Mode whose application circuit is shown in **Figure 3**. The dial is implemented by a variable resistor with the center tap connected to the chip. KT0922M measures the ratio of two parts of the variable resistor and maps the result to the real control parameters, such as channel frequency, volume, etc.

The channel controller enters dial mode by setting register CH_PIN<1:0> to 10. The illustration circuit is shown in Figure 3. If the center tap of the variable resistor is located in the white area, the tuned channel could be expressed as:

$$f_{tune} = \frac{X}{X+Y}(f_{top} - f_{bot} + 2 \times N_{guard} \times f_{step}) - N_{guard} \times f_{step} + f_{bot}$$

Where f_{step} is the channel step, set by register FMSPACE<1:0> or AMSPACE<1:0>, f_{top} is the upper bound of the band, f_{bot} is the lower bound of the band and N_{guard} is the number of guard channel in channel step to prevent mechanical limit of the wheels. Each band's guard number can be configured by register FM1_GUARD<7:0>, FM2_GUARD<7:0>, FM3_GUARD<7:0> and AM_GUARD<7:0>, separately. When the center tap goes in the shaded guard area , the tuned channel stays at the upper or lower bound of band.

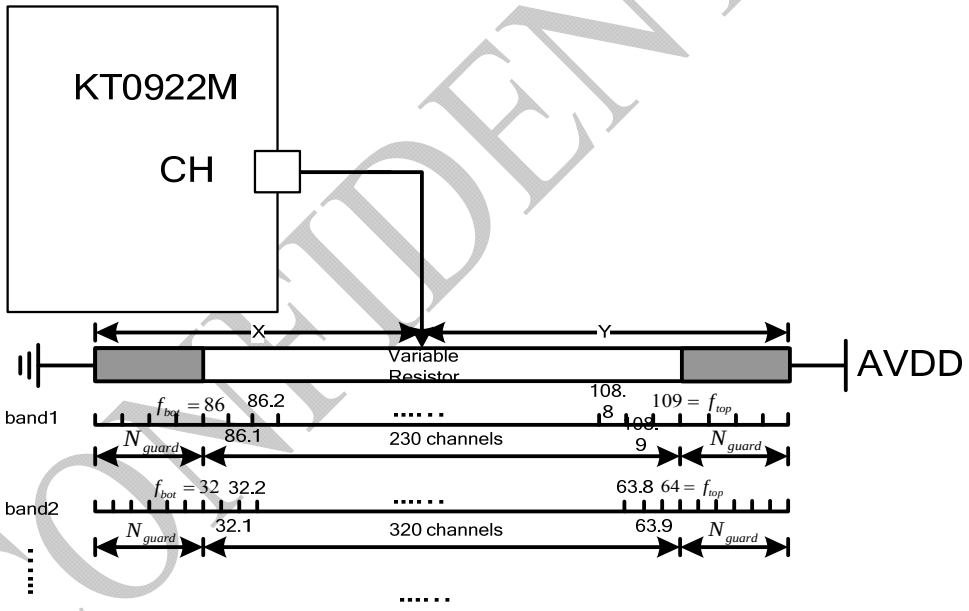


Figure 3: CH pin connection in dial-mode

The volume controller enters dial-mode by setting register VOL_PIN<1:0> to 10. Figure 4 illustrates an application circuit. The actual volume set by the dial could be expressed as:

$$VOL(dBFS) = [\frac{X}{X+Y}(64 + N_{guard})] - \frac{N_{guard}}{2} - 62$$

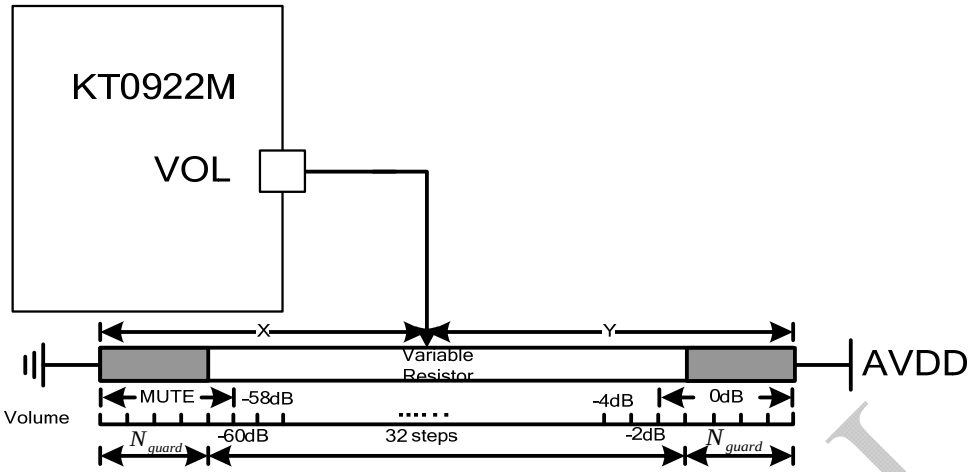


Figure 4: VOL pin connection in dial-mode

Where N_{guard} is the guard number of volume control, in 2 dB step, which can be set in register VOL_GUARD<3:0>.
The bands can be changed by band-switch in dial-mode by setting register SPAN_PIN<1:0> to 10. The application circuit together with recommended resistor values is shown in Figure 5.

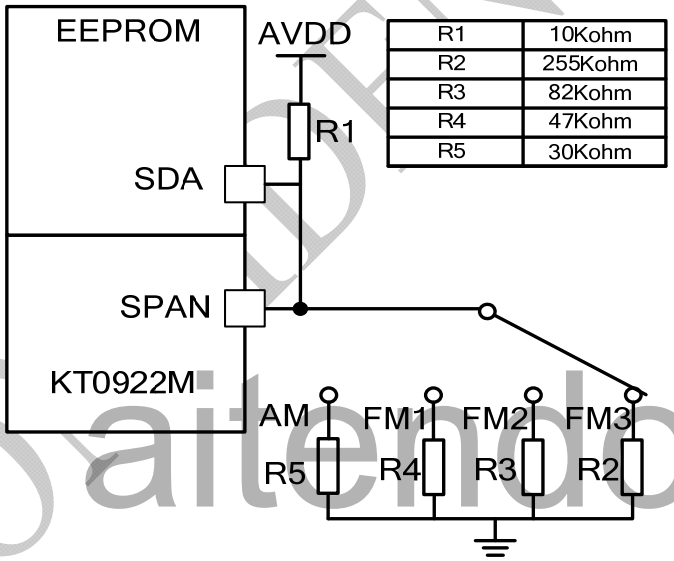


Figure 5: SPAN pin connection in dial-mode

3.8. Chip Configuration

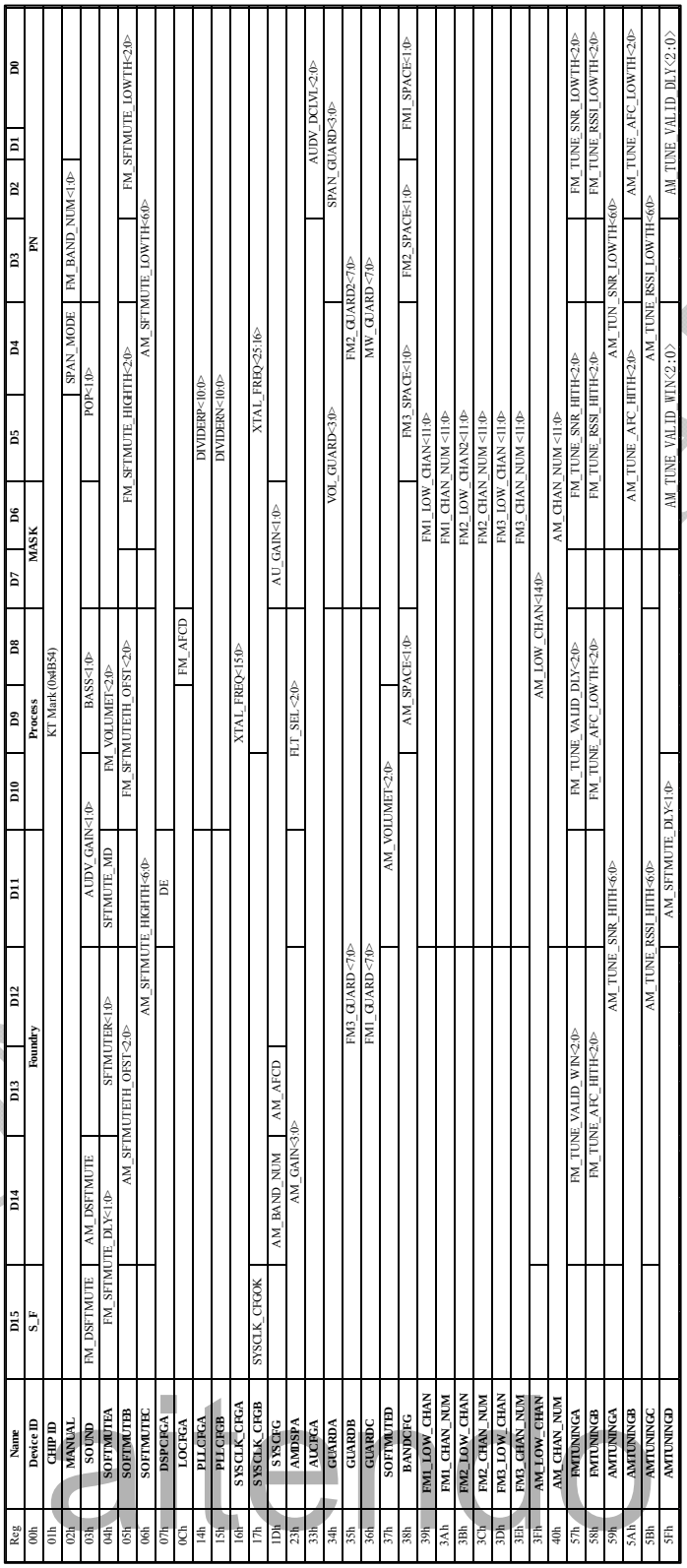
An I2C master interface is integrated in KT0922M and can be used to initialize and operate the chip together with an external EEPROM (e.g. 24LC02). The initialization information is written into the EEPROM beforehand. When powered on, KT0922M will readout all the data stored in the EEPROM and write them into internal register bank. The mapping relationship of the register bit between KT0922M internal register

bank and 24LC02 can be found in Table 6. The effective device address for EEPROM is from 000(A2:A0) to 110.

Table 6: Register Bits Mapping Relationship between 24LC02 and KT0922M

24LC02		**KT0922M**	
address	bits	address	bits
0x00	D7:D0	0x00	D15:D8
0x01	D7:D0		D7:D0
0x02	D7:D0	0x01	D15:D8
0x03	D7:D0		D7:D0
…	…	…	…
…	…		…
0xFE	D7:D0	0x7F	D15:D8
0xFF	D7:D0		D7:D0

3.9. Register Bank



Reg	Name	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
00h	Device ID	S_F	Foundry					Process		MASK			PN				
01h	CHIP ID	KT Mark (0x4B54)															
02h	MANUAL												SPAN_MODE	FM_BAND_NUM<1:0>			
03h	SOUND	FM_DSFTMUTE	AM_DSFTMUTE			AUDV_GAIN<1:0>		BASS<1:0>				POP<1:0>					
04h	SOFTMUTEA	FM_SFTMUTE_DLY<1:0>		SFTMUTER<1:0>		SFTMUTE_MD		FM_VOLUMET<2:0>									
05h	SOFTMUTEB		AM_SFTMUTETH_ORST<2:0>					FM_SFTMUTETH_ORST<2:0>				FM_SFTMUTE_HIGHTH<2:0>				FM_SFTMUTE_LOWTH<2:0>	
06h	SOFTMUTEC	AM_SFTMUTE_HIGHTH<6:0>											AM_SFTMUTE_LOWTH<6:0>				
07h	DSPCFGA	DE															
0Ch	LOCFGA	FM_AFCD										DIVIDERP<10:0>					
14h	PLLCFGA	DIVIDERN<10:0>															
15h	PLLCFGB	XTAL_FREQ<15:0>															
16h	SYSCLK_CFGA	XTAL_FREQ<25:16>															
17h	SYSCLK_CFGB	SYSCLK_CFOOK								AU_GAIN<1:0>							
1Dh	SYSCFG	AM_BAND_NUM		AM_AFCD				FLT_SEL<2:0>								AUDV_DCLVL<2:0>	
23h	AMDSPA	AM_GAIN<3:0>										VOL_GUARD<3:0>				SPAN_GUARD<3:0>	
33h	AUCFGA																
34h	GUARDA	FM3_GUARD<7:0>											FM2_GUARD2<7:0>				
35h	GUARDB	FM1_GUARD<7:0>											MW_GUARD<7:0>				
36h	GUARDC	AM_VOLUMET<2:0>															
37h	SOFTMUTED							AM_SPACE<1:0>				FM3_SPACE<1:0>		FM2_SPACE<1:0>		FM1_SPACE<1:0>	
38h	BANDCFG	FM1_LOW_CHAN										FM1_LOW_CHAN<11:0>					
39h	FM1_LOW_CHAN	FM1_CHAN_NUM										FM1_CHAN_NUM <11:0>					
3Ah	FM1_CHAN_NUM	FM2_LOW_CHAN										FM2_LOW_CHAN2<11:0>					
3Bh	FM2_LOW_CHAN	FM2_CHAN_NUM										FM2_CHAN_NUM <11:0>					
3Ch	FM2_CHAN_NUM	FM3_LOW_CHAN										FM3_LOW_CHAN <11:0>					
3Dh	FM3_LOW_CHAN	FM3_CHAN_NUM										FM3_CHAN_NUM <11:0>					
3Eh	FM3_CHAN_NUM	AM_LOW_CHAN<14:0>															
3Fh	AM_LOW_CHAN											AM_CHAN_NUM <11:0>					
40h	AM_CHAN_NUM																
57h	FMTUNINGA	FM_TUNE_VALID_WIN<2:0>						FM_TUNE_VALID_DLY<2:0>				FM_TUNE_SNR_HITH<2:0>				FM_TUNE_SNR_LOWTH<2:0>	
58h	FMTUNINGB	FM_TUNE_AFC_HITH<2:0>						FM_TUNE_AFC_LOWTH<2:0>				FM_TUNE_RSSI_HITH<2:0>				FM_TUNE_RSSI_LOWTH<2:0>	
59h	AMTUNINGA	AM_TUNE_SNR_HITH<6:0>											AM_TUN_SNR_LOWTH<6:0>				
5Ah	AMTUNINGB											AM_TUNE_AFC_HITH<2:0>				AM_TUNE_AFC_LOWTH<2:0>	
5Bh	AMTUNINGC	AM_TUNE_RSSI_HITH<6:0>											AM_TUNE_RSSI_LOWTH<6:0>				
5Fh	AMTUNINGD	AM_SFTMUTE_DLY<1:0>										AM_TUNE_VALID_WIN<2:0>				AM_TUNE_VALID_DLY<2:0>	

3.9.1. CHIP ID (Address 0x01)

Bit	Symbol	Access	Default	Functional Description
15:0	KT Mark	R	0x4B54	**ASCII form of string "KT".**

3.9.2. MANUAL (Address 0x02)

Bit	Symbol	Access	Default	Functional Description
15:5	Reserved	RW	0000_0100_000	**Reserved.**
4	SPAN_MODE	RW	0	**SPAN mode selection.** 0 = AM/FM switching controlled by AM_FM pin. 1 = AM/FM switching controlled by SPAN pin.
3	FM_BAND_NUM <1:0>	RW	01	**FM band number selection.** 00 = 0 (AM only) 01 = 1 10 = 2 11 = 3
1:0	Reserved	RW	11	**Reserved.**

3.9.3. SOUND (Address 0x03)

Bit	Symbol	Access	Default	Functional Description
15	FM_DSFTMUTE	RW	1	**FM softmute disable**. 0 = Enable FM softmute. 1 = Disable FM softmute.
14	AM_DSFTMUTE	RW	1	**AM softmute disable.** 0 = Enable AM softmute. 1 = Disable AM softmute.
13:12	Reserved	RW	10	**Reserved.**
11:10	AUDV_GAIN<1:0>	RW	00	**Audio driver gain control.** 00 = 0 01 = 2dB 10 = 4dB 11 = 6dB
9:8	BASS<1:0>	RW	00	**Bass boost effect selection.** 00 = Disable 01 = Low 10 = Med 11 = High
7:6	Reserved	RW	10	**Reserved.**
5:4	POP<1:0>	RW	00	**Audio DAC Anti-pop Configuration.** 00 : 100uF AC-coupling capacitor. 01 : 60uF AC-coupling capacitor.

				10 : 20uF AC-coupling capacitor. 11 : 10uF AC-coupling capacitor.
3:0	Reserved	RW	0100	**Reserved.**

3.9.4. SOFTMUTEA (Address 0x04)

Bit	Symbol	Access	Default	Functional Description
15:14	FM_SFTMUTE_DLY<1:0>	RW	00	**Delay time after channel change to start softmute operation.** 00 = Shortest delay time. 01 = Short delay time. 10 = Long delay time. 11 = Longest delay time.
13:12	SFTMUTER<1:0>	RW	00	**Softmute attenuation rate.** 00 = Longest softmute time. 01 = Long softmute time. 10 = Short softmute time. 11 = Shortest softmute time.
11	SFTMUTE_MD	RW	0	**Softmute mode selection.** 0 = RSSI mode. 1 = SNR mode.
10:8	FM_VOLUMET<2:0>	RW	000	**Softmute target gain.** 000 = mute 001 = -54dB 010 = -48dB 011 = -40dB 100 = -32dB 101 = -24dB 110 = -16dB 111 = -8dB
7:0	Reserved	RW	0000_0000	**Reserved.**

3.9.5. SOFTMUTEB (Address 0x05)

Bit	Symbol	Access	Default	Functional Description
15	Reserved	RW	0	**Reserved.**
14:12	AM_SFTMUTETH _OFST<2:0>	RW	000	**Softmute offset value for AM invalid channel; the value set by these bits will be added to AM_SFTMUTE_HIGHTH and AM_SFTMUTE_LOWTH respectively when the channel is invalid.** 000 = Minimum offset value. …… 111 = Maximum offset value.

11	Reserved	RW	0	**Reserved.**
10:8	FM_SFTMUTETH _OFST<2:0>	RW	000	**Softmute offset value for FM invalid channel, the value set by these bits will be added to FM_SFTMUTE_HIGHTH and FM_SFTMUTE_LOWTH respectively when the channel is invalid.** 000 = Minimum offset value. …… 111 = Maximum offset value.
7	Reserved	RW	0	**Reserved.**
6:4	FM_SFTMUTE_HIGHTH<2:0>	RW	000	**FM softmute high threshold.** **For RSSI mode:** 000 = Minimum RSSI threshold. …… 111 = Maximum RSSI threshold. **For SNR mode:** 000 = Minimum SNR. …… 111 = Maximum SNR.
3	Reserved	RW	0	
2:0	FM_SFTMUTE_LOWTH<2:0>	RW	000	**FM softmute low threshold.** **For RSSI mode:** 000 = Minimum RSSI threshold. …… 111 = Maximum RSSI threshold. **For SNR mode:** 000 = Minimum SNR threshold. …… 111 = Maximum SNR threshold.

3.9.6. SOFTMUTEC (Address 0x06)

Bit	Symbol	Access	Default	Functional Description
15	Reserved	RW	0	**Reserved.**
14:8	AM_SFTMUTE_HIGHTH<6:0>	RW	000_0000	**AM softmute high threshold.** **For RSSI mode:** 0000000 = Minimum RSSI threshold. …… 1111111 = Maximum RSSI threshold. **For SNR mode:** 0000000 = Minimum SNR. …… 1111111 = Maximum SNR.
7	Reserved	RW	0	**Reserved.**

6:0	AM_SFTMUTE_LOWTH<6:0>	RW	000_0000	**AM softmute high threshold.** **For RSSI mode:** 0000000 = Minimum RSSI threshold. …… 1111111 = Maximum RSSI threshold. **For SNR mode:** 0000000 = Minimum SNR threshold. …… 1111111 = Maximum SNR threshold.

3.9.7. DSPCFGA (Address 0x07)

Bit	Symbol	Access	Default	Functional Description
15:12	Reserved	RW	0110	**Reserved.**
11	DE	RW	0	**De-emphasis Time Constant Selection.** 0 = 75us 1 = 50us
10:0	Reserved	RW	000_1000_0001	**Reserved.**

3.9.8. LOCFGA (Address 0x0C)

Bit	Symbol	Access	Default	Functional Description
15:9	Reserved	RW	001_0010	**Reserved.**
8	FM_AFCD	RW	0	**FM AFC disable.** 0 = Enable FM AFC loop. 1 = Disable FM AFC loop.
7:0	Reserved	RW	0000_0000	**Reserved.**

3.9.9. PLLCFGA (Address 0x14)

Bit	Symbol	Access	Default	Functional Description
15:11	Reserved	RW	0_0000	**Reserved.**
10:0	DIVIDERP<10:0>	RW	000_0000_0001	**PLL divider P configuration.**

3.9.10. PLLCFGB (Address 0x15)

Bit	Symbol	Access	Default	Functional Description
15:11	Reserved	RW	0_0000	**Reserved.**
10:0	DIVIDERN<10:0>	RW	010_1001_1100	**PLL divider N configuration.**

3.9.11. SYSCLK_CFGA (Address 0x16)

Bit	Symbol	Access	Default	Functional Description
15:0	XTAL_FREQ<15:0>	RW	0x8000	**Lower 16 bits of crystal or reference clock frequency setting.**

3.9.12. SYSCLK_CFGB (Address 0x17)

Bit	Symbol	Access	Default	Functional Description
15:10	Reserved	RW	00_0000	**Reserved.**
9:0	XTAL_FREQ<25:16>	RW	00_0000 _0000	**Higher 10 bits of crystal or reference clock frequency setting.**

3.9.13. SYS_CFG (Address 0x1D)

Bit	Symbol	Access	Default	Functional Description
15	Reserved	RW	0	**Reserved.**
14	AM_BAND_NUM	RW	1	**AM band number selection.** 0 = FM only. 1 = One AM band.
13	AM_AFCD	RW	0	**AM AFC disable.** 0 = Enable. 1 = Disable.
12:8	Reserved	RW	0_0010	**Reserved.**
7:6	FM_GAIN<1:0>	RW	11	**FM audio gain setting in DSP block.** 00 = 3dB 01 = 6dB 10 = -3dB 11 = 0dB
5:0	Reserved	RW	00_0000	**Reserved.**

3.9.14. AMDSPA (Address 0x23)

Bit	Symbol	Access	Default	Functional Description
15:12	AM_GAIN<3:0>	RW	0100	**AM audio gain setting in DSP block.** 0000 = 6dB 0001 = 3dB 0010 = 0dB 0011 = -3dB 0100 = -6dB 0101 = -9dB 0110 = -12dB 0111 = -15dB 1000 = -18dB
11	Reserved	RW	1	**Reserved.**

10:8	FLT_SEL<2:0>	RW	001	**AM channel filter bandwidth selection.** 000 = 1KHz 001 = 2KHz 010 = 3KHz 011 = 4KHz 100 = 5KHz Other = Reserved.
7:0	Reserved	RW	0000_0000	**Reserved.**

3.9.15. AUCFGA (Address 0x33)

Bit	Symbol	Access	Default	Functional Description
15:3	Reserved	RW	0000_0000_000_0	**Reserved.**
2:0	AUDV_DCLVL <2:0>	RW	000	**Common mode voltage setting of audio drive stage.** 000 = 0.85V 001 = 0.95V 010 = 1.05V 011 = 1.15V 100 = 1.2V 101 = 1.35V 110 = 1.5V 111 = 1.6V

3.9.16. GUARDA (Address 0x34)

Bit	Symbol	Access	Default	Functional Description
15:8	Reserved	RW	0000_1101	**Reserved**
7:4	VOL_GUARD<3:0>	RW	0010	**Volume guard range in dial mode.**
3:0	SPAN_GUARD<3:0>	RW	0010	**Span guard range in dial mode.**

3.9.17. GUARDB (Address 0x35)

Bit	Symbol	Access	Default	Functional Description
15:8	FM3_GUARD<7:0>	RW	0010_0000	**FM3 guard range in dial mode.**
7:0	FM2_GUARD<7:0>	RW	0001_1011	**FM2 guard range in dial mode.**

3.9.18. GUARDB (Address 0x36)

Bit	Symbol	Access	Default	Functional Description
15:8	FM1_GUARD<7:0>	RW	0001_1011	**FM1 guard range in dial mode.**
7:0	AM_GUARD<7:0>	RW	0111_1000	**AM guard range in dial mode.**

3.9.19. SOFTMUTED(Address 0x37)

Bit	Symbol	Access	Default	Functional Description
15:12	Reserved	RW	1000	**Reserved.**
11:9	AM_VOLUMET<2:0>	RW	000	**Softmute target gain.** 000 = -21dB 001 = -18dB 010 = -15dB 011 = -12dB 100 = -9dB 101 = -6dB 110 = -3dB 111 = 0dB
8:0	Reserved	RW	0_1100_0000	**Reserved.**

3.9.20. BANDCFG (Address 0x38)

Bit	Symbol	Access	Default	Functional Description
15:10	Reserved	RW	1101_00	**Reserved.**
9:8	AM_SPACE<1:0>	RW	00	**AM space selection.** 00 = 1KHz 01 = 9KHz 10 = 10KHz 11 = 10KHz
7:6	Reserved	RW	00	**Reserved.**
5:4	FM3_SPACE<1:0>	RW	01	**FM band 3 space selection.** 00 = 200KHz 01 = 100KHz 10 = 50KHz 11 = Reserved
3:2	FM2_SPACE<1:0>	RW	01	**FM band 2 space selection.** 00 = 200KHz 01 = 100KHz 10 = 50KHz 11 = Reserved
1:0	FM1_SPACE<1:0>	RW	01	**FM band 1 space selection.** 00 = 200KHz 01 = 100KHz 10 = 50KHz 11 = Reserved

3.9.21. FM1_LOW_CHAN (Address 0x39)

Bit	Symbol	Access	Default	Functional Description
15:12	Reserved	RW	0000	**Reserved.**
11:0	FM1_LOW_CHAN<11:0>	RW	0110_1011_1000	**Low edge frequency of FM1 band with 50KHz per LSB and default is 86MHz.**

3.9.22. FM1 _CHAN_NUM (Address 0x3A)

Bit	Symbol	Access	Default	Functional Description
15:12	Reserved	RW	0000	**Reserved.**
11:0	FM1_CHAN_NUM<11:0>	RW	0000_1110_0110	**Channel number of FM1 band and the channel number is FM1_CHAN_NUM<11:0> + 1. IF FM1_CHAN_NUM<11:0> is set to 0, only one channel is defined.**

3.9.23. FM2_LOW_CHAN (Address 0x3B)

Bit	Symbol	Access	Default	Functional Description
15:12	Reserved	RW	0000	**Reserved.**
11:0	FM2_LOW_CHAN<11:0>	RW	0101_0000_0000	**Low edge frequency of FM2 band and default is 64MHz.**

3.9.24. FM2 _CHAN_NUM (Address 0x3C)

Bit	Symbol	Access	Default	Functional Description
15:12	Reserved	RW	0000	**Reserved.**
11:0	FM2_CHAN_NUM<11:0>	RW	0001_0000_1110	**Channel number of FM2 band and default are 271 channels. Thus the frequency band is from 64MHz to 91MHz.**

3.9.25. FM3_LOW_CHAN (Address 0x3D)

Bit	Symbol	Access	Default	Functional Description
15:12	Reserved	RW	0000	**Reserved.**
11:0	FM3_LOW_CHAN<11:0>	RW	0010_1000_0000	**Low edge frequency of FM3 band and default is 32MHz.**

3.9.26. FM3 _CHAN_NUM (Address 0x3E)

Bit	Symbol	Access	Default	Functional Description
15:12	Reserved	RW	0000	**Reserved.**
11:0	FM3_CHAN_NUM<11:0>	RW	0001_0100_0000	**Channel number of FM3 band and default is 321 channels.**

3.9.27. AM_LOW_CHAN (Address 0x3F)

Bit	Symbol	Access	Default	Functional Description
15	Reserved	RW	0	**Reserved.**
14:0	AM_LOW_CHAN <14:0>	RW	000_0001_1111_1000	**Low edge frequency of AM band and default is 504KHz.**

3.9.28. AM _CHAN_NUM (Address 0x40)

Bit	Symbol	Access	Default	Functional Description
15:12	Reserved	RW	0000	**Reserved.**
11:0	AM_CHAN_NUM<11:0>	RW	0000_1000_0110	**Channel number of AM band and default is 135 channels.**

3.9.29. FMTUNINGA (Address 0x57)

Bit	Symbol	Access	Default	Functional Description
15	Reserved	RW	0	**Reserved.**
14:12	FM_TUNE_VALID_WIN<2:0>	RW	000	**Time interval for valid tuning indicator judgment.** 000 = Shortest window time. …… 111 = Longest window time.
11	Reserved	RW	0	**Reserved.**
10:8	FM_TUNE_VALID_DLY<2:0>	RW	000	**First time judgment after TUNE operation.** 000 = Shortest delay time. …… 111 = Longest delay time.
7	Reserved	RW	0	**Reserved.**
6:4	FM_TUNE_SNR_HITH <2:0>	RW	000	**SNR high threshold for FM valid channel indicator.** 000 = Minimum SNR threshold. …… 111 = Maximum SNR threshold.

3	Reserved	RW	0	**Reserved.**
2:0	FM_TUNE_SNR_LOWTH<2:0>	RW	000	**SNR low threshold for FM valid channel indicator.** 000 = Minimum SNR threshold. …… 111 = Maximum SNR threshold.

3.9.30. FMTUNINGB (Address 0x58)

Bit	Symbol	Access	Default	Functional Description
15	Reserved	RW	0	**Reserved.**
14:12	FM_TUNE_AFC_HITH<2:0>	RW	000	**AFC high threshold for FM valid channel indicator.** 000 = Minimum AFC threshold. …… 111 = Maximum AFC threshold.
11	Reserved	RW	0	**Reserved.**
10:8	FM_TUNE_AFC_LOWTH<2:0>	RW	000	**AFC low threshold for FM valid channel indicator.** 000 = Minimum AFC threshold. …… 111 = Maximum AFC threshold.
7	Reserved			**Reserved.**
6:4	FM_TUNE_RSSI_HITH<2:0>	RW	000	**RSSI high threshold for FM valid channel indicator** 000 = -103dBm 001 = -100dBm 010 = -97dBm 011 = -94dBm 100 = -91dBm 101 = -88dBm 110 = -85dBm 111 = -82dBm
3	Reserved	RW	0	**Reserved.**
2:0	FM_TUNE_RSSI_LOWTH<2:0>	RW	000	**RSSI low threshold for FM valid channel indicator** 000 = -106dBm 001 = -103dBm 010 = -100dBm 011 = -97dBm 100 = -94dBm 101 = -91dBm

				110 = -88dBm 111 = -85dBm

3.9.31. AMTUNINGA (Address 0x59)

Bit	Symbol	Access	Default	Functional Description
15	Reserved	RW	0	**Reserved.**
14:8	AM_TUNE_SNR_HITH<6:0>	RW	000_0000	**SNR high threshold for AM valid channel indicator** 0000000 = Minimum SNR threshold. 1111111 = Maximum SNR threshold.
7	Reserved	RW	0	**Reserved.**
6:0	AM_TUNE_SNR_LOWTH<6:0>	RW	000_0000	**SNR low threshold for AM valid channel indicator.** 0000000 = Minimum SNR threshold. 1111111 = Maximum SNR threshold.

3.9.32. AMTUNINGB (Address 0x5A)

Bit	Symbol	Access	Default	Functional Description
15:7	Reserved	RW	0000_0000	**Reserved.**
6:4	AM_TUNE_AFC_HITH<2:0>	RW	000	**AFC high threshold for AM valid channel indicator.** 000 = Minimum AFC threshold. …… 111 = Maximum AFC threshold.
3	Reserved	RW	0	**Reserved.**
2:0	AM_TUNE_AFC_LOWTH<2:0>	RW	000	**AFC low threshold for AM valid channel indicator.** 000 = Minimum AFC threshold. …… 111 = Maximum AFC threshold.

3.9.33. AMTUNINGC (Address 0x5B)

Bit	Symbol	Access	Default	Functional Description
15	Reserved	RW	0	**Reserved.**
14:8	AM_TUNE_RSSI_HITH<6:0>	RW	000_0000	**RSSI high threshold for AM valid channel indicator.** 0000000 = Minimum RSSI

				threshold. 1111111 = Maximum RSSI threshold.
7	Reserved	RW	0	**Reserved.**
6:0	AM_TUNE_RSSI_LOWTH<2:0>	RW	000_0000	**RSSI low threshold for AM valid channel indicator.** 0000000 = Minimum RSSI threshold. 1111111 = Maximum RSSI threshold.

3.9.34. AMTUNINGD (Address 0x5Fh)

Bit	Symbol	Access	Default	Functional Description
15:12	Reserved [15:0]	RW	1111	**Reserved.**
11:10	AM_SFTMUTE_DLY<1:0>	RW	00	**Delay time after TUNE operation to start softmute operation.** 00 = Shortest delay time. 01 = Short delay time. 10 = Long delay time. 11 = Longest delay time.
9:7	Reserved	RW	110	**Reserved.**
6:4	AM_TUNE_VALID_WIN<2:0>	RW	000	**Time interval for valid tuning indicator judgment.** 000 = Shortest window time. ….. 111 = Longest window time.
3	Reserved	RW	0	**Reserved.**
2:0	AM_TUNE_VALID_DLY<2:0>	RW	000	**First time judgment after TUNE operation.** 000 = Shortest delay time. ….. 111 = Longest delay time.

4. Typical Application Circuit

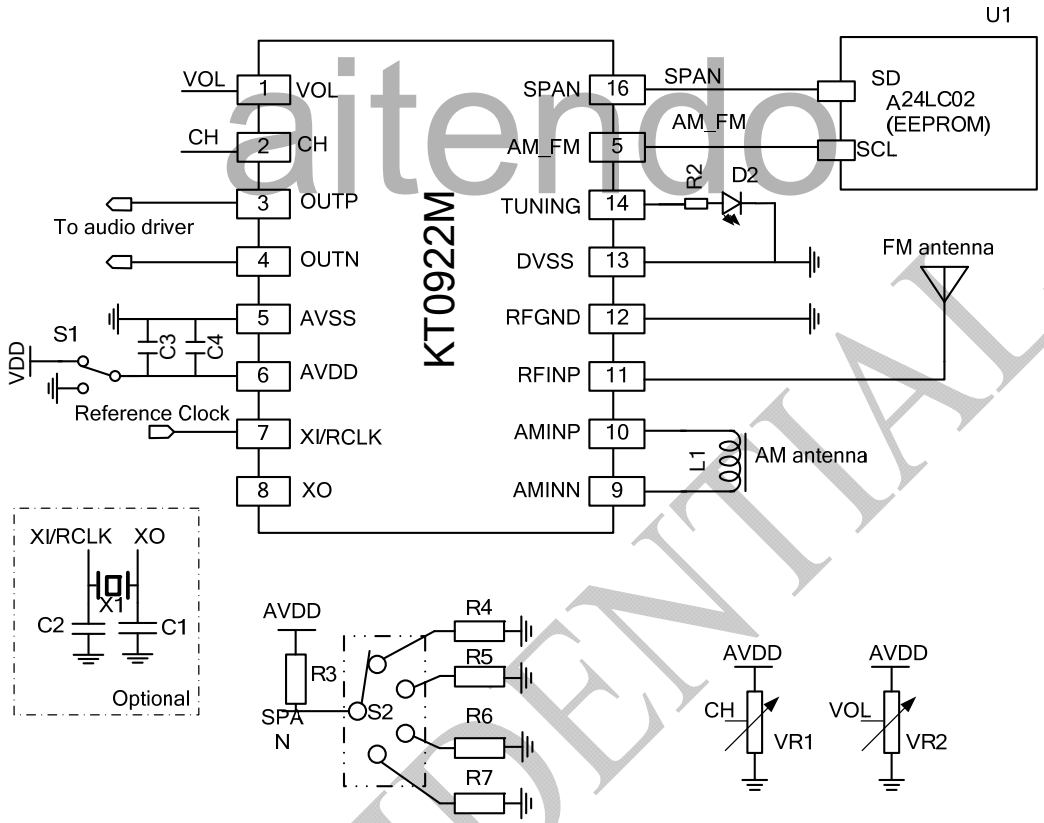
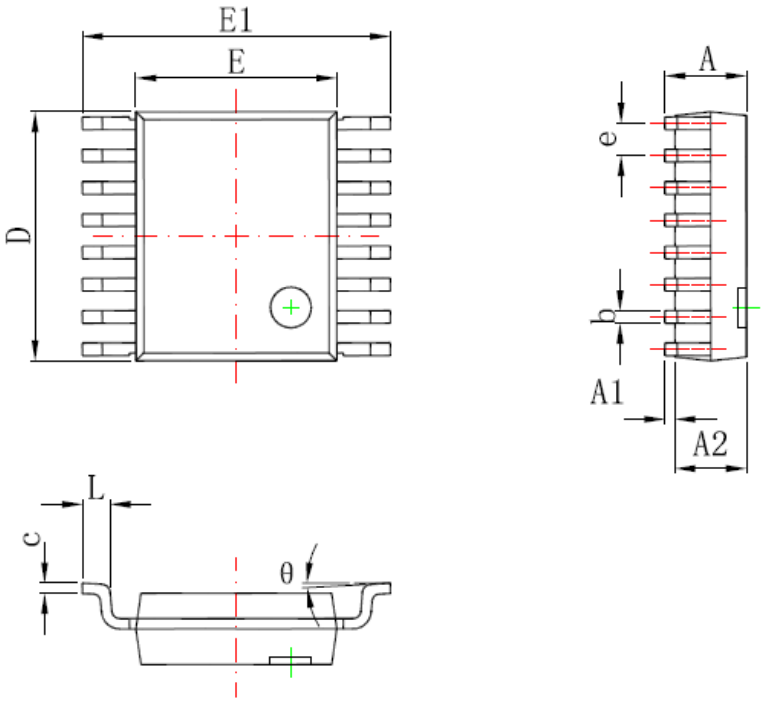


Figure 6: Typical Application Circuits for Dial Mode

Components	Description	Value
C1,C2	Crystal oscillator capacitor	C1=C2=24pF
C3,C4	Supply decoupling capacitor	C3=10uF, C4=0.1uF
C5,C6	AC coupling for SW application	C5=C6=1uF
D2	Tuning indicator light	LED
R2	Current limiter resistor	R2=500ohm
L1	AM ferrite antenna	L1=300uH
S1	On-off switch	Single-pole/Double-Throw switch
S2	Band switch	Single-pole/Multiple-Throw switch
VR1,VR2	Variable resistor	100kohm
R3~R7	Resistor network for band switch	Please refer to the application note.
U1	EEPROM for chip configuration	24LC02
X1	Crystal	32.768KHz

5. Package Outline



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	**Max**	**Min**	**Max**
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.200	0.300	0.008	0.012
c	0.170	0.250	0.007	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	0.635(BSC)		0.025(BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

6. Order Information

Part number	Description	Package	MOQ
KT0922M	Monolithic mono digital AM/FM receiver	SSOP16, Pb free	5000 pcs

7. Revision History

V1.0 First Official Release
V1.1 Update register map.