

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

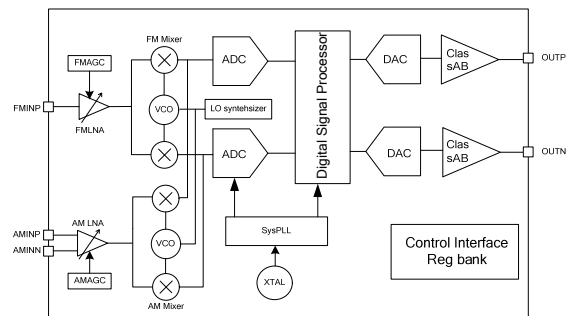
- From 30KHz to 40MHz with 1Hz step

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

Information furnished by KT Micro is believed to be accurate and reliable. However, no responsibility is assumed by KT Micro for its use, nor for any infringements of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of KT Micro, Inc.

Table of Content

| | |
|--------------------------------------------------------------------|-----------|
| 1. Electrical Specification | 3 |
| 2. Pin List | 5 |
| 3. Function Description | 6 |
| 3.1. Overview | 6 |
| 3.2. FM Receiver..... | 6 |
| 3.3. AM Receiver | 6 |
| 3.4. Softmute | 6 |
| 3.5. Operation Bands..... | 7 |
| 3.6. Crystal and Reference clock..... | 7 |
| 3.7. Dial Mode for Channel Control and Volume Control | 8 |
| 3.8. Chip Configuration | 9 |
| 3.9. Register Bank | 11 |
| 3.9.1. CHIP ID (Address 0x01)..... | 12 |
| 3.9.2. MANUAL (Address 0x02)..... | 12 |
| 3.9.3. SOUND (Address 0x03) | 12 |
| 3.9.4. SOFTMUTEA (Address 0x04) | 13 |
| 3.9.5. SOFTMUTEB (Address 0x05)..... | 13 |
| 3.9.6. SOFTMUTEC (Address 0x06)..... | 14 |
| 3.9.7. DSPCFG (Address 0x07) | 15 |
| 3.9.8. LOCFG (Address 0x0C)..... | 15 |
| 3.9.9. PLLCFG (Address 0x14)..... | 15 |
| 3.9.10. PLLCFGB (Address 0x15)..... | 15 |
| 3.9.11. SYSCLK_CFG (Address 0x16) | 16 |
| 3.9.12. SYSCLK_CFGB (Address 0x17)..... | 16 |
| 3.9.13. SYS_CFG (Address 0x1D) | 16 |
| 3.9.14. AMDSPA (Address 0x23)..... | 16 |
| 3.9.15. AUCFG (Address 0x33)..... | 17 |
| 3.9.16. GUARDA (Address 0x34)..... | 17 |
| 3.9.17. GUARDB (Address 0x35) | 17 |
| 3.9.18. GUARDB (Address 0x36) | 18 |
| 3.9.19. SOFTMUTED(Address 0x37) | 18 |
| 3.9.20. BANDCFG (Address 0x38)..... | 18 |
| 3.9.21. FM1_LOW_CHAN (Address 0x39)..... | 19 |
| 3.9.22. FM1_CHAN_NUM (Address 0x3A) | 19 |
| 3.9.23. FM2_LOW_CHAN (Address 0x3B)..... | 19 |
| 3.9.24. FM2_CHAN_NUM (Address 0x3C) | 19 |
| 3.9.25. FM3_LOW_CHAN (Address 0x3D)..... | 19 |
| 3.9.26. FM3_CHAN_NUM (Address 0x3E)..... | 20 |
| 3.9.27. AM_LOW_CHAN (Address 0x3F) | 20 |
| 3.9.28. AM_CHAN_NUM (Address 0x40) | 20 |
| 3.9.29. FMTUNINGA (Address 0x57) | 20 |
| 3.9.30. FMTUNINGB (Address 0x58)..... | 21 |
| 3.9.31. AMTUNINGA (Address 0x59)..... | 22 |
| 3.9.32. AMTUNINGB (Address 0x5A)..... | 22 |
| 3.9.33. AMTUNINGC (Address 0x5B)..... | 22 |
| 3.9.34. AMTUNINGD (Address 0x5Fh) | 23 |
| 4. Typical Application Circuit | 24 |
| 5. Package Outline | 25 |
| 6. Order Information..... | 26 |
| 7. Revision History | 26 |
| 8. Contact Information..... | 27 |

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 | °C |

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°C, 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 3 rd Order Intermodulation Production ^{4,5} | IIP3 | | | 85 | | dBuVEMF |
| Adjacent Channel Selectivity | | ±200KHz | 35 | | 51 | dB |
| Alternate Channel Selectivity | | ±400KHz | 50 | | 70 | dB |
| Image Rejection Ratio | | | | 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:

- FMOD=1KHz, 75us de-emphasis
- MONO=1
- ΔF=22.5KHz
- V_{EMF}=1mV, F_{rx}=32MHz~110MHz
- AGCD=1
- ΔF=75KHz
- VOLUME<4:0>=11111
- The supported RCLK frequency is not continuous. Please refer to application notes.

Table 4: AM Receiver Characteristics
(Unless otherwise noted Ta = -30~70°C, 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} | S _{en} | (S+N)/N=26dB | | 15 | | uV _{emf} |
| 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. F _{MOD} =1KHz | | | | | | |
| 2. Modulation index is 30% | | | | | | |
| 3. V _{EMF} =1mV, F _{rx} =500KHz~1710KHz | | | | | | |
| 4. VOLUME<4:0>=11111 | | | | | | |

CONFIDENTIAL

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. |

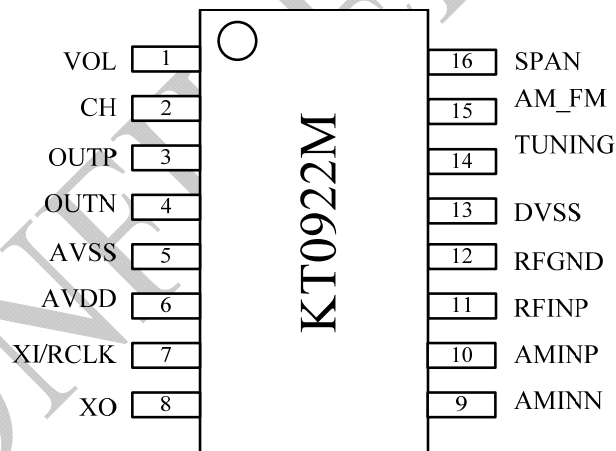


Figure 1: KT0922M Pin assignment (Top view)

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_HIGTH<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.

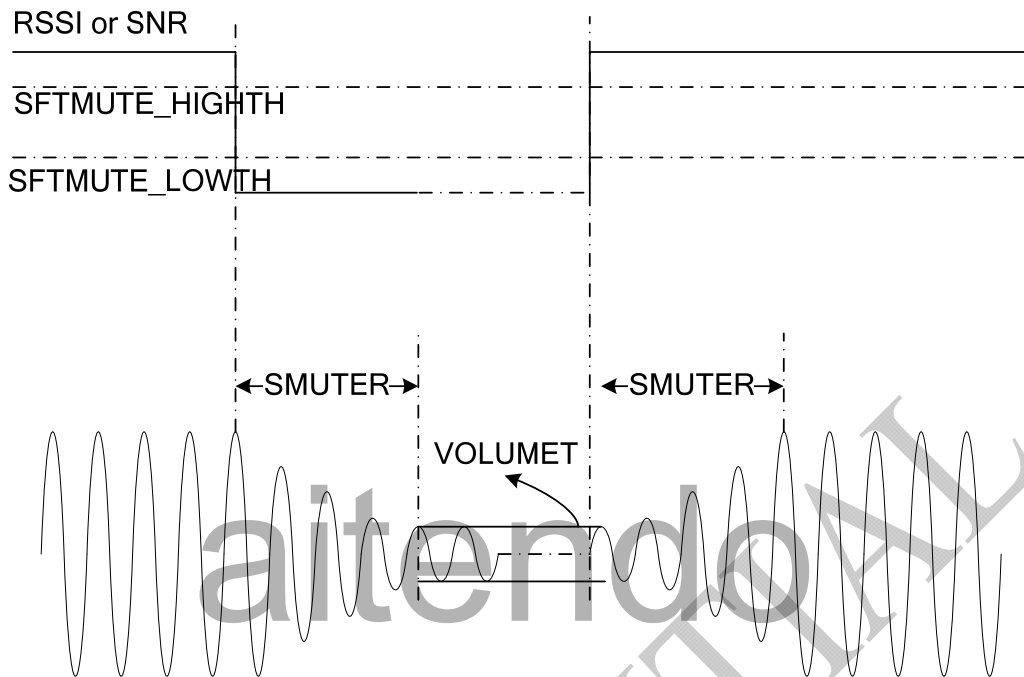


Figure 2 Softmute

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 $FM_i_LOW_CHAN<11:0>$ and $FM_i_CHAN_NUM<11:0>$, 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 $FM_iSPACE<1:0>$, 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.

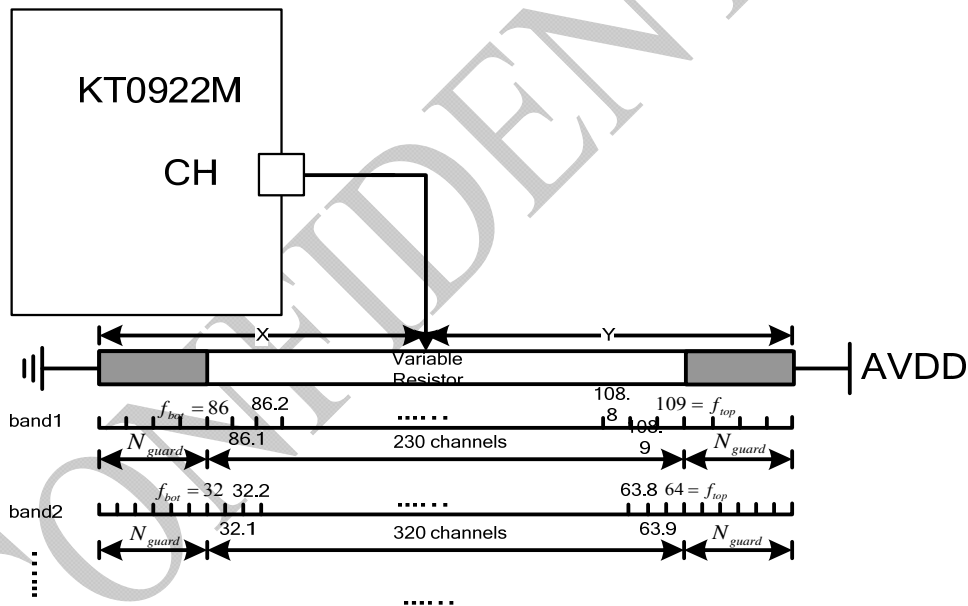


Figure 3: CH pin connection in dial-mode

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:

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

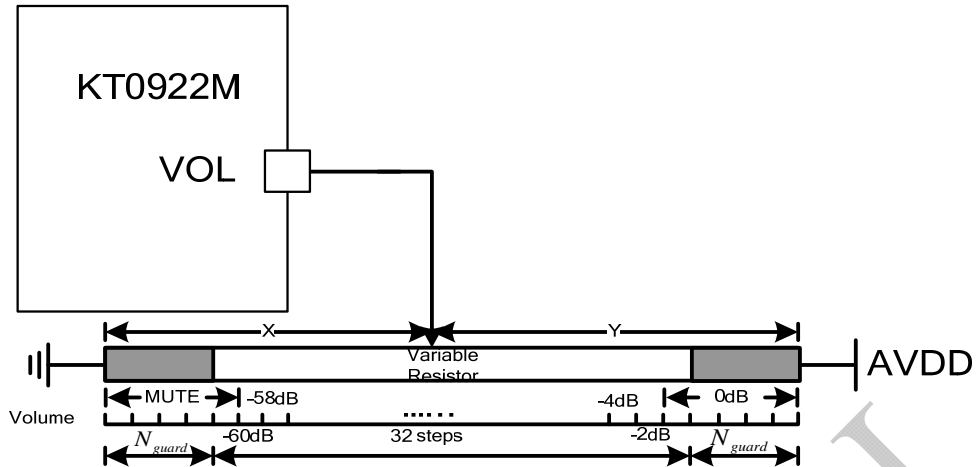


Figure 4: VOL pin connection in dial-mode

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.

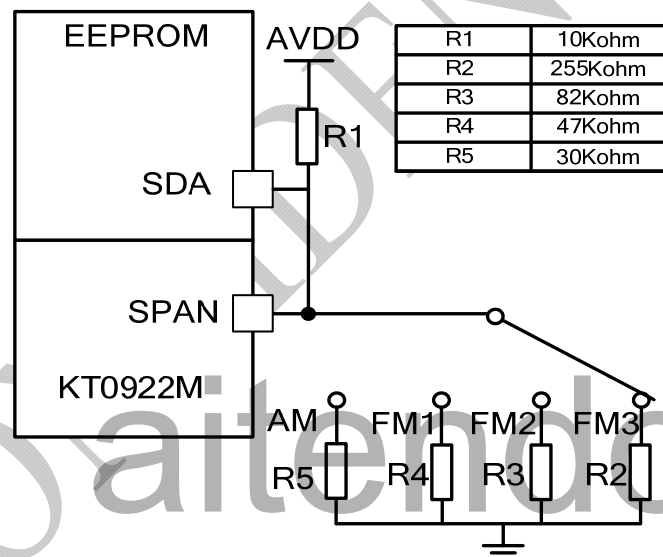


Figure 5: SPAN pin connection in dial-mode

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 |

CONFIDENTIAL

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 | | | | | | | | | | | | | | | | |
| 01h | CHIP ID | | | | | | | | | | | | | | | | |
| 02h | MANUAL | | | | | | | | | | | | | | | | |
| 03h | SOUND | | | | | | | | | | | | | | | | |
| 04h | SOFTMUTE | FM_DSFTMUTE | AM_DSFTMUTE | | AUDV_GAIN<10> | | BASS<10> | | | | | | SPAN_MODE | | FM_BAND_NUM<10> | | |
| 05h | SOFTMUTEA | FM_SFTMUTE | DMY<10> | | SFTMUTE<10> | | FM_VOLTIME<20> | | | | | | POP<10> | | | | |
| 06h | SOFTMUTEB | | AM_SFTMUTE | CHST<20> | | FM_SFTMUTE | CHST<20> | | | | | | FM_SFTMUTE | HGHTH<20> | | | FM_SFTMUTE_LOWTH<20> |
| 07h | SOFTMUTEC | | | | AM_SFTMUTE | HGHTH<60> | | | | | | | | | | | AM_SFTMUTE_LOWTH<60> |
| 08h | DSPCFGA | | | | DE | | | | FM_AFCD | | | | | | | | |
| 09h | LOCFGA | | | | | | | | | | | | | | | | |
| 10h | PILCFGA | | | | | | | | | | | | | | | | |
| 11h | PILCFGB | | | | | | | | | | | | | | | | |
| 12h | SYSCLK_CFGA | | | | | | | | | | | | | | | | |
| 17h | SYSCLK_CFGB | | | | | | | | | | | | | | | | |
| 18h | SYSCLK_CFGC | | | | | | | | | | | | | | | | |
| 19h | SYSCLK_CFGD | | | | | | | | | | | | | | | | |
| 20h | SYSCLK_CFGE | | | | | | | | | | | | | | | | |
| 21h | SYSCLK_CFGF | | | | | | | | | | | | | | | | |
| 22h | SYSCLK_CFGG | | | | | | | | | | | | | | | | |
| 23h | SYSCLK_CFGH | | | | | | | | | | | | | | | | |
| 24h | SYSCLK_CFGI | | | | | | | | | | | | | | | | |
| 25h | SYSCLK_CFGJ | | | | | | | | | | | | | | | | |
| 26h | SYSCLK_CFGK | | | | | | | | | | | | | | | | |
| 27h | SYSCLK_CFGL | | | | | | | | | | | | | | | | |
| 28h | SYSCLK_CFGM | | | | | | | | | | | | | | | | |
| 29h | SYSCLK_CFGN | | | | | | | | | | | | | | | | |
| 30h | SYSCLK_CFGO | | | | | | | | | | | | | | | | |
| 31h | SYSCLK_CFGP | | | | | | | | | | | | | | | | |
| 32h | SYSCLK_CFGQ | | | | | | | | | | | | | | | | |
| 33h | SYSCLK_CFGR | | | | | | | | | | | | | | | | |
| 34h | SYSCLK_CFGS | | | | | | | | | | | | | | | | |
| 35h | SYSCLK_CFGT | | | | | | | | | | | | | | | | |
| 36h | SYSCLK_CFGU | | | | | | | | | | | | | | | | |
| 37h | SYSCLK_CFGV | | | | | | | | | | | | | | | | |
| 38h | SYSCLK_CFGW | | | | | | | | | | | | | | | | |
| 39h | SYSCLK_CFGX | | | | | | | | | | | | | | | | |
| 40h | SYSCLK_CFGY | | | | | | | | | | | | | | | | |
| 41h | SYSCLK_CFGZ | | | | | | | | | | | | | | | | |
| 42h | AM_BAND_NUM | | | | | | | | | | | | | | | | |
| 43h | AM_GAIN<30> | | | | | | | | | | | | | | | | |
| 44h | AM_GUARD<70> | | | | | | | | | | | | | | | | |
| 45h | AM_VOLTIME<20> | | | | | | | | | | | | | | | | |
| 46h | AM_SPACE<10> | | | | | | | | | | | | | | | | |
| 47h | AM_CHAN_NUM<110> | | | | | | | | | | | | | | | | |
| 48h | AM_TUNE_VALID_WIN<20> | | | | | | | | | | | | | | | | |
| 49h | AM_TUNE_VALID_WIN<20> | | | | | | | | | | | | | | | | |
| 50h | AM_TUNE_VALID_WIN<20> | | | | | | | | | | | | | | | | |
| 51h | AM_TUNE_VALID_WIN<20> | | | | | | | | | | | | | | | | |
| 52h | AM_TUNE_VALID_WIN<20> | | | | | | | | | | | | | | | | |
| 53h | AM_TUNE_VALID_WIN<20> | | | | | | | | | | | | | | | | |
| 54h | AM_TUNE_VALID_WIN<20> | | | | | | | | | | | | | | | | |
| 55h | AM_TUNE_VALID_WIN<20> | | | | | | | | | | | | | | | | |

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 |
|-----------|-------------------------|--------|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 15:1 4 | 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. |
| 13:1 2 | 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_SFTMUTET H_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_SFTMUTET H_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 | Reserved. |
| 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_HI GHTH<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_LO WTH<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. LOCFGGA (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 N<11:0> | RW | 0110_10 11_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 M<11:0> | RW | 0000_11 10_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 N<11:0> | RW | 0101_00 00_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 M<11:0> | RW | 0001_00 00_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 N<11:0> | RW | 0010_10 00_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_01 00_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_11 11_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_WINDOW<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_DELAY<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_LOW TH<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_HIT H<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_LOW TH<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_HIT H<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_LO WTH<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_RS SI_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

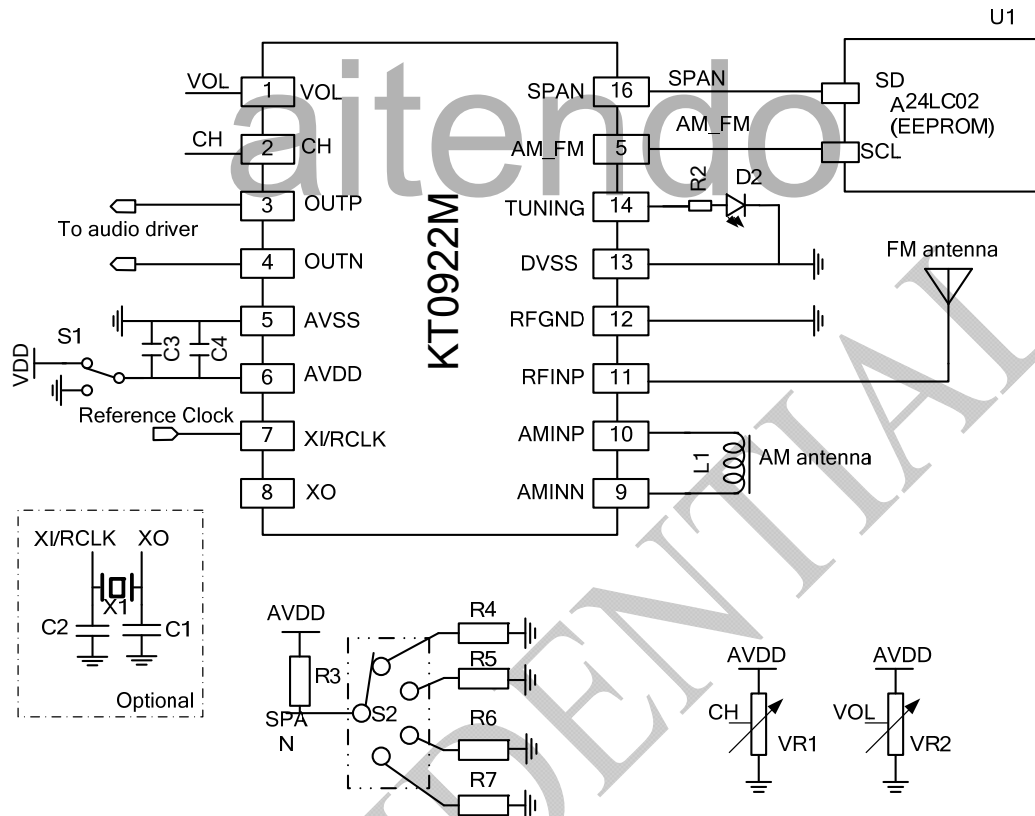
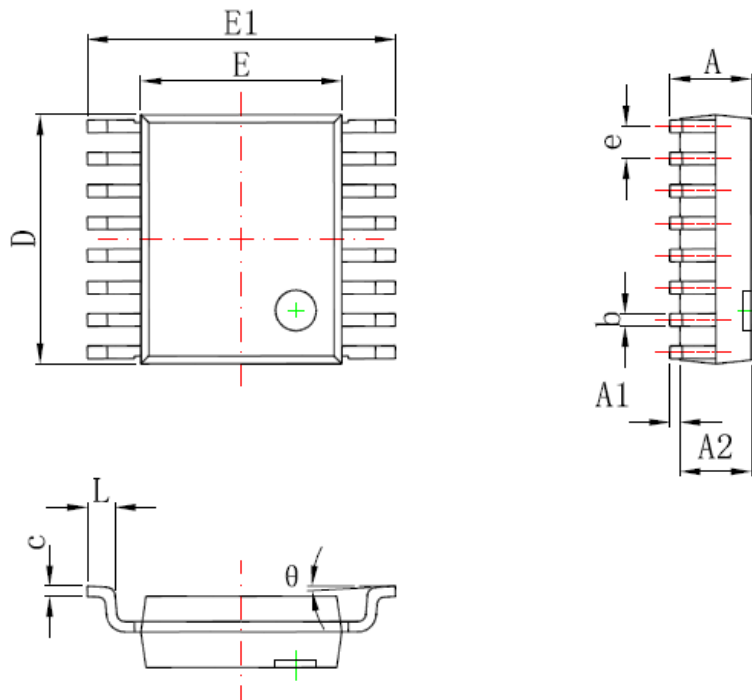


Figure 6: Typical Application Circuits for Dial Mode

| 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.

CONFIDENTIAL