

## 3V AM/FM+MPX TUNER IC(FOR DIGITAL TUNING SYSTEM)

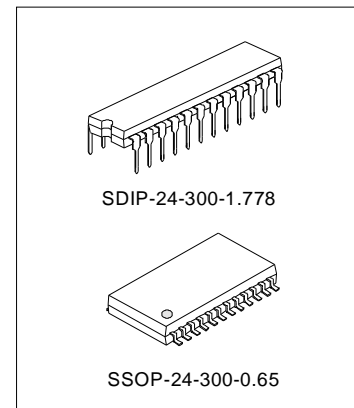
## DESCRIPTION

The SA2104/SA2104S are single-chip tuner ICs that incorporate FM/AM and MPX circuits, which are designed for portable radios and 3V headphone radios.

The SA2104/SA2104S are suitable for digital tuning system applications. FM local oscillation voltage is set up low relatively, for NEW FCC.

## FEATURES

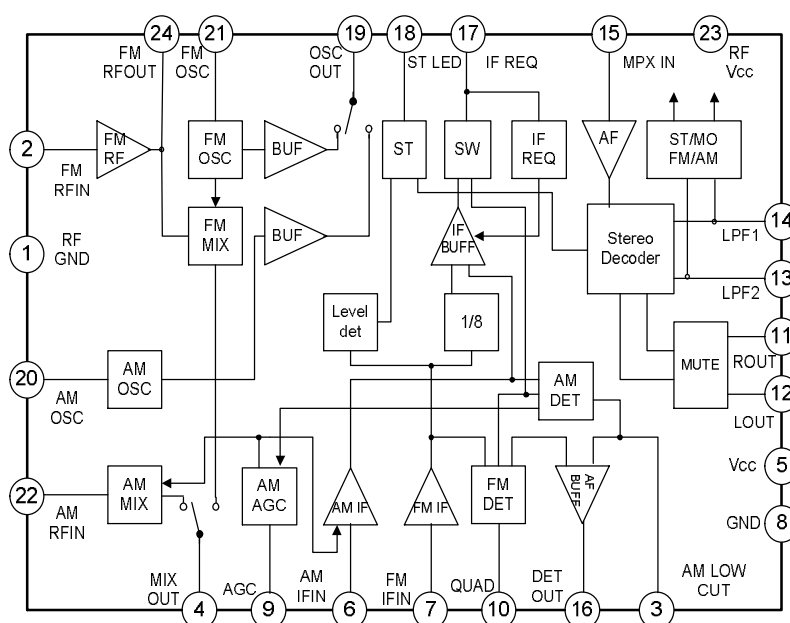
- \* Operating supply voltage range:  $V_{CC}=1.8\sim 10V$  ( $T_{amb}=25^{\circ}C$ )
- \* For NEW FCC
- \* FM/AM and MPX integrated in a single-chip.
- \* Build in FM/AM IF count buffer.
  - FM: 1.3375MHz (1/8 dividing)
  - AM: 450kHz
- \* Build in mute circuit for IF count output according to field strength.
- \* Build in FM MPX VCO circuit
- \* Build in FM/AM OSC buffer output for DTS applications.
- \* Build in AM low cut circuit
- \* Build in stereo indicator.
- \* Low supply current. ( $V_{CC}=3V$ ,  $T_{amb}=25^{\circ}C$ )
  - $ICC_q$  (FM)=11.0mA (Typ.)
  - $ICC_q$  (AM)=7.5mA (Typ.)



## ORDERING INFORMATION

| Part No. | Package           |
|----------|-------------------|
| SA2104   | SDIP-24-300-1.778 |
| SA2104S  | SSOP-24-300-0.65  |

## BLOCK DIAGRAM



MAXIMUM RATINGS (T<sub>amb</sub>=25°C)

| Parameter               |         | Symbol                | Rating   | Unit |
|-------------------------|---------|-----------------------|----------|------|
| Maximum Supply Voltage  |         | V <sub>CC</sub>       | 14       | V    |
| Indicator Drive Current |         | I <sub>LED</sub>      | 10       | mA   |
| Indicator Voltage       |         | V <sub>LED</sub>      | 8        | V    |
| Power Dissipation       | SA2104  | P <sub>D</sub> (note) | 1200     | mW   |
|                         | SA2104S |                       | 500      |      |
| Operating Temperature   |         | T <sub>opr</sub>      | -20~+70  | °C   |
| Storage Temperature     |         | T <sub>stg</sub>      | -40~+125 | °C   |

Note: Derated above T<sub>amb</sub>=25°C in the proportion of 9.6mW/°C for SA2104 of 4mW/°C for SA2104S.

**ELECTRICAL CHARACTERISTICS** (Unless otherwise specified, T<sub>amb</sub>=25°C, V<sub>CC</sub>=3V, F/E : f=98 MHz, fm=1 kHz, FM IF : f=10.7 MHz, Δf =±22.5 kHz, fm=1 kHz. AM : f=1 MHz, MOD=30%, fm=1 kHz. MPX: fm=1kHz)

| Parameter                   |                                    | Symbol                        | Test Condition                                | Min.   | Typ.   | Max.        | Unit        |
|-----------------------------|------------------------------------|-------------------------------|---|--------|--------|-------------|-------------|
| Quiescent Current           |                                    | ICC(FM)                       | V <sub>IN</sub> =0, FM mode                   | --     | 11.0   | 18          | mA          |
|                             |                                    | ICC(AM)                       | V <sub>IN</sub> =0, AM mode                   | --     | 7.5    | 14          |             |
| F/E                         | Input Limiting Voltage             | V <sub>in(lim)</sub>          | V <sub>IN</sub> =60 dBμV EMF<br>-3dB limiting | --     | 10     | --          | dBμV<br>EMF |
|                             | Local OSC BUFFER<br>OUTPUT Voltage | V <sub>osc (buff)</sub><br>FM | F <sub>OSC</sub> =108.7MHz                    | 23     | 35     | --          | mVrms       |
| FM<br>IF                    | Input Limiting Voltage             | V <sub>in(lim) IF</sub>       | V <sub>IN</sub> =80dBμV EMF<br>-3dB limiting  | 35     | 38     | 47          | dBμV<br>EMF |
|                             | Recovered Output Voltage           | V <sub>OD</sub>               | V <sub>IN</sub> =80dBμV EMF                   | 200    | 270    | 300         | mVrms       |
|                             | Signal To Noise Ratio              | S/N                           | V <sub>IN</sub> =80dBμV EMF                   | --     | 75     | --          | dB          |
|                             | Total Harmonic Distortion          | THD                           | V <sub>IN</sub> =80dBμV EMF                   | --     | 0.3    | --          | %           |
|                             | AM Rejection Ration                | AMR                           | V <sub>IN</sub> =80dBμV EMF                   | --     | 60     | --          | dB          |
|                             | IF Count Output<br>Frequency       | f <sub>IF</sub> (FM)          | V <sub>IN</sub> =80dBμV EMF<br>SW7: ON        | 1.3373 | 1.3375 | 1.3377      | MHz         |
|                             | IF Count Output Voltage            | V <sub>IF</sub> (FM)          | V <sub>IN</sub> =80dBμV EMF<br>SW7: ON        | 200    | 260    | --          | mVp-p       |
| AM                          | IF Count Output Sensitivity        | IF sens<br>(FM)               | SW7: ON                                       | 40     | 45     | 50          | dBμV<br>EMF |
|                             | Gain                               | GV                            | V <sub>IN</sub> =27dBμV EMF                   | 20     | 38     | 70          | mVrms       |
|                             | Recovered Output Voltage           | V <sub>OD</sub>               | V <sub>IN</sub> =60dBμV EMF                   | 60     | 90     | 120         | mVrms       |
|                             | Signal To Noise Ratio              | S/N                           | V <sub>IN</sub> =60dBμV EMF                   | --     | 41     | --          | dB          |
|                             | Total Harmonic Distortion          | THD                           | V <sub>IN</sub> =60dBμV EMF                   | --     | 0.7    | --          | %           |
|                             | Local OSC Buffer Output<br>Voltage | V <sub>osc (buff)</sub><br>AM | f <sub>OSC</sub> =1.45MHz                     | 44     | 66     | --          | mVrms       |
|                             | IF Count Output Voltage            | V <sub>IF</sub> (AM)          | V <sub>IN</sub> =60dBμV EMF, SW7: ON          | 200    | 250    | --          | mVp-p       |
| IF Count Output Sensitivity | IF sens<br>(AM)                    | SW7: ON                       | 38  | 43     | 48     | dBμV<br>EMF |             |

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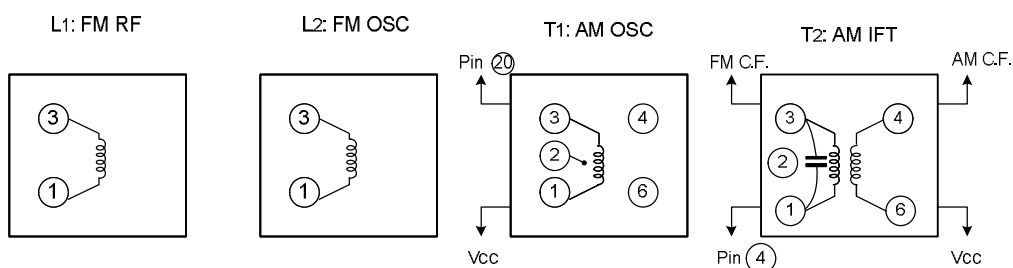
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| Parameter                           |          | Symbol           | Test Condition                                    | Min. | Typ. | Max. | Unit  |
|-------------------------------------|----------|------------------|---|------|------|------|-------|
| Pin (17) Output Resistance          |          | R17              | FM mode   | --   | 0.75 | --   | kΩ    |
|                                     |          |                  | AM mode   | --   | 15.5 | --   |       |
| Input Resistance                    |          | RIN              | --  | --   | 55   | --   | kΩ    |
| Output Resistance                   |          | ROUT             | --  | --   | 5    | --   | kΩ    |
| Max. Composite Signal Input Voltage |          | Vin MAX (Stereo) | L+R=90%, P=10%,<br>SW3: LPF ON fm=1kHz,<br>THD=3% | --   | 700  | --   | mVrms |
| Separation                          |          | Sep              | L+R=180mVrms, fm=100Hz                            | --   | 44   | --   | dB    |
|                                     |          |                  | P=20mVrms fm=1kHz                                 | 35   | 44   | --   |       |
|                                     |          |                  | SW3: LPF ON fm=10kHz                              | --   | 44   | --   |       |
| Total Harmonic Distortion           | Monaural | THD (Monaural)   | Vin=200mVrms                                      | --   | 0.3  | --   | %     |
|                                     | Stereo   | THD (Stereo)     | L+R=180mVrms,<br>P=20mVrms SW3: LPF ON            | --   | 0.3  | --   |       |
| Voltage Gain                        |          | GV               | Vin=200mVrms                                      | -2.7 | -1.2 | 0.2  | dB    |
| Channel Balance                     |          | C.B.             | Vin=200mVrms                                      | -1.5 | 0    | 1.5  | dB    |
| Stereo LED Sensitivity              | ON       | VL (ON)          | Pilot input(19KHZ)                                | --   | 10   | 14   | mVrms |
|                                     | OFF      | VL (OFF)         |   | 5    | 8    | --   |       |
| Stereo LED Hysteresis               |          | VH               | To LED turn off from LED turn on                  | --   | 2    | --   | mVrms |
| Capture Range                       |          | C.R.             | P=15mVrms   | --   | ±8   | --   | %     |
| Signal To Noise Ratio               |          | S/N              | Vin=200mVrms                                      | --   | 80   | --   | dB    |
| Muting Attenuation                  |          | MUTE             | Vin=200mVrms                                      | --   | 80   | --   | dB    |

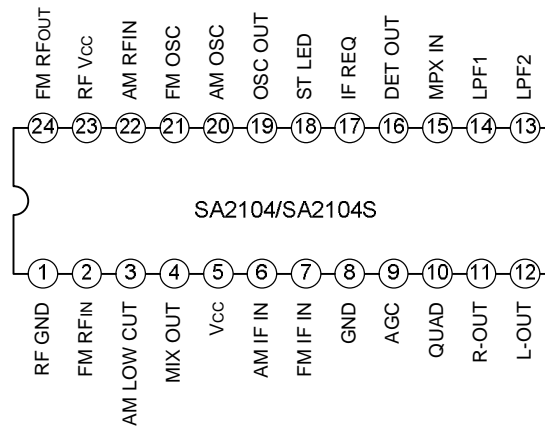
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## COIL DATA

| Coil No.  | Test Freq. | L (μH) | Co (pF) | Qo | Turns |     |     |                 |     | Wire (mmØ) |
|-----------|------------|--------|---------|----|-------|-----|-----|-----------------|-----|------------|
|           |            |        |         |    | 1-2   | 2-3 | 1-3 | 1-4             | 4-6 |            |
| L1 FM RF  | 100MHz     | --     | --      | 79 | --    | --  | --  | 2 $\frac{1}{2}$ | --  | 0.16UEW    |
| L2 FM OSC | 100MHz     | --     | --      | 76 | --    | --  | --  | 2               | --  | 0.16UEW    |
| T1 AM OSC | 796kHz     | 268    | --      | 65 | 19    | 95  | --  | --              | --  | 0.05UEW    |
| T2 AM IFT | 455kHz     | --     | 470     | 60 | --    | --  | 109 | --              | 7   | 0.05UEW    |



PIN CONFIGURATION

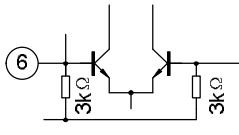
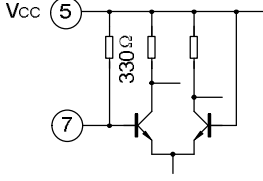
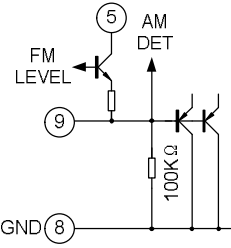
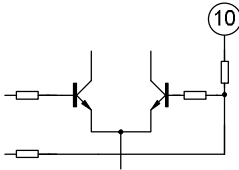
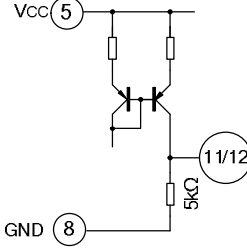
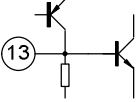


PIN DESCRIPTIONS AND QUIESCENT VOLTAGE

| Pin No. | Symbol     | Pin description                 | Internal circuit | Pin voltage (Typ.) (V) |     |
|---------|------------|---------------------------------|------------------|------------------------|-----|
|         |            |                                 |                  | AM                     | FM  |
| 1       | RF GND     | GND for FM OSC stage            | --               | 0                      | 0   |
| 2       | FM-RFin    | FM-RF input pin.                |                  | 0                      | 0.8 |
| 3       | AM LOW CUT | AM low frequency cut down pin   |                  | 1.0                    | --  |
| 4       | MIX OUT    | AM/FM mixer output pin.         |                  | 3.0                    | 0.5 |
| 5       | VCC        | VCC for AM, FM IF, FM MPX stage | --               | 3.0                    | 3.0 |

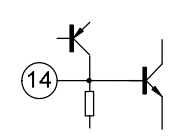
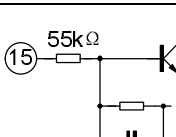
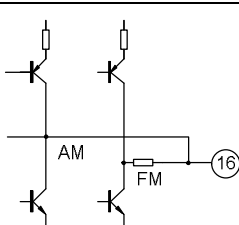
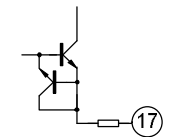
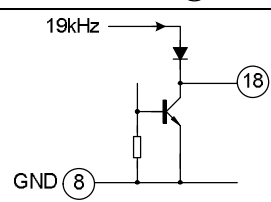
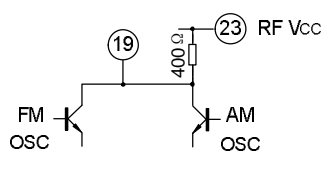
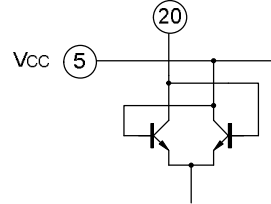
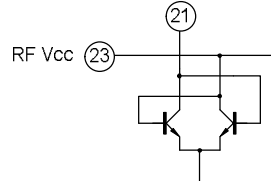
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| Pin No.  | Symbol         | Pin description  | Internal circuit   | Pin voltage (Typ.) (V) |     |
|----------|----------------|--|--|------------------------|-----|
|          |                |  |  | AM                     | FM  |
| 6        | AMIF IN        | AMIF input pin.  |    | 2.3                    | 2.5 |
| 7        | FMIF IN        | FMIF input.  |    | 3.0                    | 3.0 |
| 8        | GND            | GND for AM, FM IF, FM MPX stage.   | --   | 0                      | 0   |
| 9        | AGC            | Auto gain control pin.   |   | 0                      | 0   |
| 10       | QUAD           | FM Quad  |  | 2.5                    | 2.2 |
| 11<br>12 | R-OUT<br>L-OUT | Right/Left channel output port.  |  | 1.2                    | 1.2 |
| 13       | LPF2           | LPF terminal for phase detector<br>Bias terminal for AM/FM SW circuit<br>V13=GND→AM<br>V13=OPEN→FM |  | 0                      | 2.2 |

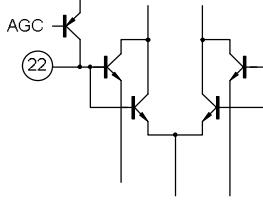
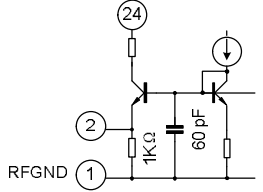
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| Pin No. | Symbol  | Pin description  | Internal circuit   | Pin voltage (Typ.) (V) |     |
|---------|---------|--|--|------------------------|-----|
|         |         |  |  | AM                     | FM  |
| 14      | LPF1    | LPF terminal for synchronous detector<br>VCO stop terminal<br>V14=GND→VCO STOP |    | 0.7                    | 2.4 |
| 15      | MPX IN  | MPX input pin.   |    | 0.7                    | 0.7 |
| 16      | DET OUT | FM/AM detector output pin.   |    | 1.0                    | 0.9 |
| 17      | IF REQ  | AM/FM IF output pin.   |   | --                     | --  |
| 18      | ST LED  | Stereo indicator.  |  | --                     | --  |
| 19      | OSC OUT | AM/FM oscillator output pin.   |  | 2.8                    | 2.7 |
| 20      | AM OSC  | AM oscillator input pin.   |  | 3.0                    | 3.0 |
| 21      | FM OSC  | FM oscillator input pin.   |  | 3.0                    | 3.0 |

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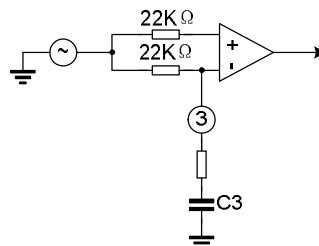
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| Pin No. | Symbol    | Pin description        | Internal circuit   | Pin voltage (Typ.) (V) |     |
|---------|-----------|------------------------|--|------------------------|-----|
|         |           |                        |  | AM                     | FM  |
| 22      | AM RF IN  | AM RF input pin.       |  | 3.0                    | 3.0 |
| 23      | RF Vcc    | (Vcc for FM OSC stage) | --   | 3.0                    | 3.0 |
| 24      | FM RF OUT | FM RF output pin.      |  | 3.0                    | 3.0 |

## FUNCTION DESCRIPTION

Application note:

### 1. AM low-cut circuit



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When pin3 is open, no AF signal can pass through the AMP stage because of the common mode.

When the value of C3 that connected to pin3 is over 1uF, all AF signal can pass through the AMP stage.

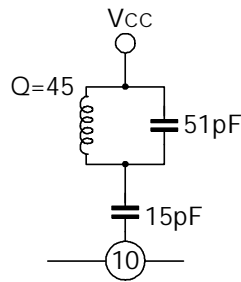
The cut-off frequency  $f_L$  is determined by the internal resistance 22kΩ (Typ.) and the external capacitor C3 as below:

$$f_L = \frac{1}{2 \times \pi \times 22 \times 10^3 \times C3} \text{ (Hz)}$$

It is possible to reduce the recovered output level at AM mode, by additional resistance between the pin (3) and GND line.

### 2. FM detection circuit

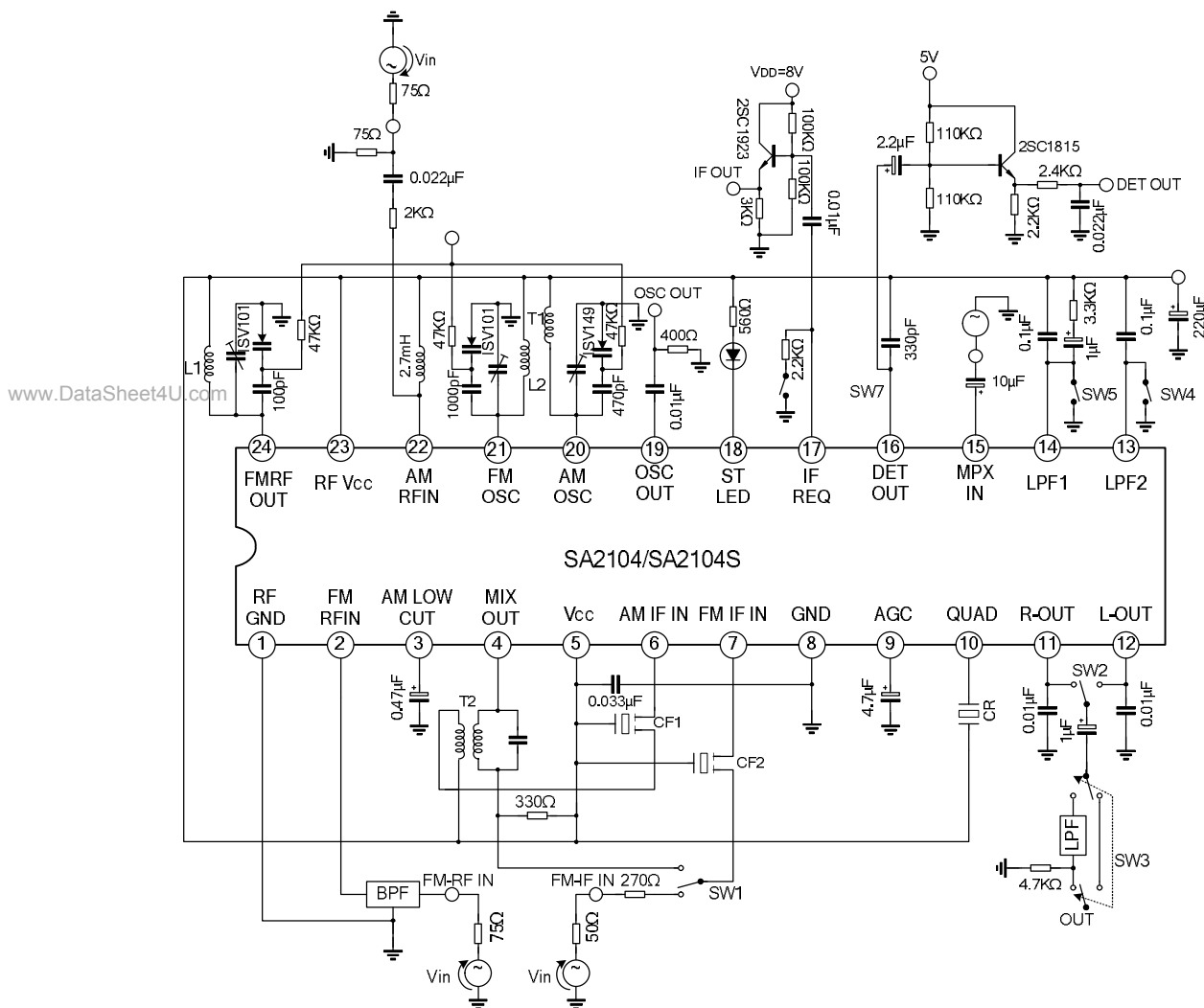
Recommended circuit and recommended coil are as follows. (Test frequency is 10.7M)



3. FM/AM switch and forced monaural switch.

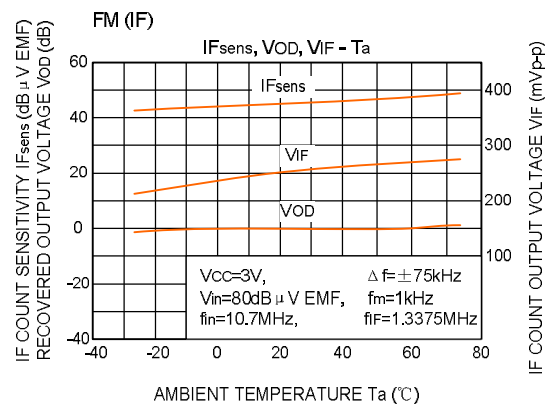
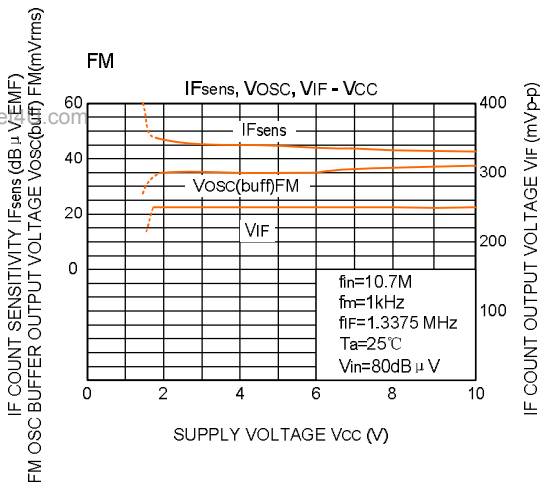
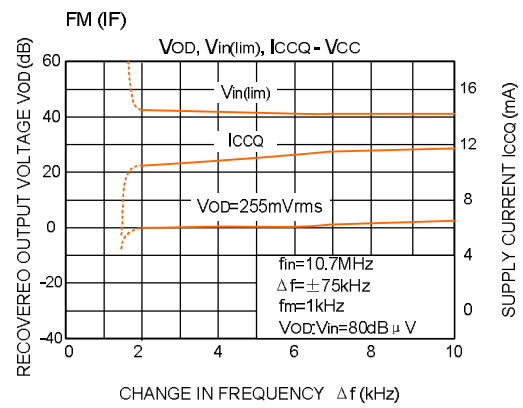
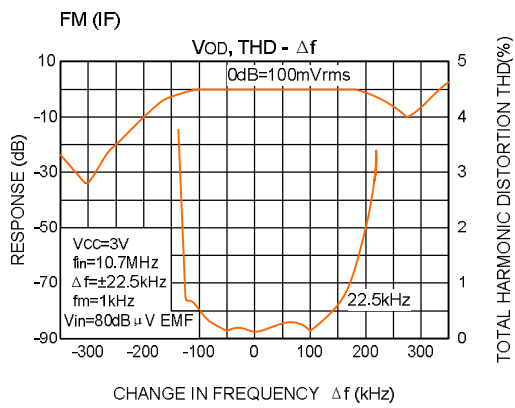
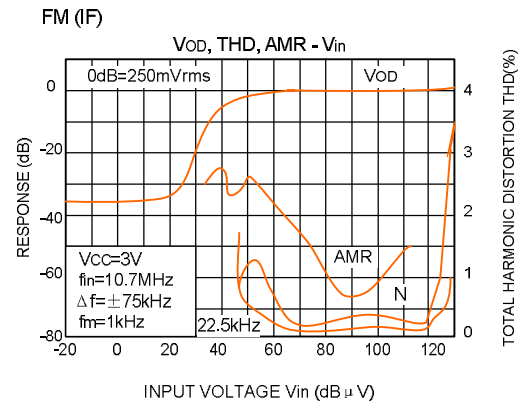
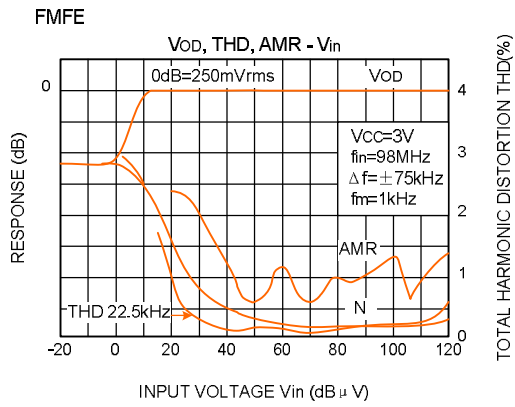
| mode            | Vpin13                               | Vpin14                              |
|-----------------|--------------------------------------|-------------------------------------|
| AM              | LOW (Vth=0.2V(Typ.), Ith 30μA(Typ.)) | /                                   |
| FM              | OPEN                                 | /                                   |
| STEREO          | /                                    | OPEN                                |
| FORCED MONAURAL | /                                    | LOW(Vth=0.2V(Typ.), Ith 30μA(Typ.)) |

TEST CIRCUIT

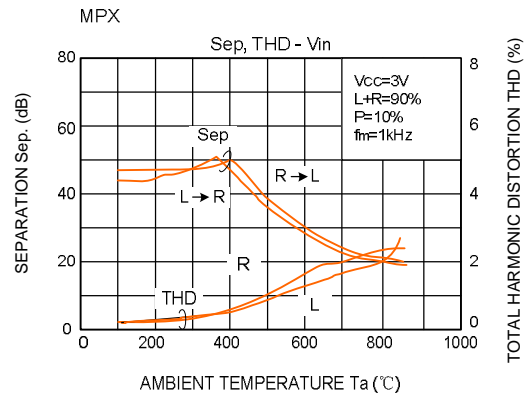
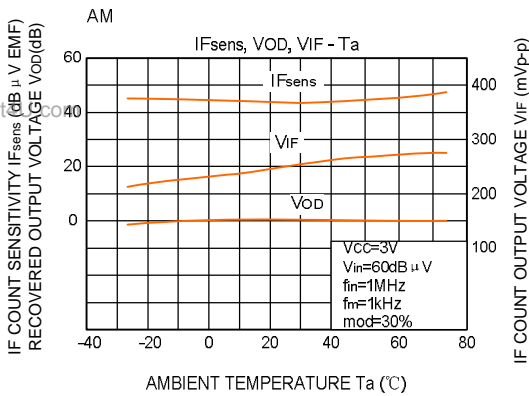
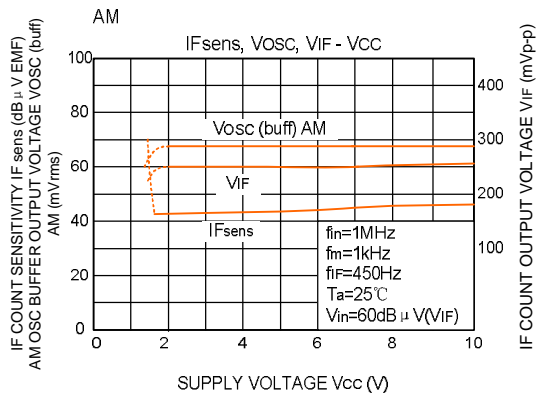
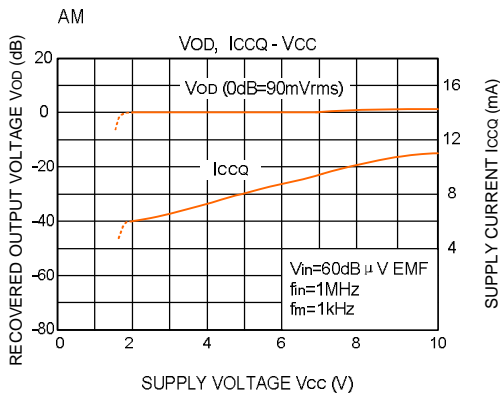
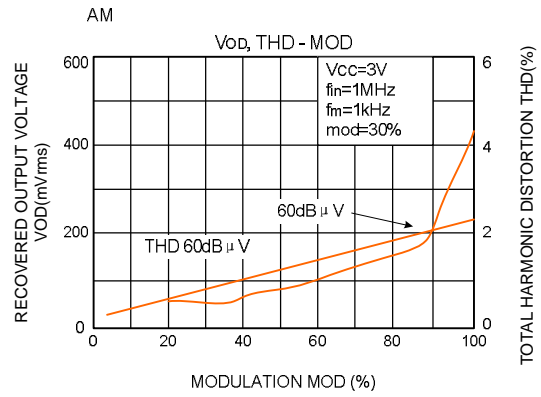
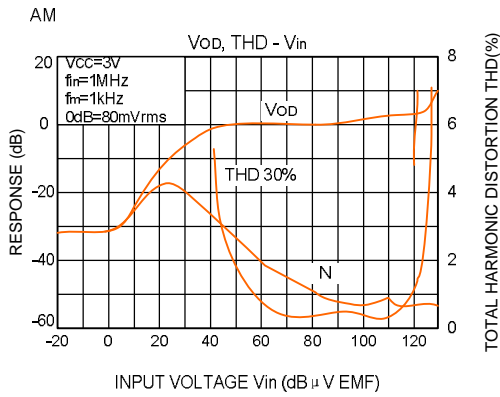




ELECTRICAL CHARACTERISTICS CURVES

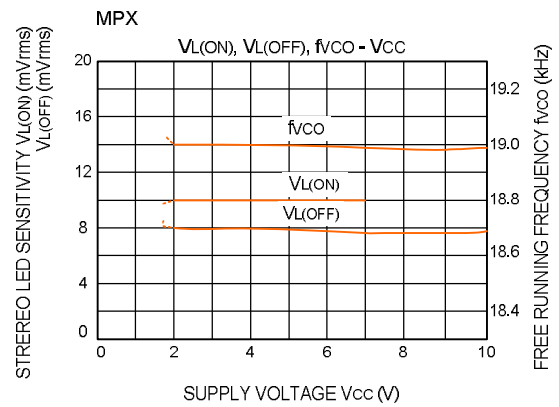
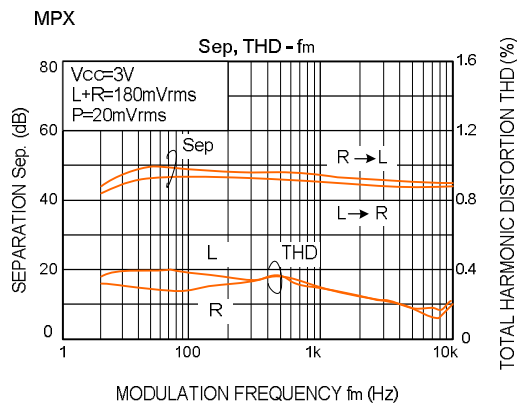


ELECTRICAL CHARACTERISTICS CURVES (Continued)



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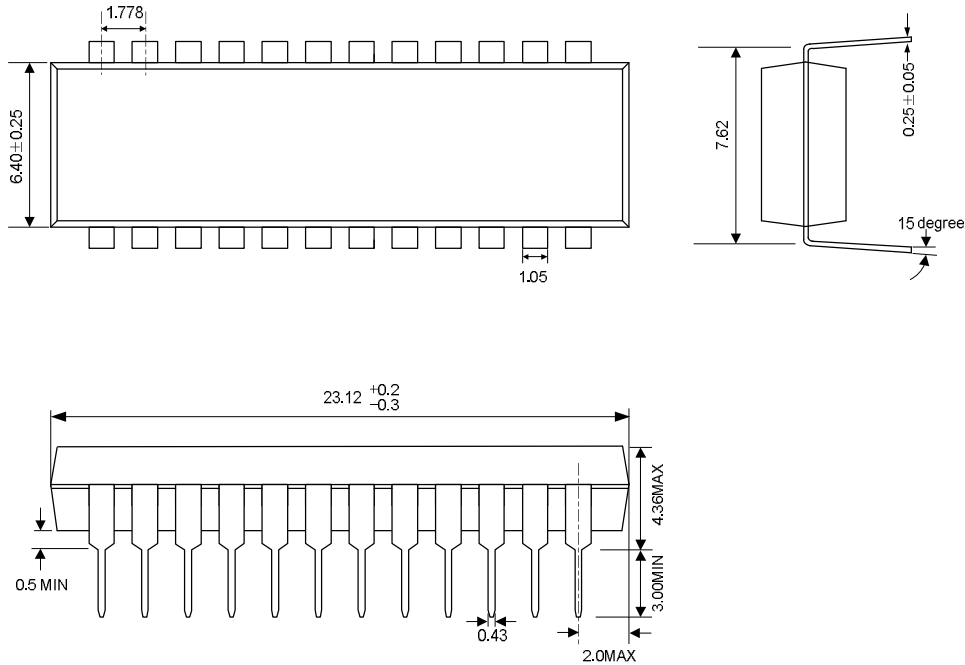
CHARACTERISTICS CURVES (Continued)



PACKAGE OUTLINE

SDIP-24-300-1.778

UNIT: mm



SSOP-24-300-0.65

UNIT: mm

