



SANYO Semiconductors

## DATA SHEET

LA1823

Monolithic Linear ICs

LA1823M

Single-Chip Tuner ICs

for Use in Radio Cassette Recorder

## Overview

The LA1823 and the LA1823M are single-chip tuner ICs that incorporate FM/AM and MPX circuits and support electronic tuning. The built-in MPX-VCO allows these ICs to be adjustment-free and to require no external components.

## Features

- AM, FM frontend/IF and MPX integrated in a single-chip.
- Built-in MPX VCO circuit
- Electronic tuning (AM oscillator output, AM/FM IF output)
- Adjustment-free FM detection (uses a ceramic discriminator)
- Packages : DIP24S (300mil) [LA1823]  
~~MFP24S (300mil) [LA1823M]~~

## Functions

AM : RF amplifier, mixer, oscillator, oscillator buffer, IF amplifier, detector, AGC, IF count buffer output.

FM-RF : RF amplifier, mixer, and oscillator.

FM-IF : IF amplifier, quadrature detector, S-meter, and IF counter buffer output.

MPX : PLL stereo decoder, stereo indicator, forced monaural, VCO on chip, Audio mute.

## Specifications

Maximum Ratings at  $T_a = 25^\circ\text{C}$ 

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	$V_{CC\text{ max}}$		7.0	V
Indicator drive current	$I_{LED}$	Pin 8	20	mA
Allowable power dissipation	$P_d\text{ max}$	$T_a \leq 70^\circ\text{C}$	300	mW
Operating temperature	$T_{opr}$		-20 to +70	$^\circ\text{C}$
Storage temperature	$T_{stg}$		-40 to +125	$^\circ\text{C}$

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## Operating Conditions at $T_a = 25^\circ\text{C}$

Parameter	Symbol	Conditions	Ratings	Unit
Recommended supply voltage	$V_{CC}$		4.5	V
Operation supply voltage range	$V_{CC\ op}$		1.8 to 6.0	V

## Operating Characteristics at $T_a = 25^\circ\text{C}$ , $V_{CC} = 4.5\text{V}$ , in the specified test circuit

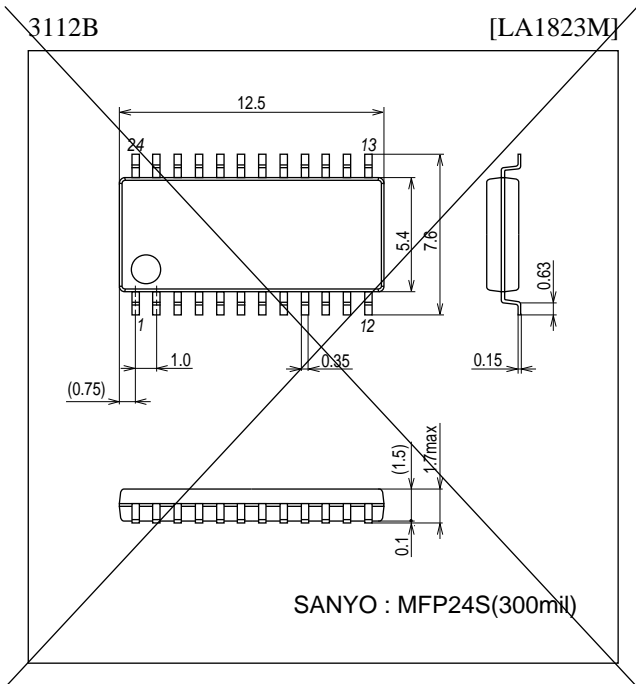
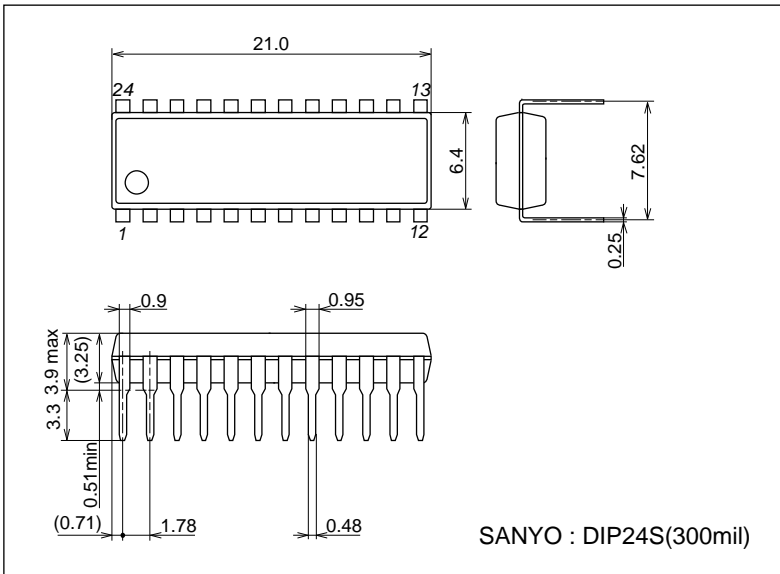
Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Quiescent supply current						
FM-mode quiescent current	$I_{CC\ (FM)}$		10.0	15.0	20.0	mA
AM-mode quiescent current	$I_{CC\ (AM)}$		6.5	9.2	14.5	mA
FM front-end characteristics at $f_c = 98\text{MHz}$ , $V_{IN} = 60\text{dB}\mu\text{V}$ EMF, $f_m = 1\text{kHz}$ , $22.5\text{kHz}$ dev						
Local oscillator voltage	$V_{OSC}$	No. input, $f_{osc} = 108.7\text{MHz}$ , the pin 20 output		100		mVrms
Input limiting voltage	3dB L.S.	Referenced to $22.5\text{kHz}$ dev, a 3dB down input		12		$\text{dB}\mu\text{V}$ EMF
FM IF characteristics (monaural) at $f_c = 10.7\text{MHz}$ , $V_{IN} = 100\text{dB}\mu\text{V}$ , $f_m = 1\text{kHz}$ , $75\text{kHz}$ dev						
Demodulation output	$V_O$	The pin 16 output	125	165	210	mVrms
Signal-to-noise ratio	S/N	The pin 16 output	63	72		dB
Total harmonic distortion (monaural)	THD	The pin 16 output		0.5	1.5	%
Input limiting voltage	3dB L.S.	Referenced to $75\text{kHz}$ dev, a 3dB down input	31	38	45	$\text{dB}\mu\text{V}$
IF count buffer on level	IF buff on	No modulation	35	45	55	$\text{dB}\mu\text{V}$
IF count buffer output	$V_{IF\ buff}$	No modulation, the pin 7 output	120	180	240	mVrms
FM IF characteristics (stereo) at $f_c = 10.7\text{MHz}$ , $V_{IN} = 100\text{dB}\mu\text{V}$ , $f_m = 1\text{kHz}$ , $75\text{kHz}$ dev, L+R = 90%, PILOT = 10%						
Separation	SEP	Left channel modulated, the pin 16 and pin 17 outputs	25	40		dB
Stereo on level	ST-ON	The pilot modulation such that the pin 8 voltage becomes lower than 0.5V	2.4	3.5	7.2	%
Total harmonic distortion (stereo)	THD	Main modulation, the pin 16 output		0.5	1.7	%
AM characteristics at $f_c = 1000\text{kHz}$ , $f_m = 1\text{kHz}$ , mod = 30%						
Detector output	$V_{O1}$	$V_{IN} = 23\text{dB}\mu\text{V}$ , the pin 16 output	14	26	50	mVrms
	$V_{O2}$	$V_{IN} = 80\text{dB}\mu\text{V}$ , the pin 16 output	50	75	120	mVrms
Signal-to-noise ratio	S/N1	$V_{IN} = 23\text{dB}\mu\text{V}$ , the pin 16 output	15	20		dB
	S/N2	$V_{IN} = 80\text{dB}\mu\text{V}$ , the pin 16 output	47	54		dB
Total harmonic distortion	THD	$V_{IN} = 80\text{dB}\mu\text{V}$ , the pin 16 output		0.5	1.5	%
OSC buffer output	$V_{OSC\ buff}$	No input, the pin 8 output	80	100	160	mVrms
IF count buffer on level	IF buff on	No modulation	15	25	32	$\text{dB}\mu\text{V}$
IF count buffer output	$V_{IF\ buff}$	$V_{IN} = 80\text{dB}\mu\text{V}$ , no modulation, the pin 7 output	110	180	220	mVrms

### Package Dimensions

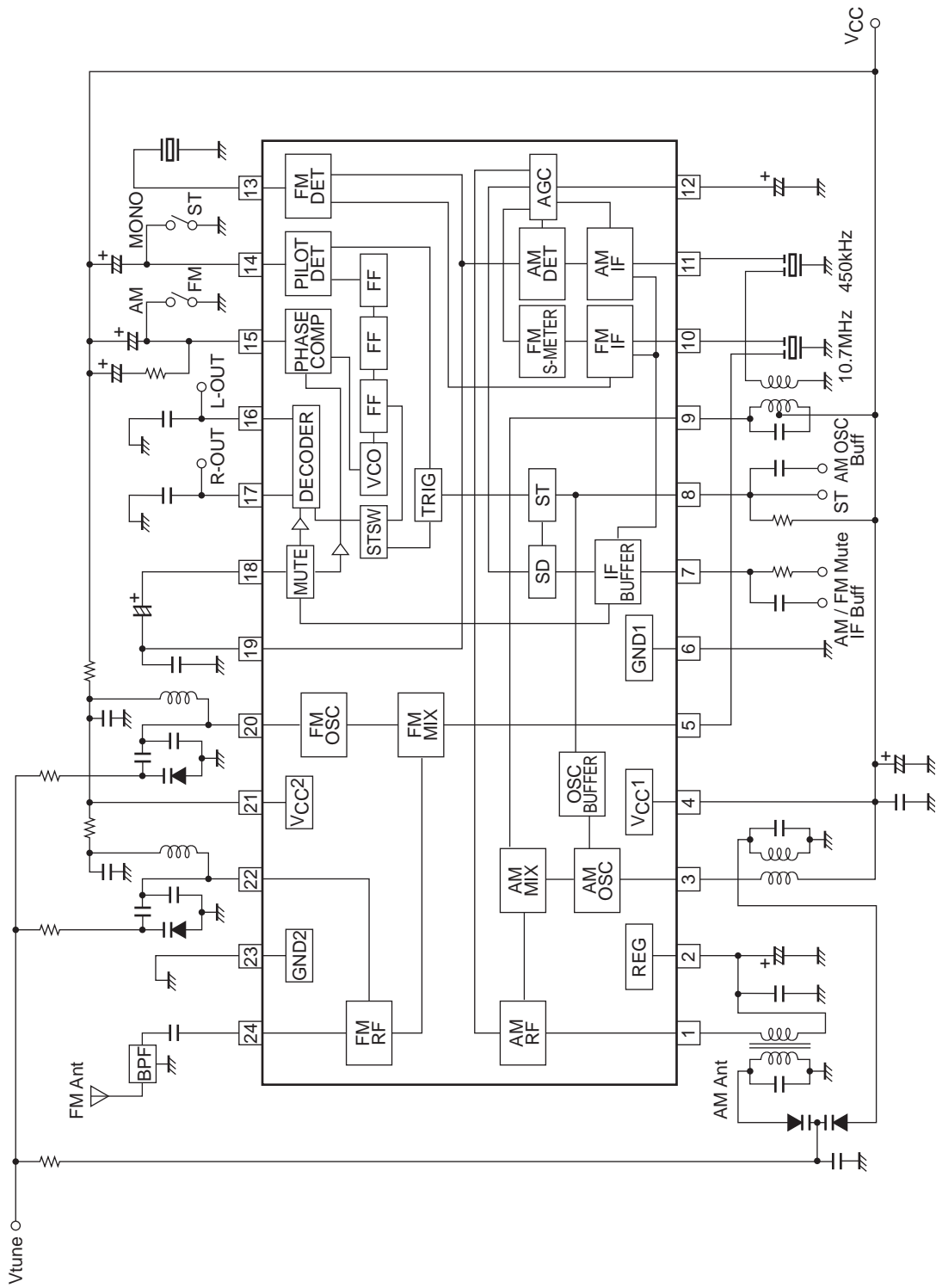
unit : mm (typ)

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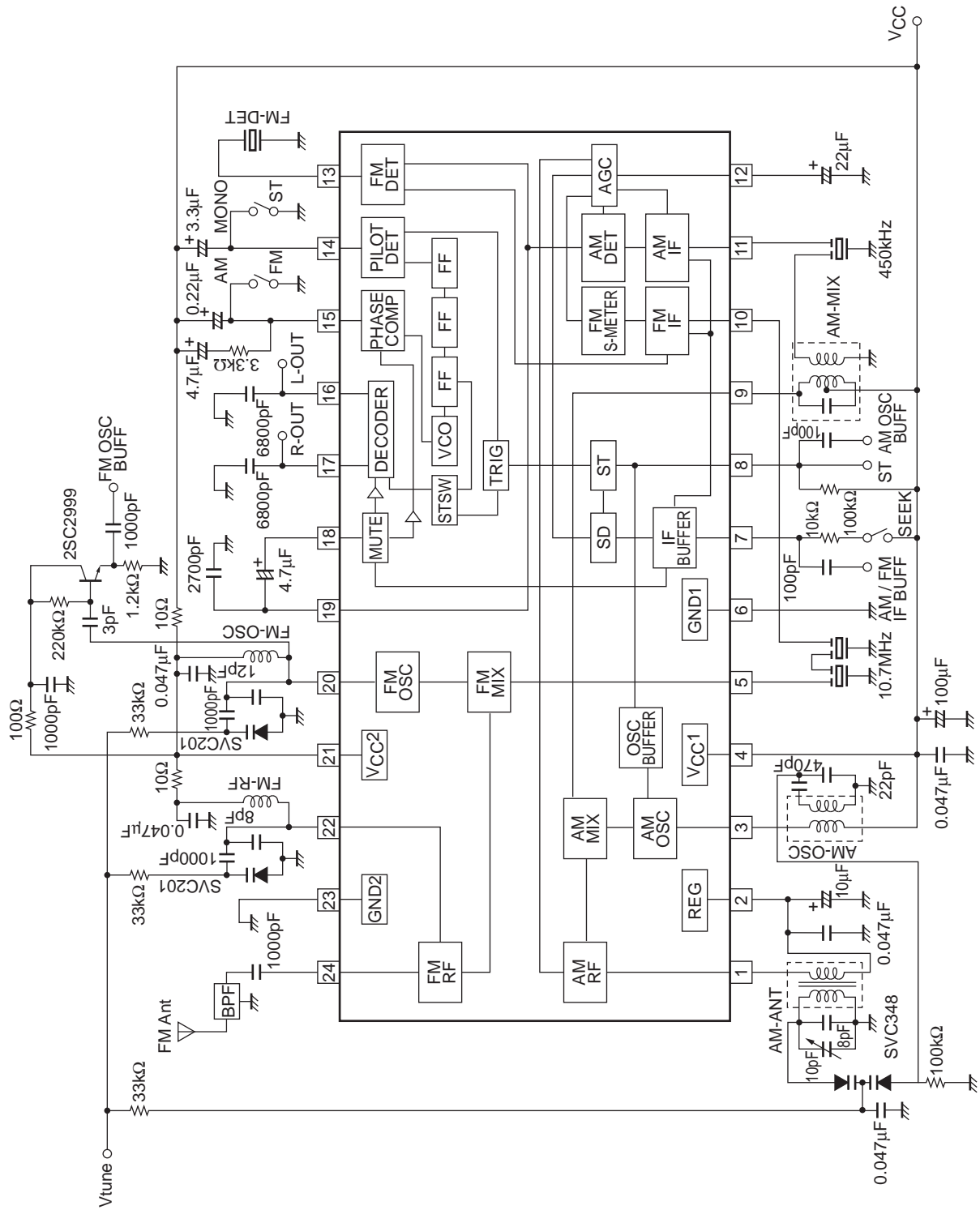
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Block Diagram



Sample Application Circuit Diagram





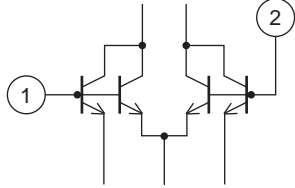
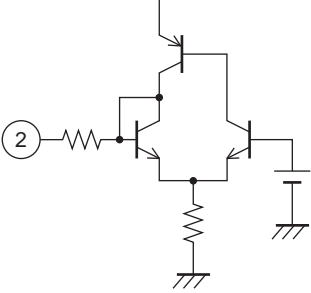
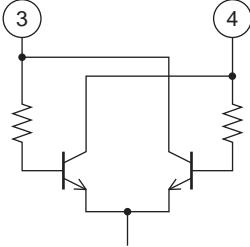
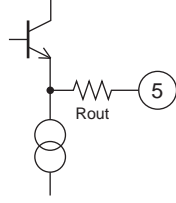
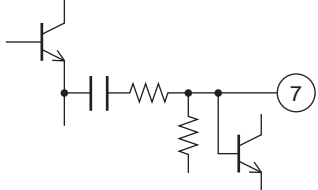
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## Coil specifications (bottom view)

<ul style="list-style-type: none"> <li>• FM-BPF : SA-309 (Sumida) 88MHz to 108MHz</li> </ul>	
<ul style="list-style-type: none"> <li>• FM-RF : SA-149 (Sumida) 3.6mm diameter, air core, 0.6mm wire, 41/2 T</li> </ul>	
<ul style="list-style-type: none"> <li>• FM-OSC : SA-151 (Sumida) 3.6mm diameter, air core, 0.6mm wire, 31/2 T</li> </ul>	
<ul style="list-style-type: none"> <li>• FM-IF filter, discriminator :                      SK107M1-AE-10, CDF107F-AE-029 (Toko)                      SFE10.7MA5, CDA10.7MG1-A (Murata) : tentative</li> </ul>	
<ul style="list-style-type: none"> <li>• AM-OSC : SA-181 (Sumida)</li> </ul> <p style="margin-left: 40px;">             6-4      37T              3-1      74T              0.06UEW  <math>f_o = 796\text{kHz}</math>  <math>Q_o \geq 80</math>  <math>L = 140\mu\text{H}</math> </p>	<ul style="list-style-type: none"> <li>• L7BRS-3132AQ (Toko)</li> </ul> <p style="margin-left: 40px;">             3-1      64T              6-4      32T              0.06-2UEW  <math>f_o = 796\text{kHz}</math>  <math>Q_o \geq 65</math>  <math>L = 140\mu\text{H}</math> </p>
<ul style="list-style-type: none"> <li>• AM-MIX : SA-1136 (Sumida)</li> </ul> <p style="margin-left: 40px;">             3-2      122T              4-6      9T              2-1      62T              0.06UEW  <math>f_o = 450\text{kHz}</math>, <math>Q_o \geq 65</math>              180pF internal         </p>	<ul style="list-style-type: none"> <li>• PCFAZ-082 (Toko)</li> </ul> <p style="margin-left: 40px;">             1-2      47T              2-3      100T              4-6      12T  <math>f_o = 450\text{kHz}</math>              180pF internal              With AM-IF filter         </p> <p style="text-align: center;">ACFA-450L08</p>
<ul style="list-style-type: none"> <li>• AM-IF filter : SFU450B (Murata)</li> </ul>	
<ul style="list-style-type: none"> <li>• MW Bar-antenna : C8E-A0105 (Toko)</li> </ul> <p style="margin-left: 40px;">             1-2      67T              3-4      9T  <math>f_o = 796\text{kHz}</math>  <math>Q_u = 180\text{min}</math>  <math>L = 260\mu\text{H}</math> </p>	

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## Pin Descriptions and Quiescent Voltage at $V_{CC} = 4.5V$

Pin number	Function	Quiescent voltage (V)		Remarks	Equivalent circuit
		AM	FM		
1	AM-RF input	1.2	1.2	Connect the AM antenna coil between this pin and pin 2 (Reg)	
2	Reg	1.2	1.2		
3	AM-OSC	4.5	4.5	Connect the AM oscillator coil between this pin and pin 4 ( $V_{CC1}$ )	
4	$V_{CC1}$	4.5	4.5	AM/FM-IF/MPX block $V_{CC}$	
5	FM-MIX output	2.4	2.2	$R_{out} = 270\Omega$	
6	GND1	0	0	AM/FM-IF/MPX block ground	
7	IF buffer output and mute switch	4.5	4.5	$V_7 \geq 1.3V$ : IF buffer output and muting on	

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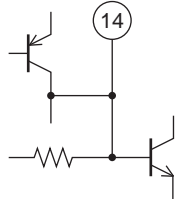
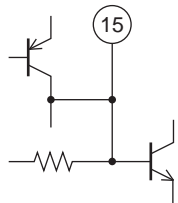
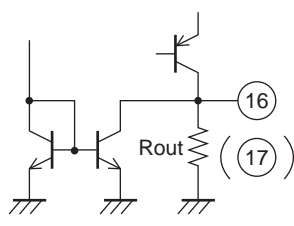
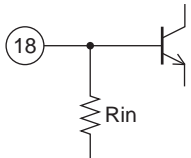
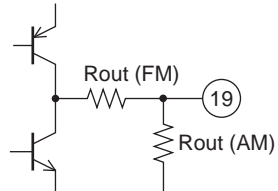
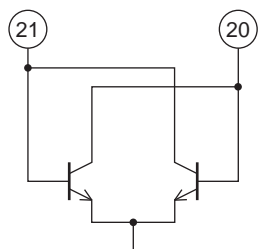
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Pin number	Function	Quiescent voltage (V)		Remarks	Equivalent circuit
		AM	FM		
8	Stereo indicator, AM-oscillator buffer output	4.5	4.5	Active-low Open-collector output  AM oscillator signal is output in AM mode	
9	AM-MIX output	4.5	4.5	Connect the AM mixer coil between this pin and pin 4 (V <sub>CC1</sub> )	
10	FM-IF input	1.2	1.2	R <sub>in</sub> = 330Ω	
11	AM-IF input	1.2	1.2	R <sub>in</sub> = 2kΩ	
12	AM-AGC output and FM signal meter output	0.4	0.1	Internal load resistance R = 16.6kΩ	
13	FM-DET	3.9	3.7	Recommended ceramic discriminator : CDF107F-AE-029 (Toko) CDA10.7MG1-A (Murata, tentative)	

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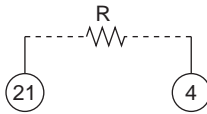
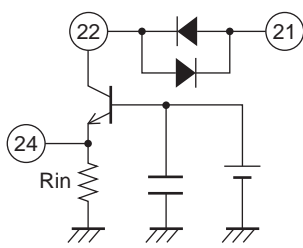
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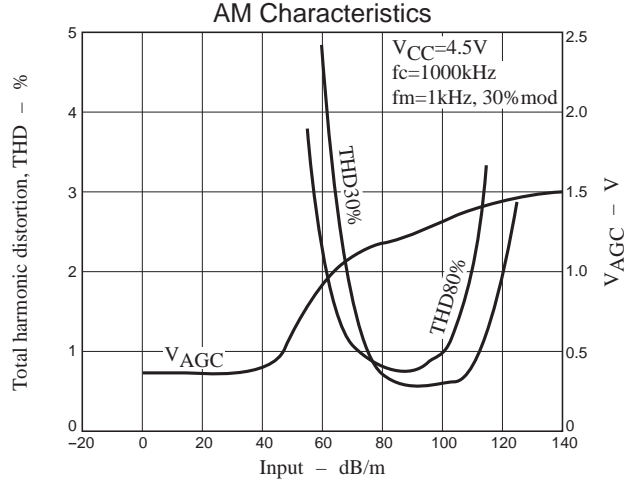
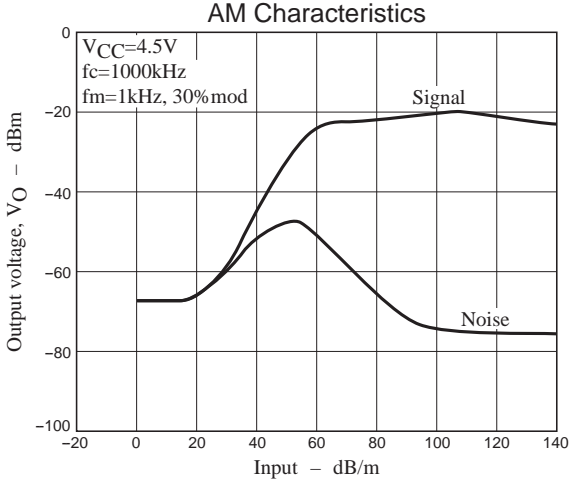
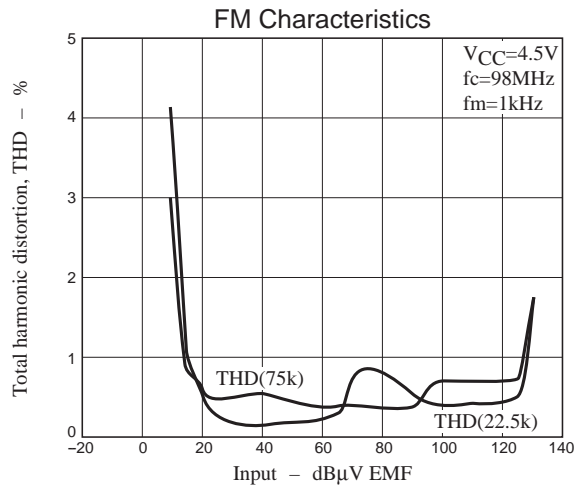
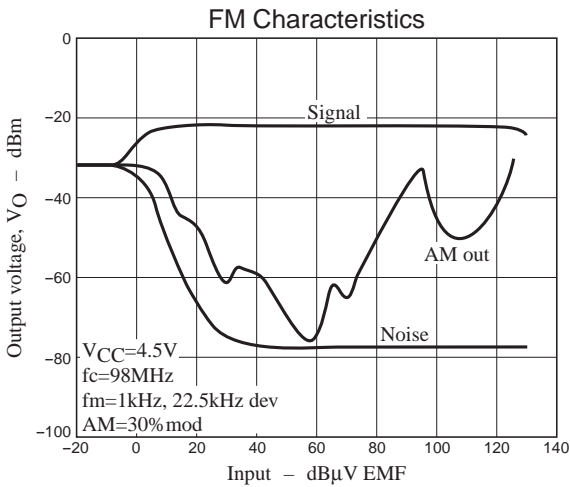
Pin number	Function	Quiescent voltage (V)		Remarks	Equivalent circuit
		AM	FM		
14	Pilot detector filter (forced monaural mode)	2.9	3.8	Forced monaural mode when pin 14 is connected to ground	
15	Phase comparator filter (AM/FM switch)	0	3.8	FM mode is when pin 15 is open, and AM mode is when pin 15 is connected to ground	
16 17	L output R output	1.2	1.2	Rout = 7.5kΩ	
18	MPX input	1.2	1.2	Rin = 50kΩ	
19	AM/FM detector output	0.3	1.0	Output impedance AM : Rout = 50kΩ FM : Rout = 500Ω  The channel separation can be adjusted with an external capacitor connected between this pin and ground	
20	FM-OSC	4.5	4.4	Connect the FM oscillator coil between this pin and pin 21 (VCC2)	

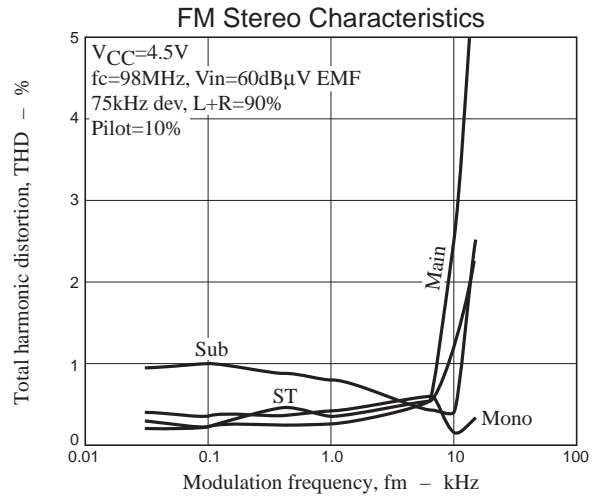
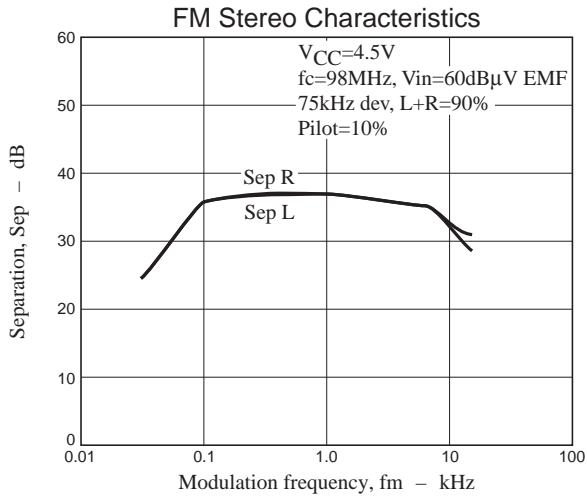
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Pin number	Function	Quiescent voltage (V)		Remarks	Equivalent circuit
		AM	FM		
21	V <sub>CC2</sub>	4.5	4.4	FM-FE block V <sub>CC</sub>  Power is supplied from pin 4 (V <sub>CC1</sub> ) via external resistor (10Ω)	
22	FM-RF output	4.5	4.4	Connect the FM-RF coil between this pin and pin 21 (V <sub>CC2</sub> )  R <sub>in</sub> = 1.8kΩ	
24	FM-RF input	0	0.9		
23	GND2	0	0	FM-FE block ground	





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