

AM/FM Stereo Radio

Description

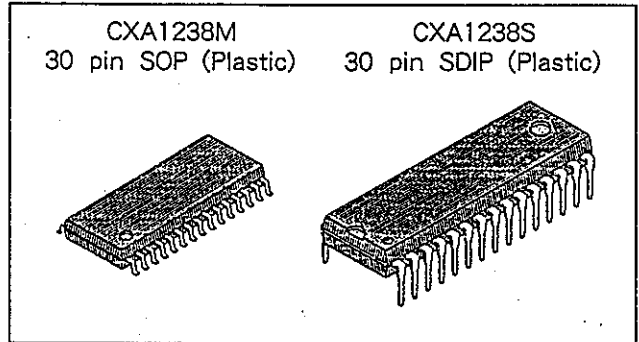
The CXA1238M and CXA1238S are high performance one-chip bipolar ICs designed for AM/FM stereo radios. These include an FM/AM front end, FM/AM IF amplifier, FM/AM detection output and FM stereo demodulator output.

Features

- Low current consumption
(In FM mode $I_D = 11.0$ mA, in AM mode 8.5 mA, $V_{CC} = 6.0V$)
- Built-in LED drive circuit for tuning.
- Built-in LED drive circuit for stereo indicator.
- Built-in detune muting circuit for the FM band.
- Few external parts.

Structure

Bipolar silicon monolithic IC



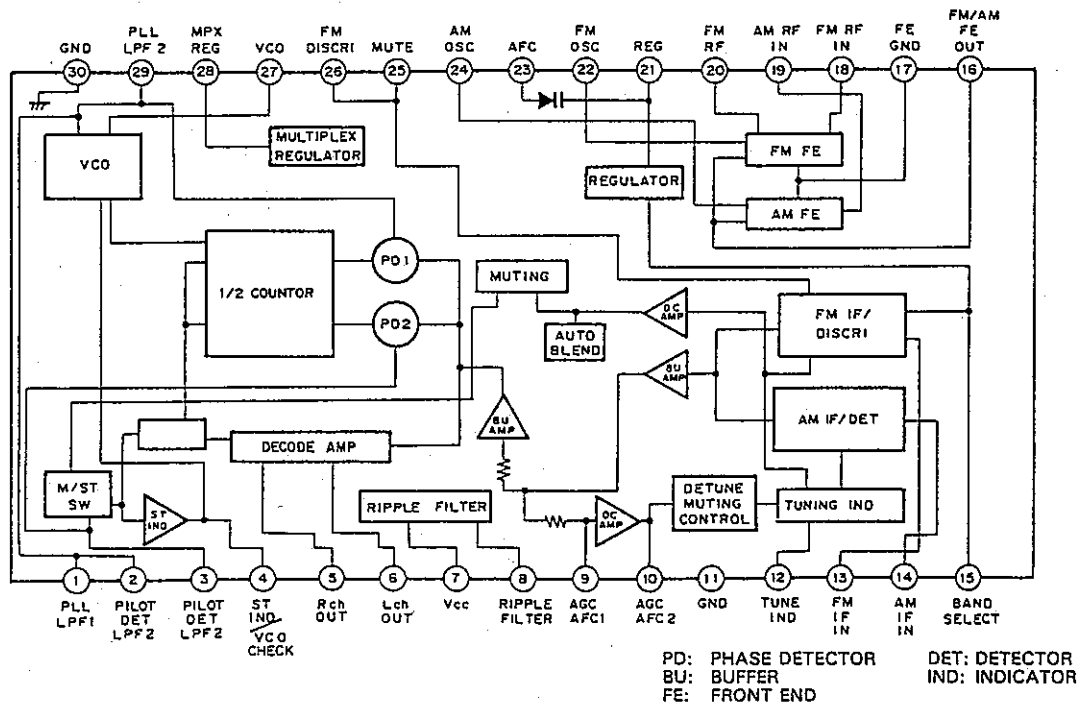
Absolute Maximum Ratings ($T_a = 25^\circ C$)

• Supply voltage	V_{CC}	10	V
• Operating temperature	T_{opr}	-10 to +60	$^\circ C$
• Storage temperature	T_{stg}	-55 to +150	$^\circ C$
• Junction temperature	T_{jmax}	125	$^\circ C$
• Allowable power dissipation	PD	500	mW (CXA1238M) 1050 mW (CXA1238S)

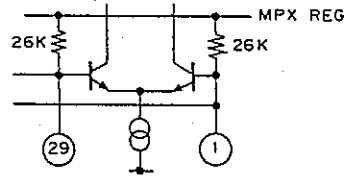
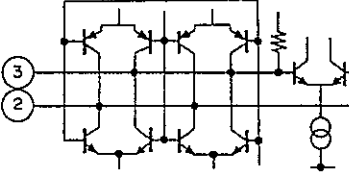
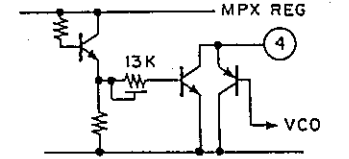
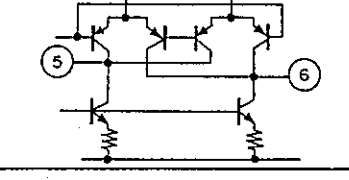
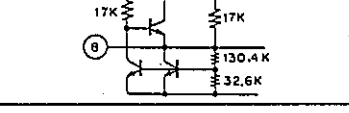
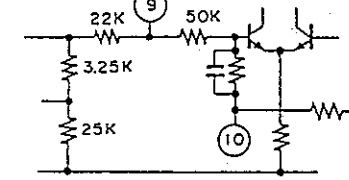
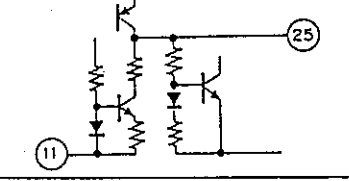
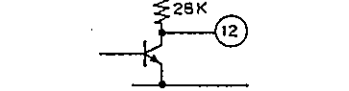
Recommended Operating Conditions

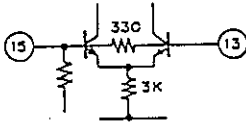
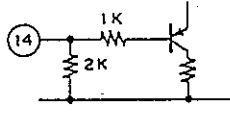
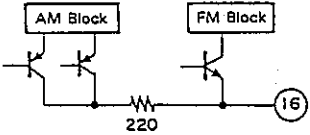
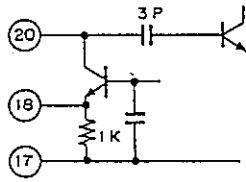
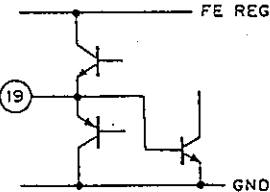
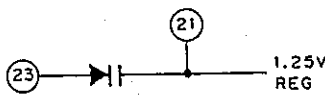
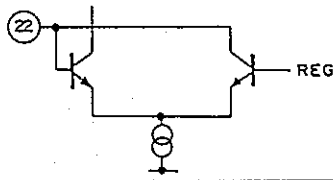
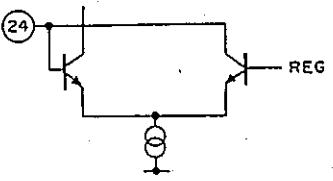
- Supply voltage V_{CC} 2 to 9 V

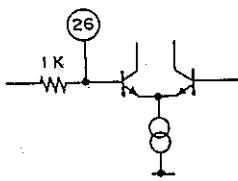

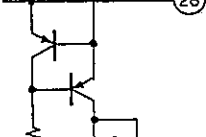
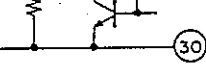
Block Diagram



Pin Description and Equivalent Circuit

No.	Symbol	Pin Voltage (V)				Equivalent Circuit	Description
		Vcc = 3V		Vcc = 6V			
		FM	AM	FM	AM		
1	PLL LPF	0.86	0.86	0.86	0.86		LPF for PLL.
29	PLL LPF2						
2	PILOT DET LPF	0.95	0.95	0.95	0.95		LPF's C (1µF) for PILOT DET inserted between pins 2 and 3.
3	PILOT DET LPF	0.95	0.95	0.95	0.95		
4	ST IND VCO CHECK	1.6	1.6	4.5	4.5		Stereo indicator drive circuit and output for VCO check.
5	Rch OUT	0.66	0.66	1.5	1.5		Stereo Rch output pin
6	Lch OUT	0.66	0.66	1.5	1.5		Stereo Lch output pin
7	Vcc	3.0	3.0	6.0	6.0		Supply pin
8	Ripple FILTER	2.7	2.7	4.0	4.0		Ripple filter
9	AGC/AFC1	1.47	1.15	1.47	1.15		AFC pin in J band, determines time constant of AGC in AM (depending on external capacitor).
10	AGC/AFC2	1.15	1.47	1.15	1.47		AFC pin in W band, determines time constant of AGC in AM (depending on external capacitor).
11	GND	0	0	0	0		GND of FM/AM IF and DET stage.
25	MUTE	0.05	0.01	0.05	0.01		Time constant for muting provided.
12	TUNE IND	1.6	1.6	4.5	4.5		FM/AM tuning indicator drive circuit

No.	Symbol	Pin Voltage (V)				Equivalent Circuit	Description
		Vcc = 3V		Vcc = 6V			
		FM	AM	FM	AM		
13	FM IF IN	1.25	0	1.25	0		FM IF input pin
15	BAND SELECT						FM/AM band switching pin: AM at GNF and FM at OPEN.
14	AM IF IN	0	0	0	0		AM IF input pin
16	FM/AM FE OUT	0.57	0.2	0.8	0.2		AM/FM IF output pin to connect with IF filter.
17	FE GND	0	0	0	0		GND of FM/AM front.
18	FM RF IN	0.3	0	0.3	0		FM RF amplifier circuit for RM RF input.
20	FM RF	1.25	1.25	1.25	1.25		FM RF amplifier circuit to connect to RF tank circuit.
19	AM RF IN	1.25	1.25	1.25	1.25		AM RF input to connect to bar antenna.
21	REG	1.25	1.25	1.25	1.25		Regulator output
23	AFC						Variable capacitance for AFC.
22	FM OSC	1.25	1.25	1.25	1.25		FM local oscillation circuit
24	AM OSC	1.25	1.25	1.25	1.25		AM local oscillation circuit

No.	Symbol	Pin Voltage (V)				Equivalent Circuit	Description
		Vcc = 3V		Vcc = 6V			
		FM	AM	FM	AM		
26	FM DISCRI	2.18	2.70	3.08	3.60		Phase shift circuit to connect to ceramic discriminator.
27	VCO						VCO control pin for stereo demodulation.
28	MPX REG2	1.65	1.65	1.65	1.65		Regulator for MPX.
30	GND	0	0	0	0		GND of MPX block.

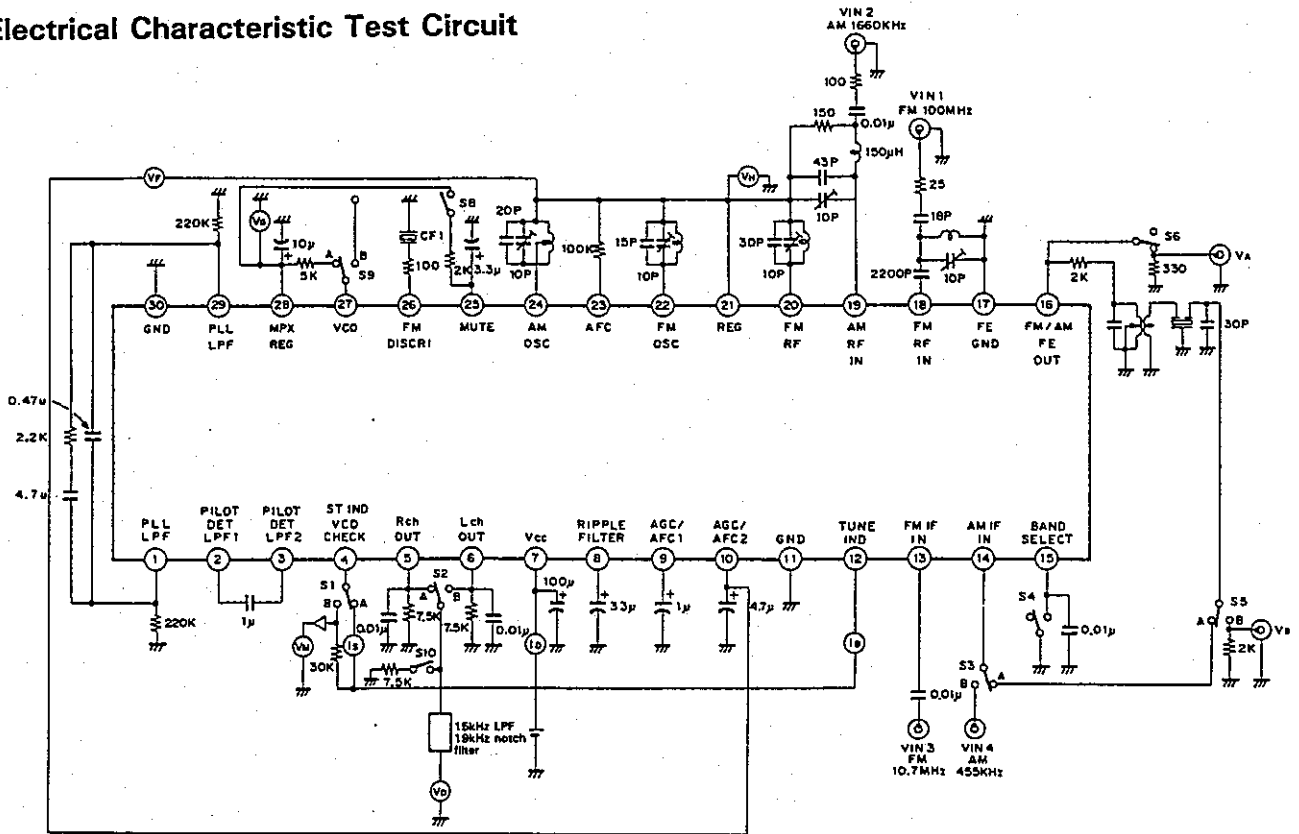
Electrical Characteristics

Ta = 25°C, Vcc = 6V

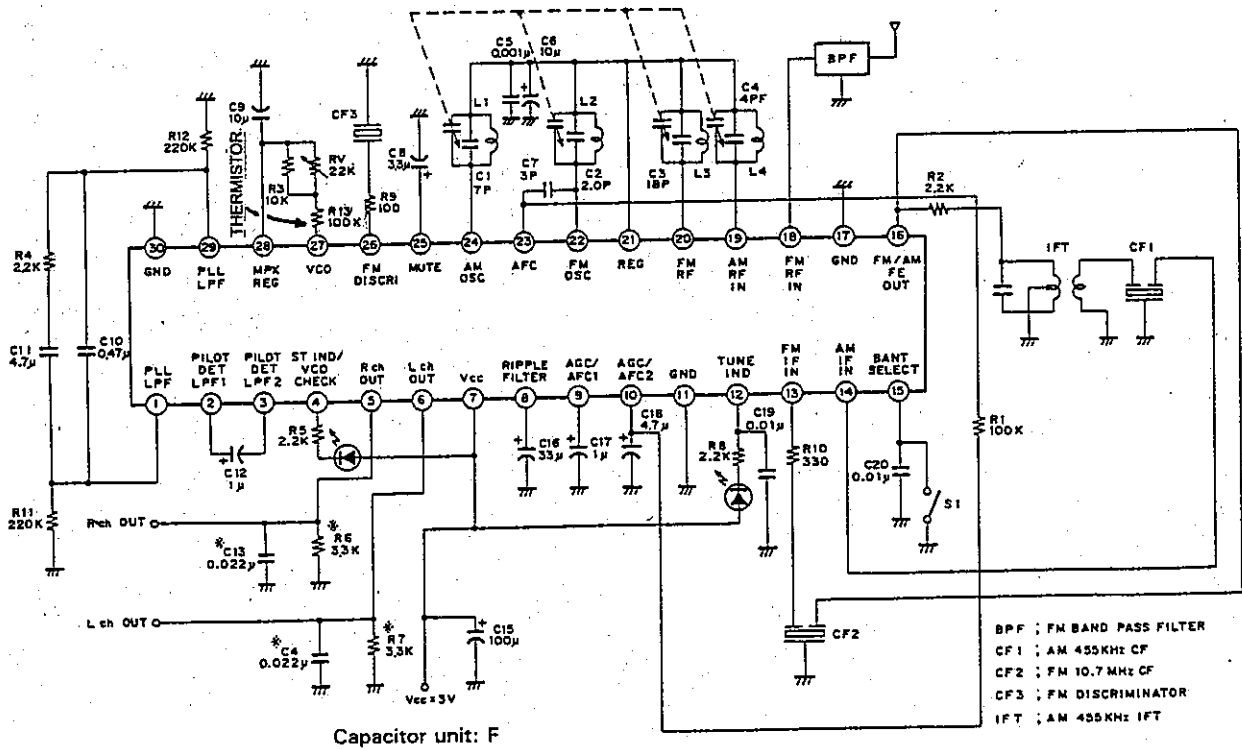
Item	Symbol	Test point	Output waveform and Test method	SW condition										Min.	Typ.	Max.	Unit
				1	2	3	4	5	6	8	9	10					
Circuit current(1)	ID1	I _o	With AM no signal V ₁ to V ₅ input short FM no signal	A	A	A	B	A	B	OFF	A	OFF	5.0	8.5	12.0	mA	
Circuit current(2)	ID2	I _o		▼	▼		A					▼		7.0	11.0	15.0	mA
Separation	SEP	V _o		B	A / B							B	30	40	—	dB	
FM MUTE	A ₁	V _o	V _{IN5} = 245mVrms MONO 1kHz ATT volume for Lch, Rch V _{IN3} = No signal S ₈ ON/OFF V _o , V _o ; 1 kHz sin wave	A	A							ON / OFF	16	23	30	dB	
STEREO indicator output	I _s	I _s	V _{IN5} = 245mVrms MONO STEREO 1kHz (MONO conversion)									OFF	1.8	3.0	5.0	mA	
FM front end voltage gain (1)	GV ₁	V _A	V _{IN1} = 40dBμV 100MHz CW V _A = 10.7MHz CW		▼					A			28	35	42	dB	
FM detection (MONO) output level L,R	VD ₁	V _o	V _{IN3} = 90dBμV 10.7MHz 1kHz 30% MOD V _o = 1kHz sin wave		A / B					B			35.0	77.5	138	mV rms	
FM detection (MONO) L,R (STEREO)				▼													
FM-IF knee level	VD ₂	V _{IN3}	V _{IN3} = 90dBμV 10.7MHz Input level at -3dB of 1kHz 30% MOD output		A								—	25	31	dBμV	
FM-IF distortion L,R (MONO)	THD ₁	V _o	V _{IN3} = 90dBμV 10.7MHz 1kHz 100% MOD V _o = 1kHz sin wave		A / B								—	0.1	2.0	%	
FM-IF distortion L,R (STEREO)				▼										0.1	2.0	%	
FM-IF center frequency deviation	ΔF ₁	V _F	V _{IN3} = 90dBμV 10.7MHz CW Voltage between pins 10 and 21 (Regulated by ±50kHz DC voltage)		A								-50	0	+50	kHz	
FM meter current (1)	I _{B1}	I _B	V _{IN3} = 60dBμV, 10.7MHz CW										1.8	3.5	7.0	mA	
M/ST switching level by IF input	VI ₁	I _s											M→ST 38	43	48	dBμV	
				▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	ST→M 35	41	46
Auto blend	VI ₂	V _{IN3}		A	A	A	A	A	B	OFF	B	OFF	1	10	41	dB	
AM front end voltage gain (2)	GV ₂	V _B	V _{IN2} = 60dBμV 1660kHz CW V _B = 455kHz CW			▼	B	B			A		19	24	28	dB	
AM-IF voltage gain (4)	GV ₃	V _{IN4}	V _{IN4} level at output of 15.5 mVrms		▼	B		A					15	21	29	dBμV	
AM detection output level (L,R)	VD ₃	V _o	V _{IN4} = 85dBμV 455 kHz (1kHz 30% MOD) V _o = 1kHz sin wave		A / B								35.0	77.5	138	mV rms	
AM meter current (2)	I _{B2}	I _B	V _{IN4} = 85dBμV, 455 kHz CW		A	▼							1.3	3.0	7.0	mA	
AM detection output distortion level (L,R)	THD ₂	V _o	V _{IN2} = 95dBμV 1660kHz (1kHz 30% MOD) V _o = 1kHz sin wave	▼	▼	A	▼	▼	▼	▼	▼	▼	—	0.6	2.0	%	

0dBμV = 1μV

Electrical Characteristic Test Circuit

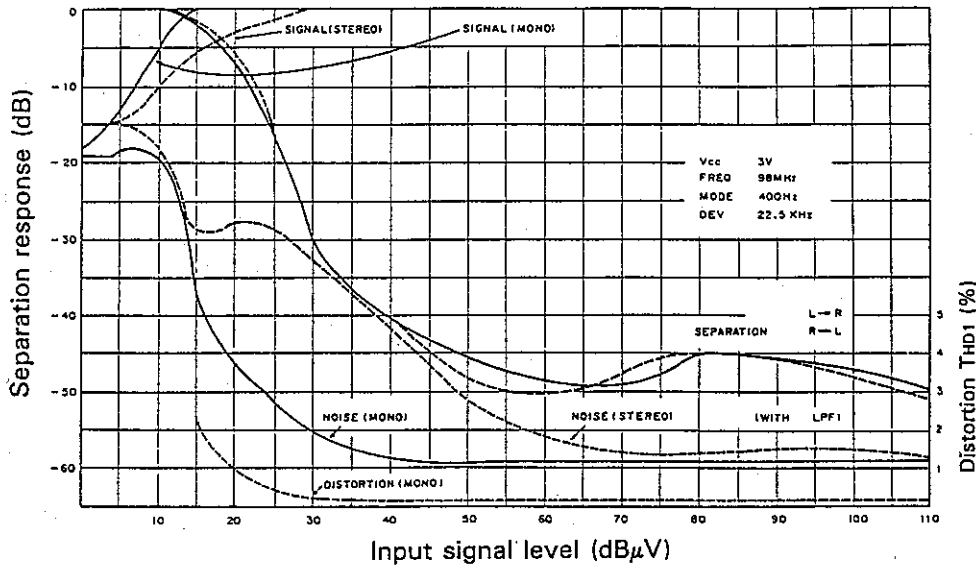


Application Circuit

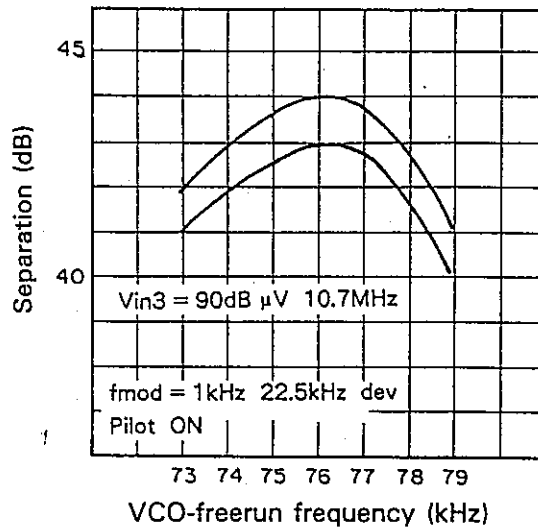
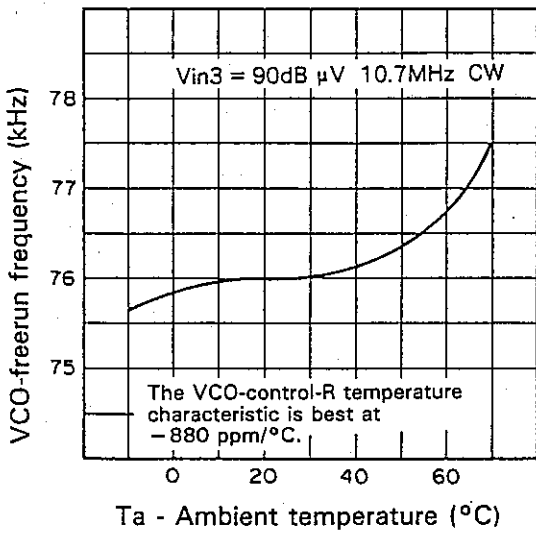
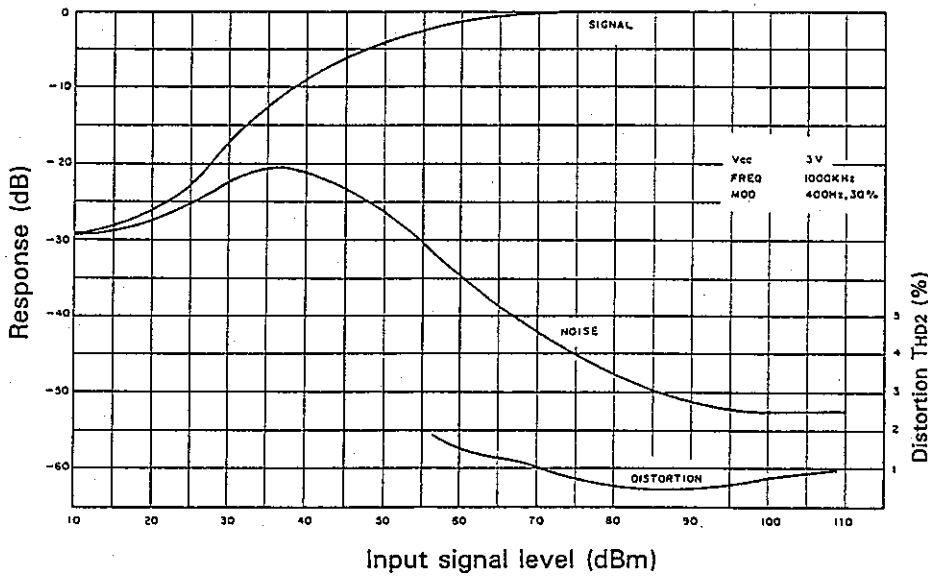


Note) This circuit is an application example and is not guaranteed for all applications.

FM I/O characteristics

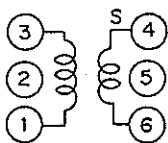


AM I/O characteristics



Coil Data

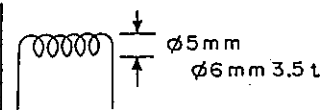
AM OSC



Core diameter ϕ 0.06 mm 2UEW

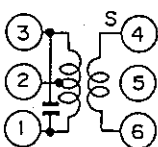
f (kHz)	L (μ H)	Qo	Number of windings (t)	
			1 to 3	4 to 6
796	270	125	107	29

FM RF



Equivalent to L-5K7H5 R12-1684X, Mitsumi Electric Co., Ltd. or 7TRS-8441 TOKO Co., Ltd.

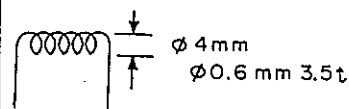
AM IFT



Core diameter ϕ 0.07 mm UEW

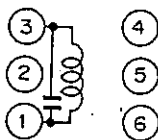
Co (pF)	Qo	Number of windings (t)		
		1 to 2	2 to 3	4 to 6
180	90	111	35	7

FM OSC



Equivalent to 21K7H5 R12-8558A, Mitsumi Electric Co., Ltd. or 7MC-7789N TOKO Co., Ltd.

FM Discriminator

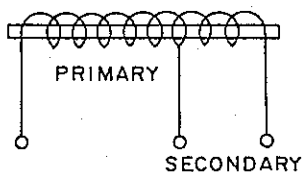


Core diameter ϕ 0.1 mm 2UEW

Co (pF)	Qo	Number of windings (t)		
		1 to 3		
82	95	11		

Equivalent to 119ASC-12200Z, TOKO Co., Ltd.

AM Bar Antenna



f (kHz)	L (μ H)	Primary	Secondary
796	650	91t	20t

PFWE8

BPF

(88 to 108MHz) Soshin Electric Co., Ltd.

CF1

SFU-455B Murata Mfg. Co., Ltd. or BFCFL-455 TOKO Co., Ltd.

CF2

SFE10.7MA5 Murata Mfg. Co., Ltd.

CF3

CDA10.7MG1 Murata Mfg. Co., Ltd.

VC

PVC2LXT16L Mitsumi Electric Co., Ltd.

VC (Rear Mount)

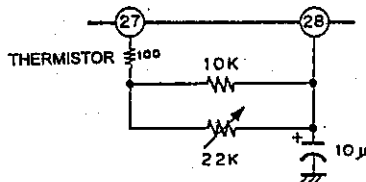
HU22124N700 TOKO Co., Ltd.

PVC2LXT16B Mitsumi Electric Co., Ltd.

Notes on Applications

1. VCO free run frequency adjustment method

As this IC has built-in oscillation capacitance, the oscillation frequency can be controlled with an external resistor.

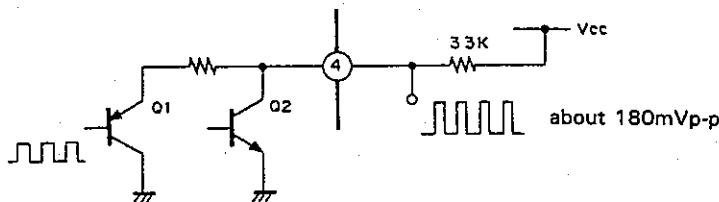


Capacitor for decoupling

1) VCO Adjustment Method

Pin 4 is the stereo indicator and VCO check pin. Therefore, in stereo mode (when stereo indicator drive Tr Q2 is switched on), pin 4 voltage lowers down, Q1 is cut off and VCO oscillation waveform can not be seen. In AM mode as well, the oscillation waveform can not be seen as VCO turns off.

Adjust the free run frequency at 76 kHz \pm 50 Hz.

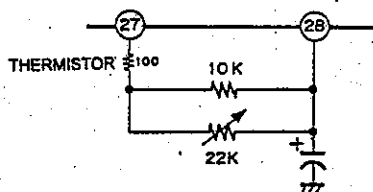


In this IC, tuner and MPX sections are directly connected. Therefore, free run frequency is not stable, being affected by noise except in reception mode. For free run adjustment, input signals from either RF or IF.

(Input signal should be RF [Tuning frequency] or IF (10.7 MHz) and input more than 60 dB μ .)

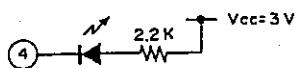
2) Control Resistor of VCO Oscillation Frequency

For the VCO control resistor of this IC, a carbon film resistor suffices. For easier adjustment of temperature characteristics and VCO free run frequency, the following combination is recommended.

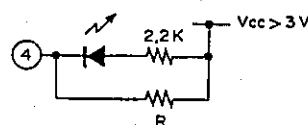


3) How to Deal with pin 4 After Adjustment.

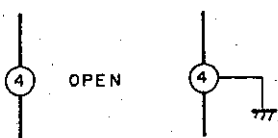
With the use of a stereo indicator.



When Vcc is 3V or more, insert a bypass resistance R to prevent LED malfunction.



Without the use of a stereo indicator.



Turn pin 4 to open or drop to GNG.

2. MPX circuit

1) MPX load resistance

When power supply voltage is over 3V, change the MPX load resistor R6, R7 from 3.3 kΩ to 6.8 kΩ.

In this case, the output level is increased by about 6 dB.

2) Time constant of de-emphasis

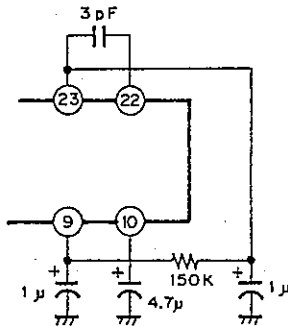
Refer to the following table as the time constant is determined at C12 and C14.

	3.3 kΩ	6.8 kΩ
50 μs	0.015μF	0.0082μF
75μs	0.022μF	0.012 μF

3. AFC circuit

1) This IC has a built in variable capacitances.

Change to the following circuit when designing J band, because the standard circuit is for W band.

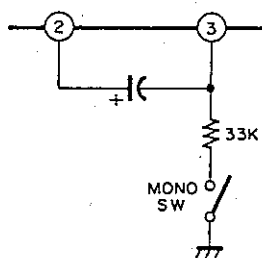


2) AFC pull-in range is expanded by increasing the capacitance of standard circuit C7 3pF. Adjust the value of capacitance according to the set specification.

4. Auto blend circuit

This IC has a built-in auto blend circuit and a MONO switch is not required as a rule. This circuit controls the separation in proportion to the signal level and reduces noise automatically for stereo reception below the mid electric field when the electric field strength reaches lower than about 40 dBμ. When the electric field strength turns below 10 to 15 dBμ, MONO operation is automatically activated.

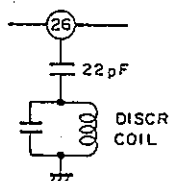
To switch MONO mode on externally, ground pin 3 with 33 kΩ.



5. FM discriminator

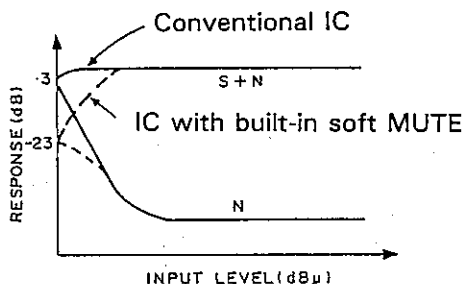
For FM detection, the quadrature detection system is adopted. As a phase shifter, a ceramic resonator (CF 3 Discriminator) applies to achieve adjustment-free detection. Though the sensitivity and selectability will be slightly affected, the discriminator can be replaced by a coil as shown below. Combining CF2 (FMIF) and CF3 (PM discriminator) poses problems with the distortion factor when deviation with the IF band central frequency f_0 occurs. To this effect, use pairs of the same rank as indicated in the chart.

	f_0 of CF2 and CF3
A Red	10.70 MHz
B Blue	10.67 MHz
C Orange	10.73 MHz
D Black	10.64 MHz
E White	10.76 MHz



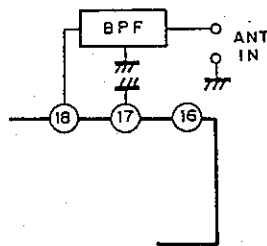
6. FM muting circuit

This IC has a built-in soft muting circuit. As shown in the following I/O characteristics diagram, 23 dB (Typ.) muting is applied and noise level reduced during weak electric field and out of tune instances.



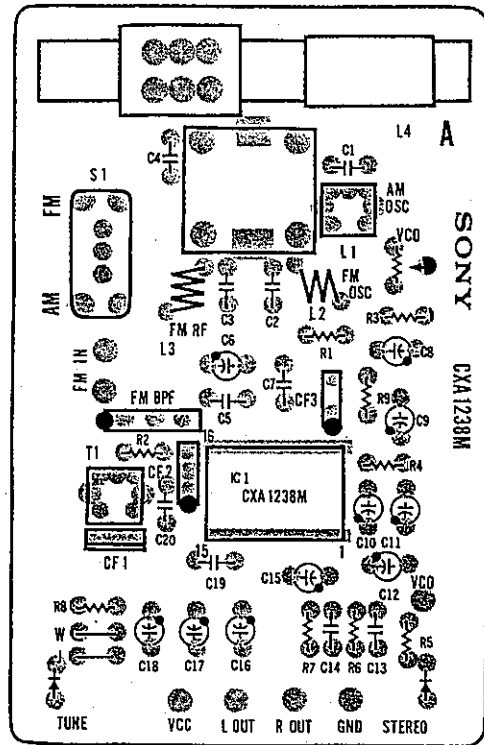
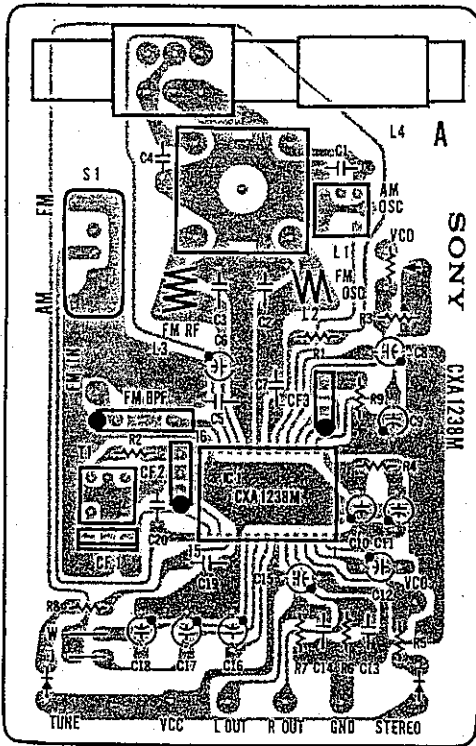
7. Notes on patterns

- 1) Positions of FM, ANT and OSC coils
Locate those at right angles to each others to avoid inductance M through coupling. Further, insert a pin 21 pattern between patterns of pins 22, 30 and coils. (See the reference circuit board).
- 2) Tuning circuit
As the capacitances C1 to C4, L2 and L3 are the constants on the standard circuit board, check the constants when a new circuit board is used.
- 3) Grounding pins
Pin 17 is a grounding pin for AM, FM and FE; pin 11 for IF; and pin 30 for MPX. Use as thick as possible a pattern since the grounding between ANT IN, BPF and pin 11 significantly stability, NF and characteristics affects.

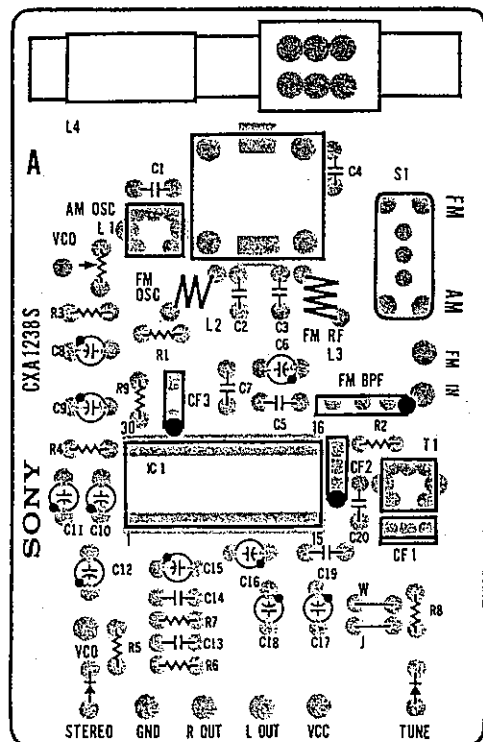
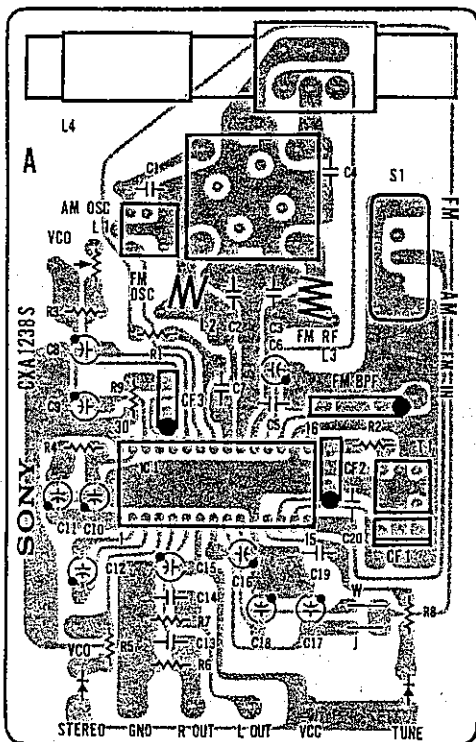


- 4) Ground bypass capacitors C5 (0.001μF) and C6 (10μF) connected to pin 21 as close as possible to pin 17.

CXA1238M



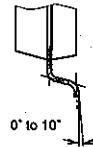
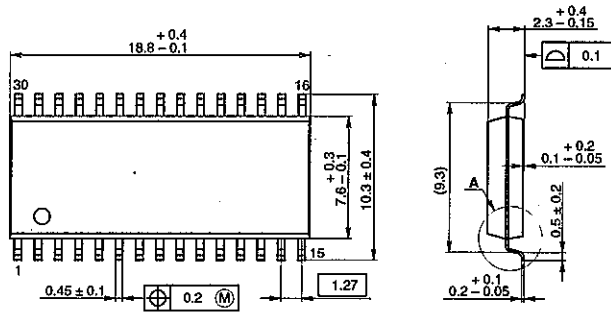
CXA1238S



Package Outline Unit:mm

30PIN SOP (PLASTIC)

CXA1238M



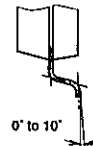
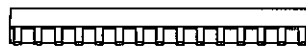
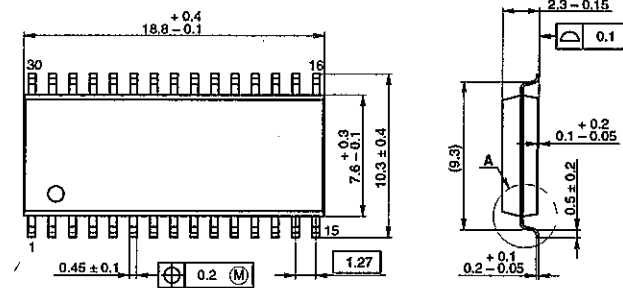
DETAIL A

SONY CODE	SOP-30P-L03
EIAJ CODE	SOP030-P-0375
JEDEC CODE	

PACKAGE STRUCTURE

PACKAGE MATERIAL	EPOXY RESIN
LEAD TREATMENT	SOLDER PLATING
LEAD MATERIAL	COPPER ALLOY
PACKAGE MASS	0.7g

30PIN SOP (PLASTIC)



DETAIL A

SONY CODE	SOP-30P-L03
EIAJ CODE	SOP030-P-0375
JEDEC CODE	

PACKAGE STRUCTURE

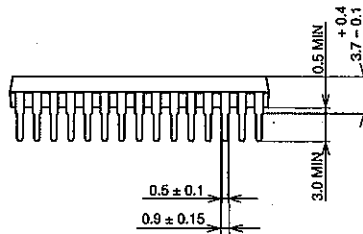
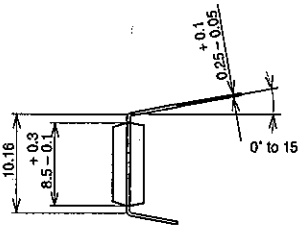
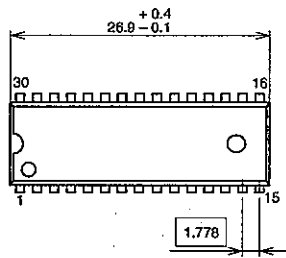
PACKAGE MATERIAL	EPOXY RESIN
LEAD TREATMENT	SOLDER PLATING
LEAD MATERIAL	COPPER ALLOY
PACKAGE MASS	0.7g

LEAD PLATING SPECIFICATIONS

ITEM	SPEC.
LEAD MATERIAL	COPPER ALLOY
SOLDER COMPOSITION	Sn-Bi:Bi:1-4wt%
PLATING THICKNESS	5-18µm

CXA1238S

30PIN SDIP (PLASTIC)



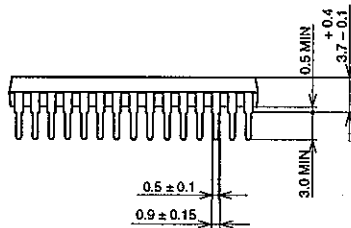
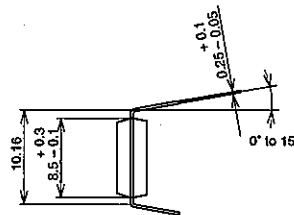
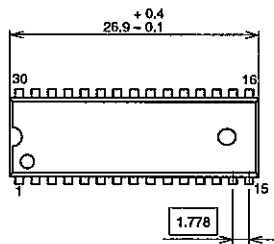
Two kinds of package surface:
 1. All mat surface type.
 2. All mirror surface type.

PACKAGE STRUCTURE

SONY CODE	SDIP-30P-01
EIAJ CODE	P-SDIP30-8.5x26.9-1.778
JEDEC CODE	

MOLDING COMPOUND	EPOXY RESIN
LEAD TREATMENT	PALLADIUM PLATING
LEAD MATERIAL	COPPER ALLOY
PACKAGE MASS	1.8g

30PIN SDIP (PLASTIC)



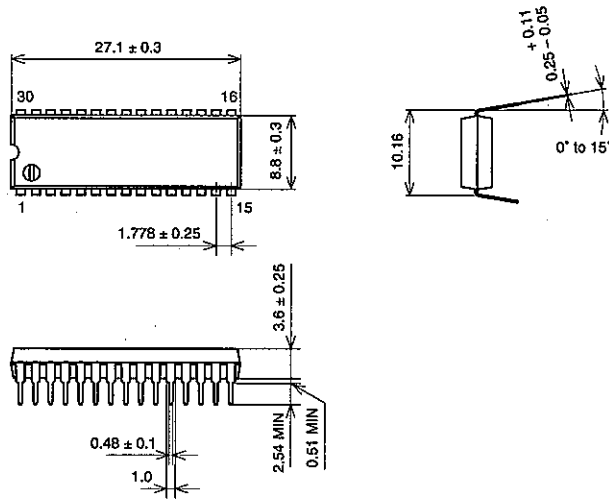
Two kinds of package surface:
 1. All mat surface type.
 2. All mirror surface type.

PACKAGE STRUCTURE

SONY CODE	SDIP-30P-01
EIAJ CODE	P-SDIP30-8.5x26.9-1.778
JEDEC CODE	

MOLDING COMPOUND	EPOXY RESIN
LEAD TREATMENT	SOLDER PLATING
LEAD MATERIAL	COPPER ALLOY
PACKAGE MASS	1.8g

30PIN SDIP (PLASTIC) 400mil



SONY CODE	SDIP-30P-051
EIAJ CODE	SDIP030-P-0400-AH
JEDEC CODE	_____

PACKAGE STRUCTURE

PACKAGE MATERIAL	EPOXY RESIN
LEAD TREATMENT	SOLDER PLATING
LEAD MATERIAL	42 ALLOY
PACKAGE MASS	1.9g