SONY

FM/AM Stereo Radio

CXA1838N

Description

The CXA1838N is the high performance one-chip bipolar IC designed for FM/AM stereo radios.
This IC includes 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}=6.0 V）
- ◆LED drive circuit for tuning
- ◆LED drive circuit for stereo indicator
- ◆Muting circuit for the FM band
- ◆Few external parts

Package

30 pin SSOP（Plastic）

Structure

Bipolar silicon monolithic IC

Absolute Maximum Ratings

（Ta=25 ˚C）

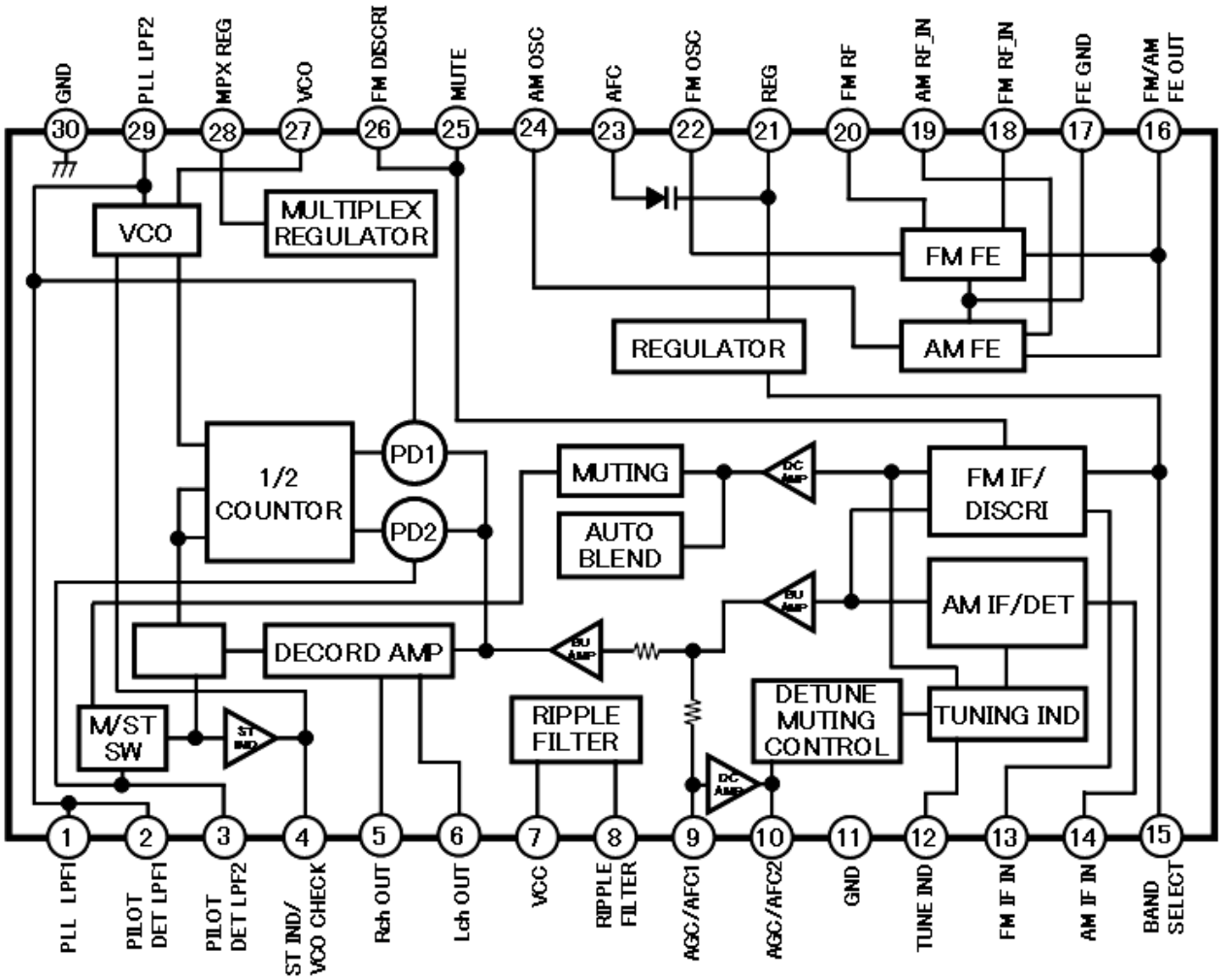
Supply voltage	V_{CC}	10	V
Operating temperature	Topr	-10 to +60	˚C
Storage temperature	Tstg	-55 to +150	˚C
Junction temperature	Tjmax	125	˚C
Allowable power dissipation	P_D	500	mW

Recommended Operating Conditions

Supply voltage	V_{CC}	2 to 9	V

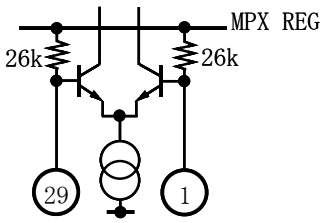
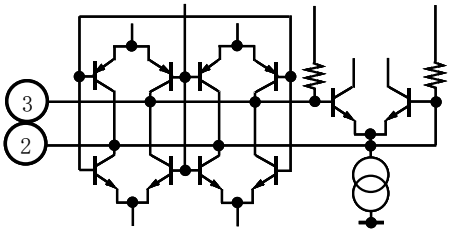
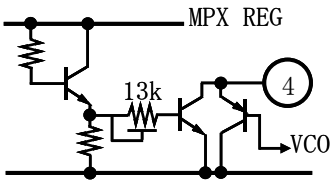
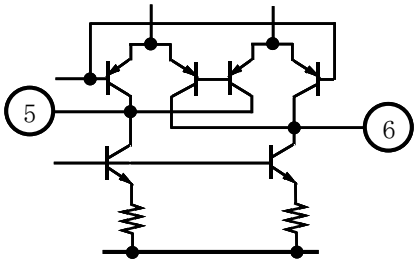
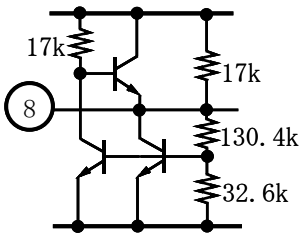
E12307

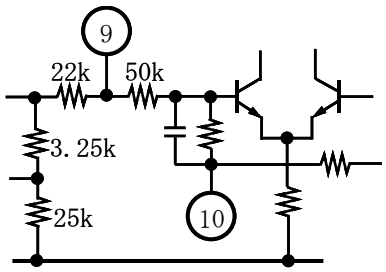
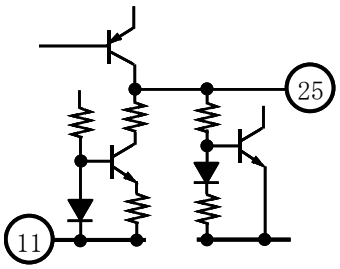
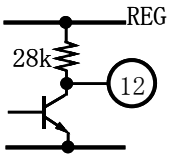
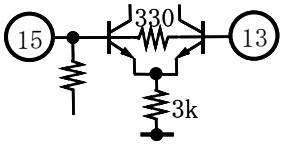
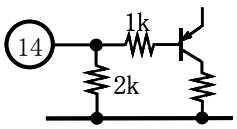
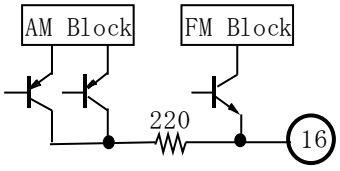
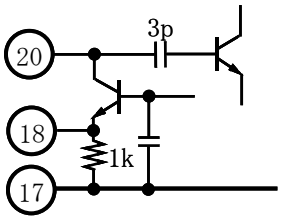
Block Diagram

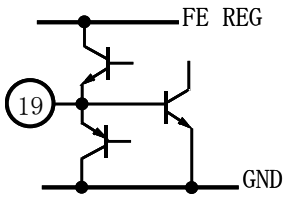
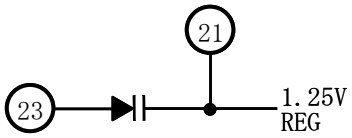
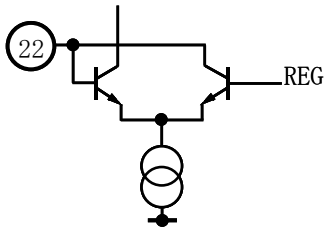
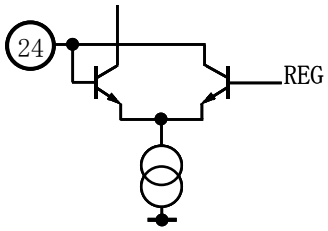
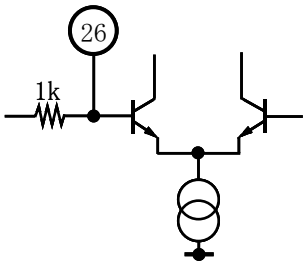
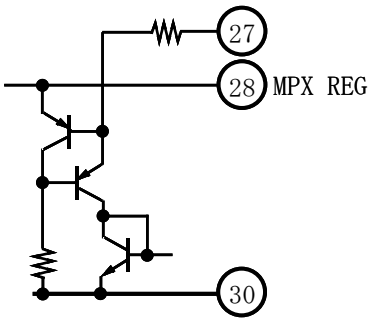


PD : PHASE DETECTOR
BU : BUFFER
FE : FRONT END
DET : DETECTOR
IND : INDICATOR

Pin Description and Equivalent Circuit

Pin No.	Symbol	Pin Voltage (V)				Equivalent circuit	Description
		V_{CC}=3 V		V_{CC}=6 V			
		FM	AM	FM	AM		
1	PLL LPF1	0.86	0.86	0.86	0.86		LPF for PLL
29	PLL LPF2						
2	PILOT DET LPF1	0.95	0.95	0.95	0.95		LPF capacitor (1 µF) for PILOT DET inserted between Pins 2 and 3.
3	PILOT DET LPF2	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	V_{CC}	3	3	6	6		Supply pin.
8	RIPPLE FILTER	2.7	2.7	4	4		Ripple filter.

Pin No.	Symbol	Pin Voltage (V)				Equivalent circuit	Description
		V_{CC}=3 V		V_{CC}=6 V			
		FM	AM	FM	AM		
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		AM/FM tuning indicator drive circuit.
13	FM IF IN	1.25	0	1.25	0		FM IF input pin.
15	BAND SELECT						FM/AM band switching pin: AM at GND 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 to IF filter.
17	FE GND	0	0	0	0		GND for FM/AM front end.
18	FM RF IN	0.3	0	0.3	0		FM RF amplifier circuit for FM RF input.
20	FM RF	1.25	1.25	1.25	1.25		FM RF amplifier circuit to connect to FM tank circuit.

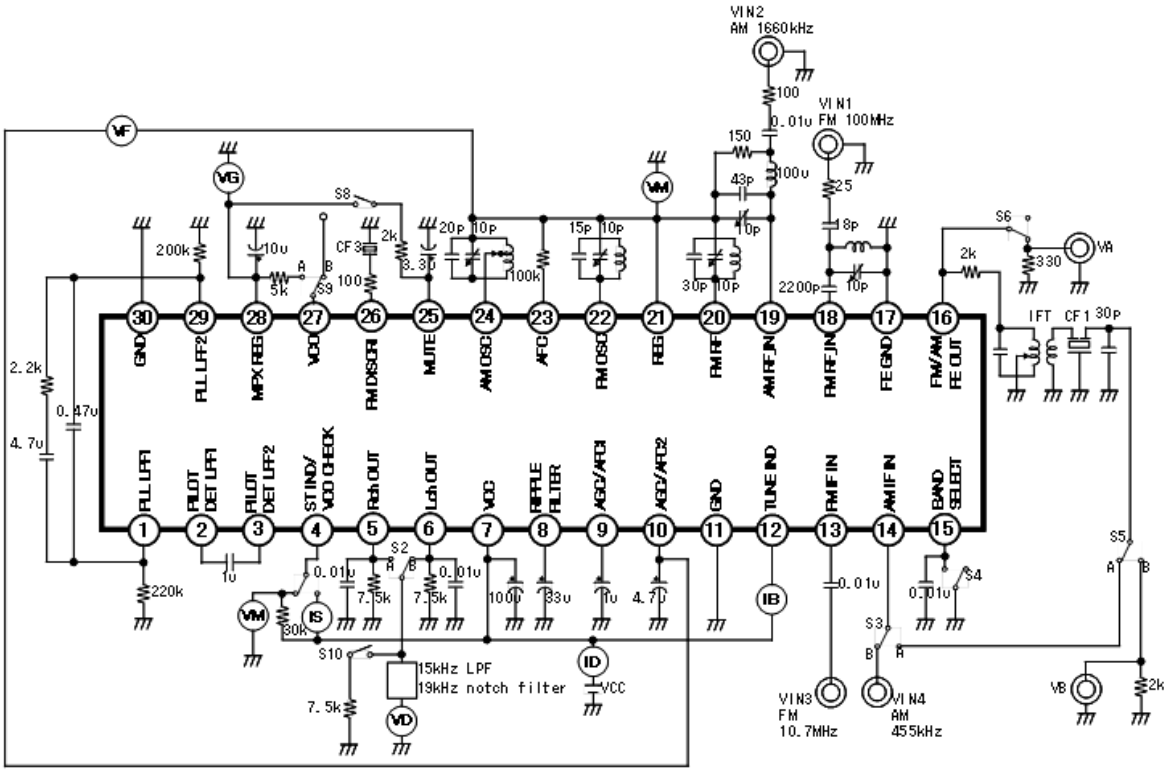
Pin No.	Symbol	Pin Voltage (V)				Equivalent circuit	Description
		V_{CC}=3 V		V_{CC}=6 V			
		FM	AM	FM	AM		
19	AM RF IN	1.25	1.25	1.25	1.25		AM RF input to connect to bar antenna.
21	REG	1.25	1.25	1.25	1.25		Regulator output
23	AFC						Variable capacitance for AFC
22	FM OSC	1.25	1.25	1.25	1.25		FM local oscillation circuit.
24	AM OSC	1.25	1.25	1.25	1.25		AM local oscillation circuit.
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 REG	1.65	1.65	1.65	1.65		Regulator for MPX.
30	GND	0	0	0	0		GND of MPX block.

Electrical Characteristics

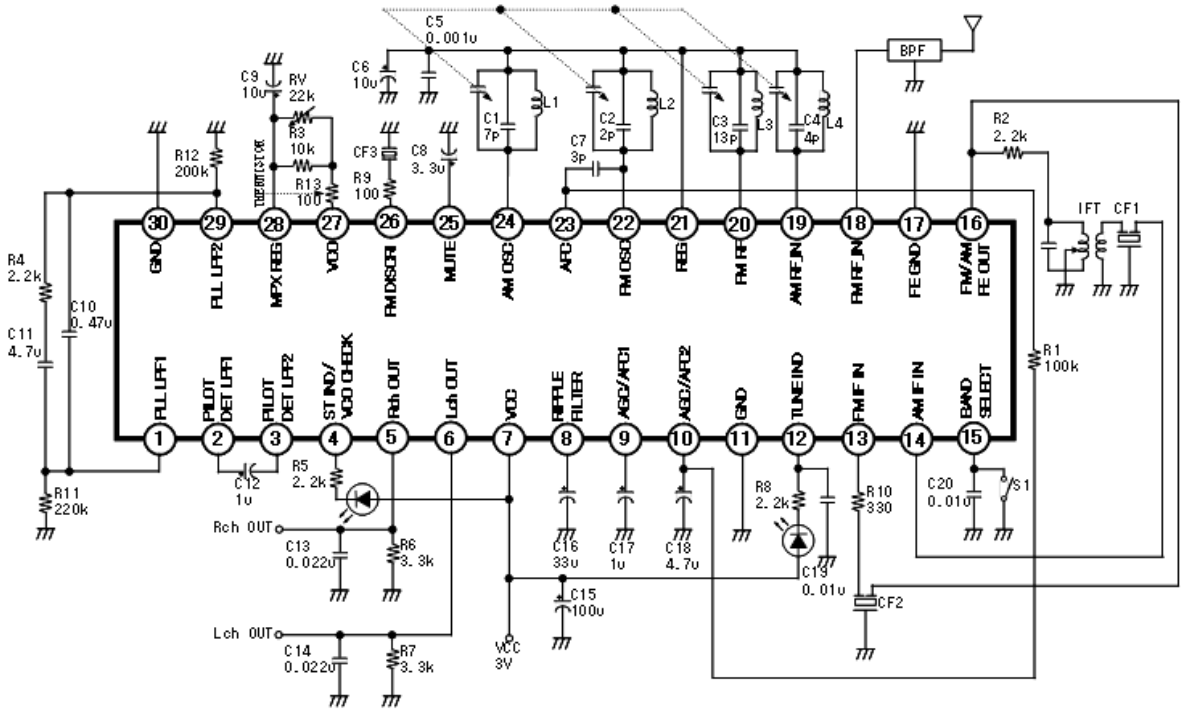
Electrical Characteristics (Ta=25℃、Vcc=6V) 0dBμ V=1μ V

Item	Signal	Measure-ment point	Output waveform and measurement method	SW condition									Min.	Typ.	Max.	Unit
				1	2	3	4	5	6	8	9	10				
AM circuit current	ID1	ID	V1 to V5 input shorted with AM no signal	A	A	A	B	A	B	OFF	A	OFF	5.0	8.5	12.0	mA
FM circuit current	ID2	ID	V1 to V5 input shorted with FM no signal	↓	↓	↓	A	↓	↓	↓	↓	↓	7.0	11.0	15.0	mA
Separation	SEP	VD	Separation when Vin3=50dBμ V 10.7MHz, 1kHz 22.5kHz dev. input	B	A/B	↓	↓	↓	↓	↓	B	↓	30	40	–	dB
FM MUTE	A1	VD	ATT amount of noise level for Vin3=no signal S8 ON/OFF	A	A	↓	↓	↓	↓	OFF /ON	↓	↓	16	23	30	dB
STEREO indicator output	IS	IS	Vin3=60dBμ V 10.7MHz CW, pilot on	↓	↓	↓	↓	↓	↓	OFF	↓	↓	1.8	3.0	7.0	mA
FM front end voltage gain	GV1	VA	Vin1=40dBμ V 100MHz CW, VA=10.7MHz CW	↓	↓	↓	↓	↓	A	↓	↓	↓	28	35	42	dB
FM detection outout level L,R(MONO)	VD1	VD	Vin3=90dBμ V 10.7MHz, 1kHz 22.5kHz dev. VD=1kHz sin wave	↓	A/B	↓	↓	↓	B	↓	↓	↓	35.0	77.5	138	mVrms
FM detection output level L,R(STEREO)																
FM IF knee level	VD2	Vin3	Input level decreased by 3dB compared to the output when Vin3=90dBμ V 10.7MHz, 1kHz 22.5kHz dev.	↓	A	↓	↓	↓	↓	↓	↓	↓	–	25	31	dBμ V
FM IF distortion L,R(MONO)	THD1	VD	Vin3=90dBμ V 10.7MHz, 1kHz 75kHz dev. VD=1kHz sin wave	↓	A/B	↓	↓	↓	↓	↓	↓	↓	–	0.1	2.0	%
FM IF distortion L,R(STEREO)																
FM IF center frequency deviation	△F1	VF	Vin3=90dBμ V 10.7MHz CW	↓	A	↓	↓	↓	↓	↓	↓	↓	−50	0	50	kHz
FM meter current	IB1	IB	Vin3=60dBμ V 10.7MHz CW	↓	↓	↓	↓	↓	↓	↓	↓	↓	1.8	3.5	7.0	mA
MONO/STEREO switching level by IF input	VI1	IS	MONO → STEREO switching level	↓	↓	↓	↓	↓	↓	↓	↓	↓	36	43	48	dBμ V
			STEREO → MONO switching level										33	41	46	
Auto blend	VI2	VIN3		↓	A/B	↓	↓	↓	↓	↓	↓	↓	1	10	41	dB
AM front end voltage gain	GV2	VB	Vin2=60dBμ V 1660kHz CW, VB=455kHz CW	↓	A	↓	B	B	↓	↓	A	↓	19	24	28	dB
AM IF voltage gain	GV3	VIN4	Vin4 level at output of 15.5mVrms	↓	↓	B	↓	A	↓	↓	↓	↓	15	21	29	dBμ V
AM detection output level L,R	VD3	VD	Vin4=85dBμ V 455kHz (1kHz 30% MOD) VD=1kHz sin wave	↓	A/B	↓	↓	↓	↓	↓	↓	↓	35.0	77.5	138	mVrms
AM IF distortion L,R	THD2	IB	Vin2=95dBμ V 1660kHz (1kHz 30% MOD) VD=1kHz sin wave, VCC=7.8V	↓	↓	↓	↓	↓	↓	↓	↓	↓	–	0.6	2.0	%
AM meter current	IB2	VD	Vin4=85dBμ V 455KkHz CW	↓	A	A	↓	↓	↓	↓	↓	↓	1.3	3.0	7.0	mA

Electrical Characteristics Measurement Circuit



Application Circuit

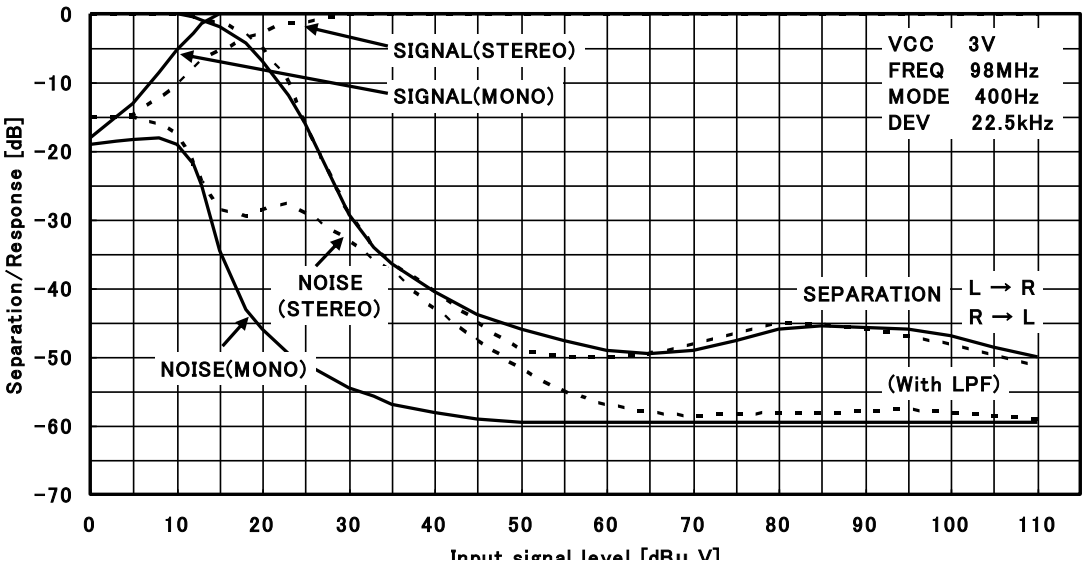


BPF	: FM BAND PASS FILTER
CF1	: AM 455 kHz CF
CF2	: FM 10.7 MHz CF
CF3	: FM DISCRIMINATOR
IFT	: AM 455 kHz IFT

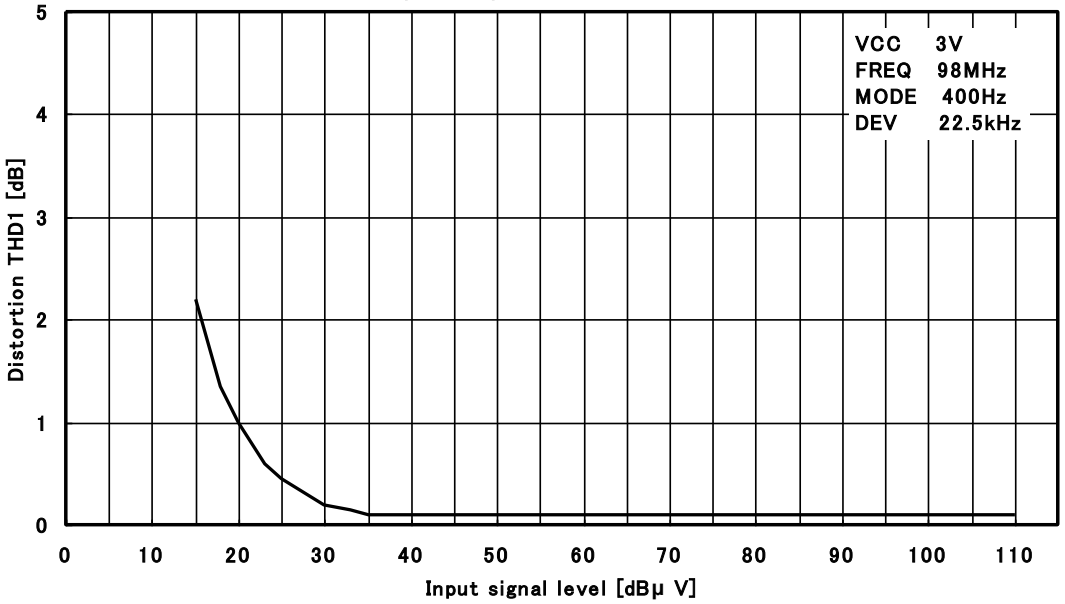
Application circuits shown are typical examples illustrating the operation of the devices. Sony cannot assume responsibility for any problems arising out of the use of these circuits or for any infringement of third party patent and other right due to same.

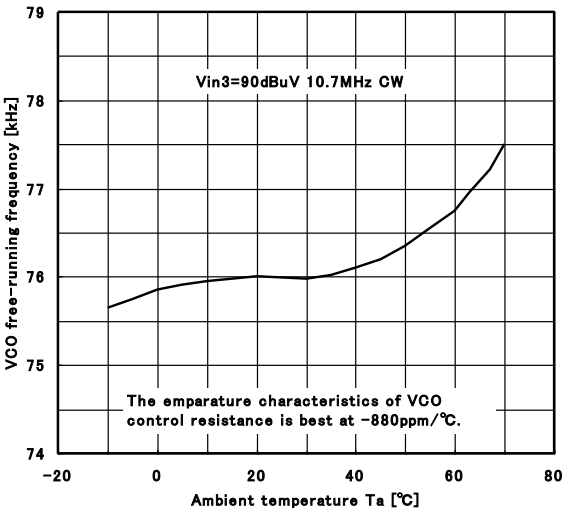
Example of Representative Characteristics

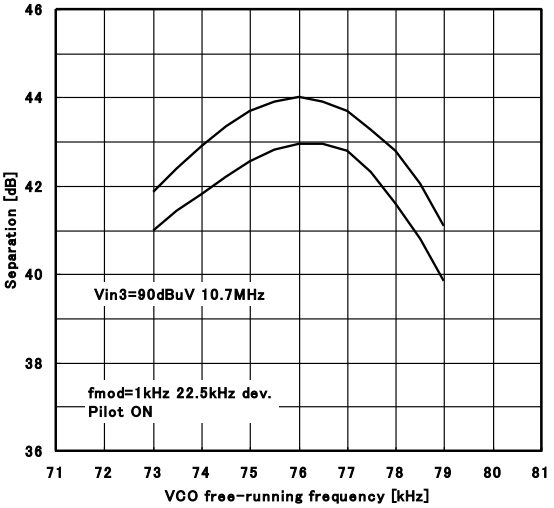
FM Input/Output characteristics

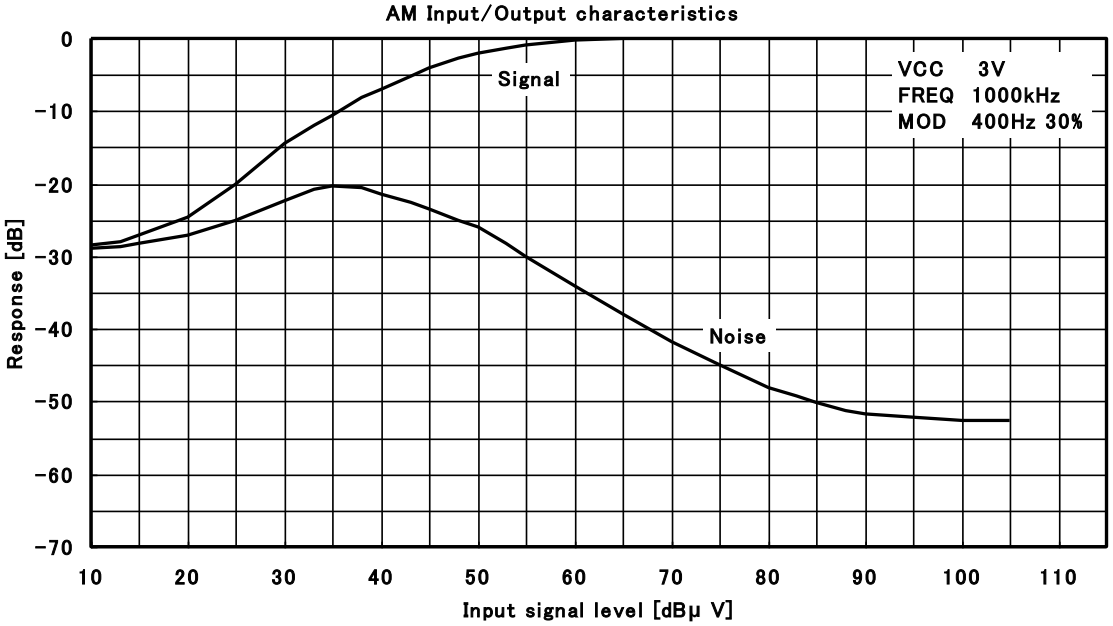


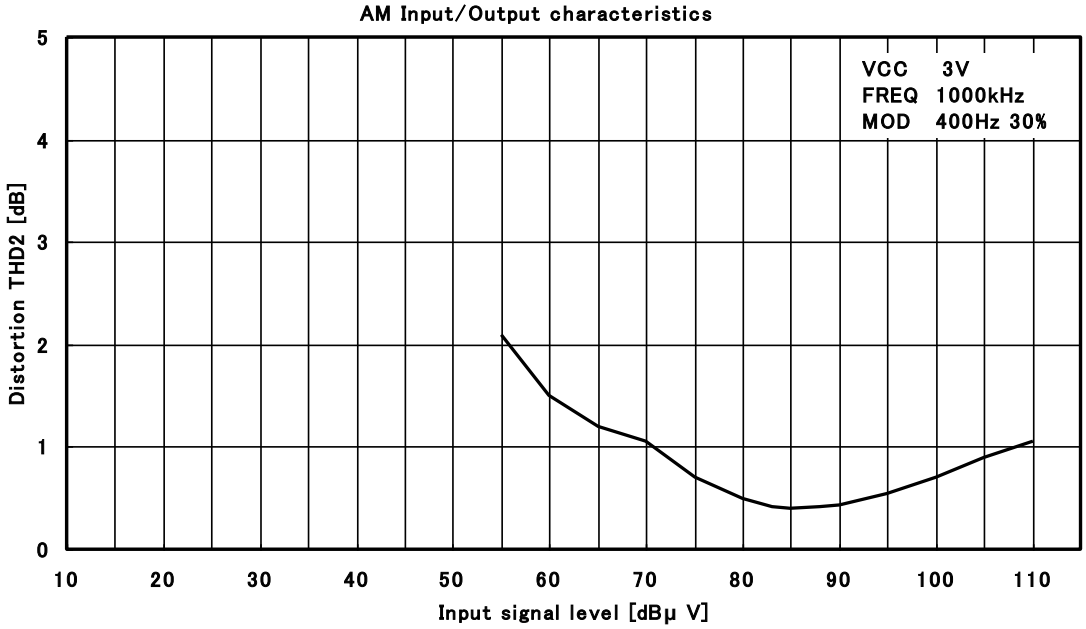
FM Input/Output characteristics





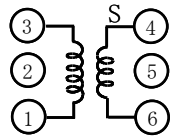



AM Input/Output characteristics
Signal
Noise
VCC 3V
FREQ 1000kHz
MOD 400Hz 30%
Response [dB]
0
-10
-20
-30
-40
-50
-60
-70
10
20
30
40
50
60
70
80
90
100
110
Input signal level [dBμ V]


AM Input/Output characteristics
VCC 3V
FREQ 1000kHz
MOD 400Hz 30%
Distortion THD2 [dB]
5
4
3
2
1
0
10
20
30
40
50
60
70
80
90
100
110
Input signal level [dBμ V]

Coil Data

AM OSC

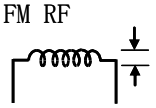


Core diameter ϕ0.06mm 2UEW

f (kHz)	L (μH) 1～3	Qo 1～3	Number of windings(t)	
			1～3	4～6
796	270	125	107	29

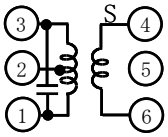
Equivalent to L-5K7H5 R12-1684X Mitsumi Electric Co., Ltd.
or 7TRS-8441 TOKO Co., Ltd.

FM RF



Φ5mm
Φ6mm 3.5t

AM IFT

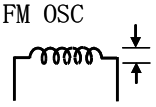


Core diameter ϕ0.07mm UEW

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

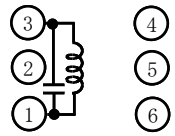
Equivalent to 21K7H5 R12-8558A Mitsumi Electric Co., Ltd.
or 7MC-7789N TOKO Co., Ltd.

FM OSC



Φ4mm
Φ0.6mm 3.5t

FM DISCRIMINATOR

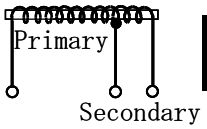


Core diameter ϕ0.1mm 2UEW

Co (pF) 1～3	Qo 1～3	Number of windings(t)		
		1～2		
82	95	111		

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

AM Bar Antenna



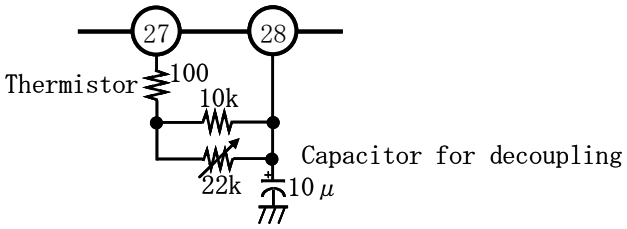
f (kHz)	L (μH)	Primary	Secondary
796	650	91t	20t

BPF	PFWE8 (88 to 108 MHz)	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.	

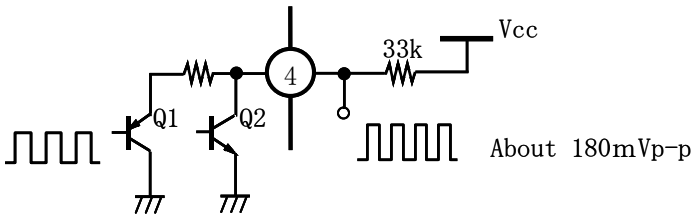
Notes on Operation

1. VCO free-running frequency adjustment method

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

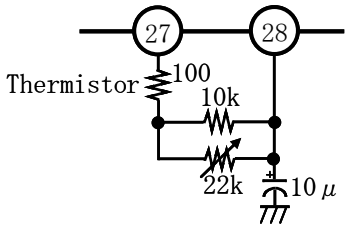


1) VCO adjustment method
Pin 4 is the stereo indicator and VCO check pin. Therefore, in stereo mode (when stereo indicator drive Tr Q2 is switched on), the Pin 4 voltage lowers down, Q1 is cut off and VCO Oscillation waveform can not be seen. In AM mode as well, the oscillation waveform can not be seen as VCO turns off.
Adjust the free-running frequency to 76 kHz ±50 Hz. The capture range is about ±4 %.



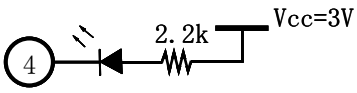
In this IC, the tuner and MPX blocks are directly connected. Therefore, the free-running frequency is not stable, being affected by the noise except in reception mode. For free-running frequency adjustment, input signals from RF or IF.
(The input signal should be RF [tuned frequency] or f0 of the discriminator using IF, and input more than 60 dBμV)

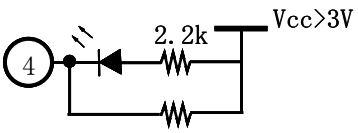
2) Control resistor of VCO oscillation frequency
For the VCO control resistor of this IC, a carbon film resistor is enough. For easier adjustment of temperature characteristics and VCO free-running frequency, the following combination is recommended.



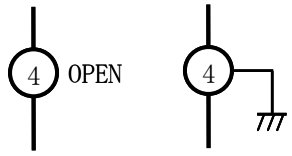
3) How to deal with Pin 4 after adjustment
A. With the use of a stereo indicator.

When V_{CC} is 3 V or more, insert a bypass resistor R to prevent LED malfunction.





B. Without the use of a stereo indicator



2. MPX circuit

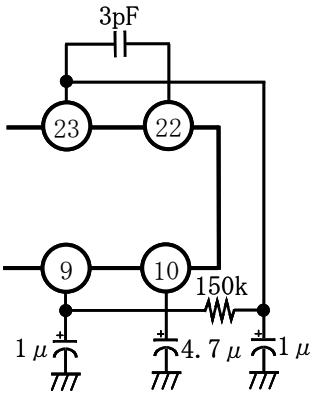
1) MPX load resistance
When the power supply voltage is over 3 V, change the MPX load resistors R6 and R7 from 3.3 kΩ to 6.8 kΩ. In this case, the output level is increased by about 6 dB.

2) Time constant of de-emphasis
Refer to the following table as the time constant is determined at C13 and C14.

R6,R7	3.3 kΩ	6.8 kΩ
50 µS	0.015 µS	0.0082 µS
75 µS	0.022 µS	0.012 µS

3. AFC circuit

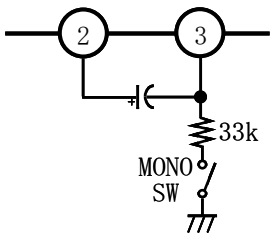
1) This IC has a built-in variable capacitances.
Change to the following circuit when designing for J band, because the standard circuit is for W band.



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

4. Auto blend circuit

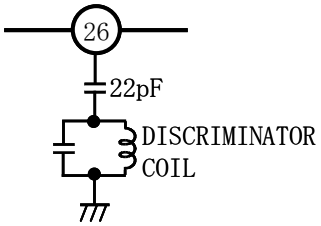
This IC has a built-in auto blend circuit and a monaural switch is not required as a rule. This circuit controls the separation in proportion to the signal level and reduces the noise automatically for stereo reception below the mid electric field when the electric field strength reaches lower than about 40 dBµV. When the electric field strength becomes below 10 dBµV to 15 dBµV, monaural operation is automatically activated.
The switch monaural mode on externally, ground Pin 33 with 33 kΩ.



5. FM discriminator

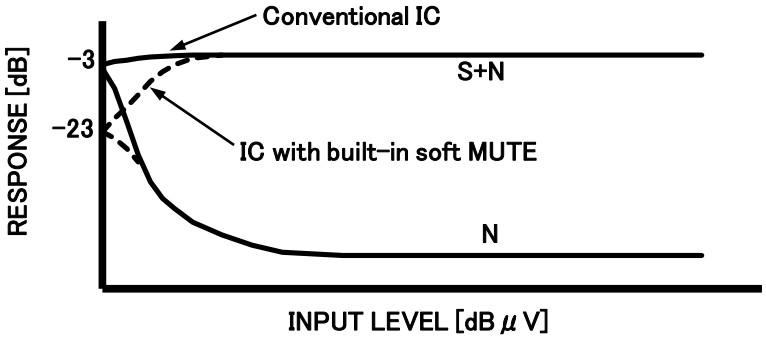
For FM detection, the quadrature detection system is adopted. As a phase shifter, a ceramic reasonator (CF3 discriminator) is employed to achieve adjustment-free detection. Though the sensitivity and selectability will be slightly affected, the discriminator can be replaced by a coil as shown below. Combining CF2(FM IF) and CF3(FM discriminator) poses problems with the detection factor when deviation with the IF band center frequency f0 occurs. To this effect, use pairs of the same rank as indicated in the chart.

	F0 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 Input/Output characteristics diagram, 23 dB (typ.) muting is applied and noise level reduces for weak electric field and out of tune instances.

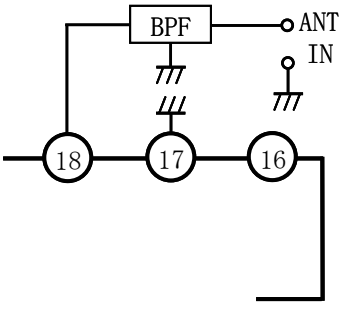


7. Notes on patterns

1) Positions of FM Antenna and OSC coils
Locate those at right 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) Ground pins
Pin 17 is a ground pin for AM, FM and FE; Pin 11 for IF; and Pin 30 for MPX. Use as thick a pattern as possible since the grounding between ANT IN, BPF and Pin 11 significantly affects the stability, NF characteristics.

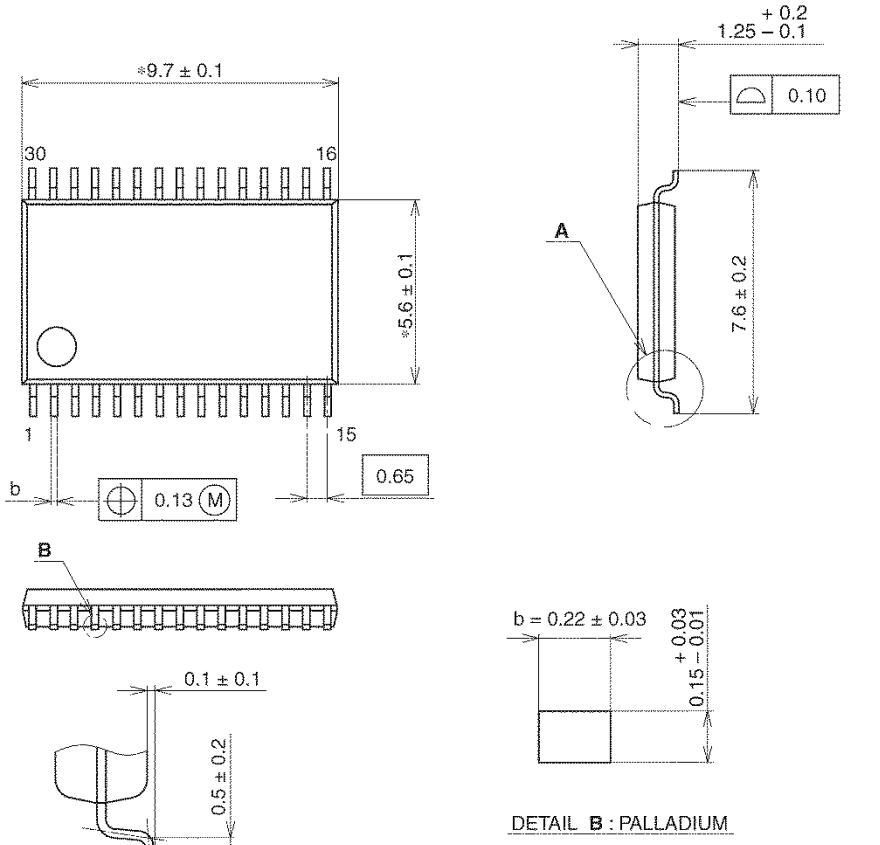


4) Ground bypass capacitors C5 (0.001 μF) and C6 (10 μF) connected to Pin 21 as close to Pin 17 as possible.

Package Outline

Unit : mm

30PIN SSOP (PLASTIC)



NOTE: Dimension "*" does not include mold protrusion.

SONY CODE	SSOP-30P-L01
EIAJ CODE	P-SSOP30-5.6x9.7-0.65
JEDEC CODE	————

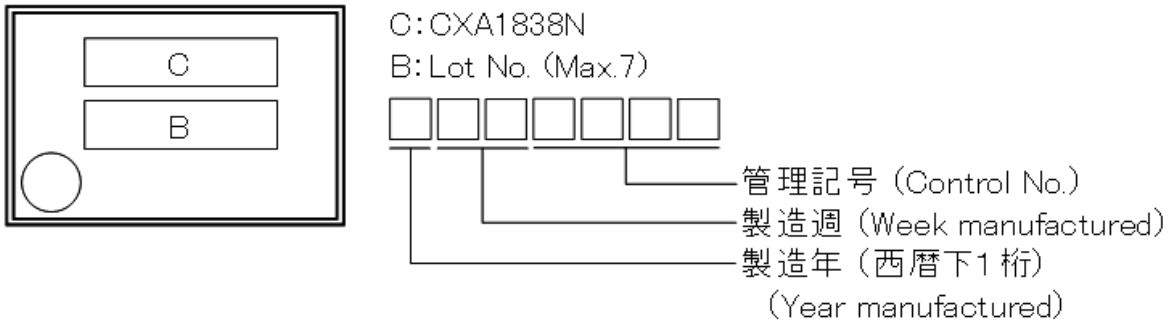
PACKAGE STRUCTURE

PACKAGE MATERIAL	EPOXY RESIN
LEAD TREATMENT	PALLADIUM PLATING
LEAD MATERIAL	COPPER ALLOY
PACKAGE MASS	0.1g

AP-4000-30005S

00.11.29

Marking


C
B
C:CXA1838N
B:Lot No. (Max.7)
管理記号 (Control No.)
製造週 (Week manufactured)
製造年 (西暦下1桁)
(Year manufactured)

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