Noise Reduction

Description

The CX20099/CX20148 is a bipolar IC designed for the 8 mm VTR PCM audio noise reduction system.

Application in the PCM audio recording and playback system makes it possible to obtain about a 100 dB dynamic range.

CX20099	CX20148
28 pin SOP (Plastic)	28 pin DIP (Plastic)

Features

- 5V single power supply operation
- Low power consumption (70 mW typical in operation)
- Logarithmic compress/expand compandor is provided. (Compress/Expand ratio: 2)
- REC/PB electronic switching (Compatible with TTL)
- Noise modulation reduction with the fixed preemphasis
- Improvement in low band distortion with the holding recovery characteristics
- Built-in two channels
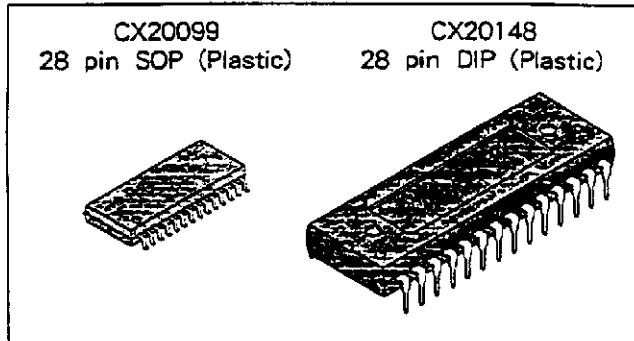
Structure

Bipolar silicon monolithic IC

Absolute Maximum Ratings (Ta = 25°C)

- Power supply voltage　Vcc　10　V
- Operating temperature　Topr　−20 to +75　°C
- Storage temperature　Tstg　−55 to +150　°C
- Allowable power dissipation　PD　CX20099　800 mW

CX20148　1170 mW

Recommended Operating Condition

Vcc　4.2 to 6.0　V　(5.0V typical)

E51138B9Z − ST

Block Diagram
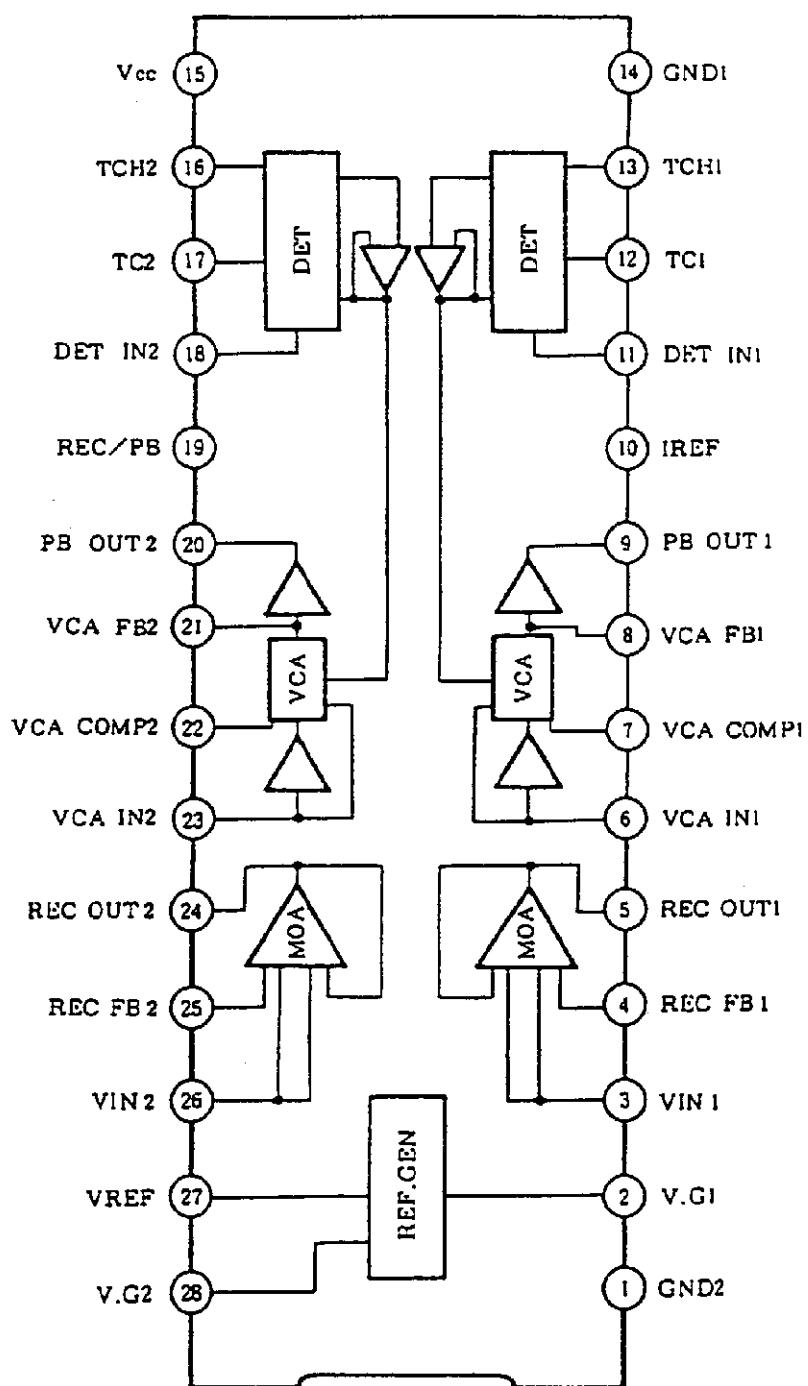
Pin Description

DC voltage (Ta = 25°C, Vcc = 5.0V, See Fig. 1.)

No.	Name	Function	DC voltage (V) (Typical)	Remark
1	GND2	Circuit GND for VREF · V.G (median point)	0.0	
2	V.G1	V.G signal reference for 1ch	2.50	Maximum current $\simeq \pm 200\mu A$ Output impedance $\simeq 260\,\Omega$ typical
3	VIN1	REC/PB common input terminal for 1ch	2.50	Bias current $\simeq 150nA$
4	RECFB1	MOA inverter phase input terminal In REC, PB output for 1ch is feedback	2.50	Bias current $\simeq 150nA$
5	RECOUT1	REC output for 1ch	2.50	Maximum output $\simeq 2.8$ Vp-p (RL = 7KΩ) (2.1dBm)
6	VCAIN1	VCA input terminal for 1ch to input current with the same voltage as V.G.	2.50	Bias current $\simeq 100nA$ Max. current $\simeq 1.7mAp$-p (Iin + Iout) (at Vcc = 5.0V)
7	VCACOMP1	1ch VCA phase compensation terminal	2.46	
8	VCAFB1	1ch VCA output amp inverted phase input terminal to convert I to V	2.50	Bias current $\simeq 150nA$
9	PBOUT1	1ch PB output terminal	2.50	Max. output $\simeq 3.0$Vp-p (RL = 5kΩ) (3.7dBm)
10	IREF	Reference current input terminal for both ch detectors	0.91	
11	DETIN1	1ch detector input terminal to input current	1.36	
12	TC1	For smoothing the 1ch detector full-wave rectified waveform. It also determines the attack and recovery time constants.	2.15	
13	TCH1	It determines the 1ch detector hold time constant.	2.74	
14	GND1	Signal and control GND for both channels	0.0	
15	Vcc	Power supply terminal for both channels	5.0	
16	TCH2	It determines the 2ch detector hold time constant.	2.74	
17	TC2	For smoothing the 2ch detector full-wave rectified waveform. It also determines the attack and recovery time constants.	2.15	
18	DETIN2	2ch detector input terminal to input current	1.36	

| No.	Name	Function	DC voltage (V) (Typical)	Remark
19	REC/PB	REC/PB mode switching terminal	0.50	In REC, $0 \leq V_L \leq 0.5V$ $I_L \approx 50\mu A$ max. In PB, $2.5V \leq V_H \leq V_{cc}$ $I_H \approx 0$
20	PB$_{OUT2}$	2ch PB output terminal	2.50	Max. output $\approx 3.0Vp-p$ (R$_L$ = 5K Ω) (3.7dBm)
21	VCA$_{FB2}$	2nd VCA output amp inverted phase input terminal to convert I to V.	2.50	Bias current $\approx 150nA$
22	VCA$_{COMP2}$	2nd ch VCA phase compensation terminal	2.46	
23	VCA$_{IN2}$	2ch VCA input terminal with the same voltage as V.G. to input current.	2.50	Bias current $\approx 100nA$. Max. current $\approx 1.7mAp-p$ (Iin + Iout) (at Vcc = 5.0V)
24	REC$_{OUT2}$	2ch REC output terminal	2.50	Max. output $\approx 2.8Vp-p$ (R$_L$ = 7K Ω) (2.1dBm)
25	REC$_{FB2}$	MOA inverter phase input terminal In REC, PB output for 1ch is feedback	2.50	Bias current $\approx 150nA$
26	V$_{IN2}$	REC/PB common input terminal for 2ch	2.50	Bias current $\approx 150nA$
27	V$_{REF}$	Reference voltage for VCA gain	1.95	Max. current $\approx 4mA$ typical Output impedance $\approx 10 \Omega$ typical
28	V.G2	V.G signal reference for 2 ch	2.50	Max. current $\approx \pm 200\mu A$ Output impedance $\approx 260 \Omega$ typical

Electrical Characteristics

See the filter circuit of Electrical Characteristics Measuring Circuit

(Ta＝25°C, Vcc＝5V)

Measuring No.	Item	Symbol	SW1	SW2	SW3	SW4	SW5	SW6	/VIN (KHz)	VIN (dBm)	Measuring point	Description of output waveform and measuring method	Min.	Typ.	Max.	Unit
1	Circuit current	Icc	OFF	OFF	OFF	OFF	OFF	OFF	No signal		Vcc		10.0	14.0	18.0	mA
2	Decoder offset voltage (1)	Voff (1)	ON	1ch					No signal		PB OFFSET 1	Measure DC centering on 2.5 V	−330	0	330	mV
3	Decoder offset voltage (2)	Voff (2)		2ch					No signal		PB OFFSET 2		−330	0	330	mV
4	Reference level (1)	E − F − R(1)	OFF	OFF					0.4	−10	REC OUT 1		−11.5	−10.0	−8.5	dBm
5	Reference level (2)	E − F − R(2)							0.4		REC OUT 2		−11.5	−10.0	−8.5	dBm
6	Frequency response 1-(1)	E − F − 1(1)							0.4	−50	REC OUT 1	Measure the difference with the reference level.	−21.5	−20.0	−18.5	dB
7	Frequency response 1-(2)	E − F − 1(2)							0.4	−50	REC OUT 2		−21.5	−20.0	−18.5	dB
8	Frequency response 2-(1)	E − F − 2(1)							7.0		REC OUT 1		−17.4	−15.9	−14.4	dB
9	Frequency response 2-(2)	E − F − 2(2)							7.0		REC OUT 2		−17.4	−15.9	−14.4	dB
10	Frequency response 3-(1)	E − F − 3(1)							0.4	−30	REC OUT 1		−11.5	−10.0	−8.5	dB
11	Frequency response 3-(2)	E − F − 3(2)							0.4	−30	REC OUT 2		−11.5	−10.0	−8.5	dB
12	Frequency response 4-(1)	E − F − 4(1)							7.0		REC OUT 1		−7.4	−5.9	−4.4	dB
13	Frequency response 4-(2)	E − F − 4(2)							7.0		REC OUT 2		−7.4	−5.9	−4.4	dB
14	Frequency response 5-(1)	E − F − 5(1)							14.0	−30	REC OUT 1		−6.2	−4.7	−3.2	dB
15	Frequency response 5-(2)	E − F − 5(2)							14.0		REC OUT 2		−6.2	−4.7	−3.2	dB

Measuring No.	Item	Symbol	SW1	SW2	SW3	SW4	SW5	SW6	f VIN (KHz)	VIN (dBm)	Measuring point	Description of output waveform and measuring method	Min.	Typ.	Max.	Unit
16	Frequency response 6-(1)	E – F – G (1)	OFF	OFF	OFF	OFF	OFF	OFF	7.0	-10	REC OUT 1	Measure the difference with the reference level.	2.6	4.1	5.6	dB
17	Frequency response 6-(2)	E – F – G (2)									REC OUT 2		2.6	4.1	5.6	dB
18	REC output distortion factor (1)	THD – R (1)							0.4	-10	REC OUT 1	Measure the distortion factor.	–	0.13	0.40	%
19	REC output distortion factor (2)	THD – R (2)									REC OUT 2		–	0.13	0.40	%
20	Signal handling (1)	S – H (1)	ON						1.0	-3.0	PB OUT 1	Measure the distortion factor.	–	0.2	1.1	%
21	Signal handling (2)	S – H (2)									PB OUT 2		–	0.2	1.1	%
22	REC output SN ratio (F)(1)	SN – R – F(1)	OFF			ON			No signal		Filter OUT	20 Hz to 20 kHz Use filter (20 dB) Rg = 600 Ω	–	-40.0	-34.0	dBm
23	REC output SN ratio (F)(2)	SN – R – F(2)			ON				No signal		Filter OUT		–	-40.0	-34.0	dBm
24	REC output SN ratio (A)(1)	SN – R – A(1)			OFF		ON		No signal		Filter OUT	"A" curve Use filter (20 dB) Rg = 600 Ω	–	-40.0	-34.0	dBm
25	REC output SN ratio (A)(2)	SN – R – A(2)			ON				No signal		Filter OUT		–	-40.0	-34.0	dBm
26	Crosstalk 1—2 (REC)	CT (1 – 2)					OFF	ON	1.0	-10	Filter OUT	Use 1 kHz (20 dB) BPF — VIN1 input	–	-45.0	-39.0	dBm
27	Crosstalk 2—1 (REC)	CT (2 – 1)			OFF						Filter OUT	VIN2 input	–	-45.0	-39.0	dBm
28	Reference voltage	VREF				OFF		OFF	No signal		VREF		1.80	1.95	2.10	V
29	Median voltage 1	V.G1							No signal		V.G1		2.2	2.5	2.8	V
30	Median voltage 2	V.G2							No signal		V.G2		2.2	2.5	2.8	V

## Electrical Characteristics Measuring Circuit
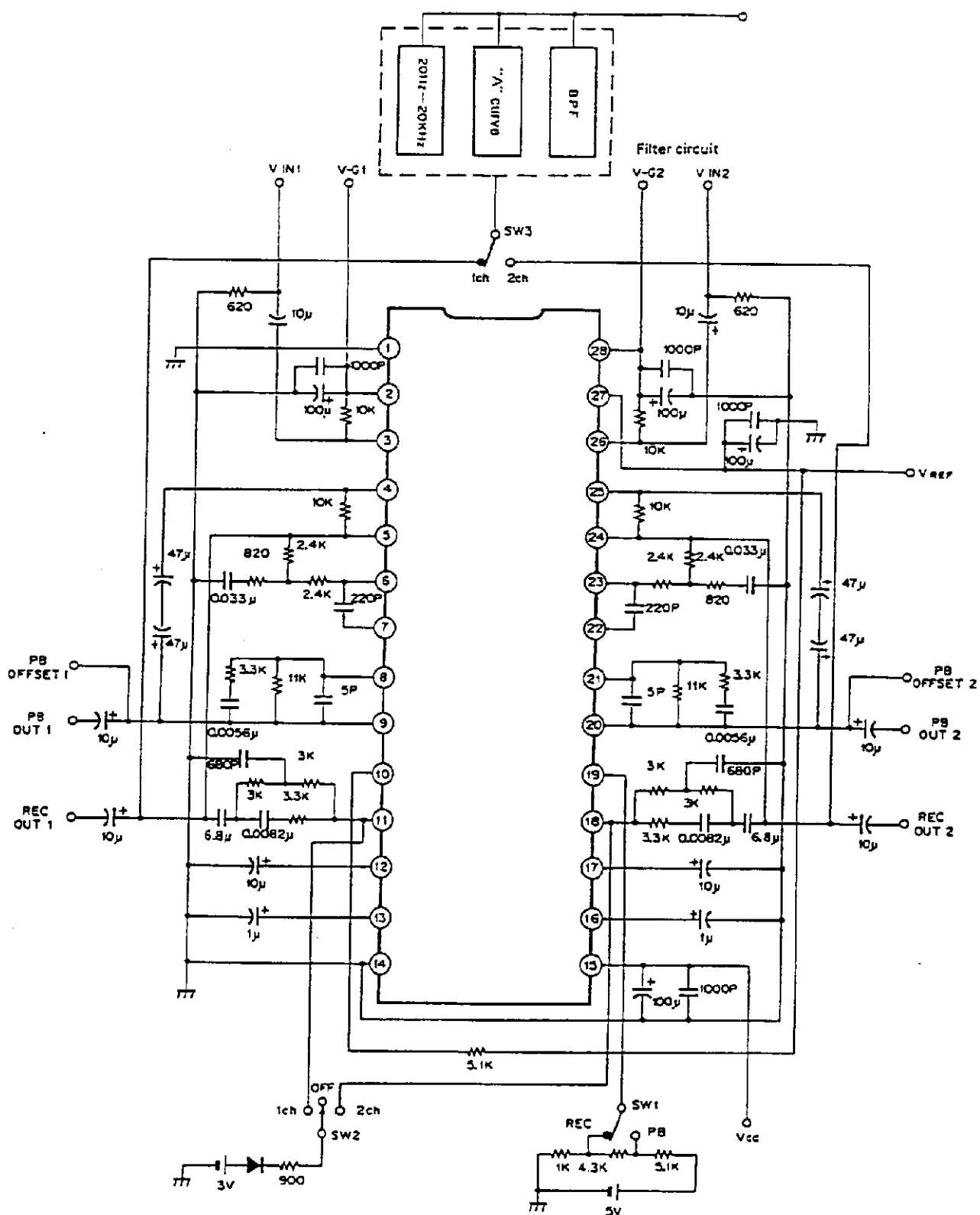
Filter Circuit
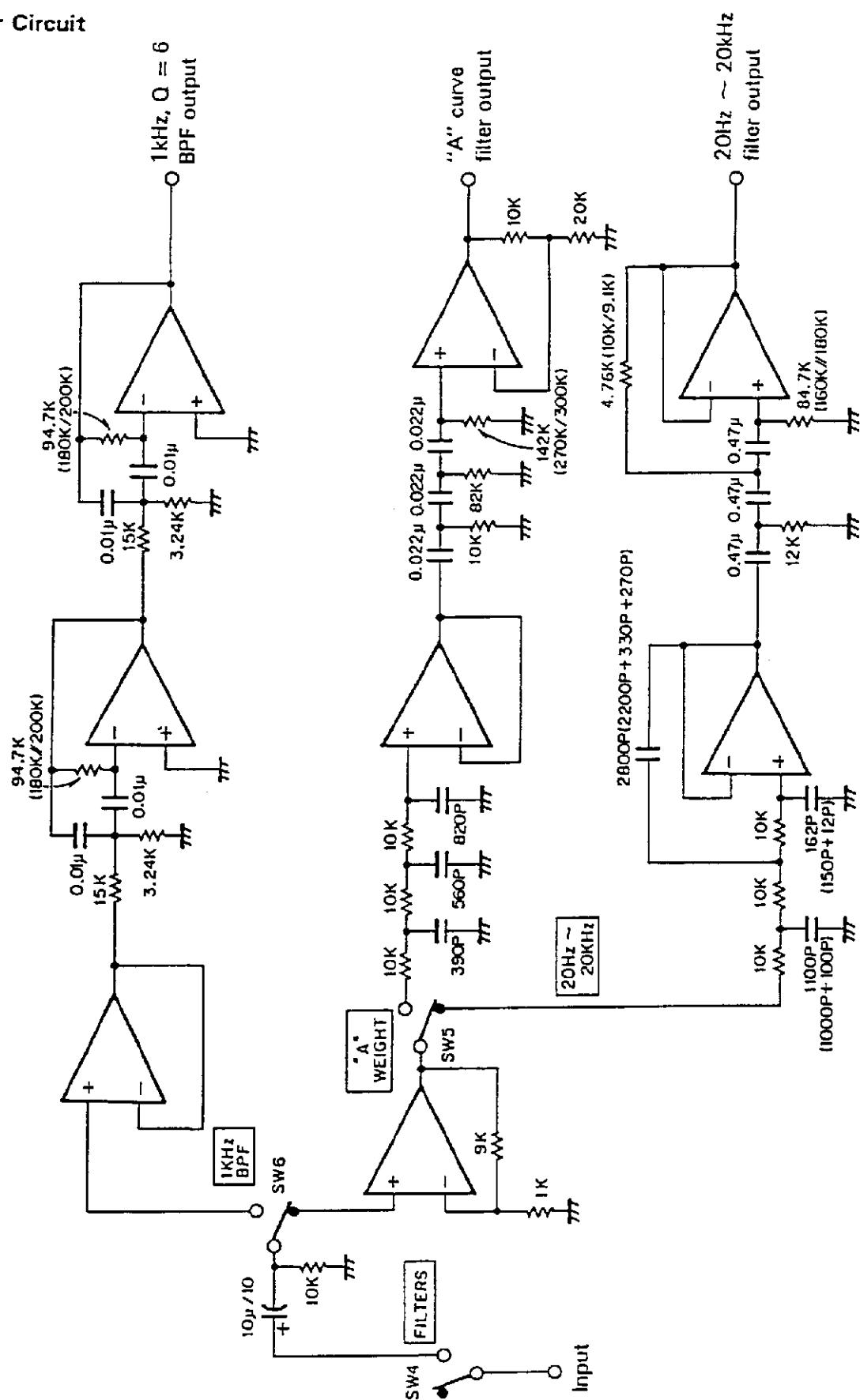
Example of Application Circuit
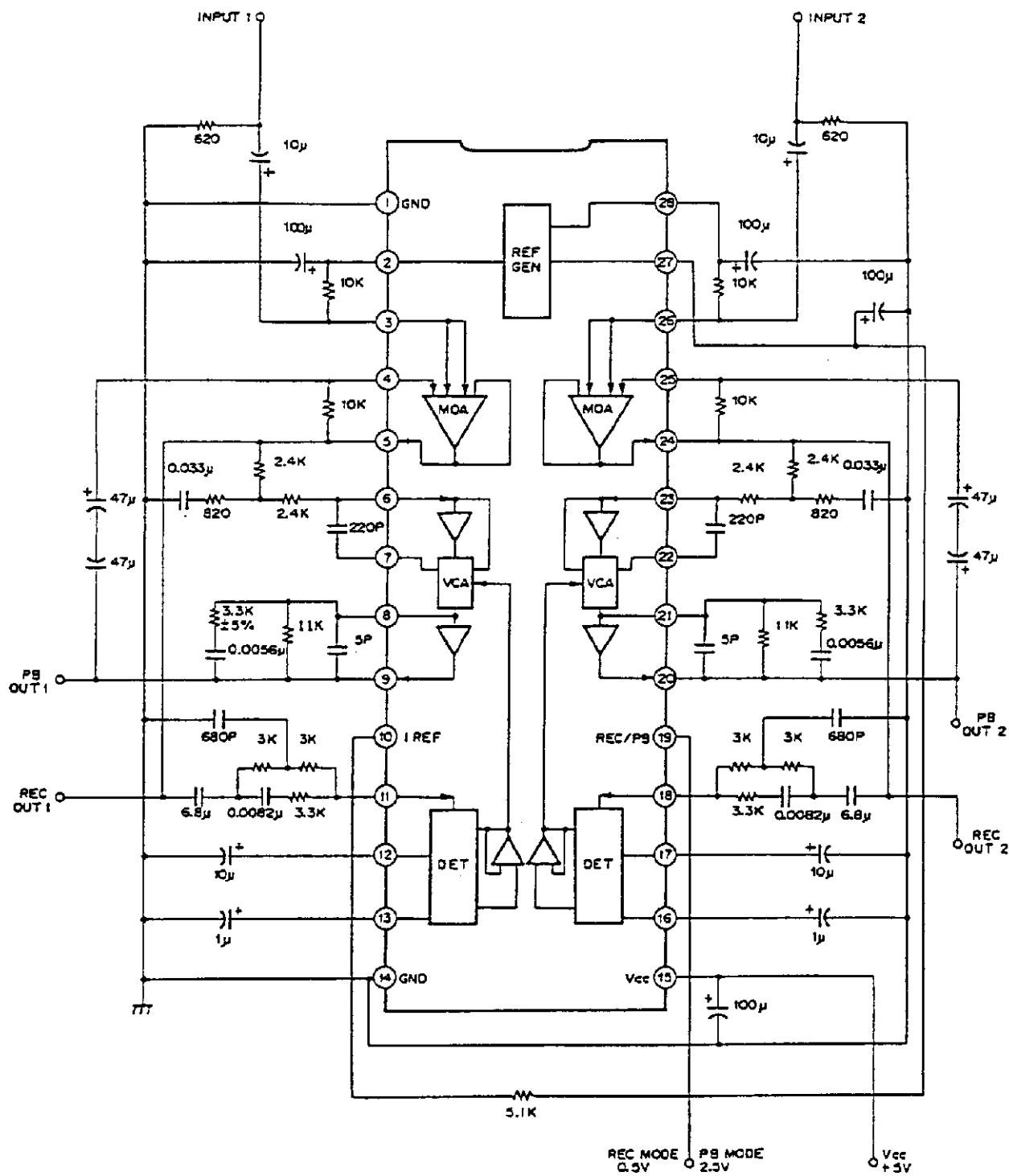
Description of Functions

(1) MOA (Main Op Amp)

With the internal switching, it operates as the voltage follower in PB and has the encoding characteristics in REC by inputting to the decoder circuit into the MOA feedback loop.

(2) VCA (Voltage Controlled Amp)

VCA is comprised of the current input and the power supply current divider. Before and after the VCA, the impedance elements (performing the emphasis as well) for the voltage — current and current — voltage conversions are connected.
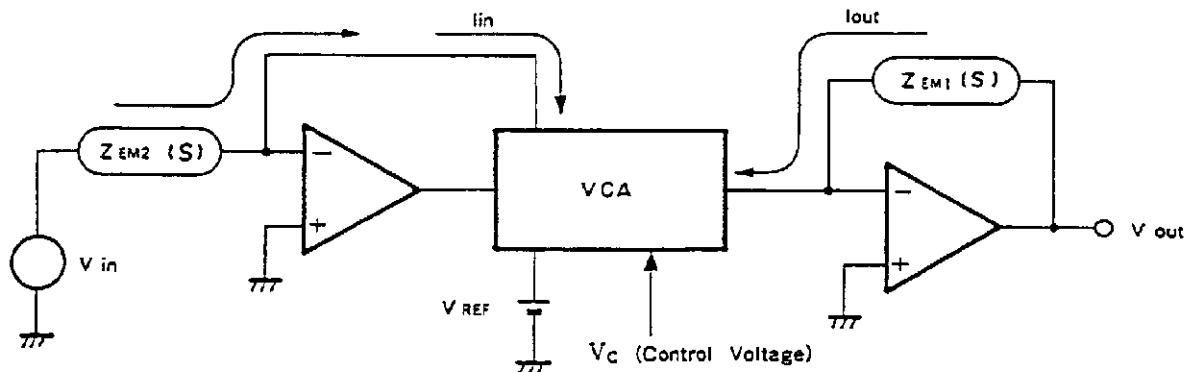
The VCA control sensitivity is 0.33dB/mV and the VCA gain is determined based on the V_{REF} reference. When $(V_{REF} - V_C) = 30$ mV, the VCA gain becomes 10 dB; when the VCA gain is set as G_{VCA} in the above diagram,

$$V_{OUT} = V_{in} \cdot G_{VCA} \cdot Z_{EM1}(S)/Z_{EM2}(s).$$

In this VCA, the maximum Io value depends on the power supply voltage when $Io = Iin + Iout$. That is, the maximum Io will be as follows:

$$Vcc = 5.0V \longrightarrow Io \text{ max.} \approx 1.7mAp-p.$$
$$Vcc = 4.2V \longrightarrow Io \text{ max.} \approx 1.4mAp-p.$$

(3) DET (Detector)

Current input is applied to the detector to cover a wide dynamic range with logarithm conversion.
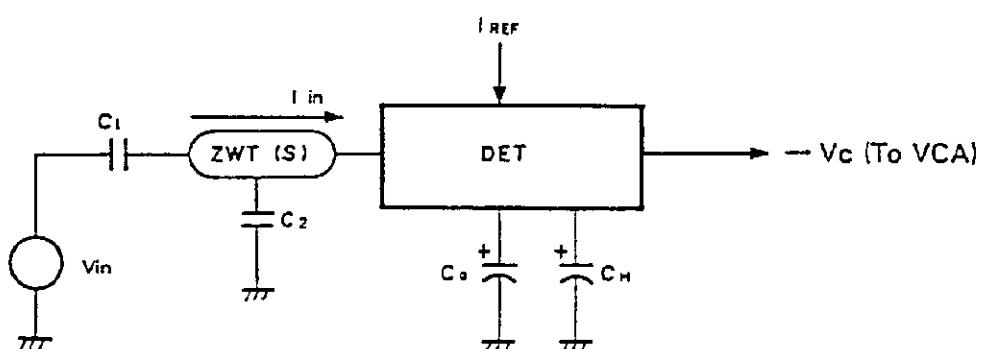
The DC component in the detector input is eliminated by the capacitor (C_1). Capacitor (C_2) is also required to eliminate high frequency components as the $Z_{WT}(S)$ impedance is small.

In this case, the input current lin will be,

$$lin = Vin/Z_{WT}(S).$$

The VCA control voltage Vc will be a function of the ratio between lin and lref. When lref = 100 μA, lin will be 81.4 μArms and

$$Vc = Vref (VCA \ gain = 0dB).$$

The recovery time constant is determined by Co. As it is set to be comparatively short, the detector output ripple component will increase causing low band distortion due to modulation from mixing.

Therefore, the distortion factor is corrected using a short recovery time constant by holding the full-wave rectified waveform peaks with C_H.

Frequency Characteristics (Compression Mode)

0dB : −10dBm   Input level

REC output level (dB) vs Frequency (Hz)

+10dB
0dB
−20dB
−40dB

Frequency Characteristics (Expansion Mode)

0dB : −10dBm   Input level

PB output level (dB) vs Frequency (Hz)

15dB
0dB
−10dB
−20dB
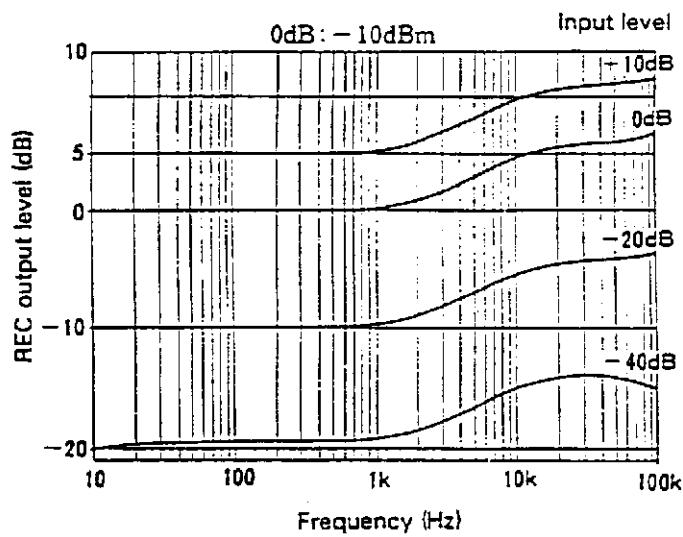
Output Level
— THD Characteristics (Compression Mode)
● 400Hz(30kHz LPF)
× 1kHz(400Hz HPF, 30kHz LPF)
○ 10kHz(400Hz HPF, 30kHz LPF)

THD (%) vs Output level (dBm)
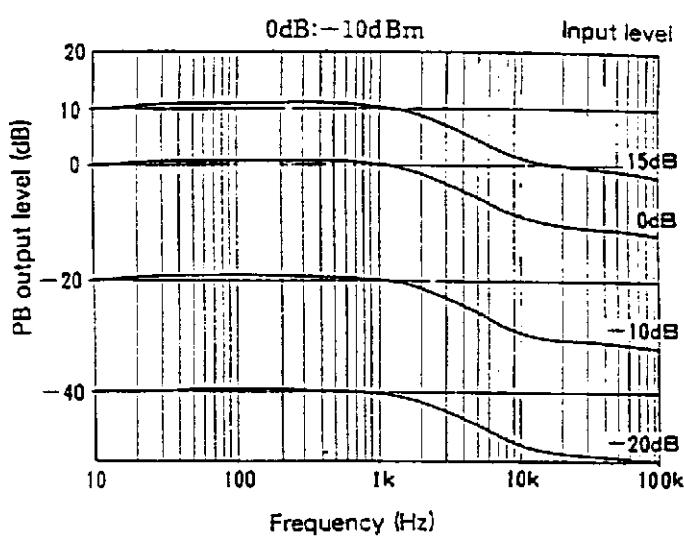
Output Level
— THD Characteristics (Expansion Mode)
● 400Hz(30kHz LPF)
× 1kHz(400Hz HPF, 30kHz LPF)
○ 10kHz(400Hz HPF, 30kHz LPF)

THD (%) vs Output level (dBm)
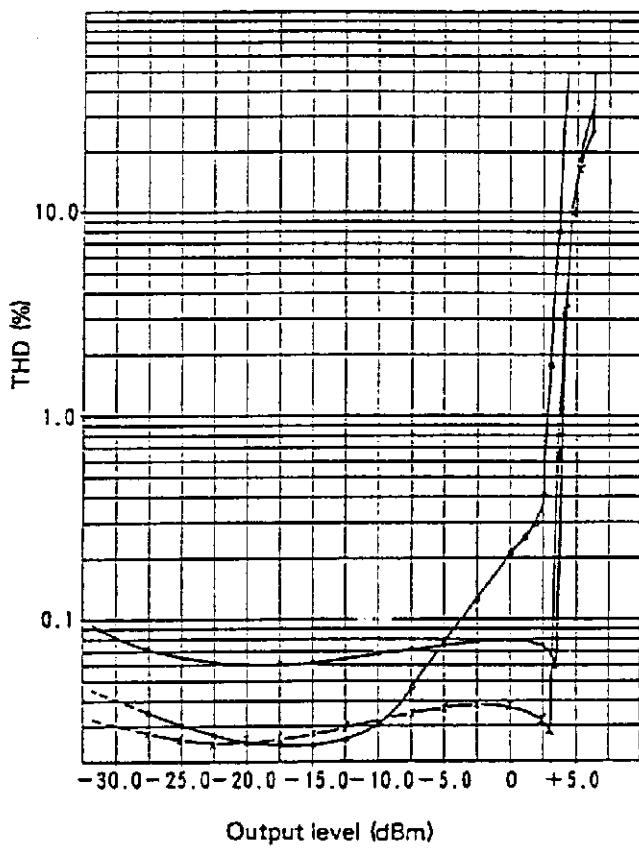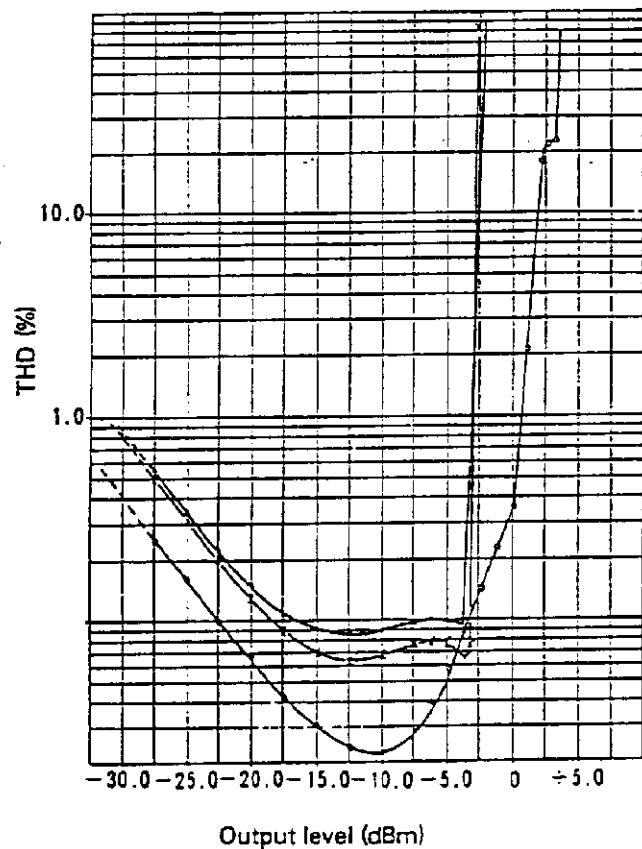
Frequency
— THD Characteristics (Compression Mode)
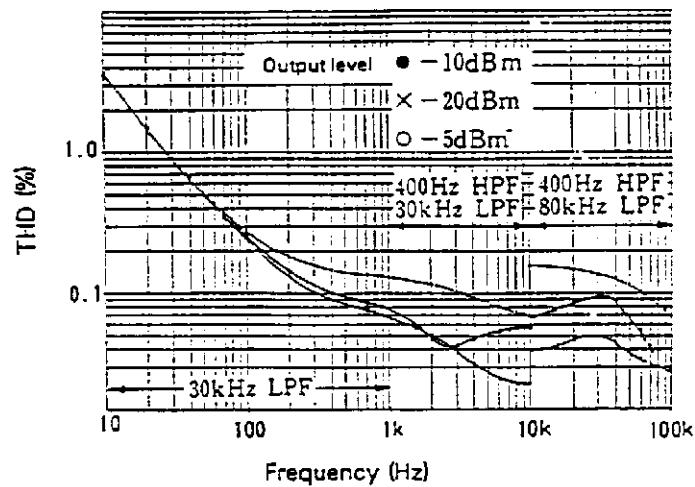
Frequency
— THD Characteristics (Expansion Mode)
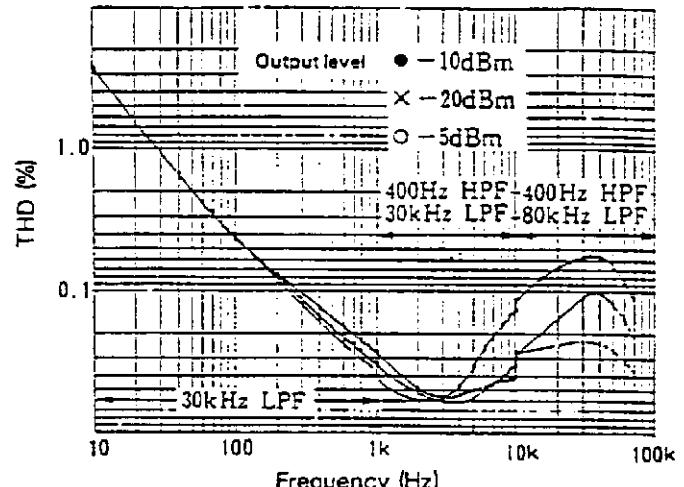
Signal Handling (Compression Mode)
f = 1 kHz, 1% distortion

(400Hz HPF, 30kHz LPF)
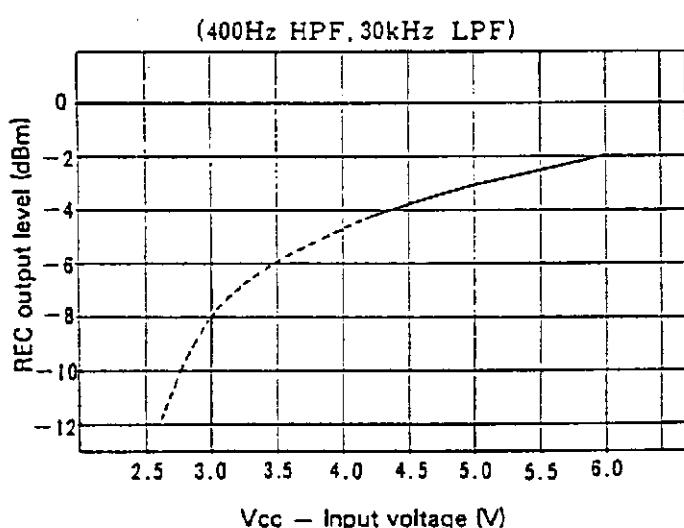
Signal Handling (Expansion Mode)
f = 1 kHz, 1% distortion

(400Hz HPF, 30kHz LPF)
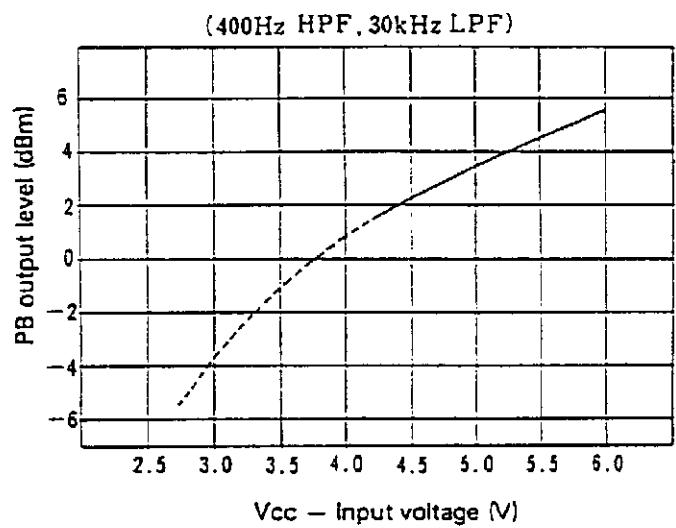
Crosstalk (between Channels)

2ch — 1ch (compression mode)
Crosstalk — Difference between input and REC output.


Frequency (Hz)
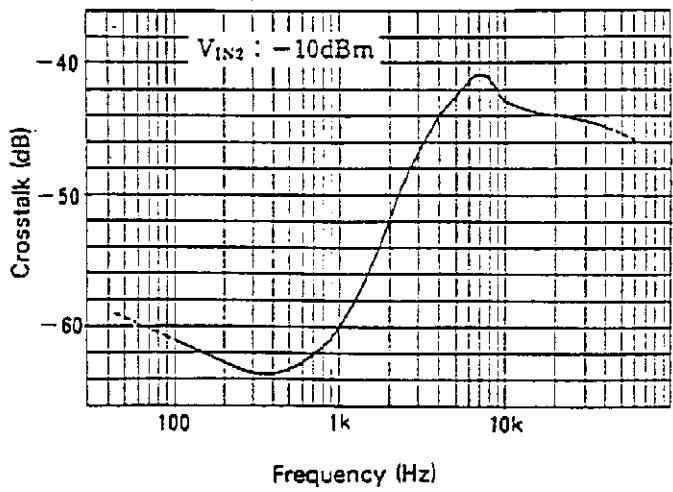
Crosstalk (between Channels)

1ch — 2ch (compression mode)
Crosstalk — Difference between input and REC output.

Frequency (Hz)
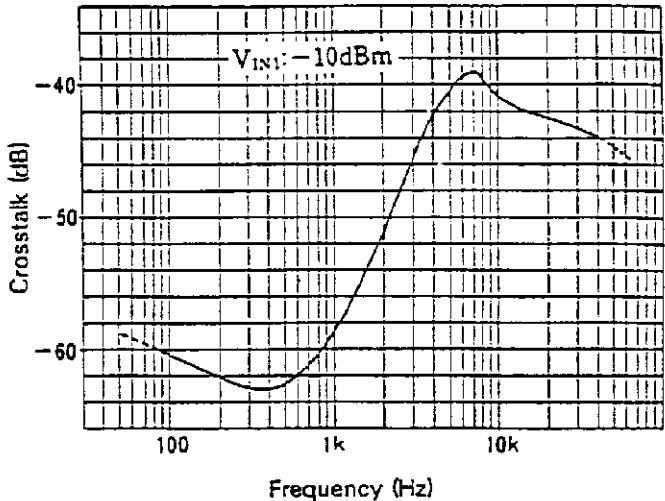
Signal Source Impedance
## — Noise Level (S/N) Characteristics

Compression mode   No signal

20Hz to 20kHz filter
"A" weighting filter

Signal source impedance (Ω)
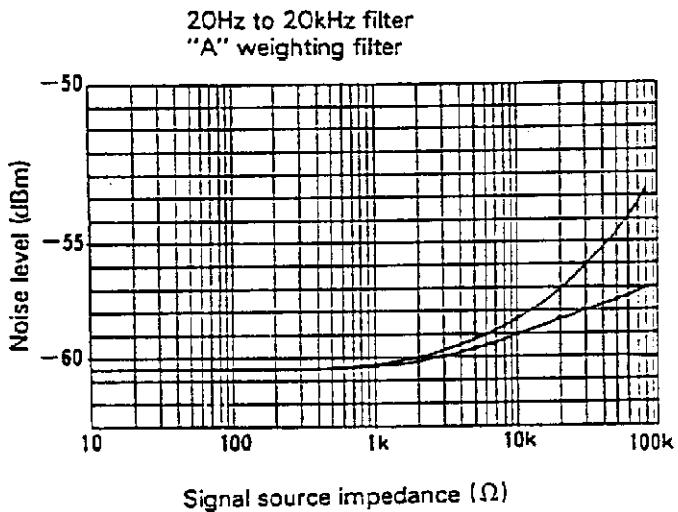
Reference Voltage
— Power Supply Voltage Characteristics

Power supply voltage (V)

— 15 —
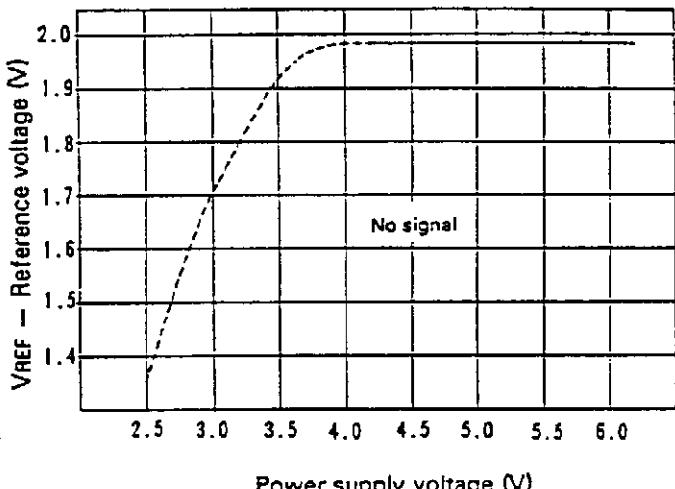
Circuit Current
— Power Supply Voltage Characteristics

Compression mode   No signal

Power supply voltage (V)
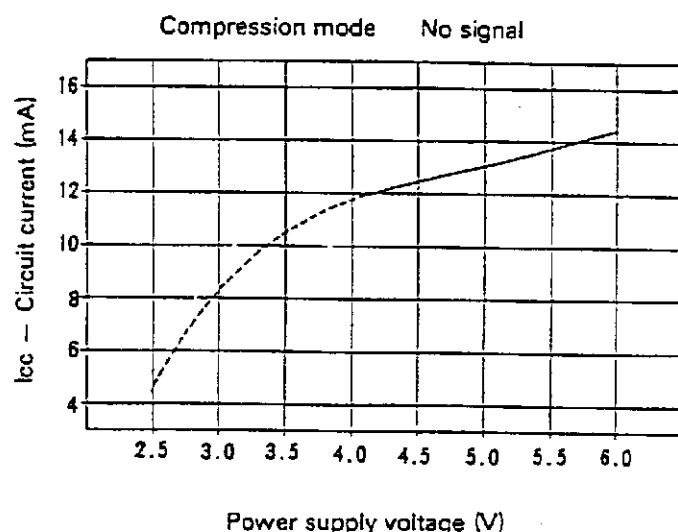
Package Outline   Unit : mm

CX20099   28 pin SOP (Plastic)

SONY NAME	SOP-28P-L02
EIAJ NAME	*SOP028-P-0375-B
JEDEC CODE	—
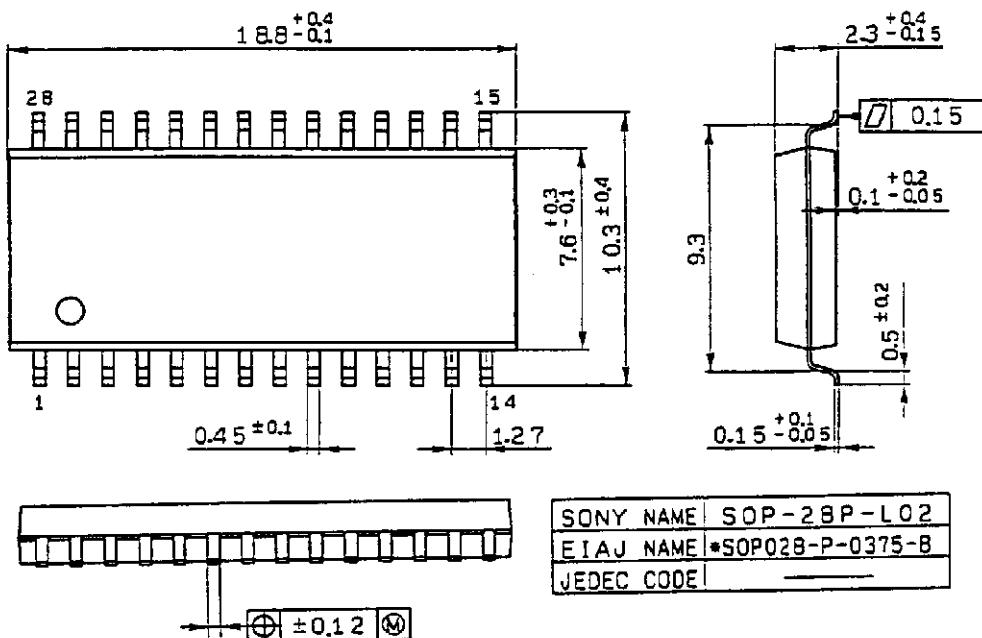
CX20148   28 pin DIP (Plastic)

SONY NAME	DIP-28P-03
EIAJ NAME	*DIP028-P-0600-C
JEDEC CODE	—