

## Dolby® B-C Type Noise Reduction System

### Description

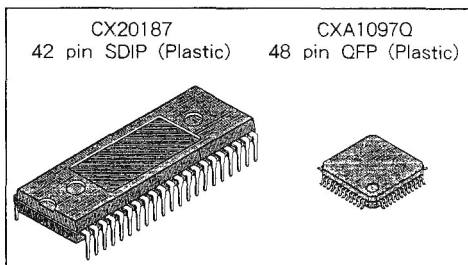
CX20187/CXA1097Q are integrated circuits designed for use in Dolby B and C type noise reduction systems. These devices offer complete stereo Dolby B and C type noise reduction processors with just one IC and a few external components.

### Features

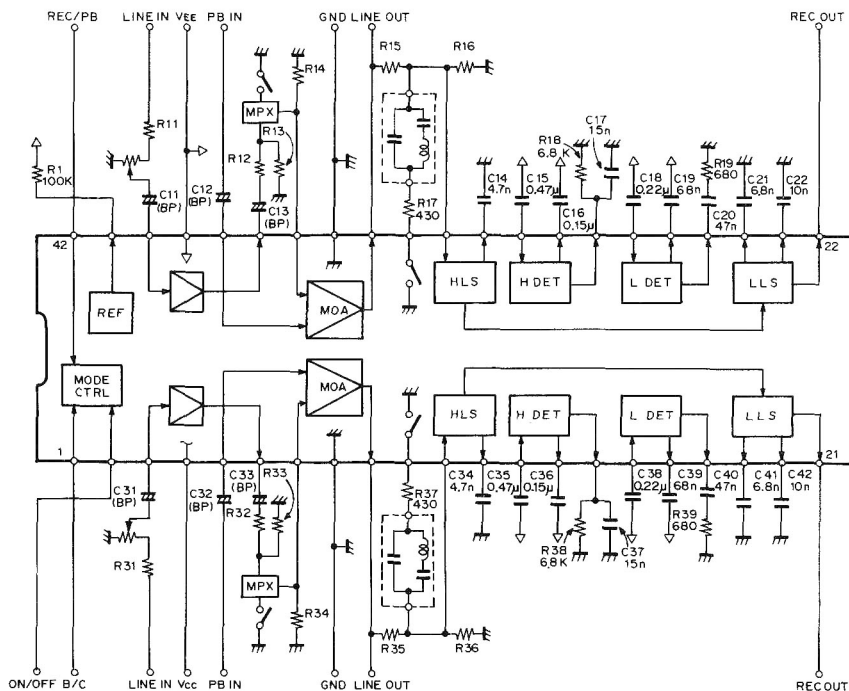
- Dual channel processors integrated in one chip
- Minimum number of external components
- Programmable line output level
- Multiplex filter buffers included
- Low supply current (14 mA typ.)
- Wide supply voltage range (8 to 16V)

### Structure

Bipolar silicon monolithic IC



### Block Diagram (CX20187)



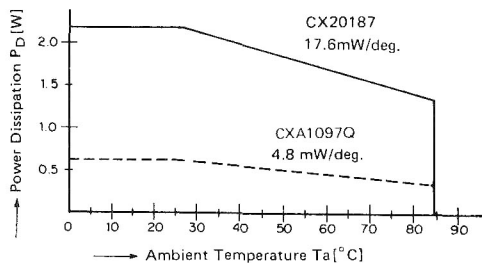
**Note:** CXA1097Q refer to Pin Configuration

**Absolute Maximum Ratings**

(Ta=25°C, unless otherwise specified)

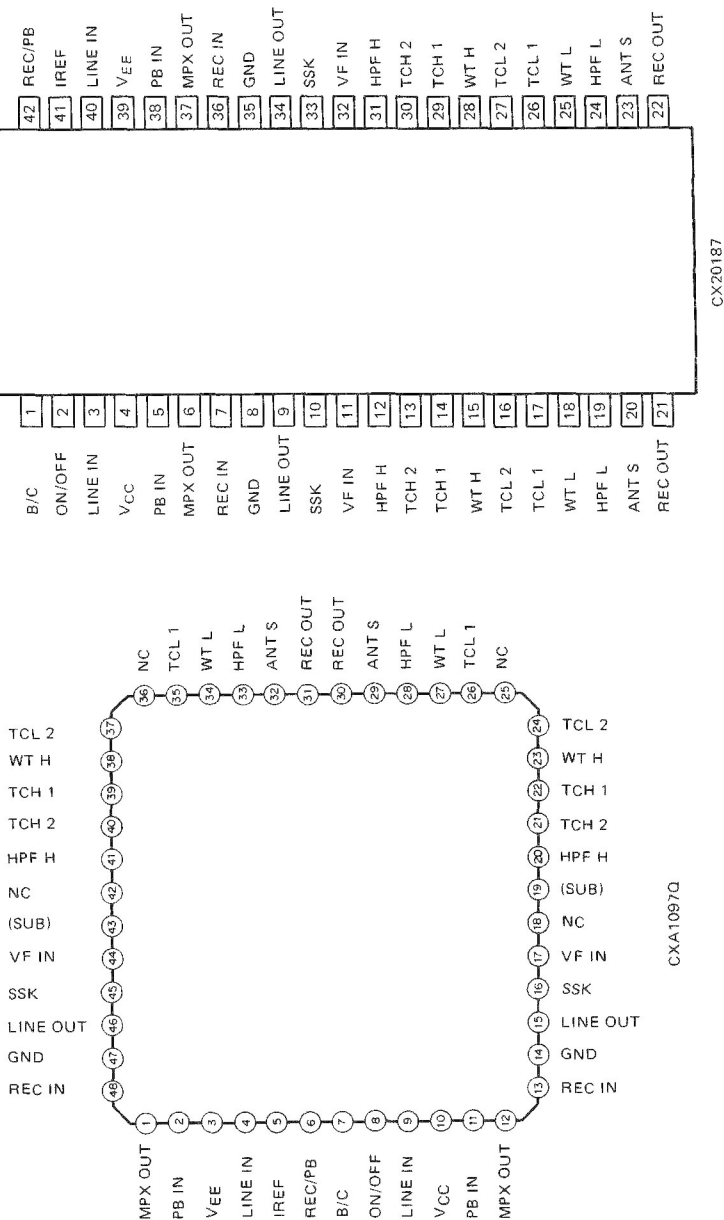
- Supply Voltage  $V_{CC} - V_{EE}$  17 V
- Allowable Power Dissipation  $P_D$  CX20187 2200 mW  
CXA1097Q 600 mW
- Operating Temperature Range  $T_{opr.}$  -30 to +85 °C
- Storage Temperature Range  $T_{stg.}$  -55 to +150 °C

Power Dissipations are indicated in the following Derating Curves.



- \* These ICs are available only to the licensees of Dolby Laboratories Licensing Corporation from whom licensing and application information may be obtained.
- \* "Dolby" and double D symbol are trade marks of Dolby Laboratories Licensing Corporation.

Pin Configuration



Ta=25°C, Vcc=7.5V, VEE=-7.5V, unless otherwise specified.

Dolby Level: -10 dBm = 245 mVrms at Rec Out.

## Electrical Characteristics

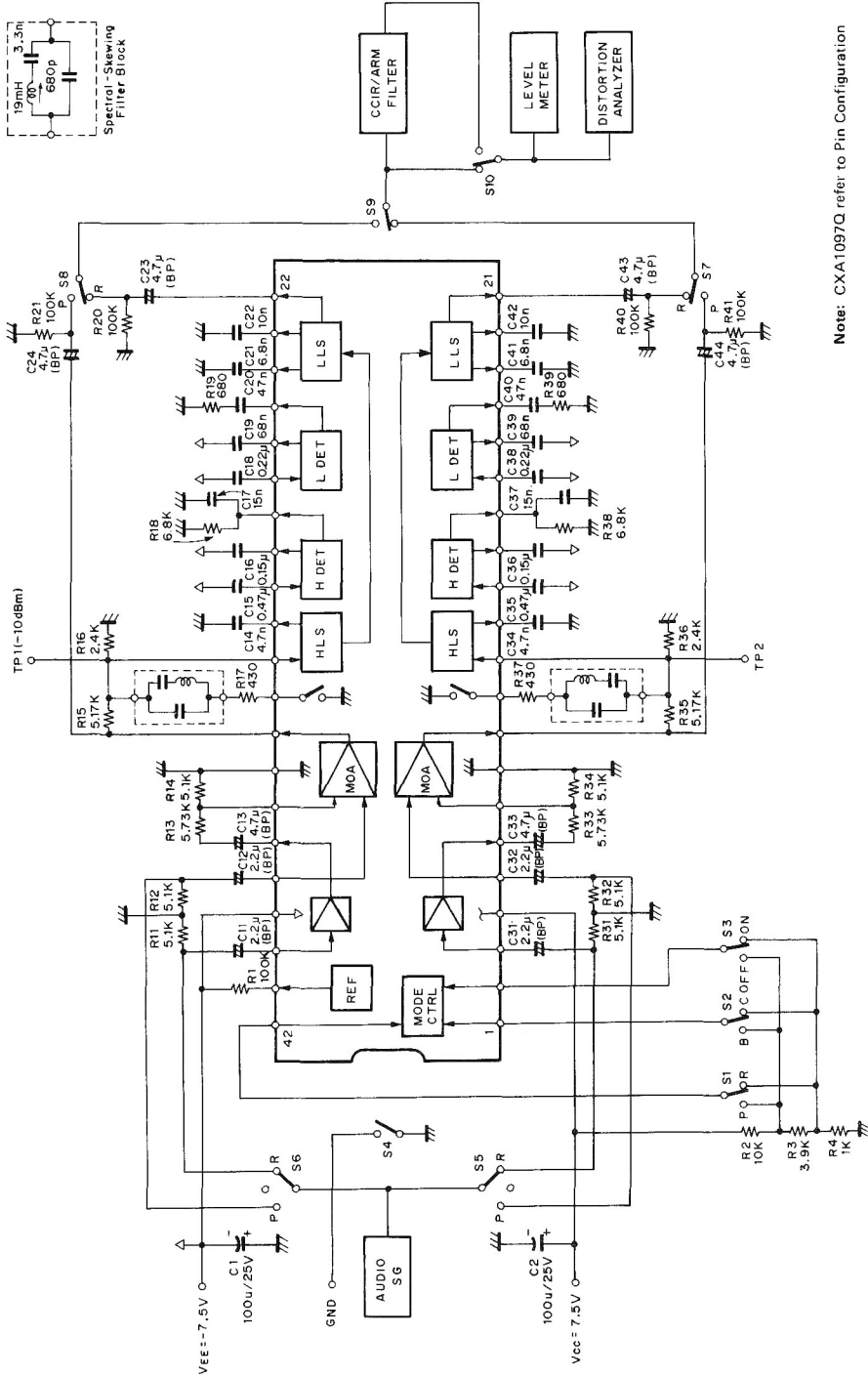
Characteristics	Symbol	Test Conditions *1				Specification			unit
		R/P	NR	f(Hz)	Other conditions	min.	typ.	max.	
Operating Voltage	Vopr	—	—	—	Split Single	±4 8	— —	±8 16	V
Supply Current	Icc	R	OFF	—	No signal *2	10.0	14.0	18.0	mA
Encode Characteristics (Boost)									
B type (1)	B-R-1	R	B	500	-25 dB	1.7	2.9	4.1	dB
(2)	B-R-2	R	B	2k	-25 dB	5.8	7.0	8.2	dB
(3)	B-R-3	R	B	5k	-25 dB	4.2	5.4	6.6	dB
(4)	B-R-4	R	B	10k	-40 dB	9.7	10.4	11.6	dB
(5)	B-R-5	R	B	10k	0 dB	-0.8	0.4	1.6	dB
C type (1)	C-R-1	R	C	500	-60 dB	14.7	16.2	17.7	dB
(2)	C-R-2	R	C	500	-25 dB	7.7	9.2	10.7	dB
(3)	C-R-3	R	C	2k	-60 dB	19.7	20.7	22.2	dB
(4)	C-R-4	R	C	2k	-25 dB	5.9	7.4	8.9	dB
(5)	C-R-5	R	C	5k	-25 dB	4.0	5.5	7.0	dB
(6)	C-R-6	R	C	10k	0 dB	-5.0	-3.5	-2.0	dB
Frequency Response	F-R	R	OFF	20k	refer to 1kHz	-0.5	0.0	0.5	dB
Signal Handling *3	Vomax	R	OFF	1k	(Rec Out) T.H.D = 1%	13.0	15.5	—	dB
Total Harmonic Distortion									
NR OFF	T.H.D (OFF)	R	OFF	1k	+10 dB	—	0.12	0.30	%
C type	T.H.D (C)	R	C	1k	0 dB	—	0.05	0.15	%
MPX Amp Gain	GMPX	R	—	1k	LINE IN-MPX OUT	—	12.0	—	dB
MOA Gain	GMOA	R	—	1k	REC IN-LINE OUT	—	20.0	—	dB
Decode Gain	GPB	P	—	1k	PB IN-REC OUT	—	22.0	—	dB
Input impedance									
LINE IN	ZLINE	R	—	—		—	70	—	kohm
REC IN	ZREC	R	—	—		—	50	—	kohm
PB IN	ZPB	P	—	—		—	50	—	kohm
C type Encode S/N Ratio (CCIR)	SN (CCIR)	R	C	—	Rg=5kohm	60	64	—	dB
Crosstalk									
REC-PB	CT-(1)	P	OFF	1k	0 dB	—	-93	—	dB
PB-REC	CT-(2)	R	OFF	1k	0 dB	—	-95	—	dB
Channel to Channel									
REC	CT-(3)	R	OFF	1k	0 dB	—	-85	—	dB
PB	CT-(4)	P	OFF	1k	0 dB	—	-84	—	dB
REC OUT Offset Voltage (C-OFF)	Voff	R	C	—		-40	—	40	mV
Control Voltage									
"H" Level	V-CH	—	—	—		2.5	—	—	V
"L" Level	V-CL	—	—	—		—	—	0.5	V

\*1 0 dB = Dolby Level at Rec Out

\*2 Single Supply Operation

\*3 The reference level of Line Output is 0 dBm (775 mVrms)

External Components and Test Circuit (CX20187)



Note: CXA1097Q refer to Pin Configuration

Quiescent Current vs. Supply Voltage

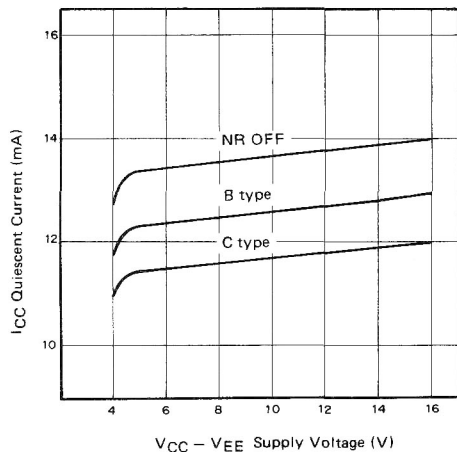


Fig. 1

Supply Current vs. Input Level

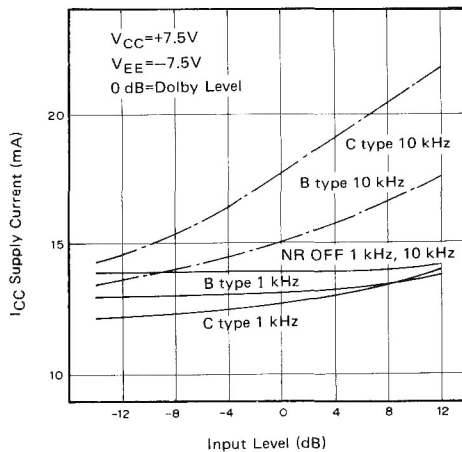


Fig. 2

B type Encode Characteristics

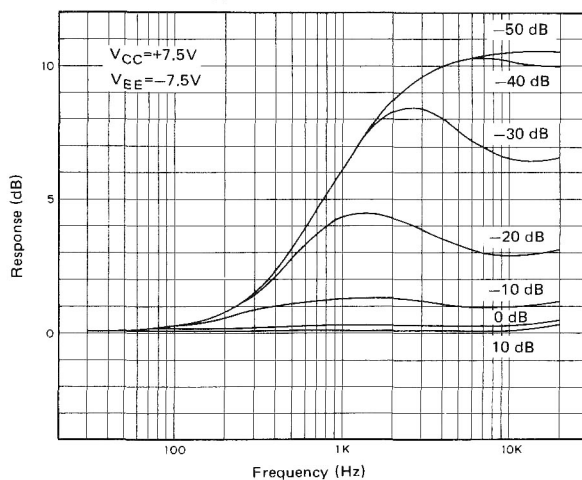


Fig. 3

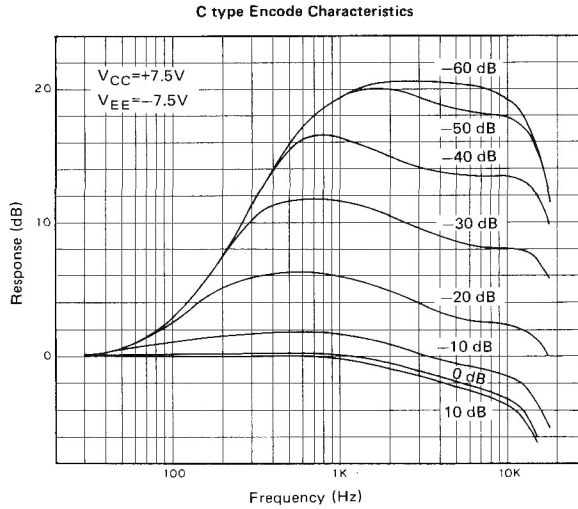


Fig. 4

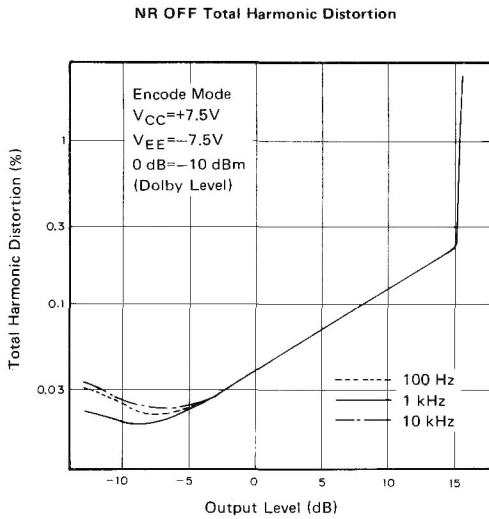


Fig. 5

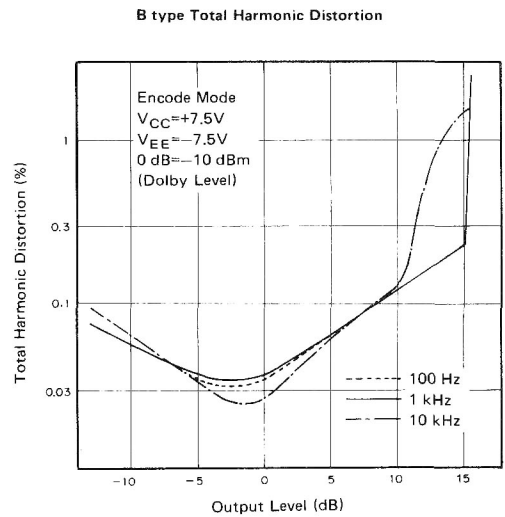


Fig. 6

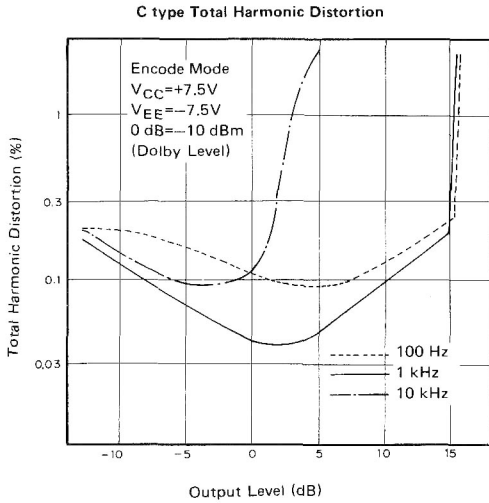


Fig. 7

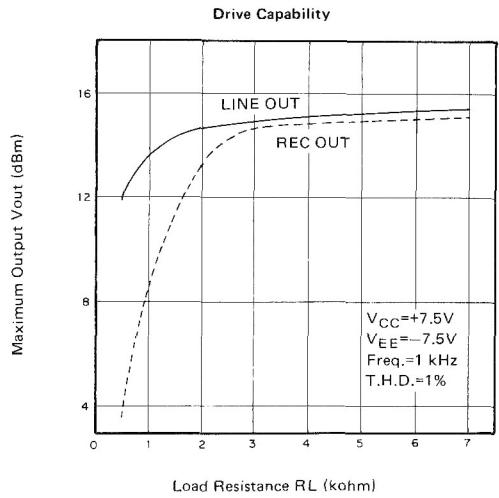


Fig. 8

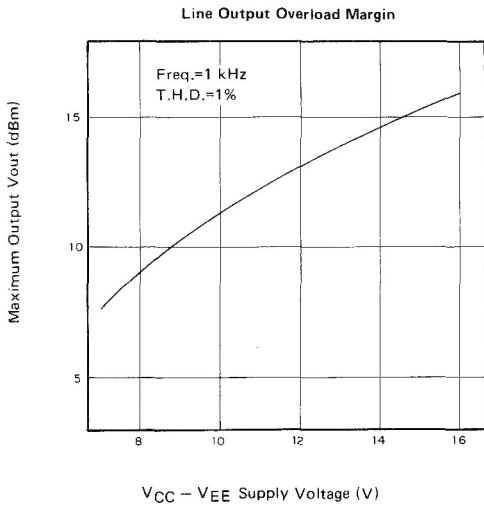


Fig. 9

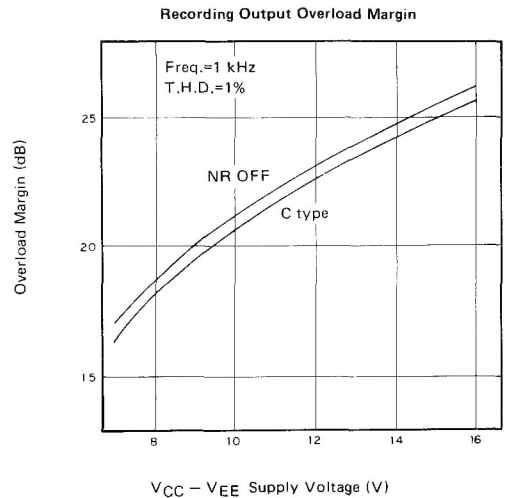


Fig. 10



## Channel to Channel Crosstalk

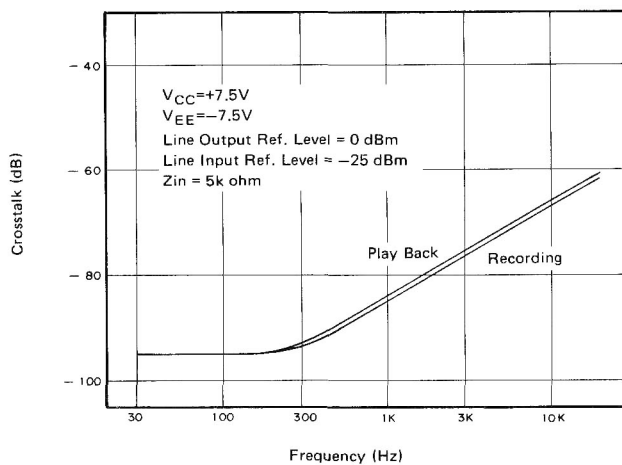


Fig. 11

## Recording and Play Back Crosstalk

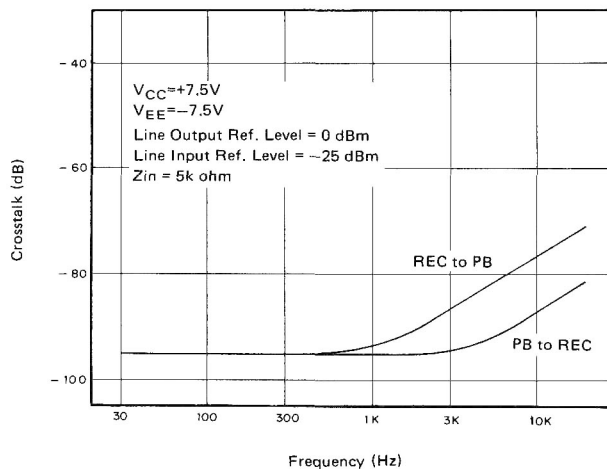


Fig. 12

## Application Notes

### 1) Power Supply

The CX20187/CXA1097Q are designed to operate on either single supply or split supply. For single supply applications these devices generate the internal signal grounds of half the supply voltage. The range of the supply voltage is

- (a) Single supply operation : +8 to +16 volts  
 (b) Split supply operation :  $\pm 4$  to  $\pm 8$  volts

The current consumption is roughly independent of supply voltage.

A useful feature of this device is the provision for programmable line output level, which will permit an optimum overload margin for various supply conditions. The overload margin therefore depends on both of the supply voltage and the line output reference level. Table a-1 shows the maximum line output reference levels to satisfy overload margins of 12 dB and 15 dB. Dolby Laboratories specifies 12 dB of minimum overload margin.

### 2) Operation Mode Control

The CX20187/CXA1097Q provide fully electronic switching circuits. The functions are controlled by DC voltages of the three control terminals of REC/PB, B type/C type and NR ON/OFF. The switching truth tables are shown in Table a-2. The switching levels, which are compatible with most commonly used logic gates, are as follows

- (a) Single supply operation  
 $V_{CC}/2 + 2.5V \leq V_H \leq V_{CC}$   
 $V_{CC}/2 + 0.5V \geq V_L \geq GND$   
 (b) Split supply operation  
 $2.5V \leq V_H \leq V_{CC}$   
 $0.5V \geq V_L \geq V_{EE}$

Supply Voltage	Overload Margin	
	12 dB	15 dB
8V ( $\pm 4V$ )	-3.0 dBm	-6.0 dBm
10V ( $\pm 5V$ )	-0.7 dBm	-3.7 dBm
12V ( $\pm 6V$ )	1.1 dBm	-1.9 dBm
15V ( $\pm 7.5V$ )	3.3 dBm	0.3 dBm

Table a-1 Maximum Line Output Reference Levels

It is desirable to provide a CR circuit at REC/PB terminal with time constant from 100 mSec to 1 Sec, which will reduce switching clicks effectively.

### 3) Reference Levels

Characteristics of the Dolby noise reduction processors are defined with reference to the Dolby level. This particular level in these devices is -10 dBm (245 mVrms), and is measured at the Test Point (VF IN) or the recording output (REC OUT). Signal levels at other terminals, referred to Dolby level at the Test Point, are as follows

- Recording output : -10 dBm (245 mVrms) (fixed)  
 Play back input : -32 dBm (20 mVrms) (fixed)  
 Line output : variable  
 Line input : variable

REC/PB	"VH"	"VL"
Function	PB (Decode)	REC (Encode)

ON/OFF B/C	"VH"	"VL"
"VH"	NR OFF	B type
"VL"	NR OFF	C type

Table a-2 Switching Truth Tables

The reference level of the line output (LINE OUT) is determined by an attenuation factor of the spectral skewing circuit. In Fig. a-1, an attenuation factor Hssk is defined as

$$H_{ssk} = 20 \cdot \log (1 + R15/R16) \text{ (dB)}$$

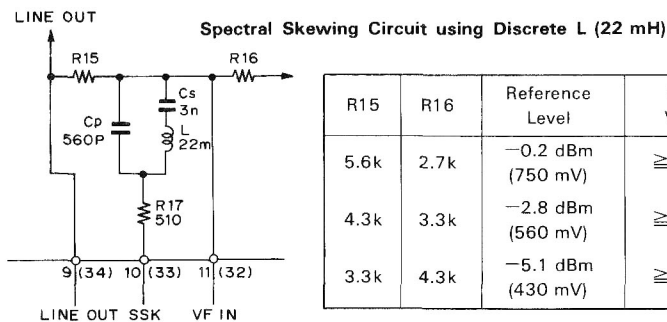


Fig. a-1

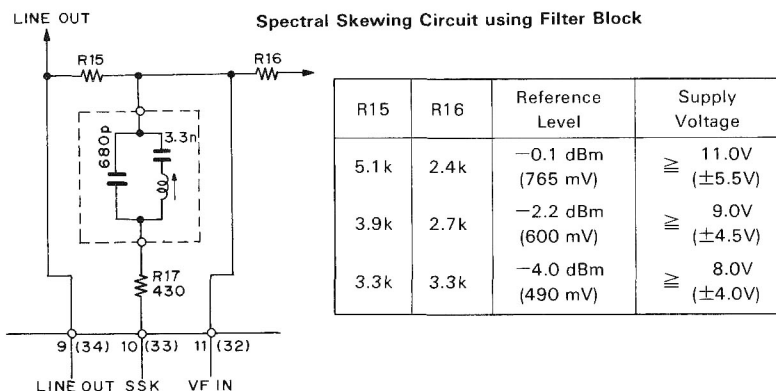


Fig. a-2

Thus the line output reference level becomes

$$\text{Line output reference level} = H_{ssk} - 10 \text{ (dBm)}$$

The parallel combination of R15 and R16 has to maintain a constant value to keep the accurate spectral skewing characteristics, that is 1.88 kohm for an inductor L with the inductance of 22 mH. The table in Fig. a-1 shows useful combinations of R15 and R16 for various applications.

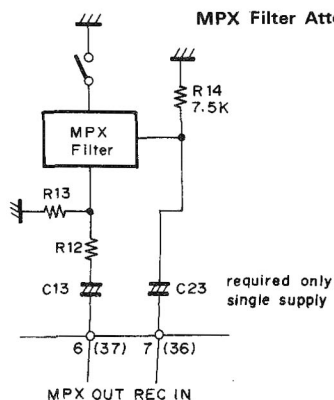
A spectral skewing filter block, which is provided for the Dolby ICs of the CX20187/CXA1097Q and the CX20027/20028 series, will be effective for the practical applications, and will offer accurate characteristics. The application using the spectral skewing filter block and combinations of R15 and R16 are shown in the table of Fig. a-2. This filter block requires 1.64 kohm for the parallel combination of R15 and R16.

A gain from the line input (LINE IN) to the line output (LINE OUT) in the recording (encode) mode is formed by a total gain of MOA gain (REC IN → LINE OUT), MPX buffer gain and a MPX (multiplex) filter attenuation. The line input reference level can be adjusted by the MPX filter attenuation. MOA gain and MPX buffer gain are

MOA gain (REC IN → LINE OUT) 20 dB

MPX buffer gain (LINE IN → MPX OUT) 12 dB

In Fig. a-3 the attenuation factor MPX depends on the ratio of R12 and R13.



Available only for  
 $Z_{in}=3.3\text{kohm}$ ,  $Z_{out}=6.8\text{kohm}$

R12	R13	HMPX (loss)
8.2k	5.6k	11.4 dB
6.8k	6.2k	9.9 dB
5.6k	8.2k	8.1 dB
4.7k	12.0k	6.5 dB

HMPX is

$$\text{HMPX} = 20 \cdot \log \left( 1 + R12 \cdot \left( \frac{1}{R13} + \frac{1}{R14} + \frac{1}{R_{in}} \right) \right) \text{ (dB)}$$

where,  $R_{in}$  is the input impedance of REC IN, which is typically 50 kohm. Thus the line input reference level is

$$\begin{aligned} \text{Line input reference level} &= \text{Line output reference level} \\ &\quad - 32 + \text{HMPX (dBm)} \end{aligned}$$

The parallel combination of R14 and  $R_{in}$  ( $=50\text{ kohm}$ ) should be equal to the output termination impedance of a MPX filter, and parallel combination of R12 and R13 should be equal to the input termination impedance of it. For example, combinations of R12 and R13 are shown in the table of Fig. a-3, which is available only for the MPX filter with 3.3 kohm of the input termination impedance and 6.8 kohm of the output termination impedance.

Fig. a-4 shows the level diagram of these devices. Increase of the line input sensitivity will degrade the overall noise reduction effect, which has to satisfy more than 17 dB according to the requirement of Dolby Laboratories. A recommendable line input reference level is approximately  $-25\text{ dBm}$  (44 mVrms).

#### Level Diagram in the Recording Mode

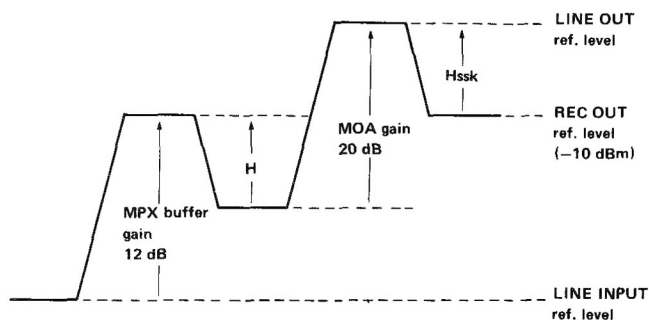


Fig. a-4

#### 4) Application Circuits

##### (a) Switchable Processor with Split Supply (Fig. a-6)

Supply voltage	: $\pm 7V$ typ. ( $\pm 5.5$ to $\pm 8V$ )
Line output level	: $-0.1$ dBm (765 mVrms)
Recording output level	: $-10.0$ dBm (245 mVrms)
Line input level	: $-25.6$ dBm (41 mVrms)
Play back input level	: $-32.0$ dBm (20 mVrms)

This circuit is suitable for high grade cassette decks.

##### (b) Switchable Processor with Single Supply (Fig. a-7)

Supply voltage	: $+12V$ typ. ( $+9$ to $+16V$ )
Line output level	: $-2.2$ dBm (600 mVrms)
Recording output level	: $-10.0$ dBm (245 mVrms)
Line input level	: $-24.3$ dBm (47 mVrms)
Play back input level	: $-32.0$ dBm (20 mVrms)

This circuit is most appropriate for general applications.

##### (c) Play Back Processor with AUX input (Fig. a-8)

Supply voltage	: $+9V$ typ. ( $+8$ to $+16V$ )
Line output level	: $-4.0$ dBm (490 mVrms)
Tape input level	: $-32.0$ dBm (20 mVrms)
AUX input level	: $-24.0$ dBm (49 mVrms)

This unique application providing AUX input is suitable for car stereo players and car stereo cassette decks. AUX input will be useful for a tuner input. REC/PB switching operates as the switching of AUX/Tape. The operation in AUX input mode is independent of the switch positions of B type/C type and NR ON/OFF.

##### (d) Application for Dubbing Cassette Decks

The CX20187/CXA1097Q simplifies the structure of dubbing decks. Conventional dubbing decks utilize the Dolby processors commonly for two systems. Problems occur on the dubbing mode of a Dolby NR encoded tape. Listeners will be forced to monitor non-decoded sound. This device offers a simple solution, which is to utilize the recording output signal in the play back mode as shown in Fig. a-5. In the dubbing mode the processor operates as a decode (play back) mode. The monitor (line output) signal from the deck A will be decoded if necessary, however, the deck B will record directly without decoding. This special application is possible because this device generates a non-decoded signal at the recording output in the decode mode even though it operates on the B type or C type NR.

#### Application for Dubbing Deck

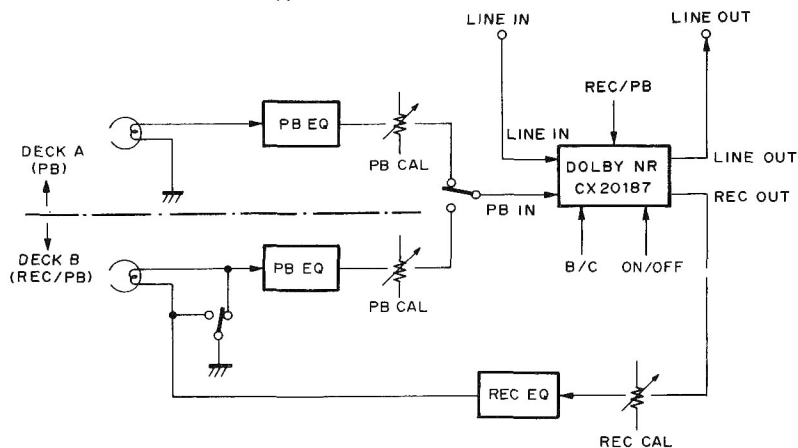
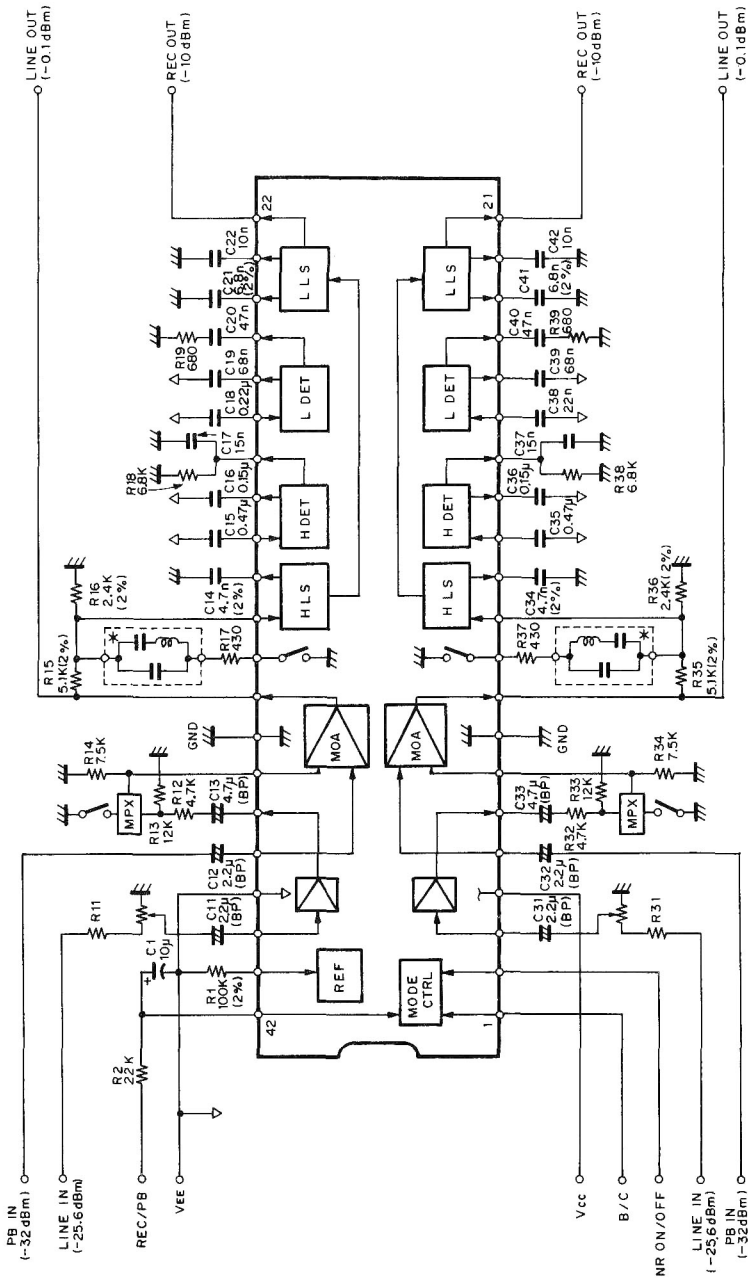


Fig. a-5

Switchable Processor with Split Supply (CX20187)



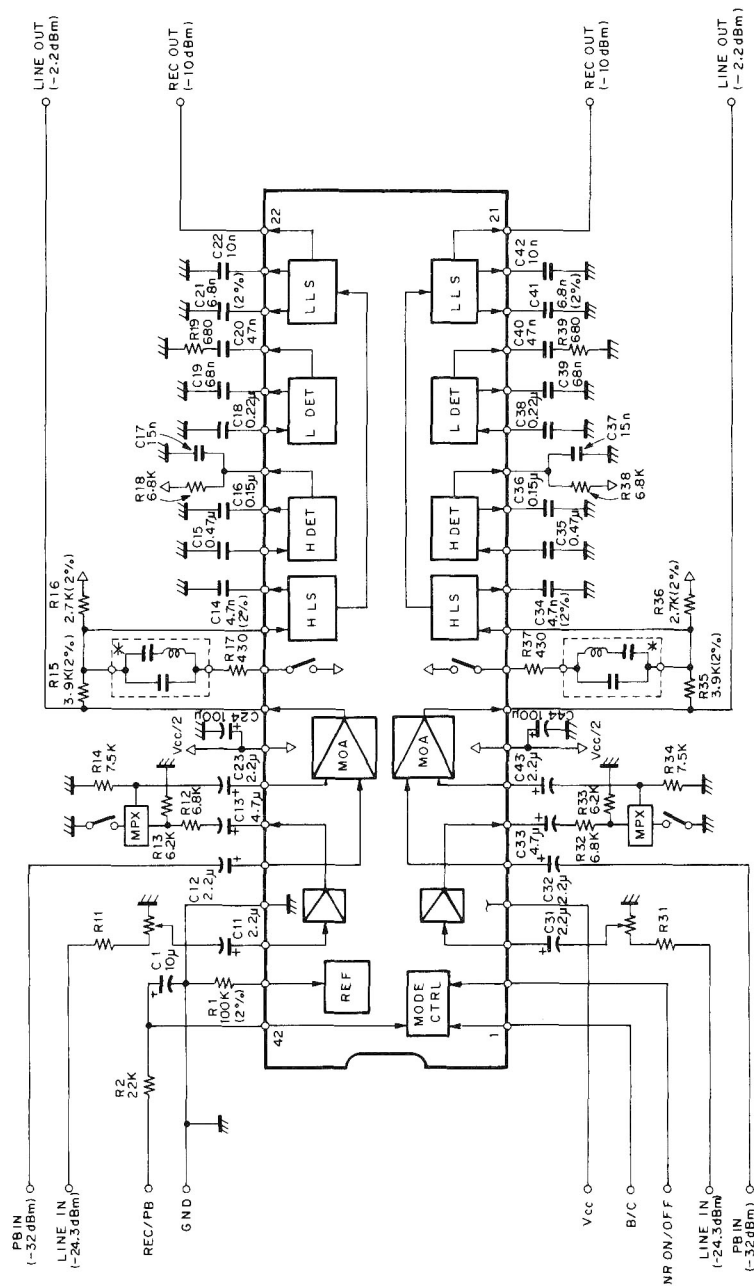
## Notes

1. Resistor tolerances are  $\pm 5\%$  unless otherwise specified
2. Capacitor tolerances are  $\pm 5\%$  unless otherwise specified except for coupling capacitors
3. CXA1097Q refer to Pin Configuration

\* Spectral Skewing Filter Block (See Application Notes 31.)

Fig. a-6

Switchable Processor with Single Supply (CX20187)



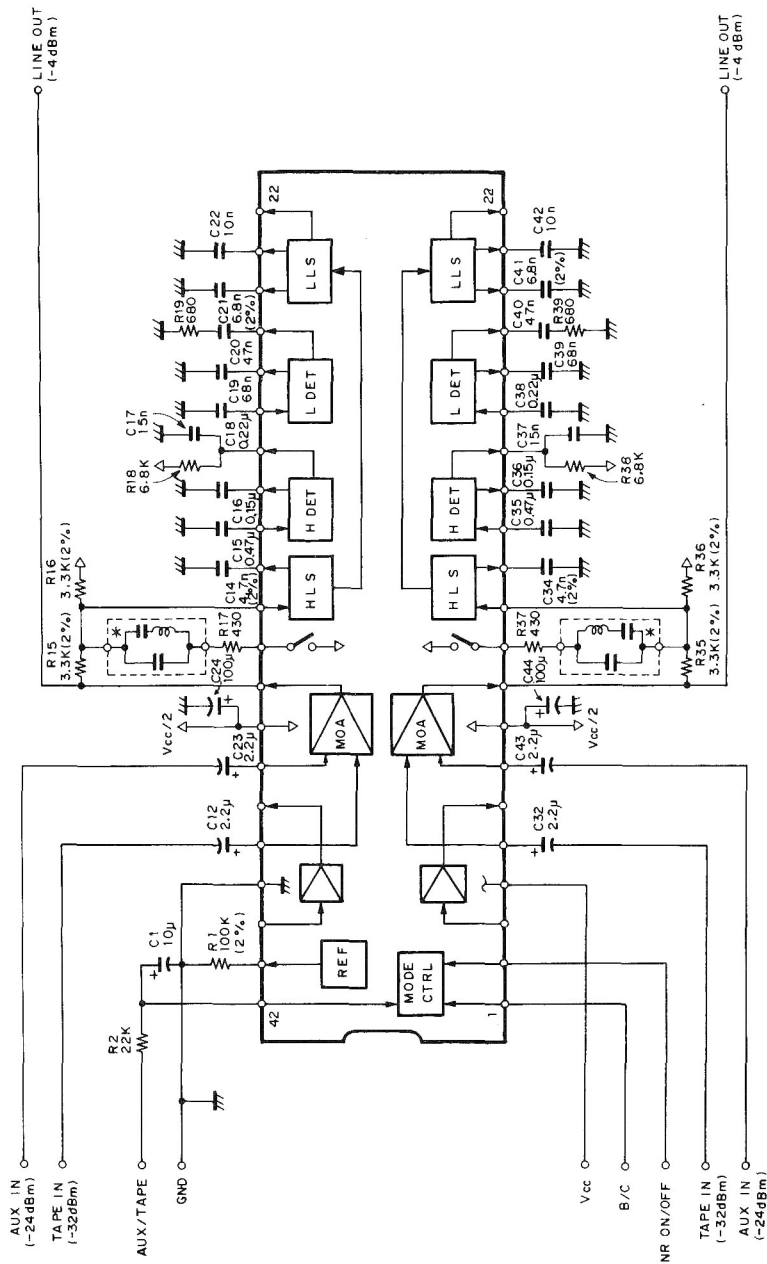
## Notes

1. Resistor tolerances are  $\pm 5\%$  unless otherwise specified
2. Capacitor tolerances are  $\pm 5\%$  unless otherwise specified except for coupling capacitors
3. Terminals of Vcc/2, for Ch 1 and Ch 2 should be separated in single supply
4. CXA1097Q refer to Pin Configuration

Fig. a.7

\* Spectral Skewing Filter Block (See Application Notes 31.)

Play Back Processor with AUX Input (CX20187)



## Notes

1. Resistor tolerances are  $\pm 5\%$  unless otherwise specified
2. Capacitor tolerances are  $\pm 5\%$  unless otherwise specified except for coupling capacitors
3. Terminals of  $V_{cc}/2$  for Ch 1 and Ch 2 should be separated in single supply
4. CXA10970 refer to Pin Configuration

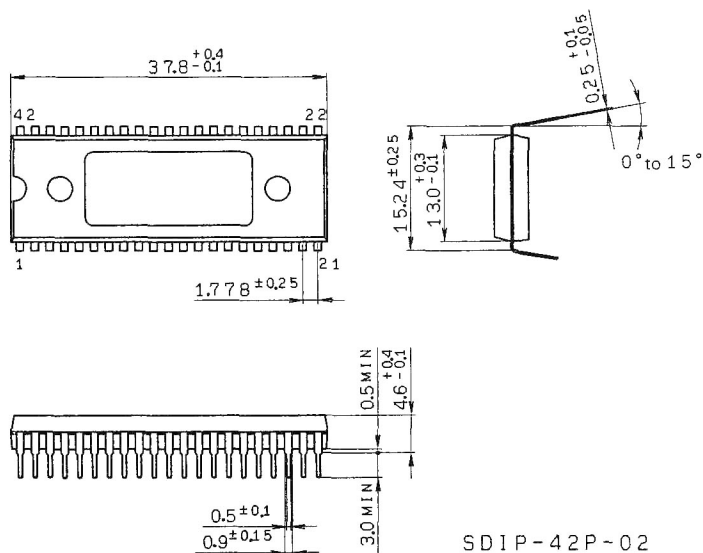
\* Spectral Skewing Filter Block (See Application Notes 3).)

Fig. a-8



## Package Outline Unit : mm

CX20187 42 pin SDIP (Plastic) 600mil 4.2g



CXA1097Q 48 pin QFP (Plastic) 0.6g

