BIPOLAR ANALOG INTEGRATED CIRCUIT

μPC2535

FM TUNER FOR ELECTRONIC-TUNING CAR RADIO

The μPC2535 is an IC developed for an FM tuner for car radio. An IF (Intermediate Frequency) amplifier, quadrature FM detector (Q detector), noise canceler, and stereo demodulator circuits are incorporated on a single chip.

Combining the μPC2535 with an FM front end allows the users to create a high-performance FM tuner.

FEATURES

- Signal meter circuit with enhanced linearity
- Quadrature FM detector
- SD (Station Detector) compatible with both tuning systems of high/low and IF-counter
- On-chip high-pass filter for noise canceler and delay circuit
- Double noise detection by signal meter circuit output and FM detector output
  - Substantial reduction of noise in weak to strong inputs
- Stereo demodulator circuit comprising a non-adjusting VCO (Voltage Controlled Oscillator) circuit using a ceramic oscillator
- On-chip HCC (High Cut Control) and SNC (Stereo Noise Control) functions, and independent adjustment of their operating points
  - Natural acoustic control condition setting enabled by setting HCC and SNC recovery time constants properly
- Desired maximum muting level setting for weak input signal
  - Optimization of inter-station noise
- Multipath noise and adjacent station interfering noise reduction functions
  - HCC and SNC control through detection of AM components in carrier wave
  - Serious interference muting function

ORDERING INFORMATION

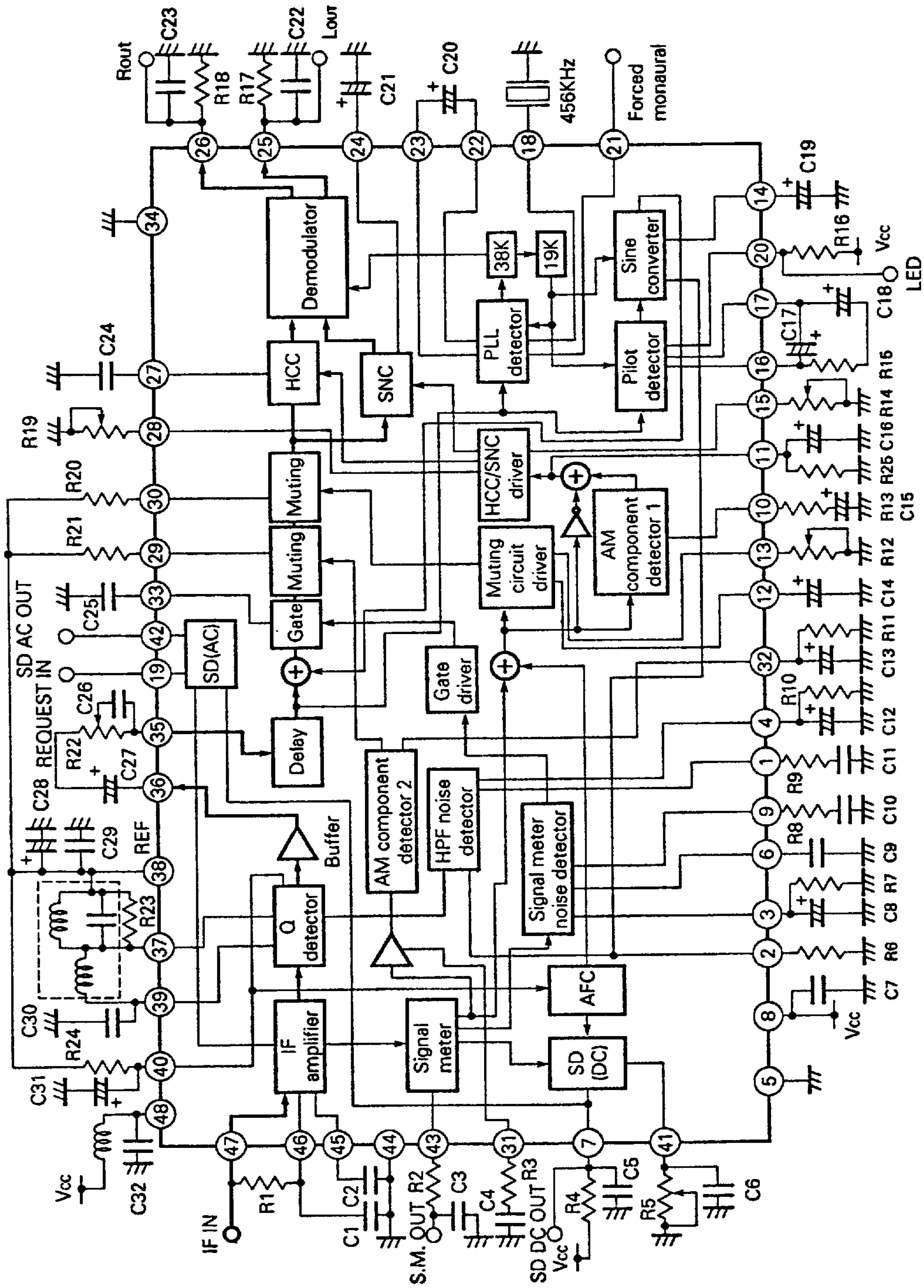
Part Number	Package	Quality Grade
μPC2535GH-2A5	48-pin plastic QFP (10 X 14 mm)	Standard

Please refer to "Quality grade on NEC Semiconductor Devices" (Document number IEI-1209) published by NEC Corporation to know the specification of quality grade on the devices and its recommended applications.

The information in this document is subject to change without notice.

Document No. ID-3148
(O.D.No. ID-8661)
Date Published October 1992 P
Printed in Japan

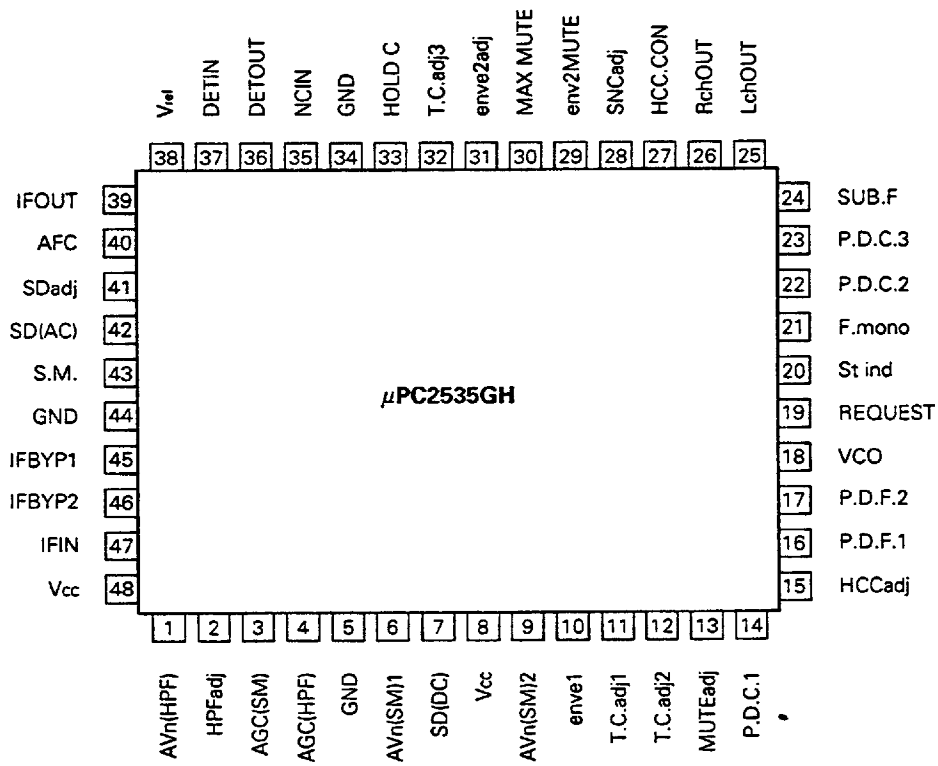
BLOCK DIAGRAM



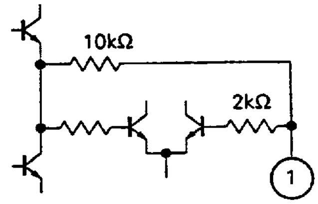
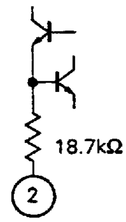
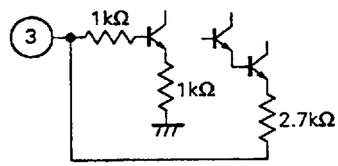
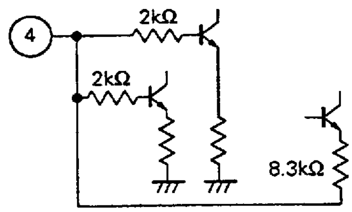
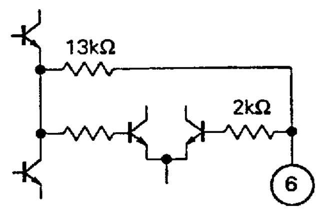
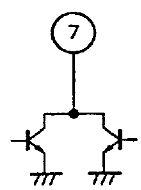
Remark Bold arrows indicate the audio signal flow.

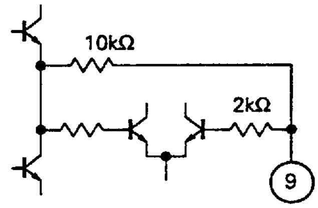
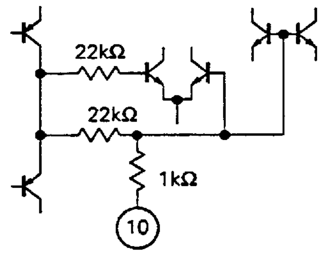
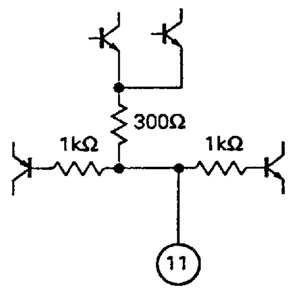
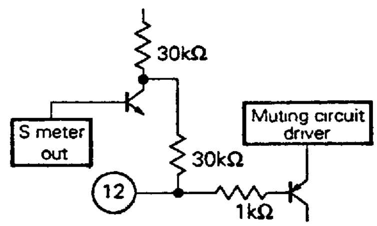
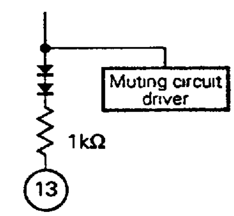
Pin Configuration (Top View)

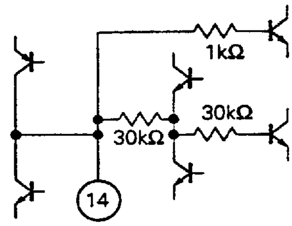
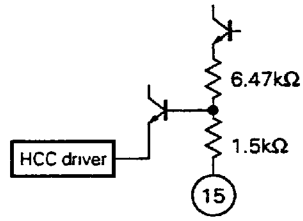
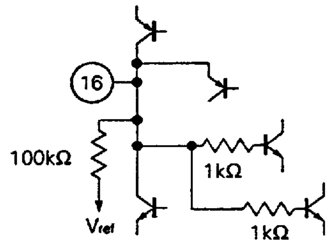
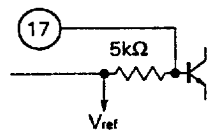
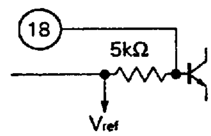
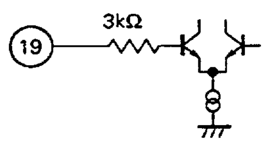
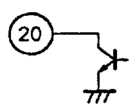
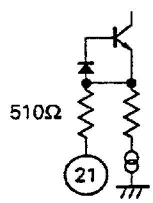
48-pin QFP

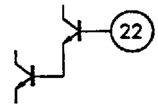
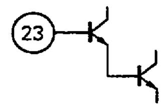
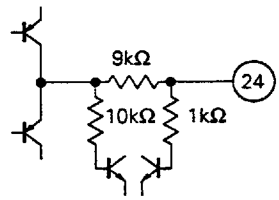
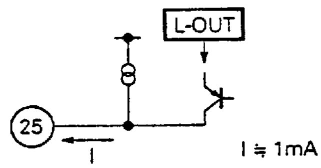
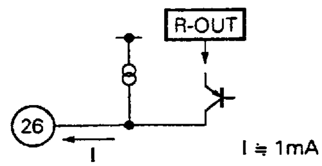
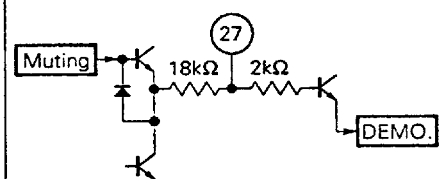
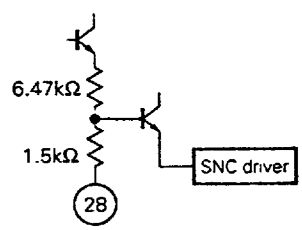


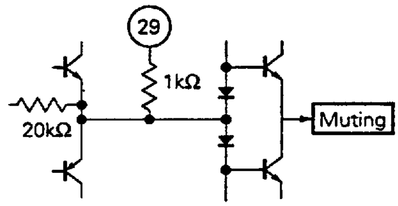
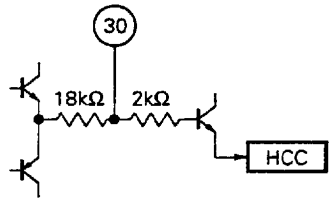
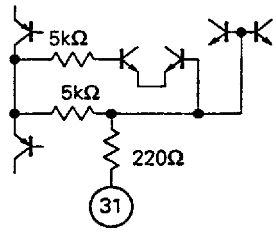
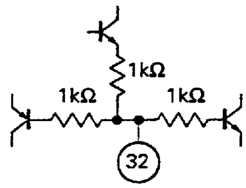
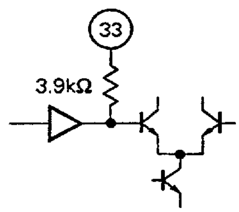
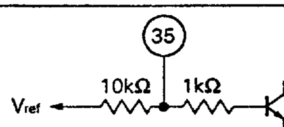
1. Equivalent Circuits

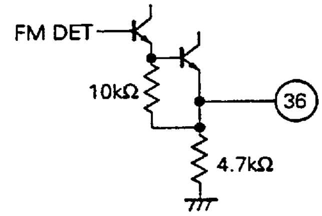
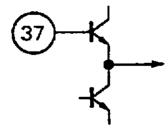
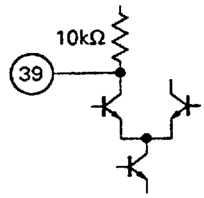
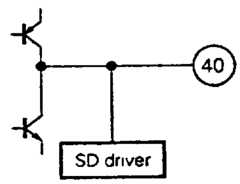
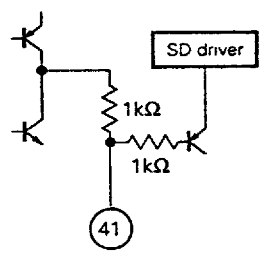
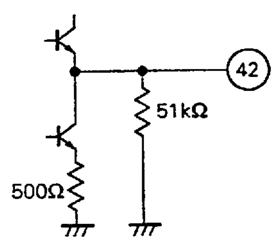
Pin No.	Symbol	Pin Name	Equivalent Circuit
1	AVn(HPF)	HPF noise detection gain set	
2	HPFadj	HPF cut-off frequency set	
3	AGC(SM)	Signal meter noise detection AGC set	
4	AGC(HPF)	HPF noise detection AGC set	
5	GND	Ground	GND
6	AVn(SM)1	Signal meter noise detection gain set	
7	SD(DC)	SD/DC output	

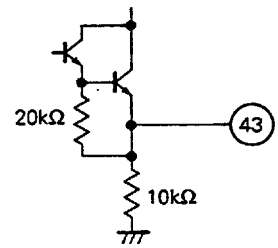
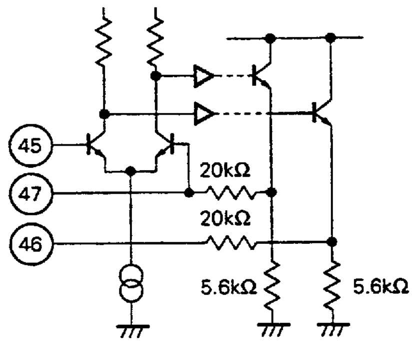
Pin No.	Symbol	Pin Name	Equivalent Circuit
8	Vcc	Power supply	Vcc
9	AVn(SM)2	Signal meter noise detection gain set 2	
10	enve1	AM component detection sensitivity set	
11	T.C.adj1	HCC/SNC time constant set	
12	T.C.adj2	Muting time constant set	
13	MUTEadj	Muting function operating point set	

Pin No.	Symbol	Pin Name	Equivalent Circuit
14	P.D.C.1	Pilot detection smooth 1	
15	HCCadj	HCC function operating point adjust	
16	P.D.F.1	Pilot detection filter 1	
17	P.D.F.2	Pilot detection filter 2	
18	VCO	Pilot VCO	
19	REQUEST	IF count request	
20	ST ind	Stereo indicator	
21	F.mono	Forced monaural	

Pin No.	Symbol	Pin Name	Equivalent Circuit
22	P.D.C.2	Pilot detection smooth 2	
23	P.D.C.3	Pilot detection smooth 3	
24	SUB F.	SUB signal bypass	
25	LchOUT	Left channel signal output	
26	RchOUT	Right channel signal output	
27	HCC.CON	High cut level set	
28	SNCadj	SNC function operating point adjust	

Pin No.	Symbol	Pin Name	Equivalent Circuit
29	env2MUTE	Serious interference muting level set	
30	MAX MUTE	Weak field muting level set	
31	enve2adj	Serious interference muting sensitivity set	
32	T.C.adj3	Serious interference muting time constant set	
33	HOLD C.	Hold capacitor	
34	GND	Ground	GND
35	NCIN	Noise canceling input	

Pin No.	Symbol	Pin Name	Equivalent Circuit
36	DETOUT	FM detection output	
37	DETIN	FM detection input	
38	Vref	Reference voltage	Reference voltage (+4 V)
39	IFOUT	IF output	
40	AFC	AFC output	
41	SDadj	SD sensitivity adjust	
42	SD(AC)	IF count output	

Pin No.	Symbol	Pin Name	Equivalent Circuit
43	S.M.	Signal meter output	
44	GND	Ground	GND
45	IFBYP1	IF bypass 1	
46	IFBYP2	IF bypass 2	
47	IFIN	IF input	
48	Vcc	Power supply	Vcc

2. FUNCTION OF BLOCKS

This chapter explains the circuit blocks of the μPC2535 and the characteristics that can be changed by external components.

2.1 IF AMPLIFIER, SIGNAL METER, AND QUADRATURE FM DETECTOR BLOCK

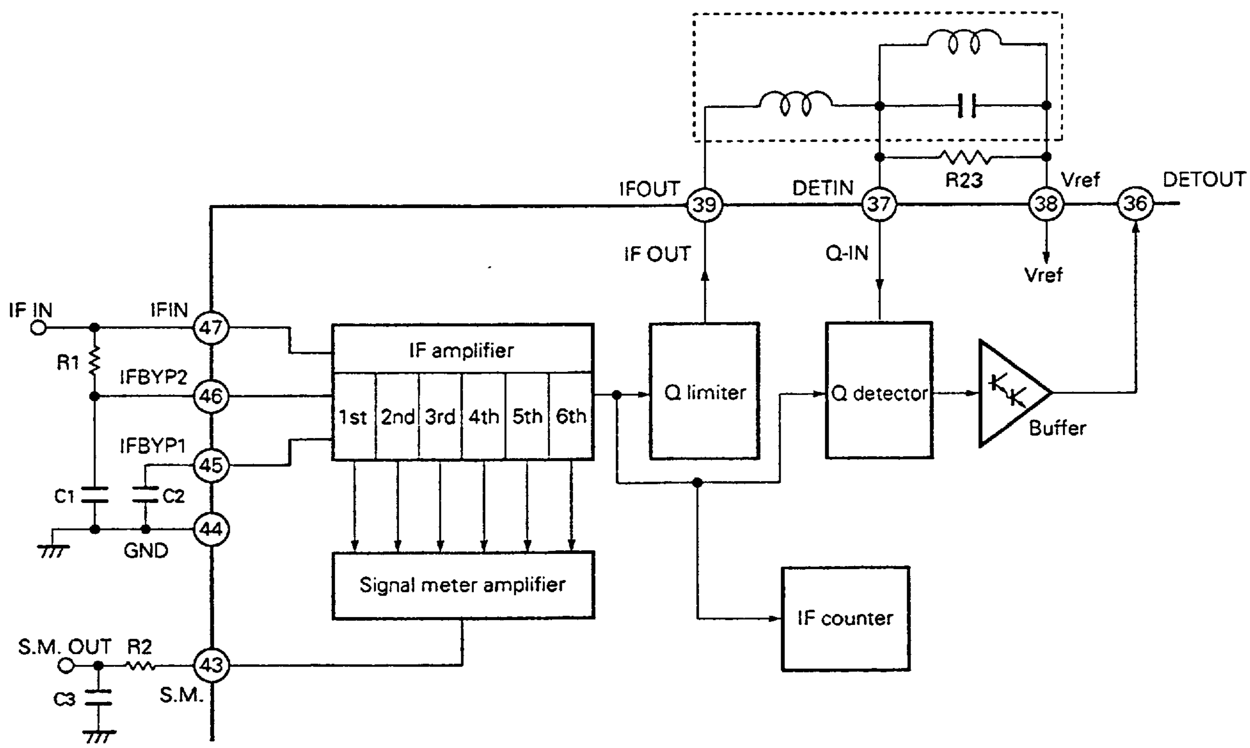
Fig. 2-1 shows the block diagram.

The IF amplifier consists of six stages, attaining the gain of about 60 dB.

The signal meter circuit adds the outputs from six stages of the IF amplifier, enhancing the linearity of the signal meter output. The signal meter voltage is used to drive the noise canceler, muting, and HCC/SNC circuits. Since about 0.5 V is applied to the μPC2535 at no signal, a carrier change in the weak field can be detected.

The quadrature FM detector (Q detector) outputs an approximately 280 mVp-p IF signal through the IF OUT pin at the output impedance of approximately 390 Ω. The FM detection signal is output through a buffer amplifier, allowing the μPC2535 to be interfaced with another IC such as an RDS (Radio Data System) IC easily.

Fig. 2-1 IF amplifier, signal meter, and Q detector block



2.2 STATION DETECTOR BLOCK

The station detection output of the μPC2535 is compatible with both the high/low system using DC and the IF count system using AC.

Fig. 2-2 shows the station detector block diagram.

Since the DC output is ORed with the AFC output (detuning detection) and it is an open-collector output, connect a pull-up resistor. If only the high/low system is used, connect pin 19 to the GND and make pin 42 open.

The AC output starts in synchronization with the DC output, so the band setting of the AC output is the same as that of the DC output.

When detuning is detected, the internal signal meter output stops; the muting, HCC (High-Cut Control), and SNC (Stereo Noise Control) functions will be activated at the same time (**See 2.5 and 2.6**).

To set the SD sensitivity of the DC output, connect resistor R5 between pin 41 and GND. To set the SD band, connect resistor R24 with a suitable resistance value between pins 40 and 38 and connect capacitor C31 with a suitable capacitance value. Fig. 2-3 shows the relationships between external resistors and SD output characteristics. Table 2-1 lists SD band setting values.

Fig. 2-2 Station detector block

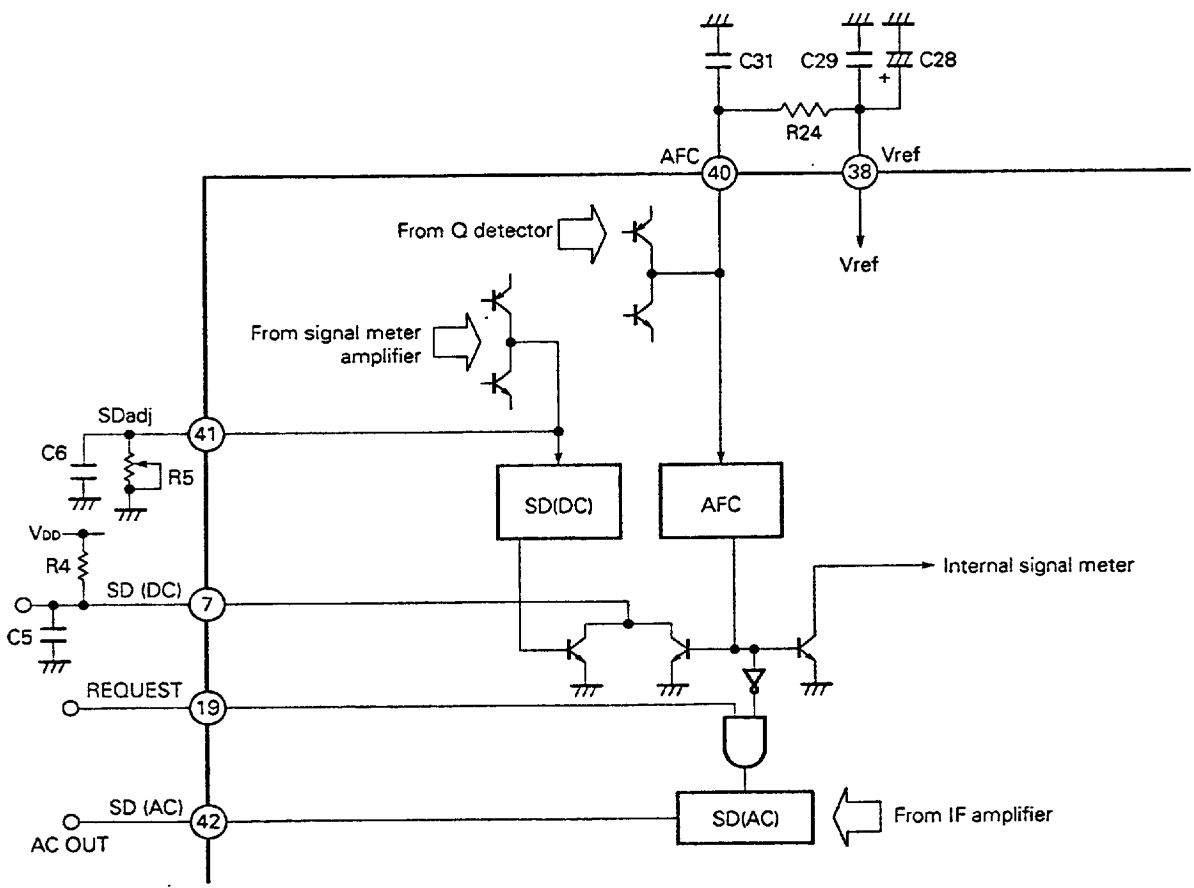
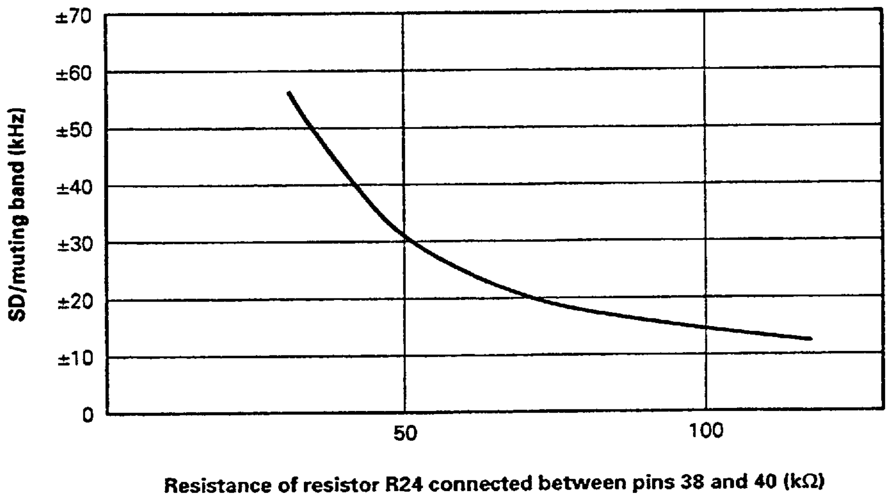


Table 2-1 SD band setting values

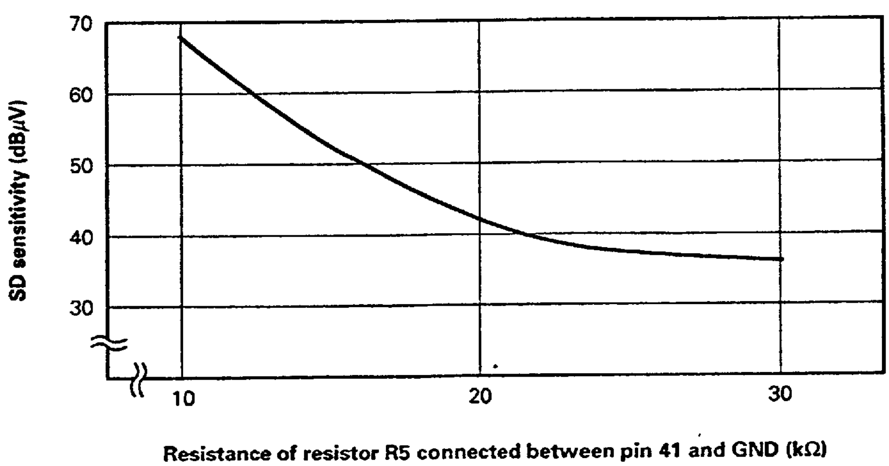
Channel step	R24	C31
50 kHz	56 kΩ	≧ 0.1 μF
100 kHz	33 kΩ	≧ 0.22 μF
200 kHz	18 kΩ	≧ 0.33 μF

Fig. 2-3 External resistors and SD output characteristics

(a) Relationship between SD/muting band and resistance of resistor R24 connected between pins 38 and 40



(b) Relationship between SD sensitivity and resistance of resistor R5 connected between pin 41 and GND



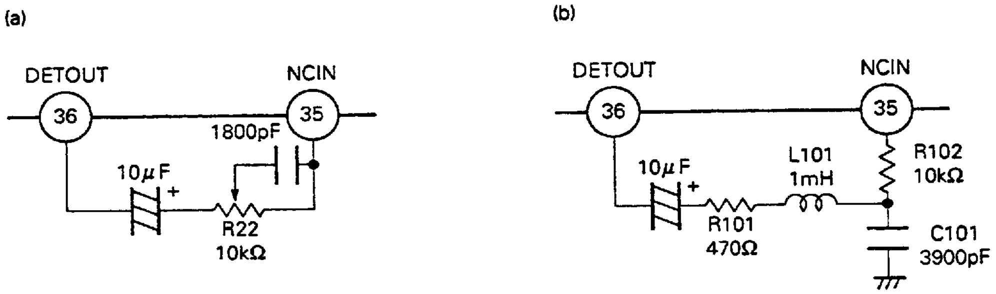
2.3 DETECTION OUTPUT BLOCK (NOISE CANCELER AND INTER-MPX CONNECTION: COMPENSATION OF SEPARATION AND ANTI-BIRDIE FILTER)

Separation is compensated by the external circuit connected between pins 36 and 35 as shown in Fig. 2-4 (a). Modifying this circuit to the circuit shown in Fig. 2-4 (b) forms an anti-birdie filter.

Note that the constant depends on the filtration range of the ceramic filter. If separation is impaired, adjust it with the R22 or R101.

The output impedance of pin 36 is about 50 kΩ and the input impedance of pin 35 is about 10 kΩ. If the stereo pilot-on sensitivity is too low, reduce the resistance of R22 or R102 to increase the apparent sensitivity.

Fig. 2-4 Detection output block



2.4 NOISE CANCELER BLOCK

The μPC2535 uses the high-frequency component of the IF detector output and the AC component of the signal meter to detect the pulse noise to be canceled, suppressing pulse noise in weak to strong inputs steadily. Fig. 2-5 shows the noise canceler block diagram.

The μPC2535 incorporates a quartic HPF to extract the high-frequency component from the IF detector output. In the medium-to-strong input range, the gate is turned off when HPF pulse noise is detected. In the weak-to-medium input range, the gate is turned off when signal meter pulse noise is detected. (See Fig. 2-6.)

The HPF cut-off frequency, HPF pulse noise detection sensitivity, and signal meter pulse noise detection sensitivity can be set by selecting external resistors and capacitors shown in Fig. 2-5. Table 2-2 summarizes these external resistors and capacitors. Fig. 2-7 shows the relationships between the HPF cut-off frequency and the resistance of resistor R6 connected between pin 2 and GND.

When pulse noise is input continuously, the μPC2535 turns on the gate forcibly about 100 μs later, preventing the gate-off state from lasting long. Each noise detector circuit is provided with an AGC function so that the gate does not malfunction due to noise other than pulse noise.

Fig. 2-5 Noise canceler block

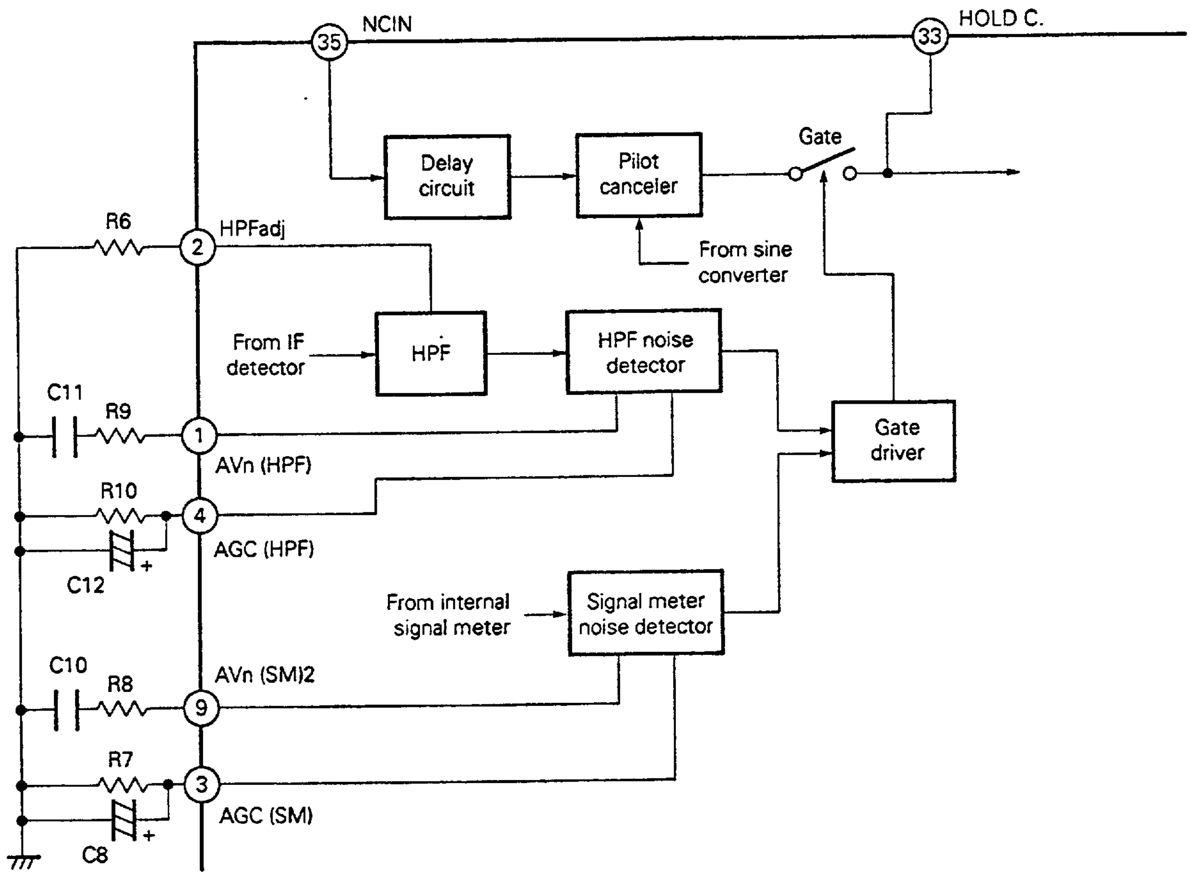


Fig. 2-6 Input levels and gate operations

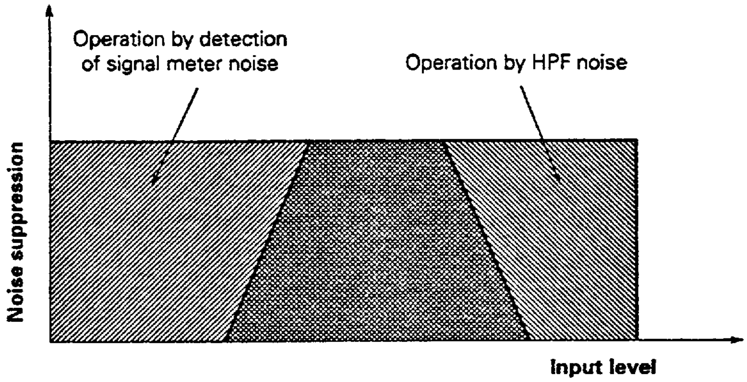
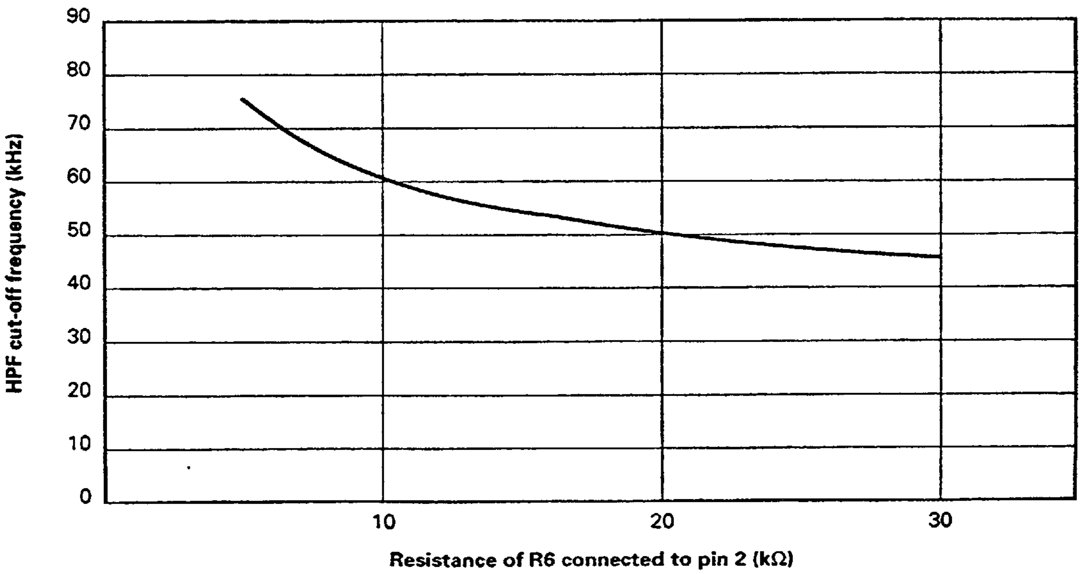


Table 2-2 External parts for noise canceler setting

Pin No.		Purpose	Measurement circuit value	When value is small	When value is large
2	R6	HPF cut-off frequency setting	12 kΩ	See Fig. 2-7	
1	R9	HPF noise detection gain setting	39 kΩ	Gain increases.	Gain reduces.
	C11		0.01 μF	Frequency characteristic adjustment	Frequency characteristic adjustment
4[Note]	R10	AGC setting for HPF noise detection	68 kΩ	Noise suppression effect reduces.	Noise suppression effect increases.
	C12		0.47 μF	Response speed increases.	Response speed reduces.
9	R8	Signal meter noise detection gain setting.	33 kΩ	Gain increases.	Gain reduces.
	C10		2200 pF	Frequency characteristic adjustment	Frequency characteristic adjustment
3[Note]	R7	AGC setting for signal meter noise detection	3.9 kΩ	Noise suppression effect reduces.	Noise suppression effect increases.
	C8		4.7 μF	Response speed increases.	Response speed reduces.

Note Pulling up pins 3 and 4 to V_{CC} with a 10 kΩ resistor will stop noise cancellation, allowing you to check the noise cancellation effect.

Fig. 2-7 Relationship between HPF cut-off frequency and resistance of resistor R6 connected between pin 2 and GND



2.5 MUTING BLOCK

The muting circuit of the μPC2535 allows the muting function operating point and muting level to be independently set by connecting suitable external resistors. To set the muting function operating point, connect a suitable resistor R12 between pin 13 and GND. To set the muting level, connect a suitable resistor R20 between pins 30 and 38.

The muting level is found by:

$$\text{Muting level VoMUTE (dB)} = 20 \times \log \frac{R20}{18\ k\Omega(\text{on-chip}) + R20}$$

The input/output characteristic vaires with the resistance of R12 connected between pin 13 and GND as shown in Fig. 2-8. The relationship between the muting function operating point and the resistance of resistor R12 connected between pin 13 and GND is shown in Fig. 2-9.

Muting time constants are determined by the capacitance of capacitor C14 connected between pin 12 and GND.

Attack time $T_{Attack} = 30 \times 10^3 \times C14$ (seconds)
Recovery time $T_{Recovery} = 60 \times 10^3 \times C14$ (seconds)

In the forced monaural mode, the muting function is canceled and the detuning muting function is activated in synchronization with the SD band.

Fig. 2-8 Input/output characteristic variation with resistance of R12

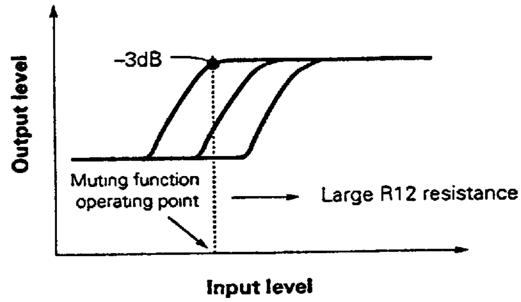
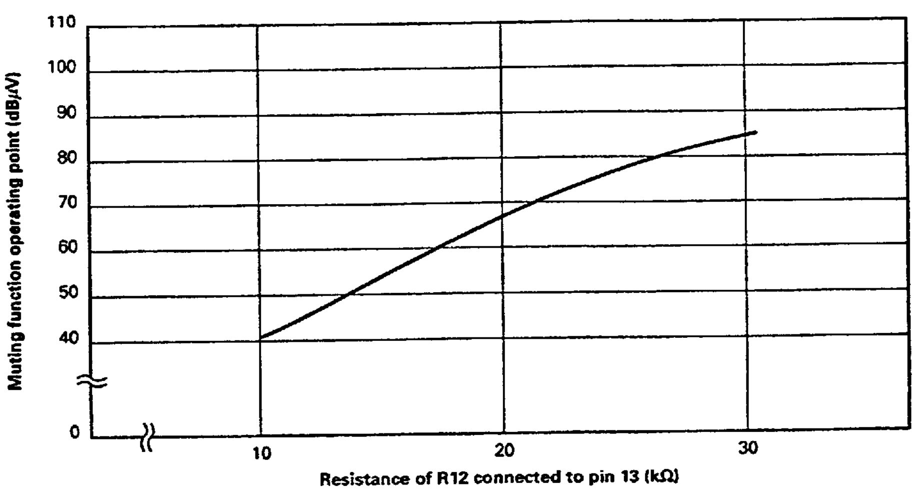


Fig. 2-9 Relationship between muting function operating point and resistance of R12 connected to pin 13



2.6 HCC (High-Cut Control)/SNC (Stereo Noise Control) Block

Fig. 2-10 shows the HCC/SNC block diagram.

The μPC2535 cuts high frequencies and controls stereo noise with reference to the signal meter voltage. The operating points of these control functions can be set independently. The HCC function operating point can be set by connecting a suitable resistor R14 between pin 15 and GND. The SNC function operating point can be set by connecting a suitable resistor R19 between pin 28 and GND. Setting the SNC function operating point at 74 dBμV or higher (operating point setting resistance; 22 kΩ or more) may disable separation. Take care. Fig. 2-11 shows the relationships between HCC/SNC function operating points and operating point setting resistances.

The high cut level of the HCC function is determined by the primary LPF that consists of the capacitor C24 connected between pin 27 and GND and the on-chip resistor (18 kΩ). Therefore, the high cut level of the HCC function can be changed by selecting capacitance of capacitor C24 as summarized in Table 2-3.

Fig. 2-10 AM component detector block and HCC/SNC block

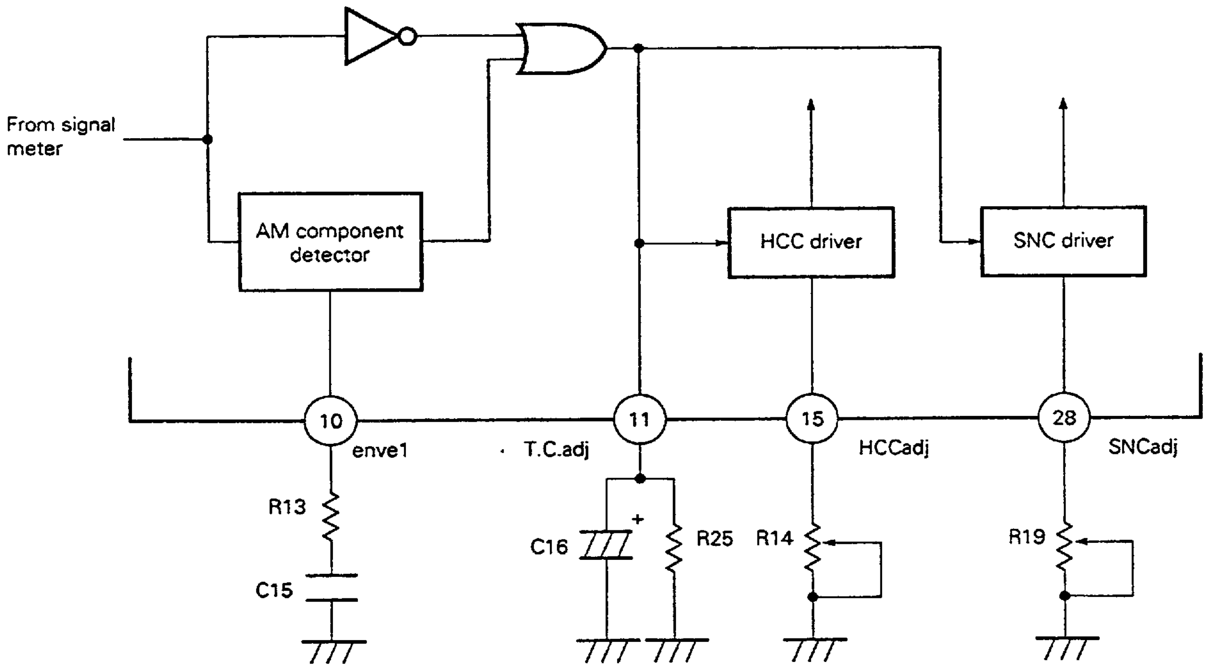


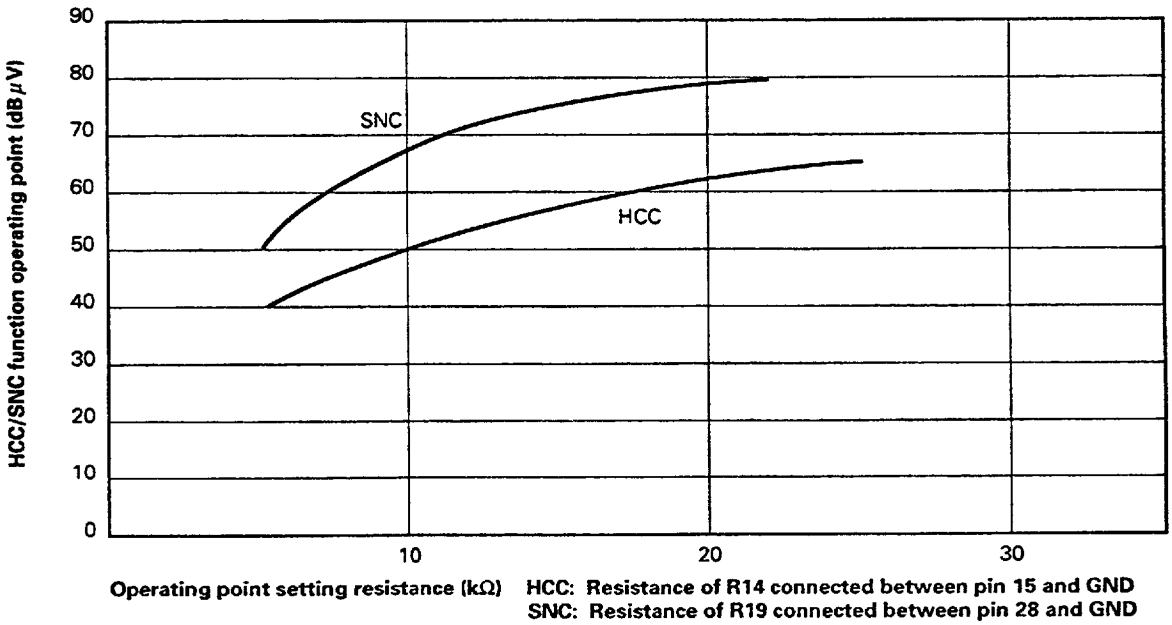
Table 2-3 Capacitance between pin 27 and GND and high cut level

C24	High cut level (10 kHz)
1000 pF	–3.6 dB
1500 pF	–6.0 dB
1800 pF	–7.0 dB
2700 pF	–10.0 dB

HCC and SNC time constants are determined by the capacitance of capacitor C16 connected between pin 11 and GND and resistance of resistor R25. They are found by:

Attack time T_{Attack} = 300 × C16 (seconds)
Recovery time $T_{Recovery}$ = R25 × C16 (seconds)

Fig. 2-11 Relationships between HCC/SNC operating points and operating point setting resistances



2.7 AM COMPONENT DETECTOR BLOCK

Fig. 2-10 shows the AM component detector block.

The μPC2535 incorporates an AM component detector circuit which rectifies and detects the AM component of the signal meter output to activate the HCC and SNC functions, suppressing the noise caused by multipath.

Sensitivity of the AM detector circuit is high. If it is too high, increase the resistance of resistor R13 connected to pin 10.

Control pin 11 is commonly used to control HCC and SNC functions with reference to the signal meter voltage. Accordingly, HCC and SNC time can be obtained in the same manner as for the HCC/SNC block.

2.8 SERIOUS INTERFERENCE MUTING CIRCUIT

The serious muting circuit equivalent to the AM component detector circuit causes muting forcibly, reducing the serious noise which is generated by interference caused by adjacent stations or serious multipath.

Sensitivity of this circuit must also be adjusted with resistor R3. If it is too high, increase the resistance of resistor R3 connected to pin 31. Time constants are determined by the resistance of resistor R11 connected between pin 32 and GND and capacitor C13. They are found by:

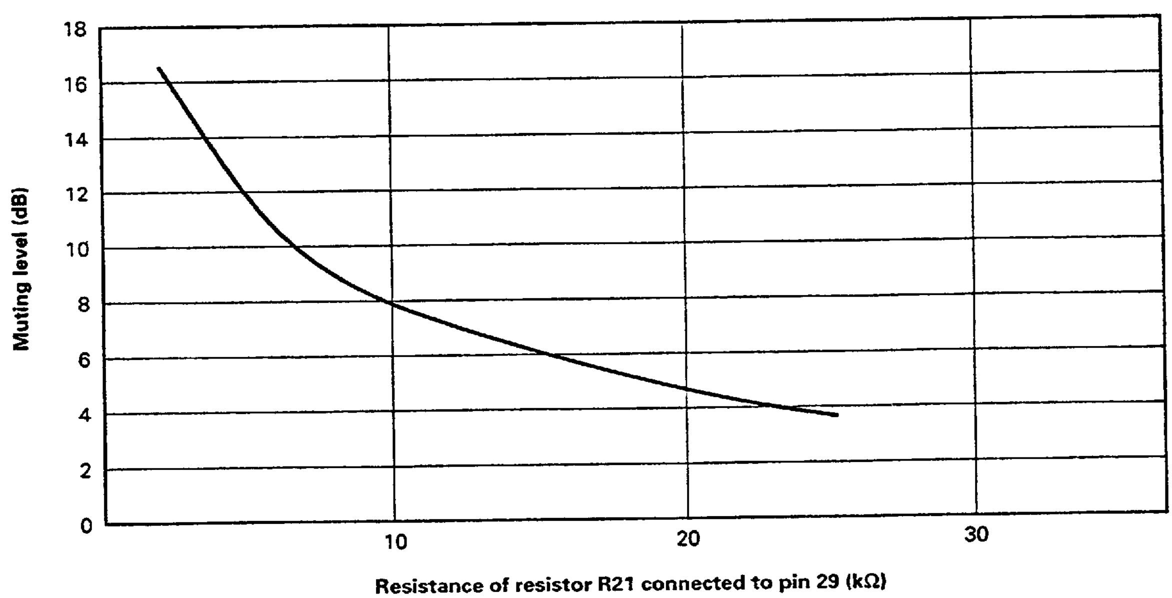
Attack time T_{Attack} = 300 × C13 (seconds)
Recovery time $T_{Recovery}$ = R11 × C13 (seconds)

The muting level is determined by the resistance of resistor R21 connected between pin 29 and GND. It is found by:

$$\text{Muting level } V_{OMUTE}\text{ (dB)} = 20 \times \log \frac{1\text{ k}\Omega\text{(on-chip)} + R21}{21\text{ k}\Omega\text{(on-chip)} + R21}$$

Fig. 2-12 shows the relationship between the muting level and the resistance of resistor R21 connected to pin 29 when the serious interference muting circuit operates.

Fig. 2-12 Relationship between muting level and resistance of resistor R21 connected to pin 29



2.9 MPX BLOCK

A PLL is used to detect a stereo pilot signal. A 456 kHz ceramic oscillator is used as a VCO. A pseudo sine wave generated from a triangular wave in the converter circuit is used for pilot cancellation, thus attaining a cancellation of about 25 dB without making any adjustment.

However, a desired cancellation may not be obtained because the pseudo sine wave distortion ratio is impaired depending on the level of the triangular wave. In this case, adjust the level of the triangular wave by connecting a suitable resistor R6 to pin 2. Since force monaural pin 21 is also used as a monitor pin, the level of the triangular wave can be monitored with this pin.

The triangular wave and HPF cut-off frequency disperse for the same reason, their adjustments are interlocked. Therefore, if the HPF cut-off frequency is greatly changed from approximately 55 kHz, the expected pilot cancellation may not be obtained.

Since stereo indicator output is an open collector output, connect a pull-up resistor.

3. ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings (Ta = +25 °C)

Parameter	Symbol	Condition	Rating	Unit
Supply voltage characteristic	V_{CC}		10	V
Allowable package dissipation	P_D		600	mW
Operating temperature range	T_{OPT}		–30 to +75	°C
Storage tempearture range	T_{STG}		–55 to +125	°C

Recommended Operation Range (Ta = +25 °C)

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
Supply voltage	V_{CC}		7.5	8	8.5	V
Input voltage	V_{IN}				132	dBμV
LED pin input current	I_{Stind}				1.0	mA
Forced monaural input voltage	$V_{F.mono}$		4.0	5.0	6.0	V

Electrical Characteristics (Ta = +25 °C, Vcc = 8.0 V)

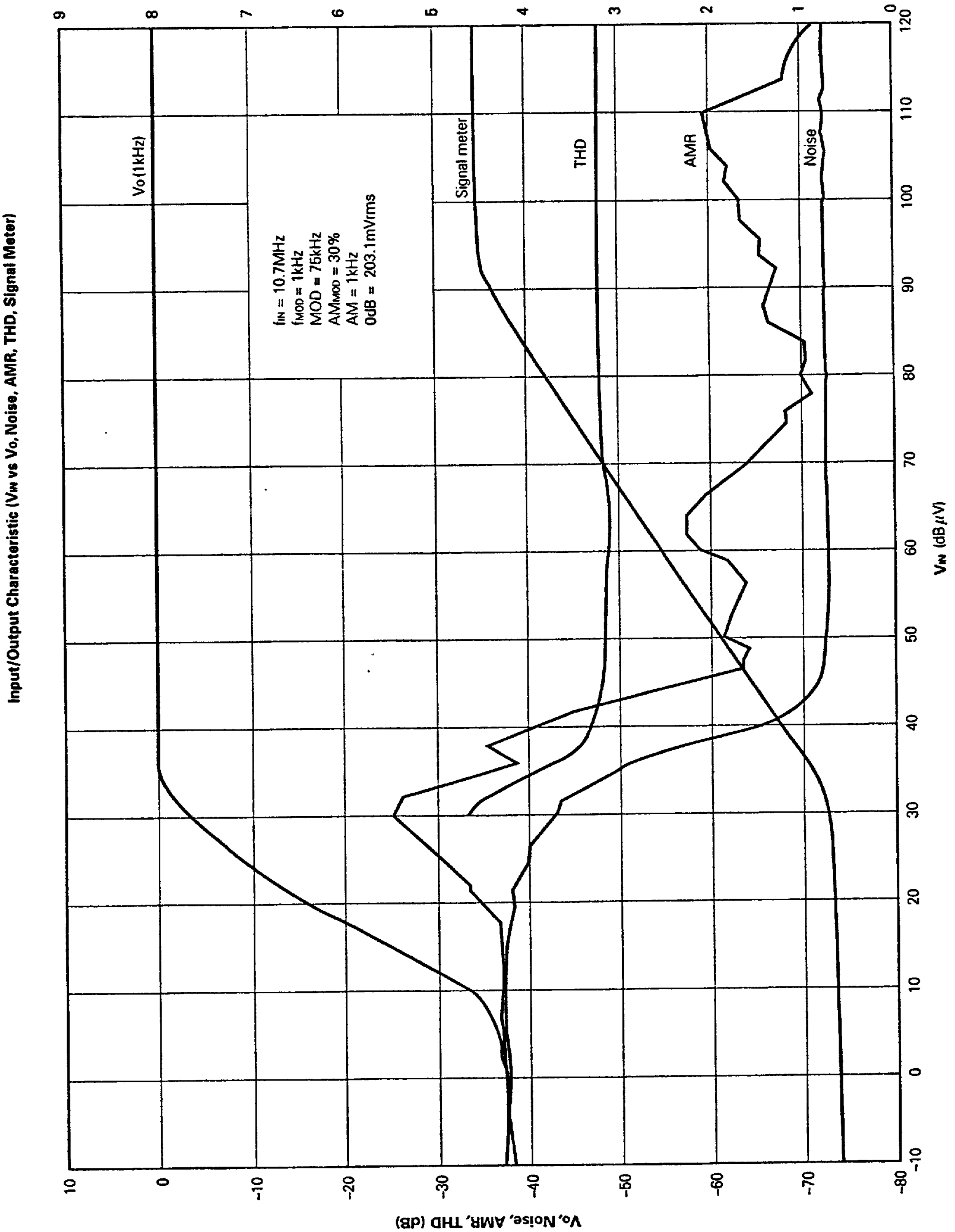
V_I = 100 dBμV, f_{MOD} = 1 kHz, Δf = ±75 kHz, Stereo; L = R = 45 %, Pilot = 10 %, unless otherwise specified.
The input level is specified at pin 47.

Parameter	Symbol	Measurement Condition	Specification Value			Unit
			MIN.	TYP.	MAX.	
Circuit current	I_{CC}	V_{IN} = 100 dBμV, no modulation	—	58	70	mA
IF block						
Limiting sensitivity	V_I limit	V_O = V_OAF–3dB (MUTE OFF)	28	31	34	dB
AM suppression ratio	AMR	AM: 400 Hz, MOD = 30 %	50	63	—	dB
Detector output level	V_O DET	(Level of pin 36)	180	240	300	mV_{rms}
Detector output distortion ratio	THD DET	(Level of pin 36)	—	0.5	0.7	%
Signal meter voltage 1	V_{SM}(0)	No signal	0.35	0.55	0.75	V
Signal meter voltage 2	V_{SM}(60)	V_I = 60 dBμV	2.12	2.42	2.72	V
Signal meter voltage 3	V_{SM}(100)	V_I = 100 dBμV	4.2	4.5	5.0	V
SD sensitivity	SS	RSD = 11 kΩ	47	52	57	dBμV
SD band width	SD width	RAFC = 56 kΩ	40	50	70	kHz
Blend control block						
Muting function operating point	V_I(MUTE)	–3dB point, R13 = 9.1kΩ R20 = 3 kΩ	31	41	51	dBμV
HCC function operating point	V_I(HCC)	–3dB point, f = 10 kHz, R14 = 12 kΩ	48	56	64	dBμV
SNC function operating point	V_I(SNC)	–11 dB point, Sub 90 %, R19 = 12 kΩ	59	69	79	dBμV
MPX block						
Output signal level 1	V_OAF	(Pin 25/26): Monaural 100 %	150	210	270	mV_{rms}
Output signal level 2	V_OAFmain	Main 90 %, Pilot 10 %	130	190	240	mV_{rms}
Total harmonic distortion 1	THDmono	Monaural 100 %	—	0.32	0.5	%
Total harmonic distortion 2	THDmain	Main 90 %, Pilot 10 %	—	0.25	0.5	%
Signal-to-noise ratio	S/N	Monaural 100 %	70	75	—	dB
Separation	Sep	L-only/R-only (when adjusted)	40	45	—	dB
Channel balance	Ch.B	Main 90 %, Pilot 10 %	—	0	1.0	dB

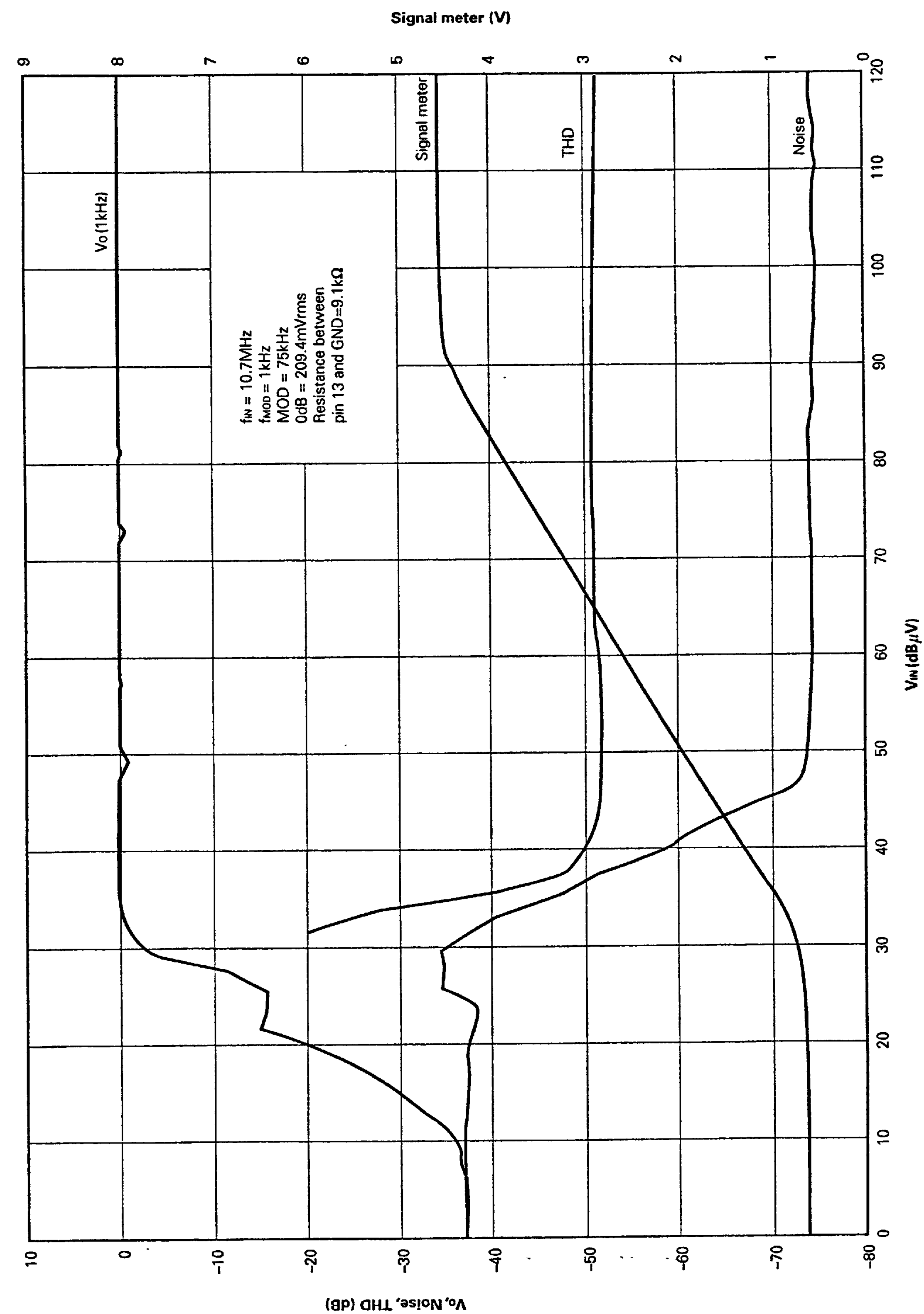
Parameter	Symbol	Measurement Condition	Specification Value			Unit
			MIN.	TYP.	MAX.	
Pilot cancellation ratio	Rej(19K)	Pilot 10 % only (when not adjusted) R6 = 12 kΩ	15	25	—	dB
Harmonic suppression ratio	Rej(38K)	Pilot 10 % only	35	45	—	dB
LED-on sensitivity	Pon	Pilot level of pin 36	8	13	18	mV_{rms}
LED-off sensitivity	Poff	Pilot level of pin 36	2	4	8	mV_{rms}
Pilot current	PI IN	Pilot 10 % only	0.8	1.5	2.0	mA
Forced monaural sensitivity	V(mono)	Voltage applied to pin 21	4.0	—	—	V
Pilot capture range	CR	Pilot 10 % only	±0.5	±0.9	±2.0	%
IF count output voltage	Vo(SDAC)	VI = 100 dBμV, Request on, Connect 10 pF capacitor between pin 42 and GND	60	140	—	mV_{rms}
IF count leakage voltage	L(SDAC)	VI = 100 dBμV, Request off	—		10	mV_{rms}
Serious interference muting level	VoMUTE2	VI = 60 dBμV, AM.MOD = 80 %	10	15	20	dB
Reference characteristics						
Noise sensitivity 1	Vpulse1	VI = 100 dBμV, 1 μs, 1kHz, SM OFF	—	60	—	mV_{p-p}
Noise sensitivity 2	Vpulse2	VI = 80 dBμV, 1μs, 1 kHz, HPF OFF	—	13	—	mV_{p-p}
Gating time	TGATE	1 μs, 1 kHz, HPF OFF	—	25	—	μs
Maximum muting level	VoMUTE	VO = 0 dBμV (R20 = 3 kΩ)	—	13	—	dB
NC delay 1	DLY1	1 kHz, 200 mV_{rms}	—	10	—	μs
NC delay 2	DLY2	50 kHz, 200 mV_{rms}	—	9.5	—	μs
Separation 2	Sep2	L-only, f = 100 Hz	—	45	—	dB
Separation 3	Sep3	L-only, f = 10 Hz	—	29	—	dB

4. CHARACTERISTIC CURVES

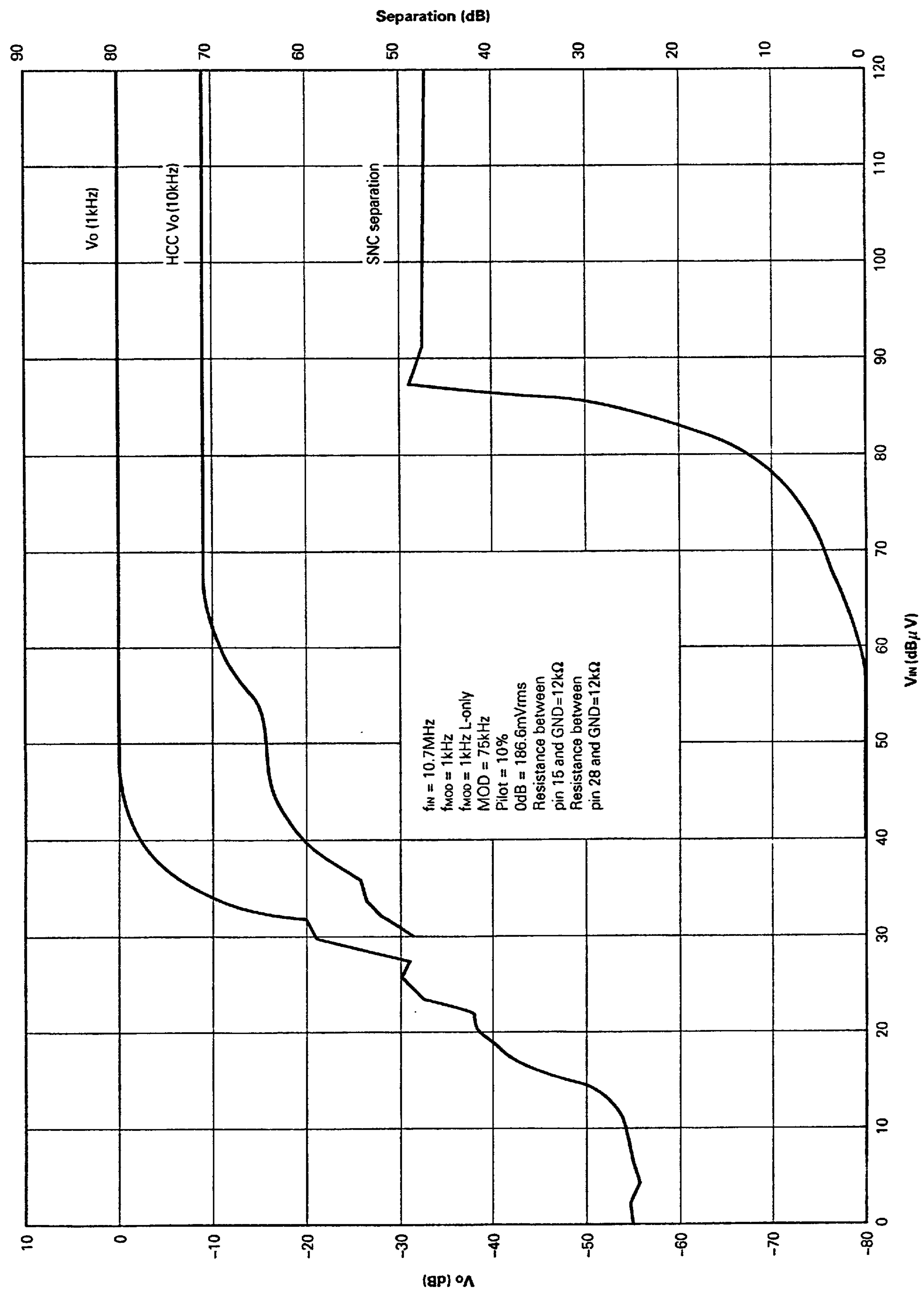
(1) Input/Output Characteristics



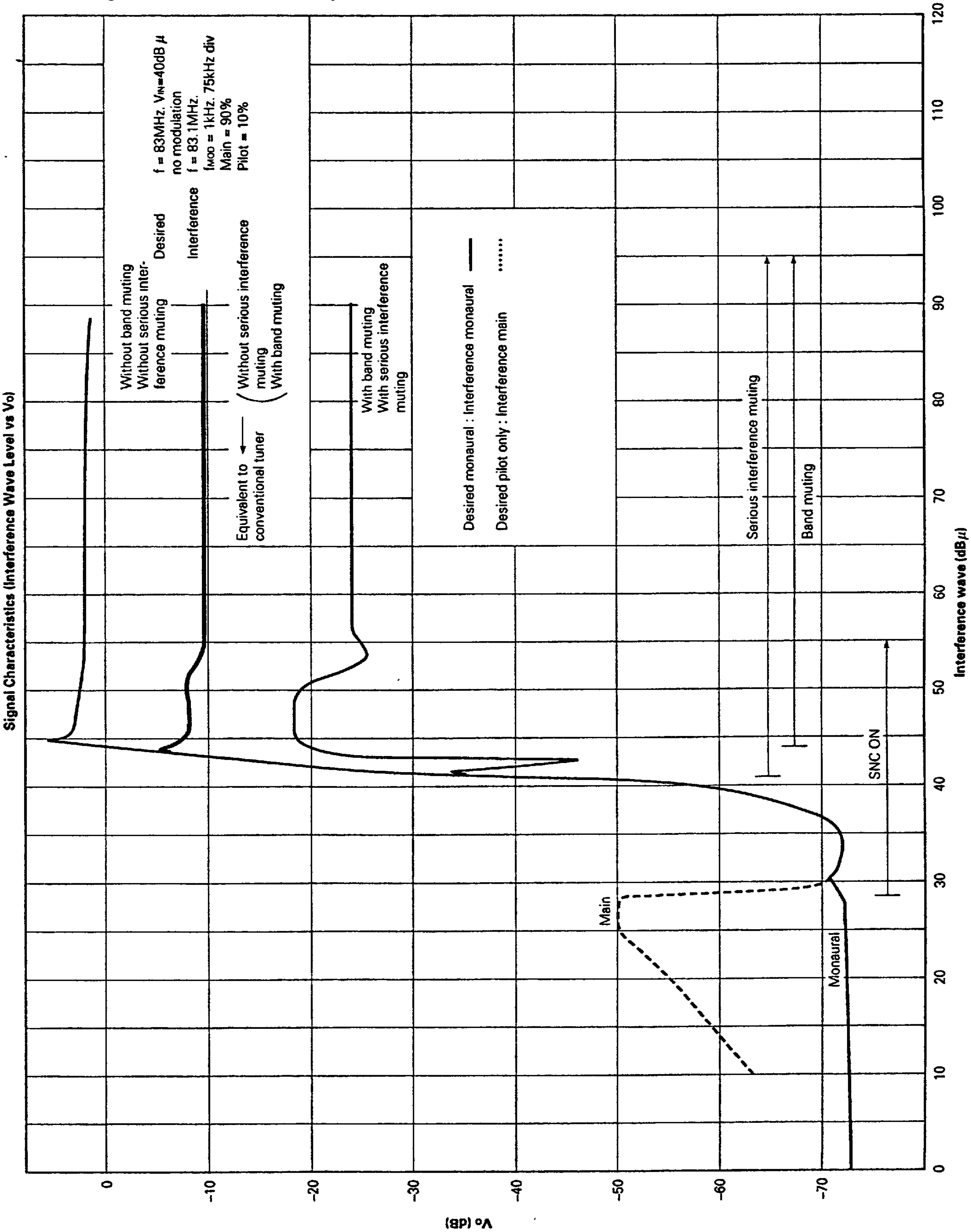
Input/Output Characteristic (VIN vs Vo, Noise, THD, Signal Meter)



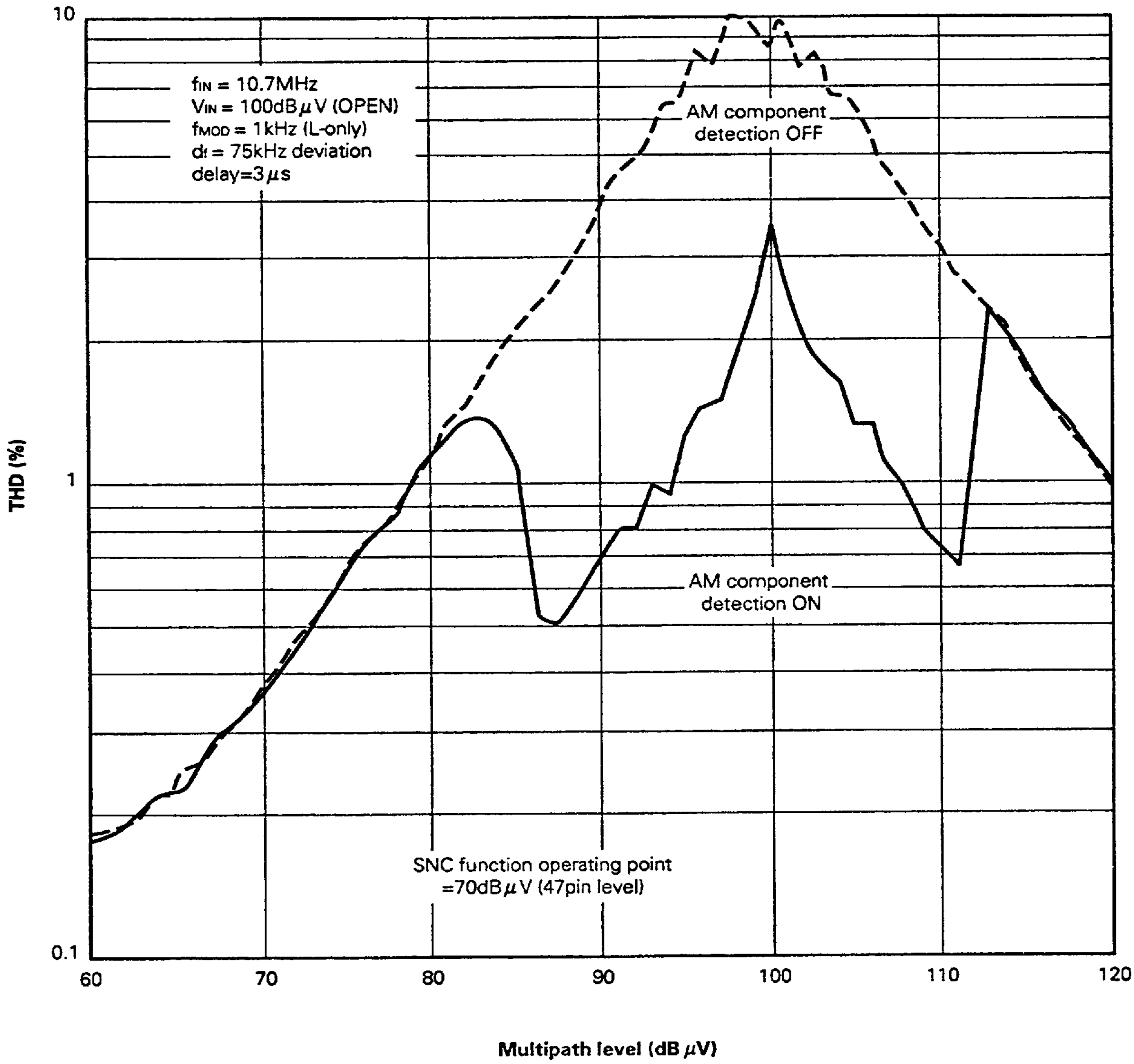
HCC/SNC Input/Output Characteristic

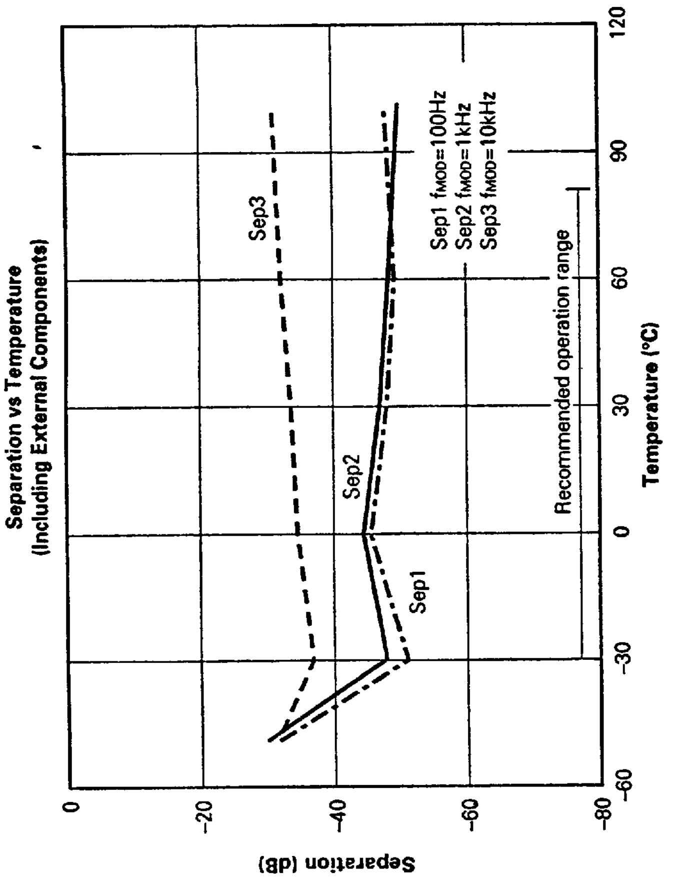


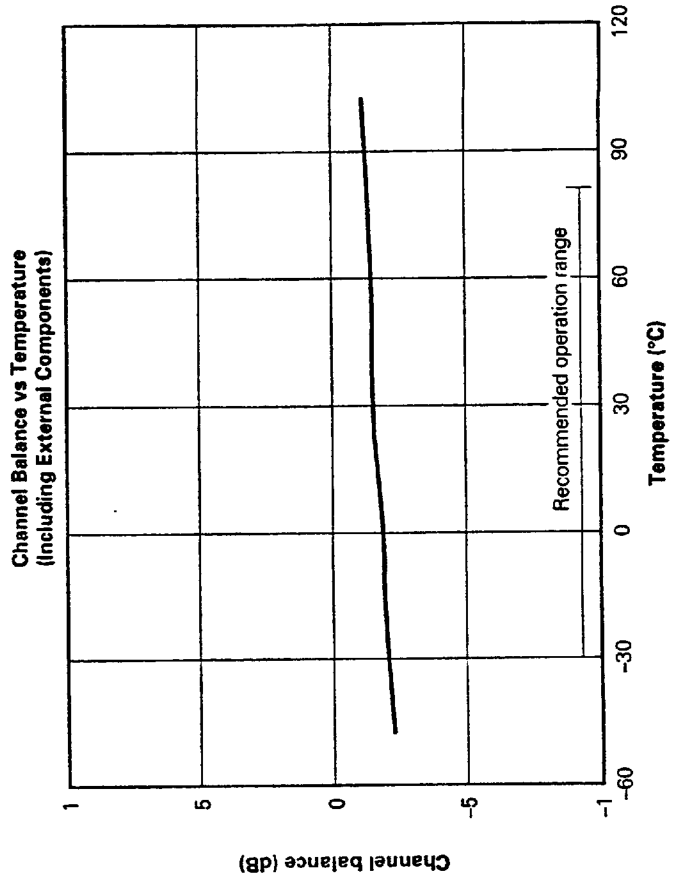
(2) Signal Characteristics (FE Input)

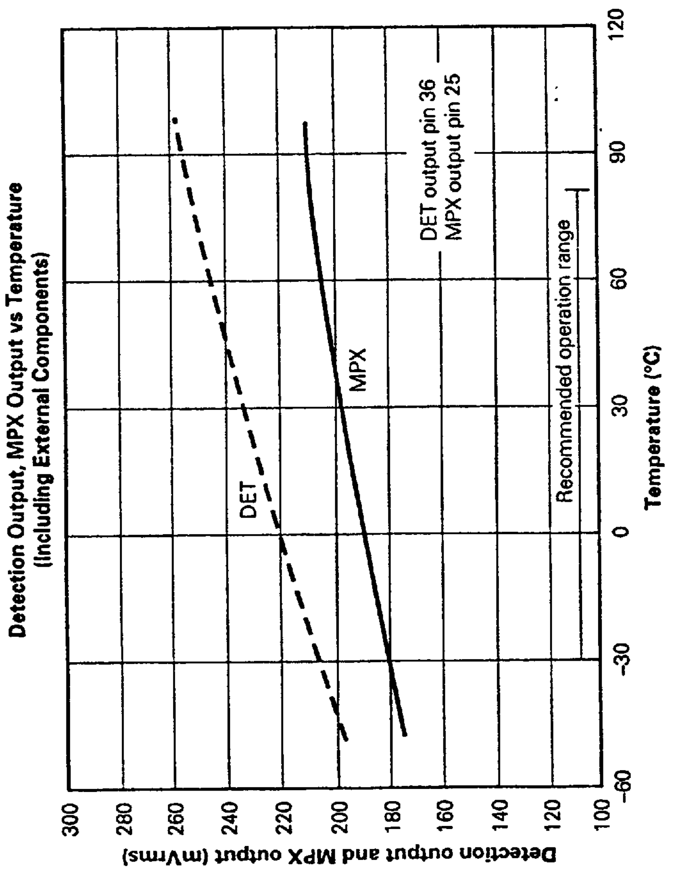


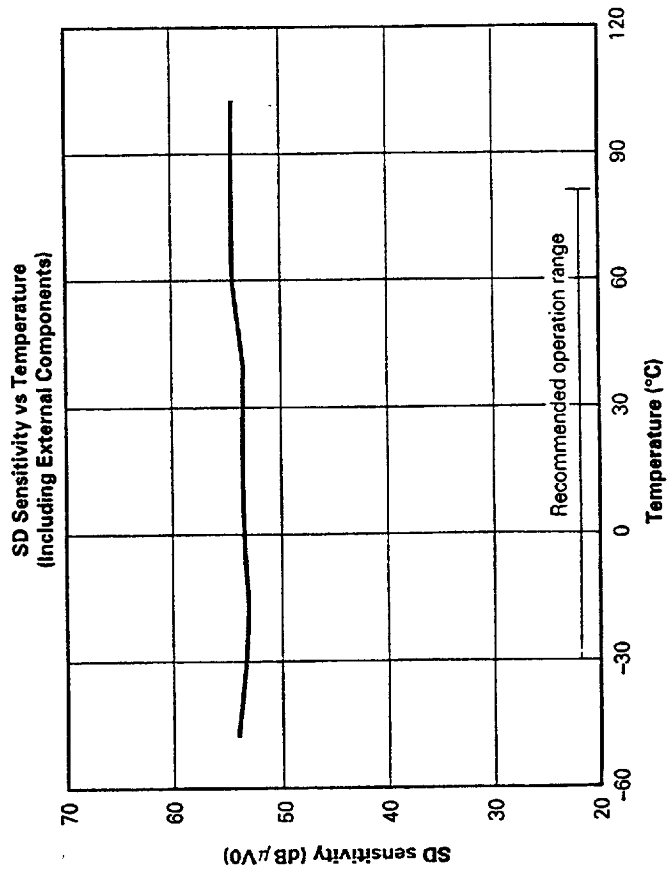
Multipath Level vs THD



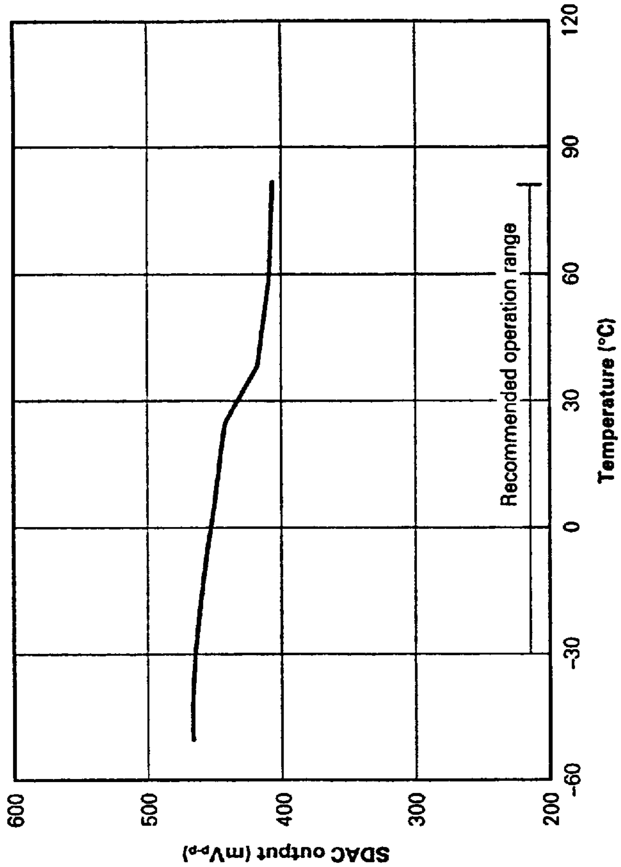

Separation vs Temperature
(Including External Components)
Separation (dB)
0
-20
-40
-60
-80
Temperature (°C)
-60
-30
0
30
60
90
120
Sep1
Sep2
Sep3
Sep1 fMOD=100Hz
Sep2 fMOD=1kHz
Sep3 fMOD=10kHz
Recommended operation range


Channel Balance vs Temperature
(Including External Components)
Channel balance (dB)
1
5
0
-5
-1
Temperature (°C)
-60
-30
0
30
60
90
120
Recommended operation range

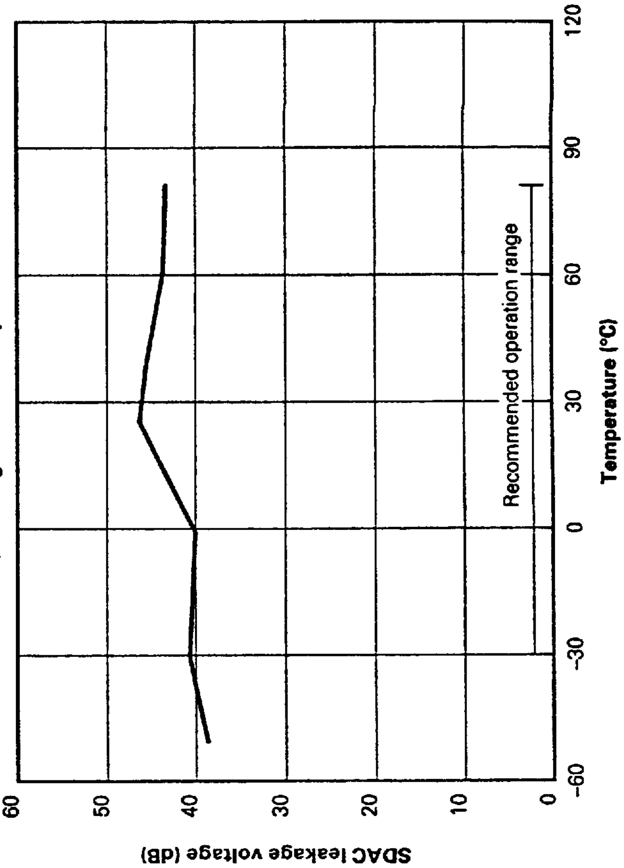

Detection Output, MPX Output vs Temperature
(Including External Components)
Detection output and MPX output (mVrms)
300
280
260
240
220
200
180
160
140
120
100
Temperature (°C)
-60
-30
0
30
60
90
120
DET
MPX
DET output pin 36
MPX output pin 25
Recommended operation range


SD Sensitivity vs Temperature
(Including External Components)
SD sensitivity (dBμV0)
70
60
50
40
30
20
Temperature (°C)
-60
-30
0
30
60
90
120
Recommended operation range

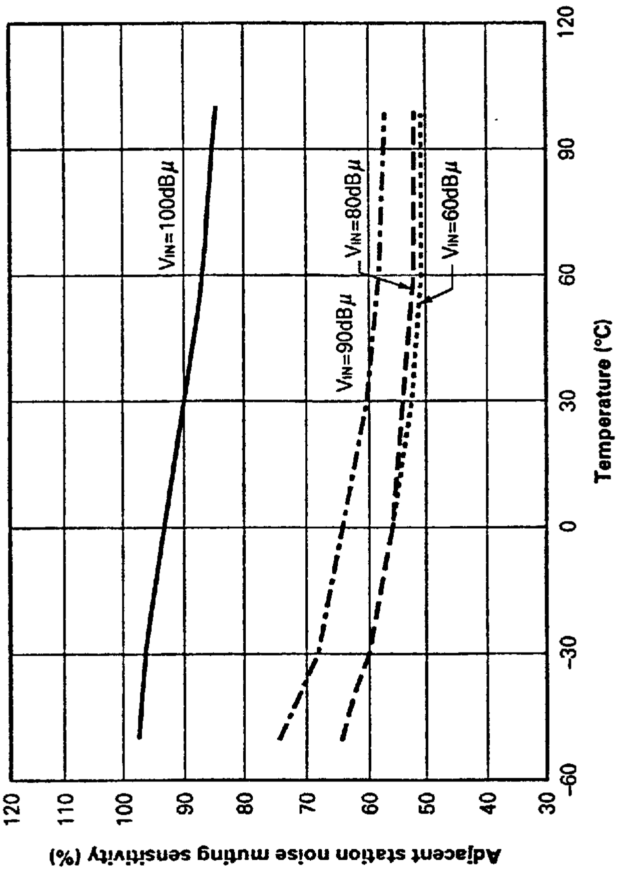
SDAC Output vs Temperature
(Including External Components)



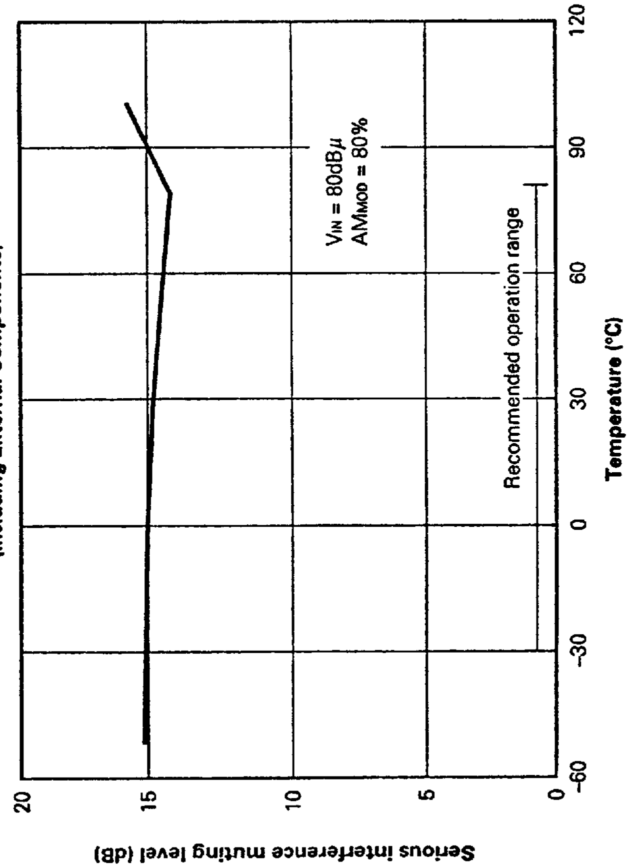
SDAC Leakage Voltage vs Temperature
(Including External Components)

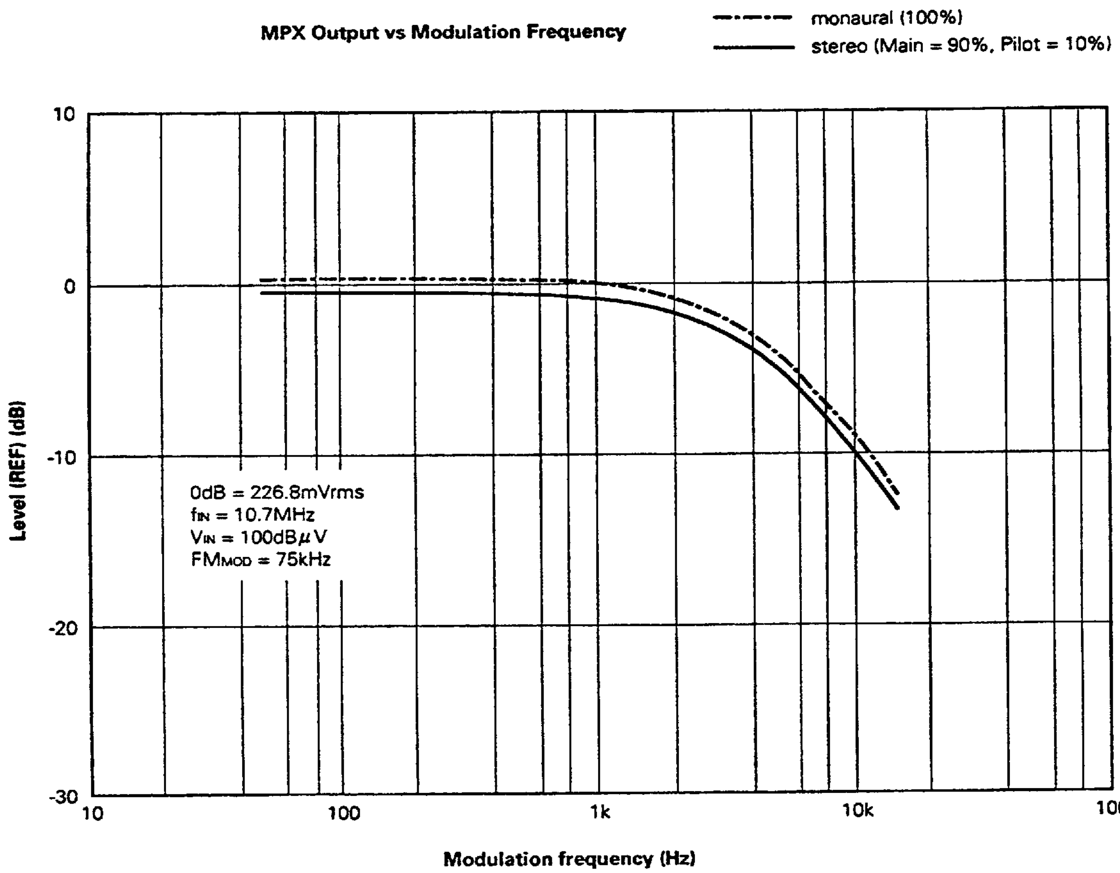


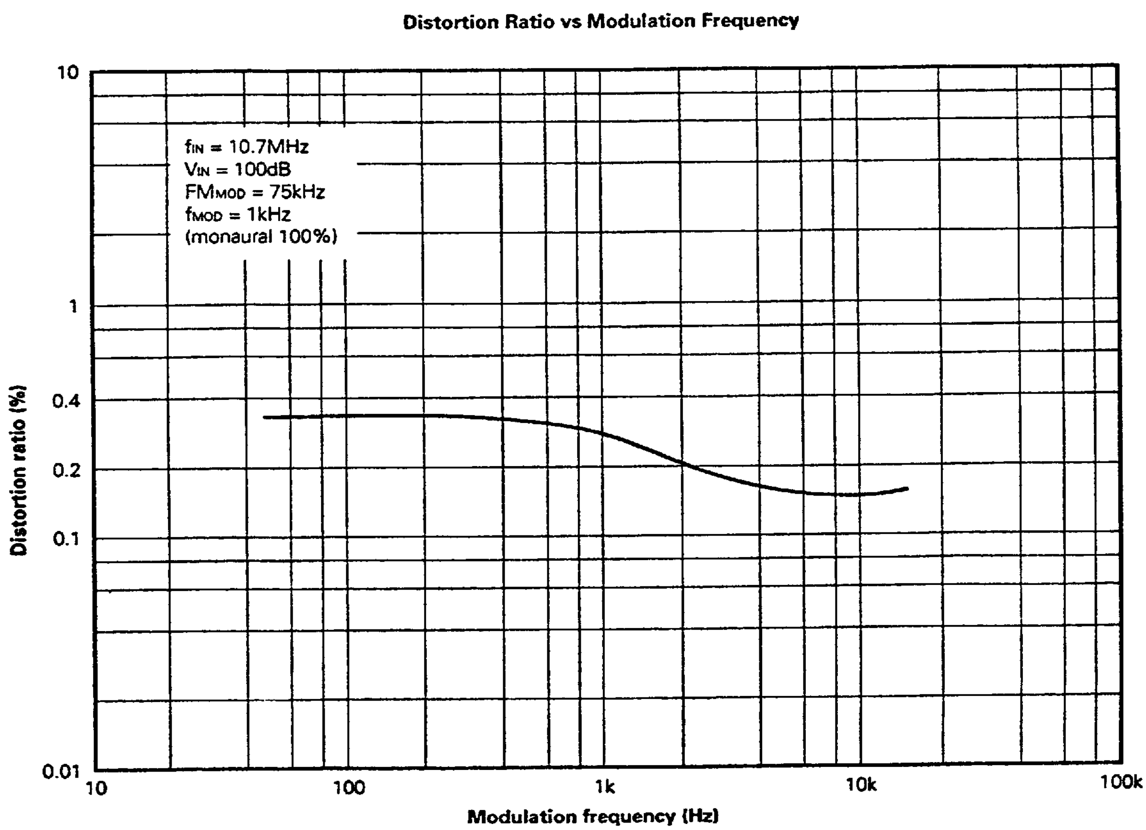
Adjacent Station Noise Muting Sensitivity vs Temperature
(Including External Components)



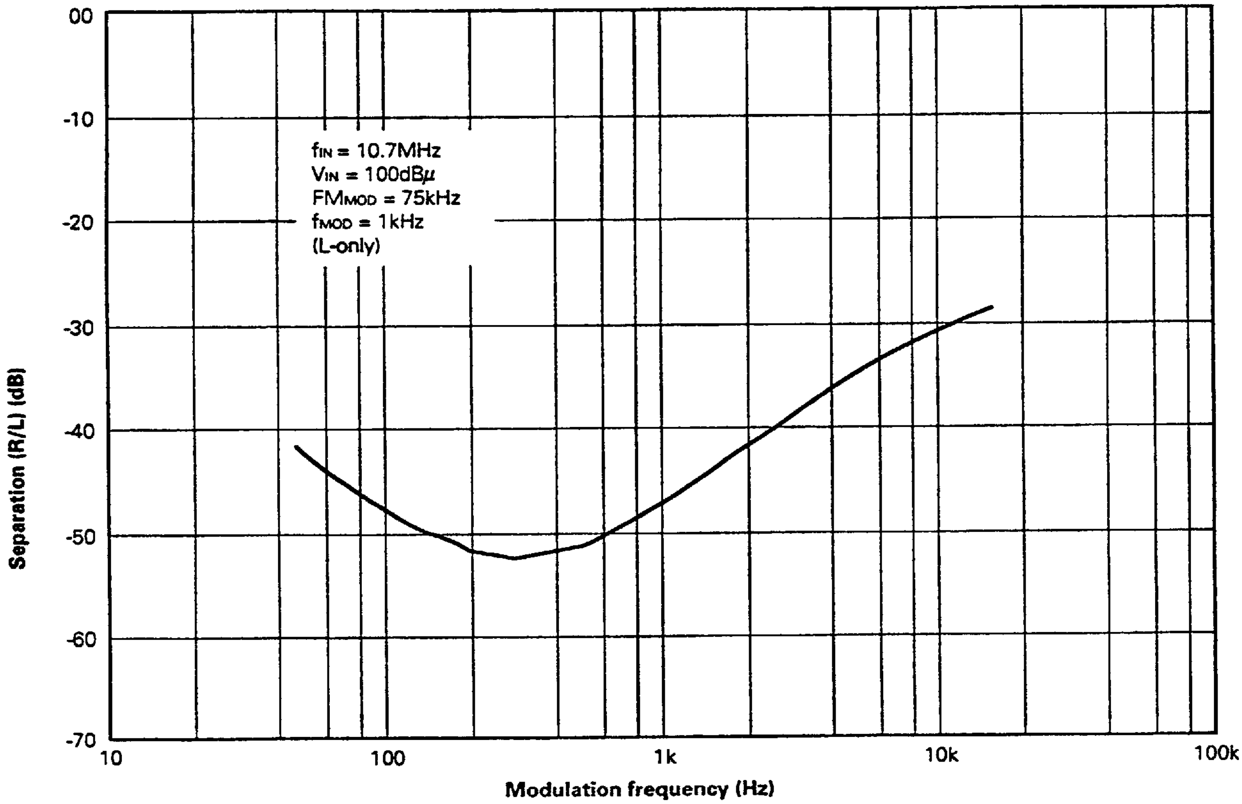
Serious Interference Muting vs Temperature
(Including External Components)



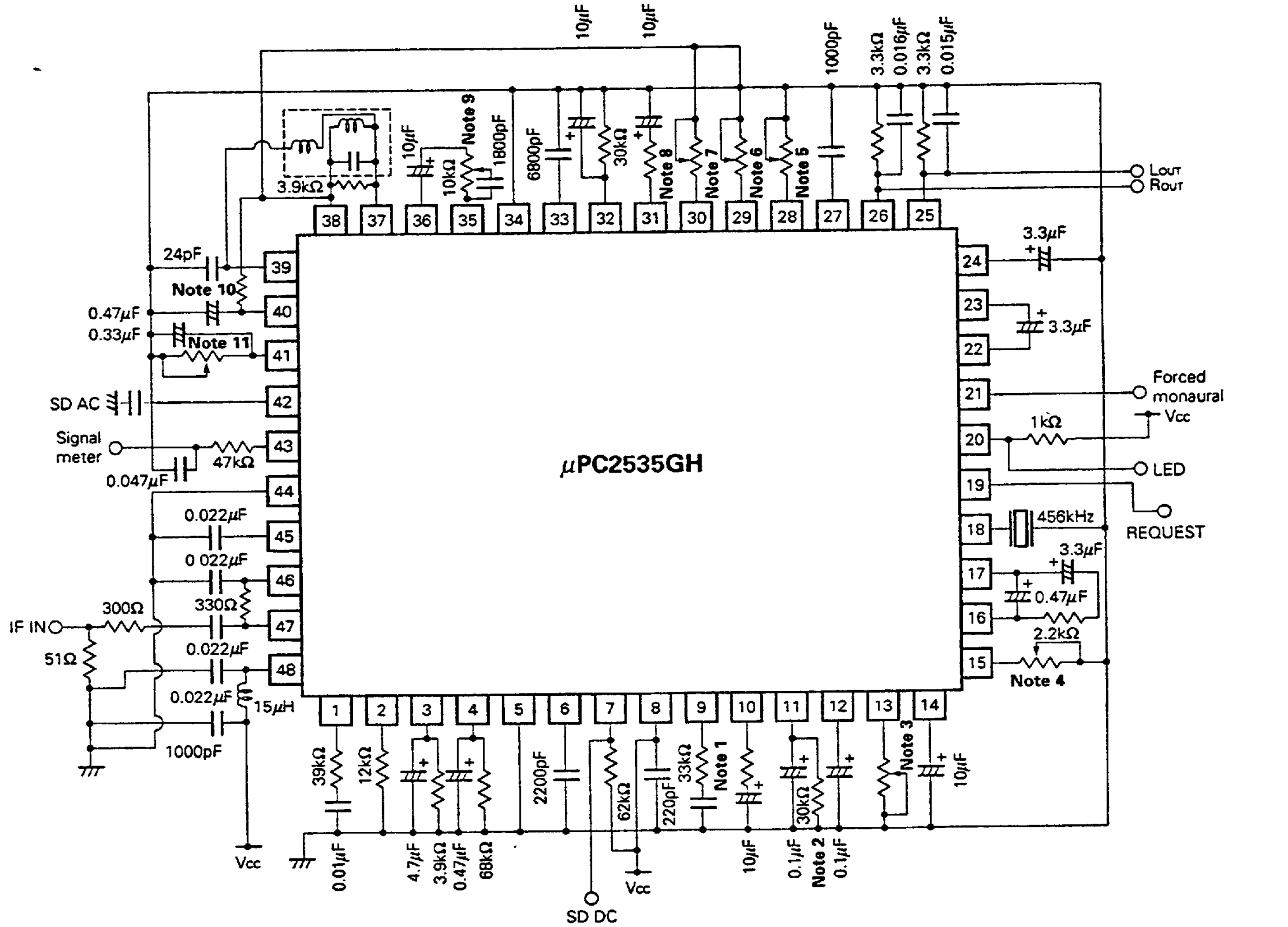

MPX Output vs Modulation Frequency
monaural (100%)
stereo (Main = 90%, Pilot = 10%)
10
0
-10
-20
-30
Level (REF) (dB)
0dB = 226.8mVrms
fIN = 10.7MHz
VIN = 100dBμV
FMMOD = 75kHz
10
100
1k
10k
100
Modulation frequency (Hz)


Distortion Ratio vs Modulation Frequency
10
1
0.4
0.2
0.1
0.01
Distortion ratio (%)
fIN = 10.7MHz
VIN = 100dB
FMMOD = 75kHz
fMOD = 1kHz
(monaural 100%)
10
100
1k
10k
100k
Modulation frequency (Hz)

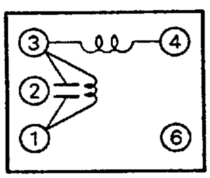
Separation vs Modulation Frequency



5. MEASUREMENT CIRCUIT



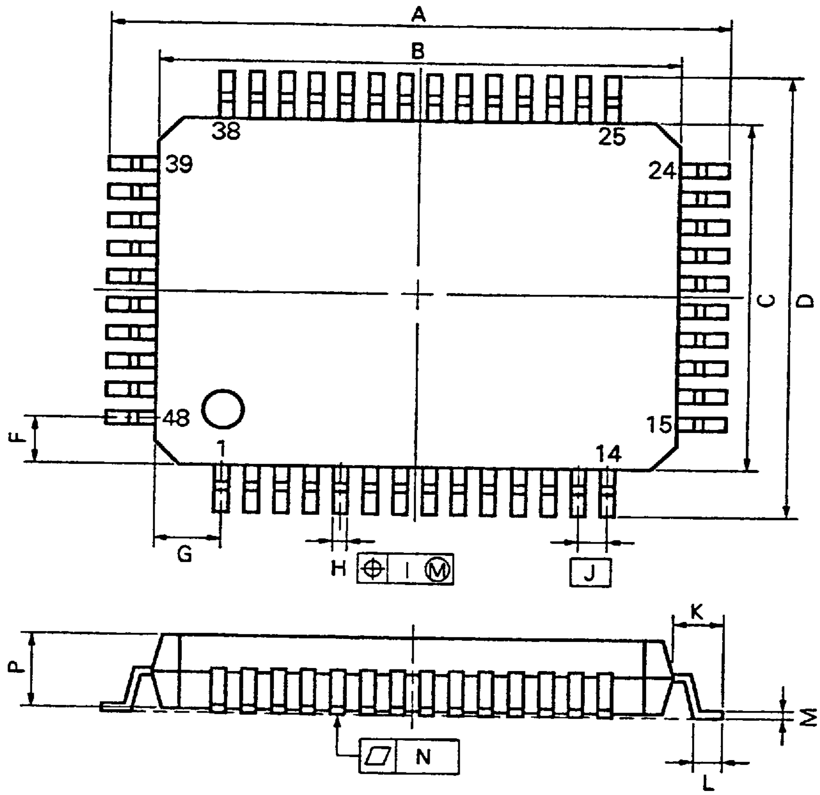
Coil Specifications

Connection Diagram	Reproduction No.	Specifications
	X402LES-1032DLE TOKO, INC.	①-③ 21T ③-④ 41 1/2T C = 91 pF Qu = 34 ± 20 % fo = 10.7 MHz

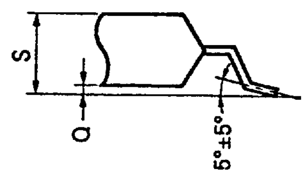
Ceramic oscillator: Murata CSB456F24, JF24

Note
1. Multipath HCC/SNC control sensitivity setting
2. HCC/SNC time constant setting
3. Muting function operating point adjustment
4. HCC function operating point adjustment
5. SNC function operating point adjustment
6. Serious interference muting level setting
7. Maximum muting level setting
8. Serious interference muting sensitivity setting
9. Separation adjustment
10. Band SD width setting
11. SD sensitivity setting

48 PIN PLASTIC QFP (10 × 14)



detail of lead end



P48GH-80-2A5-2

NOTE

Each lead centerline is located within 0.15 mm (0.006 inch) of its true position (T.P.) at maximum material condition.

ITEM	MILLIMETERS	INCHES
A	16.8±0.4	$0.661^{+0.017}_{-0.016}$
B	14.0±0.2	0.551±0.008
C	10.0±0.2	$0.394^{+0.008}_{-0.009}$
D	12.8±0.4	0.504±0.016
F	1.4	0.055
G	1.8	0.071
H	0.35±0.10	$0.014^{+0.004}_{-0.005}$
I	0.15	0.006
J	0.8 (T.P.)	0.031 (T.P.)
K	1.4±0.2	0.055±0.008
L	0.6±0.2	$0.024^{+0.008}_{-0.009}$
M	$0.20^{+0.10}_{-0.05}$	$0.008^{+0.004}_{-0.003}$
N	0.12	0.005
P	2.2±0.1	$0.087^{+0.004}_{-0.005}$
Q	0.1±0.1	0.004±0.004
S	2.5 MAX.	0.099 MAX.

6. RECOMMENDED SOLDERING CONDITIONS

The following conditions (See table below) must be met when soldering the μPC2535.

Please consult with our sales offices in case other soldering process is used, or in case soldering is done under different conditions.

For more details, refer to our document "SEMICONDUCTOR DEVICE MOUNTING TECHNOLOGY MANUAL" (IEI-1207).

TYPE OF SURFACE MOUNT DEVICE

μPC2535GH-2A5

Soldering process	Soldering conditions	Symbol
Infrared Ray Reflow	Peak package's surface temperature: 230 °C or below, Reflow time: 30 seconds or below (210 °C or higher), Number of reflow process: 1	IR-30-00-1
VPS	Peak package's temperature: 215 °C or below, Reflow time: 40 seconds or below (200 °C or higher), Number of reflow process: 1	VP15-00-1
Wave Soldering	Solder temperature: 260 °C or below, Flow time: 10 seconds or below, Temperature of pre-heat: 120 °C or below (Plastic surface temperature) Number of flow process: 1	WS-60-00-1
Partial Heating Method	Terminal temperature: 300 °C or below, Time: 3 seconds or below (Per side of leads)	———

Caution Do not apply more than one soldering method at any one time, except for "Partial heating method".