

Cellular Radio Telephone Filter LSI

Description

The CXD1237Q/R is a filter LSI developed for cellular radio telephone. Ultra low current consumption LSI built in voice signal processing and electrical volume, in addition to DATA, SAT processing.

Usage in conjunction with control signal processing LSI CXD1270Q/R provides a modem.

Features

- Ultra low current consumption
 $I_{DD}=1.8\text{mA}$ (in operation)
 $I_{DD}=0.6\text{mA}$ (at power save)(at 5V, Typ.)
- Power save is possible by standby control
- AMPS, TACS, DOC standards
- Adoption of SCF technology obtains stable characteristics.
- Built in electrical volume (3dB step 8 stages)

Functions

- Filtering of received WBD
- Filtering of received SAT
- PLL lock detection of received SAT
- Summing of WBD, ST, SAT to be transmitted
- Filtering of received VOICE
- Filtering of transmitted VOICE
- Volume control (2-channel)

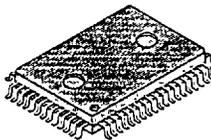
Absolute Maximum Ratings

• Supply voltage	V_{DD}	-0.3 to +7.0	V
• Input voltage	V_{IN}	-0.3 to $V_{DD}+0.3$	V
• Output voltage	V_{OUT}	-0.3 to $V_{DD}+0.3$	V
• Operating temperature	T_{opr}	-34 to +85	°C
• Storage temperature	T_{stg}	-55 to +150	°C

Recommended Operating Conditions

• Supply voltage	V_{DD}	4.5 to 5.5	V
• Operating temperature	T_{opr}	-34 to +85	°C

CXD1237Q
64 pin QFP (Plastic)

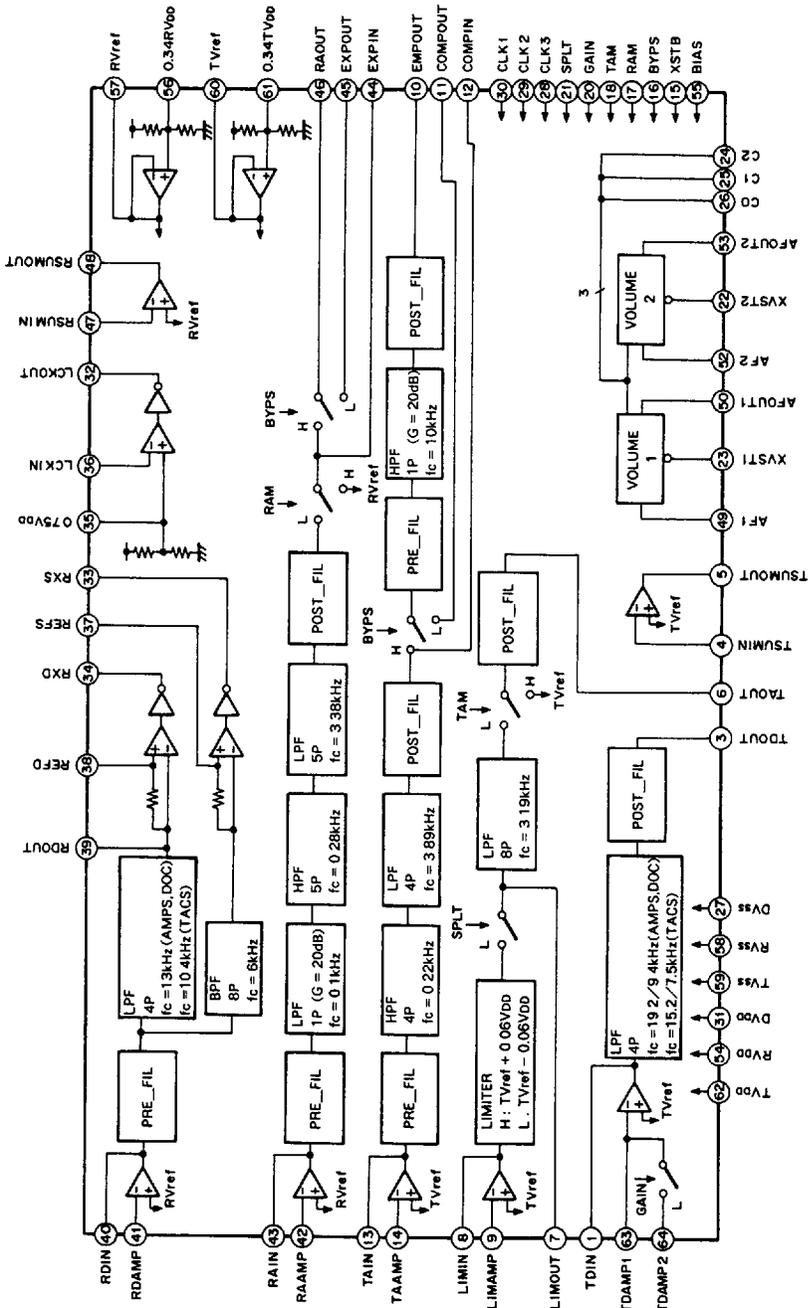


CXD1237R
64 pin VQFP (Plastic)

**Structure**

Silicon gate CMOS IC

Block Diagram



Note) Pin No. for QFP package.

Pin Description

Pin No.		Symbol	I/O	Description
QFP	VQFP			
1	63	TDIN	O	Summing amplifier output for TX WBD, ST, SAT inputs
2	64	NC	—	—
3	1	TDOUT	O	Filter outputs of TX WBD, ST, SAT
4	2	TSUMIN	I	TX summing amplifier input. Use this pin to add data (TDOUT output) and voice (TAOUT output).
5	3	TSUMOUT	O	TX summing amplifier output
6	4	TAOUT	O	TX voice filter output
7	5	LIMOUT	I/O	TX voice limiter output. Use this pin as input when testing rear portion TX splutter filter characteristics independently.
8	6	LIMIN	O	Limiter input gain control amplifier output for TX voice
9	7	LIMAMP	I	Limiter input gain control amplifier input for TX voice
10	8	EMPOUT	O	Emphasis output. Normally, input to limiter.
11	9	COMPOUT	I	Input external output compandor. This pin must be biased by applying the output of TV ref pin (60 pin) through a resistor as input.
12	10	COMPIN	O	Output pin to input to external compandor. Bypass control of compandor is executed at BYPS pin.
13	11	TAIN	O	TX voice gain control amplifier output.
14	12	TAAMP	I	TX voice gain control amplifier input.
15	13	XSTB	I	Standby control pin other than volume block. Only RX WBD filter block is active during standby. Standby at "L".
16	14	BYPS	I	Compandor, expander bypass control. Compandor, expander is bypassed at "H".
17	15	RAM	I	RX voice mute control. Mute at "H".
18	16	TAM	I	TX voice mute control. Mute at "H".
19	17	NC	—	—
20	18	GAIN	I	TX data summing input gain control. (Switching input for TDAMP2 pin) Open at "H".

4

Pin No.		Symbol	I/O	Description
QFP	VQFP			
21	19	SPLT	I	Switching input for TX splutter filter. At "H", input from LIMOUT, splutter filter own characteristics can be observed. Normally, at "L". With pull down resistor.
22	20	XVST2	I	Electrical volume 2 standby control. Standby at "L". With pull down resistor.
23	21	XVST1	I	Electrical volume 1 standby control. Standby at "L". With pull down resistor.
24	22	C2	I	Electrical volume 1, 2 control pin (MSB). Control at 3 bits; C2, C1 and C0. With pull down resistor.
25	23	C1	I	Electrical volume 1, 2 control pin. With pull down resistor.
26	24	C0	I	Electrical volume 1, 2 control pin (LSB). With pull down resistor.
27	25	DVss	—	Digital GND
28	26	CLK3	I	CLK input for TX DATA. At AMPS, DOC: 400/200kHz. At TACS: 320/160kHz
29	27	CLK2	I	CLK input for voice filter 400kHz.
30	28	CLK1	I	CLK input for RX DATA. At AMPS, DOC: 400kHz. At TACS: 320kHz
31	29	DV _{DD}	—	Digital power supply
32	30	LCKOUT	O	Comparator output for RX SAT PLL lock detection
33	31	RXS	O	Comparator output for RX SAT
34	32	RXD	O	Comparator output for RX WBD
35	33	0.75V _{DD}	I	Comparator reference voltage input for RX SAT PLL lock detection. Bias 0.75 times of power supply voltage. Normally, an external capacitance of 1 μ F is required between this pin and RV _{SS} .
36	34	LCKIN	I	Comparator input for RX SAT PLL lock detection.
37	35	REFS	I	Comparator reference voltage input for RX SAT. Eliminates front portion band pass filter output offset by means of 0.1 μ F capacitance between this pin and RV _{SS} .
38	36	REFD	I	Comparator reference voltage input for RX WBD. Eliminates front portion low pass filter output offset by means of 0.1 μ F capacitance between this pin and RV _{SS} .
39	37	RDOUT	O	RX WBD filter output. Usable as RX voice introduction filter.
40	38	RDIN	O	Gain control amplifier output for RX WBD and SAT input.

Pin No.		Symbol	I/O	Description
QFP	VQFP			
41	39	RDAMP	I	Gain control amplifier input for RX WBD and SAT
42	40	RAAMP	I	Gain control amplifier input for RX voice input
43	41	RAIN	O	Gain control amplifier output for RX voice input
44	42	EXPIN	O	External expander input
45	43	EXPOUT	I	External expander output. Bypass control at BYPS, the same as TX compandor.
46	44	RAOUT	O	RX voice filter output
47	45	RSUMIN	I	RX summing amplifier input. Used to sum up DTMF HT and LT.
48	46	RSUMOUT	O	RX summing amplifier output
49	47	AF1	I	Electrical volume input 1.
50	48	AFOUT1	O	Electrical volume output 1. Volume is controlled at C2, C1 and C0.
51	49	NC	—	—
52	50	AF2	I	Electrical volume input 2.
53	51	AFOUT2	O	Electrical volume output 2. Volume is controlled at C2, C1 and C0.
54	52	RV _{DD}	—	RX power supply
55	53	BIAS	I	Bias current setting pin of internal OP amplifier. Normally, connect 500k Ω between this pin and RV _{DD} . (See Notes on Operation)
56	54	0.34RV _{DD}	I	OP amplifier reference voltage input for RX block. Bias 0.34 times of power supply voltage. Normally, an external capacitance of 1 μ F is required between this pin and RV _{SS} .
57	55	RV _{ref}	O	OP amplifier reference voltage output for RX block. Bias 0.34 times of power supply voltage. Normally, an external capacitance of 1 μ F is required between this pin and RV _{SS} .
58	56	RV _{SS}	—	RX ground pin
59	57	TV _{SS}	—	TX ground pin
60	58	TV _{ref}	O	OP amplifier reference voltage output for TX block. Bias 0.34 times of power supply voltage. Normally, an external capacitance of 1 μ F is required between this pin and TV _{SS} .
61	59	0.34TV _{DD}	I	OP amplifier reference voltage output for TX block. Bias 0.34 times of power supply voltage. Normally, an external capacitance of 1 μ F is required between this pin and TV _{SS} .
62	60	TV _{DD}	—	TX power supply
63	61	TDAMP1	I	TX SAT input
64	62	TDAMP2	I	TX WBD, ST input. Gain control at GAIN pin (Switching)

Electrical Characteristics

(V_{DD}=5V ±10%, T_a=-34 to +85 °C)

Item	Symbol	Pin name	Condition	Standards			Unit
				Min.	Typ.	Max.	
Power supply current 1	I _{DD}	RV _{DD} TV _{DD} DV _{DD}) Total	XSTB="H" XVST1="H" XVST2="H" BIAS resistor=500kΩ	—	1.8	2.8	mA
Power supply current 2	I _{STB1}	The same as above	XSTB="L" XVST1="L" XVST2="L" BIAS resistor=500kΩ	—	0.6	1	mA
Power supply current 3	I _{STB2}	The same as above	XSTB="L" XVST1="H" XVST2="H" BIAS resistor=500kΩ	—	0.8	1.2	mA
Digital input voltage at "L"	V _{IL}	SPLT, GAIN, TAM, RAM, BYPS, XSTB, XVST1, XVST2, C0, C1, C2, CLK1, CLK2, CLK3	—	—	—	0.3V _{DD}	V
Digital input voltage at "H"	V _{IH}	The same as above	—	0.7V _{DD}	—	—	V
Digital input current at "L"	I _{IL}	The same as above	V _{IN} =GND	-10	—	10	μA
Digital input current at "H"	I _{IH1}	GAIN, TAM, RAM, BYPS, XSTB, CLK1, CLK2, CLK3	V _{IN} =V _{DD}	-10	—	10	μA
Digital input current at "H" (With pull down resistor)	I _{IH2}	SPLT, XVST1, XVST2, C0, C1, C2	The same as above	—	—	100	μA
Digital output voltage at "L"	V _{OL}	RXD, RXS, LCKOUT	I _{OL} =0.4mA	0.8	—	—	V
Digital output voltage at "H"	V _{OH}	The same as above	I _{OH} =-0.4mA	—	—	4	V
Analog input voltage range	V _{IA}	RDAMP, RAAMP, TAAMP, LIMAMP, TDAMP1, TDAMP2, RSUMIN, TSUMIN, AF1, AF2	—	—	—	1	V _{p-p}
Analog input resistor 1	R _{I1}	AF1, AF2	Input pin -0.34V _{DD}	70	130	190	kΩ
Analog input resistor 2	R _{I2}	COMPOUT	The same as above	500	640	800	kΩ
Analog input resistor 3	R _{I3}	TDAMP2, EXPOUT	The same as above	—	0.6	1	kΩ

Item	Symbol	Pin name	Condition	Standards			Unit
				Min.	Typ.	Max.	
Analog output load resistor 1	RL1	EXPIN, RAOUT, EMPOUT, COMPIN, TAOUT, TDOUT, RSUMOUT, AFOUT1, TSUMOUT, AFOUT2	Output pin -0.34V _{DD} BIAS resistor=500kΩ	10	—	—	kΩ
Analog output load resistor 2	RL2	RDIN, RAIN, TAIN, LIMIN, TDIN	The same as above	100	—	—	kΩ
Analog output voltage range	VOA	EXPIN, RAOUT, EMPOUT, COMPIN, RSUMOUT, TSUMOUT, TAOUT, TDOUT, RDOUT, AFOUT1, AFOUT2	BIAS resistor=500kΩ Load resistor=10kΩ	—	—	0.4	Vp-p
Limiter voltage at "L"	VLL	LIMAMP – LIMOUT	SPLT="L"	0.34V _{DD} -0.066V _{DD}	0.34V _{DD} -0.06V _{DD}	0.34V _{DD} -0.054V _{DD}	V
Limiter voltage at "H"	VLH	The same as above	The same as above	0.34V _{DD} +0.054V _{DD}	0.34V _{DD} +0.06V _{DD}	0.34V _{DD} +0.066V _{DD}	V
Electrical volume step voltage	VSTEP	AF1 – AFOUT1 AF2 – AFOUT2	—	2.5	3	3.5	dB
RX DATA filter gain 1 (AMPS)	GRD1	RDAMP – RDOUT	Input: -18dBV 13kHz CLK1=400kHz	-5	-3	-1	dB
RX DATA filter gain 2 (TACS)	GRD2	The same as above	Input: -18dBV 10.4kHz CLK1=320kHz	-4	-3	-2	dB
RX SAT filter gain	GSAT	RDAMP – REFS	Input: -18dBV 6kHz CLK2=400kHz	-1	0	1	dB
TX DATA filter gain 1 (AMPS)	GTD1	TDAMP1 – TDOUT	Input: -18dBV 19.2kHz CLK3=400kHz	-5	-3	-1	dB
TX DATA filter gain 2 (AMPS)	GTD2	The same as above	Input: -18dBV 9.4kHz CLK3=200kHz	-4	-3	-2	dB
TX DATA filter gain 3 (TACS)	GTD3	The same as above	Input: -18dBV 15.2kHz CLK3=320kHz	-5	-3	-1	dB
TX DATA filter gain 4 (TACS)	GTD4	The same as above	Input: -18dBV 7.5kHz CLK3=160kHz	-4	-3	-2	dB

Item	Symbol	Pin name	Condition	Standards			Unit
				Min.	Typ.	Max.	
RX voice filter gain	GRA	RAAMP – RAOUT	Input: –18dBV 1kHz RAM="L" BYPS="H"	–1	–0.3	1	dB
RX voice mute	GRAM	The same as above	Input: –18dBV 1kHz RAM="H" BYPS="H"	50	—	—	dB
RX voice S/N	SNR	The same as above	Input: –18dBV 1kHz RAM="L" BYPS="H" Band: 50Hz to 30kHz	50	—	—	dB
RX voice distortion factor	THDR	The same as above	The same as above	—	—	–50	dB
TX voice gain	GTA	TAAMP – TAOUT	Input: –18dBV 1kHz TAM="L" BYPS="H" SPLT="L" EMPOUT → LIMAMP	–1	–0.3	1	dB
TX voice mute	GTAM	The same as above	Input: –18dBV 1kHz TAM="H" BYPS="H" SPLT="L" EMPOUT → LIMAMP	50	—	—	dB
TX voice S/N	SN _T	The same as above	Input: –18dBV 1kHz TAM="L" BYPS="H" SPLT="L" EMPOUT → LIMAMP Band: 50Hz to 30kHz	45	—	—	dB
TX voice distortion factor	THDT	The same as above	The same as above	—	—	–45	dB

Description of Operation

CXD1237Q/R is a filter IC developed for cellular mobile telephone based on North American AMPS Standards (Advanced Mobile Phone Service), British TACS Standards (Total Access Communication System) and Canadian DOC Standards (Document of Canada).

By using this LSI in conjunction with control signal processing LSI CXD1270Q/R, a modem with the following functions can be set up:

- (1) Filtering of received WIDE BAND DATA
- (2) Filtering of received SAT
- (3) PLL lock detection of received SAT
- (4) Summing of WIDE BAND DATA, ST and SAT to be transmitted
- (5) Filtering of WIDE BAND DATA, ST and SAT to be transmitted
- (6) Filtering of received voice
- (7) Filtering of transmitted voice
- (8) Volume control

This section provides brief descriptions of these functions.

1. Filtering of received WIDE BAND DATA

With the cellular mobile telephone system, data is transmitted between land and mobile stations, during speech or hand-off, in order to set channels. This data, called WIDE BAND DATA, is manchester code. Transfer speed is 20kbaud for AMPS and DOC standards and 16kbaud for TACS standards. The received WIDE BAND DATA is fed through gain control amplifier and prefilter to the 4 pole Butterworth low pass filter that operates as a data demodulating roll-off filter. In CXD1237Q/R, as a switched capacitor filter is used, a cutoff frequency proportionate to the sampling clock frequency is obtained. Accordingly, with AMPS and DOC standards, when the sampling clock frequency is 400kHz, the low pass filter cutoff frequency is 13kHz (Typ.). Similarly, with TACS standards, when the sampling clock frequency is 320kHz, the low pass filter cutoff frequency is 10.4kHz (Typ.). The filter output is shaped to the CMOS logic level by means of a comparator and then sent out to CXD1270Q/R.

4

2. Filtering of received SAT

In the cellular mobile telephone system, even during speech, a sine wave signal called SAT (Supervisory Audio Tone) is transmitted between land and mobile stations to have them recognize each other. SATs of three frequencies, 5.97kHz, 6.00kHz and 6.03kHz, are available for, both AMPS, TACS and DOC. The SAT frequency to be used is determined at the hand-off time by 2 bits data called SCC (SAT Collar Code) which is transmitted from the land station to the mobile station. During speech, the mobile station recognizes the land station by receiving SAT from the land station, and the land station recognizes the mobile station by receiving SAT from the mobile station.

Similarly to the WIDE BAND DATA, SAT received from the land station is fed through the gain control amplifier and prefilter. Then SAT is fed to the 6kHz 8 pole Butterworth band pass filter to prevent interference from the voice component (300Hz to 3kHz), and then to the 6kHz 8 pole Butterworth band pass filter to reduce the high band noise (6kHz to 13kHz) in the event of a weak electric field strength. SAT can be efficiently detected by adopting switched capacitor filter. The output of the 6kHz band pass filter is shaped to the CMOS logic level with a comparator, and is then sent out to CXD1270Q/R.

3. PLL lock detection of received SAT

In CXD1270Q/R, DPLL locks when the SAT having the frequency specified with SCC is received. CXD1237Q/R has a comparator to detect this lock/unlock state. The comparator output changes from "low" level to "high" level when the level of the SAT lock detect signal (SDET) from CXD1270Q/R exceeds the reference voltage (0.75V_{DD}).

4. Summing of WIDE BAND DATA, ST and SAT to be transmitted

In the cellular mobile telephone system, WIDE BAND DATA or ST and SAT are transmitted from the mobile station to the land station. ST is a signal transmitted at the end of the call or ringing. The frequency is 10kHz for AMPS and DOC standards and 8kHz for TACS standards. From CXD1270Q/R to CXD1237Q/R, the WIDE BAND DATA, ST and the SAT are fed through an attenuation pad.

CXD1237Q/R has an inverting amplifier which operates as a summing amplifier to sum these signals before transmission. In the transmission filter of the next stage summing amplifier during WIDE BAND DATA transmission, a 4 pole Butterworth low pass filter with a cutoff frequency of 19.2kHz for AMPS and DOC standards and 15.2kHz for TACS standards, is selected. During ST transmission a 4 pole Butterworth low pass filter with a cutoff frequency of 9.4kHz for AMPS and DOC standards and 7.5kHz for TACS standards, is selected.

To compensate for the amplitude characteristics difference between the 19.2kHz, 15.2kHz and 9.4kHz, 7.5kHz low pass filters at the ST frequency (10kHz), the summing amplifier gain can be selected in two ways. When ST is transmitted, + several dB gain can be obtained by setting the gain control input (GAIN) to "low" level, and - several dB gain by setting GAIN to "high" level. Adjust external resistor to obtain suitable gain.

5. Filtering of WIDE BAND DATA, ST and SAT to be transmitted

In the next stage of the summing amplifier, a low pass filter is provided to remove high-order harmonics from the summing amplifier output. The AMPS and DOC standards require a "20kHz \pm 10% 4 pole Butterworth low pass filter" as the transmission WIDE BAND DATA roll-off filter. In CXD1237Q/R, the filter used in the next stage of the summing amplifier is an 19.2kHz 4 pole Butterworth low pass filter, and this filter also satisfies the condition of 38dB or more attenuation at 60kHz specified by AMPS. When ST and SAT are transmitted, the cutoff frequency of this transmitting filter must be lowered from 19.2kHz because the frequencies of ST and SAT are 10kHz and 6kHz, respectively. CXD1237Q/R making the best of the switched capacitor filter merits, provides a cutoff frequency of 19.2kHz (Typ.) when the sampling frequency is 400kHz, and 9.4kHz (Typ.) when the sampling frequency is 200kHz.

Similarly, for the TACS standards, a cutoff frequency of 15.2kHz (Typ.) when the sampling frequency is 320kHz, and 7.5kHz (Typ.) when the sampling frequency is 160kHz, are provided to cope with the transmission speed difference.

6. Filtering of received voice

To satisfy various standards 3 types of Butterworth filters are included.

At the input stage a gain control amplifier is available with a prefilter to eliminate folded distortion. At the output stage a post filter is equipped to eliminate carriers.

RDOU output is input to the gain control amplifier. After passing through the prefilter, deemphasis is performed at 1 pole Butterworth low pass filter. Then band limitation is executed at 5 pole Butterworth high pass filter and 5 pole Butterworth low pass filter to pass through the post filter for output.

At RAM muting control and at BYPS expander bypass control are executed.

7. Filtering of transmitted voice

In the transmission system, after passing through the gain control amplifier and the prefilter, band limitation occurs at the 4 pole Butterworth high pass filter and the 4 pole Butterworth low pass filter. After going through the post filter prefilter, emphasis is executed at 1 pole Butterworth high pass filter, to pass through the post filter for output.

After what this output is passed through the gain control amplifier and input to the limiter to be clipped at $1.7V \pm 0.3V$ (Typ. when $V_{DD}=5V$). It is then passed through a steep 8 pole Butterworth low pass filter as splutter filter to be output after going through the post filter.

Muting control is executed at TAM and the compander bypass control, at BYPS.

Normally SPLIT is at "L". However, by turning is to "H" the splutter filter own characteristics can be observed without passing through the limiter.

8. Volume control

As the volume control for voice, ringing and others, 2 systems of electrical volumes are featured (3dB step, 8 stages). Control for both volumes is commonly executed through 3 bits C0, C1 and C2.

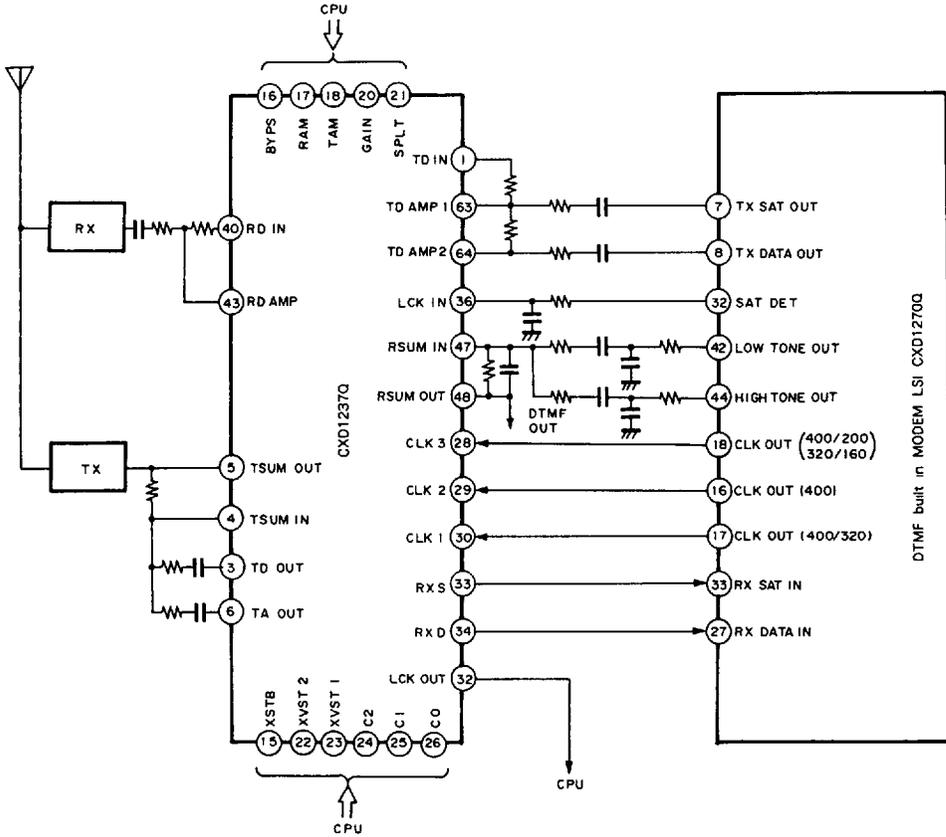
C2	C1	C0	Gain (dB)
L	L	L	0
L	L	H	-3
L	H	L	-6
L	H	H	-9
H	L	L	-12
H	L	H	-15
H	H	L	-18
H	H	H	-21

9. Others

One summing amplifier is available for each of the receiving and transmission systems respectively.

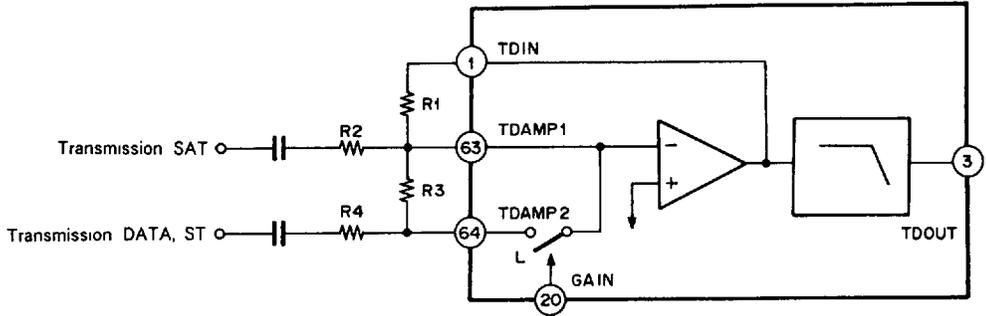
The summing amplifier for the receiving system can be used to sum up LT and HT of DTMF while that of the transmission system can be used to add data and voice.

Connecting Example of CXD1237Q/R and CXD1270Q/R (CXD1237: Pin No. of QFP)



Notes on Operation

1. Gain adjustment of the summing amplifier for transmission data



Note) Pin No. for QFP package

Attenuation adjustment of transmission SAT is executed at R2 and R1 in the above circuit and that for transmission DATA, ST at R4, R3 and R1. Attenuation at -20dB is recommended.

Moreover, to correct the transmission output level difference between DATA and ST, adjustment is effected at R3.

During ST transmission GAIN is set to "L" and gain raised. During DATA transmission GAIN is set to "H" and gain lowered for use.

2. Selection of AMPS, TACS and DOC

Selection of the various standards is effected by varying the input frequency to CLK1 and CLK3 as indicated below.

Standard	CLK1	CLK3
AMPS, DOC	400kHz	400kHz (DATA) 200kHz (ST, SAT)
TACS	320kHz	320kHz (DATA) 160kHz (ST, SAT)

CLK2 is fixed to 400kHz.

3. Standby control

CXD1237Q/R features 3 independent standby control pins XSTB, XVST1 and XVST2 that control the 3 blocks as indicated below.

Pin	Control block	H	L
XSTB	All blocks except Volume 1 and 2	Active	Only the block up to RDAMP-RXD and RVref generating circuit active
XVST1	Volume 1	Active	Standby
XVST2	Volume 2	Active	Standby

4. Output voltage range and supply current adjustment

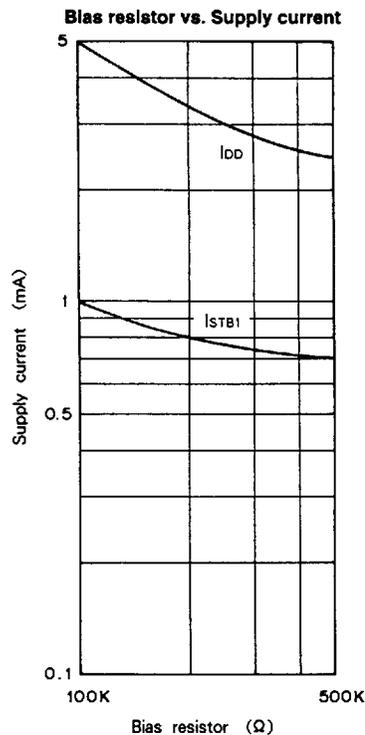
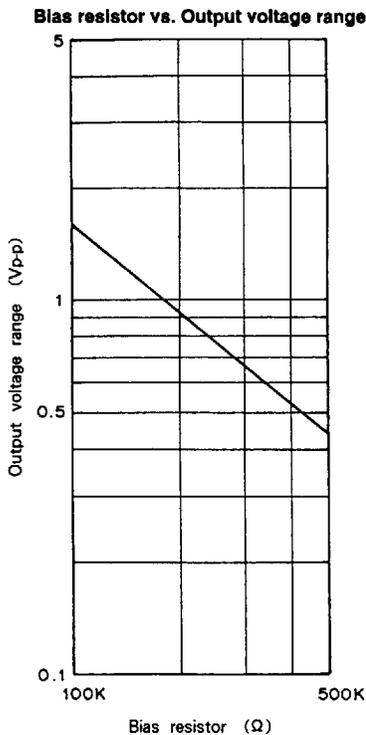
In CXD1237Q/R, output level range and supply current vary according to the bias resistor connected between BIAS and RV_{DD}.

Details indicated in the Electrical Characteristics are values when the bias resistor=500k Ω and the output load is at 10k Ω .

The bias current of the internal operational amplifier is determined through the bias resistor. Reducing this bias resistor will enlarge the output level range and supply current while inversely, enlarging it will reduce the output range and supply current.

That is through the adjustment of the bias resistor the desired output voltage range and supply current can be obtained.

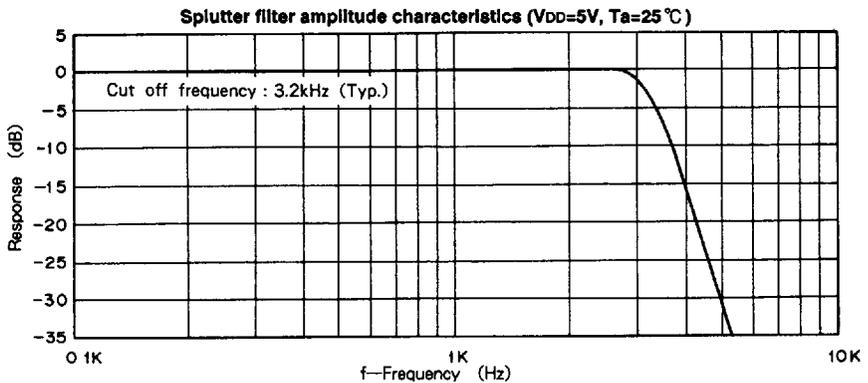
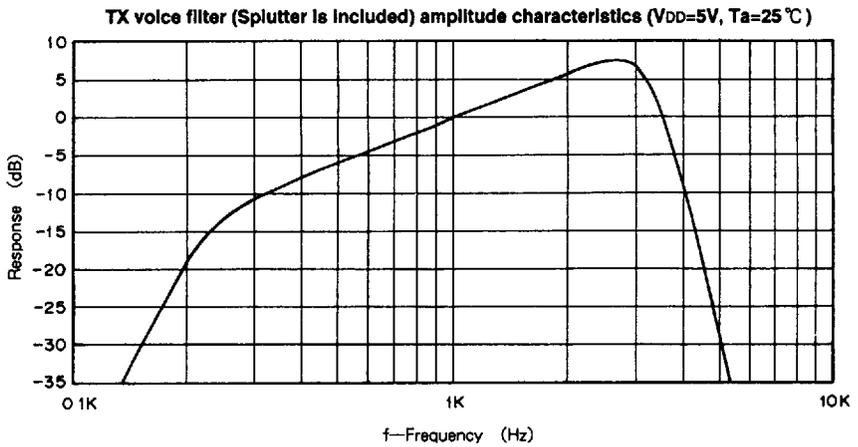
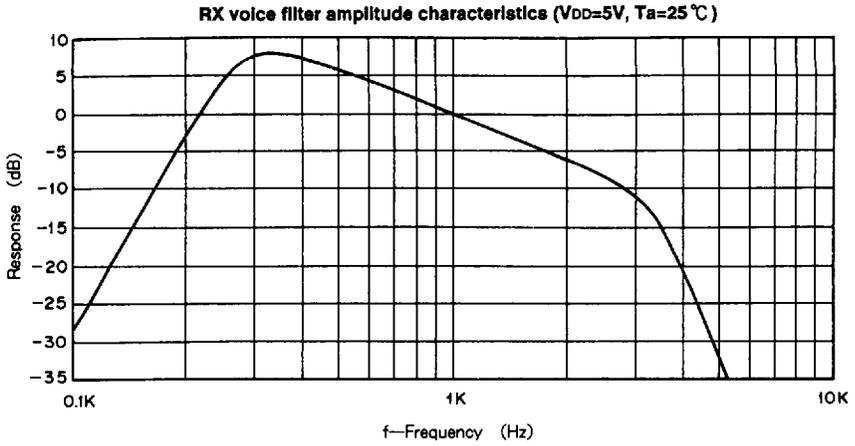
For reference, the relation between the bias resistor and output level range, supply current is shown below.

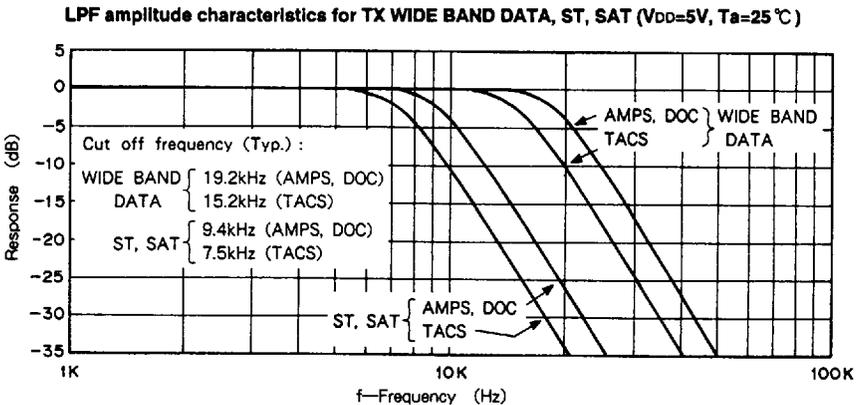
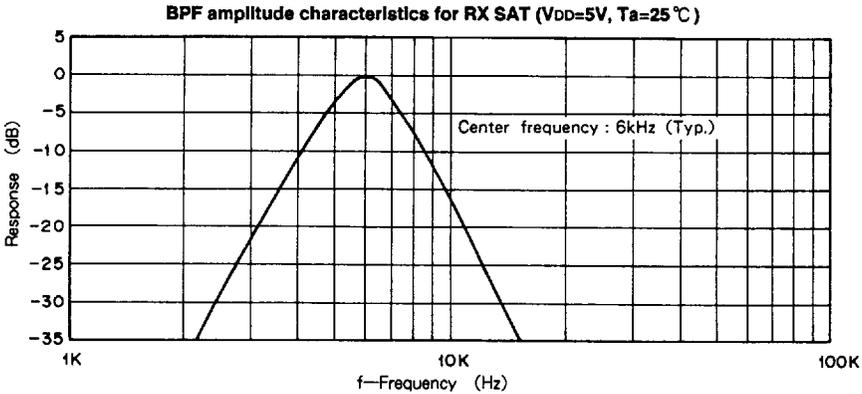
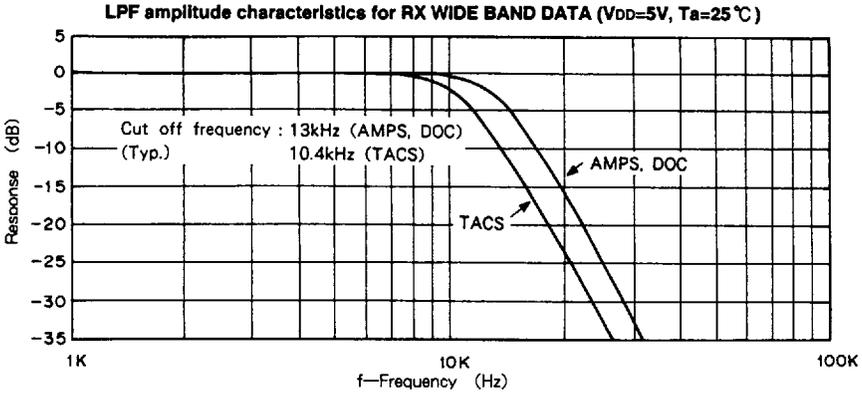


5. Others

- 1) Note that there is a 2-pin difference between QFP and VQFP packages.
- 2) Pins with pull down resistances (6 pins)
SPLT, XVST1, XVST2, C0, C1, C2

Filter Characteristics

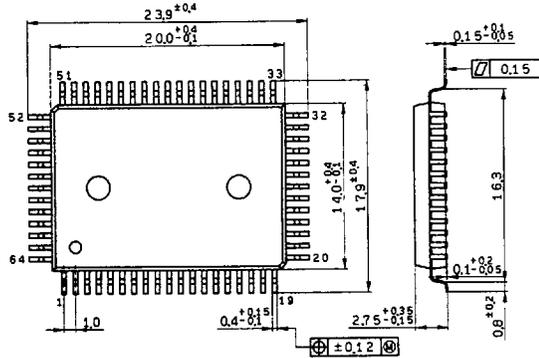




Package Outline Unit: mm

CXD1237Q

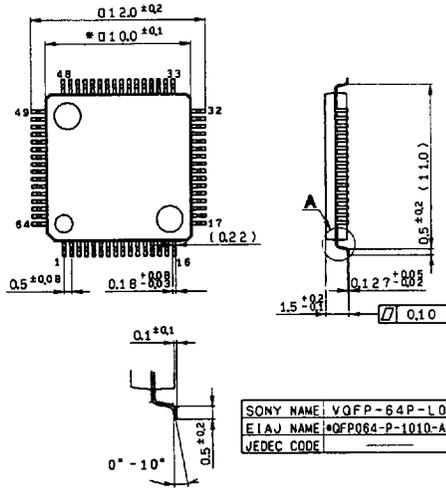
64 pin QFP (Plastic) 1.5g



SONY NAME	QFP-64P-L01
EIAJ NAME	#QFP064-P-1420-A
JEDEC CODE	

CXD1237R

64 pin VQFP (Plastic) 0.3g



SONY NAME	VQFP-64P-L01
EIAJ NAME	#QFP064-P-1010-A
JEDEC CODE	

Detailed diagram of A

Note) Dimensions marked with * do not include resin residue.

Package Name

Type	Package name		Package	Features					
	Symbol	Description		Material	Lead pitch	Lead shape	Lead pull out direction		
Inserted	Standard	D I P	DUAL IN-LINE PACKAGE		P C	2.54mm (100MIL)	Through Hole Lead	2-direction	
		S I P	SINGLE IN LINE PACKAGE		P	2.54mm (100MIL)	Through Hole Lead	1-direction	
		Z I P	ZIG ZAG IN-LINE PACKAGE		P	2.54mm (100MIL) Zig-Zag in-line	Through Hole Lead	1-direction	
		P G A	PIN GRID ARRAY		C	2.54mm (100MIL)	Through Hole Lead	Package under side	
		PIGGY BACK	PIGGY BACK		C	2.54mm (100MIL)	Through Hole Lead	2-direction	
	Shrink	SDIP	SHRINK DUAL IN-LINE PACKAGE		P	1.778mm (70MIL)	Through Hole Lead	2-direction	
		SZIP	SHRINK ZIG-ZAG IN-LINE PACKAGE		P	1.778mm (70MIL) Zig-Zag in-line	Through Hole Lead	1-direction	
	Surface mounted	Standard flat package	Q F P	QUAD FLAT L LEADED PACKAGE		P C	1.0mm 0.8mm 0.65mm	Gull-Wing	4-direction
			S O P	SMALL OUTLINE L-LEADED PACKAGE		P	1.27mm (50MIL)	Gull-Wing	2-direction
		Standard 2-direction chip carrier	S O J	SMALL OUTLINE J-LEADED PACKAGE		P	1.27mm (50MIL)	J-Lead	2-direction
Shrink flat package		VQFP	VERY SMALL QUAD FLAT PACKAGE		P	0.5mm	Gull-Wing	4-direction	
		VSOP	VERY SMALL OUTLINE PACKAGE		P	0.65mm	Gull-Wing	2-direction	
		TSOP	THIN SMALL OUTLINE PACKAGE		P	0.5mm (0.55mm)	Gull-Wing	2-direction	
Standard chip carrier		Q F J	QUAD FLAT J-LEADED PACKAGE		P	1.27mm (50MIL)	J-Lead	4-direction	
		Q F N	QUAD FLAT NON-LEADED PACKAGE		C	1.27mm (50MIL)	Leadless	Package under side	

* PPlastic, CCeramic

2