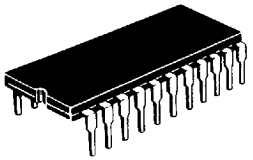
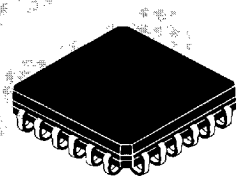
AUDIO/SUB-AUDIO FILTER ARRAY



MX336J (CDIP)
MX336P (PDIP)
22 pins



MX336LH
(24p PLCC)

FEATURES:

- **High Order 300 Hz Highpass Filter**
- **Low Group Delay 2550 Hz Lowpass Filter**
- **On-chip 120-175 Hz Bandpass Filter**
- **Uncommitted Amplifier and Analog Switch**
- **50 dB Rejection Below 170 Hz**
- **Low Power CMOS**
- **Powersave Feature**

APPLICATIONS:

- **R2000 Mobile Radio Trunking System**
- **Other Trunking Systems with Sub-Audible Control Tones**

DESCRIPTION:

The MX336 is a CMOS switched capacitor filter array used to process speech and sub-audible data. As depicted in Figure 1, the device consists of:

1) a highpass audio filter with additional attenuation of signals below 170 Hz.
2) a lowpass audio filter for band-limiting speech. Group delay characteristics are controlled over the 900 to 2100 Hz range, allowing passage of 1200 Baud MSK data.
3) a narrow bandpass filter for sub-audio data processing.
4) an uncommitted audio amplifier
5) a mute switch with external control

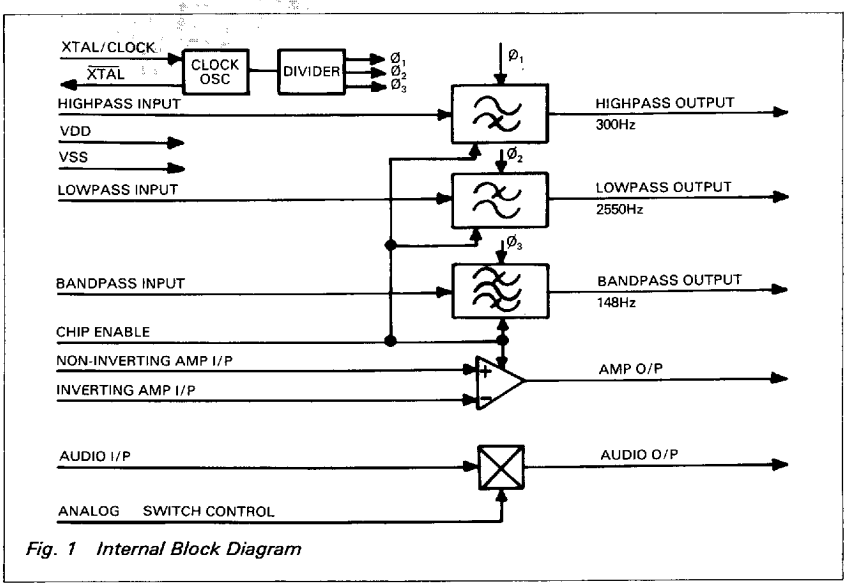
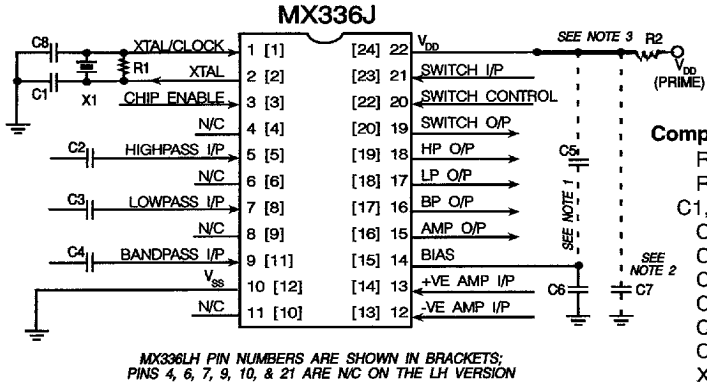


Fig. 1 Internal Block Diagram

MX336 PIN FUNCTION TABLE

PIN		FUNCTION/DESCRIPTION
MX336P	MX336LH	
1	1	**Xtal/Clock:** This is the input to the clock oscillator inverter. 1MHz crystal input or externally derived clock can be injected into this input.
2	2	**$\overline{\text{Xtal}}$:** Output of clock oscillator inverter.
3	3	**Chip Enable:** This input has an internal 1MΩ pull up resistor to V_{dd}. When pulled to V_{ss} (logic '0') all internal amplifiers are disabled and current consumption is reduced.
4	4	**No Connection.**
5	5	**HP I/P:** Input to highpass filter.
6	6 & 7	**No Connection.**
7	8	**LP I/P:** Input to lowpass filter.
8	9 & 10	**No Connection.**
9	11	**BP I/P:** Input to narrow bandpass filter.
10	12	**V_{ss}:** Negative supply.
11	—	**No Connection.**
12	13	**Amp Negative:** Inverting input of uncommitted amplifier.
13	14	**Amp Positive:** Non-inverting input of uncommitted amplifier.
14	15	**Bias:** This is the bias or analog ground pin and is set internally at $V_{dd}/2$. It should be decoupled to V_{ss} by an externally connected 0.1μF (min) capacitor.
15	16	**Amp Output:** Output of uncommitted amplifier.
16	17	**BP Output:** Output of narrow bandpass filter.
17	18	**LP Output:** Output of lowpass filter.
18	19	**HP Output:** Output of highpass filter.
19	20	**SW Output:** Output of analog switch.
—	21	**No connection.**
20	22	**SW Control:** Control input of analog switch, internally pulled to V_{dd} by 1MΩ resistor with switch in 'closed' position. When this input is pulled to VSS, the switch is in 'open' position.
21	23	**SW Input:** Input of analog switch.
22	24	**V_{dd}:** Positive supply.



Component	Value	Tolerance
R1	1MΩ	±10%
R2	-	±10% (Note 3)
C1, C8	33pF	±20%
C2	0.1µF	±20%
C3	0.1µF	±20%
C4	0.1µF	±20%
C5	0.1µF	±20% (Note 1)
C6	0.1µF	±20% (Note 1)
C7	-	Notes 2 and 3
X1	1x10⁶Hz	Selectable

Notes:

1. Bias may be decoupled to V_{SS} and V_{DD} using C5 and C6 when input signals are referenced to the bias pin. For input signals referenced to V_{SS}, decouple Bias to V_{SS} using C6 only.

2. Use C1 when input signals are referenced to V_{SS}, to decouple V_{DD}.

3. Use R2 to assist decoupling of high frequency power supply noise (R2, C1, typically 300µs)

Figure 2 - External Component Connections

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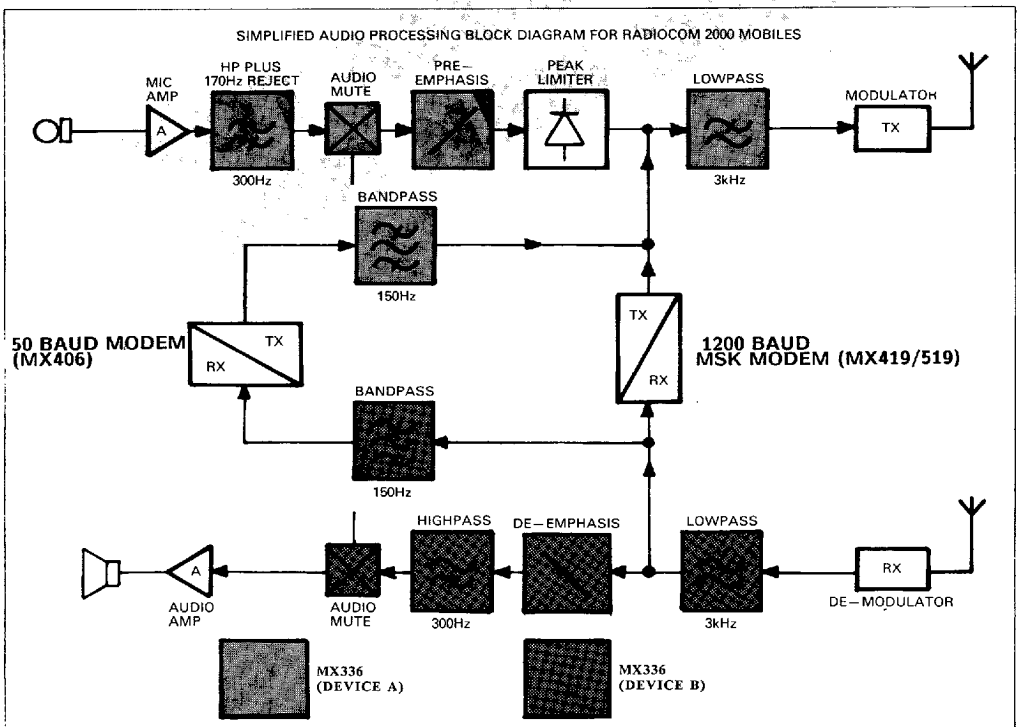

Fig. 3 **MX336 TYPICAL APPLICATION**

MX336 ELECTRICAL SPECIFICATIONS

Absolute Maximum Ratings

Exceeding the maximum rating can result in device damage. Operation of the device outside the operating limits is not implied.

Supply voltage		−0.3V to 7.0V
Input voltage at any pin (ref VSS = OV)		−0.3V to (VDD + 0.3V)
Output sink/source current (total)		20mA
Operating temperature range:	MX336J	−30°C to +85°C
	MX336LH, MX336P	−30°C to +70°C
Storage temperature range:	MX336J	−55°C to +125°C
	MX336LH, MX336P	−40°C to +85°C

Operating Limits

All characteristics measured using the following parameters unless otherwise specified:
VDD = 5V, T_{amb} = 25°C, ∅ = 1MHz, $\Delta f_{\varnothing}$ = 0, f_{in} = 1kHz

Characteristics			See Note	Min	Typ	Max	Unit
Static Characteristics							
Supply voltage				4.5	5	5.5	V
Supply current (Enabled)				—	3	—	mA
Supply current (Disabled)				—	500	—	µA
Input impedance (Filters & Amplifier)				100	2000	—	kΩ
Output impedance (Filters)				—	1.0	—	kΩ
Output impedance (Amplifier open loop)				—	800	—	Ω
Output impedance (Amplifier closed loop)				—	6	—	Ω
Input logic '1'				3.5	—	—	V
Input logic '0'				—	—	1.5	V
Dynamic Characteristics							
Passband Ripple	(300-2550Hz)	HP+LP	1	—	—	2	dB
	(120-175Hz)	BP	2	—	—	3	dB
Cut-off Frequency	(−3dB)	HP		—	265	—	Hz
	(−3dB)	LP		—	3800	—	Hz
	(−6dB)	BP		110	—	180	Hz
Attenuation	<170Hz	HP		43	55	—	dB
	>9000Hz	LP		40	47	—	dB
	<65Hz>290Hz	BP		30	40	—	dB
Group Delay Distortion	(900-2100Hz)	LP		—	30	60	µs
	(900-2100Hz)	HP+LP		—	200	—	µs
	(136-164Hz)		3	—	100	—	µs
Output Noise	(rms)	LP	4	—	1	—	mV
		HP	4	—	1	—	mV
		BP	4	—	4	—	mV
Signal Input	(rms)	LP	5	—	0.4	1.0	V
		HP	5	—	0.4	1.0	V
		BP	5	—	0.4	1.0	V
Insertion Loss	(1kHz)	HP+LP		−1	0	+1	dB
	(150Hz)	BP		−1	0	+1	dB
Aliasing Frequency				50	—	—	kHz

Characteristics	See Note	Min	Typ	Max	Unit
Audio Switch					
Output Noise (rms)	4	—	—	1	mV
Channel Resistance (on)		—	10	—	kΩ
Channel Resistance (off)		10	—	—	MΩ
Uncommitted Amplifier					
Open loop gain		35	50	—	dB
Bandwidth		—	200	—	kHz

Notes: *1. Absolute ripple — see Fig. 4.*
2. Absolute ripple — see Fig. 5.
3. Relative delay between 136 and 164Hz.
4. Measured with input a.c. s/c.
5. 'MAX' figure specified for nominal 3% distortion (30dB)
'TYP' figure specified for minimum distortion (MAX SINAD).

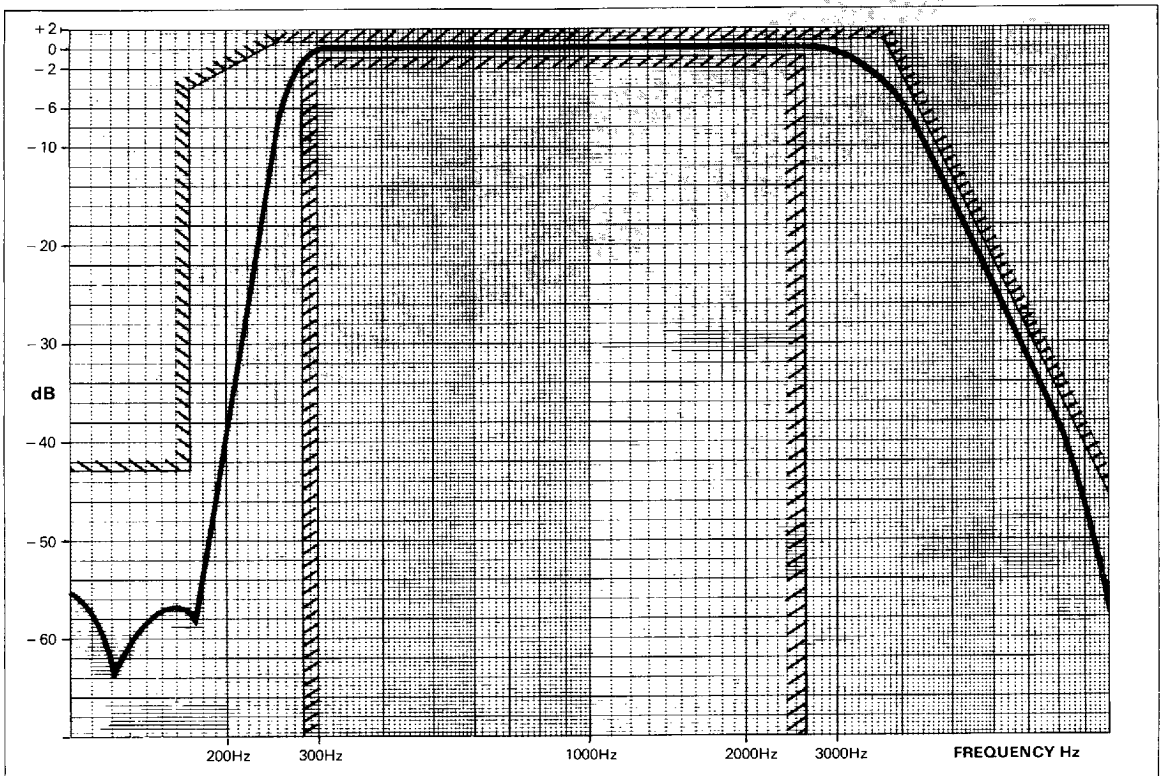

Fig. 4 Typical audio bandpass filter frequency response versus R2000 filter specification.

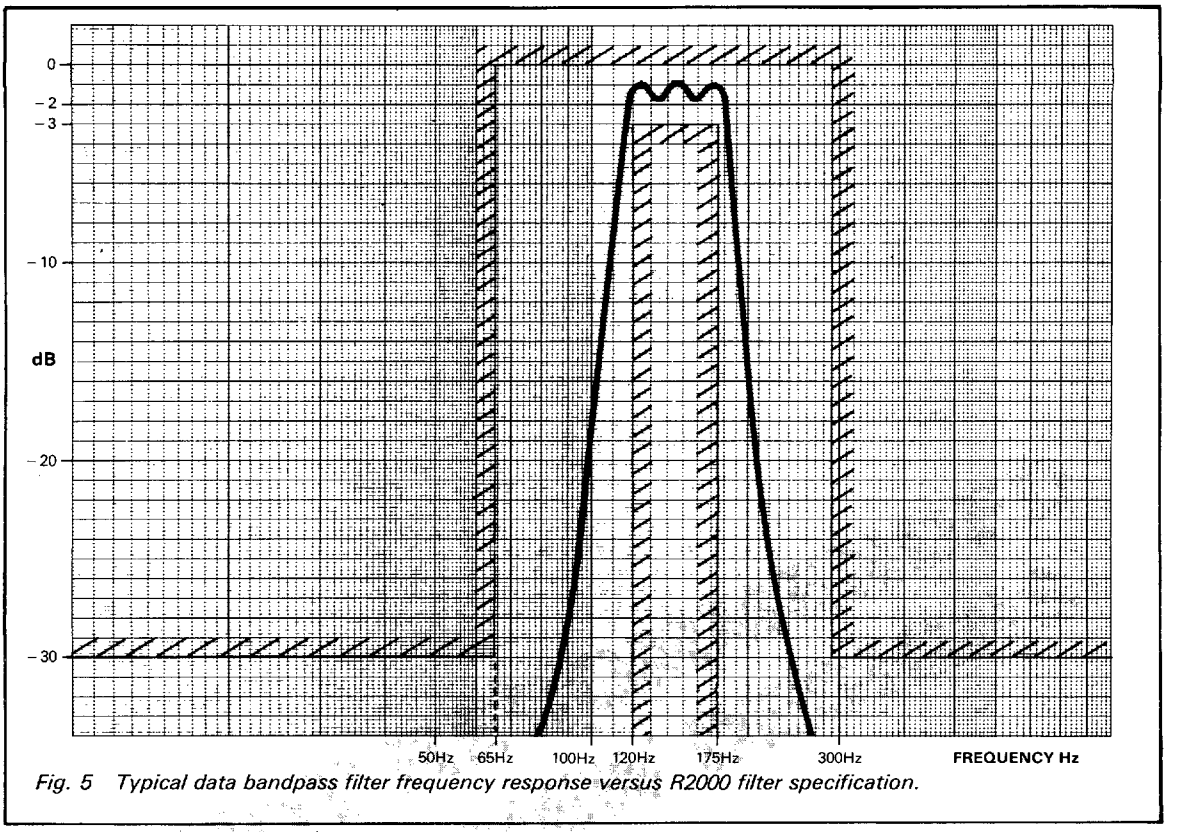

Fig. 5 Typical data bandpass filter frequency response versus R2000 filter specification.

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