

# CML Semiconductor Products

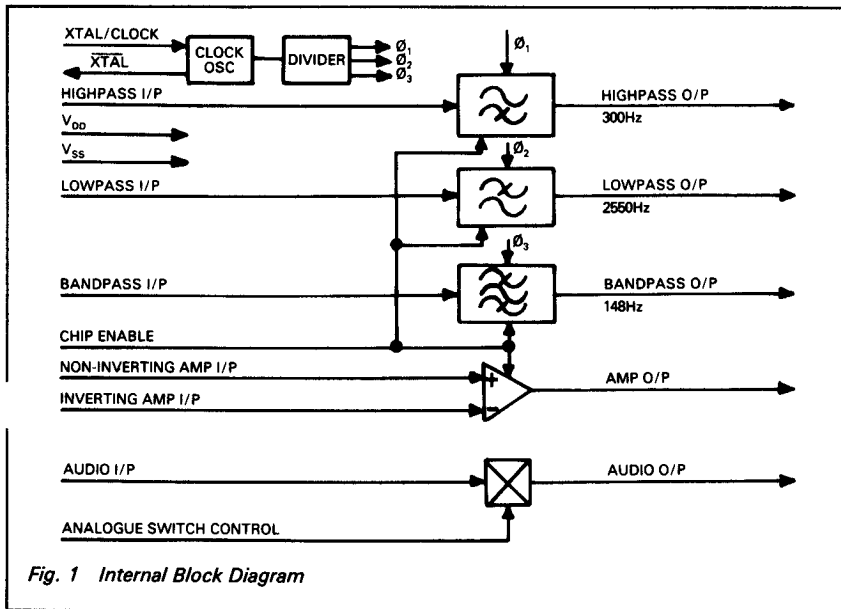
PRODUCT INFORMATION

## FX336 R2000 Filter Array

Publication D/336/3 July 1994

### Features/Applications

- R2000 Trunked Radio Audio Processing
- High Order 300Hz Highpass Filter
- Low Group Delay 2550Hz Lowpass Filter
- On-Chip 120–175Hz Bandpass
- Uncommitted Amplifier and Analogue Switch
- Typical 43dB Rejection Below 170 Hz
- Switched Capacitor Filters
- Xtal Controlled
- Single 5 Volt CMOS Process
- Chip Enable Powersave Feature
- Surface Mount or DIL Package Styles



### Brief Description

The device is a single chip CMOS filter array used to process speech and 50 baud FSK signals as specified in the Radiocom 2000 system specification. The device consists of:

- (a) Highpass audio filter with typically 43dB attenuation of signals below 170 Hz.
- (b) Lowpass audio filter for band-limiting speech in 12.5 kHz channel spacing radios.

The group delay of this lowpass filter is controlled over the range 900–2100Hz, hence allowing the filter to pass 1200 Baud FFSK data.

- (c) Narrow bandpass filter for processing 50 baud FSK data.
- (d) Uncommitted audio amplifier.
- (e) Mute switch with external control.

## Pin Number

## Function

FX336J	FX336LG /LS	FX336LH	
1	1	1	<b>Xtal/Clock:</b> This is the input to the clock oscillator inverter. 1MHz xtal input or externally derived clock can be injected into this input.
2	2	2	<b>Xtal:</b> Output of clock oscillator inverter.
3	3	3	<b>Chip Enable:</b> This input has an internal 1M $\Omega$ pull up resistor to V <sub>DD</sub> . When pulled to V <sub>SS</sub> (logic '0') all internal amplifiers are disabled and current consumption is reduced.
4	4	4, 5	<b>No Connection.</b>
5	5	6	<b>Highpass I/P:</b> Input to highpass filter.
6	6, 7	7, 8	<b>No Connection.</b>
7	8	9	<b>Lowpass I/P:</b> Input to lowpass filter.
8	9, 10	10, 11, 12	<b>No Connection.</b>
9	11	13	<b>Bandpass I/P:</b> Input to narrow bandpass filter.
10	12	14	<b>V<sub>SS</sub>:</b> Negative supply.
11	—	15	<b>No Connection.</b>
12	13	16	<b>Amp Negative:</b> Inverting input of uncommitted amplifier.
13	14	17	<b>Amp Positive:</b> Non-inverting input of uncommitted amplifier.
14	15	18	<b>Bias:</b> This is the bias or analogue ground pin and is set internally at V <sub>DD</sub> /2. It should be decoupled to V <sub>SS</sub> by an externally connected 1.0 $\mu$ F (min).
—	—	19	<b>No Connection.</b>
15	16	20	<b>Amp O/P:</b> Output of uncommitted amplifier.
16	17	21	<b>Bandpass O/P:</b> Output of narrow bandpass filter.
17	18	22	<b>Lowpass O/P:</b> Output of lowpass filter.
18	19	23	<b>Highpass O/P:</b> Output of highpass filter.
19	20	24	<b>Switch O/P:</b> Output of analogue switch. This output is internally biased to approximately V <sub>DD</sub> /2.
—	21	25	<b>No connection.</b>
20	22	26	<b>Switch Control:</b> Control input of analogue switch, internally pulled to V <sub>DD</sub> by 1M $\Omega$ resistor with switch in 'closed' position. When this input is pulled to V <sub>SS</sub> the switch is in 'open' position.
21	23	27	<b>Switch I/P:</b> Input of analogue switch.
22	24	28	<b>V<sub>DD</sub>:</b> Positive supply.
			<b>Note: Output Loading.</b> Large capacitive loads could cause the output pins of this device to oscillate. If capacitive loads in excess of 200pF are unavoidable, a resistor of typically <100 $\Omega$ put in series with the load should minimise this effect.

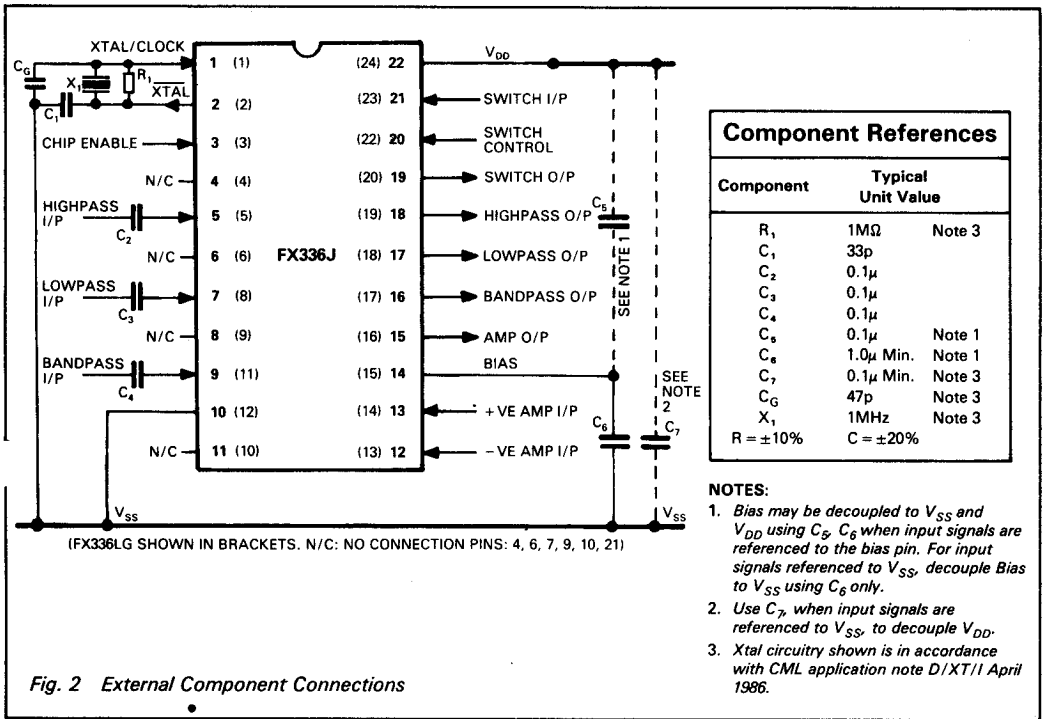


Fig. 2 External Component Connections

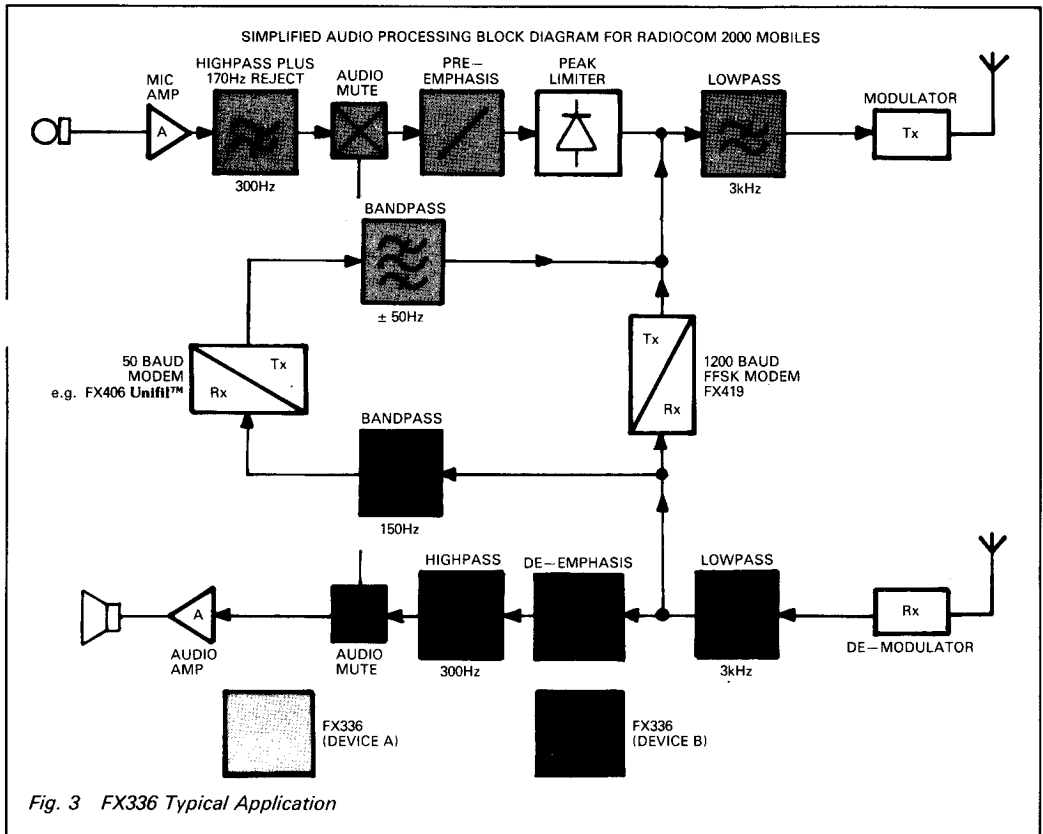


Fig. 3 FX336 Typical Application

## Specification

### 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 $V_{SS} = 0V$ )		-0.3V to ( $V_{DD} + 0.3V$ )
Output sink/source current (total)		20mA
Operating Temperature:	FX336J	-30°C to +85°C
	FX336LG/LS	-30°C to +70°C
Storage Temperature:	FX336J	-55°C to +125°C
	FX336LG/LS	-40°C to +85°C

### Operating Limits

All characteristics measured using the following parameters unless otherwise specified:

$V_{DD} = 5V$ ,  $T_{amb} = 25^{\circ}C$ ,  $\emptyset = 1MHz$ ,  $\Delta f_O = 0$ ,  $f_{in} = 1kHz$ ,  $V_{in} = 1.0 V(rms)$

Characteristics		See Note	Min	Typ	Max	Unit	
<b>Static Characteristics</b>							
Supply voltage			4.5	5	5.5	V	
Supply current (Enabled)			—	6.8	—	mA	
Supply current (Disabled)			—	600	—	$\mu A$	
Input impedance (Filters & Amplifier)			100	800	—	k $\Omega$	
Output impedance (Filters & Amplifier)			—	1.0	—	k $\Omega$	
Input logic '1'			70% $V_{DD}$	—	—	V	
Input logic '0'			—	—	30% $V_{DD}$	V	
<b>Dynamic Characteristics</b>							
Passband Ripple	(300-2550Hz)	HP + LP	1	—	—	2	dB
	(280-300Hz)	HP + LP	2	+1	0	-2	dB
	(120-175Hz)	BP	2	—	—	3	dB
Cut-off Frequency	(-3dB)	HP	—	—	265	—	Hz
	(-3dB)	LP	—	—	3800	—	Hz
	(-6dB)>150Hz	BP	—	—	190	—	Hz
	(-6dB)<150Hz	BP	—	—	115	—	Hz
Stopband Attenuation	<170Hz	HP	—	40	43	—	dB
	>9000Hz	LP	—	40	47	—	dB
	<65Hz>290Hz	BP	—	30	40	—	dB
Group Delay Distortion	(900-2100Hz)	LP	—	—	30	60	$\mu s$
	(900-2100Hz)	HP + LP	—	—	300	—	$\mu s$
	(136-164Hz)	BP	3	—	1.7	—	ms
Output Noise		LP	4	—	2.0	—	mV(rms)
		HP	4	—	2.0	—	mV(rms)
		BP	4	—	2.0	—	mV(rms)
Signal Input		LP	5	—	0.5	1.0	V(rms)
		HP	5	—	0.5	1.0	V(rms)
		BP	5	—	0.5	1.0	V(rms)
Passband Gain	(1kHz)	HP + LP	—	-0.5	+0.5	+1.5	dB
	(150Hz)	BP	—	-1	0	+1	dB
Aliasing Frequency			50	—	—	kHz	
<b>Audio Switch</b>							
Output Noise (rms)		4	—	—	1	mV	
Channel Resistance (on)			—	500	—	k $\Omega$	
Channel Resistance (off)			10	—	—	M $\Omega$	
<b>Uncommitted Amplifier</b>							
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; at 30kHz Bw.

5. 'MAX' figure specified for nominal 3% distortion (30dB).

'TYP' figure specified for minimum distortion (MAX SINAD).

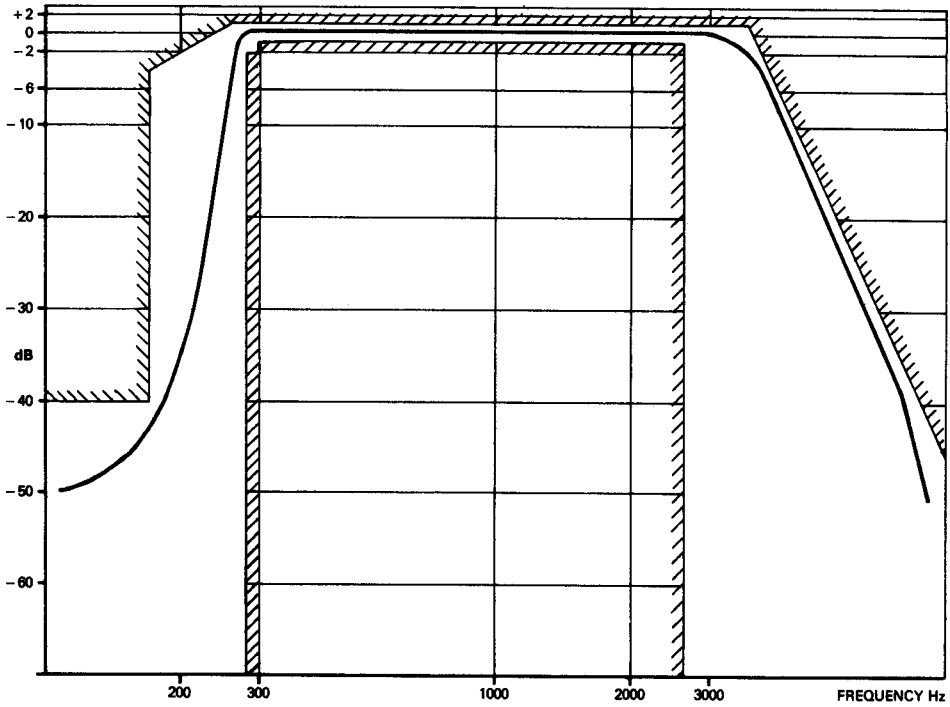


Fig. 4 Typical audio bandpass filter frequency response versus R2000 filter specification.

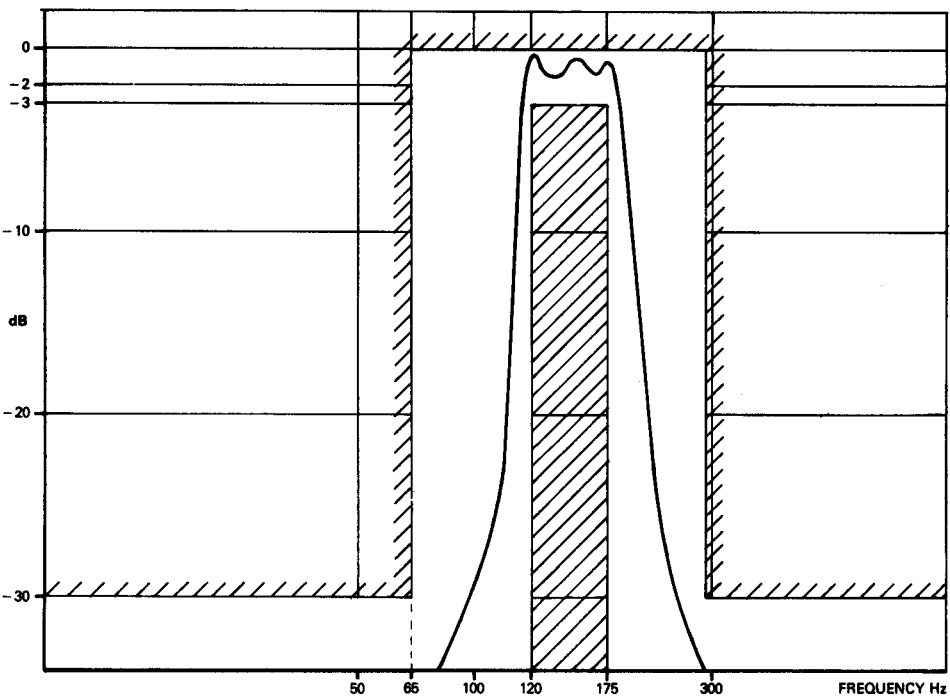


Fig. 5 Typical data bandpass filter frequency response versus R2000 filter specification.

## Package Outlines

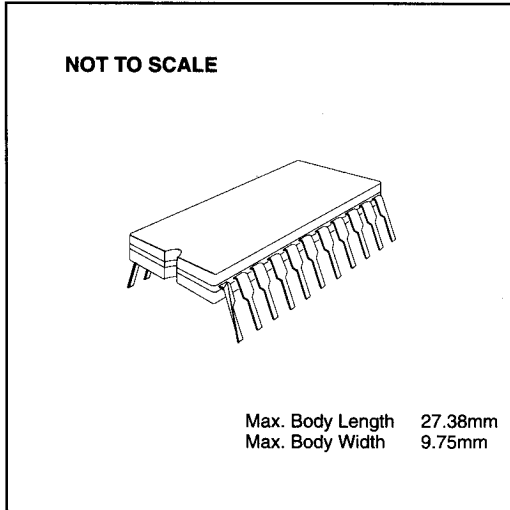
The FX336 is available in the package styles outlined below. Mechanical package diagrams and specifications are detailed in Section 10 of this document.

Pin 1 identification marking is shown on the relevant diagram and pins on all package styles number anti-clockwise when viewed from the top.

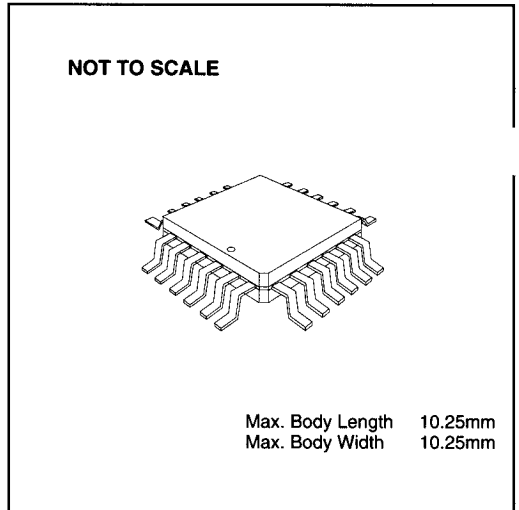
## Handling Precautions

The FX336 is a CMOS LSI circuit which includes input protection. However precautions should be taken to prevent static discharges which may cause damage.

**FX336J** 22-pin cerdip DIL (J3)



**FX336LG** 24-pin quad plastic encapsulated bent and cropped (L1)



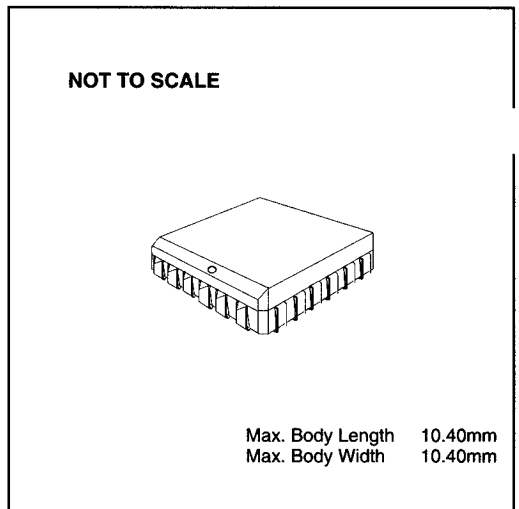
## Ordering Information

**FX336J** 22-pin cerdip DIL (J3)

**FX336LG** 24-pin encapsulated bent and cropped (L1)

**FX336LS** 24-lead plastic leaded chip carrier (L2)

**FX336LS** 24-lead plastic leaded chip carrier (L2)





**CML Microcircuits**

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## CML Product Data

In the process of creating a more global image, the three standard product semiconductor companies of CML Microsystems Plc (*Consumer Microcircuits Limited (UK)*, *MX-COM, Inc (USA)* and *CML Microcircuits (Singapore) Pte Ltd*) have undergone name changes and, whilst maintaining their separate new names (*CML Microcircuits (UK) Ltd*, *CML Microcircuits (USA) Inc* and *CML Microcircuits (Singapore) Pte Ltd*), now operate under the single title **CML Microcircuits**.

These companies are all 100% owned operating companies of the CML Microsystems Plc Group and these changes are purely changes of name and do not change any underlying legal entities and hence will have no effect on any agreements or contacts currently in force.

### CML Microcircuits Product Prefix Codes

Until the latter part of 1996, the differentiator between products manufactured and sold from MXCOM, Inc. and Consumer Microcircuits Limited were denoted by the prefixes MX and FX respectively. These products use the same silicon etc. and today still carry the same prefixes. In the latter part of 1996, both companies adopted the common prefix: CMX.

This notification is relevant product information to which it is attached.

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