CML Semiconductor Products

PRODUCT INFORMATION

T-75-27-13

FX336 R2000 Filter Array

Publication D/336/2 November 1986
Provisional Issue

CONSUMER MICROCIRCUITS

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

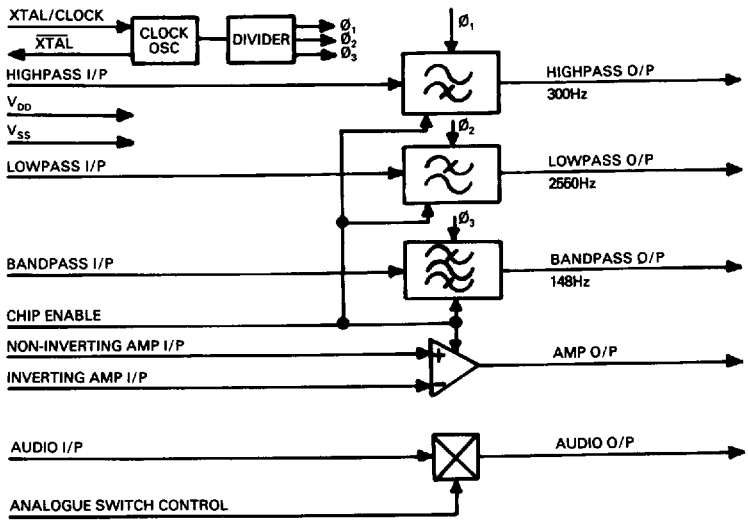


Fig. 1 Internal Block Diagram

FX336

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.

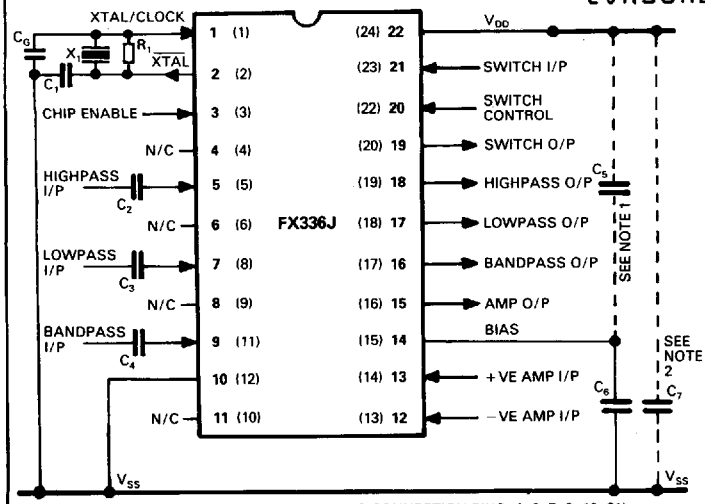
(c) Narrow bandpass filter for processing 50 baud FSK data.

(d) Uncommitted audio amplifier.

(e) Mute switch with external control.

Pin Number			Function
FX336J	FX336LG	FX336LH	
1	1	1	**Xtal/Clock:** 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	**$\overline{\text{Xtal}}$:** Output of clock oscillator inverter.
3	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	4, 5	**No Connection.**
5	5	6	**Highpass I/P:** Input to highpass filter.
6	6, 7	7, 8	**No Connection.**
7	8	9	**Lowpass I/P:** Input to lowpass filter.
8	9, 10	10, 11, 12	**No Connection.**
9	11	13	**Bandpass I/P:** Input to narrow bandpass filter.
10	12	14	**V_{SS}:** Negative supply.
11	—	15	**No Connection.**
12	13	16	**Amp Negative:** Inverting input of uncommitted amplifier.
13	14	17	**Amp Positive:** Non-inverting input of uncommitted amplifier.
14	15	18	**Bias:** This is the bias or analogue ground pin and is set internally at $V_{DD}/2$. It should be decoupled to V_{SS} by an externally connected 1.0μF (min).
—	—	19	**No Connection.**
15	16	20	**Amp O/P:** Output of uncommitted amplifier.
16	17	21	**Bandpass O/P:** Output of narrow bandpass filter.
17	18	22	**Lowpass O/P:** Output of lowpass filter.
18	19	23	**Highpass O/P:** Output of highpass filter.
19	20	24	**Switch O/P:** Output of analogue switch. This output is internally biased to approximately $V_{DD}/2$.
—	21	25	**No connection.**
20	22	26	**Switch Control:** Control input of analogue switch, internally pulled to V_{DD} by 1MΩ resistor with switch in 'closed' position. When this input is pulled to V_{SS} the switch is in 'open' position.
21	23	27	**Switch I/P:** Input of analogue switch.
22	24	28	**V_{DD}:** Positive supply.

Note: Output Loading.
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 <100Ω put in series with the load should minimise this effect.



(FX336LG SHOWN IN BRACKETS. N/C: NO CONNECTION PINS: 4, 6, 7, 9, 10, 21)

Component References

Component	Typical Unit Value	
R_1	1MΩ	Note 3
C_1	33p	
C_2	0.1μ	
C_3	0.1μ	
C_4	0.1μ	
C_5	0.1μ	Note 1
C_6	1.0μ Min.	Note 1
C_7	0.1μ Min.	Note 3
C_G	47p	Note 3
X_1	1MHz	Note 3
R = ±10%	C = ±20%	

NOTES:

1. *Bias may be decoupled to V_{SS} and V_{DD} using C_5, C_6 when input signals are referenced to the bias pin. For input signals referenced to V_{SS}, decouple Bias to V_{SS} using C_6 only.*
2. *Use C_7, when input signals are referenced to V_{SS}, to decouple V_{DD}.*
3. *Xtal circuitry shown is in accordance with CML application note D/XT/I April 1986.*

Fig. 2 External Component Connections

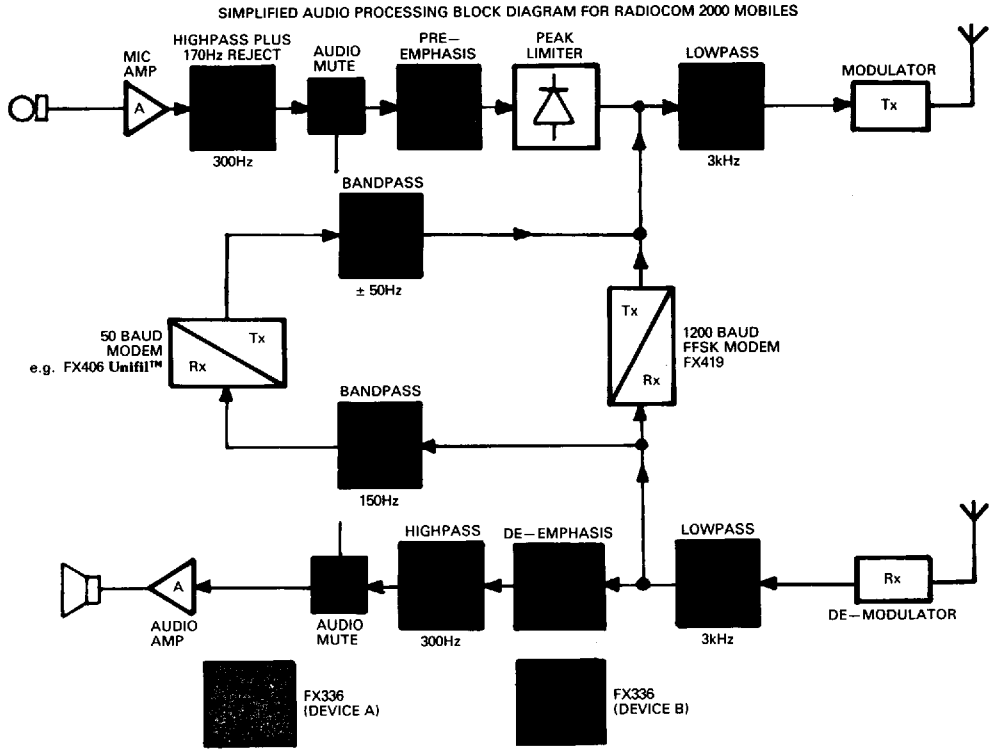


Fig. 3 FX336 Typical Application

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} = OV)		−0.3V to (V_{DD} + 0.3V)
Output sink/source current (total)		20mA
Operating temperature range:	FX336J	−30°C to + 85°C
	FX336LG/LH	−30°C to + 70°C
Storage temperature range:	FX336J	−55°C to +125°C
	FX336LG/LH	−40°C to + 85°C

Operating Limits

All characteristics measured using the following parameters unless otherwise specified:
V_{DD} = 5V, T_{amb} = 25°C, Ø = 1MHz, Δf_O = 0, f_{in} = 1kHz, V_{in} = 1.0 V(rms)

Characteristics		See Note	Min	Typ	Max	Unit
Static Characteristics						
Supply voltage			4.5	5	5.5	V
Supply current (Enabled)			—	6.8	—	mA
Supply current (Disabled)			—	600	—	μA
Input impedance (Filters & Amplifier)			100	800	—	kΩ
Output impedance (Filters & Amplifier)			—	1.0	—	kΩ
Input logic '1'			70%V_{DD}	—	—	V
Input logic '0'			—	—	30%V_{DD}	V
Dynamic Characteristics						
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	μs
	(900-2100Hz)	HP + LP		—	300	—	μs
	(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
Audio Switch						
Output Noise	(rms)		4	—	—	1	mV
Channel Resistance	(on)			—	500	—	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; at 30kHz Bw.
5. 'MAX' figure specified for nominal 3% distortion (30dB).
'TYP' figure specified for minimum distortion (MAX SINAD).

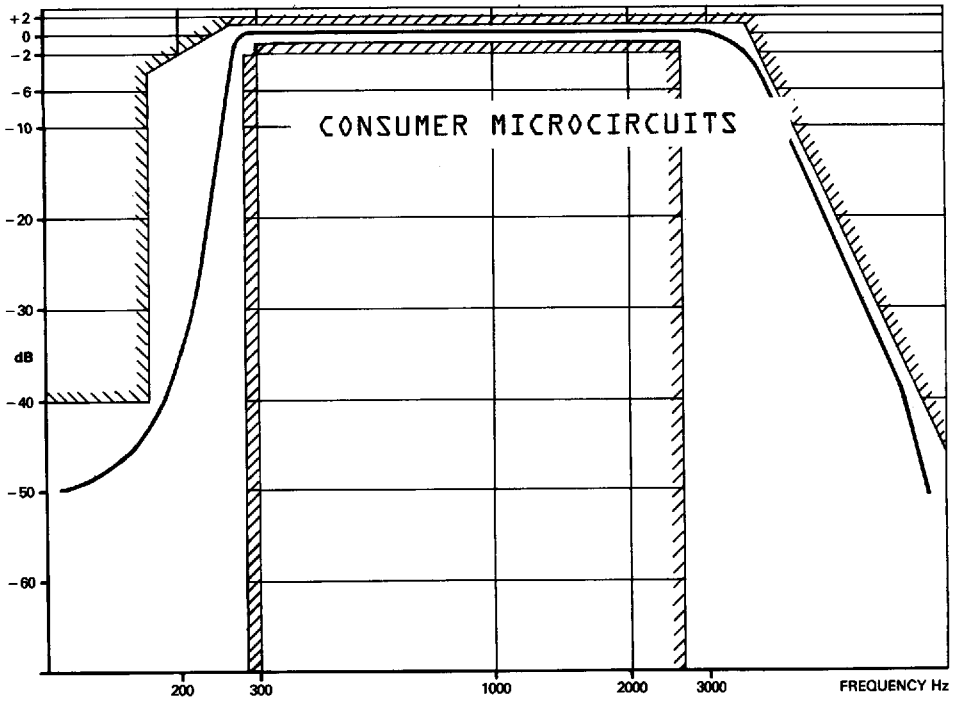


Fig. 4 Typical audio bandpass filter frequency response versus R2000 filter specification.

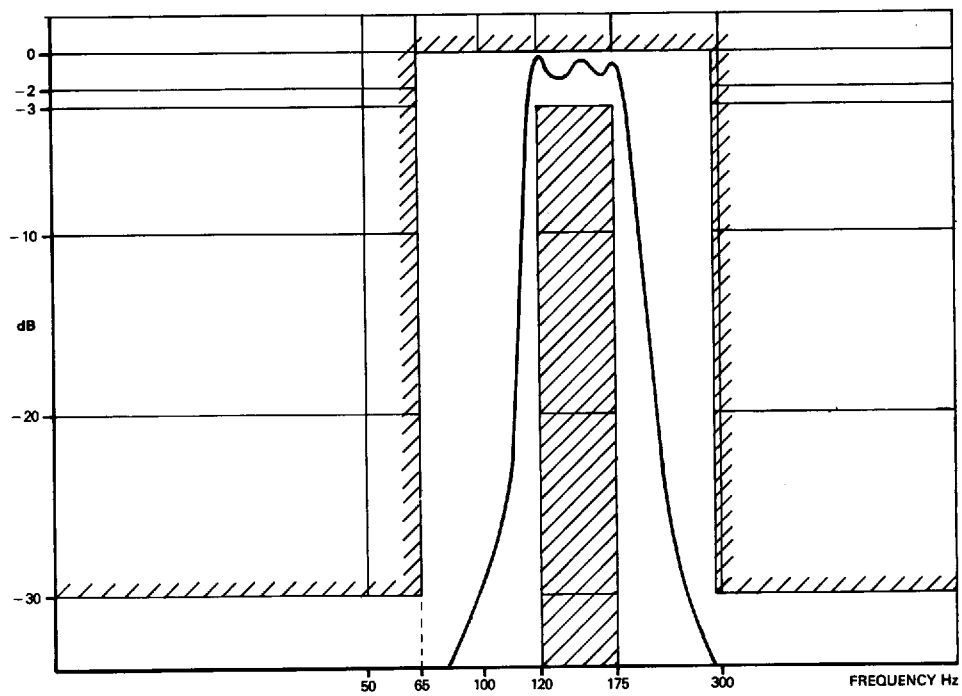


Fig. 5 Typical data bandpass filter frequency response versus R2000 filter specification.

Package Outlines

The FX336J, the cerdip package is illustrated in *Figure 6.* The 'LG' version is shown in *Figure 7* and the 'LH' version in *Figure 8.* Both 'LG' and 'LH' packages are supplied in conductive trays for handling convenience. To allow complete identification, the FX336LG and LH packages have an indent spot adjacent to Pin 1 and a chamfered corner between Pins 3 and 4 for LG package, between Pins 4 and 5 for LH package. Pins number anti-clockwise when viewed from the top (indent side).

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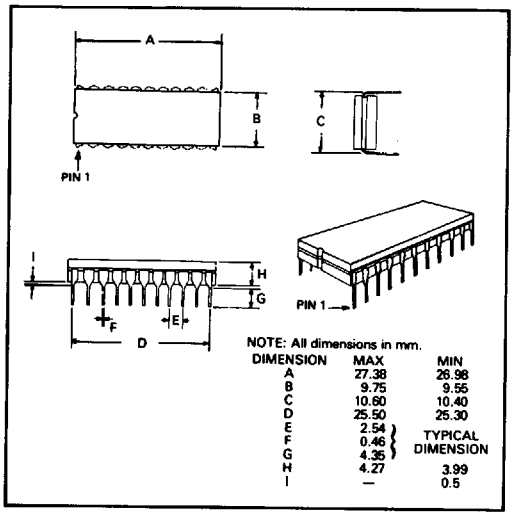
Fig. 6 **FX336J** *DIL Package*



NOTE: All dimensions in mm.

DIMENSION	MAX	MIN
A	27.38	26.98
B	9.75	9.55
C	10.60	10.40
D	25.50	25.30
E	2.54	TYPICAL DIMENSION
F	0.46	
G	4.35	
H	4.27	3.99
I	—	0.5

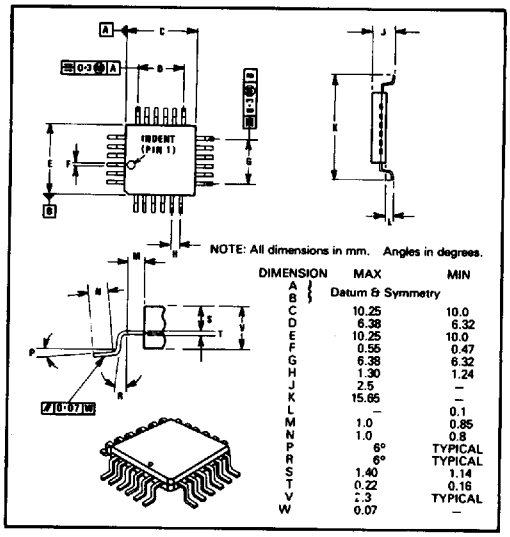
Ordering Information

FX336J	**22-pin cerdip D I L**
FX336LG	**24-pin quad plastic encapsulated, bent and cropped**
FX336LH	**28-lead plastic leaded chip carrier**

Handling Precautions

The FX336J/LG/LH is a CMOS LSI circuit which includes input protection. However, precautions should be taken to prevent static discharges which may cause damage.

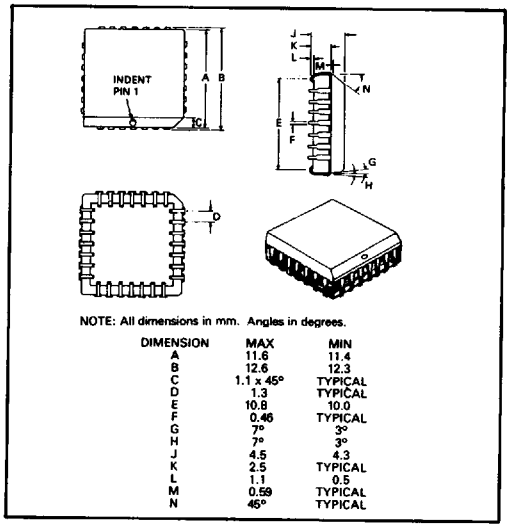
Fig. 7 **FX336LG** *Quad Package*



NOTE: All dimensions in mm. Angles in degrees.

DIMENSION	MAX	MIN
A, B	Datum & Symmetry	
C	10.25	10.0
D	6.38	6.32
E	10.25	10.0
F	0.55	0.47
G	6.38	6.32
H	1.30	1.24
J	2.5	—
K	15.65	—
L	—	0.1
M	1.0	0.85
N	1.0	0.8
P	6°	TYPICAL
R	6°	TYPICAL
S	1.40	1.14
T	0.22	0.16
V	2.3	TYPICAL
W	0.07	—

Fig. 8 **FX336LH** *PLCC Package*



NOTE: All dimensions in mm. Angles in degrees.

DIMENSION	MAX	MIN
A	11.6	11.4
B	12.6	12.3
C	1.1 x 45°	TYPICAL
D	1.3	TYPICAL
E	10.8	10.0
F	0.46	TYPICAL
G	7°	3°
H	7°	3°
J	4.5	4.3
K	2.5	TYPICAL
L	1.1	0.5
M	0.59	TYPICAL
N	45°	TYPICAL

Integrated Circuits Data Book

T-90-20

Section 11

CONSUMER MICROCIRCUITS

Packaging and Applications

CML Packaging

For ease and convenience CML products are packaged for despatch in industry standard bulk or individual packaging as described below.

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- Trays (17cm x 10.5cm) and cardboard boxes with conductive foam.
- 50-pocket conductive trays for surface-mount microcircuits.
- Anti-static coated tubes, of various sizes, with thumbplugs.
- 13-inch reel Tape-and-Reel packaging which fully conforms to the latest EIC specification. The conductive embossed tape provides a secure cavity sealed with a peel-back cover tape. 500 units/reel – no partial reel counts are available.

CML Tape and Reel Specification

1. Scope

The specification relates to the tape packaging of integrated circuits suitable for use in "surface mount" assembly. It includes only those dimensions which are essential for the purchaser to use the product.

2. Dimensions (Refer to Figures 1a, 1b and 1c)

2.1	**Tape width**		W = 24 + 0.3mm
2.2	**Carrier Tape Thickness**		t = 0.3mm Max.
2.3	**Pitch of Sprocket Holes**		Po = 4.0 + 0.1mm
2.4	**Diameter of Sprocket Holes**		D = 1.5 + 0.1mm 1.5 - 0.00mm
2.5	**Distance**		E = 1.75 + 0.1mm
2.6	**Distance, centre to centre**		F = 11.5 + 0.1mm
2.7	**Dimension, centre to centre**		
2.7.1	LG		P2 = 10 + 0.1mm
2.7.2	LH		P2 = 6 + 0.1mm
2.7.3	LS		P2 = 6 + 0.1mm
2.8	**Embossed Pocket Dimension Ao and Bo**		
2.8.1	LG		Ao = 15.8 + 0.1mm
2.8.2	LG		Bo = 15.8 + 0.1mm
2.8.3	LH		Ao = 13.1 + 0.1mm
2.8.4	LH		Bo = 13.1 + 0.1mm
2.8.5	LS		Ao = 11.7 + 0.1mm
2.8.6	LS		Bo = 11.7 + 0.1mm
2.9	**Embossed Tape Dimension Ko**		
2.9.1		LG	Ko = 2.8 + 0.1mm
2.9.2		LH	Ko = 4.9 + 0.1mm
2.9.3		LS	Ko = 4.3 + 0.1mm
2.10	**Pitch of Component Compartments**		
2.10.1		LG	P = 20 + 0.1mm
2.10.2		LH	P = 16 + 0.1mm
2.10.3		LS	P = 16 + 0.1mm
2.11	**Outside Dimension of Pocket**		
2.11.1		LG	B1 = 16.4 + 0.1mm
2.11.2		LH	B1 = 13.8 + 0.1mm
2.11.3		LS	B1 = 12.3 + 0.1mm
2.12	**Pocket Centre Holes**		
2.12.1		LG	D1 = 2.0mm Min.
2.12.2		LH	D1 = 2.0mm Min.
2.12.3		LS	D1 = 2.0mm Min.

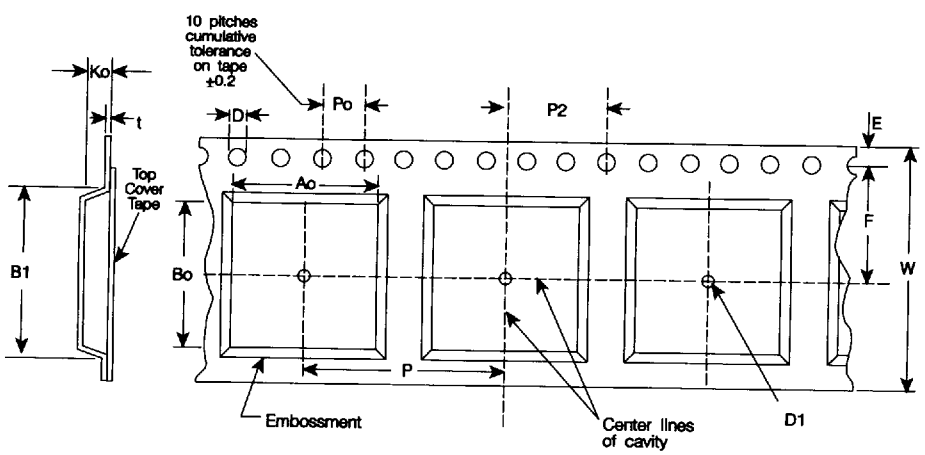

Fig.1a

CML Packaging .....

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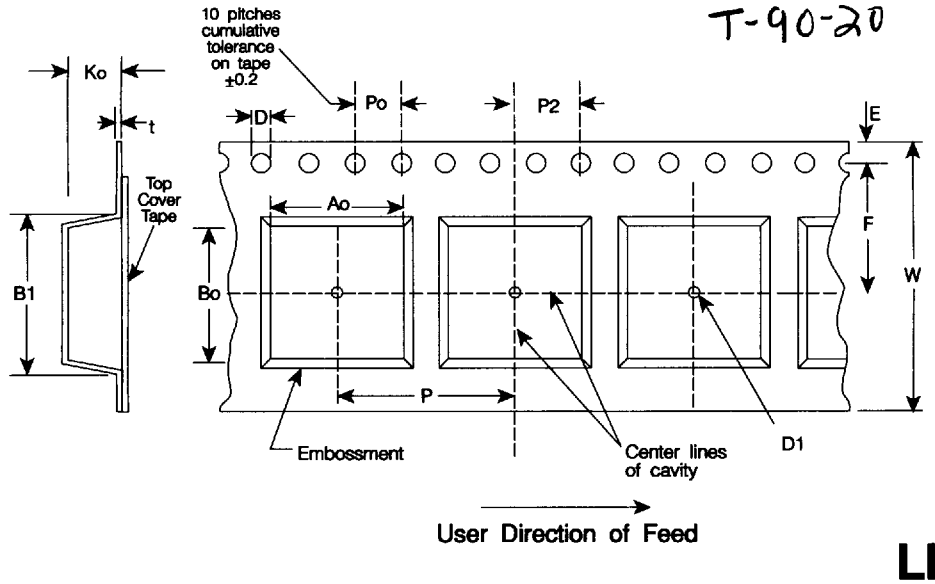

Fig.1b

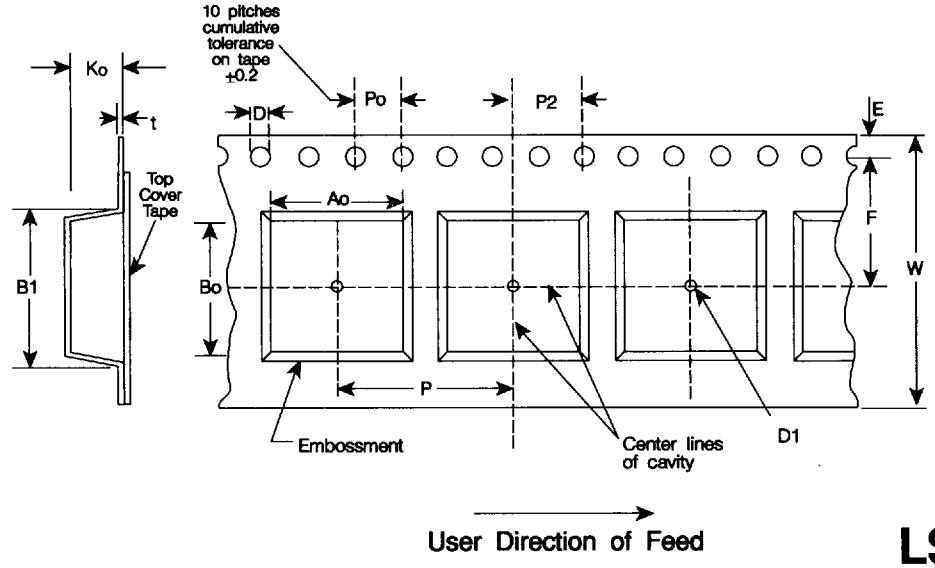

Fig.1c

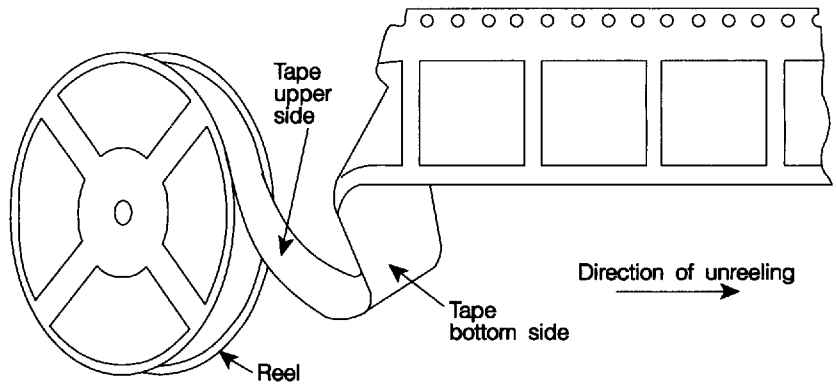

Fig.2 Tape Top and Bottom Orientation

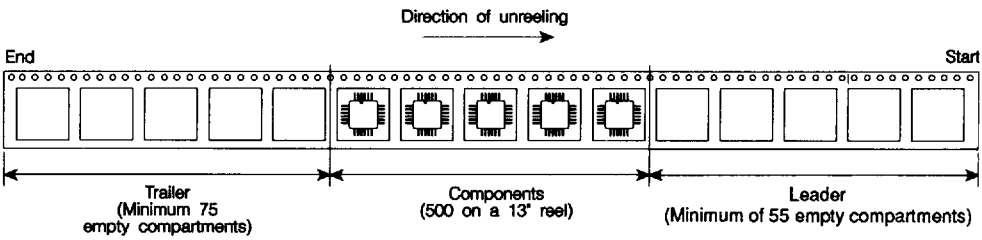

Fig.3 Layout of Tape

3. Materials

3.1 Carrier tape to be made of a conductive grade of polystyrene.

3.2 Conductive polycarbonate is also an approved carrier tape material and may be used under certain circumstances.

3.3 Cover tape is an anti-static grade of polypropylene/polyester film with a strip of pressure sensitive adhesive approximately 1mm wide along each edge.

4. Polarity and Orientation of Components in Tape

4.1 All components will be placed such that Pin 1 is adjacent to the sprocket holes (See Figures 6a and 6b).

4.2 The mounting side of the component shall be oriented to the bottom side of the tape (See Figure 2).

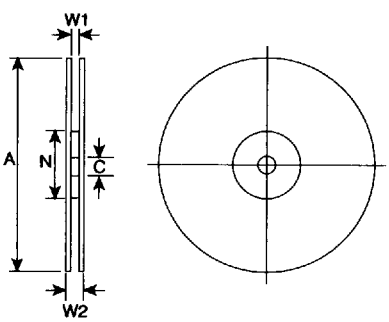

Fig.4 Reel Dimensions

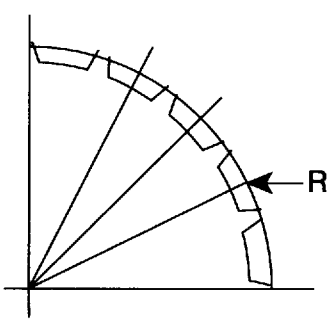

Fig.5 Minimum Radius = 30mm

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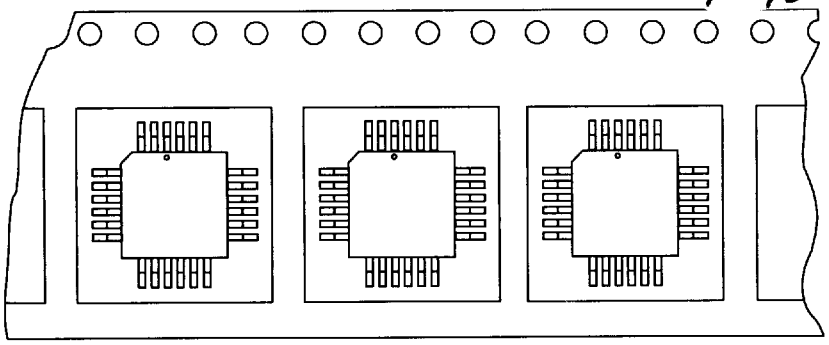
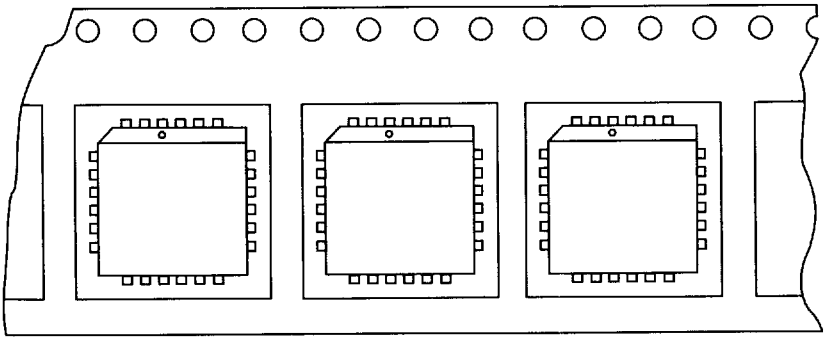
Fig.6a



User direction of feed

Fig.6b



User direction of feed

Fig.6 Component Orientation

5. Fixing of Components in Tape

5.1 Cover tapes shall not cover the sprocket holes.

5.2 Tapes in adjacent layers shall not stick together in the packing.

5.3 The adhesive of the cover tape shall not adversely effect the mechanical and electrical characteristics and marking of the components.

5.4 Components shall not stick to the carrier tape or the cover tape.

5.5 The tapes shall be suitable to withstand storage of the taped components without danger or migration of the terminations or the giving off of vapours which would impair soldering or deteriorate the component properties or termination by chemical action.

5.6 When the tape is bent with a minimum radius (See Figure 5) of 30mm, the tape shall not be damaged and the components shall remain in their position and orientation in the tape.

5.7 The peel strength of the cover tape shall be 50 ±25 grams measured at 175° - 180° with respect to the carrier tape along its longitudinal axis. The peel speed shall be 240mm/min.

5.8 After baking at 60°C for 48 hours or storage in ideal conditions for three months, the peel strength shall remain within the specified limits.

CML Packaging .....

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6. Packaging

6.1 Tape will be wound on anti-static plastic reels (See Figure 4)

Dimensions

6.1.1	A	C	N	W1	W2
	Reel Dia.	Centre Hole	Hub Outer Dia.	Inside Cheek Width	Outside Cheek Width
	330mm	12.7mm	62.5mm	24.5mm	28.8mm

6.2 There will be a leader of a minimum of 55 empty compartments, at the start of the carrier tape (See Figure 3).

6.3 There will be no missing components between the first and last part of working tape in any reel.

6.4 At the end of the tape there will be a trailer of a minimum of 75 empty compartments (See Figure 3).

6.5 The tape shall release from the reel hub as the last portion of the carrier tape unwinds from the reel.

6.6 Components on a reel.

6.6.1 LG = 500
6.6.2 LH = 500
6.6.3 LS = 500

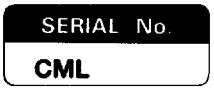
6.7 The tape will be prevented from unreeling by winding a paper tape around the reel and fixing with adhesive tape.

6.8 All reels will display:

1. Device Type
2. Quantity on reel
3. Date code
4. A static hazard warning label
5. CML Serial Number

6.9 Reel packed into anti-static bubble bag then in a cardboard box, with appropriate labelling as in paragraph 6.8.

6.10 Ideal storage conditions are 15°C to 20°C with a relative humidity of 60% - 70%.



Handling Precautions

CML microcircuits are CMOS LSI devices which include input protection. However precautions should be taken, at all times, to prevent static discharges which may cause device damage.

- It is recommended that the user initially stores and transports the microcircuit in the original supplied packaging.
- At all times observe anti-static precautions including the correct use of a conductive wrist-band and cord.
- Keep benches, personnel and test equipment at the same electrical potential.
- Ensure that the microcircuit is stored and operated well away from any potential source of static discharge.
- Do not insert or remove a microcircuit from an application whilst any power remains applied.
- Whenever possible ensure that the microcircuit is inserted after all other components have been mounted.
- Do not apply signals to a microcircuit until the power supply is suitably established.