Consumer Microcircuits Limited

PRODUCT INFORMATION

FX316 NMT Audio Filter Array

Publication D/316/2 May 1985
PROVISIONAL ISSUE

Features

- Cellular Radio Audio Processing
- NMT 450 & 900MHz Base Station and Mobile Specifications
- High Order Lowpass Filter including SAT Rejection
- Low Group Delay Distortion
- 4kHz SAT Recovery Bandpass Filter
- Uncommitted Operational Amplifier
- Switched Capacitor Filters
- Xtal Controlled
- Single 5 Volt CMOS Process
- Chip Enable Powersave Feature
- Few External components
- Surface Mounted or DIL Package Style

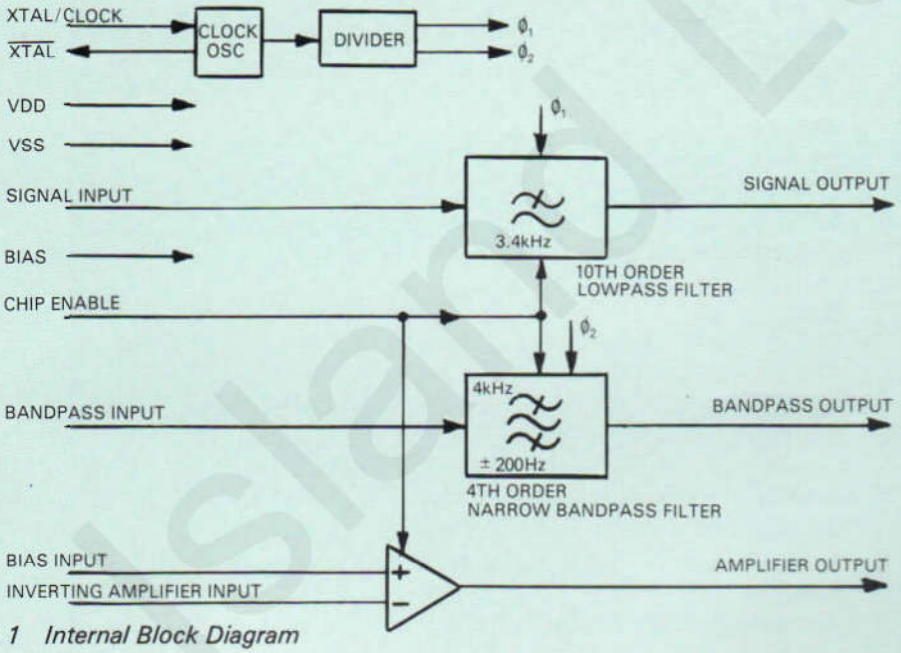


Fig. 1 Internal Block Diagram

FX316

Brief Description

The FX316 is a low power CMOS Switched Capacitor filter array designed to meet NMT Base and Mobile specifications.

The device in detail consists of:

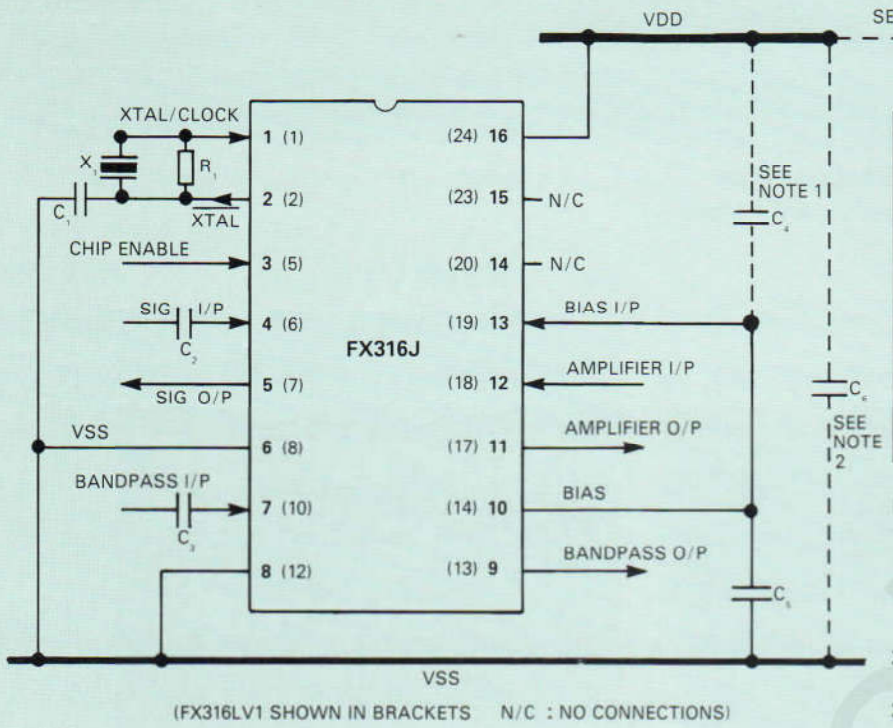
(1) a 10th order 3.4kHz lowpass filter with sufficient rejection of 4kHz signals to meet NMT 450 and 900 filter response specifications for both base and mobile equipments. The lowpass filter also provides a low group delay distortion path.

(2) a 4th order 4kHz narrow bandpass filter which meets the NMT 450 and 900 mobile specifications for SAT recovery.

(3) an uncommitted amplifier which may be used for any specific applications such as pre-emphasis, de-emphasis, buffering etc. An on chip oscillator uses a 1MHz xtal and provides all reference clocks for the switched capacitor filters via a divider chain. Alternatively, an external clock may be used. The chip enable feature is used to disable the three circuit elements thus reducing current consumption.

Pin Number		Function
FX316J	FX316LV1	
1	1	**Xtal/Clock:** 1 MHz xtal I/P or externally derived clock can be injected into this I/P. Input to on-chip inverting oscillator.
2	2	**$\overline{\text{Xtal}}$:** 1 MHz xtal O/P. Inverting output of on-chip oscillator.
3	5	**Chip Enable:** Internally pulled to VDD. A logic '0' applied to this input will disable all filters and the uncommitted amplifier (powersave mode).
4	6	**Signal I/P:** Input to lowpass filter. This input is internally biased and externally a.c. coupled by C_2.
5	7	**Signal O/P:** Lowpass filter output internally biased to VDD/2.
6	8	**VSS:** Negative supply.
7	10	**BP I/P:** Input to bandpass filter. This input is internally biased and externally a.c. coupled by C_3.
8	12	**VSS:** Negative Supply.
9	13	**BP O/P:** Bandpass filter output internally biased to VDD/2.
10	14	**Bias:** VDD/2 Bias Pin. Externally decoupled by C_5 (see Fig 2, Note 1).
11	17	**Amp O/P:** Uncommitted amplifier output.
12	18	**Amp I/P:** Uncommitted amplifier inverting input.
13	19	**Bias I/P:** Connect externally to 'Bias' pin.
14	20	**N/C:** Internally connected leave open circuit.
15	23	**N/C:** Internally connected leave open circuit.
16	24	**VDD:** Positive Supply.

FX316LV1 Pin numbers 3, 4, 9, 11, 15, 16, 21 and 22 are not connected.

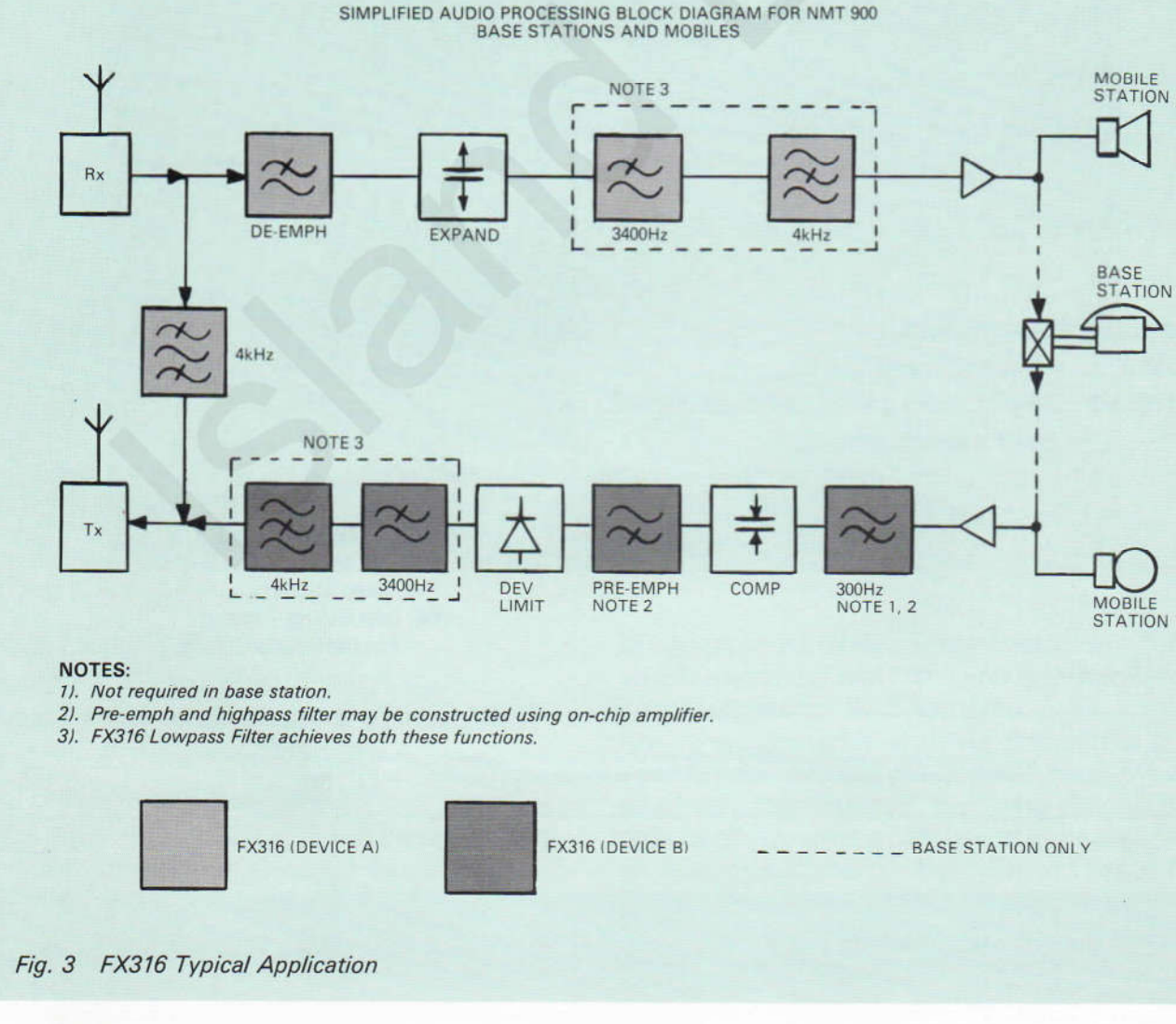


Component References		
Component	Unit Value	Tolerance
R_1	1M	± 10%
R_2	—	(See note 3)
C_1	33p	
C_2	0.1μ	
C_3	0.1μ	± 20%
C_4	0.1 μ	
C_5	0.1 μ	(See note 1)
C_6	—	(See note 2, 3)
X_1	Crystal	

NOTES:

1. *Bias may be decoupled to VSS and VDD using C_4, C_5 when input signals are referenced to the bias pin. For input signals referenced to VSS, decouple Bias to VSS using C_5 only.*
2. *Use C_6, when input signals are referenced to VSS, to decouple VDD.*
3. *Use R_2 to assist decoupling of high frequency power supply noise (R_2 C_6 typically 300μs)*

Fig.2 External Component Connections



NOTES:

1). Not required in base station.
2). Pre-emph and highpass filter may be constructed using on-chip amplifier.
3). FX316 Lowpass Filter achieves both these functions.

Fig. 3 FX316 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 VSS = OV)		−0.3V to (VDD + 0.3V)
Output sink/source current (total)		20mA
Operating temperature range:	FX316J	−30°C to + 85°C
	FX316LV1	−30°C to + 70°C
Storage temperature range:	FX316J	−55°C to +125°C
	FX316LV1	−40°C to + 85°C
Maximum device dissipation:		All versions 100mW

Operating Limits

All characteristics measured using the following parameters unless otherwise specified:
VDD = 5V, T_{amb} = 25°C, ϕ = 1MHz, Δf_{ϕ} = 0, f_{in} = 1kHz.

Characteristics		See Note	Min	Typ	Max	Unit
Static Characteristics						
Supply voltage			4.5	5	5.5	V
Supply current (Enabled)			—	3.5	—	mA
Supply current (Disabled)			—	500	—	µA
Input impedance (Filters & Amplifier)			100	—	—	kΩ
Output impedance (Filters)			—	3	—	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—3000Hz) LP		—	—	2	dB
	(4kHz ±55Hz) BP		—	—	2	dB
Cutoff Frequency	(−3dB) LP		3000	3600	3800	Hz
	(−6dB) BP		3800	—	4200	Hz
Attentuation	(3800—4200Hz) LP		36	40	—	dB
	(<2000Hz, >6000Hz) BP		35	37	—	dB
Group Delay Distortion	(900—2100Hz) LP		—	60	—	µs
	(600—3000Hz) LP		—	300	—	µs
Output Noise (rms)	LP	1	—	1.6	—	mV
	BP	1	—	4	—	mV
Signal Input (rms)	LP	2	—	0.4	1.0	V
	BP	2	—	0.4	1.0	V
Insertion Loss (1kHz)	LP		—	0	—	dB
(4kHz)	BP		—	0	—	dB
Aliasing Frequency			50	—	—	kHz
Inverting Amplifier						
Open loop gain		3		30		dB
Gain bandwidth product				1		MHz

Note:

1). Measured with input a.c. s/c

2). 'MAX' figure specified for nominal 3% distortion (30dB SINAD)
'TYP' figure specified for minimum distortion (MAX SINAD)

3). Relative to 1kHz 100mV rms input level

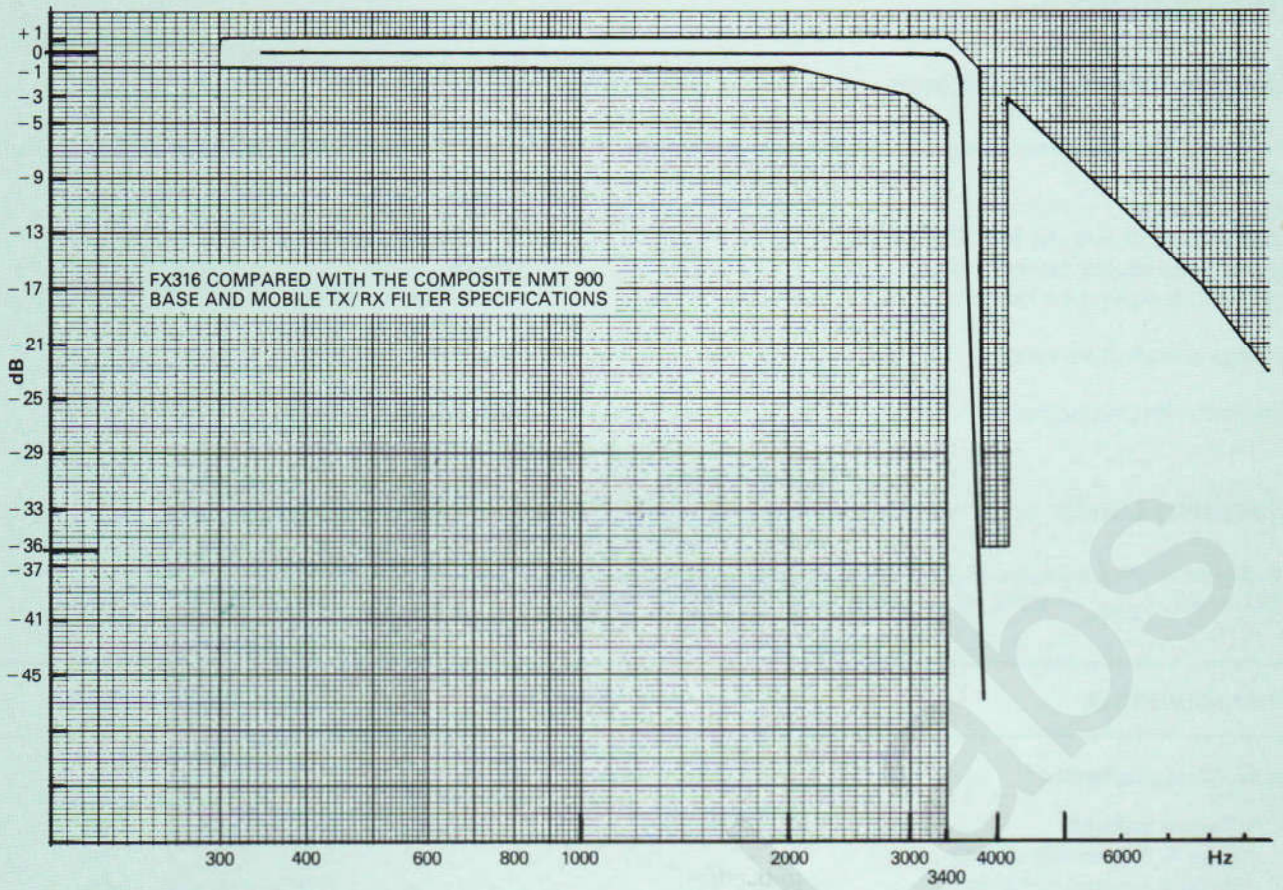


Fig. 4 Typical FX316 Lowpass Filter Response

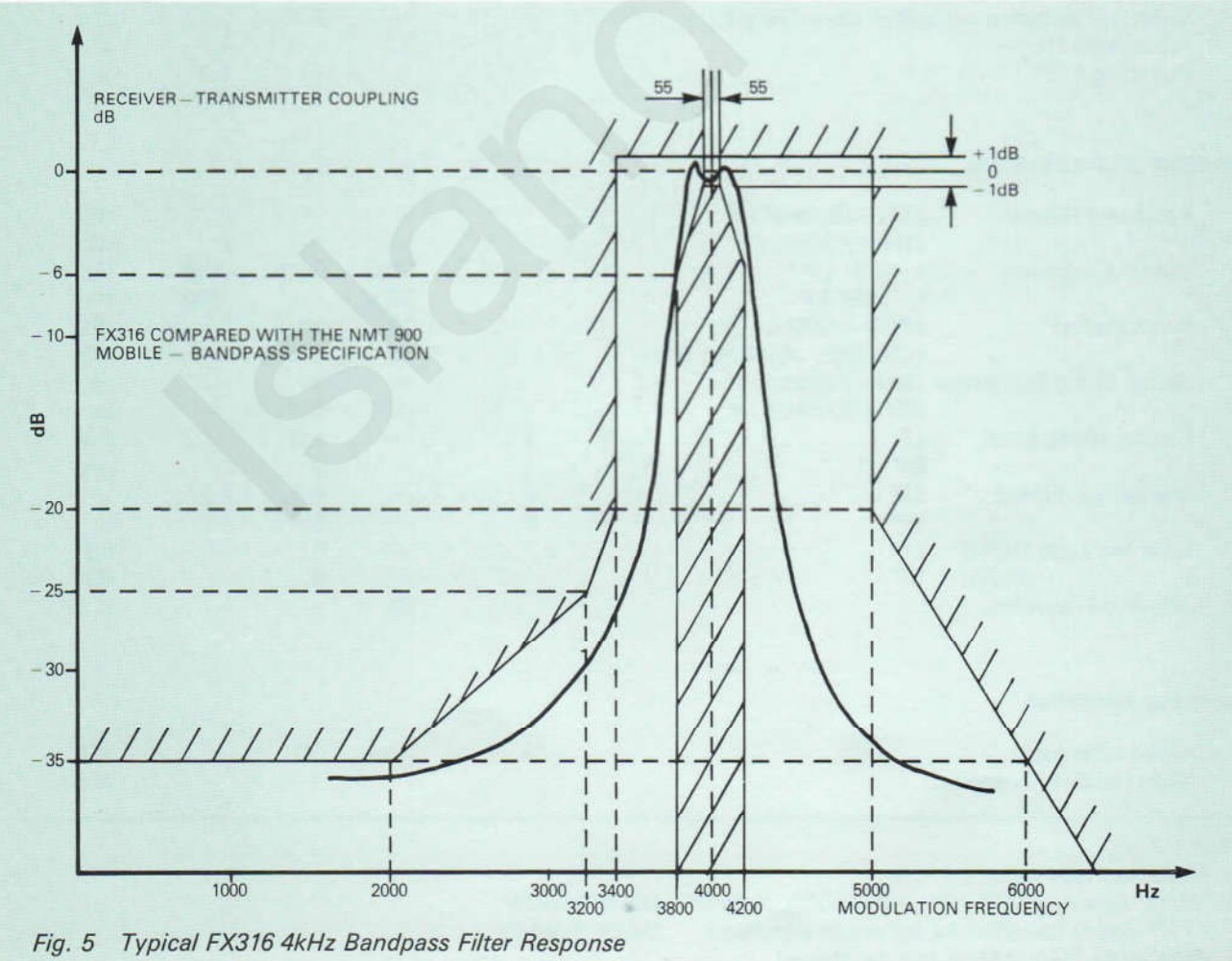


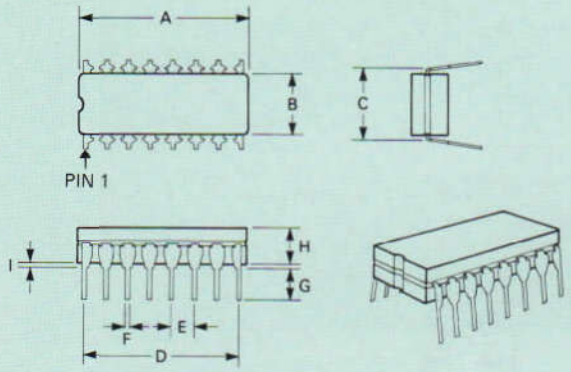
Fig. 5 Typical FX316 4kHz Bandpass Filter Response

Package Outlines

The cerdip package of the FX316J is shown in *Figure 6.* The FX316LV1 of *Figure 7* is supplied in a conductive tray.

The FX316LV1 has an indent (spot) adjacent to Pin 1 and a chamfered corner between Pins 3 and 4 to allow complete identification. Pins number counter-clockwise when viewed from the top (indent side).

Fig. 6 ***FX316J*** *D.I.L. Package*



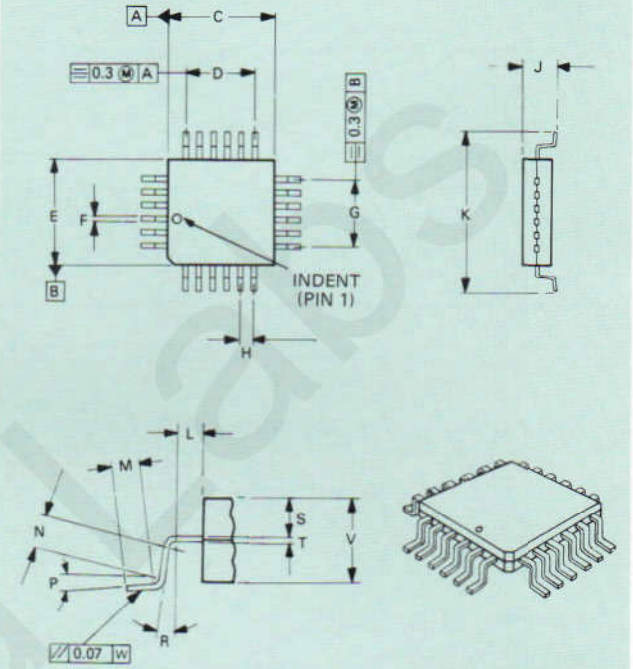
NOTE: All dimensions in mm.

DIMENSION	MAX.	MIN.
A	19.45	19.15
B	6.38	6.22
C	8.00	7.80
D	17.78	TYPICAL DIMENSION
E	2.54	TYPICAL DIMENSION
F	0.46	TYPICAL DIMENSION
G	3.89	TYPICAL DIMENSION
H	4.27	3.99
I	—	0.50

Handling Precautions

The FX316J/LV1 is a CMOS LSI circuit which includes input protection. However, precautions should be taken to prevent static discharges which can cause damage.

Fig. 7 ***FX316LV1*** *Package*



NOTE: All dimensions in mm. Angles in degrees.

DIMENSION	MAX.	MIN.	DIMENSION	MAX.	MIN
A, B	Datum & Symmetry		M	1.0	0.8
			N	1.15	1.0
C	10.25	10.0	P	6.0°	5.0°
D	6.38	6.32	R	5.5°	4.5°
E	10.25	10.0	S	1.40	1.14
F	0.55	0.47	T	0.22	0.16
G	6.38	6.32	V	3.02	2.44
H	1.30	1.24	W//	0.07	—
J	3.40	3.33			
K	15.65	—			
L	1.0	0.85			

Ordering Information

FX316J 16-pin Cerdip D.I.L.

FX316LV1 24-pin quad plastic encapsulated. bent and cropped.

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PRODUCT MODIFICATIONS

FX316 NMT Audio Filter Array

The FX316 is currently CML's highest volume selling circuit. Since going into production some design changes have been made, mainly at the request of our most important Scandinavian NMT Mobile Radio customers.

Internal Block Diagram

As can be seen from the internal block diagram the Lowpass has been increased from a 10th to a 12th order filter. Similarly, the 4kHz narrow Bandpass has been increased from a 4th order to a 6th order filter.

Frequency Responses

Not only has the redesign resulted in improved performance, as can be seen from the greater roll-off, but the frequency response is now stable over the temperature and voltage range. Also the output noise characteristic is improved. It is worth noting that the use of high order filtering - ie more complex circuitry has resulted in an increased current consumption from the original device.

Chartech

FX316 APPLICATION