

# CML Semiconductor Products

PRODUCT INFORMATION

## FX419 FFSK Modem



With compliments  
of Island Labs

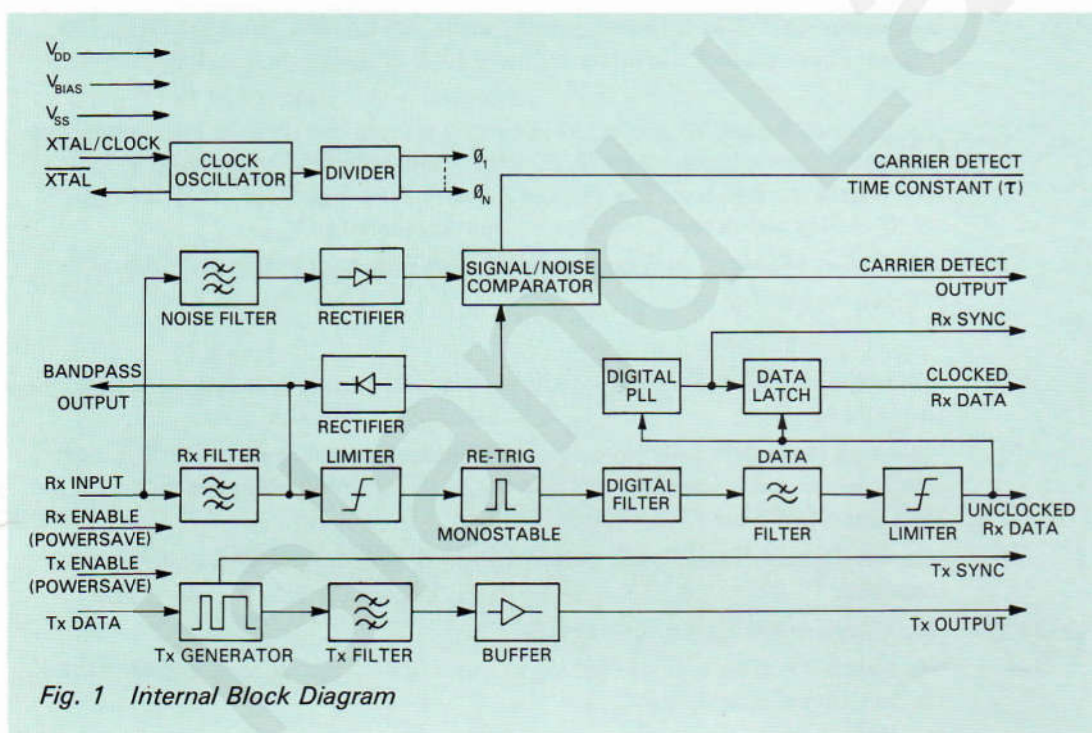
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### Features

- 1200 Baud FFSK Modem
- Meets Cellular and Trunked Radio Specifications
- Full Duplex 1200 Baud
- On-Chip Rx and Tx Bandpass Filters
- Clock Recovery and Carrier Detect Facilities
- Single 5 Volt CMOS Process
- Surface Mount or DIL Package Styles

### Applications

- Mobile and Cellular Radio Data Signalling
- NMT 450/900
- Band III
- Radiocom 2000
- ZVEI
- Personal Radio
- Portable Data Terminals
- General Purpose Applications



# FX419

### Brief Description

The FX419 is a single chip CMOS LSI circuit which operates as a 1200 baud FFSK modem. The mark and space frequencies are 1200Hz and 1800Hz phase continuous and the frequency transitions occur at the zero crossing point. The transmitter and receiver will work independently, thus providing full duplex operation at 1200 baud. The baud rate, transmit mark and space frequencies, Tx synchronization and Rx synchronization are all derived from a crystal oscillator for high stability, and an external 1.008MHz

crystal is required for this purpose. The device includes circuitry for carrier detect and facility for the Rx clock recovery. An on-board switched capacitor 900Hz—2100Hz bandpass filter provides optimum carrier filtering. The use of switched capacitor analogue filters and digital signal processing results in excellent dynamic performance with few external components, the CMOS process and current saving techniques offer low standby supply current for portable battery powered applications.



## Pin Number

## Function

DIL FX419J	Quad Plastic FX419LG	PLCC FX419LH	
1	1	1	<b>Xtal/Clock:</b> The input to an on-chip inverter for use with a 1.008MHz xtal. Alternatively, a 1.008MHz clock may be used.
2	2	2	<b>Xtal:</b> Output of on-chip inverter.
—	—	3	<b>No Connection:</b> Leave open circuit.
3	3	4	<b>Tx Sync O/P:</b> A 1200Hz squarewave used to synchronize the input of logic data and transmission of the FFSK signal (See Fig. 5).
4	4	5,6	<b>No Connection:</b> Leave open circuit.
5	5	7	<b>Tx Signal O/P:</b> With transmitter disabled, this pin is set to a high impedance state. When transmitter is enabled, this pin outputs the 1200/1800Hz (140 step pseudo-sine wave) FFSK signal (See Fig. 5).
—	—	8	<b>No Connection:</b> Leave open circuit.
6	7	9	<b>Tx Data I/P:</b> Serial logic data to be transmitted, is input to this pin and synchronized by the "Tx Sync O/P" (See Fig. 5).
7	8	10	<b>Tx Enable:</b> A logic '1' applied to this input will put the transmitter into powersave whilst forcing "Tx Sync O/P" to logic '1' and "Tx Signal O/P" to a high impedance state. A logic '0' will enable the transmitter (See Fig. 5). This pin is internally pulled to $V_{DD}$ .
8	9	11	<b>Bandpass O/P:</b> This is the output of the Rx 900-2100Hz bandpass filter. The output impedance of this pin is typically 10k $\Omega$ and may require buffering prior to use.
9	10	12	<b>Rx Enable:</b> A logic '0' applied to this input will put the receiver into powersave whilst forcing "Clocked Data O/P" and "Carrier Detect" to logic '0'. A logic '1' will enable the receiver (See Figures 2 and 6). "Rx Sync Out" may be logic '1' or '0' during powersave. This pin is internally pulled to $V_{DD}$ .
10	11	13	<b>Bias:</b> Provides bias internally and should be decoupled externally to $V_{SS}$ by a capacitor (See Fig 2).
11	12	14	$V_{SS}$ : Negative supply.
12	13	15	<b>Unclocked Data O/P:</b> This pin outputs recovered asynchronous serial data from the receiver.
13	14	16	<b>Clocked Data O/P:</b> This pin outputs recovered synchronous serial data from the receiver and is internally latched out by a recovered clock appearing on the "Rx Sync O/P" pin (See Figures 2 and 6).
14	15	17	<b>Carrier Detect:</b> This pin will output a logic '1' when an FFSK signal is being received.
—	—	18,19	<b>No Connection:</b> Leave open circuit.
15	16	20	<b>Rx Signal I/P:</b> This is the FFSK signal input pin for the receiver and should be decoupled via a capacitor $C_3$ .
16	17	21	<b>No Connection:</b> Leave open circuit.
17	18	22	<b>Rx Sync O/P:</b> This is a flywheel 1200Hz squarewave output which upon presentation of FFSK data signal is synchronised internally to the incoming data (See Figures 2 and 6).
18,19	19,20,21	23,24, 25,26	<b>No Connection:</b> Leave open circuit.
20	22	27	<b>Carrier Detect Time Constant (<math>\tau</math>):</b> This input forms part of the carrier detect integration function. The value of $C_4$ connected to this pin will affect the carrier detect response time and hence noise performance (See Fig. 2, Note 4).
21	23	—	<b>No Connection:</b> Leave open circuit.
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 <100 $\Omega$  put in series with the load should minimise this effect.



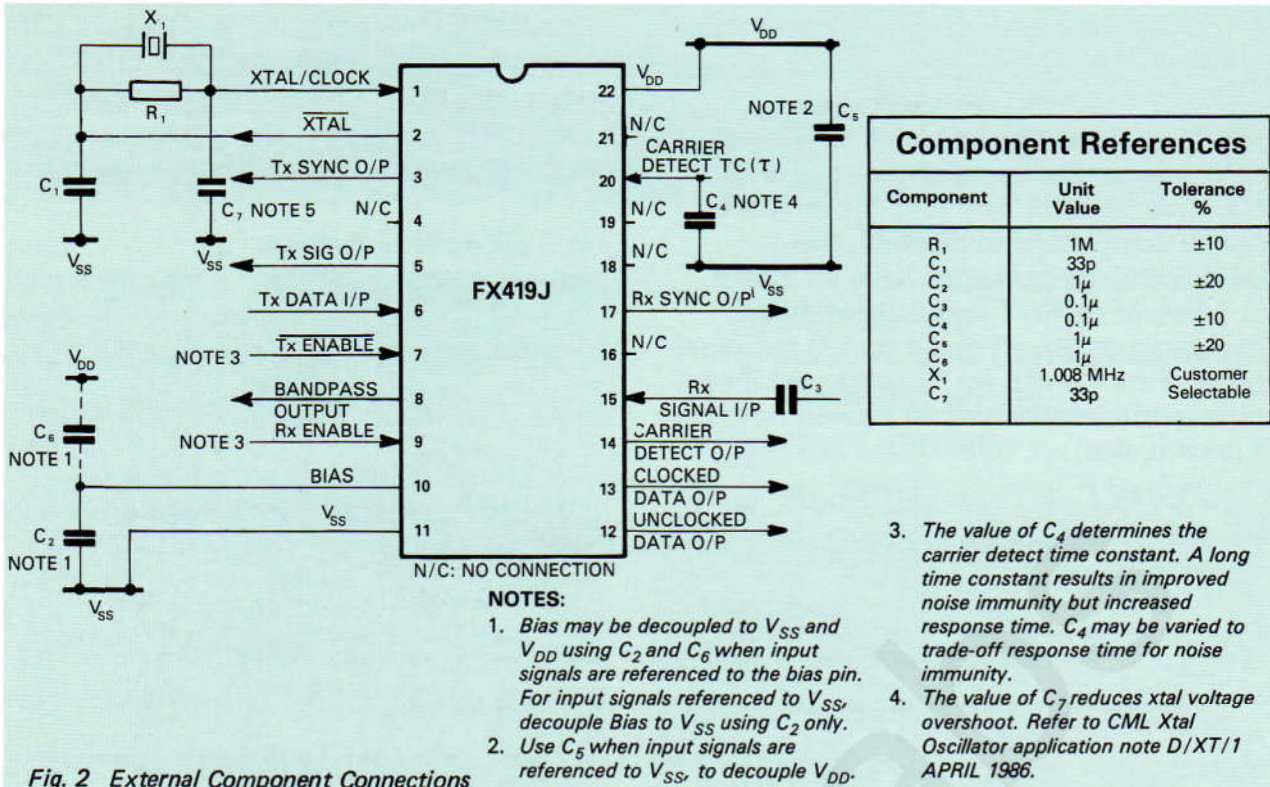


Fig. 2 External Component Connections

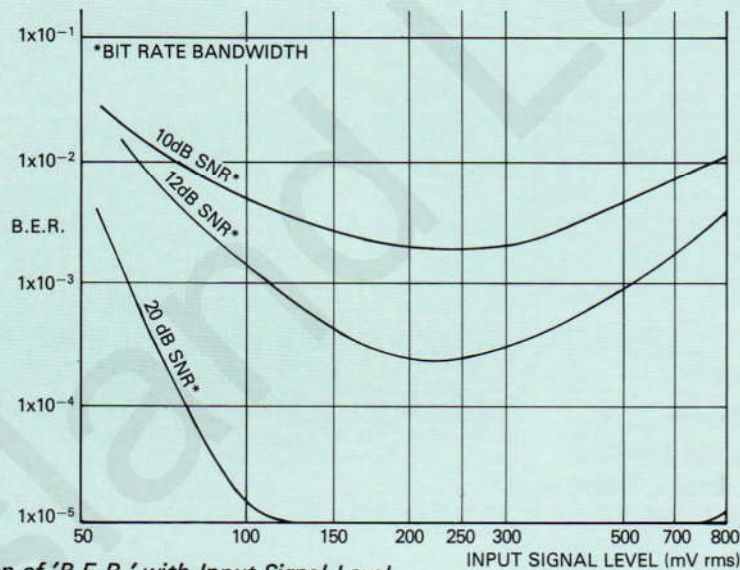


Fig. 3 Typical Variation of 'B.E.R.' with Input Signal Level

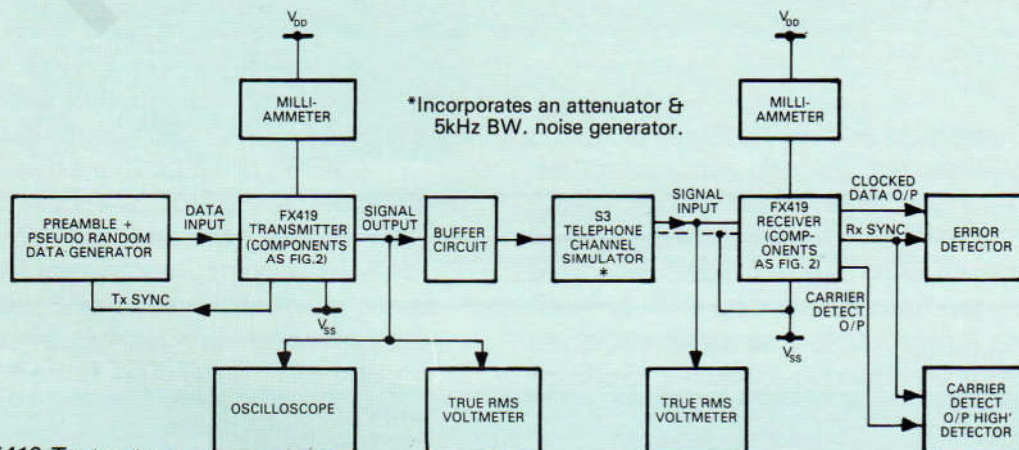


Fig. 4 FX419 Test set-up.

## 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 range: FX419J	-30°C to + 85°C
FX419LG/LH	-30°C to + 70°C
Storage temperature range: FX419J	-55°C to + 125°C
FX419LGLH	-40°C to + 85°C
Maximum device dissipation:	All versions 100mW

### Operating Limits

$V_{DD} = +5V$ ,  $T_{amb} = 25^{\circ}C$ ,  $\phi = 1.008MHz$  (Xtal),  $\Delta f\phi = 0$

All characteristics measured using the standard test circuit (figure 4) with the following test parameters and is valid for all tests unless otherwise stated:

0dB reference	300mV rms
Noise	(band limited 5kHz gaussian white noise)
SNR ratio measured in bit rate bandwidth (1200Hz)	

Characteristics	See Note	Min	Typ	Max	Unit
<b>Static Characteristics</b>					
Supply volts		4.5	5.0	5.5	V
Supply current: Rx (Enabled) Tx (Disabled)		—	3.6	—	mA
Rx (Enabled) Tx (Enabled)		—	4.5	—	mA
Rx (Disabled) Tx (Disabled)		—	650	—	$\mu A$
Logic '1' level		80% $V_{DD}$	—	—	V
Logic '0' level		—	—	20% $V_{DD}$	V
Digital O/P Impedance		—	4	—	k $\Omega$
Analogue and Digital input impedance		100	—	—	k $\Omega$
Tx O/P impedance		—	10	—	k $\Omega$
On-chip crystal oscillator:					
$R_{in}$		10	—	—	M $\Omega$
$R_{out}$		5	—	15	k $\Omega$
Inverter gain		10	—	20	dB
Gain Bandwidth Product		$3 \times 10^6$	—	—	
Crystal frequency	1	—	1.008	—	MHz
<b>Dynamic Characteristics</b>					
<b>Receiver:</b>					
Signal Input: Dynamic range (50dB SNR)	2, 3	100	230	1000	mV rms
Bit Error Rate: 12dB SNR	3	—	7.0	—	$10^{-4}$
20dB SNR	3	—	1.0	—	$10^{-8}$
<b>Receiver Synchronization 12dB SNR:</b>					
Probability of bit 8 being correct			0.99		
Probability of bit 16 being correct			0.995		
<b>Carrier Detect</b>					
Probability of Carrier Detect being high:	6				
12dB SNR after bit 8	4		0.99	0.98	
12dB SNR after bit 16	4		0.999	0.995	
0dB noise				0.01	
<b>Transmitter O/P</b>					
Tx O/P level		—	775	—	mV rms
Output level variation 1200/1800Hz		0	—	$\pm 1.00$	dB
O/P distortion		—	3	5	%
3rd harmonic distortion		—	2	3	%
Logic '1' carrier frequency	5	—	1200	—	Hz
Logic '0' carrier frequency	5	—	1800	—	Hz
Isochronous distortion					
1200Hz – 1800Hz		—	25	40	$\mu s$
1800Hz – 1200Hz		—	20	40	$\mu s$

**Notes:** 1. Crystal tolerance depends on system requirements.

2. See Fig. 3.

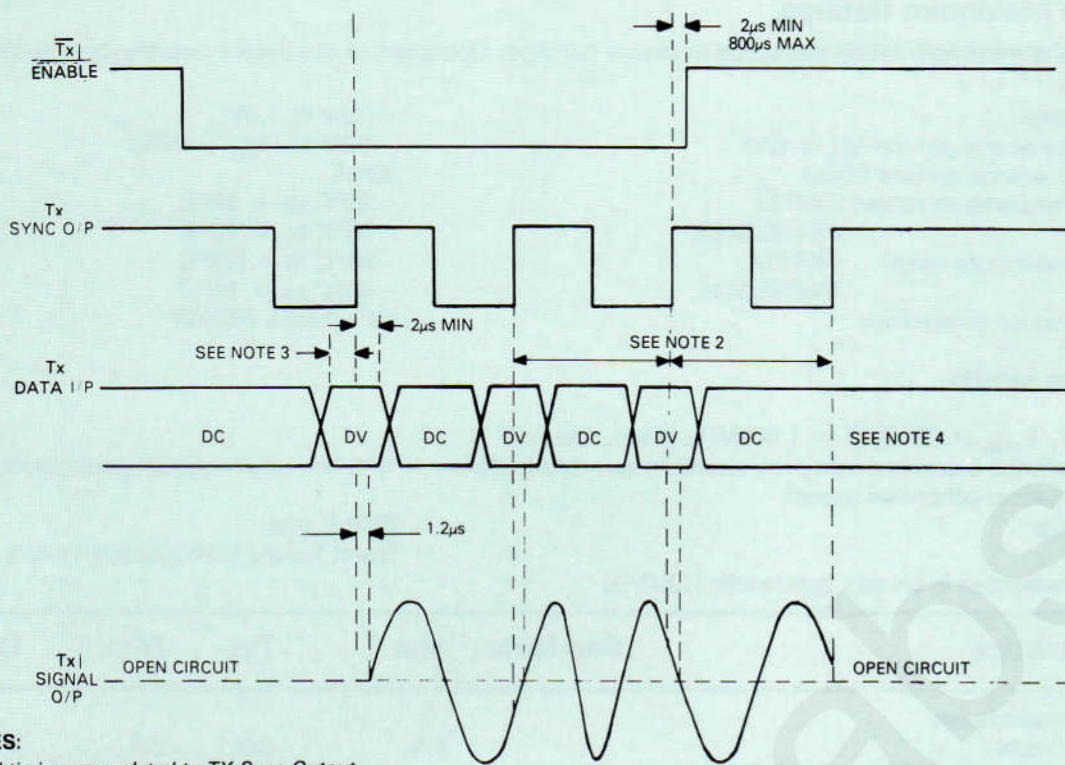
3. SNR (Bit Rate Bandwidth).

4. See Fig. 2 Note 5.

5. Depending on crystal tolerance.

6. 101010 Pattern.

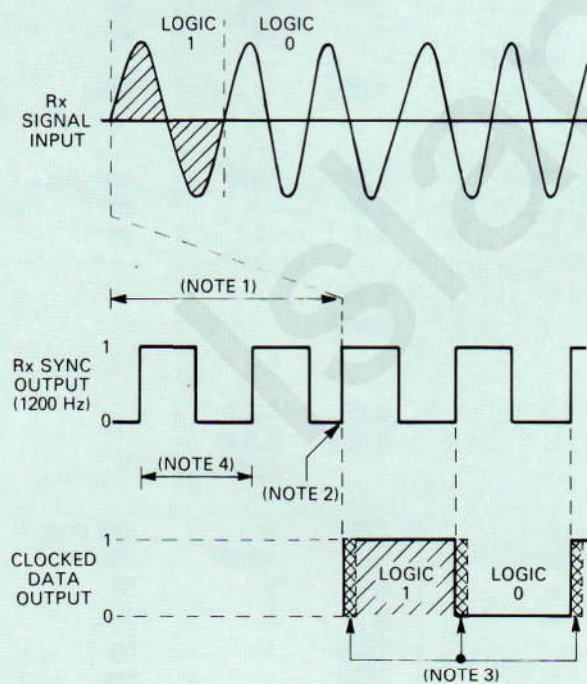




#### NOTES:

1. All timings are related to TX Sync Output.
2.  $0.833\text{ms}$  for  $1.008\text{MHz}$  Crystal Input.
3.  $2\mu\text{s Min} + \text{Crystal tolerance}$ .
4. DC = Don't Care, DV = Data Valid.

Fig. 5 Transmitter Timing Diagram



#### NOTES:

1. Internal Delay- $\text{typ } 1.5\text{ms}$ .
2. From freely running to Sync in 8 data bits (See spec).
3. Undetermined state— $2\mu\text{s max}$ .
4. Min.  $800\mu\text{s}$ —Max.  $865\mu\text{s}$ .

Fig. 6 Receiver Timing Diagram

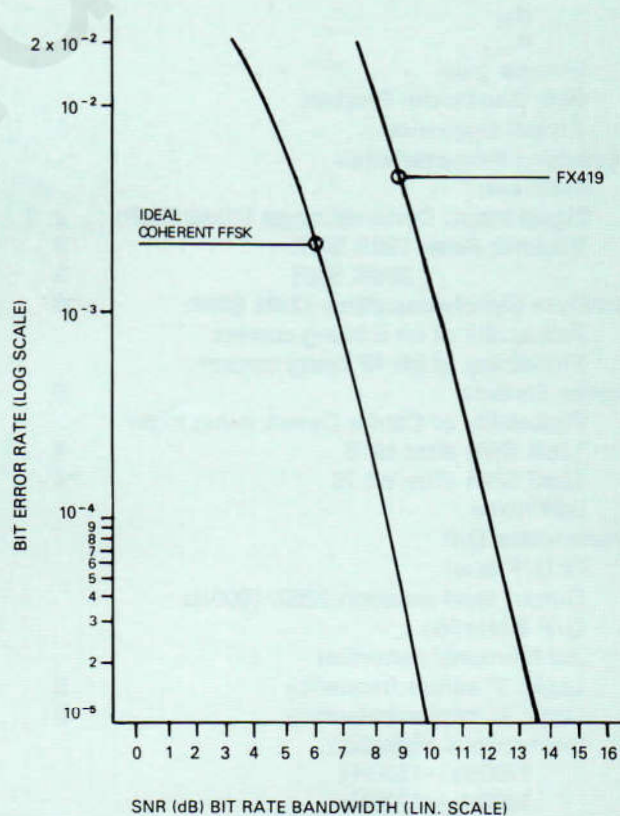


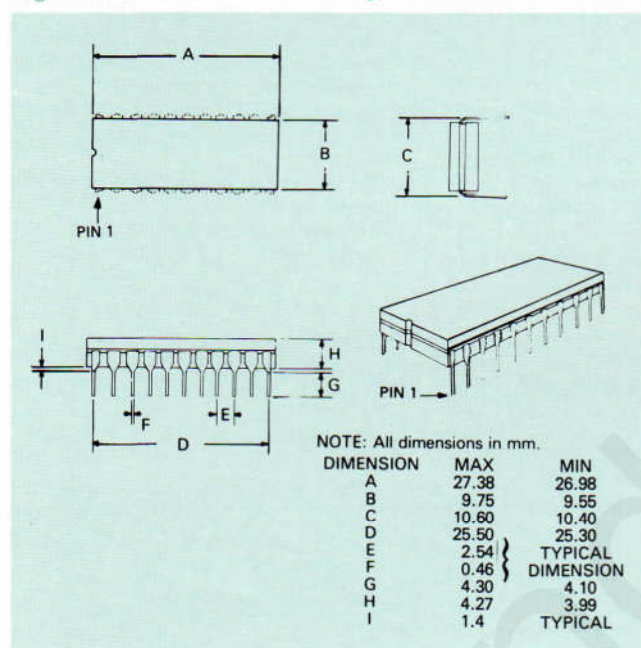
Fig. 7 Receiver B.E.R. Vs SNR



## Package Outlines

The FX419J, the cerdip package, is illustrated in *Figure 8*. The 'LG' version is shown in *Figure 9*, and the 'LH' version in *Figure 10*. Both 'LG' and 'LH' packages are supplied in conductive trays for handling convenience. To allow complete identification, the FX419LG 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).

*Fig. 8 FX419J DIL Package*



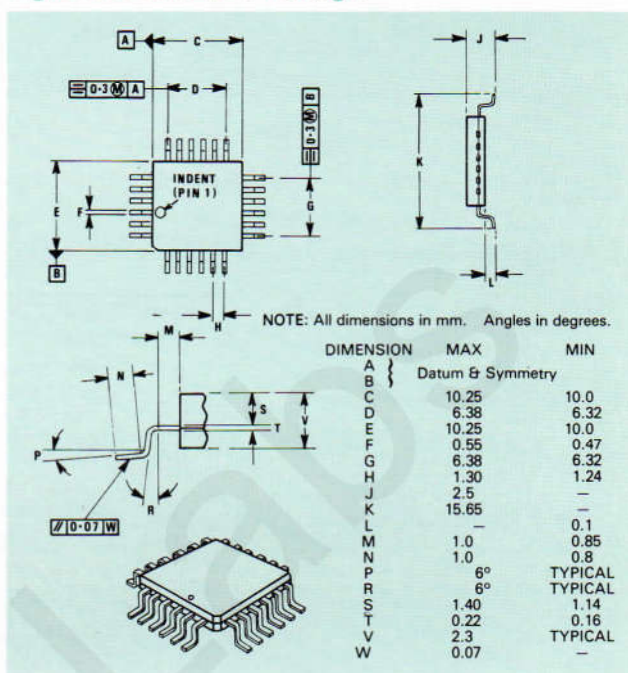
## Ordering Information

- FX419J** 22-pin Cerdip DIL  
**FX419LG** 24-pin quad plastic encapsulated, bent and cropped.  
**FX419LH** 28-lead Plastic leaded chip carrier.

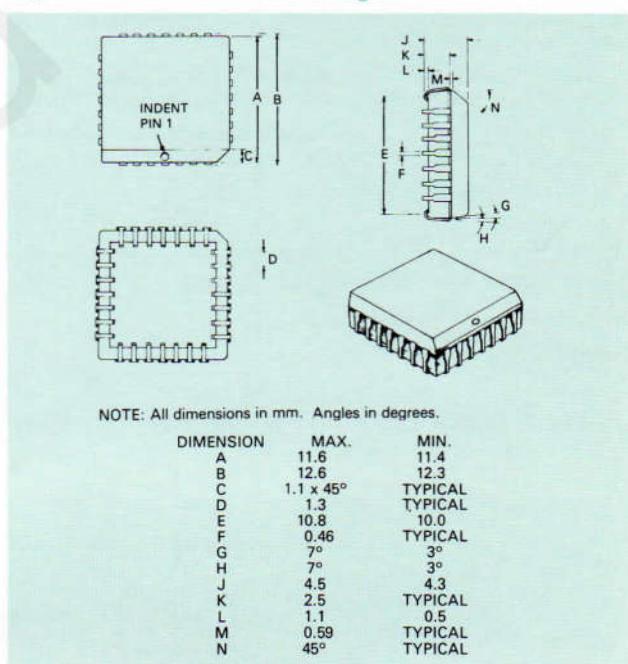
## Handling Precautions

The FX419J/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. 9 FX419LG Package*



*Fig. 10 FX419LH Package*



CML does not assume any responsibility for the use of any circuitry described. No circuit patent licences are implied and CML reserves the right at any time without notice to change the said circuitry.



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