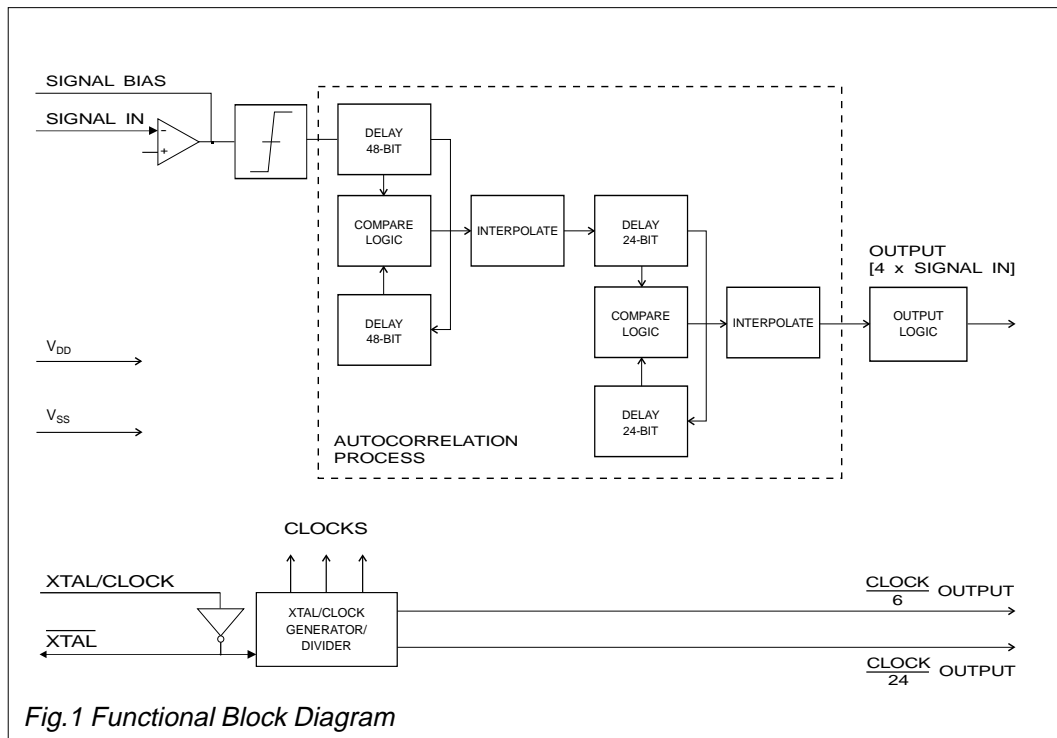


Features

- Up to 8.5dB Signal-to-Noise Improvement
- Input Frequency Range: 17Hz to 13kHz [Sub-Audio and Audio Frequencies]
- Low-Voltage Operation: 2.5 Volts
- 10mVrms Minimum Signal Input
- Digital Output Signal ($f_{IN} \times 4$)
- 'Divided-Down' Clock Outputs

Applications

- Radio Communications and Paging Systems
- Tone Detection
- Sonar Detection and Analysis
- Slow Data-Rate Communications
- Medical Equipment
- Interference Investigation



FX002

Fig.1 Functional Block Diagram

Brief Description

The FX002 is a single-chip device to extract single periodic signals from very high random-noise environments.

Using patented autocorrelation techniques the FX002 will enhance the input signal's signal-to-noise ratio by as much as 8.5dB and provide a digital output signal centred at four times (x4) the input frequency.

The amplitude of non-periodic components of the signal is substantially reduced. The patented autocorrelator compares the incoming signal to itself; the more elements of the waveform that are seen as periodic, the higher the energy at the microcircuit output.

The FX002 cascades two autocorrelators, each one improving the signal-to-noise ratio.

With a random noise input the output will swing rail-to-rail at random (peak-limited). The input/output signal delay is fixed by the choice of clock frequency and the length of the internal register. The FX002 will operate at supply voltages of between 2.5 volts and 5.5 volts and with Xtal/clock frequencies from 20kHz to 2.5MHz. Using various Xtal/clock inputs the device can be set to accept input signal frequencies, in bands, from 17.0Hz to 13.0kHz.

Two uncommitted clock outputs are available to supply 'divided-down' Xtal/clock frequencies for use in external and peripheral functions.

This low-power signal processing device is available in 16-pin cerdip dual-in-line (DIL) and plastic small outline (S.O.I.C.) surface mount packages.

Pin Number

Function

FX002DW	FX002J									
1	1	Signal In: The inverting input to the analogue amplifier/comparator. Used with the Signal Bias pin; external coupling components are required (see Figure 2).								
3	3	Signal Bias: The output of the analogue amplifier/comparator. Do not load this pin with peripheral circuitry; there is no drive capacity for off-chip signalling. The feedback resistor should be not less than 200kΩ. See Figure 2.								
4	4	V_{DD}: Positive supply rail. A single, stable power supply is required. Note that this device has two V _{DD} pins; this input is positioned to prevent cross-talk, either or both may be connected to the host circuit's supply line. Do not attempt to draw current from either V _{DD} pin.								
5	5	Clock/24: A squarewave output clock signal at the rate of $X_{tal}/clock/24$; provided for peripheral and test purposes.								
6	6	Xtal: The output of the on-chip clock oscillator inverter.								
8	7	<p>Xtal/Clock: The input to the on-chip clock oscillator inverter; this may be a Xtal, resonator or clock pulse input. The selection of this frequency will affect the operational input signal bandwidth (and output frequency) of this device; refer to Table 2. Note that the choice of V_{DD} will determine the maximum Xtal/clock frequency and hence the maximum useable signal input frequency. Operation of any CML microcircuit without an active Xtal or clock input may cause device damage. A clock pulse input is fed directly into this pin; Xtal/clock components are not required.</p> <p>Table 1 provides a guide to maximum usable Xtal/clock frequencies at pre-determined V_{DD} values.</p> <table border="1" data-bbox="587 1176 1019 1355"> <thead> <tr> <th>V_{DD} (V)</th> <th>Max. Xtal/Clock Freq. (MHz)</th> </tr> </thead> <tbody> <tr> <td>2.5</td> <td>0.625</td> </tr> <tr> <td>3.0</td> <td>1.0</td> </tr> <tr> <td>5.0</td> <td>2.5</td> </tr> </tbody> </table> <p style="text-align: right;"><i>Table 1</i></p>	V _{DD} (V)	Max. Xtal/Clock Freq. (MHz)	2.5	0.625	3.0	1.0	5.0	2.5
V _{DD} (V)	Max. Xtal/Clock Freq. (MHz)									
2.5	0.625									
3.0	1.0									
5.0	2.5									
9	9	V_{SS}: Negative supply rail (GND).								
11	11	Clock/6: A squarewave output clock signal at the rate of $X_{tal}/clock/6$; provided for peripheral and test purposes.								
13	13	<p>Output: ($f_{OUT} = 4 \times f_{SIGNAL IN}$). The auto-correlated output signal at four times (x 4) the input signal (see Figure 4).</p> <p>There is a time delay between input and output signals (see Specifications).</p>								
16	16	<p>V_{DD}: Positive supply rail. A single, stable power supply is required. Note that this device has two V_{DD} pins; either or both may be connected to the host circuit's supply line. Do not attempt to draw current from either V_{DD} pin. The choice of V_{DD} will determine the maximum Xtal/clock frequency and hence the maximum useable signal input frequency (see Figure 3).</p>								
2, 7, 10, 12, 14, 15	2, 8, 10, 12, 14, 15	No internal connection. Leave open-circuit.								

Application Information

External Components

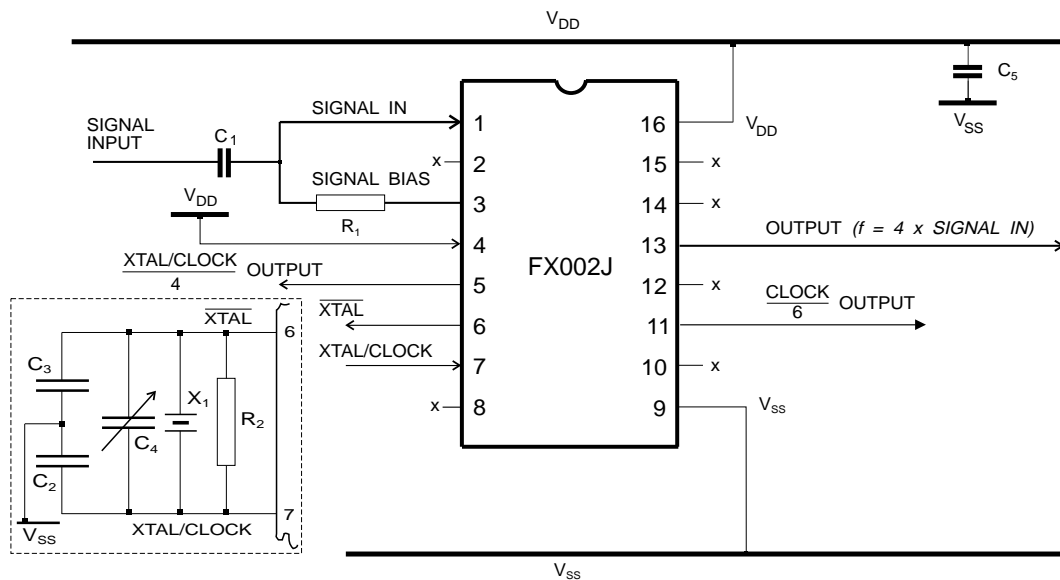


Fig.2 Recommended External Components

Xtal/Clock Freq. (kHz)	Input Freq. (Hz)		BW (Hz)
	Min	Max	
20	17	105	88
100	88	526	443
200	166	1052	886
300	250	1579	1329
400	333	2105	1772
500	416	2632	2216
560	467	2947	2480
600	500	3158	2658
700	583	3684	3101
800	667	4210	3543
900	750	4737	3987
1000	833	5263	4430
2000	1667	10526	8859
2500	2083	13157	11074

Table 2 Input Signal Ranges vs Xtal/Clock Frequency

Component	Value for $V_{DD} = 5.0V$
R_1	2.2M Ω
R_2	1.0M Ω
C_1	0.01 μF
C_2	47.0pF -see below
C_3	47.0pF -see below
C_4	5 - 65pF -see below
C_5	1.0 μF
X_1	560kHz resonator
X_1 range	20kHz to 2.5MHz

Table 3 Recommended External Components

Xtal/Clock Components

C_4 is suggested for frequency setting when using a resonator; when a Xtal is used C_4 is omitted. Values of capacitors C_2 and C_3 should be reduced for higher Xtal frequencies and/or lower supply voltages (V_{DD}).

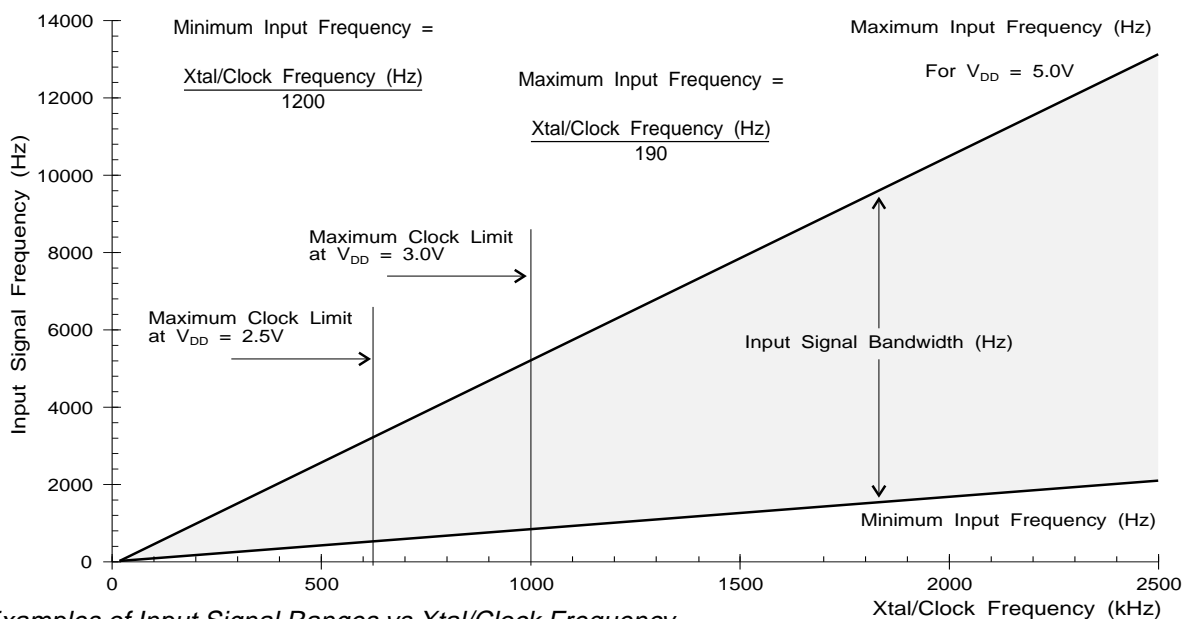
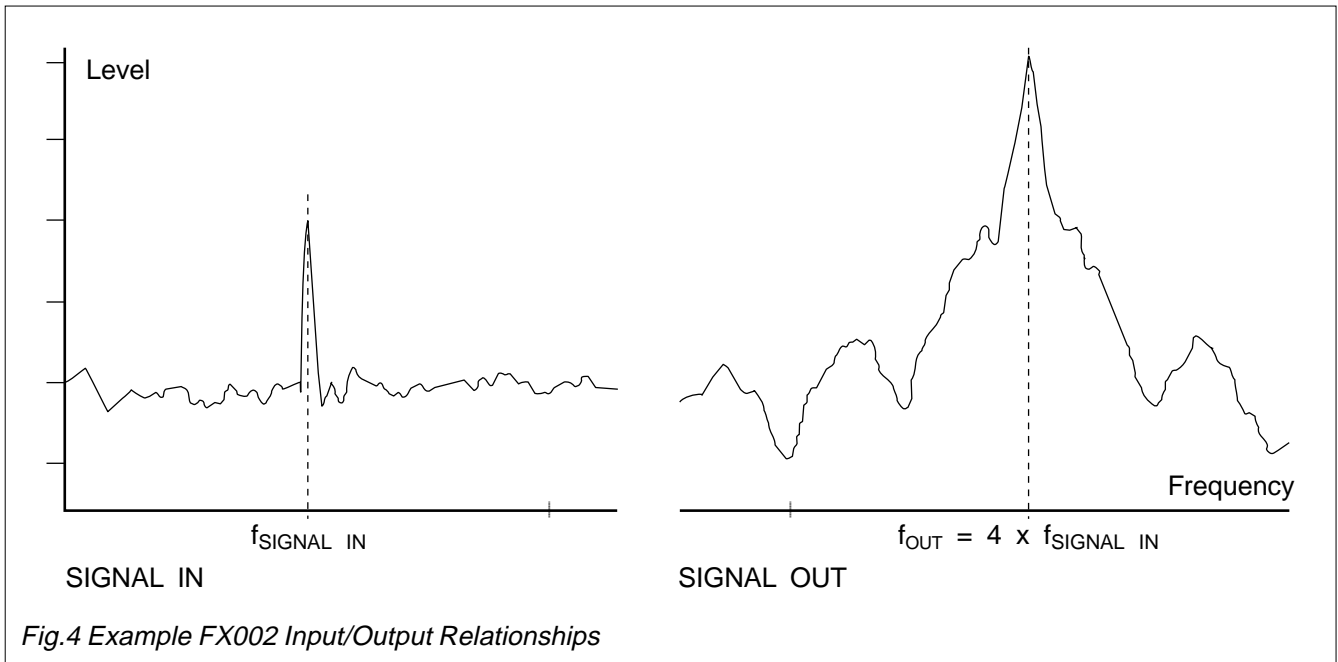


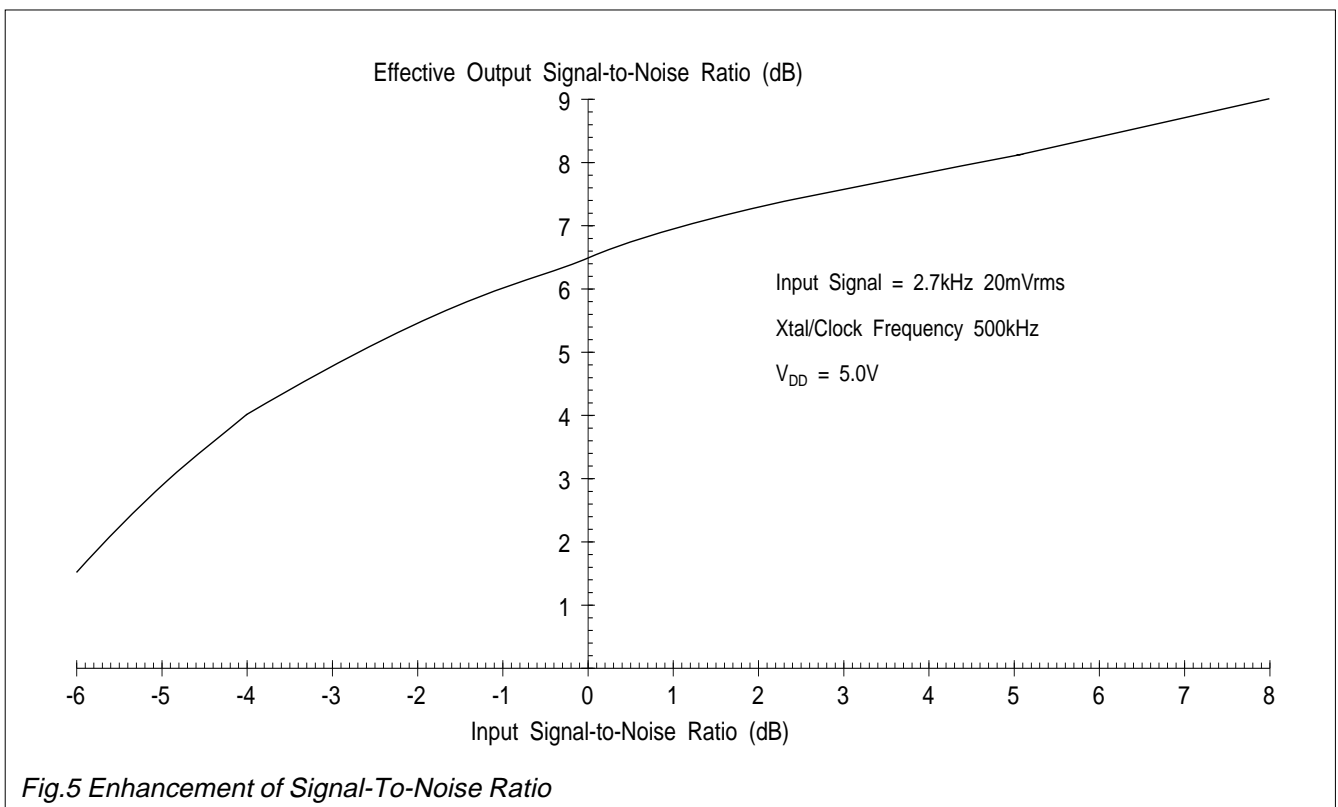
Fig.3 Examples of Input Signal Ranges vs Xtal/Clock Frequency

Application Information



The diagrams in Figure 4 are example spectrums of the input and output signal conditions of the FX002. Note that the frequency of the output signal is four times (x4) that of the input signal.

The graph shown in Figure 5 illustrates the signal-to-noise enhancement that can be obtained, under varying input conditions, from the FX002.



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	-0.3 to 7.0V
Input voltage at any pin (ref $V_{SS} = 0V$)	-0.3 to ($V_{DD} + 0.3V$)
Sink/source current (supply pins)	+/- 30mA
(other pins)	+/- 20mA
Total device dissipation @ $T_{AMB} = 25^{\circ}C$	800mW Max.
Derating	10mW/ $^{\circ}C$
Operating temperature range: FX002DW	-40 $^{\circ}C$ to +85 $^{\circ}C$
FX002J	-40 $^{\circ}C$ to +85 $^{\circ}C$
Storage temperature range: FX002DW	-40 $^{\circ}C$ to +85 $^{\circ}C$
FX002J	-55 $^{\circ}C$ to +125 $^{\circ}C$

Operating Limits

Correct operation of the device outside these limits is not implied.

	Remarks	Min.	Max.	Unit
Supply Voltage (V_{DD})	Note 1	2.5	5.5	V
Operating Temperature		-40.0	+85.0	$^{\circ}C$
Xtal/Clock Frequency	($V_{DD} = 2.5V$)	20.0	625	kHz
	($V_{DD} = 5.0V$)	0.02	2.5	MHz

Operating Characteristics

All device characteristics are measured under the following conditions unless otherwise specified:

$V_{DD} = 5.0V$, $T_{AMB} = 25^{\circ}C$. Xtal/Clock Frequency = 560kHz. Input Test Signal = 1.0kHz at 200mVrms.

Characteristics	See Note	Min.	Typ.	Max.	Unit
Static Values					
Supply Current (I_{DD})		-	1.0	2.5	mA
	2	-	4.0	-	mA
Output Logic '1'		80%	-	-	V_{DD}
Output Logic '0'		-	-	20%	V_{DD}
Digital Output Impedance		-	4.0	10.0	$k\Omega$
Dynamic Values					
Signal Input Levels	3	10.0	20.0	1000	mVrms
Analogue (Input) Amplifier Gain	4	20.0	-	-	dB
	5	9.0	-	-	dB
	6	10.0	-	-	dB
Recommended Input Signal Mark-to-Space Ratio		35.0	-	-	%
Freq. In/Freq. Out Ratio		4.0	-	4.0	
Maximum Xtal/Clock Frequency	1	2.5	-	-	MHz
Minimum Xtal/Clock Frequency		-	-	20.0	kHz
Frequency Input Range (Xtal/Clock = 560kHz)		500	-	3000	Hz
(Table 2)	7	1/1200	-	1/190	Xtal/Clock
Input to Output Delay	8	-	1.4	-	ms
Output Resolution		-	1/6	-	Xtal/Clock

Notes

- Maximum Xtal/clock frequency allowed varies with applied supply voltage (V_{DD}).
- I_{DD} requirement for Xtal/clock frequency of 2.24MHz.
- Signal input level required to provide a constant autocorrelated output.
- Measured with a 6.0kHz sinewave at the signal input.
- Measured with $V_{DD} = 2.5$ volts.
- Measured with a 12kHz input signal.
- Recommended input signal frequency range to correlation circuits.
- Input (Signal In) to output (Output) time with a 2.24MHz Xtal/clock input.

Package Outlines

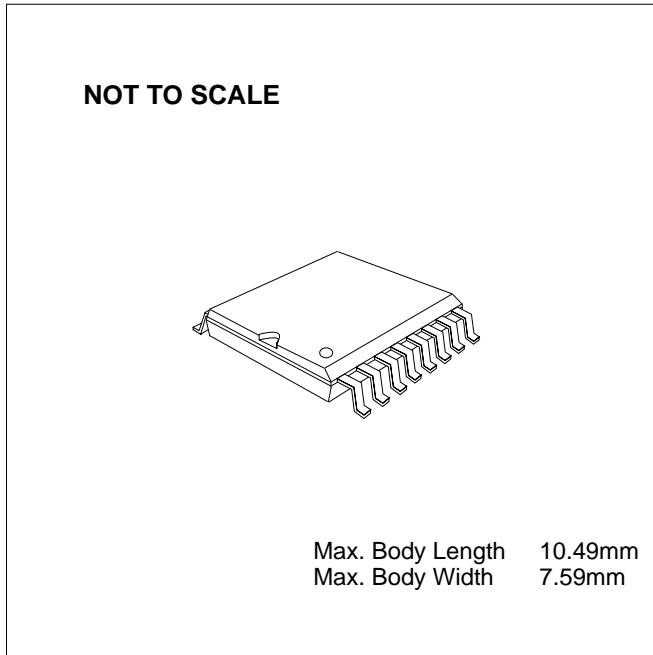
The FX002 is available in the package styles outlined below. Mechanical package diagrams and specifications are detailed in Section 10 of this document.

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

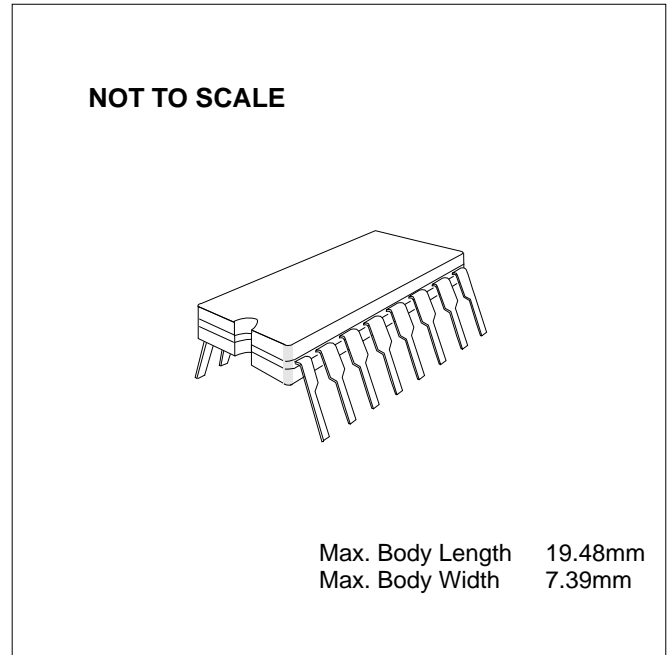
Handling Precautions

The FX002 is a CMOS LSI circuit which includes input protection. However precautions should be taken to prevent static discharges which may cause damage.

FX002DW 16-pin plastic S.O.I.C. (D4)



FX002J 16-pin cerdip DIL (J2)



Ordering Information

FX002DW 16-pin plastic S.O.I.C. (D4)

FX002J 16-pin cerdip DIL (J2)