AUTOCORRELATING SIGNAL PROCESSOR

FEATURES

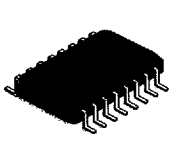
- Low Signal Level Input of 20mVrms
- Wide Signal Frequency Range from 2Hz to 12kHz
- On-Chip Gain Amplifier
- On-Chip Xtal Oscillator
- Low Supply Voltage Operation of 2.5 V
- Low Current Drain
- SMT Package

BENEFITS

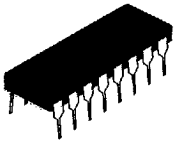
- Improved Signal Sensitivity
- No Timing Required
- Digital Output Signal
- Serves 2-Cell Applications

APPLICATIONS

- Medical Instruments
- Sonar Detection
- Remote Signaling
- Pagers
- Mobile Radio



MX102DW
16-pin SOIC



MX102J
16-pin CDIP

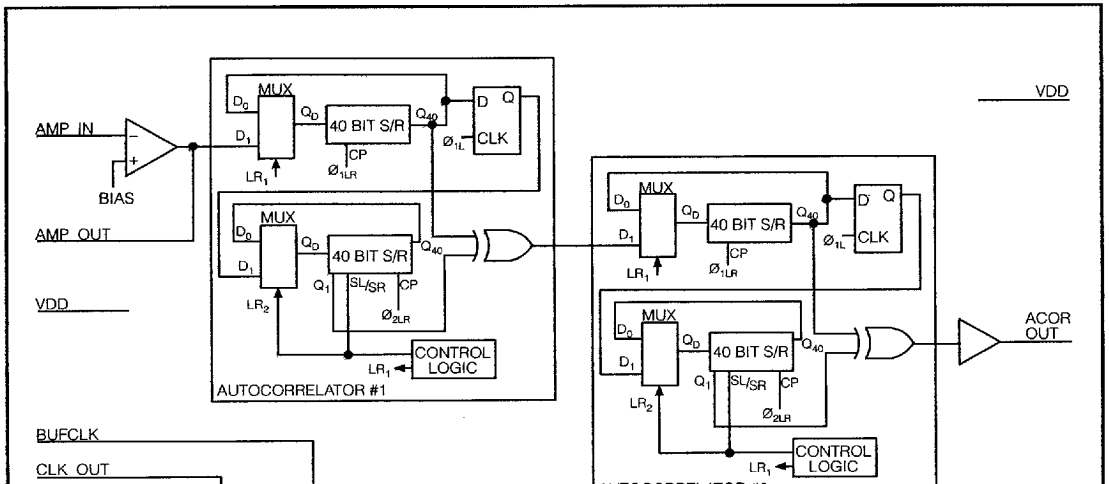


Figure 1 - Block Diagram

Description

The MX102 low power CMOS Autocorrelator extracts periodic signals from random noise environments. The amplitude of non-periodic components is substantially reduced. Its 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 output at 4 times the input frequency.

The MX102 cascades two autocorrelators, each one improving the signal to noise ratio. The signal between these two autocorrelators is centered at twice the incoming frequency, and the output signal is centered at four times the incoming signal, as shown in Figure 2. With random noise applied the output will swing rail-to-rail at random (peak-limited). The output signal delay is fixed by the chip clock frequency and the length of the internal register.

The MX102 contains an input operational amplifier. The frequency response is shown in Figure 6. The low end 3dB frequency response can be adjusted to 2.0 Hz using an 0.68 µF input capacitor.

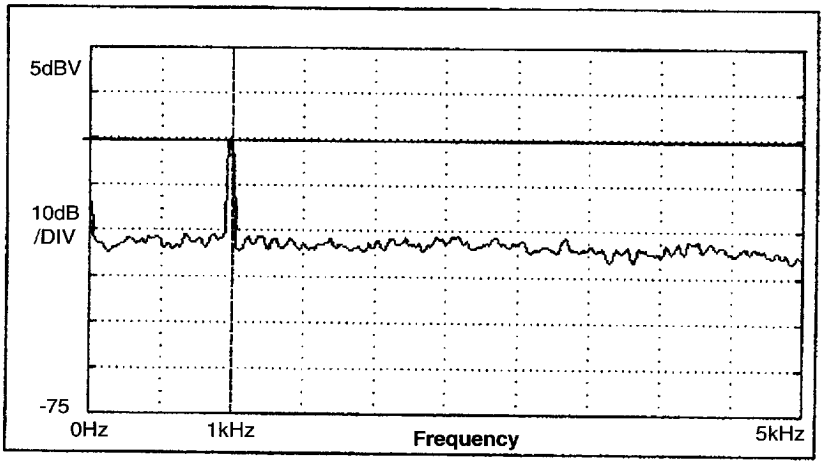


Figure 2a - Input Signal-to-Noise = dB

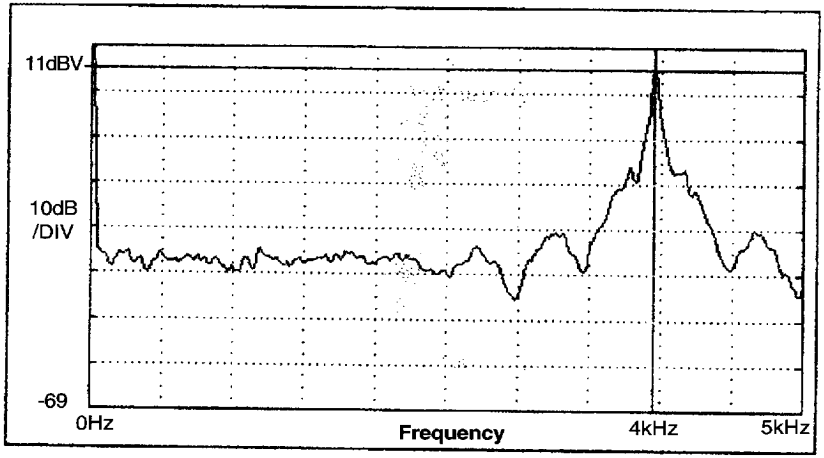


Figure 2b - Output Signal

Note: All measurements made with 47.7 kHz bandwidth.

Input Frequency Range

The MX102 has a wide input frequency range, but care must be taken to choose the xtal frequency appropriate for your application. The input frequency range is from 1/1200 to 1/190 of the xtal frequency. This results in the following design equation:

$$f_{in} \text{ max} \times 190 \leq f_{xtal} \leq f_{in} \text{ min} \times 1200$$

Once your xtal frequency is chosen, it can be compared against Figure 3 to find the valid range of supply voltages. The constraint on supply voltage is only important at the extremes of the frequency input range.

For example, if your maximum input frequency is 12kHz,

$f_{xtal} \geq 2.28\text{MHz}$

and $V_{DD} \geq 4 \text{ @ } f_{xtal} = 2.28\text{MHz}$

If your minimum input frequency is 2Hz,

$f_{xtal} \leq 2400\text{Hz}$

and $V_{DD} \leq 4.5 \text{ @ } f_{xtal} = 2400\text{Hz}$

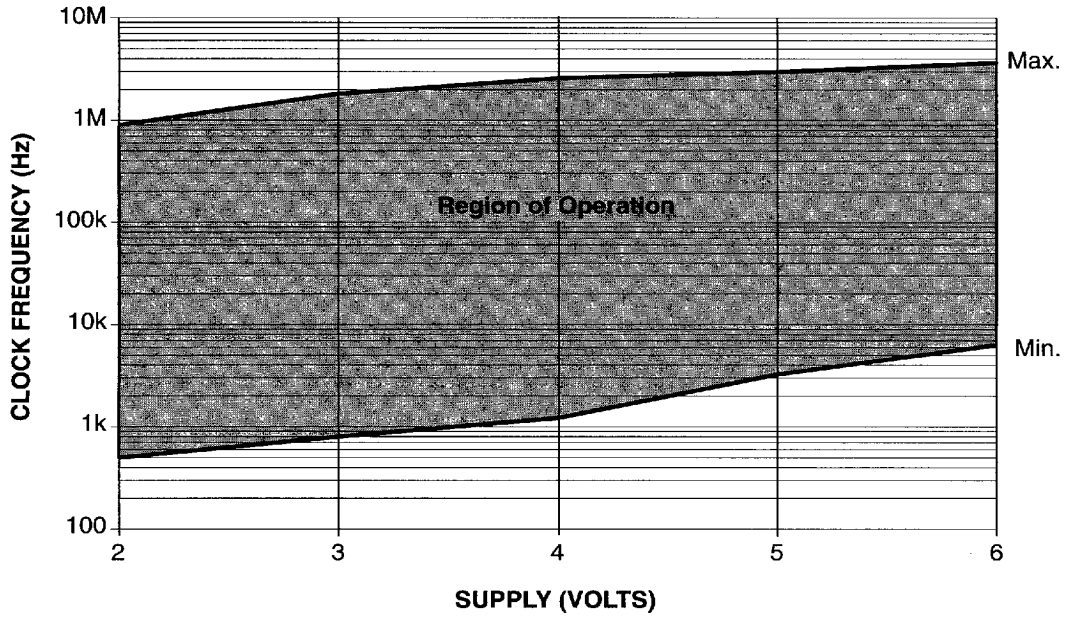


Figure 3 - Clock Frequency vs Supply Voltage

Note: this graph is intended as a guideline; the limits are not production-tested.

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PIN FUNCTIONS

Pin	Function
1	**AMP IN**: Inverting input to analog amplifier/comparitor. This pin is normally 'AC' coupled to the incoming signal with a feedback resistor to its output.
3	**AMP OUT**: Output of analog amplifier/comparitor. This pin does not have the drive capacity for any off chip signaling. Feedback resistance should be greater than 200 kΩ.
4	**V_{DD}**: Positive Supply
5	**BUFCLK**: Buffered inverter oscillator digital output. May be used as test point to align clock frequency or to drive other circuitry.
6	**CLK OUT**: Output of oscillator inverter.
8	**CLK IN**: Input to oscillator inverter.
9	**V_{SS}**: Negative Supply
11	**CLK ÷ 6**: A digital output signal derived by dividing the clock input frequency by 6.
13	**ACOR**: Autocorrelator digital output signal. Frequency is at four times the input frequency.
16	**V_{DD}**: Positive Supply

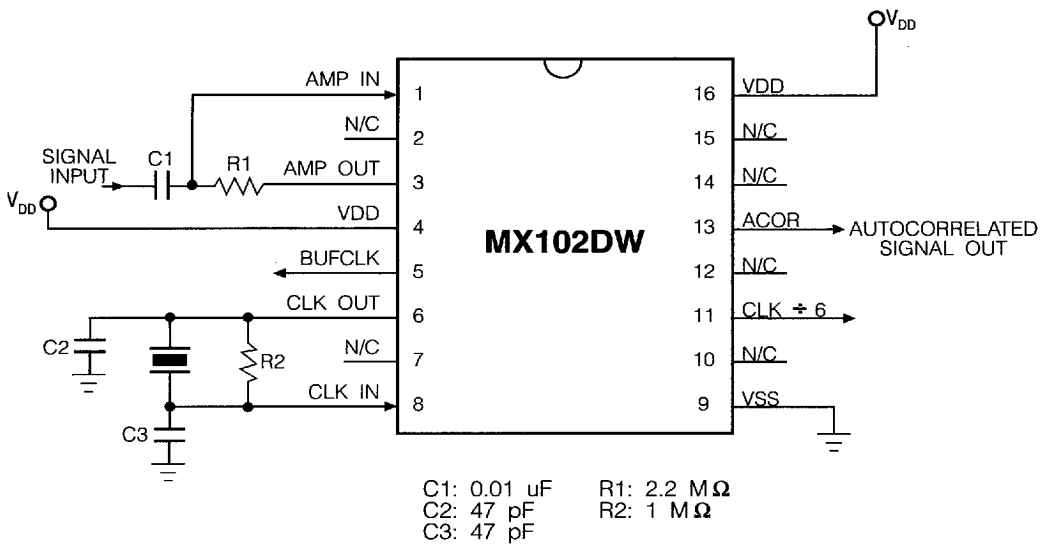

Figure 4 - External Components

TIMING

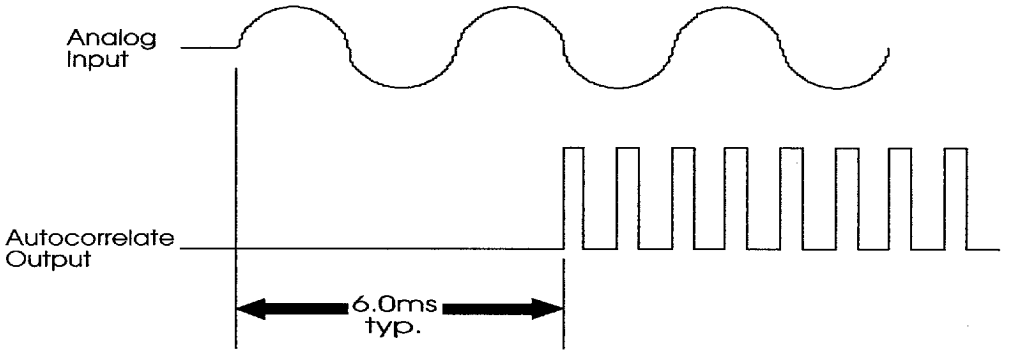

Figure 5 - Timing Diagram

AMPLIFIER FREQUENCY RESPONSE

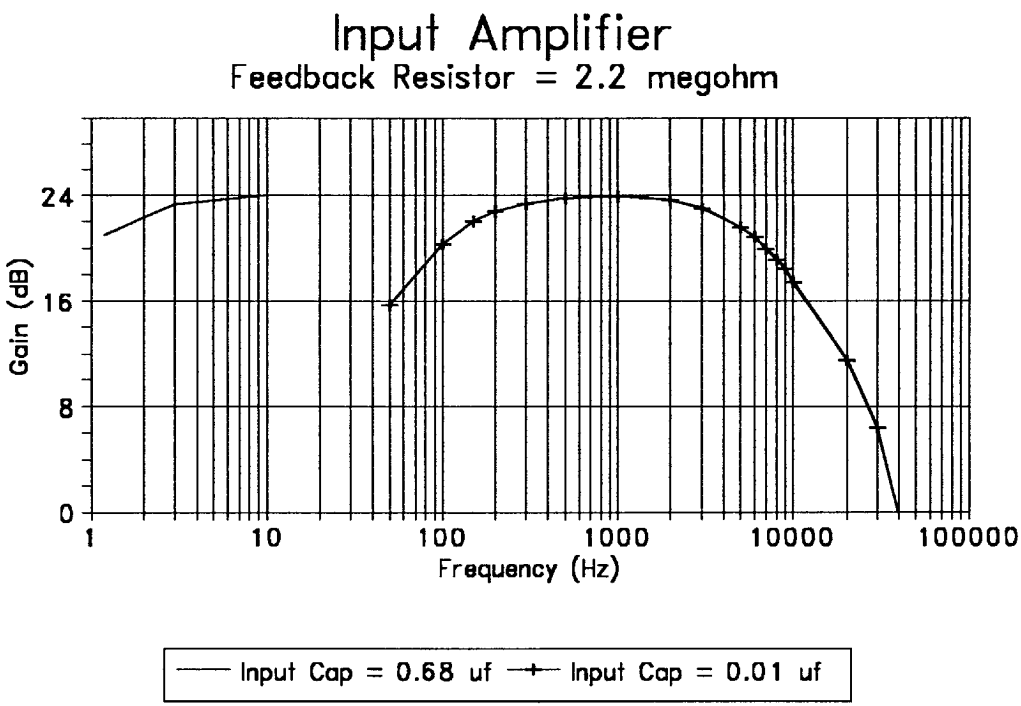

Figure 6 - Input Amplifier Frequency Response

SPECIFICATIONS

ABSOLUTE MAXIMUM RATINGS

Exceeding the maximum rating can result in device damage. Operation of the device outside the operating limits is not suggested.

Supply Voltage	-0.3 to 7.0 volts
Input Voltage at any pin	-0.3 to (Vdd+0.3 volts)
Sink/Source Current (Total)	20 mA
Maximum Device Dissipation	100 milliwatts
Operating Temperature	-30°C to +85°C
Storage Temperature	-40°C to +125°C

OPERATING LIMITS

All devices are measured under the following conditions unless otherwise noted.

V_{DD}	5.0 volts
T_{AMB}	25°C
Xtal/Clock	560 kHz
Input Test Signal	1 kHz at 200 mV rms
External Connections	see Figure 1

Characteristics	Spec Note	Min	Typ	Max	Unit
Supply Voltage	1	2.5	5.0	5.5	V
Supply Current		-	1.0	2.0	mA
	2	-	4.0	-	mA
Logic '1' Level		4.0	-	-	V
Logic '0' Level		-	-	1.0	V
Digital Output Impedance		-	4.0	-	kΩ
Analog Amplifier DC voltage gain		-	50	-	dB
Dynamic Values					
Signal Input	3	20	100	1000	mVrms
Analog Amplifier Gain	4	20	-	-	dB
	5	9.0	-	-	dB
	6	10.0	-	-	dB
Minimum Input Waveform Duty Cycle		-	35	-	%
Freq Out/Frequency In Ratio		4	-	4	
Maximum Clock Frequency		2.5	-	-	MHz
Frequency Input Range	7	500	-	3000	Hz
Input to Output Delay	8	-	-	5.9	ms
	9	-	1.4	-	ms
Capture Range	10	-	-	3	dB

NOTES

1. Maximum Clock frequency varies with supply voltage.
2. Operating current at 2.24 MHz clock.
3. Signal input required to provide constant autocorrelated output.
4. Measured at 6000 kHz.
5. Measured at 2.5 vdc input.
6. Measured with 12 kHz input signal.
7. The frequency input range is 1/190 to 1/1200 of the xtal clock frequency (see "Frequency Input Range" section).
8. Time from pulsed input signal to correlation output.
9. Time from pulsed input signal to correlation output with 2.24 MHz clock.
10. Two tone input, level difference