

## 0.02 Hz to 20 kHz Resistor Programmable

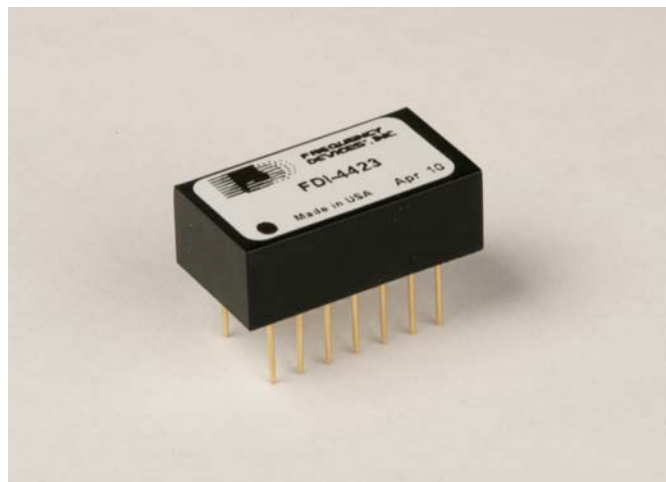
## 14 Pin DIP Quadrature Oscillator

### Description

The Model FDI-4423 Resistor Programmable Precision Quadrature Oscillator has two outputs that are 90 out of phase with each other. The output frequency of the FDI-4423 is programmable using two resistors or two resistors and two capacitors. It can be set to any frequency from 0.02 Hz to 20 kHz (and may work as low as 0.002 Hz).

The FDI-4423 also has one uncommitted Op Amp that can be used in any way the user wishes. It is packaged in a small 14-pin DIP package and works from non-critical  $\pm 12$  Volt to  $\pm 18$  Volt power supplies.

The FDI-4423 will work very similar to the now discontinued Texas Instruments\* (Burr-Brown\*) 4423P Precision Quadrature Oscillator. We recommend that the user test any implementation before placing large orders.



### Features/Benefits:

- Sine and Cosine Output
- Resistor Programmable Outputs
- Wide Frequency range: 0.2 Hz to 20 kHz
- Low Distortion: 0.2% (-54 dB) up to 5 kHz
- Easy Adjustments
- Small size: 0.85" X 0.46" box

### Applications

- Communication systems and electronics
- Medical electronics equipment and research
- Aerospace, navigation and sonar

\*Texas Instruments and Burr-Brown are registered trademarks of their respective companies.



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## Electrical Characteristics

Specifications typical at +25°C and ±15 VDC power supply.

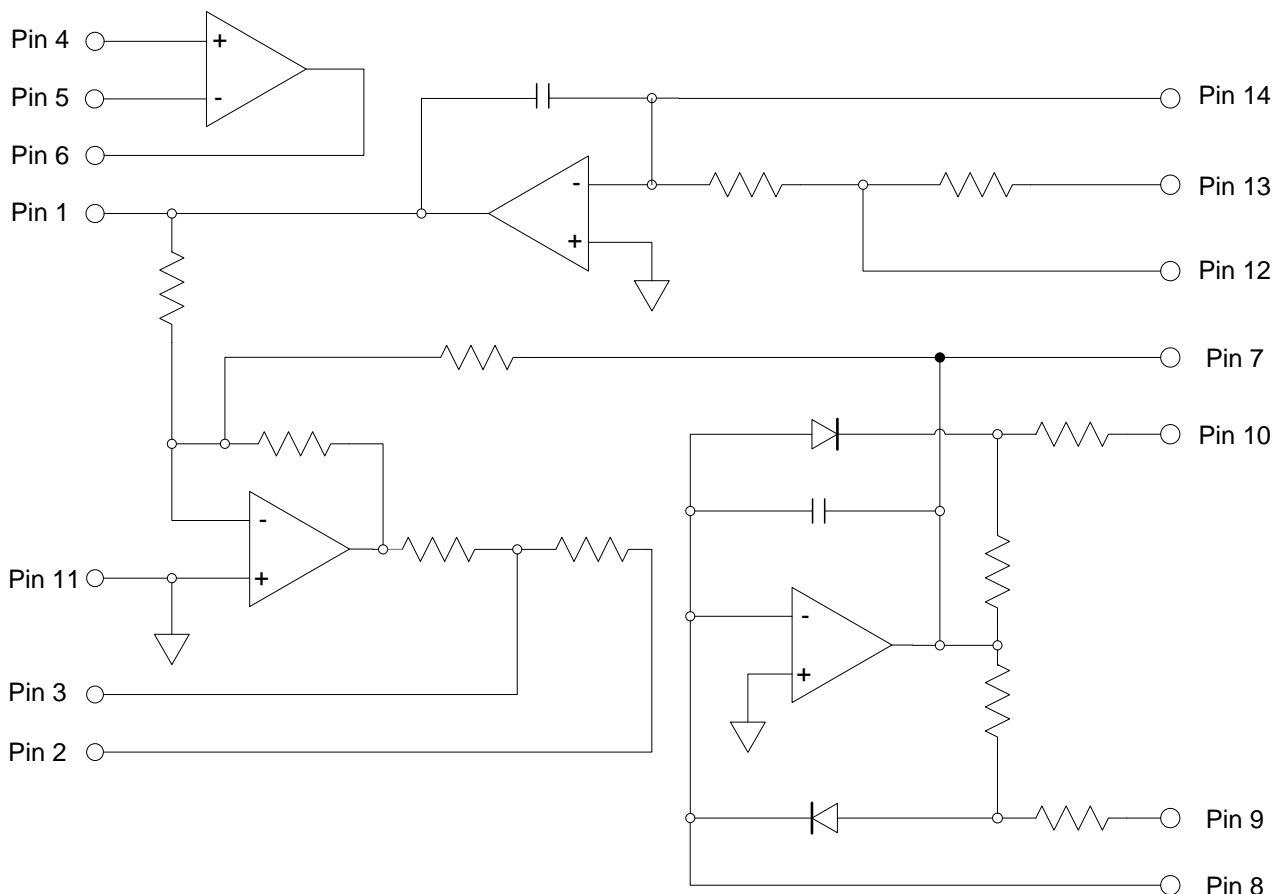
Parameter	Test Conditions	FDI-4423			Units
		Min.	Typ.	Max.	
Frequency					
Initial frequency	No Adjustment	20.0	21.0	22.0	kHz
Frequency Range	Using two resistor only	2		20	kHz
	Using two resistors and two capacitors	0.02		20k	Hz
Accuracy of Frequency Equation			±1	±5	%
Stability vs Temperature (1)			±50	±100	ppm/°C
Quadrature Phase Error			±0.1		degrees
Distortion					
Sine output (pin 1)	0.2Hz to 5kHz			0.2	%
	5kHz to 20kHz			0.5	%
Cosine Output (pin 7)	0.2Hz to 5kHz		0.2		%
	5kHz to 20kHz		0.8		%
Distortion vs Temperature			0.015		%/°C
Output					
Amplitude (sine)	At 20kHz	6.5	7	7.5	Vrms
	vs Temperature		0.05		%/°C
	vs Supply		0.4		V/V
Output Current				20	mA
Output Impedance			1		Ω
Uncommitted Op Amp					
Input Offset Voltage			1.1		mV
Input Bias Current			20		pA
Input Impedance			10 <sup>12</sup>		Ω
Output Impedance			1		Ω
Unity Gain Bandwidth			8	10	MHz
Output Current				20	mA
Power Supply					
Rated Supply Voltage			±15		V
Supply Voltage Range		±12		±18	V
Quiescent Current			±9	±15	mA
Temperature Range					
Specified		0		+70	°C
Storage		-55		+125	°C



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## FDI-4423 Typical Circuit



### Terminal Functions

Terminal		Description
Name	No.	
E1	1	Sine Output
	2	Frequency Adjustment
	3	Frequency Adjustment
+In	4	Uncommitted Op amp
-In	5	Uncommitted Op amp
Output	6	Uncommitted Op amp
E2	7	Cosine Output

Terminal		
Name	No.	
	8	Frequency Adjustment
-Vcc	9	-15VDC
+Vcc	10	+15VDC
Com	11	Ground
	12	Frequency Adjustment
	13	Frequency Adjustment
	14	Frequency Adjustment

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### External Connections

#### 20 kHz Quadrature Oscillator

The FDI-4423 does not require any external components to obtain a 20 kHz quadrature oscillation. The connection diagram is shown in Figure 1.

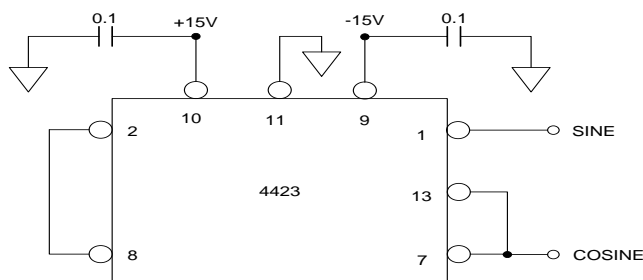


Figure 1

#### Resistor Programmable Quadrature Oscillator

For resistor programmable frequencies in the 2 kHz to 20 kHz frequency range the connection diagram is provided in Figure 2. Note that only two resistors of equal value are required. Resistor values are found using Equation 1.

$$R = \frac{3.785f}{42.05 - 2f}$$

Where R is in KΩ and f is in kHz.

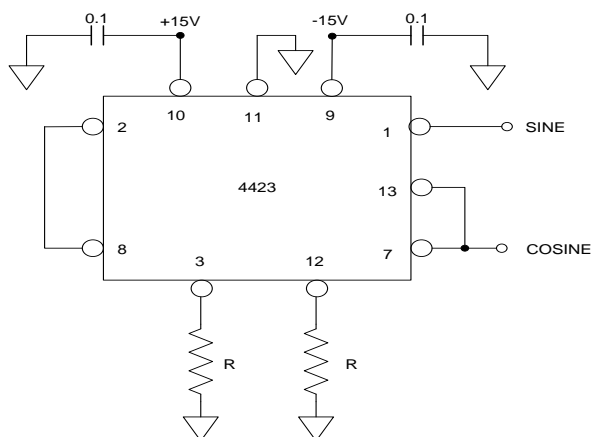


Figure 2

#### Quadrature Oscillator Programmable to 0.02 Hz

For oscillation frequencies below 2 kHz the addition of two resistors and two capacitors of equal value is required. The connections of Figure 3 should be used. The frequency of oscillation can be found using Equation 2.

$$f = \frac{42.05}{(C + 0.001)(3.785 + 2R)} \quad (2)$$

Where f is in Hz, C is in μF, and R is in KΩ.

Alternately you can select a capacitance using Figure 4 and calculate the resistance required using Equation 3.

$$R = \frac{3.785f(C + 0.001)}{42.05 - 2f(C + 0.001)} \quad (3)$$

Where R is in KΩ, f is in Hz, and C is in μF.

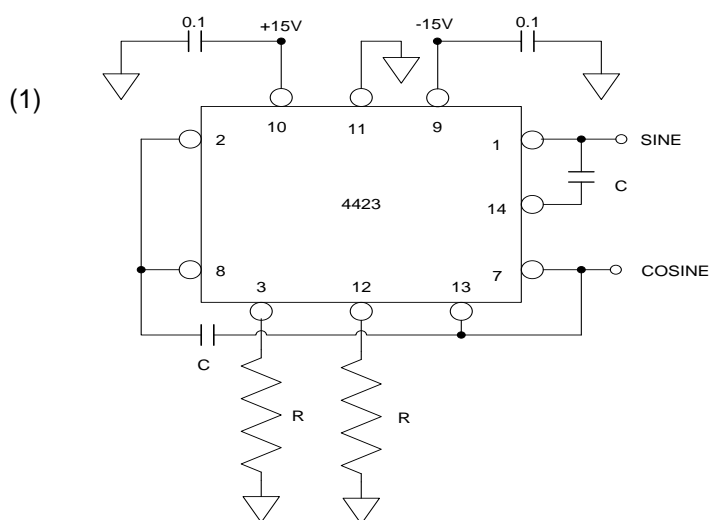


Figure 3



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## Recommended Capacitor Values

For best results use capacitor values shown in Figure 4 for each frequency range. It is important that the two capacitors be as close to the same value as possible.

Frequency	2 kHz to 20 kHz	200 Hz to 2 kHz	20 Hz to 200 Hz	2 Hz to 20 Hz	0.2 Hz to 2 Hz	0.02 Hz to 0.2 Hz
External Capacitors	0	0.01 $\mu$ FD	0.1 $\mu$ FD	1 $\mu$ FD	10 $\mu$ FD	100 $\mu$ FD

Figure 4

### Recommended Capacitor Types

The FDI-4423 Quadrature Oscillator will only work with non-polarized capacitors with Dissipation Factors of less than 0.01 (or 1%). Best results will be obtained using ceramic capacitors.

### Oscillation Amplitude

Depending on the frequency it can take a long time to build up to the full output amplitude. In general the lower the frequency the longer it takes the oscillation to start.

There are two methods that can be used to shorten the start up time:

Method one involves adding a large value resistor between pins 3 and 14 of the FDI-4423. The lower this resistor the quicker the oscillation will start but the worse the distortion of the two outputs. A typical value to try would be 100 K $\Omega$ .

Method two is similar to method one but the resistor is inserted only during start up of the oscillation. For instance if a 1 K $\Omega$  resistor in series with a push button is installed between pins 3 and 14 and the button pushed during start up the oscillator will start quickly and then will revert to low distortion after the button is released.

### Low Frequency Operation

At low frequencies there may be problems getting the Quadrature Oscillator to start oscillating. Placing a resistor between pins 3 and 14 can cure this problem. For instance a 34K $\Omega$  resistor can be used in the 0.2 Hz to 2 Hz range.

### Uncommitted Op Amp

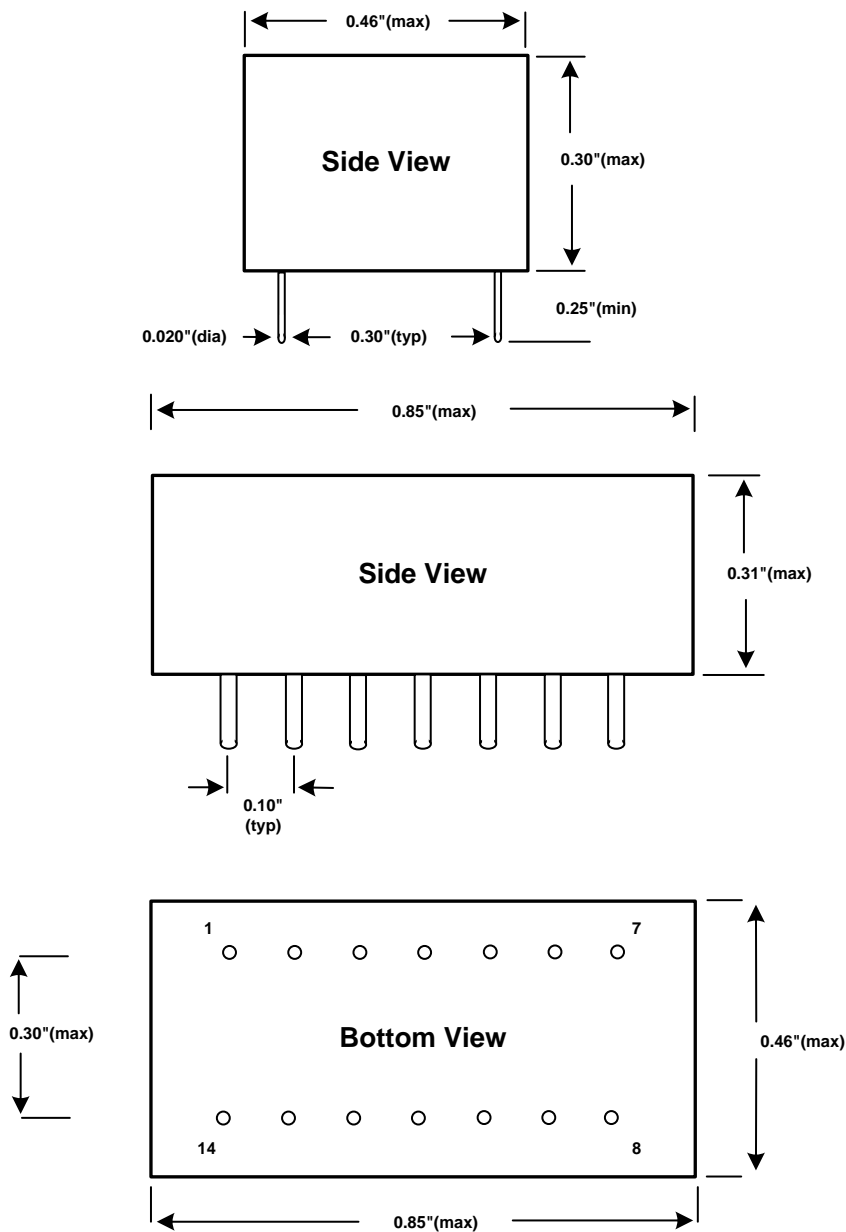
Pins 4, 5, and 6 of the FDI-4423 are connected to an Op amp that is available to be used. It can be used as a buffer or gain stage. If this Op Amp is not used then pins 4 and 5 of the FDI-4423 should be connected to power supply ground.



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FDI-4423



All dimensions are in inches  
All case dimensions  $\pm 0.01"$

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