ICS3726-02

HIGH PERFORMANCE VCXO

Description

The ICS3726-02 is a low cost, low-jitter, high-performance 3.3 volt VCXO designed to replace expensive discrete VCXOs modules. The ICS3726-02 offers a wider operating frequency range and improved power supply noise rejection. The on-chip Voltage Controlled Crystal Oscillator accepts a 0 to 3.3 V input voltage to cause the output clocks to vary by ±200 ppm. Using ICS' patented VCXO techniques, the device uses an inexpensive external pullable crystal in the range of 20 to 52 MHz to produce a VCXO output clock at that same frequency.

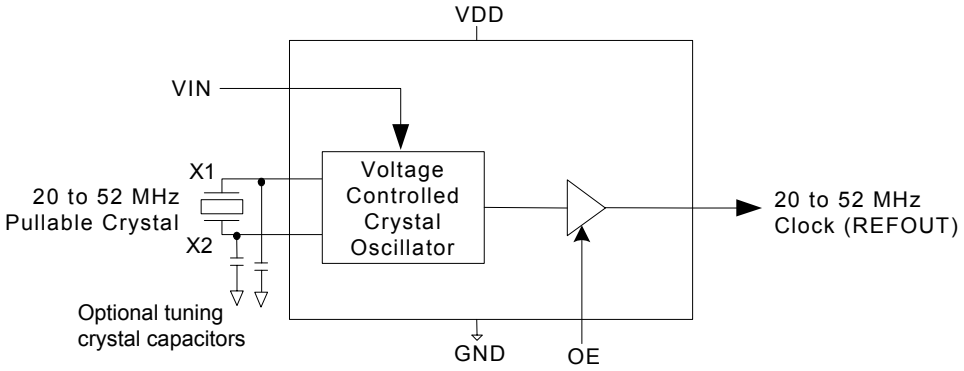
This part is ideal for Set-Top Box, multimedia clock synthesizers and ADSL/VDSL applications.

The frequency of the on-chip VCXO is adjusted by an external control voltage input into pin VIN. Because VIN is a high-impedance input, it can be driven directly from an PWM RC integrator circuit. Frequency output increases with VIN voltage input. The usable range of VIN is 0 to VDD.

Features

- Packaged in 8-pin SOIC
- Operational frequency range of 20 MHz to 52 MHz
- Uses an inexpensive external crystal
- On-chip patented VCXO with pull range of 400 ppm
- VCXO tuning voltage of 0 to VDD
- Output Enable control
- Operating voltage of 3.3 V
- 12 mA output drive capability at TTL levels
- Works with surface mount crystal with CL=10 pF
- Advanced, low-power, sub-micron CMOS process
- Available in Pb (lead) free package

Block Diagram



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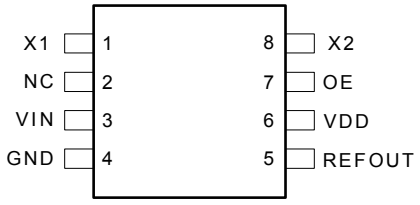
Pin Assignment



ICS3726-02

8-Pin (150 mil) SOIC

Pin Descriptions

Pin Number	Pin Name	Pin Type	Pin Description
1	XI	Input	Crystal connection. Connect to the external pullable crystal.
2	NC	—	Do connet to this pin.
3	VIN	Input	Voltage input to VCXO. Zero to VDD signal which controls the VCXO frequency.
4	GND	Power	Connect to ground.
5	REFOUT	Output	VCXO CMOS level clock output matches the nominal frequency of the crystal.
6	VDD	Power	Connect to +3.3 V (0.01 μf decoupling capacitor recommended).
7	OE	Input	Output enable, OE=1 enables outputs, OE=0 disables REFOUT, internal pull-up.
8	X2	Input	Crystal connection. Connect to a pullable 20 to 52 MHz crystal.

External Component Selection

The ICS3726-02 requires a minimum number of external components for proper operation.

Decoupling Capacitors

A decoupling capacitor of 0.01 μF should be connected between VDD and GND on pins 6 and 4 as close to the ICS3726-02 as possible. For optimum device performance, the decoupling capacitor should be mounted on the component side of the PCB. Avoid the use of vias in the decoupling circuit.

Series Termination Resistor

When the PCB trace between the clock output and the load is over 1 inch, series termination should be used. To series terminate a 50Ω trace (a commonly used trace impedance), place a 33Ω resistor in series with the clock line, as close to the clock output pin as possible. The nominal impedance of the clock output is 20Ω.

Quartz Crystal

The ICS3726-02 VCXO function consists of the external crystal and the integrated VCXO oscillator circuit. To assure the best system performance (frequency pull range) and reliability, a crystal device with the recommended parameters (shown below) must be used, and the layout guidelines discussed in the following section shown must be followed.

The oscillation frequency of a quartz crystal is determined by its “cut” and by the load capacitors connected to it. The ICS3726-02 incorporates on-chip variable load capacitors that pull (change) the frequency of the crystal. The crystal specified for use with the ICS3726-02 is designed to have zero frequency error when the total of on-chip + stray capacitance is 10 pF.

Recommended Crystal Parameters:

Initial Accuracy at 25°C	±20 ppm
Temperature Stability	±30 ppm
Aging	±20 ppm
Load Capacitance	14 pF
Shunt Capacitance, C0	7 pF max
C0/C1 Ratio	250 max
Equivalent Series Resistance	35 Ω max

The external crystal must be connected as close to the chip as possible and should be on the same side of the PCB as the ICS3726-02. There should be no via’s between the crystal pins and the X1 and X2 device pins. There should be no signal traces underneath or close to the crystal. See application note MAN05.

Crystal Tuning Load Capacitors

The crystal traces should include pads for small fixed capacitors, one between X1 and ground, and another between X2 and ground. Stuffing of these capacitors on the PCB is optional. The need for these capacitors is determined at system prototype evaluation, and is influenced by the particular crystal used (manufacture and frequency) and by PCB layout. The typical required capacitor value is 1 to 4 pF. This chip has internal load capacitors and is designed to work with surface mount crystals with 10 pF load capacitance.

The procedure for determining the value of these capacitors can be found in application note MAN05.

Absolute Maximum Ratings

Stresses above the ratings listed below can cause permanent damage to the ICS3726-02. These ratings, which are standard values for ICS commercially rated parts, are stress ratings only. Functional operation of the device at these or any other conditions above those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods can affect product reliability. Electrical parameters are guaranteed only over the recommended operating temperature range.

Item	Rating
Supply Voltage, VDD	7 V
All Inputs and Outputs	-0.5 V to VDD+0.5 V
Ambient Operating Temperature	0 to +70°C
Storage Temperature	-65 to +150°C
Soldering Temperature	260°C

Recommended Operation Conditions

Parameter	Min.	Typ.	Max.	Units
Ambient Operating Temperature	0	–	+70	°C
Power Supply Voltage (measured in respect to GND)	+3.15		+3.45	V
Reference crystal parameters	Refer to page 3			

DC Electrical Characteristics

VDD=3.3 V ±5% , Ambient temperature 0 to +70°C, unless stated otherwise

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Operating Voltage	VDD		3.15		3.45	V
Output High Voltage	V_{OH}	I_{OH} = -12 mA	2.4			V
Output Low Voltage	V_{OL}	I_{OL} = 12 mA			0.4	V
Output High Voltage (CMOS Level)	V_{OH}	I_{OH} = -4 mA	VDD-0.4			V
Operating Supply Current	IDD	No load		6		mA
Short Circuit Current	I_{OS}			±50		mA
VIN, VCXO Control Voltage	V_{IA}		0		3.3	V

AC Electrical Characteristics

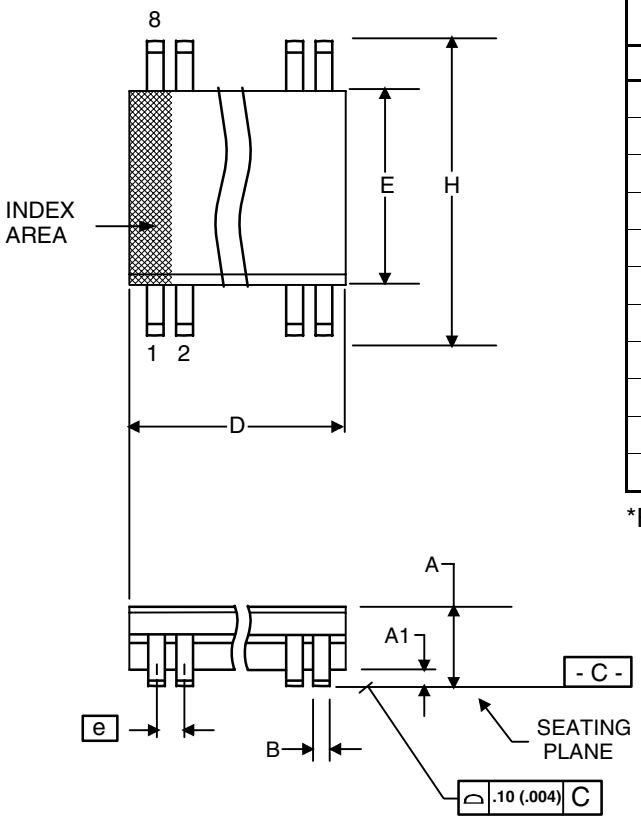
VDD = 3.3 V ±5%, Ambient Temperature 0 to +70° C, unless stated otherwise

Parameter		Symbol	Conditions	Min.	Typ.	Max.	Units
Output Frequency							
		F_O		20		52	MHz
Crystal Pullability							
		F_P	0V≤ VIN ≤ 3.3 V, Note 1	± 200			ppm
VCXO Gain							
			VIN = VDD/2 ± 1 V, Note 1		150		ppm/V
Output Rise Time		t_{OR}	0.8 to 2.0 V, C_L=15 pF			1.5	ns
Output Fall Time		t_{OF}	2.0 to 0.8 V, C_L=15 pF			1.5	ns
Output Clock Duty Cycle		t_D	Measured at 1.4 V, C_L=15 pF	40	50	60	%
Period Jitter RMS		t_J	C_L=15 pF @35.328 MHz		6.7		ps
Period Jitter P- P		t_J	C_L=15 pF@35.328 MHz		46		ps
Integrated Jitter RMS			Integrated 12 kHz to 20 MHz @ 35.328 MHz		1		ps
Phase Noise relative to Carrier			@35.328 MHz Carrier frequency				
	@10 Hz				-65		dBc/Hz
	@100 Hz				-90		dBc/Hz
	@1 kHz				-120		dBc/Hz
	@10 kHz				-140		dBc/Hz
	@100 kHz				-147		dBc/Hz
	@1 MHz				-147		dBc/Hz

Note 1: External crystal device must conform with Pullable Crystal Specifications listed on page 3.

Package Outline and Package Dimensions (8-pin SOIC)

Package dimensions are kept current with JEDEC Publication No. 95



	Millimeters		Inches*	
Symbol	**Min**	**Max**	**Min**	**Max**
A	1.35	1.75	.0532	.0688
A1	0.10	0.25	.0040	.0098
B	0.33	0.51	.013	.020
C	0.19	0.25	.0075	.0098
D	4.80	5.00	.1890	.1968
E	3.80	4.00	.1497	.1574
e	1.27 BASIC		0.050 BASIC	
H	5.80	6.20	.2284	.2440
h	0.25	0.50	.010	.020
L	0.40	1.27	.016	.050
α	0°	8°	0°	8°

*For reference only. Controlling dimensions in mm.

Ordering Information

Part / Order Number	Marking	Shipping Packaging	Package	Temperature
ICS3726M-02	3726M-02	Tubes	8-pin SOIC	0 to +70° C
ICS3726M-02T	3726M-02	Tape and Reel	8-pin SOIC	0 to +70° C
ICS3726M-02LF	3726M02L	Tubes	8-pin SOIC	0 to +70° C
ICS3726M-02LFT	3726M02L	Tape and Reel	8-pin SOIC	0 to +70° C

Parts that are ordered with a "LF" suffix to the part number are the Pb-Free configuration and are RoHS compliant.