



MK2731-01

Low Cost VCXO

Description

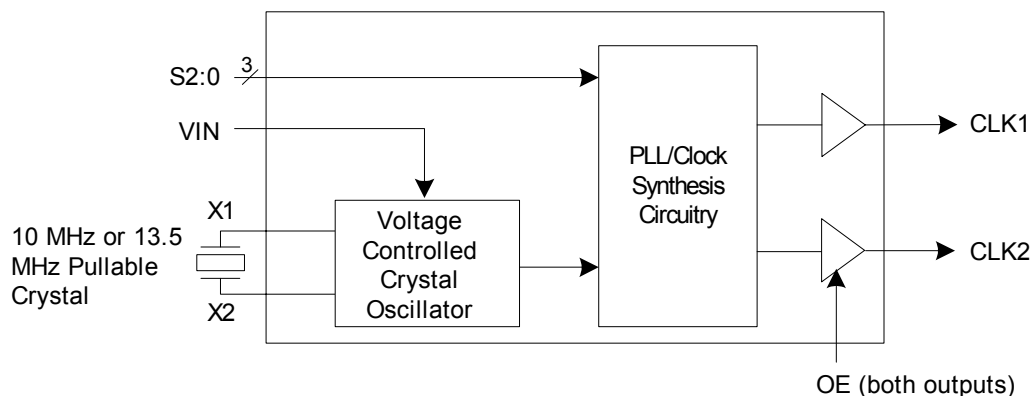
The MK2731-01 is a low cost, low jitter, high-performance VCXO and PLL clock synthesizer designed to replace expensive discrete VCXOs, PLLs and oscillators. The on-chip Voltage Controlled Crystal Oscillator accepts a 0 to 3V input voltage to cause the output clocks to vary by ± 100 ppm. Using ICS's patented VCXO and analog Phase-Locked Loop (PLL) techniques, the device uses an inexpensive 10 MHz or 13.5 MHz pullable crystal input to produce two low skew output clocks.

ICS manufactures a large variety of Set-Top Box and multimedia clock synthesizers for all applications. If more clock outputs are needed, see the MK277x family of parts. Consult ICS to eliminate VCXOs, crystals and oscillators from your board.

Features

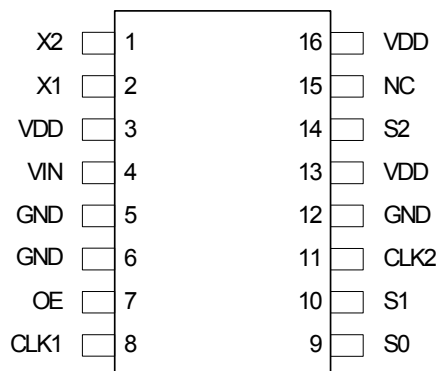
- Packaged in 16-pin narrow SOIC
- Uses an inexpensive 10 or 13.5 MHz crystal
- On-chip VCXO (patented) with pull range of 200 ppm (minimum)
- VCXO tuning voltage of 0 to 3 V
- Zero ppm synthesis error in all clocks
- Low skew output clocks - 1 ns maximum
- CMOS level outputs with 25 mA output drive capability at TTL levels
- Advanced, low power, sub-micron CMOS process
- 5 V operating voltage

Block Diagram





Pin Assignment



16-pin narrow (150 mil) SOIC

Output Clock Select Table

Input	S2	S1	S0	CLK1	CLK2
10	0	0	0	40	80
10	0	0	1	40	OFF
13.5	0	1	0	40	OFF
13.5	0	1	1	27	54
13.5	1	0	0	33.33	66.66
13.5	1	0	1	24.576	49.152
—	1	1	0	Test use	
13.5	1	1	1	32	64

(All OFF outputs are stopped low)

Pin Descriptions

Pin Number	Pin Name	Pin Type	Pin Description
1	X2	Output	Crystal connection. Connect to a 10 or 13.5 MHz pullable crystal.
2	X1	Input	Crystal connection. Connect to a 10 or 13.5 MHz pullable crystal.
3	VDD	Power	Connect to +5 V.
4	VIN	Input	Voltage input to VCXO. Zero to 3 V signal which controls the VCXO frequency.
5	GND	Power	Connect to ground.
6	GND	Power	Connect to ground.
7	OE	Input	Output Enable. Active high. Tri-states both outputs when low.
8	CLK1	Output	Clock output 1 determined by status of S2, S1, and S0. See table above.
9	S0	Input	Fixed Clock Select 0. Selects outputs per table above.
10	S1	Input	Fixed Clock Select 1. Selects outputs per table above.
11	CLK2	Output	Clock output 2 determined by status of S2, S1, and S0. See table above.
12	GND	Power	Connect to ground.
13	VDD	Power	Connect to +5 V.
14	S2	Input	Fixed Clock Select 2. Selects outputs per table above.
15	NC	--	No connect.
16	VDD	Power	Connect to +5 V.



External Component Selection

The MK2731-01 requires a minimum number of external components for proper operation.

Decoupling Capacitors

Decoupling capacitors of 0.01 μ F should be connected between VDD and GND, as close to the MK2731-01 as possible. For optimum device performance, the decoupling capacitors 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 traces between the clock outputs and the loads are over 1 inch, series termination should be used. To series terminate a 50 Ω trace (a commonly used trace impedance) place a 33 Ω resistor in series with the clock line, as close to the clock output pin as possible. The nominal impedance of the clock output is 20 Ω .

Quartz Crystal

The MK2731-01 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 meeting ICS' recommended parameters must be used, and the layout guidelines discussed in the following section must be followed.

See Application Note MAN05 for a full list of crystal parameters.

The frequency of oscillation of a quartz crystal is determined by its "cut" and by the load capacitors connected to it. The MK2731-01 incorporates on-chip variable load capacitors that "pull" (change) the frequency of the crystal. The crystal specified for use with the MK2731-01 is designed to have zero frequency error when the total of on-chip + stray capacitance is 14 pF.

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 MK2731-01. 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.

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.

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 MK2731-01. 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)	+4.75		+5.25	V
Reference crystal parameters	Refer to page 3			

DC Electrical Characteristics

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

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Operating Voltage	VDD		4.75		5.25	V
Output High Voltage	V _{OH}	I _{OH} = -25 mA	2.4			V
Output Low Voltage	V _{OL}	I _{OL} = 25 mA			0.4	V
Output High Voltage (CMOS Level)	V _{OH}	I _{OH} = -8 mA	VDD-0.4			V
Input High Voltage (X1 only)	V _{IH}		3.5	2.5		V
Input High Voltage	V _{IH}		2.0			V
Input Low Voltage (X1 only)	V _{IL}			2.5	1.5	V
Input Low Voltage	V _{IL}				0.8	V
Operating Supply Current	IDD	No load, S2:0 = 000		20		mA
Short Circuit Current	I _{OS}	Each output		\pm 100		mA
VIN, VCXO Control Voltage	V _{IA}		0		3	V
Frequency Synthesis Error		All clocks			0	ppm
Input Capacitance	C _{IN}	S0, S1, S2, OE		7		pF



AC Electrical Characteristics

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

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
CLK1 and CLK2 Output Pullability	f _P	0V \leq VIN \leq 3 V, Note 1	\pm 100			ppm
Input Crystal Frequency				10 or 13.5		MHz
Input Crystal Accuracy					\pm 30	ppm
Output Clock Rise Time	t _{OR}	0.8 to 2.0V			1.5	ns
Output Clock Fall Time	t _{OF}	2.0 to 0.8V			1.5	ns
Output Clock Duty Cycle	t _D	Measured at 1.4V	40	50	60	%
Maximum Absolute Jitter, short term	t _J	C _L =15pF		200		ps
Skew of CLK1 (with respect to CLK2)		Measured at 1.4V			1	ns

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

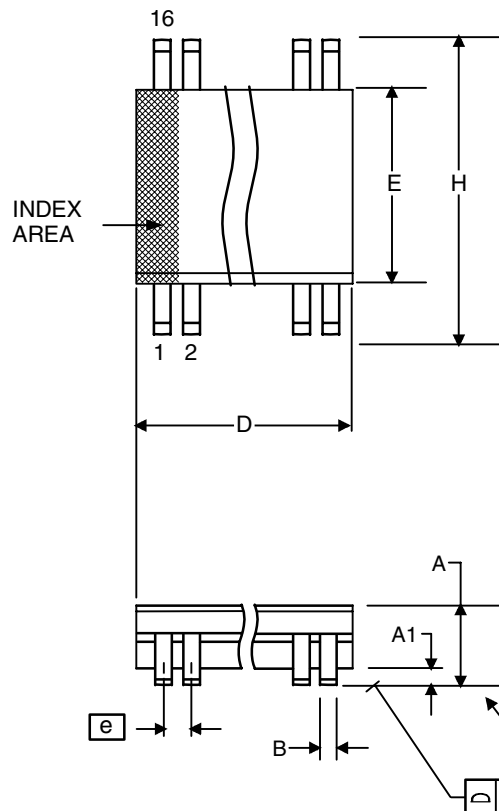
Thermal Characteristics

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Thermal Resistance Junction to Ambient	θ_{JA}	Still air		120		°C/W
	θ_{JA}	1 m/s air flow		115		°C/W
	θ_{JA}	3 m/s air flow		105		°C/W
Thermal Resistance Junction to Case	θ_{JC}			58		°C/W

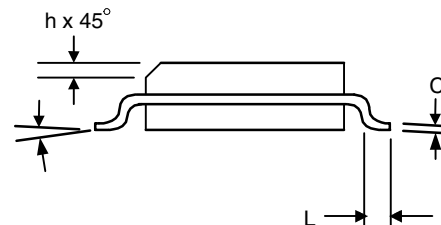


Package Outline and Package Dimensions (16-pin 150 mil SOIC)

Package dimensions are kept current with JEDEC Publication No. 95



Symbol	Millimeters		Inches	
	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	9.80	10.00	.3859	.3937
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°



Ordering Information

Part / Order Number	Marking	Shipping packaging	Package	Temperature
MK2731-01G	MK2731-01	Tubes	16-pin SOIC	0 to +70° C
MK2731-01GTR	MK2731-01	Tape and Reel	16-pin SOIC	0 to +70° C

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