

DS32kHz 32.768kHz Temperature-Compensated Crystal Oscillator

GENERAL DESCRIPTION

The DS32kHz is a temperature-compensated crystal oscillator (TCXO) with an output frequency of 32.768kHz. This device addresses applications requiring better timekeeping accuracy, and can be used to drive the X1 input of most Dallas Semiconductor real-time clocks (RTCs), chipsets, and other ICs containing RTCs. This device is available in commercial (DS32kHz) and industrial (DS32kHz-N) temperature versions.

APPLICATIONS

GPS Receivers

Telematics

Network Timing and Synchronization in Servers,
Routers, Hubs, and Switches

Automatic Power Meters

FEATURES

- Accurate to ± 4 Minutes/Year (-40°C to $+85^{\circ}\text{C}$)
- Accurate to ± 1 Minute/Year (0°C to $+40^{\circ}\text{C}$)
- Battery Backup for Continuous Timekeeping
- V_{BAT} Operating Voltage: 2.7V to 5.5V with V_{CC} Grounded
- V_{CC} Operating Voltage: 4.5V to 5.5V
- Operating Temperature Range:
 - 0°C to $+70^{\circ}\text{C}$ (Commercial)
 - -40°C to $+85^{\circ}\text{C}$ (Industrial)
- No Calibration Required
- Low-Power Consumption
- Surface Mountable Using BGA Package
- UL Recognized

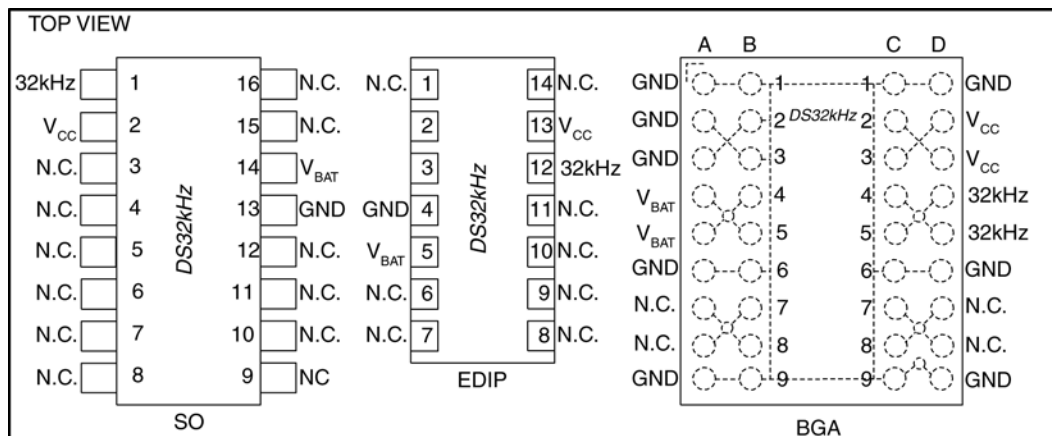
ORDERING INFORMATION

PART	TEMP RANGE	PIN-PACKAGE	TOP MARK*
DS32KHZ/DIP	0°C to $+70^{\circ}\text{C}$	14 DIP	DS32KHZ
DS32KHZN/DIP	-40°C to $+85^{\circ}\text{C}$	14 DIP	DS32KHZ-N
DS32KHZS	0°C to $+70^{\circ}\text{C}$	16 SO (0.300")	DS32KHZS
DS32KHZS#	0°C to $+70^{\circ}\text{C}$	16 SO (0.300")	DS32KHZS
DS32KHZSN	-40°C to $+85^{\circ}\text{C}$	16 SO (0.300")	DS32KHZSN
DS32KHZSN#	-40°C to $+85^{\circ}\text{C}$	16 SO (0.300")	DS32KHZSN
DS32KHZ/WBGA	0°C to $+70^{\circ}\text{C}$	36 BGA	DS32KHZ
DS32KHZN/WBGA	-40°C to $+85^{\circ}\text{C}$	36 BGA	DS32KHZ-N

#Denotes a RoHS-compliant device that may include lead that is exempt under the RoHS requirements. The lead finish is JESD97 category e3, and is compatible with both lead-based and lead-free soldering processes.

*A “#” anywhere on the top mark denotes a RoHS-compliant device. An “N” denotes an industrial device.

PIN CONFIGURATIONS



ABSOLUTE MAXIMUM RATINGS

Voltage Range on Any Pin Relative to Ground.....	-3.0V to +7.0V
Operating Temperature Range (Noncondensing)	
Commercial:.....	0°C to +70°C
Industrial:.....	-40°C to +85°C
Storage Temperature Range.....	-40°C to +85°C
Soldering Temperature (BGA, SO).....	See the <i>Handling, PC Board Layout, and Assembly</i> section.
Soldering Temperature, Leads (DIP).....	+260°C for 10 seconds (Note 1)

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to the absolute maximum rating conditions for extended periods may affect device reliability.

RECOMMENDED DC OPERATING CONDITIONS

($T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$) (Note 1)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Power-Supply Voltage	V_{CC}	(Note 2)	4.5	5.0	5.5	V
Battery Voltage	V_{BAT}	(Notes 2, 3)	2.7	3.0	3.5, 5.5	V

DC ELECTRICAL CHARACTERISTICS

(Over the operating range, unless otherwise specified.) (Note 1)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Active Supply Current	I_{CC}	$V_{BAT} = 0\text{V}$ or $2.7\text{V} \leq V_{BAT} \leq 3.5\text{V}$ (Notes 3, 4)		150	220	μA
Battery Input-Leakage Current	I_{BATLKG}	$V_{CC\text{ MIN}} \leq V_{CC} \leq V_{CC\text{ MAX}}$	-50		+50	nA
High Output Voltage (V_{CC})	V_{OH}	$I_{OH} = -1.0\text{mA}$ (Note 2)	2.4			V
Low Output Voltage	V_{OL}	$I_{OL} = 2.1\text{mA}$ (Note 2)			0.4	V
High Output Voltage (V_{BAT})	V_{OH}	$I_{OH} = -0.1\text{mA}$ (Note 2)	2.4			V
Battery Switch Voltage	V_{SW}	(Note 2)		V_{BAT}		V

($V_{CC} = 0\text{V}$, $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$.) (Note 1)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Active Battery Current	I_{BAT}	$V_{BAT} = 3.3\text{V}$ (Notes 4, 5, 6)		1	4	μA
Battery Current During Temperature Measurement	I_{BATCNV}	$V_{BAT} = 3.3\text{V}$ (Notes 4, 5, 7)		450		μA

Note 1: Limits at -40°C are guaranteed by design and are not production tested.

Note 2: All voltages are referenced to ground.

Note 3: V_{BAT} must be no greater than 3.5V when the device is used in the dual-supply operating modes.

Note 4: Typical values are at $+25^\circ\text{C}$ and 5.0V V_{CC} , 3.0 V_{BAT} , unless otherwise indicated.

Note 5: These parameters are measured under no output load conditions.

Note 6: This current is the active-mode current sourced from the backup supply/battery.

Note 7: A temperature conversion lasts 122ms (typ) and occurs on power-up and then once every 64 seconds.

AC TIMING CHARACTERISTICS

(Over the operating range, unless otherwise specified.)

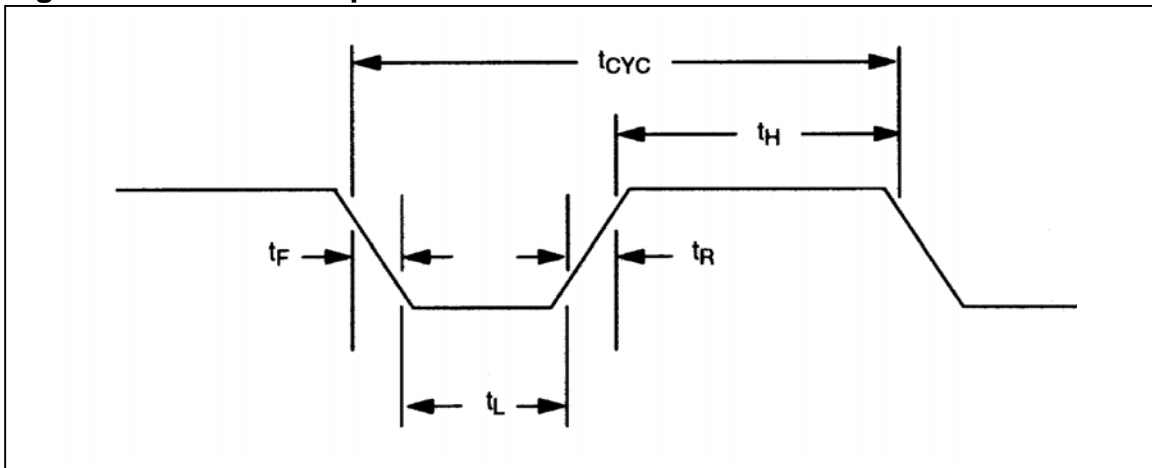
PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Output Frequency	f_{OUT}			32.768		kHz
Frequency Stability vs. Temperature	$\Delta f/f_0$	0°C to +40°C	-2.0		+2.0	ppm
		-40°C to +85°C or 0°C to +70°C	-7.5		+7.5	
Duty Cycle	t_W/t		45	50	55	%
Cycle Time	t_{CYC}	(Note 8)		30.518		μ s
High/Low Time	t_H/t_L	(Note 8)		15.06		μ s
Rise Time	t_R	(Note 8)		200		ns
Fall Time	t_F	(Note 8)		60		ns
Oscillator Startup Time	t_{OSC}	(Note 8)		1		seconds
Frequency Stability vs. Operating Voltage	$\Delta f/V$	$V_{CC} = 5.0V$ or $V_{BAT} = 3.0V, V_{CC} = 0V$ (Notes 4, 9)		+2.5		ppm/V
Crystal Aging (First Year)	$\Delta f/f_0$	(Notes 4, 10)		± 1.0		ppm

Note 8: These parameters are measured using a 15pF load.

Note 9: Error is measured from the nominal supply voltage of whichever supply is powering the device.

Note 10: After reflow.

Figure 1. DS32kHz Output Waveform



RELATED APPLICATION NOTES

Application Note 58: Crystal Considerations with Dallas Real-Time Clocks

Application Note 701: Using the DS32kHz with Dallas RTCs

HANDLING, PC BOARD LAYOUT, AND ASSEMBLY

These packages contain a quartz tuning-fork crystal. Pick-and-place equipment may be used, but precautions should be taken to ensure that excessive shocks are avoided. Ultrasonic cleaning should be avoided to prevent damage to the crystal.

Avoid running signal traces under the package, unless a ground plane is placed between the package and the signal line. All N.C. (no connect) pins must be connected to ground.

The BGA package may be reflowed as long as the peak temperature does not exceed +225°C. Peak reflow temperature ($\geq 220^\circ\text{C}$) duration should not exceed 10 seconds, and the total time above 200°C should not exceed 40 seconds (30 seconds nominal). For the SO package, refer to the IPC/JEDEC J-STD-020 specification for reflow profiles. Exposure to reflow is limited to 2 times maximum. The DIP package can be wave-soldered, provided that the internal crystal is not exposed to temperatures above +150°C.

Moisture sensitive packages are shipped from the factory dry-packed. Handling instructions listed on the package label must be followed to prevent damage during reflow. Refer to the IPC/JEDEC J-STD-020 standard for moisture-sensitive device (MSD) classifications.

THERMAL INFORMATION

PACKAGE TYPE	THETA-J _A (°C/W)	THETA-J _C (°C/W)
16-pin SO (300 mils)	73	23
36-pin BGA	43.9	18.4

PACKAGE INFORMATION

PACKAGE TYPE	DOCUMENT NO.
14-pin Encapsulated DIP	56-G0001-002
16-pin SO (300 mils)	56-G4009-001
36-pin BGA	56-G6023-001