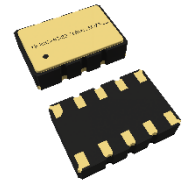


DTCXO TEMPERATURE COMPENSATED REAL-TIME-CLOCK MODULE WITH I2C BUS



Features

- RTC module with built-in “Tuning Fork” crystal oscillating at 32.768 kHz
- Factory calibrated, all built-in Temperature Compensation circuitry
- Time accuracy Option A & B. See Part Identification on Page 6 for details
- Ultra low power consumption: 800nA typ @ $V_{DD} = 3.0V$ / $T_{amb} = 25^{\circ}C$
- Wide clock operating voltage: 1.3 – 5.5V
- Wide interface operating voltage: 1.4 – 5.5V
- Extended operating temperature range: $-40^{\circ}C$ to $+125^{\circ}C$
- I2C serial interface with fast mode SCL clock frequency of 400kHz
- Provides year, month, day, weekday, hours, minutes and seconds
- Highly versatile alarm and timer functions
- Integrated Low-Voltage Detector, Power-On Reset and Self-Recovery System
- Main Power Supply to Backup Battery switchover circuitry with Trickle Charger
- Programmable CLKOUT pins for peripheral devices (32.768 kHz / 1024 Hz / 32 Hz / 1 Hz)
- Small and compact package size: 3.7 x 2.5 x 0.9 mm
- [REACH/RoHS II Compliant](#) | [MSL Level 1](#)

Typical Applications

- Wide range in communication & measuring equipment
- Commercial & Industrial applications
- Automotive electronics applications
- Wireless communications
- Credit Cards with Security Technology

Absolute Maximum Ratings

Parameters	Min.	Typ.	Max.	Units	Notes
Supply Voltage (V_{DD})	GND-0.3		+6.0	V	>GND / < V_{DD}
Supply Current (I_{DD} ; I_{SS})	-50		+50	mA	V_{DD} Pin
Input Voltage (V_I)	GND-0.3		$V_{DD} + 0.3$	V	Input Pin
Output Voltage (V_O)	GND-0.5		$V_{DD} + 0.5$	V	TNT/CLKOUT
DC Input Current (I_I)	-10		+10	mA	
DC Output Current (I_O)	-10		+10	mA	
Total Power Dissipation (P_{TOT})			300	mW	
Operating Temperature Range (T_{OPR})	-40		+125	$^{\circ}C$	
Storage Temperature (T_{STO})	-55		+125	$^{\circ}C$	Stored as bare product

DTCXO TEMPERATURE COMPENSATED REAL-TIME-CLOCK MODULE WITH I2C BUS

Frequency and Time Characteristics

V_{DD}=3.0V; V_{SS}=0V; T_{AMB}=+25°C; f_{OSC}=32.768kHz

Parameters	Min.	Typ.	Max.	Units	Notes
32.768kHz Oscillator Characteristics					
Frequency Accuracy ($\Delta F/F$)		±10	±20	ppm	F _{CLKOUT} =32.768kHz; T _{AMB} =+25°C; V _{DD} =3.0V
Frequency vs Voltage ($\Delta F/V$)		±0.5	±1.0	ppm/V	T _{AMB} =+25°C; V _{DD} =1.4~5.5V
Frequency vs Temperature ($\Delta F/T_{OPR}$)	-0.035ppm/°C ² (T _{OPR} -T _O) ² ±10%			ppm	T _{OPR} =-40~+125°C; V _{DD} =3.0V
Turnover Temperature (T _O)	+20	+25	+30	°C	
Aging (first year)	-3		+3	ppm	T _{AMB} =+25°C
Start-up Time Voltage (V _{START})					
Start-up Time (T _{START})		0.5	3	s	T _{AMB} =-40 ~ +85°C
		1	3		T _{AMB} =-40 ~ +125°C
CLKOUT duty cycle	40	50	60	%	F _{CLKOUT} =32.768kHz; T _{AMB} =+25°C
Time accuracy, DTCXO Digitally Temperature Compensated					
Time Accuracy Option: A ($\Delta t/t$)	T _{AMB} =+25°C	±1	±3	ppm	
	T _{AMB} =0 ~ +50°C	±2	±4		
	T _{AMB} =-10 ~ +65°C	±3	±5		
	T _{AMB} =-40 ~ +85°C	±4	±6		
	T _{AMB} =-40 ~ +125°C	±5	±8		
Time Accuracy Option: B ($\Delta t/t$)	T _{AMB} =+25°C	±1	±3	ppm	
	T _{AMB} =0 ~ +50°C	±3	±5		
	T _{AMB} =-10 ~ +65°C	±5	±10		
	T _{AMB} =-40 ~ +85°C	±10	±25		
	T _{AMB} =-40 ~ +125°C	±15	±30		

Static Characteristics

V_{DD}=1.4~5.5V; V_{SS}=0V; T_{AMB}=-40°C ~ +125°C; f_{OSC}=32.768kHz

Parameters	Min.	Typ.	Max.	Units	Notes
Supplies					
Supply Voltage (V _{DD})	1.4		5.5	V	Time-keeping mode
	3.0		5.5		I ² C bus reduced speed
Minimum Supply Voltage Detection (V _{LOW1})	1.8		2.1	V	T _{AMB} =-40 ~ +125°C
Minimum Supply Voltage Detection (V _{LOW2})	1.0		1.4	V	T _{AMB} =-40 ~ +125°C
Main Supply to Backup Supply Switchover Hysteresis (V _{HYST})		20		mV	V _{DD} to V _{BACK} = 3.0V
Supply Current I _{DD} (V _{BACK} =0V) or I _{BACK} (V _{DD} =0V)	V _{DD} =1.4V T _{AMB} = -40°C ~ +85°C	0.6	1.5	μA	I ² C bus inactive CLKOUT disabled V _{BACK} = 0V Or V _{DD} = 0V
	V _{DD} =1.4V T _{AMB} = -40°C ~ +125°C		4.6		
	V _{DD} =3.3V T _{AMB} = -40°C ~ +85°C	0.8	2.0		
	V _{DD} =3.3V T _{AMB} = -40°C ~ +125°C		5.2		
	V _{DD} =5.0V T _{AMB} = -40°C ~ +85°C	0.9	2.2		
	V _{DD} =5.0V T _{AMB} = -40°C ~ +125°C		5.5		

DTCXO TEMPERATURE COMPENSATED REAL-TIME-CLOCK MODULE WITH I2C BUS

Continued

Parameters		Min.	Typ.	Max.	Units	Notes
Supply Current (I _{DD})	SCL= 100kHz V _{DD} = 1.4V T _{AMB} = -40°C ~ +85°C			12	μA	I ² C bus active CLKOUT disabled
	SCL= 100kHz V _{DD} = 1.4V T _{AMB} = -40°C ~ +125°C			15		
	SCL= 400kHz V _{DD} = 3.3V T _{AMB} = -40°C ~ +85°C			35		
	SCL= 400kHz V _{DD} = 3.3V T _{AMB} = -40°C ~ +125°C			40		
	SCL= 400kHz V _{DD} = 5.0V T _{AMB} = -40°C ~ +85°C			50		
	SCL= 400kHz V _{DD} = 5.0V T _{AMB} = -40°C ~ +125°C			60		
Current Consumption (I _{DD32K})	V _{DD} =5.0V		2.5	3.4	μA	I ² C bus inactive CLKOUT=32.768kHz C _{LOAD} =7.5pF
	V _{DD} =3.3V		1.5	2.2		
	V _{DD} =1.4V		1.1	1.6		
Input						
LOW Level Input Voltage (V _{IL})				20%* V _{DD}	V	V _{DD} = 1.4 ~ 5.5V _{DD} Pins:SCL,SDA,CLKOE
HIGH Level Input Voltage (V _{IH})		80%* V _{DD}			V	
Input Leakage Current (I _L)	T _{amb} = -40 ~+85°C	-1		+1	μA	V _{SS} >V _I <V _{DD}
	T _{amb} = -40 ~+125°C	-1.5		+1.5		
Pull-down resistance (R _{PD}) on pin CE			240	550	kΩ	
Input Capacitance (C _I)				7	pF	
Output						
HIGH Level Output Voltage (V _{OH})	V _{DD} = 1.4V; I _{OH} = 0.1mA	1.0			V	
	V _{DD} = 3.3V; I _{OH} = 1.5mA	2.7				
	V _{DD} = 5.0V; I _{OH} = 2.0mA	4.5				
LOW Level Output Voltage (V _{OL})	V _{DD} = 1.4V; I _{OL} = 0.4mA			0.2	V	
	V _{DD} = 3.3V; I _{OL} = 1.5mA			0.25		
	V _{DD} = 5.0V; I _{OL} = 5.0mA			0.8		
HIGH Level Output Current (I _{OH})	V _{OH} = 4.5V/ V _{DD} = 5V			2.0	mA	
LOW Level Output Current (I _{OL})	V _{OL} = 0.8V/ V _{DD} = 5V			-5.0	mA	
Output Leakage Current (I _{LO})	V _O = V _{DD} or V _{SS} T _{AMB} = -40°C ~ +85°C	-1	0	+1	μA	
	V _O = V _{DD} or V _{SS} T _{AMB} = -40°C ~ +125°C	-1.5	0	+1.5		
Operating Temperature Range						
Operating Temperature Range (T _{OPR})		-40		+125	°C	
EEPROM Characteristics						
Read Voltage (V _{Read})	T _{AMB} = -40°C ~ +125°C	1.4			V	
Programming Voltage (V _{Prog})	T _{AMB} = -40°C ~ +125°C	2.2			V	
EEPROM Programming Time (T _{Prog})	T _{AMB} = -40°C ~ +125°C 1 Byte EEPROM User			35	ms	
	T _{AMB} = -40°C ~ +125°C 1 Byte EEPROM Control			100		
	T _{AMB} = -40°C ~ +125°C 2-4 Byte EEPROM Control			135		
EEPROM Write/Erase Cycles (V _{HYST})	V _{DD} to V _{BACK} = 3.0V	5000			Cycles	

DTCXO TEMPERATURE COMPENSATED REAL-TIME-CLOCK MODULE WITH I2C BUS

Continued

Parameters		Min.	Typ.	Max.	Units	Notes
Trickle Charger						
Current Limiting Resistors	R80K		80		kΩ	V _{DD} = 5.0V V _{BACK} = 3.0V T _{AMB} = 25°C
	R20k		20			
	R5k		5			
	R1.5k		1.5			
Thermometer						
Thermometer Precision (T _E)	T _{AMB} = -40°C ~ +85°C		±4		°C	
	T _{AMB} = -40°C ~ +125°C		±6			

I²C Interface Dynamic Characteristics

$V_{SS}=0V$; $T_{AMB}=-40^{\circ}C \sim +125^{\circ}C$; All timing values are valid within the operating supply voltage range and references to V_{IL} and V_{IH} with an input voltage swing from V_{SS} and V_{DD} .

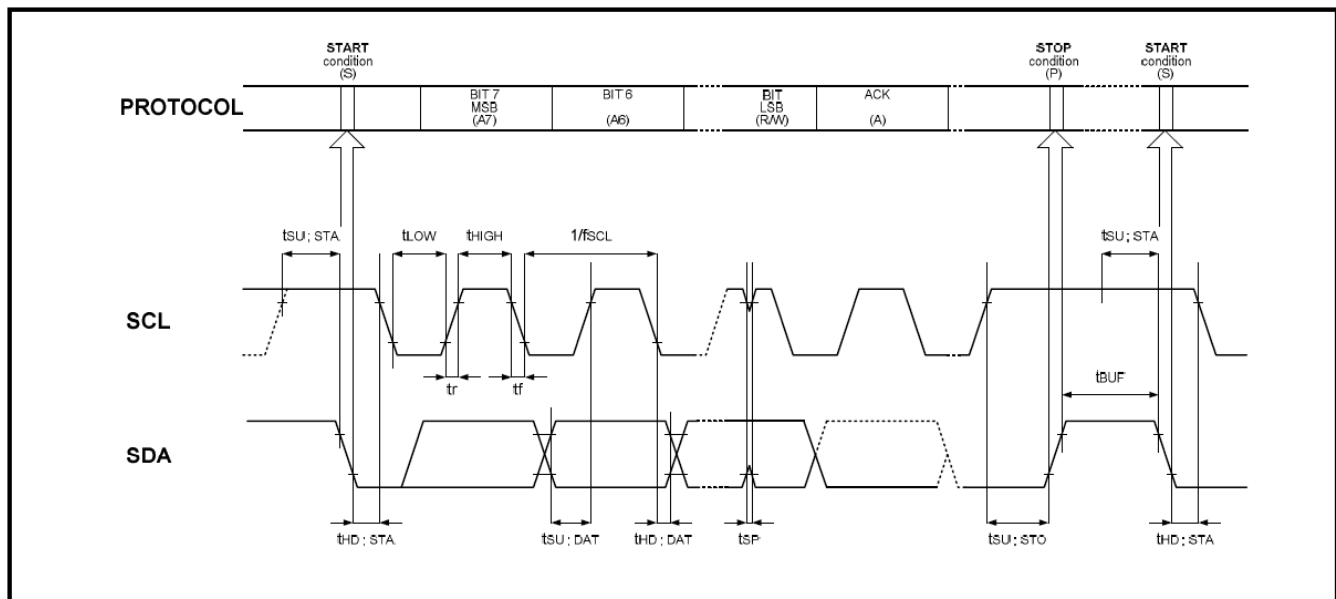
Parameters	Min.	Typ.	Max.	Units	Notes
SCL Clock Frequency (f_{SCL})			100	kHz	$V_{DD} \geq 1.4V$
			300		$V_{DD} \geq 1.8V$
			400		$V_{DD} \geq 3.0V$
Start Condition Set-up Time ($t_{SU}; STA$)	50			μs	$V_{DD} \geq 1.4V$
	30				$V_{DD} \geq 1.8V$
	20				$V_{DD} \geq 3.0V$
Start Condition Hold Time ($t_{HD}; STA$)	0.2			μs	$V_{DD} \geq 1.4V$
					$V_{DD} \geq 1.8V$
					$V_{DD} \geq 3.0V$
Data Set-up Time ($t_{SU}; DAT$)	100			ns	$V_{DD} \geq 1.4V$
	80				$V_{DD} \geq 1.8V$
	50				$V_{DD} \geq 3.0V$
Data Hold Time ($t_{HD}; DAT$)	50			ns	$V_{DD} \geq 1.4V$
	30				$V_{DD} \geq 1.8V$
	20				$V_{DD} \geq 3.0V$
Data Valid Time ($t_{VD}; DAT$)	4.0			μs	$V_{DD} \geq 1.4V$
	1.5				$V_{DD} \geq 1.8V$
	1.2				$V_{DD} \geq 3.0V$
Data Valid Acknowledge Time ($t_{VD}; ACK$)	3.5			μs	$V_{DD} \geq 1.4V$
	1.1				$V_{DD} \geq 1.8V$
	0.9				$V_{DD} \geq 3.0V$
Stop Condition Set-up Time ($t_{SU}; STO$)	50			ns	$V_{DD} \geq 1.4V$
	30				$V_{DD} \geq 1.8V$
	20				$V_{DD} \geq 3.0V$
Bus Free Time between STOP and START Condition (t_{BUF})	1.0			μs	$V_{DD} \geq 1.4V$
	0.5				$V_{DD} \geq 1.8V$
	0.4				$V_{DD} \geq 3.0V$
SCL "LOW time" (t_{LOW})	4.5			μs	$V_{DD} \geq 1.4V$
	1.7				$V_{DD} \geq 1.8V$
	1.3				$V_{DD} \geq 3.0V$
SCL "High time" (t_{HIGH})	0.6			μs	$V_{DD} \geq 1.4V$
	0.5				$V_{DD} \geq 1.8V$
	0.4				$V_{DD} \geq 3.0V$

DTCXO TEMPERATURE COMPENSATED REAL-TIME-CLOCK MODULE WITH I2C BUS

Continued

Parameters	Min.	Typ.	Max.	Units	Notes
SCL and SDA Rise Time (t_r)			1.0	μs	$V_{DD} \geq 1.4\text{V}$
			0.3		$V_{DD} \geq 1.8\text{V}$
			0.2		$V_{DD} \geq 3.0\text{V}$
SCL and SDA Fall Time (t_f)			0.4	μs	$V_{DD} \geq 1.4\text{V}$
			0.3		$V_{DD} \geq 1.8\text{V}$
			0.2		$V_{DD} \geq 3.0\text{V}$
Tolerance Spike Time on Bus (t_{SP})			50	ns	
SCL and SDA I/O Capacitance ($C_{I/O}$)			10	pF	
Capacitive Load Bus Lines (C_B)			200	pF	

I²C Interface Timing Characteristics



DTCXO TEMPERATURE COMPENSATED REAL-TIME-CLOCK MODULE WITH I2C BUS

Options and Part Identification

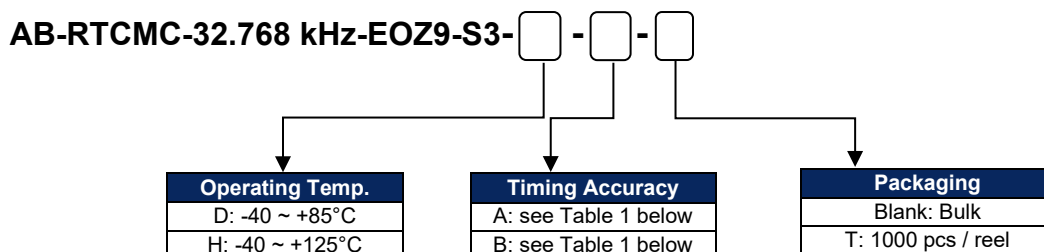
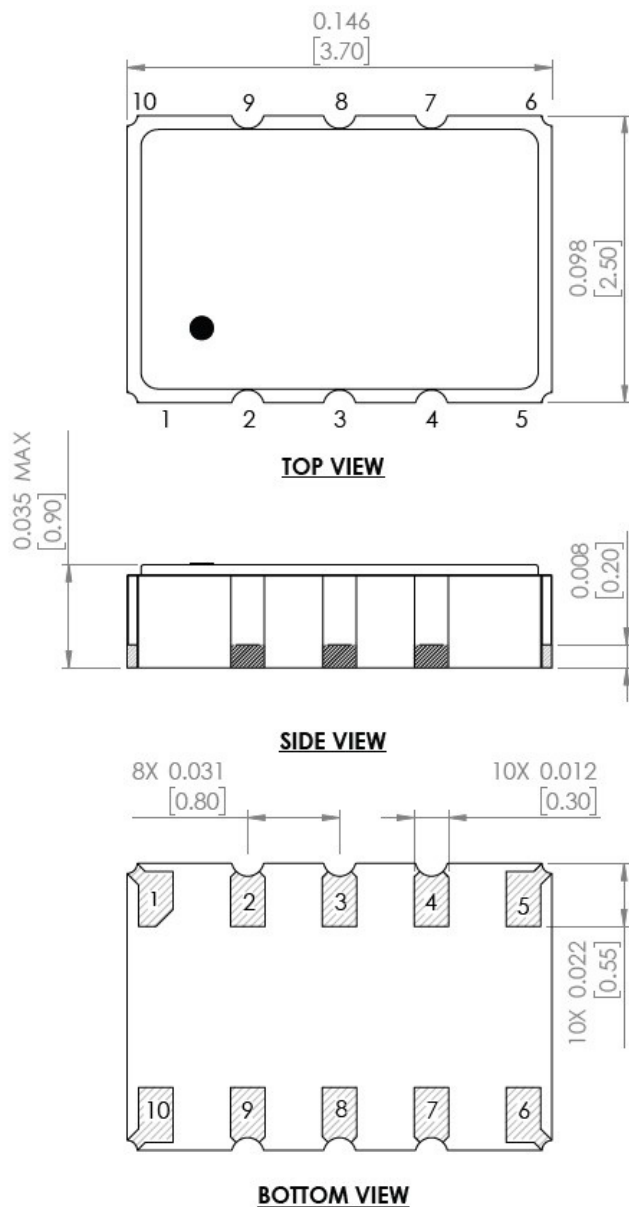


Table 1. Time accuracy, DTCXO Digitally Temperature Compensated

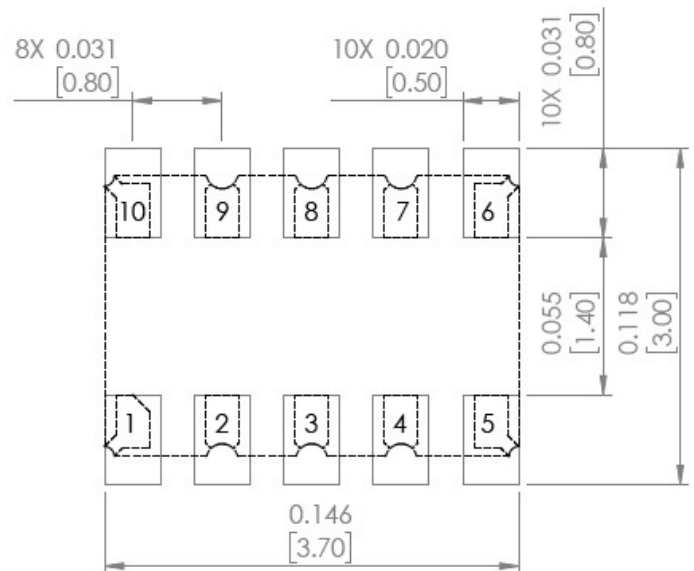
Parameters		Min.	Typ.	Max.	Units
Time Accuracy Option: A	T _{AMB} =+25°C		±1	±3	ppm
	T _{AMB} =0 ~ +50°C		±2	±4	
	T _{AMB} =-10 ~ +65°C		±3	±5	
	T _{AMB} =-40 ~ +85°C		±4	±6	
	T _{AMB} =-40 ~ +125°C		±5	±8	
Time Accuracy Option: B	T _{AMB} =+25°C		±1	±3	ppm
	T _{AMB} =0 ~ +50°C		±3	±5	
	T _{AMB} =-10 ~ +65°C		±5	±10	
	T _{AMB} =-40 ~ +85°C		±10	±25	
	T _{AMB} =-40 ~ +125°C		±15	±30	

DTCXO TEMPERATURE COMPENSATED REAL-TIME-CLOCK MODULE WITH I2C BUS

Mechanical Dimensions



RECOMMENDED LAND PATTERN



Note: Metal Lid is Connected to Vss (Pin #6)

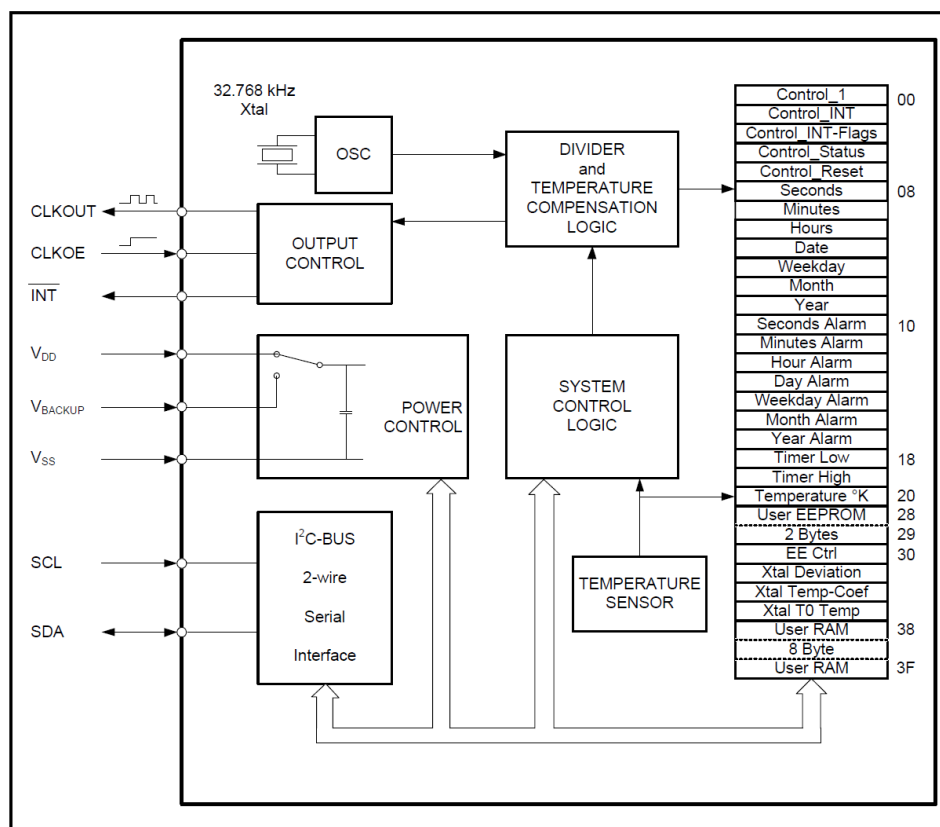
Dimensions: inches [mm]

DTCXO TEMPERATURE COMPENSATED REAL-TIME-CLOCK MODULE WITH I2C BUS

Pin Description

Pin No.	Pin Name	Function
1	CLKOE	CLKOUT enable/disable pin; enable is active HIGH; tie to GND when not using CLKOUT
2	V _{DD}	Positive supply voltage; positive or negative steps in supply voltage may affect oscillator performance, recommend 10 nF decoupling capacitor close to device
3	CLKOUT	Clock Output pin; CLKOUT or $\overline{\text{INT}}$ function can be selected. (Control_1; bit7; Clk/Int) CLKOUT output push-pull / $\overline{\text{INT}}$ function open-drain requiring pull-up resistor
4	SCL	Serial Clock Input pin; requires pull-up resistor
5	SDA	Serial Data Input-Output pin; open-drain; requires pull-up resistor
6	V _{SS}	Ground
7	$\overline{\text{INT}}$	Interrupt output pin; open-drain; active LOW
8	N.C.	Not connected; internally used for test. do not connect other signals than ground
9	V _{BACKUP}	Backup Supply Voltage; tie to GND when not using backup supply voltage
10	N.C.	Not connected; internally used for test. do not connect other signals than ground

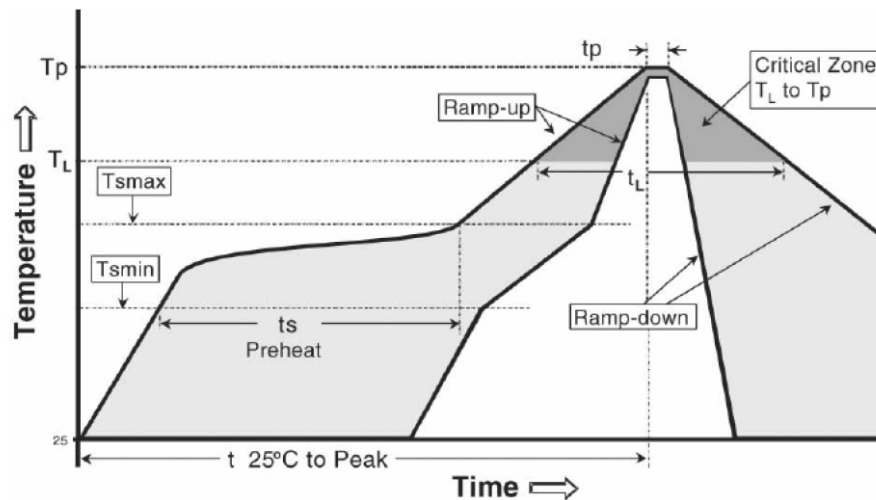
Block Diagram



DTCXO TEMPERATURE COMPENSATED REAL-TIME-CLOCK MODULE WITH I2C BUS

Recommended Reflow Profile

Maximum Reflow Conditions in accordance with IPC/JEDEC J-STD-020C "Pb-free"

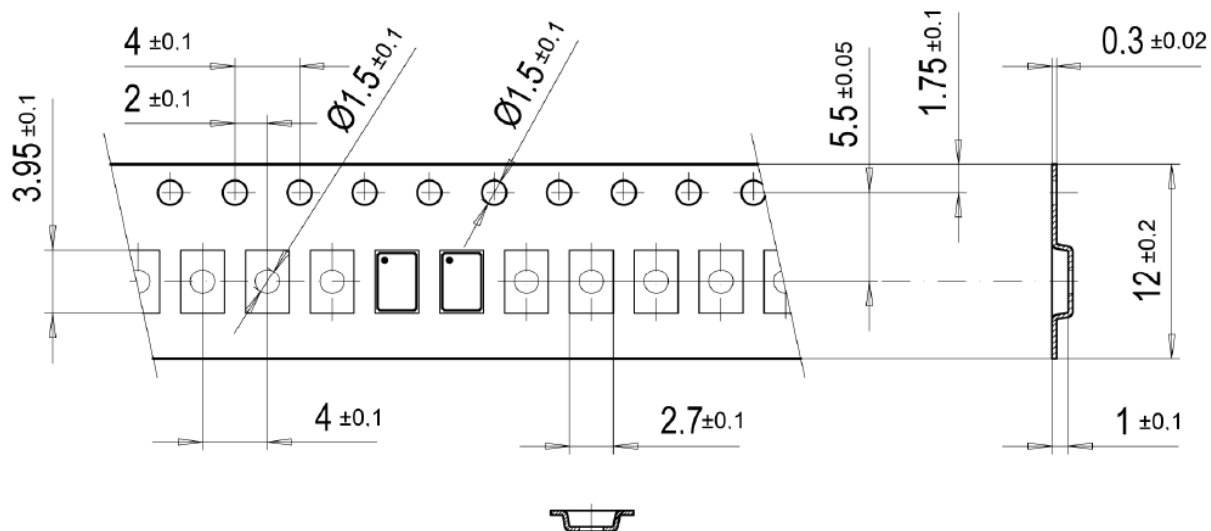


Temperature	Conditions	Units
Average Ramp-up Rate (T_{Smax} to T_P)	3°C/second max	°C/s
Ramp Down Rate (T_{cool})	6°C/second max	°C/s
Time 25°C to Peak Temperature ($T_{to-peak}$)	8 minutes max	m
Preheat		
Temperature Min (T_{Smin})	150	°C
Temperature Max (T_{Smax})	200	°C
Time T_{Smin} to T_{Smax} (t_s)	60 ~ 180	sec
Time Above Liquidus		
Temperature Liquidus (T_L)	217	°C
Time above Liquidus (t_L)	60 ~ 150	sec
Peak Temperature		
Peak Temperature (T_P)	260	°C
Time within 5°C of Peak Temperature (t_P)	20 ~ 40	sec

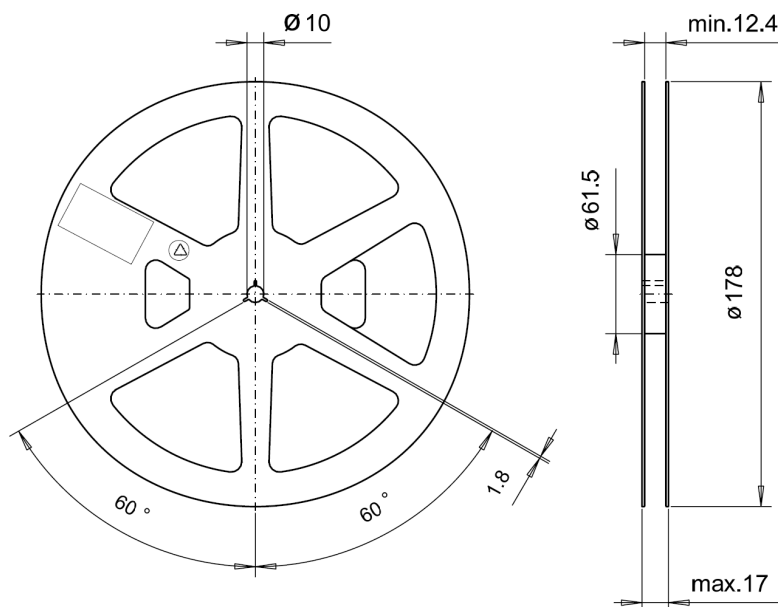
DTCXO TEMPERATURE COMPENSATED REAL-TIME-CLOCK MODULE WITH I2C BUS

Packaging

T=1000pcs/reel



 User Direction of Feed



Dimensions: mm

Revision: A
10/14/2025

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