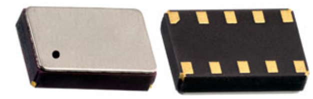
DTCXO Temperature Compensated Real-Time-Clock Module with SPI bus



3.7 x 2.5 x 0.9 mm

AB-RTCMC-32.768kHz-EOA9-S3

RoHS/RoHS II compliant

Moisture Sensitivity Level: MSL=1

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 7 for details
- Ultra low power consumption: 800nA typ @ VDD = 3.0V / Tamb = 25°C
- Wide clock operating voltage: 1.3 – 5.5V
- Wide interface operating voltage: 1.4 – 5.5V
- Extended operating temperature range: -40°C to +125°C
- SPI serial interface with fast mode SCL clock frequency of 1 MHz
- 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. RoHS-compliant and 100% leadfree

APPLICATIONS:

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

STANDARD SPECIFICATIONS:

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	$\overline{INT}$ / 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	ºC	
Storage Temperature (T_{STO})	-55		+125	ºC	Stored as bare product

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 (ΔF/F)		±10	±20	ppm	F_{CLKOUT}=32.768kHz; T_{AMB}=+25°C; V_{DD}=3.0V
Frequency vs Voltage (ΔF/V)		±0.5	±1.0	ppm/V	T_{AMB}=+25°C; V_{DD}=1.4~5.5V
Frequency vs Temperature (ΔF/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

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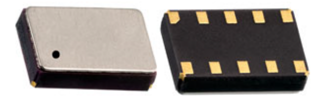

3.7 x 2.5 x 0.9 mm

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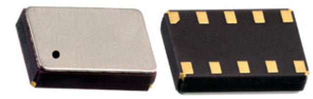
Parameters		Min.	Typ.	Max.	Units	Notes
Time accuracy, DTCXO Digitally Temperature Compensated						
Time Accuracy Option: A ($\Delta t/t$)	T_{AMB}=+25°C		±1	±3	ppm	
	T_{AMB}=0 ~ +50°C		±2	±4		
	T_{AMB}=-10 ~ +65°C		±3	±5		
	T_{AMB}=-40 ~ +85°C		±4	±6		
	T_{AMB}=-40 ~ +125°C		±5	±8		
Time Accuracy Option: 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 I²C bus reduced speed
		2.1		5.5		I²C bus full 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	SPI 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		



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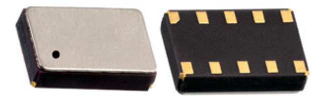
Parameters		Min.	Typ.	Max.	Units	Notes
Supply Current (I_{DD})	SCL= 200kHz V_{DD} = 1.4V T_{AMB}= -40℃ ~ +85℃			14	µA	SPI bus active CLKOUT disabled
	SCL= 200kHz V_{DD} = 1.4V T_{AMB}= -40℃ ~ +125℃			18		
	SCL= 1MHz V_{DD} = 3.3V T_{AMB}= -40℃ ~ +85℃			50		
	SCL= 1MHz V_{DD} = 3.3V T_{AMB}= -40℃ ~ +125℃			55		
	SCL= 1MHz V_{DD} = 5.0V T_{AMB}= -40℃ ~ +85℃			65		
	SCL= 1MHz V_{DD} = 5.0V T_{AMB}= -40℃ ~ +125℃			75		
Current Consumption (I_{DD32K})	V_{DD}=5.0V		2.5	3.4	µA	SPI 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,SDI,CLKOE,CE
HIGH Level Input Voltage (V_{IH})		80%* V_{DD}			V	
Input Leakage Current (I_L)	T_{amb}=-40 ~+85℃	-1		+1	µA	V_{SS}>V_I<V_{DD}
	T_{amb}=-40 ~+125℃	-1.5		+1.5		
Input Capacitance (C_I)				7	pF	



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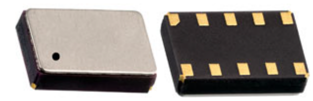
Parameters		Min.	Typ.	Max.	Units	Notes
Output						
HIGH Level Output Voltage (V_{OH})	V_{DD} = 1.4V; I_{OH} = 0.1mA	1.0			V	
	V_{DD} = 3.3V; I_{OH} = 1.5mA	2.7				
	V_{DD} = 5.0V; I_{OH} = 2.0mA	4.5				
LOW Level Output Voltage (V_{OL})	V_{DD} = 1.4V; I_{OL} = 0.4mA			0.2	V	
	V_{DD} = 3.3V; I_{OL} = 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℃ ~ +85℃	-1	0	+1	µA	
	V_O = V_{DD} or V_{SS} T_{AMB}= -40℃ ~ +125℃	-1.5	0	+1.5		
Operating Temperature Range						
Operating Temperature Range (T_{OPR})		-40		+125	℃	
EEPROM Characteristics						
Read Voltage (V_{Read})	T_{AMB}= -40℃ ~ +125℃	1.4			V	
Programming Voltage (V_{Prog})	T_{AMB}= -40℃ ~ +125℃	2.2			V	
EEPROM Programming Time (T_{Prog})	T_{AMB}= -40℃ ~ +125℃ 1 Byte EEPROM User			35	ms	
	T_{AMB}= -40℃ ~ +125℃ 1 Byte EEPROM Control			100		
	T_{AMB}= -40℃ ~ +125℃ 2-4 Byte EEPROM Control			135		
EEPROM Write/Erase Cycles (V_{HYST})	V_{DD} to V_{BACK} = 3.0V	5000			Cycles	



3.7 x 2.5 x 0.9 mm

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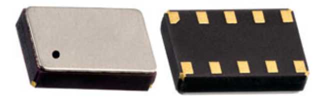
Parameters		Min.	Typ.	Max.	Units	Notes
Trickle Charger						
Current Limiting Resistors	R80K		80		kΩ	V_{DD} = 5.0V V_{BACK} = 3.0V T_{AMB}= 25℃
	R20k		20			
	R5k		5			
	R1.5k		1.5			
Thermometer						
Thermometer Precision (T_E)	T_{AMB}= -40℃ ~ +85℃		±4		℃	
	T_{AMB}= -40℃ ~ +125℃		±6			

SPI Interface Dynamic Characteristics

V_{SS}=0V; T_{AMB}=-40℃ ~+125℃; 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}.

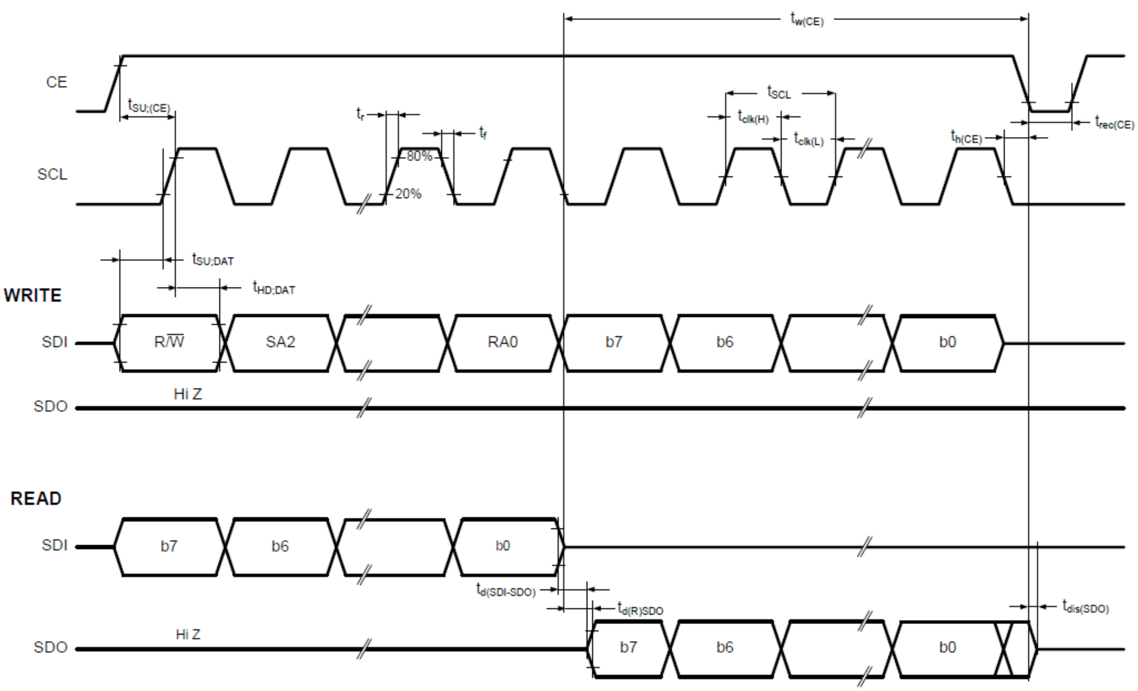
Parameters	Symbol	Notes	V_{DD}=1.6V		V_{DD}=2.4V		V_{DD}=3.3V		V_{DD}=5.0V		Units
			Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
SCL Clock Frequency	$f_{clk\ (SCL)}$			0.2		0.6		1.0		1.0	MHz
SCL Time	t_{SCL}		5		1.7		1		1		µs
Clock HIGH Time	$t_{clk(H)}$		1500		700		400		400		ns
Clock LOW Time	$t_{clk(L)}$		1500		700		400		400		ns
Rise Time	t_r	For SCL signal		800		800		200		200	ns
Fall Time	t_f	For SCL signal		800		800		200		200	ns
CE Setup Time	$t_{su(CE)}$		100		100		100		100		ns
CE Hold Time	$t_{h(CE)}$		500		300		200		200		ns
CE Recovery Time	$t_{rec(CE)}$		400		300		200		200		ns
CE Pulse Width	$t_{w(CE)}$	Measured after valid subaddress is received		0.49		0.49		0.49		0.49	s
Setup Time	t_{su}	Setup time for SDI data	20		20		20		20		ns
Hold Time	t_h	Hold time for SDI data	500		300		200		200		ns
SDO Read Delay Time	$t_{d(R)SDO}$	Bus load = 50pF		1300		650		350		350	ns
SDO Disable Time	$t_{dis(SDO)}$	No load value; bus will be held up by bus-capacitance; use RC time constant with application values		200		100		50		50	ns
Transition Time SDI to SDO	$t_{t(SDI-SDO)}$	Prepare for 0s to avoid bus conflict	0		0		0		0		ns



RoHS/RoHS II compliant

3.7 x 2.5 x 0.9 mm

Interface Timing Characteristics



PART IDENTIFICATION:

AB-RTCMC-32.768 kHz-EOA9-S3-□□□

Operating Temp. Range
D: -40 ~ +85°C
H: -40 ~ +125°C

Timing Accuracy
A: see Table 1 below
B: see Table 1 below

Packaging
Blank: Bulk
T: 1000pcs/reel

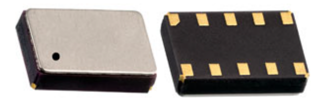
Table 1. Time accuracy, DTCXO Digitally Temperature Compensated

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 SPI bus

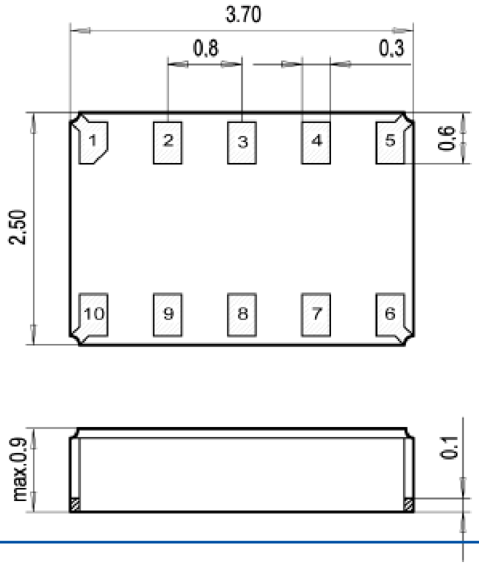
AB-RTCMC-32.768kHz-EOA9-S3

RoHS/RoHS II compliant

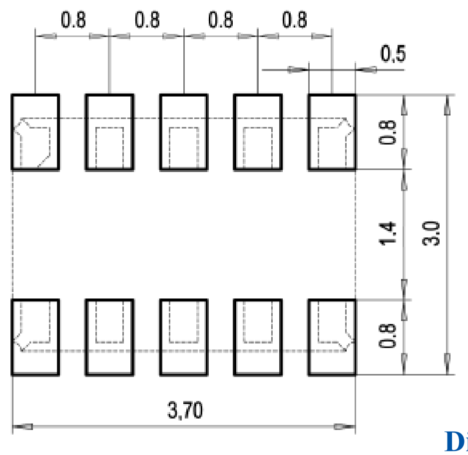


3.7 x 2.5 x 0.9 mm

OUTLINE DIMENSIONS:



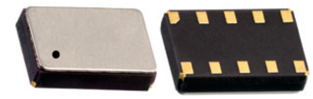
Recommended Land Pattern



Dimensions: mm

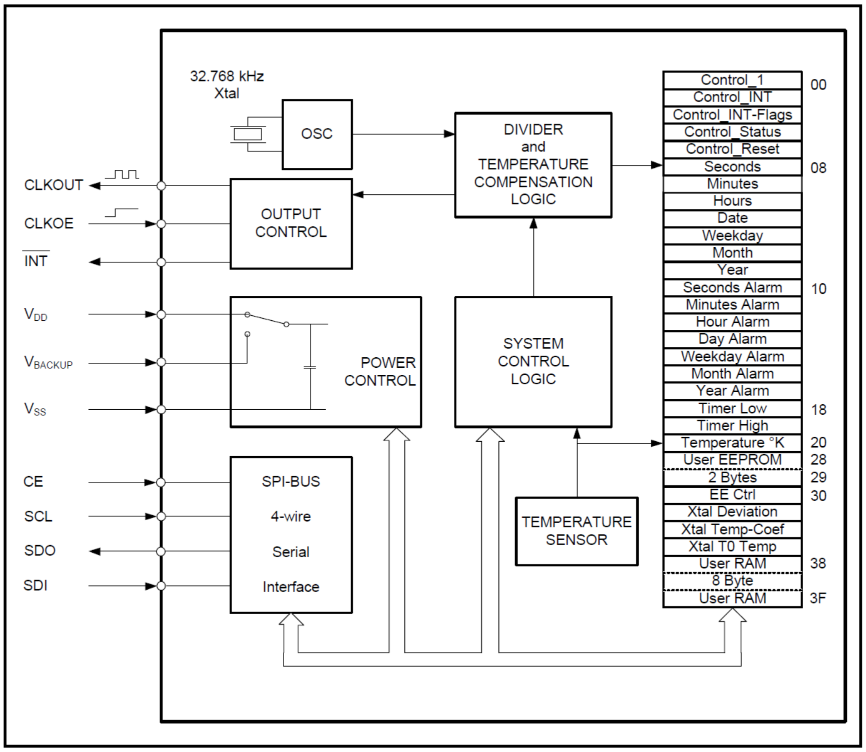
PIN DESCRIPTION:

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; may float when CE inactive
5	SDO	Serial Data Output pin; push-pull; high-impedance when not driving; can be connected to SDI for single-wire data line.
6	V_{SS}	Ground
7	$\overline{\text{INT}}$	Interrupt output pin; open-drain; active LOW
8	CE	Chip Enable input; active HIGH
9	V_{BACKUP}	Backup Supply Voltage; tie to GND when not using backup supply voltage
10	SDI	Serial Data Input pin; may float when CE inactive



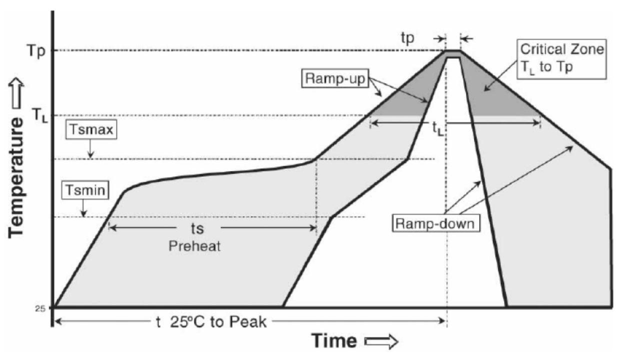
3.7 x 2.5 x 0.9 mm

BLOCK DIAGRAM:

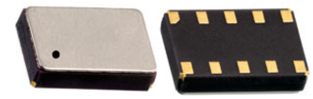


RECOMMENDED REFLOW PROFILE:

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



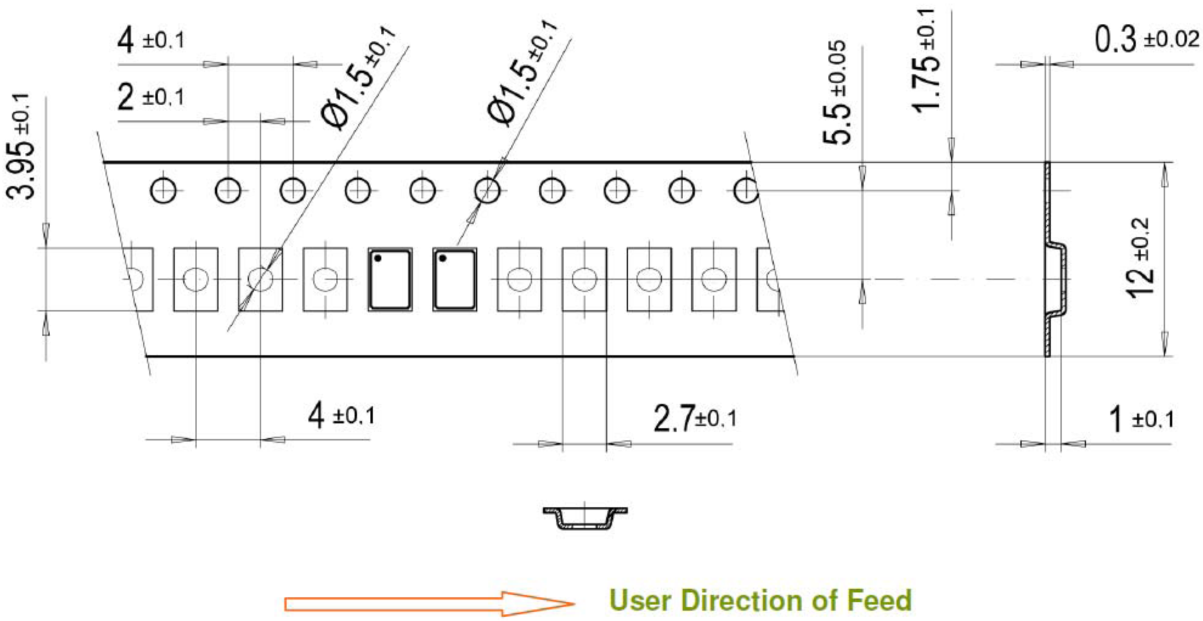
Temperature	Conditions	Units
Average Ramp-up Rate (T_{Smax} to T_P)	3°C/second max	°C/s
Ramp Down Rate (T_{cool})	6°C/second max	°C/s
Time 25°C to Peak Temperature ($T_{to\text{-}peak}$)	8 minutes max	m
Preheat		
Temperature Min (T_{Smin})	150	°C
Temperature Max (T_{Smax})	200	°C
Time Ts_{min} to Ts_{max} (ts)	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

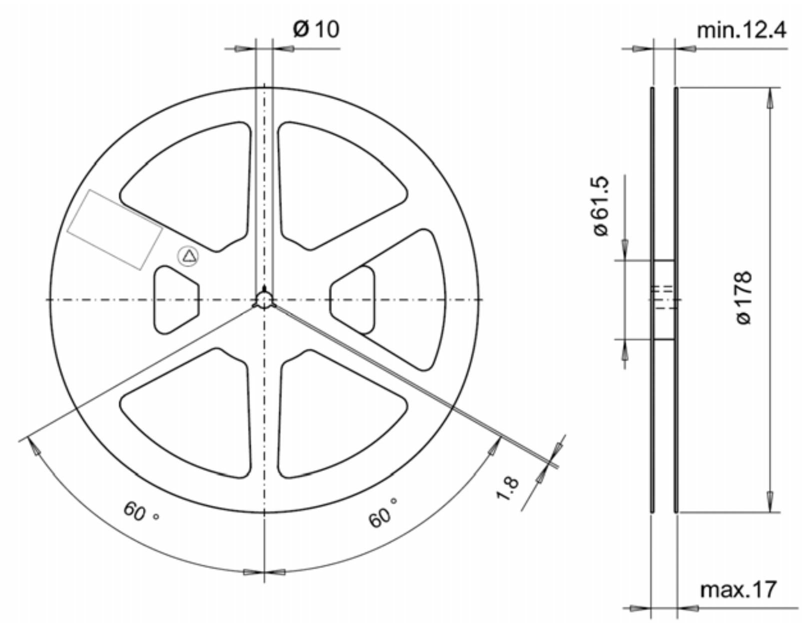


3.7 x 2.5 x 0.9 mm

TAPE & REEL:

T = 1000pcs/reel





Dimension: mm

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