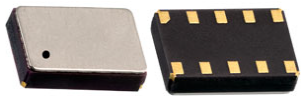
Real Time Clock Module with I²C Bus



3.7 x 2.5 x 0.9 mm

AB-RTCMC-32.768kHz-B5ZE-S3

RoHS/RoHS II compliant

Moisture Sensitivity Level: MSL=1

FEATURES:

- With state-of-the-art RTC Technology by Micro Crystal AG
- RTC module with built-in crystal oscillating at 32.768 kHz
- 1 MHz Fast-mode Plus (Fm+) two-wire I2C interface
- Wide Interface operating voltage: 1.6 – 5.5 V
- Wide clock operating voltage: 1.2 – 5.5 V
- Ultra low power consumption: 130 nA typ @ 3.0V / 25°C
- Provides year, month, day, weekday, hours, minutes, seconds
- Freely programmable Alarm and Timer functions with interrupt capability
- Low voltage detector, internal power on reset
- Battery backup input pin and switch-over circuit
- INT_1 can be programmed either as interrupt or clock output (open-drain)
- Programmable clock output for peripheral devices (32.768 kHz, 16.384 kHz, 8192 Hz, 4096 Hz, 1024 Hz, 32 Hz and 1 Hz)
- Programmable offset register for frequency adjustment
- I2C slave address: read D1h, write D0h
- 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})	-0.5		+6.5	V	
Battery Supply voltage (V_{BACKUP})	-0.5		+6.5	V	
Input Voltage (V_I)	-0.5		+6.5	V	
Output Voltage (V_O)	-0.5		+6.5	V	
Supply Current (I_{DD})	-50		+50	mA	
DC Input Current (I_I)	-10		+10	mA	
DC Output Current (I_O)	-10		+10	mA	
Operating Temperature Range (T_{OPR})	-40		+85	°C	
Storage Temperature (T_{STO})	-55		+125	°C	Stored as bare product

Frequency Characteristics

Parameters	Min.	Typ.	Max.	Units	Notes
Frequency Accuracy (ΔF/F)		±10	±20	ppm	T_{AMB}=+25°C; V_{DD}=3.0V
Frequency vs Voltage (ΔF/V)		±0.8	±1.5	ppm/V	T_{AMB}=+25°C; V_{DD}=1.8~5.5V
Frequency vs Temperature ($\Delta F/T_{OPR}$)	-0.035ppm/°C^2 (T_{OPR}-T_O)^2 ±10%			ppm	T_{REF}=+25°C; V_{DD}=3.0V
Turnover Temperature (T_O)	+20	+25	+30	°C	
Aging (first year)	-3		+3	ppm	T_{AMB}=+25°C
Oscillator Start-up Time (T_{START})		350	500	ms	T_{AMB}=+25°C
CLKOUT duty cycle	40	50	60	%	T_{AMB}=+25°C

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Static Characteristics

V_{DD} = 1.2 V to 5.5 V; V_{SS} = 0 V; T_{AMB} = -40°C to +85°C; f_{OSC} = 32.768 kHz; unless otherwise specified

Parameters		Min.	Typ.	Max.	Units	Notes
Supply Voltage (V_{DD})	For clock data integrity I²C bus inactive	1.2		5.5	V	
	I²C bus active	1.6		5.5		
	Power management function active	1.8		5.5		
Slew Rate (SR)	Of V_{DD}			±0.5	V/ms	
Battery Supply Voltage (V_{BACKUP})	Power management function active	1.8		5.5	V	
Current Consumption (I_{DD}) I²C bus active	f_{SCL}=1000kHz V_{DD} = 3.0V		100	200	µA	
	f_{SCL}=100kHz V_{DD} = 3.0V		50	100	µA	
Current Consumption (I_{DDO}) [1]	V_{DD} = 3.0V		130	180	nA	I²C bus inactive (f_{SCL}=0Hz) Interrupts disabled CLKOUT disabled Power management fct. disabled (PM[2:0] = 111) T_{amb}= +25°C
	V_{DD} = 2.0V		110	160	nA	
Current Consumption (I_{DDO}) [1]	V_{DD} = 2.0 to 5.0V			500	nA	I²C bus inactive (f_{SCL}=0Hz) Interrupts disabled CLKOUT disabled Power management fct. disabled (PM[2:0] = 111) T_{amb}= -40 ~ +85°C
Current Consumption (I_{DD32k}) [2]	V_{BACKUP} or V_{DD} = 3.0V		1200		nA	I²C bus inactive (f_{SCL}=0Hz) Interrupts disabled CLKOUT enabled (32.768kHz) Power management fct. enabled (PM[2:0] = 000) T_{amb}= +25°C
Current Consumption (I_{DD32k}) [2]	V_{BACKUP} or V_{DD} = 2.0 to 5.0V			3600	nA	I²C bus inactive (f_{SCL}=0Hz) Interrupts disabled CLKOUT enabled (32.768kHz) Power management fct. enabled (PM[2:0] = 000) T_{amb}= -40 ~ +85°C
Battery Leakage Current ($I_{L(bat)}$)	V_{DD} active; V_{BACKUP} =3.0V		50	100	nA	

(Continued)

V_{DD} = 1.2 V to 5.5 V; V_{SS} = 0 V; T_{AMB} = -40°C to +85°C; f_{OSC} = 32.768 kHz; unless otherwise specified

Parameters		Min.	Typ.	Max.	Units	Notes
Power Management						
Battery Switch Threshold Voltage ($V_{th(sw)bat}$)		2.28	2.5	2.7	V	
Inputs [3]						
LOW Level Input Voltage (V_{IL})				30%V_{DD}	V	
HIGH Level Input Voltage (V_{IH})		70%V_{DD}			V	
Input Voltage (V_I)		-0.5		V_{DD}+0.5	V	
Input Leakage Current (I_L)	V_I = V_{DD} or V_{SS}		0		nA	
	Post ESD Event	-1		+1	µA	
Input Capacitance (C_I) [4]				7	pF	
Outputs						
Output Voltage (V_O)	On pin $\overline{INT\_1}$, $\overline{INT\_2}$, CLKOUT, SDA (refers to ext. pull-up voltage)	-0.5		+5.5	V	
LOW Level Output Voltage (V_{OL})		V_{SS}		0.4	V	
LOW Level Output Current (I_{OL}) [5]	Output sink current; On pin $\overline{INT\_1}$, $\overline{INT\_2}$, CLKOUT V_{OL}=0.4V; V_{DD}=5.0V	1.5			mA	
	On pin SDA V_{OL}=0.4V; V_{DD}=3.0V	20			mA	
Output Leakage Current (I_{LO})	V_O = V_{DD} or V_{SS}		0		nA	
	Post ESD Event	-1		+1	µA	

1) Timer source clock = 1/3600 Hz, level of pins SCL and SDA is V_{SS} or V_{DD}.
2) When the device is supplied via the V_{BACKUP} pin instead of the V_{DD} pin, the current values for I_{BACKUP} will be as specified for I_{DD} under the same conditions.
3) The I²C bus is 5V tolerant.
4) Implicit by design.
5) Tested on sample basis.

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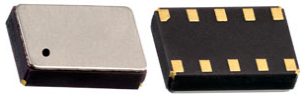
AB-RTCMC-32.768kHz-B5ZE-S3

RoHS/RoHS II compliant



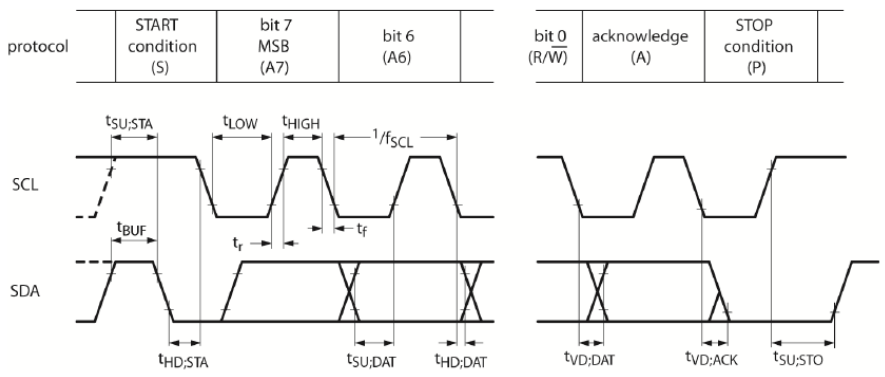
3.7 x 2.5 x 0.9 mm

I²C Interface Dynamic Characteristics

Parameters	Symbol	Standard Mode		Fast Mode (FM)		Fast Mode Plus (FM+) [1]		Units
		Min.	Max.	Min.	Max.	Min.	Max.	
Pin SCL								
SCL clock frequency [2]	f_{SCL}		100		400		1000	kHz
LOW period of SCL clock	t_{LOW}	4.7		1.3		0.5		µs
HIGH period of SCL clock	t_{HIGH}	4.0		1.6		0.26		µs
Pin SDA								
Data setup time	$t_{SU;DAT}$	250		100		50		ns
Data hold time	$t_{HD;DAT}$	0		0		0		ns
Pin SCL and SDA								
Bus free time between STOP and START condition	t_{BUF}	4.7		1.3		0.5		µs
Setup time for STOP condition	$t_{SU;STO}$	4.0		0.6		0.26		µs
Hold time (repeated) START condition	$t_{HD;STA}$	4.0		0.6		0.26		µs
Setup time for repeated START condition	$t_{SU;STA}$	4.7		0.6		0.26		µs
Rise time of both SDA and SCL signals [3] [4]	t_r		1000	$20+0.1C_b$	300		120	ns
Fall time of both SDA and SCL signals [3] [4]	t_f		300	$20+0.1C_b$	300		120	ns
Capacitive load for each bus line	C_b		400		400		550	pF
Data valid acknowledge time [5]	$t_{VD;ACK}$		3.45		0.9		0.45	µs
Data valid time [6]	$t_{VD;DAT}$		3.45		0.9		0.45	µs
Pulse width of spikes that must be suppressed by the input filter [7]	t_{SP}		50		50		50	ns

1) Fast mode plus guaranteed at 3.0 V < V_{DD} < 5.5 V.
2) The minimum SCL clock frequency is limited by the bus time-out feature, which resets the serial bus interface if either the SDA or SCL is held LOW for a minimum of 25 ms. The bus time-out feature must be disabled for DC operation.
3) A master device must internally provide a hold time of at least 300 ns for the SDA signal (refer to the V_{IL} of the SCL signal) in order to bridge the undefined region of the falling edge of SCL.
4) The maximum t_f for the SDA and SCL bus lines is 300 ns. The maximum fall time for the SDA output stage, t_f is 250 ns. This allows series protection resistors to be connected between the SDA pin, the SCL pin and the SDA/SCL bus lines without exceeding the maximum t_f.
5) $t_{VD;ACK}$ = time for acknowledgement signal from SCL LOW to SDA output LOW.
6) $t_{VD;DAT}$ = minimum time for valid SDA output following SCL LOW.
7) Input filters on the SDA and SCL inputs suppress noise spikes of less than 50 ns.

I²C Interface Timing Characteristics



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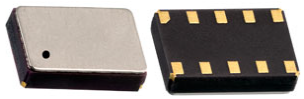


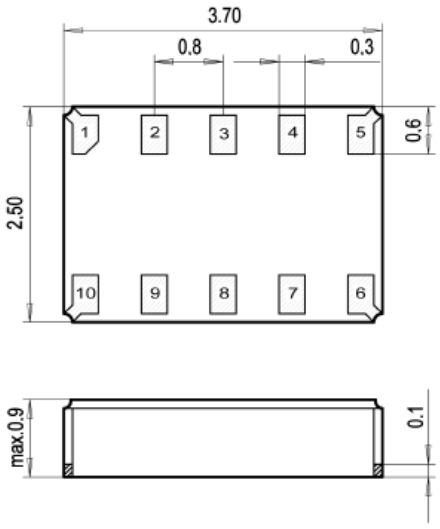
3.7 x 2.5 x 0.9 mm

PART IDENTIFICATIONS:

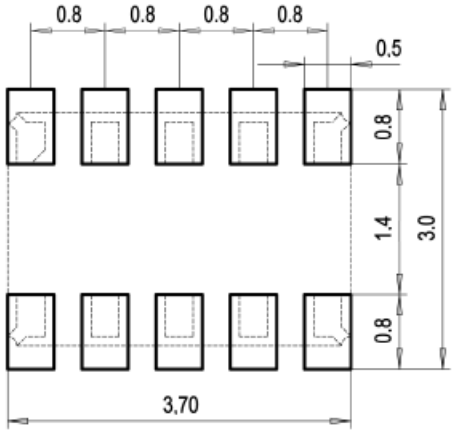
AB-RTCMC-32.768 kHz-B5ZE-S3- ☐

Packaging
Blank: Bulk
T: 1000pcs/reel

OUTLINE DIMENSIONS:



Recommended Land Pattern



Dimensions: mm

PIN DESCRIPTIONS:

Pin No.	Pin Name	Function
1	V_{DD}	Power Supply Voltage
2	$\overline{INT\_1}$	Interrupt _1 Output pin
3	SCL	Serial Clock Input pin
4	SDA	Serial Data Input-Output pin
5	CLKOUT	Clock Output pin; push-pull
6	$\overline{INT\_2}$	Interrupt _2 Output pin
7	V_{SS}	Ground
8	V_{BACKUP}	Backup Supply Voltage
9	N.C.	Not Connected
10	N.C.	Not Connected

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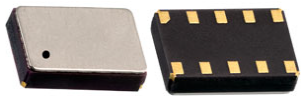

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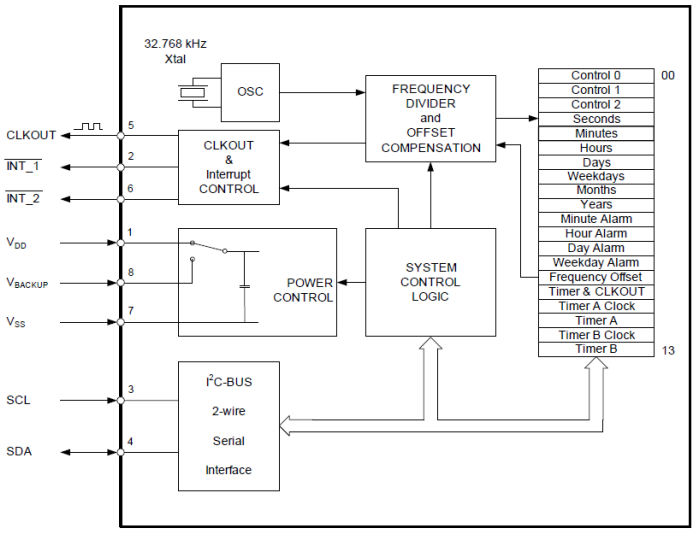
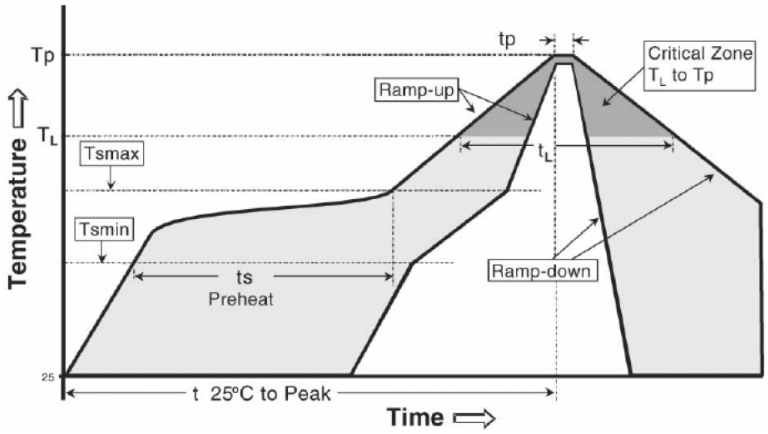
BLOCK DIAGRAM:



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

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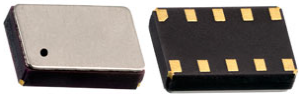

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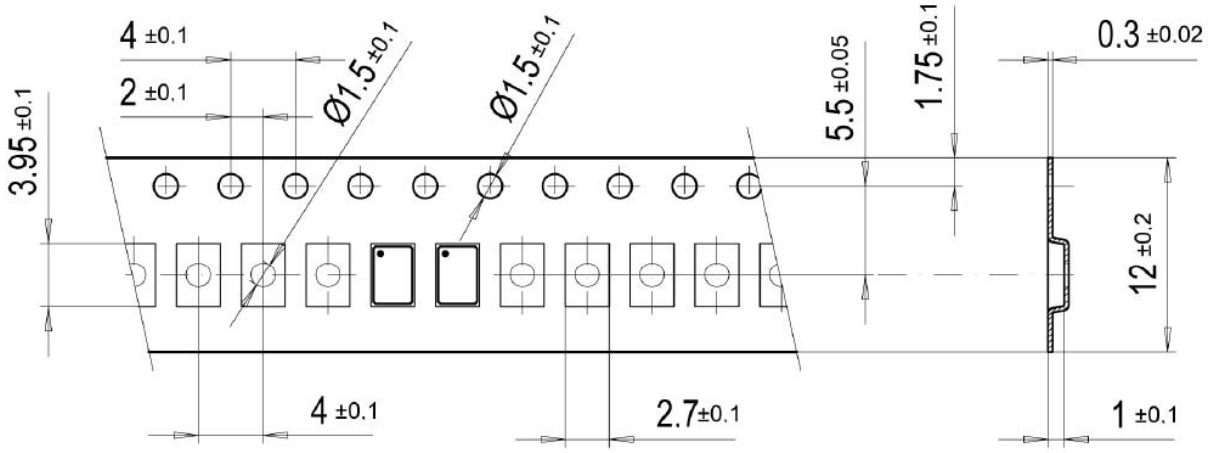
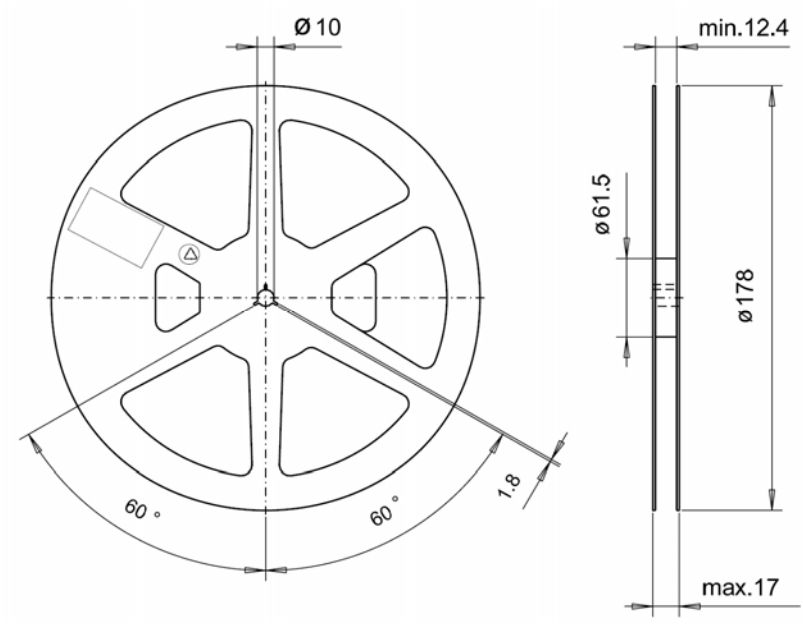
TAPE & REEL:

T = 1000pcs/reel





Dimension: mm

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