TQ 012-30

EPSON

THE CRYSTALMASTER

Product Catalog

1997/1998

SEIKO EPSON CORP.

ENERGY SAVING EPSON

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TABLE OF CRYSTAL UNITS

Frequency range

	Model	20 KHz	100 KHz	1 MHz	24 MHz	40 MHz	64 MHz
Low and medium-frequency crystal units (tuning fork crystal units)	C-001R	● 32.768 KHz					
	C-002RX	● 32.768 KHz					
	C-004R	● 32.768 KHz					
	C-005R	● 32.768 KHz					
	C-2-TYPE	20 KHz to 165 KHz, 307.2 KHz					
	C-4-TYPE	32 KHz to 120 KHz, 192 KHz *1					
	MC-206	32 KHz to 100 KHz					
	MC-306	20 KHz to 165 KHz *1					
	MC-405/406	20 KHz to 165 KHz, 307.2 KHz *1					
High-frequency crystal units (AT-cut crystal units)	CA-301			4 MHz to 64 MHz *2			
	MA-306			17.7 MHz to 41 MHz			
	MA-406			4 MHz to 64 MHz *2			
	MA-505/506						
	CA-303HS			9.6 MHz to 27 MHz			
	MA-406H						
	SA-315H/HZ			10 MHz to 27 MHz			
	FA-365/7/8			14 MHz to 41 MHz			

* 1 Since there are unavailable frequencies, please be sure to contact your nearest distributor or please refer to the frequency list. (page 14)
* 2 8.0 MHz < f < 8.2 MHz: unavailable. For frequencies less than 5.5MHz, please refer to the frequency list. (page 18)

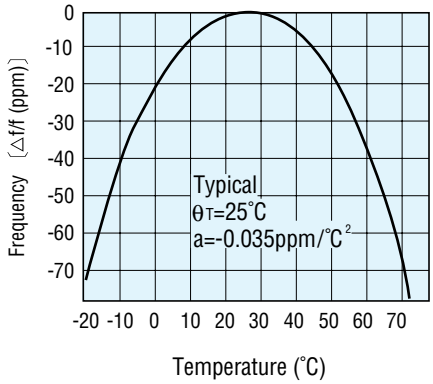
Specifications

Item	Dimensions	Nominal frequency	Frequency tolerance (standard)	Frequency temperature characteristics	Series resistance	Load capacitance	Storage temperature range	Operating temperature range
	L x W x H (mm)	f	Δf/f		R1	CL	TSTG	TOPR
C-001R	ø3.1 x 8.0	32.768 KHz	±20ppm	Peak temperature (θT): 25°C typ.	35 KΩ to 50 KΩ	6pF to ∞	-20 to +70°C	-10 to +60°C
C-002RX	ø2.0 x 6.0							
C-004R	ø1.5 x 5.0							
C-005R	ø1.2 x 4.6							
C-2-TYPE	ø2.0 x 6.0	20KHz to 165KHz 307.2 KHz	±20 to ±100ppm	Temperature coefficient (a): -0.035ppm/°C² typ. Δf/f (ppm) =a (θT-θX)²	6 to 55 KΩ			
C-4-TYPE	ø1.5 x 5.0	32 KHz to 120 KHz 192 KHz	±50 to ±100ppm		10 to 55 KΩ			
MC-206	7.3 x 4.1 x 2.0	32 KHz to 100 KHz	±20 to ±100ppm		15 to 55 KΩ			
MC-306	8.0 x 3.8 x 2.54	20 KHz to 165 KHz			6 to 55 KΩ		-55 to +125°C	-40 to +85°C
MC-405/406	10.4 x 4.1 x 3.56	20 KHz to 165 KHz 307.2 KHz						
CA-301	ø3.1 x 8.9 ø3.1 x 10.3	4 MHz to 64 MHz	±30ppm	±30ppm (±50ppm)	40 to 150 Ω	Fundamental: 10pF to ∞, 3rd overtone: 5pF to ∞	-40 to +85°C	-20 to +70°C
MA-306	8.0 x 3.8 x 2.54	17.734 MHz to 41 MHz	±50ppm	±30ppm	60 KΩ		-55 to +100°C	
MA-406	11.7 x 4.8 x 3.7	4 MHz to 64 MHz		±30ppm (±50ppm)	40 to 150 Ω			
MA-505/506	13.5 x 5.1 x 4.57							
CA-303HS	ø3.1 x 8.9	9.6 MHz to 27 MHz	±10ppm	±3 to ±20ppm	25 to 50 Ω	10pF to ∞	-55 to +125°C	-40 to +85°C
MA-406H	11.7 x 4.8 x 3.7							
SA-315H/HZ	8.0 x 3.0 x 1.55	10 MHz to 27 MHz			30 to 40 Ω			
FA-365/7/8	6.2 x 3.7 x 1.4	14 MHz to 41 MHz	±50ppm,±100ppm	±30ppm	50 Ω			-20 to +70°C

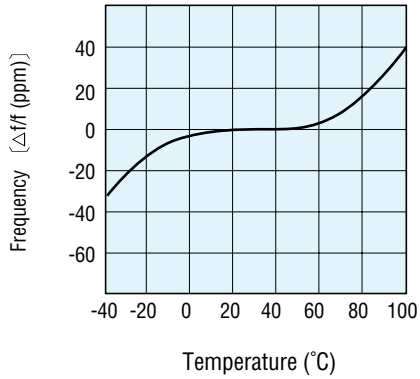
Note: For detailed specifications, refer to the individual specifications for each product.

Frequency and temperature characteristics example

● Tuning fork crystal units



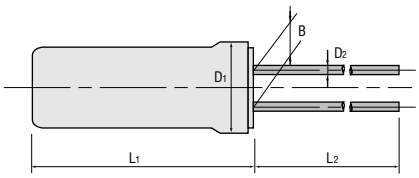
● AT-cut crystal units



Dimensions

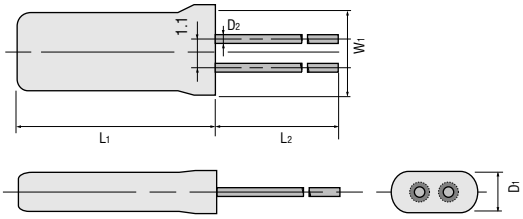
(Unit: mm)

Cylinder

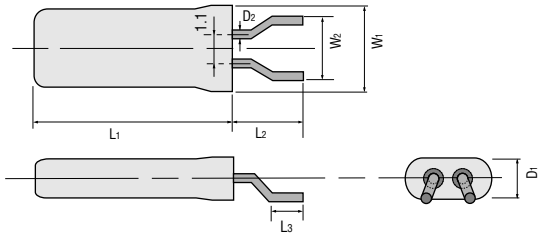


Model		L1	L2	D1	D2	B
C-001R		8.0 max.	9.0 min.	ø3.1 max.	ø0.3	1.1
C-002RX/C-2-TYPE		6.0 max.	4.0 min.	ø2.0 max.	ø0.2	0.7
C-004R/C-4-TYPE		5.0 max.	4.0 min.	ø1.5 max.	ø0.2	0.5
C-005R		4.6 max.	4.0 min.	ø1.2 max.	ø0.15	0.3
CA-301	Over 5.5 MHz	8.9 max.	9.5 min.	ø3.1 max.	ø0.3	1.1
	Under 5.5 MHz	10.3 max.	9.5 min.	ø3.1 max.	ø0.3	1.1
CA-303HS		8.9 max.	9.5 min.	ø3.1 max.	ø0.3	1.1

SA-315H

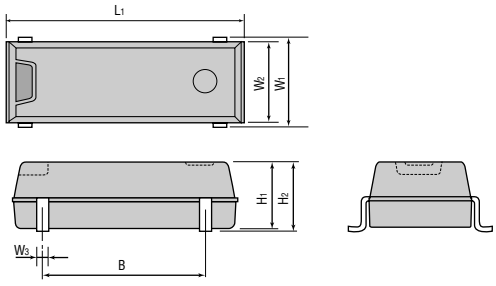


SA-315HZ

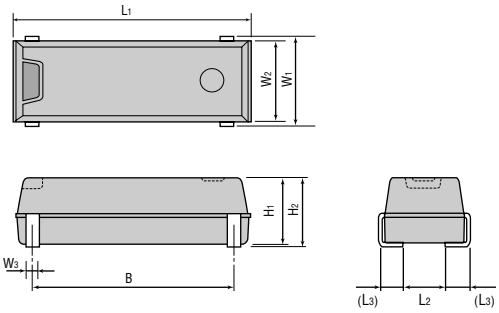


Model	L1	L2	L3	W1	W2	D1	D2	B
SA-315H	8.0 max.	7.5 min.	–	3.0 max.	–	1.55	ø 0.3	1.1
SA-315HZ	8.0 max.	2.0 min.	0.7 min.	3.0 max.	2.5 max.	1.55	ø 0.3	1.1

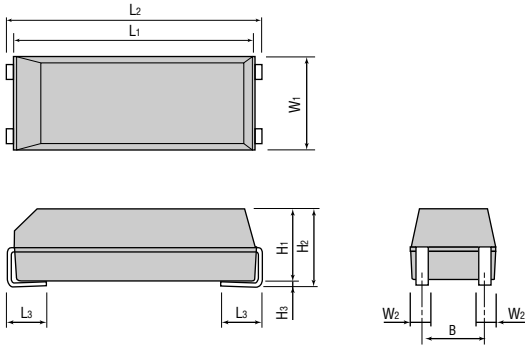
SMD



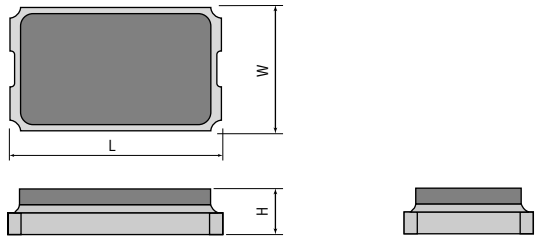
Model	L1	W1	W2	W3	H1	H2	B
MC-206	7.3 max.	4.1	2.5	0.4	1.8	2.0 max.	5.08



Model	L1	L2	L3	W1	W2	W3	H1	H2	B
MC/MA-306	8.0 max.	1.9	(0.9)	3.8 max.	3.2	0.5	2.38	2.54 max.	5.5
MA-406/406H	11.7 max.	2.1	(1.2)	4.8 max.	4.0	0.7	3.50	3.7 max.	9.6



Model	L1	L2	L3	W1	W2	B	H1	H2	H3
MC-405/406	9.6	10.41 max.	2.54	4.06 max.	0.51	2.29	3.15	3.60 max.	0.2 min.
MA-505/506	12.7	13.46 max.	2.54	5.08 max.	1.09	3.30	4.19	4.60 max.	0.2 min.



Model	L	W	H
FA-365/367/368	6.2 max.	3.7 max.	1.4 max.

TABLE OF CRYSTAL OSCILLATORS

Frequency range

	Model	1 Hz — 100 KHz — 1 MHz — 26 MHz — 40 MHz — 67 MHz — 125 MHz
Low and medium-frequency crystal oscillators (builtin tuning fork crystal unit)	SPG-8640 series	0.005 Hz to 1 MHz
	SPG-8650 series	0.00027 Hz to 153.6 KHz
	SPG-8651 series	0.00027 Hz to 100 KHz
	SG-10	10 Hz to 153.6 KHz
High-frequency crystal oscillators (builtin AT-cut crystal unit)	SG-11	1.5 MHz to 24 MHz
	SG-51P	1.025 MHz to 26.00 MHz
	SG-531P	
	SG-615P	
	SG-51PTJ	26.0001 MHz to 66.6667 MHz
	SG-531PTJ	
	SG-615PTJ	
	SG-51PH	
	SG-531PH	
	SG-615PH	
	SG-636PTF	2.2 MHz to 41 MHz
	SG-636PTJ	41 MHz to 70 MHz
	SG-636PH	
	SG-636SCE	2.2 MHz to 40 MHz
	SG-636PCE	
High-stability oscillators	HG-1012JA	1.5 MHz to 28.6363 MHz
	HG-2012JA	
Voltage-controlled crystal oscillator data sheets	VG-1011JA	
	VG-2320SC	12 MHz to 20 MHz
Multi-output crystal oscillators (builtin AT-cut crystal unit)	MG-3020	1.1 MHz to 40 MHz
	MG-7010	20 MHz to 120 MHz

Specifications

Model \ Item	Output frequency range	Frequency stability	Current consumption	Package type	Operating temperature	Operating voltage	Output load	Output control
SPG-8640 series	0.005 Hz to 1 MHz	±100ppm	2mA max.	DIP 16-pin	-10˚C to +70˚C	5V ±0.5V	TTL 1 C_L 15pF	RESET
SPG-8650 series	0.00027 Hz to 153.6 KHz	±50ppm	0.5mA max.					
SPG-8651 series	0.00027 Hz to 100 KHz	±5ppm			-10˚C to +60˚C			
SG-10	10 Hz to 153.6 KHz	±50ppm (±10ppm)						
SG-11	1.5 MHz to 24 MHz	±100ppm	10mA max.	SIP 3-pin	-10˚C to +70˚C			—
SG-51P SG-531P SG-615P	1.025 MHz to 26.00 MHz		23mA max.	DIP 14-pin DIP 8-pin SMD			TTL 10 C_L 50pF	
SG-51PTJ SG-531PTJ SG-615PTJ	26.0001 MHz to 66.6667 MHz		35mA max.	DIP 14-pin DIP 8-pin SMD			TTL 5	
SG-51PH SG-531PH SG-615PH				DIP 14-pin DIP 8-pin			C_L 50pF	OE
SG-636PTF	2.2 MHz to 41 MHz		17mA max.					
SG-636PTJ	41 MHz to 70 MHz		35mA max.				TTL 5	
SG-636PH							CL20pF(< 55 MHz) CL15pF (> 55 MHz)	
SG-636SCE	2.2 MHz to 40 MHz		9mA max.	SMD		3.3V ± 0.3V	C_L 30pF	ST
SG-636PCE								OE
HG-1012JA HG-2012JA	1.5 MHz to 28.6363 MHz	±15 to±30ppm	10mA max.		-20˚C to +70˚C	5V ±0.25V	C_L 15pF	
VG-1011JA		±15 to±25ppm			-40˚C to +85˚C	5V ±0.5V	TTL 2 C_L 15pF	—
VG-2320SC	12 MHz to 20 MHz	±15ppm	2.5mA max.		-20˚C to +75˚C	3V ±0.3V	2KΩ // 10pF	
MG-3020	1.1 MHz to 40 MHz	±100ppm	20mA max.	DIP 14-pin	-10˚C to +70˚C	5V ±0.25V	C_L 15pF	RESET
MG-7010	20 MHz to 120 MHz		27mA max.	SOP 14-pin		2.7V to 5.5V		ST/OE

- OE: Output enable
- ST: Stand-by (low level)
- For detailed specifications, refer to the individual specifications for product.

Frequency range of SG-8002 series

	Model	1 MHz	55 MHz	90 MHz	125 MHz
SG-8002 series	SG-8002DB PT	1.0MHz to 125MHz (-20 to +70°C)			
	SG-8002DB ST				
	SG-8002DC PT				
	SG-8002DC ST				
	SG-8002DB PH	1.0MHz to 55MHz (-40 to +85°C)			
	SG-8002DB SH				
	SG-8002DC PH				
	SG-8002DC SH				
	SG-8002DB PC	1.0MHz to 90MHz (-40 to +85°C)			
	SG-8002DB SC				
	SG-8002DC PC				
	SG-8002DC SC				
	SG-8002JA PT	1.0MHz to 125MHz (-20 to +70°C)			
	SG-8002JA ST				
	SG-8002JA PH	1.0MHz to 55MHz (-40 to +85°C)			
	SG-8002JA SH				
	SG-8002JA PC	1.0MHz to 90MHz (-40 to +85°C)			
	SG-8002JA SC				
	SG-8002JC PT	1.0MHz to 125MHz (-20 to +70°C)			
	SG-8002JC ST				
	SG-8002JC PH				
	SG-8002JC SH				
	SG-8002JC PC	1.0MHz to 90MHz (-20 to +70°C)			
	SG-8002JC SC				
	SG-8002CA PT	1.0MHz to 125MHz (-20 to +70°C)			
	SG-8002CA ST				
	SG-8002CA PH	1.0MHz to 55MHz (-40 to +85°C)			
	SG-8002CA SH				
	SG-8002CA PC	1.0MHz to 90MHz (-40 to +85°C)			
	SG-8002CA SC				

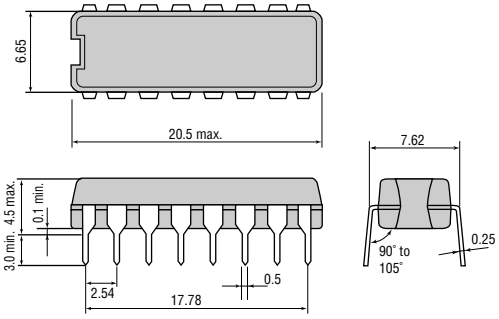
Specifications of SG-8002 series

Model \ Item	Output frequency range	Frequency stability	Current consumption	Package type	Operating temperature	Operating voltage	Output load	Output control
SG-8002DB PT	1.0MHz to 125.0MHz	B: ± 50ppm (-20 to +70°C)	45mA max.	DIP 14-pin	-20°C to +70°C (-45 to +85°C)	4.5V to 5.5V	5TTL + 15pF (-20 to +70°C)	OE
SG-8002DB ST								ST
SG-8002DC PT				DIP 8-pin				OE
SG-8002DC ST								ST
SG-8002DB PH				DIP 14-pin			25pF (-20 to +70°C)	OE
SG-8002DB SH								ST
SG-8002DC PH				DIP 8-pin				OE
SG-8002DC SH								ST
SG-8002DB PC	1.0MHz to 90.0MHz	C: ± 100ppm (-20 to +70°C) M: ± 100ppm (-45 to +85°C)	25mA max.	DIP 14-pin	-45 to +85°C	2.7V to 3.6V	15pF (-45 to +85°C/3.3V)	OE
SG-8002DB SC								ST
SG-8002DC PC				DIP 8-pin				OE
SG-8002DC SC								ST
SG-8002JA PT	1.0MHz to 125.0MHz	B: ± 50ppm (-20 to +70°C) C: ± 100ppm (-20 to +70°C)	45mA max.	SMD	-20°C to +70°C (-45 to +85°C)	4.5V to 5.5V	5TTL + 15pF (-20 to +70°C)	OE
SG-8002JA ST								ST
SG-8002JA PH							25pF (-20 to +70°C)	OE
SG-8002JA SH								ST
SG-8002JA PC	1.0MHz to 90.0MHz		25mA max.		-45 to +85°C	2.7V to 3.6V	15pF (-45 to +85°C/3.3V)	OE
SG-8002JA SC								ST
SG-8002JC PT	1.0MHz to 125.0MHz		45mA max.		-20°C to +70°C	4.5V to 5.5V	15pF (-20 to +70°C)	OE
SG-8002JC ST								ST
SG-8002JC PH							15pF (-20 to +70°C)	OE
SG-8002JC SH								ST
SG-8002JC PC	1.0MHz to 90.0MHz		25mA max.			2.7V to 3.6V	15pF (-20 to +70°C/ 3.3V)	OE
SG-8002JC SC								ST
SG-8002CA PT	1.0MHz to 125.0MHz	B: ± 50ppm (-20 to +70°C) C: ± 100ppm (-20 to +70°C)	45mA max.		-20°C to +70°C (-45 to +85°C)	4.5V to 5.5V	5TTL + 15pF (-20 to +70°C)	OE
SG-8002CA ST								ST
SG-8002CA PH							25pF (-20 to +70°C)	OE
SG-8002CA SH								ST
SG-8002CA PC	1.0MHz to 90.0MHz	M: ± 100ppm (-45 to +85°C)	25mA max.		-45 to +85°C	2.7V to 3.6V	15pF (-45 to +85°C/3.3V)	OE
SG-8002CA SC								ST

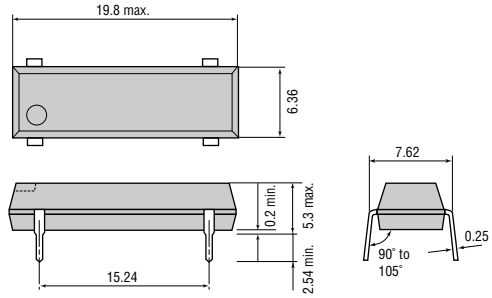
Dimensions

(Unit: mm)

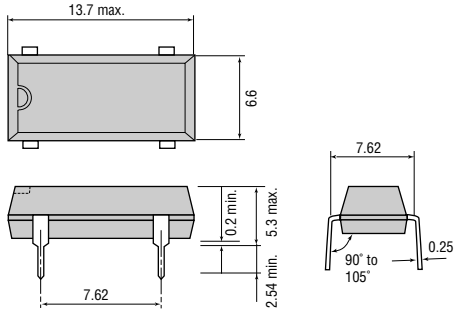
DIP 16-pin (SPG series)



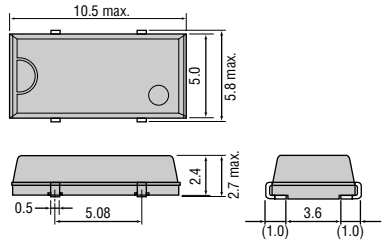
Compatible with full-size metal can (SG-51 series, SG-8002DB series)



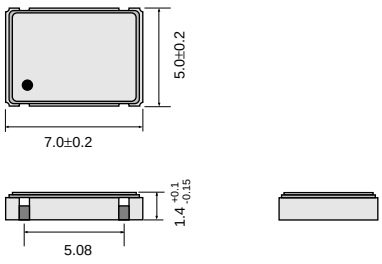
Compatible with half-size metal can (SG-531 series, SG-8002DC series)



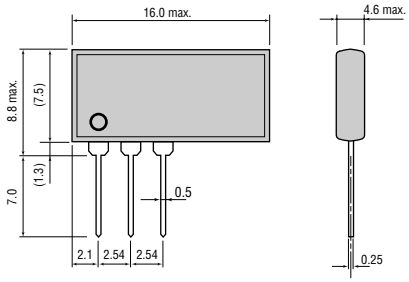
SMD (SG-636 series, SG-8002JC series)



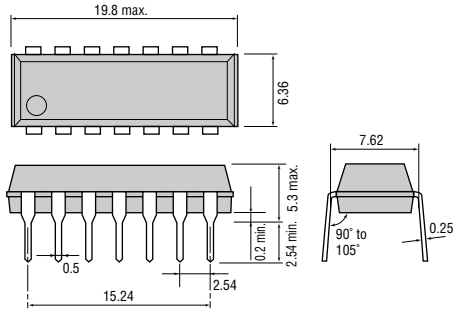
SMD (SG-8002CA series)



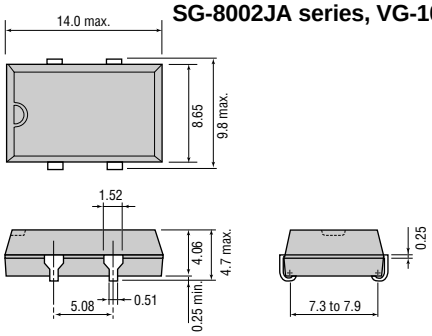
SIP 3-pin (SG-10/11)



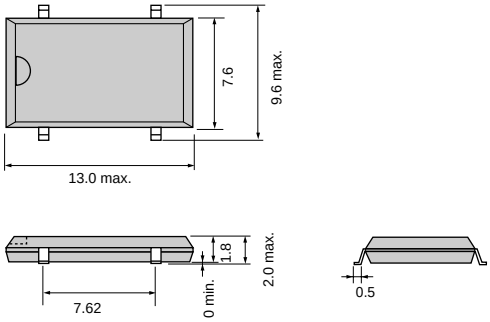
DIP 14-pin (MG-3020)



SMD (SG-615 series, HG-1012JA/2012JA, SG-8002JA series, VG-1011JA series)



SOP (VG-2320SC series)



SOP 14-pin (MG-7010)

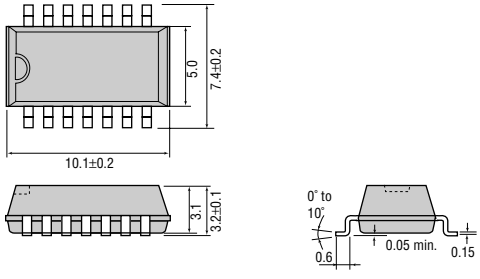


TABLE OF REAL TIME CLOCK MODULES

Characteristics

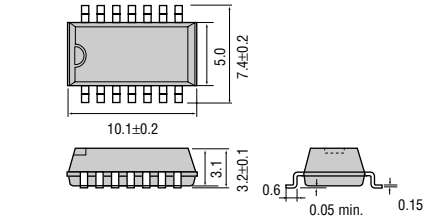
Item / Model	Package	Counter (time counting)	Access time (synchronous signal cycle)	Data bit	Address bit	Memory	Alarm	Time interval of standard pulse	Other features
RTC-4513	SOP 14-pin	Second to year, day of the week	(CLK: 300ns)	Serial		—	—	64 Hz, 1 min., 1 hour	
RTC-4543 SA	SOP 14-pin		(CLK: 0.75μs)					32.768 KHz,1 Hz	32.768 KHz OUTPUT
RTC-4543 SB	SOP 18-pin								
RTC-4553	SOP 14-pin		(CLK: 2μs)			4bit x 30		1024 Hz, 10 sec.	High-frequency stability (±5ppm)
RTC-8583		1/100sec. to year, day of the week	(SCL: 10μs)			8bit x 240	1/100 sec. to month	—	I²C-bus
RTC-8593/ SB	SOP 14/ 18pin					—			
RTC-58321	DIP 16-pin	Second to year and day of the week	2μs	4	4	—		1024 Hz to 1 hour	I/O Connection
RTC-58323	SOP 24-pin								
RTC-62421	DIP 18-pin		120ns					64 Hz, 1 second, 1 min.,1 hour	Intel bus
RTC-62423	SOP 24-pin								
RTC-72421	DIP 18-pin								Intel bus (low current consumption)
RTC-72423	SOP 24-pin								
RTC-63421	DIP 18-pin		Intel bus: 120ns Motorola bus: 220ns			4bit x 17 (select)	Second to month and day of the week	1024 Hz, 128 Hz, 64 Hz, 16 Hz, 2 Hz, 1 sec.,1 min.,10 min.	Intel bus
RTC-63421M									Motorola bus
RTC-63423	SOP 24-pin								"MOTEL bus" system
RTC-64611	DIP 24-pin	Sec. to year, day of the week, and 64Hz to 1Hz	85ns			4bit	Sec. to date, day of the week and 64 Hz	64 Hz, 32 Hz, 16 Hz, 8 Hz, 4 Hz, 2 Hz, 1 Hz	Same bus interface and battery backup as S-RAM
RTC-64613	SOP 24-pin								
RTC-65271	DIP 28-pin	Second to year, day of the week		8		4-kBytes	Sec. to hour	8192 Hz to 2 Hz	Builtin battery holder
RTC-6593	SOP 24-pin		325ns		6	114-Bytes	Sec. to hour and Sec. to month (extended alarm)		Extended alarm

Note: For detail specifications, refer to the individual specifications for each product.

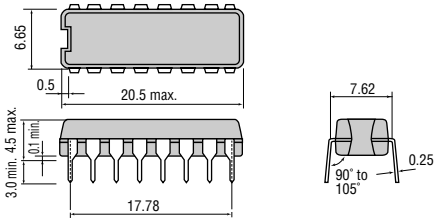
Dimensions

(Unit: mm)

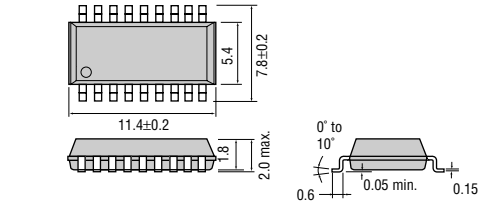
● **SOP 14-pin (RTC-4513/4543SA/4553/8583/8593)**



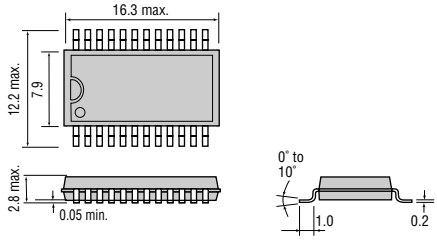
● **DIP 16-pin (RTC-58321)**



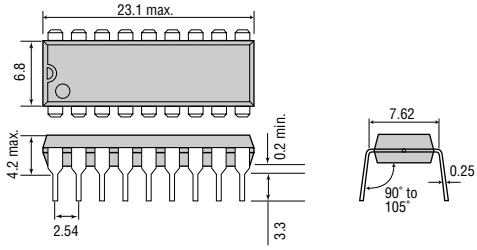
● **SOP 18-pin (RTC-4543SB/RTC-8593SB)**



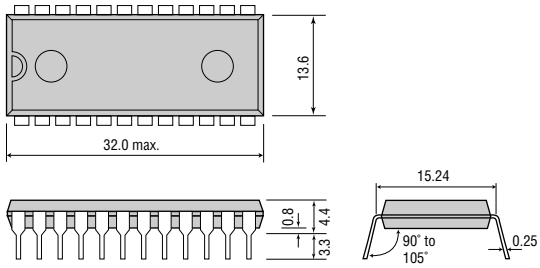
● **SOP 24-pin (RTC-58323/62423/72423/63423/64613/6593)**



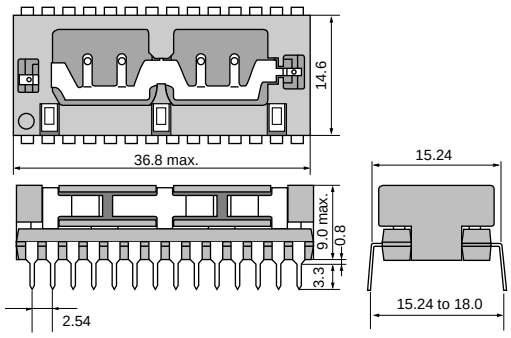
● **DIP 18-pin (RTC-62421/72421/63421/63421M)**



● **DIP 24-pin (RTC-64611)**



● **DIP 28-pin (RTC-65271)**



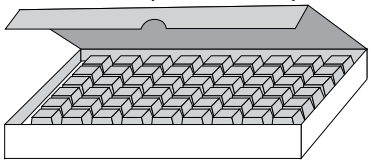
PACKING SPECIFICATIONS

1. Cylinder

Cylinder products are packed in vinyl bags per lot of 250 to 1,000pcs. From 5 to 20 bags are then placed in inner boxes to make a lot. Inner boxes are then placed in cartons for shipment. (the quantity varies with the model.)

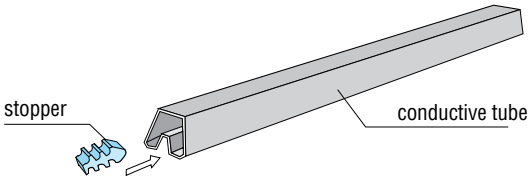
2. SIP

SIP products are packed in inner boxes per lot of 100pcs. They are then placed onto the conductive foam and placed in cartons for shipment.



3. DIP

DIP products are placed into conductive IC tubes and packed into boxes for shipment.



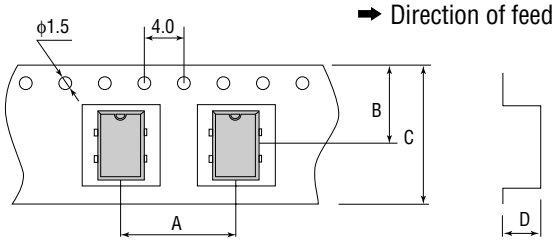
Model	Quantity
SG-531 series SG-8002DC series	35 pcs/tube
SG-51 series SG-8002DB series SPG series MG-3020 RTC-58321/62421 63421/63421M/72421	25 pcs/tube
RTC-64611	18 pcs/tube
RTC-65271	15 pcs/tube

4. SMD

(1) Tape and reel packing

These are packed for shipment in boxes per lot of 1,000 pcs/reel in accordance with taping standards EIA-481A and EIAJ-1009B.
(leader tape: min.1,000mm; trailer tape: min.10 empty pockets)
MC/MA-306, MC-206 and SA-315HZ is packed per lot of 3,000pcs. /reel (max.). (3,000 and 1,000)

(Unit: mm)

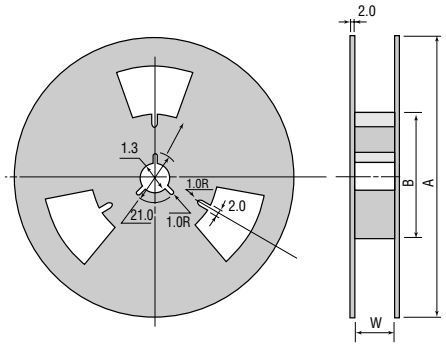


Model	Dimension A	B	C	D	Tape type (L=left direction)
SA-315HZ	8.0	9.25	16.0	2.6	TE1608R
MC-206 MC-306 MC-405/406 MA-306 SG-8002JC series SG-8002CA series SG-636 series				∗1	TE1608L
MA-406/406H MA-505/506 SG-8002JA series SG-615 series VG-1011JA series HG-1012JA/2012JA VG-2320SC	12.0	13.25	24.0	∗2	TE2412L
SOP14-pin	12.0	9.25	16.0	3.65	TE1612L
SOP18-pin	12.0	11.5	24.0	2.86	TE2416L
SOP24-pin	16.0	13.25	24.0	2.95	
FS-555, FA-365/367/368	8.0	7.25	12.0	∗3	TE1208L

∗1 MC-306,MA-306: 3.0; MC-405/406: 3.9; SG-8002JC/CA; SG-636 series: 3.3; MC-206: 2.2;
∗2 MA-406/406H: 4.0; MA-505/6, SG-8002JA, 615 series, HG-1012JA/2012JA: 4.8, VG-1011JA, VG-2320SC: 2.2
∗3 FS-555: 2.0; FA-365/367/368: 1.6

● **Reel dimensions**

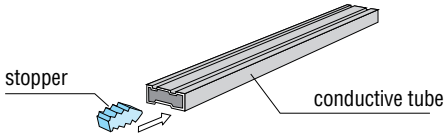
(Unit: mm)



Model	Dimension A	B	W
MC-206·MC-306·MC-405/406· MA-306·SA-315HZ·SG-8002JC series· SG-636 series·SOP14-pin	Ø330	Ø80	17.5
MA-406/406H·MA-505/506 SG-8002JA series SG-615 series HG-1012JA/2012JA VG-1011JA SOP24-pin VG-2320SC			25.5
SOP18-pin			24.4
FS-555			13.5
FA-365/367/368	Ø180	Ø60	13.0
SG-8002CA series	Ø255	Ø80	17.5

(2) Tube packing

These are placed into conductive IC tubes per lot of 25 to 55pcs./tube and packed into boxes for shipment.



Note: The above is shown in the standard packing specifications. Small-lot or sample orders may be submitted in a different packing style.

HANDLING PRECAUTIONS

Common points for all products

1. Shock resistance

EPSON's crystal products are designed to endure physical shocks. (Drop tests consist of three drops onto a hard wooden board from a height of 75cm. Alternatively, three-directional excitation tests are performed with 1/2 sine wave of 3,000G for a duration of 0.3ms.) Nevertheless, under some conditions, crystals may be damaged by drops or shocks during mounting. It is important, therefore, to run mounting machines as slowly as permissible to prevent undue shocks. Please review conditions prior to using a mounting machine.

- Products that are more sensitive to shock: SPG-8640N series

2. Heat resistance

Use or storage under extreme temperatures over a long period may cause the quality of the crystal products to deteriorate and affect frequency stability. It is advisable to use and store at normal temperature and humidity levels.

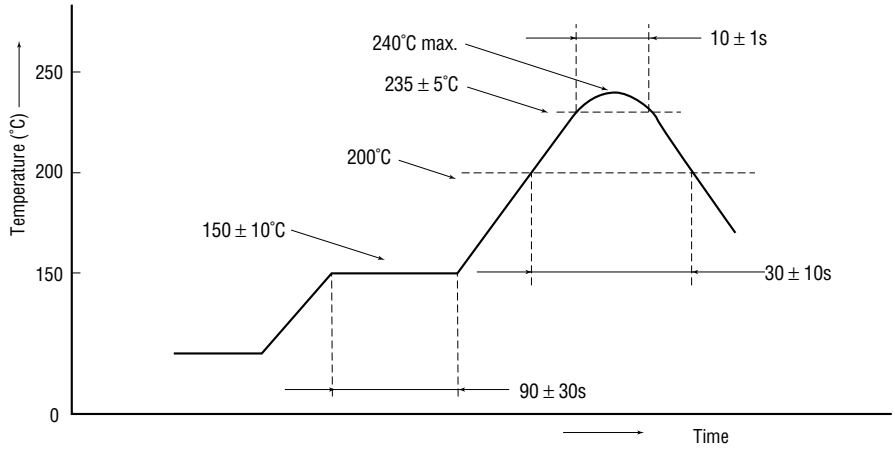
3. Soldering heat resistance

Since all crystal units except SMD products utilize solder having a 180˚C to 200˚C melting point, heating the package more than 150˚C may cause the characteristics to deteriorate or damage the product. If you are mounting at temperatures of more than 150˚C, we recommend that SMD products be used.

- Maximum soldering conditions for quartz products other than SMDs: 280˚C for 5 sec., or 260˚C for 10 sec. (lead portion)
- Maximum soldering conditions for SMDs: twice at 260˚C for 10 sec., or 230˚C for 3 min.

● Soldering conditions chart for SMD product (example)

● Infrared-reflow



4. Ultrasonic cleaning

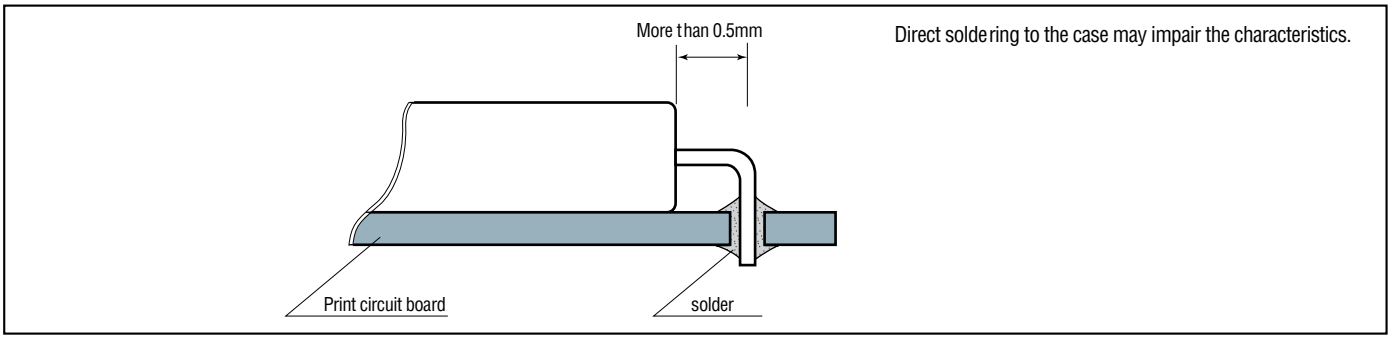
- Products using an AT-cut crystal can be cleaned ultrasonically. However, since the crystal chip may be affected under some conditions, be sure to check the suitability of your system in advance.
- Products using a tuning-fork crystal cannot be guaranteed for ultrasonic cleaning, as they are susceptible to damage by resonance vibration.

5. Handling of lead terminal

(1) Cylindrical products

Pulling the lead strongly may cause cracking of the hermetic glass seal at the root of the lead and lower the airtightness, thus deteriorating the characteristics. If it is necessary to install the product as in the figure below, leave more than 0.5 mm of lead from the case. When the lead needs to be repaired, do not pull on it, and hold the bent part to correct it.

● Installation example



(2) SMD products

When leads are soldered directly to the board pattern, avoid applying stress sufficient to deform the leads. Particular care must be taken with SOP products.

(3) SIP products

If leads need to be bent, bend the part beyond the stand-off (1.3 mm or more from the case).

(4) DIP products

Deformed leads cannot be inserted into board holes.Avoid applying an stress sufficient to deform leads.

6. Handling of reels

(1) Products should be stored at the normal temperature and humidity (refer to the standard conditions of test site JIS Z-8703). Avoid storing them over a long period and mount them immediately after unpacking.

(2) Please carefully handle the inner and outer boxes and reel. External pressure may cause deformation of reel and tape.

7. Storage

We recommend storing products at 15˚C to 35˚C and 25%RH to 85%RH.

■ Crystal unit

1. Drive level

Applying excessive drive level to the crystal units may cause deterioration of characteristics or damage.
Circuit design must be such as to maintain a proper drive level. (page 10)

2. Negative resistance

Unless adequate negative resistance is allocated in the oscillation circuit, oscillation start up time may increase or oscillation may not occur at all. To avoid this, provide enough negative resistance in the circuit design.
(refer to page 10 "AIIowance for Oscillation".)

3. Load capacitance

Differences in the load capacitance in the oscillation circuit may result in deviations in the oscillation frequency from the desired frequency. Attempting to tune by force may merely cause abnormal oscillation. Before use, please specify the load capacitance of the oscillation circuit. (page 11)

■ Crystal oscillator and real time clock module

AII crystal oscillators and real time clock modules are provided with a C-MOS IC. Please pay attention to the following points.

1. Static electricity

Although an anti-static-electricity protection circuit is provided in the circuit, excessive levels of static electricity may damage the IC. Choose conductive materials for packing and container. Use a soldering gun and a measuring circuit free from high-voltage leak and provide grounding connection when working with them.

2. Noise

Applying excessive level of extraneous noise to power source or input terminal may cause latchup or spurious phenomenon, which results in malfunction and breakdown.

To maintain stable operation, provide by-pass capacitor with more than 0.1µF at a location as near as possible to the power source terminal of the crystal products (between V_{DD} - GND). Do not permit any objects which emit a high level of noise in a location near the crystal oscillator.

3. Power supply line

Line impedance of a power supply should be as low as possible.

4. Output load

It is recommended that output load is installed as close as possible to an oscillator (within 20 mm).

5. Treatment of unused input terminals

Unused pins that are left open may collect noise, thereby resulting in malfunction. AIso, power consumption may increase when both P-channel and N-channel are turned on, therefore connect unused input terminals to V_{DD} or GND.

6. Heat impact

Repeated large changes in temperature may degrade the characteristics of the deteriorate crystal unit and cause breakage of wires inside the plastic mold. This must be avoided.

7. Mounting direction

Incorrect mounting of the oscillator may cause malfunction and breakdown, so please check the mounting direction when installing.

PRECAUTIONS IN DESIGNING OSCILLATION CIRCUITS

1. Drive level

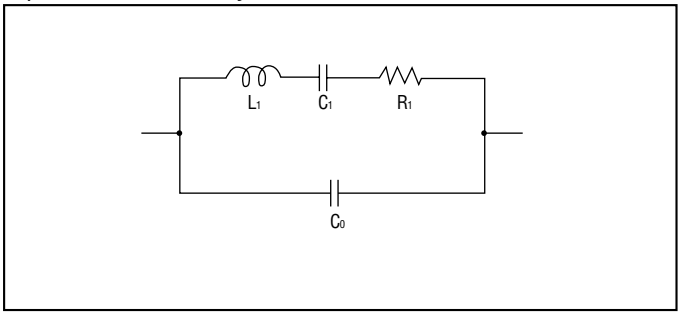
Drive level denotes electric power required to oscillate a crystal unit, which can be calculated using the following formula.

Drive level (P) = I^2Re

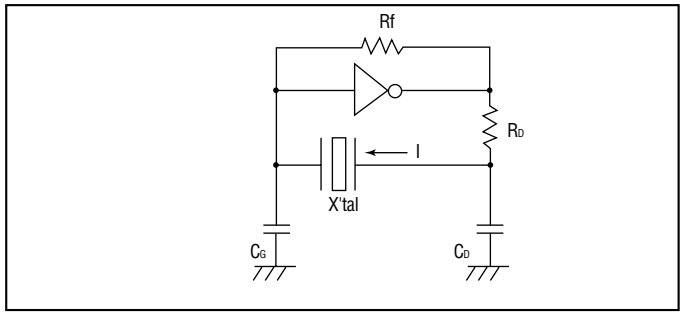
Where I stands for current to pass in the crystal unit, Re for effective resistance of crystal unit, and $Re=R_1(1+Co/C_L)^2$.

If the Drive level (P) exceeds the specified level, oscillation frequency will shift. This occurs because an excessive level of power causes stress for the crystal and consequent temperature rise. If excessive drive level of power is applied to the crystal unit, this may deteriorate or damage the characteristics.

Equivalent circuit of crystal unit



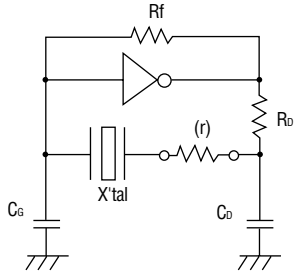
Oscillation circuit



2. Allowance for oscillation

Unless adequate negative resistance is allocated in the oscillation circuit, oscillation start-up time may be increase, or **NO OSCILLATION** may occur. In order to avoid this, provide enough negative resistance in the circuitry design.

● **How to check the allowance for oscillation**



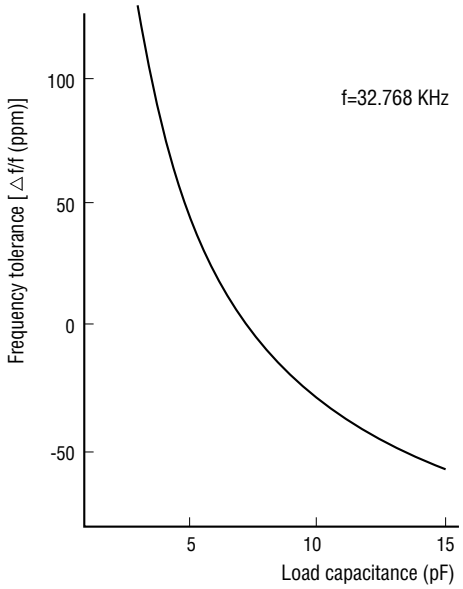
(1) Connect the resistance (r) to the circuit in series with the crystal unit.
(2) Adjust (r) so that oscillation can start (or stop).
(3) Measure (r) when oscillation just starts (or stops) in (2) above.
(4) Recommended (r)
(r) > CI x (5 to 10)

3. Load capacitance

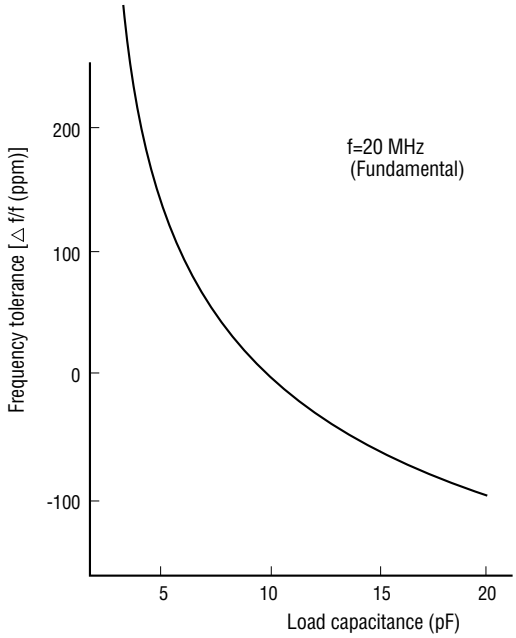
Differences in the load capacitance of the oscillation circuit may result in a different oscillation frequency from the desired one, as shown in the figure below. Approximate expression of the load capacitance of the circuit $C_L \fallingdotseq C_G \times C_D / (C_G + C_D) + C_S$.
Where C_S Stands for stray capacity of the circuit.

● **Frequency and load capacitance characteristics**

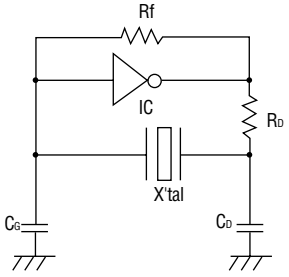
Tuning fork crystal unit (example)



AT-cut crystal unit (example)



4. Reference for setting parameters of oscillation circuit



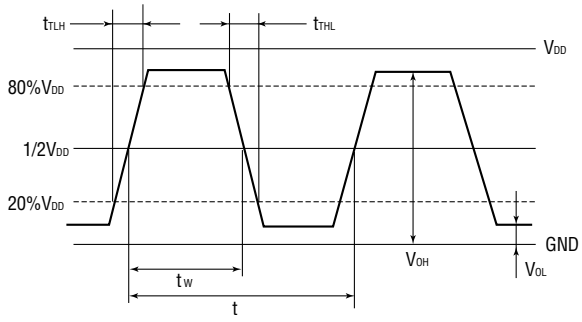
IC: equivalent to TC74HCU04P
(TC74HCU04P is a product number of Toshiba Corp.)

Symbol / Frequency range	R_F (MΩ)	R_D (KΩ)	C_G (pF)	C_D (pF)
20 KHz to 60 KHz	20	500	10	
60 KHz to 165 KHz	10	300		
5.5 MHz to 30 MHz (Fundamental)	1	0.5	5 to 15	

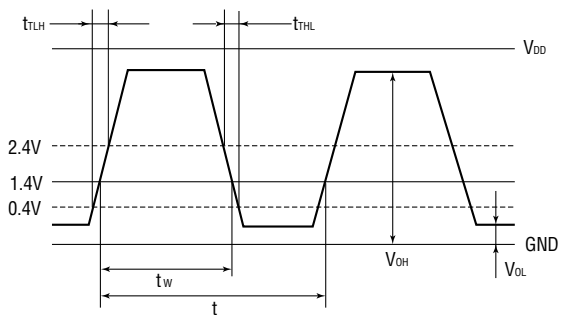
OUTPUT WAVEFORM AND TEST CIRCUIT

1. Timing chart

(1) C-MOS load



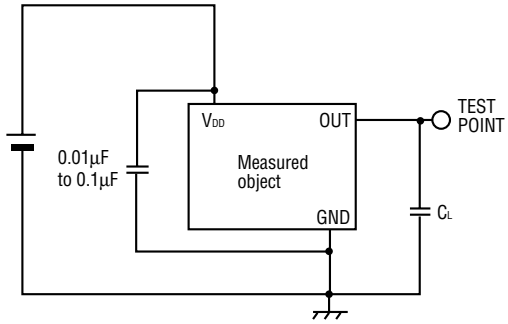
(2) TTL load



Duty[%]=$t_w/t \times 100$

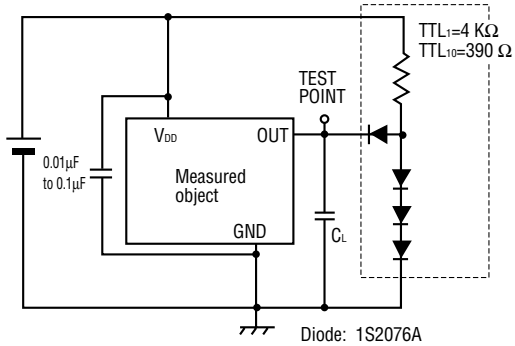
2. Test circuit

(1) C-MOS load



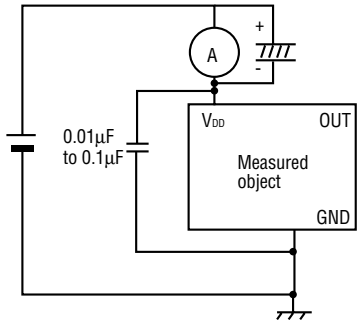
For C_L value, refer to the specifications of each model.

(2) TTL load



Diode: 1S2076A

(3) Current consumption



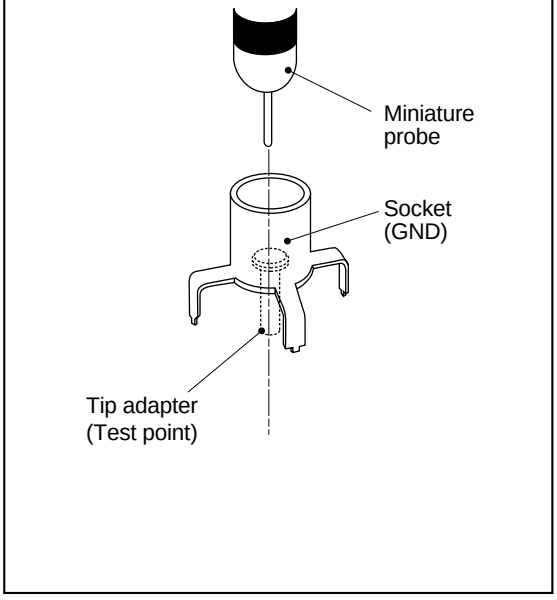
3. Test conditions

(1) Supply voltage
- More than 150µs until voltage level reaches 4.5V from 0V.
- Supply voltage impedance is less than 2 Ω of resistance.

(2) Oscilloscope
- Input impedance of more than 1 MΩ.
- Input capacitance of less than 15pF.
- Frequency range of more than 100 MHz (around 300 to 400 MHz).
- Earth lead of the probe should be as short as possible.
- Probe impedance when measuring frequency is to be more than 1 MΩ. Simultaneous measurement of waveform (frequency and waveform) is not possible; however, measurement is possible as the waveform passes from the amplifier stage of an oscilloscope.

(3) Miscellaneous
- C_L includes the probe capacitance.
- The device should be earthed at one point.
- Ammeter with small internal impedance should be used.
- To observe wave form, please use a miniature socket. (do not use a long ground wire of the probe.)

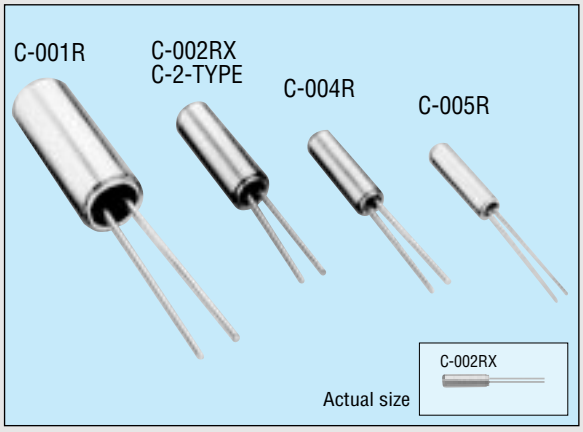
Miniature socket parts



CYLINDER LOW/MEDIUM-FREQUENCY CRYSTAL UNIT

C-2-TYPE/C-TYPE

- Photolithography finished allows uniform and stable performance.
- Excellent shock resistance and environmental capability.
- Respond to an extensive range of frequency, from 20 kHz to 165 kHz, and 307.2 kHz.



■ Specifications for C-2-TYPE (characteristics)

Item		Symbol	Specifications	Remarks
Nominal frequency range		f	20 kHz to 165 kHz, 307.2 kHz	Please refer to frequency example page 13
Temperature range	Storage temperature	T_{STG}	-20°C to +70°C	
	Operating temperature	T_{OPR}	-10°C to +60°C	
Maximum drive level		GL	1.0μW max.	
Soldering condition (lead part)		T_{SOL}	Under 280°C within 5 sec.	Do not heat the package to more than 150°C
Frequency tolerance (standard)		Δf/f	±20ppm,±50ppm,±100ppm (307.2 kHz: ±100ppm)	Ta=25°C, DL=0.1μW
Peak temperature (frequency)		θT	25°C ±5°C	
Temperature coefficient (frequency)		a	-0.04ppm/°C² max.	
Load capacitance		C_L	6pF to ∞	Please specify
Series resistance		R_1	20 kHz ≤f< 30 kHz: 55 kΩ max. 30 kHz ≤f< 40 kHz: 45 kΩ max. 40 kHz ≤f< 60 kHz: 20 kΩ max. 60 kHz ≤f< 70 kHz: 15 kΩ max. 70 kHz ≤f< 120 kHz: 12 kΩ max. 120 kHz ≤f< 165 kHz: 10 kΩ max. 307.2 kHz: 6 kΩ max.	
Motional capacitance		C_1	4.0fF max.	
Shunt capacitance		C_0	2.0pF max.	
Insulation resistance		IR	500 MΩ min.	
Aging		fa	±5ppm/year max.	Ta=25°C±3°C, first year
Shock resistance		S.R.	±5ppm max.	Three drops on a hard board from 75 cm or excitation test with 3000G x 0.3ms x 1/2 sine wave x 3 directions

• Please refer to the external dimensions on page 14.

■ Specifications for C-TYPE (characteristics)

Item		Symbol	C-001R	C-002RX	C-004R	C-005R	Remarks
Nominal frequency range		f	32.768 kHz				
Temperature range	Storage temperature	T_{STG}	-20°C to +70°C				
	Operating temperature	T_{OPR}	-10°C to +60°C				
Maximum drive level		GL	1.0μW max.				
Soldering condition (lead part)		T_{SOL}	Under 280°C within 5 sec.				∗1
Frequency tolerance (standard)		Δf/f	±20ppm				Ta=25°C, DL=0.1μW
Peak temperature (frequency)		θ T	25°C ±5°C				
Temperature coefficient (frequency)		a	-0.04ppm/°C² max.				
Load capacitance		C_L	6pF to ∞				Please specify
Series resistance		R_1	35 kΩ max.(18 kΩ typ.)	50 kΩ max. (30 kΩ typ.)		50 kΩ max. (37 kΩ typ.)	
Motional capacitance		C_1	2.1fF typ.	2.0fF typ.		1.9fF typ.	
Shunt capacitance		C_0	0.9pF typ.	0.8pF typ.		0.7pF typ.	
Insulation resistance		IR	500 MΩ min.				
Aging		fa	±3.0ppm/year max.				Ta=25°C ± 3°C, first year
Shock resistance		S. R.	±5ppm max.				Three drops on a hard board from 75 cm or excitation test with 3000G x 0.3ms x 1/2 sine wave x 3 directions

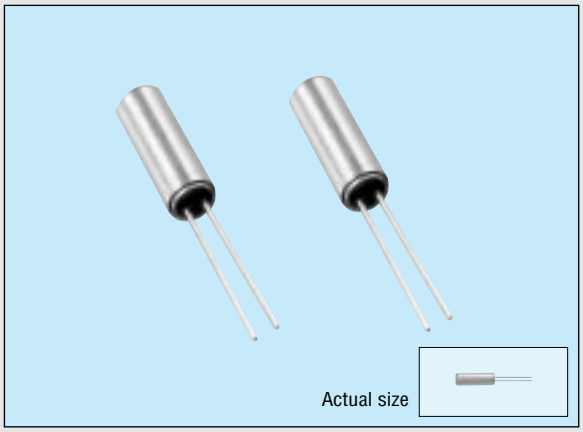
• Please refer to the external dimensions on page 14.

∗1 Do not heat the package to more than 150°C

SMALL CYLINDER LOW/MEDIUM-FREQUENCY CRYSTAL UNIT

C-4-TYPE

- Photolithography finished allows uniform and stable performance.
- Small and light weight. (ø1.5 x 6mm)
- Excellent shock resistance and environmental capability.
- Most suitable for pagers and card products like PCMCIA.



Specifications (characteristics)

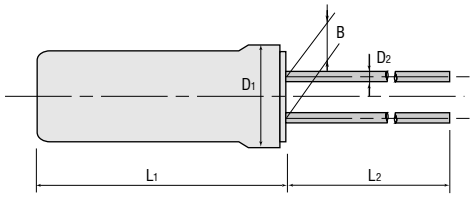
Item		Symbol	Specifications	Remarks
Nominal frequency		f	32.000 kHz to 120.000 kHz 192 kHz	Please refer to frequency list below
Temperature range	Storage temperature	T_{STG}	-20˚C to +70˚C	
	Operating temperature	T_{OPR}	-10˚C to +60˚C	
Maximum drive level		GL	1.0µW max.	
Recommended drive level (characteristics)		DL	0.1µW typ.	
Soldering condition		T_{SOL}	Under 280˚C with in 5 sec.	Do not heat the package to more than 150˚C
Frequency tolerance (standard)		Δf/f	±50ppm,±100ppm	Ta=25˚C, DL=0.1µW
Peak temperature (frequency)		θT	25˚C ±5˚C	
Temperature coefficient (frequency)		a	-0.04ppm/˚C² max.	
Load capacitance		C_L	6pF to ∞	Please specify
Series resistance		R_1	32 kHz ≤ f < 40 kHz: 55 kΩ max. 40 kHz ≤ f < 60 kHz: 30 kΩ max. 60 kHz ≤ f < 70 kHz: 25 kΩ max. 70 kHz ≤ f ≤ 100 kHz: 22 kΩ max. 100 kHz < f ≤ 120 kHz: 15 kΩ max. 192 kHz: 10 kΩ max.	
Motional capacitance		C_1	3.0fF max.	
Shunt capacitance		C_0	1.5pF max.	
Insulation resistance		IR	500 MΩ min.	
Aging		fa	±5ppm/year max.	Ta=25˚C±3˚C, first year
Shock resistance		S.R.	±5ppm max.	Three drops on a hard board from 75 cm or excitation test with 3000G x 0.3ms x 1/2 sine wave x 3 directions

Frequency example

Type	Frequency	C_L Value
C-2-TYPE	26.6667 kHz	10.0pF, 11.0pF
	32.5600 kHz	7.0pF
	36.8640 kHz	13.5pF
	38.4000 kHz	10.0pF
	44.7340 kHz	10.0pF
	48.0000 kHz	15.0pF
	75.0000 kHz	6.5pF, 9.0pF,20.0pF
	77.5030 kHz	10.0pF, 20.0pF
	76.8000 kHz	6.0pF, 10.0pF,11.0pF
	96.0000 kHz	6.0pF, 8.4pF,11.0pF
	153.6000 kHz	11.0pF
	307.2000 kHz	11.0pF
C-4-TYPE	38.4000 kHz	11.0pF
	50.0000 kHz	9.0pF
	76.8000 kHz	11.0pF
	77.5030 kHz	10.0pF
	192.0000 kHz	11.0pF

External dimensions

(Unit: mm)



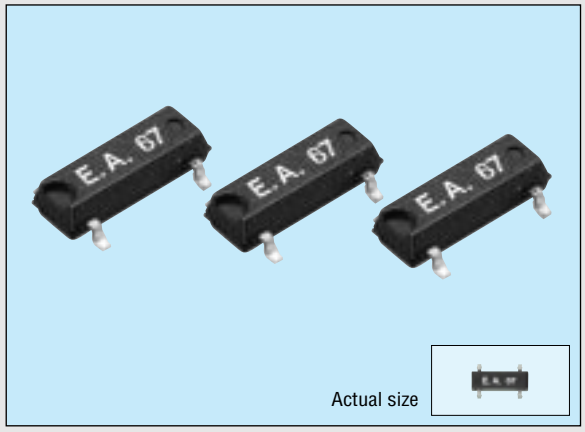
Model	L_1	L_2	D_1	D_2	B
C-2-TYPE	6.0 max.	4.0 min.	ø2.0 max.	ø0.2	0.7
C-001R	8.0 max.	9.0 min.	ø3.1 max.	ø0.3	1.1
C-002RX	6.0 max.	4.0 min.	ø2.0 max.	ø0.2	0.7
C-004R	5.0 max.	4.0 min.	ø1.5 max.	ø0.2	0.5
C-005R	4.6 max.	4.0 min.	ø1.2 max.	ø0.15	0.3
C-4-TYPE	5.0 max.	4.0 min.	ø1.5 max.	ø0.2	0.5

(160 to 165kHz, 307.2 kHz: D_1=ø2.2 max.)

THIN SMD LOW/MEDIUM-FREQUENCY CRYSTAL UNIT

MC-206

- High-density mounting-type SMD of max. 2.0mm thickness.
- Small with small packaging area and light weight.
- High heat resistance allows reflow soldering.
- Excellent shock resistance and environmental capability.
- Most suitable for small communications devices.



Specifications (characteristics)

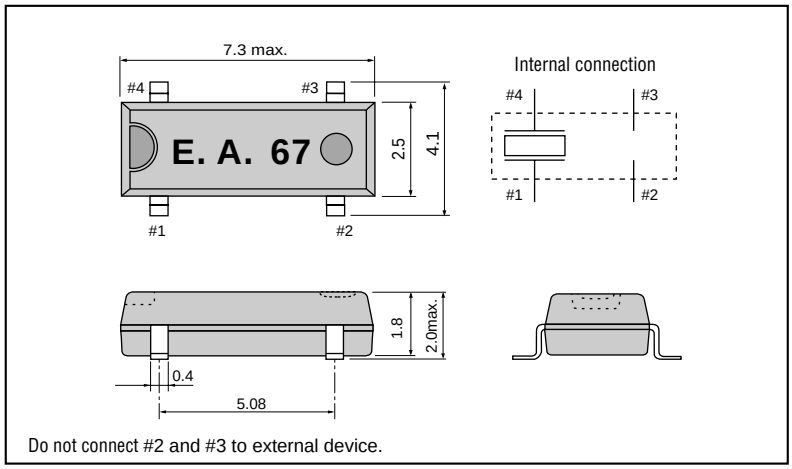
Item		Symbol	Specifications		Remarks
Nominal frequency		f	32.768 kHz	32.000 kHz to 100.000 kHz	
Temperature range	Storage temperature	T_{STG}	-55°C to +125°C		
	Operating temperature	T_{OPR}	-40°C to +85°C		
Maximum drive level		GL	1.0μW max.		
Soldering condition		T_{SOL}	Twice at under 260°C within 10 sec. or under 230°C within 3 min.		
Frequency tolerance (standard)		Δf/f	±20ppm or ±50ppm	±50ppm, ±100ppm	Ta=25°C, DL=0.1μW
Peak temperature (frequency)		θT	25°C ±5°C		
Temperature coefficient (frequency)		a	-0.04ppm/°C² max.		
Load capacitance		C_L	6pF to ∞		Please specify
Series resistance		R_1	50 kΩ max.	55 kΩ to 10 kΩ	As per below table
Motional capacitance		C_1	1.8fF typ.	3.0fF max.	
Shunt capacitance		C_0	0.9pF typ.	1.5pF max.	
Insulation resistance		IR	500 MΩ min.		
Aging		fa	±3ppm/Y max.	±5ppm/Y max.	Ta=25°C ±3°C, first year
Shock resistance		S.R.	±5ppm max.		Three drops on a hard board from 75 cm or excitation test with 3000G x 0.3ms x 1/2 sine wave x 3 directions

Series resistance

Frequency (kHz)	32 ≤ f < 40	40 ≤ f < 60	60 ≤ f < 70	70 ≤ f ≤100
Series resonance resistance (Ω)	55K Ω max.	30K Ω max.	25K Ω max.	22K Ω max.

External dimensions

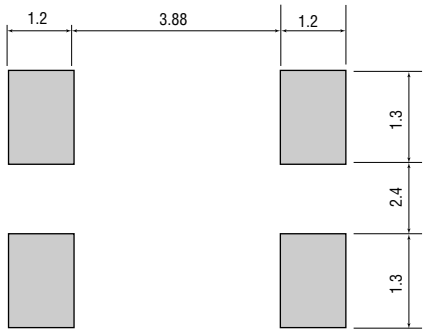
(Unit: mm)



Do not connect #2 and #3 to external device.

Recommended soldering pattern

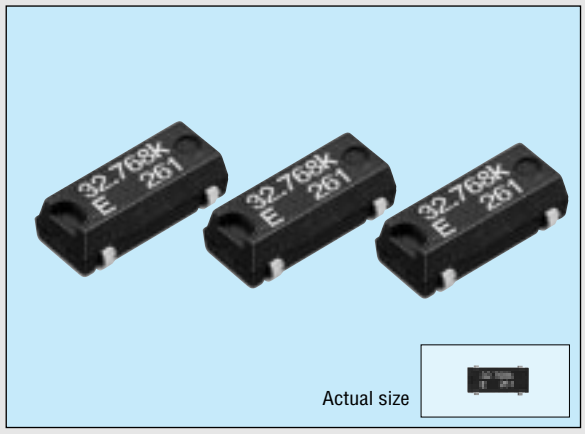
(Unit: mm)



SMALL SMD LOW / MEDIUM-FREQUENCY CRYSTAL UNIT

MC-306

- High-density mounting-type SMD.
- Photolithography finished allows uniform and stable performance.
- Excellent reliability and environmental capability.
- 2.54mm thickness is equal to SMD-type IC.



Specifications (characteristics)

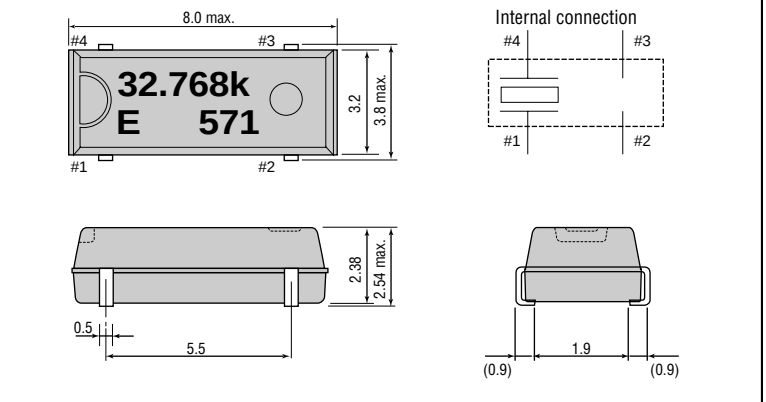
Item		Symbol	Specifications		Remarks
Nominal frequency		f	32.768 kHz	20.000 kHz to 165.000 kHz	Please consult us except for 32.768 kHz
Temperature range	Storage temperature	T_{STG}	-55˚C to +125˚C		Stored as bare product after unpacking
	Operating temperature	T_{OPR}	-40˚C to +85˚C		
Maximum drive level		GL	1.0μW max.		
Soldering condition		T_{SOL}	Twice at under 260˚C within 10 sec. or under 230˚C within 3 min.		
Frequency tolerance (standard)		Δf/f	±20ppm or ±50ppm	±50ppm, ±100ppm	Ta=25˚C, DL=0.1μW
Peak temperature (frequency)		θT	25˚C ±5˚C		
Temperature coefficient (frequency)		a	-0.04ppm/˚C² max.		
Load capacitance		C_L	6pF to ∞		Please specify
Series resistance		R_1	50 kΩ max.	55 kΩ to 10 kΩ	As per below table
Motional capacitance		C_1	1.8fF typ.	4.0fF to 0.6fF	
Shunt capacitance		C_0	0.9pF typ.	2.0pF to 0.6pF	
Insulation resistance		IR	500 MΩ min.		
Aging		fa	±3ppm/Y max.	±5ppm/Y max.	Ta=25˚C ±3˚C, first year
Shock resistance		S.R.	±5ppm max.		Three drops on a hard board from 75 cm or excitation test with 3000G x 0.3ms x 1/2 sine wave x 3 directions

Series resistance

Frequency (kHz)	20 ≤ f < 30	30 ≤ f < 45	40 ≤ f < 60	60 ≤ f < 70	70 ≤ f < 120	120 ≤ f < 165
Series resonance resistance (Ω)	55K Ω max.	45K Ω max.	20K Ω max.	15K Ω max.	12K Ω max.	10K Ω max.

External dimensions

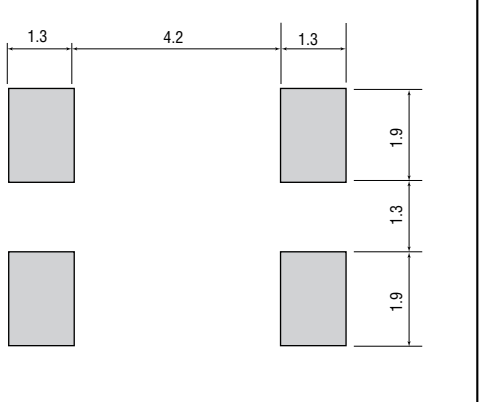
(Unit: mm)



Do not connect #2 and #3 to external device.

Recommended soldering pattern

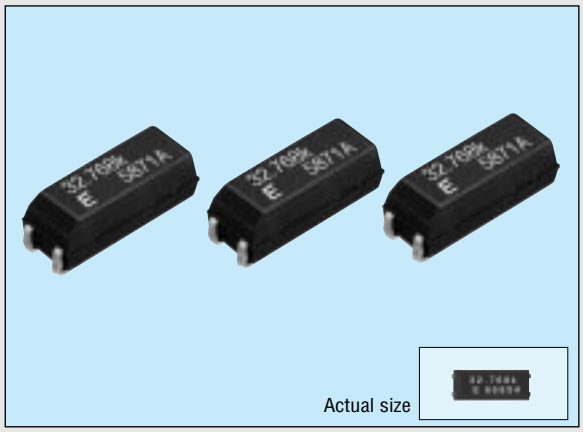
(Unit: mm)



SMD LOW/MEDIUM-FREQUENCY CRYSTAL UNIT

MC-405/MC-406

- High-density mounting-type SMD.
- Photolithography finished allows uniform, stable performance.
- Excellent shock resistance and environmental capability.
- Capable of covering low-frequency range from 20 kHz to 165 kHz.
- Suitable for timekeeping of clock and microcomputer.

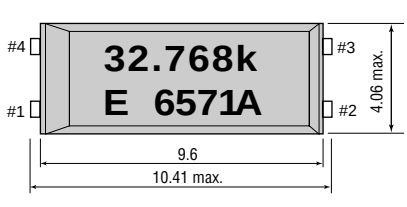


Specifications (characteristics)

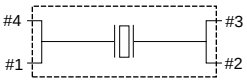
Item		Symbol	Specifications		Remarks
Nominal frequency range		f	32.768 kHz	20.000 kHz to 165.000 kHz 307.2 kHz	Please consult us except for 32.768 kHz
Temperature range	Storage temperature	T_{STG}	-55°C to +125°C		Stored as bare product after unpacking
	Operating temperature	T_{OPR}	-40°C to +85°C		
Maximum drive level		GL	1.0μW max.		
Soldering condition		T_{SOL}	Twice at under 260°C within 10 sec. or under 230°C within 3 min.		
Frequency tolerance (standard)		Δf/f	±20ppm or ±50ppm	±50ppm, ±100ppm (307.2 kHz: ±100ppm)	Ta=25°C, DL=0.1μW
Turnover temperature (frequency)		θT	25°C ±5°C		
Temperature coefficient (frequency)		a	-0.04ppm/°C² max.		
Load capacitance		C_L	6pF to ∞		Please specify
Series resistance		R_1	50 kΩ max.	55 kΩ to 6 kΩ	For details, refer to 16
Motion capacitance		C_1	2.0fF typ.	4.0fF to 0.6fF	
Shunt capacitance		C_0	0.85pF typ.	2.0pF to 0.6pF	
Insulation resistance		IR	500 MΩ min.		
Aging		fa	±3ppm/year max.	±5ppm/year max.	Ta=25°C±3°C, first year
Shock resistance		S.R.	±5ppm max.		Three drops on a hard board from 75 cm or excitation test with 3000G x 0.3ms x 1/2 sine wave x 3 directions

External dimensions

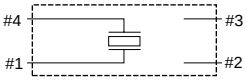
(Unit: mm)

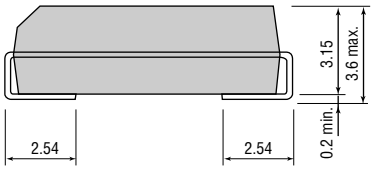


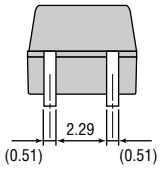
Internal connection in MC-405



Internal connection in MC-406





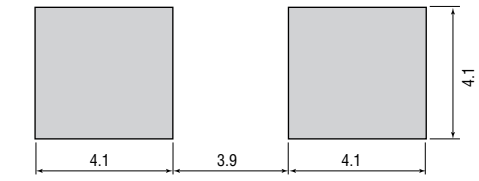


Do not connect #2 and #3 of MC-406 to external device.
The first digit of No. means: {5XXXX → MC-405 / 6XXXX → MC-406

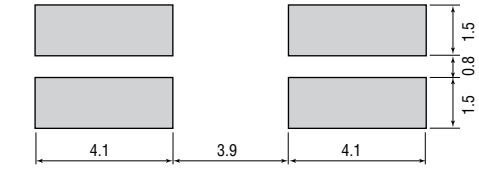
Recommended soldering pattern

(Unit: mm)

MC-405



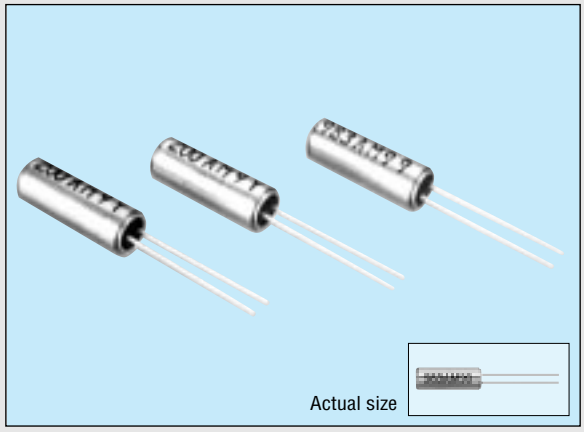
MC-406



CYLINDER HIGH-FREQUENCY CRYSTAL UNIT

CA-301

- Compact design with case as small as 3mm in diameter while still maintaining excellent characteristics of AT-cut.
- Excellent shock resistance.
- High-stability assured with tight vacuum sealing.
- Capable of covering a frequency range from 4 MHz to 64 MHz.



Specifications (characteristics)

Item		Symbol	Specifications	Remarks
Nominal frequency range		f	4.000 MHz to 30.000 MHz *1	Fundamental mode
			26.000 MHz to 64.000 MHz	3rd overtone mode
Temperature range	Storage temperature	T_{STG}	-40°C to +85°C	The operating temperature range is -10°C to 60° for 5.5MHz and below
	Operating temperature	T_{OPR}	-20°C to +70°C	
Drive level	Maximum drive level	GL	2mW max.	Only crystal oscillation is guaranteed
	Recommended level	DL	10μW to 100μW	
Soldering condition (only lead part)		T_{SOL}	Under 260°C within 10 sec.	Do not heat the package to more than 150°C
Frequency tolerance (standard)		Δf/f	±30ppm	Ta=25°C
Frequency temperature characteristics (standard)			Under 5.5MHz: ±50ppm	-10°C to +60°C
			Over 5.5MHz: ±30ppm	-20°C to 70°C
Load capacitance		C_L	Fundamental: 10pF to ∞. Over tone: 5pF to ∞	Please specify
Series resistance		R_1	As per below table	-20°C to +70°C, DL=100μW
Shunt capacitance		C_0	5pF max.	
Insulation resistance		IR	500 MΩ min.	
Aging		fa	±5ppm/year max.	Ta=25°C±3°C, first year
Shock resistance		S.R.	±10ppm max.	Three drops on a hard board from 75cm height or excitation test with 3000G x 0.3ms x 1/2 sine wave x 3 directions

*1 8.0 MHz < f < 8.2 MHz: Unavailable.
26.000 MHz to 30.000 MHz: standard (3rd overtone mode).

Series resistance

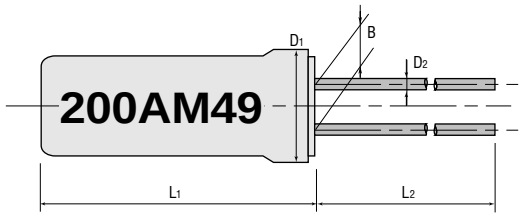
Frequency (MHz)	Series resistance (Ω)	mode
4.0 ≤ f < 5.5	150 Ω max.	Fundamental
5.5 ≤ f < 6.0	100 Ω max.	
6.0 ≤ f < 10.0	80 Ω max.	
10.0 ≤ f < 12.0	60 Ω max.	
12.0 ≤ f < 16.0	50 Ω max.	
16.0 ≤ f < 30.0	40 Ω max.	
26.0 ≤ f < 36.0	100 Ω max.	3rd overtone
36.0 ≤ f ≤ 64.0	80 Ω max.	

Available frequencies from 4.0 MHz to less than 5.5 MHz

Frequency (MHz)	
4.000 MHz	4.433619 MHz
4.032 MHz	4.500 MHz
4.096 MHz	4.800 MHz
4.190 MHz	4.842673 MHz
4.194304 MHz	4.9152 MHz

External dimensions

(Unit: mm)



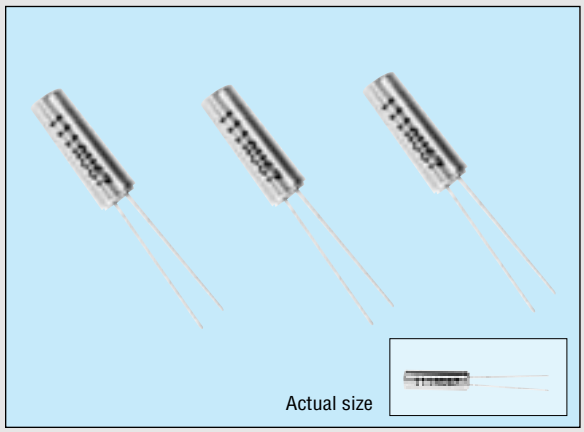
Model		L_1	L_2	D_1	D_2	B
CA-301	Under 5.5 MHz	10.3 max.	9.5 min.	ø3.1 max.	ø0.3	1.1
	Over 5.5 MHz	8.9 max.	9.5 min.	ø3.1 max.	ø0.3	1.1

Sample products are without marking.

CYLINDER HIGH-STABILITY CRYSTAL UNIT

CA-303HS

- High-stability in a dia.3mm cylindrical package.
- Small package allows high-density mounting and less weight.
- Excellent shock resistance and environmental capability.
- High-stability with tight vacuum sealing and AT-cut single side mounting structure.
- Suitable for small telecommunication equipment.



Specifications (characteristics)

Item		Symbol	Specifications	Remarks
Nominal frequency range		f	9.600 MHz to 27.000 MHz	Fundamental mode
Temperature range	Storage temperature	T_{STG}	-55˚C to +125˚C	
	Operating temperature	T_{OPR}	-40˚C to +85˚C	
Drive level	Maximum drive level	GL	2mW max.	Only crystal oscillation is guaranteed
	Recommended drive level	DL	10µW to 100µW	
Soldering condition		T_{SOL}	240˚C max. within 10sec. and under 200˚C within 40 sec.	
Frequency tolerance (standard)		Δf/f	±10ppm	Ta =25˚C ±3˚C,DL=100µW
Frequency temperature characteristics			As per below table	
Load capacitance		C_L	10pF to ∞	Please specify
Series resistance		R_1	As per below table	Operable temperature range, DL=100µW
Shunt capacitance		C_0	3.0pF max.	
Insulation resistance		IR	500 MΩ min.	
Aging		fa	±1ppm/year max.	Ta =25˚C ±1˚C, 100µW
Shock resistance		S.R.	±1ppm max.	Three drops on a hard wooden board from 75 cm or excitation test with 3000G x 0.3ms x 1/2 sine wave x 3 directions

Measured values for frequency tolerance and temperature characteristics need to be brought into mutual correlation prior to the start of production. Please see samples.

Frequency temperature characteristics

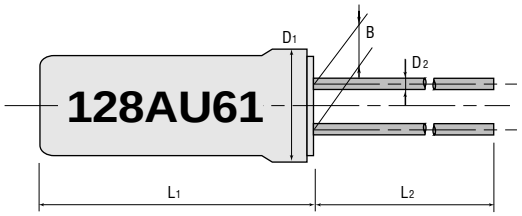
Temperature range	Min. frequency specifications
0˚C to +50˚C	± 3ppm min.
-10˚C to +60˚C	± 5ppm min.
-20˚C to +70˚C	± 7ppm min.
-30˚C to +80˚C	±10ppm min.
-40˚C to +85˚C	±15ppm min.

Series resistance

Frequency (MHz)	Series resistance (Ω)
9.6 ≤ f < 10.0	50 Ω max.
10.0 ≤ f < 12.0	40 Ω max.
12.0 ≤ f < 16.0	30 Ω max.
16.0 ≤ f ≤ 27.0	25 Ω max.

External dimensions

(Unit: mm)



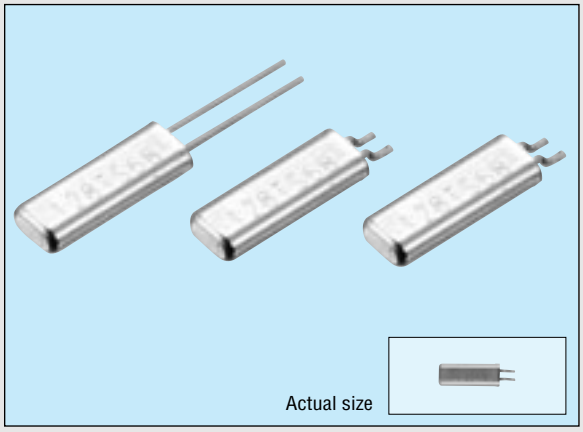
L_1	L_2	D_1	D_2	B
8.9 max.	9.5 min.	ø3.1 max.	ø0.3	1.1

Sample products are without marking.

THIN CYLINDER HIGH-STABILITY CRYSTAL UNIT

SA-315H / 315HZ

- Thin cylinder of 1.55mm thickness featuring high stability.
- Small and thin with small mounting area and light weight.
- High heat resistance allows reflow soldering.
- Excellent shock resistance and environmental capability.
- Embossed tape usable for SMD.(SA-315HZ)
- Most suitable for small communications devices.



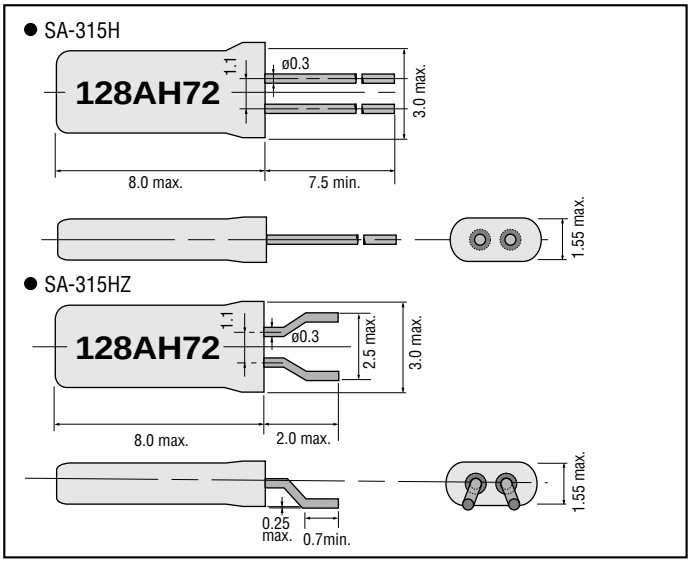
Specifications (characteristics)

Item		Symbol	Specifications	Remarks
Nominal frequency range		f	10.000 MHz to 27.000 MHz	Fundamental mode
Temperature range	Storage temperature	T_{STG}	-55˚C to +125˚C	
	Operating temperature	T_{OPR}	-40˚C to +85˚C	Specified equivalent series resistance must be satisfied.
	Operable temperature	T_{USE}	As per below table	Specified equivalent series resistance and frequency-temperature characteristics must be satisfied.
Drive level	Maximum drive level	GL	2mW max.	Only crystal oscillation is guaranteed
	Recommended drive level	DL	10µW to 100µW	
Soldering condition		T_{SOL}	240˚C max. within 10sec. and under 200˚C within 40 sec.	
Frequency tolerance (standard)		Δf/f	±10ppm	DL=100µW at Ta=25˚C ±3˚C and specified load capacity.
Frequency temperature characteristics			As per below table	
Load capacitance		C_L	10pF to ∞	Please specify
Series resistance		R_1	As per below table	Operable temperature range, DL=100µW
Shunt capacitance		C_0	3.0pF max.	
Insulation resistance		IR	500 MΩ min.	
Aging		fa	±1ppm/Year max.	Ta =25˚C ±1˚C, 100µW
Shock resistance		S.R.	±1ppm max.	Three drops on a hard wooden board from 75 cm or excitation test with 3000G x 0.3ms x 1/2 sine wave x 3 directions

Measured values for frequency tolerance and temperature characteristics need to be brought into mutual correlation prior to the start of production. Please see samples.

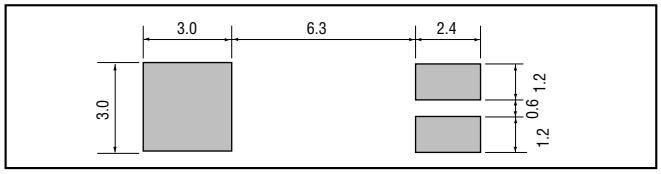
External dimensions

(Unit: mm)



Recommended soldering pattern(SA-315HZ)

(Unit: mm)



Frequency temperature characteristics

Operating temperature range	Frequency temperature characteristics
0˚C to +50˚C	± 3ppm min.
-10˚C to +60˚C	± 5ppm min.
-20˚C to +70˚C	± 7ppm min.
-30˚C to +80˚C	±10ppm min.
-40˚C to +85˚C	±15ppm min.

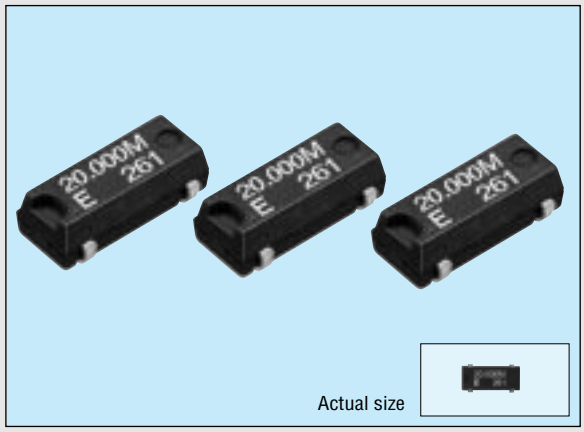
Series resistance

Frequency (MHz)	Series resistance (R_1)
10.0 ≤ f < 12.0	40 Ω max.
12.0 ≤ f ≤ 27.0	30 Ω max.

SMALL SMD HIGH - FREQUENCY CRYSTAL UNIT

MA-306

- High-density mounting-type SMD.
- Excellent reliability and environment capability.
- Capable of covering a wide frequency range. (from 17.734 MHz to 41 MHz)
- 2.54mm thickness is equal to SMD-type IC.

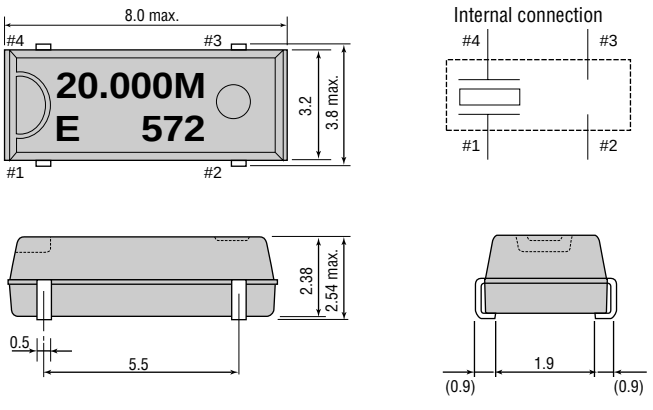


Specifications (characteristics)

Item		Symbol	Specifications	Remarks
Nominal frequency		f	17.734 MHz to 41.000 MHz	Fundamental mode
Temperature range	Storage temperature	T_{STG}	-55˚C to +100˚C	Stored as bare product after unpacking
	Operating temperature	T_{OPR}	-20˚C to +70˚C	
Drive level	Maximum drive level	GL	2mW max.	Only crystal oscillation is guaranteed
	Recommended drive level	DL	10µW to 100µW	
Soldering condition		T_{SOL}	Twice at under 260˚C within 10 sec. or under 230˚C within 3 min.	
Frequency tolerance (standard)		Δf/f	±50ppm	Ta=25˚C±3˚C
Frequency temperature characteristics (standard)			±30ppm	-20˚C to +70˚C
Load capacitance		C_L	10pF to ∞	Please specify
Series resistance		R_1	60 Ω max.	-20˚C to +70˚C, DL=100µW
Shunt capacitance		C_0	5pF max.	
Insulation resistance		IR	500 MΩ min.	
Aging		fa	±5ppm/Y max.	Ta=25˚C±3˚C, first year
Shock resistance		S.R.	±10ppm max.	Three drops on a hard board from 75 cm or excitation test with 3000G x 0.3ms x 1/2 sine wave x 3 directions

External dimensions

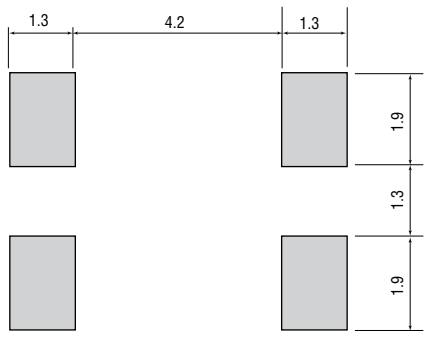
(Unit: mm)



Do not connect #2 and #3 to external device.

Recommended soldering pattern

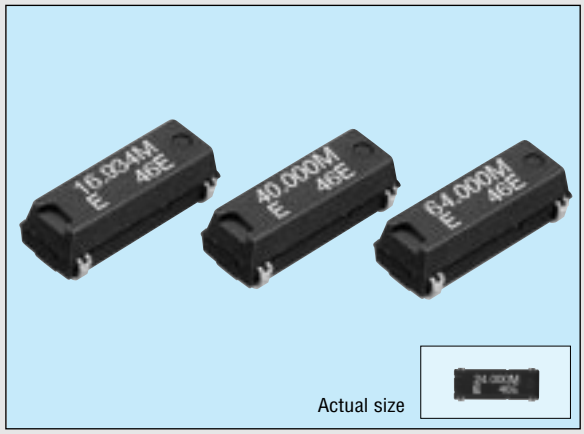
(Unit: mm)



SMD HIGH-FREQUENCY CRYSTAL UNIT

MA-406

- High-density mounting-type SMD.
- Excellent heat-resistance and environment capability.
- Cover a wide frequency range, from 4 MHz to 64 MHz.



Specifications (characteristics)

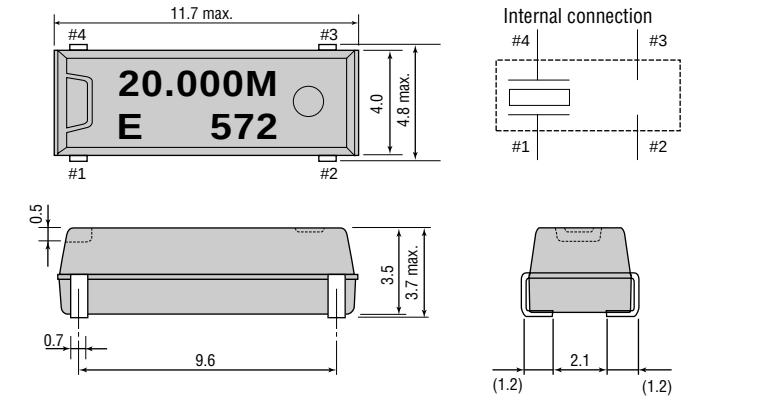
Item		Symbol	Specifications	Remarks
Nominal frequency		f	4.000 MHz to 30.000 MHz *1	Fundamental mode
			26.000 MHz to 64.000 MHz	3rd overtone mode
Temperature range	Storage temperature	TSTG	-55°C to +125°C	Stored as bare product after unpacking
	Operating temperature	TOPR	-20°C to +70°C	
Drive level	Maximum drive level	GL	2mW	Only crystal oscillation is guaranteed
	Recommended drive level	DL	10µW to 100µW	
Soldering condition		TSOL	Twice at under 260°C within 10 sec. or under 230°C within 3 min.	
Frequency tolerance (standard)		Δf/f	±50ppm	Ta=25°C±3°C
Frequency temperature characteristics (standard)			Under 5.5 MHz: ±50ppm	-20°C to +70°C
			Over 5.5 MHz: ±30ppm	
Load capacitance		CL	Fundamental: 10pF to ∞	Please specify
			Over tone: 5pF to ∞	
Series resistance		R1	As per table below	-20°C to +70°C, DL=100µW
Shunt capacitance		C0	5pF max.	
Insulation resistance		IR	500 MΩ min.	
Aging		fa	±5ppm/year	Ta=25°C±3°C, first year
Shock resistance		S.R.	±10ppm max.	Three drops on a hard board from 75 cm or excitation test with 3000G x 0.3ms x 1/2 sine wave x 3 directions

*1 8.0 MHz < f < 8.2 MHz: Unavailable.
For frequencies below 5.5 MHz, see "Avallable frequencies form 4.0 MHz to less than 5.5 MHz" on page 18.
26.000 MHz to 30.000 MHz: standard (3rd overtone mode).

Frequency (MHz)	4.0 ≤ f < 5.5	5.5 ≤ f < 6.0	6.0 ≤ f < 10.0	10.0 ≤ f < 12.0	12.0 ≤ f < 16.0	16.0 ≤ f < 30.0	26.0 ≤ f ≤ 36.0	36.0 < f ≤ 64.0
Series resonance resistance (Ω)	150 Ω max.	100 Ω max.	80 Ω max.	60 Ω max.	50 Ω max.	40 Ω max.	100 Ω max.	80 Ω max.
Mode	Fundamental mode						3rd overtone mode	

External dimensions

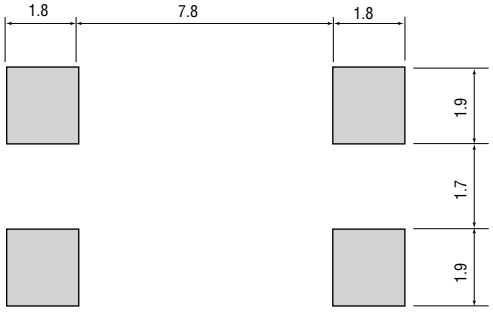
(Unit: mm)



Do not connect #2 and #3 external device.

Recommended soldering pattern

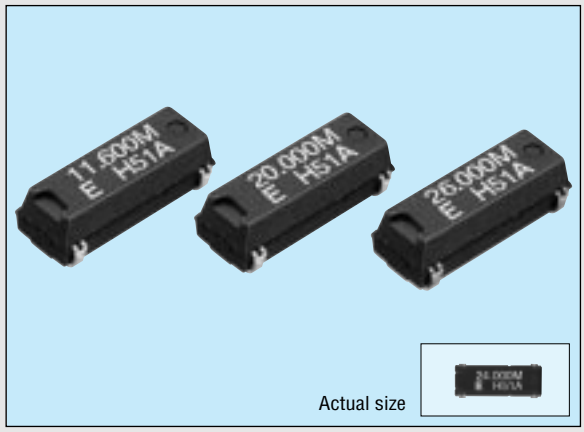
(Unit: mm)



SMD HIGH-STABILITY CRYSTAL UNIT

MA-406H

- High-density mounting-type SMD.
- Excellent heat-resistance and environment capability.
- 9.6 MHz to 27.0 MHz available.



Specifications (characteristics)

Item		Symbol	Specifications	Remarks
Nominal frequency range		f	9.600 MHz to 27.000 MHz	Fundamental mode
Temperature range	Storage temperature	T_{STG}	-55˚C to +125˚C	Stored as bare product after unpacking
	Operable temperature	T_{OPR}	-40˚C to 85˚C	
Drive level	Maximum drive level	GL	2mW max.	Only crystal oscillation is guaranteed
	Recommended drive level	DL	10µW to 100µW	
Soldering condition		T_{SOL}	240˚C max. within 10 sec. and under 200˚C within 40 sec.	
Frequency tolerance (standard)		Δf/f	±10ppm	Ta=25˚C±3˚C,DL=100µW
Frequency temperature characteristics			As per below table	
Load capacitance		C_L	10pF to ∞	Please specify
Series resistance		R_1	As per below table	Operable temperature range, DL=100µW
Shunt capacitance		C_0	5.0pF max.	
Insulation resistance		IR	500 MΩ min.	
Aging		fa	±1ppm/year max.	Ta=25˚C ±1˚C, DL=100µW
Shock resistance		S. R.	±1ppm max.	Three drops on a hard wooden board from 75 cm or excitation test with 3000G x 0.3ms x 1/2 sine wave x 3 directions

Measured values for frequency tolerance and temperature characteristics need to be brought into mutual correlation prior to the start of production.
Please see samples.

Frequency temperature characteristics

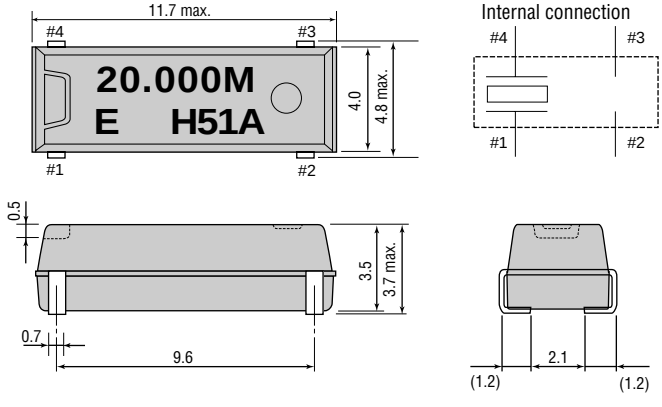
Temperature range	Min. frequency specifications
0˚C to +50˚C	± 3ppm min.
-10˚C to +60˚C	± 5ppm min.
-20˚C to +70˚C	± 7ppm min.
-30˚C to +80˚C	±10ppm min.
-40˚C to +85˚C	±15ppm min.

Series resistance

Frequency (MHz)	Series resistance (Ω)
9.6 ≤ f < 10.0	50 Ω max.
10.0 ≤ f < 12.0	40 Ω max.
12.0 ≤ f < 16.0	30 Ω max.
16.0 ≤ f ≤ 27.0	25 Ω max.

External dimensions

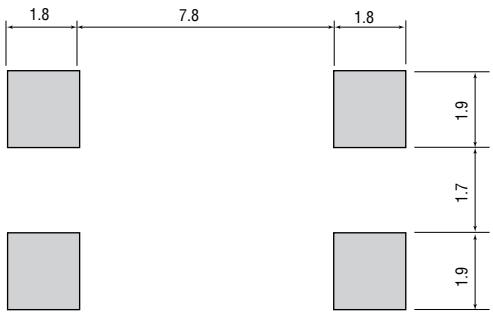
(Unit: mm)



Do not connect #2 and #3 external device.

Recommended soldering pattern

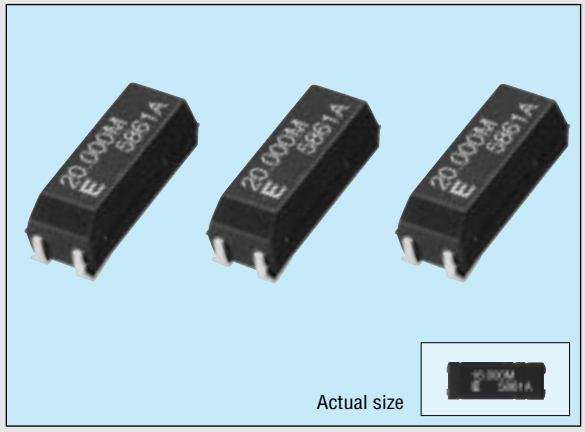
(Unit: mm)



SMD HIGH-FREQUENCY CRYSTAL UNIT

MA-505/MA-506

- High-density mounting-type SMD.
- Excellent heat-resistance and environment capability.
- Capable of covering a wide range of frequency range from 4.0 MHz to 64 MHz.



Specifications (characteristics)

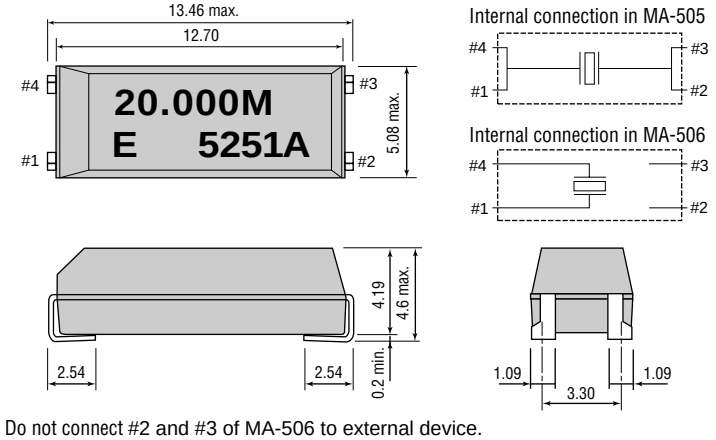
Item		Symbol	Specifications	Remarks
Nominal frequency range		f	4.000 MHz to 30.000 MHz ∗1	Fundamental mode
			26.000 MHz to 64.000 MHz	3rd overtone mode
Temperature range	Storage temperature	T_{STG}	-55˚C to +125˚C	Stored as bare product after unpacking
	Operating temperature	T_{OPR}	-20˚C to +70˚C	
Drive level	Maximum drive level	GL	2mW max.	Only crystal oscillation is guaranteed
	Recommended drive level	DL	10μW to 100μW	
Soldering condition		T_{SOL}	Twice at under 260˚C within 10 sec. or under 230˚C within 3 min.	
Frequency tolerance (standard)		Δf/f	±50ppm	Ta=25˚C±3˚C, DL=100μW
Frequency temperature characteristics (standard)			Under 5.5 MHz: ±50ppm	-20˚C to +70˚C, DL=100μW
			Over 5.5 MHz: ±30ppm	
Load capacitance		C_L	Fundamental: 10pF to ∞. Over tone: 5pF to ∞	Please specify
Series resistance		R_1	As per below table	-20˚C to +70˚C, DL=100μW
Shunt capacitance		C_0	5pF max.	
Insulation resistance		IR	500 MΩ min.	
Aging		fa	±5ppm/year max.	Ta=25˚C±3˚C, first year
Shock resistance		S. R.	±10ppm max.	Three drops on a hard board from 75 cm or excitation test with 3000G x 0.3ms x 1/2 sine wave x 3 directions

∗1 8.0 MHz < f < 8.2 MHz: Unavailable.
For frequencies below 5.5 MHz, see "Available frequencies from 4.0 MHz to less than 5.5 MHz" on page 18.
26.000 MHz to 30.000 MHz: standard (3rd overtone mode).

Frequency (MHz)	4.0 ≤ f < 5.5	5.5 ≤ f < 6.0	6.0 ≤ f < 10.0	10.0 ≤ f < 12.0	12.0 ≤ f < 16.0	16.0 ≤ f < 30.0	26.0 ≤ f ≤ 36.0	36.0 < f ≤ 64.0
Series resonance resistance (Ω)	150 Ω max.	100 Ω max.	80 Ω max.	60 Ω max.	50 Ω max.	40 Ω max.	100 Ω max.	80 Ω max.
Mode	Fundamental mode						3rd overtone mode	

External dimensions

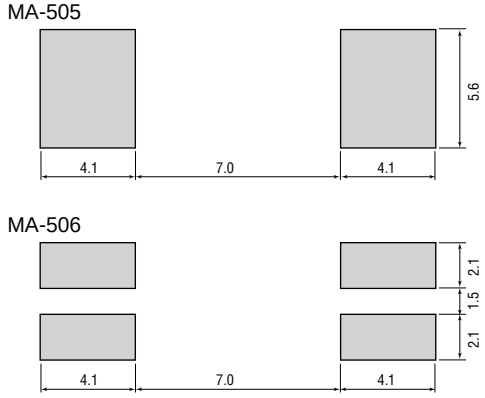
(Unit: mm)



Do not connect #2 and #3 of MA-506 to external device.
The first digit of lot No. means: {5XXXX→MA-505, 6XXXX→MA-506

Recommended soldering pattern

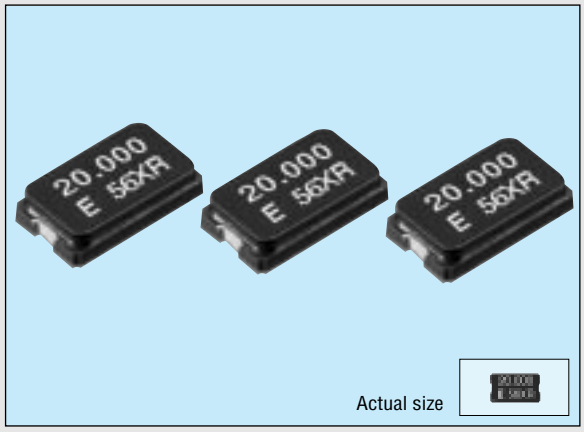
(Unit: mm)



THIN SMD HIGH-FREQUENCY CRYSTAL UNIT

FA-365/367/368

- High-density mounting-type SMD.
- Excellent reliability and environment capability.
- Capable of covering a wide frequency range. (from 14 MHz to 41 MHz)
- 1.4mm thickness is equal to SMD-type IC.

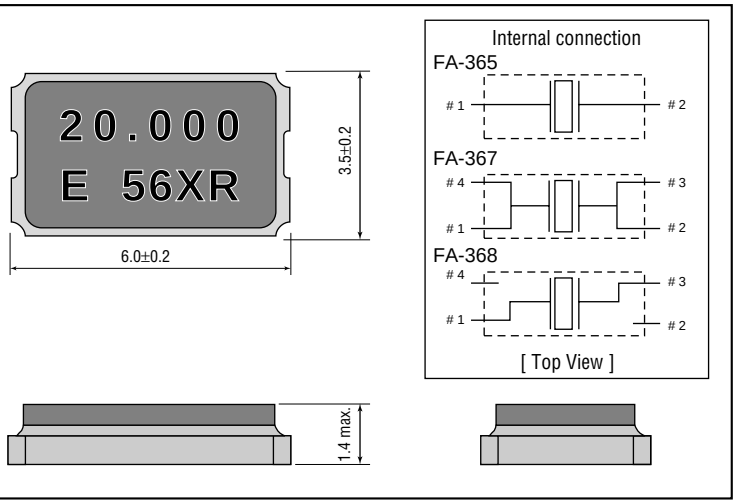


Specifications (characteristics)

Item		Symbol	Specifications	Remarks
Nominal frequency range		f	14.000 MHz to 41.000 MHz	Fundamental mode
Temperature range	Storage temperature	T_{STG}	-55˚C to +125˚C	Stored as bare product after unpacking
	Operating temperature	T_{OPR}	-20˚C to +70˚C	
Drive level	Maximum drive level	GL	2mW max.	Only crystal oscillation is guaranteed
	Recommended drive level	DL	10μW to 100μW	
Soldering condition		T_{SOL}	Twice at under 260˚C within 10 sec. or under 230˚C within 3 min.	
Frequency tolerance (standard)		Δf/f	±50ppm, ±100ppm	Ta=25˚C±3˚C
Frequency temperature characteristics (standard)			±30ppm	-20˚C to +70˚C
Load capacitance		C_L	10pF to ∞	Please specify
Series resistance		R_1	50 Ω max.	-20˚C to +70˚C,DL=100μw
Shunt capacitance		C_0	5.0pF max.	
Insulation resistance		IR	500 MΩ min.	
Aging		fa	±5ppm/year max.	Ta=25˚C ±3˚C, first year
Shock resistance		S. R.	±10ppm max.	Three drops on a hard board from 75 cm or excitation test with 3000G x 0.3ms x 1/2 sine wave x 3 directions

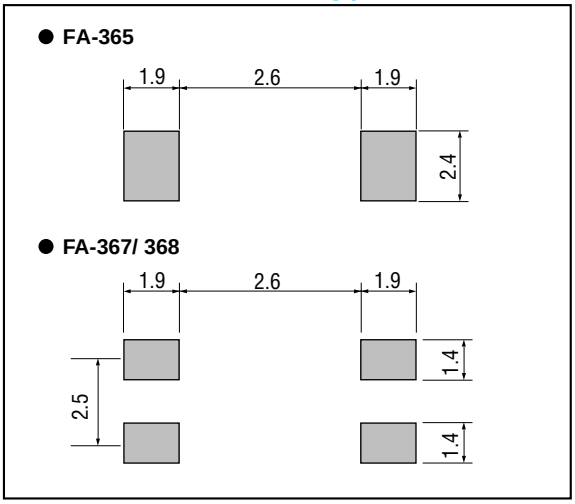
External dimensions

(Unit: mm)



Recommended soldering pattern

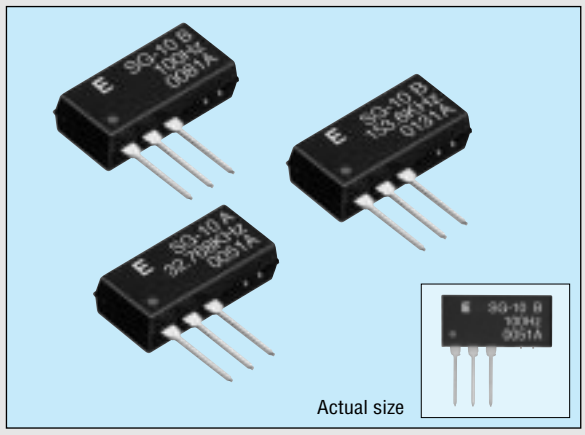
(Unit: mm)



SIP LOW/MEDIUM-FREQUENCY CRYSTAL OSCILLATOR

SG-10

- Low current consumption.
- Small suited to high-density mounting.
- Mountable on a standard printed circuit board.
- Cylindrical low/medium-frequency crystal unit builtin, thus assuring high reliability.



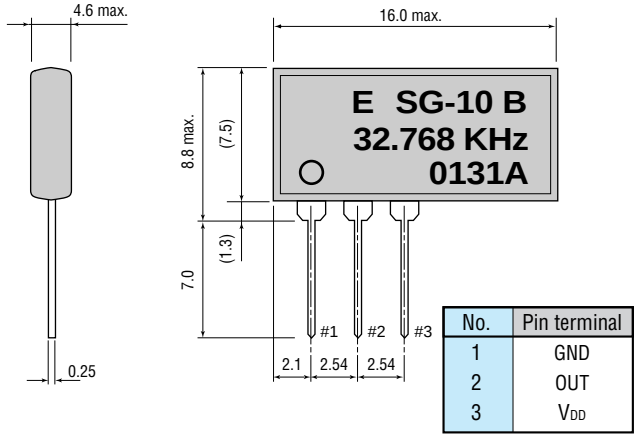
Specifications (characteristics)

Item		Symbol	Specifications	Remarks
Output frequency range		f_0	10.0000 Hz to 153.6000 kHz	For output frequency, see the table below
Power source voltage	Max. supply voltage	V_{DD}-GND	-0.3V to +7.0V	
	Operating voltage	V_{DD}	4.5V to 5.5V	
Temperature range	Storage temperature	T_{STG}	-55˚C to +125˚C	
	Operating temperature	T_{OPR}	-10˚C to +70˚C	
Soldering condition (lead part)		T_{SOL}	Under 260˚C within 10 sec.	Do not heat the package to more than 150˚C
Frequency tolerance		$\Delta f/f_0$	A: ±10ppm B: ±50ppm	V_{DD}=5V Ta=25˚C
Frequency temperature characteristics			+10ppm / -120ppm	-10˚C to +70˚C, taking Ta=25˚C as the reference
Frequency voltage characteristics			±10ppm max.	
Current consumption		I_{OP}	0.5mA max.	No load condition
Duty		t_w/t	40% to 60% (except for cases of 1/3 and 1/5 divided frequency.)	1/2 V_{DD} or 1.4V level
Output voltage		V_{OH}	V_{DD} -1.0V min.	I_{OH}= -40µA
		V_{OL}	0.4V max.	I_{OL}=1.6mA
Output load condition (fan out)		N/C_L	1TTL max./15pF max.	TTL load/C-MOS load
Output rise time		t_{TLH}	60ns max.	Refer to output waveform (page 11)
Output fall time		t_{THL}	50ns max.	
Oscillation start up time		t_{OSC}	1 s max.	For more than 1ms until V_{DD}=0V→4.5V. Time at 4.5V to be 0 sec.
Aging		fa	±5ppm/year max.	Ta=25˚C ±3˚C, V_{DD}=5V, first year
Shock resistance		S.R.	±10ppm max.	Three drops on a hard board from 75 cm or excitation test with 3000G x 0.3ms x 1/2 sine wave in 3 directions

Unless otherwise stated, characteristics (specifications) shown in the above table are based on the rated operating temperature and voltage condition.

External dimensions

(Unit: mm)



No.	Pin terminal
1	GND
2	OUT
3	V_{DD}

Output frequency table

Oscillation source	32.768 kHz,60.000 kHz, 96.000 kHz, 100.000 kHz, 153.600 kHz
Divided frequency output (calculation method)	Oscillation source frequency x (any arbitrary one of 1/1, 1/2, 1/3, 1/4, 1/5, 1/6, 1/12 x (any arbitrary one of 1/1, 1/10, 1/100, 1/1000). Over 10.0 Hz range.

For frequencies other than the above, please consult us. (min. order lot 10,000 pcs.)

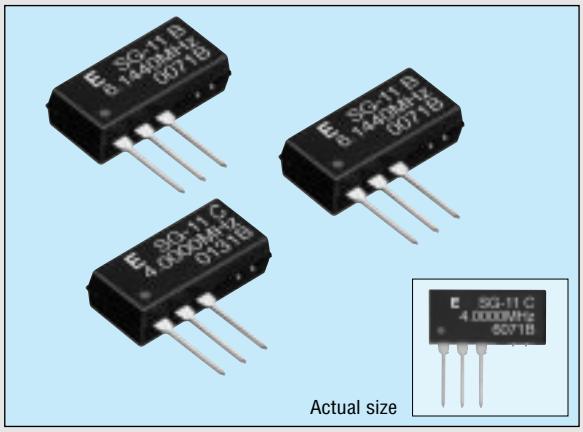
Output frequency example

Oscillation source	32.768 kHz , 60.000 kHz , 96.000 kHz, 100.000 kHz ,153.600 kHz
Divided frequency	10.000 Hz , 50.000 Hz , 100.000 Hz , 1.000 kHz, 4.800 kHz , 9.600 kHz, 19.200 kHz , 38.400 kHz, 50.000 kHz , 76.800 kHz

SIP HIGH-FREQUENCY CRYSTAL OSCILLATOR

SG-11

- Use of C-MOS IC allows low current consumption.
- Small suited to high-density mounting.
- Mountable on a standard printed board.
- Cylindrical AT-cut crystal unit builtin, thus assuring high reliability.



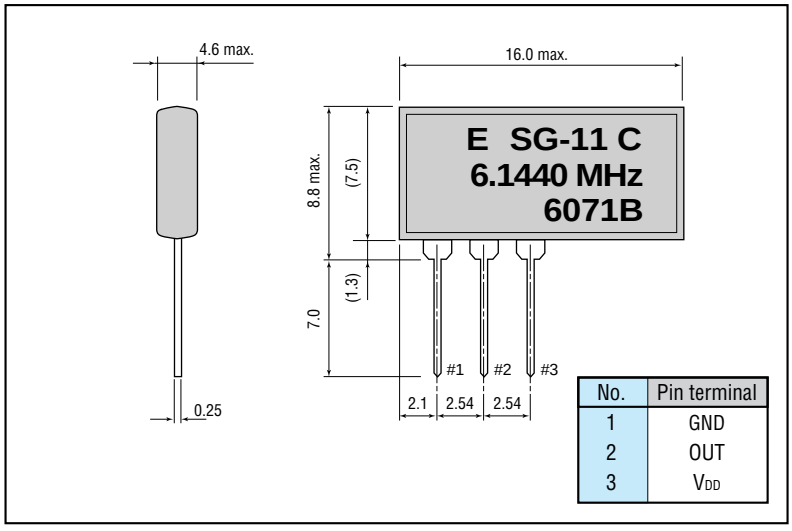
■ Specifications (characteristics)

Item		Symbol	Specifications	Remarks
Output frequency range		f_0	1.5 MHz to 24.0000 MHz	For output frequency, refer to the table below
Power source voltage	Max. supply voltage	V_{DD}-GND	-0.3V to +7.0V	
	Operating voltage	V_{DD}	4.5V to 5.5V	
Temperature range	Storage temperature	T_{STG}	-55˚C to +125˚C	
	Operating temperature	T_{OPR}	-10˚C to +70˚C	
Soldering condition (lead part)		T_{SOL}	Under 260˚C within 10 sec.	Do not heat the package to more than 150˚C
Frequency stability		$\Delta f/f_0$	C: ±100ppm	-10˚C to +70˚C
Current consumption		I_{OP}	10mA max.	No load condition
Duty		t_w/t	40% to 60%	1/2 V_{DD} or 1.4V level
Output voltage		V_{OH}	V_{DD} -0.4V min.	I_{OH}=-40µA
		V_{OL}	0.4V max.	I_{OL}=1.6mA
Output load condition (fan out)		N/C_L	1TTL max./15pF max.	TTL load /C-MOS load
Output rise time		t_{TLH}	20ns max.	Refer to output waveform (page 11)
Output fall time		t_{THL}	15ns max.	
Oscillation start up time		t_{OSC}	10ms max.	For more than 1ms until V_{DD} =0V→4.5V Time at 4.5V to be 0 sec.
Aging		fa	±10ppm max. (3ppm typ.)	Ta=25˚C ±3˚C, V_{DD}=5V, first year
Shock resistance		S.R.	±10ppm max.	Three drops on a hard board from 75 cm or excitation test with 3000G x 0.3ms x 1/2 sine wave x 3 directions

Unless otherwise stated, characteristics (specifications) shown in the above table are based on the rated operating temperature and voltage condition.

■ External dimensions

(Unit: mm)



No.	Pin terminal
1	GND
2	OUT
3	V_{DD}

■ Output frequency example

Output frequency
3.579545 MHz
4.0000 MHz
4.9152 MHz
6.1440 MHz
8.0000 MHz
9.8304 MHz
12.0000 MHz
14.31818 MHz
16.0000 MHz
18.4320 MHz
19.6608 MHz
20.0000 MHz
24.0000 MHz

FULL-SIZE DIP HIGH-FREQUENCY CRYSTAL OSCILLATOR

SG-51 series

- Pin compatible with full-size metal can.

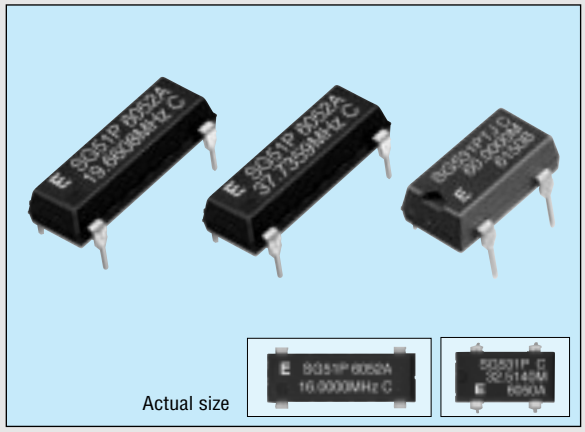
HALF-SIZE DIP HIGH-FREQUENCY CRYSTAL OSCILLATOR

SG-531 series

- Pin compatible with half-size metal can.

Common

- Cylindrical AT-cut crystal unit builtin, thus assuring high reliability.
- Use of C-MOS IC enables reduction of current consumption.



Specifications (characteristics)

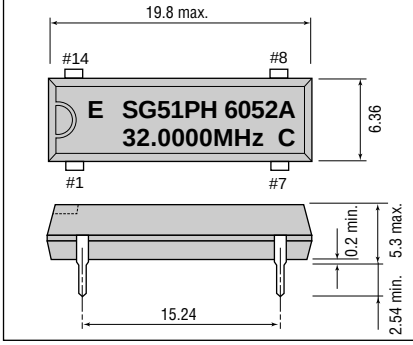
Item		Symbol	SG-51P/531P	SG-51PTJ/531PTJ	SG-51PH/531PH	Remarks
			Specifications			
Output frequency range		f_0	1.0250 MHz to 26.0000 MHz	26.0001 MHz to 66.6667 MHz		
Power source voltage	Max. supply voltage	V_{DD}-GND		-0.3V to +7.0V		
	Operating voltage	V_{DD}		5.0V±0.5V		
Temperature range	Storage temperature	T_{STG}	-55°C to +125°C	-55°C to +100°C		
	Operating temperature	T_{OPR}		-10°C to +70°C		
Soldering condition (lead part)		T_{SOL}	Under 260°C within 10 sec.			Don't heat the package to more than 150°C
Frequency stability		$\Delta f/f_0$		B: ± 50ppm C: ±100ppm		-10°C to +70°C B type is possible up to 55.0 MHz
Current consumption		Iop	23mA max.	35mA max.		No load condition
Duty	C-MOS level	t_w/t	40% to 60%	—	40% to 60%	1/2 V_{DD} level
	TTL level		45% to 55%		—	1.4V level
Output voltage		V_{OH}	-0.4V min.	2.4V min.	V_{DD} -0.4V min.	
		(I_{OH})	-400μA		-4mA	
		V_{OL}		0.4V max.		
		(I_{OL})	16mA	8mA	4mA	
Output load condition (fan out)	C-MOS	C_L	50pF max.	—	50pF max.	
	TTL	N	10TTL max.	5TTL max.	—	
Output enable/disable input voltage		V_{IH}	2.0V min.	3.5V min.	2.0V min.	I_{IH}=1μA max. (OE=V_{DD})
		V_{IL}	0.8V max.	1.5V max.	0.8V max.	I_{IL}= -100μA min. (OE=GND), PTJ: -500μA
Output disable current		I_{OE}	12mA max.	28mA max.	20mA max.	OE=GND
Output rise time	C-MOS level	t_{TLH}	8ns max.	—	7ns max.	C-MOS load: 20%→80% V_{DD}
	TTL level			5ns max.	—	TTL load: 0.4V→2.4V
Output fall time	C-MOS level	t_{THL}	8ns max.	—	7ns max.	C-MOS load: 80%→20% V_{DD}
	TTL level			5ns max.	—	TTL load: 2.4V→0.4V
Oscillation start up time		t_{OSC}	4ms max.	10ms max.		More than for 1ms until V_{DD} =0V→4.5V Time at 4.5V to be 0 sec.
Aging		fa		±5ppm/year max.		Ta=25°C, V_{DD} =5V,first year
Shock resistance		S.R.		±20ppm max.		Three drops on a hard board from 75 cm or excitation test with 3000G x 0.3ms x 1/2 sine wave in 3 directions

Note: • Unless otherwise stated, characteristics (specifications) shown in the above table are based on the rated operating temperature and voltage condition.
• External by-pass capacitor is recommended.

External dimensions

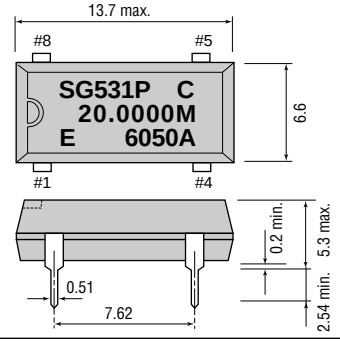
(Unit: mm)

SG-51 series



No.	Pin terminal
1	OE
7	GND
8	OUT
14	V_{DD}

SG-531 series

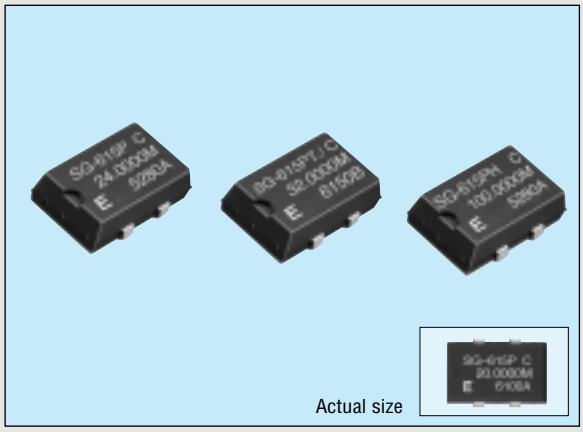


No.	Pin terminal
1	OE
4	GND
5	OUT
8	V_{DD}

SMD HIGH-FREQUENCY CRYSTAL OSCILLATOR

SG-615 series

- High-density mounting-type SMD.
- A general-purpose SMD with heat-resisting cylindrical AT-cut crystal unit and allowing almost the same soldering temperature as SMD IC.
- Cylindrical AT crystal unit builtin, thus assuring high reliability.
- Provided with output enable function.
- Low current consumption.



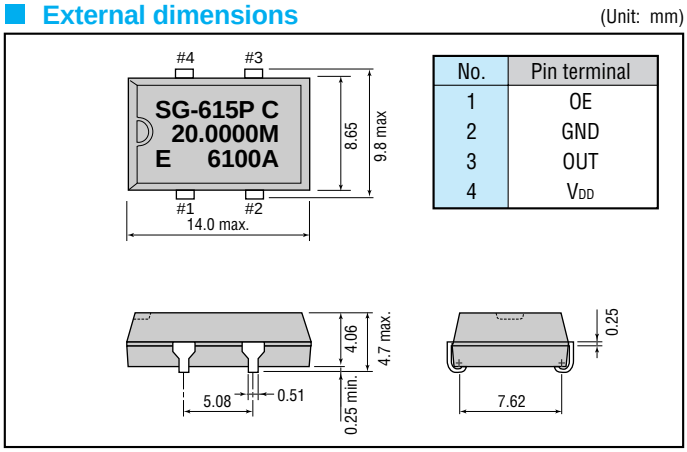
Specifications (characteristics)

Item		Symbol	SG-615P	SG-615PTJ	SG-615PH	Remarks
			Specifications			
Output frequency range		f_0	1.0250 MHz to 26.0000 MHz	26.0001 MHz to 66.6667 MHz		
Power source voltage	Max. supply voltage	V_{DD}-GND	-0.3V to +7.0V			
	Operating voltage	V_{DD}	5.0V±0.5V			
Temperature range	Storage temperature	T_{STG}	-55°C to +125°C			Stored as bare product after unpacking
	Operating temperature	T_{OPR}	-10°C to 70°C (-40°C to 85°C)			
Soldering condition		T_{SOL}	Twice at under 260°C within 10 sec. or under 230°C within 3 min.			
Frequency stability		$\Delta f/f_0$	B: ±50ppm C: ±100ppm			B type is possible up to 55 MHz
Current consumption		Iop	23mA max.	35mA max.		No load condition
Duty	C-MOS level	t_w/t	40% to 60%	—	40% to 60%	C-MOS load: 1/2V_{DD}
	TTL level		45% to 55%		—	TTL load: 1.4V
Output voltage		V_{OH}	V_{DD} -0.4V min.	2.4V min.	V_{DD} -0.4V min.	
		(I_{OH})	-400μA		-4mA	
		V_{OL}	0.4V max.			
		(I_{OL})	16mA	8mA	4mA	
Output load condition (fan out)	C-MOS	C_L	50pF max.	—	50pF max.	
	TTL	N	10TTL max.	5TTL max.	—	
Output enable/disable input voltage		V_{IH}	2.0V min.	3.5V min.	2.0V min.	I_{IH}=1μA max.(OE=V_{DD})
		V_{IL}	0.8V max.	1.5V max.	0.8V max.	I_{IL}=-100μA min.(OE=GND) I_{IL}=-500μA min.(OE=GND) PTJ
Output disable current		I_{OE}	12mA max.	28mA max.	20mA max.	OE=GND
Output rise time	C-MOS level	t_{TLH}	8ns max.	—	7ns max.	C-MOS load: 20%→80% V_{DD}
	TTL level			5ns max.	—	TTL load: 0.4V→2.4V
Output fall time	C-MOS level	t_{THL}		—	7ns max.	C-MOS load: 80%→20% V_{DD}
	TTL level			5ns max.	—	TTL load: 2.4V→0.4V
Oscillation start up time		t_{OSC}	4ms max.	10ms max.		Time at 4.5V to be 0 sec.
Aging		fa	±5ppm/year max.			Ta= 25°C, V_{DD} = 5V, first year
Shock resistance		S.R.	±20ppm max.			Three drops on a hard board from 75 cm or excitation test with 3000G x 0.3ms x 1/2sine wave in 3 directions

Note: • Unless otherwise stated, characteristics (specifications) shown in the above table are based on the rated operating temperature and voltage condition.
• External by-pass capacitor is recommended.

External dimensions

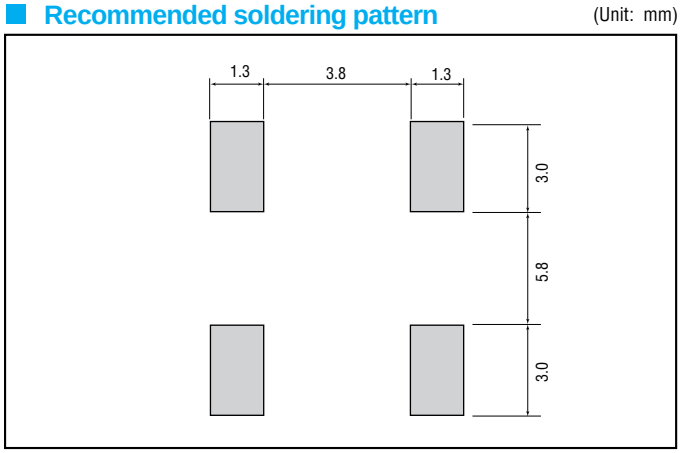
(Unit: mm)



No.	Pin terminal
1	OE
2	GND
3	OUT
4	V_{DD}

Recommended soldering pattern

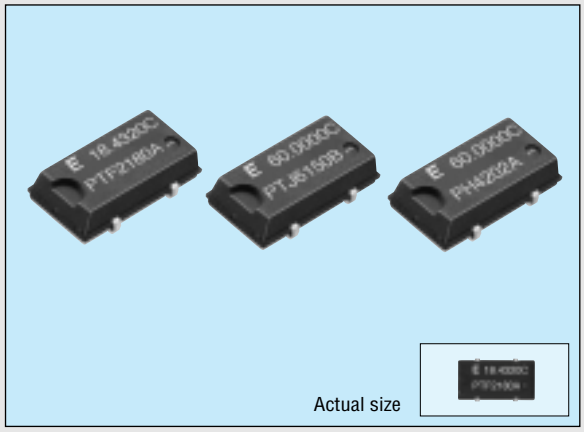
(Unit: mm)



SMALL SMD HIGH-FREQUENCY CRYSTAL OSCILLATOR

SG-636 series

- A small SMD that enables high-density mounting.
- A general-purpose device with builtin heat-resisting cylindrical AT-cut crystal and allowing almost the same temperature condition for soldering as SMD IC.
- Low current consumption.
- Provided with output enable function.
- 3.3V operation, stand-by function available.



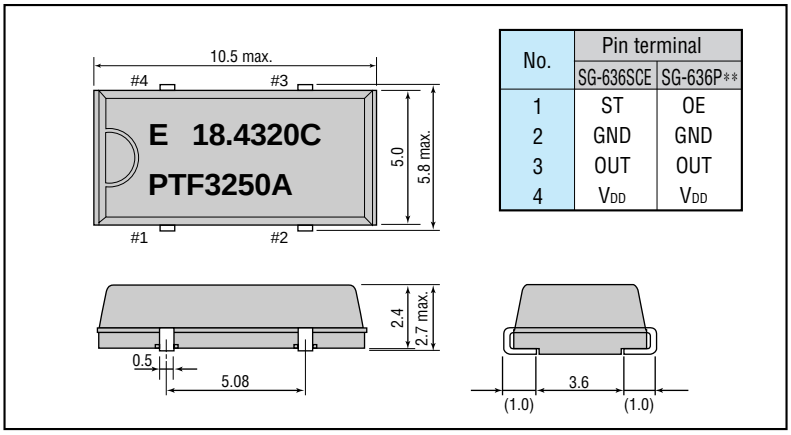
Specifications (characteristics)

Item		Symbol	SG-636PTF	SG-636PTJ	SG-636PH	SG-636SCE/PCE	Remarks
			Specifications				
Output frequency range		f_0	2.21675 MHz to 41.0000 MHz	41.0001 MHz to 70.0000 MHz		2.21675 MHz to 40.0000 MHz	
Power source voltage	Max. supply voltage	V_{DD}-GND	-0.5V to +7.0V	-0.3V to +7.0V	-0.5V to +7.0V		
	Operating voltage	V_{DD}		5.0V ±0.5V		3.3V ±0.3V	
Temperature range	Storage temperature	T_{STG}	-55°C to +100°C				Stored as bare product after unpacking
	Operating temperature	T_{OPR}	-10°C to +70°C				
Soldering condition		T_{SOL}	Twice at under 260°C within 10 sec. or under 230°C within 3 min.				
Frequency stability		$\Delta f/f_0$	C: ±100ppm				-10°C to +70°C
Current consumption		Iop	17mA max.	35mA max.		9mA max.	No load condition
Duty	C-MOS level	t_w/t	45% to 55%	—	40% to 60%	45% to 55%	C-MOS load: 1/2V_{DD} level
	TTL level		45% to 55%		—		TTL load: 1.4V level
Output voltage		V_{OH}	V_{DD} -0.4V min.	2.4V min.	V_{DD} -0.4V min.		
		(I_{OH})	-8mA	-400μA	-4mA		
		V_{OL}	0.4V max.				
		(I_{OL})	16mA	8mA	4mA		
Output load condition (fan out)	C-MOS	C_L	50pF max.	15pF	20pF max.(≤ 55 MHz) 15pF max.(> 55 MHz)	30pF max.	
	TTL	N	10TTL max.	5TTL max.	5 LSTTL max.	—	
Output enable/disable input voltage		V_{IH}	2.0V min.	3.5V min.	2.0V min.	0.8V_{DD} min.	I_{IH}=1μA max.(OE=V_{DD})PTF.PTJ.PH
		V_{IL}	0.8V max.	1.5 max.	0.8V max.	0.2V_{DD} max.	I_{IL}=-100μA min. (OE=GND) PTF.PH -500μA min. (OE=GND) PTJ
Output disable current		I_{OE}	10mA max.	28mA max.	20mA max.	5mA max.	OE=GND, ST=GND 2uA max.(SCE)
Output rise time	C-MOS level	t_{TLH}	7ns max.	—	5ns max.		C-MOS load: 20%→80%V_{DD}
	TTL level		5ns max.		—		TTL load: 0.4V→2.4V
Output fall time	C-MOS level	t_{THL}	7ns max.	—	5ns max.		C-MOS load: 80%→20%V_{DD}
	TTL level		5ns max.		—		TTL load: 2.4V→0.4V
Oscillation start up time		tosc	4ms max.	10ms max.		4ms max.	Time at 4.5V to be 0 sec.
Aging		fa	±5ppm/year max.				Ta=25°C,V_{DD}=5V,first year
Shock resistance		S.R.	±20ppm max.				Three drops on a hard board from 75 cm or excitation test with 3000G x 0.3ms x 1/2 sine wave in 3 directions

Note: • Unless otherwise stated,characteristics (specifications) shown in the above table are based on the rated operating temperature and voltage condition.
• External by-pass capacitor is required.

External dimensions

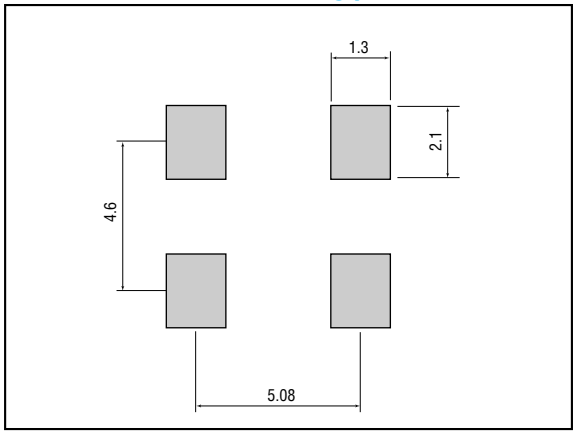
(Unit: mm)



No.	Pin terminal	
	SG-636SCE	SG-636P**
1	ST	OE
2	GND	GND
3	OUT	OUT
4	V_{DD}	V_{DD}

Recommended soldering pattern

(Unit: mm)



REFERENCE DATA

Duty of SG-51,531,615 and 636 series

Duty 45%,55%
Duty 45%,55%
Duty 40%,60%
..... possible depending on load condition.

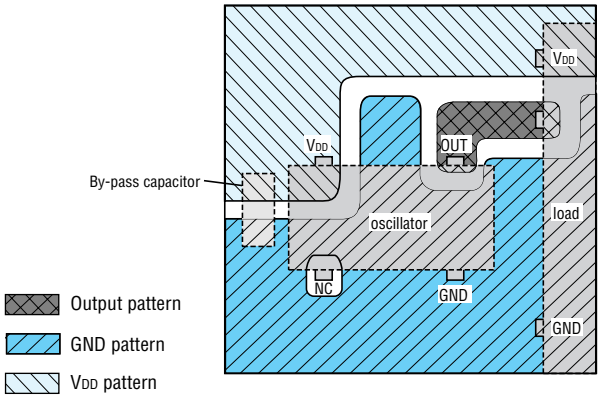
Model	Load	Frequency
		1.025M 2.2167M / 16.0M / 21.026M / 26.0M / 40.0M / 66.67M / 70M
SG-51P/SG-531P/SG-615P	TTL	
	C-MOS	CL=15pF max.
SG-51PTJ/SG-531PTJ/SG-615PTJ	TTL	
SG-51PH/SG-531PH/SG-615PH	C-MOS	
SG-636PTF	TTL	
	C-MOS	
SG-636PTJ	TTL	
SG-636PH	C-MOS	
SG-636PCE/SG-636SCE		

*1 Duty 45% to 55% of SG-615 is guaranteed in an operating temperature range of from -10 to +70°C.

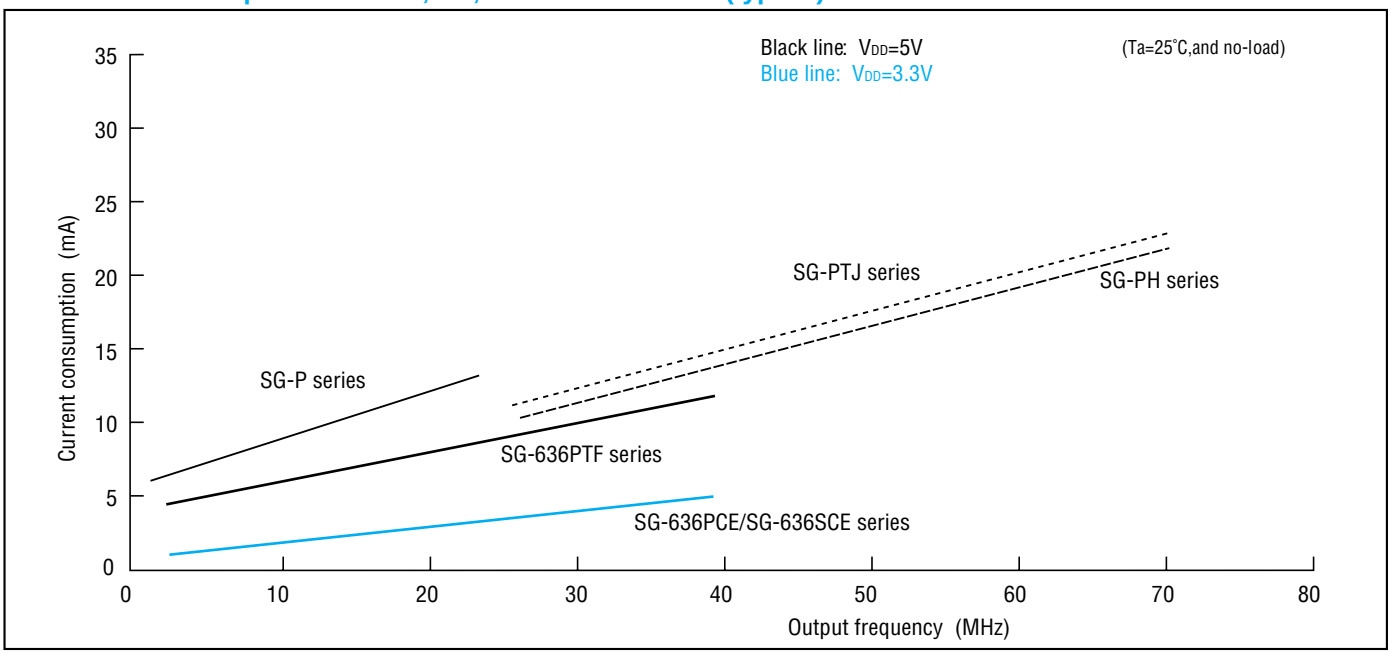
*2 Common conditions for all products.

(1) Line impedance of a power supply should be minimized by V_{DD} and GND patterns.
(2) A 0.01µF power supply by-pass capacitor should be installed very close to an oscillator.
(3) Output load should be as close as possible to an oscillator (within 20mm).
(4) Power supply range: operating voltage.
(5) 10 TTL: RL ≥ 390 Ω, C_L ≤ 15pF.

● Circuit configuration sample



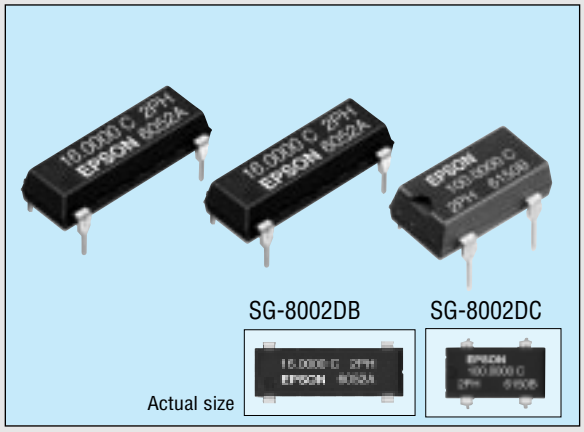
Current consumption of SG-51,531,615 and 636 series (typical)



PROGRAMMABLE HIGH-FREQUENCY CRYSTAL OSCILLATOR

SG-8002DB/ DC series

- Wide frequency range from 1MHz to 125MHz.
- Quick delivery of samples and short lead time by mass production.
- Use of C-MOS IC assures low current consumption.
- Excellent shock resistance and environmental capability.
- Output enable function (OE) and stand-by function (ST) can be used for low current consumption applications.
- Pin compatible with full size and half size.



Specifications (characteristics)

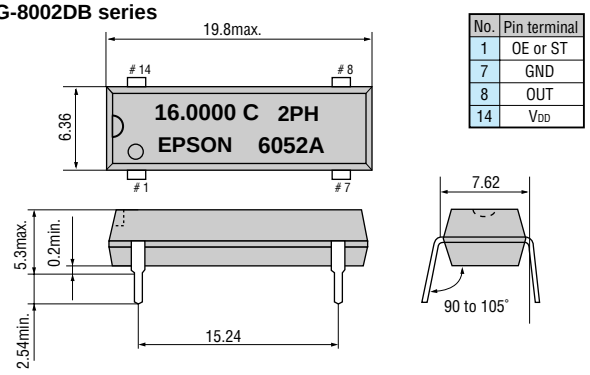
Item		Symbol	PT/ST	PH/SH	PC/SC	Remarks
			Specifications			
Output frequency range		f_0	1.0000 MHz to 125.0000 MHz		1.0000 MHz to 90.0000 MHz	
Power source voltage	Max. supply voltage	V_{DD}-GND		-0.5V to +7.0V		
	Operating voltage	V_{DD}	5.0V±0.5V		2.7V to 3.3V	
Temperature range	Storage temperature	T_{STG}		-55°C to +125°C		
	Operating temperature	T_{OPR}	-20°C to +70°C (-40°C to +85°C)		-40°C to +85°C	Operating voltage range
Soldering condition		T_{SOL}	Under 260°C within 10 sec.			
Frequency stability		$\Delta f/f_0$	B: ±50ppm C: ± 100ppm M: ±100ppm(-40°C to +85°C)			-20°C to +70°C
Current consumption		Iop	45mA max.		25mA max.	No load condition, Max. frequency range
Output disable current		I_{OE}	30mA max.		15mA max.	OE=GND(PT, PH, PC)
Standby current		I_{ST}		50μA max.		ST=GND(ST, SH, SC)
Duty		t_w/t	—	40% to 60%		C-MOS load: 1/2V_{DD} level
			40% to 60%	—		TTL load: 1.4V level
High output voltage		V_{OH}		V_{DD} -0.4V min.		I_{OH}=-16mA(PT/ST, PH/SH),-8mA(PC/SC)
Low output voltage		V_{OL}		0.4V max.		I_{OL}= 16mA(PT/ST, PH/SH), 8mA(PC/SC)
Output load condition (fan out)	TTL	N	5TTL max.	—		Max. frequency and max. operating voltage range
	C-MOS	C_L	15pF max.	25pF max.	15pF max.	
Output enable/disable input voltage		V_{IH}	2.0V min.		0.7 × V_{DD} min.	$\overline{ST}$, OE terminal
		V_{IL}	0.8V max.		0.2 × V_{DD} max.	
Output rise time	C-MOS level	t_{TLH}	—	4ns max.		C-MOS load: 20%→80% V_{DD}
	TTL level		4ns max.	—		TTL load: 0.4V→2.4V
Output fall time	C-MOS level	t_{THL}	—	4ns max.		C-MOS load: 80%→20% V_{DD}
	TTL level		4ns max.	—		TTL load: 2.4V→0.4V
Oscillation start up time		t_{OSC}		10ms max.		V_{DD}=Operating voltage, t=0
Aging		fa		±5ppm/Year max.		Ta= 25°C, V_{DD} = 5.0V/3.3V(PC/SC)
Shock resistance		S.R.		±20ppm max.		Three drops on a hard board from 75 cm or excitation test with 3000G x 0.3ms x 1/2sine wave in 3 directions

Note: • Please contact us for inquiries about operating temperature(-40°C to +85°C), usable frequencies, duty and output load conditions. Checking possible by the Frequency Checking Program. **http://www.epson.co.jp/CRYSTAL/**

External dimensions

(Unit: mm)

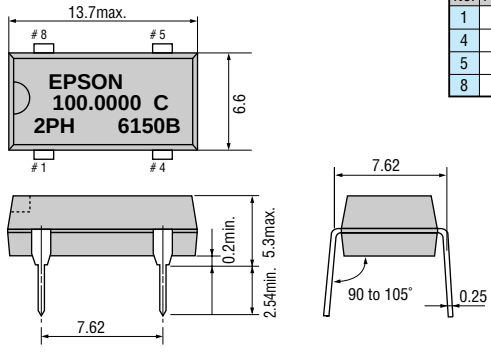
● **SG-8002DB series**



No.	Pin terminal
1	OE or ST
7	GND
8	OUT
14	V_{DD}

(Unit: mm)

● **SG-8002DC series**

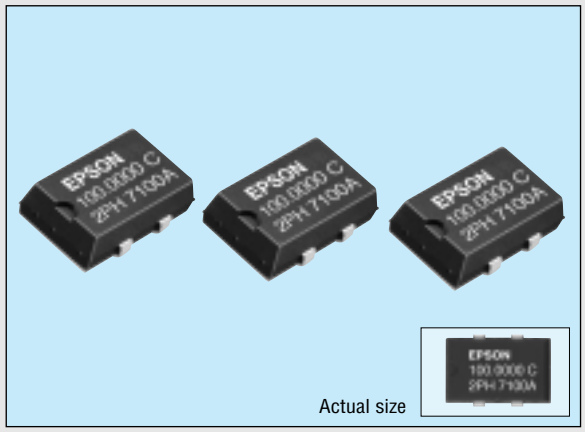


No.	Pin terminal
1	OE or ST
4	GND
5	OUT
8	V_{DD}

PROGRAMMABLE HIGH-FREQUENCY CRYSTAL OSCILLATOR

SG-8002JA series

- Wide frequency range from 1MHz to 125MHz.
- Quick delivery of samples and short lead time by mass production.
- Use of C-MOS IC assures low current consumption.
- Excellent shock resistance and environmental capability.
- Output enable function (OE) and stand-by function (ST) can be used for low current consumption applications.
- Shape and pin compatible with SG-615.



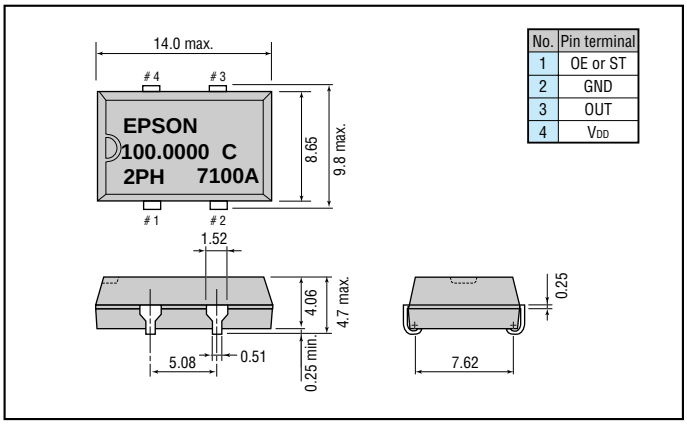
Specifications (characteristics)

Item		Symbol	PT/ST	PH/SH	PC/SC	Remarks
			Specifications			
Output frequency range		f_0	1.0000 MHz to 125.0000 MHz		1.0000 MHz to 90.0000 MHz	
Power source voltage	Max. supply voltage	V_{DD}-GND		-0.5V to +7.0V		
	Operating voltage	V_{DD}	5.0V±0.5V		2.7V to 3.6V	
Temperature range	Storage temperature	T_{STG}		-55°C to +125°C		
	Operating temperature	T_{OPR}	-20°C to +70°C (-40°C to +85°C)		-40°C to +85°C	Operating voltage range
Soldering condition		T_{SOL}	Twice at under 260°C within 10 sec. or under 230°C within 3 min.			
Frequency stability		$\Delta f/f_0$	B: ±50ppm C: ± 100ppm M: ±100ppm(-40°C to +85°C)			-20°C to +70°C
Current consumption		Iop	45mA max.		25mA max.	No load condition, Max. frequency range
Output disable current		I_{OE}	30mA max.		15mA max.	OE=GND(PT, PH, PC)
Standby current		I_{ST}		50µA max.		ST=GND(ST, SH, SC)
Duty		t_w/t	—	40% to 60%		C-MOS load: 1/2V_{DD} level
			40% to 60%	—		TTL load: 1.4V level
High output voltage		V_{OH}		V_{DD} -0.4V min.		I_{OH}=-16mA(PT/ST, PH/SH),-8mA(PC/SC)
Low output voltage		V_{OL}		0.4V max.		I_{OL}= 16mA(PT/ST, PH/SH), 8mA(PC/SC)
Output load condition (fan out)	TTL	N	5TTL max.	—		Max. frequency and max. operating voltage range
	C-MOS	C_L	15pF max.	25pF max.	15pF max.	
Output enable/disable input voltage		V_{IH}	2.0V min.		0.7 × V_{DD} min.	$\overline{ST}$, OE terminal
		V_{IL}	0.8V max.		0.2 × V_{DD} max.	
Output rise time	C-MOS level	t_{TLH}	—	4ns max.		C-MOS load: 20%→80% V_{DD}
	TTL level		4ns max.	—		TTL load: 0.4V→2.4V
Output fall time	C-MOS level	t_{THL}	—	4ns max.		C-MOS load: 80%→20% V_{DD}
	TTL level		4ns max.	—		TTL load: 2.4V→0.4V
Oscillation start up time		t_{OSC}		10ms max.		Time at operating voltage to be 0 sec.
Aging		fa		±5ppm/year max.		Ta= 25°C, V_{DD} = 5.0V/3.3V(PC/SC)
Shock resistance		S.R.		±20ppm max.		Three drops on a hard board from 75 cm or excitation test with 3000G x 0.3ms x 1/2sine wave in 3 directions

Note: • Please contact us for inquiries about operating temperature(-40°C to +85°C), usable frequencies, duty and output load conditions. Checking possible by the Frequency Checking Program. **http://www.epson.co.jp/CRYSTAL/**

External dimensions

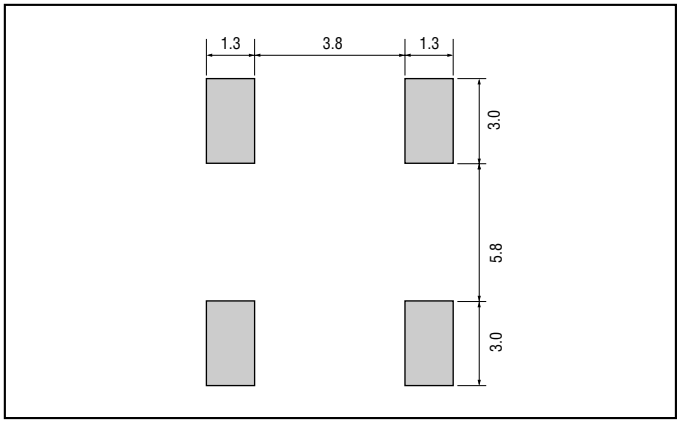
(Unit: mm)



No.	Pin terminal
1	OE or ST
2	GND
3	OUT
4	V_{DD}

Recommended soldering pattern

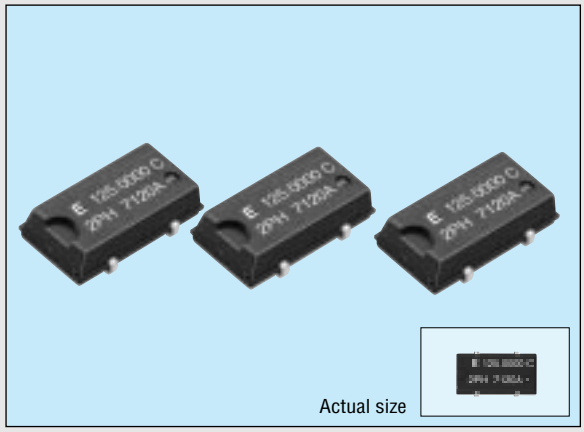
(Unit: mm)



PROGRAMMABLE HIGH-FREQUENCY CRYSTAL OSCILLATOR

SG-8002JC series

- Wide frequency range from 1MHz to 125MHz.
- Quick delivery of samples and short lead time by mass production.
- Use of C-MOS IC assures low current consumption.
- Excellent shock resistance and environmental capability.
- Output enable function (OE) and stand-by function (ST) can be used for low current consumption applications.
- Shape and pin compatible with SG-636.



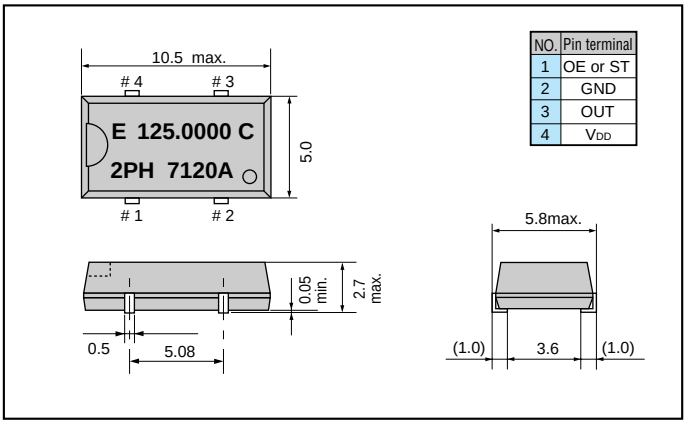
Specifications (characteristics)

Item		Symbol	PT/ST	PH/SH	PC/SC	Remarks
			Specifications			
Output frequency range		f_0	1.0000 MHz to 125.0000 MHz		1.0000 MHz to 90.0000 MHz	
Power source voltage	Max. supply voltage	V_{DD}-GND		-0.5V to +7.0V		
	Operating voltage	V_{DD}	5.0V±0.5V		2.7V to 3.6V	
Temperature range	Storage temperature	T_{STG}		-55°C to +100°C		
	Operating temperature	T_{OPR}		-20°C to +70°C		Operating voltage range
Soldering condition		T_{SOL}	Twice at under 260°C within 10 sec. or under 230°C within 3 min.			
Frequency stability		$\Delta f/f_0$	B: ±50ppm C: ± 100ppm			-20°C to +70°C
Current consumption		Iop	45mA max.		25mA max.	No load condition, Max. frequency range
Output disable current		I_{OE}	30mA max.		15mA max.	OE=GND(PT, PH, PC)
Standby current		I_{ST}		50µA max.		ST=GND(ST, SH, SC)
Duty		t_w/t	—	40% to 60%		C-MOS load: 1/2V_{DD} level
			40% to 60%		—	TTL load: 1.4V level
High output voltage		V_{OH}		V_{DD} -0.4V min.		I_{OH}=-16mA(PT/ST,PH/SH),-8mA(PC/SC)
Low output voltage		V_{OL}		0.4V max.		I_{OL}= 16mA(PT/ST,PH/SH), 8mA(PC/SC)
Output load condition (fan out)	TTL	N	5TTL max.		—	Max. frequency and max. operating voltage range
	C-MOS	C_L		15pF max.		
Output enable/disable input voltage		V_{IH}	2.0V min.		0.7 × V_{DD} min.	$\overline{ST}$, OE terminal
		V_{IL}	0.8V max.		0.2 × V_{DD} max.	
Output rise time	C-MOS level	t_{TLH}	—	4ns max.		C-MOS load: 20%→80% V_{DD}
	TTL level		4ns max.		—	TTL load: 0.4V→2.4V
Output fall time	C-MOS level	t_{THL}	—	4ns max.		C-MOS load: 80%→20% V_{DD}
	TTL level		4ns max.		—	TTL load: 2.4V→0.4V
Oscillation start up time		t_{OSC}		10ms max.		Time at operating voltage to be 0 sec.
Aging		fa		±5ppm/year max.		Ta= 25°C, V_{DD} = 5.0V/3.3V(PC/SC)
Shock resistance		S.R.		±20ppm max.		Three drops on a hard board from 75 cm or excitation test with 3000G x 0.3ms x 1/2sine wave in 3 directions

Note: • Please contact us for inquiries about usagle frequencies, duty and output load conditions. Checking possible by the Frequency Checking Program. **http://www.epson.co.jp/CRYSTAL/**

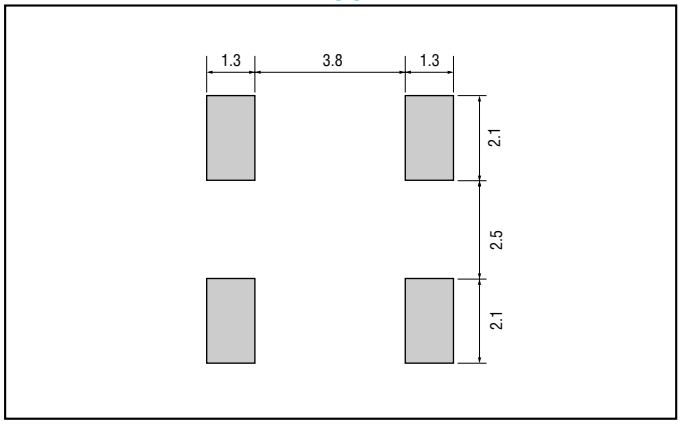
External dimensions

(Unit: mm)



Recommended soldering pattern

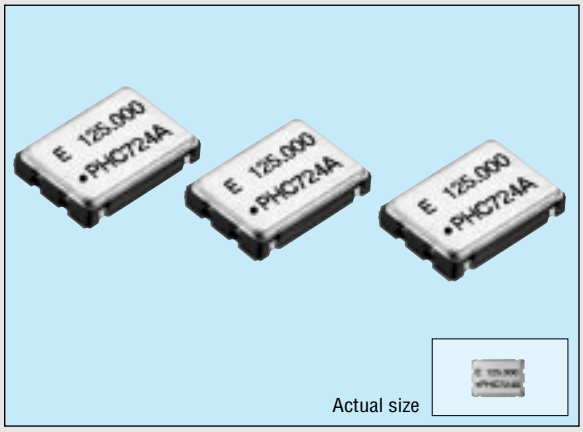
(Unit: mm)



PROGRAMMABLE HIGH-FREQUENCY CRYSTAL OSCILLATOR

SG-8002CA series

- Wide frequency range from 1MHz to 125MHz.
- Quick delivery of samples and short lead time by mass production.
- Use of C-MOS IC assures low current consumption.
- Excellent shock resistance and environmental capability.
- Output enable function (OE) and stand-by function (ST) can be used for low current consumption applications.



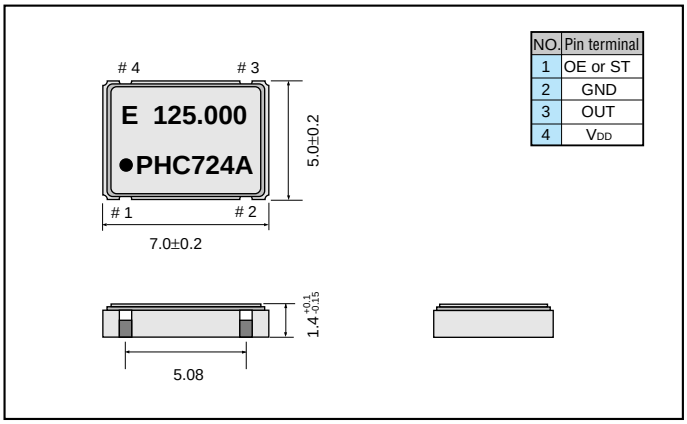
Specifications (characteristics)

Item		Symbol	PT/ST	PH/SH	PC/SC	Remarks
			Specifications			
Output frequency range		f_0	1.0000 MHz to 125.0000 MHz		1.0000 MHz to 90.0000 MHz	
Power source voltage	Max. supply voltage	V_{DD}-GND		-0.5V to +7.0V		
	Operating voltage	V_{DD}	5.0V±0.5V		2.7V to 3.6V	
Temperature range	Storage temperature	T_{STG}		-55°C to +125°C		
	Operating temperature	T_{OPR}	-20°C to +70°C (-40°C to +85°C)		-40°C to +85°C	Operating voltage range
Soldering condition		T_{SOL}	Twice at under 260°C within 10 sec. or under 230°C within 3 min.			
Frequency stability		$\Delta f/f_0$	B: ±50ppm C: ± 100ppm M: ±100ppm(-40°C to +85°C)			-20°C to +70°C
Current consumption		Iop	45mA max.		25mA max.	No load condition, Max. frequency range
Output disable current		I_{OE}	30mA max.		15mA max.	OE=GND
Standby current		I_{ST}	50µA max.			ST=GND
Duty		t_W/t	—	40% to 60%		C-MOS load: 1/2V_{DD} level
			40% to 60%	—		TTL load: 1.4V level
High output voltage		V_{OH}	V_{DD} -0.4V min.			I_{OH}=-16mA(PT/ST,PH/SH),-8mA(PC/SC)
Low output voltage		V_{OL}	0.4V max.			I_{OL}= 16mA(PT/ST,PH/SH), 8mA(PC/SC)
Output load condition (fan out)	TTL	N	5TTL max.	—		Max. frequency and max. operating voltage range
	C-MOS	C_L	15pF max.	25pF max.	15pF max.	
Output enable/disable input voltage		V_{IH}	2.0v min.		0.7 × V_{DD} min.	$\overline{ST}$, OE terminal
		V_{IL}	0.8V max.		0.2 × V_{DD} max.	
Output rise time	C-MOS level	t_{TLH}	—	4ns max.		C-MOS load: 20%→80% V_{DD}
	TTL level		4ns max.	—		TTL load: 0.4V→2.4V
Output fall time	C-MOS level	t_{THL}	—	4ns max.		C-MOS load: 80%→20% V_{DD}
	TTL level		4ns max.	—		TTL load: 2.4V→0.4V
Oscillation start up time		t_{OSC}		10ms max.		Time at Operating voltage to be 0 sec.
Aging		fa		±5ppm/year max.		Ta= 25°C, V_{DD} = 5.0V/3.3V(PC/SC)
Shock resistance		S.R.		±20ppm max.		Three drops on a hard board from 75 cm or excitation test with 3000G x 0.3ms x 1/2sine wave in 3 directions

Note: • Please contact us for inquiries about operating temperature(-40°C to +85°C), usagle frequencies, duty and output load conditions. Checking possible by the Frequency Checking Program. **http://www.epson.co.jp/CRYSTAL/**

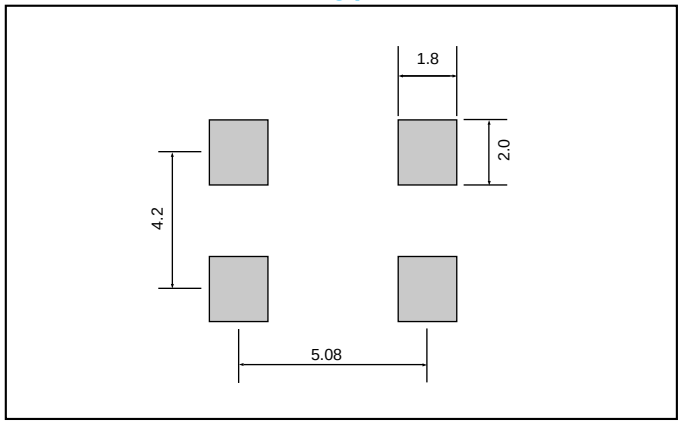
External dimensions

(Unit: mm)



Recommended soldering pattern

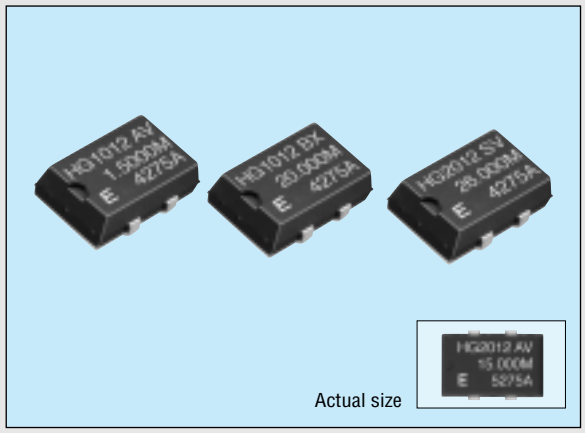
(Unit: mm)



HIGH-STABILITY HIGH-FREQUENCY OSCILLATOR

HG-1000/2000 series

- Cylindrical AT crystal unit builtin, thus assuring high reliability.
- Excellent shock resistance and heat resistance.
- Low current consumption.

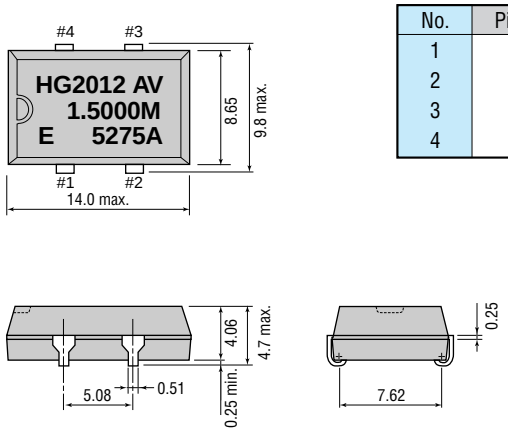


Specifications (characteristics)

Item		Symbol	HG-1012JA	HG-2012JA	Remarks
			Specifications		
Output frequency range		f_0	1.5000 MHz to 28.63636 MHz		V_{DD} =4.75V to 5.25V
Power source voltage	Max. supply voltage	V_{DD}-GND	-0.5V to +7.0V		
	Operating voltage	V_{DD}	5.0V ±0.25V		
Temperature range	Storage temperature	T_{STG}	-55°C to +125°C		
	Operable temperature	T_{OPR}	-40°C to + 85°C		
Soldering condition		T_{SOL}	Under 260°C within 10 sec. x 2 times		
Frequency stability		$\Delta f/f_0$	AV: ±20ppm, BV: ±25ppm	SV: ±15ppm, AV: ±20ppm	Ta= -20°C to +70°C
			BX: ±25ppm, CX: ±30ppm	BX: ±25ppm	Ta= -40°C to +85°C
Current consumption		Iop	10mA max.		No load condition
Duty		tw/t	40% to 60%		1/2 V_{DD} level
High output voltage		V_{OH}	V_{DD} -0.4V min.		I_{OH}= -0.8mA
Low output voltage		V_{OL}	0.4V max.		I_{OL}=3.2mA
Output load condition		C_L	15pF max.		
Output rise time		t_{TLH}	8ns max.		20%→80% V_{DD} level
Output fall time		t_{THL}			80%→20% V_{DD} level
Oscillation start up time		t_{OSC}	4ms max.		Time at 4.75V to be 0 sec.
Aging		fa	±5ppm/year max.	±2ppm/year max.	Ta=25°C
Shock resistance		S.R.	±10ppm max.	±2ppm max.	Three drops on a hard wooden board from 75 cm or excitation test with 3000G x 0.3ms x 1/2sine wave in 3 directions

External dimensions

(Unit: mm)

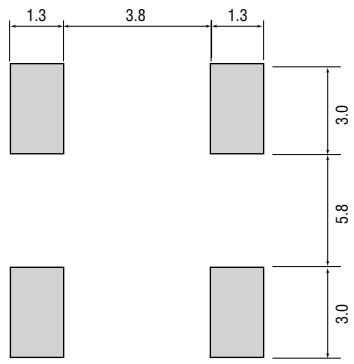


No.	Pin terminal
1	T_S
2	GND
3	OUT
4	V_{DD}

Do not connect Ts-pin external device.

Recommended soldering pattern

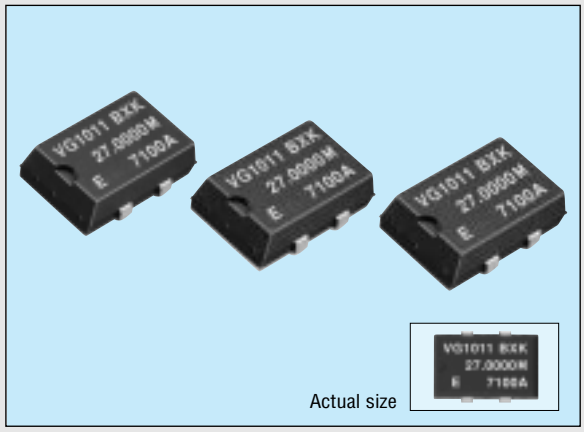
(Unit: mm)



VOLTAGE-CONTROLLED CRYSTAL OSCILLATOR

VG-1011JA series

- High accuracy and high reliability due to trimmerless design.
- Built-in heat-resisting AT-cut crystal provides heat resistance equivalent to that of general-purpose ICs.
- Use of C-MOS IC assures low current consumption.
- Excellent shock resistance and environmental capability.
- Supply voltage: 5V, Control voltage:5V

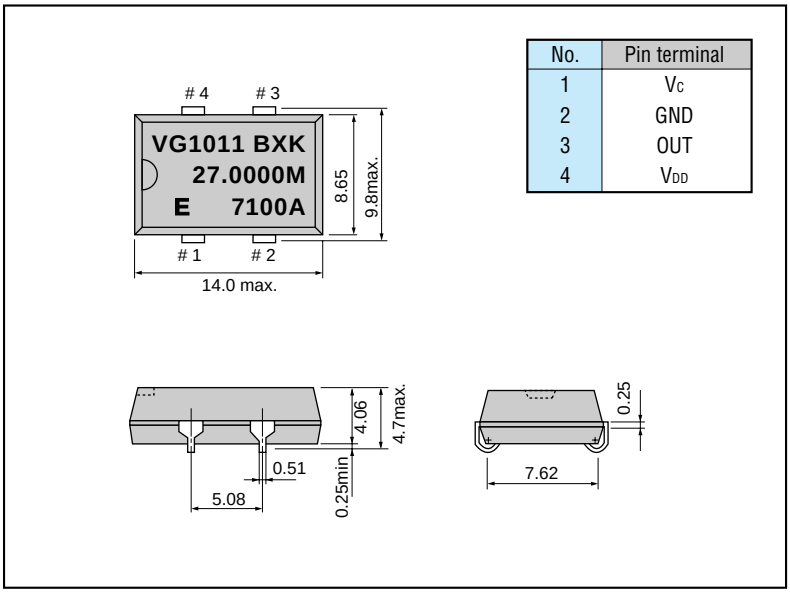


Specifications (characteristics)

Item		Symbol	Specifications	Remarks
Output frequency range		f_0	1.5000 MHz to 28.63636 MHz	
Power source voltage	Max. supply voltage	V_{DD}-GND	-0.5V to +7.0V	
	Operating voltage	V_{DD}	5.0V ±0.5V	
Temperature range	Storage temperature	T_{STG}	-55°C to +125°C	
	Operating temperature	T_{OPR}	As per below table	
Soldering condition		T_{SOL}	Twice at under 260°C whthin 10 sec.	
Frequency stability		$\Delta f/f_0$	As per below table	
Current consumption		Iop	10mA max.	No load condition
Variable frequency range		Δf_C	As per below table	V_C=2.5±2.0V
Input resistance		Z_{IN}	10MΩ min.	DC Level
Frequency change polarity			Positive polarity	V_C=0.5 to 4.5V
Duty		tw/t	40% to 60%	1.4V or 1/2V_{DD}level
Output voltage		V_{OH}	V_{DD} -0.4V min.	I_{OH}= -0.8mA
		V_{OL}	0.4V max.	I_{OL}=1.6mA
Output load condition (fan out)		N/C_L	2TTL or 15pF max.	TTL load/C-MOS load
Output rise time		t_{TLH}	8ns. max.	C-MOS load: 20%→80% V_{DD}
			5ns. max.	TTL load: 0.4V→2.4V
Output fall time		t_{THL}	8ns. max.	C-MOS load: 80%→20% V_{DD}
			5ns. max.	TTL load: 2.4V→0.4V
Oscillation start up time		tosc	4ms. max.	Time at 4.5V to be 0 sec.
Aging		fa	±5ppm max.	Ta=25°C, V_{DD} =5V, first year
Shock resistance		S.R.	±5ppm max.	Three drops on a hard board from 75 cm or excitation test with 3000G x 0.3ms x 1/2sine wave in 3 directions

External dimensions

(Unit: mm)



No.	Pin terminal
1	Vc
2	GND
3	OUT
4	V_{DD}

Stability / Temperature range

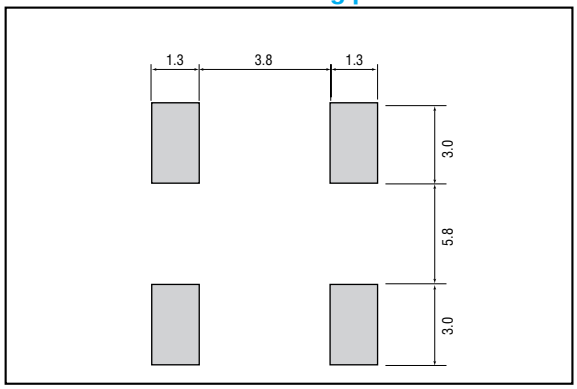
Stability		Temperature range		
		-20°C to 70°C	-30°C to 75°C	-40°C to 85°C
	No.	V	W	X
± 15ppm	S	–	B	–
± 20ppm	A	G, K, N	–	–
± 25ppm	B	–	–	G, K, N

Variable frequency range

No.	Variable frequency range
B	± 20ppm min.
G	± 50ppm min.
K	± 75ppm min.
N	± 100ppm min.

Recommended soldering pattern

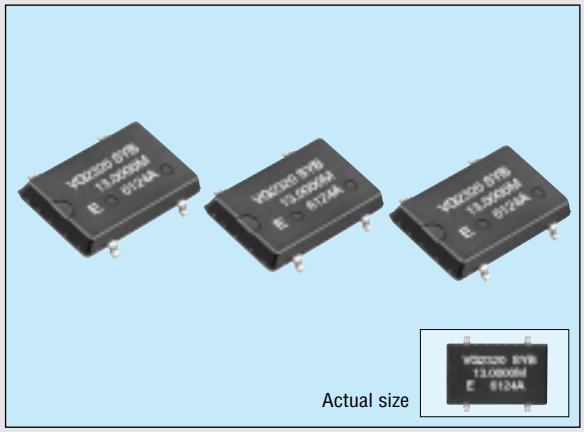
(Unit: mm)



VOLTAGE-CONTROLLED CRYSTAL OSCILLATOR

VG-2320SC series

- Thin package of 2mm thickness.
- High accuracy and high reliability due to trimmerless design.
- Excellent shock resistance and environmental capability.
- Low current consumption by the use of C-MOS IC.
- Operating voltage: 2.7 to 3.3V, Vc=1.5V ±1.2V
- Optimal as reference signal source for mobile communications equipment.

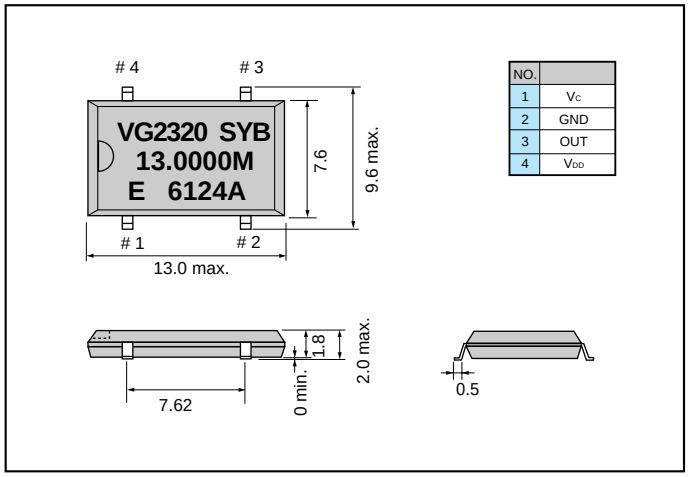


Specifications (characteristics)

Item		Symbol	VG-2320SC SYB Specifications	Remarks
Output frequency range		f_0	12.0000 MHz to 20.0000 MHz	
Power source voltage	Max. supply voltage	V_{DD}-GND	-0.3V to +7.0V	
	Operating voltage	V_{DD}	3.0V ±0.3V	
Temperature range	Storage temperature	T_{STG}	-55°C to +125°C	
	Operating temperature	T_{OPR}	-20°C to + 75°C	
Soldering condition		T_{SOL}	Twice at under 240°C whthin 10 sec.	
Frequency stability		$\Delta f/f_0$	±15ppm	
Current consumption		Iop	2.5mA max.	No load condition
Variable frequency range		Δf_c	±20ppm min.	Vc=1.5±1.2V
Control voltage sensitivity			19ppm/V min.	
Input resistance		Z_{IN}	10MΩ min.	DC Level
Frequency change polarity			Positive polarity	Vc=0.3 to 2.7V
Duty		tw/t	40% to 60%	GND Level
Output load condition (fan out)		R_L/C_L	2kΩ /10pF	
Output level		V_{PP}	1.0V min.	
Output signal harmonic ratio			-5dBc max.	
Phase noise			-120dBc/Hz max.	Offset: 1kHz
Oscillation start up time		tosc	4ms. max.	Time at V_{DD}=2.7V to be 0 sec.
Aging		fa	±1ppm max.	Ta=25°C, V_{DD} =3V
Shock resistance		S.R.	±1ppm max.	Three drops on a hard board from 75 cm or excitation test with 3000G x 0.3ms x 1/2sine wave in 3 directions

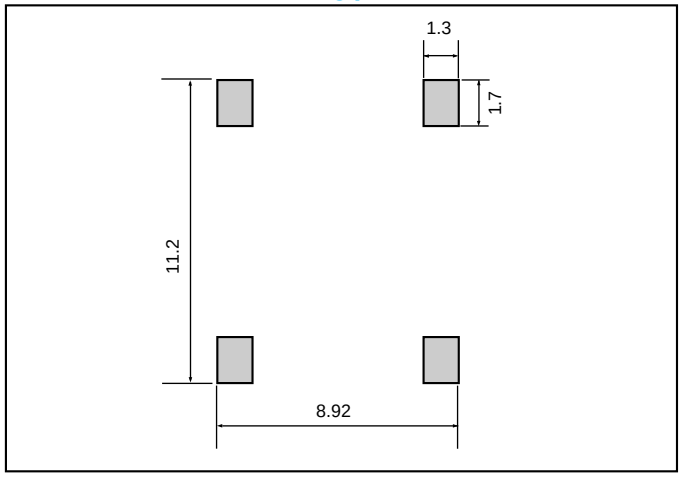
External dimensions

(Unit: mm)



Recommended soldering pattern

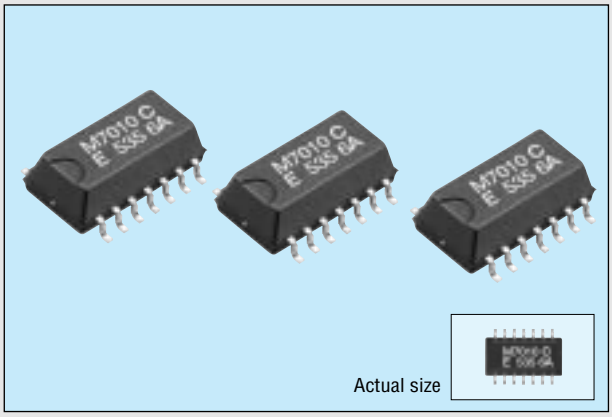
(Unit: mm)



SELECTABLE-OUTPUT PLL OSCILLATOR

MG-7010

- Can output one CPU frequency among 15 selections.
- Reflowable, high-density mounting-type SMD.
- Provided with output enable and stand-by function to allow low current consumption.
- Using C-MOS IC allows low current consumption and assures high reliability.



Specifications (characteristics)

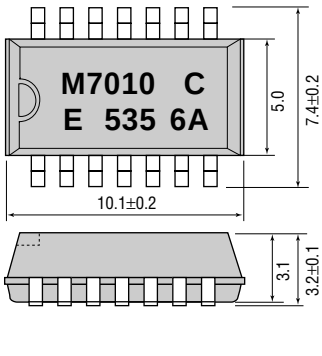
Item		Symbol	Specifications	Remark
Frequency change time		t_{ft}	10ms max.	S0, S1, S2, S3 changing
Output frequency range		f_0	20 MHz to 120 MHz	V_{DD}=4.5V to 5.5V
			20 MHz to 80 MHz	V_{DD}=2.7V to 5.5V
Power source voltage	Max. supply voltage	V_{DD}-GND	-0.5V to +7.0V	
	Operating voltage	V_{DD}	2.7V to 5.5V	
Temperature range	Storage temperature	T_{STG}	-55°C to +100°C	Stored as bare product after unpacking
	Operating temperature	T_{OPR}	-10°C to +70°C	
Soldering condition		T_{SOL}	Twice at under 260°C within 10 sec. or under 230°C within 3 min.	
Frequency stability		$\Delta f / f_0$	C: ±100ppm	-10°C to +70°C, V_{DD}=2.7V to 5.5V
Current consumption		I_{op}	45mA max.	No load condition (fo=120 MHz)
Output disable current		I_{OE}	25mA max.	OE=GND, fo=120 MHz
Standby current		I_{ST}	10µA max.	$\overline{ST}$=GND
Duty		t_w/t	40% to 60%	1.4V level
High output voltage		V_{OH}	V_{DD} -0.5V min.	I_{OH} = -16mA (V_{DD}=5±0.5V)
Low output voltage		V_{OL}	0.4V max.	I_{OL} = 16mA (V_{DD}=5±0.5V)
Output load condition		C_L	25pF max.	V_{DD}=4.5V to 5.5V($f_0 \leq$ 80 MHz)
			15pF max.	V_{DD}=2.7V to 4.5V or $f_0 >$ 80 MHz
High input voltage		V_{IH}	2.0V min.	$\overline{ST}$,OE terminal
Low input voltage		V_{IL}	0.8V max.	$\overline{ST}$,OE terminal
Output rise time		t_{TLH}	4.0ns max.	20%→80%V_{DD} level
Output fall time		t_{THL}	4.0ns max.	80%→20%V_{DD} level
Oscillation start up time		t_{OSC}	10ms max.	Time at 4.5V to be 0 sec.
Aging		f_a	±5ppm/year max.	Ta=25°C, V_{DD} =3.3V or 5.5V
Shock resistance		S.R.	±20ppm max.	Three drops on a hard board from 75 cm or excitation test with 3000g x 0.3ms 1/2 sine wave in 3 directions

Output frequency

Select bit	Output frequency (MHz)															
	100.0	33.33	30.0	120.0	25.0	20.0	70.0	80.0	75.0	66.66	60.0	60.0	50.0	45.0	90.0	40.0
S3	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
S2	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
S1	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
S0	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1

External dimensions

(Unit: mm)



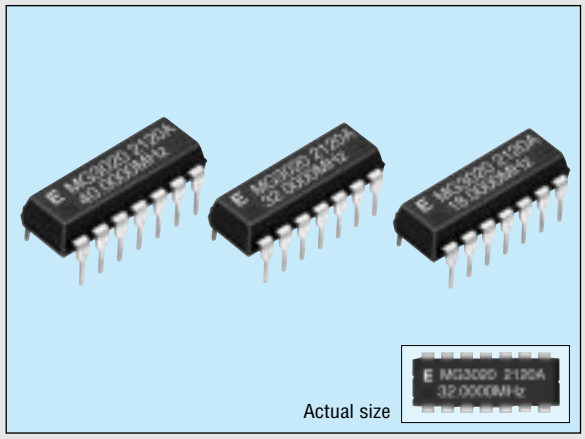
Terminal connection

Terminal No.	Terminal symbol	Function
1	S3	Frequency select bit 3
2	GND	Ground
4	S0	Frequency select bit 0
5	S1	Frequency select bit 1
6	OE	Output Enable control Clock out at "H" high-impedance at "L"
7	$\overline{ST}$	Stand by control "H" = Clock out "L" = "Llevel"
8	V_{DD}	Power supply
13	OUT	Clock output
14	S2	Frequency select bit 2
3, 9, 10 11, 12	N.C	No connection

MULTI-OUTPUT CRYSTAL OSCILLATOR

MG-3020

- Simultaneous output. (1/1, 1/2, 1/4, 1/8 and 1/16 output frequency ratio)
- Builtin cylindrical-type AT-cut crystal unit assures high reliability.
- DIP 14-pin plastic package allows automatic mounting.
- External clock select function, dividing circuit reset function and 1/2 divider select function.



Specifications (characteristics)

Absolute Max. rating

Item	Symbol	Rating
Supply voltage	V_{DD}	-0.5V to +7.0V
Input voltage	V_I	-0.5V to V_{DD} +0.5V
Output current	I_O	30mA max.
Storage temperature	T_{STG}	-55˚C to +100˚C
Soldering condition	T_{SOL}	Under 260˚C within 10 sec. (lead part) Package should be less than 150˚C

Operating range

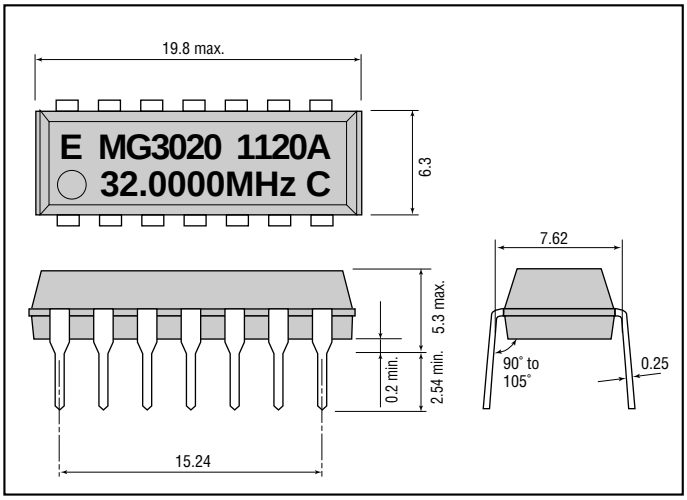
Item	Symbol	Rating			Unit
		Min.	Typ.	Max.	
Operating voltage	V_{DD}	4.5	5.0	5.5	V
Output current	I_O			1.6	mA
Operating temperature	T_{OPR}	-10	25	70	˚C
Output load condition	C_L			15	pF

Frequency characteristics
oscillation source frequency is 17.7340 to 40.000 MHz

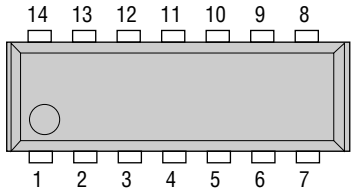
Item	Symbol	Specification	Remarks
Frequency stability	$\Delta f/f_0$	±100 ppm	-10 to +70˚C
Aging	fa	±5 ppm/Y	Ta=25˚C, V_{DD} =5V first year

External dimensions

(Unit: mm)



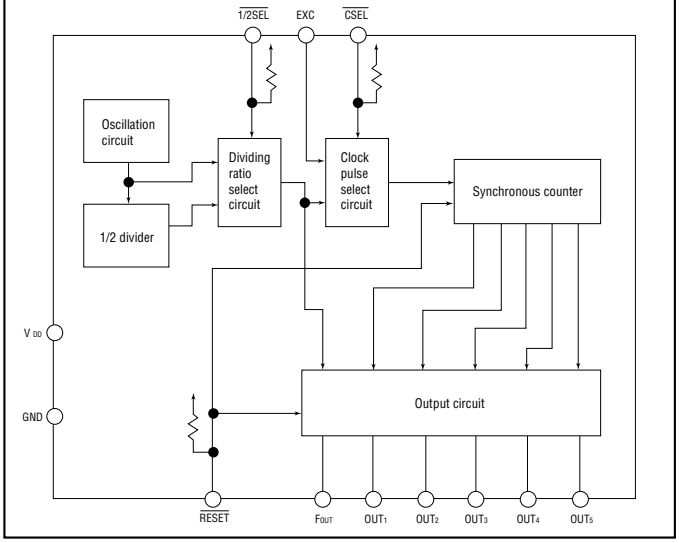
Terminal connection



Terminal	Pin No.	Function
V_{DD}	14	+5V power supply
GND	7	GND
OUT_1	8	1/1 source frequency
OUT_2	9	1/2 source frequency
OUT_3	10	1/4 source frequency
OUT_4	11	1/8 source frequency
OUT_5	12	1/16 source frequency
F_{OUT}	13	Source frequency
$\overline{CSEL}$	4	When this pin is made L, the external clock is selected (pull-up resistor incorporated)
EXC	5	External clock pulse input pin
$\overline{RESET}$	3	Stops output at $\overline{RESET}$=L (pull-up resistor incorporated)
$\overline{1/2\ SEL}$	6	1/2 frequency output at $\overline{1/2SEL}$=L (pull-up resistor incorporated)
NC	1 and 2	NC is not connected internally

When the power switch is turned on in $\overline{RESET}$ L level mode, please note that all output becomes high impedance. To resume normal operation, disable the $\overline{RESET}$ terminal.

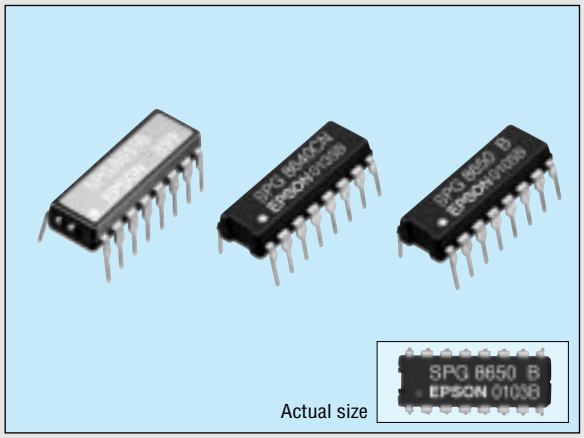
Block diagram



SELECTABLE-OUTPUT CRYSTAL OSCILLATOR

SPG series

- Capable of selecting 57 varieties of frequency output.
- Low current consumption.
- Easy to mount DIP 16-pin package.



Specifications (characteristics)

Item		Symbol	Specifications										Remarks
Model name			8640AN	8640BN	8640CN	8650A	8650B	8650C	8650D	8650E	8651A	8651B	8651E	
Oscillation source frequency		fo	600kHz	1MHz	768kHz	60kHz	100kHz	96kHz	153.6kHz	32.768kHz	60kHz	100kHz	32.768kHz	For output frequency, refer to the table in the next page
Power source voltage	Max. supply voltage	VDD-GND	-0.3V to +7.0V											
	Operating voltage	VDD	5.0V±0.5V											
Temperature range	Storage temperature	TSTG	-55°C to +125°C								-30°C to +80°C			
	Operating temperature	TOPR	-10°C to +70°C								-10°C to +60°C			
Soldering condition (lead part)		TSOL	Under 260°C within 10 sec.											Package should be less than 150°C
Frequency tolerance		Δf/f0	±100ppm			±50ppm					±5ppm *1			VDD=5V, Ta=25°C
Frequency temperature characteristics			+10/-120ppm											VDD=5V
Frequency voltage characteristics			±20ppm	±10ppm	±20ppm	±10ppm					±5ppm			VDD=4.5 to 5.5V
Aging		fa	±5ppm/year max.								±3ppm/year max.			VDD=5V, Ta=25°C, first year
Current consumption		Iop	1.0mA max.	2.0mA max.	1.5mA max.	0.5mA max.								No load condition

*1 Frequency tolerance of 8651 system shows the value guaranteed at the time of shipment.

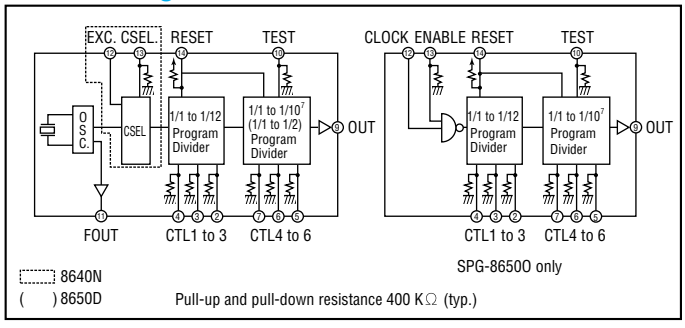
Electric characteristics

VDD=5V±0.5V, Ta=-10 to 70°C CL ≤ 15pF

Item	Symbol	Min.	Typ.	Max.	Unit	Remarks
L. input voltage	VIL	0		0.8	V	
H. input voltage	VIH	VDD-1.0		VDD		
L. input current (Reset)	IRL	-30		-5	μA	Reset=GND
H input current (Reset)	IRH			0.5		Reset=VDD
L. input current (input terminal except for Reset)	IIL	-0.5				
H input current (input terminal except for Reset)	IIH	5		30		IOL=1.6mA
L. output voltage	VOL			0.4	V	IOH= -40μA
H. output voltage	VOH	VDD-1.0				VOL=0.4V
L. output current	IOL	1.6			mA	VOH=VDD-1.0V
H. output current	IOH			-40	μA	
Output rise time	tTLH		30	60	ns	
Output fall time	tTHL		25	50		
Duty		40		60	%	Except in the case of 1/3 and 1/5
Min. reset pulse width	tRW	1.0			μs	
Reset delay time	tR			1.0		
Reset release synchronous error	tE	tw-*1 1/2 to		tw *2		
External signal input frequency	FIN			1M	Hz	8640N only
External signal input pulse width	tIN	0.5			μs	
Oscillation start up time	tOSC		0.2	1	s	*3

*1 to=oscillation source cycle. *2 tw=1/2 cycle of preset frequency.
*3 For more than 1ms until VDD=0→4.5V. Time at 4.5V is to be 0.

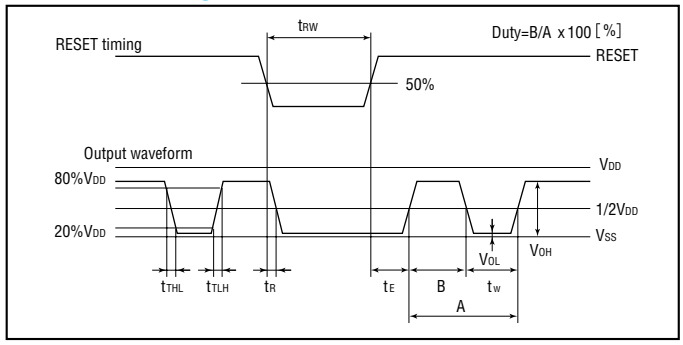
Block diagram



Divider IC (without quartz crystal)

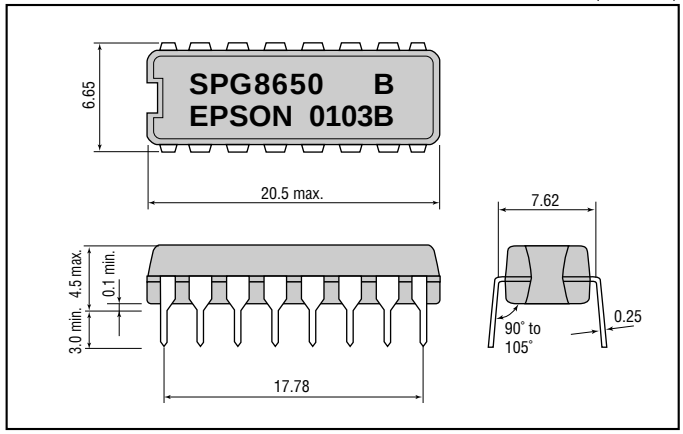
Item	Symbol	Specifications	Remarks
Model name		8650 O	
Input clock frequency		1 MHz max.	
Current consumption	Iop	About 2 mA	No load condition

RESET timing

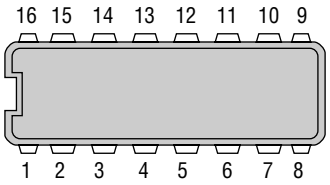


External dimensions

(Unit: mm)



Terminal connection



No.	Pin terminal	No.	Pin terminal
1	NC	16	V_{DD}
2	CTL 3	15	NC
3	CTL 2	14	$\overline{\text{RESET}}$
4	CTL 1	13	NC (CSEL)
5	CTL 6	12	NC (EXC)
6	CTL 5	11	FOUT
7	CTL 4	10	TEST
8	GND	9	OUT

( ) shown 8640N only

NC: Do not connect to the external teminal.

For 8650 O
11. NC 12. CLOCK 13. ENABLE

Explanation of terminal

(a) CTL 1 to 6 : Programs dividing ratio. (pull-down resistor incorporated.)
(b) OUT : Output frequency preset by CTL1 to 6. (refer to the procedure for setting output frequency.)
(c) FOUT : Constantly outputs the oscillation source frequency of builtin crystal unit.
(d) RESET : Stops output at RESET= "L". (pull-up resistor incorporated.)
(e) TEST : Used for the input terminal for testing. When CTL4 is H, output will be 1000 times larger than the preset value at TEST= "H". (pull-down resistor incorporated.)
(f) EXC (8640N only) : Serves as input terminal when using an external clock by changing to the builtin oscillator. Effective only when CSEL is H.
(g) CSEL (8640N only) : When this terminal is made H, the external clock is selected. (pull-down resistor incorporated.)

(Note) Treatment of empty terminals. When RESET terminal is not used, this should be connected to V_{DD}, and when TEST terminal, CSEL terminal, and CTL 1 to 6 terminals are not used, to GND.

Explanation of terminal (8650 O)

(a) CLOCK: Clock input (max. 1 MHz) (b) ENABLE: Be sure to connect to V_{DD}

Setting of divider output

CTL1	CTL2	CTL3	Dividing ratio
0	0	0	1/1
0	0	1	1/10
0	1	0	1/2
0	1	1	1/3
1	0	0	1/4
1	0	1	1/5
1	1	0	1/6
1	1	1	1/12

CTL4	CTL5	CTL6	Dividing ratio
0	0	0	1/1 (1/1)
0	0	1	1/10 (1/2)
0	1	0	$1/10^2$ $(1/2)^2$
0	1	1	$1/10^3$ $(1/2)^3$
1	0	0	$1/10^4$ $(1/2)^4$
1	0	1	$1/10^5$ $(1/2)^5$
1	1	0	$1/10^6$ $(1/2)^6$
1	1	1	$1/10^7$ $(1/2)^7$

0= "L" 1="H" ( )8650D

Setting of output frequency

8640AN

(Unit: Hz)

Set terminal		CTL4	0	0	0	0	1	1	1	1
		CTL5	0	0	1	1	0	0	1	1
CTL1	CTL2	CTL3 \ CTL6	0	1	0	1	0	1	0	1
0	0	0	600K	60K	6K	600	60	6.0	0.6	0.06
0	0	1	60K	6K	600	60	6	0.6	0.06	0.006
0	1	0	300K	30K	3K	300	30	3.0	0.3	0.03
0	1	1	200K	20K	2K	200	20	2.0	0.2	0.02
1	0	0	150K	15K	1.5K	150	15	1.5	0.15	0.015
1	0	1	120K	12K	1.2K	120	12	1.2	0.12	0.012
1	1	0	100K	10K	1K	100	10	1.0	0.1	0.01
1	1	1	50K	5K	500	50	5	0.5	0.05	0.005

8640BN

Set terminal		CTL4	0	0	0	0	1	1	1	1
		CTL5	0	0	1	1	0	0	1	1
CTL1	CTL2	CTL3 \ CTL6	0	1	0	1	0	1	0	1
0	0	0	1M	100K	10K	1K	100	10	1	1/10
0	0	1	100K	10K	1K	100	10	1	1/10	1/100
0	1	0	500K	50K	5K	500	50	5	1/2	1/20
0	1	1	333.3K	33.3K	3.3K	333.3	33.3	3.33	1/3	1/30
1	0	0	250K	25K	2.5K	250	25	2.5	1/4	1/40
1	0	1	200K	20K	2K	200	20	2	1/5	1/50
1	1	0	166.6K	16.6K	1.6K	166.6	16.6	1.6	1/6	1/60
1	1	1	83.3K	8.3K	833.3	83.3	8.3	0.83	1/12	1/120

8650A 8651A

Set terminal		CTL4	0	0	0	0	1	1	1	1
		CTL5	0	0	1	1	0	0	1	1
CTL1	CTL2	CTL3 \ CTL6	0	1	0	1	0	1	0	1
0	0	0	60K	6.0K	600	60	6.0	0.6	0.06	0.006
0	0	1	6K	600	60	6	0.6	0.06	0.006	0.0006
0	1	0	30K	3.0K	300	30	3.0	0.3	0.03	0.003
0	1	1	20K	2.0K	200	20	2.0	0.2	0.02	0.002
1	0	0	15K	1.5K	150	15	1.5	0.15	0.015	0.0015
1	0	1	12K	1.2K	120	12	1.2	0.12	0.012	0.0012
1	1	0	10K	1.0K	100	10	1.0	0.1	0.01	0.001
1	1	1	5K	500	50	5	0.5	0.05	0.005	0.0005

8650B 8651B

Set terminal		CTL4	0	0	0	0	1	1	1	1
		CTL5	0	0	1	1	0	0	1	1
CTL1	CTL2	CTL3 \ CTL6	0	1	0	1	0	1	0	1
0	0	0	100K	10K	1K	100	10	1	1/10	1/100
0	0	1	10K	1K	100	10	1	1/10	1/100	1/1000
0	1	0	50K	5K	500	50	5	1/2	1/20	1/200
0	1	1	33.3K	3.3K	333.3	33.3	3.33	1/3	1/30	1/300
1	0	0	25K	2.5K	250	25	2.5	1/4	1/40	1/400
1	0	1	20K	2K	200	20	2	1/5	1/50	1/500
1	1	0	16.6K	1.6K	166.6	16.6	1.6	1/6	1/60	1/600
1	1	1	8.3K	833.3	83.3	8.3	0.83	1/12	1/120	1/1200

8650E 8651E

Set terminal		CTL4	0	0	0	0	1	1	1	1
		CTL5	0	0	1	1	0	0	1	1
CTL1	CTL2	CTL3 \ CTL6	0	1	0	1	0	1	0	1
0	0	0	32768	3276.8	327.68	32.768	3.276	0.3276	0.03276	0.00327
0	0	1	3276.8	327.68	32.768	3.276	0.327	0.0327	0.00327	0.00032
0	1	0	16384	1638.4	163.84	16.384	1.638	0.1638	0.01638	0.00163
0	1	1	10922.6	1092.26	109.226	10.922	1.092	0.1092	0.01092	0.00109
1	0	0	8192	819.2	81.92	8.192	0.819	0.0819	0.00819	0.00081
1	0	1	6553.6	655.36	65.536	6.553	0.655	0.0655	0.00655	0.00065
1	1	0	5461.3	546.13	54.613	5.461	0.546	0.0546	0.00546	0.00054
1	1	1	2730.6	273.06	27.306	2.730	0.273	0.0273	0.00273	0.00027

Note: Lower digits are omitted.

Baud rate generator

8640CN

CTL1	CTL2	CTL3	CTL4	CTL5	CTL6	Output frequency	Baud rate output example (fo/16)
0	0	0	0	0	0	768 kHz	48000bits/sec.
1	0	1	0	0	0	153.6	9600
0	0	1	0	0	0	76.8	4800
0	1	0	0	0	1	38.4	2400
1	0	0	0	0	1	19.2	1200

8650C

CTL1	CTL2	CTL3	CTL4	CTL5	CTL6	Output frequency	Baud rate output example (fo/16)
0	0	0	0	0	0	96.0 kHz	6000bits/sec.
1	0	1	0	0	0	19.2	1200
0	0	1	0	0	0	9.6	600
0	1	0	0	0	1	4.8	300
0	1	1	0	0	1	3.2	200
1	0	0	0	0	1	2.4	150
1	1	0	0	0	1	1.6	100
1	1	1	0	0	1	0.8	50

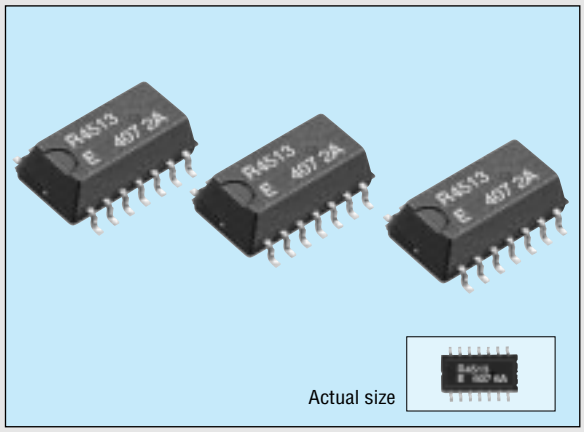
8650D

CTL1	CTL2	CTL3	CTL4	CTL5	CTL6	Output frequency	Baud rate output example (fo/16)
0	0	0	0	0	0	153.6 kHz	9600bits/sec.
0	0	0	0	0	1	76.8	4800
0	0	0	0	1	0	38.4	2400
0	0	0	0	1	1	19.2	1200
0	0	0	1	0	0	9.6	600
0	0	0	1	0	1	4.8	300
0	1	1	1	0	0	3.2	200
0	0	0	1	1	0	2.4	150
1	1	0	1	0	0	1.6	100
0	0	0	1	1	1	1.2	75
1	1	1	1	0	0	0.8	50

SERIAL-INTERFACE REAL TIME CLOCK MODULE

RTC-4513

- Builtin crystal unit allows adjustment-free efficient operation.
- Using a serial interface, controllable only three signal lines.
- Automatic leap year correction.
- 30 second adjustment, available.
- Wide operating voltage from 2.7V to 5.5V.



Specifications (characteristics)

Absolute Max. rating

Item	Symbol	Condition	Min.	Max.	Unit
Power source voltage	V_{DD}	V_{DD}-GND	-0.3	7.0	V
Input voltage	V_{IN}			V_{DD}+0.3	
Output voltage	V_{OUT}				
Storage temperature	T_{STG}		-55	+125	˚C

Operating range

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Operating voltage	V_{DD}		2.7	5.0	5.5	V
Date holding voltage	V_{CLK}		2.0			
Operating temperature	T_{OPR}		-40		+85	˚C

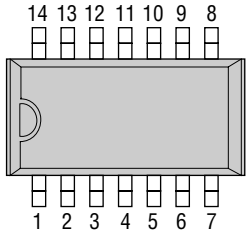
Frequency characteristics

Item	Symbol	Condition	Range	Unit
Frequency tolerance	Δf/fo	Ta=25˚C, V_{DD}=3V	0±25	ppm
Frequency temperature characteristics	Top	-10 to +70˚C	+10/-120	
f-V characteristics	f_V	Ta=25˚C, V_{DD}=2.0 to 5.5V	±5	ppm/V
Aging	fa	First year Ta=25˚C, V_{DD}=3V		ppm/year

Electrical characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
“H” input voltage	V_{IH}	—	0.8V_{DD}			V
“L” input voltage	V_{IL}	—			0.2V_{DD}	
Input leak current 1	I_{IL1}	V_{IN}=V_{DD}/GND (CE,CLK)			1/-1	μA
Input leak current 2	I_{IL2}	V_{IN}=V_{DD}/GND (DATA)			10/-10	
“L” output voltage 1	V_{OL1}	I_O=1mA (DATA)			0.2V_{DD}	V
“H” output voltage	V_{OH}	I_O=-400μA (DATA)	0.8V_{DD}			
“L” output voltage 2	V_{OL2}	I_O=1mA (STD.P)			0.2V_{DD}	
Off leak current	I_{OFLK}	V_O=V_{DD}			10.0	μA
Current consumption 1	I_{DD1}	V_{DD}=5V, V_{IN} (CE) =0V		10.0	20.0	
Current consumption 2	I_{DD2}	V_{DD}=3V, V_{IN} (CE) =0V		2.5	5.0	
Current consumption 3	I_{DD3}	V_{DD}=2V, V_{IN} (CE) =0V		1.0	2.0	

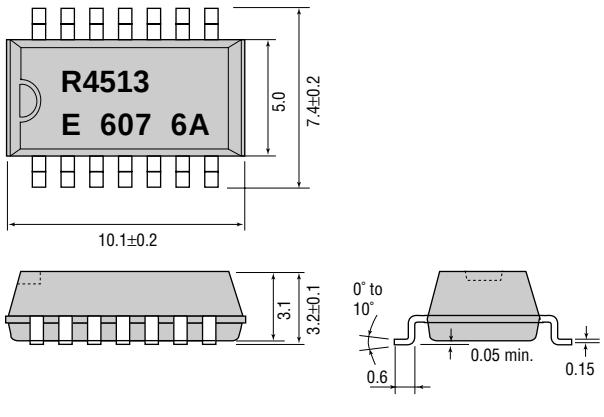
Terminal connection



No.	Pin terminal	No.	Pin terminal
1	N.C	14	N.C
2	DATA	13	CLK
3	STD.P	12	CE
4	N.C	11	N.C
5	N.C	10	N.C
6	V_{DD}	9	GND
7	N.C	8	N.C

External dimensions

(Unit: mm)



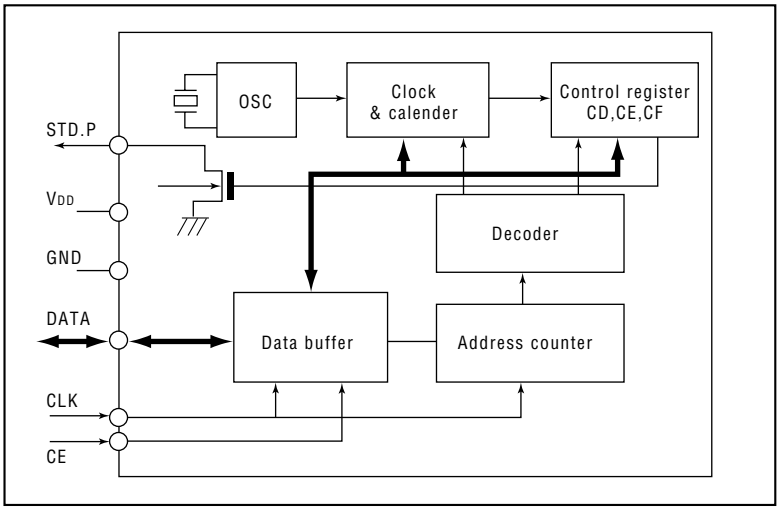
Register table

	Address				Register symbol	D_3 (MSB)	D_2	D_1	D_0 (LSB)		Register name
	A_3	A_2	A_1	A_0							
0	0	0	0	0	S_1	s8	s4	s2	s1	0 to 9	1-second digit register
1	0	0	0	1	S_{10}	f0	s40	s20	s10	0 to 5	10-second digit register
2	0	0	1	0	MI_1	mi8	mi3	mi2	mi1	0 to 9	1-minute digit register
3	0	0	1	1	MI_{10}	fr	mi40	mi20	mi10	0 to 5	10-minute digit register
4	0	1	0	0	H_1	h8	h4	h2	h1	0 to 9	1-hour digit register
5	0	1	0	1	H_{10}	fr	pm/am	h20	h10	0 to 1,2	10-hour digit register
6	0	1	1	0	D_1	d8	d4	d2	d1	0 to 9	1-day digit register
7	0	1	1	1	D_{10}	fr	*	d20	d10	0 to 3	10-day digit register
8	1	0	0	0	MO_1	mo8	mo4	mo2	mo1	0 to 9	1-month digit register
9	1	0	0	1	MO_{10}	fr	*		mo10	0 to 1	10-month digit register
A	1	0	1	0	Y_1	y8	y4	y2	y1	0 to 9	1-year digit register
B	1	0	1	1	Y_{10}	y80	y40	y20	y10		10-year digit register
C	1	1	0	0	W	fr	w4	w2	w1	0 to 6	day of the week register
D	1	1	0	1	CD	30ADJ	IRQ-F	CAL/HW	HOLD	—	Control register D
E	1	1	1	0	CE	t1	t0	INT/STND	MASK		Control register E
F	1	1	1	1	CF	TEST	24/12	STOP	RESET		Control register F

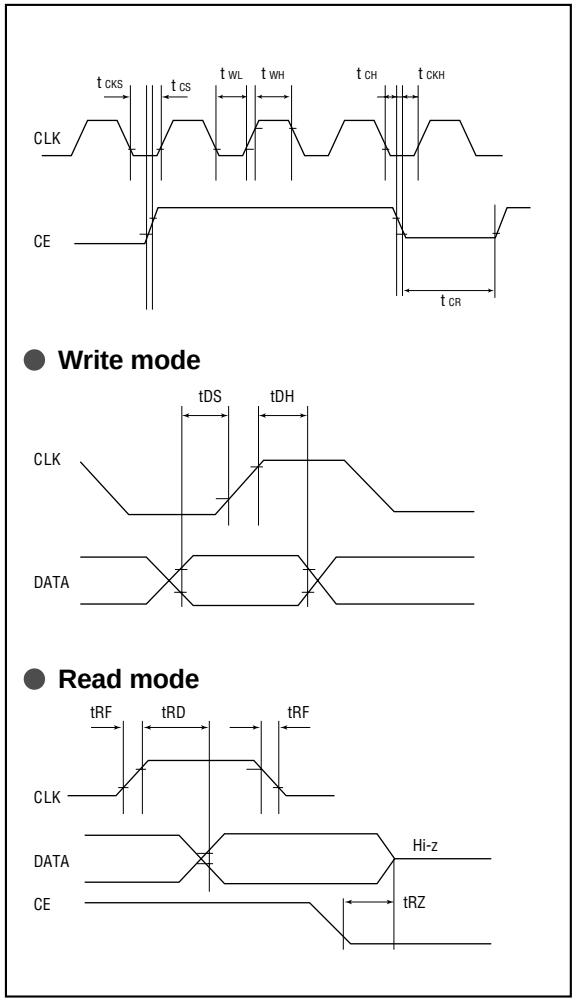
Switching characteristics

Item	Symbol	Condition	Min.	Max.	Unit
CLK "H" time	t_{WH}		300		
CLK "L" time	t_{WL}				
CE setup time	t_{CS}		150		
CE hold time	t_{CH}		200		
CE recovery time	t_{CR}	—	300	—	
CLK setup time	t_{CKS}		20		ns
CLK hold time	t_{CKH}				
Write data setup time	t_{DS}		50		
Write data hold time	t_{DH}				
Read data delay time	t_{RD}	C_L=50pF		250	
Read data disable delay time	t_{RZ}	—	—	100	
CLK rise time/fall time	t_{RF}			20	

Block diagram



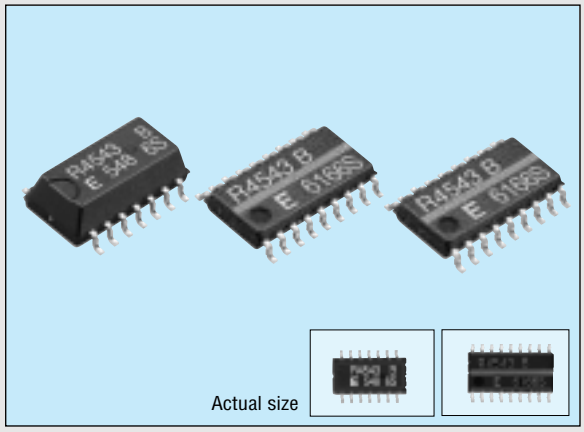
Timing chart



SERIAL-INTERFACE REAL TIME CLOCK MODULE

RTC-4543

- Builtin crystal unit allows adjustment-free efficient operation.
- Automatic leap year correction.
- Output selectable between 32.768 KHz/1 Hz.
- Operating voltage range: 2.5V to 5.5V.
- Supply voltage detection voltage: 1.7±0.3V.
- Low current consumption: 1.0 µA/2.0V (Max.)



Specifications (characteristics)

Absolute Max. rating

Item	Symbol	Condition	Min.	Max.	Unit
Power source voltage	V_{DD}	V_{DD}-GND	-0.3	7.0	V
Input voltage	V_{IN}	—		V_{DD}+0.3	
Output voltage	V_{OUT}				
Storage temperature	T_{STG}		-55	+125	˚C

Operating range

Item	Symbol	Condition	Min.	Max.	Unit
Operating voltage	V_{DD}	—	2.5	5.5	V
Date holding voltage	V_{CLK}		1.4		
Operating temperature	T_{OPR}		-40	+85	˚C

Frequency characteristics

Item	Symbol	Condition	Range	Unit
Frequency tolerance	Δf/fo	Ta=25˚C, V_{DD}=5V	5±23	ppm
Frequency temperature characteristics	T_{op}	-10 to +70˚C	+10/-120	
Frequency voltage characteristics	f_V	Ta=25˚C, V_{DD}=2.0 to 5.5V	±2	ppm/V
Oscillation start time	t_{OSC}	Ta=25˚C, V_{DD}=2.5V	3	s
Aging	fa	First year Ta=25˚C, V_{DD}=5V	±5	ppm/year

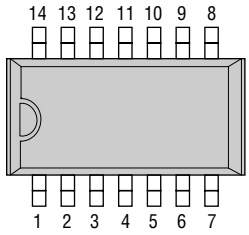
DC characteristics

(V_{DD}=5V±0.5V, Ta=-40 to 85˚C)

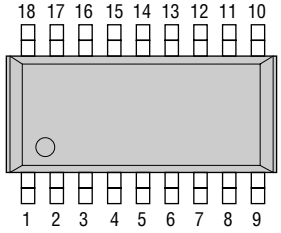
Item		Symbol	Condition		Min.	Typ.	Max.	Unit
"H" input voltage		V_{IH}	WR, DATA, CE, CLK, F_{OE},F_{SEL} pins		0.8V_{DD}	—	—	V
"L" input voltage		V_{IL}			—		0.2V_{DD}	
Input off-leak current		I_{OFF}	WR, CE, CLK, F_{OE},F_{SEL} pins				0.5	µA
"H" output voltage		V_{OH1}	V_{DD}=5.0V	I_{OH}=-1.0 mA DATA, F_{OUT} pins	4.5		—	V
		V_{OH2}	V_{DD}=3.0V		2.5			
"L" output voltage		V_{OL1}	V_{DD}=5.0V		—		0.5	
		V_{OL2}	V_{DD}=3.0V				0.8	
Output leak current		I_{OZH}	V_{OUT}=5.5V	DATA, F_{OUT} pins	-1.0		1.0	µA
		I_{OZL}	V_{OUT}=0V					
Supply detection voltage		V_{DT}	—		1.4	1.7	2.0	V
Output load conditions		C_L	F_{OUT} pin		30 pF(max.)			
		N			2LS-TTL			
Current consumption	1	I_{DD1}	V_{DD}=5.0V	CE="L", F_{OE}="L" F_{SEL}="H"	—	1.5	3.0	µA
	2	I_{DD2}	V_{DD}=3.0V			1.0	2.0	
	3	I_{DD3}	V_{DD}=2.0V			0.5	1.0	
	4	I_{DD4}	V_{DD}=5.0V	CE="L", F_{OE}="H" F_{SEL}="L"		4.0	10.0	
	5	I_{DD5}	V_{DD}=3.0V			2.5	6.5	
	6	I_{DD6}	V_{DD}=2.0V	No load on the F_{OUT} pin		1.5	4.0	

Terminal connection

● **RTC-4543SA**



● **RTC-4543SB**

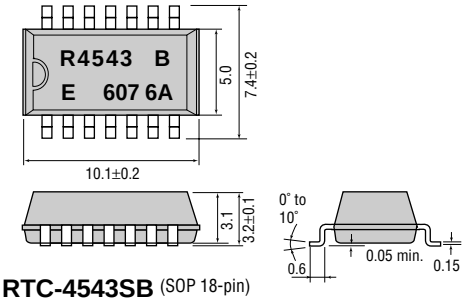


No.	4543SA	4543SB
1	GND	N.C
2	N.C	N.C
3	CE	N.C
4	F_{SEL}	N.C
5	WR	F_{OE}
6	F_{OE}	WR
7	N.C	F_{SEL}
8	N.C	CE
9	V_{DD}	GND
10	CLK	F_{OUT}
11	DATA	DATA
12	N.C	CKL
13	N.C	N.C
14	F_{OUT}	V_{DD}
15	—	N.C
16	—	N.C
17	—	N.C
18	—	N.C

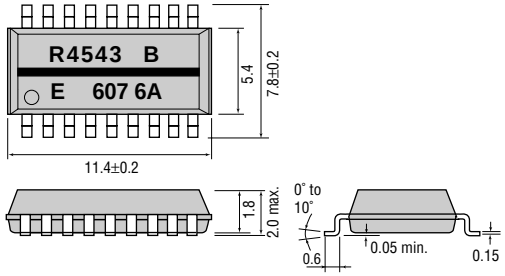
External dimensions

(Unit: mm)

● **RTC-4543SA** (SOP 14-pin)



● **RTC-4543SB** (SOP 18-pin)



Register table

	MSB							
Seconds (0 to 59)	FDT	s 40	s 20	s 10	s 8	s 4	s 2	s 1
Minutes (0 to 59)	*	mi 40	mi 20	mi 10	mi 8	mi 4	mi 2	mi 1
Hour (0 to 23)	*	*	h 20	h 10	h 8	h 4	h 2	h 1
Day of the week (1 to 7)					*	w 4	w 2	w 1
Day (1 to 31)	*	*	d 20	d 10	d 8	d 4	d 2	d 1
Month (1 to 12)	TM	*	*	mo 10	mo 8	mo 4	mo 2	mo 1
year (0 to 99)	y 80	y 40	y 20	y 10	y 8	y 4	y 2	y 1

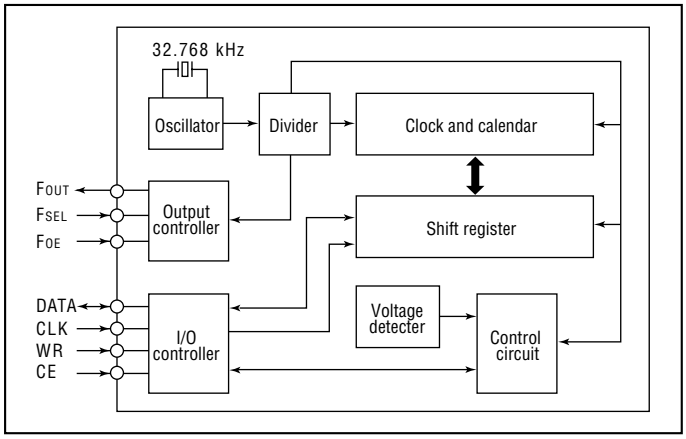
FDT bit: Supply voltage detection bit. * bit: Any data may be written to these bits. TM bit: Tast bit Always set this bit to "0".

Switching characteristics

(Ta=-40 to +85°C, C_L=30 pF)

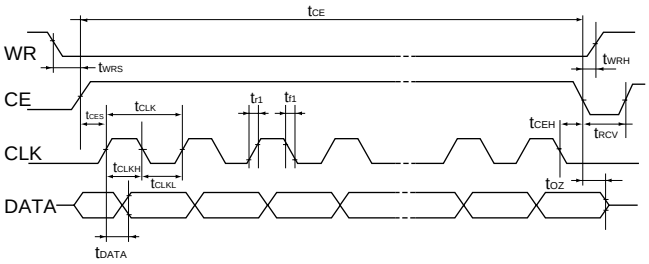
Item		Symbol	V_{DD}= 5V± 10%		V_{DD}= 3V± 10%		Unit
			Min.	Max.	Min.	Max.	
CLK clock cycle		t_{CLK}	0.75	7800	1.5	7800	µs
CLK high pulse width		t_{CLKH}	0.375	3900	0.75	3900	
CLK low pulse width		t_{CLKL}					
CE setup time		t_{CES}					
CE hold time		t_{CEH}		—		—	
CE enable time		t_{CE}	—	0.9	—	0.9	s
Write data setup time		t_{SD}	0.1	—	0.2	—	µs
Write data hold time		t_{HD}			0.1		
WR setup time		t_{WRS}	100		100		ns
WR hold time		t_{WRH}					
DATA output delay time		t_{DATA}	—	0.2	—	0.4	µs
DATA output floating time		t_{DZ}		0.1		0.2	
Clock input rise time		t_{r1}		50		100	ns
Clock input fall time		t_{f1}					
F_{OUT} rise time	C_L= 30pF	t_{r2}		100		200	
F_{OUT} fall time		t_{f2}					
Disable time		t_{XZ}					
Enable time		t_{ZX}					
F_{OUT} duty ratio		Duty	40	60	40	60	%
Wait time		t_{rcv}	0.95	—	1.9	—	µs

Block diagram

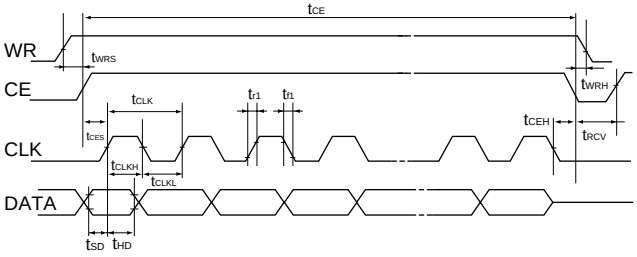


Timing chart

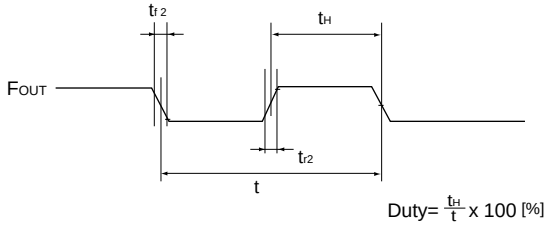
Data read



Data write

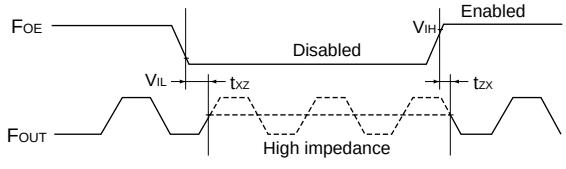


FOUT



Duty= $\frac{t_H}{t}$ x 100 [%]

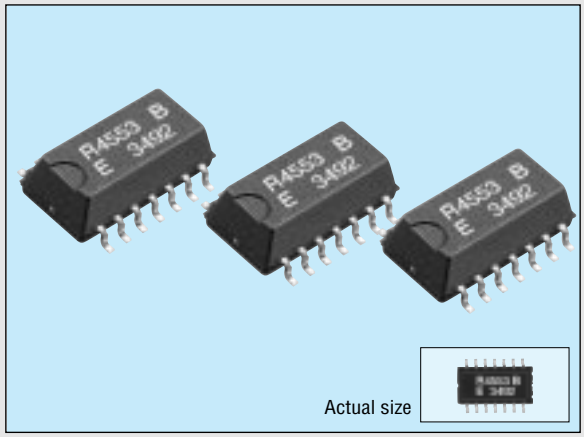
Disabled and Enabled



SERIAL-INTERFACE REAL TIME CLOCK MODULE

RTC-4553

- Builtin crystal unit allows adjustment-free efficient operation.
- The small package makes high-density mounting possible. (SOP 14-pin)
- Automatic calendar function (year, month, day, day of the week, hour, minute, second).
- Automatic leap year correction. (up to 2099)
- Builtin 30 x 4-bit S-RAM.
- High-speed access.
- Reference pulse output. (1024 Hz, 1/10 Hz)
- Low current consumption. (1 µA typical)
- Similar mounting method to that used for universal type SMD IC.



Specifications (characteristics)

Absolute Max. rating

Item	Symbol	Condition	Min.	Max.	Unit
Supply voltage	V_{DD}	V_{DD}-GND	-0.3	+6.0	V
Input voltage	V_{IN}	S_{IN}, $\overline{SCK}$, $\overline{WR}$, $\overline{CS_0}$, CS_1		V_{DD}+0.3	
Output voltage	V_{OUT}	S_{OUT}, $\overline{T_{POUT}}$			
Storage temperature	T_{STG}	Stored without tape & reel	-55	+125	°C
Soldering conditions	T_{SOL}		Twice at under 260°C within 10 sec. or under 230°C within 3 min.		

Operating range

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Operating voltage	V_{DD}	—	2.7	5.0	5.5	V
Operating temperature	T_{OPR}		-30	—	+70	°C

Frequency characteristics

Item	Symbol	Condition		Range	Unit
Frequency tolerance	Δf/fo	Ta=25°C, V_{DD}=5V	AA	5±5	ppm
			A	5±10	
			B	5±20	
Frequency temperature characteristics	T_{op}	Ta=-10 to 70°C, V_{DD}=5V Reference at 25°C		+10 -120	
Frequency voltage characteristics	fv	Ta=Fix, V_{DD}=2 to 5.5V Reference at 5V		±5	
Aging	fa	Ta=25°C, V_{DD}=5V, first year			ppm/year

DC characteristics

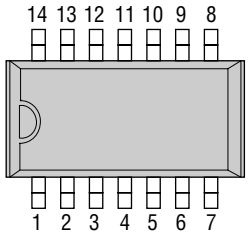
● V_{DD}=5V±10% (GND=0V, Ta=-30°C to +70°C)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Data holding voltage	V_{DH}	—	2.0	—	5.5	V
Current consumption	I_{DD1}	$\overline{SCK}$=500 kHz	—		100	µA
	I_{DD2}	$\overline{SCK}$=DC		1.0	3.0	
Output voltage	V_{OH}	I_{OH}=-400µA	V_{DD}-04	—		V
	V_{OL}	I_{OL}=1.6mA	—		0.4	
Off leak current	I_{OZH}	V_{OUT}=5.5V	-2.0	—	2.0	µA
	I_{OZL}	V_{OUT}=0V				
Input voltage	V_{IH}	—	4/5 V_{DD}		—	V
	V_{IL}		—		1/5 V_{DD}	
Input current	I_{IH}	V_{IN}=5.5V	-2.0		2.0	µA
	I_{IL}	V_{IN}=0V				
Oscillation start-up time	T_{osc}	Ta=25°C	—		3.0	s

● V_{DD}=3V±10% (GND=0V, Ta=-30°C to +70°C)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Data holding voltage	V_{DH}	—	2.0	—	3.3	V
Current consumption	I_{DD1}	$\overline{SCK}$=300 kHz	—		100	µA
	I_{DD2}	$\overline{SCK}$=DC		1.0	3.0	
Output voltage	V_{OH}	I_{OH}=-400µA	V_{DD}-0.4	—	—	V
	V_{OL}	I_{OL}=1.6mA	—		0.4	
Off leak current	I_{OZH}	V_{OUT}=3.3V	-2.0	—	2.0	µA
	I_{OZL}	V_{OUT}=0V				
Input voltage	V_{IH}	—	4/5 V_{DD}		—	V
	V_{IL}		—		1/5 V_{DD}	
Input current	I_{IH}	V_{IN}=3.3V	-2.0		2.0	µA
	I_{IL}	V_{IN}=0V				
Oscillation start-up time	T_{osc}	Ta=25°C	—		3.0	s

Terminal connection

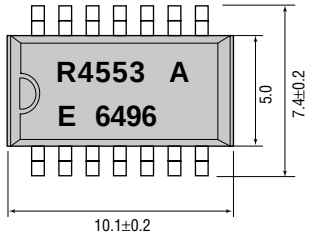


No.	Pin terminal	No.	Pin terminal
1	GND	14	$\overline{TP_{OUT}}$
2	$\overline{WR}$	13	S_{OUT}
3	S_{IN}	12	CS_1
4	$\overline{SCK}$	11	$\overline{CS_0}$
5	L1	10	L5
6	L2	9	L4
7	L3	8	V_{DD}

L1 to L5 are test pin. Do not connect them to any terminals.

External dimensions

(Unit: mm)



Register table

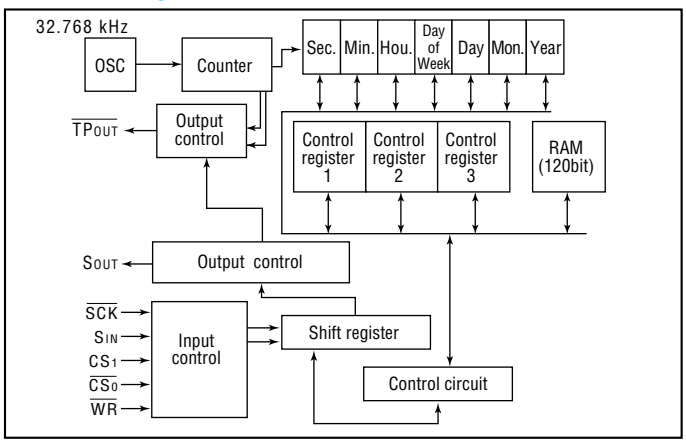
Address					MODE 0						MODE 1				MODE 2			
					Register symbol	Counter control register					User RAM Domain 1				User RAM Domain 2			
	A_3	A_2	A_1	A_0		D_3	D_2	D_1	D_0	Register name	D_3	D_2	D_1	D_0	D_3	D_2	D_1	D_0
0	0	0	0	0	S_1	S_8	S_4	S_2	S_1	1-second digit register	RA_3	RA_2	RA_1	RA_0	RA_{63}	RA_{62}	RA_{61}	RA_{60}
1	0	0	0	1	S_{10}	0	S_{40}	S_{20}	S_{10}	10-second digit register	RA_7	RA_6	RA_5	RA_4	RA_{67}	RA_{66}	RA_{65}	RA_{64}
2	0	0	1	0	MI_1	mi_8	mi_4	mi_2	mi_1	1-minute digit register	RA_{11}	RA_{10}	RA_9	RA_8	RA_{71}	RA_{70}	RA_{69}	RA_{68}
3	0	0	1	1	MI_{10}	0	mi_{40}	mi_{20}	mi_{10}	10-minute digit register	RA_{15}	RA_{14}	RA_{13}	RA_{12}	RA_{75}	RA_{74}	RA_{73}	RA_{72}
4	0	1	0	0	H_1	h_8	h_4	h_2	h_1	1-hour digit register	RA_{19}	RA_{18}	RA_{17}	RA_{16}	RA_{79}	RA_{78}	RA_{77}	RA_{76}
5	0	1	0	1	H_{10}	PM/AM	0	h_{20}	h_{10}	10-hour digit register	RA_{23}	RA_{22}	RA_{21}	RA_{20}	RA_{83}	RA_{82}	RA_{81}	RA_{80}
6	0	1	1	0	W	0	w_4	w_2	w_1	Day of the week digit register	RA_{27}	RA_{26}	RA_{25}	RA_{24}	RA_{87}	RA_{86}	RA_{85}	RA_{84}
7	0	1	1	1	D_1	d_8	d_4	d_2	d_1	1-day digit register	RA_{31}	RA_{30}	RA_{29}	RA_{28}	RA_{91}	RA_{90}	RA_{89}	RA_{88}
8	1	0	0	0	D_{10}	0	0	d_{20}	d_{10}	10-day digit register	RA_{35}	RA_{34}	RA_{33}	RA_{32}	RA_{95}	RA_{94}	RA_{93}	RA_{92}
9	1	0	0	1	MO_1	mo_8	mo_4	mo_2	mo_1	1-month digit register	RA_{39}	RA_{38}	RA_{37}	RA_{36}	RA_{99}	RA_{98}	RA_{97}	RA_{96}
A	1	0	1	0	MO_{10}	0	0	0	mo_{10}	10-month digit register	RA_{43}	RA_{42}	RA_{41}	RA_{40}	RA_{103}	RA_{102}	RA_{101}	RA_{100}
B	1	0	1	1	Y_1	y_8	y_4	y_2	y_1	1-year digit register	RA_{47}	RA_{46}	RA_{45}	RA_{44}	RA_{107}	RA_{106}	RA_{105}	RA_{104}
C	1	1	0	0	Y_{10}	y_{80}	y_{40}	y_{20}	y_{10}	10-year digit register	RA_{51}	RA_{50}	RA_{49}	RA_{48}	RA_{111}	RA_{110}	RA_{109}	RA_{108}
D	1	1	0	1	C_1	TPS	30ADJ	CNTR	24/12	Control register 1	RA_{55}	RA_{54}	RA_{53}	RA_{52}	RA_{115}	RA_{114}	RA_{113}	RA_{112}
E	1	1	1	0	C_2	BUSY	PONC	—	*	Control register 2	RA_{59}	RA_{58}	RA_{57}	RA_{56}	RA_{119}	RA_{118}	RA_{117}	RA_{116}
F	1	1	1	1	C_3	SYSR	TEST	MS_1	MS_0	Control register 3	Same as MODE 0				Same as MODE 0			

Note: * TEST bit should be "0".

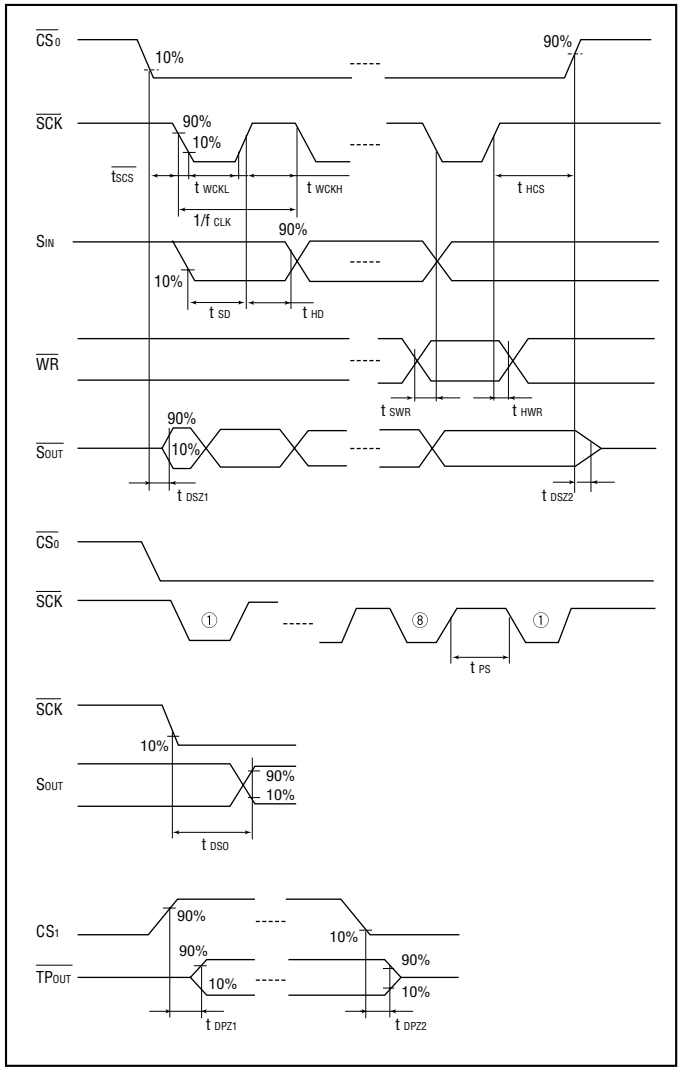
Switching characteristics (Ta=-30°C to +70°C, V_{DD}=5V±10%, GND=0V)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
$\overline{SCK}$ input frequency	f_{SCK}	—	—	—	500	kHz
$\overline{SCK}$ "L" time	t_{WSCKL}		1.0		—	μs
$\overline{SCK}$ "H" time	t_{WSCKH}					
$\overline{SCK}$ pause time	t_{PS}					
$\overline{CS_0}$ setup time	t_{SCS}	—	0	—	—	
$\overline{CS_0}$ hold time	t_{HCS}		0.5			
S_{IN} data setup time	t_{SD}		0.2			
S_{IN} data Hold time	t_{HD}					
$\overline{WR}$ setup time	t_{SWR}		1.0			
$\overline{WR}$ hold time	t_{HWR}		0.5			
S_{OUT} delay time	t_{DSO}	C_L=100pF	—	150	500	ns
$\overline{CS_0}$, and CS_1 enable to S_{OUT} output	t_{DSZ1}			—	100	
$\overline{CS_0}$ disenable to S_{OUT} high Z	t_{DSZ2}					
CS_1 enable to S_{OUT} output	t_{DPZ1}					
CS_1 enable to S_{OUT} high Z	t_{DPZ2}					

Block diagram



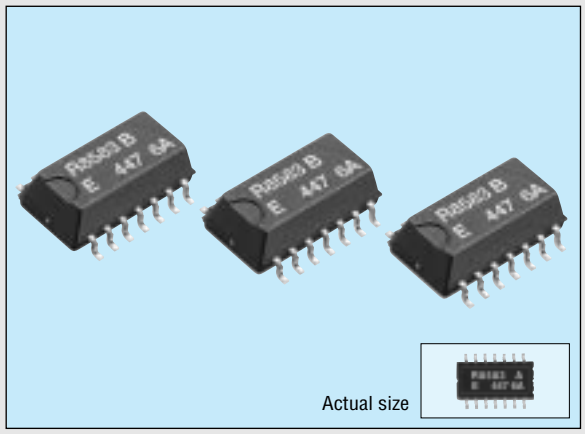
Timing chart



I² C-BUS COMPATIBLE REAL TIME CLOCK MODULE

RTC-8583/8593

- Builtin crystal unit. Adjustment free with 10pF external capacitor.
- Small package (SOP 14-pin).
- Three mode operations: internal crystal oscillation, external 50 Hz clock and event counter.
- I²C-Bus interface compatible.
- Builtin 240 x 8 bit S-RAM available (RTC8583).
- Alarm and timer functions available.
- Wide operating voltage range 2.5V to 6.0V.
- Wide data hold voltage range 1.0V to 6.0V.
- Low current consumption (RTC8593, 1.0µA typical).



Specifications (characteristics)

Absolute Max. rating

Item	Symbol	Condition	Min.	Max.	Unit
Supply voltage	V_{DD}	V_{DD}-GND	-0.8	+7.0	V
Input voltage	V_{IN}			V_{DD}+0.8	
Input current	Ii			10	mA
Output current	Io				
Storage temperature	T_{STG}		-55	+125	˚C

Operating range

Item	Symbol	Condition	Min.	Max.	Unit
Operating voltage	V_{DD}		2.5	6.0	V
Data holding voltage	V_{CLK}		1.0		
Operating temperature	T_{OPR}		-30	+70	˚C
External capacitor	C_G		10±5%		pF

Frequency characteristics

Item	Symbol	Condition	Max.	Unit
Frequency tolerance	Δf/fo	Ta=25˚C, V_{DD}=5V	A: 5±20 B: 5±50	ppm
Frequency temperature characteristics	T_{op}	Ta=-10 to 70˚C, V_{DD}=5V	+10 -120	
Frequency voltage characteristics	fv	Ta=25˚C, V_{DD}=2.0 to 6.0V	±3	
Oscillation start-up time	t_{OSC}	Ta=25˚C, V_{DD}=5V	3	s
Aging	fa	Ta=25˚C, V_{DD}=5V first year	±5	ppm/year

DC characteristics

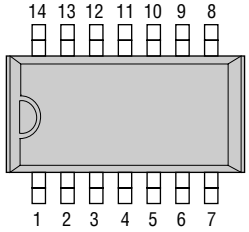
Item			Symbol	Condition	Min.	Typ.	Max.	Unit
"H" input voltage			V_{IH}	—	0.7V_{DD}		V_{DD}+0.8	V
"L" input voltage			V_{IL}		-0.8		0.3	
"L" output current			I_{OL}	V_{CL}=0.4V	3			mA
Input leak current							1	µA
Leak current			I_L	V_{IN}=V_{DD} or GND			250	
Output current			I_{OL}	V_{CL}=0.4V	1			mA
Leak current			I_L	V_{IN}=V_{DD} or GND			1	µA
Source current (access)			I_{DD0}	fSCL=100 kHz			200	
Current Consumption (non access)	8583	1	I_{DD1}	V_{DD}=5V, fSCL=0 Hz		10	50	
		2	I_{DD2}	V_{DD}=3V, fSCL=0 Hz		3.5	15	
		3	I_{DD3}	V_{DD}=2V, fSCL=0 Hz		2.0	10	
	8593	1	I_{DD1}	V_{DD}=5V, fSCL=0 Hz		3.0	15	
		2	I_{DD2}	V_{DD}=3V, fSCL=0 Hz		1.2	10	
		3	I_{DD3}	V_{DD}=2V, fSCL=0 Hz		1.0	8	

Item	Symbol	Condition	Min.	Max.	Unit
SDA					
Ao RESET OSC1					
INT					
INT SCL					

The I²C-Bus is a trademark of Philips Electronics N.V.

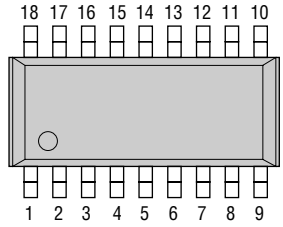
Terminal connection

● **RTC-8583/8593(SA)**



No.	8583	8593	8593SB
1	GND1	N.C	N.C
2	SCL	SCL	N.C
3	GND2	SDA	N.C
4	SDA	N.C	N.C
5	N.C	GND	N.C
6	N.C	OSC1	N.C
7	A0	N.C	N.C
8	OSC1	N.C	RESET
9	N.C	RESET	GND
10	N.C	N.C	SDA
11	V_{DD}	V_{DD}	SCL
12	N.C	N.C	INT
13	N.C	N.C	V_{DD}
14	INT	INT	OSC1
15			N.C
16			N.C
17			N.C
18			N.C

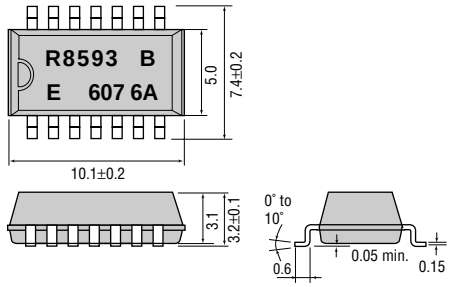
● **RTC-8593SB**



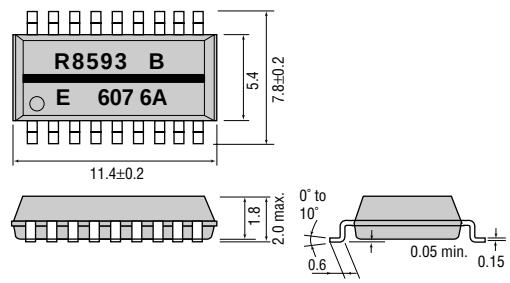
External dimensions

(Unit: mm)

● **RTC-8583/8593(SA)** (SOP 14-pin)



● **RTC-8593SB** (SOP 18-pin)



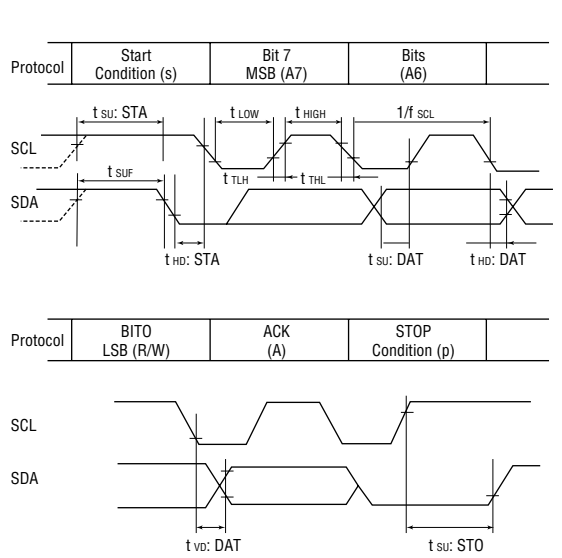
Register table

Address	Register name	count	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
00	CNT		STOP	HOLD	MODE1	MODE2	MASK	ALM	AF	TF
01	1/100SEC	0 to 99	8/10	4/10	2/10	1/10	8/100	4/100	2/100	1/100
02	SEC	0 to 59	10S8	10S4	10S2	10S1	S8	S4	S2	S1
03	MIN	0 to 59	10MIN8	10MIN4	10MIN2	10MIN1	MIN8	MIN4	MIN2	MIN1
04	HOUR	0 to 23	12/24	AM/PM	10HOUR2	10HOUR1	HOUR8	HOUR4	HOUR2	HOUR1
05	DAY	0 to 31	YEAR2	YEAR1	10DAY2	10DAY1	DAY8	DAY4	DAY2	DAY1
06	MONTH	0 to 12	W4	W2	W1	10MONTH1	MONTH8	MONTH4	MONTH2	MONTH1
07	TIMER	0 to 99	10TIMER8	10TIMER4	10TIMER2	10TIMER1	TIMER8	TIMER4	TIMER2	TIMER1
08	ALARM		AIE	TAIE	AS1	AS0	TIE	TCP2	TCP1	TCP0
09	A-1/100	0 to 99	A-8/10	A-4/10	A-2/10	A-1/10	A-8/100	A-4/100	A-2/100	A-1/100
0A	A-SEC	0 to 59	10A-SEC8	10A-SEC4	10A-SEC2	10A-SEC1	10A-SEC8	10A-SEC4	10A-SEC2	10A-SEC1
0B	A-MIN	0 to 59	10A-MIN8	10A-MIN4	10A-MIN2	10A-MIN1	10A-MIN8	10A-MIN4	10A-MIN2	10A-MIN1
0C	A-HR	0 to 23	A-12/24	A-AM/PM	10A-HR2	10A-HR1	A-HR8	A-HR4	A-HR2	A-HR1
0D	A-DAY	0 to 31	—		A-DAY2	A-DAY1	A-DAY8	A-DAY4	A-DAY2	A-DAY1
0E	A-MON	0 to 12	—			10A-MON1	10A-MON8	10A-MON4	10A-MON2	10A-MON1
0F	A-TIM	0 to 99	10A-TIM8	10A-TIM4	10A-TIM2	10A-TIM1	A-TIM8	A-TIM4	A-TIM2	A-TIM1
10 to FF		0 to FF	User's RAM (RTC-8583 is available)							

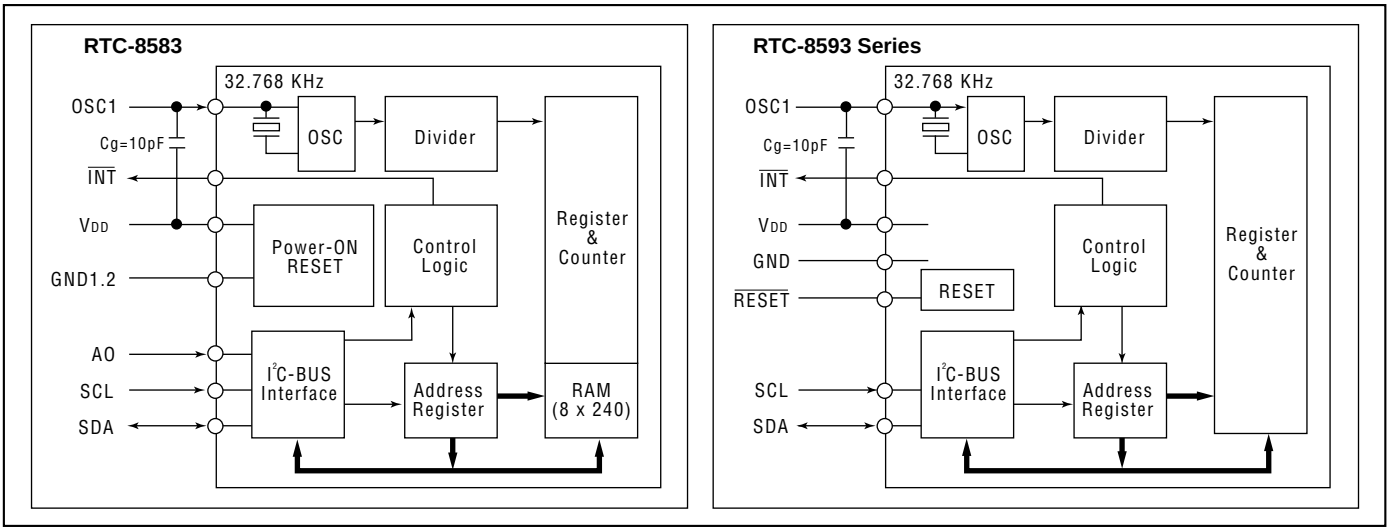
Switching characteristics

Item	Symbol	Min.	Max.	Unit
SCL clock frequency	f_{SCL}	—	100	KHz
Spike folerance on bus	t_{SW}			ns
Bus free time	t_{BUF}	4.7	—	μs
Start condition set-up time	$t_{SU;\ STA}$			
Hold time	$t_{HD;\ STA}$	4.0		
SCL "L" time	t_{LOW}	4.7		
SCL "H" time	t_{HIGH}	4.0		
SCL, SDA rise time	t_{TLH}	—	1.0	
SCL, SDA fall time	t_{THL}		0.3	
Date set-up time	$t_{SU;\ DAT}$	250	—	ns
Date hold time	$t_{HD;\ DAT}$	0		
SCL low to data out valid	$t_{VD;\ DAT}$	—	3.4	μs
Stop condition set-up time	$t_{SU;\ STO}$	4.0	—	
Event counter frequency	fi	—	1.0	MHz

Timeing chart



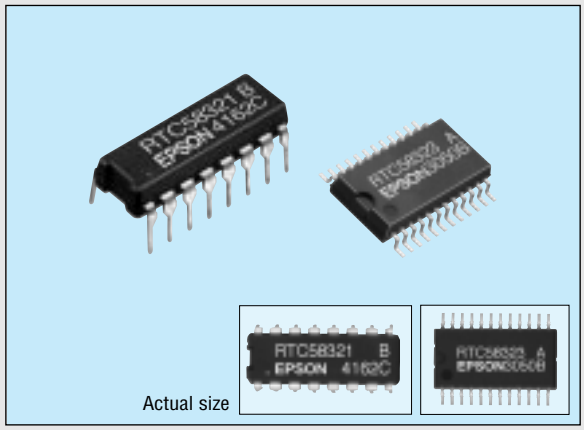
Block diagram



4-bit I/O CONNECTION REAL TIME CLOCK MODULE

RTC-58321/58323

- Builtin crystal unit allows adjustment-free efficient operation.
- Incorporating time counter (hour, minute, sec.) and calender counter (year, month, day of week).
- Either 12H or 24H selectable and leap year automatically adjustable.
- Standard signal output selectable among a choice of 1024 Hz, 1 sec., 60 sec., and 1 hour.
- Provided with counter start, stop and reset functions.
- Data transmission is by 4-bit bidirectional bus line and memory read and write method.
- Low current consumption and backup function provided.



Specifications (characteristics)

Absolute Max. rating

Item	Symbol	Condition	Specifications	Unit
Power source voltage	V_{DD}	Ta=25°C	-0.3 to 6.5	V
Input and output voltage	$V_{I/O}$		-0.3 to V_{DD}+0.3	
storage temperature	T_{STG}	—	-55 to +85	°C
Soldering condition	T_{SOL}	RTC-58321	Under 260°C within 10 sec. (lead part) (package should be less than 150°C)	
		RTC-58323	Twice at under 260°C within 10 sec. or under 230°C within 3 min.	

Operating range

Item	Symbol	Condition	Specifications	Unit
Operating voltage	V_{DD}	—	4.5 to 5.5	V
Operating temperature	T_{OPR}	RTC-58321	-10 to +70	°C
		RTC-58323	-30 to +85	
Data holding voltage	V_{DH}	—	2.2 to 5.5	V
CSI data holding time	t_{CDR}	Refer to the data holding timing	0 min.	µs
Operation restoring time	t_R			

Frequency characteristics and current consumption characteristics

Item	Symbol	Condition		Specifications	Unit
Frequency tolerance	Δf/fo	Ta=25°C V_{DD}=5v	58321 A	±10	ppm
			58321 B	±50	
			58323	5±20	
Frequency temperature characteristics	—	-10 to +70°C (25°C reference temperature)		+10/-120	
Aging	fa	V_{DD}=5V, Ta=25°C, first year		±5 max.	ppm/Y
Shock resistance	S.R.	Three drops on a hard board from 75 cm or 3000G x 0.3ms x 1/2 sine wave x 3 directions		±10 max.	ppm
Current consumption	$I_{DD\,1}$	V_{DD}=5V, CS_1=0V		40 max.	µA
	$I_{DD\,2}$	V_{DD}=3V, CS_1=0V		20 max.	

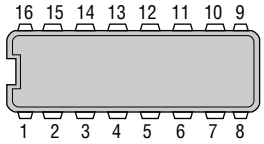
Electrical characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Applicable terminal
"H" input voltage	V_{IH1}	—	3.6	—	—	V	Input other than CS_1
"H" input voltage	V_{IH2}		V_{DD}-0.5				CS_1
"L" input voltage	V_{IL}		—		0.8		—
"L" output voltage	V_{OL}	I_{OL}=1.6mA		—	0.4		
"L" output current	I_{OL}	V_O=0.4V	1.6		—	mA	
"H" input current	I_{IH}	V_I=5V	10	30	80	µA	Input other than D_0 to D_3
"L" input current	I_{IL}	V_I=0V	—	—	-1		
Input leak current	I_{LIH}	V_I=5V			1		D_0 to D_3
Input off leak current	I_{LIL}	V_I=0V			-1		—
Input capacity	C_I	Input frequency 1 MHz		5	—	pF	
Oscillation start-up time	t_{OSC}	V_{DD}=5V Ta=25°C		1.5	3.0	s	Busy output

Unless otherwise stated, characteristics (specifications) shown in the above table are based on the rated operating temperature and voltage condition.

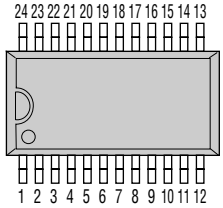
Terminal connection

RTC-58321



No.	58321	No.	58323
1	CS_2	1 to 4	N.C
2	WRITE	5	CS_2
3	READ	6	WRITE
4	D_0	7	READ
5	D_1	8	D_0
6	D_2	9	D_1
7	D_3	10	D_2
8	GND	11	D_3
9	ADDRESS WRITE	12	GND
10	BUSY	13	ADDRESS WRITE
11	STOP	14	BUSY
12	TEST	15	STOP
13	CS_1	16	TEST
14 to 15	N.C	17	CS_1
16	V_{DD}	18 to 24	V_{DD}

RTC-58323

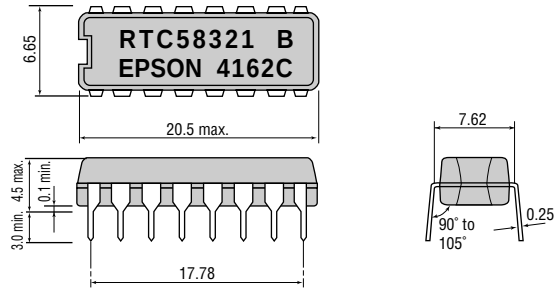


● NC is not connected internally.

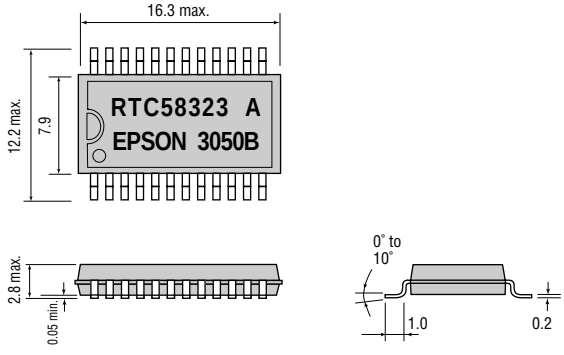
External dimensions

(Unit: mm)

RTC-58321



RTC-58323



Supplement

0= "L" level 1= "H" level

Item	Description
* mark	Writable. Recognized as 0 while in read mode
24/12	"1" =24 H mode,"0" =12H mode
PM/AM	"1" =PM, "0" =AM. In 24 H mode, this will be "0"
D_3 and D_2 of 10 days digit	Used to select leap year. Calculated according to the surplus after dividing 10 year digit by 4
Reset register	These selections are for resetting 5-stage and the busy circuit after $1/2^{15}$ frequency stage. Resetting is activated by latching this code on to the address latch and setting WRITE=H
Standard signal register	By latching this code to the address latch and setting READ to H, the standard signals will be output at D_0 to D_3

Calendar	D_3	D2	Surplus after dividing 10 year digit by 4	Example of leap year
Gregorian calendar	0	0	0	96, 00
Spare		1	3	
	1	0	2	
		1	1	

Note: • Do not enter erroneous data for clock.
• This may result in time keeping error.
• Do not change STOP more than once while in BUSY mode.

Switching characteristics

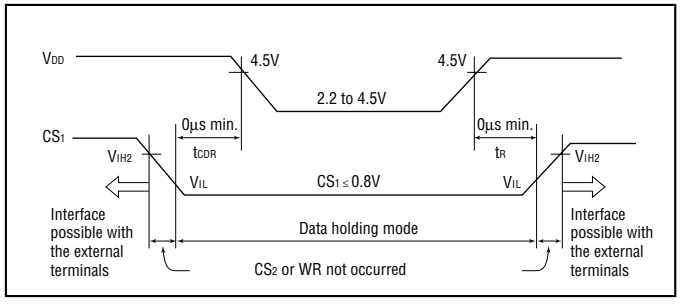
Write & read mode

(V_{DD}=5V±0.5V)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit.
CS setup time	t_{CS}		0			
Address setup time	t_{AS}					
Address write pulse width	t_{AW}		0.5			
Address hold time	t_{AM}		0.1		—	
Data setup time	t_{DS}		0			
Write pulse width	tww	—	2	—		µs
Data hold time	t_{CH}		0			
Read inhibit time	t_{RI}					
Read access time	t_{RA}		—		*1	
Read delay time	t_{DD}				1	
CS hold time	t_{CH}		0		—	

*1 $t_{RA}=1\mu S+C \times R \times \ln [V_{DD}/(V_{DD}-V_H)]$ C: Data line capacity
R: Pull-up resistance
V_H: "H" input voltage connected to the data line
ln: Natural logarithm

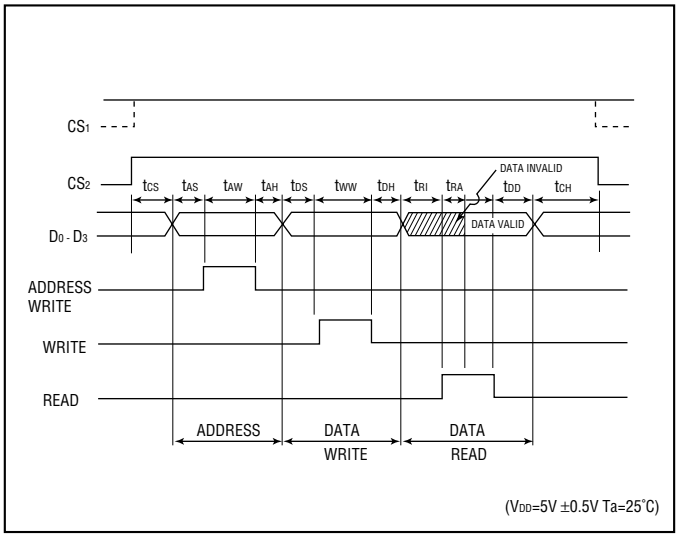
Date holding timing



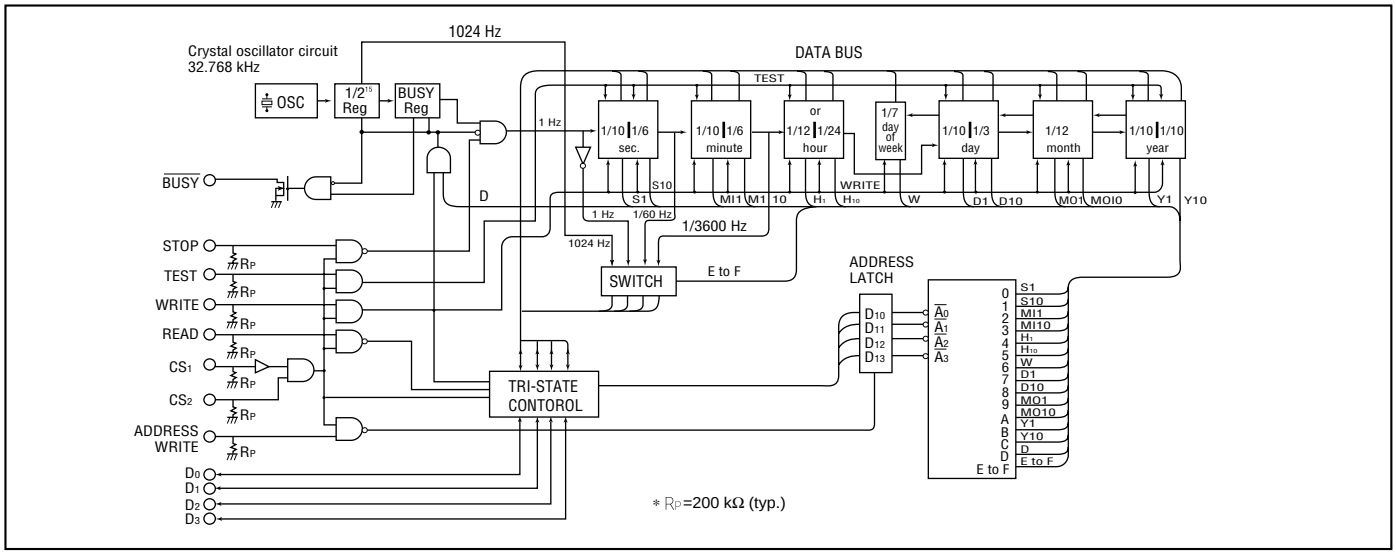
Register table

Address	D_3 A_3	D_2 A_2	D_1 A_1	D_0 A_0	Name of register	D_3	D_2	D_1	D_0	Count	Note
0	0	0	0	0	S_1	S_8	S_4	S_2	S_1	0 to 9	1- sec. digit register
1	0	0	0	1	S_{10}	*	S_{40}	S_{20}	S_{10}	0 to 5	10 - sec. digit register
2	0	0	1	0	MI_1	mi_8	mi_4	mi_2	mi_1	0 to 9	1 - min. digit register
3	0	0	1	1	MI_{10}	*	mi_{40}	mi_{20}	mi_{10}	0 to 5	10 - min. digit register
4	0	1	0	0	H_1	h_8	h_4	h_2	h_1	0 to 9	1 - hour digit register
5	0	1	0	1	H_{10}	24/12	PM/AM	h_{20}	h_{10}	0 to 2 or 0 to 1	10 - hour digit register
6	0	1	1	0	W	*	W_4	W_2	W_1	0 to 6	Week register
7	0	1	1	1	D_1	d_8	d_4	d_2	d_1	0 to 9	1 - day digit register
8	1	0	0	0	D_{10}	Leap year selection		d_{20}	d_{10}	0 to 3	10 - day digit register
9	1	0	0	1	MO_1	mo_8	mo_4	mo_2	mo_1	0 to 9	1- month digit register
A	1	0	1	0	MO_{10}	*			mo_{10}	0 to 1	10 -month digit register
B	1	0	1	1	Y_1	y_8	y_4	y_2	y_1	0 to 9	1 - year digit register
C	1	1	0	0	Y_{10}	y_{80}	y_{40}	y_{20}	y_{10}		10 - year digit register
D	1	1	0	1	—	*					Reset register
E	1	1	1	0	—	1 hour	1 min.	1 sec.	1024 Hz		Standard signal register
F	1	1	1	1							

Write and read timing



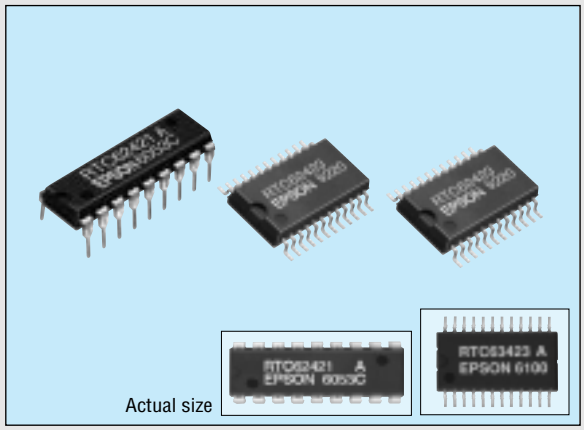
Block diagram



4-bit REAL TIME CLOCK MODULE

RTC-62421/62423

- Builtin crystal unit allows adjustment-free efficient operation.
- Directly connectable with CPU t_{WW}=120 nsec. (min.) t_{RD}=120 nsec. (max.).
- Low standby voltage and current consumption (1.8µA at 2V).
- Wide range of operating temperature (from -40˚C to +85˚C).
- 24H/12H changeable and leap year automatically adjustable (gregorian calendar).
- Similar mounting method (RTC-62423) to that used for universal type SMD IC.
- Pins and functions are compatible with the MSM6242 series.



Specifications (characteristics)

Absolute Max. rating

Item	Symbol	Condition	Specifications	Unit
Power source voltage	V_{DD}	Ta=25˚C	-0.3 to 7.0	V
Input and output voltage	$V_{I/O}$		-0.3 to V_{DD}+0.3	
Storage temperature	T_{STG}	RTC-62421	-55 to +85	˚C
		RTC-62423	-55 to +125	
Soldering condition	T_{SOL}	RTC-62421	Under 260˚C within 10 sec. (lead part) (package should be less than 150˚C)	
		RTC-62423	Twice at under 260˚C within 10 sec. or under 230˚C within 3 min.	

Operating range

Item	Symbol	Condition	Specifications	Unit
Operating voltage	V_{DD}		4.5 to 5.5	V
Operating temperature	T_{OPR}		-40 to +85	˚C
Data holding voltage	V_{DH}		2.0 to 5.5	V
CS_1 data holding time	t_{CDR}	Refer to the data holding timing	2.0 min.	µs
Operation restoring time	t_R			

Frequency characteristics and current consumption characteristics

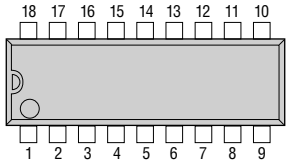
Item	Symbol	Condition		Specifications	Unit
Frequency tolerance	Δf/fo	Ta=25˚C V_{DD}=5V	62421 A	±10	ppm
			62421 B	±50	
			62423 A	±20	
			62423	±50	
Frequency temperature characteristics		-10 to +70˚C (25˚C reference temperature)		+10/-120	
		-40 to +85˚C (25˚C reference temperature)		+10/-220	
Aging	fa	V_{DD}=5V, Ta=25˚C, first year		±5 max.	ppm/Y
Shock resistance	S.R.	Three drops on a hard board from 75 cm or 3000G x 0.3ms x 1/2 sine wave x 3 directions		±10 max.	ppm
Current consumption	I_{DD1}	CS_1=0V	V_{DD}=5V	30 max.	µA
	I_{DD2}		V_{DD}=2V	1.8 max.	

Electrical characteristics

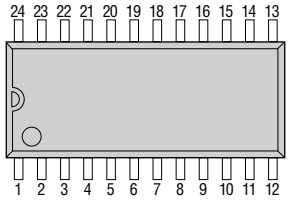
Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Applicable terminal
"H" input voltage (1)	V_{IH1}	—	2.2	—	—	V	All inputs other than CS_1
"L" input voltage (1)	V_{IL1}		—		0.8		
Input leak current (1)	I_{LK1}	V_I=V_{DD}/0V			1/-1	µA	Input other than D_0 to D_3
Input leak current (2)	I_{LK2}				10/-10		D_0 to D_3
"L" output voltage (1)	V_{OL1}	I_{OL}=2.5mA			0.4	V	
"H" output voltage	V_{OH}	I_{OH}=-400µA	2.4		—		
"L" output voltage (2)	V_{OL2}	I_{OL}=2.5mA	—		0.4		STD.P
OFF leak current	I_{OFFLK}	V_I=V_{DD}/0V			10	µA	
Input capacity	C_I	Input frequency 1 MHz		5	—	pF	
"H" input voltage (2)	V_{IH2}	V_{DD}=2 to 5.5V	4/5 V_{DD}	—	—	V	CS_1
"L" input voltage (2)	V_{IL2}		—		1/5 V_{DD}		

Terminal connection

RTC-62421



RTC-62423



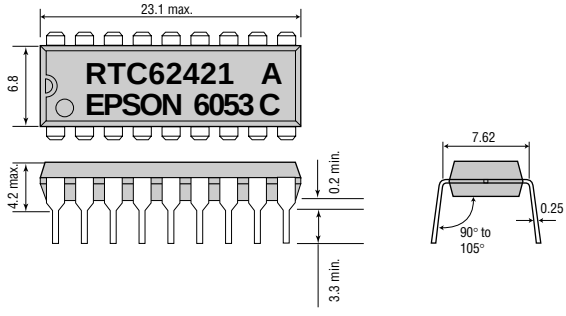
No.	62421	No.	62423
1	STD. P	1	STD. P
2	$\overline{CS_0}$	2	$\overline{CS_0}$
3	ALE	3	NC
4	A_0	4	ALE
5	A_1	5	A_0
6	A_2	6	NC
7	A_3	7	A_1
8	RD	8	NC
9	GND	9	A_2
10	$\overline{WR}$	10	A_3
11	D_3	11	$\overline{RD}$
12	D_2	12	GND
13	D_1	13	$\overline{WR}$
14	D_0	14	D_3
15	CS_1	15	D_2
16	(V_{DD})	16	D_1
17	(V_{DD})	17	NC
18	V_{DD}	18	NC
		19	D_0
		20	CS_1
		21	NC
		22	(V_{DD})
		23	(V_{DD})
		24	V_{DD}

- (V_{DD}) and V_{DD} are to have the same level of voltage. Do not connect it to any external terminals.
- NC is not connected internally.

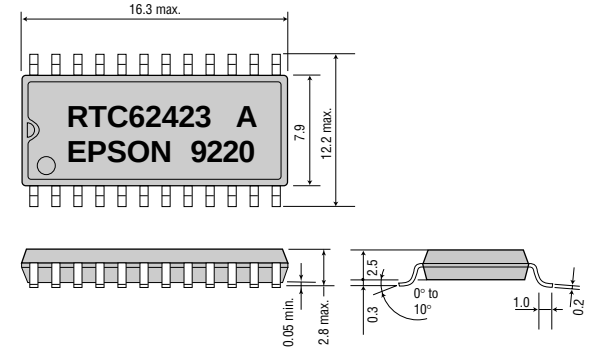
External dimensions

(Unit: mm)

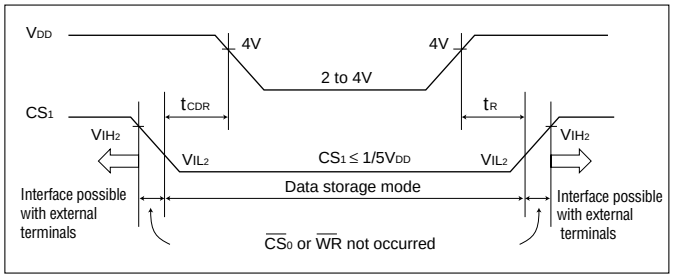
RTC-62421



RTC-62423



Data holding timing



Register table

Address	A3	A2	A1	A0	Name of register	D3	D2	D1	D0	Count	Note
0	0	0	0	0	S1	s8	s4	s2	s1	0 to 9	1 - sec. digit register
1	0	0	0	1	S10	*	s40	s20	s10	0 to 5	10 - sec. digit register
2	0	0	1	0	MI1	mi8	mi4	mi2	mi1	0 to 9	1 - min. digit register
3	0	0	1	1	MI10	*	mi40	mi20	mi10	0 to 5	10 - min. digit register
4	0	1	0	0	H1	h8	h4	h2	h1	0 to 9	1 - hour digit register
5	0	1	0	1	H10	*	PM/AM	h20	H10	0 to 2 or 0 to 1	10 - hour digit register
6	0	1	1	0	D1	d8	d4	d2	d1	0 to 9	1 - day digit register
7	0	1	1	1	D10	*		d20	d10	0 to 3	10 - day digit register
8	1	0	0	0	MO1	mo8	mo4	mo2	mo1	0 to 9	1 - month digit register
9	1	0	0	1	MO10	*			mo10	0 to 1	10 - month digit register
A	1	0	1	0	Y1	y8	y4	y2	y1	0 to 9	1 - year digit register
B	1	0	1	1	Y10	y80	y40	y20	y10		10 - year digit register
C	1	1	0	0	W	*	w4	w2	w1	0 to 6	Week register
D	1	1	0	1	CD	30 sec. ADJ	IRQ FLAG	BUSY	HOLD		Control register D
E	1	1	1	0	CE	t1	t0	ITRPT /STND	MASK		Control register E
F	1	1	1	1	CF	TEST	24/12	STOP	RESET		Control register F

Supplement

0="L" level. 1="H" level

	PM/AM	24/12	ITRPT/STND
1	PM	24	ITRPT
0	AM	12	STND

Bit name	Description
* mark	Writable. Recognized as 0 while in read mode.
BUSY	Read only (effective only when HOLD=1)
IRQ FLAG	Enter "0" only when clearing interruption. Enter "1" otherwise.
24H/12H	Setabil only when RESET=1
TEST	For our company's testing. TEST should be "0" in normal use.

Note: Do not enter erroneous data for clock. This may result in time keeping error.

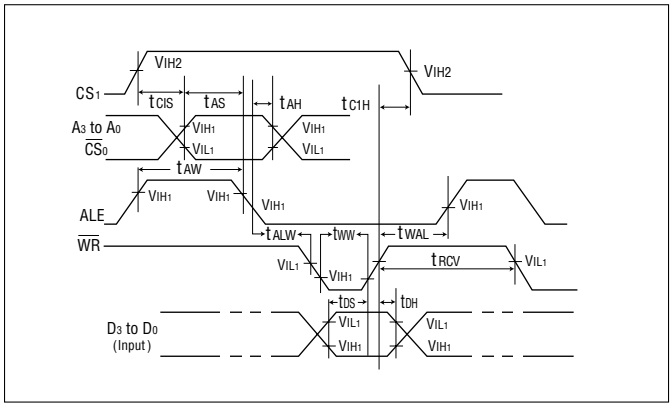
Switching characteristics

(VDD = 5V±0.5V, Ta = -40 to +85°C)

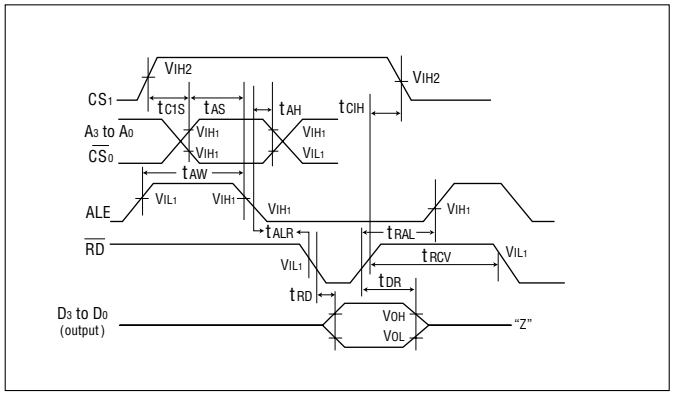
(ALE = While in use)

Item	Symbol	Condition	Min.	Max.	Unit
CS1 setup time	tCIS		1000		
CS1 hold time	tCIH		1000		
Address setup time	tAS		25		
Address hold time	tAH		25		
ALE pulse width	tAW	—	40	—	
ALE before WRITE	tALW		10		
ALE before READ	tALR		10		
ALE after WRITE	tWAL		20		ns
ALE after READ	tRAL		10		
WRITE pulse width	tWW		120		
RD to data	tRD	CL=150pF		120	
DATA hold	tDR		0	45	
DATA setup time	tDS	—	100		
DATA hold time	tDH		10	—	
RD/WR recovery time	tRCV		60		

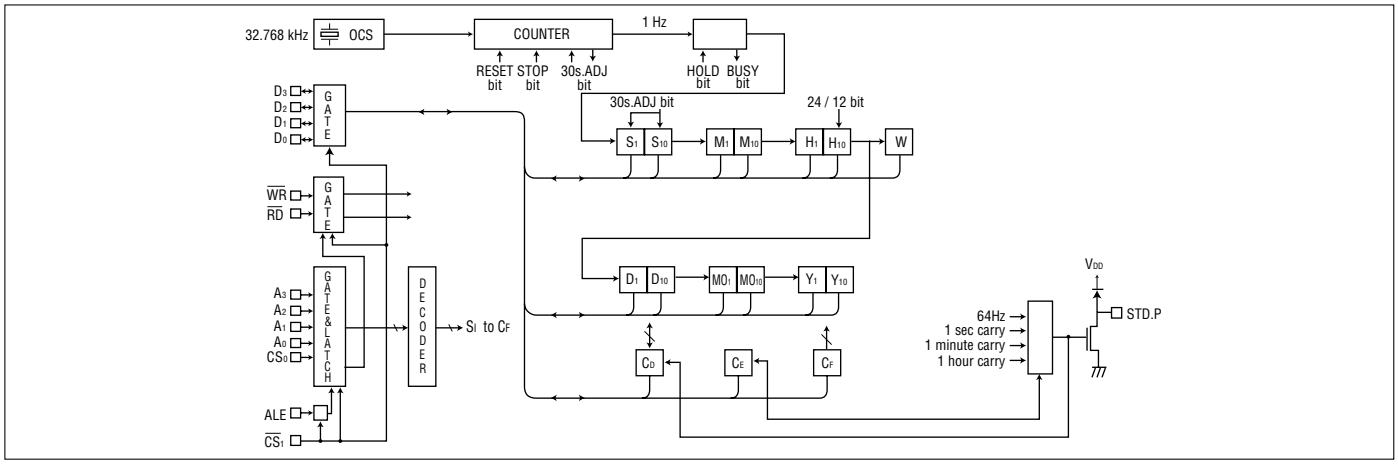
Write mode



Read mode



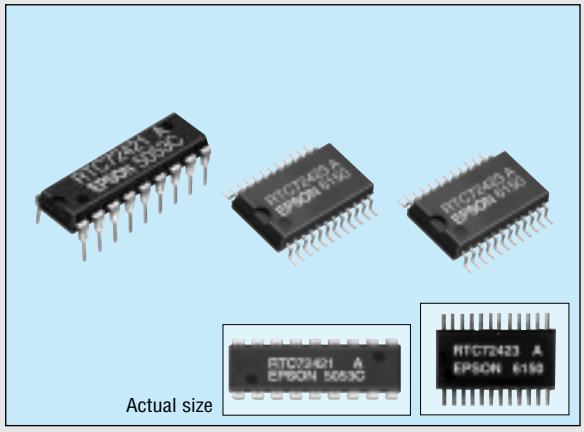
Block diagram



4-bit REAL TIME CLOCK MODULE

RTC-72421/72423

- Builtin crystal unit allows adjustment-free efficient operation.
- Direct bus compatibility (120 ns. access time).
- ALE input terminal available for 8048, 8051, and 8085 series.
- 12/24H clock switchover function and automatic leap year setting.
- Interrupt masking.
- 30 second adjustment function.
- Low current consumption and features a backup function.



Specifications (characteristics)

Absolute Max. rating

Item	Symbol	Condition	Specifications	Unit
Power source voltage	V_{DD}	Ta=25°C	-0.3 to 7.0	V
Input and output voltage	$V_{I/O}$	Ta=25°C	GND -0.3 to V_{DD}+0.3	V
Storage temperature	T_{STG}	RTC-72421	-55 to +85	°C
		RTC-72423	-55 to +125	°C
Soldering condition	T_{SOL}	RTC-72421	Under 260°C within 10 sec. (lead part) (package should be less than 150°C)	
		RTC-72423	Twice at under 260°C within 10 sec. or under 230°C within 3 min.	

Operating range

Item	Symbol	Condition	Specifications	Unit
Operating voltage	V_{DD}		4.5 to 5.5	V
Operating temperature	T_{OPR}	RTC-72421	-10 to 70	°C
		RTC-72423	-40 to 85	°C
Data holding voltage	V_{DH}		2.0 to 5.5	V
CSI data holding time	t_{CDR}	Refer to the data holding timing	2.0 min.	µs
Operation restoring time	t_R			µs

Frequency characteristics and current consumption characteristics

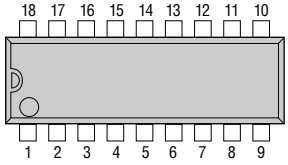
Item	Symbol	Condition		Specifications	Unit
Frequency tolerance	Δf/fo	Ta=25°C V_{DD}=5V	72421 A	±10	ppm
			72421 B	±50	
			72423 A	±20	
			72423	±50	
Frequency temperature characteristics		-10 to +70°C (25°C reference temperature)		+10/-120	
Aging	fa	V_{DD}=5V, Ta=25°C, first year		±5 max.	ppm/Y
Shock resistance	S.R.	Three drops on a hard board from 75 cm or 3000G x 0.3ms x 1/2 sine wave x 3 directions		±10 max.	ppm
Current consumption	I_{DD1}	CS_1=0V Exclude input/output current	V_{DD}=5V	10 max.	µA
	I_{DD2}		V_{DD}=2V	5 max.	µA

Electrical characteristics

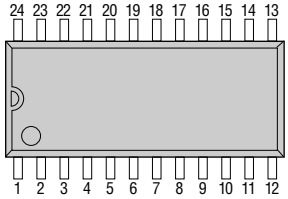
Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Applicable terminal
"H" input voltage (1)	V_{IH1}	—	2.2	–	—	V	All inputs other than CS_1
"L" input voltage (1)	V_{IL1}		—		0.8		
Input leak current (1)	I_{LK1}	V_I=V_{DD}/0V	—		±1	µA	Input other than D_0 to D_3
Input leak current (2)	I_{LK2}				±10		D_0 to D_3
"L" output voltage (1)	V_{OL1}	I_{OL}=2.5mA			0.4	V	
"H" output voltage	V_{OH}	I_{OH}=-400µA	2.4		—		
"L" output voltage (2)	V_{OL2}	I_{OL}=2.5mA	—		0.4		STD.P
Off leak current	I_{OFFLK}	V_I=V_{DD}/0V			10	µA	
Input capacity	C_I	Input frequency 1 MHz		10	—	pF	Input other than D_0 to D_3
				20			D_0 to D_3
"H" input voltage (2)	V_{IH2}	V_{DD}=2 to 5.5V	4/5 V_{DD}	—	—	V	CS_1
"L" input voltage (2)	V_{IL2}		—		1/5 V_{DD}		

Terminal connection

RTC-72421



RTC-72423



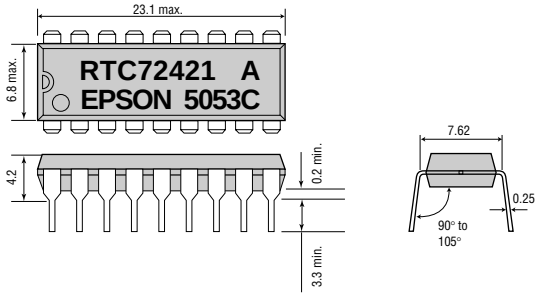
No.	72421	No.	72423
1	STD. P	1	STD. P
2	$\overline{CS_0}$	2	$\overline{CS_0}$
3	ALE	3	NC
4	A_0	4	ALE
5	A_1	5	A_0
6	A_2	6	NC
7	A_3	7	A_1
8	$\overline{RD}$	8	NC
9	GND	9	A_2
10	$\overline{WR}$	10	A_3
11	D_3	11	$\overline{RD}$
12	D_2	12	GND
13	D_1	13	$\overline{WR}$
14	D_0	14	D_3
15	CS_1	15	D_2
16	(V_{DD})	16	D_1
17	(V_{DD})	17	NC
18	V_{DD}	18	NC
		19	D_0
		20	CS_1
		21	NC
		22	(V_{DD})
		23	(V_{DD})
		24	V_{DD}

- (V_{DD}) and V_{DD} are to have the same level of voltage. Do not connect it to any external terminals.
- NC is not connected internally.

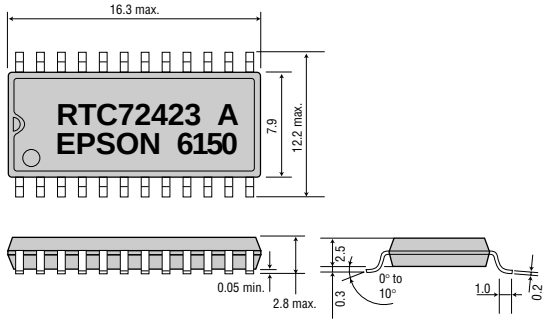
External dimensions

(Unit: mm)

RTC-72421



RTC-72423



Register table

Address	A_3	A_2	A_1	A_0	Register	Data D_3	Data D_2	Data D_1	Data D_0	Count Value	Remarks
0	0	0	0	0	S_1	s_8	s_4	s_2	s_1	0 to 9	1- second digit register
1	0	0	0	1	S_{10}	*	s_{40}	s_{20}	s_{10}	0 to 5	10- second digit register
2	0	0	1	0	MI_1	mi_8	mi_4	mi_2	mi_1	0 to 9	1- minute digit register
3	0	0	1	1	MI_{10}	*	mi_{40}	mi_{20}	mi_{10}	0 to 5	10- minute digit register
4	0	1	0	0	H_1	h_8	h_4	h_2	h_1	0 to 9	1- hour digit register
5	0	1	0	1	H_{10}	*	PM/AM	h_{20}	h_{10}	0 to 2 or 0 to 1	PM/AM,10- hours digit register
6	0	1	1	0	D_1	d_8	d_4	d_2	d_1	0 to 9	1- day digit register
7	0	1	1	1	D_{10}	*	*	d_{20}	d_{10}	0 to 3	10 -day digit register
8	1	0	0	0	MO_1	mo_8	mo_4	mo_2	mo_1	0 to 9	1- month digit register
9	1	0	0	1	MO_{10}	*	*	*	mo_{10}	0 to 1	10- month digit register
A	1	0	1	0	Y_1	y_8	y_4	y_2	y_1	0 to 9	1- year digit register
B	1	0	1	1	Y_{10}	y_{80}	y_{40}	y_{20}	y_{10}		10- year digit register
C	1	1	0	0	W	*	w_4	w_2	w_1	0 to 6	Week register
D	1	1	0	1	RegD	30 sec. ADJ	IRQ FLAG	BUSY	HOLD	—	Control Register D
E	1	1	1	0	RegE	t_1	t_0	ITRPT /STND	MASK		Control Register E
F	1	1	1	1	RegF	TEST	24/12	STOP	REST		Control Register F

0="L" level,1="H" level, REST = RESET ITRPT/ STND=INTERRUPT/STANDARD

1) Bit * does not exist.
2) Please mask AM/PM bit with 10's of hours operastions.
3) Busy is read only. IRQ can only. IRQ can only be set low ("0").
4)

Data Bit	PM/AM	ITRPT/STND	24/12
1	PM	ITRPT	24
0	AM	STND	12

5) TEST bit should be "0".

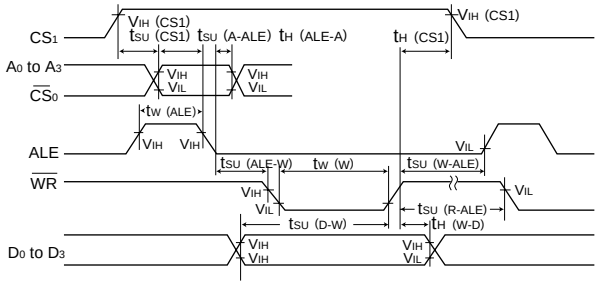
Switching characteristics (with ALE)

(Please connect ALE to V_{DD} if the microprocessor does not have an ALE output.)

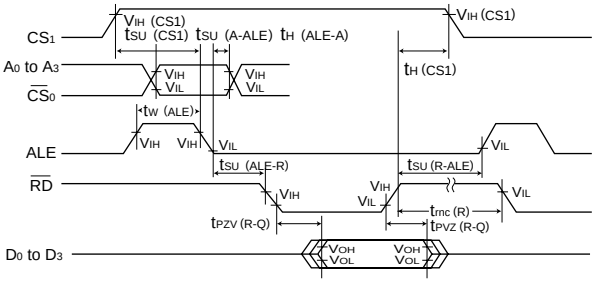
Item	Symbol	Condition	Min.	Max.	Unit
CS_1 setup time	$t_{SU\ (CS1)}$		1000	—	ns
Address setup time before ALE	$t_{SU\ (A-ALE)}$		50		
Address hold time after ALE	$t_{H\ (ALE-A)}$		50		
ALE pulse width	$t_{W\ (ALE)}$		80		
ALE setup time before WRITE	$t_{SU\ (ALE-W)}$		0		
ALE setup time before READ	$t_{SU\ (ALE-R)}$		0		
ALE setup time after WRITE	$t_{SU\ (W-ALE)}$		50		
ALE setup time after READ	$t_{SU\ (R-ALE)}$		50		
WRITE pulse width	$t_{W\ (W)}$		120		
DATA delay time after READ	$t_{PZV\ (R-Q)}$	C_L=150pF	—	120	
DATA Hold time after READ	$t_{PVZ\ (R-Q)}$		0	70	
DATA setup time before WRITE	$t_{SU\ (D-W)}$		80	—	
DATA hold time after WRITE	$t_{H\ (W-D)}$		10		
CS_1 hold time	$t_{H\ (CS1)}$		1000		
READ/WRITE recovery time	$t_{REC\ (R/W)}$		200		

(V_{DD} = 5V ± 0.5V)

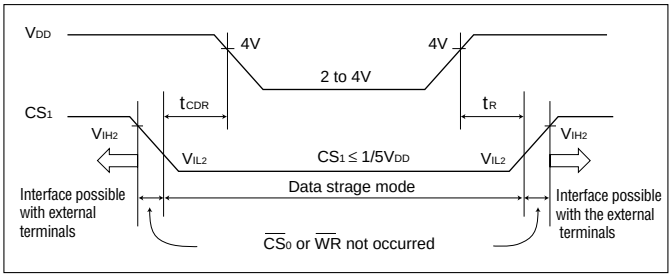
Write mode (with ALE)



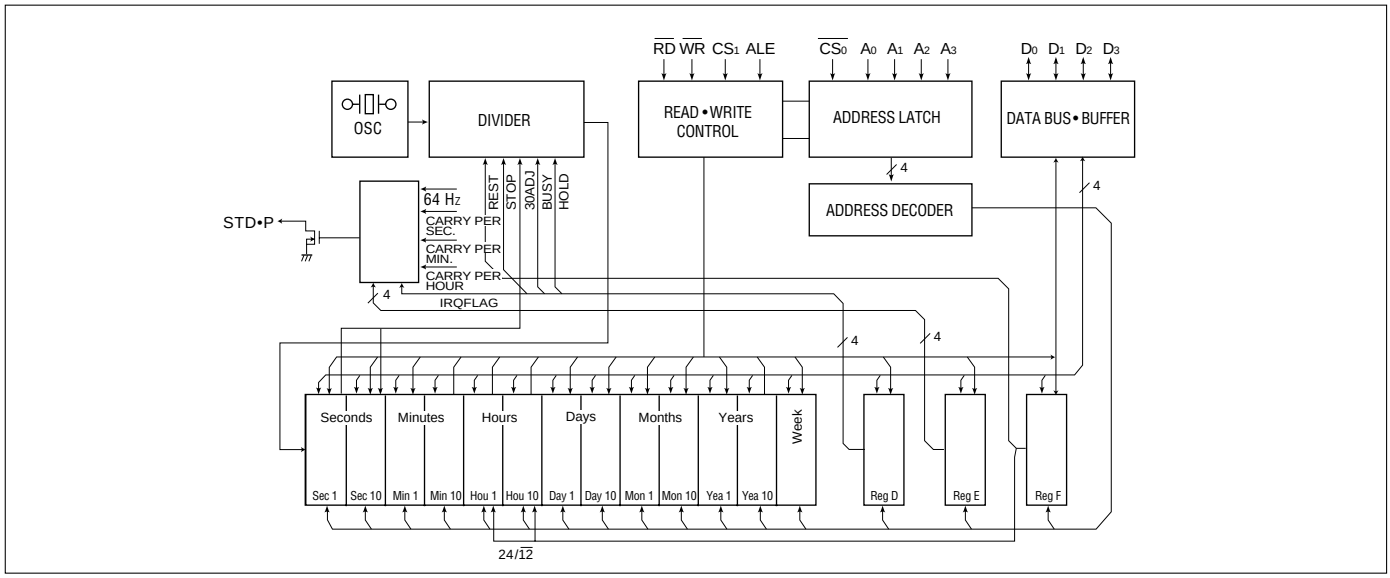
Read mode (with ALE)



Data holding timing



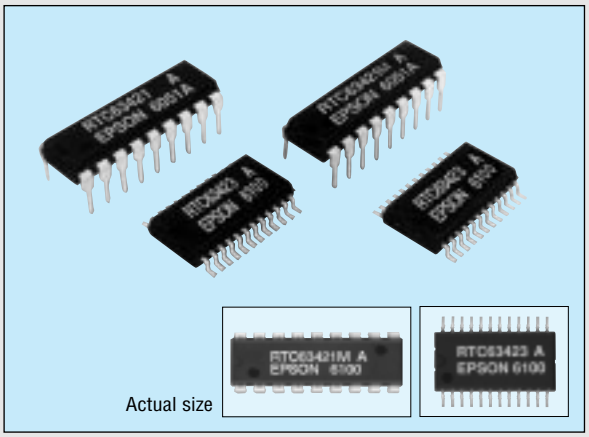
Block diagram



4-bit MULTIFUNCTIONAL REAL TIME CLOCK MODULE

RTC-63421/63421M/63423

- Builtin crystal unit allows adjustment-free efficient operation.
- Alarm interruption of sec. to month and day of week possible.
- Provided with microcomputer compatible bus interface.
- Standard signal output selectable in a range of 10min. to 1024 Hz.
- Either sec. to hour and day of week or sec. to year and day of week is selectable.
- Reference area of time /alarm register is setabil. Provided with RAM bits. (marked on "∗" which is shown resister table)
- Provided with START/STOP 30 second adjusting function.
- Similar mounting method (RTC-63423) to the used for normal type SMD IC.



Model	Applicable CPU
RTC-63421	Intel bus system
RTC-63421M	Motorola bus system
RTC-63423	"MOTEL" bus system

Specifications (characteristics)

Absolute Max. rating

Item	Symbol	Condition	Specifications	Unit
Power source voltage	V_{DD}	Ta=25°C	-0.3 to 7.0	V
Input voltage	V_{IN}	Ta=25°C	-0.3 to V_{DD}+0.3	V
storage temperature	T_{STG}	RTC-63421 RTC-63421M	-55 to +85	°C
		RTC-63423	-55 to +125	°C
Soldering condition	T_{SOL}	RTC-63421 RTC-63421M	Under 260°C within 10 sec. (lead part) (package should be less than 150°C)	
		RTC-63423	Twice at under 260°C within 10 sec. or under 230°C within 3 min.	

Operating range

Item	Symbol	Condition	Specifications	Unit
Operating voltage	V_{DD}	——	4.5 to 5.5	V
Operating temperature	T_{OPR}	——	-40 to +85	°C
Data holding voltage	V_{DH}	——	2.0 to 5.5	V
CS data holding time	t_{CDR}	Refer to the data holding timing	2.0 min.	µs
Operation restoring time	t_R	Refer to the data holding timing	2.0 min.	µs

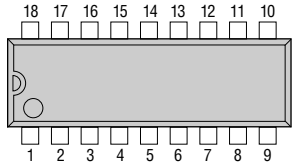
Frequency characteristics and current consumption characteristics

Item	Symbol	Condition		Specifications	Unit
Frequency tolerance	Δf/fo	Ta=25°C V_{DD}=5V	63421A/63421MA	+15/-5 (5±10)	ppm
			63421B/63421MB	+55/-45 (5±50)	ppm
			63423 A	+25/-15 (5±20)	ppm
			63423	+55/-45 (5±50)	ppm
Frequency temperature characteristics		-10 to +70°C (25°C reference temperature)		+10/-120	ppm
		-30 to +85°C (25°C reference temperature)		+10/-220	ppm
Aging	fa	V_{DD}=5V, Ta=25°C, first year		±5 max.	ppm/Y
Shock resistance	S.R.	Three drops on a hard board from 75 cm or 3000G x 0.3ms x 1/2 sine wave x 3 directions		±10 max.	ppm
Current consumption	I_{DD1}	CS 1=0V	V_{DD}=5V	30max.	µA
	I_{DD2}	CS 1=0V	V_{DD}=2V	1.8 max.	µA

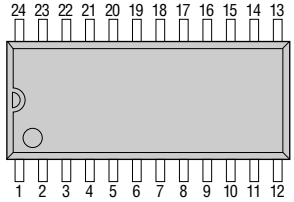
Unless otherwise stated, characteristics (specifications) shown in the above table are based on the rated operating temperature and voltage condition.

Terminal connection

RTC-63421/63421M



RTC-63423



No.	63421/63421M	No.	63423
1	INTERRUPT	1	INTERRUPT
2	$\overline{CS_0}$	2	$\overline{CS_0}$
3	ALE	3	$\overline{ALARM}$
4	A_0	4	ALE
5	A_1	5	A_0
6	A_2	6	30sec.Adj
7	A_3	7	A_1
8	$\overline{RD}$ (E ∗1)	8	68/$\overline{80}$
9	GND	9	A_2
10	$\overline{WR}$ (R/$\overline{W}$ ∗1)	10	A_3
11	D_3	11	$\overline{RD}$ (E ∗2)
12	D_2	12	GND
13	D_1	13	$\overline{WR}$ (R/$\overline{W}$ ∗2)
14	D_0	14	D_3
15	CS_1	15	D_2
16	(V_{DD})	16	D_1
17	(V_{DD})	17	1Hz
18	V_{DD}	18	D_0
		19	CS_1
		20	STOP/$\overline{START}$
		21	NC
		22	(V_{DD})
		23	(V_{DD})
		24	V_{DD}

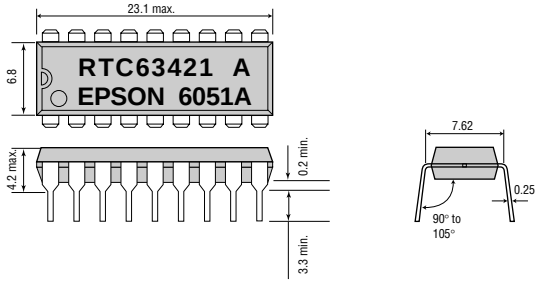
∗ 1=63421M ∗ 2=Motorola bus system

- (V_{DD}) is to be same level as V_{DD}. Do not connect it to any external terminals.
- NC is not connected internally.

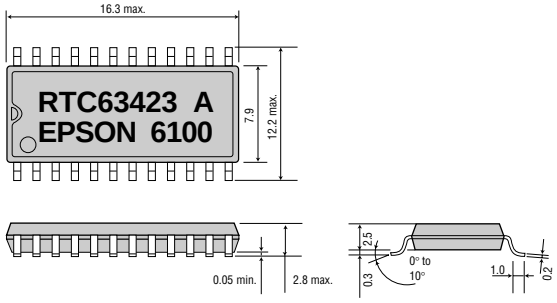
External dimensions

(Unit: mm)

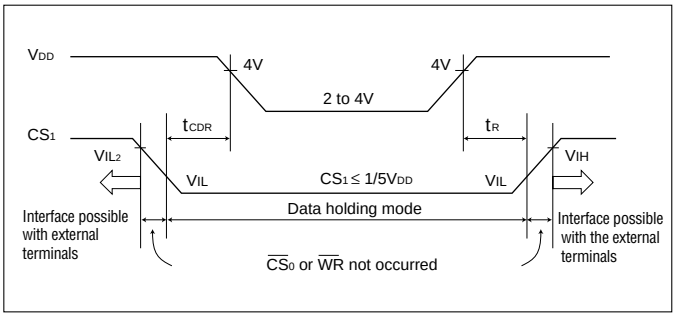
RTC-63421/63421M



RTC-63423



Data hoiding timing



Register table

Address	Symbol of register	BANK 0 D3	D2	D1	D0	Real time register name
0	R-S1	r-S8	r-S4	r-S2	r-S1	1 - sec. digit register
1	R-S10	*	r-S40	r-S20	r-S10	10 - sec. digit register
2	R-MI1	r-mi8	r-mi4	r-mi2	r-mi1	1 - min. digit register
3	R-MI10	*	r-mi40	r-mi20	r-mi10	10 - min. digit register
4	R-H1	r-h8	r-h4	r-h2	r-h1	1 - hour digit register
5	R-H10	*	r-PM/$\overline{AM}$	r-h20	r-h10	10 - hour digit register
6	R-D1	r-d8	r-d4	r-d2	r-d1	1 - day digit register
7	R-D10	*		r-d20	r-d10	10 - day digit register
8	R-MO1	r-mo8	r-mo4	r-mo2	r-mo1	1 - month digit register
9	R-MO10	*			r-mo10	10 - month digit register
A	R-Y1	r-y8	r-y4	r-y2	r-y1	1 - year digit register
B	R-Y10	r-y80	r-y40	r-y20	r-y10	10 - year digit register
C	R-W	*	r-w4	r-w2	r-w1	Week register
D	CD	IT/PLS2	IT/PLS1	MASK2	MASK1	Control register D
E	CE	IRQ · FLAG0	RESET	IRQ · FLAG2	IRQ · FLAG1	Control register E
F	CF	BANK1 BANK0	STOP	30 sec. ADJ	READ FLAG	Control register F

Symbol of register	BANK 1 D3	D2	D1	D0	Alarm register name
A-S1	a-S8	a-S4	a-S2	a-S1	1 - sec. digit register
A-S10	*	a-S40	a-S20	a-S10	10 - sec. digit register
A-MI1	a-mi8	a-mi4	a-mi2	a-mi1	1 - min. digit register
A-MI10	*	a-mi40	a-mi20	a-mi10	10 - min. digit register
A-H1	a-h8	a-h4	a-h2	a-h1	1 - hour digit register
A-H10	*	a-PM/$\overline{AM}$	a-h20	a-h10	10 - hour digit register
A-D1	a-d8	a-d4	a-d2	a-d1	1 - day digit register
A-D10	*		a-d20	a-d10	10 - day digit register
A-MO1	a-mo8	a-mo4	a-mo2	a-mo1	1 - month digit register
A-MO10	*			a-mo10	10 - month digit register
A-W	*	r-w4	a-w2	a-w1	Week register
A-EMB	ae8	ae4	ae2	ae1	Area define register
CC	*		TEST2	TEST1	Test register
CD	*	CY2	CY1	CY0	Control register D
CE	HD/SFT	24/$\overline{12}$	CAL	D · P	Control register E
CF	Same as BANK 0				Control register F

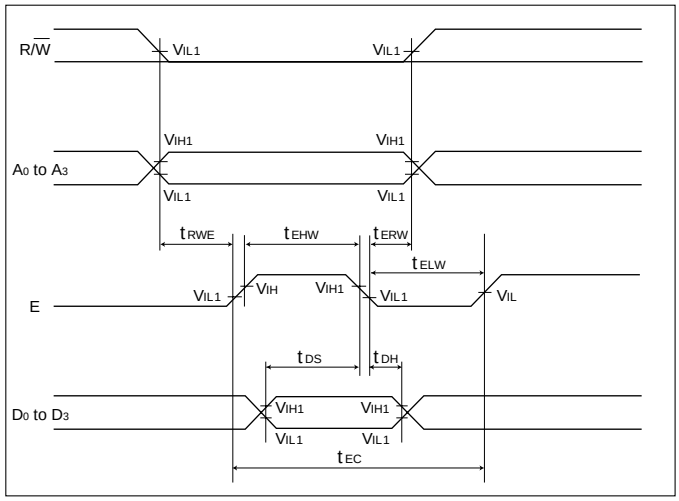
Switching characteristics

Motorola bus system (VDD = 5V ± 0.5V, Ta = 0 to + 70°C)

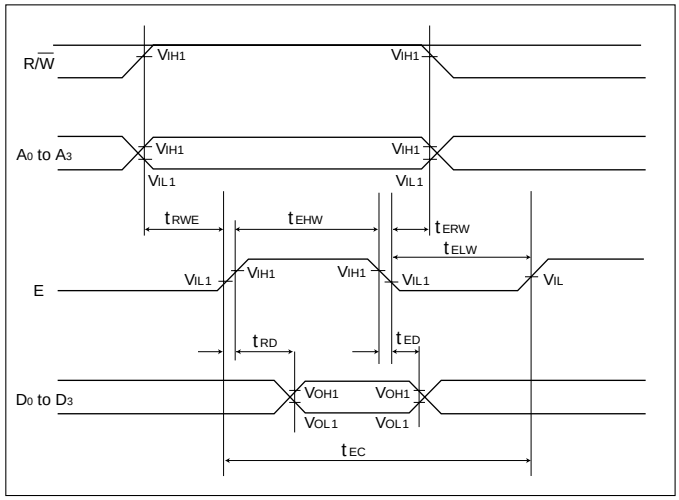
Item	Symbol	Min.	Max.	Unit
R/$\overline{W}$, address setup time	tRWE	100	—	ns
E "H" pulse width	tEHW	220		
R/$\overline{W}$, address hold time	tERW	20		
E "L" pulse width	tELW	220		
E cycle time	tEC	500		
DATA setup time	tDS	180		
DATA hold time	tDH	20		
E to data (CL=150pF)	tRD	—	120	
Data hold	tED	10	—	

Switching characteristics on the Intel bus system are the same as those for the RTC-6242 series.

Write mode



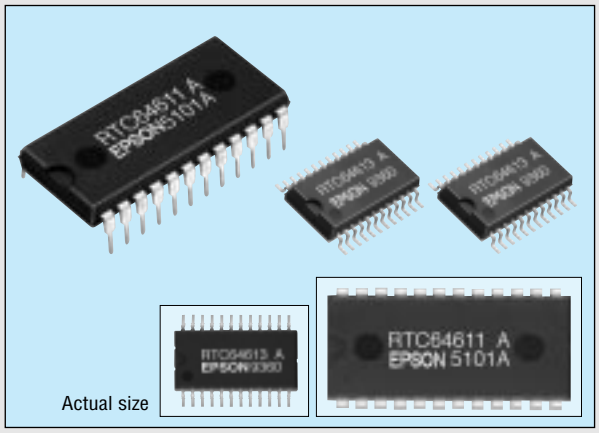
Read mode



8-bit REAL TIME CLOCK MODULE

RTC-64611/64613

- Builtin crystal unit allows adjustment-free efficient operation.
- 8-bit data bus and high speed access (85 nsec. max.).
- Provided with the same interface as S-RAM and battery backup function.
- Interruption of alarm of sec. to day and day of week and carry interruption.
- Reference signal selectable in a range of 1 Hz to 64 Hz (binary).
- Leap year automatically adjustable (gregorian calendar).
- With 1 Hz output terminal.
- Provided with START/STOP, 30 second adjust function.
- RTC-64613 uses a similar mounting method to that of a normal SMD IC.



Specifications (characteristics)

Absolute Max. rating

Item	Symbol	Condition	Specifications	Unit
Power source voltage	V_{DD}	Ta=25°C	-0.5 to 7.0	V
Input voltage	V_{IN}		-0.5 to V_{DD}+0.3	
Storage temperature	T_{STG}	RTC-64611	-55 to +85	°C
		RTC-64613	-55 to +125	
Soldering condition	T_{SOL}	RTC-64611	Under 260°C within 10 sec. (lead part) (package should be less than 150°C)	
		RTC-64613	Twice at under 260°C within 10 sec. or under 230°C within 3 min.	

Operating range

Item	Symbol	Condition	Specifications	Unit
Operating voltage	V_{DD}	—	4.5 to 5.5	V
Operating temperature	T_{OPR}		-20 to + 75	°C
Data holding voltage	V_{DH}	$\overline{CS} \geq V_{DD}$ - 0.2V	2.0 to 4.5	V
CS data holding time	t_{CDR}		0 min.	ns
Operation restoring time	t_R		t_{RC} (85 ns.)	

Frequency characteristics and current cosumption characteristics

Item	Symbol	Condition		Specifications	Unit
Frequency tolerance	Δf/fo	Ta=25°C V_{DD}=5V	64611 A	+15/-5(5±10)	ppm
			64611 B	+55/-45(5±50)	
			64613 A	+25/-15(5±20)	
			64613	+55/-45(5±50)	
Frequency temperature characteristics		-10 to +70°C (25°C reference temperature)		+10/-120	
		-20 to +75°C (25°C reference temperature)		+10/-220	
Aging	fa	V_{DD}=5V, Ta=25°C, first year		±5 max.	ppm/Y
Shock resistance	S.R.	Three drops on a hard board from 75 cm or 3000G x 0.3ms x 1/2 sine wave x 3 directions		±10 max.	ppm
Current consumption	I_{DD1}	No load	V_{DD}=5V	2 max.	mA
	I_{DD2}	$\overline{CS} \geq$ 1.8V	V_{DD}=2V		μA

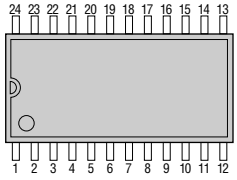
Unless otherwise stated, characteristics (specifications) shown in the above table are based on the rated operating temperature and voltage condition.

DC characteristics

(V_{DD} = 5V±0.5V, Ta = -20 to + 75°C)

Item	Symbol	Condition	V_{DD}= 5V±10%		V_{DD}= 2V		Unit
			Min.	Max.	Min.	Max.	
"H" input voltage	V_{IH}		2.2	V_{DD}	V_{DD}-0.2	V_{DD}	V
"L" input voltage	V_{IL}		-0.3	0.8	-0.3	0.2	
Input leak current	I_{IN}		—	± 2	—	± 2	μA
Three-state leak current	I_{TSL}			±10		±10	
Output leak current	I_{LOH}						
"H" output voltage (except for 1 Hz, $\overline{IRQ}$, OSC_2)	V_{OH}	I_{OH}=-1mA	2.4	—	—	—	V
"L" output voltage	V_{OL}	I_{OL}=2.1mA	—	0.4			
Input capacity	C_{IN}	V_{IN}=0V Ta=25°C f =1.0 MHz		12.5			pF
Output capacity	C_{OUT}						

Terminal connection



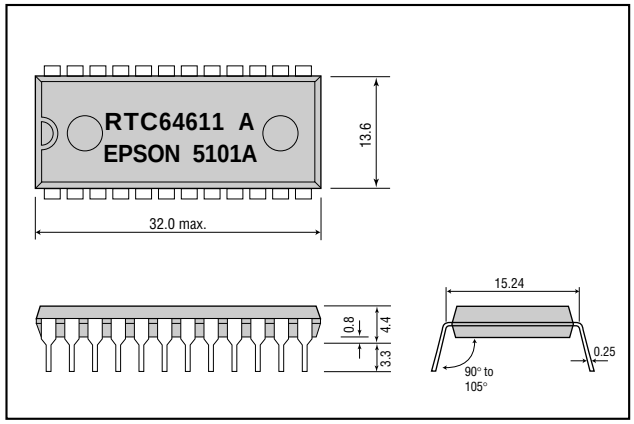
No.	Pin terminal	No.	Pin terminal
1	GND	13	I/O_4
2	H-START/STOP	14	I/O_5
3	IRQ	15	I/O_6
4	1Hz	16	I/O_7
5	A_3	17	I/O_8
6	A_2	18	$\overline{CS}$
7	A_1	19	$\overline{OE}$
8	A_0	20	$\overline{WE}$
9	I/O_1	21	NC
10	I/O_2	22	(V_{DD})
11	I/O_3	23	(V_{DD})
12	GND	24	V_{DD}

- (V_{DD}) is to be same level as V_{DD}. Do not connect it to any external terminals.
- NC is not connected internally.

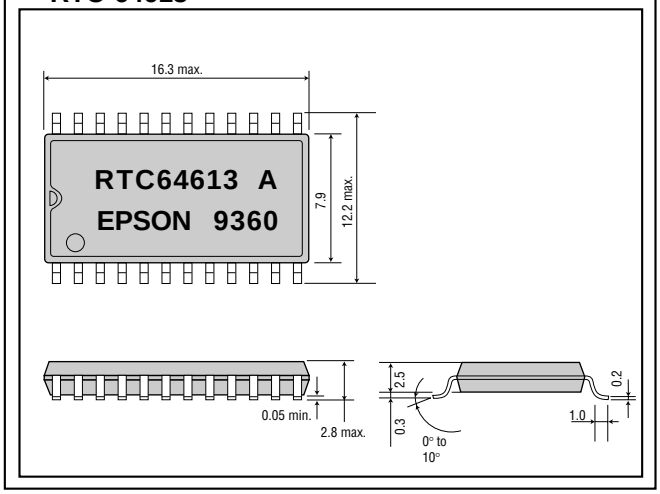
External dimensions

(Unit: mm)

RTC-64611



RTC-64613



Register table

Address	Data b7	b6	b5	b4	b3	b2	b1	b0	Remarks
0		1 Hz	2 Hz	4 Hz	8 Hz	16 Hz	32 Hz	64 Hz	Counter
1	*	10-sec. digit			1-sec. digit				
2		10-min. digit			1-min. digit				
3	*		10-hour digit		1-hour digit				
4	*					Day-of-week digit			
5	*		10-day digit		1-day digit				
6	*			10-month digit	1-month digit				
7	10-year digit				1-year digit				
8	ENB	1 Hz	2 Hz	4 Hz	8 Hz	16 Hz	32 Hz	64 Hz	Alarm register
9		10-sec. digit			1-sec. digit				
A		10-min. digit			1-min. digit				
B		*	10-hour digit		1-hour digit				
C		*				Day-of-week digit			
D		*	10-day digit		1-day digit				
E	Carry flag	*		Carry interruption enable	Alarm interruption enable	*		Alarm flag	Control register
F	RAM7	RAM6	RAM5	RAM4	TEST *1	30-sec. adjustment	RESET	S.START /STOP	

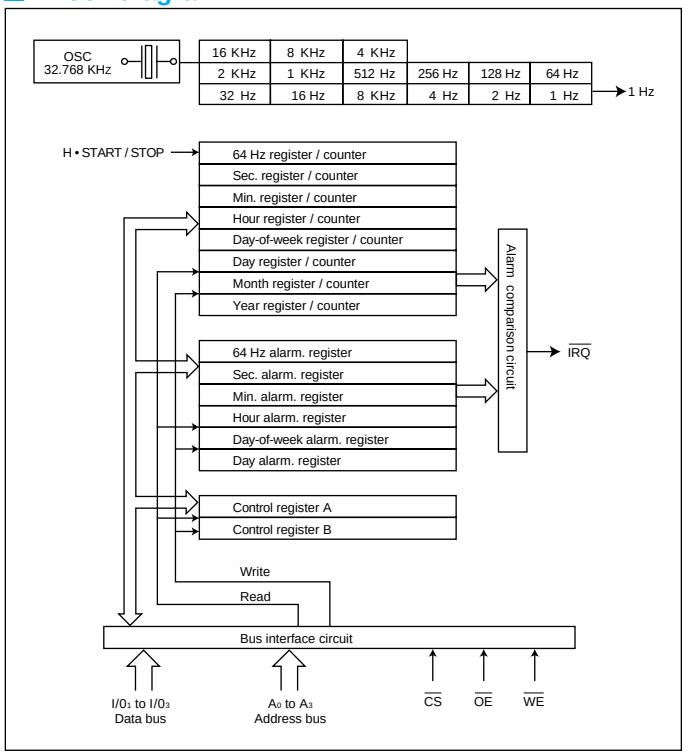
*1 Be sure to enter "0" to TEST bit.

Supplement

Bit name	Description
* mark	Empty bit and unwritable Recognized as "0" while reading
10-hour digit (b_5)	Only for 24H mode
Under-sec. counter	Read only (unwritable) Used as binary code data
Under-sec. alarm register	Used as binary code data
Sec.to year	Both counter and alarm register use BCD code
Day of week	Coded data is used EX: 0…Sunday 1…Monday 2…Tuesday 3…Wednesday 4…Thursday 5…Friday 6…Saturday

Note: Do not enter erroneous data for clock. This may result in time keeping error.

Block diagram



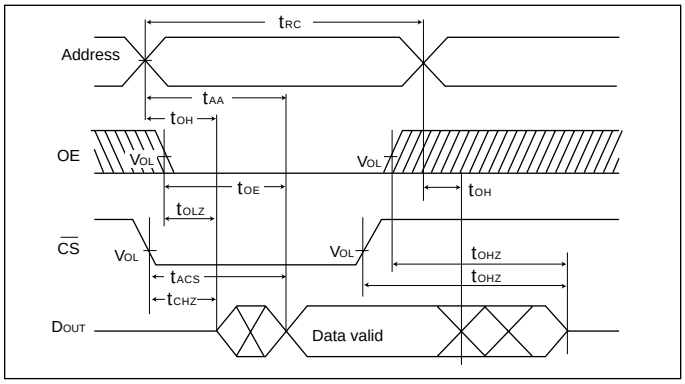
Switching characteristic

Measuring condition

- Input pulse level: 0.8 to 2.4V
- Input risetime, falltime: 5 nsec.
- IN/OUT timing pulse level: 1.5V
- Out put loard: 1 TTL Gate +100pF

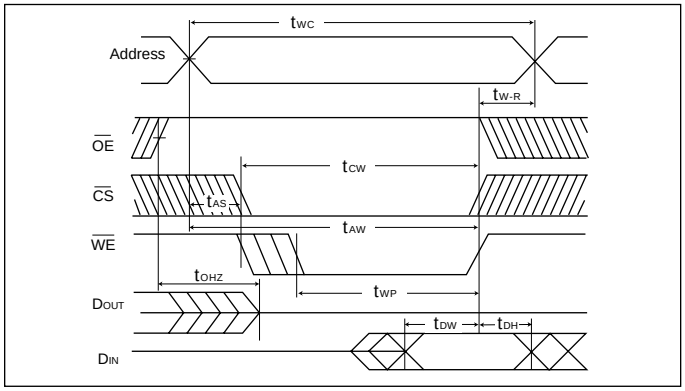
Read mode

Item	Symbol	Min.	Max.	Unit
Read cycle time	t_{RC}	85	—	ns
Address access time	t_{AA}	—	85	
Chip select access time	t_{ACS}			
Output enable access time	t_{OE}		45	
Output hold time	t_{OH}	10	—	
Chip select / output set time	t_{CLZ}			
Output enable / output set time	t_{OLZ}	5		
Chip deselect / output floating	t_{CHZ}	0	35	
Output disable / output floating	t_{OHZ}			



Write mode

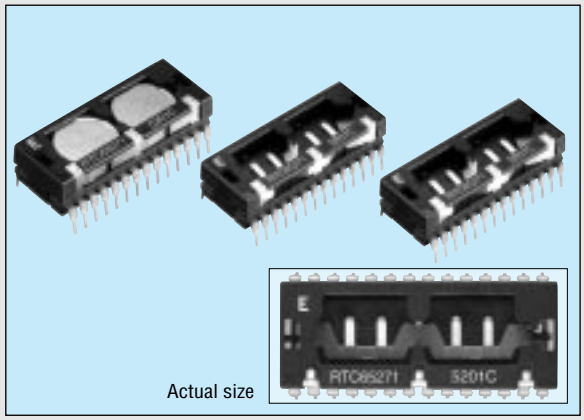
Item	Symbol	Min.	Max.	Unit
Write cycle time	t_{WC}	85	—	ns
Chip select time	t_{CW}	75		
Address valid time	t_{AW}			
Address setup time	t_{AS}	0		
Write pulse time	t_{WP}	60		
Address holding time	t_{WR}	10		
$\overline{WE}$ output floating	t_{WHZ}	0	35	
Input data set time	t_{DW}	40	—	
Input data hold time	t_{DH}	0		
Output disable / output floating	t_{OHZ}		35	
$\overline{WE}$ output set time	t_{OW}	5	—	



8-bit REAL TIME CLOCK MODULE

RTC-65271

- Builtin crystal unit allows adjustment-free efficient operation.
- A builtin power supply switching circuit makes it possible to provide automatic power supply backup to both the RTC and extended RAM.
- The real-time clock block consists of:
  Indirect register: 1-byte Control register: 4-bytes
  Clock, alarm, calendar: 10-bytes User RAM: 50-bytes
- Extended RAM: 4K-bytes of builtin S-RAM
  Page register: 1-byte Configuration: 32-bytes x 128 pages
- The package is a 28-pin DIP IC with a battery holder that makes battery replacement possible.
- Batteries (BR1225) are available as an option. (Batteries are packed separately from the RTC.)



Batteries in this photograph are used only to show the inserted condition. This RTC is not supplied with the batteries inserted.

Specifications (characteristics)

Absolute Max. rating

Item	Symbol	Condition	Min.	Max.	Unit
Supply voltage	V_{DD}	V_{DD} - GND	-0.3	+7.0	V
Input voltage	V_{IN}	Input Pin		V_{DD}+0.3	
Storage temperature	T_{STG}	*1	-40	+85	˚C
Soldering condition	T_{SOL}	260˚C or less, for 10 seconds or less; (package should be 150˚C or less)			

*1 Storage temperature as a discrete component.

Operating conditions

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply voltage	V_{DD}	—	4.5	5.0	5.5	V
Operating temperature	T_{OPR}		-10	—	+70	˚C

Frequency characteristics

Item	Symbol	Condition	Max.	Unit
Frequency tolerance	Δf/fo	Ta=25˚C, V_{DD}=5V	5±20	ppm
Temperature characteristics	T_{OP}	Ta=-10 to 70˚C, V_{DD}=5V *1	+10 -120	
Voltage characteristics	fv	Ta=stable, V_{DD}=3V *1	±5	
Aging	fa	Ta=25˚C, V_{DD}=5V, first year	±5	ppm/year

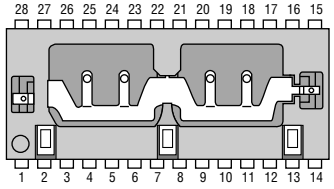
*1: The frequency deviation (Oppm) at Ta=25˚C for "top" or at V_{DD} =5V for "fv" is used as the reference value.

DC characteristics

(V_{DD} = 5.0V ± 10%, Ta = -10 to + 70˚C)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Input voltage	V_{IH}	—	2.2	—	V_{DD}+0.3	V
	V_{IL}		-0.3		0.8	
Input leak current	I_I	$\overline{RESET}$, $\overline{RD}$, $\overline{WR}$, $\overline{RTC}$, $\overline{XRAM}$, D_0 to D_7, A_0 to A_5	—	—	±1	μA
Output voltage	V_{OH}	V_{DD}=5V, I_{LOAD}=-4mA	2.4	—	—	V
	V_{OL}	V_{DD}=5V, I_{LOAD}=4mA	—		0.4	
Power supply current	I_{DD}	Output unloaded			15	mA
Current when using battery backup	I_{BAT}	Ta=25˚C		0.5	1.0	μA
Input current	I_{STBY}	$\overline{STBY}$=GND		—	2	

Terminal connection

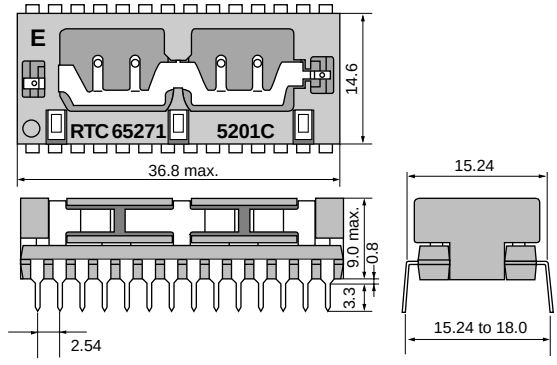


No.	Pin Terminal	No.	Pin Terminal
1	A_0	15	$\overline{RTC}$
2	A_1	16	$\overline{XRAM}$
3	TMODE	17	$\overline{WR}$
4	TCLOCK	18	NC
5	$\overline{STBY}$	19	$\overline{RD}$
6	D_0	20	$\overline{RESET}$
7	D_1	21	$\overline{IRQ}$
8	D_2	22	NC
9	D_3	23	A_5
10	D_4	24	A_4
11	D_5	25	SQW
12	D_6	26	V_{DD}
13	D_7	27	A_3
14	GND	28	A_2

- NC is not connected internally.

External dimensions

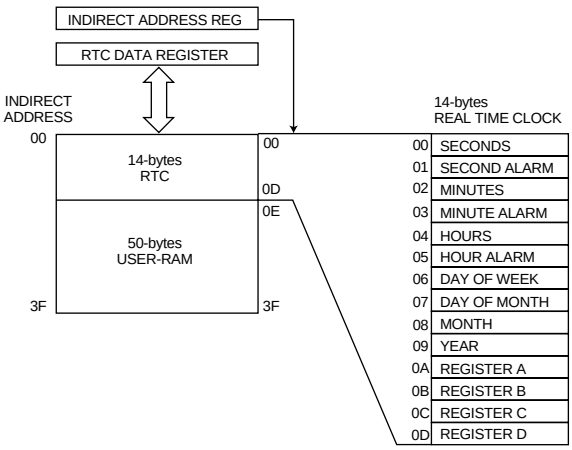
(Unit: mm)



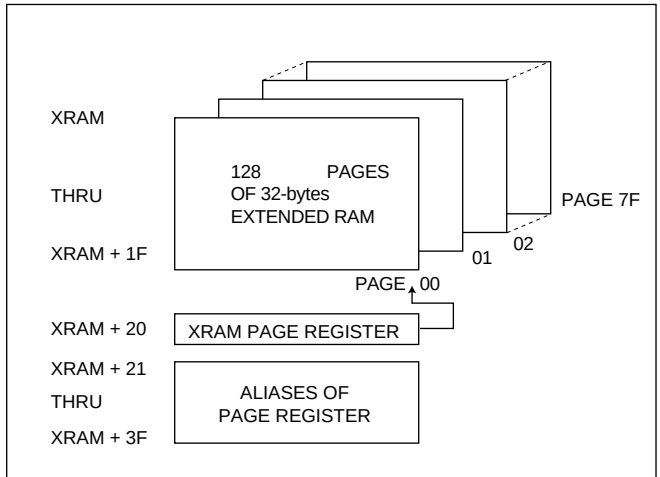
Note: For information on handling batteries, please independently refer to the pertinent regulations, as this product does not come equipped with batteries.

Address map

RTC address map



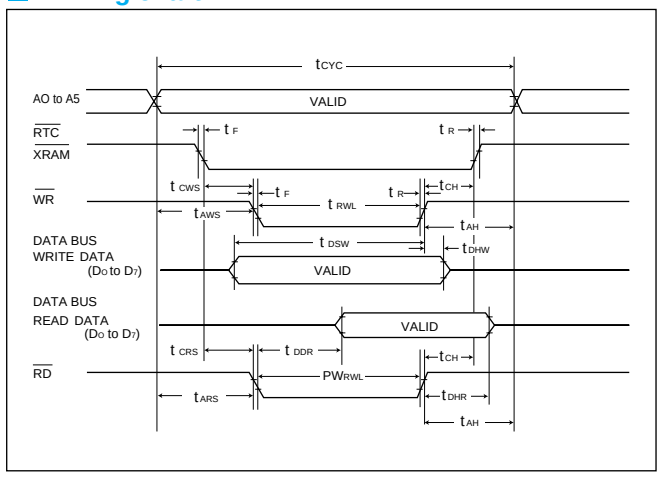
Extended RAM address map



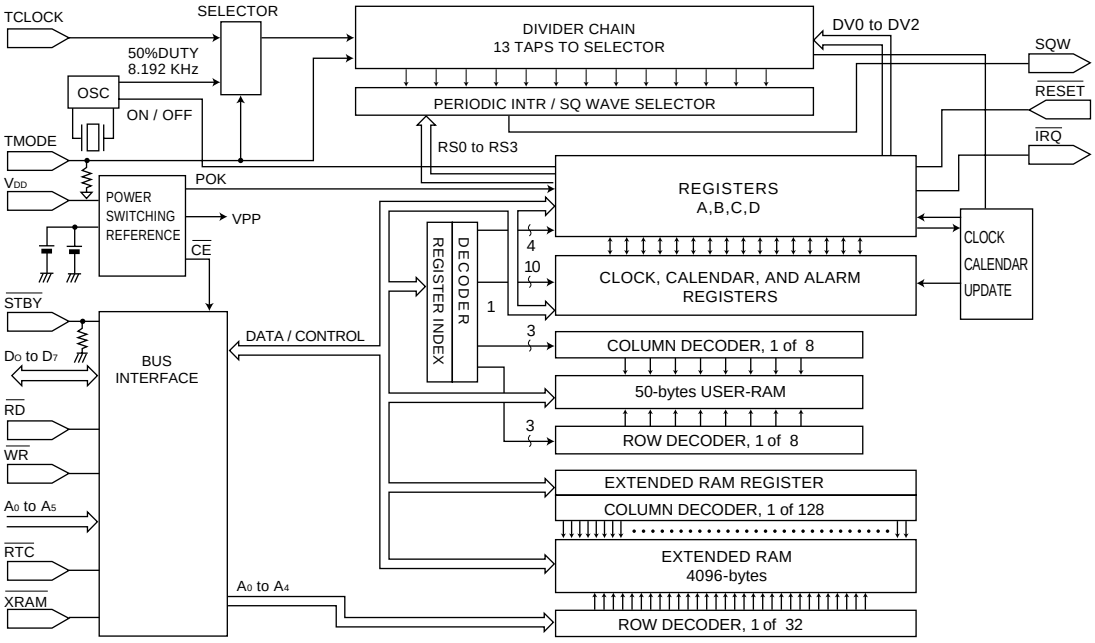
Switching characteristics (V_{DD} = 5V ± 10%, GND =0V, Ta = -10 to +70°C)

Item	Symbol	Min.	Max.	Remarks
Cycle Time	t_{CYC}	395	DC	ns
Pulse width $\overline{RD}$/$\overline{WR}$="L" interval	t_{RWL}	325	—	
Signal rise / fall time CS, $\overline{RD}$, $\overline{WR}$	t_R, t_F	—	30	
Address holding time	t_{AH}	20	—	
Address setup before $\overline{RD}$	t_{ARS}	50		
Address setup before $\overline{WR}$	t_{AWS}	0		
Chip select setup time before $\overline{RD}$	t_{CRS}	50		
Chip select setup time before $\overline{WR}$	t_{CWS}	0		
Chip select hold time a after $\overline{RD}$/$\overline{WR}$	t_{CH}	20		
Read data holding time	t_{DHR}	10	100	
Write data holding time	t_{DHW}	0	—	
$\overline{RD}$ Peripheral output data delay time	t_{DDR}	20	240	
Peripheral write data setup time	t_{DSW}	200	—	

Timing chart



Block diagram

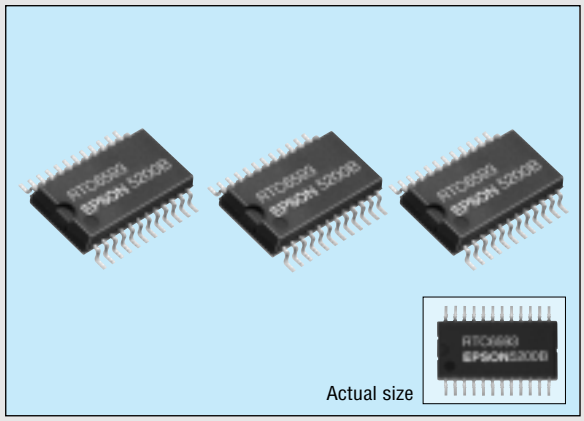


REAL TIME CLOCK MODULE FOR PC/AT *1

RTC-6593

- Builtin crystal unit allows adjustment-free efficient operation.
- Provides 114-bytes of backed-up RAM.
- Extended alarm function.
- Low current consumption.
- A builtin power supply switching circuit makes it possible to provide automatic power supply backup to both the RTC and extended RAM.

*1 PC/AT is a trademark of International Business Machines Corporation.



Specifications (characteristics)

Absolute Max. rating

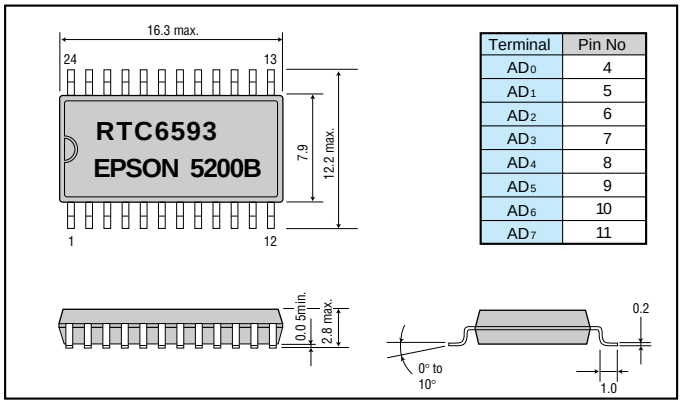
Item	Symbol	Condition	Rating	Unit
Supply voltage	V_{DD}	V_{DD}-GND	- 0.3 to + 7.0	V
Input voltage	V_{IN}	Input pin	- 0.3 to V_{DD} + 0.3	
Storage temperature	T_{STG}	—	- 55 to +125	˚C
Soldering conditions	T_{SOL}	Twice under 260˚C within 10 seconds or under 230˚C within 3 minutes		

Operating range, frequency and DC characteristics

Item		Symbol	Condition	Min.	Typ.	Max.	Unit
Supply voltage		V_{DD}	V_{DD} - GND	4.5	5.0	5.5	V
Operating temperature		T_{OPR}	—	-10		+70	˚C
Frequency tolerance		Δf/fo	Ta=25˚C, V_{DD}=5V			5±20	ppm
Temperature characteristics		Top	Ta=-10 to 70˚C 25˚C standard			+10 -120	
Voltage characteristics		fv	Ta=stable			±6	ppm/V
Aging		fa	Ta=25˚C, V_{DD}=5V First year			±5	ppm/Y
Input voltage	High level	V_{IH}	—	2.2		V_{DD}+0.3	V
	Low level	V_{IL}		-0.3		0.8	
Output voltage	High level	V_{OH}	V_{DD}=5V I_{LOAD}=-4mA	2.4			
	Low level	V_{OL}	V_{DD}=5V I_{LOAD}=+4mA			0.4	
Power supply current		I_{DD}	Output unloaded	—	3	10	mA
Battery supply current		I_{BAT}	V_{BAT}=3V V_{DD}= 0V		0.5	1.0	μA

External dimensions

(Unit: mm)



Terminal	Pin No
AD_0	4
AD_1	5
AD_2	6
AD_3	7
AD_4	8
AD_5	9
AD_6	10
AD_7	11

Terminal functions

Terminal	Function	Pin No.
MOT	Model select (input)	1
AD_0 to $_7$	Multiplexed bi-direction address/data buses	4 to 11
GND	Power supply (grand)	12
$\overline{RTC}$	Real time clock select (input)	13
AS	Address strobe (input)	14
R/$\overline{W}$	Read/Write (input)	15
DS	Data strobe (input)	17
$\overline{RESET}$	Reset (input)	18
$\overline{IRQ}$	Interrupt request (output)	19
V_{BAT}	Back-up power supply	20
$\overline{XIRQ}$	Extended alarm interrupt request (output)	21
$\overline{XALM}$	Extended alarm select (input)	22
SQW	Square wave output	23
V_{DD}	Power supply (+5V)	24
NC	Not connected internally	2,3,16

Address map

RTC address map

00	14-bytes	00 h	0	Seconds
			1	Second Alarm
			2	Minutes
13		0D h	3	Minute Alarm
14	114-bytes	OE h	4	Hours
			5	Hour Alarm
			6	Day of the Week
			7	Day of Month
			8	Month
			9	Year
			10	Register A
			11	Register B
			12	Register C
			13	Register D
127		7F h	14 127	General purpose RAM

Extended alarm address map

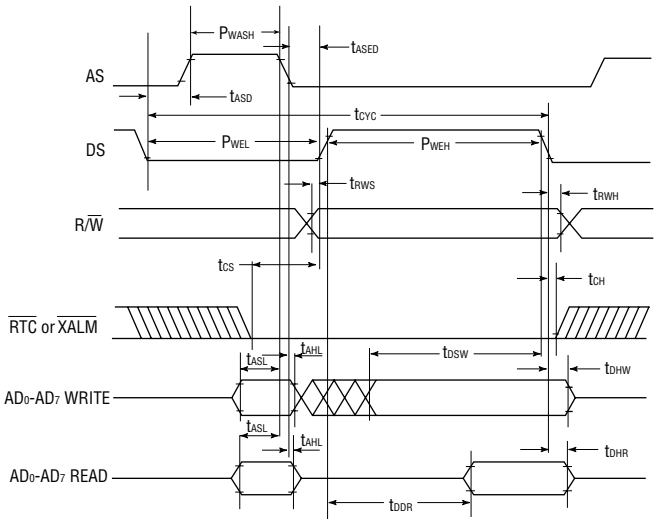
00	8-bytes	00 h	0	Extended Second Alarm
			1	Extended Minute Alarm
			2	Extended Hour Alarm
			3	Extended Day of the Week Alarm
			4	Extended Day of Month Alarm
			5	Extended Month Alarm
			6	Register 6
07		07 h	7	Register 7

Bus timing

(Ta=-10˚C to 70˚C, V_{DD}=4.5V+5.5V)

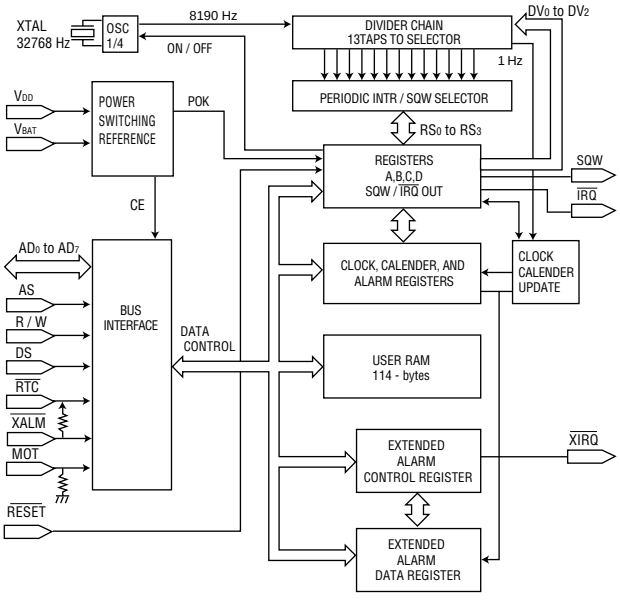
Parameter	Symbol	Min.	Max.	Unit
Cycle time	t_{CYC}	956	DC	ns
Pulse width DS low or $\overline{RD}$/ $\overline{WR}$ high	P_{WEL}	300	—	
Pulse width DS high or $\overline{RD}$/ $\overline{WR}$ low	P_{WEH}	325		
Input rise/fall time	t_R,t_F	—	30	
R/$\overline{W}$ hold time	t_{RWH}	10	—	
R/$\overline{W}$ setup time before DS	t_{RWS}	80		
Chip select setup time before DS, $\overline{WR}$ or$\overline{RD}$	t_{CS}	25		
Chip select hold time	t_{CH}	0		
Read data hold time	t_{DHR}	10	100	
Write data hold time	t_{DHW}	0	—	
Multiplexed address valid time to AS fall	t_{ASL}	50		
Multiplexed address hold time	t_{AHL}	20		
Delay time DS to AS rise	t_{ASD}	50		
Pulse width AS high	P_{WASH}	135		
Delay time AS to DS rise	t_{ASED}	60		
Output data delay time from DS or $\overline{RD}$	t_{DDR}	20	240	
Write data setup time	t_{DSW}	200	—	

For motorola timing



Notes: V_{DD}=4.5V to 5.5V
V_{IH}=2.2V V_{OH}=2.4V
V_{IL}=0.8V V_{OL}=0.4V

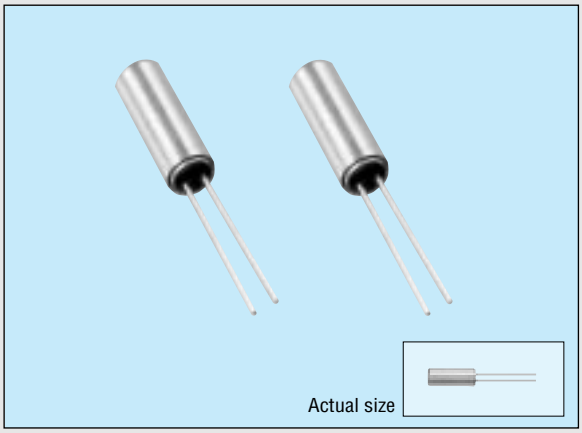
Block diagram



TEMPERATURE SENSING CRYSTAL

HTS-206

- Crystal used to sense the change in temperature.
- 2mm in diamater and 6mm in length.
- Good linearity frequency and temperature.
- Low frequency (40 KHz) enables low current consumption.
- Wide temperature range (-40 to +85˚C).
- Suitable for DTCXO and temperature equipment.

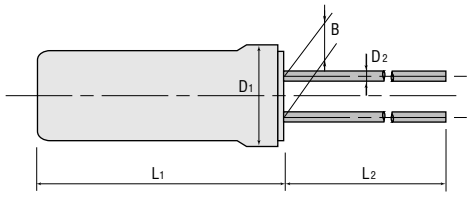


Specifications (characteristics)

Item		Symbol	Specifications	Remarks
Nominal frequency		f_0	40 kHz	
Temperature range	Storage temperature	T_{STG}	-55˚C to +125˚C	
	Operating temperature	T_{OPR}	-40˚C to +85˚C	
Drive level	Maximum	GL	1.0 μ W max.	
	Recommended	DL	0.1 μ W typ.	
Frequency tolerance (standard)		Δf/f	±2%	Ta=25˚C, DL=0.1μW
Temperature coefficient	1st	α	-29.6×10^{-6}/˚C [±2%]	
	2nd	β	-6.4×10^{-8}/˚C^2 [±8%]	
	3rd	γ	-1.5×10^{-10}/˚C^3 max.	
Series resistance		R_1	30 KΩ max.	Ta=25˚C, DL=1.0μW
Motion capacitance		C_1	2.0 fF typ.	
Shunt capacitance		C_0	0.9 pF typ.	
Insulation resistance		IR	500 MΩ min.	
Aging		fa	±3ppm/year max.	Ta=25˚C ±3˚C
Shock resistance		S.R.	±3ppm max.	Three drops on a hard board from 50 cm

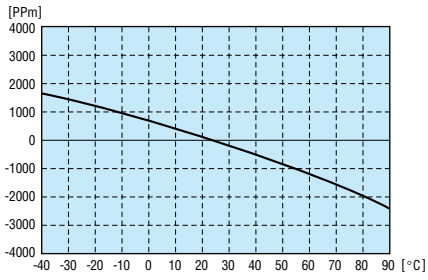
External dimensions

(Unit: mm)



Model	L_1	L_2	D_1	D_2	B
HTS-206	6.0 max.	4.0 min.	ø2.0 max.	ø0.2	0.7

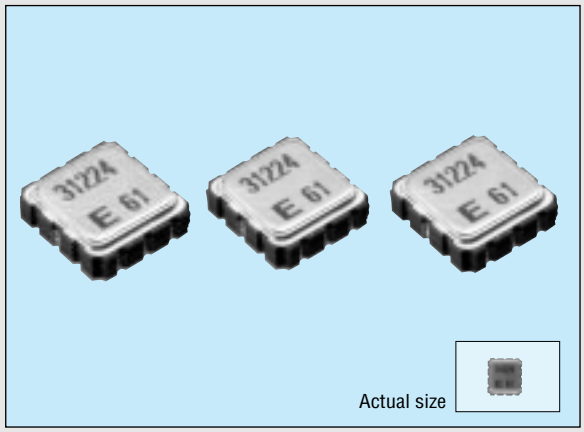
Temperature characteristic



SAW RESONATOR

FS-555

- Reflow solderable SMD ceramic package.
- Capable of covering a wide frequency range, from 200 MHz to 500 MHz.
- 1.5mm thickness is equal to SMD-type IC.
- Perfect for small wireless equipment.

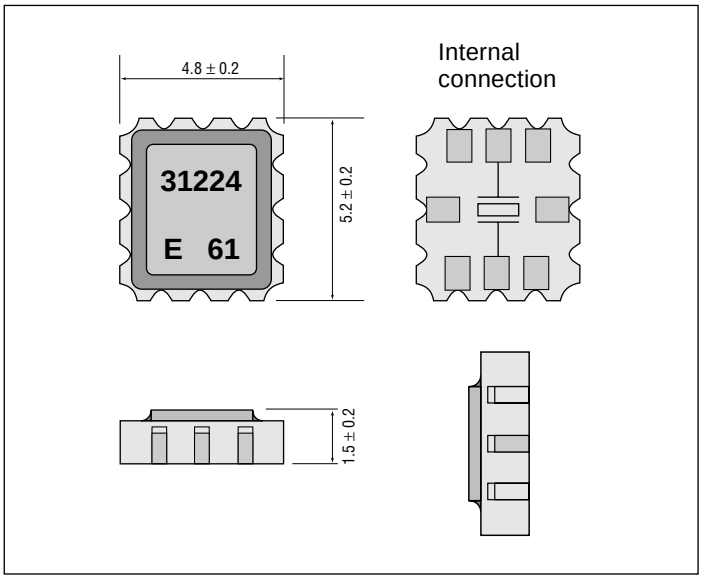


Specifications (characteristics)

Item		Symbol	Specifications	Remarks
Nominal frequency range		f_0	200 MHz to 500 MHz	
Temperature range	Storage temperature	T_{STG}	-40˚C to +85˚C	Stored as bare product after unpacking
	Operating temperature	T_{OPR}	-20˚C to +70˚C	
Maximum drive level		GL	10mW max.	
Recommended level		DL	2mW typ.	
Frequency tolerance (standard)		$\Delta f/f$	±25ppm, ±50ppm, ±100ppm	Ta=25˚C ± 3˚C
Peak temperature		θT	25˚C ± 15˚C	
Temperature coefficient		α	-3.4±0.8 x 10^{-8}/˚C^2	
Harmonic ratio		R_S/R_1	2 min.	
Series resistance		R_1	40 Ω max.	200 MHz to 249.9 MHz, Ta=25˚C
			25 Ω max.	250 MHz to 500 MHz, Ta=25˚C
Motional capacitance		C_1	2.6 fF typ.	(f_0=312.24 MHz)
Shunt capacitance		C_0	4.3 pF typ.	(f_0=312.24 MHz)
Insulation resistance		IR	500 M Ω min.	
Aging		fa	±10ppm/year max.	Ta=25˚C ±3˚C
Shock resistance		S.R.	±10ppm max.	Five drops on a hard board from 150 cm or excitation test with 3000G x 0.3ms x 1/2 sine wave x 3 directions

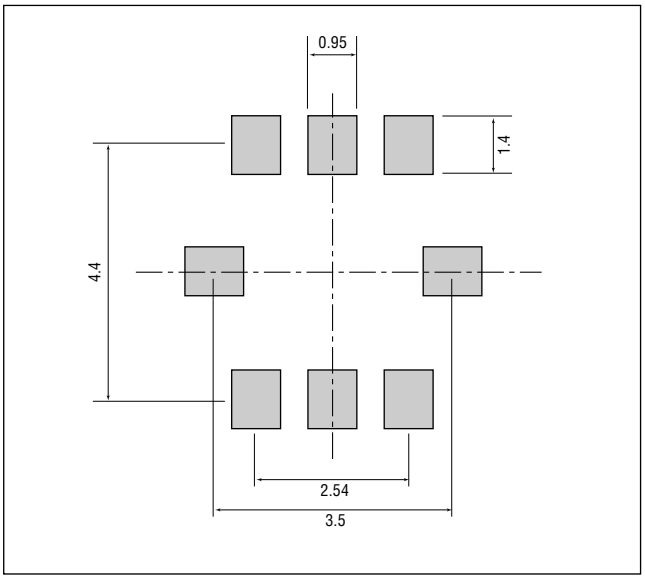
External dimensions

(Unit: mm)

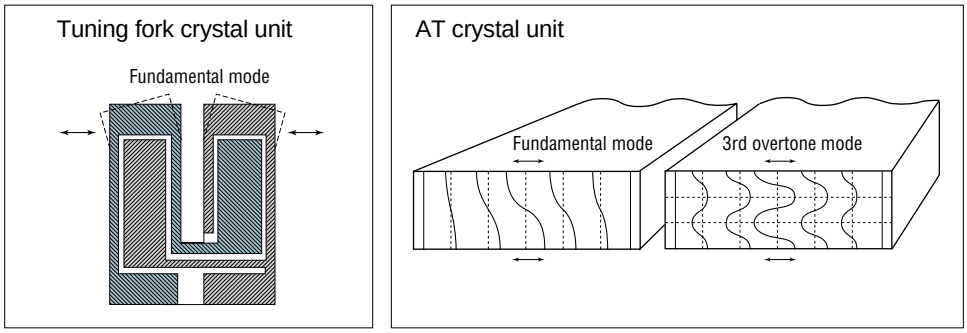
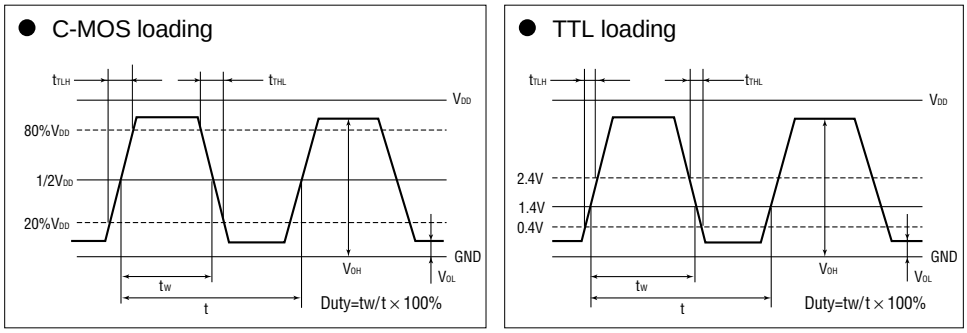


Recommended soldering pattern

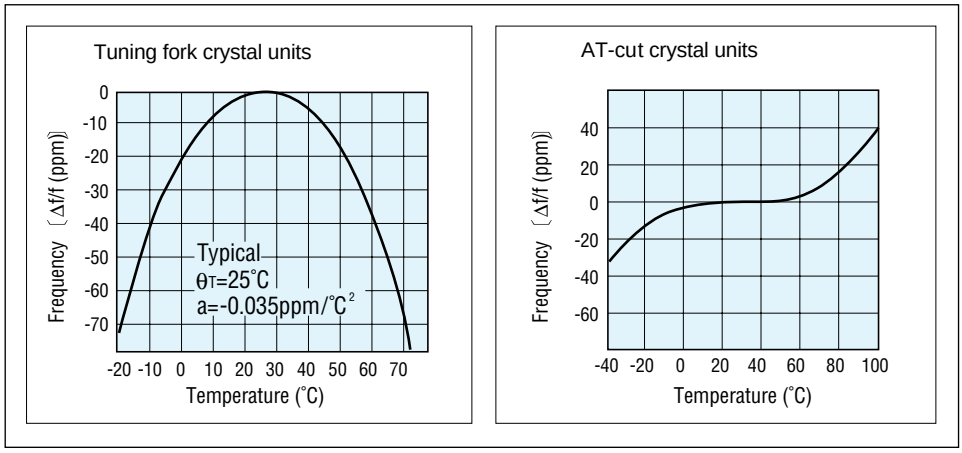
(Unit: mm)



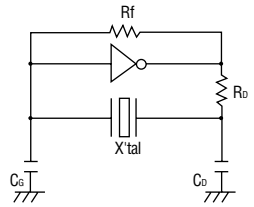
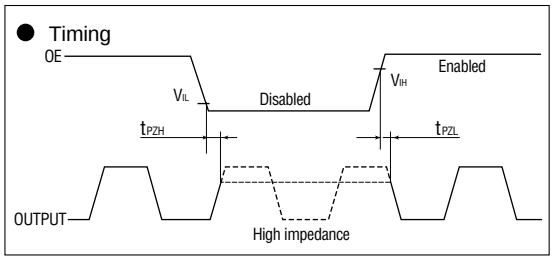
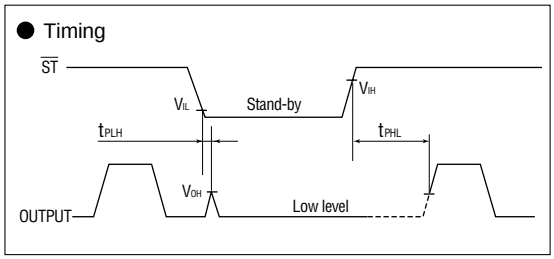
Glossary

Item	Content	Object
Fundamental mode	First harmonic crystal vibration mode. The AT resonance frequency is determined by the thickness of the crystal, but even with the same thickness the third overtone will be about three times the frequency of the fundamental. With tuning fork crystal unit, the second overtone is about six times the fundamental. AT fundamental mode $f\ (MHz) = \frac{1670}{t\ (\mu m)}$ 	X'tal,OSC
Baud rate	The rate of data transmission, i.e. how many data can be transmitted in one second.	OSC
Divided frequency	The output frequency that is divided by the internal IC.	OSC
Duty (tw/t) (symmetry)	Ratio of full and half cycles. For C-MOS loading duty is rated at $1/2V_{DD}$, and for TTL loading at 1.4V. 	OSC
(Equivalent) series capacitance (C_1) (motional capacitance)	Energy distortion to the (equivalent) internal charge capacitance component of the crystal unit, at the series resonant frequency.	X'tal
(Equivalent) series resonant resistance (R_1)	Vibration loss to the (equivalent) internal resistance component of the crystal resonator, at the series resonant frequency. A measure of the easiness of oscillation.	X'tal
Drive level (DL)	Current or voltage level in the oscillating (operating) state. (Drive power=power required to oscillate crystal unit.)	X'tal
Frequency (f_0)	Number of waves (cycles) per second. The relation between frequency and cycle is f_0 (Hz) =1/t (sec). 1 kHz=1ms, 1 MHz=1 µs, 1 GHz=1ns.	ALL
(Frequency) aging (f_a)	Amount of frequency drift when operated under the specified conditions for a specified term.	ALL
Frequency tolerance precision ($\Delta f/f$)	Under specified conditions at an ambient temperature of 25˚C, the difference in actual (measured) frequency from the nominal frequency.	ALL
Frequency stability ($\Delta f/fo$)	Within standard temperature and operational voltage ranges, the drift in the output frequency. The output frequency drift including frequency temperature characteristics and frequency voltage characteristics.	OSC

X'tal: Crystal unit, OSC: Crystal oscillator, RTC: Real time clock module

Item	Content	Object
Frequency temperature characteristics	Taking the frequency at 25 degrees Centigrade as the reference, the change in frequency in response to ambient temperature. • Tuning fork crystal unit. $\Delta f/f\ (ppm) = a(\theta_T - \theta_X)^2$, θ_X: specified temperature • AT crystal unit. $\Delta f/f = \alpha(\theta - 25) + \beta(\theta - 25)^2 + \gamma(\theta - 25)^3$ Examples of frequency temperature characteristics 	ALL
Frequency voltage characteristics	Taking the output frequency at the central voltage in the operating voltage range as the reference, the change in output frequency to voltage. Causes of this change are changes in crystal deformation, and changes in IC internal constants for chips mounted in the oscillator and RTC. The effects of the ICs are larger.	OSC,RTC
Insulation resistance (IR)	Resistance between lead and lead, or between lead and case package. (conductive package)	ALL
Load capacitance(C_L)	Effective capacitance (series equivalent charge capacitance) of the oscillation circuit as seen from the pins of the crystal unit. This capacitance is determined as a condition when the crystal unit is connected to the oscillation circuit and will determine the output frequency. Load capacitance approximation: $C_L \neq C_G \times C_D / (C_G + C_D) + C_S$ (C_S=stray capacitance)	X'tal
Max. drive level (GL)	Rating for the drive level. Current or power input over this level may result in characteristic degradation or destruction.	X'tal
Max. supply voltage (V_{DD}-GND)	Maximum rated value for power input to the power supply pin. Input over this value may result in characteristic degradation or destruction.	OSC,RTC
Nominal frequency (f)	Nominal value of frequency of crystal unit.	X'tal
Operating temperature range (T_{OPR})	Temperature range where specification characteristics are fulfilled, unless otherwise specified.	ALL
Operating voltage (V_{DD})	Voltage input to V_{DD} pin which will support continuous operation with specification characteristics.	OSC,RTC
Origin frequency (f_0)	Oscillation source frequency of oscillator inside oscillation system.	OSC

X'tal: Crystal unit, OSC: Crystal oscillator, RTC: Real time clock module

Item	Content	Object
Oscillation circuit	Circuit needed to oscillate crystal unit. Circuit constants will differ with type of crystal unit and frequency. Basic oscillation circuit using C-MOS IC 	X'tal
Oscillation start up time (t_{OSC})	The time from power on until the waveform stabilizes. However, voltage rise times depend on the power supply, therefore the time is measured from a specific set of initial conditions.	OSC,RTC
Output enable (OE)	Output is switched to high impedance, and wired OR connection can be used to select multiple outputs (frequency). OE pin: High or open. Specified frequency output = enabled. OE pin: Low. Output is high impedance = disabled. Oscillation is not stopped, so the clock after disabled is cleared is not synchronized with OE (clock is continuous). ● Timing 	OSC
Output fall time (t_{THL})	The time it takes for the output waveform to change from the high voltage (high level) to the low voltage (low level). Also called waveform fall time. See waveform diagram under duty.	OSC
Output frequency (fo)	The frequency output from the oscillator circuit or the crystal oscillator system.	OSC,RTC
Output load conditions (N or C_L)	The types and quantities (power) of the loads that can be connected to the oscillator. Calculated for 1 TTL as I_{OH}=-40 µA, I_{OL}=1.6mA and for LS-TTL as I_{OH}=-20 µA, I_{OL},=0.4mA, 1 C-MOS=5pF.	OSC
Output rise time (t_{TLH})	The time it takes for the output waveform to change from the low voltage (low level) to the high voltage (high level). AIso called waveform rise time. See waveform diagram under duty.	OSC
Overtone	Vibration state when crystal in vibrating as a high harmonic (see base wavelength). It is harder to match the overtone oscillation circuit with the crystal unit than the fundamental oscillation circuit.	X'tal,OSC
Shunt capacitance (C_0)	Charge capacitance between the two electrodes in the crystal unit.	X'tal
Recommended drive level (DL)	Excitation level for optimum oscillation characteristics.	X'tal
Soldering conditions (T_{SOL})	Soldering conditions that can be assured at mounting. Temperatures or times over these limits may result in characteristic degradation or destruction.	ALL
Stand-by (ST)	Function that halts crystal unit oscillation and frequency division. Cuts the current consumed by the oscillators circuit and the frequency division stage. ST pin - high or open: Specified frequency output. ST Pin - low: Output is low level, clock stops. Because oscillation is halted, If ST is also dropped to low, output is high impedance but output is also unstable after function is restarted, for the same reason. ● Timing 	OSC
Storage temperature range (T_{STG})	Maximum absolute rating for the discharged state (no input of voltage, current or power). Exposure to temperatures over this level may result in characteristic degradation or destruction. To assure precision, store at room temperature whenever possible.	ALL

X'tal: Crystal unit, OSC: Crystal oscillator, RTC: Real time clock module

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