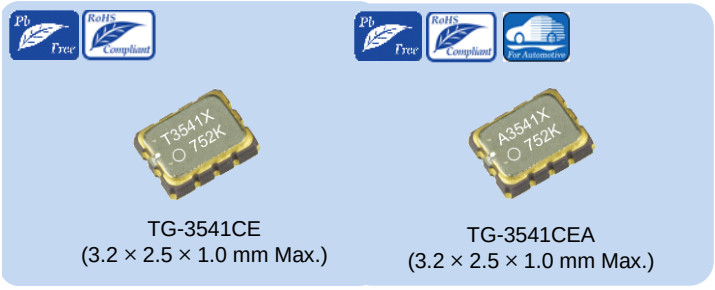
Low power, wide temp range and automotive compliant
32.768kHz D-TCXO

TG-3541CE / TG-3541CEA

Features

- Built-in frequency adjusted 32.768 kHz crystal unit and D-TCXO.
- Operation temperature -40 °C to +105 °C
- Use of CMOS IC enables reduction of current consumption.
- V_{IO} controls swing amplitude.
- AEC-Q100 compliant (TG-3541CEA)



TG-3541CE
(3.2 × 2.5 × 1.0 mm Max.)

TG-3541CEA
(3.2 × 2.5 × 1.0 mm Max.)

Applications

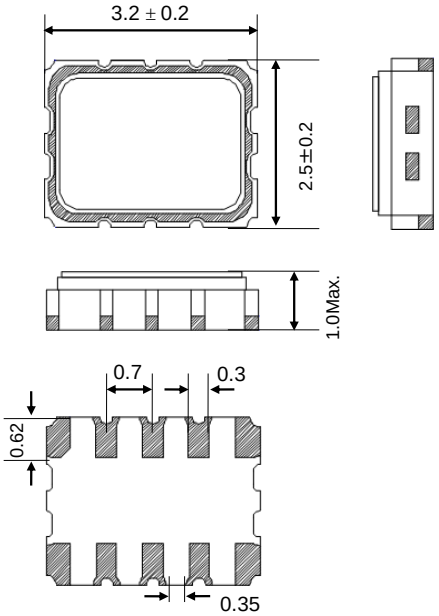
· TG-3541CE
Industrial, Security, Smart Meter,
Clock for Time counting and Sleep function

· TG-3541CEA
Infotainment and communication devices, Body (ECU*)
Clock for Time counting and Sleep function.
*ECU: Electronic control unit

Description

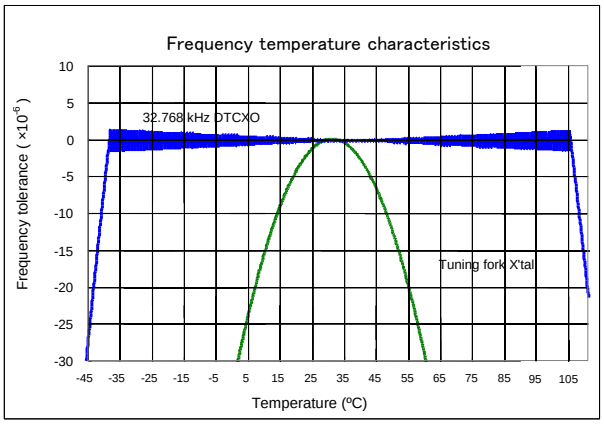
low power, wide temp range and automotive compliant
32.768 kHz Crystal Oscillator with D-TCXO, offered in 3.2 x 2.5 mm, 10 pins package.

Outline Drawing

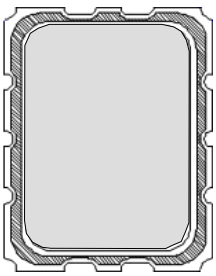


Typical Performance

■ 32.768 kHz-DTCXO Frequency temperature characteristics (Example)



Terminal



1.	OE	10.	TEST
2.	V_{CC}	9.	GND
3.	TEST	8.	TEST
4.	OUT	7.	TEST
5.	TEST	6.	TEST

Pin	Connection
1	OE
2	V_{CC}
3	TEST (*1)
4	OUT
5	TEST (*2)
6	TEST (*3)
7	TEST (*2)
8	TEST (*2)
9	GND
10	TEST (*3)

∗OE is active HIGH input,
Do not leave floating.
(∗1) #3 connect to V_{CC}
(∗2) #5, 7, 8 connect to GND
(*3) #6,10: N.C. must be left open

1. Number / Product Name

1.1 Product Number

TG-3541CE XA : X 1B00035 1 0001 00
TG-3541CE XB : X 1B00035 1 0002 00
TG-3541CEA XA : X 1B00036 1 A001 00
TG-3541CEA XB : X 1B00036 1 A002 00
(1) (2) (3) (4) (5)

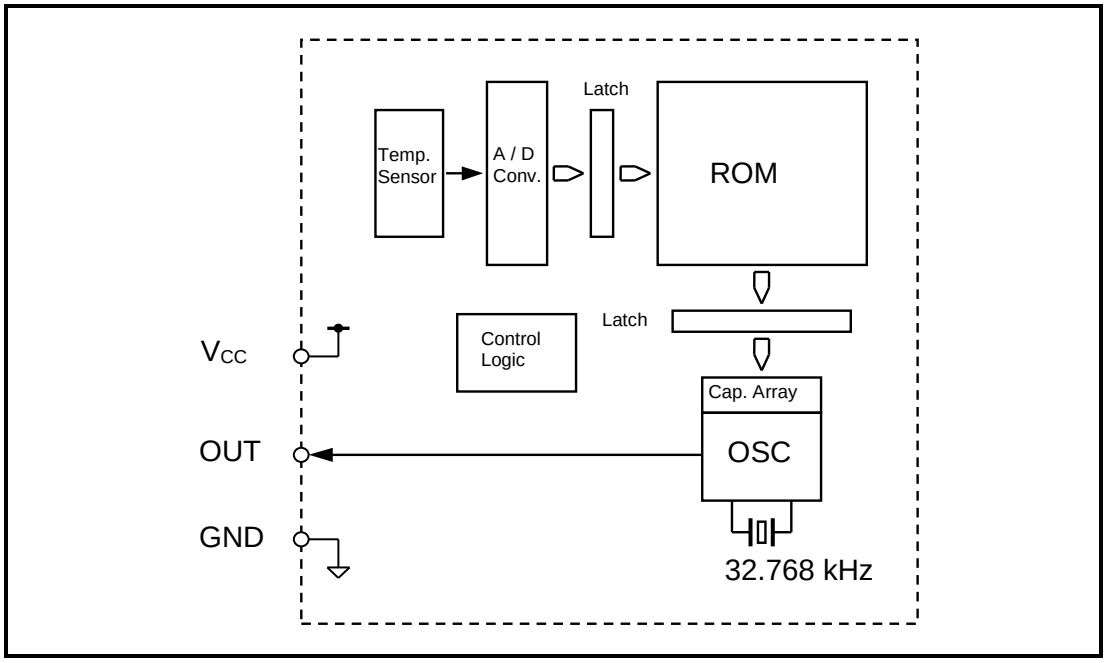
(1) Crystal devices
(2) Model
(3) Pb free code (1 : EU RoHS compliant / Pb free)
(4) Detail specifications
(5) Packing (00 : 2 000 pcs/reel)

1.2 Product Name (Standard Form)

TG-3541 CE XA 32.768000 kHz
TG-3541 CE A XB 32.768000 kHz
(a) (b) (d) (e) (c)

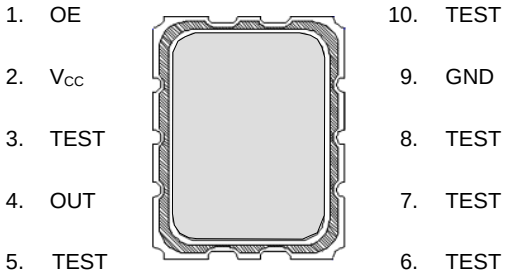
(a) Model
(b) Package type (CE : 3.2 x 2.5 x 1.0 mm size)
(c) Output Frequency
(d) For Automotive
(e) Frequency / Temperature characteristics

2. Block Diagram



3. Terminal Description

3.1. Terminal Arrangement



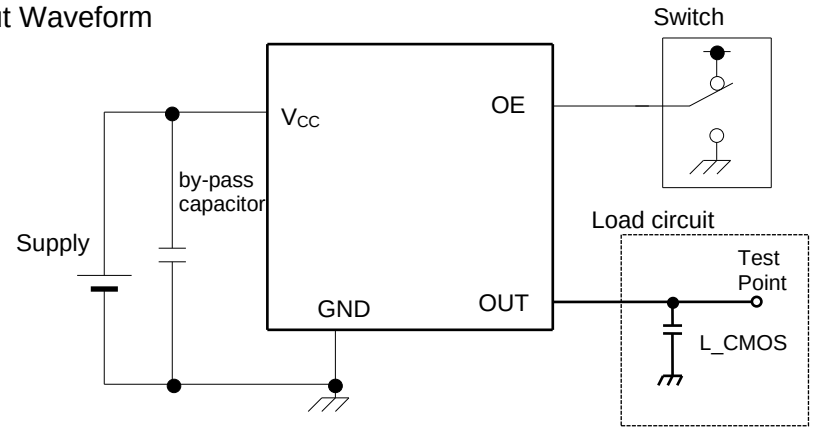
3.2. Terminal Function

Signal name	I/O	Function
OUT	Output	This is the C-MOS output pin with output control provided via the OE pin. OE = "H" (high level), this pin outputs a 32.768 kHz signal. When OE = "L" (low level), output is stopped, the OUT pin = Hi-Z (high impedance).
OE	Input	This is an input pin used to control the output mode of the OUT pin. When this pin's level is high, the OUT pin is in output mode. When it is low, output via the OUT pin is stopped.
V_{CC}	–	This pin is connected to a positive power supply.
GND	–	This pin is connected to a ground.
TEST	–	Test terminal. TEST should be connected as below. #3: Vcc, #5,7,8: GND, #6,10: N.C.

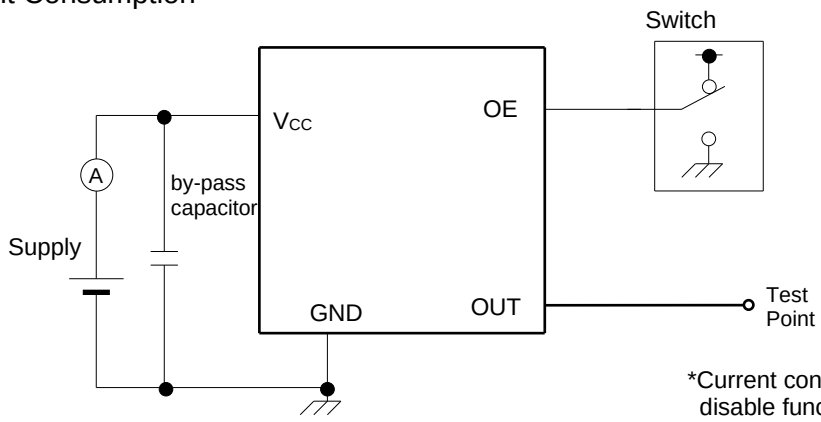
Note: Be sure to connect a bypass capacitor rated at least 0.1 µF between V_{CC} and GND.

4. External Connection Example

1) Output Waveform



2) Current Consumption



*Current consumption under the disable function should be OE= GND.

3) Condition

(1) Oscilloscope
- Band width should be minimum 5 times higher (wider) than measurement frequency.
- Probe earth should be placed closely from test point and lead length should be as short as possible.

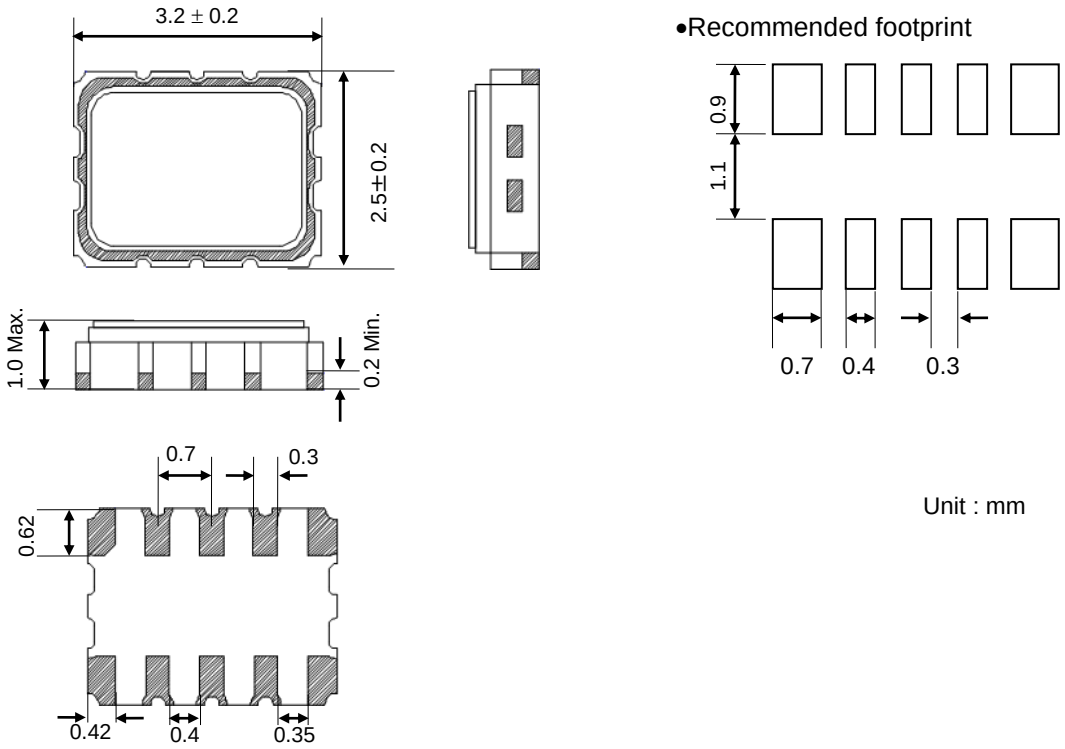
* Recommendable to use miniature socket. (Don't use earth lead.)

(2) L_CMOS also includes probe capacitance.
(3) By-pass capacitor (at least 0.1 µF) is placed closely between V_{CC} and GND.
(4) Use the current meter whose internal impedance value is small.

5. Outline Drawing / Marking Layout

5.1. Outline Drawing

TG-3541CE / TG-3541CEA



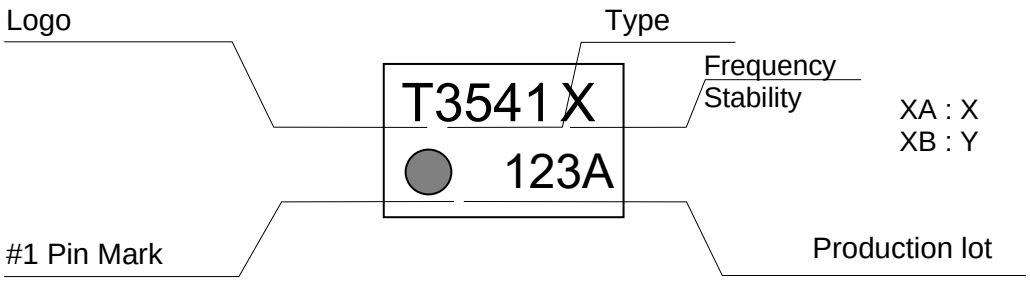
Unit : mm

The small metal pads on the short side of the ceramic package are used to test the crystal.
When assembling the part, please be careful not to connect or short circuit those pads.
In addition, please avoid short circuit between these metal parts by dew condensation or particle adhesion.

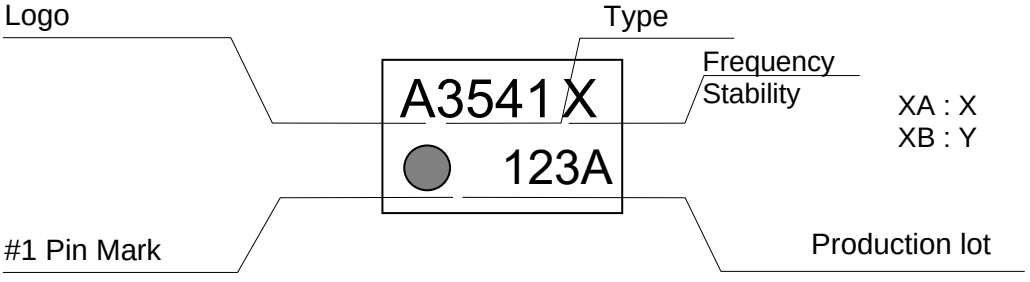
5.2. Marking Layout

TG-3541CE / TG-3541CEA

(1) TG-3541CE



(2) TG-3541CEA



∗ The display contents indicate the outline of the seal and display, and do not specify the details of the shape, size and position.

6. Absolute Maximum Ratings

Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
Supply voltage	V_{CC}-GND	-0.3	-	+6.5	V	
Input voltage	V_{IN}	GND – 0.3	-	+6.5	V	OE pin
Output voltage	V_{OUT1}	GND – 0.3	-	V_{CC} + 0.3	V	OUT pin
Storage temperature range	T_stg	-55	-	+125	°C	When stored separately, without packaging

7. Recommended Operating Conditions

Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
Supply voltage	V_{CC}	1.5	3.0	5.5	V	
	GND	0.0	-	0.0	V	
Operating temperature range	T_use	-40	+25	+105	°C	No condensation
Output load	L_CMOS	-	-	30	pF	

8. Frequency Characteristics

(Condition : GND = 0.0 V, L_CMOS = 30 pF Max., T_use = +25 °C)

Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
Output frequency	fo	32.768			kHz	
Frequency / Temperature characteristics (XA)	fo-Tc	-1.9		+1.9	× 10^{-6}	T_use = 0 °C to +50 °C, V_{CC} = 3.0 V, Include initial frequency tolerance *1
		-3.4	-	+3.4		T_use = -40 °C to +85 °C, V_{CC} = 3.0 V, Include initial frequency tolerance *2
		-8.0	-	+8.0		T_use = +85 °C to +105 °C, V_{CC} = 3.0 V, Include initial frequency tolerance *3
Frequency / Temperature characteristics (XB)	fo-Tc	-3.8		+3.8	× 10^{-6}	T_use = 0 °C to +50 °C, V_{CC} = 3.0 V, Include initial frequency tolerance *1
		-5.0	-	+5.0		T_use = -40 °C to +85 °C, V_{CC} = 3.0 V, Include initial frequency tolerance *2
		-8.0	-	+8.0		T_use = +85 °C to +105 °C, V_{CC} = 3.0 V, Include initial frequency tolerance *3
Frequency / Voltage coefficient	fo- V_{CC}	-1.0	-	+1.0	× 10^{-6}	V_{CC} = 1.6 V to 5.5 V
Start up time	t_str	-	-	1.0	s	T_use = +25 *C, V_{CC} = 1.6 V to 5.5 V
		-	-	3.0		T_use =–40 to +105 °C, V_{CC} = 1.6 V to 5.5 V
Frequency aging	f_age	-3.0	-	+3.0	× 10^{-6}	T_use = +25 °C, V_{CC} = 3.0 V First year
Reflow shift	-	-3.0	-	+3.0	× 10^{-6}	+260 °C (Max.), 2 times *4

*1 (XA) Equivalent to 5 seconds of month deviation ($\pm 1.9 \times 10^{-6}$)
*2 (XA) Equivalent to 9 seconds of month deviation ($\pm 3.4 \times 10^{-6}$)
*3 (XA) Equivalent to 21 seconds of month deviation ($\pm 8.0 \times 10^{-6}$)
*1 (XB) Equivalent to 10 seconds of month deviation ($\pm 3.8 \times 10^{-6}$)
*2 (XB) Equivalent to 13.2 seconds of month deviation ($\pm 5.0 \times 10^{-6}$)
*3 (XB) Equivalent to 21 seconds of month deviation ($\pm 8.0 \times 10^{-6}$)
*4 Measurement of frequency deviation is made 24 h after reflow soldering

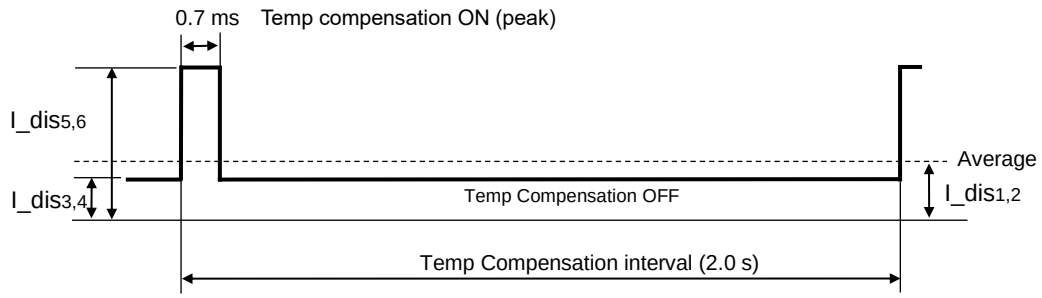
9. Electrical Characteristics

*Unless otherwise specified,
GND = 0 V, V_{CC} = 1.5 V to 5.5 V, T_use = −40 °C to +105 °C

Item	Symbol	Min.	Typ.	Max.	Unit	Condition
Current consumption	I_{CC1}		1.1	3.1	μA	OE = V_{CC}, V_{CC} = 5.0 V, L_CMOS= No load Temp compensation interval 2.0 s
	I_{CC2}		1.0	3.0	μA	OE = V_{CC}, V_{CC} = 3.0 V L_CMOS= No load Temp compensation interval 2.0 s
	I_{CC3}		6.1	8.1	μA	OE = V_{CC}, V_{CC} = 5.0 V L_CMOS= 30 pF Temp compensation interval 2.0 s
	I_{CC4}		4.0	6.0	μA	OE = V_{CC}, V_{CC} = 3.0 V L_CMOS= 30 pF Temp compensation interval 2.0 s
Output disable current OUT : stopped (Hi-z)	I_dis1		0.40	1.6	μA	OE = GND, V_{CC} = 5.0 V Temp compensation interval 2.0 s
	I_dis2		0.35	1.5	μA	OE = GND, V_{CC} = 3.0 V Temp compensation interval 2.0 s
	I_dis3		0.38	1.55	μA	OE = GND, V_{CC} = 5.0 V Temp compensation is stopped.
	I_dis4		0.33	1.45	μA	OE = GND, V_{CC} = 3.0 V Temp compensation is stopped.
	I_dis5		55	100	μA	OE = GND, V_{CC} = 5.0 V Temp compensation ON (peak)
	I_dis6		50	95	μA	OE = GND, V_{CC} = 3.0 V Temp compensation ON (peak)
Symmetry	SYM	40	50	60	%	50 % V_{CC} Level, L_CMOS = 30 pF
Input voltage	V_{IH}	0.8 × V_{CC}		5.5	V	OE pin
	V_{IL}	GND − 0.3		0.2 × V_{CC}		
Output voltage	V_{OH1}	4.5		5.0	V	OUT pin, V_{CC} = 5.0 V, I_{OH} = −1 mA
	V_{OH2}	2.2		3.0		OUT pin, V_{CC} = 3.0 V, I_{OH} = −1 mA
	V_{OH3}	2.9		3.0		OUT pin, V_{CC} = 3.0 V, I_{OH} = −100 μA
	V_{OL1}	GND		GND + 0.5	V	OUT pin, V_{CC} = 5.0 V, I_{OL} = 1 mA
	V_{OL2}	GND		GND + 0.8		OUT pin, V_{CC} = 3.0 V, I_{OL} = 1 mA
	V_{OL3}	GND		GND + 0.1		OUT pin, V_{CC} = 3.0 V, I_{OL} = 100 μA
Input leakage current	I_{LK}	−0.5		0.5	μA	OE pin = V_{CC} or GND
Output leakage current	I_{OZ}	−0.5		0.5	μA	OUT pin = V_{CC} or GND

- Temperature compensation and consumption current

The current consumption of TG-3541 increases at a timing of a temperature compensation.
As for this peak current consumption, it occurs in about 0.7 ms.
I_dis1, I_dis2 is the average current consumption at temperature compensation in 2.0 s cycle.



10. How To Use

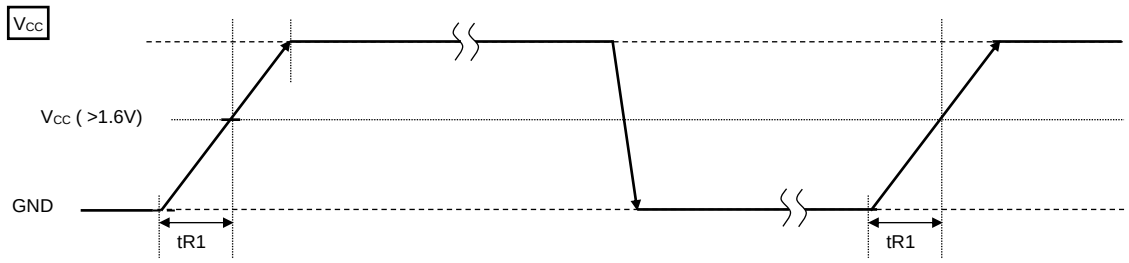
10.1. Start Up

※This circuit is sensitive to power supply noise and supply voltage should be stabilized to avoid negative impact on the accuracy.

※tR1 is needed for a proper power-on reset.

※In case of repeated ON/OFF of the power supply within short term, it is possible that the power-on reset becomes unstable.

After power-OFF, keep V_{CC} = GND for more than 10 seconds for a proper power-on reset.



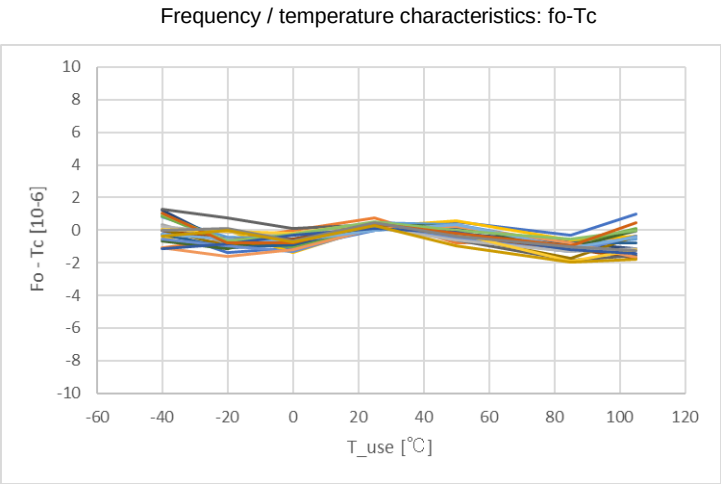
*Unless otherwise specified,

GND = 0 V , V_{CC} = 1.5 V to 5.5 V , T_use = –40 °C to +105 °C

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Power supply rise time1	tR1	V_{CC} = GND to 1.6 V	1	-	10	ms/V

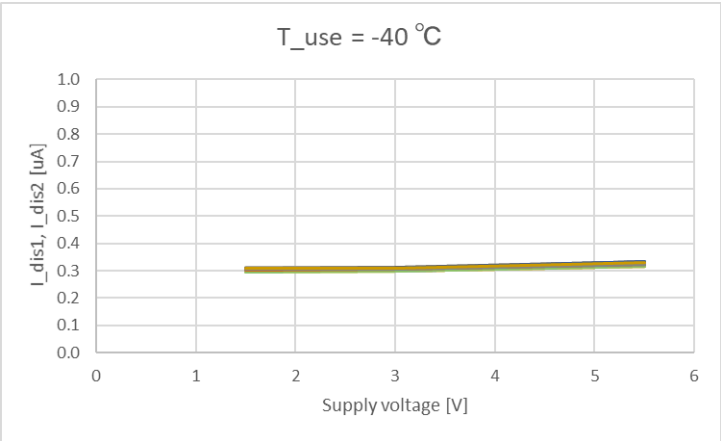
11. Characteristic Data

11.1. Frequency Temperature Coefficient

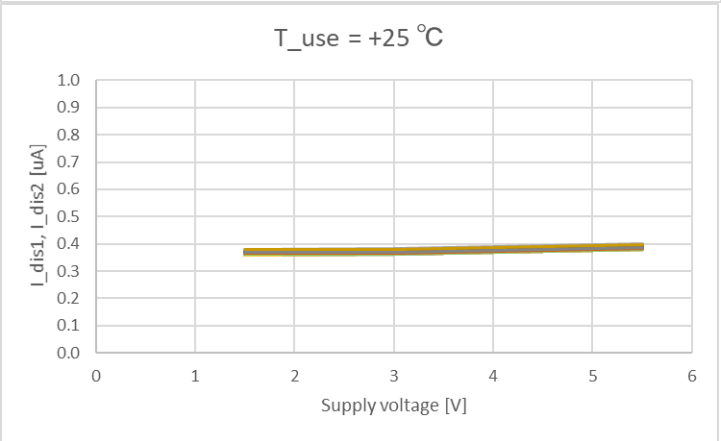


Test Conditions:
No Load, n = 22 pcs.

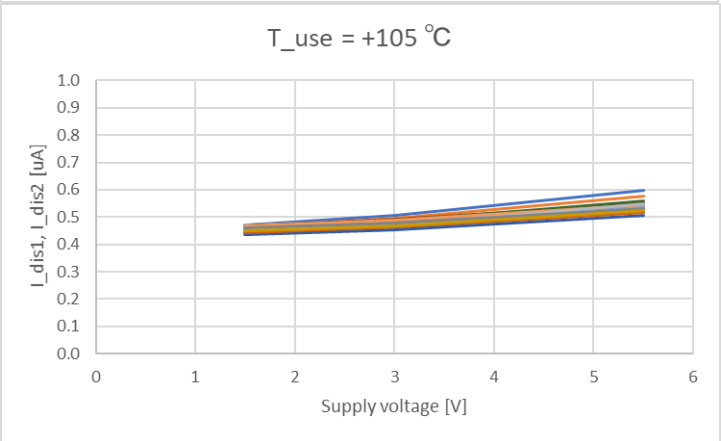
11.2. Current Consumption (Output disable)



Test Conditions:
No Load, T_use = -40 °C, n = 22 pcs.

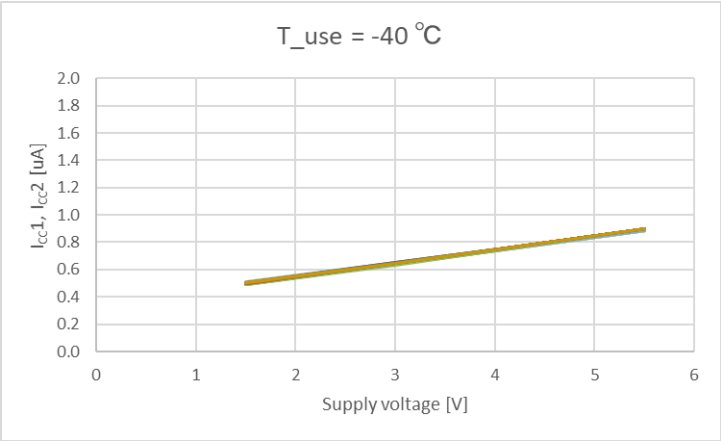


Test Conditions:
No Load, T_use = +25 °C, n = 22 pcs.

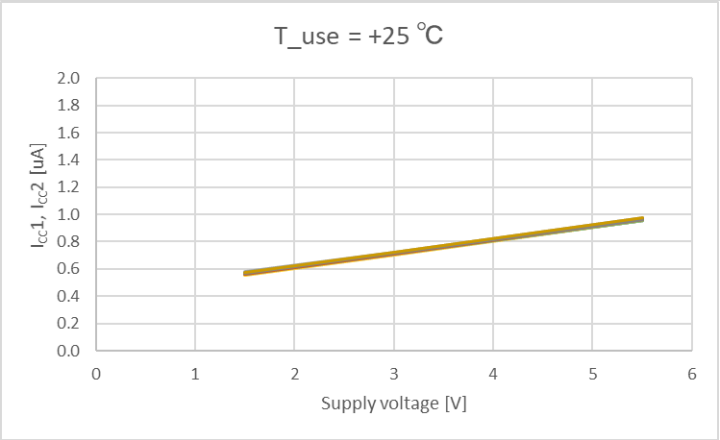


Test Conditions:
No Load, T_use = +105 °C, n = 22 pcs.

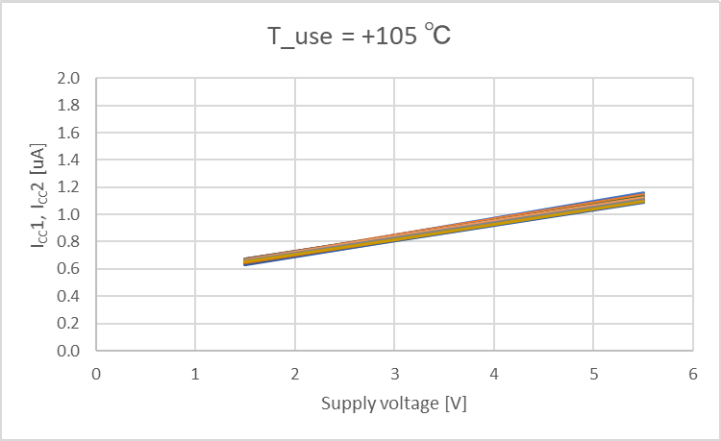
11.3. Current Consumption (Output enable)



Test Conditions:
No Load, T_use = -40 °C, n = 22 pcs.



Test Conditions:
No Load, T_use = +25 °C, n = 10 pcs.

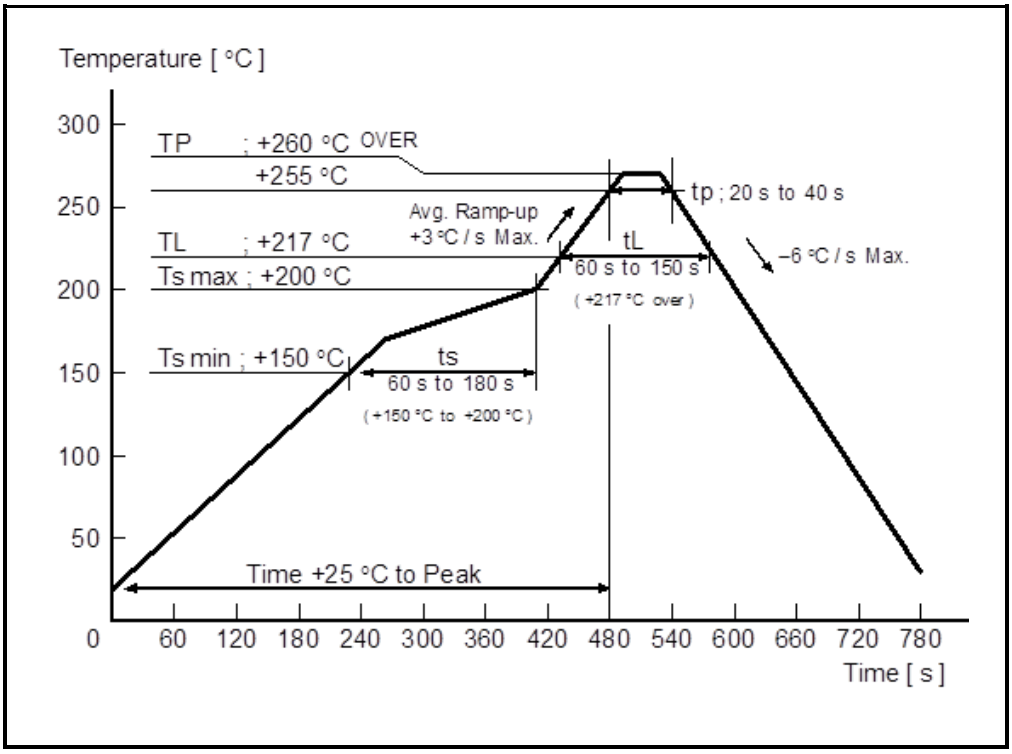


Test Conditions:
No Load, T_use = +105 °C, n = 22 pcs.

12. Moisture Sensitivity

Item	Class	Test Condition
MSL	LEVEL 1	JEDEC J-STD-020D.1

13. Reflow Profiles (follow to IPC / JEDEC J-STD-020D.1)



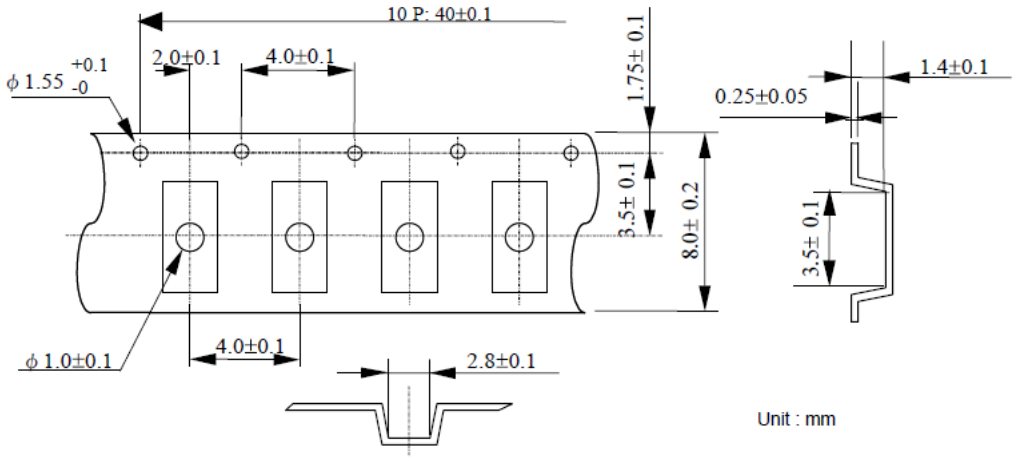
14. Taping Specification

Subject to EIA-481 , IEC 60286 , JIS C0806.

(1) Tape dimensions TE0804L

Material of the Carrier Tape: PS

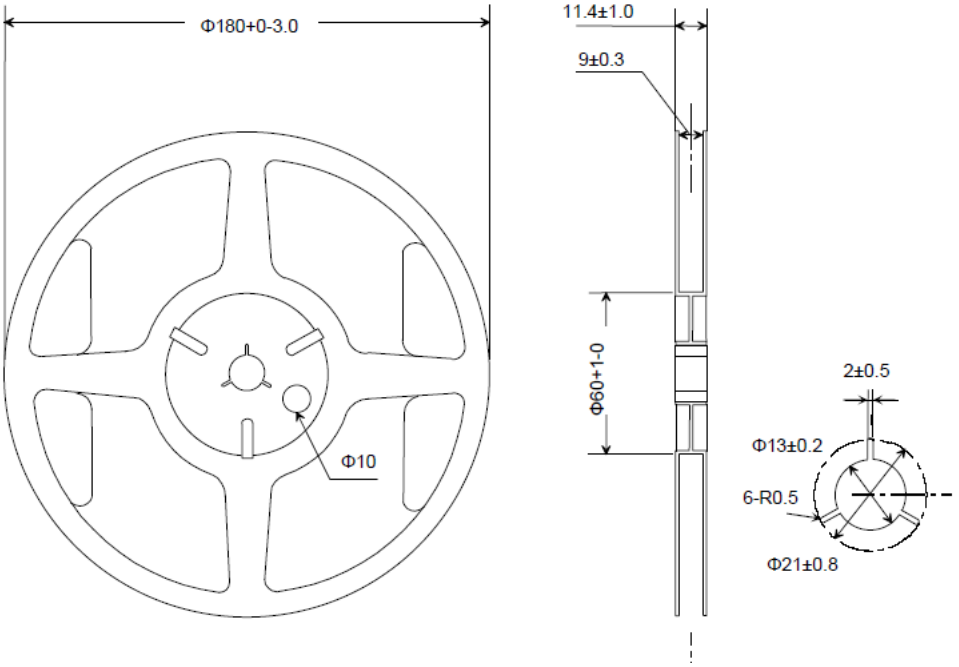
Material of the Top Tape : PET+PE



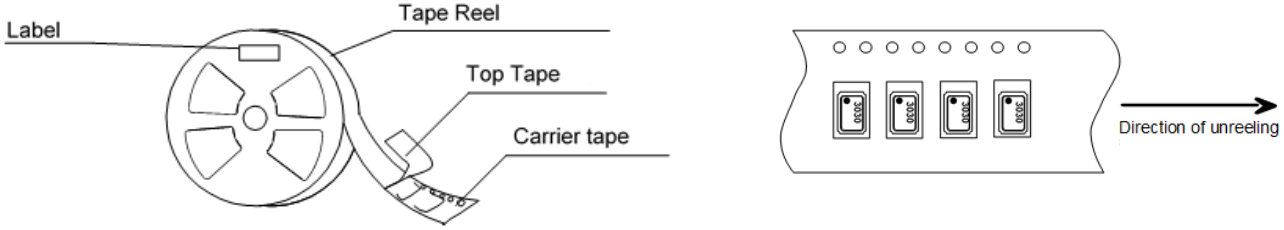
(2) Reel dimensions

Material of the Reel: PS

Form and Size of reel window shows are one of the example



(3) Storage Form



(4) Storage Quantity

The product number is X1B000351000100 (TG-3541CE XA), X1B000351000200 (TG-3541CE XB)
X1B000361A00100 (TG-3541CEA XA), X1B000361A00200 (TG-3541CEA XB)
Packing quantity is defined by 14th and 15th digit of product number.
The standard is "00", 2 000 pcs/Reel.

15. Handling Precautions

1) Notes on handling

This device contains a crystal resonator, so please don't expose excessive shock or vibration.
This device uses a C-MOS IC to realize low power consumption. Carefully note the following cautions when handling.

(1) Static electricity

While this module has built-in circuitry designed to protect it against electrostatic discharge, the chip could still be damaged by a large discharge of static electricity. Containers used for packing and transport should be constructed of conductive materials. In addition, only soldering irons, measurement circuits, and other such devices which do not leak high voltage should be used with this module, which should also be grounded when such devices are being used.

(2) Noise

If a signal with excessive external noise is applied to the power supply or input pins, the device may malfunction or "latch up." In order to ensure stable operation, connect a filter capacitor (preferably ceramic) of greater that 0.1 μF as close as possible to the power supply pins (between Vcc and GNDs). Also, avoid placing any device that generates high level of electronic noise near this module.
* Do not connect signal lines to the shaded area in the figure shown in Fig. 1 and, if possible, embed this area in a GND land.

(3) Voltage levels of input pins

When the input pins are at the mid-level, this will cause increased current consumption and a reduced noise margin, and can impair the functioning of the device. Therefore, try as much as possible to apply the voltage level close to Vcc or GND.

(4) Handling of unused pins

Since the input impedance of the input pins is extremely high, operating the device with these pins in the open circuit state can lead to unstable voltage level and malfunctions due to noise. Therefore, please apply the voltage level close to Vcc or GND.

(5) Storage

This device is equivalent to JEDEC J-STD-020D.1 Moisture Sensitivity Level 1. After opening the packing, store it in an environment with a temperature of + 30 ° C or less and humidity of 85 ° C or less, and mount it within 6 months.

2) Notes on packaging

(1) Soldering heat resistance.

If the temperature within the package exceeds +260 °C, the characteristics of the crystal oscillator will be degraded and it may be damaged. The reflow conditions within our reflow profile is recommended. Therefore, always check the mounting temperature and time before mounting this device. Also, check again if the mounting conditions are later changed.
* See Fig. 1 profile for our evaluation of Soldering heat resistance for reference.

(2) Mounting equipment

While this module can be used with general-purpose mounting equipment, the internal crystal oscillator may be damaged in some circumstances, depending on the equipment and conditions. Therefore, be sure to check this. In addition, if the mounting conditions are later changed, the same check should be performed again.
The high-speed mounter (stationary type of parts cassette) can not be used because storage vibrations in parts cassettes cause scraping of carrier tape due to friction between the embossed carrier tape and the product.

(3) Ultrasonic cleaning

Depending on the usage conditions, there is a possibility that the crystal oscillator will be damaged by resonance during ultrasonic cleaning. Since the conditions under which ultrasonic cleaning is carried out (the type of cleaner, power level, time, state of the inside of the cleaning vessel, etc.) vary widely, this device is not warranted against damage during ultrasonic cleaning.

(4) Mounting orientation

This device can be damaged if it is mounted in the wrong orientation. Always confirm the orientation of the device before mounting.

(5) Leakage between pins

Leakage between pins may occur if the power is turned on while the device has condensation or dirt on it. Make sure the device is dry and clean before supplying power to it.