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.
- VIO controls swing amplitude.
- AEC-Q100 compliant

Applications

- Industrial, Security, Smart Meter,
- Clock for Time counting and Sleep function

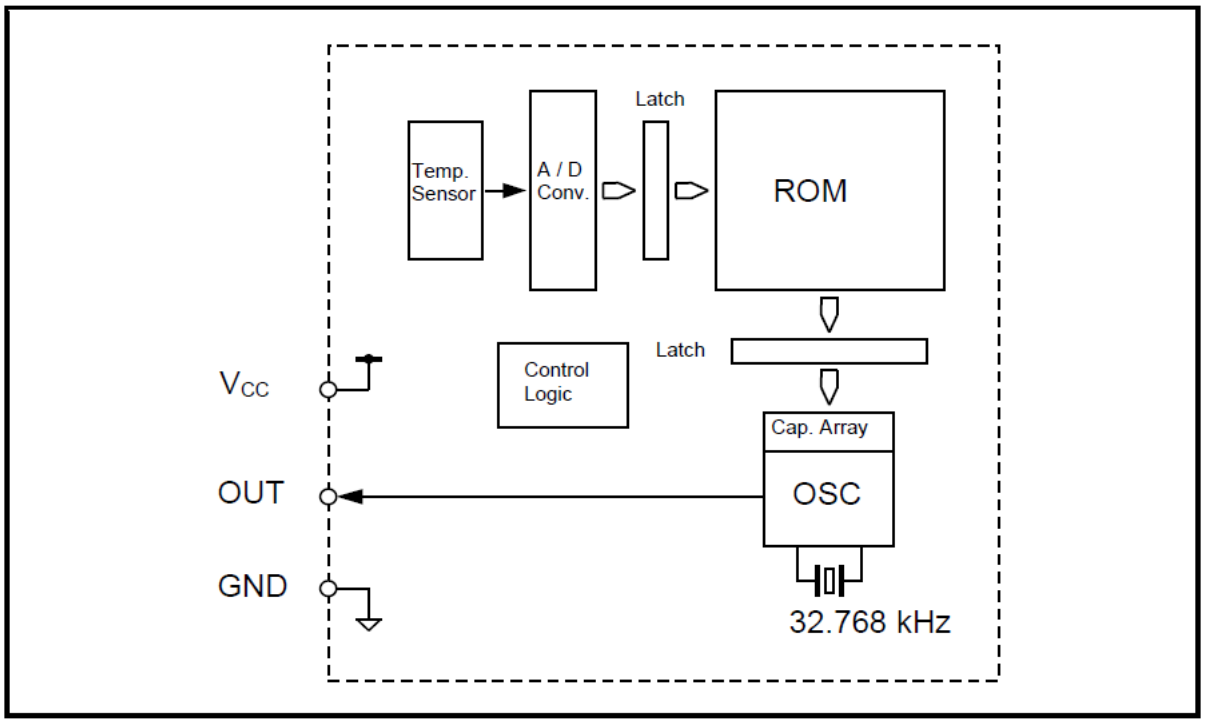
Description

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.

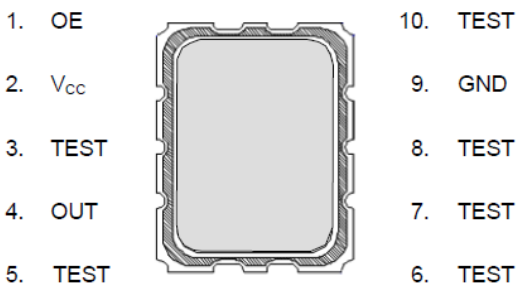
Ordering Information

Part Number	Package	Description
TCXO5032Q	3225-10L	3.2mm x2.5mm

Block Diagram



Pin configuration



3225-10L

Pin Name	Type	Description
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.
VCC	–	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.

Absolute Maximum Ratings

Parameter	Symbol	MIN	TYP	MAX	Unit	Note
Supply voltage	V_{CC}-GND	-0.3	-	6.5	V	
Input voltage	Vin	GND − 0.3	-	6.5	V	OE pin
Output voltage	Vout1	GND − 0.3	-	V_{CC} + 0.3	V	OUT pin
Storage temperature range	T_stg	-55	-	125	°C	When stored separately, without packaging

Recommended Operating Conditions

Parameter	Symbol	MIN	TYP	MAX	Unit	Note
Temp. compensation voltage	V_{TEMP}	2	3	5.5	V	
Supply voltage	V_{CC}	2	3	5.5	V	
	GND	0	-	0	V	
Operating temperature range	T_use	-40	25	105	°C	No condensation
Output load	L_CMOS	-	-	30	pF	

Frequency Characteristics

(Condition: GND = 0V, L_CMOS = 30 pF Max., T_use = +25 °C)

Symbol	Paramater	Suffix	Condition	MIN	TYP	MAX	Unit
Δf / f	Frequency stability		Ta= -40 to +105℃, VDD=3.0 V	-5		5	ppm
f / V	Frequency/voltage characteristics		Ta= +25℃ , VDD=2.0 V to 5.5 V	-1.0		1.0	ppm
tSTA	Oscillation start time		Ta= +25℃, VDD=1.6 V to 5.5 V			1.0	s
			Ta= -40 to +105℃, VDD=1.6 V to 5.5 V			3.0	
fa	Aging		Ta= +25℃ , VDD=3.0 V, first year	-3.0		3.0	ppm
Tsensor	Temperature Sensor Accuracy		VDD=3.0 V	-4.0		4.0	℃
Duty	FOUT duty		50% of VDD level	40	50	60	%

- Equivalent to 13 seconds of month deviation ($\pm 5.0 \times 10^{-6}$)

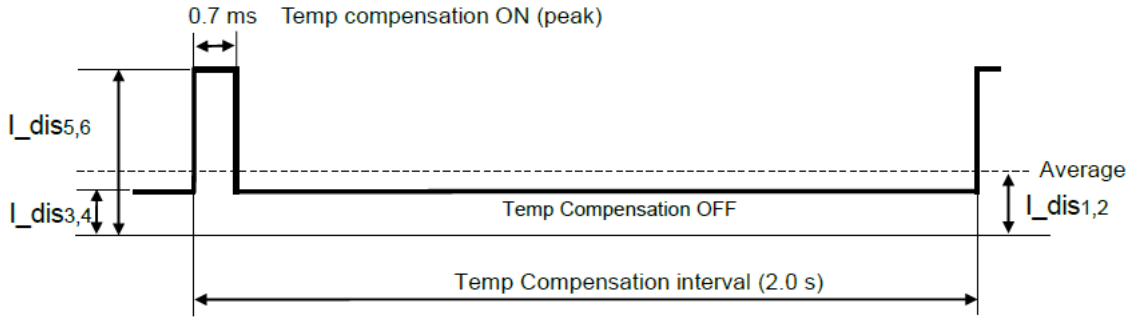
Electrical Characteristics

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

Parameter	Symbol	MIN	TYP	MAX	Unit	Condition
Current consumption	I_{CC1}		1.6	5.3	µA	OE = V_{CC}, V_{CC} = 5.0 V, L_CMOS= No load Temp compensation interval 2.0 s
	I_{CC2}		1.15	4.5	µA	OE = V_{CC}, V_{CC} = 3.0 V L_CMOS= No load Temp compensation interval 2.0 s
	I_{CC3}		6.75	13	µA	OE = V_{CC}, V_{CC} = 5.0 V L_CMOS= 30 pF Temp compensation interval 2.0 s
	I_{CC4}		4.18	9.5	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		0.59	3.8	µA	OE = GND, V_{CC} = 5.0 V Temp compensation interval 2.0 s
	I_dis2		0.54	3.6	µA	OE = GND, V_{CC} = 3.0 V Temp compensation interval 2.0 s
	I_dis3		0.44	3.5	µA	OE = GND, V_{CC} = 5.0 V Temp compensation is stopped.
	I_dis4		0.39	3.4	µA	OE = GND, V_{CC} = 3.0 V Temp compensation is stopped.
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	$V_{OH}1$	4.5		5.0	V	OUT pin, V_{CC} = 5.0 V, I_{OH} = −1 mA
	$V_{OH}2$	2.2		3.0		OUT pin, V_{CC} = 3.0 V, I_{OH} = −1 mA
	$V_{OH}3$	2.9		3.0		OUT pin, V_{CC} = 3.0 V, I_{OH} = −100 µA
	$V_{OL}1$	GND		GND + 0.5	V	OUT pin, V_{CC} = 5.0 V, I_{OL} = 1 mA
	$V_{OL}2$	GND		GND + 0.8		OUT pin, V_{CC} = 3.0 V, I_{OL} = 1 mA
	$V_{OL}3$	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 TCXO5032Q increases at a timing of a temperature compensation. As for this peak current consumption, it occurs in about 0.7 ms.
I_dis_1, I_dis_2 is the average current consumption at temperature compensation in 2.0 s cycle.

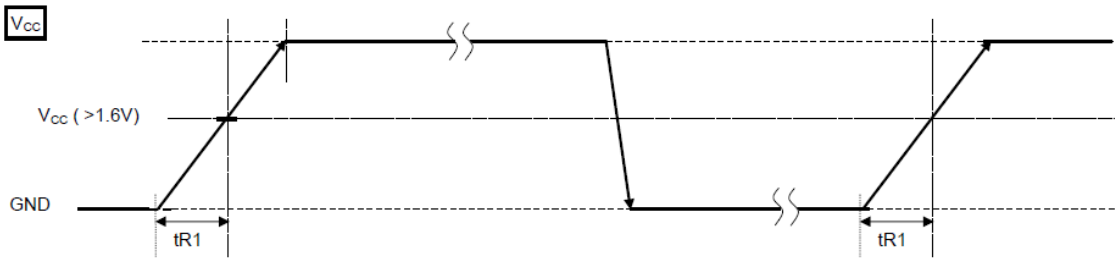


Application

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.

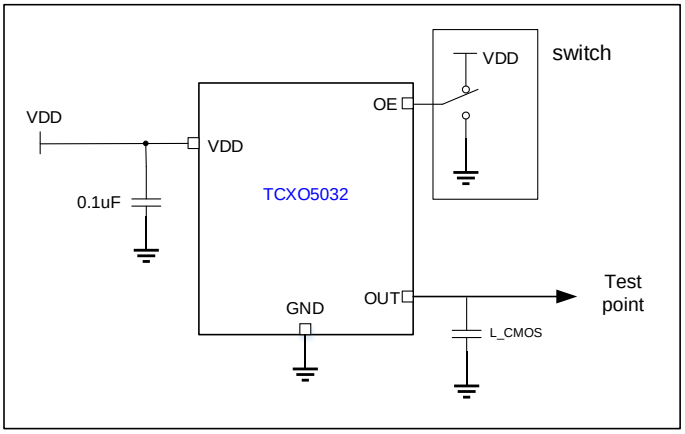


*Unless otherwise specified, GND = 0 V , V_{CC} = 1.5 V to 5.5 V , T_use = −40 °C to +105 °C

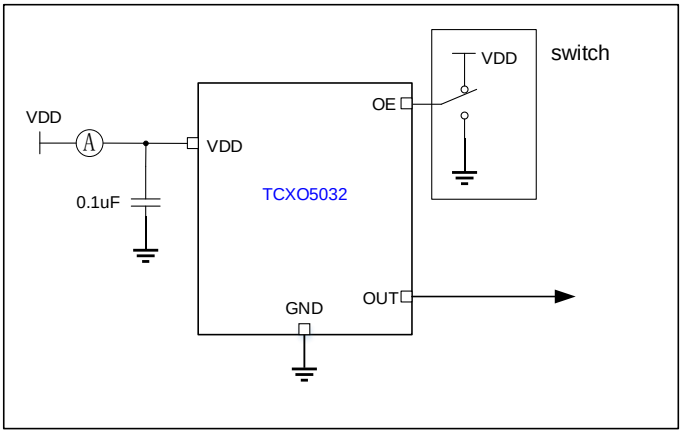
Paramater	Symbol	Condition	MIN	TYP	MAX	Unit
Power supply rise time1	tR1	V_{CC} = GND to 1.6 V	1	-	10	ms/V

External Connection Example

Output Waveform



Current Consumption



Notes:

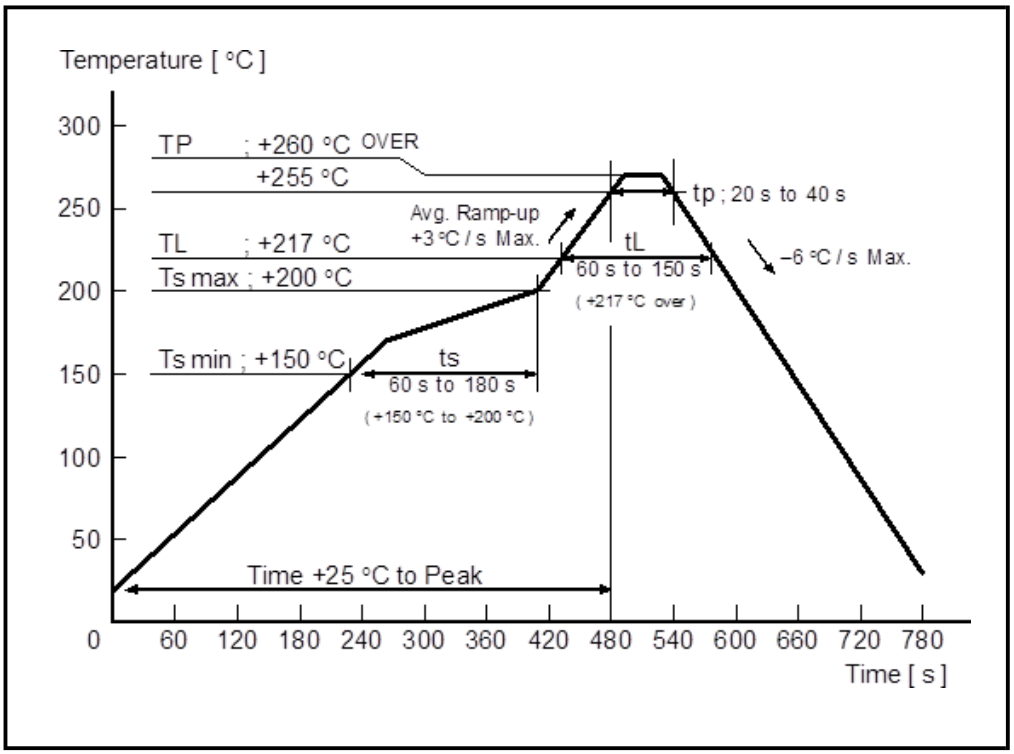
(1) Oscilloscope
- Band width should be minimum 5 times higher (wider) than measurement frequency.
- Probe earth should be placed closely from test point and lead length should be as short as possible.
- Recommendable to use miniature socket. (Don't use earth lead.)

(2) L_CMOS also includes probe capacitance.

(3) By-pass capacitor (at least 0.1 μF) is placed closely between VCC and GND.

(4) Use the current meter whose internal impedance value is small.

Reflow Profiles



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.

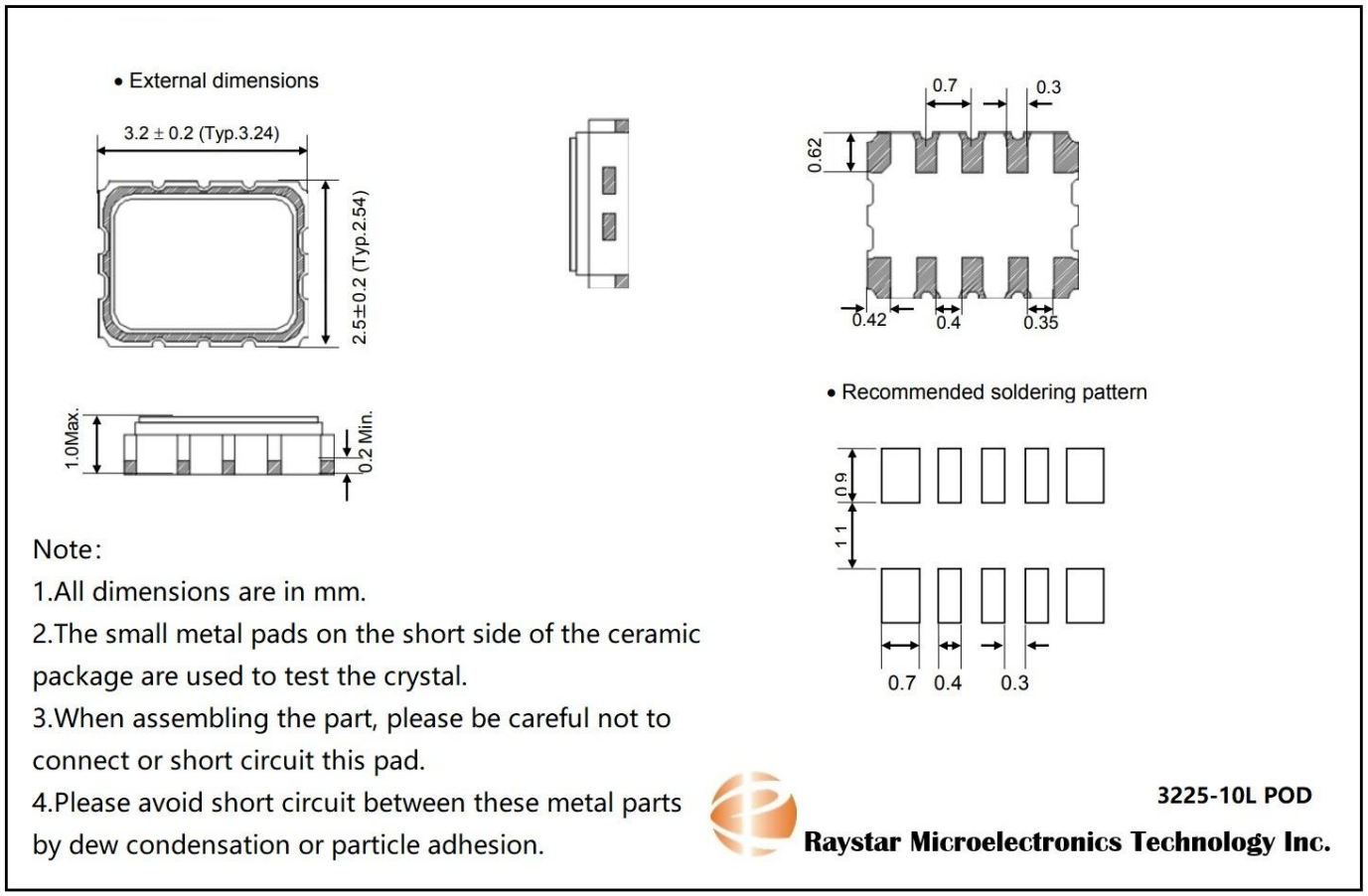
(3) Ultrasonic cleaning
Depending on the usage conditions, there is a possibility that the crystal oscillator will be damaged by resonance during ultrasonic cleaning. Since the conditions under which ultrasonic cleaning is carried out (the type of cleaner, power level, time, state of the inside of the 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.

Package Information

3225 -10 pin



Revision History

Revision	Description	Date
0.9	Preliminary	2025/02/18
1.0	Add Vtemp description	2025/03/14