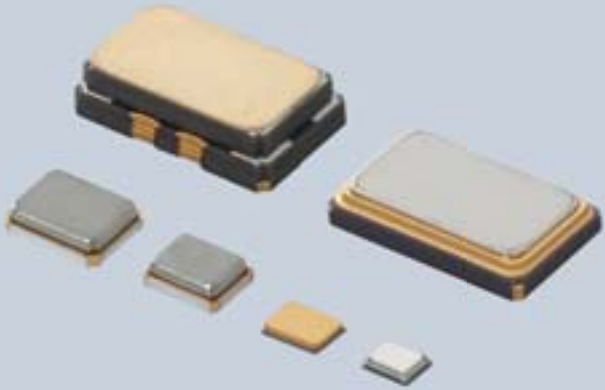


Crystal Units/Crystal Oscillators





EU RoHS Compliant

- All the products in this catalog comply with EU RoHS.
- EU RoHS is "the European Directive 2011/65/EU on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment."
- For more details, please refer to our web page, "Murata's Approach for EU RoHS" (<https://www.murata.com/en-eu/support/compliance/rohs>).



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Contents

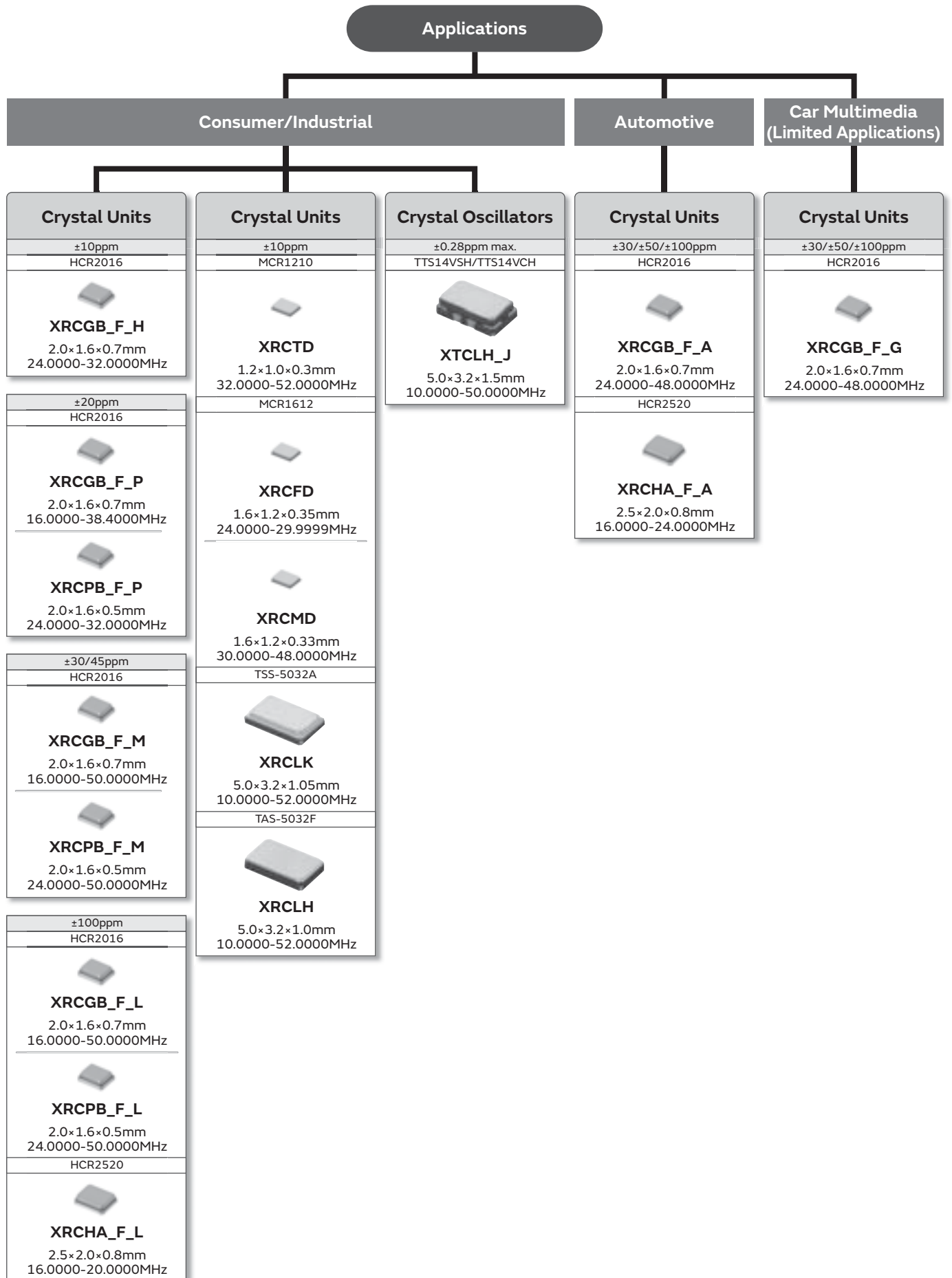
Product specifications are as of October 2018.

Bluetooth® is a registered trademark or trademark of Bluetooth SIG, Inc. in the United States and other countries.

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Please check the MURATA website (<https://www.murata.com/>) if you cannot find a part number in this catalog.

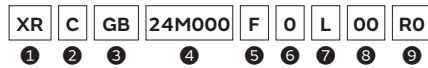
Selection Guide



● Part Numbering

Crystal Unit

(Part Number)



① Product ID

Product ID	
XR	Crystal Unit

② Lead Style

Code	Lead Style
C	SMD

③ Size · Structure

Code	Size · Structure
TD	1210 (STD) Metal Sealing
FD	1612 (STD) Metal Sealing
MD	1612 (Low Profile) Metal Sealing
GB	2016 (STD) Resin Sealing
PB	2016 (Low Profile) Resin Sealing
LH	5032 Metal Sealing
LK	5032 Seam Sealing

④ Nominal Center Frequency

Expressed by six-digit alphanumeric. The unit is in hertz (Hz).
 Decimal point is expressed by capital letter "M".

⑤ Overtone Order

Code	Overtone Order
F	Fundamental
K	Customized Fundamental

⑥ Frequency Tolerance

Code	Frequency Tolerance
0	±100ppm
1	±10ppm
2	±20ppm
3	±30ppm
4	±45ppm
5	±50ppm
A	±25ppm
X	Total Frequency Tolerance*1

*1 Including Initial Tolerance+Temperature Characteristics

⑦ Frequency Shift by Temperature

Code	Frequency Shift by Temperature
A	±100ppm max. (Automotive Grade)
G	±50ppm (Car Multimedia Grade)
L	±50ppm min.
M	±40ppm
N	±25ppm or 30ppm
P	±20ppm
H/Q	±10ppm to ±15ppm

⑧ Individual Specification

Code	
**	Two-digit alphanumerics express Individual Specification.

00: Standard specification type.

⑨ Packaging (Quantity and Plastic taping reel diameter are expressed by one-digit number in "**")

Code	Packaging
R*/E*/J*/P*	Plastic Taping

Crystal Oscillator

(Part Number)

XN	C	HH	19M200	T	J	E	A5	P0
①	②	③	④	⑤	⑥	⑦	⑧	⑨

① Product ID

Product ID	
XT	VC-TCXO
XN	TCXO

② Lead Style

Code	Lead Style
C	SMD

③ Size · Structure

Code	Size · Structure
HH	2520 Metal Sealing
JH	3225 Metal Sealing
LH	5032 Metal Sealing

④ Nominal Center Frequency

Expressed by six-digit alphanumeric. The unit is in hertz (Hz).
 Decimal point is expressed by capital letter "M".

⑤ Output Wave

Code	Output Wave
T	Clipped Sign Wave
C	CMOS

⑥ Frequency Tolerance

Code	Frequency Tolerance
J	±1.0 to ±1.4ppm

⑦ Frequency Shift by Temperature

Code	Frequency Shift by Temperature
E	±0.5ppm max.
J	Less than ±0.3ppm

⑧ Individual Specification

Code	
**	Two-digit alphanumerics express Individual Specification.

⑨ Packaging (Quantity and Plastic taping reel diameter are expressed by one-digit number in "**")

Code	Packaging
E*/G*/P*	Plastic Taping

Crystal Units

for Consumer and Industrial




These crystal units feature a small package and highly accurate frequency, based on Murata's excellent package technology and high grade quartz crystal elements.

Features

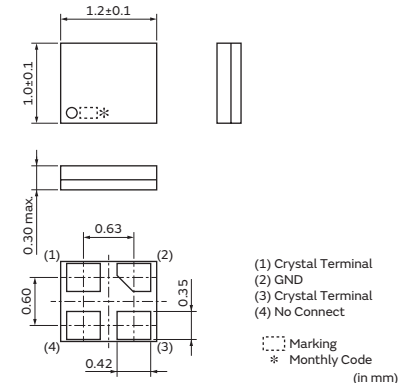
1. This series is ideal for applications requiring high accuracy crystal units, especially communication clocks such as GPS, Wi-Fi, B.T. (Bluetooth®), BLE (Bluetooth® Low Energy), SATA and USB3.0.
2. The crystal units are extremely small, contributing to a reduction in the mounting area.
3. The series complies to RoHS directive, being lead-free (phase 3).

Applications

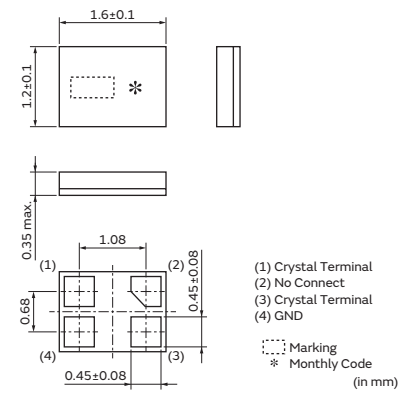

1. Clock for GPS controller ICs:
 smartphone, wearable equipment, module, etc.
2. Clock for Wi-Fi, B.T. and ACPU controller ICs:
 smartphone, wearable device, module, etc.
3. Clock for BLE controller ICs:
 wearable, fitness and healthcare devices, module, etc.
4. Storage devices with SATA interface:
 HDD, SSD, Optical storage device, etc.
5. Clock for USB (Ultra-Speed and High-Speed) controller ICs: Mobile phone, DVC, DSC, Portable audio, PC peripheral, etc.
6. Clock for PC, visual equipment controller ICs
7. Audio equipment and musical instrument, etc.
8. Clock for PLC, Inverter, Servo Amp, Servo Motor, etc. controller ICs
9. Clock for LCD, Programmable display and Visual equipment controller ICs
10. Other applications for replacement of other crystal units or oscillators.



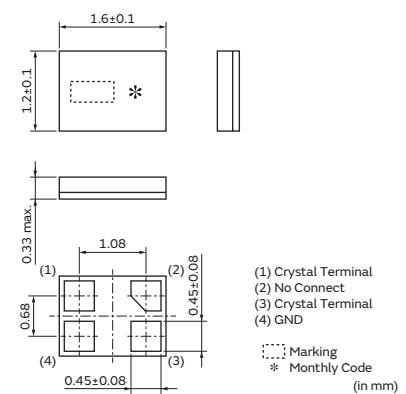

XRC1210
(MCR1210)
 32.0000–52.0000MHz





XRC1612
(MCR1612)
 24.0000–29.9999MHz

XRC1612
(MCR1612)
 30.0000–48.0000MHz

XRCGB
(HCR2016)
 16.0000–50.0000MHz



XRCPB
(HCR2016)
 24.0000–50.0000MHz

Dimensions: 2.0±0.1 (width), 1.6±0.1 (height), 0.65±0.05 (thickness), 1.8 (total length), 0.15 (terminal offset), 0.5±0.1 (terminal spacing), 0.9±0.1 (terminal width), 0.25±0.1 (terminal offset), 1.3±0.1 (terminal width).

Terminal Labels: (1) Crystal Terminal, (2) No Connect, (3) Crystal Terminal

Marking: * Monthly Code (in mm)

Continued on the following page. ↗



<XRCGB_F_H>

Part Number	Type	Frequency (MHz)	Frequency Tolerance (ppm max.) [at 25°C±3°C]	Frequency Shift by Temperature (ppm max.) [Standard Condition: +25°C]	Frequency Aging (ppm max./Year)	ESR* (Ωmax.)	Load Capacitance (pF)	Drive Level (μW max.)
XRCGB24M000F1H00R0	HCR2016	24.0000	±10	±10 (-20 to +70°C)	±2	80	6	300
XRCGB25M000F1H00R0	HCR2016	25.0000	±10	±10 (-20 to +70°C)	±2	80	6	300
XRCGB26M000F1H00R0	HCR2016	26.0000	±10	±10 (-30 to +85°C)	±2	60	6	300
XRCGB32M000F1H00R0	HCR2016	32.0000	±10	±10 (-30 to +85°C)	±2	60	6	300

* Equivalent Series Resistance

<XRCGB_F_P/XRCPB_F_P>

Part Number	Type	Frequency (MHz)	Frequency Tolerance (ppm max.) [at 25°C±3°C]	Frequency Shift by Temperature (ppm max.) [Standard Condition: +25°C]	Frequency Aging (ppm max./Year)	ESR* (Ωmax.)	Load Capacitance (pF)	Drive Level (μW max.)
XRCGB16M000FXN01R0	HCR2016	16.0000	±40ppm (Total)(-30 to +85°C)		±5	200	8	100
XRCGB24M000F2P00R0	HCR2016	24.0000	±20	±20 (-30 to +85°C)	±5	150	6	300
XRCGB25M000F2P00R0	HCR2016	25.0000	±20	±20 (-30 to +85°C)	±5	150	6	300
XRCGB26M000F2P00R0	HCR2016	26.0000	±20	±20 (-30 to +85°C)	±5	150	6	300
XRCGB27M000F2P00R0	HCR2016	27.0000	±20	±20 (-30 to +85°C)	±5	150	6	300
XRCGB27M120F2P00R0	HCR2016	27.1200	±20	±20 (-30 to +85°C)	±5	150	6	300
XRCGB30M000F2P00R0	HCR2016	30.0000	±20	±20 (-30 to +85°C)	±5	100	6	300
XRCGB31M250F2P00R0	HCR2016	31.2500	±20	±20 (-30 to +85°C)	±5	100	6	300
XRCGB32M000F2P00R0	HCR2016	32.0000	±20	±20 (-30 to +85°C)	±5	100	6	300
XRCGB38M400F2P00R0	HCR2016	38.4000	±20	±20 (-30 to +85°C)	±5	100	6	300
XRCPB24M000F2P00R0	HCR2016	24.0000	±20	±20 (-30 to +85°C)	±5	150	6	300
XRCPB25M000F2P00R0	HCR2016	25.0000	±20	±20 (-30 to +85°C)	±5	150	6	300
XRCPB26M000F2P00R0	HCR2016	26.0000	±20	±20 (-30 to +85°C)	±5	150	6	300
XRCPB27M000F2P00R0	HCR2016	27.0000	±20	±20 (-30 to +85°C)	±5	150	6	300
XRCPB27M120F2P00R0	HCR2016	27.1200	±20	±20 (-30 to +85°C)	±5	150	6	300
XRCPB30M000F2P00R0	HCR2016	30.0000	±20	±20 (-30 to +85°C)	±5	100	6	300
XRCPB31M250F2P00R0	HCR2016	31.2500	±20	±20 (-30 to +85°C)	±5	100	6	300
XRCPB32M000F2P00R0	HCR2016	32.0000	±20	±20 (-30 to +85°C)	±5	100	6	300

* Equivalent Series Resistance

<XRCGB_F_M/XRCPB_F_M>

Part Number	Type	Frequency (MHz)	Frequency Tolerance (ppm max.) [at 25°C±3°C]	Frequency Shift by Temperature (ppm max.) [Standard Condition: +25°C]	Frequency Aging (ppm max./Year)	ESR* (Ωmax.)	Load Capacitance (pF)	Drive Level (μW max.)
XRCGB24M000F3M00R0	HCR2016	24.0000	±30	±40 (-30 to +85°C)	±5	150	6	300
XRCGB24M576F3M00R0	HCR2016	24.5760	±30	±40 (-30 to +85°C)	±5	150	6	300
XRCGB25M000F3M00R0	HCR2016	25.0000	±30	±40 (-30 to +85°C)	±5	150	6	300
XRCGB26M000F3M00R0	HCR2016	26.0000	±30	±40 (-30 to +85°C)	±5	150	6	300
XRCGB27M000F3M00R0	HCR2016	27.0000	±30	±40 (-30 to +85°C)	±5	150	6	300
XRCGB27M120F3M00R0	HCR2016	27.1200	±30	±40 (-30 to +85°C)	±5	150	6	300
XRCGB30M000F3M00R0	HCR2016	30.0000	±30	±40 (-30 to +85°C)	±5	100	6	300
XRCGB31M250F3M00R0	HCR2016	31.2500	±30	±40 (-30 to +85°C)	±5	100	6	300
XRCGB32M000F3M00R0	HCR2016	32.0000	±30	±40 (-30 to +85°C)	±5	100	6	300
XRCGB33M868F4M00R0	HCR2016	33.8688	±45	±40 (-30 to +85°C)	±5	100	6	300
XRCGB38M400F4M00R0	HCR2016	38.4000	±45	±40 (-30 to +85°C)	±5	100	6	300
XRCGB40M000F4M00R0	HCR2016	40.0000	±45	±40 (-30 to +85°C)	±5	100	6	300
XRCGB48M000F4M00R0	HCR2016	48.0000	±45	±40 (-30 to +85°C)	±5	100	6	300
XRCGB50M000F4M00R0	HCR2016	50.0000	±45	±40 (-30 to +85°C)	±5	65	6	300
XRCPB24M000F3M00R0	HCR2016	24.0000	±30	±40 (-30 to +85°C)	±5	150	6	300
XRCPB24M576F3M00R0	HCR2016	24.5760	±30	±40 (-30 to +85°C)	±5	150	6	300
XRCPB25M000F3M00R0	HCR2016	25.0000	±30	±40 (-30 to +85°C)	±5	150	6	300
XRCPB26M000F3M00R0	HCR2016	26.0000	±30	±40 (-30 to +85°C)	±5	150	6	300
XRCPB27M000F3M00R0	HCR2016	27.0000	±30	±40 (-30 to +85°C)	±5	150	6	300
XRCPB27M120F3M00R0	HCR2016	27.1200	±30	±40 (-30 to +85°C)	±5	150	6	300
XRCPB30M000F3M00R0	HCR2016	30.0000	±30	±40 (-30 to +85°C)	±5	100	6	300
XRCPB31M250F3M00R0	HCR2016	31.2500	±30	±40 (-30 to +85°C)	±5	100	6	300

* Equivalent Series Resistance

Continued on the following page. ↗



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1

Part Number	Type	Frequency (MHz)	Frequency Tolerance (ppm max.) [at 25°C±3°C]	Frequency Shift by Temperature (ppm max.) [Standard Condition: +25°C]	Frequency Aging (ppm max./Year)	ESR* (Ωmax.)	Load Capacitance (pF)	Drive Level (μW max.)
XRCPB32M000F3M00R0	HCR2016	32.0000	±30	±40 (-30 to +85°C)	±5	100	6	300
XRCPB33M868F4M00R0	HCR2016	33.8688	±45	±40 (-30 to +85°C)	±5	100	6	300
XRCPB40M000F4M00R0	HCR2016	40.0000	±45	±40 (-30 to +85°C)	±5	100	6	300
XRCPB48M000F4M00R0	HCR2016	48.0000	±45	±40 (-30 to +85°C)	±5	100	6	300
XRCPB50M000F4M00R0	HCR2016	50.0000	±45	±40 (-30 to +85°C)	±5	65	6	300

* Equivalent Series Resistance

<XRCGB_F_L/XRCPB_F_L>

Part Number	Type	Frequency (MHz)	Frequency Tolerance (ppm max.) [at 25°C±3°C]	Frequency Shift by Temperature (ppm max.) [Standard Condition: +25°C]	Frequency Aging (ppm max./Year)	ESR* (Ωmax.)	Load Capacitance (pF)	Drive Level (μW max.)
XRCGB24M000F0L00R0	HCR2016	24.0000	±100	±50 (-30 to +85°C)	±5	150	6	300
XRCGB24M576F0L00R0	HCR2016	24.5760	±100	±50 (-30 to +85°C)	±5	150	6	300
XRCGB25M000F0L00R0	HCR2016	25.0000	±100	±50 (-30 to +85°C)	±5	150	6	300
XRCGB26M000F0L00R0	HCR2016	26.0000	±100	±50 (-30 to +85°C)	±5	150	6	300
XRCGB27M000F0L00R0	HCR2016	27.0000	±100	±50 (-30 to +85°C)	±5	150	6	300
XRCGB27M120F0L00R0	HCR2016	27.1200	±100	±50 (-30 to +85°C)	±5	150	6	300
XRCGB30M000F0L00R0	HCR2016	30.0000	±100	±50 (-30 to +85°C)	±5	100	6	300
XRCGB31M250F0L00R0	HCR2016	31.2500	±100	±50 (-30 to +85°C)	±5	100	6	300
XRCGB32M000F0L00R0	HCR2016	32.0000	±100	±50 (-30 to +85°C)	±5	100	6	300
XRCGB33M868F0L00R0	HCR2016	33.8688	±100	±50 (-30 to +85°C)	±5	100	6	300
XRCGB38M400F0L00R0	HCR2016	38.4000	±100	±50 (-30 to +85°C)	±5	100	6	300
XRCGB40M000F0L00R0	HCR2016	40.0000	±100	±50 (-30 to +85°C)	±5	100	6	300
XRCGB48M000F0L00R0	HCR2016	48.0000	±100	±50 (-30 to +85°C)	±5	100	6	300
XRCGB50M000F0L00R0	HCR2016	50.0000	±100	±50 (-30 to +85°C)	±5	100	6	300
XRCPB24M000F0L00R0	HCR2016	24.0000	±100	±50 (-30 to +85°C)	±5	150	6	300
XRCPB24M576F0L00R0	HCR2016	24.5760	±100	±50 (-30 to +85°C)	±5	150	6	300
XRCPB25M000F0L00R0	HCR2016	25.0000	±100	±50 (-30 to +85°C)	±5	150	6	300
XRCPB26M000F0L00R0	HCR2016	26.0000	±100	±50 (-30 to +85°C)	±5	150	6	300
XRCPB27M000F0L00R0	HCR2016	27.0000	±100	±50 (-30 to +85°C)	±5	150	6	300
XRCPB27M120F0L00R0	HCR2016	27.1200	±100	±50 (-30 to +85°C)	±5	150	6	300
XRCPB30M000F0L00R0	HCR2016	30.0000	±100	±50 (-30 to +85°C)	±5	100	6	300
XRCPB31M250F0L00R0	HCR2016	31.2500	±100	±50 (-30 to +85°C)	±5	100	6	300
XRCPB32M000F0L00R0	HCR2016	32.0000	±100	±50 (-30 to +85°C)	±5	100	6	300
XRCPB33M868F0L00R0	HCR2016	33.8688	±100	±50 (-30 to +85°C)	±5	100	6	300
XRCPB40M000F0L00R0	HCR2016	40.0000	±100	±50 (-30 to +85°C)	±5	100	6	300
XRCPB48M000F0L00R0	HCR2016	48.0000	±100	±50 (-30 to +85°C)	±5	100	6	300
XRCPB50M000F0L00R0	HCR2016	50.0000	±100	±50 (-30 to +85°C)	±5	100	6	300

* Equivalent Series Resistance

<XRCHA_F_L>

Part Number	Type	Frequency (MHz)	Frequency Tolerance (ppm max.) [at 25°C±3°C]	Frequency Shift by Temperature (ppm max.) [Standard Condition: +25°C]	Frequency Aging (ppm max./Year)	ESR* (Ωmax.)	Load Capacitance (pF)	Drive Level (μW max.)
XRCHA16M000F0L01R0	HCR2520	16.0000	±100	±100 (-30 to +85°C)	±5	100	8	300
XRCHA20M000F0L01R0	HCR2520	20.0000	±100	±100 (-30 to +85°C)	±5	80	8	300

* Equivalent Series Resistance

<XRCLK>

Part Number	Type	Frequency (MHz)	Frequency Tolerance (ppm max.) [at 25°C±3°C]	Frequency Shift by Temperature (ppm max.) [Standard Condition: +25°C]	Frequency Aging (ppm max./Year)	ESR* (Ωmax.)	Load Capacitance (pF)	Drive Level (μW max.)
XRCLK10M000F1QA8P0	TSS-5032A	10.0000	±10	±15 (-30 to +85°C)	±3	80	8	60
XRCLK12M000F1QA6P0	TSS-5032A	12.0000	±10	±15 (-30 to +85°C)	±3	60	8	60
XRCLK14M745F1QB6P0	TSS-5032A	14.7456	±10	±15 (-30 to +85°C)	±3	60	8	60
XRCLK16M000F1QA7P0	TSS-5032A	16.0000	±10	±15 (-30 to +85°C)	±3	60	8	60
XRCLK21M250F1QA8P0	TSS-5032A	21.2500	±10	±15 (-30 to +85°C)	±3	60	8	60
XRCLK52M000F1QA0P0	TSS-5032A	52.0000	±10	±15 (-30 to +85°C)	±3	60	8	60

* Equivalent Series Resistance

8

<XRCLH>

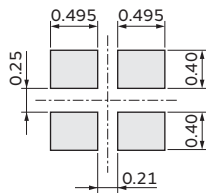
Part Number	Type	Frequency (MHz)	Frequency Tolerance (ppm max.) [at 25°C±3°C]	Frequency Shift by Temperature (ppm max.) [Standard Condition: +25°C]	Frequency Aging (ppm max./Year)	ESR* (Ωmax.)	Load Capacitance (pF)	Drive Level (μW max.)
XRCLH10M000F1QA4P0	TAS-5032F	10.0000	±10	±15 (-30 to +85°C)	±1 (±3/5Years)	60	8	60
XRCLH12M000F1QA0P0	TAS-5032F	12.0000	±10	±15 (-30 to +85°C)	±1 (±3/5Years)	60	8	60
XRCLH14M745F1QA0P0	TAS-5032F	14.7456	±10	±15 (-30 to +85°C)	±1 (±3/5Years)	40	8	60
XRCLH16M000F1QA2P0	TAS-5032F	16.0000	±10	±15 (-30 to +85°C)	±1 (±3/5Years)	40	8	60
XRCLH21M250F1QA0P0	TAS-5032F	21.2500	±10	±15 (-30 to +85°C)	±1 (±3/5Years)	40	8	60
XRCLH52M000F1QA1P0	TAS-5032F	52.0000	±10	±15 (-30 to +85°C)	±1 (±3/5Years)	40	8	60

* Equivalent Series Resistance

Standard Land Pattern Dimensions

XRCTD
 (MCR1210)

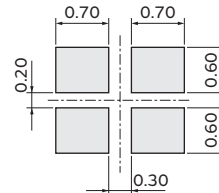
(Recommended Land Pattern)



(in mm)

XRCFD, XRCMD
 (MCR1612)

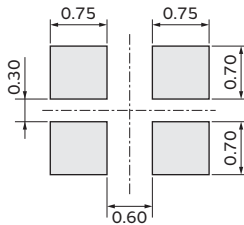
(Recommended Land Pattern)



(in mm)

XRCGB_F_H/P/M/L, XRCPB_F_P/M/L
 (HCR2016)

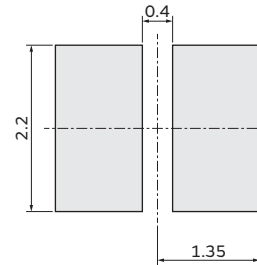
(Recommended Land Pattern)



(in mm)

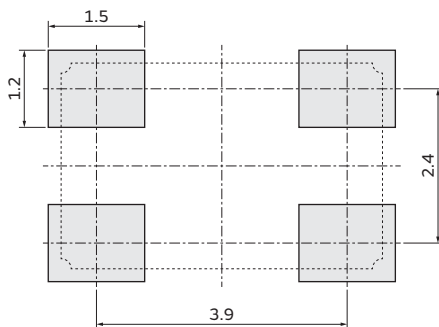
XRCHA_F_L
 (HCR2520)

(Recommended Land Pattern)



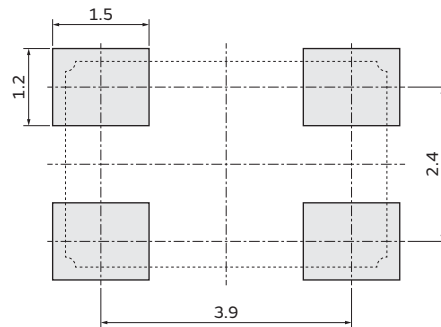
(in mm)

XRCLK
 (TSS-5032A)



(in mm)

XRCLH
 (TAS-5032F)



Avoid putting signal lines under the product except referenced land pattern.

(in mm)

Notice -Crystal Units for Consumer and Industrial-

1

<XRCTD, XRCFD, XRCMD Series>

Notice (Soldering and Mounting)

1.1. Soldering Condition

Reflow

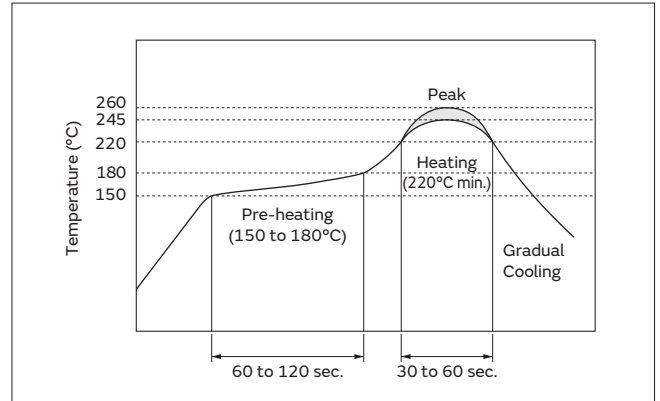
Please mount components on a circuit board by the reflow soldering.

Flux: Please use rosin based flux; but do not use water soluble flux.

Solder: Please use solder (Sn-3.0Ag-0.5Cu) under the following condition.

Standard thickness of soldering paste: 0.10 to 0.15mm

	Condition	
Pre-heating	150 to 180°C	60 to 120 sec.
Heating	220°C min.	30 to 60 sec.
Peak Temperature	245°C min. 260°C max.	5 sec. max.



1.2. Optimum Solder Amount for Soldering

Please keep the solder volume below the height of the substrate. When exceeding the substrate, the damage of sealing part between the metal cap and the substrate may occur.

2. Notice for Mounting

The component is recommended with placement

machines employing optical placement capabilities.

The component might be damaged by mechanical force depending on placement machine and condition.

Make sure that you have evaluated by using placement machines before going into mass production.

Do not use placement machines employing mechanical positioning.

Please contact Murata for details beforehand.

Continued on the following page. ↗

Notice -Crystal Units for Consumer and Industrial-

Continued from the preceding page. ↘

Notice (Storage and Operating Condition)

1. Product Storage Condition

Please store the products in room where the temperature/humidity is stable. And avoid such places where there are large temperature changes. Please store the products under the following conditions:

Temperature: -10 to + 40 degrees C

Humidity: 15 to 85% R.H.

2. Expire Date on Storage

Expiration date (shelf life) of the products is 6 months after delivery under the conditions of an unopened package. Please use the products within 6 months after delivery. If you store the products for a long time (more than 6 months), use carefully because the products may be degraded in solderability and/or rusty.

Please confirm solderability and characteristics for the products regularly.

3. Notice on Product Storage

(1) Please do not store the products in a chemical atmosphere (Acids, Alkali, Bases, Organic gas, Sulfides and so on), because the characteristics may be reduced in quality, and/or be degraded in solderability due to the storage in a chemical atmosphere.

(2) Please do not put the products directly on the floor without anything under them to avoid damp places and/or dusty places.

(3) Please do not store the products in the places under direct sunlight, heat and vibration.

(4) Please use the products immediately after the package is opened, because the characteristics may be reduced in quality, and/or be degraded in solderability due to storage under poor conditions.

(5) Please do not drop the products to avoid cracking the crystal element.

Notice (Rating)

The component may be damaged if excess mechanical stress is applied.

Notice (Handling)

1. Please confirm circuit the conditions on your set, because irregular or stop oscillation may occur under unmatched circuit conditions.

2. Be sure to provide an appropriate fail-safe function on your product to prevent a second damage that may be caused by the abnormal function or the failure of our product.

3. Please do not use these products in the following applications in transportation equipment: vehicles, trains, ships, etc.

(example: engine control, brake control, steering control, body control.)

Notice -Crystal Units for Consumer and Industrial-

1

<XRCGB_F_H/P/M/L, XRCPB_F_P/M/L, XRCHA_F_L, XRCLK, XRCLH Series>

Notice (Soldering and Mounting)

1.1. Soldering Condition

(1) Reflow

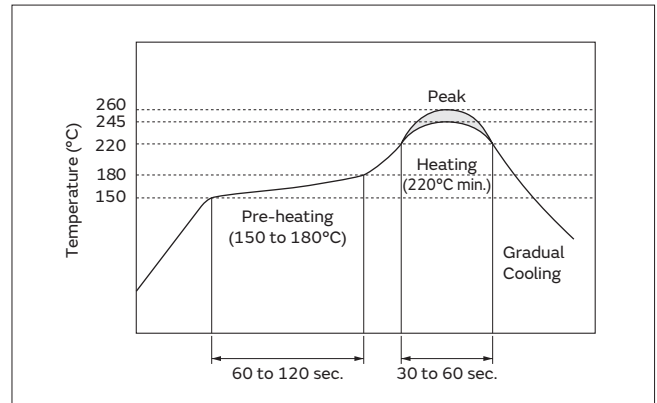
Please mount components on a circuit board by the reflow soldering.

Flux: Please use rosin based flux; but do not use water soluble flux.

Solder: Please use solder (Sn-3.0Ag-0.5Cu) under the following condition.

Standard thickness of soldering paste: 0.10 to 0.15mm

	Condition	
Pre-heating	150 to 180°C	60 to 120 sec.
Heating	220°C min.	30 to 60 sec.
Peak Temperature	245°C min. 260°C max. 5 sec. max.	



(2) Soldering Iron

If compelled to mount the component by using a soldering iron, please do not directly touch the component with the soldering iron. The component terminals or electrical characteristics may be damaged if excessive thermal stress is applied. Please keep solder away from the metal cap (Lid) portion.

	Condition
Pre-heating	150°C 60 sec.
Heating of the Soldering Iron	350°C max.
Watt	30W max.
Shape of the Soldering Iron	ø3mm max.
Soldering Time	5 sec. max.
Solder	Sn-3.0Ag-0.5Cu

1.2. Optimum Solder Amount for Soldering

Please keep the solder volume below the height of the substrate. When exceeding the substrate, the damage of sealing part between the metal cap and the substrate may occur.

2. Wash

The component cannot withstand washing.

3. Notice for Mounting

The component is recommended with placement machines employing optical placement capabilities. The component might be damaged by mechanical force depending on placement machine and condition. Make sure that you have evaluated by using placement machines before going into mass production. Do not use placement machines employing mechanical positioning. Please contact Murata for details beforehand.

Continued on the following page. ↗

Notice -Crystal Units for Consumer and Industrial-

Continued from the preceding page. ↘

Notice (Storage and Operating Condition)

1. Product Storage Condition

Please store the products in room where the temperature/humidity is stable. And avoid such places where there are large temperature changes. Please store the products under the following conditions:

Temperature: -10 to + 40 degrees C

Humidity: 15 to 85% R.H.

2. Expire Date on Storage

Expiration date (shelf life) of the products is 6 months after delivery under the conditions of an unopened package. Please use the products within 6 months after delivery. If you store the products for a long time (more than 6 months), use carefully because the products may be degraded in solderability and/or rusty.

Please confirm solderability and characteristics for the products regularly.

3. Notice on Product Storage

(1) Please do not store the products in a chemical atmosphere (Acids, Alkali, Bases, Organic gas, Sulfides and so on), because the characteristics may be reduced in quality, and/or be degraded in solderability due to the storage in a chemical atmosphere.

(2) Please do not put the products directly on the floor without anything under them to avoid damp places and/or dusty places.

(3) Please do not store the products in the places under direct sunlight, heat and vibration.

(4) Please use the products immediately after the package is opened, because the characteristics may be reduced in quality, and/or be degraded in solderability due to storage under poor conditions.

(5) Please do not drop the products to avoid cracking the crystal element.

4. Other

Conformal coating or washing of the component is not acceptable.

Please be sure to consult with our sales representative or engineer prior to using the products.

Notice (Rating)

The component may be damaged if excess mechanical stress is applied.

Notice (Handling)

1. Please confirm circuit the conditions on your set, because irregular or stop oscillation may occur under unmatched circuit conditions.

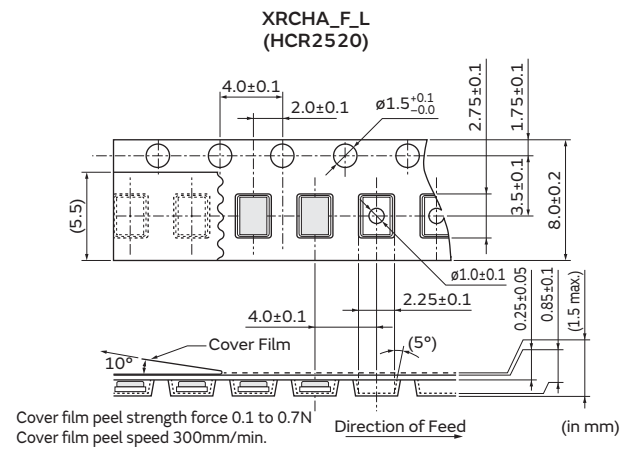
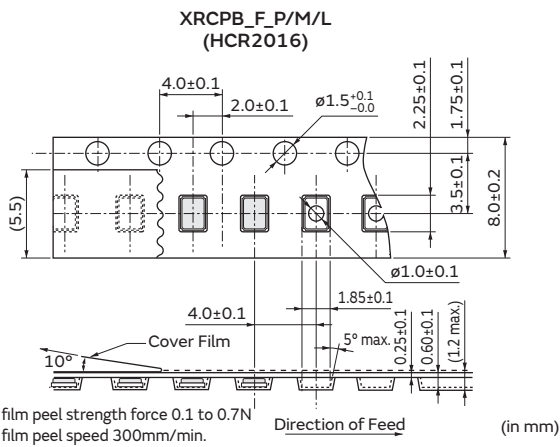
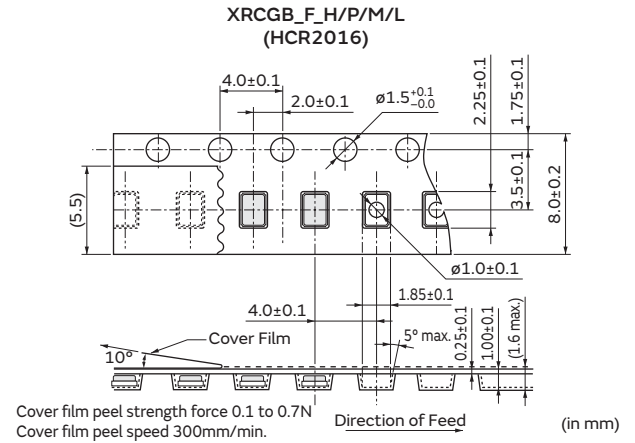
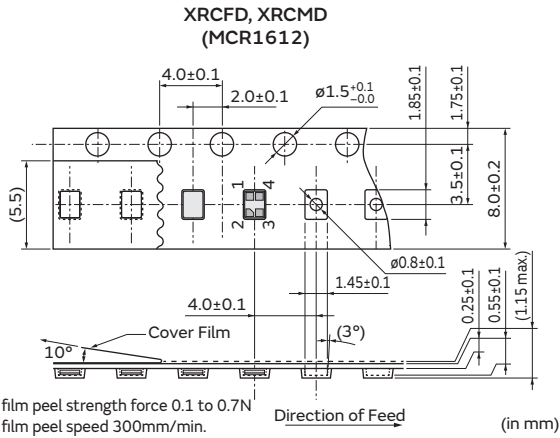
2. Be sure to provide an appropriate fail-safe function on your product to prevent a second damage that may be caused by the abnormal function or the failure of our product.

3. Please do not use these products in the following applications in transportation equipment: vehicles, trains, ships, etc.

(example: engine control, brake control, steering control, body control.)

Packaging -Crystal Units for Consumer and Industrial-

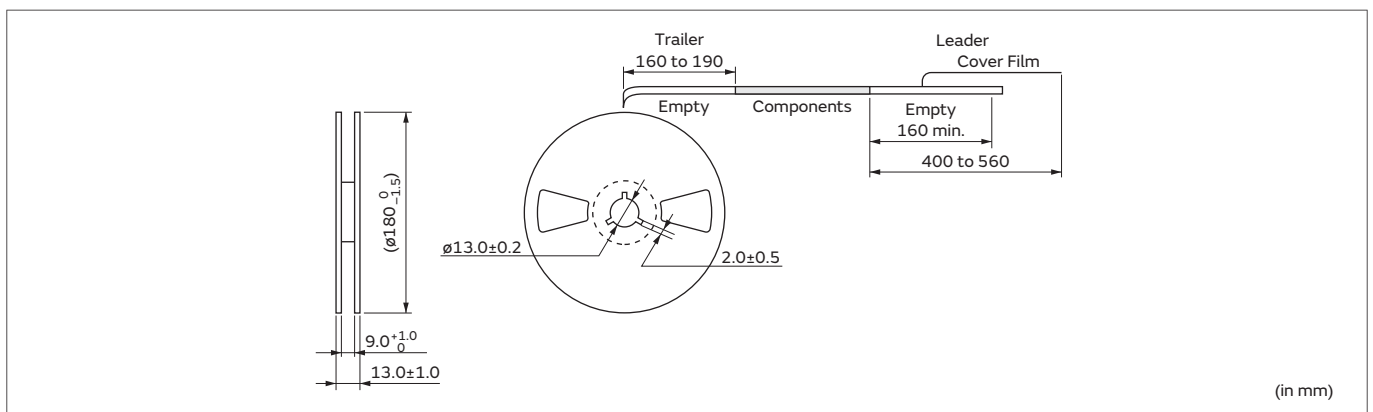
Dimensions of Taping



Minimum Quantity/Dimensions of Reel

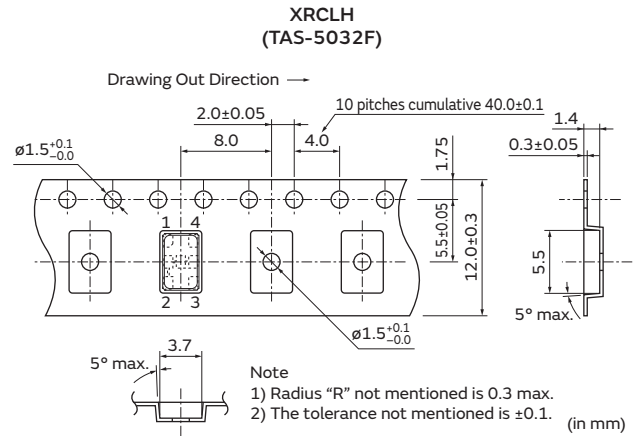
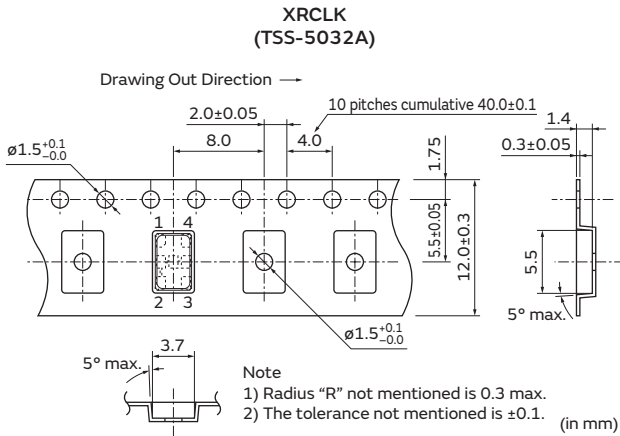
Plastic Tape ø180mm	Plastic Tape ø330mm
3,000	9,000

(pcs.)



1 Packaging -Crystal Units for Consumer and Industrial-

Dimensions of Taping

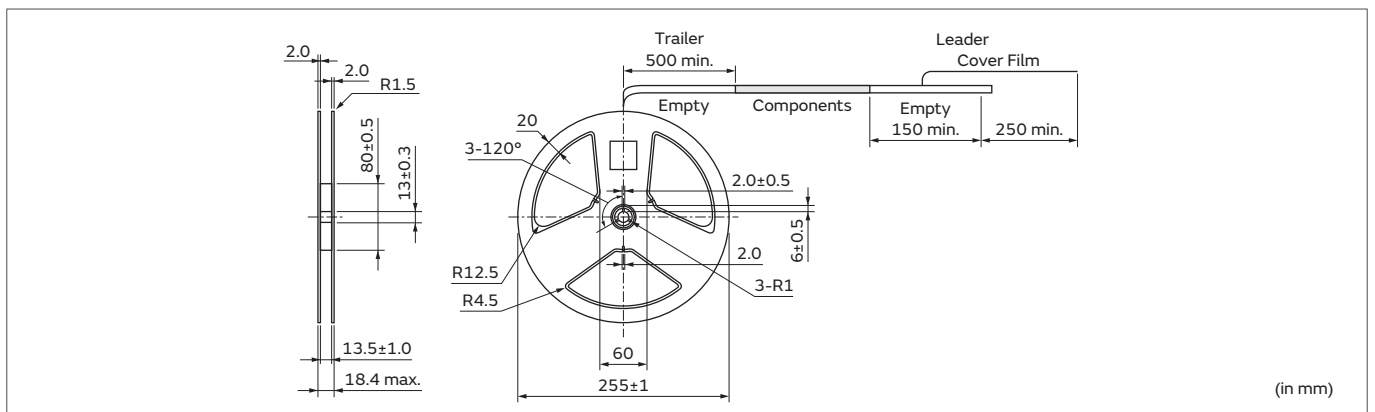


Minimum Quantity/Dimensions of Reel

Plastic Tape $\phi 255\text{mm}$

3,000

(pcs.)



Crystal Oscillators

for Consumer and Industrial



We offer a varied lineup of TCXO (Temperature compensated crystal oscillator)/VC-TCXO (Voltage-controlled temperature compensated crystal oscillator) based on highly reliable crystal units, superior temperature compensation and adjusting method fostered by our long experience and expertise.

Features

1. Excellent frequency stability over temperature
2. Low profile
3. Low supply voltage
4. SMD type (Reflow soldering available)
5. The series complies to RoHS directive, being lead-free (phase 3).

Applications

1. Business radios
2. GPS (GNSS) systems
3. Small cells
4. Wireless devices

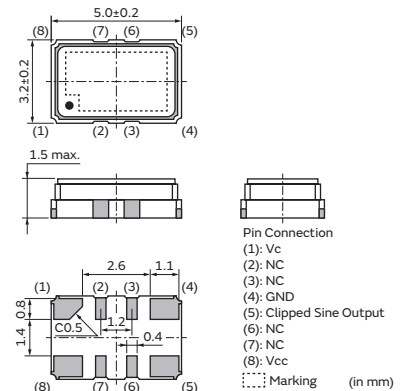
Series

Series	Type	Size	Package	Frequency (MHz)	Frequency Tolerance (ppm max.) [at 25°C±3°C]	Frequency Shift by Temperature (ppm max.) [Standard Condition: +25°C]	Frequency Aging (ppm max./Year)	Operating Temperature Range (°C)	VC Function
XTCLH_J	TTS14VSH	5032	Metal	10.0000 to 50.0000	±0.5	±0.2	±0.5	-40 to +85°C	○
	TTS14VCH					±0.28			

Part Number List

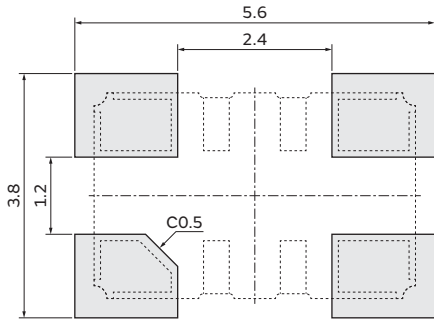
<XTCLH_J>

Part Number	Type	Frequency (MHz)	Frequency Tolerance (ppm max.)	Frequency Shift by Temperature (ppm max.) [Standard Condition: +25°C]	Frequency Aging (ppm max./Year)	Frequency Controlled Range (ppm)	Output
XTCLH19M200TJJC3PO	TTS14VSH	19.2000	±0.5ppm max. (25±3°C)	±0.2(-40 to +85°C)	±0.5	±3min. to ±6max.	Clipped Sine Wave
XTCLH25M000TJA5PO	TTS14VSH	25.0000	±0.5ppm max. (25±3°C)	±0.2(-40 to +85°C)	±0.5	±3min. to ±6max.	Clipped Sine Wave
XTCLH26M000TJA6PO	TTS14VSH	26.0000	±0.5ppm max. (25±3°C)	±0.2(-40 to +85°C)	±0.5	±3min. to ±6max.	Clipped Sine Wave
XTCLH20M000CYJB6PO	TTS14VCH	20.0000	±1.12ppm max. (25±2°C)	±0.28(-40 to +85°C)	±0.8	±4.12min. to ±9max.	CMOS
XTCLH40M000CYJC4PO	TTS14VCH	40.0000	±1.12ppm max. (25±2°C)	±0.28(-40 to +85°C)	±0.8	±4.12min. to ±9max.	CMOS
XTCLH10M000CHJA1PO	TTS14VCH	10.0000	±0.5ppm max. (25±3°C)	±0.28(-40 to +85°C)	±0.5	±3min. to ±6max.	CMOS
XTCLH20M000CHJA0PO	TTS14VCH	20.0000	±0.5ppm max. (25±3°C)	±0.28(-40 to +85°C)	±0.5	±3min. to ±6max.	CMOS
XTCLH40M000CHJA0PO	TTS14VCH	40.0000	±0.5ppm max. (25±3°C)	±0.28(-40 to +85°C)	±0.5	±3min. to ±6max.	CMOS
XTCLH50M000CHJA3PO	TTS14VCH	50.0000	±0.5ppm max. (25±3°C)	±0.28(-40 to +85°C)	±0.5	±3min. to ±6max.	CMOS



Standard Land Pattern Dimensions

XTCLH_J (TTS14VSH/TTS14VCH)



(in mm)

Notice -Crystal Oscillators for Consumer and Industrial-

Notice (Soldering and Mounting)

1.1. Soldering Condition

(1) Reflow

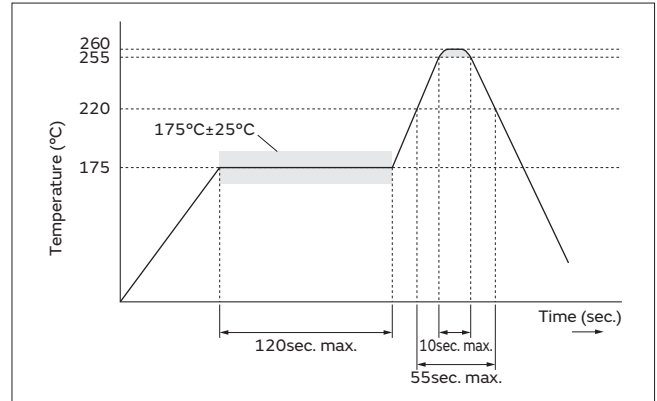
Please mount components on a circuit board by the reflow soldering.

Flux: Please use rosin based flux; but do not use water soluble flux.

Solder: Please use solder (Sn-3.0Ag-0.5Cu) under the following condition.

Standard thickness of soldering paste: 0.10 to 0.15mm

	Condition	
Pre-heating	150 to 200°C	120 sec. max.
Heating	220°C min.	55 sec. max.
Peak Temperature	255°C min. 260°C max.	10 sec. max.



(2) Soldering Iron

If compelled to mount the component by using a soldering iron, please do not directly touch the component with the soldering iron. The component terminals or metal lid may be damaged if excessive thermal stress is applied.

	Condition
Pre-heating	150°C 60 sec.
Heating of the Soldering Iron	350°C max.
Watt	30W max.
Shape of the Soldering Iron	ø3mm max.
Soldering Time	5 sec. max.
Solder	Sn-3.0Ag-0.5Cu

1.2. Optimum Solder Amount for Soldering

Please keep the solder volume below the height of the substrate. When exceeding the substrate, damage of sealing part between the metal cap and the substrate may occur.

2. Wash

The component cannot withstand washing.

3. Notice for Mounting

The component is recommended with placement machines employing optical placement capabilities. The component might be damaged by mechanical force depending on placement machine and condition. Make sure that you have evaluated by using placement machines before going into mass production. Do not use placement machines employing mechanical positioning. Please contact Murata for details beforehand.

Continued on the following page. ↗

Notice -Crystal Oscillators for Consumer and Industrial-

Continued from the preceding page. ↘

Notice (Storage and Operating Condition)

1. Product Storage Condition

Please store the products in a room where the temperature/humidity is stable. And avoid such places where there are large temperature changes. Please store the products under the following conditions:

Temperature: -10 to + 40 degrees C

Humidity: 15 to 85% R.H.

2. Expire Date on Storage

Expiration date (shelf life) of the products is 6 months after delivery under the conditions of an unopened package. Please use the products within 6 months after delivery. If you store the products for a long time (more than 6 months), use carefully because the products may be degraded in solderability and/or rusty.

Please confirm solderability and characteristics for the products regularly.

3. Notice on Product Storage

(1) Please do not store the products in a chemical atmosphere (Acids, Alkali, Bases, Organic gas, Sulfides and so on), because the characteristics may be reduced in quality, and/or be degraded in the solderability due to storage in a chemical atmosphere.

(2) Please do not put the products directly on the floor without anything under them to avoid damp places and/or dusty places.

(3) Please do not store the products in the places under direct sunlight, heat and vibration.

(4) Please use the products immediately after the package is opened, because the characteristics may be reduced in quality, and/or be degraded in solderability due to storage under poor conditions.

(5) Please do not drop the products to avoid cracking the crystal element.

4. Other

Conformal coating or washing of the component is not acceptable.

Please be sure to consult with our sales representative or engineer whenever and prior to using the products.

Notice (Rating)

The component may be damaged if excess mechanical stress is applied.

Notice (Handling)

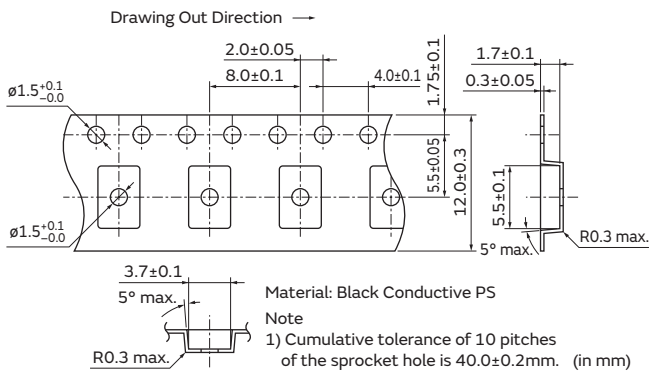
1. Be sure to provide an appropriate fail-safe function on your product to prevent a second damage that may be caused by the abnormal function or the failure of our product.

2. Please do not use these products in the following applications in transportation equipment (vehicles, trains, ships, etc.).
(example: engine control, brake control, steering control, body control.)

Packaging -Crystal Oscillators for Consumer and Industrial-

Dimensions of Taping

XTCLH_J (TTS14VSH/TTS14VCH)

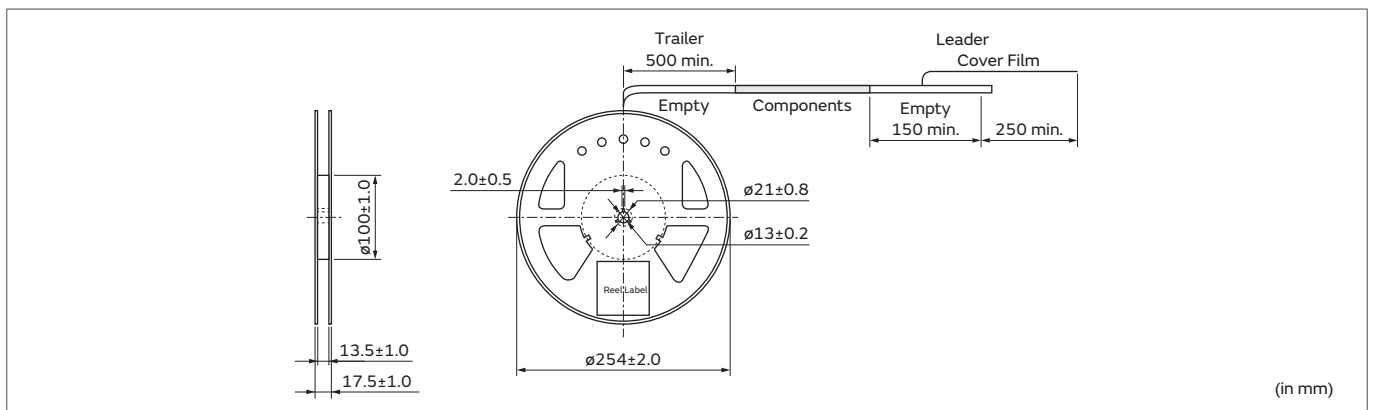


Minimum Quantity/Dimensions of Reel

Plastic Tape ø255mm

2,000

(pcs.)



Crystal Units

for Automotive



These crystal units for automotive feature a small package and highly accurate frequency, based on Murata's excellent package technology and high grade quartz crystal elements.

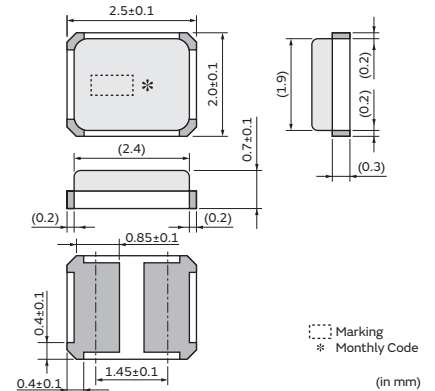
Features

1. The series has high reliability and is available for a wide temperature range.
2. The crystal units are extremely small, contributing to a reduction in the mounting area.
3. The series complies to RoHS and ELV directives, being lead-free (phase 3).
4. The series complies to AEC-Q200.

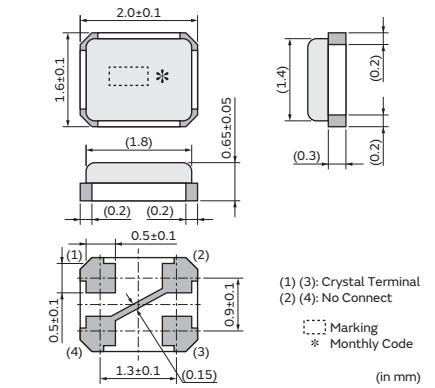
Applications

1. Power Train (ex. Engine/Transmission management ECU)
2. ADAS (ex. Camera for driver assist, Image processing, Emergency Brake Assist ECU)
3. Chassis, Safety applications, etc.
4. Car multimedia equipment.

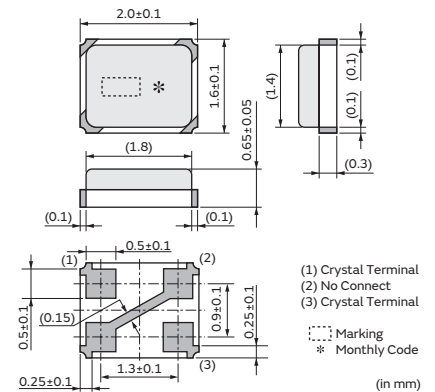
XRCHA_F_A
 (HCR2520)
 16.0000–24.0000MHz



XRCGB_F_A
 (HCR2016)
 24.0000–48.0000MHz



XRCGB_F_G
 (HCR2016)
 24.0000–48.0000MHz



Series

Series	Type	Package	Frequency (MHz)	Frequency Tolerance (ppm max.) [at 25°C±3°C]	Frequency Shift by Temperature (ppm max.) [Standard Condition: +25°C]	Frequency Aging (ppm max./Year)	Operating Temperature Range (°C)	Applications
XRCHA_F_A	HCR2520	Resin	16.0000 to 24.0000	±100	±100	±5	-40 to +125*	ADAS, Power Train, Chassis, Safety
XRCGB_F_A	HCR2016		24.0000 to 48.0000	±30/±50	±35/±65	±2	-40 to +125	ADAS, Power Train, Chassis, Safety
XRCGB_F_G				±30/±45/±100	±50	±5	-40 to +85	Car Multimedia

* +150°C is available.

Part Number List

<XRCHA_F_A (For Automotive)>

Part Number	Type	Frequency (MHz)	Frequency Tolerance (ppm max.) [at 25°C±3°C]	Frequency Shift by Temperature (ppm max.) [Standard Condition: +25°C]	Frequency Aging (ppm max./Year)	ESR* (Ωmax.)	Load Capacitance (pF)	Drive Level (μW max.)
XRCHA16M000FOA01R0	HCR2520	16.0000	±100	±100 (-40 to +125°C)	±5	100	8	300
XRCHA16M000FOA11R0	HCR2520	16.0000	±100	±100 (-40 to +125°C)	±5	100	8	600
XRCHA16M000FOA12R0	HCR2520	16.0000	±100	±100 (-40 to +150°C)	±5	100	8	300
XRCHA16M000FOA13R0	HCR2520	16.0000	±100	±100 (-40 to +150°C)	±5	100	8	600
XRCHA20M000FOA01R0	HCR2520	20.0000	±100	±100 (-40 to +125°C)	±5	80	8	300
XRCHA20M000FOA11R0	HCR2520	20.0000	±100	±100 (-40 to +125°C)	±5	80	8	600
XRCHA20M000FOA12R0	HCR2520	20.0000	±100	±100 (-40 to +150°C)	±5	80	8	300
XRCHA20M000FOA13R0	HCR2520	20.0000	±100	±100 (-40 to +150°C)	±5	80	8	600
XRCHA24M000FOA01R0	HCR2520	24.0000	±100	±100 (-40 to +125°C)	±5	80	8	300
XRCHA24M000FOA11R0	HCR2520	24.0000	±100	±100 (-40 to +125°C)	±5	80	8	600
XRCHA24M000FOA12R0	HCR2520	24.0000	±100	±100 (-40 to +150°C)	±5	80	8	300
XRCHA24M000FOA13R0	HCR2520	24.0000	±100	±100 (-40 to +150°C)	±5	80	8	600

* Equivalent Series Resistance

<XRCGB_F_A (For Automotive)>

Part Number	Type	Frequency (MHz)	Frequency Tolerance (ppm max.) [at 25°C±3°C]	Frequency Shift by Temperature (ppm max.) [Standard Condition: +25°C]	Frequency Aging (ppm max./Year)	ESR* (Ωmax.)	Load Capacitance (pF)	Drive Level (μW max.)
XRCGB24M000F3A00R0	HCR2016	24.0000	±30	±35 (-40 to +125°C)	±2	120	6	300
XRCGB25M000F3A00R0	HCR2016	25.0000	±30	±35 (-40 to +125°C)	±2	100	6	300
XRCGB26M000F3A00R0	HCR2016	26.0000	±30	±35 (-40 to +125°C)	±2	80	6	300
XRCGB27M000F3A00R0	HCR2016	27.0000	±30	±35 (-40 to +125°C)	±2	80	6	300
XRCGB27M120F3A00R0	HCR2016	27.1200	±30	±35 (-40 to +125°C)	±2	80	6	300
XRCGB30M000F5A00R0	HCR2016	30.0000	±50	±65 (-40 to +125°C)	±2	70	6	300
XRCGB40M000F5A00R0	HCR2016	40.0000	±50	±65 (-40 to +125°C)	±2	70	6	300
XRCGB48M000F5A00R0	HCR2016	48.0000	±50	±65 (-40 to +125°C)	±2	60	6	300

* Equivalent Series Resistance

<XRCGB_F_G (For Car Multimedia)>

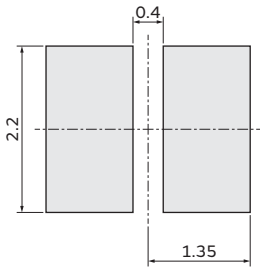
Part Number	Type	Frequency (MHz)	Frequency Tolerance (ppm max.) [at 25°C±3°C]	Frequency Shift by Temperature (ppm max.) [Standard Condition: +25°C]	Frequency Aging (ppm max./Year)	ESR* (Ωmax.)	Load Capacitance (pF)	Drive Level (μW max.)
XRCGB24M000FOG00R0	HCR2016	24.0000	±100	±50 (-40 to +85°C)	±5	150	6	300
XRCGB24M000F3G00R0	HCR2016	24.0000	±30	±50 (-40 to +85°C)	±5	150	6	300
XRCGB24M576FOG00R0	HCR2016	24.5760	±100	±50 (-40 to +85°C)	±5	150	6	300
XRCGB24M576F3G00R0	HCR2016	24.5760	±30	±50 (-40 to +85°C)	±5	150	6	300
XRCGB25M000FOG00R0	HCR2016	25.0000	±100	±50 (-40 to +85°C)	±5	150	6	300
XRCGB25M000F3G00R0	HCR2016	25.0000	±30	±50 (-40 to +85°C)	±5	150	6	300
XRCGB26M000FOG00R0	HCR2016	26.0000	±100	±50 (-40 to +85°C)	±5	150	6	300
XRCGB26M000F3G00R0	HCR2016	26.0000	±30	±50 (-40 to +85°C)	±5	150	6	300
XRCGB27M000FOG00R0	HCR2016	27.0000	±100	±50 (-40 to +85°C)	±5	150	6	300
XRCGB27M000F3G00R0	HCR2016	27.0000	±30	±50 (-40 to +85°C)	±5	150	6	300
XRCGB27M120F3G00R0	HCR2016	27.1200	±30	±50 (-40 to +85°C)	±5	150	6	300
XRCGB30M000FOG00R0	HCR2016	30.0000	±100	±50 (-40 to +85°C)	±5	100	6	300
XRCGB30M000F3G00R0	HCR2016	30.0000	±30	±50 (-40 to +85°C)	±5	100	6	300
XRCGB33M868FOG00R0	HCR2016	33.8688	±100	±50 (-40 to +85°C)	±5	100	6	300
XRCGB33M868F4G00R0	HCR2016	33.8688	±45	±50 (-40 to +85°C)	±5	100	6	300
XRCGB40M000FOG00R0	HCR2016	40.0000	±100	±50 (-40 to +85°C)	±5	100	6	300
XRCGB40M000F4G00R0	HCR2016	40.0000	±45	±50 (-40 to +85°C)	±5	100	6	300
XRCGB48M000FOG00R0	HCR2016	48.0000	±100	±50 (-40 to +85°C)	±5	100	6	300
XRCGB48M000F4G00R0	HCR2016	48.0000	±45	±50 (-40 to +85°C)	±5	100	6	300

* Equivalent Series Resistance

Standard Land Pattern Dimensions

XRCHA_F_A
(HCR2520)

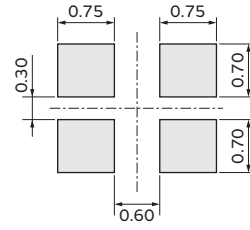
(Recommended Land Pattern)



(in mm)

XRCGB_F_A/G
(HCR2016)

(Recommended Land Pattern)



(in mm)

Notice -Crystal Units for Automotive-

Notice (Soldering and Mounting)

1.1. Soldering Condition

(1) Reflow

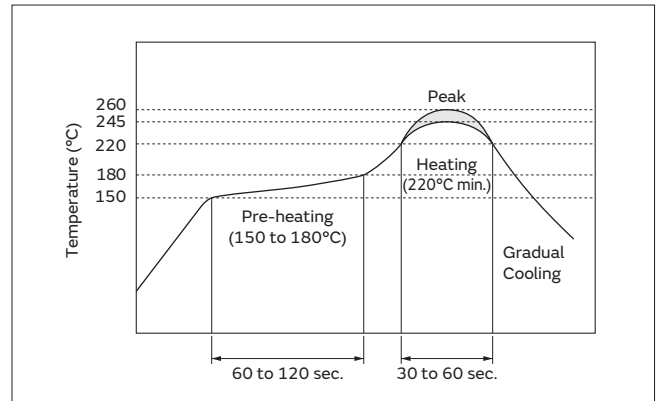
Please mount components on a circuit board by the reflow soldering.

Flux: Please use rosin based flux; but do not use water soluble flux.

Solder: Please use solder (Sn-3.0Ag-0.5Cu) under the following condition.

Standard thickness of soldering paste: 0.10 to 0.15mm

	Condition	
Pre-heating	150 to 180°C	60 to 120 sec.
Heating	220°C min.	30 to 60 sec.
Peak Temperature	245°C min. 260°C max. 5 sec. max.	



(2) Soldering Iron

If compelled to mount the component by using a soldering iron, please do not directly touch the component with the soldering iron. The component terminals or electrical characteristics may be damaged if excessive thermal stress is applied.

	Condition
Pre-heating	150°C 60 sec.
Heating of the Soldering Iron	350°C max.
Watt	30W max.
Shape of the Soldering Iron	ø3mm max.
Soldering Time	5 sec. max.
Solder	Sn-3.0Ag-0.5Cu

1.2. Optimum Solder Amount for Soldering

Please keep the solder volume below the height of the substrate. When exceeding the substrate, damage of sealing part between the metal cap and the substrate may occur.

2. Wash

The component cannot withstand washing.

3. Notice for Mounting

The component is recommended with placement machines employing optical placement capabilities. The component might be damaged by mechanical force depending on placement machine and condition. Make sure that you have evaluated by using placement machines before going into mass production. Do not use placement machines employing mechanical positioning. Please contact Murata for details beforehand.

Continued on the following page. ↗

Notice -Crystal Units for Automotive-

Continued from the preceding page. ↘

Notice (Storage and Operating Condition)

1. Product Storage Condition

Please store the products in room where the temperature/humidity is stable. And avoid such places where there are large temperature changes. Please store the products under the following conditions:

Temperature: -10 to + 40 degrees C

Humidity: 15 to 85% R.H.

2. Expire Date on Storage

Expiration date (shelf life) of the products is 6 months after delivery under the conditions of an unopened package. Please use the products within 6 months after delivery. If you store the products for a long time (more than 6 months), use carefully because the products may be degraded in solderability and/or rusty.

Please confirm solderability and characteristics for the products regularly.

3. Notice on Product Storage

(1) Please do not store the products in a chemical atmosphere (Acids, Alkali, Bases, Organic gas, Sulfides and so on), because the characteristics may be reduced in quality, and/or be degraded in solderability due to the storage in a chemical atmosphere.

(2) Please do not put the products directly on the floor without anything under them to avoid damp places and/or dusty places.

(3) Please do not store the products in the places under direct sunlight, heat and vibration.

(4) Please use the products immediately after the package is opened, because the characteristics may be reduced in quality, and/or be degraded in solderability due to storage under poor conditions.

(5) Please do not drop the products to avoid cracking the crystal element.

4. Other

Conformal coating or washing of the component is not acceptable because it is not hermetically sealed.

Please be sure to consult with our sales representative or engineer whenever and prior to using the products.

Notice (Rating)

The component may be damaged if excess mechanical stress is applied.

Notice (Handling)

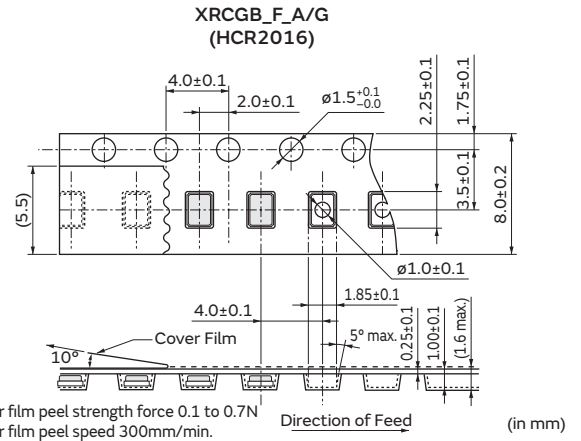
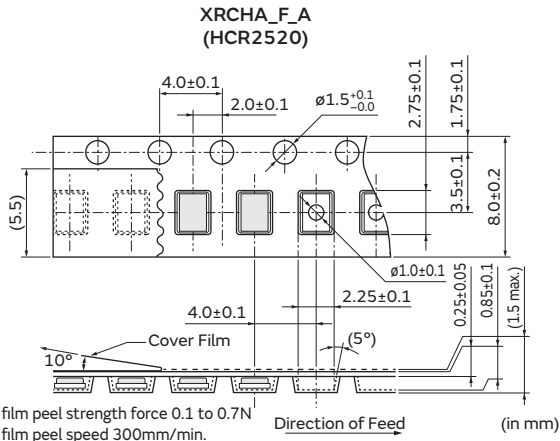
1. Irregular or stopped oscillation may occur under unmatched circuit conditions.

Please design your oscillation circuit to get 5 times or more of a negative resistance against the maximum value of the Equivalent Series Resistance, that is specified in order.

2. Be sure to provide an appropriate fail-safe function on your product to prevent a second damage that may be caused by the abnormal function or the failure of our product.

Packaging -Crystal Units for Automotive-

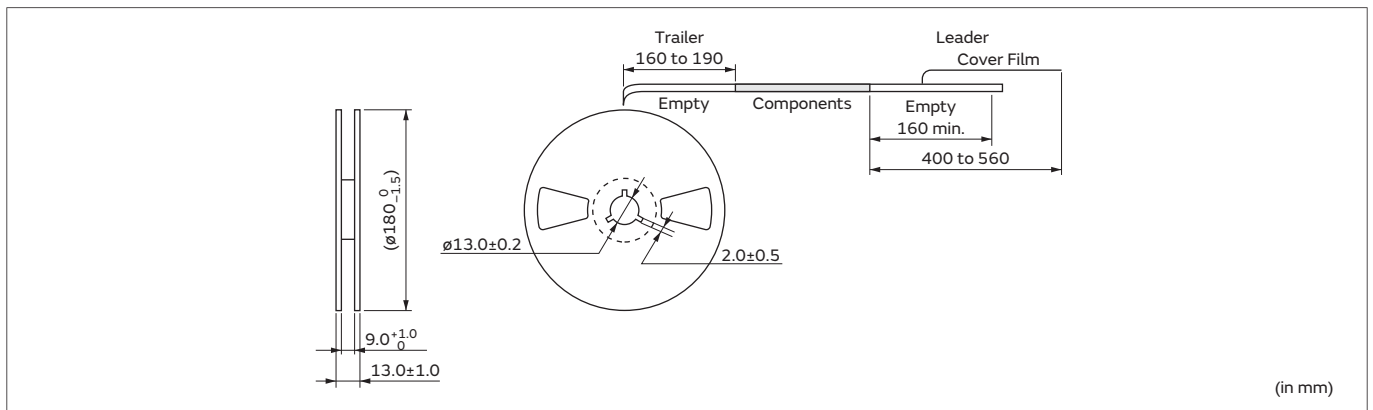
Dimensions of Taping



Minimum Quantity/Dimensions of Reel

Plastic Tape ø180mm	Plastic Tape ø330mm
3,000	9,000

(pcs.)



Measuring Circuit of Crystal Units

Measuring Circuit

1. Frequency Measuring Method

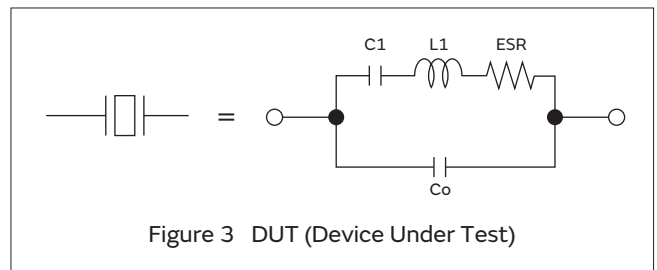
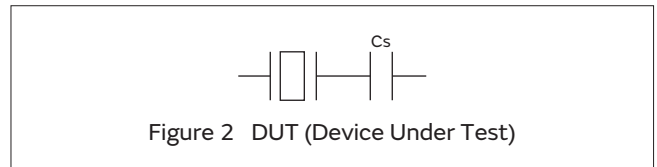
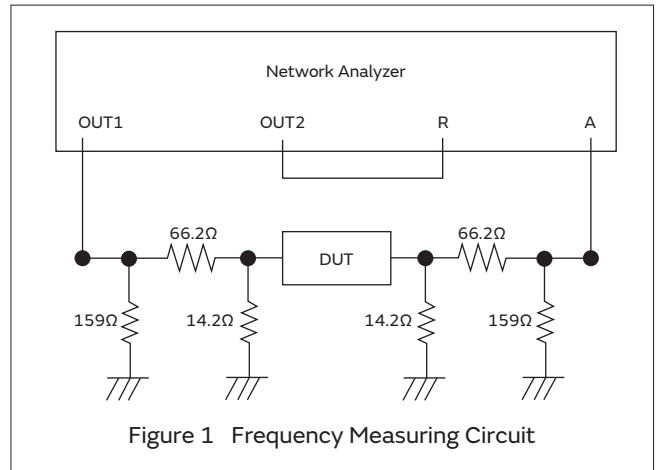
The load resonance frequency (Lower frequency of the two given when the electrical impedance of the component becomes resistant near its resonance point) is measured by network analyzer (KEYSIGHT E5100A or the equivalent) and the circuit in Figure 1. DUT is shown in Figure 2, and the value of Cs refers to the load capacitance value in specifications.

2. Equivalent Series Resistance

The equivalent series resistance (ESR) is measured by network analyzer (KEYSIGHT E5100A or equivalent) and the circuit in Figure 1. DUT is shown in Figure 3.

3. Measuring Condition

Standard conditions for measurement shall be $+25\pm 3^{\circ}\text{C}$ temperature and humidity of 45 to 85%R.H.



Global Locations

For details please visit www.murata.com



⚠ Note

1 Export Control

For customers outside Japan:

No Murata products should be used or sold, through any channels, for use in the design, development, production, utilization, maintenance or operation of, or otherwise contribution to (1) any weapons (Weapons of Mass Destruction [nuclear, chemical or biological weapons or missiles] or conventional weapons) or (2) goods or systems specially designed or intended for military end-use or utilization by military end-users.

For customers in Japan:

For products which are controlled items subject to the "Foreign Exchange and Foreign Trade Law" of Japan, the export license specified by the law is required for export.

2 Please contact our sales representatives or product engineers before using the products in this catalog for the applications listed below, which require especially high reliability for the prevention of defects which might directly damage a third party's life, body or property, or when one of our products is intended for use in applications other than those specified in this catalog.

- ① Aircraft equipment
- ② Aerospace equipment
- ③ Undersea equipment
- ④ Power plant equipment
- ⑤ Medical equipment
- ⑥ Transportation equipment (vehicles, trains, ships, etc.)
- ⑦ Traffic signal equipment
- ⑧ Disaster prevention / crime prevention equipment
- ⑨ Data-processing equipment
- ⑩ Application of similar complexity and/or reliability requirements to the applications listed above

3 Product specifications in this catalog are as of October 2018. They are subject to change or our products in it may be discontinued without advance notice. Please check with our sales representatives or product engineers before ordering. If there are any questions, please contact our sales representatives or product engineers.

4 Please read rating and ⚠CAUTION (for storage, operating, rating, soldering, mounting and handling) in this catalog to prevent smoking and/or burning, etc.

5 This catalog has only typical specifications. Therefore, please approve our product specifications or transact the approval sheet for product specifications before ordering.

6 Please note that unless otherwise specified, we shall assume no responsibility whatsoever for any conflict or dispute that may occur in connection with the effect of our and/or a third party's intellectual property rights and other related rights in consideration of your use of our products and/or information described or contained in our catalogs. In this connection, no representation shall be made to the effect that any third parties are authorized to use the rights mentioned above under licenses without our consent.

7 No ozone depleting substances (ODS) under the Montreal Protocol are used in our manufacturing process.

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