

























Quartz Crystals  
Clock Oscillators  
TCXO, VCXO, VCTCXO  
Ceramic Resonators  
SAW Filters

Technical Data








Edition 11












Quartz Crystals	size mm	frequency range	page
 SMD KX-327S	8,7/3,8/2,5	32,768 kHz	04
 SMD KX-327L	7,0/1,5/1,4	32,768 kHz	05
 SMD KX-327NHT	3,2/1,5/0,90	32,768 kHz	06
 SMD KX-327XS	4,95/1,82/0,96	32,768 kHz	07
 SMD KX-5	2,0/1,6/0,45	20,0 ~ 80,0 MHz	08
 SMD KX-6	2,5/2,0/0,55	16,0 ~ 80,0 MHz	09
 SMD KX-7	3,2/2,5/1,2	12,0 ~ 60,0 MHz	10
 SMD KX-8	4,0/2,5/0,8	12,0 ~ 60,0 MHz	11
 SMD KX-9A	5,0/3,2/1,0	8,0 ~ 300,0 MHz	12
 SMD KX-12B	6,0/3,5/1,2	8,0 ~ 50,0 MHz	13
 SMD KX-13	7,0/5,0/1,3	6,0 ~ 160,0 MHz	14
 SMD KX-20	11,6/5,5/1,6	3,579545 ~ 25,0 MHz	15
 SMD KX-K/KX-KS	12,3/4,5/4,2 (3,2)	3,50 ~ 70,0 MHz	16
 SMD KX-C	12,5/4,6/3,7	3,50 ~ 30,0 MHz	17
 Low profile HC-49/U3H KX-3H	11,35/5,0/3,50	3,20 ~ 70,0 MHz	18
 HC-49/U KX-49	11,3/4,9/13,6	1,84320 ~ 200,0 MHz	19
 Cylindrical types 2x6mm, 3x8mm, 3x9mm KX-26 KX-38 KX-39	6,2/2,0 Ø - 8,0/3,0 Ø	32,768 kHz / 77,50 kHz	20

Clock Oscillators	size mm	frequency range	page
 SMD KXO-V95 2,5 ~ 3,3 Volt	2,5/2,0/0,82	1,0 ~ 70,0 MHz	21
 SMD KXO-V96 2,5 ~ 3,3 Volt	3,2/2,5/1,2	1,0 ~ 133,0 MHz	22
 SMD KXO-V99 1,8 ~ 3,3 Volt	5,0/3,2/1,2	1,0 ~ 200,0 MHz	23
 SMD KXO-V97 1,8 ~ 3,3 Volt	7,0/5,08/1,8	1,0 ~ 160,0 MHz	24
 SMD KXO-97 5,0 Volt	7,0/5,08/1,8	1,0 ~ 100,0 MHz	25
 DIL 14, KXO-200, KXO-400, TTL/CMOS, Tristate	20,8/13,2/5,08	0,5 ~ 100,0 MHz	26-27
 DIL 8, KXO-210, KXO-410, TTL/CMOS, Tristate	13,2/13,2/6,0	0,5 ~ 100,0 MHz	26-27

**Clock Oscillators**

			size mm	frequency range	page
	SMD VCXO	KXO-75	7,0/5,0/1,70	1,544 ~ 77,760 MHz	28
	SMD VCTCXO	KXO-82	7,0/5,0/2,0	12,60 ~ 20,0 MHz	29
	SMD VCTCXO	KXO-83	5,0/3,2/1,5	12,0 ~ 26,0 MHz	30
	SMD VCTCXO	KXO-84	3,2/2,5/0,9	12,60 ~ 26,0 MHz	31
	SMD LVDS	KXO-V65	7,0/5,0/1,7	19,440 ~ 700,0 MHz	32
	SMD LVDS VCXO	KXO-V63	7,0/5,0/1,7	27,0 ~ 700,0 MHz	33
	SMD PECL	KXO-67	7,0/5,0/1,7	50,0 ~ 212,50 MHz	34

**Ceramic Resonators**

			size mm	frequency range	page
	SMD KX-ZTT-CW MX		2,4/1,9/1,5	16,0 ~ 50,0 MHz	35
	SMD KX-ZTT-CV MT/MX		3,7/3,1/1,0	8,0 ~ 50,0 MHz	36
	SMD KX-ZTT-CE MG		3,2/1,3/1,0	8,0 ~ 12,0 MHz	37
	SMD KX-ZTT-CR MG		4,5/2,0/1,2	4,0 ~ 8,0 MHz	38
	SMD KX-ZTT-CC MG		7,4/3,4/1,8	1,84 ~ 8,0 MHz	39
	SMD KX-ZTT-CS MT/MX		4,7/4,1/1,6	8,0 ~ 50,0 MHz	40
	KX-ZTT series		10,0/5,5/8,0(10,0)	1,84 ~ 50,0 MHz	41
	KX-ZTA series		10,0/5,0/7,5(10,0)	1,84 ~ 50,0 MHz	42
	KX-ZTB series			190 ~ 1250 kHz	43
Ceramic Resonators - Precaution of Handling					44

**Filters**

45-47

**Terms and Conditions of Delivery and Payment**

48-49


**Fax order sheet for samples free of charge**

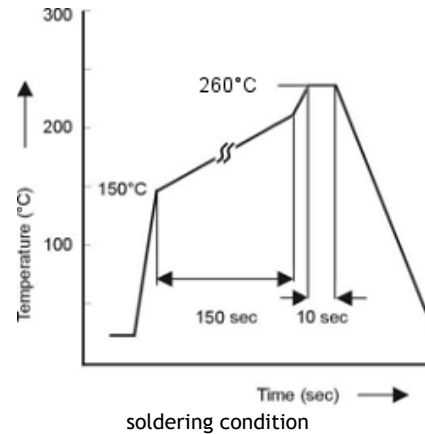
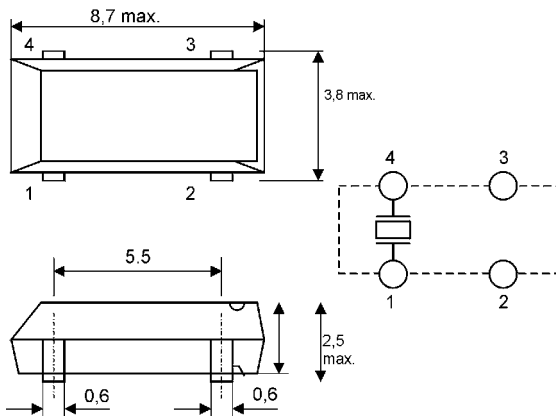
50

# Quartz Crystal

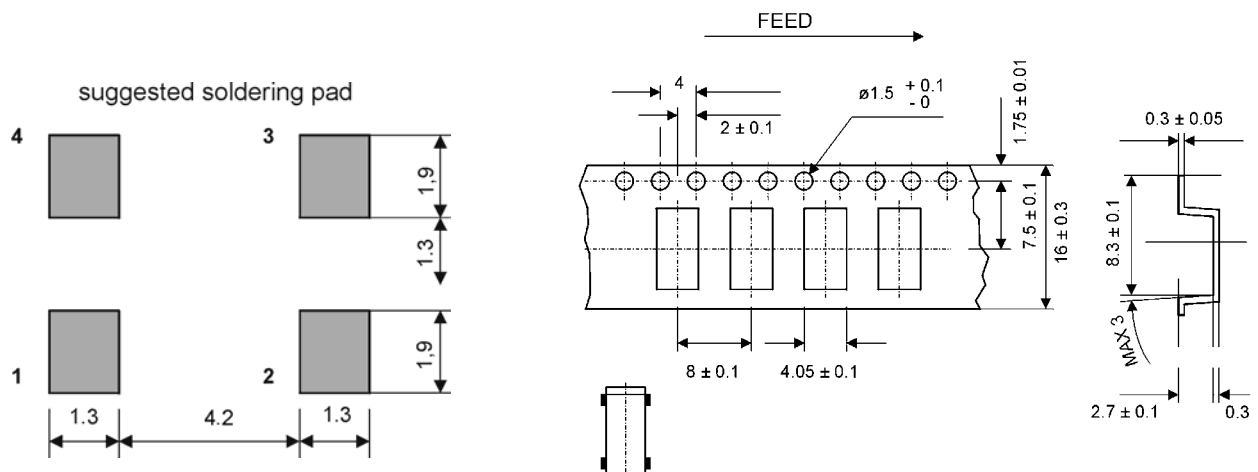
32,768 kHz

SMD-version

model	KX - 327S	
frequency	32,768 kHz	
operating temperature	standard -20° ~ +70° C available -40° ~ +85° C (= KX-327ST)	
frequency tolerance at +25° C	± 30 ppm standard ± 20 ppm available	
temperature tolerance at -20° ~ +70° C -40° ~ +85° C	-0,034 ±0,006 ppm/°C <sup>2</sup> typ., -0,042 ppm/°C <sup>2</sup> max.	
load capacitance C <sub>L</sub>	12,5 pF	
series resonance R <sub>1</sub> max.	50k Ohm	
aging ( first year )	± 5 ppm	
shunt capacitance C <sub>0</sub> max.	2 pF	
drive level in mW max.	0,001	
RoHS	started from date code May, 2005	
contents of reel	3000 pcs.	 actual size
part no.	12.87110 ~ 12.87149	



tape lead out direction



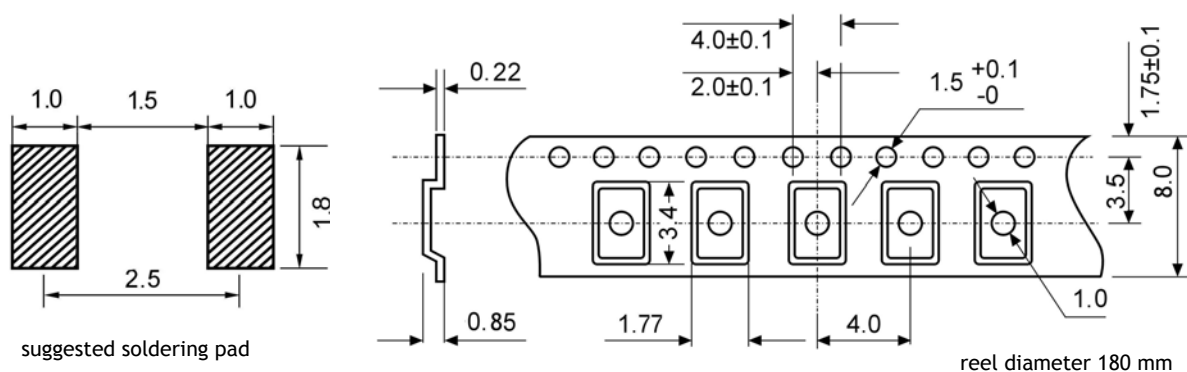
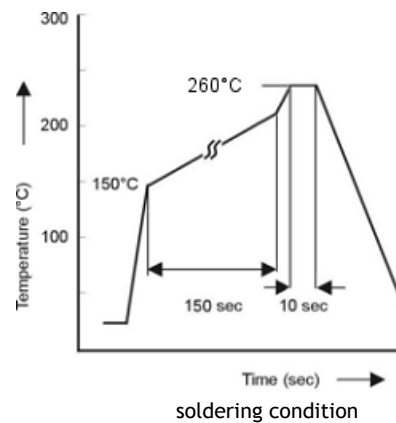
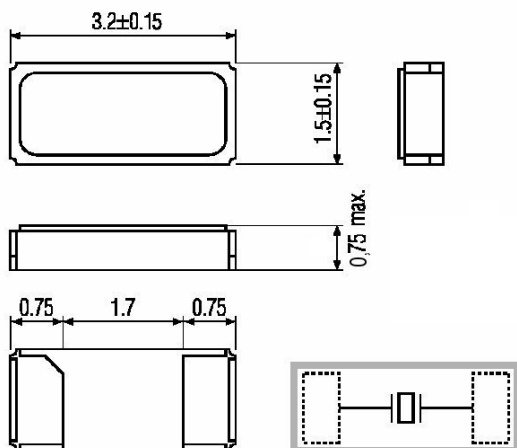


## Quartz Crystal

32,768 kHz

SMD-version

model	KX-327NHT	
frequency	32,768 kHz	
operating temperature	-40° ~ +85° C	
frequency tolerance (df/F) at +25° C ± 3° C	± 20 ppm (±0,002%)	
temperature tolerance at -40° ~ +85° C	-0,035 ppm/° C <sup>2</sup> typ.	
storage temperature range	-55° C ~ +125° C	
turnover temperature	+25° C ± 5° C	
capacitance ratio (C0/C1)	440, typ.	
load capacitance C <sub>L</sub>	12,5 pF ± 1,0 pF	
motional capacitance (C1)	0,0036 pF, typ.	
series resonance R <sub>1</sub> max.	80k Ohm	
aging (df/F) ( first year ) at 25° C ± 3° C	± 3 ppm max.	
shunt capacitance C <sub>0</sub>	1,6 pF typ.	
drive level in μW max.	0,1 typ. (1,0 μW max.)	
quality factor (Q)	20000 min.	
reflow soldering condition	10 seconds at +260° C max. (2 times max.)	
RoHS	since production start	
contents of reel	3000 pcs.	actual size
part no.	12.87110 ~ 12.87149	

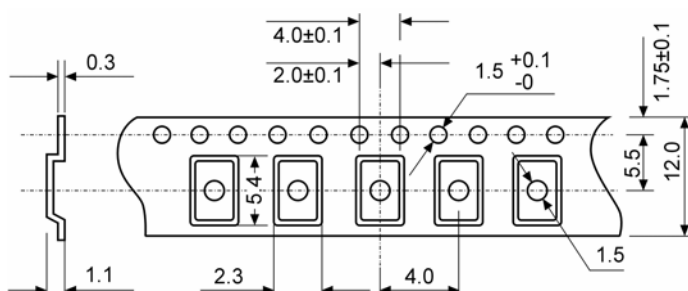
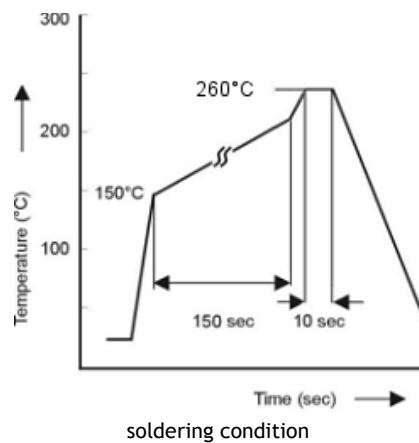
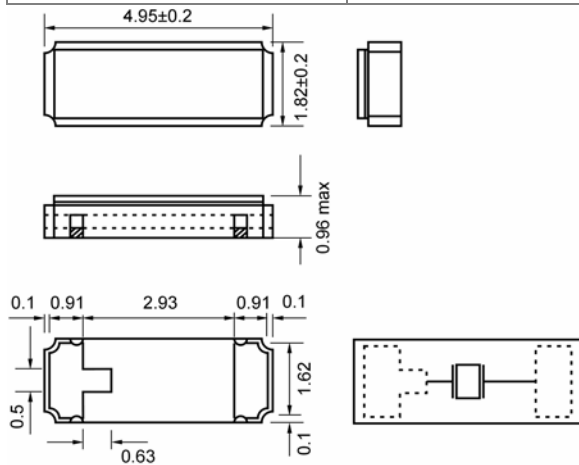


## Quartz Crystal

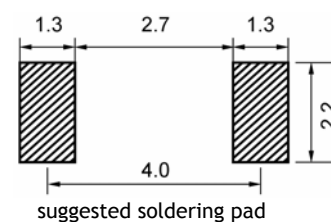
32,768 kHz

SMD-version

model	KX - 327XS	
frequency	32,768 kHz	
operating temperature	standard -20° ~ +70°C available -40° ~ +85°C (= KX-327XST)	
frequency tolerance at +25°C	standard ± 30 ppm available ± 20 ppm	
temperature tolerance at -20° ~ +70°C -40° ~ +85°C	-0,034 ± 0,006 ppm/°C <sup>2</sup> typ	
load capacitance C <sub>L</sub>	standard 12,5 pF available 6 - 12,5 pF	
series resonance R <sub>1</sub> max.	65k Ohm	
aging ( first year )	± 5 ppm	
shunt capacitance C <sub>0</sub> max.	2 pF	
drive level in mW max.	0,001	
RoHS	started from date code May, 2005	
contents of reel	3000 pcs.	actual size
part no.	12.87110 ~ 12.87149	



reel diameter 178 mm

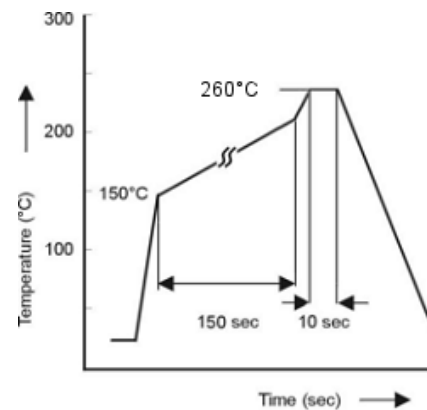
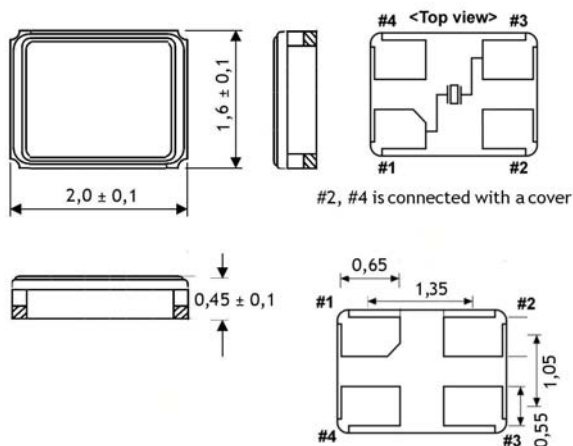


## Quartz Crystal

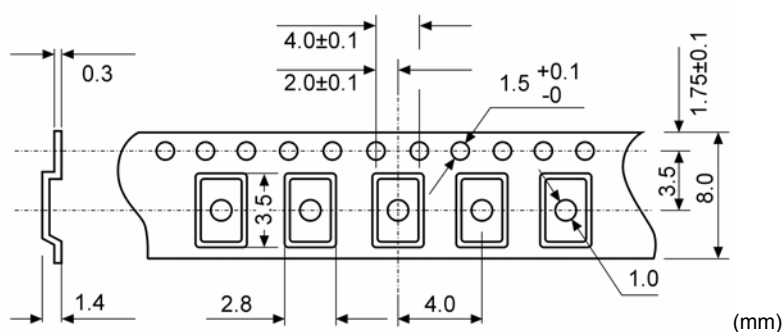
MHz range

SMD-version

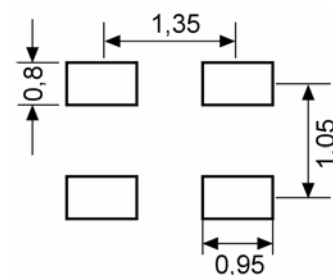
model	KX - 5		
frequency range	20,0 ~ 80,0 MHz		
mode	fundamental		
operating temperature	standard -20° ~ + 70°C available -40° ~ + 85°C (=KX-5T)		
frequency tolerance at +25°C	standard ± 30 ppm available ± 30 ~ ± 50 ppm		
temperature tolerance -20° ~ + 70°C -40° ~ + 85°C	standard ± 50 ppm, available ±30 ~ ±50 ppm standard ±100 ppm, available ±30 ~ ±100 ppm		
load capacitance $C_L$	standard 8 pF available 8 ~ 16 pF		
series resonance $R_1$ max.	20,0 ~ 30,0 MHz	100 Ohm	
	30,1 ~ 80,0 MHz	80 Ohm	
aging ( first year )	± 5 ppm		
shunt capacitance $C_0$ max.	5,0 pF		
drive level max.	50 µW		
RoHS	since production start		
contents of reel	3000 pcs.		actual size
part no.	12.85500 ~ 12.85999		



soldering condition



reel diameter 245 mm




suggested soldering pad

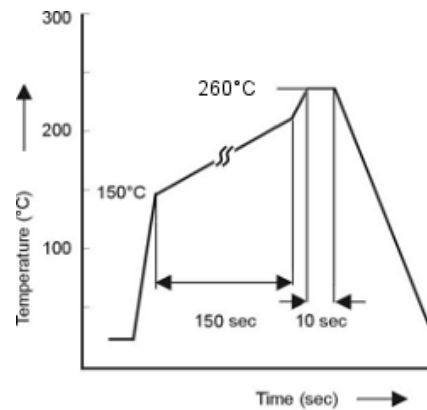
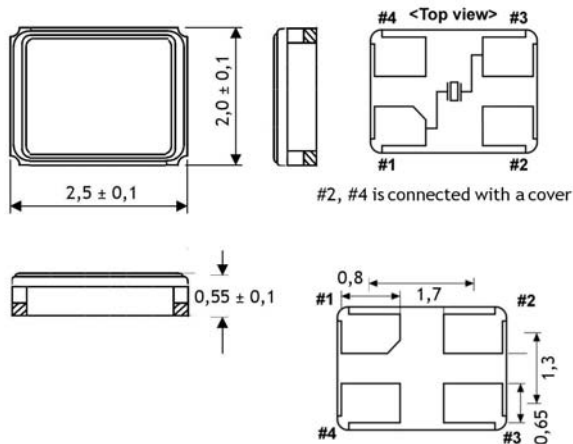


## Quartz Crystal

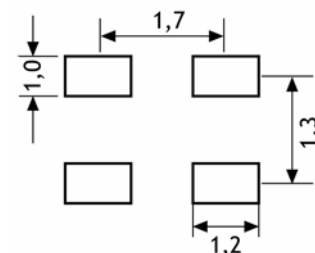
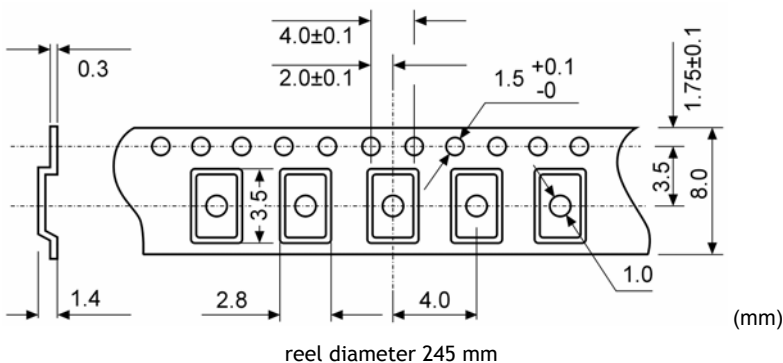
MHz range

SMD-version

model	KX - 6	
frequency range	16,0 ~ 80,0 MHz	
mode	fundamental	
operating temperature	standard -20° ~ + 70° C available -40° ~ + 85° C (=KX-6T) available -40° ~ + 105° C (=KX-6E)	
frequency tolerance at +25° C	standard ± 30 ppm available ± 10 ~ ± 50 ppm	
temperature tolerance -20° ~ + 70° C -40° ~ + 85° C -40° ~ +105° C	standard ± 50 ppm, available ±10 ~ ±50 ppm standard ±100 ppm, available ±25 ~ ± 100 ppm standard ±150 ppm, available ±50 ~ ± 120 ppm	
load capacitance $C_L$	standard 10 pF available 8 ~ 16 pF	
series resonance $R_1$ max.	16,0 ~ 20,0 MHz 120 Ohm 20,1 ~ 30,0 MHz 100 Ohm 30,1 ~ 80,0 MHz 50 Ohm	
aging ( first year )	± 5 ppm	
shunt capacitance $C_0$ max.	5,0 pF	
drive level max.	50 $\mu$ W	
RoHS	since production start	
contents of reel	3000 pcs.	 actual size
part no.	12.86500 ~ 12.86699	



soldering condition



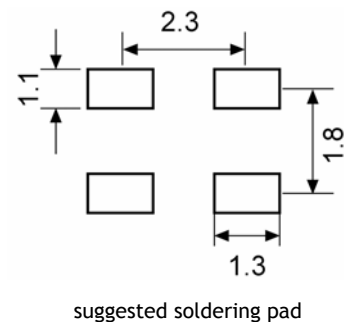
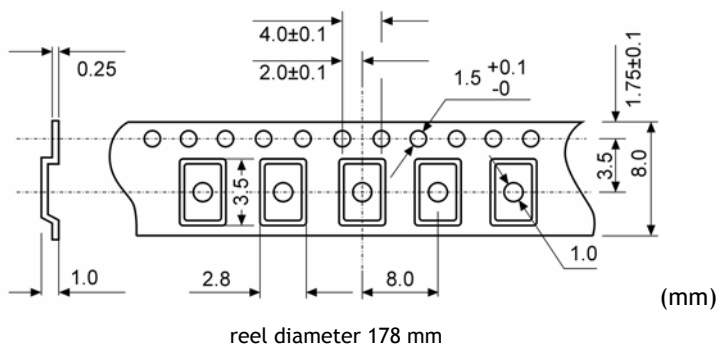
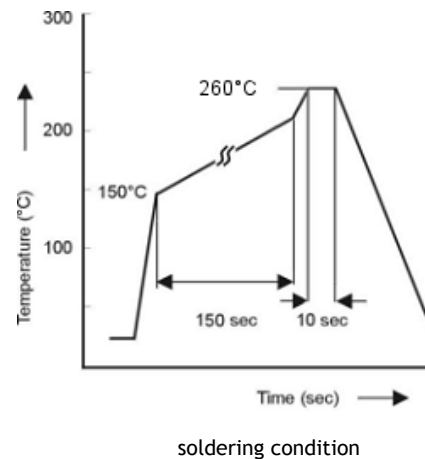
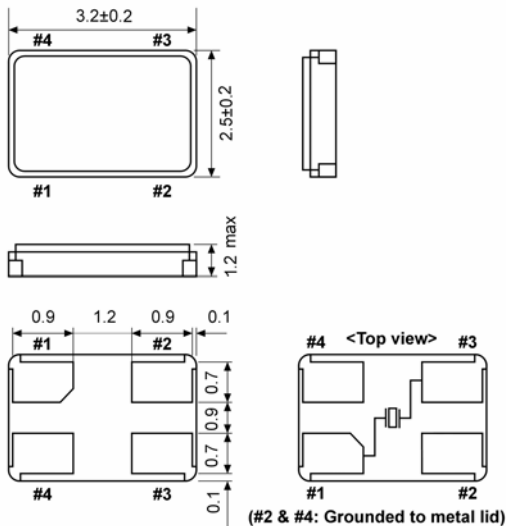
suggested soldering pad

## Quartz Crystal

MHz range

SMD-version

model	KX - 7		
frequency range	12,0 ~ 60,0 MHz		
mode	fundamental		
operating temperature	standard -20° ~ + 70° C available -40° ~ + 85° C (=KX-7T) available -40° ~ +105° C (=KX-7E)		
frequency tolerance at +25° C	standard ± 30 ppm available ± 10 ~ ± 50 ppm		
temperature tolerance -20° ~ + 70° C -40° ~ + 85° C -40° ~ +105° C	standard ± 50 ppm, available ±10 ~ ±50 ppm standard ±100 ppm, available ±20 ~ ± 100 ppm standard ±120 ppm, available ±30 ~ ± 120 ppm		
load capacitance $C_L$	standard 12 pF available 7 ~ 20 pF		
series resonance $R_1$ max.	12,0 ~ 30,0 MHz	100 Ohm	
	30,1 ~ 60,0 MHz	50 Ohm	
aging ( first year )	± 5 ppm		
shunt capacitance $C_0$ max.	5,0 pF		
drive level in mW max.	0,05		
RoHS	since production start		
contents of reel	1000 pcs.		actual size
part no.	12.88600 ~ 12.88799		

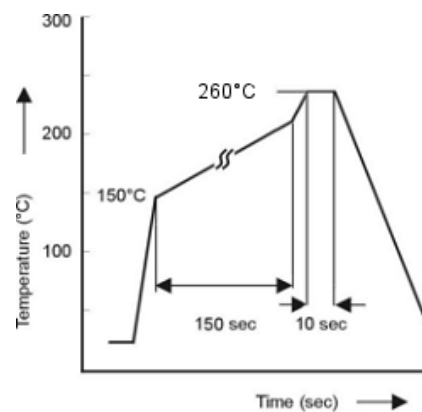
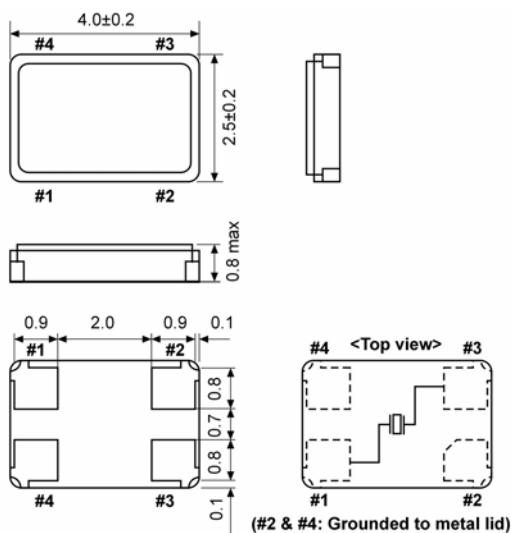


## Quartz Crystal

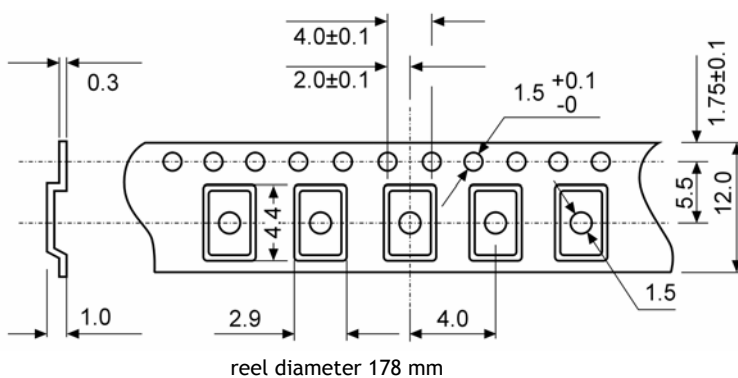
MHz range

SMD-version

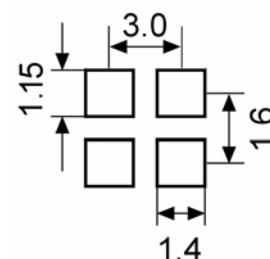
model	KX - 8	
frequency range	12,0 - 60,0 MHz	
mode	fundamental	
operating temperature	standard -20° ~ + 70° C	available -40° ~ + 85° C (=KX-8T)
	available -40° ~ +105° C	(=KX-8E)
frequency tolerance at +25° C	standard ± 30 ppm available ± 10 ~ ± 50 ppm	
temperature tolerance -20° ~ + 70° C -40° ~ + 85° C -40° ~ +105° C	standard ± 50 ppm, available ±10 ~ ±50 ppm standard ±100 ppm, available ±20 ~ ± 100 ppm standard ±120 ppm, available ±30 ~ ± 120 ppm	
load capacitance $C_L$	standard 16 pF available 10 ~ 20 pF	
series resonance $R_1$ max.	12,0 - 29,99 MHz 100 Ohm	30,0 - 60,0 MHz 50 Ohm
aging ( first year )	± 5 ppm	
shunt capacitance $C_0$ max.	5,0 pF	
drive level in mW max.	0,05	
RoHS	since production start	
contents of reel	2000 pcs.	actual size
part no.	12.88800 ~ 12.88999	



soldering condition



(mm)



suggested soldering pad

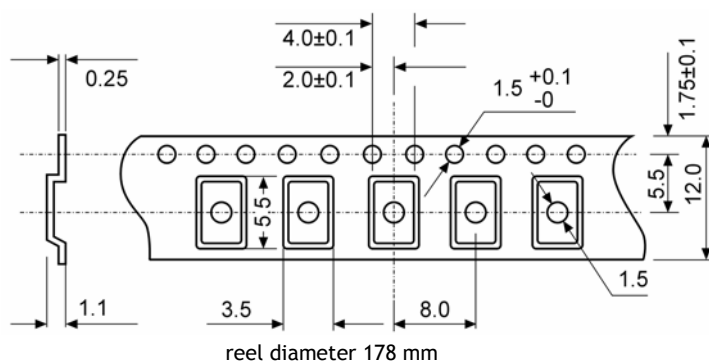
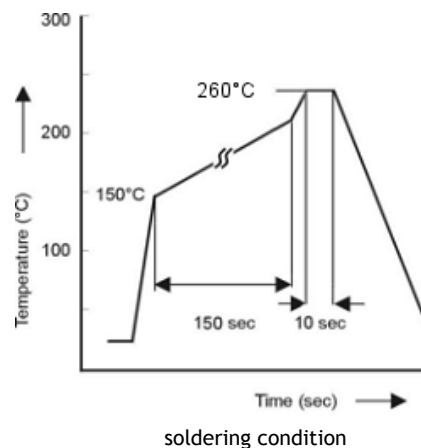
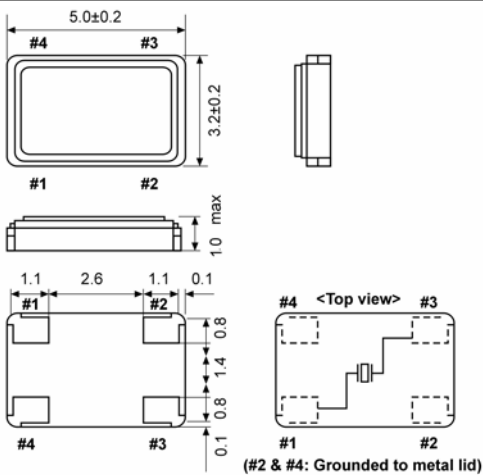
## Quartz Crystal

MHz range

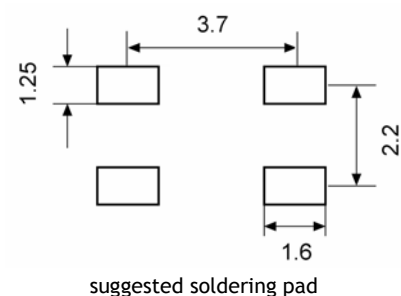
SMD-version

model	KX - 9A		
frequency range	8,0 - 300,0 MHz		
mode	fundamental, 3 <sup>rd</sup> overtone, 5 <sup>th</sup> overtone		
operating temperature	standard	-20° ~ + 70° C	
	available	-40° ~ + 85° C (=KX-9AT)	
	available	-40° ~ +105° C (=KX-9AE)	
frequency tolerance at +25° C	standard	± 30 ppm	
	available	± 10 ~ ± 50 ppm	
temperature tolerance		standard ± 50 ppm, available ±10 ~ ±50 ppm	
-20° ~ + 70° C		standard ±100 ppm, available ±20 ~ ± 100 ppm	
-40° ~ + 85° C		standard ±120 ppm, available ±30 ~ ± 120 ppm	
-40° ~ +105° C			
load capacitance C <sub>L</sub>	standard 16 pF, available 10 - 20 pF		
series resonance R <sub>1</sub> max.	fundamental	8,0 - 9,99 MHz	150 Ohm
		10,0 - 12,0 MHz	100 Ohm
		12,1 - 16,0 MHz	80 Ohm
		16,1 - 20,0 MHz	60 Ohm
		20,1 - 50,0 MHz	40 Ohm
		50,1 - 130,0 MHz	30 Ohm
	3 <sup>rd</sup> overtone	70,0 - 300,0 MHz	80 Ohm
	5 <sup>th</sup> overtone	120,0 - 250,0 MHz	80 Ohm
aging ( first year )	± 2 ppm		
shunt capacitance C <sub>0</sub> max.	5,0 pF		
drive level in mW max.	0,05		
RoHS	since production start		
contents of reel	1000 pcs.		
part no.	12.89000 - 12.89199		

 actual size




(mm)

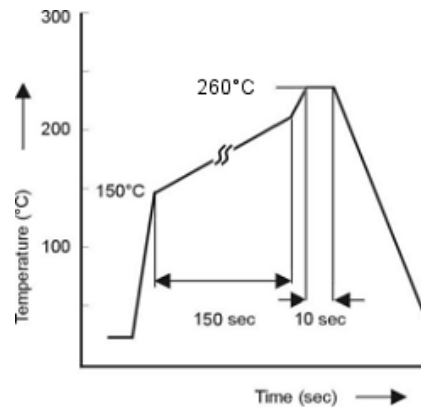
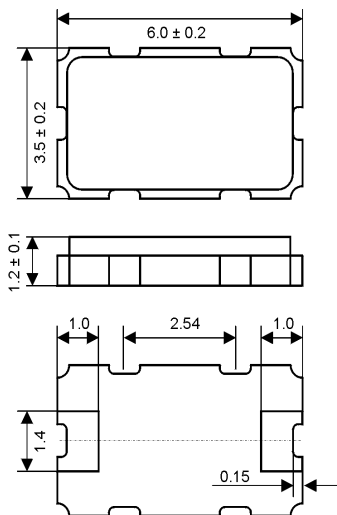


## Quartz Crystal

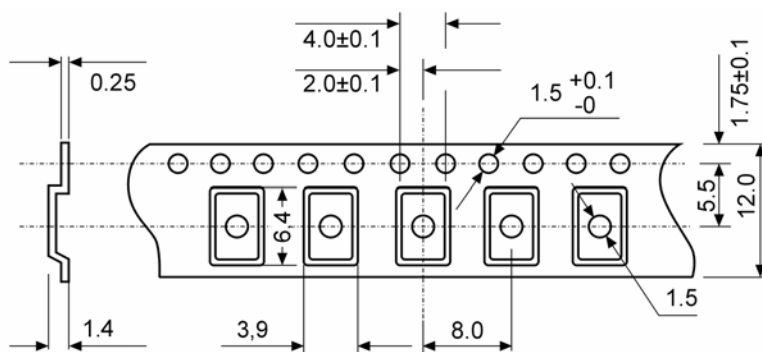
MHz range

SMD-version

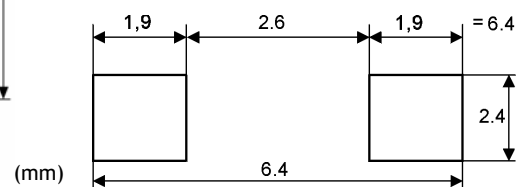
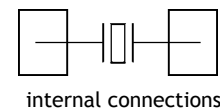
model	KX - 12B	
frequency range	8,0 ~ 50,0 MHz	
mode	fundamental, 3 <sup>rd</sup> overtone upon request	
operating temperature	standard -20° ~ + 70° C available -40° ~ + 85° C (= KX-12BT) available -40° ~ +105° C (= KX-12BE)	
frequency tolerance at +25° C	± 30 ppm	
temperature tolerance -20° ~ + 70° C -40° ~ + 85° C -40° ~ +105° C	standard ± 50 ppm, available ± 10 ~ ± 30 ppm standard ± 100 ppm, available ± 30 ~ ± 50 ppm standard ± 120 ppm, available ± 50 ~ ± 80 ppm	
load capacitance C <sub>L</sub>	standard 16 pF available 12 ~ 20 pF	
series resonance R <sub>1</sub> max.	8,0 ~ 9,79 MHz 150 Ohm 9,8 ~ 11,99 MHz 80 Ohm 12,0 ~ 50,0 MHz 40 Ohm	
aging ( first year )	± 5 ppm	
shunt capacitance C <sub>0</sub> max.	7,0 pF	
drive level in mW	0,05	
RoHS	since production start	
contents of reel	1000 pcs.	 actual size
part no.	12.87700 ~ 12.87799	



soldering condition



reel diameter 178 mm



suggested soldering pad

## Quartz Crystal

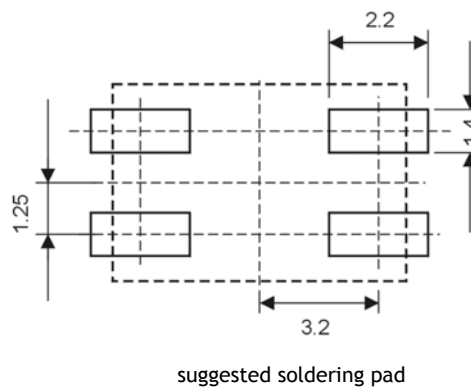
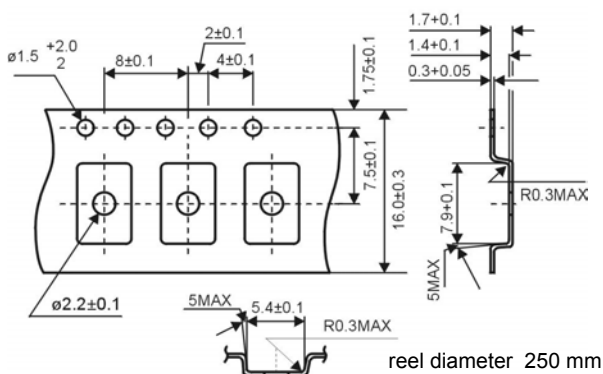
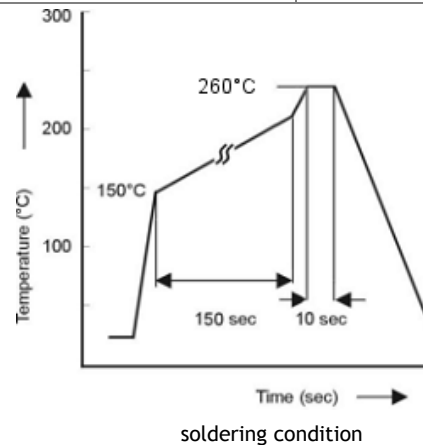
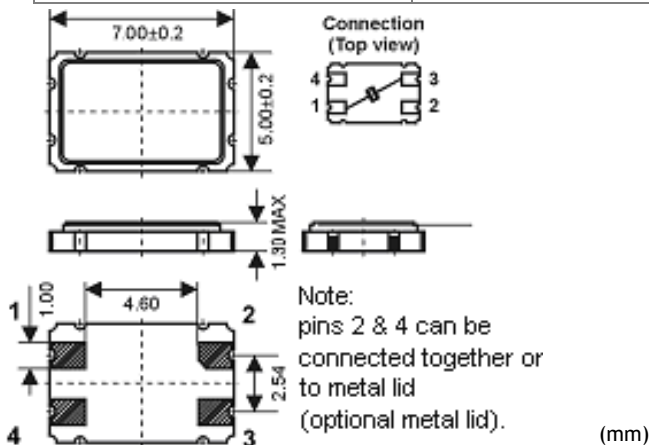
MHz range

SMD-version

model	KX - 13		
frequency range	6,0 ~ 160,0 MHz		
mode	fundamental, 3 <sup>rd</sup> overtone, 5 <sup>th</sup> overtone		
operating temperature	standard -20° ~ + 70° C available -40° ~ + 85° C (= KX-13T) available -40° ~ + 105° C (= KX-13E)		
frequency tolerance at +25° C	standard ± 30 ppm available ± 10 ~ ± 50 ppm		
temperature tolerance at -20° ~ + 70° C -40° ~ + 85° C -40° ~ +105° C	standard ± 50 ppm, available ± 10 ~ ± 30 ppm, standard ± 100 ppm, available ± 20 ~ ± 50 ppm standard ± 120 ppm, available ± 30 ~ ± 80 ppm		
load capacitance C <sub>L</sub>	standard 16 pF available 12 ~ 20 pF		
series resonance R <sub>1</sub> max.	fundamental	6,0 ~ 7,00 MHz	120 Ohm
		7,1 ~ 10,99 MHz	100 Ohm
		11,0 ~ 13,99 MHz	50 Ohm
		14,0 ~ 15,99 MHz	40 Ohm
		16,0 ~ 40,50 MHz	30 Ohm
	3 <sup>rd</sup> overtone	35,0 ~ 39,99 MHz	100 Ohm
		40,0 ~ 49,99 MHz	80 Ohm
		50,0 ~ 90,00 MHz	50 Ohm
	5 <sup>th</sup> overtone	90,0 ~ 260,00 MHz	100 Ohm
aging ( first year )	standard: ± 5 ppm, possible ± 1 ppm		
shunt capacitance C <sub>0</sub> max.	7,0 pF		
drive level in mW	0,05		
RoHS	since production start		
contents of reel	1000 pcs.		
part no.	12.87900-12.87999		




actual size

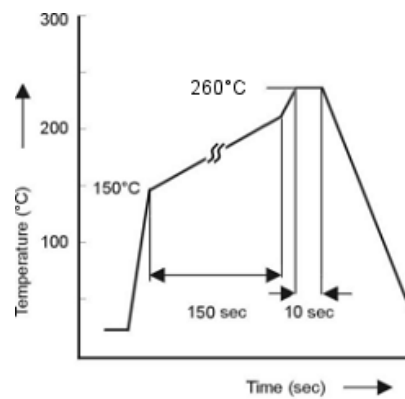
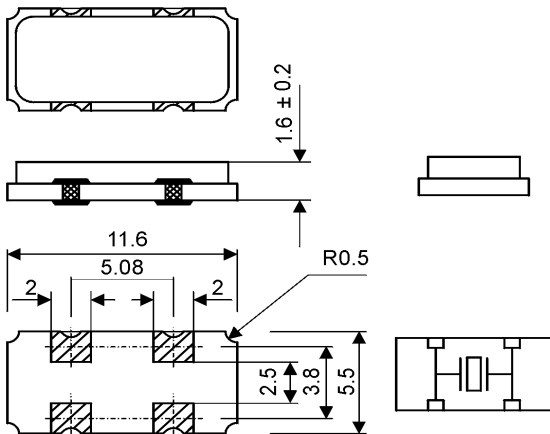


## Quartz Crystal

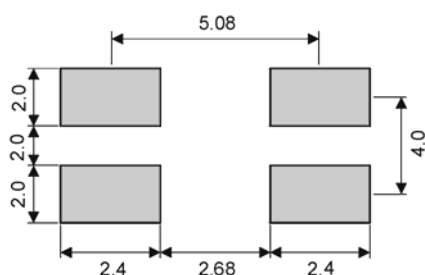
MHz range

SMD-version

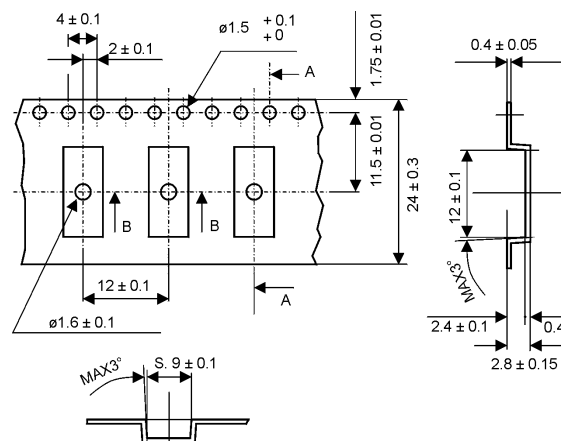
model	KX - 20		
frequency range	3,579545 - 25,0 MHz		
mode	fundamental, 3 <sup>rd</sup> overtone		
operating temperature	standard -20° ~ + 70° C available -40° ~ + 85° C (= KX-20T) available -40° ~ + 105° C (= KX-20E)		
frequency tolerance at +25° C	± 50 ppm		
temperature tolerance at -20° ~ + 70° C at -40° ~ + 85° C at -40° ~ + 105° C	± 50 ppm ± 100 ppm ± 120 ppm		
load capacitance C <sub>L</sub>	standard 16 pF available 12 - 20 pF		
series resonance R <sub>1</sub> max.	fundamental	3,5 - 3,9 MHz 4,0 - 5,99 MHz 6,0 - 7,99 MHz 8,0 - 9,99 MHz 10,0 - 45,0 MHz	150 Ohm 120 Ohm 80 Ohm 60 Ohm 50 Ohm
	3 <sup>rd</sup> overtone	32,0 - 70,0 MHz	100 Ohm
aging ( first year )	± 5 ppm		
shunt capacitance C <sub>0</sub> max.	7,0 pF		
drive level in mW	0,1		
RoHS	since production start		
contents of reel	2000 pcs.		
part no.	12.87500-12.87799		
			 actual size



soldering condition



suggested soldering pad



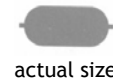
reel diameter 330 mm

## Quartz Crystals

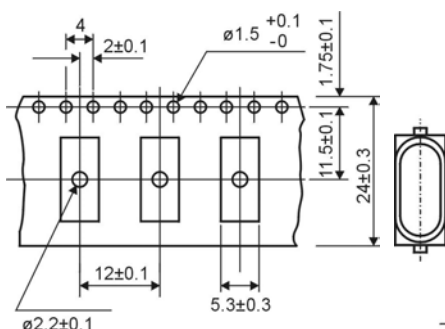
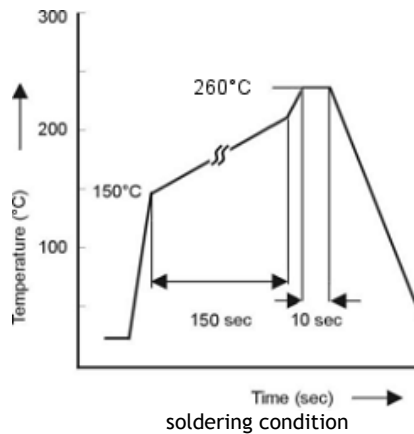
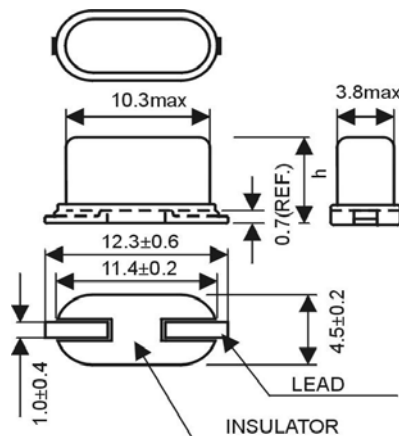
MHz range

SMD-version

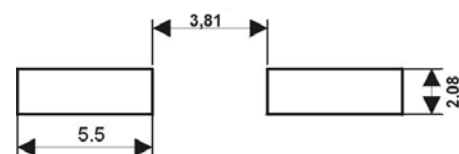
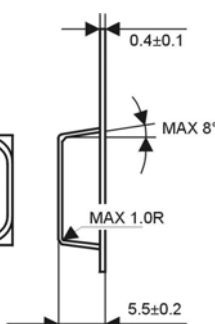
model	KX - K	KX-KS
frequency range	3,50 - 70,0 MHz	
mode	fundamental, 3 <sup>rd</sup> overtone	
operating temperature	standard -20° ~ + 70° C available -40° ~ + 85° C (=KX-KT / KX-KST)	
frequency tolerance at +25° C	standard ± 30 ppm, available ± 10 ~ ± 50 ppm	
temperature tolerance at -20° ~ +70° C -40° ~ +85° C	standard ± 50 ppm, available ± 15 ~ ± 50 ppm standard ± 100 ppm, available ± 25 ~ ± 100 ppm	
load capacitance C <sub>L</sub>	standard: 16 pF, avail. 12 ~ 30 pF	
series resonance R <sub>1</sub> max.	fundamental	3,5 ~ 3,99 MHz 150 Ohm 4,0 ~ 5,99 MHz 120 Ohm 6,0 ~ 7,99 MHz 80 Ohm 8,0 ~ 9,99 MHz 60 Ohm 10,0 ~ 40,0 MHz 50 Ohm
	3 <sup>rd</sup> overtone	35,0 ~ 39,99 MHz 100 Ohm 40,0 ~ 49,99 MHz 80 Ohm 50,0 ~ 70,0 MHz 50 Ohm
aging ( first year )	± 5 ppm	
shunt capacitance C <sub>0</sub> max.	7,0 pF	
drive level in mW	0,1	
height (h) max.	4,2 mm	3,2 mm
RoHS	started from date code May, 2005	
contents of reel	1000 pcs.	
part no.	12.87800 ~ 12.87899	12.88000 ~ 12.88199



actual size



reel diameter 330 mm




suggested soldering pad

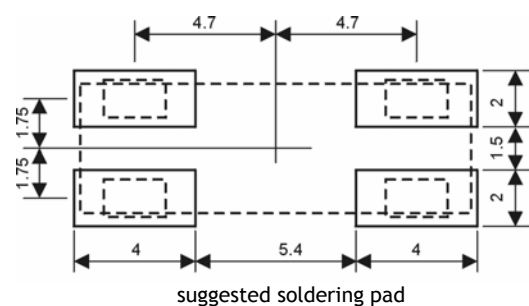
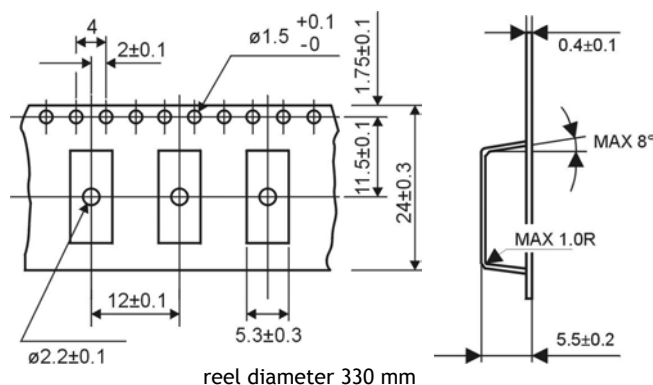
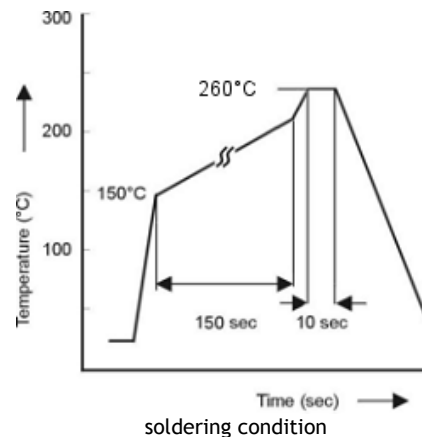
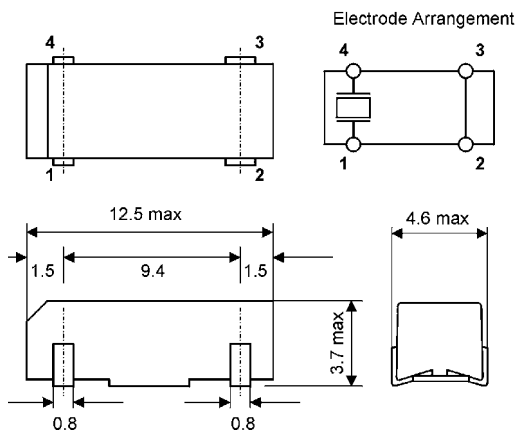


## Quartz Crystal

MHz range

SMD-version

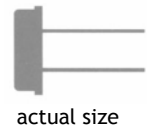
model	KX - C	
frequency range	3,50 ~ 30,0 MHz	
mode	fundamental, 3 <sup>rd</sup> overtone upon request	
operating temperature	standard -20° ~ + 70°C available -40° ~ + 85°C (=KX-CT) available -40° ~ +105°C (=KX-CE)	
frequency tolerance at +25°C	± 50 ppm	
temperature tolerance at -20° ~ + 70°C -40° ~ + 85°C -40° ~ +105°C	± 50 ppm ± 100 ppm ± 120 ppm	
load capacitance C <sub>L</sub>	standard: 16 pF, avail. 12 ~ 20 pF	
series resonance R <sub>1</sub> max.	3,5 ~ 3,9 MHz 150 Ohm 4,0 ~ 5,99 MHz 120 Ohm 6,0 ~ 7,99 MHz 80 Ohm 8,0 ~ 9,99 MHz 60 Ohm > 10,0 MHz 50 Ohm	
aging ( first year )	± 5 ppm	
shunt capacitance C <sub>0</sub> max.	7,0 pF	
drive level in mW	0,5	
RoHS	started from date code May, 2005	
contents of reel	1000 pcs.	 actual size
part no.	12.87260 ~ 12.87399	



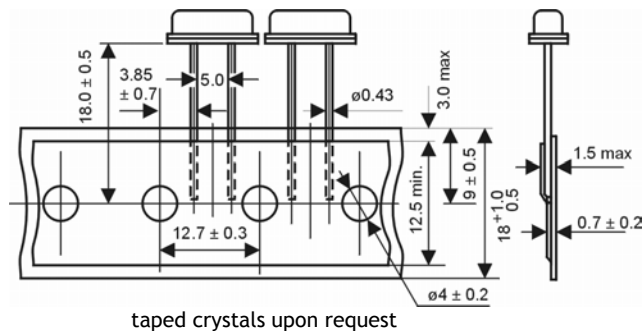
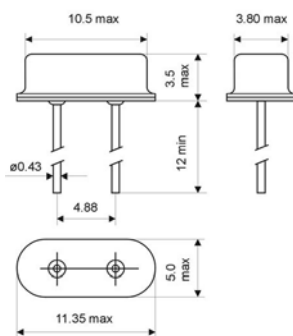
## Quartz Crystal

## HC-49/U3H (low profile)

model	KX - 3H		
frequency range	3,20 ~ 70 MHz		
holder type	HC-49/U3H		
mode	fundamental, 3 <sup>rd</sup> overtone		
operating temperature	standard -20° ~ +70°C available -40° ~ +85°C (= KX-3HT) available -40° ~ +105°C (= KX-3HE)		
frequency tolerance at +25°C	standard ± 30 ppm, available ±10 ~ ± 30 ppm		
temperature tolerance at -20° ~ +70°C at -40° ~ +85°C at -40° ~ +105°C	standard ± 50 ppm , available ± 15 ~ ± 50 ppm standard ± 100 ppm , available ± 25 ~ ± 100 ppm standard ± 120 ppm , available ± 35 ~ ± 120 ppm		
load capacitance C <sub>L</sub>	standard: 16 pF, avail. 12 ~ 30 pF		
series resonance R <sub>1</sub> max.	fundamental	3,5 ~ 3,99 MHz	150 Ohm
		4,0 ~ 5,99 MHz	120 Ohm
		6,0 ~ 7,99 MHz	80 Ohm
	3 <sup>rd</sup> overtone	8,0 ~ 9,99 MHz	60 Ohm
		10,0 ~ 40,0 MHz	50 Ohm
		35,0 ~ 39,99 MHz	100 Ohm
	40,0 ~ 49,99 MHz	80 Ohm	
	50,0 ~ 70,0 MHz	50 Ohm	
aging (first year)	± 5 ppm		
shunt capacitance C <sub>0</sub> max.	3 pF		
drive level mW	0,1		
RoHS	started from date code July, 2005		
part no.	12.84100 ~ 12.84999		



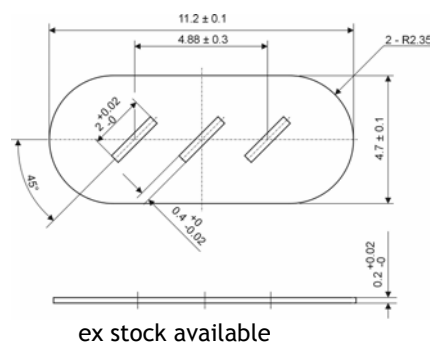
actual size



taped crystals upon request

## Accessories Insulators for Quartz Crystals

model	KX-INS
material	Teflon (PTFE)
thickness	0,200 mm
heat resistance	260°C
case design	HC-49/U, HC-49/U3H
packing unit (MOQ)	500 pcs.
part no.	12.89500

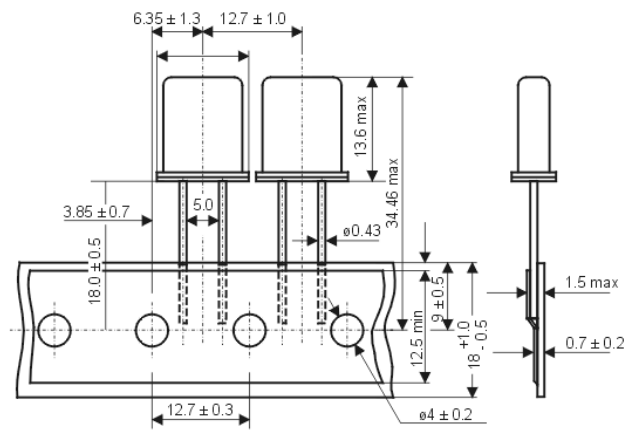
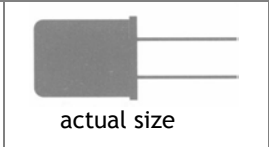
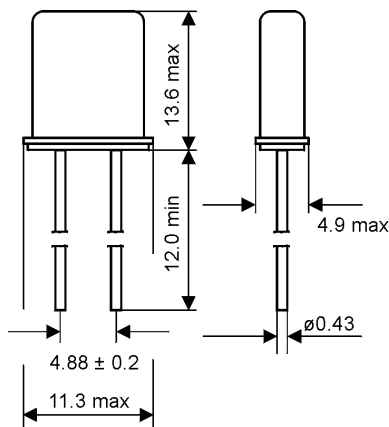


ex stock available

# Quartz Crystal

HC-49/U

model	KX-49			
frequency range	1,84320 - 30 MHz	20 - 90 MHz	50 - 150 MHz	110 - 200 MHz
mode	fundamental	3 <sup>rd</sup> overtone	5 <sup>th</sup> overtone	7 <sup>th</sup> overtone
operating temperature	standard -20° ~ + 70° C available -40° ~ + 85° C (= KX-49T) available -40° ~ +105° C (= KX-49E)			
frequency tolerance at +25° C	standard: 30 ppm available: ± 5 - 50 ppm			
temperature tolerance at -20° ~ +70° C	standard: 50 ppm available ± 5 - 50 ppm			
load capacitance C <sub>L</sub>	standard: 30 pF avail: 10 - 30 pF	20,0-40,0 MHz: 20-30 pF > 40,0 MHz: series	series	
series resonance R <sub>1</sub> max.	1,8432 600 Ohm 2,0 400 Ohm 2,4576 200 Ohm 3,0 150 Ohm > 4,0 60 Ohm	30 - 60 Ohm	40 - 70 Ohm	80 - 120 Ohm
aging (first year)	± 5 ppm			
shunt capacitance C <sub>0</sub> max.	7 pF			
drive level mW max	0,5 - 2		0,1 - 0,5	
RoHS	started from date code July, 2005			
part no.	12.81100 - 12.81999			



taped crystals upon request

## Quartz Crystals

## Cylindrical type

model	KX-26		KX-38	
frequency range	32,768 kHz	77,50 kHz	32,768 kHz	32,768 kHz
holder type	2 x 6 mm		3 x 8 mm	
operating temperature	standard - 20°C ~ +70°C available - 40°C ~ +85°C (= KX-26T / KX-38T)			
frequency tolerance at +25°C	±30 ppm		±20 ppm	
temperature tolerance at -20° ~ +70°C at -40° ~ +85°C	-0.042ppm / °C <sup>2</sup> typ.		-0.042ppm / °C <sup>2</sup> typ.	
load capacitance C <sub>L</sub>	12,5 pF		6 pF	12,5 pF
series resistance R <sub>1</sub> max.	30k Ohm			
aging (first year)	± 3 ppm			
shunt capacitance C <sub>0</sub> max.	1,3 pF			
drive level in mW	0,01			
RoHS material	started from date code July, 2005			
solderable	wave soldering max. 10s 260°C following reflow soldering only up to 240°C			
drawing	fig. 2		fig. 1	
part no.	12.80111	12.80110	12.80104	12.80100

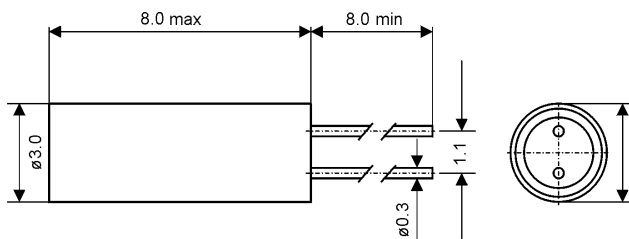


fig. 1

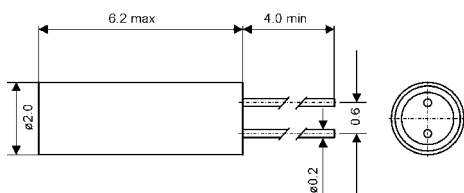
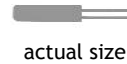
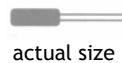


fig.2

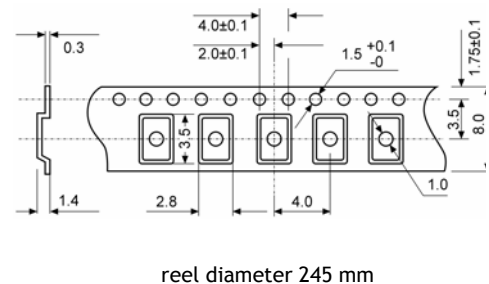
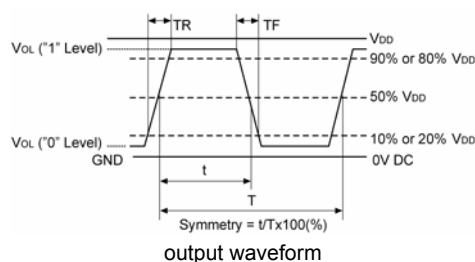
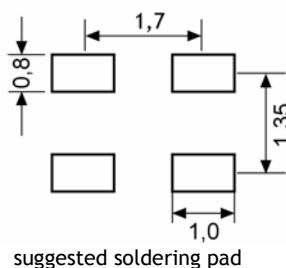
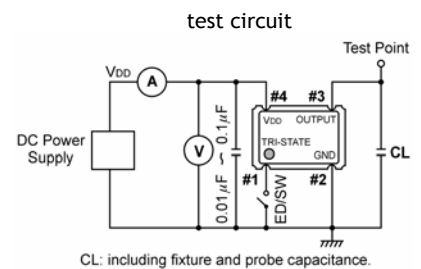
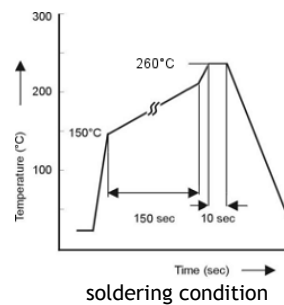
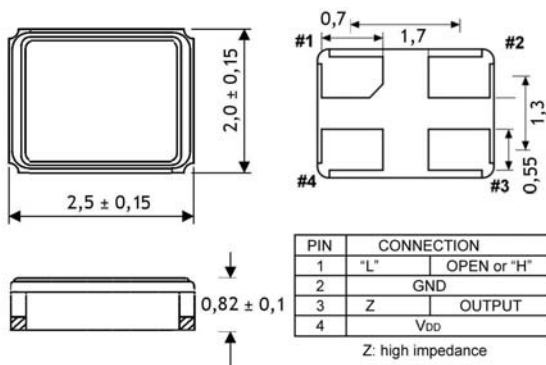


## Clock Oscillator

SMD-version 2,5 / 2,8 / 3,0 / 3,3V

model	KXO-V95	
frequency range	1,0 - 70,0 MHz	
frequency stability at -20° ~ +70°C at -40° ~ +85°C	± 50 ppm ± 100 ppm	
operating temperature	standard -20° ~ +70°C available -40° ~ +85°C (=KXO-V95T)	
storage temperature	-40° ~ +85°C	
symmetry	40% ~ 60% at 50% Vdd level	
rise & fall time max.	10 ns (10% Vdd ~ 90% Vdd level)	
"0" level max.	VOL: 10% Vdd	
"1" level min.	VOH: 90% Vdd	
input voltage Vdd	+2,5 ~ +3,3V ±5%	
tri-state control voltage (Pin#1)	VIH: Vdd x 0,7 min. VIL: Vdd x 0,3 max.	
supply voltage	-0,5V ~ +7,0V	
input current max.	15 mA	
output load max.	15pF (CMOS)	
start up time max.	10 ms	
disable delay time max.	150 ns	
enable delay time max.	10 ms	
stand by current max.	50 µA (Pin #1=VIL)	
aging for first year max.	±5 ppm at +25°	
jitter	deterministic jitter 5ps max. random jitter 7ps max. norm 1-sigma 7ps max. peak to peak 40ps max.	
RoHS	since production start	
contents of reel	1000 pcs.	
part no.	12.95500 ~ 12.95999	

actual size



## Clock Oscillator

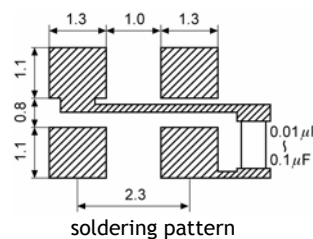
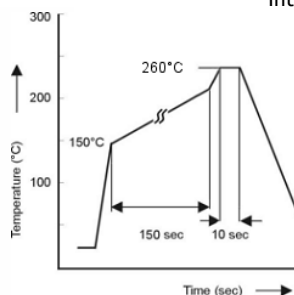
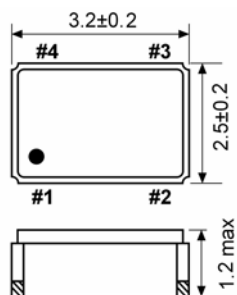
SMD-version

2,5 / 3,0 / 3,3V

model	KXO-V96	
frequency range	1,0 - 133,0 MHz	
frequency stability at -20° ~ +70°C at -40° ~ +85°C	± 50 ppm ± 100 ppm	
operating temperature	standard -20° ~ +70°C available -40° ~ +85°C (=KXO-V96T)	
storage temperature	-50° ~ +125°C	
symmetry	40% - 60% at 50% V <sub>DD</sub> level	
rise & fall time max.	5 ns (10% V <sub>DD</sub> - 90% V <sub>DD</sub> level)	
"0" level max.	VOL: 10% V <sub>DD</sub>	
"1" level min.	VOH: 90% V <sub>DD</sub>	
input voltage V <sub>DD</sub>	+2,5 ~ +3,3V ±5%	
stand-by control voltage (pin#1)	VIH(min): 70% V <sub>DD</sub> VIL(max): 30%V <sub>DD</sub> *	
supply voltage	-0,5V ~ +7,0V	
input current max.	1,0 - 90,0 MHz 20 mA (pin #1=Open or VIH) 90,1 - 133,0 MHz 50 mA (pin #1=Open or VIH)	
output load max.	15pF (CMOS)	
start up time max.	10 ms	
disable delay time max.	150 ns	
enable delay time max.	10 ms	
stand by current max.*	50 µA (pin #1=VIL)	
aging for first year max.	±5 ppm at +25°C	
jitter	deterministic jitter 5ps max. random jitter 7ps max. norm 1-sigma 7ps max. peak to peak 40ps max.	
RoHS	since production start	
contents of reel	1000 pcs.	
part no.	12.95000 ~ 12.95499	

actual size

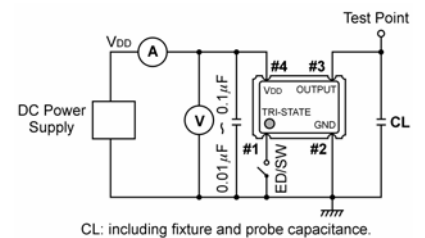
\* Internal crystal oscillation to be halted (pin#1=VIL)



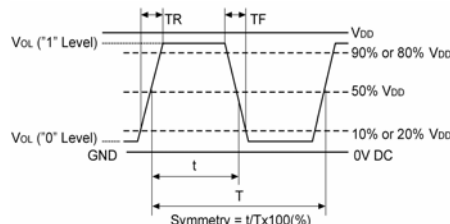
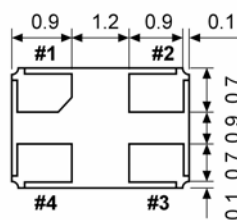
soldering pattern

soldering condition

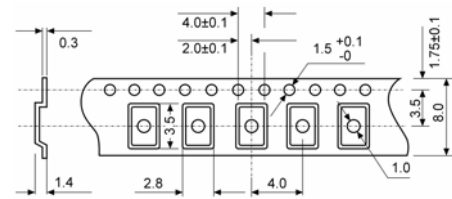
test circuit



CL: including fixture and probe capacitance.



output waveform



reel diameter 245 mm


PIN	CONNECTION	
1	"L"	OPEN or "H"
2	GND	
3	Z	OUTPUT
4	V <sub>DD</sub>	

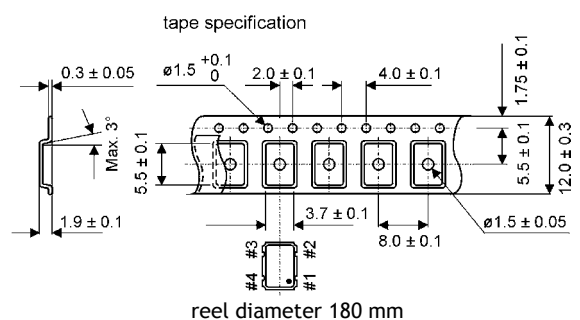
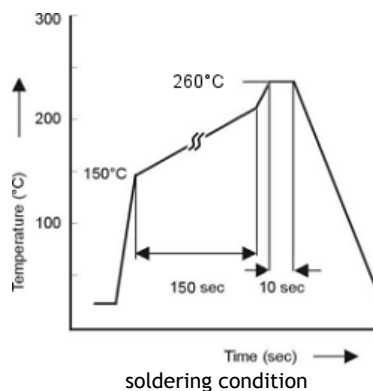
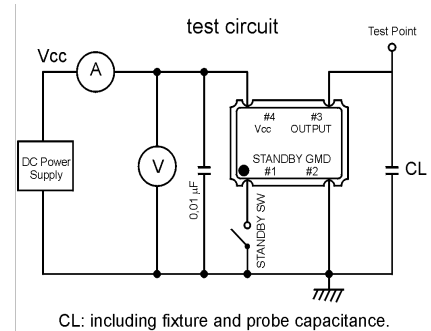
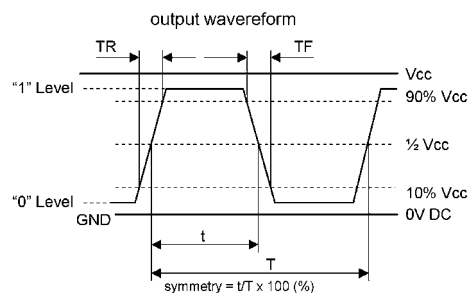
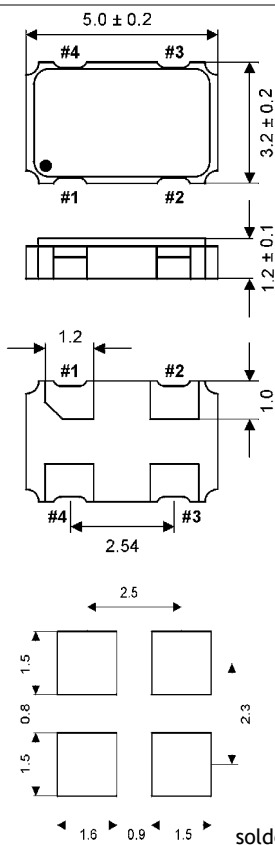
Z: high impedance

# Clock Oscillator

SMD-version

1,8 / 2,5 / 3,0 / 3,3V

model	KXO-V99	
frequency range	1,0 ~ 200,0 MHz	
frequency stability at -20° ~ +70°C at -40° ~ +85°C	± 50 ppm ± 100 ppm	
operating temperature	standard -20° ~ +70°C available -40° ~ +85°C (=KXO-V99T)	
storage temperature	-55° ~ +125°C	
symmetry at 1,0 ~ 70,0 MHz at 70,1 ~ 200,0 MHz	45%/55% ± 10% at ½ Vcc level 40%/60% ± 10% at ½ Vcc level	
rise & fall time max.	4 ns	
"0" level max.	Vcc x 0,1V	
"1" level min.	Vcc x 0,9 V	
input voltage Vcc	standard +3,3V ±5% available +1,8V / +2,5V / +3,0V each type ±5%	
input current max.	8 mA max. ( 1,0 ~ 20,0 MHz) 15 mA max. ( 20,1 ~ 40,0 MHz) 22 mA max. ( 40,1 ~ 60,0 MHz) 25 mA max. ( 60,1 ~ 70,0 MHz)	30 mA max. ( 70,1 ~ 125,0 MHz) 65 mA max. (125,1 ~ 165,0 MHz) 75 mA max. (165,1 ~ 200,0 MHz)
output load	15pF	
start up time max.	10 ms	
stand by current	10 µA max.	
contents of reel	1000 pcs.	 actual size
RoHS	since production start	
part no.	12.94600 ~ 12.94799	



reel diameter 180 mm

## Clock Oscillator

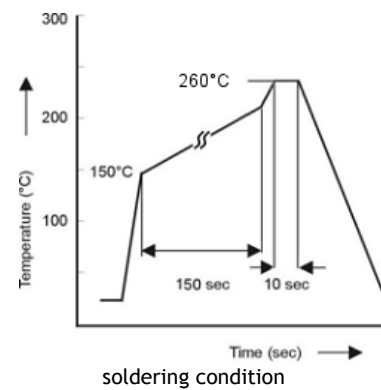
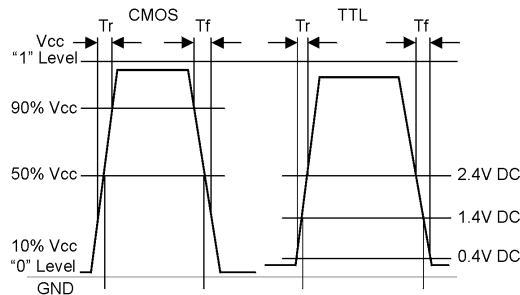
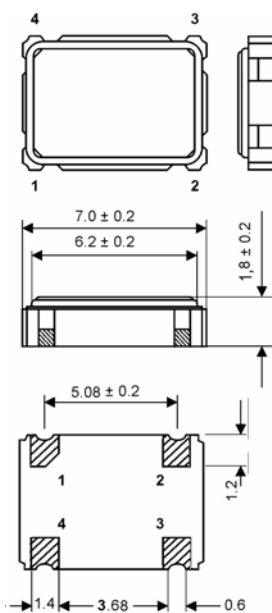
SMD-version

1,8 / 2,5 / 3,0 / 3,3V

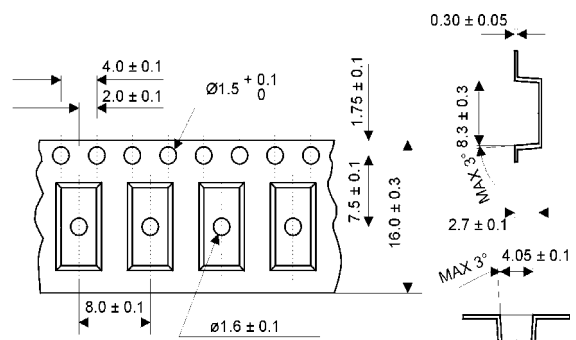
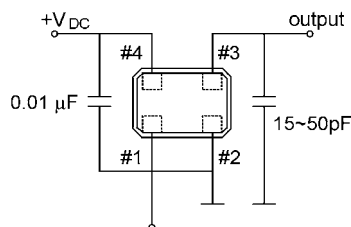
model	KXO-V97		
frequency range	1,0 - 50,0 MHz	50,1 - 80,0 MHz	80,1 - 160,0 MHz
frequency stability at -20° ~ +70°C at -40° ~ +85°C	$\pm 50$ ppm $\pm 100$ ppm		
operating temperature	standard -20° ~ +70°C available -40° ~ +85°C (=KXO-V97T)		
storage temperature	-40° ~ +85°C		
symmetry	50% $\pm$ 10% at 1/2 Vcc level		
rise & fall time max.	6 ns	5 ns	2,5 ns
"0" level max.	+ 0,4V		
"1" level min.	Vcc - 0,5V		
input voltage Vcc	standard + 3,3V $\pm$ 10% available +1,8V $\pm$ 5% / +2,5V $\pm$ 5% / +3,0V $\pm$ 10%		
input current max.	20 mA	25 mA	40 mA
output load	30 pF	15 pF	
start up time max.	10 ms	15 ms	4 ms
tristate funcion	yes		
enable/disable delay time	100 ns max.		
random jitter	7ps max.		
peak to peak jitter	40ps max.		
contents of reel	1000 pcs.		
RoHS	since production start		
part no.	12.94200 - 12.94599		



actual size



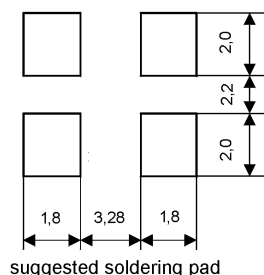
test circuit



reel diameter 330 mm

PIN	CONNECTION
1	"L" (OV) "H" or OPEN
2	GND
3	Z OUTPUT
4	Vcc

Z: high impedance



suggested soldering pad



## Clock Oscillator

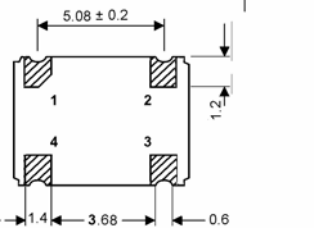
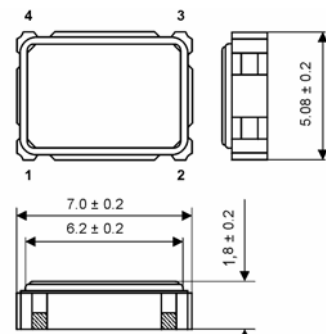
SMD-version

5V

model	KXO-97		
frequency range	1,0 - 50,0 MHz	50,1 - 80,0 MHz	80,1 - 100,0 MHz
frequency stability at -20° ~ +70°C at -40° ~ +85°C	± 50 ppm ± 100 ppm		
operating temperature	standard -20° ~ +70°C available -40° ~ +85°C (=KXO-97T)		
storage temperature	-40° ~ +85°C		
symmetry	50% ± 10% at 1,4V DC level or ½ Vcc level		
rise & fall time max.	TTL: 6 ns / CMOS: 10 ns		5 ns
"0" level max.	+ 0,4V (TTL) + 0,5V (CMOS)		
"1" level min.	+2,4 (TTL) Vcc -0,5V (CMOS)		
input voltage Vcc	+ 5V DC ± 10%		
Input current	15 - 40 mA	40 - 60 mA	60 - 80 mA
output load	10 TTL gates CMOS: 50 pF	5TTL 50 - 100 MHz gate 25pF (50,1 - 100 MHz)	
start up time max.	10 ms		
tristate funcion	yes		
enable/disable delay time	100 ns max.		
random jitter	7ps max.		
peak to peak jitter	40ps max.		
RoHS	since production start		
contents of reel	1000 pcs.		
part no.	12.94200 - 12.94599		

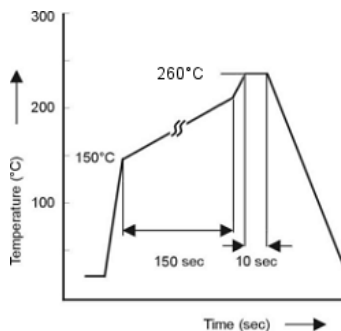
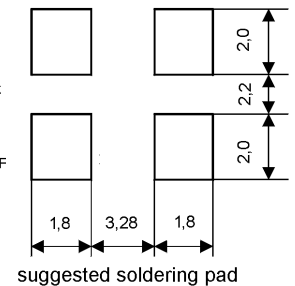
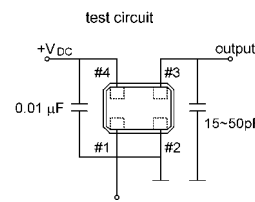
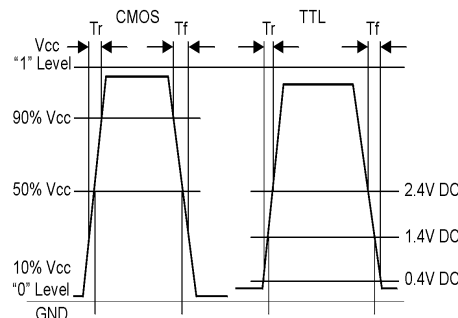


actual size

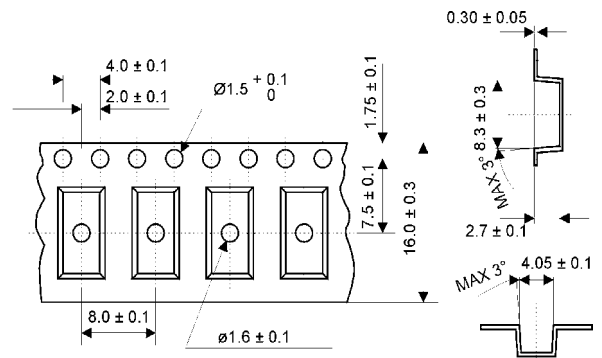


PIN	CONNECTION
1	"L" (OV) "H" (+5V) or OPEN
2	GND
3	Z OUTPUT
4	Vcc

Z: high impedance



soldering condition



reel diameter 330 mm

## Clock Oscillators

## TTL / HCMOS, TRISTATE

Combine state-of-the-art, thick film hybrid technology with precision quartz oscillators to achieve unsurpassed qualities of small size, cost, high reliability and frequency accuracy.

The crystal clock oscillator is composed of a crystal resonator and an oscillator circuit which is made by the hybrid IC technique. So, the oscillator itself is the perfect stable oscillator. This technique and process are entirely Integrated Circuits, so you can expect high reliability every time.

### Standard Specifications

item	TTL & HCMOS		Tri-State																
	KXO-200	KXO-210	KXO-400	KXO-410															
package	DIL 14	DIL 8	DIL 14	DIL 8															
frequency range	0,5 ~ 100 MHz *		0,5 ~ 100 MHz																
frequency stability	standard $\pm 100$ ppm available $\pm 25$ ppm $\sim \pm 100$ ppm																		
storage temperature range	-55 °C ~ +125 °C																		
operating temperature range	standard -20 °C ~ + 70 °C available -40 °C ~ + 85 °C (=KXO-205/215) (=KXO-405/415)																		
symmetry	standard 60/40% (+ ½ V <sub>DD</sub> ) available 55/45%		standard 60/40% (+ ½ V <sub>DD</sub> ) available 55/45%																
rise and fall time max.	10 ns 0.5 ~ 25 MHz 6 ns 25.1 ~ 70 MHz 4 ns 70.1 ~ 100 MHz		10 ns 0.5 ~ 25 MHz 6 ns 25.1 ~ 70 MHz 4 ns 70.1 ~ 100 MHz																
"0" level (max.)	+0.5V (10%V <sub>DD</sub> )		+0.5V (10%V <sub>DD</sub> )																
"1" level (min.)	+ 4.5V (90%V <sub>DD</sub> )		+4.5V (90%V <sub>DD</sub> )																
input voltage	+5.0VDC $\pm 10\%$		+5.0VDC $\pm 10\%$																
input current max.	20 mA 0.5 ~ 20 MHz 40 mA 20.1 ~ 70 MHz 60 mA 70.1 ~ 100 MHz		20 mA 0.5 ~ 20 MHz 40 mA 20.1 ~ 70 MHz 60 mA 70.1 ~ 100 MHz																
output load	1 - 8 TTL or CL = 50pF (TYP)		1 - 8TTL or CL = 50pF (TYP)																
dimension	fig.1	fig.2	fig.1	fig.2															
logic family	TTL & HCMOS compatible		TTL or HCMOS compatible																
test circuit	fig. 3, 4		fig. 3, 4																
pin connection	# 1 (#1): N/C # 7 (#4): CASE GND # 8 (#5): OUTPUT #14 (#8): +V <sub>DD</sub>		<table border="1"> <thead> <tr> <th>PIN</th> <th colspan="2">CONNECTION</th> </tr> </thead> <tbody> <tr> <td>#1 (#1)</td> <td>„L“(OV)</td> <td>„H“( +5V) or OPEN</td> </tr> <tr> <td>#7 (#4)</td> <td colspan="2">GND</td> </tr> <tr> <td>#8 (#5)</td> <td>Z</td> <td>OUTPUT</td> </tr> <tr> <td>#14 (#8)</td> <td colspan="2">Vcc</td> </tr> </tbody> </table>		PIN	CONNECTION		#1 (#1)	„L“(OV)	„H“( +5V) or OPEN	#7 (#4)	GND		#8 (#5)	Z	OUTPUT	#14 (#8)	Vcc	
PIN	CONNECTION																		
#1 (#1)	„L“(OV)	„H“( +5V) or OPEN																	
#7 (#4)	GND																		
#8 (#5)	Z	OUTPUT																	
#14 (#8)	Vcc																		
lead-free	started from date code May, 2005																		
packing unit	25 pcs.	40 pcs.	25 pcs.	40 pcs.															
order no.	12.90000-12.90449	12.91500-12.91999	12.90000-12.90449	12.91500-12.91999															

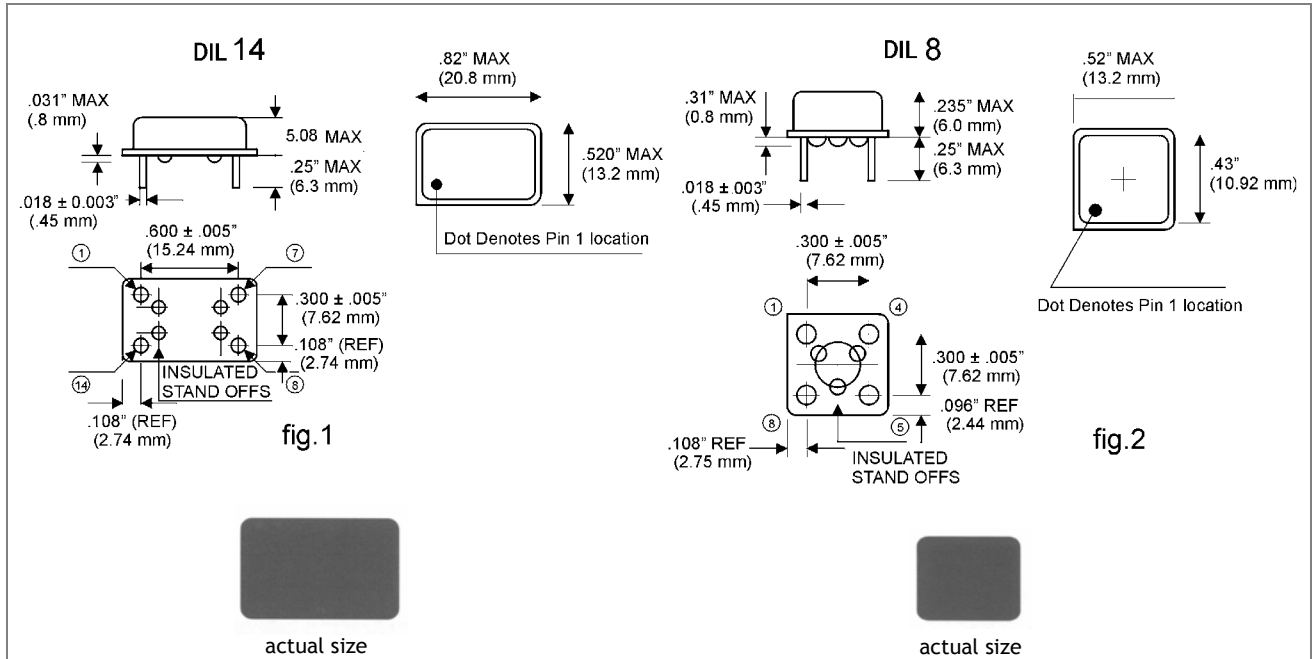
\* > 100,0 MHz on request

Z: high impedance

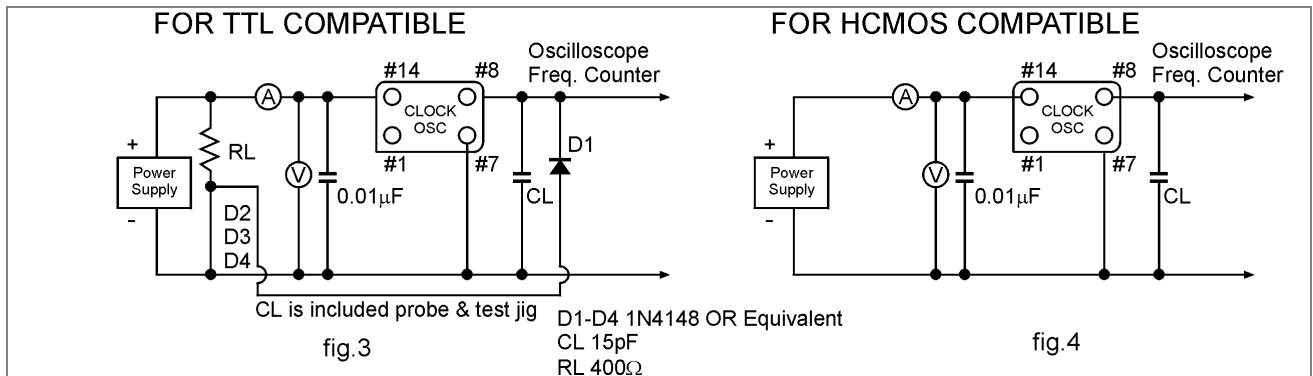
**Enable/Disable Phase  
Delay Time 100 ns max.**

## Clock Oscillators

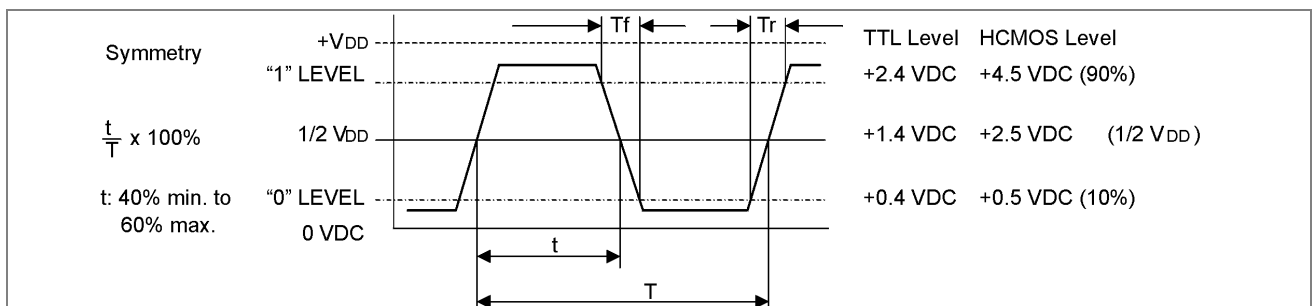
### Dimensions



### Test Circuit




### Output Wave Shape

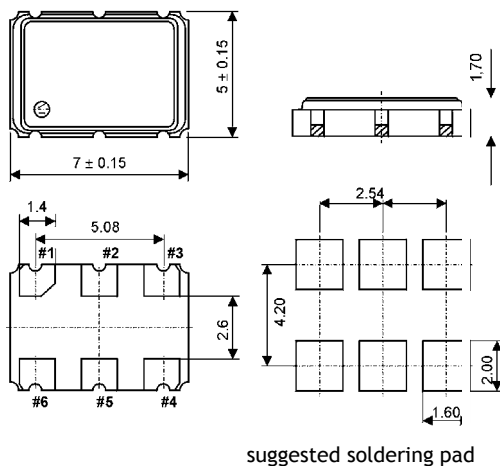


# VCXO Voltage Controlled Crystal Oscillator

SMD-version

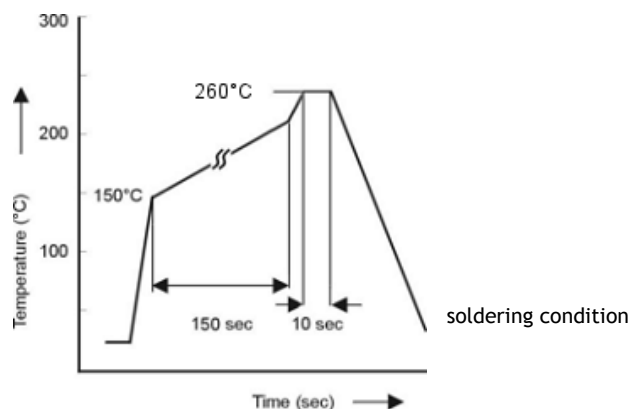
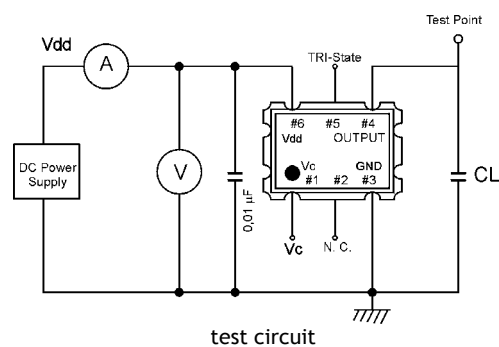
model	KXO-75	 actual size
frequency range	1,544 ~ 77,760 MHz	
frequency stability at -10° ~ +60°C	±10 ~ ±50 ppm	
at -20° ~ +70°C	±20 ~ ±50 ppm	
at -40° ~ +85°C	±30 ~ ±50 ppm	
storage temp.range	-40°C ~ +85°C	
operating temp.range	-10°C ~ +60°C -40°C ~ +85°C	
symmetry at ½ Vdd level	50% ± 5%	
rise and fall time (max.) 20% ~ 80% Vdd level	5 ns	
start up time (max.)	10 ms	
output level	VOH : 90% of Vdd min. VOL: 10% of Vdd max.	
input voltage (Vdd)	3,3V ± 5%	
input current (max.) no load	1,544 ~ 20,0 MHz = 10mA 20,1 ~ 40,0 MHz = 15mA 40,1 ~ 77,760 MHz = 25mA	
output load CMOS	15 pF	
control voltage* (Vc)	0 V ~ 3,3 V	
pulling range	±10 ~ ±150 ppm min.	
frequency linearity max.	± 15%	
period jitter: absolut	±100ps max	
period jitter: one sigma	± 10ps max.	
RoHS	since production start	
part no.	12.96700 ~ 12.96799	

\* Vc should be kept ground level or left open when the VCXO is powered on.



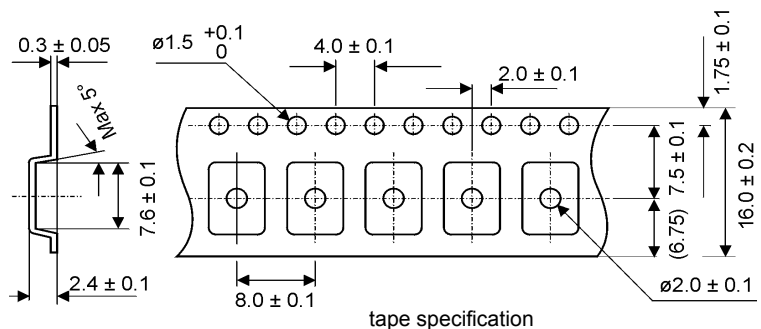
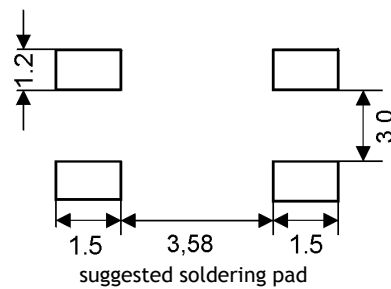
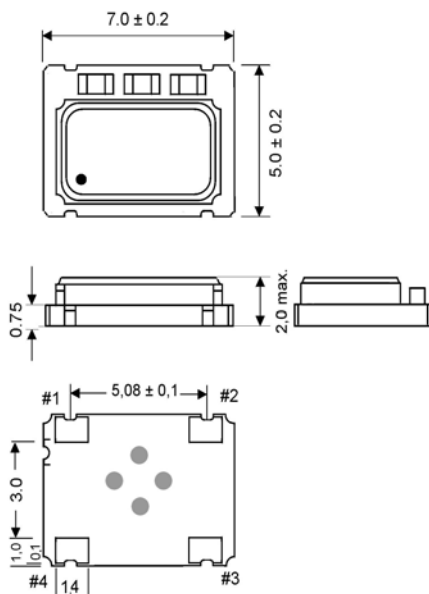
PIN	Connection	
1	Vc	
2	N.C.	
3	GND	
4	Z	OUTPUT
5	"L" (OV)	"H" (+3,3V) or OPEN
6	Vdd	

Z= High Impedance



**VCTCXO** Voltage Controlled Temperature Compensated Crystal Oscillator **SMD-version**

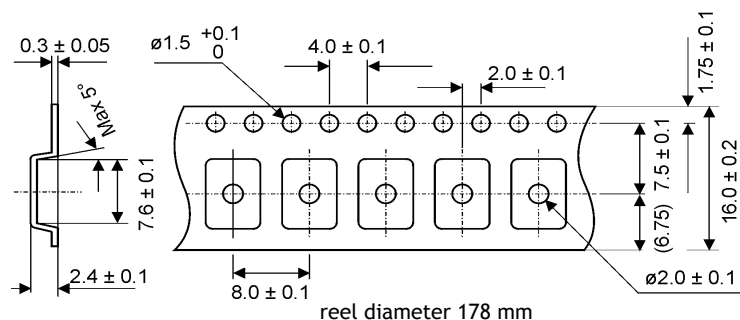
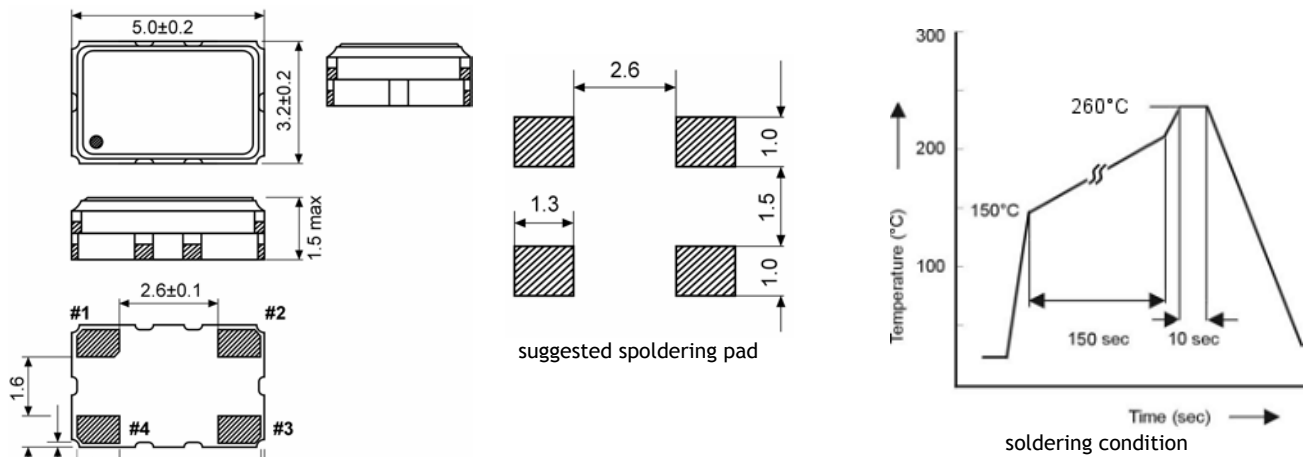
model	KXO-82	
frequency range	12,60 ~ 20,0 MHz	
output	load	10 kOhm // 10pF
	level	0,8Vp-p min.
	waveform	clipped sine-wave (DC-cut)
frequency Stability	vs. temp.range	±2,0 ppm
	vs. input voltage	±0,2 ppm max. at ±3V DC ±5%
	vs. load	±0,2 ppm max. at 10 kOhm ± 10%/ / 10 pF ±10%
	vs. aging	± 1,0 ppm / year max. at +25 °C
operating temperature range	-30 °C ~ +80 °C	
input voltage Vcc	+3V DC ± 5%	
frequency control voltage (VC)	+1,5V DC ± 1V	
input current max.	1,2 mA typ. (20mA max. without load)	
frequency adjustment (pullability)	voltage control ±5 ppm min. positive slope	
SSB phase noise	-120 dBc/Hz at 1 kHz offset	
start-up time	3 ms max.	
harmonic distortion	-5 dBc max.	
storage temperature	-40 °C ~ +85 °C	
pin connection	# 1 : VC # 2 : GND # 3 : Output # 4 : Vcc	
size l/w/h	7,0 x 5,0 x 1,9mm	
RoHS	since production start	
contents of reel	2000 pcs.	
part no.	12.97100 ~ 12.97199	



**VCTCXO** Voltage Controlled Temperature Compensated Crystal Oscillator

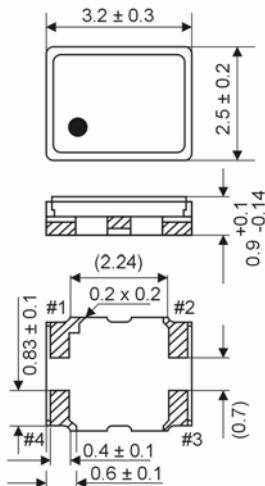
**SMD-version**

model	KXO-83	
frequency range	12,0 ~ 26,0 MHz	
output	load	10 kOhm // 10pF
	voltage	0,8Vp-p min.
	waveform	clipped sine-wave
frequency Stability	vs. temp.range	±1,5 ~ ±5,0 ppm at -10°C ~ +60°C ±2,0 ~ ±5,0 ppm at -20°C ~ +70°C ±2,0 ~ ±5,0 ppm at -40°C ~ +85°C
	vs. input voltage	± 0,3 ppm max. ± 5%
	vs. load	± 0,3 ppm max. at 10 kOhm ± 10%/10 pF ± 10%
	vs. aging	± 1,0 ppm / year max. at +25°C
operating temperature range	-10°C ~ +60°C -20°C ~ +70°C -40°C ~ +85°C	
input voltage Vcc	+ 3V DC ± 5%	
frequency control voltage (VC)	+ 1,5Vdc ± 1Vdc positiv transfer characteristic	
input current max.	1,2 mA typ. (2mA max. without load)	
frequency adjustment (pullability)	voltage control ± 5 ppm min. positive slope	
start-up time	3 ms max.	
aging at 25°C	±1ppm/year max.	
pin connection	# 1 : VC      # 3 : Output # 2 : GND    # 4 : Vcc	
RoHS	since production start	
contents of reel	1000 pcs.	actual size
part no.	12.97200 ~ 12.97299	

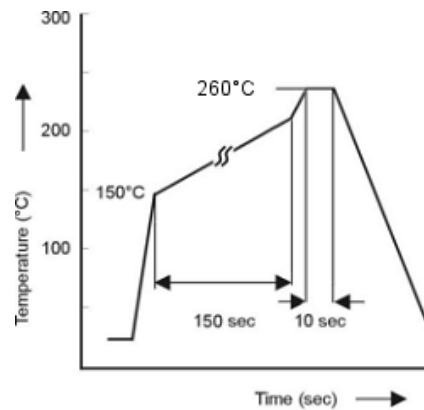


**VCTCXO** Voltage Controlled Temperature Compensated Crystal Oscillator **SMD-version** 2,8 / 3,3V

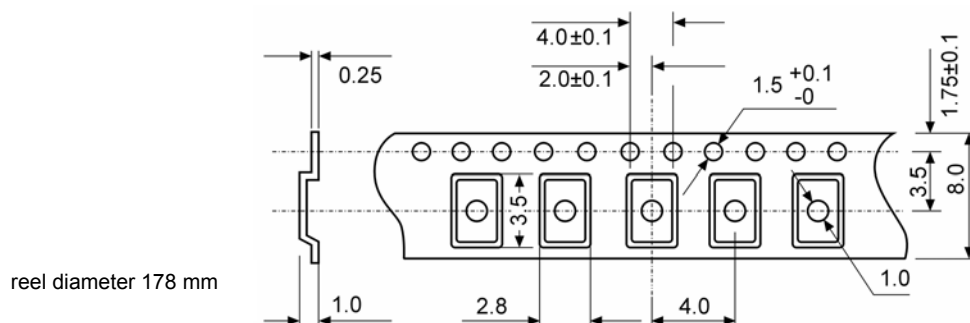
model	KXO-84	
frequency range	12,60 - 26,0 MHz	
output	load	10 kOhm $\pm$ 10% // 10pF $\pm$ 10%
	voltage	0,8Vp-p min. at 10 kohm // 10 pF
	waveform	clipped sine-wave
frequency stability	vs. temp.range	$\pm$ 2,5 ppm at -30°C - +75°C
	vs. input voltage	$\pm$ 0,3 ppm at Vdc
	vs. load	$\pm$ 0,2 ppm max. at 10 kOhm $\pm$ 10%/10 pF $\pm$ 10%
	vs. aging	$\pm$ 1,0 ppm / year max. at +25°C
operating temperature range	-30°C - +75°C	
storage temperature	-40°C - +85°C	
input voltage Vcc	+2,8Vdc or +3,3Vdc $\pm$ 5%	
frequency control voltage (VC)	+ 1,2Vdc $\pm$ 1Vdc	
input current max.	1,5 mA	
frequency adjustment (pullability)	$\pm$ 9ppm - $\pm$ 15ppm (VC= +1,2Vdd $\pm$ 1Vdc)	
start-up time	3 ms max.	
harmonics	-5,0 dBc max.	
phase noise	-110 dBc/Hz at 100 Hz offset -112 dBc/Hz typ. at 100 Hz offset (at 25°C $\pm$ 2°C)	
pin connection	# 1 : VC or GND # 2 : GND # 3 : Output # 4 : Vcc	
RoHS	since production start	
contents of reel	1000 pcs.	actual size
part no.	12.97450 ~ 12.97499	



PAD No.	CONNECTION
#1	V.C. or GND
#2	GND
#3	OUTPUT
#4	+DC



soldering condition




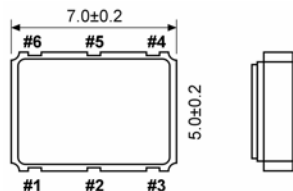
reel diameter 178 mm

# LVDS Clock Oscillator

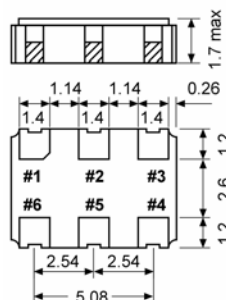
SMD-version

2,5 / 3,3V

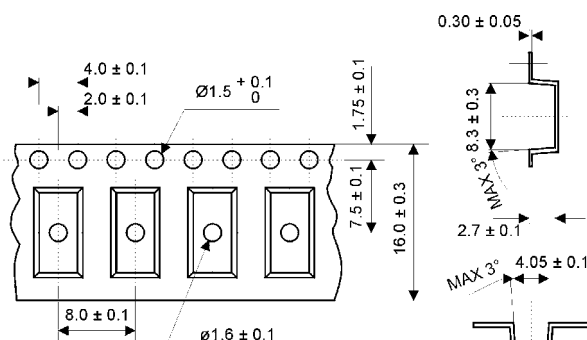
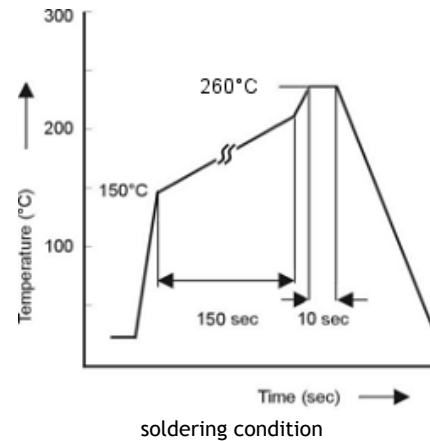
model	KXO-V65	
frequency range	19,440 - 700,0 MHz	
frequency stability at -20° ~ +70°C at -40° ~ +85°C	± 50 ppm ± 100 ppm	
operating temperature	standard -20° ~ +70°C available -40° ~ +85°C (=KXO-V65T)	
storage temperature	-55° ~ +125°C	
symmetry	50% ±5% at ½ Vcc level	
rise & fall time (Tr) max.	600ps typ 850ps max. (20% - 80% of waveform)	
rise & fall time (Tf) max.	600ps typ 850ps max. (80% - 20% of waveform)	
LVDS offset output voltage	1,125V - 1,375V	
"0" level max.	0,9V - 1,1V	
"1" level min.	1,43V - 1,6V	
input voltage V <sub>DD</sub>	standard + 3,3V ± 5% available +2,5V ±5%	
input current max.	50 mA	
output load	100 Ohm	
start up time max.	10 ms	
tristate funcion	yes	
enable/disable delay time	200 ns max.	
phase jitter (12kHz - 20MHz)	RMS: 1ps typ, 3ps max.	
contents of reel	1000 pcs.	 actual size
RoHS	since production start	
part no.	12.93600 - 12.93799	



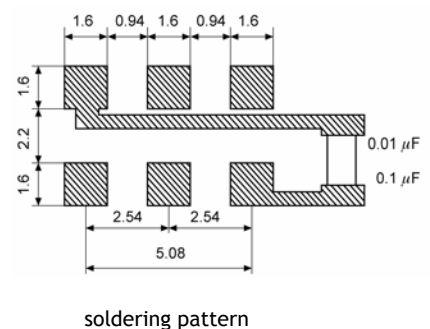
pin #1	pin #4 / pin #5
"L" (0 V)	HIGH IMPEDANCE (Z)
"H" (+3.3 V) or OPEN	OUTPUT



PIN	CONNECTION
1	Tri-state
2	N.C.
3	GND
4	Output
5	C-Output
6	V <sub>DD</sub>



reel diameter 330 mm




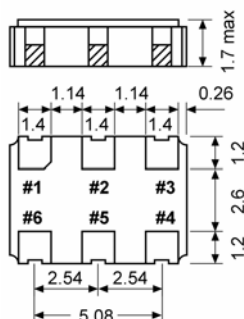
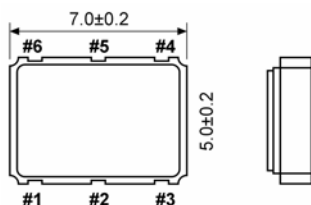


## LVDS VCXO

SMD-version

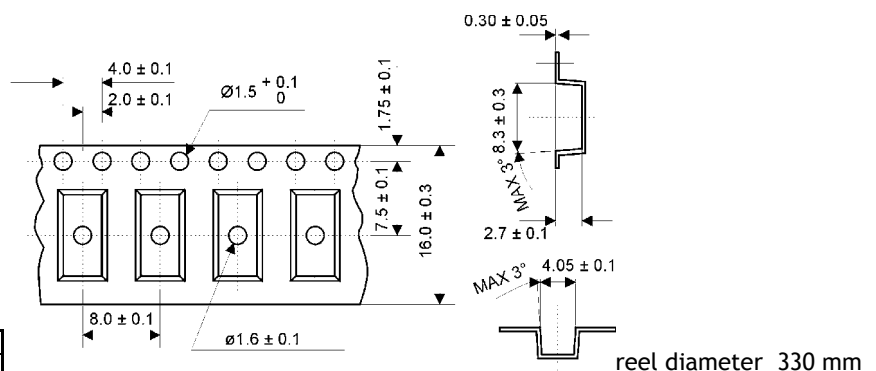
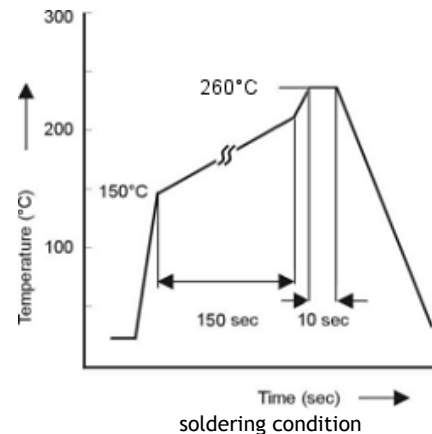
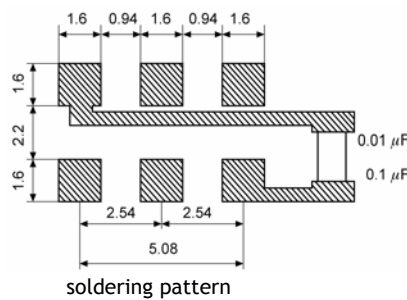
2,5 / 3,3V

model	KXO-V63	
frequency range	27,0 - 700,0 MHz	
frequency stability incl. temperature stability input voltage and load stability, aging. at -20° - +70° C at -40° - +85° C	±25 ppm ~ ±100 ppm ±25 ppm ~ ±100 ppm	
operating temperature	standard -20° - +70° C available -40° - +85° C (=KXO-V63T)	
storage temperature	-40° - +125° C	
symmetry	50% of waveform	
rise & fall time (Tr) max.	400ps typ 850ps max. (20% - 80% of waveform)	
rise & fall time (Tf) max.	400ps typ 850ps max. (80% - 20% of waveform)	
LVDS offset output voltage	1,125V - 1,375V	
"0" level max.	0,9V - 1,1V	
"1" level min.	1,43V - 1,6V	
input voltage V <sub>DD</sub>	standard + 3,3V ± 5% available +2,5V ±5%	
input current max.	45 - 60 mA	
output load	100 Ohm	
start up time max.	10 ms	
frequency adjustment (pullability)	± 50 ppm, ± 100 ppm	
tristate funcion	yes	
enable/disable delay time	200 ns max.	
phase jitter (12kHz - 20MHz)	RMS: 1ps typ, 3ps max.	
contents of reel	1000 pcs.	 actual size
RoHS	since production start	
part no.	12.93400 - 12.93599	



PIN	CONNECTION
1	V <sub>c</sub>
2	Tri-state
3	GND
4	Output
5	C-Output
6	V <sub>DD</sub>

pin #2 "L" (0 V) "H" (+3.3 V) or OPEN	pin #4 / pin #5 HIGH IMPEDANCE (Z) OUTPUT
---	---



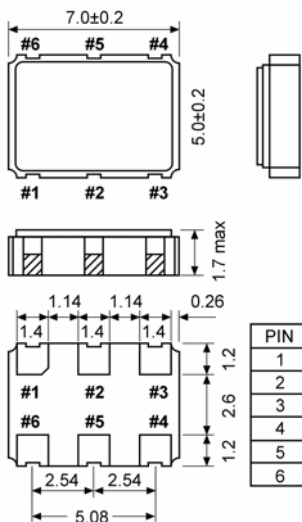
## PECL Positive Emitter Coupled Oscillator

SMD-version

model	KXO-67	
frequency range	50,0 ~ 212,50 MHz	
frequency stability over all conditions	±100 ppm = KXO-67A ±50 ppm = KXO-67B ±25 ppm = KXO-67D	
storage temperature range	-50 °C ~ +125 °C	
operating temperature range	standard -20 °C ~ +70 °C available -40 °C ~ +85 °C	
symmetry	40% ~ 60% (at crossing point)	
rise and fall time (max.)	0,8 ns (20% ~ 80% of amplitude)	
start up time (max.)	10 ms	
"0" level max.	Vdd to +1,63V	
"1" level min.	Vdd to +1,02V	
disable delay time max.	100 ns	
enable delay time max.	10 ms	
input voltage (Vdd)	+3,3V DC ±5%	
supply voltage	-0,5V to +7,0V	
input current (Pin#1=Open or VIH)	90 mA max.	
load	50 Ohm (Vdd to +2,0V)	
stand-by control voltage	VIH: +0,7Vdd min. VIL: +0,3Vdd max.*	
stand-by current (Pin#1=VIL)	10 µA max.	
RMS jitter (12 kHz to 20 MHz band)	1 ps max.	
aging (first year)	± 5ppm max.	
RoHS	since production start	
contents of reel	1000 pcs.	
part no.	12.93200 - 12.93499	

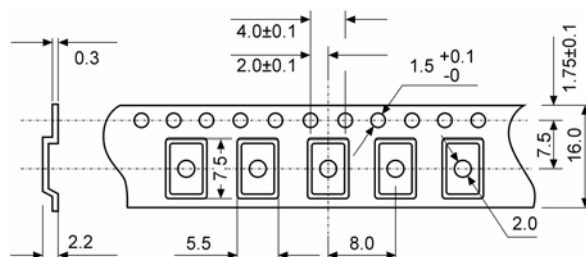
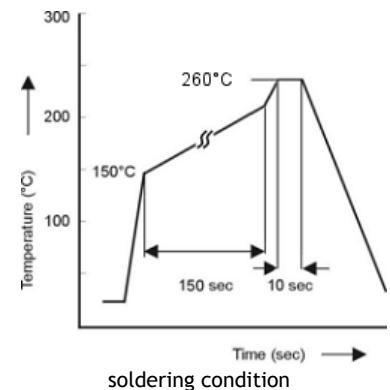
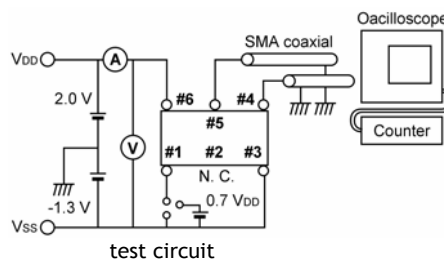


\* Internal crystal oscillation to be halted (Pin#1=VIL).

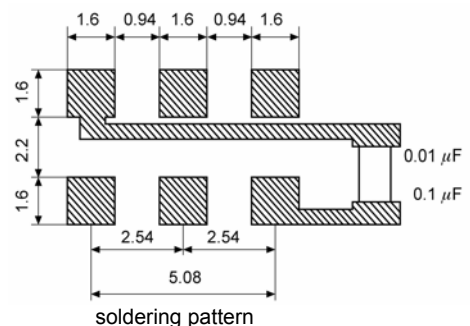


PIN	CONNECTION
1	Tri-state*
2	N.C.
3	GND
4	Output
5	C-Output
6	VDD

\*enable high



reel diameter 245 mm



# Ceramic Resonator

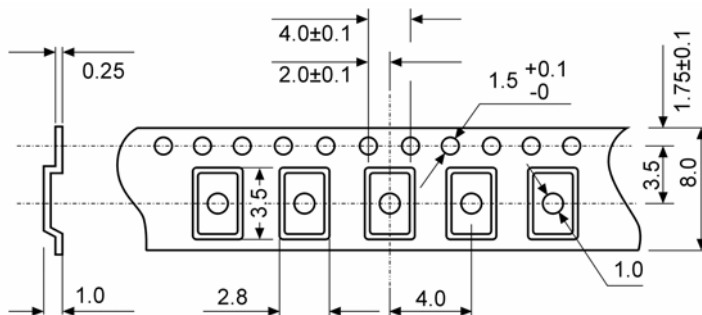
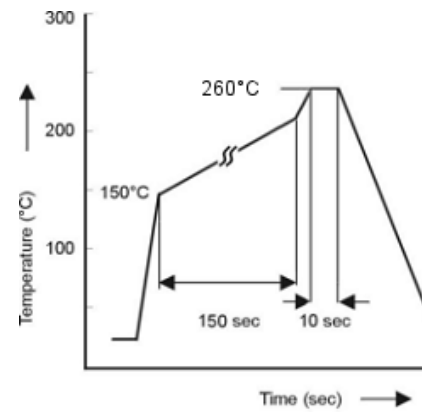
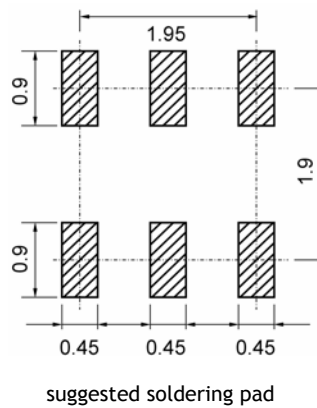
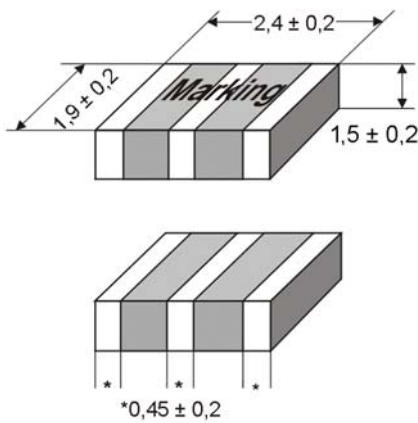
KX-ZTT CW series

SMD-version

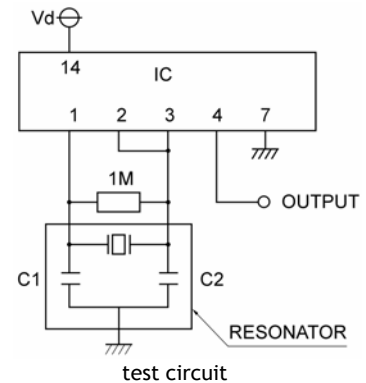
Built-in capacitor types

model	KX-ZTT-CW MX	
frequency range	16,0 ~ 50,0 MHz	
internal capacitance C <sub>1</sub> , C <sub>2</sub>	16,0 ~ 25,99 MHz 15 pF	26,0 ~ 50,0 MHz 5 pF
frequency tolerance at +25 °C	± 0,5%	
frequency stability at -20 ° ~ +80 °C	± 0,3%	
aging for 10 years	± 0,3%	
resonant resistance max.	16,0 ~ 25,99 MHz 60 Ohm	26,00 ~ 50,0 MHz 50 Ohm
test circuit IC	74 HCU04 AP (Toshiba)	
RoHS *	started from date code May, 2005	
contents of reel	3000 pcs.	■ actual size
part no.	12.99000 ~ 12.99999	

\* Please note our Precaution of Handling on page 44.



reel diameter 178 mm



# Ceramic Resonator

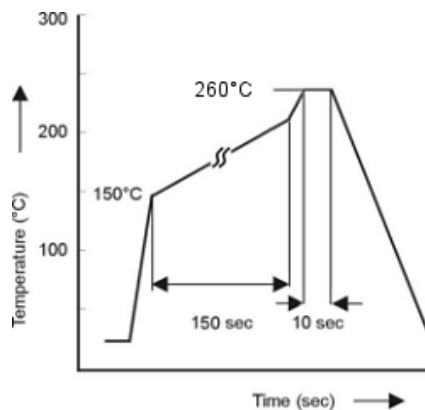
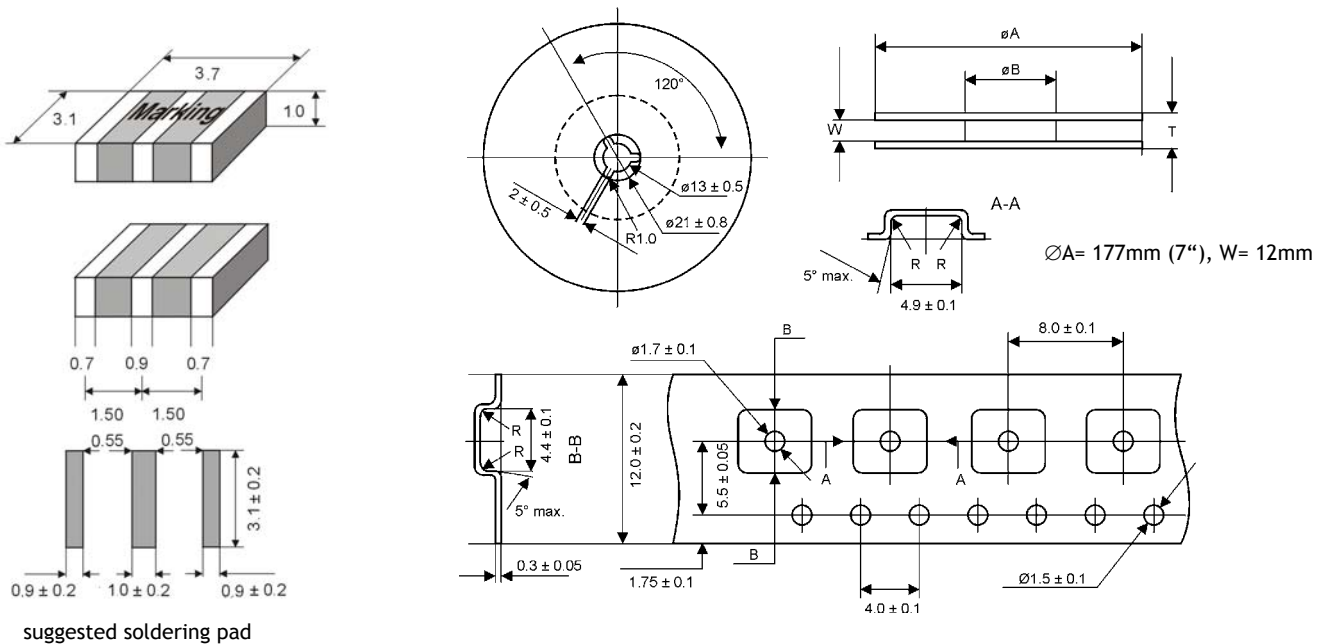
KX-ZTT CV series

SMD-version

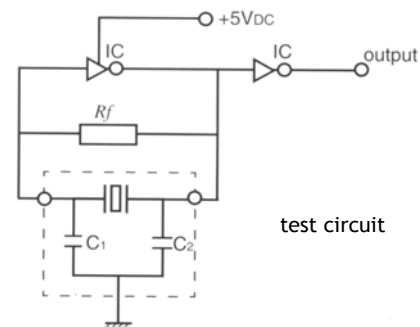
Built-in capacitor types

model	KX-ZTT-CV MT	KX-ZTT CV MX	
frequency range	8,0 - 13,0 MHz	13,1 ~ 16,0 MHz	16,1 ~ 50,0 MHz
internal capacitance C <sub>1</sub> , C <sub>2</sub>	20 pF		16,01 ~ 40,0 MHz 10 pF 40,01 ~ 50,0 MHz 5 pF
frequency tolerance at +25°C	± 0,5%		
frequency stability at -20° ~ +80°C	± 0,4%	± 0,3%	
aging for 10 years	± 0,3%		
resonant resistance max.	30 Ohm	60 Ohm	40 Ohm
test circuit IC	TC 74 HCU04		
RoHS *	started from date code May, 2005		
contents of reel	1000 pcs.		
part no.	12.99000 ~ 12.99999		

\* Please note our Precautions of Handling on page 44.



soldering condition



test circuit

## Ceramic Resonator

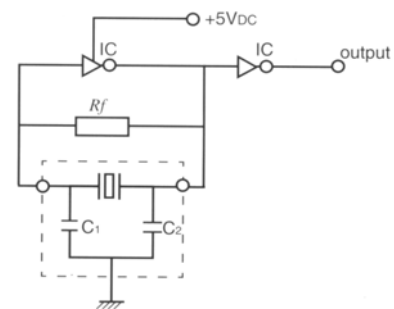
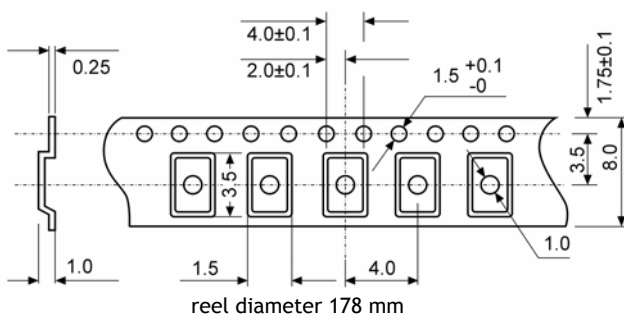
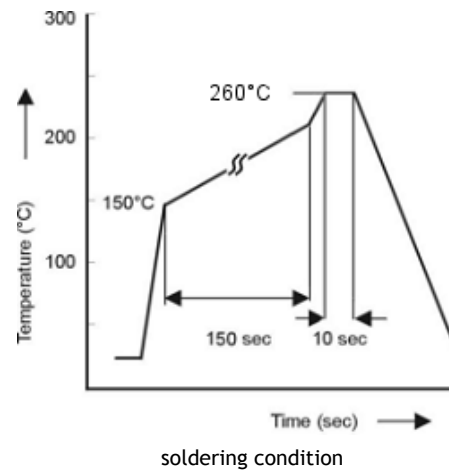
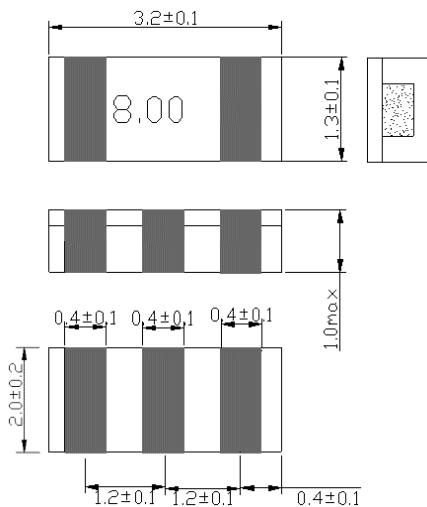
KX-ZTT CE series

SMD-version

Built-in capacitor types

model	KX-ZTT-CE MG
frequency range	8,0 - 12,0 MHz
internal capacitance C <sub>1</sub> , C <sub>2</sub>	15 pF
frequency tolerance at +25 °C	± 0,5%
frequency stability at -25 ~ +85 °C	± 0,3%
aging for 10 years	± 0,3%
resonant resistance max.	40 Ohm
test circuit IC	TC 74 HCU04
RoHS *	started from date code May, 2005
contents of reel	3000 pcs.
part no.	12.99000 - 12.99999

\* Please note our [Precautions of Handling](#) on page 44.



test circuit

# Ceramic Resonator

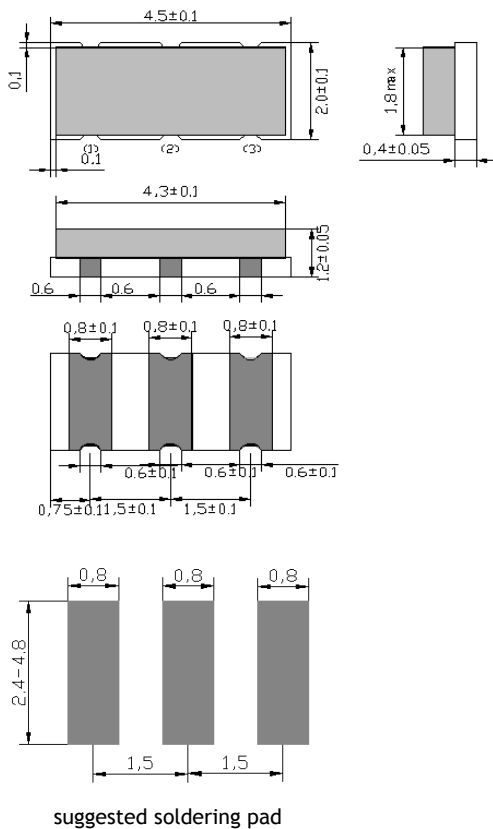
KX-ZTT CR series

SMD-version

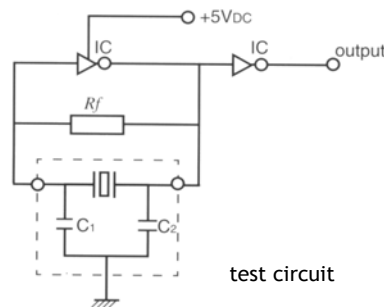
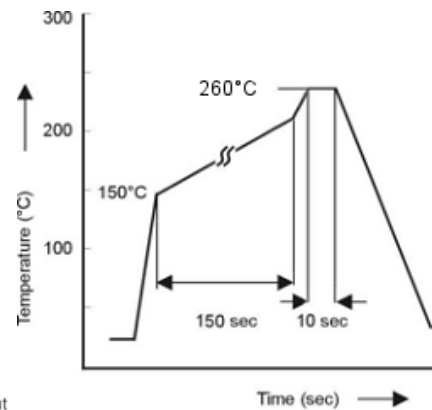
Built-in capacitor types

model	KX-ZTT-CR MG
frequency range	4,0 - 8,0 MHz
internal capacitance C <sub>1</sub> , C <sub>2</sub>	15 pF
frequency tolerance at +25 °C	± 0,5%
frequency stability at -25 ~ +85 °C	± 0,3%
aging for 10 years	± 0,3%
resonant resistance max.	40 Ohm
test circuit IC	TC 74 HCU04
RoHS *	started from date code May, 2005
contents of reel	3000 pcs.
part no.	12.99000 ~ 12.99999

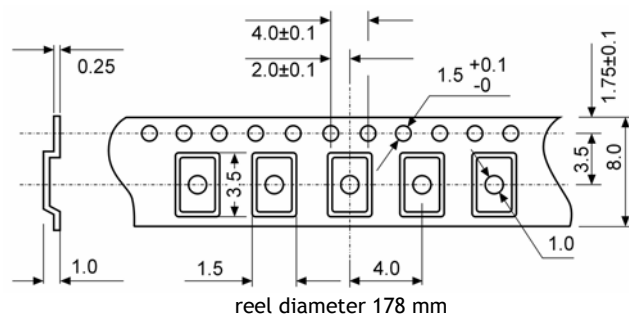
\* Please note our Precautions of Handling on page 44.



soldering condition



test circuit



## Ceramic Resonators

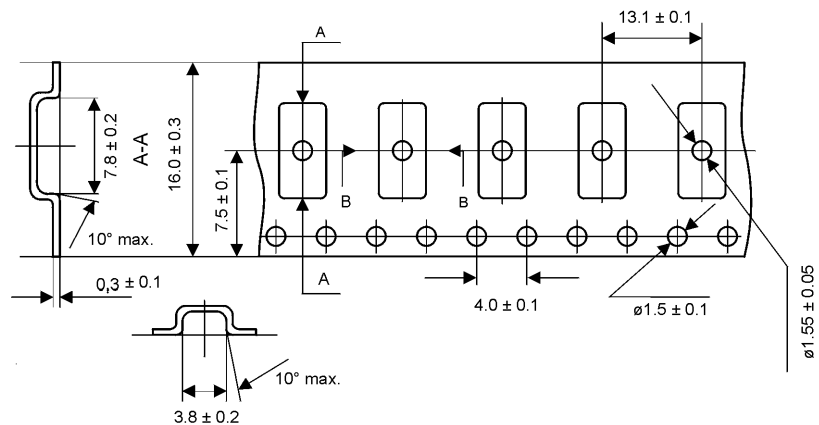
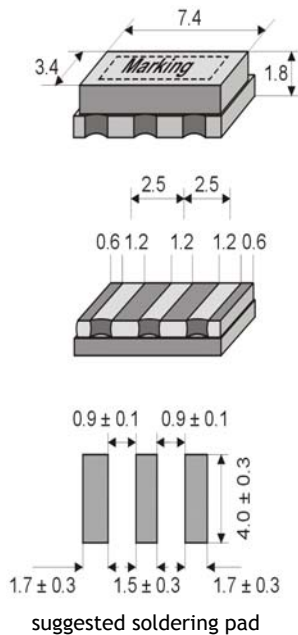
## KX-ZTT C series

## SMD-version

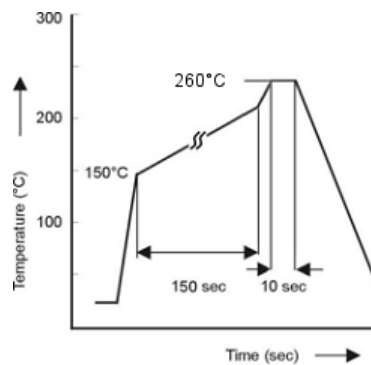
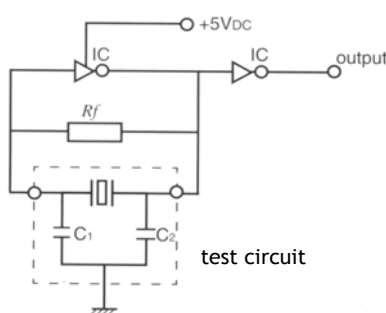
Built-in capacitor types

model	KX-ZTT CC MG
frequency range	1,84 ~ 8,0 MHz
internal capacitance C <sub>1</sub> , C <sub>2</sub>	1,84 - 2,40 MHz 33 pF 2,41 - 8,0 MHz 22 pF
frequency tolerance at +25 °C	± 0,5%
frequency stability at -20° ~ +80 °C	± 0,3%
aging for 10 years	± 0,3%
resonant resistance max.	1,84 - 2,99 MHz 100 Ohm 3,00 - 3,49 MHz 50 Ohm 3,50 - 8,00 MHz 30 Ohm
test circuit IC	CD 4069 UBXP2
RoHS *	started from date code May, 2005
contents of reel	4000 pcs.
part no.	12.99000 ~ 12.99999

\* Please note our Precautions of Handling on page 44.



tape specification: ØA= 330mm (13"), W= 16mm



soldering condition

# Ceramic Resonators

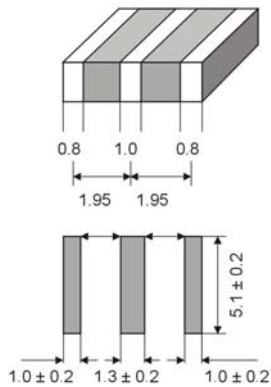
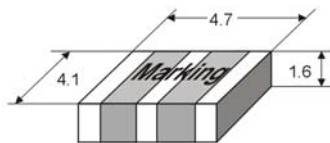
## KX-ZTT C series

## SMD-version

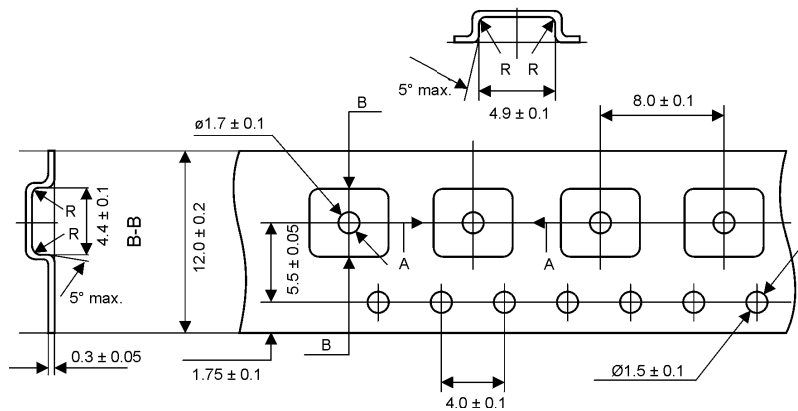
Built-in capacitor types

model	KX-ZTT CS MT	KX-ZTT CS MX
frequency range	8,0 ~ 13,0 MHz	13,01 ~ 50,0 MHz
internal capacitance C <sub>1</sub> , C <sub>2</sub>	22 pF	13,01 - 16,0 MHz 22 pF 16,01 - 40,0 MHz 15 pF 40,01 - 50,0 MHz 5 pF
frequency tolerance at +25 °C	± 0,5%	
frequency stability at -20 ° ~ +80 °C	± 0,4%	± 0,3%
aging for 10 years	± 0,4%	± 0,3%
resonant resistance max.	30 Ohm	40 Ohm
test circuit IC	CD 4069 UBXP2	TC 74 HCU04
RoHS *	started from date code May, 2005	
contents of reel	1000 pcs.	
part no.	12.99000 ~ 12.99999	

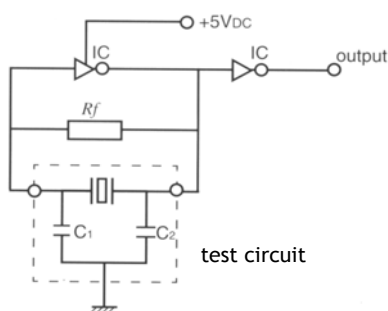
\* Please note our Precautions of Handling on page 44.



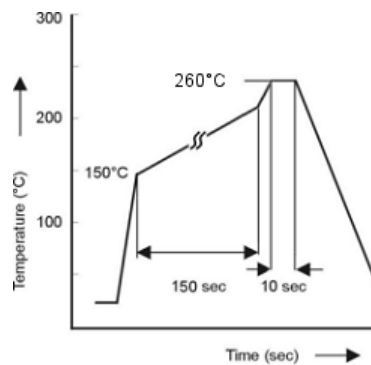
suggested soldering pad



tape specification: ØA= 177mm (7"), W= 12mm



test circuit



soldering condition



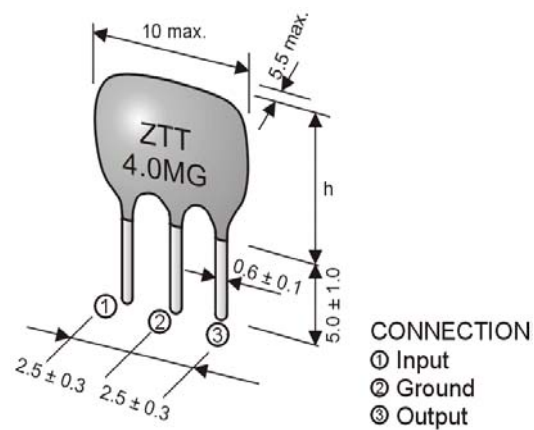
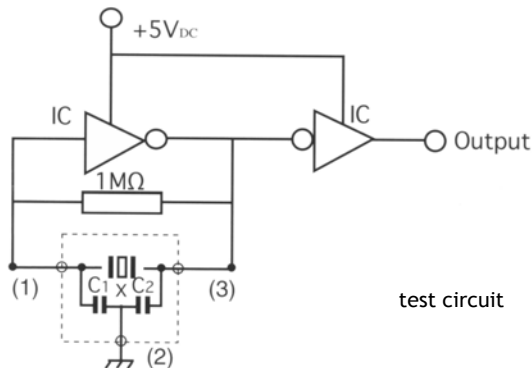
## Ceramic Resonators

## KX-ZTT series

Built-in capacitor types

model	KX-ZTT MG	KX-ZTT MT	KX-ZTT MX
frequency range	1,84 ~ 7,99 MHz	8,0 ~ 13,0 MHz	13,1 ~ 50,0 MHz
internal capacitance C <sub>1</sub> , C <sub>2</sub>	30 pF	22 pF	13,1 ~ 20,0 MHz 30 pF 20,1 ~ 25,99 MHz 15 pF 26,0 ~ 50,0 MHz 5 pF
frequency tolerance at +25°C	± 0,5%		
frequency stability at -20° ~ +80°C	± 0,3%		
aging for 10 years	± 0,3%		
resonant resistance max.	80 Ohm	30 Ohm	
test circuit IC	1/6 CD 4069 UBEX2		TC 74 HCU04
height (h) max.	8,0 mm	10,0 mm	
RoHS *	started from date code May, 2005		
packing unit	500 pcs.		
part no.	12.99000 ~ 12.99999		

\* Please note our [Precautions of Handling](#) on page 44.



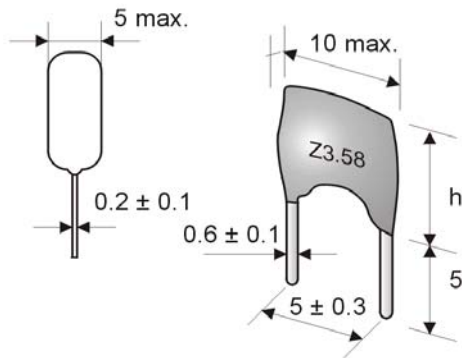
## Ceramic Resonators

## KX-ZTA series

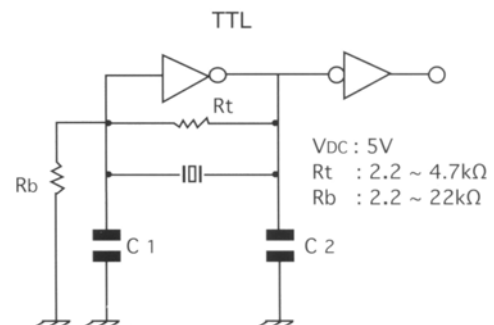
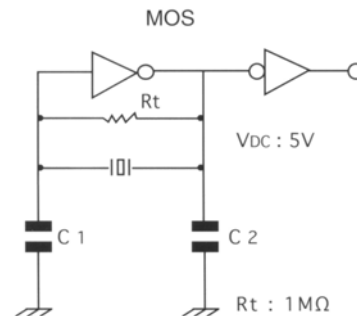
None capacitor types

model	KX-ZTA MG	KX-ZTA MT	KX-ZTA MX
frequency range	1,84 ~ 5,0 MHz	5,01 ~ 13,0 MHz	13,1 ~ 50,0 MHz
external capacitance C <sub>1</sub> , C <sub>2</sub>		1,84 ~ 20,0 MHz 30 pF 20,01 ~ 25,99 MHz 15 pF 26,0 ~ 50,0 MHz 5 pF	
frequency tolerance at +25°C		± 0,5%	
frequency stability at -20° ~ +80°C		± 0,3%	
aging for 10 years		±0,3%	
resonant resistance max.	80 Ohm	30 Ohm	
test circuit IC		for MOS: 1/6 CD 4069UBEX2 for TTL: 1/6 SN 74LS04NX2	
RoHS *		started from date code May, 2005	
packing unit		500 pcs.	
height (h) max.	7,5 mm	10,0 mm	
part no.		12.99000 ~ 12.99999	

\* Please note our [Precautions of Handling](#) on page 44.



test circuits:



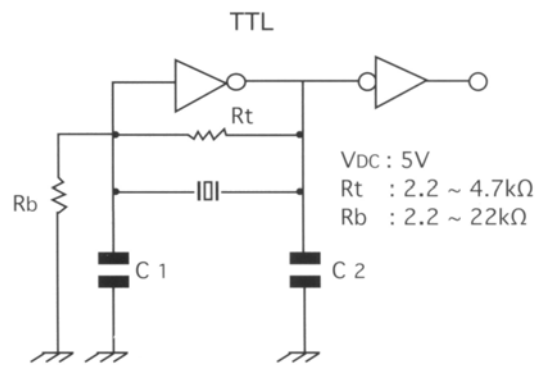
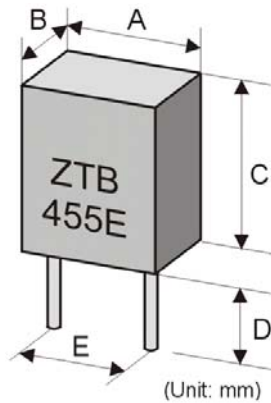
## Ceramic Resonators

## KX-ZTB series

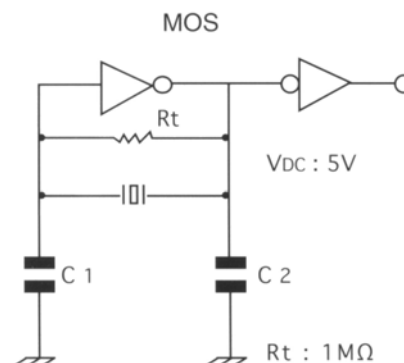
None capacitor types

model	KX-ZTB D	KX-ZTB D	KX-ZTB P	KX-ZTB E	KX-ZTB P	KX-ZTB J	KX-ZTB J
frequency range in kHz	190-249	250-374	375-429	430-509	510-699	700-999	1000-1250
external capacitance C <sub>1</sub> , C <sub>2</sub>	330/470	220/470	120/470	100/100	100/100	100/100	100/100
frequency tolerance at +25°C	±1kHz	±1kHz	±2kHz	±2kHz	±2kHz	±0,5%	±0,5%
frequency stability at -20° ~ +80°C	± 0,3%						
aging for 10 years	0,3%						
resonance impedance max.	20 Ohm				30 Ohm	70 Ohm	100 Ohm
test circuit IC	for MOS: 1/6 CD 4069UBEX2 for TTL: 1/6 SN 74LS04NX2						
RoHS *	started from date code May, 2005						
packing unit	500 pcs.						
dimensions in mm	A	B	C	D	E		
	13,5	3,8	14,7	8,0	10,0	11,0	3,8
			12,2	7,0	7,7	7,9	3,6
			9,3	7,0	5,0	7,0	3,5
			9,0	4,0 (6,0)	5,0	7,0	3,5
			6,8	3,5	2,5	5,2	2,8
part no.	12.99000 ~ 12.99999						

\* Please note our Precautions of Handling on page 44.



test circuits



## CERAMIC RESONATORS Precautions for Handling

### 1. Precautions for Safety.

- 1.1 Fail-Safe Design for Equipment in application of the Ceramic Resonators (Chip Type), it is recommended that equipment shall be protected by adding a protective and/or retardant design circuit against deteriorations and failures of the Ceramic Resonators.
- 1.2 Operating Temperature Ranges. The Ceramic Resonators (Chip Type) shall not be operated beyond the specified „Operating Temperature Range“ in the Catalogue or the Specifications.
- 1.3 Changes/Drifts in Oscillating Frequency. It shall be noted that oscillating frequencies of the Ceramic Resonators (Chip Type) may drift depending IC applied (the type names, the manufacturer) and capacitance values of external capacitors  $C_1^*$  and  $C_2^*$  and the circuit design. Note \*Refer to „Standard Test Circuit Diagram“ in the Catalogue or the individual Specification.
- 1.4 Abnormal Oscillation. The Ceramic Resonators (Chip Type) are always accompanied by superior resonances. Hence in the circuit, superior oscillations or stop of oscillation may occur depending on the circuit design (IC applied, frequency characteristics of the IC, supply voltage etc.) and/or environmental conditions. Attention shall be paid to those abnormalities above mentioned in circuit design.
- 1.5 Stray Capacitance. Stray capacitances and insulation resistances on printed circuit board may cause abnormalities of the Ceramic Resonators such as „higher harmonic oscillations“ or „stop of oscillation“ Attention shall be paid to those abnormalities above mentioned in Circuit design.
- 1.6 Matching Capacitors. In application of the Ceramic Resonators (Chip Type), two selected capacitors\*\* shall be added for constructing „Colpitts Oscillation Circuit“. Note \*\*The capacitance values are specified in the Catalogue.

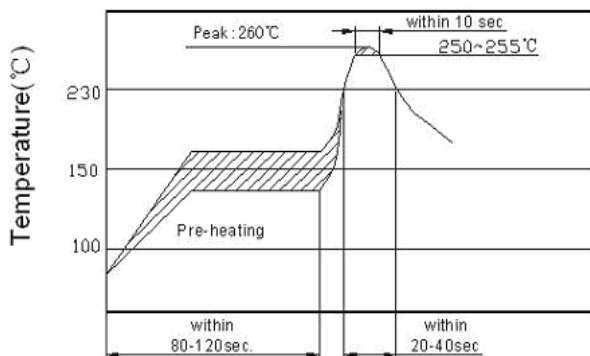
### 2. Prohibited Applications

- 2.1 „Flow Soldering“ shall not be applied to the Ceramic Resonators (Chip Type).
- 2.2 „Ultrasonic Cleaning“ and „Ultrasonic Welding“ shall not be applied to the Ceramic Resonators (Chip Type) for preventing them from electrical failures and mechanical damages.
- 2.3 Lacquer shall not be applied to resonator types KX-ZTT CC and KX-ZTT CR.

### 3. Application Notes

- 3.1 Overvoltages Spikes & Electrostatic Discharges Abnormal/excess electrical stresses such as over voltage spikes and electrostatic discharges may cause electrical deteriorations and failures of the Ceramic Resonators and affect reliability of the devices.
- 3.2 Abnormal Mechanical Stresses. (1) Abnormal/excess mechanical stresses such as falling shocks shall not be applied to the Ceramic Resonators (Chip Type) in handling to prevent them from being damaged or cracked. (2) Dropped devices shall not be used.
- 3.3 Surface Mounting Consideration. In automated mounting of The Ceramic Resonators (Chip Type) on printed circuit boards, any bending expanding and pulling forces or shocks against the Ceramic Resonators (Chip Type) shall be kept minimum to prevent them from electrical failures and mechanical damages of the devices.
- 3.4 Soldering (Reflow). (1) Solderings of The Ceramic Resonators (ChipType) shall conform to the soldering conditions in the individual Specifications. (2) The Resonators are designed for „Reflow Soldering“. (3) In the reflow solderings, too high soldering temperatures and too large temperature gradient such as rapid heating or cooling may cause electrical failures and mechanical damages of the devices.
- 3.5 Soldering Flux. a) Resin-based and non-activated soldering flux is recommended. b) The content of halogen in the flux shall be 0,1 wt.% or less.
- 3.6 Post Soldering Cleaning. (1) Application of ultrasonic cleaning is prohibited. (2) Cleaning Conditions such as kinds of cleaning solvents, immersion time and temperatures etc. shall be checked by experiments before production.
- 3.7 Operating and Storage Conditions. The Ceramic Resonators (Chip type) shall not be operated and/or stored under following environmental conditions. a) To be exposed directly to water or salt water b) To be exposed directly to sun-light c) Under conditions of dew formation d) Under conditions of corrosive atmosphere such as hydrogen sulfide, sulfurous acid, chlorine and ammonia.
- 3.8 Long Term Storage. The Ceramic Resonators (Chip Type) shall not be stored under severe conditions of high temperatures and high humidities. Store them indoors under 40°C max. and 75% RH max. Use them within one year and check.

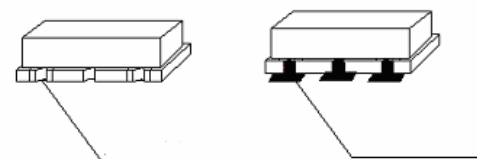
### 4. Lead-free procedure recommendation



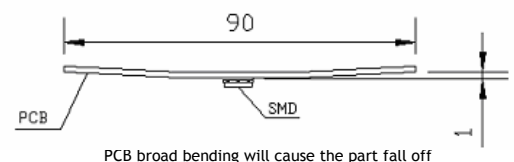
Reflow of high soldering temperature district: 260°C max., 10s max.

Manual soldering recommendation: Temperature of soldering iron is 270±5°C, putting the soldering iron on the equipment of 0.5mm high. Moreover, putting the dissolved soldering on the electrode for 3±1s.

\*The Resonator will be unstable and lose function if the above soldering temperature is overheated.



The metallic part should be soldered fully otherwise the part may be fallen off



### 5. Application notice of SMD products:

PCB soldering point should be satisfied with requirement of specification recommendation: Otherwise, the accurate level of soldering point will be lower, parts may fall off. Parts may fall off if PCB winding is overlarge.

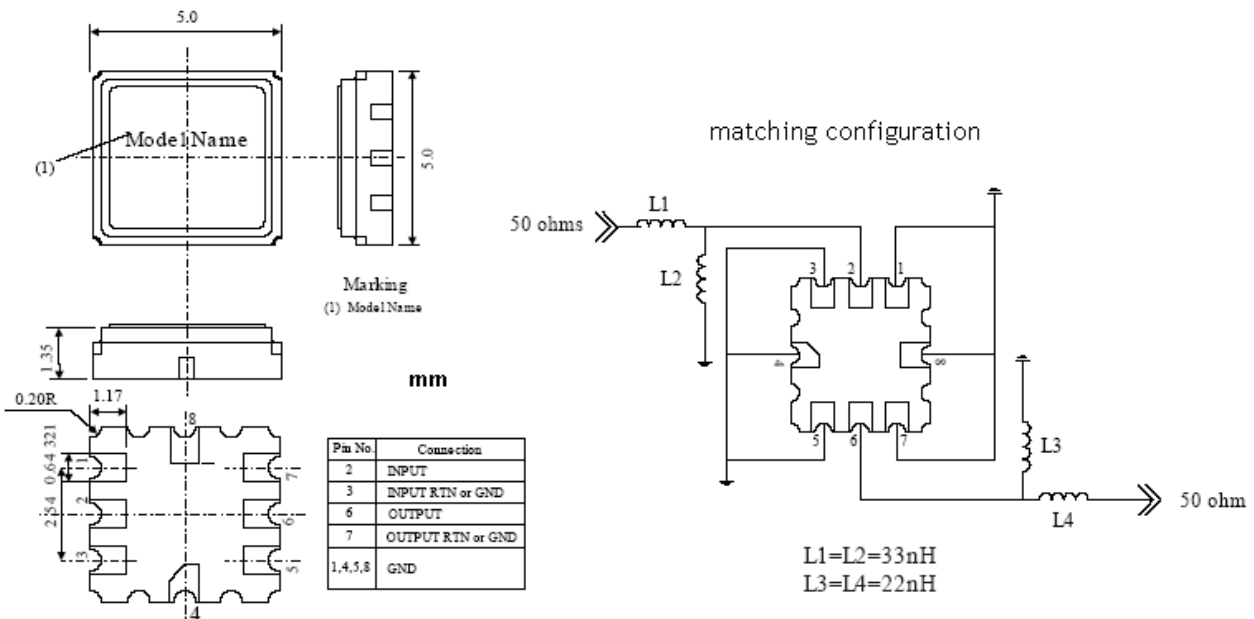
### 6. Application notice of SMD products with SMD mounting machines.

Since our products are Ceramic parts, please do not put too much mechanical pressure on the parts. We suggest using Mounting Machine of optical positioning rather than that of mechanical positioning. Damage of parts will happen if mechanical force is too large. Please estimate clearly on mounting before use.

## Filters

## SAW Resonators

Frequency [MHz]	Part Number	Frequency Variation [MHz]	Insertion Loss Max. [dB]	50 Ohm Loaded Q [Typical]	Package Type
288.0	R528801	±0.075	2.5	2100	SMD 5.0 x 5.0
293.125	R529311				
297.2	R529721				
303.875	R530381				
304.6	R530461				
311.0625	R531101				
315.0	R531501				
318.625	R531861				
384.0	R538401				
418.187	R541811				
433.92	R543391				
1000.0	R510001				
1100.0	R511001				



## Filters

### Low - Loss Bandpass Filters

Application	Frequency [MHz]	Part Number	BW3 Min. [MHz]	BW 3Typ. [MHz]	I. L. Max [dB]	Ripple Max [dB]	SMD Package Type
CDMA	70.0	504089	1.50	1.60	9.6	0.5	<u>19.0 x 6.5</u>
	70.0	506140	9.60	9.62	10.9	0.5	13.3 x 6.5
	70.0	506146	14.50	15.00	14.5	0.8	
	80.0	507401	9.70	9.77	9.6	0.5	
	95.38	508055	1.23	1.35	15.5	0.5	
	130.38	508061	1.23	3.38	6.8	0.5	<u>3.8 x 3.8</u>
	160.0	506440	9.70	9.80	15.5	0.5	13.3 x 6.5
	170.0	507601	9.70	9.80	15.5	0.5	
GSM	<u>225.0</u>	508151	0.16	0.23	5.0	1.0	<u>7.0 x 5.0</u>
	<u>246.0</u>	508153	0.16	0.23	5.0	1.0	
	<u>282.0</u>	508155	0.16	0.23	6.5	1.0	5.0 x 5.0
	<u>360.0</u>	508157	0.16	0.36	6.5	1.0	
	<u>400.0</u>	508159	0.16	0.36	6.5	1.0	
	440.0	508161	0.16	0.36	6.5	1.0	
AMPS	83.16	508253	0.03	0.05	4.0	0.5	<u>13.3 x 6.5</u>
WLAN	140.0	504308	3.00	3.20	19.5	0.4	19.0 x 6.5
	371.0	505706	2.00	2.08	15.0	0.65	<u>9.1 x 7.1</u>
	374.0	505707	17.00	22.10	9.5	0.5	5.0 x 5.0
WLL	70.0	506139	8.00 @BW1dB	8.10 @BW1dB	11.4	0.7	13.3 x 6.5
	549.5	505704	2.00	1.80	15.7	0.7	
	549.5	505705	10.00	16.00	-	-	<u>5.0 x 5.0</u>
CATV	169.25	505605	1.00	2.00	7.7	0.5	13.3 x 6.5
	337.25	505702	1.00	2.00	15.0	0.6	
	487.25	505703	1.00	1.80	15.0	0.6	
Bluetooth	110.592	505606	1.10	1.15	11.5	0.3	7.0 x 5.0
GPS	140.0	506336	9.60	8.80	13.7	0.3	13.3 x 6.5

## Filters

## RF SAW Filters

Frequency [MHz]	Part Number	Inbandwidth [MHz Min.]	I. L. Max. [MHz]	Ripple Max. [dB]	Attenuation Min. [dB]	Impedance [Ohm//L,C]	SMD Package Type
139.0	F51398	8	6.5	2.0	40	210//Tuning	<u>5.0 x 5.0</u>
147.0	F51478	8	6.5	2.0	40	210//Tuning	
155.0	F51558	8	6.5	2.0	40	210//Tuning	
165.0	F51658	8	6.5	2.0	40	210//Tuning	
171.0	F51718	8	6.5	2.0	40	210//Tuning	
273.0	F52734	4	4.5	1.5	55	50//0	
281.0	F52816	6.4	4.5	1.5	55	150//0	
325.3	F53256	6.6	4.5	1.5	55	150//0	<u>3.8 x 3.8</u>
410.0	F54104	4	3.5	1.0	55	150//0	
412.0	F54124	4	3.5	1.0	55	150//0	
419.0	F54194	4	3.5	1.0	55	150//0	
434.0	F54344	4	3.5	1.0	55	50//0	
446.0	F54464	4	3.5	1.0	55	150//0	
448.0	F54484	4	3.5	1.0	55	150//0	
450.0	F54504	4	3.5	1.0	55	150//0	
454.0	F54544	4	3.5	1.0	55	150//0	
458.0	F54584	4	2.5	1.0	55	150//0	
458.0	F54588	8	4.5	1.0	55	150//0	
462.0	F54624	4	3.5	1.0	55	150//0	
465.0	F54654	4	3.5	1.0	55	150//0	
465.0	F54655	4	3.5	1.0	55	50//0	
466.0	F54664	4	3.5	1.0	55	150//0	
478.0	F54784	4	3.5	1.0	55	150//0	
841.0	F58414	4	3.5	1.5	55	50//0	
897.5	F58973	35	3.5	1.5	45	50//0	
902.5	F59023	35	3.5	1.5	45	50//0	
1000.0	F1G020	20	5	1.5	40	50//0	
1100.0	F1G120	20	5	1.5	40	50//0	

## General Terms and Conditions of Sale of GEYER ELECTRONIC e.K. (Rev. 05/2007)

### I. Scope of Validity

1. These Conditions shall apply exclusively to all our offers, supplies and services to our Customer. These Conditions shall also apply for future orders, supplies and services without the need of any express agreement thereon at the conclusion of such transaction.
2. Any conditions of the Customer, which differ from our Conditions shall not be recognized, whether or not we have objected to such conditions. Our Conditions shall also apply, if we, knowing of any contradictory or dissenting conditions of our Customer, unconditionally execute the supply.
3. Our Conditions shall apply only to contractors as defined by § 310, Section 1 BGB (German Civil Code).

### II. Offer and Acceptance

1. Our quotations are subject to change without notice and are not binding unless they are expressly described as being binding.
2. Any describing data of our products, such as illustrations, drawings, specifications, weights, dimensions, performance-, operational- and consumption data, loading capacities, tolerances, and information relating to the use or suitability for a particular application, contained in our offer, in prospectus, catalogues or similar documents, constitute an approximate guide and shall not be binding unless expressly described as binding. Any such data relate to serial products which have been tested under central European operation conditions and describe their standard functions. They are not to be deemed guaranteed properties but are descriptions or definitions of the goods or services.
3. Customary changes in quantities, quality or specifications of the goods, changes as a result of a change of law and technical improvements shall be allowed. We may also replace parts of the goods with other equal parts provided such parts do not impair their suitability for the purpose provided for by the contract.
4. We reserve the right of ownership and copyright of all quotation documents; they may not be made available to third parties unless upon our approval.
5. Offers made by the Customer shall be in writing (letter, telefax, e-mail).
6. We may accept an order made by a Customer within 4 weeks after its receipt, which shall be confirmed in writing.

### III. Prices and Terms of Payment

1. The prices quoted by us are in EURO and are given on the basis of carriage paid (CPT as per Incoterms 2000) to the destination stated by the Customer for deliveries within Germany, subject to the provisions under Section IV.2 hereunder. Where the goods are supplied for export from Germany, the price basis shall be Ex Works (EXW as per Incoterms 2000). Value added tax shall be added at the rate applicable at the time of invoicing.
2. Unless otherwise agreed, the price shall be paid for goods delivered within Germany within 10 calendar days with a discount of 3% and for deliveries for export within 30 calendar days (without discount).
3. If the Customer is in delay in making payment, we are entitled to charge interest for late payment at the rate of 8% p.a. above the relevant base rate of the Deutsche Bundesbank. If we are able to demonstrate a greater loss as a result of late payment, then we are entitled to claim for this loss.
4. Any offsetting or retaining of payment by the Customer is only permitted if Customer's counterclaims are not contested or have been finally decided by the court.

### IV. Delivery

1. Deliveries within Germany shall be made CPT (according to Incoterms 2000) to the destination stated by the Customer, subject to the provisions in Section IV.2 hereunder, and for deliveries for export EXW (according to Incoterms 2000). We are entitled to make partial deliveries. At the request of the Customer, the deliveries will be insured by us at his expense.
2. The means of shipment shall be at our discretion. We will deliver in customary packaging. We will make deliveries up to an order value of EURO 499,- (without VAT) for a lump sum packaging- and shipping cost surcharge of EURO 6,90 per parcel with a weight of up to 10 kg and for a surcharge of EURO 18,- in case of pallet consignment. In case of excess weights the surcharge shall be billed according to the actual cost. Deliveries exceeding an order value of EURO 500,- shall be made without surcharge.
3. We are entitled to charge the Customer for costs incurred by us due to Customer's failure to accept the goods or because of false information given by him.
4. The minimum order value for shipments shall be EURO 25,- (without VAT).

### V. Transfer of Risk

1. The risk of accidental loss and accidental deterioration of the goods passes to the Customer when the goods are handed over to him, to the carrier or to such other party in charge of the transport.
2. If the delivery is delayed due to circumstances for which the Customer is responsible for, the risk passes over to him from the date of readiness for shipment.

### VI. Transportation Damages

1. The Customer shall give notice in writing without delay to us as well as to the carrier or such other party in charge of the transport of any transport damage within the following time-limits:

#### In case of damaged packaging:

- a) Mail: The damage needs to be confirmed upon handing over and to be notified at the post office within 24 hours (!). The damage needs to be notified to us within 48 hours.
- b) Parcel Post: The damaged goods need to be unpacked in the presence of the driver and the damage needs to be confirmed by him. The damage is to be notified to us within 48 hours.
- c) Transport: The damaged goods need to be unpacked in the presence of the driver and the damage needs to be confirmed on the bill of lading. The damage is to be notified to us within 48 hours.

#### In case of undamaged packaging:

- a) Mail: Immediately (within 24 hours) the post office in charge needs to be notified and an inspection and a finding of facts is to be applied for. The damage is to be notified to us within 48 hours.
- b) Parcel Post: The damage is to be notified to us within 48 hours.
- c) Transport: The damaged goods need to be unpacked in the presence of the driver and the damage needs to be confirmed on the bill of lading, indicating that the packaging has been undamaged prior to the ascertainment of the damage. The damage is to be notified to us within 48 hours.

### VII. Delivery Time

1. Compliance with the agreed due dates for delivery requires that the Customer has fulfilled all his obligations in good time and in the appropriate way.
2. The delivery time has been complied with if by the end of the delivery period, the ordered goods have been handed over to the Customer, or the carrier or the other party in charge of the transport, or is ready for shipment and this has been notified to the Customer.
3. If non-compliance with an agreed delivery period is due to force majeure or other circumstances for which we are not responsible, the delivery period will be extended by the duration of such events.
4. If a delivery is in delay due to circumstances for which we are responsible for, or becomes impossible, our liability for damages shall be limited in accordance with the provisions of Section X hereunder.

### VIII. Retention of Title

1. The property of all goods supplied shall remain with us until all amounts outstanding to us under the business relationship with the Customer are fully paid. In the event of a breach of contract by the Customer, especially in case of default of payment or in case of enforcement measures by third parties, we are entitled to demand return of the goods. Return of the goods or their seizure shall not be deemed termination or cancellation of the contract, unless we have expressly declared so. We are entitled to the sale or any other use or exploitation of such returned goods.



2. The Customer may neither pledge nor assign the goods by way of security. The Customer shall notify us immediately in the event of seizures of or other enforcement measures by third parties to the goods.

3. The Customer is entitled to resell the goods in the ordinary course of business.

Once the goods are resold, payment claims by the customer against his own buyer as a result of the resale are deemed to have been assigned to us, whether or not such goods have been incorporated into, processed or mixed with other goods. We herewith accept such assignment. Upon assignment the Customer shall be entitled to collect any receivables arising from the resale of the goods. We reserve our right to collect such receivables by ourselves in case the Customer fails to fulfil his payment obligations.

4. Any processing of the goods shall always be made in our name and for our behalf. In case the goods are incorporated into or mixed with other goods not belonging to us, we will become the co-owner of such other goods in relation to the value of our goods to the value of the other goods.

5. We undertake to release the securities due to us at the request of the Customer in so far as their value exceed the secured debts by more than 20 %, in so far as these have not yet been settled.

#### IX. Liability for Defects

1. We accept liability for defects of the goods or services supplied only if the Customer has complied with his legal inspection and notification duties. The Customer shall inspect the goods without delay upon delivery and shall give notice to us of any defect without delay. If the Customer fails to give such notice, the goods shall be conclusively accepted, except for a defect which has not been detectable during inspection.

2. In case of a defect, we shall make good such defect at our option by repair or by the supply of a replacement. In case of repair we will bear all expenses necessary for such repair, except those expenses which are the result of the goods being transferred to another location than the place of performance agreed upon.

3. If repair or replacement is unsuccessful, the Customer is entitled, at his option, to demand a corresponding reduction in the purchase price or cancellation of the contract.

4. No claims for defects can be made in case of minor deviations from the properties agreed upon or in case of a minor impairment of the suitability, in case of normal wear and tear, in case of damages resulting from misuse, use of unsuitable operating materials, in case of external influences, which have not been agreed upon or have not been a condition of the contract, or in case of defects of the software which cannot be reproduced.

5. This liability for defects does also not apply if the Customer modifies the goods without our consent or has them modified by third parties and such modification makes the remedy more difficult or impossible. In either case the Customer shall be liable for the additional expenses incurred due to such modification.

6. In case of defects in goods as are not of our manufacture, we are entitled at our option to pursue our warranty claims against the manufacturer or supplier of such goods or to assign such claims to our Customer. The Customer may claim against us in case of such defects only, if Customers claim against the supplier or manufacturer has been unsuccessful or, for instance due to insolvency, is unpromising.

7. Claims for defects hereunder are always subject to the return of defective parts by the Customer to us.

8. The defects liability period is one (1) year from delivery of the goods.

9. Used goods are sold without any liability for defects.

10. We are not giving the Customer any guarantees within the legal meaning of the word, unless we expressly grant such a guarantee in a given case.

11. The provisions under Section X - Liability apply to any claims for damages by the Customer.

#### X. Liability

1. Our liability for damages or compensation, irrespective of the legal ground, in particular with respect to impossibility of performance, delays, defective or false supply, breach of contract, defective or non performed consulting or information, breach of duties in negotiations and wrongful acts, in so far as negligence is legally required, shall be limited to the extent set forth in this Section X.

2. We shall not be liable in case of ordinary negligence on the part of our managing director, legal representatives, executives or other agents.

3. We are liable under the legal provisions, if the damage was caused by negligent breach of a major contractual obligation (cardinal obligation); in such a case our liability for compensation shall be limited to the foreseeable damage that may typically occur. Cardinal obligations are understood to be obligations, which are mandatory for the proper performance of the contract and upon which the Customer could rely upon on a regular basis.

4. The foregoing limitations and exclusions of liability shall not apply in case of guaranteed properties, not in case of physical injuries or damage to health or loss of life for which we are responsible for and shall also not apply for claims made by the Customer under product liability.

#### XI. Waste Disposal under the German Electrical and Electronic Appliances Act

1. If the goods are subject to the German Electrical and Electronic Appliances Act, we offer to our Customer the option to carry out for him the waste disposal as stipulated by law. This service is provided against reimbursement of the actual cost that have been incurred and on condition that it has been requested in writing at the time of the purchase contract. Otherwise the Customer himself shall be liable for the correct legally stipulated waste disposal of the delivered goods at his own expense upon the termination of use of the goods.

2. In such a case the Customer shall indemnify us and our suppliers against any duties arising from section 10 II of the German Electrical and Electronic Appliances Act (Reacceptance Duty of the Manufacturer) and thus also against any associated third-party claims.

3. The Customer shall impose a contractual commitment on any third-party contractor to which he passes on the delivered good, specifying that the third party shall, at its own expense, ensure the correct legally stipulated waste disposal of the delivered good upon termination of use and that the third party shall furthermore impose the same commitment on further third parties in case that the relevant goods are passed on further. If the customer fails to impose a waste disposal commitment and a passing-on duty in respect of this commitment in his relationship with third-party contractors to which he passes on the delivered goods, then the Customer shall be liable to reaccept the delivered goods upon termination of use at his own expense and to ensure correct legally stipulated waste disposal of the same. If the Customer passes on the goods to non contractors, then the provisions of Section XI.2 hereabove shall apply.

4. Our claim towards Customer for take-over/indemnification shall not become subject to statute-barring until the expiration of two years following the final termination of use of the goods. This period shall start no earlier than our receipt of written notification from the Customer and/or from the Customer's customer concerning termination of use.

#### XII. Final Provisions

1. In the case of disputes arising out of the business relationship with contractors, Munich is agreed as the legal venue, or, at our option, the principal place of business of our Customer.

2. Unless otherwise agreed, the place of performance is Munich.

3. The laws of the Federal Republic of Germany shall apply. The provisions of the United Nations Convention on Contracts for the International Sale of Goods do not apply.

GEYER ELECTRONIC e.K.

This catalogue replaces all former catalogue.

All specifications represent the latest technical information and are subject to change without notice.

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