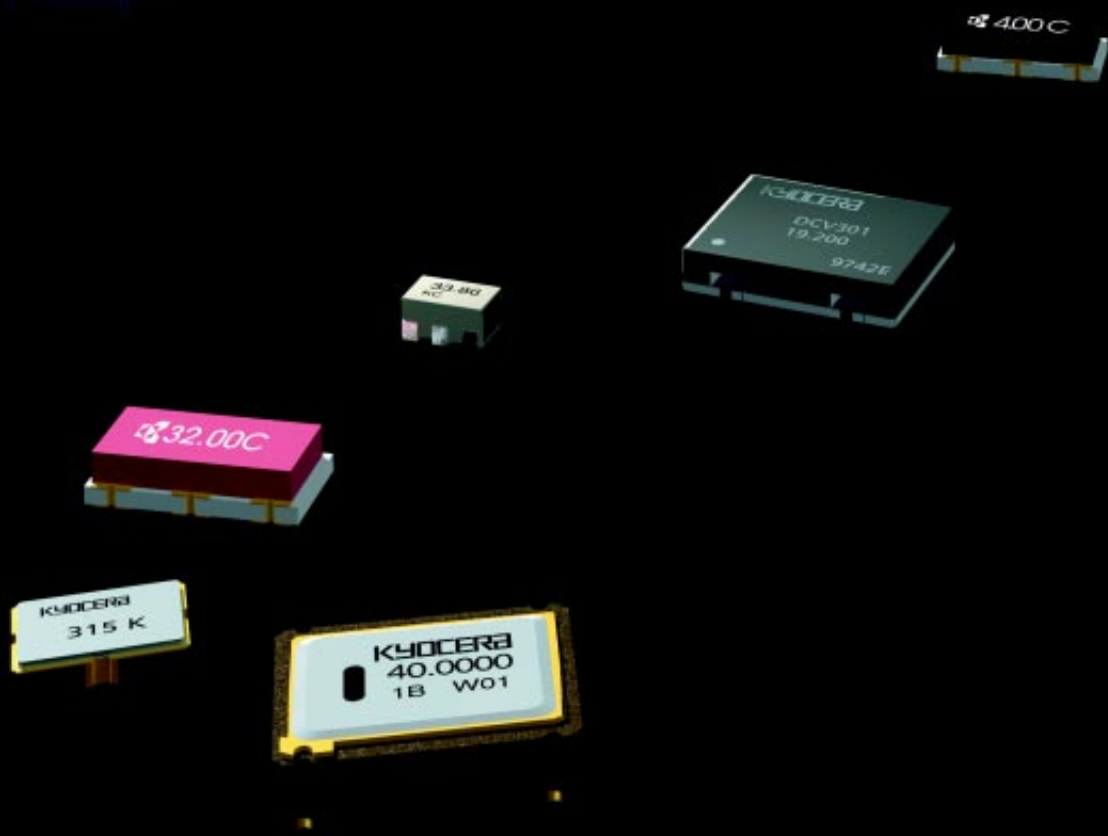


# AVIX



**KYOCERA**  
**Timing Devices**

**Resonators**

**Crystals**

**Oscillators**

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## QUARTZ CRYSTALS, RESONATORS and CLOCK OSCILLATORS

Product Name		Type	Oscillating Frequency						Applications	
			1KHz	10KHz	100KHz	1MHz	10MHz	100MHz		1GHz
Quartz Crystal		Leaded				12.0M	22.0M			Telecommunication
		SMD				12.0M	22.0M			Telecommunication
Ceramic Resonator	KHz Band	Leaded	190k ~ 680k 795k ~ 815k			960k ~ 1050k				Micro Processor
		SMD	380k ~ 430k 440k ~ 525k 600k ~ 655k			795k ~ 815k 960k ~ 1050k				Micro Processor
	MHz Band	Leaded			1.92M	40.0M				Micro Processor
		SMD			2.0M	60.0M				Micro Processor
Saw Resonator		Leaded				46M	479M			RF Modulator Keyless Entry
		SMD				300M	479M			RF Modulator Keyless Entry
Clock Oscillator		Leaded		500k	72M					Micro Processor
		SMD			8.0M	68M				Micro Processor
	KT 11,12,14 Series	SMD				12.0M	20.0M			Telecommunication

## VOLTAGE CONTROLLED OSCILLATORS

Application	System	Frequency				Application Availability			
		500MHz	1GHz	1.5GHz	2GHz	VK Series	EK Series	YK Series	RK Series
Cordless Phone	JPN	■				●			
	CTI CTI+	■				●			
	PHS		■				●		
	DECT			■					●
	CT2+				■				●
Low Power Transmitter	Transceiver LAN Remote Controller Control	■				●			
	Wireless Microphone		■				●		
Cellular Phone	AMPS		■				●		
	TACS		■				●		
	NMT		■				●		
	NTT		■				●		
	PDC	■	■			●	●	●	
	GSM		■				●		●
	US digital		■				●		
PCN							●	●	
Satellite	GPS		■				●		●

# AVX/Kyocera Ceramic Resonators

## KHz BAND CERAMIC RESONATORS

Part Series	Frequency Range	Type	Lead Configuration
<b>KBR-Y</b>	380 to 1050 kHz	SMT	Gull Wing Surface Mount
<b>KBR-B</b>	190 to 680 kHz	Std $Q_m$	Standard, Single-in-line, Formed Leads
<b>KBR-BK</b>	380 to 655 kHz	Std $Q_m$	Standard, Single-in-line
<b>KBR-F</b>	795 to 1050 kHz	High $Q_m$	Standard, Single-in-line
<b>Specials</b>	Per application	—	—

## MHz BAND CERAMIC RESONATORS

Part Series	Frequency Range*	Type
<b>PBRC-A</b>	2.00 to 8.00 MHz	SMT without Capacitor
<b>PBRC-B/D</b>	2.00 to 36.00 MHz	SMT with Built-in Capacitor
<b>SSR-B</b>	16.00 to 60.00 MHz	Ultraminiature SMT with Built-in Capacitor
<b>KBR-MS</b>	2.00 to 3.57 MHz	Standard
<b>KBR-MSA</b>	3.58 to 8.00 MHz	Water resistant
<b>KBR-MSB</b>	3.58 to 6.00 MHz	“No-Clean” Process only
<b>KBR-M</b>	6.01 to 13.00 MHz	Standard
<b>KBR-MY</b>	13.01 to 16.00 MHz	CMOS
<b>KBR-MSA</b>	16.00 to 36.00 MHz	High Frequency Standard
<b>KBR-MKS</b>	3.58 to 8.00 MHz	Built-in Capacitor –Low Profile
<b>KBR-MKC</b>	3.58 to 8.00 MHz	Built-in Capacitor -“No-Clean” Process only
<b>KBR-MKD</b>	3.58 to 8.00 MHz, 16.00 to 36 MHz	Built-in Capacitor-Water resistant

\*For additional frequencies consult factory.

## GENERAL DESCRIPTION

AVX/Kyocera produces a broad range of high quality ceramic resonators covering both the kilohertz and megahertz frequency ranges. The high quality and extensive coverage of this product line allows optimum design of almost any oscillating circuit.

Ceramic resonators stand between quartz crystal oscillators and LC/RC oscillators in regard to accuracy but are considerably smaller, require no adjustments, have improved start-up times, and are low in cost.

Their oscillation is dependent upon mechanical resonance associated with their piezoelectric crystalline structure. These materials (usually barium titanate or lead-zirconium titanate, PZT) have large dipole movement which causes the distortion or growth of the crystal by an applied

electric field. The resonance frequency depends on the vibration mode as shown in Figure 1.

A basic feedback circuit is shown in Figure 2. It consists of an amplifier with a 180° phase shift and attenuator. A negative polar output (volt) is obtained with an amplitude equal to the gain of the amplifier times the input voltage ( $G \times V_{IN}$ ). After the signal goes through the feedback network with an attenuation ratio of  $\beta$ , a negative polar wave equal to  $\beta \times (G \times V_{IN})$  is fed back to the input. If this feedback is greater than the initial input voltage ( $V_{IN}$ ), oscillation will occur. This satisfies the two conditions necessary for oscillation:

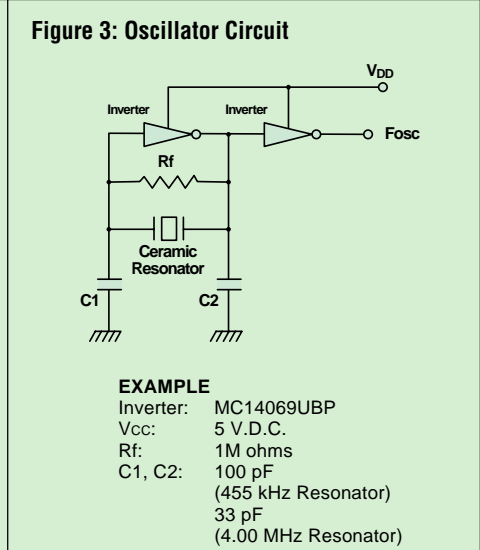
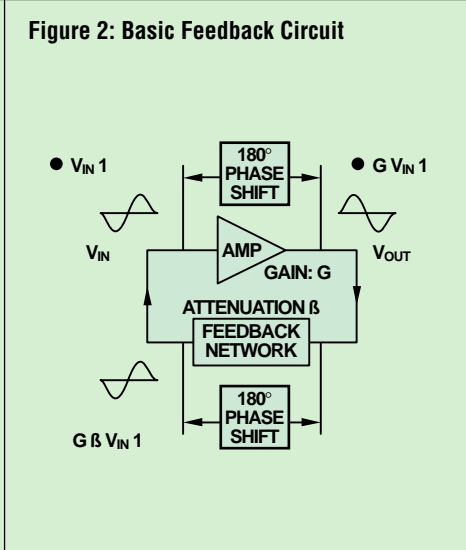
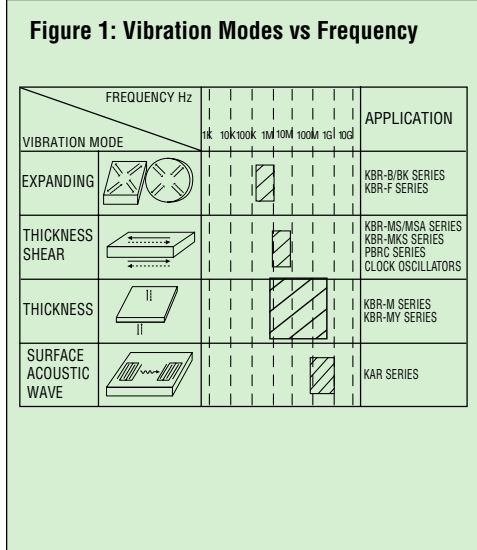
1.  $G \times \beta > 1$
2. Phase cycle around the loop is an integral multiple of 360°.

**Table I  
Oscillators and Resonator Frequency Application**

	(Hz)	10k	20k	100k	200k	1M	2M	10M	20M	100M	200M	1G
Ceramic Resonators 190 kHz ~ 60 MHz												
SAW Resonators 46 MHz ~ 315 MHz												
Oscillators 1 MHz ~ 2 GHz												
Quartz Crystals 12 MHz ~ 22 MHz												

**Table II  
Timing Devices**

Type	Symbol	Frequency Tolerance	Typical Frequency Stability	Relative Size	Cost
LC		±2%	±500ppm/°C	Largest	Low
RC		±1%	±100ppm/°C	Smallest	Low
Ceramic Resonator		±0.5%	±50ppm/°C	Next to Smallest	Low
Quartz Crystal		±0.002%	±1ppm/°C	Next to Largest	High



# AVX/Kyocera Ceramic Resonators

## GENERAL DESCRIPTION continued

The mechanical vibration of a ceramic resonator can be represented by an equivalent electrical circuit consisting of L, C, and R's (Figure 4). The impedance and phase curves of a ceramic resonator are shown in Figure 5.

Between the resonant frequency ( $f_r$ ) and the anti-resonant frequency ( $f_a$ ), the ceramic resonator acts like an inductor with performance identical to a coil and a resistor (Figure 4-B). At other frequencies, it has capacitive characteristics (Figure 4-A).

The equivalent circuit parameters can be determined from the resonant and anti-resonant frequencies. These equations are shown in Table III with the equivalent circuit parameters of typical AVX/Kyocera resonators shown in Table IV.

Ceramic resonators have much lower  $Q_m$  and higher equivalent capacitances than crystal oscillators. Oscillation circuits of various I.C.'s can be either low (inverter) or high (Schmidt) gain.

**Figure 4:  
Electrical Equivalent Circuit**

A.  $f = f_r$

B.  $f_r \leq f \leq f_a$

**Figure 5:  
Impedance and Phase Charts**

**Table III: Equivalent Circuit Equations**

$$f_r = \frac{1}{2\pi\sqrt{L_0 C_0}}$$

$$f_a = \frac{1}{2\pi\sqrt{L_0 C_0 C_1 / (C_0 + C_1)}}$$

$$f_a = f_r \sqrt{1 + \left(\frac{C_0}{C_1}\right)}$$

$$Q_m = \frac{1}{2\pi f_r R_0 C}$$

$$L_0 = \frac{1}{4\pi^2 f_r^2 C \left[1 - \left(\frac{f_r}{f_a}\right)^2\right]}$$

$$C_0 = C \left[1 - \left(\frac{f_r}{f_a}\right)^2\right]$$

where  $C = C_0 + C_1$

$$Q_m = \frac{1}{2\pi f_r R_0 C \left[1 - \left(\frac{f_r}{f_a}\right)^2\right]}$$

**Table IV: Typical Parameters of the Equivalent Circuit**

	KBR-4.00MSA/MSB	KBR-455(BK)
$R_0$	8Ω	6Ω
$L_0$	318μH	3.2mH
$C_0$	5.4pF	43pF
$C_1$	42pF	360pF
$Q_M$	970	1600

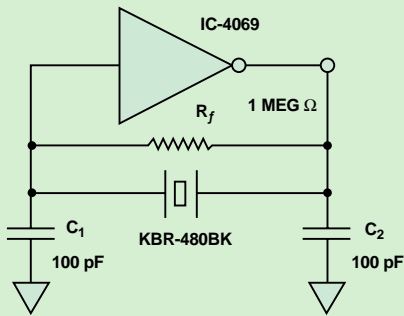
## APPLICATION AND TEST CIRCUITS

In some circuits, a feedback resistor ( $R_f$ , Figure 1) is required to allow oscillation to start when the power is initially applied. Its value is generally 1 M $\Omega$  in ceramic resonator circuits.

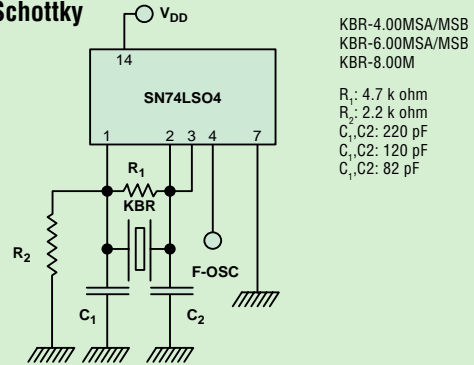
Special attention should be paid to the design of oscillator circuits, because they have a significant impact on the performance of the system. To determine proper circuit parameters, careful consideration must be given

to each component's characteristics under normal and marginal working conditions. Recommended component values for various IC's and microprocessors are given in the Appendix "Application Circuits for Ceramic Resonators." These values should be checked in the actual operating circuit to confirm their performance over changing conditions of input voltage and temperature.

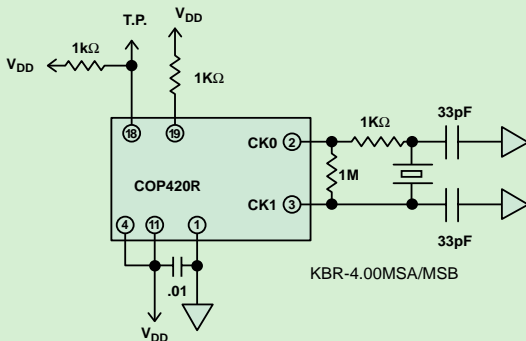
**Figure 1:**  
**CMOS Clock Generator 480kHz**



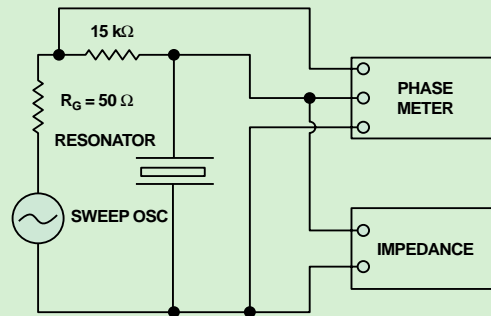
**Figure 2:**  
**Low Power Schottky**



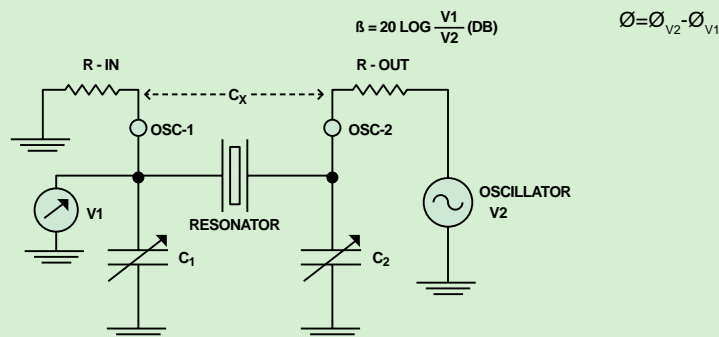
**Figure 3:**  
**4 Bit Microprocessor Clock**



**Figure 4:**  
**Test Circuit Spurious Response**



**Figure 5:**  
**Simulation Circuit**



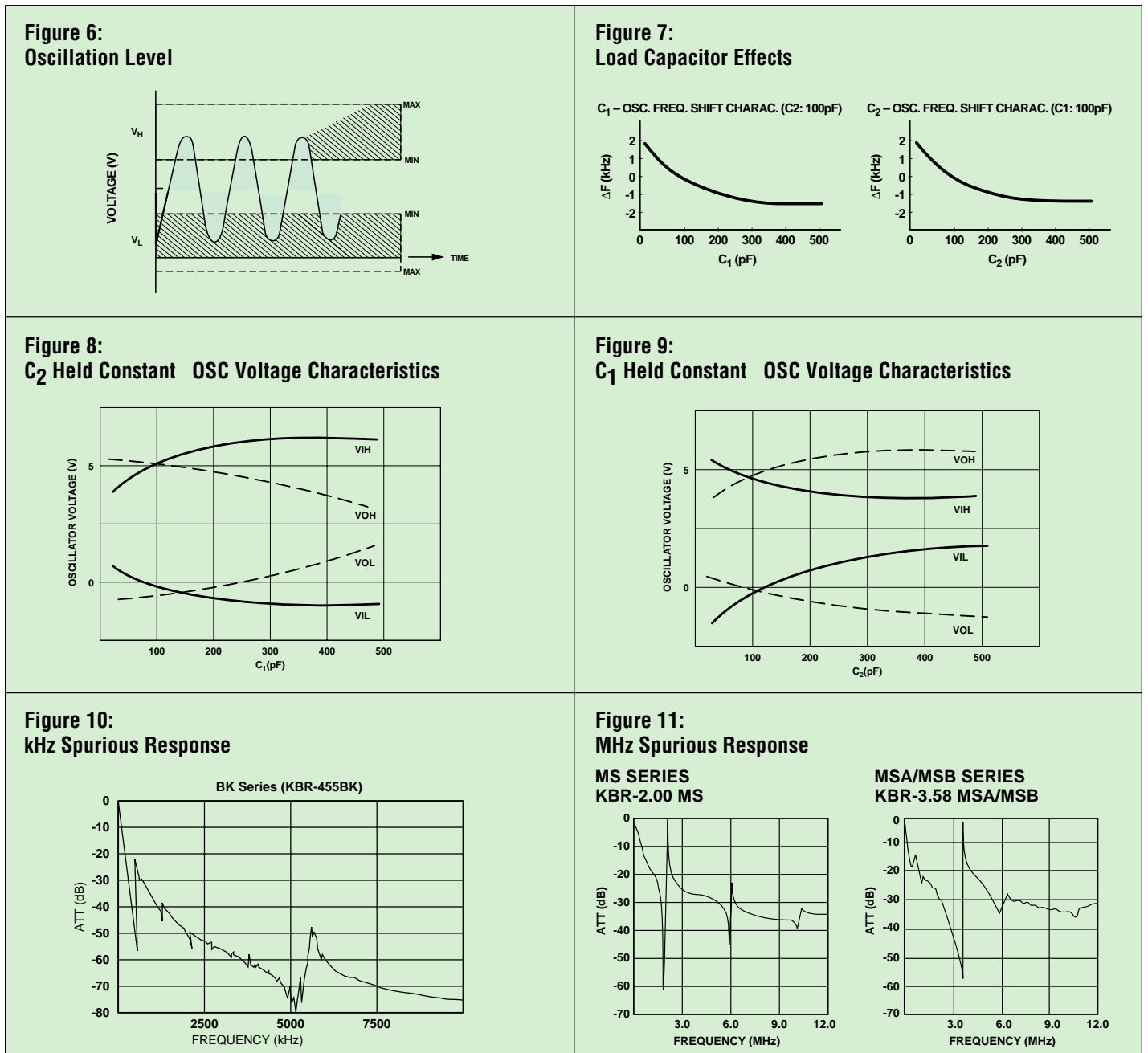
## APPLICATION AND TEST CIRCUITS continued

The design of an oscillation circuit requires an accurate choice of circuit components to ensure oscillation within the specific voltage range of the IC (Figure 6). Semiconductor manufacturers' data books categorize  $V_H$  and  $V_L$  for both input and output requirements. The next stage of a design can be driven from either the IC input or output. Special attention should be paid to  $V_{IH}$  and  $V_{IL}$  or  $V_{OH}$  and  $V_{OL}$  depending upon where the next stage comes from the IC.

Oscillation frequency and amplitude depend upon the values of the external load capacitors ( $C_1$ ,  $C_2$ ). These

effects are illustrated in Figures 7, 8 and 9. When the feedback ratio and the input oscillation amplitude are decreased too far, the circuit becomes vulnerable to external noise and might oscillate spuriously with the external noise.

There are some cases when a high gain IC or one with a wide non-linear range will give abnormal oscillation from sub-vibration of the resonator. This can be prevented by adding a damping resistor to decrease the feedback ratio or by increasing the load capacitance values. The spurious characteristics of typical AVX/Kyocera kHz and MHz resonators are shown in Figures 10 and 11.





# KBR -Y Series Surface Mountable Ceramic Resonators

kHz Band SMT Formed Leads Ceramic Resonators

$f_0$ : 380 to 1050 kHz

### FEATURES

- 1) Reflow solderable
- 2) Washable
- 3) Surface mountable
- 4) 1000 pcs. per reel
- 5) Sold in increments of 2000 pcs.

### HOW TO ORDER

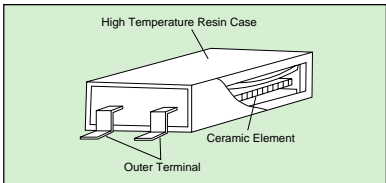
## KBR - 455 Y TR

- ① ② ③ ④

- ① Type: (Kyocera Bulk Resonator)
- ② Oscillation frequency: 380 to 1050 kHz
- ③ Resonator type: Y = Surface mountable
- ④ Packaging: TR = Tape and reel



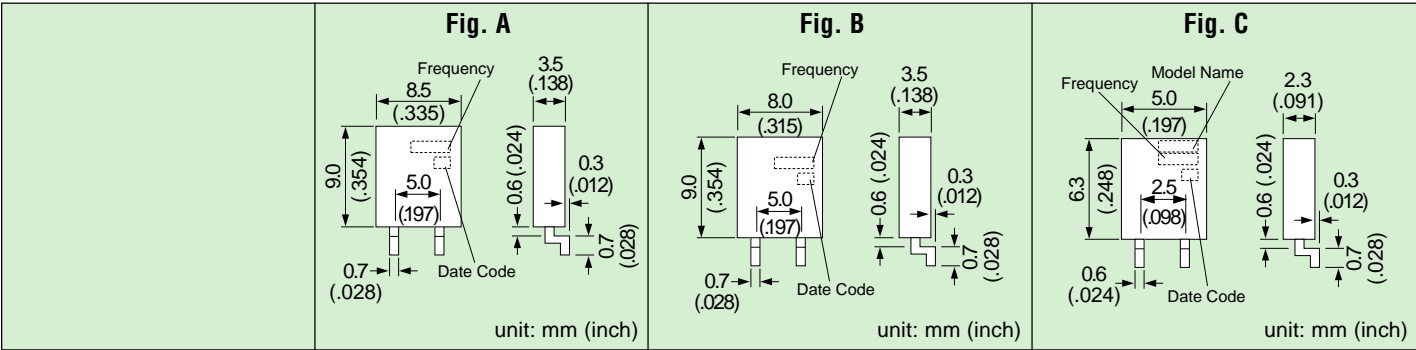
### STRUCTURE



### SPECIFICATIONS (KBR-□ Y)

Parameters	Fig. A		Fig. B		Fig. C	
	380 to 430 kHz	440 to 525 kHz	600 to 655 kHz	795 to 815 kHz	960 to 1020 kHz	
Frequency Range	380 to 430 kHz	440 to 525 kHz	600 to 655 kHz	795 to 815 kHz	960 to 1020 kHz	
Frequency Tolerance	±0.5%	±0.5%	±0.5%	±0.5%	±0.5%	
Resonant Impedance	20 Max	20 Max	50 Max	70 Max	100 Max	
Anti-resonant Impedance	30k Min	35k Min	50k Min	70k Min	70k Min	
Temperature Characteristics (-20 to +80°C)	±0.3%	±0.3%	±0.3%	±0.3%	±0.3%	
C <sub>1</sub>	100pF	100pF	100pF	100pF	100pF	
C <sub>2</sub>	470pF	100pF	100pF	100pF	100pF	
Standard Oscillation Frequency	400kHz	455kHz 480kHz 500kHz	600kHz 640kHz	800kHz	1000kHz	

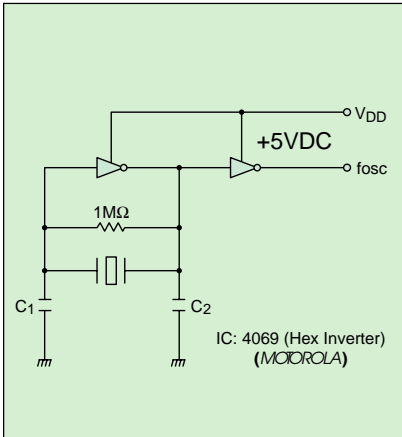
### DIMENSIONS



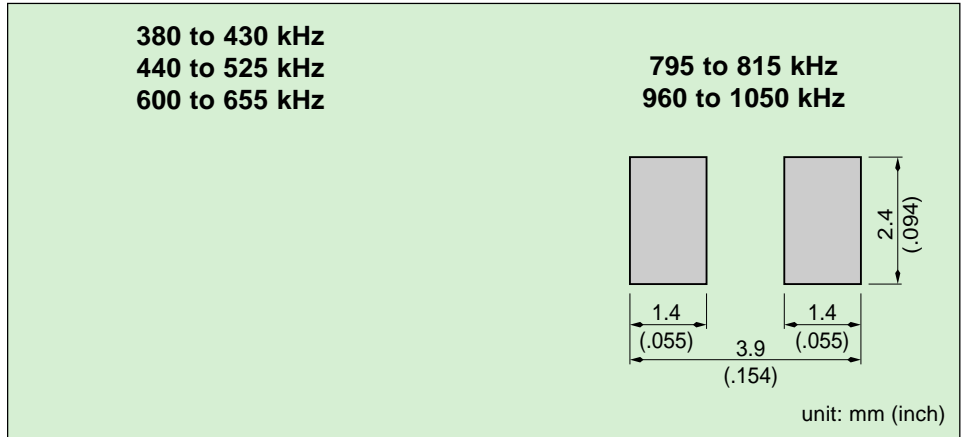
# KBR -Y Series Surface Mountable Ceramic Resonators

kHz Band SMT Formed Leads Ceramic Resonators  $f_o$ : 380 to 1050 kHz

## TEST CIRCUIT



## SUGGESTED LAND PATTERNS



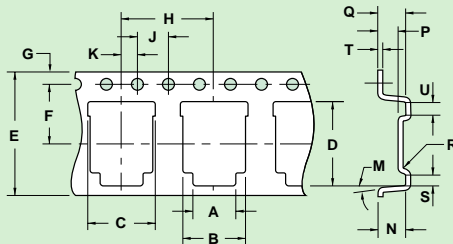
## PACKAGING (KBR-□Y TYPE)

### TAPE DIMENSIONS – 380 TO 430 / 440 TO 525 / 600 TO 655 kHz

A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R	S	T	U
±0.2	±0.2	±0.2	±0.2	±0.3	±0.2	±0.1	±0.1	±0.1	±0.1	±0.1	10max	±0.2	±0.2	±0.2		±0.2	±0.1	±0.2
6.7	8.5	8.7	11.25	16.0	7.5	1.75	12.0	4.0	2.0	1.5		4.8	4.1	4.3	.3max	1.7	0.4	1.9

### TAPE DIMENSIONS – 795 TO 815 / 960 TO 1050 kHz

A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R	S	T	U
±0.2	±0.2	±0.2	±0.2	±0.3	±0.2	±0.1	±0.1	±0.1	±0.1	±0.1	10max	±0.2	±0.2	±0.2		±0.2	±0.1	±0.2
3.9	5.5	5.7	8.55	16.0	7.5	1.75	8.0	4.0	2.0	1.5		3.6	2.9	3.1	.3max	1.7	0.4	1.9



Note: Quantity per reel equals 1000 pieces.

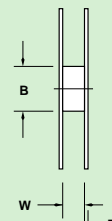
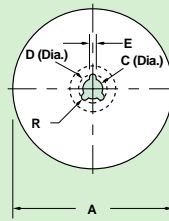
unit: mm

### REEL DIMENSIONS – 380 TO 430 / 440 TO 525 / 600 TO 655 kHz

A	B	C	D	E	R	W	T
±1.5	±1.0	±0.5	±0.5	±0.5		±2.5	
330	80	13	21	2.0	1.0R	17.5	3.0max

### REEL DIMENSIONS – 795 TO 815 / 960 TO 1050 kHz

A	B	C	D	E	R	W	T
±1.5	±1.0	±0.5	±0.5	±0.5		±2.5	
250	80	13	21	2.0	1.0R	17.5	2.5max



unit: mm

# KBR -B, -BK, -F Series Ceramic Resonators

## kHz Band Ceramic Resonators

$f_o$ : 190 to 1050 kHz

### FEATURES

- 1) Optimum selection of oscillation parameters possible according to application
- 2) Highly reliable design with excellent environmental resistance
- 3) Standard frequency range of 190 kHz to 1050 kHz
- 4) Formed lead type also standardized for use in low profile devices
- 5) Packaged in bags of 500 pcs.
- 6) Sold in increments of 2000 pcs.

### HOW TO ORDER

#### KBR - 455 BK TS

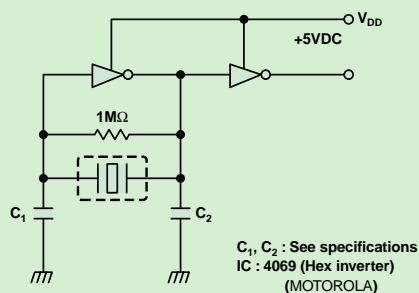
- ① ② ③ ④
- ① Type: (Kyocera Bulk Resonator)
  - ② Oscillation frequency:  
190 to 1050 kHz
  - ③ Resonator types:  
B/BK = 190 to 680 kHz  
F = 795 to 1050 kHz
  - ④ Lead style:  
□ = Standard  
TS = Single-in-line  
TL = Formed lead



### SPECIFICATIONS (KBR-□B/KBR-□BK/KBR-□F)

Configuration	Fig. A	Fig. B	Fig. C	Fig. D	Fig. E			Fig. F		Fig. G	
Type	B	B	BK	B	BK	BK	BK	B	B	F	F
Frequency Range	190 to 249 kHz	250 to 379 kHz	380 to 430 kHz	431 to 439 kHz	440 to 525 kHz	540 to 599 kHz	600 to 655 kHz	526 to 539 kHz	656 to 680 kHz	795 to 815 kHz	960 to 1050 kHz
Frequency Tolerance	±0.5%	±0.5%	±0.5%	±0.5%	±0.5%	±0.5%	±0.5%	±0.5%	±0.5%	±0.5%	±0.5%
Resonant Impedance	20 Max	20 Max	20 Max	20 Max	20 Max	20 Max	50 Max	20 Max	50 Max	70 Max	100 Max
Antiresonant Impedance	25k Min	30k Min	30k Min	30k Min	35k Min	35k Min	50k Min	35k Min	50k Min	70k Min	70k Min
C <sub>1</sub>	330pF	220pF	100pF	100pF	100pF	100pF	100pF	100pF	100pF	100pF	100pF
C <sub>2</sub>	470pF	470pF	470pF	470pF	100pF	100pF	100pF	100pF	100pF	100pF	100pF
Temperature Characteristics (-20 to +80°C)	±0.3%	±0.3%	±0.3%	±0.3%	±0.3%	±0.3%	±0.3%	±0.3%	±0.3%	±0.3%	±0.3%
(-40 to +85°C)	+0.3% -0.5%	+0.3% -0.5%	+0.3% -0.5%	+0.3% -0.5%	+0.3% -0.5%	+0.3% -0.5%	+0.3% -0.5%	+0.3% -0.5%	+0.3% -0.5%	+0.3% -0.5%	+0.3% -0.5%
Standard Oscillation Frequency	200kHz	300kHz	400kHz	—	455, 480, 500kHz	540, 560kHz	600, 640kHz	—	680kHz	800kHz	1000kHz
Case Color	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Green	Green

### TEST CIRCUIT

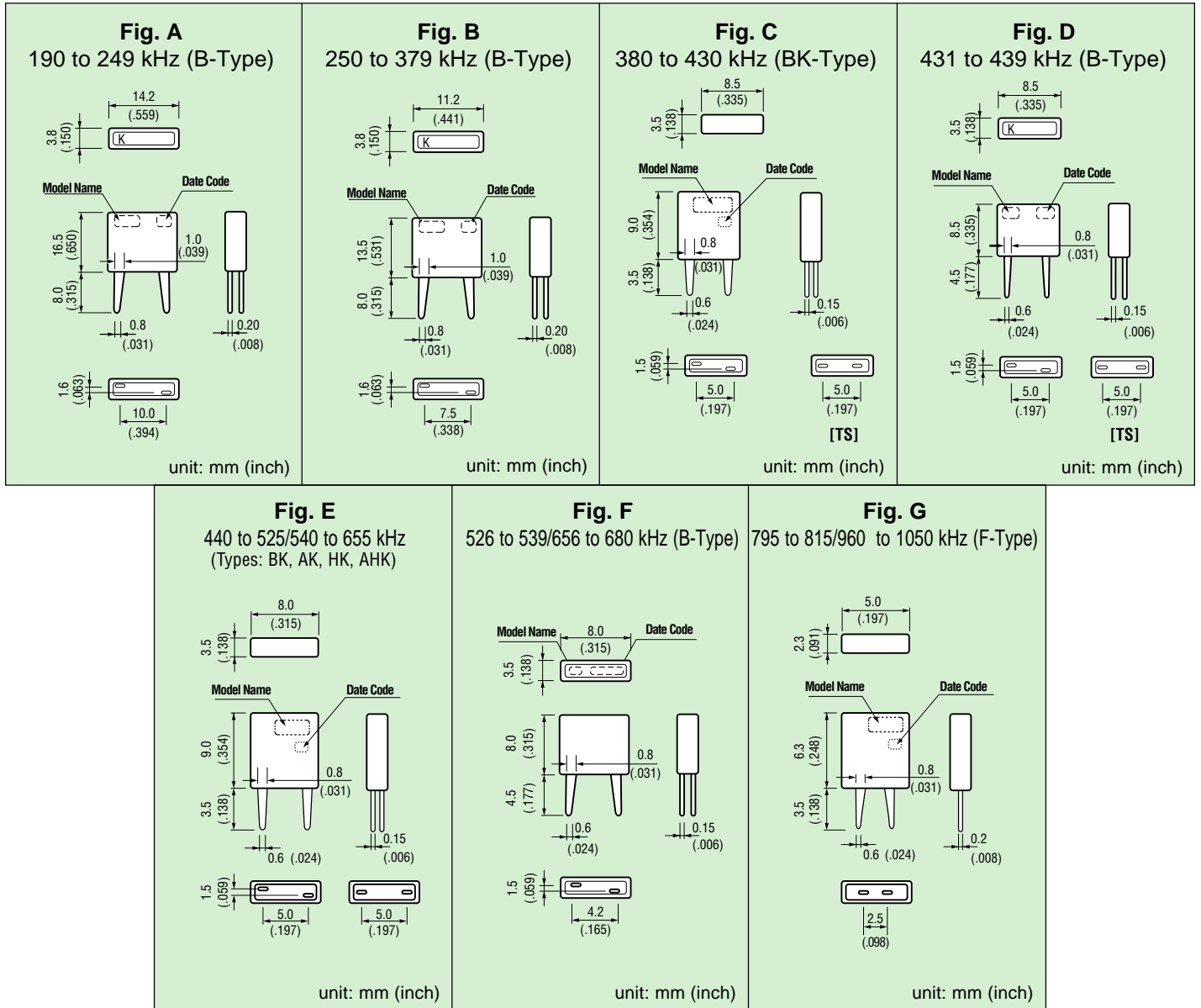


# KBR -B, -BK, -F Series Ceramic Resonators

kHz Band Ceramic Resonators

$f_o$ : 190 to 1050 kHz

## DIMENSIONS



## LEAD FORMATIONS

Lead Type	Lead Shape	Frequency Range								
		B-Type		BK-Type		F-Type				
TS		—		380 to 430 kHz 440 to 525 kHz 540 to 655 kHz		795 to 815 kHz 960 to 1050 kHz <b>Single in-line is standard for F series</b>				
TL		250 to 379 kHz	A* 3.0	B* 3.0	380 to 430 kHz	A* 3.5	B* 5.0	795 to 815 kHz	A* 1.9	B* 1.9
		431 to 439 kHz	4.5	6.0	440 to 525 kHz	3.5	5.0	960 to 1050 kHz	1.9	1.9
		526 to 539 kHz	4.5	6.0	540 to 655 kHz	3.5	5.0			
		656 to 680 kHz	4.5	6.0						

\*Dimensions in mm.

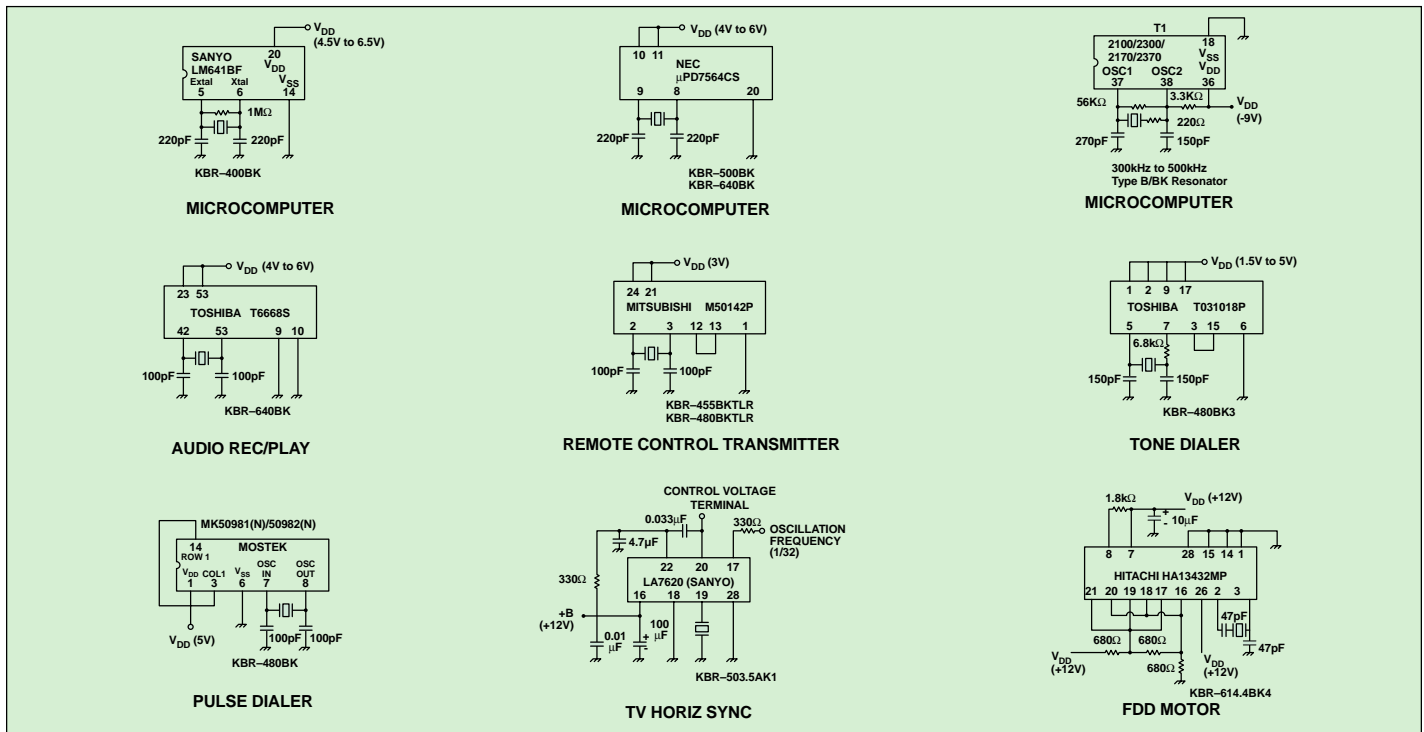
## kHz Band Ceramic Resonators

### SPECIAL RESONATORS

Application	Model No.	Oscillation Frequency	Variable Frequency Range	Resonant Impedance	Anti-resonant Impedance	Temperature Characteristics	Dimensions (page 11)	IC		
Horizontal synchronous oscillator control circuit of TV set	KBR-503.5AKTS1	504.5±2.0kHz	±15kHz min.	30 max.	—	±0.5% max. (-20°C~+80°C)	Fig. E	LA7620 (SANYO)		
	KBR-503.5AKTS12	504.5±2.0kHz	±12.8kHz min.					LA7650(SANYO)		
	KBR-503.5AKTS16	501.7±2.0kHz						LA7680(SANYO)		
	KBR-503.5AKTS2	503.5±2.0kHz	±15kHz min					μPC1400C(NEC)		
	KBR-503.5AKTS3	503.5±2.0kHz	±15kHz min					μPC1401CA (NEC)		
	KBR-503.5AKTS4	525.6±2.0kHz *1 (fr)	52±10kHz *2 (f)					M51307SP (MITSUBISHI)		
	KBR-503.5AKTS5	516.4±2.0kHz*1 (fr)	51±10kHz *2 (f)					μPC1403CA (NEC)		
Horizontal synchronous detection circuit of VCR	KBR-500AHKTS2	500.0±1.5kHz	—	20 max.	70k min.	±0.6% max. (-20°C~+80°C)	Fig. E	LA2710LA7212		
	KBR-503.5AHKTS2	503.5±1.5kHz						LA7215 (SANYO)		
FM stereo MPX	KBR-457HKTS	18.950kHz±38Hz	17.0kHz min. *2 (f)	20 max.	70k min.	±0.2% max. (-15°C~+75°C)	Fig. E	LA3400N, LA3401		
	KBR-457HKTS1							LA3410, LA3430 (SANYO)		
	KBR-912F102	912kHz±0.3%	38kHz min. *2 (f)	100 max.	30k min.	—	Fig. G	LA3400 (SANYO)		
	KBR-912F103							TA2080F (TOSHIBA)		
	KBR-912F104							TA2046FN (TOSHIBA)		
KBR-912F108	LA1867M(SANYO)									
								LA1780M(SANYO)		
Detection of search stop signal of electronic tuner	KBR-450AHKTS5	450.0±0.5kHz *1 (fr)	9.0±2.0kHz *2 (f)	30 max.	—	±0.5% max. (-20°C ~ +60°C)	Fig. E	—		
	KBR-450AHKTS8	450.0±0.8kHz *1 (fr)								
	KBR-450AHKTS1	450.0±1.0kHz *1 (fr)								
	KBR-459AHKTS5	459.0±0.5kHz *1 (fr)								
	KBR-459AHKTS8	459.0±0.8kHz *1 (fr)								
	KBR-459AHKTS1	459.0±1.0kHz *1 (fr)	±0.8% max. (-20°C ~ +60°C)							
RF modulator for PAL system	KBR-500AHKTS15	500.0±1.5kHz	—	20 max.	70k min.	±0.3% max. (-20°C ~ +80°C)	Fig. E	BA7004 (Rohm)		
	KBR-500AHKTS3	500.0±1.5kHz						LA7053 (SANYO)		
FDD motor control circuit	KBR-491.5BKOL2	491.5kHz±0.3%	—	20 max.	35 min.	±0.3% max. (-20°C ~ +80°C)	—	HA13440MP(HITACHI)		
	KBR-983FOL1	983kHz±0.3%		100 max.	70k min.			HA13468MP(HITACHI)		
	KBR-610.2BKOL4	610.2kHz±0.3%		50 max.	50k min.			M51785(MITSUBISHI)		
	KBR-460.8BK4	460.8kHz±0.3%		20 max.	35k min.			BA6472 (Rohm)		
Telephone unit	KBR-480BKTS3	480kHz±0.3%	—	20 max.	35k min.	±0.3% max. (-20°C~ +80°C)	Fig. E	TC31018P(TOSHIBA)		
	KBR-480BKTS-TM1	480kHz±0.3%						100 max.	70k min.	TMP47C26N(TOSHIBA)
	KBR-960F3	960kHz±0.3%								Fig. G

\*1:  $f_r$ =resonant frequency, \*2:  $f = f_a - f_r$  ( $f_a$ =anti-resonant frequency), \*3: When used in conjunction with special stereo MPX IC's.

### APPLICATION CIRCUITS



# PBRC -A Series Chip Resonators

## MHz Band SMT Resonators

$f_0$ : 2.00 to 8.00 MHz

### FEATURES

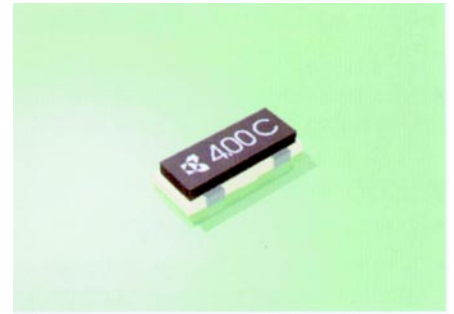
- 1) High reliability chip resonator in a ceramic case which can be reflow soldered and washed
- 2) Ultra-miniature size is suitable for compact equipment and high mounting density
- 3) Rectangular shape allows easy "pick and place" operation
- 4) 2000 pcs. per reel
- 5) Sold in increments of 2000 pcs.

### HOW TO ORDER

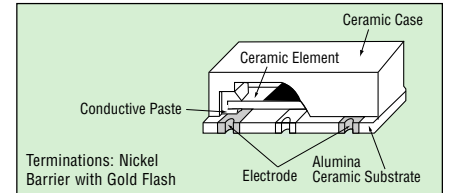
**PBRC - 4.00 A R**

①                      ②                      ③                      ④

- ① Type: (Piezo Bulk Resonator Chip)
- ② Oscillation frequency (MHz)
- ③ Resonator type:  
A = Without capacitor
- ④ Packaging:  
R = Tape and reel



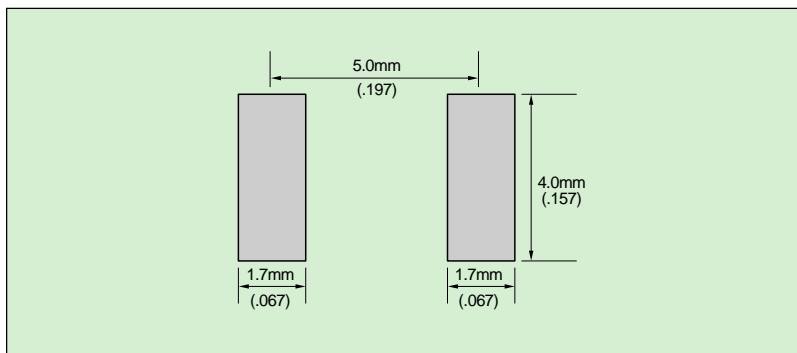
### STRUCTURE



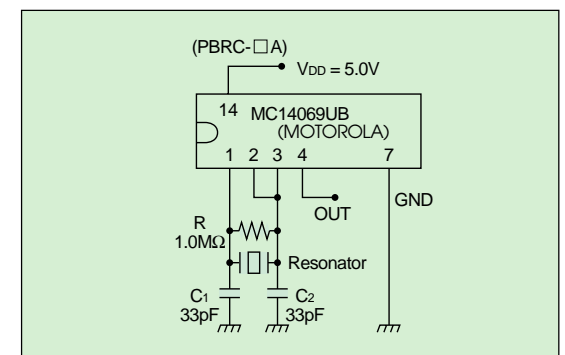
### SPECIFICATIONS (PBRC-□A)

Frequency Range	2.00 to 8.00 MHz
Frequency Tolerance	±0.5%
Resonant Impedance	200Ω Max at 2.00~2.90MHz 100Ω Max at 3.00~3.57MHz 30Ω Max at 3.58~8.00MHz
Temperature Characteristics (-20 to +80°C)	±0.3%

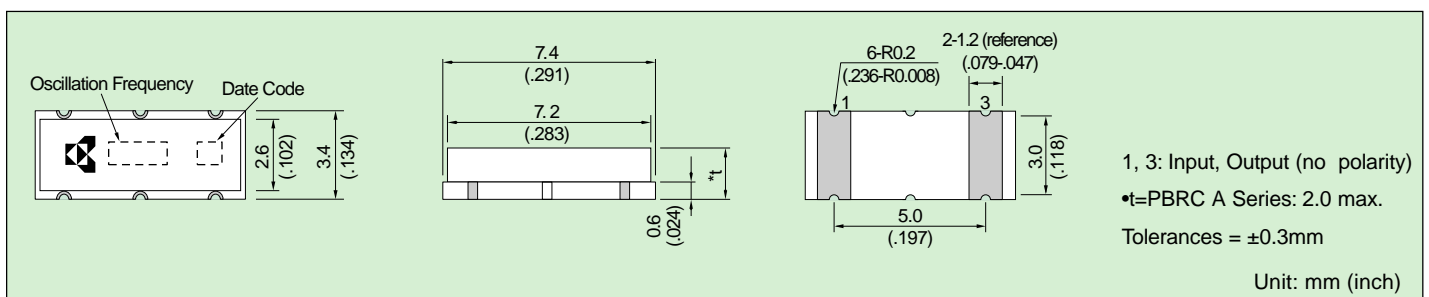
### RECOMMENDED LAND PATTERN FOR PBRC-□A



### STANDARD TEST CIRCUIT



### DIMENSIONS



# PBRC -B, -D Series Chip Resonators

## Built-in Capacitor MHz Band SMT Resonators

$f_o$ : 2.00 to 36.00 MHz

### FEATURES

- 1) Built-in load capacitor
- 2) High reliability chip resonator in a ceramic case which can be reflow soldered and washed
- 3) Ultra-miniature size is suitable for compact equipment and high mounting density
- 4) Rectangular shape allows easy "pick and place" operation
- 5) 2000 pcs. per reel
- 6) Sold in increments of 2000 pcs.

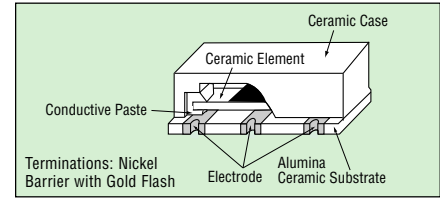
### HOW TO ORDER

**PBRC - 4.00 B R** \_

- ① Type: (Piezo Bulk Resonator Chip)
- ② Oscillation frequency (MHz)
- ③ Resonator type:  
B = With capacitor (2.00~20.00MHz)  
D = With capacitor (20.01~36.00MHz)
- ④ Packaging:  
R = Tape and reel
- ⑤ Frequency tolerance:  
□ = ±0.5% (2.00~8.00MHz)  
07 = ±0.7% (8.01~20.00MHz)  
□ = ±0.5% (20.01~36.00MHz)



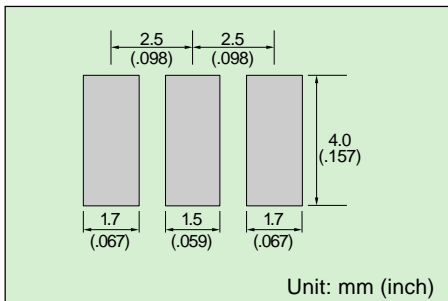
### STRUCTURE



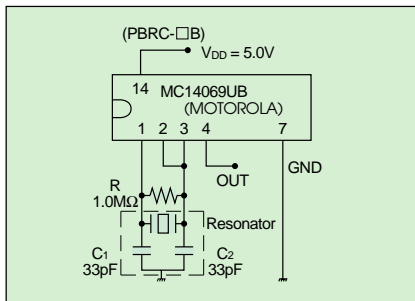
### SPECIFICATIONS (PBRC-□B/PBRC-□D)

Series Type	B		D
Frequency Range	2.00 to 8.00 MHz		8.01 to 20.00 MHz
Load Capacitor	33 pF (typ.)		10 pF (typ.)
Frequency Tolerance	±0.5%		±0.7%
Resonant Impedance	2.00-2.90MHz 3.00-3.57MHz 3.58-8.00MHz	200Ω max. 100Ω max. 30Ω max.	150 Ω Max. 150 Ω Max. 150 Ω Max.
Temperature Characteristics (-20 to +80°C)	±0.3%		±0.1%

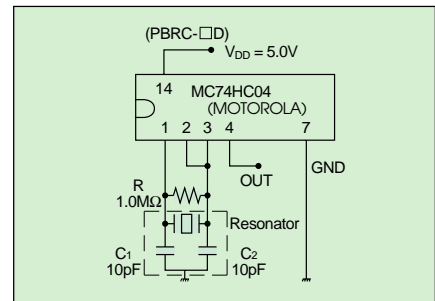
### RECOMMENDED LAND PATTERN FOR PBRC-□B/D



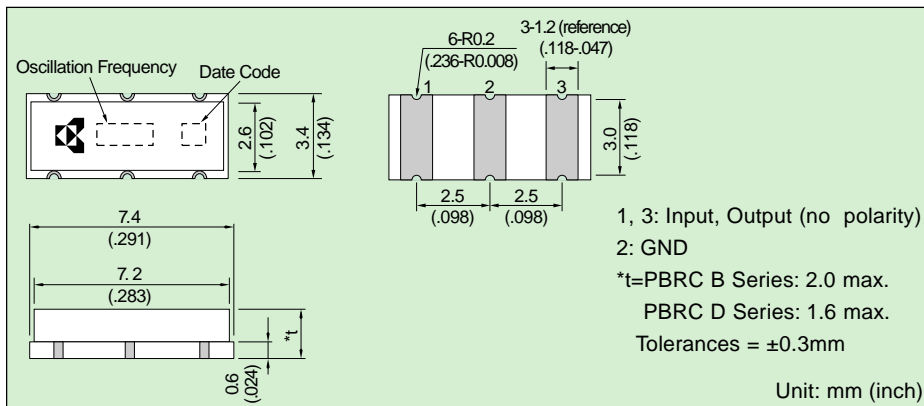
### STANDARD TEST CIRCUIT 2.00 ~ 8.00 MHz



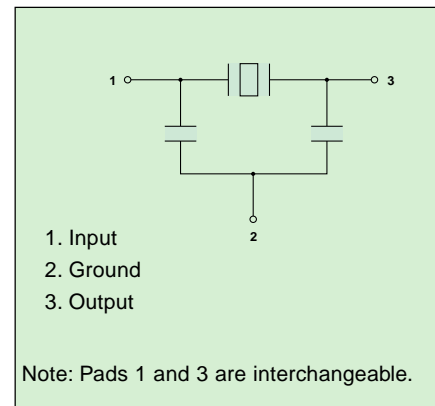
### STANDARD TEST CIRCUIT 8.01 ~ 36.00 MHz



### DIMENSIONS



### PAD CONNECTION



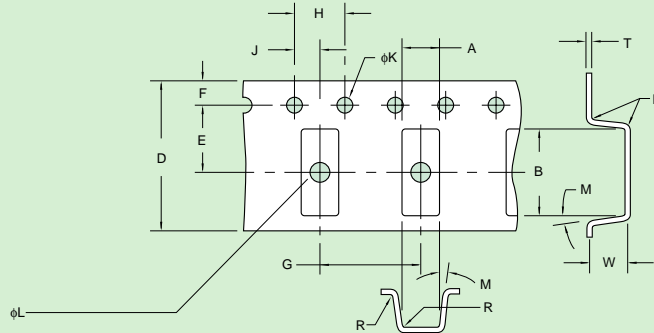
# Tape & Reel Packaging

## Surface Mountable Chip Resonators PBRC -A, -B, -D Types

2000 pieces per reel with 10 positions open at beginning and end of reel. Leader will be 200mm maximum.

### TAPE DIMENSIONS

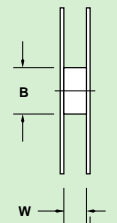
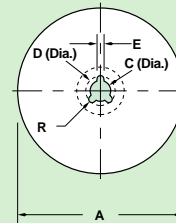
A	B	D	E	F	G	H	J	φK	M	R	W	T	φL
±0.2	±0.2	±0.3	±0.1	±0.1	±0.1	±0.1	±0.1	±0.1			±0.2	±0.1	±0.05
3.8	7.8	16.0	7.5	1.75	8.0	4.0	2.0	1.5	10°max	0.3max	2.1	0.3	1.55



Units:mm

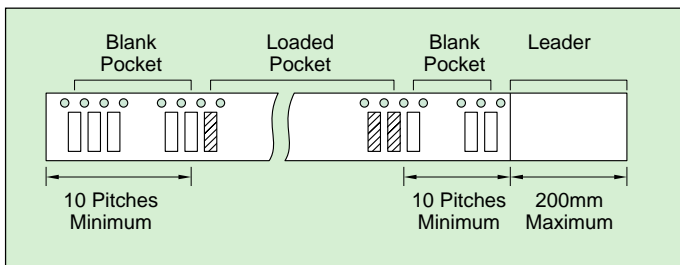
### REEL DIMENSIONS

A	B	C	D	E	R	W	T
255	80	13	25	2	1.0R	17.5	2
±1.0	±0.5	±0.5	±0.8	±0.5		±1.5	±0.5

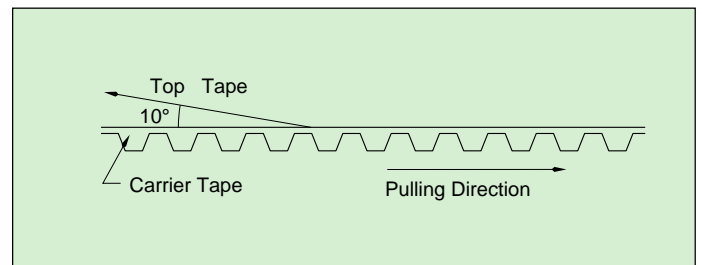


Units:mm

### PACKING METHOD



### TEST CONDITION OF PEELING STRENGTH



### MARKING

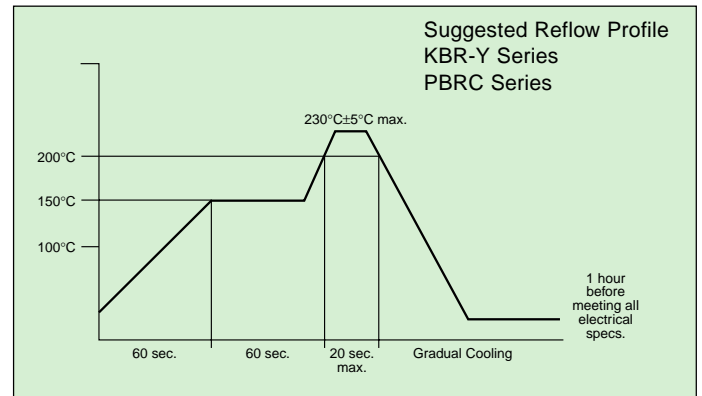
#### Marking of Reel

- Type Name
- Lot No.
- Quantity
- Vendor Name

#### Marking of Exterior Package

- Type Name
- Lot No.
- Quantity of Reel
- Shipping Date
- Vendor Name

### REFLOW PROFILE





# Capacitor Built-In Type Chip

## MHz Band Ceramic Resonators - SSR-B Series

### FEATURES

- 1) World's smallest (2.1x3.2x1.5 mm)
- 2) High density mounting possible
- 3) Wide frequency range in same case size
- 4) 2000 pieces per reel
- 5) Sold in increments of 2000 pieces

### HOW TO ORDER

#### **SSR 33.86 B R**

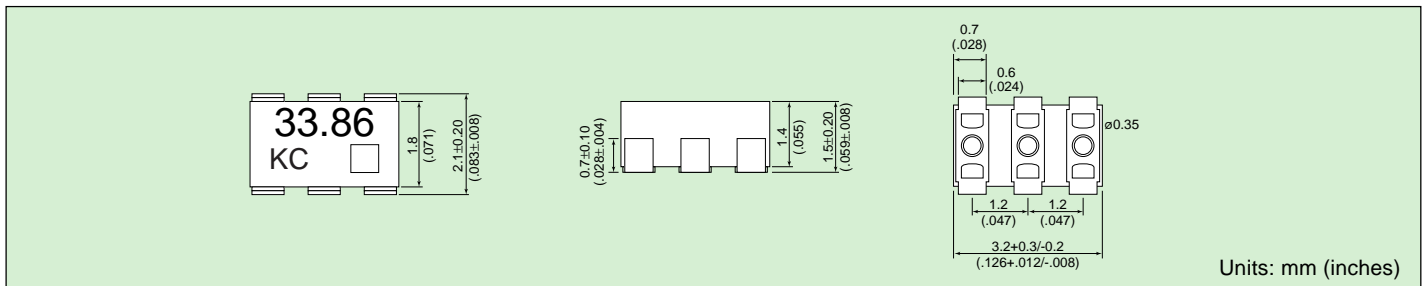
- ① ② ③ ④
- ① Type: (Super Small Resonator)
  - ② Oscillating frequency
  - ③ Resonator type: B = With capacitor
  - ④ Packaging: R = Tape and reel



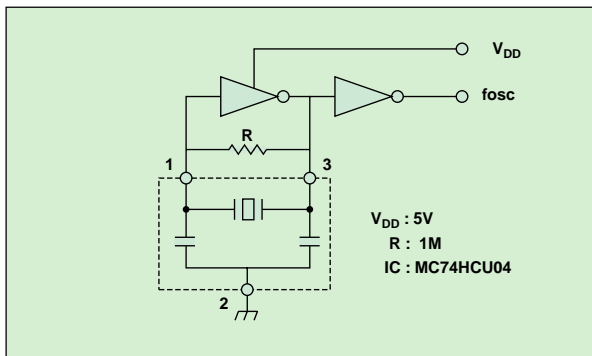
### SPECIFICATIONS

Frequency Range	Frequency Tolerance	Resonant Impedance	Temperature Stability (-20~80°C)	IC	Popular Frequencies
16~60MHz	±0.5%	100 max.	±0.3%	MC74HCU04 (MOTOROLA)	16, 25, 27, 29, 33.86, 40

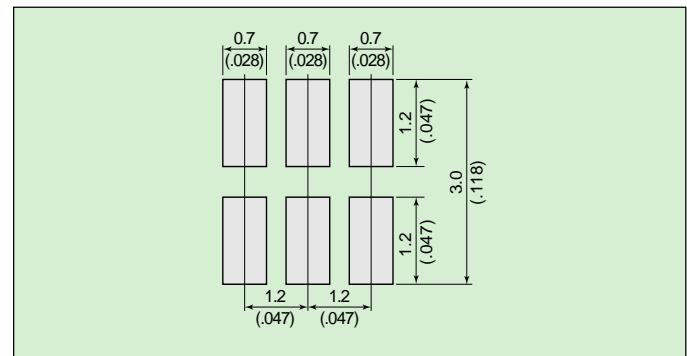
### DIMENSIONS



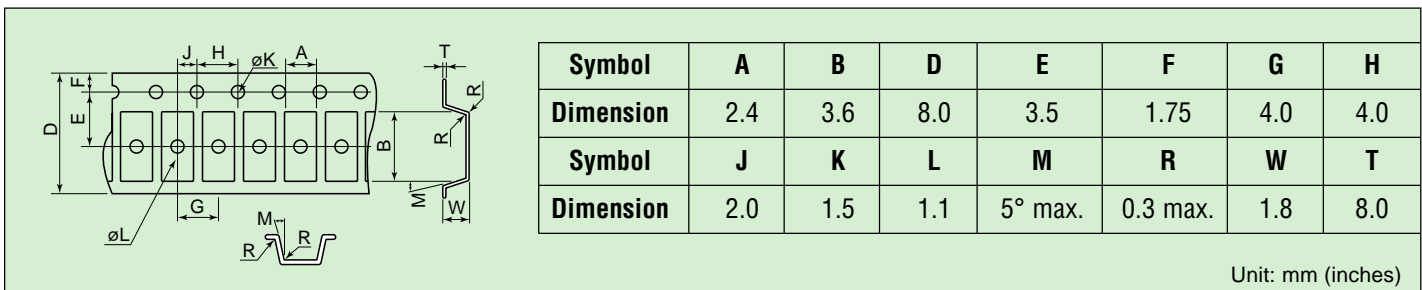
### TEST CIRCUIT



### RECOMMENDED LAND PATTERN



### PACKAGING: TAPE and REEL



# KBR -M, -MS, -MSA, -MSB Series Ceramic Resonators

## MHz Band Ceramic Resonators

$f_o$ : 2.00 to 13.00 MHz

### FEATURES

- 1) Ultracompact, lightweight design
- 2) Resistant to damage from impact and vibration
- 3) Excellent temperature stability ( $\pm 0.3\%$ )
- 4) Low cost
- 5) Bulk packaged 500 pieces per bag or 2000 pieces per reel
- 6) Sold in increments of 200 pieces

### HOW TO ORDER

#### KBR - 4.00 MSA TR

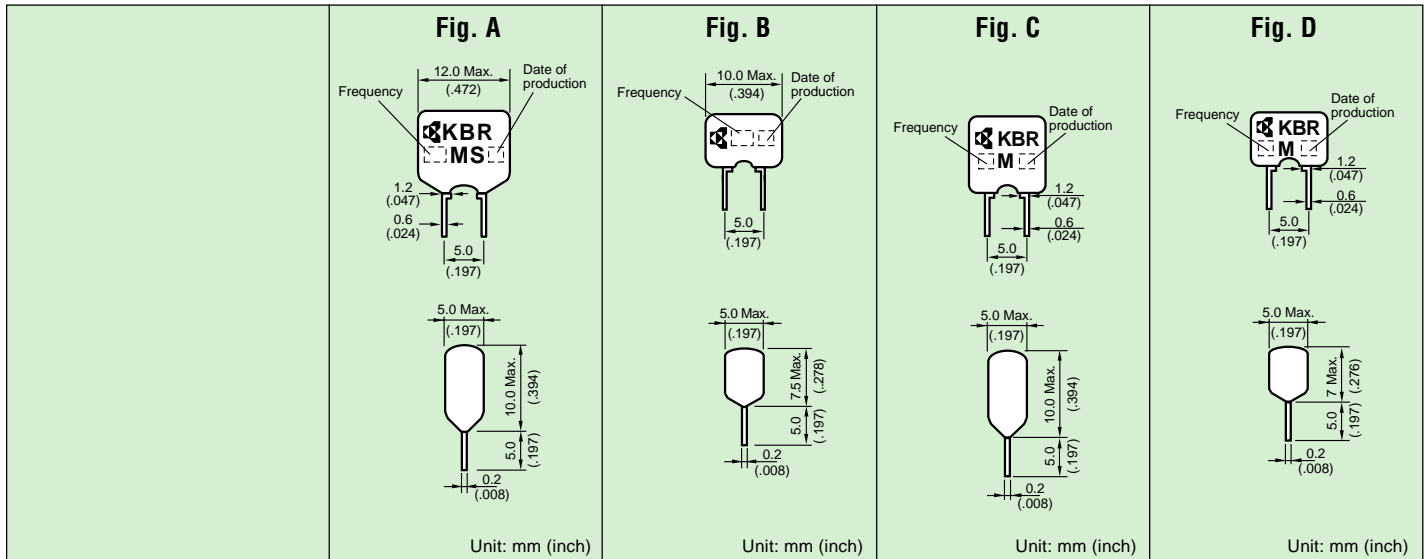
- ①      ②      ③      ④
- ① Type: (Kyocera Bulk Resonator)
  - ② Oscillation frequency (MHz)
  - ③ Resonator type:  
 MS = 2.00 to 3.57 MHz  
 MSA = 3.58 to 8.00 MHz (Water resistant)  
 MSB = 3.58 to 6.00 MHz ("No-Clean" Process only)  
 M = 6.01 to 13.00 MHz
  - ④ Packaging:  
 TR = Tape and reel  
 □ = Bulk



### SPECIFICATIONS (KBR-□MS/KBR-□MSA/KBR-□MSB/KBR-□M Series)

Series	MS	MSA, -MSB	M	M
Dimension	Fig. A	Fig. B	Fig. C	Fig. D
Oscillation Frequency	2.00 to 3.57 MHz	3.58 to 8.00 MHz	6.01 to 6.99 MHz	7.00 to 13.00 MHz
Frequency Tolerance	$\pm 0.5\%$	$\pm 0.5\%$	$\pm 0.5\%$	$\pm 0.5\%$
Resonant Impedance	100 Max	30 Max	40 Max	40 Max
Temperature Characteristic (-20 to +80°C)	$\pm 0.3\%$	$\pm 0.3\%$	$\pm 0.5\%$	$\pm 0.5\%$

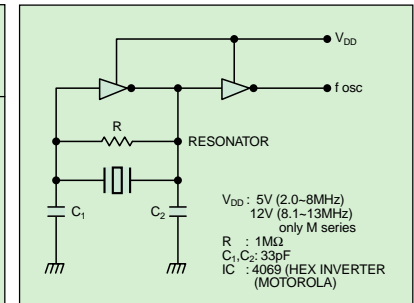
### DIMENSIONS



### KBR-3.58MSA - 200 series for Telephone D.T.M.F. Applications

### TEST CIRCUIT

P/N	Frequency	Frequency Tolerance	Resonant Resistance	Temperature Stability (-20 to +80°C)	Dimensions
KBR-3.58MSA-201	3.5795MHz	+0 -0.25%	30 Max	$\pm 0.3\%$	Fig. B
KBR-3.58MSA-202		+0.15 -0.10%			
KBR-3.58MSA-203		+0.30 -0.05%			
KBR-3.58MSA-204		+0.45 +0.20%			
KBR-3.58MSA-205		+0.60 +0.35%			
KBR-3.58MSA-206		-0.30 -0.55%			
KBR-3.58MSA-207		-0.15 -0.40%			



# KBR -MY Series Ceramic Resonators

High Frequency MHz Band Ceramic Resonators  $f_o$ : 13.01 to 36.00 MHz

## FEATURES

- 1) High frequency resonator to match high-speed needs
- 2) Faster start-up time as compared to quartz crystals
- 3) High durability
- 4) Bulk packaged 500 pieces per bag or 2000 pieces per reel
- 5) Sold in increments of 2000 pieces

## HOW TO ORDER

### KBR - 16.00 MSA TR

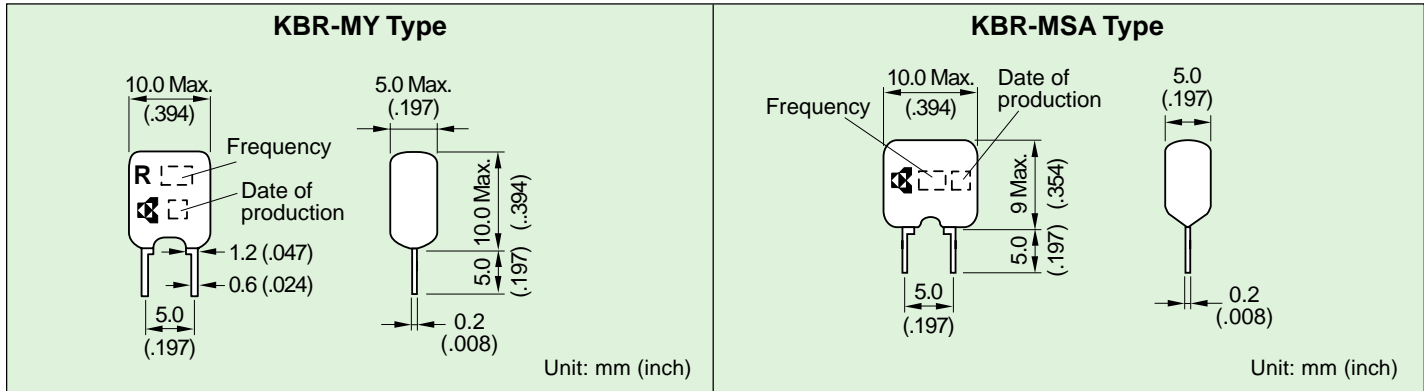
- ① Type: (Kyocera Bulk Resonator)
- ② Oscillation frequency (MHz)
- ③ Resonator type:  
MY = CMOS IC  
MSA = Standard
- ④ Packaging:  
□ = Bulk  
TR = Tape and reel



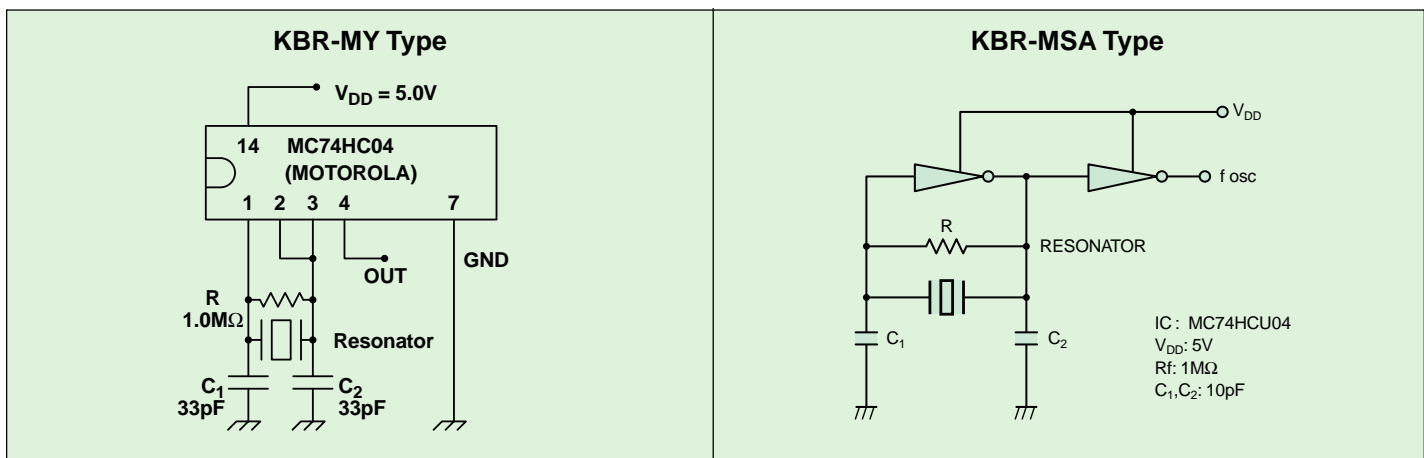
## SPECIFICATIONS (KBR-□MY/KBR-□MSA)

Series Type	KBR -MY	KBR -MSA
Frequency Range	13.01 to 15.99 MHz	16.00 to 36.00
Frequency Tolerance	±0.5%	±0.5%
Resonant Impedance	30 max.	30 max.
Temperature Characteristics (-20 to +80°C)	±0.3% max.	±0.3% max.

## DIMENSIONS



## STANDARD TEST CIRCUIT



# KBR -MKC, -MKD, -MKS Series Ceramic Resonators

Built-in Capacitor MHz Band Ceramic Resonators  $f_o$ : 3.45 to 8.00 MHz  
16.00 to 36.00 MHz

## FEATURES

- 1) Built-in load capacitance
- 2) Simplified circuit
- 3) Reduced parts cost
- 4) Reduced mounting cost
- 5) High density mounting
- 5) Bulk packaged 500 pieces per bag or 2000 pieces per reel
- 7) Sold in increments of 2000 pieces

## HOW TO ORDER

**KBR - 4.00 MKC TR**

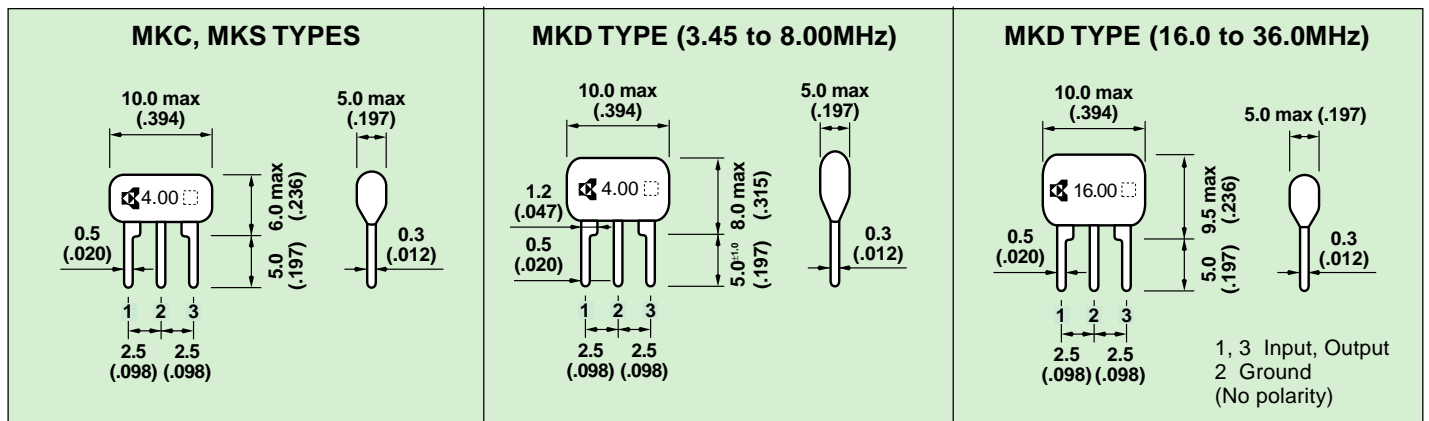
- ① Type: (Kyocera Bulk Resonator)
- ② Oscillation frequency (MHz)
- ③ Resonator type:  
MKC = "No-Clean" Process only  
MKD = Water resistant  
MKS = Standard
- ④ Packaging:  
□ = Bulk  
TR = Tape and reel



## SPECIFICATIONS (KBR-□MKC/KBR-□MKD/KBR-□MKS)

Series Type	KBR -MKC, -MKD, -MKS	KBR -MKD
Frequency Range	3.45 to 8.00 MHz	16.00 to 36.00
Frequency Tolerance	±0.5%	±0.5%
Resonant Impedance	30	30
Temperature Characteristics (-20 to +80°C)	±0.5%	±0.3%

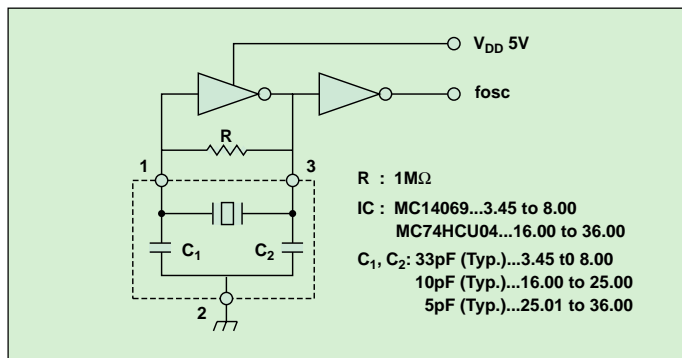
## DIMENSIONS



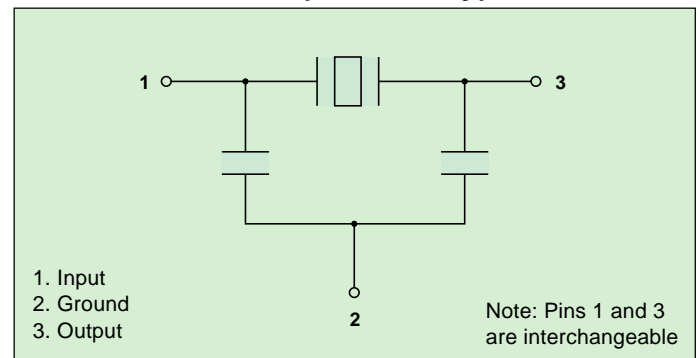
Unit: mm (inch)

Tolerance ±0.2mm unless otherwise specified

## TEST CIRCUIT



## PIN CONNECTION (No Polarity)



# Tape & Reel Packaging

## MHz Ceramic Resonators

### TAPE AND REEL PACKAGING

- 2000 pieces per reel
- Min. of 3 open positions at the beginning and end of tape

### AMMO PACK

- 2000 pieces per package
- A minimum of 38.1mm or three positions shall be open at beginning and end of tape
- Each fold shall be 317.35mm in length or the equivalent of twenty-five positions

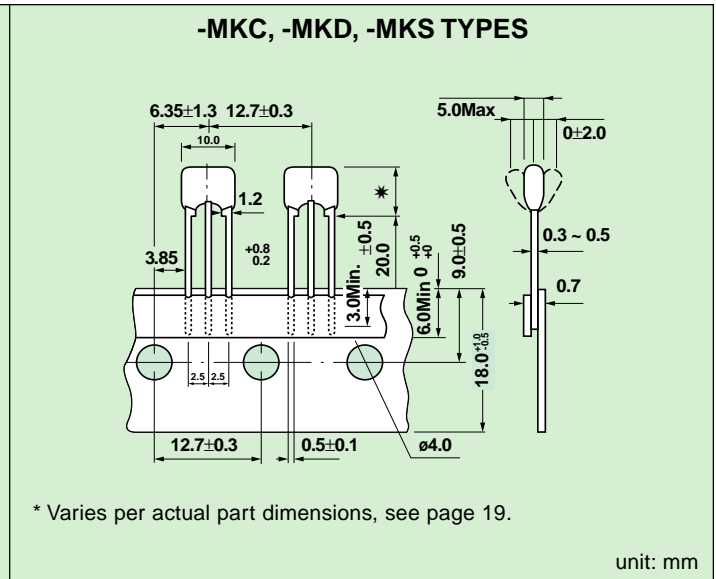
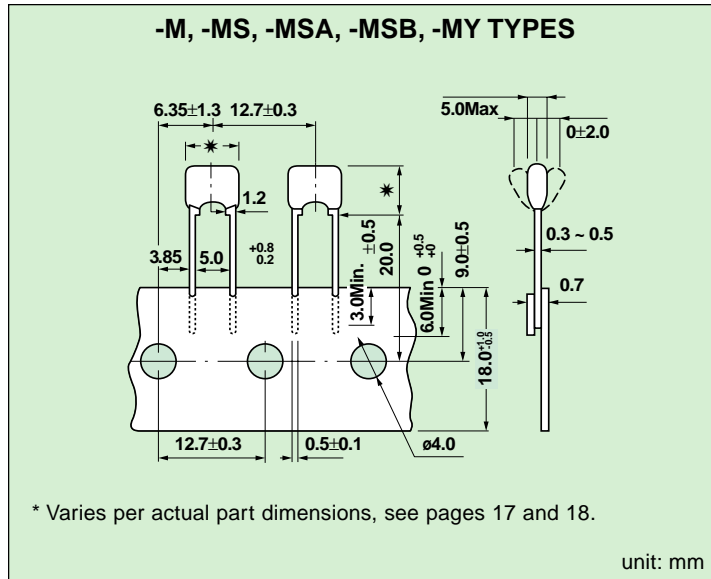
### HOW TO ORDER

**KBR - [ ] [ ] TR**

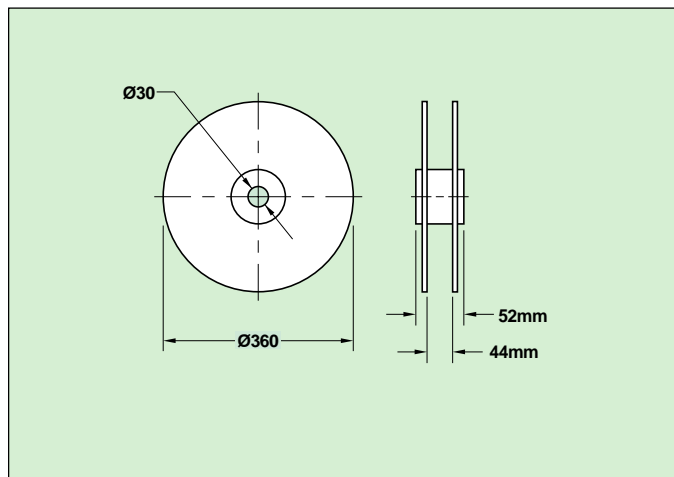
- ①                      ②                      ③                      ④

- ① Type: (Kyocera Bulk Resonator)
- ② Oscillation frequency (MHz)
- ③ Resonator type = M/MS/MSA/MSB/MY/MKC/MKD
- ④ Packaging:  
TR = Tape and reel  
TF = Ammo pack

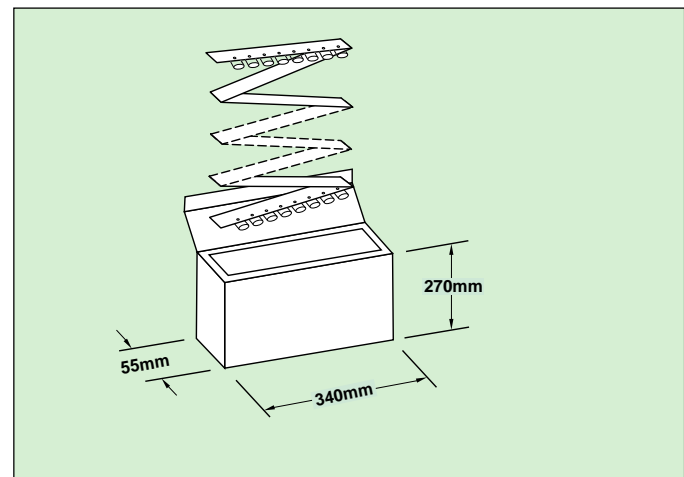
### TAPE DIMENSIONS



### REEL DIMENSIONS



### AMMO PACK DIMENSIONS



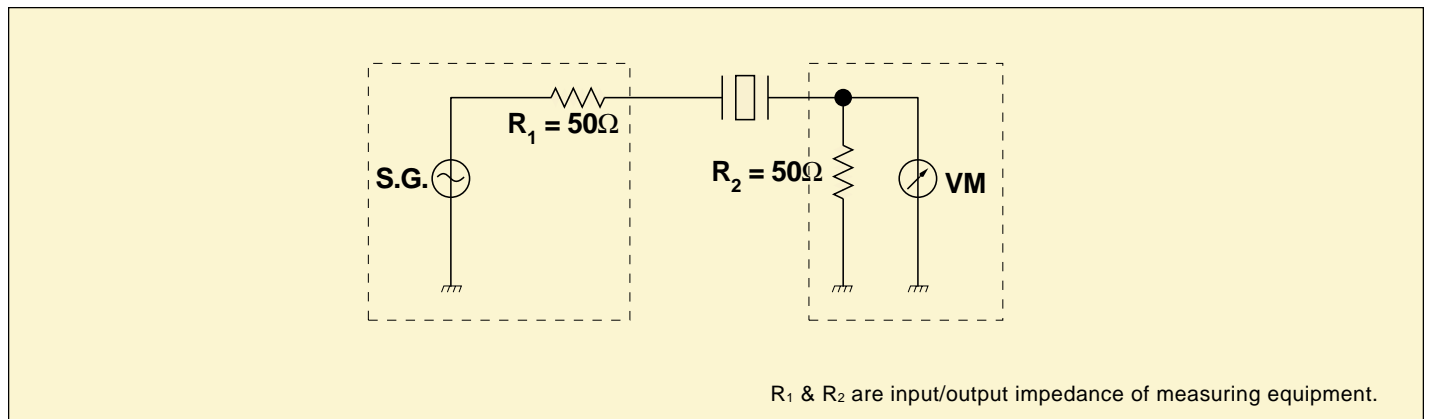
# Surface Acoustic Wave Resonators

## GENERAL DESCRIPTION

The fundamental wave oscillation of AVX/Kyocera Surface Acoustic Wave (SAW) Resonators eliminates spurious response, which leads to a reduction in the number of components used for spurious frequency suppression. This feature, in addition to the good shock resistance characteristics of the SAW resonator, helps to simplify the assembly process and promotes higher stability.

Kyocera Surface Acoustic Wave (SAW) resonators are ideal for use in RF modulators for videotape recorders, video discs and cable television. These unique SAW resonators contain two channels in one package. Custom design features can be manufactured for specific applications.

## TEST CIRCUIT



## ENVIRONMENTAL CHARACTERISTICS

TEST	CONDITION
High Temperature Storage Test	+85±2°C
Low Temperature Storage Test	-40°±2°C
Humidity Loading Test	40±2°C, 90%RH, 6VDC
Solderability Test	260±10°C, 10±1 sec.
Thermal Shock Test	-20°C 30 min., 70°C 30 min. 5 cycles
Shock Test	90G: 6 msec XYZ direction totally 18 times

# Surface Mount SAW Resonators

## PAR Series

### FEATURES

- 1) Frequency range: 300 to 450 MHz
- 2) 1 port type SMD resonator
- 3) Small size (5.5X3.8mm)
- 4) Low profile (1.5mm max)
- 5) SMT ceramic package
- 6) Excellent temperature characteristics: +100ppm ~ -250ppm (-40 ~ 85°C)
- 7) 2000 pieces per reel
- 8) Sold in increments of 2000 pieces

### HOW TO ORDER

## PAR S 433.92 K 04 R

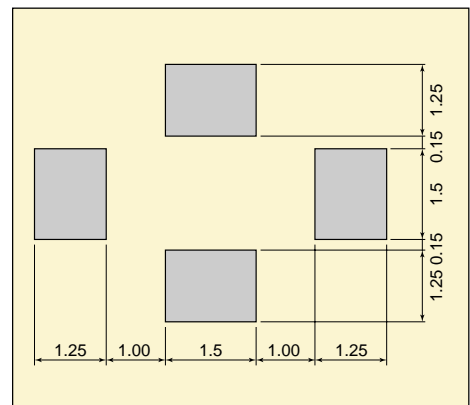
- ① SMT SAW Resonator
- ② Type: C = Glass seal, S = Seam weld
- ③ Frequency
- ④ Marking code (please see table)
- ⑤ Freq. Tolerance or custom spec.  
 00 : ±250KHz    01 : ±200KHz  
 02 : ±150KHz    03 : ±100KHz  
 04 : ±75KHz     10 : Tolerance  
 11 : Custom spec.
- ⑥ Package: R=Tape & reel



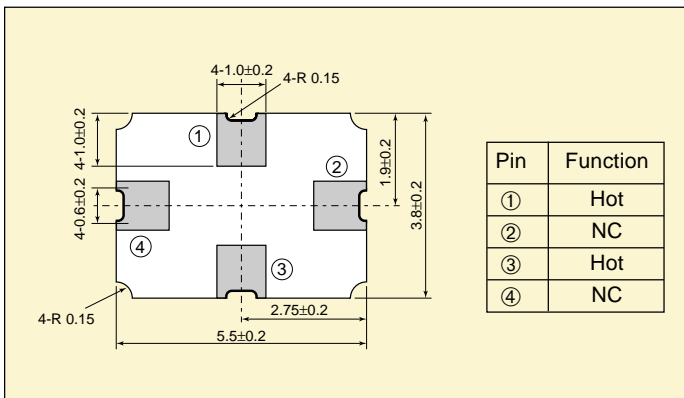
### ELECTRICAL CHARACTERISTICS

Part Number	Resonant Frequency (MHz)	Resonant Loss (dB)	Parallel Capacitance (pF)
PARS 304.45LXXR	304.45	2.5 max.	4.0 max.
PARS 310.00KXXR	310.00	2.5 max.	4.0 max.
PARS 314.00KXXR	314.00	2.5 max.	3.2 max.
PARS 314.50LXXR	314.50	2.5 max.	3.2 max.
PARS 315.00KXXR	315.00	2.5 max.	3.2 max.
PARS 320.65KXXR	320.65	2.5 max.	3.2 max.
PARS 423.22KXXR	423.22	2.5 max.	3.2 max.
PARS 432.92KXXR	432.92	2.5 max.	3.2 max.
PARS 433.42LXXR	433.42	2.5 max.	3.2 max.
PARS 433.92KXXR	433.92	2.5 max.	3.2 max.

### RECOMMENDED LAND PATTERN



### DIMENSIONS



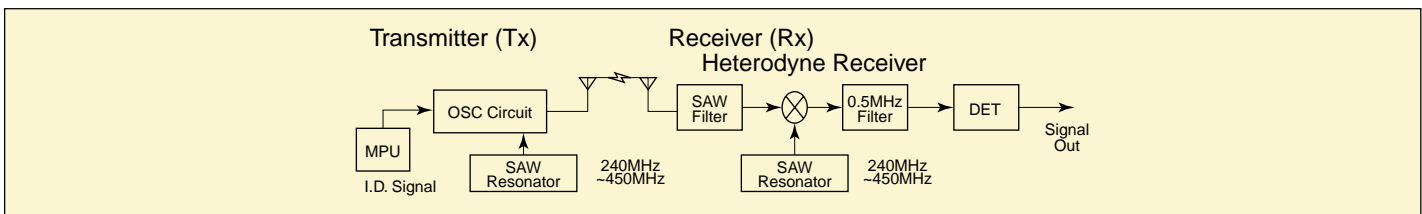
### MARKING CODE

Resonant Frequency (MHz)	Marking Code
304.45	304 L
310.00	310 K
314.00	314 K
314.50	314 L
315.00	315 K
320.65	320 K
423.22	423 K
432.92	432 K
433.42	433 L

Monthly Code

(4 digits Frequency Marking)

### BLOCK DIAGRAM (Example application)



# KAR Series SAW Resonators

## MHz Band SAW Resonators

$f_o$ : 46 to 315 MHz

### FEATURES

- 1) 2 channels encased in one package
- 2) Utilization of fundamental wave oscillation suppresses spurious response
- 3) No adjustment of peripheral circuits required
- 4) Good vibration and shock resistance
- 5) Superior temperature stability
- 6) Reduces the number of peripheral components

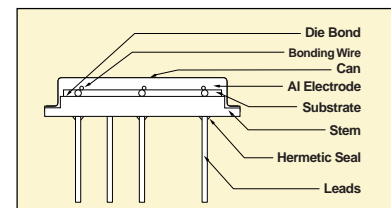
### HOW TO ORDER

#### KAR-91-CS

- ① ② ③
- ① Type: (Kyocera Acoustic Resonator)
  - ② Oscillation frequency (MHz)
  - ③ Resonator type:  
 CS, CT = Small package – Fig. B  
 CD, CB = Standard package – Fig. A  
 CK, CL = Round shape package – Fig. C.  
 CF, CG = Small square package – Fig. D.



### STRUCTURE



### SPECIFICATIONS (KAR-□-□)

Part No.	Channel*	Resonant Frequency (MHz)**	Resonant Loss (dB)	Parallel Capacitance (pF)	Temperature Stability -10°C to +60°C (ppm/°C)	Dimension
KAR-55CT	U- $\frac{2}{3}$	55.24±0.08 61.24±0.08	6.0 MAX	3.6±1 3.7±1	±8	Figure A
KAR-83CB	U- $\frac{5}{6}$	77.24±0.08 83.24±0.08	4.0 MAX	4.5±1 4.2±1	±7	
KAR-55CS	W- $\frac{3}{4}$	55.24±0.08 62.24±0.08	5.0 MAX	4.8±1 4.8±1	±8	
KAR-86CB	A- $\frac{3}{4}$	86.24±0.08 95.24±0.08	3.0 MAX	4.2±1 4.0±1	±5	
KAR-85CB	O- $\frac{4}{5}$	85.24±0.08 93.24±0.08	3.0 MAX	4.2±1 4.0±1	±5	
KAR-61CT	U- $\frac{3}{4}$	61.24±0.08 67.24±0.08	5.0 max	4.4±1 2.8±1	±8	Figure B
KAR-77CS	O- $\frac{3}{4}$	77.24±0.08 85.24±0.08	4.5 MAX	3.1±1 2.8±1	±8	
KAR-91CS	J- $\frac{1}{2}$	91.24±0.08 97.24±0.08	3.0 MAX	4.0±1 4.0±1	±5	
KAR-211CS	U-13	211.24±0.15	2.7 MAX	3.0±1	±8	

\*J: Japan U: USA W: Germany A: Australia O: East Europe

\*\*Other frequencies available on request.

### SPECIFICATIONS (for Keyless Entry)

Part No.	Channels	Resonant Frequency (MHz)	Resonant Loss (dB)	Parallel Capacitance (pF)	Temperature Characteristics (ppm/°C)	Dimension
KAR-303CS	JPN	303.875±0.25	2.5 Max.	4.0 Max.	±8 Max.	Fig. B
KAR-304CS	US	304.30±0.25				
KAR-310CS	US	310.00±0.25		3.2 Max.		
KAR-314CS	US	314.00±0.25				
KAR-314CT	US	314.50±0.25				
KAR-315CS	US	315.00±0.25				
KAR-320CS	JPN	320.65±0.25				
KAR-345CS	US	345.00±0.25				
KAR-359CS	US	359.90±0.25				
KAR-417CS	UK	417.50±0.25		2.3 Max.		
KAR-418CS	UK	418.00±0.25				
KAR-423CS	EU	423.22±0.25				
KAR-432CS	EU	432.92±0.25				
KAR-433CS	EU	433.92±0.25				
KAR-433CT	EU	433.42±0.25				
KAR-479CS	JPN	479.50±0.5				



# SAW Resonators Sample Circuits

## RF Modulators

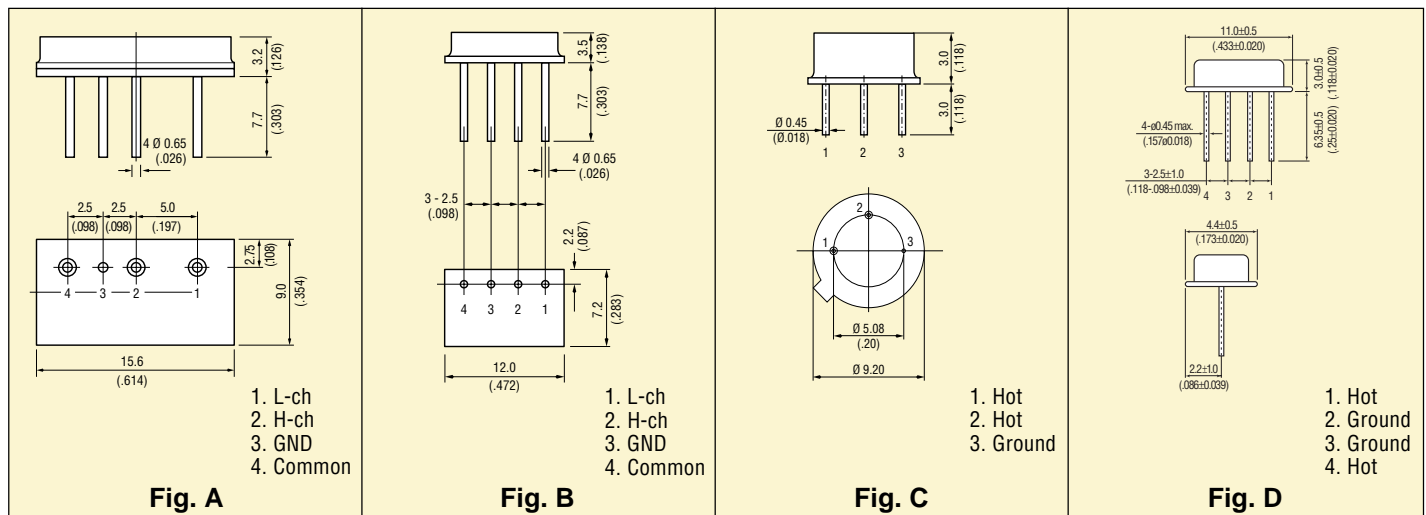
### SPECIFICATIONS (for Keyless Entry)

Part No.	Channels	Resonant Frequency (MHz)	Resonant Loss (dB)	Parallel Capacitance (pF)	Temperature Characteristics (ppm/°C)	Dimension
KAR-303CK	JPN	303.875±0.25	2.5 Max.	4.0 Max.	±8 Max.	Fig. C
KAR-304CK	US	304.30±0.25				
KAR-310CK	US	310.00±0.25				
KAR-314CK	US	314.00±0.25				
KAR-314CL	US	314.50±0.25				
KAR-315CK	US	315.00±0.25		3.2 Max.		
KAR-320CK	JPN	320.65±0.25				
KAR-345CK	US	345.00±0.25				
KAR-359CK	US	359.90±0.25				
KAR-417CK	UK	417.50±0.25				
KAR-418CK	UK	418.00±0.25		2.3 Max.		
KAR-423CK	EU	423.22±0.25				
KAR-432CK	EU	432.92±0.25				
KAR-433CK	EU	433.92±0.25				
KAR-433CL	EU	433.42±0.25				
KAR-479CK	JPN	479.50±0.5	2.5 Max.	4.0 Max.	±8 Max.	Fig. D
KAR-303CF	JPN	303.875±0.25				
KAR-304CF	US	304.30±0.25				
KAR-310CF	US	310.00±0.25				
KAR-314CF	US	314.00±0.25				
KAR-314CG	US	314.50±0.25		3.2 Max.		
KAR-315CF	US	315.00±0.25				
KAR-320CF	JPN	320.65±0.25				
KAR-345CF	US	345.00±0.25				
KAR-359CF	US	359.90±0.25				
KAR-417CF	UK	417.50±0.25		2.3 Max.		
KAR-418CF	UK	418.00±0.25				
KAR-423CF	EU	423.22±0.25				
KAR-432CF	EU	432.92±0.25				
KAR-433CF	EU	433.92±0.25				
KAR-433CG	EU	433.42±0.25	2.3 Max.			
KAR-479CF	JPN	479.50±0.5				

\*JPN: Japan U: United States EU: Europe

\* For other frequencies, please contact your nearest sales office.

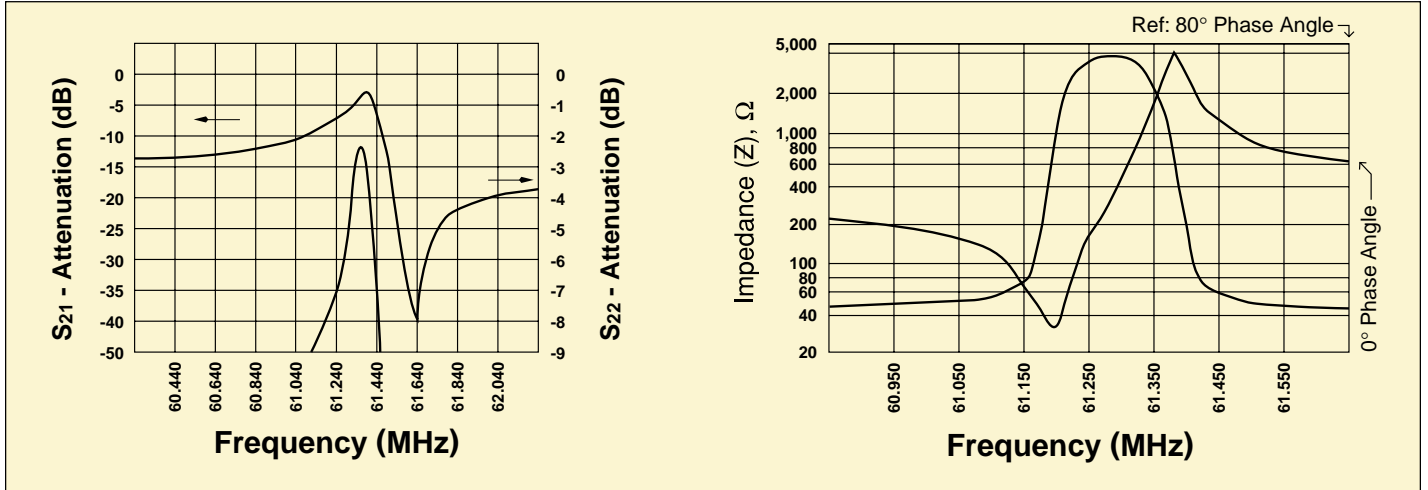
### DIMENSIONS



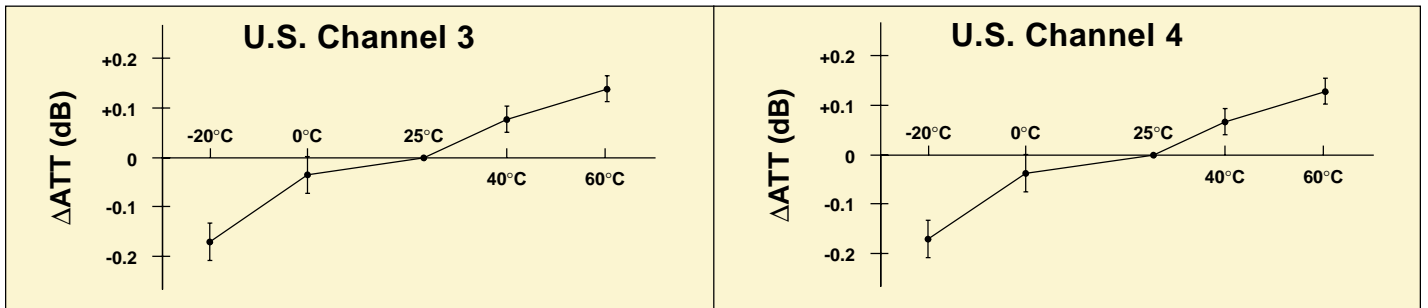
# Surface Acoustic Wave Resonators

**ATTENUATION vs FREQUENCY  
KAR-61CT  
U.S. CHANNEL 3**

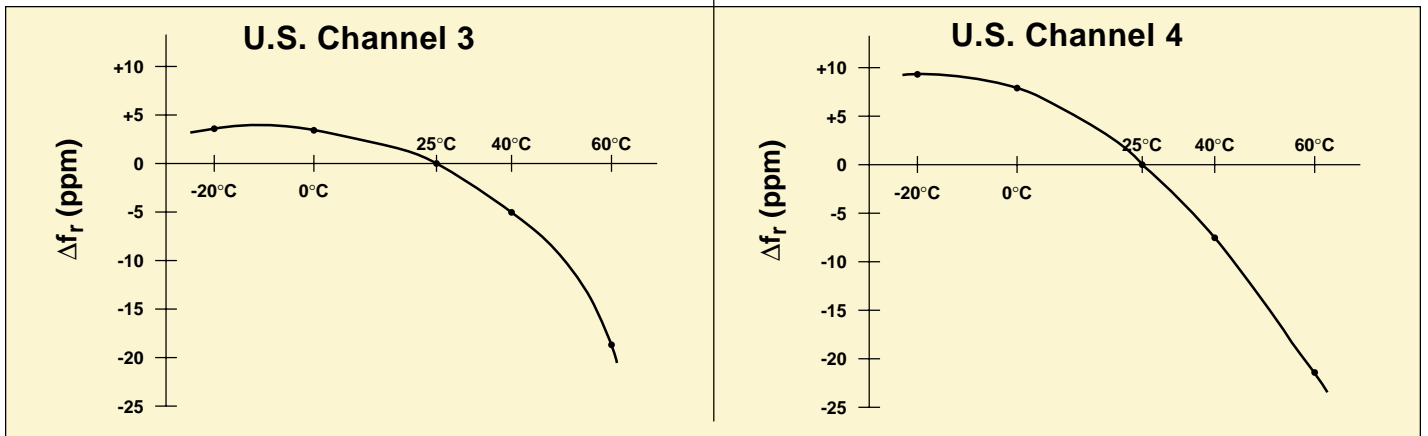
**IMPEDANCE and PHASE ANGLE  
KAR-61CT  
U.S. CHANNEL 3**



**Attenuation Change at Resonance with Temperature  
KAR-61CT**



**Resonant Frequency Change with Temperature  
KAR-61CT**



# MHz Band Quartz Crystals

## SMD Type - KSX Series

### FEATURES

- 1) Reference frequency for telecommunicaton system
- 2) High reliability ceramic package
- 3) 1000 pieces per reel
- 4) Sold in increments of 2000 pieces

### HOW TO ORDER

**KSX - 36 - 192M - \*\*\*\***

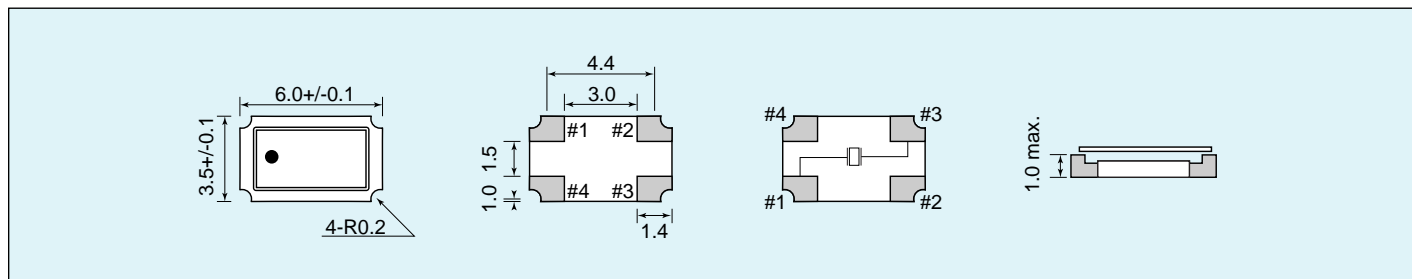
- ① Model: KSX-36  
 ② Frequency: 19.2 MHz  
 ③ Specification: 4 digits on end of part number



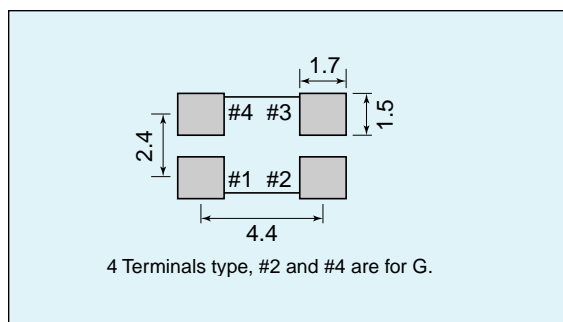
### SPECIFICATIONS (KSX)

Parameters	Code	Specification	Remarks
Frequency Range	fo	12~22MHz	See available frequencies below
Load Capacitance	CL	12.0pF	
Frequency Tolerance	$\Delta f/f$	$\pm 10$ ppm	+25 $\pm 2^{\circ}\text{C}$
Storage Temperature	Tstg	-40 $^{\circ}\text{C}$ ~+85 $^{\circ}\text{C}$	
Operating Temperature	Topr	-30 $^{\circ}\text{C}$ ~+80 $^{\circ}\text{C}$	
Frequency Stability vs. Temperature	$\Delta f/T$	$\pm 10$ ppm	-10 $^{\circ}\text{C}$ ~+60 $^{\circ}\text{C}$ (+25 $^{\circ}\text{C}$ standard)
Crystal Impedance	CI	30 (max.)	0/25/50 $^{\circ}\text{C}$ & 1 $\mu\text{W}$ /100 $\mu\text{W}$

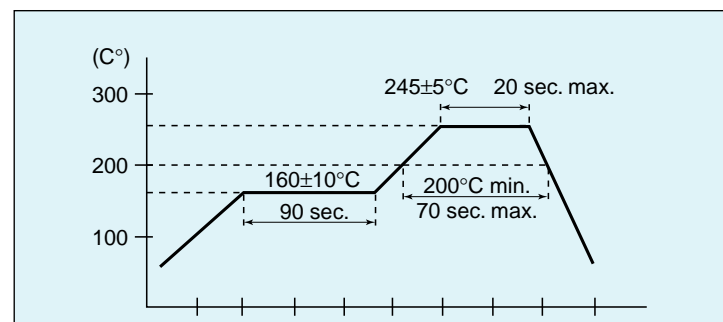
### DIMENSIONS



### RECOMMENDED LAND PATTERN



### RECOMMENDED REFLOW PROFILE



### FREQUENCY (MHz)

12.00	12.600	13.000	13.8650	14.850	16.368	19.200	19.800	21.145	21.400
12.500	12.800	13.824	14.400	15.360	16.800	19.680	20.945	21.250	26.000

# MHz Band Quartz Crystals

## Leaded Type - KT Series

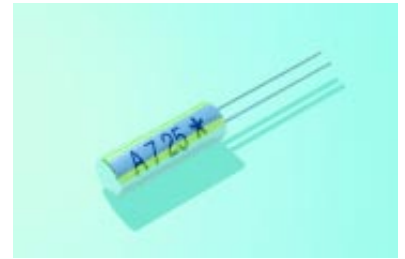
### FEATURES

- 1) Reference frequency for telecommunication system
- 2) High stability of characteristics due to vacuum pack can
- 3) Reflow solderable (Drift after solder: ±1ppm)
- 4) Bulk packaged 500 pieces/bag
- 5) Sold in increments of 2000 pieces

### HOW TO ORDER

**KT-308 - 192M \*\*\*\***

- ①      ②      ③
- ① Model: KT-308
  - ② Frequency: 19.2MHz
  - ③ Specification: 4 digits on end of part number



### SPECIFICATIONS (KT)

Parameters	Code	Specification	Remarks
Frequency Range	fo	12~22MHz	See available frequencies below
Load Capacitance	CL	13.0pF	
Frequency Tolerance	Δf/f	±10ppm	+25±2°C
Storage Temperature	Tstg	-40°C~+85°C	
Operating Temperature	Topr	-30°C~+80°C	
Frequency Stability vs. Temperature	Δf/T	±10ppm	-10°C~+60°C (+25°C standard)
Crystal Impedance	CI	30 (max.)	-10/25/50°C & -10dbm/-30dbm

### DIMENSIONS AND MARKING

A : Frequency (19.2MHz)  
 7 : Production Year (1997)  
 25: Production Week (25th week)  
 \* : Option

### FREQUENCY (MHz)

12.00	12.800	13.824	14.400	15.360	16.800	20.945	19.800	21.250
12.600	13.000	13.8650	14.850	16.368	19.200	19.800	21.145	21.400

## GENERAL DESCRIPTION

Clock oscillators are devices which generate the pulses to control the timing and operation of logic circuitry. They differ from other components used to control the timing of logic circuits, such as quartz crystals and ceramic resonators, in that clock oscillators need a power supply but no additional external circuitry to operate. Clock oscillators are usually made by combining in a single package a frequency control device such as a quartz crystal, and a hybrid circuit of resistors, capacitors, and either transistors or an integrated circuit. The package is often either a welded steel can or ceramic package hermetically sealed which protects the crystal and electronics from environmental effects and also reduces the unwanted electromagnetic and radio-frequency emissions which oscillators can generate.

## OSCILLATION DEVICES

Various types of circuits can be used to generate timing waveforms for electronic devices. The simplest of these is a simple circuit using capacitors, inductors and an active element such as a transistor or operational amplifier. This is an easy, low cost solution but the frequency is not very stable due to temperature and individual component variations. A more stable circuit would utilize a ceramic resonator, which has the advantage of better frequency tolerance, but resonators are only available in certain frequency ranges and stability of  $\pm 0.5\%$  is the best that can be achieved. If better frequency stability is needed, then the most popular method is to use a circuit which relies on the piezoelectric properties of quartz crystals to stabilize the oscillation.

If an alternating electrical field is applied to a cut and polished quartz crystal, the crystal lattice will deform due

to what is called the piezoelectric effect. At one particular frequency, which is determined by the geometry and size of the crystal, vibration will occur much more easily than at any other frequency. This is called the “resonant” frequency. If an oscillation circuit is built around this crystal, the mechanical vibrations can be used to control the electrical oscillations very precisely.

AVX/Kyocera builds its high quality clock oscillators from the substrate up. The whole module is hermetically sealed into an all-metal welded package to protect it from humidity. The case is directly grounded into a pin to help minimize RF radiation and meet FCC’s EMI specifications.

A full range of clock oscillators are manufactured by AVX/Kyocera. These extend from 1 MHz up to 72 MHz and include TTL and HCMOS compatible drive levels. AVX/Kyocera also offers special low power consumption clocks for long life battery applications. (See chart page 28.) Application specific designs for critical requirements of today’s high-speed, 32-bit microprocessors are available.

## WAVEFORM

The diagram below shows a typical waveform of a clock oscillator with an explanation of the parameters important for correct selection of the appropriate device.

Often called the symmetry of a waveform, duty cycle is a measure of how close to being equal the high and low parts of a waveform are. A perfectly symmetrical waveform will have duty cycle of 50%. We usually specify the minimum and maximum variations of the duty cycle as, for example: 60/40%. This is computed from the times shown on the diagram below as  $A/A+B$ .

Series	Output Frequency (MHz)	Fan Out	Output Level		Features
			V <sub>OH</sub> Min	V <sub>OL</sub> Max	
<b>TTL</b>					
K50 -HC* -C †	8 to 68	50pF	0.9 V <sub>DD</sub>	0.1 V <sub>DD</sub>	CMOS/TTL Drive
KXO -01	8 to 50	10 TTL	2.4	0.4	Cost Performance
KXO -HC* -T (KHO -HC* -T)	1 to 72	10 TTL	2.4	0.4	Versatile Drive Capabilities
<b>HCMOS</b>					
K50 -HC* -C †	8 to 68	50pF	0.9 V <sub>DD</sub>	0.1 V <sub>DD</sub>	CMOS/TTL Drive
K50 -CS* -SE	8 to 50	15pF	V <sub>DD</sub> -0.5	0.5	Low Power Consumption
KXO -HC* -C (KHO -HC* -C)	1 to 72	50 pF	0.9 V <sub>DD</sub>	0.1 V <sub>DD</sub>	Versatile Drive Capabilities
386 -HC	24,32,40,50	7 TTL	0.9V <sub>DD</sub>	0.1 V <sub>DD</sub>	Drives 80386
<b>Low Voltage</b>					
K50 -3C (3.3V)	8 to 68	15pF	0.9 V <sub>DD</sub>	0.1 V <sub>DD</sub>	Low Supply Voltage

†Will also drive TTL. See catalog for details – page 31.

Cordless & Cellular Phones	Frequency (MHz)	Output	Features
Temperature Compensated			
KT11	12.8, 13.0, 14.4, 14.85, 15.36, 16.8, 19.2	1Vp-p/10k /10pF	Surface Mount
KT12	12.8, 13.0, 14.4, 16.8, 19.2, 19.68	1Vp-p/10k /10pF	Miniature Surface Mount
KT14	13.0, 14.4, 14.85, 16.8, 19.2, 19.44, 19.68, 19.8	1Vp-p/10k /10pF	Ultra Low Profile Surface Mount
VCO	200~2000		High Performance Surface Mount

# AVX/Kyocera Clock Oscillators

## GENERAL DESCRIPTION continued

### CLOCK OSCILLATOR APPLICATIONS

In a typical personal computer system 5 or 6 clock oscillators may be used in the main processing unit, for all the add-on boards, video graphics adapters, co-processors, etc., and all the peripheral devices such as printers, modems and networking equipment. Many different companies may be involved in the manufacture of all these individual parts of the system.

The telecommunications industry uses clock oscillators in fax machines, cellular phones, pagers, and radio systems. These oscillators are typically very high precision, temperature compensated and voltage controlled devices.

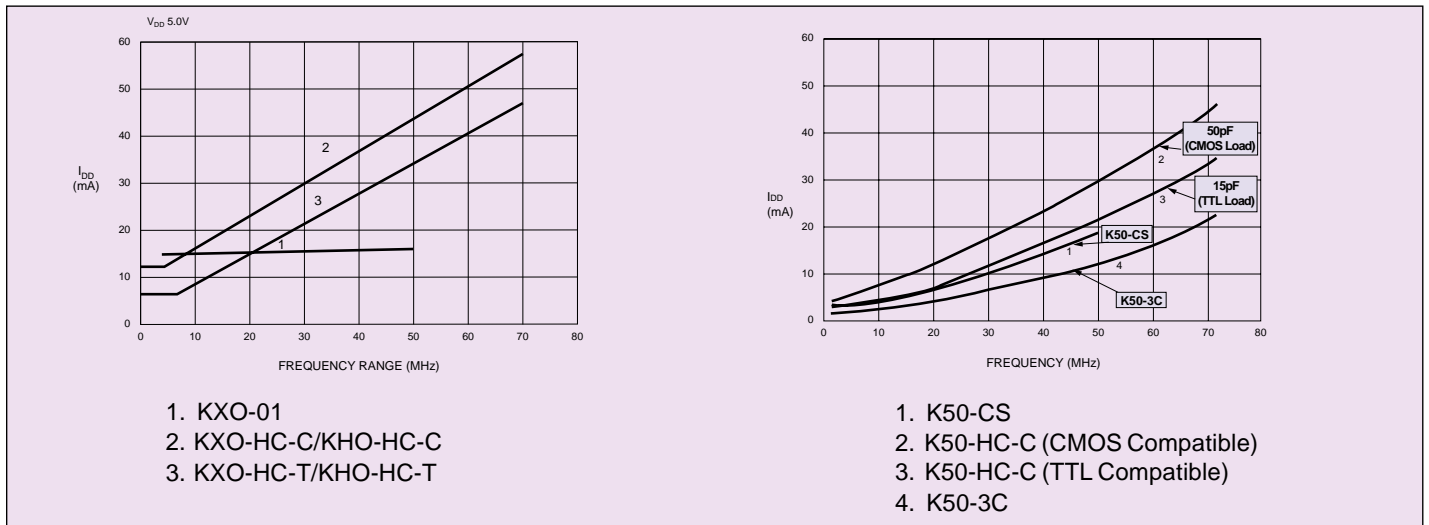
Clock oscillators are manufactured by combining a quartz crystal into a hybrid module containing passive components and active digital devices.

AVX/Kyocera builds its high quality clock oscillators from the substrate up. The whole module is hermetically sealed into an all-metal welded package to protect it from humidity. The case is directly grounded to a pin to help minimize RF radiation and meet FCC's EMI specifications.

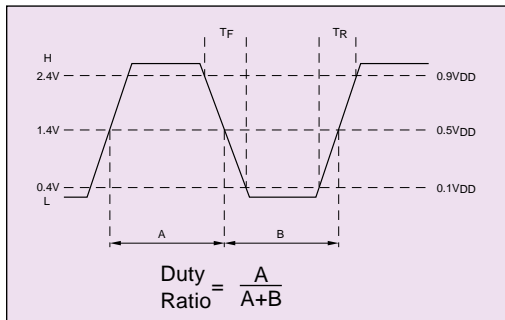
### PACKAGING

The diagrams below show the basic design of the 14 pin and 8 pin DIP (dual inline packages) and ceramic SMT packages in which most of the clock oscillators are available. Leaded oscillators are tube packaged. SMT K50 units are tape and reel packaged 1000 units per reel. Tube packages hold 25 units each for the KXO-01 and KXO-HC series, and 40 units each for the KHO-HC series products.

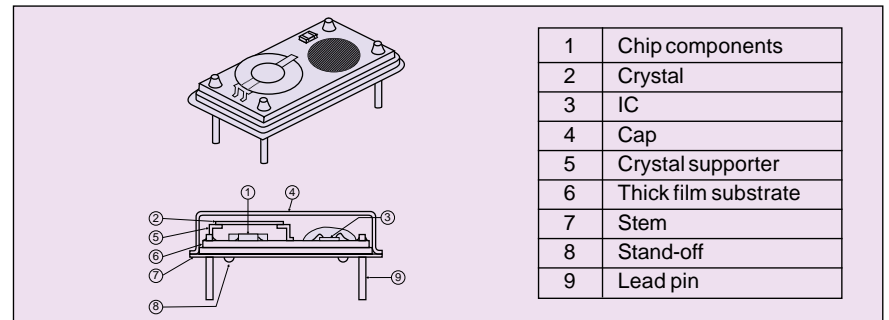
## FREQUENCY vs. POWER SUPPLY CURRENT



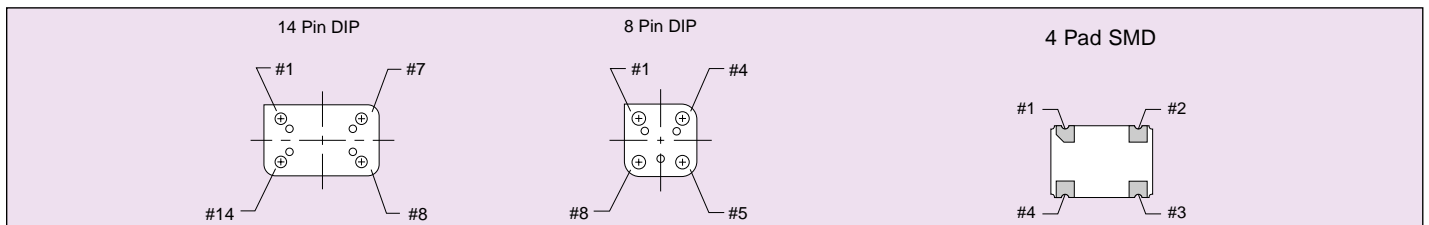
## OUTPUT WAVEFORM



## CLOCK OSCILLATOR GENERAL CONSTRUCTION



## PACKAGES



# AVX/Kyocera Crystal Clock Oscillators

## MECHANICAL

Readings to be made one hour after completion of test.

**Shock Resistance** - Drop module onto a hard wooden surface from a height of 50cm, three times. Unit must meet initial electrical requirements after test.

**Vibration Resistance** - Vibrations with an amplitude of 1.5mm and a sweep between 10 and 55Hz of 1 minute shall be applied for 2 hours in each of the X, Y, and Z axes for a total test time of 6 hours. Unit must meet initial electrical requirements after test.

**Pin Pull and Bend** - A load of 1kg shall be applied for 30 seconds in the direction of each pin. The pin will withstand without damage a bend from its base of 90° in one direction twice. Unit must meet initial electrical requirements after test.

**Solvent Resistance** - After immersion in Freon TF, Freon TE or IPA Liquid, at 25±5°C for a period of 10 minutes, unit shall meet initial electrical requirements.

**Ultrasonic Resistance** - Unit shall withstand ultrasonic washing at 28 to 31kHz and 300 watts per 20 liters of fluid in either Freon TF, Freon TE or IPA for up to 30 seconds without damage.

## ENVIRONMENTAL

Readings to be made two hours after completion of test.

**Soldering Heat** - Immerse pin to within 1mm of the glass stand-off in a solder bath of 280±10°C for 10 seconds. Unit shall meet initial electrical requirements after test.

**Heat Resistance** - After exposure to +85°C for 500 hours, frequency change shall be within ±10ppm of initial value.

**Cold Resistance** - After exposure to -40°C for 500 hours, unit must meet initial electrical requirements.

**Humidity Resistance** - After exposure to +85°C and 85% RH for 500 hours, unit must meet initial electrical requirements and show no significant rusting.

**Thermal Shock** - After 15 cycles of immersions in baths of 100°C and 0°C for 5 minutes with transfer times within 10 seconds, units will meet initial electrical requirements.

**Hermeticity** - Helium leak detector test should be performed under  $5 \times 10^{-7}$  atm, and measured after application of 10kg/sq cm of pressure for three hours and exposure to air for 30 minutes. No air bubbles shall be found when immersed in 75°C water for 5 minutes.

## AVX/Kyocera Crystal Clock Oscillator



# K50-HC-C Series Miniature SMT Crystal Clock Oscillators

**HCMOS Compatible**

**$f_o$ : 8 to 68 MHz**

**Features:**

- 1) Miniature SMT ceramic package
- 2) Frequency: 8~68MHz
- 3) Stability: 100ppm, 50ppm
- 4) Load: 50pF maximum
- 5) Tristate output inhibit
- 6) Hermetically sealed package
- 7) 1000 pieces per reel
- 8) Sold in increments of 1000 pieces

**How to Order**

**K50-HC 1 CS E 40.0000M R**

- ①      ②      ③      ④      ⑤      ⑥

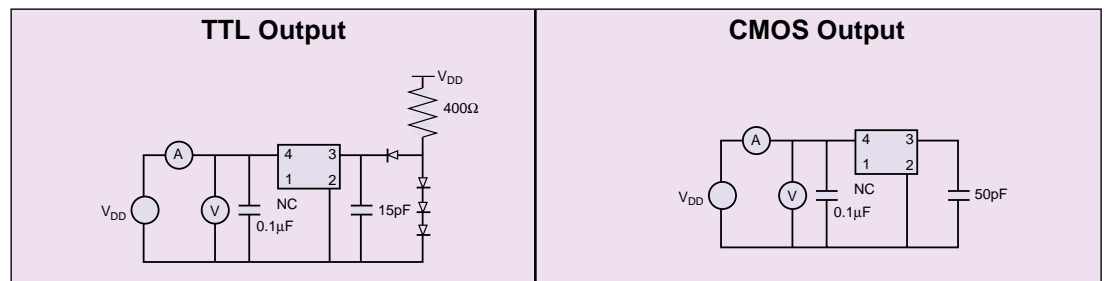
- ① Type: (K50-HC series)
- ② Stability: 1-100ppm, 0-50ppm
- ③ Output compatibility:  
CS = CMOS 45/55 duty cycle @ 50%  $V_{DD}$   
CS = TTL 40/60 duty cycle @ 1.4 volts
- ④ Tristate output: E with function
- ⑤ Frequency (MHz)
- ⑥ Packaging: R=Tape and reel



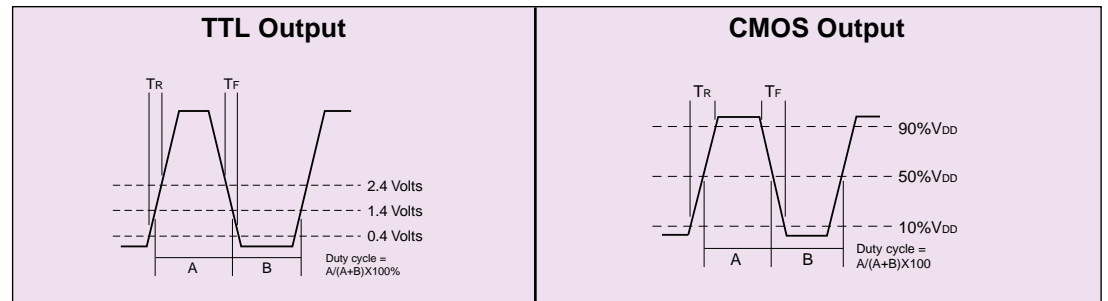
**SPECIFICATIONS (K50-HC)**

Parameters	Code	TTL Output		CMOS Output		Unit
		Rating	Remarks	Rating	Remarks	
Output Frequency	$f_{OUT}$	8~68		8~68		MHz
Frequency precision	$\Delta f/f$	1=100, 0=50	-10 to 70°C, $V_{DD}=5\pm 0.5V$	1=100, 0=50	-10 to 70°C, $V_{DD}=5\pm 0.5V$	ppm
Operating temp.	$t_{OPR}$	-10 to +70		-10 to +70		°C
Storage temp.	$t_{STOR}$	-55 to +125		-55 to +125		°C
Supply voltage	$V_{DD}$	5 ±0.5		5 ±0.5		V
Supply current	$I_{DD}$	40 max @ 10TTL/15pF	25°C, 50MHz	50 max @ 50pF	25°C, 50MHz	mA
Duty cycle	$S_Y$	40/60	at 1.4 volts	45/55	@50% $V_{DD}$	%
Output "0" level	$V_{OL}$	0.4max	@ $I_{OL} = 16mA$	0.5max	@ $I_{OL} = 16mA$	V
Output "1" level	$V_{OH}$	2.4min	@ $I_{OH} = -1mA$	$V_{DD}-0.5min$	@ $I_{OH} = -1mA$	V
Rise / Fall time	$T_R/T_F$	5max	0.4V-2.4V	10max	10-90% $V_{DD}$ , 50pF	nS
Load		$f_o \leq 50MHz = 50pF$ $f_o > 50MHz = 15pF$		$f_o \leq 50MHz = 50pF$ $f_o > 50MHz = 15pF$		
Enable/disable time		100max		100max		nS
Aging rate		±5max		±5max		ppm/y
Input voltage-high	$V_{IH}$	2.2min		2.2min		V
Input voltage-low	$V_{IL}$	0.8max		0.8max		V

**TEST CIRCUIT**



**OUTPUT WAVEFORM**





# K50-3C Series Miniature SMT Crystal Clock Oscillators

3.3 Volt

$f_o$ : 8 to 68 MHz

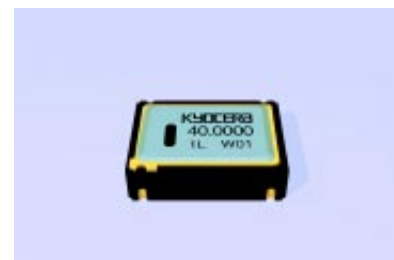
## Features

- 1) 3.3 volt operation
- 2) Tristate output inhibit and oscillation shutdown to reduce power supply current draw
- 3) Miniature SMT ceramic package
- 4) Frequency: 8 to 68MHz
- 5) Stability: 100ppm
- 6) Load: up to 15pF
- 7) Hermetically sealed package
- 8) 1000 pieces per reel
- 9) Sold in increments of 1000 pieces

## How to Order

**K50-3C 1 E 40.0000M R**

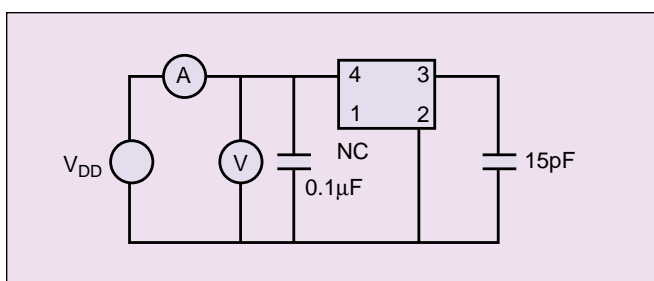
- ① Type: (K50-3C series)  
 ② Stability: 1-100ppm  
 ③ Tristate o/p and shutdown: E with function  
 ④ Frequency (MHz)  
 ⑤ Packaging: R=Tape and reel



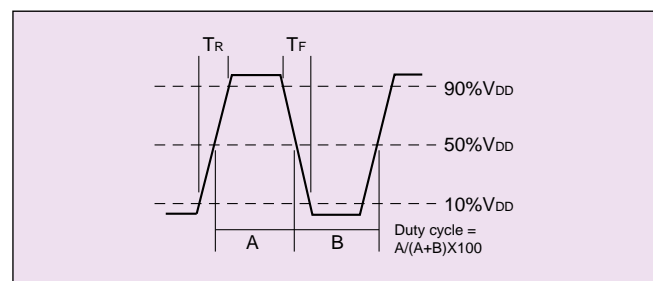
## SPECIFICATIONS (K50-3C)

Parameters	Code	Rating	Unit	Remarks
Output Frequency	$f_{OUT}$	8 to 68	MHz	
Frequency precision	$D_{F/F}$	1=100, 0=50	ppm	-10 to 70°C, $V_{DD}=3.3\pm 10\%$
Operating temp	$t_{OPR}$	-10 to +70	°C	
Storage temp	$t_{STOR}$	-55 to +125	°C	
Supply voltage	$V_{DD}$	3.3 $\pm 10\%$	V	
Supply current <sub>(1)</sub>	$I_{DD(1)}$	25 max @ 15pF	mA	25°C, 68MHz
Supply current <sub>(2)</sub>	$I_{DD(2)}$	100 max	$\mu A$	Oscillation shutdown (pad #1= low, pad #3=high imp.)
Duty cycle	$S_Y$	40/60	%	@50% $V_{DD}$
Output "0" level	$V_{OL}$	10% $V_{DD}$ max	V	@15pF load
Output "1" level	$V_{OH}$	90% $V_{DD}$ min	V	@15pF load
Rise / Fall time	$T_R/T_F$	10max	nS	10%-90% $V_{DD}$ , 15pF
Load		15max	pF	or 5LSTTL
Enable/disable time		5	mS	8.0000 to 32.0000MHz
		150max	nS	32.0001 to 50.0000MHz
		5	mS	50.0001 to 68.0000MHz
Aging rate		$\pm 5$ max	ppm/y	
Input voltage-high	$V_{IH}$	2.0min	V	$V_{DD} = 3.3V$ , $I_{IH} = 10\mu A$
Input voltage-low	$V_{IL}$	0.5max	V	

## TEST CIRCUIT



## OUTPUT WAVEFORM



# K50-CS Series Miniature SMT Crystal Clock Oscillators

Low Power Consumption

$f_o$ : 8 to 50 MHz

## Features

- 1) Miniature SMT ceramic package
- 2) Low power consumption
- 3) Frequency: 8-50MHz
- 4) Stability: 100ppm, 50ppm
- 5) Load: 15pF
- 6) Tristate output inhibit
- 7) Hermetically sealed package
- 8) 1000 pieces per reel
- 9) Sold in increments of 1000 pieces

## How to Order

**K50-CS 1 S E 40.0000M R**

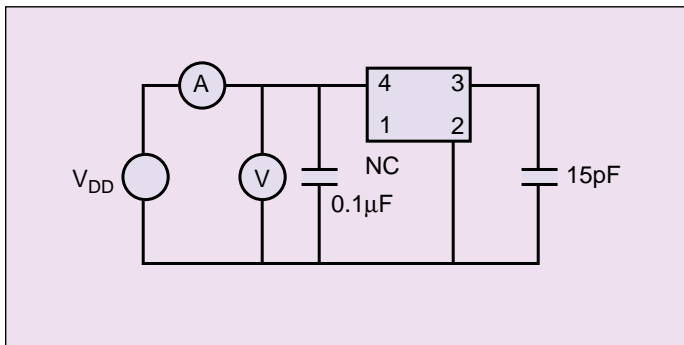
- ① Type: (K50-CS series)  
 ② Stability: 1-100ppm, 0-50ppm  
 ③ Duty cycle: S-45/55  
 ④ Tristate o/p: E with function  
 ⑤ Frequency  
 ⑥ Packaging: R=Tape and reel



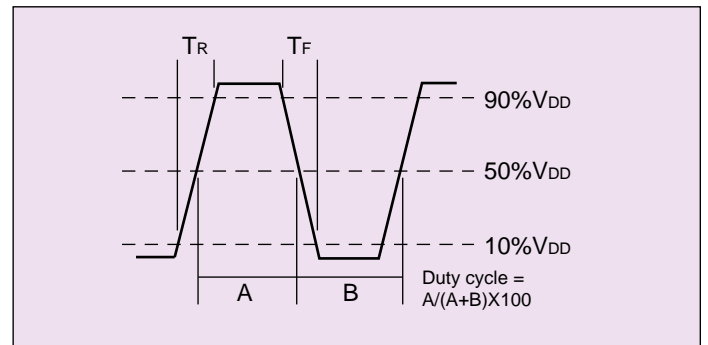
## SPECIFICATIONS (K50-CS)

Parameters	Code	Rating	Unit	Remarks
Output Frequency	$f_{OUT}$	8 to 50	MHz	
Frequency precision	$\Delta f/f$	1=100, 0=50	ppm	-10 to 70°C, $V_{DD}=5\pm 0.5V$
Operating temp	$t_{OPR}$	-10 to +70	°C	
Storage temp	$t_{STOR}$	-55 to +125	°C	
Supply voltage	$V_{DD}$	$5 \pm 0.5$	V	
Supply current	$I_{DD}$	30 max @ 15pF	mA	25°C, 50MHz
Duty cycle	$S_Y$	45/55	%	@50% $V_{DD}$
Output "0" level	$V_{OL}$	$0.1V_{CC}$ max	V	@ $I_{OL} = 4.0mA$
Output "1" level	$V_{OH}$	$0.9V_{CC}$ min	V	@ $I_{OH} = -4.0mA$
Rise / Fall time	$T_R/T_F$	10max	nS	$0.1V_{CC}-0.9V_{CC}$
Load		15max	pF	
Enable/disable time		100max	nS	
Aging rate		$\pm 5$ max	ppm/y	
Input voltage-high	$V_{IH}$	2.2min	V	
Input voltage-low	$V_{IL}$	0.8max	V	

## TEST CIRCUIT



## OUTPUT WAVEFORM



# K50 Series Miniature SMT Clock Oscillators

## Ceramic Package

### DIMENSIONS

Pad #	Function
1	Output Disable*
2	GND/ Case GND
3	Output
4	+VDD

\*Logic "0" disables o/p

\*Marking: \*1) 1 = 100ppm, 0 = 50ppm. \*2) A = CS-E, B = HC-CSE, L = 3C-LE (3.3 volt)

Units: mm (inches)

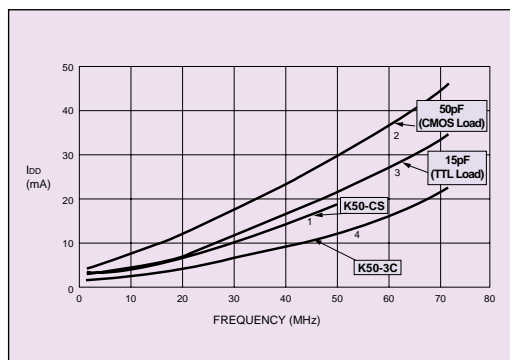
### SOLDERING

#### Suggested IR Reflow Profile

#### Suggested Solder Pad Layout

Units: mm (inches)

### FREQUENCY VS. POWER SUPPLY CURRENT



### ENABLE/DISABLE FUNCTION CHART

K50-HC-C, K50-CS Series		K50-3C-L Series	
#1 Pad	#3 Pad	#1 Pad	#3 Pad
High or Open	Oscillation	High	Oscillation
Low	High Impedance	Low	High Impedance Oscillation Stops

### PACKAGING

#### Reel Dimensions

Detail of Hub

#### Embossed Carrier Tape Dimensions

Units: mm (inches)

# KT11 Series SMT Crystal Clock Oscillators

## Temperature Compensated

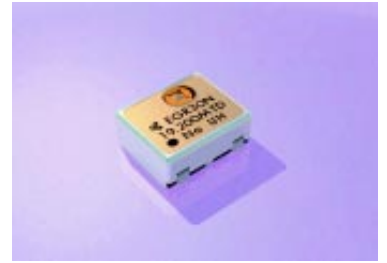
### FEATURES

- 1) Frequency adjustment free after reflow soldering process
- 2) Ultra miniature type (11X9X4mm)
- 3) AFC function available (option)
- 4) 3V/5V drive available
- 5) 1000 pieces per reel
- 6) Sold in increments of 1000 pieces

### HOW TO ORDER

**KT11 - E G R 30 N - 19.200M T**

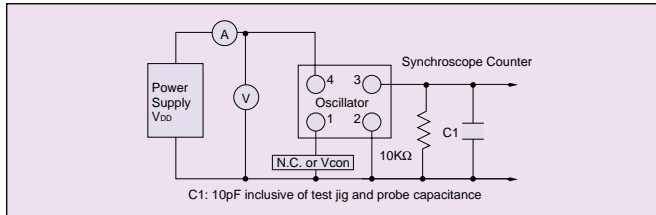
- ① ② ③ ④ ⑤ ⑥ ⑦ ⑧
- ① Type
  - ② Frequency precision: D=±2ppm, E=±2.5ppm, K=±5ppm
  - ③ Lower temperature limit: C=-30°C; E=-20°C, G=-10°C
  - ④ Upper temperature limit: R=60°C; T=70°C; V=80°C
  - ⑤ Supply voltage: 30=3.0V; 50=5.0V
  - ⑥ AFC function; V=with; N=without; L=with (trimmerless)
  - ⑦ Frequency: See table below.
  - ⑧ Packaging: T=Tape and reel



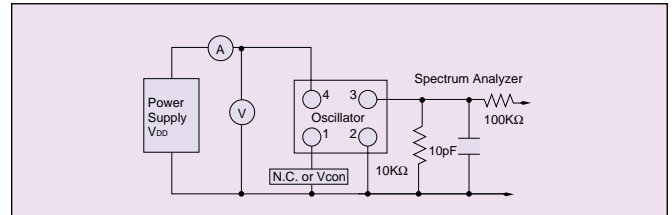
### SPECIFICATIONS

Frequency	19.200MHz/PHS	12.8, 13.0, 14.4, 14.85, 15.36, 15.9, 16.8MHz/Cellular
V <sub>DD</sub>	3V±5%	3V or 5V±5%
Output (10k /10pF)	1.0Vp-p min.	1.0Vp-p min.
Current consumption (no load)	2.0mA max.	2.0mA max.
Frequency stability ( $\Delta f/f_a$ )	Temperature	±2.5ppm (-10~+60°C)
	Load (10pF/10kΩ ±10%)	±0.2ppm max. (-30~+80°C)
	Voltage (3.0V ±5%)	±0.3ppm max.
Trimmer adjustment ( $\Delta f/f_a$ )	±3.0ppm min.	±3.0ppm min.
Voltage control (1.5V±1.0V) $\Delta f/V$	±4~±8ppm (±30ppm: Trimmerless type)	±4~±8ppm (±30ppm: Trimmerless type)
Spurious ratio	-3dBc max.	-3dBc max.
Aging	±1.0ppm / y max.	±1.0ppm / y max.

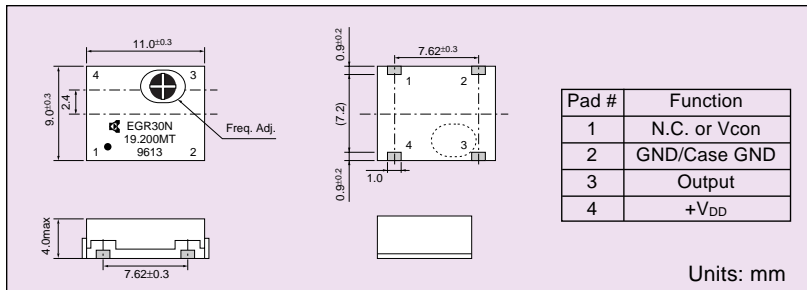
### TEST CIRCUIT (EXCEPT FOR HARMONIC)



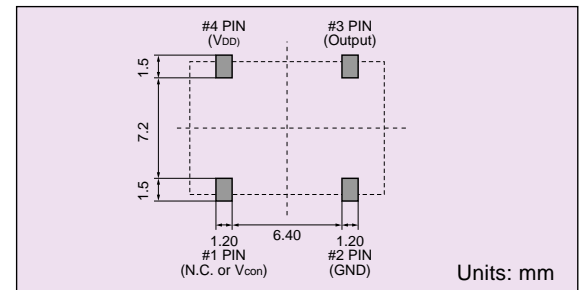
### TEST CIRCUIT (HARMONIC)



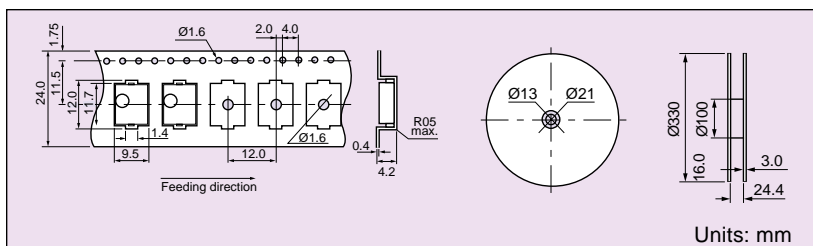
### DIMENSIONS



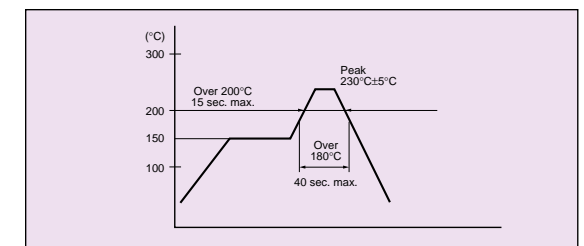
### RECOMMENDED PAD LAYOUT



### TAPING DIMENSIONS



### RECOMMENDED REFLOW PROFILE



# KT12 Series SMD Crystal Clock Oscillators

## Temperature Compensated

### FEATURES

- 1) Miniature SMD type (11.6x9.6x2.3mm)
- 2) Frequency adjustment free after reflow soldering process
- 3) AFC function available (option)
- 4) 3V/5V drive available
- 5) Frequency stability:  $\pm 2$ ppm at  $-30 \sim +80^\circ\text{C}$
- 6) 2000 pieces per reel
- 7) Sold in increments of 2000 pieces

### HOW TO ORDER

**KT12**  - **D C V 33 V** - **19.680M T**

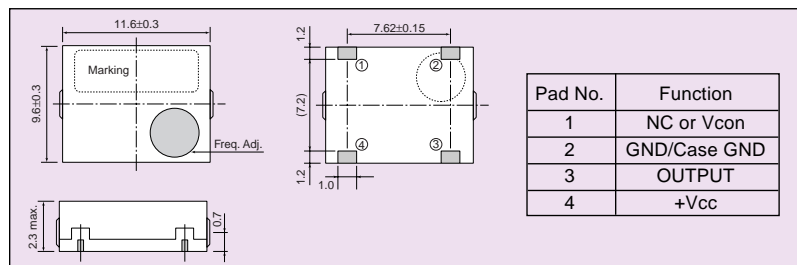
- ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
- ① Type
  - ② Terminals: Blank ()=4 terminals, A=6 terminals, B=8 terminals
  - ③ Frequency stability: D= $\pm 2$ ppm, E= $\pm 2.5$ ppm, K= $\pm 5$ ppm
  - ④ Lower operating temp.: C= $-30^\circ\text{C}$ ; E= $-20^\circ\text{C}$ , G= $-10^\circ\text{C}$
  - ⑤ Upper operating temp.: R= $60^\circ\text{C}$ ; T= $70^\circ\text{C}$ ; V= $80^\circ\text{C}$
  - ⑥ Supply voltage: 30=3.0V; 50=5.0V
  - ⑦ AFC function; V=with; N=without; L=with (trimmerless)
  - ⑧ Frequency: See table below
  - ⑨ Packaging: T= Tape and reel



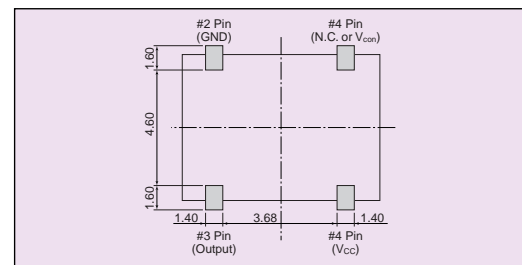
### SPECIFICATIONS

Parameters	Code	Specification		Unit	Remarks
		PHS	Cellular		
Supply Voltage	Vcc	3.0V $\pm 5\%$	3.0V $\pm 5\%$ 5.0V $\pm 5\%$	V	
Output Frequency	Fout	19.200	19.680   19.200 16.800   14.400 13.000   12.800	MHz	—
Operating Temp.	Topr	-10 ~ 60	-30 ~ 80 max.	$^\circ\text{C}$	—
Storage Temp.	Tstr	-20 ~ 70	-40 ~ 85	$^\circ\text{C}$	—
Frequency Stability	f/fo	$\pm 2.5$ max.	$\pm 2.0$ max. $\pm 2.5$ max.	ppm	vs. Temp. (After Reflow) vs. Load vs. Voltage
Aging Rate	Aging		$\pm 1.0$ max.	ppm/year	1 Year
Output Voltage	Vout		1.0 min.	Vp-p	Load 10k /10pF
Supply Current	Icc		2.0 max.	mA	—
Trimmer Control Range	f/C		$\pm 3.0$ min.	ppm	Internal Trimmer
Voltage Control Range	f/V		ex: $\pm 4.0 \sim \pm 8.0$	ppm	1.5V $\pm 1$ V, 2.5 $\pm 1$ V
Harmonics	—		-3.0 max.	dBc	—

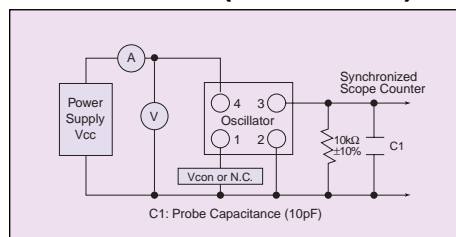
### DIMENSIONS



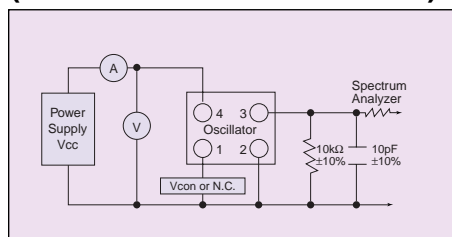
### RECOMMENDED LAND PATTERN



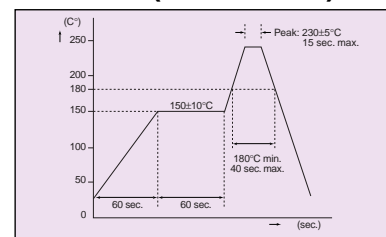
### TEST CIRCUIT (AMPLITUDE)



### TEST CIRCUIT (HARMONICS & FREQUENCY)



### RECOMMENDED REFLOW PROFILE (IR REFLOW)



# KT14 Series SMD Crystal Clock Oscillators

## Temperature Compensated

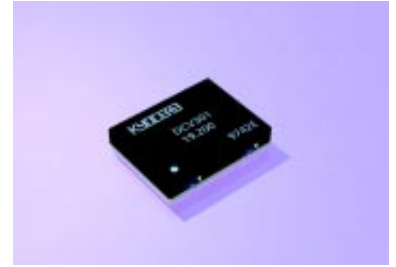
### FEATURES

- 1) Ultra low profile SMD type (9.0x7.0x1.7mm)
- 2) Frequency adjustment free after reflow soldering process
- 3) AFC function available (option)
- 4) 2.8, 3.0, 3.3V drive available
- 5) 2000 pieces per reel
- 6) Sold in increments of 2000 pieces

### HOW TO ORDER

## KT14 - E C T 28 L - 19.440 M T

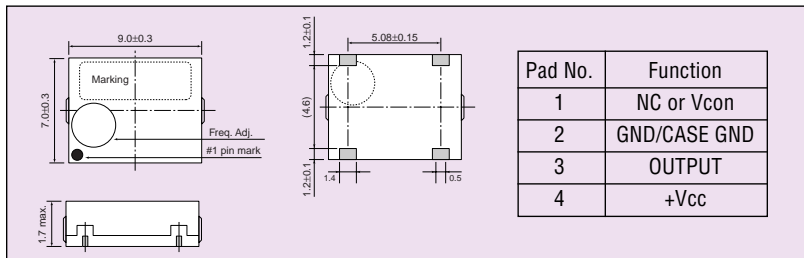
- ① ② ③ ④ ⑤ ⑥ ⑦ ⑧
- ① Type
  - ② Frequency stability: D=±2ppm, E=±2.5ppm, K=±5ppm
  - ③ Lower operating temp.: C=-30°C; E=-20°C, G=-10°C
  - ④ Upper operating temp.: R=60°C; T=70°C; V=80°C
  - ⑤ Supply voltage: 28=2.8V; 50=3.0V
  - ⑥ AFC function; V=with; N=without; L=with (trimmerless)
  - ⑦ Frequency: See table below.
  - ⑧ Packaging: T=Tape and reel



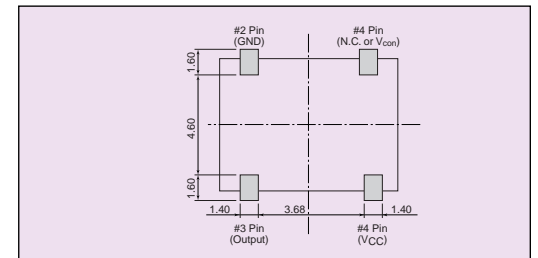
### SPECIFICATIONS

Parameters	Code	Specification		Unit	Remarks	
		PHS	Cellular			
Supply voltage	Vcc	2.8V±5%	2.8V±5%	V	—	
			3.0V±5%			
			3.3V±5%			
Output Frequency	Fout	19.200	13.000	14.400	MHz	—
			14.850	16.800		
			19.200	19.440		
			19.680	19.800		
Operating Temp.	Topr	-10 ~ 60	-30 ~ 80 max.		°C	—
Storage Temp.	Tstr	-20 ~ 70	-40 ~ 85		°C	—
Frequency Stability	f/fo	±2.5 max.	±2.0 max.		ppm	vs. Temp. (After Reflow)
			±2.5 max.			
			vs. Load			
Aging Rate	Aging	±1.0 max.	—		ppm/year	1 Year
Output Voltage	Vout	1.0 min.		Vp-p	Load 10K /10pF	
Supply Current	Icc	2.0 max.		mA	No Load	
Trimmer Control Range	f/C	±3.0 min.	—		ppm	—
Voltage Control Range	f/V	—	ex: ±8.0 ~ ±15.0		ppm	1.5V±1V, 2.5±1V
Harmonics	—	-3.0 max.		dBc	—	

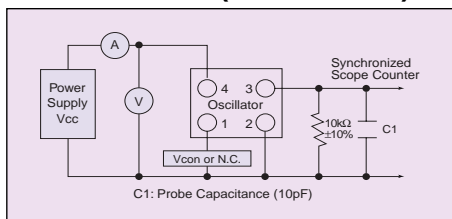
### DIMENSIONS



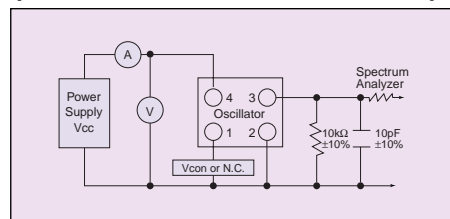
### RECOMMENDED LAND PATTERN



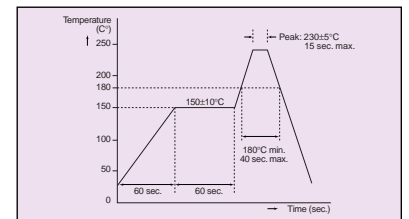
### TEST CIRCUIT (AMPLITUDE)



### TEST CIRCUIT (HARMONICS & FREQUENCY)



### RECOMMENDED REFLOW PROFILE (IR REFLOW)



# Voltage Control Oscillator

## VK Series - Surface Mount

$f_o$ : 100 to 700 MHz

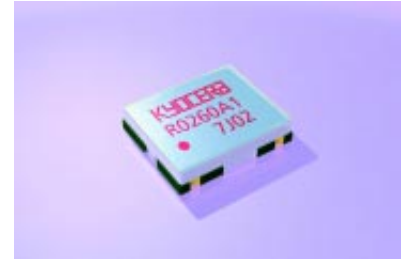
### FEATURES

- 1) Covers UHF band
- 2) For PDC mixing and PHS 2nd local
- 3) Available 2.2V, 3mA typ.
- 4) Small (9x7mm)
- 5) Low profile (2.00mm max.)
- 6) 2000 pieces per reel
- 7) Sold in increments of 2000 pieces

### HOW TO ORDER

## VK - 120 R 0130 A1 W

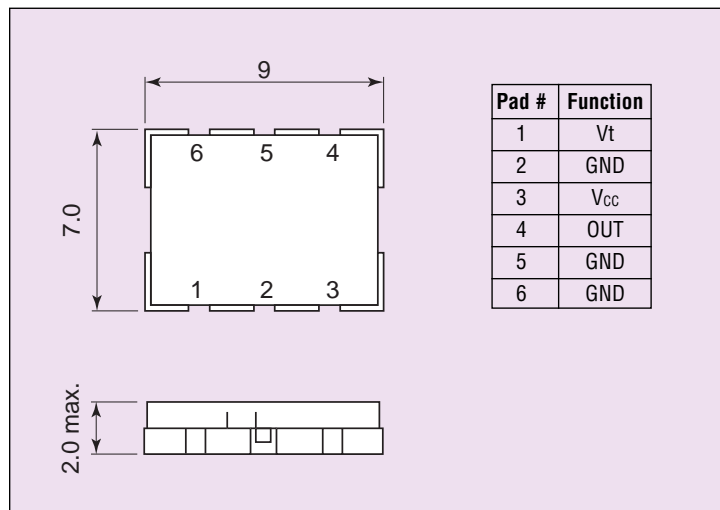
- ① Series: VK=100~700MHz
- ② Dimensions: 120=9x7mm
- ③ Applications: R=RX
- ④ Frequency: 0130=130MHz
- ⑤ Individual specification
- ⑥ Packaging: W = Tape and reel



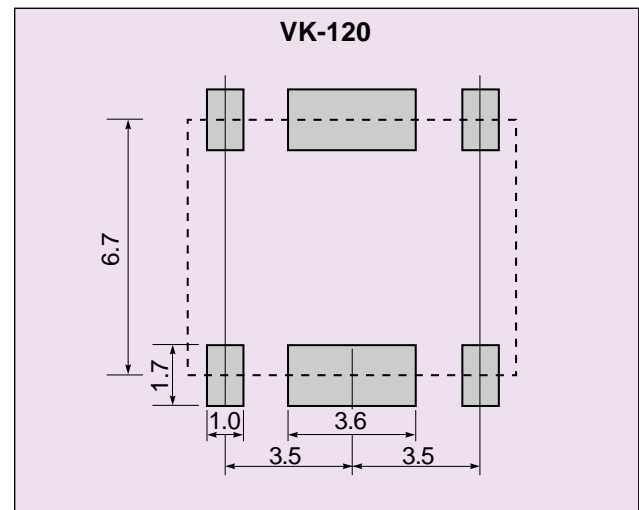
### SPECIFICATIONS

Parameters	Specifications	Unit	Condition
Supply Voltage	2.2±0.2	V	—
Current Consumption	4.0	mA	Ta=25±5°C Vcc=2.2±0.05[V]
Frequency	129.545	MHz	Vt=0.5 ~ 2.5V
Output Level	-3±3	dBm	Ta=25±5°C Vcc=2.2±0.05[V]
Tuning Voltage Sensitivity	2.5±1.0	MHz/V	[f(2.5) - f(0.5)]/2.0
C/N (Phase Noise)	70	dBc	off-set 25kHz 16kHz B.W.
PSU Stability	±200	kHz	Vcc=2.2V ±0.2V
Temperature Stability	±1	MHz	-20 ~ +70°C @25°C
Pulling Stability	±200	kHz	VSWR=2 All phase
Spurious Level	-10	dBc	Reference is fundamental, Harmonics Level
Operating Temp. Range	-20 ~ 70	°C	—

### DIMENSIONS and PAD CONNECTION



### RECOMMENDED LAND PATTERN



# Voltage Control Oscillator

## EK Series - Surface Mount

$f_o$ : 700 to 1300 MHz

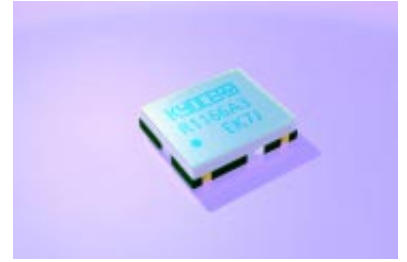
### FEATURES

- 1) High reliability construction
- 2) Reflow soldering available
- 3) High performance for C/N and S/N
- 4) 2000 pieces per reel
- 5) Sold in increments of 2000 pieces

### HOW TO ORDER

## EK - 304 R 0972 AA W

- ① ② ③ ④ ⑤ ⑥
- ① Series: EK=700~1300MHz
  - ② Dimensions
  - ③ Applications: R=RX
  - ④ Frequency: 0927=927MHz
  - ⑤ Individual specification
  - ⑥ Packaging: W = Tape and reel

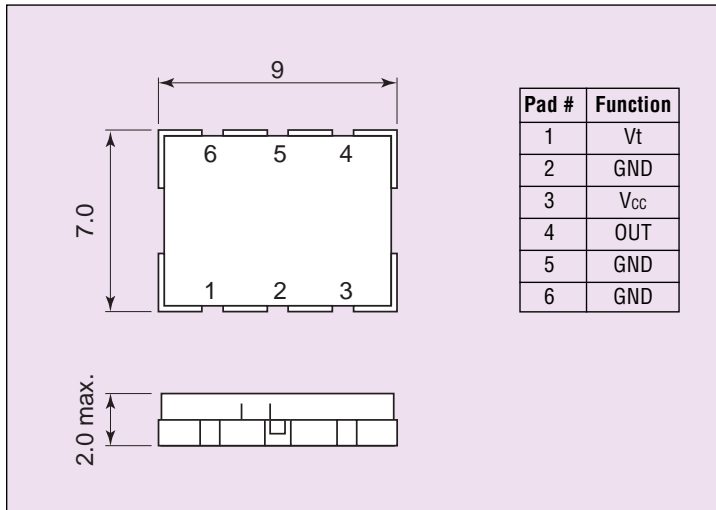


### SPECIFICATIONS

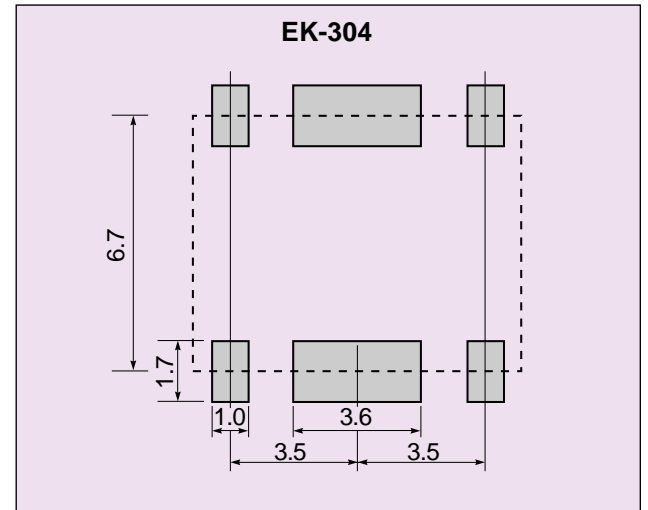
Type		Frequency (MHz)	Part No.	Specifications (Ta=25°C)					
System	Module			V <sub>cc</sub> (V)	I <sub>cc</sub> (mA)	P <sub>o</sub> (DBM)	F <sub>TU</sub> (MHZ/V)	C/N (dBc)	T <sub>OP</sub> (°C)
N-TACS	RX	765 ~ 800	EK-304R0783A1	3 ±0.2	9 max.	-1±3	23±3	65 min. (12.5kHz off BW 8kHz)	-20 ~ 70
PDC		1069~ 1090	EK-304R1080A1	2.2 ±0.2	6 max.	-3±3	25±3	70 min. (50kHz off BW21kHz)	-20~ 80
AMPS		914~939	EK-304R0927A9	2.55 ±0.05	12 max.	+3±2	14±2	108 min. (20kHz off)	-30~ 85
PCS		1310 ~ 1393	EK-304R1352A2	2.8 ±0.1	10 max.	-6 min.	39±4	100 min. (25kHz off)	-10 ~ 75
GSM		1006~ 1031	EK-304R1019A6				15±3		-20~ 75
PDC		780 ~ 841	EK-304R0811A1	2.2 ±0.2	8 max.	-1±3	46±7	67 min. (50kHz off 21kHz BW)	-30 ~ 85

V<sub>cc</sub>: Power supply, I<sub>cc</sub>: Current consumption, P<sub>o</sub>: Output level, F<sub>TU</sub>: Tuning voltage sensitivity, T<sub>OP</sub>: Operating temperature range

### DIMENSIONS and PAD CONNECTION



### RECOMMENDED LAND PATTERN





# Voltage Control Oscillator

## YK Series - Surface Mount

$f_o$ : 700 to 1600 MHz

### FEATURES

- 1) SMD type
- 2) Covers 700~1600Mhz band
- 3) Small (7.8X6.0mm),  
Low Profile (2.00mm max.)
- 4) 2000 pieces per reel
- 5) Sold in increments of 2000 pieces

### HOW TO ORDER

**YK - 501 R 1171 A1 W**

- ① ② ③ ④ ⑤ ⑥
- ① Series: YK=700~1600MHz
  - ② Dimensions
  - ③ Applications: R=RX
  - ④ Frequency: 1171=1171MHz
  - ⑤ Individual specification
  - ⑥ Packaging: W=Tape and reel

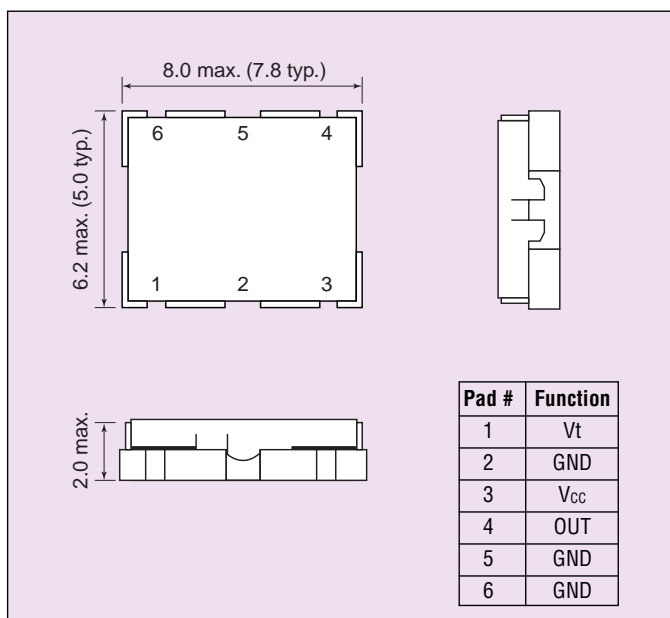


### ELECTRICAL CHARACTERISTICS

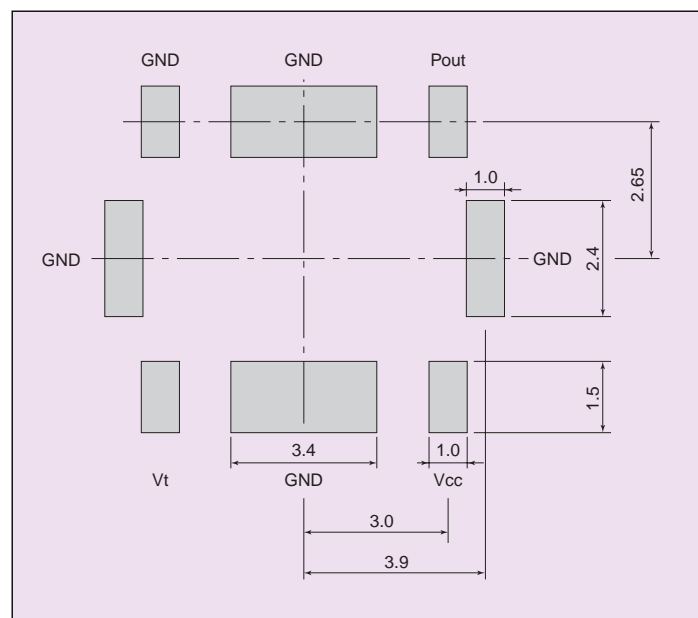
Parameters	Specifications	Unit	Condition
Supply Voltage	2.6±0.1	V	—
Current Consumption	8.0	mA	Ta=25±5°C Vcc=2.5±0.05[V]
Frequency	1136 ~ 1206	MHz	Vt=0.3 ~ 2.4[V]
Output Level	-6	dBm	Ta=25±5°C Vcc=2.5±0.05[V]
Tuning Voltage Sensitivity	46±7	MHz/V	[f(2.4)-f(0.3)] / 2.1
C/N (Phase Noise)	98	dBc/Hz	off set 25kHz 1Hz B.W.
PSU Stability	±1000	kHz	Vcc=2.6V ±0.1V
Temperature Stability	±3	MHz	-10 ~ 60°C ref 25°C
Pulling Stability	±1.5	MHz	VSWR=2 All Phase
Spurious Level	-10	dBc	Reference is fundamental
Operating Temp Range	-10 ~ 60	°C	—

\*Covering frequency range is between 700MHz ~ 1600MHz

### DIMENSIONS and PAD CONNECTION



### RECOMMENDED LAND PATTERN



# Voltage Control Oscillator

## RK Series - Surface Mount

$f_o$ : 1.3 to 2.0 GHz

### FEATURES

- 1) Ultraminiature size based on low temperature co-firable laminated substrate technology
- 2) Printed conductive line on inner layer contributes to ultra high density mounting
- 3) Reflow soldering available
- 4) 2000 pieces per reel
- 5) Sold in increments of 2000 pieces

### HOW TO ORDER

## RK - 405 R 1668 A1 W

- ① ② ③ ④ ⑤ ⑥
- ① Series: RK=1300~2000MHz
  - ② Dimensions
  - ③ Applications: R=RX
  - ④ Frequency: 1668=1668Mhz
  - ⑤ Individual specification
  - ⑥ Packaging: W=Tape and reel

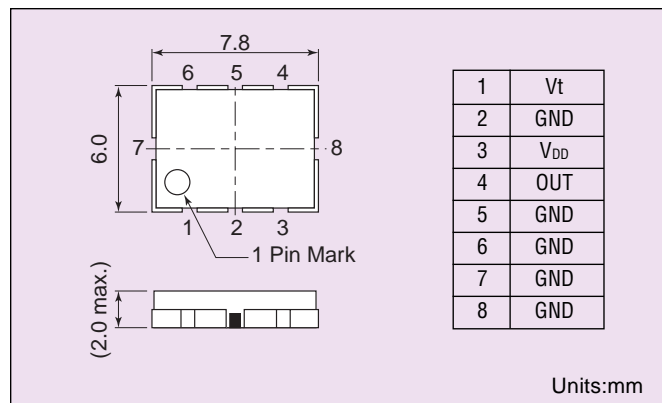


### ELECTRICAL CHARACTERISTICS

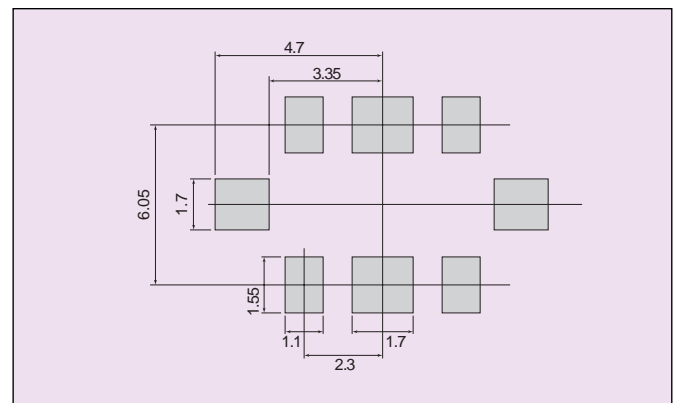
Type		Frequency (MHz)	Part No.	Specifications (Ta=25°C)						
System	Module			Vcc (V)	Icc (mA)	Po (dBm)	f <sub>tu</sub> (MHz/V)	C/N		Top (°C)
								Min	Typ	
PHS	RX	1647 ~ 1669	RK-405R1658	3.0 ±0.15	6.5 max.	-1±3	24±5 V <sub>t</sub> =0.5 ~ 2.5V	123 min (600kHz off)	128	-20°C ~ +60°C
PHS	RX	1651 ~ 1685	RK-405R1668	3.0 ±0.15	6.5 max.	-1±3	31±6 V <sub>t</sub> =0.5 ~ 2.5V	123 min. (600kHz off)	127	-20°C ~ +60°C

Vcc: Power supply, Icc: current consumption, Po: Output level, f<sub>tu</sub>: tuning voltage sensitivity, Top: Operation temperature

### DIMENSIONS and PAD CONNECTION



### RECOMMENDED LAND PATTERN

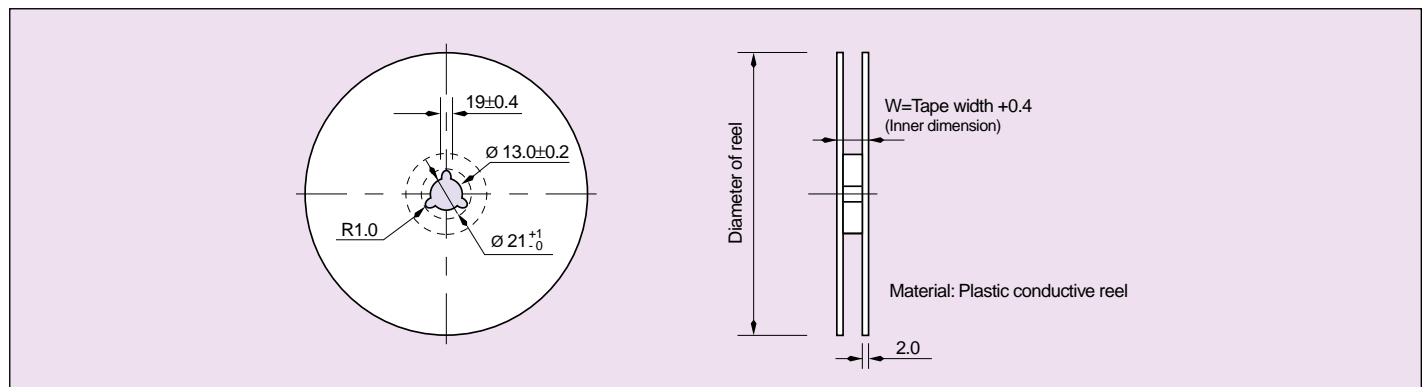


# Voltage Control Oscillator

## TAPE DIMENSIONS

Part No.	Specifications		
	Tape width, guide pitch	Diameter of Reel	Unit
VK-120		Ø 330	2000pcs
EK-304		Ø 330	2000pcs
YK-501		Ø 330	2000pcs
RK-405		Ø 330	2000pcs

## REEL DIMENSIONS



# KXO-01 Series Crystal Clock Oscillators

TTL Drive - TTL Compatible

$f_o$ : 8.0 to 50 MHz

## FEATURES

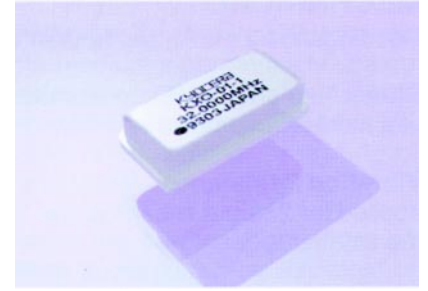
- 1) Lower Cost
- 2) 14 pin DIP compatible
- 3) Wide frequency range (8MHz - 50MHz)
- 4) All metal package minimizes RF radiation
- 5) Meets FCC EMI specifications
- 6) Solder coated pins
- 7) 25 pieces per tube
- 8) Sold in increments of 100 pieces

## HOW TO ORDER

**KXO-01 - 1 - 32.0000M T**

①                      ②                      ③                      ④

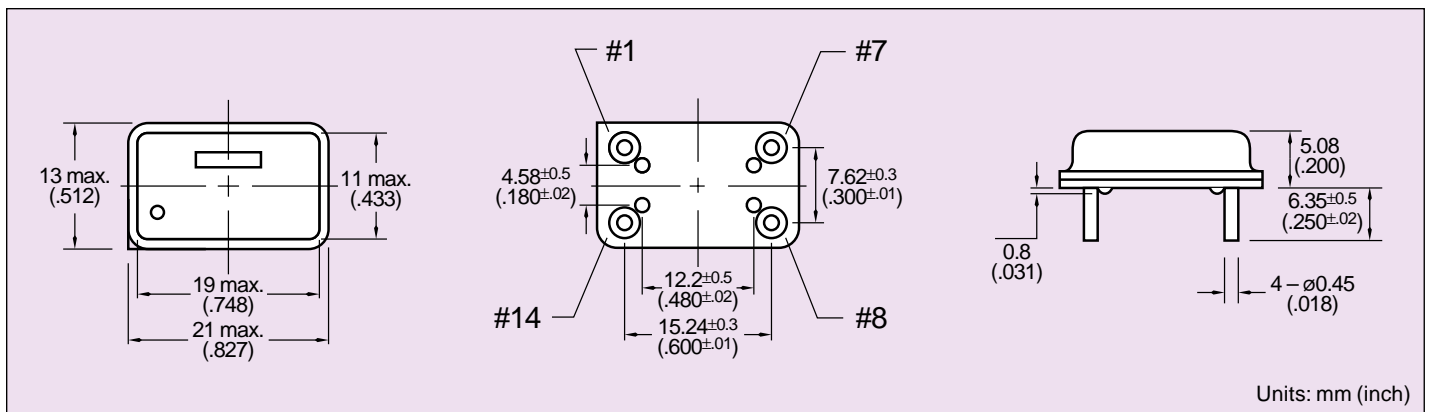
- ① Type: (Kyocera Crystal Oscillators)
- ② Frequency precision:  
0 =  $\pm 50$ ppm (special)  
1 =  $\pm 100$ ppm
- ③ Frequency
- ④ Packaging: T = Tube



## SPECIFICATIONS (KXO-01)

Parameters		Code	Rating	Unit	Remarks
Output Frequency		$f_{out}$	8 to 50	MHz	
Frequency Precision		$\Delta f/f_o$	0: $\pm 50$	ppm	0 to 70°C
			1: $\pm 100$	ppm	4.5V to 5.5V
Aging Rate		$\Delta f/f$	$\pm 5$	ppm/y	
Operating Temperature Range		$T_{opr}$	0 to $\pm 70$	°C	
Storage Temperature Range			-55 to +125	°C	
Voltage		$V_{DD}$	5 $\pm$ 0.5	VDC	
Electrical Current Consumption		$I_{DD}$	35 max	mA	
Output	Duty Ratio	$S_y$	40 to 60	%	1.4V DC level
	"0" Level	$V_{OL}$	0.4 max	V	At $I_{OL}=16$ mA
	"1" Level	$V_{OH}$	2.4 min	V	At $I_{OH}=400\mu$ A
	Rise and Fall Time	$T_R, T_F$	15 max	nsec	8 to 32MHz
10 max			nsec	32.1 to 50MHz	
Fan Out			1 to 10	TTL	

## DIMENSIONS

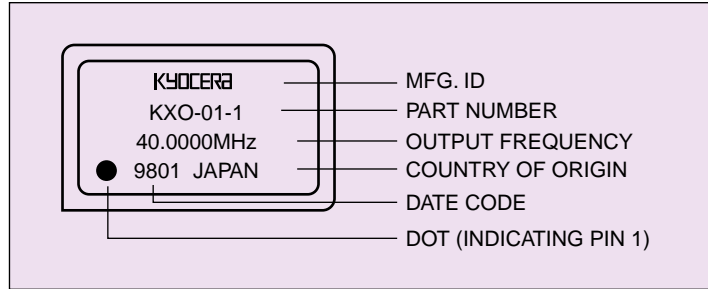


# KXO-01 Series Crystal Clock Oscillators

TTL Drive - TTL Compatible

$f_o$ : 8.0 to 50 MHz

## MARKING



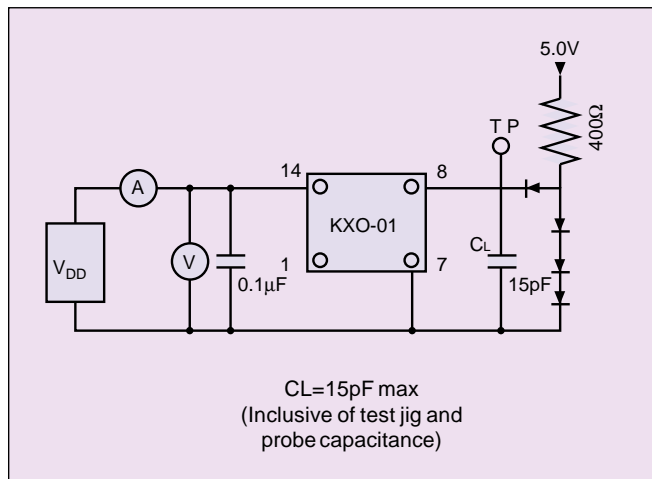
## PIN CONNECTION

PIN #	FUNCTION
1	N.C.
7	Case /GND
8	Output
14	+5.0V D.C.

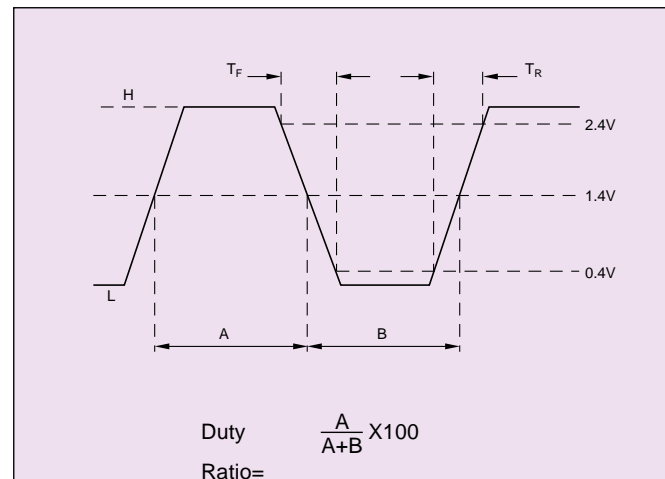
## POPULAR FREQUENCY LIST

8.0000MHz	16.0000MHz	25.0000MHz
10.0000MHz	19.6608MHz	32.0000MHz
12.0000MHz	20.0000MHz	40.0000MHz
14.31818MHz	24.0000MHz	50.0000MHz

## TEST CIRCUIT



## SHAPE OF OUTPUT WAVE



# KXO-HC/KHO-HC Series Crystal Clock Oscillators

HCMOS Drive - TTL or CMOS Compatible

$f_o$ : 1 to 72 MHz

## FEATURES

- 1) High speed CMOS clock oscillator
- 2) High power drive level
- 3) Low current consumption
- 4) Output available with TTL or CMOS compatibility
- 5) Enable/disable option
- 6) KHO-HC: 8 pin DIP
- 7) KXO-HC: 14 pin DIP
- 8) KXO: 25 pieces per tube  
KHO: 40 pieces per tube
- 9) KXO: Sold in increments of 100 pieces  
KHO: Sold in increments of 120 pieces

## HOW TO ORDER

**KXO-HC 1 - T S E - 32.0000M T**

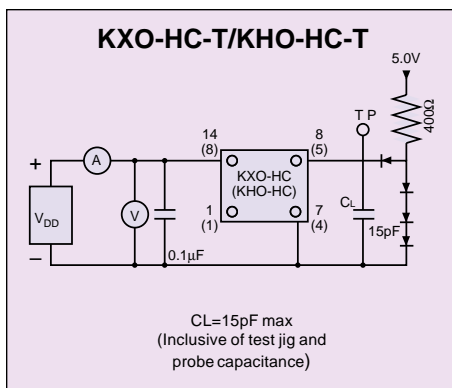
- ① ② ③ ④ ⑤ ⑥
- ① Type: KXO = 14 pin DIP; KHO = 8 pin DIP
  - ② Frequency precision:  
S =  $\pm 25$ ppm, 0 =  $\pm 50$ ppm, 1 =  $\pm 100$ ppm
  - ③ Output level/Duty cycle:  
TS = TTL compatible/45 to 55%  
CS = CMOS compatible/45 to 55%
  - ④ Enable/Disable function:  
 = without function, E = with function
  - ⑤ Frequency
  - ⑥ Packaging: T = Tube



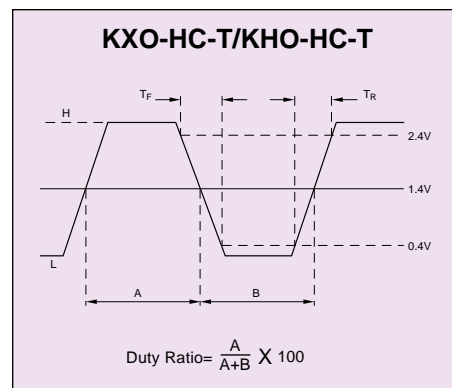
## SPECIFICATIONS: TTL COMPATIBLE (KXO-HC-T/KHO-HC-T)

Parameters		Code	Rating		Unit	Remarks
Output Frequency		$f_{OUT}$	1 to 50	>50	MHz	
Frequency Precision		$f/f_o$	S: $\pm 25$ 0: $\pm 50$ 1: $\pm 100$	S: $\pm 25$ 0: $\pm 50$ 1: $\pm 100$	ppm ppm ppm	0 to 70°C 4.5V to 5.5V
Operating Temperature Range		$T_{OPR}$	0 to +70	0 to +70	°C	
Storage Temperature		$T_{STR}$	-55~+125	-55~+125	°C	
Voltage		$V_{DD}$	5 $\pm$ 0.5	5 $\pm$ 0.25	V	
Electrical Current Consumption		$I_{DD}$	50 max	70 max	mA	$f=50$ MHz, $C_L=15$ pF (10TTL load)
Output	Duty Cycle	$S_Y$	45 to 55	45 to 55	%	1.4V DC level
	"0" Level	$V_{OL}$	0.4 max	0.4 max	V	At $I_{OL}=16$ mA
	"1" Level	$V_{OH}$	2.4 min	2.4 min	V	At $I_{OH}=-1$ mA
	Rise and Fall Time	$T_R, T_F$	5.0 max	3.5 max	nsec	0.4V to 2.4V, $C_L=15$ pF (10TTL load)
Fan Out			TTL 10 gates	TTL 10 gates		CMOS level OK
Time to Enable/Disable			100 max	100 max	nsec	Tristate output
Input Current		$I_{IH}$ $I_{IL}$	10 max -150 max	10 max -150 max	$\mu$ A $\mu$ A	
Input Voltage		$V_{IH}$ $V_{IL}$	2.2 min 0.8 max	2.2 min 0.8 max	V V	
Aging		$f/f$	$\pm 5$	$\pm 5$	ppm/yr	

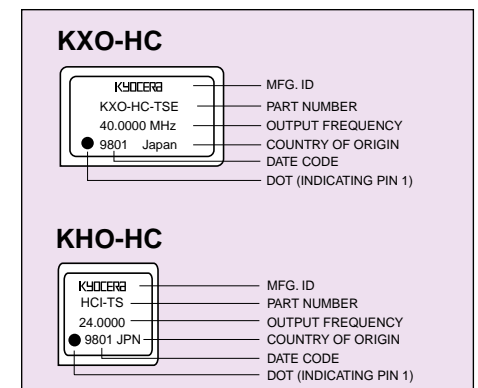
## TEST CIRCUIT



## SHAPE OF OUTPUT WAVE



## MARKINGS



# KXO-HC/KHO-HC Series Crystal Clock Oscillators

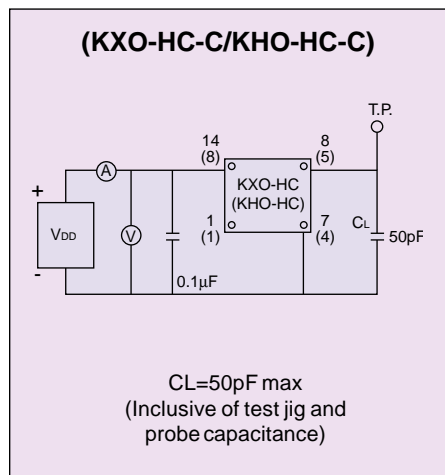
HCMOS Drive - TTL or CMOS Compatible

$f_o$ : 1 to 72 MHz

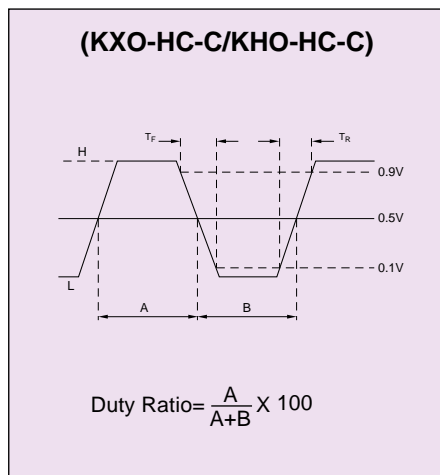
## SPECIFICATIONS: CMOS COMPATIBLE (KXO-HC-C/KHO-HC-C)

Parameters		Code	Rating		Unit	Remarks
Output Frequency		$f_{OUT}$	1 to 50	>50	MHz	
Frequency Precision		$f/f_o$	S:±25 0:±50 1:±100	S:±25 0:±50 1:±100	ppm ppm ppm	0 to 70°C 4.5V to 5.5V
Operating Temperature Range		$T_{OPR}$	0 to +70	0 to +70	°C	
Storage Temperature Range		$T_{str}$	-55~+125	-55~+125	°C	
Voltage		$V_{DD}$	5±0.5	5±0.25	V	
Electrical Current Consumption		$I_{DD}$	50 max	80 max	mA	$f > 50\text{MHz}$ , $C_L = 15\text{pF}$ $f < 50\text{MHz}$ , $C_L = 50\text{pF}$
Output	Duty Cycle	$S_Y$	45 to 55	45 to 55	%	1/2 $V_{DD}$ level
	"0" Level	$V_{OL}$	0.1 $V_{DD}$ max	0.1 $V_{DD}$ max	V	At $I_{OL} = 16\text{mA}$
	"1" Level	$V_{OH}$	0.9 $V_{DD}$ min	0.9 $V_{DD}$ min	V	At $I_{OH} = -1\text{mA}$
	Rise and Fall Time	$T_R, T_F$	10 max	6 max	nsec	10% $V_{DD}$ to 90% $V_{DD}$ $C_L = 50\text{pF}$
Time to Enable Disable			100 max	100 max	nsec	Tristate Output
Input Current		$I_{IH}$	10 max	10 max	μA	
		$I_{IL}$	-150 max	-150 max	μA	
Input Voltage		$V_{IH}$	2.2 min	2.2 min	V	
		$V_{IL}$	0.8 max	0.8 max	V	
Aging		$f/f$	±5	±5	ppm/yr	

### TEST CIRCUIT



### SHAPE OF OUTPUT WAVE



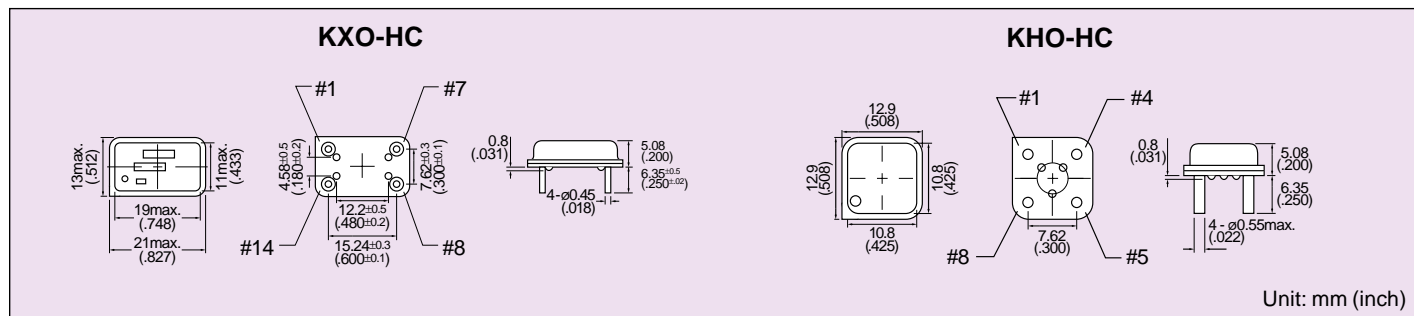
### PIN CONNECTION

KXO	KHO	
1	1	N.C. or Control
7	4	Case /GND
8	5	Output
14	8	+5.0V D.C.

### ENABLE/DISABLE FUNCTION CHART

Pin 1	Pin 8
High or Open	Oscillation
Low	High Impedance

### DIMENSIONS



# 386 Series Clock Oscillators

HCMOS Drive - CMOS Compatible

$f_o$ : 24, 32, 40, 50 MHz

## FEATURES

- 1) Capable of driving the 80386 and surrounding LSI directly up to 150pF load
- 2) Replaces existing clock generator and/or buffer
- 3) 45/55 symmetry for all standard frequencies even at 150pF load
- 4) Enable/disable function as standard
- 5) 25 pieces per tube
- 6) Sold in increments of 100 pieces

## HOW TO ORDER

**386-HC 1 - C S E - 40.0000M T**

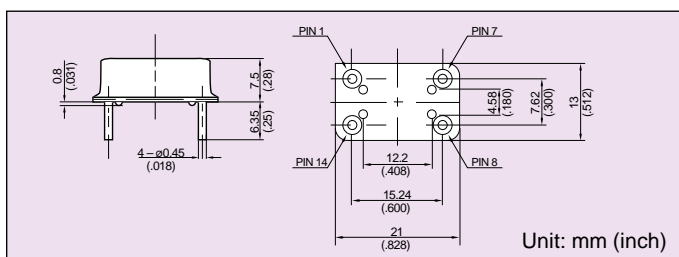
- ① Type: 386 = 14 pin DIP  
 ② Frequency precision: 1 =  $\pm 100$ ppm  
 ③ Output level/Duty cycle  
 CS = CMOS compatible/45 to 55%  
 ④ Enable/disable function:  
 □ = without function, E = with function  
 ⑤ Frequency  
 ⑥ Packaging: T = Tube



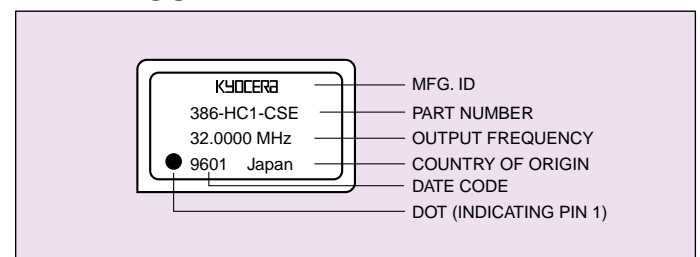
## SPECIFICATIONS (386-HC)

Parameters		Code	Rating	Unit	Remarks
Output Frequency		$f_{OUT}$	24, 32, 40 50	MHz MHz	CL=150pFmax CL=80pFmax
Frequency Precision (Inclusive of Temp. Voltage variation)		$\Delta f/f$	1: $\pm 100$	ppm	Ta=0~70°C
Aging Rate		$\Delta f/f$	$\pm 5$	ppm/yr	
Operating Temperature		T <sub>OPR</sub>	0~+70	°C	
Storage Temperature Range		T <sub>STR</sub>	-55~+125	°C	
Supply Voltage		V <sub>DD</sub>	5 $\pm$ 0.25	V	
Supply Current		I <sub>CC</sub>	65 max	mA	Cl=150pF, Ta=25°C
Output	Duty Ratio	Sy	45~55	%	1/2 V <sub>DD</sub> level
	"0" Level	V <sub>OL</sub>	0.1V <sub>DD</sub> max	V	I <sub>OL</sub> =12mA
	"1" Level	V <sub>OH</sub>	0.9V <sub>DD</sub> min	V	I <sub>OL</sub> =-1mA
	Rise and Fall Time	T <sub>R</sub> , T <sub>F</sub>	See Clock Time Table	nsec	
Enable/Disable Time			100 max 100 max	nsec nsec	Type E Tristate Output
Input	Current	I <sub>IH</sub>	10 max	$\mu$ A	V <sub>DD</sub> = 5.25V
		I <sub>IL</sub>	-150 max	$\mu$ A	V <sub>DD</sub> =5.25V
	Voltage	V <sub>IH</sub>	2.2 min	V	
		V <sub>IL</sub>	0.8 max	V	
Fan Out			7	TTL	
Load Capacitance		C <sub>L</sub>	150 80	pF pF	f=12.0MHz~40MHz f=40.1MHz~50MHz

## DIMENSIONS



## MARKINGS



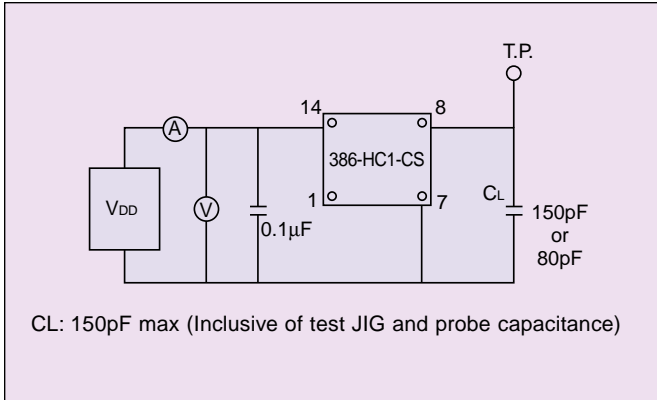


# 386 Series Clock Oscillators

HCMOS Drive - CMOS Compatible

$f_o$ : 24, 32, 40, 50 MHz

## TEST CIRCUIT



## PIN CONNECTION

386	Function
1	N.C. or Control
7	Case GND
8	Output
14	V <sub>DD</sub>

## CLOCK TIME TABLE (32MHz, 40MHz)

Frequency	32MHz		40MHz	
	Min	Max	Min	Max
Clock time (ns)				
Clock high time t <sub>2a</sub>	9	-	8	-
Clock high time t <sub>2b</sub>	5	-	5	-
Clock low time t <sub>3a</sub>	9	-	8	-
Clock low time t <sub>3b</sub>	7	-	6	-
Clock tall time t <sub>4</sub>	-	7.5	-	8
Clock tall time t <sub>5</sub>	-	7.5	-	8

## CLOCK TIME TABLE (50MHz)

Frequency	50MHz	
Clock time(ns)	Min	Max
Clock high time t <sub>2a</sub>	7	-
Clock high time t <sub>2b</sub>	4	-
Clock low time t <sub>3a</sub>	7	-
Clock low time t <sub>3b</sub>	5	-
Clock tall time t <sub>4</sub>	-	7
Clock tall time t <sub>5</sub>	-	7

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FAX: 317-844-9314

### AVX Northeast, MA

Tel: 508-485-8114  
FAX: 508-485-8471

### AVX Mid-Pacific, CA

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FAX: 408-437-1500

### AVX Southwest, AZ

Tel: 602-834-7919  
FAX: 602-834-8078

### AVX South Central, TX

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FAX: 972-669-2090

### AVX Southeast, NC

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FAX: (86) 21-6249-0313

### AVX, Malaysia

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FAX: (60) 4-228-1196

### Elco, Japan

Tel: 045-943-2906  
FAX: 045-943-2910

### Kyocera, Japan

Tel: (81) 75-593-4518  
FAX: (81) 75-502-2705

### Contact:



<http://www.avxcorp.com>