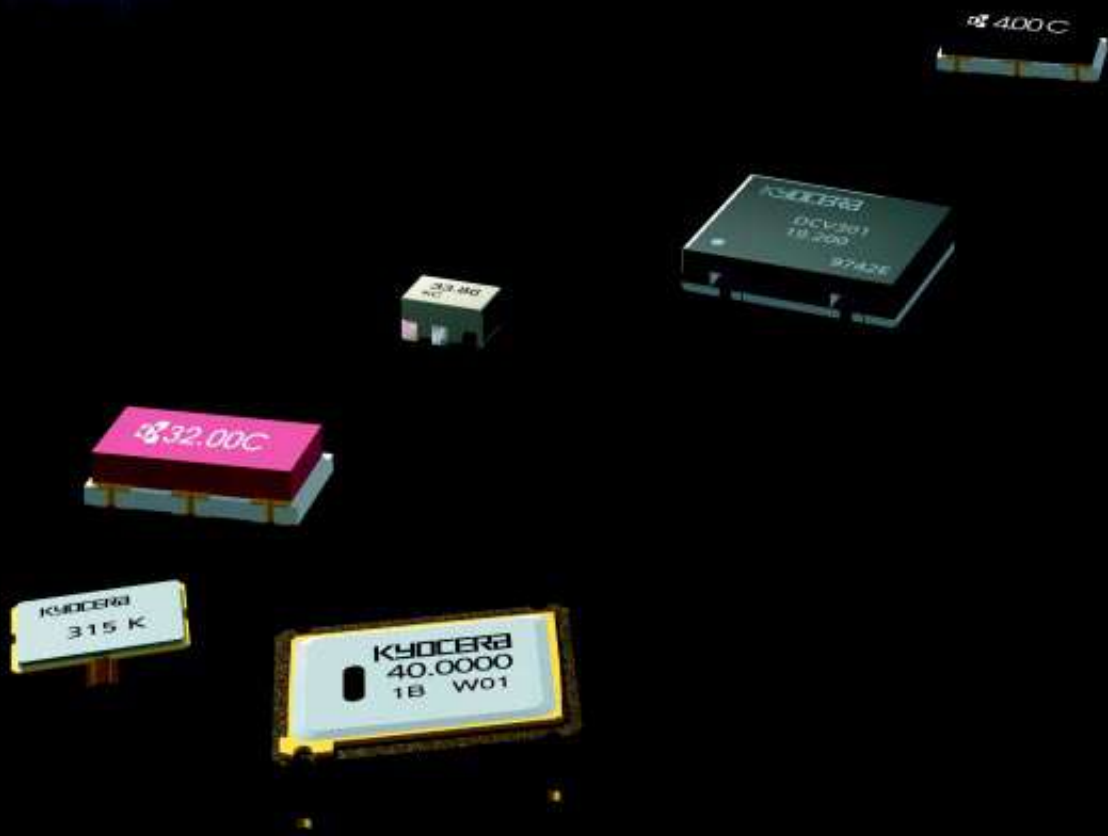


AVIX



**KYOCERA
Timing Devices**

Resonators

Crystals

Oscillators

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Timing Device Product Offering

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 CT1+					●				
	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
KBR-Y	380 to 1050 kHz	SMT	Gull Wing Surface Mount
KBR-B	190 to 680 kHz	Std Q_m	Standard, Single-in-line, Formed Leads
KBR-BK	380 to 655 kHz	Std Q_m	Standard, Single-in-line
KBR-F	795 to 1050 kHz	High Q_m	Standard, Single-in-line
Specials	Per application	—	—

MHz BAND CERAMIC RESONATORS

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

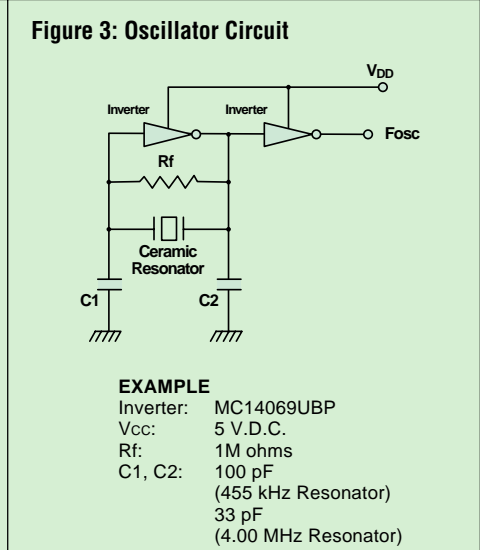
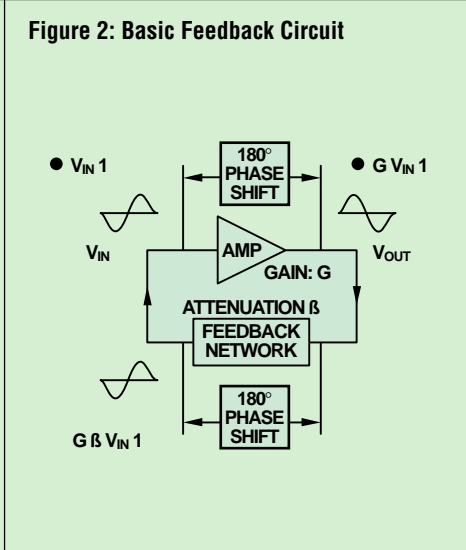
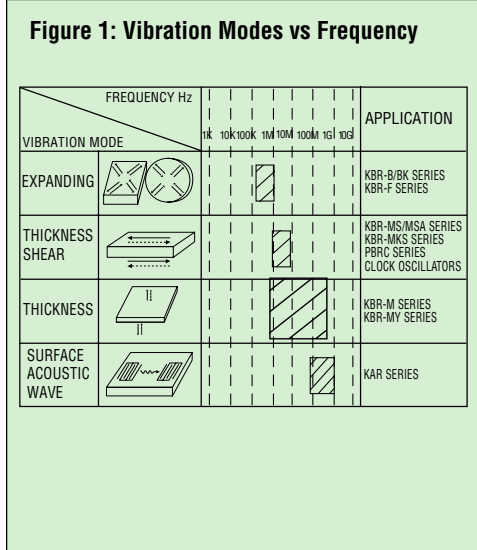
Their oscillation is dependent upon mechanical resonance associated with their piezoelectric crystalline structure. These materials (usually barium titanate or lead-zirconium titanate, PZT) have large dipole movement which causes the distortion or growth of the crystal by an applied

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 β , 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		Table II Timing Devices											
		(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													
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 Ω 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

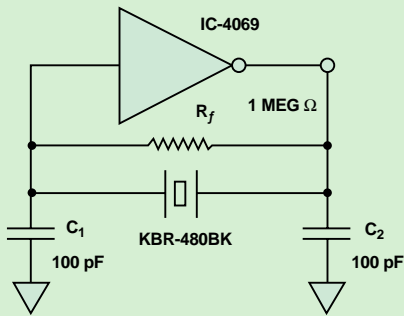


Figure 2:
Low Power Schottky

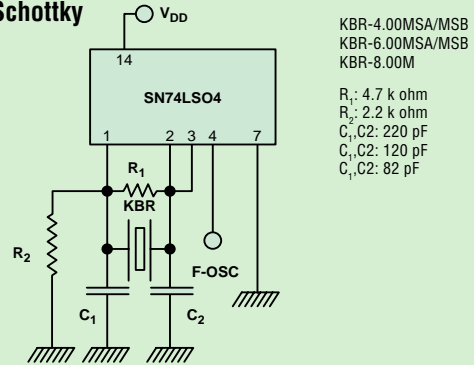


Figure 3:
4 Bit Microprocessor Clock

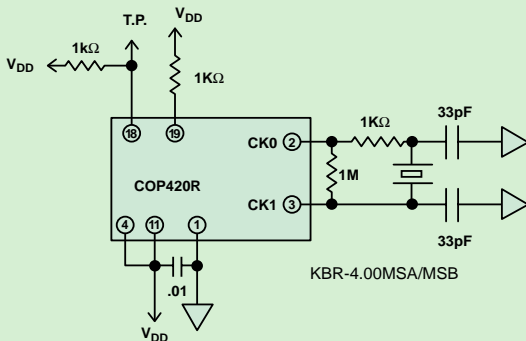


Figure 4:
Test Circuit Spurious Response

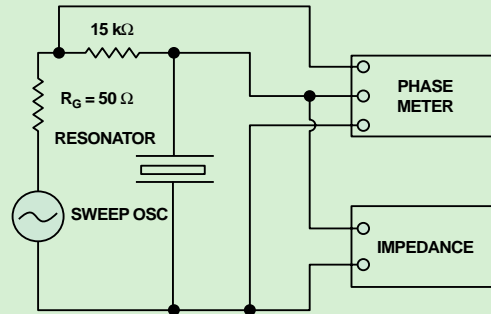
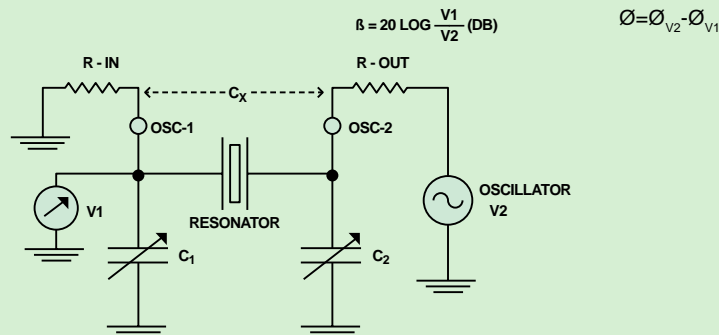


Figure 5:
Simulation Circuit



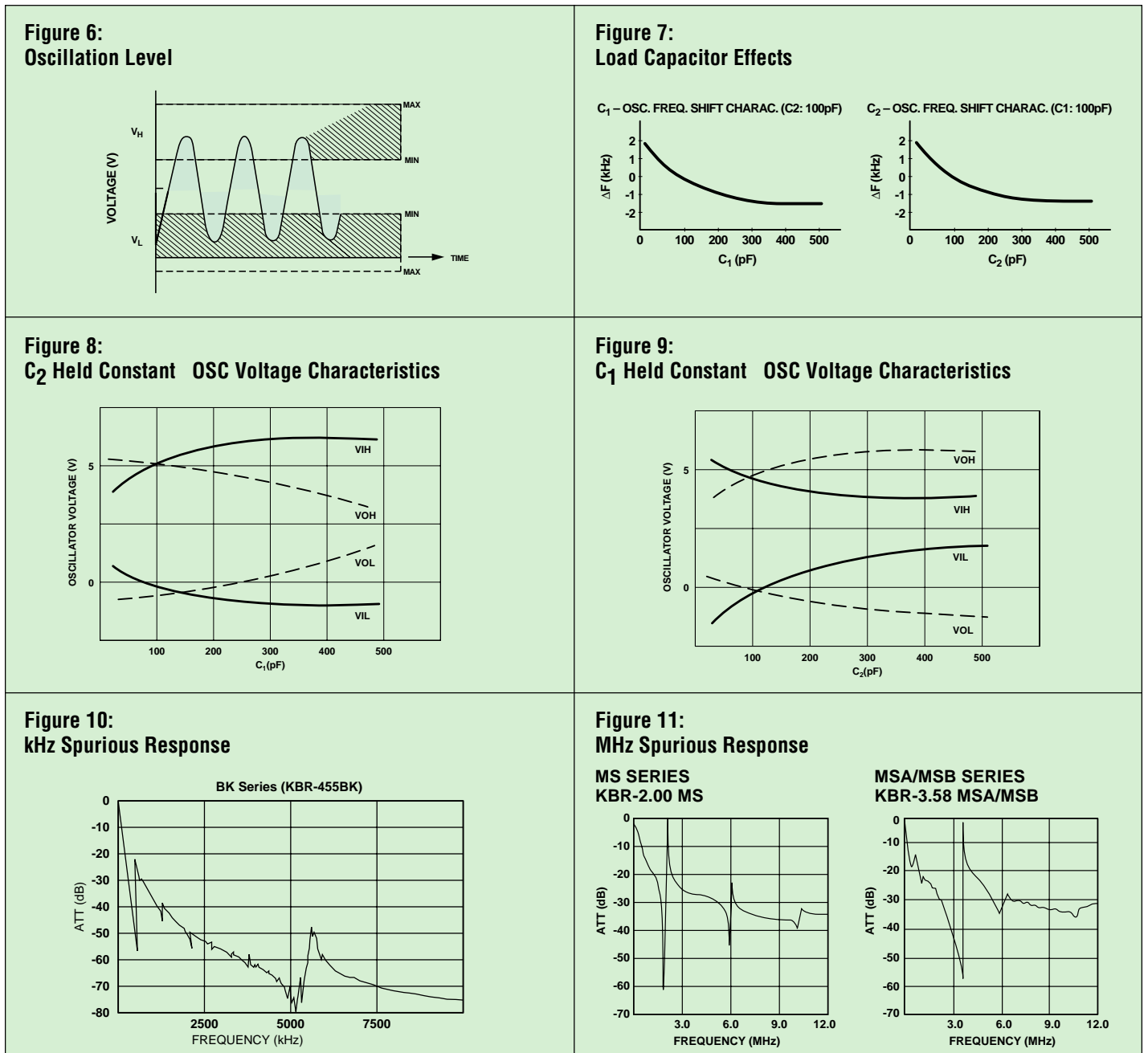
APPLICATION AND TEST CIRCUITS continued

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 -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

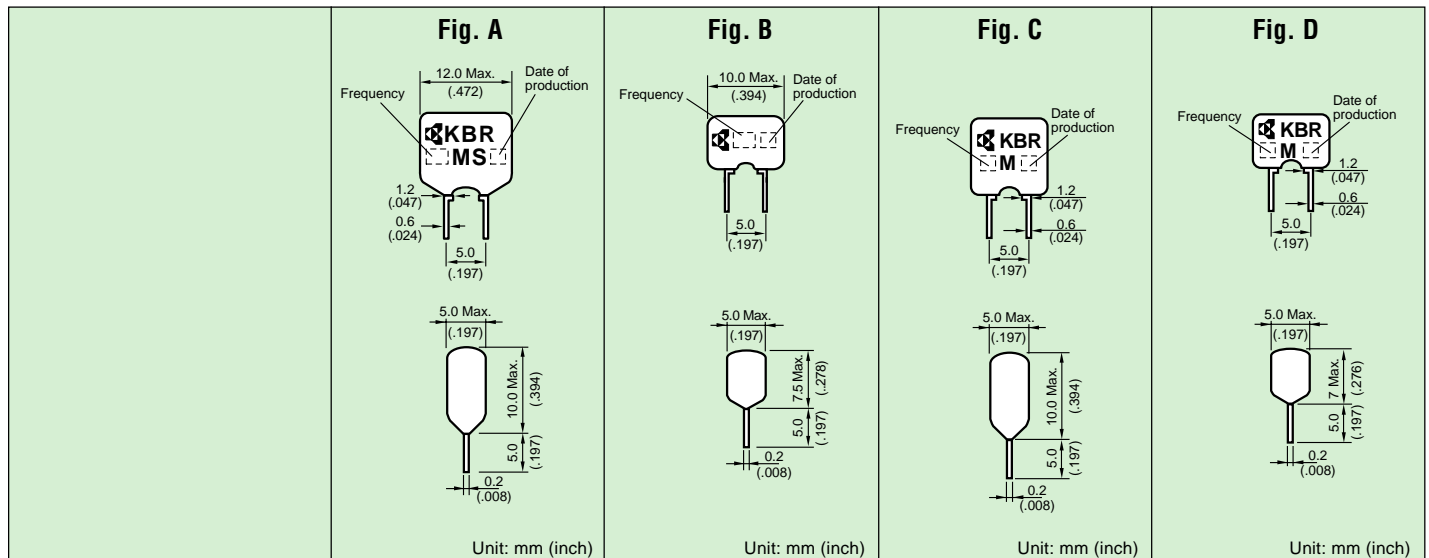
- ① ② ③ ④
- ① Type: (Kyocera Bulk Resonator)
 - ② Oscillation frequency (MHz)
 - ③ Resonator type:
 MS = 2.00 to 3.57 MHz
 MSA = 3.58 to 8.00 MHz (Water resistant)
 MSB = 3.58 to 6.00 MHz ("No-Clean" Process only)
 M = 6.01 to 13.00 MHz
 - ④ Packaging:
 TR = Tape and reel
 □ = Bulk



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)	$\pm 0.3\%$	$\pm 0.3\%$	$\pm 0.5\%$	$\pm 0.5\%$

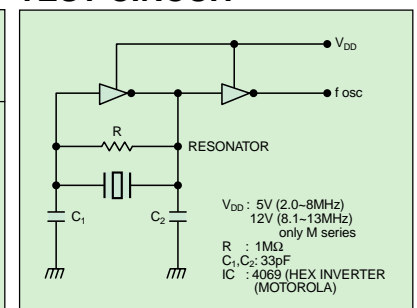
DIMENSIONS



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

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%			

TEST CIRCUIT



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

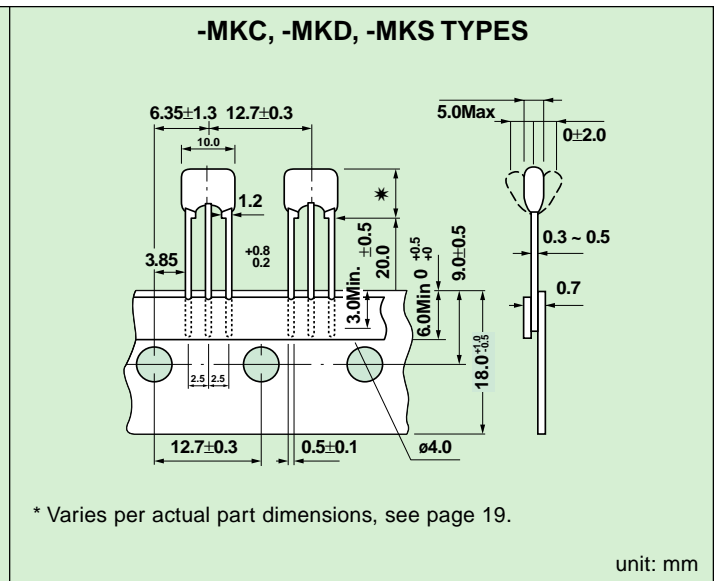
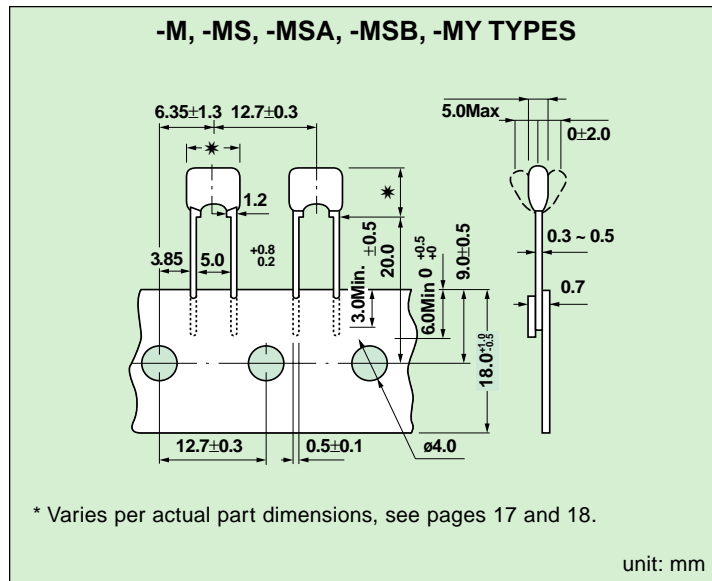
HOW TO ORDER

KBR - [] [] TR

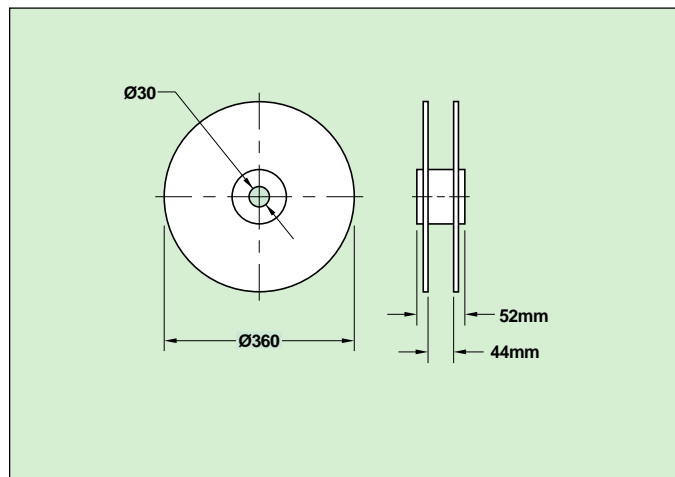
- ① ② ③ ④

- 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

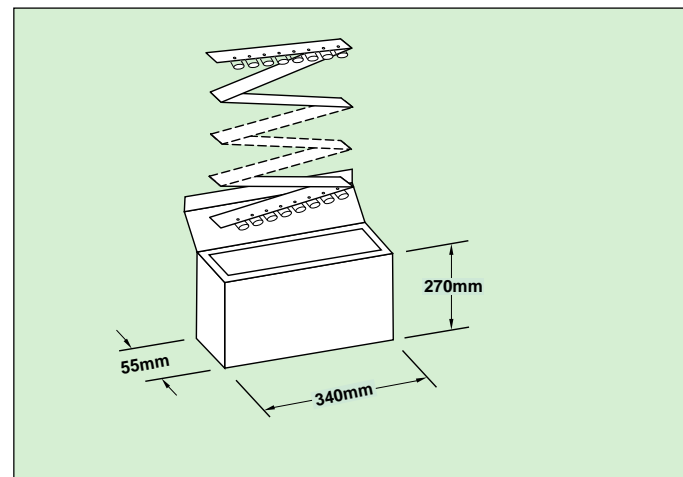
TAPE DIMENSIONS



REEL DIMENSIONS



AMMO PACK DIMENSIONS



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