



中电熊猫晶体科技有限公司

CHINA ELECTRONICS PANDA CRYSTAL TECHNOLOGY CORPORATION

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Crystal

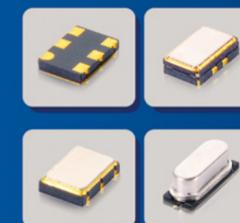
Oscillator

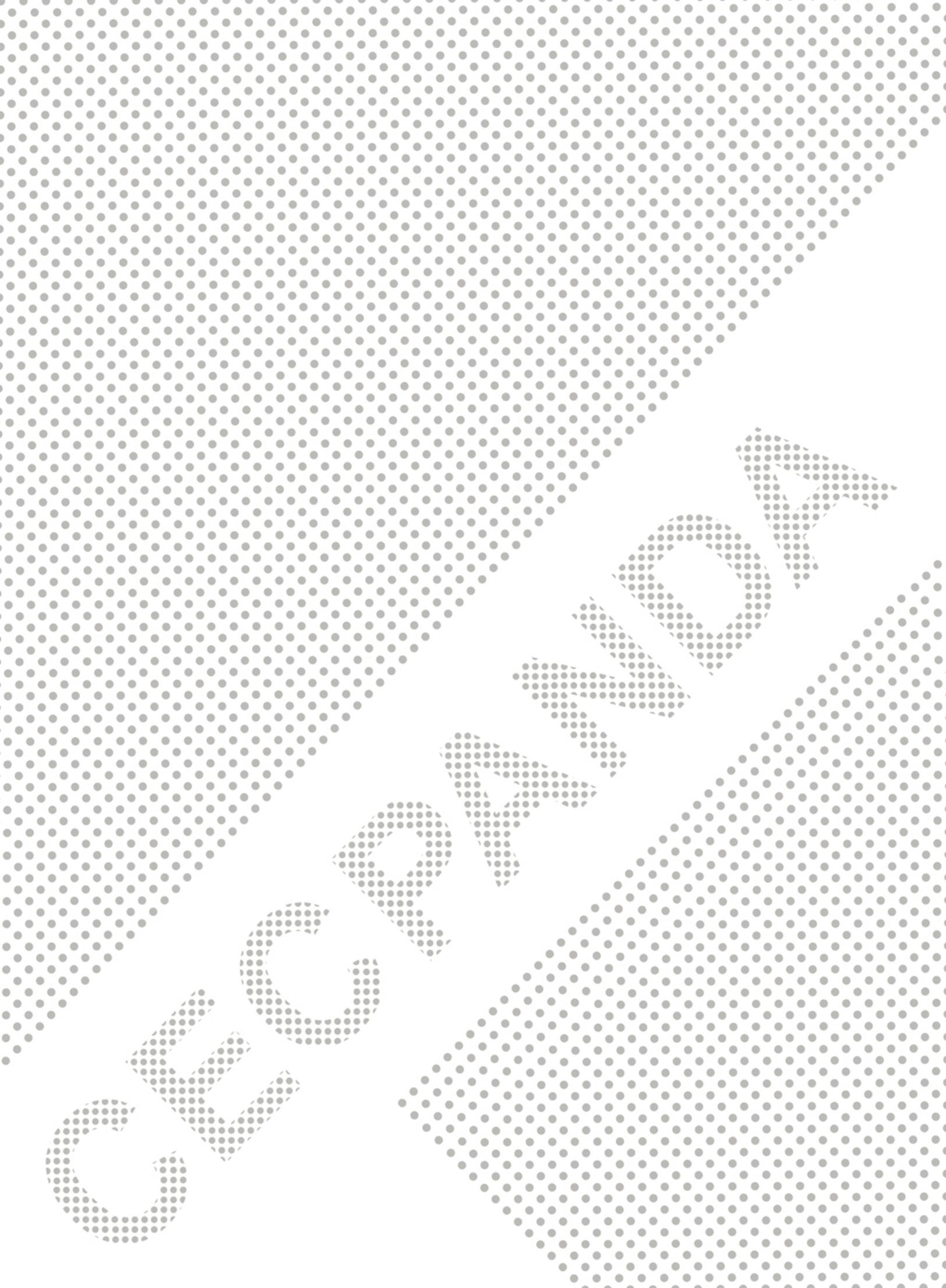
Filter

Vcxo

Tcxo

Ocxo





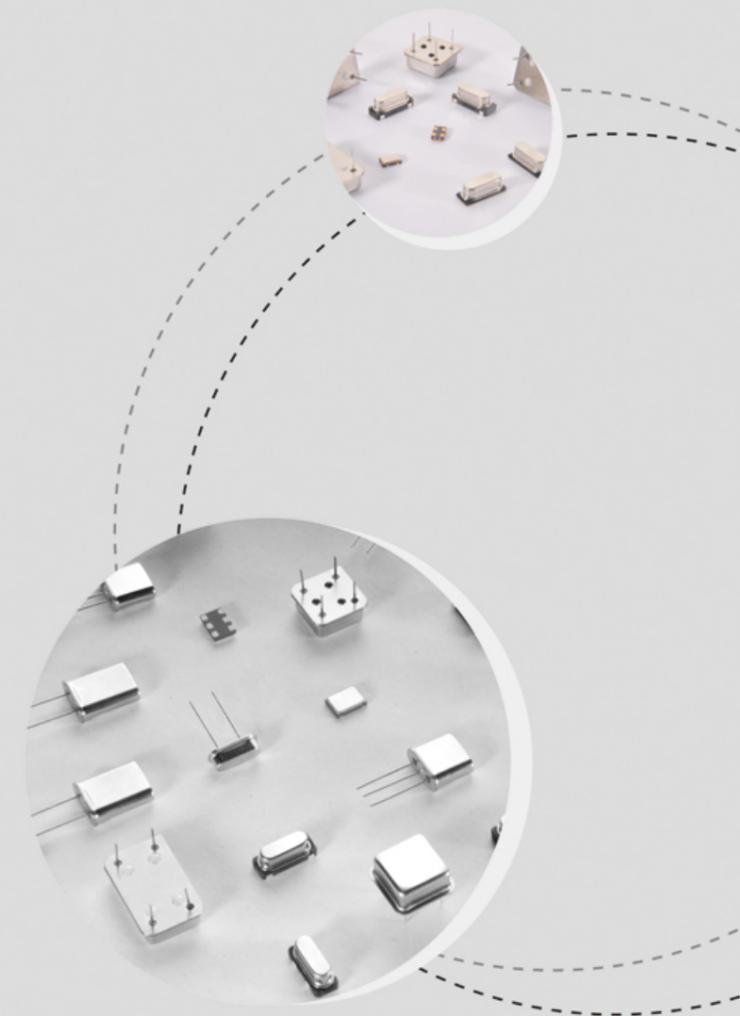
COMPANY PROFILE 公司简介

中电熊猫晶体科技有限公司是中电熊猫信息产业集团旗下晶体元器件制造的核心和重点发展的企业。由南京中电熊猫晶体科技有限公司、河北廊坊中电熊猫晶体科技有限公司和深圳中电熊猫晶体科技有限公司组成。根据中电熊猫信息产业集团对晶体科技产业整体的规划，目前已经完成了晶体元器件产业珠三角、长三角、京津塘的战略布局。

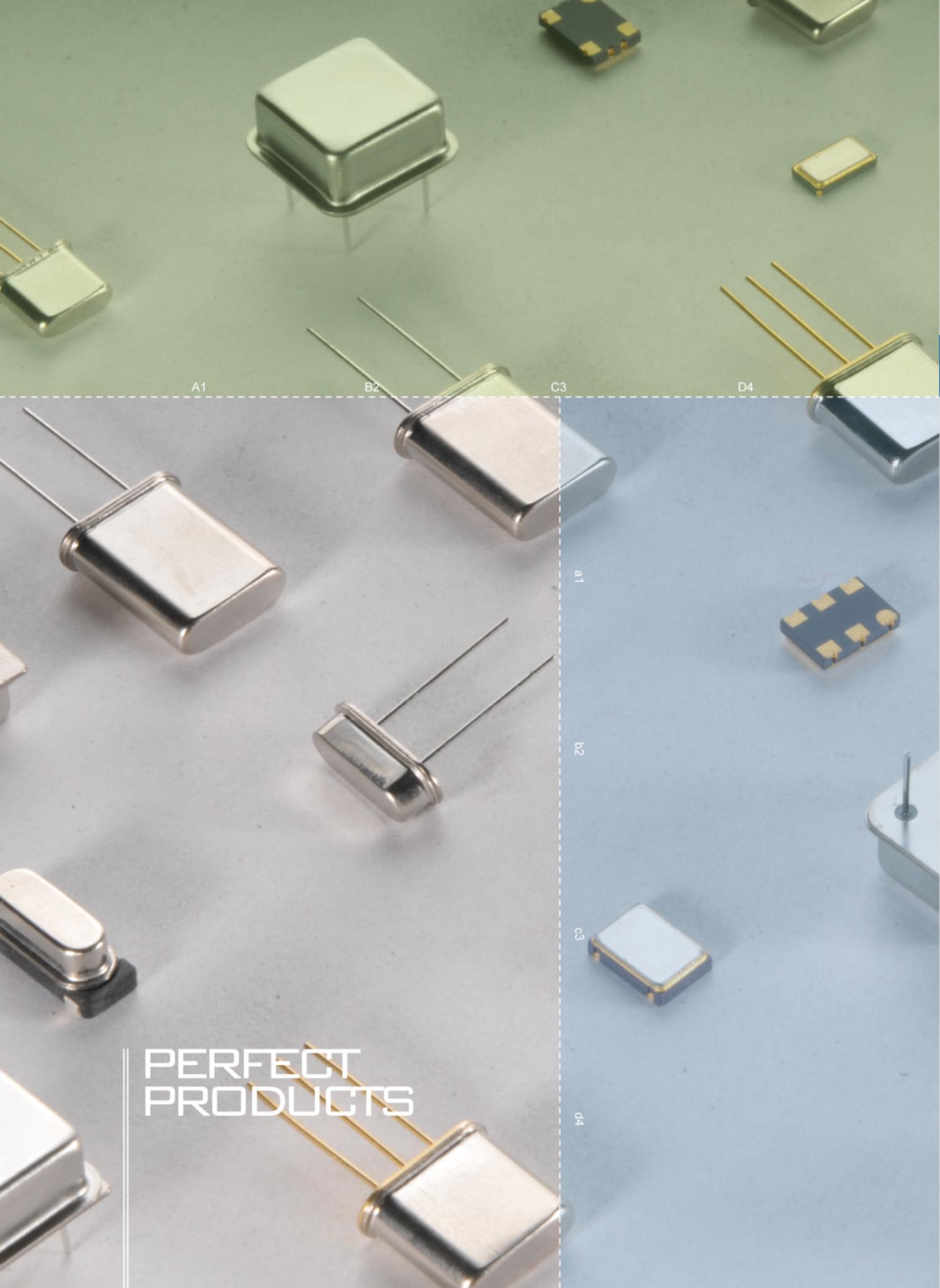
中电熊猫晶体科技有限公司，有数十年丰富的石英晶体元器件制造经验，技术研发、生产规模、产品质量等均为全国“领先”。在创自主品牌战略指导下，主要依靠自主研发实现关键技术的突破。先进的生产线设计与配置，可以规模化生产谐振器、振荡器、滤波器等系列石英晶体元器件产品。与全球众多的知名企业结为紧密的战略合作伙伴，成为国际一流晶体元器件制造商。

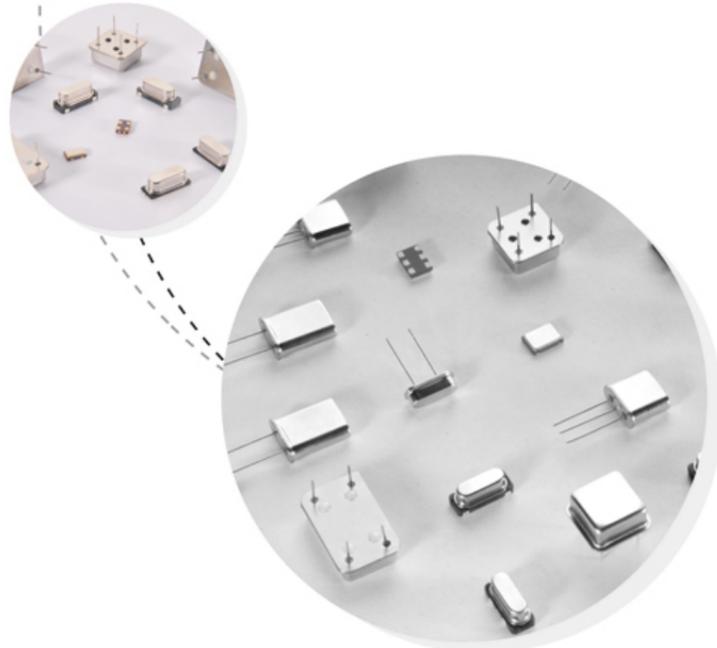
CEC Panda Crystal Technology Corporation. is a CEC Panda Information Industry Group's Crystal components manufacturer in the core and focus on the development business. Nanjing CEC Panda Crystal Technology Corporation, Hebei Langfang CEC Panda Crystal Technology Corporation. and Shenzhen CEC Panda Crystal Technology Corporation. According to CEC Panda Information Industry Group's industry planning on the crystal technology industry as a whole, and currently has completed crystal industry strategic layout, located at Pearl River Delta, Yangtze River Delta, and Jing Jin Tang.

CEC Panda Crystal Technology Corporation. owns decades a wealth of quartz crystal components manufacturing experience, whose technology research and development, production scale, product quality are the national "leader." Under the guidance of creating own brand strategy , mainly rely on independent R & D, achieving breakthroughs in key technologies. It owns advanced production line design and configuration, with large-scale production of resonators, oscillators, filters, etc. series of quartz crystal components products. Has formed a close strategic partnership with a large number of global well-known enterprises , and becomes world-class ranks of crystal components manufacturer.



PERFECT
PRODUCTS





MILESTONES
重要里程碑



Lang Fang CEC Panda Crystal Technology Corporation
廊坊中电熊猫晶体科技有限公司

Lang Fang CEC Panda Crystal Technology Corporation.
Invested by CEC, with old name Lang Fang CEC Dacheng
Electronics Co., Ltd.
廊坊中电熊猫晶体科技有限公司, 由中国电子信息产业集团
投资, 原名为廊坊中电大成电子有限公司

The company was founded on 18th, May, 2003.
2003年5月18日, 公司注册成立.

The company was integrated by Nanjing CEC Panda
Crystal Technology Corporation at the beginning of
2008.
2008年初由南京中电熊猫晶体科技有限公司整合.

Nanjing CEC Panda Crystal Technology Corporation
南京中电熊猫晶体科技有限公司

Nanjing CEC Panda Crystal Technology Co., Ltd, was
invested by Nanjing Hua Dong Group and Hong Kong
Jointly, with old name Nanjing HuaLianXing
Electronics Corporation.
南京中电熊猫晶体科技有限公司, 由南京华东电子集团与香
港合资建立, 原名为南京华联兴电子有限公司

The company was founded on 2nd, March, 1993.
1993年3月2日, 公司注册成立

The company became the first domestic manufacturer
who could produce SMD crystal.
1997年公司开始生产陶瓷表面贴装石英晶体谐振器, 为国内
首家

The company integrated Lang Fang CEC Dacheng
Electronics Co., Ltd, at the beginning of 2008.
2008年初公司整合廊坊中电大成电子有限公司

The company bought Uniden Crystal Division in
Oct. 2009, and Shenzhen CEC Panda Crystal Technology
Corporation was established.
2009年10月, 公司收购友利电晶体事业部, 成立深圳中电熊
猫晶体科技有限公司

Shenzhen CEC Panda Crystal Technology Corporation
深圳中电熊猫晶体科技有限公司

Uniden Crystal Division was established in Sept. 1971
1971年9月, 友利电晶体事业部成立

Shenzhen CEC Panda Crystal Technology Corporation
was established in Oct. 2009.
2009年10月, 成立深圳中电熊猫晶体科技有限公司

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Part Number Guide

T-M-FF.FFFM-LC-FTFS-OT-ESR-TR-S

T (Type型号): D=5x7 SMD 4pads

DB=5x7 SMD 2pads

M (Mode of Operation振荡模式): F=Fundamental T=Third Overtone, etc

F (Frequency标称频率): Normal - 5 digitals of Frequency, e.g. 8.0000M, 12.000M

Special - All digitals of Frequency, e.g. 13.225625M

LC (Load Capacitance负载电容): 20=20pf 00=series, etc

FT (Frequency Tolerance调整频差): 30=±30 ppm, etc

FS (Frequency Stability温度频差): 50=±50 ppm, etc

OT (Operating Temperature工作温度): 1060=-10°C to +60°C 4085=-40°C to +85°C, etc

ESR (Equivalent Series Resistance等效阻抗)

TR (Tape and Reel编带)

S (Special Requirement特殊要求)

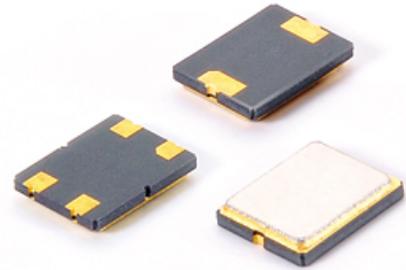
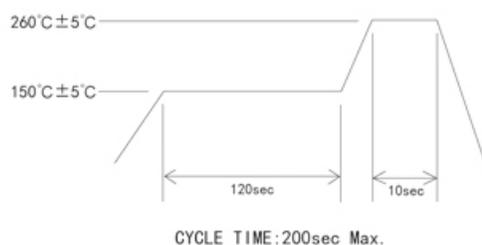
Electrical Specifications 电气参数

型号	Holder Type	5x7mm Ceramic Surface Mount
频率范围	Frequency Range	5.5000MHz to 150.00MHz
调整频差	Frequency Tolerance (ΔF) (at 25°C)	±10ppm to ±100ppm
温度频差	Frequency Stability	±10ppm to ±100ppm
工作温度范围	Operating Temperature Range	-10°C ~ +60°C to -40°C ~ +85°C
储存温度范围	Storage Temperature Range	-40°C ~ +85°C / -55°C ~ +125°C
老化	Aging (25°C)	±5ppm/year Maximum
静电容	Shunt Capacitance (C0)	7pF Maximum
激励功率	Drive Level	100μW Typical
绝缘阻抗	Insulation Resistance (Rs)	500 Megaohms Minimum at D.C100V
负载电容	Load Capacitance (CL)	Suggested by customer

Equivalent Series Resistance and Mode of Operation 等效阻抗和振荡模式

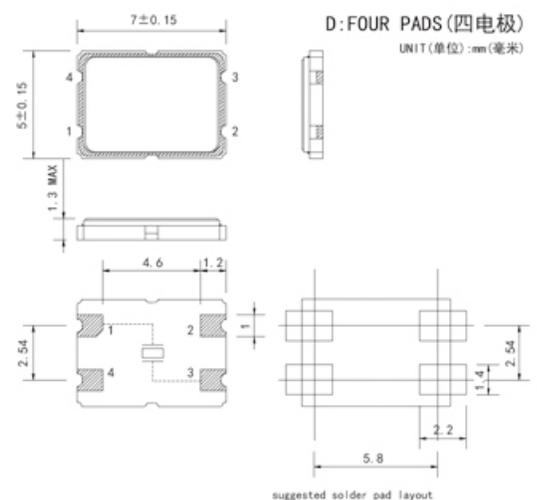
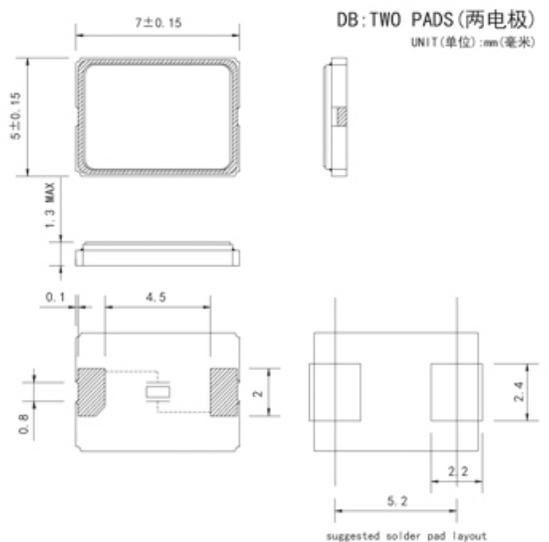
Frequency Range 频率范围	ESR (Ω) 等效阻抗	Mode 振荡模式
5.5000 - 8.0000MHz	100Max	Fundamental
8.0000 - 10.0000MHz	60Max	Fundamental
10.0000 - 14.0000MHz	50Max	Fundamental
14.0000 - 20.0000MHz	40Max	Fundamental
≥20.0000MHz	30Max	Fundamental
35.0000 - 150.00MHz	80Max	Third Overtone

Reflow Condition 回流焊条件



Pb Free **RoHS Compliant**
Directive 2002/95/EC

Mechanical Dimensions 外型尺寸



Note) #2, #4 is connected with a cover
(Please connect with a GND or a power supply)

Part Number Guide

T-M-FF.FFFM-LC-FTFS-OT-ESR-TR-S

T (Type型号): C=6x3.5 SMD 4pads

CB=6x3.5 SMD 2pads

M (Mode of Operation振荡模式): F=Fundamental T=Third Overtone, etc

F (Frequency标称频率): Normal - 5 digitals of Frequency, e.g. 8.0000M, 12.000M

Special - All digitals of Frequency, e.g. 13.225625M

LC (Load Capacitance负载电容): 20=20pf 00=series, etc

FT (Frequency Tolerance调整频差): 30=±30 ppm, etc

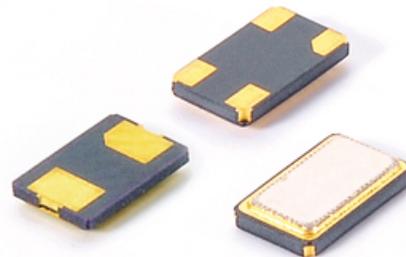
FS (Frequency Stability温度频差): 50=±50 ppm, etc

OT (Operating Temperature工作温度): 1060=-10°C to +60°C 4085=-40°C to +85°C, etc

ESR (Equivalent Series Resistance等效阻抗)

TR (Tape and Reel编带)

S (Special Requirement特殊要求)



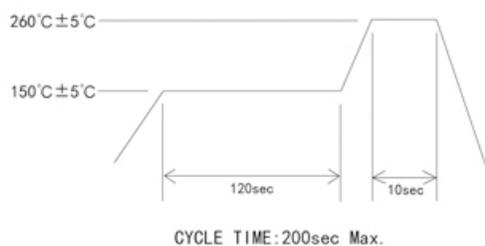
Electrical Specifications 电气参数

型号	Holder Type	6x3.5mm Ceramic Surface Mount
频率范围	Frequency Range	7,600MHz to 150,00MHz
调整频差	Frequency Tolerance (ΔF) (at 25°C)	±10ppm to ±100ppm
温度频差	Frequency Stability	±10ppm to ±100ppm
工作温度范围	Operating Temperature Range	-10°C ~ +60°C to -40°C ~ +85°C
储存温度范围	Storage Temperature Range	-40°C ~ +85°C / -55°C ~ +125°C
老化	Aging (25°C)	±5ppm/year Maximum
静电容	Shunt Capacitance (C0)	7pF Maximum
激励功率	Drive Level	100μW Typical
绝缘阻抗	Insulation Resistance (Rs)	500 Megaohms Minimum at D.C 100V
负载电容	Load Capacitance (CL)	Suggested by customer

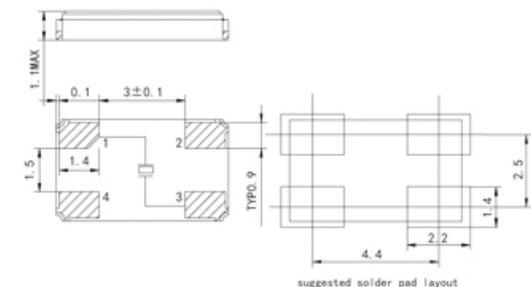
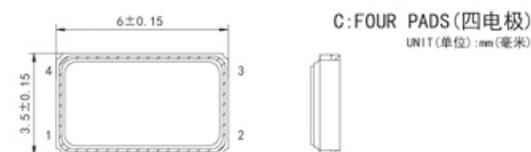
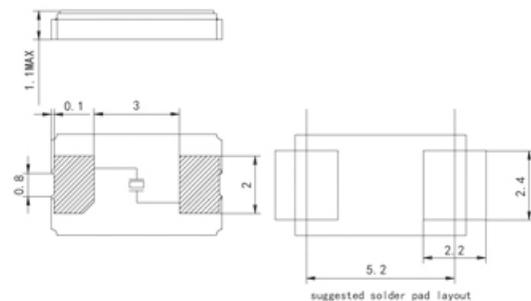
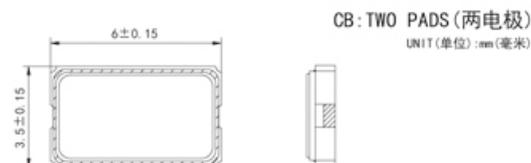
Equivalent Series Resistance and Mode of Operation 等效阻抗和振荡模式

Frequency Range 频率范围	ESR (Ω) 等效阻抗	Mode 振荡模式
7,600 - 10,000MHz	60Max	Fundamental
10,000 - 14,000MHz	50Max	Fundamental
14,000 - 20,000MHz	40Max	Fundamental
≥20,000MHz	30Max	Fundamental
40,000 - 150,00MHz	80Max	Third Overtone

Reflow Condition 回流焊条件



Mechanical Dimensions 外型尺寸



Note) #2, #4 is connected with a cover
(Please connect with a GND or a power supply)

Part Number Guide

T-M-FF.FFFM-LC-FTFS-OT-ESR-TR-S

T (Type型号): I=5x3.2 SMD 4pads

IB=5x3.2 SMD 2pads

M (Mode of Operation振荡模式): F=Fundamental T=Third Overtone, etc

F (Frequency标称频率): Normal - 5 digitals of Frequency, e.g. 8.0000M, 12.000M

Special - All digitals of Frequency, e.g. 13.225625M

LC (Load Capacitance负载电容): 20=20pf 00=series, etc

FT (Frequency Tolerance调整频差): 30=±30 ppm, etc

FS (Frequency Stability温度频差): 50=±50 ppm, etc

OT (Operating Temperature工作温度): 1060=-10°C to +60°C 4085=-40°C to +85°C, etc

ESR (Equivalent Series Resistance等效阻抗)

TR (Tape and Reel编带)

S (Special Requirement特殊要求)

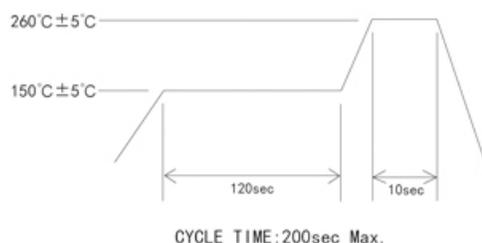
Electrical Specifications 电气参数

型号	Holder Type	5 x 3.2mm Ceramic Surface Mount
频率范围	Frequency Range	8.0000MHz to 150.00MHz
调整频差	Frequency Tolerance (ΔF) (at 25°C)	±10ppm to ±100ppm
温度频差	Frequency Stability	±10ppm to ±100ppm
工作温度范围	Operating Temperature Range	-10°C ~ +60°C to -40°C ~ +85°C
储存温度范围	Storage Temperature Range	-40°C ~ +85°C / -55°C ~ +125°C
老化	Aging (25°C)	±5ppm/year Maximum
静电容	Shunt Capacitance (C0)	7pF Maximum
激励功率	Drive Level	100µW Typical
绝缘阻抗	Insulation Resistance (Rs)	500 Megaohms Minimum at D.C 100V
负载电容	Load Capacitance (CL)	Suggested by customer

Equivalent Series Resistance and Mode of Operation 等效阻抗和振荡模式

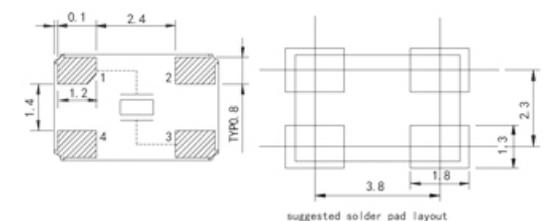
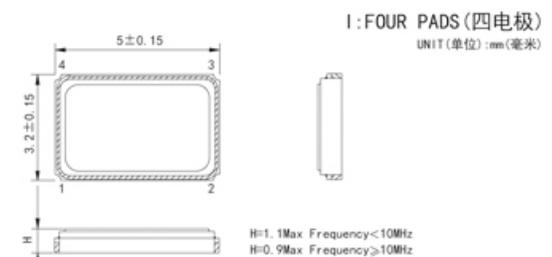
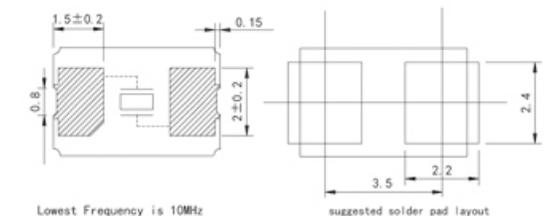
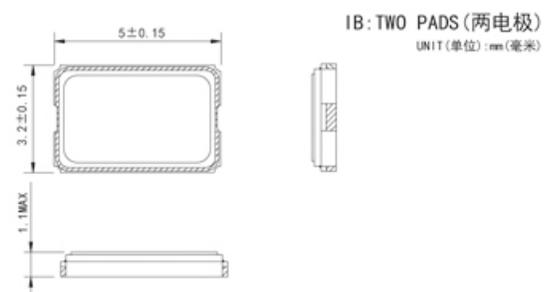
Frequency Range 频率范围	ESR (Ω) 等效阻抗	Mode 振荡模式
8.0000 - 10.000MHz	100Max	Fundamental
10.000 - 12.000MHz	80Max	Fundamental
12.000 - 16.000MHz	60Max	Fundamental
16.000 - 20.000MHz	50Max	Fundamental
20.000 - 24.000MHz	40Max	Fundamental
24.000 - 50.000MHz	30Max	Fundamental
40.000 - 150.00MHz	80Max	Third Overtone

Reflow Condition 回流焊条件



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Directive 2002/95/EC

Mechanical Dimensions 外型尺寸



Part Number Guide

T-M-FF.FFFM-LC-FTFS-OT-ESR-TR-S

T (Type型号): J=4x2.5 SMD 4pads

M (Mode of Operation振荡模式): F=Fundamental T=Third Overtone, etc

F (Frequency标称频率): Normal - 5 digitals of Frequency, e.g. 12.000M

Special - All digitals of Frequency, e.g. 13.225625M

LC (Load Capacitance负载电容): 20=20pf 00=series, etc

FT (Frequency Tolerance调整频差): 30=±30 ppm, etc

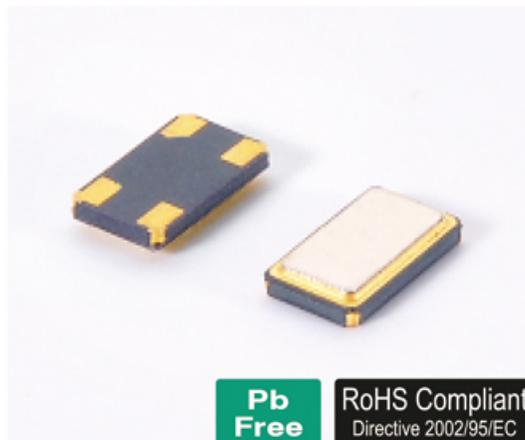
FS (Frequency Stability温度频差): 50=±50 ppm, etc

OT (Operating Temperature工作温度): 1060=-10°C to +60°C 4085=-40°C to +85°C, etc

ESR (Equivalent Series Resistance等效阻抗)

TR (Tape and Reel编带)

S (Special Requirement特殊要求)



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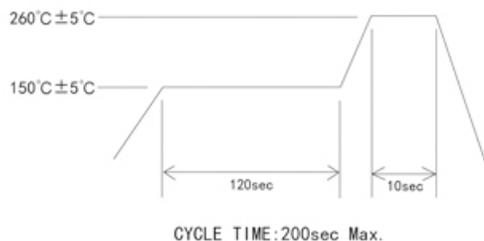
Electrical Specifications 电气参数

型号	Holder Type	4x2.5mm Ceramic Surface Mount
频率范围	Frequency Range	12.000MHz to 150.00MHz
调整频差	Frequency Tolerance (ΔF) (at 25°C)	±10ppm to ±100ppm
温度频差	Frequency Stability	±10ppm to ±100ppm
工作温度范围	Operating Temperature Range	-10°C ~ +60°C to -40°C ~ +85°C
储存温度范围	Storage Temperature Range	-40°C ~ +85°C / -55°C ~ +125°C
老化	Aging (25°C)	±5ppm/year Maximum
静电容	Shunt Capacitance (C0)	7pF Maximum
激励功率	Drive Level	10µW Typical
绝缘阻抗	Insulation Resistance (Rs)	500 Megaohms Minimum at D.C100V
负载电容	Load Capacitance (CL)	Suggested by customer

Equivalent Series Resistance and Mode of Operation 等效阻抗和振荡模式

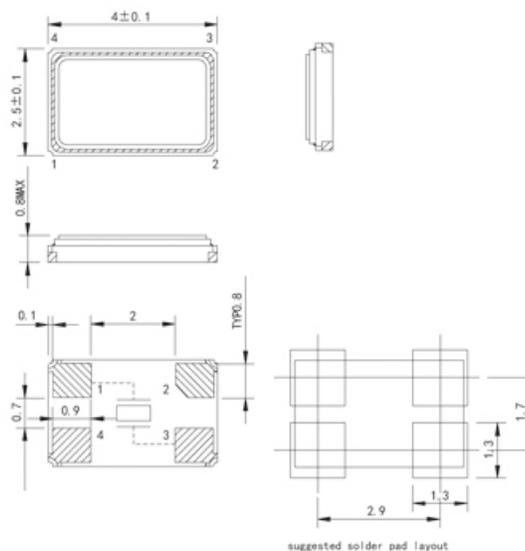
Frequency Range 频率范围	ESR (Ω) 等效阻抗	Mode 振荡模式
12.000-16.000MHz	80Max	Fundamental
16.000-20.000MHz	60Max	Fundamental
20.000-24.000MHz	50Max	Fundamental
24.000-60.000MHz	40Max	Fundamental
80.000-150.00MHz	80Max	Third Overtone

Reflow Condition 回流焊条件



Mechanical Dimensions 外型尺寸

UNIT (单位): mm (毫米)



suggested solder pad layout
Note) #2, #4 is connected with a cover (Please connect with a GND or a power supply)

Part Number Guide

T-M-FF.FFFM-LC-FTFS-OT-ESR-TR-S

T (Type型号): K=3.2x2.5 SMD 4pads

M (Mode of Operation振荡模式): F=Fundamental T=Third Overtone, etc

F (Frequency标称频率): Normal - 5 digitals of Frequency, e.g. 12.000M

Special - All digitals of Frequency, e.g. 13.225625M

LC (Load Capacitance负载电容): 20=20pf 00=series, etc

FT (Frequency Tolerance调整频差): 30=±30 ppm, etc

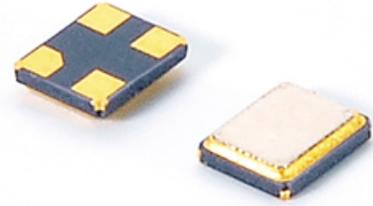
FS (Frequency Stability温度频差): 50=±50 ppm, etc

OT (Operating Temperature工作温度): 1060=-10°C to +60°C 4085=-40°C to +85°C, etc

ESR (Equivalent Series Resistance等效阻抗)

TR (Tape and Reel编带)

S (Special Requirement特殊要求)



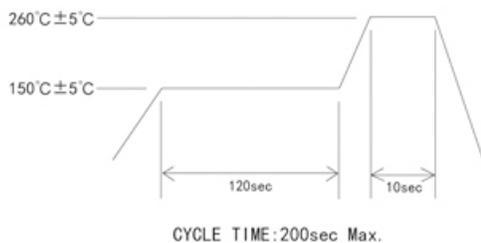
Electrical Specifications 电气参数

型号	Holder Type	3.2x2.5mm Ceramic Surface Mount
频率范围	Frequency Range	12.000MHz to 150.00MHz
调整频差	Frequency Tolerance (ΔF) (at 25°C)	±10ppm to ±100ppm
温度频差	Frequency Stability	±10ppm to ±100ppm
工作温度范围	Operating Temperature Range	-10°C ~ +60°C to -40°C ~ +85°C
储存温度范围	Storage Temperature Range	-40°C ~ +85°C / -55°C ~ +125°C
老化	Aging (25°C)	±5ppm/year Maximum
静电容	Shunt Capacitance (C0)	7pF Maximum
激励功率	Drive Level	10μW Typical
绝缘阻抗	Insulation Resistance (Rs)	500 Megaohms Minimum at D.C100V
负载电容	Load Capacitance (CL)	Suggested by customer

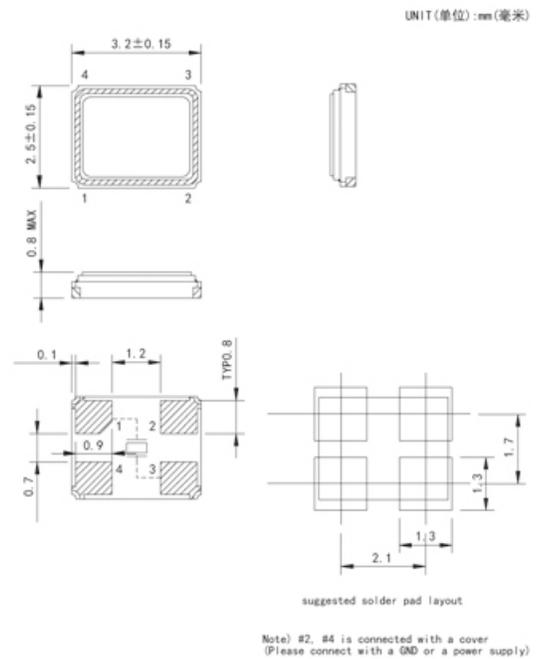
Equivalent Series Resistance and Mode of Operation 等效阻抗和振荡模式

Frequency Range 频率范围	ESR (Ω) 等效阻抗	Mode 振荡模式
12,000-16,000MHz	100Max	Fundamental
16,000-20,000MHz	80Max	Fundamental
20,000-24,000MHz	60Max	Fundamental
24,000-60,000MHz	40Max	Fundamental
80,000-150,00MHz	100Max	Third Overtone

Reflow Condition 回流焊条件



Mechanical Dimensions 外型尺寸



Part Number Guide

T-M-FF.FFFM-LC-FTFS-OT-ESR-TR-S

T (Type型号): N=2.5x2.0 SMD 4pads

M (Mode of Operation振荡模式): F=Fundamental

F (Frequency标称频率): Normal - 5 digitals of Frequency, e.g. 16.000M

Special - All digitals of Frequency, e.g. 28.63636M

LC (Load Capacitance负载电容): 20=20pf 00=series, etc

FT (Frequency Tolerance调整频差): 30= ± 30 ppm, etc

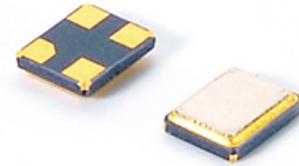
FS (Frequency Stability温度频差): 50= ± 50 ppm, etc

OT (Operating Temperature工作温度): 1060= -10°C to $+60^{\circ}\text{C}$ 4085= -40°C to $+85^{\circ}\text{C}$, etc

ESR (Equivalent Series Resistance等效阻抗)

TR (Tape and Reel编带)

S (Special Requirement特殊要求)



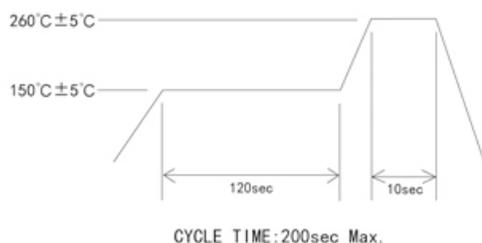
Electrical Specifications 电气参数

型号	Holder Type	2.5x2.0mm Ceramic Surface Mount
频率范围	Frequency Range	16,000MHz to 60,000MHz
调整频差	Frequency Tolerance (ΔF) (at25°C)	± 10 ppm to ± 100 ppm
温度频差	Frequency Stability	± 10 ppm to ± 100 ppm
工作温度范围	Operating Temperature Range	-10°C ~ $+60^{\circ}\text{C}$ to -40°C ~ $+85^{\circ}\text{C}$
储存温度范围	Storage Temperature Range	-40°C ~ $+85^{\circ}\text{C}$ / -55°C ~ $+125^{\circ}\text{C}$
老化	Aging (25°C)	± 5 ppm/year Maximum
静电容	Shunt Capacitance (C0)	7pF Maximum
激励功率	Drive Level	10 μ W Typical
绝缘阻抗	Insulation Resistance (Rs)	500 Megaohms Minimum at D.C100V
负载电容	Load Capacitance (CL)	Suggested by customer

Equivalent Series Resistance and Mode of Operation 等效阻抗和振荡模式

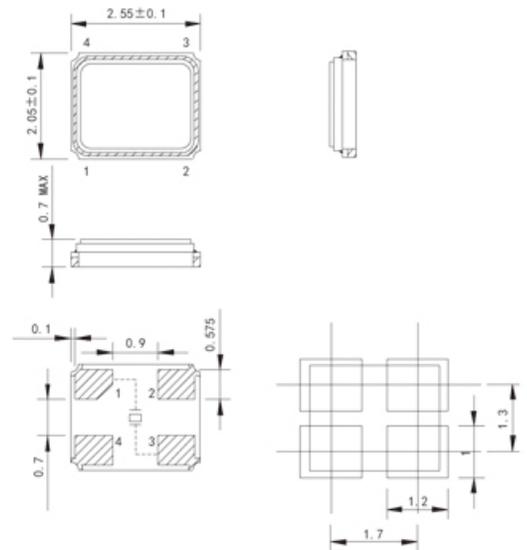
Frequency Range 频率范围	ESR (Ω) 等效阻抗	Mode 振荡模式
16,000-20,000MHz	100Max	Fundamental
20,000-30,000MHz	80Max	Fundamental
30,000-40,000MHz	60Max	Fundamental
40,000-60,000MHz	40Max	Fundamental

Reflow Condition 回流焊条件



Mechanical Dimensions 外型尺寸

UNIT (单位): mm (毫米)



suggested solder pad layout

Note) #2, #4 is connected with a cover (Please connect with a GND or a power supply)

Part Number Guide

T-M-FF.FFFM-LC-FTFS-OT-ESR-TR-S

T (Type型号): KC=2.0x1.6 SMD 4pads

M (Mode of Operation振荡模式): F=Fundamental

F (Frequency标称频率): Normal - 5 digitals of Frequency, e.g. 26.000M

Special - All digitals of Frequency, e.g. 28.63636M

LC (Load Capacitance负载电容): 20=20pf 00=series, etc

FT (Frequency Tolerance调整频差): 30=±30 ppm, etc

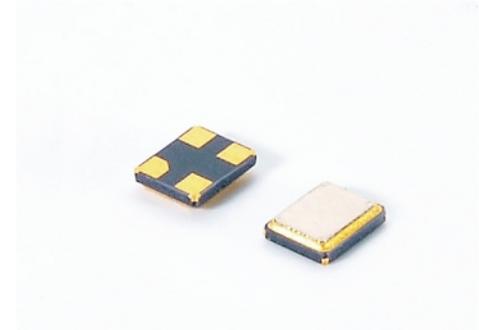
FS (Frequency Stability温度频差): 50=±50 ppm, etc

OT (Operating Temperature工作温度): 1060=-10°C to +60°C 4085=-40°C to +85°C, etc

ESR (Equivalent Series Resistance等效阻抗)

TR (Tape and Reel编带)

S (Special Requirement特殊要求)

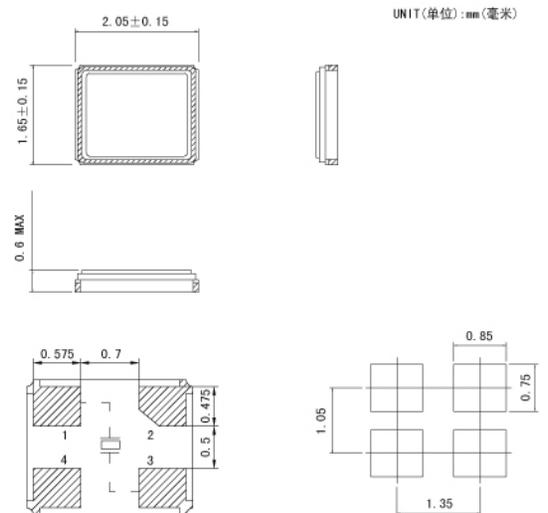


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Electrical Specifications 电气参数

型号	Holder Type	2.0x1.6mm Ceramic Surface Mount
频率范围	Frequency Range	24.000MHz to 60.000MHz
调整频差	Frequency Tolerance (ΔF) (at 25°C)	±10ppm to ±100ppm
温度频差	Frequency Stability	±10ppm to ±100ppm
工作温度范围	Operating Temperature Range	-10°C ~ +60°C to -40°C ~ +85°C
储存温度范围	Storage Temperature Range	-40°C to +85°C
老化	Aging (25°C)	±5ppm/year Maximum
静电容	Shunt Capacitance (C0)	7pF Maximum
激励功率	Drive Level	10µW Typical
绝缘阻抗	Insulation Resistance (Rs)	500 Megaohms Minmun at D.C100V
负载电容	Load Capacitance (CL)	Suggest by customer

Mechanical Dimensions 外型尺寸



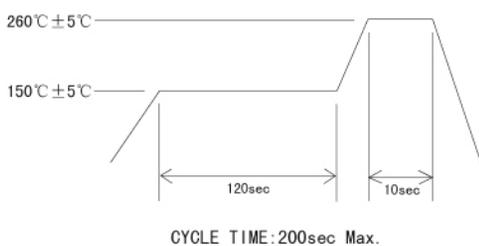
Equivalent Series Resistance and Mode of Operation 等效阻抗和振荡模式

Frequency Range 频率范围	ESR (Ω) 等效阻抗	Mode 振荡模式
24.000-26.000MHz	80Max	Fundamental
26.000-40.000MHz	60Max	Fundamental
40.000-60.000MHz	50Max	Fundamental

suggested solder pad layout

Note) #2, #4 is connected with a cover
(Please connect with a GND or a power supply)

Reflow Condition 回流焊条件



Part Number Guide

T-M-FF.FFFM-LC-FTFS-OT-ESR-TR-S

T (Type型号): KD=1.6x1.2 SMD 4pads

M (Mode of Operation振荡模式): F=Fundamental

F (Frequency标称频率): Normal - 5 digitals of Frequency, e.g. 26.000M

Special - All digitals of Frequency, e.g. 28.63636M

LC (Load Capacitance负载电容): 20=20pf 00=series, etc

FT (Frequency Tolerance调整频差): 30=±30 ppm, etc

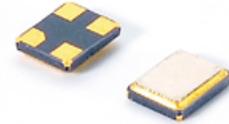
FS (Frequency Stability温度频差): 50=±50 ppm, etc

OT (Operating Temperature工作温度): 1060=-10°C to +60°C 4085=-40°C to +85°C, etc

ESR (Equivalent Series Resistance等效阻抗)

TR (Tape and Reel编带)

S (Special Requirement特殊要求)



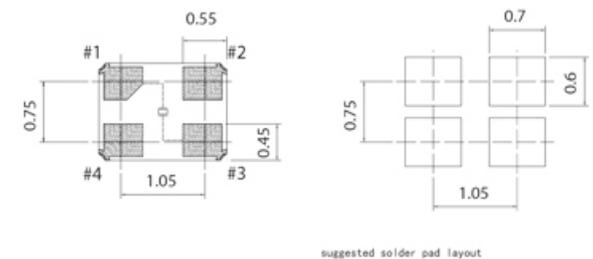
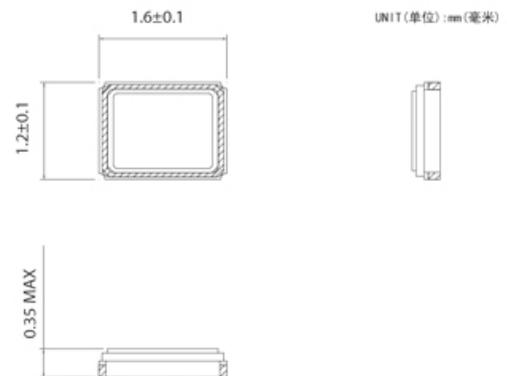
Electrical Specifications 电气参数

型号	Holder Type	1.6x1.2mm Ceramic Surface Mount
频率范围	Frequency Range	26,000MHz to 60,000MHz
调整频差	Frequency Tolerance (ΔF) (at 25°C)	±10ppm to ±100ppm
温度频差	Frequency Stability	±10ppm to ±100ppm
工作温度范围	Operating Temperature Range	-10°C ~ +60°C to -40°C ~ +85°C
储存温度范围	Storage Temperature Range	-40°C to +85°C
老化	Aging (25°C)	±5ppm/year Maximum
静电容	Shunt Capacitance (C0)	7pF Maximum
激励功率	Drive Level	10µW Typical
绝缘阻抗	Insulation Resistance (Rs)	500 Megaohms Minmun at D.C100V
负载电容	Load Capacitance (CL)	Suggest by customer

Equivalent Series Resistance and Mode of Operation 等效阻抗和振荡模式

Frequency Range 频率范围	ESR (Ω) 等效阻抗	Mode 振荡模式
26,000-32,000MHz	150Max	Fundamental
32,000-38,000MHz	100Max	Fundamental
38,000-60,000MHz	80Max	Fundamental

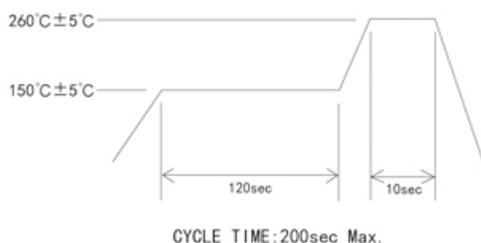
Mechanical Dimensions 外型尺寸



suggested solder pad layout

Note) #2, #4 is connected with a cover
(Please connect with a GND or a power supply)

Reflow Condition 回流焊条件



Part Number Guide

T-M-FF.FFFM-LC-FTFS-OT-ESR-TR-S

T (Type型号): U=HC-49U, 2 Leads with height of 13.2mm Max
 U2=HC-49T, 2 Leads with height of 10.35mm Max
 UB=HC-49U, 3 Leads with height of 13.2mm Max
 UB2=HC-49T, 3 Leads with height of 10.35mm Max

M (Mode of Operation振荡模式): F=Fundamental T=Third Overtone, etc

F (Frequency标称频率): Normal - 5 digitals of Frequency, e.g. 8.0000M, 12.000M
 Special - All digitals of Frequency, e.g. 13.225625M

LC (Load Capacitance负载电容): 20=20pf 00=series, etc

FT (Frequency Tolerance调整频差): 30= ± 30 ppm, etc

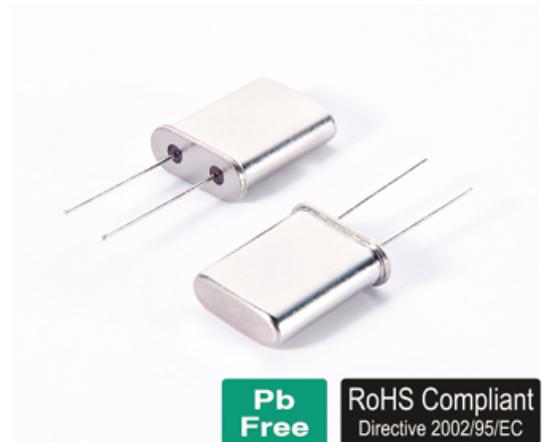
FS (Frequency Stability温度频差): 50= ± 50 ppm, etc

OT (Operating Temperature工作温度): 1060= -10°C to $+60^{\circ}\text{C}$ 4085= -40°C to $+85^{\circ}\text{C}$, etc

ESR (Equivalent Series Resistance等效阻抗)

TR (Tape and Reel编带)

S (Special Requirement特殊要求)



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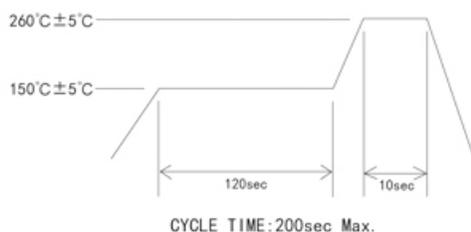
Electrical Specifications 电气参数

型号	Holder Type	HC - 49U
频率范围	Frequency Range	1,5360MHz to 130,00MHz
调整频差	Frequency Tolerance (ΔF) (at25°C)	± 10 ppm to ± 100 ppm
温度频差	Frequency Stability	± 10 ppm to ± 100 ppm
工作温度范围	Operating Temperature Range	-10°C ~ $+60^{\circ}\text{C}$ to -40°C ~ $+85^{\circ}\text{C}$
储存温度范围	Storage Temperature Range	-40°C ~ $+85^{\circ}\text{C}$ / -55°C ~ $+125^{\circ}\text{C}$
老化	Aging (25°C)	± 5 ppm/year Maximum
静电容	Shunt Capacitance (C0)	7pF Maximum
激励功率	Drive Level	100 μW Typical
绝缘阻抗	Insulation Resistance (Rs)	500 Megaohms Minimum at D.C100V
负载电容	Load Capacitance (CL)	Suggested by customer

Equivalent Series Resistance and Mode of Operation 等效阻抗和振荡模式

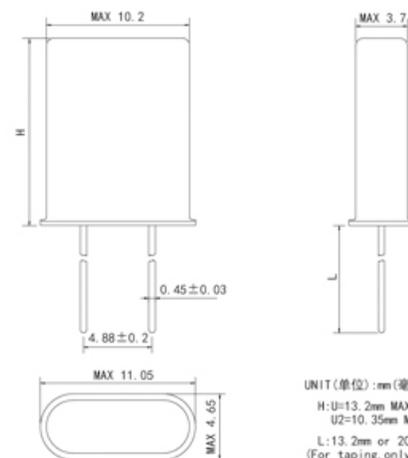
Frequency Range 频率范围	ESR (Ω) 等效阻抗	Mode 振荡模式
1,5360 - 2,0000MHz	500Max	Fundamental
2,0000 - 2,4560MHz	450Max	Fundamental
2,4570 - 3,0000MHz	350Max	Fundamental
3,0000 - 4,0000MHz	90Max	Fundamental
4,0000 - 5,0000MHz	70Max	Fundamental
5,0000 - 8,0000MHz	60Max	Fundamental
8,0000 - 10,000MHz	30Max	Fundamental
10,000 - 50,000MHz	25Max	Fundamental
24,000 - 130,00MHz	40Max	Third Overtone

Reflow Condition 回流焊条件

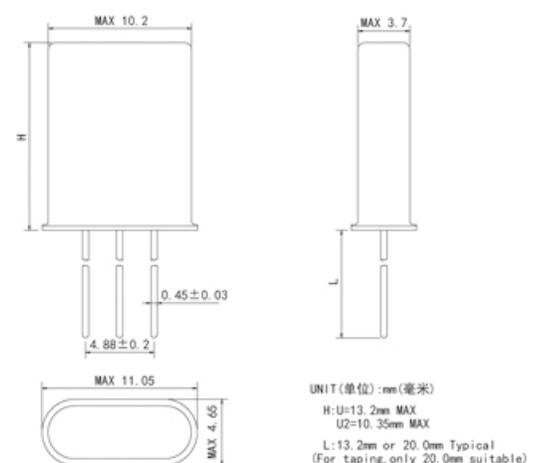


Mechanical Dimensions 外型尺寸

U: TWO LEADS (两引线) UNIT (单位): mm (毫米)



UB: THREE LEADS (三引线) UNIT (单位): mm (毫米)



Part Number Guide

T-M-FF.FFFM-LC-FTFS-OT-ESR-TR-S

T (Type型号): S=HC-49S, 2 Leads with height of 3.38mm Max

S2=HC-49S, 2 Leads with height of 2.8mm Max

S3=HC-49S, 2 Leads with height of 2.5mm Max

SB=HC-49S, 3 Leads with height of 3.38mm Max

SB2=HC-49S, 3 Leads with height of 2.8mm Max

SB3=HC-49S, 3 Leads with height of 2.5mm Max

M (Mode of Operation振荡模式): F=Fundamental T=Third Overtone, etc

F (Frequency标称频率): Normal - 5 digitals of Frequency, e.g. 8.0000M, 12.000M

Special - All digitals of Frequency, e.g. 13.225625M

LC (Load Capacitance负载电容): 20=20pf 00=series, etc

FT (Frequency Tolerance调整频差): 30=±30 ppm, etc

FS (Frequency Stability温度频差): 50=±50 ppm, etc

OT (Operating Temperature工作温度): 1060=-10°C to +60°C 4085=-40°C to +85°C, etc

ESR (Equivalent Series Resistance等效阻抗)

TR (Tape and Reel编带)

S (Special Requirement特殊要求)

Electrical Specifications 电气参数

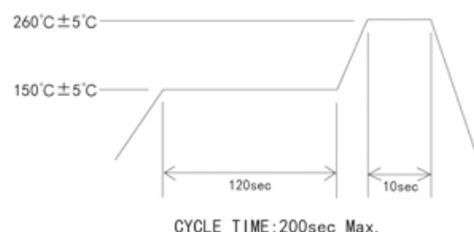
型号	Holder Type	HC - 49U/S
频率范围	Frequency Range	3.2000MHz to 130.00MHz ※(See Notes)
调整频差	Frequency Tolerance (ΔF) (at25°C)	±10ppm to ±100ppm
温度频差	Frequency Stability	±10ppm to ±100ppm
工作温度范围	Operating Temperature Range	-10°C ~ +60°C to -40°C ~ +85°C
储存温度范围	Storage Temperature Range	-40°C ~ +85°C / -55°C ~ +125°C
老化	Aging (25°C)	±5ppm/year Maximum
静电容	Shunt Capacitance (C0)	7pF Maximum
激励功率	Drive Level	100μW Typical
绝缘阻抗	Insulation Resistance (Rs)	500 Megaohms Minimum at D.C100V
负载电容	Load Capacitance (CL)	Suggested by customer

※Notes: For 2.5mm height, lowest frequency is 10 MHz.
For 2.8mm height, lowest frequency is 6 MHz.

Equivalent Series Resistance and Mode of Operation 等效阻抗和振荡模式

Frequency Range 频率范围	ESR (Ω) 等效阻抗	Mode 振荡模式
3,2000 - 3,5700MHz	250Max	Fundamental
3,5790 - 4,0000MHz	150Max	Fundamental
4,0000 - 5,0000MHz	120Max	Fundamental
5,0000 - 6,0000MHz	100Max	Fundamental
6,0000 - 7,0000MHz	80Max	Fundamental
7,0000 - 10,000MHz	60Max	Fundamental
10,000 - 14,000MHz	50Max	Fundamental
14,000 - 20,000MHz	40Max	Fundamental
≥20,000MHz	30/40 (BT cut) Max	Fundamental
24,000 - 35,000MHz	100Max	Third Overtone
≥35,000MHz	80Max	Third Overtone

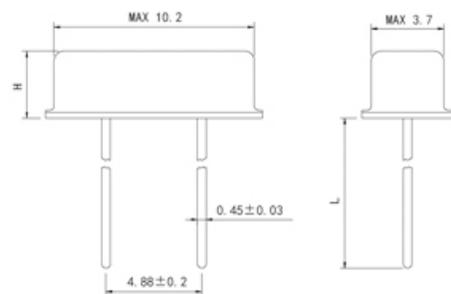
Reflow Condition 回流焊条件



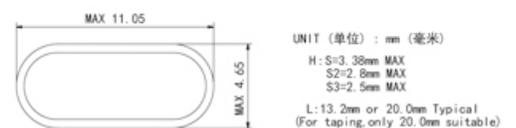
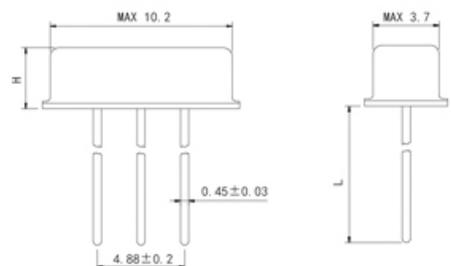
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Mechanical Dimensions 外型尺寸

S: TWO LEADS (两引线) UNIT (单位): mm (毫米)



SB: THREE LEADS (三引线) UNIT (单位): mm (毫米)



Part Number Guide

T-M-FF.FFFM-LC-FTFS-OT-ESR-TR-S

T (Type型号): M=HC-49USM with height of 4.0mm Max

M2=HC-49USM with height of 3.5mm Max

M3=HC-49USM with height of 3.2mm Max

M4=HC-49USM with height of 3.0mm Max

M (Mode of Operation振荡模式): F=Fundamental T=Third Overtone, etc

F (Frequency标称频率): Normal - 5 digitals of Frequency, e.g. 8.0000M, 12.000M

Special - All digitals of Frequency, e.g. 13.225625M

LC (Load Capacitance负载电容): 20=20pf 00=series, etc

FT (Frequency Tolerance调整频差): 30=±30 ppm, etc

FS (Frequency Stability温度频差): 50=±50 ppm, etc

OT (Operating Temperature工作温度): 1060=-10°C to +60°C 4085=-40°C to +85°C, etc

ESR (Equivalent Series Resistance等效阻抗)

TR (Tape and Reel编带)

S (Special Requirement特殊要求)

Electrical Specifications 电气参数

型号	Holder Type	HC - 49USM
频率范围	Frequency Range	3.2000MHz to 130.00MHz ※(See Notes)
调整频差	Frequency Tolerance (ΔF) (at25°C)	±10ppm to ±100ppm
温度频差	Frequency Stability	±10ppm to ±100ppm
工作温度范围	Operating Temperature Range	-10°C ~ +60°C to -40°C ~ +85°C
储存温度范围	Storage Temperature Range	-40°C ~ +85°C / -55°C ~ +125°C
老化	Aging (25°C)	±5ppm/year Maximum
静电容	Shunt Capacitance (C0)	7pF Maximum
激励功率	Drive Level	100μW Typical
绝缘阻抗	Insulation Resistance (Rs)	500 Megaohms Minimum at D.C 100V
负载电容	Load Capacitance (CL)	Suggested by customer

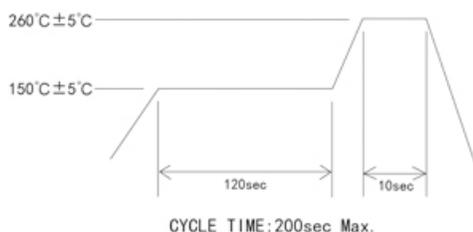
※Notes: For 3.0mm height, lowest frequency is 10 MHz.

For 3.2mm & 3.5mm height, lowest frequency is 6 MHz.

Equivalent Series Resistance and Mode of Operation 等效阻抗和振荡模式

Frequency Range 频率范围	ESR (Ω) 等效阻抗	Mode 振荡模式
3.2000 - 3.5790MHz	250Max	Fundamental
3.5790 - 4.0000MHz	150Max	Fundamental
4.0000 - 5.0000MHz	120Max	Fundamental
5.0000 - 6.0000MHz	100Max	Fundamental
6.0000 - 7.0000MHz	80Max	Fundamental
7.0000 - 10.000MHz	60Max	Fundamental
10.000 - 14.000MHz	50Max	Fundamental
14.000 - 20.000MHz	40Max	Fundamental
≥20.000MHz	30/40 (BT cut) Max	Fundamental
24.000 - 35.000MHz	100Max	Third Overtone
≥35.000MHz	80Max	Third Overtone

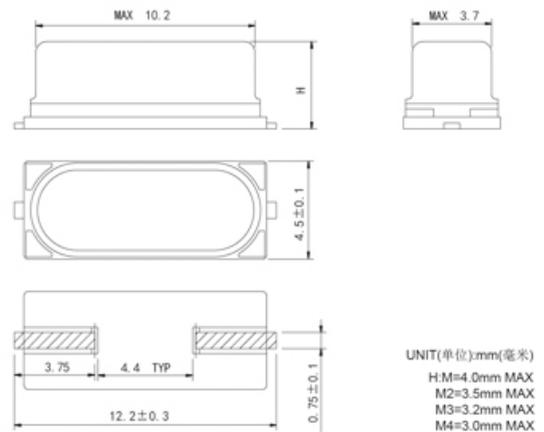
Reflow Condition 回流焊条件



Pb Free **RoHS Compliant**
Directive 2002/95/EC

Mechanical Dimensions 外型尺寸

Drawing For M



Part Number Guide

T-M-FF.FFFM-LC-FTFS-OT-ESR-TR-S

T (Type型号): MB=HC-49USM 4 Pads with height of 5.0mm Max
MB2=HC-49USM 4 Pads with height of 4.5mm Max
M (Mode of Operation振荡模式): F=Fundamental T=Third Overtone, etc
F (Frequency标称频率): Normal - 5 digitals of Frequency, e.g. 8.0000M, 12.000M
Special - All digitals of Frequency, e.g. 13.225625M
LC (Load Capacitance负载电容): 20=20pf 00=series, etc
FT (Frequency Tolerance调整频差): 30=±30 ppm, etc
FS (Frequency Stability温度频差): 50=±50 ppm, etc
OT (Operating Temperature工作温度): 1060=-10°C to +60°C 4085=-40°C to +85°C, etc
ESR (Equivalent Series Resistance等效阻抗)
TR (Tape and Reel编带)
S (Special Requirement特殊要求)

Electrical Specifications 电气参数

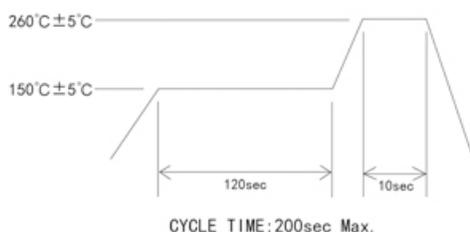
型号	Holder Type	HC - 49USM 4Pads
频率范围	Frequency Range	3.2000MHz to 130.00MHz ※(See Notes)
调整频差	Frequency Tolerance (ΔF) (at25°C)	±10ppm to ±100ppm
温度频差	Frequency Stability	±10ppm to ±100ppm
工作温度范围	Operating Temperature Range	-10°C ~ +60°C to -40°C ~ +85°C
储存温度范围	Storage Temperature Range	-40°C ~ +85°C / -55°C ~ +125°C
老化	Aging (25°C)	±5ppm/year Maximum
静电容	Shunt Capacitance (C0)	7pF Maximum
激励功率	Drive Level	100μW Typical
绝缘阻抗	Insulation Resistance (Rs)	500 Megaohms Minimum at D.C 100V
负载电容	Load Capacitance (CL)	Suggested by customer

※Notes: For 4.5mm height, lowest frequency is 10 MHz.

Equivalent Series Resistance and Mode of Operation 等效阻抗和振荡模式

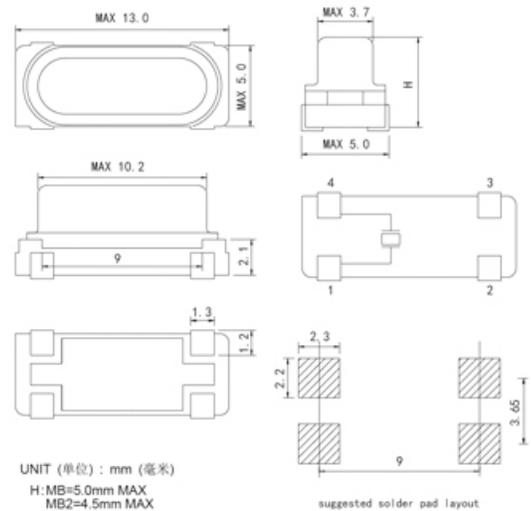
Frequency Range 频率范围	ESR (Ω) 等效阻抗	Mode 振荡模式
3.2000 - 3.5790MHz	250Max	Fundamental
3.5790 - 4.0000MHz	150Max	Fundamental
4.0000 - 5.0000MHz	120Max	Fundamental
5.0000 - 6.0000MHz	100Max	Fundamental
6.0000 - 7.0000MHz	80Max	Fundamental
7.0000 - 10.000MHz	60Max	Fundamental
10.000 - 14.000MHz	50Max	Fundamental
14.000 - 20.000MHz	40Max	Fundamental
≥20.000MHz	30/40 (BT cut) Max	Fundamental
24.000 - 35.000MHz	100Max	Third Overtone
≥35.000MHz	80Max	Third Overtone

Reflow Condition 回流焊条件



Mechanical Dimensions 外型尺寸

Drawing For MB



Part Number Guide

T-M-FF.FFFM-LC-FTFS-OT-ESR-TR-S

T (Type型号): MD=HC-49USM 4 Pads with height of 5.0mm Max

MD2=HC-49USM 4 Pads with height of 4.5mm Max

M (Mode of Operation振荡模式): F=Fundamental T=Third Overtone, etc

F (Frequency标称频率): Normal - 5 digitals of Frequency, e.g. 8.0000M, 12.000M

Special - All digitals of Frequency, e.g. 13.225625M

LC (Load Capacitance负载电容): 20=20pf 00=series, etc

FT (Frequency Tolerance调整频差): 30=±30 ppm, etc

FS (Frequency Stability温度频差): 50=±50 ppm, etc

OT (Operating Temperature工作温度): 1060=-10°C to +60°C 4085=-40°C to +85°C, etc

ESR (Equivalent Series Resistance等效阻抗)

TR (Tape and Reel编带)

S (Special Requirement特殊要求)

Electrical Specifications 电气参数

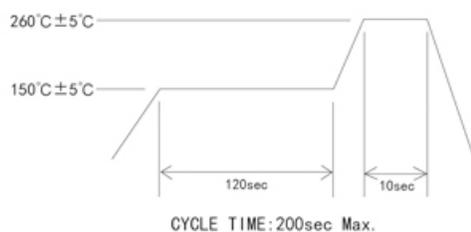
型号	Holder Type	HC - 49USM 4Pads
频率范围	Frequency Range	3,200MHz to 130,00MHz ※(See Notes)
调整频差	Frequency Tolerance (ΔF) (at25°C)	±10ppm to ±100ppm
温度频差	Frequency Stability	±10ppm to ±100ppm
工作温度范围	Operating Temperature Range	-10°C ~ +60°C to -40°C ~ +85°C
储存温度范围	Storage Temperature Range	-40°C ~ +85°C / -55°C ~ +125°C
老化	Aging (25°C)	±5ppm/year Maximum
静电容	Shunt Capacitance (C0)	7pF Maximum
激励功率	Drive Level	100μW Typical
绝缘阻抗	Insulation Resistance (Rs)	500 Megaohms Minimum at D.C 100V
负载电容	Load Capacitance (CL)	Suggested by customer

※Notes: For 4.5mm height, lowest frequency is 10 MHz.

Equivalent Series Resistance and Mode of Operation 等效阻抗和振荡模式

Frequency Range 频率范围	ESR (Ω) 等效阻抗	Mode 振荡模式
3,200 - 3,5790MHz	250Max	Fundamental
3,5790 - 4,0000MHz	150Max	Fundamental
4,0000 - 5,0000MHz	120Max	Fundamental
5,0000 - 6,0000MHz	100Max	Fundamental
6,0000 - 7,0000MHz	80Max	Fundamental
7,0000 - 10,000MHz	60Max	Fundamental
10,000 - 14,000MHz	50Max	Fundamental
14,000 - 20,000MHz	40Max	Fundamental
≥20,000MHz	30/40 (BT cut) Max	Fundamental
24,000 - 35,000MHz	100Max	Third Overtone
≥35,000MHz	80Max	Third Overtone

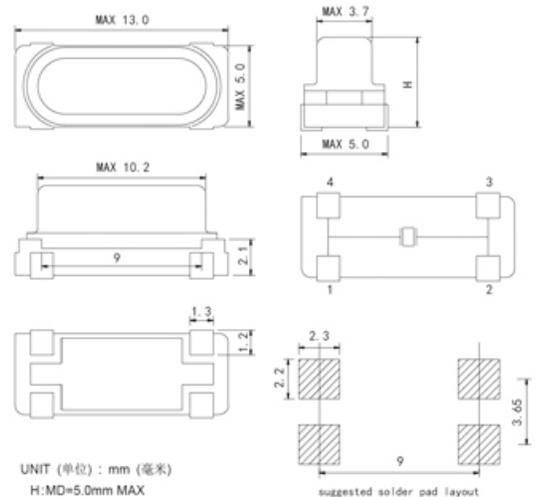
Reflow Condition 回流焊条件



Pb Free **RoHS Compliant**
Directive 2002/95/EC

Mechanical Dimensions 外型尺寸

Drawing For MD



Part Number Guide

T-M-FF.FFFM-LC-FTFS-OT-ESR-TR-S

T (Type型号): ME=HC-49USM 4 Pads with height of 5.0mm Max
ME2=HC-49USM 4 Pads with height of 4.5mm Max
M (Mode of Operation振荡模式): F=Fundamental T=Third Overtone, etc
F (Frequency标称频率): Normal - 5 digitals of Frequency, e.g. 8.0000M, 12.000M
Special - All digitals of Frequency, e.g. 13.225625M
LC (Load Capacitance负载电容): 20=20pf 00=series, etc
FT (Frequency Tolerance调整频差): 30=±30 ppm, etc
FS (Frequency Stability温度频差): 50=±50 ppm, etc
OT (Operating Temperature工作温度): 1060=-10°C to +60°C 4085=-40°C to +85°C, etc
ESR (Equivalent Series Resistance等效阻抗)
TR (Tape and Reel编带)
S (Special Requirement特殊要求)

Electrical Specifications 电气参数

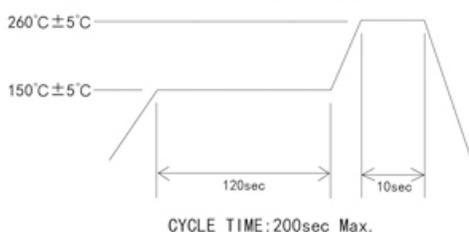
型号	Holder Type	HC - 49USM 4Pads
频率范围	Frequency Range	3,200MHz to 130,00MHz ※(See Notes)
调整频差	Frequency Tolerance (ΔF) (at25°C)	±10ppm to ±100ppm
温度频差	Frequency Stability	±10ppm to ±100ppm
工作温度范围	Operating Temperature Range	-10°C ~ +60°C to -40°C ~ +85°C
储存温度范围	Storage Temperature Range	-40°C ~ +85°C / -55°C ~ +125°C
老化	Aging (25°C)	±5ppm/year Maximum
静电容	Shunt Capacitance (C0)	7pF Maximum
激励功率	Drive Level	100μW Typical
绝缘阻抗	Insulation Resistance (Rs)	500 Megaohms Minimum at D.C 100V
负载电容	Load Capacitance (CL)	Suggested by customer

※Notes: For 4.5mm height, lowest frequency is 10 MHz.

Equivalent Series Resistance and Mode of Operation 等效阻抗和振荡模式

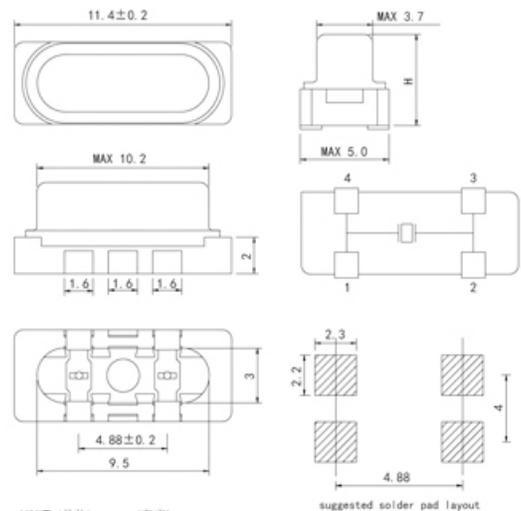
Frequency Range 频率范围	ESR (Ω) 等效阻抗	Mode 振荡模式
3,200 - 3,5790MHz	250Max	Fundamental
3,5790 - 4,0000MHz	150Max	Fundamental
4,0000 - 5,0000MHz	120Max	Fundamental
5,0000 - 6,0000MHz	100Max	Fundamental
6,0000 - 7,0000MHz	80Max	Fundamental
7,0000 - 10,000MHz	60Max	Fundamental
10,000 - 14,000MHz	50Max	Fundamental
14,000 - 20,000MHz	40Max	Fundamental
≥20,000MHz	30/40 (BT cut) Max	Fundamental
24,000 - 35,000MHz	100Max	Third Overtone
≥35,000MHz	80Max	Third Overtone

Reflow Condition 回流焊条件



Mechanical Dimensions 外型尺寸

Drawing For ME



UNIT (单位): mm (毫米)
H: ME=5.0mm MAX
ME2=4.5mm MAX

Part Number Guide

T-M-FF.FFFM-LC-FTFS-OT-ESR-B-G-S

T (Type型号): A=UM-1 Crystal, 2 Leads,

A2=UM-1 Crystal, 3 Leads,

M (Mode of Operation振荡模式): F=Fundamental T=Third Overtone, etc

F (Frequency标称频率): Normal - 5 digitals of Frequency, e.g. 8,0000M, 12,000M

Special - All digitals of Frequency, e.g. 13,225625M

LC (Load Capacitance负载电容): 20=20pf 00=series, etc

FT (Frequency Tolerance调整频差): 30= ± 30 ppm, etc

FS (Frequency Stability温度频差): 50= ± 50 ppm, etc

OT (Operating Temperature工作温度): 1060= -10°C to $+60^{\circ}\text{C}$ 4085= -40°C to $+85^{\circ}\text{C}$, etc

ESR (Equivalent Series Resistance等效阻抗)

B (Bulk Pack散装) OR TR (Tape and Reel编带)

G (Gull Wing夹持器)

S (Special Requirement特殊要求)

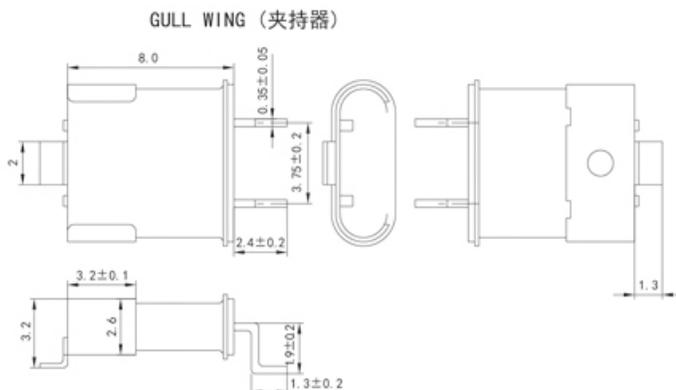


Electrical Specifications 电气参数

型号	Holder Type	UM - 1
频率范围	Frequency Range	6,600MHz to 100,00MHz
调整频差	Frequency Tolerance (ΔF) (at25°C)	± 10 ppm to ± 100 ppm
温度频差	Frequency Stability	± 10 ppm to ± 100 ppm
工作温度范围	Operating Temperature Range	-10°C ~ $+60^{\circ}\text{C}$ to -40°C ~ $+85^{\circ}\text{C}$
储存温度范围	Storage Temperature Range	-40°C ~ $+85^{\circ}\text{C}$ / -55°C ~ $+125^{\circ}\text{C}$
老化	Aging (25°C)	± 5 ppm/year Maximum
静电容	Shunt Capacitance (C0)	7pF Maximum
激励功率	Drive Level	100 μ W Typical
绝缘阻抗	Insulation Resistance (Rs)	500 Megaohms Minimum at D.C 100V
负载电容	Load Capacitance (CL)	Suggested by customer

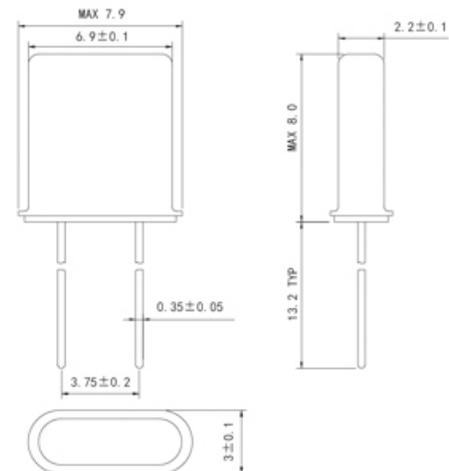
Equivalent Series Resistance and Mode of Operation 等效阻抗和振荡模式

Frequency Range 频率范围	ESR (Ω) 等效阻抗	Mode 振荡模式
6,600 - 20,000MHz	30Max	Fundamental
20,000 - 50,000MHz	25Max	Fundamental
40,000 - 100,00MHz	40Max	Third Overtone

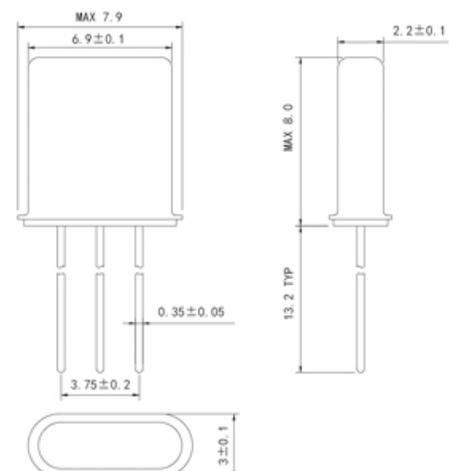


Mechanical Dimensions 外型尺寸

TWO LEADS (两引线) UNIT (单位): mm (毫米)



THREE LEADS (三引线) UNIT (单位): mm (毫米)



Part Number Guide

T-M-FF.FFFM-LC-FTFS-OT-ESR-B-G-S

T (Type型号): B=UM-5 Crystal, 2 Leads.

B2=UM-5 Crystal, 3 Leads.

M (Mode of Operation振荡模式): F=Fundamental T=Third Overtone, etc

F (Frequency标称频率): Normal - 5 digitals of Frequency, e.g. 12.000M

Special - All digitals of Frequency, e.g. 13.225625M

LC (Load Capacitance负载电容): 20=20pf 00=series, etc

FT (Frequency Tolerance调整频差): 30=±30 ppm, etc

FS (Frequency Stability温度频差): 50=±50 ppm, etc

OT (Operating Temperature工作温度): 1060=-10°C to +60°C 4085=-40°C to +85°C, etc

ESR (Equivalent Series Resistance等效阻抗)

B (Bulk Pack散装) OR TR (Tape and Reel编带)

G (Gull Wing夹持器)

S (Special Requirement特殊要求)

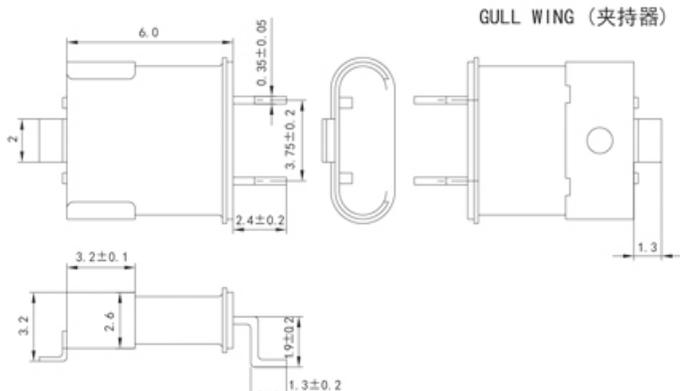


Electrical Specifications 电气参数

型号	Holder Type	UM - 5
频率范围	Frequency Range	10.000MHz to 100.00MHz
调整频差	Frequency Tolerance (ΔF) (at 25°C)	±10ppm to ±100ppm
温度频差	Frequency Stability	±10ppm to ±100ppm
工作温度范围	Operating Temperature Range	-10°C ~ +60°C to -40°C ~ +85°C
储存温度范围	Storage Temperature Range	-40°C ~ +85°C / -45°C ~ +125°C
老化	Aging (25°C)	±5ppm/year Maximum
静电容	Shunt Capacitance (C0)	7pF Maximum
激励功率	Drive Level	100µW Typical
绝缘阻抗	Insulation Resistance (Rs)	500 Megaohms Minimum at D.C 100V
负载电容	Load Capacitance (CL)	Suggested by customer

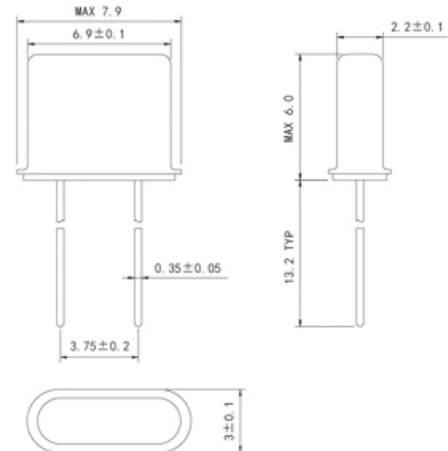
Equivalent Series Resistance and Mode of Operation 等效阻抗和振荡模式

Frequency Range 频率范围	ESR (Ω) 等效阻抗	Mode 振荡模式
10.000 - 14.000MHz	50Max	Fundamental
14.000 - 20.000MHz	40Max	Fundamental
≥20.000MHz	30Max	Fundamental
40.000 - 100.00MHz	40Max	Third Overtone

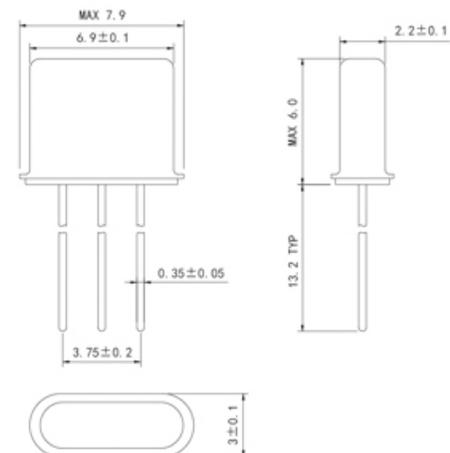


Mechanical Dimensions 外型尺寸

TWO LEADS (两引线) UNIT (单位): mm (毫米)



THREE LEADS (三引线) UNIT (单位): mm (毫米)



Part Number Guide

T-FF.FFFK-LC-FT-OT-ESR-TR-G-S

T (Type型号): WB=2x6 Tuning Fork

F (Frequency标称频率)

LC (Load Capacitance负载电容): 12.5=12.5pf 00=series, etc

FT (Frequency Tolerance调整频差): 30=±30 ppm, etc

OT (Operating Temperature工作温度): 1060=-10°C to +60°C 4085=-40°C to +85°C, etc

ESR (Equivalent Series Resistance等效阻抗)

TR (Tape and Reel编带) OR B (Bulk Pack散装)

G (Gull Wing夹持器)

S (Special Requirement特殊要求)

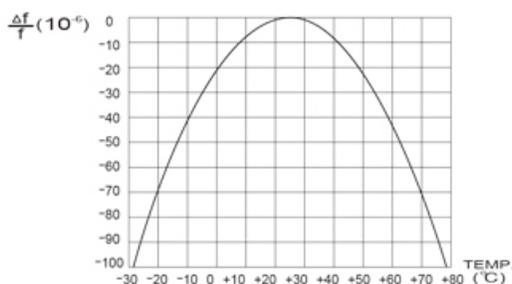
Electrical Specifications 电气参数

型号	Holder Type	Turning Fork 206(KHZ)
频率范围	Frequency Range	30,000KHz to 200,00KHz
调整频差	Frequency Tolerance (ΔF) (at 25°C)	±10ppm to ±100ppm
频率温度系数	Parabolic curvature constant	$[-0.035 \pm 0.01] \text{ppm}/^\circ\text{C}^2$
工作温度范围	Operating Temperature Range	-10°C ~ +60°C to -40°C ~ +85°C
老化	Aging (at 25°C)	±5ppm/year Maximum
保存温度范围	Storage Temperature Range	-40°C to +85°C
静电容	Shunt Capacitance (C0)	1.55pF Typical
动电容	Motional Capacitance (C1)	2.5fF Typical
激励功率	Drive Level	1μW Maximum
绝缘阻抗	Insulation Resistance (Rs)	500 Megaohms Minimum at D.C 100V
负载电容	Load Capacitance (CL)	Suggested by customer

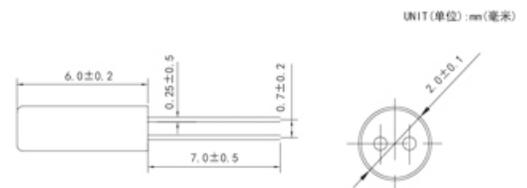
Equivalent Series Resistance and Mode of Operation 等效阻抗和振荡模式

Frequency Range 频率范围	ESR (Ω) 等效阻抗
30,000 - 40,000KHz	40KMAX
40,000 - 60,000KHz	30KMAX
60,000 - 70,000KHz	25KMAX
70,000 - 100,00KHz	22KMAX
100,00 - 200,00KHz	20KMAX

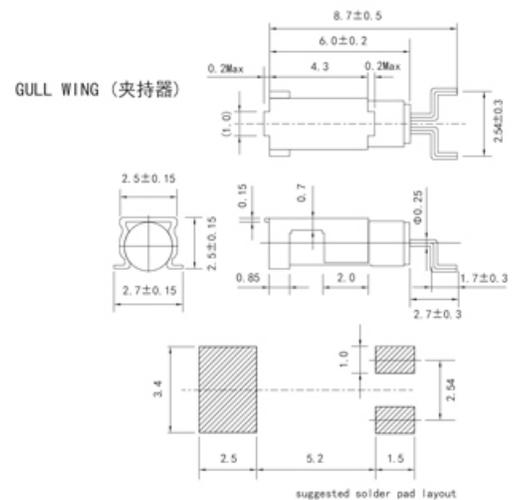
Frequency vs. Temperature Curve 频率温度曲线



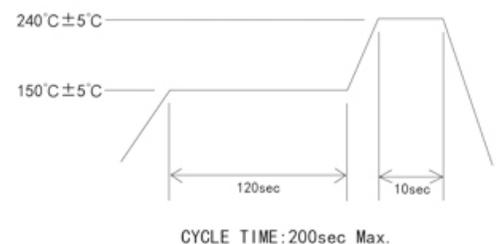
Mechanical Dimensions 外型尺寸



Lead Forming (引线折弯)



Reflow Condition 回流焊条件



Part Number Guide

T-M-FF.FFFM-LC-FTFS-OT-ESR-TR-G-S

- T (Type型号): WB=2x6 Tuning Fork
- M (Mode of Operation振荡模式): F=Fundamental
- F (Frequency标称频率)
- LC (Load Capacitance负载电容): 20=20pf 00=series, etc
- FT (Frequency Tolerance调整频差): 30=±30 ppm, etc
- FS (Frequency Stability温度频差): 50=±50 ppm, etc
- OT (Operating Temperature工作温度): 1060=-10°C to +60°C 4085=-40°C to +85°C, etc
- ESR (Equivalent Series Resistance等效阻抗)
- TR (Tape and Reel编带) OR B (Bulk Pack散装)
- G (Gull Wing夹持器)
- S (Special Requirement特殊要求)



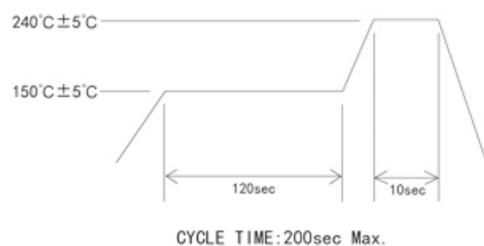
Electrical Specifications 电气参数

型号	Holder Type	Turning Fork 206(MHZ)
频率范围	Frequency Range	12,000MHz to 30,000MHz
调整频差	Frequency Tolerance (ΔF) (at 25°C)	±10ppm to ±100ppm
温度频差	Frequency Drift	±10ppm to ±100ppm
工作温度范围	Operating Temperature Range	-10°C ~ +60°C to -40°C ~ +85°C
老化	Aging (at 25°C)	±5ppm/year Maximum
保存温度范围	Storage Temperature Range	-40°C to +85°C
静电容	Shunt Capacitance (CO)	5.0pF Maximum
激励功率	Drive Level	100μW Maximum
绝缘阻抗	Insulation Resistance (Rs)	500 Megaohms Minimum at D.C 100V
负载电容	Load Capacitance (CL)	Suggested by customer

Equivalent Series Resistance and Mode of Operation 等效阻抗和振荡模式

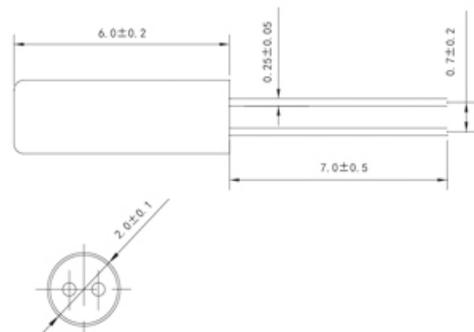
Frequency Range 频率范围	ESR (Ω) 等效阻抗	Mode 振荡模式
12,000-10,000MHz	120Max	Fundamental
10,000-20,000MHz	100Max	Fundamental
20,000-30,000MHz	80Max	Fundamental

Reflow Condition 回流焊条件

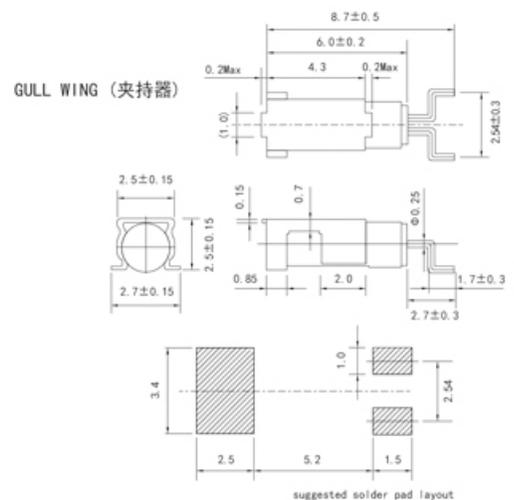


Mechanical Dimensions 外型尺寸

UNIT (单位): mm (毫米)



Lead Forming (引线折弯)



Part Number Guide

T-FF.FFFK-LC-FT-OT-ESR-TR-S

T (Type型号): W=3x8 Tuning Fork

F (Frequency标称频率)

LC (Load Capacitance负载电容): 12.5=12.5pf 00=series, etc

FT (Frequency Tolerance调整频差): 30=±30 ppm, etc

OT (Operating Temperature工作温度): 1060=-10°C to +60°C 4085=-40°C to +85°C, etc

ESR (Equivalent Series Resistance等效阻抗)

TR (Tape and Reel编带)

S (Special Requirement特殊要求)

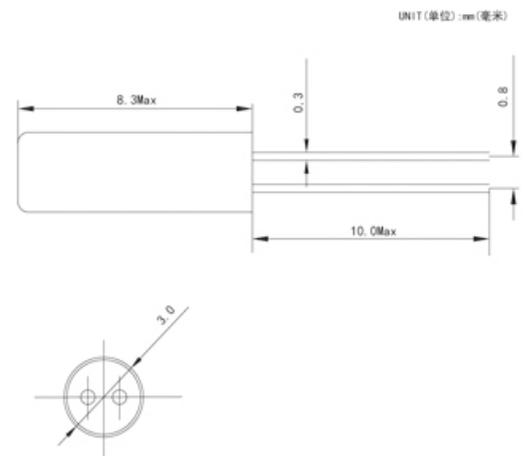
Electrical Specifications 电气参数

型号	Holder Type	Turning Fork 308(KHZ)
频率范围	Frequency Range	30,000KHz to 100,00KHz
调整频差	Frequency Tolerance (ΔF) (at 25°C)	±10ppm to ±100ppm
频率温度系数	Parabolic curvature constant	$[-0.035 \pm 0.01] \text{ppm}/^\circ\text{C}^2$
工作温度范围	Operating Temperature Range	-10°C ~ +60°C to -40°C ~ +85°C
老化	Aging (at 25°C)	±5ppm/year Maximum
保存温度范围	Storage Temperature Range	-40°C to +85°C
静电容	Shunt Capacitance (C0)	1.75pF Typical
动电容	Motional Capacitance (C1)	3.5fF Typical
激励功率	Drive Level	1μW Maximum
绝缘阻抗	Insulation Resistance (Rs)	500 Megaohms Minimum at D.C 100V
负载电容	Load Capacitance (CL)	Suggested by customer



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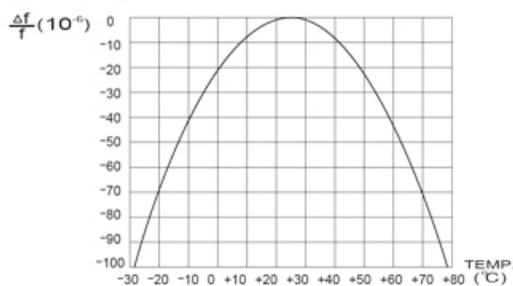
Mechanical Dimensions 外型尺寸



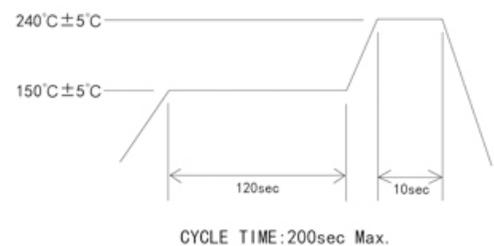
Equivalent Series Resistance and Mode of Operation 等效阻抗和振荡模式

Frequency Range 频率范围	ESR (Ω) 等效阻抗
30,000 - 40,000KHz	40KMax
40,000 - 100,00KHz	30KMax

Frequency vs. Temperature Curve 频率温度曲线



Reflow Condition 回流焊条件



Part Number Guide

T-M-FF.FFFM-LC-FTFS-OT-ESR-TR-S

T (Type型号): W=3x8 Tuning Fork

M (Mode of Operation振荡模式): F=Fundamental T=Third Overtone, etc

F (Frequency标称频率): Normal - 5 digitals of Frequency, e.g. 4,0000M, 12,000M
Special - All digitals of Frequency, e.g. 13,225625M

LC (Load Capacitance负载电容): 20=20pf 00=series, etc

FT (Frequency Tolerance调整频差): 30= ± 30 ppm, etc

FS (Frequency Stability温度频差): 50= ± 50 ppm, etc

OT (Operating Temperature工作温度): 1060= -10°C to $+60^{\circ}\text{C}$ 4085= -40°C to $+85^{\circ}\text{C}$, etc

ESR (Equivalent Series Resistance等效阻抗)

TR (Tape and Reel编带)

S (Special Requirement特殊要求)



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Electrical Specifications 电气参数

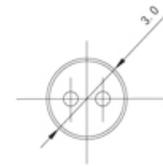
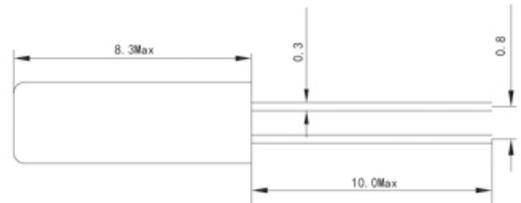
型号	Holder Type	Turning Fork 308(MHZ)
频率范围	Frequency Range	4,000MHz to 70,000MHz
调整频差	Frequency Tolerance (ΔF) (at25°C)	± 10 ppm to ± 100 ppm
温度频差	Frequency Stability	± 10 ppm to ± 100 ppm
工作温度范围	Operating Temperature Range	-10°C ~ $+60^{\circ}\text{C}$ to -40°C ~ $+85^{\circ}\text{C}$
老化	Aging (at 25°C)	± 5 ppm/year Maximum
保存温度范围	Storage Temperature Range	-40°C to $+85^{\circ}\text{C}$
静电容	Shunt Capacitance (C0)	5.0pF Maximum
激励功率	Drive Level	100 μ W Maximum
绝缘阻抗	Insulation Resistance (Rs)	500 Megaohms Minimum at D.C 100V
负载电容	Load Capacitance (CL)	Suggested by customer

Equivalent Series Resistance and Mode of Operation 等效阻抗和振荡模式

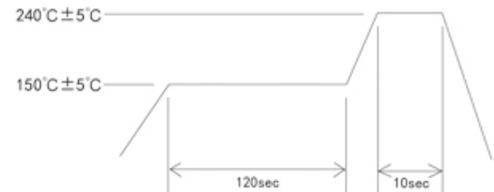
Frequency Range 频率范围	ESR (Ω) 等效阻抗	Mode 振荡模式
4,000-6,000MHz	120Max	Fundamental
6,000-10,000MHz	80Max	Fundamental
10,000-27,000MHz	50Max	Fundamental
27,000-36,000MHz	100Max	Third Overtone
36,000MHz-70,000MHz	80Max	Third Overtone

Mechanical Dimensions 外型尺寸

UNIT(单位):mm(毫米)



Reflow Condition 回流焊条件



CYCLE TIME:200sec Max.

Part Number Guide

T-FF.FFFK-LC-FT-OT-ESR-TR-S

T (Type型号): H=3x8 Tuning Fork (SMD)

F (Frequency标称频率): 5 digitals of Frequency, e.g. 32,768K, 100,00K

LC (Load Capacitance负载电容) 12.5=12.5pf 00=series, etc

FT (Frequency Tolerance调整频差): 30=±30 ppm, etc

OT (Operating Temperature工作温度): 1060=-10°C to +60°C 4085=-40°C to +85°C, etc

ESR (Equivalent Series Resistance等效阻抗)

TR (Tape and Reel编带)

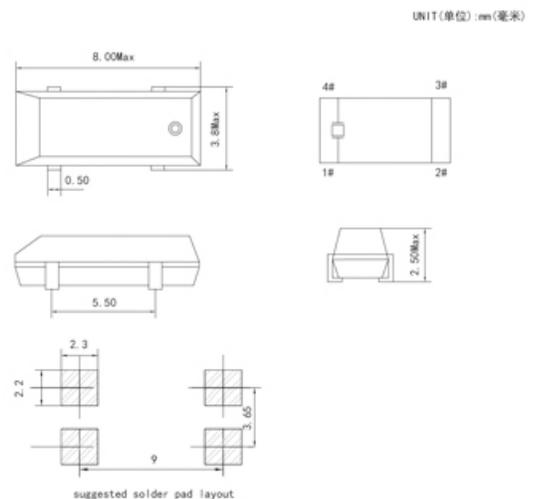
S (Special Requirement特殊要求)

Electrical Specifications 电气参数

型号	Holder Type	Turning Fork 308(SMD)
频率范围	Frequency Range	30,000kHz to 200,00kHz
调整频差	Frequency Tolerance (ΔF) (at 25°C)	±10ppm to ±100ppm
频率温度系数	Parabolic curvature constant	$[-0.035 \pm 0.01] \text{ppm}/^\circ\text{C}^2$
工作温度范围	Operating Temperature Range	-10°C ~ +60°C to -40°C ~ +85°C
老化	Aging (at 25°C)	±5ppm/year Maximum
保存温度范围	Storage Temperature Range	-40°C to +85°C
激励功率	Drive Level	1μW Maximum
绝缘阻抗	Insulation Resistance (Rs)	500 Megaohms Minimum at D.C 100V
负载电容	Load Capacitance (CL)	Suggested by customer



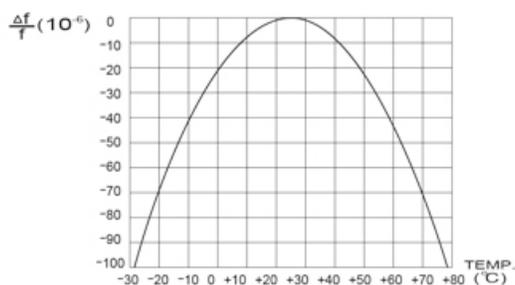
Mechanical Dimensions 外型尺寸



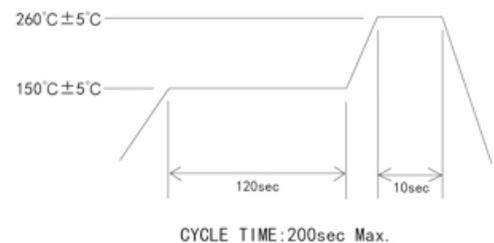
Equivalent Series Resistance and Mode of Operation 等效阻抗和振荡模式

Frequency Range 频率范围	ESR (Ω) 等效阻抗
30,000 - 40,000kHz	40KMax
40,000 - 60,000kHz	30KMax
60,000 - 70,000kHz	25KMax
70,000 - 100,00kHz	22KMax
100,00 - 200,00kHz	20KMax

Frequency vs. Temperature Curve 频率温度曲线



Reflow Condition 回流焊条件



Part Number Guide

T-FF.FFFM-LC-FTFS-OT-ESR-TR-S

- T (Type型号): HB=4.7x12.5 Tuning Fork (SMD)
- F (Frequency标称频率): 5 digitals of Frequency, e.g. 3.5000M, 70.000M
- LC (Load Capacitance负载电容) 20=20pf 00=series, etc
- FT (Frequency Tolerance调整频差): 30=±30 ppm, etc
- FS (Frequency Stability温度频差): 50=±50 ppm, etc
- OT (Operating Temperature工作温度): 1060=-10°C to +60°C 4085=-40°C to +85°C, etc
- ESR (Equivalent Series Resistance等效阻抗)
- TR (Tape and Reel编带)
- S (Special Requirement特殊要求)

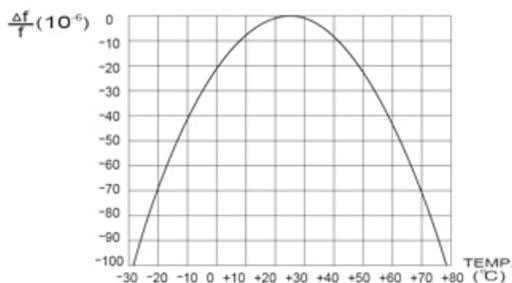
Electrical Specifications 电气参数

型号	Holder Type	Turning Fork 4.7 x 12.5(SMD)
频率范围	Frequency Range	3.5000MHz to 70.000MHz
调整频差	Frequency Tolerance (ΔF) (at 25°C)	±10ppm to ±100ppm
温度频差	Frequency Stability	±10ppm to ±100ppm
工作温度范围	Operating Temperature Range	-10°C ~ +60°C to -40°C ~ +85°C
老化	Aging (at 25°C)	±5ppm/year Maximum
保存温度范围	Storage Temperature Range	-40°C to +85°C
静电容	Shunt Capacitance (C0)	5pF Maximum
激励功率	Drive Level	100µW Maximum
绝缘阻抗	Insulation Resistance (Rs)	500 Megaohms Minimum at D.C 100V
负载电容	Load Capacitance (CL)	Suggested by customer

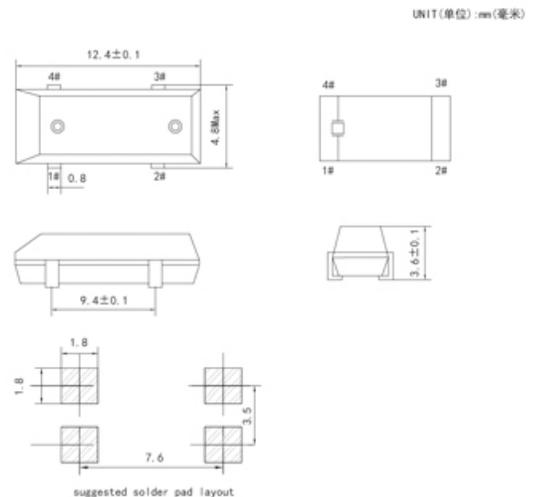
Equivalent Series Resistance and Mode of Operation 等效阻抗和振荡模式

Frequency Range 频率范围	ESR (Ω) 等效阻抗	Mode 振荡模式
3.5000 - 4.0000MHz	150Max	Fundamental
4.0000 - 6.0000MHz	120Max	Fundamental
6.0000 - 10.0000MHz	80Max	Fundamental
10.000 - 27.000MHz	50Max	Fundamental
27.000 - 36.000MHz	30Max	Fundamental
27.000 - 36.000MHz	100Max	Third Overtone
36.000 - 70.000MHz	80Max	Third Overtone

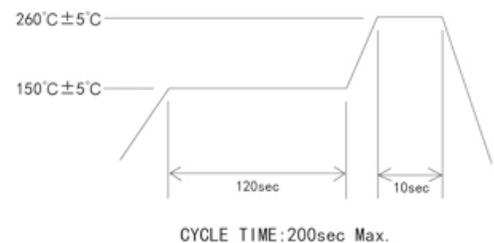
Frequency vs. Temperature Curve 频率温度曲线



Mechanical Dimensions 外型尺寸



Reflow Condition 回流焊条件



Part Number Guide

T-M-FF.FFFM-LC-FTFS-OT-ESR-TR-S

T (Type型号): WF=3×9 Tuning Fork

M (Mode of Operation振荡模式): F=Fundamental T=Third Overtone, etc

F (Frequency标称频率): Normal - 5 digitals of Frequency, e.g. 4.0000M, 12.000M
Special - All digitals of Frequency, e.g. 13.225625M

LC (Load Capacitance负载电容): 20=20pf 00=series, etc

FT (Frequency Tolerance调整频差): 30=±30 ppm, etc

FS (Frequency Stability温度频差): 50=±50 ppm, etc

OT (Operating Temperature工作温度): 1060=-10°C to +60°C 4085=-40°C to +85°C, etc

ESR (Equivalent Series Resistance等效阻抗)

TR (Tape and Reel编带)

S (Special Requirement特殊要求)

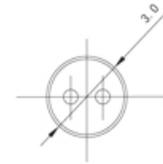
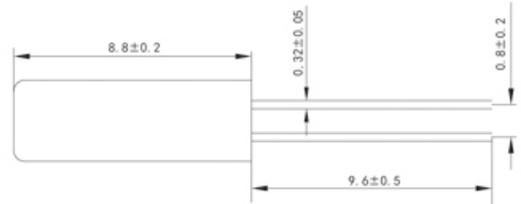


Electrical Specifications 电气参数

型号	Holder Type	Turning Fork 309(MHZ)
频率范围	Frequency Range	4.0000MHz to 70.000MHz
调整频差	Frequency Tolerance (ΔF) (at25°C)	±10ppm to ±100ppm
温度频差	Frequency Stability	±10ppm to ±100ppm
工作温度范围	Operating Temperature Range	-10°C ~ +60°C to -40°C ~ +85°C
老化	Aging (at 25°C)	±5ppm/year Maximum
保存温度范围	Storage Temperature Range	-40°C to +85°C
静电容	Shunt Capacitance (C0)	5.0pF Maximum
激励功率	Drive Level	100μW Maximum
绝缘阻抗	Insulation Resistance (Rs)	500 Megaohms Minimum at D.C 100V
负载电容	Load Capacitance (CL)	Suggested by customer

Mechanical Dimensions 外型尺寸

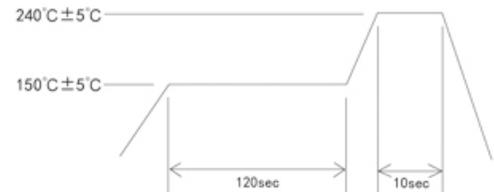
UNIT(单位):mm(毫米)



Equivalent Series Resistance and Mode of Operation 等效阻抗和振荡模式

Frequency Range 频率范围	ESR (Ω) 等效阻抗	Mode 振荡模式
4.0000-6.0000MHz	120Max	Fundamental
6.0000-10.000MHz	80Max	Fundamental
10.000-27.000MHz	50Max	Fundamental
27.000-36.000MHz	100Max	Third Overtone
36.000MHz-70.000MHz	80Max	Third Overtone

Reflow Condition 回流焊条件



CYCLE TIME:200sec Max.

Part Number Guide

T-M-FF.FFFM-LC-FTFS-OT-ESR-TR-S

T(Type型号):WD=3X10 Tuning Fork

M(Mode of Operation振荡模式):F=Fundamental

F(Frequency标称频率):5 digitals of Frequency, e.g. 3.5000M, 4.0000M

LC(Load Capacitance负载电容):20=20pf 00=series, etc

FT(Frequency Tolerance调整频差):30= ± 30 ppm, etc

FS(Frequency Stability温度频差):50= ± 50 ppm, etc

OT(Operating Temperature工作温度):1060= -10°C to $+60^{\circ}\text{C}$ 4085= -40°C to $+85^{\circ}\text{C}$, etc

ESR(Equivalent Series Resistance等效阻抗)

TR(Tape and Reel编带)

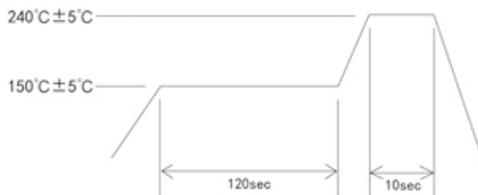
S(Special Requirement特殊要求)



Electrical Specifications 电气参数

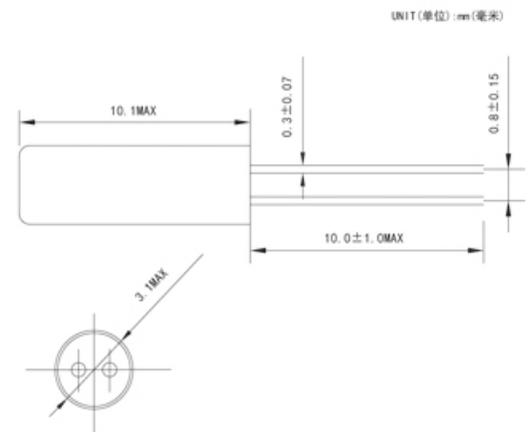
型号	Holder Type	Turning Fork 310 (MHZ)
频率范围	Frequency Range	3.500MHz to 4.000MHz
调整频差	Frequency Tolerance (ΔF) (at25°C)	± 10 ppm to ± 100 ppm
温度频差	Frequency Stability	± 10 ppm to ± 100 ppm
工作温度范围	Operating Temperature Range	-10°C ~ $+60^{\circ}\text{C}$ to -40°C ~ $+85^{\circ}\text{C}$
等效阻抗	Equivalent Series Resistance	150 Ω Maximum
老化	Aging (at 25°C)	± 5 ppm/year Maximum
保存温度范围	Storage Temperature Range	-40°C to $+85^{\circ}\text{C}$
静电容	Shunt Capacitance (C0)	1.35pF Typical
动电容	Motional Capacitance (C1)	3.5fF Typical
激励功率	Drive Level	1 μW Maximum
绝缘阻抗	Insulation Resistance (Rs)	500 Megaohms Minimum at D.C 100V
负载电容	Load Capacitance (CL)	Suggested by customer

Reflow Condition 回流焊条件



CYCLE TIME:200sec Max.

Mechanical Dimensions 外型尺寸



Part Number Guide

T-V-S-FF.FFFM- FS-OT-OP -TR-S

T (Type型号): 0=5×7×1.4mm Max ceramic osc

OF=5×7×1.4mm Max ceramic osc(side pad)

V (Input Voltage输入电压): 1,8=1.8V 2,5=2.5V 2,85=2.85V 3=3.3V 5=5.0V, etc

S (Symmetry占空比): 5=45/55 Max 6=40/60 Max

F (Frequency标称频率): Normal - 5 digitals of Frequency, e.g. 8.0000M, 12.000M

Special - All digitals of Frequency, e.g. 13.225625M

FS (Frequency Stability总频差): 50=±50 ppm, etc

OT (Operating Temperature工作温度): 0070= 0°C to +70°C 4085= -40°C to +85°C, etc

OP (Output输出): 1=15PF HCMOS 2=10TTL 3=30PF 4=50PF 5=10TTL/15PF

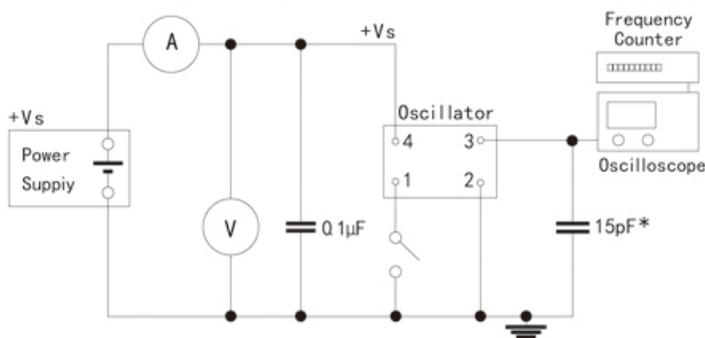
TR (Tape and Reel编带)

S (Special Requirement特殊要求)

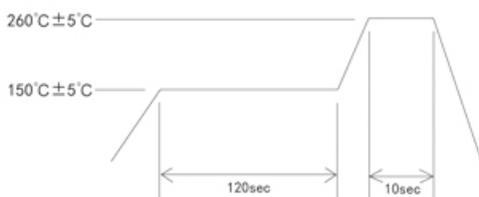
Electrical Specifications 电气参数

型号	Holder Type	5x7mm SMD OSCILLATOR
频率范围	Frequency Range	1.0000 MHz to 150.00 MHz
总频差	Frequency Stability	±25ppm to ±50ppm
输入电压	Supply Voltage	5.0V or 3.3V ±10%
工作温度范围	Operating Temperature Range	-10°C ~ +60°C to -40°C ~ +85°C
储存温度范围	Storage Temperature Range	-40°C ~ +85°C / -55°C ~ +125°C
占空比	Symmetry (Duty Cycle)	40/60 Standard
输出	Output Load	10 TTL or 15pF HCMOS
消耗电流	Current Consumption (15pf only)	1.0000MHz - 36.000MHz=25mA Max
		(5.0V)
		36.000MHz - 70.000MHz=60mA Max
	Current Consumption (15pf only)	1.0000MHz - 36.000MHz=20mA Max
		(1.8V 2.5V 2.85V 3.3V)
		36.000MHz - 70.000MHz=40mA Max
		70.000MHz - 150.00MHz=60mA Max
上升/下降时间	Rise/Fall Time	10nS Max

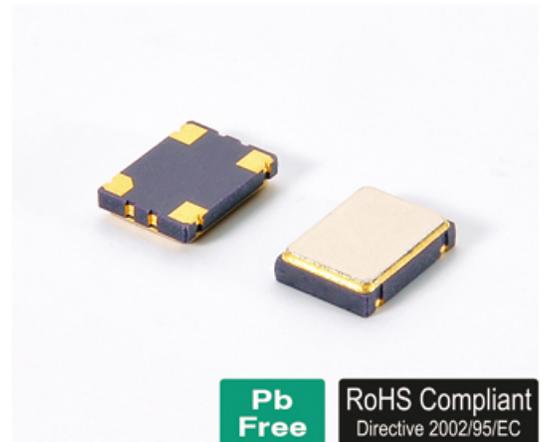
Test Circuit 测试电路



Reflow Condition 回流焊条件

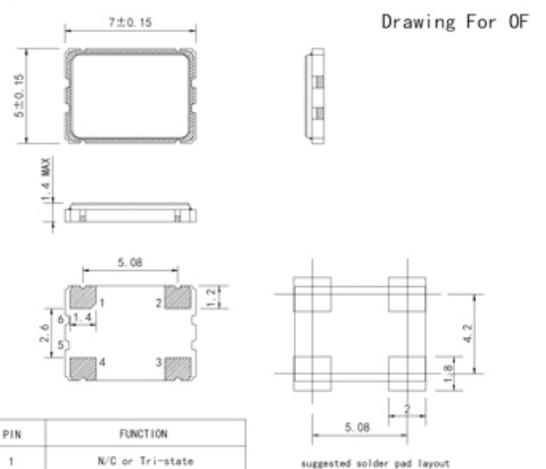
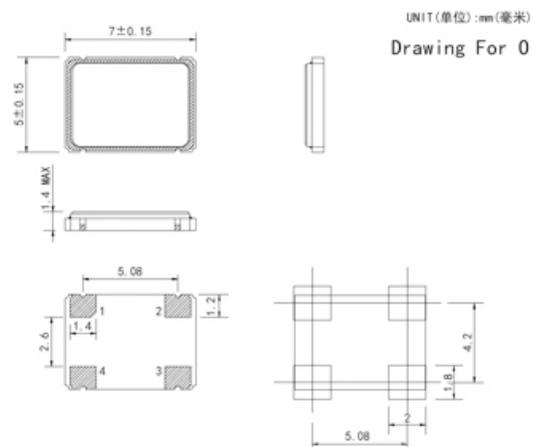


CYCLE TIME: 200sec Max.



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Mechanical Dimensions 外型尺寸



PIN	FUNCTION
1	N/C or Tri-state
2	Ground
3	Output
4	Vdd
5	Crystal
6	Crystal

Part Number Guide

T-V-S -FF.FFFM -FS-OT-P-TR-S

T (Type型号): OH=5X7SMD OSC ,PECL/LVDS Output

V (Input Voltage输入电压): 3=3.3V 2.5=2.5V, etc

S (Symmetry占空比): 5=45/55 Max 6=40/60 Max

F (Frequency标称频率): Normal - 5 digitals of Frequency, e.g. 8.0000M, 12.000M
Special - All digitals of Frequency, e.g. 13.225625M

FS (Frequency Stability总频差): 50=±50 ppm, etc

OT (Operating Temperature工作温度): 0070=0°C to +70°C 4085=-40°C to +85°C, etc

P (Output输出): P=PECL

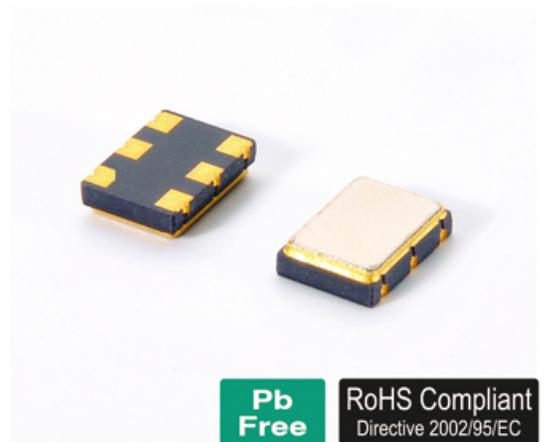
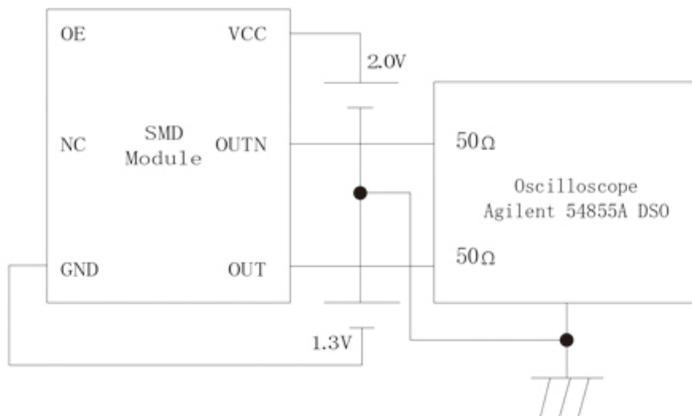
TR (Tape and Reel编带)

S (Special Requirement特殊要求)

Electrical Specifications 电气参数

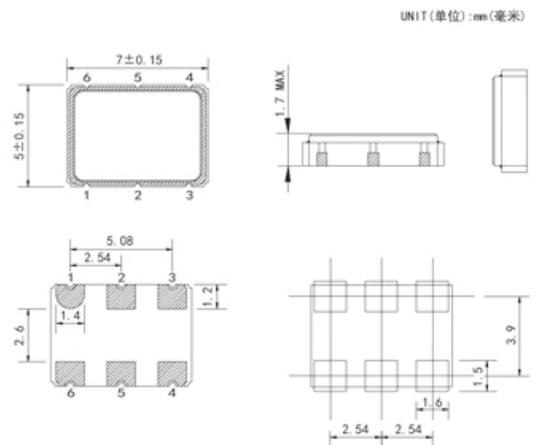
型号	Holder Type	5x7mm SMD OSC(PECL Output)
频率范围	Frequency Range	1.0000MHz to 220.00MHz
总频差	Frequency Stability	±25ppm to ±50ppm
输入电压	Supply Voltage	2.5V or 3.3V ±10%
工作温度范围	Operating Temperature Range	-10°C ~ +60°C to -40°C ~ +85°C
储存温度范围	Storage Temperature Range	-40°C ~ +85°C / -55°C ~ +125°C
占空比	Symmetry (Duty Cycle)	40/60 Standard
负载	Load	50Ω
消耗电流	Current Consumption (2.5V)	55mA typ(88mA max)
	Current Consumption (3.3V)	60mA typ(90mA max)
相位噪声	Phase Noise	-130dBc/Hz@1KHz(155.52MHz 3.3V)
抖动	Rms Jitter(12KHz to 20MHz)	0.17Ps(156.25MHz 3.3V)
典型频率	Typical Frequency	61.44MHz, 122.88MHz, 155.52MHz, 156.25MHz

Test Circuit 测试电路



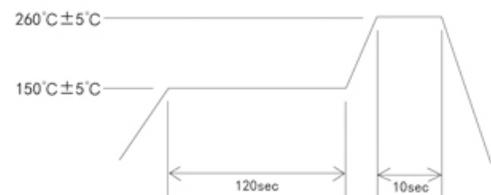
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Mechanical Dimensions 外型尺寸



PAD NO.	CONNECTION
#1	N/C or Tri-state
#2	N.C.
#3	Ground
#4	Output
#5	Output
#6	+DC

Reflow Condition 回流焊条件



CYCLE TIME: 200sec Max.

Part Number Guide

T-V-S -FF.FFFM -FS-OT-D-TR-S

T (Type型号): OH=5X7SMD OSC ,PECL/LVDS Output

V (Input Voltage输入电压): 3=3.3V 2.5=2.5V, etc

S (Symmetry占空比): 5=45/55 Max 6=40/60 Max

F (Frequency标称频率): Normal - 5 digitals of Frequency, e.g. 8.0000M, 12.000M
Special - All digitals of Frequency, e.g. 13.225625M

FS (Frequency Stability总频差): 50=±50 ppm, etc

OT (Operating Temperature工作温度): 0070=0°C to +70°C 4085=-40°C to +85°C, etc

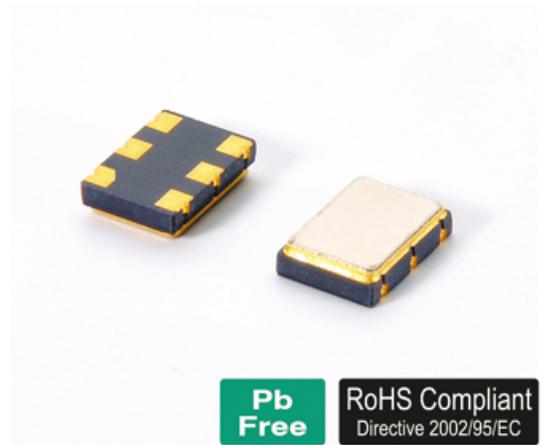
D (Output输出): D=LVDS

TR (Tape and Reel编带)

S (Special Requirement特殊要求)

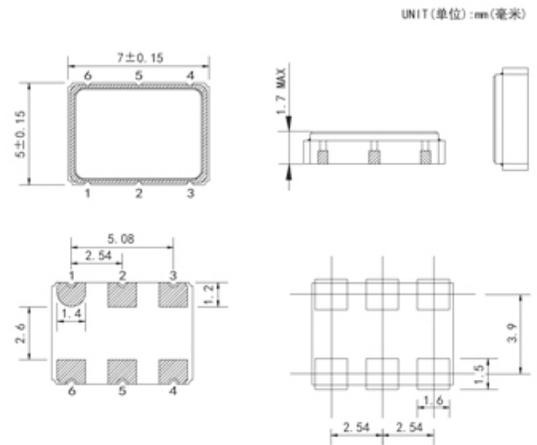
Electrical Specifications 电气参数

型号	Holder Type	5x7mm SMD OSC(LVDS Output)
频率范围	Frequency Range	1.0000MHz to 220.00MHz
总频差	Frequency Stability	±25ppm to ±50ppm
输入电压	Supply Voltage	2.5V or 3.3V ±10%
工作温度范围	Operating Temperature Range	-10°C ~ +60°C to -40°C ~ +85°C
储存温度范围	Storage Temperature Range	-40°C ~ +85°C / -55°C ~ +125°C
占空比	Symmetry (Duty Cycle)	40/60 Standard
负载	Load	100Ω
消耗电流	Current Consumption (2.5V)	55mA typ(88mA max)
	Current Consumption (3.3V)	60mA typ(90mA max)
相位噪声	Phase Noise	-130dBc/Hz@1KHz(155.52MHz 3.3V)
抖动	Rms Jitter(12KHz to 20MHz)	0.17Ps(156.25MHz 3.3V)
典型频率	Typical Frequency	61.44MHz, 122.88MHz, 155.52MHz, 156.25MHz

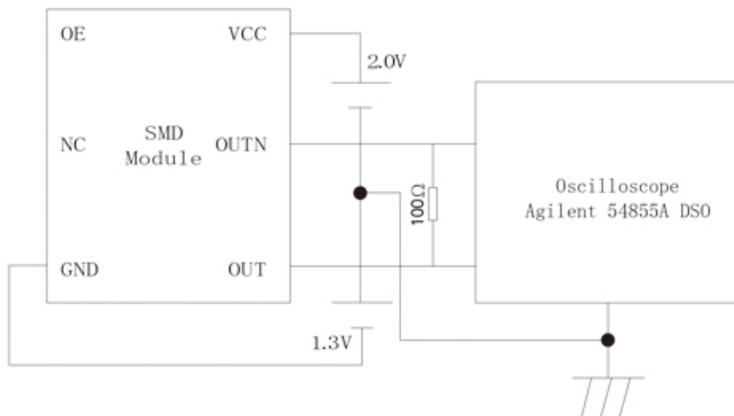


Pb Free **RoHS Compliant**
Directive 2002/95/EC

Mechanical Dimensions 外型尺寸

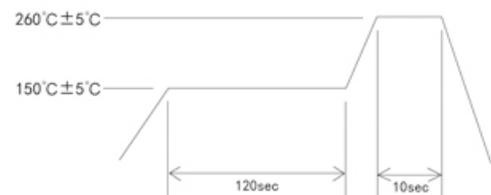


Test Circuit 测试电路



PAD NO.	CONNECTION
#1	N/C or Tri-state
#2	N.C.
#3	Ground
#4	Output
#5	Output
#6	+DC

Reflow Condition 回流焊条件



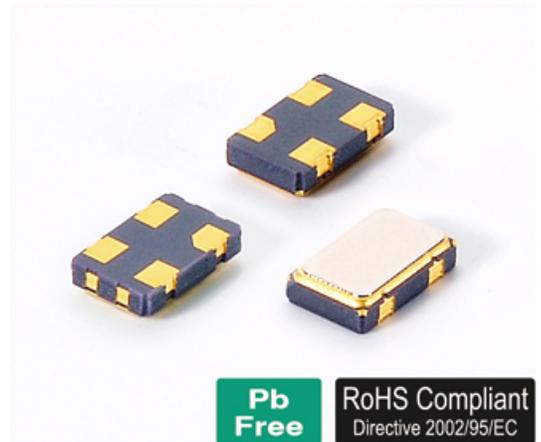
CYCLE TIME: 200sec Max.

5x3.2 SMD OSCILLATOR

●Part Number Guide

T-V-S-FF.FFFM- FS-OT-OP -TR-S

- T (Type型号): R=5×3.2×1.3mm Max ceramic osc
- V (Input Voltage输入电压): 1.8=1.8V 2.5=2.5V 2.85=2.85V 3=3.3V 5=5.0V, etc
- S (Symmetry占空比): 5=45/55 Max 6=40/60 Max
- F (Frequency标称频率): Normal - 5 digitals of Frequency, e.g. 8.0000M, 12.000M
Special - All digitals of Frequency, e.g. 13.225625M
- FS (Frequency Stability总频差): 50=±50 ppm, etc
- OT (Operating Temperature工作温度): 0070= 0°C to +70°C 4085= -40°C to +85°C, etc
- OP (Output输出): 1=15PF HCMOS 2=10TTL 3=30PF 4=50PF 5=10TTL/15PF
- TR (Tape and Reel编带)
- S (Special Requirement特殊要求)



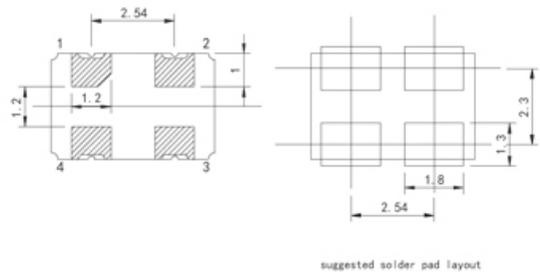
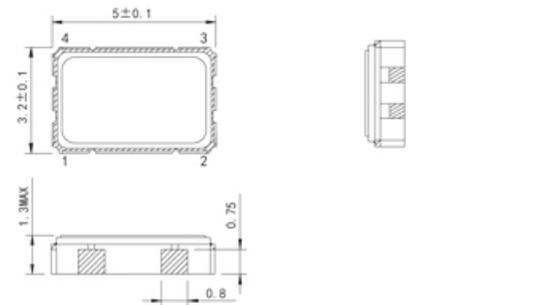
Pb Free **RoHS Compliant**
Directive 2002/95/EC

●Electrical Specifications 电气参数

型号	Holder Type	5x3.2mm SMD OSCILLATOR
频率范围	Frequency Range	1.000MHz to 150.00MHz
总频差	Frequency Stability	±25ppm to ±50ppm
输入电压	Supply Voltage	5.0V or 3.3V ±10%
工作温度范围	Operating Temperature Range	-10°C ~ +60°C to -40°C ~ +85°C
储存温度范围	Storage Temperature Range	-40°C ~ +85°C / -55°C ~ +125°C
占空比	Symmetry (Duty Cycle)	40/60 Standard
输出	Output Load	10 TTL or 15pF HCMOS
消耗电流	Current Consumption (15pf only)	1.000MHz ~ 36.000MHz=25mA Max
		(5.0V) 36.000MHz ~ 70.000MHz=60mA Max 70.000MHz ~ 150.00MHz=80mA Max
	Current Consumption (15pf only)	1.000MHz ~ 36.000MHz=20mA Max
		(1.8V 2.5V 2.85V 3.3V) 36.000MHz ~ 70.000MHz=40mA Max 70.000MHz ~ 150.00MHz=60mA Max
上升/下降时间	Rise/Fall Time	10nS Max

●Mechanical Dimensions 外型尺寸

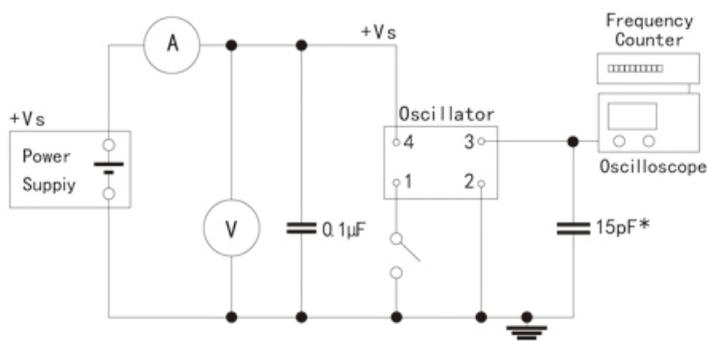
UNIT (单位): mm (毫米)



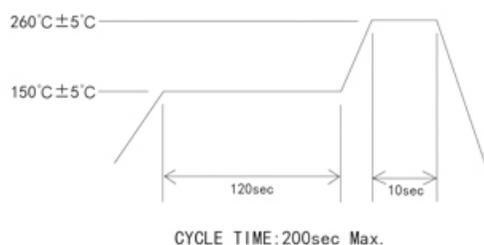
suggested solder pad layout

PIN	FUNCTION
1	N/C or Tri-state
2	Ground
3	Output
4	Vdd

●Test Circuit 测试电路



●Reflow Condition 回流焊条件



3.2x2.5 SMD OSCILLATOR

Part Number Guide

T-V-S-FF.FFFM- FS-OT-OP -TR-S

T (Type型号): L=3.2x2.5x1.2mm Max ceramic osc

V (Input Voltage输入电压): 1.8=1.8V 2.5=2.5V 2.85=2.85V 3=3.3V 5=5.0V, etc

S (Symmetry占空比): 5=45/55 Max 6=40/60 Max

F (Frequency标称频率): Normal - 5 digitals of Frequency, e.g. 8.0000M, 12.000M

Special - All digitals of Frequency, e.g. 13.225625M

FS (Frequency Stability总频差): 50=±50 ppm, etc

OT (Operating Temperature工作温度): 0070= 0°C to +70°C 4085= -40°C to +85°C, etc

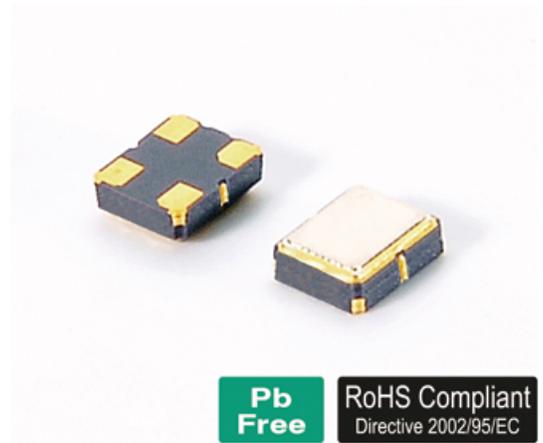
OP (Output输出): 1=15PF HCMOS 2=10TTL 3=30PF 4=50PF 5=10TTL/15PF

TR (Tape and Reel编带)

S (Special Requirement特殊要求)

Electrical Specifications 电气参数

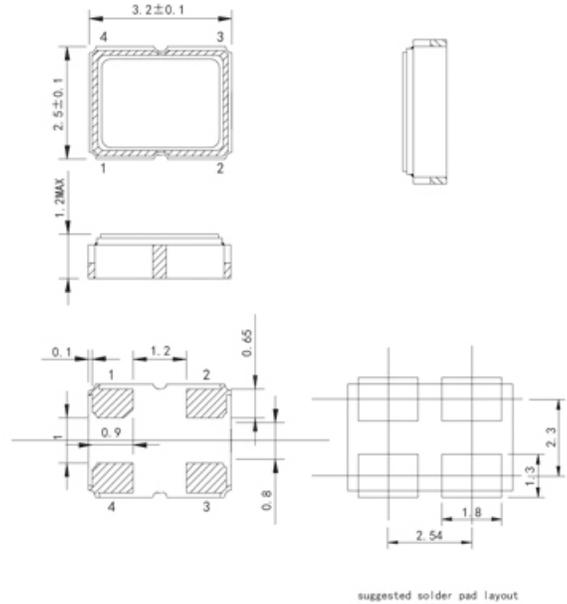
型号	Holder Type	3.2x2.5mm SMD OSCILLATOR
频率范围	Frequency Range	1,000MHz to 150,00MHz
总频差	Frequency Stability	±25ppm to ±50ppm
输入电压	Supply Voltage	5.0V or 3.3V ±10%
工作温度范围	Operating Temperature Range	-10°C ~ +60°C to -40°C ~ +85°C
储存温度范围	Storage Temperature Range	-40°C ~ +85°C / -55°C ~ +125°C
占空比	Symmetry (Duty Cycle)	40/60 Standard
输出	Output Load	15pF HCMOS or 10TTL
消耗电流	Current Consumption (15pf only)	1,000MHz - 150,00MHz=25mA Max
	(5.0V)	
	Current Consumption (15pf only)	1,000MHz - 150,00MHz=20mA Max
	(1.8V 2.5V 2.85V 3.3V)	
上升/下降时间	Rise/Fall Time	10nS Max



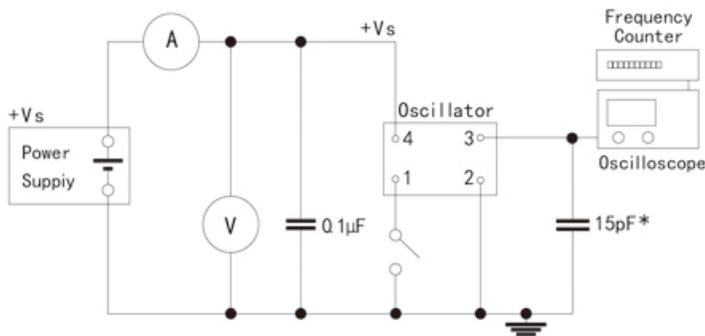
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Mechanical Dimensions 外型尺寸

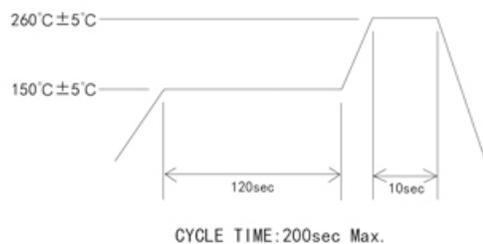
UNIT (单位): mm (毫米)



Test Circuit 测试电路



Reflow Condition 回流焊条件



PIN	FUNCTION
1	N/C or Tri-state
2	Ground
3	Output
4	Vdd

2.5x2.0 SMD OSCILLATOR

Part Number Guide

T-V-S-FF.FFFM-FS-OT-OP-TR-S

T (Type型号): ON=2.5x2.0x0.9mm Max ceramic osc

V (Input Voltage输入电压): 1.8=1.8V 2.5=2.5V 2.85=2.85V 3=3.3V etc

S (Symmetry占空比): 5=45/55 Max 6=40/60 Max

F (Frequency标称频率): Normal - 5 digitals of Frequency, e.g. 8.0000M, 12.000M

Special - All digitals of Frequency, e.g. 13.225625M

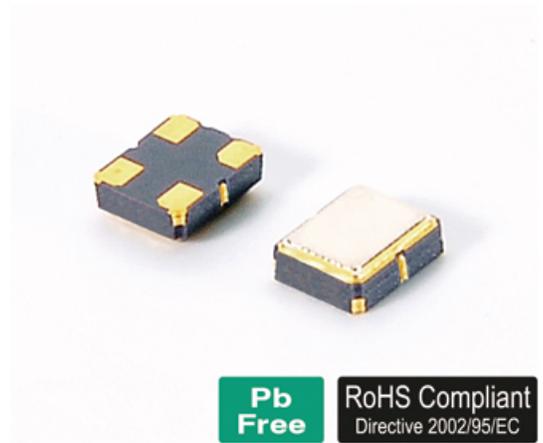
FS (Frequency Stability总频差): 50=±50 ppm, etc

OT (Operating Temperature工作温度): 0070= 0°C to +70°C 4085= -40°C to +85°C, etc

OP (Out put输出): 1=15PF HCMOS 2=10TTL 3=30PF 4=50PF 5=10TTL/15PF

TR (Tape and Reel编带)

S (Special Requirement特殊要求)

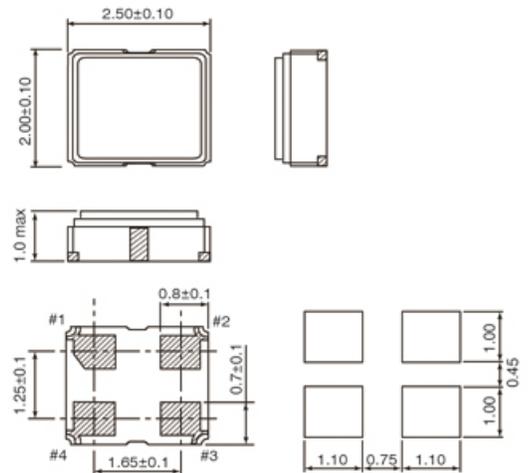


Electrical Specifications 电气参数

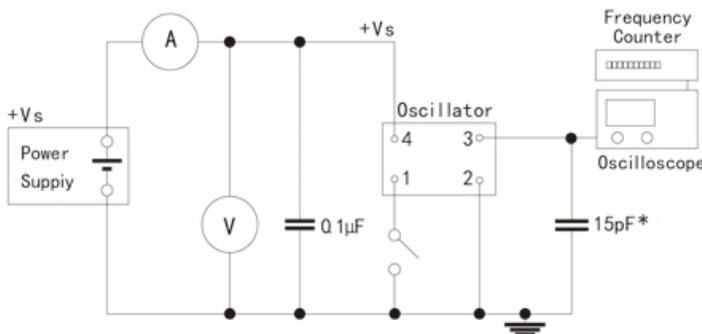
型号	Holder Type	2.5x2.0mm SMD OCILLATOR
频率范围	Frequency Range	1.0000MHz to 60.000MHz
总频差	Frequency Stability	±25ppm to ±50ppm
输入电压	Supply Voltage	5.0V or 3.3V ±10%
工作温度范围	Operating Temperature Range	-10°C ~ +60°C to -40°C ~ +85°C
储存温度范围	Storage Temperature Range	-40°C ~ +85°C / -55°C ~ +125°C
占空比	Symmetry (Duty Cycle)	40/60 Standard
输出	Output Load	15pF HCMOS or 10TTL
消耗电流	Current Consumption (15pf only)	1.0000MHz ~ 60.000MHz=15mA Max
	(5.0V)	
	Current Consumption (15pf only)	1.0000MHz ~ 60.000MHz=10mA Max
	(1.8V 2.5V 2.85V 3.3V)	
上升/下降时间	Rise/Fall Time	10nS Max

Mechanical Dimensions 外型尺寸

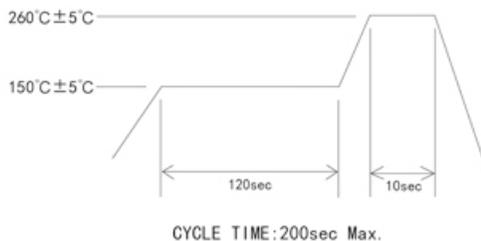
UNIT (单位): mm (毫米)



Test Circuit 测试电路



Reflow Condition 回流焊条件



PIN	FUNCTION
1	N/C or Tri-state
2	Ground
3	Output
4	Vdd

Part Number Guide

T-V-S-FF.FFFM- FS-OT-OP -TU-S

T (Type型号): Q=FULL SIZE (14PIN) OSCILLATOR

V (Input Voltage输入电压): 3=3.3V 5=5.0V, etc

S (Symmetry占空比): 5=45/55 Max 6=40/60 Max

F (Frequency标称频率): Normal - 5 digitals of Frequency, e.g. 8.0000M, 12.000M

Special - All digitals of Frequency, e.g. 13.225625M

FS (Frequency Stability总频差): 50=±50 ppm, etc

OT (Operating Temperature工作温度): 0070= 0°C to +70°C 4085= -40°C to +85°C, etc

OP (Output输出): 1=15PF HCMOS 2=10TTL 3=30PF 4=50PF 5=10TTL/15PF

TU (Tube摆管)

S (Special Requirement特殊要求)

Electrical Specifications 电气参数

型号	Holder Type	FULL SIZE (14PIN) OSCILLATOR
频率范围	Frequency Range	1.0000MHz to 100.00MHz
总频差	Frequency Stability	±25ppm to ±50ppm
输入电压	Supply Voltage	5.0V or 3.3V ±10%
工作温度范围	Operating Temperature Range	-10°C ~ +60°C to -40°C ~ +85°C
储存温度范围	Storage Temperature Range	-40°C ~ +85°C / -55°C ~ +125°C
占空比	Symmetry (Duty Cycle)	40/60 Standard
输出	Output Load 5.0 V	10TTL or 15pF HCMOS
	Output Load 3.3 V	10TTL or 15pF HCMOS
消耗电流	Current Consumption 5.0V (15pf only)	1.0000MHz ~ 36.000MHz=25mA Max
		36.000MHz ~ 70.000MHz=60mA Max
		70.000MHz ~ 100.00MHz=80mA Max
	Current Consumption 3.3V (15pf only)	1.0000MHz ~ 36.000MHz=20mA Max
		36.000MHz ~ 70.000MHz=40mA Max
		70.000MHz ~ 100.00MHz=60mA Max
上升/下降时间	Rise/Fall Time	10nS Max

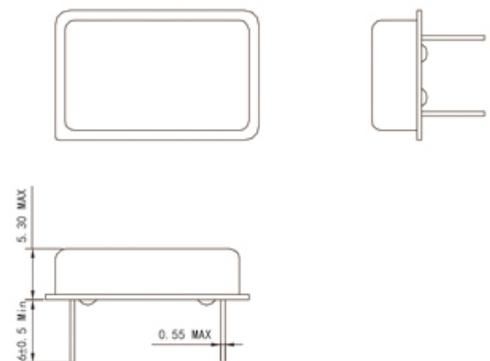


Pb Free

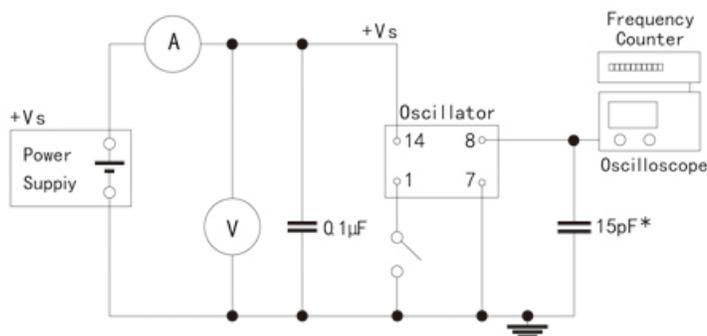
RoHS Compliant
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Mechanical Dimensions 外型尺寸

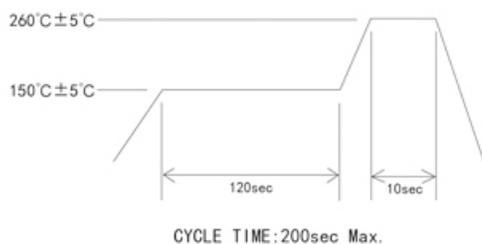
UNIT (单位): mm (毫米)



Test Circuit 测试电路



Reflow Condition 回流焊条件



PIN	FUNCTION
1	N/C or Tri-state
7	Ground
8	Output
14	Vdd

Part Number Guide

T-V-S-FF.FFFM- FS-OT-OP -TU-S

T (Type型号): OB=HALF SIZE (8PIN) OSCILLATOR

V (Input Voltage输入电压): 3=3.3V 5=5.0V, etc

S (Symmetry占空比): 5=45/55 Max 6=40/60 Max

F (Frequency标称频率): Normal - 5 digitals of Frequency, e.g. 8.0000M, 12.000M

Special - All digitals of Frequency, e.g. 13.225625M

FS (Frequency Stability总频差): 50=±50 ppm, etc

OT (Operating Temperature工作温度): 0070= 0°C to +70°C 4085= -40°C to +85°C, etc

OP (Output输出): 1=15PF HCMOS 2=10TTL 3=30PF 4=50PF 5=10TTL/15PF

TU (Tube摆管)

S (Special Requirement特殊要求)

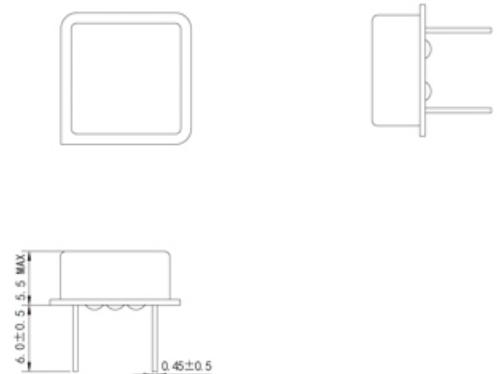


Electrical Specifications 电气参数

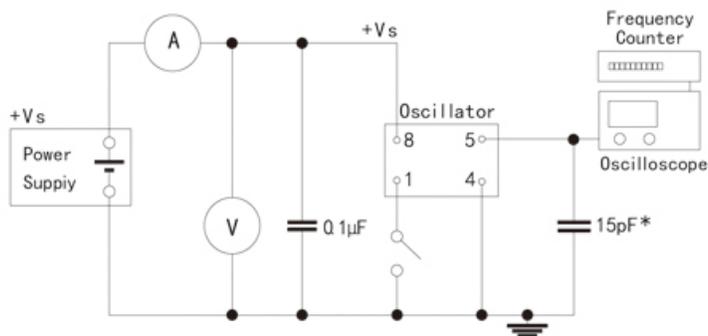
型号	Holder Type	HALF SIZE (8PIN) OSCILLATOR
频率范围	Frequency Range	1.0000MHz to 100.00MHz
总频差	Frequency Stability	±25ppm to ±50ppm
输入电压	Supply Voltage	5.0V or 3.3V ±10%
工作温度范围	Operating Temperature Range	-10°C ~ +60°C to -40°C ~ +85°C
储存温度范围	Storage Temperature Range	-40°C ~ +85°C / -55°C ~ +125°C
占空比	Symmetry (Duty Cycle)	40/60 Standard
输出	Output Load 5.0 V	10TTL or 15pF HCMOS
	Output Load 3.3 V	10TTL or 15pF HCMOS
消耗电流	Current Consumption 5.0V (15pf only)	1.0000MHz - 36.000MHz=25mA Max
		36.000MHz - 70.000MHz=60mA Max
		70.000MHz - 100.00MHz=80mA Max
	Current Consumption 3.3V (15pf only)	1.0000MHz - 36.000MHz=20mA Max
		36.000MHz - 70.000MHz=40mA Max
		70.000MHz - 100.00MHz=60mA Max
上升/下降时间	Rise/Fall Time	10nS Max

Mechanical Dimensions 外型尺寸

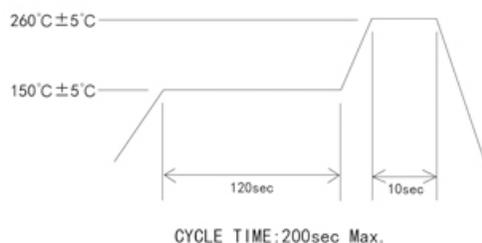
UNIT (单位): mm (毫米)



Test Circuit 测试电路



Reflow Condition 回流焊条件



PIN	FUNCTION
1	N/C or Tri-state
4	Ground
5	Output
8	Vdd

Part Number Guide

T-V-FF.FFFM -FS-OT-Pu-TR-S

T (Type型号): V=5x7 SMD VCXO

V (Input Voltage输入电压): 3=3.3V 5=5.0V, etc

F (Frequency标称频率): Normal - 5 digitals of Frequency, e.g. 8.0000M, 12.000M
Special - All digitals of Frequency, e.g. 13.225625M

FS (Frequency Stability总频差): 50=±50 ppm, etc

OT (Operating Temperature工作温度): 0070=0°C to +70°C 4085=-40°C to +85°C, etc

Pu (Pullability): 100=100ppm, etc

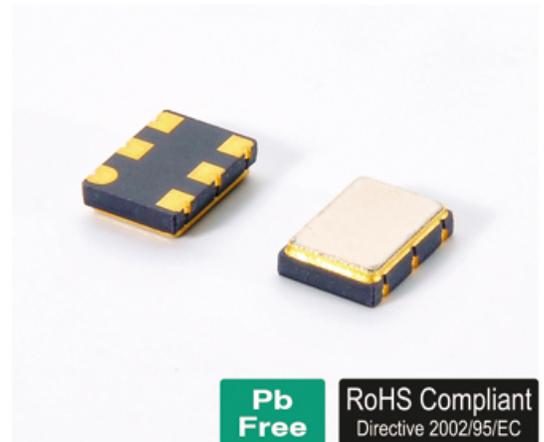
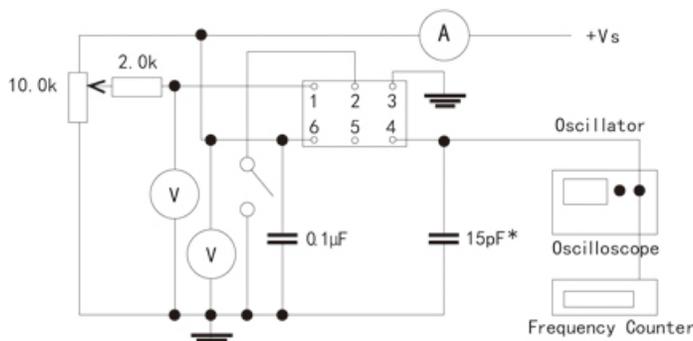
TR (Tape and Reel编带)

S (Special Requirement特殊要求)

Electrical Specifications 电气参数

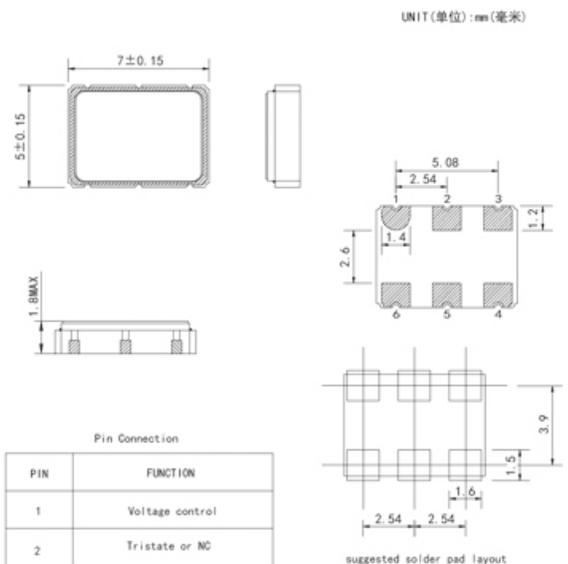
型号	Holder Type	5x7mm SMD VCXO			
频率范围	Frequency Range	F	1,000 to 80,000	80,000 to 250,00	MHz
总频差	Frequency Stability	$\Delta F/F$	±25 to ±50		ppm
输入电压	Input Voltage	Vdd	5.0 or 3.3 ± 10%	3.3 ± 10%	V
控制电压	Control Voltage	Vc	1.65 ± 1.5 or 2.5 ± 2.25	1.65 ± 1.5	V
输入电流	Input Current	Idd	20 Max	35 Max	mA
工作温度范围	Operating Temperature		-10 ~ +60 to -40 ~ +85		°C
贮存温度范围	Storage Temperature		-40 ~ +85 / -55 ~ +125		°C
上升/下降时间	Rise/Fall Time	Tr/Tf	6 Max		ns
占空比	Duty Cycle		40/60 Standard		
线性	Linearity		10% Max		
牵引量	Pullability		±50 ~ ±100		ppm
相位噪声	Phase Noise		-140dBc/Hz@1KHz	-120dBc/Hz@1KHz	
抖动	Rms Jitter (12KHz to 20MHz)		1 Max	2.5 typ	Ps
典型频率	Typical Frequency		2.048 16.384 32.768 61.44 70.656 77.76	125 155.52 156.25 200	MHz

Test Circuit 测试电路

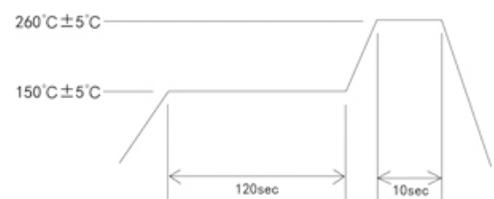


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Mechanical Dimensions 外型尺寸



Reflow Condition 回流焊条件



CYCLE TIME: 200sec Max.

Part Number Guide

T-V-FF.FFFM -FS-OT-Pu-D-TR-S

T (Type型号): VH=5X7 SMD VCXO, PECL/LVDS Output

V (Input Voltage输入电压): 3=3.3V

F (Frequency标称频率): Normal - 5 digitals of Frequency, e.g. 8.0000M, 12.000M
Special - All digitals of Frequency, e.g. 13.225625M

FS (Frequency Stability总频差): 50=±50 ppm, etc

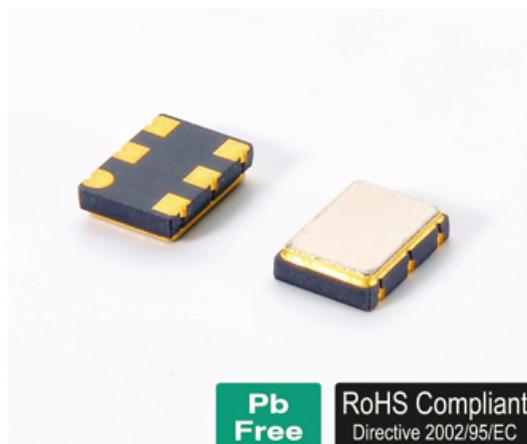
OT (Operating Temperature工作温度): 0070=0°C to +70°C 4085=-40°C to +85°C, etc

Pu (Pullability): 100=100ppm, etc

D (Output输出模式): D=LVDS

TR (Tape and Reel编带)

S (Special Requirement特殊要求)

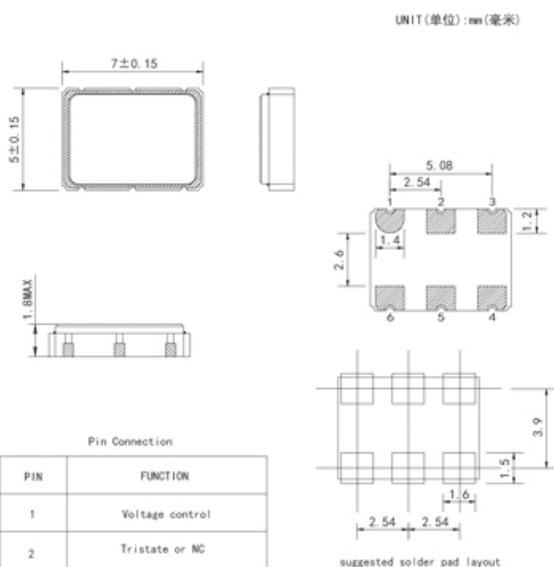


Pb Free **RoHS Compliant**
Directive 2002/95/EC

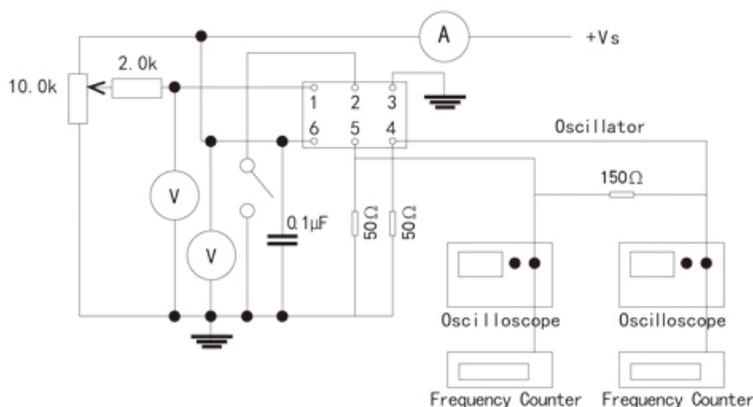
Electrical Specifications 电气参数

型号	Holder Type	5x7mm SMD VCXO(LVDS)			
频率范围	Frequency Range	F	1,000 to 80,000	60,000 to 250.00	MHz
总频差	Frequency Stability	$\Delta F/F$	±25 to ±50		ppm
输入电压	Input Voltage	V _{dd}	3.3 ± 10%		V
控制电压	Control Voltage	V _c	1.65 ± 1.5 or 2.5 ± 2.25		V
输入电流	Input Current	I _{dd}	40 Max	70 Max	mA
工作温度范围	Operating Temperature		-10 ~ +60 to -40 ~ +85		°C
贮存温度范围	Storage Temperature		-40 ~ +85 / -55 ~ +125		°C
上升/下降时间	Rise/Fall Time	T _r /T _f	1.5 Max		ns
占空比	Duty Cycle		40/60 Standard		
线性	Linearity		10% Max		
牵引量	Pullability		±50 ~ ±100		ppm
相位噪声	Phase Noise		-130dBc/Hz@1KHz	-110dBc/Hz@1KHz	
抖动	Rms Jitter (12KHz to 20MHz)		0.25 typ	0.25 typ	Ps
典型频率	Typical Frequency		61.44 77.56	120.88 155.52 156.25 200	MHz

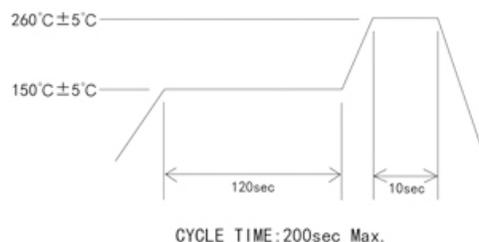
Mechanical Dimensions 外型尺寸



Test Circuit 测试电路



Reflow Condition 回流焊条件



Part Number Guide

T-V-FF.FFFM -FS-OT-Pu-P-TR-S

T (Type型号): VH=5X7 SMD VCXO, PECL/LVDS Output

V (Input Voltage输入电压): 3=3.3V

F (Frequency标称频率): Normal - 5 digitals of Frequency, e.g. 8.0000M, 12.000M
Special - All digitals of Frequency, e.g. 13.225625M

FS (Frequency Stability总频差): 50=±50 ppm, etc

OT (Operating Temperature工作温度): 0070=0°C to +70°C 4085=-40°C to +85°C, etc

Pu (Pullability): 100=100ppm, etc

P (Output输出模式): P=PECL

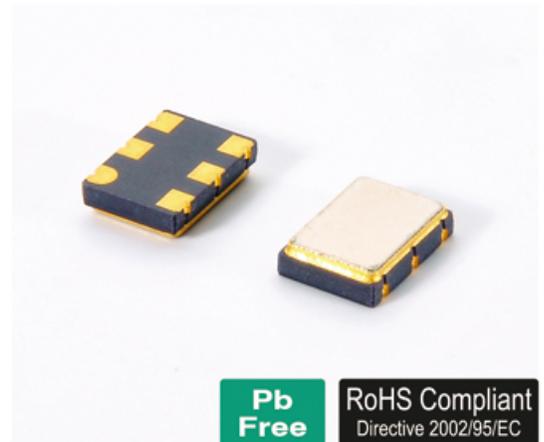
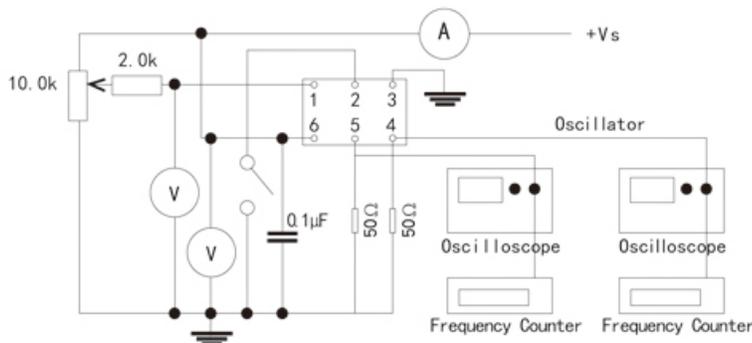
TR (Tape and Reel编带)

S (Special Requirement特殊要求)

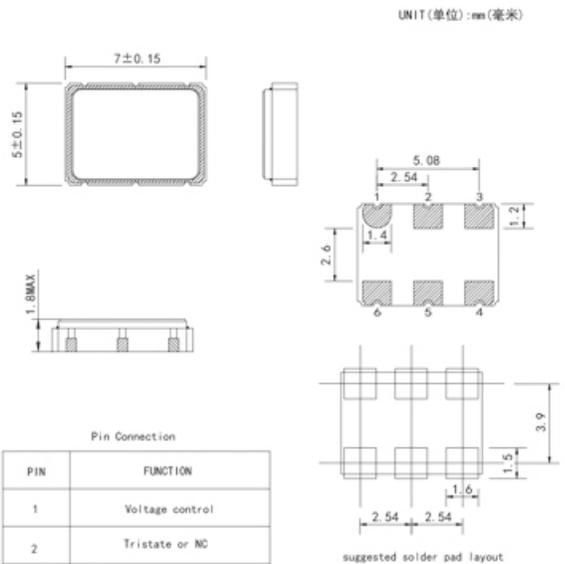
Electrical Specifications 电气参数

型号	Holder Type	5x7mm SMD VCXO(PECL)			
频率范围	Frequency Range	F	1,000 to 80,000	60,000 to 250,00	MHz
总频差	Frequency Stability	$\Delta F/F$	±25 to ±50		ppm
输入电压	Input Voltage	Vdd	3.3 ± 10%		V
控制电压	Control Voltage	Vc	1.65 ± 1.5 or 2.5 ± 2.25		V
输入电流	Input Current	Idd	40 Max	70 Max	mA
工作温度范围	Operating Temperature		-10 ~ +60 to -40 ~ +85		°C
贮存温度范围	Storage Temperature		-40 ~ +85 / -55 ~ +125		°C
上升/下降时间	Rise/Fall Time	Tr/Tf	1.5 Max		ns
占空比	Duty Cycle		40/60 Standard		
线性	Linearity		10% Max		
牵引量	Pullability		±50 ~ ±100		ppm
相位噪声	Phase Noise		-130dBc/Hz@1KHz	-110dBc/Hz@1KHz	
抖动	Rms Jitter (12KHz to 20MHz)		0.25 typ	0.25 typ	Ps
典型频率	Typical Frequency		61.44 77.56	120.88 155.52 156.25 200	MHz

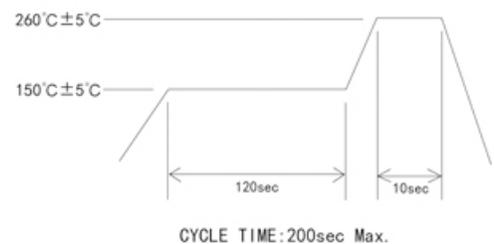
Test Circuit 测试电路



Mechanical Dimensions 外型尺寸



Reflow Condition 回流焊条件



Part Number Guide

T-V-FF.FFFM -FS-OT-Pu-TR-S

T (Type型号): VA=5x3.2 SMD VCXO

V (Input Voltage输入电压): 3=3.3V 5=5.0V, etc

F (Frequency标称频率): Normal - 5 digitals of Frequency, e.g. 8.0000M, 12.000M
Special - All digitals of Frequency, e.g. 13.225625M

FS (Frequency Stability总频差): 50=±50 ppm, etc

OT (Operating Temperature工作温度): 0070=0°C to +70°C 4085=-40°C to +85°C, etc

Pu (Pullability): 100=100ppm, etc

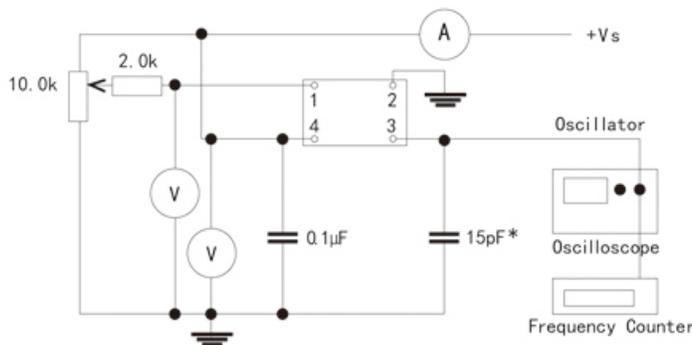
TR (Tape and Reel编带)

S (Special Requirement特殊要求)

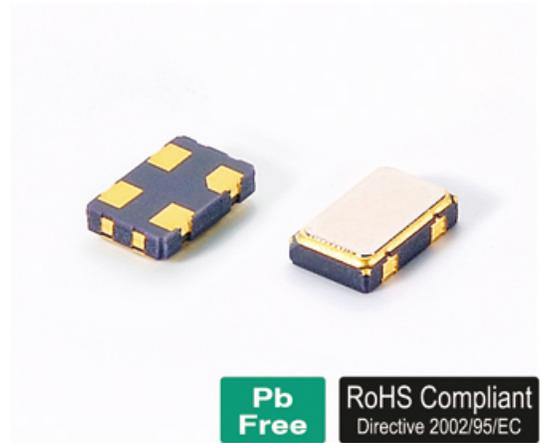
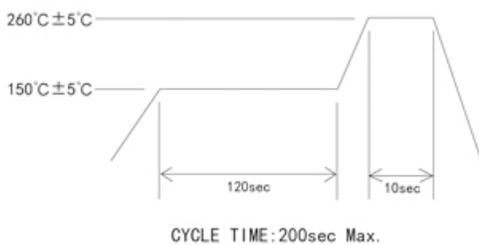
Electrical Specifications 电气参数

型号	Holder Type	5x3.2mm SMD VCXO		
频率范围	Frequency Range	F	1.7500 to 50.000	MHz
总频差	Frequency Stability	$\Delta F/F$	±25 to ±50	ppm
输入电压	Input Voltage	Vdd	5.0 or 3.3 ± 10%	V
控制电压	Control Voltage	Vc	1.65±1.5 or 2.5±2.25	V
输入电流	Input Current	Idd	35 Max	mA
工作温度范围	Operating Temperature		-10 ~ +60 to -40 ~ +85	°C
贮存温度范围	Storage Temperature		-40 ~ +85 / -55 ~ +125	°C
上升/下降时间	Rise/Fall Time	Tr/Tf	6 Max	ns
占空比	Duty Cycle		40/60 Standard	
线性	Linearity		10%Max	
牵引量	Pullability		±50 ~ ±100	ppm

Test Circuit 测试电路

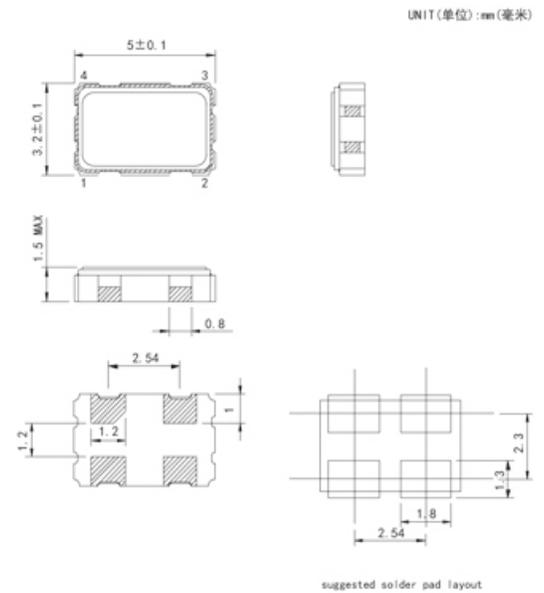


Reflow Condition 回流焊条件



Pb Free **RoHS Compliant**
Directive 2002/95/EC

Mechanical Dimensions 外型尺寸



PIN	FUNCTION
1	N/C or Tri-state
2	Ground
3	Output
4	Vdd

Part Number Guide

T-V-FF.FFFM-OT-TR-S

T (Type型号): TC=3.2×2.5 SMD VCTCXO

V (Input Voltage输入电压): 3=3.3V, 5=5.0V, etc

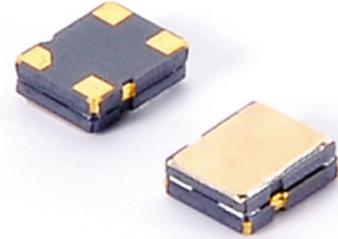
F (Frequency标称频率): Normal - 5 digitals of Frequency, e.g. 8.0000M, 12.000M

Special - All digitals of Frequency, e.g. 13.225625M

OT (Operating Temperature工作温度): 0070=0°C to +70°C 4085=-40°C to +85°C, etc

TR (Tape and Reel编带)

S (Special Requirement特殊要求)

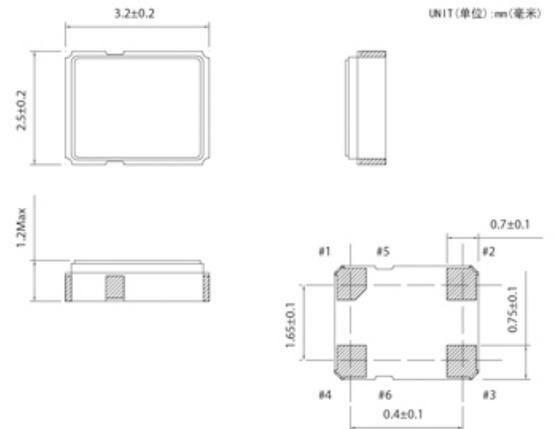


Electrical Specifications 电气参数

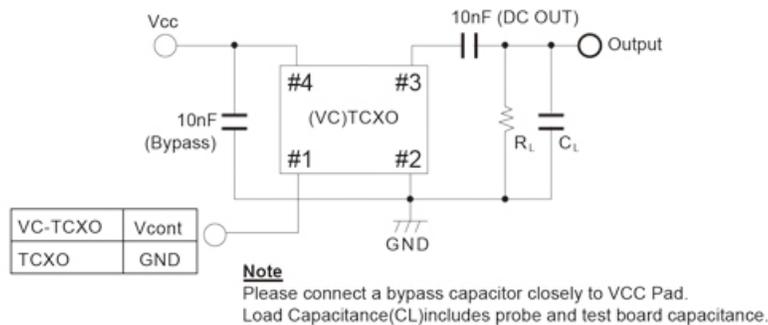
型号	Holder Type	3.2×2.5 SMD VCTCXO
频率范围	Frequency Range	8.0000MHz to 52.0000MHz
典型频点	Typical Frequency	13.000MHz/19.200MHz/19.680MHz/26.000MHz
输入电压	Supply Voltage (VCC)	+1.68V to +3.3V
工作温度范围	Operating Temperature Range	-10°C ~ +60°C to -40°C ~ +85°C
储存温度范围	Storage Temperature Range	-40°C ~ +85°C / -55°C ~ +125°C
负载	Load	(10 kΩ // 10 pF) ± 10 %
频率偏差	Frequency Tolerance	1.0, 2.5ppm Max
频率稳定度	Frequency Stability	0.5, 1.0, 2.5ppm Max
	vs. Supply Voltage	± 0.1ppm Max (VCC ± 5%)
	vs. Load	± 0.2ppm Max (10kΩ // 10pF ± 10% each)
老化	Aging	± 1ppm/year Max
消耗电流	Current Consumption	2.0mA Max
相位噪声	Phase Noise	
	100Hz offset typical	-115dBc/Hz Max
	1KHz offset typical	-125dBc/Hz Max
	10KHz offset typical	-135dBc/Hz Max



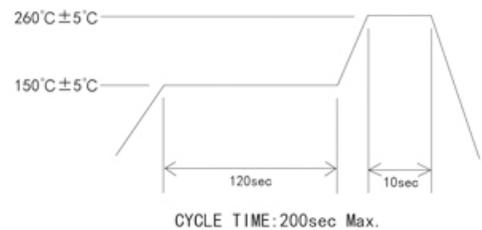
Mechanical Dimensions 外型尺寸



Test Circuit 测试电路



Reflow Condition 回流焊条件



Part Number Guide

T-OT-TS-V-W-VC-FF.FFFM-H-S

T (Type型号): OXA=OCXO3627

OT (Operating Temperature工作温度): B=-40°C to 85°C
F=-20°C to 70°C G=0°C to 70°C

TS (Temperature Stability温度稳定度): O20=20ppb

V (Supply Voltage工作电压): 33=3.3V 05=5.0V 12=12V

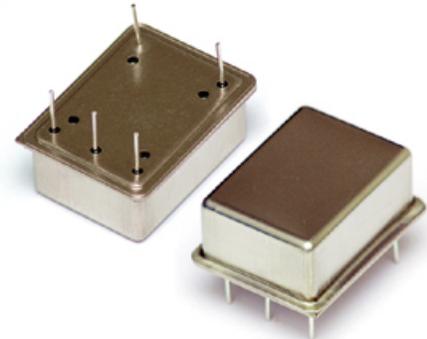
W (Output Wave Form输出波形): H=HCOMS S=SINE

VC (Vc or Nc有无压控): V=Voltage Control N=Nc

F (Frequency标称频率): Normal - 5 digitals of Frequency, e.g. 10.000M, 100.00M
Special - All digitals of Frequency, e.g. 13.225625M

H (Height高度): A=12.15mm B=13.65mm

S (Special Requirement特殊要求)

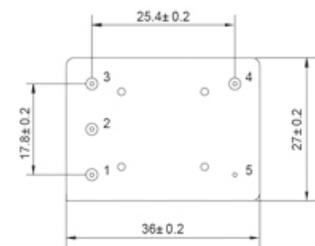
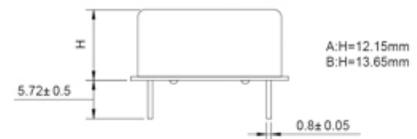


Electrical Specifications 电气参数

型号	Holder Type	OCXO-A			
模式	Model	SC-cut/AT-cut			
频率范围	Frequency Range	10.000MHz to 100.00MHz			
温度范围	Temperature Range	-40°C to 85°C -20°C to 70°C 0°C to 70°C			
温度稳定性	Temperature Stability	AT cut 100PPB 50PPB 20PPB			
		SC cut 20PPB 10PPB 5PPB			
输入电压	Supply Voltage	+3.3V +5.0V +12V			
日老化率	Aging/Day	2ppb to 0.5ppb			
年老化率	Aging/Year	0.1ppm to 0.05ppm			
预热功率	Warm-up Power	5 W			
预热时间	Warm-up Time	5 minutes to better than 0.1 PPM of operating frequency			
		10 minutes to better than 0.05 PPM of steady state frequency at 4 hours			
稳态功率	Steady State Power (25 C)	<1.5 Watts			
老化调整	Aging Adjustment	External potentiometer / DAC / Synchronization			
调整范围	Adjustment Range	0.5 PPM Min. 2.0 PPM Max.			
中心电压	Center Voltage	2.5V for 5V, 12V Input			
		1.65V for 3.3V Input			
斜率	Slope	Positive			
相位噪声	Phase Noise @(at 10.000 MHz)	AT cut		SC cut	
	Output Wave Form	SINE	HCOMS	SINE	HCOMS
	1 Hz	-75 dBc/Hz	-65 dBc/Hz	-90 dBc/Hz	-90 dBc/Hz
	10 Hz	-100 dBc/Hz	-90 dBc/Hz	-120 dBc/Hz	-115 dBc/Hz
	100 Hz	-130 dBc/Hz	-125 dBc/Hz	-135 dBc/Hz	-135 dBc/Hz
	1k Hz	-140 dBc/Hz	-135 dBc/Hz	-150 dBc/Hz	-140 dBc/Hz
	10k Hz	-150 dBc/Hz	-145 dBc/Hz	-150 dBc/Hz	-145 dBc/Hz
	100k Hz	-150 dBc/Hz	-145 dBc/Hz	-150 dBc/Hz	-145 dBc/Hz
输出波形	Output Wave Form	Sine/HCOMS			
	Spurious	-75 dBc			
寄生	Harmonics	-30 dBc			
负载	Load	50 ohms SINE/15PF HCOMS			

Mechanical Dimensions 外型尺寸

UNIT (单位): mm (毫米)



Pin Connection

PIN	FUNCTION
1	Control Voltage or N/C
2	Reference Voltage or N/C
3	Vcc
4	Output
5	GND

Part Number Guide

T-OT-TS-V-W-VC-FF.FFFM-S

T (Type) : OXB=OCXO2525

OT (Operating Temperature工作温度) : B=-40°C to 85°C
F=-20°C to 70°C G=0°C to 70°C

TS (Temperature Stability温度稳定度) : O20=20ppb

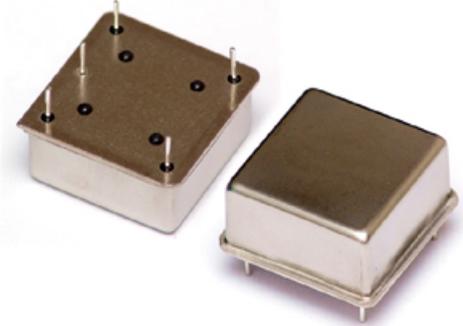
V (Supply Voltage工作电压) : 33=3.3V 05=5.0V 12=12V

W (Output Wave Form输出波形) : H=HCOMS S=SINE

VC (Vc or Nc有无压控) : V=Voltage Control N=Nc

F (Frequency标称频率) : Normal - 5 digitals of Frequency, e.g. 10.000M, 100.00M
Special - All digitals of Frequency, e.g. 13.225625M

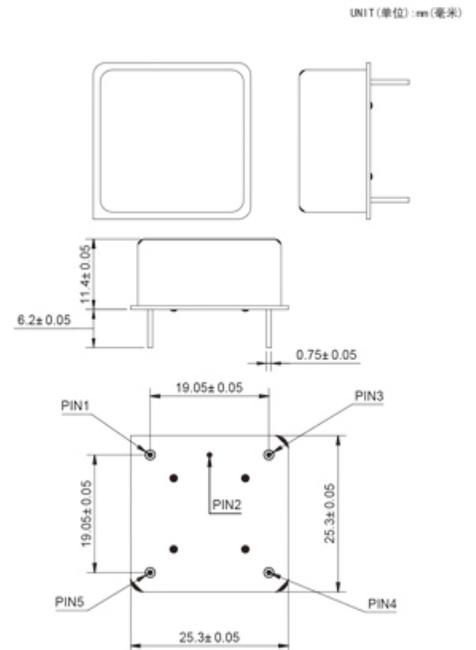
S (Special Requirement特殊要求)



Electrical Specifications 电气参数

型号	Holder Type	OCXO-B			
模式	Model	SC-cut/AT-cut			
频率范围	Frequency Range	10.000MHz to 100.00MHz			
温度范围	Temperature Range	-40°C to 85°C -20°C to 70°C 0°C to 70°C			
温度稳定性	Temperature Stability	AT cut		100PPB 50PPB	
		SC cut		20PPB 10PPB	
输入电压	Supply Voltage	+3.3V +5.0V +12V			
日老化率	Aging/Day	2ppb to 0.5ppb			
年老化率	Aging/Year	0.1ppm to 0.05ppm			
预热功率	Warm-up Power	5 W			
预热时间	Warm-up Time	5 minutes to better than 0.1 PPM of operating frequency			
		10 minutes to better than 0.05 PPM of steady state frequency at 4 hours			
稳态功率	Steady State Power (25 C)	<1.5 Watts			
老化调整	Aging Adjustment	External potentiometer / DAC / Synchronization			
调整范围	Adjustment Range	0.5 PPM Min. 2.0 PPM Max.			
中心电压	Center Voltage	2.5V for 5V,12V Input			
		1.65V for 3.3V Input			
斜率	Slope	Positive			
相位噪声	Phase Noise @(at 10.000 MHz)	AT cut		SC cut	
	Output Wave Form	SINE	HCOMS	SINE	HCOMS
	1 Hz	-75 dBc/Hz	-65 dBc/Hz	-90 dBc/Hz	-90 dBc/Hz
	10 Hz	-100 dBc/Hz	-90 dBc/Hz	-120 dBc/Hz	-115 dBc/Hz
	100 Hz	-130 dBc/Hz	-125 dBc/Hz	-135 dBc/Hz	-135 dBc/Hz
	1k Hz	-140 dBc/Hz	-135 dBc/Hz	-150 dBc/Hz	-140 dBc/Hz
	10k Hz	-150 dBc/Hz	-145 dBc/Hz	-150 dBc/Hz	-145 dBc/Hz
100k Hz	-150 dBc/Hz	-145 dBc/Hz	-150 dBc/Hz	-145 dBc/Hz	
输出波形	Output Wave Form	Sine/HCOMS			
	Spurious	-75 dBc			
寄生	Harmonics	-30 dBc			
负载	Load	50 ohms SINE/15PF HCOMS			
功率	Power	0 dBm (higher levels available with 12 VDC version)			

Mechanical Dimensions 外型尺寸



Pin Connection

PIN	FUNCTION
1	Output
2	GND
3	Control Voltage or N/C
4	Reference Voltage or N/C
5	Vcc

Part Number Guide

T-OT-TS-V-W-VC-FF.FFFM-S

T (Type) : OXC=OCXO2020

OT (Operating Temperature/工作温度) : B=-40°C to 85°C
F=-20°C to 70°C G=0°C to 70°C

TS (Temperature Stability/温度稳定度) : 020=20ppb

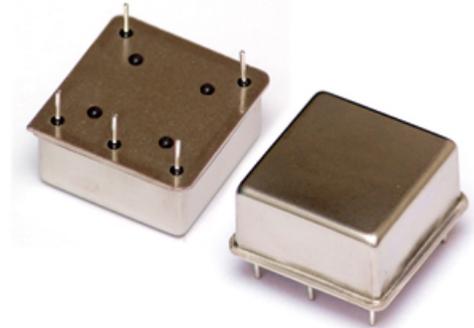
V (Supply Voltage/工作电压) : 33=3.3V 05=5.0V 12=12V

W (Output Wave Form/输出波形) : H=HCOMS S=SINE

VC (Vc or Nc有无压控) : V=Voltage Control N=Nc

F (Frequency/标称频率) : Normal - 5 digitals of Frequency, e.g. 10.000M
Special - All digitals of Frequency, e.g. 13.225625M

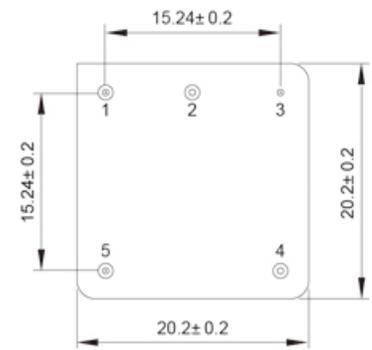
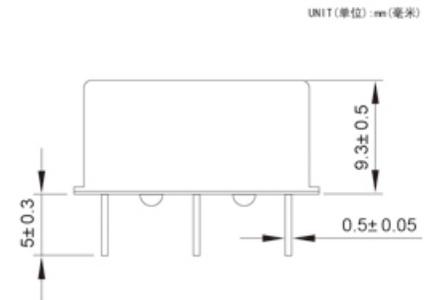
S (Special Requirement/特殊要求)



Electrical Specifications 电气参数

型号	Holder Type	OCXO-C	
模式	Model	SC-Cut/AT-Cut	
频率范围	Frequency Range	10.000MHz to 60.000MHz	
温度范围	Temperature Range	-40°C to 85°C -20°C to 70°C 0°C to 70°C	
温度稳定性	Temperature Stability	AT-Cut 250PPB 100PPB	
		SC-Cut 100PPB 50PPB 20PPB	
工作电压	Supply Voltage	+3.3V +5.0V +12V	
日老化率	Aging/Day	0.01ppm to 0.5ppb	
年老化率	Aging/Year	± 1ppm to ± 0.5ppm	
预热功率	Warm-up Power	5 W	
预热时间	Warm-up Time	5 minutes to better than ± 100ppb of final frequency (4 hours reading)@+25°C	
稳态功率	Steady State Power (25°C)	1 W to 1.5 W (@+25°C)	
老化调整	Aging Adjustment	External potentiometer / DAC / Synchronization	
调整范围	Adjustment Range	0.5 ppm Min. 4.0 ppm Max.	
中心电压	Center Voltage	1.65V for 3.3V Input	
		2.5V for 5.0V, 12V Input	
斜率	Slope	Positive	
相位噪声	Phase Noise @(at 10.000 MHz)	AT cut	SC cut
	1 Hz	-65 dBc/Hz	-90 dBc/Hz
	10 Hz	-90 dBc/Hz	-115 dBc/Hz
	100Hz	-125 dBc/Hz	-135 dBc/Hz
	1k Hz	-135 dBc/Hz	-140 dBc/Hz
	10k Hz	-145 dBc/Hz	-145 dBc/Hz
100k Hz	-145 dBc/Hz	-145 dBc/Hz	
输出波形	Output Wave Form	HCMOS	
输出负载	Output Load	15pf HCMOS	

Mechanical Dimensions 外型尺寸



Pin Connection

PIN	FUNCTION
1	VCC
2	Output
3	GND
4	Control Voltage or N/C
5	Reference Voltage or N/C

Part Number Guide

T-OT-TS-V-W-VC-FF.FFFM-S

T (Type) : OXD=OCXODip14&PTH

OT (Operating Temperature工作温度) : B=-40°C to 85°C
F=-20°C to 70°C G=0°C to 70°C

TS (Temperature Stability温度稳定度) : 020=20ppb

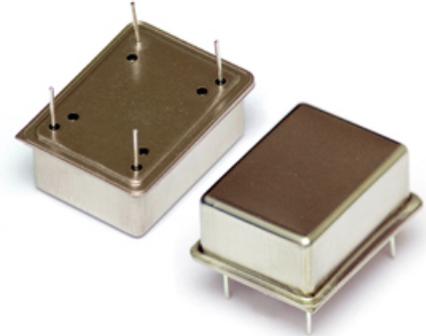
V (Supply Voltage工作电压) : 33=3.3V 05=5.0V 12=12V

W (Output Wave Form输出波形) : H=HCMOS S=SINE

VC (Vc or Nc有无压控) : V=Voltage Control N=Nc

F (Frequency标称频率) : Normal - 5 digitals of Frequency, e.g. 10.000M
Special - All digitals of Frequency, e.g. 13.225625M

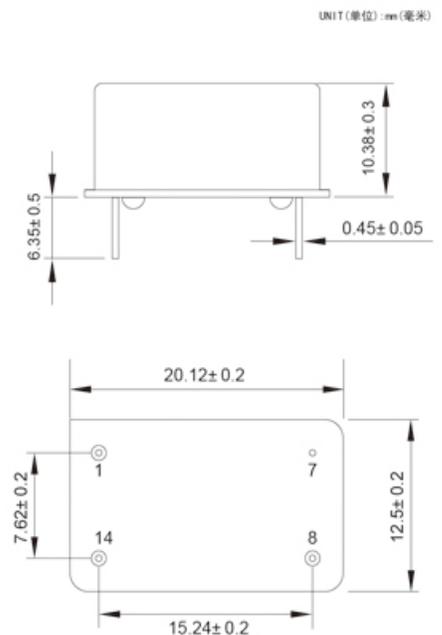
S (Special Requirement特殊要求)



Electrical Specifications 电气参数

型号	Holder Type	OCXO-D
模式	Model	AT-Cut
频率范围	Frequency Range	10,000MHz to 60,000MHz
温度范围	Temperature Range	-40°C to 85°C -20°C to 70°C 0°C to 70°C
温度稳定性	Temperature Stability	250PPB/100PPB
工作电压	Supply Voltage	+3.3V +5.0V
日老化率	Aging/Day	± 0.01ppm
年老化率	Aging/Year	± 1ppm to ± 0.5ppm
预热功率	Warm-up Power	3 W
预热时间	Warm-up Time	3 minutes to better than ± 200ppb of final frequency (4 hours reading)@+25°C
稳态功率	Steady State Power (25°C)	1.2 W (@+25°C)
老化调整	Aging Adjustment	External potentiometer / DAC / Synchronization
调整范围	Adjustment Range	≥ ± 4ppm
中心电压	Center Voltage	1.65V for 3.3V Input 2.5V for 5.0V Input
斜率	Slope	1Hz offset from the carrier < -65dBc/Hz
相位噪声	Phase Noise	10Hz offset ≤ -90dBc/Hz
		100Hz offset ≤ -125dBc/Hz
		1K offset ≤ -135dBc/Hz
		10K offset ≤ -145dBc/Hz
输出波形	Output Wave Form	HCMOS
输出负载	Output Load	15pf HCMOS

Mechanical Dimensions 外型尺寸



Pin Connection

PIN	FUNCTION
1	Control Voltage
7	GND
8	Output
14	VCC

Part Number Guide

T-OT-TS-V-W-VC-FF.FFFM-S

T (Type) : OXE=OCXODip14&SMD

OT (Operating Temperature工作温度) : B=-40°C to 85°C
F=-20°C to 70°C G=0°C to 70°C

TS (Temperature Stability温度稳定度) : 020=20ppb

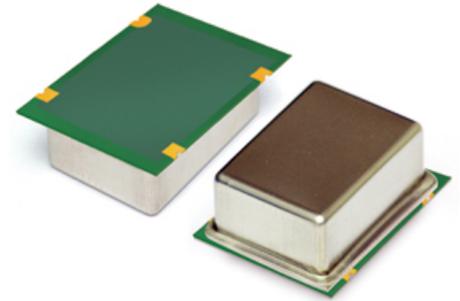
V (Supply Voltage工作电压) : 33=3.3V 05=5.0V 12=12V

W (Output Wave Form输出波形) : H=HCMOS S=SINE

VC (Vc or Nc有无压控) : V=Voltage Control N=Nc

F (Frequency标称频率) : Normal - 5 digitals of Frequency, e.g. 10.000M
Special - All digitals of Frequency, e.g. 13.225625M

S (Special Requirement特殊要求)

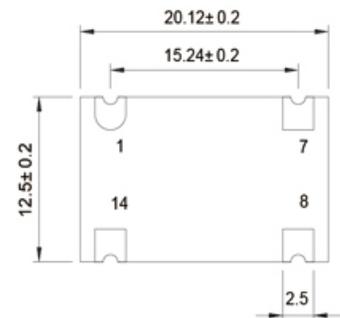


Electrical Specifications 电气参数

型号	Holder Type	OCXO-E
模式	Model	AT-Cut
频率范围	Frequency Range	10.000MHz to 60.000MHz
温度范围	Temperature Range	-40°C to 85°C -20°C to 70°C 0°C to 70°C
温度稳定性	Temperature Stability	250PPB/100PPB
工作电压	Supply Voltage	+3.3V +5.0V
日老化率	Aging/Day	± 0.01ppm
年老化率	Aging/Year	± 1ppm to ± 0.5ppm
预热功率	Warm-up Power	3 W
预热时间	Warm-up Time	3 minutes to better than ± 200ppb of final frequency (4 hours reading)@+25°C
稳态功率	Steady State Power (25°C)	1.2 W (@+25°C)
老化调整	Aging Adjustment	External potentiometer / DAC / Synchronization
调整范围	Adjustment Range	≥ ± 4ppm
中心电压	Center Voltage	1.65V for 3.3V Input 2.5V for 5.0V Input
斜率	Slope	Positive
相位噪声	Phase Noise	1Hz offset from the carrier <-65dBc/Hz
		10Hz offset ≤ -90dBc/Hz
		100Hz offset ≤ -125dBc/Hz
		1K offset ≤ -135dBc/Hz
		10K offset ≤ -145dBc/Hz
输出波形	Output Wave Form	HCMOS
输出负载	Output Load	15pf HCMOS

Mechanical Dimensions 外型尺寸

UNIT (单位) : mm (毫米)



Pin Connection

PIN	FUNCTION
1	Control Voltage
7	GND
8	Output
14	Vcc



TECHNOLOGY

CEC
PANDA
CRYSTAL

Part Number Guide

T-M-FF.FFFM-PBW-Pole-S

T (Type型号): F=UM - 1 Filter

M (Mode of Operation振荡模式): F=Fundamental T=Third Overtone, etc

F (Frequency标称频率): Normal - 5 digitals of Frequency, e.g. 10.000M

Special - All digitals of Frequency, e.g. 13.225625M

PBW (Pass Bandwidth通带宽度): 08=±3.75KHz 15=±7.50KHz 09=±4.50KHz

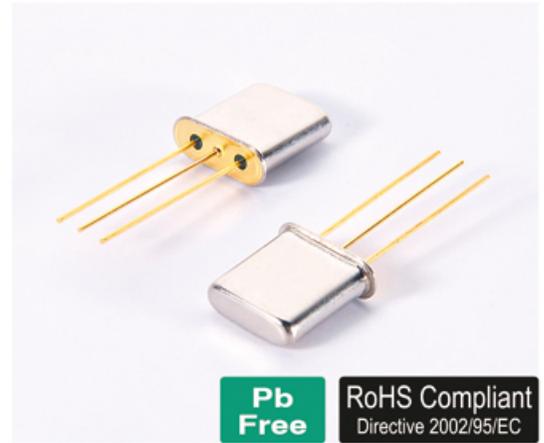
20=±10.00KHz 12=±6.00KHz 30=±15.00KHz

Pole (极点): A=2 Poles B=4 Poles

S (Special Requirement特殊要求)

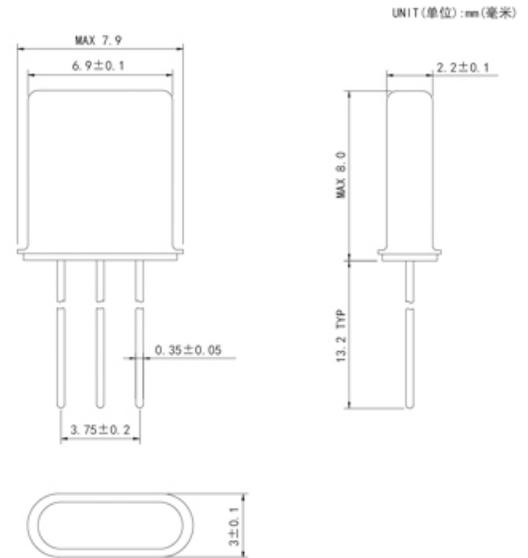
Electrical Specifications 电气参数

型号	Holder Type	UM-1 Filter
标称频率	Nominal Frequency	10.7MHz 16.9MHz 21.4MHz 21.6MHz 21.7MHz 44.85MHz 45MHz
通带宽度	Pass Band Width	±3.75KHz ±4.50KHz ±6.00KHz ±7.50KHz ±10.00KHz ±15.00KHz (at-3db)
阻带宽度	Stop Band Width	Determined by customer
带内波动	Ripple	0.5db 1.0db
插入损耗	Insertion Loss	1.0db 2.0db
终端阻抗	Terminal Impedance	Determined by customer
工作温度范围	Operating Temperature	-20°C to +70°C
极点	Pole	2Poles/4Poles



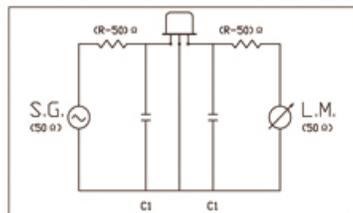
Pb Free **RoHS Compliant**
Directive 2002/95/EC

Mechanical Dimensions 外型尺寸

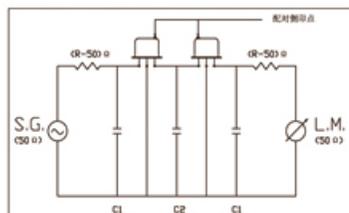


Test Circuit 测试电路

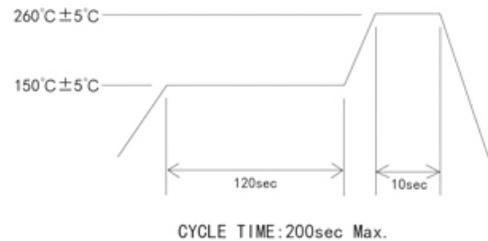
Test Circuit (2 Poles) 测试电路 (2引脚)



Test Circuit (4 Poles) 测试电路 (4引脚)



Reflow Condition 回流焊条件



Part Number Guide

T-M-FF.FFFM-PBW-Pole-S

T (Type型号): E=UM - 5 Filter

M (Mode of Operation振荡模式): F=Fundamental T=Third Overtone, etc

F (Frequency标称频率): Normal - 5 digitals of Frequency, e.g. 10,000M

Special - All digitals of Frequency, e.g. 13,225625M

PBW (Pass Bandwidth通带宽度): 08=±3,75KHz 15=±7,50KHz 09=±4,50KHz

20=±10,00KHz 12=±6,00KHz 30=±15,00KHz

Pole (极点): A=2 Poles B=4 Poles

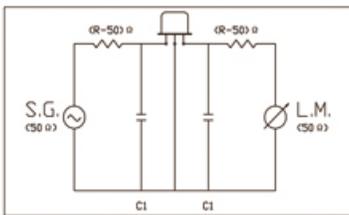
S (Special Requirement特殊要求)

Electrical Specifications 电气参数

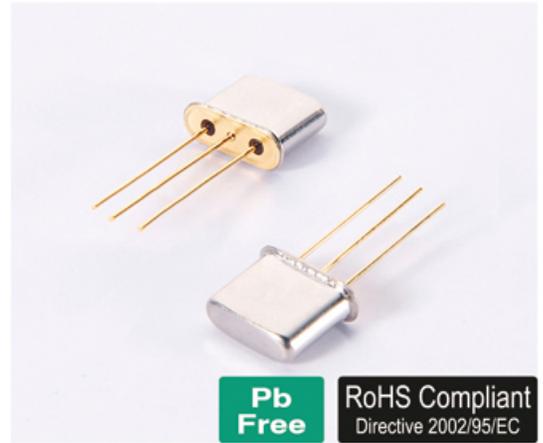
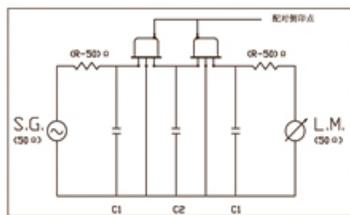
型号	Holder Type	UM-5 Filter
标称频率	Nominal Frequency	10,7MHz 16,9MHz 21,4MHz 21,6MHz 21,7MHz 45MHz
通带宽度	Pass Band Width	±3,75KHz ±4,50KHz ±6,00KHz ±7,50KHz ±10,00KHz ±15,00KHz (at-3db)
阻带宽度	Stop Band Width	Determined by customer
带内波动	Ripple	0,5db 1,0db
插入损耗	Insertion Loss	1,0db 2,0db
终端阻抗	Terminal Impedance	Determined by customer
工作温度范围	Operating Temperature	-20°C to +70°C
极点	Pole	2Poles/4Poles

Test Circuit 测试电路

Test Circuit (2 Pole) 测试电路 (2引脚)



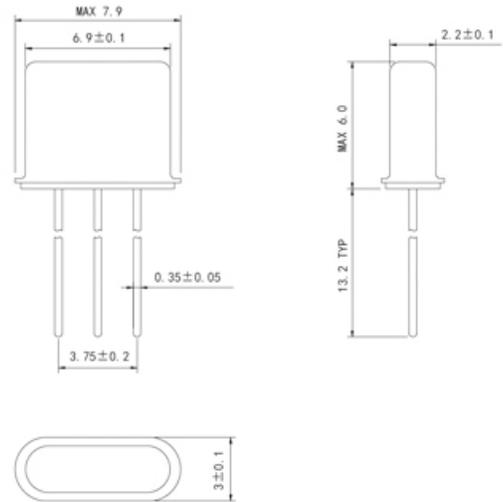
Test Circuit (4 Pole) 测试电路 (4引脚)



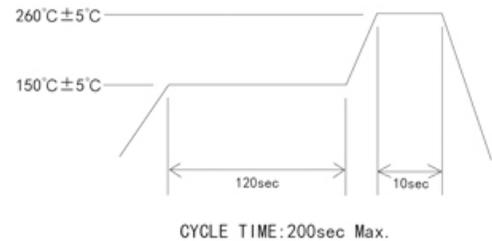
Pb Free **RoHS Compliant**
Directive 2002/95/EC

Mechanical Dimensions 外型尺寸

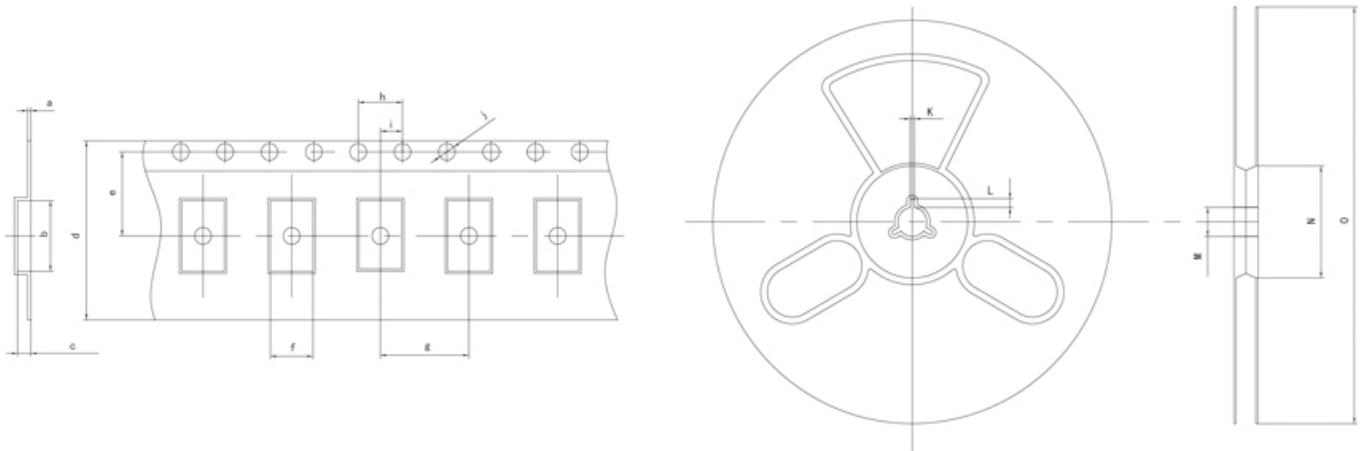
UNIT (单位): mm (毫米)



Reflow Condition 回流焊条件



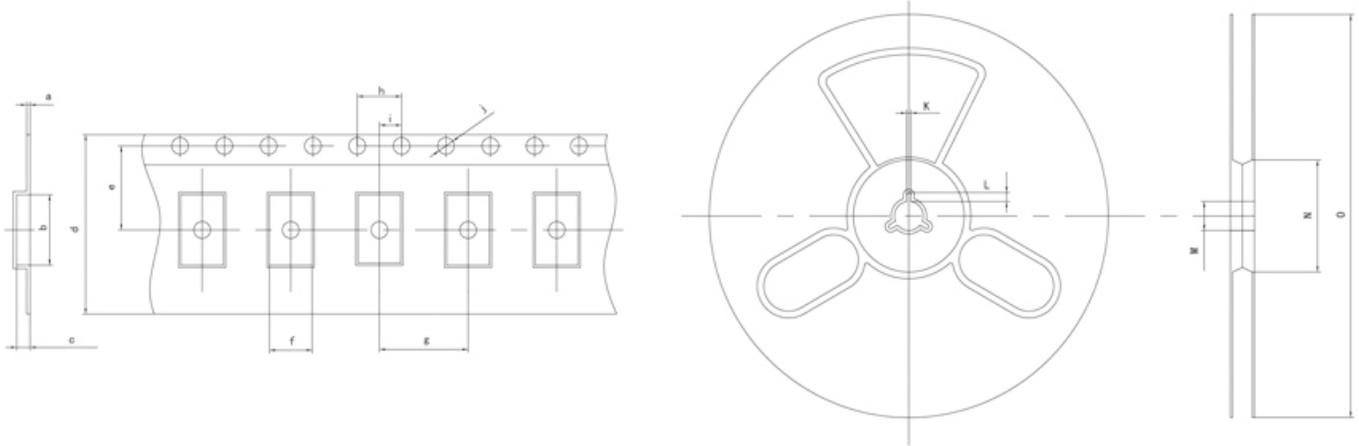
•SMD Crystal



UNIT (单位): mm (毫米)

CRYSTALS	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	SPQ
7,0X5,0 SMD	0,3	7,3	1,6	16	7,5	5,3	8	4	2	1,5	2	4	13	50	180	1K/Reel
6,0X3,5 SMD	0,3	6,3	1,4	16	7,5	4,0	8	4	2	1,5	2	4	13	50	180	1K/Reel
5,0X3,2 SMD	0,3	5,5	1,2	12	5,5	3,7	8	4	2	1,5	2	4	13	50	180	1K/Reel
4,0X2,5 SMD	0,3	4,4	0,8	12	5,5	2,9	8	4	2	1,5	2	4	13	50	180	1K/Reel
3,2X2,5 SMD	0,3	3,5	1,2	12	5,5	2,9	8	4	2	1,5	2	4	13	50	180	3K/Reel
2,5X2,0 SMD	0,3	2,8	0,75	8,0	3,5	2,3	4	4	2	1,5	2	4	13	50	180	3K/Reel
2,0X1,6 SMD	0,3	2,2	0,6	8,0	3,5	2,2	4	4	2	1,5	2	4	13	50	180	3K/Reel
1,6X1,2 SMD	0,3	1,8	0,5	8,0	3,5	1,4	4	4	2	1,5	2	4	13	50	180	3K/Reel

•SMD (Oscillator VCXO TCXO)

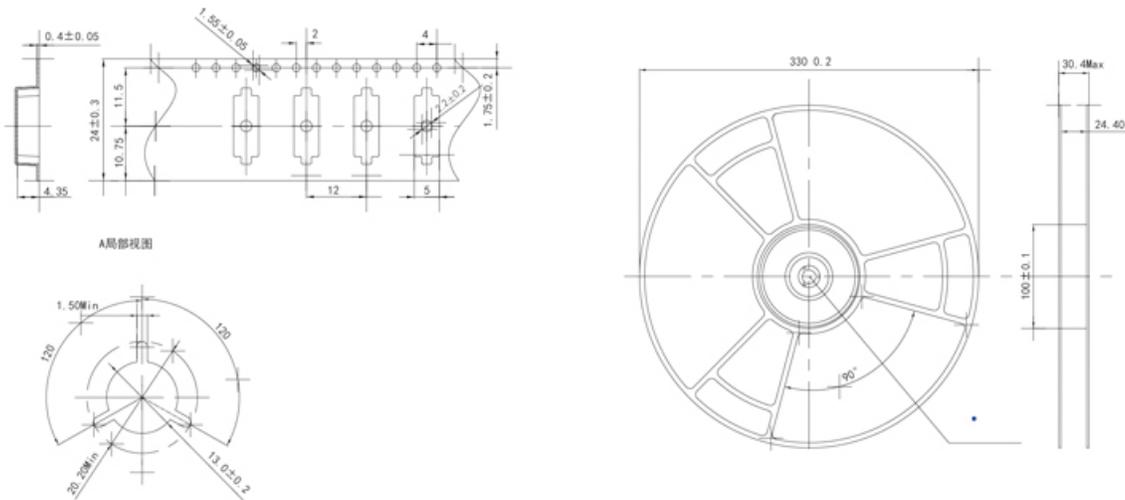


UNIT (单位): mm (毫米)

TYPE	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	SPQ
5X7 OSC	0.3	7.5	1.8	16	7.5	5.5	8	4	2	1.5	2	4	13	50	180	1K/Reel
5X3.2 OSC	0.3	5.5	1.5	12	5.5	3.7	8	4	2	1.5	2	4	13	50	180	1K/Reel
3.2X2.5 OSC	0.25	3.6	1.3	8	3.5	2.9	4	4	2	1.5	2	4	13	50	180	3K/Reel
2.5X2.0 OSC	0.25	2.8	1.0	8	3.5	2.3	8	4	2	1.5	2	4	13	50	180	3K/Reel
5X7 VCXO	0.3	7.5	1.8	16	7.5	5.5	4	4	2	1.5	2	4	13	50	180	1K/Reel
3.2X2.5 TCXO	0.25	3.6	1.3	8	3.5	2.9	4	4	2	1.5	2	4	13	50	180	1K/Reel

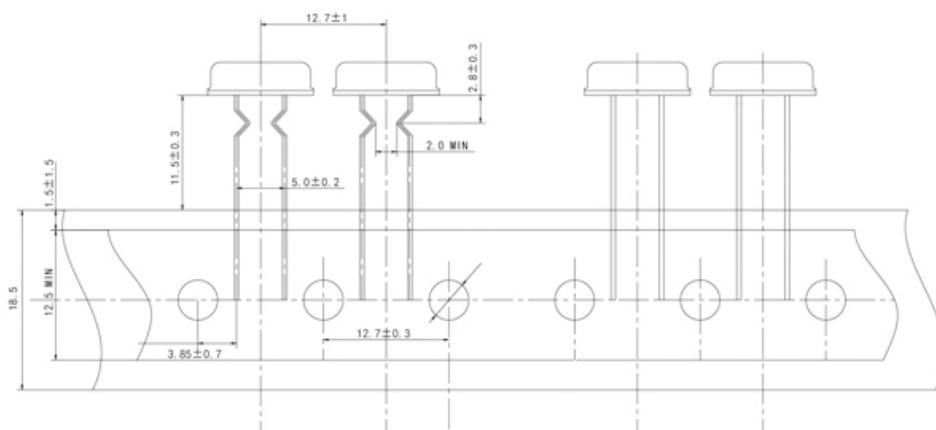
●HC49USM

UNIT(单位):mm(毫米)



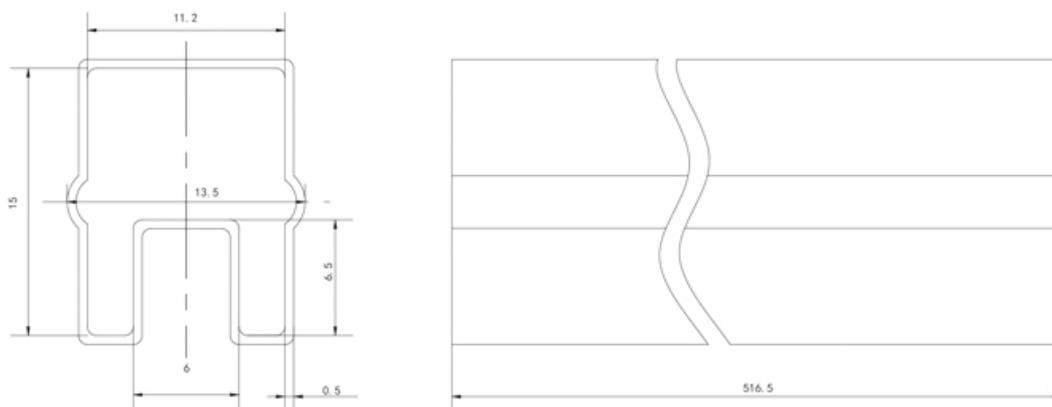
●HC49U/S

UNIT(单位):mm(毫米)



•Tube for Full Size and Half Size Series

UNIT (单位): mm (毫米)



●Marking Definitions(印字说明)

FF, FFF	For tuning Fork
FF, FFFCECYMX	For 49S, 49USM Crystal
CEC YM FF, FFFX	For 49U, UM-1, UM-5 Crystal
CFF, F	For 2016 SMD and 1612 SMD Crystal
C YM FF, FFX	For 2520 SMD Crystal
CEC YM FF, FFX	For 3225 SMD and 4025 SMD Crystal
CEC YM FF, FFX	For 5032 SMD and 6035 SMD Crystal
CEC FF, FFF X YM	For 7050 SMD Crystal
C YM ●FF, FX	For 2520 OSC
CEC YM ●FF, FFX	For 3225 OSC, 5032 OSC, 5032 VCX0
CEC YM FF, FFF ●X A, AV	For 7050 OSC, Dip OSC and Dip VCX0
CEC YM FF, FFFMHZ ●X A, AL	For 7050 OSC (PECL, LVDS)
CEC YM ●FF, FFX	For 3225 TCX0

CEC: Brand 商标
Y/Year 年的最后一位数字
the last digit of year (1:2011;2:2012;3:2013.....)
M/Month Code 月度代码
A, B, C, D, E, F, G, H, J, K, L, M
FF, FFF (FF, FF, FF, F)/Frequency 中心频率的前五(四、三)位数字
1st 5 significant digits of center frequency
A, A/Voltage 电压
L=P (or D) : PECL (or LVDS)
X/Factory 制造工厂
N: Nanjing南京工厂, S: Shenzhen深圳工厂, L: Langfang廊坊工厂

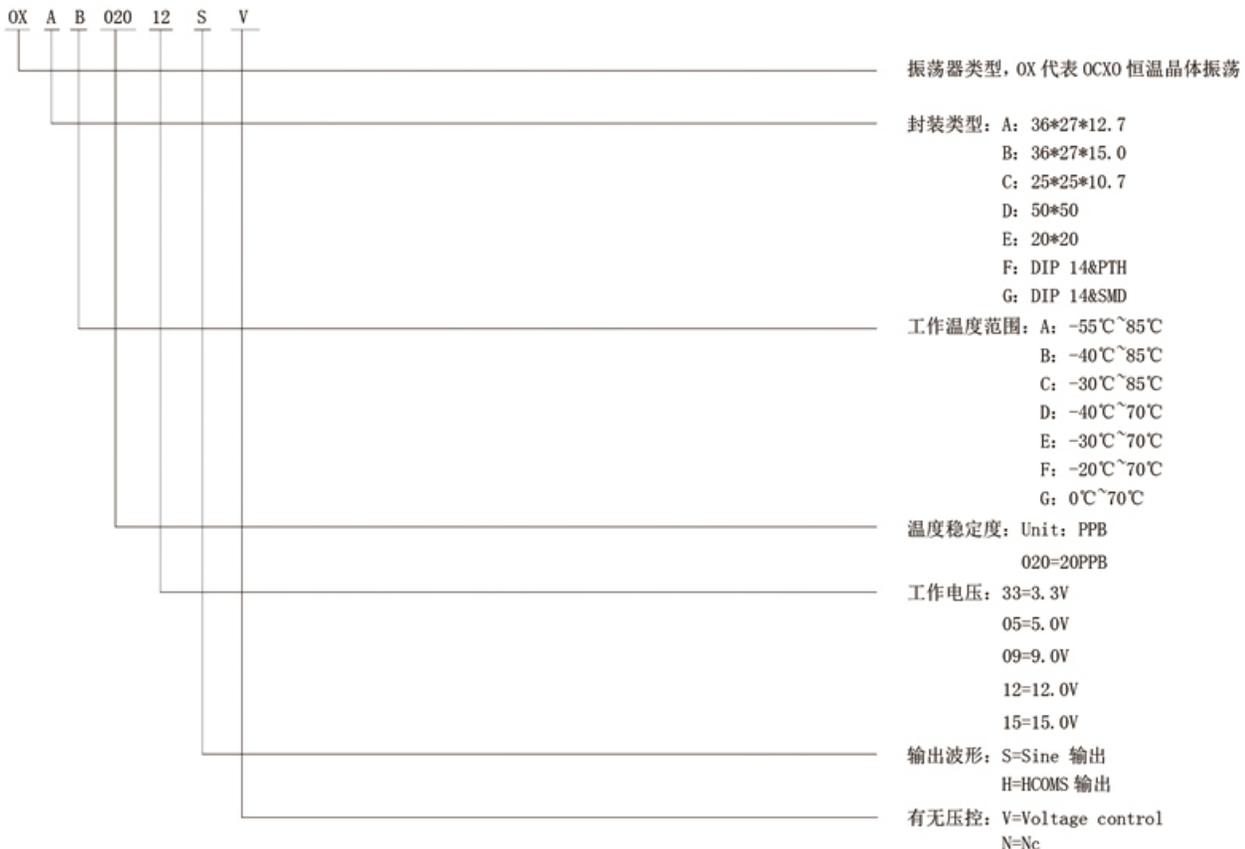
●Marking Definitions(印字说明)——OCXO



月	1月	2月	3月	4月	5月	6月	7月	8月	9月	10月	11月	12月
代码	A	B	C	D	E	F	G	H	I	J	K	L

年	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
代码	9	0	1	2	3	4	5	6	7	8

流水号为该产品的生产初始日期加产品顺序号，如1 F 29 1 001, 1代表2011年，F代表06月，29代表日期，1代表批次号，001代表产品顺序号。



Series vs. Parallel: "Series" resonant crystals are intended for use in circuits which contain no reactive components in the oscillator feedback loop. "Parallel" resonant crystals are intended for use in circuits which contain reactive components (usually capacitors) in the oscillator feedback loop. Such circuits depend on the combination of the reactive components and the crystal to accomplish the phase shift necessary to start and maintain oscillation at the specified frequency. Basic depictions of two such circuits are shown below.

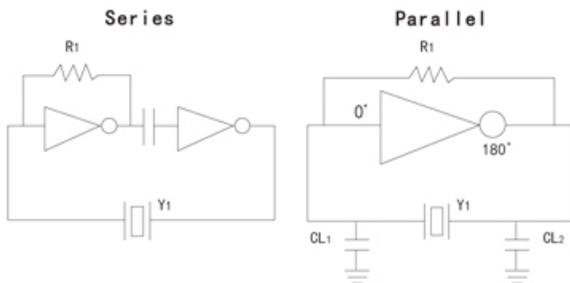


Figure A) Depictions of Series and Parallel Resonant Circuits

Load Capacitance: This refers to capacitance external to the crystal, contained within the feedback loop of the oscillator circuit. If the application requires a "parallel" resonant crystal, the value of load capacitance must be specified. If the application requires a "series" resonant crystal, load capacitance is not a factor and need not be specified. Load capacitance is the amount of capacitance measured or computed across the crystal terminals on the PCB.

Frequency Tolerance: Frequency tolerance refers to the allowable deviation from nominal, in parts per million (PPM), at a specific temperature, usually +25°C.

Frequency Stability: Frequency stability refers to the allowable deviation, in parts per million (PPM), over a specified temperature range. Deviation is referenced to the measured frequency at +25°C.

Aging: Aging refers to the cumulative change in frequency experienced by a crystal unit over time. The rate of frequency change is fastest during the first 45 days of operation. The most common factors affecting aging include drive level, internal contamination, crystal surface change, ambient temperature, wire fatigue and frictional wear. All these problems can be minimized by proper circuit design which allows for low operating temperatures, minimum drive levels and static pre-aging.

Pullability: Pullability refers to the change in frequency of a crystal unit, either from the natural resonant frequency (Fr) to a load resonant frequency (FL), or from one load resonant frequency to another. See Figure C. The amount of pullability exhibited by a given crystal unit at a given value of load capacitance is a function of the shunt capacitance (Co) and the motional capacitance (C1) of the crystal unit.

If pullability is a factor in design, collaboration with our engineers is advisable; bandwidth can be controlled to some extent, during fabrication, by varying the crystal parameters. An approximation of the pulling limits for standard crystals can be obtained from the following formula:

$$\Delta f = 0.5f_s \left(\frac{C_1}{C_0 + C_L} \right)$$

The exact limits also depend upon the Q of the crystal as well as associated stray capacitances. Pullability can be approximately doubled by modified crystal fabrication and by adding capacitance or inductance external to the crystal. If the Co and C1 are known then the pulling in ppm between two capacitances can be obtained using the following formula.

$$\text{ppm} = \frac{C_1(C_{L2} - C_{L1})10^6}{2(C_0 + C_{L2})(C_0 + C_{L1})}$$

e.g. $C_1 = 0.020\text{pF}$ $C_{L1} = 20\text{pF}$
 $C_0 = 4.5\text{pF}$ $C_{L2} = 30\text{pF}$

$$\text{ppm} = \frac{.02(30-20)10^6}{2(4.5+30)(4.5+20)}$$

To obtain AVERAGE pulling per pF about a known load capacitance use the following formula.

$$\text{ppm} = \frac{C_1 \times 10^6}{2(C_0 + C_L)^2}$$

e.g. Using figures as above and 30 pF CL

$$\text{ppm/pF} = \frac{.02 \times 10^6}{2(4.5+30)^2} = 8.4016 \text{ppm/pF average.}$$

Equivalent Circuit: The equivalent circuit, shown in Figure B is an electrical depiction of the quartz crystal unit when operating at a frequency of natural resonance. The Co, or shunt capacitance, represents the capacitance of the crystal electrodes plus the capacitance of the holder and leads. R1, C1, and L1 compose the "motional arm" of the crystal and are referred to as the motional parameters. The motional inductance (L1), represents the vibrating mass of the crystal unit. The motional capacitance (C1), represents the elasticity of the quartz and the resistance (R1), represents bulk losses occurring within the quartz.

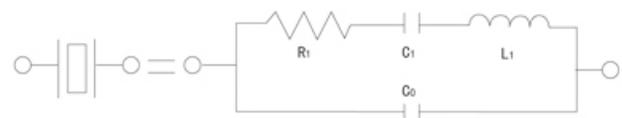
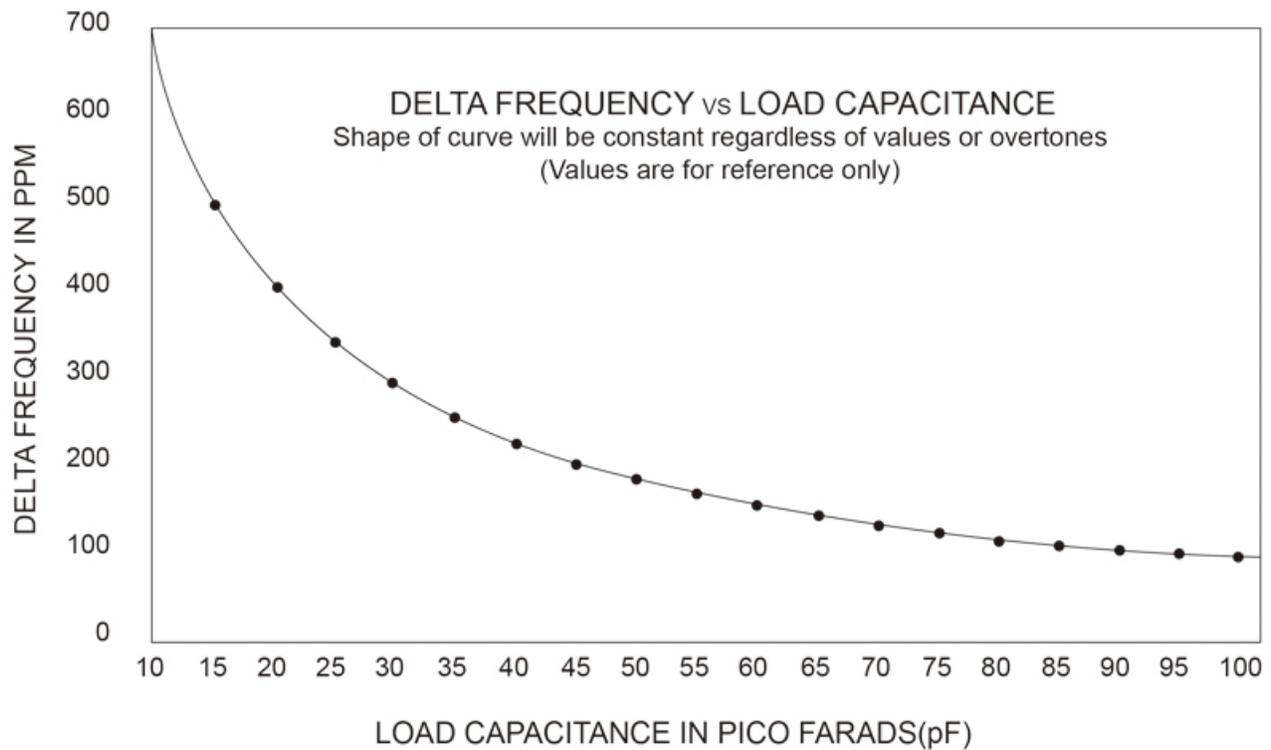


Figure B) Equivalent Circuit



Impedance/Reactance Curve: A crystal has two frequencies of zero phase, as illustrated in Figure D. The first, or lower of the two, is the Series Resonance Frequency, denoted as (f_s). At this point, the crystal appears resistive in the circuit, impedance is at a minimum and current flow is maximum. As the frequency is increased beyond the point of series resonance, the crystal appears inductive in the circuit. When the reactances of the motional inductance and shunt capacitance cancel, the crystal is at the Frequency of Anti-resonance, denoted as (f_a). At this point, impedance is maximized and current flow is minimized.

Shock Characteristics: Although crystals are designed to handle normal shock in handling, shock impulses (such as half sine, square, sawtooth and complex combinations) can occur in the field. Because crystals are relatively delicate, they should be isolated from equipment to minimize shock damage. But, avoid overspecification, since the elastic properties of the materials and the degree of isolation afforded by the equipment can decrease the destructive potential of a shock.

Quality Factor (Q): The "Q" value of a crystal unit is a measure of the units relative quality, or efficiency of oscillation. The maximum attainable stability of a crystal unit is dependent on the "Q" value. In Figure D the separation between the series and parallel frequencies is called the bandwidth. The smaller the bandwidth, the higher the "Q" value, and

the steeper the slope of the reactance. Changes in the reactance of external circuit components have less effect (less "pullability") on a high "Q" crystal, therefore such a part is more stable.

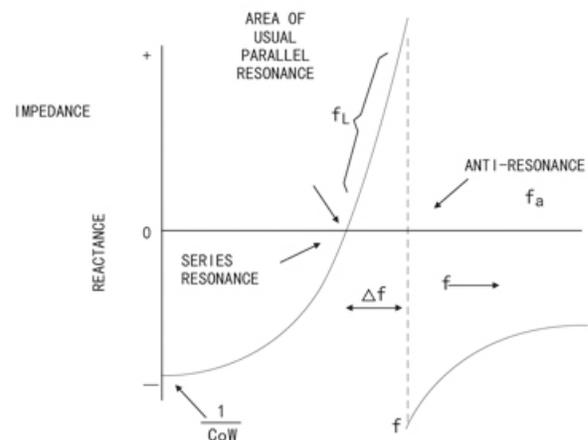


Figure D) Reactance vs. Frequency Curve

Calculation of Load Capacitance: If the circuit configuration is as shown in Figure A for the parallel version, the load capacitance may be calculated by means of the following equation:

$$CL = \frac{CL_1 \cdot CL_2}{CL_1 + CL_2} + C_{stray}$$

C_{stray} includes the pin to pin input and output capacitance of the microprocessor chip at the Crystal 1 and Crystal 2 pins, plus any parasitic capacitances. As a rule of thumb, C_{stray} may be assumed to equal 5.0 pE. Therefore, if CL₁ = CL₂ = 50pF, CL = 30pE

Trim Sensitivity: Trim sensitivity is a measure of the incremental fractional frequency change for an incremental change in the value of the load capacitance. Trim sensitivity (S) is expressed in terms of PPM/pF and is calculated by the following equation:

$$S = \frac{C_1 \cdot 1000000}{2 \cdot C_1^2}$$

Where (C_t) is the sum of C₀ and C_L.

Solder Reflow of Sffrface Mount Devices: Mounting of SMD units is typically accomplished by means of solder reflow, as indicated in Figure E either by infrared heat or by vapor phase. The following graphs depicts the recommended times and temperatures for each of the two methods:

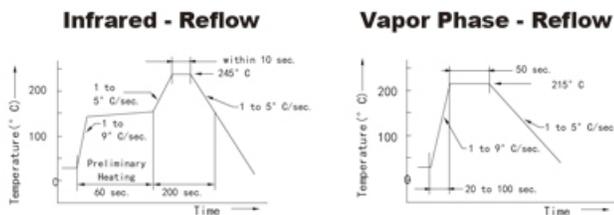


Figure E) Time Temperature Profiles

Soldering Characteristics: A variety of methods can be used to solder ECS products to EC. B. s and substrates:

- . Wave or Dual Wave
- . Hot Air or Convection Flow
- . Vapor Phase Reflow
- . Infrared Reflow
- . Bubble Solder Immersion
- . Other (Laser, etc.)

PRODUCT	SOLDERING TEMP. T(C°)	SOLDERING TEMP t(sec.)
HC-49, HC-49US, UM-1,5	240°~250°	20 sec. max.
ECS-1x5, 2x6, 2x8, 3x10, 31 all SMD Devices	230°	10 sec. max.
All Clock Oscillators	240°~250°	20 sec. max.

Due to the natural characteristics of material, some of our products cannot withstand heat shock. Extreme temperatures can cause tin (Sn) plating from the inside of the enclosure to reach its melting point, depositing solder on the quartz element. This can cause the component to oscillate at a lower frequency or fail completely. In other cases, solder contact can degrade, resulting in an open circuit. These problems can be avoided by preheating the components and board, and following the recommended soldering process time/temperature profiles noted above.

Note: It is important to check with your ECS factory representative before subjecting any crystal components to extreme environmental conditions.

Useful Crystal Equations:

EQUATION	LEGEND
$f_s = (\text{Series}) \text{ frequency} = \frac{1}{2\pi\sqrt{L_1 C_1}}$	f = Nominal freq. in HZ
$f_L - f_s = \Delta f = \frac{C_1}{2(C_0 + C_L)}$	f _s = Series resonant freq. in HZ
$L_1 = \text{Motional Inductance} = \frac{1}{4\pi^2 f_s^2 C_1}$	f _L = Anti-resonant freq. in HZ
$C_1 = \text{Motional capacitance} = 2(C_0 + C_L) \Delta f$	L = Inductance in Henrys
$Q = \text{Quality factor} = \frac{2\pi \cdot f_s \cdot L_1}{R_1}$	C ₁ = Motional capacit. in farads
$R_1 = \text{Series resistance} = \frac{2\pi \cdot f_s \cdot L_1}{Q}$	C ₀ = Static capacit. in farads
$C_0 = \text{Shunt capacitance} = \frac{C_1}{2 \cdot \Delta f} - C_L$	C _L = Load capacit. in farads
$C_L = \text{Load capacitance} = \frac{C_1}{2 \cdot \Delta f} - C_0$	R ₁ = Series resistance Ω
$P_L = \text{Pullability} = \frac{C_1 \cdot 10^6}{2(C_0 + C_L)^2}$	Q = Quality factor
	P _L = Pullability (ppm/pF)

Field Vibration: There are two basic types of vibration, periodic and random. Typically, vibration in the field produces complex waves of motion which can affect the output of quartz crystals. Most failures due to vibration occur as a direct result of mechanically amplified resonances, as higher acceleration levels are reached by resonant areas, resulting in higher potential for damage. All factors influencing vibrations should be thoroughly evaluated by using a prototype. Structural system, component location, mounting and encapsulation should all be considered to maximize stability. Remember that crystals are designed to withstand normal handling vibration; added ruggedizing may adversely affect desirable qualities such as stability tolerance or aging.

The purpose of these application notes is to help customers in specifying Clock Oscillators. Background information about the type of Oscillators offered by ECS is included along with some common definitions and helpful formulas. The ECS Oscillator product line consists of Clock Oscillators, TCXOs, VCXOs, VCTCXOs and VCOs.

Clock Oscillator: The standard clock oscillator is the most common type of oscillator used and has applications in virtually every aspect of the electronics industry. The clock oscillator is used to establish a reference frequency used for timing purposes. A typical application is the sequencing of events in a computer.

A crystal controlled clock oscillator typically consist of an amplifier and a feedback network that selects a part of the amplifier output and returns it to the amplifier input. A simplified block diagram of such a circuit is shown below in (Fig. 1).

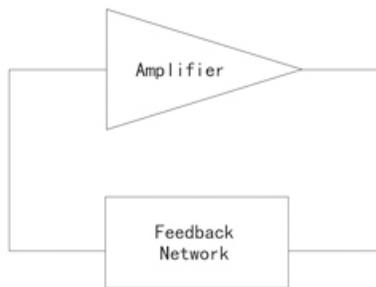


Figure 1) Simplified Block Diagram of a Crystal Controlled Clock Oscillator

The basic criteria for oscillation in an oscillator are: 1. The open loop gain must be greater than the losses around the oscillator loop and 2. The phase shift around the oscillator loop must be either 0 or 360 degrees.

An oscillator can be used to generate different types of waveforms. The most common types of waveforms produced by an oscillators are sinusoidal and square.

The main parameters used in specifying a clock oscillator are listed below.

Logic TTL, HCMOS: In general, an HCMOS oscillator will drive TTL circuitry (not vice versa). The industry is moving away from the TTL logic as IC manufacturers are discontinuing the supply of many common TTL IC's. Most ECS clock oscillators are HCMOS/TTL compatible.

Frequency Stability: The most common stabilities are 25, 50 and 100 PPM. Overall stability usually includes accuracy at 25°C, effects due to changes in operating temperature, input voltage, aging, shock and vibration. The +100 PPM stability has been the most popular as it is sufficient to run microprocessors. The telecommunications industry has been moving toward tighter and tighter stabilities. Stabilities beyond +100 PPM are no longer offered in commercial (0-70°C) applications, since standard process controls achieve this stability as a minimum. Requesting

50 PPM is usually a little more expensive. Clock Oscillators requiring 25 PPM can significantly affect the price. For tighter than 25 PPM stability applications, please consult the factory or consider a TCXO.

TCXOs (Temperature Compensated Crystal Oscillators)

typically consists of tight tolerance quartz crystal, a temperature compensation network, an oscillator circuit and a variety of buffer and/or output stages determined by the output requirement. The crystal has a characteristic of changing frequency when a capacitor is inserted in series with the crystal unit as shown in (Fig. 2).

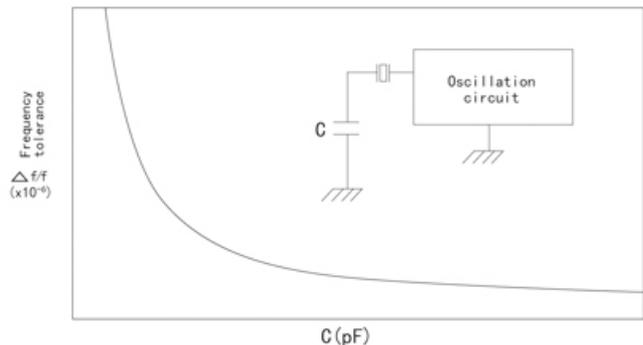


Figure 2) Load Capacitance Characteristics of Crystal Unit

Utilizing the above characteristics, frequency can be stabilized by inserting a temperature compensation circuit consisting of thermistors, resistors and capacitors in the oscillation loop as shown in (Fig. 3). The temperature compensation network is used to sense the ambient temperature and "pull" the crystal frequency in a manner which reduces frequency vs. temperature effect of the quartz crystal.

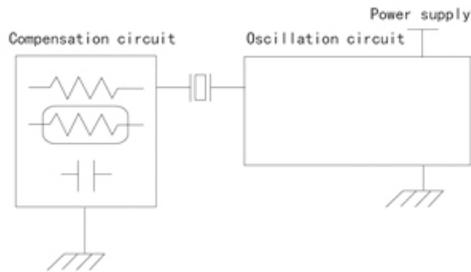


Figure 3) Temperature Compensation Circuit

A TCXO is generally required when overall stability needs are greater than those of a clock oscillator. Also, the long term aging effects of a TCXO are better than those of most clock oscillators.

Input Voltage: Most TCXOs are designed to operate at 5VDC, 3.3 VDC or a combination of both.

RF Output: A TCXO can be manufactured with various types of outputs: sine wave, clipped sine wave, TTL, HCMOS and ECL. Be sure to specify the desired output type, signal requirements and the load that the oscillator will be driving.

TCXOs also have a frequency adjustment feature which allow for re-adjustment of the oscillator to its center frequency to compensate for aging. This adjustment can be provided in the following ways.

- 1) A mechanical adjustment (internal trimmer) within the oscillator accessible via hole in the enclosure.
- 2) .An electrical adjustment via a lead in the enclosure for either a remotely located potentiometer or a voltage. An oscillator using this technique is called a Temperature Compensated Voltage Controlled Crystal Oscillator or TCVCXO.
- 3) A combination of both mechanical and electrical adjustment.

VCXOs (Voltage Controlled Crystal Oscillator) are crystal controlled oscillators in which the output frequency can be adjusted by varying the external control voltage across a variable capacitor (varactor diode) within the oscillator circuit. The associated change in frequency due to the change in control voltage is known as pullability. VCXOs are used widely in telecommunications, instrumentation and other electronic equipment where a stable but electrically tunable oscillator is required.

The varactor diode is a semiconductor device that is designed to act as a variable capacitor when a voltage is applied to it. When used in series with a crystal, as shown in (Fig. 4), changing the control voltage causes diode capacitance to change. This change in capacitance causes the total crystal load capacitance to change and subsequently causes a change in crystal frequency.

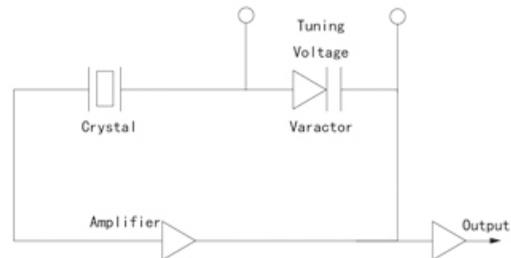


Figure 4) Typical VCXO circuit

Due to the growing applications of VCXOs in digital data transmissions phase jitter (short-term stability) has become an important consideration. Phase jitter provides a precise way to establish when a phase transition occurs.

Definitions:The following definitions will aid you in understanding oscillator performance and terminology.

Nominal Frequency:The center or nominal output of a crystal oscillator.

Frequency Tolerance:The deviation from the nominal frequency in terms of parts per millions (PPM) at room temperature. (25°C \pm 5°C)

Frequency Range:The frequency band that the oscillator type or model can be offered.

Frequency Stability:The maximum allowable frequency deviation compared to the measured frequency at 25°C over the temperature window, i.e. 0°C to +70°C. The typical stability for clock oscillators is +0.01% (\pm 100 PPM).

Operating Temperature:Temperature range within which output frequency and other electrical, environmental characteristics meet the specifications.

Aging:The relative frequency change over a certain period of time. Typically, aging for clock oscillators is \pm 5 PPM over 1 year maximum.

Storage Temperature:The temperature range within which the unit is safely stored without damaging or changing the performance of the unit.

Supply Voltage:The maximum voltage which can safely be applied to the VCC terminal with respect to ground.

Input Voltage (VIN):The maximum voltage which can be safely applied to any input terminal of the oscillator.

Output HIGH Voltage (VOH):The minimum voltage at an output of the oscillator under proper loading.

Output LOW Voltage (VOL):The maximum voltage at an output of the oscillator under proper loading.

Input HIGH Voltage (VIH):The minimum voltage to guarantee threshold trigger at the input of the oscillator.

Input LOW Voltage (VIL):The maximum voltage to guarantee threshold trigger at the input of the oscillator.

Supply Current:The current flowing into Vcc terminal with respect to ground. Typically supply current is measured without load.

Symmetry or Duty Cycle:The symmetry of the output waveform at the specified level (at 1.4 V for TTL, at 1/2 Vcc for HCMOS, or 1/2 waveform peak level for ECL).

Rise Time (TR):Waveform rise time from Low to High transition measured at the specified level (20% to 80% for HCMOS, ECL and 0.4 V to 2.4 V for TTL).

Fall Time (TF):The waveform fall time from High to Low transition, measured at the specified level (80% to 20% for the HCMOS, ECL and 2.4 V to 0.4V for TTL).

Load/Fan Out:The maximum load that the different families of oscillators can drive is defined as the output load driving capability. The load driving capability (fan-out) of each family of oscillators is specified in terms of the number of gates an oscillator can drive.

Jitter (short-term stability):The modulation in phase or frequency of the oscillator output.

HCMOS/TTL Compatible:The oscillator is designed with ACMOS logic with driving capability of TTL and HCMOS loads while maintaining minimum logic High of HCMOS.

Tri-State Enable:When the input is left OPEN or tied to logic "1" the normal oscillation occurs. When the input is grounded (tied to logic "0", the output is in HIGH IMPEDANCE state. The input has an internal pull-up resistor thus allowing the input to be left open.

Output Logic:The output of an oscillator is designed to meet various specified logic's, such as TTL, HCMOS, ECL, Sine, Clipped-Sine (DC cut).

Harmonic Distortion:The non-linear distortion due to unwanted harmonic spectrum component related with target signal frequency. Each harmonic component is the ratio of electric power against desired signal output electric power and is expressed in terms of dbc, i.e. -20 dBc. Harmonic distortion specification is important especially in sine output when a clean and less distorted signal is required.

Dual and Multiple Outputs:More than one signal is capable of being generated from a single oscillator. The signals may be related (usually a multiple or divisor of the signal) produced by a single crystal).

Start-Up Time:The start up time of an oscillator is defined as the time an oscillator takes to reach its specified RF output amplitude.

Crystal controlled oscillators may be considered as consisting of an amplifier and a feedback network that selects a part of the amplifier output and returns it to the amplifier input. A generalized depiction of such a circuit is shown below.

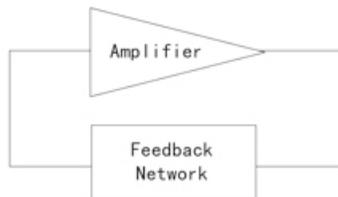


Figure A) Amplifier Feedback Network

In order for an oscillator circuit to operate, two (2) conditions must be met:

- (A) The loop power gain must be equal to unity.
- (B) The loop phase shift must be equal to $0, 2\pi, 4\pi$, etc. radians

The power fed back to the input of the amplifier must be adequate to supply the oscillator output, the amplifier input and to overcome circuit losses.

The exact frequency at which an oscillator will operate is dependent on the loop phase angle shifts within the oscillator circuit. Any net change in phase angle will result in a change in the output frequency. As the usual goal of an oscillator is to provide a frequency that is essentially independent of variables, some means of minimizing the net phase shift must be employed. Perhaps the best, and certainly the most common means of minimizing the net phase shift is to use a quartz crystal unit in the feedback loop.

The impedance of a quartz crystal changes so dramatically with changes in the applied frequency that all other circuit components can be considered as being of essentially constant reactance. Therefore, when a crystal unit is used in the feedback loop of an oscillator, the frequency of the crystal unit will adjust itself so that the crystal unit presents a reactance which satisfies the loop phase requirements. A depiction of the reactance vs. frequency of a quartz crystal unit is shown below.

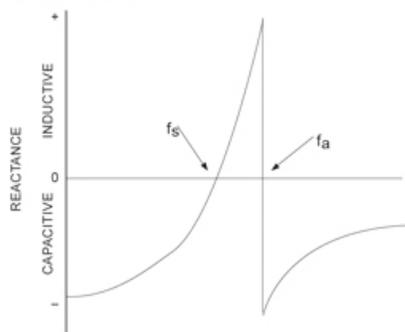


Figure B) Reactance vs. Frequency Curve

As is apparent from Figure B, quartz crystal unit has two frequencies of zero phase. The first, or lower of the two, is the series resonant frequency, usually abbreviated as F_s . The second, or higher of the

two frequencies of zero phase is the parallel, or anti-resonant frequency, usually abbreviated as F_a . Both the series and parallel resonant frequencies appear resistive in an oscillator circuit. At the series resonant point, the resistance is minimal and the current flow is maximal.

At the parallel point, the resistance is maximal and the current flow is minimal. Therefore, the parallel resonant frequency, F_a , should never be used as the controlling frequency of an oscillator circuit. A quartz crystal unit can be made to oscillate at any point along the line between the series and parallel resonant points by the inclusion of reactive components (usually capacitors) in the feedback loop of the oscillator circuit. In such a case, the frequency of oscillation will be higher than the series resonant frequency but lower than the parallel resonant frequency. Because of the fact that the frequency resulting from the addition of capacitance is higher than the series resonant frequency, it is usually called the parallel frequency, though it is lower than the true parallel frequency.

Just as there are two frequencies of zero phase associated with a quartz crystal unit, there are two primary oscillator circuits. These circuits are generally described by the type of crystal unit to be used, namely "series" or "parallel."

SERIES CIRCUIT: A series resonant oscillator circuit uses a crystal which is designed to operate at its natural series resonant frequency. In such a circuit, there will be no capacitors in the feedback loop. Series resonant oscillator circuits are used primarily because of their minimal component count. These circuits may, however, provide feedback paths other than through the crystal unit. Therefore, in the event of crystal failure, such a circuit may continue to oscillate at some arbitrary frequency. A depiction of a basic series resonant oscillator circuit is given below.

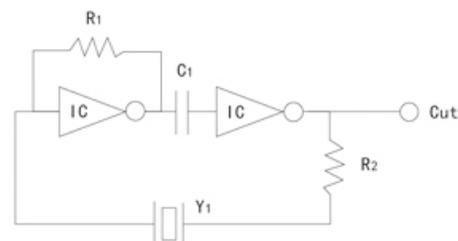


Figure C) Series Resonant Oscillator Circuit

As is apparent from Figure C, a series resonant oscillator circuit provides no means of adjusting the output frequency, should adjustment be required. In the above circuit, resistor R_1 is used to bias the inverter and to cause it to operate in its linear region. This resistor also provides negative feedback to the inverter. Capacitor C_1 is a coupling capacitor, used to block DC voltage. Resistor R_2 is used to bias the crystal unit. This resistor strongly influences the drive current seen by the crystal unit, therefore care must be taken that too small a value is not chosen. Crystal unit Y_1 is a series resonant crystal unit, specified to operate at the desired frequency and with the desired frequency tolerance and stability.

PARALLEL CIRCUIT: A parallel resonant oscillator circuit uses a crystal unit which is designed to operate with a specified value of load capacitance. This will result in a crystal frequency which is higher than the series resonant frequency but lower than the true parallel resonant frequency. These circuits do not provide paths other than through the crystal unit to complete the feedback loop. In the event of crystal unit failure, the circuit will not continue to oscillate. A basic depiction of a parallel resonant circuit is given below.

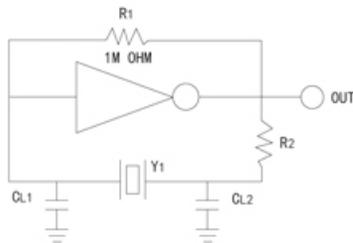


Figure A) Parallel Resonant Circuit

FREQUENCY (MHz)	CL1, CL2, (pF)	R2, (Ω)	CL (pF)
3 ~ 4	27	5.6k	16
4 ~ 5	27	3.9k	16
5 ~ 6	27	2.7k	16
6 ~ 8	18	2.7k	12
8 ~ 12	18	1.8k	12
12 ~ 15	18	1.0k	12
15 ~ 20	15	560	10
20 ~ 25	12	560	10

Figure A1) Typical Values for a Parallel Circuit

This circuit uses a single inverter, with two capacitors in the feedback loop. These capacitors comprise the "load capacitance" and together with the crystal unit, establish the frequency at which the oscillator will operate. As the value of the load capacitance is changed, so is the output frequency of the oscillator. Therefore, this circuit does provide a convenient means of adjusting the output frequency, should adjustment be required.

The resistors R1 and R2 serve the same functions as detailed for the series resonant circuit shown in Figure C. The two load capacitors, CL1 and CL2, serve to establish the frequency at which the crystal unit and therefore the oscillator will operate. Crystal unit Y1 is a parallel resonant crystal unit, specified to operate with a specified value of load capacitance, at the desired frequency and with the desired frequency tolerance and stability.

LOAD CAPACITANCE: Reference has been made to a "specified load capacitance." Load capacitance may be defined as "that value of capacitance, either measured or calculated, present in the oscillator circuit, across the connection points of the crystal." In the case of a series resonant circuit, there is no capacitance present between the connecting points of the crystal unit and therefore, load capacitance need not be specified for a series resonant crystal unit. In the case of a parallel resonant oscillator circuit, capacitance is present. As a direct measurement of this capacitance is impractical, it is usually necessary to calculate the value.

The calculation of the value of the load capacitance is done with the following equation:

$$CL = \frac{CL1 \cdot CL2}{CL1 + CL2} + Cs \quad (1)$$

Where CL 1 and CL2 are the load capacitors and Cs is the circuit stray capacitance, usually 3.0 to 5.0 pE.

It must be noted that changes in the value of the load capacitance will result in changes in the output frequency of the oscillator. Therefore, if precise frequency control is required, then a precise specification of load capacitance is required. To illustrate, assume that a crystal unit is specified to operate at a frequency of 20.000 MHz with a load capacitance of 20.0 pE. Assume that the crystal unit is then placed in a circuit which presents a value of 30.0 pF. The frequency of the crystal unit will then be lower than the specified value. Conversely, should the circuit in question present a value of 10.0 pE the frequency will be higher than the specified value. The relationship between frequency and load capacitance is shown below.

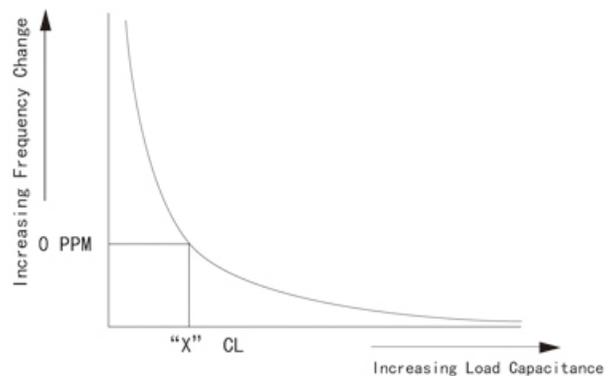


Figure E) Frequency vs Load Capacitance

DRIVE LEVEL: The "drive level" is the power dissipated by the crystal unit while operating. The power is a function of the applied current and is usually expressed in terms of Milliwatts or Microwatts.

Crystal units are specified as having certain maximum values of drive level, which change as functions of the frequency and mode of operation. It is well to consult with the crystal unit vendor as to the maximum value of drive level allowed for a particular crystal unit. Exceeding the maximum drive level for a given crystal unit may result in unstable operation increased aging rates, and in some cases, catastrophic damage. The drive level may be calculated by the following equation

$$POWER = (I_{rms}^2 * R) \quad (2)$$

Where I is the rms current through the crystal unit and R is the maximum resistance value of the specific crystal unit in question. Equation (2) is simply "Ohms law" for power.

Measurement of the actual drive level in an operating oscillator circuit may be accomplished by temporarily inserting a resistor in series with the crystal unit. The resistor must be of the same ohmic value as the crystal unit. The voltage drop across the resistor may then be read and the current and power dissipation calculated. The resistor must then be removed. As an alternative means of measuring the drive level, a current probe may be used at the output lead of the crystal unit, space permits. The method is described below in Figure 1.

$$R_L = R_1 \left(1 + \frac{C_0}{C_L} \right)^2$$

where R_L = loaded resonance resistance
 R_1 = resonance resistance of crystal unit
 I_q = current flowing to crystal unit
 C_0 = shunt capacitance
 C_L = load capacitance

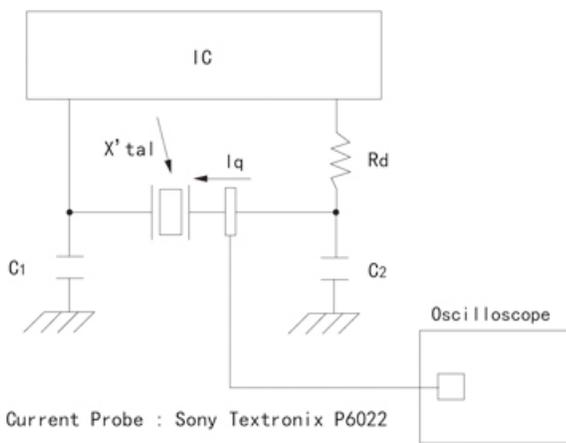


Figure 1) Drive Level Measurement

FREQUENCY vs MODE: The frequency of a quartz crystal unit is limited by the physical dimensions of the vibrating quartz element. In some cases, the limiting dimension (s) are the length and width. In the case of the most popular crystal unit, the "AT" cut crystal unit, the limiting dimension is the thickness of the vibrating quartz element. As the thickness is diminished, the frequency is increased. At some point, usually around 30,000 MHz, the thickness of the quartz plate becomes too thin for processing. Should it be desired to develop an oscillator at a frequency higher than the limiting frequency, advantage must be taken of the fact that quartz crystal units will oscillate at odd integer multiples of their "fundamental" frequency. We may define the "fundamental" frequency as 'that frequency which naturally occurs at a given set of mechanical dimensions.' Therefore, if a crystal unit has a fundamental frequency of 10.0 MHz, it can also be made to oscillate at 3, 5, 7, etc. times the fundamental. That is, the unit will oscillate at 30.0, 50.0, 70.0, etc. MHz.

These multiples of the fundamental frequency are called "overtones" and are identified by the integer of multiplication, as in the "third overtone", the "fifth overtone", etc. When use at an overtone frequency is required, the crystal unit must be specified to operate at the desired frequency and on the desired overtone. One should never attempt to order a fundamental mode crystal unit and then operate it at an overtone frequency. This is due to the fact that the crystal manufacturing processes differ for fundamental and overtone crystal units.

In many cases, the characteristics of the integrated circuit used in a particular oscillator design dictate that the fundamental frequency of the crystal unit be suppressed in order to ensure operation at the desired frequency and on the desired overtone. In such cases, it is usually necessary to modify the oscillator circuit. One method of modification is to add a "tank" circuit, consisting of an inductor and a capacitor. These modifications are shown in Figure F and G.

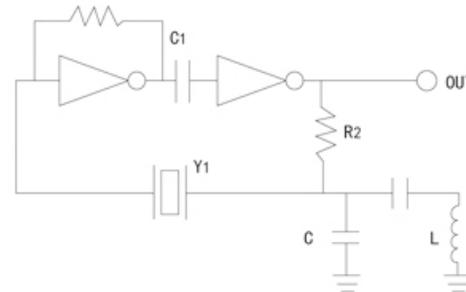


Figure F) Modifications of a Series Resonant Circuit

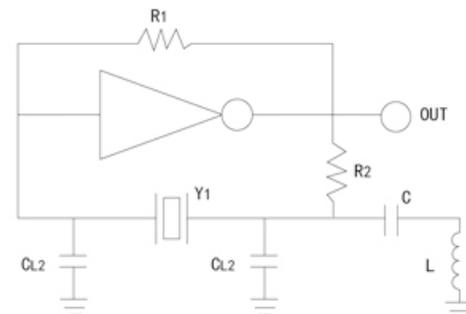


Figure G) Modifications of a Parallel Resonant Circuit

In both cases, the tank circuit is tuned to resonate at some frequency between the fundamental and the desired frequency. This results in the unwanted frequency being shunted to ground, leaving only the desired frequency being present at the output of the oscillator.

DESIGN CONSIDERATIONS: For good operation of an oscillator circuit, certain design considerations should be followed. In all cases, it is recommended that parallel traces be avoided in order to reduce circuit stray capacitance. All traces should be kept as short as possible and components should be isolated in order to prevent coupling. Ground planes should be used to isolate signals.

NEGATIVE RESISTANCE:For optimum performance, an oscillator circuit must be designed in such a way as to enhance "negative resistance," which is sometimes called the "oscillation allowance." Evaluation of the amount of negative resistance in a given circuit is accomplished by temporarily installing a variable resistor in series with the crystal unit. The resistor should be set initially at its lowest setting, preferably close to zero ohms. The oscillator is then started and the output monitored on an oscilloscope. The variable resistor is then adjusted so that resistance is increased while the output is continuously monitored. At some value of resistance, oscillation will be stopped. At this point, the variable resistor is measured to determine the ohmic value at which oscillation ceased. To this value, the maximum resistance of the crystal unit, as specified by the vendor, must be added. The total ohmic resistance is deemed to be the "negative resistance" or the "oscillation allowance." For good, reliable circuit operation, it is recommended that the negative resistance be a minimum of five times the specified maximum resistance value of the crystal unit.

Values of negative resistance exceeding five times the maximum resistance of the crystal unit are better yet. As negative resistance tends to decrease at elevated temperatures, it is recommended that the test be performed at the highest temperature of the operating range. See the special procedure illustrated below.

Procedures For Negative Resistance Measurement

- 1) Open either end of the crystal unit in the main circuit used, and insert a variable resistor in series with the crystal unit, as shown. Change the resistance value to examine the limits of oscillation and resistance in ohms observed at that time. In this case power must be turned on and off, without fail.
- 2) Negative resistance ($-R$) in the circuit is the sum of the value obtained by Step 1) above and the resonant resistance R_1 of the crystal.
- 3) C_1 and C_2 should be used within the range of 10 - 30 pF. If C_1 and C_2 are used below 10 pF or above 30 pF, oscillation performance may be easily affected. Drive Level may increase, or negative resistance may decrease, thus failure to maintain oscillation.

Note: This measurement should be carried out at both the upper and lower limits of the operating temperature range.

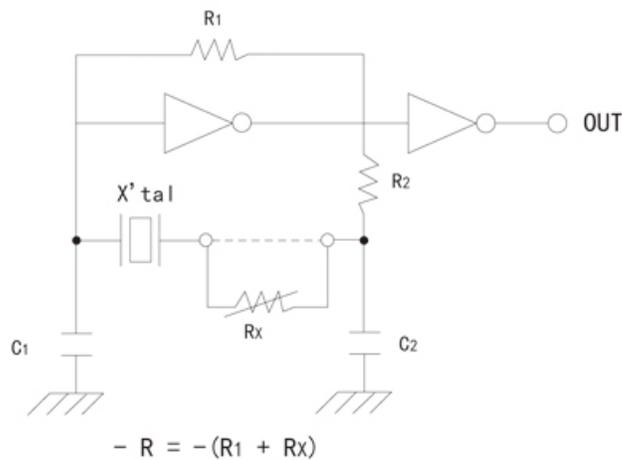


Figure H) Negative Resistance Measurement Procedure



