

## 石英晶体简介

### CRYSTAL TERMS

#### ● 等效电阻EQUIVALENT SERIES RESISTANCE (ESR)

通常我们测量串联谐振频率下的电阻，并联谐振负载频率下的电阻值称为实际电阻。单位欧姆( $\Omega$ )。

The resistive element, measured in ohms, of a crystal device. The ESR measurement is only at the series resonant frequency ( $F_s$ ), not at some predetermined parallel resonant frequency ( $F_1$ ) crystal resistance measured at some parallel load resonant frequency is called the effective resistance.

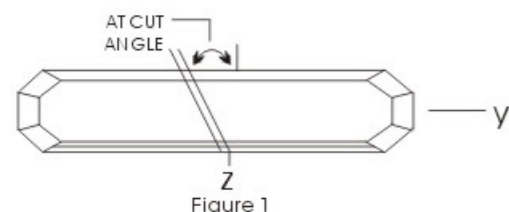
#### ● 负载电容CL

晶体的负载电容是和晶体联合决定工作频率的外部电容，单位皮法(pf)

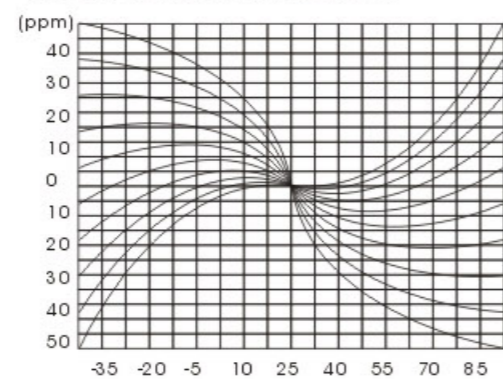
Crystal load capacitance is comprised of the circuits discrete load capacitance, strayboard capacitance, and capacitance from semiconductor miller effects, specified in pico farads (PF)

#### ● 晶片切型和切角

TYPE/ANGLE OF QUARTZ CUT



#### ● 中心频率 CENTER FREQUENCY



AT CUT 频率温度特性曲线  
AT CUT Frequency vs Temp

#### ● 晶片切型和切角TYPE/ANGLE OF QUARTZ CUT

晶片的切型和切角决定晶体的各项参数，最重要的是晶体频率的稳定性。频率的稳定性取决于晶片在晶体坐标系中所处的方位，即我们所说的切型。如图1所示极为常见的取自Y棒晶体AT切型，图2则为AT切型晶体的温度特性曲线，注意拐点(25°C左右)和不同切角的极值点位置。

The type and angle of a quartz cut effects the crystal device operating parameters, the most significant being frequency stability. The frequency stability is dependant upon the plane or the crystal element in relation to the crystalline axes or the crystal. The plane or angle is referred to as the crystal cut. As shown in Figure 1, a common type of thickness shear crystal fabricated from Y bar quartz is the AT cut. In Figure 2, the frequency stability versus operating temperature range is plotted as a function of AT cut angle( $\theta$ ). Note the inflection point at approximately 25°C and the location of the adjacent upper and lower turning points for each cut angle. The frequency stability and operating temperature range required by the customer determine the angle of cut utilize.

## HC-49/U、HC-49/T 石英晶体谐振器 HC-49/U、HC-49/T QUARTZ CRYSTAL RESONATOR



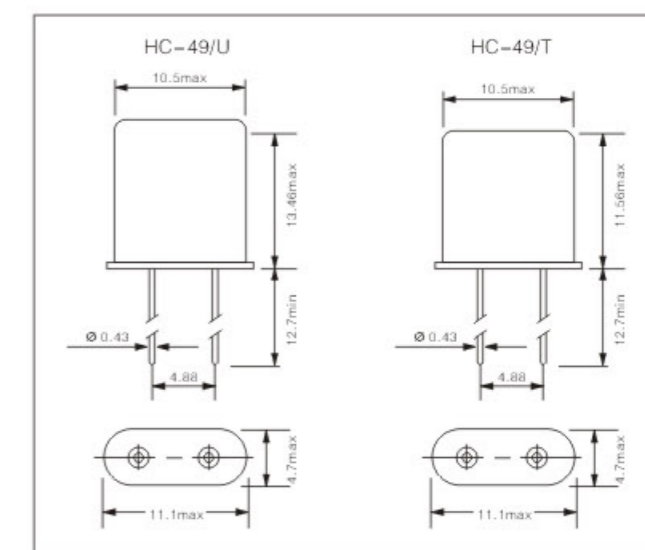
#### ● 技术参数: Specifications

项目 Item	标记 Symbol	技术 Specifications	备注 Remarks
频率范围 Freq. Range	f	1.8432MHz to 40.000MHz	基频模式 Fundamental mode
		24.000MHz to 150.000MHz	泛音模式 Overtone mode
调整频差 Freq. Tol	$\Delta f/f$	$\pm 30$ ppm	公差内 Tight Tolerance Available
负载电容 Load Capacitance	CL	Fund: 10pf to $\infty$ ; O.T: 5pf to $\infty$	明确注释 Please specify
温度频差 Temp Tol	$\Delta f/f$	$\pm 50$ ppm	公差内 Tight Tolerance Available
温度范围 Temp Range	储存温度 Storage Temp	TSTG	-55°C to 125°C
	工作温度 Operating Temp	TOPR	-10°C to 60°C
激励功率 Drive Level	最大值 Max. drive level	MDL	1000 $\mu$ w
	建议使用 Rec. drive level	RDL	10 $\mu$ w to 100 $\mu$ w
静电容 Shunt Capacitance	Co	7pf max	
绝缘电阻 Insulation Resistance	IR	500M $\Omega$ Min	
老化率 Aging	$\Delta FA$	$\pm 5$ ppm/year max	

#### ● 谐振电阻: Resonance Resistance

频率范围 Freq. Range	模式 Mode	谐振电阻 Rr( $\Omega$ )
1.8432 < f $\leq$ 3.0	F	300
3 < f $\leq$ 5.0	F	70
5.0 < f $\leq$ 6.0	F	50
6.0 < f $\leq$ 9.0	F	40
9.0 < f $\leq$ 11.0	F	30
11 < f $\leq$ 31	F	20
24 < f $\leq$ 75	3rd	40
75 < f $\leq$ 90	3rd	35
75 < f $\leq$ 120	5rd	70
125 < f $\leq$ 150	5rd	100

#### ● 外部尺寸图: External Dimensions



HC-49/US、HC-49/US-SMD 石英晶体谐振器  
HC-49/US、HC-49/US-SMD QUARTZ CRYSTAL RESONATOR



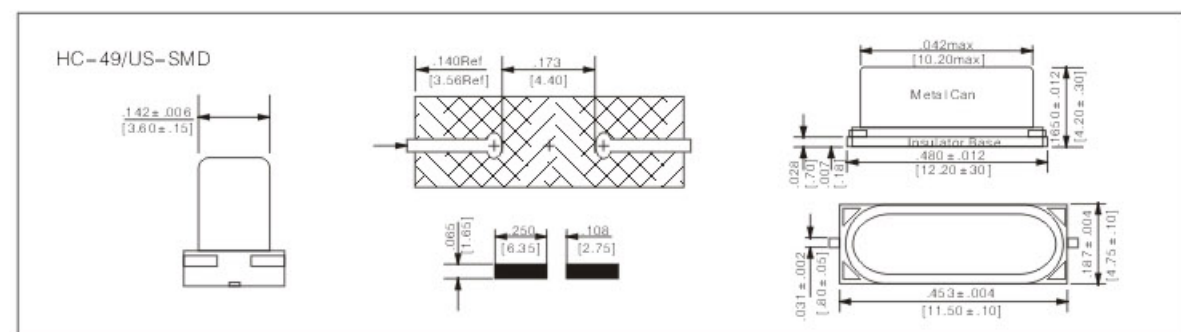
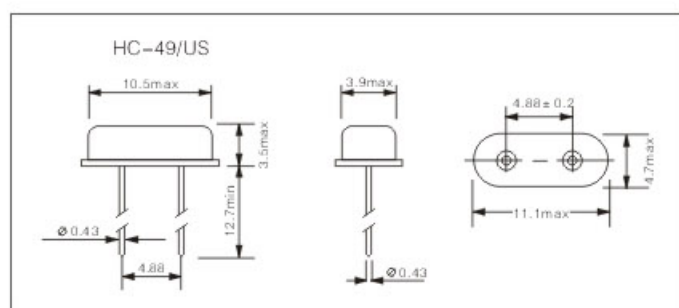
● 技术参数: Specifications

项目 Item	标记 Symbol	技术 Specifications	备注 Remarks
频率范围 Freq. Range	f	3.5MHz to 40.000MHz	基频模式 Fundamental mode
		24.000MHz to 90.000MHz	泛音模式 Overtone mode
调整频差 Freq. Tol	$\Delta f/f$	$\pm 30\text{ppm}$	公差内 Tight Tolerance Available
负载电容 Load Capacitance	CL	Fund:10pf to $\infty$ ; O.T:5pf to $\infty$	明确注释 Please specify
温度频差 Temp Tol	$\Delta f/f$	$\pm 50\text{ppm}$	公差内 Tight Tolerance Available
温度范围 Temp Range	储存温度 Storage Temp	Tstg	-55°C to 125°C
	工作温度 Operating Temp	ToPR	-10°C to 60°C
激励功率 Drive Level	最大值 Max. drive level	MDL	1000 $\mu\text{w}$
	建议使用 Rec. drive level	RDL	10 $\mu\text{w}$ to 100 $\mu\text{w}$
静电容 Shunt Capacitance	Co	7pf max	
绝缘电阻 Insulation Resistance	IR	500M $\Omega$ Min	
老化率 Aging	$\Delta\text{FA}$	$\pm 5\text{ppm/year max}$	

● 谐振电阻: Resonance Resistance

频率范围 Freq. Range	模式 Mode	谐振电阻 Rr( $\Omega$ )
3.5<f $\leq$ 4.0	F	120
4.0<f $\leq$ 6.0	F	100
6.0<f $\leq$ 10	F	60
6.0<f $\leq$ 9.0	F	40
15<f $\leq$ 24	F	25
24<f $\leq$ 33	F	20
24<f $\leq$ 50	3rd	100
50<f $\leq$ 90	3rd	70

● 外部尺寸图: External Dimensions



UM-1/UM-5 石英晶体谐振器  
UM-1/UM-5 QUARTZ CRYSTAL RESONATOR



● 技术参数: Specifications

项目 Item	标记 Symbol	技术 Specifications	备注 Remarks
频率范围 Freq. Range	f	6.000MHz to 40.000MHz	基频模式 Fundamental mode
		30.000MHz to 180.000MHz	泛音模式 Overtone mode
调整频差 Freq. Tol	$\Delta f/f$	$\pm 10\text{ppm}$	公差内 Tight Tolerance Available
负载电容 Load Capacitance	CL	Fund:10pf to $\infty$ ; O.T:5pf to $\infty$	明确注释 Please specify
温度频差 Temp Tol	$\Delta f/f$	$\pm 30\text{ppm}$	公差内 Tight Tolerance Available
温度范围 Temp Range	储存温度 Storage Temp	Tstg	-55°C to 125°C
	工作温度 Operating Temp	ToPR	-10°C to 60°C
激励功率 Drive Level	最大值 Max. drive level	MDL	1000 $\mu\text{w}$
	建议使用 Rec. drive level	RDL	10 $\mu\text{w}$ to 100 $\mu\text{w}$
静电容 Shunt Capacitance	Co	7pf max	
绝缘电阻 Insulation Resistance	IR	500M $\Omega$ Min	
老化率 Aging	$\Delta\text{Fa}$	$\pm 5\text{ppm/year max}$	

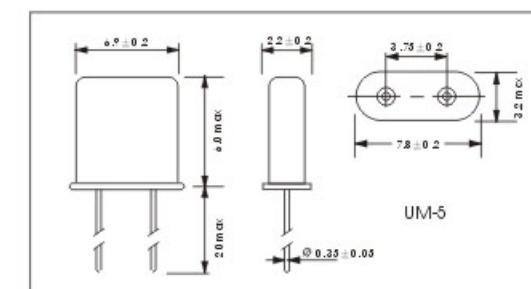
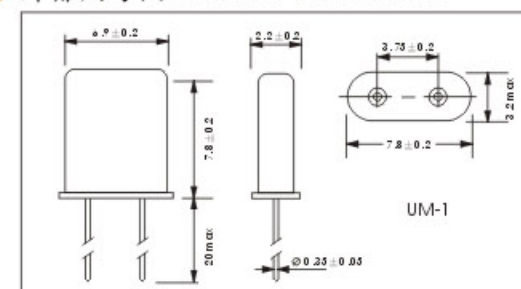
● 谐振电阻: Resonance Resistance

盒型 Type	频率范围 Freq. Range	模式 Mode	谐振电阻 Rr( $\Omega$ )	盒型 Type	频率范围 Freq. Range	模式 Mode	谐振电阻 Rr( $\Omega$ )
UM-1	6~16MHz	F	25	UM-5	11~19MHz	F	25
UM-1	7~31MHz	F	15	UM-5	20~31MHz	F	15
UM-1	38~95MHz	3rd	30	UM-5	40~95MHz	3rd	35
UM-1	75~150MHz	5rd	65	UM-5	75~150MHz	5rd	70

● 温度频差: Tolerance over Temperature Range

温度范围 Temp Range	$\pm 2.5\text{ppm}$	$\pm 3\text{ppm}$	$\pm 5\text{ppm}$	$\pm 7\text{ppm}$	$\pm 10\text{ppm}$	$\pm 15\text{ppm}$
0°C - $\pm 50$ °C	$\Delta$	$\Delta$	$\Delta$	$\Delta$	$\Delta$	$\Delta$
-10°C - $\pm 60$ °C		$\Delta$	$\Delta$	$\Delta$	$\Delta$	$\Delta$
-20°C - $\pm 70$ °C			$\Delta$	$\Delta$	$\Delta$	$\Delta$
-40°C - $\pm 85$ °C				$\Delta$	$\Delta$	$\Delta$

● 外部尺寸图: External Dimensions



SMD 石英晶体谐振器  
SERIES CRYSTAL RESONATOR



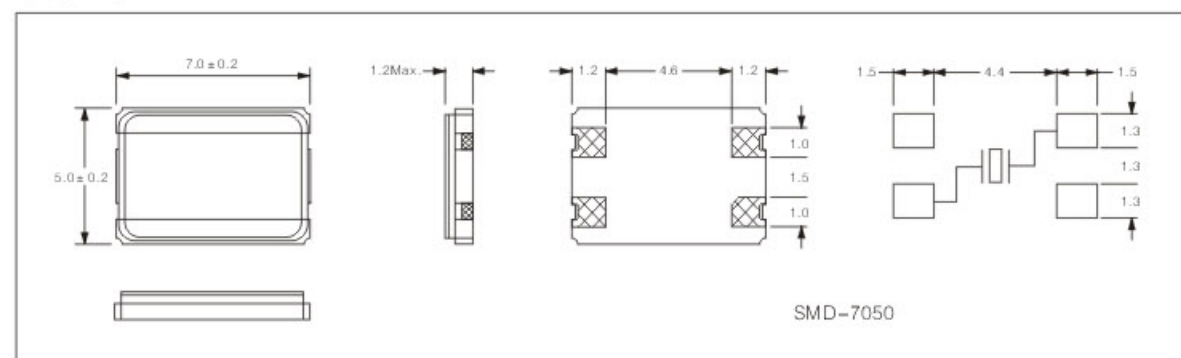
● 技术参数: Specifications

项目 Item	标记 Symbol	技术 Specifications	备注 Remarks
频率范围 Freq. Range	f	8.000MHz to 30.000MHz	基频模式 Fundamental mode
		30.000MHz to 80.000MHz	泛音模式 Overtone mode
频率偏差 Freq. Tol. Ta=25°C ± 3°C	Δf/f	±30ppm	公差内 Tight Tolerance Available
负载电容 Load Capacitance	CL	Fund: 10pf to ∞ ; O.T: 5pf to ∞	明确注释 Please specify
温度频差 Temp Tol	Δf/f	±30ppm	公差内 Tight Tolerance Available
温度范围 Temp Range	储存温度 Storage Temp	TSTG	-55°C to 125°C
	工作温度 Operating Temp	TOPR	-10°C to 60°C
激励功率 Drive Level	最大值 Max. drive level	MDL	500 μ w
	建议使用 Rec. drive level	RDL	10 μ w to 100 μ w
串联电阻 Series Resistance	R1	As Per Table	
静电容 Shunt Capacitance	Co	7pF Max	
绝缘电阻 Insulation Resistance	IR	500M Ω Min	
老化率 Aging	ΔFa	± 5PPM/Year Max	
焊接条件 Soldering condition	Tsol	Twice at under 240°C within 10 Second/ reflow time within 3 minutes	
抗冲击能力 Shock Resistance	SR	± 10PPM Max	Conditions depend of frequencies

● 谐振电阻: Resonance Resistance

频率范围 Freq. Range	模式 Mode	谐振电阻 Rr(Ω)	频率范围 Freq. Range	模式 Mode	谐振电阻 Rr(Ω)
8.0 < f ≤ 16	F	60	30 < f ≤ 40	3rd	80
16 < f ≤ 30	F	40	40 < f ≤ 80	3rd	70-100

● 外部尺寸图: External Dimensions



3X8.2X6 表晶  
3X8.2X6 CRYSTAL



● 技术参数: Specifications

项目 Item	标记 Symbol	技术 Specifications	备注 Remarks
系列 Series		THLF-38 THLF-26	
频率范围 Freq. Range	f	32.768kHz	Standard
		30kHz to 200kHz	Available
频率偏差 Freq. Tol. Ta=25°C ± 3°C	Δf/f	± 20PPM	Standard
Turn Over Temperature	θ T	25°C ± 2°C	
温度系数 Temp Coefficient	A	-0.04 X 10 <sup>-6</sup> /°C	Maximum
负载电容 Load Capacitance	CL	12.5pF	Available from 6.0pF to ∞
温度范围 Temp Range	储存温度 Storage Temp	TSTG	-20°C to 70°C
	工作温度 Operating Temp	TOPR	-10°C to 60°C
激励电平 Maximum Drive Level	MDL	1.0 μ w	
串联电阻 Series Resistance	R1	50kΩ Max	32.768kHz. Other please see ESR table
动态电容 Motional Capacitance	C1	4.0fF	Typical
静电容 Shunt Capacitance	Co	2.0pF	Typical
绝缘电阻 Insulation Resistance	IR	500M Ω Min	DC=100V
老化率 Aging	ΔFa	± 5PPM Min	Standard, Ta=25° ± 3° , first year

● 谐振电阻: Resonance Resistance

频率范围 Freq. Range	谐振电阻 Rr(Ω)	频率范围 Freq. Range	谐振电阻 Rr(Ω)
30kHz ≤ f < 40kHz	40k Ω Max	70kHz ≤ f < 120kHz	22k Ω Max
40kHz ≤ f < 60kHz	30k Ω Max	120kHz ≤ f < 200kHz	20k Ω Max
60kHz ≤ f < 70kHz	25k Ω Max		

● 外部尺寸图: External Dimensions

