Technical Support of Crystal Unit

TECHNICAL LINK CO., LTD.

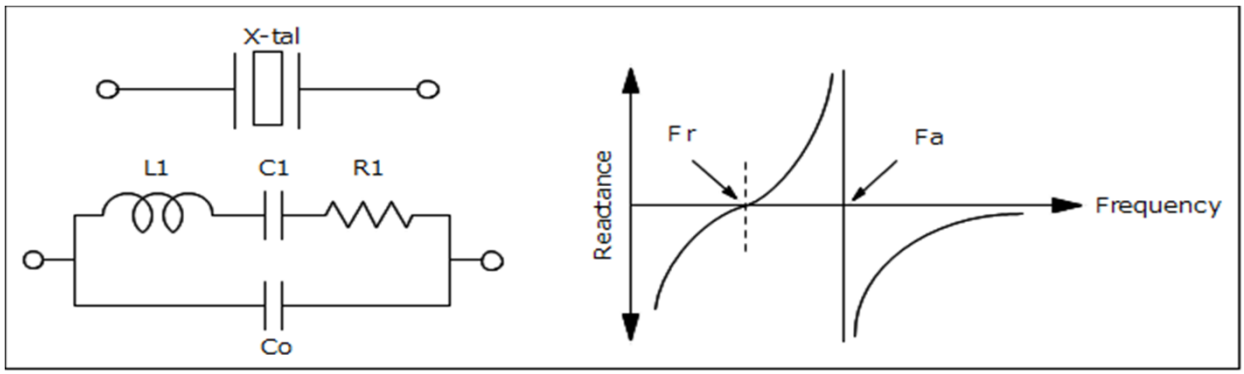


Fig1-1, Equivalent Circui

Fig1-2, Reactance Characteristics

* Series resonance frequency $Fr = \frac{1}{2\pi\sqrt{L1*C1}}$

* Antiresonance frequency $Fa = \frac{1}{2\pi}\sqrt{\frac{C1+Co}{L1*C1*Co}}$

* Equivalent series resistance $R1 = \frac{2\pi*Fr*L1}{Q}$

* Motional capacitance $C1 = \frac{2(CL+Co)*\Delta f}{Fr}$

* Motional inductance $L1 = \frac{2(CL+Co)*\Delta f}{(2\pi*Fr)^2*C1}$

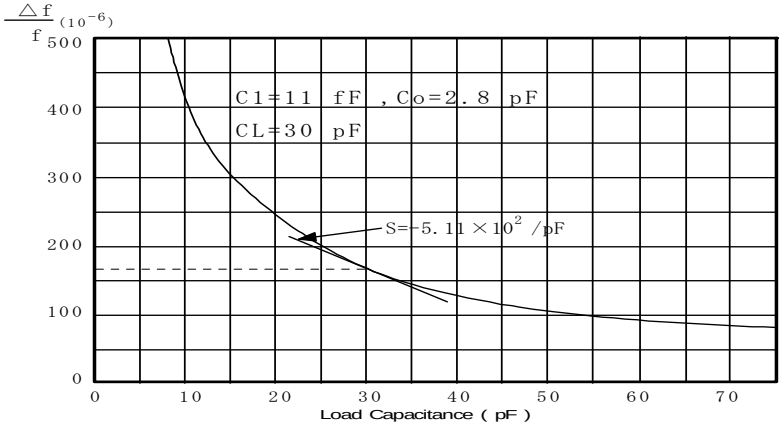
* Capacitance ratio $r = \frac{Co}{C1}$

* Quality factor $Q = \frac{2\pi*Fr*L1}{R1}$

* Parallel capacitance Co

* Load capacitance CL

Fig1-3, Formula



$$\frac{\Delta fL}{Fr} = \frac{1}{2r} * \frac{1}{1+\frac{CL}{Co}} = \frac{C1}{2(Co+CL)}$$

$\Delta fL = FL - Fr$

Fig1-4, Crystal Resonatores and Load Capacita

Cut	Frequency Range	Frequency Vibration	Frequency Formula
AT	800 KHz ~ 60 MHz	Thickness - Shear	1670 / t
AT	1 MHz ~ 60 MHz	Thickness - Shear	1670×n / t n = 3 / 5 / 7 / 9
BT	25 MHz ~ 300 MHz	Thickness - Shear	2560 / t
BT	130 KHz ~ 1 MHz	Thickness - Shear	2560×n / t n = 3 / 5 / 7 / 9
CT	60 KHz ~ 1 MHz	Face - Shear	3080 / l
DT	60 KHz ~ 1 MHz	Face - Shear	2070 / l
SL	360 KHz ~ 1 MHz	Length - Extentional	4610 / l
MT	50 KHz ~ 500 KHz	Length - Extentional	2700 / l
NT	4 KHz ~ 100 KHz	Length - Width Flexure	5700×W / 1^2
+5° x	45 KHz ~ 250 KHz	Length - Extentional	2830 / l
+5° x	10 KHz ~ 50 KHz	Length - Width Flexure	5200×W / 1^2
XY	130 KHz ~ 1 MHz	Length - Width Flexure	5700×W / 1^2
X	3 MHz ~ 300 MHz	Thickness - Extentional	2970 / l
Y	3 MHz ~ 300 MHz	Thickness - Shear	1980 / l

Table1-1, Characteristics by Cut of Crystal

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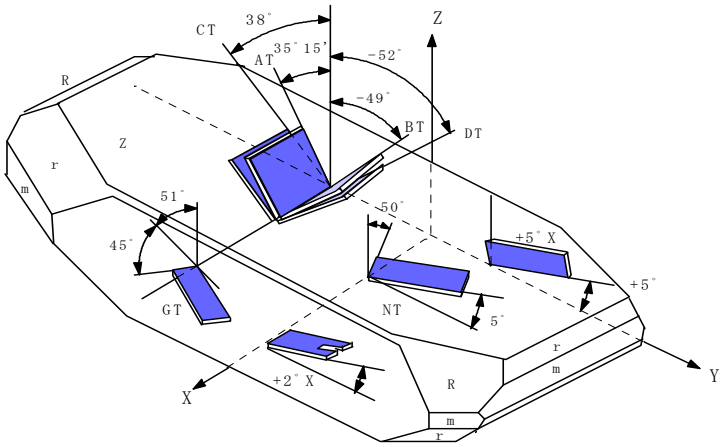

Fig1-5, Name of Crystal Cutting

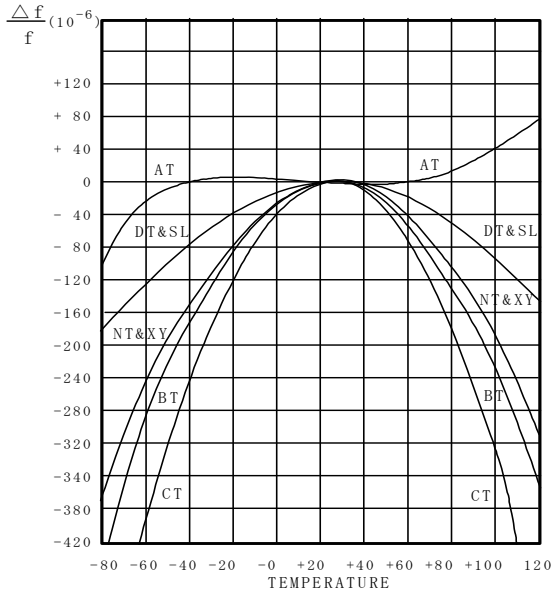

Fig1-6, Frequency Curves by Cut

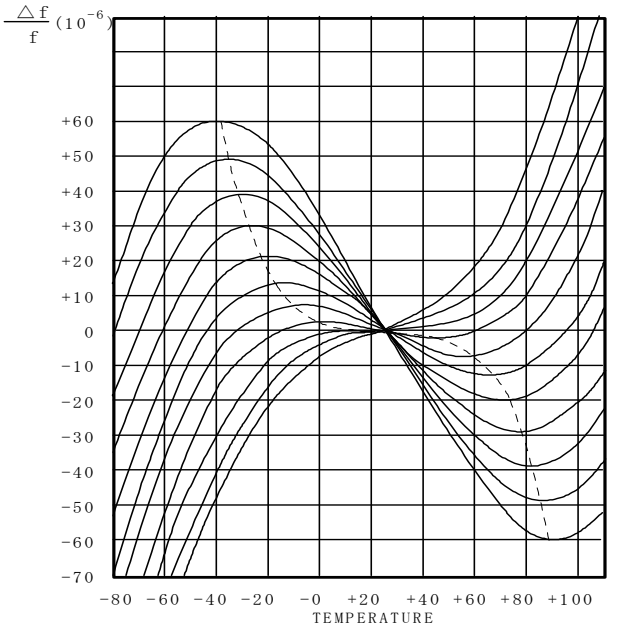

Fig1-7, Frequency Curves by AT Cu

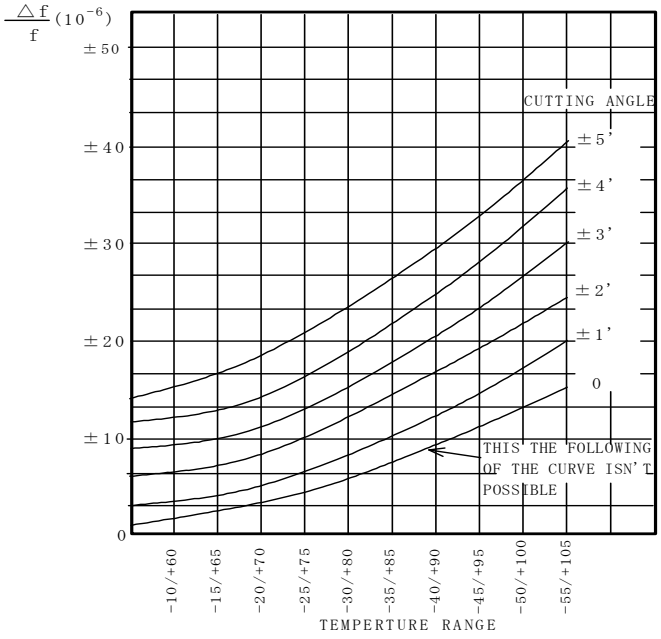

Fig1-8, Manufacturing Diffculty Degr

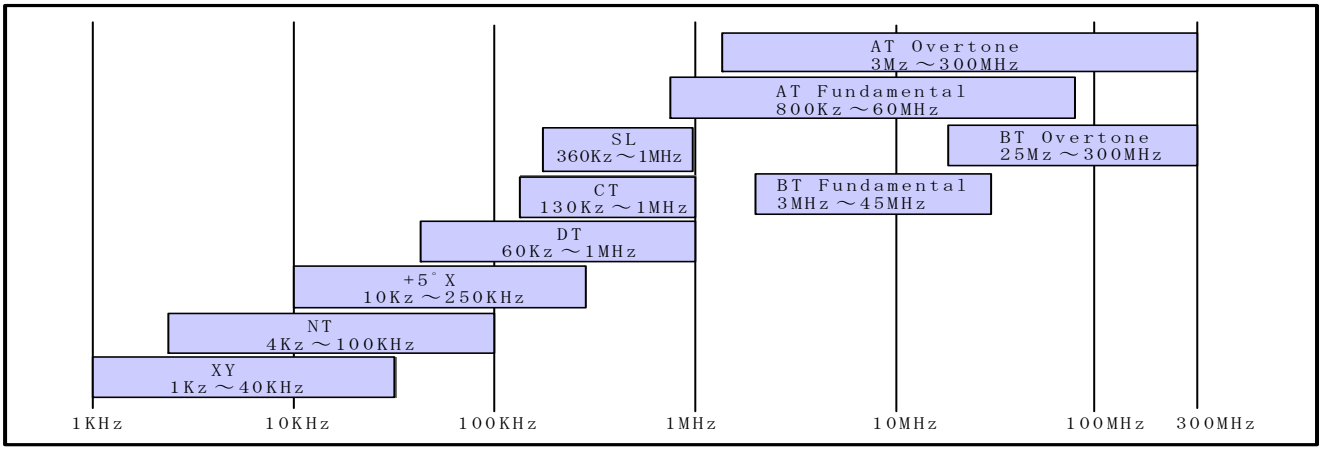

Fig1-9, Frequency Ranges by Cuts of Crystals