Quartz crystals - professional applications HC-49/SMD-like

9922 522 43... series

FEATURES

- Outstanding electrical performance
- Low resistance values
- High pullability values
- High mechanical and electrical stability
- Low ageing.

APPLICATIONS

- Microprocessors
- Traffic control
- Weather balloons
- Medical systems
- Military applications
- Communication systems
- Agrarian applications
- Machine control
- Environmental applications.

DESCRIPTION

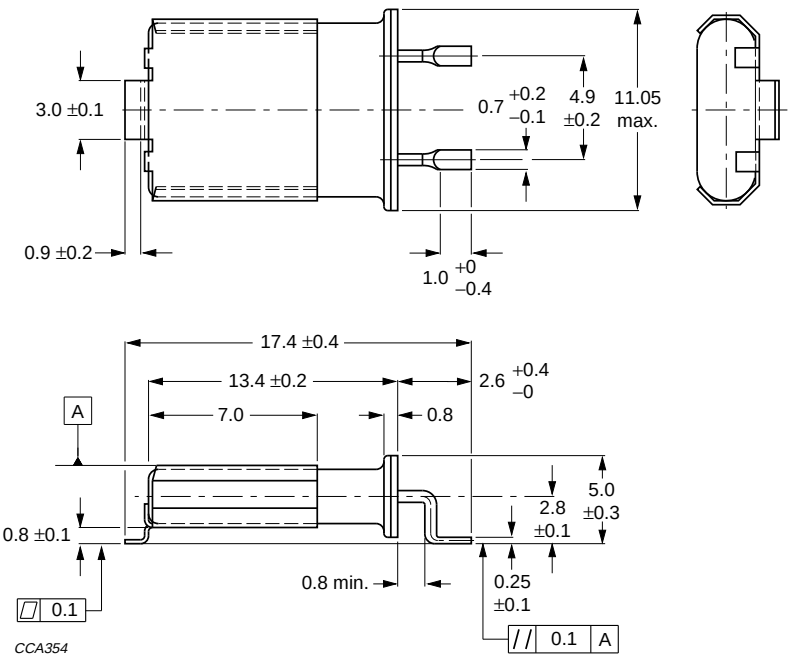
The unit consists of a silver-plated AT-cut quartz plate, encapsulated in a nitrogen-filled metal holder. The holder is hermetically sealed by resistance welding and provided with connections for surface mounting.

QUICK REFERENCE

SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT
f_{nom}	nominal frequency:				
	fundamental mode	2.4	–	27.0	MHz
	third overtone	16.8	–	75.0	MHz
	fifth overtone	50.0	–	125.0	MHz
T_{oper}	operating temperature	–40	–	+105	°C
T_{op}	operable temperature	–55	–	+155	°C
$\Delta f/f_{nom}$	adjustment tolerance	±5	±10	–	ppm
$\Delta f/f_{25}$	frequency stability over temperature range: –20 to +70 °C with respect to T_{amb} = 25 °C:				
	class 0	–	±10	–	ppm
	class 1	–	±15	–	ppm
	class 2	–	±20	–	ppm
C_1	motional capacitance tolerance	±5	±10	–	%
C_0	parallel capacitance tolerance	±5	±10	–	%
$\Delta f/f$	ageing over 10 years at 25 °C	±3	–	±5	ppm

MECHANICAL DATA

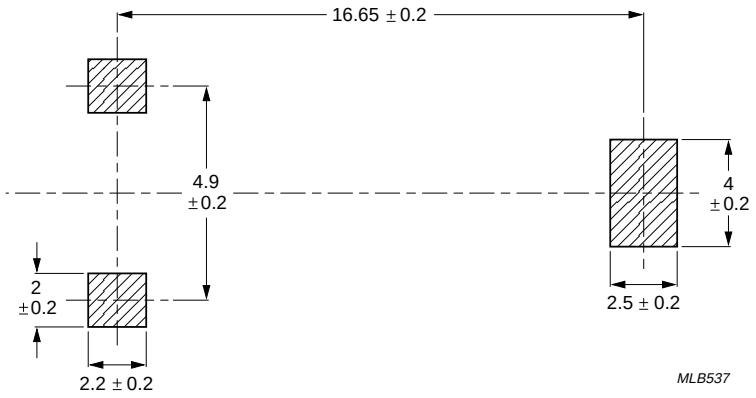
Package outlines



Dimensions in mm.

Fig.1 Style 1: HC-49/U17-SMD/Clip I.

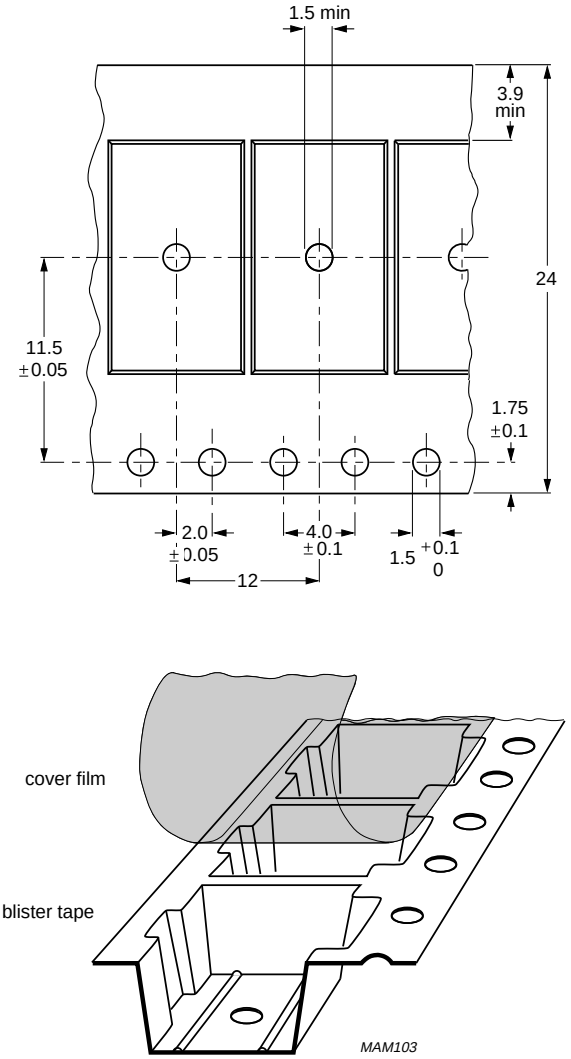
Recommended pad layout



Dimensions in mm.

Fig.2 HC-49/U-SMD/Clip I.

Tape and reel data

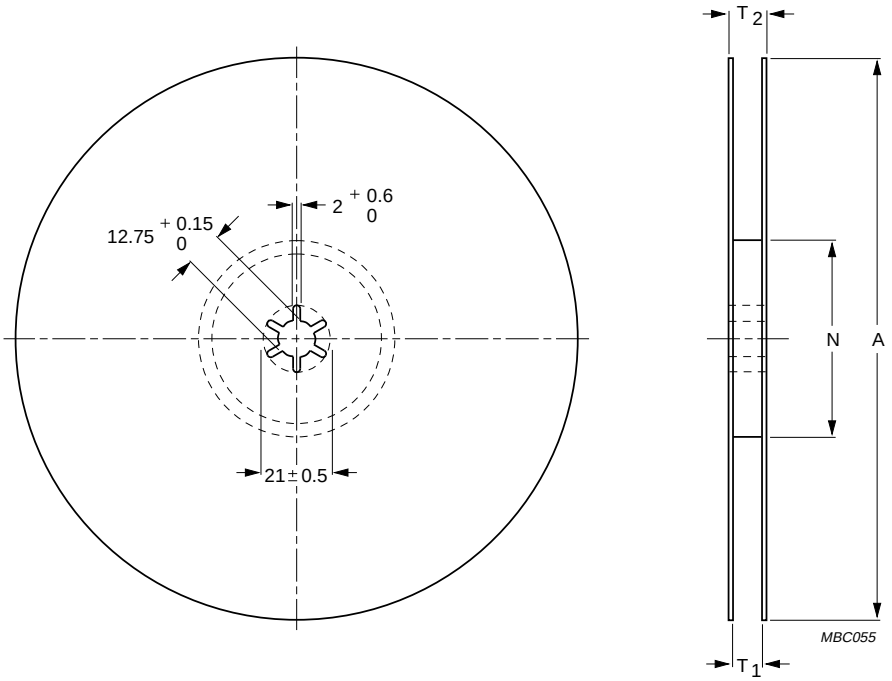


Dimensions in mm.
Crystal connections are adjacent to sprocket holes.
Cumulative pitch error: ≤0.2 mm over 10 pitches.

Total tape height of tape with top film: 5.8 mm maximum.
Tape thickness: 0.3 mm.
The blister is made of conductive polystyrene. Taping is performed in accordance with *"IEC 286-3"*.
Leader: minimum 400 mm including 100 mm sealed with empty compartments.
Trailer: minimum 160 mm sealed with empty compartments.

Pocket dimensions:
Length = 18.3 ±0.1 mm
Width = 11.4 ±0.1 mm
Depth = 5.6 +0.05/–0 mm.

Fig.3 Blister tape.



Dimensions in mm.
For dimensions see Table 1.

Fig.4 Reel dimensions.

Table 1 Reel dimensions; see Fig.4

TAPE WIDTH (mm)	A (mm)	N (mm)	T_1 (mm)	T_2 (mm)
24	330	62 ±1.5	24.4 +0.2/–0	28.4 ±0.2

PACKAGING AND QUANTITIES

STYLE	PACKAGING	QUANTITY	DIMENSIONS OF BOX (mm)		
			LENGTH	WIDTH	HEIGHT
1	blister tape on reel	700 units per reel	338	338	38
	blister tray	700 units per box	200	125	70

STANDARD MARKING(1)

- Line 1: PHILIPS
- Line 2: frequency in kHz (fundamental mode) or in MHz (overtone)
- LIne 3: last five digits of catalogue number followed by the manufacturing date code (last three digits of week code).

MASS AND LEADS

Typical mass: 1.2 g.

The leads are finished with either Sn99Cu1 or Sn60Pb40 on a nickel underplate.

The first 1 mm from the body is not guaranteed for soldering.

(1) Special marking on product and/or package is available on request.

ELECTRICAL DATA

Valid at T_{amb} = 25 ± 2 °C and a nominal drive level of 100 μW into 25 Ω unless otherwise specified. Measuring system: π-network in accordance with *"IEC 444"* recommendations.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
f_{nom}	nominal frequency	fundamental	2.4	–	27.0	MHz
		third overtone	16.8	–	75.0	MHz
		fifth overtone	50.0	–	125.0	MHz
$\Delta f/f_{nom}$	adjustment tolerance		±5	±10	–	ppm
R_r	resonance resistance	see note 1	–	–	–	Ω
C_L	load capacitance	see note 2	5	20	∞	pF
T_{oper}	operating temperature		–40	–	+105	°C
T_{op}	operable temperature		–55	–	+155	°C
$\Delta f/f_{25}$	frequency stability over temperature range, with respect to T_{amb} = 25 °C		see Table 2			ppm
R_r (T)	resonance resistance over temperature range	see note 1	available from R_r upwards			Ω
C_1	motional capacitance					fF
	tolerance		±5	±10	–	%
C_0	parallel capacitance					pF
	tolerance		±5	±10	–	%
S	pulling sensitivity		$S = -0.5\ C_1 / (C_0 + C_L)^2$			ppm/pF
R_n	resonance resistance of unwanted response (spurious)	fundamental mode; f_{nom} ±20%	2 R_r (T)	–	–	Ω
			+6	–	–	dB
		overtones; f_{nom} ±200 kHz	2 R_r (T)	–	–	Ω
			+6	–	–	dB
R_{dld}	drive level dependency, being the resonance resistance in the drive level range	drive level range 10^{-16} W to 10^{-4} W; note 1	see note 2			Ω
R_{ins}	insulation resistance	DC test voltage = 100 V	500	–	–	MΩ
$\Delta f/f_{nom}$	total frequency stability with respect to f_{nom}	including temperature range and ageing	see Table 2			ppm
	frequency hysteresis or discontinuity		–	–	1	ppm
$\Delta f/f$	ageing	see Figs 5 and 6	±3	–	±5	ppm

Notes

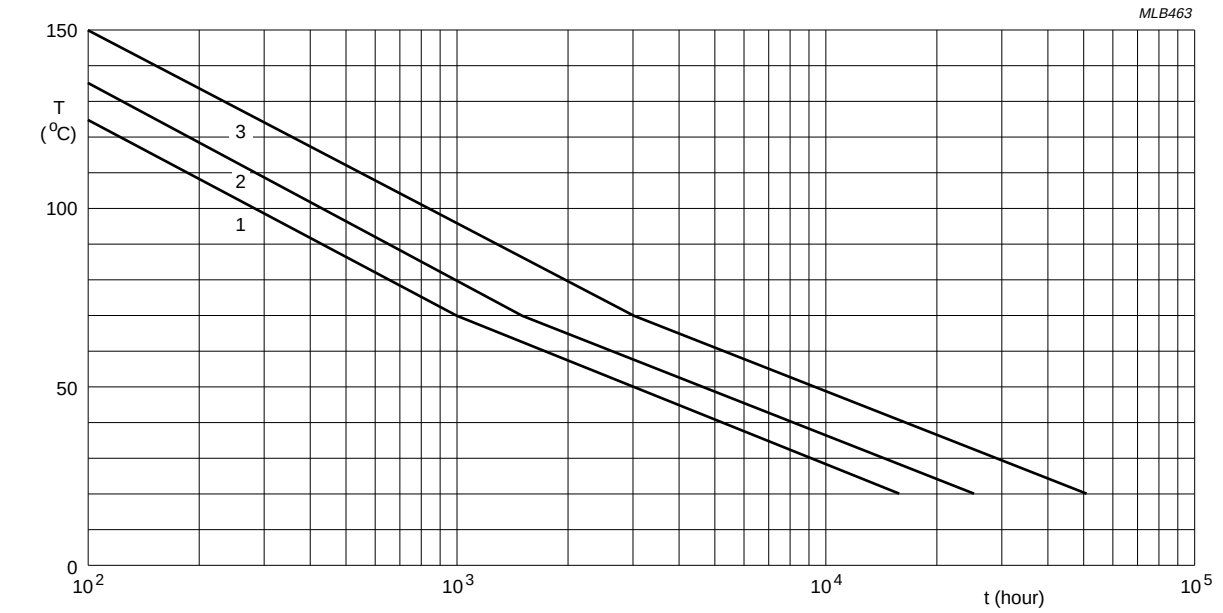
1. All resistance values are measured in series resonance. Load resonance measurement is available on request.
2. Values available on request.

Table 2 Frequency stability with temperature variation (available maximum values)

TEMPERATURE RANGE[1] (°C)	FREQUENCY STABILITY (ppm)		
	CLASS 0	CLASS 1	CLASS 2
+20/+30	±1.0	±1.5	±2.0
0/+50	±5.0	±7.5	±10.0
–10/+60	±7.5	±10.0	±15.0
–20/+70	±10.0	±15.0	±20.0
–30/+80	±12.5	±20.0	±25.0
–40/+90	±17.5	±25.0	±30.0
–55/+105	±25.0	±30.0	±40.0
–40/+130	–	±50.0	±80.0

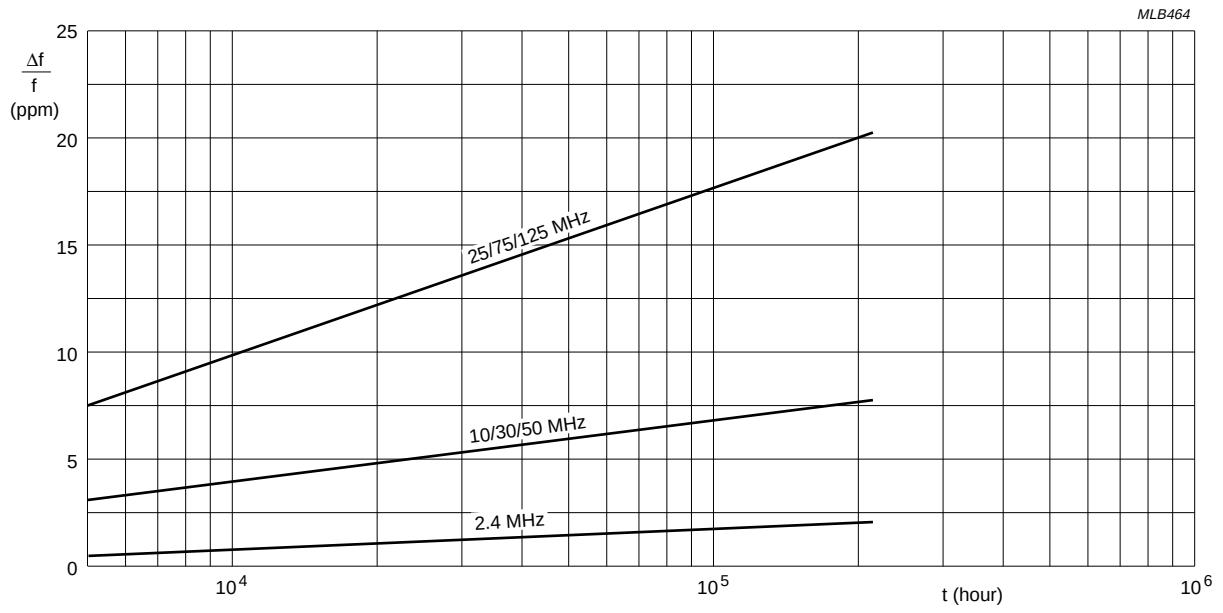
Note

1. To obtain the same stability at frequencies below 8.0 MHz, the upper temperature limit is 10 °C lower.



Curve 1 = 1000 hours at 70 °C.
Curve 2 = 720 hours at 85 °C.
Curve 3 = 240 hours at 130 °C.

Fig.5 Time/temperature relation at which ageing is approximately equivalent.



Fundamental, third and fifth overtones.
Necessary pre-ageing can be calculated using Fig.5.

Fig.6 Typical frequency ageing as a function of time at 25 °C, **without pre-ageing of crystals.**

TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance with IEC publication 68-2, *"Recommended basic climatic and mechanical robustness testing procedure for electronic components"* and IEC publication 1178-1, *"Generic specification for quartz crystal units"*.

Table 3 Test procedures and requirements; note 1

IEC 68-2 METHOD	TEST	PROCEDURE	REQUIREMENTS
Ba	ageing	1000 hours at 70 °C	$\Delta f/f \leq \pm 5$ ppm ΔR_r ±5 Ω or ±20% whichever is the greater
Db	accelerated damp heat	+25 to +55 °C; 6 cycles at RH >95%	$\Delta f/f \leq \pm 5$ ppm ΔR_r ±5 Ω or ±20% whichever is the greater
Ea	shock; note 2	100 g; half sinewave; 6 directions; 1 blow/direction	$\Delta f/f \leq \pm 5$ ppm ΔR_r ±5 Ω or ±20% whichever is the greater
Eb	bump; note 2	4000 bumps of 40 g	$\Delta f/f \leq \pm 5$ ppm ΔR_r ±5 Ω or ±20% whichever is the greater
Ed	free fall; note 2	3 times on hard wood; for height of fall (h) see Table 4	$\Delta f/f \leq \pm 5$ ppm ΔR_r ±5 Ω or ±20% whichever is the greater
Fc	vibration	frequency 10 to 500 to 10 Hz; acceleration 10 g; 3 directions; 30 minutes/direction	$\Delta f/f \leq \pm 5$ ppm ΔR_r ±5 Ω or ±20% whichever is the greater
Na	temperature cycling test	–40 to +85 °C; 10 cycles; 0.1 hour/cycle	$\Delta f/f \leq \pm 5$ ppm ΔR_r ±5 Ω or ±20% whichever is the greater
Q	sealing (method 1)	16 hours; 700 kPa He	$<1 \times 10^{-8}$ ncc/s He
Ta	solderability	235 ±5 °C; 2 ±0.5 s; flux 600 (activated); optional steam pre-heat 8 hours. This reflects at least 36 months of storage at room conditions	≥90%, on the flat lead part; no visible damage, no leaks
Tb	resistance to reflow soldering	rise 10 K/s; dwell 2 min/160 °C; rise 10 K/s up to 280 °C; cool down	$\Delta f/f \leq \pm 5$ ppm ΔR_r ±5 Ω or ±20% whichever is the greater

IEC 68-2 METHOD	TEST	PROCEDURE	REQUIREMENTS
Other applicable tests			
Xa	resistance to solvents; note 3: Bio-Act EC7®; Neutropon P3® and Saxin P3®; Meta Clean 820®; Lonco 446®; Isopropanol cleaning solvent; Dowanol DPM® (glass crystals only)	in accordance with *"IEC 68-2-45"*, *"IEC 653"* (immersion time 5 minutes) and *"MIL 202 E215"*. At ambient temperature and ultrasonic frequency (40 kHz)	no degradation of marking

Notes

1. Test table including MIL-specs (*"MIL-Std 883"* and *"MIL-Std 202"*) can be provided upon request.
2. Mechanical tests to be performed on units clamped to a printed-circuit board for the total unit height.
3. Bio-Act is a registered trademark of Petroform.
   Neutropon P3 and Saxin P3 are registered trademarks of Henkel.
   Meta Clean 820 is a registered trademark of Mavom.
   Lonco 447 is a registered trademark of London Chemical Co.
   Dowanol DPM is a registered trademark of Dow Chemical.

Table 4 Height of fall

h (mm)	PRODUCT LENGTH (mm)	FREQUENCY RANGE(1) (MHz)		
		FUNDAMENTAL MODE	THIRD OVERTONE	FIFTH OVERTONE
750	17	2.4 to 16.0	20.0 to 48.0	50.0 to 80.0
500	17	16.1 to 27.0	48.1 to 75.0	80.1 to 125.0

Note

1. Standard values. Actual designs can be made to obtain higher or lower values.

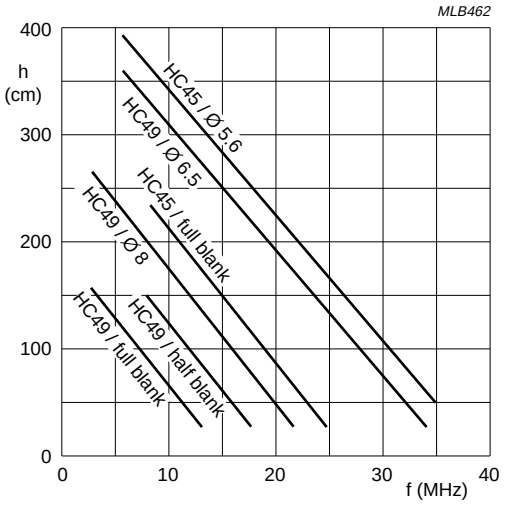


Fig.7 Typical height of fall values (3× on hard wood) for various quartz blank and holder combinations. ‘Full’ and ‘half’ blanks refer to rectangular quartz designs; ‘∅’ designates circular quartz designs and the appropriate diameter.