DATA SHEET

9922 515 000.. series

Voltage controlled Temperature Compensated Crystal Oscillator Type VTCXO in B8 and B9 (sine wave)

Product specification
Supersedes data of 1998 May 12
File under SARONIX B.V., SBV2

1998 Nov 10

SaRonix

Voltage controlled Temperature Compensated Crystal Oscillator Type VTCXO in B8 and B9

9922 515 000.. series

FEATURES

- High stability
- Sine-wave output
- Various pullability and modulation values
- Very low phase noise
- Trough-hole and SMD-like versions
- Low-profile DIL-14 like; or DIL-8 like.

APPLICATIONS

- Cellular telephone
  - Digital: GSM, NADC, PDC
  - Analog: AMPS, TACS, NMT
- Satellite pager/phone (e.g. INMARSAT, UMTS)
- Private mobile radio (e.g. rescue services)
- Position finding receiver (e.g. D-GPS)
- Wireless LAN (e.g. CDPD, Mobitex).

DESCRIPTION

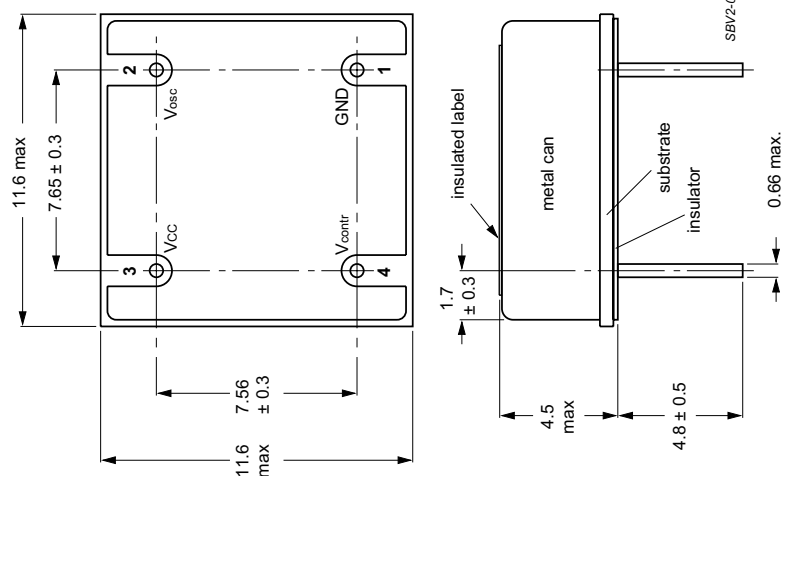
The type VTCXO voltage-controlled temperature-compensated crystal oscillator comprises a quartz crystal and an integrated circuit (IC). The IC contains the oscillator, the temperature compensation and the modulation function. The components are assembled on a hybrid circuit. A metal cover is placed on top of the hybrid for shielding. An external voltage is applied for calibration, adjustment and modulation.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	MIN.	NOM.	MAX.	UNIT
f_{nom}	nominal frequency	8.0	–	20.0	MHz
V_{CC}	supply voltage	4.75	5.0	5.25	V
V_{contr}	control voltage	0.5	2.5	4.5	V
$V_{osc(p-p)}$	output voltage (peak-to-peak value)				
	8 to 13 MHz	1.0	–	–	V
	13 to 16 MHz	0.8	–	–	V
	16 to 20 MHz	0.7	–	–	V
T_{oper}	operating temperature	–30	25	+80	°C
L	phase noise at 1 kHz offset:				
	standard	–	–	–120	dB_c/Hz
	option	–	–	–135	dB_c/Hz

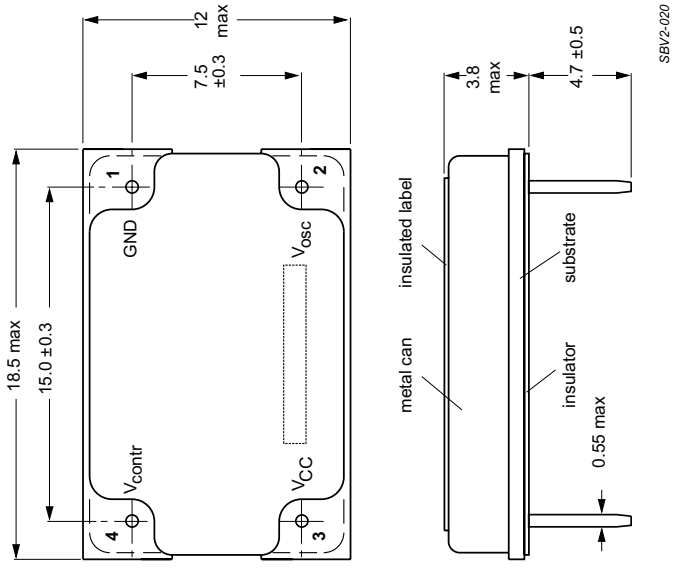
Frequency stability over the temperature range and pullability

TYPE	MAXIMUM STABILITY		PULLABILITY	UNIT
	OPTIONAL	STANDARD	TYPICAL	
VTC01	±1.0	±1.5	±8.5	ppm
VTC02	±1.5	±2.5	±15.0	ppm
VTC03	±2.0	±4.0	±40.0	ppm
VTC04	±2.5	±8.0	> ±40.0	ppm



Dimensions in mm.

Fig.2 Style 2: Package outline B9.



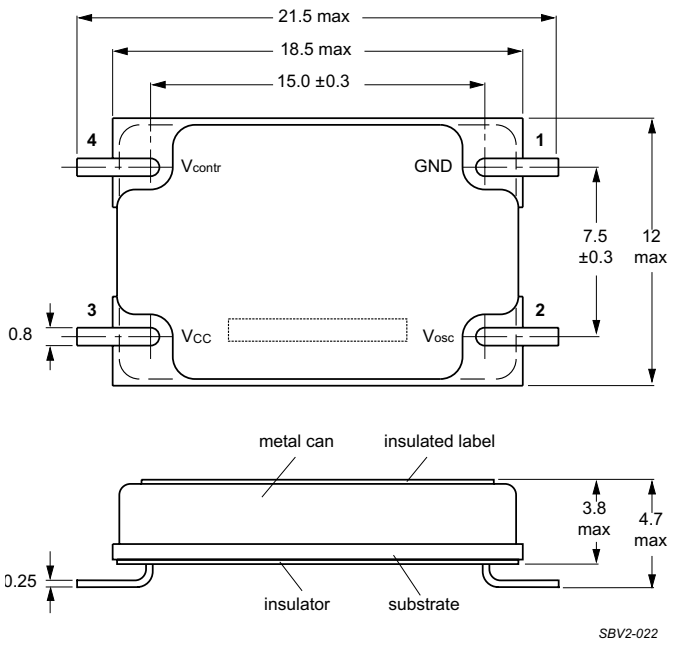
Dimensions in mm.

Fig.1 Style 1: Package outline B8.

MECHANICAL DATA

Voltage controlled Temperature Compensated Crystal Oscillator Type VTCXO in B8 and B9

9922 515 000.. series



Dimensions in mm.

Fig.3 Style 3: Package outline B8 SMD-like.

Mass and leads

B8: 1.5 g (typical)

B9: 1.2 g (typical)

The leads have a Sn60Pb40 finish on a nickel underplate.

Pinning to B8, B9 and B8 SMD-like(1)

SYMBOL	PIN (B8,B9 AND B8 SMD-LIKE)	DESCRIPTION
V_{contr}	4	control voltage
V_{CC}	3	supply voltage
V_{osc}	2	oscillator output
GND	1	ground (case)

Marking: holder type B8 and B8 SMD-like

- Line 1: PHILIPS *(2)
- Line 2: frequency in MHz
- Line 3: last five digits of catalogue number followed by code for year and week of manufacture.

Marking: holder type B9

- Line 1: PH *(3)
- Line 2: frequency in MHz
- Line 3: code for year and week of manufacture.

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

(2) * On top of case indicates pin number one.

(3) * On top of case indicates pin number one.

PACKAGING AND QUANTITIES

Table 1 B8, B9 and B8 SMD-like

STYLE	PACKAGING	QUANTITY	DIMENSIONS OF BOX (mm)		
			LENGTH	WIDTH	HEIGHT
1, 2 and 3	in tray	50 units per tray	280	118	23

ELECTRICAL DATA

Table 2 Electrical data

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Operating conditions						
V_{CC}	supply voltage	internally decoupled with:	4.75	5.0	5.25	V
I_{CC}	supply current	100 nF (type B9); 22 nF (type B8)	–	2.65	3.0	mA
$V_{osc(p-p)}$	output voltage (peak-to-peak value) (load 10 kΩ // 10 pF)	see Fig.4				
		8 - 13 MHz	1.0	1.2	–	V
		13 - 16 MHz	0.8	1.1	–	V
		16 - 20 MHz	0.7	1.0	–	V
R_L	load resistor	R_L // C_L	10	–	–	kΩ
C_L	load capacitor		–	–	10	pF
T_{oper}	operating temperature		–30	+25	+80	°C
T_o	operable temperature		–40	–	+90	°C
T_{stg}	storage temperature		–45	–	+100	°C
t_{st}	start-up time	0 to 90% output level	–	2	5	ms
		1.5 × rated frequency stability	–	–	0.2	s
		rated frequency stability	–	–	1	s
Frequency characteristics at nominal V_{contr}						
f_{nom}	nominal frequency		8.0	–	20.0	MHz
$\Delta f/f_{nom}$	initial frequency tolerance, (reference to f_{nom})	notes 4 and 6	–	–	–	
$\Delta f/f_{25}(T)$	frequency stability as a function of temperature change, (reference to initial frequency)	T_{oper} = +80 to –30 °C				
		VTC01 optional	–	–	±1.0	ppm
		VTC02 optional	–	–	±1.5	ppm
		VTC03 optional	–	–	±2.0	ppm
		VTC04 optional	–	–	±2.5	ppm
		VTC01 standard	–	–	±1.5	ppm
		VTC02 standard	–	–	±2.5	ppm
		VTC03 standard	–	–	±4.0	ppm
		VTC04 standard	–	–	±8.0	ppm

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$\Delta f/\Delta T$	frequency change gradient at any point in the temperature range	VTC01	–	±0.2	±0.4	ppm/°C
		VTC02	–	±0.35	±0.7	ppm/°C
		VTC03	–	±0.55	±1.1	ppm/°C
		VTC04	–	±1.0	±2.0	ppm/°C
$\Delta f/f_{25}(V_{CC})$	frequency tolerance as a function of supply voltage change, (reference to initial frequency)	V_{CC} = 5 V ±5%				
		VTC01	–	–	±0.2	ppm
		VTC02	–	–	±0.2	ppm
		VTC03	–	–	±0.3	ppm
		VTC04	–	–	±0.3	ppm
$\Delta f/f_{25}(Z)$	frequency tolerance as a function of load change, (reference to initial frequency)	10 kΩ // 10 pF ±10%				
		VTC01	–	–	±0.2	ppm
		VTC02	–	–	±0.3	ppm
		VTC03	–	–	±0.5	ppm
		VTC04	–	–	±1.0	ppm
$\Delta f/f_{25}(t)$	frequency ageing, (reference to initial frequency)	1st year at 35 °C	0	0.5	±1.0	ppm
		10 years at 35 °C	0	0.5	±3.0	ppm
Control characteristics						
$\Delta f/f_{nom}$ (V_{contr})	pullability in control voltage range, (reference to f_{nom})	note 5				
		VTC01	–	±8.5	–	ppm
		VTC02	–	±15	–	ppm
		VTC03	–	±40	–	ppm
		VTC04	–	>±40	–	ppm
V_{contr}	control voltage		0.5	2.5	4.5	V
Modulation tuning characteristics						
$\Delta f/f_{nom}$ (V_{mod})	frequency modulation range, (reference to f_{nom})	see notes 1 and 5				
		VTC01	–	±4.0	–	ppm
		VTC02	–	±7.0	–	ppm
		VTC03	–	±19.0	–	ppm
		VTC04	–	±38.0	–	ppm
V_{bias}	bias voltage	notes 2 and 6	1.75	2.5	3.25	V
$V_{mod(p-p)}$	modulation voltage range (peak-to-peak value)	note 3	±0.6	±0.9	±1.2	V
L	phase noise; see Fig.6	offset = 100 Hz	–	–110	–	dB_c/Hz
		offset = 1 kHz	–	–130	–120	dB_c/Hz
		offset = 10 Hz	–	–150	–	dB_c/Hz
	ULTRA LOW phase noise (optional for VTC01/VTC02 in B8 and B8 SMD-like only; see Fig.7 and note 8	offset = 100 Hz	–	–120	–	dB_c/Hz
		offset = 1 kHz	–	–145	–135	dB_c/Hz
		offset = 10 kHz	–	–150	–	dB_c/Hz

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
	modulation non-linearity	over maximum modulation range	–	–	±5	%
			–	–	±0.4	dB
	modulation distortion	rated maximum modulation	–	10	–	%
		0.2 × maximum modulation	–	1	–	%
		10 to 150 Hz	–	3	–	%
Z_{mod}	modulation input impedance to ground		100	–	150	kΩ
			–	3	5	pF
ΔZ_{mod}	impedance stability over temperature range	T_{oper} = –30 to +80 °C	–	–	10	%
	modulation frequency response versus tuning bandwidth; note 7	DC to 150 Hz	–	±0.17	–	dB
		DC to 2 kHz	–	±0.25	–	dB
		DC to 3 kHz	–	±1.0	–	dB
		DC to 6 kHz (standard)	–	±3.0	–	dB

Notes

1. The frequency modulation figure indicates the nominal modulation obtained when the modulation voltage has a certain value within the specified range.
2. The DC bias voltage is the part of the control voltage that may be used for calibration at 25 °C.
3. The modulation voltage range is the remaining part of the control voltage and relative to a DC bias voltage of 2.5 ±0.75 V
4. The initial frequency tolerance does not degrade the margin between pullability and stability as the pullability is stated relative to the nominal frequency.
5. Different pullability or modulation values are available in versions 1S and 2S having the same basic stability values as the versions 1 and 2, respectively.
6. The initial tolerance (at the nominal bias voltage) depends on the method of mounting. The oscillator should be mounted contiguous to a flat metallized surface in order to avoid frequency offset.
7. When the ULTRA LOW Phase noise option is chosen, the Modulation Response will be affected. A low pass (–3 dB) turn-over frequency at approximately 30 Hz will be introduced.

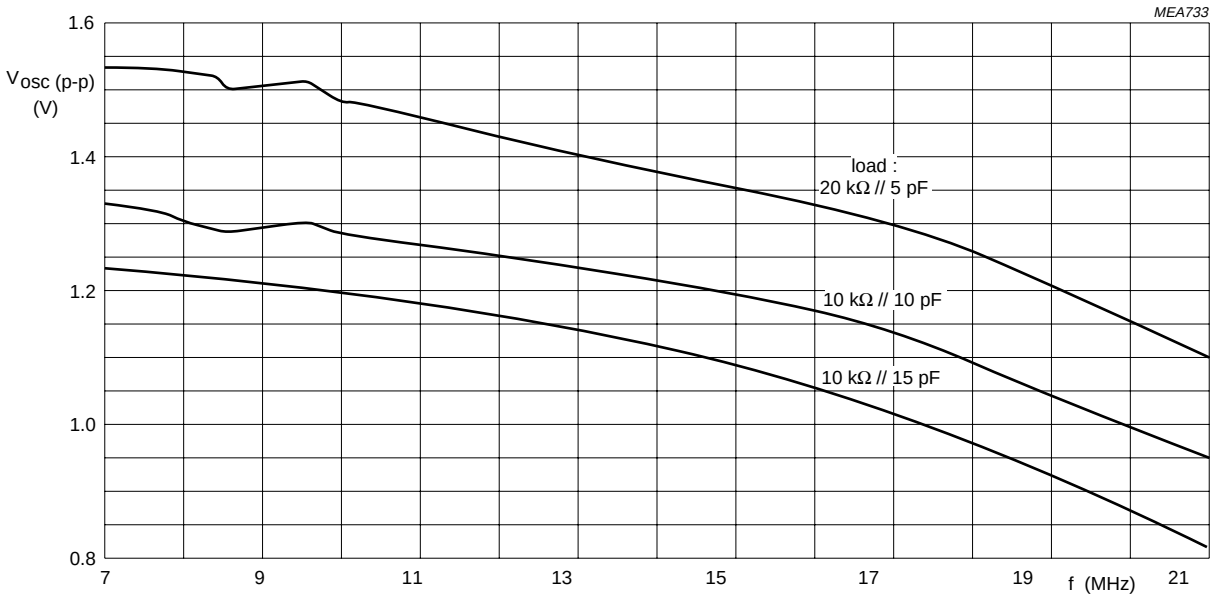


Fig.4 Output voltage (peak-to-peak value) versus frequency; typical values.

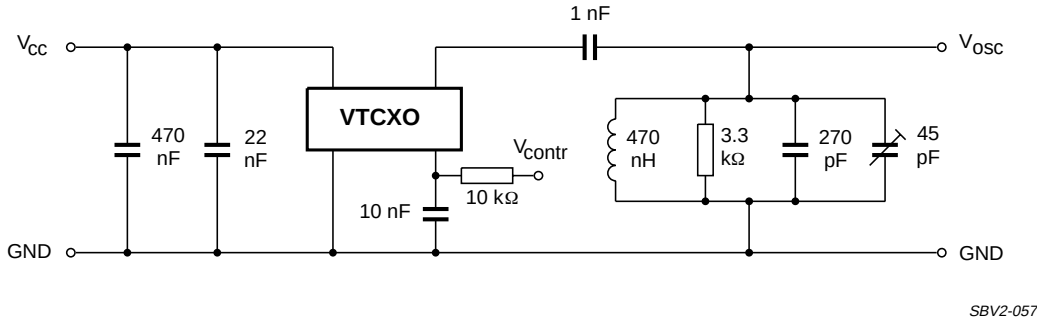
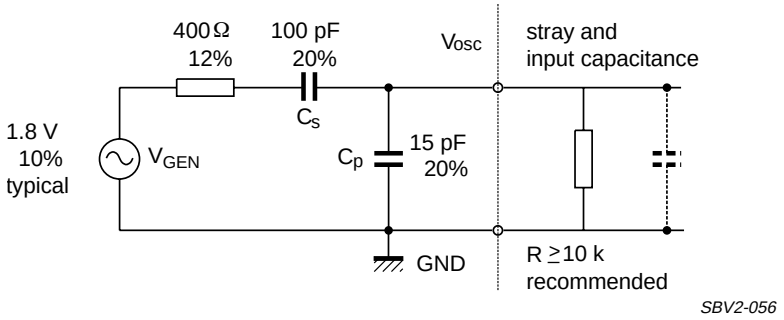


Fig.5 Application specific measurement circuit.

Figure 5 shows a tuned measurement circuit, representing a specific application load to obtain maximum output voltage, instead of the standard 10 pF//10 kΩ load; specific for f=13 MHz.



Note: Tracking between capacitors better than 5%.
Ratio $C_s/C_p = 6.67 \pm 5\%$.

Fig.6 Equivalent measurement circuit.

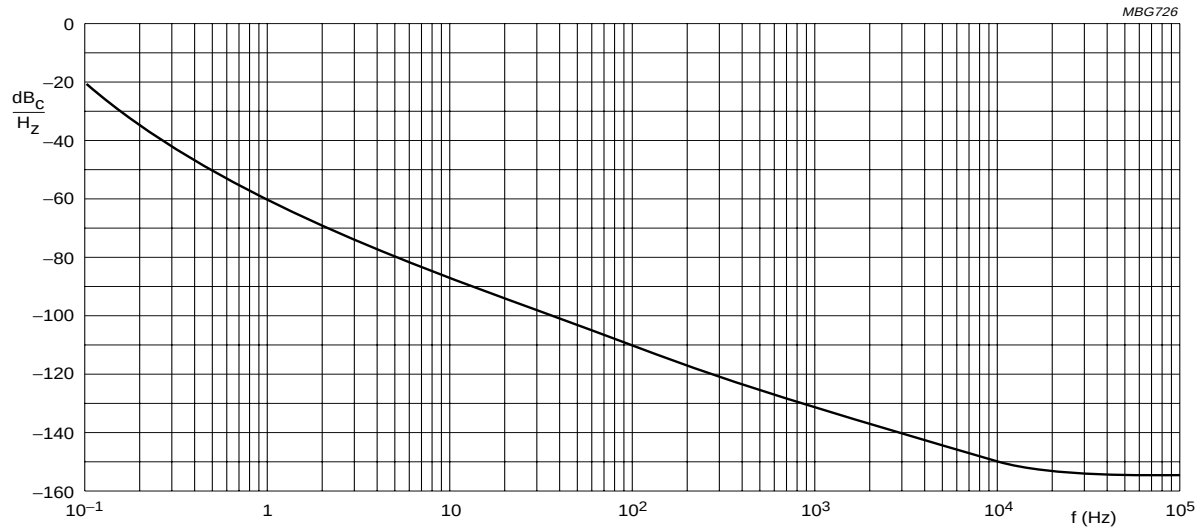


Fig.7 Typical phase noise of a 10 MHz VTCXO type.

Voltage controlled Temperature Compensated Crystal Oscillator Type

9922 515 000.. series

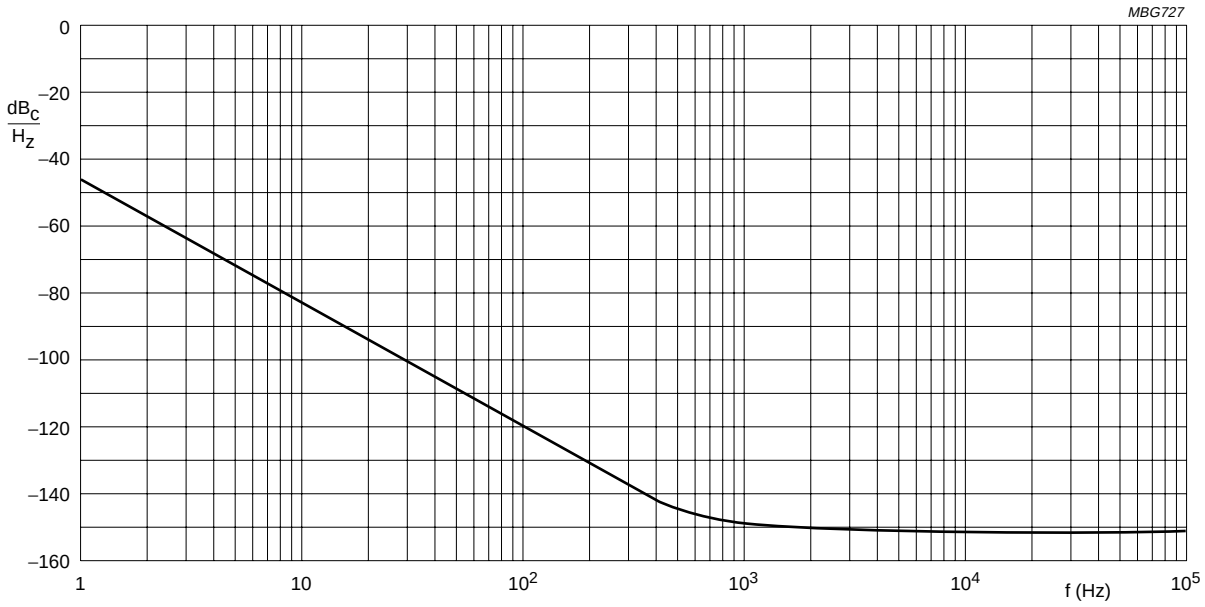


Fig.8 Typical phase noise of 12.3 MHz VTC01/VTC02 types in B8 and B8 SMD-like with ULTRA LOW Phase Noise option.

TESTS AND REQUIREMENTS

Table 3 Test procedures and requirements

IEC 68-2	TEST	PROCEDURE	REQUIREMENTS
Ea	shock	100 g; half sinewave 6 directions; 1 shock/direction	$\Delta f/f \leq \pm 0.5$ ppm
Ed	free fall	500 mm on hard wood; 3 random drops	$\Delta f/f \leq \pm 0.5$ ppm
Fc	vibration	frequency 10 to 500 Hz; acceleration 20 g; 3 directions; 30 minutes	$\Delta f/f \leq \pm 0.5$ ppm
Nb	rapid change of temperature	30 minutes at –40 °C and 30 minutes at +85 °C; transition time ≈10 minutes; 10 cycles prolonged to 50 cycles.	$\Delta f/f \leq \pm 1$ ppm at 10 cycles no major defects at 50 cycles
Ta-1	solderability	235 ±5 °C; 2 ±0.5 s; flux 600 (activated)	good tinning
Tb-1a	resistance to soldering heat	260 ±5 °C; 10 ±1s; note 1	$\Delta f/f \leq \pm 0.5$ ppm
Ub	bending of wire terminations	1 bend of 90°; load 5N, (not applicable to SMD-like)	no electrical or mechanical degradation
Ue-1	robustness of terminations and integral mounting devices	D = 4 mm (SMD-like only)	no electrical or mechanical degradation
Additional test in accordance with IEC 679-1			
9.3.1	ageing	1000 hours at 125 °C	$\Delta f/f \leq \pm 3.0$ ppm
		10 years at 35 °C	$\Delta f/f \leq \pm 3.0$ ppm
		1st year at 35 °C	$\Delta f/f \leq \pm 1.0$ ppm

Note

1. SMD-like products should only be soldered by hand or laser.