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**NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

GB/T 6427-2025

Replacing GB/T 6427-1999

**Test method for frequency temperature stability of piezoelectric
ceramic vibrator**

压电陶瓷振子频率温度稳定性的测试方法

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Foreword

This document complies with the provisions of GB/T 1.1-2020 "Standardization Work Guidelines Part 1: Structure and Drafting Rules of Standardization Documents". Drafting.

This document supersedes GB/T 6427-1999 "Test Method for Frequency Temperature Stability of Piezoelectric Ceramic Resonators" and is consistent with GB/T 6427-1999.

In comparison, aside from structural adjustments and editorial changes, the main technical changes are as follows.

- a) The "Transmission Line Law" was deleted (see 6.1.1 in the 1999 edition);
- b) The testing equipment and requirements have been changed (see Chapter 5, 6.1.1.2 of the 1999 edition);
- c) The testing procedure has been changed (see Chapter 8, 6.1.1.3 of the 1999 edition).

Please note that some content in this document may involve patents. The issuing organization of this document assumes no responsibility for identifying patents.

This document was proposed and is under the jurisdiction of the National Technical Committee on Standardization of Marine Ships (SAC/TC12).

This document was drafted by: China Electronics Technology Standardization Institute,

Haiying Enterprise Group Co., Ltd., and China Electronics Technology Group Corporation.

The 26th Research Institute of the Company.

The main drafters of this document are: Cao Kewei, Jiang Xingbing, Xian Xiaojun, Zhao Junsha, Chi Wenchao, Zhang Hui, Shi Zeyuan, and Feng Jie.

This document was first published in 1986, revised for the first time in 1999, and this is the second revision.

Frequency temperature stability of piezoelectric ceramic oscillators Test methods

1 Scope

This document describes a test method for the frequency temperature stability of piezoelectric ceramic oscillators.

This document applies to the series harmonic testing of piezoelectric ceramic oscillators for radial and transverse length-stretching vibration modes of discs and strips.

Temperature stability of resonant frequency and parallel resonant frequency; other piezoelectric ceramic oscillators should refer to this standard for use.

2 Normative references

GB/T 2414.1

GB/T 2414.2

GB/T 3389

GB/T 3389.1

3 Terms and Definitions

The terms and definitions defined in GB/T 3389.1 apply to this document.

4 Testing Principle

Temperature stability refers to the property of piezoelectric ceramics as a function of temperature. Frequency temperature stability refers to the property of frequency as a function of temperature.

It can be described using two methods. frequency temperature coefficient or maximum relative frequency drift.

At a given temperature, the ratio of the change in frequency value to the actual value of that frequency at a temperature change of 1°C is called the frequency temperature coefficient.

(Tf), can be expressed by formula (1). $Tf = -df/d\theta$ (1) In the formula.

Tf --- Temperature coefficient of frequency, measured in degrees Celsius ($^{\circ}\text{C}^{-1}$);

f --- Frequency at a certain temperature, measured in Hertz (Hz); $df/d\theta$

- The rate of change of frequency with temperature, expressed in Hertz per degree Celsius ($\text{Hz}/^{\circ}\text{C}$).

The frequency of a piezoelectric ceramic oscillator changes non-linearly with temperature, and its temperature coefficient is a function of temperature.

In addition, the maximum relative frequency drift is usually used to characterize the frequency-temperature stability of piezoelectric ceramic oscillators, which can be expressed by formulas (2) and (3). express. $(\Delta f)_p = |f(\theta_p) - f(25^{\circ}\text{C})| / f(25^{\circ}\text{C})$ (2) $(\Delta f)_N = |f(\theta_N) - f(25^{\circ}\text{C})| / f(25^{\circ}\text{C})$ (3) In the formula.

$(\Delta f)_p$ --- Maximum relative frequency drift at positive temperature;

$(\Delta f)_N$ --- Maximum relative frequency drift at negative temperatures;

$f(\theta_p)_m$ --- The maximum frequency that deviates from room temperature by 25°C within a positive temperature range (e.g., 25°C to 85°C), expressed in Hertz. (Hz);

$f(\theta_N)_m$ --- The maximum frequency deviation from room temperature (25°C) within the negative temperature range (e.g., -65°C to 25°C), expressed in Hertz. Hz;

$f(25^{\circ}\text{C})$ --- Frequency value at room temperature of 25°C , in Hertz (Hz).

Measure the sample's maximum admittance frequency (f_m), minimum admittance frequency (f_n), or resonant frequency (f_r), and anti-resonant frequency (f_a) (in the first order near-terminal range).

Like $f_m T = f_m = f_r = f_s$, $f_n T = f_n = f_a = f_p$.

By placing the sample in a positive and negative temperature environment test device and measuring the corresponding frequencies at different temperature points within a specified temperature range, the frequency can be obtained.

The relationship curve between frequency and temperature is obtained, thereby determining the frequency temperature coefficient or the maximum relative frequency drift.

5 Testing Equipment

5.1 Bridge. Frequency accuracy better than 10^{-5} Hz. Impedance resolution better than 0.05 ohm.

5.2 Positive and Negative Temperature Environment Test Chamber. Capable of providing uniform and continuously adjustable positive and negative temperatures within the required temperature range (e.g., -65°C to 85°C).

Temperature environment, temperature control deviation not greater than $\pm 2^{\circ}\text{C}$.

5.3 Sample Box. The sample box should be made of a material with good thermal conductivity. The clamping force of the internal support clamp should be small, just enough to hold the sample, and ensure that the clamping force is sufficient.

The fixture should make good contact with the sample electrode. The diameter of the contact surface between the fixture and the sample should be 0.3 mm to 1.0 mm, and it should be clamped at the sample node. Sample The box should be covered, and the relative humidity inside the box should be less than 75%.

6 Test Samples

Round disc specimens shall conform to GB/T 2414.1, strip specimens shall conform to GB/T 2414.2, and other specimens shall conform to GB/T 3389.

The sample should be kept clean and dry. It should be kept at that temperature for at least 1 hour before testing at each temperature point.

7 Test Conditions

The electric field strength (E) at the test frequency is not greater than 30mV/mm.

8 Test Procedures

8.1 Connect the test equipment as shown in Figure 1 and build the test circuit. Index number explanation. 1---Wheatstone bridge;

2---Positive and negative temperature environment test chamber; 3---Sample box; 4---Sample.

Figure 1 Schematic diagram of the test circuit

8.2 Test of room temperature frequency

Place the sample into the sample box (5.3), seal the lid, and place it in a positive and negative temperature environment test chamber. Adjust the frequency of the bridge (5.1) to make the sample...

The impedance is at its minimum, and the frequency at this point is the maximum admittance frequency (f_m). Then, adjust the frequency of the bridge (5.1) to make the sample phase zero; at this point, the frequency is the resonance frequency.

Frequency (f_r). Increase the frequency of the bridge (5.1) further to maximize the sample impedance; at this point, the frequency is the minimum admittance frequency (f_n). Adjust the bridge (5.1) again.