

AXTAL CONSULTING
Services for Frequency Control Products

Our Service:

- **Qualification tests of samples according to the IEC and MIL standards**
- **Quality monitoring through incoming sample tests of critical parameters**
- **Application support and optimisation of specifications for your customers**
- **Support in case of customer rejects. Failure analysis and determination of necessary corrective actions**
- **Evaluation of workmanship according to IPC-610**
- **Technical seminars for your customers on request**

Crystal Units:

Quartz, Gallium-Orthophosphate, Langasite and other piezoelectric resonators.

Qualification tests to IEC 60122-1. Measurements based on IEC 60444-x

Frequency, resistance, motional parameters (R_1 , C_1 , L_1 , C_0), Load resonance, Pullability, spurious resonances, start-up behaviour (Drive Level Dependence DLD), isolation resistance, temperature response of frequency and resistance in the range from -55°C to $+125^\circ\text{C}$, activity dips (band breaks), hysteresis, aging

Crystal Oscillators:

Qualification tests to IEC 60679-1 and MIL-PRF-55310.

Frequency, signal waveform, pulling range, current consumption, temperature response, frequency-load-coefficient, frequency-voltage-coefficient, start-up behaviour, start-up time, stabilisation time, frequency retrace, AM and FM modulation, phase noise, short-term stability (Allan variance), output spectrum, aging

Crystal Filters:

Qualification tests to IEC 60368-1.

Frequency response of attenuation and phase, group delay, bandwidth, ripple, selectivity, reflection attenuation, intermodulation, temperature response

Some of Our Test Equipment:

Rubidium frequency standard (Rohde & Schwarz), GPS frequency generator (Datum), oscilloscopes (HP/Agilent, Tektronix), spectrum analyser (Tektronix), network analysers (HP/Agilent), synthesizers (HP/Agilent, Schomandl, Adret), vector voltmeter (Rohde & Schwarz), Vector impedance meter (HP), Precision RLC meter (HP), frequency counters (Agilent, Racal, Philips, GuideTech), RF millivoltmeters (Rohde & Schwarz, Racal), modulation meter (Racal), temperature test chambers (Saunders, Delta, Sun), Phase noise test system (Europtest), automatic crystal test systems (Transat, Saunders), power supplies (HP/Agilent, Philips), digital multimeters (HP/Agilent, Fluke), RF and DC switching units (HP/Agilent, Rohde & Schwarz), bake-out oven (Heraeus), leak tester (Trio-Tech), isolation resistance meter (Megger), visual inspection system (Vision Engineering), microscope, etc. ...

Seminar on Crystals and Frequency Control Products
Lecturer: Dipl.-Phys. Dipl.-Ing. Bernd Neubig

Morning Session:

1. ***Characteristics of crystal units (90 min)***
 - Piezoelectric effect
 - Major crystal cuts: tuning forks, AT, BT, SC –cut. Properties, temperature response
 - The equivalent Electrical Circuit Diagram. Element values vs. Frequency, overtones
 - Undesired characteristics: spurious responses, DLD, Dips, Hysteresis, Aging
 - Modern crystal technologies: HFF, Packaging technologies
 - Alternative Piezoelectric crystals: Langasite (LGS) and Gallium phosphate (GaPO₄)

2. ***Specification and measurement of Crystals (90 min)***
 - Key parameters and optional parameters
 - Blank data sheet form
 - Measurement techniques according to IEC 60444
 - Resonance frequency, -resistance, motional parameters, load resonance
 - Measurement above 80 MHz, s-Parameter-technique
 - Spurious resonances, temperature stability, aging, short-term stability

Afternoon Session:

3. ***Oscillator circuits for crystals (90 min)***
 - Survey of oscillator circuits
 - Design rules for popular circuits Pierce & Colpitts
 - Circuits for frequency pulling
 - Crystal drive level
 - Short-term and Long-term stability

4. ***Characteristics and application of crystal oscillators (45 min)***
 - Survey of basic oscillator types (PXO, VCXO, TCXO, OCXO etc.)
 - Frequency stability: determining factors and typical values for various types
 - Measurement technique according to IEC 60679

5. ***Other piezoelectric components (45 min)***
 - Piezoelectric filters
 - Monolithic filter
 - SAW – devices
 - Piezoelectric sensors

On request this seminar can be held in „Hands-on“ style with practical demonstrations using a Network Analyser