AC Quantum Voltmeter Cooler

Programmable Josephson Voltage Standard

DESCRIPTION

The **cryocooled AC Quantum Voltmeter** is a turn-key programmable Josephson voltage standard system applicable for the highest level of precision voltage measurements from DC up to kHz frequencies. It was developed by Supracon in cooperation with the Physikalisch-Technische Bundesanstalt Braunschweig (PTB) and esz AG. It facilitates a variety of voltage calibrations and measuring functions:

- **Primary DC & AC Josephson voltage standard** up to kHz frequencies,
- Calibration of **calibrators,**
- Calibration of **secondary voltage standards,**
- Calibration of **voltmeter linearity,**
- Calibration of **thermal converters** (optional),
- **Voltage source** with ultimate precision and lowest noise level

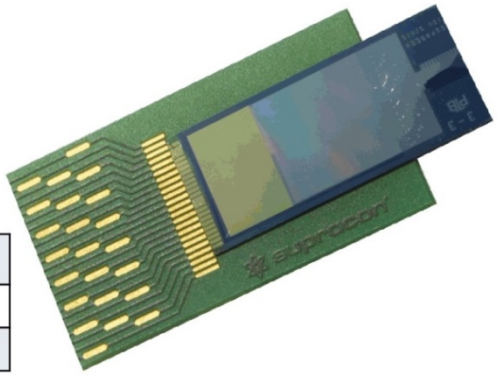
The cryocooled **AC Quantum Voltmeter** consists of the following components:

1. **10 V programmable JVS array** on thermal interface
2. Two-stage **Pulse Tube Cooler**
3. Air-cooled **Compressor**, 4 kW input power
4. Compact **70 GHz microwave source**
5. **Programmable 20 channel bias source**
6. **Control electronics** with optical isolation unit
7. Nanovoltmeter as **DC null detector**
8. **Sampler** for AC voltage measurements
9. **Waveform generator** with synchronisation unit
10. **Multiplexer** with polarity switch
11. Host computer with **control software**
12. **Sensors** for temperature, humidity, and pressure
13. **Optional:** Vacuum pump, GPS 10 MHz frequency reference

PROGRAMMABLE JOSEPHSON VOLTAGE STANDARD ARRAY

The centre piece of the **AC Quantum Voltmeter** is a 10 Volt programmable Josephson voltage standard circuit

- **Number of Josephson junctions:** 69632
- **Maximum output voltage:** ±10.1 V
- **Operating frequency:** 70 GHz
- **Zero & first order Shapiro step:** 1 mA
- **Bias current:** ±4 mA
- **Voltage increment:** 145 µV



$V = n \times f / K_{J90}$			
V	Josephson voltage	K_{J90}	Josephson constant
n	programmable integer	f	microwave frequency

Supracon AG | An der Lehmgrube 11 | 07751 Jena | Germany
Telefon: +49 3641 2328100 | Fax: +49 3641 2328109
info@supracon.com | www.supracon.com

AC Quantum Voltmeter Cooler

Programmable Josephson Voltage Standard

supracon

PTB Physikalisch-Technische Bundesanstalt Braunschweig und Berlin

esz

TRUE AC

SPECIFICATIONS

DC voltage up to ±10 V

Typical calibration accuracy (direct comparison to a second Josephson voltage standard)

±1 nV @ 10 V $\Delta V/V_{10V} = 1\times10^{-10}$

Typical calibration accuracy of DC voltage standards, e.g. Fluke 732B (limited by the noise of the DC voltage standard)

±100 nV @ 10 V $\Delta V/V_{10V} = 1\times10^{-8}$

AC voltage up to 2 kHz frequencies

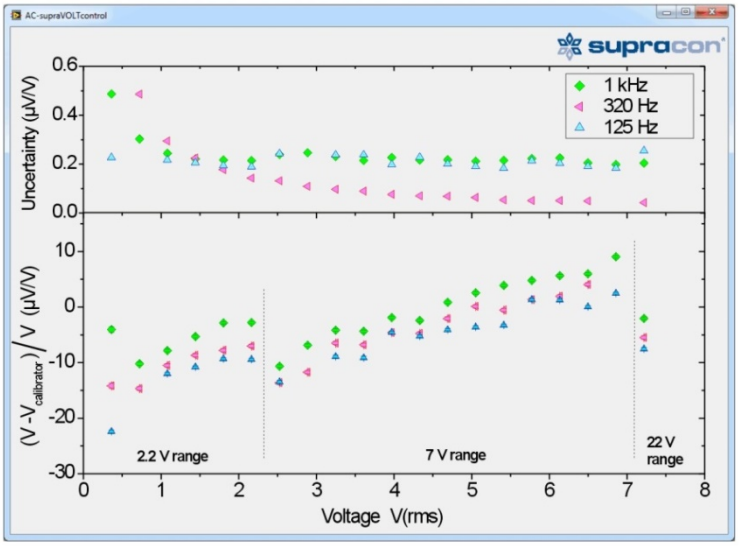
Typical calibration accuracy (direct comparison of Josephson waveforms)

±20 nV @ 1 Vrms, 250 Hz $\Delta V/V = 2\times10^{-8}$

Typical calibration accuracy of calibrators, e.g. Fluke 5720A (limited by the noise of the calibrator)

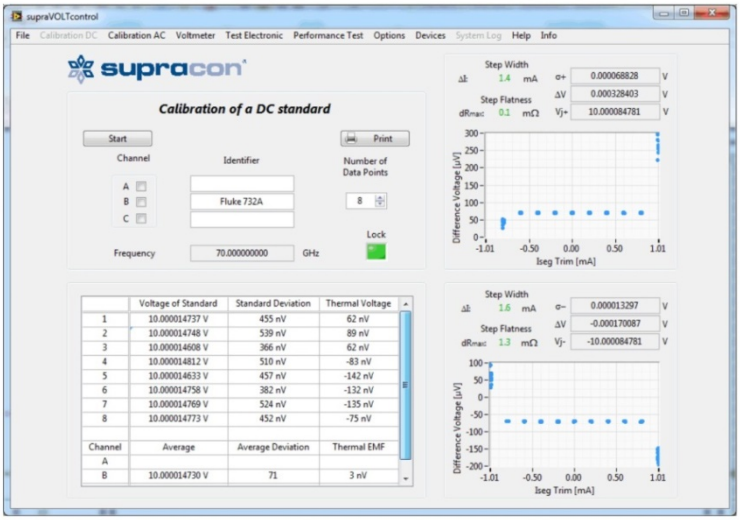
$\Delta V/V = 5\times10^{-7}$ @ $V \leq 7.2$ Vrms, $f \leq 2$ kHz, 10 second measuring time

CALIBRATION MODES [Samples]



▲ AC reference standard (e.g. FLUKE 5720A)

◀ Measured calibrator RMS voltages with type A uncertainty for three AC frequencies



▲ DC reference standard (e.g. FLUKE 732B)

◀ Software interface for DC voltage standards

TÜV CERT DIN EN ISO 9001 : 2000 Zertifikat 15 100 21403

Supracon AG | An der Lehmgrube 11 | 07751 Jena | Germany
Telefon: +49 3641 2328100 | Fax: +49 3641 2328109
info@supracon.com | www.supracon.com

supracon