AC Quantum Voltmeter

Programmable Josephson Voltage Standard

supracon

PTB
Physikalisch-Technische Bundesanstalt
Braunschweig und Berlin

esz

Gefördert durch:
Bundesministerium für Wirtschaft und Technologie
aufgrund eines Beschlusses des Deutschen Bundestages

TRUE AC

DESCRIPTION

The **AC Quantum Voltmeter** is a programmable Josephson voltage standard system applicable for the highest level of precision voltage measurements from DC up to kHz frequencies. It was developed by the Physikalisch-Technische Bundesanstalt Braunschweig (PTB) in cooperation with the companies esz AG and Supracon 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 **AC Quantum Voltmeter** consists of the following components:

1. **10 V programmable JVS array chip**
2. **Cryoprobe** with magnetic shield
3. Compact **70 GHz microwave source**
4. **Programmable 20 channel bias source**
5. **Control electronics** with optical isolation unit
6. Nanovoltmeter as **DC null detector**
7. **Sampler** for AC voltage measurements
8. **Waveform generator** with synchronisation unit
9. **Multiplexer** with polarity switch
10. Host computer with **control software**
11. **Sensors** for temperature, humidity, and pressure
12. **Optional:** Liquid helium Dewar, 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:** ±6 mA
- **Voltage increment:** 145 µV

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

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

AC Quantum Voltmeter

Programmable Josephson Voltage Standard

supracon

PTB
Physikalisch-Technische Bundesanstalt
Braunschweig und Berlin

esz

Gefördert durch:
Bundesministerium für Wirtschaft und Technologie
aufgrund eines Beschlusses des Deutschen Bundestages

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 1 kHz frequencies

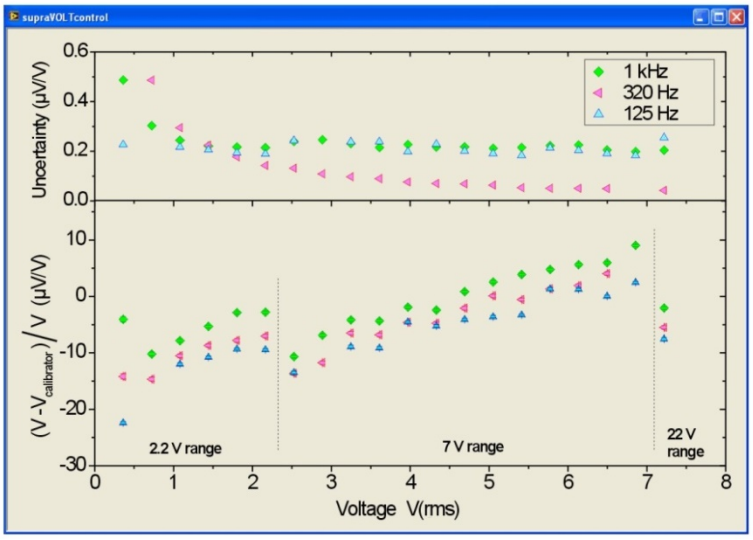
Typical calibration accuracy (direct comparison of two 4-sample Josephson waveforms)

±200 nV @ 20 Vpp, 1 kHz $\Delta V/V = 2\times10^{-8}$

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

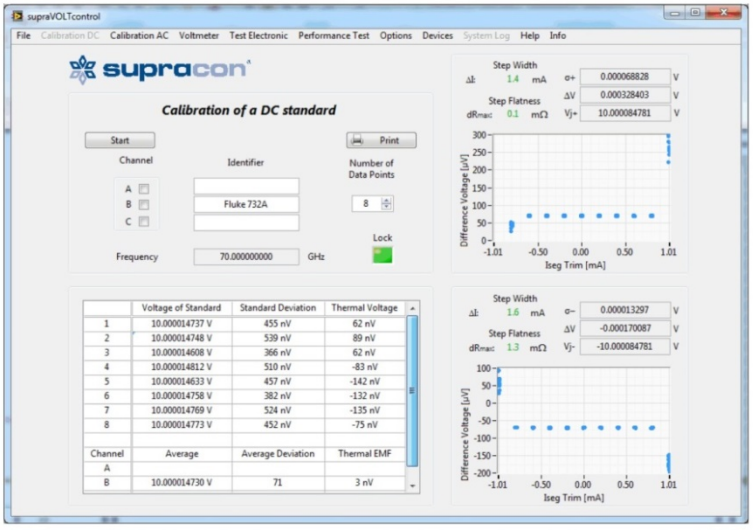
$\Delta V/V = 5\times10^{-7}$ @ $V \leq 7.2$ V(rms), $f \leq 2$ kHz, 10 second measuring time

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