

Blackmarket PPM verification certificate (X7000II SN: C1)

The measurements in this document are for indication purposes only to assert functionality. And is not in reference with regards to determining accuracy and uncertainty in comparison to the highest level of practical realisations of the SI units of measurements.

## Functionality check & board overview

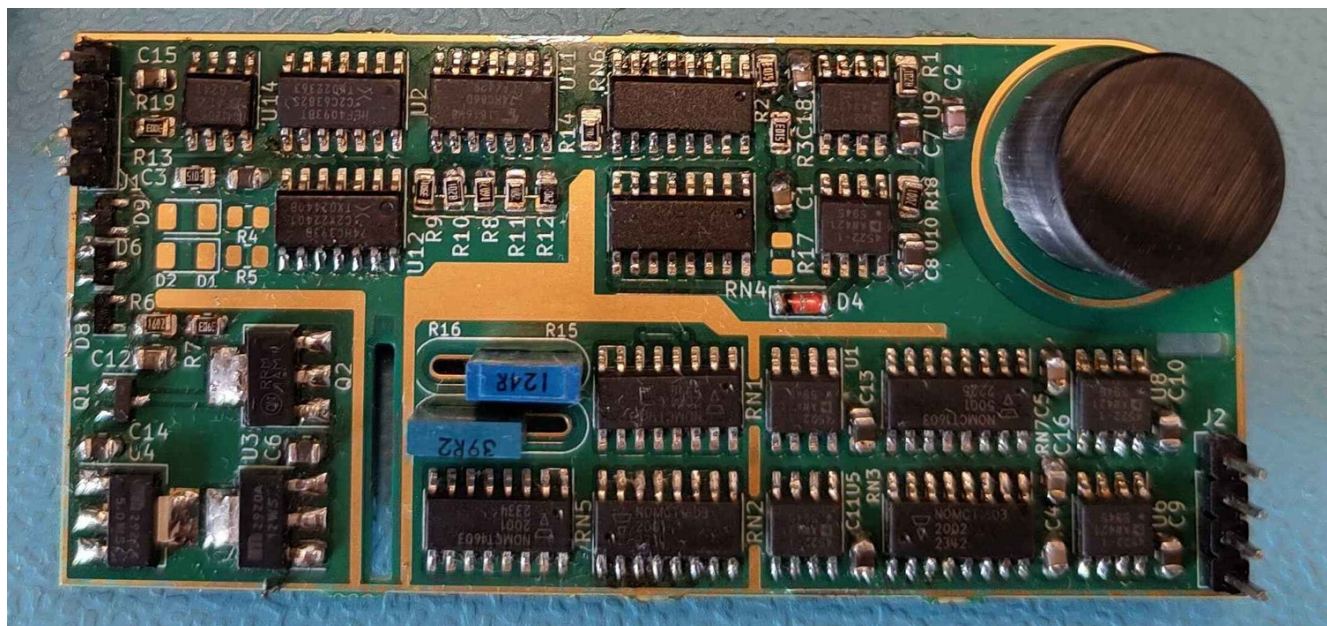


Figure 1: Voltage Reference

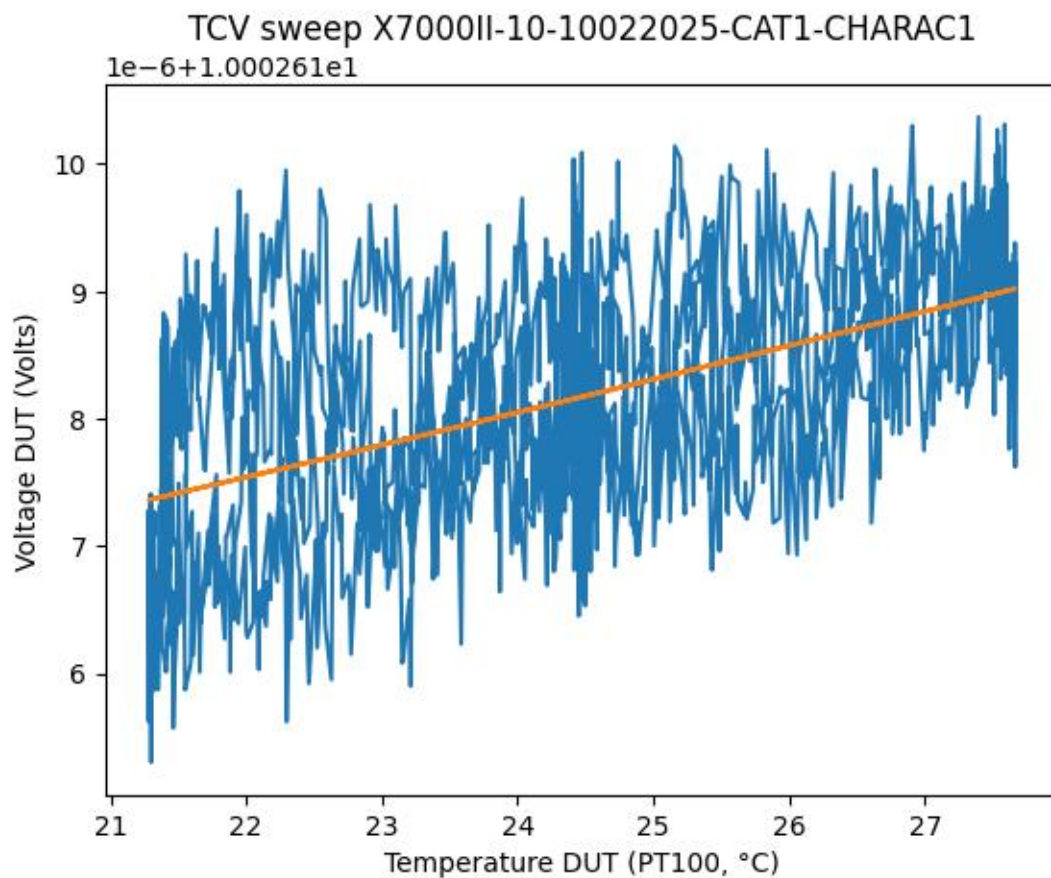
Trimmed output Value: 10.0026V	Nominal current consumption: 32mA	Result: Pass
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## Temperature coefficient test

Temperature coefficient test was measured using the following equipment:

- Newport 350B TEC controller
- class A PT100 with Advantest R6581T as readout.
- 3458A at 100NPLC set to measure with Auto-Zero measuring DUT.

The 1st order of the fitted polynomial extrapolated from the measured result was 27 nV/K.



## Transfer & uncertainty to known Voltage standard

The measurements were performed utilizing the following equipment and standards:

- Keithley 182 Sensitive Voltmeter
- Keithley 7168 Nanovolt Scanner
- Environmental monitoring via BME280
- X7000 SN: 01 as transfer standard

Measurement of the DUT to the transfer standard was performed with the Keithley 182 Sensitive Voltmeter set to measure the two respective references differentially. Both references being referred to the same ground. Compensation for thermal offset was done by means of nulling the voltmeter through shorted channels on the Keithley 7168 Nanovolt Scanner with uncertainty being monitored.

### Uncertainty budget Transfer Standard to SI (X7000II SN: 01)

Quantity	Type	Sensitivity	Uncertainty
Thermal coefficient of the DUT	A	36 nV/K	5 nV/K
Temperature sensing error	B	0.006 K	+/-1degC
Measured output voltage of the DUT	A	0.1 nV	34.4 uV
Residual thermal voltage in the zeroing switch	A	0.1 nV	196 nV
Voltage due to gain error of the nanovoltmeter	B	0.1 nV	115 nV
Reference Frequency Accuracy	B	0.01 nV	0.35 nV
Voltage due to residual thermal EMF	B	0.01 nV	2.9 nV
Voltage due to leakage current	B	0.01 nV	0.13 nV

Measured at: 25.8 degC

Total Expanded uncertainty of transfer (K=2): 472.16 nV

Corrected Value to 23 degC: 9.9970124 V

### Uncertainty budget DUT to Transfer Standard (X7000II SN: C1)

Quantity	Type	Sensitivity	Uncertainty
Thermal coefficient of the DUT	A	27 nV/K	7 nV/K
Temperature sensing error	B	0.006 K	+/-1degC
Measured output voltage of the DUT	A	1 nV	1.31 uV
Residual thermal voltage in the zeroing switch	A	1 nV	656 nV
Voltage due to gain error of the nanovoltmeter	B	1 nV	2580 nV
Expanded uncertainty of transfer standard	A	1nV	472.16 nV
Drift uncertainty of transfer standard	B	1nV	6000 nV

Measured at: 20.6 degC

Corrected Value to 23 degC: 10.0026628 V

Total Expanded uncertainty of transfer (K=2): 18296.16 nV