Precision Current Sources for Beam EDM

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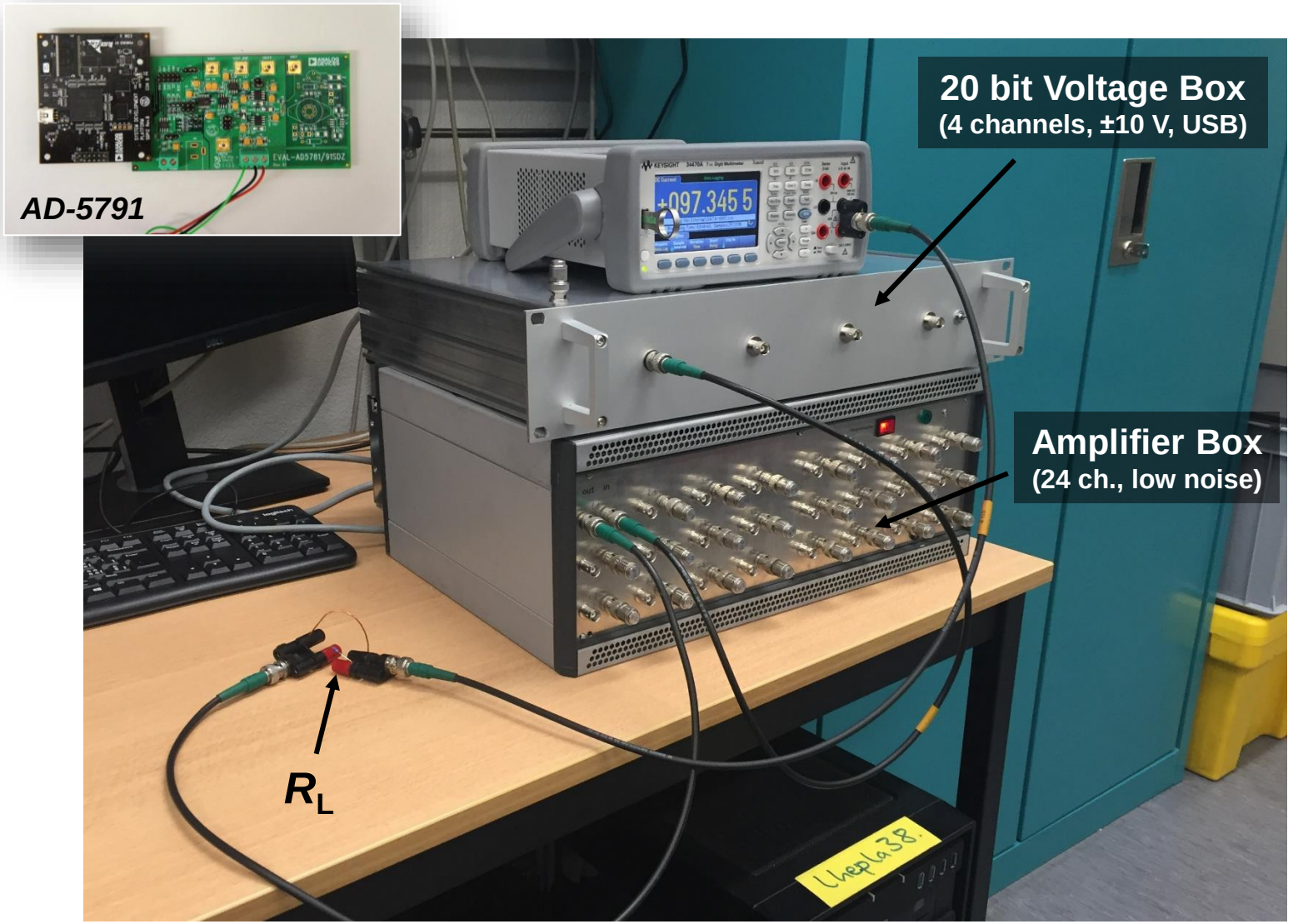
Setup & Characterization Measurement



$I_{out} = U_{in} / R_L$

R_L determines max. current range and bit-resolution (R_L: 100, 1k, 10k)

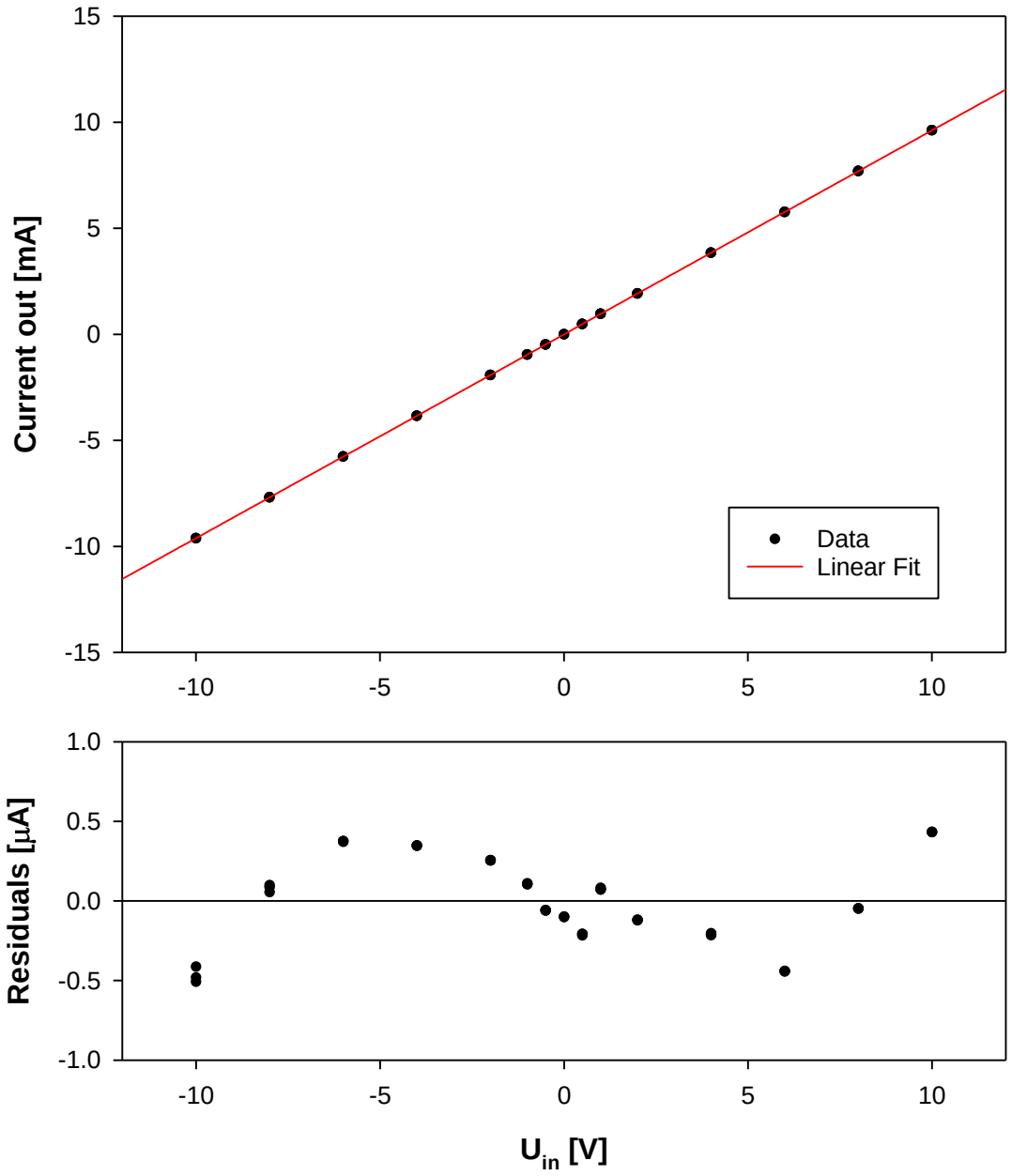
Measurement needs correction for burden voltage!

Specifications 34470A (Continued)

DC and AC current burden voltage at full scale

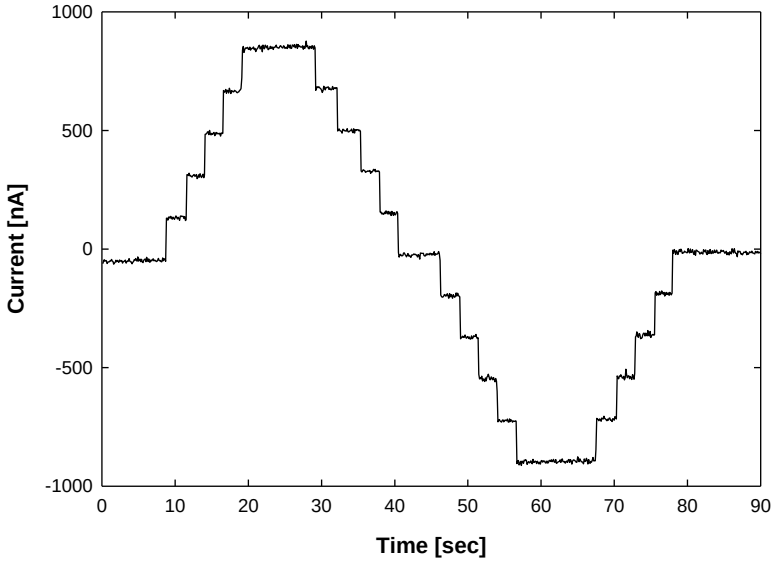
DC current range	Burden voltage	
1 µA	< 0.0011 V	< 1.1 kΩ
10 µA	< 0.011 V	
100 µA	< 0.11 V	
1 mA	< 0.11 V	< 110 Ω
10 mA	< 0.027 V	< 2.7 Ω
100 mA	< 0.27 V	
1 A	< 0.7 V/0.05 V [21]	< 0.7 Ω
3A	< 2.0 V/0.15 V [21]	< 0.75 Ω
10 A	< 0.5 V	< 0.05 Ω

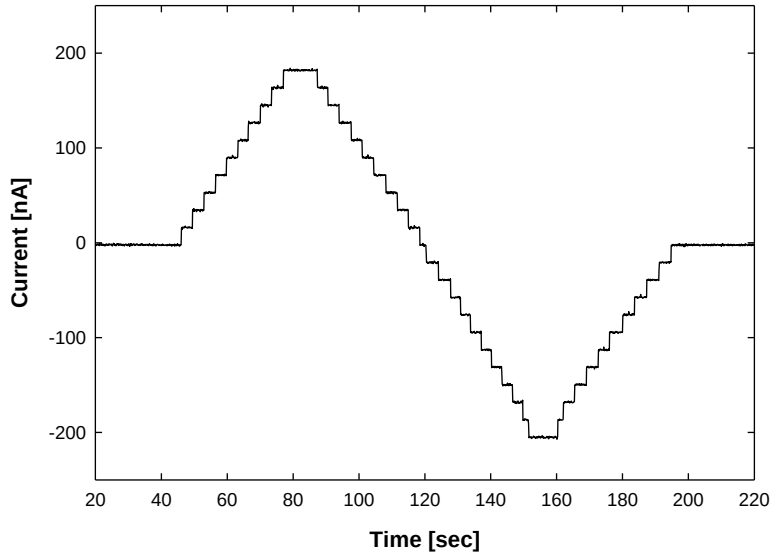
Linearity (R_L = 1000 Ohm)

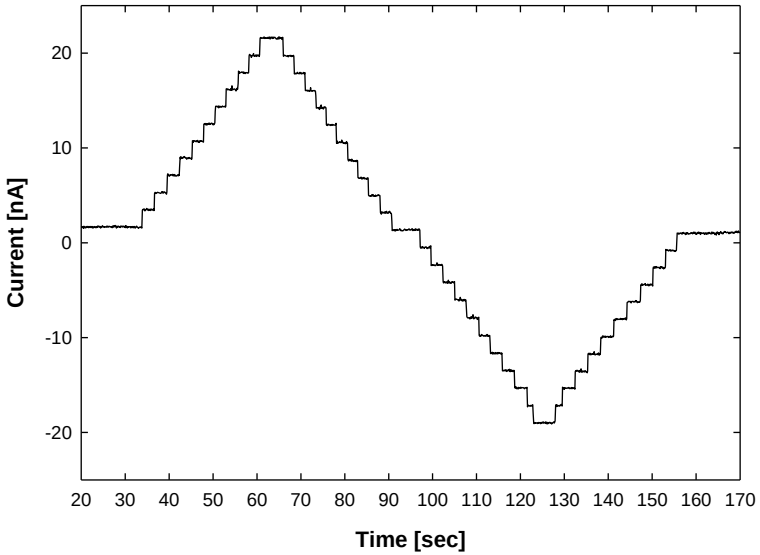


Least Significant Bit – Jump (20 bit)

Theoretically: $\mathbf{LSB} = \frac{20\,V}{2^{20}.R_L} = \frac{19\,\mu A}{R_L\,[\Omega]}$







R_L = 100 Ohm

LSB = 179 nA

Max. Range = ± 100 mA

R_L = 1000 Ohm

LSB = 18.7 nA

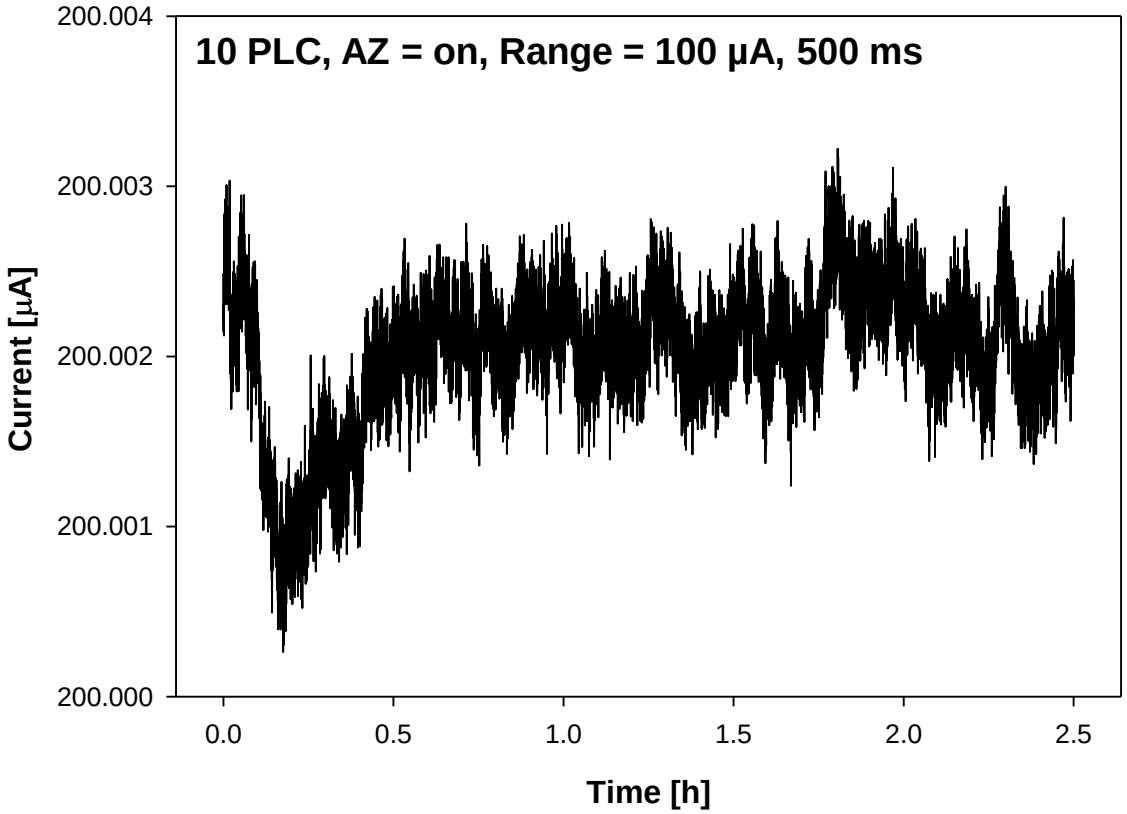
Max. Range = ± 10 mA

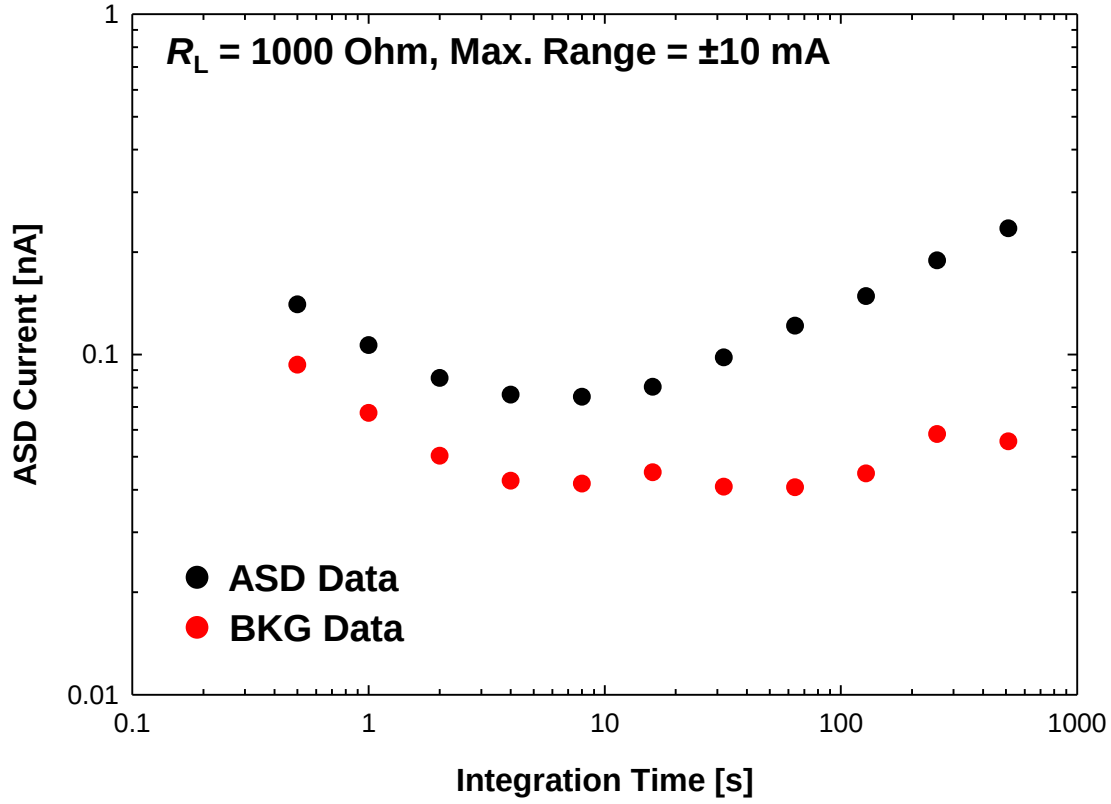
R_L = 10 kOhm

LSB = 1.85 nA

Max. Range = ± 1 mA

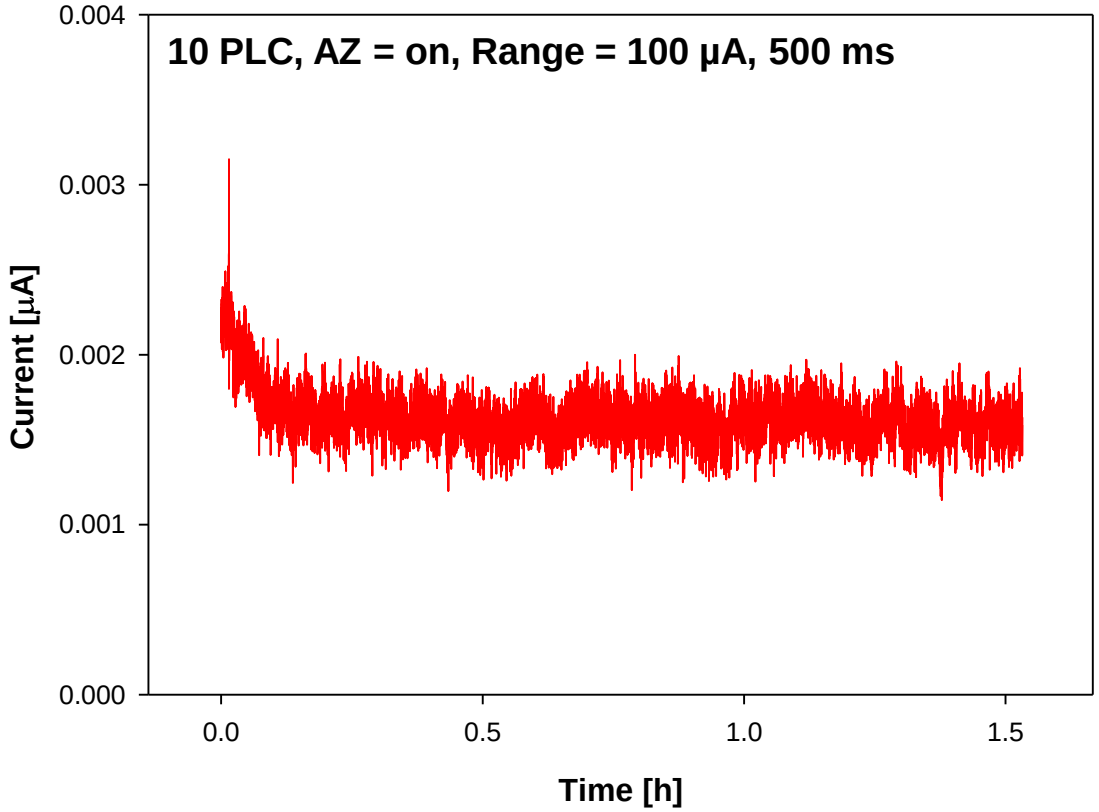
Stability / Noise (R_L = 1000 Ohm)

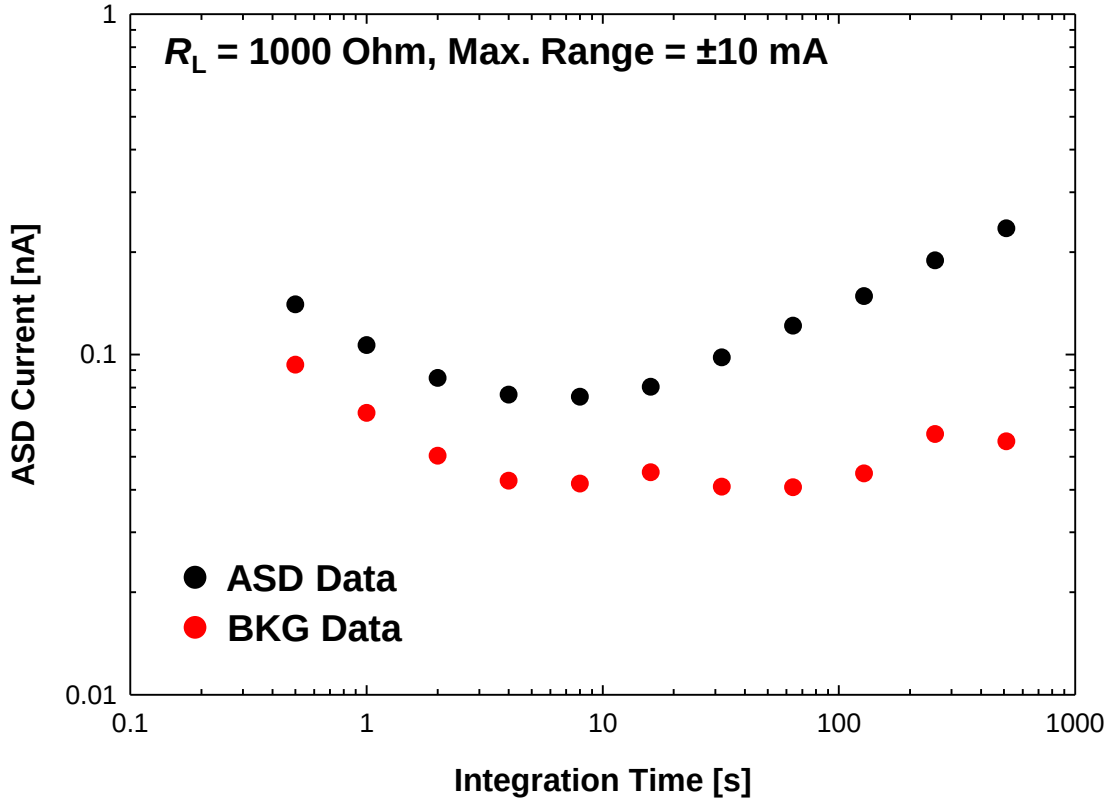




Noise @ 1 sec: 0.1 nA / 10 mA = 1×10^{-8}
Noise @ 250 sec: 0.2 nA / 10 mA = 2×10^{-8}

Stability / Noise (R_L = 1000 Ohm)

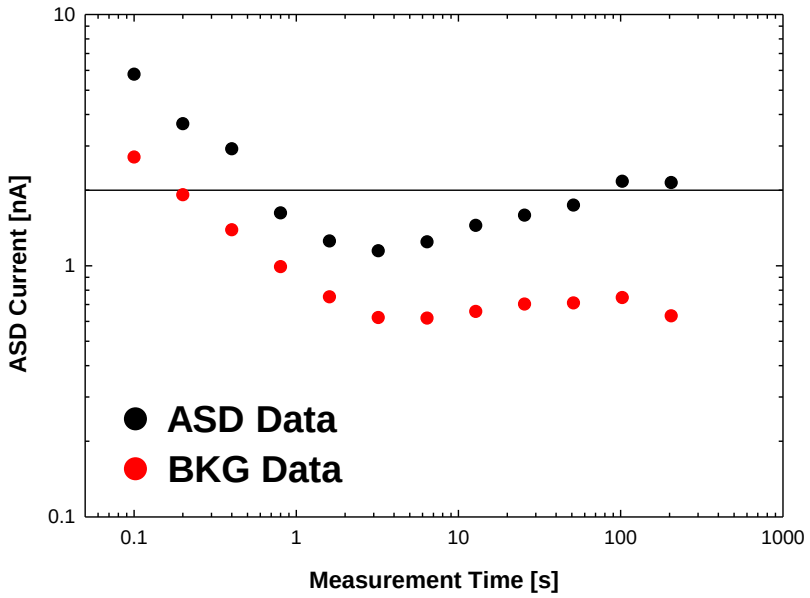




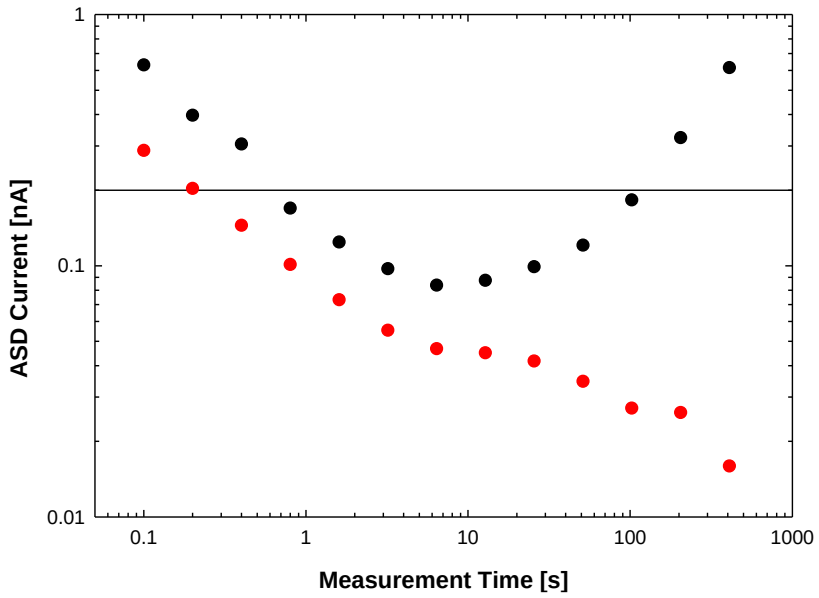
Noise @ 1 sec: 0.1 nA / 10 mA = 1×10^{-8}
Noise @ 250 sec: 0.2 nA / 10 mA = 2×10^{-8}

1 PLC, AZ = on, Range = 100 µA, 100 ms

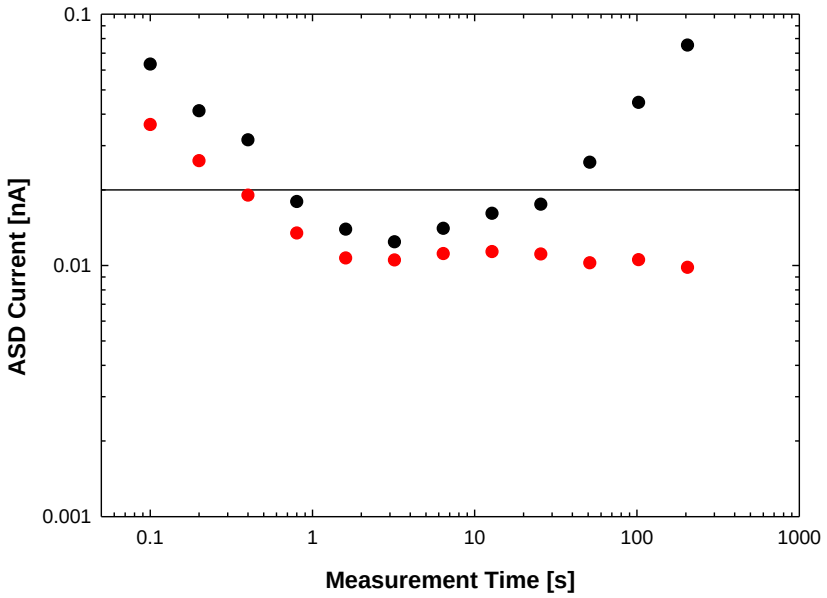
ASD 0008, 100 Ohm, max. +/- 100 mA



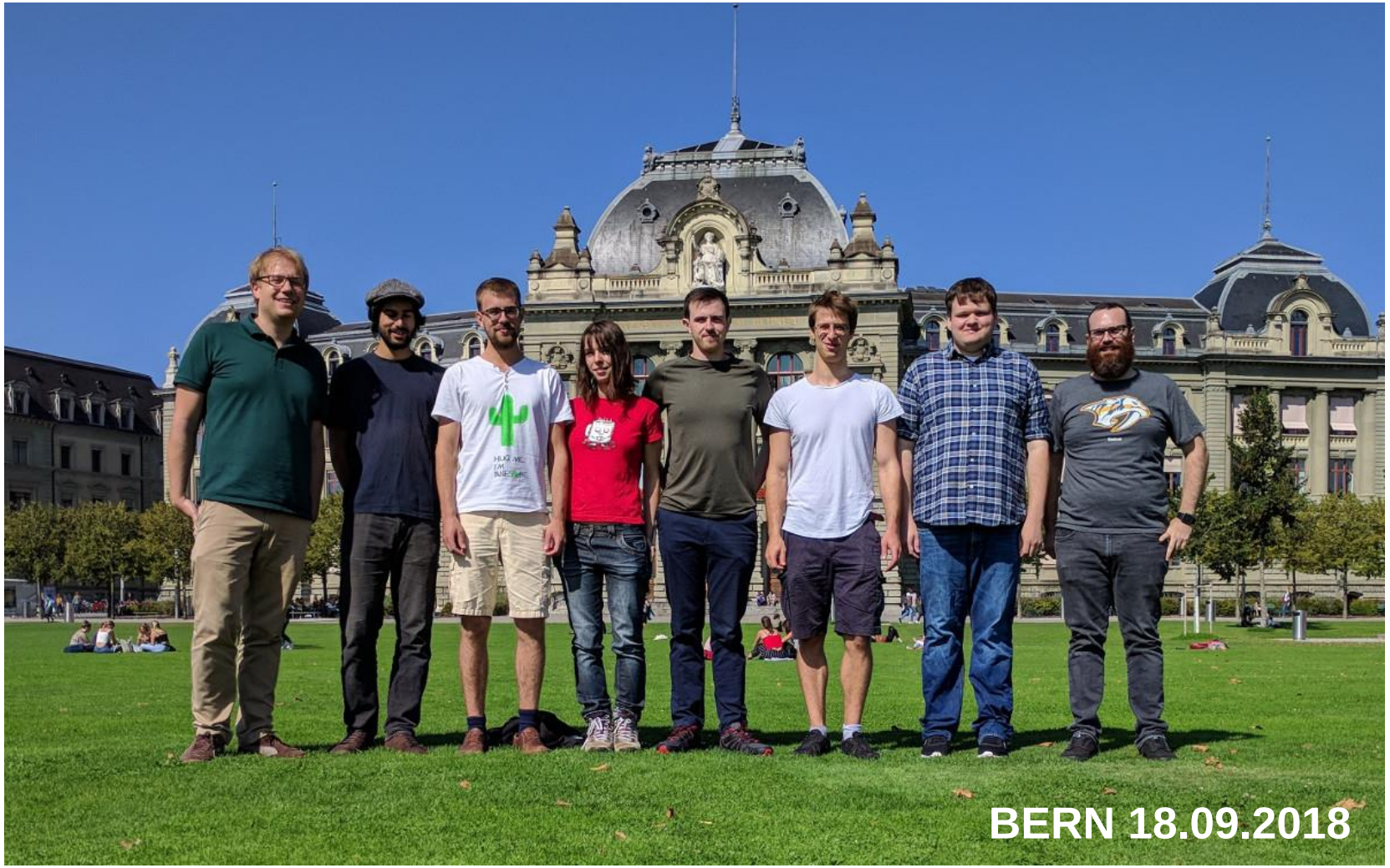
ASD 0007, 1000 Ohm, max. +/- 10 mA

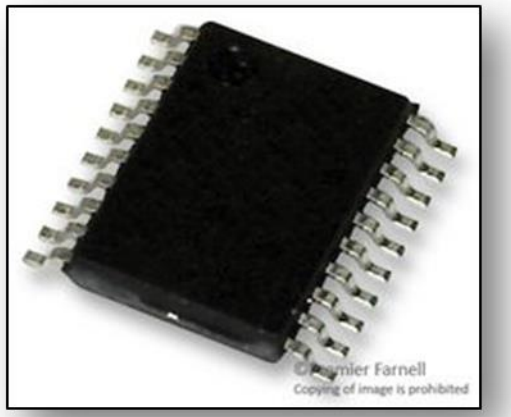


ASD 0011, 10 kOhm, max. +/- 1 mA



- **Relative current noise 1-100 sec: ca. 2×10^{-8} (for R_L = 100, 1k, 10k Ohm)**
- **Noise is more than 50 times smaller than LSB-jump → 24 bit card ?**


BERN 18.09.2018



FEATURES

1 ppm resolution
1 ppm INL
7.5 nV/√Hz noise spectral density
0.19 LSB long-term linearity stability
<0.05 ppm/°C temperature drift
1 µs settling time
1.4 nV-sec glitch impulse
Operating temperature range: −40°C to +125°C
20-lead TSSOP package
Wide power supply range up to ±16.5 V
35 MHz Schmitt triggered digital interface
1.8 V compatible digital interface

Output Voltage Noise	1.1	µV p-p	DAC code = midscale, 0.1 Hz to 10 Hz bandwidth[7]

Noise: $1.1\ \mu A_{pp} / 10\ V = 1.1 \times 10^{-7}{}_{pp} \rightarrow 2 \times 10^{-8}{}_{RMS}$

Stability: 0.19 LSB = 3.6 µV