National Physical Laboratory

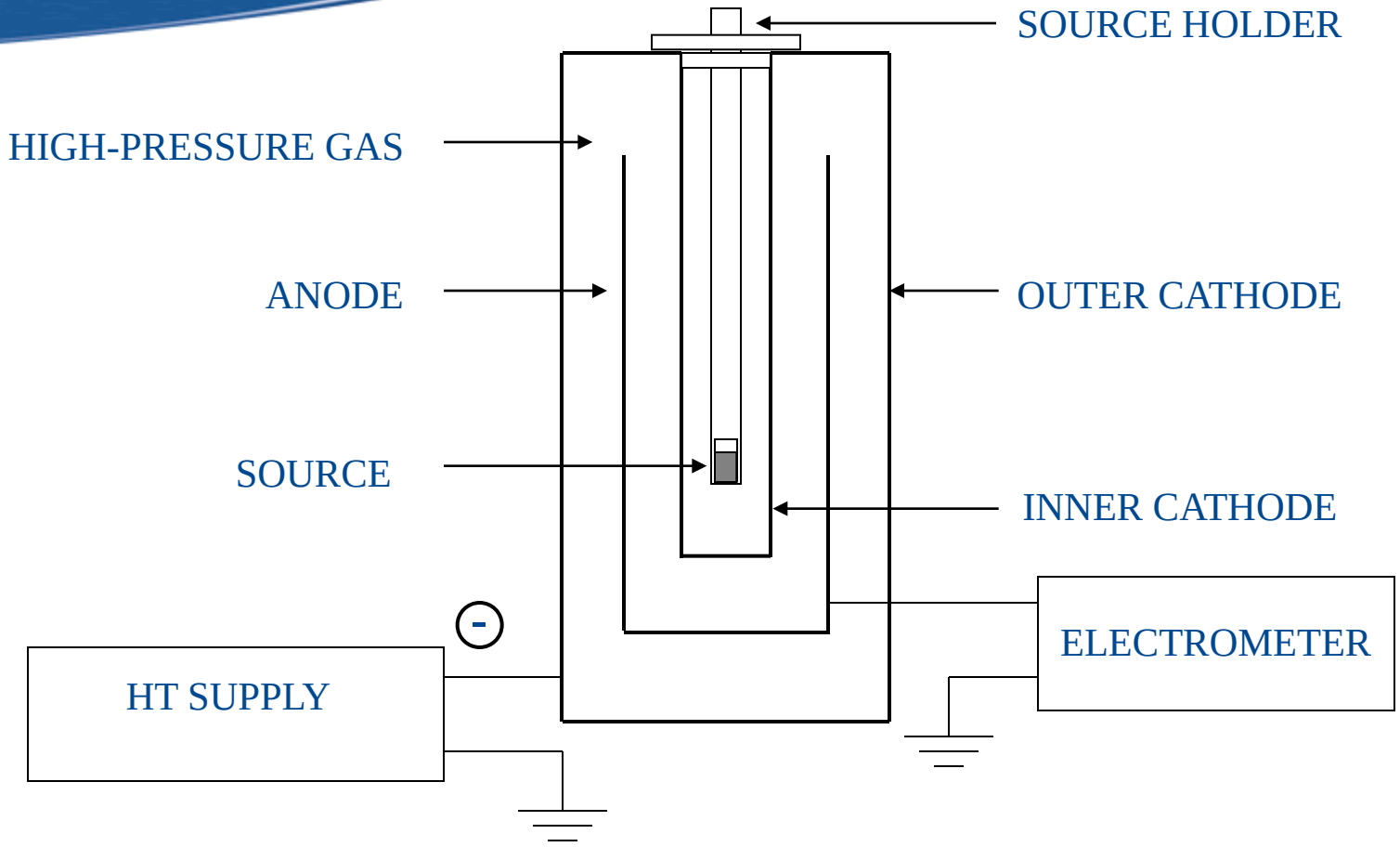
NEW ELECTROMETER SYSTEM FOR WELL TYPE IONISATION CHAMBERS

John Sephton

ICRM Life Sciences Working Group Meeting

NPL

November 2008



ION CHAMBER SCHEMATIC

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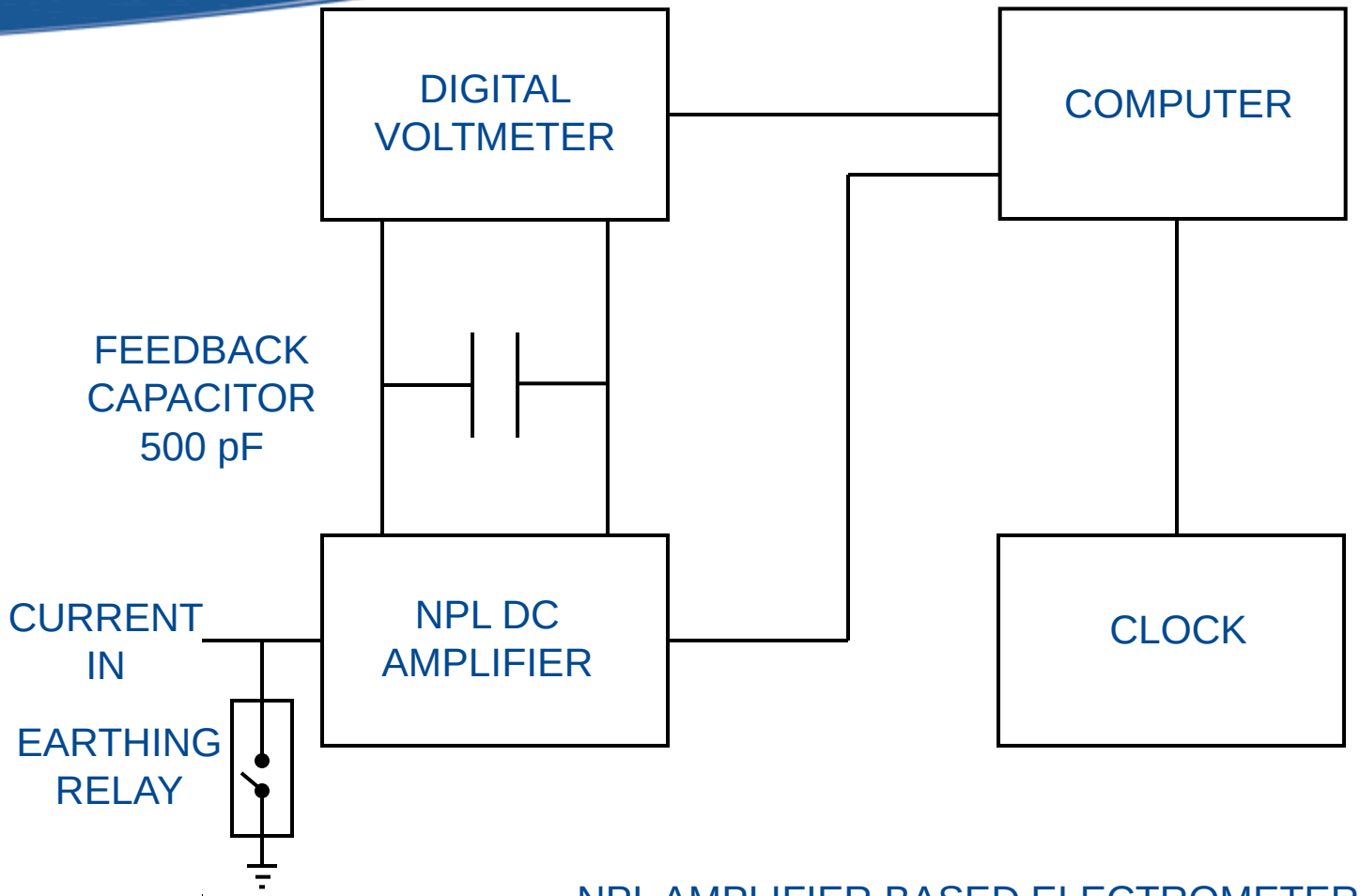
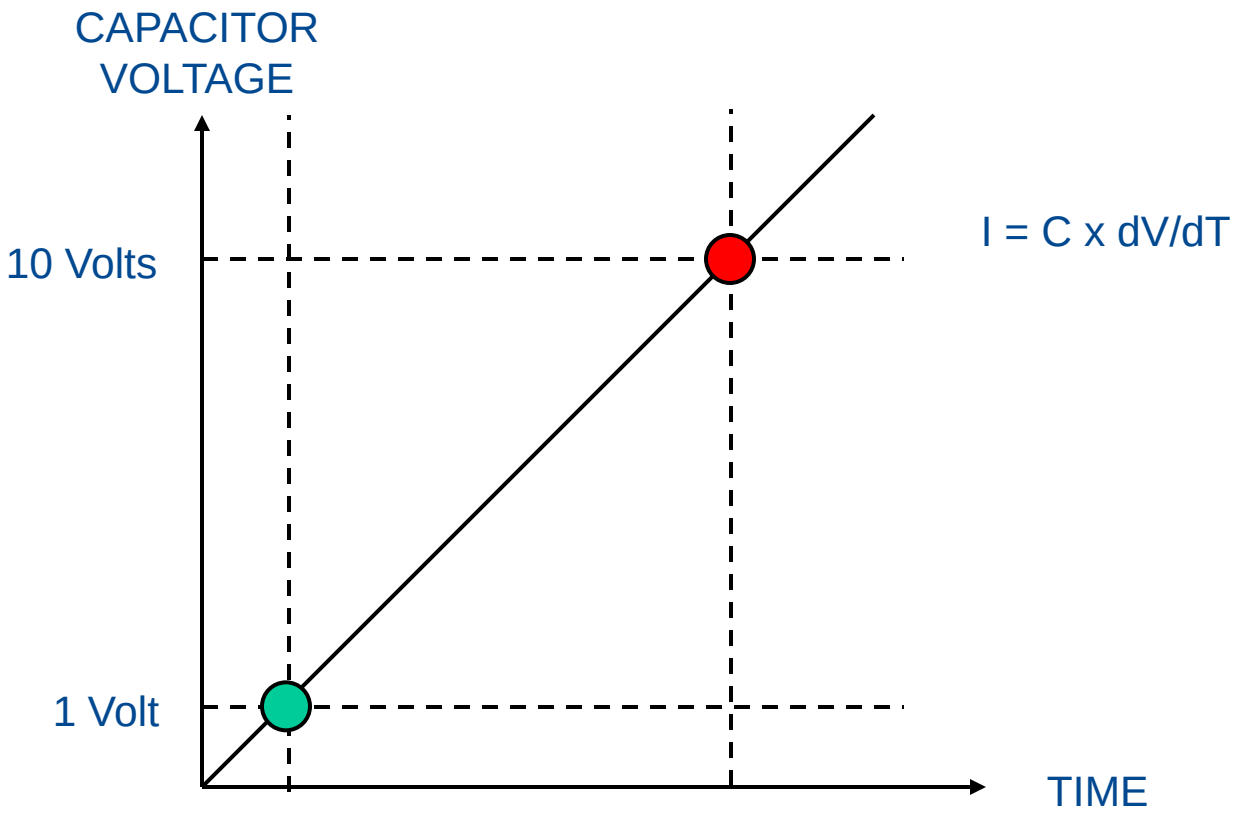
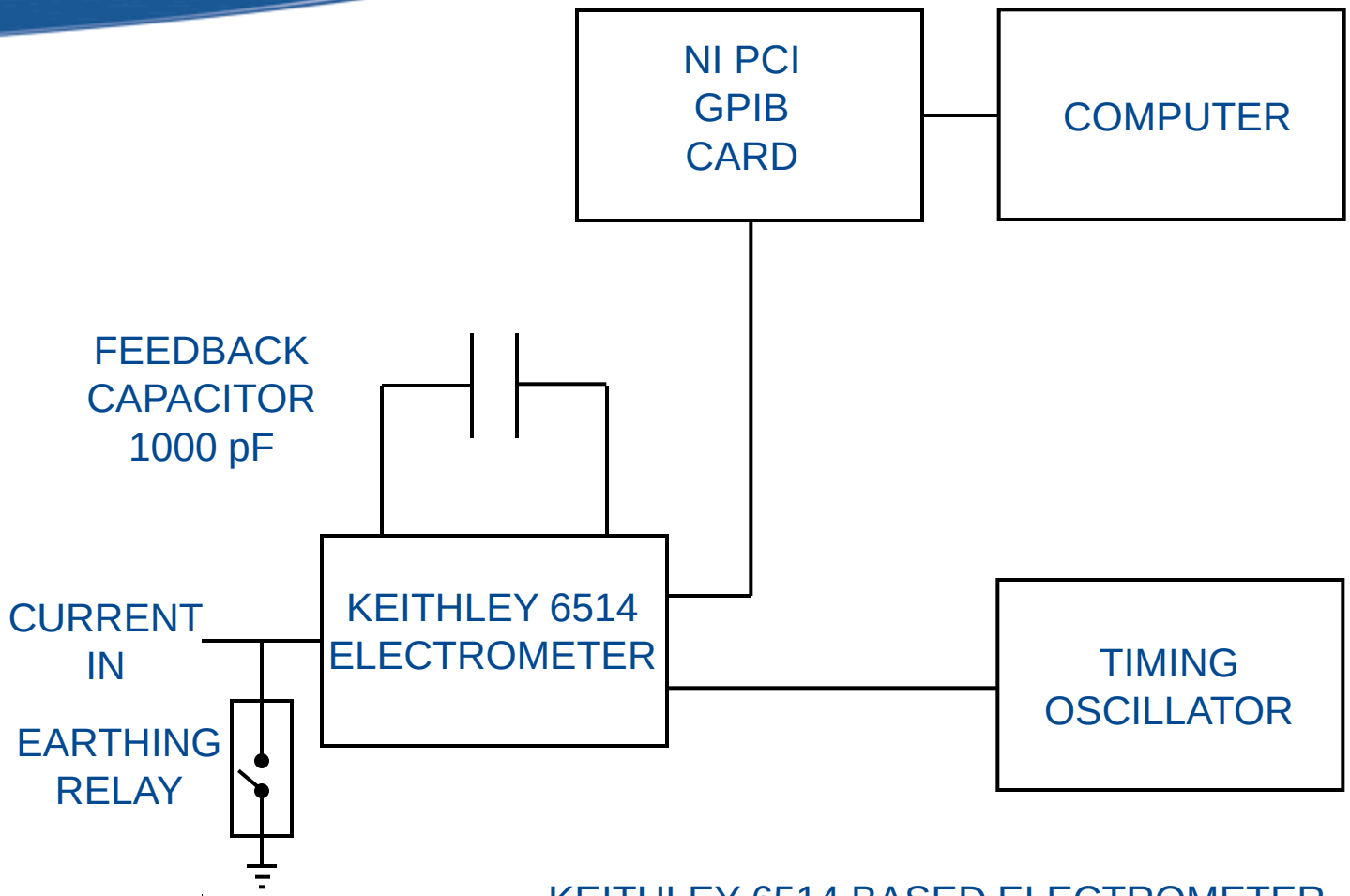


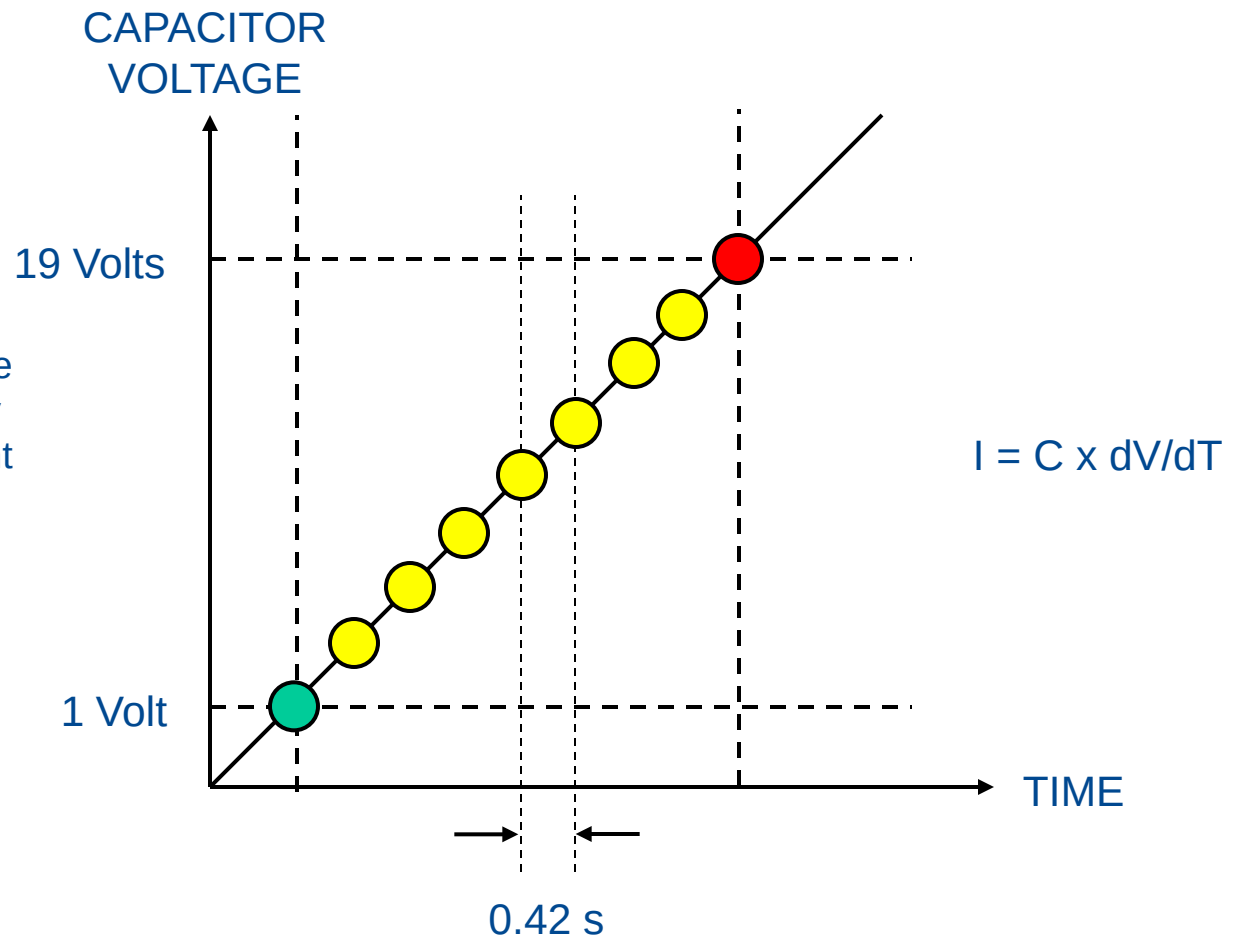
NPL AMPLIFIER BASED ELECTROMETER



SAMPLING WITH NPL BASED ELECTROMETER



KEITHLEY 6514 BASED ELECTROMETER



Voltage readings are corrected for decay during measurement

$I = C \times dV/dT$

SAMPLING WITH KEITHLEY 6514 BASED ELECTROMETER

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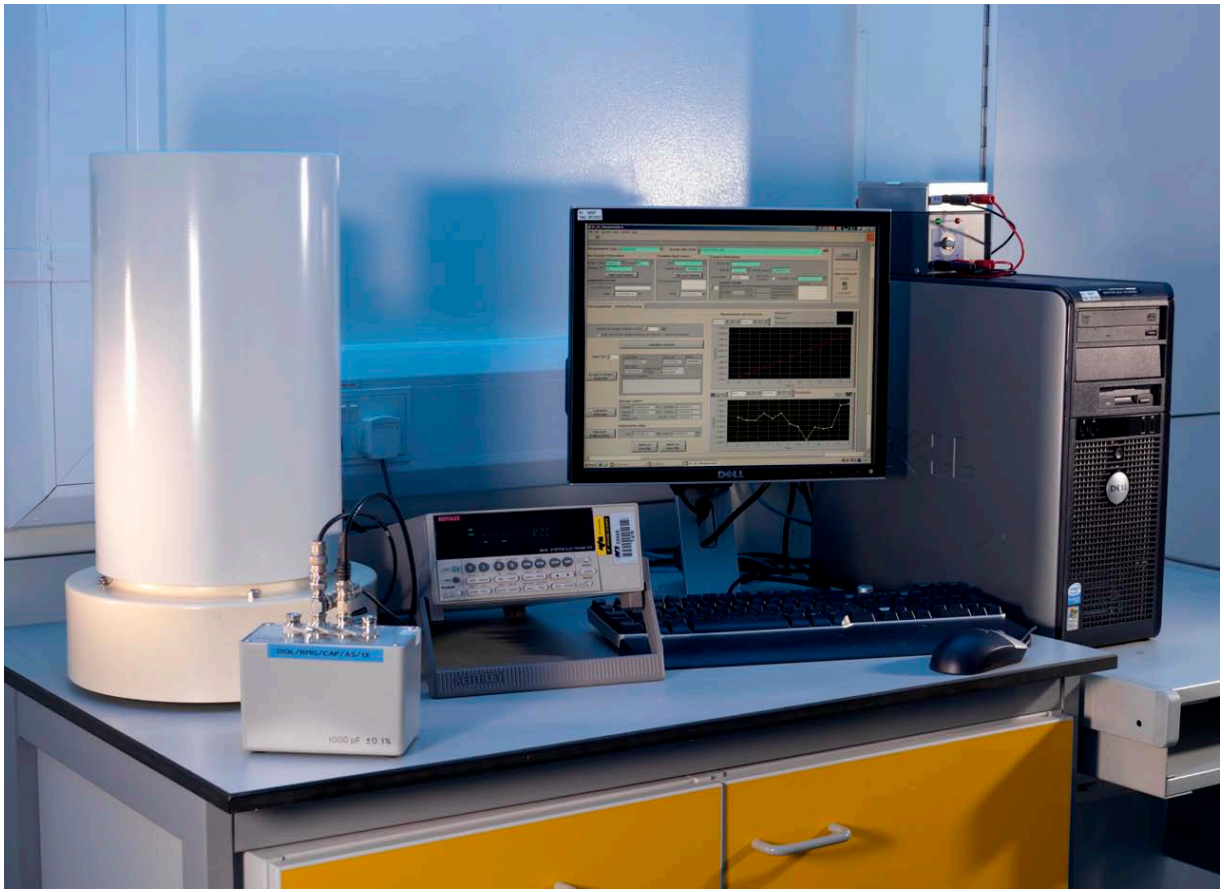
DELL
1000 pF ±0.1%

Initial Estimate of Current	Electrometer Range	Upper limit of voltage
≥ 100 pA	20 V	19 V
≥1 pA and < 100 pA	2 V	2 V or voltage after 1000 readings
< 1 pA	2 V	2 V or voltage after 2000 readings

Electrometer settings used at various currents

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TRACEABILITY

$$I = C \times dV/dT$$

VOLTAGE: Keithley electrometer calibrated with traceable voltage source

TIME: Pulse unit calibrated with traceable frequency meter

CAPACITANCE: Comparative bridge measurement made against standard capacitor

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Type A uncertainty:

Random noise

Typically 2 fA

Type B uncertainty:

Feedback capacitor drift and leakage

Voltmeter error

Current	Type A Uncertainty (%) (5 minute run)	Type B Uncertainty (%)
1 nA	0.0002	0.05
100 pA	0.002	0.03
10 pA	0.02	0.05
1 pA	0.2	0.5
100 fA	2	5

Typical Type A (statistical) and Type B (non-statistical) uncertainties at $k = 2$ (95% confidence limits)

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Acknowledgements

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Any questions?