SOUTHWEST RESEARCH INSTITUTE®
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Institute Quality Systems
Institute Calibration Laboratory
Phone: 210-522-5215 Fax 210-522-4834

# Certificate of Calibration

**Cost Center:** DIV20
**Mail Stop:** B51
**Customer:** DON BANNON
**Manufacturer/Model:** KEITHLEY / 617
**Description:** ELECTROMETER
**Serial Number:** 537418
**Asset Number:** 001044
**Procedure:** KEITHLEY 617 - 14 SEP 06

**Work Order:** 303088969
**Date Issued:** 15-Jul-2009
**Date Calibrated:** 15-Jul-2009
*** Date Due :** 15-Jan-2010
**** Results:** FOUND-LEFT
**Temperature:** 74°F
**Humidity:** 40 %

This certificate documents traceability to the National Institute of Standards and Technology (NIST) and the International System of Units (SI). The Laboratory quality system conforms to ISO/IEC 17025, 2005, ANSI/NCSL Z540-1-1994 and relevant requirements of the ISO 9000-2000 standard. This certificate shall not be reproduced, except in full, without the written approval of the Southwest Research Institute Calibration Laboratory. This certificate shall not be used to claim product endorsement by Southwest Research Institute or any agency of the U. S. Government. Results of this calibration relate only to the instrument described above at the time of calibration and does not imply any long term stability of the instrument.

*Determined by the customer, does not imply the instrument will remain within tolerance as any number of factors may cause an out-of-tolerance condition before this date. **Data type found in this certificate or attached measurement report must be interpreted as: Found-left - adjustment and/or repair was not performed, As-found - data is before unit is adjusted and/or repaired, As-left - data is after adjusted and/or repaired was performed. The customer has sole responsibility for determination of in-/out-of-tolerance or compliance/noncompliance.

Measurement uncertainty calculated in accordance with the method described in the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM), for a confidence level of approximately 95 percent using a coverage factor of $k=2$.

**Remarks:** Limited Cal: Coulombs, 2 pA, 20 pA and 200 pA not calibrated.

## Standards Used

| Asset # | Manufacturer | Model | Description | Cal Date | Due Date |
|---|---|---|---|---|---|
| 000182 | FLUKE | 5700A/EP | CALIBRATOR | 5-May-2009 | 5-Aug-2009 |
| 000201 | FLUKE | 5725A | AMPLIFIER | 5-May-2009 | 5-Aug-2009 |
| 001022 | FLUKE | 742A-10K | STANDARD RESISTOR | 5-May-2009 | 5-May-2010 |
| 001505 | HEWLETT-PACKARD | 3458A/OPT 002 | MULTIMETER | 29-Jan-2009 | 29-Jan-2010 |
| 012977 | FLUKE | 8508A-7000K | STANDARD RESISTOR | 22-Aug-2008 | 22-Aug-2009 |
| 014915 | FLUKE | 742A-1M | STANDARD RESISTOR | 21-Aug-2008 | 21-Aug-2009 |
| 014917 | FLUKE | 742A-10M | STANDARD RESISTOR | 26-Aug-2008 | 26-Aug-2009 |
| 014920 | FLUKE | 742A-100K | STANDARD RESISTOR | 21-Aug-2008 | 21-Aug-2009 |

Walt Hill
Laboratory Manager

Bob Trollinger
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

| | | | | | |
|---|---|---|---|---|---|
| Work Order: | 303088969 | Mfr: | KEITHLEY | Technician: | blt |
| Asset No: | 001044 | Model: | 617 | | |
| Serial No: | 537418 | Type: | ELECTROMETER | Cal Date: | 15-Jul-09 |
| Remarks: | | | | | |
| Coulombs, 2 pA, 20 pA and 200 pA not calibrated. | | | | | |

| Function/Range | Test Point | TI Reading | Difference | +/-Test Limits | +/-Uncertainty | Found/Left |
|---|---|---|---|---|---|---|
| DC Amps | mAmps | mAmps | mAmps | mAmps | mAmps | Result |
| 20 mA | 19.000 | 19.002 | 0.002 | 0.030 | 0.0014 | Pass |
| 2 mA | 1.9000 | 1.8998 | -0.0002 | 0.0033 | 0.00014 | Pass |
| | uAmps | uAmps | uAmps | uAmps | uAmps | |
| 200 uA | 190.00 | 190.02 | 0.02 | 0.30 | 0.029 | Pass |
| 20 uA | 19.000 | 19.001 | 0.001 | 0.030 | 0.0019 | Pass |
| 2 uA | 1.9000 | 1.8993 | -0.0007 | 0.0033 | 0.00022 | Pass |
| | nAmps | nAmps | nAmps | nAmps | nAmps | |
| 200 nA | 190.00 | 189.95 | -0.05 | 0.49 | 0.021 | Pass |
| 20 nA | 19.000 | 18.987 | -0.013 | 0.049 | 0.0017 | Pass |
| 2 nA | 1.9000 | 1.9026 | 0.0026 | 0.0053 | 0.00017 | Pass |
| | pAmps | pAmps | pAmps | pAmps | pAmps | |
| DCV | mVolts | mVolts | mVolts | mVolts | mVolts | |
| 200 mVolt | 190.00 | 189.97 | -0.03 | 0.14 | 0.012 | Pass |
| | Volts | Volts | Volts | Volts | Volts | |
| 2 Volt | 1.9000 | 1.9000 | 0.0000 | 0.0011 | 0.00012 | Pass |
| 20 Volt | 19.000 | 19.000 | 0.000 | 0.011 | 0.0012 | Pass |
| 200 Volt | 190.00 | 190.01 | 0.01 | 0.14 | 0.012 | Pass |
| Resistance | GOhm | GOhm | GOhm | GOhm | GOhm | |
| 20 GOhm | 1.000 | 1.00 | 0.000 | 0.02 | 0.020 | Pass |
| 2 GOhm | 0.9990 | 1.007 | 0.0080 | 0.02 | 0.00025 | Pass |
| | MOhm | MOhm | MOhm | MOhm | MOhm | |
| 200 MOhm | 100.00 | 100.07 | 0.07 | 0.31 | 0.10 | Pass |
| 20 MOhm | 10.000 | 10.001 | 0.001 | 0.026 | 0.0012 | Pass |
| 2 MOhm | 1.0000 | 0.9998 | -0.0002 | 0.0026 | 0.00012 | Pass |
| | kOhm | kOhm | kOhm | kOhm | kOhm | |
| 200 kOhm | 100.00 | 99.99 | -0.01 | 0.26 | 0.012 | Pass |
| 20 kOhm | 10.000 | 10.000 | 0.000 | 0.016 | 0.0017 | Pass |
| 2 kOhm | 1.0000 | 1.0005 | 0.0005 | 0.00211 | 0.00010 | Pass |
| Voltage Source | Volts | Volts | Volts | Volts | Volts | |
| | 0.000 | -0.032 | -0.032 | 0.050 | 0.0012 | Pass |
| | 1.000 | 1.015 | 0.015 | 0.052 | 0.0012 | Pass |
| | 10.000 | 10.003 | 0.003 | 0.070 | 0.0012 | Pass |
| | 25.000 | 24.994 | -0.006 | 0.100 | 0.0015 | Pass |
| | 50.000 | 49.975 | -0.025 | 0.150 | 0.0015 | Pass |
| | 100.000 | 99.942 | -0.058 | 0.250 | 0.0012 | Pass |

END OF REPORT