KEITHLEY

Keithley Instruments, Inc.
28775 Aurora Road
Cleveland, Ohio 44139
(216) 248-0400
Fax: 248-6168

Certificate of Calibration

Model 614 Serial No. 0704936 Date 12-07-98

This notification serves to certify that the unit described above has been inspected and tested in accordance with specifications published by Keithley Instruments, Inc.

The accuracy and calibration of this instrument are traceable through reference standards that are compared, at planned intervals, to national standards maintained by the National Institute of Standards and Technology (NIST), by comparison to natural physical constants or self-calibrating ratio type measurements.

The measurement standards which support this calibration are calibrated on a schedule to maintain required accuracy level.

James A. Crane

James A. Crane
Metrology Services

Southwest Research Institute
6220 Culebra Road
San Antonio, TX 78238
(210) 522-5215
Department of Quality Assurance
Calibration Laboratory

Certificate of Calibration

8 March 1999

Issued to: DARRELL DUNN DIV20 B57
Manufacturer/Model: KEITHLEY 614
Description: ELECTROMETER
Serial Number: 0704936
Asset Number: 007089

This certifies the above item was calibrated in compliance with MIL-STD-45662A and ANSI/NCSL Z540-1-1994. Standards used in this calibration, described in the referenced calibration procedure with associated uncertainties or tolerances, are traceable to the National Institute of Standards and Technology (NIST). Supporting documentation relative to traceability is on file and is available for examination upon request. This certificate is not to be reproduced, except in full, without the written approval of the Southwest Research Institute Department of Quality Assurance Calibration Laboratory.

The uncertainty of the calibration was sufficient to determine that the item met the manufacturer's published specifications unless stated otherwise below.

Ambient Conditions: **Temperature:** 73.0 Degrees Fahrenheit **Humidity:** 32 % RH

Calibration Date: 2 Mar 99 **Calibration Procedure:** MFG

Condition as Received: IN TOLERANCE

Condition as Released: IN TOLERANCE

Vendor/Calibration Location: ROTHE DEVELOPMENT, SAN ANTONIO, TX

Remarks: ROTHE CERTIFICATE NO.: 56841.

Mark Romero / Clerk

Certificate # 33134

SOUTHWEST RESEARCH INSTITUTE
CALIBRATION LABORATORY
MEMORANDUM

June 11, 2003

To: DARRELL DUNN DIV20 B57

From: Walt Hill, Metrology Group Leader
Institute Calibration Laboratory

Subject: Status of Calibration Supplier

Manufacturer/Model: KEITHLEY 614
Description: ELECTROMETER
Serial Number: 0704936
Asset Number: 007089
Work Order Number: 444053960
Date Calibrated: June 9, 2003
Supplier: ROTHE DEVELOPMENT, SAN ANTONIO TX - AUDIT - 648-3131
Remarks: Rothe Cert # 28151:1055169953

(✓) Supplier is on the Approved Suppliers List (ASL).

( ) Supplier is not on the Approved Suppliers List.

( ) Calibration is ISO 17025 accredited.

(✓) Calibration is not ISO 17025 accredited.

( ) There is no known supplier to meet ISO 17025 accreditation at this time.

Please notify the Institute Calibration Laboratory, extension 5215, of any discrepancies with the item or calibration documentation.

Attachment(s) 3

m:\nonasl2.rpt Rev 7 Dec 01

CERT. NUMBER:
28151:1055169953

ROTHE DEVELOPMENT, INC.

METROLOGY SERVICES DIVISION

4614 SINCLAIR RD., SAN ANTONIO, TEXAS 78222 PH:210-648-3131

CERTIFICATE OF CALIBRATION

ISSUED TO: Southwest Research Institute
(30)
6220 Culebra
San Antonio, TX 78284

MFG: Keithley
MODEL: 614
NOMEN: Electrometer
S/N: 0704936
CUST. ID: 7089

CAL DATE: 6/9/2003
DUE DATE:

CONTROL NO.: 103 - 28151
TECHNICIAN: 4
SPECIFICATIONS: MFG
PROCEDURE: MFG
WORK ORDER: 002029592
CUSTOMER P.O.: 01571R/ST408442/1.20 00
RECEIVED CONDITION: IN TOLERANCE
RETURNED CONDITION: IN TOLERANCE

CALIBRATION PERFORMED AT: RDMSD
CALIBRATION INTERVAL: 0
TEMPERATURE: 73.0 °F
RELATIVE HUMIDITY: 37 %

DATE RECEIVED: 6/5/2003

COMMENTS:

ATTACHMENTS:

All Calibrations performed at Rothe Development, Inc. Metrology Services Division meet the requirements of ANSI/NCSL Z540-1-1994, ISO/IEC GUIDE 25, and ISO 10012-1, and are traceable to the National Institute of Standards and Technology. The collective uncertainty of the measurement(s) does not exceed 25% (TUR≥4:1) of the instrument specification(s) unless noted in the COMMENTS section.

TR#	MFG	MODEL	SERIAL NO.	DUE DATE
20	FLUKE	5700A/EP	1605002	6/25/2003
258	FLUKE	5725A	6585002	6/25/2003
75	JRL	NMN	75	1/8/2004
235	GUILDLINE	6500A	59660	12/19/2003

REGISTERED TO ISO 9002
CERTIFICATE NO. A9428

APPROVED BY: Peter J Stemmer ☑ CMS ☐ QCO **DATE** 6/10/2003

RDMSD 1001
03/01

This certificate may not be reproduced, except in full, without written approval of Rothe Development, Inc. Metrology Services Division.

ROTHE DEVELOPMENT METROLOGY SERVICES

CALIBRATION DATA: KEITHLEY 614 ELECTROMETER

CUSTOMER: SwRI
WO NUMBER: 002029592
SERIAL: 0704936
CUST ID: 7089

DATE: 9 Jun 03
TECH: Peter Stemm
INST NO: 28151

CALIBRATION DATA TAKEN

INCOMING ✓
OUTGOING ✓

CONDITION OF EQUIPMENT

IN TOLERANCE ✓
OUT OF TOLERANCE

INPUT CURRENT VERIFICATION

RANGE	INPUT	MIN	READING	MAX
20 pA	NONE	-00.06	00.01	+00.06

DC VOLTMETER ACCURACY

RANGE	INPUT	MIN	READING	MAX
.2 V	0.0 mV	-.00002	.00000	+.00002
	+190 mV	.18983	.18999	.19017
	-190 mV	.18983	.18998	.19017
2 V	+1.9 V	1.8984	1.8999	1.9016
	-1.9 V	1.8984	1.8999	1.9016
20 V	+19 V	18.984	18.997	19.016
	-19 V	18.984	18.997	19.016

DC CURRENT ACCURACY

RANGE	INPUT	MIN	READING	MAX
200 uA	190 uA	189.3	189.9	190.7
200 nA	190 nA	189.0	190.1	191.0
2000 pA	1900 pA	1871	1900	1929

DOC. DATE: 2/22/2001

RESISTANCE ACCURACY

RANGE		ACTUAL INPUT	TOLERANCE	READING
20 KΩ	(19)	19.00 k	±11 C	18.99
200 KΩ		190.0 k	±11 C	189.7
20 MΩ	(10)	10.00 M	±10 C	9.98
20 GΩ	(10)	9.98 G	±2 %	9.97

CHARGE ACCURACY

RANGE	INPUT	MIN	READING	MAX
2 nC	1.0 VDC INTO 1000 pF	0.9500	.9959	1.0500

INST NO: 28151

DOC. DATE: 2/22/2001

✓ INCOMING
✓ OUTGOING

SOUTHWEST RESEARCH INSTITUTE™

6220 Culebra Road, P.O. Drawer 28510
Institute Quality Systems
Institute Calibration Laboratory
Phone: 210-522-5215 Fax 210-522-3692

ACCREDITED
Certificate #
0972-01

Certificate of Calibration

Submitted By:	DIV20	**Work Order:**	444059297
Address:	B57	**Date Issued:**	Jun 7, 2004
Contact:	DARRELL DUNN	**Calibration Date:**	Jun 7, 2004
Manufacturer Model:	KEITHLEY 614	****Calibration Due:**	Jun 7, 2005
Description:	ELECTROMETER	**Calibration Location:**	Bldg. 64
Serial No:	0704936	**Environment:**	Temp. 73.0°F Hum. 40 %RH
Asset No:	007089	***As Found:**	IN TOLERANCE
Procedure:	CL-741, APR/03	***As Left:**	IN TOLERANCE

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, 1999 and ANSI/NCSL Z540-1-1994 which are equivalent to relevant requirements of the ISO 9000-1994 series of standards. This certificate may not be reproduced, except in full, without the written approval of the Southwest Research Institute Calibration Laboratory. The results of this calibration relate only to the individual instrument described above. This certificate shall not be used to claim product endorsement by the American Association for Laboratory Accreditation (A2LA) or any agency of the U. S. Government.

Uncertainty evaluation includes the item under test and is calculated in accordance with the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM). The uncertainty represents an expanded uncertainty using a coverage factor of k=2 to approximate a 95% confidence level. See Remarks or attached Calibration Report with the same Work Order number for calibration data.

*The client has sole responsibility for determination of in/out of tolerance or compliance/noncompliance. An in/out of tolerance opinion is provided for your convenience based only on the Test Instrument (TI) reading(s) and limits as reported. The reported uncertainty relates only to the results at the time of calibration and does not imply any short or long term stability of the TI.

**Calibration interval is determined by the client and does not assure the instrument will remain within tolerance until this date. Any number of factors may cause the instrument to be out of tolerance before the next calibration date.

Remarks: None

Standards Used

Asset	Manufacturer	Model	Description	Cal Due
000108	GENERAL RADIO	1433G	DECADE RESISTOR	Mar 24, 05
009753	GEN RAD	1422-CB	CAPACITOR STANDARD	Oct 31, 04
000101	BIDDLE	72-5346-1	DECADE RESISTOR	Oct 06, 04
000182	FLUKE	5700A/EP	CALIBRATOR	Jun 08, 04
009829	ESI	SR1050-10M	DECADE RESISTOR	Nov 26, 04

Approved by: Walt Hill
Metrology Group Leader

Measurements by: Scott Kester
Metrology Technician

m:\a2la1.rpt Rev date 11, May 04

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	444059297	Mfr.	KEITHLEY	Technician	SRK
Asset No.	007089	Model	614		
Serial No.	0704936	Type.	Electrometer	Cal Date.	07-Jun-04
Remarks:					

Function/Range	Test Point	TI Reading	Difference	+/-Test Limits	+/-Uncertainty	Found/Left
Zero	mVolts	mVolts	mVolts	mVolts	mVolts	Results
	0.00000	0.00000	0.00000	0.00001	0.0000012	Pass
Reference	10.0000					
DCV	Volts	Volts	Volts	Volts	Volts	
0.2 V	0.19000	0.18999	-0.00001	0.00017	0.000022	Pass
0.1 V	0.10000	0.10000	0.00000	0.00010	0.000022	Pass
2 Volt	1.9000	1.8999	-0.0001	0.0016	0.00012	Pass
	1.0000	1.0001	0.0001	0.0009	0.00012	Pass
20 Volt	19.000	18.997	-0.003	0.016	0.0012	Pass
	10.000	9.999	-0.001	0.009	0.0012	Pass
DC Amps	uAmps	uAmps	uAmps	uAmps	uAmps	
20 uAmp	19.00	19.00	0.00	0.08	0.014	Pass
	nAmps	nAmps	nAmps	nAmps	nAmps	
200 nAmp	190.0	190.1	0.1	1.1	0.12	Pass
	pAmps	pAmps	pAmps	pAmps	pAmps	
2000 pAmp	1900	1894	-6	29	0.12	Pass
Resistance	kOhm	kOhm	kOhm	kOhm	kOhm	
20 kOhm	19.00	18.99	-0.01	0.11	0.012	Pass
200 kOhm	190.0	189.7	-0.3	1.1	0.12	Pass
	MOhm	MOhm	MOhm	MOhm	MOhm	
20 MOhm	10.00	9.98	-0.02	0.10	0.012	Pass
	GOhm	GOhm	GOhm	GOhm	GOhm	
20 GOhm	10.00	10.03	0.03	0.22	0.014	Pass
Charge Calibration						
2 nC	1.0000	1.0300	0.0300	0.0500	0.00012	Pass

END OF REPORT