KEITHLEY

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

Certificate of Calibration

Model 617 **Serial No.** 0579628 **Date** 9-06-94

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
Metrology Services

SOUTHWEST RESEARCH INSTITUTE

Department of Quality Assurance
Calibration Laboratory

CERTIFICATE OF CALIBRATION
10/11/94

Issued to: DARRELL DUNN DIV20 ,B57
Manufacturer: KEITH
Nomenclature: ELECTROMETER
Serial Number: 0579628

Asset Number: 003400
Model Number: 617
SwRI Capital Number:

ENVIRONMENTAL CONDITIONS

Temperature: 74.0F

Relative Humidity: 35 %

CALIBRATION INFORMATION

Location: ROTHE
Procedure Number: MFGR SPECS
Remarks: ROTHE CERTIFICATE #36389

Technician:
Accuracy: MFG SPEC
Received IN Tolerance

Calibration was in accordance with requirements of MIL-STD-45662A. Measurements are traceable to the National Institute of Standards and Technology. Inspection and test data are on file and available for inspection.

STANDARDS USED FOR CERTIFICATION

Asset #	Serial #	Mfg	Model #	Nomenclature	Cal Date	Int.	Cal Due
VENDOR							

Certified by : _____

Calibration Date: 10/07/94
Interval: 12 months
Next Calibration Due: 10/07/95

Work Order: 15195R

REVISED CERTIFICATE. CAL CYCLE 12 MONTHS 10/11/94

SOUTHWEST RESEARCH INSTITUTE

Department of Quality Assurance
Calibration Laboratory

CERTIFICATE OF CALIBRATION
10/11/94

Issued to: DARRELL DUNN DIV20 ,B57
Manufacturer: KEITH
Nomenclature: ELECTROMETER
Serial Number: 0579628

Asset Number: 003400
Model Number: 617

SwRI Capital Number:

ENVIRONMENTAL CONDITIONS

Temperature: 74.0F

Relative Humidity: 35 %

CALIBRATION INFORMATION

Location: ROTHE
Procedure Number: MFGR SPECS
Remarks: CERTIFICATE #36389

Technician:
Accuracy: MFG SPEC
Received IN Tolerance

Calibration was in accordance with requirements of MIL-STD-45662A. Measurements are traceable to the National Institute of Standards and Technology. Inspection and test data are on file and available for inspection.

STANDARDS USED FOR CERTIFICATION

Asset #	Serial #	Mfg	Model #	Nomenclature	Cal Date	Int. Cal Due
VENDOR						

Certified by :

Calibration Date: 10/07/94
Interval: 6 months
Next Calibration Due: 04/07/95

Work Order: 15195

Rothe Development Inc.

Metrology Services Division

4614 SINCLAIR RD., SAN ANTONIO, TEXAS 78222 210-648-3131 FAX 210-648-4091

Certificate of Calibration

36389

CAL DATE: 10/05/94

DUE DATE: 10/05/95

ISSUED TO: Southwest Research Institute (30)
6220 Culebra, Bldg. 64/Division 30
San Antonio, TX 78284
684-5111 * 2702

MFG Keithley

MODEL 617

SERIAL # 0579628

CONTROL: 103 - 19349

TYPE Electrometer

SPECIFICATIONS: MFG
PROCEDURE: MFG
WORK ORDER #: 45030
CUSTOMER PO #: 03602/ST#244821/

RECEIVED IN-SPECS ☒
OUT-OF-SPECS ☐

All Calibration measurements performed at ROTHE DEVELOPMENT INC. METROLOGY SERVICES meet the requirements of MIL-STD-45662A, and are traceable to the National Institute of Standards and Technology through Primary NIST Calibration or Secondary Calibration performed by other Metrological facilities. Ambient conditions: Temperature 74oF , Relative Humidity 35% .

Test Report Number and Calibration Standards Used

Ref #	Model #	Mfgr	Serial #	Description	Cal Date	Int	Cal Due
TR 20	5700A	FLUKE	4605002	CALIBRATOR	08/25/94	3	11/25/94
TR 235	6500A	GUILDLINE	59660	TERAOHMETER	08/24/94	12	08/24/95
TR 75	NMN	JRL	75	RESISTANCE BOX	05/03/94	12	05/03/95

------- Test Report Numbers -------

DCV	FLUKE	CERT#	DH70
ACV	FLUKE	CERT#	DP30
OHM	NIST	TEST#	250839
TEMP	NIST	TEST#	251316
Hz	WWVB Transmission		

INSPECTED BY Jose A Mendoza
COMMENTS:

RDI 1001

ROTHE DEVELOPMENT METROLOGY SERVICES

CALIBRATION DATA : KEITHLEY 617

CUSTOMER : SwRI
WO NUMBER : 45030
SERIAL : 0579628

DATE : 5 Oct 94
TECH : PJS
INST NO : 19349

CAL DATA TAKEN

INCOMING ✓
OUTGOING ✓

CONDITION

IN TOLERANCE ✓
OUT OF TOLERANCE

INPUT CURRENT VERIFICATION

SET-UP: 2PA RANGE, INPUT CAPPED, TOLERANCE <66 C

READING .0027

CURRENT ACCURACY

RANGE	INPUT	MIN	READING	MAX
20 MA	ZERO CHECK	-0.001	0.000	+0.001
	19 MA	18.970	18.999	19.030
2 MA	1.9 MA	1.8967	1.8999	1.9033
200 UA	190 UA	189.70	189.96	190.30
20 UA	19 UA	18.970	18.997	19.030

RANGE	NOMINAL	ACTUAL	TOLERANCE		READING
2 UA	1.9 UA	1.9 ua	±.15% +4C	P / F	1.8996
200 NA	190 NA	190 na	±.25% +1C	P / F	190.01
20 NA	19 NA	19 na	±.25% +1C	P / F	19.004
2 NA	1.9 NA	1.9 na	±.25% +5C	P / F	1.9004
200 PA	190 PA	190 Pa	±1.6% +1C	P / F	190.03
20 PA	19 PA	19 pa	±1.6% +7C	P / F	19.033
2 PA	1.9 PA	1.9 pa	±1.6% +66C	P / F	1.8993

COULOMB ACCURACY

RANGE	INPUT	MIN	READING	MAX
2NC	1V / 1000 PFD	0.995	.998	1.005

DC VOLTAGE ACCURACY

RANGE	INPUT	MIN	READING	MAX
200 MV	+190 MV	189.87	190.01	190.13
	-190 MV	189.87	190.01	190.13
2 V	+1.9 V	1.8990	1.9001	1.9010
	-1.9 V	1.8990	1.9001	1.9010
20 V	+19 V	18.990	18.999	19.010
	-19 V	18.990	19.000	19.010
200 V	+190 V	189.86	189.99	190.14
	-190 V	189.86	189.99	190.14

RESISTANCE ACCURACY

RANGE	ACUTAL INPUT	TOLERANCE		READING
2 KΩ (19)	1.9000 K	±0.2% +4C	P / F	1.9001
20 KΩ	18.999 K	±0.15% +1C	P / F	19.000
200 KΩ	189.99 K	±0.25% +1C	P / F	190.01
2 MΩ	1.9000 M	±0.25% +1C	P / F	1.8999
20 MΩ	18.997 M	±0.25% +1C	P / F	18.991
200 MΩ (1)	100.24 M	±0.3% +1C	P / F	100.08
2 GΩ	1.0019 G	±1.5% +1C	P / F	1.0024
20 GΩ	9.979 G	±1.5% + 1C	P / F	9.975
200 GΩ	98.81 G	±1.5% + 1C	P / F	98.25

OUTPUT VOLTAGE SOURCE ACCURACY

OUTPUT SETTING	MIN	READING	MAX
00.00 V	-0.050	+ 0.021	+0.050
+01.00 V	+0.948	1.022	+1.052
-01.00 V	-0.948	0.978	-1.052
+10.00 V	+9.930	10.025	+10.07
-10.00 V	-9.930	9.979	-10.07
+25.00 V	+24.90	25.026	+25.10
-25.00 V	-24.90	24.982	-25.10
+50.00 V	+49.85	50.028	+50.15
-50.00 V	-49.85	49.985	-50.15
+100.00 V	+99.75	100.028	+100.25
-100.00 V	-99.75	99.986	-100.25

SOUTHWEST RESEARCH INSTITUTE

Department of Quality Assurance
Calibration Laboratory

CERTIFICATE OF CALIBRATION
10/06/95

Issued to: DARRELL DUNN DIV20 ,B57
Manufacturer: KEITH
Nomenclature: PROGRAMMABLE ELECTROMETER
Serial Number: 0579628
Notes:

Asset Number: 003400
Model Number: 617
SwRI/Div. I.D. #:

ENVIRONMENTAL CONDITIONS

Temperature: 73.0F

Relative Humidity: 36%

CALIBRATION INFORMATION

Procedure Number: MFGR SPECS
Remarks: CALIBRATED BY ROTHE DEV., CERT# 40526

Accuracy: MFG SPEC
Received IN Tolerance

Calibration was in accordance with requirements of MIL-STD-45662A. Measurements are traceable to the National Institute of Standards and Technology. Inspection and test data are on file and available for inspection.

STANDARDS USED FOR CERTIFICATION

Asset #	Serial #	Mfg	Model #	Nomenclature	Cal Date	Int. Cal Due
VENDOR						

Certified by :

Calibration Date: 10/05/95
Interval: 12 months
Next Calibration Due: 10/05/96

Certificate#: 18889

Rothe Development Inc.

Metrology Services Division

4614 SINCLAIR RD., SAN ANTONIO, TEXAS 78222 210-648-3131 FAX 210-648-4091

Certificate of Calibration

40526

CAL DATE: 10/05/95

DUE DATE: 10/05/96

ISSUED TO: Southwest Research Institute (30)
6220 Culebra, Bldg. 64/Division 30
San Antonio, TX 78284
684-5111 * 2702

MFG Keithley

MODEL 617

SERIAL # 0579628

TYPE Electrometer

RECEIVED IN-SPECS ☒
OUT-OF-SPECS ☐

CONTROL: 103 - 19349
TECHNICIAN #: 4
SPECIFICATIONS: MFG
PROCEDURE: MFG
WORK ORDER #: 50279
CUSTOMER PO #: 03602/ST271409/20-5704-

All Calibration measurements performed at ROTHE DEVELOPMENT INC. METROLOGY SERVICES meet the requirements of MIL-STD-45662A, and are traceable to the National Institute of Standards and Technology through Primary NIST Calibration or Secondary Calibration performed by other Metrological facilities. Ambient conditions: Temperature 73°F , Relative Humidity 36% .

Test Report Number and Calibration Standards Used

Ref #	Model #	Mfgr	Serial #	Description	Cal Date	Int	Cal Due
TR 20	5700A	FLUKE	4605002	CALIBRATOR	09/05/95	3	12/05/95
TR 75	NMN	JRL	75	RESISTANCE BOX	07/11/95	12	07/11/96
TR 235	6500A	GUILDLINE	59660	TERAOHMETER	09/01/95	12	09/01/96

------- Test Report Numbers -------
DCV FLUKE CERT# DH70
ACV FLUKE CERT# DP30
OHM NIST TEST# 250839
TEMP NIST TEST# 251316
Hz WWVB Transmission

INSPECTED BY Joe A Mendoza
COMMENTS:

RDI 1001

ROTHE DEVELOPMENT METROLOGY SERVICES

CALIBRATION DATA: KEITHLEY 617 ELECTROMETER

CUSTOMER: SWRI
WO NUMBER: 50279
SERIAL: 0579628

DATE: 5 Oct 95
TECH: PJS
INST NO: 19349

CALIBRATION DATA TAKEN

INCOMING
OUTGOING ✓

CONDITION OF EQUIPMENT

IN TOLERANCE ✓
OUT OF TOLERANCE

INPUT CURRENT VERIFICATION

SET-UP: 2PA RANGE, INPUT CAPPED, TOLERANCE <66 C — READING .0037

CURRENT ACCURACY

RANGE	INPUT	MIN	READING	MAX
20 mA	ZERO CHECK	-0.001	0.000	+0.001
	19 mA	18.970	18.999	19.030
2 mA	1.9 mA	1.8967	1.9000	1.9033
200 uA	190 uA	189.70	190.00	190.30
20 uA	19 uA	18.970	19.001	19.030

RANGE	NOMINAL	ACTUAL	TOLERANCE		READING
2 uA	1.9 uA	1.900 ua	±.15% +4C	P / F	1.8999
200 nA	190 nA	190.0 na	±.25% +1C	P / F	190.01
20 nA	19 nA	19.00 na	±.25% +1C	P / F	19.001
2 nA	1.9 nA	1.900 na	±.25% +5C	P / F	1.9004
200 pA	190 pA	190.0 pa	±1.6% +1C	P / F	189.97
20 pA	19 pA	19.00 pa	±1.6% +7C	P / F	18.999
2 pA	1.9 pA	1.900 pa	±1.6% +66C	P / F	1.9051

COULOMB ACCURACY

RANGE	INPUT	MIN	READING	MAX
2nC	1V / 1000pF	0.995	.999	1.005

DC VOLTAGE ACCURACY

RANGE	INPUT	MIN	READING	MAX
200 mV	+190 mV	189.87	190.00	190.13
	-190 mV	189.87	189.99	190.13
2 V	+1.9 V	1.8990	1.9000	1.9010
	-1.9 V	1.8990	1.8999	1.9010
20 V	+19 V	18.990	19.000	19.010
	-19 V	18.990	19.000	19.010
200 V	+190 V	189.86	189.99	190.14
	-190 V	189.86	190.00	190.14

RESISTANCE ACCURACY

RANGE	ACUTAL INPUT	TOLERANCE		READING
2 KΩ (19)	1.9000 k	±0.2% +4C	P / F	1.9000
20 KΩ	18.999 k	±0.15% +1C	P / F	19.000
200 KΩ	190.00 k	±0.25% +1C	P / F	190.01
2 MΩ	1.9000 M	±0.25% +1C	P / F	1.9000
20 MΩ	18.997 M	±0.25% +1C	P / F	18.994
200 MΩ (1)	99.99 M	±0.3% +1C	P / F	100.01
2 GΩ	1.0021 G	±1.5% +1C	P / F	1.0022
20 GΩ	9.980 G	±1.5% + 1C	P / F	9.973
200 GΩ	98.82 G	±1.5% + 1C	P / F	98.28

OUTPUT VOLTAGE SOURCE ACCURACY

OUTPUT SETTING	MIN	READING	MAX
00.00V	-0.050	-0.017	+0.050
+01.00 V	+0.948	1.017	+1.052
-01.00 V	-0.948	.980	-1.052
+10.00 V	+9.930	10.022	+10.07
-10.00 V	-9.930	9.984	-10.07
+25.00 V	+24.90	25.027	+25.10
-25.00 V	-24.90	24.990	-25.10
+50.00 V	+49.85	50.036	+50.15
-50.00 V	-49.85	49.997	-50.15
+100.00 V	+99.75	100.046	+100.25
-100.00 V	-99.75	100.008	-100.25

OUT

ROTHE DEVELOPMENT METROLOGY SERVICES

CALIBRATION DATA: KEITHLEY 617 ELECTROMETER

CUSTOMER: SwRI
WO NUMBER: 50279
SERIAL: 0579628

DATE: 5 Oct 95
TECH: PJS
INST NO: 19349

CALIBRATION DATA TAKEN

INCOMING ✓
OUTGOING

CONDITION OF EQUIPMENT

IN TOLERANCE ✓
OUT OF TOLERANCE

INPUT CURRENT VERIFICATION

SET-UP: 2PA RANGE, INPUT CAPPED, TOLERANCE <66 C — READING .0025

CURRENT ACCURACY

RANGE	INPUT	MIN	READING	MAX
20 mA	ZERO CHECK	-0.001	0.000	+0.001
	19 mA	18.970	19.000	19.030
2 mA	1.9 mA	1.8967	1.8999	1.9033
200 uA	190 uA	189.70	189.95	190.30
20 uA	19 uA	18.970	19.000	19.030

RANGE	NOMINAL	ACTUAL	TOLERANCE		READING
2 uA	1.9 uA	1.900 uA	±.15% +4C	P / ~~F~~	1.8997
200 nA	190 nA	190.0 nA	±.25% +1C	P / ~~F~~	190.02
20 nA	19 nA	19.00 nA	±.25% +1C	P / ~~F~~	19.005
2 nA	1.9 nA	1.900 nA	±.25% +5C	P / ~~F~~	1.9009
200 pA	190 pA	190.0 pA	±1.6% +1C	P / ~~F~~	190.06
20 pA	19 pA	19.00 pA	±1.6% +7C	P / ~~F~~	18.987
2 pA	1.9 pA	1.900 pA	±1.6% +66C	P / ~~F~~	1.8892

COULOMB ACCURACY

RANGE	INPUT	MIN	READING	MAX
2nC	1V / 1000pF	0.995	.999	1.005

DC VOLTAGE ACCURACY

RANGE	INPUT	MIN	READING	MAX
200 mV	+190 mV	189.87	190.02	190.13
	-190 mV	189.87	190.02	190.13
2 V	+1.9 V	1.8990	1.9002	1.9010
	-1.9 V	1.8990	1.9002	1.9010
20 V	+19 V	18.990	18.997	19.010
	-19 V	18.990	18.996	19.010
200 V	+190 V	189.86	189.96	190.14
	-190 V	189.86	189.97	190.14

RESISTANCE ACCURACY

RANGE	ACUTAL INPUT	TOLERANCE		READING
2 KΩ (19)	1.9000 K	±0.2% +4C	P / ~~F~~	1.9000
20 KΩ	18.999 K	±0.15% +1C	P / ~~F~~	19.000
200 KΩ	190.00K	±0.25% +1C	P / ~~F~~	190.00
2 MΩ	1.9000 M	±0.25% +1C	P / ~~F~~	1.8996
20 MΩ	18.997 M	±0.25% +1C	P / ~~F~~	18.995
200 MΩ (1)	99.99 M	±0.3% +1C	P / ~~F~~	99.85
2 GΩ	1.0021 G	±1.5% +1C	P / ~~F~~	1.0022
20 GΩ	9.980 G	±1.5% + 1C	P / ~~F~~	9.970
200 GΩ	98.82 G	±1.5% + 1C	P / ~~F~~	98.27

OUTPUT VOLTAGE SOURCE ACCURACY

OUTPUT SETTING	MIN	READING	MAX
00.00V	-0.050	+ .019	+0.050
+01.00 V	+0.948	1.019	+1.052
-01.00 V	-0.948	.981	-1.052
+10.00 V	+9.930	10.023	+10.07
-10.00 V	-9.930	9.984	-10.07
+25.00 V	+24.90	25.029	+25.10
-25.00 V	-24.90	24.990	-25.10
+50.00 V	+49.85	50.036	+50.15
-50.00 V	-49.85	49.997	-50.15
+100.00 V	+99.75	100.046	+100.25
-100.00 V	-99.75	100.009	-100.25

IN

Rothe Development, Inc.

4614 SINCLAIR RD. SAN ANTONIO, TEXAS 78222-2099

210-648-3131 FAX: 210-648-4091

METROLOGY SERVICES DIVISION
PRECISION MEASUREMENT EQUIPMENT LABORATORY
TRACEABLE TO NIST

CHARGE # 107 CONTROL # 103 - 19349

WORK ORDER # 50279

CUSTOMER

RECEIVED FROM Southwest Research Institute (30) DATE 10/02/95

ADDRESS 6220 Culebra, Bldg. 64/Division 30 San Antonio, TX 78284 PHONE# 684-5111 * 2702

CONTACT (NAME) Mr. Jim Patterson FAX# 522-3692

PURCHASE ORDER # 03602/ST271409/20-5704-042

CUSTOMER COMMENTS N/T BEFORE & AFTER DATA OUT OF SPEC ITEM RUSH

ITEM

MFG Keithley

MODEL 617

SERIAL # 0579628

TYPE Electrometer

ACCES. RCVD. Leads

- [ ] REPAIR
- [ ] OPERATIONAL CHECK
- [x] CALIBRATION

CALIBRATION DATE 5 Oct 95

DATE DUE 5 Oct 96

CALIBRATION INTERVAL 12 mo.

- [x] RECEIVED IN SPECS.
- [ ] RECEIVED INOPERATIVE
- [ ] RECEIVED OUT OF SPECS.

CKT REF #	QTY.	MFG PART #	DESCRIPTION	COST

ROTHE TECH.	OUR P.O. #
PJS	
REPAIR LABOR HRS.	SERVICE CODE
	K

PARTS TOTAL		
REPAIR LABOR		
SHIPPING		
TEAR DOWN CHARGE		
CALIBRATION	97.50	
TAX		
TOTAL	97	50

THIS IS NOT AN INVOICE

TR #'s 20, 75, 235

COMMENTS

WORK PERFORMED: Cal Data Taken - minor adjustments made.

CAL

JIM PATTERSON

TEMP. 73 °F

R.H. 36 %

SPECS: (MFG) RDI

PROCEDURE: (MFG) RDI OTHER

RDI 2002

SHIP VIA: _____ DATE: _____ RECEIVED BY: _____

Southwest Research Institute
6220 Culebra Road
San Antonio, TX 78238
Department of Quality Assurance
Calibration Laboratory

Certificate of Calibration

7 October 1996

Issued to: DARRELL DUNN DIV20 B57
Manufacturer/Model: KEITHLEY 617
Description: PROGRAMMABLE ELECTROMETER
Serial Number: 0579628
Asset Number: 003400

Environmental Conditions

Temperature: 73.0 Deg. F **Humidity:** 34%

Calibration Information

Calibration was in accordance with requirements of MIL-STD-45662A and ANSI/NCSL Z540-1-1994. Measurements are traceable to the National Institute of Standards and Technology (NIST). This report may not be reproduced except in full without written approval of the originator. Inspection and test data are on file and available for inspection.

Calibration Date: 4 Oct 96 **Calibration Procedure:** MFG

Interval: 12 months **Accuracy:** MFG SPEC

Next Calibration Due: 4 Oct 97 **Received:** In Tolerance

Remarks: CAL AT ROTHE DEVELOPMENT, SAN ANTONIO, TX
CERT. #45243

Certificate # 22861

Signed:

LAST PAGE OF REPORT
Total Pages Printed: 1

Southwest Research Institute
6220 Culebra Road
San Antonio, TX 78238
Department of Quality Assurance
Calibration Laboratory

Certificate of Calibration

24 October 1997

Issued to: DARRELL DUNN DIV20 B57
Manufacturer/Model: KEITHLEY 617
Description: PROGRAMMABLE ELECTROMETER
Serial Number: 0579628
Asset Number: 003400

Environmental Conditions

Temperature: 72.00 Deg. F **Humidity:** 34 % RH

Calibration Information

Calibration was in accordance with requirements of MIL-STD-45662A and ANSI/NCSL Z540-1-1994. Measurements are traceable to the National Institute of Standards and Technology (NIST). This report may not be reproduced except in full without written approval of the originator. Inspection and test data are on file and available for inspection.

The uncertainty of the calibration was sufficient to determine that the instrument met the manufacturer's specifications.

Calibration Date: 23 Oct 97 **Calibration Procedure:** MFG

Interval: 12 months **Uncertainty:** MFG SPECS

Next Calibration Due: 23 Oct 98 **Received:** In Tolerance

Remarks: CALIBRATED BY ROTHE DEV., SAN ANTONIO, TX.
ROTHE CERT. #50046.

Standards Used

Asset	MFR	Model	Description	Serial No.	Due Cal
VENDOR					

Signed: _____

Title: _____

LAST PAGE OF REPORT
Total Pages Printed: 1

Certificate # 27162

Southwest Research Institute
6220 Culebra Road
San Antonio, TX 78238
Department of Quality Assurance
Calibration Laboratory

ACCREDITED
Certificate #
0972-01

Certificate of Calibration

28 October 1998

Issued to: DARRELL DUNN DIV20 B57
Manufacturer/Model: KEITHLEY 617
Description: PROGRAMMABLE ELECTROMETER
Serial Number: 0579628
Asset Number: 003400

Calibration Information

Calibration was in accordance with requirements of MIL-STD-45662A and ANSI/NCSL Z540-1-1994. Measurements are traceable to the National Institute of Standards and Technology (NIST). This report may not be reproduced except in full without written approval of the originator. Inspection and test data are on file and available for inspection.

This laboratory is accredited by the American Association for Laboratory Accreditation (A2LA) and the results shown in this calibration certificate have been determined in accordance with the laboratory's terms of accreditation unless stated otherwise in the report.

The uncertainty of the calibration was sufficient to determine that the instrument met the manufacturer's specifications.

Temperature: 74.0 Deg. F **Humidity:** 35 % RH

Calibration Date: 27 Oct 98 **Calibration Procedure:** MFG

Interval: 12 months **Tolerance:** MFG SPECS

Next Calibration Due: 27 Oct 99 **Received:** IN TOLERANCE

Remarks: CALIBRATED BY ROTHE DEV., SAN ANTONIO, TX.
ROTHE CERT. #55030.

Standards Used

Asset	MFR	Model	Description	Serial No.	Due Cal
VENDOR		VENDOR STANDARD	NONE	NONE	

Signed: Mark Anthony Romero
Title: Clerk II

LAST PAGE OF REPORT
Total Pages Printed: 1

Certificate # 31712

SOUTHWEST RESEARCH INSTITUTE
CALIBRATION LABORATORY
MEMORANDUM

December 27, 1999

To: DARRELL DUNN DIV20 B57

From: Jim Patterson

Subject: Calibration by an approved supplier

Manufacturer/Model: KEITHLEY 617
Description: ELECTROMETER
Serial Number: 0579628
Asset Number: 003400
Calibration Due: December 26, 2000
Remarks: ROTHE CERTIFICATE NO.:19349:946195159.

Supplier: ROTHE DEVELOPMENT, INC., SAN ANTONIO, TX

The above item was sent to an approved supplier who is listed on the SwRI Approved Suppliers List (ASL). This supplier is qualified to supply a product or service in support of project activities that require the use of approved suppliers. Please notify Mark Romero, extension 5215, of any discrepancies with the item or calibration documentation.

Attachment(s) 1

m:\asl1.rpt Rev 17 Nov 99

CERT.
19349:1015766533

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: 617
NOMEN: PROG ELECTROMETER
S/N: 0579628
CUST. ID:

CAL DATE: 3/10/2002
DUE DATE: 3/10/2003

CONTROL NO.: 103 - 19349
TECHNICIAN: 4
SPECIFICATIONS: MFG
PROCEDURE: MFG
WORK ORDER: 002018442
CUSTOMER P.O.: 01571R/ST391171/00750.00
RECEIVED CONDITION: IN TOLERANCE
RETURNED CONDITION: IN TOLERANCE

CALIBRATION PERFORMED AT: RDMSD
CALIBRATION INTERVAL: 12Mo.
TEMPERATURE: 73.0 °F
RELATIVE HUMIDITY: 25 %

DATE RECEIVED: 3/10/2002

COMMENTS:

ATTACHMENTS: CALIBRATION DATA 2 SHEETS

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	4605002	3/27/2002
258	FLUKE	5725A	6585002	3/27/2002
75	JRL	NMN	75	1/9/2003
231	HP	34401A	3146A45255	7/3/2002
235	GUILDLINE	6500A	59660	11/14/2002
186	GEN RAD	1689	7241583008	9/11/2002

ISO 9002

UL REGISTERED FIRM

REGISTERED TO ISO 9002
CERTIFICATE NO. A9428

APPROVED BY: Peter J Stemmen ☑ CMS ☐ QCO **DATE:** 3/10/2002

RDMSD 1001
03/01

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ROTHE DEVELOPMENT METROLOGY SERVICES

CALIBRATION DATA: KEITHLEY 617 ELECTROMETER

CUSTOMER: SwRI
WO NUMBER: 002018442
SERIAL: 0579628
CUST ID:

DATE: 10 Mar 02
TECH: PJS
INST NO: 19349

CALIBRATION DATA TAKEN

INCOMING ✓
OUTGOING ✓

CONDITION OF EQUIPMENT

IN TOLERANCE ✓
OUT OF TOLERANCE

INPUT CURRENT VERIFICATION

SET-UP: 2PA RANGE, INPUT CAPPED, TOLERANCE <66 C — READING .0014

CURRENT ACCURACY

RANGE	INPUT	MIN	READING	MAX
20 mA	ZERO CHECK	-0.001	0.000	+0.001
	19 mA	18.970	19.004	19.030
2 mA	1.9 mA	1.8967	1.9007	1.9033
200 uA	190 uA	189.70	189.97	190.30
20 uA	19 uA	18.970	19.005	19.030
2 uA	1.9 uA	1.8967	1.9005	1.9033
200 nA	190 nA	189.51	189.92	190.49
20 nA	19 nA	18.951	19.003	19.049
2 nA	1.9 nA	1.8947	1.9012	1.9053
200 pA	190 pA	186.95	189.99	193.05
20 pA	19 pA	18.689	19.031	19.311
2 pA	1.9 pA	1.8630	1.9099	1.9370

COULOMB ACCURACY

RANGE	INPUT	MIN	READING	MAX
2nC	1V / 1000pF	0.9949	.9999	1.0051

DOC. DATE: 2/22/2001

DC VOLTAGE ACCURACY

RANGE	INPUT	MIN	READING	MAX
200 mV	+190 mV	189.87	190.07	190.13
	-190 mV	189.87	190.07	190.13
2 V	+1.9 V	1.8990	1.9003	1.9010
	-1.9 V	1.8990	1.9004	1.9010
20 V	+19 V	18.990	18.996	19.010
	-19 V	18.990	18.996	19.010
200 V	+190 V	189.86	189.95	190.14
	-190 V	189.86	189.96	190.14

RESISTANCE ACCURACY

RANGE	ACUTAL INPUT	TOLERANCE		READING
2 KΩ (19)	1.8999 k	±0.2% +4C	P / [illegible]	1.9004
20 KΩ	18.999 k	±0.15% +1C	P / [illegible]	19.000
200 KΩ	190.00 k	±0.25% +1C	P / [illegible]	190.01
2 MΩ	1.9000 m	±0.25% +1C	P / [illegible]	1.8996
20 MΩ	18.997 m	±0.25% +1C	P / [illegible]	19.000
200 MΩ (1)	100.00 m	±0.3% +1C	P / [illegible]	100.05
2 GΩ	1.0019 G	±1.5% +1C	P / [illegible]	1.0031
20 GΩ	9.978 G	±1.5% + 1C	P / [illegible]	9.972
200 GΩ	98.72 G	±1.5% + 1C	P / [illegible]	98.41

OUTPUT VOLTAGE SOURCE ACCURACY

OUTPUT SETTING	MIN	READING	MAX
00.00V	-0.050	.017	+0.050
+01.00 V	0.948	1.018	1.052
-01.00 V	0.948	.983	1.052
+10.00 V	9.930	10.031	10.07
-10.00 V	9.930	9.994	10.07
+25.00 V	24.90	25.05	25.10
-25.00 V	24.90	25.01	25.10
+50.00 V	49.85	50.08	50.15
-50.00 V	49.85	50.04	50.15
+100.00 V	99.75	100.13	100.25
-100.00 V	99.75	100.09	100.25

INST NO: 19349

DOC. DATE: 2/22/2001

✓ INCOMING
✓ OUTGOING

SOUTHWEST RESEARCH INSTITUTE
CALIBRATION LABORATORY
MEMORANDUM

October 2, 2002

To: DARRELL DUNN DIV20 B57

From: Walt Hill, Metrology Group Leader
Institute Calibration Laboratory

Subject: Status of Calibration Supplier

Manufacturer/Model: KEITHLEY 617
Description: ELECTROMETER
Serial Number: 0579628
Asset Number: 003400
Work Order Number: 444049808
Date Calibrated: September 22, 2002
Supplier: ROTHE DEVELOPMENT, INC., SAN ANTONIO, TX
Remarks: Rothe Cert # 19349:1032675917

(✓) 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:
19349:1032675917

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: 617
NOMEN: PROG ELECTROMETER
S/N: 0579628
CUST. ID: 3400

CAL DATE: 9/22/2002
DUE DATE: 9/22/2003

CONTROL NO.: 103 - 19349
TECHNICIAN: 4
SPECIFICATIONS: MFG
PROCEDURE: MFG
WORK ORDER: 002021908
CUSTOMER P.O.: 01571R/ST404733/1.20 00
RECEIVED CONDITION: IN TOLERANCE
RETURNED CONDITION: IN TOLERANCE

CALIBRATION PERFORMED AT: RDMSD
CALIBRATION INTERVAL: 12Mo.
TEMPERATURE: 72.0 °F
RELATIVE HUMIDITY: 40 %

DATE RECEIVED: 8/15/2002

COMMENTS:

ATTACHMENTS: CALIBRATION DATA 2 SHEETS

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	4605002	9/27/2002
258	FLUKE	5725A	6585002	9/27/2002
235	GUILDLINE	6500A	59660	11/14/2002
231	HP	34401A	3146A45255	1/4/2003

ISO 9002
UL REGISTERED FIRM
REGISTERED TO ISO 9002
CERTIFICATE NO. A9428

APPROVED BY: Peter J Stemmer ☒ CMS ☐ QCO **DATE** 9/23/2002

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ROTHE DEVELOPMENT METROLOGY SERVICES

CALIBRATION DATA: KEITHLEY 617 ELECTROMETER

CUSTOMER: SwRI
WO NUMBER: 002021908
SERIAL: 0579628
CUST ID: 3400

DATE: 22 Sep 02
TECH: PJS
INST NO: 19349

CALIBRATION DATA TAKEN

INCOMING ✓
OUTGOING ✓

CONDITION OF EQUIPMENT

IN TOLERANCE ✓
OUT OF TOLERANCE

INPUT CURRENT VERIFICATION

SET-UP: 2PA RANGE, INPUT CAPPED, TOLERANCE <66 C READING -.0006

CURRENT ACCURACY

RANGE	INPUT	MIN	READING	MAX
20 mA	ZERO CHECK	-0.001	0.000	+0.001
	19 mA	18.970	19.004	19.030
2 mA	1.9 mA	1.8967	1.9004	1.9033
200 uA	190 uA	189.70	189.96	190.30
20 uA	19 uA	18.970	19.005	19.030
2 uA	1.9 uA	1.8967	1.9006	1.9033
200 nA	190 nA	189.51	189.90	190.49
20 nA	19 nA	18.951	18.997	19.049
2 nA	1.9 nA	1.8947	1.9000	1.9053
200 pA	190 pA	186.95	189.96	193.05
20 pA	19 pA	18.689	19.001	19.311
2 pA	1.9 pA	1.8630	1.9011	1.9370

COULOMB ACCURACY

RANGE	INPUT	MIN	READING	MAX
2nC	1V / 1000pF	0.9949	.9994	1.0051

DOC. DATE: 2/22/2001

DC VOLTAGE ACCURACY

RANGE	INPUT	MIN	READING	MAX
200 mV	+190 mV	189.87	190.08	190.13
	-190 mV	189.87	190.08	190.13
2 V	+1.9 V	1.8990	1.9004	1.9010
	-1.9 V	1.8990	1.9004	1.9010
20 V	+19 V	18.990	18.995	19.010
	-19 V	18.990	18.995	19.010
200 V	+190 V	189.86	189.94	190.14
	-190 V	189.86	189.95	190.14

RESISTANCE ACCURACY

RANGE	ACUTAL INPUT	TOLERANCE		READING
2 KΩ (19)	1.8999 k	±0.2% +4C	P / F	1.9003
20 KΩ	18.999 k	±0.15% +1C	P / F	19.001
200 KΩ	190.00 k	±0.25% +1C	P / F	190.02
2 MΩ	1.9000 M	±0.25% +1C	P / F	1.8998
20 MΩ	18.997 M	±0.25% +1C	P / F	19.002
200 MΩ (1)	100.00 M	±0.3% +1C	P / F	100.04
2 GΩ	1.0019 G	±1.5% +1C	P / F	1.0026
20 GΩ	9.9760 G	±1.5% + 1C	P / F	9.975
200 GΩ	98.880 G	±1.5% + 1C	P / F	98.45

OUTPUT VOLTAGE SOURCE ACCURACY

OUTPUT SETTING	MIN	READING	MAX
00.00V	-0.050	0.017	+0.050
+01.00 V	0.948	1.018	1.052
-01.00 V	0.948	.984	1.052
+10.00 V	9.930	10.030	10.07
-10.00 V	9.930	9.995	10.07
+25.00 V	24.90	25.047	25.10
-25.00 V	24.90	25.013	25.10
+50.00 V	49.85	50.075	50.15
-50.00 V	49.85	50.041	50.15
+100.00 V	99.75	100.13	100.25
-100.00 V	99.75	100.09	100.25

INST NO: 19349

✓ INCOMING
✓ OUTGOING

DOC. DATE: 2/22/2001

SOUTHWEST RESEARCH INSTITUTE
CALIBRATION LABORATORY
MEMORANDUM

September 19, 2003

To: DARRELL DUNN DIV20 B57

From: Walt Hill, Metrology Group Leader
Institute Calibration Laboratory

Subject: Status of Calibration Supplier

Manufacturer/Model: KEITHLEY 617
Description: ELECTROMETER
Serial Number: 0579628
Asset Number: 003400
Work Order Number: 444055339
Date Calibrated: September 17, 2003
Supplier: ROTHE DEVELOPMENT, SAN ANTONIO TX - AUDIT - 648-3131
Remarks: Rothe Cert # 19349:1063795436

(✓) 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:
19349:1063795436

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: 617
NOMEN: PROG ELECTROMETER
S/N: 0579628
CUST. ID: 3400

CAL DATE: 9/17/2003
DUE DATE:

CONTROL NO.: 103 - 19349
TECHNICIAN: 4
SPECIFICATIONS: MFG
PROCEDURE: MFG
WORK ORDER: 002032067
CUSTOMER P.O.: 01571R/ST417997/1.20.007
RECEIVED CONDITION: IN TOLERANCE
RETURNED CONDITION: IN TOLERANCE

CALIBRATION PERFORMED AT: RDMSD
CALIBRATION INTERVAL: 0
TEMPERATURE: 72.0 °F
RELATIVE HUMIDITY: 36 %

DATE RECEIVED: 9/15/2003

COMMENTS:

ATTACHMENTS: CALIBRATION DATA 2 SHEETS

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	4605002	9/20/2003
258	FLUKE	5725A	6585002	9/20/2003
75	JRL	NMN	76	1/8/2004
235	GUILDLINE	6500A	59660	12/19/2003

ISO 9002

REGISTERED TO ISO 9002
CERTIFICATE NO. A9428

APPROVED BY: Peter J Stamm ☑ CMS ☐ QCO **DATE** 9/18/2003

RDMSD 1001
03/01

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ROTHE DEVELOPMENT METROLOGY SERVICES

CALIBRATION DATA: KEITHLEY 617 ELECTROMETER

CUSTOMER: SwRI
WO NUMBER: 002032067
SERIAL: 0579628
CUST ID: 3400

DATE: 17 Sep 03
TECH: [illegible]
INST NO: 19349

CALIBRATION DATA TAKEN

INCOMING ✓
OUTGOING ✓

CONDITION OF EQUIPMENT

IN TOLERANCE ✓
OUT OF TOLERANCE

INPUT CURRENT VERIFICATION

SET-UP: 2PA RANGE, INPUT CAPPED, TOLERANCE <66 C — READING .0009

CURRENT ACCURACY

RANGE	INPUT	MIN	READING	MAX
20 mA	ZERO CHECK	-0.001	0.000	+0.001
	19 mA	18.970	19.004	19.030
2 mA	1.9 mA	1.8967	1.9008	1.9033
200 uA	190 uA	189.70	189.94	190.30
20 uA	19 uA	18.970	19.005	19.030
2 uA	1.9 uA	1.8967	1.9008	1.9033
200 nA	190 nA	189.51	189.89	190.49
20 nA	19 nA	18.951	19.001	19.049
2 nA	1.9 nA	1.8947	1.9006	1.9053
200 pA	190 pA	186.95	189.90	193.05
20 pA	19 pA	18.689	19.008	19.311
2 pA	1.9 pA	1.8630	1.9009	1.9370

COULOMB ACCURACY

RANGE	INPUT	MIN	READING	MAX
2nC	1V / 1000pF	0.9949	.9997	1.0051

DOC. DATE: 2/22/2001

DC VOLTAGE ACCURACY

RANGE	INPUT	MIN	READING	MAX
200 mV	+190 mV	189.87	190.09	190.13
	-190 mV	189.87	190.09	190.13
2 V	+1.9 V	1.8990	1.9005	1.9010
	-1.9 V	1.8990	1.9005	1.9010
20 V	+19 V	18.990	18.993	19.010
	-19 V	18.990	18.994	19.010
200 V	+190 V	189.86	189.93	190.14
	-190 V	189.86	189.94	190.14

RESISTANCE ACCURACY

RANGE	ACUTAL INPUT	TOLERANCE		READING
2 KΩ (19)	1.8999 k	±0.2% +4C	P / F	1.9006
20 KΩ	18.999 k	±0.15% +1C	P / F	19.001
200 KΩ	190.00 k	±0.25% +1C	P / F	190.02
2 MΩ	1.9000 M	±0.25% +1C	P / F	1.8995
20 MΩ	18.997 M	±0.25% +1C	P / F	19.001
200 MΩ (1)	100.00 M	±0.3% +1C	P / F	100.05
2 GΩ	.9960 G	±1.5% +1C	P / F	.9969
20 GΩ	9.979 G	±1.5% + 1C	P / F	9.973
200 GΩ	98.87 G	±1.5% + 1C	P / F	98.45

OUTPUT VOLTAGE SOURCE ACCURACY

OUTPUT SETTING	MIN	READING	MAX
00.00V	-0.050	0.016	+0.050
+01.00 V	0.948	1.017	1.052
-01.00 V	0.948	.985	1.052
+10.00 V	9.930	10.03	10.07
-10.00 V	9.930	9.997	10.07
+25.00 V	24.90	25.05	25.10
-25.00 V	24.90	25.02	25.10
+50.00 V	49.85	50.08	50.15
-50.00 V	49.85	50.05	50.15
+100.00 V	99.75	100.14	100.25
-100.00 V	99.75	100.11	100.25

INST NO: 19349

DOC. DATE: 2/22/2001

✓ INCOMING
✓ OUTGOING

SOUTHWEST RESEARCH INSTITUTE
CALIBRATION LABORATORY
MEMORANDUM

September 17, 2004

To: DARRELL DUNN DIV20 B57

From: Walt Hill, Metrology Group Leader
Institute Calibration Laboratory

Subject: Status of Calibration Supplier

Manufacturer/Model: KEITHLEY 617
Description: ELECTROMETER
Serial Number: 0579628
Asset Number: 003400
Work Order Number: 444060613
Date Calibrated: September 13, 2004
Supplier: ROTHE DEVELOPMENT, SAN ANTONIO TX - AUDIT - 648-3131
Remarks: Rothe Cert. #19349:1095084977.

(✓) 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) 5

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CERT. NUMBER: 19349:1095084977

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: 617
NOMEN: PROG ELECTROMETER
S/N: 0579628
CUST. ID: 3400

CAL DATE: 9/13/04
DUE DATE:

CONTROL NO: 103 - 19349
TECHNICIAN: 4
SPECIFICATIONS: MFG
PROCEDURE: MFG
WORK ORDER: 002040057
CUSTOMER P.O.: 01571R/ST418458/1.20.00755.000
RECEIVED CONDITION: IN TOLERANCE
RETURNED CONDITION: IN TOLERANCE

CALIBRATION PERFORMED AT: RDMSD
CALIBRATION INTERVAL: 0
TEMPERATURE: 73.0°F
RELATIVE HUMIDITY: 36%

DATE RECEIVED: 9/3/04

COMMENTS:

ATTACHMENTS: CALIBRATION DATA 4 SHEETS

All calibrations performed at Rothe Development, Inc. Metrology Services Division meet the requirements of ANSI / NCSL Z540-1-1994, ANSI / ISO / IEC 17025, 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	4605002	10/9/2004
258	FLUKE	5725A	6585002	10/9/2004
30	HP	3458A	2823A01926	9/21/2004
75	JRL	NMN	75	3/1/2005
235	GUILDLINE	6500A	59660	1/22/2005

APPROVED BY: Peter J Stemmer ☑ CMS ☐ QCO **DATE:** 9/14/04

RDMSD 1001
11/03

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ROTHE DEVELOPMENT METROLOGY SERVICES

CALIBRATION DATA: KEITHLEY 617 ELECTROMETER

CUSTOMER: SwRI
WO NUMBER: 0020400057
SERIAL: 0579628
CUST ID: 3400

DATE: 13 Sep 04
TECH: [illegible]
INST NO: 19349

CALIBRATION DATA TAKEN

INCOMING ✓
OUTGOING

CONDITION OF EQUIPMENT

IN TOLERANCE ✓
OUT OF TOLERANCE

INPUT CURRENT VERIFICATION

SET-UP: 2PA RANGE, INPUT CAPPED, TOLERANCE <66 C — READING .0045 pA

CURRENT ACCURACY

RANGE	INPUT	MIN	READING	MAX
20 mA	ZERO CHECK	-0.001	0.000	+0.001 mA
	19 mA	18.970	18.988	19.030
2 mA	1.9 mA	1.8967	1.8994	1.9033
200 uA	190 uA	189.70	189.93	190.30 uA
20 uA	19 uA	18.970	19.007	19.030
2 uA	1.9 uA	1.8967	1.9013	1.9033
200 nA	190 nA	189.51	189.91	190.49 nA
20 nA	19 nA	18.951	19.001	19.049
2 nA	1.9 nA	1.8947	1.9008	1.9053
200 pA	190 pA	186.95	189.90	193.05 pA
20 pA	19 pA	18.689	18.996	19.311
2 pA	1.9 pA	1.8630	1.8951	1.9370

COULOMB ACCURACY

RANGE	INPUT	MIN	READING	MAX
2nC	1V / 1000pF	0.9949	.9985	1.0051 nC

DOC. DATE: 9/12/2004

DC VOLTAGE ACCURACY

RANGE	INPUT	MIN	READING	MAX
200 mV	+190 mV	189.87	190.12	190.13 mV
	-190 mV	189.87	190.12	190.13
2 V	+1.9 V	1.8990	1.9005	1.9010 V
	-1.9 V	1.8990	1.9006	1.9010
20 V	+19 V	18.990	18.991	19.010
	-19 V	18.990	18.991	19.010
200 V	+190 V	189.86	189.91	190.14
	-190 V	189.86	189.91	190.14

RESISTANCE ACCURACY

RANGE	ACUTAL INPUT	TOLERANCE		READING	
2 kΩ (19)	1.8999 k	±0.2% +4C	P / F	1.9008	kΩ
20 kΩ	18.999 k	±0.15% +1C	P / F	19.001	
200 kΩ	190.00 k	±0.25% +1C	P / F	190.03	
2 MΩ	1.9000 M	±0.25% +1C	P / F	1.8996	MΩ
20 MΩ	18.997 M	±0.25% +1C	P / F	19.003	
200 MΩ (1)	100.00 M	±0.3% +1C	P / F	100.06	
2 GΩ	.99606	±1.5% +1C	P / F	.9971	GΩ
20 GΩ	9.9796	±1.5% + 1C	P / F	9.971	
200 GΩ	98.886	±1.5% + 1C	P / F	98.44	

OUTPUT VOLTAGE SOURCE ACCURACY

OUTPUT SETTING	MIN	READING	MAX
00.00V	-0.050	0.015	+0.050 V
+01.00 V	0.948	1.016	1.052
-01.00 V	0.948	0.986	1.052
+10.00 V	9.930	10.030	10.07
-10.00 V	9.930	9.990	10.07
+25.00 V	24.90	25.05	25.10
-25.00 V	24.90	25.02	25.10
+50.00 V	49.85	50.09	50.15
-50.00 V	49.85	50.05	50.15
+100.00 V	99.75	100.15	100.25
-100.00 V	99.75	100.12	100.25

INST NO: 19349

DOC. DATE: 9/12/2004

✓ INCOMING
___ OUTGOING

ROTHE DEVELOPMENT METROLOGY SERVICES

CALIBRATION DATA: KEITHLEY 617 ELECTROMETER

CUSTOMER: SwRI
WO NUMBER: 0020400057
SERIAL: 0579628
CUST ID: 3400

DATE: 13 Sep 04
TECH: [illegible]
INST NO: 19349

CALIBRATION DATA TAKEN

INCOMING _____
OUTGOING ✓

CONDITION OF EQUIPMENT

IN TOLERANCE ✓
OUT OF TOLERANCE _____

INPUT CURRENT VERIFICATION

SET-UP: 2PA RANGE, INPUT CAPPED, TOLERANCE <66 C — READING .0012 pA

CURRENT ACCURACY

RANGE	INPUT	MIN	READING	MAX
20 mA	ZERO CHECK	-0.001	0.000	+0.001 mA
	19 mA	18.970	19.000	19.030
2 mA	1.9 mA	1.8967	1.9000	1.9033
200 uA	190 uA	189.70	190.00	190.30 uA
20 uA	19 uA	18.970	19.000	19.030
2 uA	1.9 uA	1.8967	1.8998	1.9033
200 nA	190 nA	189.51	189.99	190.49 nA
20 nA	19 nA	18.951	19.002	19.049
2 nA	1.9 nA	1.8947	1.9001	1.9053
200 pA	190 pA	186.95	190.09	193.05 pA
20 pA	19 pA	18.689	19.009	19.311
2 pA	1.9 pA	1.8630	1.9004	1.9370

COULOMB ACCURACY

RANGE	INPUT	MIN	READING	MAX
2nC	1V / 1000pF	0.9949	.9981	1.0051 nC

DOC. DATE: 9/12/2004

DC VOLTAGE ACCURACY

RANGE	INPUT	MIN	READING	MAX
200 mV	+190 mV	189.87	190.00	190.13 mV
	-190 mV	189.87	189.99	190.13
2 V	+1.9 V	1.8990	1.9000	1.9010 V
	-1.9 V	1.8990	1.9000	1.9010
20 V	+19 V	18.990	19.000	19.010
	-19 V	18.990	19.000	19.010
200 V	+190 V	189.86	190.00	190.14
	-190 V	189.86	190.01	190.14

RESISTANCE ACCURACY

RANGE	ACUTAL INPUT	TOLERANCE		READING	
2 kΩ (19)	1.8999 k	±0.2% +4C	P / F	1.9000	kΩ
20 kΩ	18.999 K	±0.15% +1C	P / F	18.999	
200 kΩ	190.00K	±0.25% +1C	P / F	189.99	
2 MΩ	1.9000M	±0.25% +1C	P / F	1.9000	MΩ
20 MΩ	18.997M	±0.25% +1C	P / F	18.995	
200 MΩ (1)	100.00M	±0.3% +1C	P / F	100.01	
2 GΩ	.9960G	±1.5% +1C	P / F	.9974	GΩ
20 GΩ	9.979G	±1.5% + 1C	P / F	9.982	
200 GΩ	98.88G	±1.5% + 1C	P / F	98.52	

OUTPUT VOLTAGE SOURCE ACCURACY

OUTPUT SETTING	MIN	READING	MAX
00.00V	-0.050	0.015	+0.050 V
+01.00 V	0.948	1.015	1.052
-01.00 V	0.948	0.985	1.052
+10.00 V	9.930	10.018	10.07
-10.00 V	9.930	9.988	10.07
+25.00 V	24.90	25.02	25.10
-25.00 V	24.90	24.99	25.10
+50.00 V	49.85	50.03	50.15
-50.00 V	49.85	50.00	50.15
+100.00 V	99.75	100.03	100.25
-100.00 V	99.75	100.00	100.25

INST NO: 19349

DOC. DATE: 9/12/2004

✓ INCOMING
OUTGOING