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

Accredited

Certificate #
0972-01

Certificate of Calibration

3 November 1999

Issued to:	DARRELL DUNN DIV20 B57
Manufacturer/Model:	FLUKE 87 III
Description:	TRUE RMS MULTIMETER
Serial Number:	73980493
Asset Number:	007647

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.

This laboratory is accredited by the American Association for Laboratory Accreditation (A2LA) and the results of this calibration certificate were determined in accordance with the terms of accreditation unless stated otherwise below.

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: 49 %RH

Calibration Date: 3 Nov 99 **Calibration Procedure** FLUKE 87III 1YR 5720A OCT 99

Condition as Received: IN TOLERANCE

Condition as Released: IN TOLERANCE

Remarks:

Approved by:

Jim Patterson, Supervisor or Walt Hill, Metrologist

Measurements performed by:

Vince Morales, Technician

Certificate # 36610

m:\a2la.rpt Rev date 10 Mar 99

CERT.
45189:1008932351

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: FLUKE
MODEL: 87-3
NOMEN: DMM
S/N: 73980493
CUST. ID:

CAL DATE: 12/21/2001
DUE DATE: 12/21/2002

CONTROL NO.: 103-45189
TECHNICIAN: 4
SPECIFICATIONS: MFG
PROCEDURE: MFG
WORK ORDER: 002016555
CUSTOMER P.O.: 01571R/ST391033/1.20.007
RECEIVED CONDITION: IN TOLERANCE
RETURNED CONDITION: IN TOLERANCE

CALIBRATION PERFORMED AT: RDMSD
CALIBRATION INTERVAL: 12Mo.
TEMPERATURE: 72.0 °F
RELATIVE HUMIDITY: 32 %

DATE RECEIVED: 12/20/2001

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, 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	12/24/2001
258	FLUKE	5725A	6585002	12/24/2001
81	ARCO	SS-32	1534	7/18/2002
174	HP	3325A	2512A19899	5/7/2002

REGISTERED TO ISO 9002
CERTIFICATE NO. A9428

APPROVED BY: Peter J Stemmer ☑ CMS ☐ QCO **DATE:** 12/24/2001

ROTHE DEVELOPMENT METROLOGY SERVICES

CALIBRATION DATA: FLUKE 87 SERIES III MULTIMETER

CUSTOMER: SwRI
WO NUMBER: 0020165555
SERIAL: 73980493
CUST ID:

DATE: 21 Dec 01
TECH: PJS
INST NO: 45189

CALIBRATION DATA TAKEN

INCOMING ✓
OUTGOING ✓

CONDITION OF EQUIPMENT

IN TOLERANCE ✓
OUT OF TOLERANCE

ROTARY SWITCH TEST

ACV POSITION-DISPLAY READS	0	±12 C	PASS / ~~FAIL~~
DCV POSITION-DISPLAY READS	-32	±12 C	PASS / ~~FAIL~~
mV DC POSITION-DISPLAY READS	-64	±12 C	PASS / ~~FAIL~~
OHMS POSITION-DISPLAY READS	-96	±12 C	PASS / ~~FAIL~~
DIODE POSITION-DISPLAY READS	-128	±12 C	PASS / ~~FAIL~~
mA/A POSITION-DISPLAY READS	-160	±12 C	PASS / ~~FAIL~~
uA POSITION-DISPLAY READS	-192	±12 C	PASS / ~~FAIL~~

AC VOLTAGE ACCURACY

INPUT	MIN	READING	MAX
350 mV 60 Hz	347.2	348.8	352.9
350 mV 1 kHZ	346.1	349.3	353.9
350 mV 5 kHz	342.6	350.5	357.4
350 mV 20 kHz	341.0	357.6	359.0
3.5 V 60 Hz	3.473	3.490	3.527
3.5 V 1 kHZ	3.461	3.490	3.539
3.5 V 5 kHz	3.426	3.500	3.574
3.5 V 20 kHz	3.410	3.516	3.590
35 V 60 Hz	34.73	34.89	35.27
35 V 1 kHz	34.61	34.94	35.39
35 V 5 kHz	34.26	34.95	35.74
35 V 20 kHz	34.10	34.91	35.90
350 V 60 Hz	347.3	349.0	352.7
350 V 1 kHZ	346.1	349.4	353.9
350 V 2.5 kHz	342.6	349.2	357.4

DOC. DATE: 11/7/2000

900 V 60 Hz	892	902	908
900 V 1 kHz	887	903	913

FREQUENCY TEST

INPUT	MIN	READING	MAX
150 mV RMS 19 kHz	18.998	18.999	19.002
150 mV RMS 190 kHz	189.98	189.99	190.02

FREQUENCY SENSITIVITY AND TRIGGER LEVEL TEST

RANGE	INPUT SIGNAL	MIN	READING	MAX
4 V AC	300 mV 1 kHz	999.8	999.9	1000.2
4 V DC	1.7 V 1 kHz	999.8	999.9	1000.2
4 V DC	1.0 V 1 kHz		0	0000
40 V DC	6.0 V 1 kHz	999.8	999.9	1000.2
40 V DC	2.0 V 1 kHz		0	0000

DC VOLTAGE ACCURACY

INPUT	MIN	READING	MAX
+3.5 V	3.497	3.501	3.503
+35.0 V	34.97	35.00	35.03
-35.0 V	-34.97	35.00	-35.03
+350 V	349.7	350.1	350.3
+1000 V	998	1001	1002

1-mS MIN MAX TEST
SIGNAL APLLIED - 2.0 V 60 Hz

LEVEL	MIN	READING	MAX
MAX	2.705	2.804	2.951
MIN	-2.705	2.816	-2.951

mV DC VOLTAGE ACCURACY

INPUT	MIN	READING	MAX
350 mV	349.5	350.1	350.5

INST NO: 45189

DOC. DATE: 11/7/2000

✓ INCOMING
✓ OUTGOING

OHMS ACCURACY

INPUT	MIN	READING	MAX
190.0 Ω	189.4	189.9	190.6
1.9 KΩ	1.895	1.900	1.905
19 KΩ	18.95	19.00	19.05
190 KΩ	188.8	189.4	191.2
1.9 MΩ	1.888	1.900	1.912
19 MΩ	18.78	19.00	19.22
100 MΩ (nS RANGE)	9.80	9.97	10.20

CAPACITANCE ACCURACY

INPUT	MIN	READING	MAX
1.0 uF	0.95	.99	1.05
0.470 uF	0.463	.470	0.477
0.0470 uF	0.0463	.0472	0.0477
4.70 nF	4.62	4.74	4.78

DIODE TEST

INPUT	MIN	READING	MAX
3.0 V	2.939	2.988	3.061

CURRENT ACCURACY

FUNCTION	INPUT	MIN	READING	MAX
mA/A	35.0 mA	34.89	35.01	35.11
	350 mA	349.1	349.9	350.9
	35.0 mA 60 Hz	34.63	34.92	35.37
	35.0 mA 1 kHz	34.63	34.96	35.37
	350 mA 60 Hz	346.3	349.3	353.7
	350 mA 1 kHz	346.3	349.6	353.7
uA	350 uA	348.9	350.4	351.1
	3500 uA	3491	3502	3509
	350 uA 60 Hz	346.3	349.4	353.7
	350 uA 1 kHz	346.3	349.9	353.7
	3500 uA 60 Hz	3463	3496	3537
	3500 uA 1 kHz	3463	3499	3537

INST NO: 45189

✓ INCOMING
✓ OUTGOING

DOC. DATE: 11/7/2000

A	3500 mA	3489	3498	3511
	10.0 A	9.96	9.99	10.04
	3500 mA 60 Hz	3463	3490	3537
	3500 mA 1 kHz	3463	3497	3537
	10.0 A 60 Hz	9.88	10.02	10.12
	10.0 A 1 kHz	9.88	10.04	10.12

SOUTHWEST RESEARCH INSTITUTE
CALIBRATION LABORATORY
MEMORANDUM

December 27, 2001

To: DARRELL DUNN DIV20 B57

From: Walt Hill, Supervisor
Institute Calibration Laboratory

Subject: Status of Calibration Supplier

Manufacturer/Model: FLUKE 87 III
Description: MULTIMETER
Serial Number: 73980493
Asset Number: 007647
Work Order Number: 444046365
Date Calibrated: December 21, 2001
Supplier: ROTHE DEVELOPMENT, INC., SAN ANTONIO, TX
Remarks: ROTHE CERTIFICATE NO.: 45189:1008932351

( ) Supplier is on the Approved Suppliers List (ASL) and is accredited.

(✓) Supplier is on the Approved Suppliers List (ASL) but is not accredited.

( ) Supplier is not on the Approved Suppliers List (ASL). Please contact Don Dunavant at ext. 2942 if you wish to add the supplier to the ASL.

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

Attachment(s) 5

SOUTHWEST RESEARCH INSTITUTE™

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

Certificate of Calibration

Submitted By:	DIV20	**Work Order:**	444051760
Address:	B57	**Date Issued:**	Jan 8, 2003
Contact:	DARRELL DUNN	**Calibration Date:**	Jan 8, 2003
Manufacturer Model:	FLUKE 87 III	****Calibration Due:**	Jan 8, 2004
Description:	MULTIMETER	**Calibration Location:**	N/A
Serial No:	73980493	**Environment:**	Temp. 72.0°F Hum. 38 %RH
Asset No:	007647	***As Found:**	IN TOLERANCE
Procedure:	CL-230 Aug 99	***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. The calibration process provides a Test Uncertainty Ratio (TUR) of less than or equal to 25% (4:1) of the test limit unless otherwise stated in remarks or an attachment.

*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
004164	FLUKE	5500A/SC300	CALIBRATOR	Jul 25, 03

Approved by: Walt Hill
Metrology Group Leader

Measurements by: Perry Carpenter
Metrology Technician

m:\Nona2la1.rpt Rev date 15, August 02

Southwest Research Institute
Calibration laboratory
Calibration Sheet.

Work Order:	444051760	Mfr.	FLUKE	Technician	Perry Carpenter
Asset No.	7647	Model	87 III	Procedure	CL-230 Aug 99
Serial No.	73980493	Type.	DIGITAL VOLTMETER	Cal Date.	8-Jan-03

Remarks:

Switch Test

ACV	0	0	0.00	12		Pass
DCV	-32	-32	0.00	12		Pass
Mv/DC	-64	-64	0.00	12		Pass
OHMS	-96	-96	0.00	12		Pass
DIODE	-128	-128	0.00	12		Pass
mA/A	-160	-160	0.00	12		Pass
uA	-192	-192	0.00	12		Pass

Function/Range	Test Point	TI Reading	Difference	Test Limits+/-	Uncertainty	Found/Left
ACV 400 m Volts	m Volts	m Volts	m Volts	m Volts	m Volts	Results
60 Hz	350.00	348.90	-1.10	2.90	>4:1	Pass
1 kHz	350.00	348.80	-1.20	3.90	>4:1	Pass
5 kHz	350.00	350.90	0.90	7.40	>4:1	Pass
20 kHz	350.00	355.90	5.90	9.00	>4:1	Pass
ACV 4 Volts	Volts	Volts	Volts	Volts	Volts	
60 Hz	3.500	3.489	-0.011	0.027	>4:1	Pass
1 kHz	3.500	3.491	-0.009	0.039	>4:1	Pass
5 kHz	3.500	3.504	0.004	0.074	>4:1	Pass
20 kHz	3.500	3.521	0.021	0.090	>4:1	Pass
ACV 40 Volts	Volts	Volts	Volts	Volts	Volts	
60 Hz	35.00	34.98	-0.02	0.27	>4:1	Pass
1 kHz	35.00	34.94	-0.06	0.39	>4:1	Pass
5 kHz	35.00	34.96	-0.04	0.74	>4:1	Pass
20 kHz	35.00	34.94	-0.06	0.90	>4:1	Pass
ACV 400 Volts	Volts	Volts	Volts	Volts	Volts	
60 Hz	350.0	348.8	-1.2	2.7	>4:1	Pass
1 kHz	350.0	349.4	-0.6	3.9	>4:1	Pass
2.5 kHz	350.0	348.9	-1.1	7.4	>4:1	Pass
20 kHz	100.0	99.1	-0.9	2.4	>4:1	Pass
ACV 4000 Volts	Volts	Volts	Volts	Volts	Volts	
60 Hz	900.0	902.0	2.0	8.0	>4:1	Pass
1 kHz	900.0	903.0	3.0	13.0	>4:1	Pass
FREQ TEST	Freq kHz	Freq kHz	Freq kHz	Freq kHz	Freq kHz	
150 mVolt	19.000	18.999	-0.001	0.002	>4:1	Pass
	190.00	189.99	-0.01	0.02	>4:1	Pass

Southwest Research Institute
Calibration laboratory
Calibration Sheet.

Work Order:	444051760	Mfr.	FLUKE	Technician	Perry Carpenter
Asset No.	7647	Model	87 III	Procedure	CL-230 Aug 99
Serial No.	73980493	Type.	DIGITAL VOLTMETER	Cal Date.	8-Jan-03

Function/Range	Test Point	TI Reading	Difference	Test Limits+/-	Uncertainty	Found/Left
Freq Sensitivity	Freq.	Freq	Freq	Freq	Freq	Results
4 VAC 300mV	1000.0	999.9	-0.1	30.0	>4:1	Pass
4 VDC 1.7V	1000.0	999.9	-0.1	30.0	>4:1	Pass
4 VDC 1 V	0.0	0.0	0.0	0.0	>4:1	Pass
40 VDC 6 V	1000.0	999.9	-0.1	30.0	>4:1	Pass
40 VDC 2 V	0.0	0.0	0.0	0.0	>4:1	Pass
DCV 4 Volt	Volts	Volts	Volts	Volts	Volts	
	3.500	3.501	0.001	0.005	2.5:1	Pass
DCV 40 Volt	Volts	Volts	Volts	Volts	Volts	
	35.00	35.01	0.01	0.05	2.5:1	Pass
	-35.00	-35.00	0.00	0.05	2.5:1	Pass
DCV 400 Volt	Volts	Volts	Volts	Volts	Volts	
	350.00	350.10	0.10	0.50	2.5:1	Pass
DCV 4000 Volt	Volts	Volts	Volts	Volts	Volts	
	1000	1001	1	2	1:1	Pass
IMS MIN-MAX	Volts	Volts	Volts	Volts	Volts	
2 v @ 60 Hz	2.828	2.804	-0.024	0.123	2.5:1	Pass
	-2.828	-2.848	0.048	0.123	2.5:1	Pass
DC mV	Volts	Volts	Volts	Volts	Volts	
	350.0	350.1	0.1	0.5	>4:1	Pass
Ohm	Ohms	Ohms	Ohms	Ohms	Ohms	
190	190.00	190.00	0.00	0.6	3:1	Pass
19.00k	19.00	19.00	0.00	0.05	2.5:1	Pass
1.9M	1.900	1.900	0.000	0.005	2.5:1	Pass
19M	19.00	19.00	0.00	0.22	>4:1	Pass
	nS	nS	nS	nS	nS	
100M	10.00	9.98	-0.02	0.20	>4:1	Pass
CAPACITANCE	uF	uF	uF	uF	uF	
	1.00	0.98	-0.02	0.05	2.5:1	Pass
	0.470	0.4670	-0.003	0.008	3.5:1	Pass
	0.0470	0.0467	-0.0003	0.0008	3.5:1	Pass

Southwest Research Institute
Calibration laboratory
Calibration Sheet.

Work Order:	444051760	Mfr.	FLUKE	Technician	Perry Carpenter
Asset No.	7647	Model	87 III	Procedure	CL-230 Aug 99
Serial No.	73980493	Type.	DIGITAL VOLTMETER	Cal Date.	8-Jan-03

Function/Range	Test Point	TI Reading	Difference	Test Limits+/-	Uncertainty	Found/Left
CAPACITANCE	nF	nF	nF	nF	nF	
	4.70	4.72	0.02	0.07	1.8:1	Pass
DIODE	Volts	Volts	Volts	Volts	Volts	
	3.000	2.988	-0.012	0.061	>4:1	Pass
DC mAmps	mAmps	mAmps	mAmps	mAmps	mAmps	
	35.00	35.01	0.01	0.09	>4:1	Pass
	350.0	350.0	0.00	0.9	>4:1	Pass
AC Amps	mAmps	mAmps	mAmps	mAmps	mAmps	
60 Hz	35.00	34.92	-0.08	0.37	>4:1	Pass
1 kHz	35.00	34.97	-0.03	0.37	>4:1	Pass
60 Hz	350.0	349.3	-0.7	3.7	>4:1	Pass
1 kHz	350.0	349.7	-0.3	3.7	>4:1	Pass
DC uAmp	uAmp	uAmp	uAmp	uAmp	uAmp	
	350.0	350.7	0.7	0.9	>4:1	Pass
	3500	3505.0	5.00	9.0	>4:1	Pass
AC uAmp	uAmp	uAmp	uAmp	uAmp	uAmp	
60 Hz	350.0	349.7	-0.3	3.7	>4:1	Pass
1 kHz	350.0	350.3	0.3	3.7	>4:1	Pass
60 Hz	3500	3498	-2	37	>4:1	Pass
1 kHz	3500	3503	3	37	>4:1	Pass
DC Amps	mAmps	mAmps	mAmps	mAmps	mAmps	
	3500	3501	1	9	>4:1	Pass
DC Amps	DC Amps	DC Amps	DC Amps	DC Amps	DC Amps	
	10.00	9.99	-0.01	0.04	>4:1	Pass
AC Amp	mAmps	mAmp	mAmp	mAmp	mAmp	
60 Hz	3500	3490	-10	37	>4:1	Pass
1 kHz	3500	3496	-4	37	>4:1	Pass
AC Amp	Amp	Amp	Amp	Amp	Amp	
60 Hz	10.00	10.02	0.02	0.12	>4:1	Pass
1 kHz	10.00	10.04	0.04	0.12	>4:1	Pass

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:**	444056980
Address:	B57	**Date Issued:**	Jan 15, 2004
Contact:	DARRELL DUNN	**Calibration Date:**	Jan 15, 2004
Manufacturer Model:	FLUKE 87 III	****Calibration Due:**	Jan 15, 2005
Description:	MULTIMETER	**Calibration Location:**	Bldg. 64
Serial No:	73980493	**Environment:**	Temp. 72.0°F Hum. 40 %RH
Asset No:	007647	***As Found:**	IN TOLERANCE
Procedure:	MULTIMETERS, DEC/02	***As Left:**	IN TOLERANCE

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**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
000182	FLUKE	5700A/EP	CALIBRATOR	Mar 04, 04
000201	FLUKE	5725A	AMPLIFIER	Sep 03, 05
009981	ARCO	SS-32	CAPACITOR SET	Jan 20, 04

Walt Hill

Approved by: Walt Hill
Metrology Group Leader

Bob Trollinger

Measurements by: Bob Trollinger
Metrology Technician

m:\a2la1.rpt Rev date 15, August 02

Southwest Research Institute
Calibration Laboratory
Calibration Report

Work Order:	444056980	Mfr.	FLUKE	Technician	blt
Asset No.	007647	Model	87 III		
Serial No.	73980493	Type.	MULTIMETER	Cal Date.	15-Jan-04
Remarks:					

Function/Range	Test Point	TI Reading	Difference	+/-Limit	+/-Uncertainty	Found/Left
Switch Test	Display	Display	Display	Display	N/A	Result
ACV	0	0	0.00	12	N/A	Pass
DCV	-32	-35	-3.00	12	N/A	Pass
Mv/DC	-64	-70	-6.00	12	N/A	Pass
OHMS	-96	-102	-6.00	12	N/A	Pass
DIODE	-128	-131	-3.00	12	N/A	Pass
mA/A	-160	-161	-1.00	12	N/A	Pass
uA	-192	-192	0.00	12	N/A	Pass
ACV 400mVolts	mVolts	mVolts	mVolts	mVolts	mVolts	
60 Hz	350.0	348.8	-1.2	2.9	0.2	Pass
1 kHz	350.0	349.5	-0.5	3.9	0.2	Pass
5 kHz	350.0	350.7	0.7	7.4	0.2	Pass
20 kHz	350.0	357.8	7.8	9.0	0.2	Pass
AC Volts	Volts	Volts	Volts	Volts	Volts	
4 V at 60 Hz	3.500	3.490	-0.010	0.027	0.002	Pass
1 kHz	3.500	3.491	-0.009	0.039	0.002	Pass
5 kHz	3.500	3.503	0.003	0.074	0.002	Pass
20 kHz	3.500	3.519	0.019	0.090	0.002	Pass
40 V at 60 Hz	35.00	34.89	-0.11	0.27	0.02	Pass
1 kHz	35.00	34.94	-0.06	0.39	0.02	Pass
5 kHz	35.00	34.95	-0.05	0.74	0.02	Pass
20 kHz	35.00	34.92	-0.08	0.90	0.11	Pass
400 V at 60 Hz	350.0	348.9	-1.1	2.7	0.2	Pass
1 kHz	350.0	349.4	-0.6	3.9	0.2	Pass
2.5 kHz	350.0	349.2	-0.8	7.4	0.2	Pass
20 kHz	100.0	99.0	-1.0	4.0	0.9	Pass
4000 V at 60 Hz	900	902	2	8	2	Pass
1 kHz	900	903	3	13	2	Pass
Frequency	kHz	kHz	kHz	kHz	kHz	
150 mVolt	19.000	18.998	-0.002	0.002	0.002	Pass
	190.00	189.98	-0.02	0.02	0.02	Pass
Sensitivity	Hz	Hz	Hz	Hz	Hz	
4 VAC with 300mV	1000.0	999.9	-0.1	0.2	0.2	Pass
4 VDC with 1.7V	1000.0	999.9	-0.1	0.2	0.2	Pass
4 VDC with 1 V	0.0	0.0	0.0	0.0	0.2	Pass
40 VDC with 6 V	1000.0	999.9	-0.1	0.2	0.2	Pass
40 VDC with 2 V	0.0	0.0	0.0	0.0	0.2	Pass

Southwest Research Institute
Calibration Laboratory
Calibration Report

Work Order:	444056980	Mfr.	FLUKE	Technician	blt
Asset No.	007647	Model	87 III		
Serial No.	73980493	Type.	MULTIMETER	Cal Date.	15-Jan-04

Function/Range	Test Point	TI Reading	Difference	+/-Limit	+/-Uncertainty	Found/Left
DC Volts	Volts	Volts	Volts	Volts	Volts	Result
4 Volts	3.500	3.501	0.001	0.003	0.002	Pass
40 Volts	35.00	35.00	0.00	0.03	0.02	Pass
	-35.00	-35.00	0.00	0.03	0.02	Pass
400 Volt	350.0	350.1	0.1	0.3	0.2	Pass
4000 Volt	1000	1001	1	2	2	Pass
IMS Min-Max	Volts	Volts	Volts	Volts	Volts	
	2.828	2.840	0.012	0.123	0.002	Pass
	-2.828	-2.828	0.028	0.123	0.002	Pass
DC mV	mVolts	mVolts	mVolts	mVolts	mVolts	
	350.0	350.1	0.1	0.5	0.2	Pass
Ohm	Ohms	Ohms	Ohms	Ohms	Ohms	
190	190.00	190.40	0.40	0.6	0.2	Pass
	kOhms	kOhms	kOhms	kOhms	kOhms	
19.00k	19.00	19.00	0.00	0.05	0.02	Pass
	MOhms	MOhms	MOhms	MOhms	MOhms	
1.9M	1.90	1.90	0.00	0.012	0.02	Pass
19M	19.00	19.00	0.00	0.22	0.02	Pass
	nS	nS	nS	nS	nS	
100M	10.00	9.98	-0.02	0.20	0.07	Pass
Capacitance	uF	uF	uF	uF	uF	
	1.00	0.98	-0.02	0.05	0.02	Pass
	0.470	0.4680	-0.002	0.008	0.002	Pass
	0.0470	0.0472	0.0002	0.0008	0.0002	Pass
	nF	nF	nF	nF	nF	
	4.70	4.73	0.03	0.08	0.04	Pass
Diode	Volts	Volts	Volts	Volts	Volts	
	3.000	2.988	-0.012	0.061	0.001	Pass
DC mAmps	mAmps	mAmps	mAmps	mAmps	mAmps	
	35.00	35.01	0.01	0.09	0.02	Pass
	350.0	349.9	-0.1	0.9	0.2	Pass
AC Amps	mAmps	mAmps	mAmps	mAmps	mAmps	
60 Hz	35.00	34.92	-0.08	0.37	0.04	Pass
1 kHz	35.00	34.96	-0.04	0.37	0.04	Pass
60 Hz	350.0	349.3	-0.7	3.7	0.4	Pass
1 kHz	350.0	349.5	-0.5	3.7	0.4	Pass

Southwest Research Institute
Calibration Laboratory
Calibration Report

Work Order:	444056980	Mfr.	FLUKE	Technician	blt
Asset No.	007647	Model	87 III		
Serial No.	73980493	Type.	MULTIMETER	Cal Date.	15-Jan-04

Function/Range	Test Point	TI Reading	Difference	+/-Limit	+/-Uncertainty	Found/Left
DC uAmp	uAmp	uAmp	uAmp	uAmp	uAmp	Result
	350.0	350.8	0.8	0.9	0.2	Pass
	3500	3505	5	9	2	Pass
AC uAmp	uAmp	uAmp	uAmp	uAmp	uAmp	
60 Hz	350.0	349.7	-0.3	3.7	1	Pass
1 kHz	350.0	350.1	0.1	3.7	1	Pass
60 Hz	3500	3508	8	37	5	Pass
1 kHz	3500	3501	1	37	5	Pass
DC Amps	mAmps	mAmps	mAmps	mAmps	mAmps	
	3500	3498	-2	11	3	Pass
	Amps	Amps	Amps	Amps	Amps	
	10.00	9.99	-0.01	0.04	0.02	Pass
AC Amp	mAmps	mAmp	mAmp	mAmp	mAmp	
60 Hz	3500	3490	-10	37	5	Pass
1 kHz	3500	3497	-3	37	5	Pass
AC Amp	Amp	Amp	Amp	Amp	Amp	
60 Hz	10.00	10.02	0.02	0.12	0.02	Pass
1 kHz	10.00	10.04	0.04	0.12	0.02	Pass

END OF REPORT

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:**	444062772
Address:	B57	**Date Issued:**	Feb 9, 2005
Contact:	DARRELL DUNN	**Calibration Date:**	Feb 9, 2005
Manufacturer Model:	FLUKE 87 III	****Calibration Due:**	Feb 9, 2006
Description:	MULTIMETER	**Calibration Location:**	Bldg. 64
Serial No:	73980493	**Environment:**	Temp. 73.0°F Hum. 44 %RH
Asset No:	007647	***As Found:**	IN TOLERANCE
Procedure:	MULTIMETERS, JAN/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
004164	FLUKE	5500A/SC300	CALIBRATOR	Aug 03, 05

Approved by: Walt Hill
Metrology Group Leader

Measurements by: Curtis Laurence
Metrology Technician

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	444062772	Mfr.	FLUKE	Technician	WCL
Asset No.	007647	Model	87 III		
Serial No.	73980493	Type.	MULTIMETER	Cal Date.	9-Feb-05
Remarks:					

Function/Range	Test Point	TI Reading	Difference	+/-Limit	+/-Uncertainty	Found/Left
Switch Test	Display	Display	Display	Display	N/A	Result
ACV	0	0	0.00	12	N/A	Pass
DCV	-32	-32	0.00	12	N/A	Pass
Mv/DC	-64	-64	0.00	12	N/A	Pass
OHMS	-96	-96	0.00	12	N/A	Pass
DIODE	-128	-128	0.00	12	N/A	Pass
mA/A	-160	-160	0.00	12	N/A	Pass
uA	-192	-192	0.00	12	N/A	Pass
ACV 400mVolts	mVolts	mVolts	mVolts	mVolts	mVolts	
60 Hz	350.0	348.7	-1.3	2.9	0.14	Pass
1 kHz	350.0	348.8	-1.2	3.9	0.14	Pass
5 kHz	350.0	350.9	0.9	7.4	0.14	Pass
20 kHz	350.0	357.9	7.9	9.0	0.17	Pass
AC Volts	Volts	Volts	Volts	Volts	Volts	
4 V at 60 Hz	3.500	3.488	-0.012	0.027	0.0014	Pass
1 kHz	3.500	3.490	-0.010	0.039	0.0014	Pass
5 kHz	3.500	3.504	0.004	0.074	0.0014	Pass
20 kHz	3.500	3.521	0.021	0.090	0.0022	Pass
40 V at 60 Hz	35.00	34.88	-0.12	0.27	0.019	Pass
1 kHz	35.00	34.93	-0.07	0.39	0.019	Pass
5 kHz	35.00	34.95	-0.05	0.74	0.019	Pass
20 kHz	35.00	34.94	-0.06	0.90	0.11	Pass
400 V at 60 Hz	350.0	348.9	-1.1	2.7	0.16	Pass
1 kHz	350.0	349.4	-0.6	3.9	0.16	Pass
2.5 kHz	350.0	349.2	-0.8	7.4	0.16	Pass
20 kHz	100.0	99.0	-1.0	4.0	0.88	Pass
4000 V at 60 Hz	900	902	2	8	1.2	Pass
1 kHz	900	903	3	13	1.2	Pass
Frequency	kHz	kHz	kHz	kHz	kHz	
150 mVolt	19.000	18.999	-0.001	0.002	0.0012	Pass
	190.00	189.99	-0.01	0.02	0.012	Pass
Sensitivity	Hz	Hz	Hz	Hz	Hz	
4 VAC with 300mV	1000.0	999.9	-0.1	0.2	0.12	Pass
4 VDC with 1.7V	1000.0	999.9	-0.1	0.2	0.12	Pass
4 VDC with 1 V	0.0	0.0	0.0	0.2	0.12	Pass
40 VDC with 6 V	1000.0	999.9	-0.1	0.2	0.12	Pass
40 VDC with 2 V	0.0	0.0	0.0	0.2	0.12	Pass

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	444062772	Mfr.	FLUKE	Technician	WCL
Asset No.	007647	Model	87 III		
Serial No.	73980493	Type.	MULTIMETER	Cal Date.	9-Feb-05

Function/Range	Test Point	TI Reading	Difference	+/-Limit	+/-Uncertainty	Found/Left
DC Volts	Volts	Volts	Volts	Volts	Volts	Result
4 Volts	3.500	3.501	0.001	0.003	0.0012	Pass
40 Volts	35.00	35.00	0.00	0.03	0.012	Pass
	-35.00	-35.00	0.00	0.03	0.012	Pass
400 Volt	350.0	350.1	0.1	0.3	0.12	Pass
4000 Volt	1000	1001	1	2	1.2	Pass
IMS Min-Max	Volts	Volts	Volts	Volts	Volts	
	2.828	2.832	0.004	0.123	0.0012	Pass
	-2.828	-2.832	0.032	0.123	0.0012	Pass
DC mV	mVolts	mVolts	mVolts	mVolts	mVolts	
	350.0	350.1	0.1	0.5	0.12	Pass
Ohm	Ohms	Ohms	Ohms	Ohms	Ohms	
190	190.00	190.00	0.00	0.6	0.12	Pass
	kOhms	kOhms	kOhms	kOhms	kOhms	
19.00k	19.00	19.00	0.00	0.05	0.012	Pass
	MOhms	MOhms	MOhms	MOhms	MOhms	
1.9M	1.900	1.900	0.000	0.012	0.0012	Pass
19M	19.00	19.00	0.00	0.22	0.014	Pass
	nS	nS	nS	nS	nS	
100M	10.00	9.96	-0.04	0.20	0.062	Pass
Capacitance	uF	uF	uF	uF	uF	
	1.00	0.98	-0.02	0.05	0.012	Pass
	0.470	0.4670	-0.003	0.008	0.0016	Pass
	0.0470	0.0470	0.0000	0.0008	0.00012	Pass
	nF	nF	nF	nF	nF	
	4.70	4.71	0.01	0.08	0.032	Pass
Diode	Volts	Volts	Volts	Volts	Volts	
	3.000	2.988	-0.012	0.061	0.0012	Pass
DC mAmps	mAmps	mAmps	mAmps	mAmps	mAmps	
	35.00	35.01	0.01	0.09	0.013	Pass
	350.0	350.0	0.0	0.9	0.12	Pass
AC Amps	mAmps	mAmps	mAmps	mAmps	mAmps	
60 Hz	35.00	34.92	-0.08	0.37	0.041	Pass
1 kHz	35.00	34.97	-0.03	0.37	0.041	Pass
60 Hz	350.0	349.4	-0.6	3.7	0.34	Pass
1 kHz	350.0	349.8	-0.2	3.7	0.34	Pass

Southwest Research Institute
Calibration Laboratory
Measurement Report

Work Order:	444062772	Mfr.	FLUKE	Technician	WCL
Asset No.	007647	Model	87 III		
Serial No.	73980493	Type.	MULTIMETER	Cal Date.	9-Feb-05

Function/Range	Test Point	TI Reading	Difference	+/-Limit	+/-Uncertainty	Found/Left
DC uAmp	uAmp	uAmp	uAmp	uAmp	uAmp	Result
	350.0	350.8	0.8	0.9	0.14	Pass
	3500	3505	5	9	1.3	Pass
AC uAmp	uAmp	uAmp	uAmp	uAmp	uAmp	
60 Hz	350.0	349.8	-0.2	3.7	1.0	Pass
1 kHz	350.0	350.3	0.3	3.7	1.0	Pass
60 Hz	3500	3499	-1	37	2.7	Pass
1 kHz	3500	3503	3	37	2.7	Pass
DC Amps	mAmps	mAmps	mAmps	mAmps	mAmps	
	3500	3498	-2	11	2.7	Pass
	Amps	Amps	Amps	Amps	Amps	
	10.00	9.99	-0.01	0.04	0.013	Pass
AC Amp	mAmps	mAmp	mAmp	mAmp	mAmp	
60 Hz	3500	3491	-9	37	4.2	Pass
1 kHz	3500	3498	-2	37	4.2	Pass
AC Amp	Amp	Amp	Amp	Amp	Amp	
60 Hz	10.00	10.02	0.02	0.12	0.017	Pass
1 kHz	10.00	10.04	0.04	0.12	0.017	Pass

END OF REPORT