

# Certificate of Calibration

**Certificate Number: 20190411-63844**



Manufacturer: **IET Labs, Inc.**  
Model: **HARS-X-5-0.1**  
Description: **High Accuracy Resistance Substituter**  
Serial Number: **E1-19145595**  
Customer Designation:

IET Item ID # 53558

IET Labs, Inc. hereby certifies that the above-referenced instrument meets or exceeds its published specifications. IET Labs, Inc. hereby certifies that its measurement and calibration procedures are compliant with DIS10012, ISO9001, ISO/IEC17025, ANSI/NCSL Z540-1-1994, and MIL-STD-45662A. The calibration and measurement procedures are defined in Quality Policy Manual QM-100 and associated procedures. The calibration and measurement procedures use primary or secondary standards whose calibration is traceable, through NIST or other National Standards Institutes, to the International System of Units (SI) or to accepted intrinsic standards of measurement, or whose accuracy have been determined by ratio-type calibration techniques. The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a level of confidence of approximately 95%. Except where noted, IET Labs maintains at least a 4:1 Test Uncertainty Ratio. The reported data is valid only at the time of test and does not take into account the effects of voltage/current, humidity, long-term drift, transportation or other factors that may affect the stability of the tested device.

- Condition Received**
- New unit
  - Out of tolerance
  - Physical Damage (see Details of Damage)
  - Met manufacturer's specifications
  - Inoperative
- Condition Returned**
- Calibrated/Certified to manufacturer's specifications
  - Repaired
  - Other (see Condition Returned Notes)

**Test Procedure** The instrument listed above was calibrated by IET Labs, according to Calibration Procedure HARS-TP, Rev C

**Decision Rules** RDS (Root Difference Square) rule: PASS if MEASURED value <= Test limit <(Specification Limit^2 - Measurement Uncertainty^2)^0.5  
This gives a PFA (Probability of False Accept) of < 0.6%.

A PASS\* indicates the MEASURED value is ≥Test Limits and <Specification Limits.

For TL = SL this gives a PFA of <2% at a TUR of 4:1.

The user should determine conformity, when PASS\* is indicated based upon the desired rule of; RDS in which case PASS\* is a FAIL or TL = SL in which case PASS\* is a PASS.

**Measurement Uncertainty - Resistance** Measurement Uncertainty was calculated in accordance with the principles of "ISO Guide to the Expression of Uncertainty in Measurement (GUM)".

1 mΩ decade steps = 0.2 mΩ		1 kΩ decade steps = 20 ppm
10 mΩ decade steps = 0.2 mΩ		10 kΩ decade steps = 20 ppm
100 mΩ decade steps = 0.2 mΩ		100 kΩ decade steps = 20 ppm
1 Ω decade steps = 30 ppm		1 MΩ decade steps = 25 ppm
10 Ω decade steps = 20 ppm		10 MΩ decade steps = 100 ppm
100 Ω decade steps = 20 ppm		

Associated Test Reports	Report #	Date	Test Description
	111115	11-Apr-2019	As Built



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## Standards Used

<i>Manufacturer</i>	<i>Model</i>	<i>Description</i>	<i>Serial Number</i>	<i>Cal Date</i>	<i>Due Date</i>
Fluke	8508A	8½ Digit Reference Multimeter	46422	04-Sep-2018	04-Sep-2019

**Calibration Facility:** IET Labs, Inc.  
1202 VFW Parkway  
West Roxbury, MA 02132

**Calibration Date:** 11-Apr-19  
**Next Recommended Calibration Date:**

Authorized Signature \_\_\_\_\_ CTS



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## Test Report Number: 11115

TestDataRpt\_0002

Test Description: **As Built**

Environmental Conditions: Temp (Deg C): 21.5      Test Date: 11-Apr-2019      Test Version: 5.1  
 RH (%): 30.0      Tech: CTS

Test Conditions: Least Significant Step: 100.0 mohm (dc)  
 Number of Decades: 5

SPECIFICATION LIMITS	TEST LIMITS
Schedule @: <5.000 mohm	<5.000 mohm
Schedule A: ±(0.0100% + 2.000 mohm) with Zero Subtraction	±(0.0070% + 1.000 mohm)   with Zero Subtraction

COLUMN LEGEND - SCH: Schedule applied for particular measurement.  
 NOMINAL: Expected/ideal value.  
 READING: Value reported by the measurement equipment.  
 LOWER LIM: The minimum acceptable value.  
 MEASURED: Represents the calibrated value. If ZERO SUBTRACTION is specified in Schedule, this is the reading minus the measured ZERO.  
 UPPER LIM: The maximum acceptable value.  
 P/F: PASS or FAIL; Pass if MEASURED is >=LOWER LIM. AND <=UPPER LIM., otherwise FAIL.  
 % ERROR: Percent error between the NOMINAL and the MEASURED values.  
 = [(MEASURED-NOMINAL)/NOMINAL]\*100  
 ABS. ERROR: Absolute error between the NOMINAL and MEASURED values.  
 = (MEASURED-NOMINAL)

Series: HARS  
 Model: HARS-X-5-0.1

SCH	NOMINAL (Ω)	READING (Ω)	LOWER LIM (Ω)	MEASURED (Ω)	UPPER LIM (Ω)	% ERROR	ABS.ERROR	P/F
@	0.0000	4.020000m	0.000000	4.020000m	5.000000m	+80.4000%	+4.020m	PASS
A	100.00m	103.9530m	97.99000m	99.93300m	102.0100m	-0.0670%	-67.000u	PASS
A	200.00m	204.0010m	197.9800m	199.9810m	202.0200m	-0.0095%	-19.000u	PASS
A	300.00m	304.0050m	297.9700m	299.9850m	302.0300m	-0.0050%	-15.000u	PASS
A	400.00m	403.9130m	397.9600m	399.8930m	402.0400m	-0.0268%	-107.000u	PASS
A	500.00m	503.9580m	497.9500m	499.9380m	502.0500m	-0.0124%	-62.000u	PASS
A	600.00m	604.1440m	597.9400m	600.1240m	602.0600m	+0.0207%	+124.000u	PASS
A	700.00m	704.0810m	697.9300m	700.0610m	702.0700m	+0.0087%	+61.000u	PASS
A	800.00m	804.0930m	797.9200m	800.0730m	802.0800m	+0.0091%	+73.000u	PASS
A	900.00m	904.1680m	897.9100m	900.1480m	902.0900m	+0.0164%	+148.000u	PASS
A	1.0000	1.004043	997.9000m	1.000023	1.002100	+0.0023%	+23.000u	PASS
A	1.0000	1.004177	997.9000m	1.000157	1.002100	+0.0157%	+157.000u	PASS
A	2.0000	2.004160	1.997800	2.000140	2.002200	+0.0070%	+140.000u	PASS
A	3.0000	3.004010	2.997700	2.999990	3.002300	-0.0003%	-10.000u	PASS
A	4.0000	4.004440	3.997600	4.000420	4.002400	+0.0105%	+420.000u	PASS
A	5.0000	5.004650	4.997500	5.000630	5.002500	+0.0126%	+630.000u	PASS
A	6.0000	6.004380	5.997400	6.000360	6.002600	+0.0060%	+360.000u	PASS
A	7.0000	7.004280	6.997300	7.000260	7.002700	+0.0037%	+260.000u	PASS
A	8.0000	8.004300	7.997200	8.000280	8.002800	+0.0035%	+280.000u	PASS
A	9.0000	9.004440	8.997100	9.000420	9.002900	+0.0047%	+420.000u	PASS
A	10.0000	10.00400	9.997000	9.99998	10.00300	-0.0002%	-20.000u	PASS



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## Test Report Number: 11115

TestDataRpt\_0002

SCH	NOMINAL ( $\Omega$ )	READING ( $\Omega$ )	LOWER LIM ( $\Omega$ )	MEASURED ( $\Omega$ )	UPPER LIM [ ( $\Omega$ )	% ERROR	ABS.ERROR ]	P/F
A	10.000	10.00402	9.997000	10.00000	10.00300 [	+0.0000%	+0.000	PASS
A	20.000	20.00390	19.99600	19.99988	20.00400 [	-0.0006%	-120.000u	PASS
A	30.000	30.00390	29.99500	29.99988	30.00500 [	-0.0004%	-120.000u	PASS
A	40.000	40.00390	39.99400	39.99988	40.00600 [	-0.0003%	-120.000u	PASS
A	50.000	50.00470	49.99300	50.00068	50.00700 [	+0.0014%	+680.000u	PASS
A	60.000	60.00470	59.99200	60.00068	60.00800 [	+0.0011%	+680.000u	PASS
A	70.000	70.00570	69.99100	70.00168	70.00900 [	+0.0024%	+1.680m	PASS
A	80.000	80.00580	79.99000	80.00178	80.01000 [	+0.0022%	+1.780m	PASS
A	90.000	90.00650	89.98900	90.00248	90.01100 [	+0.0028%	+2.480m	PASS
A	100.00	100.0070	99.98800	100.0030	100.0120 [	+0.0030%	+2.980m	PASS
A	100.00	100.0037	99.98800	99.9997	100.0120 [	-0.0003%	-320.000u	PASS
A	200.00	200.0050	199.9780	200.0010	200.0220 [	+0.0005%	+980.000u	PASS
A	300.00	300.0100	299.9680	300.0060	300.0320 [	+0.0020%	+5.980m	PASS
A	400.00	400.0090	399.9580	400.0050	400.0420 [	+0.0012%	+4.980m	PASS
A	500.00	500.0120	499.9480	500.0080	500.0520 [	+0.0016%	+7.980m	PASS
A	600.00	600.0140	599.9380	600.0100	600.0620 [	+0.0017%	+9.980m	PASS
A	700.00	700.0190	699.9280	700.0150	700.0720 [	+0.0021%	+14.980m	PASS
A	800.00	800.0210	799.9180	800.0170	800.0820 [	+0.0021%	+16.980m	PASS
A	900.00	900.0240	899.9080	900.0200	900.0920 [	+0.0022%	+19.980m	PASS
A	1.0000k	1.000022k	999.8980	1.000018k	1.000102k [	+0.0018%	+17.980m	PASS
A	1.0000k	999.9650	999.8980	999.9610	1.000102k [	-0.0039%	-39.020m	PASS
A	2.0000k	1.999920k	1.999798k	1.999916k	2.000202k [	-0.0042%	-84.020m	PASS
A	3.0000k	2.999880k	2.999698k	2.999876k	3.000302k [	-0.0041%	-124.020m	PASS
A	4.0000k	3.999820k	3.999598k	3.999816k	4.000402k [	-0.0046%	-184.020m	PASS
A	5.0000k	4.999760k	4.999498k	4.999756k	5.000502k [	-0.0049%	-244.020m	PASS
A	6.0000k	5.999710k	5.999398k	5.999706k	6.000602k [	-0.0049%	-294.020m	PASS
A	7.0000k	6.999710k	6.999298k	6.999706k	7.000702k [	-0.0042%	-294.020m	PASS
A	8.0000k	7.999650k	7.999198k	7.999646k	8.000802k [	-0.0044%	-354.020m	PASS
A	9.0000k	8.999580k	8.999098k	8.999576k	9.000902k [	-0.0047%	-424.020m	PASS
A	10.000k	9.99952k	9.998998k	9.99952k	10.00100k [	-0.0048%	-484.020m	PASS

No Failures Recorded.



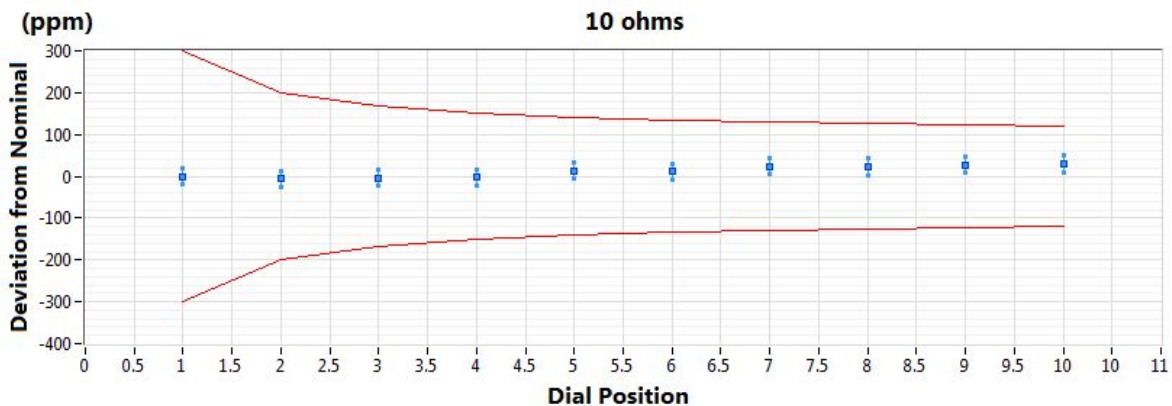
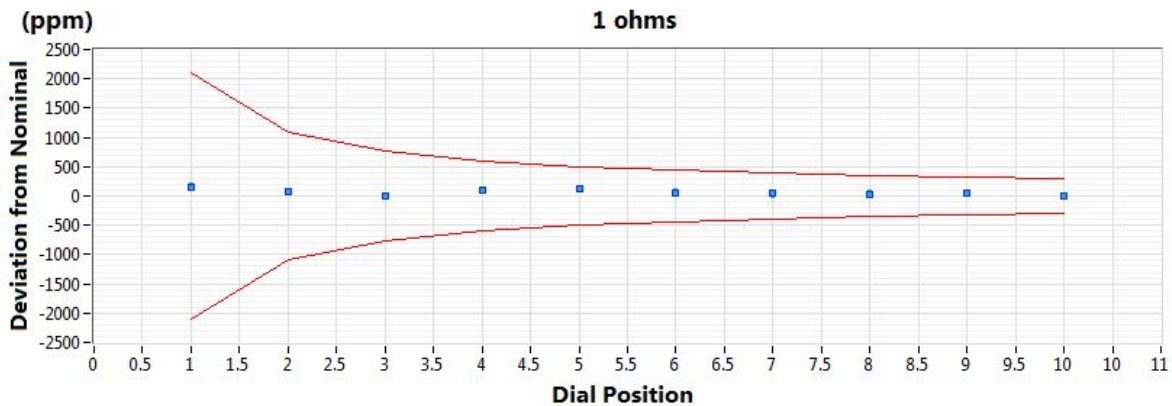
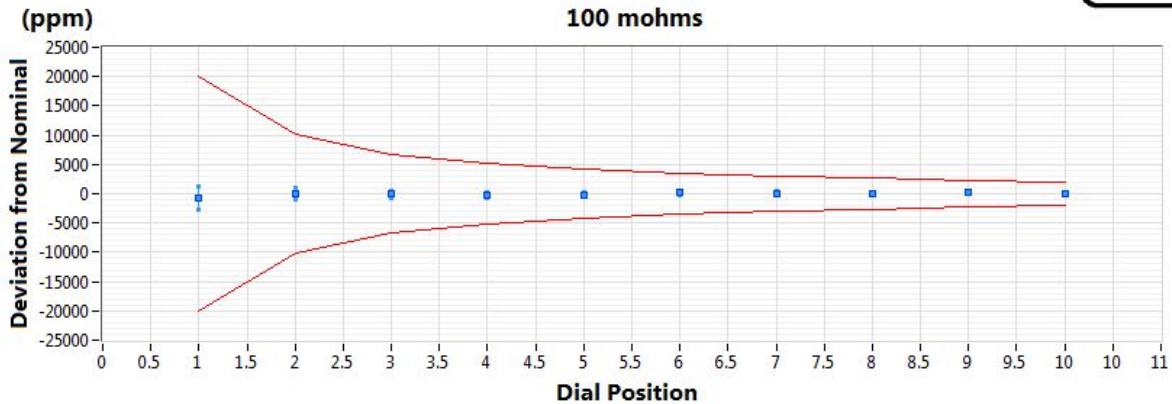
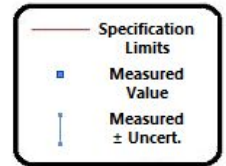
# Appendix to Certificate

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V. 1.1

## As Built - Test Seq: 111115



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