

#### Service License Nº:ĐK283

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Cert.#: AC-1868



# **CERTIFICATE OF CALIBRATION**

Certificate Number TSG-374853



Customer: PEPPERL + FUCHS (VIETNAM) CO., LTD

LOT S12-16A, STREET 20 TAN THUAN EPZ, TAN THUAN DONG WARD, DISTRICT 7, HO CHI MINH CITY, VIETNAM

Manufacturer: KEITHLEY Calibrated by: HUNG HUYNH HAI

Description:Digital MultimeterCalibration Date:20/Nov/2023Model Number:DMM7510Recommended Due:20/Nov/2024

Size / Range: Multi Range Calibration Location: On-Site

 Serial #:
 4610808
 Condition Received:
 IN TOLERANCE

 Asset Number:
 DMM-0654
 Condition Returned:
 IN TOLERANCE

P.O. Number: TEV-PF 231020 Procedure: Manufacturer's Manual

Accessories: Environment:  $26 \pm 2$  °C /  $58 \pm 3$  %RH

This certifies that the above instrument was calibrated in compliance with the Calibration Systems Requirement of ISO/IEC 17025:2017 in accordance with referenced procedures. Standards used to perform this calibration are traceable to SI units;, their source of traceability derives from a National Metrology Institute such as NIST,CENAM, NPL, DIN, VMI..., from natural physical constants, consensus standards procedures or derived by the ratio type of calibrations. Estimated statements of uncertainty are determined as required with a distribution that corresponds to a probability of approximately 95% (k=2), no sampling plan or other process was used for this calibration, the results reported herein apply only to the calibration of the item describe above .All calibrations are performed to manufacturer's specifications, unless otherwise noted. Customer has been contacted concerning re-certification interval and documentation has been received and is on file. This form shall not be reproduced, except in full, without the expressed written consent of Techmaster Electronics. If the manufacturer has a specified tolerance for this item,then the calibration results, with our uncertainty value added, are compared to this tolerance, and the combined value.

Calibration Accuracy: Base on Manufacturer's Specifications or Customer's Specifications.

Remark:

#### Standards Utilzed

Standard Number	Manufacturer	Model	Due Date	Report Number	Traceability
EL0040	AGILENT	3458A	29/Mar/2024	TSG-0-313809-R2	TSD
EL0089	AGILENT	33250A	19/Apr/2024	TSG-0-288654-R3	TSD
EL0263	FLUKE	5522A	30/Mar/2025	TSG-0-311902	TSD

Quality Assurance: (Đảm bảo chất lượng)

Nguyễn Văn Tiến

Technical Manager: (Giám sát kỹ thuật)

Lê Nguyễn Vũ Nghiệp

Issued on: 2023-12-03 23:48:43.4200000 -08:00

540.1/Certificate.VE Rev 08



Manufacturer: KEITHLEY Model: DMM7510 Asset No.:/ Serial No.: DMM-0654 / 4610808

#### Front -Panel Verification

## 1. Zero Offset Verification .

Function	Range	Nominal	Unit	Measured	Tolerand	ce Limits	Result
i dilotion	rtungo	Value	0	Value	Min	Max	rtooun
DCV	1 V	0.0000000	V	0.0000000	-0.0000020	0.0000020	PASS
	10 V	0.000000	V	0.000000	-0.000012	0.000012	PASS
	100 V	0.00000	V	0.00000	-0.00050	0.00050	PASS
	1000 V	0.0000	V	-0.0001 -0.0050 0.0050		0.0050	PASS
Ohm - 4 Wire	1 Ω	0.0000000	Ω	0.0000002	-0.0000500	0.0000500	PASS
	10 Ω	0.000000	Ω	0.000001	-0.000050	0.000050	PASS
	100 Ω	0.00000	Ω	0.00003	-0.00040	0.00040	PASS
	1 kΩ	0.0000000	000 kΩ 0.0000003 -0.0000030 0.0000030		PASS		
	10 kΩ	0.000000	kΩ	0.000001	-0.000030	0.000030	PASS
	100 kΩ	0.00000	kΩ	0.00002	-0.00030	0.00030	PASS

# 2. DC Voltage Gain Verification .

Range	Standard	Unit	Measured	Toleran	ce Limits	Result	Expanded
Kange	Value	Offic	Value	Min	Max	Result	Uncertainty
100 mV	100	mV	100.00022	99.99730	100.00270	PASS	0.0019
	50	mV	49.99969	49.99820	50.00180	PASS	0.0014
	-50	mV	-49.99977	-50.00180	-49.99820	PASS	0.0014
	-100	mV	-100.00014	-100.00270	-99.99730	PASS	0.0019
1 V	1	V	1.0000029	0.9999830	1.0000170	PASS	0.0000094
	0.5	V	0.4999993	0.4999905	0.5000095	PASS	0.0000053
	-0.5	V	-0.4999991	-0.5000095	-0.4999905	PASS	0.0000053
	-1	V	-1.0000017	-1.0000170	-0.9999830	PASS	0.0000094
10 V	10	V	10.000014	9.999848	10.000152	PASS	0.000098
	5	V	4.999994	4.999918	5.000082	PASS	0.000051
	-5	V	-4.999995	-5.000082	-4.999918	PASS	0.000051
	-10	V	-10.000024	-10.000152	-9.999848	PASS	0.000098
100 V	100	V	100.00022	99.99730	100.00270	PASS	0.00103
	50	V	49.99989	49.99840	50.00160	PASS	0.00056
	-50	V	-49.99989	-50.00160	-49.99840	PASS	0.00056
	-100	V	-100.00032	-100.00270	-99.99730	PASS	0.00103
1000 V	1000	V	1000.0045	999.9720	1000.0280	PASS	0.013
	500	V	499.9987	499.9835	500.0165	PASS	0.006
	-500	V	-499.9992	-500.0165	-499.9835	PASS	0.006
	-1000	V	-1000.0022	-1000.0280	-999.9720	PASS	0.013



Manufacturer: KEITHLEY Model: DMM7510 Asset No.:/ Serial No.: DMM-0654 / 4610808

## 3. AC Voltage Gain Verification .

D	F	Standard	11	Measured	Toleran	ce Limits	Dogult	Expanded
Range 100 mV	Freq.	Value	Unit	Value	Min	Max	Result	Uncertainty
100 mV	30 Hz	100	mV	100.0072	99.9100	100.0900	PASS	0.0290
	1 kHz	100	mV	100.0082	99.9100	100.0900	PASS	0.0190
	50 kHz	100	mV	100.0288	99.8100	100.1900	PASS	0.0450
	100 kHz	100	mV	100.0614	99.3200	100.6800	PASS	0.1100
1 V	30 Hz	1	V	1.000145	0.999100	1.000900	PASS	0.00019
	1 kHz	1	V	1.000082	0.999100	1.000900	PASS	0.000086
	50 kHz	1	V	1.000191	0.998100	1.001900	PASS	0.00015
	100 kHz	1	V	1.000547	0.993200	1.006800	PASS	0.00033
10 V	30 Hz	10	V	10.00145	9.99100	10.00900	PASS	0.0019
	1 kHz	10	V	10.00118	9.99100	10.00900	PASS	0.0008
	50 kHz	10	V	10.00134	9.98100	10.01900	PASS	0.0015
	100 kHz	1	V	1.00197	0.98600	1.01400	PASS	0.0006
100 V	30 Hz	100	V	100.0046	99.9100	100.0900	PASS	0.0088
	1 kHz	100	V	100.0100	99.9100	100.0900	PASS	0.0088
	50 kHz	100	V	100.0115	99.8100	100.1900	PASS	0.026
	100 kHz	100	V	100.1091	99.3200	100.6800	PASS	0.058
700 V	50 Hz	700	V	700.078	699.370	700.630	PASS	0.30
	1 kHz	700	V	700.115	699.370	700.630	PASS	0.06
	50 kHz	210	V	210.059	209.356	210.644	PASS	0.10
	100 kHz	210	V	210.148	208.180	211.820	PASS	0.02



Manufacturer: KEITHLEY Model: DMM7510 Asset No.:/ Serial No.: DMM-0654 / 4610808

# 4. Digitize DC Voltage Verification .

Dan	Standard	Unit	Measured	Toleran	ce Limits	Result	Expanded
Range	Value	Unit	Value	Min	Max	Result	Uncertainty
100 mV	100	mV	99.999	99.968	100.032	PASS	0.002
	50	mV	50.001	49.979	50.021	PASS	0.002
	-50	mV	-50.001	-50.021	-49.979	PASS	0.002
	-100	mV	-99.994	-100.032	-99.968	PASS	0.002
1 V	1	V	0.99999	0.99981	1.00020	PASS	0.00001
	0.5	V	0.50001	0.49987	0.50014	PASS	0.00001
	-0.5	V	-0.50002	-0.50014	-0.49987	PASS	0.00001
	-1	V	-0.99997	-1.00020	-0.99981	PASS	0.00001
10 V	10	V	9.9996	9.9981	10.0020	PASS	0.0001
	5	V	5.0002	4.9987	5.0014	PASS	0.0001
	-5	V	-5.0002	-5.0014	-4.9987	PASS	0.0001
	-10	V	-9.9997	-10.0020	-9.9981	PASS	0.0001
100 V	100	V	99.998	99.981	100.020	PASS	0.001
	50	V	50.003	49.987	50.014	PASS	0.001
	-50	V	-50.002	-50.014	-49.987	PASS	0.001
	-100	V	-99.997	-100.020	-99.981	PASS	0.001
1000 V	1000	V	999.99	999.81	1000.20	PASS	0.01
	500	V	500.01	499.87	500.14	PASS	0.01
	-500	V	-500.02	-500.14	-499.87	PASS	0.01
	-1000	V	-999.99	-1000.20	-999.81	PASS	0.01



Manufacturer: KEITHLEY Model: DMM7510 Asset No.:/ Serial No.: DMM-0654 / 4610808

## 5. Frequency Gain Verification.

Applied Voltage	Standard	Unit	Measured	Tolerance Limits		Result	Expanded
Applied voltage	Value	Unit	Value	Min	Max	Result	Uncertainty
5 V	10	Hz	10.000000	9.999197	10.00080	PASS	0.000058
5 V	1	kHz	1.0000000	0.9999197	1.000080	PASS	0.0000058
5 V	10	kHz	10.000001	9.999197	10.00080	PASS	0.000058
5 V	100	kHz	100.00001	99.99197	100.0080	PASS	0.00058
5 V	250	kHz	249.9999	249.9799	250.0201	PASS	0.0014
5 V	500	kHz	499.9999	499.9598	500.0402	PASS	0.0029

# 6. Simulated Temperature Verification .

Function	Applied Value	Nominal	Unit	Measured	Tolerand	e Limits	Result	Expanded
Function	Applied value	Value	Unit	Value	Min	Max	Result	Uncertainty
Type J	-7.659 mV	-190	°C	-190.0	-190.2	-189.8	PASS	0.4
Thermocouple	0.000 mV	0	°C	0.1	-0.2	0.2	PASS	0.2
	42.281 mV	750	°C	750.0	749.8	750.2	PASS	0.3
4-Wire RTD	19.00 Ω	-198.88	°C	-198.86	-198.94	-198.82	PASS	0.06
	100.00 Ω	0.00	°C	0.02	-0.06	0.06	PASS	0.06
	190.00 Ω	238.69	°C	238.70	238.63	238.75	PASS	0.12

# 7. Dry Circuit Resistance Verification .

Range	Standard	Unit	Measured	Tolerand	ce Limits	Result	Expanded
Kange	Value	Onit	Value	Min	Max	Result	Uncertainty
1 Ω	0.000000	Ω	0.000007	-0.000080	0.000080	PASS	0.0092
	1.000000	Ω	0.999982	0.999870	1.000130	PASS	0.0094
10 Ω	0.00000	Ω	0.00000	-0.00080	0.00080	PASS	0.00003
	10.00000	Ω	10.00010	9.99870	10.00130	PASS	0.00032
100 Ω	0.0000	Ω	0.0014	-0.0080	0.0080	PASS	0.0001
	100.0000	Ω	99.9992	99.9830	100.0170	PASS	0.0020
1 kΩ	0.000000	kΩ	0.000006	-0.000080	0.000080	PASS	0.000023
	1.000000	kΩ	1.000018	0.999740	1.000260	PASS	0.000023
10 kΩ	0.00000	kΩ	0.00006	-0.00080	0.00080	PASS	0.00002
	10.00000	kΩ	10.00068	9.99600	10.00400	PASS	0.00021



Manufacturer: KEITHLEY Model: DMM7510 Asset No.:/ Serial No.: DMM-0654 / 4610808

## 8. 4-Wire Ohm Gain Verification .

Donne	Standard	Unit	Measured	Tolerand	ce Limits	Result	Expanded
Range	Value	Unit	Value	Min	Max	Result	Uncertainty
1 Ω	0.0000000	Ω	0.0000010	-0.0000500	0.0000500	PASS	0.0092
	1.0000000	Ω	0.9999920	0.9999200	1.0000800	PASS	0.0094
10 Ω	0.000000	Ω	0.000010	-0.000050	0.000050	PASS	0.00003
	10.000000	Ω	9.999941	9.999650	10.000350	PASS	0.00032
100 Ω	0.00000	Ω	0.00002	-0.00040	0.00040	PASS	0.00002
	100.00000	Ω	99.99981	99.99690	100.00310	PASS	0.0020
1 kΩ	0.0000000	kΩ	0.0000001	-0.0000030	0.0000030	PASS	0.000023
	1.0000000	kΩ	0.9999976	0.9999730	1.0000270	PASS	0.000023
10 kΩ	0.000000	kΩ	0.000004	-0.000030	0.000030	PASS	0.000021
	10.000000	kΩ	10.000013	9.999670	10.000330	PASS	0.000208
100 kΩ	0.00000	kΩ	0.00004	-0.00030	0.00030	PASS	0.00002
	100.00000	kΩ	100.00003	99.99670	100.00330	PASS	0.00219
1 ΜΩ	0.0000000	МΩ	0.0000001	-0.0000040	0.0000040	PASS	0.000030
	1.0000000	МΩ	1.0000064	0.9999360	1.0000640	PASS	0.000030
10 ΜΩ	0.000000	МΩ	0.000019	-0.000100	0.000100	PASS	0.000058
	10.000000	МΩ	9.999958	9.997900	10.002100	PASS	0.00058

## 9. 2-Wire Ohm Gain Verification .

Range	Standard Unit		Unit Measured		Tolerance Limits		Expanded
Range	Value	Onit	Value	Min	Max	Result	Uncertainty
100 ΜΩ	0.00000	МΩ	0.00042	-0.00300	0.00300	PASS	0.00006
	100.00000	МΩ	99.96955	99.79700	100.20300	PASS	0.070
1 GΩ	1.000000	GΩ	1.001638	0.990900	1.009100	PASS	0.0068



Manufacturer: KEITHLEY Model: DMM7510 Asset No.:/ Serial No.: DMM-0654 / 4610808

# 10. DC Current Verification .

Danas	Standard	Unit	Measured	Tolerand	ce Limits	Result	Expanded
Range	Value	Unit	Value	Min	Max	Result	Uncertainty
10 μΑ	10	μΑ	10.000126	9.998950	10.001050	PASS	0.0014
	5	μΑ	4.999953	4.999325	5.000675	PASS	0.0012
	-5	μΑ	-4.999926	-5.000675	-4.999325	PASS	0.0012
	-10	μA	-10.000074	-10.001050	-9.998950	PASS	0.0014
100 μΑ	100	μΑ	100.00124	99.99310	100.00690	PASS	0.0039
	50	μΑ	49.99934	49.99610	50.00390	PASS	0.0025
	-50	μA	-49.99953	-50.00390	-49.99610	PASS	0.0025
	-100	μA	-100.00097	-100.00690	-99.99310	PASS	0.0039
1 mA	1	mA	0.9999910	0.9999310	1.0000690	PASS	0.000035
	0.5	mA	0.5000062	0.4999610	0.5000390	PASS	0.000021
	-0.5	mA	-0.5000055	-0.5000390	-0.4999610	PASS	0.000021
	-1	mA	-0.9999910	-1.0000690	-0.9999310	PASS	0.000035
10 mA	10	mA	9.999890	9.999310	10.000690	PASS	0.00028
	5	mA	5.000055	4.999610	5.000390	PASS	0.00015
	-5	mA	-5.000031	-5.000390	-4.999610	PASS	0.00015
	-10	mA	-9.999876	-10.000690	-9.999310	PASS	0.00028
100 mA	100	mA	100.00270	99.98200	100.01800	PASS	0.0047
	50	mA	49.99790	49.98950	50.01050	PASS	0.0024
	-50	mA	-49.99948	-50.01050	-49.98950	PASS	0.0024
	-100	mA	-100.00216	-100.01800	-99.98200	PASS	0.0047
1 A	1	Α	0.9999685	0.9995500	1.0004500	PASS	0.000070
	0.5	Α	0.5000200	0.4997500	0.5002500	PASS	0.000036
	-0.5	Α	-0.5000300	-0.5002500	-0.4997500	PASS	0.000036
	-1	Α	-0.9999235	-1.0004500	-0.9995500	PASS	0.000070
3 A	2	Α	1.999917	1.999080	2.000920	PASS	0.00014
	1.5	Α	1.500079	1.499280	1.500720	PASS	0.00010
	-1.5	Α	-1.500130	-1.500720	-1.499280	PASS	0.00010
	-2	Α	-1.999834	-2.000920	-1.999080	PASS	0.00014



Manufacturer: KEITHLEY Model: DMM7510 Asset No.:/ Serial No.: DMM-0654 / 4610808

#### 11. Digitize DC Current Verification.

D	Standard	I I m i f	Measured	Toleran	ce Limits	Danult	Expanded
Range	Value	Unit	Value	Min	Max	Result	Uncertainty
10 μΑ	10	μA	9.9998	9.9977	10.0024	PASS	0.0014
	5	μΑ	5.0003	4.9985	5.0016	PASS	0.0012
	-5	μΑ	-5.0003	-5.0016	-4.9985	PASS	0.0012
	-10	μA	-9.9997	-10.0024	-9.9977	PASS	0.0014
100 μΑ	100	μA	99.997	99.977	100.024	PASS	0.004
	50	μA	50.003	49.985	50.016	PASS	0.003
	-50	μA	-50.003	-50.016	-49.985	PASS	0.003
	-100	μA	-100.004	-100.024	-99.977	PASS	0.004
1 mA	1	mA	1.00003	0.99977	1.00024	PASS	0.00004
	0.5	mA	0.49998	0.49985	0.50016	PASS	0.00003
	-0.5	mA	-0.49997	-0.50016	-0.49985	PASS	0.00003
	-1	mA	-1.00001	-1.00024	-0.99977	PASS	0.00004
10 mA	10	mA	10.0003	9.9977	10.0024	PASS	0.0003
	5	mA	4.9997	4.9985	5.0016	PASS	0.0002
	-5	mA	-4.9999	-5.0016	-4.9985	PASS	0.0002
	-10	mA	-10.0000	-10.0024	-9.9977	PASS	0.0003
100 mA	100	mA	99.992	99.945	100.055	PASS	0.005
	50	mA	50.006	49.968	50.033	PASS	0.003
	-50	mA	-50.006	-50.033	-49.968	PASS	0.003
	-100	mA	-100.008	-100.055	-99.945	PASS	0.005
1 A	1	Α	1.00009	0.99939	1.00061	PASS	0.00007
	0.5	Α	0.49994	0.49964	0.50036	PASS	0.00004
	-0.5	Α	-0.49997	-0.50036	-0.49964	PASS	0.00004
	-1	Α	-1.00002	-1.00061	-0.99939	PASS	0.00007
3 A	2	Α	2.0003	1.9978	2.0023	PASS	0.0002
	1.5	Α	1.4998	1.4982	1.5018	PASS	0.0001
	-1.5	Α	-1.4998	-1.5018	-1.4982	PASS	0.0001
	-2	Α	-2.0001	-2.0023	-1.9978	PASS	0.0002



Manufacturer: KEITHLEY Model: DMM7510 Asset No.:/ Serial No.: DMM-0654 / 4610808

## 12. AC Current Gain Verification .

Range	Freq.	Standard Value	Unit	Measured Value	Tolerance Limits		Danult	Expanded
					Min	Max	Result	Uncertainty
1 mA	40 Hz	1	mA	1.000132	0.998900	1.001100	PASS	0.00070
	1 kHz	1	mA	1.000112	0.998900	1.001100	PASS	0.00035
	5 kHz	1	mA	1.000159	0.998800	1.001200	PASS	0.00093
10 mA	40 Hz	10	mA	10.00111	9.98900	10.01100	PASS	0.023
	1 kHz	10	mA	10.00145	9.98900	10.01100	PASS	0.021
	5 kHz	10	mA	10.00099	9.98800	10.01200	PASS	0.22
100 mA	40 Hz	100	mA	100.0123	99.8900	100.1100	PASS	0.046
	1 kHz	100	mA	100.0222	99.8900	100.1100	PASS	0.023
	5 kHz	100	mA	100.0219	99.8800	100.1200	PASS	0.092
1 A	40 Hz	1	Α	1.000170	0.997600	1.002400	PASS	0.00092
	1 kHz	1	Α	1.000241	0.997600	1.002400	PASS	0.00092
	5 kHz	1	Α	1.001014	0.990800	1.009200	PASS	0.0013
3 A	40 Hz	2	Α	2.000387	1.994500	2.005500	PASS	0.0018
	1 kHz	2	Α	2.000771	1.994500	2.005500	PASS	0.0018
	5 kHz	2	Α	2.001530	1.980900	2.019100	PASS	0.0025

## 13. Capacitance Gain Verification .

Range	Standard Value	Unit	Measured Value	Tolerance Limits		Result	Expanded
Kange				Min	Max	Result	Uncertainty
1 nF	0.1	nF	0.1003	0.0970	0.1030	PASS	0.0002
	0.7	nF	0.7009	0.6910	0.7090	PASS	0.0185
10 nF	1	nF	1.002	0.980	1.020	PASS	0.020
	10	nF	10.017	9.890	10.110	PASS	0.057
100 nF	10	nF	10.01	9.86	10.14	PASS	0.06
	100	nF	100.05	99.50	100.50	PASS	0.49
1 μF	0.1	μF	0.1003	0.0986	0.1014	PASS	0.0005
	1	μF	1.0008	0.9950	1.0050	PASS	0.0050
10 μF	1	μF	1.003	0.986	1.014	PASS	0.005
	10	μF	10.008	9.950	10.050	PASS	0.035
100 μF	10	μF	10.01	9.86	10.14	PASS	0.04
	100	μF	100.04	99.50	100.50	PASS	0.75



Model: DMM7510 Asset No.:/ Serial No.: DMM-0654 / 4610808

**Rear -Panel Verification** 

#### 14. DC Current 10 A Range Verification .

Manufacturer : KEITHLEY

( Performed "Rel Value" to zero system prior to starting calibration )

Range	Standard Value	Unit	Measured Value	Tolerance Limits		Result	Expanded
Kange				Min	Max	Result	Uncertainty
10 A	10	Α	10.003195	9.982250	10.017750	PASS	0.00094
	5.0	Α	4.998155	4.989750	5.010250	PASS	0.00094
	-5.0	Α	-5.001948	-5.010250	-4.989750	PASS	0.00094
	-10	Α	-9.996628	-10.017750	-9.982250	PASS	0.00094

# 15. Digitize Current 10 A Range Verification .

( Performed "Rel Value" to zero system prior to starting calibration )

Range	Standard	Unit	Measured Value	Tolerance Limits		Result	Expanded
Kange	Value			Min	Max	Result	Uncertainty
10 A	10	Α	9.9972	9.9815	10.0185	PASS	0.0009
	5.0	Α	5.0021	4.9890	5.0110	PASS	0.0009
	-5.0	Α	-4.9989	-5.0110	-4.9890	PASS	0.0009
	-10	Α	-10.0024	-10.0185	-9.9815	PASS	0.0009

# 16. AC Current 10 A Range Verification .

Range	Freq.	Standard Value	Unit	Measured Value	Tolerance Limits		Result	Expanded
					Min	Max	Result	Uncertainty
10 A	45 Hz	10	Α	9.9960	9.9550	10.0450	PASS	0.012
	1 kHz	10	Α	9.9937	9.9550	10.0450	PASS	0.017
	5 kHz	10	Α	9.9842	9.9070	10.0930	PASS	0.046

# \* Notes :

- The tolerances limit on table above are based on manufacturer's specification .
- No Adjustment

