



MICRO PRECISION CALIBRATION PTE LTD
BLOCK 5008 ANG MO KIO AVENUE 5 #07-02/03
TECHPLACE II SINGAPORE 569874
65 67484384



Certificate of Calibration

Date: May 7, 2020

Cert No. 551220083598091

Customer:

WATERS PACIFIC PTE LTD

1 SCIENCE PARK ROAD, #02-08 THE CAPRICORN
SINGAPORE SCIENCE PARK II
SINGAPORE 117528

Work Order #: SG-11014064

MPC Control #: 3211A01907

Serial Number: 3211A01907

Asset ID: PWAT-16GC0002

Department: N/A

Gage Type: ELECTRONIC LOAD

Performed By: SENGTHYE CHEW

Manufacturer: HEWLETT PACKARD

Received Condition: IN TOLERANCE

Model Number: 60502B

Returned Condition: IN TOLERANCE

Size: N/A

Cal. Date: April 30, 2020

Temp/RH: 22.0°C / 50.0%

Cal. Interval: 12 MONTHS

Location: Calibration performed at Customer's facility

Cal. Due Date: April 30, 2021

Calibration Notes:

Please refer to the attached calibration data. (2 pages)

Unit was calibrated with 6050A DC Load Mainframe S/N:3312A02661.

Calibration performed at GES SINGAPORE PTE LTD.

Standards Used to Calibrate Equipment

I.D.	Description.	Model	Serial	Manufacturer	Cal. Due Date	Traceability #
CA8094	MULTIMETER	3458A	2823A25888	HEWLETT PACKARD	Jan 10, 2021	1-12015829011-1
CV0251	SYSTEM DC POWER SUPPLY	6031A	MY41000451	AGILENT	Nov 15, 2020	551220083344238
CS0610	PRECISION CURRENT SHUNT	HA-150-50	289	EMPRO	Oct 18, 2020	551220083310785
DA4027	DIGITAL PHOSPHOR OSCILLOSCOPE	TDS3054	B017095	TEKTRONIX	Nov 14, 2020	551220083324151
DB8884	CALIBRATOR	5500A	7520009	FLUKE	Sep 13, 2020	551220083209610

Procedures Used in this Event

Procedure Name	Description
AGILENT 60501B/60502B	150 & 300 Watt Electronic Load Modules, Agilent 60501B/60502B, Sep-01-1999

Calibrating Technician:

SENGTHYE CHEW

QC Approval:

JUN CALIMAG

STATEMENTS OF PASS OR FAIL CONFORMANCE: The uncertainty of measurement has been taken into account when determining compliance with specification, as per ILAC-G8.03/2009. All measurements and test results guard banded to ensure the probability of false-accept does not exceed 2% in compliance with ANSI/NCCL Z540.3-2006 and in case without guard banded the probability of false-accept depending on test uncertainty ratio.

THE CALIBRATION REPORT STATUS:

PASS - Term used when compliance statement is given, and the measurement result is PASS.

PASS² - Term used when compliance statement is given, and the measurement result is conditional passed or PASS².

FAIL - Term used when compliance statement is given, and the measurement result is FAIL.

FAIL² - Term used when compliance statement is given, and the measurement result is conditional failed or FAIL².

REPORT OF VALUE - Term used when reported measurement is not requiring compliance statement in report.

ADJUSTED - When adjustments are made to an instrument which changes the value of measurement from what was measured as found to new value as left.

LIMITED - When an instrument fails calibration but is still functional in a limited manner.

The expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%, unless otherwise stated. This calibration report complies with ISO/IEC 17025:2017 and ANSI/NCCL Z540.3. Calibration cycles and resulting due dates were submitted/approved by the customer. Any number of factors may cause an instrument to drift out of tolerance before the next scheduled calibration. Recalibration cycles should be based on frequency of use, environmental conditions and customer's established systematic accuracy. All standards are traceable to SI through the National Institute of Standards and Technology (NIST) and/or recognized national or international standards laboratories. Services rendered include proper manufacturer's service instruction and are warranted for no less than thirty (30) days. The information on this report pertains only to the instrument identified, this may not be reproduced in part or in a whole without the prior written approval of the issuing MP Calibration Laboratory.

Calibration Report of Hewlett Packard 60502B Electronic Load

MPC Control #: 3211A01907	Serial Number: 3211A01907
Asset ID: PWAT-16GC0002	Calibration Date: April 30, 2020

Constant Voltage Mode

Function Tested	Nominal	Lower Limit	As Found	As Left	Error	Upper Limit	Result	Uncertainty (±)
Output Accuracy	60.0000 V	59.8900 V	60.0158 V	60.0158 V	0.0263 %	60.1100 V	PASS	0.00047 V
Readback Error	0.0000 V	-0.0750 V	-0.0158 V	-0.0158 V	0.0158 %	0.0750 V	PASS	0.000057 V
Output Accuracy	3.0000 V	2.9470 V	3.0018 V	3.0018 V	0.0600 %	3.0530 V	PASS	0.000016 V
Readback Error	0.0000 V	-0.0460 V	-0.0018 V	-0.0018 V	0.0018 %	0.0460 V	PASS	0.000057 V

Constant Resistance Mode

Function Tested	Nominal	Lower Limit	As Found	As Left	Error	Upper Limit	Result	Uncertainty (±)
Low	1.0000 Ω	0.9840 Ω	0.9989 Ω	0.9989 Ω	0.11000 %	1.0160 Ω	PASS	0.000014 Ω
Low	0.05000 Ω	0.04160 Ω	0.04985 Ω	0.04985 Ω	0.30000 %	0.05840 Ω	PASS	0.00000070 Ω
Middle	30.00 Ω	20.40 Ω	28.75 Ω	28.75 Ω	4.16667 %	39.60 Ω	PASS	0.00042 Ω
Middle	1.0000 Ω	0.9890 Ω	0.9948 Ω	0.9948 Ω	0.52000 %	1.0110 Ω	PASS	0.000014 Ω
High	120.00 Ω	61.10 Ω	99.78 Ω	99.78 Ω	16.85000 %	178.90 Ω	PASS	0.0014 Ω
High	12.00 Ω	10.70 Ω	11.58 Ω	11.58 Ω	3.50000 %	13.30 Ω	PASS	0.00017 Ω

Constant Current Mode (60A Range)

Function Tested	Nominal	Lower Limit	As Found	As Left	Error	Upper Limit	Result	Uncertainty (±)
Output Accuracy	60.0000 A	59.8650 A	59.9862 A	59.9862 A	0.0230 %	60.1350 A	PASS	0.011 A
Readback Error	0.0000 A	-0.0950 A	0.0138 A	0.0138 A	0.0138 %	0.0950 A	PASS	0.000057 A
Output Accuracy	1.0000 A	0.9240 A	0.9965 A	0.9965 A	0.3500 %	1.0760 A	PASS	0.00014 A
Readback Error	0.0000 A	-0.0650 A	0.0035 A	0.0035 A	0.0035 %	0.0650 A	PASS	0.000057 A

Constant Current Mode (6A Range)

Function Tested	Nominal	Lower Limit	As Found	As Left	Error	Upper Limit	Result	Uncertainty (±)
Output Accuracy	6.0000 A	5.9190 A	5.9958 A	5.9958 A	0.0700 %	6.0810 A	PASS	0.00084 A
Readback Error	0.0000 A	-0.0680 A	0.0042 A	0.0042 A	0.0042 %	0.0680 A	PASS	0.000057 A
Output Accuracy	1.0000 A	0.9240 A	0.9965 A	0.9965 A	0.3500 %	1.0760 A	PASS	0.00014 A
Readback Error	0.0000 A	-0.0650 A	0.0035 A	0.0035 A	0.0035 %	0.0650 A	PASS	0.000057 A

Transient Slew

Slew Rate	Nominal	Lower Limit	As Found	As Left	Error	Upper Limit	Result	Uncertainty (±)
0.05A / μS	100.0 μS	75.0 μS	98.7 μS	98.7 μS	1.30 %	125.0 μS	PASS	0.057 μS
2.5A / μS	2.00 mS	1.50 mS	1.84 mS	1.84 mS	8.00 %	2.50 mS	PASS	0.0057 mS

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Calibration Report of Hewlett Packard 60502B Electronic Load

MPC Control #:	3211A01907	Serial Number:	3211A01907
Asset ID:	PWAT-16GC0002	Calibration Date:	April 30, 2020

Power Limit

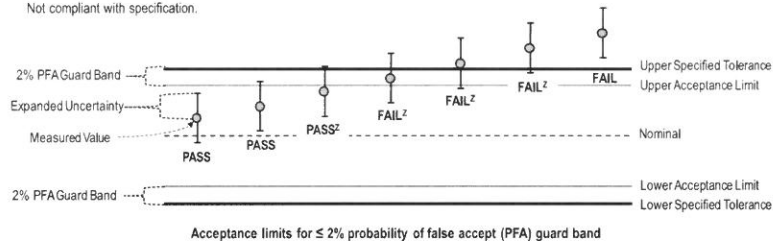
Function Tested	Nominal	Lower Limit	As Found	As Left	Error	Upper Limit	Result	Uncertainty (±)
Power Limit	PASS	NA	PASS	PASS	NA	NA	PASS	NA

Statements of Pass or Fail Conformance

The uncertainty of measurement has been taken into account when determining compliance with specification, as per ILAC-G8:03/2009.
All measurements and test results guard banded to ensure the probability of false-accept does not exceed 2% in compliance with ANSI/NCCL Z540.3-2006

The status of compliance with the acceptance criteria is reported as:

- PASS** — Compliant with specification.
- PASS^z** — The measured value is within acceptance limits.
However, a portion of the expanded uncertainty of measurement at 95% exceeds the specified tolerance.
- FAIL^z** — The measured value is not within the acceptance limits.
However, a portion of the expanded uncertainty of measurement at 95% is within the specified tolerance.
- FAIL** — Not compliant with specification.



The expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k = 2$, which for a normal distribution corresponds to a coverage probability of approximately 95%, unless otherwise stated.

This calibration report complies with ISO/IEC 17025:2017 and ANSI/NCCL Z540.3-2006, Method 6 — Guard Bands Based on Test Uncertainty Ratio.

- End of Calibration Report -

RF 15/05/20