

Certificate of Calibration



ISO/IEC 17025:2005 and ANSI/NCSL Z540.1-1994

Certificate Number 1-6215927876-1

Model Number 8720D
Manufacturer Hewlett Packard Co
Description Network analyzer 50MHz to 20GHz
Serial Number US39150600
Options Installed 1D5 010

Date of Calibration 16 Sep 2014
Procedure STE-50114355-A.04.01
Temperature (23 ± 3) °C
Humidity (45 ± 25) %RH

Customer
Kirkby Microwave Ltd
Burnham Rd
Stokes Hall Lodge
ALTHORNE CM3 6DT
United Kingdom

Location of Calibration
Keysight Technologies UK Limited
610 Wharfedale Road
Winnersh Triangle
Wokingham Berkshire RG41 5TP
United Kingdom

This certifies that the equipment has been calibrated using applicable Keysight Technologies procedures and in compliance with ISO/IEC 17025:2005 and ANSI/NCSL Z540.1-1994 (R2002). The quality management system is registered to ISO 9001:2008.

As Received Conditions

The measured values of the equipment were observed IN SPECIFICATION at the points tested.

Action Taken

- No corrective actions were necessary.

As Completed Conditions

The measured values of the equipment were observed IN SPECIFICATION at the points tested.

Remarks or Special Requirements

This calibration certificate may reference instruments manufactured by HP, Agilent and Keysight as being manufactured by Keysight Technologies, Inc.

The test limits stated in the report correspond to the published specifications of the equipment, at the points tested.

Based on the customer's request, the next calibration is due on 16 Sep 2015.

Keysight Technologies UK Limited
610 Wharfedale Road
Winnersh Triangle
Wokingham Berkshire RG41 5TP
United Kingdom

A handwritten signature in black ink that reads "Edgar Leckel".

Edgar Leckel - European Operations Manager

Certificate of Calibration



ISO/IEC 17025:2005 and ANSI/NCSL Z540.1-1994

Certificate Number 1-6215927876-1

Traceability Information

Technician ID Number 00526995

Measurements are traceable to the International System of Units (SI) via national metrology institutes (e.g., NIST, NPL, PTB, NMIJ, NRC, KRIS, SIRIM, etc.) that are signatories to the CIPM Mutual Recognition Arrangement.

This certificate shall not be reproduced, except in full, without prior written approval of the laboratory.

Calibration Equipment Used

Model Number	Model Description	Equipment ID	Cal Due Date	Certificate Number
5071A	Primary frequency standard	UK13623	11 Feb 2015	1-5668289000-1
5352B	CW Microwave frequency counter	UK7633	31 Mar 2015	1-5447048344-1
8485A	Power Sensor, 50 MHz to 26.5 GHz, -30 to +20 dBm	UK7555	25 Nov 2014	1-3785080875-1
85052B	Standard mechanical calibration kit, DC to 26.5 GHz, 3.5 mm	UK14139	28 Apr 2015	1-5923469892-1
85053A	3.5 MM verification kit	UK12892	2 Dec 2014	1-5532814825-1
E4418B	Power meter - EPM series, single channel	UK14890	8 May 2016	1-6009041100-1

Traceability Table

	Model	Model Description	Equipment ID	Certificate Number	Trace Value
W,R	5071A	Primary frequency standard	UK13623	1-5668289000-1-UKAS:C 0147	Frequency
W	5352B	CW Microwave frequency counter	UK7633	1-5447048344-1	
R	5071A	Primary frequency standard	UK13623	1-4986815336-1-UKAS:C 0147	Frequency
W	8485A	POWER SENSOR	UK7555	1-3785080875-1	
R	8485A	POWER SENSOR	UK13386	1-2987337965-1-UKAS:0478	RF Power
W,R	85052B	Standard mechanical calibration kit, DC to 26.5 GHz, 3.5 mm	UK14139	1-5923469892-1-A2LA:2079.01	Reflection Coefficient Transmission Coefficient
W,R	85053A	3.5 MM verification kit	UK12892	1-5532814825-1-A2LA:2079.01	Reflection Coefficient Transmission Coefficient
W	E4418B	Power meter - EPM series, single channel	UK14890	1-6009041100-1	
R	478A	Coaxial Thermistor Mount, 10 MHz to 10 GHz	UK10764	1-4614972293-1-UKAS:C 0147	RF Power

Legend

W - Working Standard The calibration equipment used for the calibration of the Model indicated on the first page of the Certificate of calibration.

R - Reference Standard The Reference Standard (Accredited or NMI-calibrated ETE) used to provide traceability to the SI-Units for the calibration parameters listed.

Certificate of Calibration



ISO/IEC 17025:2005 and ANSI/NCSL Z540.1-1994

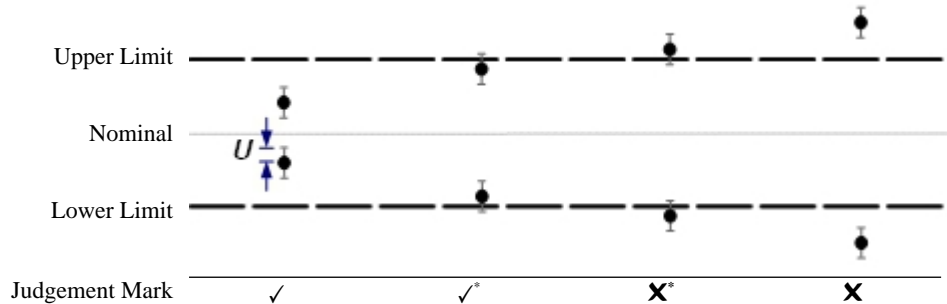
Certificate Number 1-6215927876-1

Compliance with Specification

In the assessment of compliance with specification, the uncertainty of measurement has been taken into account. If the uncertainty of measurement overlaps the specification limit (upper limit or lower limit), it is not possible to state compliance/non-compliance based on a 95% level of confidence. However, where a confidence level less than 95% is acceptable, a compliance/non-compliance statement may be possible.

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

- ✓ - Compliant with specification.
- ✓^{*} - Compliance with specification providing a lower level of confidence is acceptable.
- ✗^{*} - Non-compliance with specification providing a lower level of confidence is acceptable.
- ✗ - Not compliant with specification.



The diagram above shows the typical compliance status for measured values as defined by this service. The vertical bar (U) above and below each measurement value represents the uncertainty of measurement.

As Received Conditions/As Completed Conditions

A compilation for all performed tests of the status as received (before any adjustment/repair) and the status as completed (after any adjustment/repair) is reported on the first page of this report. The compliance with typical (non-warranted) specifications will not affect the status as received or the status as completed reported on the first page.

The status summaries relate to the tested item only. A final decision about whether the item's performance actually satisfies requirements of the user can only be made by the user.

Uncertainty of Measurement

The uncertainty evaluation has been performed in accordance with ISO/IEC Guide 98-3:2008 (GUM). The reported expanded measurement uncertainty is the standard uncertainty multiplied by the coverage factor $k=2$ (for a normal distribution) or $k=1.65$ (for a uniform distribution), which corresponds to a coverage probability of approximately 95%. Where this is not the case, the distribution, coverage factor (k), effective degrees of freedom (ν_{eff}) and coverage probability (p) are stated.

Any quoted measurement uncertainty applies only to the measured value and does not imply anything regarding the long-term stability of the equipment.

Certificate of Calibration



ISO/IEC 17025:2005 and ANSI/NCSL Z540.1-1994

Certificate Number 1-6215927876-1

Performance Test Results Summary

<u>Test Name</u>	<u>As Received Status</u>
PORT 1 OPERATIONAL CHECK	PASSED
PORT 2 OPERATIONAL CHECK	PASSED
SYSTEM VERIFICATION	PASSED
FREQUENCY ACCURACY	PASSED
POWER FLATNESS	PASSED
POWER LINEARITY	PASSED
DYNAMIC RANGE	PASSED
OPT1D5 HI STAB TIMEBASE	PASSED

PORT 1 OPERATIONAL CHECK

PASSED

TEST CONDITIONS	STATUS
Service Test 21 Status:	PASSED

PORT 2 OPERATIONAL CHECK

PASSED

TEST CONDITIONS	STATUS
Service Test 22 Status:	PASSED

SYSTEM VERIFICATION

PASSED

TEST CONDITIONS	STATUS
20 dB attenuator	
S11/S22 Magnitude	PASSED
S21/S12 Magnitude	PASSED
S21/S12 Phase	PASSED
40 dB attenuator	
S11/S22 Magnitude	PASSED
S21/S12 Magnitude	PASSED
S21/S12 Phase	PASSED
50 Ohm airline	
S11/S22 Magnitude	PASSED
S11/S22 Phase	PASSED
S21/S12 Magnitude	PASSED
S21/S12 Phase	PASSED
25 Ohm mismatch airline	
S11/S22 Magnitude	PASSED
S11/S22 Phase	PASSED
S21/S12 Magnitude	PASSED
S21/S12 Phase	PASSED

FREQUENCY ACCURACY

PASSED

TEST COND.	MINIMUM	MEASURED	MAXIMUM	UNCERT.	
Frequency Setting					
20.0 GHz	19.999800 GHz	20.000000 GHz	20.000200 GHz	0.000028 GHz	✓

POWER FLATNESS

PASSED

TEST CONDITIONS	MINIMUM	MEASURED	MAXIMUM	UNCERT.	
0 dBm Power Level					
0.05 GHz - 20.0 GHz					
PORT 1:					
Max Power Reading	-2.00 dBm	0.61 dBm	2.00 dBm	0.25 dB	✓
Min Power Reading	-2.00 dBm	-0.67 dBm	2.00 dBm	0.25 dB	✓
0 dBm Power Level					
0.05 GHz - 20.0 GHz					
PORT 2:					
Max Power Reading	-2.00 dBm	0.65 dBm	2.00 dBm	0.25 dB	✓
Min Power Reading	-2.00 dBm	-0.84 dBm	2.00 dBm	0.25 dB	✓

POWER LINEARITY

PASSED

TEST CONDITIONS	MINIMUM	MEASURED	MAXIMUM	UNCERT.	
PORT 1:					
Pref = -5 dBm					
P1 (Pref-5 dB):					
Max Reading	-0.35 dB	0.03 dB	0.35 dB	0.031 dB	✓
Min Reading	-0.35 dB	-0.13 dB	0.35 dB	0.031 dB	✓
P2 (Pref-10 dB):					
Max Reading	-0.60 dB	-0.04 dB	0.60 dB	0.031 dB	✓
Min Reading	-0.60 dB	-0.29 dB	0.60 dB	0.031 dB	✓
P3 (Pref+5 dB):					
Max Reading	-0.35 dB	0.02 dB	0.35 dB	0.031 dB	✓
Min Reading	-0.35 dB	-0.18 dB	0.35 dB	0.031 dB	✓
P4 (Pref+10 dB):					
Max Reading	-1.00 dB	0.19 dB	1.00 dB	0.031 dB	✓
Min Reading	-1.00 dB	-0.53 dB	1.00 dB	0.031 dB	✓

DYNAMIC RANGE

PASSED

TEST CONDITIONS	MINIMUM	MEASURED	UNCERT.	
Frequency Range				
S21:				
50 MHz - 50.000101 MHz	77.0 dB	85.3 dB	0.056 dB	✓
839.999899 MHz - 840 MHz	77.0 dB	110.1 dB	0.057 dB	✓
840 MHz - 8.0 GHz	100.0 dB	110.2 dB	0.095 dB	✓
8.0 GHz - 20.05 GHz	100.0 dB	108.5 dB	0.11 dB	✓

DYNAMIC RANGE (cont.)

TEST CONDITIONS	MINIMUM	MEASURED	UNCERT.	
Frequency Range				
S12:				
50 MHz - 50.000101 MHz	77.0 dB	85.3 dB	0.056 dB	✓
839.999899 MHz - 840 MHz	77.0 dB	110.2 dB	0.057 dB	✓
840 MHz - 8.0 GHz	100.0 dB	110.1 dB	0.095 dB	✓
8.0 GHz - 20.05 GHz	100.0 dB	108.0 dB	0.11 dB	✓

OPT1D5 HI STAB TIMEBASE

PASSED

Elapsed time after power-on: 48 h

The relative frequency (Rel. Freq.) value below is the difference frequency (actual frequency minus nominal frequency) divided by the nominal frequency.

Timebase	Actual Frequency	Rel. Freq.	Min	Freq. Error	Max	UNCERT.	
10 MHz	10.00000003739 MHz	3.73900E-09	-1.0000 Hz	0.0374 Hz	1.0000 Hz	0.0010 Hz	✓

NOTE: No adjustment needed