KEYSIGHT TECHNOLOGIES

CERTIFICATE OF CALIBRATION

1346 Yellowwood Road, Kimballton, IA 51543

ACCREDITED
Certificate #2123.01

CERTIFICATE #: 190227-141643-b82d3e

190227-141643-b82d3e

CLIENT:	Compliance Testing LLC, 1724 S Nevada Way, Mesa, AZ, 85204, USA
MANUFACTURER:	EMCO
EQUIPMENT TYPE:	Horn (Small)
MODEL NUMBER:	3116
SERIAL NUMBER:	2076
ASSET NUMBER:	i00085

Instrumentation Environment:	**TEMP:**	21°C	**RH:**	29%
Calibration Environment:	**TEMP:**	21°C	**RH:**	29%

DATE RECEIVED:	02/26/2019
DATE OF CALIBRATION:	02/28/2019
CALIBRATION DUE DATE:	02/28/2021
CALIBRATION CYCLE NOTES:	2 years from calibration date. The applied calibration cycle has been requested by the customer. The relevant documentation has been received and is on file.
CALIBRATION LOCATION:	1346 Yellowwood Road, Kimballton, IA 51543
CALIBRATION BY:	Rodger Rasmussen

EQUIPMENT STATUS

Received in tolerance:	☑	**Returned in tolerance:**	☑
Received with limited cal.:	☐	**Returned with limited cal.:**	☐
Received out of tolerance:	☐	**Returned out of tolerance:**	☐

CALIBRATION STANDARD(S)	CALIBRATION METHOD(S)	CALIBRATION PROCEDURE(S)
SAE ARP 958D 2003	Combination of SAE Clause 4 and Appendix C	356847

NOTES:

Keysight-LC Service Center Manager
Brandt Langer

This report is not to be reproduced, except in full, without written approval of Keysight Technologies.
All results of this calibration relate only to the item that was calibrated. The limits stated in the report correspond to the published specification of the equipment and/or standard, at the specified parameters.
MEASURED VALUES ARE REPORTED ON THE ATTACHED PAGES.

CALIBRATION EQUIPMENT USED:

Manufacturer	Equipment Type	Model Number	Serial Number	Trace #	Cal Due Date
Comtest	Chamber	8M Chamber	20021	170321-095049-079e1b	05/22/2019
EMCO	Horn (4.5 - 40 GHz)	3116	9003-2135	170828-134217-bd6b9c	08/28/2019
ETS	Horn (Small) 4.5-40GHz	3116	00062501	170828-134508-1e57d2	08/28/2019
Keysight Technologies, Inc.	PNA Network Analyzer	N5225A	MY56051740	1-10144781110-1	06/25/2019

CALIBRATION DATA FILE(S) THAT ARE PART OF THIS CERTIFICATE:

2019-1MV.dat 2019-1MV.txt

** All data/documentation is available online at: http://certxpress.service.keysight.com/certxpress/login.aspx*

CALIBRATION SOFTWARE:

ACF-Insertion Loss Analysis 2.9

DRWG Standard Site Method 2.12

IN TOLERANCE/OUT OF TOLERANCE EXPLANATION:

The standard criteria to determine the "In Tolerance/Out of Tolerance" status is based on one or more of the following conditions, as requested by the client:

1. If the manufacturer has a specified tolerance for the item being calibrated, then the calibration values are compared to this tolerance, and the values must fall within the manufacturer's tolerance. The tolerance may be obtained from the manufacturer's web site, data sheets, equipment manuals, etc.
2. Where tolerances are called out in a published standard, the calibration results are compared to this tolerance, and the measured values must fall within the standard's tolerance.
3. In cases where the manufacturer, standard, or client does not identify any relevant tolerances, applicable calibration results are compared to historical data with a +/- 3 dB tolerance.

CALIBRATION TRACEABILITY:

This laboratory is accredited to ISO/IEC 17025:2005 and NCSL/ANSI Z540-1-1994. All measurement instrumentation is traceable to a recognized National Metrology Institute, which is a signatory to the International Committee for Weights & Measures, Mutual Recognition Arrangement. Supporting documentation related to traceability is on file and is available for examination upon request.

INTERPRETATION TO THE GUIDANCE AND USE OF CALIBRATION DATA:

The calibration values supplied with this certificate apply to measurements made under the physical (geometric) arrangements with respect to the applicable calibration standard. This antenna has been individually calibrated in a freespace environment for stated distances from reference points on the antenna. Use of this antenna under other conditions will result in additional sources of error of which is the responsibility of the user.

CALIBRATION UNCERTAINTY:

☐ **Actual uncertainty (Expanded)** _____

☑ **Uncertainties that apply to this calibration are shown below. CMC represents our typical uncertainty for the calibration documented in this certificate since, to the best of our knowledge, the conditions under which the CMC for this facility and calibration item was determined applied to this calibration as well. The repeatability contribution to CMC is based on a type A evaluation of at least 10 data sets or more.**

Parameter/Equipment:	Range:	CMC** (+/-):
Horn Antennas/LPA's - 1 & 3 Meter Distance (CISPR 16-1-6), Far Field (ANSI C63.5)	700 MHz to 18 GHz	0.37 dB
	(18 to 26.5) GHz	0.42 dB
	(26.5 to 50) GHz	0.47 dB

** Calibration and Measurement Capability (CMC) is the smallest uncertainty of measurement that a laboratory can achieve within its scope of accreditation when performing more or less routine calibrations of nearly ideal measurement standards or nearly ideal measuring equipment. Calibration and Measurement Capabilities represent expanded uncertainties expressed at approximately the 95 % level of confidence, usually using a coverage factor of k = 2. The actual measurement uncertainty of a specific calibration performed by the laboratory may be greater than the CMC due to the behavior of the customer's device and to influences from the circumstances of the specific calibration. In the statement of CMC, M is the uncertainty contribution of the mismatch error caused by the impedance mismatch between the calibration system of the laboratory and the device under calibration.

For further detailed explanations, a complete copy of the scope of our A2LA accreditation is available upon request.

Date of Calibration = Feb 28, 2019

Date Printed: Thursday, February 28, 2019 11:01 AM
Customer Name: Compliance Testing LLC
Antenna Manufacturer: EMCO
Antenna Model: 3116
Antenna Serial No.: 2076
Temperature (Deg C): 21.0
Humidity (%): 29.0
Measurement Distance in Meters = 1.0
Antenna Polarization = VERT

NOTES:

CAL CERT #: 190227-141643-b82d3e

Freq (MHz)	ACF (dB)	Gain (dBi)	Num GAIN
18000.0000	44.997	10.308	10.736
18100.0000	44.988	10.365	10.877
18200.0000	44.968	10.434	11.050
18300.0000	44.979	10.470	11.143
18400.0000	44.854	10.642	11.594
18500.0000	44.828	10.715	11.790
18600.0000	44.907	10.684	11.705
18700.0000	44.923	10.714	11.787
18800.0000	44.933	10.750	11.885
18900.0000	44.845	10.884	12.258
19000.0000	44.857	10.918	12.354
19100.0000	44.903	10.917	12.352
19200.0000	44.878	10.989	12.556
19300.0000	44.801	11.110	12.912
19400.0000	44.832	11.125	12.955
19500.0000	44.749	11.251	13.339
19600.0000	44.644	11.401	13.807
19700.0000	44.639	11.451	13.966
19800.0000	44.595	11.539	14.252
19900.0000	44.563	11.614	14.501
20000.0000	44.522	11.698	14.785
20100.0000	44.485	11.778	15.061
20200.0000	44.487	11.821	15.207
20300.0000	44.538	11.812	15.177
20400.0000	44.577	11.815	15.189
20500.0000	44.604	11.831	15.244
20600.0000	44.604	11.874	15.395
20700.0000	44.677	11.842	15.283
20800.0000	44.701	11.860	15.347
20900.0000	44.637	11.966	15.725
21000.0000	44.620	12.025	15.939
21100.0000	44.630	12.056	16.054

21200.0000	44.636	12.090	16.182
21300.0000	44.628	12.139	16.366
21400.0000	44.599	12.209	16.631
21500.0000	44.603	12.246	16.772
21600.0000	44.691	12.199	16.590
21700.0000	44.746	12.183	16.531
21800.0000	44.794	12.175	16.501
21900.0000	44.839	12.170	16.481
22000.0000	44.940	12.108	16.249
22100.0000	45.012	12.075	16.127
22200.0000	45.046	12.082	16.149
22300.0000	45.120	12.046	16.018
22400.0000	45.110	12.094	16.198
22500.0000	45.146	12.097	16.208
22600.0000	45.230	12.052	16.040
22700.0000	45.217	12.104	16.232
22800.0000	45.291	12.068	16.098
22900.0000	45.364	12.033	15.969
23000.0000	45.447	11.988	15.804
23100.0000	45.530	11.943	15.641
23200.0000	45.602	11.907	15.515
23300.0000	45.620	11.928	15.587
23400.0000	45.588	11.996	15.835
23500.0000	45.620	12.002	15.855
23600.0000	45.627	12.031	15.963
23700.0000	45.573	12.121	16.299
23800.0000	45.529	12.202	16.605
23900.0000	45.521	12.247	16.776
24000.0000	45.534	12.271	16.868
24100.0000	45.619	12.221	16.677
24200.0000	45.736	12.140	16.369
24300.0000	45.805	12.107	16.244
24400.0000	45.910	12.037	15.986
24500.0000	46.078	11.905	15.507
24600.0000	46.156	11.863	15.356
24700.0000	46.187	11.866	15.369
24800.0000	46.213	11.876	15.403
24900.0000	46.278	11.845	15.295
25000.0000	46.287	11.872	15.388
25100.0000	46.251	11.943	15.641
25200.0000	46.218	12.010	15.885
25300.0000	46.168	12.095	16.198
25400.0000	46.100	12.196	16.582
25500.0000	46.104	12.227	16.699
25600.0000	46.006	12.358	17.212
25700.0000	46.009	12.389	17.335
25800.0000	46.074	12.358	17.212
25900.0000	46.141	12.325	17.080
26000.0000	46.272	12.227	16.700
26100.0000	46.309	12.224	16.687

26200.0000	46.388	12.178	16.512
26300.0000	46.462	12.137	16.357
26400.0000	46.518	12.114	16.271
26500.0000	46.462	12.203	16.607
26600.0000	46.407	12.291	16.947
26700.0000	46.401	12.329	17.097
26800.0000	46.342	12.420	17.460
26900.0000	46.268	12.527	17.894
27000.0000	46.248	12.580	18.112
27100.0000	46.286	12.574	18.087
27200.0000	46.295	12.596	18.181
27300.0000	46.356	12.567	18.060
27400.0000	46.398	12.557	18.018
27500.0000	46.442	12.545	17.967
27600.0000	46.508	12.511	17.826
27700.0000	46.570	12.480	17.700
27800.0000	46.585	12.496	17.766
27900.0000	46.596	12.516	17.849
28000.0000	46.579	12.564	18.047
28100.0000	46.530	12.645	18.385
28200.0000	46.449	12.756	18.862
28300.0000	46.374	12.861	19.326
28400.0000	46.392	12.875	19.385
28500.0000	46.338	12.958	19.763
28600.0000	46.364	12.963	19.784
28700.0000	46.369	12.989	19.901
28800.0000	46.409	12.979	19.856
28900.0000	46.463	12.954	19.745
29000.0000	46.514	12.933	19.649
29100.0000	46.560	12.918	19.579
29200.0000	46.612	12.895	19.477
29300.0000	46.634	12.904	19.515
29400.0000	46.612	12.954	19.745
29500.0000	46.598	12.998	19.944
29600.0000	46.617	13.008	19.991
29700.0000	46.571	13.084	20.343
29800.0000	46.533	13.151	20.659
29900.0000	46.546	13.167	20.736
30000.0000	46.528	13.215	20.964
30100.0000	46.613	13.158	20.693
30200.0000	46.617	13.184	20.814
30300.0000	46.626	13.202	20.905
30400.0000	46.734	13.124	20.529
30500.0000	46.819	13.067	20.263
30600.0000	46.840	13.074	20.297
30700.0000	46.854	13.089	20.365
30800.0000	46.872	13.100	20.415
30900.0000	46.946	13.053	20.198
31000.0000	46.946	13.082	20.331
31100.0000	46.964	13.091	20.376

31200.0000	46.994	13.089	20.366
31300.0000	47.065	13.045	20.162
31400.0000	47.100	13.038	20.129
31500.0000	47.143	13.024	20.061
31600.0000	47.201	12.993	19.920
31700.0000	47.302	12.919	19.584
31800.0000	47.490	12.759	18.875
31900.0000	47.524	12.752	18.845
32000.0000	47.610	12.693	18.591
32100.0000	47.841	12.490	17.740
32200.0000	48.097	12.261	16.829
32300.0000	48.192	12.192	16.565
32400.0000	48.192	12.219	16.668
32500.0000	48.432	12.006	15.870
32600.0000	48.693	11.771	15.035
32700.0000	48.691	11.800	15.136
32800.0000	48.702	11.816	15.191
32900.0000	48.733	11.810	15.172
33000.0000	48.973	11.598	14.447
33100.0000	49.042	11.554	14.303
33200.0000	48.964	11.659	14.652
33300.0000	48.941	11.708	14.818
33400.0000	49.103	11.572	14.361
33500.0000	49.211	11.489	14.091
33600.0000	49.164	11.562	14.330
33700.0000	49.175	11.577	14.379
33800.0000	49.169	11.610	14.487
33900.0000	49.325	11.478	14.056
34000.0000	49.466	11.364	13.689
34100.0000	49.367	11.489	14.088
34200.0000	49.294	11.587	14.410
34300.0000	49.326	11.579	14.386
34400.0000	49.348	11.584	14.400
34500.0000	49.157	11.799	15.133
34600.0000	48.996	11.986	15.797
34700.0000	48.990	12.016	15.909
34800.0000	48.936	12.096	16.202
34900.0000	48.778	12.279	16.900
35000.0000	48.663	12.418	17.451
35100.0000	48.623	12.483	17.714
35200.0000	48.704	12.427	17.486
35300.0000	48.568	12.587	18.144
35400.0000	48.440	12.741	18.795
35500.0000	48.357	12.847	19.263
35600.0000	48.291	12.938	19.670
35700.0000	48.129	13.125	20.534
35800.0000	47.889	13.388	21.819
35900.0000	47.681	13.620	23.017
36000.0000	47.415	13.912	24.612
36100.0000	47.212	14.138	25.930

36200.0000	46.904	14.470	27.990
36300.0000	46.627	14.771	29.999
36400.0000	46.332	15.091	32.289
36500.0000	46.191	15.254	33.531
36600.0000	46.040	15.430	34.913
36700.0000	45.786	15.708	37.219
36800.0000	45.579	15.937	39.242
36900.0000	45.537	16.003	39.841
37000.0000	45.522	16.042	40.198
37100.0000	45.379	16.208	41.766
37200.0000	45.304	16.306	42.721
37300.0000	45.308	16.326	42.915
37400.0000	45.381	16.276	42.425
37500.0000	45.304	16.376	43.414
37600.0000	45.245	16.458	44.242
37700.0000	45.286	16.441	44.065
37800.0000	45.300	16.450	44.156
37900.0000	45.289	16.483	44.498
38000.0000	45.282	16.514	44.811
38100.0000	45.294	16.524	44.918
38200.0000	45.360	16.481	44.475
38300.0000	45.459	16.405	43.702
38400.0000	45.478	16.408	43.735
38500.0000	45.570	16.340	43.049
38600.0000	45.639	16.292	42.583
38700.0000	45.719	16.236	42.030
38800.0000	45.914	16.062	40.386
38900.0000	45.998	16.001	39.820
39000.0000	46.037	15.984	39.666
39100.0000	46.158	15.885	38.773
39200.0000	46.287	15.778	37.830
39300.0000	46.402	15.686	37.033
39400.0000	46.464	15.645	36.690
39500.0000	46.449	15.683	37.008
39600.0000	46.584	15.570	36.057
39700.0000	46.740	15.436	34.962
39800.0000	46.964	15.233	33.368
39900.0000	47.155	15.065	32.098
40000.0000	47.283	14.959	31.323

KEYSIGHT TECHNOLOGIES

CERTIFICATE OF CALIBRATION

1346 Yellowwood Road, Kimballton, IA 51543

ACCREDITED
Certificate #2123.01

CERTIFICATE #: 190227-135209-0602f6

190227-135209-0602f6

CLIENT:	Compliance Testing LLC, 1724 S Nevada Way, Mesa, AZ, 85204, USA
MANUFACTURER:	EMCO
EQUIPMENT TYPE:	Horn (Small)
MODEL NUMBER:	3115
SERIAL NUMBER:	9208-3925
ASSET NUMBER:	i00103

Instrumentation Environment:	**TEMP:**	21°C	**RH:**	29%
Calibration Environment:	**TEMP:**	21°C	**RH:**	29%

DATE RECEIVED:	02/26/2019
DATE OF CALIBRATION:	02/28/2019
CALIBRATION DUE DATE:	02/28/2021
CALIBRATION CYCLE NOTES:	2 years from calibration date. The applied calibration cycle has been requested by the customer. The relevant documentation has been received and is on file.
CALIBRATION LOCATION:	1346 Yellowwood Road, Kimballton, IA 51543
CALIBRATION BY:	Rodger Rasmussen

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Received in tolerance:	☑	**Returned in tolerance:**	☑
Received with limited cal.:	☐	**Returned with limited cal.:**	☐
Received out of tolerance:	☐	**Returned out of tolerance:**	☐

CALIBRATION STANDARD(S)	CALIBRATION METHOD(S)	CALIBRATION PROCEDURE(S)
ANSI C63.5 2017, CISPR 16-1-6 2014	ANSI Clause 5.1.3 CISPR Clause 9.5.1.3	356847

NOTES:

Keysight-LC Service Center Manager
Brandt Langer

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CALIBRATION EQUIPMENT USED:

Manufacturer	Equipment Type	Model Number	Serial Number	Trace #	Cal Due Date
Comtest	Chamber	8M Chamber	20021	170321-095049-079e1b	05/22/2019
ETS - Lindgren	Horn (Small)	3115	00071507	170404-082254-feb513	04/04/2019
ETS-Lindgren	Horn (Small)	3115	00071508	180424-075800-c62ac2	04/24/2020
Keysight Technologies, Inc.	PNA Network Analyzer	N5225A	MY56051740	1-10144781110-1	06/25/2019

CALIBRATION DATA FILE(S) THAT ARE PART OF THIS CERTIFICATE:

2019-3MH.dat 2019-3MH.txt

2019-3MV.dat 2019-3MV.txt

** All data/documentation is available online at: http://certxpress.service.keysight.com/certxpress/login.aspx*

CALIBRATION SOFTWARE:

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DRWG Standard Site Method 2.12

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2. Where tolerances are called out in a published standard, the calibration results are compared to this tolerance, and the measured values must fall within the standard's tolerance.
3. In cases where the manufacturer, standard, or client does not identify any relevant tolerances, applicable calibration results are compared to historical data with a +/- 3 dB tolerance.

CALIBRATION TRACEABILITY:

This laboratory is accredited to ISO/IEC 17025:2005 and NCSL/ANSI Z540-1-1994. All measurement instrumentation is traceable to a recognized National Metrology Institute, which is a signatory to the International Committee for Weights & Measures, Mutual Recognition Arrangement. Supporting documentation related to traceability is on file and is available for examination upon request.

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For further detailed explanations, a complete copy of the scope of our A2LA accreditation is available upon request.

Date of Calibration = Feb 28, 2019

Date Printed: Thursday, February 28, 2019 2:27 PM
Customer Name: Compliance Testing LLC
Antenna Manufacturer: EMCO
Antenna Model: 3115
Antenna Serial No.: 9208-3925
Temperature (Deg C): 21.0
Humidity (%): 29.0
Measurement Distance in Meters = 3.0
Antenna Polarization = VERT

NOTES: Observed Pin Depth: -0.0095" from typical.

CAL CERT #: 190227-135209-0602f6

Freq (MHz)	ACF (dB)	Gain (dBi)	Num GAIN
1000.0000	24.108	6.091	4.066
1050.0000	24.398	6.226	4.194
1100.0000	24.729	6.299	4.265
1150.0000	24.598	6.816	4.804
1200.0000	25.065	6.718	4.697
1250.0000	25.383	6.756	4.738
1300.0000	25.178	7.301	5.371
1350.0000	25.221	7.586	5.736
1400.0000	25.296	7.826	6.062
1450.0000	25.231	8.197	6.602
1500.0000	25.328	8.393	6.908
1550.0000	25.328	8.678	7.376
1600.0000	25.290	8.993	7.930
1650.0000	25.569	8.981	7.908
1700.0000	26.052	8.756	7.510
1750.0000	26.930	8.130	6.502
1800.0000	26.870	8.435	6.975
1850.0000	27.159	8.385	6.894
1900.0000	27.460	8.315	6.784
1950.0000	27.615	8.385	6.895
2000.0000	27.548	8.673	7.367
2050.0000	27.569	8.866	7.702
2100.0000	27.680	8.964	7.878
2150.0000	27.840	9.008	7.959
2200.0000	27.656	9.392	8.694
2250.0000	27.631	9.612	9.146
2300.0000	27.874	9.560	9.037
2350.0000	28.344	9.278	8.468
2400.0000	28.651	9.153	8.228
2450.0000	28.630	9.354	8.617
2500.0000	28.701	9.458	8.827
2550.0000	28.929	9.402	8.713
2600.0000	29.037	9.463	8.836
2650.0000	29.015	9.649	9.225
2700.0000	28.915	9.912	9.800

2750.0000	28.922	10.065	10.150
2800.0000	29.118	10.026	10.059
2850.0000	29.212	10.084	10.196
2900.0000	29.460	9.988	9.972
2950.0000	29.869	9.727	9.391
3000.0000	30.291	9.452	8.814
3050.0000	30.501	9.385	8.680
3100.0000	30.699	9.329	8.568
3150.0000	30.952	9.214	8.345
3200.0000	30.990	9.312	8.536
3250.0000	31.021	9.417	8.743
3300.0000	31.059	9.511	8.935
3350.0000	31.203	9.498	8.908
3400.0000	31.084	9.746	9.431
3450.0000	31.120	9.836	9.630
3500.0000	31.265	9.817	9.587
3550.0000	31.271	9.933	9.848
3600.0000	31.426	9.901	9.774
3650.0000	31.649	9.797	9.543
3700.0000	31.917	9.648	9.220
3750.0000	32.294	9.386	8.682
3800.0000	32.617	9.178	8.276
3850.0000	32.693	9.216	8.349
3900.0000	32.652	9.369	8.648
3950.0000	32.550	9.582	9.082
4000.0000	32.468	9.773	9.491
4050.0000	32.445	9.905	9.783
4100.0000	32.172	10.284	10.675
4150.0000	32.054	10.507	11.238
4200.0000	32.071	10.594	11.466
4250.0000	32.011	10.757	11.904
4300.0000	32.001	10.869	12.214
4350.0000	32.009	10.961	12.476
4400.0000	32.098	10.972	12.507
4450.0000	32.184	10.983	12.540
4500.0000	32.221	11.044	12.716
4550.0000	32.253	11.107	12.904
4600.0000	32.346	11.109	12.909
4650.0000	32.473	11.076	12.812
4700.0000	32.659	10.982	12.539
4750.0000	32.783	10.950	12.446
4800.0000	32.853	10.971	12.507
4850.0000	33.145	10.769	11.938
4900.0000	33.231	10.773	11.948
4950.0000	33.125	10.967	12.494
5000.0000	33.213	10.966	12.492
5050.0000	33.419	10.847	12.153
5100.0000	33.624	10.727	11.823
5150.0000	33.714	10.722	11.809
5200.0000	33.763	10.758	11.906
5250.0000	33.868	10.736	11.846
5300.0000	33.878	10.808	12.044
5350.0000	33.988	10.780	11.966
5400.0000	34.124	10.723	11.813

5450.0000	34.143	10.785	11.981
5500.0000	34.174	10.834	12.116
5550.0000	34.150	10.936	12.405
5600.0000	34.121	11.042	12.713
5650.0000	34.092	11.149	13.029
5700.0000	34.000	11.317	13.543
5750.0000	34.027	11.366	13.697
5800.0000	34.007	11.462	14.002
5850.0000	34.045	11.499	14.121
5900.0000	34.105	11.512	14.165
5950.0000	34.261	11.429	13.897
6000.0000	34.413	11.351	13.647
6050.0000	34.433	11.403	13.812
6100.0000	34.516	11.391	13.775
6150.0000	34.623	11.354	13.659
6200.0000	34.664	11.383	13.751
6250.0000	34.654	11.464	14.008
6300.0000	34.615	11.571	14.360
6350.0000	34.583	11.672	14.697
6400.0000	34.462	11.861	15.351
6450.0000	34.387	12.004	15.864
6500.0000	34.384	12.074	16.122
6550.0000	34.476	12.048	16.027
6600.0000	34.617	11.974	15.754
6650.0000	34.861	11.795	15.119
6700.0000	35.101	11.620	14.522
6750.0000	35.287	11.500	14.124
6800.0000	35.304	11.546	14.276
6850.0000	35.334	11.580	14.388
6900.0000	35.328	11.648	14.617
6950.0000	35.376	11.663	14.667
7000.0000	35.374	11.727	14.885
7050.0000	35.365	11.798	15.130
7100.0000	35.461	11.764	15.011
7150.0000	35.604	11.683	14.732
7200.0000	35.858	11.489	14.089
7250.0000	36.152	11.255	13.350
7300.0000	36.334	11.133	12.980
7350.0000	36.423	11.102	12.890
7400.0000	36.557	11.028	12.670
7450.0000	36.602	11.041	12.709
7500.0000	36.489	11.213	13.221
7550.0000	36.425	11.334	13.596
7600.0000	36.369	11.447	13.954
7650.0000	36.349	11.525	14.206
7700.0000	36.333	11.596	14.442
7750.0000	36.340	11.646	14.608
7800.0000	36.429	11.612	14.496
7850.0000	36.547	11.551	14.291
7900.0000	36.651	11.501	14.130
7950.0000	36.749	11.458	13.990
8000.0000	36.869	11.392	13.780
8050.0000	36.930	11.386	13.759
8100.0000	36.911	11.458	13.991

8150.0000	36.968	11.455	13.980
8200.0000	36.934	11.542	14.263
8250.0000	37.046	11.483	14.070
8300.0000	37.145	11.436	13.920
8350.0000	37.186	11.447	13.955
8400.0000	37.242	11.443	13.942
8450.0000	37.352	11.385	13.756
8500.0000	37.464	11.325	13.567
8550.0000	37.476	11.363	13.687
8600.0000	37.492	11.397	13.796
8650.0000	37.641	11.300	13.489
8700.0000	37.795	11.196	13.169
8750.0000	37.881	11.160	13.060
8800.0000	37.916	11.174	13.103
8850.0000	37.963	11.175	13.108
8900.0000	37.979	11.208	13.208
8950.0000	37.961	11.275	13.413
9000.0000	37.866	11.418	13.863
9050.0000	37.851	11.481	14.065
9100.0000	37.826	11.554	14.303
9150.0000	37.766	11.663	14.665
9200.0000	37.828	11.648	14.615
9250.0000	37.862	11.661	14.659
9300.0000	37.966	11.603	14.465
9350.0000	37.999	11.618	14.513
9400.0000	38.021	11.642	14.594
9450.0000	38.080	11.629	14.551
9500.0000	38.067	11.688	14.749
9550.0000	38.036	11.765	15.013
9600.0000	37.944	11.902	15.494
9650.0000	37.917	11.973	15.752
9700.0000	37.986	11.950	15.666
9750.0000	38.025	11.955	15.686
9800.0000	38.059	11.965	15.723
9850.0000	38.143	11.926	15.581
9900.0000	38.231	11.882	15.424
9950.0000	38.293	11.864	15.359
10000.0000	38.279	11.921	15.563
10050.0000	38.284	11.959	15.701
10100.0000	38.359	11.928	15.587
10150.0000	38.388	11.941	15.636
10200.0000	38.384	11.988	15.805
10250.0000	38.398	12.016	15.908
10300.0000	38.380	12.077	16.132
10350.0000	38.338	12.161	16.447
10400.0000	38.334	12.206	16.620
10450.0000	38.307	12.276	16.888
10500.0000	38.397	12.226	16.697
10550.0000	38.444	12.222	16.678
10600.0000	38.526	12.180	16.520
10650.0000	38.537	12.210	16.634
10700.0000	38.559	12.228	16.705
10750.0000	38.516	12.313	17.032
10800.0000	38.468	12.401	17.381

10850.0000	38.491	12.417	17.447
10900.0000	38.514	12.435	17.518
10950.0000	38.574	12.414	17.435
11000.0000	38.597	12.431	17.502
11050.0000	38.590	12.478	17.691
11100.0000	38.622	12.484	17.718
11150.0000	38.615	12.531	17.909
11200.0000	38.635	12.549	17.985
11250.0000	38.617	12.606	18.222
11300.0000	38.657	12.604	18.215
11350.0000	38.655	12.645	18.386
11400.0000	38.634	12.704	18.638
11450.0000	38.683	12.693	18.591
11500.0000	38.738	12.675	18.516
11550.0000	38.813	12.639	18.360
11600.0000	38.861	12.628	18.315
11650.0000	38.966	12.561	18.033
11700.0000	39.055	12.508	17.817
11750.0000	39.142	12.458	17.613
11800.0000	39.175	12.462	17.629
11850.0000	39.187	12.488	17.732
11900.0000	39.169	12.542	17.955
11950.0000	39.103	12.644	18.383
12000.0000	38.994	12.790	19.010
12050.0000	38.850	12.969	19.812
12100.0000	38.812	13.043	20.153
12150.0000	38.749	13.143	20.619
12200.0000	38.756	13.171	20.754
12250.0000	38.682	13.280	21.283
12300.0000	38.656	13.343	21.590
12350.0000	38.615	13.419	21.972
12400.0000	38.561	13.508	22.427
12450.0000	38.531	13.572	22.762
12500.0000	38.484	13.654	23.196
12550.0000	38.491	13.681	23.342
12600.0000	38.503	13.705	23.468
12650.0000	38.521	13.721	23.555
12700.0000	38.578	13.699	23.434
12750.0000	38.681	13.630	23.065
12800.0000	38.762	13.583	22.817
12850.0000	38.854	13.525	22.514
12900.0000	38.971	13.441	22.085
12950.0000	39.065	13.381	21.781
13000.0000	39.168	13.310	21.431
13050.0000	39.171	13.342	21.585
13100.0000	39.204	13.342	21.586
13150.0000	39.327	13.252	21.143
13200.0000	39.431	13.181	20.801
13250.0000	39.541	13.103	20.432
13300.0000	39.685	12.993	19.918
13350.0000	39.873	12.836	19.215
13400.0000	39.982	12.760	18.880
13450.0000	40.094	12.681	18.538
13500.0000	40.178	12.629	18.318

13550.0000	40.316	12.522	17.875
13600.0000	40.425	12.446	17.563
13650.0000	40.520	12.382	17.307
13700.0000	40.621	12.313	17.034
13750.0000	40.683	12.283	16.916
13800.0000	40.744	12.254	16.803
13850.0000	40.836	12.193	16.569
13900.0000	40.967	12.093	16.193
13950.0000	41.101	11.991	15.815
14000.0000	41.227	11.896	15.473
14050.0000	41.410	11.743	14.939
14100.0000	41.556	11.629	14.550
14150.0000	41.636	11.580	14.387
14200.0000	41.720	11.526	14.210
14250.0000	41.826	11.450	13.964
14300.0000	41.968	11.339	13.611
14350.0000	42.064	11.273	13.406
14400.0000	42.058	11.309	13.518
14450.0000	42.104	11.293	13.468
14500.0000	42.104	11.324	13.563
14550.0000	42.103	11.355	13.660
14600.0000	42.184	11.303	13.499
14650.0000	42.185	11.331	13.587
14700.0000	42.106	11.440	13.932
14750.0000	41.879	11.697	14.781
14800.0000	41.638	11.968	15.731
14850.0000	41.432	12.203	16.606
14900.0000	41.216	12.448	17.571
14950.0000	41.037	12.655	18.431
15000.0000	40.814	12.908	19.534
15050.0000	40.591	13.160	20.701
15100.0000	40.349	13.431	22.033
15150.0000	40.060	13.748	23.704
15200.0000	39.759	14.077	25.571
15250.0000	39.527	14.338	27.153
15300.0000	39.337	14.556	28.552
15350.0000	39.160	14.763	29.940
15400.0000	38.957	14.993	31.573
15450.0000	38.721	15.258	33.557
15500.0000	38.499	15.508	35.545
15550.0000	38.280	15.754	37.621
15600.0000	38.114	15.948	39.339
15650.0000	38.031	16.060	40.361
15700.0000	37.972	16.145	41.167
15750.0000	37.940	16.206	41.743
15800.0000	37.904	16.269	42.355
15850.0000	37.828	16.373	43.379
15900.0000	37.725	16.502	44.694
15950.0000	37.656	16.600	45.705
16000.0000	37.653	16.629	46.017
16050.0000	37.673	16.637	46.097
16100.0000	37.761	16.576	45.454
16150.0000	37.824	16.539	45.074
16200.0000	37.887	16.503	44.701

16250.0000	37.936	16.482	44.479
16300.0000	37.966	16.478	44.441
16350.0000	38.073	16.398	43.628
16400.0000	38.221	16.275	42.417
16450.0000	38.371	16.152	41.230
16500.0000	38.598	15.951	39.367
16550.0000	38.796	15.779	37.840
16600.0000	38.966	15.637	36.615
16650.0000	39.111	15.518	35.626
16700.0000	39.274	15.381	34.520
16750.0000	39.431	15.249	33.490
16800.0000	39.613	15.094	32.312
16850.0000	39.784	14.948	31.246
16900.0000	39.971	14.787	30.108
16950.0000	40.203	14.581	28.712
17000.0000	40.408	14.401	27.549
17050.0000	40.609	14.226	26.459
17100.0000	40.844	14.016	25.211
17150.0000	41.109	13.776	23.857
17200.0000	41.370	13.541	22.598
17250.0000	41.638	13.297	21.367
17300.0000	41.916	13.044	20.158
17350.0000	42.133	12.852	19.286
17400.0000	42.370	12.640	18.367
17450.0000	42.581	12.454	17.597
17500.0000	42.875	12.185	16.540
17550.0000	43.187	11.899	15.484
17600.0000	43.490	11.621	14.523
17650.0000	43.834	11.301	13.493
17700.0000	44.144	11.016	12.635
17750.0000	44.380	10.803	12.032
17800.0000	44.669	10.540	11.323
17850.0000	44.925	10.308	10.735
17900.0000	45.108	10.150	10.350
17950.0000	45.250	10.032	10.073
18000.0000	45.343	9.963	9.915

MICRO PRECISION CALIBRATION
22835 INDUSTRIAL PLACE
GRASS VALLEY CA 95949
530-268-1860

Certificate of Calibration

ACCREDITED
CALIBRATION LABORATORY
AC-1969.00

Date: Jun 29, 2018 **Cert No. 551220081442532**

Customer:
COMPLIANCE TESTING LLC
1724 S NEVADA WAY
MESA AZ 85204

Work Order #: SAC-70095565

MPC Control #:	DB8287	Serial Number:	003950
Asset ID:	I00463	Department:	N/A
Gage Type:	HARMONIC MIXER	Performed By:	TIM GALVIN
Manufacturer:	AGILENT	Received Condition:	IN TOLERANCE
Model Number:	11970V	Returned Condition:	IN TOLERANCE
Size:	N/A	Cal. Date:	June 29, 2018
Temp/RH:	72.0°F / 40.0%	Cal. Interval:	12 MONTHS
Location:	Calibration performed at MPC facility	Cal. Due Date:	June 29, 2019

Calibration Notes:
See attached for data.

Standards Used to Calibrate Equipment

I.D.	Description.	Model	Serial	Manufacturer	Cal. Due Date	Traceability #
AE4788	SPECTRUM ANALYZER	8565E	3846A01029	HEWLETT PACKARD	Oct 31, 2018	512200813079274
CE4280	WAVE SOURCE	83557A	2948A00105	AGILENT	Feb 28, 2019	512200813268159
Z3548	SWEPT CW GENERATOR	83650L	3844A00330	HEWLETT PACKARD	Dec 31, 2018	512200813171979

Procedures Used in this Event

Procedure Name	Description
KEYSIGHT 11970 SERIES	Harmonic Mixers Keysight 11970 Series Users Guide Jan-1-2015

Calibrating Technician: TIM GALVIN

QC Approval: Robert Means

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty of measurement has been determined in accordance with EA's Publication and NIST Technical Note 1297, 1994 Edition. Services rendered comply with ISO/IEC 17025:2005, ANSI/NCSL Z540-1-1994, ANSI/NCSL Z540.3-2006, MPC Quality Manual, MPC CSD and with customer purchase order instructions.

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. The information on this report, pertains only to the instrument identified.

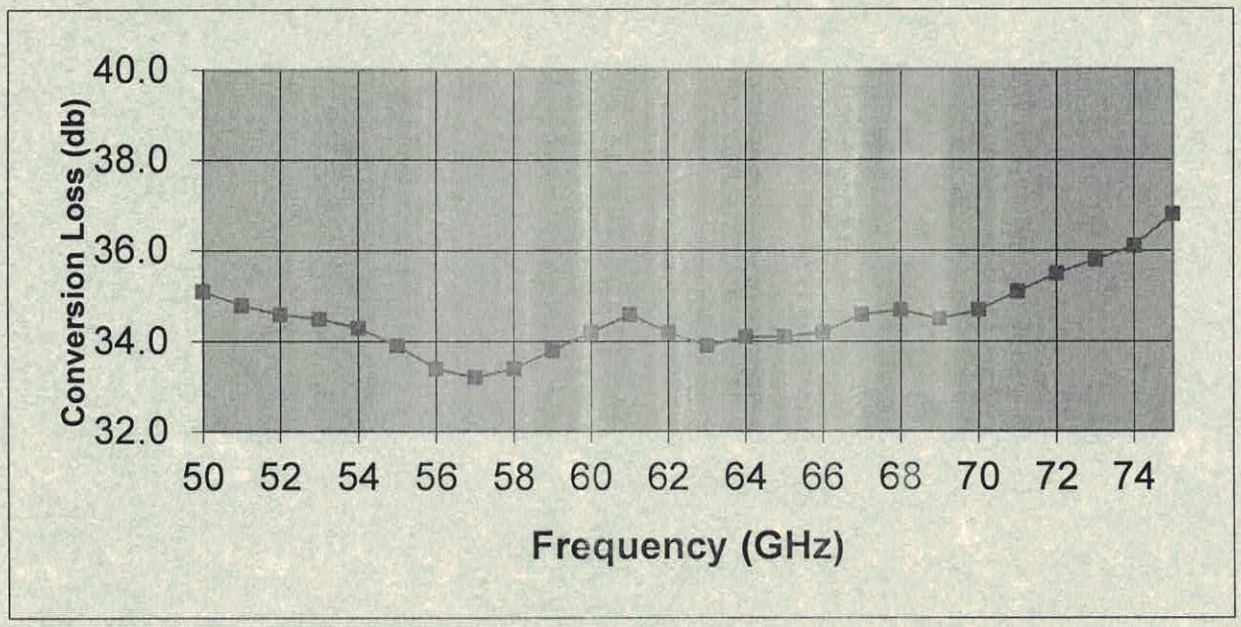
All standards are traceable to SI through the National Institute of Standards and Technology (NIST) and/or recognized national or international standards laboratories. Services rendered include proper manufacturer's service instruction and are warranted for no less than thirty (30) days. This report may not be reproduced in part or in a whole without the prior written approval of the issuing MPC lab.

MICRO PRECISION CALIBRATION INC.

Measurement Report: Harmonic Mixer 11970V

Procedure:	Manufacturer	Order Number:	SAC-70095565
ID Number:	DB8287	Calibration Date:	June 29, 2018

Frequency (GHz)	Conversion Loss	Uncertainty +/- dB
50.0	35.1	0.6
51.0	34.8	0.6
52.0	34.6	0.6
53.0	34.5	0.6
54.0	34.3	0.6
55.0	33.9	0.6
56.0	33.4	0.6
57.0	33.2	0.6
58.0	33.4	0.6
59.0	33.8	0.6
60.0	34.2	0.6
61.0	34.6	0.6
62.0	34.2	0.6
63.0	33.9	0.6
64.0	34.1	0.6
65.0	34.1	0.6
66.0	34.2	0.6
67.0	34.6	0.6
68.0	34.7	0.6
69.0	34.5	0.6
70.0	34.7	0.6
71.0	35.1	0.6
72.0	35.5	0.6
73.0	35.8	0.6
74.0	36.1	0.6
75.0	36.8	0.6


Conversion Loss (db)
40.0
38.0
36.0
34.0
32.0
50 52 54 56 58 60 62 64 66 68 70 72 74
Frequency (GHz)

MICRO PRECISION CALIBRATION
22835 INDUSTRIAL PLACE
GRASS VALLEY CA 95949
530-268-1860

Certificate of Calibration

ACCREDITED
CALIBRATION LABORATORY
AC-1969.00

Date: Jun 29, 2018 **Cert No. 551220081442570**

Customer:
COMPLIANCE TESTING LLC
1724 S NEVADA WAY
MESA AZ 85204

Work Order #: SAC-70095565

MPC Control #:	DN0031	Serial Number:	190
Asset ID:	I00464	Department:	N/A
Gage Type:	HARMONIC MIXER	Performed By:	TIM GALVIN
Manufacturer:	HEWLETT PACKARD	Received Condition:	IN TOLERANCE
Model Number:	11970W	Returned Condition:	IN TOLERANCE
Size:	N/A	Cal. Date:	June 29, 2018
Temp/RH:	72.0°F / 40.0%	Cal. Interval:	12 MONTHS
Location:	Calibration performed at MPC facility	Cal. Due Date:	June 29, 2019

Calibration Notes:
See attached for data.

Standards Used to Calibrate Equipment

I.D.	Description.	Model	Serial	Manufacturer	Cal. Due Date	Traceability #
AE4788	SPECTRUM ANALYZER	8565E	3846A01029	HEWLETT PACKARD	Oct 31, 2018	512200813079274
DF9311	WAVE SOURCE MODULE	83554A	2612A00246	HEWLETT PACKARD	Feb 26, 2019	512200813273384
Z3548	SWEPT CW GENERATOR	83650L	3844A00330	HEWLETT PACKARD	Dec 31, 2018	512200813171979

Procedures Used in this Event

Procedure Name	Description
KEYSIGHT 11970 SERIES	Harmonic Mixers Keysight 11970 Series Users Guide Jan-1-2015

Calibrating Technician: TIM GALVIN

QC Approval: Robert Means

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty of measurement has been determined in accordance with EA's Publication and NIST Technical Note 1297, 1994 Edition. Services rendered comply with ISO/IEC 17025:2005, ANSI/NCSL Z540-1-1994, ANSI/NCSL Z540.3-2006, MPC Quality Manual, MPC CSD and with customer purchase order instructions.

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. The information on this report, pertains only to the instrument identified.

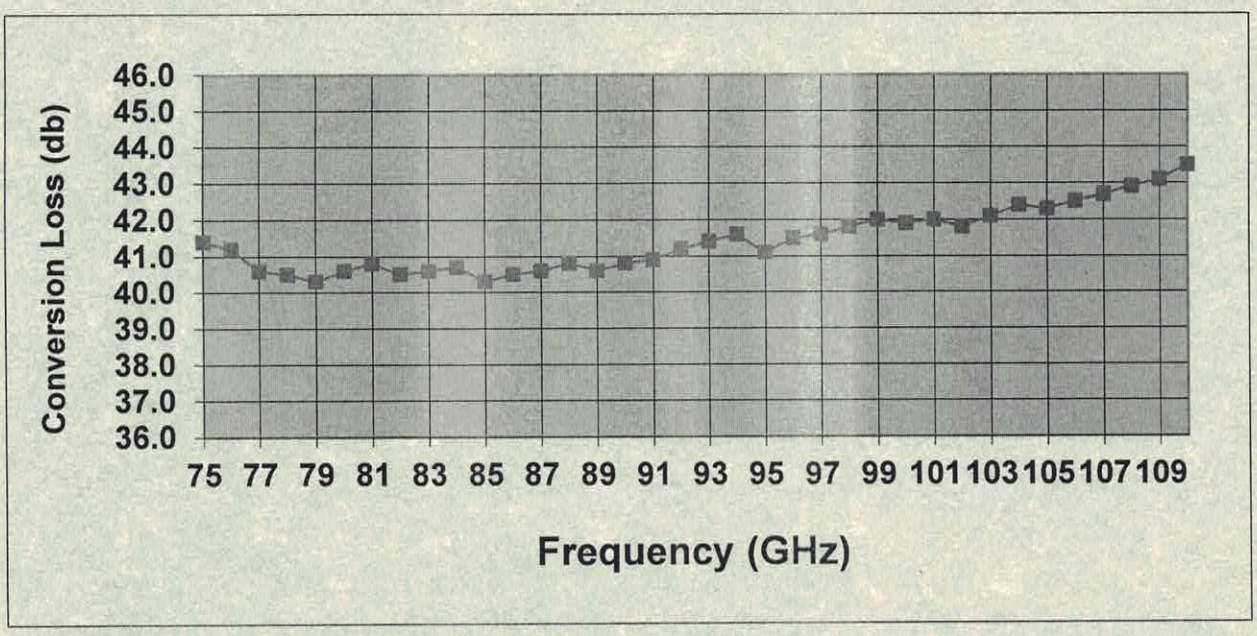
All standards are traceable to SI through the National Institute of Standards and Technology (NIST) and/or recognized national or international standards laboratories. Services rendered include proper manufacturer's service instruction and are warranted for no less than thirty (30) days. This report may not be reproduced in part or in a whole without the prior written approval of the issuing MPC lab.

MICRO PRECISION CALIBRATION INC.

Measurement Report: Harmonic Mixer 11970W

Procedure:	Manufacturer	Order Number:	SAC-70095565
ID Number:	DN0031	Calibration Date:	June 29, 2018

Frequency (GHz)	Conversion Loss	Uncertainty +/- dB
75.0	41.4	0.6
76.0	41.2	0.6
77.0	40.6	0.6
78.0	40.5	0.6
79.0	40.3	0.6
80.0	40.6	0.6
81.0	40.8	0.6
82.0	40.5	0.6
83.0	40.6	0.6
84.0	40.7	0.6
85.0	40.3	0.6
86.0	40.5	0.6
87.0	40.6	0.6
88.0	40.8	0.6
89.0	40.6	0.6
90.0	40.8	0.6
91.0	40.9	0.6
92.0	41.2	0.6
93.0	41.4	0.6
94.0	41.6	0.6
95.0	41.1	0.6
96.0	41.5	0.6
97.0	41.6	0.6
98.0	41.8	0.6
99.0	42.0	0.6
100.0	41.9	0.6
101.0	42.0	0.6
102.0	41.8	0.6
103.0	42.1	0.6
104.0	42.4	0.6
105.0	42.3	0.6
106.0	42.5	0.6
107.0	42.7	0.6
108.0	42.9	0.6
109.0	43.1	0.6
110.0	43.5	0.6


Conversion Loss (db)
46.0
45.0
44.0
43.0
42.0
41.0
40.0
39.0
38.0
37.0
36.0
75 77 79 81 83 85 87 89 91 93 95 97 99 101 103 105 107 109
Frequency (GHz)

MICRO PRECISION CALIBRATION
22835 INDUSTRIAL PLACE
GRASS VALLEY CA 95949
530-268-1860

Certificate of Calibration

ACCREDITED CALIBRATION LABORATORY AC-1969.00

Date: Jun 29, 2018 **Cert No. 551220081442541**

Customer:
COMPLIANCE TESTING LLC
1724 S NEVADA WAY
MESA AZ 85204

Work Order #: SAC-70095565

MPC Control #:	DB8289	Serial Number:	3003A03386
Asset ID:	I00465	Department:	N/A
Gage Type:	HARMONIC MIXER	Performed By:	TIM GALVIN
Manufacturer:	HEWLETT PACKARD	Received Condition:	IN TOLERANCE
Model Number:	11970Q	Returned Condition:	IN TOLERANCE
Size:	33-50 Ghz	Cal. Date:	June 29, 2018
Temp/RH:	72.0°F / 40.0%	Cal. Interval:	12 MONTHS
Location:	Calibration performed at MPC facility	Cal. Due Date:	June 29, 2019

Calibration Notes:
See attached for data.

Standards Used to Calibrate Equipment

I.D.	Description.	Model	Serial	Manufacturer	Cal. Due Date	Traceability #
AE4788	SPECTRUM ANALYZER	8565E	3846A01029	HEWLETT PACKARD	Oct 31, 2018	512200813079274
AM1913	POWER SENSOR	8487A	3318A02585	AGILENT	Jan 31, 2019	512200813260111
V8087	POWER METER	438A	3513U04859	HEWLETT PACKARD	Dec 31, 2019	512200813160759
Z3548	SWEPT CW GENERATOR	83650L	3844A00330	HEWLETT PACKARD	Dec 31, 2018	512200813171979

Procedures Used in this Event

Procedure Name	Description
KEYSIGHT 11970 SERIES	Harmonic Mixers Keysight 11970 Series Users Guide Jan-1-2015

Calibrating Technician: TIM GALVIN

QC Approval: Robert Means

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty of measurement has been determined in accordance with EA's Publication and NIST Technical Note 1297, 1994 Edition. Services rendered comply with ISO/IEC 17025:2005, ANSI/NCSL Z540-1-1994, ANSI/NCSL Z540.3-2006, MPC Quality Manual, MPC CSD and with customer purchase order instructions.

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. The information on this report, pertains only to the instrument identified.

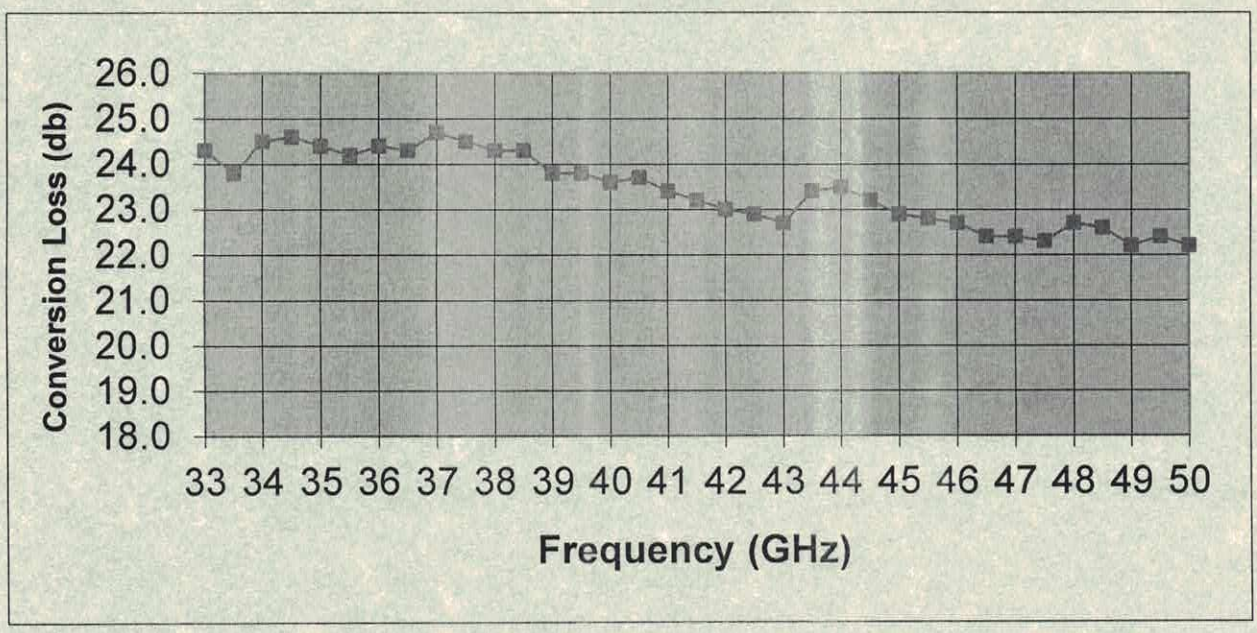
All standards are traceable to SI through the National Institute of Standards and Technology (NIST) and/or recognized national or international standards laboratories. Services rendered include proper manufacturer's service instruction and are warranted for no less than thirty (30) days. This report may not be reproduced in part or in a whole without the prior written approval of the issuing MPC lab.

MICRO PRECISION CALIBRATION INC.

Measurement Report: Harmonic Mixer 11970Q

Procedure:	Manufacturer	Order Number:	SAC-70095565
ID Number:	DB8289	Calibration Date:	June 29, 2018

Frequency (GHz)	Conversion Loss	Uncertainty +/- dB
33.0	24.3	0.6
33.5	23.8	0.6
34.0	24.5	0.6
34.5	24.6	0.6
35.0	24.4	0.6
35.5	24.2	0.6
36.0	24.4	0.6
36.5	24.3	0.6
37.0	24.7	0.6
37.5	24.5	0.6
38.0	24.3	0.6
38.5	24.3	0.6
39.0	23.8	0.6
39.5	23.8	0.6
40.0	23.6	0.6
40.5	23.7	0.6
41.0	23.4	0.6
41.5	23.2	0.6
42.0	23.0	0.6
42.5	22.9	0.6
43.0	22.7	0.6
43.5	23.4	0.6
44.0	23.5	0.6
44.5	23.2	0.6
45.0	22.9	0.6
45.5	22.8	0.6
46.0	22.7	0.6
46.5	22.4	0.6
47.0	22.4	0.6
47.5	22.3	0.6
48.0	22.7	0.6
48.5	22.6	0.6
49.0	22.2	0.6
49.5	22.4	0.6
50.0	22.2	0.6


Conversion Loss (db)
26.0
25.0
24.0
23.0
22.0
21.0
20.0
19.0
18.0
33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
Frequency (GHz)

Asset i00476_75 - 110 GHz Horn Antenna **Model: HO10R** **3/28/2017**

Antenna Gain to Antenna correction factor conversion worksheet

Enter Freq in GHz and Antenna Gain in dBi and the wavelength, numeric antenna gain, and ACF are calculated

ACF = 19.8-(20*LOG(λ))-(10*LOG(G_{num}))

λ= wavelength in meters = sped of light / frequency (Hz) => v/f
Speed of Light = 299792458 (m/sec) =~ 3 x 10^8
G_{num} = Numeric Antenna Gain = 10 ^ (Gain $_{dBi}$/10)

Asset # i00476 (75 - 110 GHz Horn antenna)						
Frequency	Frequency	speed of light	wavelength	Ant Gain	Antenna Gain	ACF
GHz	Hz	m/sec	m	dBi	numeric	dB
75	75000000000	299792458	0.003997233	22.5	177.83	45.26
76	76000000000	299792458	0.003944638	22.56	180.30	45.32
77	77000000000	299792458	0.003893409	22.6	181.97	45.39
78	78000000000	299792458	0.003843493	22.65	184.08	45.46
79	79000000000	299792458	0.003794841	22.7	186.21	45.52
80	80000000000	299792458	0.003747406	22.75	188.36	45.58
81	81000000000	299792458	0.003701141	22.8	190.55	45.63
82	82000000000	299792458	0.003656006	22.85	192.75	45.69
83	83000000000	299792458	0.003611957	22.9	194.98	45.75
84	84000000000	299792458	0.003568958	22.95	197.24	45.80
85	85000000000	299792458	0.00352697	23	199.53	45.85
86	86000000000	299792458	0.003485959	23.05	201.84	45.90
87	87000000000	299792458	0.00344589	23.1	204.17	45.95
88	88000000000	299792458	0.003406732	23.13	205.59	46.02
89	89000000000	299792458	0.003368455	23.15	206.54	46.10
90	90000000000	299792458	0.003331027	23.18	207.97	46.17
91	91000000000	299792458	0.003294423	23.19	208.45	46.25
92	92000000000	299792458	0.003258614	23.2	208.93	46.34
93	93000000000	299792458	0.003223575	23.24	210.86	46.39
94	94000000000	299792458	0.003189281	23.27	212.32	46.46
95	95000000000	299792458	0.00315571	23.3	213.80	46.52
96	96000000000	299792458	0.003122838	23.31	214.29	46.60
97	97000000000	299792458	0.003090644	23.33	215.28	46.67
98	98000000000	299792458	0.003059107	23.35	216.27	46.74
99	99000000000	299792458	0.003028207	23.35	216.27	46.83
100	1E+11	299792458	0.002997925	23.37	217.27	46.89
101	1.01E+11	299792458	0.002968242	23.38	217.77	46.97
102	1.02E+11	299792458	0.002939142	23.39	218.27	47.05
103	1.03E+11	299792458	0.002910606	24	251.19	46.52
104	1.04E+11	299792458	0.00288262	24	251.19	46.60
105	1.05E+11	299792458	0.002855166	24	251.19	46.69
106	1.06E+11	299792458	0.002828231	24	251.19	46.77
107	1.07E+11	299792458	0.002801799	24	251.19	46.85
108	1.08E+11	299792458	0.002775856	24	251.19	46.93
109	1.09E+11	299792458	0.00275039	24	251.19	47.01
110	1.1E+11	299792458	0.002725386	24	251.19	47.09

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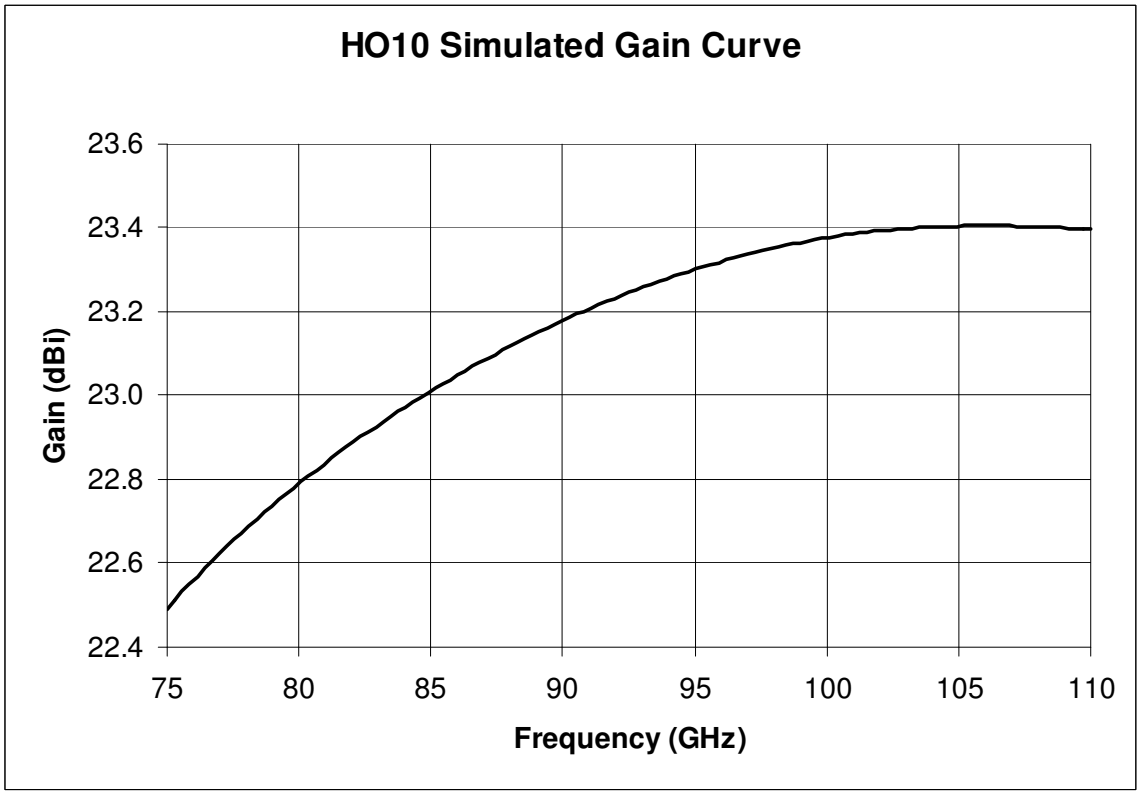

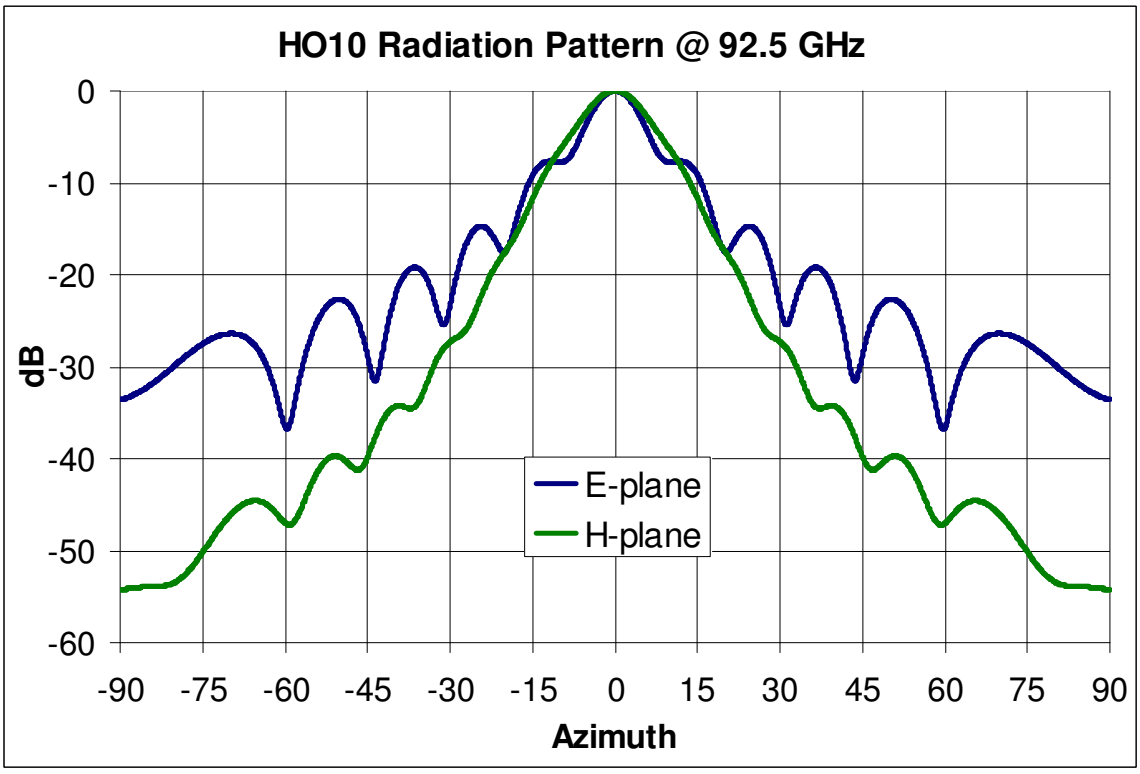

Asset # i00477 (50 - 75 GHz Horn antenna) **Model: HO15**

Antenna Gain to Antenna correction factor conversion worksheet **3/28/2017**

Enter Freq in GHz and Antenna Gain in dBi and the wavelength, numeric antenna gain, and ACF are calculated

ACF = 19.8-(20*LOG(λ))-(10*LOG(G_{num}))

λ= wavelength in meters = sped of light / frequency (Hz) => v/f
Speed of Light = 299792458 (m/sec) =~ 3 x 10^8
G_{num} = Numeric Antenna Gain = 10 ^ (Gain $_{dBi}$/10)

Asset # i00477 (50 - 75 GHz Horn antenna)						
Frequency	Frequency	speed of light	wavelength	Ant Gain	Antenna Gain	ACF
GHz	Hz	m/sec	m	dBi	numeric	dB
50	50000000000	299792458	0.005995849	22.4	173.78	41.84
51	51000000000	299792458	0.005878283	22.47	176.60	41.94
52	52000000000	299792458	0.00576524	22.5	177.83	42.08
53	53000000000	299792458	0.005656461	22.6	181.97	42.15
54	54000000000	299792458	0.005551712	22.7	186.21	42.21
55	55000000000	299792458	0.005450772	22.8	190.55	42.27
56	56000000000	299792458	0.005353437	22.85	192.75	42.38
57	57000000000	299792458	0.005259517	22.9	194.98	42.48
58	58000000000	299792458	0.005168835	22.97	198.15	42.56
59	59000000000	299792458	0.005081228	23.05	201.84	42.63
60	60000000000	299792458	0.004996541	23.1	204.17	42.73
61	61000000000	299792458	0.00491463	23.14	206.06	42.83
62	62000000000	299792458	0.004835362	23.18	207.97	42.93
63	63000000000	299792458	0.00475861	23.2	208.93	43.05
64	64000000000	299792458	0.004684257	23.25	211.35	43.14
65	65000000000	299792458	0.004612192	23.3	213.80	43.22
66	66000000000	299792458	0.00454231	23.32	214.78	43.33
67	67000000000	299792458	0.004474514	23.34	215.77	43.45
68	68000000000	299792458	0.004408713	23.36	216.77	43.55
69	69000000000	299792458	0.004344818	23.38	217.77	43.66
70	70000000000	299792458	0.004282749	23.4	218.78	43.77
71	71000000000	299792458	0.004222429	23.4	218.78	43.89
72	72000000000	299792458	0.004163784	23.4	218.78	44.01
73	73000000000	299792458	0.004106746	23.4	218.78	44.13
74	74000000000	299792458	0.004051249	23.4	218.78	44.25
75	75000000000	299792458	0.003997233	23.4	218.78	44.36

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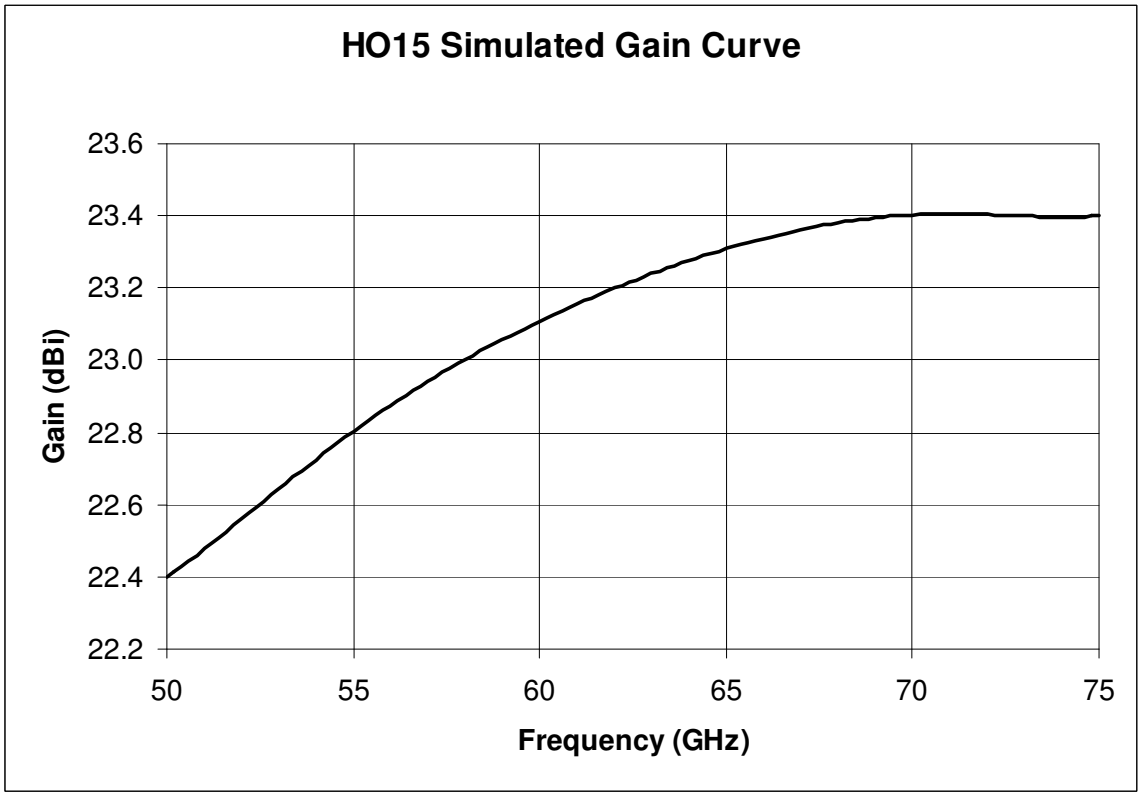

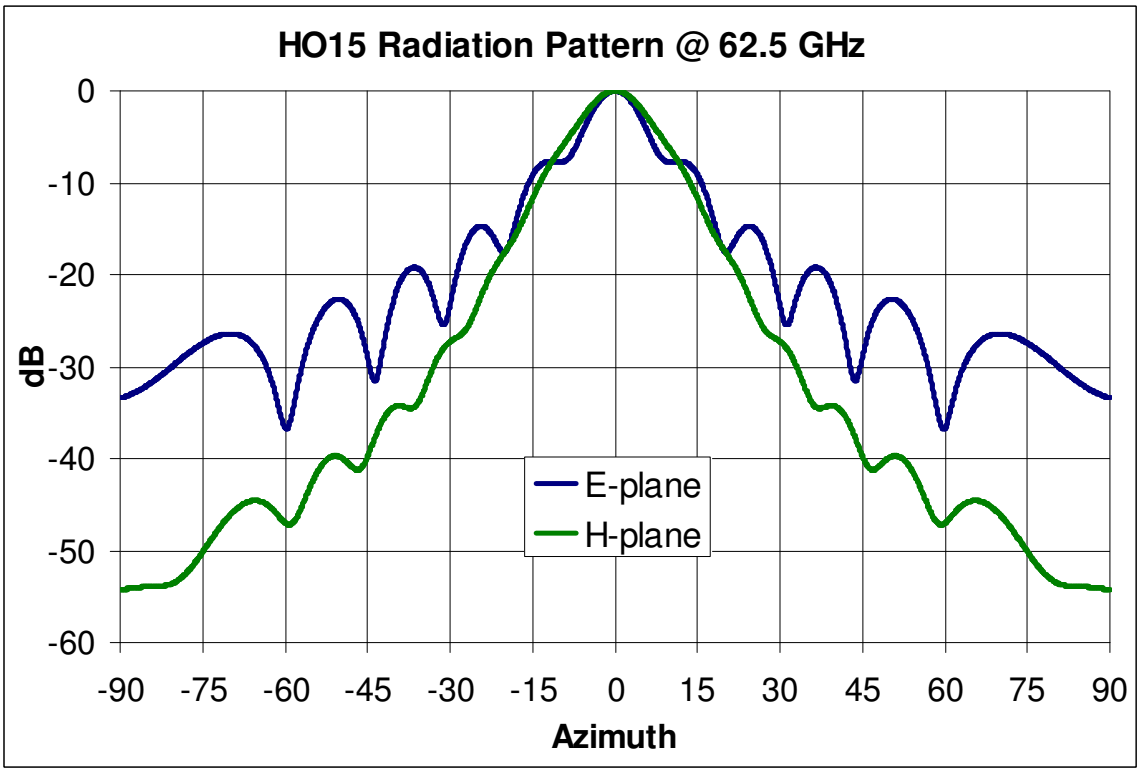

Antenna Gain to Antenna correction factor conversion worksheet **3/28/2017**

Enter Freq in GHz and Antenna Gain in dBi and the wavelength, numeric antenna gain, and ACF are calculated

ACF = 19.8-(20*LOG(λ))-(10*LOG(G_{num}))

λ= wavelength in meters = sped of light / frequency (Hz) => v/f
Speed of Light = 299792458 (m/sec) =~ 3 x 10^8
G_{num} = Numeric Antenna Gain = 10 ^ (Gain $_{dBi}$/10)

Asset # i00484 (33 - 50 GHz Horn antenna)						
Frequency	Frequency	speed of light	wavelength	Ant Gain	Antenna Gain	ACF
GHz	Hz	m/sec	m	dBi	numeric	dB
33	33000000000	299792458	0.00908462	22.6	181.97	38.03
34	34000000000	299792458	0.008817425	22.6	181.97	38.29
35	35000000000	299792458	0.008565499	22.65	184.08	38.49
36	36000000000	299792458	0.008327568	22.8	190.55	38.59
37	37000000000	299792458	0.008102499	22.9	194.98	38.73
38	38000000000	299792458	0.007889275	23	199.53	38.86
39	39000000000	299792458	0.007686986	23.05	201.84	39.03
40	40000000000	299792458	0.007494811	23.1	204.17	39.20
41	41000000000	299792458	0.007312011	23.15	206.54	39.37
42	42000000000	299792458	0.007137916	23.2	208.93	39.53
43	43000000000	299792458	0.006971918	23.25	211.35	39.68
44	44000000000	299792458	0.006813465	23.3	213.80	39.83
45	45000000000	299792458	0.006662055	23.35	216.27	39.98
46	46000000000	299792458	0.006517227	23.38	217.77	40.14
47	47000000000	299792458	0.006378563	23.4	218.78	40.31
48	48000000000	299792458	0.006245676	23.41	219.28	40.48
49	49000000000	299792458	0.006118213	23.42	219.79	40.65
50	50000000000	299792458	0.005995849	23.45	221.31	40.79

Example using i00085 test data (18 - 40 GHz Horn Antenna)						
18	18000000000	299792458	0.016655137	10.789		45.0392241

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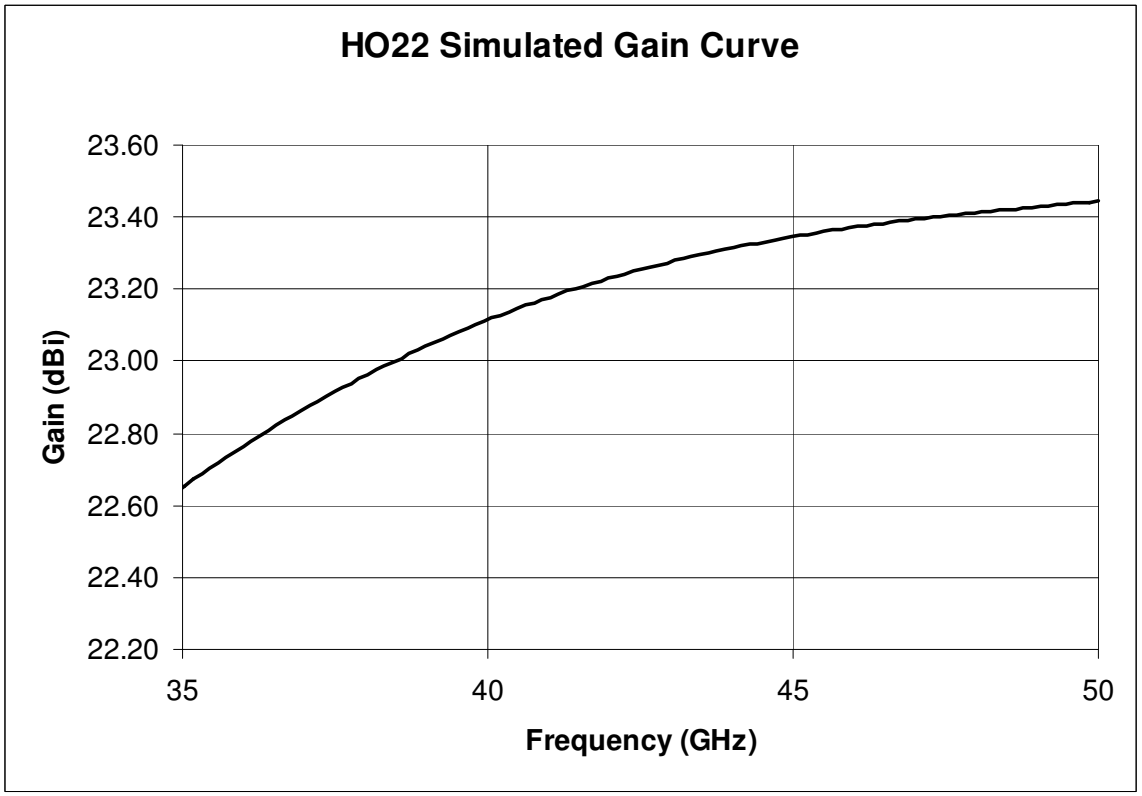
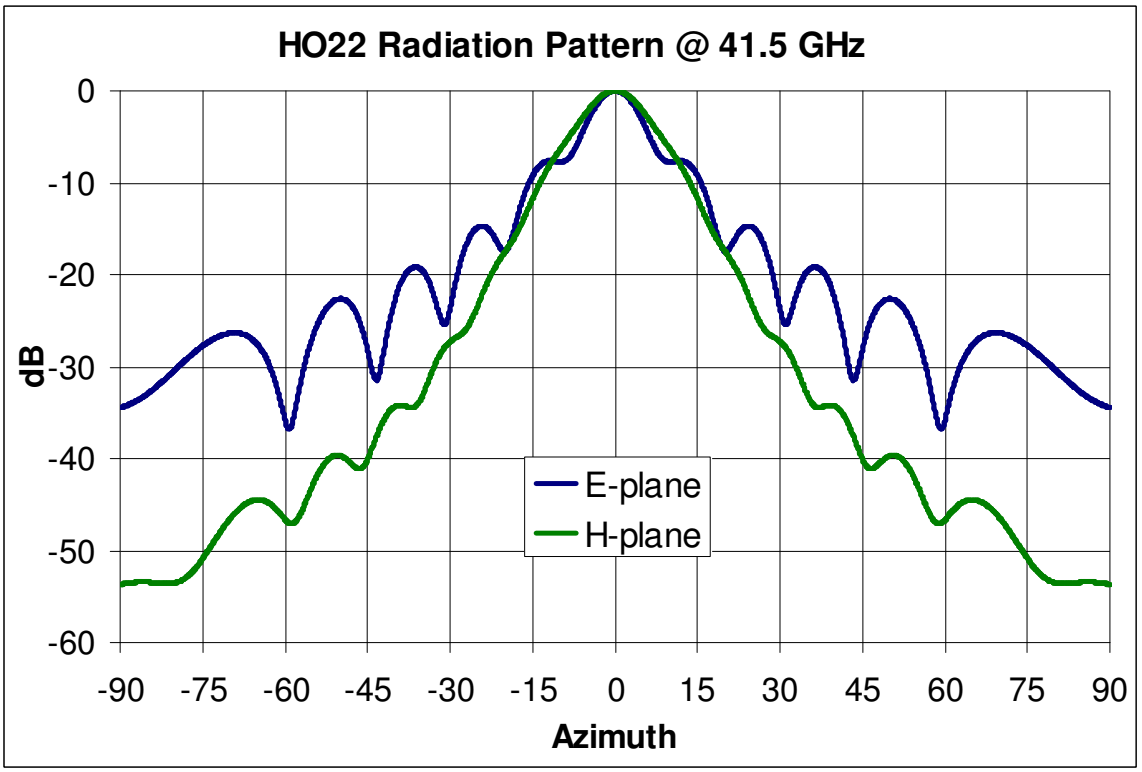




Certificate of Calibration

ISO/IEC 17025:2017 and ANSI/NCSL Z540.3-2006

Certificate Number 1-11561478968-1

AC-1498

Model Number	N9038A
Manufacturer	Keysight Technologies Inc
Description	MXE EMI Receiver
Serial Number	MY53220134
Date of Calibration	9 Sep 2019
Procedure	TME-N7818A-E.09.03
Temperature	(23 ± 5) °C
Humidity	(50 ± 30) %RH

Customer
Compliance Testing LLC
1724 S Nevada Way
MESA AZ 85204-6624
United States

Location of Calibration
Keysight Technologies Inc
10090 Foothills Blvd.
Roseville CA 95747-7102
UNITED STATES

This certifies that the equipment has been calibrated using applicable Keysight Technologies procedures and in compliance with ISO/IEC 17025:2017 and ANSI/NCSL Z540.3-2006. The quality management system is registered to ISO 9001:2015.

As Received Conditions
One or more measured values of the equipment were observed out of specification at the points tested. Additionally, the expanded measurement uncertainty intervals about one or more measured values were entirely outside the specification.

Action Taken
- The equipment was adjusted.
- The equipment was repaired.

As Completed Conditions
The measured values of the equipment were observed in specification at the points tested. Additionally, the expanded measurement uncertainty intervals about the measured values were in specification.

Remarks or Special Requirements

This calibration report shall not be reproduced, except in full. The documented results relate to the equipment calibrated only.

The test limits stated in the report correspond to the published specifications of the equipment, at the points tested.
This calibration report may refer to equipment manufactured by HP, Agilent and Keysight as being manufactured by Keysight Technologies.

Based on the customer's request, the next calibration is due on 9 Sep 2020.

Traceability Information

Technician ID Number 00821225

Measurements are traceable to the International System of Units (SI) via national metrology institutes (www.keysight.com/find/NMI) that are signatories to the CIPM Mutual Recognition Arrangement.

Calibration Equipment Used

Model Number	Model Description	Equipment ID	Cal Due Date
10 MHz External Reference	Rubidium Standard	FS72533342	27 Feb 2020
11667A	DC-18 GHz power splitter, type N, 50 ohm	11667A57715	23 Aug 2020
11667B	Power splitter, DC to 26.5 GHz, 3.5 mm female connectors	11667B54389	25 Jun 2020
11667C	DC - 50 GHz power splitter, 50 ohm	11667C52516	12 Dec 2019
33250A	Function/Arbitrary Waveform Generator, 80 MHz	33250A13731	6 Jun 2020
3458A	Digital multimeter, 8.5 digit	3458A23849	18 Oct 2019
500-13438D	10MHz-1GHz Phase Lock Frequency Source Rev.D Input	500-1343831449	3 Dec 2019
53132A	Universal Counter, 225 MHz, 12 digit/s, 150 ps. GPIB, RS232	53132A01423	15 Mar 2020
8482A	Power Sensor, 100 kHz to 4.2 GHz, -30 to +20 dBm	8482A11442	19 Jun 2020
8485A	Power Sensor, 50 MHz to 26.5 GHz, -30 to +20 dBm	8485A90935	13 Feb 2020
8487D	Power Sensor, 50 MHz to 50 GHz, -70 to -20 dBm	8487D30001	13 Jun 2020
8487D	Power Sensor, 50 MHz to 50 GHz, -70 to -20 dBm	8487D91007	15 Oct 2020
8490D	Coaxial fixed attenuator, dc-50 GHz	8490D07480	7 Jan 2020
8491B	Coaxial attenuator, dc - 18 GHz, Type N	8491BA0299	29 May 2020
8491B	Coaxial attenuator, dc - 18 GHz, Type N	8491B64432	4 Dec 2019
8491B	Coaxial attenuator, dc - 18 GHz, Type N	8491BA0514	27 Sep 2020
8493C	Coaxial fixed attenuator, dc to 26.5 GHz	8493C05761	14 Mar 2020
8493C	Coaxial fixed attenuator, dc to 26.5 GHz	8493C73530	15 Nov 2020
8494G	0-11dB programmable step ATTENUATOR., dc-4GHz	8494G40782	8 Apr 2020
8496G	0-110dB programmable step attenuator, dc-4GHz	8496G40597	8 Apr 2020
85054B	Standard mechanical calibration kit, DC to 18 GHz, type-N	85054B00214	24 Apr 2020
85056A	Standard mechanical calibration kit, DC to 50 GHz, 2.4 mm	85056A00202	28 Jan 2020
86205A	50 Ohm RF bridge 300kHz to 6GHz	86205A03005	11 Dec 2019
E5071C	ENA Series Network analyzer	E5071C02659	12 Sep 2019
E8257D	PSG analog signal generator	E8257D11509	4 Oct 2019
E8257D	PSG analog signal generator	E8257D01598	24 Jul 2021
E9304A	Power Sensor-Average, 9 kHz to 6 GHz, -60 to +20 dBm	E9304A40012	2 Oct 2020
E9304A	Power Sensor-Average, 9 kHz to 6 GHz, -60 to +20 dBm	E9304A40010	1 Oct 2020
IGUU2916	EMI Calibration Pulse Generator	IGUU2916916238	26 Sep 2019

Model Number	Model Description	Equipment ID	Cal Due Date
N1914A	Power Meter - Average, dual channel	N1914A50013	10 Aug 2020
N5230C	PNA-L network analyzer	N5230C02393	3 May 2020
N8487A	Power Sensor - Thermocouple, average, 50MHz to 50GHz	N8487A80008	16 Jun 2020
N8487A	Power Sensor - Thermocouple, average, 50MHz to 50GHz	N8487A10013	25 Apr 2021

Traceability Table

	Model	Model Description	Equipment ID	Certificate Number	Trace Value
W,R	10 MHz External Reference	Rubidium Standard	FS72533342	1-10907609122-1-ANAB:AC-1498.01	Frequency
W,R	11667A	DC-18 GHz power splitter, type N, 50 ohm	11667A57715	1-11553657402-1-ANAB:AC-1498	Reflection Coefficient
W,R	11667B	Power splitter, DC to 26.5 GHz, 3.5 mm female connectors	11667B54389	1-9999173906-1-ANAB:AC-1498	Reflection Coefficient
W,R	11667C	DC - 50 GHz power splitter, 50 ohm	11667C52516	1-10660921504-1-ANAB:AC-1498	Reflection Coefficient
W,R	33250A	Function/Arbitrary Waveform Generator, 80 MHz	33250A13731	1-11307766401-1-ANAB:AC-1498	AC Voltage Frequency
W,R	3458A	Digital multimeter, 8.5 digit	3458A23849	1-10417976162-1-ANAB:AC-1498.03	AC Voltage
W,R	500-13438D	10MHz-1GHz Phase Lock Frequency Source Rev.D Input	500-1343831449	1-10640792116-1-ANAB:AC-1498	Phase Noise
W,R	53132A	Universal Counter, 225 MHz, 12 digit/s, 150 ps. GPIB, RS232	53132A01423	1-9796975141-1-ANAB:AC-1498	Frequency
W,R	8482A	Power Sensor, 100 kHz to 4.2 GHz, -30 to +20 dBm	8482A11442	1-10667964493-1-ANAB:AC-1498	RF Power
W,R	8485A	Power Sensor, 50 MHz to 26.5 GHz, -30 to +20 dBm	8485A90935	1-10903564529-1-ANAB:AC-1498	RF Power
W,R	8487D	Power Sensor, 50 MHz to 50 GHz, -70 to -20 dBm	8487D91007	1-10432218506-1-ANAB:AC-1498	RF Power
W,R	8487D	Power Sensor, 50 MHz to 50 GHz, -70 to -20 dBm	8487D30001	1-10082236287-1-ANAB:AC-1498	RF Power
W,R	8490D	Coaxial fixed attenuator, dc-50 GHz	8490D07480	1-10765225307-1-ANAB:AC-1498	Attenuation
W,R	8491B	Coaxial attenuator, dc - 18 GHz, Type N	8491BA0299	1-11273972964-1-ANAB:AC-1498	Attenuation
W,R	8491B	Coaxial attenuator, dc - 18 GHz, Type N	8491B64432	1-10668206172-1-ANAB:AC-1498	Attenuation
W,R	8491B	Coaxial attenuator, dc - 18 GHz, Type N	8491BA0514	1-10449164270-1-ANAB:AC-1498	Attenuation
W,R	8493C	Coaxial fixed attenuator, dc to 26.5 GHz	8493C73530	1-10569576936-1-ANAB:AC-1498	Attenuation
W,R	8493C	Coaxial fixed attenuator, dc to 26.5 GHz	8493C05761	1-9800385023-1-ANAB:AC-1498	Attenuation
W,R	8494G	0-11dB programmable step ATTENUATOR., dc-4GHz	8494G40782	1-11112894720-2-ANAB:AC-1498	Attenuation

	Model	Model Description	Equipment ID	Certificate Number	Trace Value
W,R	8496G	0-110dB programmable step attenuator, dc-4GHz	8496G40597	1-11112894720-1-ANAB:AC-1498	Attenuation
W,R	85054B	Standard mechanical calibration kit, DC to 18 GHz, type-N	85054B00214	1-11125279654-1-ANAB:AC-1498	Reflection Coefficient
W,R	85056A	Standard mechanical calibration kit, DC to 50 GHz, 2.4 mm	85056A00202	1-10783639066-1-A2LA:2079.01	Reflection Coefficient
W	86205A	50 Ohm RF bridge 300kHz to 6GHz	86205A03005	1-10663915176-1	
R	85032B	50-Ohm Type-N calibration kit	85032B08649	1-10295375252-1-ANAB:AC-1498	Reflection Coefficient
W,R	E5071C	ENA Series Network analyzer	E5071C02659	1-10989177680-1-ANAB:AC-1498	Attenuation Frequency Reflection Coefficient
W,R	E8257D	PSG analog signal generator	E8257D01598	1-11409648492-1-ANAB:AC-1498	Frequency Phase Noise RF Power Spectral Purity
W,R	E8257D	PSG analog signal generator	E8257D11509	1-10421902838-1-ANAB:AC-1498	Frequency Phase Noise RF Power Spectral Purity
W,R	E9304A	Power Sensor-Average, 9 kHz to 6 GHz, -60 to +20 dBm	E9304A40010	1-10449377539-1-ANAB:AC-1498	RF Power
W,R	E9304A	Power Sensor-Average, 9 kHz to 6 GHz, -60 to +20 dBm	E9304A40012	1-10449377791-1-ANAB:AC-1498	RF Power
W,R	IGUU2916	EMI Calibration Pulse Generator	IGUU2916916238	1-8948026950-1-NMI:PTB	RF Power
W,R	N1914A	Power Meter - Average, dual channel	N1914A50013	1-10316190942-1-ANAB:AC-1498	RF Power
W,R	N5230C	PNA-L network analyzer	N5230C02393	1-11202078100-1-ANAB:AC-1498	Attenuation Frequency Reflection Coefficient
W,R	N8487A	Power Sensor - Thermocouple, average, 50MHz to 50GHz	N8487A10013	1-11481229143-1-ANAB:AC-1498	RF Power
W,R	N8487A	Power Sensor - Thermocouple, average, 50MHz to 50GHz	N8487A80008	1-11456096598-1-ANAB:AC-1498	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.

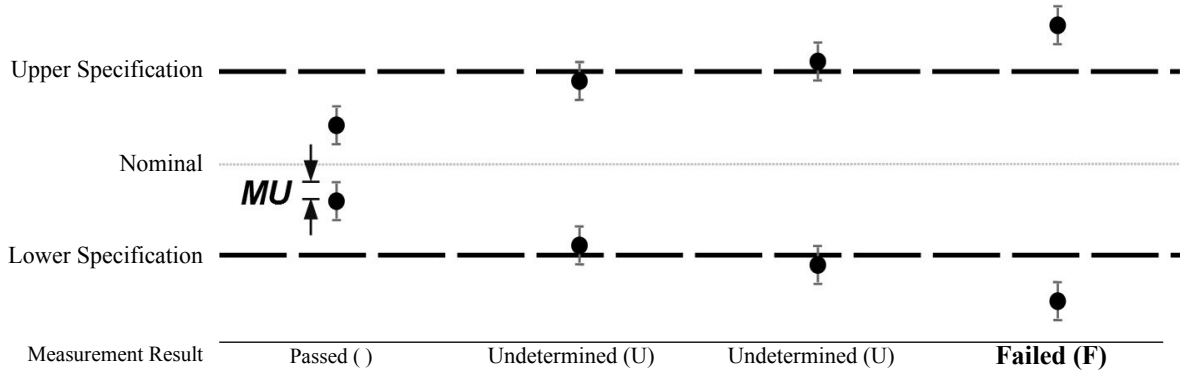
Compliance with Specification

The uncertainty of measurement has been taken into account when determining compliance with specification, as per ILAC-G8:03/2009. If the expanded measurement uncertainty intervals centered about one or more measured values were both in as well as out of specification (upper or lower), it is not possible to state compliance or non-compliance based on a 95% coverage probability for the expanded measurement uncertainty.

An overall statement of compliance for all tests performed as received, and as completed (if any adjustments / repairs were performed) is included at the beginning of this report. Statements of compliance apply only to warranted specifications. When functional verification tests are performed, results are reported in the “Functional Test” section, and do not affect these statements of compliance.
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.

Measurement results are reported as:

- Passed ( ) - The measured values of the equipment were observed in specification at the points tested. Additionally, the expanded measurement uncertainty intervals about the measured values were in specification.
- Undetermined (U) - The expanded measurement uncertainty intervals about one or more measured values were in as well as out of specification. Consequently, neither compliance nor non-compliance with specification can be declared based on the stated coverage probability.
- Failed (F) - One or more measured values of the equipment were observed out of specification at the points tested. Additionally, the expanded measurement uncertainty intervals about one or more measured values were entirely outside the specification.



( ) This result is indicated on the measurement report as a blank space in the column labeled “Status” or “Sts”.
MU = 95% expanded measurement uncertainty.

Acceptance Limit

The "Keysight Cal + Uncertainties + Guardbanding" service employs a guard band in the amount of the 95% expanded measurement uncertainty (MU). The resulting acceptance limit applied for Pass or Fail decisions, and for performing adjustments, is the difference of the specification and the guard band.

Uncertainty of Measurement

The uncertainty evaluation has been performed in accordance with ISO/IEC Guide 98-3:2008 (GUM). The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k such that the coverage probability corresponds to approximately 95%. This probability corresponds to a coverage factor of k=2 for a normal distribution.

Calibration Test Results Summary

Test Name	As Completed Status
Frequency Reference Accuracy	Passed
Power Bandwidth Accuracy	Passed
Resolution Bandwidth Switching Uncertainty	Passed
Residual Responses	Passed
Displayed Average Noise Level	Passed
Frequency Readout Accuracy	Passed
Frequency Span Accuracy	Passed
Count Accuracy	Passed
IF Frequency Response	Passed
RBW Selectivity CISPR Bands	Passed
Phase Noise	Passed
Absolute Amplitude Accuracy at 50 MHz	Passed
Input Attenuation Switching Uncertainty	Passed
Display Scale Fidelity	Passed
Freq Resp Above 3.6 GHz Preamp On	Passed
IF Input Gain Accuracy Option EXM	Passed
LO Output Power Accuracy Option EXM	Passed
Spurious Responses	Passed
Freq Resp Above 3.6 GHz Preamp Off	Passed
Second Harmonic Intercept	Passed
Gain Compression	Passed
Third Order Intermodulation Distortion	Passed
Response To Pulses (Peak, Ave, RMS)	Passed
Variation With Pulse Repetition Freq (Ave, RMS)	Passed
Response To Intermittent Disturbances (Ave, RMS)	Passed
Radiated Band Sine Wave Accuracy	Passed
Freq Resp 50 MHz to 3.6 GHz	Passed
Freq Resp 9 kHz to 50 MHz	Passed
Conducted Band Sine Wave Accuracy	Passed
Freq Resp Below 300 kHz	Passed
Response To Pulses (Peak, Ave, RMS) Bands A/B/C/D	Passed
Q-P Detector Absolute Calibration	Passed
Q-P Detector Variation With Pulse Repetition Freq	Passed
Conducted Band VSWR	Passed
Radiated Band VSWR	Passed

Functional Test Results Summary

The following functional test results are not part of an accredited delivery, even if they are part of an otherwise accredited calibration report.

The following tests document the functional verification of the instruments' non-warranted performance. Neither a statement of conformance or decision rule is used for a Functional Test, measurement uncertainties are only provided by exception. For a "Functional Test" the test results are reported as "As Expected" when showing expected performance and "Not As Expected" otherwise. "As Expected" results of individual test points are indicated in the measurement report by a blank space in the column labeled "Status" to allow easier recognition of any "Not As Expected" points. If a functional test result is reported as "Not As Expected", repair and/or adjustment is

recommended. Test results reported as “Done” are possible if no limits are applied. For qualitative or quantitative “Functional Tests” the test results are not warranted, and no judgment is made. The “actual” measured results are helpful to users for some applications.

Test Name	As Completed Status
Internal Alignment	As Expected
MIL STD RBW Selectivity	As Expected
Effective DANL Option NFE	As Expected

Tested Configuration

Firmware Version	A.19.55
Tested Options	544 B24 CR3 DP2 EDP EMC EXM LSN NFE P44 PC4 PFR SSD W7X

i00555_10 MHz - 40 GHz Pre-amplifier			
from 1-13-2020 test data			
Freq	I/L		
GHz	dB		
1.000	-43.44		
1.045	-43.45		
1.090	-43.58		
1.135	-43.53		
1.180	-43.75		
1.225	-43.79		
1.270	-43.86		
1.315	-43.96		
1.360	-43.86		
1.405	-43.90		
1.450	-43.82		
1.495	-43.83		
1.540	-43.76		
1.585	-43.67		
1.630	-43.60		
1.675	-43.52		
1.720	-43.45		
1.765	-43.36		
1.810	-43.25		
1.855	-43.24		
1.900	-43.06		
1.945	-43.00		
1.990	-42.84		
2.035	-42.74		
2.080	-42.66		
2.125	-42.54		
2.170	-42.43		
2.215	-42.31		
2.260	-42.27		
2.305	-42.13		
2.350	-42.16		
2.395	-42.02		
2.440	-42.09		
2.485	-42.13		
2.530	-41.96		
2.575	-42.03		
2.620	-41.97		
2.665	-42.04		
2.710	-41.92		
2.755	-41.93		
2.800	-41.92		
2.845	-41.92		

1/13/2020

2.890	-41.88		
2.935	-41.82		
2.980	-41.85		
3.025	-41.79		
3.070	-41.78		
3.115	-41.71		
3.160	-41.79		
3.205	-41.72		
3.250	-41.77		
3.295	-41.74		
3.340	-41.67		
3.385	-41.69		
3.430	-41.61		
3.475	-41.69		
3.520	-41.59		
3.565	-41.59		
3.610	-41.52		
3.655	-41.56		
3.700	-41.51		
3.745	-41.52		
3.790	-41.52		
3.835	-41.48		
3.880	-41.49		
3.925	-41.41		
3.970	-41.52		
4.015	-41.50		
4.060	-41.46		
4.105	-41.47		
4.150	-41.38		
4.195	-41.42		
4.240	-41.31		
4.285	-41.31		
4.330	-41.27		
4.375	-41.30		
4.420	-41.30		
4.465	-41.20		
4.510	-41.15		
4.555	-41.15		
4.600	-41.15		
4.645	-41.02		
4.690	-41.00		
4.735	-41.04		
4.780	-40.87		
4.825	-40.96		
4.870	-40.78		
4.915	-40.76		
4.960	-40.73		

5.005	-40.66		
5.050	-40.58		
5.095	-40.52		
5.140	-40.51		
5.185	-40.42		
5.230	-40.41		
5.275	-40.35		
5.320	-40.34		
5.365	-40.35		
5.410	-40.26		
5.455	-40.32		
5.500	-40.15		
5.545	-40.21		
5.590	-40.11		
5.635	-40.02		
5.680	-40.06		
5.725	-40.01		
5.770	-39.99		
5.815	-39.91		
5.860	-39.81		
5.905	-39.74		
5.950	-39.72		
5.995	-39.62		
6.040	-39.61		
6.085	-39.44		
6.130	-39.42		
6.175	-39.41		
6.220	-39.26		
6.265	-39.24		
6.310	-39.17		
6.355	-39.11		
6.400	-38.98		
6.445	-39.00		
6.490	-38.88		
6.535	-38.80		
6.580	-38.69		
6.625	-38.65		
6.670	-38.62		
6.715	-38.50		
6.760	-38.52		
6.805	-38.34		
6.850	-38.32		
6.895	-38.29		
6.940	-38.26		
6.985	-38.22		
7.030	-38.09		
7.075	-38.09		

7.120	-38.06		
7.165	-38.04		
7.210	-37.86		
7.255	-38.01		
7.300	-37.79		
7.345	-37.66		
7.390	-37.73		
7.435	-37.63		
7.480	-37.68		
7.525	-37.49		
7.570	-37.45		
7.615	-37.37		
7.660	-37.28		
7.705	-37.30		
7.750	-37.06		
7.795	-37.15		
7.840	-36.97		
7.885	-37.13		
7.930	-36.88		
7.975	-36.85		
8.020	-36.80		
8.065	-36.65		
8.110	-36.75		
8.155	-36.56		
8.200	-36.81		
8.245	-36.49		
8.290	-36.60		
8.335	-36.58		
8.380	-36.52		
8.425	-36.65		
8.470	-36.52		
8.515	-36.56		
8.560	-36.50		
8.605	-36.45		
8.650	-36.51		
8.695	-36.41		
8.740	-36.39		
8.785	-36.26		
8.830	-36.36		
8.875	-36.28		
8.920	-36.32		
8.965	-36.24		
9.010	-36.13		
9.055	-36.17		
9.100	-36.10		
9.145	-36.22		
9.190	-36.05		

9.235	-36.15		
9.280	-36.01		
9.325	-36.13		
9.370	-36.04		
9.415	-36.12		
9.460	-36.12		
9.505	-35.91		
9.550	-36.18		
9.595	-36.06		
9.640	-36.11		
9.685	-36.05		
9.730	-35.99		
9.775	-36.22		
9.820	-36.01		
9.865	-36.11		
9.910	-36.07		
9.955	-36.11		
10.000	-36.13		
10.000	-36.09		
10.050	-36.09		
10.100	-36.10		
10.150	-36.10		
10.200	-36.10		
10.250	-36.09		
10.300	-36.09		
10.350	-36.11		
10.400	-36.07		
10.450	-36.10		
10.500	-36.09		
10.550	-36.18		
10.600	-36.16		
10.650	-36.21		
10.700	-36.17		
10.750	-36.23		
10.800	-36.21		
10.850	-36.30		
10.900	-36.27		
10.950	-36.30		
11.000	-36.23		
11.050	-36.29		
11.100	-36.28		
11.150	-36.33		
11.200	-36.32		
11.250	-36.34		
11.300	-36.37		
11.350	-36.39		
11.400	-36.39		

11.450	-36.36		
11.500	-36.38		
11.550	-36.41		
11.600	-36.44		
11.650	-36.43		
11.700	-36.47		
11.750	-36.41		
11.800	-36.49		
11.850	-36.44		
11.900	-36.51		
11.950	-36.45		
12.000	-36.47		
12.050	-36.43		
12.100	-36.44		
12.150	-36.42		
12.200	-36.41		
12.250	-36.39		
12.300	-36.41		
12.350	-36.36		
12.400	-36.40		
12.450	-36.33		
12.500	-36.38		
12.550	-36.32		
12.600	-36.31		
12.650	-36.34		
12.700	-36.29		
12.750	-36.32		
12.800	-36.24		
12.850	-36.27		
12.900	-36.28		
12.950	-36.26		
13.000	-36.28		
13.050	-36.21		
13.100	-36.26		
13.150	-36.20		
13.200	-36.19		
13.250	-36.21		
13.300	-36.24		
13.350	-36.23		
13.400	-36.20		
13.450	-36.15		
13.500	-36.24		
13.550	-36.14		
13.600	-36.21		
13.650	-36.13		
13.700	-36.18		
13.750	-36.13		

13.800	-36.13		
13.850	-36.18		
13.900	-36.12		
13.950	-36.08		
14.000	-35.97		
14.050	-36.02		
14.100	-36.02		
14.150	-36.05		
14.200	-35.96		
14.250	-36.01		
14.300	-35.92		
14.350	-35.93		
14.400	-35.84		
14.450	-35.94		
14.500	-35.87		
14.550	-35.89		
14.600	-35.84		
14.650	-35.89		
14.700	-35.90		
14.750	-35.88		
14.800	-35.88		
14.850	-35.86		
14.900	-35.77		
14.950	-35.78		
15.000	-35.66		
15.050	-35.78		
15.100	-35.65		
15.150	-35.69		
15.200	-35.66		
15.250	-35.64		
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15.350	-35.50		
15.400	-35.67		
15.450	-35.56		
15.500	-35.66		
15.550	-35.50		
15.600	-35.55		
15.650	-35.42		
15.700	-35.43		
15.750	-35.31		
15.800	-35.41		
15.850	-35.23		
15.900	-35.36		
15.950	-35.18		
16.000	-35.35		
16.050	-35.18		
16.100	-35.25		

16.150	-35.07		
16.200	-35.05		
16.250	-34.99		
16.300	-34.91		
16.350	-34.94		
16.400	-34.84		
16.450	-34.85		
16.500	-34.76		
16.550	-34.72		
16.600	-34.69		
16.650	-34.65		
16.700	-34.56		
16.750	-34.60		
16.800	-34.43		
16.850	-34.55		
16.900	-34.32		
16.950	-34.42		
17.000	-34.17		
17.050	-34.29		
17.100	-34.11		
17.150	-34.18		
17.200	-33.96		
17.250	-34.02		
17.300	-33.87		
17.350	-33.92		
17.400	-33.80		
17.450	-33.86		
17.500	-33.79		
17.550	-33.69		
17.600	-33.65		
17.650	-33.55		
17.700	-33.57		
17.750	-33.37		
17.800	-33.44		
17.850	-33.32		
17.900	-33.37		
17.950	-33.17		
18.000	-33.30		
18.050	-33.12		
18.100	-33.22		
18.150	-32.91		
18.200	-33.16		
18.250	-32.92		
18.300	-33.04		
18.350	-32.75		
18.400	-32.98		
18.450	-32.81		

18.500	-32.86		
18.550	-32.74		
18.600	-32.88		
18.650	-32.84		
18.700	-32.78		
18.750	-32.73		
18.800	-32.72		
18.850	-32.70		
18.900	-32.60		
18.950	-32.66		
19.000	-32.71		
19.050	-32.73		
19.100	-32.64		
19.150	-32.74		
19.200	-32.72		
19.250	-32.76		
19.300	-32.55		
19.350	-32.75		
19.400	-32.70		
19.450	-32.80		
19.500	-32.67		
19.550	-32.86		
19.600	-32.87		
19.650	-32.91		
19.700	-32.79		
19.750	-32.94		
19.800	-32.96		
19.850	-32.93		
19.900	-32.88		
19.950	-32.95		
20.000	-33.07		
20.000	-33.07		
20.050	-32.96		
20.100	-32.97		
20.150	-33.01		
20.200	-33.15		
20.250	-33.07		
20.300	-33.14		
20.350	-33.18		
20.400	-33.33		
20.450	-33.21		
20.500	-33.35		
20.550	-33.39		
20.600	-33.52		
20.650	-33.29		
20.700	-33.36		
20.750	-33.46		

20.800	-33.53		
20.850	-33.52		
20.900	-33.44		
20.950	-33.61		
21.000	-33.47		
21.050	-33.53		
21.100	-33.53		
21.150	-33.68		
21.200	-33.55		
21.250	-33.44		
21.300	-33.51		
21.350	-33.61		
21.400	-33.47		
21.450	-33.39		
21.500	-33.38		
21.550	-33.56		
21.600	-33.49		
21.650	-33.52		
21.700	-33.57		
21.750	-33.57		
21.800	-33.48		
21.850	-33.34		
21.900	-33.38		
21.950	-33.37		
22.000	-33.35		
22.050	-33.33		
22.100	-33.46		
22.150	-33.48		
22.200	-33.42		
22.250	-33.36		
22.300	-33.40		
22.350	-33.39		
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22.600	-33.31		
22.650	-33.35		
22.700	-33.38		
22.750	-33.46		
22.800	-33.40		
22.850	-33.41		
22.900	-33.46		
22.950	-33.50		
23.000	-33.42		
23.050	-33.44		
23.100	-33.42		

23.150	-33.53		
23.200	-33.39		
23.250	-33.49		
23.300	-33.47		
23.350	-33.59		
23.400	-33.45		
23.450	-33.44		
23.500	-33.55		
23.550	-33.48		
23.600	-33.58		
23.650	-33.38		
23.700	-33.61		
23.750	-33.45		
23.800	-33.51		
23.850	-33.37		
23.900	-33.53		
23.950	-33.40		
24.000	-33.44		
24.050	-33.29		
24.100	-33.54		
24.150	-33.36		
24.200	-33.41		
24.250	-33.19		
24.300	-33.31		
24.350	-33.18		
24.400	-33.13		
24.450	-33.14		
24.500	-33.19		
24.550	-33.09		
24.600	-33.05		
24.650	-32.98		
24.700	-33.01		
24.750	-32.90		
24.800	-32.70		
24.850	-32.76		
24.900	-32.56		
24.950	-32.79		
25.000	-32.48		
25.050	-32.72		
25.100	-32.45		
25.150	-32.64		
25.200	-32.36		
25.250	-32.50		
25.300	-32.27		
25.350	-32.38		
25.400	-32.12		
25.450	-32.35		

25.500	-32.18		
25.550	-32.29		
25.600	-32.12		
25.650	-32.21		
25.700	-32.21		
25.750	-32.10		
25.800	-32.05		
25.850	-31.94		
25.900	-31.95		
25.950	-31.93		
26.000	-31.94		
26.050	-32.08		
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26.200	-32.04		
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26.300	-32.11		
26.350	-31.70		
26.400	-32.05		
26.450	-31.87		
26.500	-32.20		
26.550	-31.99		
26.600	-32.19		
26.650	-32.10		
26.700	-32.15		
26.750	-32.07		
26.800	-32.30		
26.850	-32.26		
26.900	-32.33		
26.950	-32.17		
27.000	-32.32		
27.050	-32.43		
27.100	-32.40		
27.150	-32.57		
27.200	-32.42		
27.250	-32.63		
27.300	-32.28		
27.350	-32.43		
27.400	-32.35		
27.450	-32.51		
27.500	-32.35		
27.550	-32.48		
27.600	-32.43		
27.650	-32.61		
27.700	-32.34		
27.750	-32.54		
27.800	-32.39		

27.850	-32.52		
27.900	-32.36		
27.950	-32.51		
28.000	-32.72		
28.050	-32.70		
28.100	-32.72		
28.150	-32.62		
28.200	-32.72		
28.250	-32.56		
28.300	-32.44		
28.350	-32.48		
28.400	-32.58		
28.450	-32.50		
28.500	-32.45		
28.550	-32.38		
28.600	-32.58		
28.650	-32.43		
28.700	-32.57		
28.750	-32.47		
28.800	-32.50		
28.850	-32.37		
28.900	-32.37		
28.950	-32.47		
29.000	-32.44		
29.050	-32.42		
29.100	-32.44		
29.150	-32.58		
29.200	-32.67		
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29.300	-32.69		
29.350	-32.75		
29.400	-32.64		
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29.550	-33.04		
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29.700	-33.07		
29.750	-33.09		
29.800	-33.14		
29.850	-33.25		
29.900	-33.38		
29.950	-33.57		
30.000	-33.60		
30.150	-33.86		
30.200	-33.69		
30.250	-33.87		

30.300	-33.97		
30.350	-34.07		
30.400	-34.02		
30.450	-33.95		
30.500	-34.01		
30.550	-33.91		
30.600	-33.82		
30.650	-33.71		
30.700	-33.80		
30.750	-33.72		
30.800	-33.78		
30.850	-33.70		
30.900	-33.81		
30.950	-33.59		
31.000	-33.61		
31.050	-33.43		
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31.150	-33.49		
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31.300	-33.56		
31.350	-33.57		
31.400	-33.62		
31.450	-33.58		
31.500	-33.67		
31.550	-33.53		
31.600	-33.52		
31.650	-33.54		
31.700	-33.64		
31.750	-33.71		
31.800	-33.61		
31.850	-33.78		
31.900	-33.68		
31.950	-33.77		
32.000	-33.61		
32.050	-33.75		
32.100	-33.72		
32.150	-33.78		
32.200	-33.63		
32.250	-33.67		
32.300	-33.54		
32.350	-33.45		
32.400	-33.20		
32.450	-33.16		
32.500	-33.03		
32.550	-32.92		
32.600	-32.75		

32.650	-32.76		
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33.400	-32.66		
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33.600	-32.04		
33.650	-31.96		
33.700	-32.00		
33.750	-31.92		
33.800	-32.01		
33.850	-31.99		
33.900	-31.96		
33.950	-31.88		
34.000	-31.81		
34.050	-31.98		
34.100	-32.05		
34.150	-32.28		
34.200	-32.37		
34.250	-32.52		
34.300	-32.48		
34.350	-32.43		
34.400	-32.32		
34.450	-32.37		
34.500	-32.18		
34.550	-32.17		
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34.700	-31.76		
34.750	-31.91		
34.800	-31.89		
34.850	-31.91		
34.900	-31.54		
34.950	-31.40		

35.000	-31.39		
35.050	-31.43		
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35.200	-31.57		
35.250	-31.68		
35.300	-32.00		
35.350	-32.06		
35.400	-32.25		
35.450	-32.39		
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35.650	-33.19		
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35.900	-33.72		
35.950	-33.38		
36.000	-33.28		
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36.100	-33.03		
36.150	-32.81		
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37.150	-34.18		
37.200	-34.30		
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37.300	-34.33		

37.350	-34.47		
37.400	-34.48		
37.450	-34.67		
37.500	-34.73		
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38.650	-34.97		
38.700	-34.99		
38.750	-34.85		
38.800	-34.79		
38.850	-34.73		
38.900	-34.77		
38.950	-34.71		
39.000	-34.68		
39.050	-34.85		
39.100	-34.85		
39.150	-34.73		
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39.600	-35.38		
39.650	-35.49		

39.700	-35.45		
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39.800	-35.47		
39.850	-35.36		
39.900	-35.46		
39.950	-35.47		
40.000	-35.51		

Electro Rent Corporation

15385 OXNARD ST
VAN NUYS, CA 91411

CERTIFICATE OF CONFORMANCE

Model Number:	KT-E8257DS10
Serial Number:	US52140176
Asset Number:	1320457C
Description:	75GHz-110GHz Millimeter Source module
Test Date:	02/27/19
Calibration Facility:	ELECTRO RENT CORPORATION (WDC) 15385 OXNARD ST VAN NUYS, CA 91411

The equipment listed above meets or exceeds published specifications and has been tested or otherwise verified using industry accepted methods. This certification shall not be reproduced except in full, without the written approval of Electro Rent Corporation.'

Electro Rent Corporation
Authorized Signature
KARL HAYNES

Karl Haynes

Certificate of Compliance

Certificate No: 9502719A-160728-3

Manufacturer: OML, Inc.

Model/Part No: S10MS-AG **Serial/ID No:** 160728-3

Description: WR-10 Millimeter Wave Source Module, 75-110 GHz
Keysight P/N: 0955-1811

Date of Test: February 14, 2019
Temperature: (23 +/- 5) deg C **Humidity:** 20 to 65% RH
Procedure:

This certifies that the above product was tested in compliance with OML specifications using applicable OML's procedures.

As Received : Physical Condition: Good
Within Tolerance: No

As Shipped: At the completion of the test, the product COMPLIED with the performance capability.

Remarks: Repair Service

Traceability Information: Traceability is to national standards administered by U.S. NIST, NRC Canada, Euromet members (NPL, PTB, BNM, etc.) or other recognized standards laboratories. Some measurements are traceable to natural physical constants, consensus standards or ratio type measurements. Supporting documentation relative to traceability is available for review by appointment.
In the absence of power standards above 110 GHz, power measurements and conversion loss measurements above 110 GHz are to confirm operation functionality and traceable only to OML.

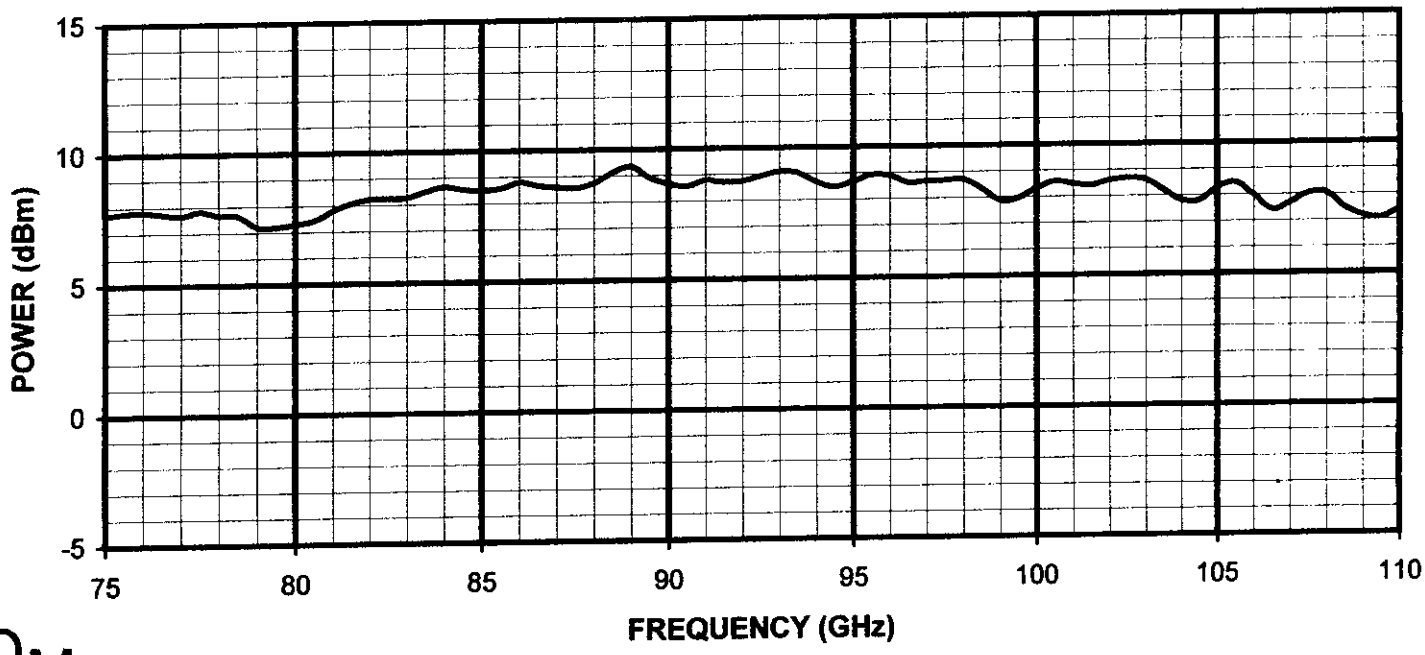
This certificate shall not be reproduced, except in full, without the written approval of OML.

Mitzi Chow, Material Manager — 02/15/2019 Date

S10MS-AG S/N: 160728-3

2/14/2019

Output Power



OML INC.

300 Digital Drive, Morgan Hill, CA 95037

Model S10MS-AG

S/N: 160728-3

2/14/2019

Tested By: IN

Output Power Test Data

Frequency (GHz)	Pwr Out (dBm)
75.00	7.69
75.50	7.78
76.00	7.81
76.50	7.73
77.00	7.65
77.50	7.82
78.00	7.66
78.50	7.63
79.00	7.20
79.50	7.19
80.00	7.28
80.50	7.43
81.00	7.80
81.50	8.07
82.00	8.22
82.50	8.23
83.00	8.27
83.50	8.48

Frequency (GHz)	Pwr Out (dBm)
84.00	8.65
84.50	8.55
85.00	8.49
85.50	8.56
86.00	8.79
86.50	8.65
87.00	8.59
87.50	8.54
88.00	8.73
88.50	9.14
89.00	9.35
89.50	8.90
90.00	8.68
90.50	8.57
91.00	8.79
91.50	8.70
92.00	8.74
92.50	8.92

Frequency (GHz)	Pwr Out (dBm)
93.00	9.09
93.50	9.05
94.00	8.68
94.50	8.48
95.00	8.68
95.50	8.92
96.00	8.88
96.50	8.61
97.00	8.66
97.50	8.68
98.00	8.71
98.50	8.34
99.00	7.87
99.50	7.96
100.00	8.32
100.50	8.58
101.00	8.48
101.50	8.42

Frequency (GHz)	Pwr Out (dBm)
102.00	8.61
102.50	8.68
103.00	8.62
103.50	8.20
104.00	7.81
104.50	7.80
105.00	8.28
105.50	8.47
106.00	7.98
106.50	7.43
107.00	7.69
107.50	8.04
108.00	8.05
108.50	7.47
109.00	7.18
109.50	7.09
110.00	7.42

9502719A

OML INC.

300 Digital Drive, Morgan Hill, CA 95037

Electro Rent Corporation

15385 OXNARD ST
VAN NUYS, CA 91411

CERTIFICATE OF CONFORMANCE

Model Number:	KT-E8257DS15
Serial Number:	US52140139
Asset Number:	1608082A
Description:	50GHz-75GHz Millimeter Source module
Test Date:	12/15/17
Calibration Facility:	ELECTRO RENT CORPORATION (WDC) 15385 OXNARD ST VAN NUYS, CA 91411

The equipment listed above meets or exceeds published specifications and has been tested or otherwise verified using industry accepted methods. This certification shall not be reproduced except in full, without the written approval of Electro Rent Corporation.'

Electro Rent Corporation
Authorized Signature
KARL HAYNES

Karl Haynes

Certificate of Compliance

Certificate No: 6517717A-140312-1

Manufacturer: OML, Inc.

Model/Part No: S15MS-AG (Funct Verif) **Serial/ID No:** 140312-1

Description: Module Source Millimeter Wave, WR-15, 50-75 GHz (Functional Verification)
Keysight P/N: 0955-1809 (Funct Verif)

Date of Test: December 4, 2017
Temperature: (23 +/- 5) deg C **Humidity:** 20 to 65% RH
Procedure:

This certifies that the above product was tested in compliance with OML specifications using applicable OML's procedures.

As Received : Physical Condition: Good
Within Tolerance: Yes

As Shipped: At the completion of the test, the product COMPLIED with the performance capability.

Remarks:

Traceability Information: Traceability is to national standards administered by U.S. NIST, NRC Canada, Euromet members (NPL, PTB, BNM, etc.) or other recognized standards laboratories. Some measurements are traceable to natural physical constants, consensus standards or ratio type measurements. Supporting documentation relative to traceability is available for review by appointment.
In the absence of power standards above 110 GHz, power measurements and conversion loss measurements above 110 GHz are to confirm operation functionality and traceable only to OML.

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

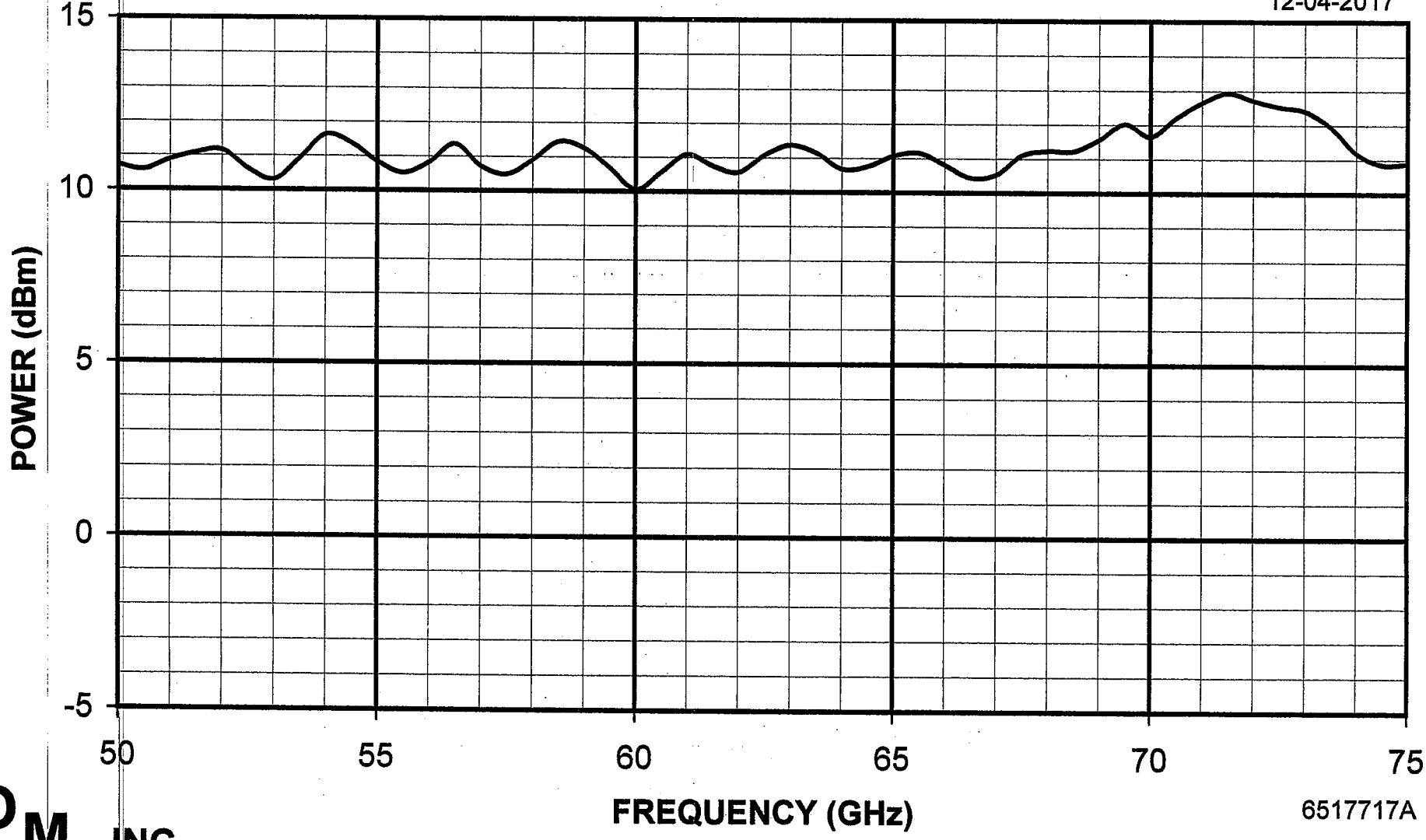
Mitzi Chow, Material Manager — 12/05/2017 Date

OML Inc.
300 Digital Drive, Morgan Hill, CA 95037 USA Tel. (408) 779 2698 Fax (408) 778 0491

S15MS-AG Power Output

Ser No. 140312-1

12-04-2017



6517717A

OML INC.

Morgan Hill, CA 95037

Electro Rent Corporation

15385 OXNARD ST
VAN NUYS, CA 91411

CALIBRATION CERTIFICATE

Certificate Number: 1778667D-07/22/19
Calibration Date: 07/22/19
Procedure Method: VENDOR CAL
Revision Level: REMARKS

Calibration Facility:
ROHDE & SCHWARZ
zavod Vimperk, s.r.o.
SPIDROVA 49, CZ-385 01
VIMPERK, CZECH REPUBLIC

The equipment listed has been calibrated using the method identified above.

Measurements are traceable to the SI as defined by the documentary standards to which compliance is claimed through the calibration equipment identified on the following page, or the supplier's certificate.

Reported results of calibration are based on calibration procedure test limits, test ratios or measurement uncertainty and decision risk rules of the documentary standards to which compliance is claimed. Electro Rent Corp. does not report indeterminate results.

Calibration measurement results with units of measurement and associated measurement uncertainty information calculated using GUM methods, or as provided by the calibration procedure are identified with the asset number in order to ensure that the page(s) is (are) recognized as a part of this calibration certificate.

This certificate and associated report may not be reproduced except in full without approval of Electro Rent Corporation.

Electro Rent West Coast Distribution Center quality management system implements ISO 9001 and is registered. Our calibration system implements ISO/IEC 17025, ANSI Z540-1, and MIL-STD-45662A.

This calibration certificate and any associated report is not intended to demonstrate traceability per ILAC P10.

Manufacturer:	Rohde & Schwarz
Model Number:	SMW200A-44
Serial Number:	107056
Asset Number:	1778667D
Description:	100kHz to 44GHz Vector Signal Generator
Customer:	COMPLIANCE TESTING 1724 S. NEVADA WAY MESA, AZ 85204
Customer PO:	6424
Performance upon receipt:	WITHIN MFR SPECS
Results of calibration:	IN TOL NO ADJ
Ambient Temp:	70.0F
Relative Humidity:	50.00%
Date of Issue:	04/21/20
Calib Due Date:	07/22/22
OS Build:	NA
Firmware:	4.60.092.24SP2

Laboratory Manager:
Alejandra Salazar

Technician:
Bernardo Gonzalez

CALIBRATION CERTIFICATE

Model Number: SMW200A-44 **Asset Number:** 1778667D
Certificate Number: 1778667D-07/22/19 **Serial Number:** 107056

Calibration Date: 07/22/19

Calibration Equipment

Description	Model	Asset	Certificate Number	Cal. Due
N/A	N/A	N/A	N/A	N/A

Remarks:

VENDOR CALIBRATION CERTIFICATE NO. 17-818537-C