ANTENNA REPORT

Report No.: RFXP01-U2A Rev A

Company: Drum Workshop

Model Name: DWE-DLM1

ANTENNA REPORT

Company Name: Drum Workshop

Model Name: DWE-DLM1

Test Report Serial No.: RFXP01-U2A Rev A

This report supersedes: NONE

Applicant: Drum Workshop
3450 Lunar Ct
Oxnard, California 93030
USA

Issue Date: 30th November 2022

This Test Report is Issued Under the Authority of:

MiCOM Labs, Inc.
575 Boulder Court
Pleasanton California 94566
USA
Phone: +1 (925) 462-0304
Fax: +1 (925) 462-0306
www.micomlabs.com

MiCOM Labs is an ISO 17025 Accredited Testing Laboratory

Table of Contents

MiCOM Labs, 575 Boulder Court, Pleasanton, California 94566 USA, Phone: +1 (925) 462 0304, Fax: +1 (925) 462 0306, www.micomlabs.com

1. ACCREDITATION, LISTINGS & RECOGNITION

1.1. TESTING ACCREDITATION

MiCOM Labs, Inc. is an accredited Electrical testing laboratory per the international standard ISO/IEC 17025:2017. The company is accredited by the American Association for Laboratory Accreditation (A2LA) www.a2la.org test laboratory number 2381.01. MiCOM Labs test schedule is available at the following URL; http://www.a2la.org/scopepdf/2381-01.pdf

ilac-MRA A2LA

Accredited Laboratory

A2LA has accredited

MICOM LABS

Pleasanton, CA

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 *General requirements for the competence of testing and calibration laboratories*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated April 2017*).

Presented this 14th day of January 2022.

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 2381.01
Valid to November 30, 2023

For the tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.

1.2. RECOGNITION

MiCOM Labs, Inc is widely recognized for its wireless testing and certification capabilities. In addition to being recognized for Testing and Certification under Phase 2 Mutual Recognition Agreements (MRA) with Canada, Europe, United Kingdom and Japan, our international recognition includes Conformity Assessment Body (CAB) designation status under agreements with Asia Pacific (APEC) MRA Phase 1 countries giving acceptance of MiCOM Labs test reports. MiCOM Labs test reports are accepted globally.

Country	Recognition Body	Status	MRA Phase	Identification No.
USA	Federal Communications Commission (FCC)	TCB	-	US0159 Test Firm Designation#: US1084
Canada	Industry Canada (ISED)	FCB	APEC MRA 2	US0159 ISED#: 4143A
Japan	MIC (Ministry of Internal Affairs and Communication)	CAB	Japan MRA 2	RCB 210
	Japan Approvals Institute for Telecommunication Equipment (JATE)			
	VCCI	--	--	A-0012
Europe	European Commission	NB	EU MRA 2	NB 2280
United Kingdom	Department for Business, Energy & Industrial Strategy (BEIS)	AB	UK MRA 2	AB 2280
Mexico	Instituto Federal de Telecomunicaciones (IFT)	CAB	Mexico MRA 1	US0159
Australia	Australian Communications and Media Authority (ACMA)	CAB	APEC MRA 1	US0159
Hong Kong	Office of the Telecommunication Authority (OFTA)			
Korea	Ministry of Information and Communication Radio Research Laboratory (RRL)			
Singapore	Infocomm Development Authority (IDA)			
Taiwan	National Communications Commission (NCC) Bureau of Standards, Metrology and Inspection (BSMI)			
Vietnam	Ministry of Communication (MIC)			

TCB – Telecommunications Certification Bodies (TCB)
FCB – Foreign Certification Body
CAB – Conformity Assessment Body
NB – Notified Body
AB – Approved Body
MRA – Mutual Recognition Agreement
MRA Phase I - recognition for product testing
MRA Phase II – recognition for both product testing and certification

1.3. PRODUCT CERTIFICATION

MiCOM Labs, Inc. is an accredited Product Certification Body per the international standard ISO/IEC 17065:2012. The company is accredited by the American Association for Laboratory Accreditation (A2LA) www.a2la.org test laboratory number 2381.02. MiCOM Labs test schedule is available at the following URL; http://www.a2la.org/scopepdf/2381-02.pdf

Accredited Product Certification Body

A2LA has accredited

MiCOM LABS

Pleasanton, CA

This product certification body is accredited in accordance with the recognized International Standard ISO/IEC 17065:2012 *Requirements for bodies certifying products, processes and services*. This product certification body also meets the *A2LA R322 – Specific Requirements – Notified Body Accreditation Requirements* and *A2LA R308 - Specific Requirements - ISO-IEC 17065 - Telecommunication Certification Body Accreditation Program*. This accreditation demonstrates technical competence for a defined scope and the operation of a management system.

Presented this 14th day of January 2022

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 2381.02
Valid to November 30, 2023

For the product certification schemes to which this accreditation applies, please refer to the organization's Product Certification Scope of Accreditation.

United States of America – Telecommunication Certification Body (TCB)
Industry Canada – Certification Body, CAB Identifier – US0159
Europe – Notified Body (NB), NB Identifier - 2280
UK – Approved Body (AB), AB Identifier - 2280
Japan – Recognized Certification Body (RCB), RCB Identifier - 210

1. DOCUMENT HISTORY

Document History		
Revision	Date	Comments
Draft	11th October 2022	Draft for client comment
Rev A	30th November 2022	Initial release

In the above table the latest report revision will replace all earlier versions.

MiCOM Labs, 575 Boulder Court, Pleasanton, California 94566 USA, Phone: +1 (925) 462 0304, Fax: +1 (925) 462 0306, www.micomlabs.com

2. REFERENCES AND MEASUREMENT UNCERTAINTY

2.1. Normative References

REF.	PUBLICATION	YEAR	TITLE
II	A2LA	22nd June 2022	R105 - Requirement's When Making Reference to A2LA Accreditation Status
III	ANSI C63.10	2020	American National Standard for Testing Unlicensed Wireless Devices
VIII	M 3003	EDITION 4 Oct 2019	Expression of Uncertainty and Confidence in Measurements

2.2. Test and Uncertainty Procedure

Conducted and radiated emission measurements were conducted in accordance with American National Standards Institute ANSI C63.4, listed in the Normative References section of this report.

Measurement uncertainty figures are calculated in accordance with ETSI TR 100 028 Parts 1 and 2.

Measurement uncertainties stated are based on a standard uncertainty multiplied by a coverage factor k = 2, providing a level of confidence of approximately 95 % in accordance with UKAS document M 3003 listed in the Normative References section of this report.

MiCOM Labs, 575 Boulder Court, Pleasanton, California 94566 USA, Phone: +1 (925) 462 0304, Fax: +1 (925) 462 0306, www.micomlabs.com

3. PRODUCT DETAILS AND TEST CONFIGURATIONS

3.1. Technical Details

Details	Description
Purpose:	Characterize the antennas of Drum Workshop DWE-DLM1 to measure the EIRP and Antenna Gain.
Applicant:	Drum Workshop 3450 Lunar Ct Oxnard, California 93030 USA
Manufacturer:	Drum Workshop
Laboratory performing the tests:	MiCOM Labs, Inc. 575 Boulder Court Pleasanton California 94566 USA
Test report reference number:	RFXP01-U2A Rev A
Date EUT received:	8th September 2022
Standard(s) applied:	NA
Dates of test (from - to):	9th - 14th September 2022
No of Units Tested:	2
Model(s):	DWE-DLM1
Technology:	DTS
Location for use:	Indoors and Outdoors
Declared Frequency Range(s):	2400 - 2483.5 MHz;
Type of Modulation:	GFSK
Declared Nominal Output Power (dBm):	+10 dBm
Transmit/Receive Operation:	Transceiver
Rated Input Voltage and Current:	Battery 3VDC
Operating Temperature Range:	+10°C to +50°C
Equipment Dimensions:	25mm x17mm x 3mm
Weight:	1 oz
Hardware Version:	Rev X1
Firmware Version:	Prototype

3.2. Scope Of Test Program

Drum Workshop DWE-DLM1

The scope of the test program was to characterize the antenna of the Drum Workshop DWE-DLM1 in the frequency ranges 2400 - 2483.5 MHz;

3.3. Equipment Model(s) and Serial Number(s)

Type (EUT/ Support)	Equipment Description	Manufacturer	Model No.	Serial No.
EUT	Conducted Module	Drum Workshop	DWE-DLM1	Proto1
EUT	Radiated Module	Drum Workshop	DWE-DLM1	Proto2

3.4. Antenna Details

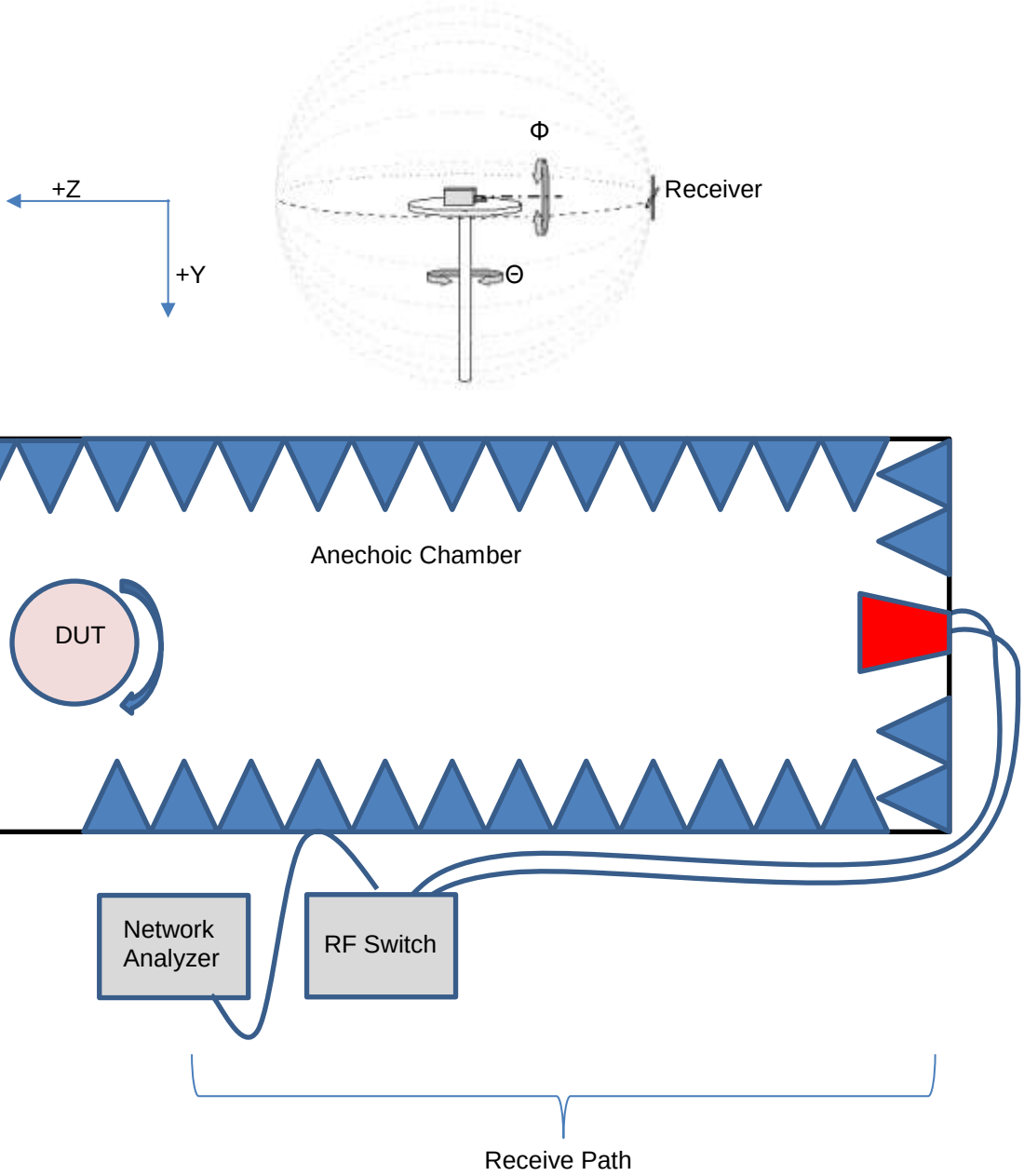
Type	Manufacturer	Model	Type	Max Gain (dBi)	Frequency Band (MHz)
Integral	MFG Johanson Technology	2450AT18A100E,	Chip	2.72	2400 - 2483.5
Integral	Drum Workshop	Wire	Wire	2.82	2400 - 2483.5

3.5. Cabling and I/O Ports

None, unit tested was a module

3.6. Test Configurations

EUT was positioned on the mast, with the top facing the inside wall (+X direction) and the WiFi symbol towards the ceiling (-Y). Theta rotation of the turntable represents the Elevation rotation of the sphere while Phi rotation of the positioner represents Azimuth Rotation. The DUT antenna was energized using the modulated signal from its own radio. The entire range was calibrated for the desired frequencies prior to testing.



For Response loss measurements the Antenna under test was connected directly to Network Analyzer.

Results for the following configurations are provided in this report:

Operational Mode(s) DTS	Data Rate with Highest Power MBit/s	Channel Frequency (MHz)			
		Low	Mid	High	Additional
		2400 - 2483.5 MHz			
GFSK	1.00	2,402.00	2,442.00	2,480.00	--

3.7. Equipment Modifications

1. NONE

3.8. Deviations from the Test Standard

The following deviations from the test standard were required in order to complete the test program:

1. NONE

4. TEST SUMMARY

List of Measurements

Test Header	Data Link
Peak EIRP and Gain	View Data
Antenna Patterns	View Data

5. TEST EQUIPMENT CONFIGURATION

A full system calibration was performed on the test station and any resulting system losses (or gains) were taken into account in the production of all final measurement data.

Asset#	Description	Manufacturer	Model#	Serial#	Calibration Due Date
294	Antenna Measurement Chamber	ETS Lindgren	AMS-8500	008	Not Required
369	Quad Ridge Horn Antenna	ETS-Lindgren	ETS 3164-08	00123798	12 Jan 2023
439	Sleeve Dipole Antenna	ETS Lindgren	3126-920	00168522	9 Sep 2023
444	SMA Cable Assembly	ETS-Lindgren	RFC-NMS-100-SMS-256 IN	001	Cal when used
477	Sleeve Dipole	MVG	SD5650-A-135	SD5650-A-135	20 May 2024
478	Sleeve Dipole	MVG	SD5150-A-94	SD5150-A-94	20 May 2024
479	Sleeve Dipole	MVG	SD2450-265	SD2450-265	20 May 2024
499	ENA Series Network Analyzer 100 kHz to 8.5 GHz	Agilent	E5071C	MY46100409	10 Jun 2024
510	Barometer/Thermometer	Digi Sense	68000-49	170871375	4 Jan 2024

6. TEST RESULTS

6.1. Peak EIRP and Antenna Gain

Test Conditions for Peak EIRP and Antenna Gain			
Standard:	-	**Ambient Temp. (ºC):**	24.0 - 27.5
Test Heading:	Peak EIRP and Antenna Gain	**Rel. Humidity (%):**	32 - 45
Standard Section(s):	-	**Pressure (mBars):**	999 - 1001
Reference Document(s):	See Normative References		

DUT is configured to transmit a continuous modulated signal on the Low, Middle and High channels and rotated through the entire measurement sphere.

At each step-in angle the power is measured using the Spectrum Analyzer for each polarization, at the end of the rotation the Total Radiated Power is calculated across the entire sphere and the peak EIRP value is located. Using this measured EIRP along with the measured conducted RF Output Power the antenna gain and Efficiency is calculated.

The DUT transmits a 1 MHz wide modulated signal near 100% Duty Cycle, to measure the power the Spectrum Analyzer is configured to monitor a 3 MHz wide span using a Peak Power Detector and a 3 MHz RBW and VBW. The sweep time was left to Auto Couple and after each trace the Peak Marker was recorded.

Equipment Configuration for Peak EIRP and Antenna Gain			
Variant:	Chip Antenna	**Duty Cycle (%):**	99
Data Rate:	1.00 MBit/s	**Beam Forming Gain (Y)(dB):**	Not Applicable
Modulation:	GFSK	**Tested By:**	JK
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Conducted Power	Peak EIRP	Efficiency	Antenna Gain
MHz	**dBm**	**dBm**	**%**	**dBi**
2402.0	7.24	9.96	64.88	2.72
2442.0	6.45	8.41	64.70	1.96
2480.0	8.35	8.83	48.51	0.48

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-03 MEASURING RF SPECTRUM MASK
Measurement Uncertainty:	±2.81 dB

Note: click the links in the above matrix to view the graphical image (plot).

MiCOM Labs, 575 Boulder Court, Pleasanton, California 94566 USA, Phone: +1 (925) 462 0304, Fax: +1 (925) 462 0306, www.micomlabs.com

Equipment Configuration for Peak EIRP and Antenna Gain			
Variant:	Wire Antenna	**Duty Cycle (%):**	99
Data Rate:	1.00 MBit/s	**Beam Forming Gain (Y)(dB):**	Not Applicable
Modulation:	GFSK	**Tested By:**	JK
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Conducted Power	Peak EIRP	Efficiency	Antenna Gain
MHz	**dBm**	**dBm**	**%**	**dBi**
2402.0	7.24	9.05	63.24	1.81
2442.0	6.45	9.27	90.64	2.82
2480.0	8.35	8.02	47.75	-0.33

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-03 MEASURING RF SPECTRUM MASK
Measurement Uncertainty:	±2.81 dB

Note: click the links in the above matrix to view the graphical image (plot).

MiCOM Labs, 575 Boulder Court, Pleasanton, California 94566 USA, Phone: +1 (925) 462 0304, Fax: +1 (925) 462 0306, www.micomlabs.com

6.2. Antenna Patterns

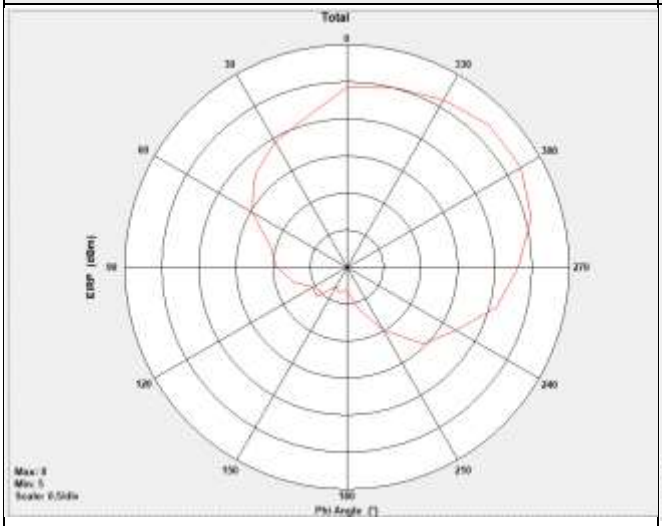
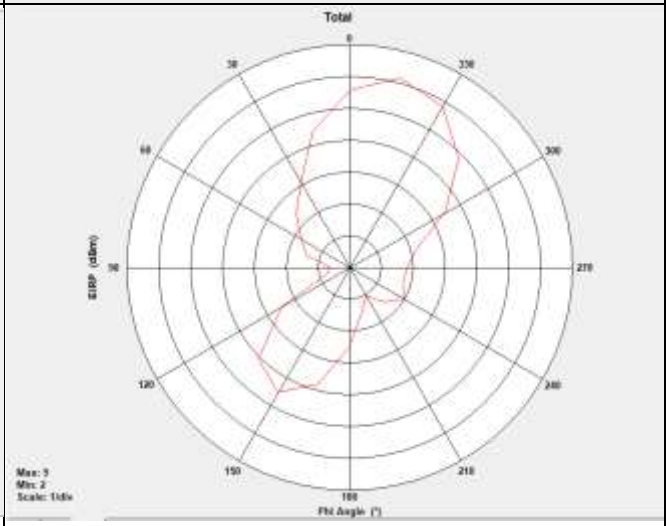
Conducted Test Conditions for Fundamental Emission Output Power			
Standard:	FCC CFR 47:15.247	**Ambient Temp. (ºC):**	24.0 - 27.5
Test Heading:	Output Power	**Rel. Humidity (%):**	32 - 45
Standard Section(s):	15.247 (b) & (c)	**Pressure (mBars):**	999 - 1001
Reference Document(s):	See Normative References		

Measured power is pulled from the 3D sphere and displayed in the Azimuth and Elevation patterns for both Horizontal and Vertical Polarizations.

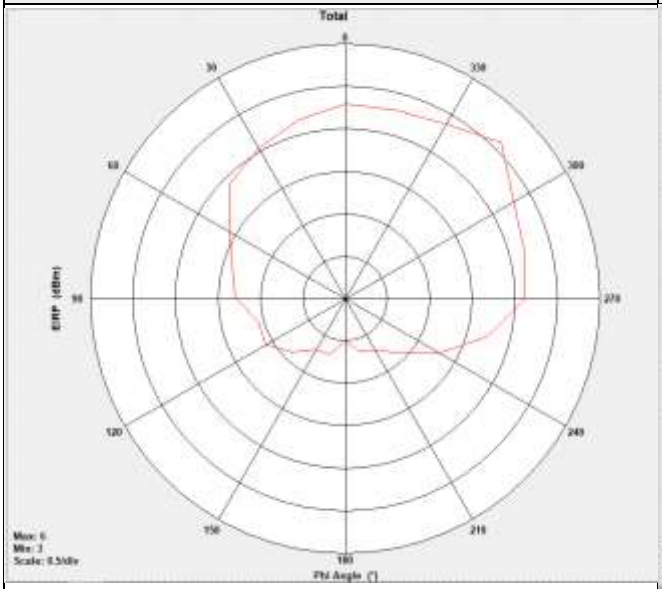
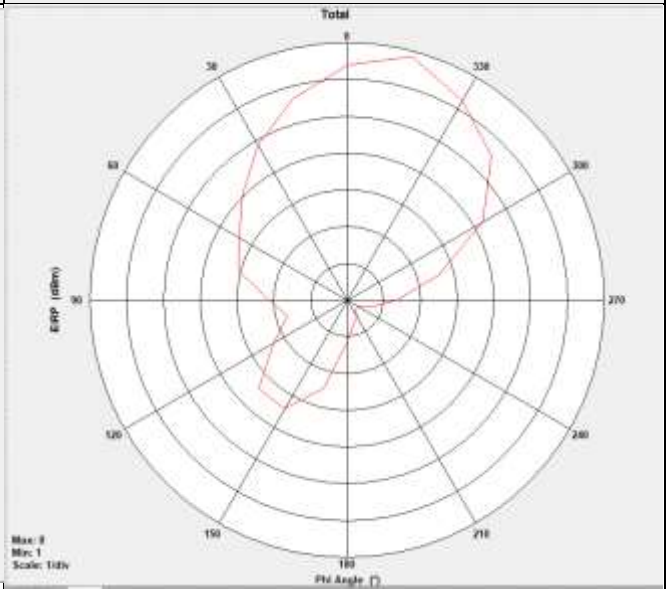
Equipment Configuration for Horizontal Antenna Pattern			
Variant:	Chip Antenna	**Duty Cycle (%):**	99.0
Data Rate:	1.00 MBit/s	**Antenna Gain (dBi):**	NA
Modulation:	GFSK	**Beam Forming Gain (Y)(dB):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	JK
Engineering Test Notes:			

Test Measurement Results

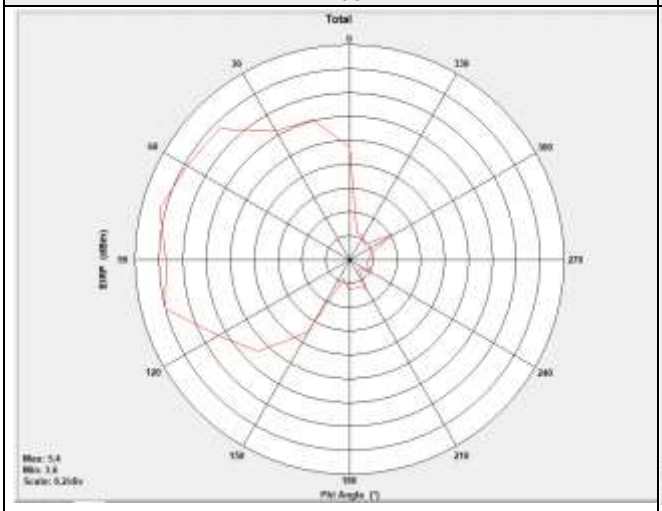
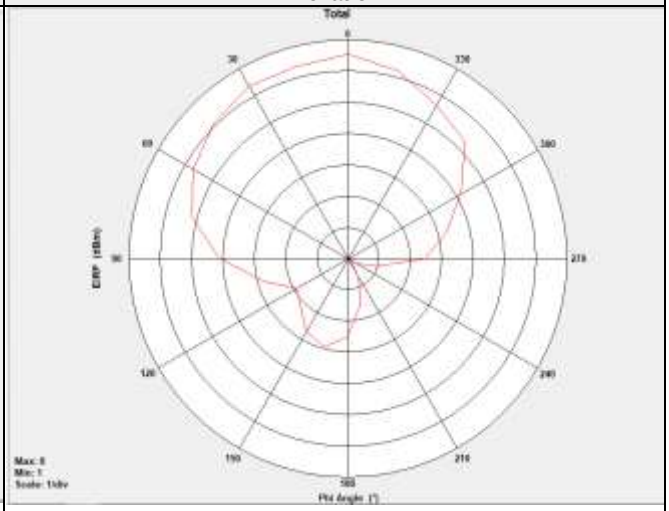
2402 MHz

Azimuth	Elevation
	

2442 MHz

Azimuth	Elevation
	

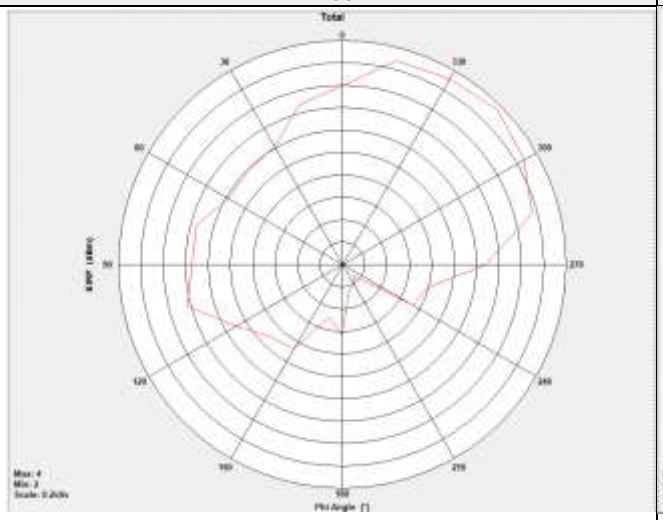
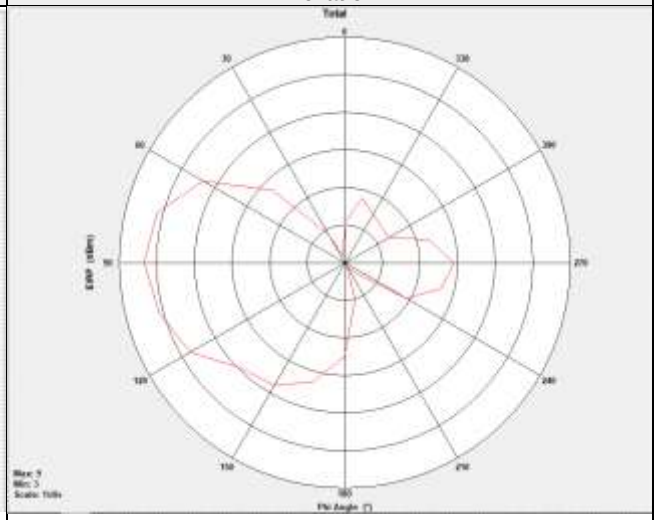
MiCOM Labs, 575 Boulder Court, Pleasanton, California 94566 USA, Phone: +1 (925) 462 0304, Fax: +1 (925) 462 0306, www.micomlabs.com

2480 MHz	
Azimuth	**Elevation**
	

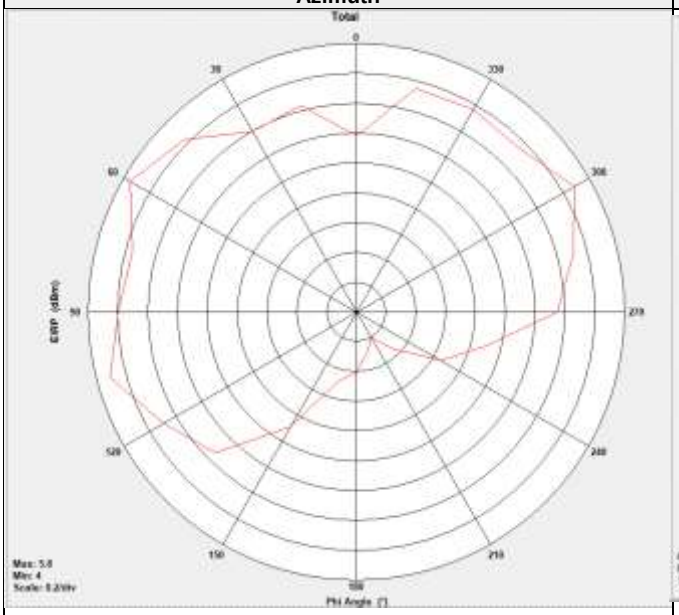
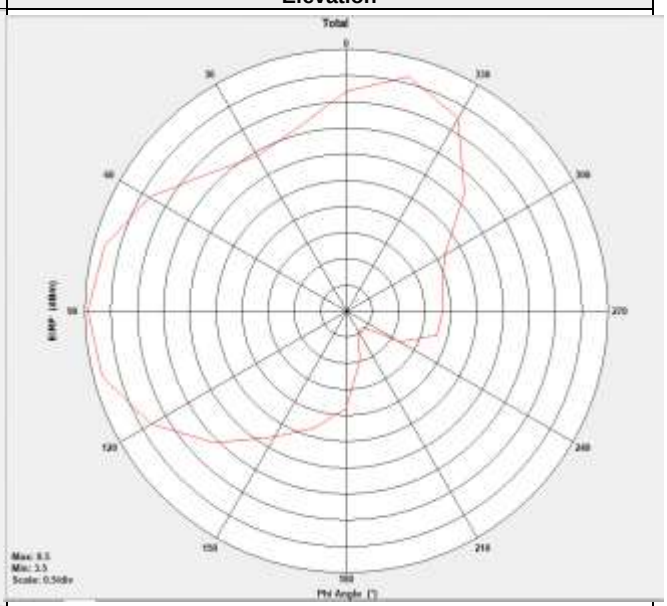
Equipment Configuration for Horizontal Antenna Pattern			
Variant:	Wire Antenna	**Duty Cycle (%):**	99.0
Data Rate:	1.00 MBit/s	**Antenna Gain (dBi):**	NA
Modulation:	GFSK	**Beam Forming Gain (Y)(dB):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	JK
Engineering Test Notes:			

Test Measurement Results

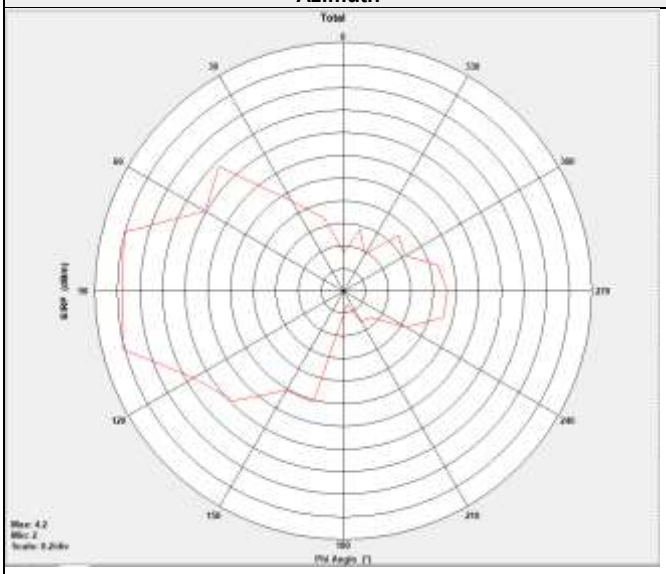
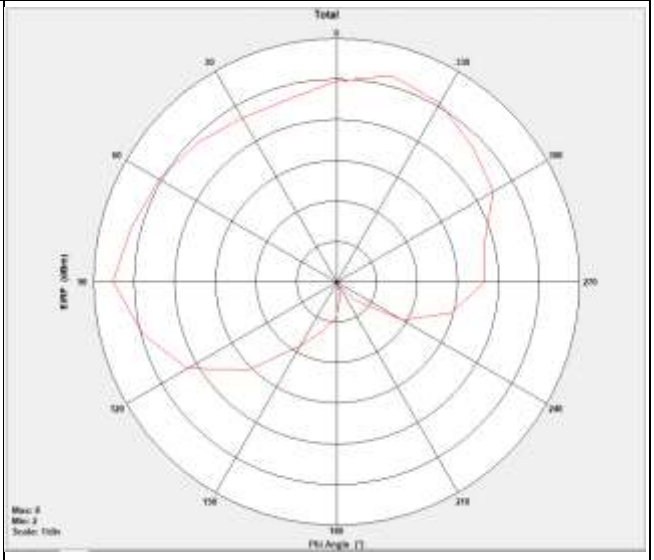
2402 MHz

Azimuth	Elevation
	

2442 MHz

Azimuth	Elevation
	

MiCOM Labs, 575 Boulder Court, Pleasanton, California 94566 USA, Phone: +1 (925) 462 0304, Fax: +1 (925) 462 0306, www.micomlabs.com

2480 MHz	
Azimuth	**Elevation**
	

575 Boulder Court
Pleasanton, California 94566, USA
Tel: +1 (925) 462 0304
Fax: +1 (925) 462 0306
www.micomlabs.com