Company: Kollmorgen

Test of: 18449-01E

To: FCC Subpart C

Report No.: KOLL01-U10 Rev B

COMPLETE TEST REPORT

MiCOM Labs

opening wireless markets

TEST REPORT

FROM

Test of: Kollmorgen 18449-01E

To: FCC Subpart C

Test Report Serial No.: KOLL01-U10 Rev B

This report supersedes: KOLL01-U10 Rev A

Applicant:	Kollmorgen Lunnagårdsgatan Mölndal - 4 431 90 Sweden
Product function:	125 kHz RFID Device
Issue Date:	24th April 2018

This Test Report is Issued Under the Authority of:

MiCOM Labs, Inc.
575 Boulder Court
Pleasanton California 94566
USA
Phone: +1 (925) 462-0304
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ACCREDITED
TESTING CERT #2381.01

MiCOM Labs is an ISO 17025 Accredited Testing Laboratory

Table of Contents

1. ACCREDITATION, LISTINGS & RECOGNITION....4
1.1. TESTING ACCREDITATION....4
1.2. RECOGNITION....5
1.3. PRODUCT CERTIFICATION....6
2. DOCUMENT HISTORY....7
3. TEST RESULT CERTIFICATE....8
4. REFERENCES AND MEASUREMENT UNCERTAINTY....9
4.1. Normative References....9
4.2. Test and Uncertainty Procedure....10
5. PRODUCT DETAILS AND TEST CONFIGURATIONS....11
5.1. Technical Details....11
5.2. Scope Of Test Program....12
5.3. Equipment Model(s) and Serial Number(s)....13
5.4. Antenna Details....13
5.5. Cabling and I/O Ports....13
5.6. Test Configurations....14
CVC600 RFID Controller with 18449-01E and No Tag....14
CVC600 RFID Controller with 18449-01E and Reading Tag....14
5.7. Equipment Modifications....14
5.8. Deviations from the Test Standard....14
6. TEST SUMMARY....15
7. TEST EQUIPMENT CONFIGURATION(S)....16
7.1. Radiated Emissions - 3m Chamber....16
8. MEASUREMENT AND PRESENTATION OF TEST DATA....19
9. TEST RESULTS....20
9.1. Antenna Requirement....20
9.2. RF Output Power....21
9.3. Occupied Bandwidth....23
9.4. Emissions....25
9.4.1. Radiated Emissions....25
9.4.1.1. TX Spurious & Restricted Band Emissions....25
CVC600 with 18449-01E and No Tag, TX Spurious 150 kHz-30 MHz....28
CVC600 with 18449-01E and Reading Tag, TX Spurious 150 kHz-30 MHz....29
CVC600 with 18449-01E and Reading Tag, TX Spurious 150 kHz-30 MHz....30
CVC600 with 18449-01E and No Tag, TX Spurious 150 kHz-30 MHz....31
A. APPENDIX - GRAPHICAL IMAGES....32
A.1. Emissions....33
A.1.1. Radiated Emissions....33
A.1.1.1. TX Spurious & Restricted Band Emissions....33

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1. ACCREDITATION, LISTINGS & RECOGNITION

1.1. TESTING ACCREDITATION

MiCOM Labs, Inc. is an accredited Electrical testing laboratory per the international standard ISO/IEC 17025:2005. 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

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 17025:2005 *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 8 January 2009*).

Presented this 4th day of February 2016.

President and CEO
For the Accreditation Council
Certificate Number 2381.01
Valid to April 30, 2018
Revised March 23, 2018

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

1.2. RECOGNITION

MiCOM Labs, Inc has widely recognized wireless testing capabilities. Our international recognition includes Conformity Assessment Body designation by APEC MRA countries. MiCOM Labs test reports are accepted globally.

Country	Recognition Body	Status	Phase	Identification No.
USA	Federal Communications Commission (FCC)	TCB	-	US0159 Listing #: 102167
Canada	Industry Canada (IC)	FCB	APEC MRA 2	US0159 Listing #: 4143A-2 4143A-3
Japan	MIC (Ministry of Internal Affairs and Communication)	CAB	APEC MRA 2	RCB 210
	VCCI	--	--	A-0012
Europe	European Commission	NB	EU MRA	NB 2280
Australia	Australian Communications and Media Authority (ACMA)	CAB	APEC MRA 1	US0159
Hong Kong	Office of the Telecommunication Authority (OFTA)	CAB	APEC MRA 1	
Korea	Ministry of Information and Communication Radio Research Laboratory (RRL)	CAB	APEC MRA 1	
Singapore	Infocomm Development Authority (IDA)	CAB	APEC MRA 1	
Taiwan	National Communications Commission (NCC) Bureau of Standards, Metrology and Inspection (BSMI)	CAB	APEC MRA 1	
Vietnam	Ministry of Communication (MIC)	CAB	APEC MRA 1	

EU MRA – European Union Mutual Recognition Agreement.
NB – Notified Body
APEC MRA – Asia Pacific Economic Community Mutual Recognition Agreement. Recognition agreement under which test lab is accredited to regulatory standards of the APEC member countries.

Phase I - recognition for product testing
Phase II – recognition for both product testing and certification

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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 4th day of February 2016.

President and CEO
For the Accreditation Council
Certificate Number 2381.02
Valid to April 30, 2018
Revised March 23, 2018

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

Japan – Recognized Certification Body (RCB), RCB Identifier - 210

2. DOCUMENT HISTORY

Document History		
Revision	Date	Comments
Draft	2nd February 2018	Draft report for client review.
Rev A	1st March 2018	Initial release.
Rev B	24th April 2018	Updated references to include FCC Rule Part 2
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In the above table the latest report revision will replace all earlier versions.

3. TEST RESULT CERTIFICATE

Manufacturer:	Kollmorgen Lunnagårdsgatan Mölndal - 4 431 90 Sweden	**Tested By:**	MiCOM Labs, Inc. 575 Boulder Court Pleasanton California 94566 USA
Model:	Kollmorgen 18449-01E	**Telephone:**	+1 925 462 0304
		Fax:	+1 925 462 0306
Type Of Equipment:	125 kHz RFID Reader		
S/N's:	18449-01E		
Test Date(s):	17th – 19th January 19, 2018	**Website:**	www.micomlabs.com

STANDARD(S)	TEST RESULTS
FCC Subpart C	EQUIPMENT COMPLIES

MiCOM Labs, Inc. tested the equipment mentioned in accordance with the requirements set forth in the above standards. Test results indicate that the equipment tested is capable of demonstrating compliance with the requirements as documented within this report.

Notes:

1. This document reports conditions under which testing was conducted and the results of testing performed.

2. Details of test methods used have been recorded and kept on file by the laboratory.

3. Test results apply only to the item(s) tested.

ACCREDITED
TESTING CERT #2381.01

Approved & Released for MiCOM Labs, Inc. by:

Graeme Grieve
Quality Manager MiCOM Labs, Inc.

Gordon Hurst
President & CEO MiCOM Labs, Inc.

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4. REFERENCES AND MEASUREMENT UNCERTAINTY

4.1. Normative References

REF.	PUBLICATION	YEAR	TITLE
I	A2LA	August 2017	R105 - Requirement's When Making Reference to A2LA Accreditation Status
II	ANSI C63.10	2013	American National Standard for Testing Unlicensed Wireless Devices
III	ANSI C63.4	2014	American National Standards for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
IV	CISPR 32	2015	Electromagnetic compatibility of multimedia equipment - Emission requirements
V	ETSI TR 100 028	2001-12	Parts 1 and 2 Electromagnetic compatibility and Radio Spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics
VI	FCC 47 CFR Part C	2016	Radio Frequency Devices; Subpart C – Intentional Radiators
VII	M 3003	Edition 3 Nov.2012	Expression of Uncertainty and Confidence in Measurements
VIII	FCC 47 CFR Part 2.1033	2016	FCC requirements and rules regarding photographs and test setup diagrams.

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4.2. 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.

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5. PRODUCT DETAILS AND TEST CONFIGURATIONS

5.1. Technical Details

Details	Description
Purpose:	Test of the Kollmorgen 18449-01E to FCC Subpart C
Applicant:	Kollmorgen Lunnagårdsgatan Mölndal - 4 431 90, Sweden
Manufacturer:	Kollmorgen
Laboratory performing the tests:	MiCOM Labs, Inc. 575 Boulder Court Pleasanton California 94566 USA
Test report reference number:	KOLL01-U10 Rev B
Date EUT received:	21st December 2017
Standard(s) applied:	FCC Subpart C 15.209, IC RSS-GEN
Dates of test (from - to):	17-19th January 2018
No of Units Tested:	1
Product Family Name:	125 kHz RFID Reader
Model(s):	18449-01E
Location for use:	Indoors/Outdoors
Declared Frequency Range(s):	125 kHz
Type of Modulation:	ASK
EUT Modes of Operation:	Sleep/Reading Tag
Declared Nominal Output Power (dBm):	41.1 dBµA/m @ 10 m
Transmit/Receive Operation:	Continuous
Rated Input Voltage and Current:	DC 12-15 Vdc, 0.25A
Operating Temperature Range:	-35 C to 70 C
Equipment Dimensions:	6.5 x: 6 x 1 inches
Weight:	1.LB
Hardware Rev:	HW486A0700
Software Rev:	SW468AA034

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5.2. Scope Of Test Program

Kollmorgen 18449-01E
The scope of the test program was to test the Kollmorgen 18449-01E Module in the frequency range 125 kHz – 30 MHz; for compliance against the following specification:

FCC Subpart C 15.209
Radio Frequency Devices; Subpart C – Intentional Radiators

The RFID Reader 18449-01E was tested as a sealed unit containing RFID transmitter module and antenna. For certification as a module the reader may be placed in different host systems, but not separated or taken apart to represent other configurations.

Kollmorgen RFID Reader 18449-01E (Module)

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

Type	Description	Manf	Model	Serial No.	Delivery Date
Support	RFID Controller with WiFi	Kollmorgen	CVC 600	WO17355850011	21st December 2017
EUT	RFID Reader	Kollmorgen	18449-01E	18449-01E	21st December 2017
Antenna	2.4 GHz Antenna	Kollmorgen	Ant-Kit	18414-42	21st December 2017
Support	Laptop PC	Dell	E6400	None	21st December 2017
Support	Router	Netgear	WGR614	None	21st December 2017

5.4. Antenna Details

Type	Manufacturer	Gain (dBi)	Dir BW	Frequency Band (MHz)
integral	Kollmorgen	0.0	360	125 kHz

Dir BW - Directional BeamWidth

5.5. Cabling and I/O Ports

Port Type	Max Cable Length (m)	# of Ports	Screened	Conn Type	Data Type	Bit Rate
RS 232	Cable <3	1	--	DB9	Digital	--

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5.6. Test Configurations

Results for the following configurations are provided in this report:

CVC600 RFID Controller with 18449-01E and No Tag

CVC600 RFID Controller with 18449-01E and Reading Tag

5.7. Equipment Modifications

The following modifications were required to bring the equipment into compliance:

1. NONE

5.8. Deviations from the Test Standard

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

1. NONE

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6. TEST SUMMARY

List of Measurements

Test Header	Result	Data Link
Antenna Requirement	Complies	View Data
RF Power Output	Complies	View Data
Occupied Bandwidth	Complies	View Data
Emissions	Complies	-
Radiated Emissions	Complies	-
(i) TX Spurious & Restricted Band Emissions	Complies	View Data

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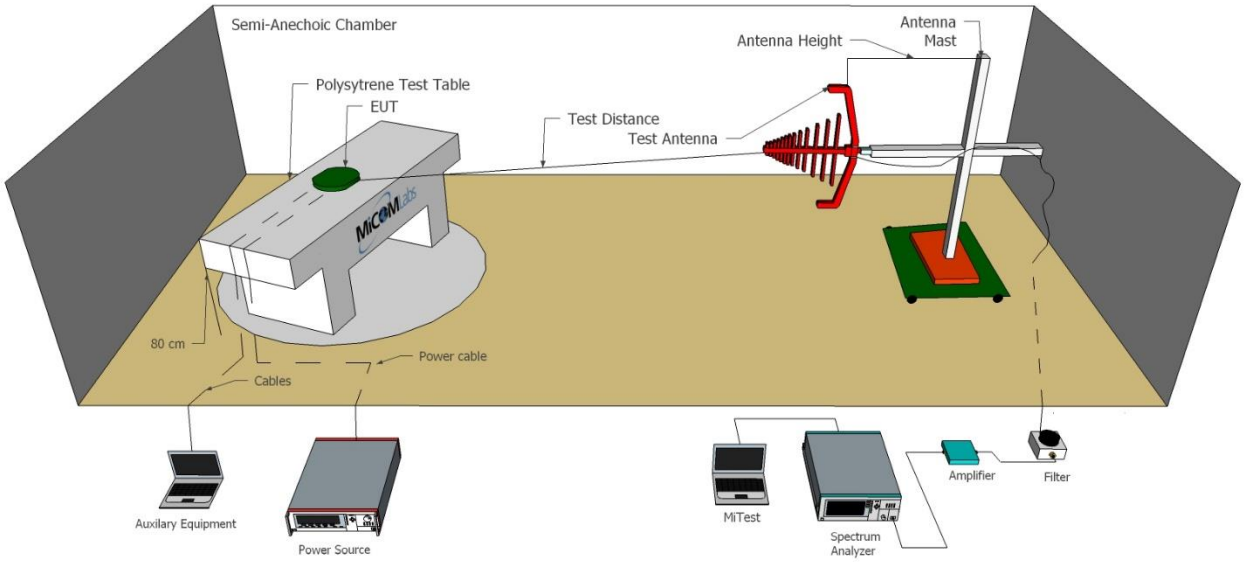
7. TEST EQUIPMENT CONFIGURATION(S)

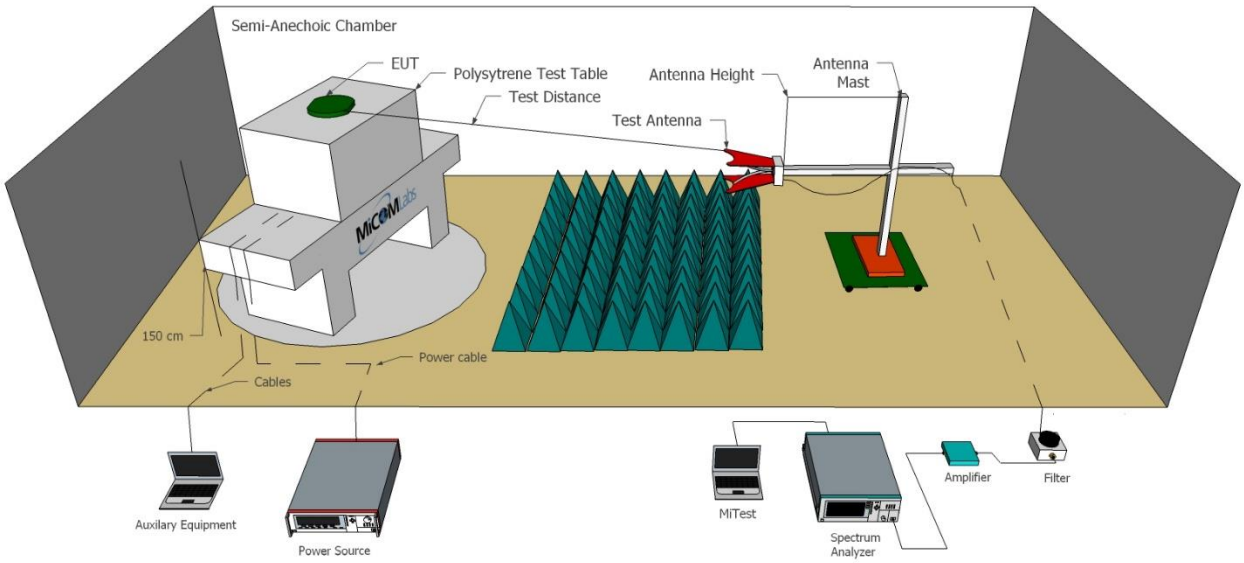
7.1. Radiated Emissions - 3m Chamber

The following tests were performed using the radiated test set-up shown in the diagram below.

Radiated Emissions Below 1GHz Test Setup



Radiated Emissions Above 1GHz Test Setup



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
510	Barometer/Thermometer	Control Company	68000-49	170871375	11 Dec 2018
170	Video System Controller for Semi Anechoic Chamber	Panasonic	WV-CU101	04R08507	Not Required
287	Rohde & Schwarz 40 GHz Receiver	Rhode & Schwarz	ESIB40	100201	2 May 2018
301	5470 to 5725 MHz Notch Filter	Microtronics	RBC50704	001	6 Oct 2018
302	5150 to 5350 MHz Notch Filter	Microtronics	BRC50703	002	6 Oct 2018
303	5725 to 5875 MHz Notch filter	Microtronics	BRC50705	003	6 Oct 2018
330	Variac 0-280 Vac	Staco Energy Co	3PN1020B	0546	Cal when used
336	Active loop Ant 10kHz to 30 MHz	EMCO	EMCO 6502	00060498	29 Nov 2019
338	Sunol 30 to 3000 MHz Antenna	Sunol	JB3	A052907	5 Oct 2018
373	26III RMS Multimeter	Fluke	Fluke 26 series III	76080720	21 Sep 2018
377	Band Rejection Filter 5150 to 5880MHz	Microtronics	BRM50716	034	6 Oct 2018
393	DC - 1050 MHz Low Pass Filter	Microcircuits	VLFX-1050	N/A	6 Oct 2018
396	2.4 GHz Notch Filter	Microtronics	BRM50701	001	6 Oct 2018
397	Amp 10 - 2500MHz	MiCOM Labs	Amp 10 - 2500 MHz	NA	12 Oct 2018
399	ETS 1-18 GHz Horn Antenna	ETS	3117	00154575	12 Oct 2018
406	Amplifier for Radiated Emissions	MiCOM Labs	40dB 1 to 18GHz Amp	0406	12 Oct 2018
410	Desktop Computer	Dell	Inspiron 620	WS38	Not Required
411	Mast/Turntable Controller	Sunol Sciences	SC98V	060199-1D	Not Required
412	USB to GPIB Interface	National Instruments	GPIB-USB HS	11B8DC2	Not Required
413	Mast Controller	Sunol Science	TWR95-4	030801-3	Not Required
414	DC Power Supply 0-60V	HP	6274	1029A01285	Cal when used
415	Turntable Controller	Sunol Sciences	Turntable Controller	None	Not Required
416	Gigabit ethernet filter	ETS-Lingren	Gigafoil 260366	None	Not Required
447	MiTest Rad Emissions Test Software	MiCOM	Rad Emissions Test Software Version 1.0	447	Not Required

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462	Schwarzbeck cable from Antenna to Amplifier.	Schwarzbeck	AK 9513	462	4 Oct 2018
463	Schwarzbeck cable from Amplifier to Bulkhead.	Schwarzbeck	AK 9513	463	4 Oct 2018
464	Schwarzbeck cable from Bulkhead to Receiver	Schwarzbeck	AK 9513	464	4 Oct 2018
468	Low pass filter	Mini Circuits	SLP-550	None	6 Oct 2018
469	Low pass filter	Mini Circuit	SLP-1000	None	6 Oct 2018
470	High Pass filter	Mini Circuits	SHP-700	None	6 Oct 2018
476	Low Pass dc-2200MHz filter	Mini Circuits	15542 NLP-2400+	VUU13801345	6 Oct 2018
480	Cable - Bulkhead to Amp	SRC Haverhill	157-3050360	480	6 Oct 2018
481	Cable - Bulkhead to Receiver	SRC Haverhill	151-3050787	481	6 Oct 2018
482	Cable - Amp to Antenna	SRC Haverhill	157-3051574	482	6 Oct 2018
87	Uninterruptible Power Supply	Falcon Electric	ED2000-1/2LC	F3471 02/01	Cal when used
VLF-1700	Low pass filter DC-1700 MHz	Mini Circuits	VLF-1700	None	6 Oct 2018

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8. MEASUREMENT AND PRESENTATION OF TEST DATA

The measurement and graphical data presented in this test report was generated automatically using state-of-the-art technology creating an easy to read report structure. Numerical measurement data is separated from supporting graphical data (plots) through hyperlinks. Numerical measurement data can be reviewed without scrolling through numerous graphical pages to arrive at the next data matrix.

Plots have been relegated into the Appendix 'Graphical Data'.

Test and report automation was performed by MiTest. MiTest is an automated test system developed by MiCOM Labs. MiTest is the first cloud based modular test system enabling end-to-end automation of regulatory compliance testing for conducted RF testing.

The MiCOM Labs "MiTest" Automated Test System" (Patent Pending)

9. TEST RESULTS

9.1. Antenna Requirement

Antenna Requirement			
Standard:	FCC CFR 47 Part 15 Subpart C 15.203	**Ambient Temp. (ºC):**	20.0 - 24.5
Test Heading:	Antenna Requirement	**Rel. Humidity (%):**	32 - 45
Standard Section(s):	15.203	**Pressure (mBars):**	999 - 1001
Reference Document(s):	See Normative References		

Requirement: FCC CFR 47 Part 15.203

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

Antenna requirement must meet at least one of the following:

.A) Antenna must be permanently attached to the device
B) Antenna must use a unique type of connector to attach to the device
C) Device must be professionally installed. Installer shall be responsible for ensuring that the correct antenna is employed with the device.

RFID antenna is integral to the sealed RFID reader, permanently attached. Meets requirement.

9.2. RF Output Power

RF Output Power			
Standard:	FCC CFR 47 Part 2.1046	**Ambient Temp. (ºC):**	20.0 - 24.5
Test Heading:	RF Output Power	**Rel. Humidity (%):**	32 - 45
Standard Section(s):	ANSI C63.10 Section 6.4	**Pressure (mBars):**	999 - 1001
Reference Document(s):	See Normative References		

Requirement: FCC CFR 47 Part 2.1046

Test Procedure
For transmitters other than single sideband, independent sideband and controlled carrier radiotelephone, power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the values of current and voltage on the circuit elements specified in §2.1033(c)(8). The electrical characteristics of the radio frequency load attached to the output terminals when this test is made shall be stated.

Tested in accordance with Section 6.4 of ANSI C63.10.

RBW: 300 Hz
VBW: 1 kHz
Detector: Peak
Sweep Time: Auto

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Equipment Configuration for RF Output Power			
EUT:	18449-01E	**Variant:**	18449-01E
Antenna Gain (dBi):	Not Applicable	**Modulation:**	ASK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	100 %
Channel Frequency (MHz):	0.125	**Data Rate:**	4 kB/s
Power Setting:	Max	**Tested By:**	JMH

Test Measurement Results

RF Output Power – 125 kHz												
Num	**Frequency MHz**	**Raw dBµV**	**Cable Loss dB**	**AF dB**	**Level dBµV/m**	**Measurement Type**	**Pol**	**Hgt cm**	**Azt Deg**	**Limit dBµV/m**	**Margin dB**	**Pass /Fail**
#1	0.125	82.60	3.00	11.20	96.80	MaxQP	Horizontal	0	332	105.7	-8.9	Pass
Test Notes: EUT CVC600 powered with 24V DC, connected to RFID reader 18449-01E and Laptop via can bus. No Tag, Antenna Vertical for maximum emissions												

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9.3. Occupied Bandwidth

Occupied Bandwidth			
Standard:	FCC CFR 47: 2.1049	**Ambient Temp. (ºC):**	20.0 - 24.5
Test Heading:	Occupied Bandwidth	**Rel. Humidity (%):**	32 - 45
Standard Section(s):	ANSI C63.10 Section 6.9	**Pressure (mBars):**	999 - 1001
Reference Document(s):	See Normative References		

Requirement: FCC CFR 47 Part 2.1049

Test Procedures:

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission. The following procedure shall be used for measuring 99% power bandwidth:
a) The instrument center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 times the OBW.
b) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW, and VBW shall be approximately three times the RBW, unless otherwise specified by the applicable requirement.
c) Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level. Specific guidance is given in 4.1.5.2.
d) Step a) through step c) might require iteration to adjust within the specified range.
e) Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used.
f) Use the 99% power bandwidth function of the instrument (if available) and report the measured bandwidth.
g) If the instrument does not have a 99% power bandwidth function, then the trace data points are recovered and directly summed in linear power terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached; that frequency is recorded as the lower frequency. The process is repeated until 99.5% of the total is reached; that frequency is recorded as the upper frequency. The 99% power bandwidth is the difference between these two frequencies.
h) The occupied bandwidth shall be reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labeled. Tabular data may be reported in addition to the plot(s).

Measurement performed for reporting purposes only.

Equipment Configuration for 99% Occupied Bandwidth

EUT:	18449-01E	**Variant:**	18449-01E
Antenna Gain (dBi):	Not Applicable	**Modulation:**	ASK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	100 %
Channel Frequency (MHz):	0.125	**Data Rate:**	4 kB/s
Power Setting:	Max	**Tested By:**	JMH

Test Measurement Results

Test Frequency	Measured 99% Bandwidth (Hz)				99% Bandwidth (Hz)			
kHz	A	B	C	D	Highest	Lowest		
125.0	847.7	-	-	-	847.7	847.7		

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

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9.4. Emissions

9.4.1. Radiated Emissions

9.4.1.1. TX Spurious & Restricted Band Emissions

Radiated Test Conditions for Radiated Spurious and Band-Edge Emissions (Restricted Bands)			
Standard:	FCC CFR 47 Part 15 Subpart C 15.209	**Ambient Temp. (ºC):**	20.0 - 24.5
Test Heading:	Radiated Spurious and Band-Edge Emissions	**Rel. Humidity (%):**	32 - 45
Standard Section(s):	15.205, 15.209	**Pressure (mBars):**	999 - 1001
Reference Document(s):	See Normative References		

Test Procedure for Radiated Spurious and Band-Edge Emissions (Restricted Bands)
Radiated emissions for restricted bands above 1 GHz are measured in the anechoic chamber at a 3-meter distance on every azimuth in both horizontal and vertical polarities. The emissions are recorded and maximized as a function of azimuth by rotation through 360° with a spectrum analyzer in peak hold mode. Depending on the frequency band spanned a notch filter and waveguide filter was used to remove the fundamental frequency. The highest emissions relative to the limit are listed for each frequency spanned. Measurements on any restricted band frequency or frequencies above 1 GHz are based on the use of measurement instrumentation employing peak and average detectors. All measurements were performed using a resolution bandwidth of 1 MHz.

Test configuration and setup for Radiated Spurious and Band-Edge Measurement were per the Radiated Test Set-up specified in this document.

Limits for Restricted Bands
Peak emission: 74 dBuV/m
Average emission: 54 dBuV/m

Field Strength Calculation
The field strength is calculated by adding the Antenna Factor and Cable Loss, and subtracting Amplifier Gain from the measured reading. All factors are included in the reported data.
FS = R + AF + CORR - FO

where:
FS = Field Strength
R = Measured Spectrum analyzer Input Amplitude
AF = Antenna Factor
CORR = Correction Factor = CL – AG + NFL
CL = Cable Loss
AG = Amplifier Gain
FO = Distance Falloff Factor
NFL = Notch Filter Loss or Waveguide Loss

Example:
Given receiver input reading of 51.5 dBmV; Antenna Factor of 8.5 dB; Cable Loss of 1.3 dB; Falloff Factor of 0 dB, an Amplifier Gain of 26 dB and Notch Filter Loss of 1 dB. The Field Strength (FS) of the measured emission is:

FS = 51.5 + 8.5 + 1.3 - 26.0 +1 = 36.3 dBmV/m

Conversion between dBmV/m (or dBmV) and mV/m (or mV) are as follows:
Level (dBmV/m) = 20 * Log (level (mV/m))

40 dBmV/m = 100 mV/m
48 dBmV/m = 250 mV/m

Restricted Bands of Operation (15.205)
(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

Frequency Band			
MHz	**MHz**	**MHz**	**GHz**
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	Above 38.6
13.36-13.41			

(b) Except as provided in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in §15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in §15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in §15.35 apply to these measurements.

(c) Except as provided in paragraphs (d) and (e) of this section, regardless of the field strength limits specified elsewhere in this subpart, the provisions of this section apply to emissions from any intentional radiator.

(d) The following devices are exempt from the requirements of this section:

(1) Swept frequency field disturbance sensors operating between 1.705 and 37 MHz provided their emissions only sweep through the bands listed in paragraph (a) of this section, the sweep is never stopped with the fundamental emission within the bands listed in paragraph (a) of this section, and the fundamental emission is outside of the bands listed in paragraph (a) of this section more than 99% of the time the device is actively transmitting, without compensation for duty cycle.

(2) Transmitters used to detect buried electronic markers at 101.4 kHz which are employed by telephone companies.

(3) Cable locating equipment operated pursuant to §15.213.

(4) Any equipment operated under the provisions of §15.253, 15.255, and 15.256 in the frequency band 75-85 GHz, or §15.257 of this part.

(5) Biomedical telemetry devices operating under the provisions of §15.242 of this part are not subject to the restricted band 608-614 MHz but are subject to compliance within the other restricted bands.

(6) Transmitters operating under the provisions of subparts D or F of this part.

(7) Devices operated pursuant to §15.225 are exempt from complying with this section for the 13.36-13.41 MHz band only.

(8) Devices operated in the 24.075-24.175 GHz band under §15.245 are exempt from complying with the requirements of this section for the 48.15-48.35 GHz and 72.225-72.525 GHz bands only, and shall not exceed the limits specified in §15.245(b).

(9) Devices operated in the 24.0-24.25 GHz band under §15.249 are exempt from complying with the requirements of this section for the 48.0-48.5 GHz and 72.0-72.75 GHz bands only, and shall not exceed the limits specified in §15.249(a).

(e) Harmonic emissions appearing in the restricted bands above 17.7 GHz from field disturbance sensors operating under the provisions of §15.245 shall not exceed the limits specified in §15.245(b).

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CVC600 with 18449-01E and No Tag, TX Spurious 150 kHz-30 MHz

Equipment Configuration for Below 30MHz Emissions (9kHz - 150kHz)

EUT:	18449-01E	**Variant:**	18449-01E
Antenna Gain (dBi):	0.0	**Modulation:**	ASK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	100 %
Channel Frequency (MHz):	0.125	**Data Rate:**	4 kB/s
Power Setting:	Max	**Tested By:**	JMH

Test Measurement Results

0.009 - 0.150 MHz												
Num	**Frequency MHz**	**Raw dBµV**	**Cable Loss dB**	**AF dB**	**Level dBµV/m**	**Measurement Type**	**Pol**	**Hgt cm**	**Azt Deg**	**Limit dBµV/m**	**Margin dB**	**Pass /Fail**
#1	0.125	82.60	3.00	11.20	96.80	MaxQP	Horizontal	0	332	105.7	-8.9	Pass
Test Notes: EUT CVC600 powered with 24V DC, connected to RFID reader 18449-01E and Laptop via can bus. No Tag, Antenna Vertical for maximum emissions												

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CVC600 with 18449-01E and Reading Tag, TX Spurious 150 kHz-30 MHz

Equipment Configuration for Below 30MHz Emissions (9kHz - 150kHz)

EUT:	18449-01E	**Variant:**	18449-01E
Antenna Gain (dBi):	Not Applicable	**Modulation:**	ASK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	100 %
Channel Frequency (MHz):	0.125	**Data Rate:**	4 kB/s
Power Setting:	Max	**Tested By:**	JMH

Test Measurement Results

0.009 - 0.150 MHz												
Num	**Frequency MHz**	**Raw dBµV**	**Cable Loss dB**	**AF dB**	**Level dBµV/m**	**Measurement Type**	**Pol**	**Hgt cm**	**Azt Deg**	**Limit dBµV/m**	**Margin dB**	**Pass /Fail**
#1	0.125	79.03	3.00	11.20	93.23	MaxQP	Horizontal	0	333	105.7	-12.4	Pass
Test Notes: EUT CVC600 powered with 24V DC, connected to RFID reader 18449-01E and Laptop via can bus. Reading Tag, Antenna Vertical for maximum emissions												

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CVC600 with 18449-01E and Reading Tag, TX Spurious 150 kHz-30 MHz

Equipment Configuration for Below 30MHz Emissions (150kHz - 30MHz)

EUT:	18449-01E	**Variant:**	18449-01E
Antenna Gain (dBi):	0.0	**Modulation:**	ASK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	100 %
Channel Frequency (MHz):	0.125	**Data Rate:**	4 kB/s
Power Setting:	Max	**Tested By:**	JMH

Test Measurement Results

0.150 - 30.00 MHz												
Num	**Frequency MHz**	**Raw dBµV**	**Cable Loss dB**	**AF dB**	**Level dBµV/m**	**Measurement Type**	**Pol**	**Hgt cm**	**Azt Deg**	**Limit dBµV/m**	**Margin dB**	**Pass /Fail**
#1	0.37	49.94	3.00	11.26	64.20	MaxQP	Horizontal	0	330	96.1	-31.9	Pass
Test Notes: EUT CVC600 powered with 24V DC, connected to RFID reader 18449-01E and Laptop via can bus. Reading Tag, Antenna Vertical for maximum emissions												

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CVC600 with 18449-01E and No Tag, TX Spurious 150 kHz-30 MHz

Equipment Configuration for Below 30MHz Emissions (150kHz - 30MHz)

EUT:	18449-01E	**Variant:**	18449-01E
Antenna Gain (dBi):	0.0	**Modulation:**	ASK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	100 %
Channel Frequency (MHz):	0.125	**Data Rate:**	4 kB/s
Power Setting:	Max	**Tested By:**	JMH

Test Measurement Results

0.150 - 30.00 MHz												
Num	**Frequency MHz**	**Raw dBµV**	**Cable Loss dB**	**AF dB**	**Level dBµV/m**	**Measurement Type**	**Pol**	**Hgt cm**	**Azt Deg**	**Limit dBµV/m**	**Margin dB**	**Pass /Fail**
#1	0.38	49.92	3.00	11.26	64.18	MaxQP	Horizontal	0	334	96.1	-31.9	Pass
Test Notes: EUT CVC600 powered with 24V DC, connected to RFID reader 18449-01E and Laptop via can bus. No Tag, Antenna Vertical for maximum emissions												

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A. APPENDIX - GRAPHICAL IMAGES

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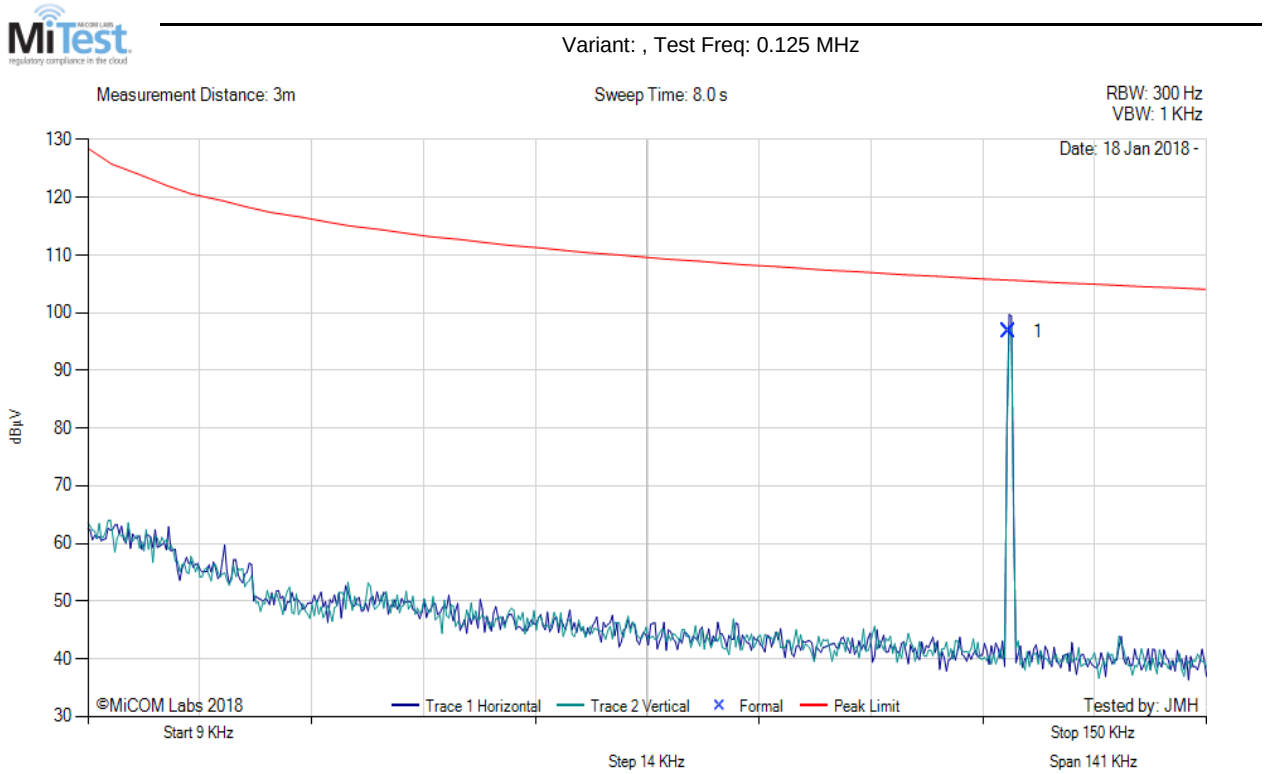
A.1. Emissions

A.1.1. Radiated Emissions

A.1.1.1. TX Spurious & Restricted Band Emissions

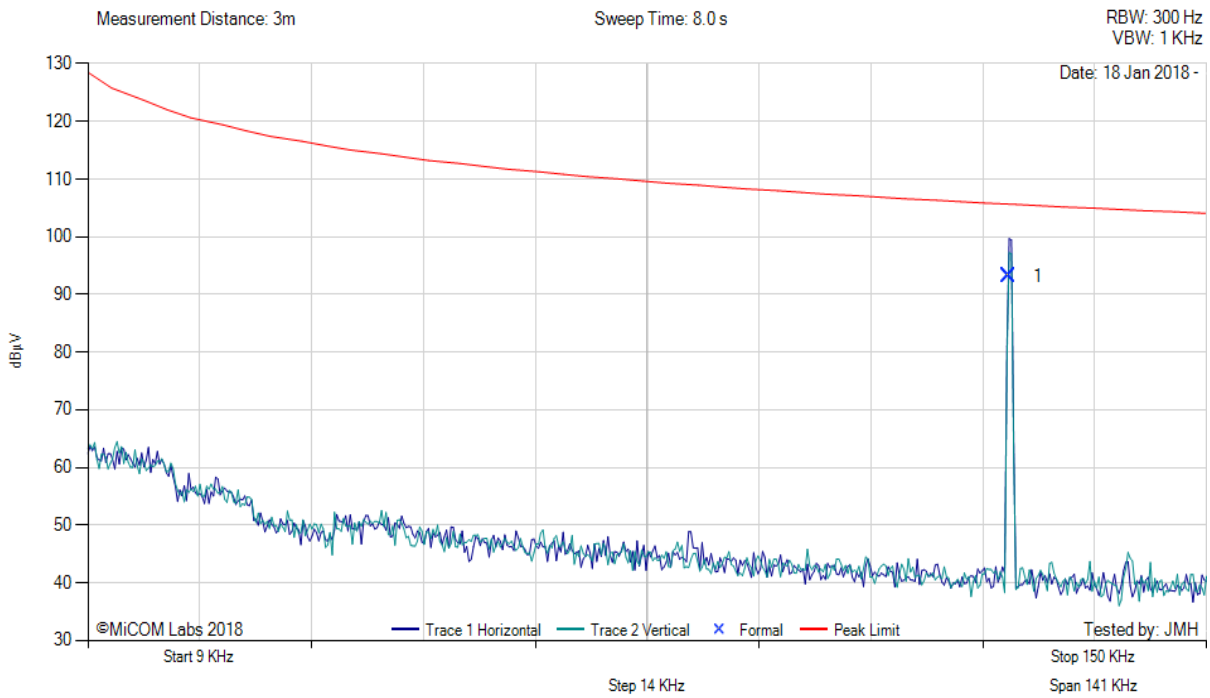


0.009 - 0.150 MHz												
Num	**Frequency MHz**	**Raw dBµV**	**Cable Loss dB**	**AF dB**	**Level dBµV/m**	**Measurement Type**	**Pol**	**Hgt cm**	**Azt Deg**	**Limit dBµV/m**	**Margin dB**	**Pass /Fail**
1	0.125	82.60	3.00	11.20	96.80	MaxQP	Horizontal	0	332	105.7	-8.9	Pass

Test Notes: EUT CVC600 powered with 24V DC, connected to RFID reader 18449-01E and Laptop via can bus. No Tag, Antenna Vertical for maximum emissions

back to matrix

Variant: , Test Freq: 0.125 MHz

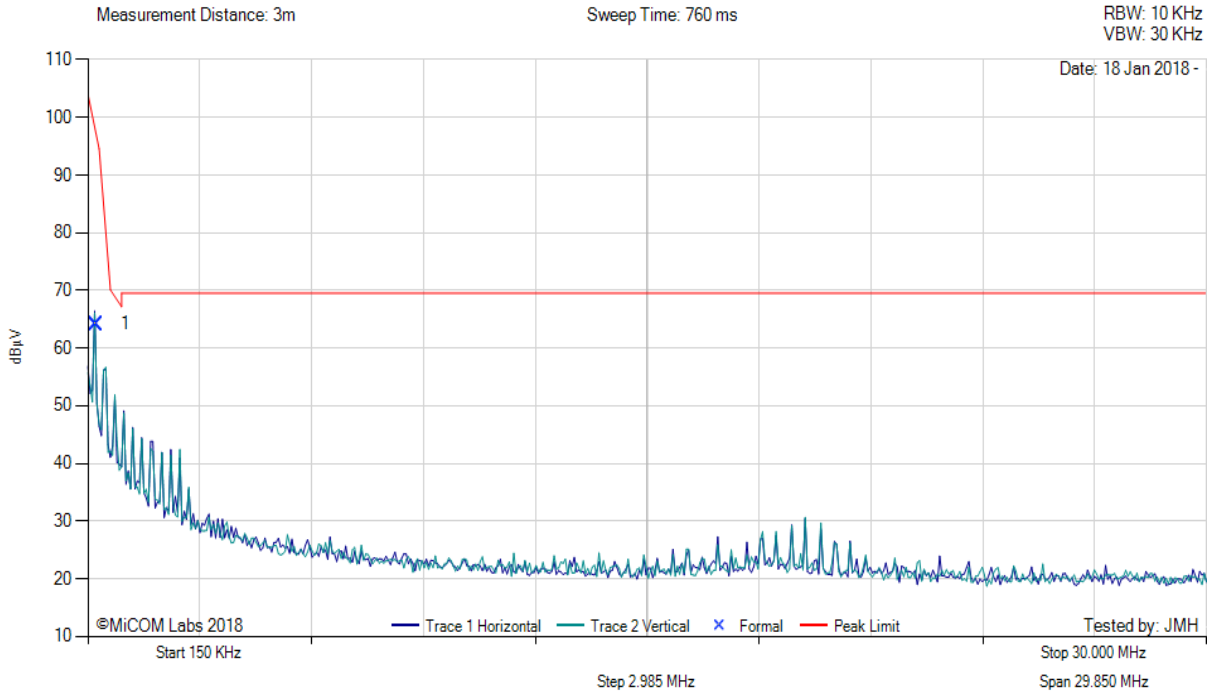


0.009 - 0.150 MHz												
Num	**Frequency MHz**	**Raw dBµV**	**Cable Loss dB**	**AF dB**	**Level dBµV/m**	**Measurement Type**	**Pol**	**Hgt cm**	**Azt Deg**	**Limit dBµV/m**	**Margin dB**	**Pass /Fail**
1	0.125	79.03	3.00	11.20	93.23	MaxQP	Horizontal	0	333	105.7	-12.4	Pass

Test Notes: EUT CVC600 powered with 24V DC, connected to RFID reader 18449-01E and Laptop via can bus. Reading Tag, Antenna Vertical for maximum emissions

back to matrix

Variant: , Test Freq: 0.125 MHz

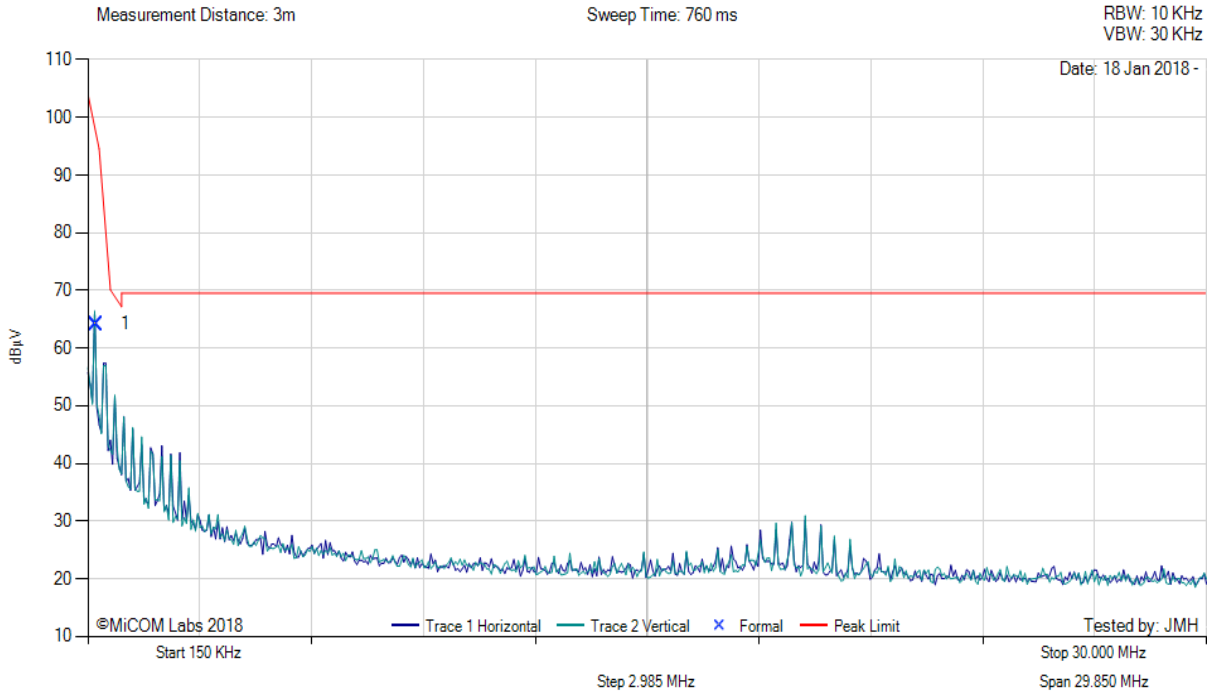


0.150 - 30.00 MHz												
Num	**Frequency MHz**	**Raw dBµV**	**Cable Loss dB**	**AF dB**	**Level dBµV/m**	**Measurement Type**	**Pol**	**Hgt cm**	**Azt Deg**	**Limit dBµV/m**	**Margin dB**	**Pass /Fail**
1	0.37	49.94	3.00	11.26	64.20	MaxQP	Horizontal	0	330	96.1	-31.9	Pass

Test Notes: EUT CVC600 powered with 24V DC, connected to RFID reader 18449-01E and Laptop via can bus. Reading Tag, Antenna Vertical for maximum emissions

back to matrix

Variant: , Test Freq: 0.125 MHz



0.150 - 30.00 MHz												
Num	**Frequency MHz**	**Raw dBµV**	**Cable Loss dB**	**AF dB**	**Level dBµV/m**	**Measurement Type**	**Pol**	**Hgt cm**	**Azt Deg**	**Limit dBµV/m**	**Margin dB**	**Pass /Fail**
1	0.38	49.92	3.00	11.26	64.18	MaxQP	Horizontal	0	334	96.1	-31.9	Pass

Test Notes: EUT CVC600 powered with 24V DC, connected to RFID reader 18449-01E and Laptop via can bus. No Tag, Antenna Vertical for maximum emissions

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