EMC TEST REPORT

NVLAP Lab Code 200033-0

Standard(s):

47 CFR FCC Part 90, Subpart M
RSS 137, Issue 2, 2009
FCC ID: M4Z6204
IC ID: 458C-6204

Class II Permissive Change

Product: Toll RFID READER and Reader Redundancy Switch
Model: 6204 and RRS
3M Division: TSSD

Report Number: RE1601012-1
Report Issue Date: January 20, 2016

Report Prepared By:

Signature: *Yuriy Litvinov*

Yuriy Litvinov
Lead EMC Engineer

Tested By:
3M EMC Laboratory
410 E. Fillmore Avenue, Building 76-01-1
St. Paul, Minnesota 55107-1000

		TABLE OF CONTENTS	
Item		**Description**	**Page**

1.0 Test Summary

Based on the results of our investigation, we have concluded the product tested complies with the requirements of the standard(s) indicated. The results obtained in this test report pertain only to the item(s) tested.

No	Standard	Test Requirements	Result	Comments
	Part15.107/RSS Gen	Conducted Emissions	N/A	See note below
	Part 15.109/RSS-Gen	Radiated Emissions	N/A	See note below
4.1	Part 90.205/RSS137, 6.4	Conducted Output Power	pass	
4.2	Part 90.210/RSS137, 6.1	Occupied Bandwidth	pass	
4.3	Part 90.210/RSS137, 6.5	Spurious Emissions at Antenna terminals	pass	
	Part 90.210/RSS137, 6.5	Field Strength of Spurious Emissions	N/A	See note below
4.4	Part 90.213/RSS137, 6.3	Frequency Stability	N/A	See note below
4.5	Part 2.1091/RSS102	RF Exposure Compliance	pass	

Note:	Fixed Non-Multilateral LMS transmitters with an emission bandwidth located more than 40 kHz from the band edge are exempt from meeting the frequency stability limits.
	Limited testing under Class II Permissive Change. Firmware update to include DSB-ASK modulation used with ISO18000-6C (ISOC) protocol. See 3M Company Test Report number RE1407019-2, issued on December 5, 2014 for the original FCC/IC certifications.

1.1 Measurement Uncertainty

The measured value related to the corresponding limit will be used to decide whether the equipment meets the requirements. The measurement uncertainty figures were calculated and correspond to a coverage factor of k=2, providing a confidence level of respectively 95.45 % in the case where the distributions characterizing the actual measurement uncertainties are normal (Gaussian).

Radiated emissions	5.20 dB
Conducted emissions	3.60 dB
Harmonics and Flicker	3.32 dB

2.0 Equipment Description

2.1	Equipment Under Test

Description:	The four-port Toll RFID Reader is a multi-protocol, multi-regional Radio Frequency Identification (RFID) System that operates in the 902-928 MHz UHF band. All antenna ports operate sequentially with only one port transmitting at the time from a single transmit source (RF path is switched between selected ports) 3M Reader Redundancy Switch (RRS) interfaces with two RFID Readers and associated antenna systems to provide an antenna change over facility in the event of a reader failure. The RRS is controlled by TTL level input signals.
Model(s):	6204 and RRS (SKU#75-0302-0128)
Serial number(s):	ID6204000021 and RRS00181
Firmware:	Version # 1.6.2

	Name:	Phone:
Client Contact:	Dave Missimer	919-281-1559

3M Division:	Traffic Safety and Security
Modifications:	None

Frequency Range (MHz) :	902.75 – 920.45MHz	
Modulation Type:	DSB-ASK	K1D
RFID Protocols:	ISO 18000-6B ISO 18000-6C (ISOC) ISO 10374 (ATA)	PS111 TDM (IAG) Title 21 (T21)
Maximum Output Power:	35.0dBm	
Equipment Category:	Non-Multilateral LMS	

Rated Input Power:	Voltage: ☒ 120VAC ☐ 230VAC ☐ VDC Frequency: ☐ 50Hz ☒ 60Hz Current: ☒ 2.0A
Test Dates:	01/18-01/19/2016
Received Date:	06/26/2014
Received Conditions:	☐ Poor ☒ Good ☐ Prototype ☒ Production

3.0 EUT Configuration

3.1 Support Equipment

No.	Product Type	Manufacturer	Model	Comments
1	Power Supply	TDK-Lambda	DSP100-24	24VDC/4.4A
2				

3.2 Cables/Ports

No.	Name	Type	Length	Shielding	Comments
1	RS232/Ethernet/Power Interface	Reader Wire Harness	13m	Unshielded	Digital I/O Connection
2	Ethernet/TTL Interface	Switch Wire Harness	2m	Unshielded	I/O Control

3.3 Operating Condition of EUT

	Operation Modes
☐	Stand by
☒	Continuous Monitored Operation
☐	Continuous Unmonitored Operation
☒	RFID reader was programmed for FHSS operation using RTS RFID software via Command Line Interface.
☒	FCC 90 Dense mode – 911.25-920.75MHz with 500KHz channels
☒	FCC 90 Band – 910.95-920.45MHz with 200KHz channels
☒	FCC 90 Low Band – 902.75-903.25MHz with 200KHz channels

3.4 Exercising of EUT

No.	Description of EUT Exercising
1	Transmitting modulated carrier at the maximum rated RF output power
2	
3	

4.0　Test Conditions and Results

4.1	Conducted Output Power
Method:	Measurements was performed with modulated carrier at the highest power level at which the transmitter is intended to operate. The carrier or mean power delivered to antenna was measured under normal test conditions. The analyzer offset was adjusted to compensate for the attenuator and other losses. The RF Power output listed in the table is the power delivered to the antenna.

	Laboratory Ambient Temperature	23°C
	Relative Humidity	45%

Reference Standard:	☐ ANSI C63.10:2009 ☒ FCC Part 90.205/RSS 137 ☒ FCC Part 2.1046	**Measurement Point** ☒ Conducted ☐ Radiated ☐
Frequency Range:	☒ 902.75-920.45MHz	

Limit ERP	902-927.25MHz	927.25-928MHz
	☒ 30 Watts	☐ 300 Watts

Nominal Voltage:	☒ 120VAC ☐ VDC	
Tested By:	Yuriy Litvinov	**Date:** 01/19/2016

Frequency (MHz)	Operating Mode	RF Power Output (dBm)	RF Power Output (Watts)	26dB OBW (KHz)
902.75	ISO18000-6C(ISOC)	34.8	3.0	431.8
903.25	ISO18000-6C(ISOC)	34.8	3.0	431.9
910.95	ISO18000-6C(ISOC)	34.6	2.9	421.6
920.45	ISO18000-6C(ISOC)	34.6	2.9	424.7
911.25	ISO18000-6C(ISOC)	34.5	2.8	423.5
920.25	ISO18000-6C(ISOC)	34.6	2.9	427.0
902.75	ISO10374(CW)	34.6	2.9	399.2
903.25	ISO10374(CW)	34.6	2.9	397.5
911.75	Title 21	35	3.16	1006.4
919.25	Title 21	35	3.16	1004.2
911.25	EASALARM	34.5	2.8	423.5
920.25	EASALARM	34.5	2.8	428.9
914.25	PS111	34	2.5	758.0
915.75	PS111	33.7	2.5	757.7
902.75	ISO18000-6C(ISOC) firm. ver.1.6	34.8	3.0	436.9
903.25	ISO18000-6C(ISOC) firm. ver.1.6	34.8	3.0	436.6
911.25	ISO18000-6C(ISOC) firm. ver.1.6	34.4	2.8	425.9
920.25	ISO18000-6C(ISOC) firm. ver.1.6	34.4	2.8	427.9
910.95	ISO18000-6C(ISOC) firm. ver.1.6	34.4	2.8	426.6
920.45	ISO18000-6C(ISOC) firm. ver.1.6	34.4	2.8	427.8

Note:	The devices may employ any type of modulation technique. The worst case modulations used by the device have been reported. ISOC physical layer mode "Miller2/LF640/6.25tari/DSB_ASK

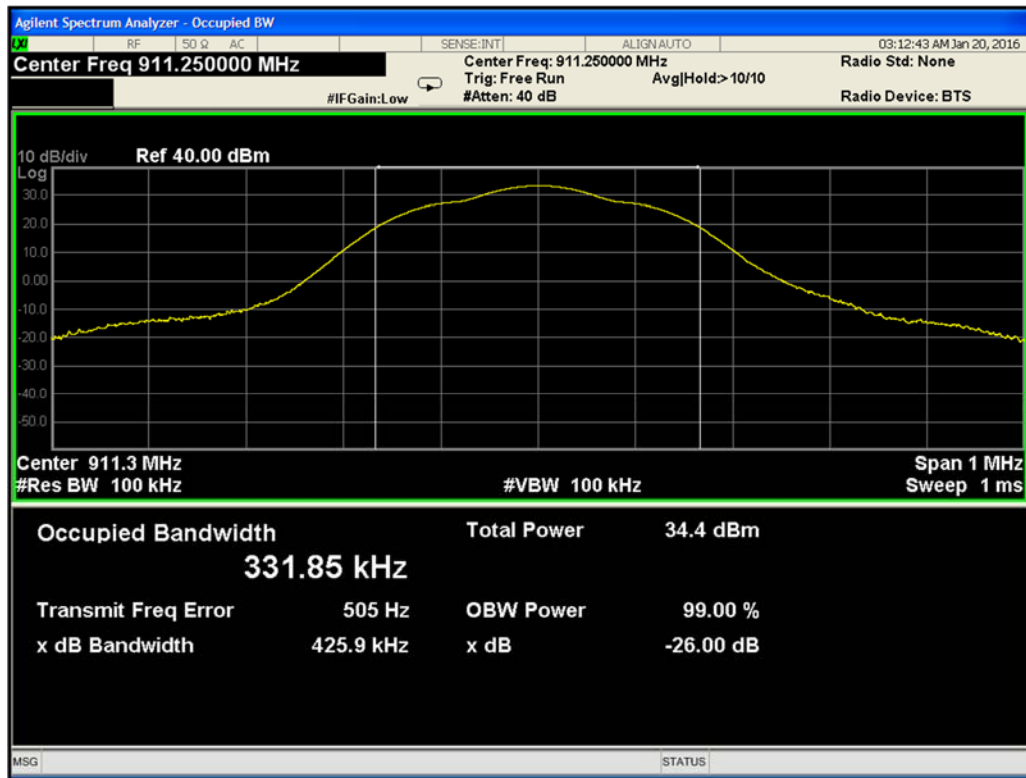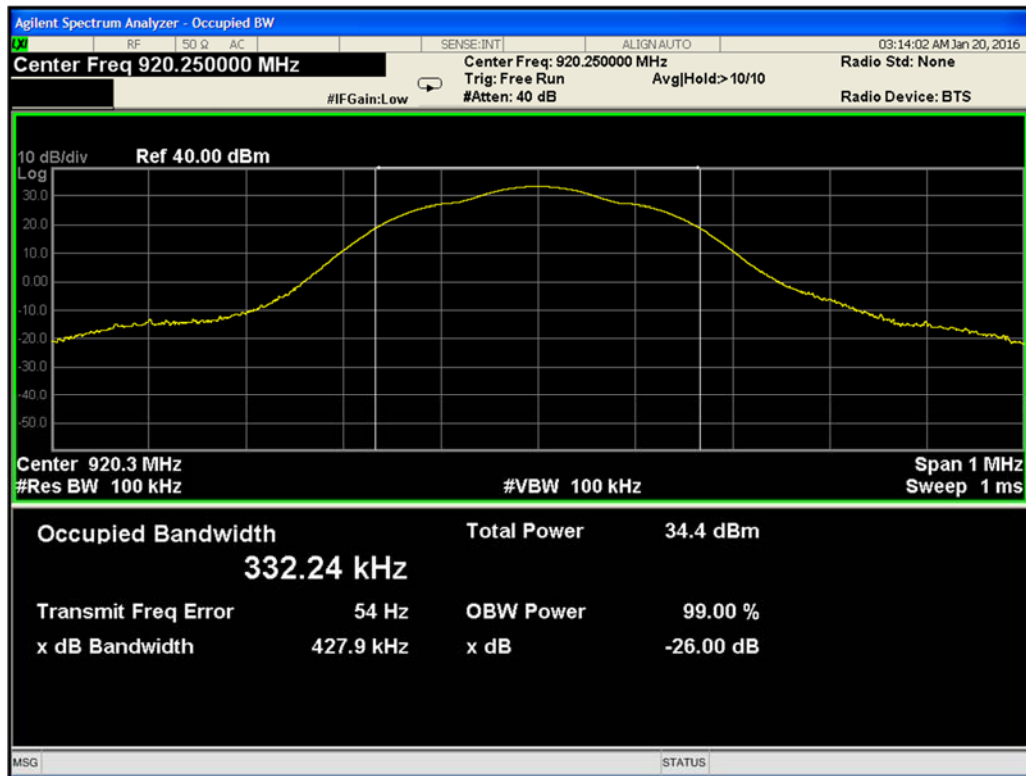| 4.2	**Occupied Bandwidth**		
Method:	The measurements were made with transmitter set to transmit continuously modulated signal. The marker delta method was used to determine the 26dB bandwidth.		
	Laboratory Ambient Temperature		23°C
	Relative Humidity		45%
Reference Standard:	☐ FCC Part 15.109/ICES 003 ☒ FCC Part 90.209/RSS 137 ☒ FCC Part 2.1046 ☒ FCC Part 15.247	**Measurement Point** ☒ Conducted ☐ Radiated ☐	
Frequency Range:	☒ 902.75-920.45MHz		
Maximum OBW	902-904MHz	909.75-921.75MHz	
	☒ 2MHz	☒ 12MHz	
Nominal Voltage:	☒ 120VAC ☐ VDC		
Tested By:	Yuriy Litvinov	**Date:** 01/20/2016	

Note:	The devices may employ any type of modulation technique. The worst case modulations used by the device have been reported.

RFID Protocol	FW ver.	Frequency Bands (MHz)	26 dB Bandwidth (KHz)
CW	1.4	902.75-903.25	399.2
ISO 18000-6C	1.4	902.75-903.25	432.6
ISO 18000-6C	1.4	911.25-920.25	427.1
ISO 18000-6C	1.4	910.95-920.45	421.1
PS111	1.4	914.25-915.75	755.8
Title 21	1.4	911.75-919.25	1006.4
ISO18000-6C(ISOC)	1.6	902.75-903.25	436.9
ISO18000-6C(ISOC)	1.6	911.25-920.25	427.9
ISO18000-6C(ISOC)	1.6	910.95-920.45	427.8

| Frequency (MHz) (FHSS FCC_dense mode)	FW ver.	Data Rate	20 dB Bandwidth (KHz)	FCC Part 15.247 Limit (KHz)	Results
Low Ch. 902.	1.4	Low	106.0	500	**pass**
High Ch.927.75	1.4	Low	106.0	500	**pass**
Low Ch. 902.3	1.4	High	190.8	500	**pass**
High Ch. 927.75	1.4	High	185.2	500	**pass**
Low Ch. 902.3	1.6	Low	104.0	500	**pass**
High Ch.927.75	1.6	Low	105.5	500	**pass**
Low Ch. 902.3	1.6	High	193.0	500	**pass**
High Ch. 927.75	1.6	High	187.2	500	**pass**

Occupied Bandwidth – FCC 90_dense (new ISOC) 911.25MHz
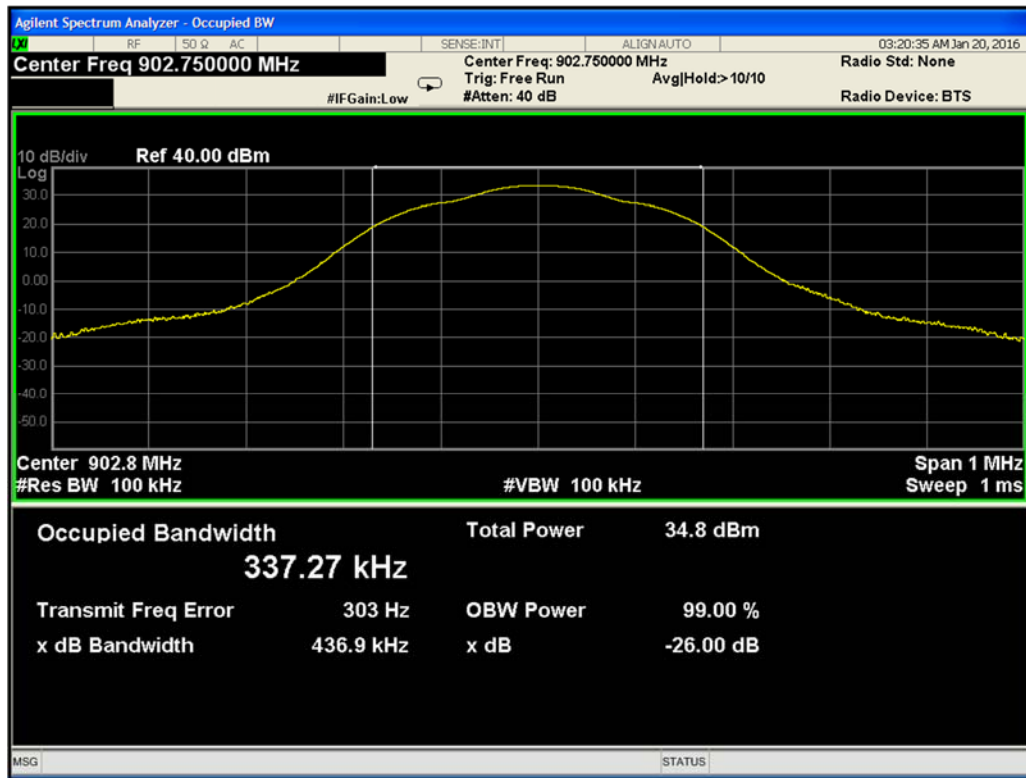

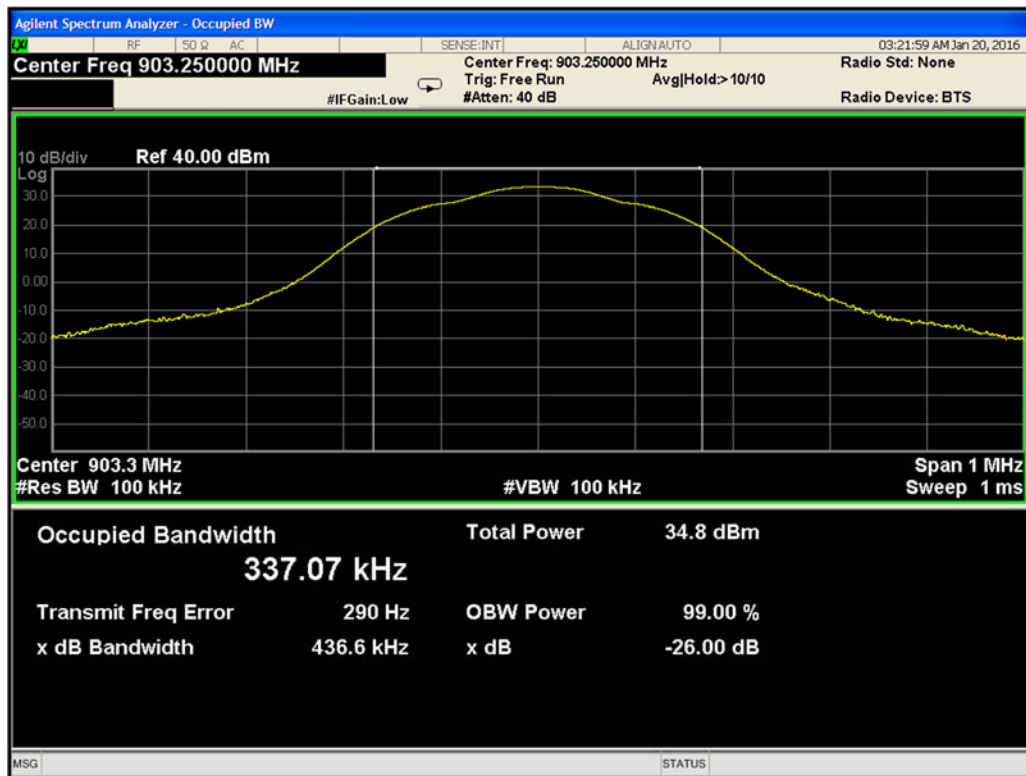**Occupied Bandwidth – FCC 90_dense (new ISOC) 920.25MHz**
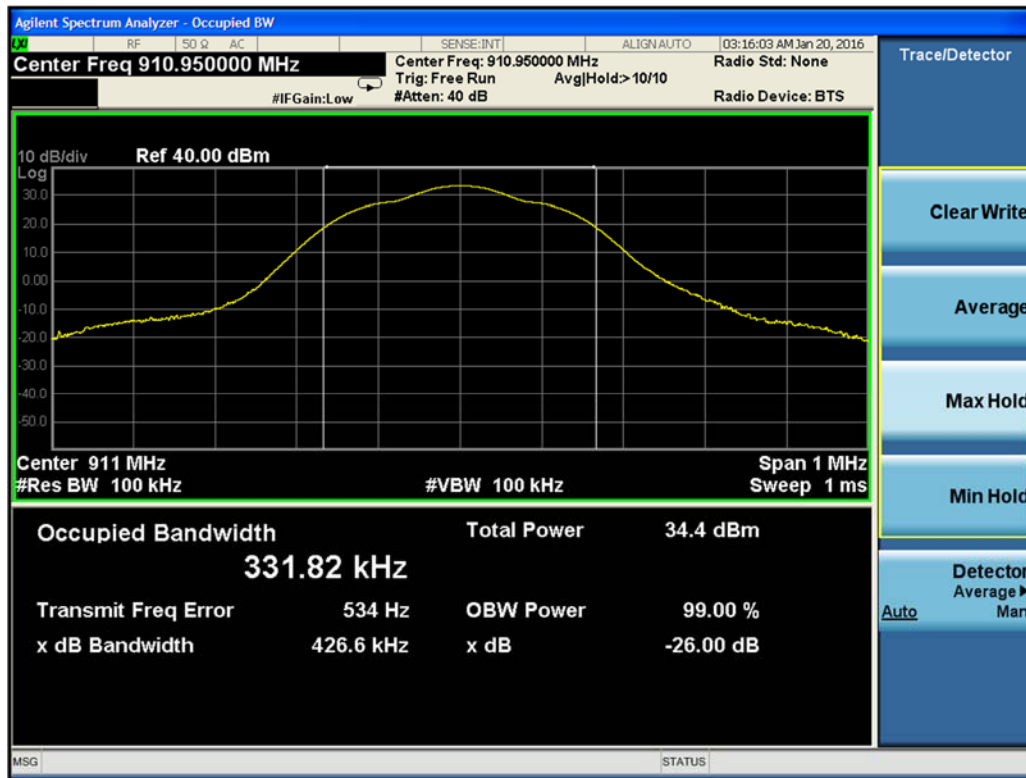
Occupied Bandwidth – FCC Part 90 (new ISOC) 910.95MHz
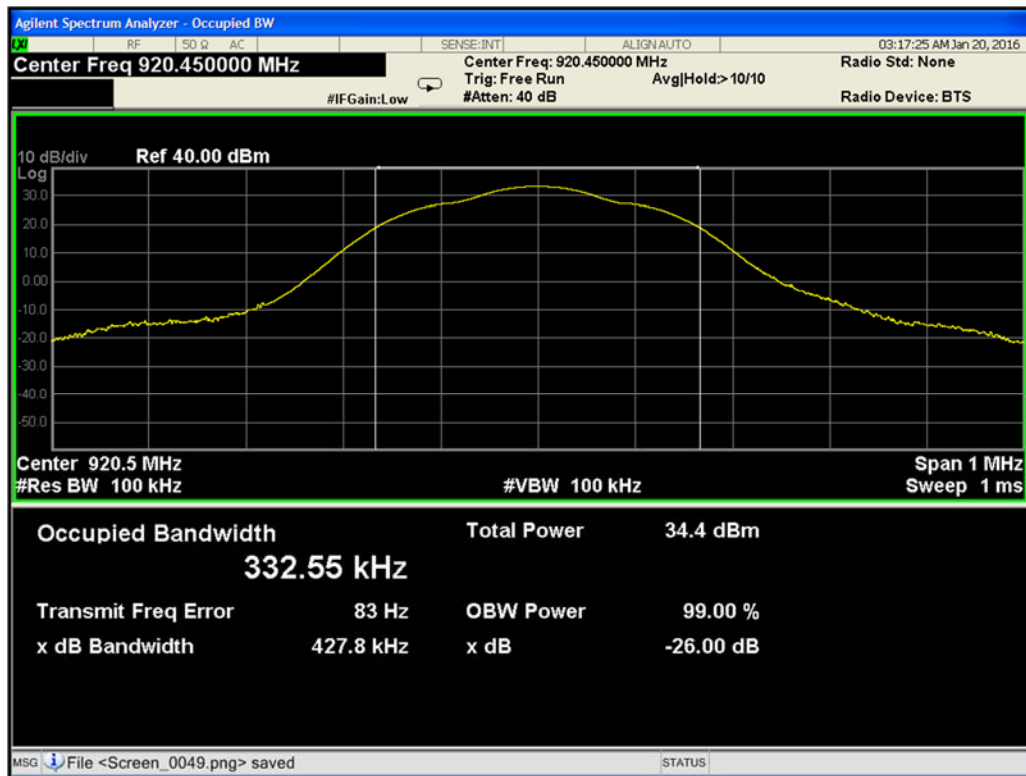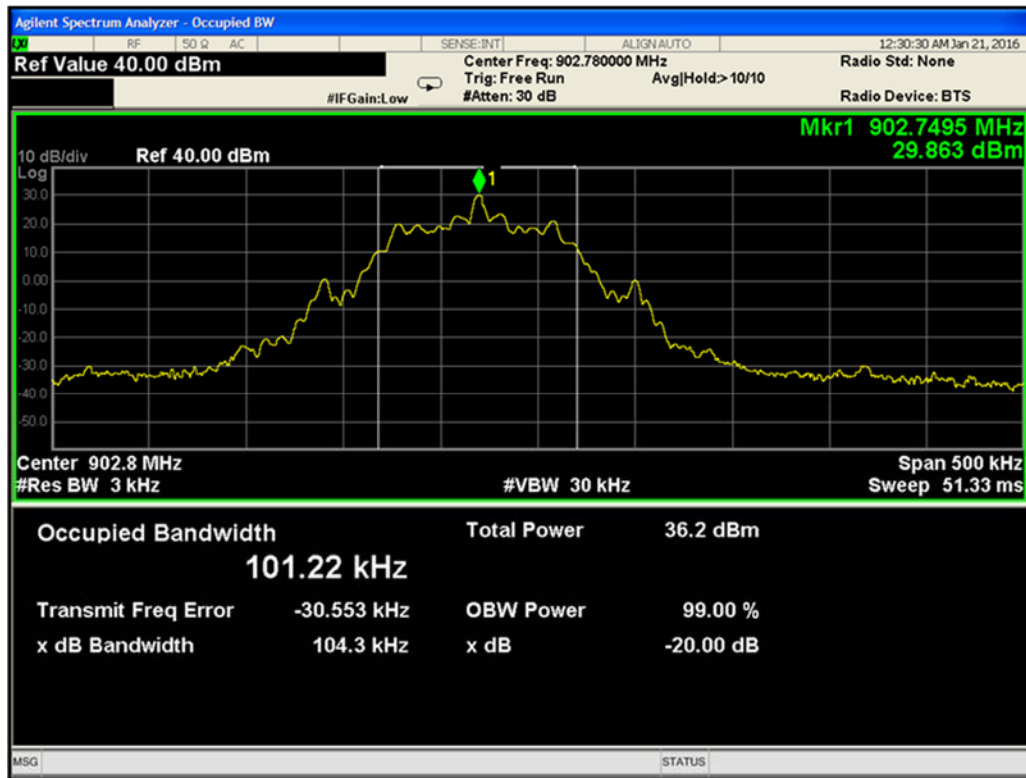

Occupied Bandwidth – FCC Part 90 (new ISOC) 920.45MHz
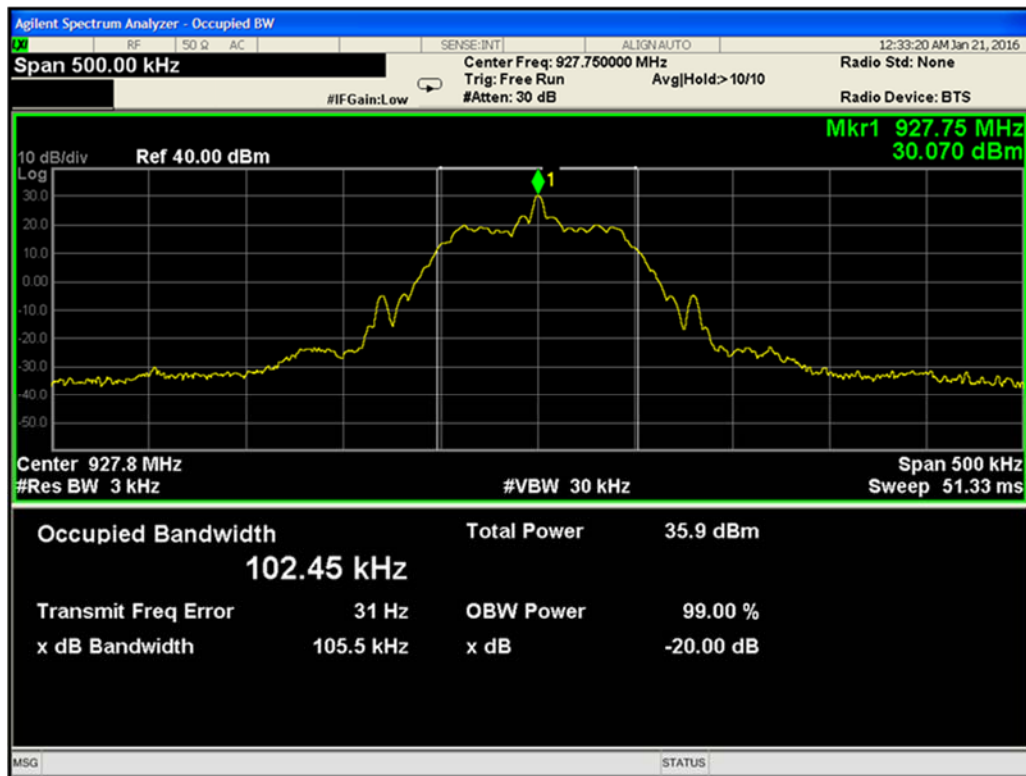
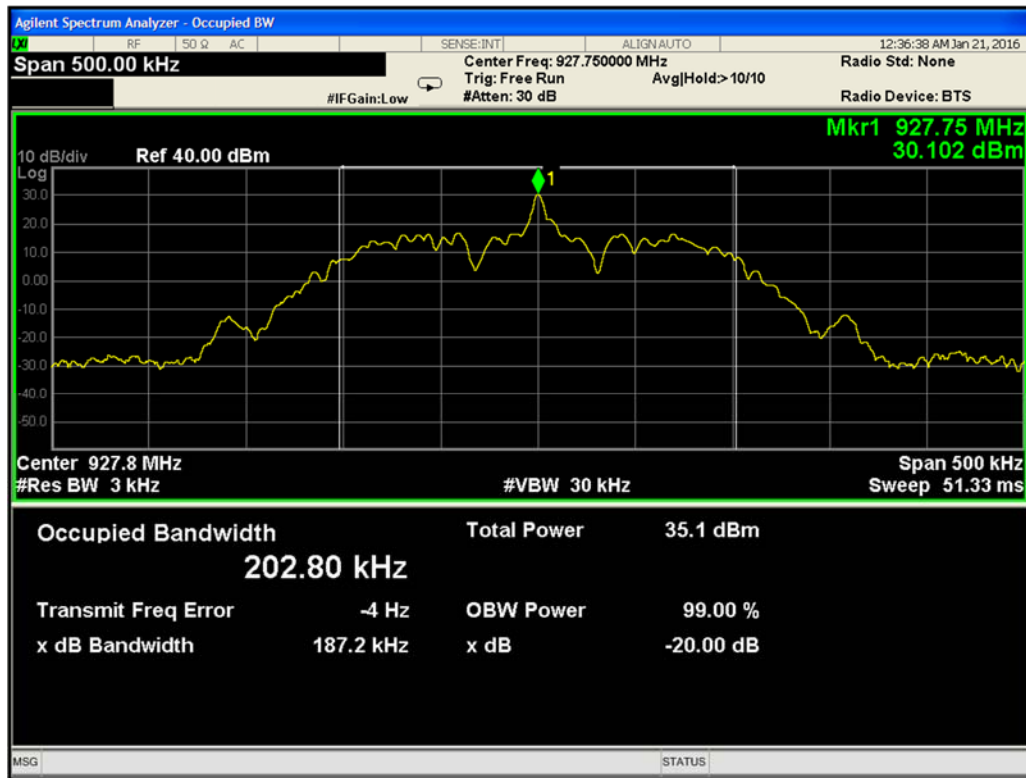**Occupied Bandwidth – FCC 90_Lowband (new ISOC) 902.75MHz**

Occupied Bandwidth – FCC 90_Lowband (new ISOC) 903.25MHz

Occupied Bandwidth – FCC Part 15.247 Low Channel/Low Data Rate

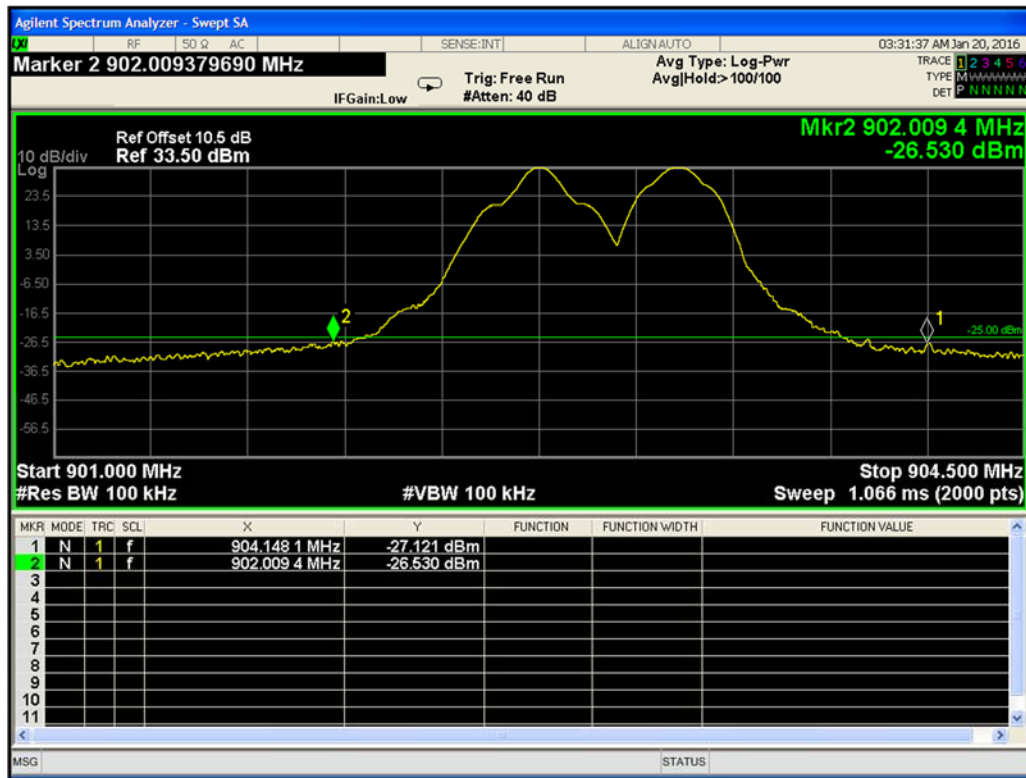**Occupied Bandwidth – FCC Part 15.247 High Channel/Low Data Rate**

**Occupied Bandwidth – FCC Part 15.247 Low Channel/High Data Rate**

Occupied Bandwidth – FCC Part 15.247 Low Channel/High Data Rate

| 4.3	Spurious Emissions at Antenna Terminals		
Method:	The measurements were made with transmitter set to transmit continuously with modulated signal. The marker delta method was used to determine band-edge compliance.		
	Laboratory Ambient Temperature		23°C
	Relative Humidity		45%
Reference Standard:	☐ FCC Part 90.210/RSS 137 ☒ FCC Part 2.1051	**Measurement Point** ☒ Conducted ☐ Radiated ☐ ___	
Frequency Range:	☒ 902.75-920.45MHz		
Limit	Emission Mask "K"(RSS137 EM "C")	**Results**	
	☒ 55+10log(Pmax)dB (-25dBm) ☒ >60dBc	**pass**	
Nominal Voltage:	☒ 120VAC ☐ VDC		
Tested By:	Yuriy Litvinov	**Date:** 01/19/2016	

Note:	

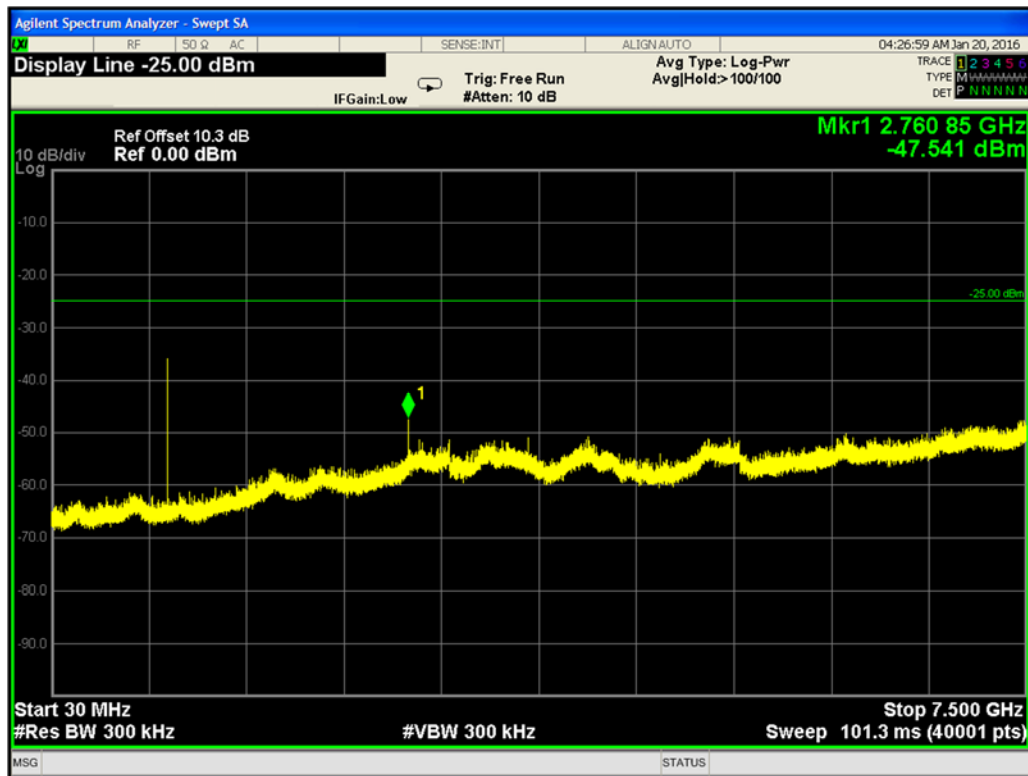**Lower and Upper Band Edge – FCC_Lowband – ISO18000-6C (ISOC)**
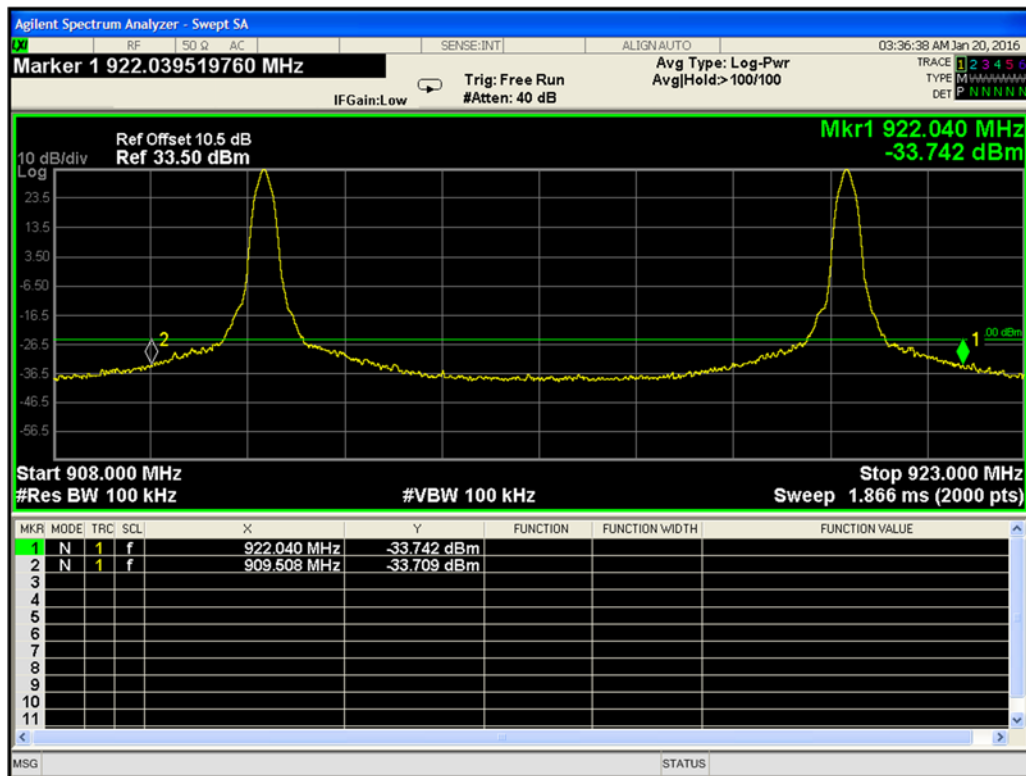
Lower and Upper Band Edge FCC_dense – ISO18000-6C (ISOC)
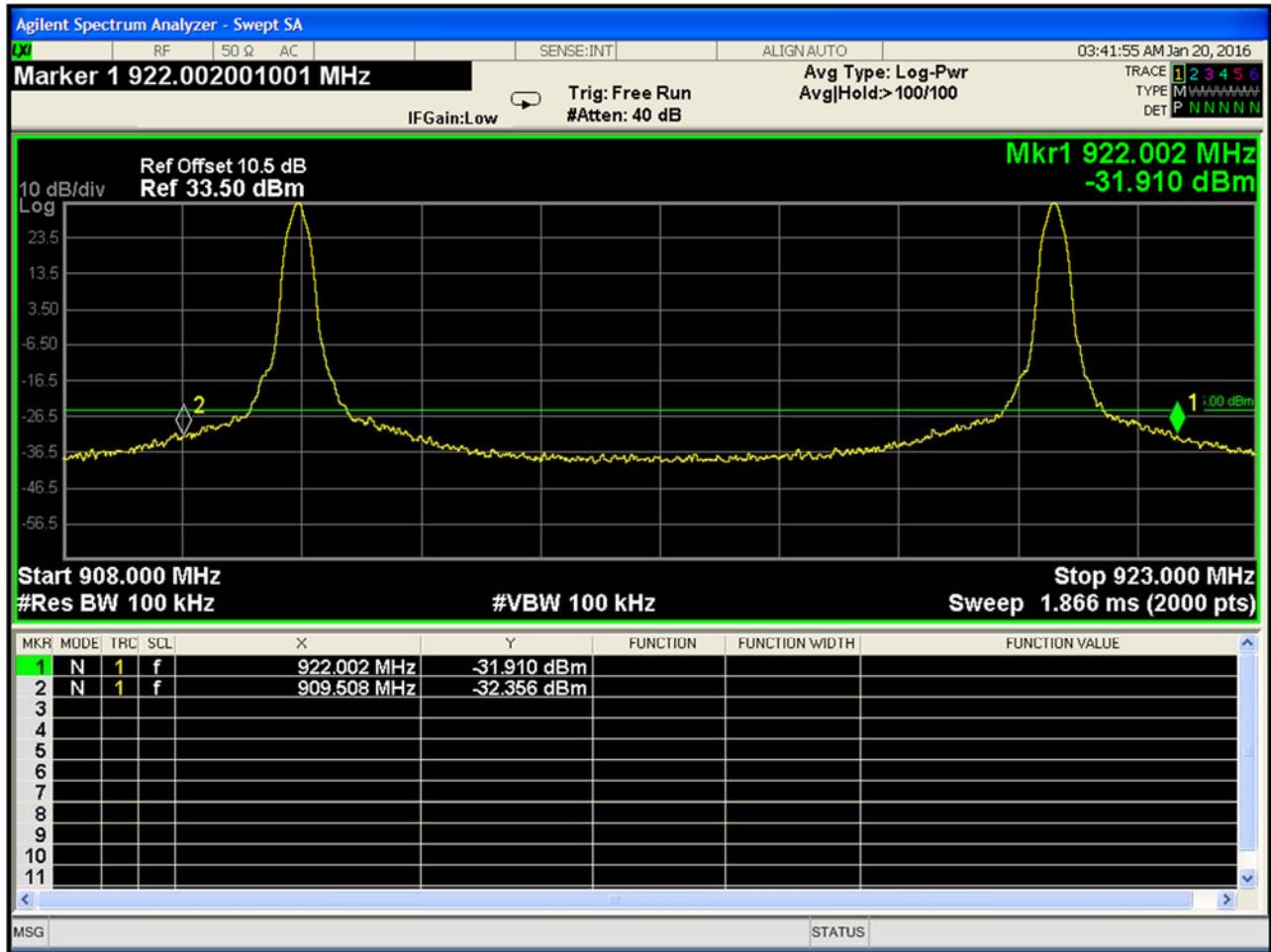
Lower and Upper Band Edge FCC_90 - ISO18000-6C (ISOC)
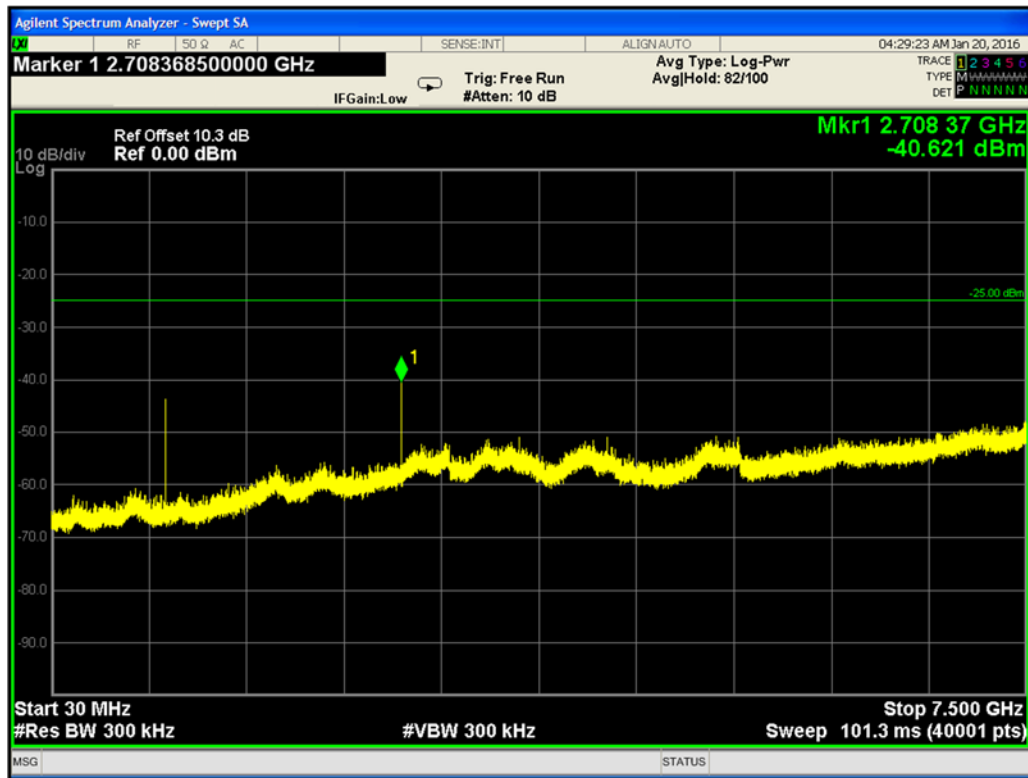
ISOC Protocol at lowest operating frequency - 902.75MHz (notched)

ISOC Protocol at highest operating frequency - 920.45MHz (notched)

4.4	Frequency Stability

Method:	The measurements was made with the device set to transmit a continuous un-modulated carrier and performed at each of the applicable frequencies.

	Laboratory Ambient Temperature	
	Relative Humidity	

Reference Standard:	☒ FCC Part 90.213/RSS 137 ☐	Measurement Point ☒ Conducted ☐ Radiated
Frequency Range:	☒ 902-928MHz	☐

Limit	Frequency Drift	Output Power
	☒ ±2.5ppm ☐	☐ ☐

Nominal Voltage:	☐ 230VAC ☐ 120VAC

Tested By:		Date:

Note:	Part 90.213(a) Note 13. Fixed non-multilateration transmitters with an authorized bandwidth that is more than 40 kHz from the band edge, intermittently operated hand-held readers, and mobile transponders are not subject to frequency tolerance restrictions.

4.5	RF Exposure Compliance	
Reference Standard:	☒ IEEE Std 1528a ☒ RSS 102, Issue 4 ☒ KDB 447498 ☐ KDB ▨▨▨ ☒ FCC Parts 2.1091 and 2.1093 ☐ OET 65	☒ MPE ☐ SAR Evaluation
Frequency Range:	☒ 902-928MHz	
Antenna Separation Distance	>120cm	
Antenna Type	15DBI	
Antenna Gain (maximum)	31.6 (numeric)	
Maximum Output Power at antenna terminal	35dBm (3162mW)	
Power Density	0.552 mW/cm^2	
GENERAL POPULATION/UNCONTROLLED LIMIT		
FCC/RSS102	0.610 mW/cm^2	

Note:	**The device doesn't transmitting simultaneously in multiple frequency bands or different FCC Parts. Frequency management is configured by the factory to comply with applicable radio regulations.** The highest RF output power of the unit was measured and recorded. According to §1.1310 of the FCC rules. The MPE was calculated at 120cm to show compliance with the power density limit. The following formula was used to calculate the Power Density: $S=PG/4\pi R^2$

5.0	Test Equipment

Test Equipment Used					
Description	**Manufacturer**	**Model**	**Identifier**	**Cal. Due**	**Check**
Biconilog Antenna	Schaffner	CBL6112B	27491	10/2016	☒
Horn Antenna	AH Systems	SAS 571	1010	10/2016	☐
Loop Antenna	EMCO	ALR25M	1011	10/2016	☐
EMI Receiver	Rohde & Schwarz	ESIB 40	100235	10/2016	☐
EMI Receiver	Agilent	E4448A	1530975	10/2016	☐
Signal Analyzer	Agilent	N9000A	MY53031040	10/2016	☒
LISN	TESEQ	NNB51	1130	10/2016	☐
Harmonic/Flicker Source	Cal. Instruments	C4-5001iX	57162	10/2016	☐
Amplifier	AR	250W1000AM	14354	10/2016	☐
Amplifier	AR	25S1G4A	4003	10/2016	☐
Signal Generator	HP	8656A	2326A05125	10/2016	☐
Signal Generator	Agilent	E8257D	160895	10/2016	☐
Field Probe	AR	FL7006	25019	10/2016	☐
Field Monitor	AR	FM2000	14292	10/2016	☐
AC CDN	Schaffner	M316,	21937	10/2016	☐
AC CDN	Teseq	M016,	26131	10/2016	☐
ISN	Teseq	T4	25652	10/2016	☐
High Pass Filter	WHK	WHK1.1/1.5G	9	10/2016	☐
EMC Software	ETS-Lindgren	TILE 6		10/2016	☒
Oscilloscope	Tektronix	DPO4104	1550	10/2016	☐

6.0	Report revision history

Revision Level	Date	Report Number	Notes
0	12/05/2014	RE1407019-2	Original Issue
1	01/16/2016	RE1601012-1	New firmware ver. 1.6, Class II PC

Certificate of Conformity
3M EMC Laboratory

SEMS Regulatory Engineering
Building 76-01-01
St. Paul, MN 55144-1000, USA

MANUFACTURER'S NAME	3M COMPANY
NAME OF EQUIPMENT	Toll RFID READER and READER REDUNDANCY SWITCH
MODEL NUMBER(S)	6204 and RRS
TEST REPORT NUMBER	R1601012-1
DATE OF ISSUE	January 20, 2016

Referring to the performance criteria and operating mode during the tests specified in this report the equipment complies with the essential requirements herein specified:

47 CFR Part 90 – Subpart M – LMS Operations in the 902-928 MHz band	FCC Part 90.353, Class II PC
Location and Monitoring Service in the Band 902-928 MHz.	RSS 137, Issue 2, 2009, Class II PC

Comments:

NVLAP Lab Code 200033-0

_____
Yuriy Litvinov
Lead EMC Engineer