

Ingersoll Rand

ADDENDUM TEST REPORT TO 92311-15

MultiTech Reader, MTK15-485

Tested To The Following Standards:

FCC Part 15 Subpart C Sections 15.207, 15.209, 15.225
and
RSS 210 Issue 8

Report No.: 92311-15A

Date of issue: June 6, 2012



This test report bears the accreditation symbol indicating that the testing performed herein meets the test and reporting requirements of ISO/IEC 17025 under the applicable scope of EMC testing for CKC Laboratories, Inc.

We strive to create long-term, trust based relationships by providing sound, adaptive, customer first testing services. We embrace each of our customers' unique EMC challenges, not as an interruption to set processes, but rather as the reason we are in business.

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ADMINISTRATIVE INFORMATION

Test Report Information

REPORT PREPARED FOR:

Ingersoll Rand
500 Golden Ridge Road.
Bldg. 1, Suite 160
Golden, CO 80401

Representative: Bryan Hoff
Customer Reference Number: 4011258

DATE OF EQUIPMENT RECEIPT:**DATE(S) OF TESTING:****REPORT PREPARED BY:**

Joyce Walker
CKC Laboratories, Inc.
5046 Sierra Pines Drive
Mariposa, CA 95338

Project Number: 92311

March 12, 2012

March 12 - April 3, 2012

Revision History

Original: Testing of the MultiTech Reader, MTK15-485 to FCC Part 15 Subpart C Sections 15.207, 15.209, 15.225 and RSS 210 Issue 8.

Addendum A: Added a justification statement for the use of a BW correction factor and added a 15.31(e) statement to the carrier data sheets. Added missing data to the frequency stability table. Updated test conditions for 15.207 testing.

Report Authorization

The test data contained in this report documents the observed testing parameters pertaining to and are relevant for only the sample equipment tested in the agreed upon operational mode(s) and configuration(s) as identified herein. Compliance assessment remains the client's responsibility. This report may not be used to claim product endorsement by A2LA or any government agencies. This test report has been authorized for release under quality control from CKC Laboratories, Inc.



Steve Behm
Director of Quality Assurance & Engineering Services
CKC Laboratories, Inc.

Test Facility Information



Our laboratories are configured to effectively test a wide variety of product types. CKC utilizes first class test equipment, anechoic chambers, data acquisition and information services to create accurate, repeatable and affordable test results.

TEST LOCATION(S):
CKC Laboratories, Inc.
5046 Sierra Pines Drive
Mariposa, CA 95338

Site Registration & Accreditation Information

Location	CB #	TAIWAN	CANADA	FCC	JAPAN
Mariposa A	US0103	SL2-IN-E-1147R	3082A-2	90477	R-563 C-578 T-1492 G-87

SUMMARY OF RESULTS

Standard / Specification: FCC Part 15 Subpart C 15.207, 15.209, 15.225 and RSS 210 Issue 8

Description	Test Procedure/Method	Results
Conducted Emissions	FCC Part 15 Subpart C Section 15.207 / ANSI C63.4 (2009)	Pass
Carrier Radiated Emissions	FCC Part 15 Subpart C Section 15.209 / ANSI C63.4 (2009)	Pass
Spurious Radiated Emissions	FCC Part 15 Subpart C Section 15.209 / ANSI C63.4 (2009)	Pass
Carrier Radiated Emissions	FCC Part 15 Subpart C Section 15.225 (a)(b)(c) / ANSI C63.4 (2009)	Pass
Spurious Radiated Emissions	FCC Part 15 Subpart C Section 15.225 (d) / ANSI C63.4 (2009)	Pass
Frequency Stability	FCC Part 15 Subpart C Section 15.225 (e) / ANSI C63.4 (2009) / ANSI C63.10 (2009)	Pass
99% Bandwidth	RSS 210 Issue 8	Pass

Conditions During Testing

This list is a summary of the conditions noted for or modifications made to the equipment during testing.

Summary of Conditions
None

EQUIPMENT UNDER TEST (EUT)

The following model has been tested by CKC Laboratories: **MultiTech Reader, MTK15-485**

The manufacturer states that the following additional models are identical electrically to the one which was tested, or any differences between them do not affect their EMC characteristics, and therefore they meet the level of testing equivalent to the tested models. **MultiTech Reader, Models: MT15-485, MT15, and MTK15**

EQUIPMENT UNDER TEST

MultiTech Reader (2)

Manuf: Ingersoll Rand

Model: MTK15-485

Serial: E0001 / E0004

PERIPHERAL DEVICES

The EUT was tested with the following peripheral device(s):

Dual Tracking DC Power Supply

Manuf: Topwards Electronic instruments CO. LTD.

Model: 4303

Serial: 918520

FCC PART 15 SUBPART C

This report contains EMC emissions test results under United States Federal Communications Commission (FCC) 47 CFR 15C requirements for Unlicensed Radio Frequency Devices, Subpart C - Intentional Radiators.

15.207 Conducted Emissions

Test Data Sheets

Test Location: CKC Laboratories, Inc. • 22116 23rd Drive SE, Suite A • Bothell, WA 98021 • 425-402-1717

Customer: **Ingersoll Rand**

Specification: **15.207 AC Mains - Average**

Work Order #: **92311**

Test Type: **Conducted Emissions**

Equipment: **MultiTech Reader**

Manufacturer: **Ingersoll Rand**

Model: **MTK15-485**

S/N: **E0001**

Date: 3/15/2012

Time: 13:15:46

Sequence#: 2

Tested By: **Michael Rauch Jr.**

120V 60Hz

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN01184	Spectrum Analyzer	8568B	5/4/2011	5/4/2013
T2	AN01183	Spectrum Analyzer Display	85662A	5/4/2011	5/4/2013
T3	ANP00082	Attenuator	PE7002-10	6/7/2011	6/7/2013
T4	ANMACOND	Cable		5/10/2011	5/10/2013
T5	AN02609	High Pass Filter	HE9615-150K-50-720B	3/15/2012	3/15/2014
T6	AN00374	50uH LISN-Black Lead Amplitude (dB)	8028-TS-50-BNC	10/31/2011	10/31/2013
	AN00374	50uH LISN-White Lead Amplitude (dB)	8028-TS-50-BNC	10/31/2011	10/31/2013

Equipment Under Test (* = EUT):

Function	Manufacturer	Model #	S/N
MultiTech Reader*	Ingersoll Rand	MTK15-485	E0001
MultiTech Reader	Ingersoll Rand	MTK15-485	E0004

Support Devices:

Function	Manufacturer	Model #	S/N
Dual Tracking DC Power Supply	Topwards Electronic instruments CO. LTD.	4303	918520

Test Conditions / Notes:

EUT set up a wooden table in the center of flush mounted turntable. EUT support equipment is located on top of the turntable. Test was performed in accordance with FCC KDB 174176 with the EUT integral antenna attached. The test was repeated at 13.56MHz with a dummy load attached to the EUT antenna terminals to determine compliance with spec limit. The measurement at the fundamental with integral antenna attached is included only for reference.

Frequencies investigated: 150k to 30MHz

Clock Frequencies of interest are: 8MHz, 27.12MHz

TX Freq: 125KHz, 13.56MHz

13.56MHz Transmitter output terminals have been terminated with a characteristic load.

RBW used in accordance with CISPR 16, VBW is greater than RBW

Temperature = 17°C

Relative Humidity = 51%

Pressure = 97.7 kPa

Ext Attn: 0 dB

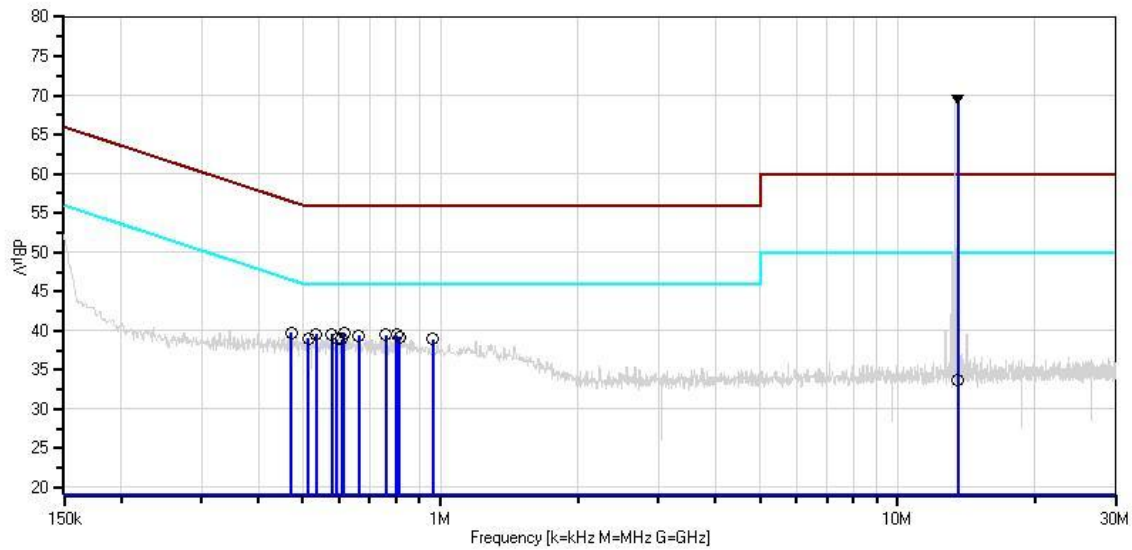
Measurement Data:

Reading listed by margin.

Test Lead: Black

#	Freq MHz	Rdng dBμV	T1 T5 dB	T2 T6 dB	T3 dB	T4 dB	Dist Table	Corr dBμV	Spec dBμV	Margin dB	Polar Ant
1	13.560M Ambient	58.3	+0.0 +0.1	+0.0 +0.1	+10.1	+1.0	+0.0	69.6	50.0 EUT with integral antenna attached	+19.6	Black
2	615.408k	25.0	+0.0 +0.3	+0.0 +4.2	+10.0	+0.2	+0.0	39.7	46.0	-6.3	Black
3	533.962k	24.9	+0.0 +0.2	+0.0 +4.3	+10.0	+0.2	+0.0	39.6	46.0	-6.4	Black
4	577.594k	24.9	+0.0 +0.2	+0.0 +4.3	+10.0	+0.2	+0.0	39.6	46.0	-6.4	Black
5	760.848k	24.8	+0.0 +0.2	+0.0 +4.2	+10.0	+0.3	+0.0	39.5	46.0	-6.5	Black
6	801.571k	24.9	+0.0 +0.2	+0.0 +4.1	+10.0	+0.3	+0.0	39.5	46.0	-6.5	Black
7	662.676k	24.8	+0.0 +0.2	+0.0 +4.2	+10.0	+0.2	+0.0	39.4	46.0	-6.6	Black
8	813.934k	24.6	+0.0 +0.2	+0.0 +4.1	+10.0	+0.3	+0.0	39.2	46.0	-6.8	Black
9	470.695k	24.9	+0.0 +0.2	+0.0 +4.4	+10.0	+0.2	+0.0	39.7	46.5	-6.8	Black
10	513.600k	24.3	+0.0 +0.2	+0.0 +4.3	+10.0	+0.2	+0.0	39.0	46.0	-7.0	Black
11	962.060k	24.3	+0.0 +0.2	+0.0 +4.1	+10.0	+0.3	+0.0	38.9	46.0	-7.1	Black
12	607.409k	24.3	+0.0 +0.2	+0.0 +4.2	+10.0	+0.2	+0.0	38.9	46.0	-7.1	Black
13	593.592k	24.2	+0.0 +0.2	+0.0 +4.3	+10.0	+0.2	+0.0	38.9	46.0	-7.1	Black
14	13.560M	22.4	+0.0 +0.1	+0.0 +0.1	+10.1	+1.0	+0.0	33.7	50.0 EUT with dummy load attached	-16.3	Black

CKC Laboratories, Inc. Date: 3/15/2012 Time: 13:15:46 Ingersoll Rand WO#: 92311
15.207 AC Mains - Average Test Lead: Black Black Sequence#: 2 Ext ATTN: 0 dB



— Sweep Data
○ Peak Readings
* Average Readings
— Readings
× QP Readings
▼ Ambient
— 1 - 15.207 AC Mains - Average
— 2 - 15.207 AC Mains - Quasi-peak

Test Location: CKC Laboratories, Inc. • 22116 23rd Drive SE, Suite A • Bothell, WA 98021 • 425-402-1717

Customer: **Ingersoll Rand**
 Specification: **15.207 AC Mains - Average**
 Work Order #: **92311**
 Test Type: **Conducted Emissions**
 Equipment: **MultiTech Reader**
 Manufacturer: **Ingersoll Rand**
 Model: **MTK15-485**
 S/N: **E0001**

Date: 3/15/2012
 Time: 10:22:15
 Sequence#: 1
 Tested By: Michael Rauch Jr.
 120V 60Hz

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN01184	Spectrum Analyzer	8568B	5/4/2011	5/4/2013
	AN01183	Spectrum Analyzer Display	85662A	5/4/2011	5/4/2013
T1	ANP00082	Attenuator	PE7002-10	6/7/2011	6/7/2013
T2	ANMACOND	Cable		5/10/2011	5/10/2013
	AN00374	50uH LISN-Black Lead Amplitude (dB)	8028-TS-50-BNC	10/31/2011	10/31/2013
T3	AN00374	50uH LISN-White Lead Amplitude (dB)	8028-TS-50-BNC	10/31/2011	10/31/2013
T4	AN02609	High Pass Filter	HE9615-150K-50-720B	3/15/2012	3/15/2014

Equipment Under Test (* = EUT):

Function	Manufacturer	Model #	S/N
MultiTech Reader*	Ingersoll Rand	MTK15-485	E0001
MultiTech Reader	Ingersoll Rand	MTK15-485	E0004

Support Devices:

Function	Manufacturer	Model #	S/N
Dual Tracking DC Power Supply	Topwards Electronic instruments CO. LTD.	4303	918520

Test Conditions / Notes:

EUT set up a wooden table in the center of flush mounted turntable. EUT support equipment is located on top of the turntable. Test was performed in accordance with FCC KDB 174176 with the EUT integral antenna attached. The test was repeated at 13.56MHz with a dummy load attached to the EUT antenna terminals to determine compliance with spec limit. The measurement at the fundamental with integral antenna attached is included only for reference.

Frequencies investigated: 150k to 30MHz

Clock Frequencies of interest are: 8MHz, 27.12MHz

TX Freq: 125KHz, 13.56MHz

13.56MHz Transmitter output terminals have been terminated with a characteristic load.

RBW used in accordance with CISPR 16, VBW is greater than RBW

Temperature = 17°C

Relative Humidity = 51%

Pressure = 97.7 kPa

Ext Attn: 0 dB

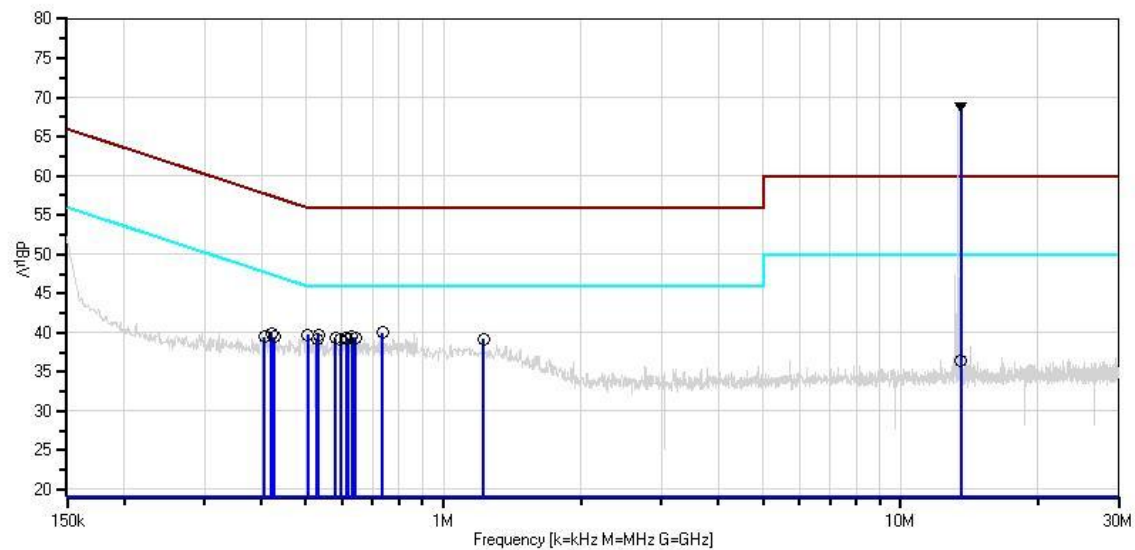
Measurement Data:

Reading listed by margin.

Test Lead: White

#	Freq MHz	Rdng dB μ V	T1 dB	T2 dB	T3 dB	T4 dB	Dist Table	Corr dB μ V	Spec dB μ V	Margin dB	Polar Ant
1	13.560M Ambient	57.6	+10.1	+1.0	+0.1	+0.1	+0.0	68.9	50.0 EUT with integral antenna attached	+18.9	White
2	736.123k	25.3	+10.0	+0.3	+4.2	+0.2	+0.0	40.0	46.0	-6.0	White
3	504.146k	24.9	+10.0	+0.2	+4.4	+0.2	+0.0	39.7	46.0	-6.3	White
4	532.507k	25.0	+10.0	+0.2	+4.3	+0.2	+0.0	39.7	46.0	-6.3	White
5	629.952k	24.7	+10.0	+0.2	+4.3	+0.3	+0.0	39.5	46.0	-6.5	White
6	612.499k	24.6	+10.0	+0.2	+4.3	+0.3	+0.0	39.4	46.0	-6.6	White
7	640.860k	24.6	+10.0	+0.2	+4.3	+0.3	+0.0	39.4	46.0	-6.6	White
8	579.775k	24.6	+10.0	+0.2	+4.3	+0.2	+0.0	39.3	46.0	-6.7	White
9	528.144k	24.5	+10.0	+0.2	+4.3	+0.2	+0.0	39.2	46.0	-6.8	White
10	616.862k	24.4	+10.0	+0.2	+4.3	+0.3	+0.0	39.2	46.0	-6.8	White
11	1.221M	24.8	+10.0	+0.3	+3.9	+0.2	+0.0	39.2	46.0	-6.8	White
12	595.774k	24.4	+10.0	+0.2	+4.3	+0.2	+0.0	39.1	46.0	-6.9	White
13	420.518k	25.1	+10.0	+0.2	+4.4	+0.2	+0.0	39.9	47.4	-7.5	White
14	427.063k	24.7	+10.0	+0.2	+4.4	+0.2	+0.0	39.5	47.3	-7.8	White
15	405.247k	24.7	+10.0	+0.2	+4.4	+0.2	+0.0	39.5	47.7	-8.2	White
16	13.560M	25.1	+10.1	+1.0	+0.1	+0.1	+0.0	36.4	50.0 EUT with dummy load attached	-13.6	White

CKC Laboratories, Inc. Date: 3/15/2012 Time: 10:22:15 Ingersoll Rand WO#: 92311
15.207 AC Mains - Average Test Lead: White White Sequence#: 1 Ext ATTN: 0 dB



— Sweep Data	— Readings
○ Peak Readings	× QP Readings
* Average Readings	▼ Ambient
— 1 - 15.207 AC Mains - Average	— 2 - 15.207 AC Mains - Quasi-peak

Test Setup Photos



15.209 Carrier and Spurious Radiated Emissions

Carrier Radiated Emissions

Test Data Sheets

Test Location: CKC Laboratories, Inc. • 5046 Sierra Pines Dr. • Mariposa, CA 95338 • (209) 966-5240

Customer: **Ingersoll Rand**

Specification: **15.209 Radiated Emissions**

Work Order #: **92311**

Date: 3/19/2012

Test Type: **Maximized Emissions**

Time: 15:11:48

Equipment: **MultiTech Reader**

Sequence#: 1

Manufacturer: Ingersoll Rand

Tested By: Michael Rauch Jr.

Model: MTK15-485

S/N: E0001

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN01184	Spectrum Analyzer	8568B	5/4/2011	5/4/2013
	AN01183	Spectrum Analyzer Display	85662A	5/4/2011	5/4/2013
T1	AN00226	Loop Antenna	6502	7/8/2011	7/8/2013
T2	ANP01017	Cable		3/16/2012	3/16/2014

Equipment Under Test (* = EUT):

Function	Manufacturer	Model #	S/N
MultiTech Reader*	Ingersoll Rand	MTK15-485	E0001

Support Devices:

Function	Manufacturer	Model #	S/N
Dual Tracking DC Power Supply	Topwards Electronic instruments CO. LTD.	4303	918520

Test Conditions / Notes:

Carrier Radiated Emissions
 EUT set up a wooden table in the center of flush mounted turntable.
 EUT support equipment is located on top of the turntable.
 Frequencies investigated: 9k to 30MHz
 Clock Frequencies of interest are: 8MHz, 27.12MHz
 TX Freq: 125KHz, 13.56MHz
 RBW used in accordance with CISPR 16, VBW is greater than RBW
 Temperature = 17°C
 Relative Humidity = 51%
 Pressure = 97.7 kPa

Ext Attn: 0 dB

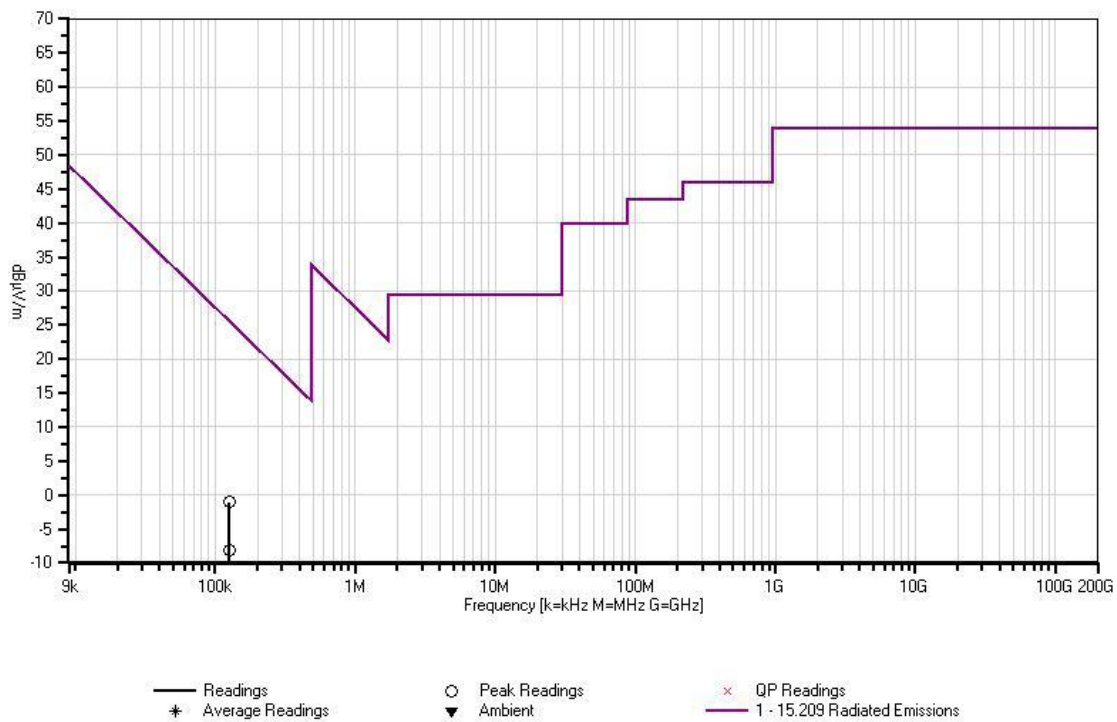
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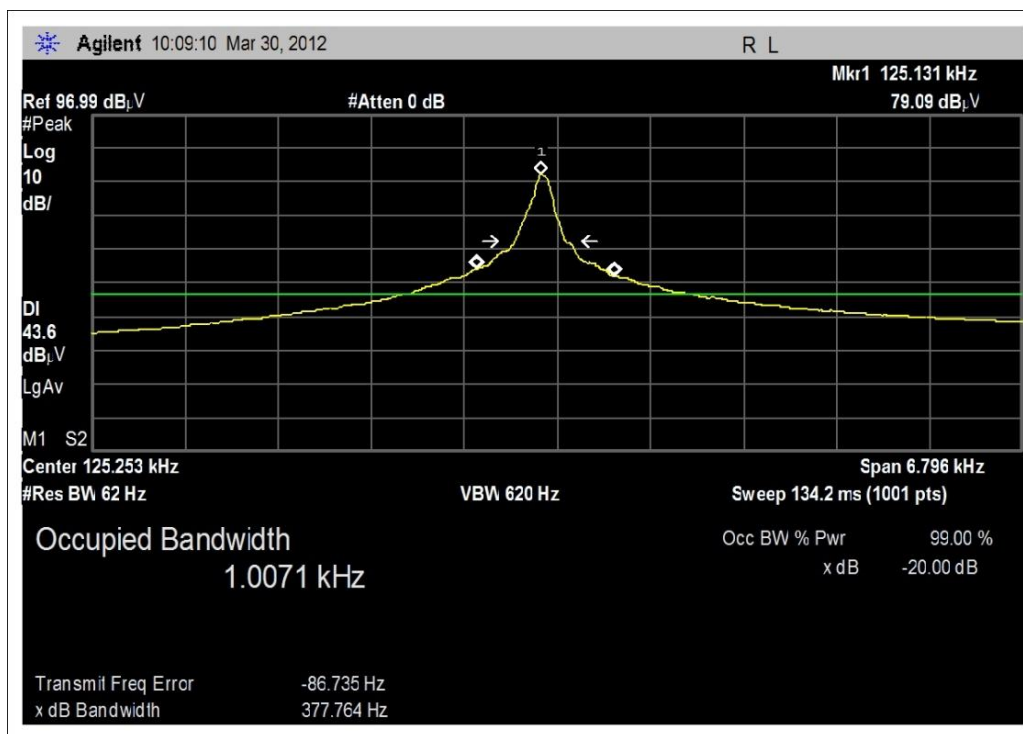
Reading listed by margin.

Test Distance: 10 Meters

#	Freq MHz	Rdng dB μ V	T1 dB	T2 dB		Dist Table	Corr dB μ V/m	Spec dB μ V/m	Margin dB	Polar Ant
1	125.358k	48.5	+9.7	-0.1		-59.1	-1.0	55.7	-56.7	Vert
2	125.314k	41.3	+9.7	-0.1		-59.1	-8.2	55.7	-63.9	Horiz

CKC Laboratories, Inc. Date: 3/19/2012 Time: 15:11:48 Ingersoll Rand WO#: 92311
15.209 Radiated Emissions Test Distance: 10 Meters Vert Sequence#: 1 Ext ATTN: 0 dB





Spurious Radiated Emissions

Test Location: CKC Laboratories, Inc. • 5046 Sierra Pines Dr. • Mariposa, CA 95338 • (209) 966-5240

Customer: **Ingersoll Rand**

Specification: **15.209 Radiated Emissions**

Work Order #: **92311**

Date: 3/19/2012

Test Type: **Maximized Emissions**

Time: 15:11:48

Equipment: **MultiTech Reader**

Sequence#: 1

Manufacturer: Ingersoll Rand

Tested By: Michael Rauch Jr.

Model: MTK15-485

S/N: E0001

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN01184	Spectrum Analyzer	8568B	5/4/2011	5/4/2013
	AN01183	Spectrum Analyzer Display	85662A	5/4/2011	5/4/2013
	AN00226	Loop Antenna	6502	7/8/2011	7/8/2013
	ANP01017	Cable		3/16/2012	3/16/2014

Equipment Under Test (* = EUT):

Function	Manufacturer	Model #	S/N
MultiTech Reader*	Ingersoll Rand	MTK15-485	E0001

Support Devices:

Function	Manufacturer	Model #	S/N
Dual Tracking DC Power Supply	Topwards Electronic instruments CO. LTD.	4303	918520

Test Conditions / Notes:

EUT set up a wooden table in the center of flush mounted turntable.

EUT support equipment is located on top of the turntable.

Frequencies investigated: 9k to 30MHz

Clock Frequencies of interest are: 8MHz, 27.12MHz

TX Freq: 125KHz, 13.56MHz

RBW used in accordance with CISPR 16, VBW is greater than RBW

Temperature = 17 °C

Relative Humidity = 51%

Pressure = 97.7 kPa

15.31(e)

Voltage variations performed in accordance with 15.31(e) no changes were observed to transmitter output.

No EUT emissions observed

Test Location: CKC Laboratories, Inc. • 22116 23rd Drive SE, Suite A • Bothell, WA 98021 • 425-402-1717

Customer: **Ingersoll Rand**
 Specification: **15.209 Radiated Emissions**
 Work Order #: **92311**
 Test Type: **Maximized Emissions**
 Equipment: **MultiTech Reader**
 Manufacturer: **Ingersoll Rand**
 Model: **MTK15-485**
 S/N: **E0001**

Date: 3/14/2012
 Time: 10:04:16
 Sequence#: 1
 Tested By: Michael Rauch Jr.

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN01183	Spectrum Analyzer Display	85662A	5/4/2011	5/4/2013
T2	AN01184	Spectrum Analyzer	8568B	5/4/2011	5/4/2013
T3	AN00062	Preamp	8447D	6/23/2010	6/23/2012
T4	ANMA10M	Cable		5/10/2011	5/10/2013
T5	AN00851	Biconilog Antenna	CBL6111C	3/14/2012	3/14/2014

Equipment Under Test (* = EUT):

Function	Manufacturer	Model #	S/N
MultiTech Reader*	Ingersoll Rand	MTK15-485	E0001

Support Devices:

Function	Manufacturer	Model #	S/N
Dual Tracking DC Power Supply	Topwards Electronic instruments CO. LTD.	4303	918520

Test Conditions / Notes:

Spurious Radiated Emissions
 EUT set up a wooden table in the center of flush mounted turntable.
 EUT support equipment is located on top of the turntable.
 Note: Ambient was hiding the EUT signal so the engineer had to lower the Resolution bandwidth in order to obtain accurate data. This was done by adding a correction factor of 10 log of 120kHz over Resolution bandwidth.

Frequencies investigated: 30MHz to 1GHz
 Clock Frequencies of interest are: 8MHz, 27.12MHz
 TX Freq: 125KHz, 13.56MHz

RBW used in accordance with CISPR 16, VBW is greater than RBW

Temperature = 17°C
 Relative Humidity = 51%
 Pressure = 97.7 kPa

Ext Attn: 0 dB

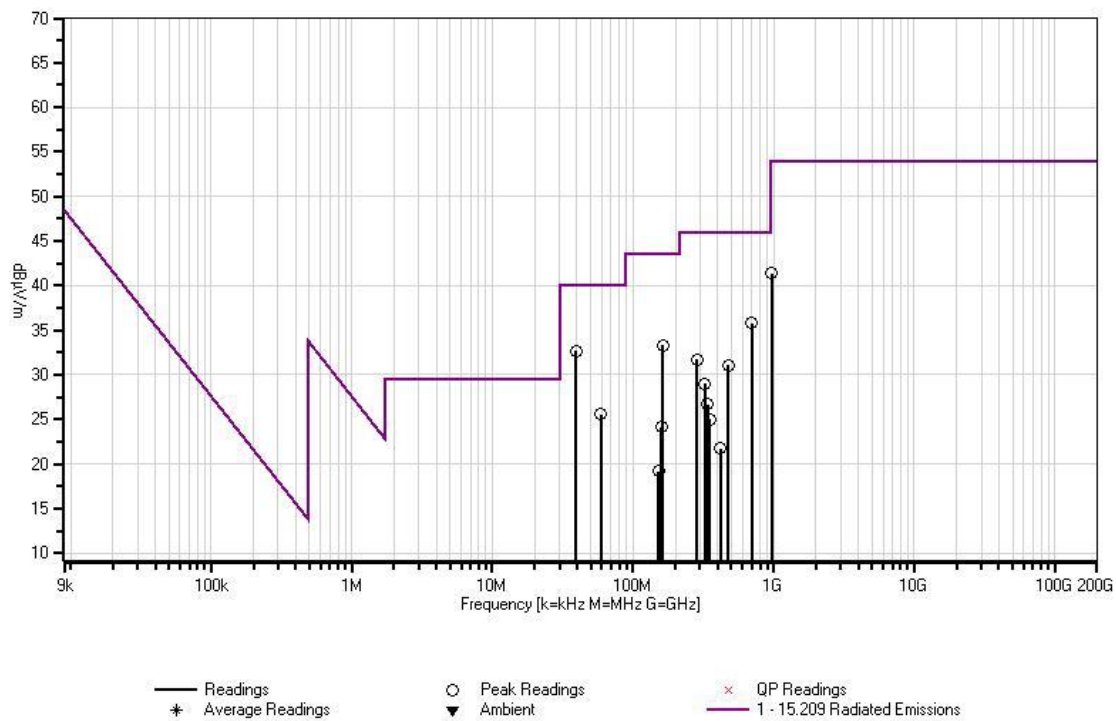
Measurement Data:

Reading listed by margin.

Test Distance: 10 Meters

#	Freq MHz	Rdng dB μ V	T1 T5 dB	T2 dB	T3 dB	T4 dB	Dist Table	Corr dB μ V/m	Spec dB μ V/m	Margin dB	Polar Ant
1	39.252M	38.6	+0.0 +13.3	+0.0	-31.0	+1.3	+10.5	32.7	40.0	-7.3	Horiz
2	702.892M	29.0	+0.0 +20.5	+0.0	-30.5	+6.3	+10.5	35.8	46.0	-10.2	Horiz
3	162.794M	38.9	+0.0 +11.5	+0.0	-30.4	+2.8	+10.5	33.3	43.5 Bandwidth correction factor used	-10.2	Vert
4	974.092M	29.9	+0.0 +22.7	+0.0	-29.4	+7.7	+10.5	41.4	54.0	-12.6	Horiz
5	284.760M	34.8	+0.0 +12.3	+0.0	-29.8	+3.9	+10.5	31.7	46.0	-14.3	Vert
6	58.981M	35.0	+0.0 +9.3	+0.0	-30.9	+1.7	+10.5	25.6	40.0	-14.4	Vert
7	475.927M	29.5	+0.0 +16.5	+0.0	-30.5	+5.1	+10.5	31.1	46.0	-14.9	Horiz
8	325.440M	30.6	+0.0 +13.7	+0.0	-30.0	+4.2	+10.5	29.0	46.0	-17.0	Vert
9	339.000M	28.0	+0.0 +13.9	+0.0	-30.0	+4.3	+10.5	26.7	46.0	-19.3	Vert
10	159.904M	29.7	+0.0 +11.6	+0.0	-30.5	+2.8	+10.5	24.1	43.5	-19.4	Horiz
11	352.560M	26.1	+0.0 +14.1	+0.0	-30.0	+4.3	+10.5	25.0	46.0	-21.0	Vert
12	419.287M	21.6	+0.0 +15.3	+0.0	-30.4	+4.7	+10.5	21.7	46.0	-24.3	Horiz
13	151.851M	24.8	+0.0 +11.8	+0.0	-30.6	+2.7	+10.5	19.2	43.5	-24.3	Vert

CKC Laboratories, Inc. Date: 3/14/2012 Time: 10:04:16 Ingersoll Rand WO#: 92311
15.209 Radiated Emissions Test Distance: 10 Meters Horiz Sequence#: 1 Ext ATTN: 0 dB



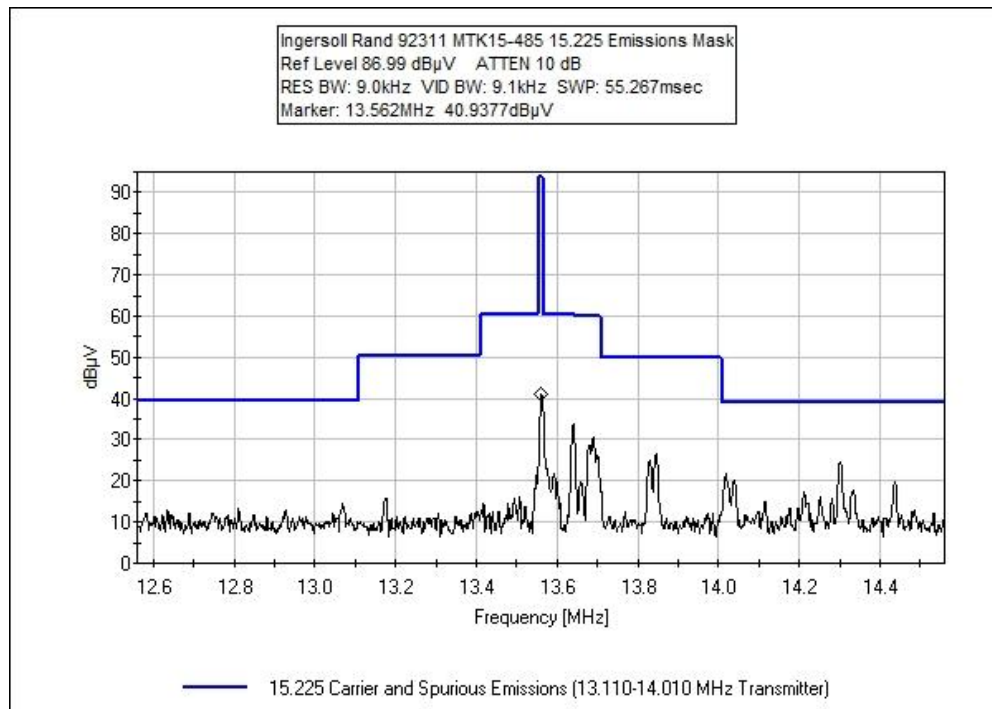
Test Setup Photos



15.225(a)(b)(c)(d) Carrier and Spurious Emissions

Carrier Radiated Emissions

Test Data



Test Location: CKC Laboratories, Inc. • 5046 Sierra Pines Dr. • Mariposa, CA 95338 • (209) 966-5240

Customer: **Ingersoll Rand**
 Specification: **15.225 Carrier and Spurious Emissions (13.110-14.010 MHz Transmitter)**
 Work Order #: **92311** Date: 3/19/2012
 Test Type: **Maximized Emissions** Time: 14:37:08
 Equipment: **MultiTech Reader** Sequence#: 1
 Manufacturer: Ingersoll Rand Tested By: Michael Rauch Jr.
 Model: MTK15-485
 S/N: E0001

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN01184	Spectrum Analyzer	8568B	5/4/2011	5/4/2013
	AN01183	Spectrum Analyzer Display	85662A	5/4/2011	5/4/2013
T1	AN00226	Loop Antenna	6502	7/8/2011	7/8/2013
T2	ANP01017	Cable		3/16/2012	3/16/2014

Equipment Under Test (* = EUT):

Function	Manufacturer	Model #	S/N
MultiTech Reader*	Ingersoll Rand	MTK15-485	E0001

Support Devices:

Function	Manufacturer	Model #	S/N
Dual Tracking DC Power Supply	Topwards Electronic instruments CO. LTD.	4303	918520

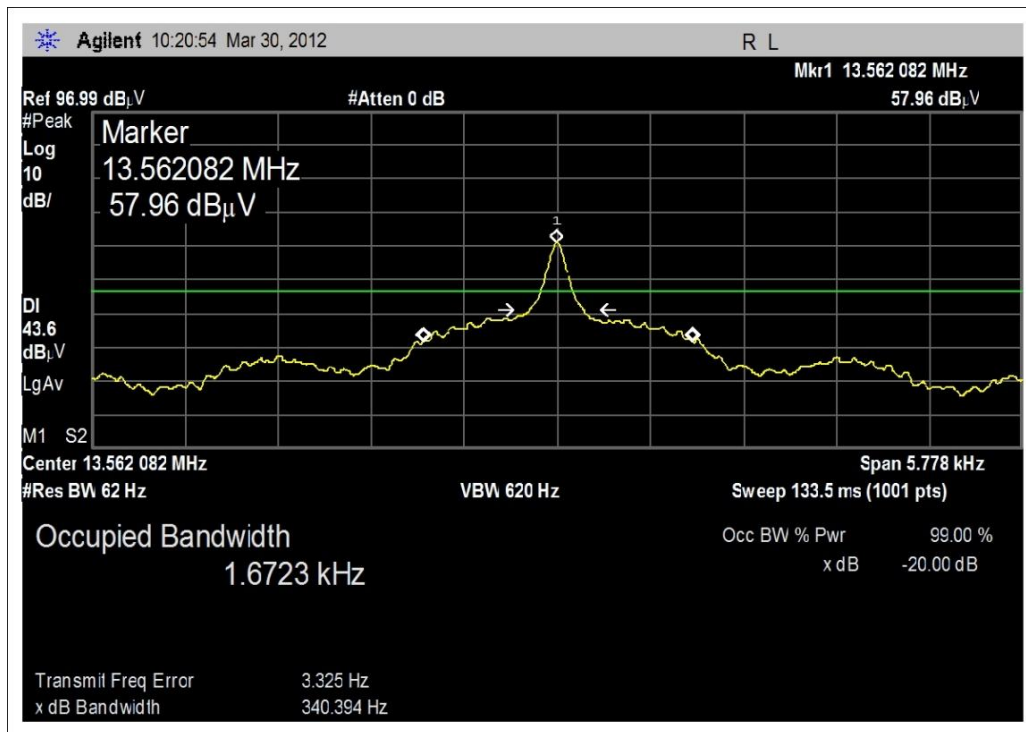
Test Conditions / Notes:

Carrier Radiated Emissions EUT set up a wooden table in the center of flush mounted turntable. EUT support equipment is located on top of the turntable. Frequencies investigated: 9kHz to 30MHz Clock Frequencies of interest are: 8MHz, 27.12MHz TX Freq: 125KHz, 13.56MHz RBW used in accordance with CISPR 16, VBW is greater than RBW 15.31(e) Voltage variations preformed in accordance with 15.31(e) no changes were observed to transmitter output. Temperature = 17°C Relative Humidity = 51% Pressure = 97.7 kPa

Ext Attn: 0 dB

Measurement Data: Reading listed by amplitude. Test Distance: 10 Meters

#	Freq MHz	Rdng dBμV	T1 dB	T2 dB	dB	dB	Dist Table	Corr dBμV/m	Spec dBμV/m	Margin dB	Polar Ant
1	13.562M	42.0	+10.2	-0.8			-19.1	32.3	84.0	-51.7	Horiz
2	13.562M	37.6	+10.2	-0.8			-19.1	27.9	84.0	-56.1	Vert



Spurious Radiated Emissions

Test Data

Test Location: CKC Laboratories, Inc. • 5046 Sierra Pines Dr. • Mariposa, CA 95338 • (209) 966-5240

Customer: **Ingersoll Rand**

Specification: **15.209 Radiated Emissions**

Work Order #: **92311**

Date: 3/28/2012

Test Type: **Maximized Emissions**

Time: 11:44:05

Equipment: **MultiTech Reader**

Sequence#: 1

Manufacturer: Ingersoll Rand

Tested By: Michael Rauch Jr.

Model: MTK15-485

S/N: E0001

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN01184	Spectrum Analyzer	8568B	5/4/2011	5/4/2013
	AN01183	Spectrum Analyzer Display	85662A	5/4/2011	5/4/2013
T1	AN00226	Loop Antenna	6502	7/8/2011	7/8/2013
	ANdBuA	Unit Conversion		1/30/2012	1/30/2014
T2	ANP01017	Cable		3/16/2012	3/16/2014

Equipment Under Test (* = EUT):

Function	Manufacturer	Model #	S/N
MultiTech Reader*	Ingersoll Rand	MTK15-485	E0001

Support Devices:

Function	Manufacturer	Model #	S/N
Dual Tracking DC Power Supply	Topwards Electronic instruments CO. LTD.	4303	918520

Test Conditions / Notes:

Spurious Radiated Emissions
EUT set up a wooden table in the center of flush mounted turntable.
EUT support equipment is located on top of the turntable.

Frequencies investigated: 9k to 30MHz
Clock Frequencies of interest are: 8MHz, 27.12MHz
TX Freq: 125KHz, 13.56MHz

RBW used in accordance with CISPR 16, VBW is greater than RBW
Temperature = 16°C
Relative Humidity = 51%
Pressure = 97.7 kPa

Ext Attn: 0 dB

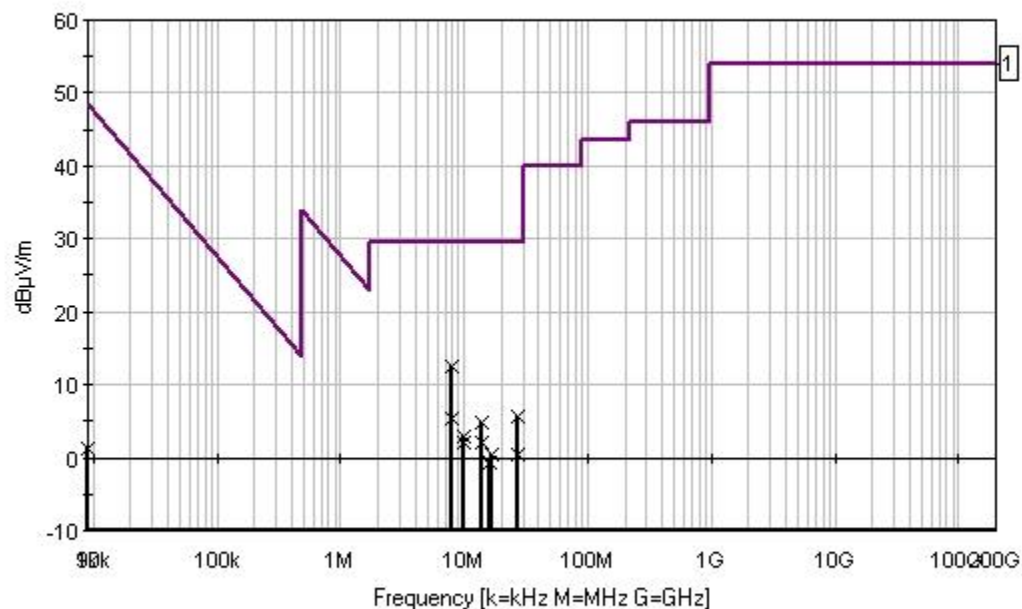
Measurement Data:

Reading listed by margin.

Test Distance: 10 Meters

#	Freq MHz	Rdng dB μ V	T1 dB	T2 dB			Dist Table	Corr dB μ V/m	Spec dB μ V/m	Margin dB	Polar Ant
1	7.998M	23.1	+9.2	-0.6			-19.1	12.6	29.5	-16.9	Vert
2	27.126M	19.9	+6.2	-1.2			-19.1	5.8	29.5	-23.7	Horiz
3	8.012M	15.8	+9.2	-0.6			-19.1	5.3	29.5	-24.2	Horiz
4	14.020M	14.2	+10.4	-0.8			-19.1	4.7	29.5	-24.8	Horiz
5	10.080M	13.7	+9.1	-0.7			-19.1	3.0	29.5	-26.5	Vert
6	9.938M	12.8	+9.1	-0.7			-19.1	2.1	29.5	-27.4	Horiz
7	14.101M	11.5	+10.4	-0.8			-19.1	2.0	29.5	-27.5	Vert
8	27.124M	14.6	+6.2	-1.2			-19.1	0.5	29.5	-29.0	Vert
9	16.854M	10.3	+10.0	-0.9			-19.1	0.3	29.5	-29.2	Horiz
10	16.049M	9.2	+10.2	-0.9			-19.1	-0.6	29.5	-30.1	Vert
11	9.000k	45.8	+14.6	-0.1			-59.1	1.2	48.5	-47.3	Horiz
12	9.000k	45.8	+14.6	-0.1			-59.1	1.2	48.5	-47.3	Vert

CKC Laboratories, Inc. Date: 3/28/2012 Time: 11:44:05 Ingersoll Rand WO#: 92311
 15.209 Radiated Emissions Test Distance: 10 Meters Horiz Sequence#: 1 Ext ATTN: 0 dB



— Readings — 1 - 15.209 Radiated Emissions × Peak Readings

Test Location: CKC Laboratories, Inc. • 22116 23rd Drive SE, Suite A • Bothell, WA 98021 • 425-402-1717

Customer: **Ingersoll Rand**
 Specification: **15.225 Carrier and Spurious Emissions (13.110-14.010 MHz Transmitter)**
 Work Order #: **92311** Date: 3/14/2012
 Test Type: **Maximized Emissions** Time: 10:04:16
 Equipment: **MultiTech Reader** Sequence#: 1
 Manufacturer: Ingersoll Rand Tested By: Michael Rauch Jr.
 Model: MTK15-485
 S/N: E0001

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN01183	Spectrum Analyzer Display	85662A	5/4/2011	5/4/2013
T2	AN01184	Spectrum Analyzer	8568B	5/4/2011	5/4/2013
T3	AN00062	Preamplifier	8447D	6/23/2010	6/23/2012
T4	ANMA10M	Cable		5/10/2011	5/10/2013
T5	AN00851	Biconilog Antenna	CBL6111C	3/14/2012	3/14/2014

Equipment Under Test (* = EUT):

Function	Manufacturer	Model #	S/N
MultiTech Reader*	Ingersoll Rand	MTK15-485	E0001

Support Devices:

Function	Manufacturer	Model #	S/N
Dual Tracking DC Power Supply	Topwards Electronic instruments CO. LTD.	4303	918520

Test Conditions / Notes:

Spurious Radiated Emissions
 EUT set up a wooden table in the center of flush mounted turntable.
 EUT support equipment is located on top of the turntable.
 Frequencies investigated: 30MHz to 1GHz
 Clock Frequencies of interest are: 8MHz, 27.12MHz
 TX Freq: 125KHz, 13.56MHz
 RBW used in accordance with CISPR 16, VBW is greater than RBW
 Temperature = 15°C
 Relative Humidity = 51%
 Pressure = 97.7 kPa

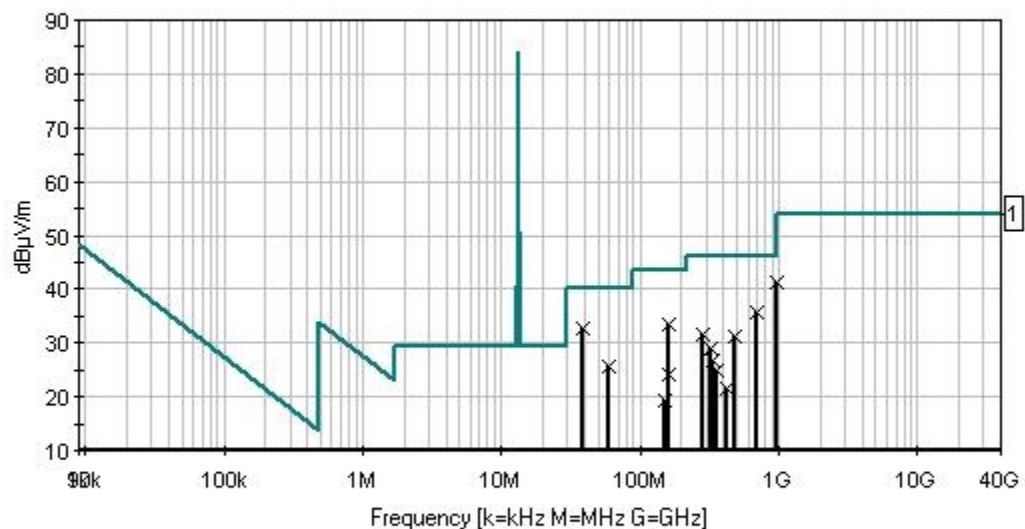
Ext Attn: 0 dB

Measurement Data: Reading listed by frequency. Test Distance: 10 Meters

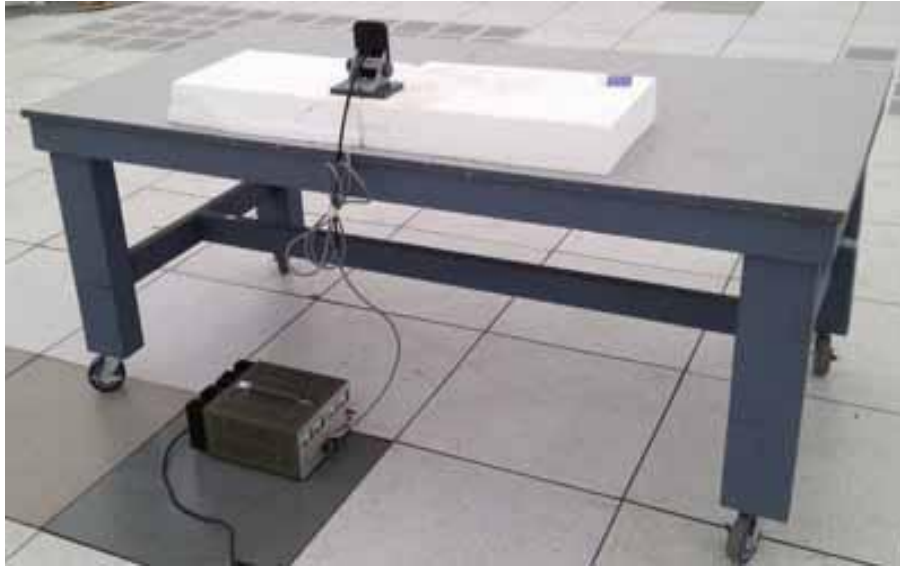
#	Freq	Rdng	T1	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dBμV	T5				Table	dBμV/m	dBμV/m	dB	Ant
1	39.252M	38.6	+0.0 +13.3	+0.0	-31.0	+1.3	+10.5	32.7	40.0	-7.3	Horiz
2	58.981M	35.0	+0.0 +9.3	+0.0	-30.9	+1.7	+10.5	25.6	40.0	-14.4	Vert
3	151.851M	24.8	+0.0 +11.8	+0.0	-30.6	+2.7	+10.5	19.2	43.5	-24.3	Vert
4	159.904M	29.7	+0.0 +11.6	+0.0	-30.5	+2.8	+10.5	24.1	43.5	-19.4	Horiz

5	162.794M	38.9	+0.0 +11.5	+0.0	-30.4	+2.8	+10.5	33.3	43.5 Bandwidth correction factor used	-10.2	Vert
6	284.760M	34.8	+0.0 +12.3	+0.0	-29.8	+3.9	+10.5	31.7	46.0	-14.3	Vert
7	325.440M	30.6	+0.0 +13.7	+0.0	-30.0	+4.2	+10.5	29.0	46.0	-17.0	Vert
8	339.000M	28.0	+0.0 +13.9	+0.0	-30.0	+4.3	+10.5	26.7	46.0	-19.3	Vert
9	352.560M	26.1	+0.0 +14.1	+0.0	-30.0	+4.3	+10.5	25.0	46.0	-21.0	Vert
10	419.287M	21.6	+0.0 +15.3	+0.0	-30.4	+4.7	+10.5	21.7	46.0	-24.3	Horiz
11	475.927M	29.5	+0.0 +16.5	+0.0	-30.5	+5.1	+10.5	31.1	46.0	-14.9	Horiz
12	702.892M	29.0	+0.0 +20.5	+0.0	-30.5	+6.3	+10.5	35.8	46.0	-10.2	Horiz
13	974.092M	29.9	+0.0 +22.7	+0.0	-29.4	+7.7	+10.5	41.4	54.0	-12.6	Horiz

CKC Laboratories, Inc. Date: 3/14/2012 Time: 10:04:16 Ingersoll Rand WO#: 92311
15.225 Carrier and Spurious Emissions (13.110-14.010 MHz Transmitter)
Test Distance: 10 Meters Horiz Sequence#: 1 Ext ATTN: 0 dB



Test Setup Photos



Frequency Stability

Test Set Up / Conditions

The Equipment is located in a temperature chamber. A loop antenna is set inside the chamber and connected to a spectrum analyzer. Voltage variations are performed using support power supply and monitored using a digital volt meter. Enclosure temperature is monitored using a digital thermometer with a sensor attached direction to the case of the EUT.

Engineer Name: M. Rauch Jr.

Test Equipment					
Asset/Serial #	Description	Model	Manufacturer	Cal Date	Cal Due
01879	Temperature Chamber	S-1.2 Min.	Thermotron	12/1/2010	12/1/2012
00170	Loop Antenna	7334-1	Solar	NCR	NCR
02660	Spectrum Analyzer	E4446A	Agilent	11/3/2011	11/3/2013
00483	Multimeter	75	Fluke	7/28/2010	7/28/2012
03197	Multimeter	MM570A	Extech	9/28/2010	9/28/2012

NCR= No Calibration Required.

Test Data

Date:		30-Mar-12	
Test Engineer:		Michael Rauch Jr.	
Test Specification		FCC 15.225	
Device Model #:		MTK15-485	
Operating Voltage:		12	VDC/VAC
Frequency Limit:		0.01	%
Temperature Variations			
		Freq (MHz)	Dev. (%)
Channel Frequency:		13.562	
Temp (C)	Voltage		
-30	12	NA	NA
-20	12	13.56210	0.00074
-10	12	13.56216	0.00118
0	12	13.56223	0.00172
10	12	13.56218	0.00129
20	12	13.56215	0.00111
30	12	13.56216	0.00119
40	12	13.56209	0.00067
50	12	13.56204	0.00029

Voltage Variations (±15%)

20	10.2	13.56215	0.00111
20	12	13.56215	0.00111
20	13.8	13.56215	0.00111

Max Deviation (%)	0.00172
	PASS

Test Setup Photos



RSS-210

99 % Bandwidth

Test Set Up / Conditions

EUT set up a wooden table in the center of flush mounted turntable. EUT support equipment is located on top of the turntable.

Frequencies investigated: 9kHz to 30MHz

Clock Frequencies of interest are: 8MHz, 27.12MHz

TX Freq: 125KHz, 13.56MHz

RBW used in accordance with CISPR 16, VBW is greater than RBW

Temperature = 17°C

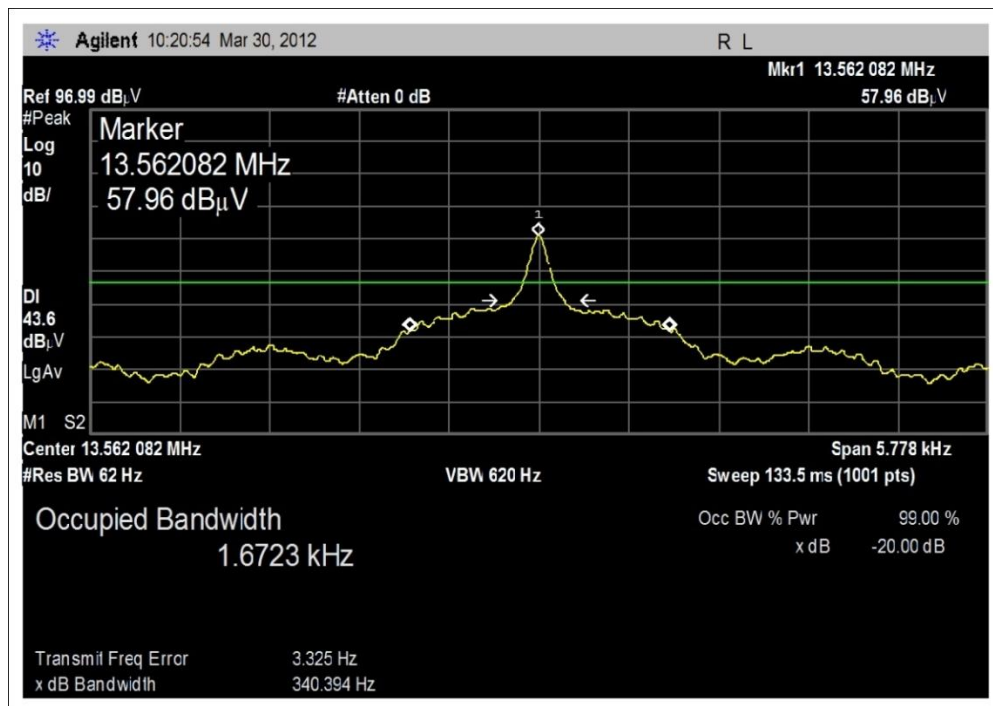
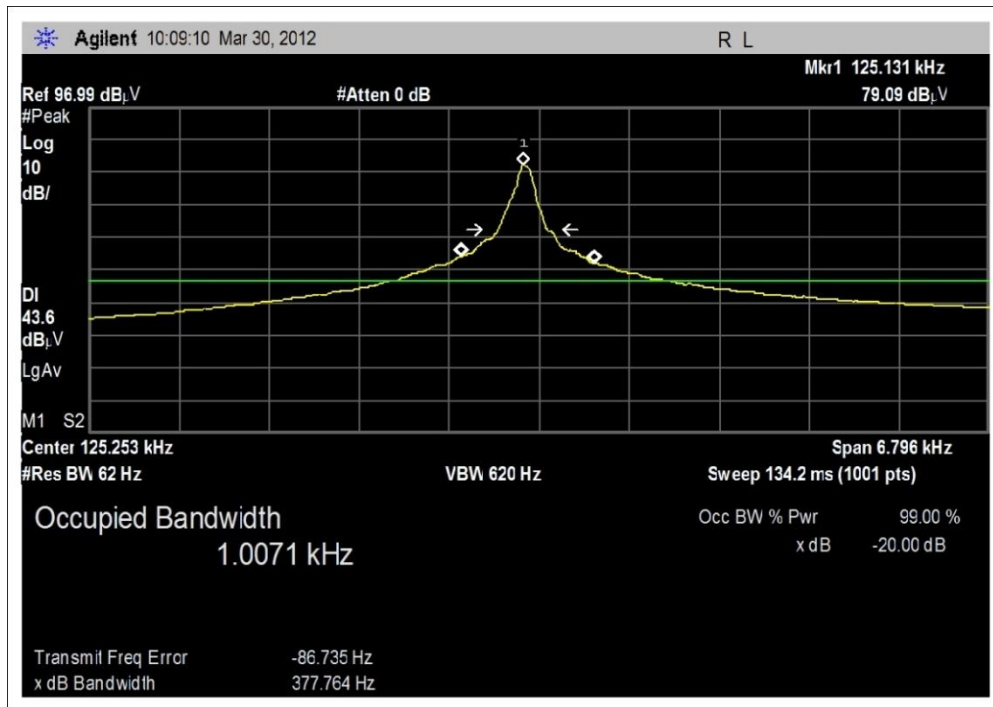
Relative Humidity = 51%

Pressure = 97.7 kPa

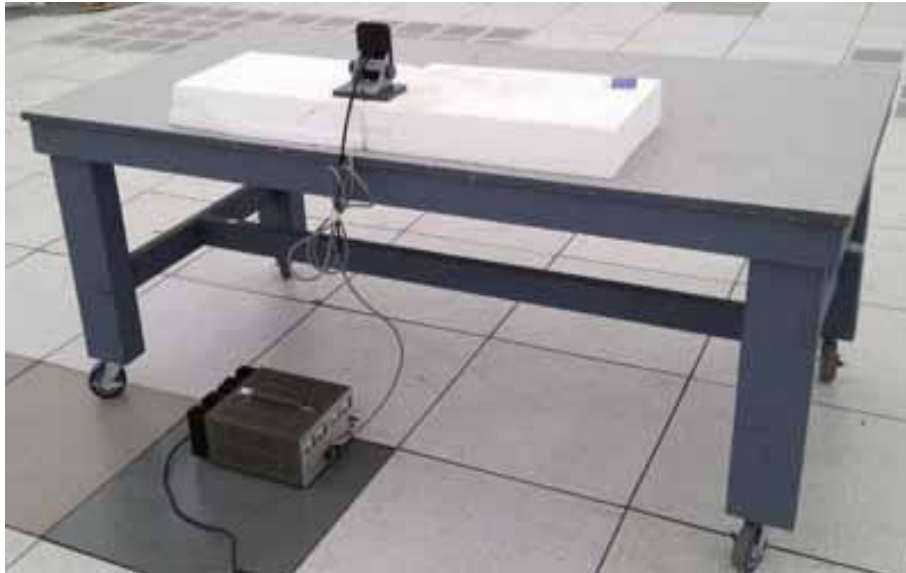
Engineer Name: M. Rauch Jr.

Test Equipment					
Asset/Serial #	Description	Model	Manufacturer	Cal Date	Cal Due
AN01184	Spectrum Analyzer	8568B	HP	5/4/2011	5/4/2013
AN01183	Spectrum Analyzer Display	85662A	HP	5/4/2011	5/4/2013
AN00226	Loop Antenna	6502	EMCO	7/8/2011	7/8/2013
ANP01017	Cable		Andrews	3/16/2012	3/16/2014
AN02660	Spectrum Analyzer	E4446A	Agilent	11/3/2011	11/3/2013
AN00062	Preamplifier	8447D	HP	6/23/2010	6/23/2012

Test Data



Test Setup Photos



SUPPLEMENTAL INFORMATION

Measurement Uncertainty

Uncertainty Value	Parameter
4.73 dB	Radiated Emissions
3.34 dB	Mains Conducted Emissions
3.30 dB	Disturbance Power

The reported measurement uncertainties are calculated based on the worst case of all laboratory environments from CKC Laboratories, Inc. test sites. Only those parameters which require estimation of measurement uncertainty are reported. The reported worst case measurement uncertainty is less than the maximum values derived in CISPR 16-4-2. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of $k=2$. Compliance is deemed to occur provided measurements are below the specified limits.

Emissions Test Details

TESTING PARAMETERS

Unless otherwise indicated, the following configuration parameters are used for equipment setup: The cables were routed consistent with the typical application by varying the configuration of the test sample. Interface cables were connected to the available ports of the test unit. The effect of varying the position of the cables was investigated to find the configuration that produced maximum emissions. Cables were of the type and length specified in the individual requirements. The length of cable that produced maximum emissions was selected.

The equipment under test (EUT) was set up in a manner that represented its normal use, as shown in the setup photographs. Any special conditions required for the EUT to operate normally are identified in the comments that accompany the emissions tables.

The emissions data was taken with a spectrum analyzer or receiver. Incorporating the applicable correction factors for distance, antenna, cable loss and amplifier gain, the data was reduced as shown in the table below. The corrected data was then compared to the applicable emission limits. Preliminary and final measurements were taken in order to ensure that all emissions from the EUT were found and maximized.

CORRECTION FACTORS

The basic spectrum analyzer reading was converted using correction factors as shown in the highest emissions readings in the tables. For radiated emissions in dB μ V/m, the spectrum analyzer reading in dB μ V was corrected by using the following formula. This reading was then compared to the applicable specification limit.

SAMPLE CALCULATIONS		
	Meter reading	(dBμV)
+	Antenna Factor	(dB)
+	Cable Loss	(dB)
-	Distance Correction	(dB)
-	Preamplifier Gain	(dB)
=	Corrected Reading	(dBμV/m)

TEST INSTRUMENTATION AND ANALYZER SETTINGS

The test instrumentation and equipment listed were used to collect the emissions data. A spectrum analyzer or receiver was used for all measurements. Unless otherwise specified, the following table shows the measuring equipment bandwidth settings that were used in designated frequency bands. For testing emissions, an appropriate reference level and a vertical scale size of 10 dB per division were used.

MEASURING EQUIPMENT BANDWIDTH SETTINGS PER FREQUENCY RANGE			
TEST	BEGINNING FREQUENCY	ENDING FREQUENCY	BANDWIDTH SETTING
CONDUCTED EMISSIONS	150 kHz	30 MHz	9 kHz
RADIATED EMISSIONS	30 MHz	1000 MHz	120 kHz
RADIATED EMISSIONS	1000 MHz	>1 GHz	1 MHz

SPECTRUM ANALYZER/RECEIVER DETECTOR FUNCTIONS

The notes that accompany the measurements contained in the emissions tables indicate the type of detector function used to obtain the given readings. Unless otherwise noted, all readings were made in the "positive peak" detector mode. Whenever a "quasi-peak" or "average" reading was recorded, the measurement was annotated with a "QP" or an "Ave" on the appropriate rows of the data sheets. In cases where quasi-peak or average limits were employed and data exists for multiple measurement types for the same frequency then the peak measurement was retained in the report for reference, however the numbering for the affected row was removed and an arrow or carrot ("^") was placed in the far left-hand column indicating that the row above takes precedence for comparison to the limit. The following paragraphs describe in more detail the detector functions and when they were used to obtain the emissions data.

Peak

In this mode, the spectrum analyzer or receiver recorded all emissions at their peak value as the frequency band selected was scanned. By combining this function with another feature called "peak hold," the measurement device had the ability to measure intermittent or low duty cycle transient emission peak levels. In this mode the measuring device made a slow scan across the frequency band selected and measured the peak emission value found at each frequency across the band.

Quasi-Peak

Quasi-peak measurements were taken using the quasi-peak detector when the true peak values exceeded or were within 2 dB of a quasi-peak specification limit. Additional QP measurements may have been taken at the discretion of the operator.

Average

Average measurements were taken using the average detector when the true peak values exceeded or were within 2 dB of an average specification limit. Additional average measurements may have been taken at the discretion of the operator. If the specification or test procedure requires trace averaging, then the averaging was performed using 100 samples or as required by the specification. All other average measurements are performed using video bandwidth averaging. To make these measurements, the test engineer reduces the video bandwidth on the measuring device until the modulation of the signal is filtered out. At this point the measuring device is set into the linear mode and the scan time is reduced.