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Test report

328936-2TRFWL

Date of issue: **May 25, 2017**

Applicant:

Omni-Pro Software

Product:

Meter and Control

Model:

C3I

FCC ID:

2ALU6-C3I173M

Specification:

FCC 47 CFR Part 90

PRIVATE LAND MOBILE RADIO SERVICES

www.nemko.com

Nemko Canada Inc., a testing laboratory, is accredited by the Standards Council of Canada. The tests included in this report are within the scope of this accreditation

FCC 47 CFR Part 90; Date: April 2015



Test location

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Site number	FCC test site registration number: 176392, IC: 2040A-4 (3 m semi anechoic chamber)

Tested by	Kevin Rose, Wireless/EMC Specialist
Reviewed by	Tom Tidwell, TCB reviewer
Date	July 18, 2017
Signature	

Limits of responsibility

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contained in this report are within Nemko Canada's ISO/IEC 17025 accreditation.

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Section 1. Report summary

1.1 Applicant and manufacturer

Company name	Omni-Pro Software
Address	23608 458th Ave
City	Madison
Province/State	SD
Postal/Zip code	57042
Country	USA

1.2 Test specifications

FCC 47 CFR Part 90

PRIVATE LAND MOBILE RADIO SERVICES

1.3 Statement of compliance

In the configuration tested, the EUT was found compliant.

Testing was completed against all relevant requirements of the test standard. Results obtained indicate that the product under test complies in full with the requirements tested. The test results relate only to the items tested.

See "Summary of test results" for full details.

1.4 Exclusions

None

1.5 Test report revision history

Revision #	Details of changes made to test report
TRF	Original report issued

Section 2. Summary of test results

2.1 FCC Part 90 test results

Part	Test description	Verdict
§90.205(d)	RF Output Power	Pass
§90.2109(d)	Conducted Spurious	Pass
§90.2109(d)	Radiated Spurious	Pass
§90.210(b)	Bandwidth limitations	Pass
§90.213(a)	Transmitter frequency stability	Pass
§90.214	Transient frequency behavior	Pass

Notes: None

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	May 1, 2017
Nemko sample ID number	1

3.2 EUT information

Product name	Wireless Gateway Transmitter
Model	C3I
Serial number	N/A

3.3 Technical information

Operating band	150-174 MHz
Modulation type/ Emission designator	FM
Power requirements	12 Vdc
Antenna information	External antenna is not provided. EUT used a 50 ohm termination for testing

3.4 Product description and theory of operation

The EUT is a wireless water meter.

3.5 EUT exercise details

The EUT was software controlled per each channel

3.6 EUT setup diagram

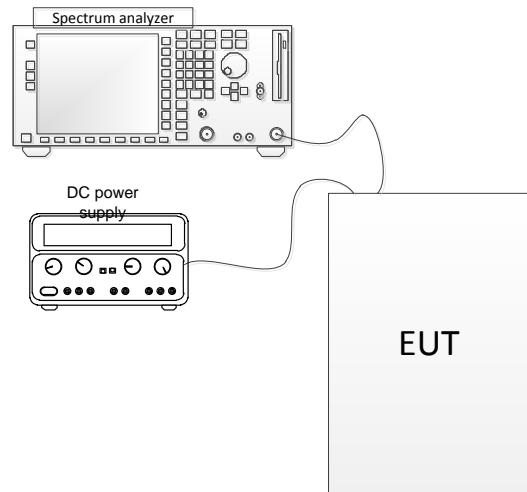


Figure 3.6-1: Setup diagram

Section 4. Engineering considerations

4.1 Modifications incorporated in the EUT

There were no modifications performed to the EUT during this assessment.

4.2 Technical judgment

None

4.3 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Section 5. Test conditions

5.1 Atmospheric conditions

Temperature	15–30 °C
Relative humidity	20–75 %
Air pressure	860–1060 mbar

When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests shall be recorded and stated.

5.2 Power supply range

The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages $\pm 5\%$, for which the equipment was designed.

Section 6. Measurement uncertainty

6.1 Uncertainty of measurement

Measurement uncertainty budgets for the tests are detailed below. Measurement uncertainty calculations assume a coverage factor of $K = 2$ with 95% certainty.

Test name	Measurement uncertainty, dB
All antenna port measurements	0.55
Conducted spurious emissions	1.13
Radiated spurious emissions	3.78
AC power line conducted emissions	3.55

Section 7. Test equipment

7.1 Test equipment list

Table 7.1-1: Equipment list

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
3 m EMI test chamber	TDK	SAC-3	FA002047	1 year	Dec. 01/17
Flush mount turntable	Sunol	FM2022	FA002082	—	NCR
Controller	Sunol	SC104V	FA002060	—	NCR
Antenna mast	Sunol	TLT2	FA002061	—	NCR
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 26	FA002043	1 year	Jan. 31/18
Bilog antenna (20–3000 MHz)	Sunol	JB3	FA002108	1 year	May. 28/17
Horn antenna (1–18 GHz)	EMCO	3115	FA000649	1 year	Sept. 15/17
Pre-amplifier (1–18 GHz)	JCA	JCA118-503	FA002091	1 year	May 2/18
50 Ω coax cable	Huber + Suhner	None	FA002074	1 year	May 12/18
50 Ω coax cable	Huber + Suhner	None	FA002830	1 year	May 12/18
Spectrum analyzer	Rohde & Schwarz	FSP	FA001920	1 year	Aug. 20/17

Note: NCR - no calibration required, VOU - verify on use

Section 8. Testing data

8.1 FCC §90.205(d) RF Output Power

8.1.1 Definitions and limits

90.205 (d) 150-174 MHz. (1) The maximum allowable station ERP is dependent upon the station's antenna HAAT and required service area and will be authorized in accordance with table 1. Applicants requesting an ERP in excess of that listed in table 1 must submit an engineering analysis based upon generally accepted engineering practices and standards that includes coverage contours to demonstrate that the requested station parameters will not produce coverage in excess of that which the applicant requires.

(2) Applications for stations where special circumstances exist that make it necessary to deviate from the ERP and antenna heights in Table 1 will be submitted to the frequency coordinator accompanied by a technical analysis, based upon generally accepted engineering practices and standards, that demonstrates that the requested station parameters will not produce a signal strength in excess of 37 dBu at any point along the edge of the requested service area. The coordinator may then recommend any ERP appropriate to meet this condition.

(3) An applicant for a station with a service area radius greater than 40 km (25 mi) must justify the requested service area radius, which will be authorized only in accordance with table 1, note 4. For base stations with service areas greater than 80 km, all operations 80 km or less from the base station will be on a primary basis and all operations outside of 80 km from the base station will be on a secondary basis and will be entitled to no protection from primary operations.

	Service area radius (km)									
	3	8	13	16	24	32	40	48 ⁴	64 ⁴	80 ⁴
Maximum ERP (w) ¹	1	28	178	2500	2500	2500	500	2500	2500	2500
Up to reference HAAT (m) ³	15	15	15	15	33	65	110	160	380	670

¹Maximum ERP indicated provides for a 37 dBu signal strength at the edge of the service area per FCC Report R-6602, Fig. 19 (See §73.699, Fig. 10).

²Maximum ERP of 500 watts allowed. Signal strength at the service area contour may be less than 37 dBu.

³When the actual antenna HAAT is greater than the reference HAAT, the allowable ERP will be reduced in accordance with the following equation: $ERP_{allow} = ERP_{max} \times (HAAT_{ref} / HAAT_{actual})^2$.

⁴Applications for this service area radius may be granted upon specific request with justification and must include a technical demonstration that the signal strength at the edge of the service area does not exceed 37 dBu.

8.1.2 Test summary

Test date	May 24, 2017	Temperature	24 °C
Test engineer	Kevin Rose	Air pressure	1002 mbar
Verdict	Pass	Relative humidity	34 %

8.1.3 Observations, settings and special notes

Worst case limit is used. Test receiver settings:

Detector mode	Peak
Resolution bandwidth	1 MHz
Integration bandwidth	>OBW
Video bandwidth	>RBW
Trace mode	Max Hold
Measurement time	Auto

8.1.4 Test data

Table 8.1-1: RF Output power results

Frequency, MHz	Conducted power output, dBm	Rated Power, dBm
173.2375	26.40	27
173.2625	26.37	27
173.3625	26.35	27

8.2 FCC §90.210(d) Conducted Spurious

8.2.1 Definitions and limits

90.210(d) Emission Mask D—12.5 kHz channel bandwidth equipment. For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

- (1) On any frequency from the center of the authorized bandwidth f_0 to 5.625 kHz removed from f_0 : Zero dB.
- (2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least $7.27(f_d - 2.88)$ dB.
- (3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5 kHz: At least $50 + 10 \log(P)$ dB or 70 dB, whichever is the lesser attenuation.
- (4) The reference level for showing compliance with the emission mask shall be established using a resolution bandwidth sufficiently wide (usually two or three times the channel bandwidth) to capture the true peak emission of the equipment under test. In order to show compliance with the emission mask up to and including 50 kHz removed from the edge of the authorized bandwidth, adjust the resolution bandwidth to 100 Hz with the measuring instrument in a peak hold mode. A sufficient number of sweeps must be measured to insure that the emission profile is developed. If video filtering is used, its bandwidth must not be less than the instrument resolution bandwidth. For emissions beyond 50 kHz from the edge of the authorized bandwidth, see paragraph (o) of this section. If it can be shown that use of the above instrumentation settings do not accurately represent the true interference potential of the equipment under test, an alternate procedure may be used provided prior Commission approval is obtained.
- (o) Instrumentation. The reference level for showing compliance with the emission mask shall be established, except as indicated in §§90.210 (d), (e), and (k), using standard engineering practices for the modulation characteristic used by the equipment under test. When measuring emissions in the 150-174 MHz and 421-512 MHz bands the following procedures will apply. A sufficient number of sweeps must be measured to insure that the emission profile is developed. If video filtering is used, its bandwidth must not be less than the instrument resolution bandwidth. For frequencies more than 50 kHz removed from the edge of the authorized bandwidth a resolution of at least 100 kHz must be used for frequencies below 1000 MHz. Above 1000 MHz the resolution bandwidth of the instrumentation must be at least 1 MHz. If it can be shown that use of the above instrumentation settings do not accurately represent the true interference potential of the equipment under test, then an alternate procedure may be used provided prior Commission approval is obtained.

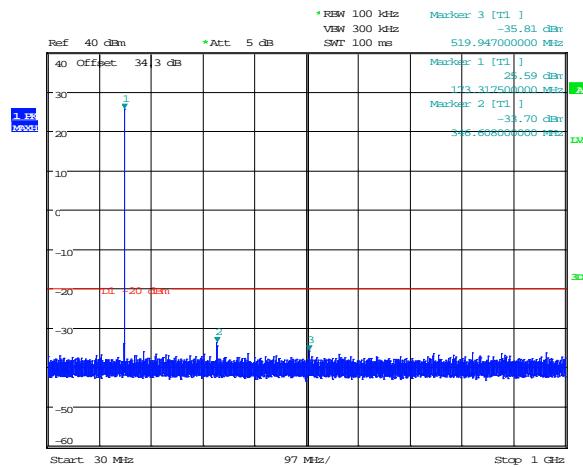
8.2.2 Test summary

Test date	May 25, 2017	Temperature	24 °C
Test engineer	Kevin Rose	Air pressure	1002 mbar
Verdict	Pass	Relative humidity	34 %

8.2.3 Observations, settings and special notes

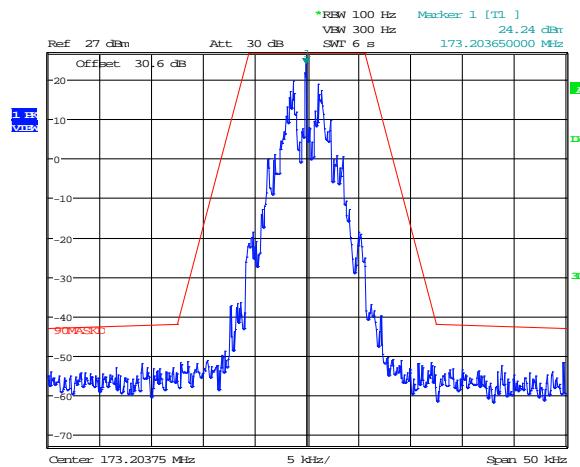
None

Frequency range	30 MHz to 10th harmonic
Detector mode	Peak
Resolution bandwidth sweep	100 kHz (below 1 GHz), 1000 kHz (above 1 GHz)
Resolution bandwidth band edge	> 1 % of OBW
Video bandwidth	>RBW
Trace mode	Max Hold
Measurement time	Auto



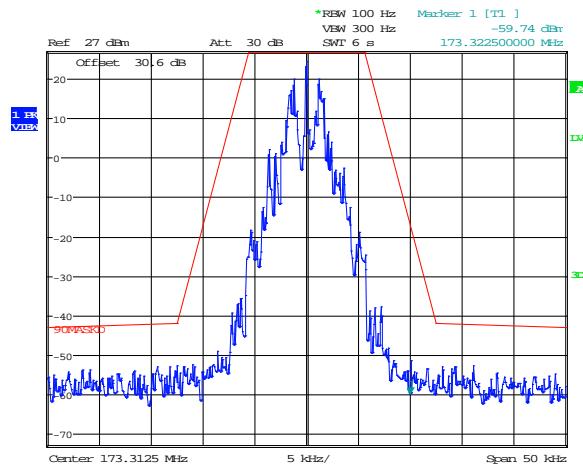
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Figure 8.2-1: 173.3125 MHz Spurious 30-1000 MHz



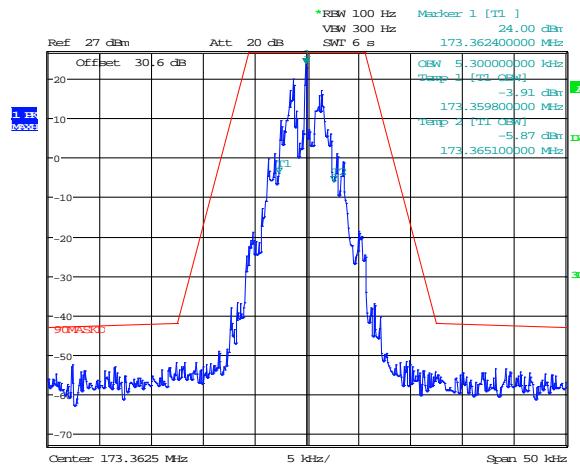
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Figure 8.2-2: 173.20375 MHz Mask D



Date: 18.APR.2017 18:33:38

Figure 8.2-3: 173.3125 MHz Mask D



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Figure 8.2-4: 173.3625 MHz Mask D

8.2.4 Test data continued

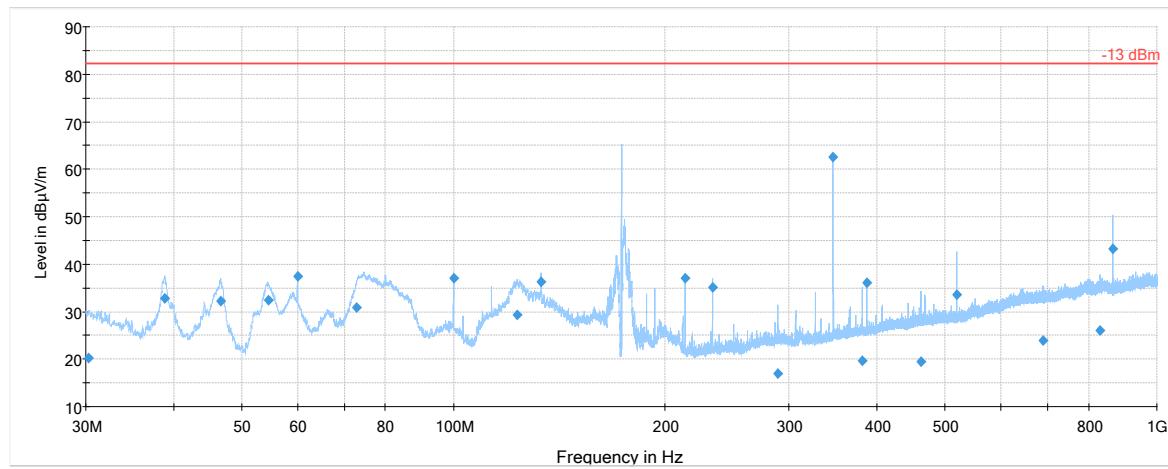


Figure 8.2-5: Spurious 30-1000 MHz

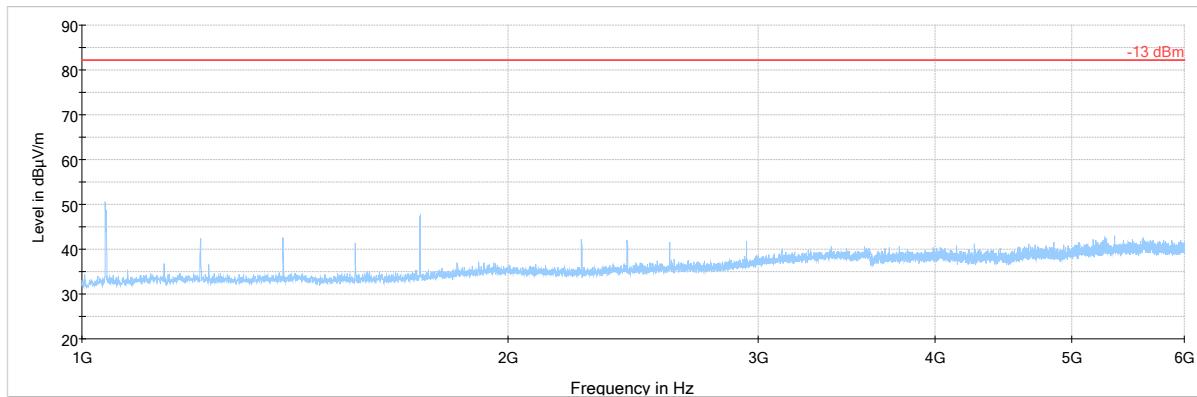


Figure 8.2-6: Spurious missions 1-6 GHz

8.3 FCC §90.210 (d)Radiated Spurious

8.3.1 Definitions and limits

§90.210 (d) Emission Mask D—12.5 kHz channel bandwidth equipment. For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

- (1) On any frequency from the center of the authorized bandwidth f_0 to 5.625 kHz removed from f_0 : Zero dB.
- (2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least $7.27(fd - 2.88 \text{ kHz})$ dB.
- (3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 12.5 kHz: At least $50 + 10 \log(P)$ dB or 70 dB, whichever is the lesser attenuation.
- (4) The reference level for showing compliance with the emission mask shall be established using a resolution bandwidth sufficiently wide (usually two or three times the channel bandwidth) to capture the true peak emission of the equipment under test. In order to show compliance with the emission mask up to and including 50 kHz removed from the edge of the authorized bandwidth, adjust the resolution bandwidth to 100 Hz with the measuring instrument in a peak hold mode. A sufficient number of sweeps must be measured to insure that the emission profile is developed. If video filtering is used, its bandwidth must not be less than the instrument resolution bandwidth. For emissions beyond 50 kHz from the edge of the authorized bandwidth, see paragraph (o) of this section. If it can be shown that use of the above instrumentation settings do not accurately represent the true interference potential of the equipment under test, an alternate procedure may be used provided prior Commission approval is obtained.

8.3.2 Test summary

Test date	December 8, 2016	Temperature	22 °C
Test engineer	Kevin Rose	Air pressure	1003 mbar
Verdict	Pass	Relative humidity	46 %

8.3.3 Observations, settings and special notes

Low, Mid, and High channels of all modulations were investigated. Worst case examples are provided.
No emissions were detected within 20 dB of the -20 dBm limit.

Receiver settings were:

Frequency range	30 MHz to 10 th harmonic
Detector mode	Peak
Resolution bandwidth	100 kHz (below 1 GHz), 1000 kHz (above 1 GHz)
Video bandwidth	>RBW
Trace mode	Max Hold

8.4 FCC §90.210(b) Bandwidth limitations

8.4.1 Definitions and limits

90.219(d) Emission Mask D—12.5 kHz channel bandwidth equipment. For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

- (1) On any frequency from the center of the authorized bandwidth f_0 to 5.625 kHz removed from f_0 : Zero dB.
- (2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least $7.27(f_d - 2.88)$ dB.
- (3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5 kHz: At least $50 + 10 \log(P)$ dB or 70 dB, whichever is the lesser attenuation.
- (4) The reference level for showing compliance with the emission mask shall be established using a resolution bandwidth sufficiently wide (usually two or three times the channel bandwidth) to capture the true peak emission of the equipment under test. In order to show compliance with the emission mask up to and including 50 kHz removed from the edge of the authorized bandwidth, adjust the resolution bandwidth to 100 Hz with the measuring instrument in a peak hold mode. A sufficient number of sweeps must be measured to insure that the emission profile is developed. If video filtering is used, its bandwidth must not be less than the instrument resolution bandwidth. For emissions beyond 50 kHz from the edge of the authorized bandwidth, see paragraph (o) of this section. If it can be shown that use of the above instrumentation settings do not accurately represent the true interference potential of the equipment under test, an alternate procedure may be used provided prior Commission approval is obtained. Except as indicated elsewhere in this part, transmitters used in the radio services governed by this part must comply with the emission masks outlined in this section. Unless otherwise stated, per paragraphs (d)(4), (e)(4), and (m) of this section, measurements of emission power can be expressed in either peak or average values provided that emission powers are expressed with the same parameters used to specify the unmodulated transmitter carrier power. For transmitters that do not produce a full power unmodulated carrier, reference to the unmodulated transmitter carrier power refers to the total power contained in the channel bandwidth. Unless indicated elsewhere in this part, the table in this section specifies the emission masks for equipment operating in the frequency bands governed under this part

Table 8.4-1: Emission mask requirements

Frequency band, (MHz)	Mask for equipment with Audio low pass filter	Mask for equipment without Audio low pass filter
Below 25	A or B	A or C
25–50	B	C
72–76	B	C
150–174	B, D, or E	C, D, or E
150 Paging only	B	C
220–222	F	F
421–512	B, D, or E	C, D, or E
450 Paging only	B	G
806–809/851–854	B	H
809–824/854–869	B	G
896–901/935–940	I	J
902–928	K	K
929–930	B	G
4940–4990	L or M	L or M
5850–5925		
All other bands	B	C

(k)(3) Other transmitters. For all other transmitters authorized under subpart M that operate in the 902–928 MHz band, the peak power of any emission shall be attenuated below the power of the highest emission contained within the licensee's sub-band in accordance with the following schedule:

- (i) On any frequency within the authorized bandwidth: Zero dB.
- (ii) On any frequency outside the licensee's sub-band edges: $55 + 10 \times \log_{10}(P)$ dB, where (P) is the highest emission (watts) of the transmitter inside the licensee's sub-band.
- (4) In the 902–928 MHz band, the resolution bandwidth of the instrumentation used to measure the emission power shall be 100 kHz, except that, in regard to paragraph (2) of this section, a minimum spectrum analyzer resolution bandwidth of 300 Hz shall be used for measurement center frequencies with 1 MHz of the edge of the authorized subband. The video filter bandwidth shall not be less than the resolution bandwidth.
- (5) Emission power shall be measured in peak values.
- (6) The LMS sub-band edges for non-multilateration systems for which emissions must be attenuated are 902.00, 904.00, 909.75 and 921.75 MHz.

Section 8
Test name
Specification

Testing data
FCC 90.210(d) Bandwidth limitations
FCC Part 90



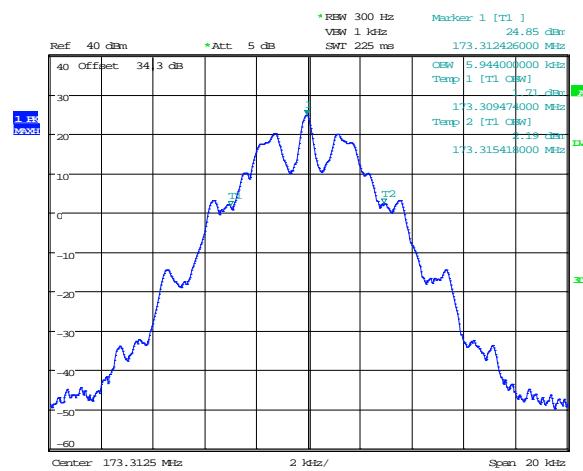
8.4.2 Test summary

Test date	May 18, 2017	Temperature	23 °C
Test engineer	Kevin Rose	Air pressure	1004 mbar
Verdict	Pass	Relative humidity	38 %

8.4.3 Observations, settings and special notes

Spectrum analyzer settings:

Detector mode	Peak
Resolution bandwidth	≥1 % of OBW
Video bandwidth	≥ RBW
Trace mode	Max Hold



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Figure 8.4-1: 173.3125 OBW

8.5 FCC §90.213(a) Transmitter frequency stability

8.5.1 Definitions and limits

FCC:

(a) Unless noted elsewhere, transmitters used in the services governed by this part must have a minimum frequency stability as specified in the following table:

Table 8.5-1: Minimum frequency stability

Frequency range (MHz)	Fixed and base stations (\pm ppm)	Mobile stations (\pm ppm)	
		Over 2 watts output power	2 watts or less output power
Below 25	100	100	200
25–50	20	20	50
72–76	5		50
150–174	5	5	50
216–220	1.0		1.0
220–222	0.1	1.5	1.5
421–512	2.5	5	5
806–809	1.0	1.5	1.5
809–824	1.5	2.5	2.5
851–854	1.0	1.5	1.5
854–869	1.5	2.5	2.5
896–901	0.1	1.5	1.5
902–928	2.5	2.5	2.5
902–928	2.5	2.5	2.5
929–930	1.5		
935–940	0.1	1.5	1.5
1427–1435	300	300	300
Above 2450			

8.5.2 Test summary

Test date	May 3, 2017	Temperature	22 °C
Test engineer	Kevin Rose	Air pressure	1003 mbar
Verdict	Pass	Relative humidity	46 %

8.5.3 Observations, settings and special notes

Assessed to remain within assigned band. Spectrum analyzer settings:

Resolution bandwidth:	20 kHz
Video bandwidth:	50 kHz
Frequency span:	2 MHz
Detector mode:	Peak
Trace mode:	Max Hold

8.5.4 Test data

Table 8.5-2: Frequency drift measurement

Test conditions	Frequency, GHz	Drift, Hz	Drift, ppm	Limit, \pm ppm	Margin, ppm
+50 °C, Nominal	173.312357	104.0	-0.60	5	4.40
+40 °C, Nominal	173.312422	39.0	-0.23	5	4.77
+30 °C, Nominal	173.312448	13.0	-0.08	5	4.92
+20 °C, +15 %	173.312461	0.0	0.00	5	5.00
+20 °C, Nominal	173.312461	Reference	Reference	Reference	Reference
+20 °C, -15 %	173.312463	-2.0	0.01	5	4.99
+10 °C, Nominal	173.312244	217.0	-1.25	5	3.75
0 °C, Nominal	173.312412	49.0	-0.28	5	4.72
-10 °C, Nominal	173.312422	39.0	-0.23	5	4.77
-20 °C, Nominal	173.312402	59.0	-0.34	5	4.66
-30 °C, Nominal	173.312472	-11.0	0.06	5	4.94

Note: Offset calculation
$$\frac{F_{Measured} - F_{reference}}{F_{reference}} \times 1 \cdot 10^6$$

8.6 FCC §90.214 Transient frequency behavior.

8.6.1 Definitions and limits

Transmitters designed to operate in the 150-174 MHz and 421-512 MHz frequency bands must maintain transient frequencies within the maximum frequency difference limits during the time intervals indicated:

Time intervals ^{1,2}	Maximum frequency difference ³	All equipment	
		150 to 174 MHz	421 to 512 MHz
Transient Frequency Behavior for Equipment Designed to Operate on 25 kHz Channels			
t_1 ⁴	±25.0 kHz	5.0 ms	10.0 ms
t_2	±12.5 kHz	20.0 ms	25.0 ms
t_3 ⁴	±25.0 kHz	5.0 ms	10.0 ms
Transient Frequency Behavior for Equipment Designed to Operate on 12.5 kHz Channels			
t_1 ⁴	±12.5 kHz	5.0 ms	10.0 ms
t_2	±6.25 kHz	20.0 ms	25.0 ms
t_3 ⁴	±12.5 kHz	5.0 ms	10.0 ms
Transient Frequency Behavior for Equipment Designed to Operate on 6.25 kHz Channels			
t_1 ⁴	±6.25 kHz	5.0 ms	10.0 ms
t_2	±3.125 kHz	20.0 ms	25.0 ms
t_3 ⁴	±6.25 kHz	5.0 ms	10.0 ms

¹ t_{on} is the instant when a 1 kHz test signal is completely suppressed, including any capture time due to phasing.

² t_1 is the time period immediately following t_{on} .

³ t_2 is the time period immediately following t_1 .

⁴ t_3 is the time period from the instant when the transmitter is turned off until t_{off} .

⁵ t_{off} is the instant when the 1 kHz test signal starts to rise.

² During the time from the end of t_2 to the beginning of t_3 , the frequency difference must not exceed the limits specified in §90.213.

³ Difference between the actual transmitter frequency and the assigned transmitter frequency.

⁴ If the transmitter carrier output power rating is 6 watts or less, the frequency difference during this time period may exceed the maximum frequency difference for this time period.

8.6.2 Test summary

Test date	May 3, 2017	Temperature	22 °C
Test engineer	Kevin Rose	Air pressure	1003 mbar
Verdict	Pass	Relative humidity	46 %

8.6.3 Observations, settings and special notes

None

Detector mode	Peak
Resolution bandwidth	100 kHz
Video bandwidth	RBW \times 3
Trace mode	Max Hold

8.6.4 Test data

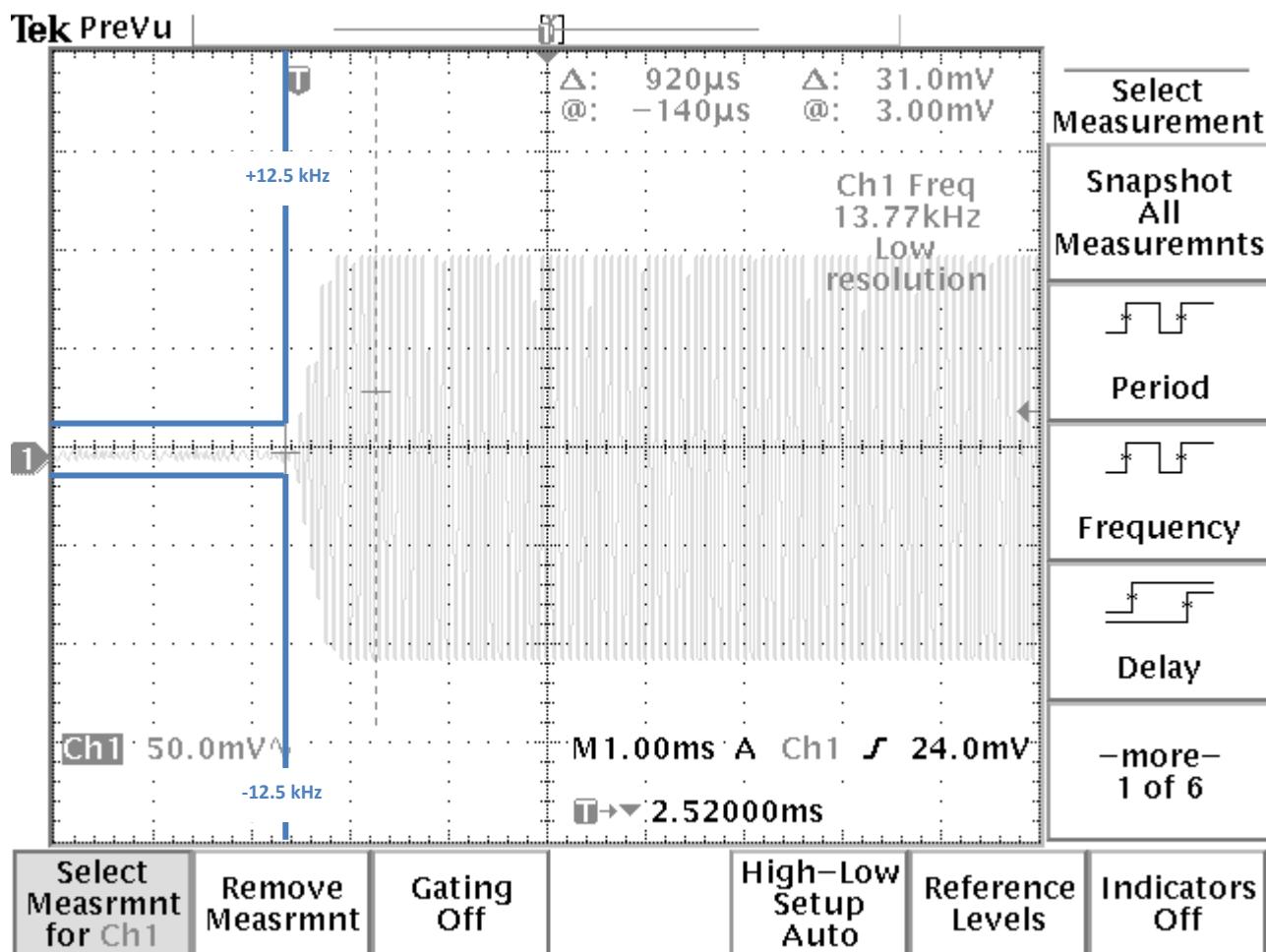


Figure 8.6-1: TX on

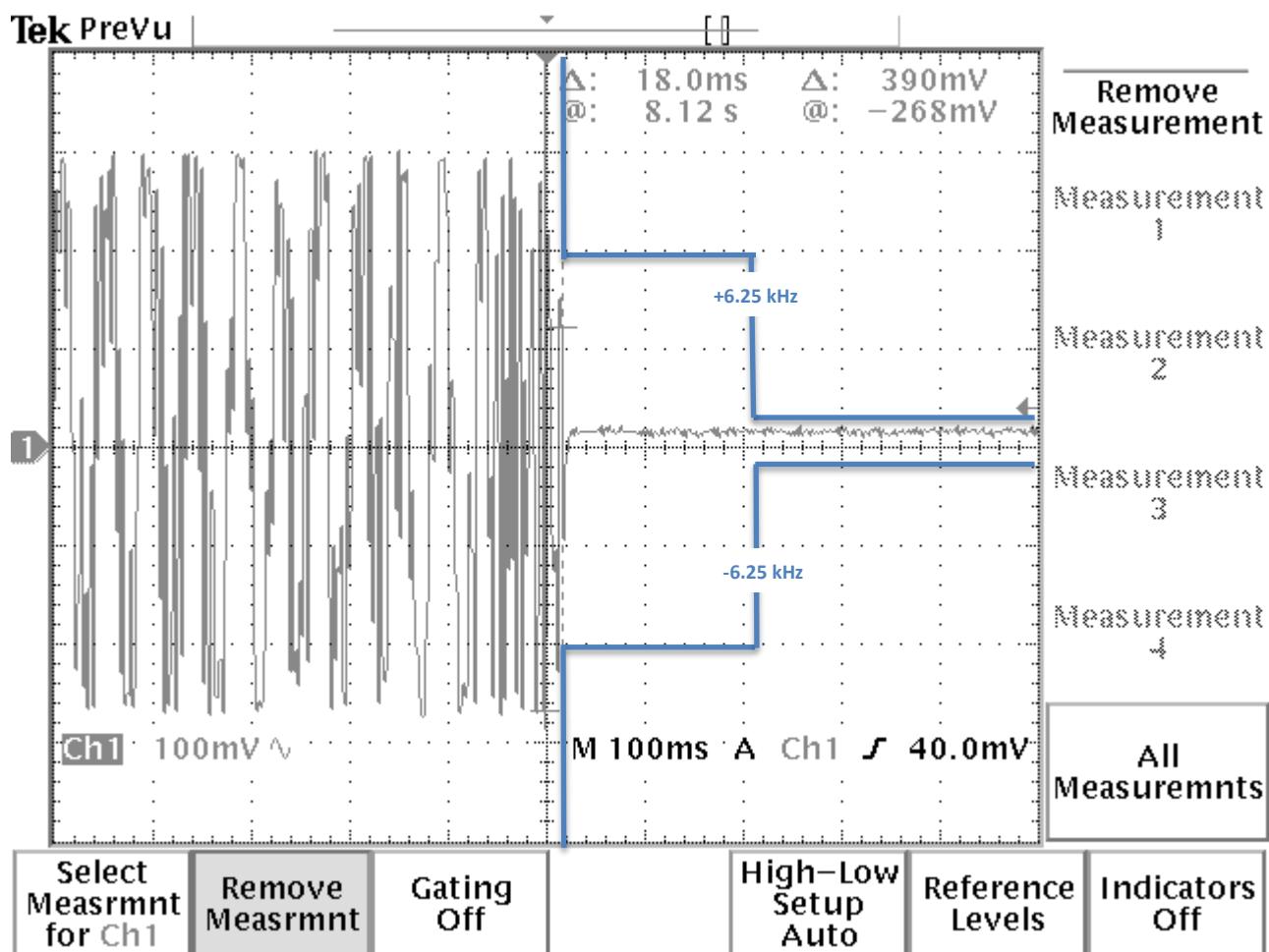


Figure 8.6-2: TX off

Section 9. Setup Photos

9.1 Set-up

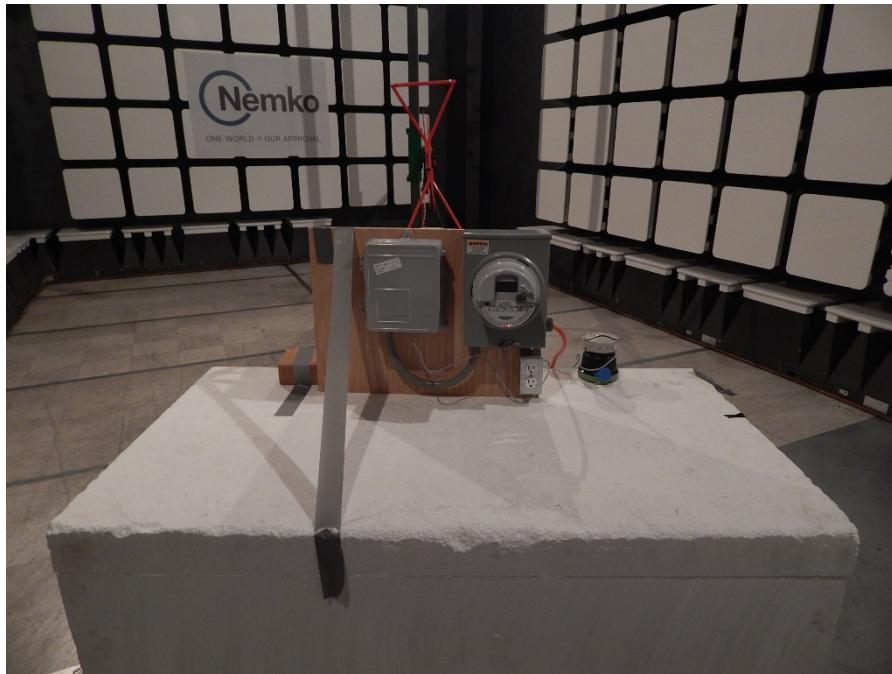


Figure 9.1-1: Radiated setup photo

Section 10. Block diagrams of test set-ups

10.1 Radiated emissions set-up

