Measurement of RF Interference from an TL9X Wireless Tank Monitor Transceiver

For	Telular 200 W. Wacker Drive, Suite 1800 Chicago, IL 60606
P.O. Number	TL1511
Date Tested	May 19, 2015 through May 22, 2015
Test Personnel	Mark Longinotti
Specification	FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Sections 15.207 and 15.247 for Digital Modulation Intentional Radiators Operating within the bands 902-928MHz, FCC “Code of Federal Regulations” Title 47, Part15, Subpart 15B, Section 15.107 and 15.109 for Receivers Industry Canada RSS-210 Industry Canada RSS-GEN

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REVISION HISTORY

Revision	Date	Description
—	06/12/2015	Initial release

Measurement of RF Emissions from a Wireless Tank Monitor, Part No. TL9X

1 INTRODUCTION

1.1 Scope of Tests

This document represents the results of the series of radio interference measurements performed on a Telular Wireless Tank Monitor, Part No. TL9X, Serial No. RA10, transceiver (hereinafter referred to as the EUT). The EUT is a digital modulation transceiver. The transceiver was designed to transmit and receive in the 902-928 MHz band using an internal, non-removable antenna. The EUT was manufactured and submitted for testing by Telular located in Chicago, IL.

1.2 Purpose

The test series was performed to determine if the EUT meets the conducted and radiated RF emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart B, Sections 15.107 and 15.109, for receivers and Subpart C, Sections 15.207 and 15.249 for Intentional Radiators Operating within the 902-928 MHz band. Testing was performed in accordance with ANSI C63.4-2009.

The test series was also performed to determine if the EUT meets the conducted and radiated RF emission requirements of the Industry Canada Radio Standards Specification, RSS-Gen, Section 8.8 and Section 7.1.2 for receivers and the Industry Canada Radio Standards Specification RSS-Gen Section 8.8 and RSS-210 Annex 8, for transmitters. Testing was performed in accordance with ANSI C63.4-2014.

1.3 Deviations, Additions and Exclusions

There were no deviations, additions to, or exclusions from the test specification during this test series

1.4 EMC Laboratory Identification

This series of tests was performed by Elite Electronic Engineering Incorporated of Downers Grove, Illinois. The laboratory is accredited by the National Institute of Standards and Technology (NIST) under the National Voluntary Laboratory Accreditation Program (NVLAP). NVLAP Lab Code: 100278-0.

1.5 Laboratory Conditions

The temperature at the time of the test was 22°C and the relative humidity was 35%.

2 APPLICABLE DOCUMENTS

The following documents of the exact issue designated form part of this document to the extent specified herein:

- Federal Communications Commission "Code of Federal Regulations", Title 47, Part 15, Subparts B and C, dated 1 October 2014

- ANSI C63.4-2009, "American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz"

- ANSI C63.4-2014, "American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz"

- Federal Communications Commission Office of Engineering and Technology Laboratory Division Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under Section 15.247, June 5, 2014

- Industry Canada RSS-210, Issue 8, December 2010, “Spectrum Management and Telecommunications Radio Standards Specification, Low-power License-exempt radio communication devices (All Frequency Bands): Category I Equipment”

- Industry Canada RSS-GEN, Issue 4, November 2014, “Spectrum Management and Telecommunications Radio Standards Specification, General Requirements and Information for the Certification of radio communication equipment”

3 EUT SETUP AND OPERATION

3.1 General Description

The EUT is a Wireless Tank Monitor, Part No. TL9X. A block diagram of the EUT setup is shown as Figure 1.

3.1.1 Power Input

The EUT was powdered by 6VDC from internal, non-rechargeable, Lithium ion batteries.

3.1.2 Peripheral Equipment

The EUT was submitted for testing with no peripheral equipment.

3.1.3 Interconnect Cables

The EUT was submitted for testing with no interconnect cables.

3.1.4 Grounding

The EUT was ungrounded during the tests.

3.2 Software

For all tests the EUT had Firmware Version 2.0 loaded onto the device to provide correct load characteristics.

3.3 Operational Mode

For all tests the EUT was placed on an 80cm high non-conductive stand. The EUT was energized. The unit was programmed to operate in one of the following modes:

- Transmit at 905MHz
- Transmit at 915MHHz
- Transmit at 925MHHz
- Receive at 905MHz
- Receive at 915MHHz
- Receive at 925MHHz

3.4 EUT Modifications

The following modifications were performed to the EUT:

- A shield was placed over the WLAN portion of the circuit board.
- 2.5 VDC was applied to the WLAN and microprocessor.

4 TEST FACILITY AND TEST INSTRUMENTATION

4.1 Shielded Enclosure

All tests were performed in a 32ft. x 20ft. x 18ft. hybrid ferrite-tile/anechoic absorber lined test chamber. With the exception of the floor, the reflective surfaces of the shielded chamber are lined with ferrite tiles on the walls and ceiling. Anechoic absorber material is installed over the ferrite tile. The floor of the chamber is used as the ground plane. The chamber complies with ANSI C63.4 for site attenuation.

4.2 Test Instrumentation

The test instrumentation and auxiliary equipment used during the tests are listed in Table 9-1.

This receiver allows measurements with the bandwidths specified by the FCC and with the quasi-peak and average detector functions.

4.3 Calibration Traceability

Test equipment is maintained and calibrated on a regular basis. All calibrations are traceable to the National Institute of Standards and Technology (NIST).

4.4 Measurement Uncertainty

All measurements are an estimate of their true value. The measurement uncertainty characterizes, with a specified confidence level, the spread of values which may be possible for a given measurement system.

The measurement uncertainty for these tests is presented below:

Conducted Emission Measurements		
Combined Standard Uncertainty	1.07	-1.07
Expanded Uncertainty (95% confidence)	2.1	-2.1

Radiated Emission Measurements		
Combined Standard Uncertainty	2.26	-2.18
Expanded Uncertainty (95% confidence)	4.5	-4.4

5 TEST PROCEDURES

5.1 Receiver

5.1.1 Powerline Conducted Emissions

5.1.1.1 Requirements

Since the EUT was powered by internal batteries and has no connections for AC power, no conducted emissions tests are required.

5.1.2 Radiated Measurements

5.1.2.1 Requirements

Per the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart B, Section 15.109(a) and Industry Canada RSS-Gen, Section 7.1.2, all radio frequency emissions from a receiver shall be below the limits shown on the following table:

RADIATION LIMITS FOR A RECEIVER

Frequency MHz	Distance between EUT And Antenna in Meters	Field Strength uV/m	Field Strength dBuV/m
30-88	3	100	40
88-216	3	150	43.5
216-960	3	200	46

Above 960	3	500	54

Note: The tighter limit shall apply at the edge between the two frequency bands.

5.1.2.2 Procedures

All tests were performed in a 32ft. x 20ft. x 18ft. hybrid ferrite-tile/anechoic absorber lined test chamber. The walls and ceiling of the shielded chamber are lined with ferrite tiles. Anechoic absorber material is installed over the ferrite tile. The floor of the chamber is used as the ground plane. The chamber complies with ANSI C63.4 for site attenuation.

The shielded enclosure prevents emissions from other sources, such as radio and TV stations from interfering with the measurements. All powerlines and signal lines entering the enclosure pass through filters on the enclosure wall. The powerline filters prevent extraneous signals from entering the enclosure on these leads.

Since a quasi-peak detector and an average detector require a long integration times, it is not practical to automatically sweep through the quasi-peak and average levels. Therefore, radiated emissions from the EUT were first scanned using a peak detector and automatically plotted. The frequencies where significant emission levels were noted were then remeasured using the quasi-peak detector or average detector.

The broadband measuring antenna was positioned at a 3 meter distance from the EUT. The frequency range from 30MHz to 1GHz was investigated using a peak detector function with the bilog antenna at several heights, horizontal and vertical polarization, and with several different orientations of the EUT with respect to the antenna. The frequency range from 1GHz to 10GHz was investigated using a peak detector function with the double ridged waveguide antenna at several heights, horizontal and vertical polarization, and with several different orientations of the EUT with respect to the antenna. The maximum levels for each antenna polarization were plotted. The resultant field strength (FS) is a summation in decibels (dB) of the receiver meter reading (MTR), the antenna correction factor (AF), and the cable loss factor (CF). If an external pre-amplifier is used, the total is reduced by its gain (-PA). If a distance correction (DC) is required, it is added to the total.

Formula 1: FS (dBuV/m) = MTR (dBuV) + AF (dB/m) + CF (dB) + (- PA (dB)) + DC (dB)

To convert the Field Strength dBuV/m term to uV/m, the dBuV/m is first divided by 20. The Base 10 AntiLog is taken of this quotient. The result is the Field Strength value in uV/m terms.

Formula 2: FS (uV/m) = AntiLog [(FS (dBuV/m))/20]

Final radiated emissions were performed on all significant broadband and narrowband emissions found in the preliminary sweeps using the following methods:

1) Measurements from 30MHz to 1GHz were made using a quasi-peak detector and a broadband bilog antenna. Measurements above 1GHz were made using an average detector and a broadband double ridged waveguide antenna.

2) To ensure that maximum or worst case, emission levels were measured, the following steps were taken:

   a) The EUT was rotated so that all of its sides were exposed to the receiving antenna.

   b) Since the measuring antenna is linearly polarized, both horizontal and vertical field components were measured.

   c) The measuring antenna was raised and lowered from 1 to 4 meters for each antenna polarization to maximize the readings.

5.1.2.3 Results

The preliminary plots with the EUT operating in the Receive at 905MHz mode are presented on pages 21 through

24. The plots are presented for a reference only, and are not used to determine compliance. The final radiated levels with the EUT operating in the Receive at 905MHz mode are presented on pages 25 and 26. As can be seen from the data, all emissions measured from the EUT were within the specification limits.

The preliminary plots with the EUT operating in the Receive at 915MHz mode are presented on pages 27 through 30. The plots are presented for a reference only, and are not used to determine compliance. The final radiated levels with the EUT operating in the Receive at 915MHz mode are presented on pages 31 and 32. As can be seen from the data, all emissions measured from the EUT were within the specification limits.

The preliminary plots with the EUT operating in the Receive at 925MHz mode are presented on pages 33 through 36. The plots are presented for a reference only, and are not used to determine compliance. The final radiated levels with the EUT operating in the Receive at 925MHz mode are presented on pages 37 and 38. As can be seen from the data, all emissions measured from the EUT were within the specification limits.

Photographs of the test configuration which yielded the highest or worst case, radiated emission levels are shown on Figure 3 and Figure 4.

5.2 Transmitter

5.2.1 Powerline Conducted Emissions

5.2.1.1 Requirements

Since the EUT was powered by internal batteries and has no connections for AC power, no conducted emissions tests are required.

5.2.2 6dB Bandwidth

5.2.2.1 Requirements

Per 15.247(a)(2),the minimum 6dB bandwidth shall be at least 500kHz for all systems using digital modulation techniques.

The EUT was setup inside the chamber. The EUT was allowed to transmit continuously. The transmit channel was set separately to low, middle, and high channels. The resolution bandwidth (RBW) was set to 100kHz and the span was set to greater than the RBW.

The 'Max-Hold' function was engaged. The analyzer was allowed to scan until the envelope of the transmitter bandwidth was defined. The analyzer's display was plotted using a 'screen dump' utility.

5.2.2.2 Results

The plots on pages 39 through 41 show that the minimum 6 dB bandwidth was 623.7kHz which is greater than minimum allowable 6dB bandwidth requirement of 500kHz for systems using digital modulation techniques. The 99% bandwidth was measured to be 797.84kHz.

5.2.3 Peak Output Power

5.2.3.1 Requirements

Per section 15.247(b)(3), for systems using digital modulation the maximum peak output conducted power shall not be greater than 1.0W (30dBm). Per section 15.247(b)(4), this limit is based on the use of antennas with directional gains that do not exceed 6dBi. Since the limit allows for a 6dBi antenna gain, the maximum EIRP can be increased by 6dB to 4 Watt (36dBm).
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5.2.3.2 Procedures

The EUT was placed on the non-conductive stand and set to transmit. A double ridged waveguide antenna was

placed at a test distance of 3 meters from the EUT. The resolution bandwidth (RBW) of the spectrum analyzer was set to greater than the 6dB bandwidth. The EUT was maximized for worst case emissions (or maximum output power) at the measuring antenna. The maximum meter reading was recorded. The peak power output was measured for the low, middle and high channels.

The equivalent power was determined from the field intensity levels measured at 3 meters using the substitution method. To determine the emission power, a second double ridged waveguide antenna was then set in place of the EUT and connected to a calibrated signal generator. The output of the signal generator was adjusted to match the received level at the spectrum analyzer. The signal level was recorded. The reading was then corrected to compensate for cable loss and antenna gain, as required. The peak power output was calculated for low, middle, and high hopping frequencies.

5.2.3.3 Results

The results are presented on pages 42 through 44. The maximum EIRP measured from the transmitter was 5.8 dBm or 3.8 mW which is below the 4 Watt limit.

5.2.4 Duty Cycle Factor Measurements

5.2.4.1 Requirements

Unless otherwise specified, when the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value. The exact method of calculating the average field strength shall be submitted with any application for certification or shall be retained in the measurement data file for equipment subject to notification or verification.

5.2.4.2 Procedures

a. The EUT was placed on the non-conductive stand and set to transmit continuously.
b. A bilog antenna was positioned at a 3 meter distance from the EUT. The output of the antenna was connected to the input of a spectrum analyzer.
c. The center frequency of the spectrum analyzer was set to the transmit frequency of the EUT.
d. The frequency span of the spectrum analyzer was set to 0Hz so that the time domain trace of the transmitted pulse of the EUT was displayed on the spectrum analyzer.
e. The sweep time of the spectrum analyzer was adjusted so that the beginning and end of a single pulse could be seen on the display of the spectrum analyzer.
f. The single sweep function of the spectrum analyzer was used multiple times to determine the maximum pulse width of the EUT.
g. The maximum pulse width display of the spectrum analyzer was recorded and then plotted using a 'screen dump' utility.
h. The sweep time of the spectrum analyzer was then adjusted to 100msec.
i. The single sweep function of the spectrum analyzer was used multiple times to determine the maximum number of transmitted pulses that occurred in a 100msec time period.
j. The maximum number of pulses transmitted in a 100msec time period was recorded and then plotted using a ‘screen dump’ utility.
k. The duty cycle correction was calculated using the following equation:

Duty Cycle Correction Factor (dB) = D.C. (dB)
D.C. (dB) = 20 x log [((pulse width (msec)) x (#pulses in a 100msecperiod)) / 100msec]

5.2.4.3 Results

Duty cycle plots are shown on pages 45 and 46. The EUT transmits an 8.34 msec pulse 1 time in a 100msec period. This results in a duty cycle correction factor of -21.6dB.

The duty cycle correction factor data was taken for informational purposes only. When performing radiated spurious emissions measurements, the EUT was programmed to transmit continuously. Therefore the trace averaging methods of 12.2.5.1 of the Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 were used instead of using the duty cycle correction factor to convert from peak to average readings.

5.2.5 Radiated Spurious Emissions Measurements

5.2.5.1 Requirements

Per section 15.247(d), in any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated emissions measurement. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must comply with the radiated emission limits specified in §15.209(a).

Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must comply with the radiated emission limits specified in §15.209(a).

Paragraph 15.209(a) has the following radiated emission limits:

Frequency MHz	Field Strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	3
30.0-88.0	100	3
88.0-216.0	150	3
216.0-960.0	200	3
Above 960	500	3

5.2.5.2 Procedures

Radiated measurements were performed in a 32ft. x 20ft. x 14ft. high shielded enclosure. The shielded enclosure prevents emissions from other sources, such as radio and TV stations from interfering with the measurements. All powerlines and signal lines entering the enclosure pass through filters on the enclosure wall. The powerline filters prevent extraneous signals from entering the enclosure on these leads.

Preliminary radiated emissions tests were performed to determine the emission characteristics of the EUT. For the preliminary test, a broadband measuring antenna was positioned at a 3 meter distance from the EUT. The entire frequency range from 30MHz to 10.0GHz was investigated using a peak detector function. The final open field emission tests were then manually performed over the frequency range of 30MHz to 10.0GHz.

1) For all harmonics not in the restricted bands, the following procedure was used:
   a) The field strength of the fundamental was measured using a bilog antenna. The bilog antenna was positioned at a 3 meter distance from the EUT. A peak detector with a resolution bandwidth of 100 kHz was used on the spectrum analyzer.
   b) The field strengths of all of the harmonics not in the restricted band were then measured using a double-ridged waveguide antenna. The waveguide antenna was positioned at a 3 meter distance from the EUT. A peak detector with a resolution bandwidth of 100 kHz was used on the spectrum analyzer.
   c) To ensure that maximum or worst case emission levels at the fundamental and harmonics were

measured, the following steps were taken when measuring the fundamental emissions and the spurious emissions:

i) The EUT was rotated so that all of its sides were exposed to the receiving antenna.

ii) Since the measuring antenna is linearly polarized, both horizontal and vertical field components were measured.

iii) The measuring antenna was raised and lowered for each antenna polarization to maximize the readings.

d) All harmonics not in the restricted bands must be at least 20 dB below levels measured at the fundamental. However, attenuation below the general limits specified in §15.209(a) is not required.

2) For all emissions in the restricted bands, the following procedure was used:

a) The field strengths of all emissions below 1 GHz were measured using a bi-log antenna. The bi-log antenna was positioned at a 3 meter distance from the EUT. A peak detector with a resolution bandwidth of 100 kHz was used on the spectrum analyzer.

b) The field strengths of all emissions above 1 GHz were measured using a double-ridged waveguide antenna. The waveguide antenna was positioned at a 3 meter distance from the EUT. A peak detector with a resolution bandwidth of 1 MHz was used on the spectrum analyzer.

c) To ensure that maximum or worst case emission levels were measured, the following steps were taken when taking all measurements:

i) The EUT was rotated so that all of its sides were exposed to the receiving antenna.

ii) Since the measuring antenna is linearly polarized, both horizontal and vertical field components were measured.

iii) The measuring antenna was raised and lowered for each antenna polarization to maximize the readings.

d) For all radiated emissions measurements below 1 GHz, if the peak reading is below the limits listed in 15.209(a), no further measurements are required. If however, the peak readings exceed the limits listed in 15.209(a), then the emissions are remeasured using a quasi-peak detector.

e) For all radiated emissions measurements above 1 GHz, the peak readings must comply with the 15.35(b) limits. 15.35(b) states that when average radiated emissions measurements are specified, there also is a limit on the peak level of the radiated emissions. The limit on the peak radio frequency emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test. Therefore, all peak readings above 1 GHz must be no greater than 20 dB above the limits specified in 15.209(a).

f) Next, for all radiated emissions measurements above 1GHz, the resolution bandwidth was set to 1MHz. The analyzer was set to linear mode with a 10Hz video bandwidth in order to simulate an average detector. An average reading was taken.

5.2.5.3 Results

Preliminary radiated emissions plots with the EUT transmitting at 905MHz are shown on pages 47 through 50. Final radiated emissions data are presented on data pages 51 through 53. As can be seen from the data, all emissions measured from the EUT were within the specification limits. The emissions level closet to the limit occurred at 3620MHz. The emissions level at this frequency was 3.6dB within the limit.

Preliminary radiated emissions plots with the EUT transmitting at 915MHz are shown on pages 54 through 57. Final radiated emissions data are presented on data pages 58 through 60. As can be seen from the data, all emissions measured from the EUT were within the specification limits. The emissions level closet to the limit occurred at 3660MHz. The emissions level at this frequency was 3.7dB within the limit.

Preliminary radiated emissions plots with the EUT transmitting at 925MHz are shown on pages 61 through 64. Final radiated emissions data are presented on data pages 65 through 67. As can be seen from the data, all

emissions measured from the EUT were within the specification limits. The emissions level closet to the limit occurred at 3700MHz. The emissions level at this frequency was 0.8dB within the limit.

Photographs of the test configuration which yielded the highest, or worst case, radiated emission levels are shown on Figure 3 and Figure 4.

5.2.6 Band Edge Compliance

5.2.6.1 Requirements

Per section 15.247(d), the emissions at the band-edges must be at least 20dB below the highest level measured within the band but attenuation below the general limits listed in 15.209(a) is not required.

5.2.6.2 Procedures

5.2.6.2.1 Low Band Edge

1) The EUT was setup inside the test chamber on a non-conductive stand.
2) A broadband measuring antenna was placed at a test distance of 3 meters from the EUT.
3) The EUT was set to transmit continuously at the channel closest to the low band-edge.
4) The EUT was maximized for worst case emissions at the measuring antenna. The maximum meter reading was recorded.
5) To determine the band edge compliance, the following spectrum analyzer settings were used:
    a. Center frequency = low band-edge frequency.
    b. Span = Wide enough to capture the peak level of the emission operating on the channel closest to the band-edge, as well as any modulation products which fall outside of the authorized band of operation.
    c. Resolution bandwidth (RBW) ≥ 1% of the span.
    d. The 'Max-Hold' function was engaged. The analyzer was allowed to scan until the envelope of the transmitter bandwidth was defined.
    e. The marker was set on the peak of the in-band emissions. A display line was placed 20dB down from the peak of the in-band emissions. All emissions which fall outside of the authorized band of operation must be below the 20dB down display line. (All emissions to the left of the center frequency (band-edge) must be below the display line.)
    f. The analyzer's display was plotted using a 'screen dump' utility.

5.2.6.2.2 High Band Edge

1) The EUT was setup inside the test chamber on a non-conductive stand.
2) A broadband measuring antenna was placed at a test distance of 3 meters from the EUT.
3) The EUT was set to transmit continuously at the channel closest to the high band-edge (hopping function disabled).
4) The EUT was maximized for worst case emissions at the measuring antenna.
5) To determine the band edge compliance, the following spectrum analyzer settings were used:

    a. Center frequency = high band-edge frequency.
    b. Span = Wide enough to capture the peak level of the emission operating on the channel closest to the band-edge, as well as any modulation products which fall outside of the authorized band of operation.
    c. Resolution bandwidth (RBW) ≥ 1% of the span.
    d. The 'Max-Hold' function was engaged. The analyzer was allowed to scan until the envelope of the transmitter bandwidth was defined.
    e. The marker was set on the peak of the in-band emissions. A display line was placed 20dB down from the peak of the in-band emissions. All emissions which fall outside of the authorized band of operation must be below the 20dB down display line. (All emissions to the right of the center frequency (band-edge) must be below the display line.)
    f. The analyzer's display was plotted using a 'screen dump' utility.

5.2.6.3 Results

Pages 68 and 69 show the radiated band-edge compliance results. As can be seen from these plots, the emissions at the low end band edge and the high end band edge are within the 20 dB down limits.

5.2.7 Power Spectral Density

5.2.7.1 Requirement

Per section 15.247(d), the peak power spectral density from the intentional radiator shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

5.2.7.2 Procedures

1) The EUT was placed on the non-conductive stand and set to transmit at a mid channel.
2) A broadband measuring antenna was placed near the EUT.
3) To determine the power spectral density, the following spectrum analyzer settings were used:
    a. Center frequency = transmit frequency
    b. Resolution bandwidth (RBW) greater than the 20dB bandwidth.
    c. Sweep time = auto
    d. The peak detector and 'Max-Hold' function was engaged. The analyzer was allowed to scan until the envelope of the transmitter bandwidth was defined.
    e. The analyzer's display was plotted using a 'screen dump' utility.
4) This reading corresponds to the peak EIRP measured for the low channel.
5) Turn on Display Line 1 and place it at the peak of the measured level. Turn on Display Line 2 and place it at the corresponding +8dBm level (e.g. if the peak output power is +18dBm then the +8dBm level will be 10dB down from the radiated level and if the peak output power is +6dBm then the +8dBm level will be 2dB above the radiated level.)
6) To determine the power spectral density, the following spectrum analyzer settings were used:
    a. Center frequency = transmit frequency
    b. Span =1.5times the channel bandwidth
    c. Resolution bandwidth (RBW) ≥3kHz
    d. Video bandwidth (VBW) ≥ 3 x RBW
    e. Sweep time = auto couple
    f. The analyzer was allowed to scan until the envelope of the transmitter bandwidth was defined. The peak detector and 'Max-Hold' function was engaged.
    g. The analyzer's display was plotted using a 'screen dump' utility.
    h. If the measured value exceeds the +8dBm limit, reduce the RBW (no less than 3kHz) and repeat step 6.

5.2.7.3 Results

Pages 70 through 75 show the power spectral density results. As can be seen from these plots, the peak power density is less than 8dBm in a 3kHz band during any time interval of continuous transmission.

6 CONCLUSIONS

With a shield placed over the WLAN portion of the circuit board and with 2.5VDC applied to the WLAN and microprocessor, the Telular Wireless Tank Monitor, Part No. TL9X digital modulation transceiver, Serial No. RA10, did fully meet the conducted and radiated emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart B, Sections 15.107 and 15.109 for receivers and Subpart C, Sections 15.207 and 15.247 for Intentional Radiators Operating within the 902-928 MHz when tested per ANSI C63.4-2009.

With a shield placed over the WLAN portion of the circuit board and with 2.5VDC applied to the WLAN and microprocessor, the Telular Wireless Tank Monitor, Part No. TL9X digital modulation transceiver, Serial No. RA10, also did fully meet the conducted and radiated RF emission requirements of the Industry Canada Radio Standards Specification, RSS-Gen, Section 8.8 and Section 7.1.2 for receivers and the Industry Canada Radio Standards Specification RSS-Gen Section 8.8 and RSS-210 Annex 8, for transmitters, when tested per ANSI

C63.4-2014.

7 CERTIFICATION

Elite Electronic Engineering Incorporated certifies that the information contained in this report was obtained under conditions which meet or exceed those specified in the test specifications.

The data presented in this test report pertains to the EUT at the test date. Any electrical or mechanical modification made to the EUT subsequent to the specified test date will serve to invalidate the data and void this certification.

8 ENDORSEMENT DISCLAIMER

This report must not be used to claim product certification, approval, or endorsement by NVLAP, NIST or any agency of the Federal Government.

9 EQUIPMENT LIST

Table 9-1 Equipment List

Eq ID	Equipment Description	Manufacturer	Model No.	Serial No.	Frequency Range	Cal Date	Due Date
APW11	PREAMPLIFIER	PMI	PE2-35-120-5R0-10-12-SFF	PL11685/1241	1GHZ-20GHZ	3/5/2015	3/5/2016
CDX8	COMPUTER	ELITE	WORKSTATION			N/A	
GSD3	SIGNAL GENERATOR	ROHDE & SCHWARZ	SMB100A	104454	9KHZ-6GHZ	9/10/2014	9/10/2015
NDQ1	TUNED DIPOLE ANTENNA	EMCO	3121C-DB4	313	400-1000MHZ	4/17/2014	4/17/2016
NTA3	BILOG ANTENNA	TESEQ	6112D	32853	25-1000MHz	3/27/2015	3/27/2016
NWQ1	DOUBLE RIDGED WAVEGUIDE ANTENNA	ETS-LINDGREN	3117	66655	1GHZ-18GHZ	3/11/2014	3/11/2016
RAKI	RF SECTION	HEWLETT PACKARD	85462A	3411A00181	0.009-6500MHZ	3/12/2015	3/12/2016
RAKJ	RF FILTER SECTION	HEWLETT PACKARD	85460A	3330A00154	---	3/12/2015	3/12/2016
RBA0	EMI TEST RECEIVER	ROHDE & SCHWARZ	ESIB26	100145	20HZ-26.5GHZ	3/3/2015	3/3/2016
SES0	24VDC POWER SUPPLY	P-TRANS	FS-32024-1M	001	18-27VDC	NOTE 1	
XPQ3	HIGH PASS FILTER	K&L MICROWAVE	4IH30-1804/T10000-0	4	1.8GHZ-10GHZ	10/24/2014	10/24/2015

I/O: Initial Only
N/A: Not Applicable
Note 1: For the purpose of this test, the equipment was calibrated over the specified frequency range, pulse rate, or modulation prior to the test or monitored by a calibrated instrument.

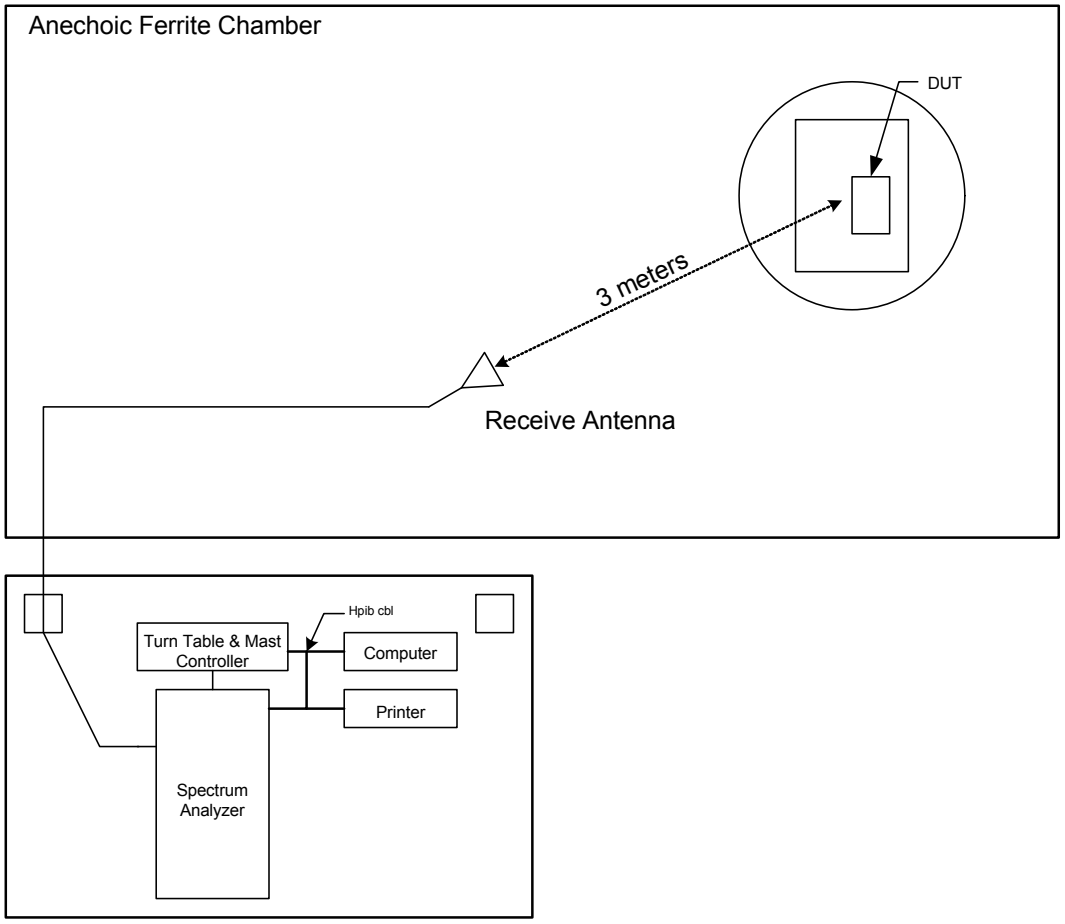
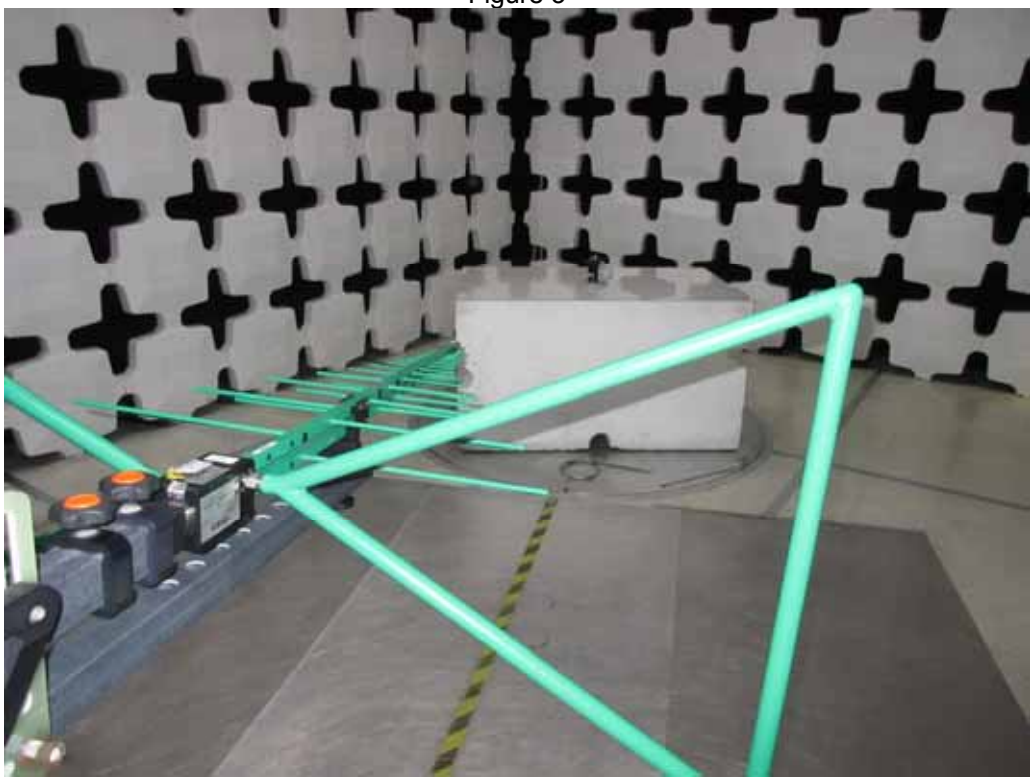


FIGURE 1 BLOCKDIAGRAM OF TEST SETUP

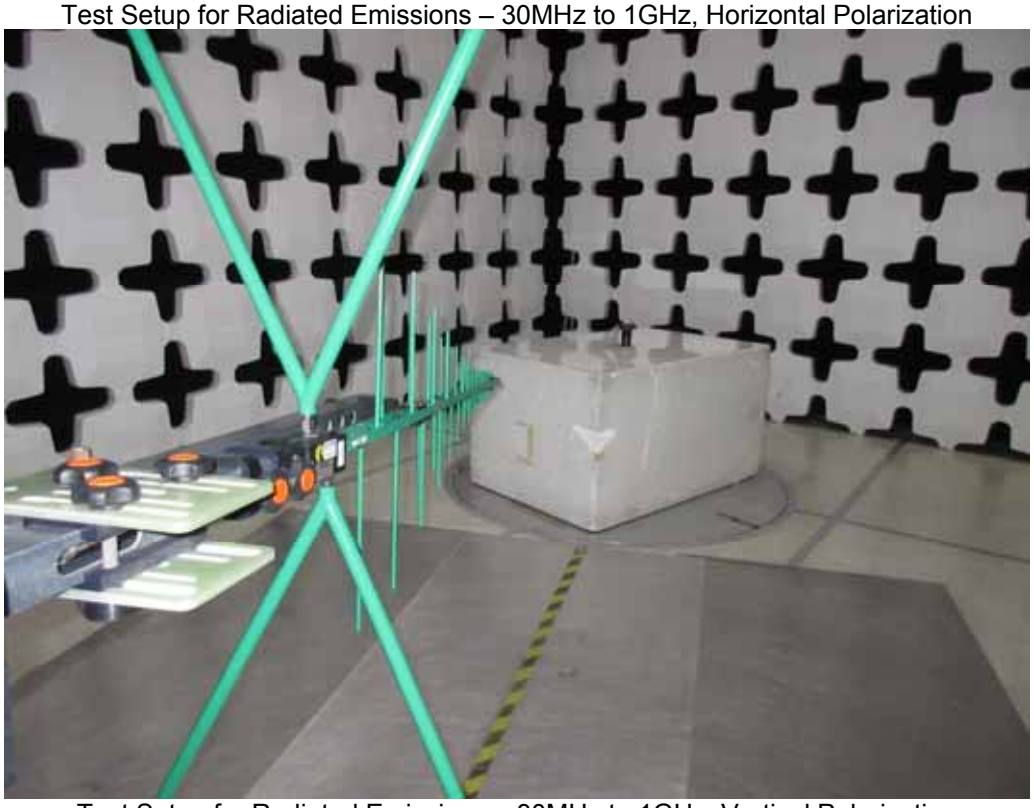
Figure 2

Photograph of the EUT

Figure 3

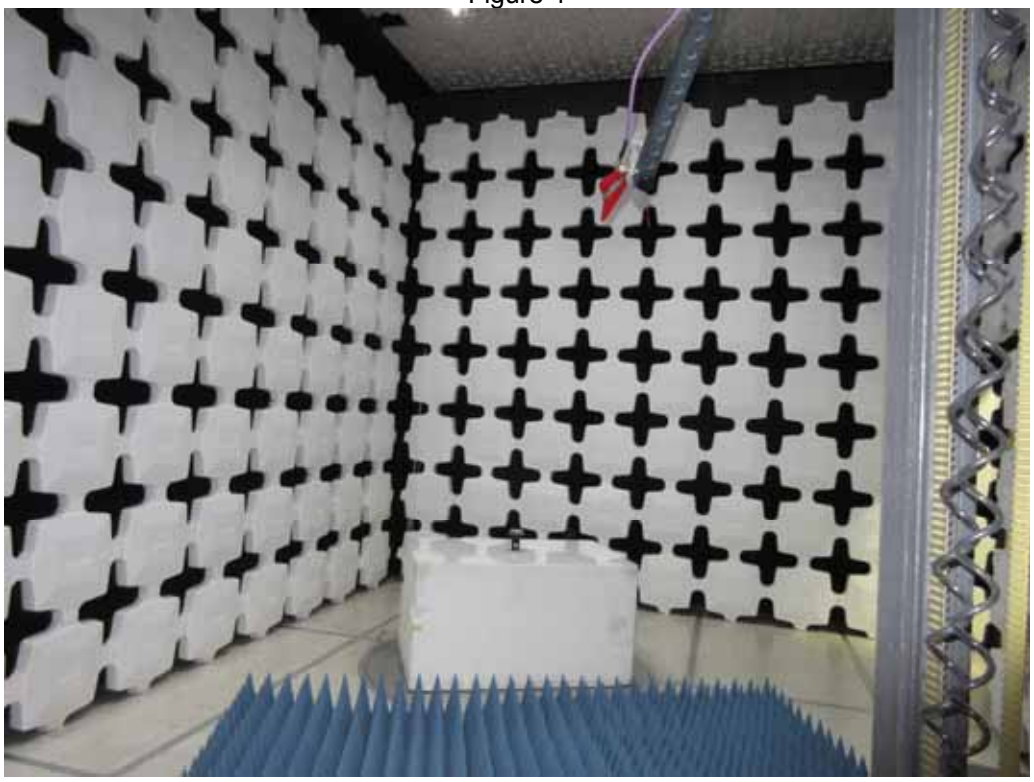


Test Setup for Radiated Emissions – 30MHz to 1GHz, Horizontal Polarization



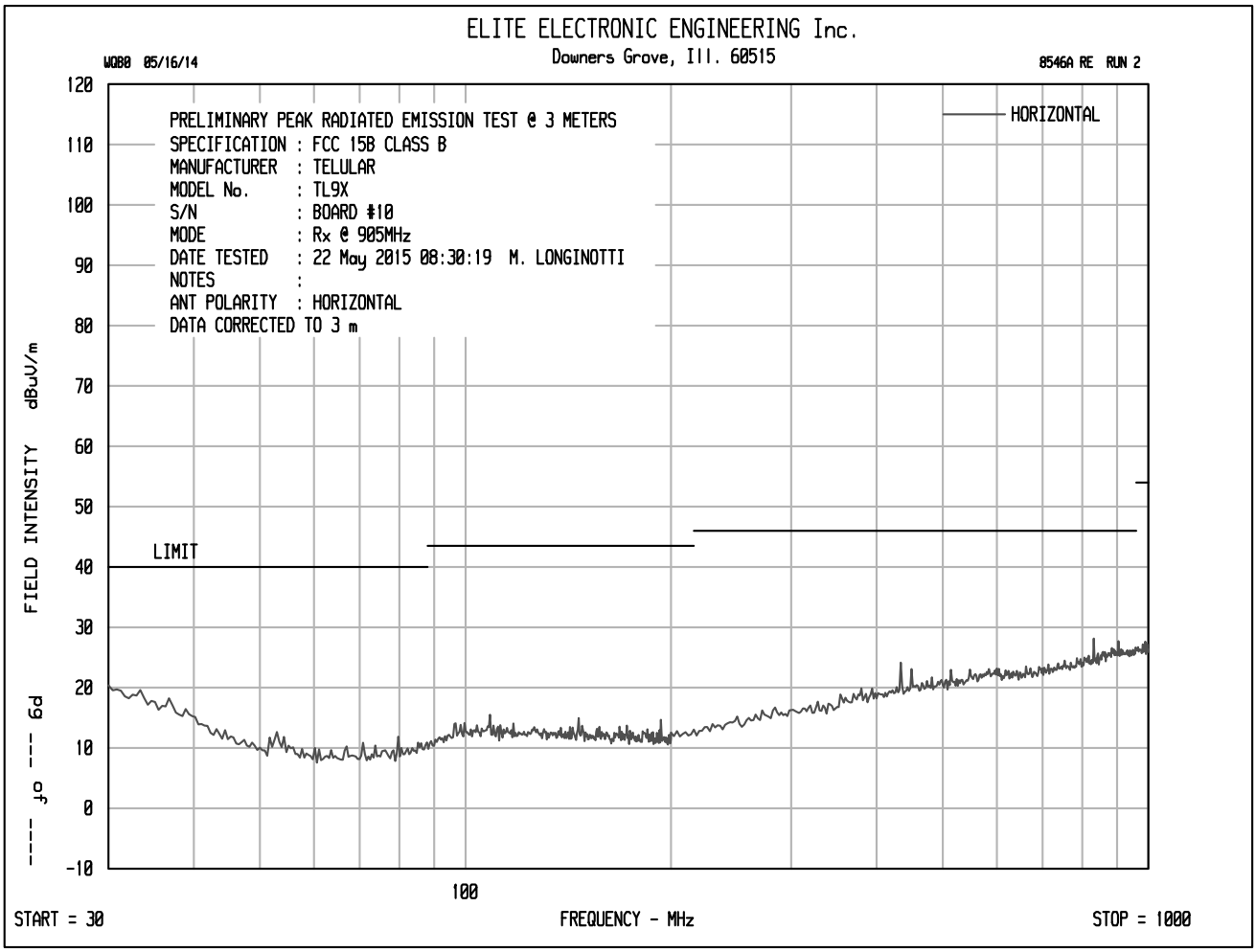
Test Setup for Radiated Emissions – 30MHz to 1GHz, Vertical Polarization

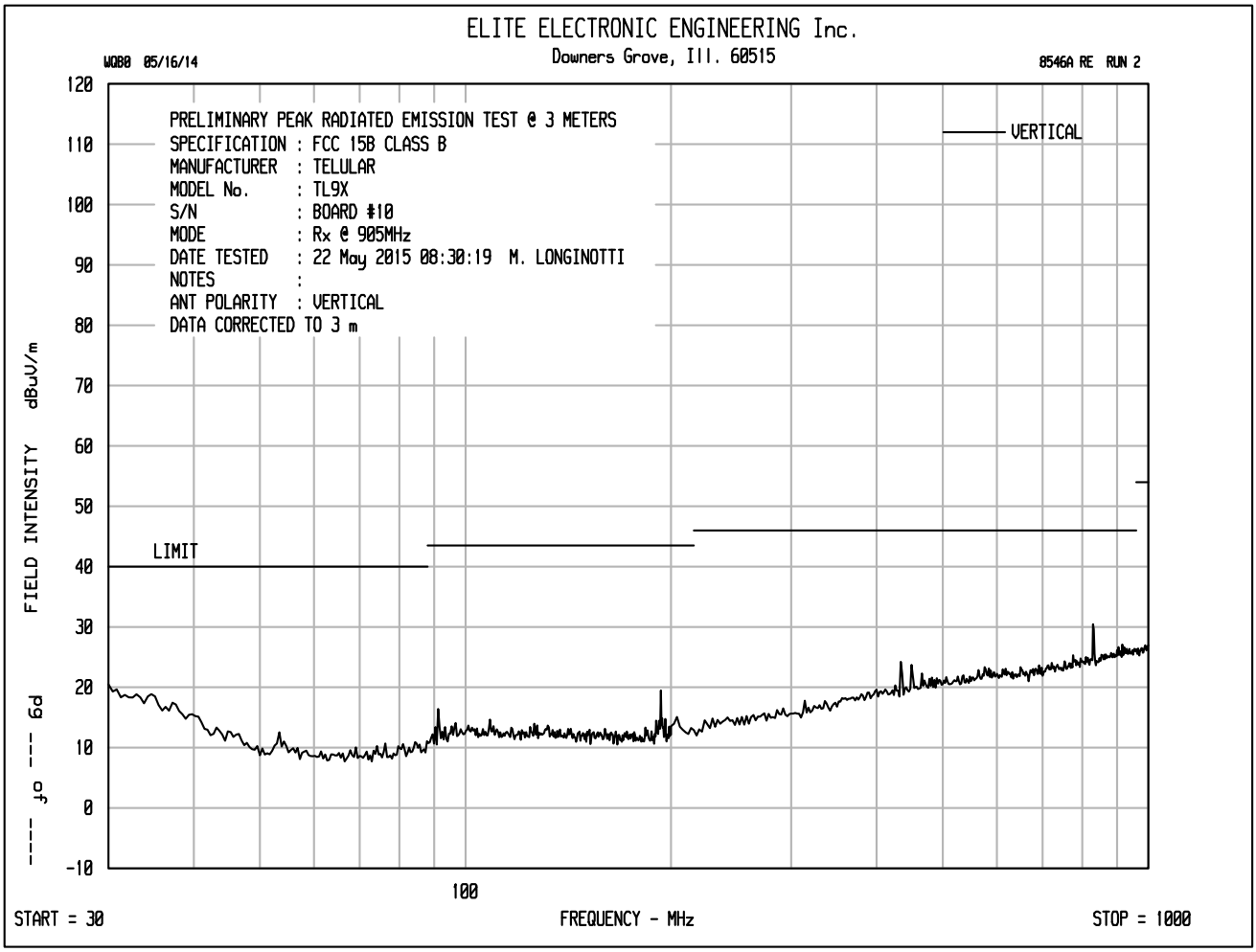
Figure 4

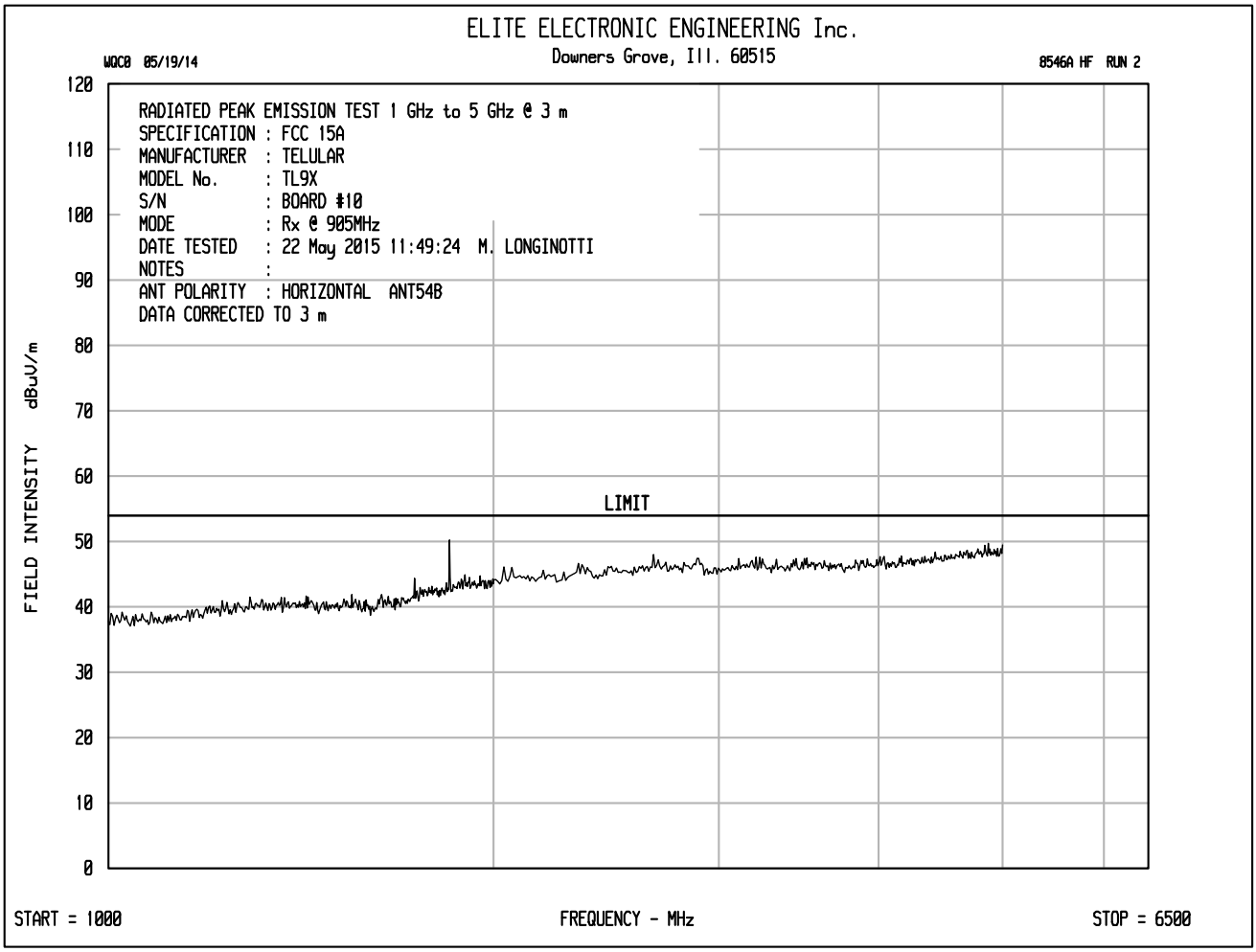


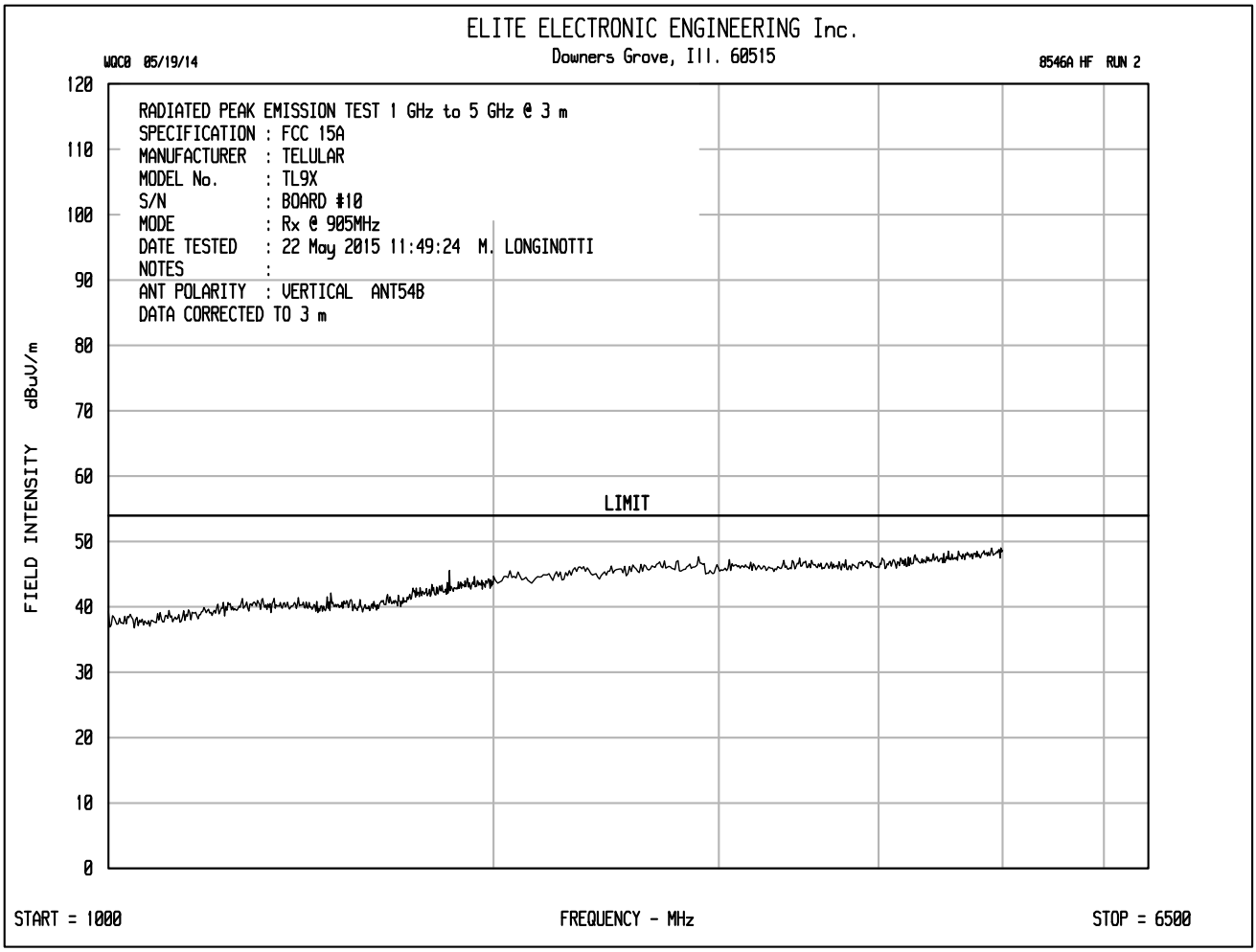
Test Setup for Radiated Emissions – 1GHz to 10GHz, Horizontal Polarization

Test Setup for Radiated Emissions – 1GHz to 10GHz, Vertical Polarization


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WQB0 05/16/14
8546A RE RUN 2
PRELIMINARY PEAK RADIATED EMISSION TEST @ 3 METERS
SPECIFICATION : FCC 15B CLASS B
MANUFACTURER : TELULAR
MODEL No. : TL9X
S/N : BOARD #10
MODE : Rx @ 905MHz
DATE TESTED : 22 May 2015 08:30:19 M. LONGINOTTI
NOTES :
ANT POLARITY : HORIZONTAL
DATA CORRECTED TO 3 m
HORIZONTAL
LIMIT
FIELD INTENSITY dBuV/m
---- of ---- dB
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
100
START = 30
FREQUENCY - MHz
STOP = 1000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
W080 05/16/14
8546A RE RUN 2
PRELIMINARY PEAK RADIATED EMISSION TEST @ 3 METERS
SPECIFICATION : FCC 15B CLASS B
MANUFACTURER : TELULAR
MODEL No. : TL9X
S/N : BOARD #10
MODE : Rx @ 905MHz
DATE TESTED : 22 May 2015 08:30:19 M. LONGINOTTI
NOTES :
ANT POLARITY : VERTICAL
DATA CORRECTED TO 3 m
VERTICAL
LIMIT
FIELD INTENSITY dBuV/m
---- to --- 6d
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
100
START = 30
FREQUENCY - MHz
STOP = 1000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WQC0 05/19/14
8546A HF RUN 2
RADIATED PEAK EMISSION TEST 1 GHz to 5 GHz @ 3 m
SPECIFICATION : FCC 15A
MANUFACTURER : TELULAR
MODEL No. : TL9X
S/N : BOARD #10
MODE : Rx @ 905MHz
DATE TESTED : 22 May 2015 11:49:24 M. LONGINOTTI
NOTES :
ANT POLARITY : HORIZONTAL ANT54B
DATA CORRECTED TO 3 m
LIMIT
FIELD INTENSITY dBuV/m
120
110
100
90
80
70
60
50
40
30
20
10
0
START = 1000
FREQUENCY - MHz
STOP = 6500


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WQC0 05/19/14
8546A HF RUN 2
RADIATED PEAK EMISSION TEST 1 GHz to 5 GHz @ 3 m
SPECIFICATION : FCC 15A
MANUFACTURER : TELULAR
MODEL No. : TL9X
S/N : BOARD #10
MODE : Rx @ 905MHz
DATE TESTED : 22 May 2015 11:49:24 M. LONGINOTTI
NOTES :
ANT POLARITY : VERTICAL ANT54B
DATA CORRECTED TO 3 m
LIMIT
FIELD INTENSITY dBuV/m
120
110
100
90
80
70
60
50
40
30
20
10
0
START = 1000
FREQUENCY - MHz
STOP = 6500

ETR No. 8546A
DATA SHEET TEST NO. 2

RADIATED QP EMISSION MEASUREMENTS in a 3 m SEMI-ANECHOIC ROOM
SPECIFICATION : FCC 15B CLASS B
MANUFACTURER : TELULAR
MODEL NO. : TL9X
SERIAL NO. : BOARD #10
TEST MODE : Rx @ 905MHz
NOTES :
TEST DATE : 22 May 2015 08:30:19
TEST DISTANCE : 3 m

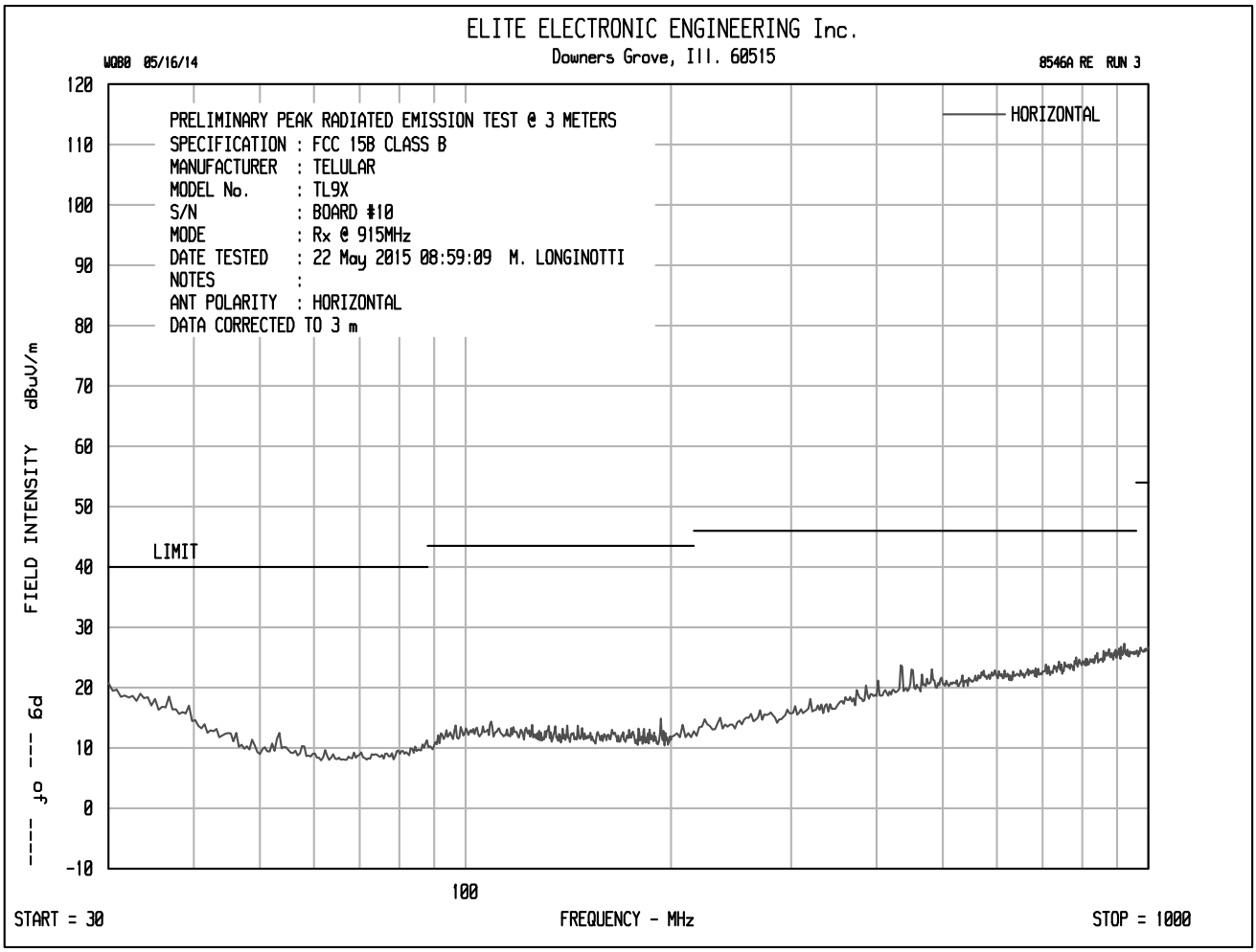
FREQUENCY MHz	QP READING dBuV	ANT FAC dB	CBL FAC dB	EXT ATTN dB	DIST FAC dB	TOTAL dBuV/m	QP LIMIT dBuV/m	AZ deg	ANT HT cm	ANT POL
30.65	-6.9	18.0	.4	0.0	0.0	11.5	40.0	180	340	V
53.99	-5.7	7.2	.4	0.0	0.0	1.9	40.0	135	120	H
90.94	6.0	9.2	.4	0.0	0.0	15.5	43.5	45	120	V
108.59	-7.7	10.9	.4	0.0	0.0	3.7	43.5	270	200	H
125.48	-7.3	10.5	.5	0.0	0.0	3.8	43.5	270	200	V
146.78	-7.4	10.2	.6	0.0	0.0	3.3	43.5	45	200	H
172.66	-7.5	9.8	.7	0.0	0.0	3.0	43.5	135	200	H
192.24	7.2	9.5	.7	0.0	0.0	17.5	43.5	225	120	V
357.06	-6.2	14.4	1.0	0.0	0.0	9.2	46.0	270	340	H
432.00	4.0	15.9	1.1	0.0	0.0	21.1	46.0	135	120	V
577.81	-6.6	18.3	1.1	0.0	0.0	12.8	46.0	180	120	V
660.01	-6.9	18.5	1.3	0.0	0.0	12.9	46.0	180	340	H
778.67	-6.4	19.6	1.5	0.0	0.0	14.7	46.0	225	120	V
826.21	-6.2	20.2	1.5	0.0	0.0	15.5	46.0	0	120	V
917.46	-5.5	20.9	1.5	0.0	0.0	16.9	46.0	270	340	V

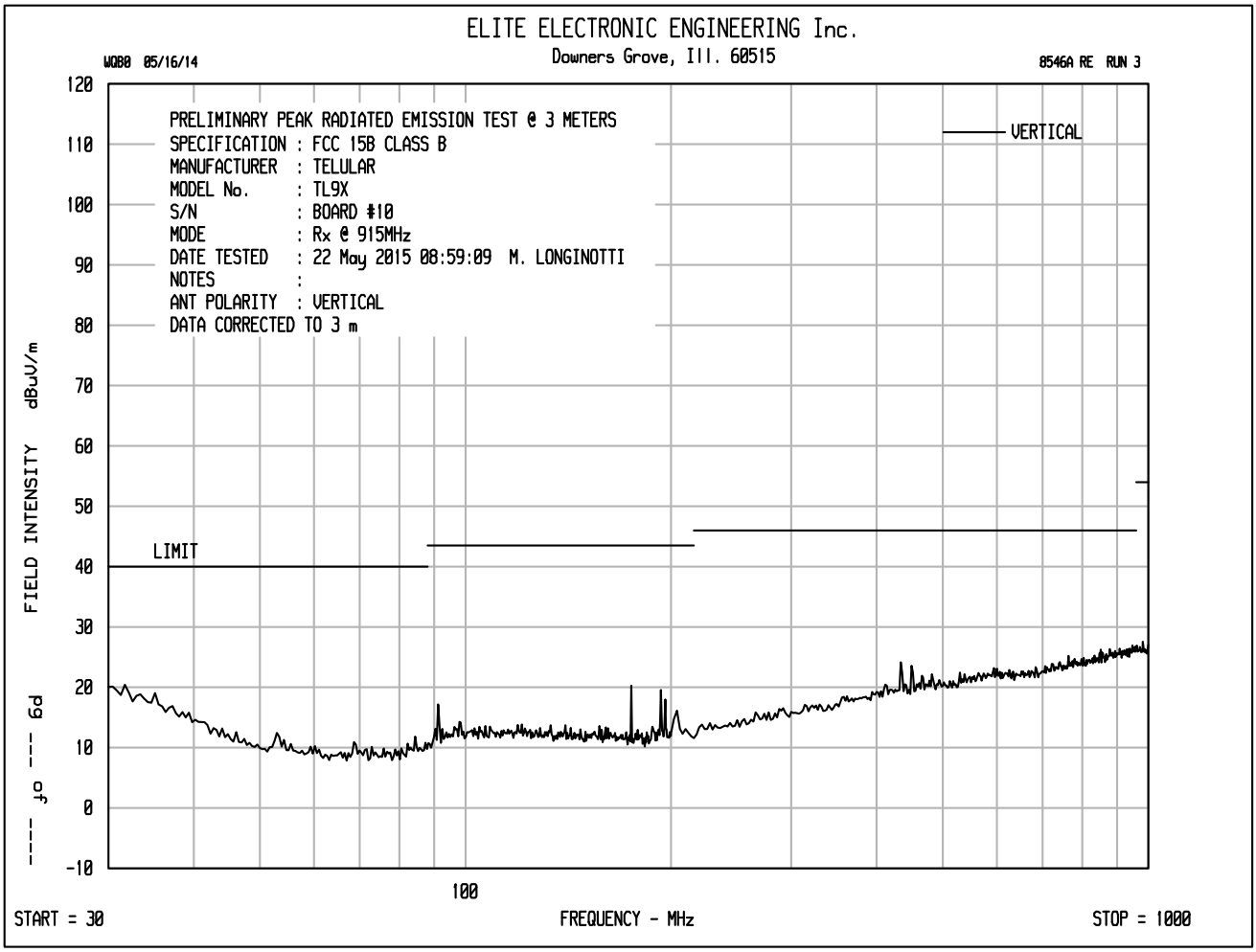
DATA SHEET HF TEST NO. 2

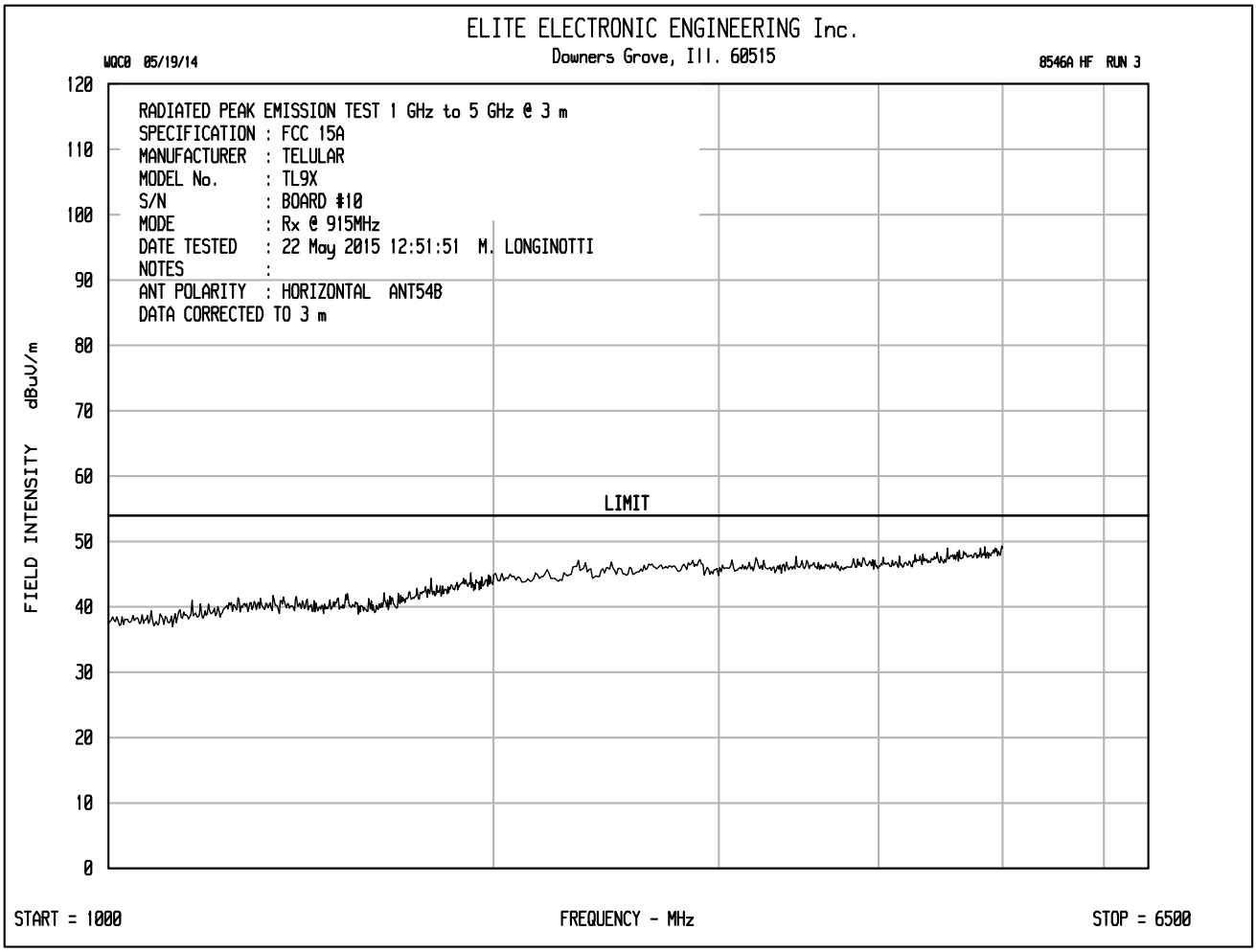
RADIATED AVG EMISSION MEASUREMENTS >=1000 MHz in a 3 m ANECHOIC ROOM

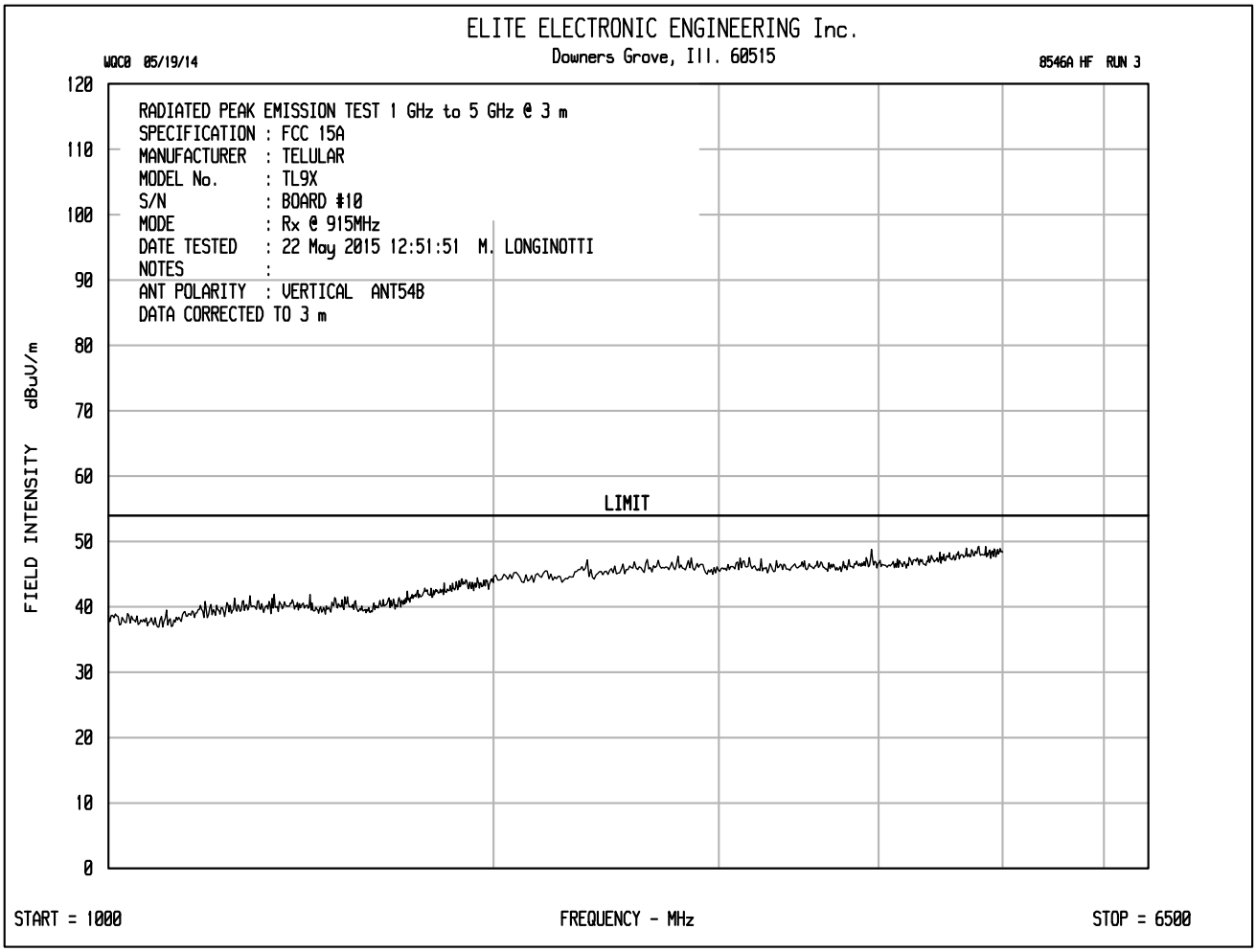
SPECIFICATION : FCC 15A
MANUFACTURER : TELULAR
MODEL NO. : TL9X
SERIAL NO. : BOARD #10
TEST MODE : Rx @ 905MHz
NOTES :
TEST DATE : 22 May 2015 11:49:24
TEST DISTANCE : 3 m
ANTENNA : ANT54B

FREQUENCY MHz	AVG READING dBuV	ANT FAC dB	CBL FAC dB	DIST FAC dB	TOTAL dBuV/m	AVG LIMIT dBuV/m	PASS/ FAIL	AZ deg	ANT HT cm	POLAR
1139.68	-4.2	27.6	1.7	0.0	25.1	54.0		180	120	V
1234.97	-4.0	28.6	1.8	0.0	26.4	54.0		270	340	H
1302.23	-4.0	29.2	1.8	0.0	27.1	54.0		180	120	H
1493.84	-4.1	28.4	2.0	0.0	26.2	54.0		225	200	V
1663.58	-4.0	29.0	2.1	0.0	27.1	54.0		180	120	V
1764.81	-3.4	30.1	2.1	0.0	28.9	54.0		90	340	H
1843.07	-4.0	31.1	2.2	0.0	29.3	54.0		45	340	H
2014.62	-3.9	31.8	2.3	0.0	30.1	54.0		315	340	H
2322.32	-2.6	31.8	2.5	0.0	31.7	54.0		-0	340	H
2657.21	-3.8	32.8	2.8	0.0	31.7	54.0		225	120	H
3212.29	-4.2	32.9	3.1	0.0	31.8	54.0		135	200	H
3470.88	-4.2	33.1	3.2	0.0	32.0	54.0		225	340	V
4186.59	-4.8	33.6	3.5	0.0	32.2	54.0		-0	200	H
4615.16	-4.5	34.5	3.7	0.0	33.6	54.0		225	120	V
4862.85	-4.6	34.8	3.8	0.0	33.9	54.0		45	200	H


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WQB0 05/16/14
8546A RE RUN 3
PRELIMINARY PEAK RADIATED EMISSION TEST @ 3 METERS
SPECIFICATION : FCC 15B CLASS B
MANUFACTURER : TELULAR
MODEL No. : TL9X
S/N : BOARD #10
MODE : Rx @ 915MHz
DATE TESTED : 22 May 2015 08:59:09 M. LONGINOTTI
NOTES :
ANT POLARITY : HORIZONTAL
DATA CORRECTED TO 3 m
HORIZONTAL
LIMIT
FIELD INTENSITY dBuV/m
---- to --- 6d
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
100
START = 30
FREQUENCY - MHz
STOP = 1000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
W080 05/16/14
8546A RE RUN 3
PRELIMINARY PEAK RADIATED EMISSION TEST @ 3 METERS
SPECIFICATION : FCC 15B CLASS B
MANUFACTURER : TELULAR
MODEL No. : TL9X
S/N : BOARD #10
MODE : Rx @ 915MHz
DATE TESTED : 22 May 2015 08:59:09 M. LONGINOTTI
NOTES :
ANT POLARITY : VERTICAL
DATA CORRECTED TO 3 m
VERTICAL
LIMIT
FIELD INTENSITY dBuV/m
---- fo --- 6d
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
100
START = 30
FREQUENCY - MHz
STOP = 1000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WQC0 05/19/14
8546A HF RUN 3
RADIATED PEAK EMISSION TEST 1 GHz to 5 GHz @ 3 m
SPECIFICATION : FCC 15A
MANUFACTURER : TELULAR
MODEL No. : TL9X
S/N : BOARD #10
MODE : Rx @ 915MHz
DATE TESTED : 22 May 2015 12:51:51 M. LONGINOTTI
NOTES :
ANT POLARITY : HORIZONTAL ANT54B
DATA CORRECTED TO 3 m
LIMIT
FIELD INTENSITY dBuV/m
120
110
100
90
80
70
60
50
40
30
20
10
0
START = 1000
FREQUENCY - MHz
STOP = 6500


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WQC0 05/19/14
8546A HF RUN 3
RADIATED PEAK EMISSION TEST 1 GHz to 5 GHz @ 3 m
SPECIFICATION : FCC 15A
MANUFACTURER : TELULAR
MODEL No. : TL9X
S/N : BOARD #10
MODE : Rx @ 915MHz
DATE TESTED : 22 May 2015 12:51:51 M. LONGINOTTI
NOTES :
ANT POLARITY : VERTICAL ANT54B
DATA CORRECTED TO 3 m
LIMIT
FIELD INTENSITY dBuV/m
120
110
100
90
80
70
60
50
40
30
20
10
0
START = 1000
FREQUENCY - MHz
STOP = 6500

ETR No. 8546A
DATA SHEET TEST NO. 3

RADIATED QP EMISSION MEASUREMENTS in a 3 m SEMI-ANECHOIC ROOM
SPECIFICATION : FCC 15B CLASS B
MANUFACTURER : TELULAR
MODEL NO. : TL9X
SERIAL NO. : BOARD #10
TEST MODE : Rx @ 915MHz
NOTES :
TEST DATE : 22 May 2015 08:59:09
TEST DISTANCE : 3 m

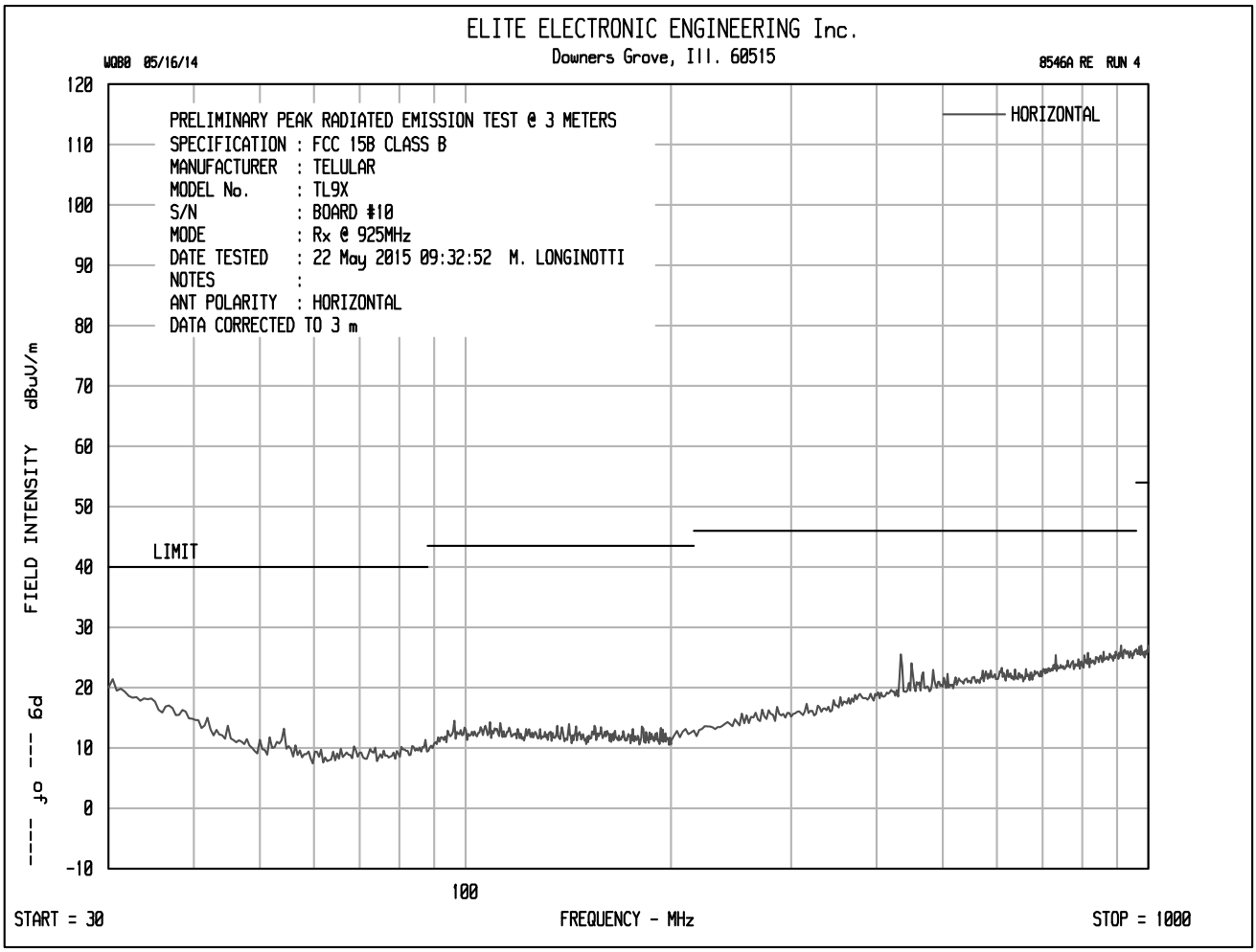
FREQUENCY MHz	QP READING dBuV	ANT FAC dB	CBL FAC dB	EXT ATTN dB	DIST FAC dB	TOTAL dBuV/m	QP LIMIT dBuV/m	AZ deg	ANT HT cm	ANT POL
31.52	-7.7	17.5	.4	0.0	0.0	10.2	40.0	135	340	H
53.79	-5.5	7.3	.4	0.0	0.0	2.2	40.0	90	340	H
90.95	6.4	9.2	.4	0.0	0.0	16.0	43.5	45	120	V
108.85	-7.5	10.9	.4	0.0	0.0	3.8	43.5	135	340	H
124.33	-7.3	10.6	.5	0.0	0.0	3.8	43.5	135	200	H
146.35	-7.5	10.2	.6	0.0	0.0	3.2	43.5	270	200	H
173.35	-7.6	9.7	.7	0.0	0.0	2.8	43.5	0	340	V
192.21	7.8	9.5	.7	0.0	0.0	18.0	43.5	225	120	V
369.50	-6.7	14.7	1.0	0.0	0.0	9.1	46.0	90	340	V
432.00	3.9	15.9	1.1	0.0	0.0	21.0	46.0	90	200	V
480.00	-.2	16.8	1.1	0.0	0.0	17.7	46.0	90	200	H
680.87	-6.5	18.5	1.3	0.0	0.0	13.4	46.0	45	340	V
768.50	-6.5	19.5	1.5	0.0	0.0	14.5	46.0	0	340	V
899.86	-5.4	20.8	1.5	0.0	0.0	16.9	46.0	45	340	H
927.98	-5.6	21.0	1.5	0.0	0.0	16.9	46.0	315	340	H

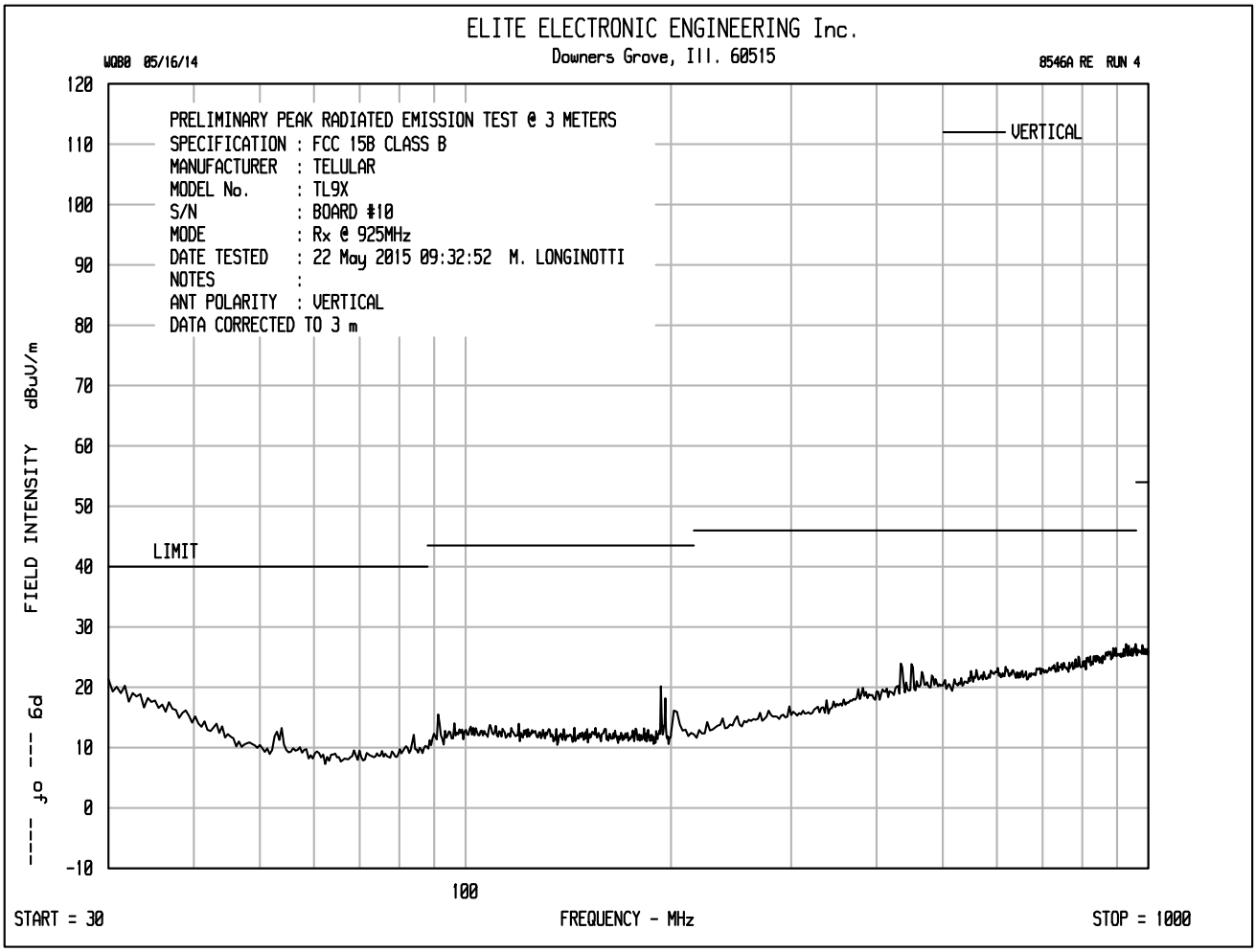
DATA SHEET HF TEST NO. 3

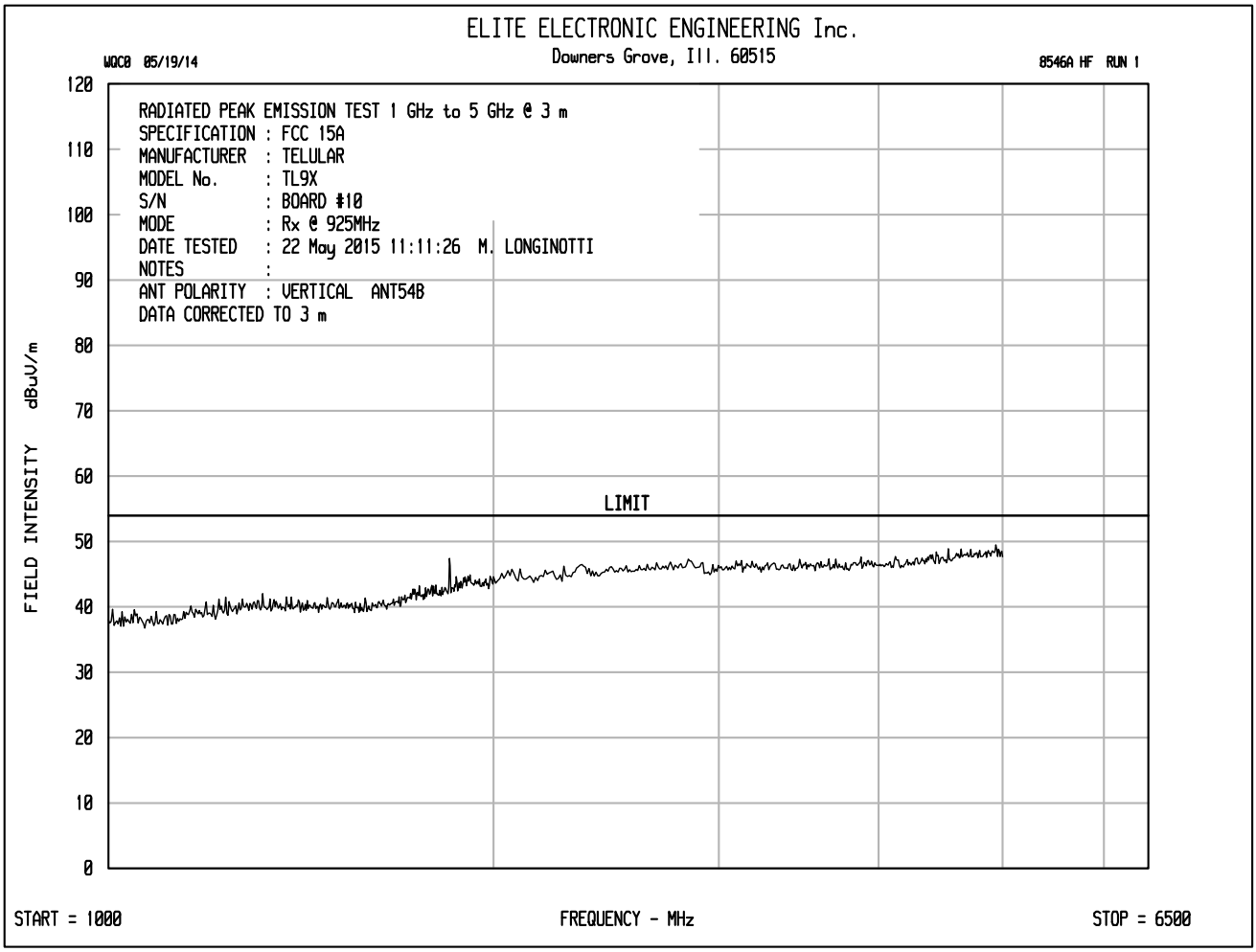
RADIATED AVG EMISSION MEASUREMENTS >=1000 MHz in a 3 m ANECHOIC ROOM

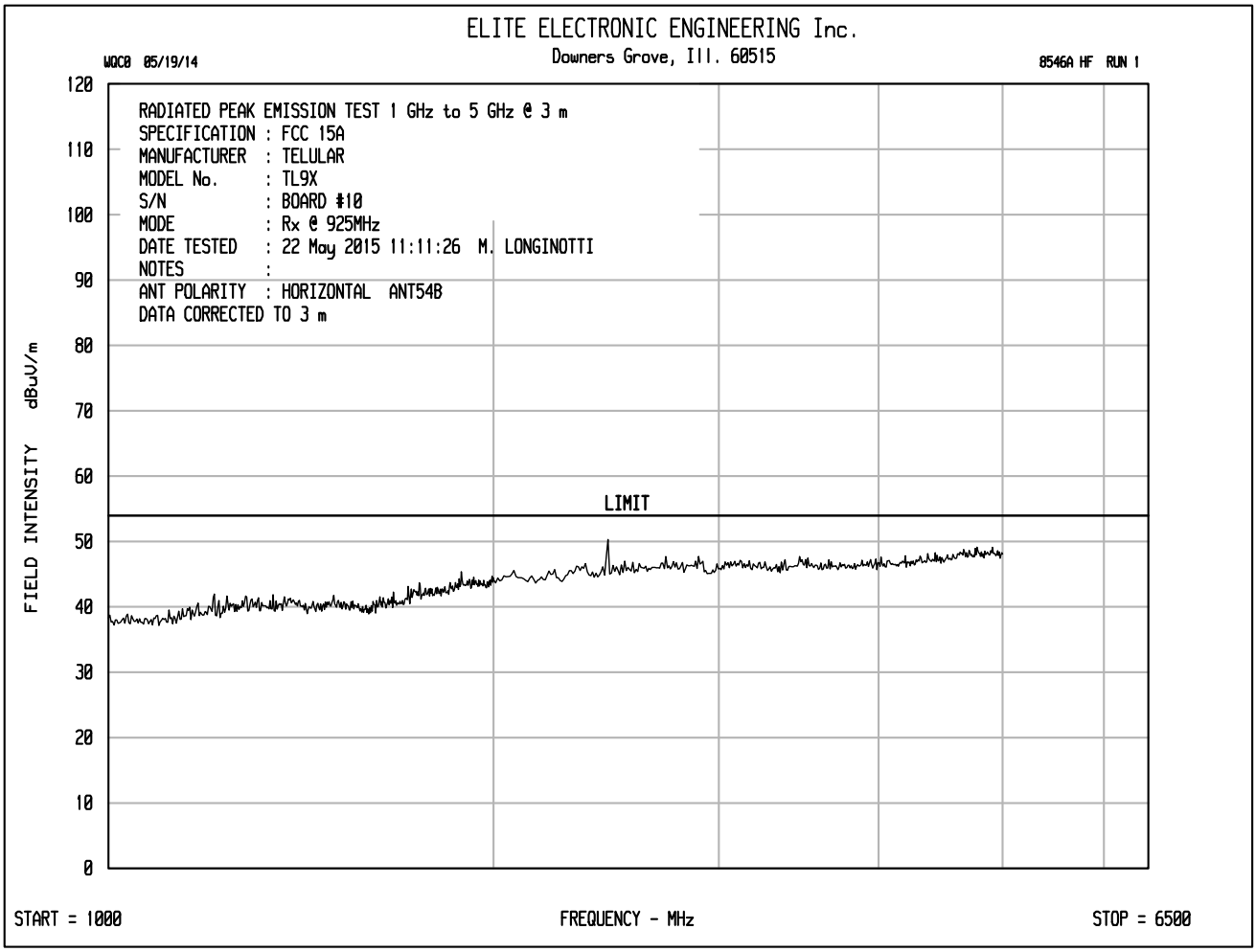
SPECIFICATION : FCC 15A
MANUFACTURER : TELULAR
MODEL NO. : TL9X
SERIAL NO. : BOARD #10
TEST MODE : Rx @ 915MHz
NOTES :
TEST DATE : 22 May 2015 12:51:51
TEST DISTANCE : 3 m
ANTENNA : ANT54B

FREQUENCY MHz	AVG READING dBuV	ANT FAC dB	CBL FAC dB	DIST FAC dB	TOTAL dBuV/m	AVG LIMIT dBuV/m	PASS/ FAIL	AZ deg	ANT HT cm	POLAR
1085.21	-4.3	27.1	1.6	0.0	24.3	54.0		180	340	V
1255.07	-4.0	28.9	1.8	0.0	26.6	54.0		135	120	H
1358.83	-4.1	29.1	1.9	0.0	26.8	54.0		90	340	V
1443.04	-4.4	28.7	1.9	0.0	26.2	54.0		315	120	V
1633.71	-4.3	28.8	2.1	0.0	26.6	54.0		45	340	H
1797.77	-3.9	30.6	2.2	0.0	28.9	54.0		0	120	H
1933.16	-4.0	31.6	2.2	0.0	29.9	54.0		0	120	H
2191.28	-3.5	31.6	2.4	0.0	30.5	54.0		225	200	H
2345.67	-2.5	31.9	2.5	0.0	32.0	54.0		270	340	V
2775.93	-3.7	32.7	2.8	0.0	31.9	54.0		270	120	V
3201.70	-4.1	32.9	3.1	0.0	31.8	54.0		225	200	V
3466.68	-4.3	33.0	3.2	0.0	31.9	54.0		135	340	H
3965.10	-5.0	33.5	3.4	0.0	32.0	54.0		225	120	V
4538.98	-4.6	34.3	3.6	0.0	33.3	54.0		90	340	H
4978.06	-4.4	34.7	3.8	0.0	34.1	54.0		315	340	H


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WQB0 05/16/14
8546A RE RUN 4
PRELIMINARY PEAK RADIATED EMISSION TEST @ 3 METERS
SPECIFICATION : FCC 15B CLASS B
MANUFACTURER : TELULAR
MODEL No. : TL9X
S/N : BOARD #10
MODE : Rx @ 925MHz
DATE TESTED : 22 May 2015 09:32:52 M. LONGINOTTI
NOTES :
ANT POLARITY : HORIZONTAL
DATA CORRECTED TO 3 m
HORIZONTAL
LIMIT
FIELD INTENSITY dBuV/m
---- to --- 6d
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
100
START = 30
FREQUENCY - MHz
STOP = 1000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
W080 05/16/14
8546A RE RUN 4
PRELIMINARY PEAK RADIATED EMISSION TEST @ 3 METERS
SPECIFICATION : FCC 15B CLASS B
MANUFACTURER : TELULAR
MODEL No. : TL9X
S/N : BOARD #10
MODE : Rx @ 925MHz
DATE TESTED : 22 May 2015 09:32:52 M. LONGINOTTI
NOTES :
ANT POLARITY : VERTICAL
DATA CORRECTED TO 3 m
VERTICAL
LIMIT
FIELD INTENSITY dBuV/m
---- to --- 6d
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
100
START = 30
FREQUENCY - MHz
STOP = 1000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WQC0 05/19/14
8546A HF RUN 1
RADIATED PEAK EMISSION TEST 1 GHz to 5 GHz @ 3 m
SPECIFICATION : FCC 15A
MANUFACTURER : TELULAR
MODEL No. : TL9X
S/N : BOARD #10
MODE : Rx @ 925MHz
DATE TESTED : 22 May 2015 11:11:26 M. LONGINOTTI
NOTES :
ANT POLARITY : VERTICAL ANT54B
DATA CORRECTED TO 3 m
LIMIT
FIELD INTENSITY dBuV/m
120
110
100
90
80
70
60
50
40
30
20
10
0
START = 1000
FREQUENCY - MHz
STOP = 6500


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WQC0 05/19/14
8546A HF RUN 1
RADIATED PEAK EMISSION TEST 1 GHz to 5 GHz @ 3 m
SPECIFICATION : FCC 15A
MANUFACTURER : TELULAR
MODEL No. : TL9X
S/N : BOARD #10
MODE : Rx @ 925MHz
DATE TESTED : 22 May 2015 11:11:26 M. LONGINOTTI
NOTES :
ANT POLARITY : HORIZONTAL ANT54B
DATA CORRECTED TO 3 m
LIMIT
FIELD INTENSITY dBuV/m
120
110
100
90
80
70
60
50
40
30
20
10
0
START = 1000
FREQUENCY - MHz
STOP = 6500

ETR No. 8546A
DATA SHEET TEST NO. 4

RADIATED QP EMISSION MEASUREMENTS in a 3 m SEMI-ANECHOIC ROOM
SPECIFICATION : FCC 15B CLASS B
MANUFACTURER : TELULAR
MODEL NO. : TL9X
SERIAL NO. : BOARD #10
TEST MODE : Rx @ 925MHz
NOTES :
TEST DATE : 22 May 2015 09:32:52
TEST DISTANCE : 3 m

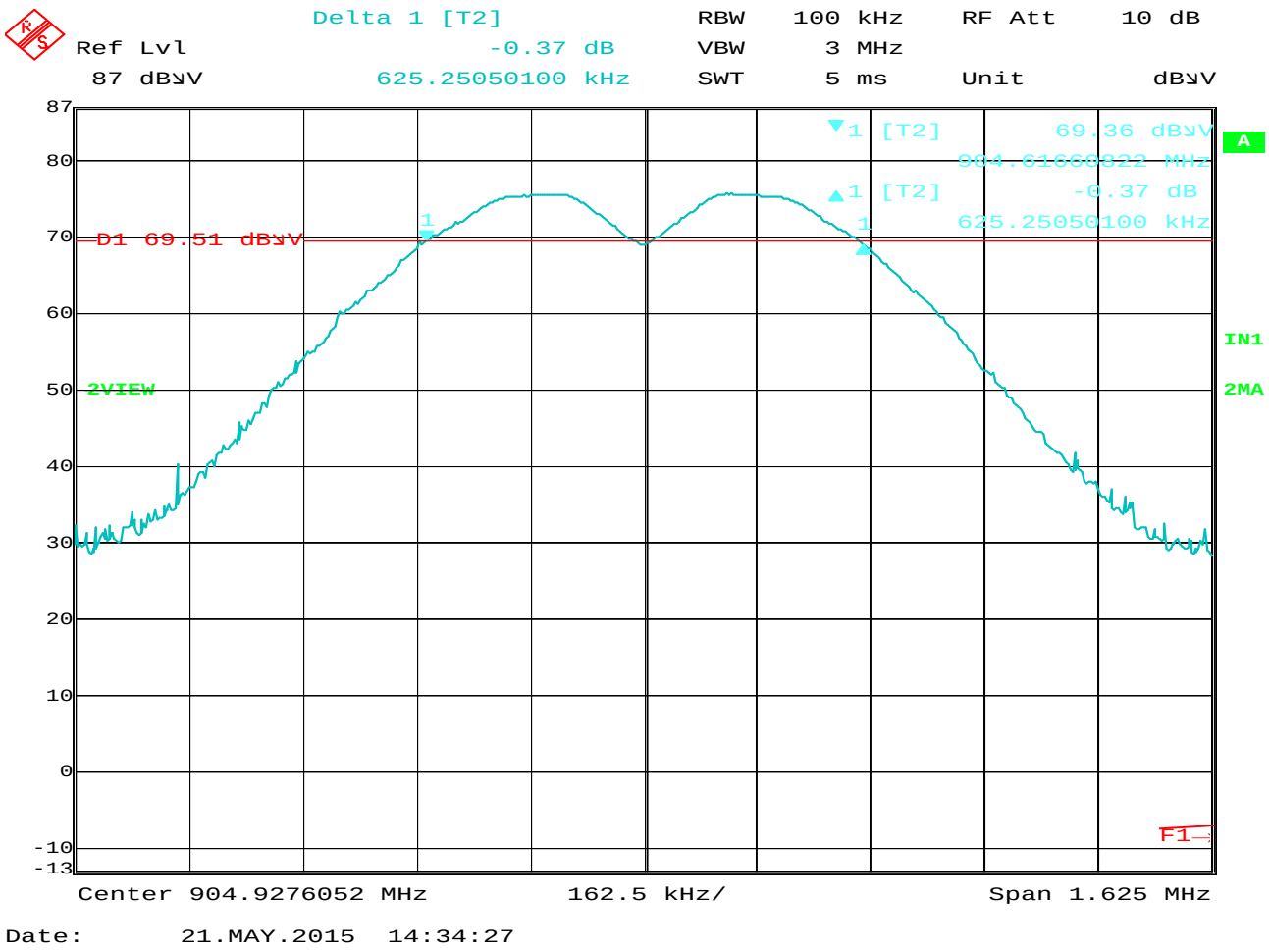
FREQUENCY MHz	QP READING dBuV	ANT FAC dB	CBL FAC dB	EXT ATTN dB	DIST FAC dB	TOTAL dBuV/m	QP LIMIT dBuV/m	AZ deg	ANT HT cm	ANT POL
32.15	-7.9	17.0	.4	0.0	0.0	9.5	40.0	270	200	H
52.85	-5.9	7.5	.4	0.0	0.0	2.0	40.0	90	120	V
82.93	-5.3	7.6	.4	0.0	0.0	2.7	40.0	45	120	V
107.88	-2.2	10.9	.4	0.0	0.0	9.1	43.5	270	200	H
142.46	-7.9	10.2	.6	0.0	0.0	2.9	43.5	90	200	H
156.78	-7.3	10.0	.6	0.0	0.0	3.3	43.5	180	200	H
178.99	-7.6	9.7	.7	0.0	0.0	2.8	43.5	135	200	H
192.23	7.5	9.5	.7	0.0	0.0	17.7	43.5	225	120	V
359.18	-6.4	14.5	1.0	0.0	0.0	9.1	46.0	270	340	H
432.00	4.2	15.9	1.1	0.0	0.0	21.3	46.0	135	120	H
480.00	-.2	16.8	1.1	0.0	0.0	17.7	46.0	270	200	H
617.99	-7.2	18.6	1.2	0.0	0.0	12.6	46.0	315	200	V
734.24	-6.3	19.0	1.4	0.0	0.0	14.1	46.0	180	340	H
891.08	-5.5	20.7	1.5	0.0	0.0	16.8	46.0	270	340	V
929.00	-5.6	21.0	1.5	0.0	0.0	17.0	46.0	135	340	V

DATA SHEET HF TEST NO. 1

RADIATED AVG EMISSION MEASUREMENTS >=1000 MHz in a 3 m ANECHOIC ROOM

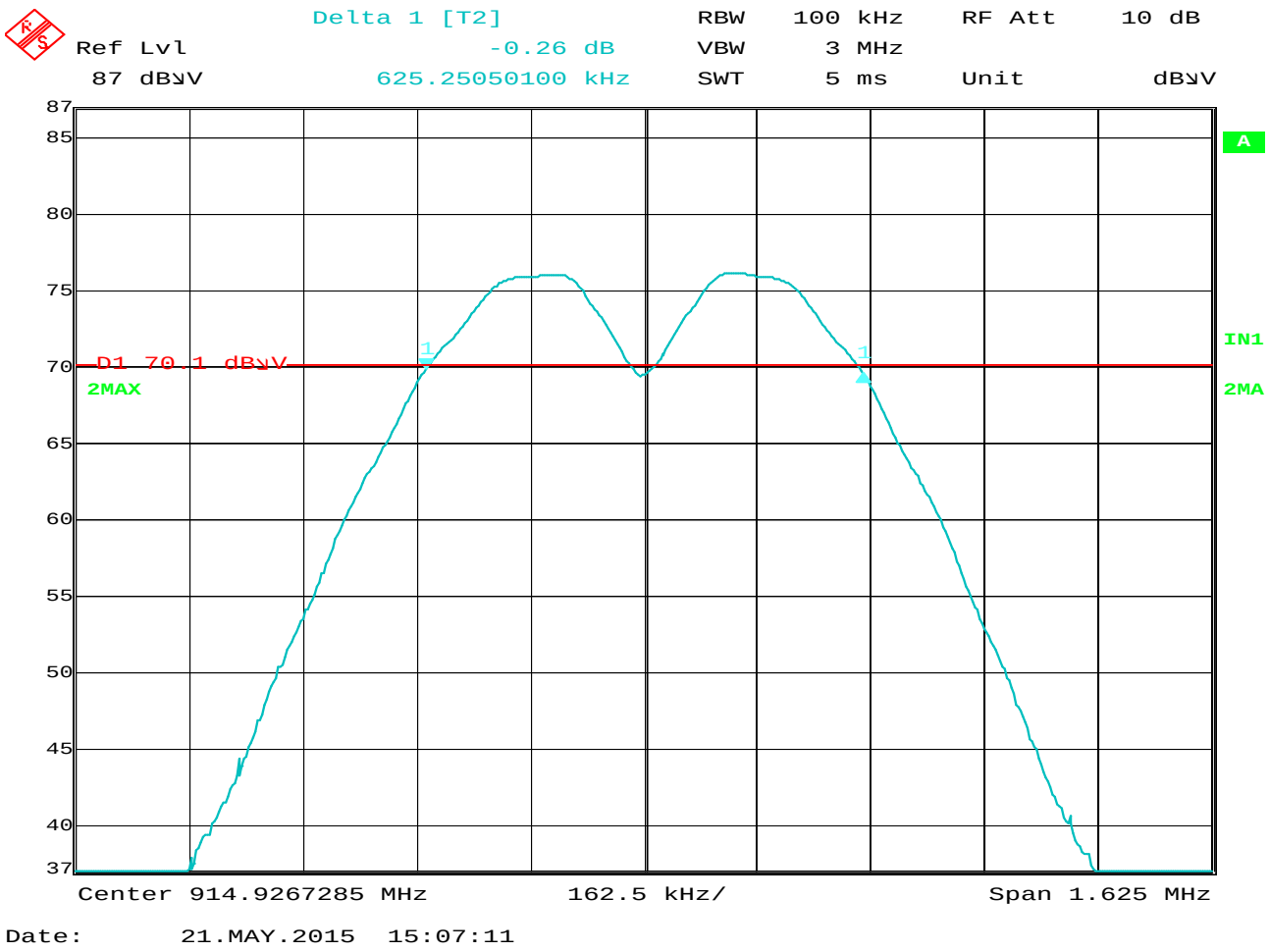
SPECIFICATION : FCC 15A
MANUFACTURER : TELULAR
MODEL NO. : TL9X
SERIAL NO. : BOARD #10
TEST MODE : Rx @ 925MHz
NOTES :
TEST DATE : 22 May 2015 11:11:26
TEST DISTANCE : 3 m
ANTENNA : ANT54B

FREQUENCY MHz	AVG READING dBuV	ANT FAC dB	CBL FAC dB	DIST FAC dB	TOTAL dBuV/m	AVG LIMIT dBuV/m	PASS/ FAIL	AZ deg	ANT HT cm	POLAR
1006.68	-3.8	27.0	1.5	0.0	24.8	54.0		45	120	V
1197.36	-3.9	28.3	1.7	0.0	26.1	54.0		180	340	H
1331.36	-3.9	29.2	1.8	0.0	27.1	54.0		90	120	V
1512.60	-4.0	28.4	2.0	0.0	26.4	54.0		90	200	H
1703.29	-4.2	29.3	2.1	0.0	27.2	54.0		45	120	H
1727.23	-3.9	29.6	2.1	0.0	27.9	54.0		45	120	H
1839.29	-4.2	31.0	2.2	0.0	29.0	54.0		90	120	V
2072.47	-3.0	31.8	2.3	0.0	31.1	54.0		180	200	V
2438.11	-3.5	32.3	2.6	0.0	31.4	54.0		315	120	H
2865.29	-3.1	32.7	2.9	0.0	32.5	54.0		180	120	H
3409.36	-4.5	33.0	3.2	0.0	31.6	54.0		135	120	H
3467.47	-4.2	33.0	3.2	0.0	32.0	54.0		270	200	H
4189.95	-4.8	33.6	3.5	0.0	32.2	54.0		135	120	H
4519.61	-4.7	34.2	3.6	0.0	33.2	54.0		45	340	V
4930.34	-4.4	34.8	3.8	0.0	34.1	54.0		225	120	V



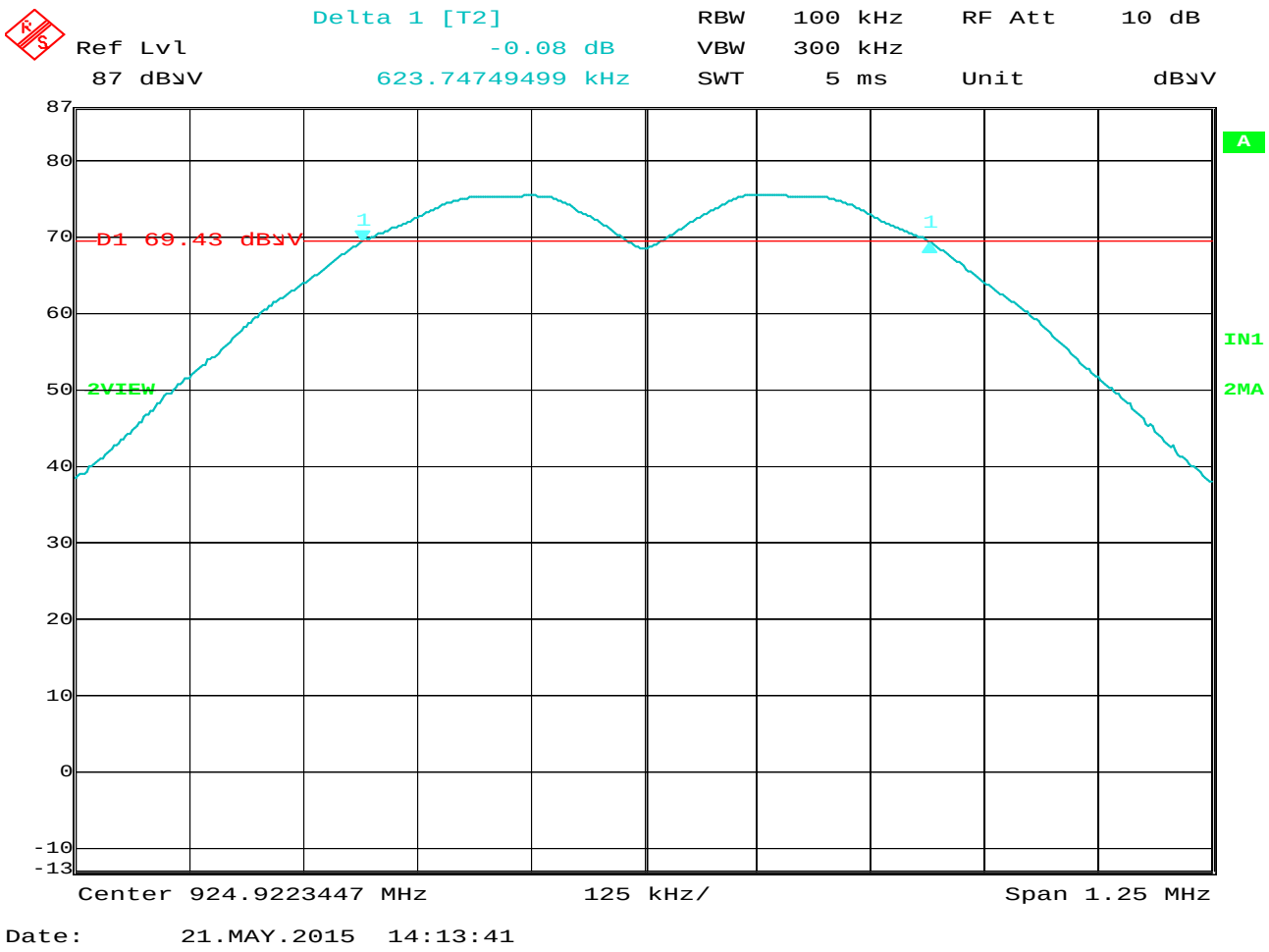
6dB Bandwidth

Manufacturer	: Telular Corporation
Model No.	: TL9X
Serial No.	: RA10
Date	: MAY 21, 2015
Test Performed	: 6dB Bandwidth = 625.25kHz
Mode	: Tx @ 905MHz
Notes	:
Equipment	: NTA3, RBA0



6dB Bandwidth

Manufacturer	: Telular Corporation
Model No.	: TL9X
Serial No.	: RA10
Date	: MAY 21, 2015
Test Performed	: 6dB bandwidth = 625.25kHz
Mode	: Tx @ 915MHz
Notes	:
Equipment	: NTA3, RBA0



6dB Bandwidth

Manufacturer	: Telular Corporation
Model No.	: TL9X
Serial No.	: RA10
Date	: MAY 21, 2015
Test Performed	: 6dB Bandwidth = 623.7kHz
Mode	: Tx @ 925MHz
Notes	:
Equipment	: NTA3, RBA0

Manufacturer : Telular
EUT : Wireless Tank Monitor
Model No. : TL9X
Serial No. : RA10
Mode : Transmit at 905MHz
Date Tested : May 20, 2015 and May 21, 2015
Test Performed : Effective Isotropic Radiated Power (EIRP)
Notes : 2.5V, with shield placed over the WLAN portion of the circuit board

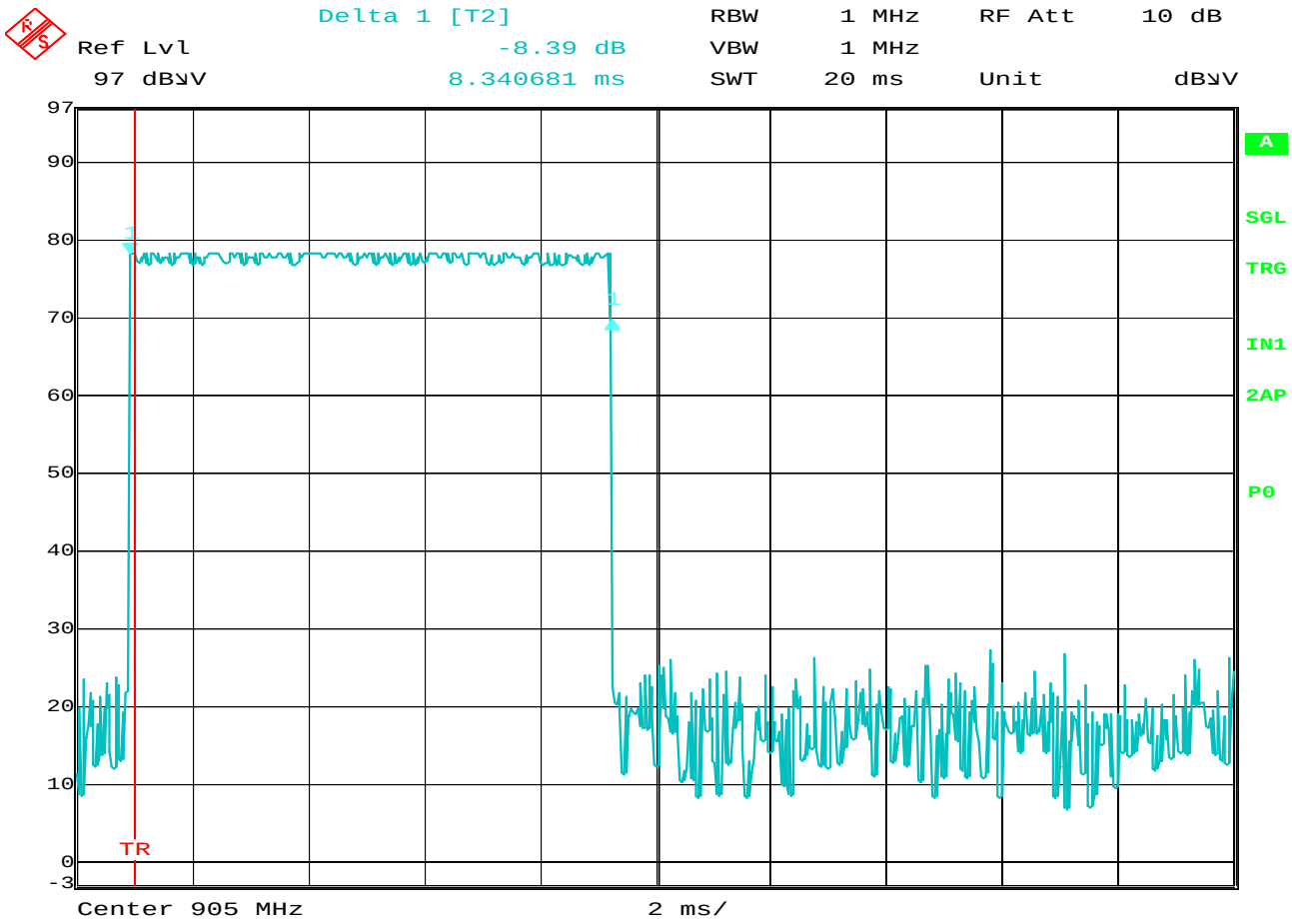
Transmit Frequency (MHz)	Ant Pol	Peak Meter Reading (dBuV)	Matched Sig. Gen. Reading (dBm)	Equivalent Antenna Gain (dB)	Cable Loss (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
905.00	H	73.3	-3.6	2.2	2.0	-3.5	30.0	-33.5
905.00	V	78.5	4.4	2.2	2.0	4.5	30.0	-25.5

Manufacturer : Telular
EUT : Wireless Tank Monitor
Model No. : TL9X
Serial No. : RA10
Mode : Transmit at 915MHz
Date Tested : May 20, 2015 and May 21, 2015
Test Performed : Effective Isotropic Radiated Power (EIRP)
Notes : 2.5V, with shield placed over the WLAN portion of the circuit board

Transmit Frequency (MHz)	Ant Pol	Peak Meter Reading (dBuV)	Matched Sig. Gen. Reading (dBm)	Equivalent Antenna Gain (dB)	Cable Loss (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
915.00	H	75.2	-1.1	2.2	2.1	-1.0	36.0	-37.0
915.00	V	79.2	5.7	2.2	2.1	5.8	36.0	-30.2

Manufacturer : Telular
EUT : Wireless Tank Monitor
Model No. : TL9X
Serial No. : RA10
Mode : Transmit at 925MHz
Date Tested : May 20, 2015 and May 21, 2015
Test Performed : Effective Isotropic Radiated Power (EIRP)
Notes : 2.5V, with shield placed over the WLAN portion of the circuit board

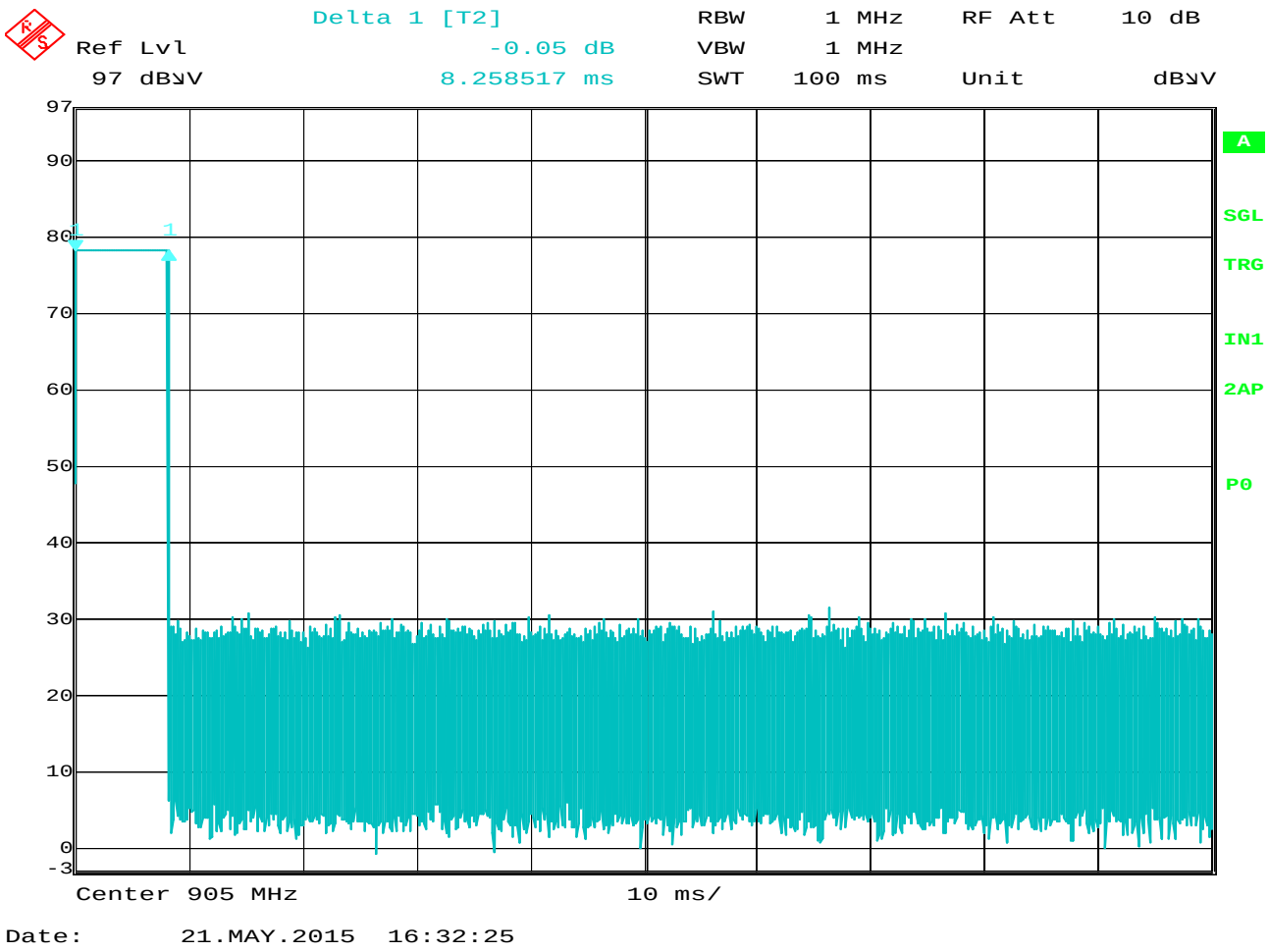
Transmit Frequency (MHz)	Ant Pol	Peak Meter Reading (dBuV)	Matched Sig. Gen. Reading (dBm)	Equivalent Antenna Gain (dB)	Cable Loss (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
925.00	H	76.6	0.8	2.2	2.1	0.9	36.0	-35.1
925.00	V	78.7	4.7	2.2	2.1	4.8	36.0	-31.2



Date: 21.MAY.2015 16:30:31

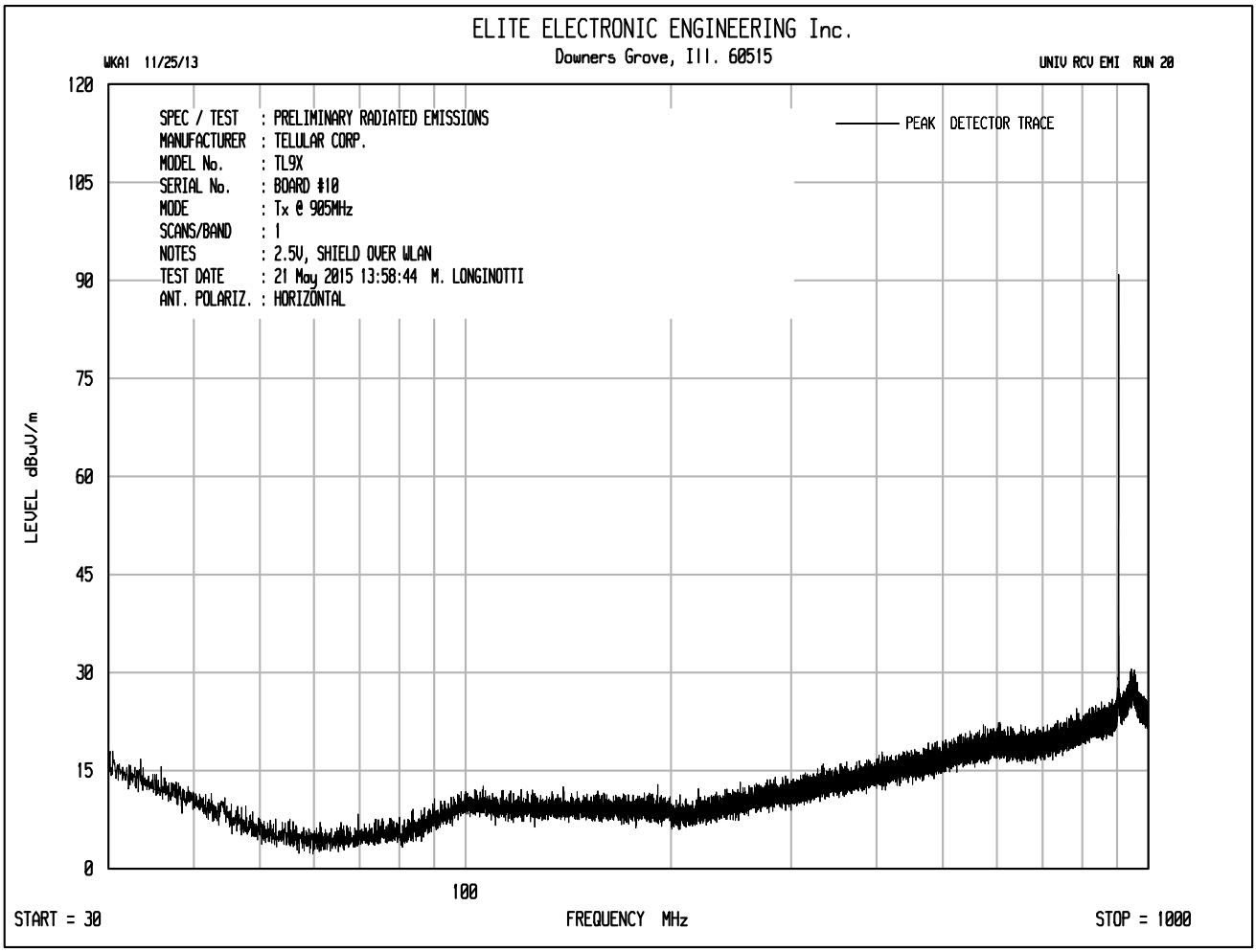
Duty Cycle Correction Factor

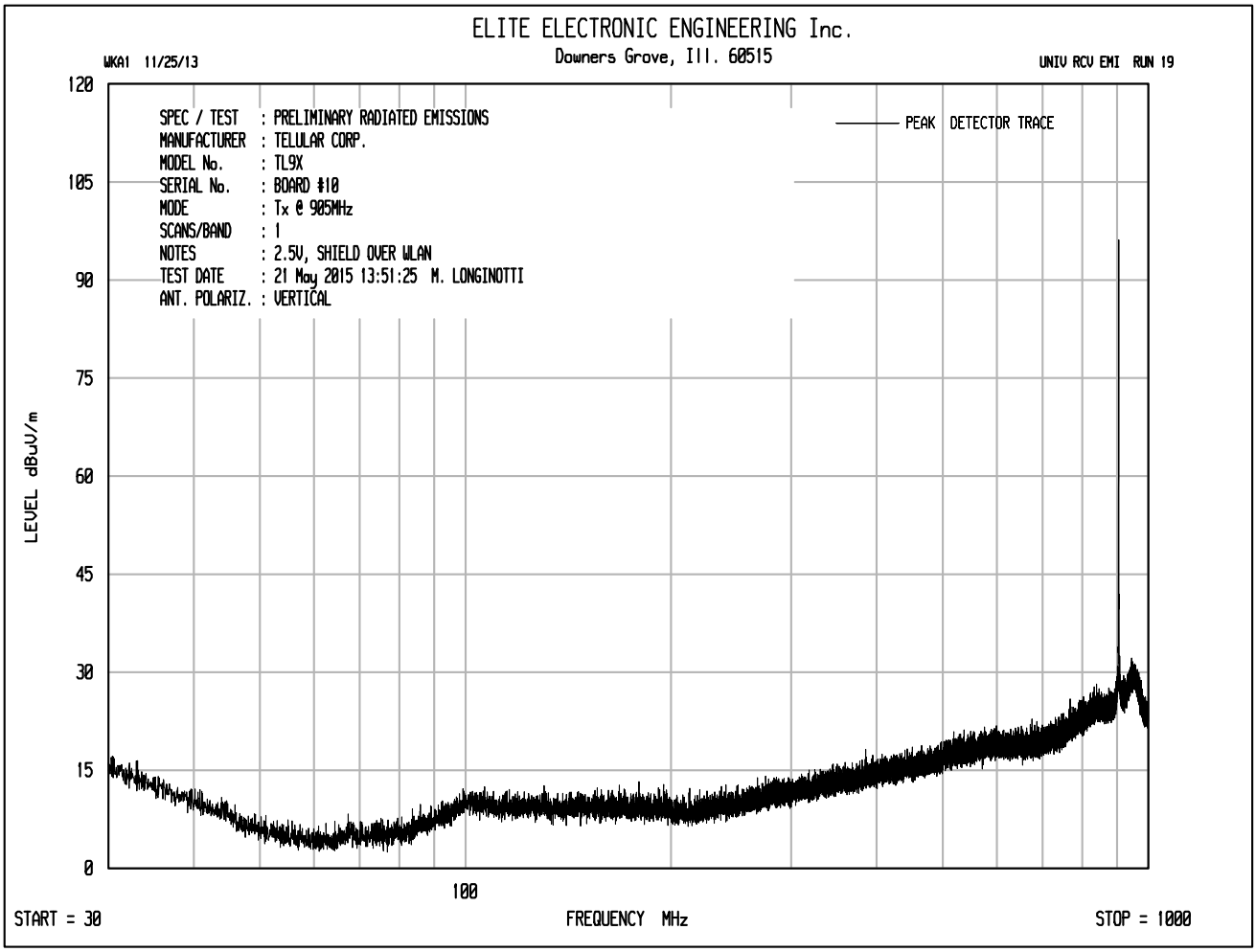
Manufacturer	: Telular Corporation
Model No.	: TL9X
Serial No.	: RA10
Date	: MAY 21, 2015
Test Performed	: Power Spectral Density
Mode	: Tx @ 905MHz
Notes	: Pulse Duration = 8.3msec
Equipment	: NTA3, RBA0

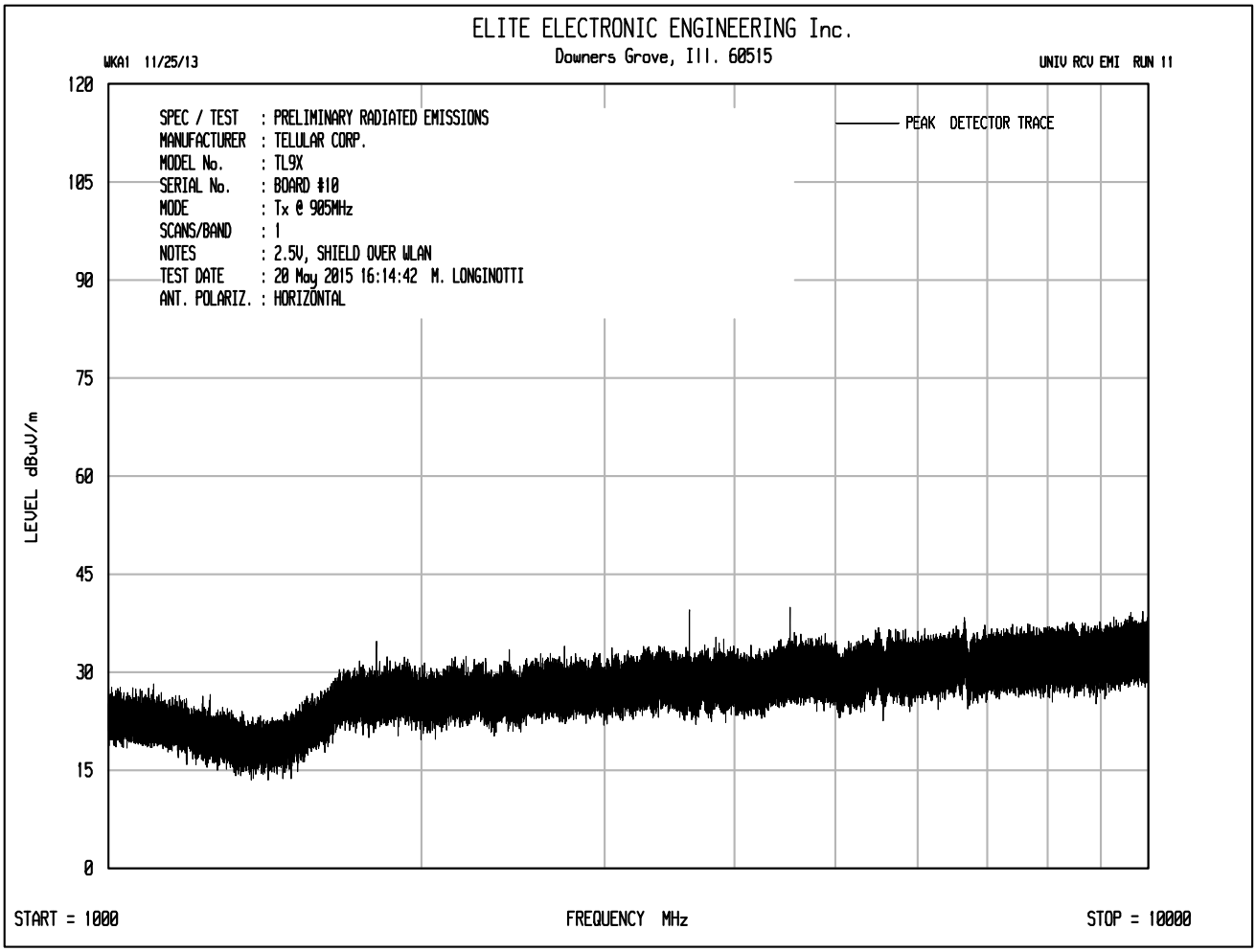


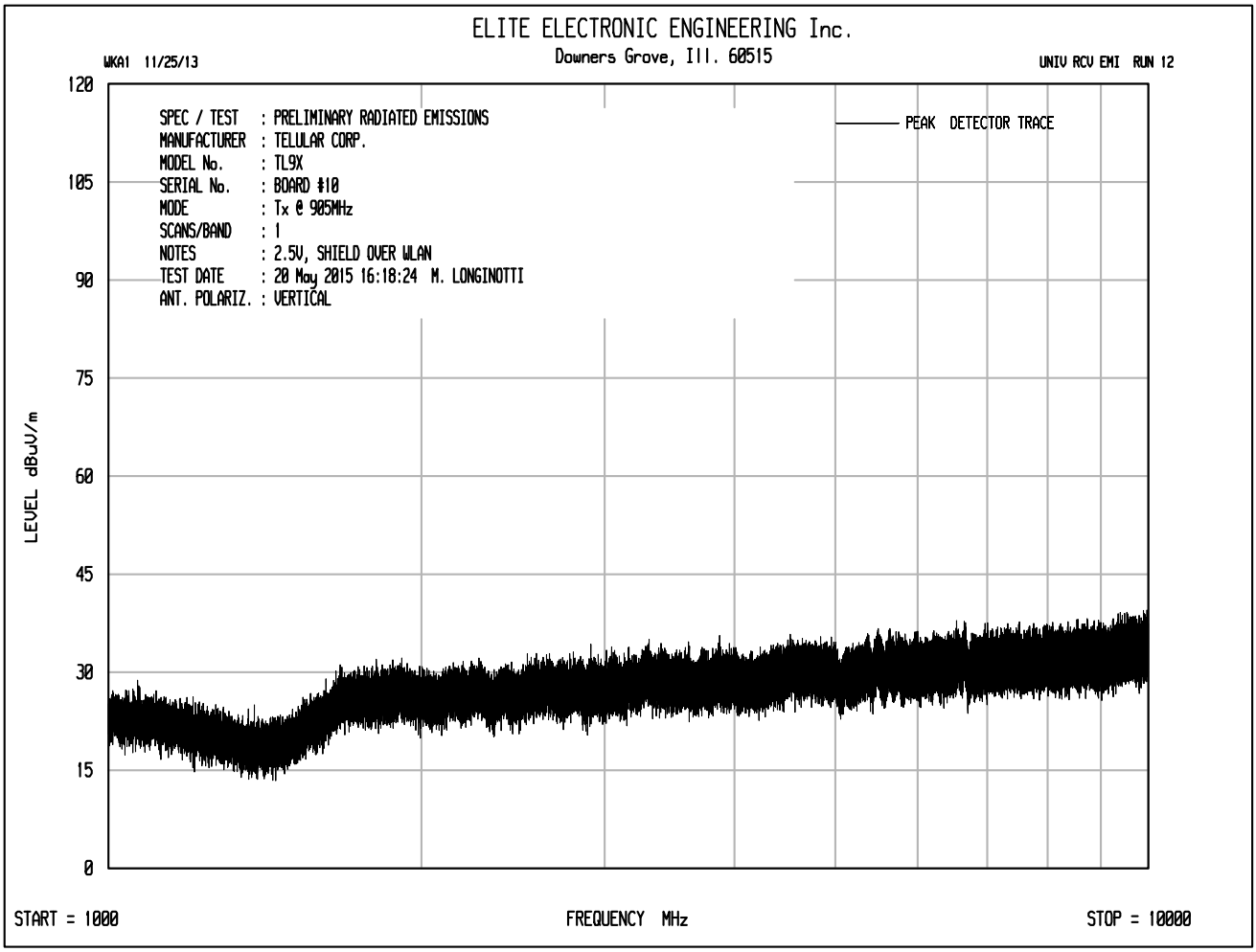
Duty Cycle Correction Factor

Manufacturer	: Telular Corporation
Model No.	: TL9X
Serial No.	: RA10
Date	: MAY 21, 2015
Test Performed	: Power Spectral Density
Mode	: Tx @ 905MHz
Notes	: Number of Pulses in a 100msec period = 1
	: Duty Cycle Correction Factor = 20 x Log (((pulse width) x (number of
	: pulses))/100msec)
	: Duty Cycle Correction Factor = 20 x Log (8.34msec)x (1)/100msec
	: Duty Cycle Correction Factor = -21.6dB
Equipment	: NTA3, RBA0


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 20
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : TELULAR CORP.
MODEL No. : TL9X
SERIAL No. : BOARD #10
MODE : Tx @ 905MHz
SCANS/BAND : 1
NOTES : 2.5V, SHIELD OVER WLAN
TEST DATE : 21 May 2015 13:58:44 M. LONGINOTTI
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
100
START = 30
FREQUENCY MHz
STOP = 1000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 19
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : TELULAR CORP.
MODEL No. : TL9X
SERIAL No. : BOARD #10
MODE : Tx @ 905MHz
SCANS/BAND : 1
NOTES : 2.5V, SHIELD OVER WLAN
TEST DATE : 21 May 2015 13:51:25 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
100
START = 30
FREQUENCY MHz
STOP = 1000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 11
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : TELULAR CORP.
MODEL No. : TL9X
SERIAL No. : BOARD #10
MODE : Tx @ 905MHz
SCANS/BAND : 1
NOTES : 2.5V, SHIELD OVER WLAN
TEST DATE : 20 May 2015 16:14:42 M. LONGINOTTI
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 10000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 12
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : TELULAR CORP.
MODEL No. : TL9X
SERIAL No. : BOARD #10
MODE : Tx @ 905MHz
SCANS/BAND : 1
NOTES : 2.5V, SHIELD OVER WLAN
TEST DATE : 20 May 2015 16:18:24 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 10000

Manufacturer : Telular
EUT : Wireless Tank Monitor
Model No. : TL9X
Serial No. : RA10
Mode : Transmit at 905MHz
Date Tested : May 20, 2015 and May 21, 2015
Test Performed : Case Spurious Radiated Emissions in non-restricted frequency bands
Notes : 2.5V, with shield placed over the WLAN portion of the circuit board
Notes : Peak readings with a 100kHz resolution bandwidth (RBW)

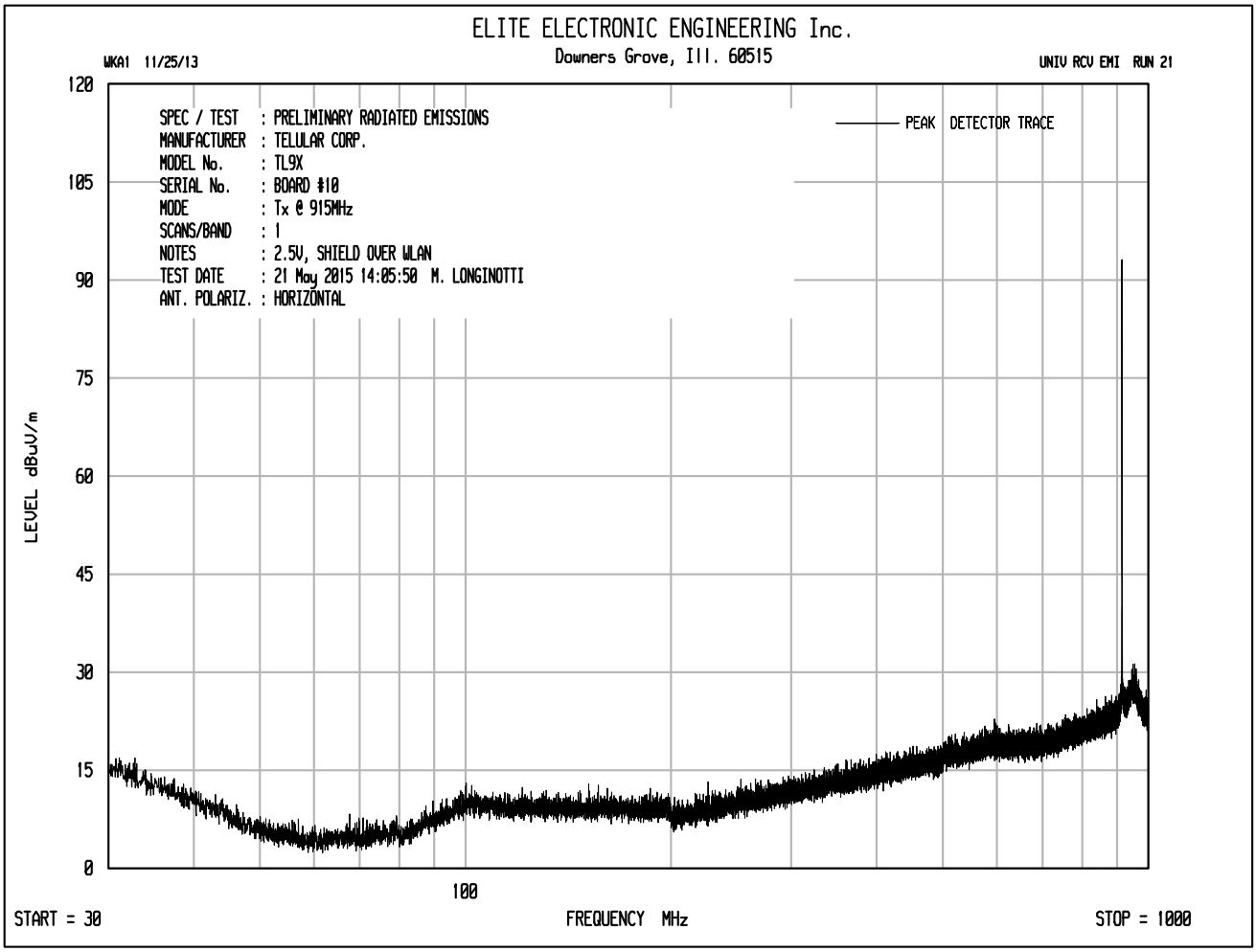
Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Peak Total dBuV/m at 3m	Peak Total uV/m at 3 m	Peak Limit uV/m at 3 m	Margin (dB)
905.00	H	69.7		1.6	20.8	0.0	92.1	40236.7		
905.00	V	75.7		1.6	20.8	0.0	98.1	80282.8		
1810.00	H	46.5		2.2	30.6	-40.0	39.3	92.3	8028.3	-38.8
1810.00	V	44.3		2.2	30.6	-40.0	37.1	71.6	8028.3	-41.0
6335.00	H	39.0	Ambient	4.3	35.7	-39.4	39.6	95.5	8028.3	-38.5
6335.00	V	37.1	Ambient	4.3	35.7	-39.4	37.7	76.8	8028.3	-40.4
7240.00	H	39.8	Ambient	4.7	35.6	-39.4	40.6	107.8	8028.3	-37.4
7240.00	V	39.2	Ambient	4.7	35.6	-39.4	40.0	100.6	8028.3	-38.0

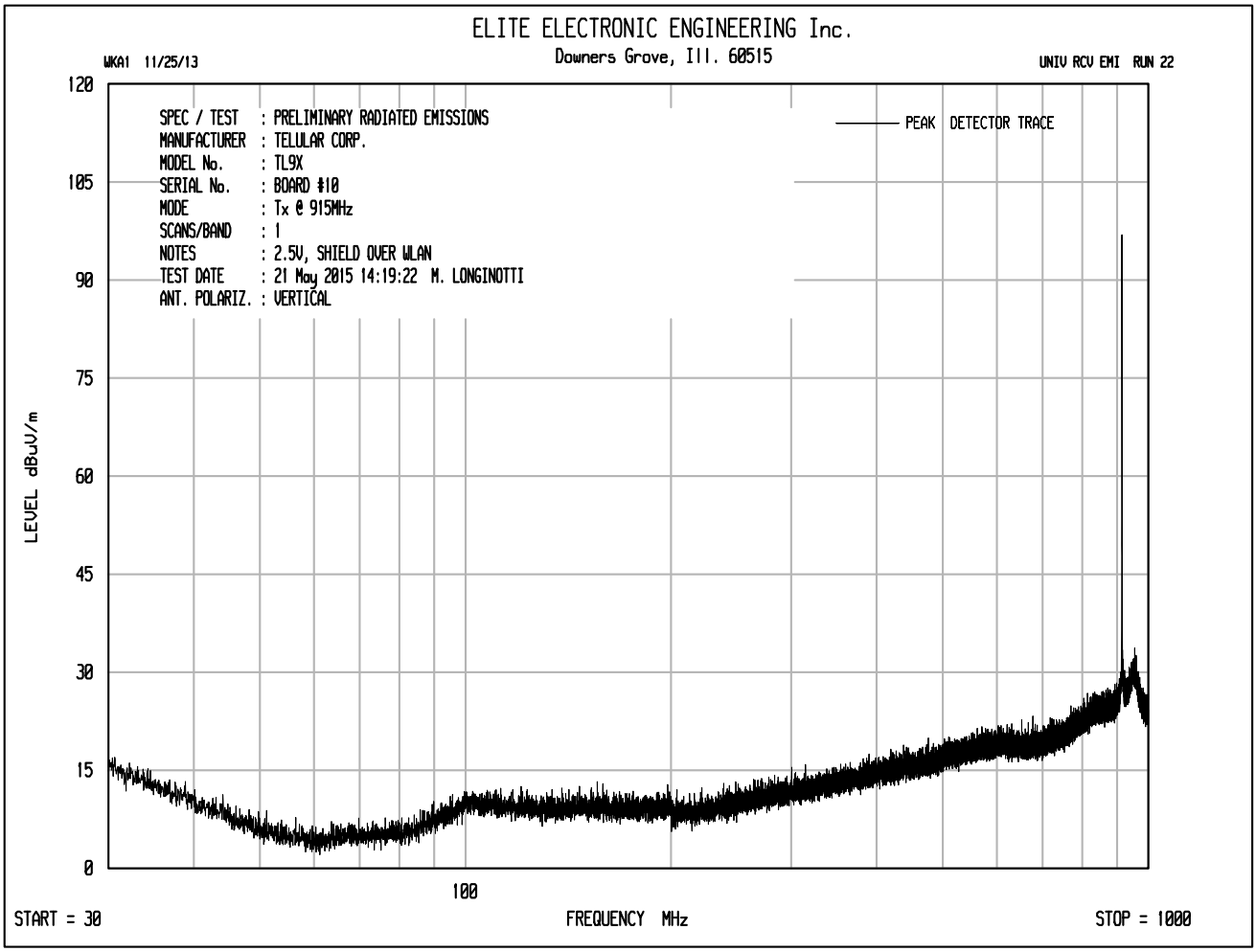
Manufacturer : Telular
EUT : Wireless Tank Monitor
Model No. : TL9X
Serial No. : RA10
Mode : Transmit at 905MHz
Date Tested : May 20, 2015 and May 21, 2015
Test Performed : Case Spurious Radiated Emissions in restricted frequency bands
Notes : 2.5V, with shield placed over the WLAN portion of the circuit board
Notes : Peak readings with a 1MHz resolution bandwidth (RBW)

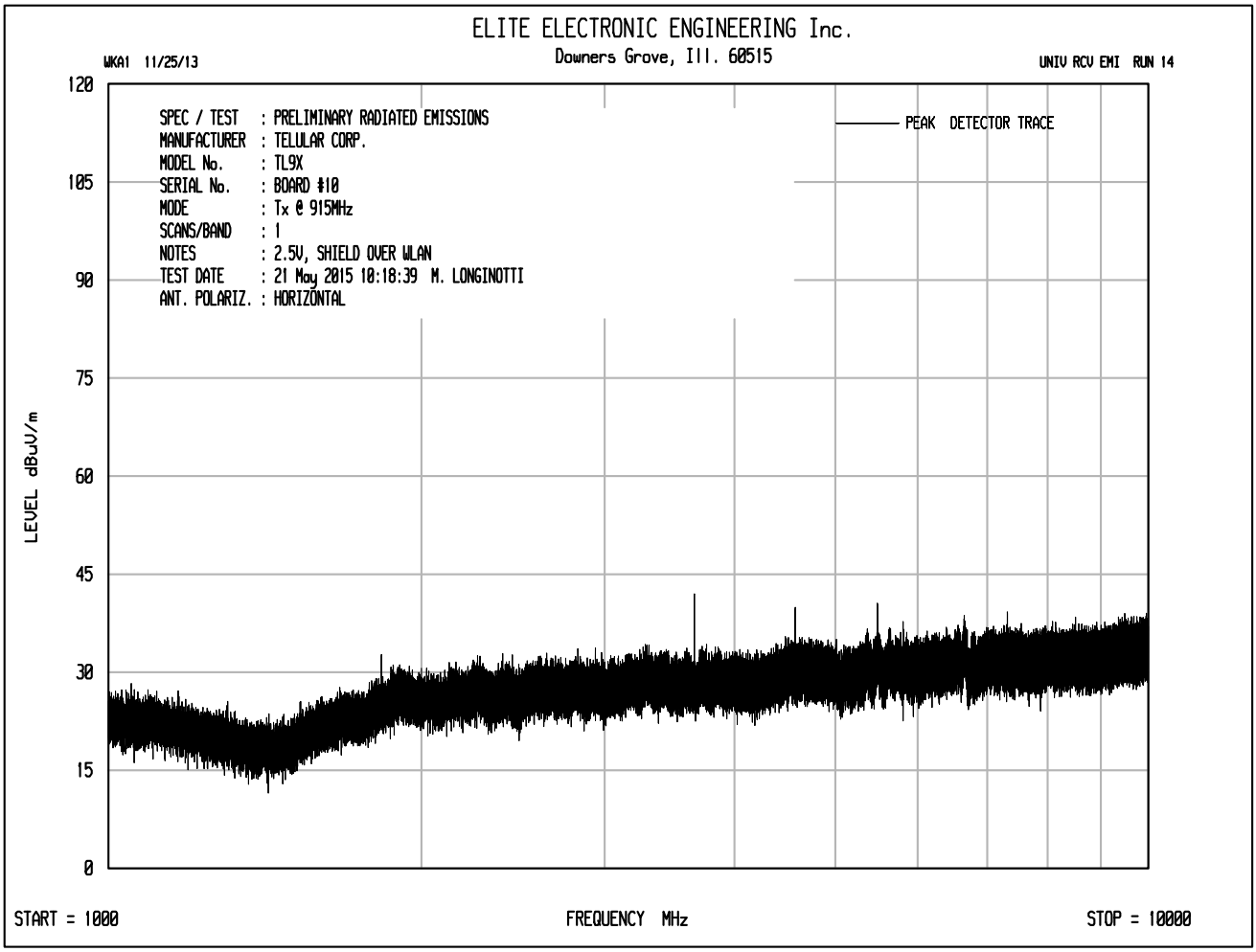
Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Peak Total dBuV/m at 3m	Peak Total uV/m at 3 m	Peak Limit uV/m at 3 m	Margin (dB)
2715.00	H	48.4	Ambient	2.8	32.8	-39.8	44.2	162.9	5000.0	-29.7
2715.00	V	49.2	Ambient	2.8	32.8	-39.8	45.0	178.6	5000.0	-28.9
3620.00	H	59.5		3.2	33.2	-39.2	56.8	690.5	5000.0	-17.2
3620.00	V	58.5		3.2	33.2	-39.2	55.8	615.4	5000.0	-18.2
4525.00	H	54.7		3.6	34.2	-39.2	53.3	462.4	5000.0	-20.7
4525.00	V	51.5		3.6	34.2	-39.2	50.1	319.9	5000.0	-23.9
5430.00	H	48.3		3.9	35.0	-39.4	47.9	247.0	5000.0	-26.1
5430.00	V	50.1		3.9	35.0	-39.4	49.7	303.9	5000.0	-24.3
8145.00	H	48.4	Ambient	4.9	35.8	-39.4	49.7	305.4	5000.0	-24.3
8145.00	V	47.5	Ambient	4.9	35.8	-39.4	48.8	275.3	5000.0	-25.2
9050.00	H	48.3	Ambient	5.0	36.2	-39.3	50.1	319.7	5000.0	-23.9
9050.00	V	48.9	Ambient	5.0	36.2	-39.3	50.7	342.5	5000.0	-23.3

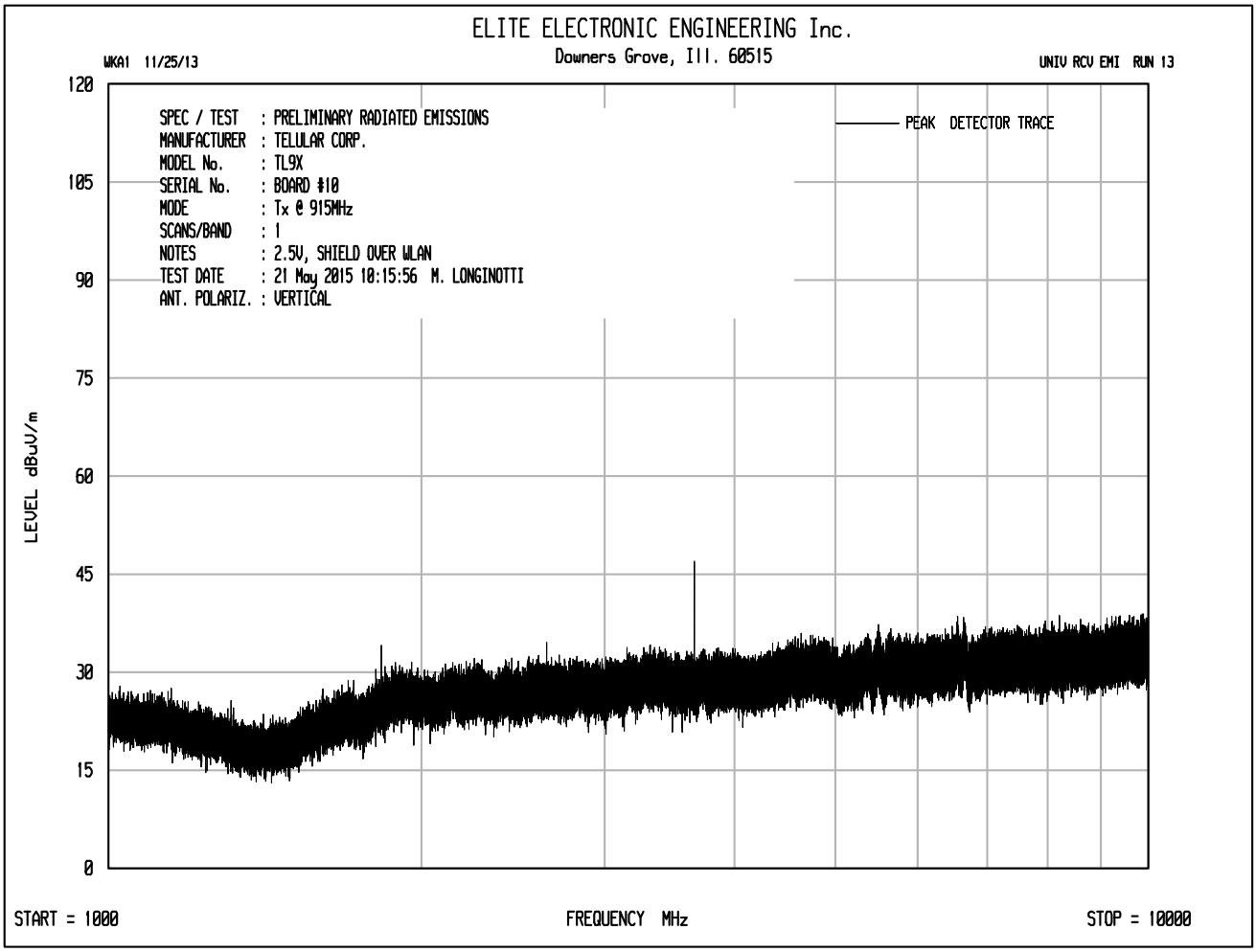
Manufacturer : Telular
EUT : Wireless Tank Monitor
Model No. : TL9X
Serial No. : RA10
Mode : Transmit at 905MHz
Date Tested : May 20, 2015 and May 21, 2015
Test Performed : Case Spurious Radiated Emissions in restricted frequency bands
Notes : 2.5V, with shield placed over the WLAN portion of the circuit board
Notes : Average readings with a 1MHz resolution bandwidth (RBW) and 10Hz video bandwidth

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Average Total dBuV/m at 3m	Average Total uV/m at 3 m	Average Limit uV/m at 3 m	Margin (dB)
2715.00	H	36.60	Ambient	2.8	32.8	-39.8	32.4	41.9	500.0	-21.5
2715.00	V	36.7	Ambient	2.8	32.8	-39.8	32.5	42.4	500.0	-21.4
3620.00	H	52.8		3.2	33.2	-39.2	50.1	319.3	500.0	-3.9
3620.00	V	53.1		3.2	33.2	-39.2	50.4	330.5	500.0	-3.6
4525.00	H	44.7		3.6	34.2	-39.2	43.3	146.2	500.0	-10.7
4525.00	V	40.7		3.6	34.2	-39.2	39.3	92.3	500.0	-14.7
5430.00	H	37.1		3.9	35.0	-39.4	36.7	68.0	500.0	-17.3
5430.00	V	38.8		3.9	35.0	-39.4	38.4	82.8	500.0	-15.6
8145.00	H	35.7	Ambient	4.9	35.8	-39.4	37.0	70.8	500.0	-17.0
8145.00	V	35.6	Ambient	4.9	35.8	-39.4	36.9	70.0	500.0	-17.1
9050.00	H	35.4	Ambient	5.0	36.2	-39.3	37.2	72.4	500.0	-16.8
9050.00	V	35.6	Ambient	5.0	36.2	-39.3	37.4	74.1	500.0	-16.6


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 21
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : TELULAR CORP.
MODEL No. : TL9X
SERIAL No. : BOARD #10
MODE : Tx @ 915MHz
SCANS/BAND : 1
NOTES : 2.5V, SHIELD OVER WLAN
TEST DATE : 21 May 2015 14:05:50 M. LONGINOTTI
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
100
START = 30
FREQUENCY MHz
STOP = 1000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 22
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : TELULAR CORP.
MODEL No. : TL9X
SERIAL No. : BOARD #10
MODE : Tx @ 915MHz
SCANS/BAND : 1
NOTES : 2.5V, SHIELD OVER WLAN
TEST DATE : 21 May 2015 14:19:22 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
100
START = 30
FREQUENCY MHz
STOP = 1000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 14
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : TELULAR CORP.
MODEL No. : TL9X
SERIAL No. : BOARD #10
MODE : Tx @ 915MHz
SCANS/BAND : 1
NOTES : 2.5V, SHIELD OVER WLAN
TEST DATE : 21 May 2015 10:18:39 M. LONGINOTTI
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 10000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 13
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : TELULAR CORP.
MODEL No. : TL9X
SERIAL No. : BOARD #10
MODE : Tx @ 915MHz
SCANS/BAND : 1
NOTES : 2.5V, SHIELD OVER WLAN
TEST DATE : 21 May 2015 10:15:56 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 10000

Manufacturer : Telular
EUT : Wireless Tank Monitor
Model No. : TL9X
Serial No. : RA10
Mode : Transmit at 915MHz
Date Tested : May 20, 2015 and May 21, 2015
Test Performed : Case Spurious Radiated Emissions in non-restricted frequency bands
Notes : 2.5V, with shield placed over the WLAN portion of the circuit board
Notes : Peak readings with a 100kHz resolution bandwidth (RBW)

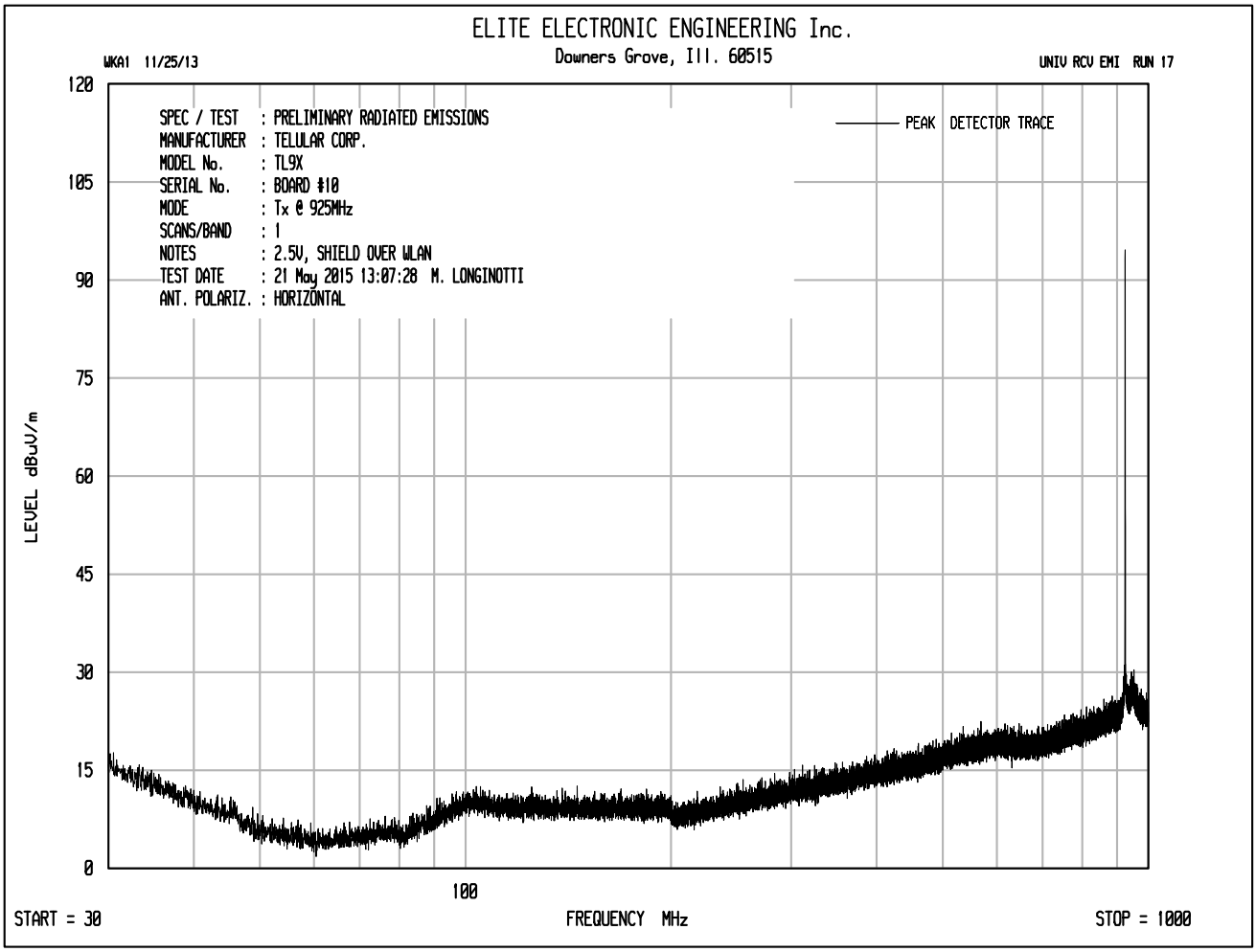
Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Peak Total dBuV/m at 3m	Peak Total uV/m at 3 m	Peak Limit uV/m at 3 m	Margin (dB)
915.00	H	71.8		1.6	20.9	0.0	94.3	51768.3		
915.00	V	76.3		1.6	20.9	0.0	98.8	86908.8		
1830.00	H	47.0		2.2	30.6	-40.0	39.8	97.8	8690.9	-39.0
1830.00	V	48.3		2.2	30.6	-40.0	41.1	113.5	8690.9	-37.7
5490.00	H	44.6		3.9	35.0	-39.4	44.2	162.2	8690.9	-34.6
5490.00	V	42.3		3.9	35.0	-39.4	41.9	125.0	8690.9	-36.8
6405.00	H	38.8	Ambient	4.3	35.8	-39.4	39.5	94.4	8690.9	-39.3
6405.00	V	38.0	Ambient	4.3	35.8	-39.4	38.7	86.1	8690.9	-40.1

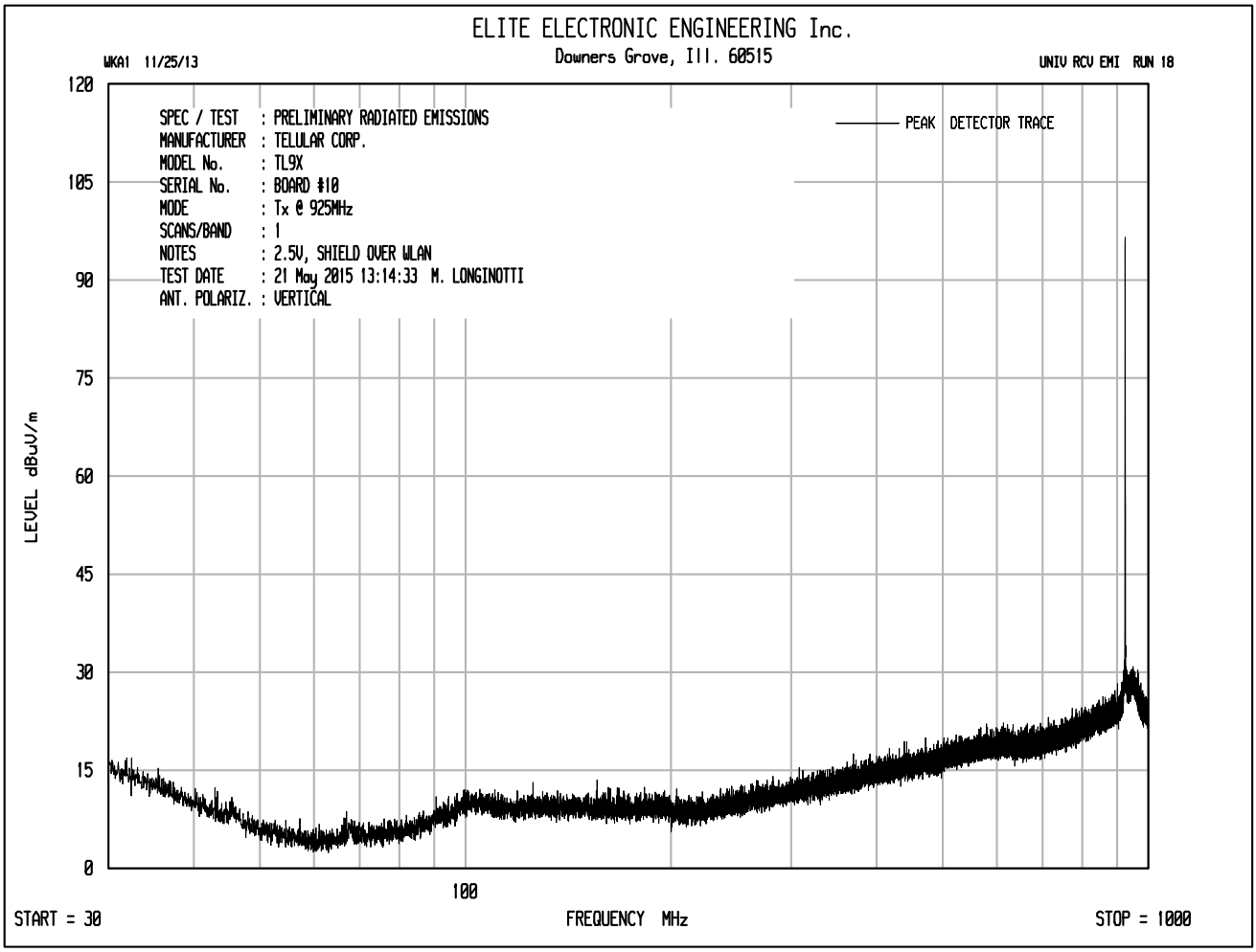
Manufacturer : Telular
EUT : Wireless Tank Monitor
Model No. : TL9X
Serial No. : RA10
Mode : Transmit at 915MHz
Date Tested : May 20, 2015 and May 21, 2015
Test Performed : Case Spurious Radiated Emissions in restricted frequency bands
Notes : 2.5V, with shield placed over the WLAN portion of the circuit board
Notes : Peak readings with a 1MHz resolution bandwidth (RBW)

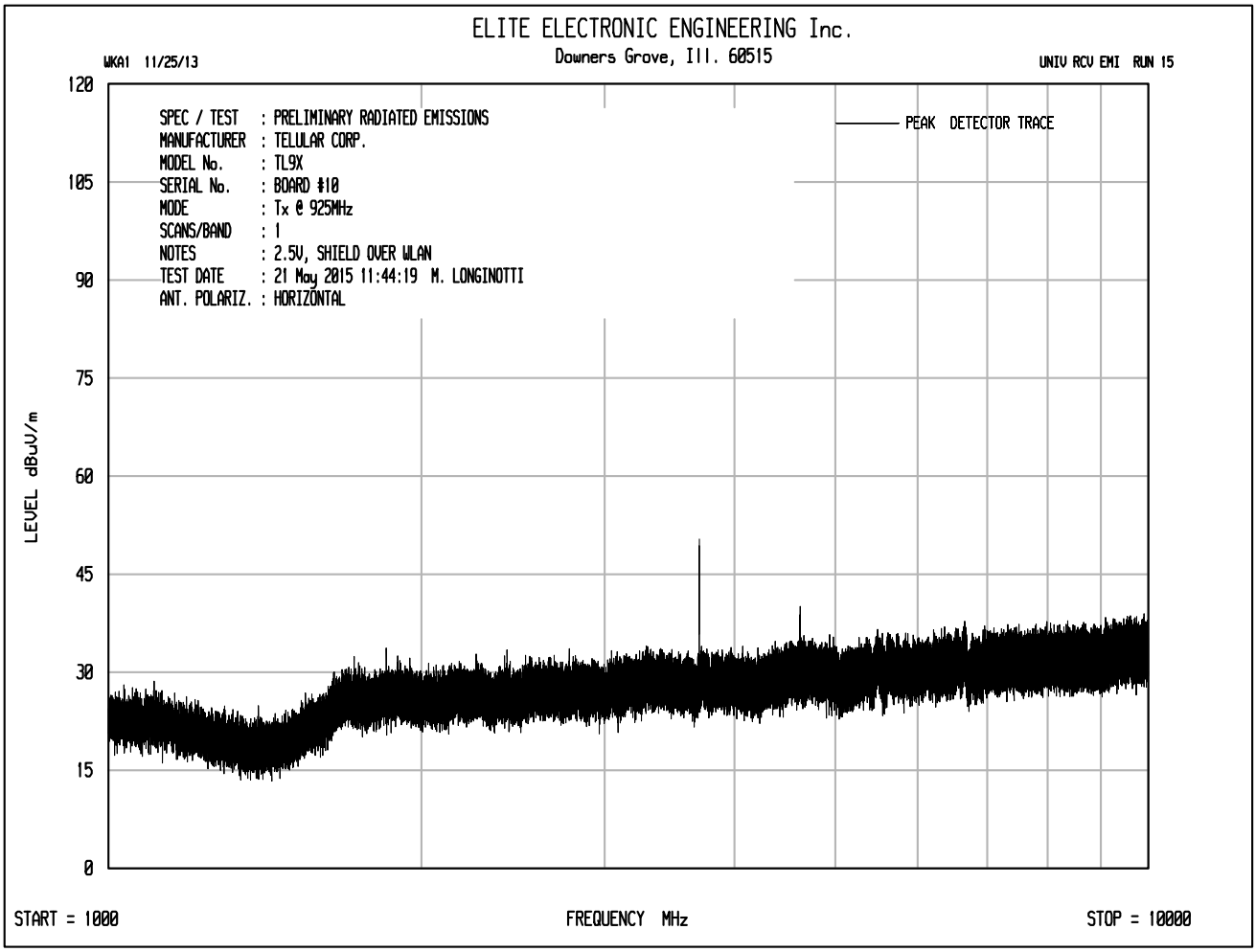
Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Peak Total dBuV/m at 3m	Peak Total uV/m at 3 m	Peak Limit uV/m at 3 m	Margin (dB)
2745.00	H	48.6	Ambient	2.8	32.8	-39.7	44.4	166.6	5000.0	-29.5
2745.00	V	49.8	Ambient	2.8	32.8	-39.7	45.6	191.3	5000.0	-28.3
3660.00	H	59.0		3.3	33.3	-39.2	56.4	657.8	5000.0	-17.6
3660.00	V	56.4		3.3	33.3	-39.2	53.8	487.6	5000.0	-20.2
4575.00	H	53.7		3.6	34.3	-39.2	52.4	416.6	5000.0	-21.6
4575.00	V	52.7		3.6	34.3	-39.2	51.4	371.3	5000.0	-22.6
7320.00	H	49.3	Ambient	4.7	35.6	-39.4	50.1	321.4	5000.0	-23.8
7320.00	V	48.8	Ambient	4.7	35.6	-39.4	49.6	303.4	5000.0	-24.3
8235.00	H	47.9	Ambient	4.9	35.9	-39.4	49.3	291.3	5000.0	-24.7
8235.00	V	47.5	Ambient	4.9	35.9	-39.4	48.9	278.2	5000.0	-25.1
9150.00	H	48.8	Ambient	5.0	36.2	-39.3	50.7	341.7	5000.0	-23.3
9150.00	V	48.9	Ambient	5.0	36.2	-39.3	50.8	345.7	5000.0	-23.2

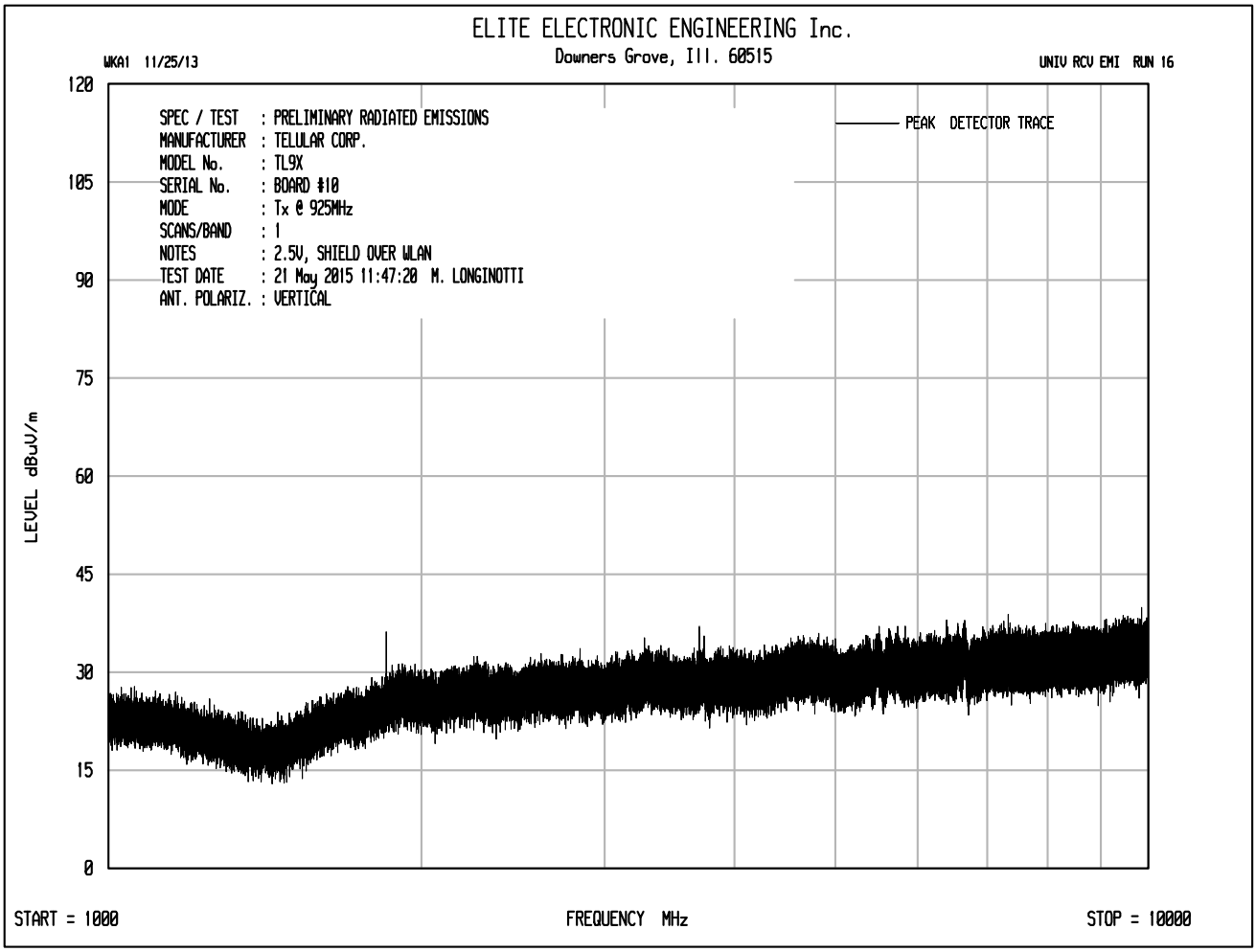
Manufacturer : Telular
EUT : Wireless Tank Monitor
Model No. : TL9X
Serial No. : RA10
Mode : Transmit at 915MHz
Date Tested : May 20, 2015 and May 21, 2015
Test Performed : Case Spurious Radiated Emissions in restricted frequency bands
Notes : 2.5V, with shield placed over the WLAN portion of the circuit board
Notes : Average readings with a 1MHz resolution bandwidth (RBW) and 10Hz video bandwidth

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Average Total dBuV/m at 3m	Average Total uV/m at 3 m	Average Limit uV/m at 3 m	Margin (dB)
2745.00	H	36.60	Ambient	2.8	32.8	-39.7	32.4	41.9	500.0	-21.5
2745.00	V	37.2	Ambient	2.8	32.8	-39.7	33.0	44.9	500.0	-20.9
3660.00	H	52.9		3.3	33.3	-39.2	50.3	325.9	500.0	-3.7
3660.00	V	49.4		3.3	33.3	-39.2	46.8	217.8	500.0	-7.2
4575.00	H	43.8		3.6	34.3	-39.2	42.5	133.3	500.0	-11.5
4575.00	V	42.2		3.6	34.3	-39.2	40.9	110.8	500.0	-13.1
7320.00	H	37.8	Ambient	4.7	35.6	-39.4	38.6	85.5	500.0	-15.3
7320.00	V	36.1	Ambient	4.7	35.6	-39.4	36.9	70.3	500.0	-17.0
8235.00	H	35.8	Ambient	4.9	35.9	-39.4	37.2	72.3	500.0	-16.8
8235.00	V	35.8	Ambient	4.9	35.9	-39.4	37.2	72.3	500.0	-16.8
9150.00	H	36.1	Ambient	5.0	36.2	-39.3	38.0	79.2	500.0	-16.0
9150.00	V	36.2	Ambient	5.0	36.2	-39.3	38.1	80.1	500.0	-15.9


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 17
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : TELULAR CORP.
MODEL No. : TL9X
SERIAL No. : BOARD #10
MODE : Tx @ 925MHz
SCANS/BAND : 1
NOTES : 2.5V, SHIELD OVER WLAN
TEST DATE : 21 May 2015 13:07:28 M. LONGINOTTI
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
100
START = 30
FREQUENCY MHz
STOP = 1000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 18
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : TELULAR CORP.
MODEL No. : TL9X
SERIAL No. : BOARD #10
MODE : Tx @ 925MHz
SCANS/BAND : 1
NOTES : 2.5V, SHIELD OVER WLAN
TEST DATE : 21 May 2015 13:14:33 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
100
START = 30
FREQUENCY MHz
STOP = 1000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 15
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : TELULAR CORP.
MODEL No. : TL9X
SERIAL No. : BOARD #10
MODE : Tx @ 925MHz
SCANS/BAND : 1
NOTES : 2.5V, SHIELD OVER WLAN
TEST DATE : 21 May 2015 11:44:19 M. LONGINOTTI
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 10000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 16
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : TELULAR CORP.
MODEL No. : TL9X
SERIAL No. : BOARD #10
MODE : Tx @ 925MHz
SCANS/BAND : 1
NOTES : 2.5V, SHIELD OVER WLAN
TEST DATE : 21 May 2015 11:47:20 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 10000

Manufacturer : Telular
EUT : Wireless Tank Monitor
Model No. : TL9X
Serial No. : RA10
Mode : Transmit at 925MHz
Date Tested : May 20, 2015 and May 21, 2015
Test Performed : Case Spurious Radiated Emissions in non-restricted frequency bands
Notes : 2.5V, with shield placed over the WLAN portion of the circuit board
Notes : Peak readings with a 100kHz resolution bandwidth (RBW)

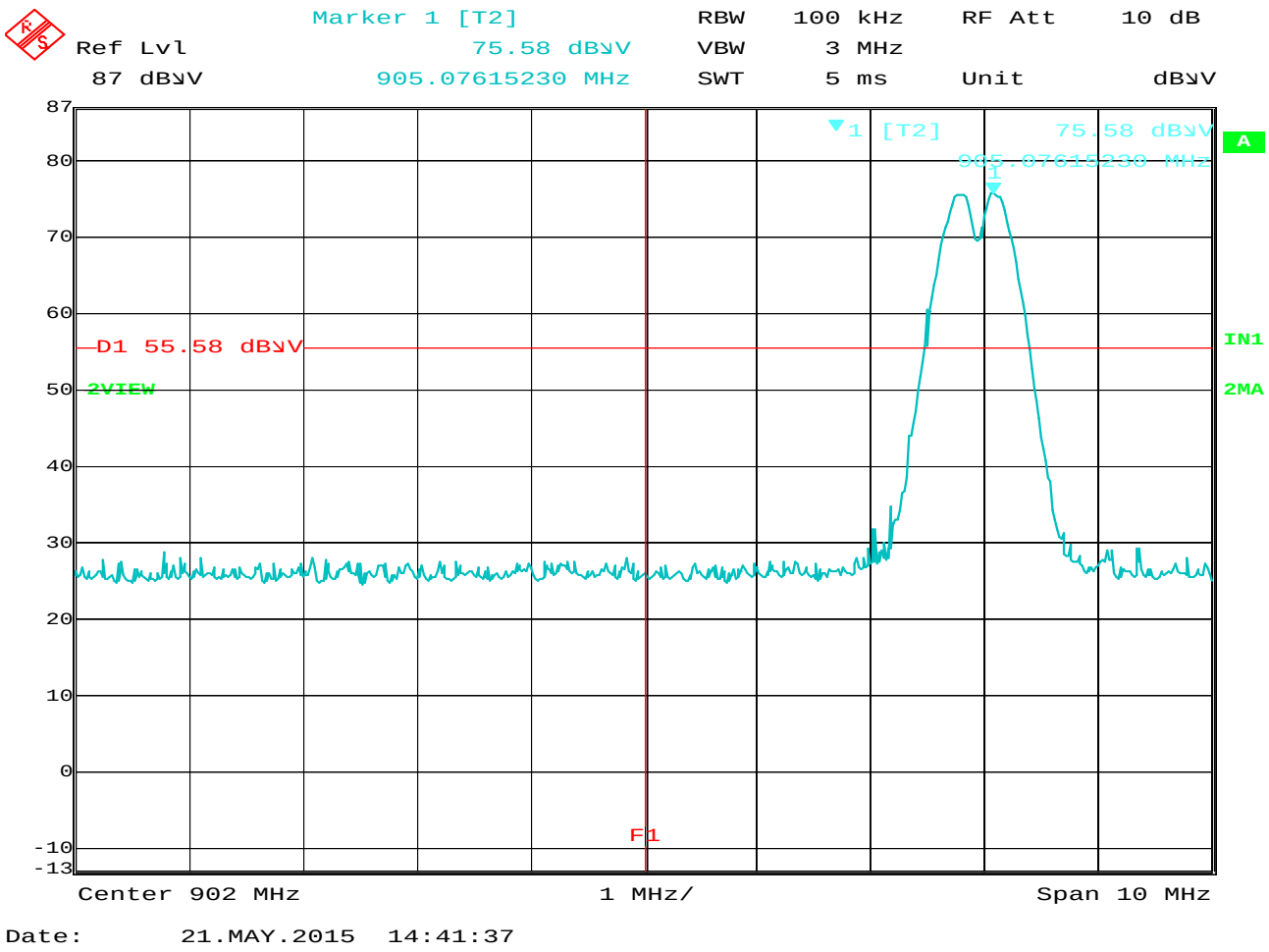
Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Peak Total dBuV/m at 3m	Peak Total uV/m at 3 m	Peak Limit uV/m at 3 m	Margin (dB)
925.00	H	73.2		1.6	21.0	0.0	95.8	61440.7		
925.00	V	75.0		1.6	21.0	0.0	97.6	75588.6		
1850.00	H	46.8		2.3	30.5	-40.0	39.6	95.6	7558.9	-38.0
1850.00	V	48.2		2.3	30.5	-40.0	41.0	112.3	7558.9	-36.6
5550.00	H	38.9		4.0	35.1	-39.4	38.6	84.7	7558.9	-39.0
5550.00	V	38.6		4.0	35.1	-39.4	38.3	81.8	7558.9	-39.3
6475.00	H	37.9	Ambient	4.3	35.9	-39.4	38.7	86.4	7558.9	-38.8
6475.00	V	37.8	Ambient	4.3	35.9	-39.4	38.6	85.4	7558.9	-38.9
9250.00	H	37.9	Ambient	5.0	36.2	-39.3	39.8	97.9	7558.9	-37.8
9250.00	V	38.6	Ambient	5.0	36.2	-39.3	40.5	106.1	7558.9	-37.1

Manufacturer : Telular
EUT : Wireless Tank Monitor
Model No. : TL9X
Serial No. : RA10
Mode : Transmit at 925MHz
Date Tested : May 20, 2015 and May 21, 2015
Test Performed : Case Spurious Radiated Emissions in restricted frequency bands
Notes : 2.5V, with shield placed over the WLAN portion of the circuit board
Notes : Peak readings with a 1MHz resolution bandwidth (RBW)

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Peak Total dBuV/m at 3m	Peak Total uV/m at 3 m	Peak Limit uV/m at 3 m	Margin (dB)
2775.00	H	52.6	Ambient	2.8	32.7	-39.7	48.4	264.2	5000.0	-25.5
2775.00	V	51.8	Ambient	2.8	32.7	-39.7	47.6	240.9	5000.0	-26.3
3700.00	H	60.9		3.3	33.3	-39.2	58.3	823.4	5000.0	-15.7
3700.00	V	61.9		3.3	33.3	-39.2	59.3	923.9	5000.0	-14.7
4625.00	H	52.6		3.6	34.5	-39.3	51.5	374.2	5000.0	-22.5
4625.00	V	52.1		3.6	34.5	-39.3	51.0	353.2	5000.0	-23.0
7400.00	H	51.8	Ambient	4.7	35.6	-39.4	52.7	430.2	5000.0	-21.3
7400.00	V	48.9	Ambient	4.7	35.6	-39.4	49.8	308.1	5000.0	-24.2
8325.00	H	48.2	Ambient	4.9	35.9	-39.4	49.6	301.7	5000.0	-24.4
8325.00	V	48.8	Ambient	4.9	35.9	-39.4	50.2	323.3	5000.0	-23.8

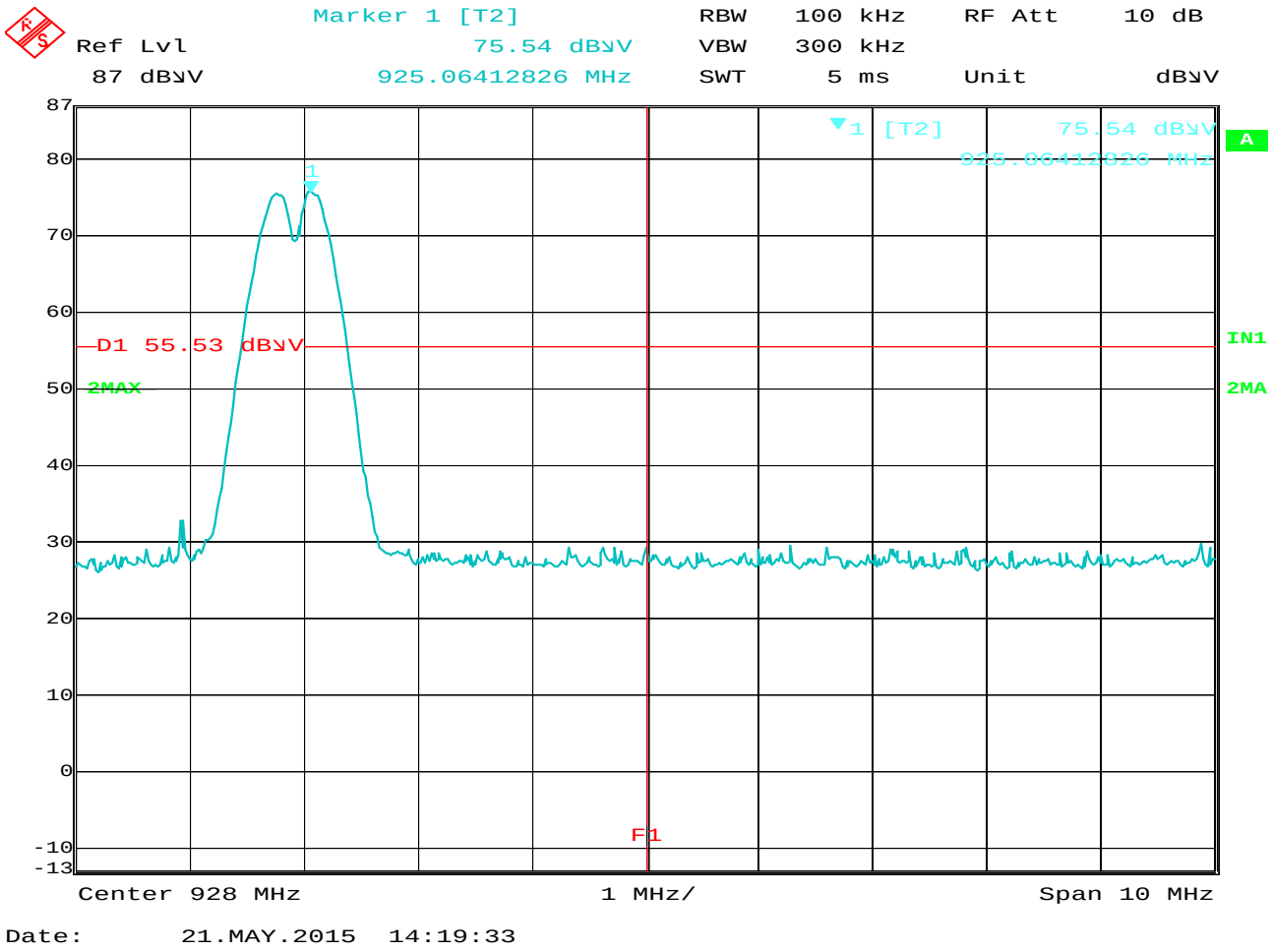
Manufacturer : Telular
EUT : Wireless Tank Monitor
Model No. : TL9X
Serial No. : RA10
Mode : Transmit at 925MHz
Date Tested : May 20, 2015 and May 21, 2015
Test Performed : Case Spurious Radiated Emissions in restricted frequency bands
Notes : 2.5V, with shield placed over the WLAN portion of the circuit board
Notes : Average readings with a 1MHz resolution bandwidth (RBW) and 10Hz video bandwidth

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Average Total dBuV/m at 3m	Average Total uV/m at 3 m	Average Limit uV/m at 3 m	Margin (dB)
2775.00	H	43.70	Ambient	2.8	32.7	-39.7	39.5	94.8	500.0	-14.4
2775.00	V	43.1	Ambient	2.8	32.7	-39.7	38.9	88.5	500.0	-15.0
3700.00	H	54.4		3.3	33.3	-39.2	51.8	389.6	500.0	-2.2
3700.00	V	55.8		3.3	33.3	-39.2	53.2	457.7	500.0	-0.8
4625.00	H	42.8		3.6	34.5	-39.3	41.7	121.1	500.0	-12.3
4625.00	V	41.6		3.6	34.5	-39.3	40.5	105.5	500.0	-13.5
7400.00	H	40.2	Ambient	4.7	35.6	-39.4	41.1	113.2	500.0	-12.9
7400.00	V	36.6	Ambient	4.7	35.6	-39.4	37.5	74.8	500.0	-16.5
8325.00	H	35.9	Ambient	4.9	35.9	-39.4	37.3	73.2	500.0	-16.7
8325.00	V	36.0	Ambient	4.9	35.9	-39.4	37.4	74.1	500.0	-16.6



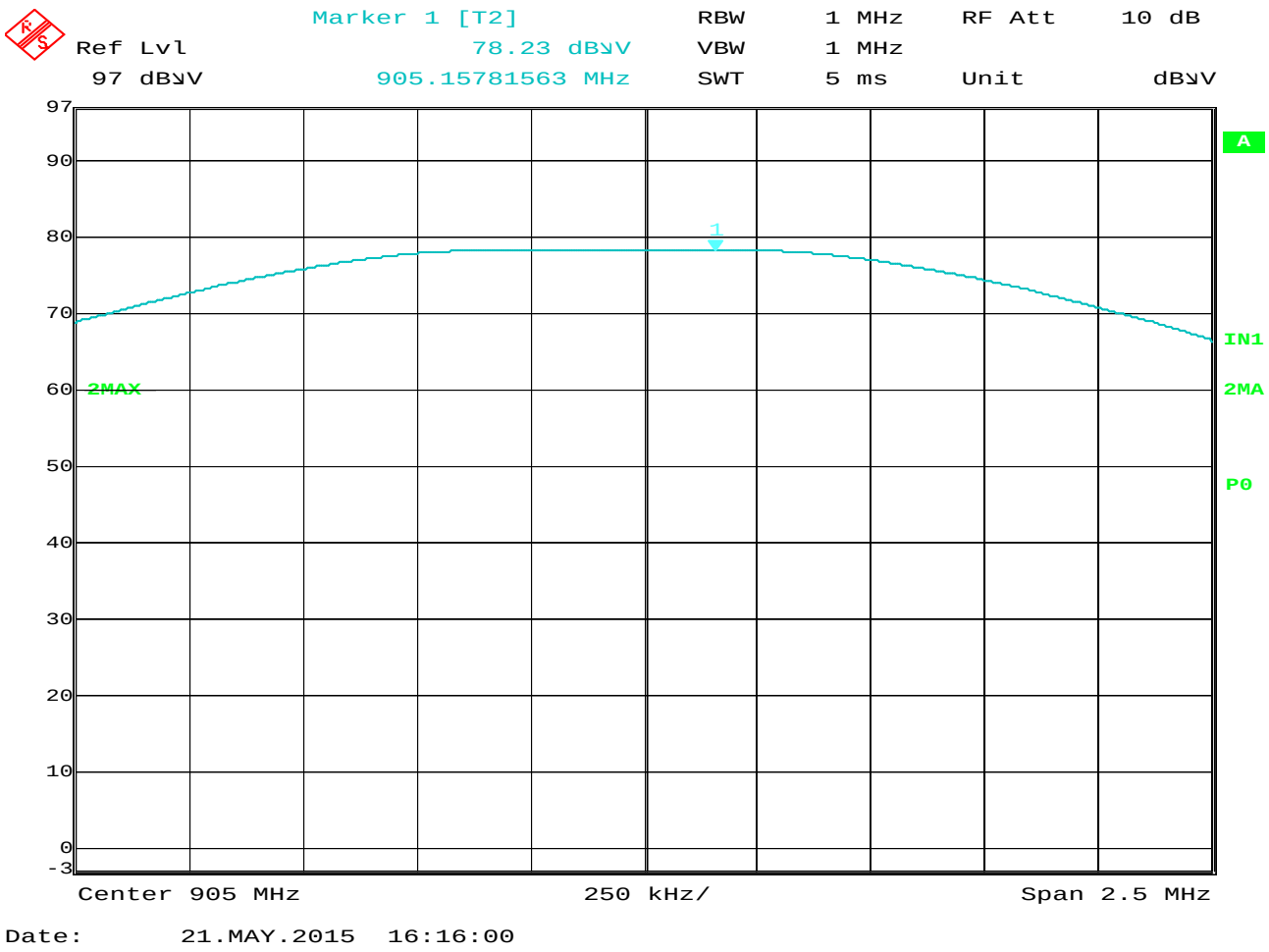
Band Edge

Manufacturer	: Telular Corporation
Model No.	: TL9X
Serial No.	: RA10
Date	: MAY 21, 2015
Test Performed	: Band Edge
Mode	: Tx @ 905MHz
Notes	: Display Line F1 represents the band edge (902MHz). Display Line D1 represents the : level 20dB down from the peak of the in-band emissions
Equipment	: NTA3, RBA0



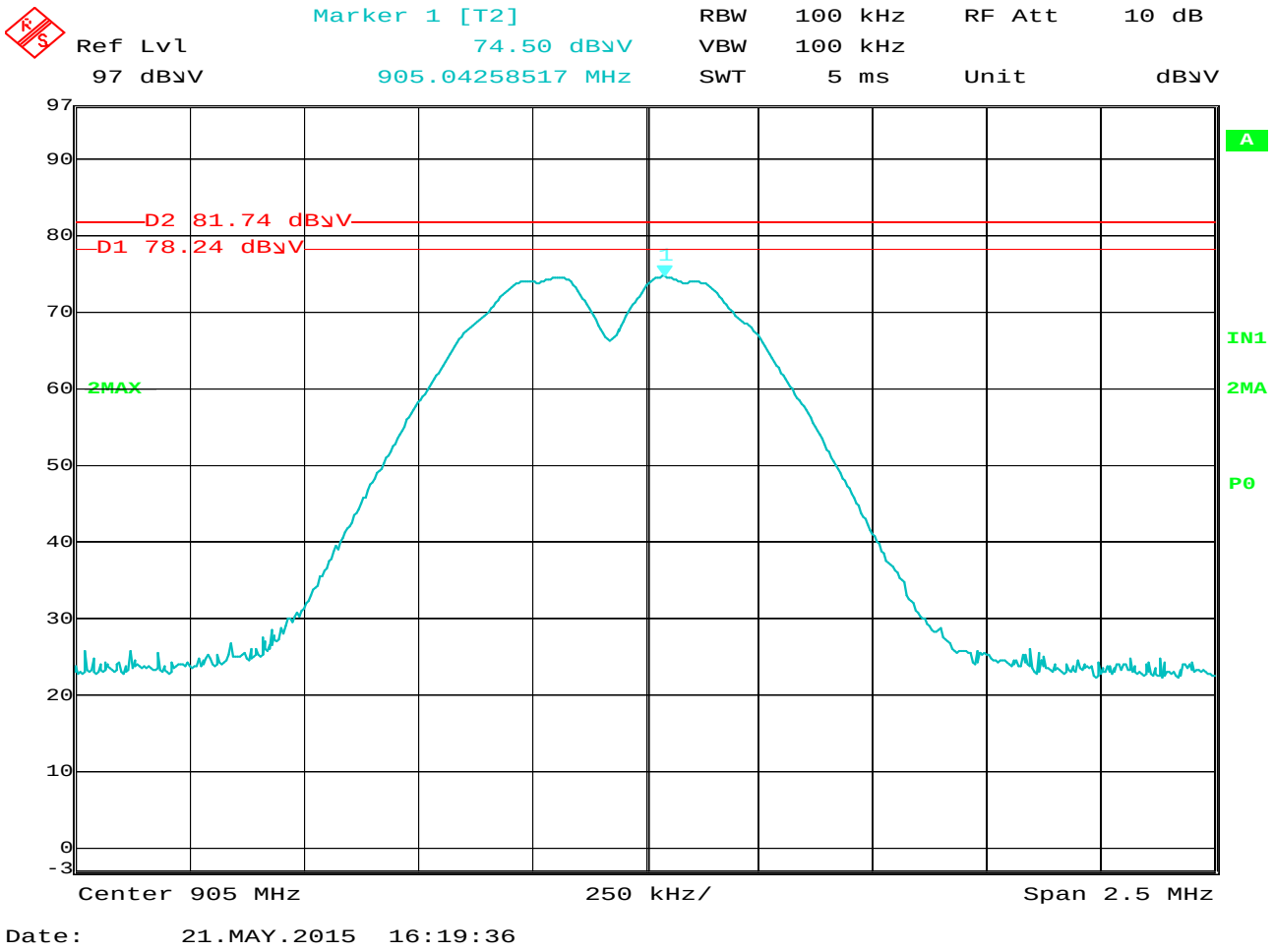
Band Edge

Manufacturer	: Telular Corporation
Model No.	: TL9X
Serial No.	: RA10
Date	: MAY 21, 2015
Test Performed	: Band Edge
Mode	: Tx @ 925MHz
Notes	: Display Line F1 represents the band edge (928MHz). Display Line D1 represents the : level 20dB down from the peak of the in-band emissions
Equipment	: NTA3, RBA0



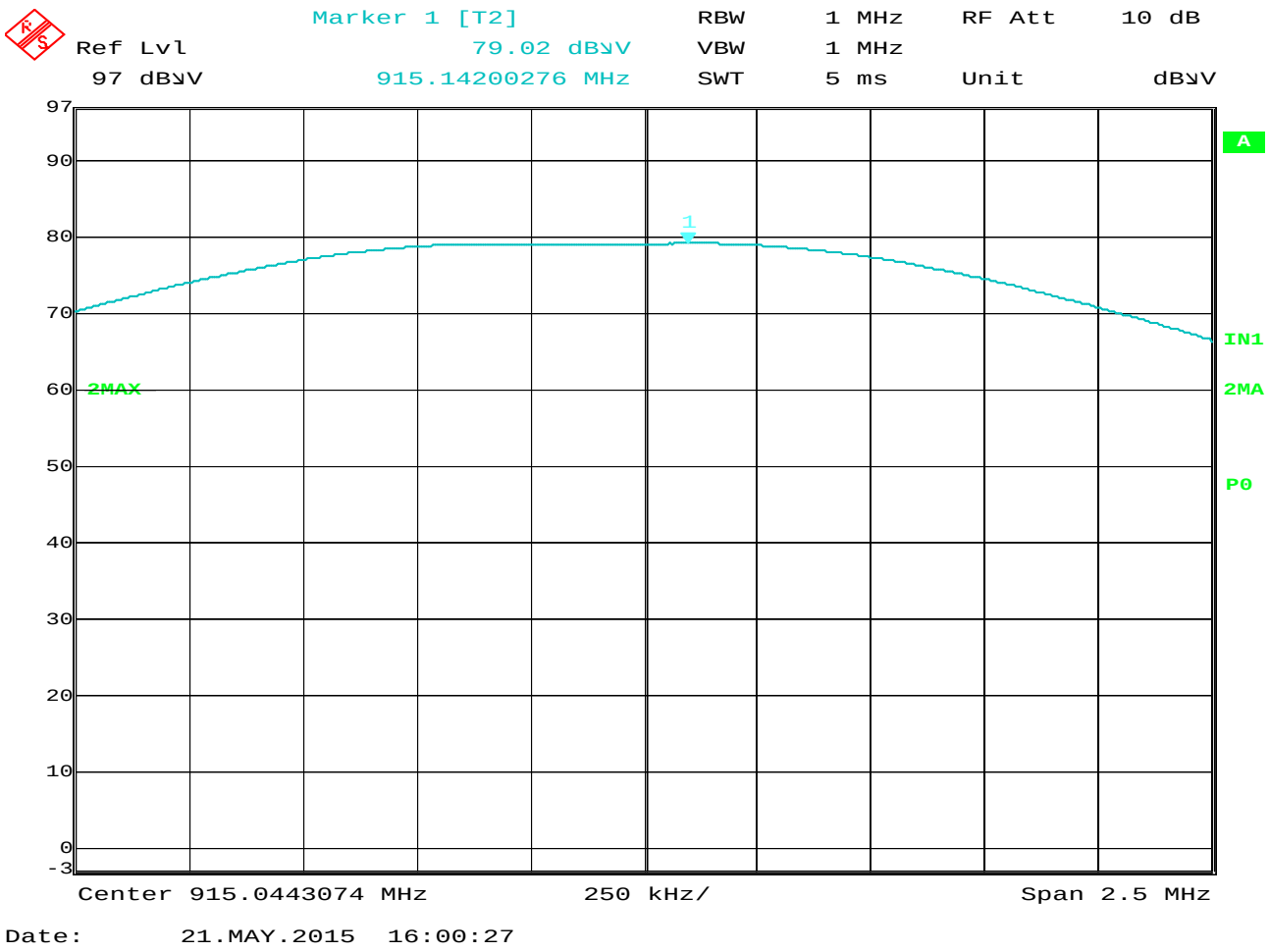
Power Spectral Density (PSD)

Manufacturer	: Telular Corporation
Model No.	: TL9X
Serial No.	: RA10
Date	: MAY 21, 2015
Test Performed	: Power Spectral Density
Mode	: Tx @ 905MHz
Notes	: The plot represents the 4.5dBm PSD in a 1MHz RBW.
Equipment	: NTA3, RBA0



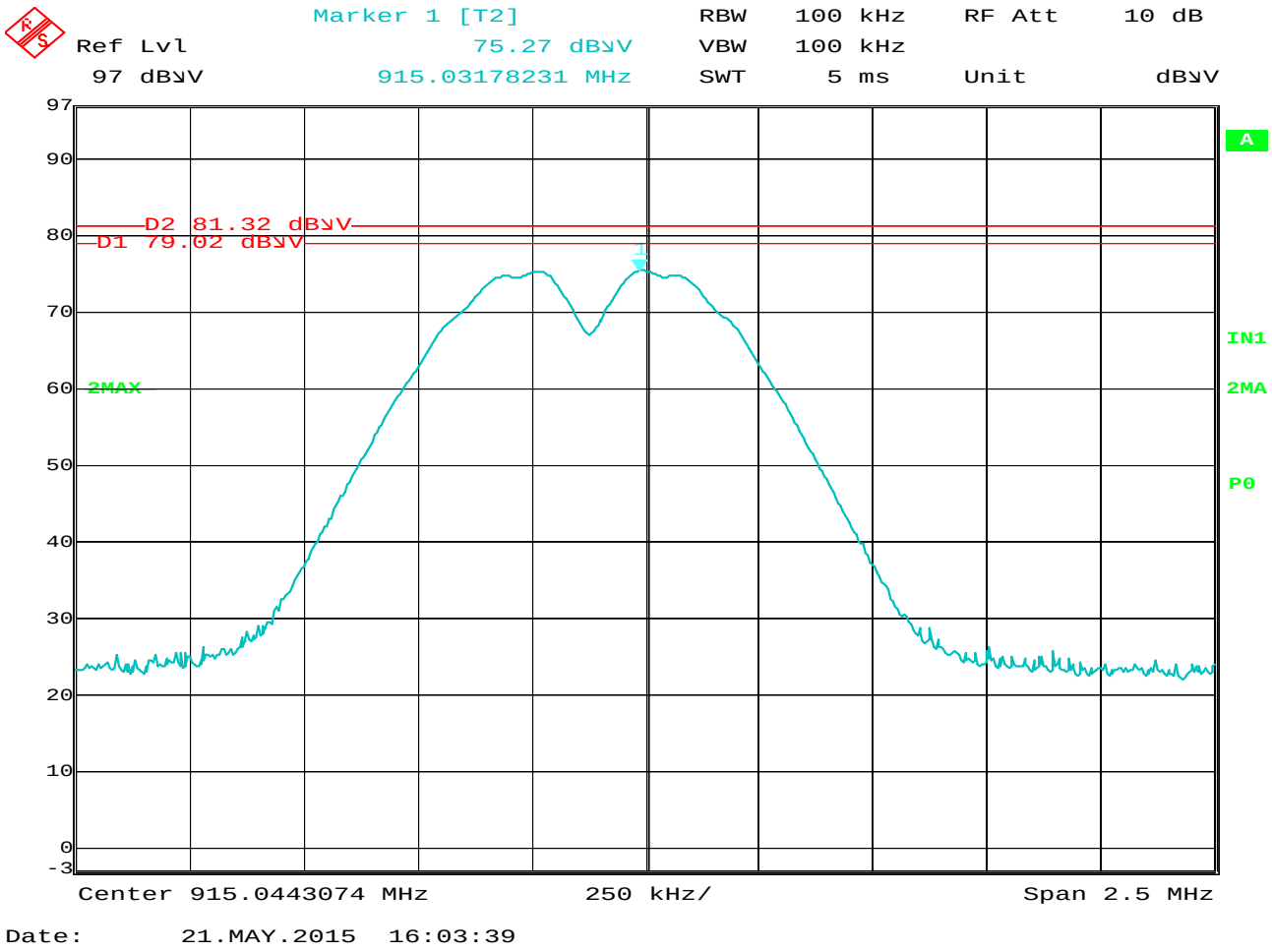
Power Spectral Density (PSD)

Manufacturer	: Telular Corporation
Model No.	: TL9X
Serial No.	: RA10
Date	: MAY 21, 2015
Test Performed	: Power Spectral Density
Mode	: Tx @ 905MHz
Notes	: The plot represents the PSD in a 100kHz RBW. Display Line D1 represents the : 4.5dBm EIRP in a 1MHz RBW. Display Line D2 represents the PSD limit of 8dBm.
Equipment	: NTA3, RBA0



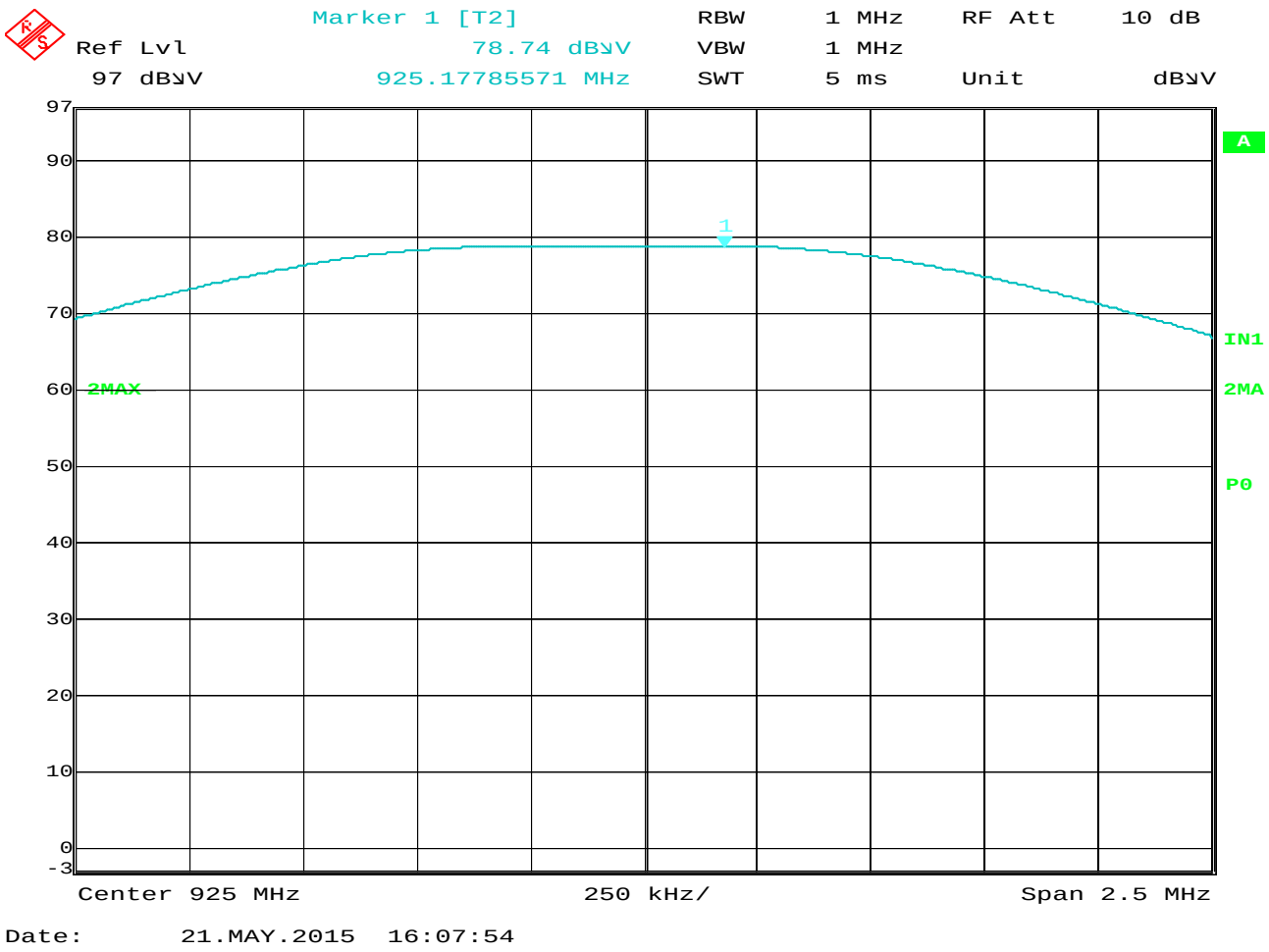
Power Spectral Density (PSD)

Manufacturer	: Telular Corporation
Model No.	: TL9X
Serial No.	: RA10
Date	: MAY 21, 2015
Test Performed	: Power Spectral Density
Mode	: Tx @ 915MHz
Notes	: Plot represents an EIRP reading of 5.7dBm in a 1MHz RBW
Equipment	: NTA3, RBA0



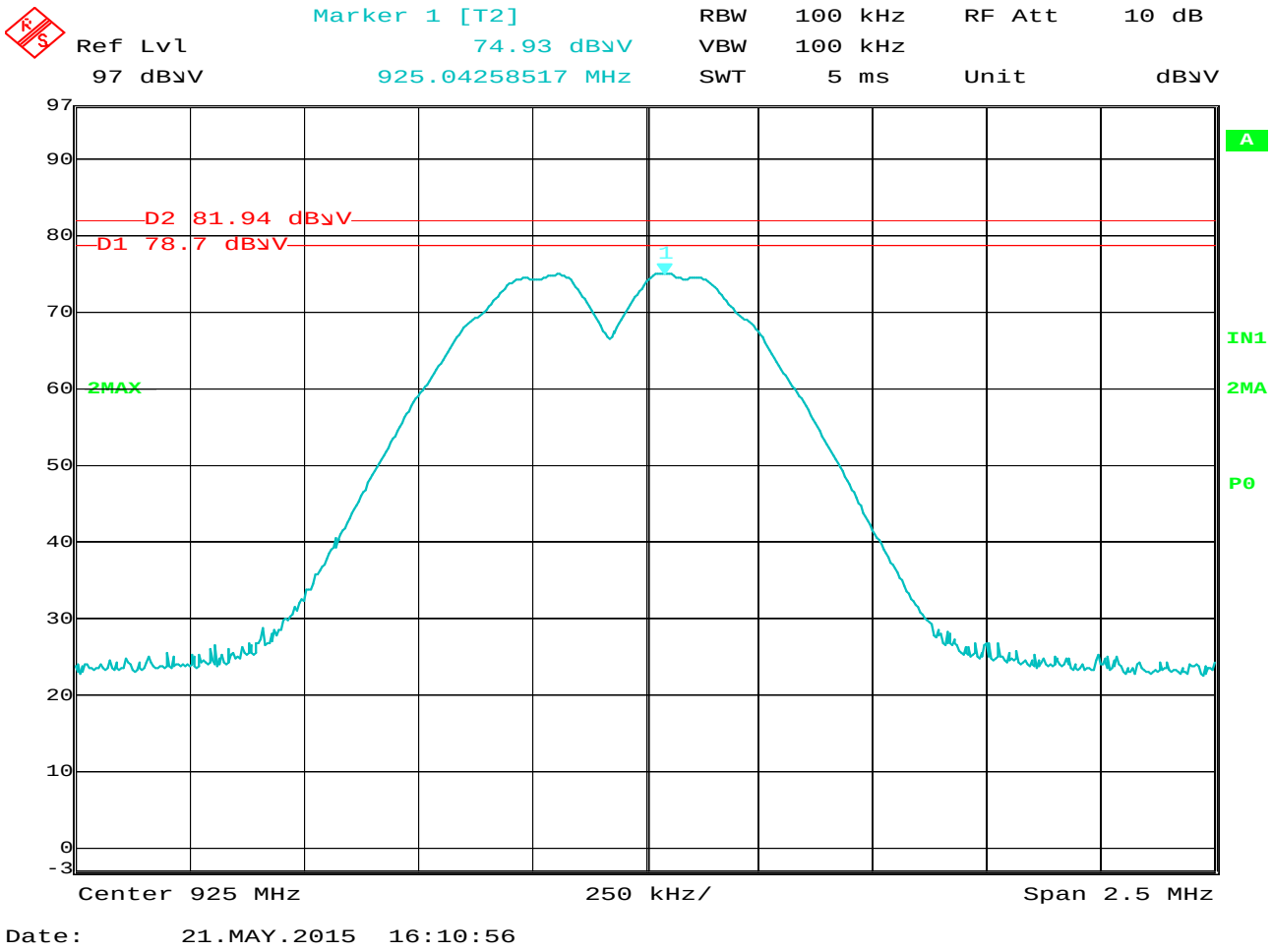
Power Spectral Density (PSD)

Manufacturer	: Telular Corporation
Model No.	: TL9X
Serial No.	: RA10
Date	: MAY 21, 2015
Test Performed	: Power Spectral Density
Mode	: Tx @ 915MHz
Notes	: Plot represents PSD in a 100kHz RBW. Display line D1 represents EIRP of : 5.7dBm in a 1MHz RBW. Display Line D2 represents the 8dBm PSD limit.
Equipment	: NTA3, RBA0



Power Spectral Density (PSD)

Manufacturer	: Telular Corporation
Model No.	: TL9X
Serial No.	: RA10
Date	: MAY 21, 2015
Test Performed	: Power Spectral Density
Mode	: Tx @ 925MHz
Notes	: Plot represents EIRP of 4.8dBm in a 1MHz RBW.
Equipment	: NTA3, RBA0



Power Spectral Density (PSD)

Manufacturer	: Telular Corporation
Model No.	: TL9X
Serial No.	: RA10
Date	: MAY 21, 2015
Test Performed	: Power Spectral Density
Mode	: Tx @ 925MHz
Notes	: Plot represents PSD in a 100kHz RBW. Display Line D1 represents the EIRP of : 4.8dBm in a 1MHz RBW. Display Line D2 represents the PSD limit of 8dBm.
Equipment	: NTA3, RBA0