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EMC Test Report

Information Technology Equipment

Class B Digital Device

FCC Part 15
Innovation, Science and Economic Development Canada ICES-003, Issue 7

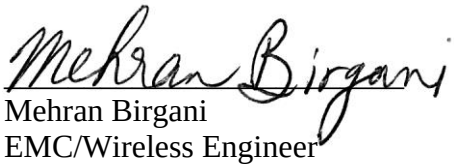
Model: TND 765

FCC ID:	A4C01003B
COMPANY:	Rand McNally 8770 West Bryn Mawr Ave. Chicago, IL 60631
TEST SITE(S):	National Technical Systems 41039 Boyce Road Fremont, CA. 94538-2435
IC SITE REGISTRATION #:	2845B-7
PROJECT NUMBER:	PR141313
REPORT DATE:	August 3, 2021
RE-ISSUED DATE:	September 28, 2021
FINAL TEST DATES:	July 23, 2021
TOTAL NUMBER OF PAGES:	37

ACCREDITED
Testing Cert #0214.26

VALIDATING SIGNATORIES

PROGRAM MGR



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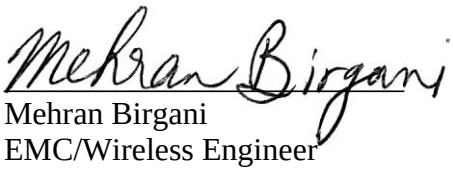

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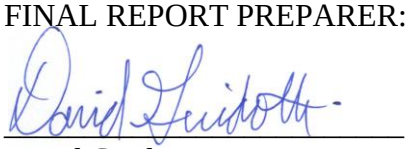

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REVISION HISTORY

Rev#	Date	Comments	Modified By
-	August 3, 2021	First release	
1	September 21, 2021	Removed photos of the device from page 11	dwb
2	September 28, 2021	Added additional details about the operation of the device during testing on page 11	dwb

TABLE OF CONTENTS

SCOPE

Governments and standards organizations around the world have published requirements regarding the electromagnetic compatibility (EMC) of electronic equipment. Testing has been performed on the Rand McNally model TND 765, pursuant to the following standards.

Standard	Title	Standard Date
FCC Part 15, Subpart B	Radio Frequency Devices	October 2020 as Amended
ICES-003, Issue 7	Information Technology Equipment (Including Digital Apparatus) - Limits and Methods of Measurement	October 2020

All measurements and evaluations have been in accordance with these specifications, test procedures, and measurement guidelines as outlined in National Technical Systems test procedures, and in accordance with the standards referenced therein (refer to Appendix E). National Technical Systems is accredited by the A2LA, certificate number 0214.26, to perform the test(s) listed in this report, except where noted otherwise.

OBJECTIVE

The objective of Rand McNally is to verify compliance with FCC and Canada's requirements for digital devices.

STATEMENT OF COMPLIANCE

The tested sample(s) of Rand McNally model TND 765 complied with the requirements of:

Standard/Regulation	Equipment Type/Class	Standard Date
Subpart B of Part 15 of the FCC Rules (CFR title 47)	Class B	2020 as amended
ICES-003, Issue 7	Class B	2020

As specified in Section 15.101 of FCC Part 15, unintentional radiators shall be authorized prior to the initiation of marketing. Based on the description of the EUT, the following criteria per Section 15.101 of FCC Part 15 were applied to the EUT:

Type of device	**Equipment authorization required**
Other Class B digital devices & peripherals	SDoC or Certification

The test results recorded herein are based on a single type test of the Rand McNally model TND 765 and therefore apply only to the tested sample(s). The sample was selected and prepared by Suwinto Gunawan of Rand McNally.

Maintenance of compliance is the responsibility of the company. Any modification of the product that could result in increased emissions or susceptibility should be checked to ensure compliance has been maintained (i.e., printed circuit board layout changes, different enclosure, different line filter or power supply, harnessing and/or interface cable changes, etc.).

DEVIATIONS FROM THE STANDARDS

No deviations were made from the published requirements listed in the scope of this report.

INFORMATION TECHNOLOGY EQUIPMENT EMISSIONS TEST RESULTS

The following emissions tests were performed on the Rand McNally model TND 765. The measurements were extracted from the data recorded during testing and represent the highest-amplitude emissions relative to the specification limits. The complete test data is provided in the appendices of this report.

CONDUCTED EMISSIONS (MAINS PORT)

Testing was not performed as the EUT is DC powered.

RADIATED EMISSIONS

Band 2

Frequency Range	Standard/Section	Requirement	Measurement Margin	Status
30-1000 MHz	FCC §15.109(g) ICES-003 Table 2 Class B	30-230 MHz, 30 dBµV/m 230-1000 MHz, 37 dBµV/m (10 m limit)	29.2 dBµV/m @ 166.67 MHz (-0.8 dB)	Complied
1-10 GHz	FCC §15.109(a) Class B	54.0 dBµV/m Av 74.0 dBµV/m Pk (3 m limit)	40.5 dBµV/m @ 5642.8 MHz (-13.5 dB)	Complied
Note 1 Pass/Fail criteria defined by standards listed above.				

Band 4

Frequency Range	Standard/Section	Requirement	Measurement Margin	Status
30-1000 MHz	FCC §15.109(g) ICES-003 Table 2 Class B	30-230 MHz, 30 dBµV/m 230-1000 MHz, 37 dBµV/m (10 m limit)	29.5 dBµV/m @ 138.48 MHz (-0.5 dB)	Complied
1-9 GHz	FCC §15.109(a) Class B	54.0 dBµV/m Av 74.0 dBµV/m Pk (3 m limit)	41.2 dBµV/m @ 8469.5 MHz (-12.8 dB)	Complied
Note 2 Pass/Fail criteria defined by standards listed above.				

Band 12

Frequency Range	Standard/Section	Requirement	Measurement Margin	Status
30-1000 MHz	FCC §15.109(g) ICES-003 Table 2 Class B	30-230 MHz, 30 dBµV/m 230-1000 MHz, 37 dBµV/m (10 m limit)	26.9 dBµV/m @ 166.67 MHz (-3.1 dB)	Complied
1-5 GHz	FCC §15.109(a) Class B	54.0 dBµV/m Av 74.0 dBµV/m Pk (3 m limit)	36.8 dBµV/m @ 2122.7 MHz (-17.2 dB)	Complied
Note 3 Pass/Fail criteria defined by standards listed above.				

MEASUREMENT UNCERTAINTIES

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below were calculated using the approach described in CISPR 16-4-2:2003 using a coverage factor of k=2, which gives a level of confidence of approximately 95%. The levels were found to be below levels of CISPR and therefore no adjustment of the data for measurement uncertainty is required.

Measurement Type	Measurement Unit	Frequency Range	Expanded Uncertainty
Conducted Emissions	dBuV or dBuA	150 kHz – 30 MHz	± 2.2 dB
Radiated Electric Field	dBuV/m	30-1000 MHz	± 3.6 dB
		1000-40,000 MHz	± 6.0 dB

EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL

The Rand McNally model TND 765 is a mobile fleet management solution that provides mobile communication, electronic logs, navigation and more. Since the EUT could be placed in any position during operation, the EUT was treated as tabletop equipment during testing to simulate the end-user environment. The electrical rating of the EUT is 12VDC.

The sample was received on July 23, 2021 and tested on July 23, 2021. The EUT consisted of the following component(s):

Company	Model	Description	Serial Number	FCC ID
Rand McNally	TND 765	Fleet Management Device	196584MHCF	A4C01003B

HIGHEST EUT INTERNAL FREQUENCY SOURCE

The highest internal frequency source (F_x) of an EUT is defined as the highest frequency generated or used within the EUT or on which the EUT operates or tunes. The highest internal frequency source determines the frequency range of test for radiated emissions.

The highest internal frequency source of the EUT was declared as LTE fundamental signal.

Based on the declared highest internal frequency source, the upper frequency range of measurement for the current project were:

FCC Part 15, Subpart B

Highest Internal Frequency Source (MHz)	Upper Frequency Range of Measurement (MHz)	Applicability
Below 1.705	30	
1.705 – 108	1000	
108 – 500	2000	
500 – 1000	5000	
Above 1000	5th harmonic of the highest internal source or 40 GHz, whichever is lower	X

OTHER EUT DETAILS

The following EUT details should be noted: The EUT has integrated Wi-Fi and Telit LE910C1-ST LTE modems. The LTE modem has modular approval and operates in Bands 2, 4/66 and 12. The LTE antenna is a Taoglas FXUB63.07.0150C. The Wi-Fi modem is disabled.

ENCLOSURE

The EUT enclosure is primarily constructed of plastic. It measures approximately 22 cm wide by 13.5 cm deep by 4.5 cm high.

MODIFICATIONS

No modifications were made to the EUT during the time the product was at National Technical Systems.

SUPPORT EQUIPMENT

No support equipment was used during testing.

EUT INTERFACE PORTS

The I/O cabling configuration during testing was as follows:

Port		Cable(s)		
From	To	Description	Shielded/Unshielded	Length(m)
DC Power	DC Power Supply	Power Cord	Shielded	2.0

EUT OPERATION

During emissions testing the EUT was configured to transmit continuously on the selected channel for the Cellular radio as applicable. The TP, LCD and GPS were all active during the tests. Messaging and fleet workflow features are software components that determine the content of data sent in normal use.

EMISSIONS TESTING

RADIATED AND CONDUCTED EMISSIONS

Final test measurements were taken at the National Technical Systems Anechoic Chambers listed below. The test sites contain separate areas for radiated and conducted emissions testing. The sites conform to the requirements of 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* and CISPR 16-1-4:2019 - *Specification for radio disturbance and immunity measuring apparatus and methods Part 1-4: Radio disturbance and immunity measuring apparatus Ancillary equipment Radiated disturbances*. They are registered with the VCCI and are on file with the FCC and Industry Canada.

Site	Registration Numbers			Location
	VCCI	FCC	Canada	
Chamber 7	Member 1211 Facility Registration A-0169	US1031	US0027	41039 Boyce Road Fremont, CA 94538-2435

RADIATED EMISSIONS CONSIDERATIONS

Radiated emissions measurements were made with the EUT powered from a supply voltage within the expected tolerances of each nominal operating voltage/frequency for each geographical regions covered by the scope of the standards referenced in this report.

EMISSIONS MEASUREMENT INSTRUMENTATION

RECEIVER SYSTEM

An EMI receiver as specified in CISPR 16-1-1:2015 is used for emissions measurements. The receivers used can measure over the frequency range of 9 kHz up to 7 GHz. These receivers allow both ease of measurement and high accuracy to be achieved. The receivers have Peak, Average, and CISPR (Quasi-peak) detectors built into their design so no external adapters are necessary. The receiver automatically sets the required bandwidth for the CISPR detector used during measurements.

For measurements above the frequency range of the receivers, a spectrum analyzer is utilized because it provides visibility of the entire spectrum along with the precision and versatility required to support engineering analysis. Average measurements above 1000 MHz are performed on the spectrum analyzer using the linear-average method with a resolution bandwidth of 1 MHz and a video bandwidth of 10 Hz.

INSTRUMENT CONTROL COMPUTER

Measurements for radiated and conducted emissions are converted to the field strength at an antenna or voltage developed at the LISN (or ISN) measurement port, which is then compared directly with the appropriate specification limit under software control of the test receivers and spectrum analyzers. This provides added accuracy since all site correction factors, such as cable loss and antenna factors are added automatically. The software used for measurements is NTS EMI Test Software (rev 2.10).

LINE IMPEDANCE STABILIZATION NETWORK (LISN)

Line conducted emission measurements utilize a 50 µH Line Impedance Stabilization Network (LISN) as the measurement point. The LISN used may also contain an additional 250 µH inductor. This network provides for calibrated radio-frequency noise measurements by the design of the internal low-pass and high-pass filters on the EUT and measurement ports, respectively.

IMPEDANCE STABILIZATION NETWORK (ISN)

Telecommunication port conducted emission measurements utilize an Impedance Stabilization Network with a 150-ohm termination impedance and specific longitudinal conversion loss as the voltage monitoring point. This network provides for calibrated radio-frequency noise measurements by the design of the internal circuitry on the EUT and measurement ports, respectively. For current measurements, a current probe with a uniform frequency response and less than 1-ohm insertion impedance is used.

FILTERS/ATTENUATORS

External filters and precision attenuators are often connected between the receiving antenna or LISN and the receiver. This eliminates saturation effects and non-linear operation due to high-amplitude transient events.

ANTENNAS

A bilog antenna or combination of biconical and log periodic antennas are used to cover the range from 30 MHz to 1000 MHz. Narrowband tuned dipole antennas may be used over the entire 30 to 1000 MHz frequency range for precision measurements of field strength. Above 1000 MHz, horn antennas are used. The antenna calibration factors are included in site factors that are programmed into the test receivers or data collection software.

ANTENNA MAST AND EQUIPMENT TURNTABLE

The antennas used to measure the radiated electric field strength are mounted on a non-conductive antenna mast equipped with a motor drive to vary the antenna height.

ANSI C63.4 specifies that the test height above ground for table-mounted devices shall be 80 centimeters. Floor-mounted equipment shall be placed on the ground plane if the device is normally used on a conductive floor or separated from the ground plane by insulating material up to 12-mm thick if the device is normally used on a non-conductive floor. During radiated measurements, the EUT is positioned on a motorized turntable in conformance with this requirement.

INSTRUMENT CALIBRATION

All test equipment is regularly checked to ensure that performance is maintained in accordance with the company's specifications. An appendix of this report contains the list of test equipment used and calibration information.

EMISSIONS TEST PROCEDURES

EUT AND CABLE PLACEMENT

The standards require that interconnecting cables be connected to the available ports of the unit and that the placement of the unit and the attached cables simulate the worst-case orientation that can be expected from a typical installation, so far as practicable. To this end, the position of the unit and associated cabling is varied within the guidelines of ANSI C63.4, and the worst-case orientation is used for final measurements.

RADIATED EMISSIONS

General

FCC Part 15 references the test methods of 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) for emissions measurements. Radiated emissions measurements are performed in two phases, preliminary scan and final maximization.

Preliminary Scan

A preliminary scan of emissions is conducted in which all significant EUT frequencies are identified with the system in a nominal configuration. At least two scans are performed, one or more of these with the antenna polarized vertically and one or more of these are performed with the antenna polarized horizontally. During the preliminary scans, the EUT is rotated through 360°, the antenna height is varied and cable positions are varied as necessary to determine the highest emission relative to the limit.

Note that for the frequency range of 1-6 GHz in the “free space” test environment, CISPR 32 allows the antenna to be set at a fixed height equal to the center height of the EUT, except for cases where additional scans are necessary with the antenna height adjusted up and down to ensure the measurement antenna illuminates the entire height of the EUT. However, in cases where a single “free space” test is performed in the 1-6 GHz frequency to simultaneously meet the requirements of FCC Part 15 (ANSI C63.4-2014 test methods) and CISPR 22, the antenna height is by default varied since required by ANSI C63.4.

In the frequency range of 30-1000 MHz, a speaker (with demodulation) is provided in the receiver to aid in discriminating between EUT and ambient emissions if required. Other possible methods for discriminating between EUT and ambient emissions involve scanning with near-field magnetic loops, monitoring I/O cables with RF current clamps, and cycling power to the EUT.

Final Maximization

During final maximization, the highest-amplitude emissions identified in the spectral search are viewed while the EUT azimuth angle is varied from 0 to 360 degrees relative to the receiving antenna. The azimuth that results in the highest emission is then maintained while varying the antenna height from one to four meters. The result is the identification of the highest amplitude for each of the highest peaks. Each recorded level is corrected in the receiver using appropriate factors for cables, connectors, antennas, and preamplifier gain. Emissions that have values close to the specification limit may also be measured with a tuned dipole antenna to determine compliance.

Final measurements in the frequency range of 30-1000 MHz are made using a quasi-peak detector and compared to the quasi-peak limit. Final measurements above 1 GHz are made using average and peak detectors and compared to the average and peak limits respectively.

The diameter of the test volume demonstrated during the test site validation of Chamber 7 was 2.5 m, while the maximum width of the boundary of the EUT, local AE, and associated cabling within the test volume was 2.5 m.

When testing above 1 GHz, the receive antenna is restricted to a maximum height of 2.5 m. Maximum emissions are found within this restricted range because emission levels decrease over distance and as the antenna is raised above 2.5 m, the distance from the EUT increases. As a result of the increased measurement distance, at antenna heights above 2.5 m, lower emission levels are measured as compared to emissions levels measured at antenna heights at 2.5 m and below. Final measurements are captured at 3 meters test distance except in cases where a closer test distance is required due to noise-floor considerations of the test-and-measurement equipment.

For measurements above 1 GHz every effort is made to ensure the EUT remains within the cone of radiation of the measurement antenna (i.e. 3 dB beam-width of the antenna). This may include rotating the product and/or angling the measurement antenna. A horn antenna having the beam width *W* at the measurement distance 3 m shown in the table below was used for the measurement. Since the height of the EUT from the turntable was 1.5 m, the antenna height was fixed to 1 m.

Frequency (GHz)	E Plane	H Plane	Θ_{3dB}	3dB beam width *W* (m) at 3m
1.0	110	90	90	6.0
2.0	50	59	50	2.8
3.0	40	62	40	2.2
4.0	42	63	42	2.3
5.0	54	42	42	2.3
6.0	48	39	39	2.1

SAMPLE CALCULATIONS

SAMPLE CALCULATIONS - RADIATED EMISSIONS

Receiver readings are compared directly to the specification limit (decibel form). The receiver internally corrects for cable loss, preamplifier gain, and antenna factor. The calculations are in the reverse direction of the actual signal flow, thus cable loss is added and the amplifier gain is subtracted. The Antenna Factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements. A distance factor, when used for electric field measurements, is calculated by using the following formula:

$$F_d = 20*LOG_{10} (D_m/D_s)$$

where:

F_d = Distance Factor in dB

D_m = Measurement Distance in meters

D_s = Specification Distance in meters

Measurement Distance is the distance at which the measurements were taken and Specification Distance is the distance at which the specification limits are based. The Antenna Factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements.

The margin of a given emission peak relative to the limit is calculated as follows:

$$R_c = R_r + F_d$$

and

$$M = R_c - L_s$$

where:

R_r = Receiver Reading in dBuV/m

F_d = Distance Factor in dB

R_c = Corrected Reading in dBuV/m

L_s = Specification Limit in dBuV/m

M = Margin in dB Relative to Spec

Appendix A Test Equipment Calibration Data

Radiated Emissions, 30 - 10,000 MHz, 23-Jul-21

Manufacturer	Description	Model	Asset #	Calibrated	Cal Due
National Technical Systems	NTS EMI Software (rev 2.10)	N/A	WC022452	N/A	
ETS-Lindgren	EMC Chamber #7	FACT-5	WC055569	9/15/2019	9/15/2022
Hewlett Packard	Spectrum Analyzer (Purple)	8564E	WC055660	8/25/2020	8/25/2021
EMCO	Horn Antenna	3115	WC062584	6/1/2021	6/1/2023
Sunol Sciences	Biconilog, 30-3000 MHz	JB3	WC064478	10/31/2018	10/31/2021
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	WC064574	3/2/2021	3/2/2022
Com-Power	Preamplifier, 1-1000 MHz	PAM-103	WC064733	7/31/2020	7/31/2021
Rhode & Schwarz	EMI Test Receiver 20Hz-26.5GHz	ESI	WC071498	6/2/2021	6/2/2022

Appendix B Test Data

TL141313-EMC Pages 19 – 33

Client:	Rand McNally	PR Number:	PR141313
Product	TND 765	T-Log Number:	TL141313-EMC
System Configuration:	-	Project Manager:	Christine Krebill
Contact:	Suwinto Gunawan	Project Engineer:	-
Emissions Standard(s):	FCC Part 15, ICES-003, RSS-247	Class:	B
Immunity Standard(s):	-	Environment:	Mobile

EMC Test Data

For The

Rand McNally

Product

TND 765

Date of Last Test: 7/26/2021

Client:	Rand McNally	PR Number:	PR141313
Model:	TND 765	T-Log Number:	TL141313-EMC
		Project Manager:	Christine Krebill
Contact:	Suwinto Gunawan	Project Engineer:	-
Standard:	FCC Part 15, ICES-003, RSS-247	Class:	B

Radiated Emissions

(NTS Silicon Valley, Fremont Facility, Semi-Anechoic Chamber)

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 7/23/2021
Test Engineer: R. Varelas / J. Semana
Test Location: FT Chamber #7
Config. Used: 1
Config Change: None
EUT Voltage: 12V Battery

General Test Configuration

The EUT and any local support equipment were located on the turntable for radiated emissions testing.
Radiated emissions tests above 1 GHz to FCC Part 15 were performed with floor absorbers in place in accordance with the test methods of ANSI C63.4 and CISPR 16-1-4.
The test distance and extrapolation factor (if applicable) are detailed under each run description.
Note, preliminary testing indicates that the emissions were maximized by orientation of the EUT and elevation of the measurement antenna. Maximized testing indicated that the emissions were maximized by orientation of the EUT, elevation of the measurement antenna, and manipulation of the EUT's interface cables.

Ambient Conditions:

Temperature: 24.1 °C
Rel. Humidity: 39 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
2	Radiated Emissions 30 - 1000 MHz, Maximized	Class B	Pass	29.2 dBµV/m @ 166.67 MHz (-0.8 dB)
3	Radiated Emissions 1 GHz - 10 GHz Maximized	FCC B	Pass	40.5 dBµV/m @ 5642.8 MHz (-13.5 dB)

Modifications Made During Testing

No modifications were made to the EUT during testing

Deviations From The Standard

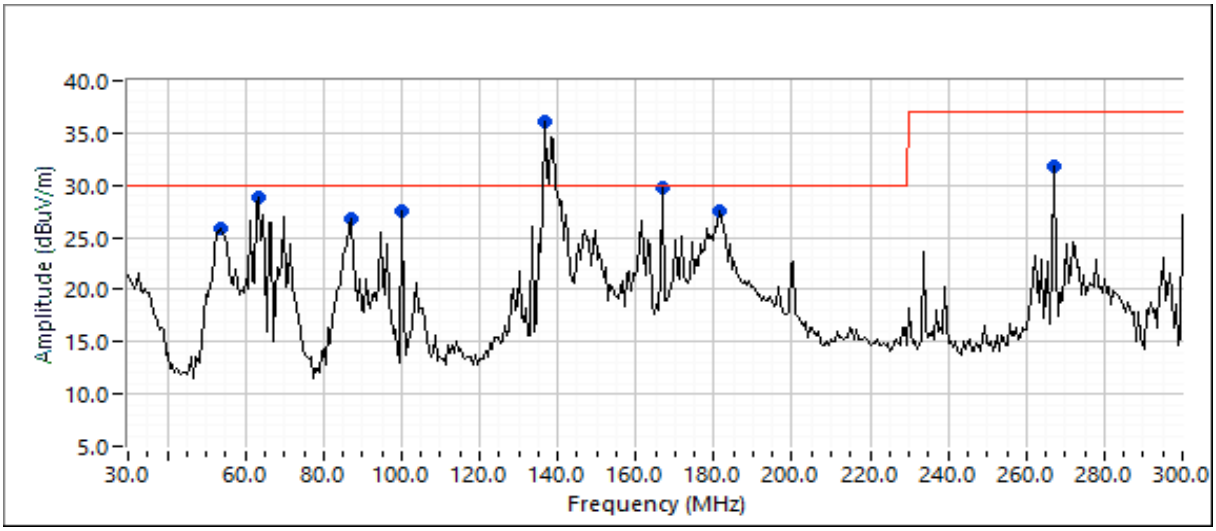
No deviations were made from the requirements of the standard.

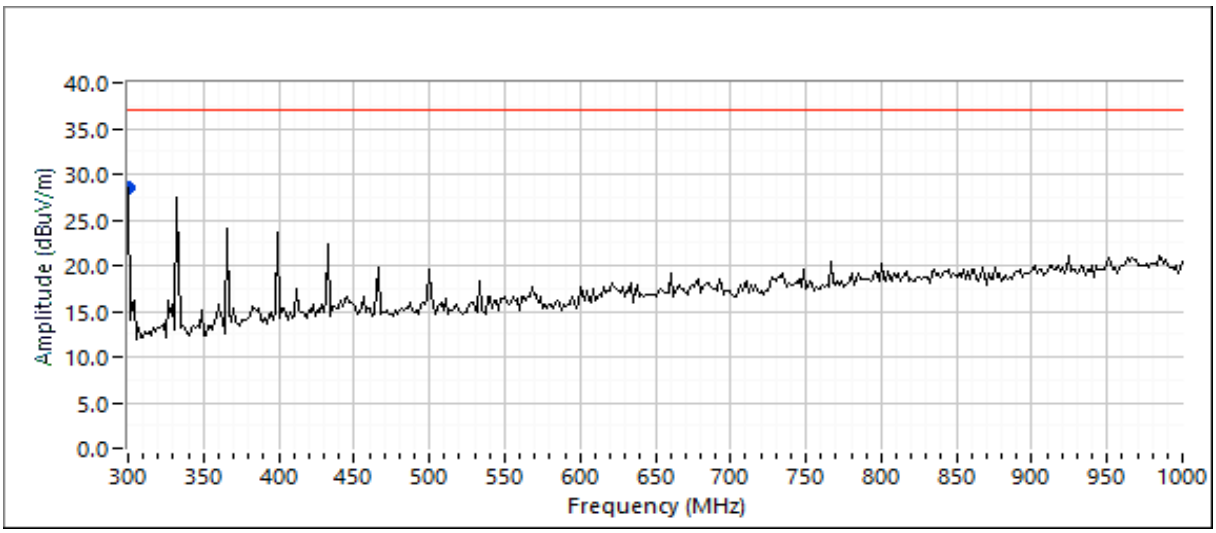
Test Parameters for Preliminary Scan(s)			
Frequency Range (MHz)	Prescan Distance (meters)	Limit Distance (meters)	Extrapolation Factor (dB, applied to data)
30 - 1000	5	10	-6.0
1000 - 10000	3	3	0.0

Client:	Rand McNally	PR Number:	PR141313
Model:	TND 765	T-Log Number:	TL141313-EMC
		Project Manager:	Christine Krebill
Contact:	Suwinto Gunawan	Project Engineer:	-
Standard:	FCC Part 15, ICES-003, RSS-247	Class:	B

Run #1: Preliminary Radiated Emissions, 30 - 1000 MHz

EUT and Test Configuration Details: *Cellular Band 2 (1960 MHz Downlink, 1880 MHz Uplink)*





Client:	Rand McNally	PR Number:	PR141313
Model:	TND 765	T-Log Number:	TL141313-EMC
		Project Manager:	Christine Krebill
Contact:	Suwinto Gunawan	Project Engineer:	-
Standard:	FCC Part 15, ICES-003, RSS-247	Class:	B

Run #1: Preliminary Radiated Emissions, 30 - 1000 MHz

EUT and Test Configuration Details: *Cellular Band 2 (1960 MHz Downlink, 1880 MHz Uplink)*

Preliminary peak readings captured during pre-scan

Frequency	Level	Pol	Class B		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
63.875	28.8	V	30.0	-1.2	Peak	24	1.0	
53.723	25.9	V	30.0	-4.1	Peak	345	1.5	
87.027	26.8	V	30.0	-3.2	Peak	248	1.5	
100.005	27.6	V	30.0	-2.4	Peak	222	1.0	
136.564	36.1	V	30.0	6.1	Peak	140	1.0	
166.670	29.7	V	30.0	-0.3	Peak	249	1.0	
182.013	27.6	V	30.0	-2.4	Peak	180	3.5	
266.673	31.9	H	37.0	-5.1	Peak	119	1.5	
299.998	28.6	V	37.0	-8.4	Peak	141	2.0	

Run #2: Maximized Readings From Run #1

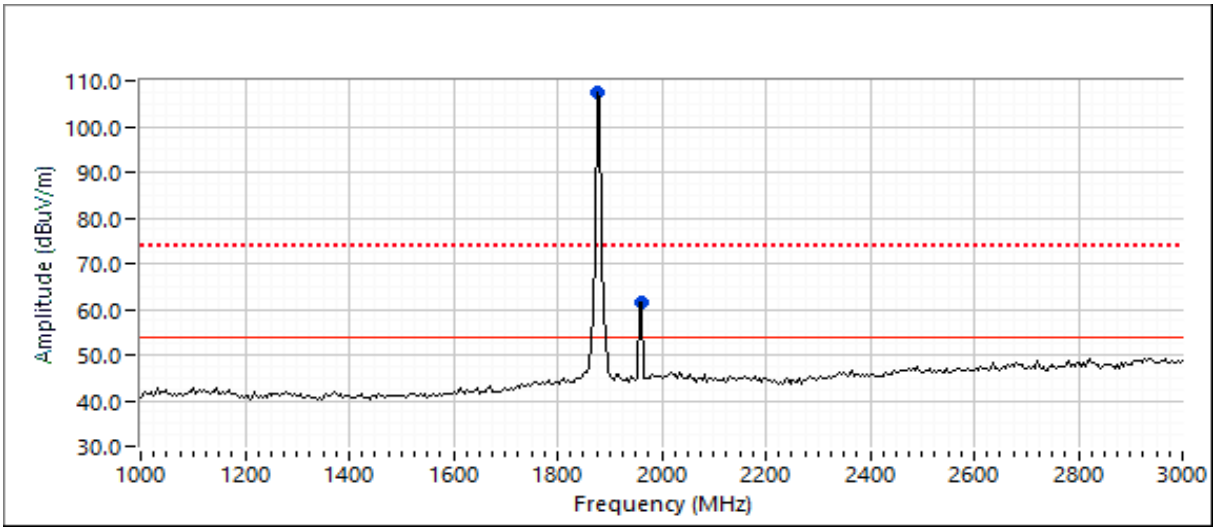
Maximized quasi-peak readings (includes manipulation of EUT interface cables)

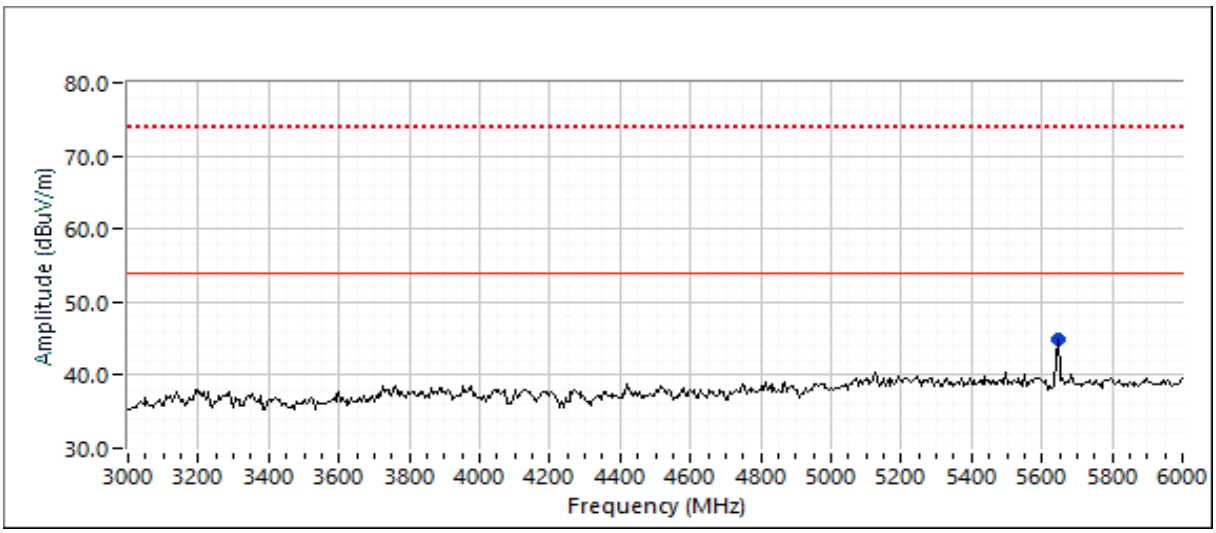
Frequency	Level	Pol	Class B		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
166.670	29.2	V	30.0	-0.8	QP	297	1.0	QP (1.00s)
100.005	27.6	V	30.0	-2.4	QP	242	1.0	QP (1.00s)
136.564	27.0	V	30.0	-3.0	QP	172	1.0	QP (1.00s)
266.673	30.9	H	37.0	-6.1	QP	140	1.7	QP (1.00s)
87.027	19.3	V	30.0	-10.7	QP	248	1.4	QP (1.00s)
53.723	18.9	V	30.0	-11.1	QP	345	1.5	QP (1.00s)
63.875	18.5	V	30.0	-11.5	QP	24	1.0	QP (1.00s)
182.013	18.0	V	30.0	-12.0	QP	198	3.8	QP (1.00s)
299.998	22.1	V	37.0	-14.9	QP	56	2.7	QP (1.00s)

Client:	Rand McNally	PR Number:	PR141313
Model:	TND 765	T-Log Number:	TL141313-EMC
		Project Manager:	Christine Krebill
Contact:	Suwinto Gunawan	Project Engineer:	-
Standard:	FCC Part 15, ICES-003, RSS-247	Class:	B

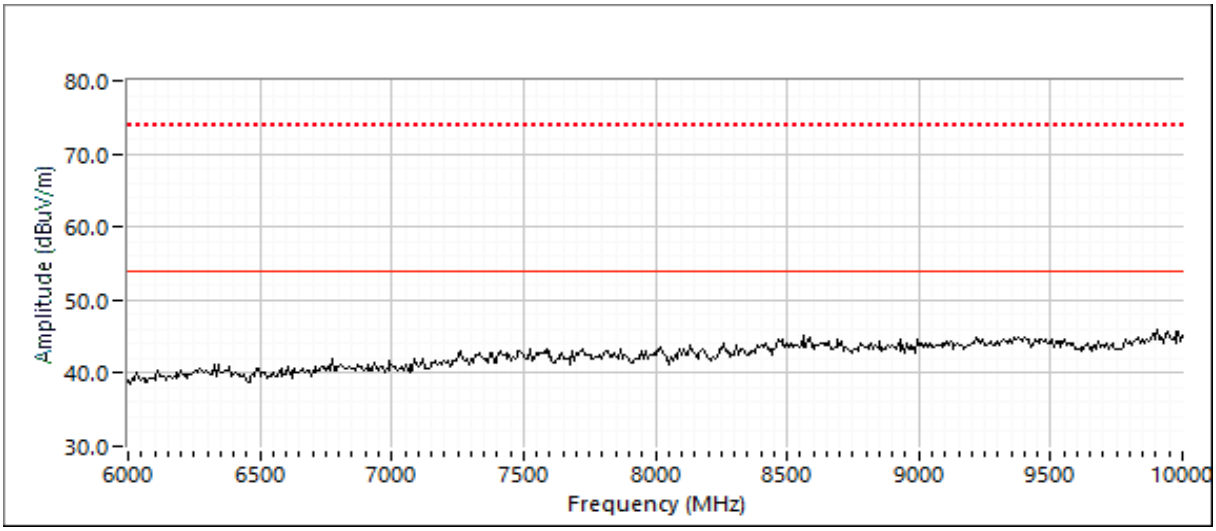
Run #3: Maximized Readings, 1000 - 10000 MHz

EUT and Test Configuration Details: *Cellular Band 2 (1960 MHz Downlink, 1880 MHz Uplink)*





Client:	Rand McNally	PR Number:	PR141313
Model:	TND 765	T-Log Number:	TL141313-EMC
		Project Manager:	Christine Krebill
Contact:	Suwinto Gunawan	Project Engineer:	-
Standard:	FCC Part 15, ICES-003, RSS-247	Class:	B



Run #3: Maximized Readings, 1000 - 10000 MHz

EUT and Test Configuration Details: *Cellular Band 2 (1960 MHz Downlink, 1880 MHz Uplink)*

Preliminary peak readings captured during pre-scan (peak readings vs. average limit)

Frequency	Level	Pol	FCC Class B		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
5645.000	44.8	V	54.0	-9.2	Peak	181	1.3	
1880.000	107.6	V	-	-	Peak	164	1.0	Uplink
1960.000	61.3	V	-	-	Peak	356	1.3	Downlink

Final peak and average readings (vs. FCC limits)

Frequency	Level	Pol	FCC Class B		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
5642.830	40.5	V	54.0	-13.5	AVG	162	1.0	RB 1 MHz;VB 10 Hz;Peak
5643.220	53.0	V	74.0	-21.0	PK	162	1.0	RB 1 MHz;VB 3 MHz;Peak

Note 1:	For FCC testing above 1 GHz, the limit is based on an average measurement. In addition, the peak reading of any emission above 1 GHz can not exceed the average limit by more than 20 dB.

Client:	Rand McNally	PR Number:	PR141313
Model:	TND 765	T-Log Number:	TL141313-EMC
		Project Manager:	Christine Krebill
Contact:	Suwinto Gunawan	Project Engineer:	-
Standard:	FCC Part 15, ICES-003, RSS-247	Class:	B

Radiated Emissions

(NTS Silicon Valley, Fremont Facility, Semi-Anechoic Chamber)

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 7/23/2021
Test Engineer: R. Varelas / J. Semana
Test Location: FT Chamber #7
Config. Used: 1
Config Change: None
EUT Voltage: 12V Battery

General Test Configuration

The EUT and any local support equipment were located on the turntable for radiated emissions testing.
Radiated emissions tests above 1 GHz to FCC Part 15 were performed with floor absorbers in place in accordance with the test methods of ANSI C63.4 and CISPR 16-1-4.
The test distance and extrapolation factor (if applicable) are detailed under each run description.
Note, preliminary testing indicates that the emissions were maximized by orientation of the EUT and elevation of the measurement antenna. Maximized testing indicated that the emissions were maximized by orientation of the EUT, elevation of the measurement antenna, and manipulation of the EUT's interface cables.

Ambient Conditions:

Temperature: 24.1 °C
Rel. Humidity: 39 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
2	Radiated Emissions 30 - 1000 MHz, Maximized	Class B	Pass	29.5 dBµV/m @ 138.48 MHz (-0.5 dB)
3	Radiated Emissions 1 GHz - 9 GHz Maximized	FCC B	Pass	41.2 dBµV/m @ 8469.5 MHz (-12.8 dB)

Modifications Made During Testing

No modifications were made to the EUT during testing

Deviations From The Standard

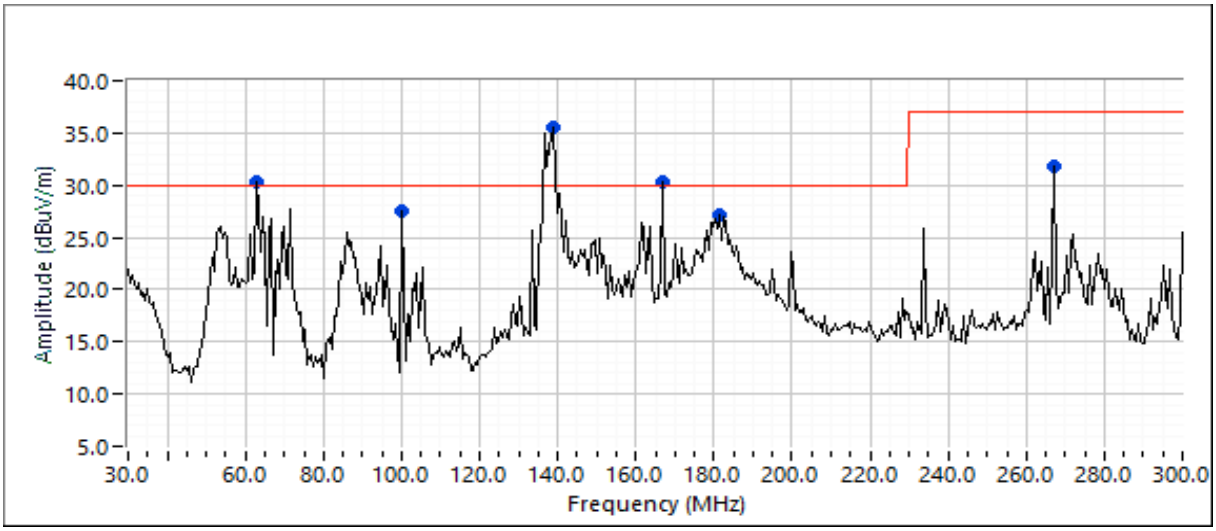
No deviations were made from the requirements of the standard.

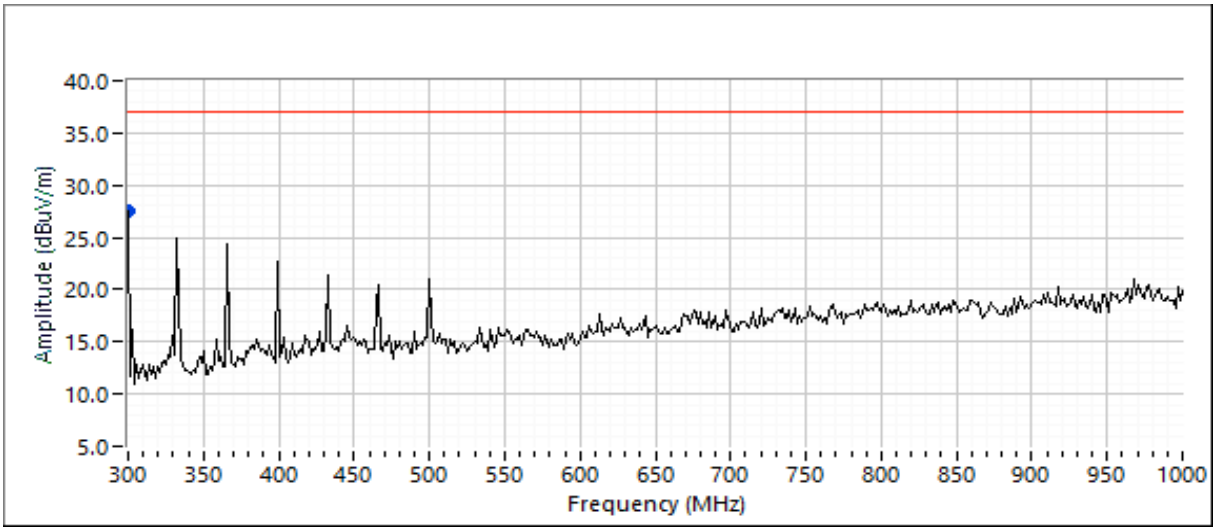
Test Parameters for Preliminary Scan(s)			
Frequency Range (MHz)	Prescan Distance (meters)	Limit Distance (meters)	Extrapolation Factor (dB, applied to data)
30 - 1000	5	10	-6.0
1000 - 9000	3	3	0.0

Client:	Rand McNally	PR Number:	PR141313
Model:	TND 765	T-Log Number:	TL141313-EMC
		Project Manager:	Christine Krebill
Contact:	Suwinto Gunawan	Project Engineer:	-
Standard:	FCC Part 15, ICES-003, RSS-247	Class:	B

Run #1: Preliminary Radiated Emissions, 30 - 1000 MHz

EUT and Test Configuration Details: *Cellular Band 4 (2132.5 MHz Downlink, 1732.5 MHz Uplink)*





Client:	Rand McNally	PR Number:	PR141313
Model:	TND 765	T-Log Number:	TL141313-EMC
		Project Manager:	Christine Krebill
Contact:	Suwinto Gunawan	Project Engineer:	-
Standard:	FCC Part 15, ICES-003, RSS-247	Class:	B

Run #1: Preliminary Radiated Emissions, 30 - 1000 MHz

EUT and Test Configuration Details: *Cellular Band 4 (2132.5 MHz Downlink, 1732.5 MHz Uplink)*

Preliminary peak readings captured during pre-scan

Frequency	Level	Pol	Class B		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
63.291	30.3	V	30.0	0.3	Peak	54	1.5	
100.005	27.5	V	30.0	-2.5	Peak	248	1.0	
138.476	35.6	V	30.0	5.6	Peak	193	1.0	
166.674	30.4	V	30.0	0.4	Peak	314	1.0	
181.911	27.2	V	30.0	-2.8	Peak	225	3.5	
266.673	31.8	H	37.0	-5.2	Peak	105	1.5	
299.999	27.6	V	37.0	-9.4	Peak	141	1.0	

Run #2: Maximized Readings From Run #1

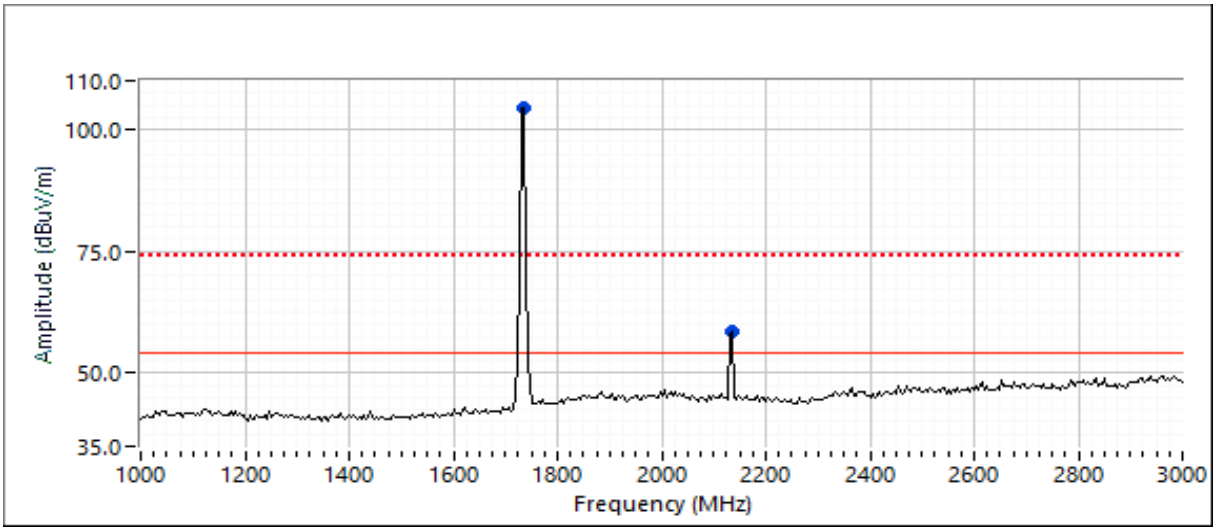
Maximized quasi-peak readings (includes manipulation of EUT interface cables)

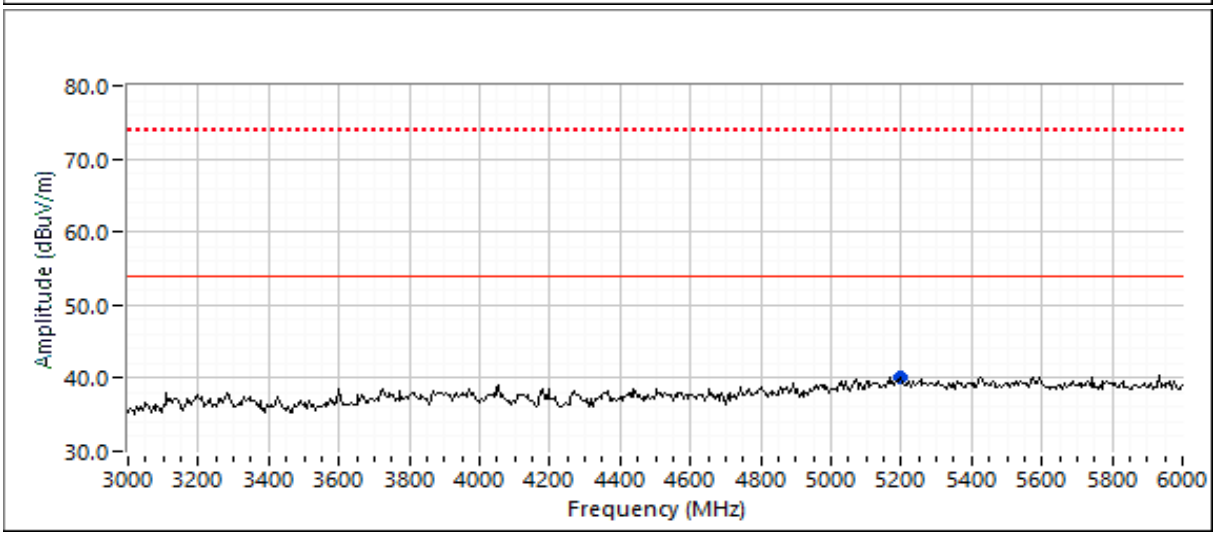
Frequency	Level	Pol	Class B		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
138.476	29.5	V	30.0	-0.5	QP	184	1.0	QP (1.00s)
166.674	29.1	V	30.0	-0.9	QP	314	1.0	QP (1.00s)
100.005	27.6	V	30.0	-2.4	QP	245	1.0	QP (1.00s)
266.673	30.8	H	37.0	-6.2	QP	123	1.7	QP (1.00s)
63.291	20.6	V	30.0	-9.4	QP	37	1.6	QP (1.00s)
181.911	17.8	V	30.0	-12.2	QP	188	3.5	QP (1.00s)
299.999	17.5	V	37.0	-19.5	QP	92	1.0	QP (1.00s)

Client:	Rand McNally	PR Number:	PR141313
Model:	TND 765	T-Log Number:	TL141313-EMC
		Project Manager:	Christine Krebill
Contact:	Suwinto Gunawan	Project Engineer:	-
Standard:	FCC Part 15, ICES-003, RSS-247	Class:	B

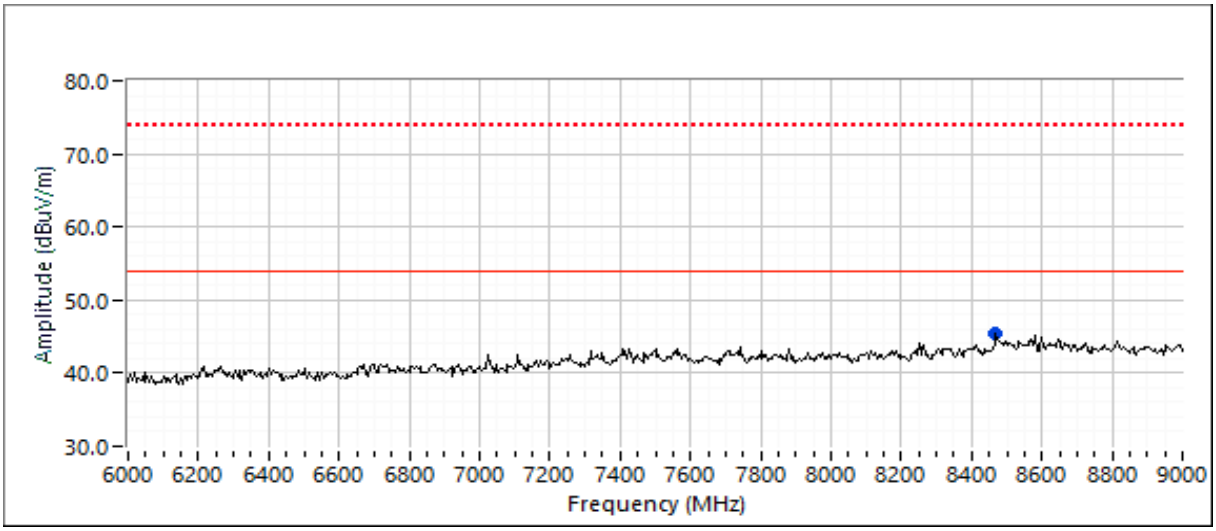
Run #3: Maximized Readings, 1000 - 9000 MHz

EUT and Test Configuration Details: *Cellular Band 4 (2132.5 MHz Downlink, 1732.5 MHz Uplink)*





Client:	Rand McNally	PR Number:	PR141313
Model:	TND 765	T-Log Number:	TL141313-EMC
		Project Manager:	Christine Krebill
Contact:	Suwinto Gunawan	Project Engineer:	-
Standard:	FCC Part 15, ICES-003, RSS-247	Class:	B



Run #3: Maximized Readings, 1000 - 9000 MHz

EUT and Test Configuration Details: *Cellular Band 4 (2132.5 MHz Downlink, 1732.5 MHz Uplink)*

Preliminary peak readings captured during pre-scan (peak readings vs. average limit)

Frequency	Level	Pol	FCC Class B		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1732.500	104.5	H	-	-	Peak	110	1.6	Uplink
2132.500	58.4	H	-	-	Peak	302	2.2	Downlink
5200.000	40.1	V	54.0	-13.9	Peak	6	2.5	
8470.400	45.4	V	54.0	-8.6	Peak	350	2.2	

Final peak and average readings (vs. FCC limits)

Frequency	Level	Pol	FCC Class B		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
8469.450	41.2	V	54.0	-12.8	AVG	0	2.5	RB 1 MHz;VB 10 Hz;Peak
5199.470	35.3	V	54.0	-18.7	AVG	0	2.4	RB 1 MHz;VB 10 Hz;Peak
8470.550	52.9	V	74.0	-21.1	PK	0	2.5	RB 1 MHz;VB 3 MHz;Peak
5200.270	48.6	V	74.0	-25.4	PK	0	2.4	RB 1 MHz;VB 3 MHz;Peak

Note 1:	For FCC testing above 1 GHz, the limit is based on an average measurement. In addition, the peak reading of any emission above 1 GHz can not exceed the average limit by more than 20 dB.

Client:	Rand McNally	PR Number:	PR141313
Model:	TND 765	T-Log Number:	TL141313-EMC
		Project Manager:	Christine Krebill
Contact:	Suwinto Gunawan	Project Engineer:	-
Standard:	FCC Part 15, ICES-003, RSS-247	Class:	B

Radiated Emissions

(NTS Silicon Valley, Fremont Facility, Semi-Anechoic Chamber)

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 7/23/2021
Test Engineer: R. Varelas / J. Semana
Test Location: FT Chamber #7
Config. Used: 1
Config Change: None
EUT Voltage: 12V Battery

General Test Configuration

The EUT and any local support equipment were located on the turntable for radiated emissions testing.
Radiated emissions tests above 1 GHz to FCC Part 15 were performed with floor absorbers in place in accordance with the test methods of ANSI C63.4 and CISPR 16-1-4.
The test distance and extrapolation factor (if applicable) are detailed under each run description.
Note, preliminary testing indicates that the emissions were maximized by orientation of the EUT and elevation of the measurement antenna. Maximized testing indicated that the emissions were maximized by orientation of the EUT, elevation of the measurement antenna, and manipulation of the EUT's interface cables.

Ambient Conditions:

Temperature: 24.1 °C
Rel. Humidity: 39 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
2	Radiated Emissions 30 - 1000 MHz, Maximized	Class B	Pass	26.9 dBµV/m @ 166.67 MHz (-3.1 dB)
3	Radiated Emissions 1 GHz - 5 GHz Maximized	FCC B	Pass	36.8 dBµV/m @ 2122.7 MHz (-17.2 dB)

Modifications Made During Testing

No modifications were made to the EUT during testing

Deviations From The Standard

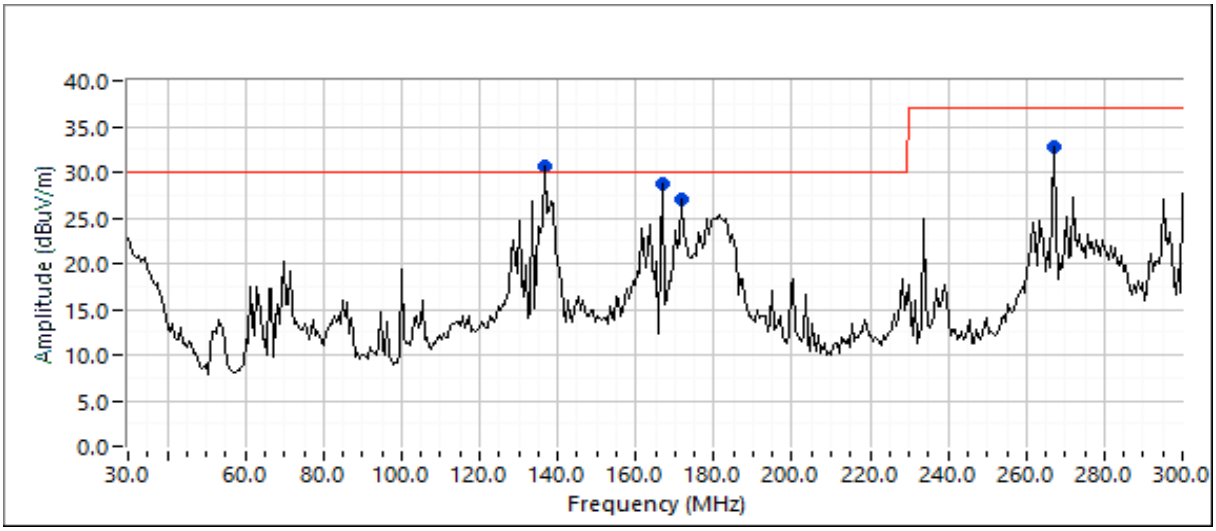
No deviations were made from the requirements of the standard.

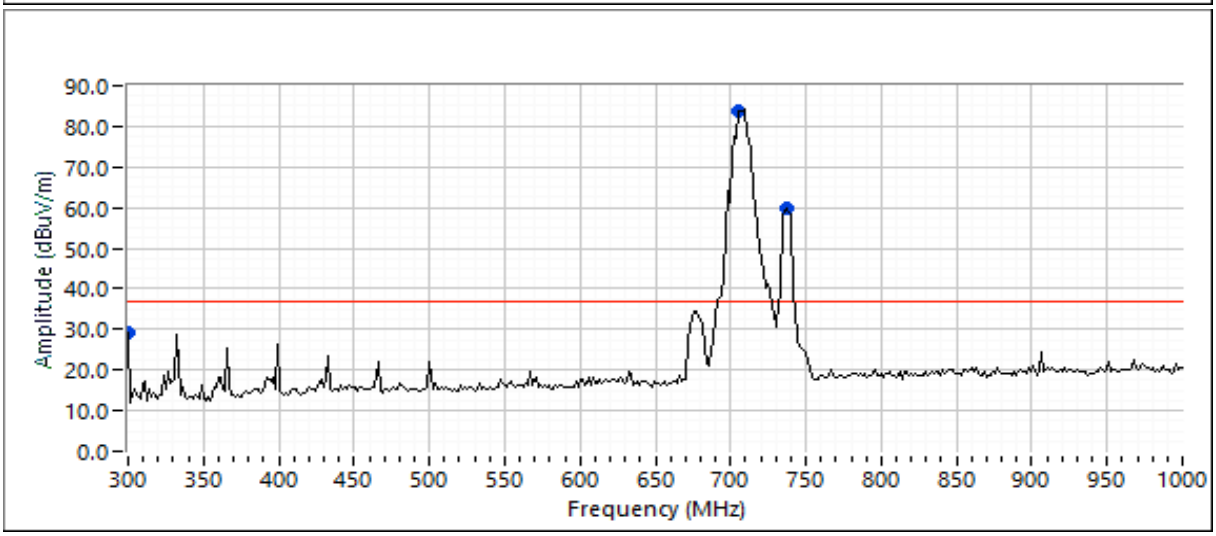
Test Parameters for Preliminary Scan(s)			
Frequency Range (MHz)	Prescan Distance (meters)	Limit Distance (meters)	Extrapolation Factor (dB, applied to data)
30 - 1000	5	10	-6.0
1000 - 5000	3	3	0.0

Client:	Rand McNally	PR Number:	PR141313
Model:	TND 765	T-Log Number:	TL141313-EMC
		Project Manager:	Christine Krebill
Contact:	Suwinto Gunawan	Project Engineer:	-
Standard:	FCC Part 15, ICES-003, RSS-247	Class:	B

Run #1: Preliminary Radiated Emissions, 30 - 1000 MHz

EUT and Test Configuration Details: *Cellular Band 12 (737.5 MHz Downlink, 707.5 MHz Uplink)*





Client:	Rand McNally	PR Number:	PR141313
Model:	TND 765	T-Log Number:	TL141313-EMC
		Project Manager:	Christine Krebill
Contact:	Suwinto Gunawan	Project Engineer:	-
Standard:	FCC Part 15, ICES-003, RSS-247	Class:	B

Run #1: Preliminary Radiated Emissions, 30 - 1000 MHz

EUT and Test Configuration Details: *Cellular Band 12 (737.5 MHz Downlink, 707.5 MHz Uplink)*

Preliminary peak readings captured during pre-scan

Frequency	Level	Pol	Class B		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
136.821	30.7	V	30.0	0.7	Peak	270	3.5	
166.672	28.8	H	30.0	-1.2	Peak	114	3.5	
171.596	27.1	V	30.0	-2.9	Peak	283	3.5	
266.677	32.8	V	37.0	-4.2	Peak	304	2.5	
299.999	29.1	H	37.0	-7.9	Peak	143	1.0	
707.500	84.0	H	-	-	Peak	154	4.0	Uplink
737.500	59.9	V	-	-	Peak	66	1.0	Downlink
333.351	28.9	V	37.0	-8.1	Peak	348	2.0	

Run #2: Maximized Readings From Run #1

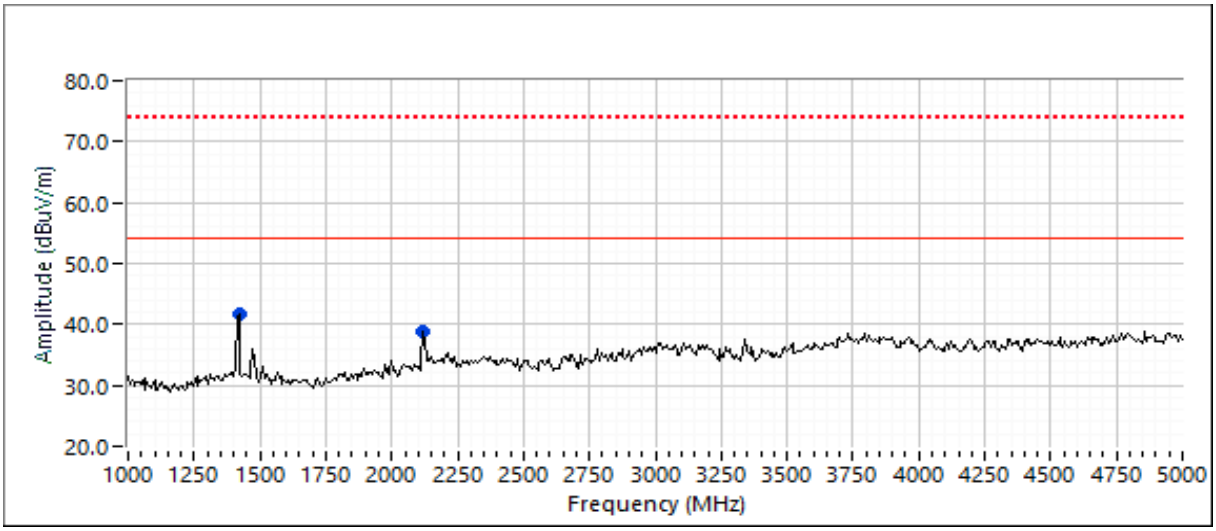
Maximized quasi-peak readings (includes manipulation of EUT interface cables)

Frequency	Level	Pol	Class B		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
166.672	26.9	H	30.0	-3.1	QP	114	3.5	QP (1.00s)
136.821	24.2	V	30.0	-5.8	QP	194	1.0	QP (1.00s)
299.999	27.5	H	37.0	-9.5	QP	140	1.0	QP (1.00s)
333.351	25.4	V	37.0	-11.6	QP	235	1.0	QP (1.00s)
171.596	15.8	V	30.0	-14.2	QP	0	1.1	QP (1.00s)
266.677	19.4	V	37.0	-17.6	QP	360	2.8	QP (1.00s)

Client:	Rand McNally	PR Number:	PR141313
Model:	TND 765	T-Log Number:	TL141313-EMC
		Project Manager:	Christine Krebill
Contact:	Suwinto Gunawan	Project Engineer:	-
Standard:	FCC Part 15, ICES-003, RSS-247	Class:	B

Run #3: Maximized Readings, 1000 - 5000 MHz

EUT and Test Configuration Details: *Cellular Band 12 (737.5 MHz Downlink, 707.5 MHz Uplink)*



Preliminary peak readings captured during pre-scan (peak readings vs. average limit)

Frequency	Level	Pol	FCC Class B		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1417.070	41.8	V	54.0	-12.2	Peak	251	1.0	
2125.410	38.9	V	54.0	-15.1	Peak	222	1.0	

Final peak and average readings (vs. FCC limits)

Frequency	Level	Pol	FCC Class B		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2122.710	36.8	V	54.0	-17.2	AVG	215	1.0	RB 1 MHz;VB 10 Hz;Peak
1415.600	36.4	V	54.0	-17.6	AVG	244	1.1	RB 1 MHz;VB 10 Hz;Peak
2123.500	48.7	V	74.0	-25.3	PK	215	1.0	RB 1 MHz;VB 3 MHz;Peak
1418.510	46.7	V	74.0	-27.3	PK	244	1.1	RB 1 MHz;VB 3 MHz;Peak

Note 1:	For FCC testing above 1 GHz, the limit is based on an average measurement. In addition, the peak reading of any emission above 1 GHz can not exceed the average limit by more than 20 dB.

Appendix C Product Labeling Requirements

The following information has been provided to clarify notification, equipment labeling requirements and information that must be included in the operator's manual. These requirements may be found in the standards/regulations listed in the scope of this report.

Label Location

The required label(s) must be in a *conspicuous location* on the product, which is defined as any location readily visible to the user of the device without the use of tools.

Label Attachment

The label(s) must be *permanently attached* to the product, which is defined as attached such that it can normally be expected to remain fastened to the equipment during the equipment's expected useful life. A paper gum label will generally not meet this condition.

United States Class B Label

> FCC ID: ABC1234567
> This device complies with Part 15 of FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

The FCC Identifier is comprised of the grantee code (in the example above **ABC**) that was assigned by the FCC plus a unique alpha-numeric specific to the product being certified. The ID must appear on the device.

If the device is too small or for such use that it is not practicable to place the US label statement on it, the statement shall be placed in a prominent location in the instruction manual or pamphlet supplied in paper form with the product. If not it shall be placed on the container in which the device is marketed or on a paper insert or removable tag on the product.

Industry Canada

For ICES-003 Issue 7, the product must be labeled with the following Innovation, Science and Economic Development Canada ICES-003 Compliance Label:

CAN ICES-3 (*)/NMB-3(*)

*Insert either “A” or “B” but not both to identify the applicable Class of ITE.

If the product is too small then the text may be placed in the manual with the approval of ISED Canada.

Appendix D User Manual Regulatory Statements

Where special accessories, such as shielded cables, are required in order to meet the emission limits, appropriate instructions regarding the need to use such accessories must be contained on the first page of text concerned with the installation of the device in the operator's manual.

A requirement by FCC regulations, and recommended for all regulatory markets, is a cautionary statement to the end user that changes or modifications to the device not expressly approved by you, the manufacturer, could void their right to operate the equipment.

United States Class B Manual Statement

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try and correct the interference by one or more of the following measures:
-Reorient or relocate the receiving antenna.
-Increase the separation between the equipment and the receiver.
-Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
-Consult the dealer or an experienced radio/TV technician for help.

Note: Additional information about corrective measures may also be provided to the user at the company's option.

The FCC has indicated that the radio interference statement be bound in the same manner as the operator's manual. Thus, a loose-leaf insert page in a bound or center-spine and stapled manual would not meet this condition.

Appendix E Basic and Reference Standards

Subpart B of Part 15 of FCC Rules for digital devices.

FCC Part 15 Subpart B references the use of ANSI C63.4–2014: "*Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz*" for the purposes of evaluating the radiated and conducted emissions from digital devices.

Industry Canada Interference Causing Equipment Standard ICES-003 Issue 7, October 2020

ICES-003 refers to ANSI C63.4-2014 and Canadian Standards Association Standard CAN/CSA-CISPR 32:17, "*Electromagnetic compatibility of multimedia equipment – Emission requirements.*" This standard is an adoption of IEC CISPR 32:2015 with Canadian deviations.

End of Report

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