Before the
Federal Communications Commission
Washington, D.C. 20554

In the matter of	)	
	)	
Application for Review of Certification of a	)	
Time Domain UWB Transmitter	)	FCC Identifier NUF-200SGT-0702

Memorandum Opinion and Order

Adopted: February 10, 2003 **Released: February 13, 2003**

By the Commission:

I. INTRODUCTION

1. On October 11, 2002, the Commission's Office of Engineering and Technology (OET) issued a grant of equipment authorization to Time Domain Corporation ("Time Domain") for an ultra-wideband ("UWB") transmitter, the Signal Generator/Tag (SG/T).[1] This device is a transmit-only radio to be used by UWB application developers to evaluate UWB propagation and co-existence with other RF devices. When paired with a receiver, it can also be configured to pass data packets that support UWB ranging and positioning, and communications.[2]

2. This grant of equipment authorization was challenged by a coalition of companies and associations ("Petitioners").[3] The Petitioners request that the Commission review and reverse the grant of Time Domain's equipment authorization because of alleged non-compliance with specific UWB limits contained in the FCC Rules. For the reasons stated below, we deny the Petitioners' application for review.

II. BACKGROUND

3. On February 14, 2002, the Commission adopted new regulations to permit the operation of UWB transmitters on an unlicensed basis under Part 15 of its rules.[4] Several categories of UWB devices were established with different standards for these devices based on their individual operating characteristics and potential for causing interference to the authorized radio services. The emission limits

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[1] *See* file for FCC ID number NUF-200SGT-0702. All equipment authorization files and correspondence referenced herein are accessible electronically at: http://www.fcc.gov/oet/fccid/.

[2] *Id.*

[3] *See* Application for Review filed by the coalition ("Petitioners") consisting of: Air Transport Association of America, Inc.; American Airlines; American Congress on Surveying and Mapping; ARINC; AT&T Wireless Services, Inc.; The Boeing Company; Delta Air Lines, Inc.; Garmin International, Inc.; General Aviation Manufacturers Association; Multispectral Solutions, Inc.; National Business Aviation Association, Inc.; NavCom Technology, Inc.; Nortel Networks, Inc.; Northwest Airlines, Inc.; NovAtel Inc.; PanAmSat Corporation; QUALCOMM Incorporated; Raytheon Company; Rockwell Collins, Inc.; Satellite Industry Association; Sirius Satellite Radio Inc.; Spatial Technologies Industry Association; Sprint Corporation; Tendler Cellular, Inc.; Trimble Navigation Ltd.; United Airlines; United States GPS Industry Council; and XM Radio Inc.

[4] *See First Report and Order* ("*R&O*") in ET Docket No. 98-153, 17 FCC Rcd 7435 (2002).

for UWB devices are more stringent than for other unlicensed devices at frequencies below 3.1 GHz, particularly in the 0.96 to1.61 GHz frequency band used by GPS and other Aeronautical Radionavigation Services. In adopting the standards for UWB devices, the Commission noted that many UWB transmission systems will incorporate digital circuitry which also will radiate RF emissions. It also noted that requiring the emissions from this associated digital circuitry to comply with some of the reduced levels adopted for UWB devices may make production infeasible. Accordingly, the Commission adopted rules to permit the emissions from digital circuitry used to enable operation of an UWB device to operate at the Part 15 general emission limits in 47 C.F.R. § 15.209 provided that it can be clearly demonstrated that those emissions are due solely to emissions from the digital circuitry and are not intended to be radiated from the UWB device's antenna.[5]

III. DISCUSSION

4. The Petitioners claim that the emissions below 3.1 GHz from the Time Domain transmitter exceed the limits permitted under the regulations.[6] The petitioners contend that only digital circuitry used for the internal operation of the transmitter, such as digital clocks or other housekeeping functions, are permitted to operate at the higher limits in 47 C.F.R. § 15.209.[7] They argue that the way to determine what emissions are from digital circuitry is to remove or to disable all components and software associated with the UWB transmitter.[8] The Petitioners also claim that there is a defect in the Time Domain certification application because it does not contain data on the filter characteristics or the measured level of emissions below 3.1 GHz.[9] The Petitioners add that the Commission should require applicants to demonstrate that unintended emissions below 3.1 GHz are from the microprocessor and are completely uncorrelated with the intended transmit signal, existing only when all circuitry and software associated with the transmitter have been removed.[10]

5. In its November 11, 2002 response to the application for review, Time Domain notes that the subject transmitter consists of a digital module and an RF module.[11] The digital module is used to facilitate the connection of the device to a computer as well as to enable the generation of the UWB signal by the RF module. Time Domain states that its transmitter fully complies with the applicable standards and that its application for certification correctly stated that there were no intentional emissions between 960 MHz and 3100 MHz.[12] Time Domain asserts that the UWB rules require that signals emitted from the antenna of its transmitter comply with the UWB emission requirements specified in our rules (47 C.F.R. § 15.517) while signals from digital circuits in the device must comply with the general emissions limits in our rules (47 C.F.R. § 15.209).[13]

6. Reply comments were filed by Sprint Corporation and by the petitioners. Sprint argues

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5 *Id*. at paragraph 207.

6 Petition at pg. 2-3.

7 *Id.* at pg. 6-7.

8 *Id.* at pg. 6.

9 *Id.* at pg. 6.

10 *Id.* at pg. 6.

11 Time Domain comments at pg. 2

12 *Id.*

13 *Id.* at pg. 3. Digital devices, which can be distinguished from digital circuitry based on the definition in 47 C.F.R. §15.3(k), are subject to the limits specified in 47 C.F.R. § 15.109. Except for the special category of Class A digital devices, permissible emission levels for digital devices are the same as the general radiated emission levels set forth in 47 C.F.R. § 15.209.

that the emissions from the Time Domain transmitter are not necessarily emissions from digital circuitry nor are they necessarily not intended to be radiated from the antenna.[14] Sprint believes that Time Domain has not clearly demonstrated that the emissions below 3.1 GHz from its transmitter are due to emissions from digital circuitry. The Petitioners reiterate their earlier arguments that Time Domain's assertions of compliance are not supported by test data, adding that the Commission's rules require a report of the emission levels in the 960 MHz to 3100 MHz band.[15] The Petitioners believe that components of the transmitter should not be categorized as digital circuitry and that the emissions from these components should not be subject only to the less stringent Part 15 general emission limits.[16] They also argue that testing for unintentional emissions with the antenna connection terminated is inconsistent with the Commission's regulations for intentional radiators, and that unintentional emission testing must be performed with the transmitter in a quiescent state with no radio frequency or associated devices active.[17] The petitioners add that allowing higher emissions from digital circuitry associated with the transmitter undermines the conservative approach taken by the Commission for protecting other radio operations.[18]

7. OET's review of the application for certification from Time Domain for its UWB transmitter found that the transmitter complies with all of the limits in the Commission's rules. Such transmitters are required to confine their 10 dB bandwidth between 3.1 and 10.6 GHz and are subject to reduced emission levels between 960 and 3100 MHz. As pointed out by the petitioners, Time Domain's application for equipment authorization did not contain data on measured emissions in the 960 to 3100 MHz frequency range. However, this omission does not render the application defective. The FCC's rules require that an application for certification include a report of measurements demonstrating compliance as determined by following the test procedures of the American National Standards Institute (ANSI) C63.4-1992.[19] According to Section 10.1.8.2 of ANSI C63.4, only the fundamental and three spurious emissions are required to be reported to the Commission. Lacking any other procedures or guidance from the Commission, Time Domain was not required to report any of the emissions detected in the 960 to 3100 MHz band in its application for certification.

8. Also, as discussed above, the regulations specifically permit emissions to comply with the Part 15 general emission limits in 47 C.F.R. § 15.209, rather than the limits specified in 47 C.F.R. § 15.517, if they are from associated digital circuitry used to enable the operation of the UWB device.[20] In conjunction with the approval process, OET staff independently tested the Time Domain equipment and confirmed that the emissions appearing in the 960 MHz to 3100 MHz band were produced by associated digital circuitry and were not intended to be emitted by the transmitter's antenna. Accordingly, these emissions are subject to the Part 15 general emission limits specified in 47 C.F.R. § 15.209 and not to the more stringent limits in 47 C.F.R. § 15.517(c).

9. Because the Time Domain device was the first non-ground penetrating radar unit submitted for equipment authorization under the new UWB rules, and because it offered OET staff engineers the first opportunity to further develop standardized UWB compliance measurement procedures, a complete RF characterization was performed on this device. The results of that testing,

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14 Sprint reply comments at pg. 3.

15 Petitioners reply comments at pg. 2.

16 *Id.* at pg. 4 and 6. .

17 *Id.* at pg. 4.

18 *Id.* at pg. 5.

19 *See* 47 C.F.R. § 2.1033(b)(6) and 47 C.F.R § 15.31(a)(6).

20 *See R&O*, *supra*, at para. 207 and 47 C.F.R. § 15.521(c). Further, emissions from associated digital devices, *e.g.*, emissions from digital circuitry used to control additional functions or capabilities other than the UWB transmission, are subject to the limits applicable to digital devices.

contained in the attached Appendix, demonstrate conclusively that the Time Domain transmitter complies with all of the relevant FCC rules for UWB equipment. Although some narrow band emissions were detected in the 960-3100 MHz band, these emissions are attributable to the associated digital circuitry contained within the UWB device, are not radiated by the UWB antenna, and are compliant with the Part 15 general emission limits in 47 C.F.R. § 15.209, as stipulated under 47 C.F.R. § 15.521(c). Our investigation identified the narrowband emissions in the 960 to 3100 MHz band as harmonics of the 19.2 MHz oscillator contained in the digital module portion of Time Domain's UWB device. To confirm that the emissions in the 960 to 3100 MHz band are not intended to be radiated by the device's antenna, the emissions levels were measured with the antenna removed and its connection port terminated. As can be seen from the OET report, under this configuration the UWB emissions were no longer present; however, the narrow band emissions were still observed. This indicates that the narrow band emissions do not radiate from the device's antenna. For further confirmation, a spectrum analyzer was attached to the UWB antenna port to measure the conducted emissions from the Time Domain transmitter. As shown in the attached report, under this test condition no narrow band emissions were observed between 960 and 3100 MHz. We reject the arguments of the petitioners that it is necessary to remove or disable all components or software associated with the UWB transmitter to determine if the emissions are generated by the digital circuitry. Such a requirement would necessitate disassembly and re-engineering of the device in order to perform the tests. This requirement is not feasible. Further, the emissions from digital circuitry associated with the transmitter are included under the provisions in 47 C.F.R. § 15.521(c). Requiring the removal of this circuitry would not provide useful test results.

10. As demonstrated above, the narrowband emissions produced in the 960 to 3100 MHz band by Time Domain's SG/T UWB device are subject to the Part 15 general emission limits contained in 47 C.F.R. § 15.209. We disagree with the claims by the petitioners that digital components used to control the transmitter are subject to the more stringent limits associated with the transmitter. It is clear that the digital circuitry discussed in 47 C.F.R. § 15.521(c) includes circuitry used to control and enable the operation of the transmitter, *e.g.*, digital circuitry used to trigger the pulse output of the transmitter. It also is clear that 47 C.F.R. § 15.521(c) permits the emissions from this digital circuitry to be radiated at the Part 15 general emission levels specified in 47 C.F.R. § 15.209.

IV. ORDERING CLAUSES

11. Accordingly, IT IS ORDERED that the Application for Review of the grant of certification issued to the UWB transmitter from Time Domain Corporation, FCC ID NUF-200SGT-0702, IS DENIED. This action is taken pursuant to Sections 302, 303(e), and 303(f) of the Communications Act of 1934, as amended, 47 U.S.C. 302, 303(e), and 303(f).

12. For further information regarding this Memorandum Opinion and Order, contact John A. Reed, Office of Engineering and Technology, (202) 418-2455, jreed@fcc.gov.

FEDERAL COMMUNICATIONS COMMISSION

Marlene H. Dortch
Secretary

APPENDIX

RADIATED EMISSIONS CHARACTERIZATION OF TIME DOMAIN CORPORATION'S SIGNAL GENERATOR/TAG (SG/TAG) ULTRA-WIDEBAND (UWB) TRANSMITTER

Federal Communications Commission
Office of Engineering and Technology/Laboratory Division

23 January 2003

1.0 INTRODUCTION

On February 14th, 2002, the Federal Communications Commission (FCC) adopted the *First Report and Order* ("*R&O*") authorizing the limited use of Ultra-Wideband (UWB) devices on an unlicensed basis under Part 15 of the FCC rules.[21] The FCC Office of Engineering and Technology (OET), through its Equipment Authorization Branch (EAB), granted the first Equipment Authorization (FCC ID: NUF-200SGT-0702) for an indoor-operating UWB transmitting device on October 11, 2002.

The application for authorization was filed with the EAB on July 29th, 2002. The application was submitted with a companion test report, documenting the results of compliance testing performed by an independent accredited test laboratory.[22] A sample of the UWB device described in the application was also provided to EAB.

Since this was the first application submitted under the new rules for indoor UWB transmitters, and because it offered OET staff engineers a first opportunity to further develop standardized UWB compliance measurement procedures, a complete radio frequency (RF) radiated emissions characterization was performed on this device. The data collected from these measurements was considered in conjunction with that provided by the applicant to determine compliance to the applicable rules.[23]

Several parties have since raised questions regarding the granting of this authorization.[24] They have expressed concerns that the device intentionally emits RF signals into the 960-3100 MHz frequency band at amplitudes that are in excess of the UWB emissions limits applicable to this frequency range.

This report documents and explains the pertinent data extracted from the FCC evaluation of the subject device. The data contained herein is a subset of the complete data set collected; however, it is adequate to address the concerns expressed within the Application for Review.

2.0 DEVICE DESCRIPTION

The UWB device for which the Equipment Authorization was granted is a Signal Generator/TAG ("SG/TAG") Model Number 100-0011C, Serial Number TGHC00103, designed and manufactured by Time Domain Corporation. This device is a transmit-only radio to be used by UWB application developers to evaluate UWB propagation and co-existence with other RF devices. When paired with a receiver, it can also be configured to pass data packets that support UWB ranging, positioning and communications.

The SG/TAG applies a nominal 500 pico-second pulse to the transmitting antenna at a non-adjustable pulse rate of 10 million pulses per second (10 MHz). The device is powered from 120 volt, 60 Hz AC power and is fitted with a non-removable power cord.

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21 *First Report and* Order in ET Docket No. 98-153, 17 FCC Rcd 7435 (2002).

22 Hiday, J.D., *Evaluation of the TAG Model Number: 100-0011C to CFR 47 Part 15, Subpart F*, Report Number: 0227351uwb.doc, Intertek Testing Services, Inc., ETL SEMKO, 22 July 2002, (hereinafter "Intertek Report").

23 The testing that is the subject of this report was conducted prior to issuing the grant of certification to Time Domain. This report summarizes the procedures that were used and test data that was obtained.

24 US GPS Industry Council, et al, *Application for Review*, 22 October 2002.

The application for authorization was submitted under CFR 47 Part 15, Subpart F, Section 15.517, "*Technical requirements for indoor UWB systems*," which is the applicable section of the UWB rules.

3.0 MEASUREMENT DETAILS

3.1 Measurement System.

The components used in performing these measurements are listed in Table 1, along with pertinent specifications. A block diagram showing the measurement equipment configuration used in the subsequent compliance tests is provided in Figure 1.

Table 1. List of Measurement Equipment.

DESCRIPTION	MANUFACTURER	MODEL	SERIAL NUMBER	FREQUENCY RANGE (GHz)
PSA Spectrum Analyzer	Agilent	E4448A	US42070179	0.000003-50.0
Swept CW Signal Generator	Agilent	83650L	3844A00650	0.01-50.0
Low Noise Pre-Amp	Hewlett-Packard	HP83017A	3611A01199	0.5-26.5
Low Noise Pre-Amp	Miteq	AFS3-01000200-06-10P-6	856403	1.0-2.0
Double Ridge Guide Horn Antenna	A.H. Systems, Inc.	SAS-200/571	387	0.7-18.0
Coaxial Cable	Times Wire and Cable	LMR-400	-	< 16.2

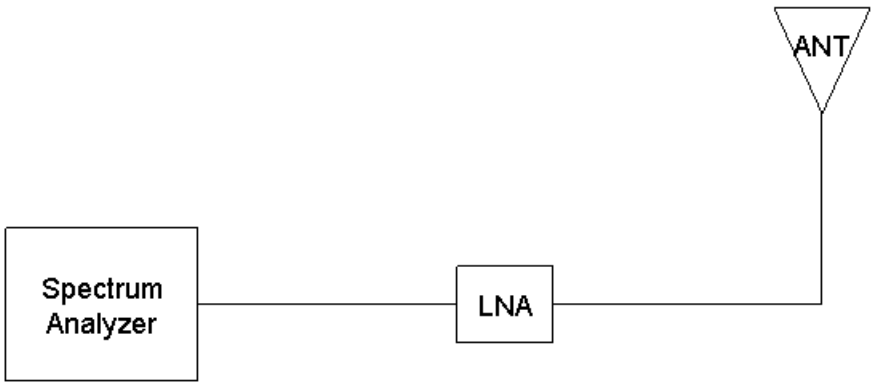

Figure 1. Block Diagram of Measurement System.

The PSA spectrum analyzer incorporates a true root-mean-square (RMS) detector and was used to perform all radiated emissions measurements above 960 MHz. The specific analyzer settings are provided in the subsequent sections describing the tests performed.

A very low-noise, octave-tuned (1-2 GHz), pre-amplifier was used to implement the LNA shown in the block diagram to facilitate the radiated emissions measurements within the 960-1610 MHz frequency range, where the UWB emission limits are extremely stringent. This configuration is necessary to reduce the measurement system operational sensitivity in order to detect radiated emissions from the device under test (DUT) at the extremely low amplitude levels defined by the emissions limit in this frequency band. A broadband (0.5-26.5 GHz) pre-amplifier was used to implement the LNA for the measurements performed in the 1610-3100 MHz frequency range. At each data point considered in these tests, the

calibrated signal generator was used to determine the measurement system characteristics at the associated frequency.

A double ridge-guide broadband horn antenna was used to receive the radiated emissions within the 960-3100 MHz band. The antenna characteristics were determined from manufacturer-supplied calibration data.

All radiated tests utilized a one-meter separation distance between the DUT and the measurement antenna. This enabled an improved signal-to-noise ratio (S/N) for the radiated tests. Although these types of measurements are typically performed at a distance of three-meters, it was necessary to reduce the measurement distance to enable discrimination between the emissions radiating from the DUT and the measurement system noise floor.

3.2 Measurement Facility

These measurements were performed at the FCC Laboratory, located on Oakland Mills Road, in Columbia, Maryland. The geographic coordinates of the laboratory are 39º10.093'N latitude and 076º49.706'W longitude.

The measurements were performed in the pre-compliance laboratory within the main facility. This room consists of two walls constructed of painted cinder block and two walls constructed of painted metal siding. The floor is covered with conventional ceramic tile and measures approximately 30 by 30 feet. The ceiling is a drop ceiling constructed of 2-feet by 4-feet acoustical tile panels at a height of approximately 18 feet above the floor. No effort was made to characterize the room in terms of reflective or resonant RF properties.

The room is not shielded from RF energy and thus is subject to the presence of ambient signals. For these measurements, the known ambient signals of concern include cellular telephone signals in the 800 MHz band, paging system signals in the 900 MHz band, Air Traffic Control Radio Beacon signals at 1030 and 1090 MHz, and PCS signals in the 1.9 GHz band. Although the cellular and paging system signals are located outside of the frequency bands examined herein, it was necessary to determine their presence and amplitude in order to assess the potential for high-power effects to the pre-amplifiers utilized in the measurement system. Measurements were performed that eliminated this factor as a cause for concern and thus, the use of pre-select filtering was determined not to be required for these tests.

3.3 Data Reduction Techniques

The data reduction performed herein is presented in terms of power spectral density (PSD). The UWB emission limits are expressed in terms of equivalent isotropic radiated power (EIRP). The PSD levels detected at the measurement antenna were related to an EIRP for comparison to the applicable emissions limits through application of the basic free-space propagation loss equation.

4.0 PEAK SPECTRAL ENVELOPE MEASUREMENT

The DUT was placed in the center of a non-conducting turntable. The measurement antenna was placed at a distance of 1-meter from the DUT. Both the resolution bandwidth (RBW) and the video bandwidth (VBW) of the analyzer were set to 3 MHz. The sweep time was automatically selected by the analyzer based on the frequency span of the measurement. The spectrum analyzer's positive peak detector was used in maximum-hold mode to capture and retain the peak power detected within each measurement bin.

A background measurement was first performed with the DUT turned off to detect any ambient signals present within the measurement area. This was necessary to enable discrimination between the emissions radiated by the DUT and any existing ambient emissions present in the measurement area. The DUT was

then turned on and continuously rotated while the measurement antenna was stepped in height between 1 and 4 meters and varied between vertical and horizontal polarization. This methodology results in a measurement of the maximum spectral envelope radiated by the DUT.

The spectral envelope measurement revealed the fundamental UWB emission, as defined by the outermost -10 dB points, to be contained entirely within the 3.1 to 10.6 GHz frequency band, as specified in the applicable rules section. However, several narrow-band (*i.e.*, 3 dB bandwidth < 2 MHz) emissions were observed in the 960-3100 MHz band. Each of these identified emissions was examined independently using the techniques described below to determine the associated RMS average amplitude levels.

5.0 AVERAGE POWER MEASUREMENTS

The emission limits specified in the applicable rules section are defined in terms of RMS average EIRP in a 1 MHz measurement bandwidth. This section describes the techniques used to measure the RMS average emission levels for comparison to the emissions limits.

The spectrum analyzer was set to utilize both a resolution and video bandwidth of 1 MHz. The RMS average detector was selected. The sweep time was set to 6 milliseconds and the detected amplitude levels were averaged over 100 consecutive sweeps. This combination resulted in a 1-millisecond integration time within each of the 601 measurement bins.

The frequency span of the analyzer was set to 10 MHz and centered to coincide with the center frequency associated with each specific narrow-band emission identified from the spectral envelope measurement. A full system calibration was performed at each of these center frequencies.

6.0 MEASUREMENT SUMMARY

Table 2 lists all of the DUT radiated emissions detected in the 960-3100 MHz frequency band that exceed the UWB emissions limit.

Table 2. Radiated Emissions Detected in the 960-3100 MHz Band.

FREQUENCY (MHz)	ADJUSTED RMS PSD (dBm/MHz)	FREE SPACE PATH LOSS @ 1m (dB)	EIRP (dBm/MHz)	MARGIN (Relative to UWB Limit) (dB)	MARGIN (Relative to 15.209 Limit) (dB)
998.4	-99.3	32.5	-66.8	8.5	-25.5
1075.2	-102.7	33.1	-69.6	5.7	-28.3
1107.8	-105.7	33.4	-72.3	3.0	-31.0
1152.0	-107.3	33.7	-73.6	1.7	-32.3
1228.8	-102.4	34.3	-68.1	7.2	-26.8
1305.6	-98.8	34.8	-64.0	11.3	-22.7
1382.4	-106.2	35.3	-70.9	4.4	-29.6
1459.2	-109.5	35.8	-73.7	1.6	-32.4
1536.0	-93.7	36.2	-57.5	17.8	-16.2

Each of these emissions was observed to be relatively narrow band, with a 3 dB bandwidth less than 2 MHz. Similarities were also noted between these emissions and those which have been observed in previous FCC studies of radiated emissions generated by digital devices.[25] Therefore, it was suspected

[25] FCC Project TRB 02-02 Report, *Measured Emissions Data for Use in Evaluating the Ultra-Wideband (UWB) Emissions Limits in the Frequency Bands Used By the Global Positioning System (GPS)*, ET Docket No. 98-153, October 22, 2002.

that the source of these narrow band emissions is the digital circuitry contained within the device. The current UWB rules allow for emissions at higher levels than the limits "*if it can be clearly demonstrated that an emission from a UWB transmitter is due solely to emissions from digital circuitry contained within the transmitter and that the emission is not intended to be radiated from the transmitter's antenna,…*"[26] In which case, *"…the limits shown in Section 15.209 of this chapter shall apply to that emission rather than the limits specified in this section.*"[27] Since this is the exception invoked in the application for certification, a methodology was formulated to determine whether these narrow band emissions are indeed attributable to the digital circuitry and not intended to be radiated from the transmitter's antenna. The details of this methodology are presented in the following section.

7.0 METHODOLOGY FOR ISOLATING DIGITAL EMISSIONS

The first method utilized for attempting to isolate the observed narrow-band emissions was to disconnect the radiating antenna from the device and terminate the antenna output port into a 50-ohm load. This was facilitated by the fact that the DUT utilizes a removable antenna connected via an external antenna port. A radiated measurement was performed with the antenna port terminated. It was observed from this measurement that the UWB emission, which is radiated from the antenna, was no longer present; however, the narrow-band emissions were still observed at equivalent amplitude levels. This is an indication that the narrow-band emissions are not being radiated from the DUT antenna.

A subsequent test was performed to ascertain that the source of these emissions is the digital circuitry within the device and not related to the UWB emission. In this test, the output from the DUT antenna port was applied directly to the spectrum analyzer in a conducted (*i.e.*, non-radiated) measurement. In this test, the UWB emission is clearly observed, but the narrow band emissions are no longer present. The results of this test provide adequate evidence that the narrow band emissions observed in the radiated tests are generated from internal digital circuitry and are not radiated from the antenna.

Although the tests described above are adequate justification for invoking the noted rule exception, an additional evaluation step was performed based on the observation of an interesting relationship recognized within the measurement data. A review of the data in Table 2 reveals that, with but one exception, all of the narrow-band emissions are related by a constant value of 76.8 MHz. Upon recognition of this relationship, the block diagram provided with the application[28] was examined. A 19.2 MHz oscillator is shown in the block diagram of the Digital Module of the DUT. The 76.8 MHz relationship observed in the measured data was determined to be an integral multiple of 19.2 MHz (*i.e.*, 19.2 MHz x 4 = 76.8 MHz). Thus, it was deduced that the narrow-band emissions observed in the radiated emissions testing of this device are most likely harmonic emissions associated with this oscillator.

The cumulative results of these tests provide compelling evidence that the narrow-band emissions observed in the 960-3100 MHz band are indeed generated by the digital circuitry contained within the transmitter and thus, are subject to the emissions limits defined in Section 15.209. The applicable emissions limit from this rules section is 500 μV/m at 3 meters, which is equivalent to an EIRP of -41.3 dBm/MHz. An examination of the measured emission levels identified in Table 2, demonstrates that each of the observed narrow-band emissions is in compliance with this limit.

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[26] 47 C.F.R. § 15.521 (c).

[27] *Id.*

[28] *See* Exhibit 3, SG/TAG Functional Block Diagram.

8.0 CONCLUSIONS

The SG/TAG Model Number 100-0011C UWB device was found to be fully compliant with the applicable rules for the category of UWB devices under which the application was submitted. All radiated UWB emissions are compliant with the applicable emissions limits depicted in the appropriate rules section. Although some narrow band emissions were detected in the 960-3100 MHz frequency band, with levels in excess of the UWB emissions limits, they were determined not to be radiating from the DUT antenna and were convincingly attributed to the digital circuitry within the device. Therefore, according to the provisions of Section 15.521(c), these emissions are not subject to the UWB emissions limits, but are instead subject to the emission limit defined in Section 15.209. Each of these narrow-band emissions was found to be compliant with the applicable emissions limit.