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Radio Frequency (RF) Exposure Evaluation

For the

Terma North America Inc.

SCANTER 1002

FCC ID: N9MSC1002

WLL Report: 15001-MPE Rev 1

Prepared for:

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Maximum Permissible Exposure Evaluation

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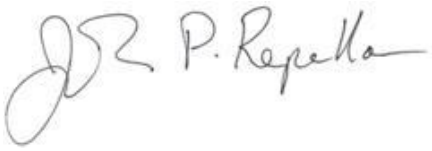

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Abstract

This report has been prepared on behalf of Terma North America to document the findings of the maximum permissible exposure evaluation on the SCANTER 1002 Ground Surveillance Radar. The purpose of this evaluation is to establish a minimum safe distance as per the RF exposure requirements as defined in in the following documents:

- ICNIRP Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic and Electromagnetic Fields (up to 300GHz): 1998
- Australia ARPNSA RP3: Radiation Protection Standard: Maximum Exposure Levels to Radiofrequency Fields — 3 kHz to 300 GHz: 2002
- Industry Canada RSS-102 Issue 5: Radio Frequency (RF) Exposure Compliance of Radio-communication Apparatus (All Frequency Bands) March:2015
- FCC CFR47 Part 1.1310 Radiofrequency radiation exposure limits.: 2013

Reference Documents:

- OET65: Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields.

The Evaluation was performed by Washington Laboratories, Ltd, 7560 Lindbergh Drive, Gaithersburg, MD 20879. Washington Laboratories, Ltd. has been accepted as an EMC Conformity Assessment Body (CAB) under the United States/European Union Memorandum of Agreement. Washington Laboratories, Ltd. is accredited by ANAB under Testing Certificate AT-1448.

Revision History	Reason	Date
Rev 0	Initial Release	July 06, 2018
Rev 1	Update to include corrections to calculations	March 25, 2019

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List of Tables

1 Introduction

This report has been prepared on behalf of Terma North America, Inc. to show compliance with the RF exposure requirements as defined in the following standards and to provide minimum safe RF distances for Humans:

- ICNIRP Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic and Electromagnetic Fields (up to 300GHz): 1998
- Australia ARPNSA RP3: Radiation Protection Standard: Maximum Exposure Levels to Radiofrequency Fields — 3 kHz to 300 GHz: 2002
- Industry Canada RSS-102 Issue 5: Radio Frequency (RF) Exposure Compliance of Radio-communication Apparatus (All Frequency Bands) March: 2015
- FCC CFR47 Part 1.1310 Radiofrequency radiation exposure limits.: 2010

Testing supporting this evaluation was performed at Washington Laboratories, Ltd, 7560 Lindbergh Drive, Gaithersburg, MD 20879. Washington Laboratories, Ltd. has been accepted as an EMC Conformity Assessment Body (CAB) under the United States/European Union Memorandum of Agreement. Washington Laboratories, Ltd. is accredited with ANAB under Testing Certificate AT-1448.

2 Product Evaluated

This evaluation is for the SCANTER 1002 System with the following antenna:

Commscope VHLP1-18-2WH

3 Limits

The standards listed in Section 1 group RF exposure limits into two general categories, Occupational/Controlled Exposure and General Population/Uncontrolled Exposure. This test report shall document the results using the General Population/ Uncontrolled Exposure limits as this is the most stringent. The following tables are excerpts from the standards showing the required exposure limits.

3.1 Summary of Limit

The system being evaluated operates between 17.1 GHz and 17.3GHz. The above exposure limits shown in tables Table 1 through Table 4 all have a power density limit 10 W/m^2 ($1mW/cm^2$). This power density will determine the minimum safe distance allowed for this system.

Table 1: ICNIRP Exposure Limits for Uncontrolled Exposure

Frequency Range	E-Field Strength V/m	H-Field Strength A/m	B-Field Strength uT	Equivalent Plane Wave Power Density W/m^2
Up to 1 Hz	--	$3.2*10^4$	$4*10^4$	--
1-8Hz	10,000	$3.2*10^4/f^2$	$4*10^4/f^2$	--
8-25Hz	10,000	$4000/f$	$5000/f$	--
0.025-0.8kHz	$250/f$	$4/f$	$5/f$	--
0.8-3kHz	$250/f$	5	6.25	--
3-150kHz	87	5	6.25	--
0.15-1MHz	87	$0.73/f$	$0.92/f$	--
1-10MHz	$87/f^{1/2}$	$0.73/f$	$0.92/f$	--
10-400MHz	28	0.073	0.092	2
400-2000MHz	$1.375f^{1/2}$	$0.0073f^{1/2}$	$0.0046f^{1/2}$	$f/200$
2-300GHz	61	0.16	0.20	10

Table 2: ARPNSA RP3 Exposure Limits

Exposure Category	Frequency Range	E-Field Strength V/m rms	H-Field Strength A/m rms	Equivalent Plane Wave Power Density W/m^2
Occupational	100kHz-1MHz	614	$163/f$	--
	1-10MHz	$614f^2$	$163/f$	$1000/f^2$
	10-400MHz	61.4	0.163	10
	400-2000MHz	$3.07*f^{1/2}$	$0.00814f^{1/2}$	$f/40$
	2-300GHz	137	0.364	50
General Public	100kHz-150kHz	86.8	4.86	--
	150kHz-1MHz	86.8	$0.729/f$	--
	1-10MHz	$86.8/ f^{1/2}$	$0.729/f$	--
	10-400MHz	27.4	0.0729	2
	400-2000MHz	$1.37*f^{1/2}$	$0.00364*f^{1/2}$	$f/200$
	2-300GHz	61.4	0.163	10

Table 3: 210 RSS-102 Exposure Limits for General Population

Frequency Range MHz	E-Field Strength V/m rms	H-Field Strength A/m rms	Power Density W/m^2	Averaging Time
0.003-1	280	219	--	6
1-10	$280/f$	$2.19/f$	--	6
10-30	28	$2.19/f$	--	6
30-300	28	0.073	2	6
300-1500	$1.585\ f^{1/2}$	$0.0042\ f^{1/2}$	$f/150$	6
1500-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	$616000/f^{1.2}$
150000-300000	$0.158\ f^{1.2}$	$4.21*10^{-5}\ f^{1.2}$	$6.67*10^{-5}$	$616000/f^{1.2}$

Table 4: FCC CFR47 Pt1.1310 Exposure Limits for General Population

Frequency Range MHz	E-Field Strength V/m	H-Field Strength A/m	Power Density mW/cm^2	Averaging Time
0.3-1.34	614	1.63	100	30
1.34-30	824/ *f*	2.19 *f*	180/*f*	30
30-300	27.5	0.073	0.2	30
300-1500	--	--	*f*/1500	30
1500-100000	--	--	1.0	30

4 Test Parameters

4.1 Test Method

Testing was performed using the Prediction Modeling Methods specified in OET65 for devices with aperture antennas. This method designates four exposure regions determined by wavelength and antenna parameters. These calculations are shown in Table 5.

Table 5: Distance vs. Power Density Formulas OET65

Region	Distance of Region	Maximum Power Density of Region
Antenna Surface	No formula- Directly in front of antenna	$S_{surface} = 4P/A$
Near-Field	$R_{nf} = D^2/4\lambda$	$S_{nf} = 16\eta P/\pi D^2$
Transition	$R_{nf} \leq R_t \leq R_{ff}$	$S_t = S_{nf} R_{nf}/R$
Far-Field	$R_{ff} = 0.6D^2/\lambda$	$S_{ff} = PG/4\pi R^2$

Where:

$S_{surface}$ = maximum power density at the antenna surface in W/m^2
S_{nf} = maximum near-field power density in W/m^2
S_t = power density in the transition region in W/m^2
S_{ff} = power density (on-axis) in W/m^2
R_{nf} = extent of near-field in m
R_{ff} = distance to beginning of near field in m
R = distance in m
P = power fed to the antenna feed horn in W
A = physical (geometrical) area of the aperture antenna in m^2
D = maximum dimension of antenna (diameter if circular) in m
G = power gain factor (linear units) in the direction of interest relative to an isotropic radiator
λ = wavelengths in m
η = aperture efficiency (typically 0.5-0.75 for circular apertures)

Aperture efficiency can be estimated with the following equation:

$$\eta = (G\lambda^2/4\pi) / (\pi D^2/4)$$

4.2 Radio Parameters

The table below summarizes the criteria and RF characteristics used to evaluate the SCANTER 1002 System not including the antenna.

Table 6: Device Summary of the Terma SCANTER 1002 System

Model Evaluated:	SCANTER 1002
Exposure Category:	General Population/ Uncontrolled
Power Output (dBm):	39.8dBm (9.55W) @17.2GHz
Modulation:	Pulsed Radar
Frequency Range:	17.1GHz-17.3GHz

4.3 Antenna Parameters

This report covers the following antenna:
Commscope VHLP1-18-2WH

Antenna Gain and Pattern plots are available in the following report:
Andrew Radiation Pattern Envelope 7010F Report.pdf

The pertinent antenna parameters are covered in the following table:

Table 7: Antenna Parameters

Model Evaluated:	**Commscope VHLP1-18-2WH**
Highest Antenna Gain (on-axis)	33dBi
Antenna Diameter	0.3m
Minimum Elevation Angle	0.0
Shape	Parabolic
Frequency Range	17.1-17.3GHz
Wavelength at Center Frequency	0.017429m

5 Test Results

5.1 SCANTER 1002 System with 0.3m Antenna

Based on 33dBi gain with a 39.8dBm (9.55 Watts) input, 20% transmission duty cycle and duty cycle due to continuous mechanical antenna rotation.

The estimated aperture efficiency for this system based on the following equation from OET65 equals:

$$\eta = (G\lambda^2/4\pi) / (\pi D^2/4) = 0.68$$

Table 8: Distance vs. Power Density Formulas for 0.3m Antenna

Region	Distance of Region (m)	Power Density of Region (W/m^2)	Power Flux Density Limit (W/m^2)
Antenna Surface	0	108**	10
Near-Field	0 - 1.291	24.0 - 6.1 (10 @ 0.75m)	10
Transition	1.291 - 3.098	5.3 - 1.2	10
Far-Field	> 3.098	< 1.2	10

** Denotes above limit condition

5.1.1 Test Summary

The main on-axis beam posed a potential RF hazard as shown in Table 8 requiring additional precautions to be taken.

5.1.2 Restrictions for operation

Calculations show that the Power Flux Density is 10 W/m^2 at 0.75m.
Adding a conservative safety margin, a 1 meter minimum keep-out zone should be placed around the SCANTER 1002 Ground Surveillance Radar. Warnings should be placed in the proximity of the antenna and in the user's manual advising that personnel shall not come closer than 1 meter nor use any climbing instruments (ladders, etc.) that would place them in the direct path of the antenna beam.