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RF-EXPOSURE ASSESSMENT REPORT

FCC 47 CFR Part 2.1091
Industry Canada RSS-102

RF-Exposure evaluation of mobile equipment

Report Reference No.....:	G0M-1407-4002-TFC091ME-V01
Testing Laboratory.....:	Eurofins Product Service GmbH
Address.....:	Storkower Str. 38c 15526 Reichenwalde Germany
Accreditation.....:	A2LA Accredited Testing Laboratory, Certificate No.: 1983.01 FCC Filed Test Laboratory, Reg.-No.: 96970 IC OATS Filing assigned code: 3470A
Applicant's name.....:	Leica Geosystems AG
Address.....:	Heinrich Wild Strasse 9435 Heerbrugg SWITZERLAND
Test specification:	
Standard.....:	47 CFR 1.1310 / 47 CFR 2.1091 / 47 CFR 2.1093 OET Bulletin 65:1997 RSS-102, Issue 4:2010 Safety Code 6:2009
Equipment under test (EUT):	
Product description	Laser Distance Meter
Model No.	Leica DISTO S910
Additional Model(s)	None
Brand Name(s)	Leica DISTO
Hardware version	V15
Firmware / Software version	2332
	FCC-ID: RFF-LD5PS IC: 3177A-LD5PS
Test result	**Passed**

Possible test case verdicts:	
- neither assessed nor tested ..... :	N/N
- required by standard but not appl. to test object..... :	N/A
- required by standard but not tested..... :	N/T
- not required by standard for the test object ..... :	N/R
- test object does meet the requirement..... :	P (Pass)
- test object does not meet the requirement..... :	F (Fail)

Testing:		
Test Lab Temperature ..... :	20 – 23 °C	
Test Lab Humidity ..... :	32 – 38 %	
Date of receipt of test item ..... :	2014-08-04	
Date (s) of assessment ..... :	2014-09-30	
Compiled by ..... :	Christian Weber	
Assessed by (+ signature) ..... : (Responsible for Assessment)	Christian Weber	C. Weber .....
Approved by (+ signature) ..... :	Jens Zimmermann	.....
Date of issue ..... :	2014-12-05	
Total number of pages ..... :	14	

General remarks:

The test results presented in this report relate only to the object tested.

The results contained in this report reflect the results for this particular model and serial number. It is the responsibility of the manufacturer to ensure that all production models meet the intent of the requirements detailed within this report.

This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory.

Additional comments:

Version History

Version	Issue Date	Remarks	Revised by
01	2014-09-30	Initial Release	

Eurofins Product Service GmbH
Storkower Str. 38c, D-15526 Reichenwalde, Germany

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1 Equipment (Test item) Description

Description	Laser Distance Meter
Model	Leica DISTO S910
Additional Model(s)	None
Brand Name(s)	Leica DISTO
Serial number	None
Hardware version	V15
Software / Firmware version	2332
FCC-ID	RFF-LD5PS
IC	3177A-LD5PS
Equipment type	End product

1.1 Reference Documents

Document type	Document No.	Issued by	Date
FCC 15.247 Test Report Bluetooth LE	G0M-1407-4002-TFC247BL-V01	Eurofins Product Service GmbH	2014-09-30
FCC 15.247 Test Report WLAN	G0M-1407-4002-TFC247WF-V01	Eurofins Product Service GmbH	2014-09-30
FCC 15.247 Test Report WLAN	266892-2	SGS Firmko Ltd.	2012-06-28

1.2 Radiation Sources

Mode #	Description	
Bluetooth LE	Frequency range [MHz]	2402 – 2480
	Channels	40
	Transmission modes	FHSS
	Modulations	GFSK
	Maximum radiated power [dBm]	-4.2
	Maximum transmission duty cycle [%]	100 (worst case)
	Antenna gain [dBi]	-0.5
	Antenna diameter [cm]	0.32
WiFi	Frequency range [MHz]	2412 – 2462
	Channels	11
	Transmission modes	DSSS, OFDM
	Modulations	BPSK, QPSK, 16-QAM, 64-QAM
	Maximum radiated power [dBm]	19.03
	Maximum transmission duty cycle [%]	100
	Antenna gain [dBi]	0.5
	Antenna diameter [cm]	~0.5

2 Result Summary

FCC 47 CFR Part 2.1091, IC RSS-102			
Product Specific Standard Section	**Requirement**	**Result**	**Remarks**
47 CFR 2.1091	Maximum permissible exposure @ 20cm below limit	PASS	
RSS-102 2.5.2	Maximum permissible exposure @ 20cm below limit	PASS	
Remarks:			

3 RF-Exposure Classifications

Device Types	
Fixed	A fixed device is defined as a device physically secured at one fixed location and cannot be easily re-located.
Mobile	A mobile device is defined as a transmitting device designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitter's radiating structure(s) and the body of the user or nearby persons. (47 CFR 2.1091)
Portable	A portable device is defined as a transmitting device designed to be used so that the radiating structure(s) of the device is/are within 20 centimeters of the body of the user. (47 CFR 2.1093)

Exposure Categories	
Occupational / Controlled	Limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.
General population / uncontrolled	Exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or cannot exercise control over their exposure.

4 Assessment

4.1 MPE Assessment – 47 CFR 2.1091 / RSS-102

MPE Assessment acc. to 47 CFR 2.1091 / IC RSS-102				Verdict: PASS
Assessment according to reference	Reference Method			
	FCC OET Bulletin 65 / RSS-102 & Safety Code 6			
Device type	mobile			
Exposure category	General public			
IC Limits – Occupational / Controlled Exposure				
Frequency range [MHz]	Electric field strength [V/M]	Magnetic field strength [A/M]	Power density [W/m^2]	Averaging time [min]
0.003 – 1.0	600	4.9	N/A	6
1 – 10	600/f	4.9/f	N/A	6
10 – 30	60	4.9/f	N/A	6
30 – 300	60	0.163	10.0*	6
300 – 1500	$3.54 \cdot f^{0.5}$	$0.0094 \cdot f^{0.5}$	f/30	6
1500 - 15000	137	0.364	50	6
15000 - 150000	137	0.364	50	$616000/f^{0.5}$
150000 - 300000	$0.354 \cdot f^{0.5}$	$9.4 \cdot 10^{-4} \cdot f^{0.5}$	$3.33 \cdot 10^{-4} \cdot f$	$616000/f^{0.5}$
IC Limits – General Population / Uncontrolled Exposure				
Frequency range [MHz]	Electric field strength [V/M]	Magnetic field strength [A/M]	Power density [W/m^2]	Averaging time [min]
0.003 – 1.0	280	2.19	N/A	6
1 – 10	280/f	2.19/f	N/A	6
10 – 30	28	2.19/f	N/A	6
30 – 300	28	0.073	2.0*	6
300 – 1500	$1.585 \cdot f^{0.5}$	$0.0042 \cdot f^{0.5}$	f/150	6
1500 - 15000	61.4	0.163	10	6
15000 - 150000	61.4	0.163	10	$616000/f^{0.5}$
150000 - 300000	$0.158 \cdot f^{0.5}$	$4.21 \cdot 10^{-4} \cdot f^{0.5}$	$6.67 \cdot 10^{-5} \cdot f$	$616000/f^{0.5}$
* = Power density is applicable at frequencies greater than 100 MHz; f in MHz				

FCC Limits – Occupational / Controlled Exposure				
Frequency range [MHz]	Electric field strength [V/M]	Magnetic field strength [A/M]	Power density [mW/cm^2]	Averaging time [min]
0.3 – 3.0	614	1.63	(100)*	6
3.0 - 30	1842/f	4.89/f	(900/f^2)*	6
30 - 300	61.4	0.163	1.0	6
300 - 1500	N/A	N/A	f/300	6
1500 - 100000	N/A	N/A	5.0	6
FCC Limits – General Population / Uncontrolled Exposure				
Frequency range [MHz]	Electric field strength [V/M]	Magnetic field strength [A/M]	Power density [mW/cm^2]	Averaging time [min]
0.3 – 1.34	614	1.63	(100)*	30
1.34 - 30	842/f	2.19/f	(180/f^2)*	30
30 - 300	27.5	0.073	0.2	30
300 - 1500	N/A	N/A	f/1500	30
1500 - 100000	N/A	N/A	1.0	30
* = Plane wave equivalent power density; f in MHz				

Assessment Relations

$$\lambda[m] = \frac{c\left[\frac{m}{s}\right]}{f[Hz]} \; ; \; R_{FF}[m] \geq \frac{2 \cdot D[m]^2}{\lambda[m]}$$

$$S[mW/cm^2] = \frac{P_{E.I.R.P.}[mW]}{4\pi R[cm]^2} \; ; \; R[cm] = \sqrt{\frac{P_{E.I.R.P.}[mW]}{4\pi S[mW/cm^2]}}$$

$$P_R[mW] = P_C[mW] \cdot G \; ; \; P_R[dBm] = P_C[dBm] + G[dBi]$$

$$DCC\,[dB] = 10 \cdot Log_{10}\left(\frac{DC[\%]}{100}\right)$$

Assessment procedure

For each radio and frequency band the worst case transmission mode with the highest peak conducted or radiated power is evaluated at the frequency that results in the most restrictive rf-exposure limit. From the peak power values, antenna gains and duty cycles taken from the reference documents, the source average radiated power values are calculated. From the average radiated power the power densities at antenna far-field distance, at 20cm separation distance from the radiation source is calculated. Compliance with the RF-Exposure limit is determined at 20cm separation distance.

Assessment results – Bluetooth LE		
Transmission mode		
Operating mode frequency range [MHz]	2402 – 2480	
Assessment frequency (f) [MHz]	2480	
Transmission duty cycle (DC) [%]	100	
Peak conducted power (P_C) [dBm]	-3.7	
Peak radiated power (P_R) [dBm e.i.r.p.]	-4.2	
Peak Antenna gain (G) [dBi]	-0.5	
Maximum Antenna Diameter D [cm]	0.32	
Antenna far-field distance		
Transmission frequency wavelength (λ)	0.121 m	12.10 cm
Antenna far-field distance (R_{FF})	0.000 m	0.02 cm
Power evaluation		
Peak conducted power (P_C)	0.43 mW	-3.70 dBm
Peak Antenna Gain (G)	0.89	-0.50 dBi
Calculated peak radiated power ($P_{R\text{-}Calc}$)	0.38 mW	-4.20 dBm
Measured peak radiated power (P_R)	0.38 mW	-4.20 dBm
Source average Power		
Maximum transmission duty cycle (DC)	100.0 %	
Duty cycle correction (DCC)	1.00	0.00 dB
Measured peak radiated power (P_R)	0.38 mW	-4.20 dBm
Averaged peak radiated power (P_{RAVG})	0.38 mW	-4.20 dBm
Power density		
Compliance power density limit	1.000 mW/cm^2	10.00 W/m^2
Power density @ Antenna far-field distance	105.553 mW/cm^2	1055.527 W/m^2
Power density @ 20cm	0.000 mW/cm^2	0.001 W/m^2
Distance for compliance power density	0.002 m	0.17 cm
Verdict		
The power density of the EUT at 20cm is below the FCC/IC MPE limit!		
Comments:		

Assessment results – WiFi		
Transmission mode		
Operating mode frequency range [MHz]	2412 – 2462	
Assessment frequency (f) [MHz]	2462	
Transmission duty cycle (DC) [%]	100	
Peak conducted power (P_C) [dBm]	18.53	
Peak radiated power (P_R) [dBm e.i.r.p.]	19.03	
Peak Antenna gain (G) [dBi]	0.5	
Maximum Antenna Diameter D [cm]	0.5	
Antenna far-field distance		
Transmission frequency wavelength (λ)	0.122 m	12.19 cm
Antenna far-field distance (R_{FF})	0.000 m	0.04 cm
Power evaluation		
Peak conducted power (P_C)	71.29 mW	18.53 dBm
Peak Antenna Gain (G)	1.12	0.50 dBi
Calculated peak radiated power ($P_{R\text{-}Calc}$)	79.98 mW	19.03 dBm
Measured peak radiated power (P_R)	79.98 mW	19.03 dBm
Source average Power		
Maximum transmission duty cycle (DC)	100.0 %	
Duty cycle correction (DCC)	1.00	0.00 dB
Measured peak radiated power (P_R)	79.98 mW	19.03 dBm
Averaged peak radiated power (P_{RAVG})	79.98 mW	19.03 dBm
Power density		
Compliance power density limit	1.000 mW/cm^2	10.00 W/m^2
Power density @ Antenna far-field distance	3780.215 mW/cm^2	37802.153 W/m^2
Power density @ 20cm	0.016 mW/cm^2	0.159 W/m^2
Distance for compliance power density	0.025 m	2.52 cm
Verdict		
The power density of the EUT at 20cm is below the FCC/IC MPE limit!		
Comments:		

Assessment results – Bluetooth LE + WiFi		
Bluetooth LE		
Compliance power density limit	1.000 mW/cm^2	10.00 W/m^2
Power density @ 20cm	0.016 mW/cm^2	0.159 W/m^2
MPE Ratio (S_{20CM} / S_{Limit})	0.016	
WiFi		
Compliance power density limit	1.000 mW/cm^2	10.00 W/m^2
Power density @ 20cm	0.000 mW/cm^2	0.001 W/m^2
MPE Ratio (S_{20CM} / S_{Limit})	0.000	
Sum of MPE Ratios		
$\sum S_{20CM} / S_{Limit}$	0.016 + 0.000 = 0.016	
Verdict		
The sum of MPE ratios is below 1; The multi-transmitter mode fulfills the FCC/IC RF-Exposure requirements		
Comments:		