FCC Test Report.

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Product:	TrafiCam2 Wireless US
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[1] This document has been composed according to Public Notice DA 00–705, March 30, 2000.

1 Description of equipment under test.

The EUT, hereafter called TrafiCam, is in fact just a carrier for the Wi.232FHSS-250-R module. The RF and protocol controller reside on the surface mount module that is soldered to the TrafiCam's back PCB. The module's RF activity is confined to 32 frequencies within the 902 to 928 MHz band. There are six pseudo-randomly ordered hopping sequences selectable; each of these sequences contains a subset of 26 of the available 32 channels. These channel sequences were derived from 5-bit pseudo-random, maximal-length polynomials and selected due to their low probability of cross-correlation intercept. The modules operate in one of two basic modes: sleep and wake. When awake, the module operates in receive and transmit sub-modes.

2 Demonstrating compliance to Section 15.203.

The TrafiCam complies with requirement 15.203 because the antenne (custom made for Traficon N.V.) is permanently mechanically attached to the TrafiCam housing and the antenna cable is soldered to the PCB.
The photographs in appendix D show the antenne before and after fixation to the housing of TrafiCam.

3 Demonstrating compliance to Section 15.204.

The TrafiCam is delivered with the antenne permanently fixed to it.
Replacement of the antenna is therefore not possible by the customer!
Therefore there is only 1 antenne specified for the 915MHz frequency.

3.1 Antenne type:

½ wave dipole antenna, omnipole radiation patern.

3.2 Manufacturer & model number.

Unilink Technology ltd
7F-5, No. 66, Nan-Kan Road, Section 2,
Lu-Chu Hsiang, Taoyuan, Taiwan
Tel: 886-3-322-9050 Fax: 886-3-322-9043

Antenne model number: `TTA-915-027-04`

3.3 Antenna gain

The antenna gain is 0dBi.
The measurement plots of the antenna gain provided by the manufacturer of the antenna are added as Appendix A.

4 Demonstrating compliance to section 15.207

See section “15.207”, page 11, of ESM test report. (Appendix C)

5 Demonstrating compliance to section 15.247a

According to section 15.204 (4), no retesting of the system configuration is required when an antenna that is of the same type and of equal directional gain as the antenne that is authorized with the intentional radiator is used.

Since our custom made antenne meets this requirement, we therefore refer to the initial test report of the Wi.232FHSS-250-R module to demonstrate compliance with the following sections. This test report has been added as appendix B.

5.1 Carrier frequency separation

See section 4.8 from the NCEE test report. (Appendix B)

5.2 Number of hopping Frequencies

See section 4.7 from the NCEE test report. (Appendix B)

5.3 Time of occupancy (dwell time)

See section 4.9 from the NCEE test report. (Appendix B)

5.4 20 dB bandwith

See section 4.4 from the NCEE test report. (Appendix B)

5.5 Pseudorandom frequency hopping Sequence

Pseudo random channel ordering was accomplished using a 5-bit linear feedback shift register of maximal length. Each hop sequence was calculated to have minimal cross-correlation.

5.6 Equal hopping frequency use.

The module keeps track of the time that a frequency is used for transmission. The algorithm tracks this usage and limits a single frequency's usage to 396ms over any 10s period. Since transmission usage is tracked independently from receiver usage, and each frequency is used for transmission maximally, each frequency is used equally on average.

5.7 System receiver input bandwith

Receiver input bandwith is 200 kHz, which is the minimum required to receive the transmitted signal.

5.8 System receiver hopping capability

When the module is awake and not transmitting, it is actively searching for a synchronization preamble to synchronize with. The receiver rapidly hops to each frequency within the selected hopping sequence table and listens for a brief period for this preamble. Once found, the receiver stops hopping and retrieves the packet's header information. If the packet is intended for this receiver, the receiver synchronizes and starts hopping at a 396ms interval until the communication is done. Once the communication is complete, or the packet isn't for this receiver, the receiver begins rapid hopping again, looking for another synchronization event.

6 Demonstrating compliance to section 15.247(b)

6.1 Peak output power

See section 4.5 from the NCEE test report. (Appendix B)

6.2 De facto EIRP limit

Due to the use of only one, permanent fixed antenna and the antenna specifications itself, compliance with these limits are always guaranteed.

6.3 Point to point operation

Not applicable.

6.4 RF exposure compliance requirements

RF exposure calculations:

The minimum separation distance is calculated from **FCC OET 65 Appendix B, table 1B** Guidelines for General Population/Uncontrolled Exposure.
This calculation is based on the highest possible EIRP possible from the system, considering maximum output of the intentional radiator and an antenna gain of 0 dBi. The exposure limit for a transmitter operating at 926.27 MHz is found in mW/cm^2 using the equations f/1200.
Since the operating frequency for channel 0 of the intentional radiator produced the lowest limit, that limit will be used in calculation. (902.971/1200 = $0.75mW/cm^2$)

$S = (Po * G)/ (4 * Pi * r^2$ or $r = SQRT[(Po * G) / (4 * Pi * S)]$

Where $S = 0.75mW/cm^2$ for 915MHz
Where $Po = 224.9mW/cm^2$
Where G = 1 (numeric equivalent of 0dB antenna gain with 0dB cable los)
Where r = minimum safe distance from antenna (cm)

For Po = 224.9mW, r = 4.89 cm (1.93 inches)

For a distance [r] of 20cm from the antenna, the field density $S = 0.0447mW/cm^2$.

Notes:

1. The minimum safe distance is based on a conservative “worst case” prediction, i.e. using the formula shown above and no duty factor. In practice the minimum distance will be much shorter. (Ref. 2)
2. The minimum safe distance has been calculated for the maximum allowed Power Density (s) limit of $0.75mW/cm^2$ for the frequency 915MHz for uncontrolled environments. (Ref. 2)

References:

1. FCC Part 15, sub-clause 15.247 (b)(4)(i)
2. FCC OET Bulletin 65, Edition 97.01
3. FCC supplement C to OET Bulletin 65, edition 01-01

6.5 Installation/Operation Manual requirements.

6.5.1 Instructions pertaining correct peak output power.

Since the output power of the intentional radiator is set in production (to max output) and the antenne is permanently fixed to the device, no instructions are necessary.

6.5.2 Point-to-point operational requirements and responsibilities.

Not applicable.

6.5.3 RF-exposure compliance requirements.

The following notice is included into the user's manual.

FCC Radiation Exposure Statement

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 4.89cm (1.93 inches) between the radiator and your body.

7 Demonstrating compliance to section 15.247(c)

7.1 Band-edge compliance of RF-conducted Emissions

See section 4.6 from the NCEE test report. (Appendix B)

7.2 Spurious RF conducted emissions

See section 4.3 from the NCEE test report. (Appendix B)

7.3 Spurious radiated emissions

See section 4.2 from the NCEE test report. (Appendix B)

8 Demonstrating compliance to section 15.247(g)

The module is an independent functional block within the system. The transmitter and receiver circuits are designed to comply with the spectral requirements imposed by the FCC for part 15.247 frequency hopping devices of 250mW or lower. Additionally, the software layer that controls the frequency hopping operation is written to comply with FCC part 15.247 rules for frequency hopping systems. The frequency hopping software layer is not directly accessible by the application.

9 Demonstrating compliance to section 15.247(h)

The module utilizes a proprietary packet structure, encoding methods, and frequency tables to avoid interoperation with other FHSS systems.

10 Appendixes.

10.1 Appendix A: measurement plots of antenna gain.

Adobe Acrobat Document

10.2 Appendix B: FCC test report of Wi.232FHSS-250-R.

Adobe Acrobat Document

10.3 Appendix C: FCC test report on TrafiCam.

Adobe Acrobat Document

10.4 Appendix D: fotographs of antenna fixation.