



<p>MEASUREMENT RECORD</p> <p>Budapest University of Technology and Economics Department of Electric Power Systems High Voltage Laboratory</p> <p>Budapest, XI. Egry József u. 18. Tel.: (+36 1) 463 32 35, Fax.: (+36 1) 463 32 31, E-mail: cselko.richard@vet.bme.hu</p>	
<p>Product safety test</p>	<p>Page 1 of 8</p>
<p>Record nr.: PST/2016/01</p>	<p>Date: 26 May 2016</p>


CUSTOMER	
Company: WM Rendszerház Ltd.	Addr.: 1222 Budapest, Villa u. 8.
Date of order: 26 April 2016	Contact person: József Mucsi

TEST		
Test type	Product safety tests	
Standard	IEC 60255-27:2013	
Applied apparatus and measuring devices:	Type and serial nr.	Accuracy
	Tektronix TBS-1052B-EDU oscilloscope S/N: C024952	96 mV (at 1 V/div)
	Haefely P12 voltage source ser.: 080347-09-81	-
	Testec HVP-15HF high voltage probe; ser.: 20132173	-
	HS Computer Ltd. CT-7081A transient current transformer, ser. : 001	-
	Uni-T UT39B multimeter Ser. : 811008405	0,45A (DC current in 20A range)
	Keysight 34460A 6 ½ Digit Multimeter ser. : MY53101523	75 µV (DC voltage in 1V range)
Location:	BME High Voltage Laboratory, Budapest, 1111, Egry J. u. 18.	
Environment:	temperature: 22 °C relative humidity: 56%	

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TESTED Module	
Type:	M2M Router CDMA450MHz S/N: 005261300516000040
Manufacturer:	WM Rendszerház Ltd.

Date of test:	12 to 25 May 2016
Date of report:	26 May 2016
Measurements performed by:	
Richard Cselkó	
Dániel Veres	
Supervisor:	
Dr. István Kiss	

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Preliminaries

The WM Rendszerház Ltd. contacted the High Voltage Laboratory of the Department of Electric Power Systems of the Budapest University of Technology and Economics in connection with product safety tests of a router module.

Based on the preliminary discussions the parties agreed that the High Voltage Laboratory will conduct measurements.

Test results

1.1 Clearances and creepage distances evaluation according to IEC60255-27:2013 (10.6.3)

The assembly and the PCB have been inspected according to Table C.5 – Functional, basic or supplementary insulation, pollution degree 1, overvoltage category III. The working voltage of the device is below 50 V, thus the required clearance is 0.15 mm.

Both the assembly and the PCB are designed so that the clearances and creepage distances are, without doubt, compliant with the requirements.

Required clearance and creep path	Result
0.15 mm	PASS

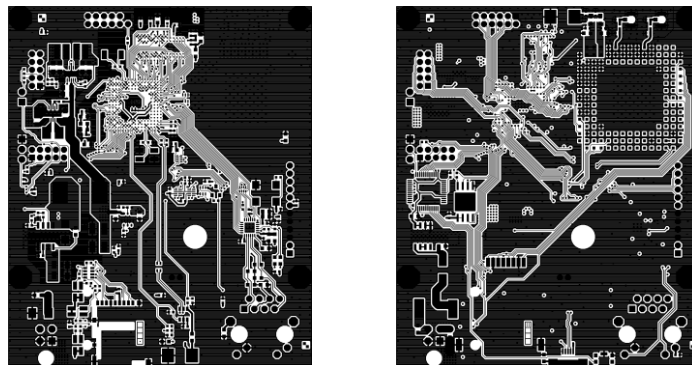



Figure 1. The layout of the PCB (bottom and top)

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1.2 Impulse voltage test according to IEC60255-27:2013 (10.6.4.2)

Measurement procedure:

- application of impulse voltage between all terminals and GND:
 - o power (2 pins) – 5 kV
 - o antenna (1 pin) – 1 kV
 - o RJ45 (LAN) (8 pins) – 1 kV
 - o micro USB (5 pins) – 1 kV
- powering up the device and establishing connection between the router and computer or checking the antenna output signals
 - o the result is PASS, if the device powers up and connects to the computer appropriately or the antenna signals are normal

CONNECTION POINT	TEST VOLTAGE	RESULT
RJ45 (LAN)	1 kV	PASS
USB	1 kV	PASS
antenna	1 kV	PASS (with disrupting discharge, antenna power nominal)
power	5 kV	PASS (with disrupting discharges; device boots up, LED1-2-3 light up when powered)

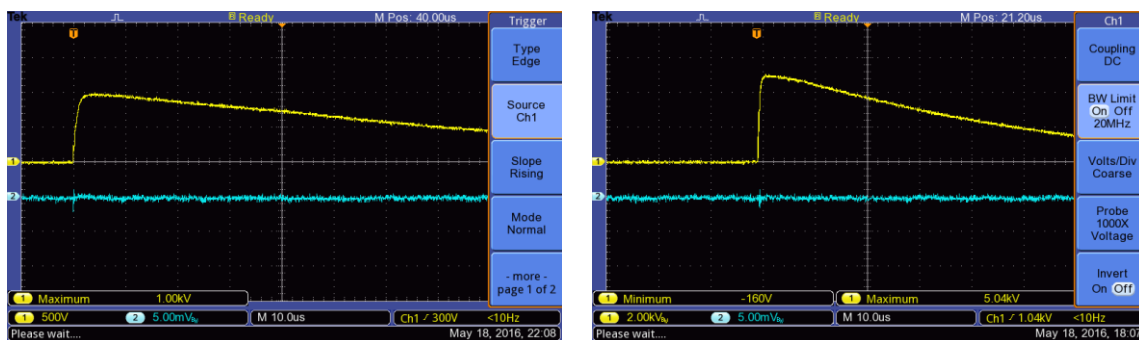


Figure 2. Open circuit voltage shapes (1 kV and 5 kV)

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1.3 Dielectric voltage test according to IEC60255-27:2013 (10.6.4.3)

Measurement procedure:

- application of AC voltage between all terminals and GND:
 - o power (2 pins) – 2 kV
 - o antenna (1 pin) – 0.5 kV
 - o RJ45 (LAN) (8 pins) – 0.5 kV
 - o micro USB (5 pins) – 0.5 kV
- powering up the device and establishing connection between the router and computer or checking the antenna signals
 - o the result is PASS, if the device powers up and connects to the computer appropriately or the antenna signals are normal

CONNECTION POINT	TEST VOLTAGE	RESULT
RJ45 (LAN)	0.5 kV	PASS
USB	0.5 kV	PASS
antenna	0.5 kV	PASS
power	2 kV	PASS

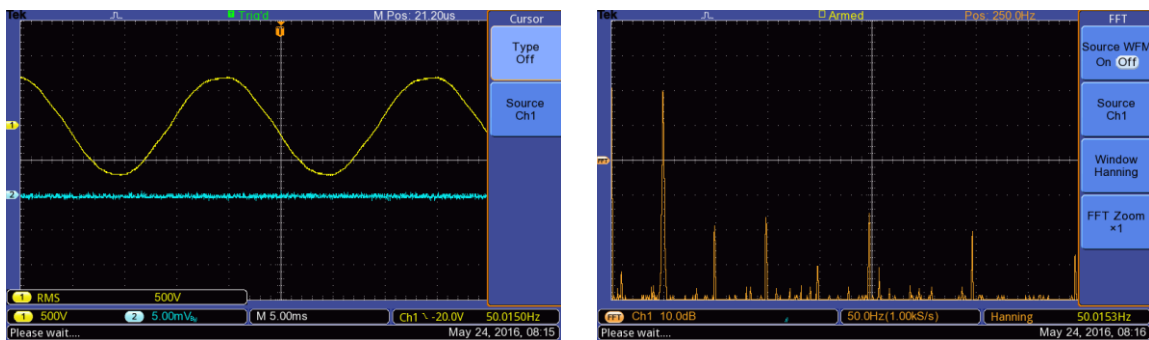



Figure 3. Waveform and spectra of the AC test voltage. The amplitude of the harmonics is by a factor of 40 dB lower than the amplitude of the 50 Hz component.


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1.4 Protective bonding resistance measurement according to IEC60255-27:2013 (10.6.4.5)

Measurement procedure:

- connection 20 A DC current source between GND terminal and other terminals and with other test leads a DC voltmeter (4-wire resistance measurement),
- sustaining the current for one minute,
- reading the voltage after one minute and calculation of the resistance.

CONNECTION POINT	Measured resistance	RESULT
RJ45 GND connection	0.073 Ω	PASS
USB GND	0.07 Ω	PASS
antenna GND	0.038 Ω	PASS
Housing (mounting screw on the front panel)	0.032 Ω	PASS

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1.5 Flammability evaluation according to IEC60255-27:2013 (7)

Based on the declaration of the manufacturer, the DC power of the device will be provided from another component, that has the following output characteristics:

- DC voltage: 24 V
- maximal current: 1.1 A,
- protection of the power supply output: 2 A fuse.

According to the criteria of 7.4.2 / a / 1, the device falls in the category “limited energy circuit”, where the risk of ignition is considered to be tolerable.

Flammability evaluation method	Category	Result
Source of ignition	Limited energy circuit	PASS

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1.6 Single fault condition assessment according to IEC60255-27:2013 (10.6.5.5)

Based on the preliminary evaluation, the only factor posing risk to the safety of the device is the polarity reversal of the power supply.

A single fault test has been performed with the following procedure:

- application of supply voltage with reversed polarity to the device (-24 V).
- observation of the temperature rise of the device. If temperature rise is detected, maintaining the reversed voltage and continuous observation until the temperature rise within one minute is less than the temperature rise detectable (0,1K).

Reverse polarity test	Observation	Result
-24 V, 15 minutes	No temperature rise observed.	PASS



Figure 4. Test arrangement and thermal image of the device after the application of the reversed voltage