



Test Report No.9512316847

Applicant:

Shirtal Diacam Ltd.

Equipment Under Test:

360 Photography Scanner for Diamonds

Model: Diacam360

Issued by:

The Standards Institution of Israel

Industry Division

Electronics & Telematics Laboratory

EMC Branch



Certificate Number: AT-1359

**Test Report No.:** 9512316847**Page 2 of 37 Pages****Title:** Test on 360 Photography Scanner for Diamonds**Model:** Diacam360

Applicant:	Shirtal Diacam Ltd.
Address:	3 Jabotinsky St., P.O.Box 297, Shimshon Bldg. Suite #1011, Ramat Gan 5252005, Israel
Sample for test selected by:	The customer
The date of test:	18 & 19/05, 7/06/2015

Description of Equipment**Under Test (EUT):** 360 Photography Scanner for Diamonds**Model:** Diacam360**Manufactured by:** Shirtal Diacam Ltd.**Reference Documents:**

- ❖ EN 55022: "Information technology equipment - Radio disturbance characteristics – Limits and methods of measurements" (2010).
- ❖ EN 61000 "Electromagnetic Compatibility (EMC)"; Part 3. "Limits."
Section 2. "Limits for harmonic current emissions (equipment input current \leq 16A per phase" (2006/A1:2009 + A2:2009).
Section 3. "Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current < 16 A per phase and not subjected to conditional connection" (2008).
- ❖ EN 55024: "Information technology equipment - Immunity characteristics - Limits and methods of measurement" (2010).

Compliance: The EUT was found to be in compliance with the requirements of the following standards:

- EN 55022 Class A;
- EN 61000-3-2;
- EN 61000-3-3;
- EN 55024.

For details refer to clause 1.

This Test Report contains 37 pages and may be used only in its entirety.	This Test Report applies only to the specimen tested and may not be applied to other specimens of the same product.
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Test	Standard	Class/ Severity level	Test result
Emission			
Conducted emission Freq. range: 150 kHz - 30 MHz	EN 55022	Class A: 230 VAC mains	Complies
Radiated emission Freq. range: 30 MHz – 1 GHz	EN 55022	Class A	Complies
Harmonic current emission test	EN 61000-3-2	Class A: AC mains	Complies
Voltage changes, Voltage fluctuations and Flicker tests	EN 61000-3-3	AC mains	Complies
Immunity (per EN 55024)			
Immunity from Electrostatic discharge (ESD)	IEC 61000-4-2	4 kV contact discharge 8 kV air discharge	Complies
Immunity from radiated electromagnetic fields	IEC 61000-4-3	3 V/m, 80 MHz ÷ 1.0 GHz, 80% AM, 1 kHz	Complies
Immunity from Electrical Fast transient (EFT)	IEC 61000-4-4	± 1.0 kV: AC mains; Tr/Th – 5/50 ns, 5 kHz	Complies
Immunity from Surge	IEC 61000-4-5	±2.0 kV CM / ±1.0 kV DM: AC mains; Tr/Th – 1.2/50 (8/20) µs	Complies
Immunity from conducted disturbances induced by RF fields	IEC 61000-4-6	3.0 VRMS: AC mains; 0.15÷80 MHz, 80% AM 1 kHz	Complies
Immunity from Voltage dips, short interruptions and voltage variations	IEC 61000-4-11	AC mains: > 95% - 10 ms; 30% - 500 ms; > 95% - 5 s	Complies

Electronics &
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28 June 2015


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Model: Diacam360

2. EUT Description

Note: All information in this section was provided by the customer.

2.1. General description:

The Equipment Under Test (hereinafter: EUT) is a 360 Photography Scanner for Diamonds. It is the compact scanner used for scanning/imaging/photographing diamonds up to 20 ct.

The EUT consists of two units, as the follows:

1. The Lower Unit - responsible to provide 24v to the entire DiaCam360 scanner.

The unit contains the power supply and the vacuum air pump. It should always be on the floor.

2. The Upper Unit responsible for the entire scanning operation.

The unit contains the camera and lens, the led strips, the electronic cards (Arduino, Big Easy Driver), the relay and the stepper.

EUT environmental conditions (in normal operation mode to give the confidence of compliance for the affected technical requirements):

Power supply: 230 / 120 VAC mains.

Temp. – [25 - +70] °C.

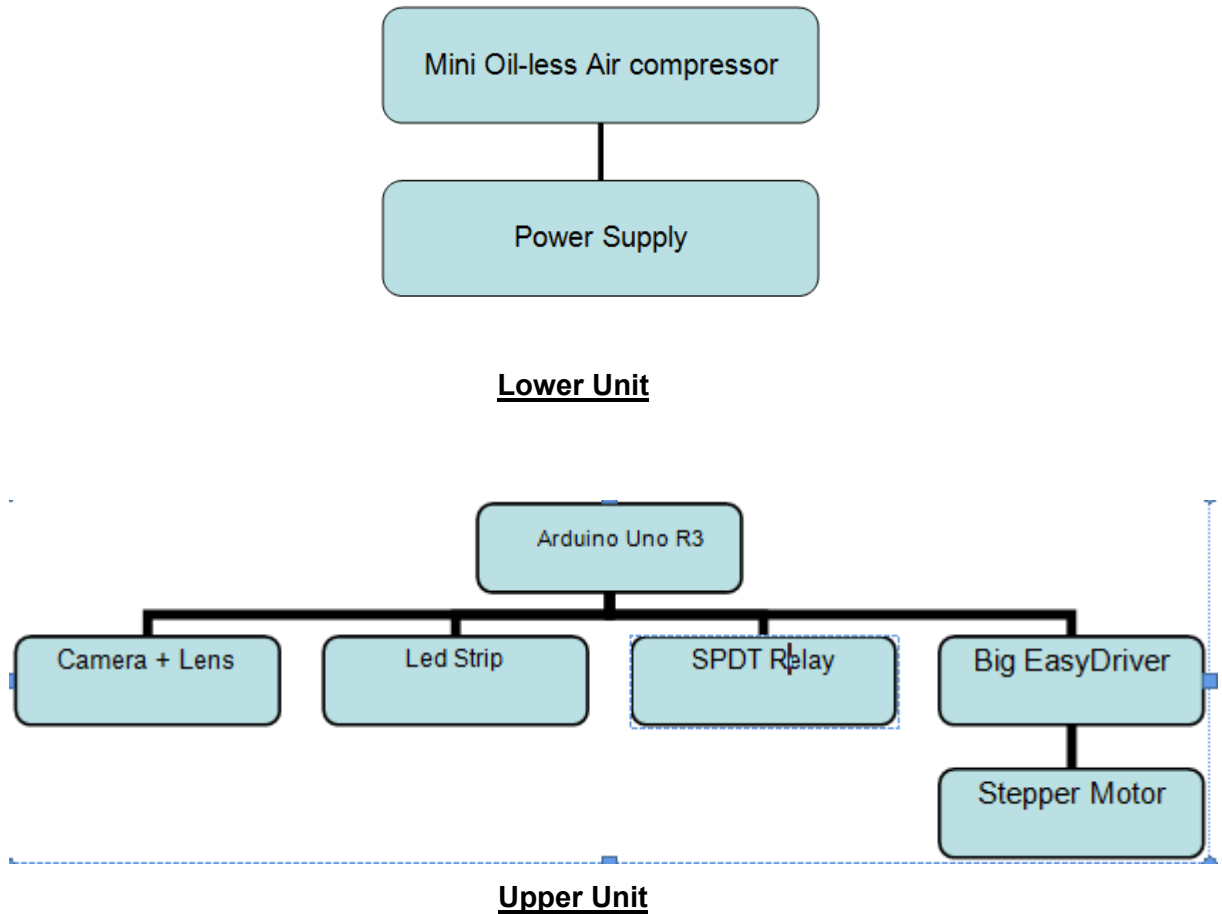
Humidity – [20 - 90] %.

The EUT dimensions: Upper unit: 29 x 81 x 17 cm approx.

Lower unit: 17 x 11 x 16 cm approx.

The EUT's connection diagram (for each unit, separately) is presented in **Picture # 1**.

The EUT's views are shown in Appendix 4.



Picture # 1. EUT's block diagram

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2.2. EUT sub-assemblies list:

Table 1. Sub-assemblies list

Module	Manufacturer	Model, Number
Upper Unit		
Camera	IDS	UI-3580LE-C-HQ
Camera lens	Tamron	M118FM25
Led Strip	Fine Led	5050-60CW/24V
Stepper Motor	MERCURY Industry CO., Limited	SM-42BYG011-25
Big EasyDriver	SparkFun	SF-ROB-12859
Arduino Uno R3	Arduino	Uno R3 DEV-11021
Basic 2-Channel SPDT Relay Carrier with 5VDC Relays	Pololu	POL-2485
Lower Unit		
Mini Oil-less Air compressor	G&M Tech	25RVS-DF1-24VDC
Power Supply; AC-DC; 24V@3.2A; 115-264V In; Enclosed; Panel Mount; Switching; RS Series	MeanWell	RS-75-24

2.3. EUT connector / cable list:

Table 2. Connector / cable list

No.	Cable description	Connector's type	Type of Cable	Length (m)	Location (from – to)	No. of identical connectors
1	AC mains	AC mains	Standard 3 pins	1.8	Between the AC mains and the Lower Unit	1
2	Interconnection power	Power	LAPP 0034703 UNITRONIC LIYCY 3X0.75 Shielded	1.8	Between Upper and Lower units	1
3	USB2	USB2 M/F	USB2	1.8	Between Upper Unit to auxiliary Laptop	1

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The supporting equipment used during the tests is detailed in Table 3 below.

Table 3. Auxiliary equipment used

Function	Manufacturer	Model
Laptop	HP	HP 250 N3540

2.5. Changes made during the tests:

To withstand the test 4 ferrite beads were added, as the follows:

1. P/N 0443167251 MFR Fair-Rite - on AC mains cable to Lower Unit (see Picture # 5 in Appendix 4).
2. P/N 0443167251 MFR Fair-Rite - on Interconnection power cable between Lower Unit and Upper Unit (see Picture # 4 in Appendix 4).
3. Two ferrite beads 742 727 33 MFR MinZN - inside of the Upper Unit (see Picture # 6 in Appendix 4)

2.6. EUT setup and operation:

The EUT was configured as detailed in Picture # 2 and photos in Appendix 4.

The EUT was powered from 230 VAC mains to the Lower Unit.

Operation mode: The customer's software (DiaCam360.exe) executed on the auxiliary HP laptop. The software controls the upper and lower units.

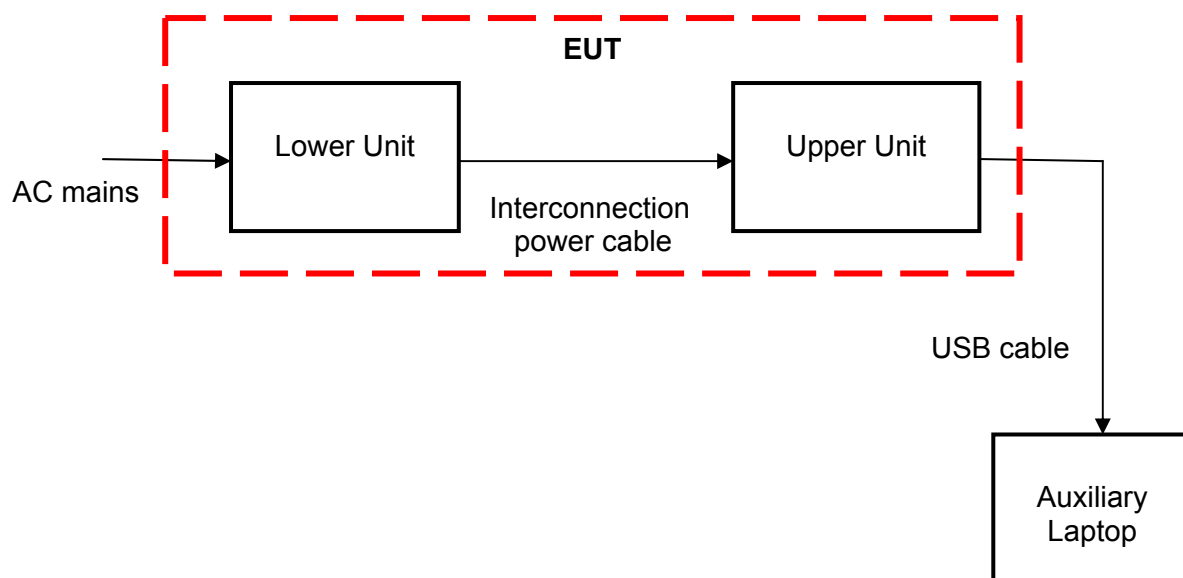
The software opens and operates of the EUT.

The process was observed on the auxiliary HP laptop via the camera.

The EUT was tested as detailed in Table 4.

Table 4. Performed tests

Emission tests				Immunity tests					
EN 55022		IEC 61000-3-x		EN 55024 & IEC 61000-4-x					
Cond.	Rad.	-2	-3	-2	-3	-4	-5	-6	-11
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓



Picture # 2. Test setup

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3. Test specification, Methods and Procedures

Test Specification:

- ❖ EN 55022: "Information technology equipment - Radio disturbance characteristics – Limits and methods of measurements" (2010).
- ❖ EN 61000 "Electromagnetic Compatibility (EMC)"; Part 3. "Limits."
Section 2. "Limits for harmonic current emissions (equipment input current $\leq 16A$ per phase" (2006/A1:2009 + A2:2009).
Section 3. "Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current $< 16 A$ per phase and not subjected to conditional connection" (2008).
- ❖ EN 55024: "Information technology equipment - Immunity characteristics - Limits and methods of measurement" (2010).

Methods and Procedures:

- ❖ EN 55022: "Information technology equipment - Radio disturbance characteristics – Limits and methods of measurements" (2010).
- ❖ EN 61000: "Electromagnetic Compatibility (EMC)";
Part 3. "Limits."
Section 2. "Limits for harmonic current emissions (equipment input current $\leq 16A$ per phase" (2006/A1:2009 + A2:2009).
Section 3. "Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current $< 16 A$ per phase and not subjected to conditional connection" (2008).
- ❖ IEC 61000: "Electromagnetic Compatibility (EMC)";
Part 4. "Testing and measurement techniques;"
Section 2: "Electrostatic discharge immunity tests", Ed. 2.0 (2008).
Section 3: "Radiated, radio-frequency, electromagnetic field immunity test", Ed. 3.1 (2008).
Section 4: "Electrical Fast Transient/burst immunity test" (2012)."
Section 5: "Surge immunity tests" (2005).
Section 6: "Immunity to conducted disturbances induced by radio-frequency fields" Ed. 3.0 (2008).
Section 11: "Voltage dips, short interruptions and voltage variations immunity tests" (2004).



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4. Additional deviations or exclusions from the test specifications

Not applicable

5. General conditions

5.1. Location of the Test Site:

All tests were conducted at the EMC Laboratory of the Standards Institution of Israel in Tel-Aviv.

5.2. Emission tests:

- * For both radiated and conducted measurements, initial scans were made using a peak detector but still using the appropriate CISPR 16 (Quasi-Peak) detector IF bandwidth.
- * For conducted emissions, a tolerance limit was set 6 dB below the specification limit. Levels above the tolerance limit were retested using the Quasi-Peak detector or an average detector.
- * For radiated emissions, a tolerance limit was set 10 dB below the specification limit. Levels above the tolerance limit were retested using the Quasi-Peak detector.

5.3. Initial visual check and functional test:

Initial visual check and brief built-in test of the EUT was performed before testing.

- No external damages were found.

The test on the EUT passed successfully.

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6. Emissions

6.1. Radiated Emission Summary

Test procedure:

1. The radiated emission measurements were performed in operation mode as detailed in section 2.6.
2. The radiated emission measurements were conducted in 3-m semi-anechoic chamber. The frequency range from 30 MHz to 1000 MHz was investigated.
3. The Biconilog Antenna antenna (20 MHz - 6000 MHz) was used during the test.
4. The measurements were performed at each frequency where the signal was 10 dB below the limit or less.
5. The levels were maximized by changing antenna polarization from vertical to horizontal, rotating turntable through 360 degree, varying antenna height from 1m to 4m and rerouting EUT cables.
6. Power supply - 230 VAC mains.

Test results:

Table 5. Radiated emission test results (summarized)

Specified Standard	Frequency range	Polariz.	Table/ Plot	Result	Remarks
EN 55022 Class A	30 MHz – 1.0 GHz	V/H	Table 6	PASS	Max. emission = 3.0 dB below limit at 31.9 MHz

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Results: Pass
Specified standard / Class: EN 55022 Class A
Frequency range: 30 MHz – 1 GHz
EUT operation mode: Section 2.6
Measured distance: 3 m

Table 6. Radiated emission test results

.	Frequency (MHz)	Antenna Polariz. V/H	Antenna Height (m)	Turn- table Angle (°)	Emission Level (dB μ V/m)	Limit @ 10 m (dB μ V/m)	Margin (dB)	Results
1	31.9	V	1.00	280	47.0	50.0	-3.0	Complies
2	42.7	V	1.00	197	40.3	50.0	-9.7	Complies
3	120.0	V	1.00	75	38.3	50.0	-11.7	Complies
4	192.0	H	1.00	165	34.5	50.0	-15.5	Complies
5	240.0	H	1.00	130	36.0	57.0	-21.0	Complies

Note: Emission level = E Reading (dB μ V) + Cable loss (dB) + Antenna Factor (dB/m)
For Cable Loss and Antenna Factor refer to Appendix 3.

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6.2. Conducted Emission Summary

Test procedure:

All measurements were performed in the operation mode, as detailed in section 2.6.

The test was started with an initial scan. Final measurements were performed at the peaks, exceeded the tolerance limit.

Test equipment (EMI receiver) setup was as follow:

Initial scan:

Detector type	Peak
Mode	Max hold
Bandwidth	9 kHz
Step size	Continuous sweep
Sweep time	>100 msec

Measurements

Detector type	Quasi-peak (CISPR)
Bandwidth	9 kHz
Observation	>15 seconds

Test results:

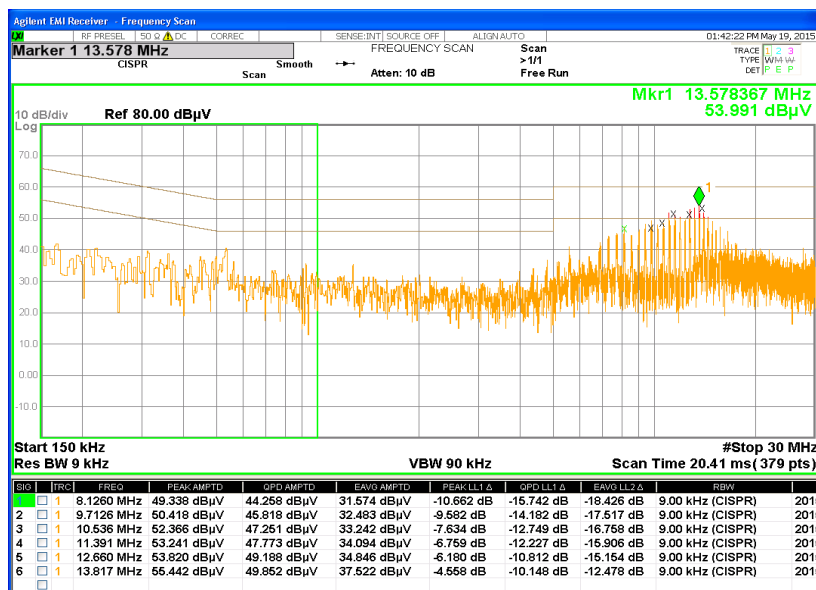
Table 7. Conducted emission test results (summarized)

Line Description	Specified standard	Meas. equipment	Ref. Plot	Result	Remarks
230 VAC mains	EN 55022 Class A / Class B	LISN	Plot # 1, Plot # 2	PASS	All received emissions were found below Class A voltage limits. Worst result =8.9 dB below Class B voltage limit @ 13.27 MHz. (NE, QO detector vs QP limit).

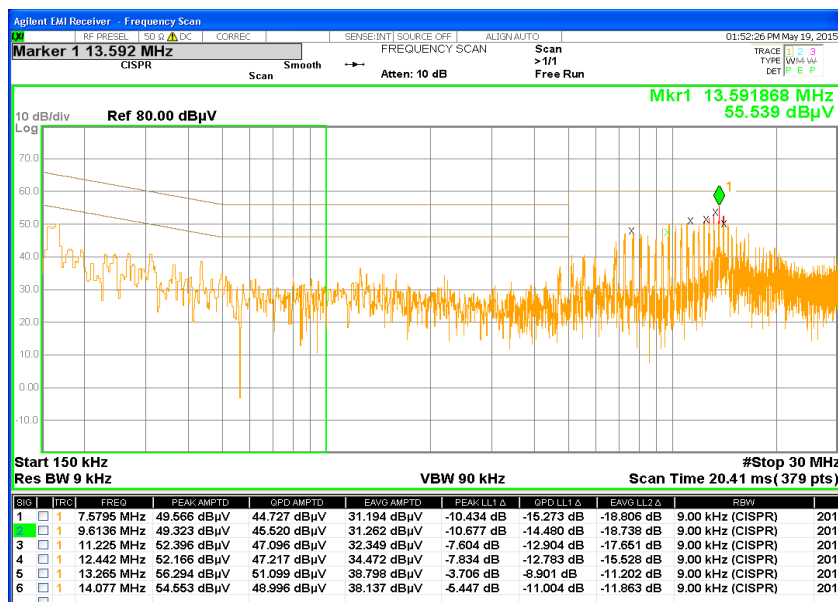
Conducted Emission Summary (Continued)

Results: **Pass**
 Specified standard / Class: EN 55022 Class B
 EUT operation mode: Section 2.6
 Frequency range: 0.15 MHz – 30 MHz
 Tested lone: AC mains

Plot # 1. Conducted emission –230 VAC mains, Phase



Plot # 2. Conducted emission –230 VAC mains, Neutral





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6.3. Harmonic current emission summary:

Results: **Pass**
See Table 8 ÷ Table 10

Specified standard: EN 61000-3-2

Test procedure: EN 61000-3-2

Limits / Classification of the EUT: Class A

EUT operation mode: Section 2.6

Mains: 230 VAC @ 50 Hz

Table 8. Harmonic current emission results (Part 1)

Product:	DIACAM 360	
Serial No:		
Description:	Voltech IEC61000-3 Windows	
Software	1.24.12	Test Date: 2015 Jun 07 10:56
Result:	SHIRTAL DIACAM	
Type of Test:	EN61000:2006 Harmonics inc. interharmonics to EN61000-4-7:2002	
Power Analyzer:	Voltech PM6000 SN: 200006700721 Firmware version: v1.22.07RC6	
AC Source:	Mains / Manual Source	
Overall Result	PASS	
Notes:		
Class:	A	
Test Parameter Details	User Entered	Measured
Specified Power		94.8195
Fundamental Current		0.422
Power Factor		0.5156
Average Input Current		0.8089
Maximum POHC		0.0764
POHC Limit		0.2514
Maximum THC		0.7043
Minimum Power	75	
Class Multiplier:	1	
Test Duration:	00:02:30	

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Harmonic	Limit 1	Limit 2	Average Reading	Av < L1	Av < L2	Max Reading	Max < L2	Pass/ FAIL
2	1.080000A	1.620000A	1.957149mA	Y	Y	2.061621mA	Y	N/A
3	2.300000A	3.450000A	382.9272mA	Y	Y	392.4834mA	Y	Pass
4	430.0000mA	645.0000mA	2.564353mA	Y	Y	2.676401mA	Y	N/A
5	1.140000A	1.710000A	349.0716mA	Y	Y	352.2496mA	Y	Pass
6	300.0000mA	450.0000mA	3.086359mA	Y	Y	3.228868mA	Y	N/A
7	770.0000mA	1.155000A	302.3069mA	Y	Y	303.4058mA	Y	Pass
8	230.0000mA	345.0000mA	3.196018mA	Y	Y	3.371228mA	Y	N/A
9	400.0000mA	600.0000mA	247.2722mA	Y	Y	250.4187mA	Y	Pass
10	184.0000mA	276.0000mA	3.009839mA	Y	Y	3.212237mA	Y	N/A
11	330.0000mA	495.0000mA	189.1906mA	Y	Y	194.3762mA	Y	Pass
12	153.3333mA	230.0000mA	2.615076mA	Y	Y	2.836172mA	Y	N/A
13	210.0000mA	315.0000mA	133.4570mA	Y	Y	139.9836mA	Y	Pass
14	131.4285mA	197.1428mA	2.059434mA	Y	Y	2.283185mA	Y	N/A
15	150.0000mA	225.0000mA	85.11970mA	Y	Y	91.87727mA	Y	Pass
16	115.0000mA	172.5000mA	1.471413mA	Y	Y	1.676346mA	Y	N/A
17	132.3529mA	198.5294mA	49.75736mA	Y	Y	54.74121mA	Y	Pass
18	102.2222mA	153.3333mA	1.109409mA	Y	Y	1.264113mA	Y	N/A
19	118.4210mA	177.6315mA	34.01055mA	Y	Y	35.62529mA	Y	Pass
20	92.00000mA	138.0000mA	1.058850mA	Y	Y	1.140891mA	Y	N/A
21	107.1428mA	160.7142mA	34.79459mA	Y	Y	38.90341mA	Y	Pass
22	83.63636mA	125.4545mA	1.189977mA	Y	Y	1.260302mA	Y	N/A
23	97.82608mA	146.7391mA	37.32687mA	Y	Y	38.41623mA	Y	Pass
24	76.66667mA	115.0000mA	1.247262mA	Y	Y	1.334903mA	Y	N/A
25	90.00000mA	135.0000mA	35.12397mA	Y	Y	35.99675mA	Y	Pass
26	70.76923mA	106.1538mA	1.149071mA	Y	Y	1.258470mA	Y	N/A
27	83.33333mA	125.0000mA	28.38430mA	Y	Y	30.36744mA	Y	Pass
28	65.71428mA	98.57142mA	0.928643mA	Y	Y	1.055308mA	Y	N/A
29	77.58620mA	116.3793mA	19.56722mA	Y	Y	21.91496mA	Y	Pass
30	61.33333mA	92.00000mA	0.656149mA	Y	Y	0.763473mA	Y	N/A
31	72.58064mA	108.8709mA	11.85065mA	Y	Y	13.23497mA	Y	Pass
32	57.50000mA	86.25000mA	0.483792mA	Y	Y	0.620008mA	Y	N/A
33	68.18182mA	102.2727mA	8.991928mA	Y	Y	14.44001mA	Y	Pass
34	54.11764mA	81.17647mA	0.502522mA	Y	Y	0.667981mA	Y	N/A
35	64.28572mA	96.42857mA	11.02854mA	Y	Y	14.28928mA	Y	Pass
36	51.11111mA	76.66667mA	0.627432mA	Y	Y	0.727321mA	Y	N/A
37	60.81081mA	91.21621mA	12.60590mA	Y	Y	13.53057mA	Y	Pass
38	48.42105mA	72.63158mA	0.661991mA	Y	Y	0.707790mA	Y	N/A
39	57.69230mA	86.53846mA	11.97919mA	Y	Y	12.50056mA	Y	Pass
40	46.00000mA	69.00000mA	0.600685mA	Y	Y	0.677077mA	Y	N/A



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Table 10. Power supply parameters

	Nominal	Measured	Deviation	Allowed Deviation	Result
Supply Voltage	230.00V	229.45V	0.55V	4.60V	Pass
Supply Frequency	50.00Hz	49.98Hz	0.02Hz	0.25Hz	Pass
Crest Factor	1.41	1.418	0.008	+/- 0.01	Pass
Harmonic	Reading	Limit	Result		
2	0.11%	0.20%	Pass		
3	0.07%	0.90%	Pass		
4	0.04%	0.20%	Pass		
5	0.05%	0.40%	Pass		
6	0.03%	0.20%	Pass		
7	0.06%	0.30%	Pass		
8	0.03%	0.20%	Pass		
9	0.05%	0.20%	Pass		
10	0.02%	0.20%	Pass		
11	0.04%	0.10%	Pass		
12	0.01%	0.10%	Pass		
13	0.03%	0.10%	Pass		
14	0.01%	0.10%	Pass		
15	0.02%	0.10%	Pass		
16	0.01%	0.10%	Pass		
17	0.02%	0.10%	Pass		
18	0.01%	0.10%	Pass		
19	0.01%	0.10%	Pass		
20	0.01%	0.10%	Pass		
21	0.01%	0.10%	Pass		
22	0.01%	0.10%	Pass		
23	0.02%	0.10%	Pass		
24	0.01%	0.10%	Pass		
25	0.02%	0.10%	Pass		
26	0.01%	0.10%	Pass		
27	0.01%	0.10%	Pass		
28	0.01%	0.10%	Pass		
29	0.01%	0.10%	Pass		
30	0.01%	0.10%	Pass		
31	0.01%	0.10%	Pass		
32	0.01%	0.10%	Pass		
33	0.01%	0.10%	Pass		
34	0.01%	0.10%	Pass		
35	0.01%	0.10%	Pass		
36	0.01%	0.10%	Pass		
37	0.01%	0.10%	Pass		
38	0.01%	0.10%	Pass		
39	0.01%	0.10%	Pass		
40	0.01%	0.10%	Pass		



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6.4. Voltage changes, Voltage fluctuations and Flicker summary

Results: **Pass**
See Table 11

Specified standard: EN 61000-3-3

Test procedure: EN 61000-3-3

Limits / Classification of the EUT: See in table below

EUT operation mode: Section 2.6

Power supply: 230 VAC mains

Table 11. Voltage changes, Voltage fluctuations and Flicker results

Product:	DIACAM 360			
Serial No:				
Description:				
Voltech IEC61000-3 Windows Software 1.24.12	Test Date:	2015 Jun 07 11:05		
Result:	SHIRTAL DIACAM			
Type of Test:	Flickermeter Test - Table			
Power Analyzer:	Voltech PM6000 SN: 200006700721			
AC Source:	Firmware version: v1.22.07RC6			
Overall Result	Mains / Manual Source			
Notes:	PASS			
	Plt test duration only 20 minutes			
	Measurement method - Voltage			
	Plt			
Limit	0.65			
Reading	0.05			
	Pst	dc(%)	dmax(%)	d(t)>3.3%(ms)
Limit	1	3.3	4	500
Reading 1	0.091	0	0.546	0
Reading 2	0.091	0	0.543	0

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7. Immunity Tests

7.1. Performance criteria

Per EN 55024 section 7:

Performance criteria A

General:

The EUT shall continue to operate as intended without operator intervention. No degradation of performance or loss of function is allowed below a minimum performance level specified by the manufacturer when the EUT is used as intended.

Performance criteria B

General:

After the test, the EUT shall continue to operate as intended without operator intervention. No degradation of performance or loss of function is allowed, after the application of the phenomena below a performance level specified by the manufacturer, when the EUT is used as intended.

During the test, degradation of performance is allowed. However, no change of operating state or stored data is allowed to persist after the test.

Performance criteria C

General:

During and after testing, a temporary loss of function is allowed, provided the function is self-recoverable, or can be restored by the operation of the controls or cycling of the power to the EUT by the user in accordance with the manufacturer's instructions.

Particular criteria for ESD test:

According to the customer declaration and respective marking (symbol IEC 60417-5134 (2003-04) for ESD sensitivity):

the connectors of Interconnection cable (on Upper and Lower Units, respectively) have ESD sensitivity.

Therefore for these connectors testing exemption is used.

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7.2. Electrostatic Discharge (ESD)

Results:	Pass
Specified standard:	EN 55024 section 10 (Table 1)
Test procedure:	IEC 61000-4-2
EUT operation mode:	See section 2.6
Performance criteria:	see section 7.1, Criteria B
Temperature:	22.6° C
Relative humidity:	59 %
Atmosphere pressure:	1012 mbar

Table 12. ESD Results

ESD type	Test points	Test Voltage (kV)	Number of pulses	EUT performance during test	Performance criteria	Results
Air	Cables	2, 4, 8	($\pm 3 \cdot 10$)	A	B	PASS
	Plastic parts	2, 4, 8	$\pm (3 \cdot 10)$	A	B	PASS
Contact	Metal parts	2, 4	$\pm (4 \cdot 10)$	A	B	PASS
	Painted parts	2, 4	$\pm (4 \cdot 10)$	A	B	PASS
	Connector bodies	2, 4	$\pm (2 \cdot 10)$	EUT stopped	B	Exempt
	To HCP	2, 4	$\pm (4 \cdot 10)$	A	B	PASS
	To VCP	2, 4	$\pm (4 \cdot 10)$	A	B	PASS

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7.3. Radiated Immunity Test

Results:	Pass
Specified standard:	EN 55024 section 10 (Table 1)
Test procedure:	IEC 61000-4-3
EUT operation mode:	See section 2.6
Performance criteria:	see section 7.1, Criteria A
Temperature:	21° C
Relative humidity:	60 %
Atmosphere pressure:	1013 mbar

Table 13. Radiated immunity Results

EUT configuration with respect to antenna	Severity level, V/m rms. unmodulated	Modulation	EUT performance during test	Performance criteria	Result
Vertical & Horizontal 80 MHz 1.0 GHz, sweep	3.0	80 % AM, 1 kHz	A	A	PASS

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7.4. Electrical Fast Transients (EFT)

Results:	Pass
Specified standard:	EN 55024 section 10 (Table 4)
Test procedure:	IEC 61000-4-4
EUT operation mode:	See section 2.6
Performance criteria:	see section 7.1, Criteria B
Temperature:	22.7° C
Relative humidity:	66 %
Atmosphere pressure:	1012 mbar

Table 14. EFT Results

No.	Cable Description	Type of coupling	Test Voltage kV	Impulse	EUT performance during test	Performance criteria	Results
1	AC mains	CDN	± 1.0	Tr/Th – 5/50 ns, 5 kHz	A	B	PASS

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7.5. Surge testing

Results:	Pass
Specified standard:	EN 55024 section 10 (Table 4)
Test procedure:	IEC 61000-4-5
EUT operation mode:	See section 2.6
Performance criteria:	see section 7.1, Criteria B
Temperature:	22.8° C
Relative humidity:	63 %
Atmosphere pressure:	1012 mbar

Table 15. Surge Results

No.	Cable Description	Test Voltage, kV	Type of coupling	Type of Surge, μ s	Pulses	EUT performance during test	Performance criteria	Results
1	AC mains	2.0 CM / 1.0 DM	CDN	1.2/50 (8/20)	± 5	A	B	PASS

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Results:	Pass
Specified standard:	EN 55024 section 10 (Table 4)
Test procedure:	IEC 61000-4-6
EUT operation mode:	See section 2.6
Performance criteria:	see section 7.1, Criteria A
Temperature:	22.3° C
Relative humidity:	60 %
Atmosphere pressure:	1012 mbar

Table 16. RF Conducted Immunity Results

No.	Cable Description	Type of coupling	Freq. range, MHz	Severity level, V unmodulated, rms	Modulation	EUT performance during test	Performance criteria	Result
1	AC mains	CDN	0.15 ÷ 80	3	AM 80%, 1 kHz	A	A	PASS

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7.7. Voltage dip and interruptions

Results:	Pass
Specified standard:	EN 55024 section 10 (Table 4)
Test procedure:	IEC 61000-4-11
EUT operation mode:	See section 2.6
Performance criteria:	see section 7.1, Criteria B & C
Temperature:	22.0° C
Relative humidity:	60 %
Atmosphere pressure:	1012 mbar

Table 17. Voltage Dips & Interruptions Results

No.	Phenomena	Reduction of supply voltage, %	Time duration, ms	Required criteria	EUT performance during test	Results
1	Voltage dips	>95 (100)	10	A	B	Pass
		30	500	A	C	Pass
2	Voltage interruptions	>95 (100)	5000	C	C	Pass

8. Appendix 1: Test equipment used

All measurements equipment is on SII calibration schedule with a recalibration interval not exceeding once a year.

Instrument	Manufacturer	Model	SII No.	Last calibration date	Next calibration date
EN 55022					
EMI Receiver 9 kHz - 6.5 GHz	HP	8546A+85460A	4068	06/14	06/15
EMI Test Receiver 20 Hz – 40 GHz	ROHDE & SCHWARZ	R&S®ESU40	5911	11/14	11/15
MXE EMI Analyzer 20 Hz - 26.5 GHz	Agilent Techn	N9038A	6501147	03/15	03/16
EMI Analyzer 10 kHz - 26.5 GHz	HP	E7405A	4944	05/14; 06/15	05/15; 06/16
LISN 9 kHz – 30 MHz	Fischer Custom	FCC - LISN -50-25- 2	4025	01/15	01/16
Line Impedance Stabilization Network (LISN) 9 kHz-30 MHz, 4X32(50)A, 230/400V	Schwarbeck Mess- Elektronik	NSLK 8128	6677	01/15	01/16
Transient limiter 0.009-200 MHz	Agilent Techn	11947A	3107A03104	08/14	08/15
Biconilog Antenna 20 MHz - 6000 MHz	ETS LINDGREN	3142D- SN:00146490	--	01/15	01/16
Software	Agilent	E7415A	SW version 1.00.1	N/A	N/A
EN 61000-3-2 / EN 61000-3-3					
AC Power Supply Phase	Elgar	SW 5250A	4684	N/A	N/A
Universal Power Analyzer 230 VAC, 3ph, 30A	Voltech	PM 6000	6501179	07/14	07/15
Software	Voltech	IEC 1000-3	Version 1.24.12	N/A	N/A

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Instrument	Manufacturer	Model	SII No.	Last calibration date	Next calibration date
IEC 61000-4-2					
Simulator, Contact Disch.: ± 0.5 to ± 8 kV, Air Discharge: ± 0.5 to ± 15 kV	Teseq AG	NSG.435	606332	11/14	11/15
IEC 61000-4-3					
Spectrum Analyzer 9 kHz - 6 GHz	ROHDE & SCHWARZ	R&S®FSL6	5912	06/14	06/15
MXG Analog Microwave Signal generator 100 KHz - 20 GHz	Agilent	N5183A	6501148	08/14	08/15
RF power amplifier 80-1000 MHz, 100W	Amplifier Research	100W1000M1	4883	N/A	N/A
Biconilog Antenna 30 – 2000 MHz	Schaffner	CBL 6112B	5119	12/14	12/15
Horn Antenna High-Gain 0.8 – 4.2 GHz; 20 W	Amplifier Research	AT4002A	4966	N/A	N/A
RF Power Amplifier 0.8 - 4.2 GHz; 25 W	Amplifier Research	25S1G4A	4991	N/A	N/A
Electric Field Probe 100 kHz - 3000 MHz	PMM	EP 330	5448	12/14	12/15
Anechoic chamber	Chase	Euroshield	4806	N/A	N/A
Software for EMC measurements	ROHDE & SCHWARZ	EMC32	Release 8.53.0	N/A	N/A
IEC 61000-4-4					
Set Multifunction Generator CDN, 1 Phase	Teseq	NSG-3060 CDN- 3061	6502113	10/14	10/15
Coupling Network, 3 PH 32 A	Teseq	NSG 3063	6502116	10/14	10/15
Capacitive coupling clamp	Teseq	CDN-3425	6502117	N/A	N/A
Software	Teseq	WIN 3000 SDR	Ver. 1.3.2	N/A	N/A
IEC 61000-4-5					
Set Multifunction Generator CDN, 1 Phase	Teseq	NSG-3060 CDN- 3061	6502113	10/14	10/15
Telecom Surge Pulse Generator (10 x 700 μ s)	Teseq	NSG-3060 Telocom	6502114	10/14	10/15
Software	Teseq	WIN 3000 SDR	Ver. 1.3.2	N/A	N/A

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Instrument	Manufacturer	Model	SII No.	Last calibration date	Next calibration date
IEC 61000-4-6					
RF Generator 10 kHz - 1040 MHz	HP	8657A	4923	03/15	03/16
RF Generator 100 kHz - 20 GHz	Agilent	N5183A	6501148	08/14	08/15
RF Generator 10 kHz - 1050 MHz	Fluke	6060B	2384	05/14; 05/15	05/15; 05/16
RF power amplifier 10 kHz - 250 MHz; 75 W	Ampl Research	75A250	4847	N/A	N/A
RF power amplifier 150 kHz - 300 MHz; 10 W	ENI	411LA	3757	N/A	N/A
Oscilloscope 300 MHz	Lecroy	9361	4009	12/14	12/15
CDN 150 kHz – 230 MHz	Schaffner	CDN M325	5122	02/15	02/16
CDN 150 kHz – 230 MHz	Schaffner	CDN T002	5123	11/14	11/15
CDN 150 kHz – 230 MHz	FCC	801-M3-16	51906	11/14	11/15
CDN 150 kHz – 80 MHz	TESEQ AG	CDN 800	606307	11/14	11/15
Attenuator 6 dB, 50W	Huber- Suhner AG	5906.17.006	302789	11/14	11/15
Sensor Probe 10 kHz – 100 MHz	TESEQ AG	CSP 9160A	606308	04/15	04/16
Bulk Current Injection Probe 10 kHz – 230 MHz	FCC	F-120-9A	53923	03/15	03/16
IEC 61000-4-11					
Set Multifunction Generator CDN, 1 phase StepTransformer	Teseq	NSG-3060 CDN- 3061 INA-6502	6502113	10/14	10/15
Immunity Test System	HAEFELY TEST AG	AXOS 5	6502105	12/14	12/15
Software	Teseq	WIN 3000 SDR	Ver. 1.3.2	N/A	N/A

9. Appendix 2: Measurement uncertainty

The test equipment has been calibrated according to its recommended procedures and is within the manufacturer's published limit of error.

The laboratory calibrates its standards by a third party (traceable to NIST, USA) on a regular basis according to equipment manufacturer requirements.

In the following table the uncertainty calculation is given.

Calculated uncertainty U_{LAB} are less than U_{CISPR} , therefore compliance is deemed to occur if no measured disturbance level exceeds the disturbance limit.

Type of disturbance Test description	Calculated uncertainty U_{LAB}	U_{CISPR}
Conducted disturbance at mains port (9 kHz to 150 kHz)	3.3 dB	3.8 dB
Conducted disturbance at mains port (150 kHz to 30 MHz)	2.8 dB	3.4 dB
Disturbance power (30 MHz to 300 MHz)	3.3 dB	4.5 dB
Radiated disturbance (electric field strength at an OATS at 10 m distance) (30 MHz to 1 000 MHz)	4.18 dB	6.3 dB
Radiated disturbance (electric field strength in a SAR at 3 m distance) (30 MHz to 1 000 MHz)	4.32 dB	6.3 dB
Radiated disturbance (electric field strength in a FAR) (1 GHz to 6 GHz)	4.47 dB	5.2 dB
Radiated disturbance (electric field strength in a FAR) (6 GHz to 18 GHz)	4.47 dB	5.5 dB

The expanded uncertainty at a level of 95% confidence is obtained by multiplying the combined standard uncertainty by coverage factor of 2.

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No.	Frequency (MHz)	Attenuation (dB)	Frequency (MHz)	Attenuation (dB)	Frequency (MHz)	Attenuation (dB)	Frequency (MHz)	Attenuation (dB)
1	0.100000	-0.1	1.613578	0.0	26.036350	0.3	420.116889	1.5
2	0.105000	-0.1	1.694257	0.1	27.338167	0.3	441.122734	1.5
3	0.110250	0.0	1.778970	0.0	28.705075	0.3	463.178870	1.6
4	0.115762	-0.1	1.867919	0.0	30.140329	0.3	486.337814	1.6
5	0.121551	-0.1	1.961315	0.1	31.647346	0.3	510.654704	1.7
6	0.127628	0.0	2.059380	0.1	33.229713	0.3	536.187440	1.7
7	0.134010	0.0	2.162349	0.1	34.891199	0.4	562.996812	1.8
8	0.140710	0.0	2.270467	0.1	36.635758	0.4	591.146652	1.8
9	0.147746	0.0	2.383990	0.1	38.467546	0.4	620.703985	1.9
10	0.155133	-0.1	2.503190	0.0	40.390924	0.4	651.739184	1.9
11	0.162889	0.0	2.628349	0.1	42.410470	0.4	684.326143	2.0
12	0.171034	0.0	2.759766	0.1	44.530993	0.4	718.542450	2.0
13	0.179586	0.0	2.897755	0.1	46.757543	0.4	754.469573	2.1
14	0.188565	0.1	3.042643	0.1	49.095420	0.4	792.193052	2.1
15	0.197993	0.0	3.194775	0.1	51.550191	0.4	831.802704	2.2
16	0.207893	0.0	3.354513	0.1	54.127701	0.4	873.392839	2.3
17	0.218287	0.0	3.522239	0.1	56.834086	0.5	917.062481	2.3
18	0.229202	0.0	3.698351	0.1	59.675790	0.5	962.915605	2.4
19	0.240662	-0.1	3.883269	0.1	62.659580	0.5	1011.061386	2.5
20	0.252695	0.1	4.077432	0.1	65.792559	0.5	1061.614455	2.6
21	0.265330	0.0	4.281304	0.1	69.082187	0.5	1114.695178	2.6
22	0.278596	0.0	4.495369	0.1	72.536296	0.5	1170.429937	2.7
23	0.292526	-0.1	4.720137	0.1	76.163111	0.6	1228.951434	2.8
24	0.307152	0.0	4.956144	0.1	79.971266	0.6	1290.399005	2.9
25	0.322510	0.0	5.203951	0.1	83.969830	0.6	1354.918955	3.0
26	0.338635	0.0	5.464149	0.1	88.168321	0.6	1422.664903	3.1
27	0.355567	0.0	5.737356	0.1	92.576737	0.6	1493.798148	3.2
28	0.373346	0.0	6.024224	0.1	97.205574	0.6	1568.488056	3.3
29	0.392013	0.0	6.325435	0.1	102.065853	0.7	1646.912459	3.4
30	0.411614	0.0	6.641707	0.1	107.169145	0.7	1729.258082	3.5
31	0.432194	0.0	6.973792	0.1	112.527603	0.7	1815.720986	3.6
32	0.453804	-0.1	7.322482	0.1	118.153983	0.7	1906.507035	3.7
33	0.476494	0.0	7.688606	0.1	124.061682	0.7	2001.832387	3.9
34	0.500319	0.0	8.073037	0.1	130.264766	0.8	2101.924006	4.0
35	0.525335	0.0	8.476688	0.2	136.778004	0.8	2207.020206	4.1
36	0.551602	0.0	8.900523	0.1	143.616904	0.8	2317.371217	4.2
37	0.579182	0.0	9.345549	0.2	150.797750	0.8	2433.239777	4.4
38	0.608141	0.0	9.812826	0.2	158.337637	0.8	2554.901766	4.6
39	0.638548	0.0	10.303468	0.2	166.254519	0.9	2682.646855	4.8
40	0.670475	0.0	10.818641	0.2	174.567245	0.9	2816.779197	4.9
41	0.703999	0.0	11.359573	0.2	183.295607	0.9	2957.618157	5.0
42	0.739199	0.0	11.927552	0.2	192.460387	0.9	3105.499065	5.1
43	0.776159	0.0	12.523929	0.2	202.083407	1.0	3260.774018	5.2
44	0.814967	0.0	13.150126	0.2	212.187577	1.0	3423.812719	5.2
45	0.855715	0.0	13.807632	0.2	222.796956	1.0	3595.003355	5.4
46	0.898501	0.0	14.498014	0.2	233.936804	1.1	3774.753523	5.5
47	0.943426	0.0	15.222914	0.2	245.633644	1.1	3963.491199	5.6
48	0.990597	0.0	15.984060	0.2	257.915326	1.1	4161.665759	6.0
49	1.040127	0.0	16.783263	0.2	270.811093	1.2	4369.749047	6.1
50	1.092133	0.0	17.622426	0.2	284.351647	1.2	4588.236499	6.4
1	1.146740	0.0	18.503548	0.3	298.569230	1.2	4817.648324	6.8
2	1.204077	0.0	19.428725	0.2	313.497691	1.2	5058.530740	6.9
3	1.264281	0.0	20.400161	0.3	329.172576	1.3	5311.457277	6.9
4	1.327495	0.0	21.420169	0.3	345.631204	1.3	5577.030141	7.2
5	1.393870	0.0	22.491178	0.3	362.912765	1.4	5855.881648	7.2
6	1.463563	0.0	23.615737	0.3	381.058403	1.4	6000.000000	7.0
7	1.536741	0.0	24.796523	0.3	400.111323	1.5		

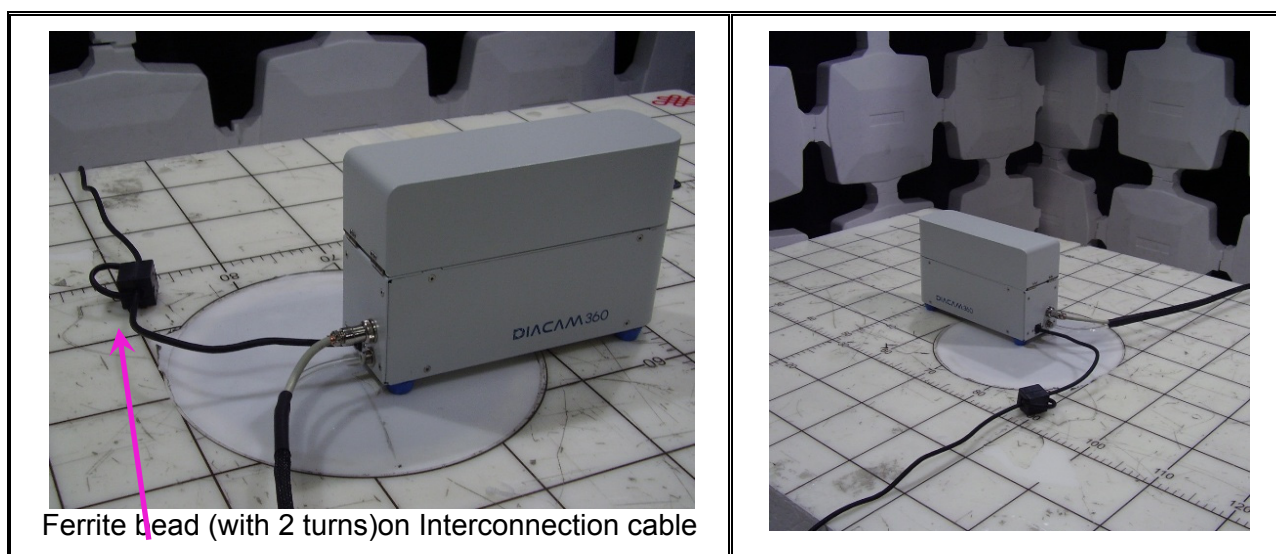
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3 m distance**

No.	f / MHz	AF / dB/m	f / MHz	AF / dB/m	f / MHz	AF / dB/m
1	30	18.7	250	12.0	2750	31.0
2	35	15.7	300	13.8	3000	31.2
3	40	12.9	400	16.2	3250	32.7
4	45	10.6	500	18.6	3500	34.5
5	50	9.0	600	20.2	3750	34.3
6	60	7.3	700	21.8	4000	34.5
7	70	7.7	800	22.9	4250	35.3
8	80	8.2	900	24.1	4500	35.5
9	90	9.2	1000	24.8	4750	36.1
10	100	9.4	1250	26.9	5000	37.4
11	120	8.5	1500	30.2	5250	38.4
12	140	8.5	1750	28.5	5000	39.9
13	160	9.1	2000	28.9	5750	38.2
14	180	10.5	2250	29.8	6000	39.1
15	200	10.9	2500	32.5		

11. Appendix 4: Test illustrations



**Picture # 3. Radiated emission test setup
Front and rear views**



**Picture # 4. Radiated emission test setup
Upper Unit views**

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Ferrite bead (with 2 turns) on AC mains cable

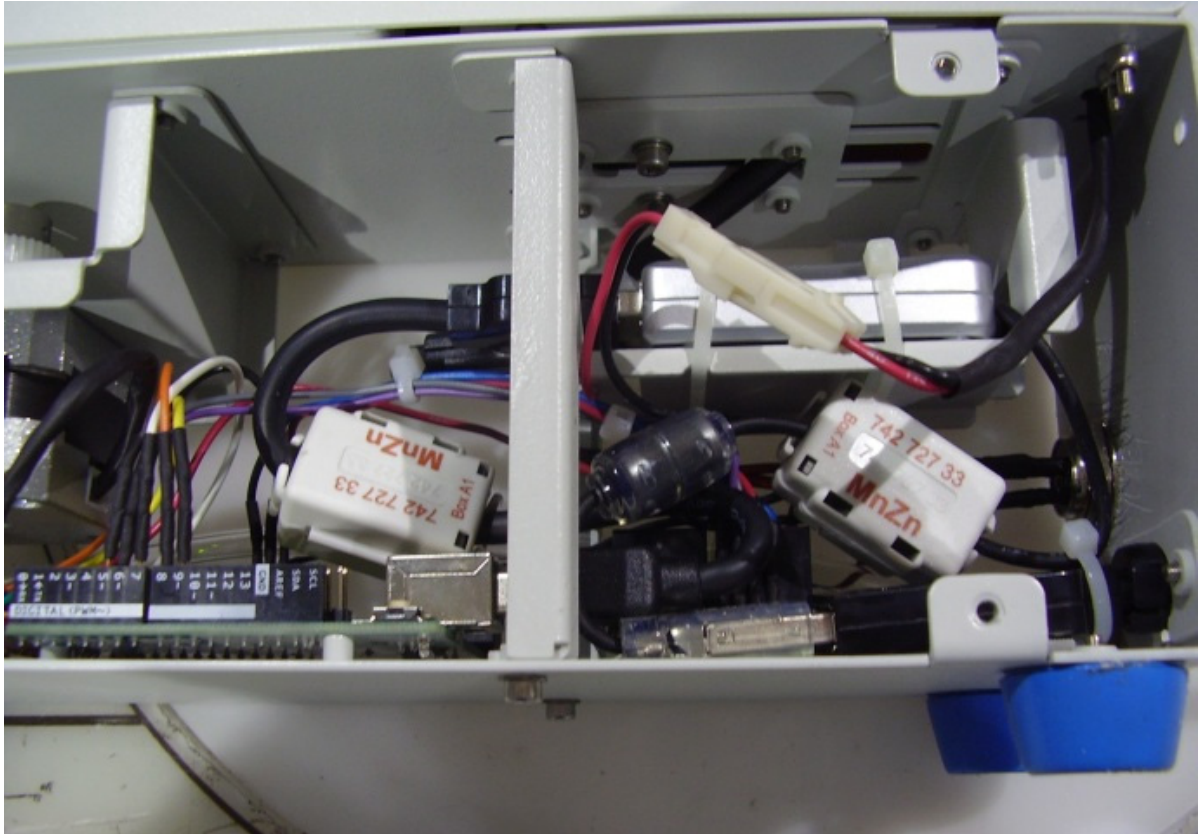
**Picture # 5. Radiated emission test setup
Lower Unit overall view**

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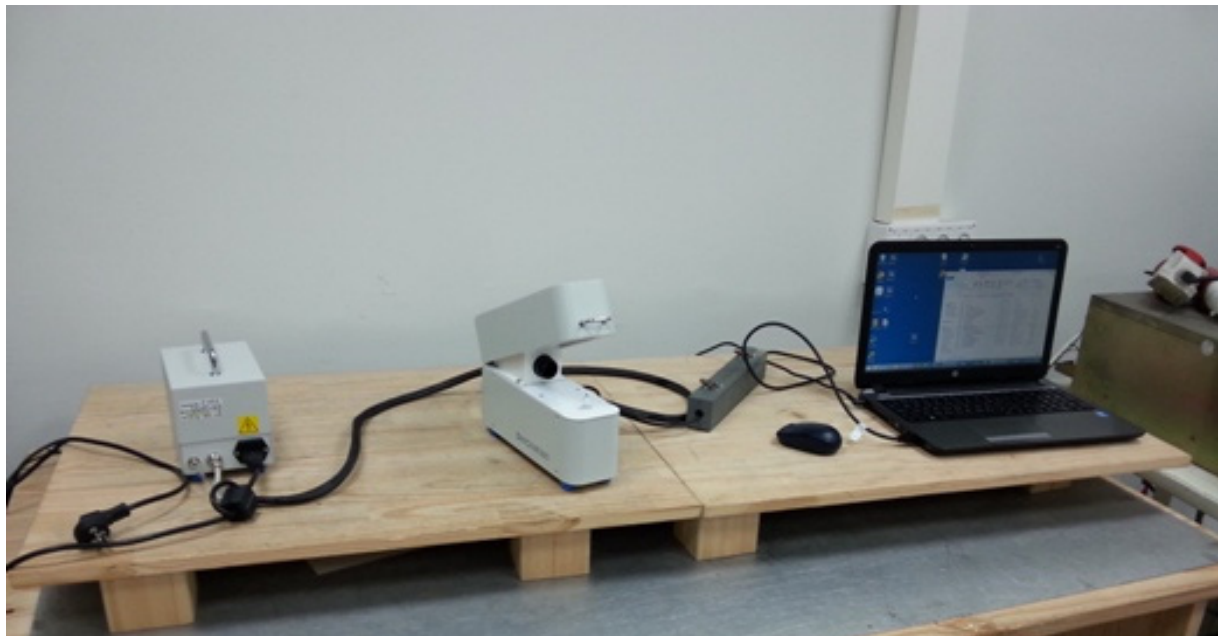
**Picture # 6. Upper unit -
internal view with ferrite beads**

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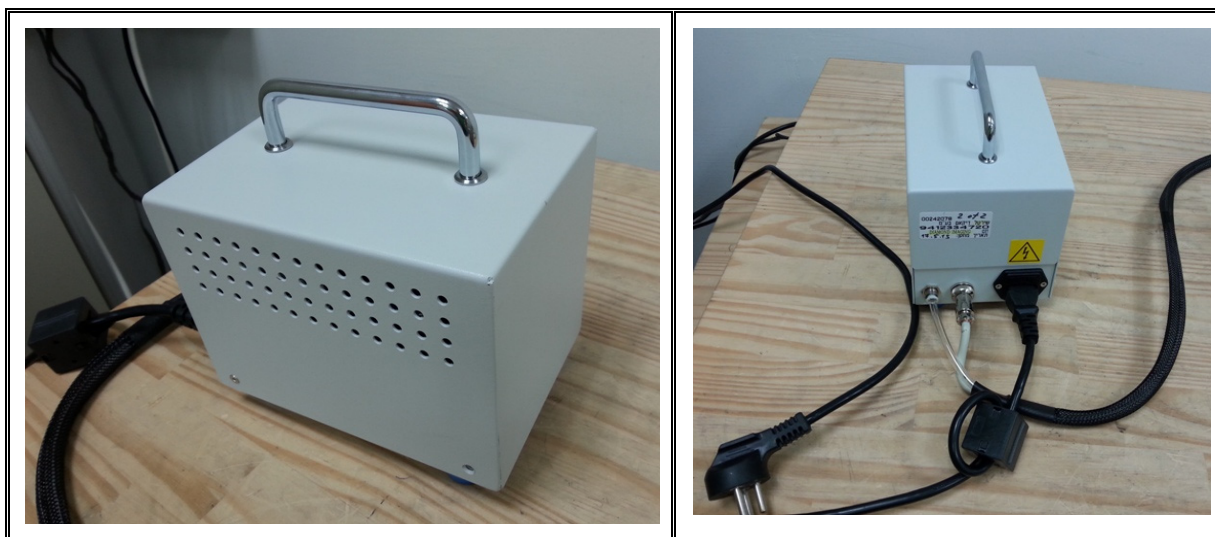
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Picture # 7. Immunity setup



Picture # 8. EUT: Lower Unit

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Picture # 9. EUT: Upper Unit (closed and opened)