

***Test Report No.8212301949 Rev.1***

***For Eldar Shany Technologies***

***Equipment Under Test:***

***Agricultural Controller***

***Name: Galileo***

***Model: Galileo***

***From The Standards Institution  
Of Israel***

***Industry Division***

***Telematics Laboratory***

***EMC Section***



***Certificate No. 1487-01***

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**Title:** Test on Agricultural Controller

**Name:** Galileo

**Model:** Galileo

<b>Order placed by:</b>	Eldar Shany Technologies
<b>Address:</b>	Yad-Mordehay, D.N.Hof Ashkelon 79145 Israel
<b>Sample for test selected by:</b>	The orderer
<b>The date of test:</b>	14/10/2001;25/10/2001; 5/12/2001; 9/01/2002; 29/04/2002, 9/05/2002, 12/05/2002

**Description of Equipment**

**Under Test (EUT):** Agricultural Controller  
**Name:** Galileo  
**Model:** Galileo  
**Serial Number:** 112188  
**Manufactured by:** Eldar Shany Technologies

**Reference Documents:**

- ❖ EN 55011: "Limits and methods of measurement of radio disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment" (1998) + A1:(1999).
- ❖ EN 61000-6-2: "Electromagnetic Compatibility (EMC)- Part 6-2: Generic standards – Immunity for industrial equipments" (1999).
- ❖ IEC 61000: "Electromagnetic Compatibility (EMC)".  
 Part 3. "Limits."  
 Section 2: "Limits for harmonic current emissions (equipment input current  $\leq 16A$  per phase" (1995).  
 Section 3: "Limits for voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current  $< 16 A$ ".

**Test Results:** See Compliance Table in Section 5

This Test Report contains 35 pages and may be used only in full.

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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## 1. EUT Description and operation

### 1.1. General description \*:

#### Description of Equipment Under Test (EUT): Agricultural Controller

<b>Name:</b>	Galileo
<b>Model:</b>	Galileo
<b>Serial Number:</b>	112188
<b>Manufactured by:</b>	Eldar Shany Technologies

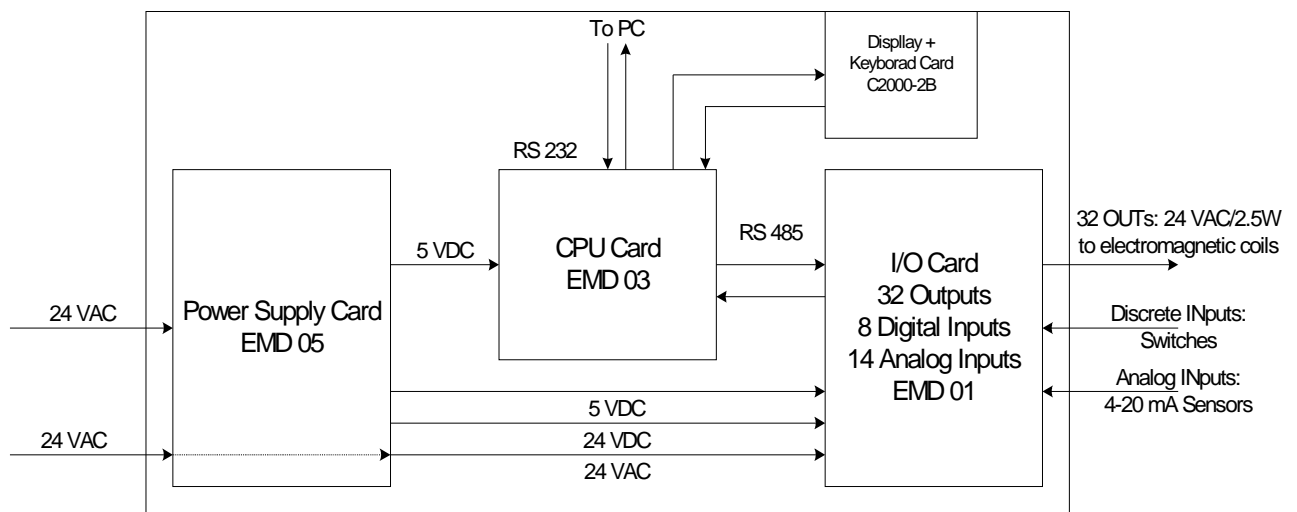
Galileo is a high performance controller based on the Intel 80188 processor for agriculture usage. The EUT consist of build-in user interface for fully stand-alone operation, along with standard RS232 communication port for PC conducted network

The EUT's dimensions are: 15.0 (L) x 34.1 (W) x 24.5 (H) (cm) approx.

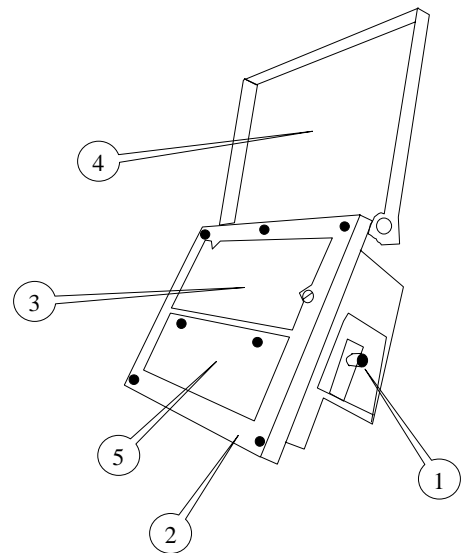
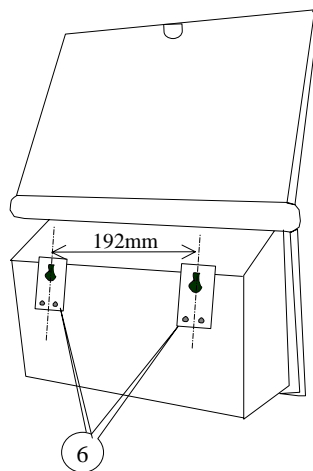
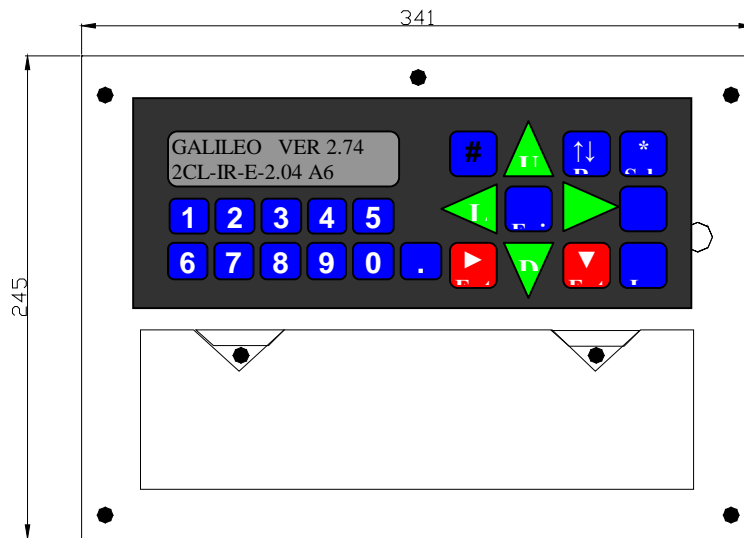
The EUT's power source: 24 VAC 80 W.

The EUT's block diagram is shown in Figure 1.the external view is shown in Figure 2.

The information is provided by the manufacturer.



**Figure 1 Galileo Block Diagram**



**Figure 2 Galileo Front panel and enclosure**

**1.2. EUT's sub-assemblies list:**

EUT's sub-assemblies list is detailed in Table 1.

**Table 1. Sub-assemblies list**

Function	Marking/Serial No./ Model
Main card (CPU card)	EMD 03
I/O Card (32 outputs, 8 digital inputs, 14 analog inputs)	EMD 01
Power supply card	EMD 05
Display + keyboard card	C2000-2B

**1. EUT connector list \*:**

A list of the EUT's connectors is detailed in Table 2.

**Table 2. Connector list**

No.	Description	Connector's type	Type of Cable	Length (m)	Location	No. of identical connectors
1	24VAC mains	4 pin CPC	unshielded	2.0	24V AC Power supply from external transformer	2
2	Outputs	Phoenix IDC	shielded	3.0	24V AC /2.5W Electromagnetic coils	32
3	Discrete inputs	Phoenix IDC	shielded	3.0	Dry switches	8
4	RS 232	RJ 45	shielded	1.5	To PC	1
5	Analog inputs	Phoenix IDC	shielded	3.0	4-20mA Sensors	14

\* Information is provided by the manufacturer.

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### 1.3. Potential emission sources \*:

The potential emission sources are detailed in Table 3.

**Table 3. Potential emission sources**

Frequency (MHz)	Location	Remarks
22	EMD03	
6	EMD 03 to C2000-2B	Communication between EMD 03 & C2000-2B
0.0192	Communication to PC	
0.0192	Communication to expansion	
0.0192	Internal communication between modules	
3.686	EMD01	

### 1.4. Auxiliary equipment used \*:

**Table 4. Auxiliary equipment used**

Name	MFR	Model	Ser. No.	Remarks
8 relay cards	Eldar-Shany	C6000-1	0801119	8 mini relays 24V mfr Takamisawa
PT100 sensor	Eldar-Shany	PT100	N/A	PT100 temperature probe with 4-20 mA adapter
OPTN	Eldar-Shany	N/A	N/A	Terminal block + lightning protection. Connected to outputs.
Dual transformer	Eldar-Shany	N/A	009279	115/230V to 24V dual transformers for stand-alone controllers.
PC Laptop	-	-	-	For immunity tests only

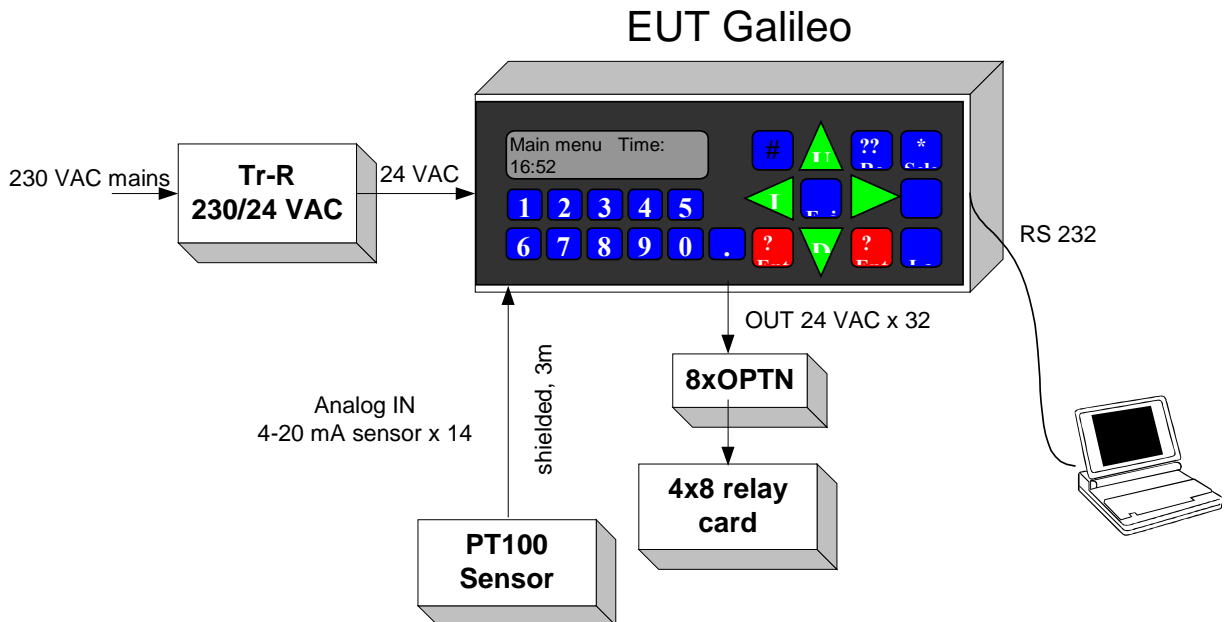
**1.5. EUT setup and operation:**

During the tests the EUT was configured as shown in Figure 3. The EUT was operated to reading and collection data from the sensors, open/close relays. The constant communication with PC via RS 232 was supported.

Protection devices:

The following external protection devices were used:

1. OPTN - lightning protection installed on 24 VAC outputs.



**Figure 3 Emission/Immunity test setup**

Note: PC was used for immunity tests only



## **1.6. Required performance criteria during the course of the immunity tests:**

### **1.6.1. Performance criteria A:**

#### General:

The EUT shall continue to operate as intended during and after the test. No degradation of performance or loss of function is allowed below a performance level specified by manufacturer, when the EUT is used as intended.

### **1.6.2. Performance criteria B:**

#### General:

The EUT will continue to operate as intended after the test. No degradation of performance or loss of function is allowed below a performance level specified by manufacturer, when the EUT is used as intended. During the test, degradation of performance is allowed. No change of actual operating state or storage data is allowed.

### **1.6.3. Performance criteria C:**

#### General:

Temporary loss of operation is allowed, provided the function is self recoverable or can be restored by the operation of the controls.

### **1.6.4. EUT performance level:**

The EUT performance level specified by manufacturer:

1. For outputs and digital inputs: Any malfunction of operation should be not longer than 2 sec.
2. For analog inputs: Any distortion of constant reading and collection data from the sensors is not allowed.
3. For RS 232: Any distortion of communication with PC should be not longer than 10 sec.

## 2. Test specification, Methods and Procedures

### Test Specification:

- ❖ EN 55011: "Limits and methods of measurement of radio disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment" (1998) + A1: (1999).
- ❖ EN 61000-6-2: "Electromagnetic Compatibility (EMC)- Part 6-2: Generic standards – Immunity for industrial equipments" (1999).
- ❖ IEC 61000: "Electromagnetic Compatibility (EMC)".  
Part 3. "Limits."  
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Section 3: "Limits for voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current  $< 16 A$ ".

### Methods and Procedures:

- ❖ EN 55011: "Limits and methods of measurement of radio disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment" (1998) + A1: (1999).
- ❖ IEC 61000: "Electromagnetic Compatibility (EMC)".  
Part 3. "Limits."  
Section 2: "Limits for harmonic current emissions (equipment input current  $\leq 16A$  per phase" (1995).  
Section 3: "Limits for voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current  $< 16 A$ ".  
Part 4. "Testing and measurement techniques".  
Section 2: "Electrostatic discharge immunity tests" (1995).  
Section 3: "Radiated, radio-frequency, electromagnetic field immunity test" (1995).  
Section 4: "Electrical Fast Transient/burst immunity test" (1995)."  
Section 5: "Surge immunity tests" (1995).  
Section 6: "Conducted disturbances induced by radio-frequency fields immunity test" (1996).  
Section 8: "Power frequency magnetic field immunity test" (1993).  
Section 11: "Voltage dips, short interruptions and voltage variations immunity tests" (1994).

## 3. Additional deviations or exclusions from the test specifications

Not applicable.

## 4. Measurements, examinations and derived results

### 4.1. Location of the Test Site:

Conducted emission tests and immunity tests were conducted at the EMC laboratory of the Standards Institution of Israel in Tel-Aviv.

Radiated emission tests were conducted in an Open Area Test Site located at Kibbutz Native Halamed Hai in Emek HaEla, Israel.

### 4.2. Test condition:

Temperature: 21 °C

Humidity: 53 %

### 4.3. 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.
- \* If the result with a Quasi-Peak detector exceeds the specification limit, it is marked with "Fails" in the margin, if it is within the measurement uncertainty, it is marked with a "\*\*".

### 4.4. Initial visual check and functional test:

Initial visual check of the EUT was performed before testing. No external damages were found.

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#### **4.5. Conducted emission tests:**

##### **4.5.1. Test Configuration:**

The EUT was placed on a non-metallic table in a shielded chamber at a height of 80 cm from the floor of the shielded chamber and 40 cm from the nearest wall of the chamber.

##### **4.5.2. Test procedure:**

The EUT was operated according to clause 1.5.

Test was performed on AC mains input.

First, initial scan were performed. Final measurements were performed for emission, which 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
Measurement time	200 seconds/MHz
Observation	>15 seconds

##### **4.5.3. Test results:**

Conducted emission measured from the EUT with peak detector was found 10.7 dB at least below EN 55011 Group 1 Class A AVG limit.

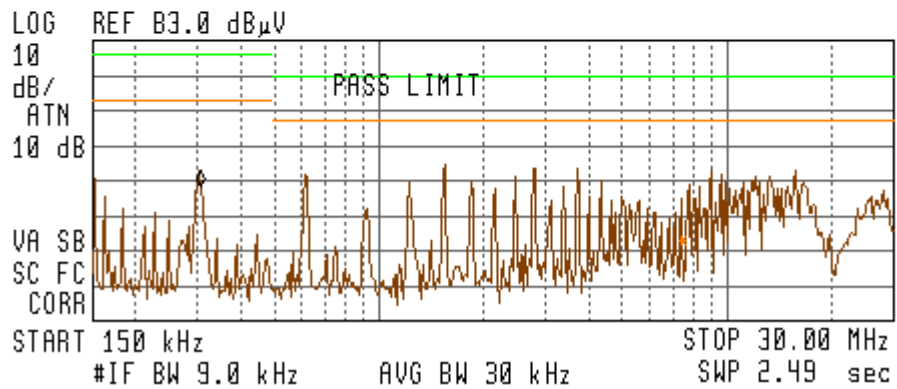
Test results are shown in the plots #1, #2.

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11:15:30 09 JAN 2002  
 ELDAR SHANY GALILEO PHASE

Signal	Freq (MHz)	PK Amp	QP Amp	AV Amp	PKΔL2
1	1.549262	43.4	48.1	44.7	-16.6
2	2.789653	49.3	42.0	39.7	-10.7
3	3.716626	47.0	43.4	40.3	-12.9
4	8.991328	41.9	44.3	34.6	-18.1
<b>5</b>	16.108760	49.1	43.0	39.3	-10.9

FREQ 310.8 kHz  
 PEAK 47.3 dBμV  
 QP 47.1 dBμV  
 AVG 45.5 dBμV



**Plot # 1.**

Scan of conducted emission  
 Specified limit: EN 55011 Group 1 Class A  
 Tested line: PHASE

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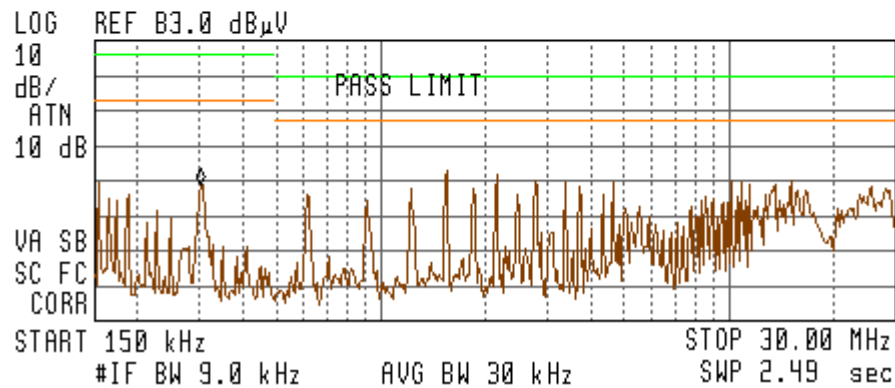
**Name:** Galileo

**Model:** Galileo

11:28:41 09 JAN 2002  
 ELDAR SHANY GALILEO NEUTRAL

Signal	Freq (MHz)	PK Amp	QP Amp	AV Amp	PK $\Delta$ L2
1	1.549798	40.7	47.0	44.3	-19.3
2	2.171389	40.6	43.8	39.3	-19.4
3	2.786152	47.2	44.5	38.3	-12.8
4	10.215702	44.5	34.3	32.1	-15.5
5	15.172110	48.0	36.3	37.7	-12.0

FREQ	308.4 kHz
PEAK	44.3 dB $\mu$ V
QP	43.2 dB $\mu$ V
AVG	42.6 dB $\mu$ V



**Plot # 2.**

Scan of conducted emission

Specified limit: EN 55011 Group 1 Class A

Tested line: NEUTRAL

#### **4.6. Radiated emission test:**

##### **4.6.1. Preliminary radiated emission tests:**

Preliminary radiated measurements were performed in a semi-anechoic chamber at a distance of 3 meters. The EUT was setup in its typical configuration and operated in its various modes. For each mode of operation the frequency spectrum was monitored. EUT configuration, cable configuration and mode of operation, which produced the maximum level of emission, were documented. A list of frequencies to be tested was prepared.

##### **4.6.2. Final measurements:**

The final radiated measurements were performed at the Open Area Test Site.

The EUT was installed on a non-metallic table 0.8 m height placed on the turn-table.

All measurements at the Open Area Test Site were performed at a 10 m measurement distance.

The Bilog 30 MHz-2 GHz antenna was used.

The EUT's configuration and mode of operation, which produced the maximum level of emissions, were selected.

The Frequency range from 30 to 2000 MHz was investigated.

The measurements were performed at each frequency found previously and at frequencies at which the signal was 10 dB below the limit or less.

All measurements at the Open Area Test Site were performed at a 10 m measurement distance from the EUT.

The levels were maximized by initially rotating turntable through 360°, varying the antenna height between 1 m and 4 m, rerouting EUT cables and changing antenna-to-EUT polarization from vertical to horizontal.

Unless stated otherwise, the measuring equipment settings were:

##### **Initial scan:**

Detector type	Peak
Mode	Max hold
Bandwidth	120 kHz
Step size	Continuous sweep
Sweep time	>1 seconds/MHz

##### **Measurements:**

Detector type	Quasi-peak (CISPR)
Bandwidth	120 kHz
Measurement time	20 seconds/MHz
Observation	>15 seconds

The EUT was operated as described in clause 1.5.

##### **4.6.3. Radiated emission test results:**

Test results are presented in Table 4.

**Table 4. Radiated emission test results**

**Ref. standard: EN 55011 Group 1 Class A**

Frequency (MHz)	Turn- table Angle (°)	Antenna Polariz.	Antenna Height (m)	Emission Level @ 10 m (dBμV/m)	Limit @ 10 m (dBμV/m)	Margin (dB)	Results
38.13	360	V	1.4	23.3	40	16.7	Complies
71.86	229	V	2.8	36.4	40	3.6	Complies
74.66	0	V	1.6	33.1	40	6.9	Complies
76.07	38	V	2.1	30.1	40	9.9	Complies
78.78	352	V	1.6	33.5	40	6.5	Complies
81.56	264	V	2.2	27.3	40	12.7	Complies
82.96	41	V	1.5	34.1	40	5.9	Complies
85.73	146	H	3.5	30.5	40	9.5	Complies
110.58	65	V	2.5	27.4	40	12.6	Complies
160.30	347	H	3.6	31.6	40	8.4	Complies
317.90	30	H	2.7	31.7	47	15.3	Complies

Note: Emission level = E Reading (dBμV) + Cable loss (dB) + Antenna Factor (dB/m)  
 where:  
 For Cable Loss and Antenna Factor refer to Appendix 2.



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#### **4.7. Harmonic current emissions and voltage fluctuation test:**

Harmonic current test (Steady State Harmonic) was performed according to EN 61000-3-2.

The EUT was operated as described in clause 1.5.

Voltage Fluctuations and Flicker meter tests were performed according to EN 61000-3-3.

##### **4.7.1. Test results:**

1. Plot #3 Harmonic current test results
2. Plot #4 Voltage Fluctuations test results
3. Plot #5 Flicker meter test results.
4. Plot # 6 Voltage/Current waveform



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Product: ELDAR SHANY		2002 Jan 09 19:11					
Serial no:		Page 1 of 1					
Description: Galileo							
Voltech IECIOOO-3 Windows Software 2.07		Test Date: 2002 Jan 09 19:08					
Result: ELDAR							
Type of Test: Steady State Harmonics Test - Table							
Power Analyzer: Voltech PM3000A v2.16 s/n 2425							
AC Source: Mains / Manual Source							
<b>PASS</b>							
Class	A						
Class Multiplier	1						
Power	18.1 W						
Harmonic	Reading	Limit	Result	Harmonic	Reading	Limit	Result
2	41.21mA	1.080A	Pass	3	87.42mA	2.300A	Pass
4	7.47mA	430mA	Pass	5	38.74mA	1.140A	Pass
6	2.56mA	300mA	N/A	7	5.18mA	770mA	Pass
8	3.84mA	230mA	N/A	9	4.71mA	400mA	N/A
10	2.56mA	184mA	N/A	11	1.74mA	330mA	N/A
12	0.43mA	153mA	N/A	13	1.32mA	210mA	N/A
14	1.27mA	131mA	N/A	15	1.01mA	150mA	N/A
16	1.03mA	115mA	N/A	17	0.57mA	132mA	N/A
18	0.25mA	102mA	N/A	19	0.21mA	118mA	N/A
20	0.50mA	92mA	N/A	21	0.29mA	107mA	N/A
22	0.38mA	84mA	N/A	23	0.17mA	98mA	N/A
24	0.13mA	77mA	N/A	25	0.13mA	90mA	N/A
26	0.14mA	71mA	N/A	27	0.15mA	83mA	N/A
28	0.17mA	66mA	N/A	29	0.17mA	78mA	N/A
30	0.07mA	61mA	N/A	31	0.10mA	73mA	N/A
32	0.02mA	58mA	N/A	33	0.12mA	68mA	N/A
34	0.01mA	54mA	N/A	35	0.16mA	64mA	N/A
36	0.07mA	51mA	N/A	37	0.15mA	61mA	N/A
38	0.09mA	48mA	N/A	39	0.12mA	58mA	N/A
40	0.11mA	46mA	N/A				

**Plot #3 Harmonic current test results**



Product:	ELDAR SHANY	2002 Jan 09 19:30
Serial no:		Page 1 of 1
Description:	GALILEO	
Voltech IEC1000-3 Windows Software 2.07		Test Date: 2002 Jan 09 19:24
Result:	ELDAR	
Type of Test:	Fluctuating Harmonics Test-Worst Case Table	
Power Analyzer:	Voltech PM3000A v2.16 s/n 2425	
AC Source:	Mains / Manual Source	
<b>PASS</b>		

Class	A
Class Multiplier	1

Harm	Reading	Limit 1	Limit 2	<L1 →L1 >L2	Result	Harm	Reading	Limit 1	Limit 2	<L1 →L1 >L2	Result
2	45.66mA	1.080A	1.620A	✓	Pass	3	69.65mA	2.300A	3.450A	✓	Pass
4	9.52mA	1.30mA	6.45mA	✓	Pass	5	42.82mA	1.140A	1.710A	✓	Pass
6	4.10mA	300mA	450mA		N/A	7	6.98mA	770mA	1.155A	✓	Pass
8	4.37mA	230mA	345mA		N/A	9	3.60mA	400mA	600mA		N/A
10	1.81mA	164mA	276mA		N/A	11	3.18mA	330mA	495mA		N/A
12	1.60mA	153mA	153mA		N/A	13	2.05mA	210mA	315mA		N/A
14	1.76mA	131mA	131mA		N/A	15	0.90mA	150mA	225mA		N/A
16	0.75mA	115mA	115mA		N/A	17	1.14mA	132mA	199mA		N/A
18	1.18mA	102mA	102mA		N/A	19	0.59mA	118mA	178mA		N/A
20	0.81mA	92mA	92mA		N/A	21	0.60mA	107mA	107mA		N/A
22	0.56mA	84mA	84mA		N/A	23	0.58mA	98mA	98mA		N/A
24	0.81mA	77mA	77mA		N/A	25	0.36mA	90mA	90mA		N/A
26	0.40mA	71mA	71mA		N/A	27	0.54mA	83mA	83mA		N/A
28	0.48mA	66mA	66mA		N/A	29	0.40mA	78mA	78mA		N/A
30	0.55mA	61mA	61mA		N/A	31	0.43mA	73mA	73mA		N/A
32	0.36mA	58mA	58mA		N/A	33	0.47mA	66mA	66mA		N/A
34	0.40mA	54mA	54mA		N/A	35	0.28mA	64mA	64mA		N/A
36	0.36mA	51mA	51mA		N/A	37	0.45mA	61mA	61mA		N/A
38	0.35mA	48mA	48mA		N/A	39	0.41mA	58mA	58mA		N/A
40	0.40mA	46mA	46mA		N/A						

<L1 : Reading is below limit 1.

>L1 : Reading is above limit 1 for less than 10% of a 2½ minute window.

→L1 : Reading is above limit 1 for more than 10% of a 2½ minute window.

>L2 : Reading is above limit 2.

N/A: Harmonic current below 0.6% of rated current or 5mA whichever is greater, are disregarded.

#### Plot #4 Fluctuating harmonics test results

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Product: ELDAR SHANY		2002 Jan 09 19:39		
Serial no:		Page 1 of 1		
Description: GALILEO				
Voltech IEC1000-3 Windows Software 2.07		Test Date: 2002 Jan 09 19:32		
Result: ELDAR				
Type of Test: Flickermeter Test - Table				
Power Analyzer: Voltech <b>PM3000A</b> v2.16 s/n 2425				
AC Source: Mains I Manual Source				
<b>PASS</b>	Measurement method - Voltage			
	<b>Pst</b>	dc (%)	dmax (%)	d(t) > 3% (ms)
Limit	1.000	3.000	4.000	200
Reading 1	0.071	0.015	0.044	0

**Plot #5 Flicker meter test results.**

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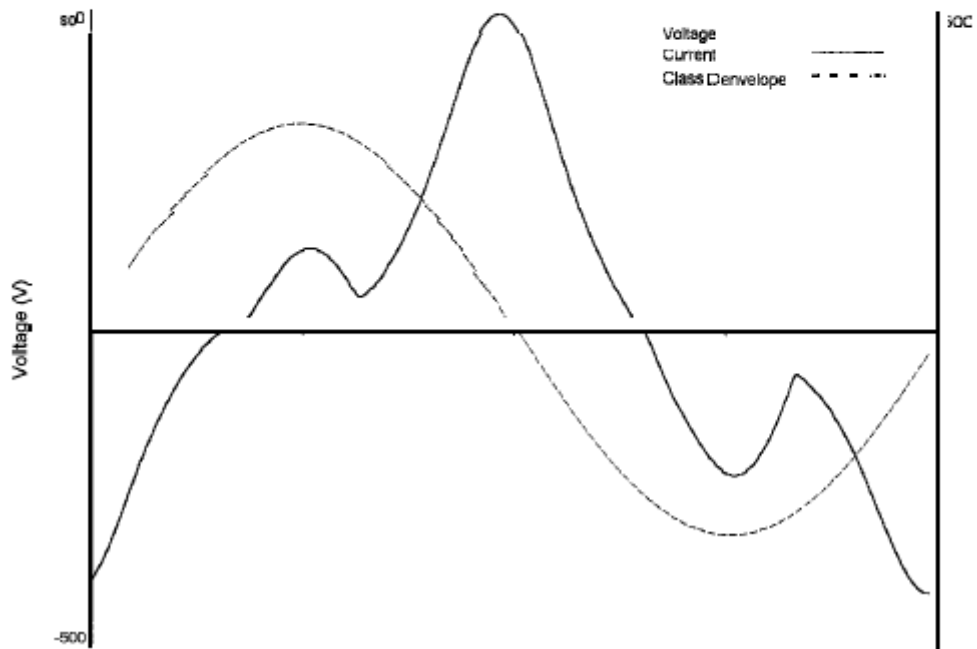
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**Name:** Galileo

**Model:** Galileo

Product: ELDAR SHANY		2002 Jan 09 19:09 Page 1 of 1
Serial no:		
Description: GALILEO		
Voltech IEC1000-3 Windows Software 2.07		Test Date: 2002 Jan 09 19:09
Result: ELDAR		
Type of Test: Waveform		
Power Analyzer: Voltech PM3000A v2.16 s/n 2425		
AC Source: Mains / Manual Source		
Waveform is not Class D		



**Plot # 6. Voltage/Current waveform**

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#### **4.8. Test of immunity from electrostatic discharge (ESD):**

According to the requirements of IEC 61000-4-2.

##### **4.8.1. Test setup:**

The EUT was placed on a horizontal coupling plane and isolated through an insulation layer. The coupling plane, placed on the non-metallic table, was connected to the reference ground plane by two resistors of 470 kΩ each.

The test was performed at the following test points:

##### **4.8.2. List of the test points:**

Test point	Location	Air discharge	Contact
1	EUT's cage	+	-
2	Buttons, Display	+	-
3	Mounting screws	-	+
4	HCP	-	+

##### **4.8.3. Test procedure:**

A preliminary test was performed and sensitive areas at a rate of 20 pulses/second were located. After this preliminary test, a final test was performed at the test points.

25 discharges, each one of them with positive and negative polarity, were made at the following tests voltages:

Contact discharge: 1kV, 2kV, 4 kV.

Air discharge: 2kV, 4kV, 6kV, 8kV.

##### **4.8.4. EUT operation and required performance criteria:**

The EUT was operated according to clause 1.5.

Performance criteria were according to clause 1.6.2.

##### **4.8.5. Results of the test:**

No malfunctions, reading or communication distortions whatsoever occurred in the operation of the EUT after the test.

#### ***4.9. Test of immunity from radiated electromagnetic fields:***

According to the requirements of IEC 61000-4-3.

##### ***4.9.1. Measurement layout:***

The EUT was placed on the non-metallic table of the semi-anechoic chamber.

A transmission antenna was placed at a distance of 3 m from the EUT.

The location of the antenna and the route of the coaxial cable connected to the antenna were present determined and laid down previously.

The EUT was placed in an area in which the electric field had been previously calibrated.

During the course of the calibration, a table of the RF output along the axis frequencies for obtaining a uniform field of 10 V/m was prepared. The location of the transmission antenna during the course of the calibration and the test were identical.

##### ***4.9.2. Test procedure:***

Swept frequency test:

The EUT was operated according to clause 1.5.

During the course of the test, electromagnetic fields were generated according to the prepared calibration table.

The dwell time at each frequency was 1 second.

The test signal was 80% amplitude modulated with 1 kHz sinewave.

The dwell time at each frequency was 1 second.

The test signal level was 10 V/m (measured on unmodulated signal), as was set out during the calibration process.

The test was performed twice: with the antenna positioned vertically and again with the antenna positioned horizontally.

##### ***4.9.3. Required performance criteria:***

According to clause 1.6.1.

##### ***4.9.4. Results of the test:***

No malfunctions, reading or communication distortions whatsoever occurred in the operation of the EUT during and after the test.

#### **4.10. Test of the immunity from Electrical Fast Transients:**

According to the requirements of IEC 61000-4-4.

##### **4.10.1. List of the cables subjected to test:**

No.	Cable Description	Type of coupling	Severity level, kV
1	AC mains	CDN	2
2	Analog IN	Capacitive coupling clamp	2
3	Digital IN	Capacitive coupling clamp	2
4	Output 24 VAC	Capacitive coupling clamp	2

##### **4.10.2. Test setup on EUT AC mains:**

The EUT was placed on the non-metallic table. The power supply was connected to input of the EUT via coupler/decoupler (CDN) of the test equipment.

The EUT was operated according to clause 1.5.

During the course of the test fast transients with intensity of 2 kV (Tr/Th – 5/50 ns, repetition frequency – 5 kHz) positive and negative polarity were applied to EUT's AC mains.

##### **4.10.3. Test setup on I/O Lines:**

The test was conducted on Analog Inputs, Digital Inputs and Output 24 VAC lines. Test voltage 2 kV positive and negative polarity. The test voltage was applied via capacitive coupling clamp.

##### **4.10.4. Required performance criteria:**

According to clause 1.6.2.

##### **4.10.5. Results of the test**

No malfunctions, reading or communication distortions whatsoever occurred in the operation of the EUT after the test.



#### **4.11. Test of immunity from Surge on the AC mains:**

According to the requirements of IEC 61000-4-5.

##### **4.11.1. List of the cables subjected to test:**

No.	Cable Description	Severity level, kV
1	AC mains	1 kV line-to line, 2 kV line –to-GND
2	Analog IN with lightning protection APT-1	0.5 kV line-to line, 0.5 kV line –to-GND
3	Digital IN	0.5 kV line-to line, 0.5 kV line –to-GND
4	Output 24 VAC with lightning protection OPTN	1 kV line-to line, 2 kV line –to-GND

##### **4.11.2. Test setup:**

The EUT was placed on the non-metallic table. The voltage supply input of the EUT was connected to the coupler/decoupler (CDN) of the test equipment. The EUT was operated according to clause 1.5.

##### **AC Power Input:**

During the course of the test, surges with intensity of 1 kV (line-to-line) and 2 kV (line-to-GND), Tr/Th – 1.2/50 (8/20)  $\mu$ sec, were injected to the EUT's AC mains.

Five positive and five negative surges were injected to each line. The phase shift between line and test voltage was 0 °, 90 ° and 270 °.

##### **I/O Lines:**

##### **Analog IN:**

Five positive and five negative surges with intensity of 0.5 kV were applied line-to-line and line-to-GND.

##### **Digital IN:**

Five positive and five negative surges with intensity of 0.5 kV were applied line-to-line and line-to-GND.

##### **Output 24 VAC with lightning protection OPTN:**

Five positive and five negative surges with intensity of 1 kV (line-to-line) and 2 kV (line-to-GND) applied.

##### **4.11.3. Required performance criteria:**

According to clause 1.6.2.

##### **4.11.4. Results of the test:**

No malfunctions, reading or communication distortions whatsoever occurred in the operation of the EUT after the test.

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#### 4.12. Test of immunity from Conducted radio frequency:

According to the requirements of IEC 61000-4-6.

##### 4.12.1. List of the cables subjected to test:

No.	Cable Description	Type of coupling	Severity level, V rms
1	AC mains	CDN	10
2	Analog IN	100 Ω	10
3	Digital IN	100 Ω	10
4	Output 24 VAC	100 Ω	10

##### 4.12.2. Test setup:

###### AC Power Input:

The EUT was placed on the non-metallic table. A coupling network (CDN) type 801-M3, was placed 0.2 meters from the projected geometry of the EUT on the ground reference plane. The EUT's main cable was connected to the "EUT" port of the CDN.

The mains cable height above the GRP was 3 cm. A RF power amplifier was connected to the CDN "in" port through a 6 dB attenuator. The power amplifier was driven by an RF signal generator.

###### I/O Lines:

The test voltage was applied via 100 Ohm resistor to the shield sleeve of each shielded I/O lines.

##### 4.12.3. Test procedure:

A calibration process was performed at the beginning of the test.

The EUT was operated as described in clause 1.5.

The frequency range was swept incrementally from 150 kHz to 80 MHz, the step size did not exceed 1% of the fundamental frequency.

The dwell time at each frequency was 1 second.

The test signal was 80% amplitude modulated with 1 kHz sinewave.

The test signal level was 10 VRMS unmodulated (as set out during the calibration process).

##### 4.12.4. Required performance criteria:

According to clause 1.6.1.

##### 4.12.5. Results of the tests:

No malfunctions, reading or communication distortions whatsoever occurred in the operation of the EUT during and after the test.

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#### **4.13. Test of immunity from Power frequency magnetic field:**

According to the requirements of IEC 61000-4-8.

##### **4.13.1. Measurement layout:**

The EUT was placed on the non-metallic table in the center of induction coil with the interposition of a 0.1 m thickness insulating support.

##### **4.13.2. Test procedure:**

The EUT was operated as described in clause 1.5.

During the course of the test the EUT was subjected to power frequency magnetic field of 30 A/m // 50 Hz (continuous field).

The application of the test field was by the immersion method.

During the course of the test the magnetic field was applied to the EUT in three orthogonal planes.

##### **4.13.3. Required performance criteria:**

According to clause 1.6.1

##### **4.13.4. Results of the test:**

No malfunctions, reading or communication distortions whatsoever occurred in the operation of the EUT during and after the test.

#### **4.14. Tests of immunity from voltage dips, short interruptions and voltage variations:**

According to the requirements of IEC 61000-4-11.

##### **4.14.1. Test setup and procedure:**

The EUT's mains cable was connected to the output port of the test equipment.

The EUT was tested for each selected combination of the test level and duration with a sequence of three dips and interruptions as described in the table below.

The EUT was tested in the operations mode as described in clause 1.5.

Changes in supply voltage were performed at zero crossing of the voltage.

No.	Phenomena	Reduction of supply voltage, %	Time duration, ms	Required criteria
1	Voltage dips	30	10	1.6.2
		60	100	1.6.3
		60	1000	1.6.3
2	Voltage interruptions	>95	5000	1.6.3

##### **4.14.2. Required performance criteria:**

According to clauses 1.6.2 and 1.6.3.

##### **4.14.3. Results of the tests:**

No deviations from specified criteria occurred in the operation of the EUT during and after the test.

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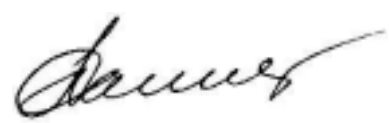
## 5. Compliance with specification

Test	Standard	Class/ Severity level	Test result
<b>Emission tests</b>			
Conducted emission on mains terminal Frequencies range of 150 kHz to 30 MHz	EN 55011	Group 1 Class A	Complies
Radiated emission Frequencies range of 30-1000 MHz	EN 55011	Group 1 Class A	Complies
Steady state harmonics test	EN 61000-3-2	--	Complies
Steady state harmonics test	EN 61000-3-2	--	Complies
<b>Immunity tests per EN 61000-6-2</b>			
Immunity from Electrostatic discharge (ESD)	IEC 61000-4-2	4 kV contact dis.; 8 kV air discharge	Complies
Immunity from Radiated electromagnetic fields	IEC 61000-4-3	10 V/m, 80÷1000 MHz	Complies
Immunity from Electrical Fast transient (EFT)	IEC 61000-4-4	2 kV on AC mains and I/O lines	Complies
Immunity from Surge	IEC 61000-4-5	1 kV line-to-line, 2 kV line-to-GND on the AC mains and on Output 24 VAC	Complies
		0.5 kV line-to-line, 0.5 kV line-to-GND on Analog IN/Digital IN	Complies
Immunity from conducted disturbances induced by radio-frequency fields	IEC 61000-4-6	10 VRMS on AC main and I/O lines 0.15÷80 MHz	Complies
Immunity from power freq. magnetic field	IEC 61000-4-8	30 A/m // 50 Hz	Complies
Immunity from Voltage dips, short interruptions and voltage variations	IEC 61000-4-11	10% - 10 ms 60 % - 100 ms 60 % - 1000 ms > 95% - 5 s	Complies



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Telematics Laboratory  
August 6, 2002



Name: Peter Sapir  
Position: Testing Engineer

## 6. Appendix 1: Test equipment used

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

### EN 55011

Instrument	Manufacturer	Model	Serial No.	Last calibration date	Next calibration date
EMI Receiver	HP	8546A+85460A	SII 4068	11/01	11/02
LISN 9 kHz – 30 MHz	FCC	LISN- 50/250-32-4-16	SII 5023	05/02	05/01
Transient limiter 0.009-200 MHz	HP	11947A	31074A3105	05/02	05/01
Antenna Bilog 30 – 2000 MHz	Schaffner- Chase	CBL6112B	S/N 2714 SII 5119	12/01	12/02
Antenna Mast	R&S	HCM	100002	N/A	N/A
Metallic turntable	R&S	HCT12	100001	N/A	N/A
Positioning controller	R&S	HCC	100002	N/A	N/A

### EN 61000-3-2/3

Instrument	Manufacturer	Model	Serial No.	Last calibration date	Next calibration date
AC Power Source 230 VAC, 3 ph, 300 V, 6.5 A	Elgar	SW 5250A	SII 4684	N/A	N/A
Universal Power Analyzer 230 VAC, 3ph, 30A	Voltech	PM 3000A	SII 4662	01/02	01/03

### EN 61000-4-2

Instrument	Manufacturer	Model	Serial No.	Last calibration date	Next calibration date
ESD Simulator	Key-Tek	MiniZAP MZ-151EC	S/N 9412303	09/01	09/02

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**EN 61000-4-3**

Instrument	Manufacturer	Model	Serial No.	Last calibration date	Next calibration date
RF generator 10 MHz-20 GHz	Anritsu	68347B	SII 4898	10/01	10/02
RF power amplifier 80-1000 MHz, 100W	Amplifier Research	100W1000M1	SII 4883	N/A	N/A
Log-Periodic/ Biconical antenna (25-1300 MHz)	ARA	LPB-2513	----	N/A	N/A
Probe Isotropic Electric Field 200 kHz – 40 GHz	Amplifier Research	FP-5240	-----	04/02	04/03
Field Monitor 0.15-3000 V/m	Amplifier Research	FM5004	-----	N/A	N/A
Anechoic chamber	Chase	--	SII 4806	N/A	N/A

**EN 61000-4-4**

Instrument	Manufacturer	Model	Serial No.	Last calibration date	Next calibration date
<u>ECAT Control Center:</u> EFT generator; EFT/Surge Coupler/Decoupler	Key-Tek	<u>ECAT</u> E411 E-4553	<u>SII 3751</u> S/N 9412212 S/N 9511398	06/02 06/02	06/03 06/03
Capacitive coupling clamp	Key-Tek	CCL-4/S	S/N 9412243	N/A	N/A
Advanced EMC Immunity Sys.	Key-Tek	EMC PRO	S/N 9805376 SII 4695	08/01	08/02

**EN 61000-4-5**

Instrument	Manufacturer	Model	Serial No.	Last calibration date	Next calibration date
<u>ECAT Control Center:</u> Surge generator Surge network EFT/Surge Coupler/Decoupler	Key-Tek	<u>ECAT</u> E501A E502 E4553	<u>SII 3751</u> S/N 9412208 S/N 9412209 S/N 9511398	06/02 06/02 06/02	06/03 06/03 06/03
Advanced EMC Immunity Sys.	Key-Tek	EMC PRO	SII 4695	08/01	08/02

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**EN 61000-4-6**

Instrument	Manufacturer	Model	Serial No.	Last calibration date	Next calibration date
RF Generator 100 KHz - 1040 MHz	HP	8657A	SII 2994	01/02	01/03
RF Generator 10 kHz - 1050 MHz	Fluke	6060B	S/N 5430202 SII 2384	03/02	03/03
RF power amplifier 150 kHz - 300 MHz; 10 W	ENI	411LA	SII 3757	N/A	N/A
Oscilloscope 300 MHz	Lecroy	9361	SII 4009	03/02	03/03
CDN 150 kHz – 230 MHz	FCC	801-M3-16	S/N 32 SII 51906	03/02	03/03
CDN 150 kHz – 230 MHz	FCC	801-AF4	S/N 04; SII 51910	03/02	03/03
CDN 150 kHz – 230 MHz	FCC	801-C1 BNC	S/N 12; SII 51905	05/02	05/03
CDN 150 kHz – 230 MHz	Schaffner	CDN M325	S/N 15141 SII 5122	03/02	03/03
CDN 150 kHz – 230 MHz	Schaffner	CDN T002	S/N 15887 SII 5123	03/02	03/03
Attenuator 6 dB, 50W	Huber- Suhner AG	5906.17.006	S/N 302789	05/02	05/03
Clamp 10 kHz – 1000 MHz	FCC	F-2031	S/N 08	05/02	05/03

**IEC 61000-4-8**

Instrument	Manufacturer	Model	Serial No.	Last calibration date	Next calibration date
Current Tr-r	SII	-	SII 50	NA	NA
Low frequency survey meter 20 Hz – 5 kHz	Holiday Ind.Inc	HI-3604	SII 42	08/01	08/02

**EN 61000-4-11**

Instrument	Manufacturer	Model	Serial No.	Last calibration date	Next calibration date
<u>ECAT Control Center:</u> Voltage Swell / Dip/ Interrupt Source	Key-Tek	<u>ECAT</u> EP61	<u>SII 3751</u> S/N 9408499	06/02	06/03
Advanced EMC Immunity Sys.	Key-Tek	EMC PRO	S/N 9805376 SII 4695	08/01	08/02



## 7. Appendix 2: Antenna Factor and Cable Loss

### Cable Loss (10m cable + Mast)

Point	Frequency (MHz)	Cable Loss (dB)	Point	Frequency (MHz)	Cable Loss (dB)
1	30	0.53	21	1000	3.68
2	50	0.75	22	1100	3.82
3	100	1.08	23	1200	4.07
4	150	1.39	24	1300	4.24
5	200	1.61	25	1400	4.43
6	250	1.752	26	1500	4.6
7	300	2.00	27	1600	4.7
8	350	2.15	28	1700	4.85
9	400	2.26	29	1800	4.98
10	450	2.383	30	1900	5.19
11	500	2.52	31	2000	5.34
12	550	2.606	32	2100	5.51
13	600	2.75	33	2200	5.69
14	650	2.856	34	2300	5.89
15	700	3.06	35	2400	6.07
16	750	3.201	36	2500	6.22
17	800	3.27	37	2600	6.28
18	850	3.38	38	2700	6.41
19	900	3.46	39	2800	6.53
20	950	3.55	40	2900	6.84

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**Antenna Factor**  
**Antenna Bilog mfr Schaffner Chase EMC Ltd.**  
**Model CBL6112B S/N 2714**

Frequency (MHz)	Antenna Factor (dB/m)	Frequency (MHz)	Antenna Factor (dB/m)	Frequency (MHz)	Antenna Factor (dB/m)	Frequency (MHz)	Antenna Factor (dB/m)	Frequency (MHz)	Antenna Factor (dB/m)
30	18.00	125	11.35	350	14.30	750	20.00	1300	23.10
32	16.90	130	11.00	360	14.50	760	20.00	1320	23.10
34	15.80	135	10.65	370	14.70	770	20.00	1340	23.30
36	14.80	140	10.40	380	14.80	780	20.00	1360	23.40
38	13.70	145	10.15	390	15.15	790	19.90	1380	23.80
40	12.60	150	9.70	400	15.70	800	19.90	1400	24.10
42	11.60	155	9.35	410	16.40	810	19.95	1420	24.40
44	10.60	160	9.10	420	16.70	820	20.20	1440	24.50
46	9.60	165	8.90	430	16.40	830	20.35	1460	24.70
48	8.80	170	8.80	440	16.30	840	20.40	1480	24.70
50	7.90	175	8.75	450	16.35	850	20.40	1500	25.00
52	7.20	180	8.60	460	16.70	860	20.30	1520	25.10
54	6.60	185	8.50	470	17.00	870	20.30	1540	25.10
56	6.00	190	8.40	480	17.20	880	20.30	1560	25.20
58	5.60	185	8.50	490	17.35	890	20.30	1580	25.20
60	5.20	200	8.70	500	17.40	900	20.30	1600	25.20
62	5.00	205	8.95	510	17.45	910	20.35	1620	25.30
64	4.80	210	8.80	520	17.50	920	20.40	1640	25.50
66	4.80	215	8.55	530	17.95	930	20.40	1660	25.70
68	4.90	220	8.90	540	18.80	940	20.60	1680	25.90
70	5.00	225	9.30	550	19.05	950	20.60	1700	25.90
72	5.30	230	9.80	560	18.80	960	20.60	1720	26.00
74	5.60	235	10.40	570	18.70	970	20.60	1740	25.90
76	6.10	240	10.90	580	18.60	980	20.70	1760	25.90
78	6.40	245	11.25	590	18.60	990	20.80	1780	25.70
80	6.90	250	11.70	600	18.80	1000	20.90	1800	25.80
82	7.30	255	12.20	610	19.10	1020	21.30	1820	25.90
84	7.60	260	12.80	620	19.20	1040	21.50	1840	26.10
86	8.00	265	12.80	630	19.20	1060	21.70	1860	26.30
88	8.40	270	12.40	640	19.20	1080	21.90	1880	26.50
90	8.80	275	12.30	650	19.10	1100	21.90	1900	26.80
92	9.20	280	12.30	660	19.10	1120	22.00	1920	27.00
94	9.60	285	12.35	670	19.00	1140	22.20	1940	27.00
96	9.90	290	12.40	680	18.90	1160	22.30	1960	27.10
98	10.40	295	12.60	690	18.95	1180	22.40	1980	27.20
100	10.70	300	12.70	700	19.10	1200	22.50	2000	27.30
105	11.15	310	13.15	710	19.35	1220	22.70		
110	11.40	320	13.50	720	19.60	1240	22.90		
115	11.50	330	13.60	730	19.90	1260	23.00		
120	11.50	340	13.80	740	20.00	1280	12.80		

## 8. Appendix 3: Test configuration illustrations



**Photo 1.**  
**Radiated emission test setup**

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**Photo 2.**  
**Radiated emission test setup**