

Date: ESPOO 28.02.2001

Page: 1 (13)

Appendices -

Number:  
No. 1 / 3

**1010750**

Date of handing in: 06.02.2001

Tested by:

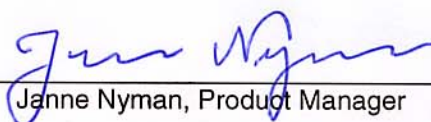


**T017 (EN 45001)**



Timo Leismala, Test Engineer

Reviewed by:



Janne Nyman, Product Manager

SORT OF EQUIPMENT:

**Radio modem**

MARKETING NAME:

**SATELLINE-3ASd Epic**

TYPE:

**SATELLINE-3ASd/125/10W/DIV**

MANUFACTURER:

**SATEL Oy, Finland**

SERIAL NUMBER:

**0102079 and 0103101**

CLIENT:

**SATEL Oy, Finland**

ADDRESS:

**Meriniitynkatu 17, FIN-24100 Salo**

TELEPHONE:

**+ 358 2 777 7891**

TEST SPECIFICATION:

**EN 300 279 (1999)**

## SUMMARY:

In regard to the performed tests the EUT fulfils the requirements defined in the test specification EN 300 279 (1999), see page 2 for details.

The test results are valid for the tested unit only. Without a written permission of EMCEC Oy it is allowed to copy this report as a whole, but not partially.

### **Summary of performed tests and test results**

Immunity tests according to the test specification EN 300 279 (1999)

Immunity test	Test method	Conclusion
Radiated radio-frequency electromagnetic field	EN 61000-4-3 (1996)	Pass
Radiated radio-frequency electromagnetic field (GSM)	ENV 50204 (1995)	Pass <sup>1)</sup>
Electrostatic discharge (ESD)	EN 61000-4-2 (1995)	Pass
Transients and surges in vehicular environment	ISO 7637-2 (1990)	Pass

<sup>1)</sup> Additional test

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## 1. General

The equipment under test (EUT) was a Radio modem. The purpose of the performed tests was to see if in regard to these tests the EUT fulfils the EMC requirements defined in the EC Council Directive 89/336/EEC. The tests were performed according to the test specification EN 300 279 (1999) by using accredited test methods.

## 2. System Configuration

### 2.1 Test set-up

Equipment under test (EUT):

- Radio modem, type SATELLINE-3ASd/125/10W/DIV, S/N: 0102079. This unit is a transceiver and during the test it was used as a transmitter.
- Radio modem, type SATELLINE-3ASd/125/10W/DIV, S/N: 0103101. This unit is a transceiver and during the test it was used as a receiver.

Cables:

- DC power input cable of the 'transmitter unit', unshielded, 2.0 m in length <sup>1)</sup>
- DC power input cable of the 'receiver unit', unshielded, 2.0 m in length <sup>1)</sup>
- RS-232 serial cable, connected from a control computer to the radio modem ('transmitter unit'), unshielded, 2.0 m in length
- RS-232 serial cable, connected from the radio modem ('receiver unit') to a monitoring computer, unshielded, 2.0 m in length

<sup>1)</sup> The length was 0.5 m in the transients and surges in vehicular environment immunity test.

Peripheral devices:

- Two separate car batteries connected in series, used as a 24 V DC power supply, model Biltema
- Control computer, model Olivetti Pentium 100 MHz
- Monitoring computer, model Hewlett-Packard

Operating voltage of the EUT:

- 24 V DC

### 2.2 Operating conditions and monitoring of the EUT

For the duration of the tests the EUT was set to a continuous communications mode of operation. A control program 'Saterm' was used in the control computer. The radio modem ('transmitter unit') was set to send a test message continuously. The monitoring computer was monitoring the messages from the receiving radio modem. The TX power of the transmitter unit was set to its maximum value, i.e. 10W.

When testing the communications mode, the monitoring was performed visually by watching the display of the monitoring computer. When testing the standby mode of operation, the monitoring was performed visually by watching the display of a monitoring spectrum analyzer. The spectrum analyzer was set to maxhold mode in order to be able to see potential unintentional responses of the transmitter.

## 2.3 Performance criteria for immunity tests

### ***Performance criteria for Continuous phenomena applied to Transmitters (CT):***

The EUT shall continue to operate as intended during and after the test. No degradation of performance is allowed. No unintentional responses are allowed. If at least four error-free symbols out of five is received correctly, the performance is considered non-degraded. The communications link shall be maintained during the test.

### ***Performance criteria for Transient phenomena applied to Transmitters (TT):***

The EUT shall continue to operate as intended after the test. Moderate degradation of performance is allowed. No unintentional responses are allowed. The communications link shall be maintained during the test.

### ***Performance criteria for Continuous phenomena applied to Receivers (CR):***

The EUT shall continue to operate as intended during and after the test. No degradation of performance is allowed. No unintentional responses are allowed. If at least four error-free symbols out of five is received correctly, the performance is considered non-degraded. The communications link shall be maintained during the test.

### ***Performance criteria for Transient phenomena applied to Receivers (TR):***

The EUT shall continue to operate as intended after the test. Moderate degradation of performance is allowed. No unintentional responses are allowed. The communications link shall be maintained during the test.

## 2.4 Transmitter and receiver exclusion bands

### ***Exclusion band of the transmitter:***

- 424.975 MHz – 425.025 MHz

### ***Exclusion band of the receiver:***

- 403.75 MHz – 446.25 MHz

### 3. Test procedures

#### 3.1 Immunity tests

##### 3.1.1 Radiated radio-frequency electromagnetic field immunity test

The test was performed as a compliance test. The test parameters concerned were as follows:

Parameter	Specification
Test method	EN 61000-4-3 (1996)
Frequency range	80 - 1000 MHz
Modulation	AM 80% 400 Hz
Sweep	Step: 1 %, Time/step: 3 s
Test level	3 V/m
Performance criterion	CT, CR
Site name	EMCEC Oy / Perkkaa
Date of testing	26.02.2001
Test equipment	176, 184, 201, 291, 292, 293, 317, 340, 428, 431, 432, 433
Test conditions	22 °C, 30 % RH

The test was carried out in an absorber-lined shielded room (see photographs 1 and 2). The EUT was placed on a non-conductive turntable 1 m above the floor absorbers. The distance between the transmitting bilog antenna and the EUT was 2.65 m measured from the tip of the antenna. The test was performed with the field generating antenna facing one of the four sides of the EUT. Both vertical and horizontal polarizations were tested. The field strength was checked with a calibrated field sensor. The uniformity of field has been calibrated.

##### 3.1.2 Radiated radio-frequency electromagnetic field (GSM) immunity test

The test was performed as a compliance test. The test parameters concerned were as follows:

Parameter	Specification
Test method	ENV 50204 (1995)
Frequency range	900 ± 5 MHz
Modulation	Keyed carrier, repetition frequency 200 Hz, duty cycle 50%
Sweep	Step: 1 %, Time/step: 3 s
Test level	3 V/m
Performance criterion	CT, CR
Site name	EMCEC Oy / Perkkaa
Date of testing	26.02.2001
Test equipment	176, 184, 201, 291, 292, 293, 317, 340, 428, 431, 432, 433
Test conditions	22 °C, 30 % RH

The test was carried out in an absorber-lined shielded room (see photographs 1 and 2). The EUT was placed on a non-conductive turntable 1 m above the floor absorbers. The distance between the transmitting bilog antenna and the EUT was 2.65 m measured from the tip of the antenna. The test was performed with the field generating antenna facing one of the four sides of the EUT. Both vertical and horizontal polarizations were tested. The field strength was checked with a calibrated field sensor. The uniformity of field has been calibrated.

### 3.1.3 Electrostatic discharge (ESD) immunity test

The test was performed as a compliance test. The test parameters concerned were as follows:

Parameter	Specification
Test method	EN 61000-4-2 (1995)
Test level	<i>Contact discharge:</i> $\pm 2$ and $\pm 4$ kVp <i>Air discharge:</i> $\pm 2$ , $\pm 4$ and $\pm 8$ kVp
Performance criterion	TT, TR
Site name	EMCEC Oy / Perkkää
Date of testing	21.02.2001
Test equipment	184, 348, 405, 406, 409
Test conditions	21 °C, 31 % RH

The test was carried out inside a shielded room. A non-conductive table was placed on the reference ground plane (RGP). A horizontal coupling plane (HCP) was placed on the non-conductive table 0.8 m high. The EUT was placed on the table. PVC sheets were used to prevent the conductive parts of the EUT touch the HCP. Indirect contact discharges were applied on the EUT by discharging to a vertical coupling plane (VCP, see photographs 3 and 4) and HCP (see photographs 5 and 6). Air discharges were applied on the non-conductive parts of the EUT. At least 10 discharges of both polarities were applied on each test point at each test level.

### 3.1.4 Transients and surges in vehicular environment immunity test

The test was performed as a compliance test. The test parameters concerned were as follows:

Parameter	Specification
Test method	ISO 7637-2 (1990)
Test pulse	1a: 10 pulses, cycle time 2.5 s 1b: 10 pulses, cycle time 2.5 s 2: 10 pulses, cycle time 2.5 s 3a: duration 5 min, cycle time 100ms 3b: duration 5 min, cycle time 100ms 4: 25 ms ( $t_b$ ) / 5 s ( $t_s$ ), five pulses
Test level	Pulse 1a: -100 V (level 2) Pulse 1b: -550 V (level 2) Pulse 2: +50 V (level 2) Pulse 3a: -70 V (level 2) Pulse 3b: +70 V (level 2) Pulse 4: -10 V / -5 V (EN 300 279 specified test level)
Performance criterion	B
Site name	EMCEC Oy / Perkkää
Date of testing	1.3.2001
Test equipment	184, 347, 348
Test conditions	22 °C, 30 % RH

The test was carried out inside a shielded room. The EUT was placed on a non-conductive support 0.8 m above the RGP. The untwisted cable between the test generator and the EUT was 0.5 m in length (see photographs 7 and 8).

## 4. Test results

### 4.1 Immunity tests

#### 4.1.1 Radiated radio-frequency electromagnetic field immunity test

Polarisation	Frequency MHz	Test level V/m	Remarks	Conclusion Pass/Fail
Vertical	80 – 1000	3	–	Pass
Horizontal	80 – 1000	3	–	Pass

#### 4.1.2 Radiated radio-frequency electromagnetic field (GSM) immunity test

Polarisation	Frequency MHz	Test level V/m	Remarks	Conclusion Pass/Fail
Vertical	890 – 960	3	–	Pass
Horizontal	890 – 960	3	–	Pass

#### 4.1.3 Electrostatic discharge (ESD) immunity test

Discharge mode	Test points	Test level kVp	Remarks	Conclusion Pass/Fail
Indirect contact	VCP and HCP	$\pm 2$ and $\pm 4$	–	Pass
Direct contact	VCP and HCP	$\pm 2$ and $\pm 4$	–	Pass
Air	Non-conductive parts of the EUT	$\pm 2$ , $\pm 4$ and $\pm 8$	–	Pass

#### 4.1.4 Transients and surges in vehicular environment immunity test

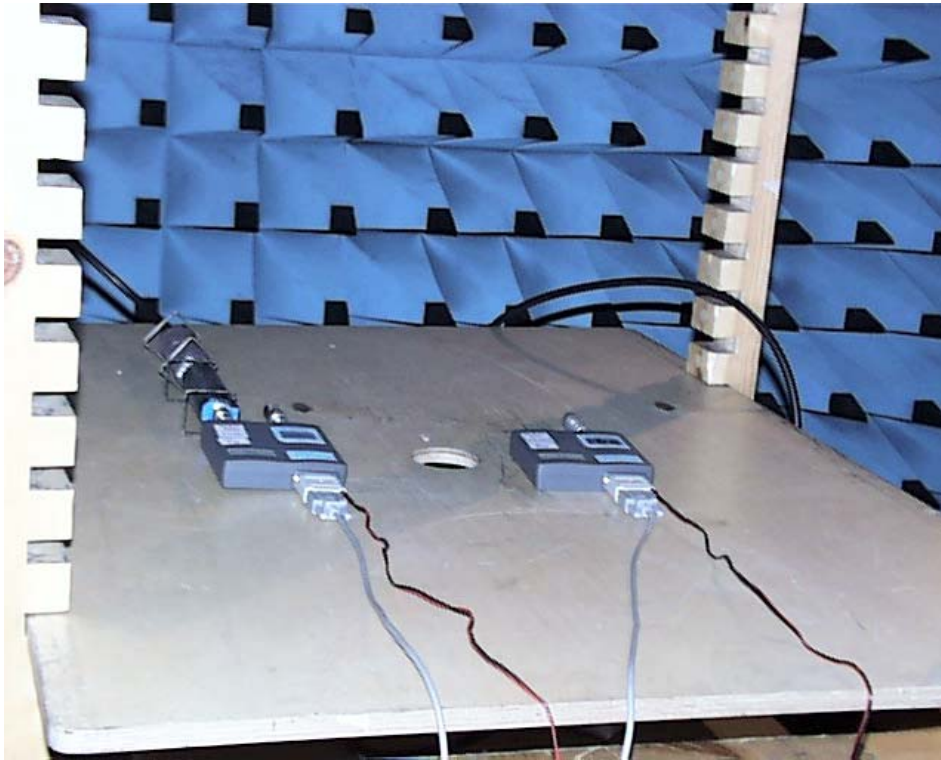
Port	Pulse	Remarks	Conclusion Pass/Fail
DC power input	1a	–	Pass
	1b	–	Pass
	2	–	Pass
	3a	–	Pass
	3b	–	Pass
	4	–	Pass



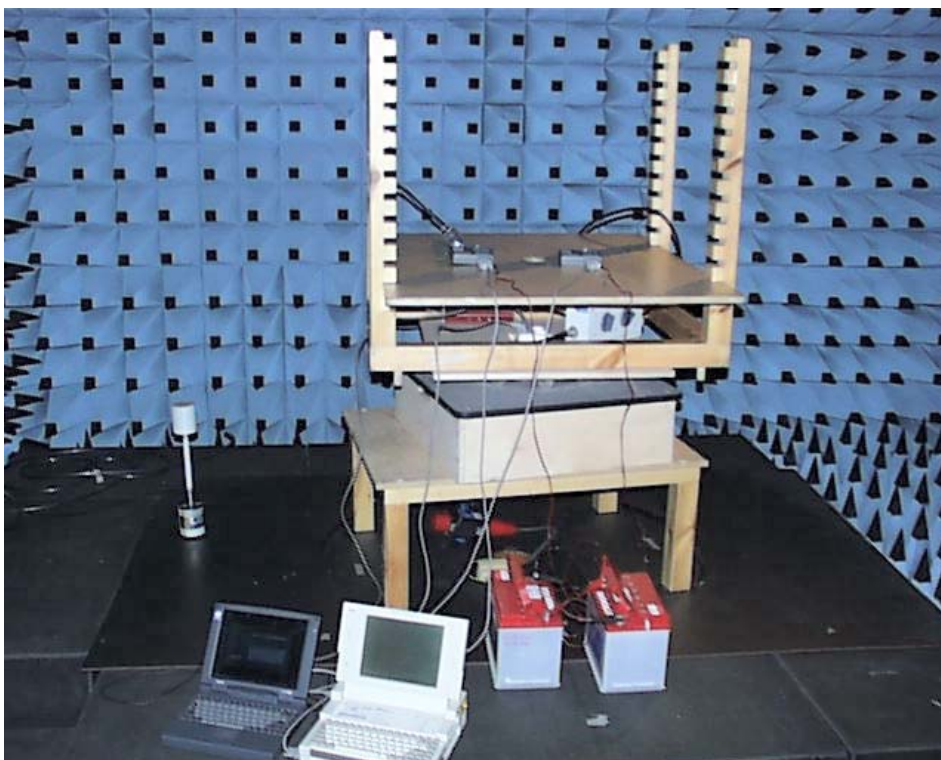
## 5. List of test equipment

No.	Equipment	Type	Manufacturer	Serial Number
3	Test receiver	ESH-2	Rohde & Schwarz	871544/061
5	Test receiver	ESH-3	Rohde & Schwarz	894718/015
6	Test receiver	ESVP	Rohde & Schwarz	861743/022
165	Spectrum monitor	EZM	Rohde & Schwarz	862065/011
338	Test receiver	ESS	Rohde & Schwarz	847151/009
9	Modulation analyzer	8901B	Hewlett Packard	2718A01220
45	Spectrum analyzer	FSBS	Rohde & Schwarz	862563/010
38	RF generator	SMG	Rohde & Schwarz	883590/035
201	RF generator	2042	Marconi	119571/062
317	RF generator	2052	Marconi	119754/058
351	RF generator	SMT 06	Rohde & Schwarz	845715/001
199	RF amplifier	ZHL-1042J	Mini-Circuits	012288-10
205	RF amplifier	ZHL-1042J	Mini-Circuits	012288-11
61	Audio amplifier	PRL 737	Self made	
340	RF-power amplifier	7100LC-CE	Kalmus	7583B1
354	RF power amplifier	AR 500W1000M7	Amplifier Research	20487
355	RF power amplifier	LA100V - CE	Kalmus	7809-1
366	RF-amplifier	AR15A25	Amplifier Research	10783
397	RF-amplifier	ZFL-2000	Mini-Circuits	-
89	Antenna, logperiodic	3147	EMCO	9202-1078
90	Antenna, biconical	3109	EMCO	9109-2582
188	Antenna, bilog	CBL 6111	Chase	1028
319	Antenna	CBL6112	Chase	2018
352	Antenna	3142	EMCO	9701-1122
417	Antenna, bilog	CBL 6141	Chase	4028
167	Artificial mains network	NSLK 8126	Schwartzbeck	8126101
168	Artificial mains network	NSLK 8127	Schwartzbeck	8127162
184	Temp. & humidity meter	HMI 32	Vaisala	63837
291	Field sensor	BA05		
292	Optical repeater	ORO1		
293	Isotropic field meter	PMM 8051		
308	Internet advisor	J2300A	Hewlett Packard	3530A00685
10	Oscilloscope	9400A	LeCroy	8878
102	Hybrid	H 9	Anzac	
413	Decoupling clamp	FGZ 40X15 C	Lüthi	4562
193	ESD generator	NSG435	Schaffner	316
405	Horizontal coupling plane	HCP1	Self made	-
406	Vertical coupling plate	VCP1	Self made	-
409	ESD generator	NSG435	Schaffner	2288
362	Power supply	B32-20R	Oltronix	653
327	Power attenuator	765-20	Narda	-
392	RF attenuator PAD	1A (6dB)	Weinschel	
395	RF attenuator PAD	757 C - 10 dB	Narda	
347	Automotive test system	NSG5000	Shaffner	EK3396-021
294	DCN-network	801-M2/M3	Lüthi GmbH	
299	RF injection clamp	EM 100	Lüthi GmbH	-
326	Power attenuator	765-6	Narda	-
428	Directional coupler	RK 100	MEB	13703
431	Power meter	NRVD	Rohde & Schwarz	826224/047
432	Voltage probe	URV5-Z2	Rohde & Schwarz	826853/030
433	Voltage probe	UVR5-Z2	Rohde & Schwarz	826853/029
176	Anechoic chamber	RFD-60	Euroshield Oy	509
348	Shielded room	RFSD-100	Euroshield Oy	1320
349	Shielded room	RFSD-100	Euroshield Oy	1319
350	Semi-anechoic shielded room	RFD-F-100	Euroshield Oy	1327

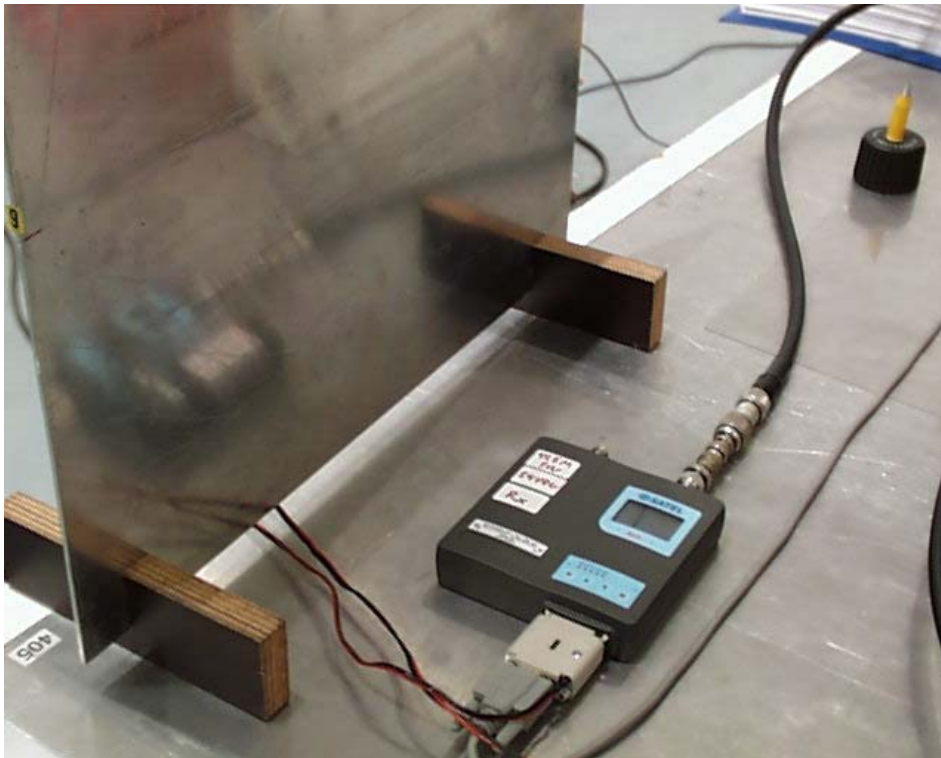
## 6. Photographs



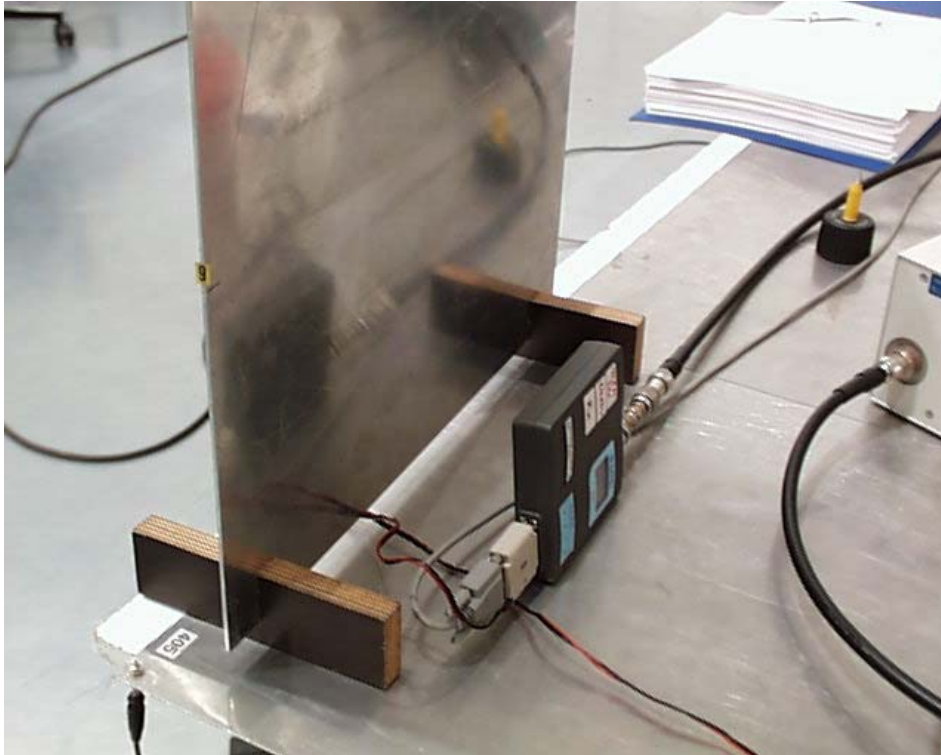
*Photograph 1. Radiated radio-frequency electromagnetic field (also GSM) immunity test.*



*Photograph 2. Radiated radio-frequency electromagnetic field (also GSM) immunity test.*

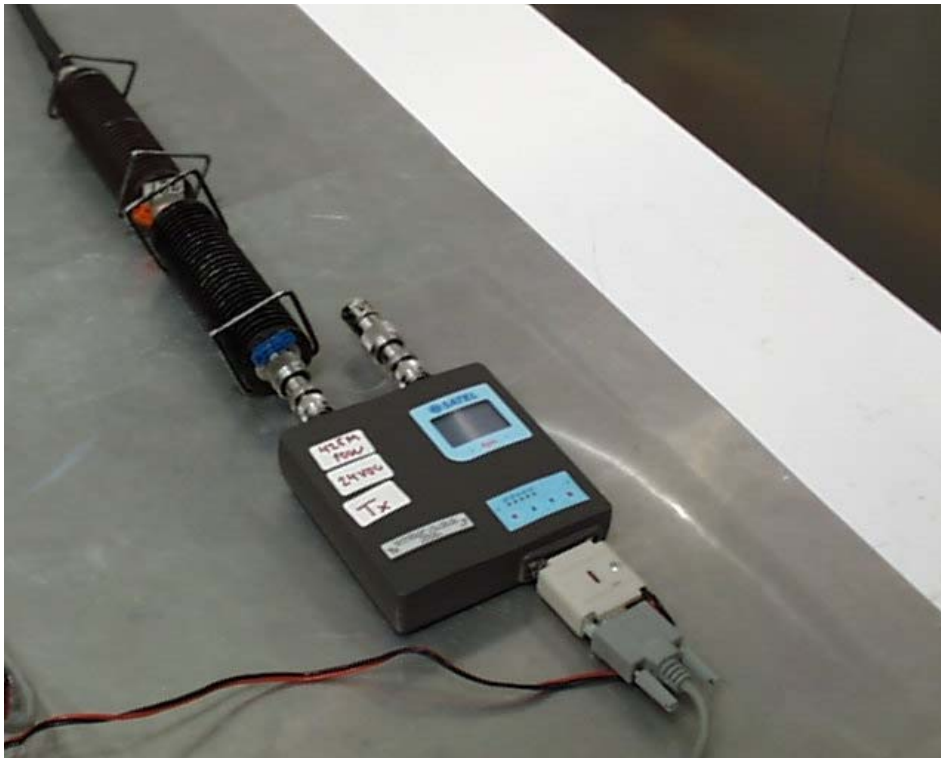


*Photograph 3. Electrostatic discharge immunity test.*

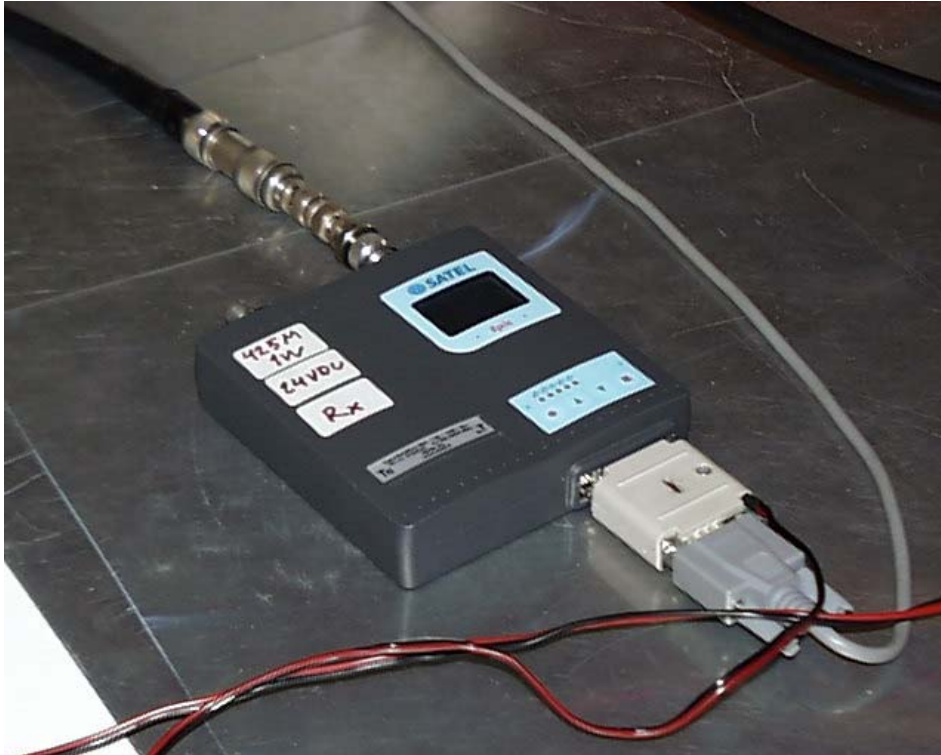


*Photograph 4. Electrostatic discharge immunity test.*





Photograph 5. Electrostatic discharge immunity test.



Photograph 6. Electrostatic discharge immunity test.



*Photograph 7. Transients and surges in vehicular environment immunity test.*



*Photograph 8. Transients and surges in vehicular environment immunity test.*