7 TEST EQUIPMENT AND ANCILLARIES

To simplify identification of the test equipment and ancillaries used, all item used are identified by the test house on each page of the test report. All numbers are referenced to the list given below.

No	Beskrivelse	Fabrikat	Type
1123	Spektrum Analyzer	Advantest	R3271
1330	Antenna Horn	EMCO	3115
1336	Generator, RF	R&S	SMP04 1035,5005,04
1212	Attenuator	Suhner	6810.17.B
1188	Generator, SHF	Gigatr.	7200/.01-20
1083	Climate Chamber Temp	ACS	TY80
1261	Antenna Log-periodic	R&S	HL 223
1410	Shielded room	ETS	Semi-anechoic
1226	Antenna Horn	EMCO	3115
1101	EMI-Receiver	R&S	ESVS30
19	Power Supply	Oltronix	B32-10R
1020	Multimeter, Digital	Fluke	87
1260	Antenna, biconical	R&S	HK 116
1337	Spektrum Analyzer	R&S	FSEK 1088,3494,30
1322	Amplifier RF	HP	8449B
1445	Amplifier, preamp	HP	10855A

ВЯРНО
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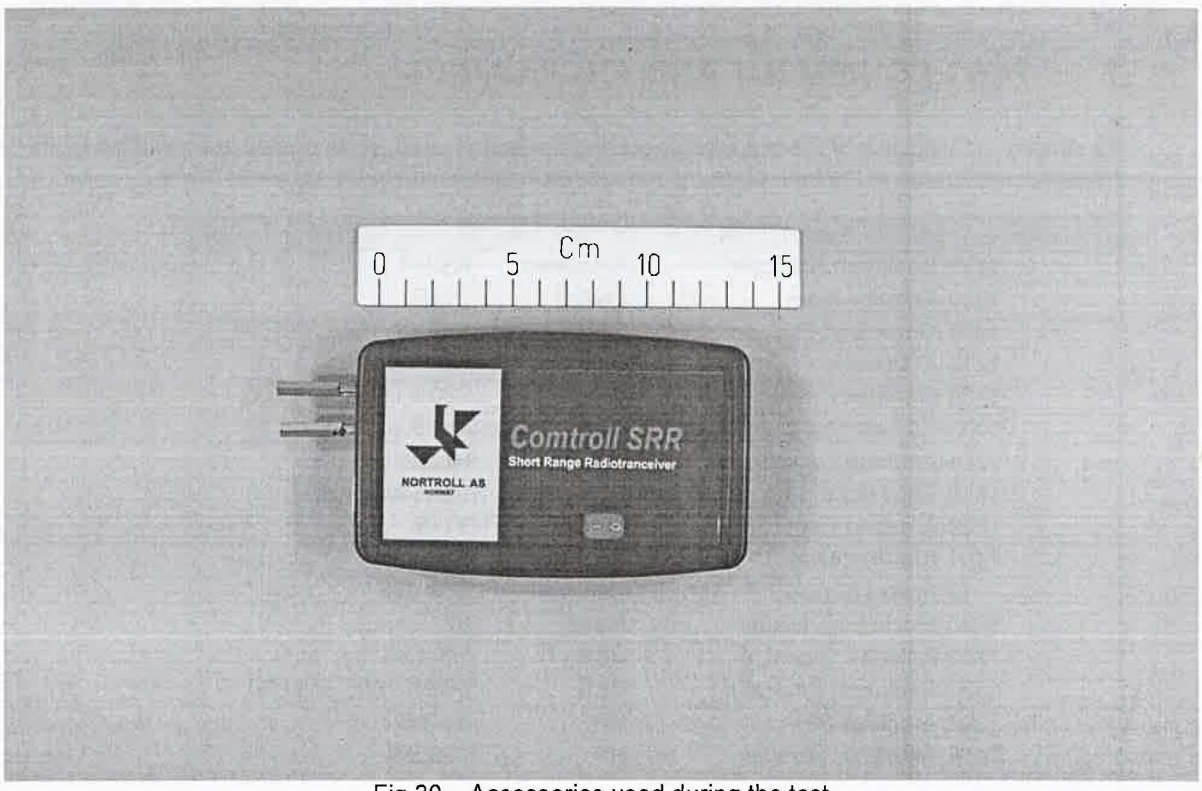

Fig 30 – Accessories used during the test

Fig 31 - Accessories used during the test

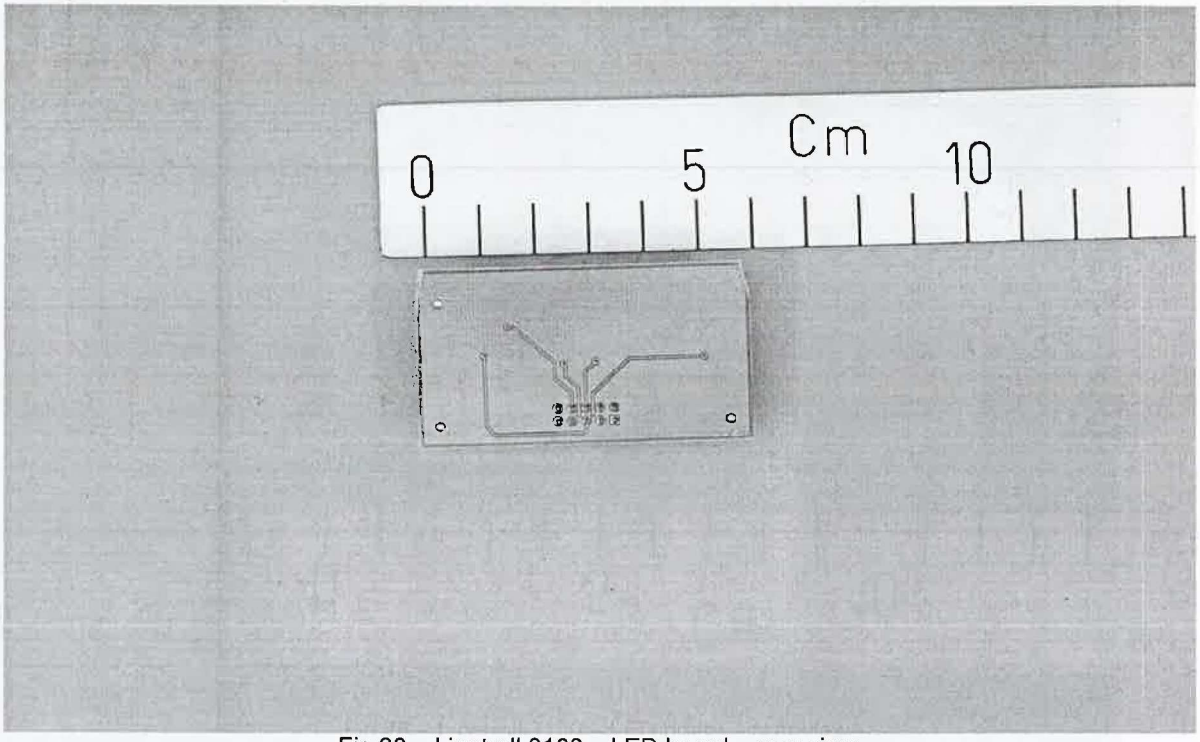

Fig 28 – Linetroll 3100 – LED board – rear view

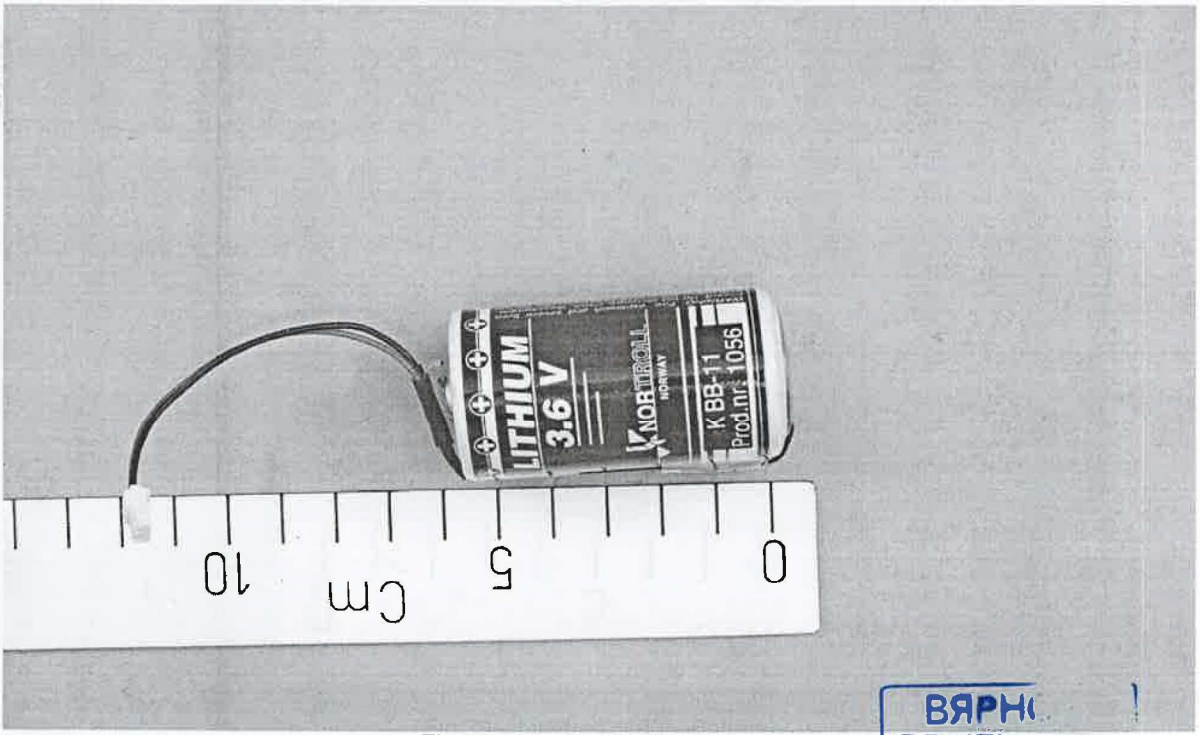

Fig 29 – Linetroll 3100 – Battery

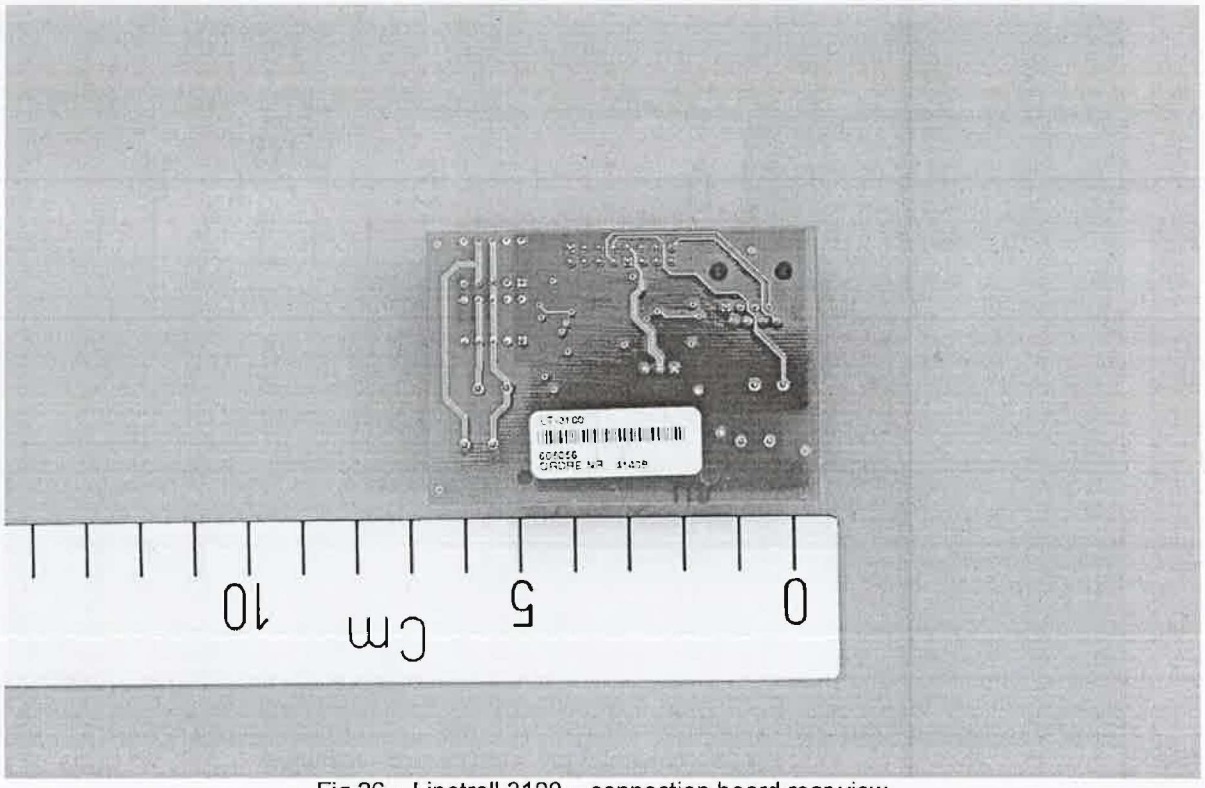

Fig 26 – Linetroll 3100 – connection board rear view

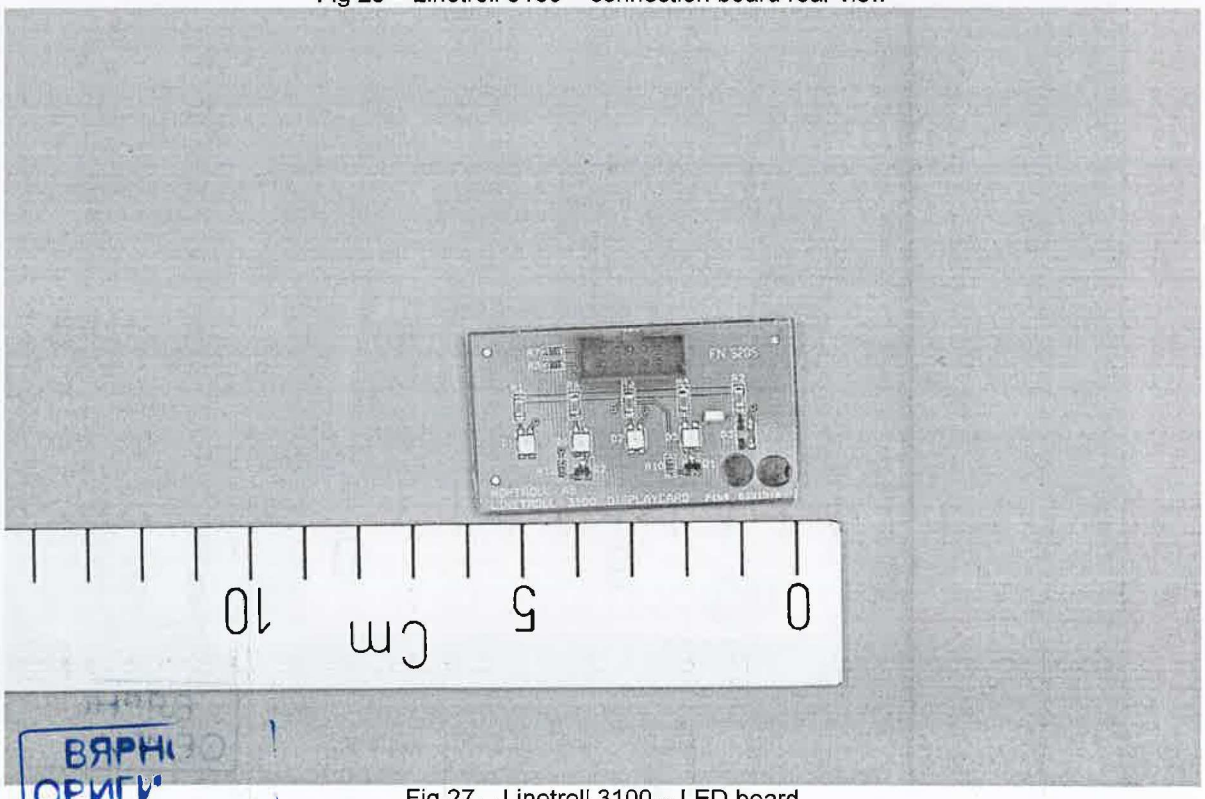

Fig 27 – Linetroll 3100 – LED board

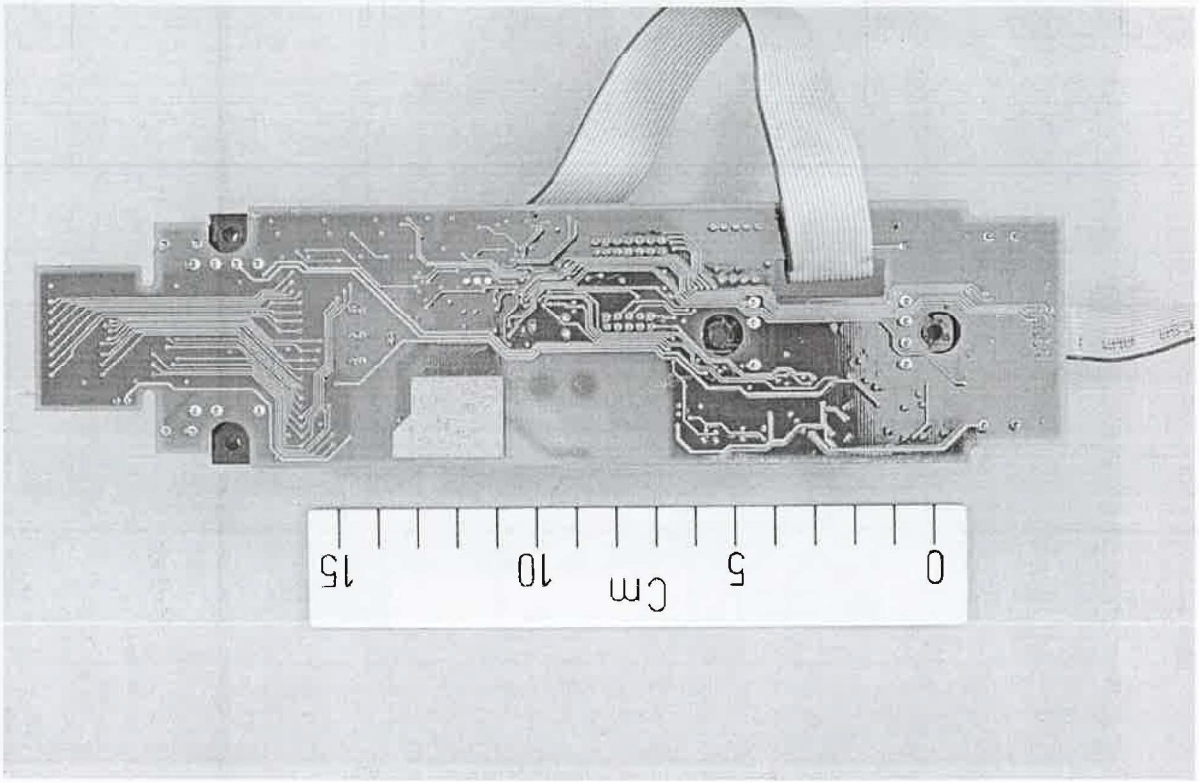

Fig 24 – Linetroll 3100 – main pcb – rear view

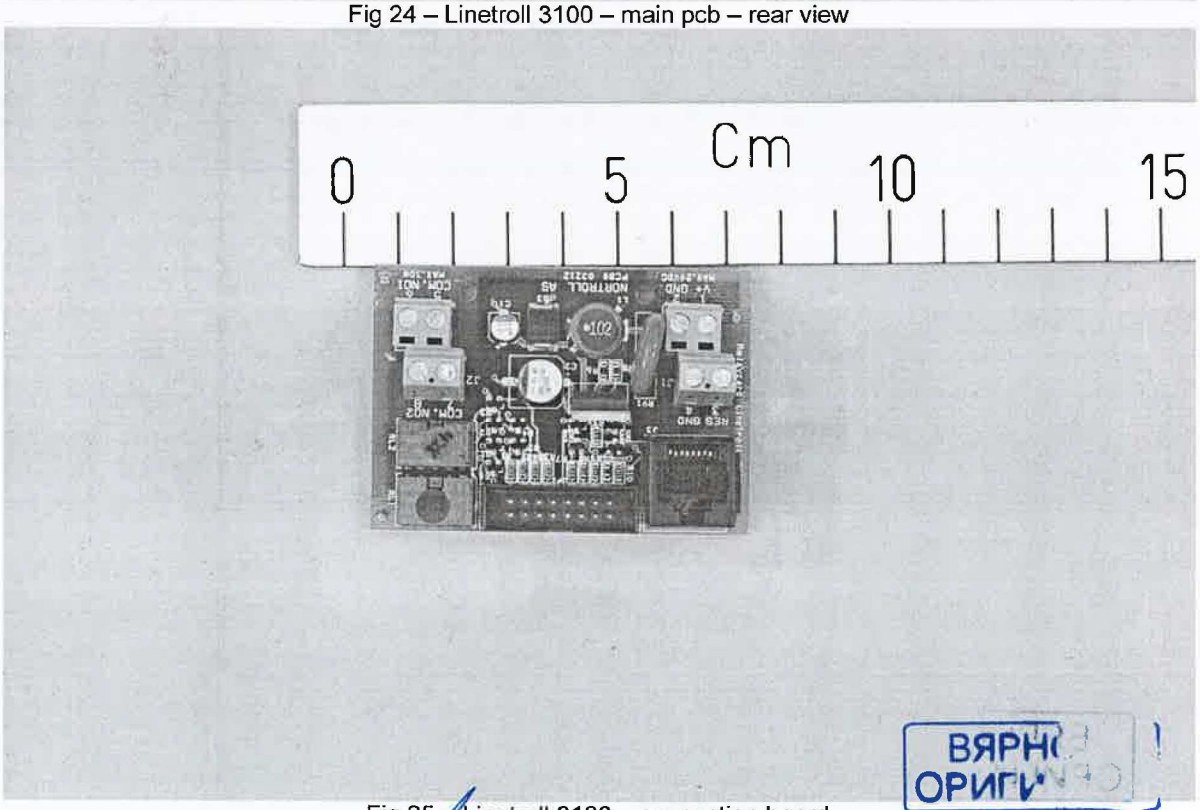

Fig 25 – Linetroll 3100 – connection board

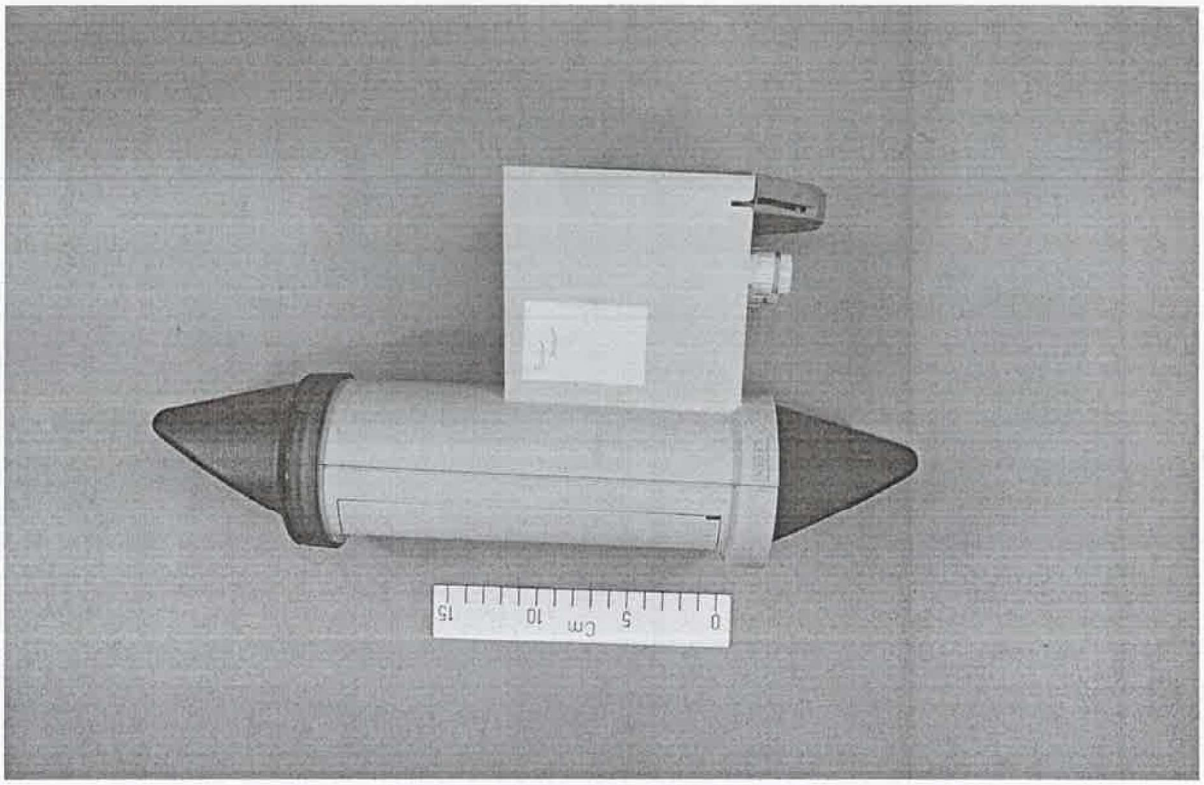

Fig22 – Linetroll 3100 – Side view

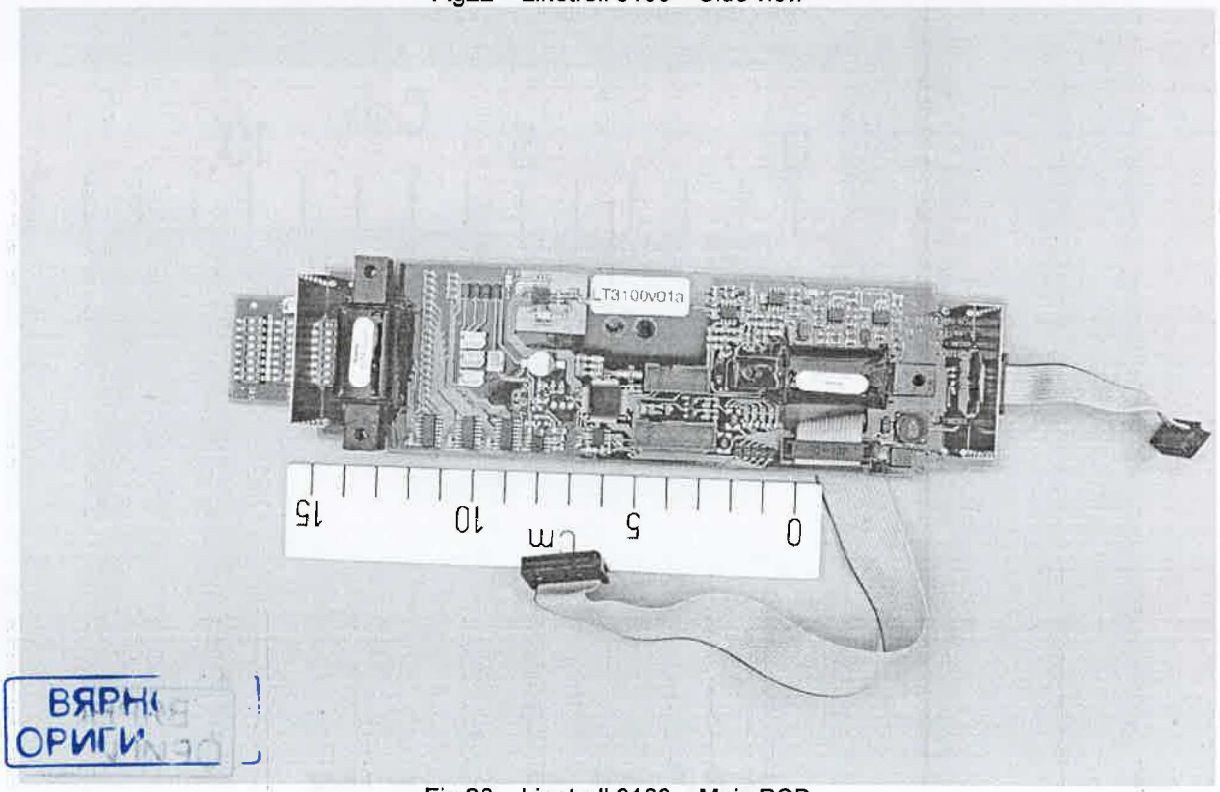

Fig 23 – Linetroll 3100 – Main PCB

6 Photographs of the EUT

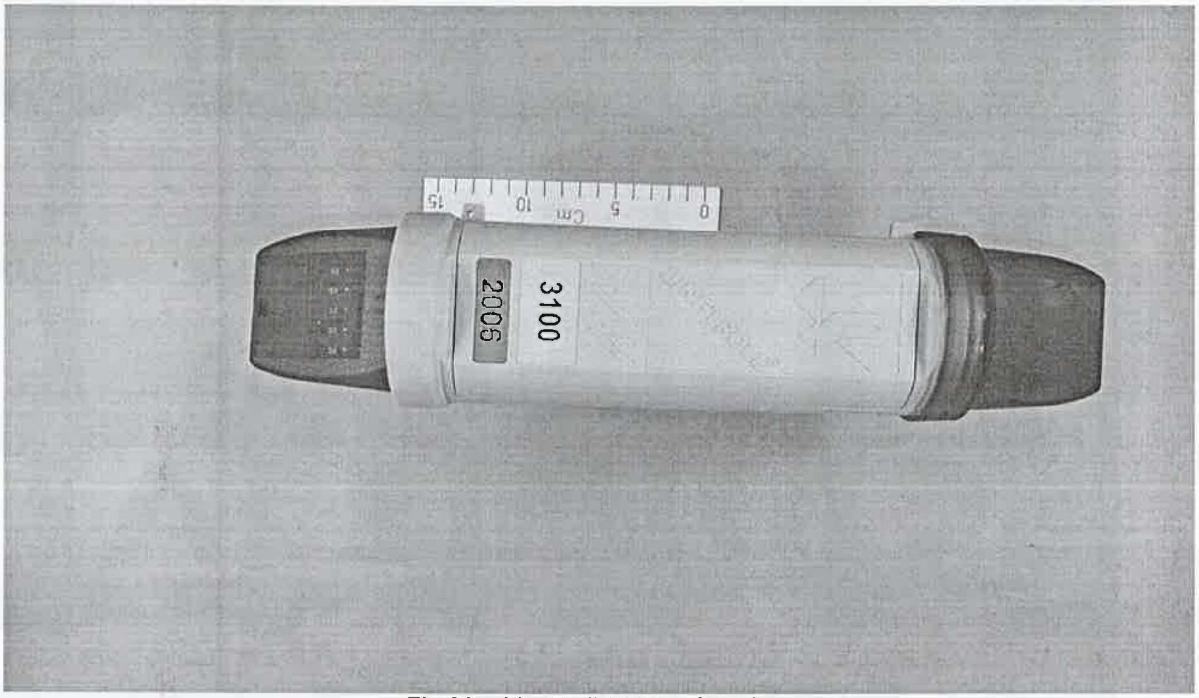

Fig 20 – LineTroll 3100 – Fronview

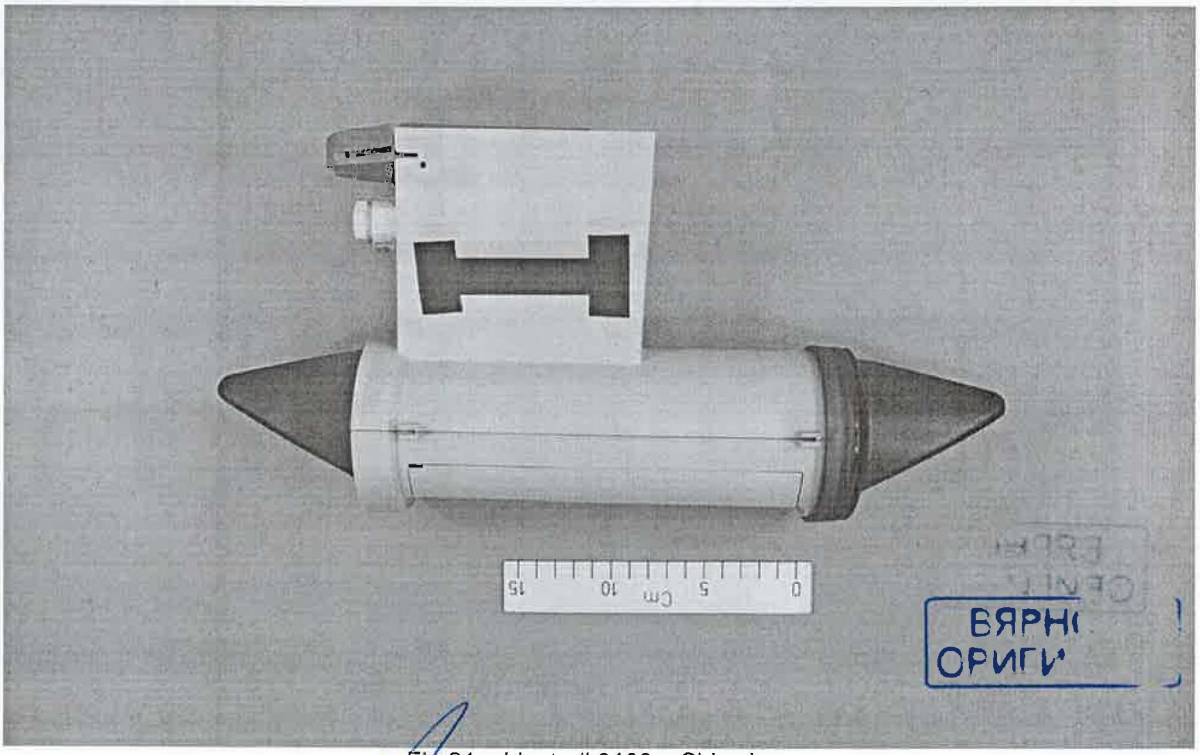

Fig 21 – Linetroll 3100 – Side view

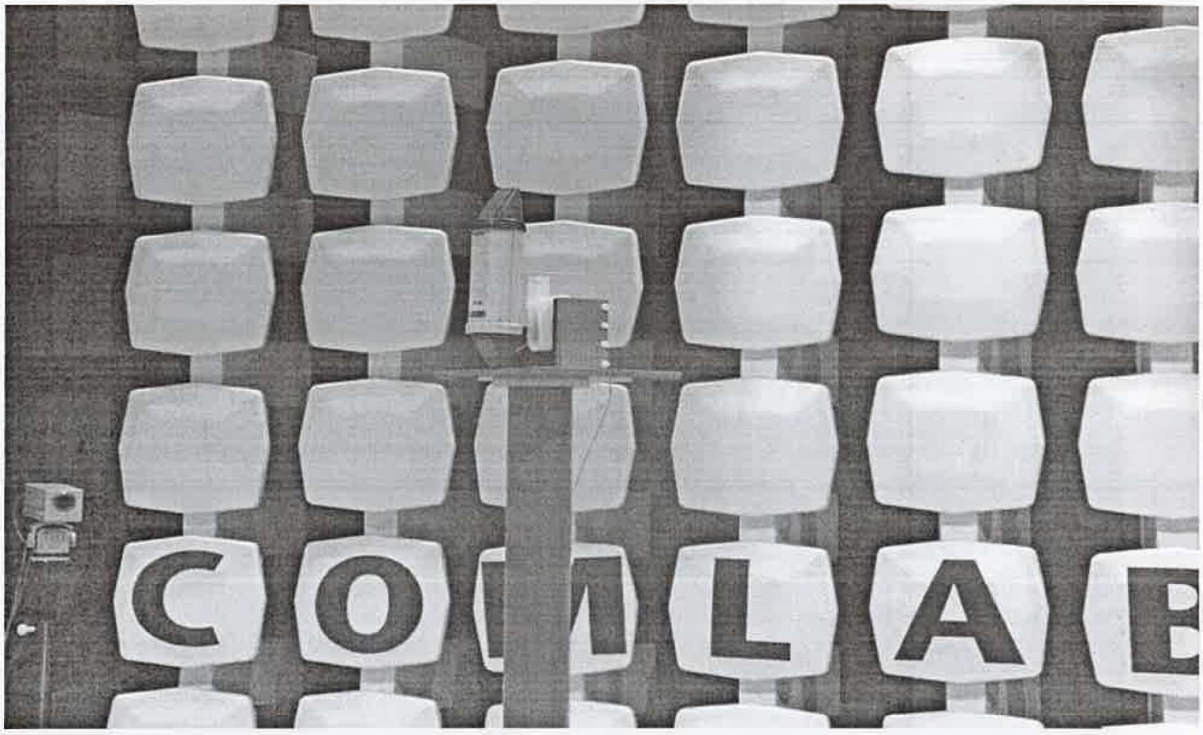

Fig 19 – Radiated measurement

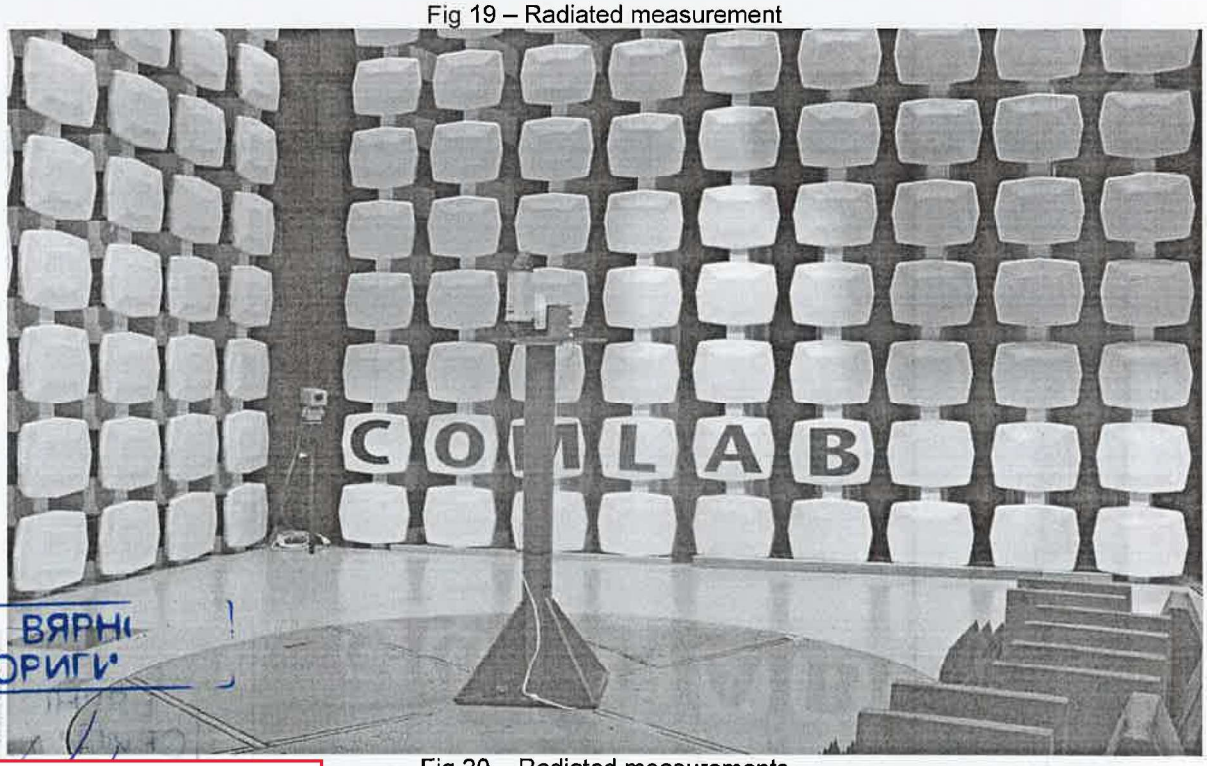

Fig 20 – Radiated measurements

5 Test set-up

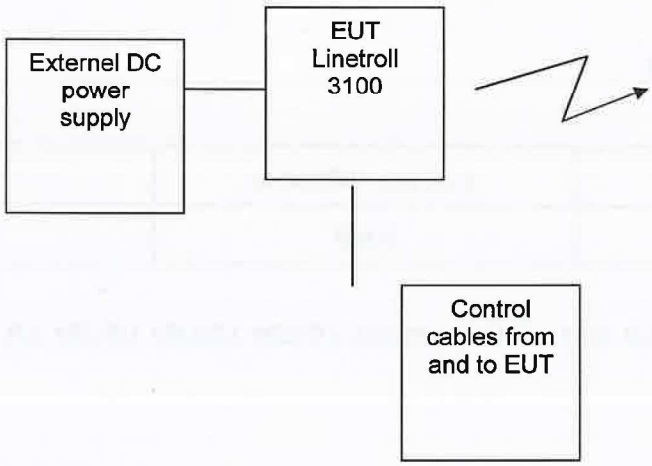

Fig 18 – Block diagram

4.2 RECEIVER MEASUREMENTS

EN 300 440

4.2.1 Spurious Radiation - Radiated

Clause 8.4.4

None detected

Limits: Clause 8.4.5

Frequency	≥ 25 to ≤ 1000 MHz	> 1000 MHz
Limits	2 nW	20 nW

Test Equipment Used: LR 1337, LR 1101, LR1330, LR1226, LR1260, LR1261, LR 1322, LR 1410, LR1445

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ОРИГИ

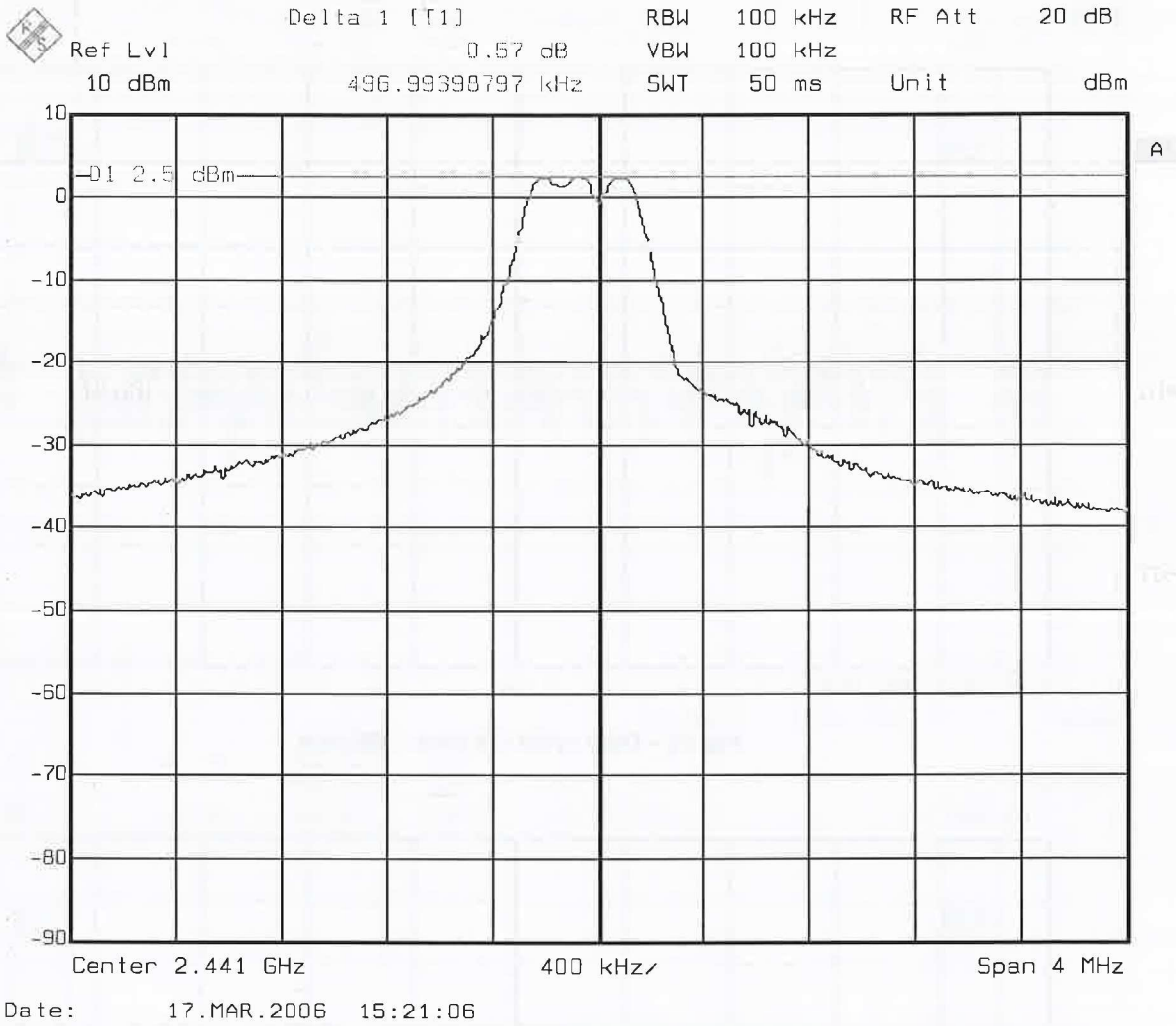

Fig 17 – 6 dB bandwidth – 496.99kHz

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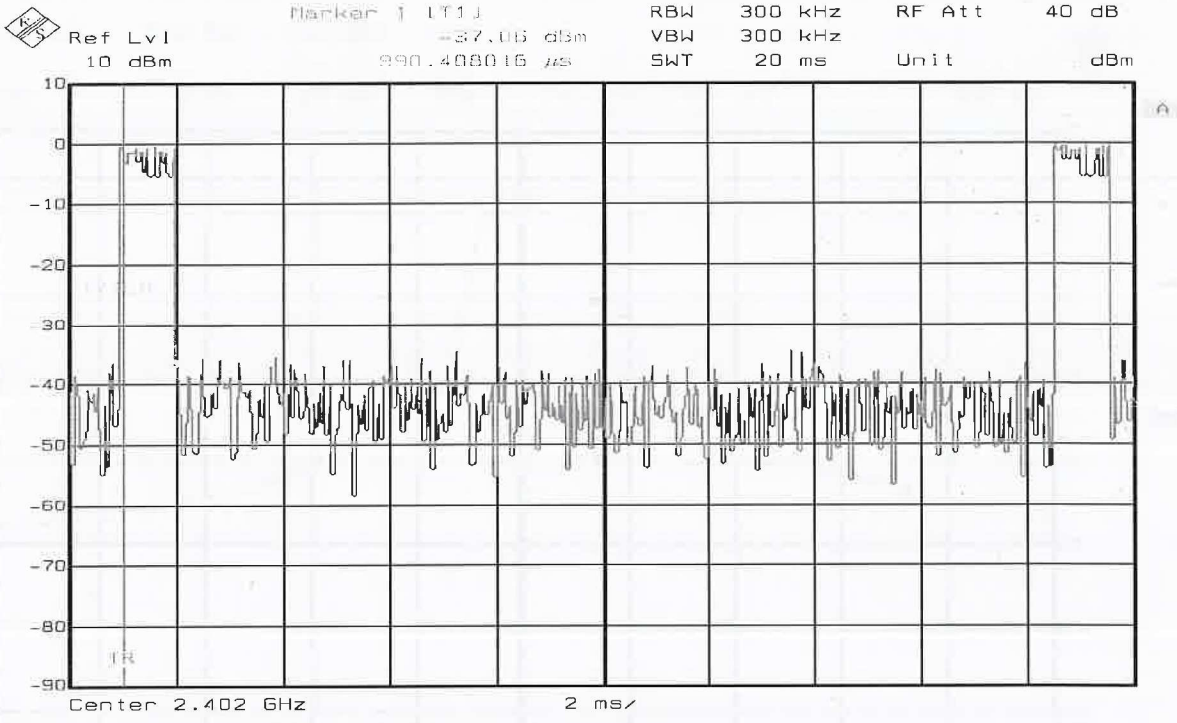

Fig 15 – Duty cycle ON time – 990.4µs

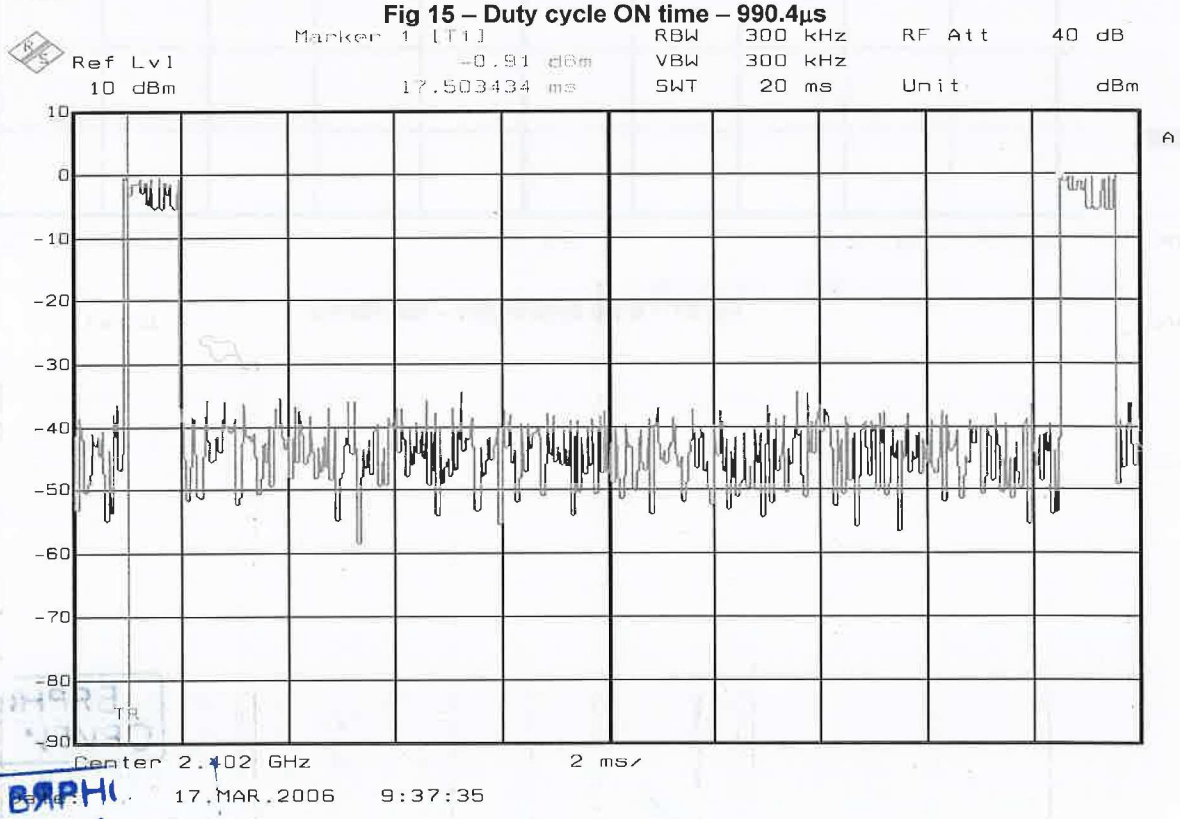

Fig 16 – Duty cycle – OFF time – 17.5 ms

EN 300 440

4.1.5 Duty Cycle

Clause 7.4

Carrier modulated 2441 **MHz**

Declaration by the manufacturer

Limits Clause 7.4.3

Duty cycle class	Duty cycle ratio
1	< 0,1 %
2	< 1,0%
3	< 10%
4	Up to 100%

See fig 15 – 17 for duty cycle ON/OFF time and for 6dB bandwidth

Test Equipment Used: LR 1337,LR 1330

EN 300 440

4.1.4 Spurious Emissions - (Transmitter In Standby) Clause 7.3

None detected

Limits: Clause 5.2.3

State	47 to 74 MHz 87,5 to 118 MHz 174 to 230 MHz 470 to 862 MHz	Other frequencies ≥ 25 to ≤ 1000 MHz	Frequencies > 1000 MHz
Operating	4 nW	250 nW	1 µW
Standby	2 nW	2 nW	20 nW

Test Equipment Used: LR 1337, LR 1101, LR1330, LR1226, LR1260, LR1261, LR 1322, LR 1410, LR1445

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ОРИГИ

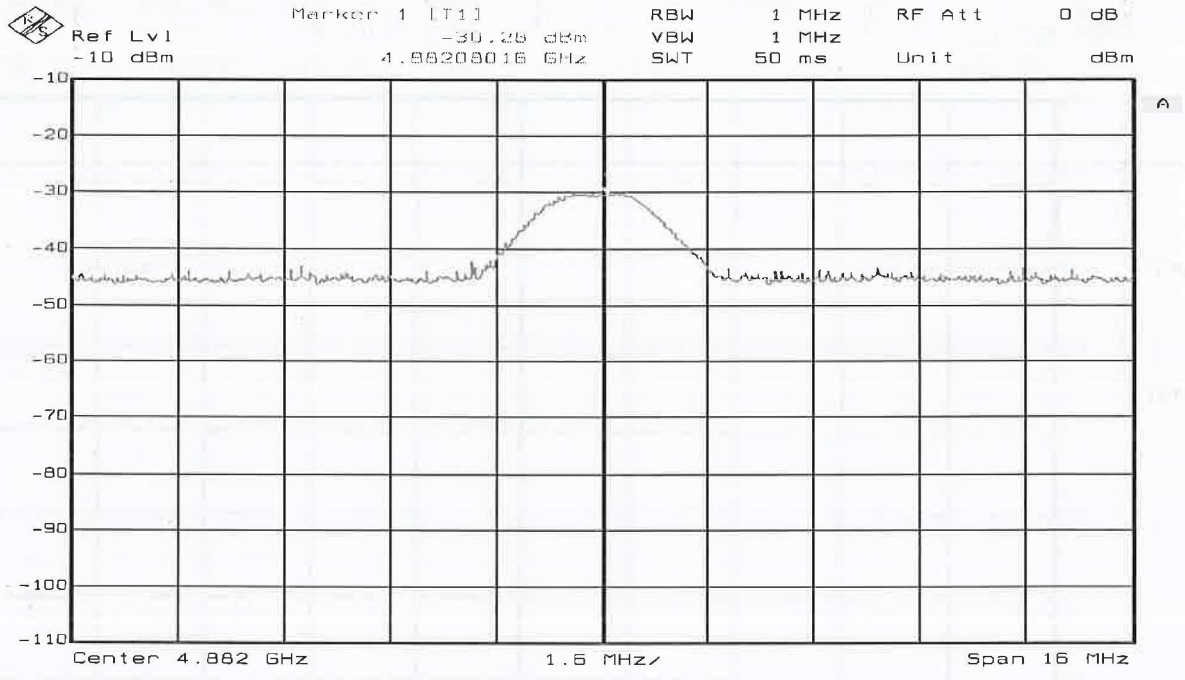

Fig 13 – 2 nd harmonic – at 3m – VP

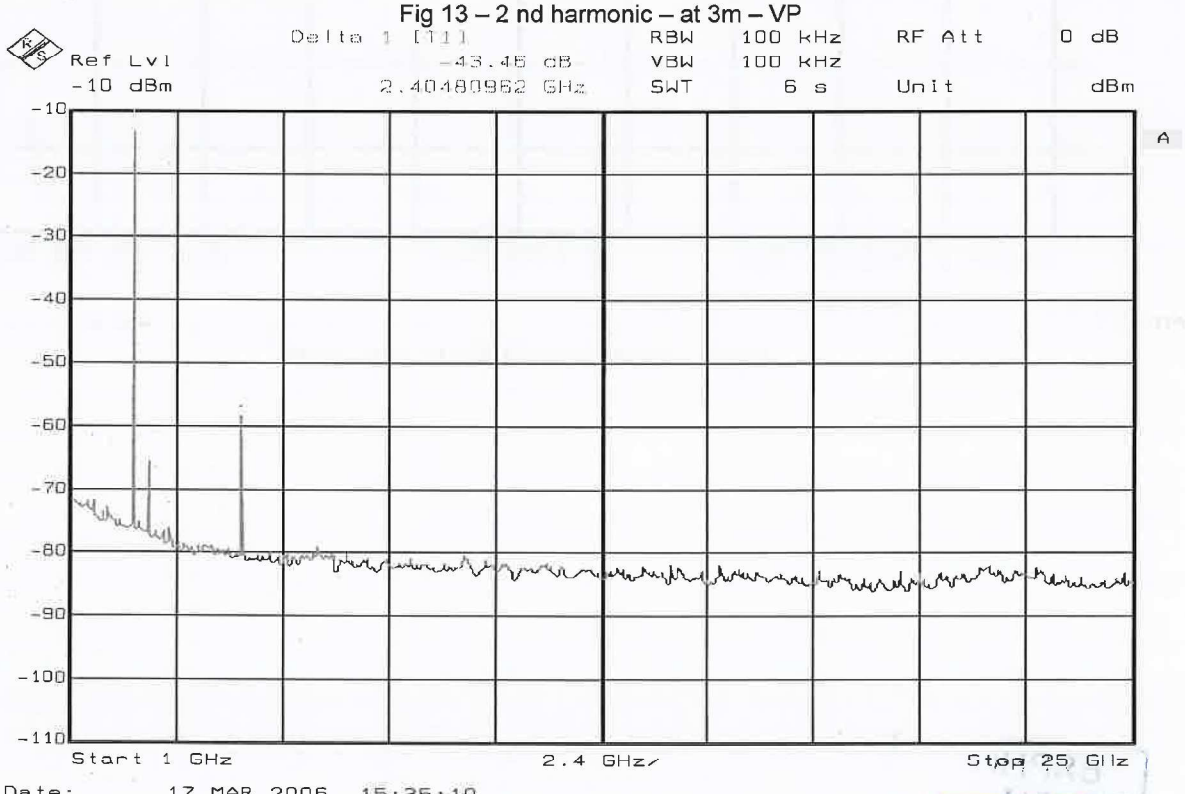

Fig 14 – Scan 1 – 25 GHz - Vp

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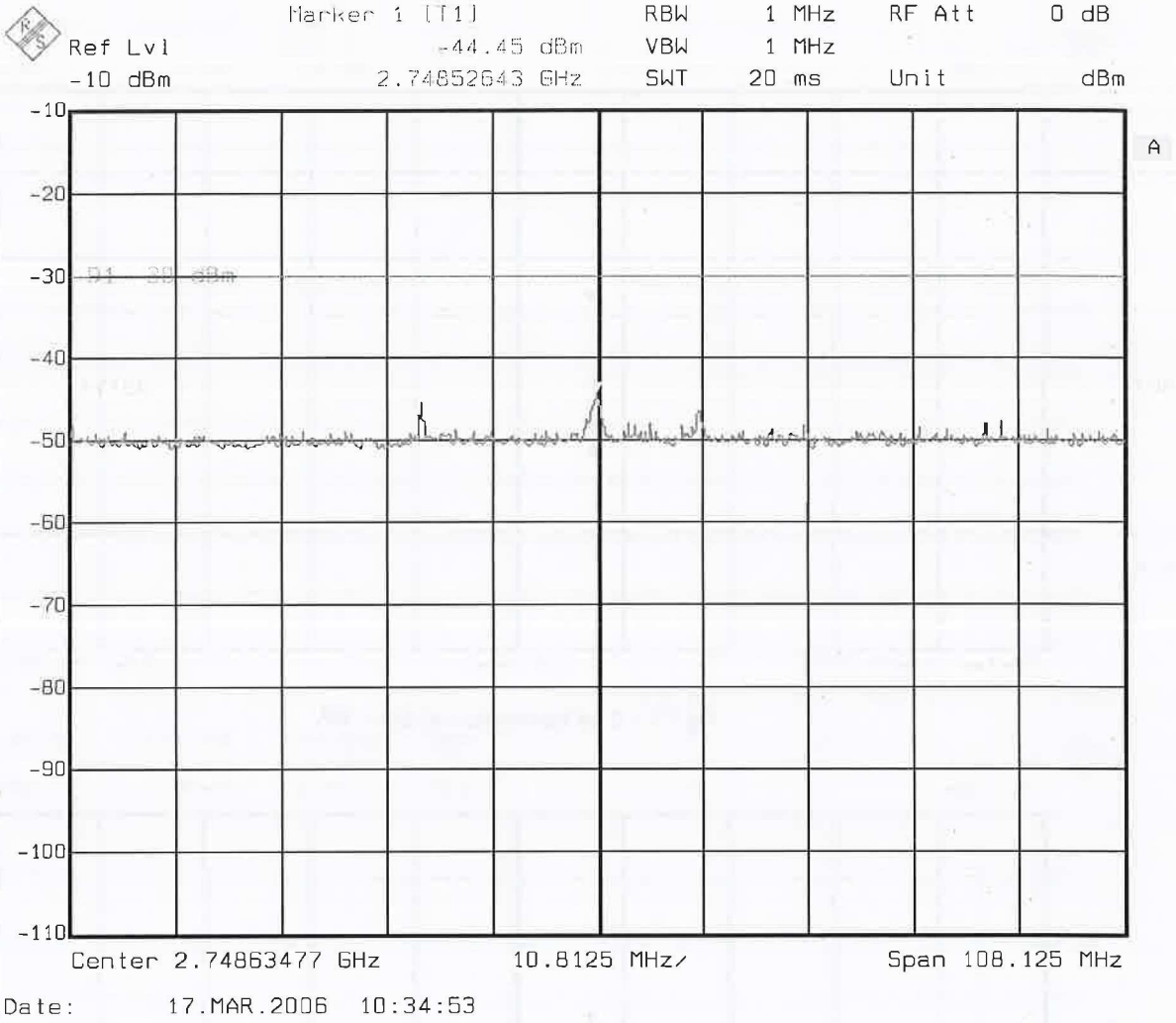

Fig 12 – Spurious at 2.748GHz – Vp – at 3m

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EN 300 440

4.1.3 Spurious Emissions - Radiated (Transmitter Operating) Clause 7.3.5

Frequency (MHz)	Measurement Bandwidth (MHz)	Spurious Emission Level (dBm)
30 – 1000	**0.1**	**None detected**
2748.52	1	-44.45
4882.08	1	-30.28
1000 - 25000	0.1	See fig 14 for scan
Measurement Uncertainty	**25 – 1GHz - +1,9/-2,4 dB 1 – 8 GHz - +1,8/-2,1 dB 8 – 18 GHz - +1,9/-2,4 dB**	

Bandwidth (MHz) refers to the bandwidth of the measuring receiver.

Limits: Clause 7.3.7

State	47 to 74 MHz 87,5 to 118 MHz 174 to 230 MHz 470 to 862 MHz	Other frequencies ≥ 25 to ≤ 1000 MHz	Frequencies > 1000 MHz
Operating	4 nW	250 nW	1 µW
Standby	2 nW	2 nW	20 nW

Test Equipment Used: LR 1337, LR 1101, LR1330, LR1226, LR1260, LR1261, LR 1322, LR 1410, LR1445

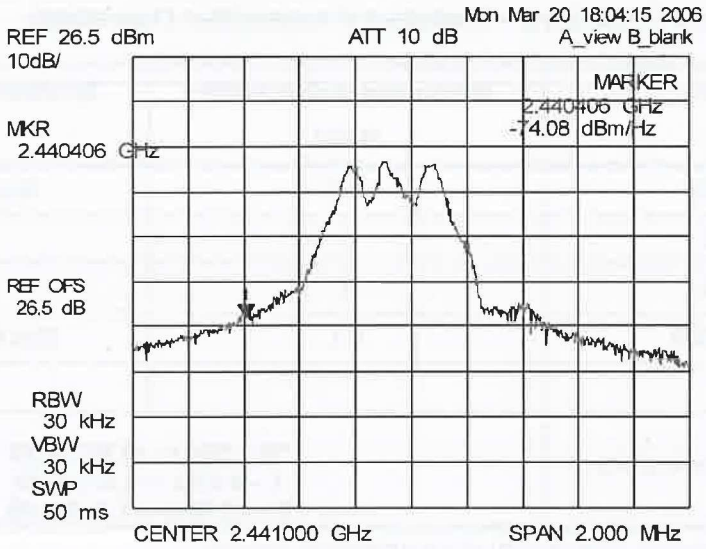
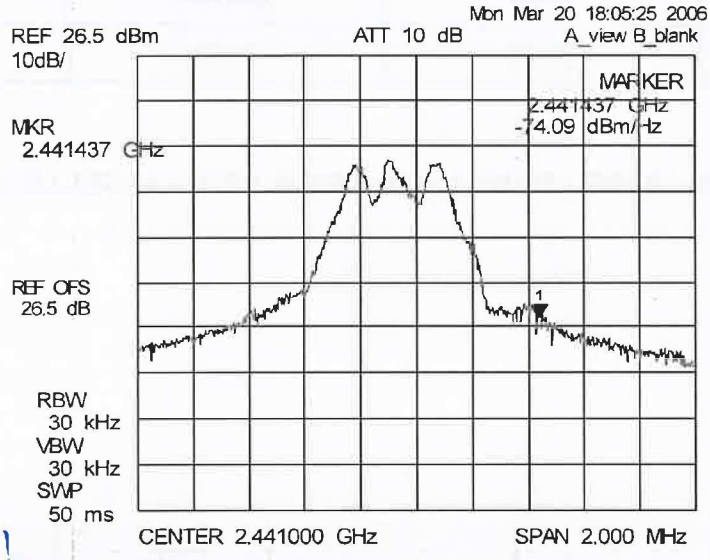


Fig 10 – 15Vdc - +55°C – Fl= 2.440406GHz



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g 11 – 15Vdc - +55°C – Fh= 2.441437GHz

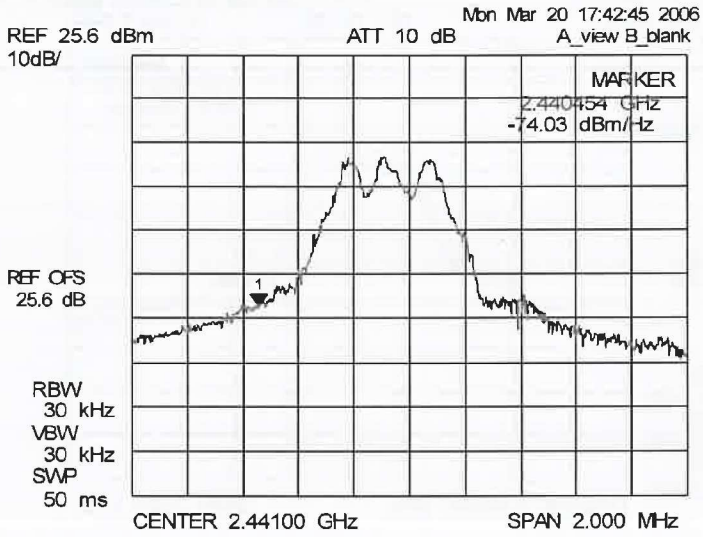

Fig.8 – 9Vdc- +55°C – Fl= 2.440454GHz

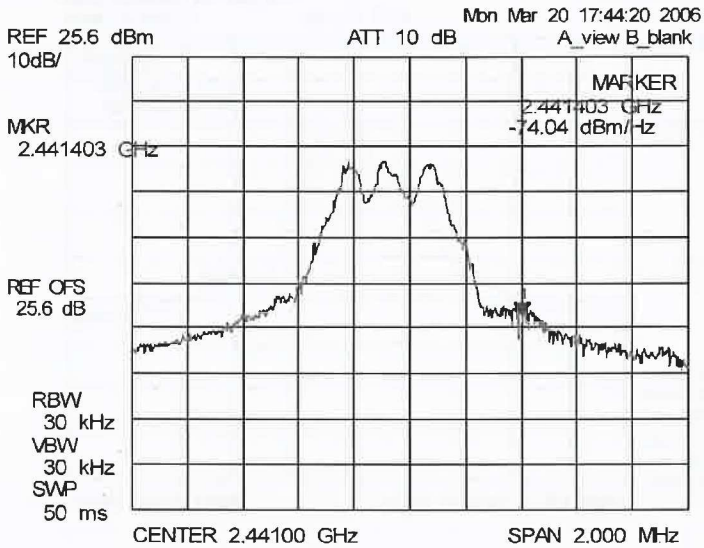

Fig 9 – 9Vdc - +55°C – Fh= 2.441403 GHz

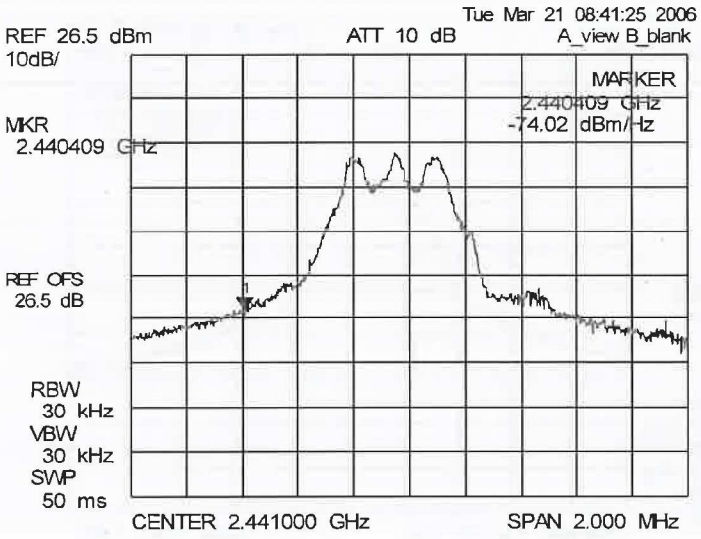

Fig 6 – 15Vdc - -20°C – Fl= 2.440409GHz

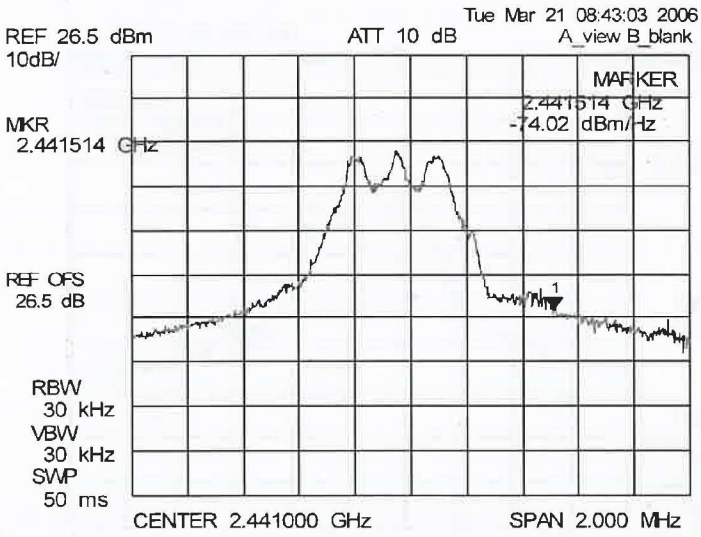

Fig. 7 – 15Vdc - -20°C – Fh= 2.441514GHz

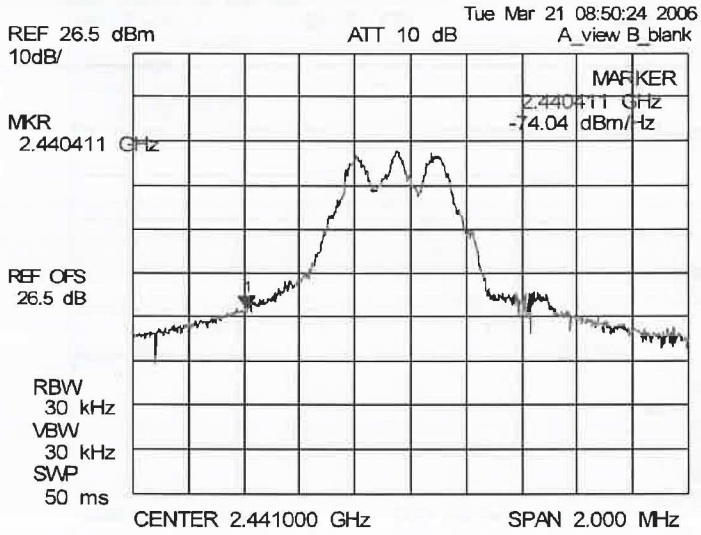

Fig 4- 9Vdc - -20°C – Fl=2.440411GHz

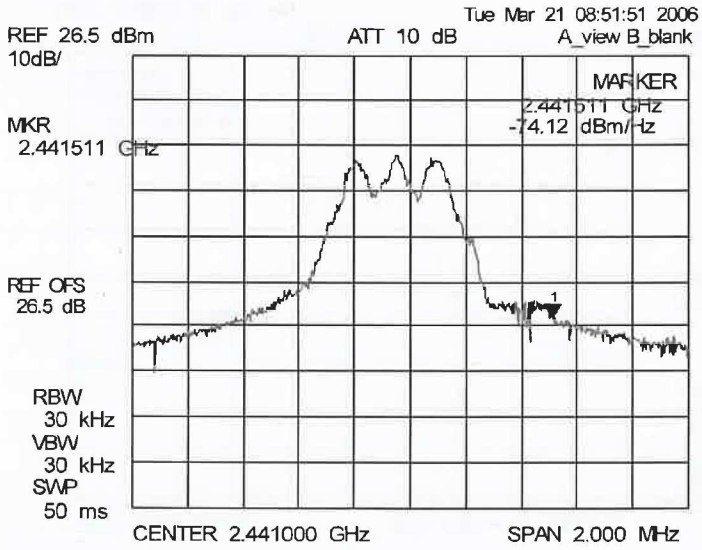

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Fig 5 – 9Vdc - -20°C – Fh= 2.441511GHz

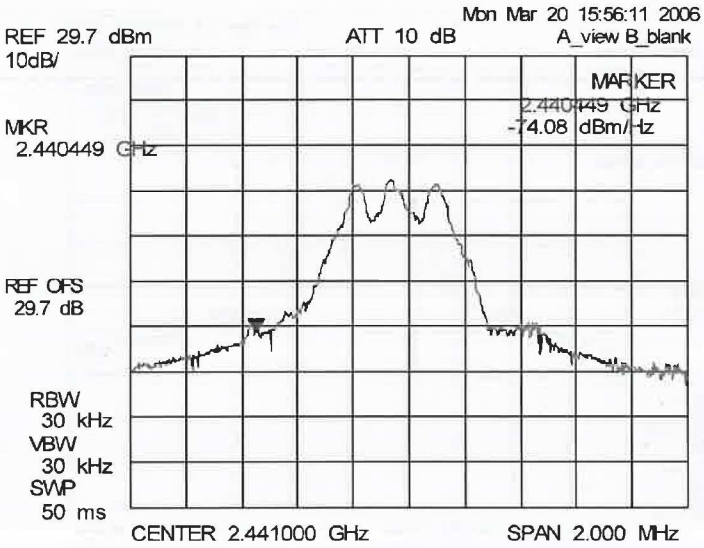
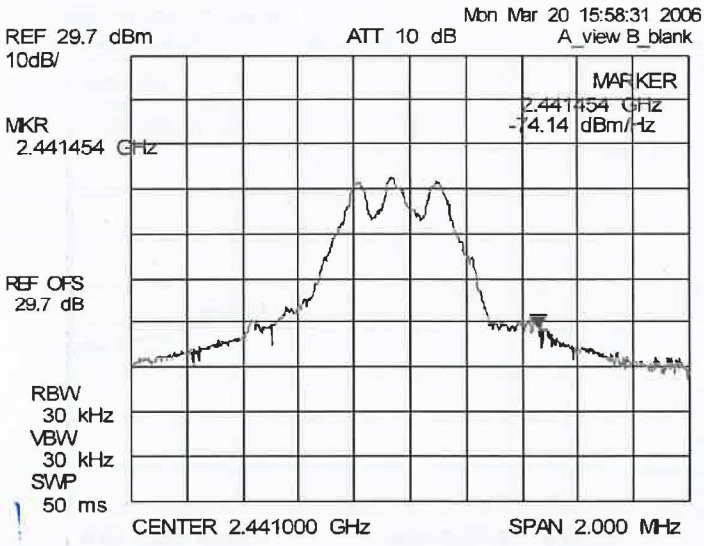


Fig 2 – 12Vdc – Nominal temp. – Fl=2.440449GHz



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3 – 12Vdc – Nominal temp. – Fh=2.441454GHz

EN 300 440

4.1.2 Permitted range of operating frequencies — Clause 7.2

Test Conditions		Frequency (MHz) At Which – 74,8 dBm/Hz Occurs	
		Lowest	**Highest**
T_{nom}(.23°C)	V_{nom}(12V)	2440.449	2441.454
T_{min}(..-20°C)	V_{min}(9V)	2440.411	2441.511
	V_{max}(15V)	2440.409	2441.514
T_{max}(..+55.°C)	V_{min}(9V)	2440.454	2441.403
	V_{max}(15V)	2440.406	2441.437
Measured frequencies (lowest and highest)		f_L=2440.406	f_H=2441.514
Measurement Uncertainty		**>Con +13 /-12 KHz or Rad +23/-20,7 KHz**	

See fig 2 – 11.

Limits: Clause 7.2.4

Under All Test Conditions	f_L > 2400 MHz f_H < 2458.3 MHz

Test Equipment Used: LR 1123, LR1020, LR019, LR1083

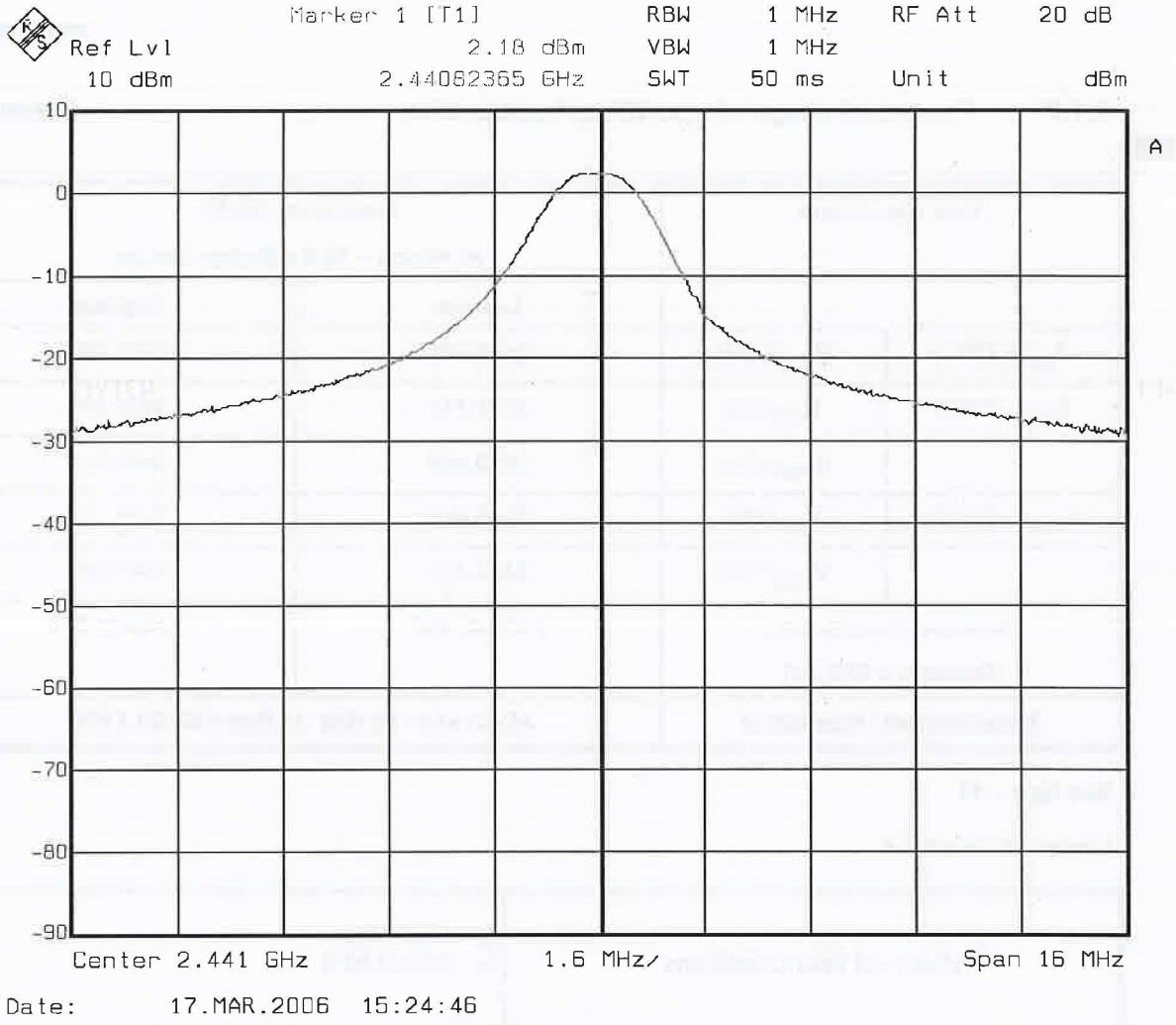

Fig 1. Eirp – measured at 3 m – VP – 2441GHz

4 TEST RESULTS

4.1 TRANSMITTER MEASUREMENTS

EN 300 440

4.1.1 Equivalent isotropically radiated power (Radiated measurements) Clause 7.1

Rated output power level (maximum) 1 mW

Test Conditions		Transmitter Power (mW)		
		Lowest Frequency -	Middle Frequency 2441MHz	Highest Frequency -
T_{nom}(.23°C)	V_{nom}(.12.V)	-	1.65	-
Measurement Uncertainty		**+1,8/2,2 dB**		

See fig 1 for measured spectrum , the value given in the plot is corrected for antenna gain + path loss+ cable loss.

Limits: Clause 7.1.3

Maximum radiated peak power (eirp)

Power Class (note 1)	Power level (conducted or radiated)
8	10 mW
9	25 mW
11	100 mW
12	500 mW (see note 2)
13	1 W
14	2 W
14a	4 W (see note 2)
NOTE 1: Class designation is based on CEPT/ERC Recommendation 70-03 **[Feil! Fant ikke referansekilden.]**.	
NOTE 2: For RFID applications, see annex C of the present document.	

Test Equipment Used: LR 1337, LR 1330, LR 1226, LR1322, LR1410

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3.2 Test Summary

Transmitter parameters

Equivalent iso-tropically radiated power (eirp)	
- conducted	(NA**)
- radiated	(P)
Permitted range of operating frequencies	
- Frequency range - for Non SS equipment	(P)
- Frequency range - for FHSS equipment	(NA)
- Frequency range - for DSSS equipment	(NA)
Spurious emission, transmitter operating	
- conducted	(NA**)
- radiated	(P)
- Cabinet	(NA**)
Spurious emission, transmitter standby	
- conducted	(NA**)
- radiated	(P)
- Cabinet	(NA**)
Duty Cycle	(#)

Receiver parameters

Adjacent channel selectivity	- in band	(%)
Adjacent band selectivity		(%)
Blocking or desensitisation		(%)
Spurious radiations	- conducted	(NA**)
	- radiated	(P)

Notes:

*	The equipment is not capable of producing an unmodulated carrier
**	The equipment is supplied with a 50 ohm RF connector
***	The equipment is not intended for transmission of speech
****	The equipment is intended for wideband transmission
%	Class 3 receiver
#	Will be declared by the manufacturer

[1] The tested equipment has integrated antenna only.

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3 TEST REPORT SUMMARY

3.1 General

The tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with –

EN 300 440 – 1 V1.3.1 (2001-09)
Electromagnetic compatibility and Radio spectrum Matters (ERM); Short range dvices; Radio equipment to be usd in the 1 GHz to 40 GHz frequency range;
Part 1: Technical characteristics and test methods

The test methods have been in accordance with According to Comlab 1003 and EN 300 440-1, Where applicable.

Radiated tests were performed is accordance with EN 300 440. The Radiated emissions are made in a 10m semi-anechoic chamber.

☒ Production Unit
☐ Pre-production Unit

THIS TEST REPORT RELATES ONLY TO THE ITEM (S) TESTED.
Deviations from, additions to, or exclusions from the test specifications are described in "Summary of Test Data".

Nemko

TEST REPORT #: 63281-3

TESTED BY : _____ Test Engineer **DATE: 24.March 2006**

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ОРИГИ

2.2 Test Environment

2.2.1 Normal test condition

Temperature:	22 – 25 °C
Relative humidity:	30 – 50 %
Normal test voltage:	12 V DC

The values are the limit registered during the test period.

2.2.2 Extreme test conditions

Voltage

Minimum Voltage:	9 V DC
Maximum Voltage:	15 V DC

Temperature

Minimum Temp.:	-20 °C
Maximum Temp.:	+55 °C

2.3 Test Period

Item received date:	2006-03-17
Test period :	from 2006-03-17 to 2006-03-21

2.4 Test Engineer

G.Suhanthakumar

2.5 Test Equipment

See list of test equipment in clause 6.

2.6 Other Comments

The EUT is tested with external DC power supply. The measurements are done with modulated carrier at constant transmitter mode (test mode).

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2 Test Information

2.1 Tested Item

Name :	LineTroll
Model/version :	3100
Serial number :	Not stated , Marked "2006"
Hardware identity and/or version:	LineTroll 3100 revision 2
Software identity and/or version :	LT3100_v0.1a
Frequency Range :	2.4 GHz – 2.4835 GHz, Used frequency – 2.441GHz
Tunable Bands :	None
Number of Channels :	Available channels 128. Used only one channel. Ch1
Operating Modes :	Transceiver
Type of Modulation :	GFSK
Emissions Designator :	NA
User Frequency Adjustment :	None
Rated Output Power :	0 dBm
Type of Power Supply :	External DC power or Battery
Antenna Connector :	Integral [1]
Antenna Diversity Supported :	None
Desktop Charger :	NA

[1] The tested equipment has integrated antennas only.

Description of Tested Device(s)

The LineTroll 3100 fault Indicator indicates earth- and short circuit-faults by detection of changes in the magnetic field set up by the fault current. The indicator can detect and independently indicate both permanent and transient faults. A cluster of red LED's for permanent fault and one green LED for transient fault. An orange LED will give indication on low battery status. High visibility,

The 2.4 GHz RF is used mainly for down loading the log files from the indicator. And in addition the indicator can be controlled remotely via 2.4GHz RF.

The EUT can be operated by battery or external DC power supply.

ВЯРНО
ОРИГ

1 GENERAL INFORMATION

1.1 Tested by

Name :	Nemko A/S
Address :	Nemko Comlab Gåsevikveien 8, Box 96 N-2027 Kjeller, NORWAY
Telephone :	+47 64 84 57 00
Fax :	+47 64 84 57 05
E-mail:	comlab@nemko.com
Number of Pages:	32

1.2 Client Information

Name :	NORTROLL AS
Address :	P.O.Box 133, 7601 Levanger, Norway
Telephone :	+47 7408 5500
Fax :	+47 7408 5501

Contact:

Name :	Olav Staberg
Telephone :	+47 7408 5516
E-mail :	ostaberg@nortroll.no

1.3 Manufacturer (if other than client)

-//-

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Nemko

COMLAB
Accredited Testing and Certification
EMC, Radio and Telecommunications

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Test report : 63281-3

Item tested : LineTroll 3100

Equipment type : SRD 2.4GHz transceiver

Client : NORTROLL AS

NORWEGIAN ACCREDITATION
TEST 031

Nemko Comlab is granted accreditation by Norwegian Accreditation under registration number TEST 031

Part of ETSI EN 300 440-1

30. March 2006

Authorized by : .....
Geir Antonsen
Technical Verificator

ВЯРНО
ОРИГ

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3.3 RESET TEST

Both indicators were programmed for current reset. The test started with running a current above the level for fault indication. When both indicators showed a fault condition the current was adjusted to a level inside the range for normal operation. Both indicators changed from fault to normal when the current was inside the range for normal operation.

3.4 CONCLUSION

The results from the tests show that the fault indicators LINETROLL 110Eμ and CABLETROLL 2600 did withstand two short-time currents of 25 kA and duration of 0,17 s. The trip current test and the reset test after the short circuit showed that the fault indicators has not been harmed of the short-circuit. All test are performed at approx. 20°C. The trip verification rating test is not performed at various temperatures throughout the specified temperature range for the indicators.

ВЯРНО
ОРИГ

3 TEST PROGRAM AND RESULTS

The tests are performed in accordance with IEEE 495-1986: Testing Faulted Circuit Indicators, Part 4.4.8 – 10. This include the following three tests:

Part 4.4.8: Short-time current test
Part 4.4.9: Trip current test
Part 4.4.10: Reset test

3.1 SHORT-TIME CURRENT TEST

The purpose of this test is to verify that the indicators are capable of withstanding a short-time current. The cable with the fault indicators were subjected to a short-circuit current of 25,8 kA and a duration of 0,17 s. Both indicators moved from normal to fault condition. After resetting the indicators a second short-circuit of 25,5 kA was submitted to the cable. The indicators moved from normal to fault after the second test.

3.2 TRIP CURRENT TEST

The trip current test is performed after the short-time current tests and includes trip current rating verification test and a test for effect of current adjacent conductor. The trip current rating verification test shall verify that the indicators will move from an indication of normal to an indication of fault when the current passes the level for fault indication.

The indicators have an inrush blocking of 5 seconds. After running a current for 5 seconds the indicators moved to normal operation. The current was then increased to a level above fault indication. Both indicators changed from normal to fault when the current increased above the level for fault indication. The trip current rating verification test is done at 20°C.

The test for effect of current adjacent conductor shall verify that the indicators will continue to indicate normal when it is positioned in any orientation near an unshielded conductor carrying a fault current of 25 kA.

The indicators were located at a distance of 1 m (manufacturer specification) from a conductor carrying a short-circuit current of 25, 4 kA. Both indicators continued to indicate normal after the short-circuit current in the conductor.

1 PURPOSE OF THE TEST

The purpose of the test is to verify that that the fault indicators are capable of withstanding short-time current, and are working in accordance with manufacturer specifications after a short-circuit.

2 TEST OBJECT

Two different types of fault indicators were tested:

1. LINETROLL 110E . Phasemounted fault indicator for MV overhead line network.
2. CABLETROLL 2600. Fault indicator for mounting on MV cable network

The indicators were mounted on a single core cable as shown in Figure 1.

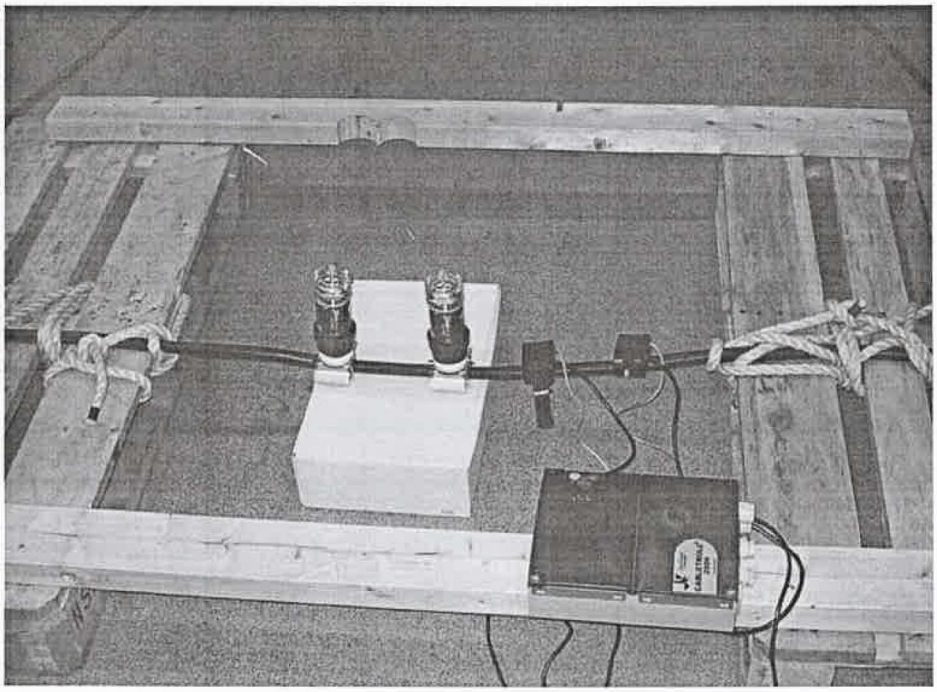

Figure 1: Test set-up with fault indicators mounted on a single core cable. Linetroll 110Eμ to the left and Cabletroll 2600 to the right.

Linetroll 110Eμ is equipped with a bracket that is used to clamp the indicator to the cable. Cabletroll 2600 consist of a main unit (electronic box) and sensors. The sensors are mounted on the cable with signal cables connection between the sensors and the main unit.

The cable was connected to a transformer with a voltage of 115 V and frequency of 50 Hz.

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