



Prüfbericht (Test Report)

CETECOM ICT Services GmbH
Untertürkheimer Straße 6-10
D-66117 Saarbrücken



TTI-P-G166/98-30

Accredited Bluetooth™ Test Facility (BQTF)

Test Report No.: 2-3063-01-03/02

ETSI EN 300 086-1 V1.2.1

TX-2020

CETECOM – ICT Services GmbH
Untertürkheimerstr. 6-10
66117 Saarbrücken, Germany

Telephone: + 49 (0) 681 / 598-0
Fax: + 49 (0) 681 / 9075

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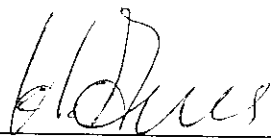
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1 General Information

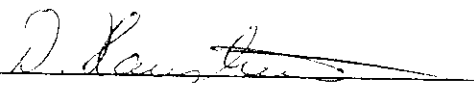
1.1 Notes

The test results of this test report relate exclusively to the item tested as specified in 1.5. The CETECOM ICT Services GmbH does not assume responsibility for any conclusions and generalisations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of the CETECOM ICT Services GmbH.

Test Laboratory Manager:

2003-01-21	RSC8414	Ames H.	
Date	Section	Name	Signature

Technical Responsibility for Area of Testing:

2003-01-21	RSC8412	Hausknecht D.	
Date	Section	Name	Signature

1.2 Testing Laboratory

CETECOM ICT Services GmbH
Untertürkheimer Straße 6 - 10
66117 Saarbrücken
Germany
Telefon : + 49 681 598 - 0
Telefax : + 49 681 598 - 9075
E-mail : info@ict.cetecom.de
Internet : www.cetecom-ict.de

details of accreditation status, where relevant)

State of accreditation: The Test laboratory (area of testing) is accredited according to DIN EN ISO/IEC 17025.

DAR registration number: TTI-P-G-166/98

Test location, where different from CETECOM ICT Services GmbH:

Name :
Street :
Town :
Country :
Telephone :
Telefax :

1.3 Details of Applicant

Name : TTI TECH CO., LTD.
Street : Room 402, Eundo Bldg., 737-19 Banpo-1 Dong, Seocho-Ku
Town : Seoul
Country : Korea
Telephone : +82 2 518 2417
Fax : +82 2 518 2419
Contact : Mr. H. J. Lee
Telephone : +82 2 518 2417

1.4 Application Details

Date of receipt of application : 2003-01-02

Date of receipt of test item : 2003-01-02

Date of test : 2003-01-21

1.5 Test item

Type of equipment : 2 Way Handheld radio

Type designation : **TX-2020**

Serial number : -/-

Manufacturer : applicant

Name :

Street :

Town :

Country :

Additional Information

Frequency : 146 MHz – 174 MHz

Channel separation : 25 kHz – Wide Band / 12,5 kHz – Narrow Band

Number of channels : 16

Antenna : Replaceable antenna – (¼ Wave)

Power supply : Tx:/Rx: 7,5V DC (NiMH)

Type of equipment : Category I

Unmodulated carrier : possible

1.6 Test Specification

ETSI EN 300 086-1 V1.2.1 (2001-03)

Electromagnetic compatibility and Radio spectrum Matters (ERM); Land mobile service.
Technical characteristics and methods of measurements, radio equipment with an internal or external RF connector intended primarily for analogue speech.

2 Technical Test

2.1 Summary of Test Results

No deviations from the technical specification(s) were ascertained in the course of the tests performed.

Remark: The antenna is removable, but has no standard RF connector.
So we used during the tests a temporary coax connector directly soldered to the antenna output port. The loss of this connection was < 1dB. The EIRP was measured with the standard external antenna.

2.2 Test Environment

Temperature

Normal test temperature (T_{nom}) : +21 °C
Extreme test temperatures (T_{max}) : +50 °C
(T_{min}) : -20 °C

Relative Humidity : 35%

Details of power supply

Normal test voltage (V_{nom}) : 7.5V
Extreme test voltage (V_{max}) : 7,5V
(V_{min}) : 6,8V

Measured channels	Tx	Rx
1 (148,050 MHz)	X	X
2		
3 (173,950 MHz)	X	X

2.3 Test results

LIST OF MEASUREMENTS

The list of parameters called for in ETSI EN 300 086 is given below.

Clause	Transmitter parameters	Performed	Page
5.1.1/8.1	Frequency error		
5.1.2/8.2	Carrier power (conducted)	yes	8
5.1.3/8.3	Effective radiated power	yes	9
5.1.4/8.4	Frequency deviation	yes	11
5.1.5/8.5	Adjacent channel power	yes	13
5.1.6/8.6	Spurious emissions	yes	17
5.1.8/8.8	Transient frequency behaviour of the transmitter	yes	19
		yes	21

Clause	Receiver parameters		
5.2.1/9.1	Maximum usable sensitivity (conducted)		
5.2.3/9.3	Amplitude characteristic of the receiver	yes	30
5.2.4/9.4	Co-channel rejection	yes	31
5.2.5/9.5	Adjacent channel selectivity	yes	32
5.2.6/9.6	Spurious response rejection	yes	34
5.2.7/9.7	Intermodulation response rejection	yes	36
5.2.8/9.8	Blocking or desensitisation	yes	37
5.2.9/9.9	Spurious radiations-(radiated)	yes	39
		yes	41

Ambient temperature : 23 °C

Relative humidity : 35%

Transmitter frequency error

ETSI EN 300 086-1 Clause 8.1

12,5 kHz – Narrow Band / 25 kHz – Wide Band

TEST CONDITIONS		FREQUENCY ERROR (Hz)		
Channel		1 (148,050 MHz)	2	3 (173,950 MHz)
T _{nom}	V _{nom}	-20		0
T _{min}	V _{min}	-25		-20
	V _{max}	-25		-20
T _{max}	V _{min}	-100		-140
	V _{max}	-100		-140
Maximum freq. error. (Hz)		-100		-140
Measurement uncertainty		< 10 ⁻⁹ ± 10 Hz		

Limits: Clause 5.1.1

CHANNEL SPACING (kHz)	FREQUENCY RANGES				
	Below 47MHz	Above 47 to 137MHz	Above 137 to 300MHz	Above 300 to 500MHz	Above 500 to 1000MHz
	LIMITS kHz				
12.5	± 0.60	± 1.00	± 1.50	± 1.50	—
20.0 & 25.0	± 0.60	± 1.35	± 2.00	± 2.00	± 2.50

Reference number(s) of test equipment used 07, 14, 15, 16 (for reference see test equipment listing)

Ambient temperature : 23 °C

Relative humidity : 35%

Carrier power (conducted)

ETSI EN 300 086-1 Clause 8.2

Rated Output Power 5,00 Watts

12,5 kHz – Narrow Band / 25 kHz – Wide Band

TEST CONDITIONS		TRANSMITTER POWER (Watts)		
Channel		1 (148,050 MHz)	2	3 (173,950 MHz)
Tnom	Vnom	5,20		4,69
Tmin	Vmin	4,96		4,29
	Vmax	5,72		4,96
Tmax	Vmin	4,66		4,34
	Vmax	4,92		4,52
Variation in output power under normal test conditions (dB)		0,0		0,0
Variation in output power under extreme test conditions (dB)		-0,60 / +0,61		-1,16
Measurement uncertainty		< ± 0.75 dB		

LIMITS CLAUSE 5.1.2

Under normal test conditions	± 1.5 (dB)
Under extreme test conditions	+ 2.0 (dB) - 3.0 (dB)

Reference number(s) of test equipment used 07, 14, 15, 16 (for reference see test equipment listing)

Ambient temperature : 23 °C

Relative humidity : 35%

Carrier power (conducted)

ETSI EN 300 086-1 Clause 8.2

Rated Output Power 1,00 Watts

12,5 kHz – Narrow Band / 25 kHz – Wide Band

TEST CONDITIONS		TRANSMITTER POWER (Watts)		
Channel		1 (148,050 MHz)	2	3 (173,950 MHz)
Tnom	Vnom	1,05		0,95
Tmin	Vmin	0,89		0,88
	Vmax	1,10		0,99
Tmax	Vmin	0,89		0,89
	Vmax	0,96		0,91
Variation in output power under normal test conditions (dB)		0,0		0,0
Variation in output power under extreme test conditions (dB)		-0,4		-0,4
Measurement uncertainty		< ± 0.75 dB		

LIMITS CLAUSE 5.1.2

Under normal test conditions	± 1.5 (dB)
Under extreme test conditions	+ 2.0 (dB) - 3.0 (dB)

Reference number(s) of test equipment used 07, 14, 15, 16 (for reference see test equipment listing)

Ambient temperature : 23 °C

Relative humidity : 35%

Transmitter carrier output power (radiated)

ETSI EN 300 086-1 Clause 8.3

Rated Output Power 5,00 Watts

12,5 kHz – Narrow Band / 25 kHz – Wide Band

TEST CONDITIONS		TRANSMITTER POWER (Watts)		
Channel		1 (148,050 MHz)	2	3 (173,950 MHz)
Tnom	Vnom	5,05		4,21
Tmin	Vmin	5,22		4,21
	Vmax	5,61		4,71
Tmax	Vmin	4,40		3,84
	Vmax	4,78		4,02
Variation in output power under normal test conditions (dB)		0,0		0,0
Variation in output power under extreme test conditions (dB)		-0,35		-0,35
Measurement uncertainty		< ± 0.75 dB		

LIMITS CLAUSE 5.1.3

Under normal test conditions	± 1.5 (dB)
Under extreme test conditions	+ 2.0 (dB) - 3.0 (dB)

Reference number(s) of test equipment used 07, 14, 15, 16 (for reference see test equipment listing)

Ambient temperature : 23 °C

Relative humidity : 35%

Transmitter carrier output power (radiated)

ETSI EN 300 086-1 Clause 8.3

Rated Output Power 1,00 Watts

12,5 kHz – Narrow Band / 25 kHz – Wide Band

TEST CONDITIONS		TRANSMITTER POWER (Watts)		
Channel		1 (148,050 MHz)	2	3 (173,950 MHz)
Tnom	Vnom	0,95		0,85
Tmin	Vmin	0,84		0,84
	Vmax	0,90		0,92
Tmax	Vmin	0,86		0,85
	Vmax	0,91		0,85
Variation in output power under normal test conditions (dB)		0,0		0,0
Variation in output power under extreme test conditions (dB)		+0,8 / -1,4		+0,4 / -1,5
Measurement uncertainty		< ± 0.75 dB		

LIMITS CLAUSE 5.1.3

Under normal test conditions	± 1.5 (dB)
Under extreme test conditions	+ 2.0 (dB) - 3.0 (dB)

Reference number(s) of test equipment used 07, 14, 15, 16 (for reference see test equipment listing)

Ambient temperature : 23 °C

Relative humidity : 35%

Transmitter frequency deviationETSI EN 300 086-1 **Clause 8.4**

12,5 kHz – Narrow Band

MODULATION FREQUENCY (Hz)	MAXIMUM DEVIATION IN kHz		
Channel	1 (148,050 MHz)	2	3 (173,950 MHz)
Lowest frequency (300 Hz)	1,42		1,62
50	0,04		0,03
100	0,19		0,16
200	0,72		0,81
300	1,38		1,47
400	1,58		1,67
500	1,71		1,78
1000	1,94		2,03
2000	1,62		1,71
2550	1,74		1,83
3000	1,70		1,80
Measurement uncertainty	< ± 5 %		

LIMITS CLAUSE 5.1.4

CHANNEL SPACING (kHz)	MAXIMUM PERMISSIBLE FREQUENCY DEVIATION
	LIMITS (kHz)
12.5	± 2.5
20.0	± 4.0
25.0	± 5.0

Reference number(s) of test equipment used 06, 07, 14, 15 (for reference see test equipment listing)

Ambient temperature : 23 °C

Relative humidity : 35%

Transmitter frequency deviation

ETSI EN 300 086-1 **Clause 8.4**

12,5 kHz – Narrow Band

MODULATION FREQUENCY (Hz)	Percentage maximum deviation (kHz) or Relative deviation (dB)		
	1 (440,050 MHz)	2	3 (469,950 MHz)
1000	1,94		2,03
2550	1,74		1,83
3000	1,70		1,80
4000	0,40		0,44
5000	0,13		0,15
6000	0,06		0,08
8000	0,03		0,04
12000	0,02		0,03
12550	0,02		0,03
20000	0,02		0,03
25000	0,02		0,03
Measurement uncertainty	< $\pm$ 3 dB		

LIMITS CLAUSE 5.1.4 APPLIES

Reference number(s) of test equipment used 06, 07, 14, 15 (for reference see test equipment listing)

Ambient temperature : 23 °C

Relative humidity : 35%

Transmitter frequency deviation

ETSI EN 300 086-1 Clause 8.4

25 kHz – Wide Band

MODULATION FREQUENCY (Hz)	MAXIMUM DEVIATION IN kHz		
Channel	1 (148,050 MHz)	2	3 (173,950 MHz)
Lowest frequency (300 Hz)			
50	0,03		0,03
100	0,39		0,57
200	2,37		2,39
300	3,51		3,75
400	3,43		3,72
500	3,60		3,96
1000	4,12		4,62
2000	3,52		3,97
2550	4,02		4,56
3000	3,95		4,47
Measurement uncertainty	< ± 5 %		

LIMITS CLAUSE 5.1.4

CHANNEL SPACING (kHz)	MAXIMUM PERMISSIBLE FREQUENCY DEVIATION
	LIMITS (kHz)
12.5	± 2.5
20.0	± 4.0
25.0	± 5.0

Reference number(s) of test equipment used 06, 07, 14, 15 (for reference see test equipment listing)

Ambient temperature : 23 °C

Relative humidity : 35%

Transmitter frequency deviation

ETSI EN 300 086-1 Clause 8.4

25 kHz – Wide Band

MODULATION FREQUENCY (Hz)	Percentage maximum deviation (kHz) or Relative deviation (dB)		
	1 (148,050 MHz)	2	3 (173,950 MHz)
1000	4,12		4,62
2550	4,02		4,56
3000	3,95		4,47
4000	0,95		1,07
5000	0,30		0,33
6000	0,13		0,14
8000	0,04		0,04
12000	0,02		0,02
12550	0,02		0,02
20000	0,02		0,02
25000	0,02		0,02
Measurement uncertainty	$< \pm 3$ dB		

LIMITS CLAUSE 5.1.4 APPLIES

Reference number(s) of test equipment used 06, 07, 14, 15 (for reference see test equipment listing)

Ambient temperature : 23 °C

Relative humidity : 35%

Transmitter adjacent channel power

ETSI EN 300 086-1 Clause 8.5

12,5 kHz – Narrow Band

Rated output power: (max) 5,00 W

MEASUREMENT	BELOW CARRIER POWER(dBc)		
Channel	1 (148,050 MHz)	2	3 (173,950 MHz)
+(12,5)kHz	-68,0		-68,1
-(12,5)kHz	-66,2		-66,2
Measurement uncertainty	< ± 5 dB		

Rated output power 1,00 W

MEASUREMENT	BELOW CARRIER POWER(dBc)		
Channel	1 (148,050 MHz)	2	3 (173,950 MHz)
+(12,5)kHz	-68,2		-68,2
-(12,5)kHz	-66,2		-66,0
Measurement uncertainty	< ± 5 dB		

Limits: Clause 5.1.5

CHANNEL SPACING (kHz)	ADJACENT CHANNEL POWER
	LIMITS
12.5	-60 dBc or 0,2 µW The limits shall not be exceeded without a need to be below 0,2 µW
20 / 25,0	-70 dBc or 0,2 µW The limits shall not be exceeded without a need to be below 0,2 µW

Ambient temperature : 23 °C

Relative humidity : 35%

Transmitter adjacent channel power

25 kHz – Wide Band

ETSI EN 300 086-1 Clause 8.5

Rated output power: (max) 5,00 W

MEASUREMENT	BELOW CARRIER POWER(dBc)		
	1 (148,050 MHz)	2	3 (173,950 MHz)
+(25,0)kHz	-81,1		-83,0
-(25,0)kHz	-79,0		-81,6
Measurement uncertainty	< ± 5 dB		

Rated output power 1,00 W

MEASUREMENT	BELOW CARRIER POWER(dBc)		
	1 (148,050 MHz)	2	3 (173,950 MHz)
+(25,0)kHz	-81,1		-82,9
-(25,0)kHz	-80,0		-81,4
Measurement uncertainty	< ± 5 dB		

Limits: Clause 5.1.5

CHANNEL SPACING (kHz)	ADJACENT CHANNEL POWER
	LIMITS
12.5	-60 dBc or 0,2 µW The limits shall not be exceeded without a need to be below 0,2 µW
20 / 25.0	-70 dBc or 0,2 µW The limits shall not be exceeded without a need to be below 0,2 µW

Ambient temperature : 23 °C

Relative humidity : 35%

Transmitter spurious emissions (radiated)

ETSI EN 300 086-1 Clause 8.6

Tx operating:

Spurious emissions level (dBm)					
Ch 1 (148,050 MHz)		Ch 2		Ch 3 (173,950 MHz)	
Frequency	Emissions	Frequency	Emissions	Frequency	Emissions
134,5 MHz	-51,6			146,3 MHz	-51,4
177,6 MHz	-51,9			160,4 MHz	-54,1
297,2 MHz	-62,0			189,5 MHz	-54,3
444,9 MHz	-61,0			349,0 MHz	-62,4
593,6 MHz	-57,6			522,5 MHz	-63,2
741,3 MHz	-58,0			697,1 MHz	-66,0
1483,3 MHz	-49,1			2436,6 MHz	-64,9
1780,0 MHz	-55,5				
2816,6 MHz	-56,4				
Measurement uncertainty		< ± 4dB			

Tx on standby: Rx mode

Spurious emissions level (dBm)(radiated and conducted)					
Ch 1		Ch 2		Ch 3	
Frequency	Emissions	Frequency	Emissions	Frequency	Emissions
no peak found				no peak found	
Measurement uncertainty		< ± 4dB			

Limits CLAUSE 5.1.6 TABLE 3 and 4

Frequency range	30 MHz to 1 GHz	Above 1 to 12 GHz, (clause 7.6.2)
Tx operating	0.25 µW (-36.0 dBm)	1.00 µW (-30.0 dBm)
Tx standby	2.0 nW (-57.0 dBm)	20.0 nW (-47.0 dBm)

Reference Number(s) of Test Equipment: 1.00, 1.1, 1.5, 1.7, 1.8, 1.9, 2.0, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, 3.0, 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9, 4.0, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 4.9, 5.0, 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8, 5.9, 6.0, 6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8, 6.9, 7.0, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, 7.8, 7.9, 8.0, 8.1, 8.2, 8.3, 8.4, 8.5, 8.6, 8.7, 8.8, 8.9, 9.0, 9.1, 9.2, 9.3, 9.4, 9.5, 9.6, 9.7, 9.8, 9.9, 10.0, 10.1, 10.2, 10.3, 10.4, 10.5, 10.6, 10.7, 10.8, 10.9, 11.0, 11.1, 11.2, 11.3, 11.4, 11.5, 11.6, 11.7, 11.8, 11.9, 12.0, 12.1, 12.2, 12.3, 12.4, 12.5, 12.6, 12.7, 12.8, 12.9, 13.0, 13.1, 13.2, 13.3, 13.4, 13.5, 13.6, 13.7, 13.8, 13.9, 14.0, 14.1, 14.2, 14.3, 14.4, 14.5, 14.6, 14.7, 14.8, 14.9, 15.0, 15.1, 15.2, 15.3, 15.4, 15.5, 15.6, 15.7, 15.8, 15.9, 16.0, 16.1, 16.2, 16.3, 16.4, 16.5, 16.6, 16.7, 16.8, 16.9, 17.0, 17.1, 17.2, 17.3, 17.4, 17.5, 17.6, 17.7, 17.8, 17.9, 18.0, 18.1, 18.2, 18.3, 18.4, 18.5, 18.6, 18.7, 18.8, 18.9, 19.0, 19.1, 19.2, 19.3, 19.4, 19.5, 19.6, 19.7, 19.8, 19.9, 20.0, 20.1, 20.2, 20.3, 20.4, 20.5, 20.6, 20.7, 20.8, 20.9, 21.0, 21.1, 21.2, 21.3, 21.4, 21.5, 21.6, 21.7, 21.8, 21.9, 22.0, 22.1, 22.2, 22.3, 22.4, 22.5, 22.6, 22.7, 22.8, 22.9, 23.0, 23.1, 23.2, 23.3, 23.4, 23.5, 23.6, 23.7, 23.8, 23.9, 24.0, 24.1, 24.2, 24.3, 24.4, 24.5, 24.6, 24.7, 24.8, 24.9, 25.0, 25.1, 25.2, 25.3, 25.4, 25.5, 25.6, 25.7, 25.8, 25.9, 26.0, 26.1, 26.2, 26.3, 26.4, 26.5, 26.6, 26.7, 26.8, 26.9, 27.0, 27.1, 27.2, 27.3, 27.4, 27.5, 27.6, 27.7, 27.8, 27.9, 28.0, 28.1, 28.2, 28.3, 28.4, 28.5, 28.6, 28.7, 28.8, 28.9, 29.0, 29.1, 29.2, 29.3, 29.4, 29.5, 29.6, 29.7, 29.8, 29.9, 30.0, 30.1, 30.2, 30.3, 30.4, 30.5, 30.6, 30.7, 30.8, 30.9, 31.0, 31.1, 31.2, 31.3, 31.4, 31.5, 31.6, 31.7, 31.8, 31.9, 32.0, 32.1, 32.2, 32.3, 32.4, 32.5, 32.6, 32.7, 32.8, 32.9, 33.0, 33.1, 33.2, 33.3, 33.4, 33.5, 33.6, 33.7, 33.8, 33.9, 34.0, 34.1, 34.2, 34.3, 34.4, 34.5, 34.6, 34.7, 34.8, 34.9, 35.0, 35.1, 35.2, 35.3, 35.4, 35.5, 35.6, 35.7, 35.8, 35.9, 36.0, 36.1, 36.2, 36.3, 36.4, 36.5, 36.6, 36.7, 36.8, 36.9, 37.0, 37.1, 37.2, 37.3, 37.4, 37.5, 37.6, 37.7, 37.8, 37.9, 38.0, 38.1, 38.2, 38.3, 38.4, 38.5, 38.6, 38.7, 38.8, 38.9, 39.0, 39.1, 39.2, 39.3, 39.4, 39.5, 39.6, 39.7, 39.8, 39.9, 40.0, 40.1, 40.2, 40.3, 40.4, 40.5, 40.6, 40.7, 40.8, 40.9, 41.0, 41.1, 41.2, 41.3, 41.4, 41.5, 41.6, 41.7, 41.8, 41.9, 42.0, 42.1, 42.2, 42.3, 42.4, 42.5, 42.6, 42.7, 42.8, 42.9, 43.0, 43.1, 43.2, 43.3, 43.4, 43.5, 43.6, 43.7, 43.8, 43.9, 44.0, 44.1, 44.2, 44.3, 44.4, 44.5, 44.6, 44.7, 44.8, 44.9, 45.0, 45.1, 45.2, 45.3, 45.4, 45.5, 45.6, 45.7, 45.8, 45.9, 46.0, 46.1, 46.2, 46.3, 46.4, 46.5, 46.6, 46.7, 46.8, 46.9, 47.0, 47.1, 47.2, 47.3, 47.4, 47.5, 47.6, 47.7, 47.8, 47.9, 48.0, 48.1, 48.2, 48.3, 48.4, 48.5, 48.6, 48.7, 48.8, 48.9, 49.0, 49.1, 49.2, 49.3, 49.4, 49.5, 49.6, 49.7, 49.8, 49.9, 50.0, 50.1, 50.2, 50.3, 50.4, 50.5, 50.6, 50.7, 50.8, 50.9, 51.0, 51.1, 51.2, 51.3, 51.4, 51.5, 51.6, 51.7, 51.8, 51.9, 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158.8, 158.9, 159.0, 159.1, 159.2, 159.3, 159.4, 159.5, 159.6, 159.7, 159.8, 159.9, 160.0, 160.1, 160.2, 160.3, 160.4, 160.5, 160.6, 160.7, 160.8, 160.9, 161.0, 161.1, 161.2, 161.3, 161.4, 161.5, 161.6, 161.7, 161.8, 161.9, 162.0, 162.1, 162.2, 162.3, 162.4, 162.5, 162.6, 162.7, 162.8, 162.9, 163.0, 163.1, 163.2, 163.3, 163.4, 163.5, 163.6, 163.7, 163.8, 163.9, 164.0, 164.1, 164.2, 164.3, 164.4, 164.5, 164.6, 164.7, 164.8, 164.9, 165.0, 165.1, 165.2, 165.3, 1

Ambient temperature : 23 °C

Relative humidity : 35%

Transmitter spurious emissions (conducted)

ETSI EN 300 086-1 Clause 8.6

Tx operating:

Spurious emissions level (dBm)					
Ch 1 (148,050 MHz)		Ch 2		Ch 3 (173,950 MHz)	
Frequency	Emissions	Frequency	Emissions	Frequency	Emissions
134,5 MHz	-46,2			146,3 MHz	-47,3
177,6 MHz	-47,3			160,4 MHz	-50,1
297,2 MHz	-55,3			189,5 MHz	-49,3
444,9 MHz	-54,8			349,0 MHz	-54,5
593,6 MHz	-51,6			522,5 MHz	-54,9
741,3 MHz	-53,1			697,1 MHz	-60,0
1483,3 MHz	-45,5			2436,6 MHz	-58,4
1780,0 MHz	-49,9				
2816,6 MHz	-51,4				
Measurement uncertainty		< ± 4dB			

Tx on standby: Rx mode

Spurious emissions level (dBm)(radiated and conducted)					
Ch 1		Ch 2		Ch 3	
Frequency	Emissions	Frequency	Emissions	Frequency	Emissions
no peak found				no peak found	
Measurement uncertainty		< ± 4dB			

Limits CLAUSE 5.1.6 TABLE 3 and 4

Frequency range	30 MHz to 1 GHz	Above 1 to 12 GHz, (clause 7.6.2)
Tx operating	0.25 µW (-36.0 dBm)	1.00 µW (-30.0 dBm)
Tx standby	2.0 nW (-57.0 dBm)	20.0 nW (-47.0 dBm)

Ambient temperature : 23 °C

Relative humidity : 35%

Transmitter transient frequency behaviour

ETSI EN 300 086-1 **Clause 8.8**

12,5 kHz – Narrow Band and 25 kHz – Wide Band

TRANSIENT TIMES (mS)	CHANNEL		
	Ch 1 (148,050 MHz)	Ch 2	Ch 3 (173,950 MHz)
t1 (ms)	1		1
t2 (ms)	8,6		5,6
t3 (ms)	1		1
Measurement uncertainty	< ± 20 %		

Confirm that during the periods t1 and t3 the frequency difference does not exceed the value of one channel separation

YES ☒ NO ☐

Confirm that during the period t2 the frequency difference does not exceed the value of half a channel separation

YES ☒ NO ☐

LIMITS CLAUSE 5.1.8

	30 to 300 MHz	300 to 500 MHz	500 to 1000MHz
t1(mS)	5.0	10.0	20.0
t2(mS)	20.0	25.0	50.0
t3(mS)	5.0	10.0	10.0

In the case of hand portable stations with a transmitter power of less than 5 watts the frequency deviation during t1 and t3 may be greater than one channel. The corresponding plot of frequency versus time during t1 and t3 shall be recorded.

Reference number(s) of test equipment used 07, 09, 13 (for reference see test equipment listing)

Ambient temperature : 23 °C

Relative humidity : 35%

Transmitter transient frequency behaviour 12,5 kHz

ETSI EN 300 086-1 Clause 8.8

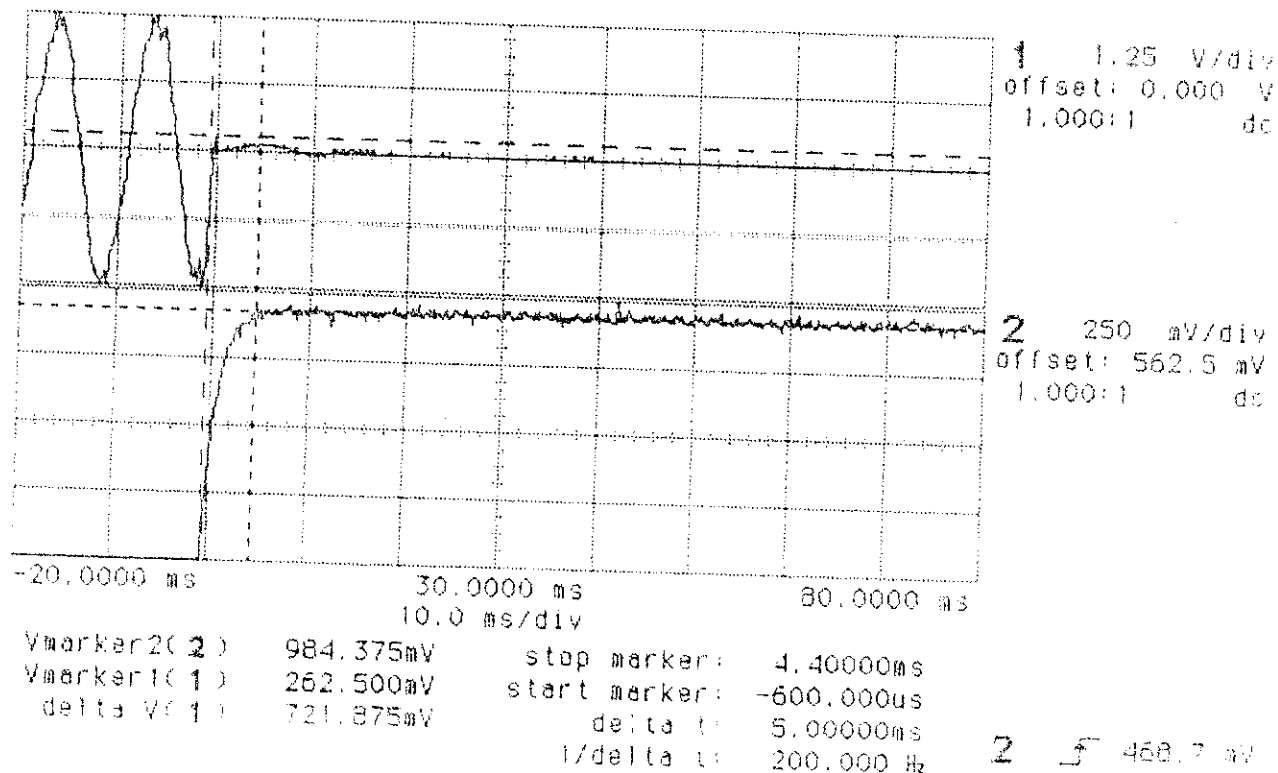
Graph 1 - Transmitter switch-on behaviour

Channel : Frequency: 148,050 MHz

Remark: channel 1 : frequency difference
(100 mV conforms to 1kHz)

channel 2 : transmitter output power
(100 mV conforms to 10 dB)

hp awaiting trigger



Reference number(s) of test equipment used 07, 09, 13 (for reference see test equipment listing)

Ambient temperature : 23 °C

Relative humidity : 35%

Transmitter transient frequency behaviour 12,5 kHz

ETSI EN 300 086-1 Clause 8.8

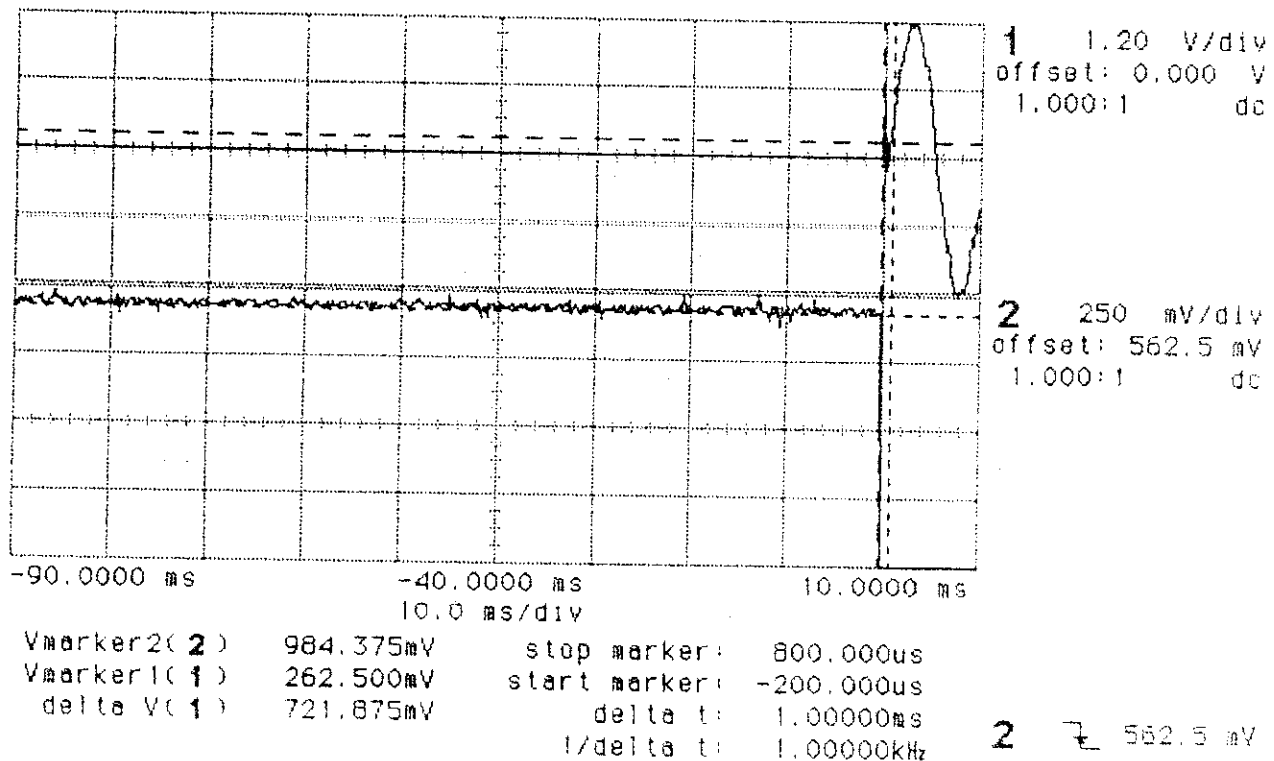
Graph 2 - Transmitter switch-off behaviour

Channel : Frequency: 148,050 MHz

Remark: channel 1 : frequency difference
(100 mV conforms to 1kHz)

channel 2 : transmitter output power
(100 mV conforms to 10 dB)

hp awaiting trigger



Reference number(s) of test equipment used 07, 09, 13 (for reference see test equipment listing)

Ambient temperature : 23 °C

Relative humidity : 35%

Transmitter transient frequency behaviour 12,5 kHz

ETSI EN 300 086-1 Clause 8.8

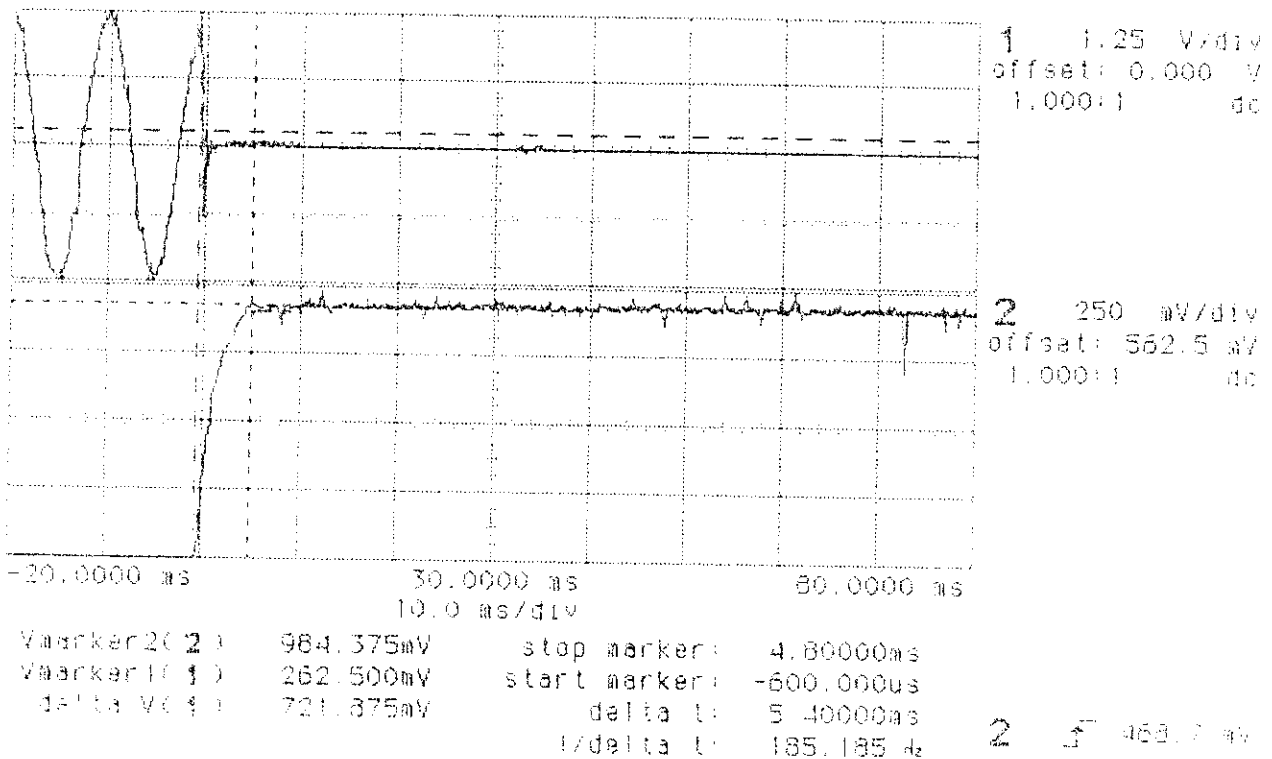
Graph 1 - Transmitter switch-on behaviour

Channel : Frequency: 173,950 MHz

Remark: channel 1 : frequency difference
(100 mV conforms to 1kHz)

channel 2 : transmitter output power
(100 mV conforms to 10 dB)

hz awaiting trigger



Reference number(s) of test equipment used 07, 09, 13 (for reference see test equipment listing)

Ambient temperature : 23 °C

Relative humidity : 35%

Transmitter transient frequency behaviour 12,5 kHz

ETSI EN 300 086-1 Clause 8.8

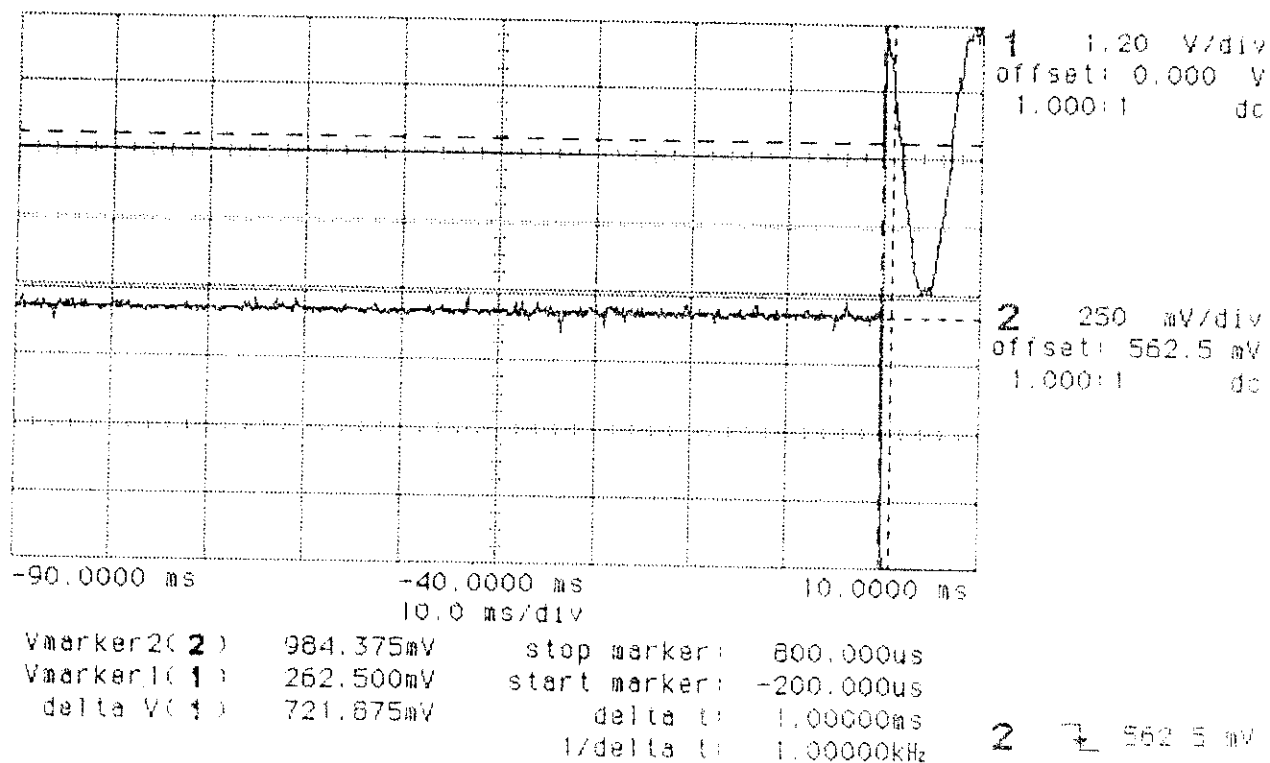
Graph 2 - Transmitter switch-off behaviour

Channel : Frequency: 173,950 MHz

Remark: channel 1 : frequency difference
(100 mV conforms to 1kHz)

channel 2 : transmitter output power
(100 mV conforms to 10 dB)

hp awaiting trigger



Reference number(s) of test equipment used 07, 09, 13 (for reference see test equipment listing)

Ambient temperature : 23 °C

Relative humidity : 35%

Transmitter transient frequency behaviour 25 kHz

ETSI EN 300 086-1 Clause 8.8

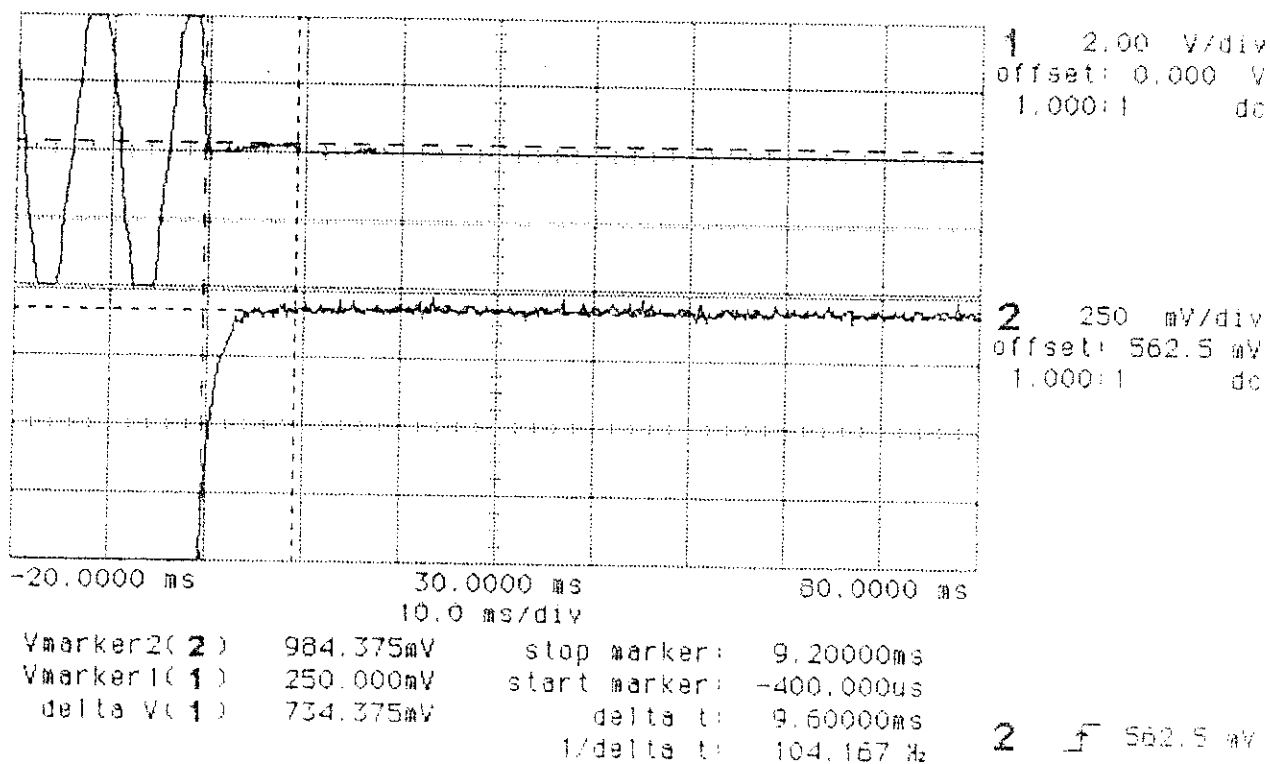
Graph 1 - Transmitter switch-on behaviour

Channel : Frequency: 148,050 MHz

Remark: channel 1 : frequency difference
(100 mV conforms to 1kHz)

channel 2 : transmitter output power
(100 mV conforms to 10 dB)

hp awaiting trigger



Reference number(s) of test equipment used 07, 09, 13 (for reference see test equipment listing)

Ambient temperature : 23 °C

Relative humidity : 35%

Transmitter transient frequency behaviour 25 kHz

ETSI EN 300 086-1 Clause 8.8

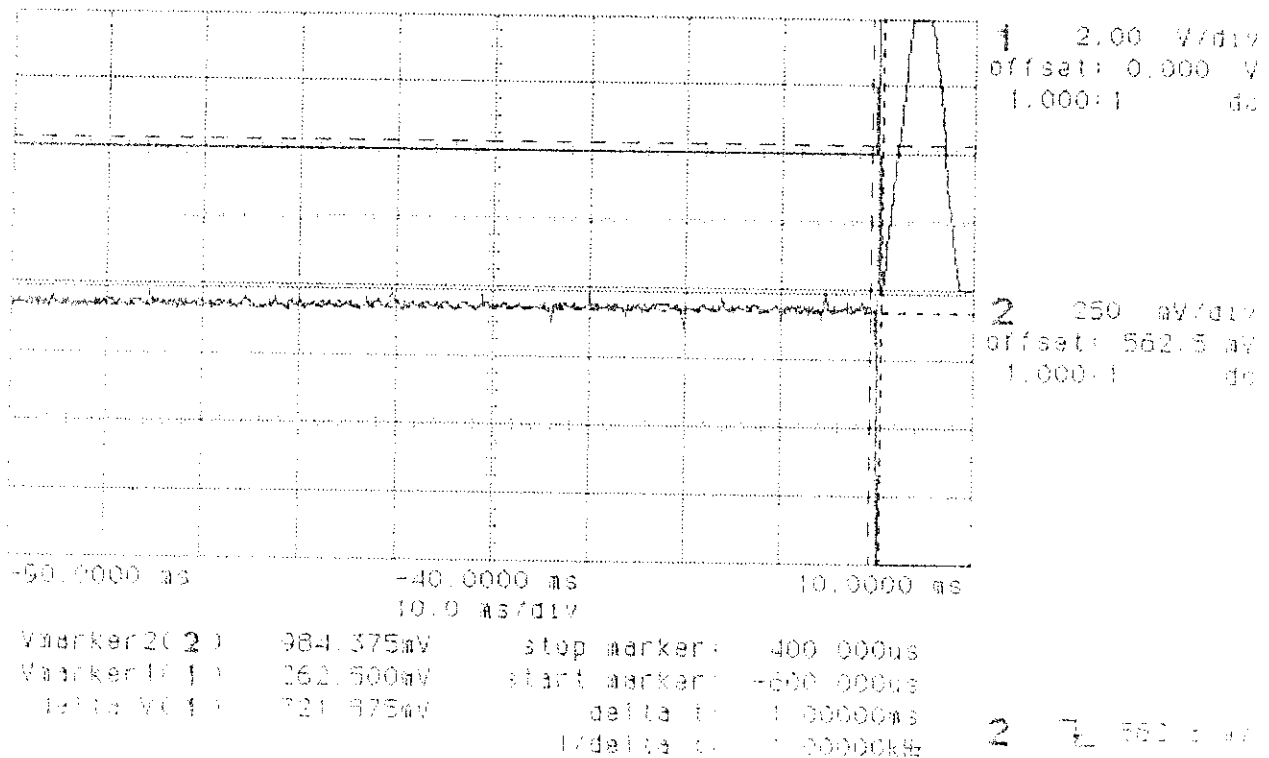
Graph 2 - Transmitter switch-off behaviour

Channel : Frequency: 148,050 MHz

Remark: channel 1 : frequency difference
(100 mV conforms to 1kHz)

channel 2 : transmitter output power
(100 mV conforms to 10 dB)

op awaiting trigger



Reference number(s) of test equipment used 07, 09, 13 (for reference see test equipment listing)

Ambient temperature : 23 °C

Relative humidity : 35%

Transmitter transient frequency behaviour 25 kHz

ETSI EN 300 086-1 Clause 8.8

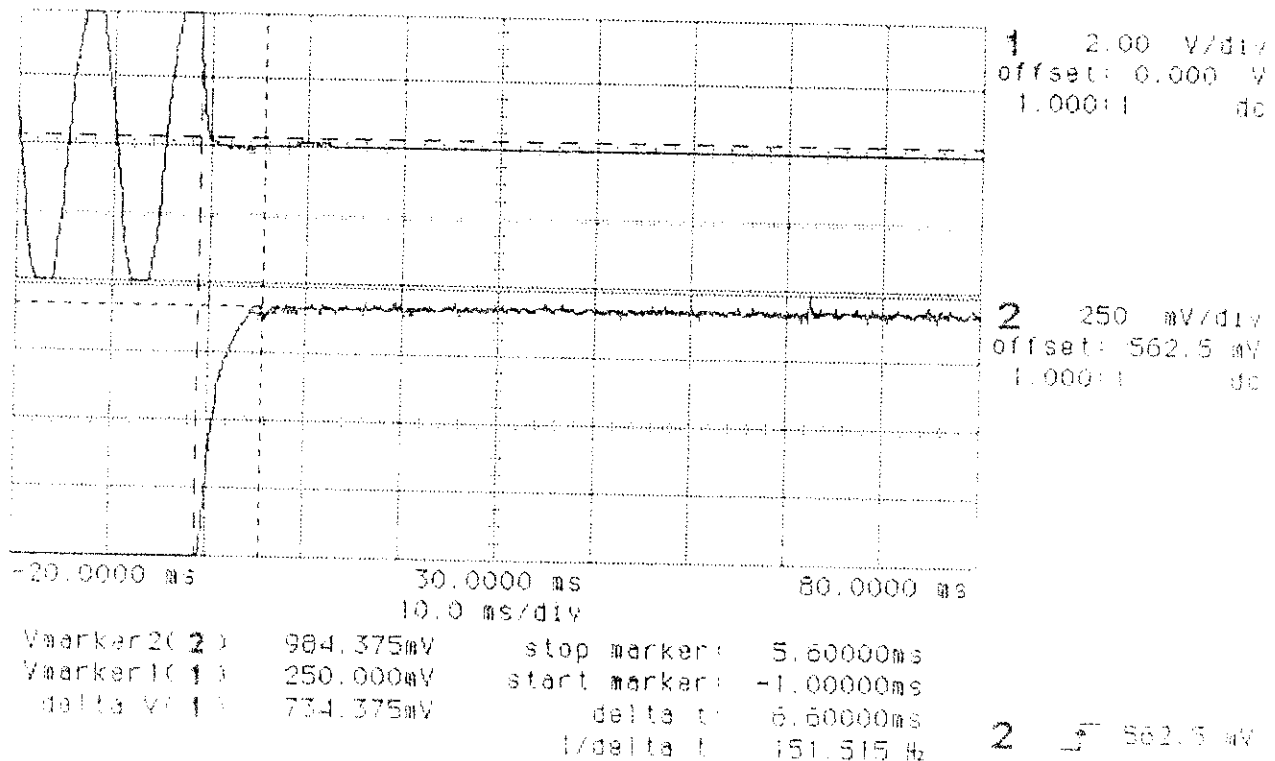
Graph 1 - Transmitter switch-on behaviour

Channel : Frequency: 173,950 MHz

Remark: channel 1 : frequency difference
(100 mV conforms to 1kHz)

channel 2 : transmitter output power
(100 mV conforms to 10 dB)

hp swaiting trigger



Reference number(s) of test equipment used 07, 09, 13 (for reference see test equipment listing)

Ambient temperature : 23 °C

Relative humidity : 35%

Transmitter transient frequency behaviour 25 kHz

ETSI EN 300 086-1 Clause 8.8

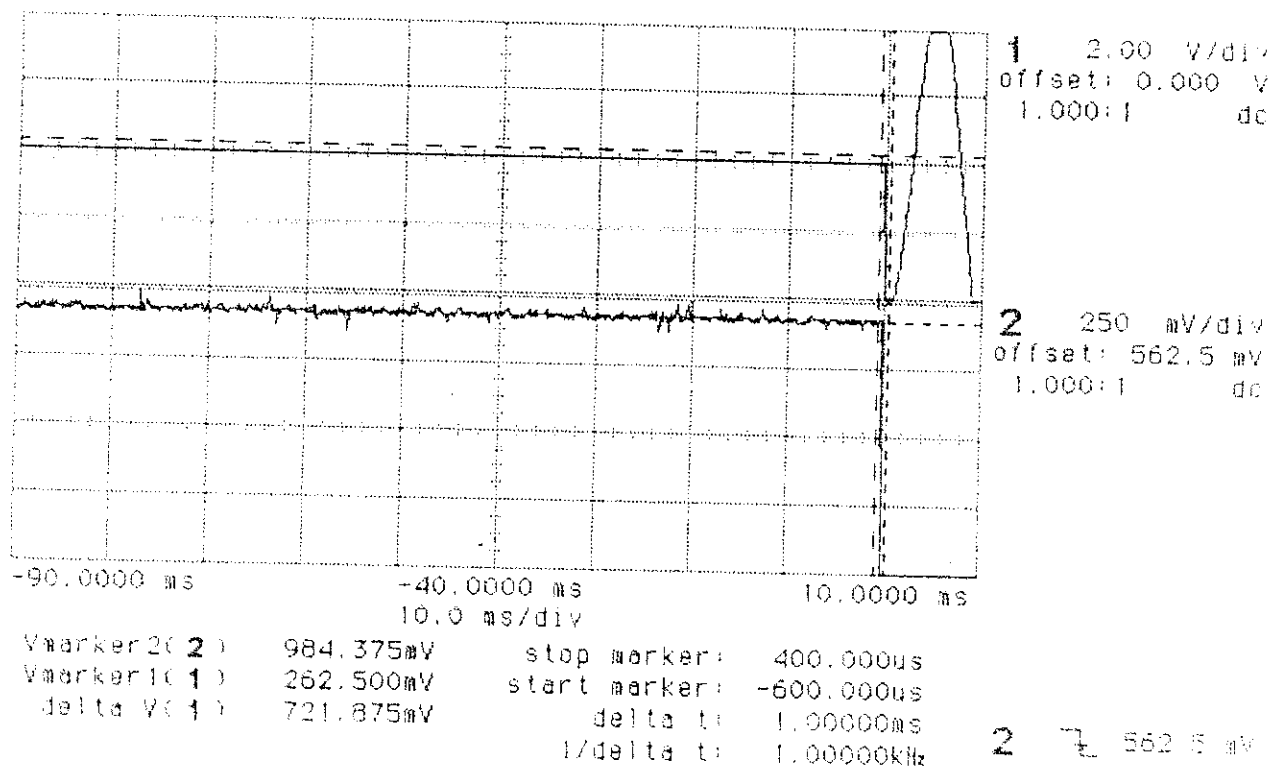
Graph 2 - Transmitter switch-off behaviour

Channel : Frequency: 173,950 MHz

Remark: channel 1 : frequency difference
(100 mV conforms to 1kHz)

channel 2 : transmitter output power
(100 mV conforms to 10 dB)

hp awaiting trigger



Reference number(s) of test equipment used 07, 09, 13 (for reference see test equipment listing)

Ambient temperature : 23 °C

Relative humidity : 35%

Receiver maximum usable sensitivity (conducted)

ETSI EN 300 086-1 Clause 9.1

12,5 kHz – Narrow Band and 25 kHz – Wide Band

TEST CONDITIONS		RECEIVER SENSIVITY (dBμV)		
Channel		Ch 1 (12,5/25 kHz) (148,050 MHz)	Ch 2	Ch 3 (12,5/25 kHz) (173,950 MHz)
Tnom	Vnom	-1,7/-1,4		-0,6/-1,6
Tmin	Vmin	-3,8/-3,2		-2,8/-2,6
	Vmax	-3,8/-3,2		-2,8/-2,6
Tmax	Vmin	-1,6/-1,4		0,5/-1,4
	Vmax	-1,6/-1,4		0,5/-1,4
Measurement uncertainty		< ± 3 dB		

AF output power under normal test conditions (at least 50% of max. rated)	200 mW
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LIMITS CLAUSE 5.2.1

Under normal test conditions	6 dBμV
Under extreme test conditions	12dBμV

Variation of the output power level under extreme test conditions	0,3 dB
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LIMIT

Under extreme test conditions	+ 3dB
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Reference number(s) of test equipment used 01, 07, 14, 15, 16(for reference see test equipment listing)

Ambient temperature : 23 °C

Relative humidity : 35%

Receiver amplitude characteristics

ETSI EN 300 086-1 **Clause 9.3**

12,5 kHz – Narrow Band / 25 kHz – Wide Band

RF INPUT TO RECEIVER	AUDIO OUTPUT CHANGE (dB)		
	Ch 1 (148,050 MHz)	Ch 2	Ch 3 (173,950 MHz)
6dBµV	AUDIO REFERENCE LEVEL SET TO 0 dB		
100dBµV	-0,6		-0,8
Measurement uncertainty	< ± 1.5 dB		

LIMIT CLAUSE 5.2.3

With input varied to reference input	3 (dB)
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(Within the specified change in radio frequency input signal level, the change of audio output level shall not exceed 3.0 dB.)

Reference number(s) of test equipment used 01-03, 05, 07, 14, 15 (for reference see test equipment listing)

Ambient temperature : 23 °C

Relative humidity : 35%

Receiver co-channel rejection

12,5 kHz – Narrow Band

ETSI EN 300 086-1 Clause 9.4

FREQUENCY OF UNWANTED SIGNAL	CHANNEL		
	REJECTION RATIO (dB)		
	Ch 1 (148,050 MHz)	Ch 2	Ch 3 (173,950 MHz)
f+12%	-7,0		-6,5
f+6%	-7,0		-7,2
f	-7,4		-7,3
f-6%	-8,5		-8,0
f-12%	-8,2		-8,1
Measurement uncertainty	< ± 4 dB		

The lowest value of the five measurement results noted shall be recorded as the co-channel rejection.

LIMIT CLAUSE 5.2.4

CHANNEL SPACING (kHz)	LIMIT (dB)
12.5	-12 and 0
20.0	-8 and 0
25.0	-8 and 0

Reference number(s) of test equipment used 01-02, 05, 07, 14, 15 (for reference see test equipment listing)

Ambient temperature : 23 °C

Relative humidity : 35%

Receiver co-channel rejection

ETSI EN 300 086-1 Clause 9.4

25 kHz – Wide Band

FREQUENCY OF UNWANTED SIGNAL	CHANNEL		
	REJECTION RATIO (dB)		
	Ch 1 (148,050 MHz)	Ch 2	Ch 3 (173,950 MHz)
f+12%	-6,0		-5,6
f+6%	-6,0		-6,0
f	-7,1		-6,7
f-6%	-7,3		-7,1
f-12%	-7,2		-7,0
Measurement uncertainty	< ± 4 dB		

The lowest value of the five measurement results noted shall be recorded as the co-channel rejection.

LIMIT CLAUSE 5.2.4

CHANNEL SPACING (kHz)	LIMIT (dB)
12.5	-12 and 0
20.0	-8 and 0
25.0	-8 and 0

Reference number(s) of test equipment used 01-02, 05, 07, 14, 15 (for reference see test equipment listing)

Ambient temperature : 23 °C

Relative humidity : 35%

Receiver adjacent channel selectivity

ETSI EN 300 086-1 Clause 9.5

12,5 kHz – Narrow Band

TEST CONDITIONS		UNWANTED SIGNAL + AND - RELATIVE TO WANTED RATIO (dB)					
Channel		Ch 1 (148,050 MHz)		Ch 2		Ch 3 (173,950 MHz)	
		+	-	+	-	+	-
Tnom	Vnom	71,8	67,4			67,5	70,1
Tmin	Vmin	62,4	60,5			64,6	66,2
	Vmax	62,4	60,7			64,6	66,2
Tmax	Vmin	57,2	56,4			68,2	68,1
	Vmax	57,2	56,4			68,2	68,1
Measurement uncertainty		< = 4 dB					

LIMITS CLAUSE 5.2.5

CHANNEL Separation (kHz)	Under normal conditions	Under extreme conditions
12.5	≥ 65 dB	≥ 55 dB
20.0	≥ 75 dB	≥ 65 dB
25.0	≥ 75 dB	≥ 65 dB

Reference number(s) of test equipment used 01-02, 05, 07, 14, 15, 16 (for reference see test equipment listing)

Ambient temperature : 23 °C

Relative humidity : 35%

Receiver adjacent channel selectivity

ETSI EN 300 086-1 **Clause 9.5**

25 kHz – Wide Band

TEST CONDITIONS		UNWANTED SIGNAL + AND - RELATIVE TO WANTED RATIO (dB)					
Channel		Ch 1 (148,050 MHz)		Ch 2		Ch 3 (173,950 MHz)	
		+	-	+	-	+	-
Tnom	Vnom	75,2	75,4			76,7	76,8
Tmin	Vmin	68,3	67,4			66,2	66,8
	Vmax	68,5	67,4			66,2	66,8
Tmax	Vmin	68,4	67,8			68,4	68,2
	Vmax	68,4	67,8			68,4	68,2
Measurement uncertainty		< ± 4 dB					

LIMITS CLAUSE 5.2.5

CHANNEL Separation (kHz)	Under normal conditions	Under extreme conditions
12.5	≥ 65 dB	≥ 55 dB
20.0	≥ 75 dB	≥ 65 dB
25.0	≥ 75 dB	≥ 65 dB

Reference number(s) of test equipment used 01-02, 05, 07, 14, 15, 16 (for reference see test equipment listing)

Ambient temperature : 23 °C

Relative humidity : 35%

Receiver spurious response rejection

ETSI EN 300 086-1 Clause 9.6

12,5 kHz – Narrow Band / 25 kHz – Wide Band

- a) List of spurious responses found in the limited frequency range
- b) List of spurious responses calculated outside the limited frequency range

SPURIOUS RESPONSES	CHANNEL		
	RATIO(dB)		
	1 (148,050 MHz)	2	3 (173,950 MHz)
a)	no peaks found < 20 dB S/N		no peaks found < 20 dB S/N
b)	no peak found < 20 dB S/N		no peaks found < 20 dB S/N
Measurement uncertainty	< ± 4 dB		

LIMIT CLAUSE 5.2.6

Limit	75 dB
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Reference number(s) of test equipment used 01 - 03, 04, 07, 14, 15 (for reference see test equipment listing)

Ambient temperature : 23 °C

Relative humidity : 35%

Receiver intermodulation response rejection

ETSI EN 300 086-1 Clause 9.7

12,5 kHz – Narrow Band

FREQUENCY INCREMENTS OF UNWANTED SIGNALS	RATIO (dB μ V/m)		
	Ch 1 (148,050 MHz)	Ch 2	Ch 3 (173,950 MHz)
+50 kHz	67,2		68,6
+100 kHz	70,4		68,6
-50 kHz	70,3		73,8
-100kHz	72,0		74,2
Measurement uncertainty	< $\pm$ 4 dB		

LIMITS CLAUSE 5.2.7

- > 65 dB for mobile stations

Reference number(s) of test equipment used 01 - 03, 05, 07, 14, 15 (for reference see test equipment listing)

Ambient temperature : 23 °C

Relative humidity : 35%

Receiver intermodulation response rejection

ETSI EN 300 086-1 Clause 9.7

25 kHz – Wide Band

FREQUENCY INCREMENTS OF UNWANTED SIGNALS	RATIO (dB μ V/m)		
	Ch 1 (148,050 MHz)	Ch 2	Ch 3 (173,950 MHz)
+50 kHz	67,2		68,6
+100 kHz	70,4		68,6
-50 kHz	70,3		73,8
-100kHz	72,0		74,2
Measurement uncertainty	< $\pm$ 4 dB		

LIMITS CLAUSE 5.2.7

- > 65 dB for mobile stations

Reference number(s) of test equipment used 01 - 03, 05, 07, 14, 15 (for reference see test equipment listing)

Ambient temperature : 23 °C

Relative humidity : 35%

Receiver blocking or desensitisation

ETSI EN 300 086-1 Clause 9.8

12,5 kHz – Narrow Band

FREQUENCY OF UNWANTED SIGNAL	RATIO (dB μ V/m)		
	Ch 1 (148,050 MHz)	Ch 2	Ch 3 (173,950 MHz)
f+10MHz	117,7		116,6
f+5MHz	114,4		115,7
f+2MHz	114,3		115,3
f+1MHz	109,7		110,1
f-1MHz	110,3		110,2
f-2MHz	114,7		114,9
f-5MHz	114,7		116,8
f-10MHz	117,8		116,9
Measurement uncertainty	< $\pm$ 4 dB		

LIMIT CLAUSE 5.2.8

The blocking ratio, for any frequency within the specified ranges shall not be less than 84dB, except at frequencies on which spurious responses are found.

Reference number(s) of test equipment used 01, 02, 05, 07, 14, 15 (for reference see test equipment listing)

Ambient temperature : 23 °C

Relative humidity : 35%

Receiver blocking or desensitisation

ETSI EN 300 086-1 Clause 9.8

25 kHz – Wide Band

FREQUENCY OF UNWANTED SIGNAL	RATIO (dB μ V/m)		
	Ch 1 (148,050 MHz)	Ch 2	Ch 3 (173,950 MHz)
f+10MHz	117,7		116,5
f+5MHz	115,7		115,9
f+2MHz	115,4		115,5
f+1MHz	110,2		110,2
f-1MHz	110,3		110,2
f-2MHz	115,1		115,5
f-5MHz	115,6		116,5
f-10MHz	119,6		116,8
Measurement uncertainty	< $\pm$ 4 dB		

LIMIT CLAUSE 5.2.8

The blocking ratio, for any frequency within the specified ranges shall not be less than 84dB, except at frequencies on which spurious responses are found.

Reference number(s) of test equipment used 01, 02, 05, 07, 14, 15 (for reference see test equipment listing)

Ambient temperature : 23 °C

Relative humidity : 35%

Receiver spurious radiation (radiated and conducted)

ETSI EN 300 086-1 Clause 9.9

FREQUENCY OF SPURIOUS RADIATIONS	LEVEL (dBm)		
	Ch 1 (148,050 MHz)	Ch 2	Ch 3 (173,950 MHz)
	no peak found		no peak found
	closer 20 dB to limit		closer 20 dB to limit
Measurement uncertainty	< ± 3 dB		

LIMIT CLAUSE 5.2.9

FREQUENCY RANGE	30 MHz to 1 GHz	> 1 GHz to 12,75 GHz
Limit	2,0 nW (-57,0 dBm)	20,0 nW (-47,0 dBm)

Reference number(s) of test equipment used 09, 14, 15 (for reference see test equipment listing)

2.4 Test Equipment and Ancillaries used for Tests

To facilitate inclusion on each page of the test equipment used for related tests, each item of test equipment and ancillaries such as cables are identified (numbered) by the Test Laboratory.

No.	Instrument/Ancillary	Type	Manufacturer	Serial No.
01	Signal Generator	SMHU	R & S	861 508/005
02	Signal Generator	SMHU	R & S	894 055/005
03	Signal Generator	SMH	R & S	864 219/033
04	Power Splitter	ZFRSC4	Mini-Circuits	920704
05	Power Splitter	ZFSC34	Mini-Circuits	924501
06	Signal Generator	APN04	R & S	860 093/013
07	Radiocommunic. Analyz.	CMTA84	R & S	894 581/013
08	Radio-Code-Analyser	4923	Schlumberger	103103
09	Spectrum Analyzer	2782	Tektronix	B 020259
10	Spectrum Analyzer	FMSF	R & S	827 831/037
11	RF - Amplifier	25W100	Amplifier res	12948
12	Bidirektionalkoppler	DC 3010	Amplifier res.	12306
13	Oscilloscope	54502A	HP	2934A01917
14	RF-Relais-Matrix	PSM	Pro Nova	18-2
15	Power Supply	110832	Heiden	1801
16	Temp. test chamber	VUK 4/5	Heraeus Vötsch	32927
17	Bandreject Filter	TTR 37	Telonic Berk.	30013-1
18	Bandreject Filter	TTR 72	Telonic Berk.	20417-2
19	Bandreject Filter	TTR 95	Telonic Berk.	20372-4
20	Bandreject Filter	TTR 190	Telonic Berk.	30036-4
21	Bandreject Filter	TTR 375	Telonic Berk.	20369-5
22	Bandreject Filter	TTR 750	Telonic Berk.	90177-1
23	Highpass Filter	HMC 500	Lark	HJ67-01
24	Highpass Filter	NHP 300	Narda	009

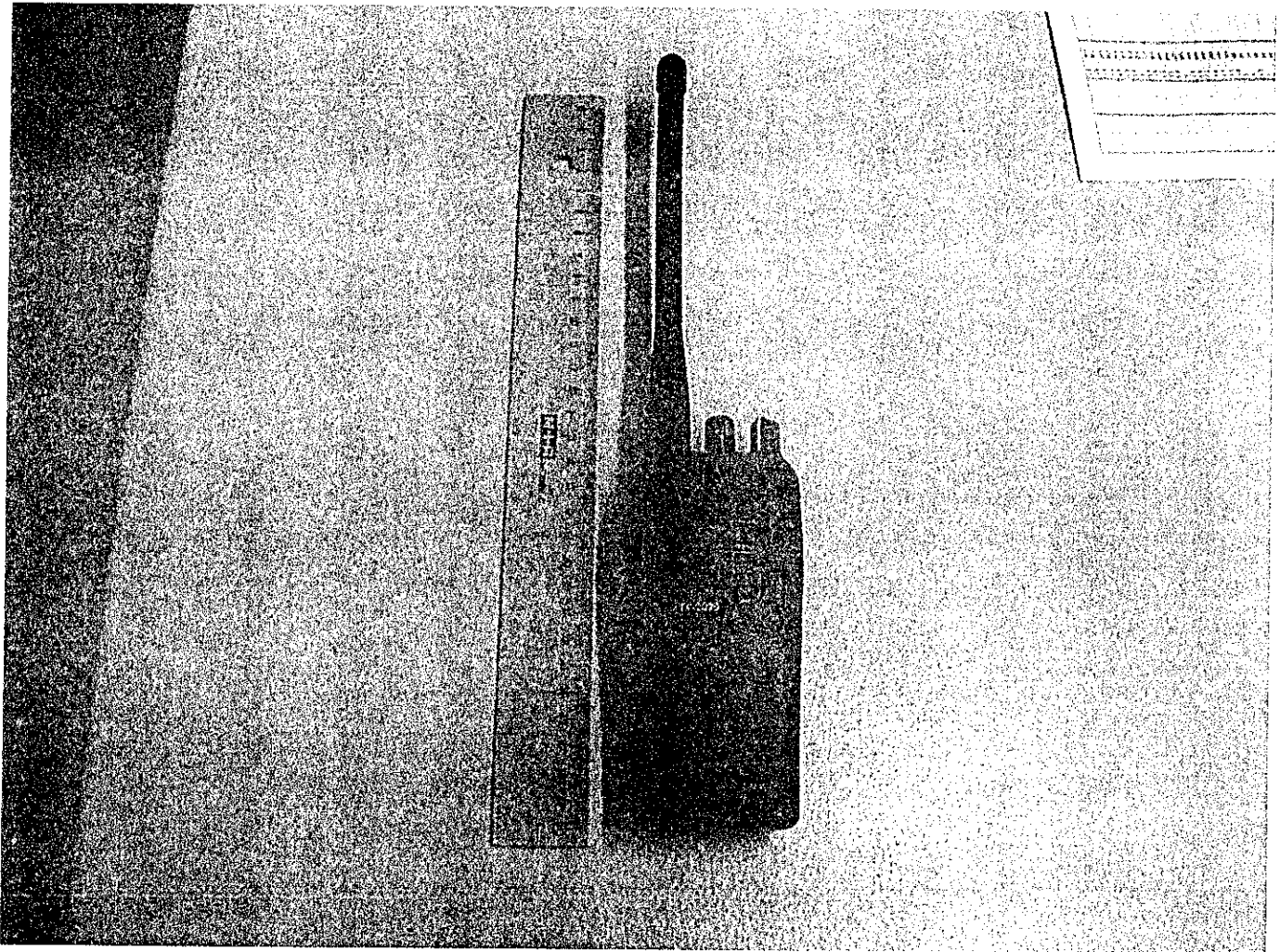
No.	Instrument/Ancillary	Type	Manufacturer	Serial No.
25	Steuerrechner	PSM7	R & S	834 621/004
26	EMI Test Receiver	ESMI	R & S	827 063/010
27	EMI Test Receiver	Disp	R & S	829 808/010
28	Controller	HD100	Deisel	100 322/93
29	Relais Matrix	PSN	R & S	829 065/003
30	Control Unit	GB016	R & S	344 122/008
31	Relais Switch Unit	RSU	R & S	316 790/001
32	Power Supply	6032A	HP	2846A04063
33	Spektrum Monitor	EZM	R & S	883 720/006
34	Meßempfänger	ESH3	R & S	890 174/002
35	Meßempfänger	ESVP	R & S	891752/005
36	Biconical Antenne	HK116	R & S	833 162/011
37	Log.Periodic Antenne	HL223	R & S	832 914/010
38	Amplifier	AFS4	Miteq Inc.	206461
39	Polarisationsnetzwerk	HL024	R & S	341570/002
40	gek.Log.Periodic Ant.	HL024	R & S	342662/002
41	Double Ridge G.Horn	3115	EMCO	9107-3696
42	Microw.Sys.Amplifier	83017A	HP	3123A00105
43	Quasi-Peak-Adapter	85650A	HP	2811A01131
44	Spectrum - Analyzer	8566B	HP	2747A05306
45	Preselector	85685A	HP	2833A00768
46	Relias-Matrix	3488A	HP	2719A15012
47	Power-Supply	6032	HP	2818A03450
48	Microwave Amplifier	83017A	HP	3123A00104
49	Power-Supply	87421	HP	3116A00292
50	Biconical Antenne	3104	EMCO	3758
51	Logperiodic Antenne	3146	EMCO	2130
52	Double Ridged Antenne	3115	EMCO	8812-3088
53	Steuerrechner	PSA 17	R & S	883086/026
54	Analyzer	EZM	R & S	883086/026

No.	Instrument/Ancillary	Type	Manufacturer	Serial No.
55	Receiver	ESH 3	R & S	881515/002
56	Relias Matrix	PSU	R & S	882943/029
57	Art.mains network	ESH2Z5	R & S	882394/007
58	Art.mains network	ESH3Z5	R & S	861189/014
59	Art.mains network	ESH3Z5	R & S	892475/017
60	Art.mains network	ESH3Z5	R & S	894981/019
61	Art.mains network	ESH3Z6	R & S	836501/652
62	Art.mains network	ESH3Z6	R & S	861406/005
63	Art.mains network	ESH3Z6	R & S	893689/012
64	Art.mains network	HFH2Z2	R & S	881058/42
65	Power Supply	6032A	HP	2818A03449

2.5 Photographs of the Equipment

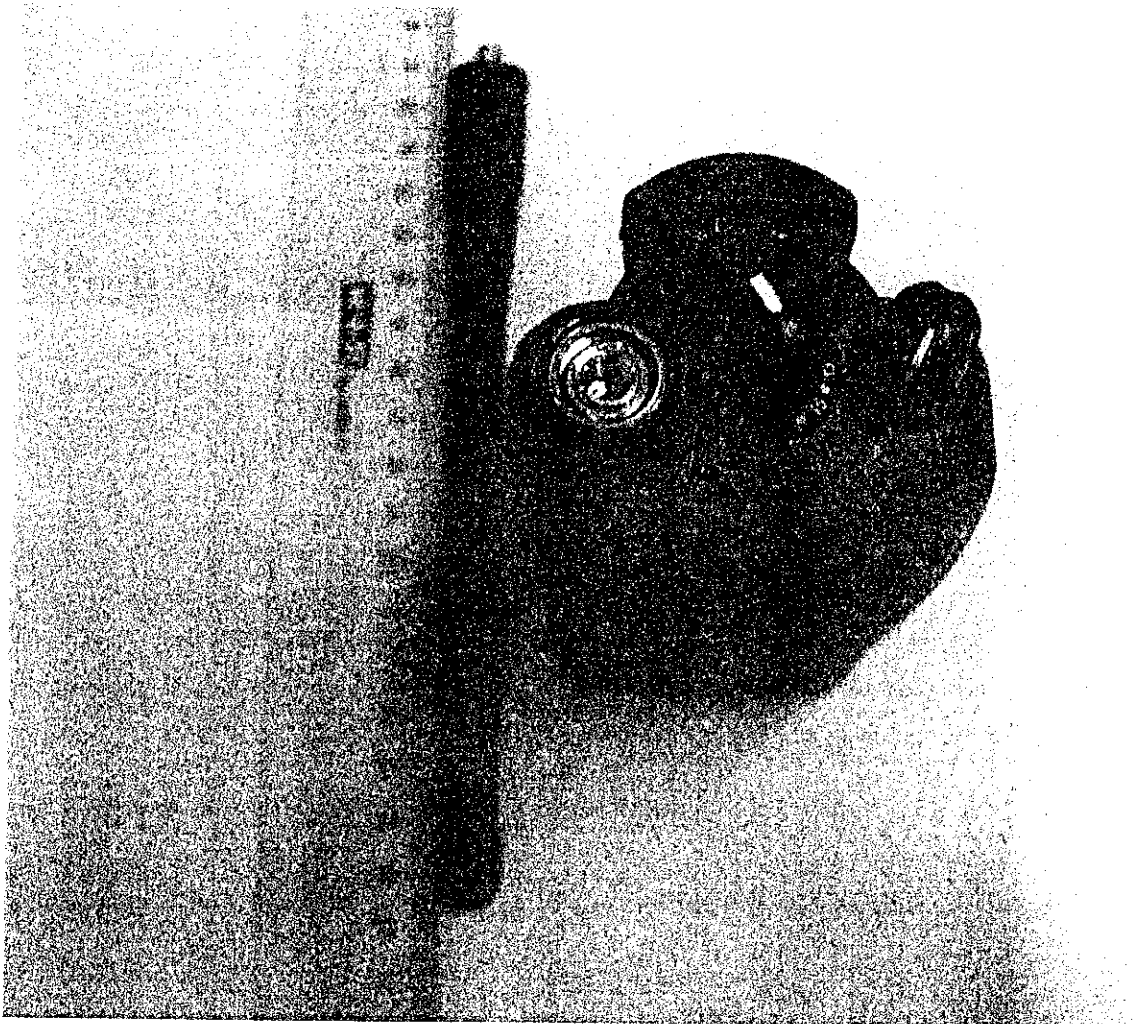
TX-2020

Photograph No. : 1



TX-2020

Photograph No. : 2



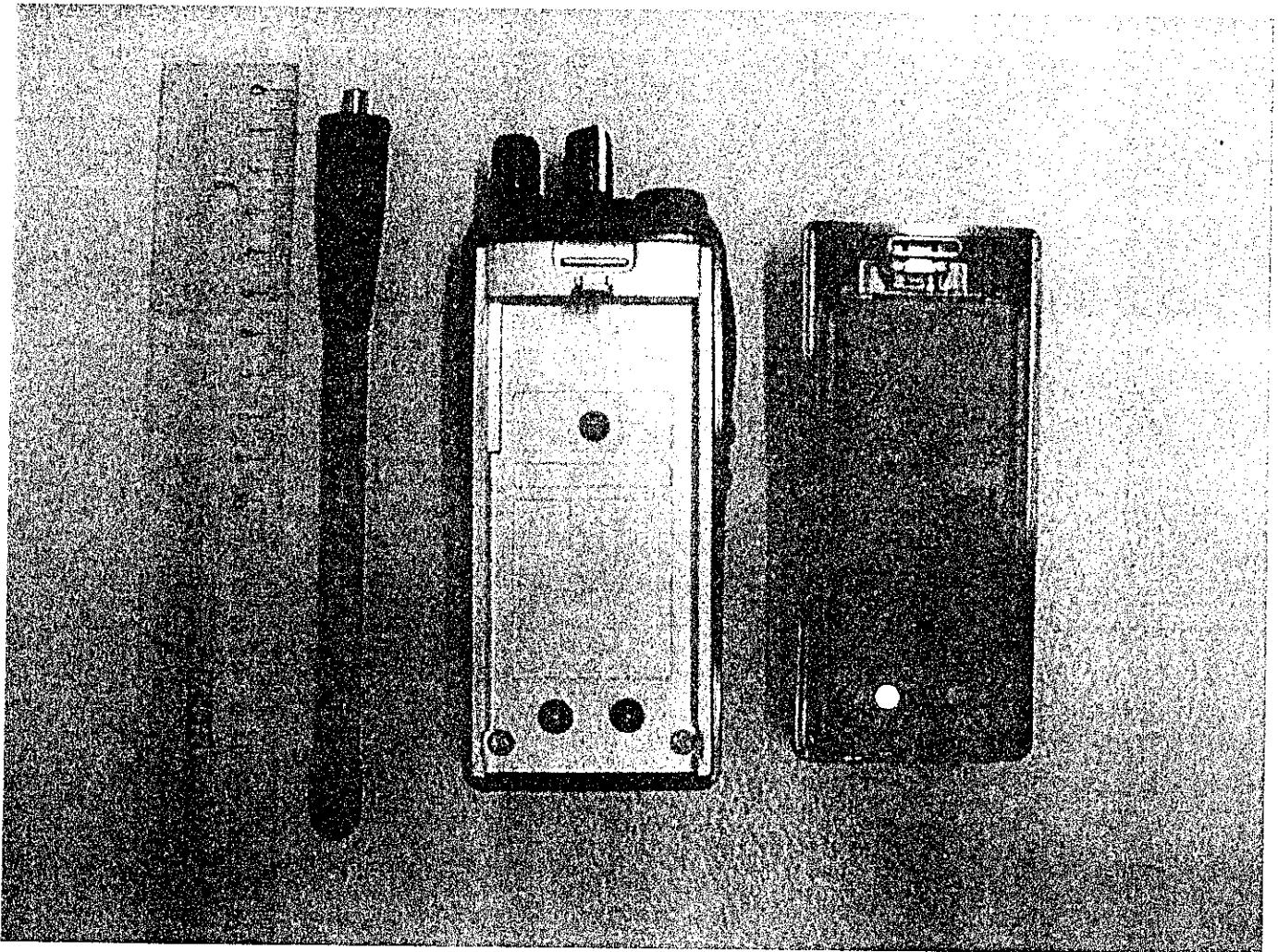
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Photograph No. : 3



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Photograph No. : 4



TX-2020

Photograph No. : 6

