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Registration number
Numéro d'accréditation : **STS 024**
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Report no:
Rapport no: **13'724b**
Bericht Nr:

Title: **Radiocom measurements on « CROS CTX and CRX » according to the ETSI EN 300 330-1 and FCC CFR 47 part 15**
Titre:
Titel:

Date of test:
Date de l'essai: **April 29 – 30 2004**
Prüfdatum:

Customer:
Client: **Phonak AG**
Kunde:

Test place: **montena emc sa**
Lieu de l'essai: **CH-1728 Rossens**
Prüfort:

Test performed by
Essai effectué par :
Prüfer

Mr J. Ding

Test report prepared by
Rapport d'essai préparé par :
Berichtersteller

Mr J. Ding

Test report controlled and approved by
Rapport d'essai contrôlé et approuvé par :
Prüfbescheinigung

Mr M. Portmann

Rossens, June 22, 2004

(Issue Date / Date d'édition / Ausstelldatum)

V0209

Main language / Langue principale / Hauptsprache: english / français / deutsch

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Total number of pages

Nombre total de pages du rapport: 28

Total Anzahl Seiten

1. Summary of test results / Résumé des résultats d'essais / Zusammenfassung der Prüfergebnisse

- ✓ Pass / Réussi / Bestanden
 X Fail / Pas réussi / Nicht bestanden
 □ Not applicable to this type of product / Pas applicable à ce type de produit / Nicht anwendbar für diese Produktart
 — Not tested / Pas vérifié / Nicht geprüft

	ETSI EN 300 330-1
Transmitter parameters	
Radiated H-field (carrier)	Chap. 7.2.1.2
RF carrier current	Not applicable
Radiated E-field (carrier)	Not applicable
Frequency range of the modulation bandwidth	Chap. 7.3
Spurious emissions conducted (< 30 MHz)	Not applicable
Spurious emissions conducted (≥ 30 MHz)	Not applicable
Spurious emissions radiated (< 30 MHz)	Chap. 7.4.3
Spurious emissions radiated (≥ 30 MHz)	Chap. 7.4.4
Duty cycle	Chap. 7.5
Receiver parameters	
Adjacent channel selectivity – in band	Not applicable
Blocking or desensitization	Not applicable
Spurious radiations	Chap. 8.3
	CFR 47 Part 15
Spurious emissions radiated, § 15.209	Pass, s. p. 9 of report

2. 1. Applied standards / Normes appliquées / Verwendete Normen

ETSI EN 300 330-1 Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD); Radio equipment in the frequency range 9 kHz to 25 MHz and inductive loop systems in the frequency range 9 kHz to 30 MHz; Part 1: Technical characteristics and test methods

CFR 47 Code of federal regulations
 Part 15 § 15.209, Radio frequency Devices

3. Client / Client / Kunde

Client name and address Nom et adresse du client Name und Adresse des Kunden	<i>Phonak AG Laubisrütlistrasse 28 CH-8712 Stäfa</i>
Contact Person / Responsable / Kontaktperson	<i>Mr F. Marquis</i>
Telephone / Téléphone / Telefon	<i>+41 26 672 96 42</i>
Fax / Télécopieur / Telefax	<i>+41 26 672 93 80</i>
Mandate no / Mandat no / Auftrag Nr.	<i>2004-6111</i>

4. Equipment under test / Equipement à l'essai / Prüfling

4.1 Identification / Identification / Identifikation

Manufacturer name and address Nom et adresse du fabricant Name und Adresse des Herstellers	<i>Phonak Communications SA Länggasse 17 CH-3280 Murten</i>
Product name / Nom du produit / Produktname	<i>CROS</i>
Product description / Description du produit / Produktbeschreibung	<i>Ear to ear audio transmission for hearing aid</i>
Production country / Pays de fabrication / Ursprungsland	<i>Switzerland</i>
Product type / Type du produit / Typ des Produktes	<i>Transmitter CROS CTX and receiver CROS CRX</i>
Serial no / No. de série / Seriennummer	<i>Id N° CTX N° 11 (only tests § 7.3) Id N° CTX N° 12 and CRX N°15 (all other tests)</i>
Software version / Version du logiciel / Softwareversion	<i>none</i>
Highest frequency / Fréquence la plus élevée / Höchste Frequenz	<i>374 kHz</i>
Supply / Alimentation / Speisung	<i>U = 1.2 V Zinc-air battery</i>
Technical documentation Documentation technique Technische Dokumentation	<i>See photographs on chap. 7. The DUT is identified by its id. no according to ISO 9001.</i>

4.2 Modifications before the tests / Modifications apportées avant les essais / Vor den Prüfungen angebrachte Änderungen

- none

4.3 Function of the EUT

Ear to ear audio transmission for hearing aid

4.4 Definitions, classifications and test conditions

Definitions	Reference ETSI EN 300 330-1	Classification
Radiated H-field or power level	Table 1	Power class 1
Risk assessment of receiver performance	Table 2	Class 3
Extreme temperature range	Chap 5.4.1.2	Category II (portable)
Product classes (antenna type)	Chap. 7.1.4	Product class 1
Duty cycle classes	Chap. 7.5.3	Duty cycle class 4

Extreme test conditions	Level or range	Remark
Classification	Category II	
Extreme temperatures	-10 °C ÷ +55 °C	
Extreme test source voltages	1.2 V typical	Zinc-air battery

Normal test conditions	Value	Remark
Temperature:	20 – 22 °C	
Pression:	1015 hPa	
Relative humidity:	35 – 45 %	
Test period:	29 to 30 April 2004	

Full description of the modulated signal: (only if EUT can not be tested in unmodulated condition)	
Modulation:	AM
Transmission frequency	374 kHz
FM Deviation:	---
Full Modulation Bandwidth:	---

Conducted tests performed with:

(only for equipment with integral antenna)

Test Fixture	<i>YES (loop antenna)</i>
Temporary connector	<i>NO</i>
Permanent internal connector	<i>NO</i>

Power source for battery operated equipment:

Internal batteries (normal test conditions)	<i>Zinc air, 1.2 V</i>
External test power source (extreme test conditions)	<i>No</i>

5. Persons present / Personnes présentes / Anwesende Personen**Test Engineer(s) / Ingénieur(s) d'essai / Prüfsingenieur(e) :***Mr J. Ding***Other(s) / Autre(s) / Andere :**

Name / Nom / Name

Company / Société / Firma

Mr F. Oberson

Phonak Communications AG

6. Measurement

6.1 H-FIELD STRENGTH SUB-CLAUSE 7.2.1 & CFR 47

(Class 1)

Rated output level: - 30 dB μ A/m* at 10m.

Antenna size: around Ø 4mm x 18

Test conditions		Transmitter field strength (dB μ A/m)		
		CH 1	CH 2	CH 3
$T_{nom}(22)^{\circ}\text{C}$	$V_{nom}(1.2\text{ V})$	≤ -15 (374 kHz)		
Maximum deviation from rated output under normal test conditions (dB)		+ 15 dBμA/m*		
Measurement uncertainty		$\pm 3.9\text{ dB}$		

LIMIT SUB-CLAUSE 7.2.1.3

Frequency range (MHz)	H-field field strength limit (Hf) dB μ A/m at 10 m
$0,009 \leq f < 0,03$	72 *
$0,03 \leq f < 0,07$ $0,119 \leq f < 0,135$	72 at 0,03 MHz descending 3,0 dB/oct *
$0,05975 \leq f < 0,06025$ $0,07 \leq f < 0,119$	42
$0,135 \leq f < 1,00$	37.7 at 0,135 MHz descending 3,0 dB/oct
$1,0 \leq f < 4,642$	29 at 1.0 MHz descending 9,0 dB/oct
$4,642 \leq f < 30$	9
$6,765 \leq f \leq 6,795\text{ (ISM)}$ $13,553 \leq f \leq 13,567\text{ (ISM)}$ $26,957 \leq f \leq 27,283\text{ (ISM)}$	42
*For the frequency ranges 9 - 70 kHz and 119 – 135 kHz: – loop area $\geq 0,16\text{ m}^2$: table values – $0,16\text{ m}^2 \geq \text{loop area} \geq 0,05\text{ m}^2$: table value + $10 \cdot \log(\text{area} / 0,16\text{ m}^2)$ – loop area $< 0,05\text{ m}^2$: table values - 10 db	

* The value of rated output declared by the manufacturer is computed. The value measured is the noise level of measurement equipment.

Measured with 88-14 and 90-28

(The indicated level at 10 m distance does not represent the emission of the EUT, but the noise of the measuring equipment. Another measurement has been performed at 1 m distance)

LIMIT CFR 47 § 15.209 at the carrier frequency (no other emissions found)

Frequency range (MHz)	E-field field strength limit $\mu\text{V/m}$ at 300 m
$0,009 \leq f < 0,490$	$2400/f$ with f in kHz
0,374	$6.4 \equiv 16.1 \text{ dB}\mu\text{V/m}$

The value of the H field measured at 10 m distance is $-15 \text{ dB}\mu\text{A/m}$ (it is more the noise of the measuring equipment).

Converted in E field (+51.5 dB) = $36.5 \text{ dB}\mu\text{V/m}$

Reduced from 10 to 300 m (-60 dB) = $-23.5 \text{ dB}\mu\text{V/m}$ (according to § 15.31 (2))

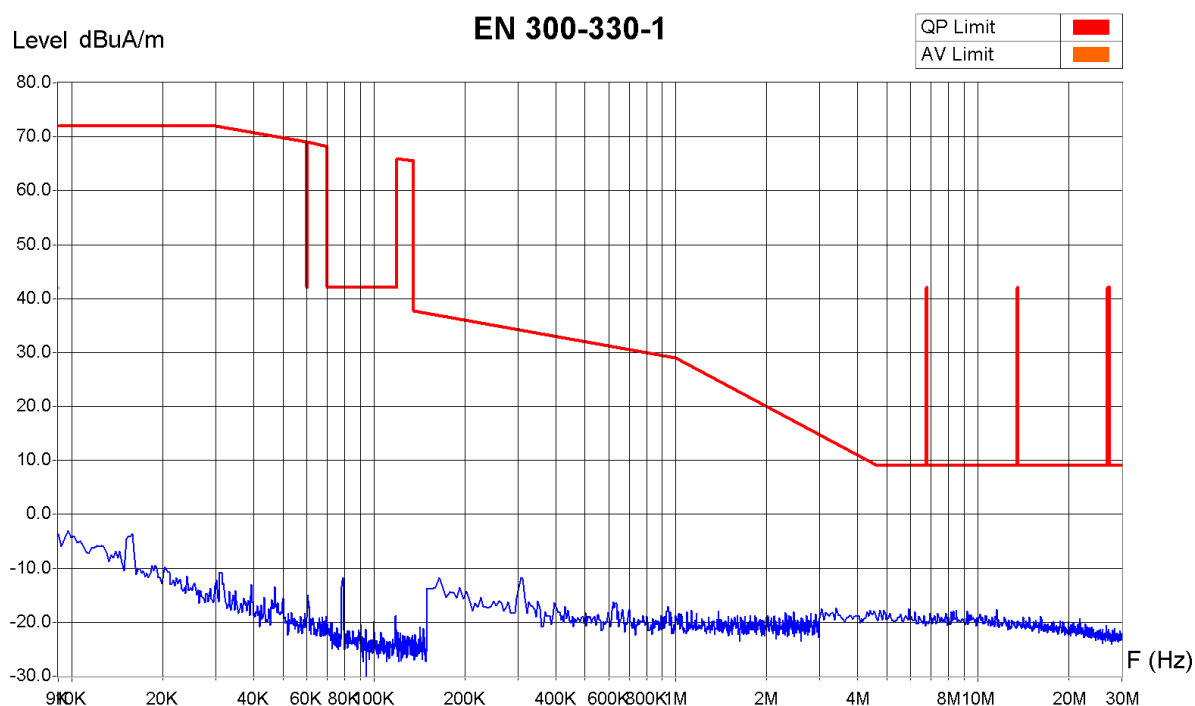
$-23.5 \text{ dB}\mu\text{V/m}$ is lower than $16.1 \text{ dB}\mu\text{V/m}$

Complies with the requirements

Measurement Type : Radiated Field
 Polarisation : Horizontal
 Table Angle : 0-360°
 Antenna Height : 1-4 m



Equipment Under Test : CROS CTX
 Set-Up : s. photo
 Operating Conditions : on
 Remarks : receiving antenna in the vertical plan



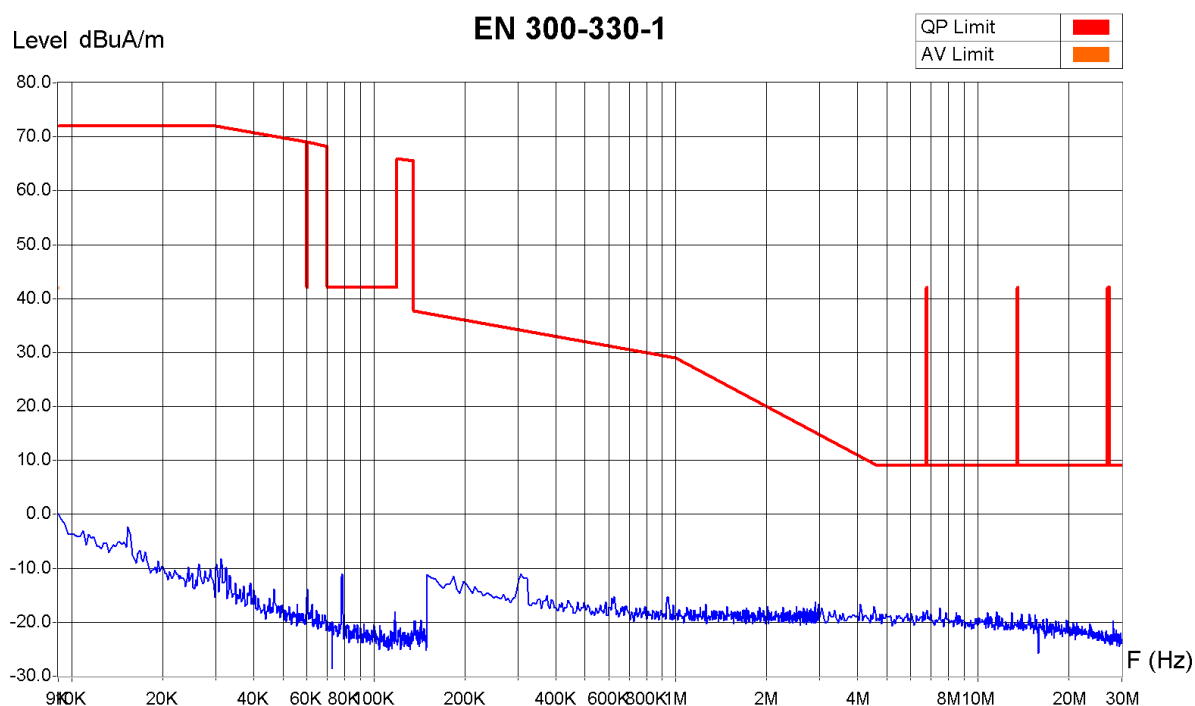
Zone	9 KHz - 150 KHz	150 KHz - 3 MHz	3 MHz - 30 MHz
Video Bandwidth	300 Hz	10 KHz	10 KHz
Resol Bandwidth	300 Hz	10 KHz	10 KHz

Operator: Ding
 Date/Time: 30.04.04 08:22
 Filename:
 CTX_01.png/.txt

Measurement Type : Radiated Field
 Polarisation : Vertical
 Table Angle : 0-360°
 Antenna Height : 1-4 m



Equipment Under Test : CROS CTX
 Set-Up : s. photo
 Operating Conditions : on
 Remarks : receiving antenna in the horizontal plan



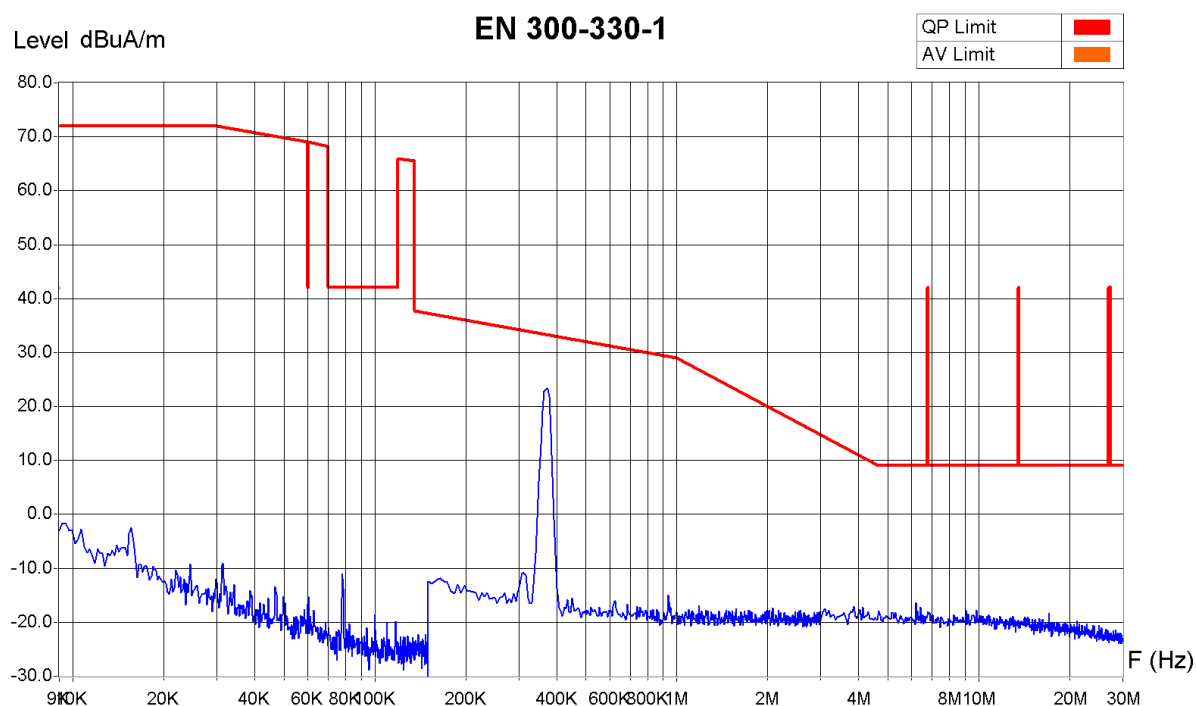
Zone	9 KHz - 150 KHz	150 KHz - 3 MHz	3 MHz - 30 MHz
Video Bandwidth	300 Hz	10 KHz	10 KHz
Resol Bandwidth	300 Hz	10 KHz	10 KHz

Operator: Ding
 Date/Time: 30.04.04 08:36
 Filename:
 CTX_02.png/.txt

Measurement Type : Radiated Field
 Polarisation : Vertical
 Table Angle : 0-360°
 Antenna Height : 1-4 m



Equipment Under Test : CROS CTX
 Set-Up : s. photo
 Operating Conditions : on
 Remarks : receiving antenna in the horizontal plan
 special measurement at 1 m distance



Zone	9 KHz - 150 KHz	150 KHz - 3 MHz	3 MHz - 30 MHz
Video Bandwidth	300 Hz	10 KHz	10 KHz
Resol Bandwidth	300 Hz	10 KHz	10 KHz

Operator: Ding
 Date/Time: 30.04.04 08:50
 Filename:
 CTX_03.png/.txt

**6.2 PERMITTED RANGE OF OPERATING FREQUENCIES
FOR WIDEBAND EQUIPMENT (>25 kHz)****SUB-CLAUSE 7.3**

Applicants declared operating frequency band:

Lowest frequency: ---

Highest frequency: ---

Test conditions		Limit		
		Frequency MHz		
T _{nom} (20)°C	V _{nom} (1.2)VDC	FL	---	Reference measurement see page 14
		FH	---	
T _{min} (-10)°C	V _{min} (1.2)VDC	FL	---	see page 15
		FH	---	
	V _{max} (1.2)VDC	FL	---	not performed
		FH	---	
T _{max} (55)°C	V _{min} (1.2)VDC	FL	---	see page 16
		FH	---	
	V _{max} (1.2)VDC	FL	---	not performed
		FH	---	
Measurement uncertainty		1 x 10 ⁻⁷		

Where

FL = Lowest frequency at the appropriate spurious emission level

FH = Highest frequency at the appropriate spurious emission level

Band edge limits

FLM= Lowest FL (measured): ---

FHM = Highest FH (measured): ---

REMARKS: Use of Zinc air battery, no measurement under extreme voltage conditions.

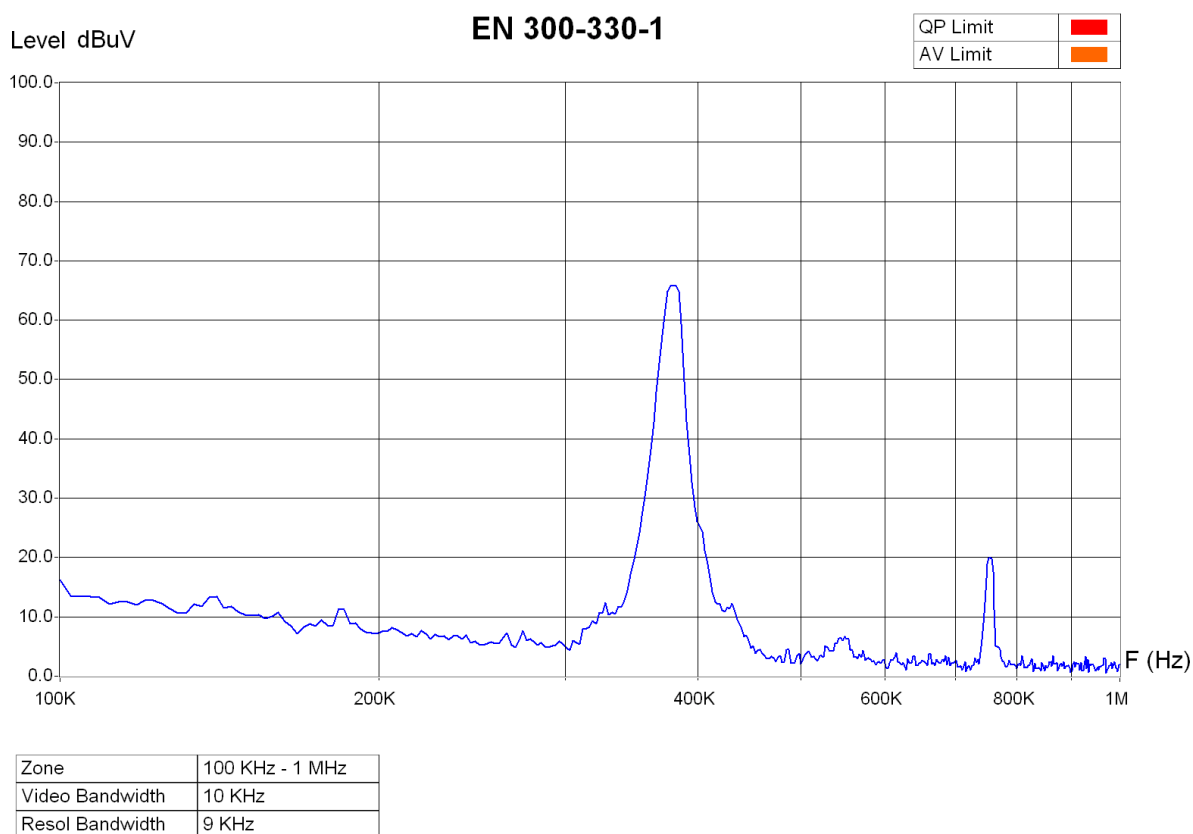
The carrier level is below the limits for spurious emissions, the peak of the carrier corresponds to a value lower than -12 dBμA/ m.

Complies with the requirements!

Measurement Type : Voltage Interference
 Supply :
 Other : voltage at measuring loop



Equipment Under Test : CROS
 Set-Up : s. photo
 Operating Conditions : only carrier
 Remarks : T= 20 °C, U=1.2 V
 373.5 kHz, 65.82 dBuV

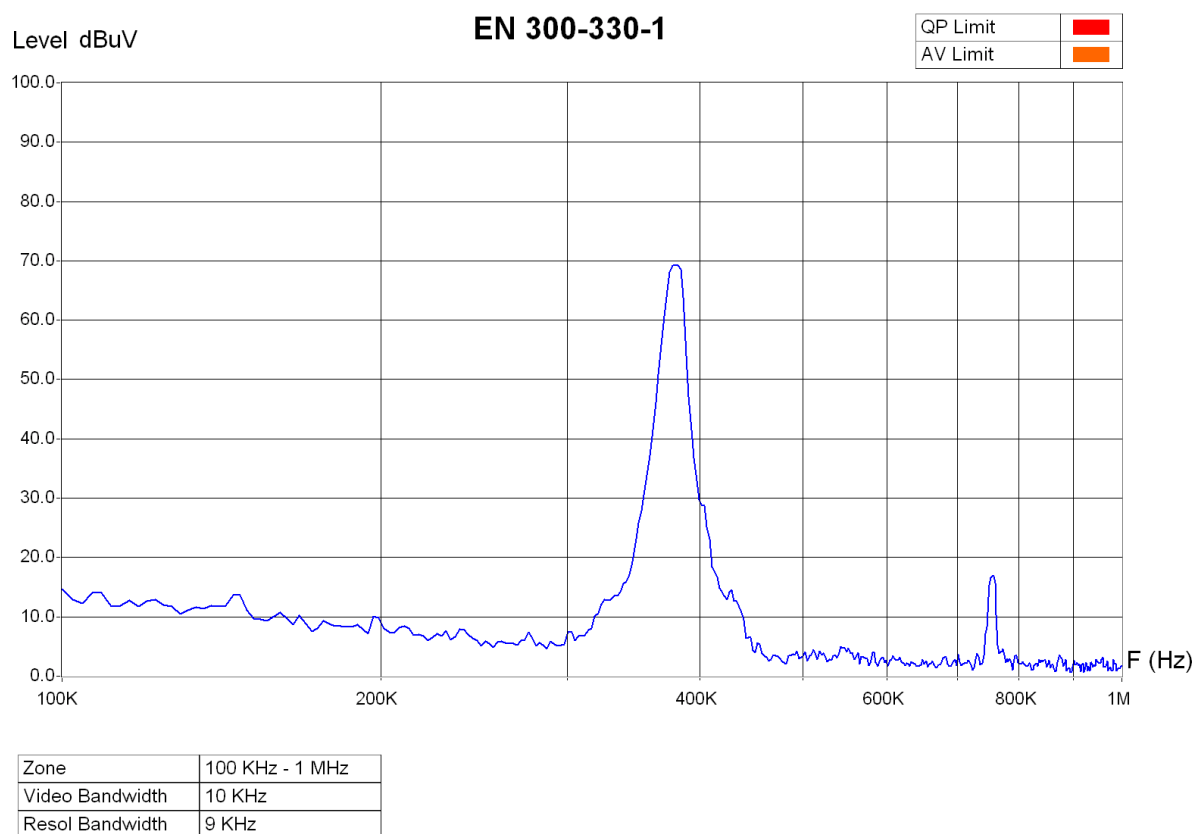


Operator: Ding
 Date/Time: 29.04.2004 09:12
 Filename:
 cros_01b.png/.txt

Measurement Type : Voltage Interference
 Supply :
 Other : voltage at measuring loop



Equipment Under Test : CROS
 Set-Up : s. photo
 Operating Conditions : only carrier
 Remarks : T= -10 °C, U=1.2 V
 375.4 kHz, 69.27dBuV

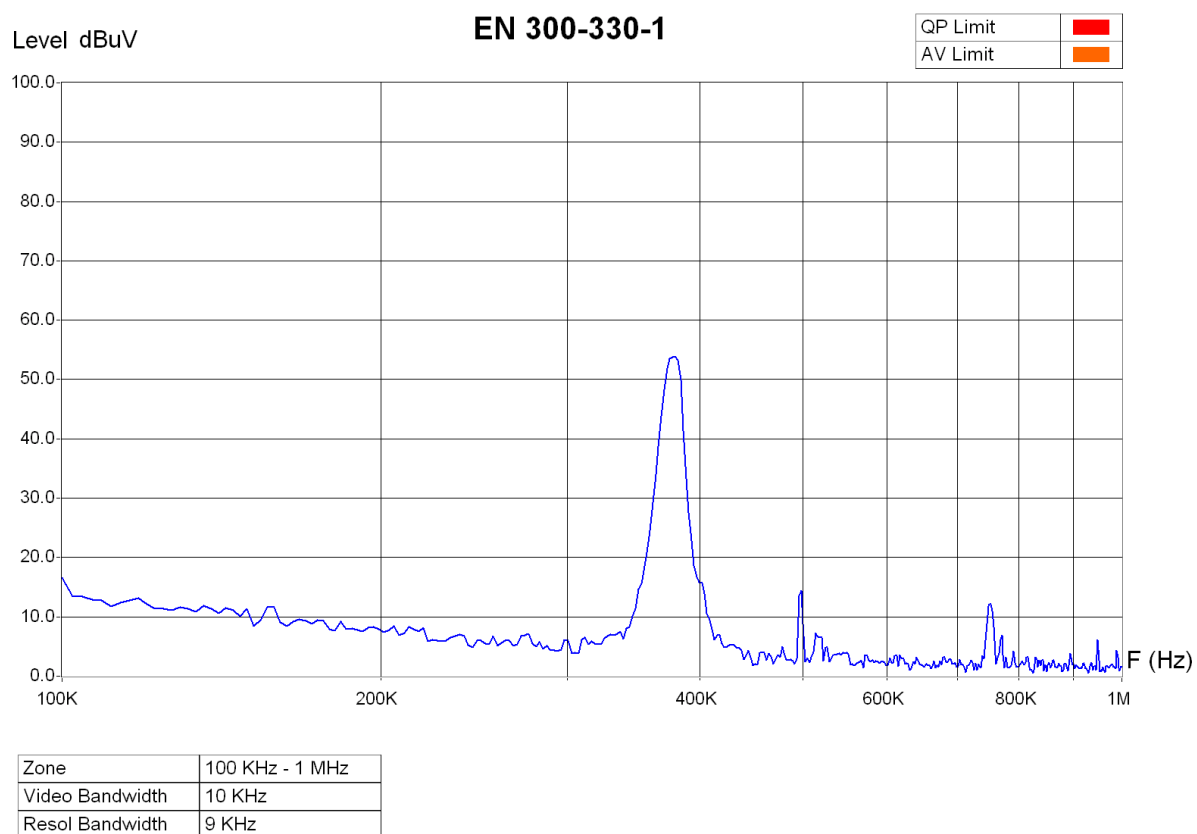


Operator: Ding
 Date/Time: 29.04.2004 09:57
 Filename:
 cros_02b.png/.txt

Measurement Type : Voltage Interference
 Supply :
 Other : voltage at measuring loop



Equipment Under Test : CROS
 Set-Up : s. photo
 Operating Conditions : only carrier
 Remarks : T= +55 °C, U=1.2 V
 373.5 kHz, 53 dBuV



Operator: Ding
 Date/Time: 29.04.2004 10:26
 Filename:
 cros_03b.png/.txt

6.3 TRANSMITTER SPURIOUS EMISSIONS RADIATED (<30 MHz) SUB-CLAUSE 7.4.3

Rated carrier output : < -12 dB μ A/m (at 10 m)

Transmitter operating

TX ON: Modulated (No stand-by possible)

RX ON (No stand-by possible)

SPURIOUS EMISSIONS LEVEL (dB μ A/m)								
CH 1			CH 2			CH 3		
f (MHz)	Band- Width** (kHz)	Level (dB μ A/m)	f (MHz)	Band- width** (kHz)	Level (dB μ A/m)	f (MHz)	Band- width** (kHz)	Level (dB μ A/m)
0.009– 0.15	0.3	OK <i>see plots</i>						
0.15 – 30	9	OK <i>see plots</i>						
Measurement uncertainty			± 3.9 dB					

** Bandwidth = the measuring receiver bandwidth

LIMIT SUB-CLAUSE 7.4.3.2

State	Frequency $9 \text{ kHz} \leq f < 10 \text{ MHz}$	Frequency $10 \text{ MHz} \leq f < 30 \text{ MHz}$
Transmit	27 dB μ A/m descending 3 dB/oct	-3.5 dB μ A/m
Standby	6 dB μ A/m descending 3 dB/oct	-24.5 dB μ A/m

REMARKS:

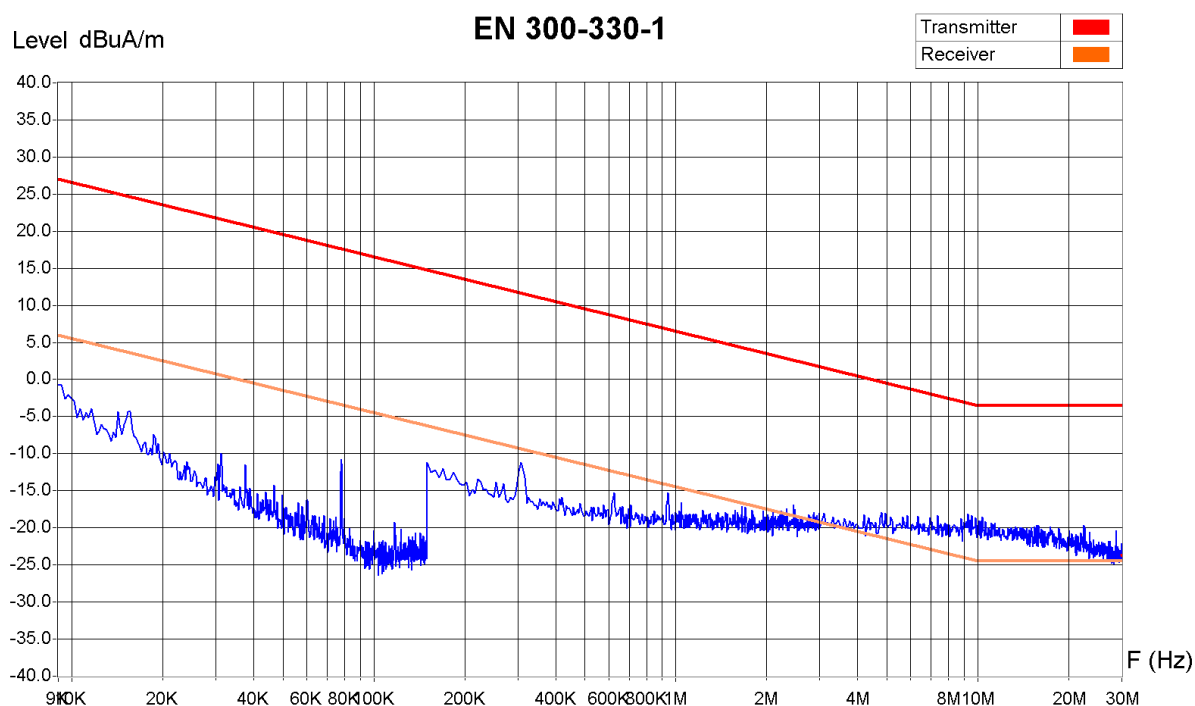
s. available limit on plots

Complies with the requirements!!!

Measurement Type : Radiated Field
 Polarisation : Vertical
 Table Angle : 0-360°
 Antenna Height : 1-4 m



Equipment Under Test : CROS CTX
 Set-Up : s. photo
 Operating Conditions : transmitting (no stand-by possible)
 Remarks :
 ONLY UPPER LIMIT AVAILABLE



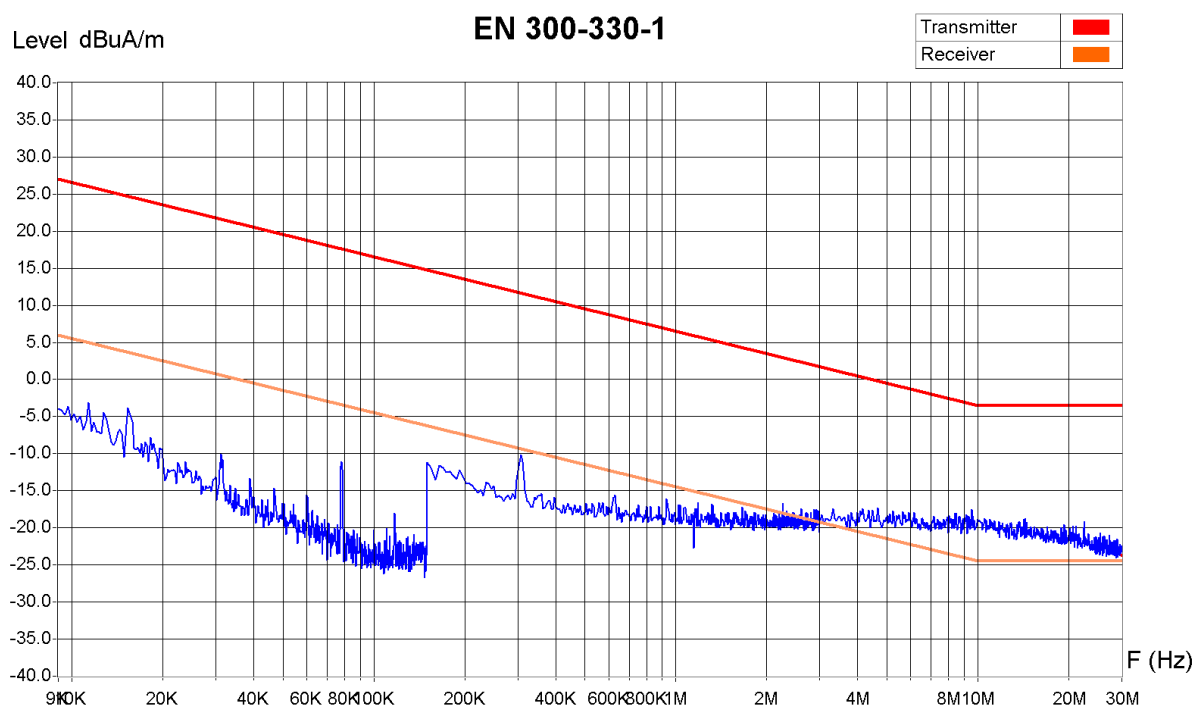
Zone	9 KHz - 150 KHz	150 KHz - 3 MHz	3 MHz - 30 MHz
Video Bandwidth	300 Hz	10 KHz	10 KHz
Resol Bandwidth	300 Hz	9 KHz	9 KHz

Operator: Ding
 Date/Time: 30.04.04 09:26
 Filename:
 CTX_05.png/.txt

Measurement Type : Radiated Field
 Polarisation : Horizontal
 Table Angle : 0-360°
 Antenna Height : 1-4 m



Equipment Under Test : CROS CTX
 Set-Up : s. photo
 Operating Conditions : transmitting (no stand-by possible)
 Remarks :
 ONLY UPPER LIMIT AVAILABLE



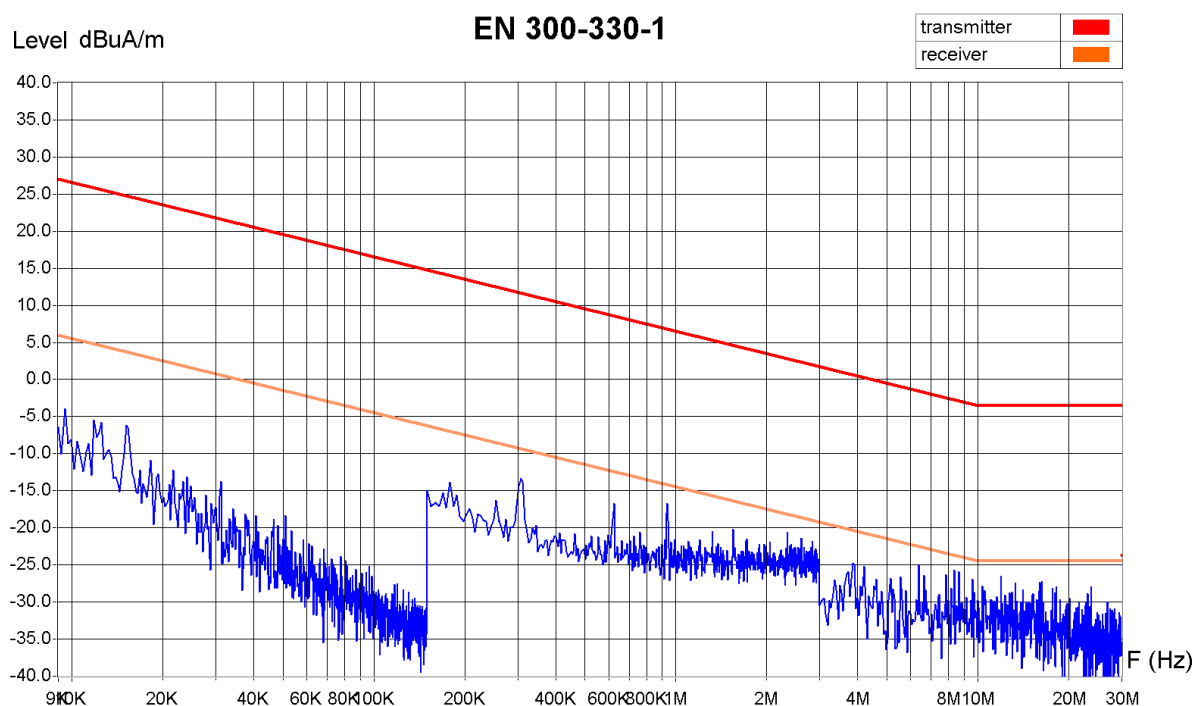
Zone	9 KHz - 150 KHz	150 KHz - 3 MHz	3 MHz - 30 MHz
Video Bandwidth	300 Hz	10 KHz	10 KHz
Resol Bandwidth	300 Hz	9 KHz	9 KHz

Operator: Ding
 Date/Time: 30.04.04 09:32
 Filename:
 CTX_06.png/.txt

Measurement Type : Radiated Field
 Polarisation : Horizontal
 Table Angle : 0-360°
 Antenna Height : 1-4 m



Equipment Under Test : CROS CRX
 Set-Up : s, photo
 Operating Conditions : active (no stand-by possible)
 Remarks : LOWER LIMIT AVAILABLE
 with measuring pre-amplifier 95-86 (low noise)



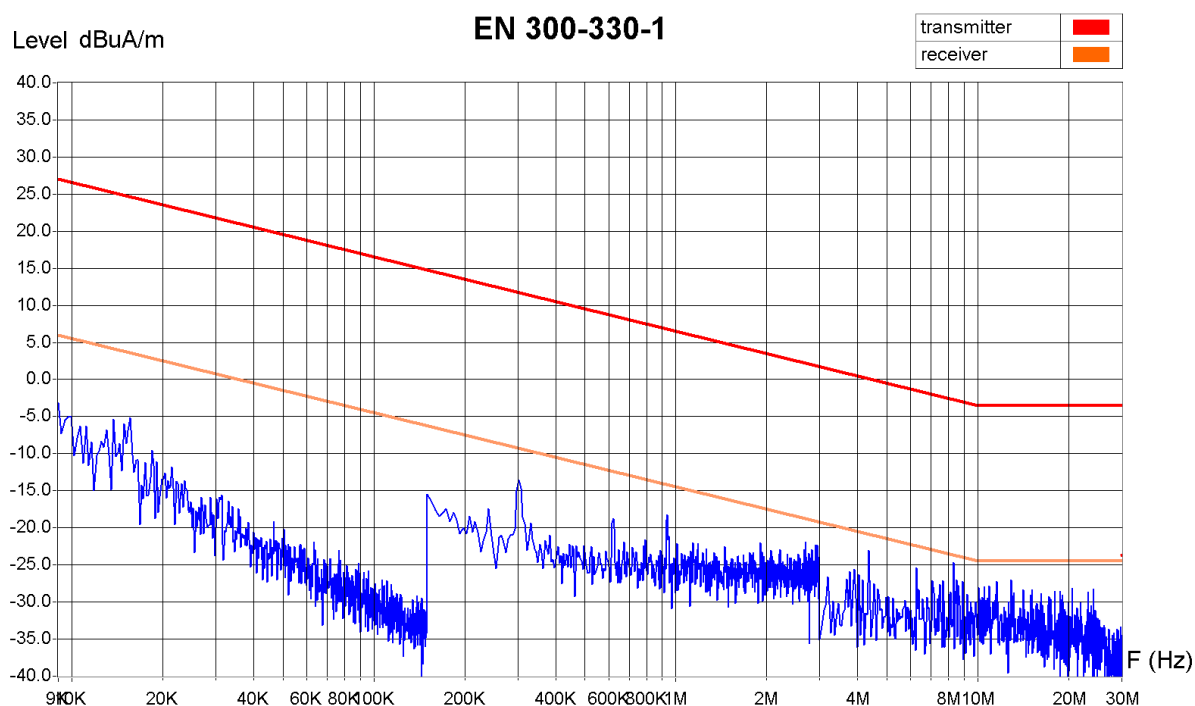
Zone	9 KHz - 150 KHz	150 KHz - 3 MHz	3 MHz - 30 MHz
Video Bandwidth	300 Hz	10 KHz	10 KHz
Resol Bandwidth	300 Hz	9 KHz	9 KHz

Operator: Ding
 Date/Time: 30.04.04 10:22
 Filename:
 CTX_07bis.png/.txt

Measurement Type : Radiated Field
 Polarisation : Vertical
 Table Angle : 0-360°
 Antenna Height : 1-4 m



Equipment Under Test : CROS CRX
 Set-Up : s, photo
 Operating Conditions : active (no stand-by possible)
 Remarks : LOWER LIMIT AVAILABLE
 with measuring pre-amplifier 95-86 (low noise)



Zone	9 KHz - 150 KHz	150 KHz - 3 MHz	3 MHz - 30 MHz
Video Bandwidth	300 Hz	10 KHz	10 KHz
Resol Bandwidth	300 Hz	9 KHz	9 KHz

Operator: Ding
 Date/Time: 30.04.04 10:33
 Filename:
 CTX_08.png/.txt

6.4 TRANSMITTER SPURIOUS EMISSIONS RADIATED (>30 MHz) SUB-CLAUSE 7.4.4Rated carrier output: < -12 dB μ A/m

Transmitter operating

Modulated

SPURIOUS EMISSIONS LEVEL (nW)								
CH 1 (8.2 MHz)			CH 2			CH 3		
f (MHz)	Band- width** (kHz)	Level (nW)	f (MHz)	Band- width** (kHz)	Level (nW)	f (MHz)	Band- Width** (kHz)	Level (nW)
30 – 300	120	≤ 2						
300 – 1000	120	≤ 2						
Measurement uncertainty			± 2 dB					

** Bandwidth = the measuring receiver bandwidth

LIMIT SUB-CLAUSE 7.4.4.2

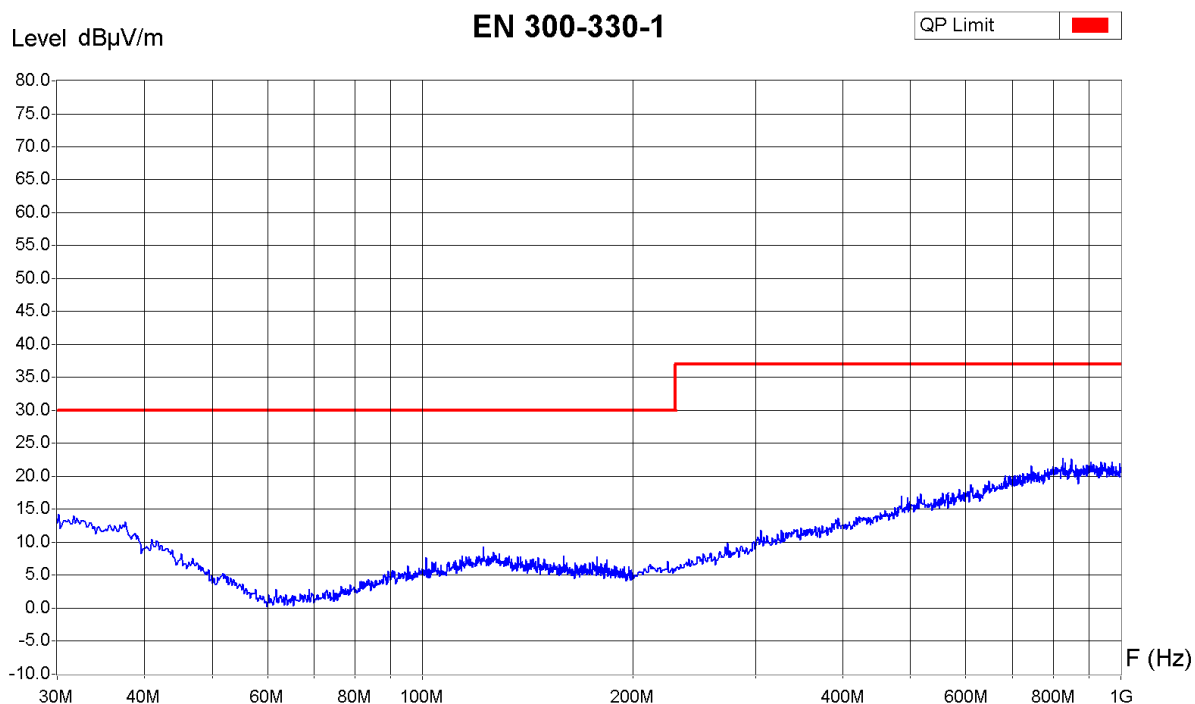
State	47 MHz to 74 MHz 87,5 MHz to 118 MHz 174 MHz to 230 MHz 470 MHz to 862 MHz	Other Frequencies between 30 to 1000 MHz
Operating	4 nW	250 nW
Standby	2 nW	2 nW

REMARKS:

Complies with the requirements

Measurement Type : Radiated Field
 Polarisation : Vertical
 Table Angle : 0-360°
 Antenna Height : 1-4 m

 Equipment Under Test : CROS CRX and CTX
 Set-Up : s. photo
 Operating Conditions : active and transmitting
 Remarks :

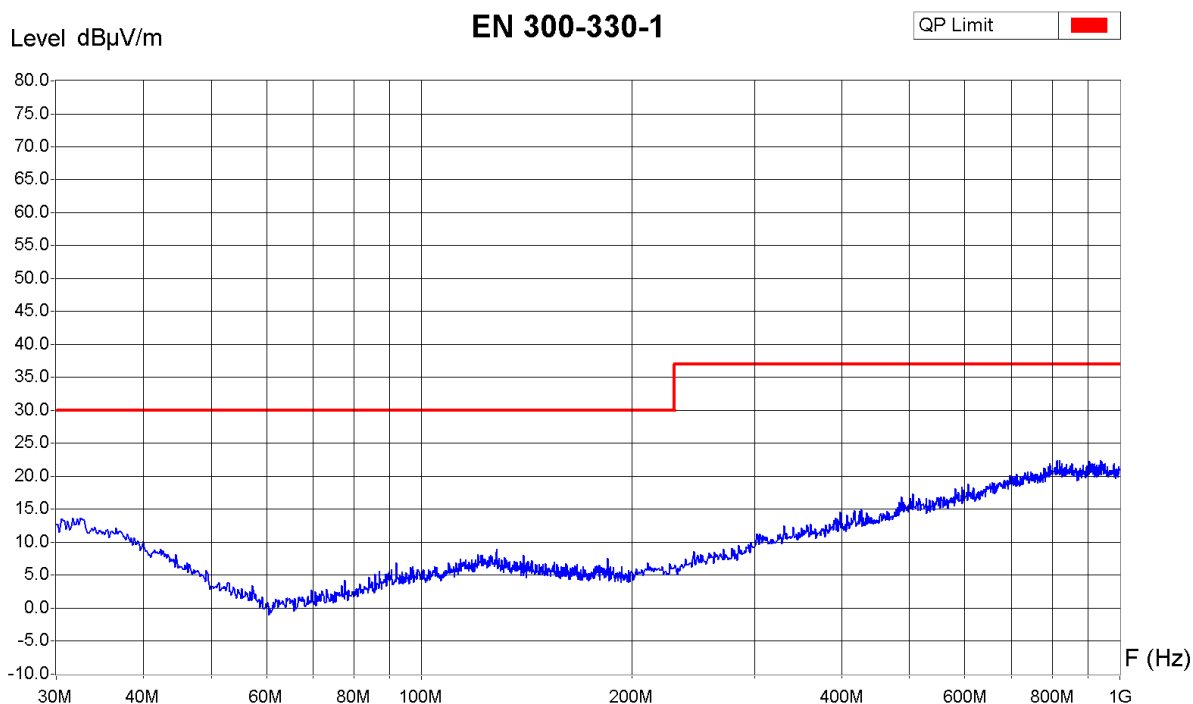


Zone	30 MHz - 199 MHz	199 MHz - 1 GHz
Video Bandwidth	100 KHz	100 KHz
Resol Bandwidth	120 KHz	120 KHz

Operator: Ding
 Date/Time: 30.04.04 17:32
 Filename:
 supercros_01.png/.txt

Measurement Type : Radiated Field
 Polarisation : Horizontal
 Table Angle : 0-360°
 Antenna Height : 1-4 m

 Equipment Under Test : CROS CRX and CTX
 Set-Up : s. photo
 Operating Conditions : active and transmitting
 Remarks :



Zone	30 MHz - 199 MHz	199 MHz - 1 GHz
Video Bandwidth	100 KHz	100 KHz
Resol Bandwidth	120 KHz	120 KHz

Operator: Ding
 Date/Time: 30.04.04 17:38
 Filename:
 supercros_02.png/.txt

6.5 DUTY CYCLE SUB-CLAUSE 7.5

The DUT is continuously transmitting.

LIMIT SUB-CLAUSE 7.5.3

Duty cycle Class	Duty cycle ratio
1	< 0.1 %
2	< 1.0 %
3	< 10 %
4	Up to 100%

The duty cycle class is 4.

7. Photos of DUT



Photo 1

Equipment under test

right: Transmitter CROS CTX

left: Receiver CROS CRX



Photo 2

Measurement of carrier and spurious emissions on CTX ($f < 30\text{MHz}$)



Photo 3

Measurement of spurious emissions on CRX ($f < 30\text{MHz}$)



Photo 4

Measurement of spurious emissions
($f > 30$ MHz)