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MACHINERY - COMPONENTS - TECHNOLOGY

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Laboratoire d'essai accrédité par l'Office Fédéral de Métrologie (Suisse)
Durch das Eidgenössische Amt für Messwesen (Schweiz) akkreditiertes Prüflabor

Registration number
Numéro d'accréditation : **STS 024**
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Service suisse d'essai
Servizio di prova in svizzera
Swiss testing service

Report no:
Rapport no: **12'782**
Bericht Nr:

Title: **Type acceptance measurements for a 216-217 MHz transmitter « Campus S » according to the Code of federal regulations 47 : Parts 2 (General rules and regulations) and 95 (LPRS transmitters)**
Titre:
Titel:

Date of test:
Date de l'essai: **July 11 – 13, 2001**
Prüfdatum:

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

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

Test performed by
Essai effectué par :
Prüfer

Mr. Manfred Portmann

Rossens, 2001-09-17

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

Mr. Manfred Portmann

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

Mr. Erich Staub

(Issue Date / Date d'édition / Ausstelldatum)

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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
- No test / Pas d'essai / Nicht geprüft

Test Type / Type d'essai / Art der Prüfung	References/ Références / Referenzen	Result / Résultat / Ergebnis
Designation of emission Désignation d'émission Bezeichnung der Emission	FCC 47 §2.201 FCC 47 §2.202	✓
RF power output Puissance RF HF Leistung	FCC 47 §2.1046 FCC 47 §95.639 (e)	✓
Modulation characteristics Caractéristiques de la modulation Modulationscharakteristiken	FCC 47 §2.1047	✓
Occupied bandwidth Bande passante Bandbreite	FCC 47 §2.1049 FCC 47 §95.635 (c)(1)	✓
Field strength of spurious radiation Champ émis Feldstärke der Nebenaussendung	FCC 47 §2.1053 FCC 47 §95.635 (c)(1)	✓
Frequency stability Stabilité de fréquence Frequenzstabilität	FCC 47 §2.1055 FCC 47 §95.629 (d)(2)	✓

United States: 47 CFR "Code of Federal Regulations" - Telecommunication
FCC Part 2: Frequency allocations and radio treaty matters; General rules and regulations
FCC Part 95: Low power radio service (LPRS)

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2. Client / Client / Kunde

Client name and address
Nom et adresse du client
Name und Adresse des Kunden
*Phonak Communications AG
Länggasse 17
CH-3280 Murten
Switzerland*

Contact Person / Responsable / Kontaktperson *Mr François Marquis*

Telephone / Téléphone / Telefon *+41 (0)26 672 96 74*

Fax / Télécopieur / Telefax *+41 (0)26 672 96 77*

Mandate no / Mandat no / Auftrag Nr. *2001-4993*

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

Manufacturer name and address
Nom et adresse du fabricant
Name und Adresse des Herstellers
*Phonak Communications AG
Länggasse 17
CH-3280 Murten
Switzerland*

Product name / Nom du produit / Produktname *Campus S*

Product description / Description du produit /
Produktbeschreibung *One channel FM-transmitter for use as an auditory assistance device in the low power radio service (LPRS) band. The device contains an audio input which is also used as antenna socket.*

Production country / Pays de fabrication /
Ursprungsland *Switzerland*

Product type / Type du produit / Typ des Produktes *Campus S*

Serial no / No. de série / Seriennummer *---*

Highest frequency / Frequence plus élevée / Höchste
Frequenz *217 MHz*

Modifications before the tests
Modifications apportées avant les essais
Vor den Prüfungen angebrachte Änderungen *None*

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4. Test instrumentation and procedures

The list of the test equipment (stocklist number) is provided for each test in the appendix. The equipment is calibrated with traceability.

The test procedures used are in accordance with ANSI C63.4-1992 "Method of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz".

5. Test specification requirements

The EUT must comply with the requirements of 47 CFR "Code of Federal Regulations" - Telecommunication, FCC Part 2 and Part 95.

6. Test conditions / Conditions d'essai / Testbedingungen

Temperature / Température / Temperatur:	22 – 25 °C
Pressure / Pression / Druck:	1007 – 1010 hPa
Relative humidity / Humidité relative / Relative Luftfeuchtigkeit:	58 – 66 %
Test period / Date des essais / Datum der Prüfungen:	July 11 – 13, 2001

7. Persons present / Personnes présentes / Anwesende Personen

Test Engineer(s) / Ingénieur(s) d'essai / Prüfsingenieur(e) :

Mr. Manfred Portmann

Other(s) / Autre(s) / Andere :

Name / Nom / Name

Company / Société / Firma

Mr. François Marquis

Phonak Communications AG



8. Emission Tests / Essais d'émission / Störaussendungsmessungen

8.1. Designiation of emission / Désignation d'émission / Bezeichnung der Emission

Standard:	United States: 47 CFR "Code of Federal Regulations" - Telecommunication ☒ FCC Part 2, Subpart C: Emission: §2.201 and §2.202
Introduction:	A system of designating emission, modulation, and transmission Characteristics shall be employed. (a) Emissions are designated according to their classification and their necessary bandwidth. (b) A minimum of three symbols are used to describe the basic characteristics of radio waves. (c) Four symbols are used to describe the necessary bandwidth.
Necessary bandwidth:	For a given class of emission, the minimum value of the occupied bandwidth sufficient to ensure the transmission of information at the rate and with the quality required for the system employed, under specified conditions. $B_n = 2M + 2D$ B_n = necessary bandwidth M = maximum modulation frequency in hertz = 7 kHz D = Peak frequency deviation = 5 kHz
Basic characteristics:	$B_n = 24$ kHz F3E F : Frequency modulation 3 : A single channel containing analogue information E : Telephony (including sound broadcasting)
Designation of emission:	24K0F3E

8.2. RF power output / Puissance RF / HF Leistung

Standard: United States: 47 CFR "Code of Federal Regulations" - Telecommunication

☒ FCC Part 2, Subpart J: Certification: §2.1046☒ FCC Part 95, Subpart E: Technical regulations: §95.639(e)

Limit for LPRS = 100 mW = 20 dBm

Distance: ☐ 30 m ☒ 10 m ☐ 3 m ☐Test site: ☐ anechoic chamber (foam) ☐ open test site
☒ anechoic chamber (ferrite) ☐

Test precision: ± 4.6 dB

Position of EUT: 0.8 m (Height of equipment under test above floor)

Test method: Since the test item is equipped with an integral antenna, the effective radiated power (ERP) was measured instead of the output power. The ERP into a dipole antenna was calculated.

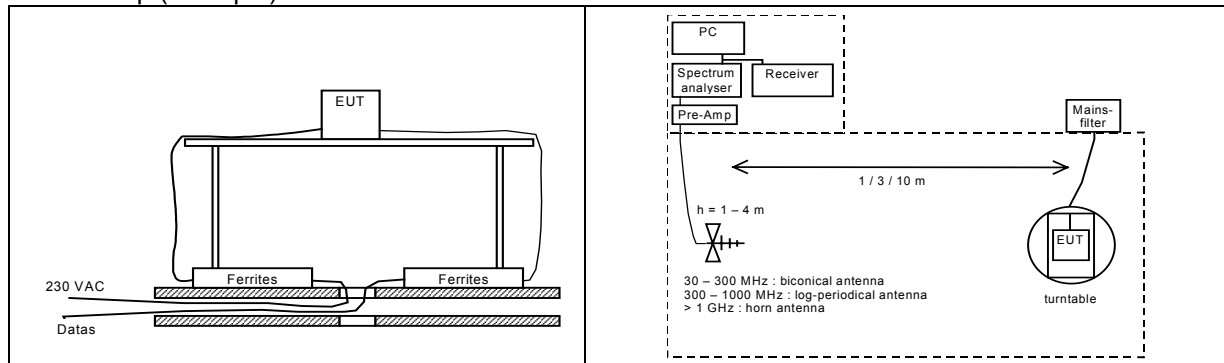
$$P = \frac{E^2 4\pi d^2}{120\pi g} = \frac{E^2 d^2}{30g} \quad \text{with} \quad \begin{array}{l} P = \text{power in watts} \\ g = \text{numeric gain} \\ E = \text{field strength in volts/meter} \\ d = \text{measurement distance in meter} \end{array}$$

Test results: With E = 78 dBμV/m ; g = 1.25 dB ; d = 10 m

The equation reduces to :

$$P(\text{dBm}) = E(\text{dB}\mu\text{V/m}) - 86 \text{ dB} = -8 \text{ dBm} \leq 0.2 \text{ mW}$$

Test set-up (example):



Test equipment:

☒ Spectrum analyzer	☒ 88-14	☐ 90-26	☐ 94-24			
☐ Receiver (CISPR 16)	☐ 85-04	☐ 90-43	☐ 94-35			
☐ Preamplifier	☐ 88-05	☐ 90-01	☐ 90-42	☐ 92-39	☐ 95-86	☐ 97-08
☐ Antenna (biconical)	☐ 82-02	☐ 87-05	☐ 87-16	☐ 91-05	☐ 94-37	
☐ Antenna (log-per)	☐ 88-20	☐ 90-30	☐ 91-35	☐ 94-64	☐	
☒ Antenna (bilog)	☒ 94-03	☐				
☐ Antenna (horn)	☐ 90-24	☐ 90-29	☐ 98-12	☐ 98-13	☐	
☒ Printer	☒ 99-33	☐				

Results: ☒ complies ☐ does not comply ☐ not applicable ☐ not done

**8.3. Modulation characteristics / Caractéristiques de modulation / Modulationscharakteristiken**

Standard: United States: 47 CFR "Code of Federal Regulations" - Telecommunication
☒ FCC Part 2, Subpart J: Certification: §2.1047

Test site: ☐ anechoic chamber (foam) ☐ open test site
☐ anechoic chamber (ferrite) ☒ laboratory

Frequency response of audio circuit: An audio signal at 1 kHz was adjusted for a 100 % rated FM deviation (= 600 mV rms). While maintaining the same audio signal, the frequency was varied. The FM deviation was measured and recorded at several frequencies in order to determine the frequency response.

[kHz]	[kHz]	[kHz]	[kHz]	[kHz]	[kHz]	[kHz]	[kHz]	[kHz]	[kHz]
0.1	4.7	0.8	3	3.0	3.6	6.5	4.2		
0.2	3.5	0.9	3	3.5	3.9	7.0	3.8		
0.3	3.2	1.0	3	4.0	4.1	7.8	3.3		
0.4	3.1	1.2	3.1	4.5	4.4	8.0	2.9		
0.5	3	1.5	3.1	5.0	4.6	8.5	2.5		
0.6	3	2.0	3.3	5.5	4.6	9.0	2.2		
0.7	3	2.5	3.4	6.0	4.5	9.5	1.9		

Modulation limiting: An audio signal at 1 kHz was adjusted for a 100 % rated FM deviation (= 600 mV rms). While maintaining the same frequency, the audio level was varied. The FM deviation was measured and recorded at audio levels in order to determine the modulation limiting.

Audio signal level [mV rms]	FM Deviation [kHz]			
	200 Hz	1000 Hz	3500 Hz	8000 Hz
2	0.3	0.3	0.3	0.2
5	0.6	0.6	0.7	0.5
10	1.1	1.1	1.3	0.9
20	2.1	2	2.6	1.8
50	2.6	2.2	2.8	2.1
100	2.8	2.4	3	2.2
200	3	2.6	3.2	2.5
500	3.4	2.9	3.7	2.8
1000	3.7	3.3	4.2	3.2
3000	4.4	4	5.4	4.1

Mic Input: The sensitivity of the microphone input is 26 dB below the sensitivity of the audio input; the adjustment is made with resistors.

The characteristics of the microphone is: 75 dBPSL $\Rightarrow$ 1 mVrms

Test equipment:

☒ Analyzer	☒ HP 8920B
☐	

Results: ☒ complies ☐ does not comply ☐ not applicable ☐ not done

**8.4. Occupied bandwidth / Bande passante / Bandbreite**

Standard: United States: 47 CFR "Code of Federal Regulations" - Telecommunication

☒ FCC Part 2, Subpart J: Certification: §2.1049☒ FCC Part 95, Subpart E: Technical regulations: §95.635(c)(1)Test site: ☐ anechoic chamber (foam) ☐ open test site
☐ anechoic chamber (ferrite) ☒ laboratoryTest precision: ± 4.6 dB

Test requirements: Emissions for transmitters operating on standard band channels (25 kHz) shall be attenuated below the unmodulated carrier in accordance with the following:

- Emissions 12.5 kHz to 22.5 kHz away from the channel center frequency: at least 30 dB
- Emissions more than 22.5 kHz away from the channel center frequency: at least $43 + 10 \log$ (carrier power in watts) dB

Test method: The audio signal input was set to 2.5 V rms (= FM deviation max of 3.5 kHz). For different input frequencies the fundamental frequency was plotted.

Test equipment:

☒ Spectrum analyzer ☒ 88-14 ☐ 90-26 ☐ 94-24☐Results: ☒ complies ☐ does not comply ☐ not applicable ☐ not done



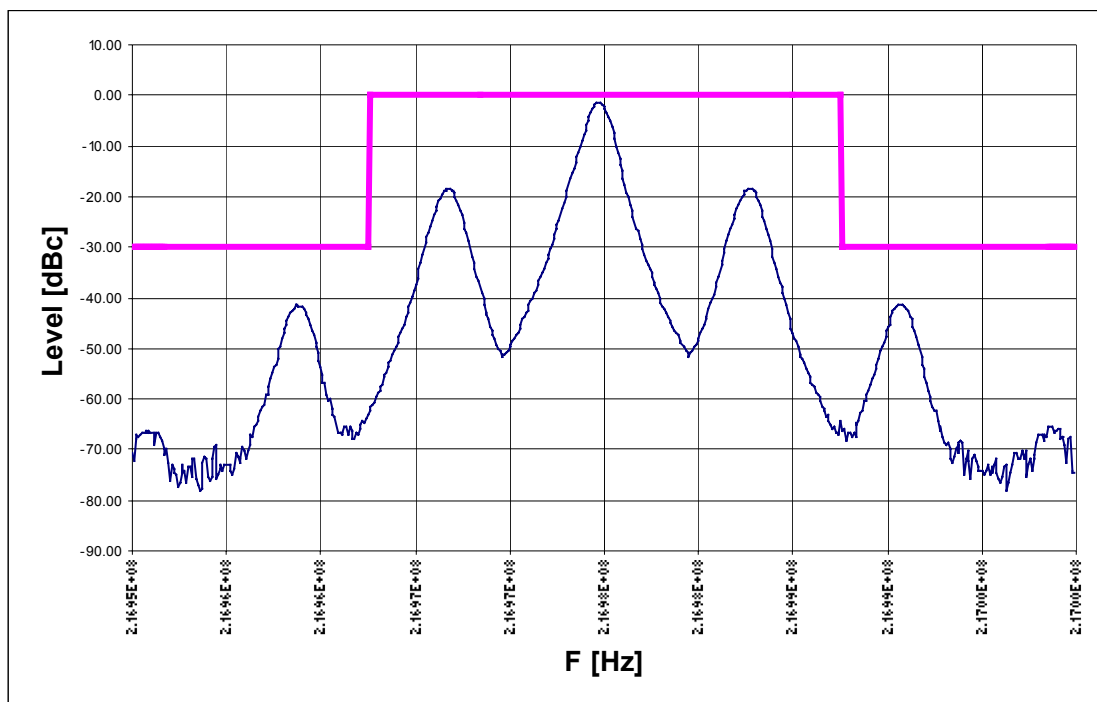
Measurement Type: Power interference

Equipment under test: Campus S

Set-Up:

Operating conditions: Faudio= 8.0 kHz, Level = 120 mV

Remarks: Audio Input





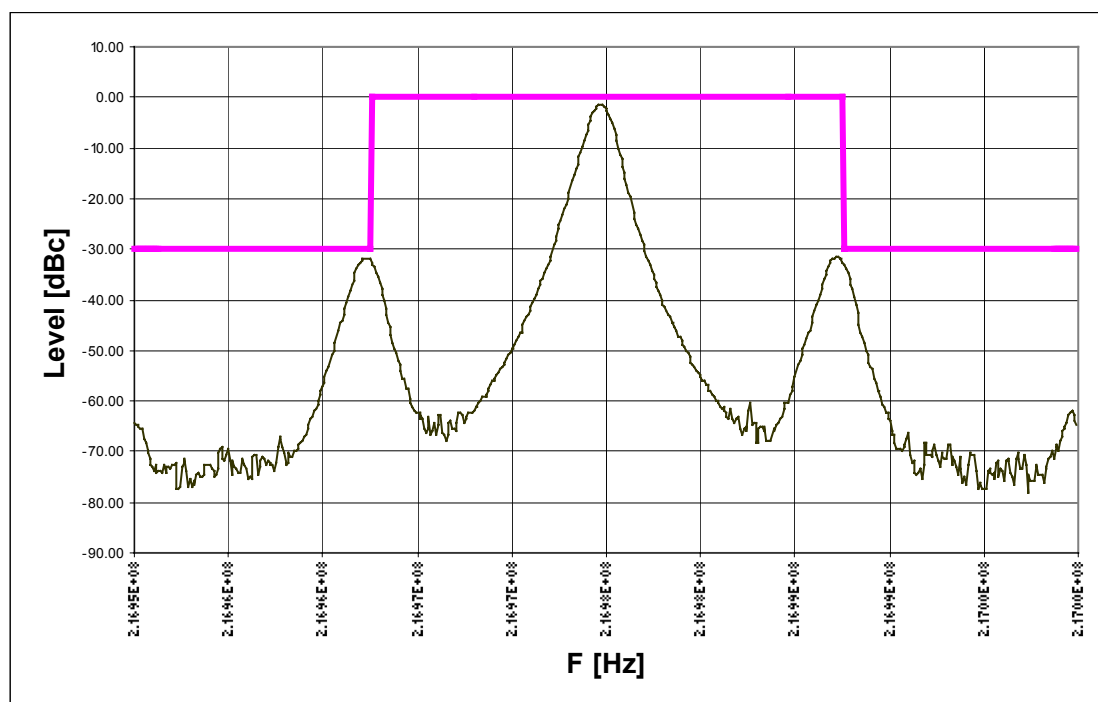
Measurement Type: Power interference

Equipment under test: Campus S

Set-Up:

Operating conditions: Faudio= 12.5 kHz, Level = 120 mV

Remarks: Audio Input





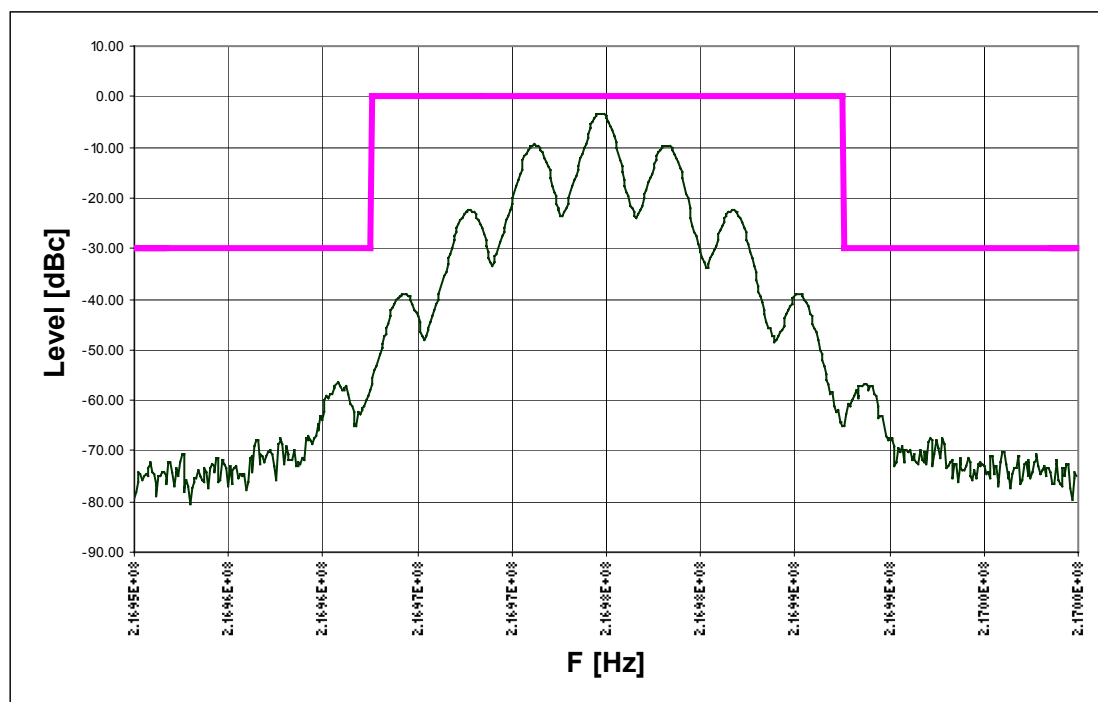
Measurement Type: Power interference

Equipment under test: Campus S

Set-Up:

Operating conditions: Faudio= 3.5 kHz, Level = 120 mV

Remarks: Audio Input





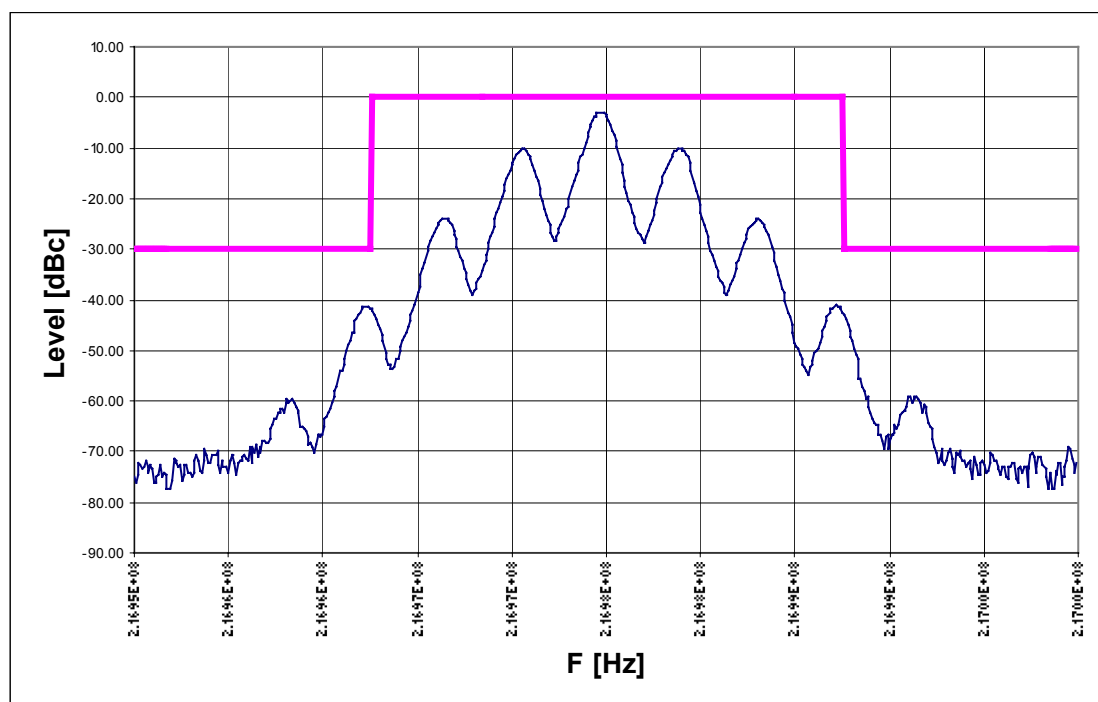
Measurement Type: Power interference

Equipment under test: Campus S

Set-Up:

Operating conditions: Faudio= 4.16 kHz, Level = 120 mV

Remarks: Audio Input





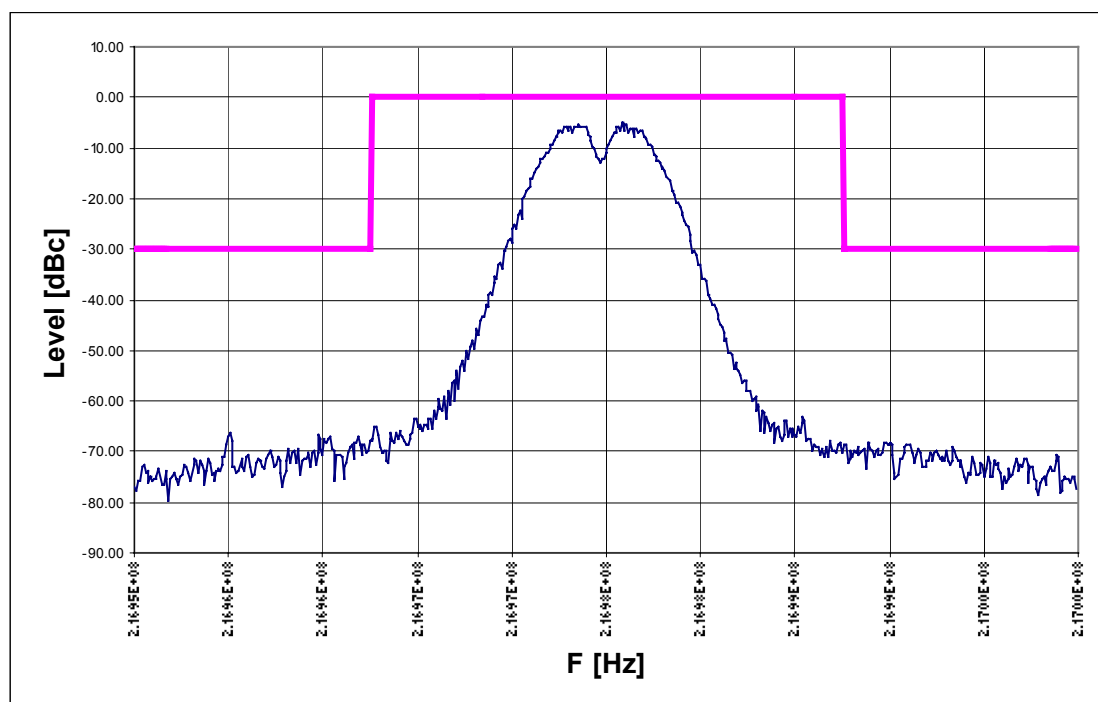
Measurement Type: Power interference

Equipment under test: Campus S

Set-Up:

Operating conditions: Faudio= 1 kHz, Level = 120 mV

Remarks: Audio Input





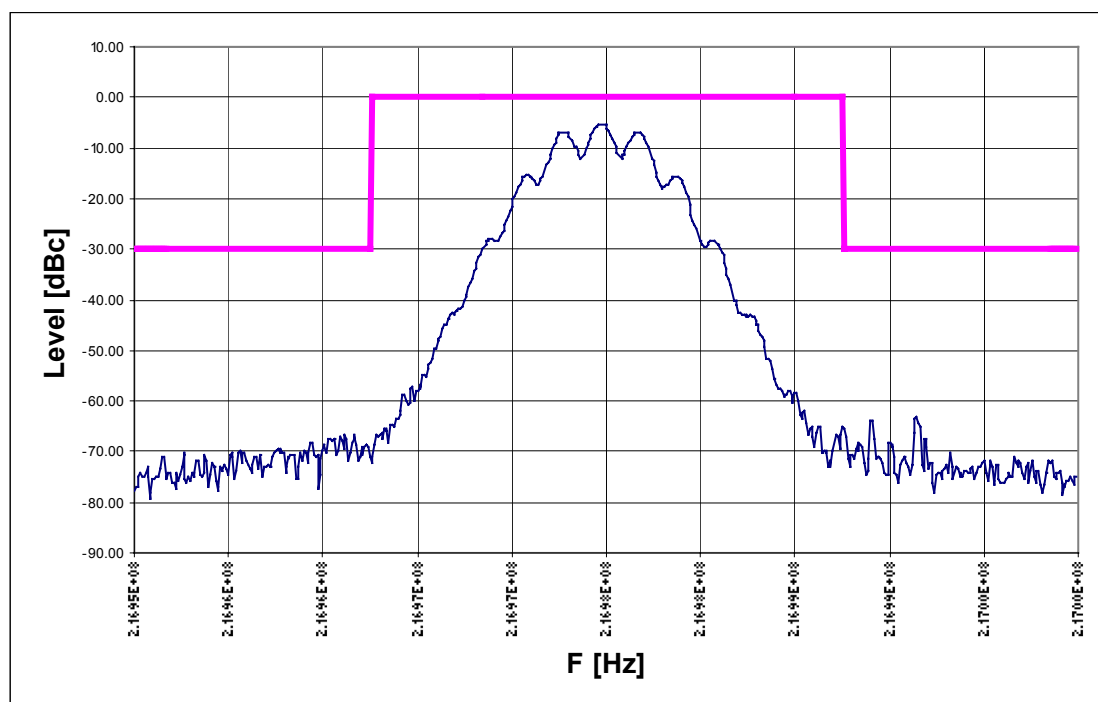
Measurement Type: Power interference

Equipment under test: Campus S

Set-Up:

Operating conditions: Faudio= 2 kHz, Level = 120 mV

Remarks: Audio Input





8.5. Field strength of spurious radiation / Champ rayonné / Störfeldstärke

Standard: United States: 47 CFR "Code of Federal Regulations" - Telecommunication
☒ FCC Part 2, Subpart J: Certification: §2.1053
☒ FCC Part 2 §2.1057: Frequency range: up to tenth harmonic or 40 GHz
☒ FCC Part 95, Subpart E: Technical regulations: §95.635(c)(1)

Distance: ☐ 30 m ☒ 10 m ☐ 3 m ☐

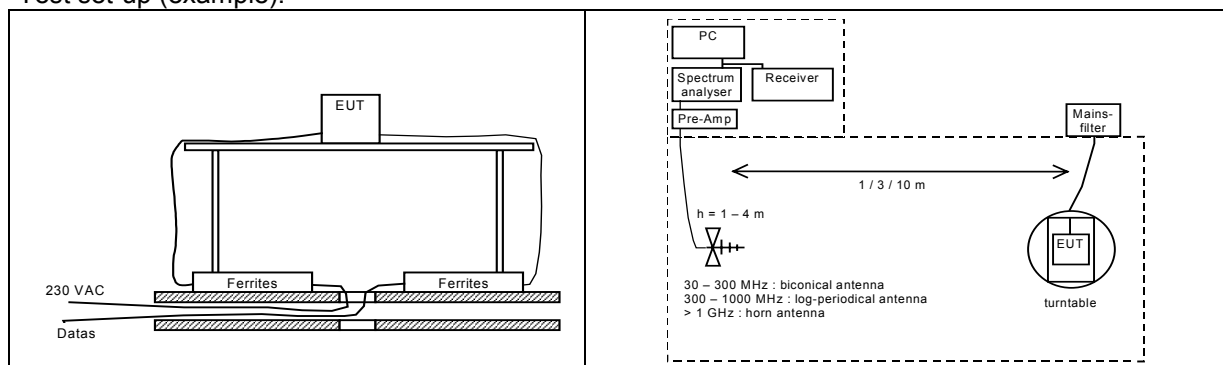
Test site: ☒ anechoic chamber (foam): 1 – 2.2 GHz
☒ anechoic chamber (ferrite): 30 MHz – 1 GHz

Test precision: ± 4.6 dB

Position of EUT: 0.8 m (Height of equipment under test above floor)

Test method: The electromagnetic disturbance radiated by the equipment is measured using a spectrum analyzer and an antenna. The equipment is placed on a wooden table at 80 cm. The turning table is operated through 360° during the measurements. The recordings are carried out taking into account the maximum value of all the disturbance appearing while the apparatus is under test. The peak values are recorded continuously on the graph. The limit must be respected in quasi-peak values (QP) up to 1 GHz and in average values (AV) above 1 GHz. The 6 dB bandwidth of the spectrum analyzer is adjusted to 120 kHz from 30 to 1000 MHz and 1 MHz above 1 GHz.

Test set-up (example):



Test equipment:

☒ Spectrum analyzer	☒ 88-14	☐ 90-26	☒ 94-24			
☐ Receiver (CISPR 16)	☐ 85-04	☐ 90-43	☒ 94-35			
☒ Preamplifier	☐ 88-05	☒ 90-01	☐ 90-42	☐ 92-39	☐ 95-86	☒ 97-08
☐ Antenna (biconical)	☐ 82-02	☐ 87-05	☐ 87-16	☐ 91-05	☐ 94-37	
☐ Antenna (log-per)	☐ 88-20	☐ 90-30	☐ 91-35	☐ 94-64	☐	
☒ Antenna (bilog)	☒ 94-03	☐				
☒ Antenna (horn)	☒ 90-24	☐ 90-29	☐ 98-12	☐ 98-13	☐	
☒ Printer	☒ 99-33	☐				
☐						

Except the carrier, each other emission is ≤ -30 dBm.

REMARK: The equipment "Campus S" is identified on the following pages by its projekt name "TX2 S".

Results: ☒ complies ☐ does not comply ☐ not applicable ☐ not done

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Measurement Type : Radiated Field



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Equipment Under Test : TX2S

Set-Up : table top

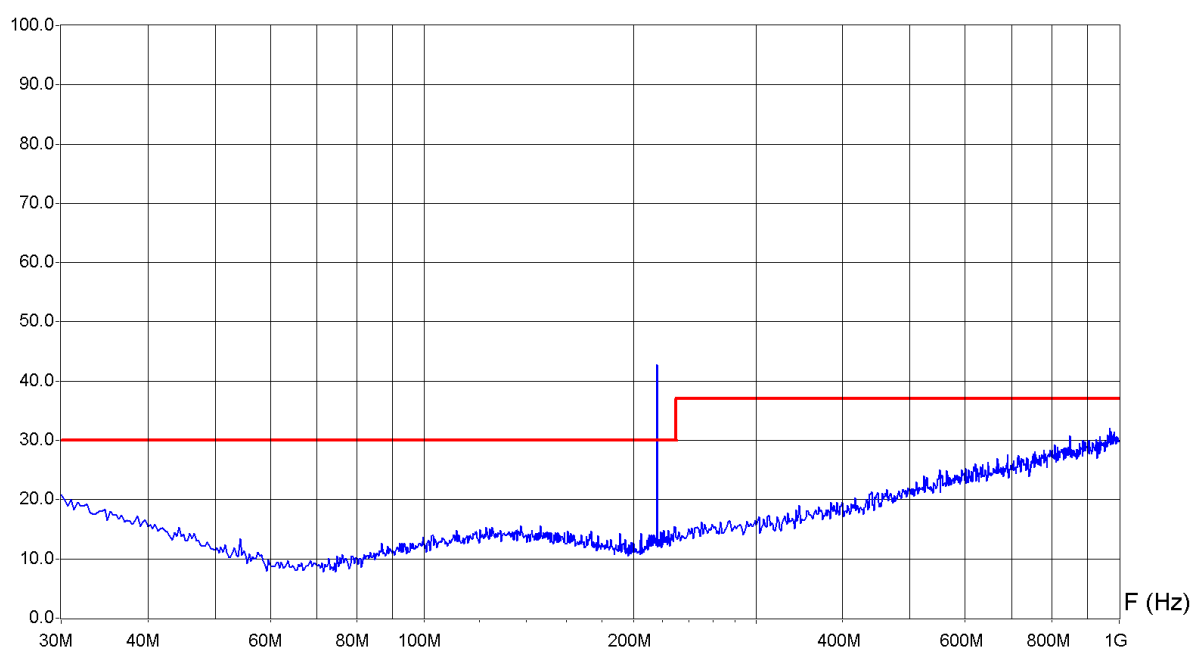
Operating Conditions : continuous sending

Remarks : both polarisation

with notch filter at 216 MHz, transmitter frequency = 216.975 MHz

Level dB μ V/m

QP Limit



Zone	30 MHz - 230 MHz	230 MHz - 1 GHz
Video Bandwidth	100 KHz	100 KHz
Resol Bandwidth	120 KHz	120 KHz
Sweep Time	42 ms	161 ms

Operator: PoM

Date/Time: 12.07.01 11:36

Filename:
330_7.png/.txt

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Measurement Type : Radiated Field



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Equipment Under Test : TX2S

Set-Up : table top

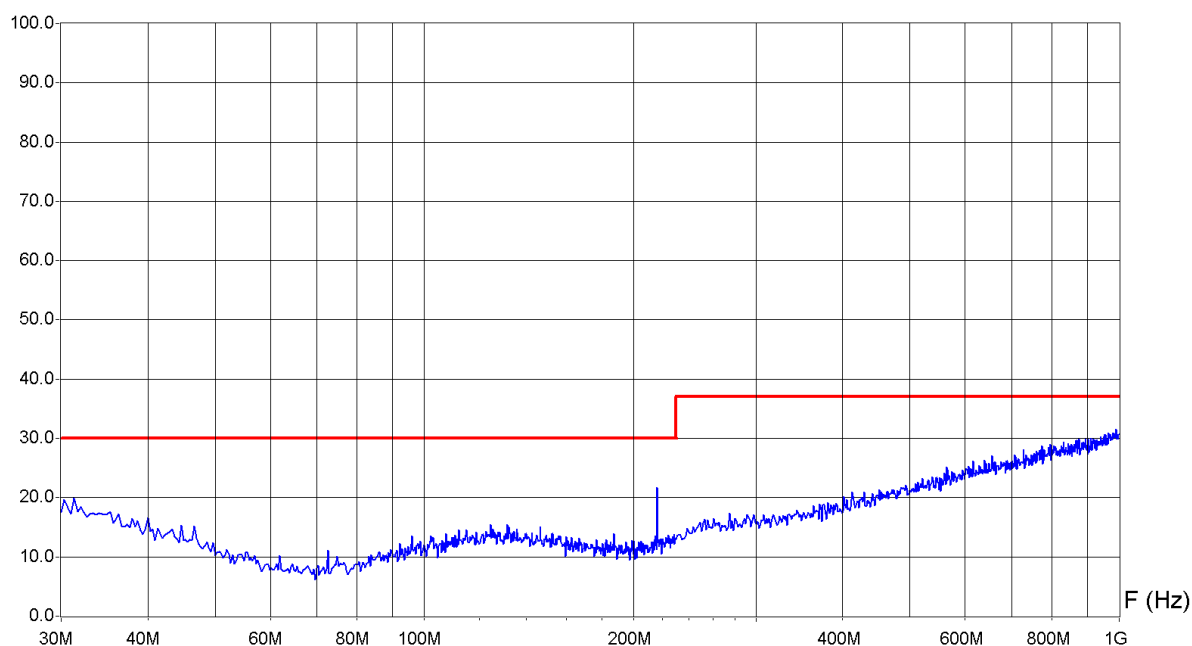
Operating Conditions : stand-by

Remarks : both polarisation

with notch filter at 216 MHz, transmitter frequency = 216.975 MHz

Level dB μ V/m

QP Limit



Zone	30 MHz - 230 MHz	230 MHz - 1 GHz
Video Bandwidth	100 KHz	100 KHz
Resol Bandwidth	120 KHz	120 KHz
Sweep Time	42 ms	161 ms

Operator: PoM

Date/Time: 12.07.01 11:41

Filename:
330_8.png/.txt

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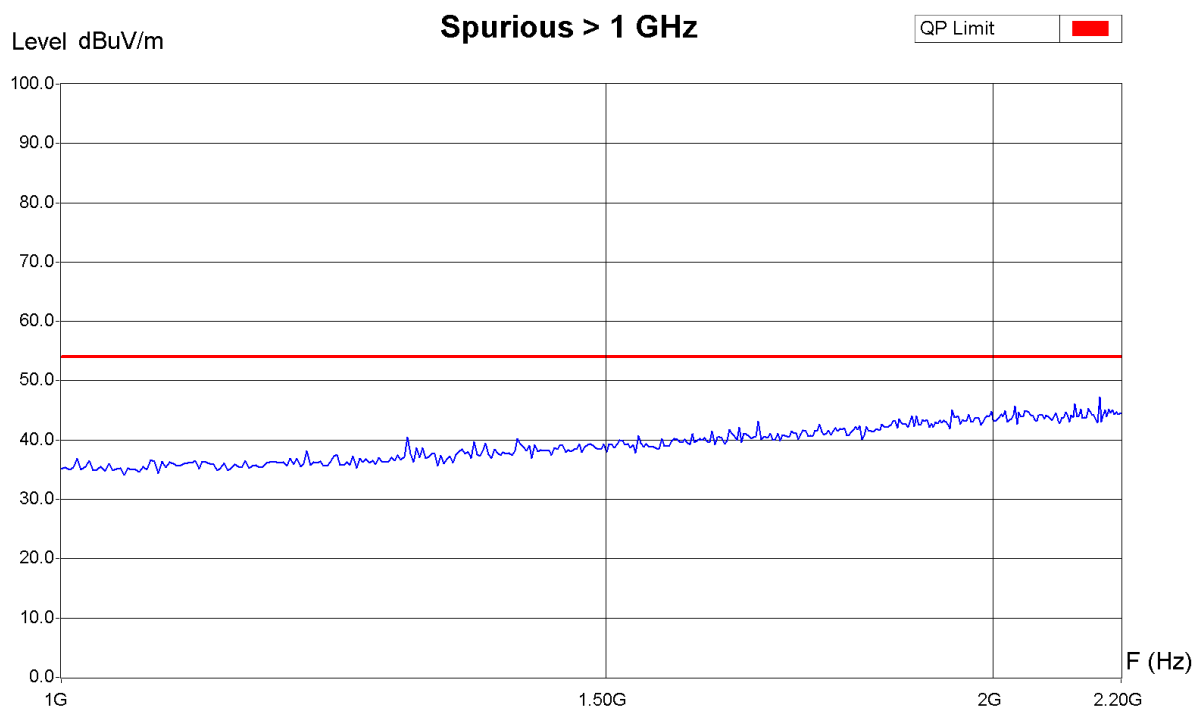
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Measurement Type : Radiated Field



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Equipment Under Test : TX2S
Set-Up : table top
Operating Conditions : continuous sending
Remarks :



Zone	1 GHz - 2.80 GHz
Video Bandwidth	100 KHz
Resol Bandwidth	100 KHz
Sweep Time	0 s

Operator: **PoM**
Date/Time: **12.07.01 11:59**
Filename:
330_9.png/.txt

**8.6. Frequency stability / Stabilité de fréquence / Frequenzstabilität**

Standard: United States: 47 CFR "Code of Federal Regulations" - Telecommunication
☒ FCC Part 2, Subpart J: Certification: §2.1055
☒ FCC Part 95, Subpart E: Technical regulations: §95.629(d)(2)

Test site: ☐ anechoic chamber (foam) ☐ open test site
☐ anechoic chamber (ferrite) ☒ laboratory

Test requirements and results: 1. $\Delta f < 50$ ppm with temperature varied from -30° to $+50^\circ$ in steps of 10 degrees.

Temperature in Degrees	Frequency [MHz]	Change ppm	Limit ppm
-30	216.973000	11.06	50
-20	216.974500	4.15	50
-10	216.974500	4.15	50
0	216.975500	0.46	50
10	216.975600	0.92	50
20	216.975400	ref	ref
30	216.974500	4.15	50
40	216.974500	4.15	50
50	216.974500	4.15	50

2. $\Delta f < 50$ ppm with supply voltage varied from 85% to 115%

Rated voltage	Frequency [MHz]	Change ppm	Limit ppm
85%	216.97450	0.46	50
Nominal	216.97460	ref	ref
115%	216.97450	0.46	50

Test equipment:

☒ Analyzer	HP 8920B
☒ Spectrum analyzer	☐ 88-14 ☒ 90-26 ☐ 94-24
☐	

Results: ☒ complies ☐ does not comply ☐ not applicable ☐ not done



9. Test set-up photos / Photos des essais / Fotos der Prüfungen

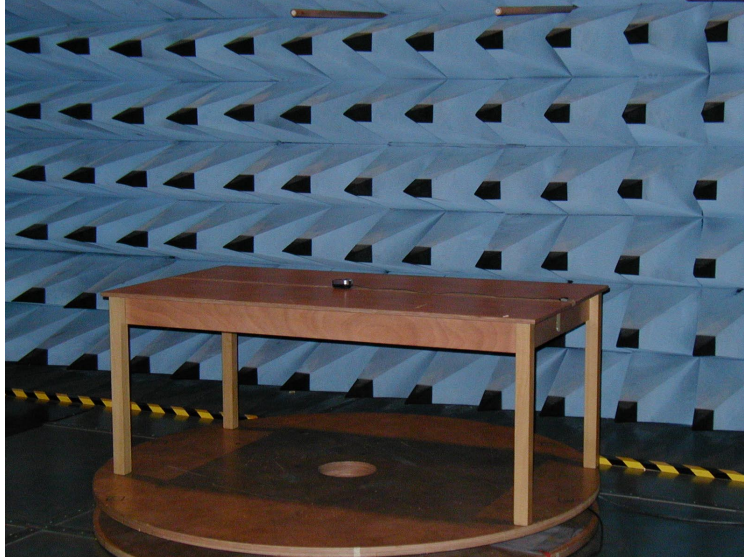


Photo 1

Spurious emission