Field strength of spurious emissions of the transmitter § 2.1053

LIMIT

90.210 (d) and 6.4 (d):
For transmitters designed to operate with a 12,5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

(3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12,5 kHz: At least 50 + 10 log (P) dB or 70 dB, whichever is the lesser attenuation.

With the given transmitter output Power of 10 mW this results in an absolute Limit of –20 dBm.

Results:

There were no other relevant emissions found except the harmonics in the spectrum from 30 MHz to the 10th harmonic.

CHANNEL					
450 MHz		460 MHz		470 MHz	
Frequency (MHz)	Level (dBm)	Frequency (MHz)	Level (dBm)	Frequency (MHz)	Level (dBm)
All	< -40	All	< -40	All	< -40

Although all three channels were measured, the graphs were only taken at 460 MHz.

Test Equipment used: NT-100; NT-110; NT-111; NT-112; NT-125; NT-207

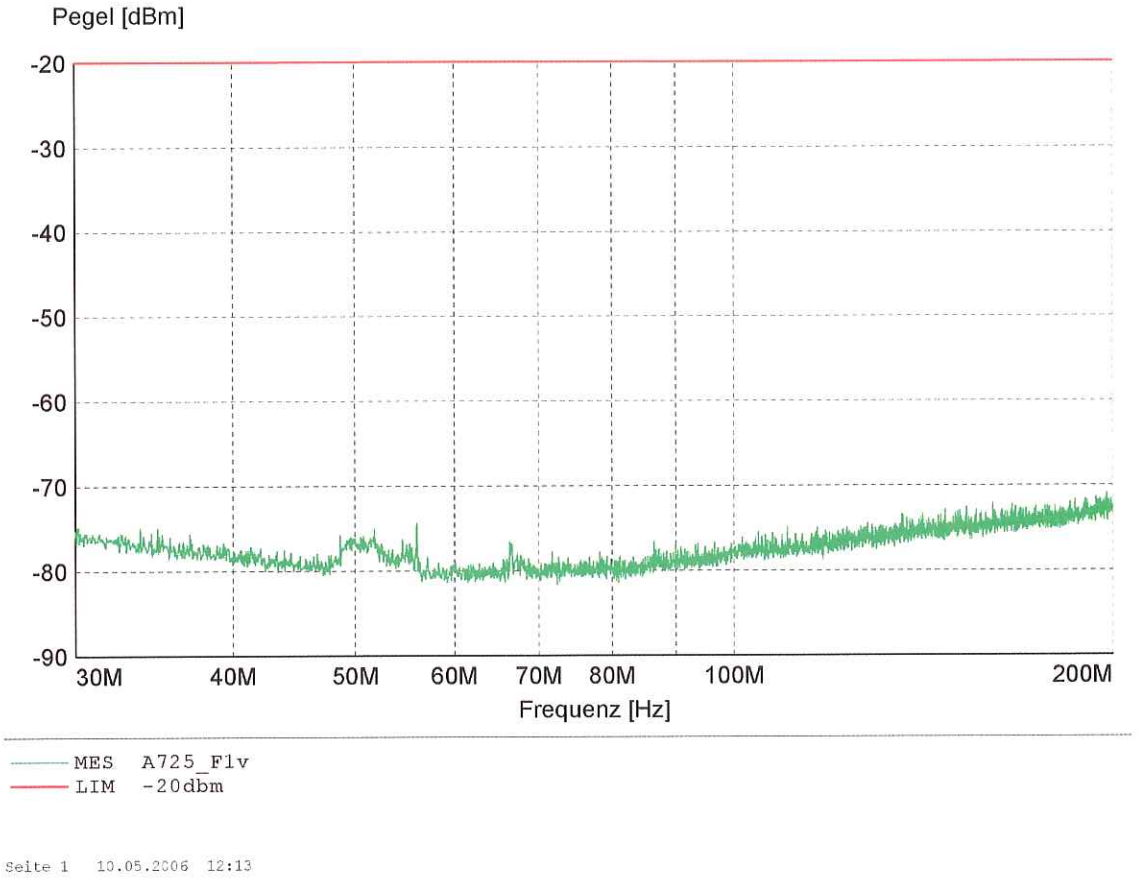
Ambient temperature: 23°C Relative humidity: 51%

Field strength of spurious emissions of the transmitter § 2.1053

Operating mode:

Frequency: 460 MHz

Modulation: unmodulated carrier



Test Equipment used: NT-100; NT-110; NT-111; NT-112; NT-125; NT-207

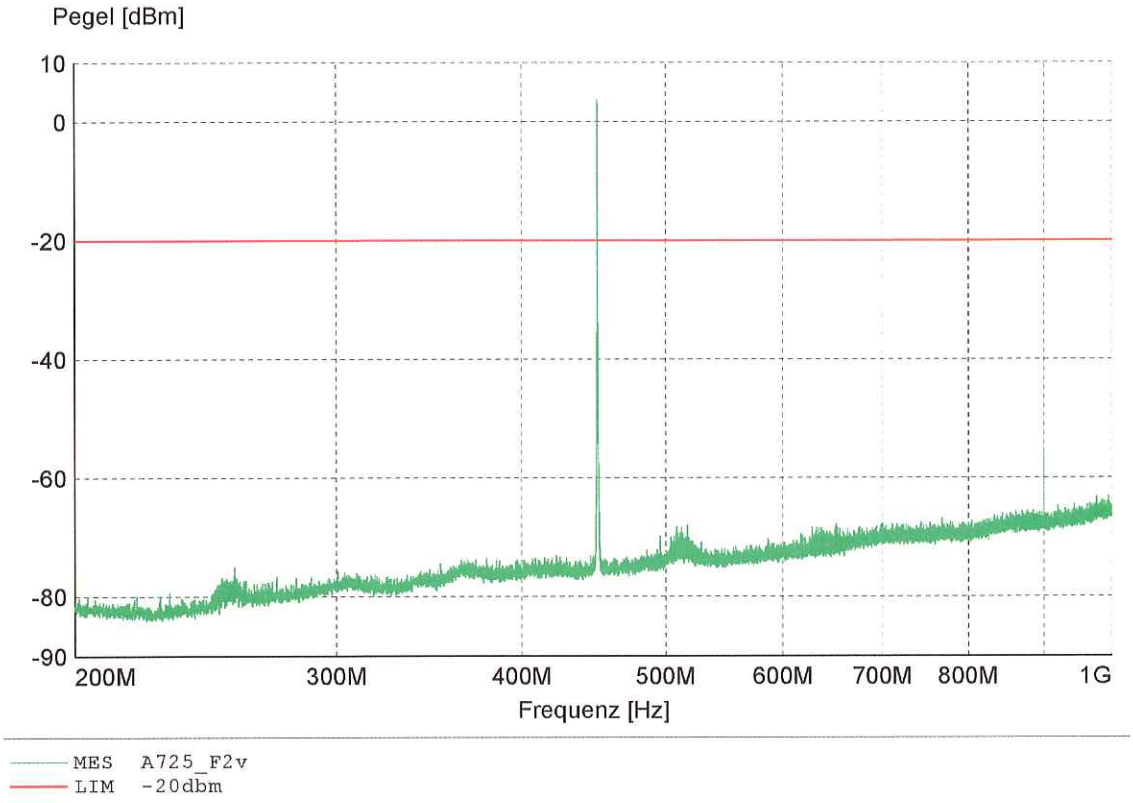
Ambient temperature: 23°C Relative humidity: 51%

Field strength of spurious emissions of the transmitter § 2.1053

Operating mode:

Frequency: 460 MHz

Modulation: unmodulated carrier



Test Equipment used: NT-100; NT-110; NT-111; NT-112; NT-125; NT-207

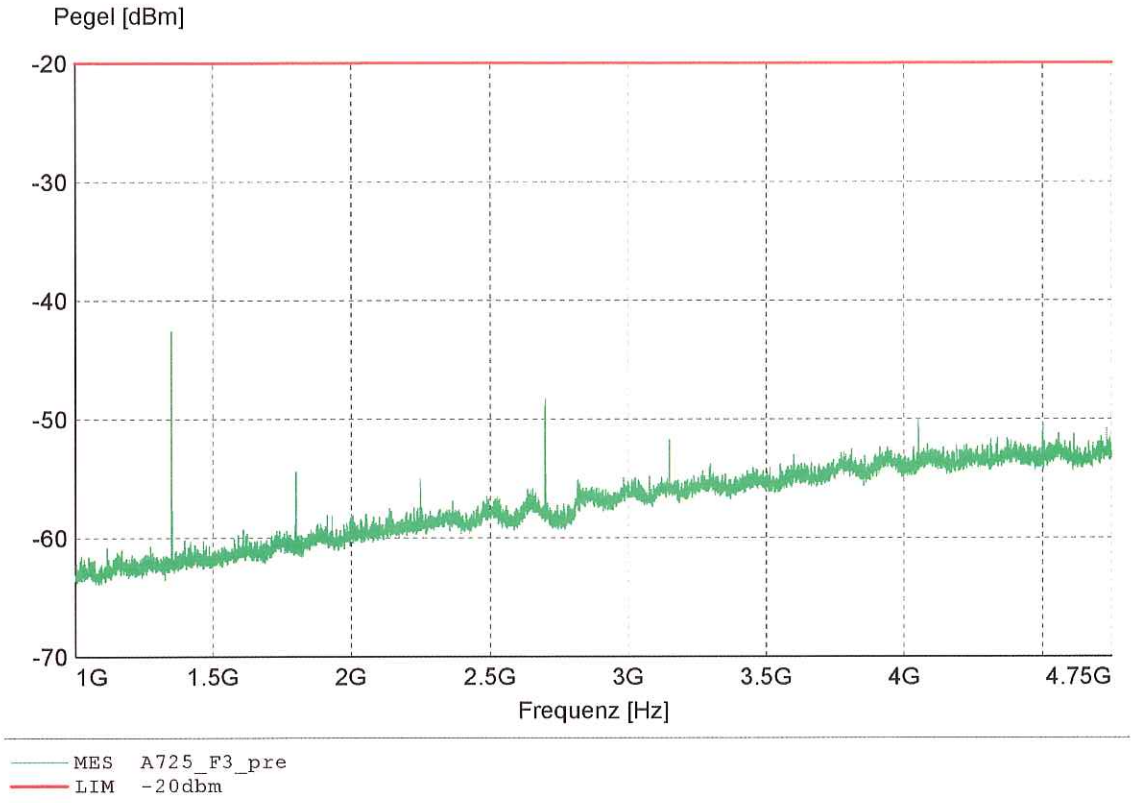
Ambient temperature: 23°C Relative humidity: 51%

Field strength of spurious emissions of the transmitter § 2.1053

Operating mode:

Frequency: 460 MHz

Modulation: unmodulated carrier



Test Equipment used: NT-100; NT-110; NT-111; NT-112; NT-125; NT-207

Frequency stability § 90.213
§ 7

Frequency error vs. Supply voltage

DC-Voltage	Frequency Error Hz			Frequency Error ppm		
	450 MHz	460 MHz	470 MHz	450 MHz	460 MHz	470 MHz
6,2 V	+230	+230	+230	+0,51	+0,50	+0,49
5,6 V	+210	+210	+210	+0,47	+0,46	+0,45
7,13 V	+210	+210	+210	+0,47	+0,46	+0,45
10 V	+190	+190	+190	+0,42	+0,41	+0,41

Frequency error vs. Temperature

Temperature °C	Frequency Error Hz			Frequency Error ppm		
	450 MHz	460 MHz	470 MHz	450 MHz	460 MHz	470 MHz
-30	+600	+610	+620	+1,33	+1,33	+1,33
-20	+560	+570	+580	+1,24	+1,24	+1,24
-10	+560	+570	+580	+1,24	+1,24	+1,24
±0	+360	+370	+380	+0,80	+0,80	+0,80
+10	+330	+340	+350	+0,74	+0,74	+0,74
+20	+300	+310	+320	+0,67	+0,67	+0,67
+30	+230	+230	+230	+0,51	+0,50	+0,49
+40	-190	-190	-190	-0,42	-0,41	-0,41
+50	-380	-390	-400	-0,85	-0,85	-0,85

LIMIT 90.213(a) (7 Table 5)

In the 421-512 (450-470) MHz band, fixed and base stations with a 12,5 kHz channel bandwith must have a frequency stability of 1,5 ppm. In the 421-512 (450-470) MHz band, mobile stations with a 12,5 kHz channel bandwith must have a frequency stability of 2,5 ppm.

Receiver spurious emissions § 8

LIMIT

8 (i):
The field strength of any spurious frequency generated by the receiver in each polarization (vertical and horizontal), measured at a distance of 3 metres, shall not exceed the limits of Table 6. The resolution bandwidth of the spectrum analyser shall be 100 kHz for measuring spurious emissions below 1,0 GHz and 1,0 MHz for above 1,0 GHz.

Table 6: Spurious Emission Limits for Receivers

Spurious frequency (MHz)	Field strength (µV/m) at 3 metres
30-88	100
88-216	150
216-960	200
960-1610	500
above 1610	1000

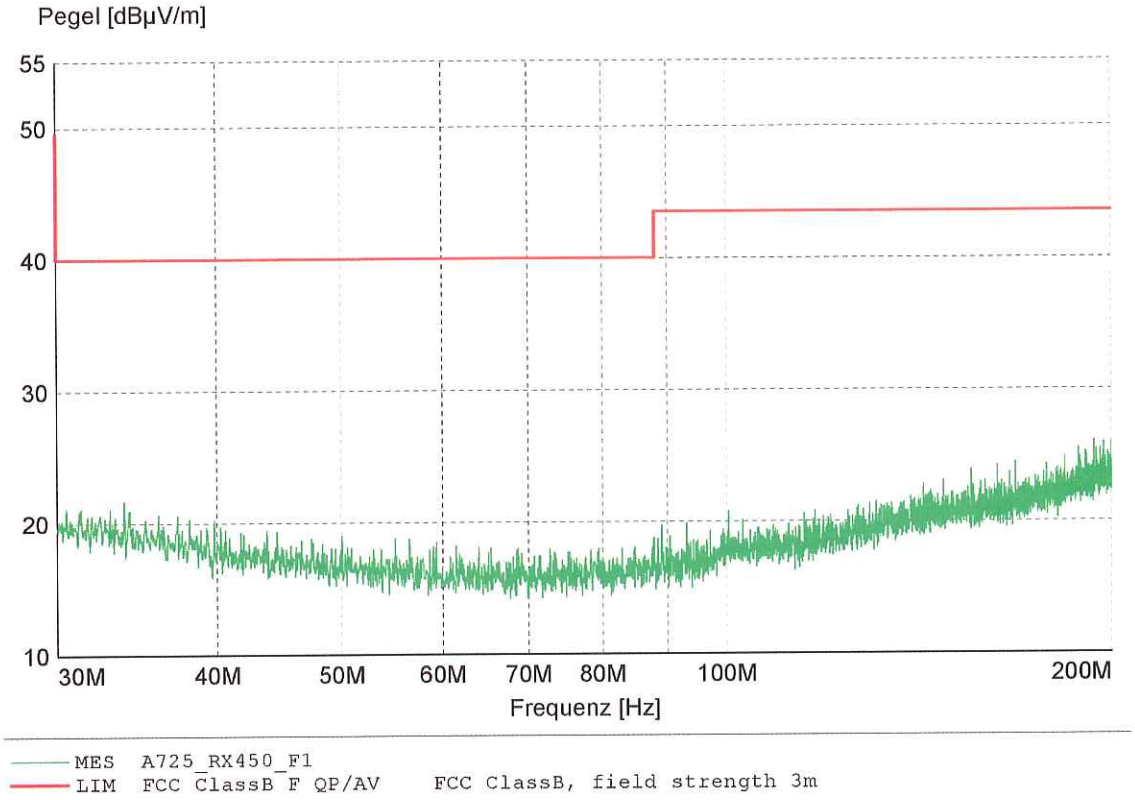
Test Equipment used: NT-100; NT-110; NT-111; NT-112; NT-125; NT-207

Receiver spurious emissions § 8

Operating mode:

Frequency: 450 MHz

Receiving



Test Equipment used: NT-100; NT-110; NT-111; NT-112; NT-125; NT-207

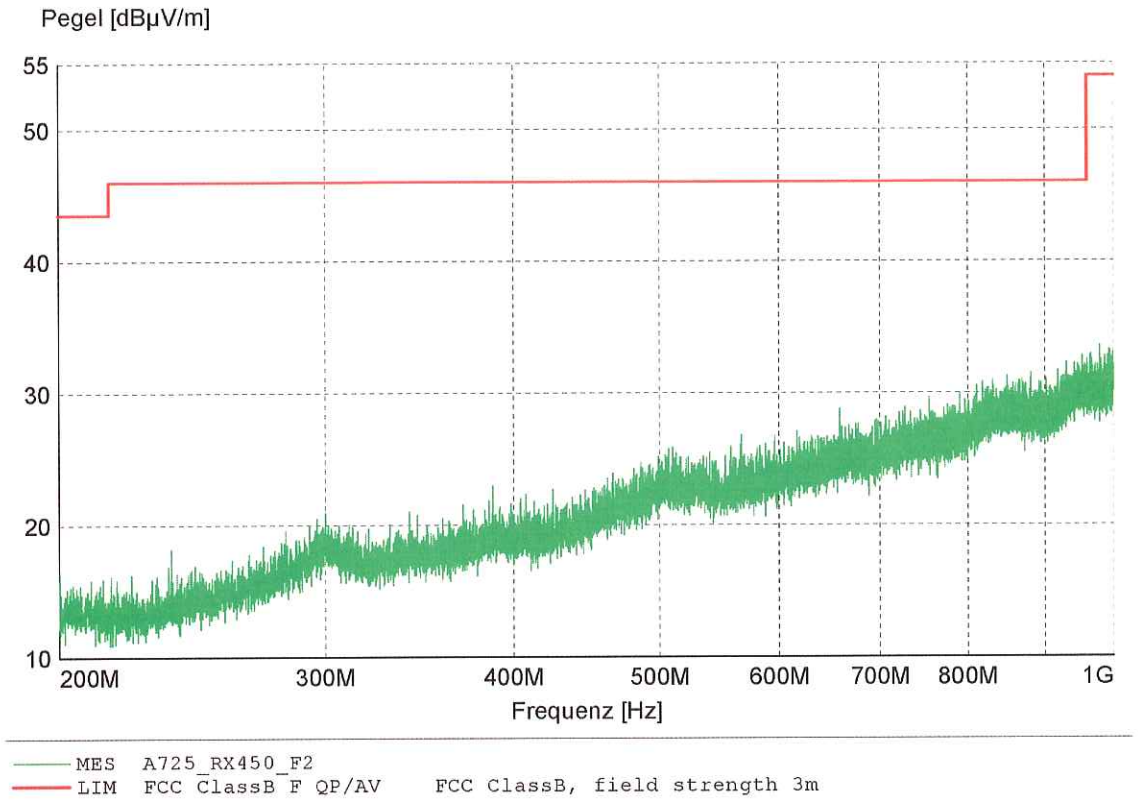
Ambient temperature: 23°C Relative humidity: 51%

Receiver spurious emissions § 8

Operating mode:

Frequency: 450 MHz

Receiving



Test Equipment used: NT-100; NT-110; NT-111; NT-112; NT-125; NT-207

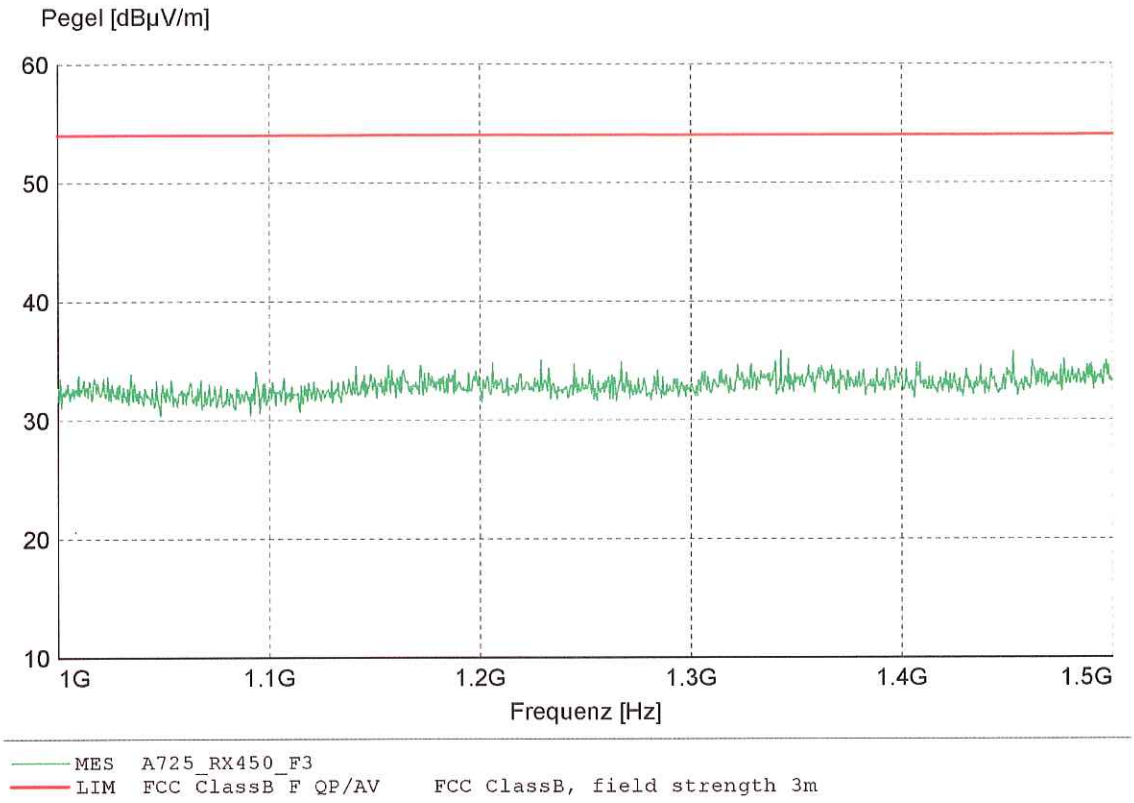
Ambient temperature: 23°C Relative humidity: 51%

Receiver spurious emissions § 8

Operating mode:

Frequency: 450 MHz

Receiving



Test Equipment used: NT-100; NT-110; NT-111; NT-112; NT-125; NT-207

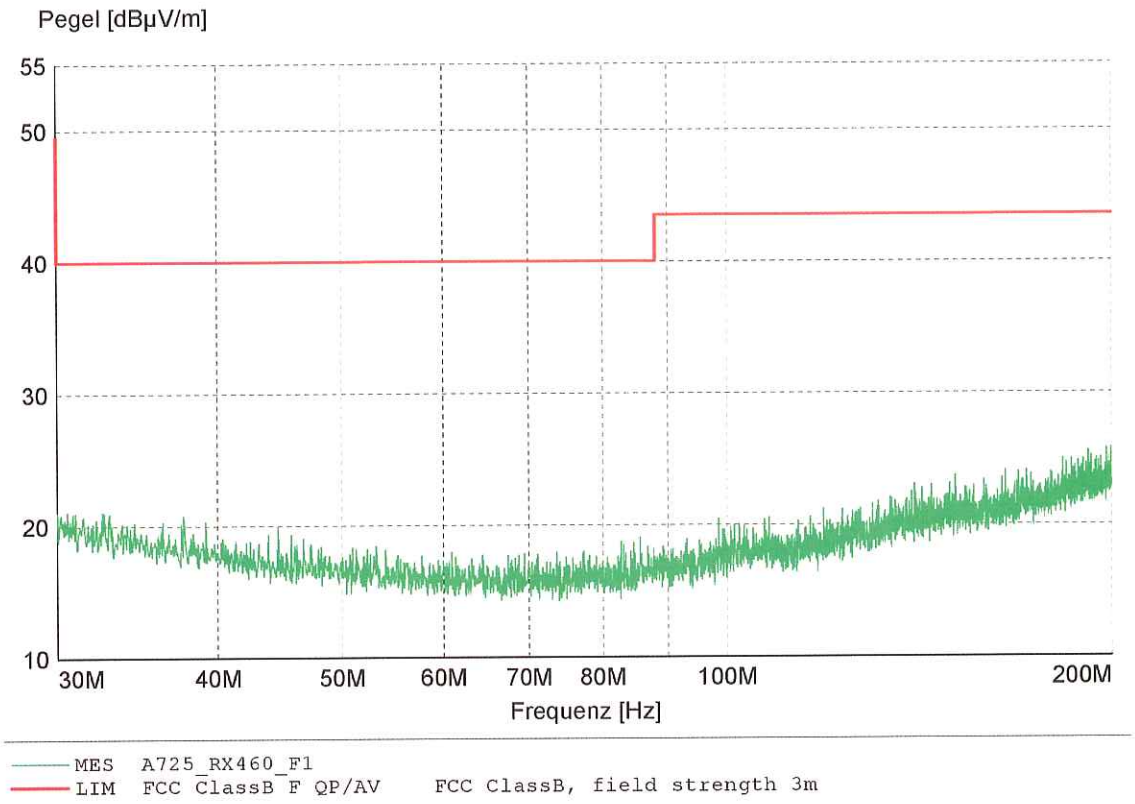
Ambient temperature: 23°C Relative humidity: 51%

Receiver spurious emissions § 8

Operating mode:

Frequency: 460 MHz

Receiving



Test Equipment used: NT-100; NT-110; NT-111; NT-112; NT-125; NT-207

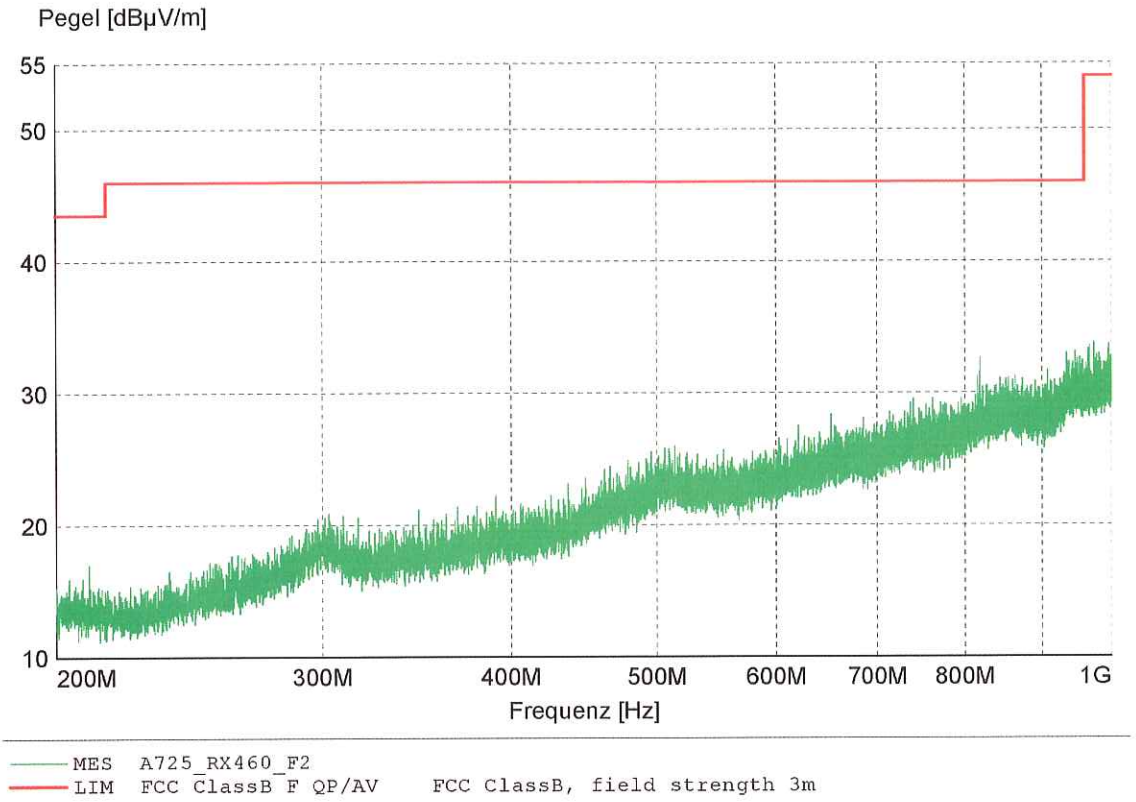
Ambient temperature: 23°C Relative humidity: 51%

Receiver spurious emissions § 8

Operating mode:

Frequency: 460 MHz

Receiving



Test Equipment used: NT-100; NT-110; NT-111; NT-112; NT-125; NT-207

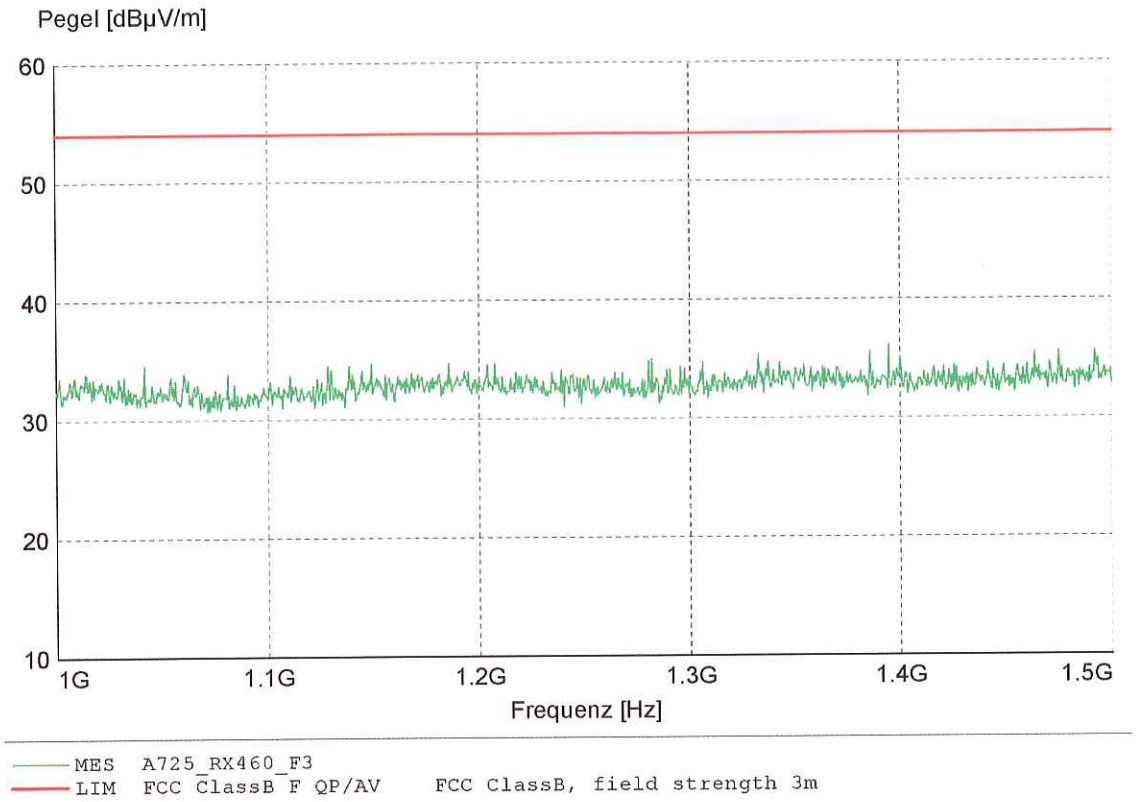
Ambient temperature: 23°C Relative humidity: 51%

Receiver spurious emissions § 8

Operating mode:

Frequency: 460 MHz

Receiving



Test Equipment used: NT-100; NT-110; NT-111; NT-112; NT-125; NT-207

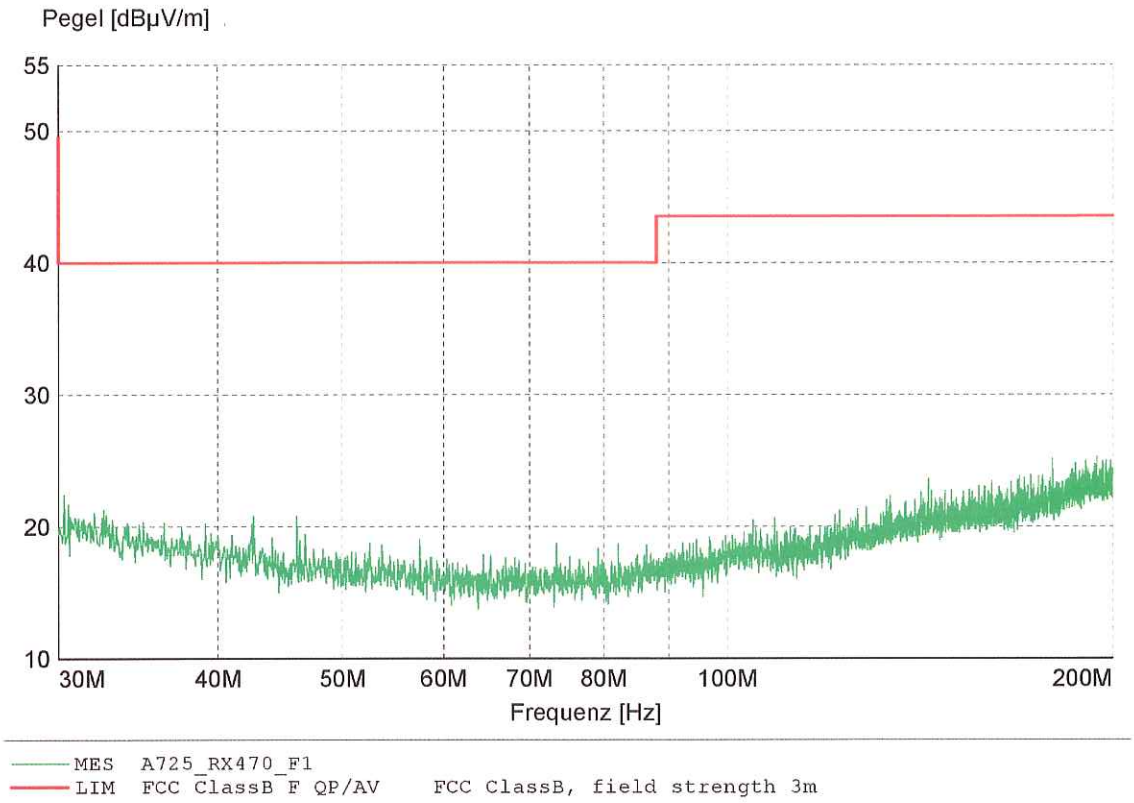
Ambient temperature: 23°C Relative humidity: 51%

Receiver spurious emissions § 8

Operating mode:

Frequency: 470 MHz

Receiving



Test Equipment used: NT-100; NT-110; NT-111; NT-112; NT-125; NT-207

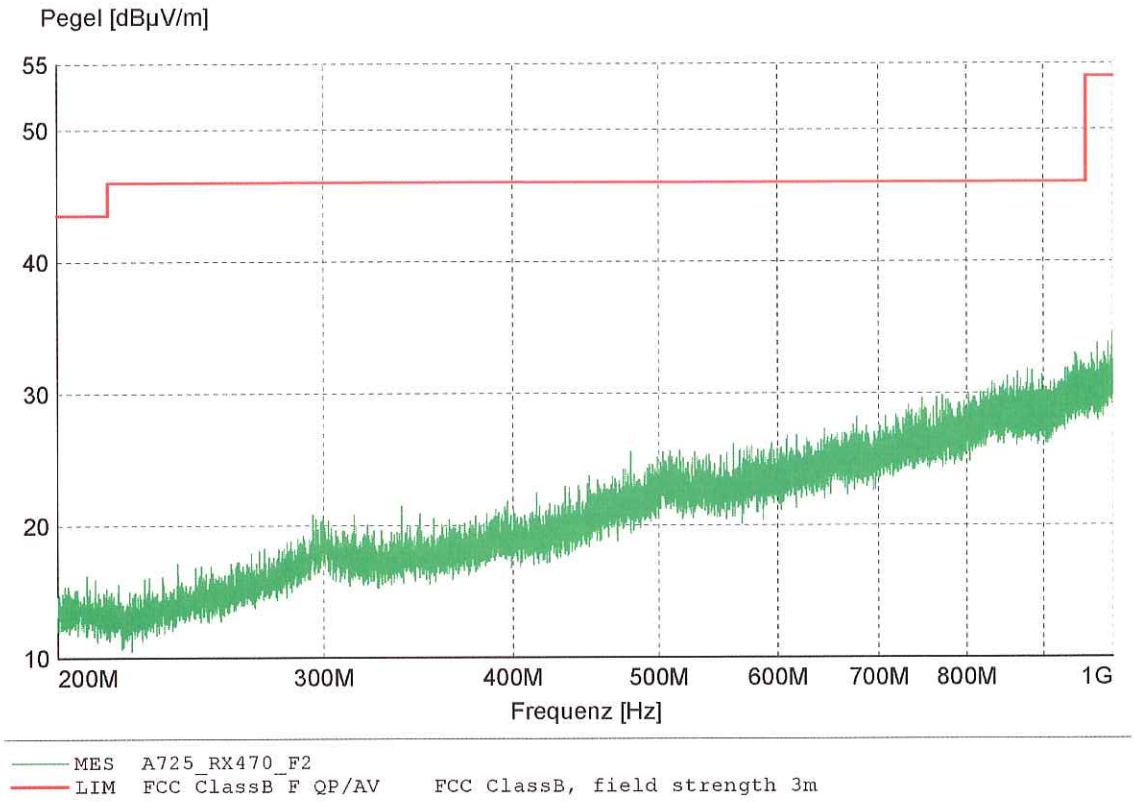
Ambient temperature: 23°C Relative humidity: 51%

Receiver spurious emissions § 8

Operating mode:

Frequency: 470 MHz

Receiving



Test Equipment used: NT-100; NT-110; NT-111; NT-112; NT-125; NT-207

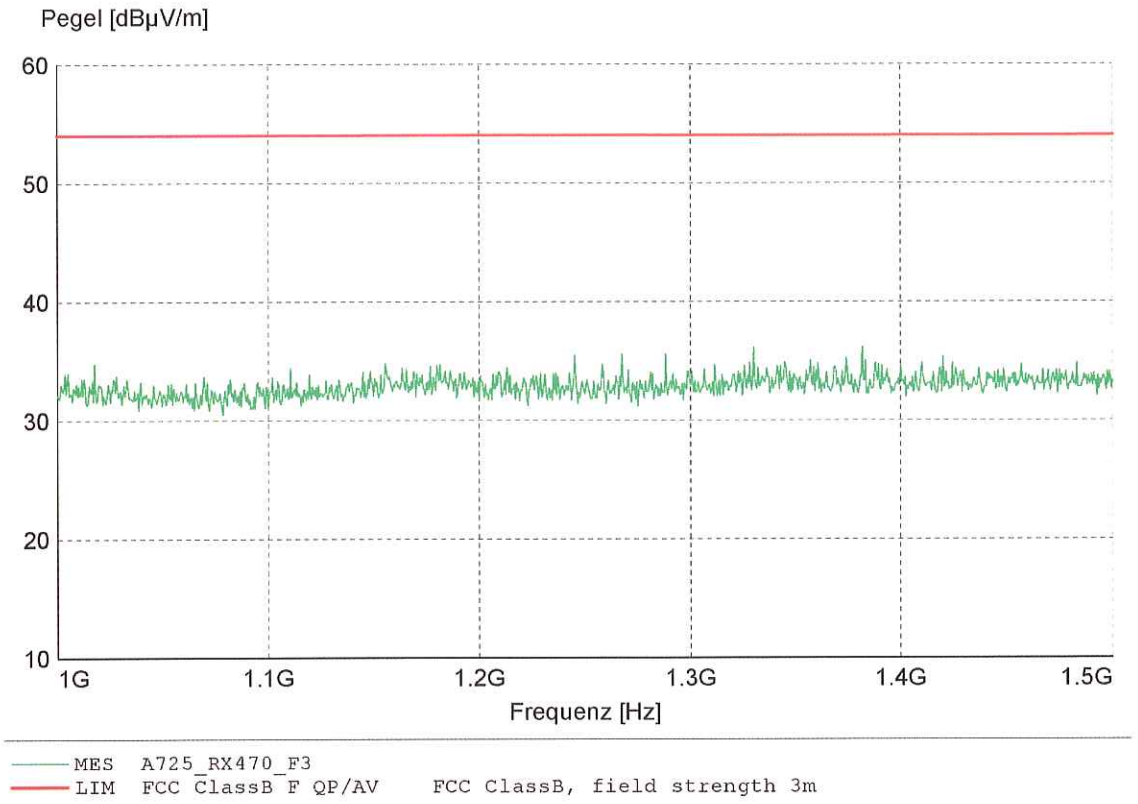
Ambient temperature: 23°C Relative humidity: 51%

Receiver spurious emissions § 8

Operating mode:

Frequency: 470 MHz

Receiving



Test Equipment used: NT-100; NT-110; NT-111; NT-112; NT-125; NT-207

Appendix 1
Test equipment used

TÜV ÖSTERREICH

☐	Anechoic Chamber with 3m measurement distance	NT-100
☐	Stripline accorcing to ISO 11452-5	NT-108
☐	MA 240 - Antenna mast 1 - 4 m height	NT-110
☐	DS 412 - Turntable 0 - 400 ° Azimuth	NT-111
☐	HD 100 Controller Mast+Turntable	NT-112
☐	HUF-Z2 - Bicon. Antennna 20 - 300 MHz	NT-120
☐	HUF-Z3 - Log. Per. Antenna 200 - 1000 MHz	NT-121
☐	HFH-Z2 - Loop Antenna. 9 kHz - 30 MHz	NT-122
☐	HFH-Z6 - Rod Antenna 9 kHz - 30 MHz	NT-123
☐	3121C - Dipole Antenna 28 - 1000 MHz	NT-124
☐	3115 - Horn Antenna 1 - 18 GHz	NT-125
☐	3116 - Horn Antenna 18 - 40 GHz	NT-126
☐	SAS-200/543 - Bicon. Ant. 20 MHz - 300 MHz	NT-127
☐	AT-1080 - Log. Per. Ant. 80 - 1000 MHz	NT-128
☐	HK-116 - bicon. Ant. 20 MHz - 300 MHz	NT-129
☐	HK-116 - bicon. Ant. 20 MHz - 300 MHz	NT-130
☐	3146 - Log. Per. Ant. 200 - 1000MHz	NT-131
☐	Loop Antenna H-Field	NT-132
☐	Horn Antenna 500 MHz - 2900 MHz	NT-133
☐	Log. per. Antenna 800 MHz - 2500 MHz	NT-134
☐	Log. per. Antenna 800 MHz - 2500 MHz	NT-135
☐	BiConiLog Antenna 26 MHz – 2000 MHz	NT-137
☐	Conical Dipol Antenna PCD8250	NT-138
☐	HZ-1 Antenna tripod	NT-150
☐	BN 1500 Antenna tripod	NT-151
☐	Ant. tripod for EN61000-4-3 Model TP1000A	NT-156
☐	Spectrumanalyzer – FSP7 9 kHz – 7 GHz	NT-200
☐	ESVP - Test receiver 20 - 1000 MHz	NT-201
☐	ESPC - Test receiver 9 kHz - 2,5 GHz	NT-203
☐	ESI26 – Test receiver 20 Hz – 26,5 GHz	NT-207
☐	Digital Radio Tester CTS55	NT-208
☐	Noise-gen., ITU-R 559-2 20 Hz – 20 kHz	NT-209
☐	CMTA - Radiocommunication analyzer ; 0,1 - 1000 MHz	NT-210
☐	3271 - Spectrum analyzer 100 Hz - 26,5 GHz	NT-211
☐	Radiocommunicationanalyzer Marconi 2945A	NT-212
☐	2855S - Communication analyzer	NT-213
☐	Mixer M28HW 26,5 GHz - 40 GHz	NT-214
☐	Diode Detector 0,01 GHz - 26,5 GHz	NT-215
☐	RubiSource T&M Timing reference	NT-216
☐	Radiocommunicationanalyzer SWR 1180 MD	NT-217
☐	Mixer M19HWD 40 GHz – 60 GHz	NT-218
☐	Mixer M12HWD 60 GHz – 90 GHz	NT-219
☐	TDS - 540 DSO Digital scope	NT-220
☐	PM97 Scopemeter	NT-221
☐	TPS 2014 Digital scope	NT-222
☐	Artificial Ear according to IEC 60318	NT-224
☐	1 kHz Sound calibrator	NT-225
☐	B10 - Harmonics and flicker analyzer	NT-232
☐	SRM-3000 Spectrumanalyzer	NT-233
☐	E-field probe SRM 75 MHz – 3 GHz	NT-234
☐	Hall-Teslameter ETM-1	NT-241
☐	EFA-3 H-field- / E-field probe	NT-243
☐	E-field measuring instrument EMR-200; 100 kHz – 3 GHz	NT-244
☐	E-field probe 100 kHz – 3 GHz	NT-245
☐	Magneticfield-Sensor 300 kHz – 30 MHz	NT-246
☐	E-field probe 3 MHz – 18 GHz	NT-247
☐	H-field probe 27 MHz – 1 GHz	NT-248
☐	ELT-400 1 Hz – 400 kHz	NT-249

Appendix 1 (continued)
Test equipment used

TÜV ÖSTERREICH

☐	MDS 21 - Absorbing clamp 30 - 1000 MHz	NT-250
☐	FCC-203I EM Injection clamp	NT-251
☐	FCC-203I-DCN Ferrite decoupling network	NT-252
☐	PR50 Current Probe	NT-253
☐	PR630 Current Probe	NT-254
☐	Fluke 87 V True RMS Multimeter	NT-260
☐	Model 2000 Digital Multimeter	NT-261
☐	Fluke 79 Digital Multimeter	NT-262
☐	ESH2-Z5 Artificial mains network 4x25A	NT-300
☐	ESH3-Z5 Artificial mains network 2x10A	NT-301
☐	ESH3-Z6 Artificial mains network 1x100A	NT-302
☐	ESH3-Z4 T-Artificial network	NT-303
☐	PHE 4500/B Power amplifier	NT-304
☐	EZ10 T-Artificial Network	NT-305
☐	ENY22 Artificial Network	NT-308
☐	ENY41 Artificial Network	NT-309
☐	SMG - Signal generator 0,1 - 1000 MHz	NT-310
☐	PM 5518 TXVPS Video generator	NT-311
☐	RefRad Reference generator	NT-312
☐	SMP 02 Signal generator 10 MHz - 20 GHz	NT-313
☐	40 MHz Arbitrary Generator T1241	NT-315
☐	PEFT - Burst generator up to 4 kV	NT-320
☐	ESD 30 System up to 25 kV	NT-321
☐	PSURGE 4.1 Surge generator	NT-324
☐	TRANSIENT 1000 Immunity test system	NT-325
☐	VCS 500-M6 Surge-Generator	NT-326
☐	BTA-250 - RF-Amplifier 9 kHz - 220 MHz / 250 W	NT-330
☐	T82-50 RF-Amplifier 2 GHz – 8 GHz	NT-331
☐	500W1000M7 - RF-Amplifier 80 - 1000 MHz / 500 W	NT-332
☐	AS0102-65R - RF-Amplifier 1 GHz - 2 GHz	NT-333
☐	APA01 – RF-Amplifier 0,5 GHz – 2,5 GHz	NT-334
☐	Preamplifier 1 GHz - 4 GHz	NT-335
☐	Preamplifier for GPS MKU 152 A	NT-336
☐	Preamplifier 100 MHz – 23 GHz	NT-337
☐	DC Block 10 MHz – 18 GHz Model 8048	NT-338
☐	2-97201 Electronic load	NT-341
☐	TSX3510P - Power supply 0-30 V / 0 - 10 A	NT-344
☐	TSX3510P - Power supply 0-30 V / 0 - 10 A	NT-345
☐	VDS 200 Mobil-impuls-generator	NT-350
☐	LD 200 Mobil-impuls-generator	NT-351
☐	MPG 200 Mobil-Impuls-Generators	NT-352
☐	EFT 200 Mobil-impuls-generator	NT-353
☐	AN 200 S1 Artificial Network	NT-354
☐	FP 16/3-1 3 ph. Coupling filter (Burst)	NT-400
☐	PHE 4500 - Mains impedance network	NT-401
☐	IP 6.2 Coupling filter for data lines (Surge)	NT-403
☐	ESH2-Z3 - Probe 9 kHz - 30 MHz	NT-410
☐	IP 4 - Capacitive clamp (Burst)	NT-411
☐	Highpass-Filter 100 MHz – 3 GHz	NT-412
☐	Highpass-Filter 600 MHz – 4 GHz	NT-413
☐	Highpass-Filter 1250 MHz – 4 GHz	NT-414
☐	Highpass-Filter 1800 MHz – 16 GHz	NT-415
☐	Highpass-Filter 3500 MHz – 18 GHz	NT-416
☐	RF-Attenuator 20 dB 0,1 - 1000 MHz / 25 W	NT-421
☐	RF-Attenuator 10 dB 0,1 - 1000 MHz / 20 W	NT-422
☐	RF-Attenuator 30 dB 0,1 - 1000 MHz / 1 W	NT-423
☐	RF-Attenuator 30 dB	NT-424
☐	RF-Attenuator 6 dB 0,1 - 1000 MHz / 1 W	NT-425

Appendix 1 (continued)
Test equipment used

TÜV ÖSTERREICH

☐	RF-Attenuator 6 dB 0,1 - 1000 MHz / 1 W	NT-426
☐	RF-Attenuator 6 dB	NT-428
☐	RF-Attenuator 0 dB - 81 dB	NT-429
☐	WRU 27 - Band blocking 27 MHz	NT-430
☐	WHJ450C9 AA - High pass 450 MHz	NT-431
☐	WHJ250C9 AA - High pass 250 MHz	NT-432
☐	RF-Load 150 W	NT-433
☐	Impedance transducer 1:4 ; 1:9 ; 1:16	NT-435
☐	RF-Attenuator DC – 18 GHz 6 dB	NT-436
☐	RF-Attenuator DC – 18 GHz 6 dB	NT-437
☐	RF-Attenuator DC – 18 GHz 10 dB	NT-438
☐	RF-Attenuator DC – 18 GHz 20 dB	NT-439
☐	I+P 7780 Directional coupler 100 - 2000 MHz	NT-440
☐	ESH3-Z2 - Pulse limiter 9 kHz - 30 MHz	NT-441
☐	Power Divider 6 dB/1 W/50 Ohm	NT-443
☐	Directional coupler 0,1 MHz – 70 MHz	NT-444
☐	Directional coupler 0,1 MHz – 70 MHz	NT-445
☐	Tube imitations according to EN 55015	NT-450
☐	FCC-801-M2-50A Coupling decoupling network	NT-459
☐	FCC-801-M5-25 Coupling decoupling network	NT-460
☐	FCC-801-AF10 Coupling decoupling network	NT-461
☐	FCC-801-S25 Coupling decoupling network	NT-462
☐	FCC-801-T4 Coupling decoupling network	NT-463
☐	FCC-801-C1 Coupling decoupling network	NT-464
☐	F-16A - Current probe 1kHz - 70MHz	NT-465
☐	95242-1 – Current probe 10 MHz – 400 MHz	NT-468
☐	PC P4 3 GHz Test computer	NT-500
☐	PC P4 1700 MHz Notebook	NT-505
☐	PC Intel Centrino 1600 MHz Notebook	NT-506
☐	Monitoring camera with Monitor	NT-511
☐	ES-K1 Version 1.71 Test software	NT-520
☐	SRM-TS Version 1.3 software for SRM-3000	NT-522
☐	SPS-PHE Test software V2.32 voltage fluctuations/harmonics	NT-525
☐	SPS-EM Test software V2.32 for PHE 4500/B	NT-527
☐	Noise power test apparatus according to EN 55014	NT-530
☐	Vertical coupling plane (ESD)	NT-531
☐	Test cable #4 for EN 61000-4-6	NT-553
☐	Test cable #3 for conducted emission	NT-554
☐	Test cable #5 ESD-cable (2x470k)	NT-555
☐	Test cable #6 ESD-cable (2x470k)	NT-556
☐	Test cable #8 Sucoflex 104EA	NT-559
☐	Test cable #9 (for outdoor measurements)	NT-580
☐	Test cable #10 (for outdoor measurements)	NT-581
☐	Test cable #13 Sucoflex 104PE	NT-584
☐	Test cable #21 for SRM-3000	NT-592
☐	Shield chamber	NT-600
☐	Climatic chamber -55°C to +180°C	M-512
☐	Control and simulation equipment for EUT	---