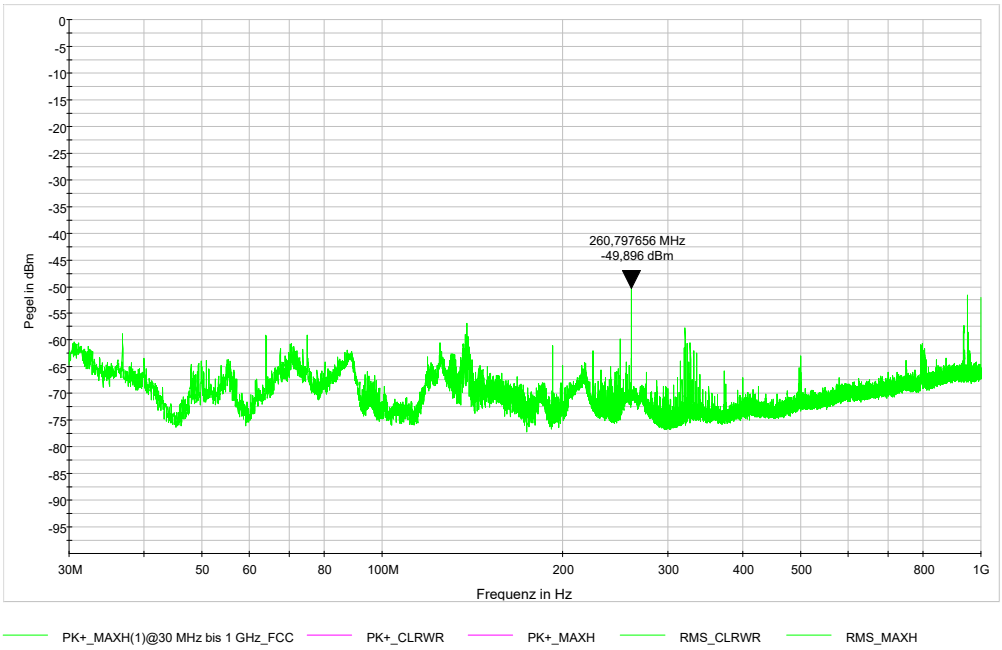
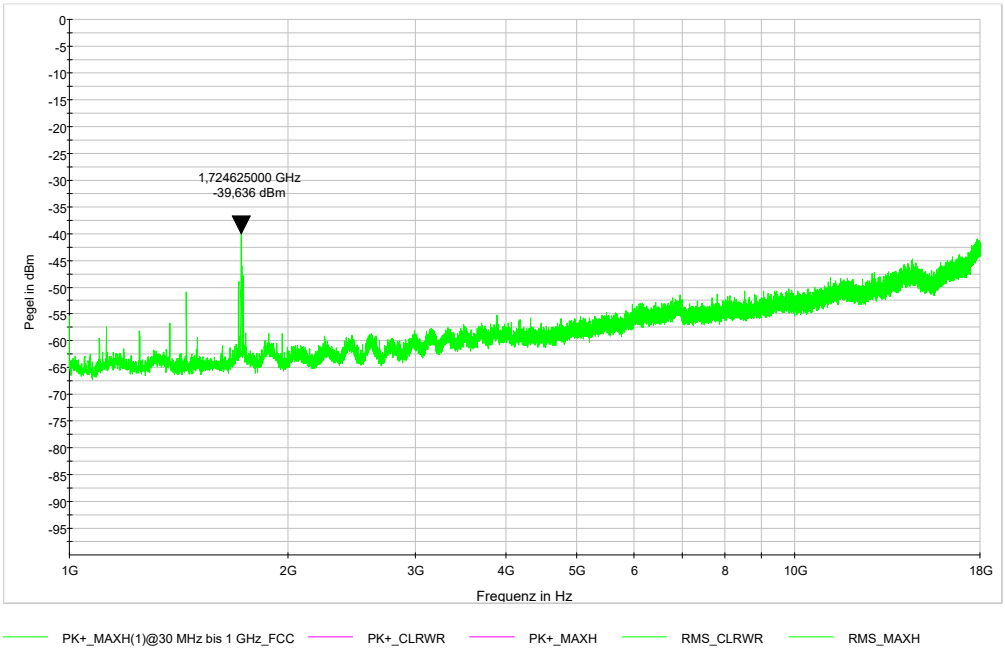
4.4.2.) Spurious emissions worst case for each frequency range

Frequency range 30 MHz – 1 GHz worst case:



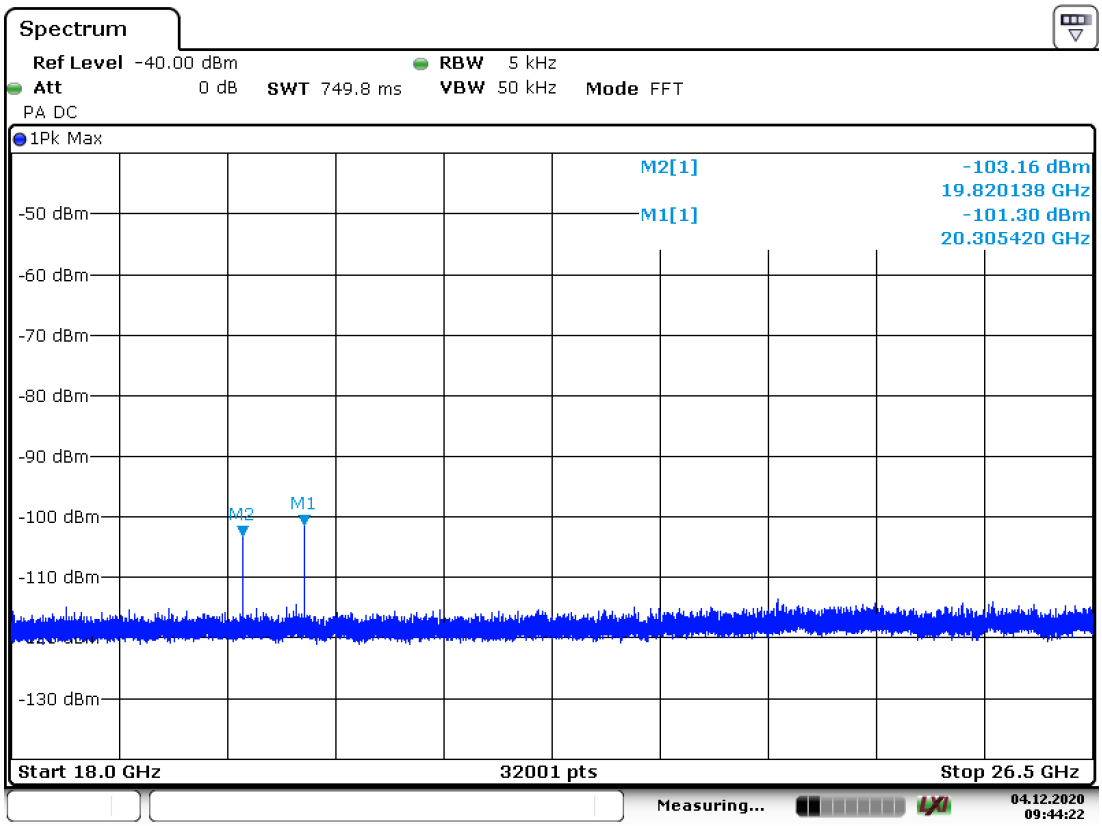
Tuned frequency = 29,003 GHz, BPSK at 5Msymbols/s

Frequency range 1 GHz – 18 GHz worst case:



Tuned frequency = 29,5 GHz, BPSK at 1Msymbol/s

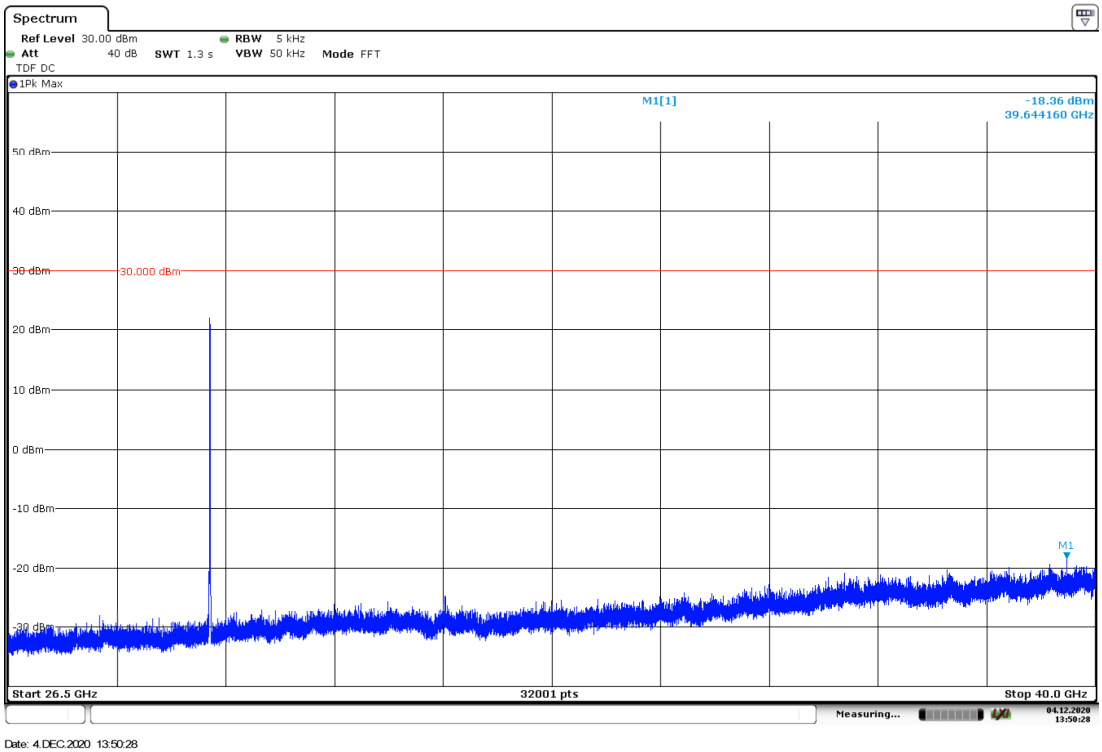
Frequency range 18 GHz – 26,5 GHz worst case:



Date: 4.DEC.2020 09:44:22

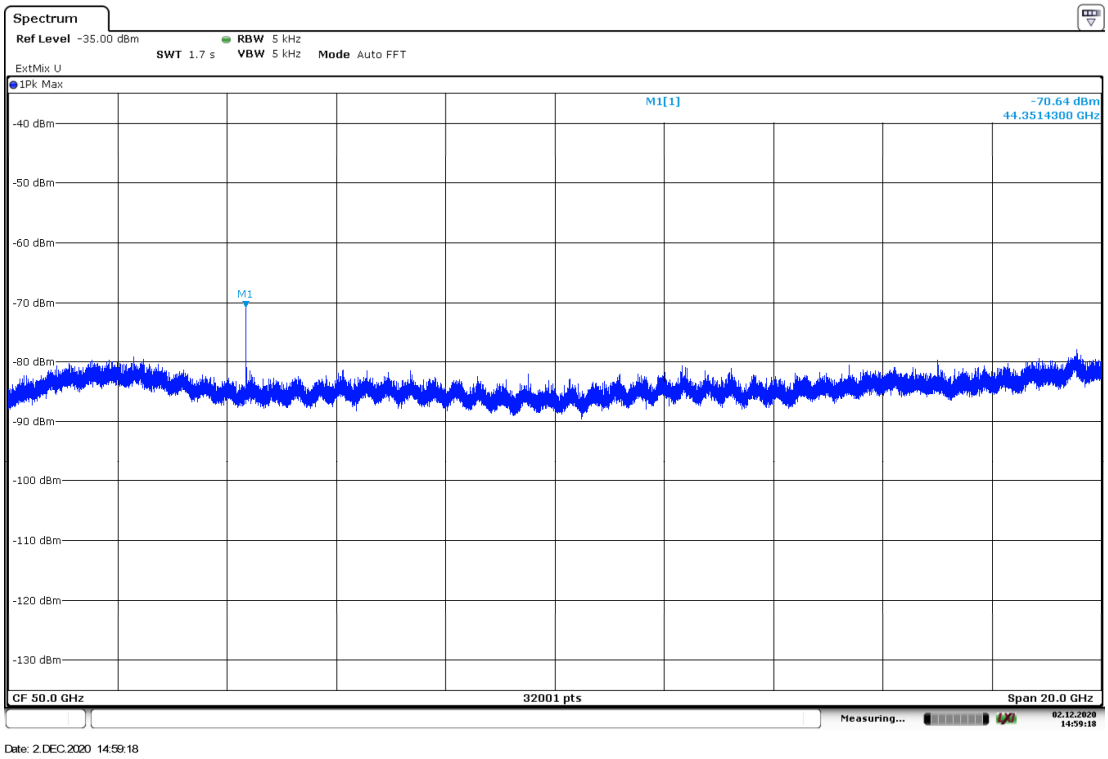
Tuned frequency = 29,001 GHz, BPSK at 1Msymbol/s

Frequency range 26,5 GHz – 40 GHz worst case:



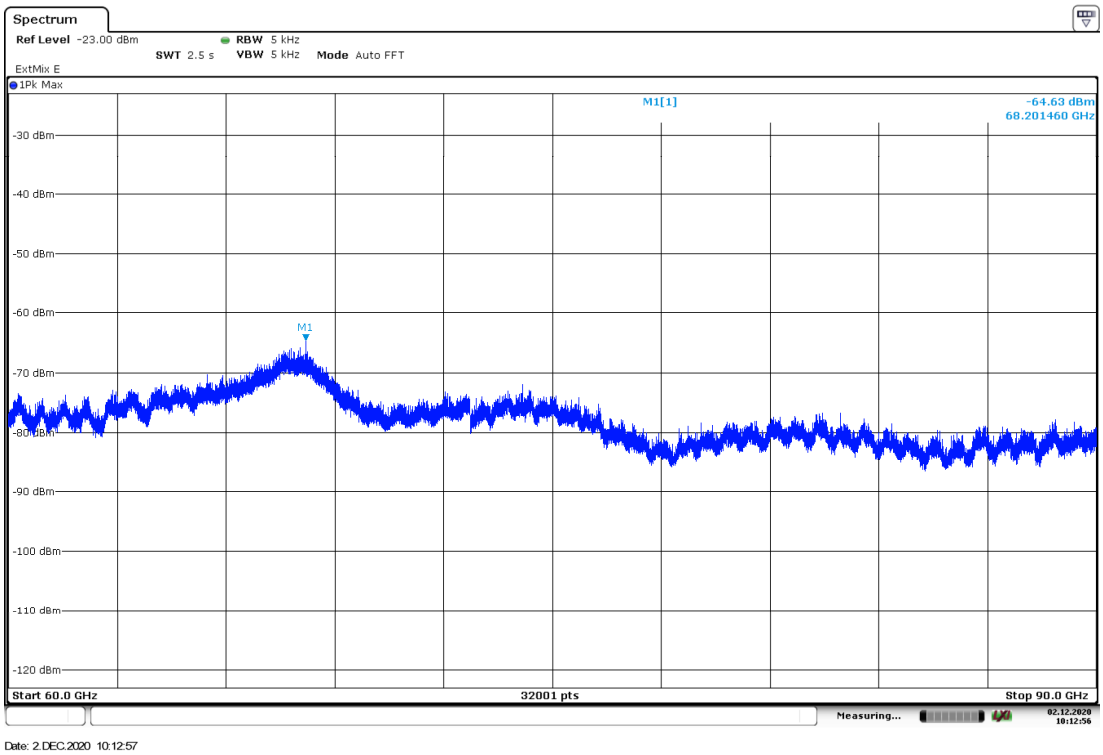
Tuned frequency = 29,003 GHz, QPSK at 5Msymbols/s

Frequency range 40 GHz – 60 GHz worst case:



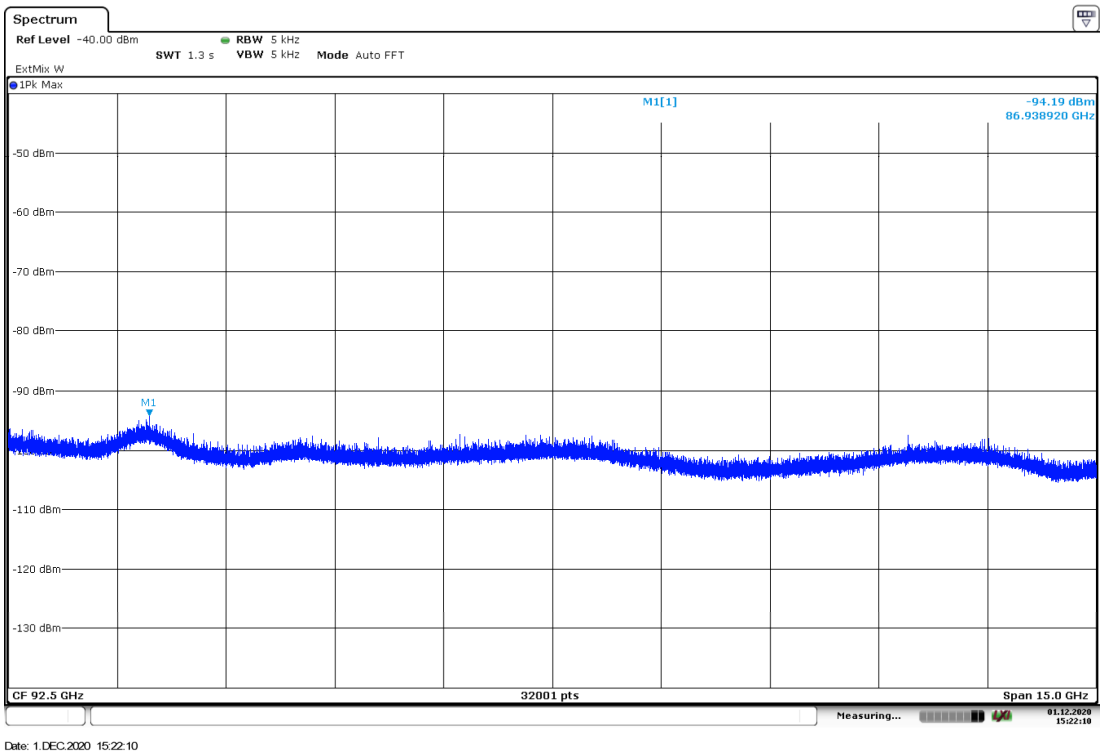
Tuned frequency = 29,997 GHz, BPSK at 5Msymbols/s

Frequency range 60 GHz – 90 GHz worst case:



Tuned frequency = 29,999 GHz, QPSK at 1Msymbol/s

Frequency range 85 GHz – 100 GHz worst case:



Tuned frequency = 29,003 GHz, 8PSK at 5Msymbols/s

4.5.) Frequency tolerance (voltage variation) § 25.202d

LIMIT: 0,001% SUBCLAUSE 25.202(d)

Tuned Frequency	Modulation	Symbol Rate	AC power			Limit	Result
			97,75 V	115 V	132,25 V		
GHz		Msym/s	peak frequency error in %			%	
29,001	BPSK	1	0,000080	0,000080	0,000081	0,001	PASS
29,001	QPSK	1	0,000080	0,000080	0,000081	0,001	PASS
29,001	8PSK	1	0,000080	0,000081	0,000081	0,001	PASS
29,500	BPSK	1	0,000080	0,000081	0,000081	0,001	PASS
29,500	QPSK	1	0,000080	0,000081	0,000081	0,001	PASS
29,500	8PSK	1	0,000080	0,000081	0,000081	0,001	PASS
29,999	BPSK	1	0,000080	0,000081	0,000081	0,001	PASS
29,999	QPSK	1	0,000080	0,000081	0,000081	0,001	PASS
29,999	8PSK	1	0,000080	0,000081	0,000081	0,001	PASS
29,003	BPSK	5	0,000080	0,000081	0,000081	0,001	PASS
29,003	QPSK	5	0,000080	0,000081	0,000081	0,001	PASS
29,003	8PSK	5	0,000080	0,000081	0,000081	0,001	PASS
29,500	BPSK	5	0,000080	0,000081	0,000081	0,001	PASS
29,500	QPSK	5	0,000080	0,000081	0,000081	0,001	PASS
29,500	8PSK	5	0,000080	0,000081	0,000081	0,001	PASS
29,997	BPSK	5	0,000081	0,000081	0,000081	0,001	PASS
29,997	QPSK	5	0,000081	0,000081	0,000081	0,001	PASS
29,997	8PSK	5	0,000081	0,000081	0,000081	0,001	PASS

Test Equipment used: FSW67 + calibrated cabling

Remarks: As can be seen in this list, the relative frequency error does neither rely on the operating frequency, nor on the modulation scheme or symbol rate. Therefor measurements during temperature variations were performed only at the center frequency with lowest available symbol rate.

4.6.) Frequency tolerance (temperature variation) § 25.202d

LIMIT: 0,001% SUBCLAUSE 25.202(d)

Tuned frequency = 29,5 GHz, BPSK at 1Msymbol/s

To comply with other regulatory requirements, the investigated temperature range was expanded to -55°C up to + 70°C. The freqeuency error was not only measured at 10 degrees steps but during the whole temperature variation process, using the max-hold function of the measuring device.

The maximum observed value of relative frequency error during various temperature changes between -55°C and +70°C and vice versa was:

0,000082 %

Test Equipment used: M-1200; FSW67 + calibrated cabling

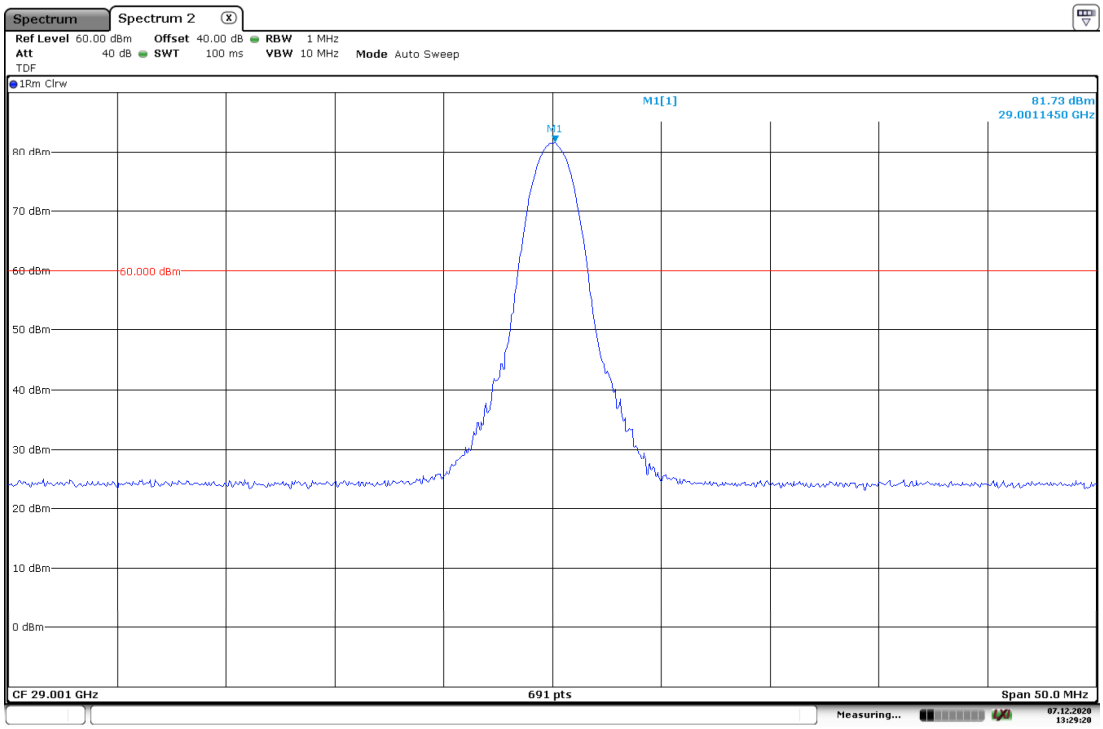
4.7.) Off Axis EIRP Emissions density within the band § 25.218

Conducted Measurement accounting for antenna gain
Test Equipment used: EMV-205 + calibrated cabling

Tuned Frequency	Modulation	Symbol Rate	Recorded Measurement
GHz		Msym/s	dBW/MHz
29,001	BPSK	1	51,73
29,001	QPSK	1	51,62
29,001	8PSK	1	51,70
29,500	BPSK	1	51,76
29,500	QPSK	1	52,29
29,500	8PSK	1	51,86
29,999	BPSK	1	51,18
29,999	QPSK	1	51,77
29,999	8PSK	1	51,76
29,003	BPSK	5	45,44
29,003	QPSK	5	45,98
29,003	8PSK	5	46,68
29,500	BPSK	5	46,22
29,500	QPSK	5	46,04
29,500	8PSK	5	46,35
29,997	BPSK	5	46,03
29,997	QPSK	5	46,13
29,997	8PSK	5	46,32

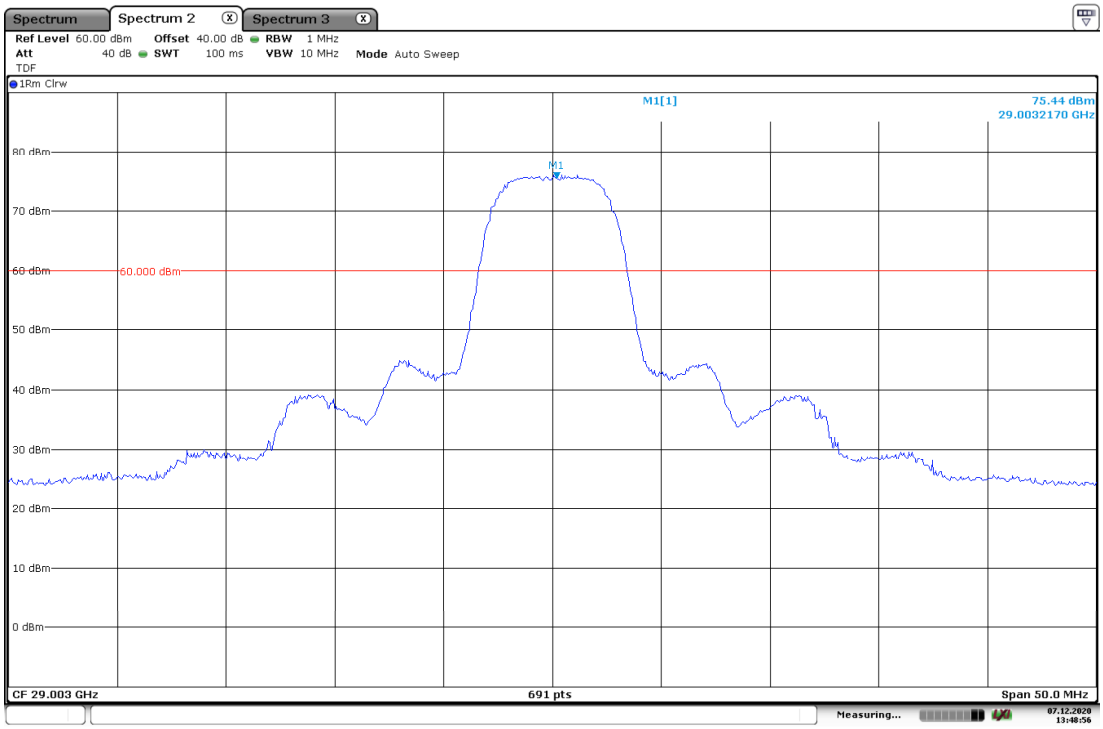
Measurements were performed conducted at the highest possible output power. For reference to the off-axis limits see declarations and measurements documented in section 4.8. of this test report.

Tuned frequency = 29.001 GHz, BPSK at 1Msymbols/s



Date: 7.DEC.2020 13:29:20

Tuned frequency = 29.003 GHz, BPSK at 5Msymbols/s



Date: 7.DEC.2020 13:48:57

4.8.) Uplink power control § 25.204

In order to compensate for any exceedances of the off-axis EIRPSD mask in the GSO plane resulting from the skew angle effect, the network employs a dynamic control mechanism of the power spectral density level radiated by the MCS-8562 terminal by varying the emission bandwidth or the power at the antenna flange or a combination of both.

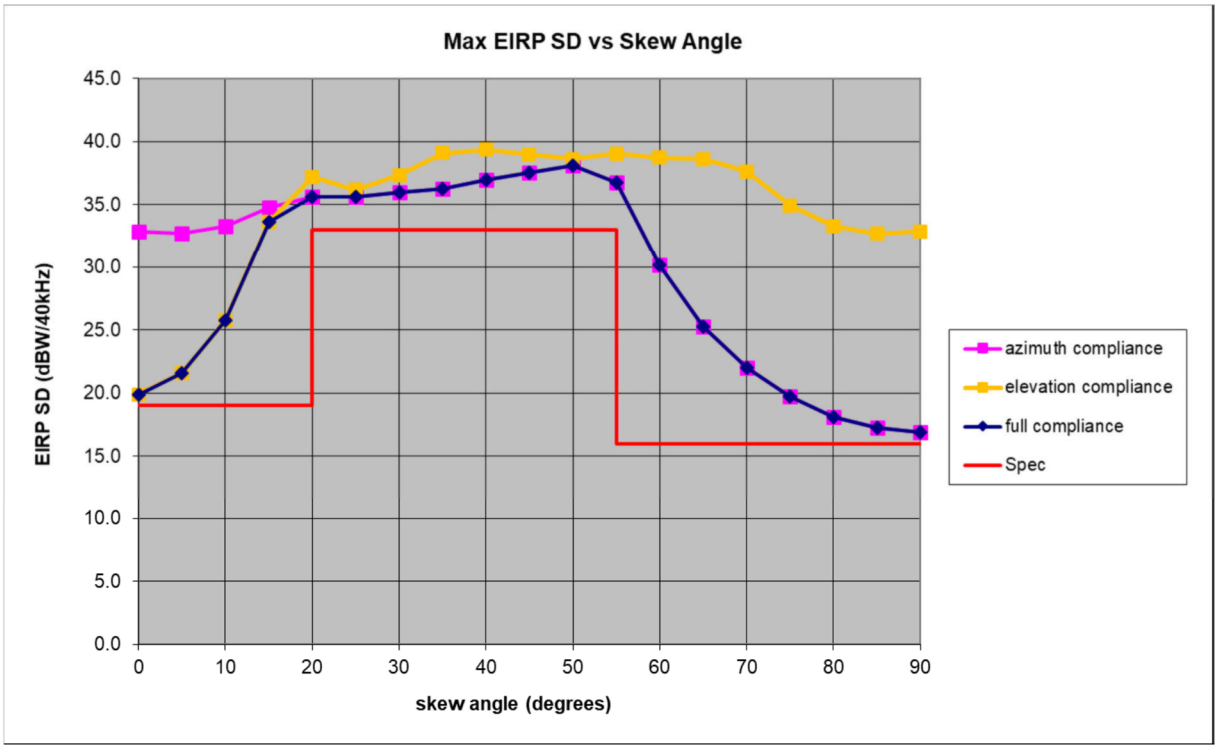
This dynamic control mechanism employs adaptive coding and modulation to ensure that the MCS-8562 terminal will protect adjacent networks under all operational conditions. The terminals in the network are capable of operating on a wide range of codes and modulations, and the network is designed to operate at the lowest power density modulation and code point that allows the link to close. When the modem has sufficient excess transmit capability, it will automatically switch to the next symbol rate and increase data rate, keeping the EIRP density at the minimum required level. The network employs active power control and reduces power when conditions permit. Therefore, each terminal will be programmed to operate only on the codes and modulation that would ensure that the transmissions are at or below the power spectral density limits, thereby avoiding potential interference with adjacent networks.

The range of permissible carriers for each terminal will vary depending on the geographic location and position of the aircraft. The allowed operational range of skew angles is provided on an on-going basis to each terminal by the network based upon the aircraft's actual position. The network will continuously monitor the position of the aircraft, and based upon the terminal location, the network will calculate nominal skew angles.

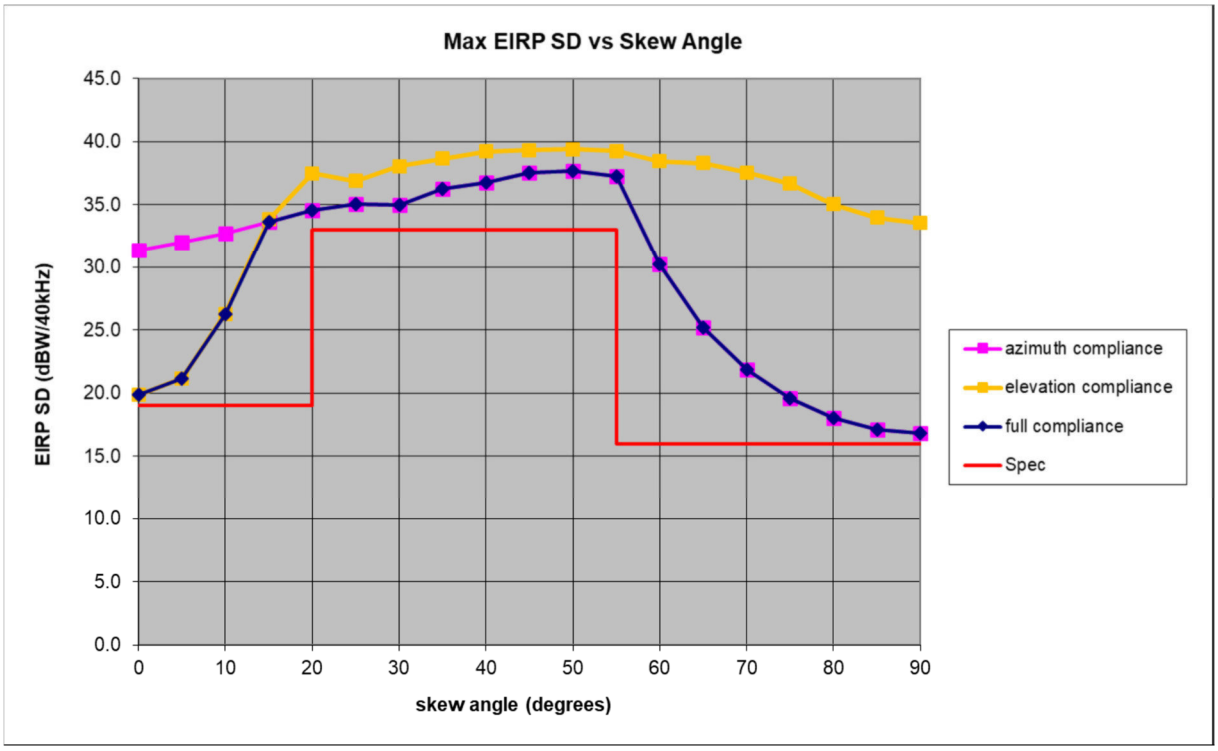
From each calculation, the network will determine carrier assignments for the aircraft based upon EIRPSD limits required by the calculated nominal skew angle. The calculation will include margin for nominal turns and turbulence expected to be experienced by the aircraft during flight. Based on these calculations, the terminal will be instructed by the network of an acceptable range of skew angles where the assigned carrier(s) can be transmitted without exceeding the EIRPSD limits.

The terminal monitors its skew angle continuously to ensure it is operating within the range of skew angles provided by the network. If the terminal detects that its skew angle falls outside of the allowed range provided by the network, that terminal will cease transmissions within 200 msec after detection. This is the same mechanism employed when the terminal detects mispointing that is greater than a given range.

4.8.1.) Max EIRPSD vs Skew – 29.0 GHz

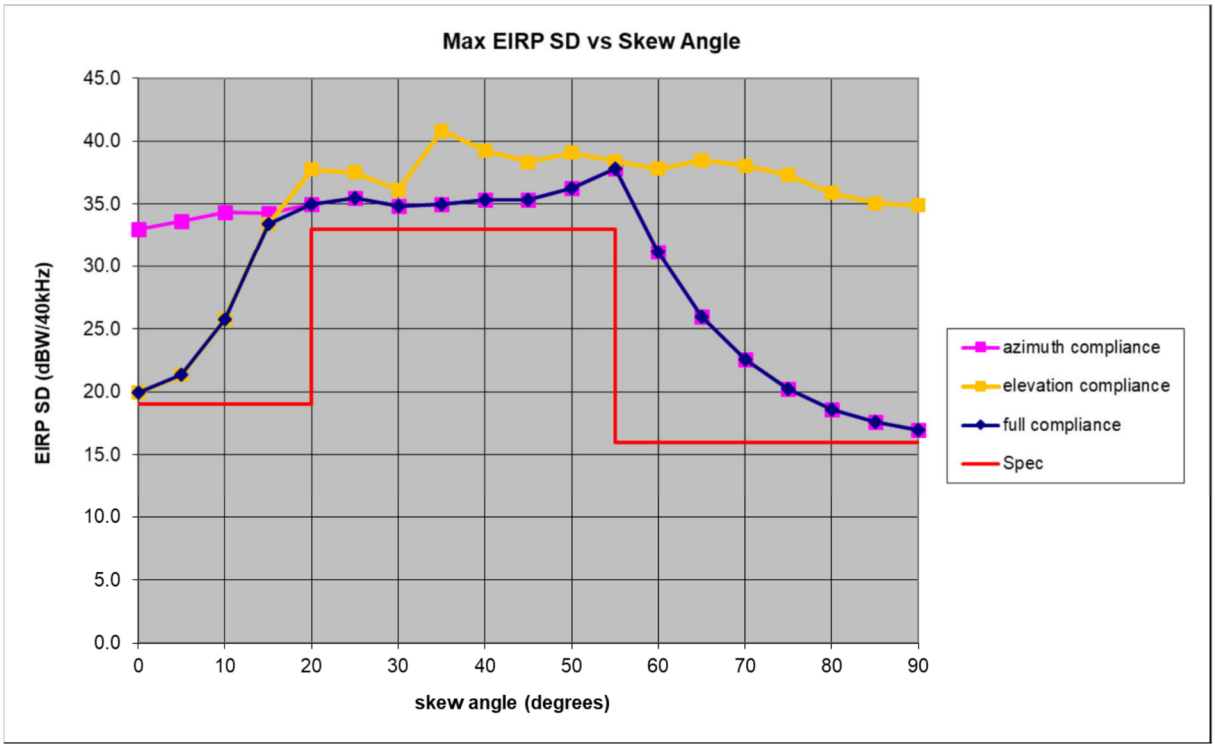


Max EIRPSD vs Skew, RHCP, 29.0 GHz

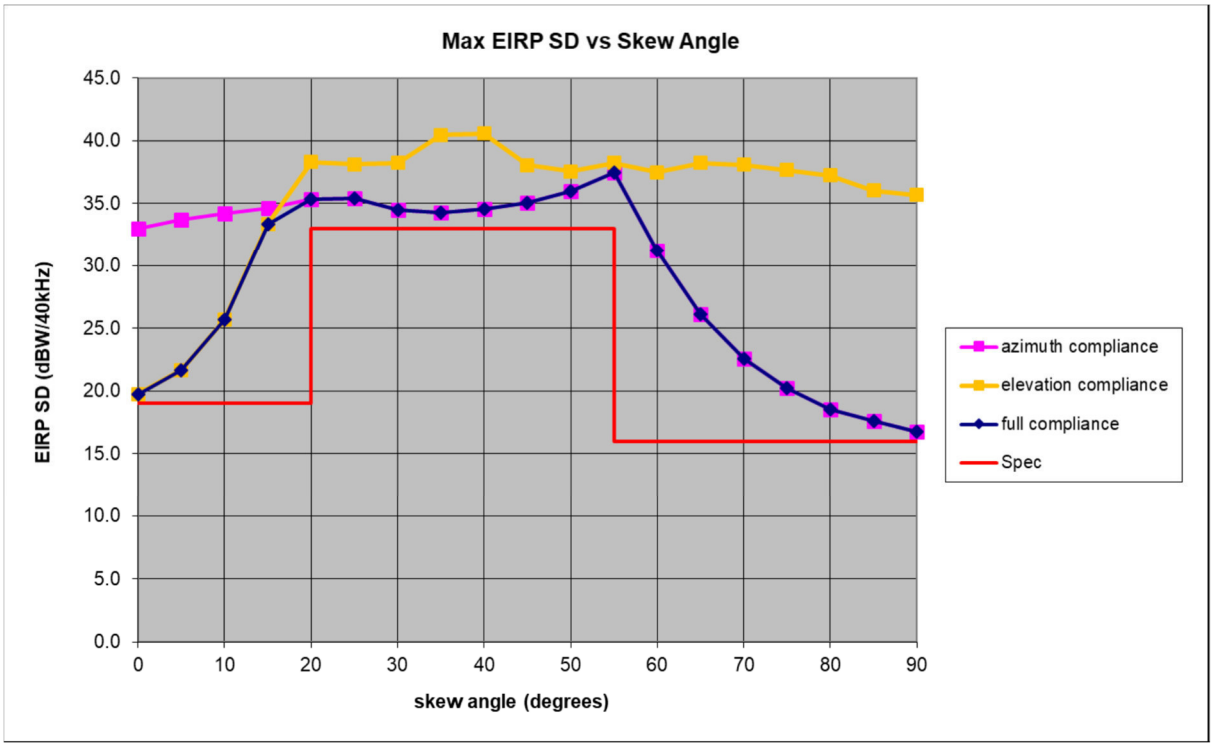


Max EIRPSD vs Skew, LHCP, 29.0 GHz

4.8.2.) Max EIRPSD vs Skew – 29.5 GHz

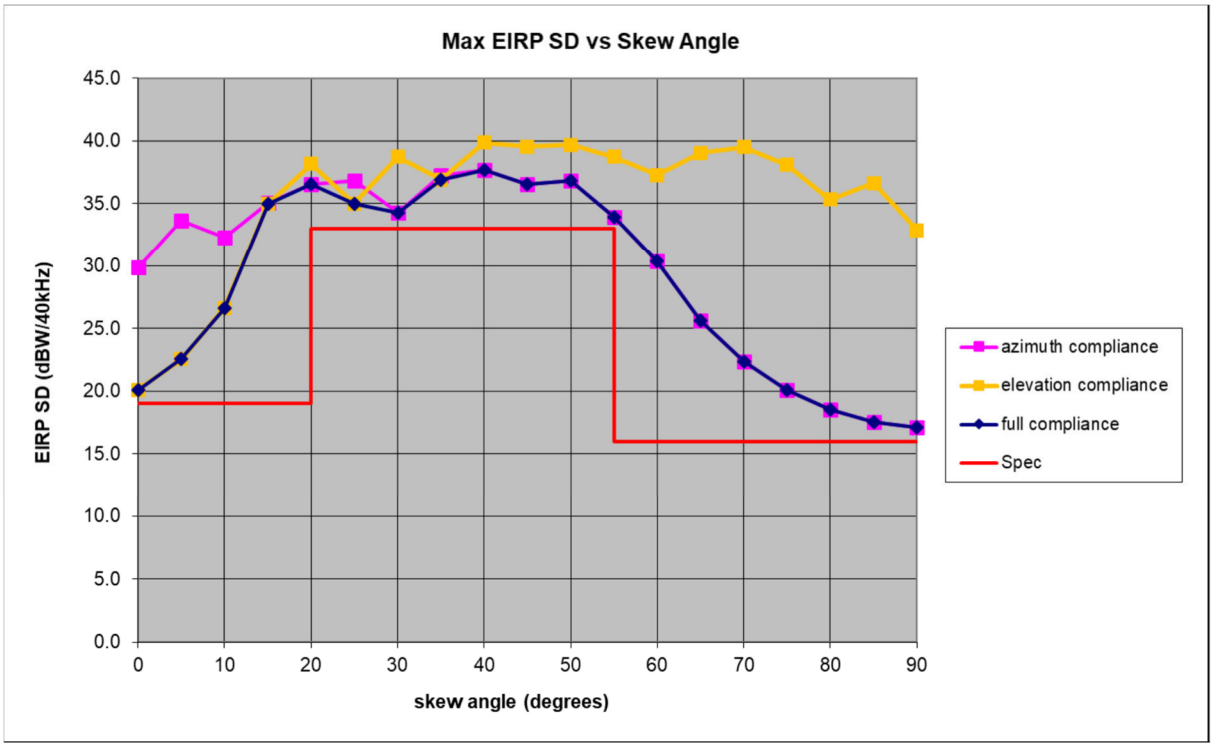


Max EIRPSD vs Skew, RHCP, 29.5 GHz

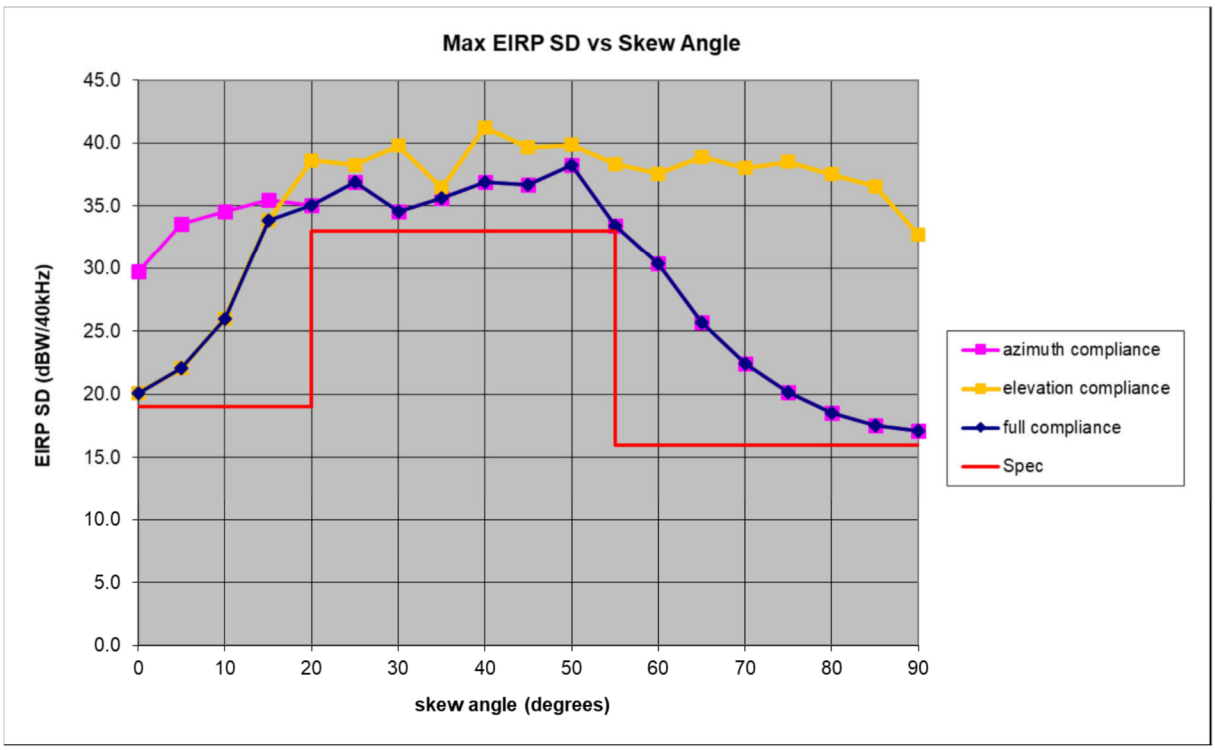


Max EIRPSD vs Skew, LHCP, 29.5 GHz

4.8.3.) Max EIRPSD vs Skew – 30.0 GHz

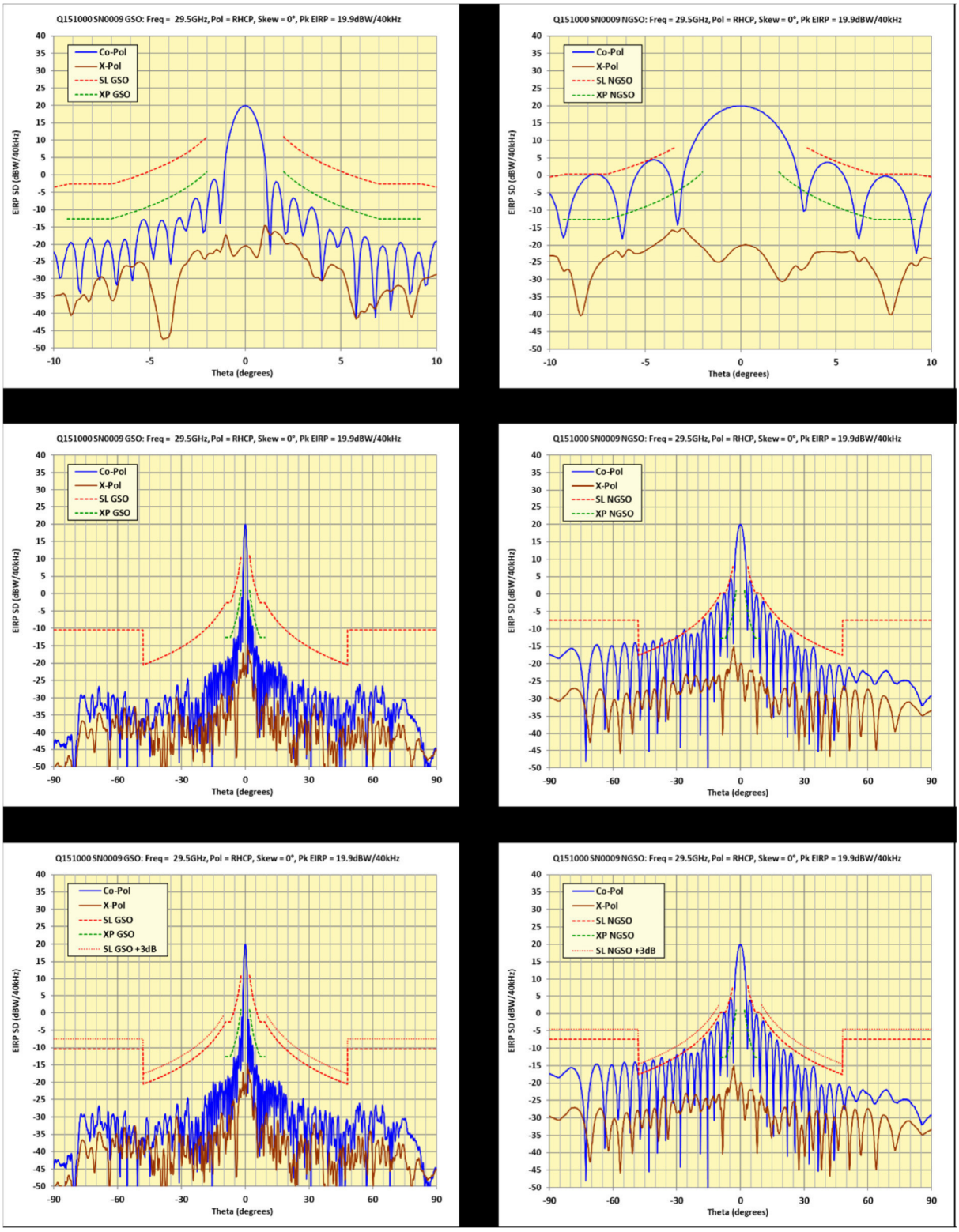


Max EIRPSD vs Skew, RHCP, 30.0 GHz

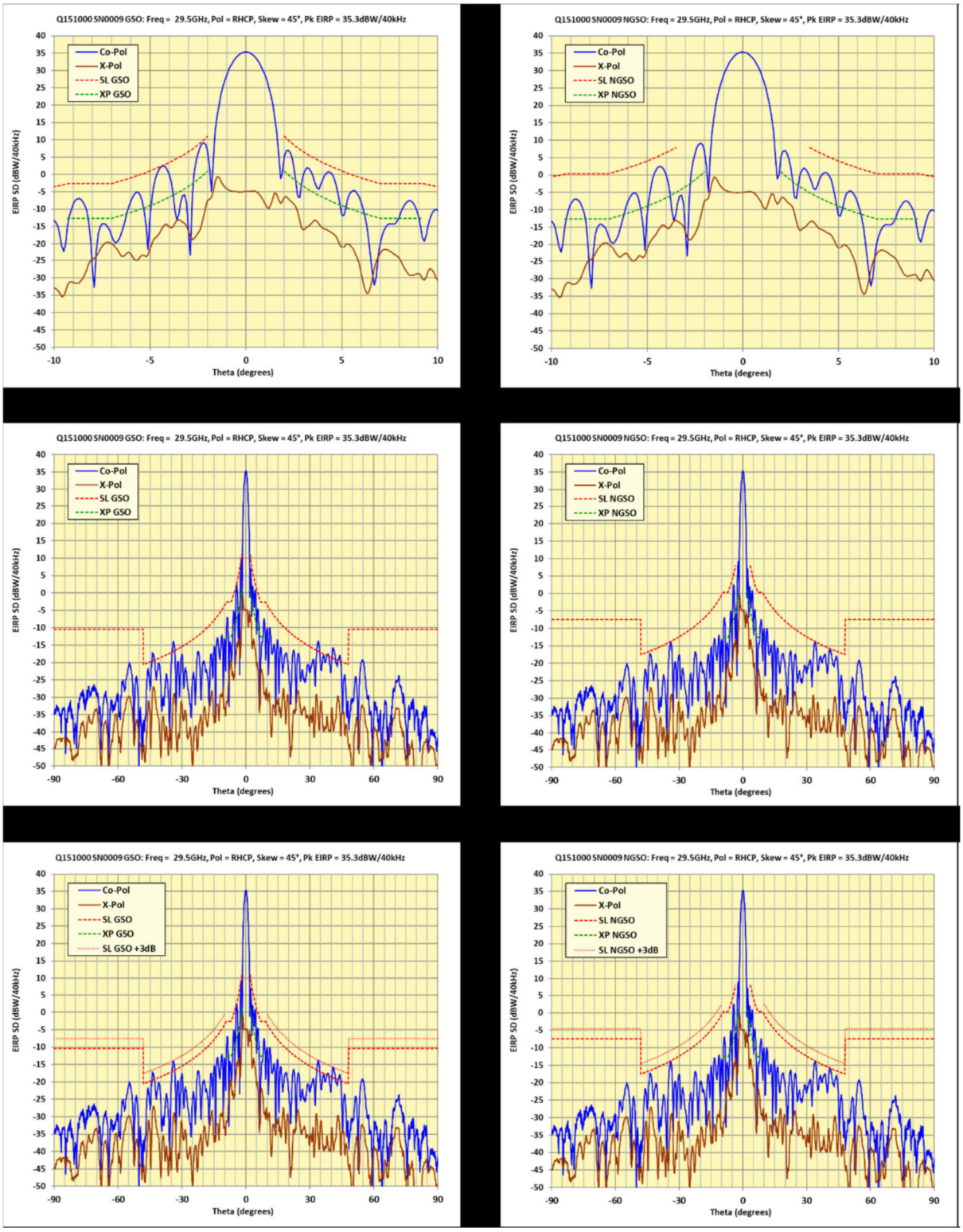


Max EIRPSD vs Skew, LHCP, 30.0 GHz

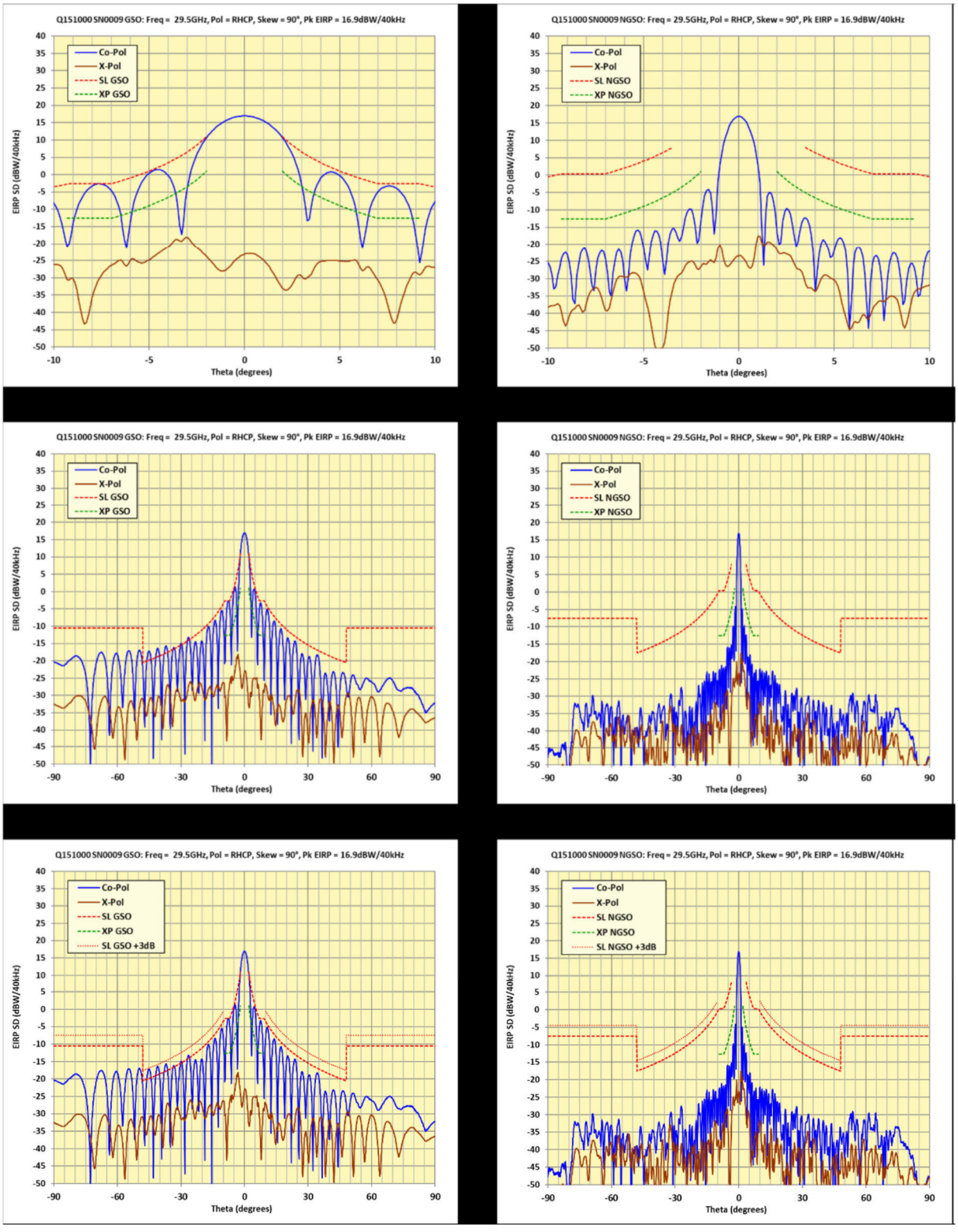
4.8.4.) Sample antenna patterns at 29,5 GHz RHCP



Skew: 0 deg



Skew: 45 deg



Skew: 90 deg

Remark: The graphs show the EIRPSD in a 40 kHz bandwidth (ETSI requirement). Nevertheless the EIRPSD in a 1 MHz bandwidth requirement by FCC is comparable for noise-like signals.

Appendix 1
Test equipment used

☒	Anechoic Chamber with 3m measurement distance	NT-100
☐	Stripline according to ISO 11452-5	NT-108
☐	MA4000 - Antenna mast 1 - 4 m height	NT-110/1
☒	DS - Turntable 0 - 400 ° Azimuth	NT-111/1
☒	CO3000 Controller Mast+Turntable	NT-112/1
☐	HUF-Z3 - Log. Per. Antenna 200 - 1000 MHz	NT-121
☐	FMZB1513 - Loop Antenna 9 kHz - 30 MHz	NT-122/1
☐	HFH-Z6 - Rod Antenna 9 kHz - 30 MHz	NT-123
☐	3121C - Dipole Antenna 28 - 1000 MHz	NT-124
☐	3115 - Horn Antenna 1 - 18 GHz (immunity)	NT-125
☐	3116 - Horn Antenna 18 - 40 GHz	NT-126
☐	SAS-200/543 - Bicon. Antenna 20 MHz - 300 MHz	NT-127
☐	AT-1080 - Log. Per. Antenna 80 - 1000 MHz	NT-128
☐	HK-116 - bicon. Antenna 20 MHz - 300 MHz	NT-129
☐	HK-116 - bicon. Antenna 20 MHz - 300 MHz	NT-130
☐	3146 - Log. Per. Antenna 200 – 1000 MHz	NT-131
☐	VULB 9163 Trilog Antenna 30 – 3000 MHz	NT-131/1
☐	Loop Antenna H-Field	NT-132
☐	Horn Antenna 500 MHz - 2900 MHz	NT-133
☐	Horn Antenna 500 MHz - 6000 MHz	NT-133/1
☐	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
☐	HF 906 - Horn Antenna 1 - 18 GHz (emission)	NT-139
☐	HZ-1 Antenna tripod	NT-150
☐	BN 1500 Antenna tripod	NT-151
☐	Ant. tripod for EN61000-4-3 Model TP1000A	NT-156
☐	Power quality analyzer Fluke 1760 (complete set)	NT-160 - NT-173
☐	Spectrumanalyzer – FSP7 9 kHz – 7 GHz	NT-200
☐	ESCI - Test receiver 9 kHz - 7 GHz	NT-203/1
☐	ESI26 – Test receiver 20 Hz – 26,5 GHz	NT-207
☐	Digital Radio Tester CMW500	NT-208/1
☐	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
☐	Digital Radio Tester Aeroflex 3920	NT-212/1
☐	Mixer M28HW 26,5 GHz - 40 GHz	NT-214
☐	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
☐	DSO9104 Digital scope	NT-220/1
☐	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-3006 Spectrumanalyzer	NT-233/1a
☐	E-field probe SRM 75 MHz – 3 GHz	NT-234
☐	Field Meter NBM-500 incl. E- and H-Field probes	NT-240a-e
☐	Hall-Teslameter ETM-1	NT-241
☐	EFA-3 H-field- / E-field probe	NT-243
☐	EHP-50F H-field- / E-field probe	NT-243/1
☐	Field Meter EMR-200 100 kHz – 3 GHz	NT-244
☐	E-field probe 100 kHz – 3 GHz	NT-245
☐	H-field probe 300 kHz – 30 MHz	NT-246

Appendix 1 (continued)
Test equipment used

☐	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
☐	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
☐	i310s Current Probe	NT-254/1
☐	Fluke 87 V True RMS Multimeter	NT-260
☐	Model 2000 Digital Multimeter	NT-261
☐	Fluke 87 V Digital Multimeter	NT-262/1
☐	ESH2-Z5-U1 Artificial mains network 4x25A	NT-300
☐	ESH3-Z5-U1 Artificial mains network 2x10A	NT-301
☐	ESH3-Z6-U1 Artificial mains network 1x100A	NT-302
☐	ESH3-Z6-U1 Artificial mains network 1x100A	NT-302a
☐	PHE 4500/B Power amplifier	NT-304
☐	EZ10 T-Artificial Network	NT-305
☐	SMG - Signal generator 0,1 - 1000 MHz	NT-310
☐	SMA100A - Signal generator 9 kHz - 6 GHz	NT-310/1
☐	RefRad Reference generator	NT-312
☐	SMP 02 Signal generator 10 MHz - 20 GHz	NT-313
☐	40 MHz Arbitrary Generator TGA1241	NT-315
☐	Artificial mains network NSLK 8127-PLC	NT-316
☐		
☐	PSURGE 4.1 Surge generator	NT-324
☐	IMU4000 Immunity test system	NT-325/1
☐	VCS 500-M6 Surge-Generator	NT-326
☐	Oscillatory Wave Simulator incl. Coupling networks	NT-328a+b+c
☐	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-EFT 32M 3 ph. Coupling filter (Burst)	NT-400/1
☐	PHE 4500 - Mains impedance network	NT-401
☐	IP 6.2 Coupling filter for data lines (Surge)	NT-403
☐	TK 9421 High Power Volt. Probe 150 kHz - 30 MHz	NT-409
☐	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

Appendix 1 (continued)
Test equipment used

☐	Highpass-Filter 3500 MHz – 18 GHz	NT-416
☐	RF-Attenuator 10 dB DC – 18 GHz / 50 W	NT-417/1
☐	RF-Attenuator 6 dB DC – 18 GHz / 50 W	NT-418
☐	RF-Attenuator 3 dB DC – 18 GHz / 50 W	NT-419
☐	RF-Attenuator 20 dB DC - 1000 MHz / 25 W	NT-421
☐	RF-Attenuator 30 dB DC - 1000 MHz / 1 W	NT-423
☐	RF-Attenuator 30 dB	NT-424
☐	RF-Attenuator 6 dB DC - 1000 MHz / 1 W	NT-425
☐	RF-Attenuator 6 dB DC - 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-M3-16A Coupling decoupling network	NT-458
☐	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
☐	SW 9605 - Current probe 150 kHz – 30 MHz	NT-465/1
☐	95242-1 – Current probe 1 MHz – 400 MHz	NT-468
☐	94106-1L-1 – Current probe 100 kHz – 450 MHz	NT-471
☐	GA 1240 Power amplifier according to EN 61000-4-16	NT-480
☐	Coupling networks according to EN 61000-4-16	NT-481 - NT-483
☐	Van der Hoofden Test Head	NT-484
☐	EMC Video/Audiosystem	NT-511/1
☐	ES-K1 Version 1.71 SP2 Test software	NT-520
☐	EMC32 Version 10.60.15 Test software	NT-520/1
☐	SRM-TS Version 1.3 software for SRM-3000	NT-522
☐	SRM-TS Version 1.3.1 software for SRM-3006	NT-522/1
☐	Spitzenberger und Spies Test software V4.1	NT-525
☐	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+#6 ESD-cable (2x470k)	NT-555 + 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	M-1200

Appendix 1 (continued)
Test equipment used

☐	Anechoic Chamber 3 m / 5 m measuring distance	EMV-100
☐	Turntabel 6 m diameter	EMV-101
☐	Antenna mast + controller	EMV-102+ EMV-103
☐	EMC Video/Audiosystem	EMV-104
☐	EMC Software EMC32 Version 10.60.15	EMV-105
☐	Hornantenna 1 – 18 GHz HF 907	EMV-110
☐	Antennapre.amp. 1 – 18 GHz ERZ-LNA0200-1800-30-2	EMV-111
☐	Trilog Antenna 30-3000 MHz VULB9163	EMV-112
☐	Monopol 9 kHz – 30 MHz VAMP 9243	EMV-113
☐	Antennapre.amp 18 – 40 GHz BBV 9721	EMV-114
☐	Hornantenna 200 – 2000 MHz AH-220	EMV-115
☐	DC Artificial Network PVDC 8300	EMV-150
☐	AC Artificial Network NNLK 8121 RC	EMV-151
☐	EMI Receiver ESR26	EMV-200
☐	Signalgenerator 9 kHz – 40 GHz N5173B	EMV-201
☐	GPS Frequency normal B-88	EMV-202
☐	DC Power supply N5745A	EMV-203
☐	Spektrum Analyzator FSV40	EMV-205
☐	Thd Multimeter Model 2015	EMV-206
☐	Poweramplifier PAS15000	EMV- 207/abc
☐	Inrush Current Source	EMV- 208/abc
☐	Arb.-generator Sycore	EMV-209
☐	Harmonics/Flicker analyzer ARS 16/3	EMV-210
☐	HF- Ampflifier 9 kHz-250 MHz BBA150	EMV-300
☐	HF- Amplifier 80 -1000 MHz BBA150	EMV-301
☐	HF- Amplifier 0,8 - 6 GHz BBA150	EMV-302
☐	High Power Ant. 20-200 MHz HPBA-2510	EMV-303/1
☐	Log.per Antenna 80-2700 MHz STLP 9128 E special	EMV-304
☐	Log.per Antenna 0,7 – 9 GHz STLP9149	EMV-305
☐	HF- Ampflifier 9 kHz-250 MHz BBA150 (low noise)	EMV-306
☐	ISO11451-2 TLS 10 kHz – 30 MHz	EMV-307
☐	Load Dump Generator LD 200N	EMV-350
☐	Ultra Compact Symulator UCS 200N100	EMV-351
☐	Automotive Power fail module PFM 200N100.1	EMV-352
☐	Voltage Drop Symulator VDS 200Q100	EMV-353
☐	Arb. Generator AutoWave	EMV-354
☐	Ultra Compact Symulator UCS 500N7	EMV-355
☐	Coupling decoupling network CNI 503B7 / 32 A	EMV-356
☐	Coupling decoupling network CNI 503B7 / 63 A	EMV-357
☐	Telecom Surge Generator TSurge 7	EMV-358
☐	Coupling decoupling network CNI 508N2	EMV-359
☐	Coupling decoupling network CNV 504N2.2	EMV-360
☐	Immunity generator NSG4060/NSG4060-1	EMV-361
☐	Coupling network CDND M316-2	EMV-362
☐	Coupling network CT419-5	EMV-363
☐	ESD Generator NSG 437	EMV-364
☐	Pulse Limiter VTSD 9561-F BNC	EMV-405
☐	Transient emission BSM200N40+BS200N100	EMV- 450+451
☐	Cap. Coupling Clamp HFK	EMV-455
☐	Mag. Field System MS100N+MC26100+MC2630	EMV- 456-458
☐	Coupling network CDN M2-100A	EMV-459
☐	Coupling network CDN M3-32A	EMV-460
☐	Coupling network CDN M5-100A	EMV-461
☐	Current Clamp CIP 9136A	EMV-462
☐	DC Artificial Network HV-AN 150	EMV- 464+465
☐	Coupling Clamp EM 101	EMV-466
☐	Decoupling Clamp FTC 101	EMV-467
☐	Power attenuator 10 dB / 250 Watt	EMV-469/2