

Satel Oy

Measurement report

for Satellar modems: 406,1 MHz ... 445 MHz
440 MHz ... 485 MHz
470 MHz ... 520 MHz

Contents

CONTENTS	2
OUTPUT POWER	3
List of measuring equipment	3
Results	3
FREQUENCY STABILITY	4
Frequency stability vs. voltage variations	4
List of measuring equipment	4
Results	4
Frequency stability vs. temperature variations	4
List of measuring equipment	4
Results	5
CONDUCTED SPURIOUS EMISSIONS	6
List of measuring equipment	6
Results	6
TRANSIENT FREQUENCY BEHAVIOR	7
List of measuring equipment	7
Results	7
OCCUPIED BANDWIDTH	12
List of measuring equipment	12
Results	12
EMISSION MASKS	14
List of measuring equipment	14
Results	14
TEST SUMMARY	15

Output Power

Test time	Test site	Measured frequencies	Standard	Performed by
26.08.2010	Satel Oy	495MHz	FCC Part §90.205(g)	TVa

Power measurements were measured when EUT was operating in a CW mode.

List of measuring equipment

- Power supply Thurlby Thandar Instruments EX354D Serial no. 144171
- Agilent E4418B Serial no. MY45105191

Results

Frequency/MHz	Measured power @1W/dBm	Measured power @100mW/dBm
495	30,8	20,1

Frequency Stability

Test time	Test site	Measured frequencies	Standard	Performed by
25-30.08.2010	Satel Oy	420MHz, 462,5MHz, 495MHz	acc. to 47 CFR 2.1055.	TVa

Frequency stability vs. voltage variations

Frequency error is measured at 85% and 115% of rated supply voltage 9-30V. Temperature in this measurement is +20°C. Frequency error is measured EUT operating in a CW mode.

List of measuring equipment

- Power supply Thurlby Thandar Instruments EX354D Serial no. 144171
- Temperature test chamber Vötsch VT4002 56608550 Serial no. 58566085500010
- Spectrum analyzer HP8560A Serial no. 2913A00130

Results

Temperature/°C	Voltage/V	420MHz	ppm error	462,5MHz	ppm error	495MHz	ppm error
20	7,65	419,99987	-0.31	462,49987	-0.28	494,9998	-0.40
20	34,5	419,99987	-0.31	462,49987	-0.28	494,9998	-0.40
Limit			±1,5				±1,5

Frequency stability vs. temperature variations

Frequency error is measured at 12V and the temperature is varied from +60°C to -30°C with 10 degree steps. At each measured temperature the EUT was switched on and left for 30 minutes for thermal balance to be obtained before measurements were done. Frequency error is measured EUT operating in a CW mode.

List of measuring equipment

- Power supply Thurlby Thandar Instruments EX354D Serial no. 144171
- Temperature test chamber Vötsch VT4002 56608550 Serial no. 58566085500010
- Spectrum analyzer Rohde & Schwarz FSP Serial no. 837619/003

Results

Temperature/°C	Voltage/V	420MHz	ppm error	462,5MHz	ppm error	495MHz	ppm error
60	12	419,99999	-0,02	462,49988	-0,26	494,99958	-0,85
50	12	419,99998	-0,05	462,4999	-0,22	494,9997	-0,61
40	12	419,99982	-0,43	462,49988	-0,26	494,99976	-0,48
30	12	419,99984	-0,38	462,4999	-0,22	494,99988	-0,24
20	12	419,99988	-0,29	462,49992	-0,17	494,99998	-0,04
10	12	419,99988	-0,29	462,49992	-0,17	495,0004	0,808
±0	12	419,99982	-0,43	462,49986	-0,3	495	0
-10	12	419,9997	-0,71	462,49976	-0,52	494,99976	-0,48
-20	12	419,99978	-0,52	462,4998	-0,43	494,9995	-1,01
-30	12	419,9999	-0,24	462,49998	-0,04	494,99932	-1,37
Max		419,99999	-0,02	462,49998	-0,04	495,0004	0,808
Min		419,9997	-0,71	462,49976	-0,52	494,99932	-1,37
Limit			±1,5		±1,5		±1,5

Conducted Spurious Emissions

Test time	Test site	Measured frequency	Standard	Performed by
27.08.2010	Satel Oy	495MHz	FCC Part §90.210	TVa

Spurious frequencies were measured while EUT was operating in a CW mode. A high pass filter was used to filter own signal away to prevent spectrum analyzer from generate harmonics. Limits on channel spacing and transmit power were calculated depending:

25kHz attenuation = $43 + 10\log(P) = 43 + 10\log(1) = 43\text{dB}$

→ Limit (dBm) $+30\text{dBm} - 43\text{dB} = -13\text{ dBm @ 1W}$

→ Limit (dBm) $+20\text{dBm} - 43\text{dB} = -23\text{ dBm @ 100mW}$

12,5kHz attenuation = $50 + 10\log(P) = 50 + 10\log(1) = 50\text{dB}$

→ Limit (dBm) $+30\text{dBm} - 50\text{dB} = -20\text{ dBm @ 1W}$

→ Limit (dBm) $+20\text{dBm} - 50\text{dB} = -30\text{ dBm @ 100mW}$

Limit used to prove compliance -20dBm for 1W and -30dBm for 100mW.

List of measuring equipment

- Power supply Thurlby Thandar Instruments EX354D Serial no. 144171
- Spectrum analyzer Rohde & Schwarz FSP Serial no. 837619/003
- Mini Circuits NHP-800+ High pass filter

Results

Harmonics

Carrier frequency:	TX PWR:	1. Harmonic/dBm	2. Harmonic /dBm	3. Harmonic /dBm	4. Harmonic /dBm
495 MHz	100 mW	-55,15	-60,07	-91,89	-89,56
495 MHz	1 W	-49,82	-51,45	-92,89	-84,75

Other spurious frequencies

Carrier frequency:	TX PWR:	Start/MHz	Stop/MHz	Largest spurious signal/MHz	Largest spurious signal/dBm
495 MHz	100 mW	10	3000	439,2	-60
495 MHz	1 W	10	3000	439,2	-67

495 MHz	OFF	10	3000	678	-79
---------	-----	----	------	-----	-----

Transient Frequency Behavior

Test time	Test site	Measured frequencies	Standard	Performed by
25-27.08.2010	Satel Oy	420MHz, 462,5MHz, 495MHz	FCC Part §90.214	TVa

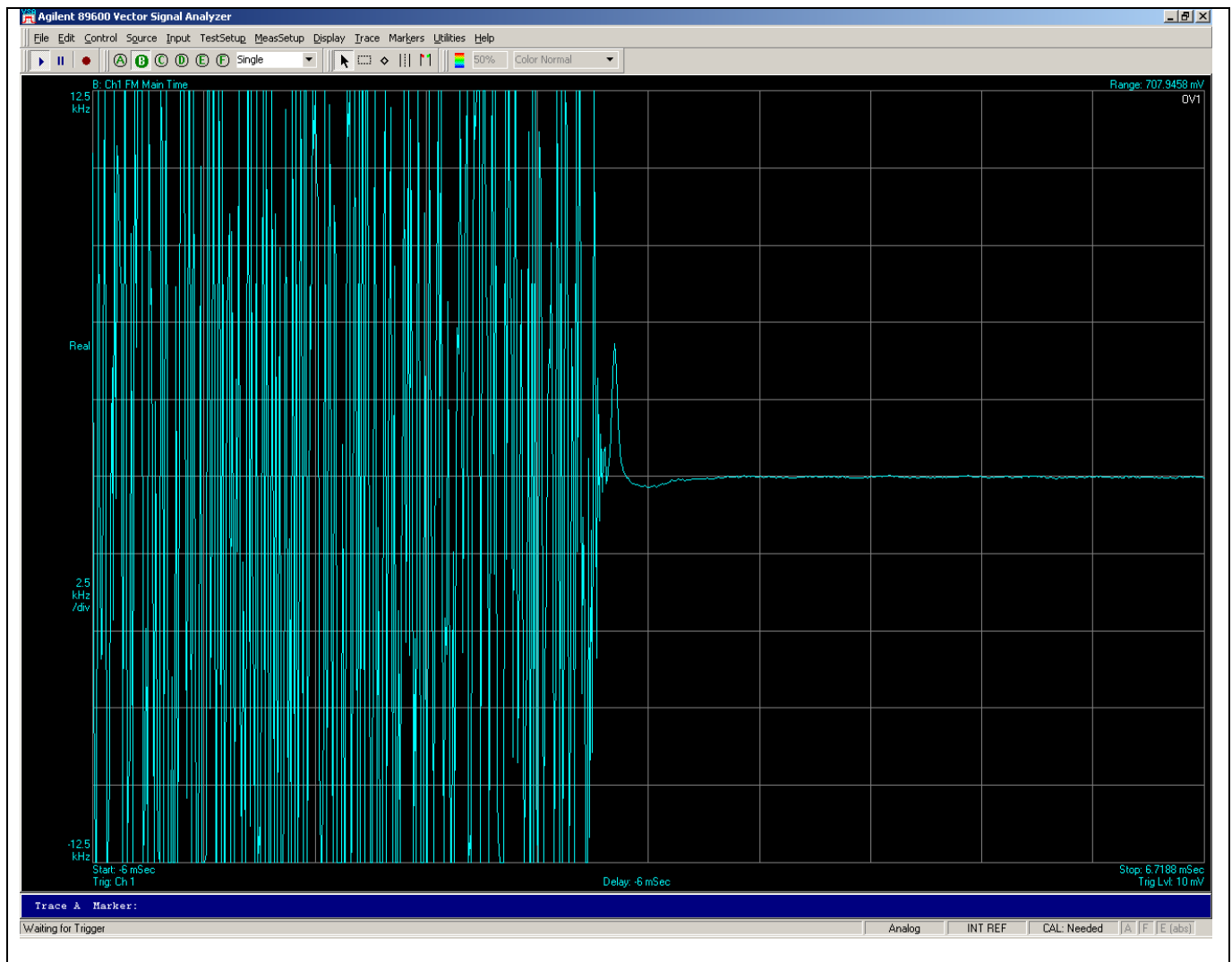
Transient frequency behavior was measured when EUT was switched on and off in CW mode.

List of measuring equipment

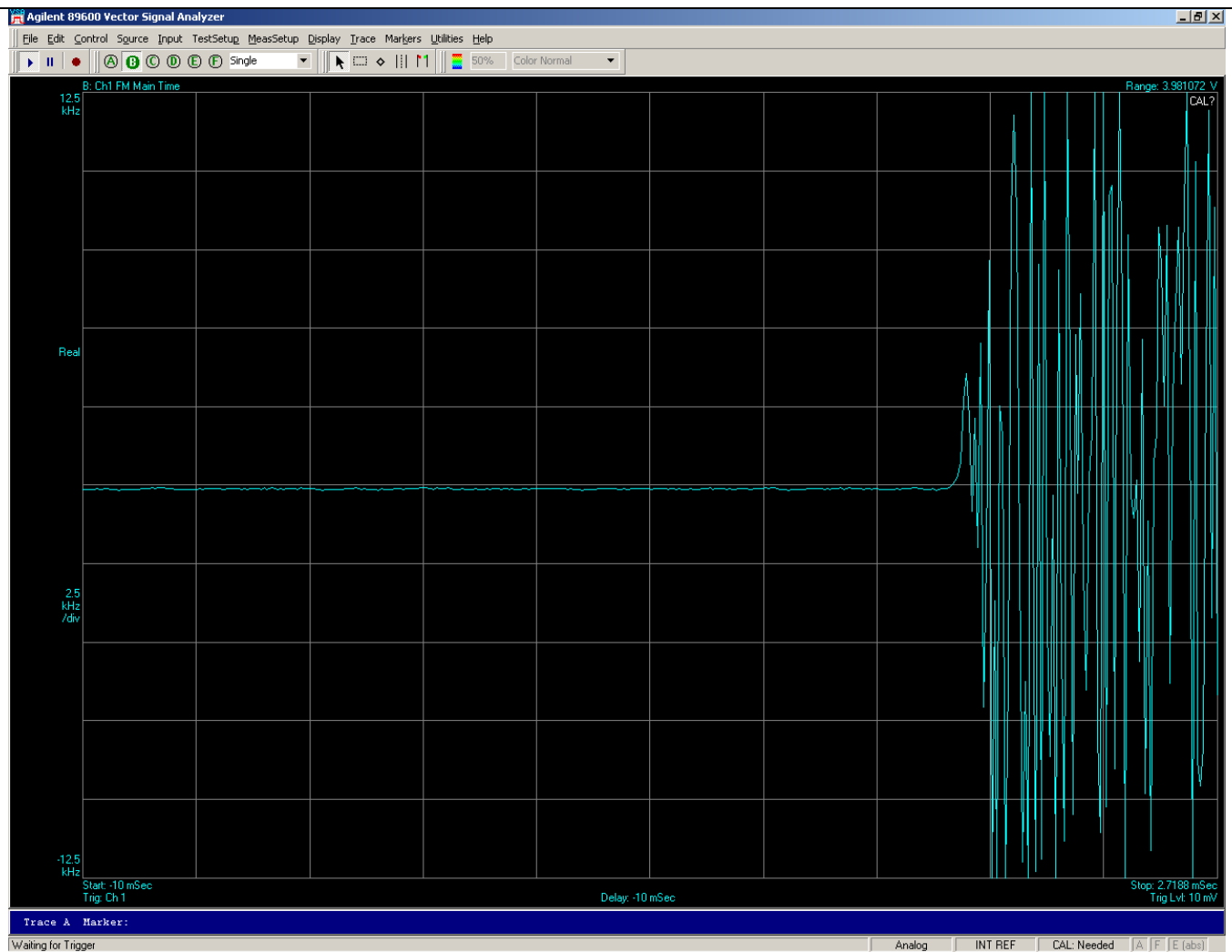
- Power supply Thurlby Thandar Instruments EX354D Serial no. 144171
- Hewlett Packard E4406A Serial no. US39030380

Results

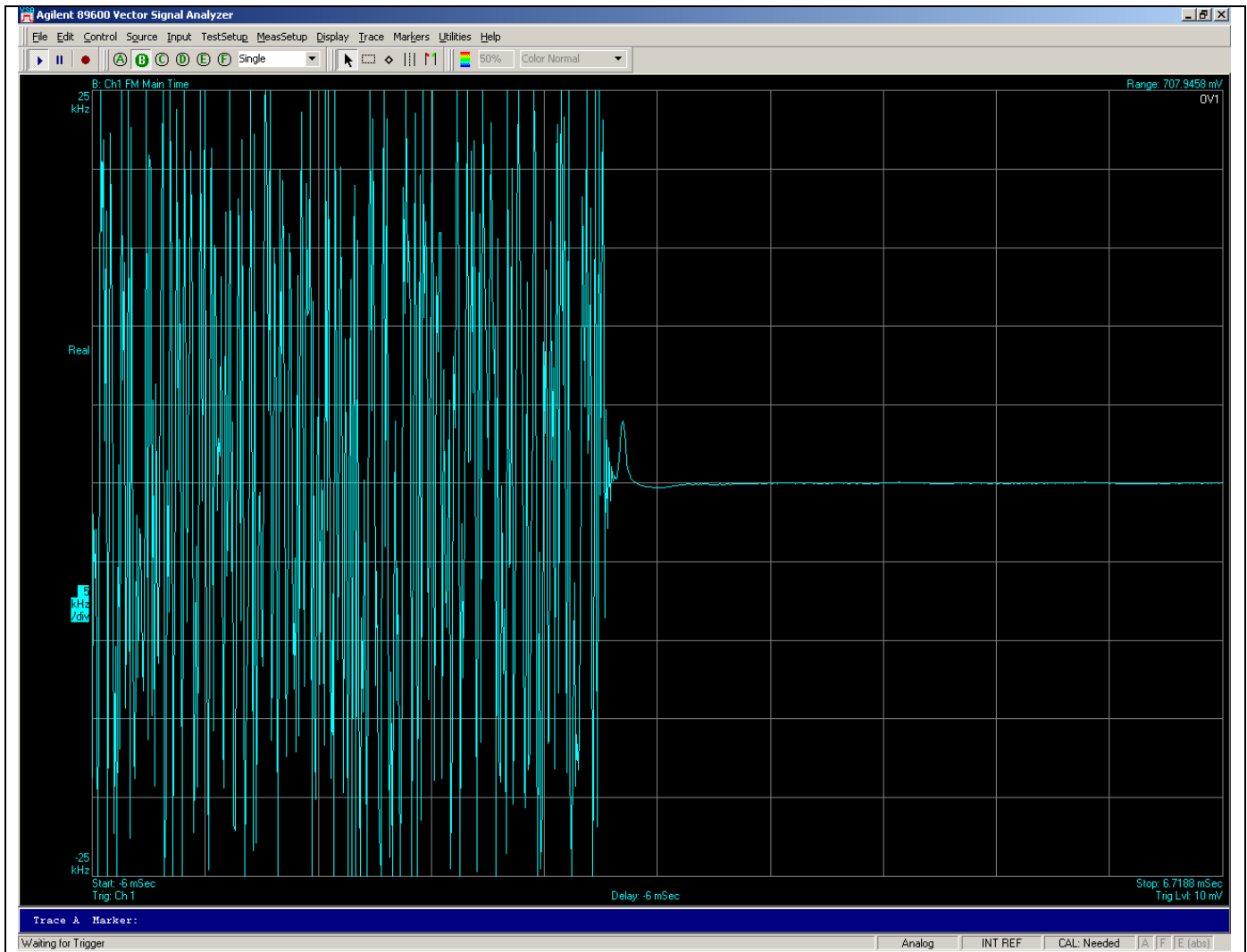
Pictures have been taken from on 420MHz



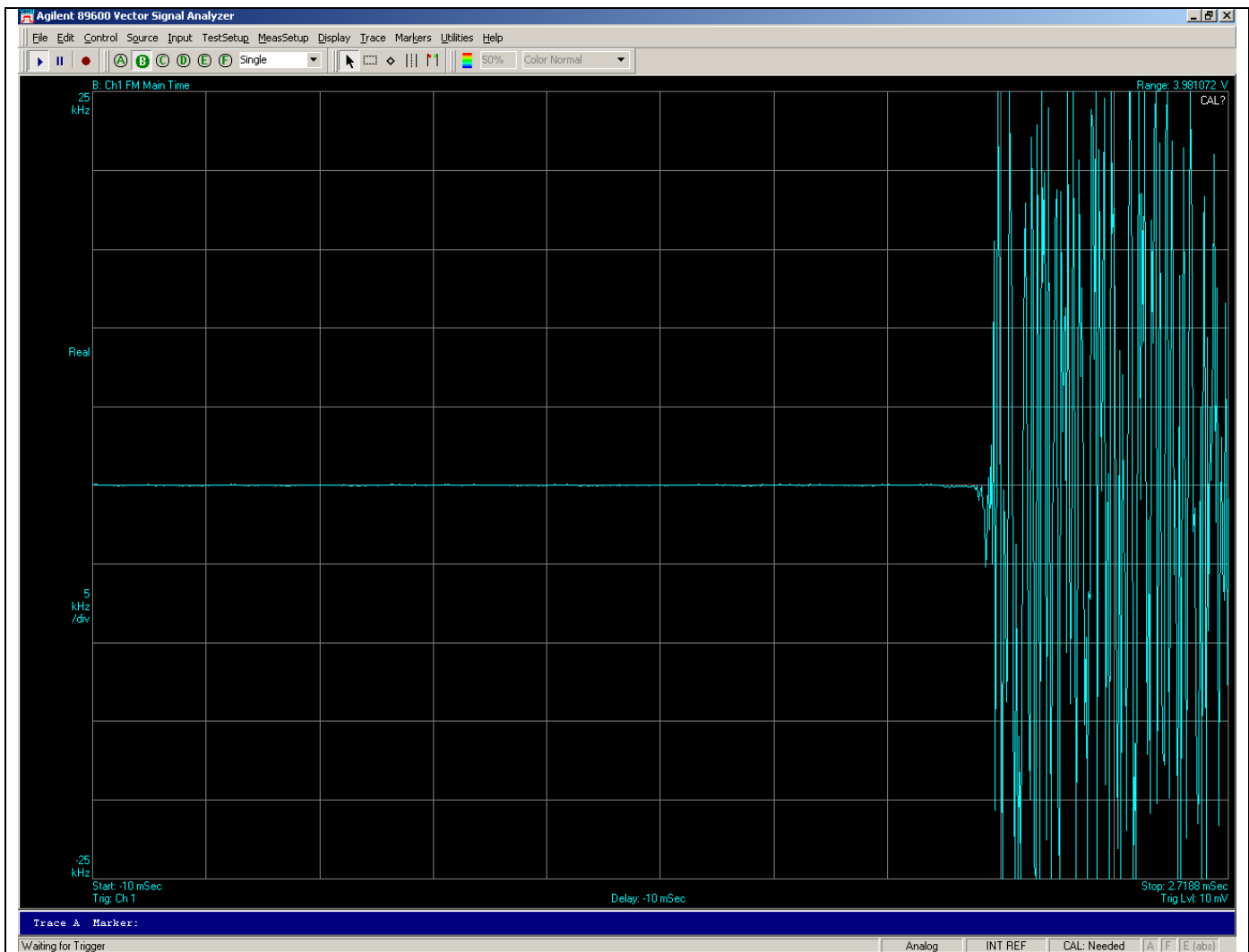
Channel Bandwidth 12,5kHz TRANSMITTER ON



Channel Bandwidth 12,5kHz TRANSMITTER OFF



Channel Bandwidth 25kHz TRANSMITTER ON



Channel Bandwidth 25kHz TRANSMITTER OFF

Frequency /MHz	Channel Bandwidth /kHz	Transient Period	Transient Behavior
420	12,5	t1 = 10 ms	<±12,5kHz
		t2 = 25 ms	<±6,25kHz
		t3 = 10 ms	<±12,5kHz
	25	t1 = 10 ms	<±25kHz
		t2 = 25 ms	<±12,5kHz
		t3 = 10 ms	<±25kHz

462,5	12,5	t1 = 10 ms	<±12,5kHz
		t2 = 25 ms	<±6,25kHz
		t3 = 10 ms	<±12,5kHz
	25	t1 = 10 ms	<±25kHz
		t2 = 25 ms	<±12,5kHz
		t3 = 10 ms	<±25kHz
495	12,5	t1 = 10 ms	<±12,5kHz
		t2 = 25 ms	<±6,25kHz
		t3 = 10 ms	<±12,5kHz
	25	t1 = 10 ms	<±25kHz
		t2 = 25 ms	<±12,5kHz
		t3 = 10 ms	<±25kHz

Occupied Bandwidth

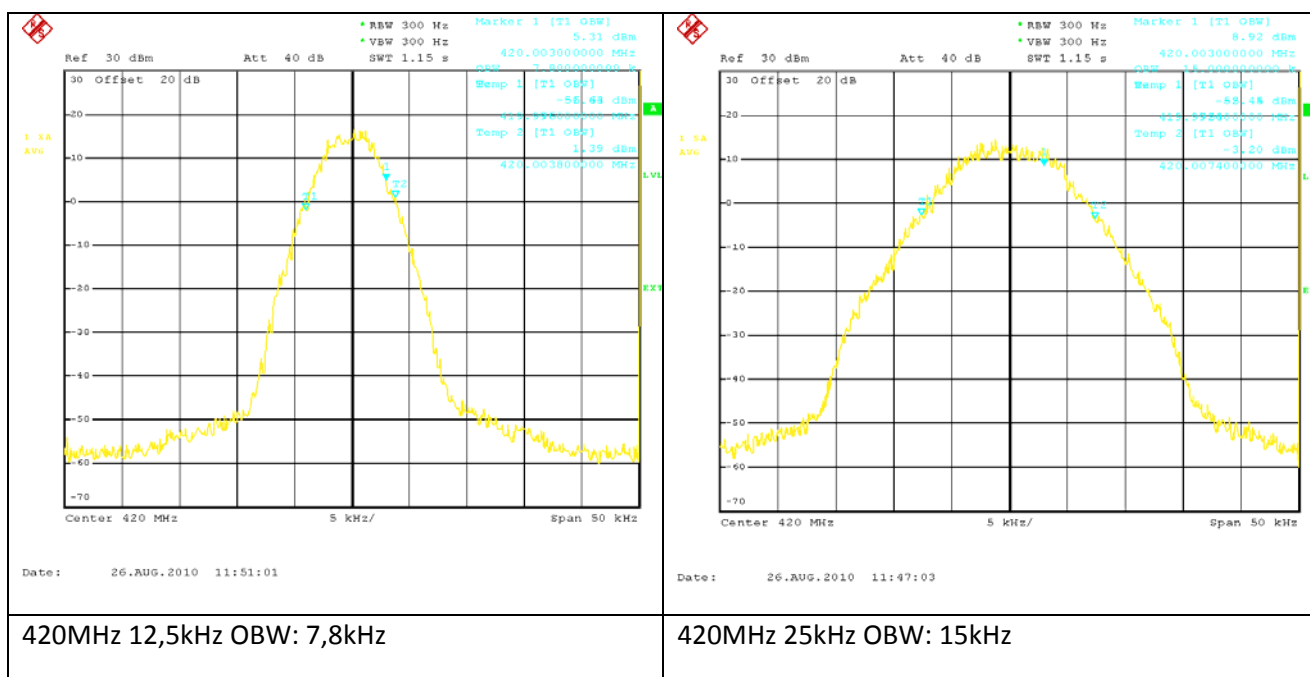
Test time	Test site	Measured frequencies	Standard	Performed by
25-31.08.2010	Satel Oy	420MHz, 462,5MHz, 495MHz	FCC Part §90.210	TVa

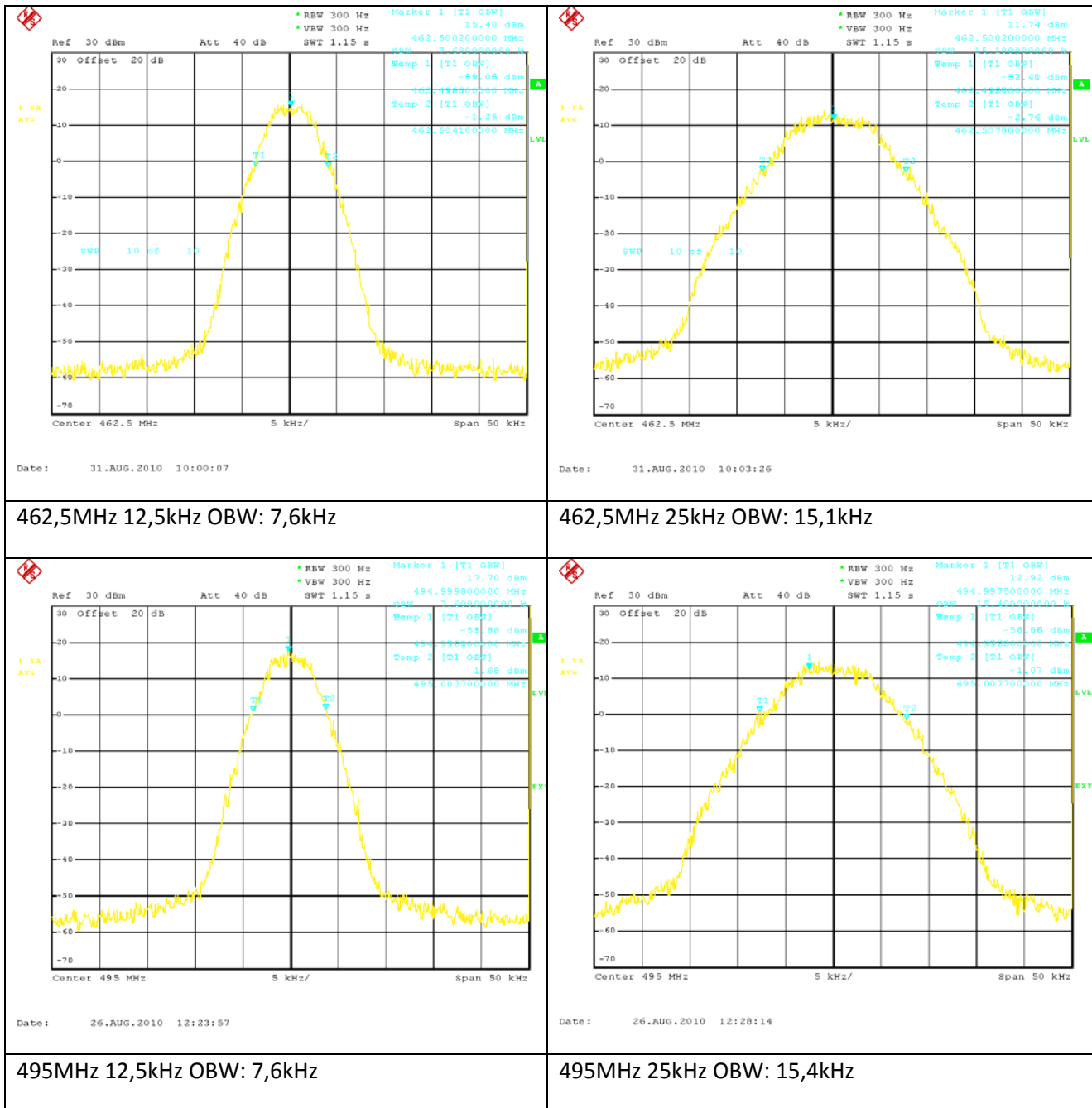
99% occupied bandwidth was measured while EUT was transmitting random data.

List of measuring equipment

- Power supply Thurlby Thandar Instruments EX354D Serial no. 144171
- Temperature test chamber Vötsch VT4002 56608550 Serial no. 58566085500010
- Spectrum analyzer Rohde & Schwarz FSP Serial no. 837619/003

Results





Emission Masks

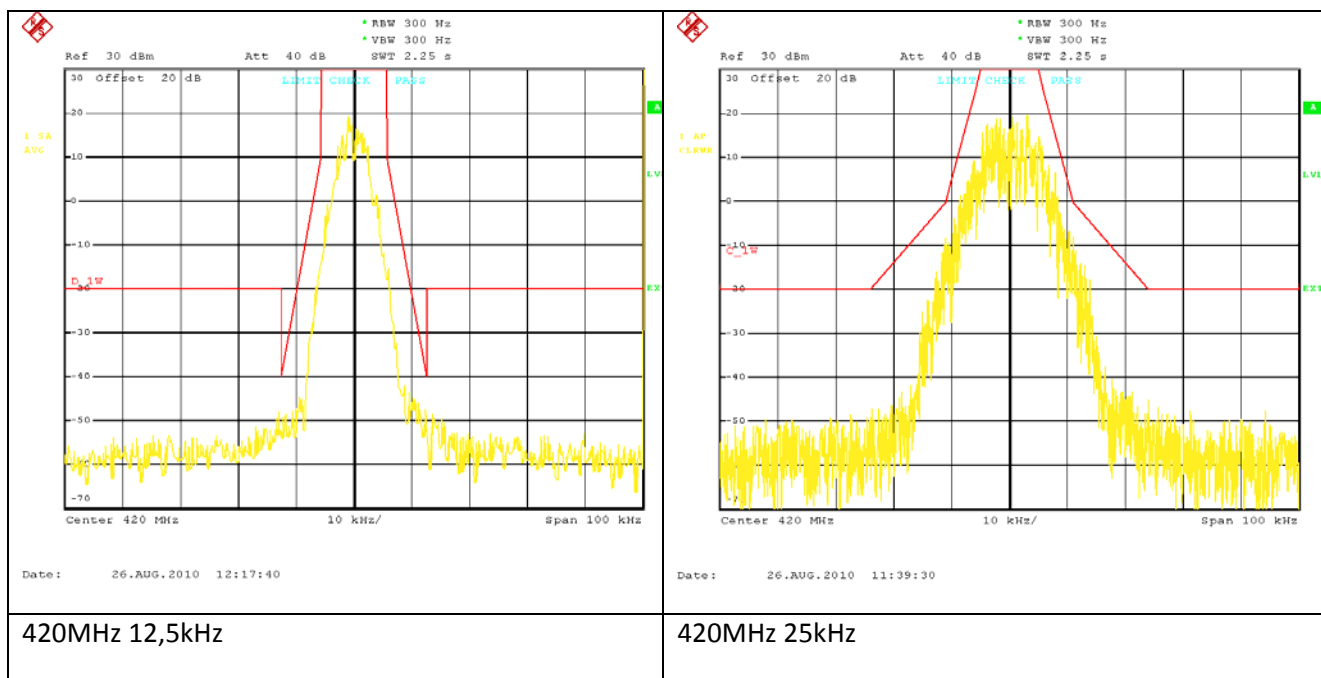
Test time	Test site	Measured frequencies	Standard	Performed by
25-31.08.2010	Satel Oy	420MHz, 462,5MHz, 495MHz	FCC Part §90.210	TVa

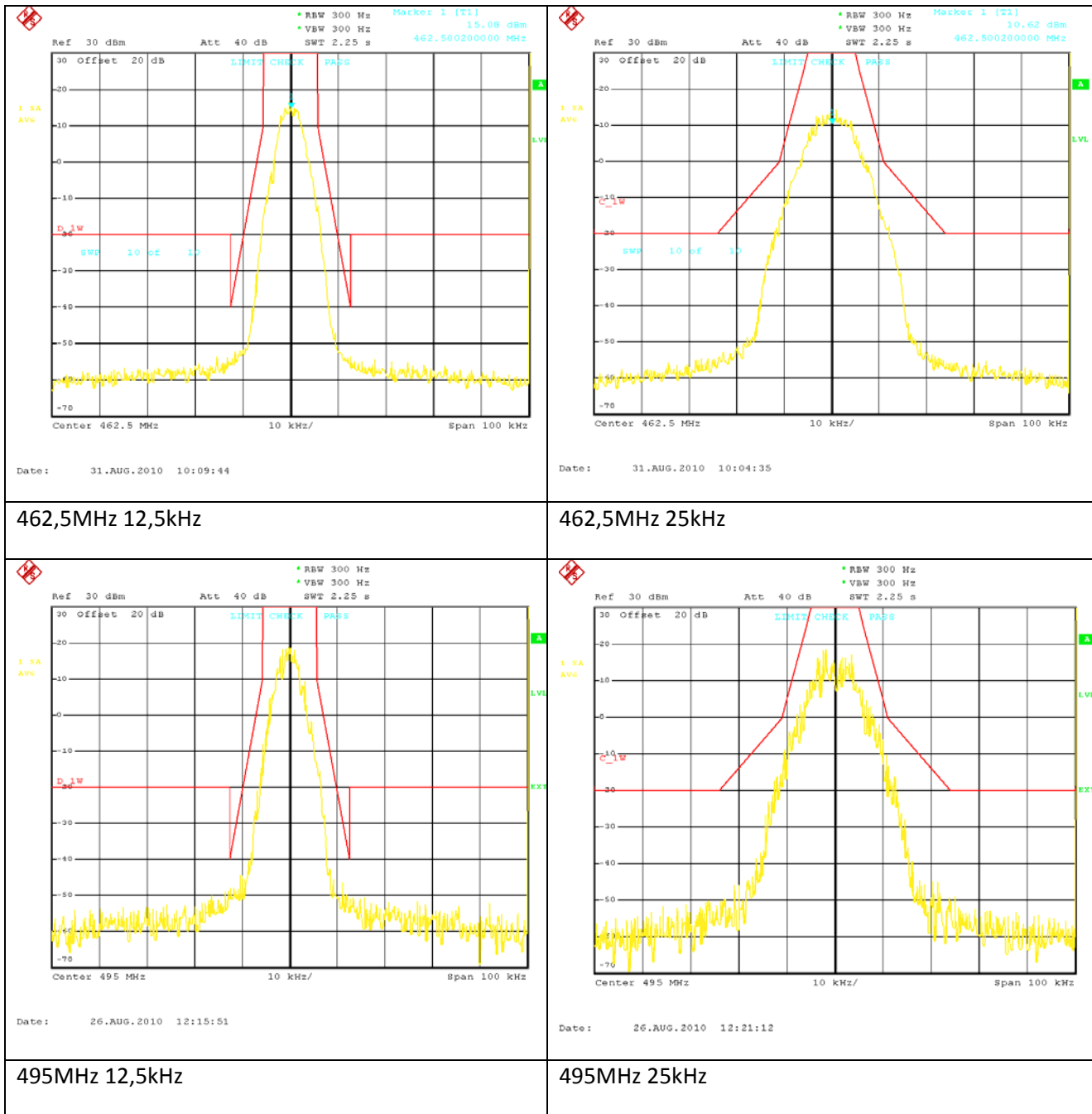
Emission Mask was measured while EUT was transmitting random data. The masks implemented are those "Without Audio Filter" for 25kHz Emission mask 'C' and for 12,5kHz Emission mask 'D'.

List of measuring equipment

- Power supply Thurlby Thandar Instruments EX354D Serial no. 144171
- Temperature test chamber Vötsch VT4002 56608550 Serial no. 58566085500010
- Spectrum analyzer Rohde & Schwarz FSP Serial no. 837619/003

Results





Test Summary

Test	FCC Standard	Pass/Fail
Output power	\$90.205(g)	Pass
Frequency Stability	\$90.213	Pass

Conducted Spurious Emissions	\$90.210	Pass
Transient Frequency Behavior	\$90.214	Pass
Occupied Bandwidth	\$90.210	Pass
Emission Masks	\$90.210	Pass