

Test data, continued

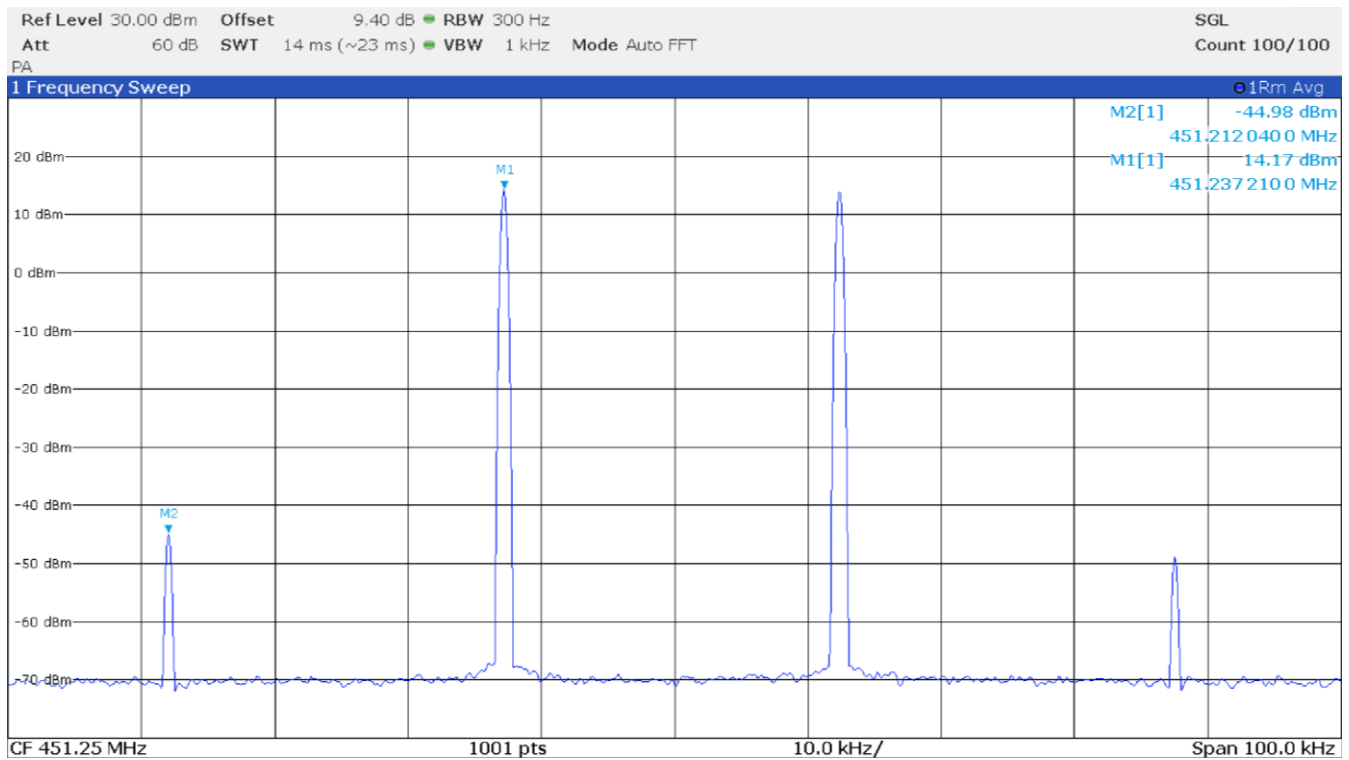


Figure 8.5-2: Down link intermodulation products with input signal at AGC threshold + 3 dB

Test data, continued

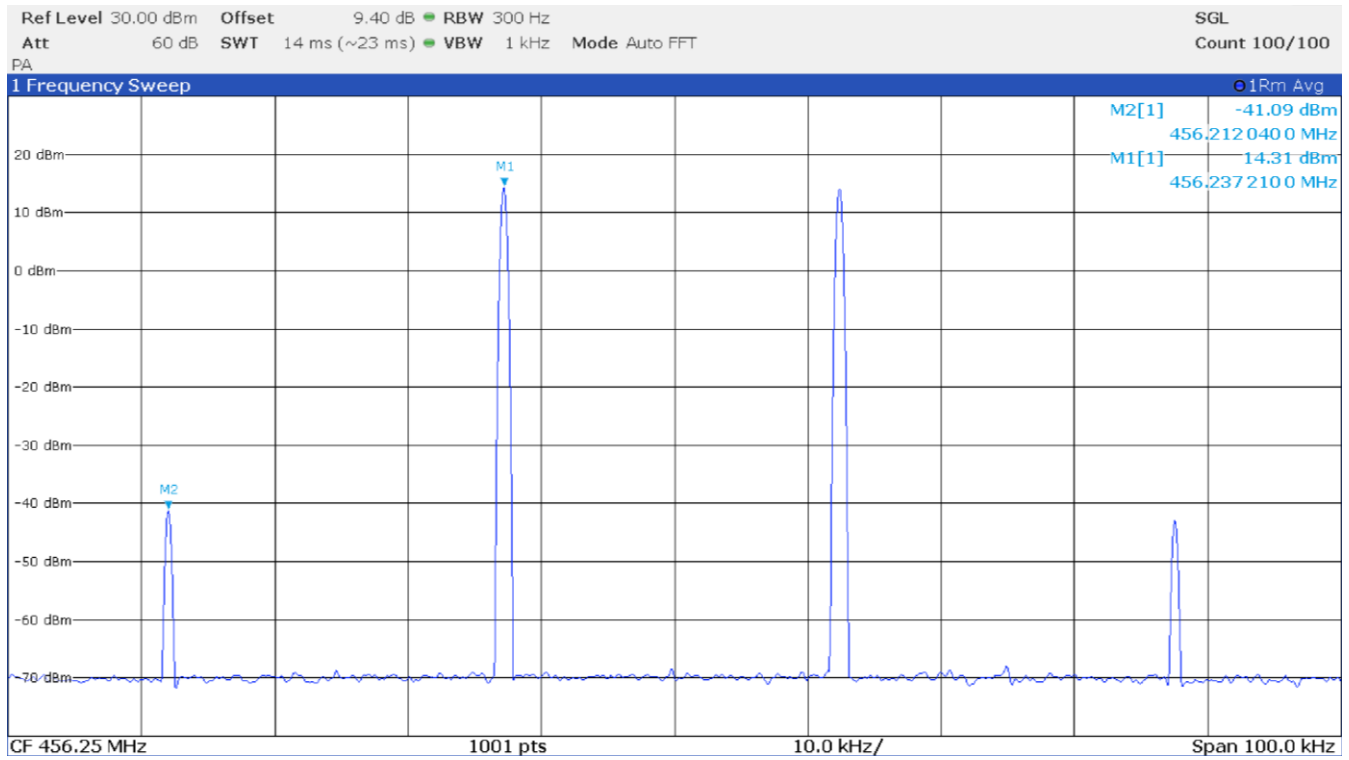


Figure 8.5-3: Up link intermodulation products with input signal at AGC threshold

Test data, continued

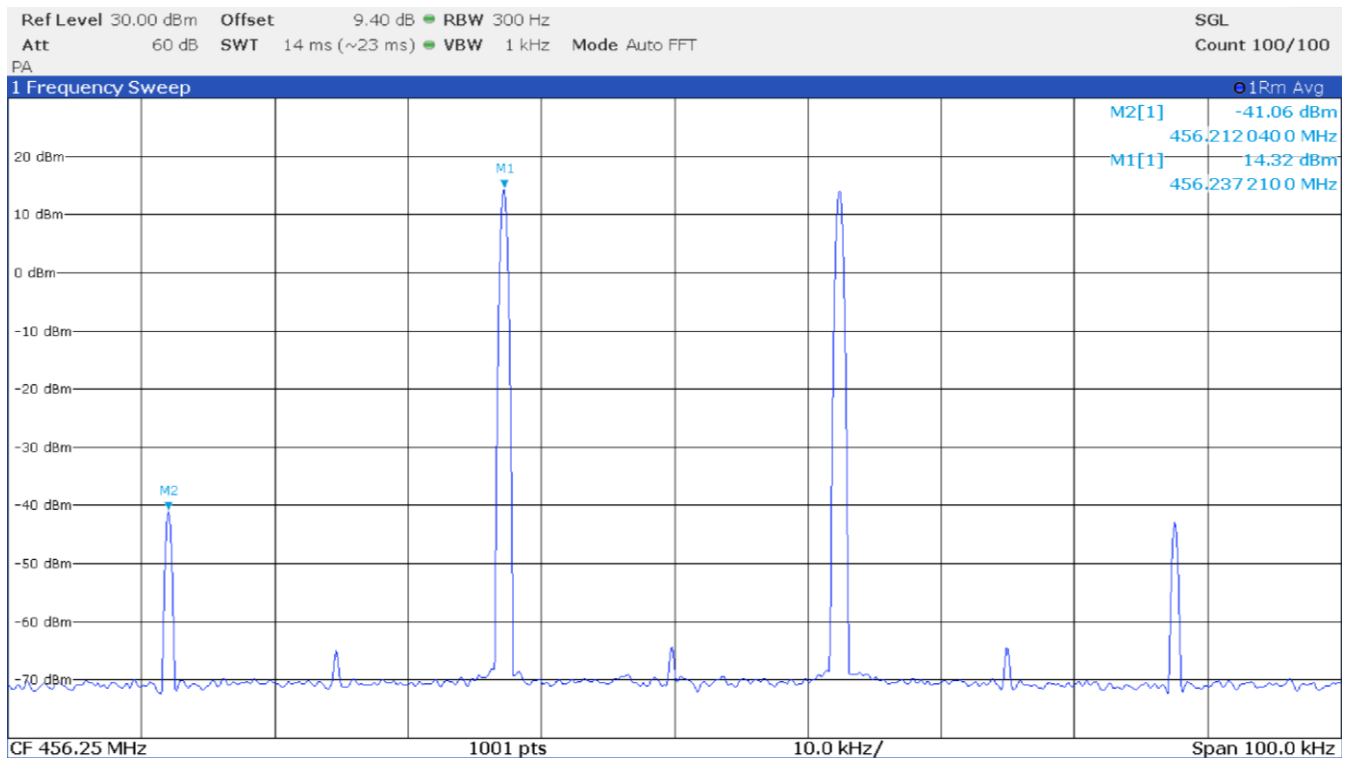


Figure 8.5-4: Up link intermodulation products with input signal at AGC threshold + 3 dB

8.6 Spurious emissions conducted measurements

8.6.1 References, definitions and limits

FCC §90.210(b)

Emission Mask B. For transmitters that are equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier power (P) as follows:

- (1) On any frequency removed from the assigned frequency by more than 50 percent, but not more than 100 percent of the authorized bandwidth: At least 25 dB.
- (2) On any frequency removed from the assigned frequency by more than 100 percent, but not more than 250 percent of the authorized bandwidth: At least 35 dB.
- (3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least $43 + 10 \log (P)$ dB.

FCC §90.219(e)

- (3) Spurious emissions from a signal booster must not exceed -13 dBm within any 100 kHz measurement bandwidth.

8.6.2 Test summary

Verdict	Pass		
Tested by	P. Barbieri	Test date	July 6, 2022

8.6.3 Observations, settings and special notes

As part of the current assessment, the test range of 9 kHz to 10th harmonic has been fully considered and compared to the actual frequencies utilized within the EUT. Since the EUT contains a transmitter in the 450 to 460 MHz range, the EUT has been deemed compliant without formal testing in the 9 kHz to 30 MHz test range, therefore formal test results (tabular data and/or plots) are not provided within this test report.

Spectrum analyser settings:

Resolution bandwidth:	100 kHz and 1 MHz
Video bandwidth:	VBW $\geq 3 \times$ RBW
Detector mode:	Peak
Trace mode:	Max Hold

Input signal frequency

Down link	451.25 MHz
Up link	456.25 MHz

8.6.4 Test equipment used

Equipment	Manufacturer	Model no.	Asset no.
Spectrum Analyzer	Rohde & Schwarz	FSW43	101767
RF Vector Signal Generator	Rohde & Schwarz	SMBV100A	263254

Notes: NCR - no calibration required, VOU - verify on use

8.6.5 Test data

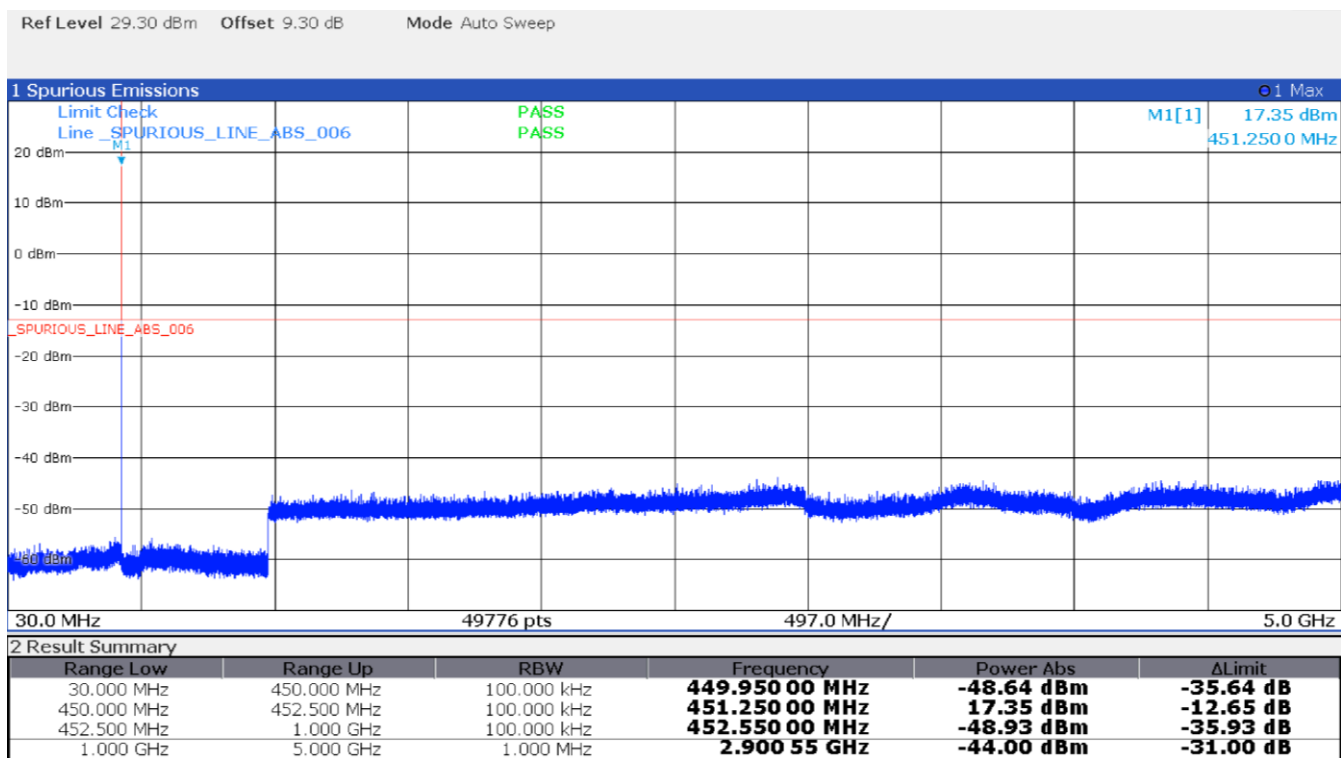


Figure 8.6-1: Conducted spurious emissions, down link

Test data, continued

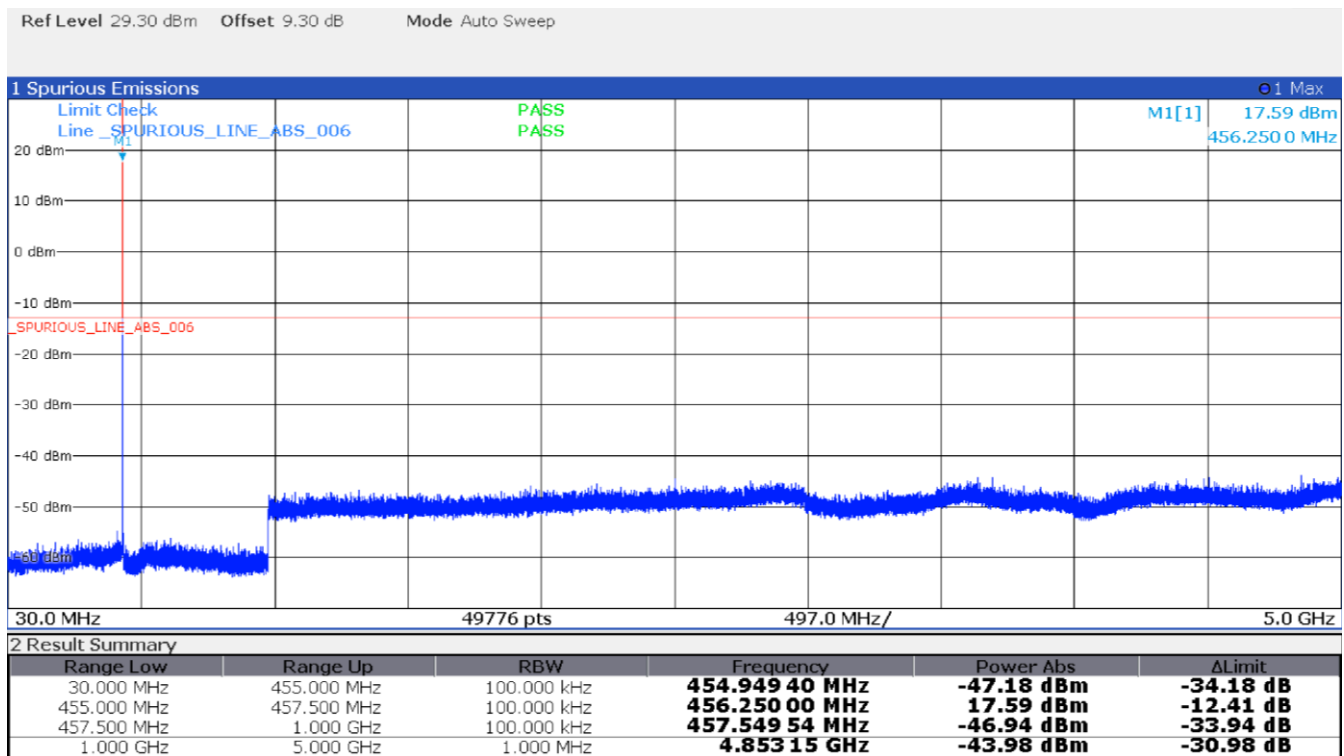


Figure 8.6-2: Conducted spurious emissions, up link

8.7 Spurious emissions radiated measurements

8.7.1 References, definitions and limits

FCC §90.210(b)

Emission Mask B. For transmitters that are equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier power (P) as follows:

- (1) On any frequency removed from the assigned frequency by more than 50 percent, but not more than 100 percent of the authorized bandwidth: At least 25 dB.
- (2) On any frequency removed from the assigned frequency by more than 100 percent, but not more than 250 percent of the authorized bandwidth: At least 35 dB.
- (3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least $43 + 10 \log (P)$ dB.

FCC §90.219(e)

- (3) Spurious emissions from a signal booster must not exceed -13 dBm within any 100 kHz measurement bandwidth.

8.7.2 Test summary

Verdict	Pass		
Tested by	P. Barbieri	Test date	July 4, 2022

8.7.3 Observations, settings and special notes

The spectrum was searched from 30 MHz to the 10th harmonic.

Testing was performed with RF ports terminated with 50 Ohm load.

In the graphics below, no radiated spurious emission found and the limit is exceeded only by the carrier.

Spectrum analyser settings:

Resolution bandwidth:	100 kHz and 1 MHz
Video bandwidth:	VBW $\geq 3 \times$ RBW
Detector mode:	Peak
Trace mode:	Max Hold

Input signal frequency

Down link	451.25 MHz
Up link	456.25 MHz

8.7.4 Test equipment used

Equipment	Manufacturer	Model no.	Asset no.
EMI Receiver	Rohde & Schwarz	ESW44	101620
RF Vector Signal Generator	Rohde & Schwarz	SMBV100A	263254
Antenna Trilog 25MHz - 8GHz	Schwarzbeck Mess-Elektronik	VULB9162	9162-025
Antenna 1 - 18 GHz	Schwarzbeck Mess-Elektronik	STLP9148	STLP 9148-152
Broadband Amplifier	Schwarzbeck Mess-Elektronik	BBV9718C	00121
Controller	Maturo	FCU3.0	10041
Tilt antenna mast	Maturo	TAM4.0-E	10042
Turntable	Maturo	TT4.0-5T	2.527
Semi-anechoic chamber	Nemko S.p.a.	10m semi-anechoic chamber	530

Notes: NCR - no calibration required, VOU - verify on use

8.7.5 Test data

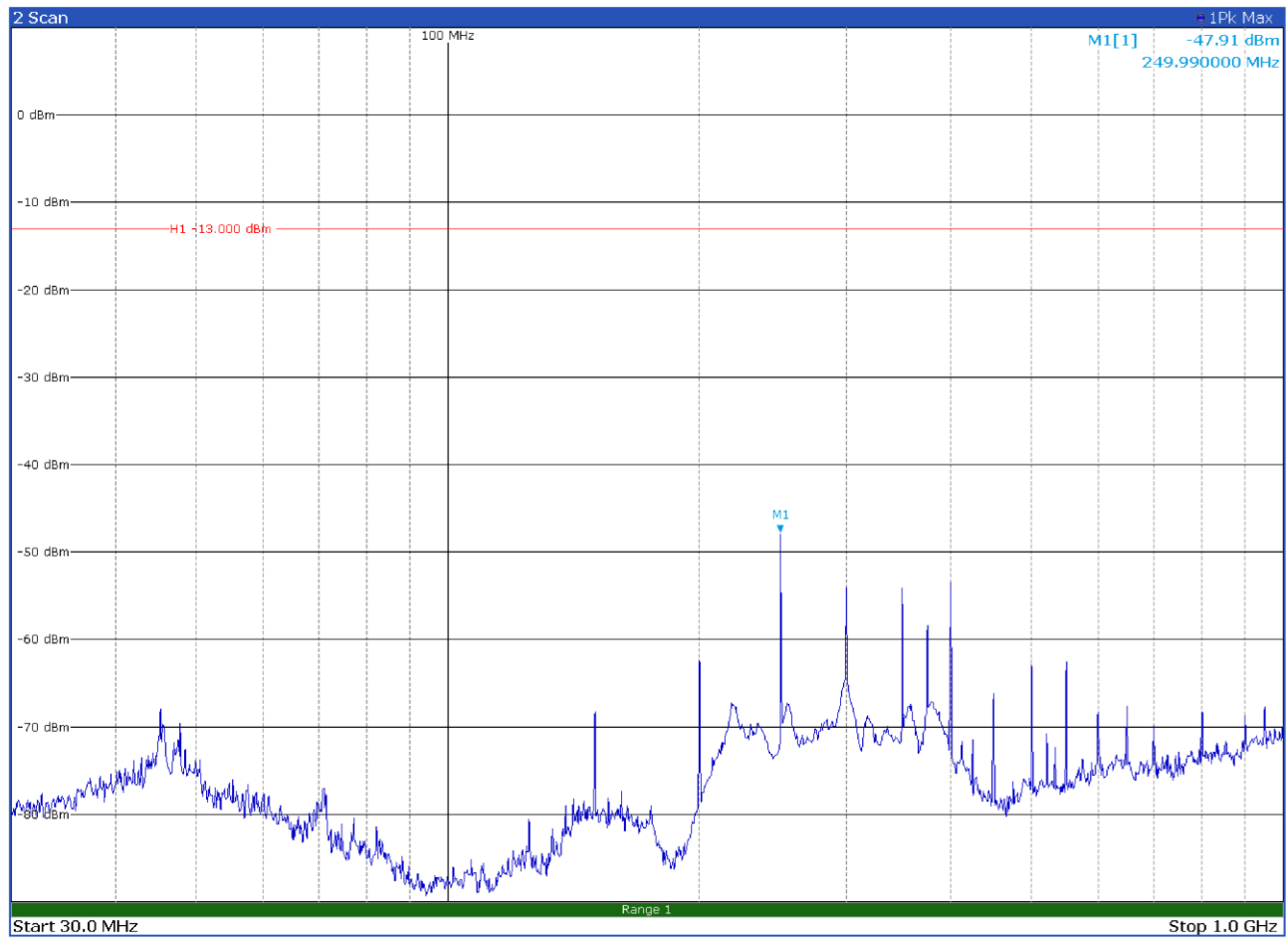


Figure 8.7-1: Radiated spurious emissions below 1 GHz with antenna in horizontal polarization – down link

Test data, continued

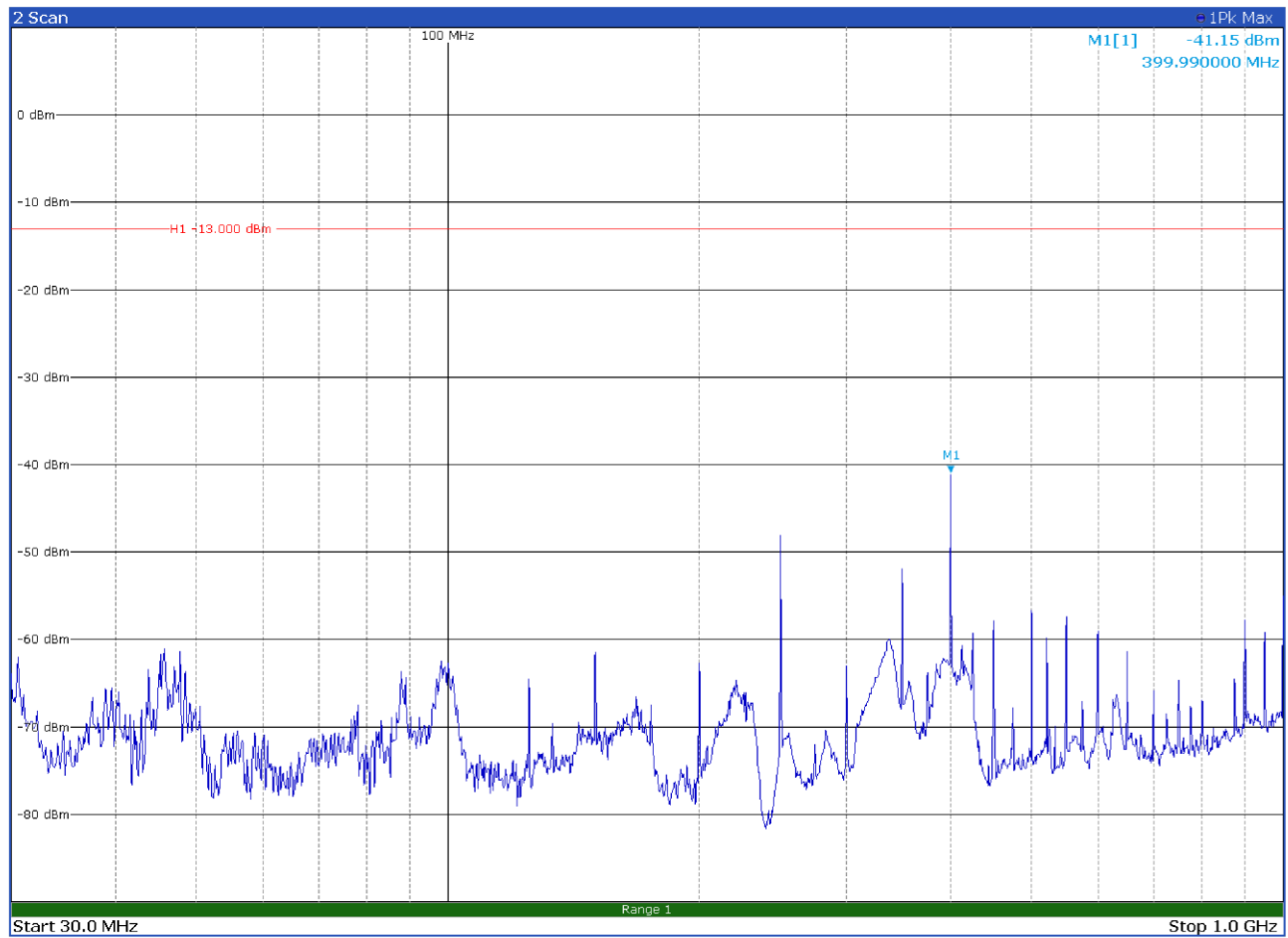


Figure 8.7-2: Radiated spurious emissions below 1 GHz with antenna in vertical polarization – down link

Test data, continued

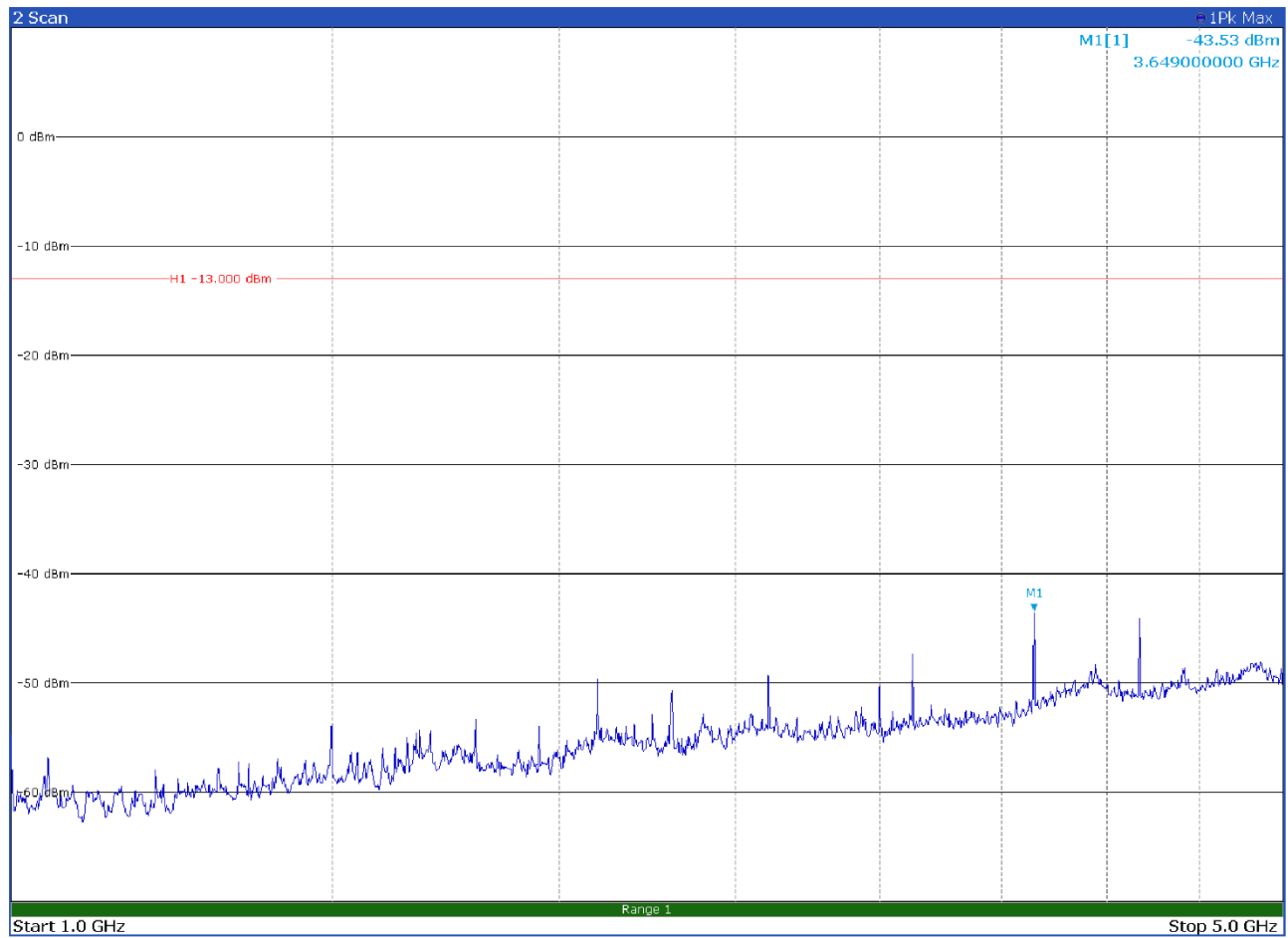


Figure 8.7-3: Radiated spurious emissions above 1 GHz with antenna in horizontal polarization – down link

Test data, continued

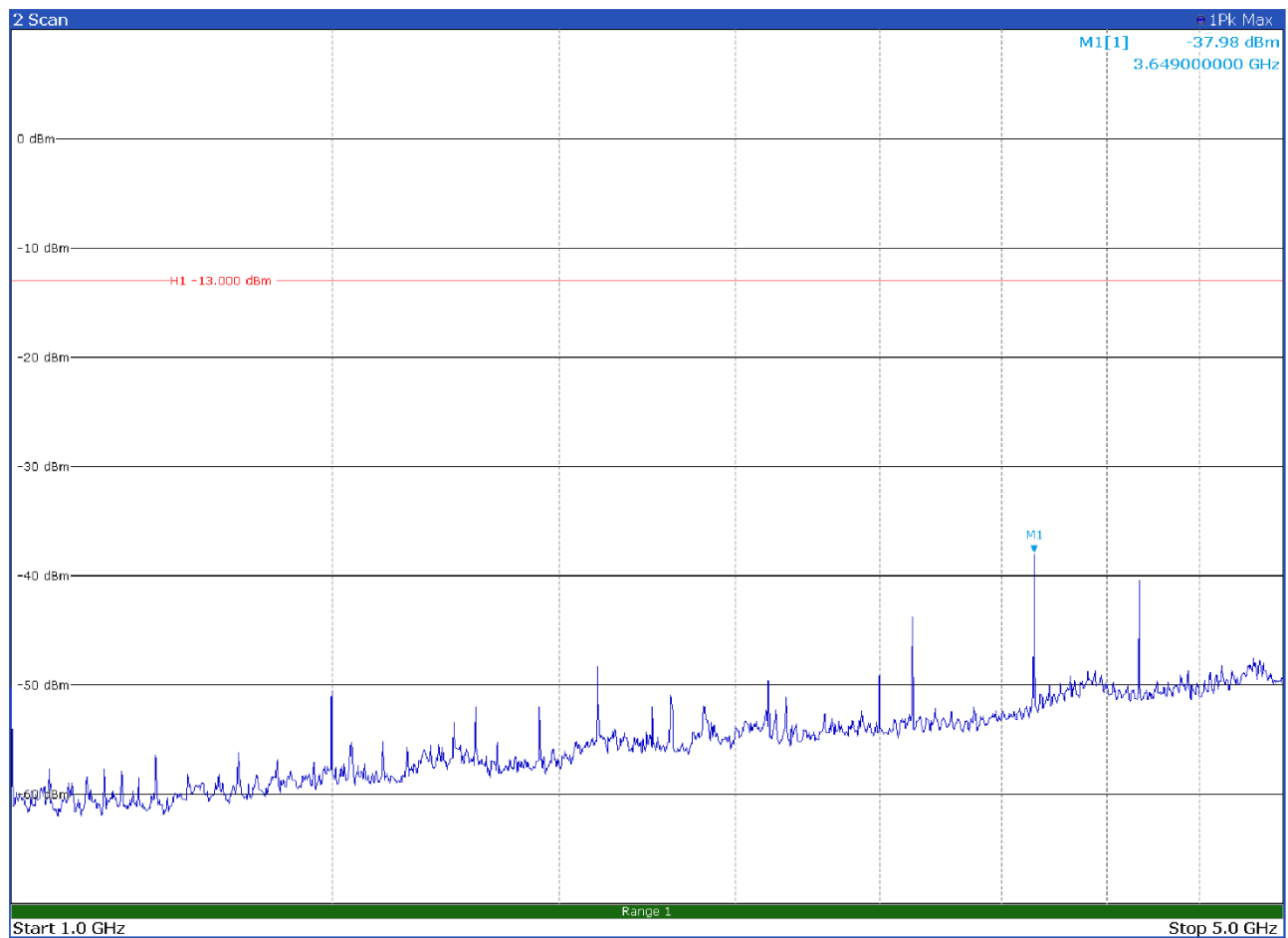


Figure 8.7-4: Radiated spurious emissions above 1 GHz with antenna in vertical polarization – down link

Test data, continued

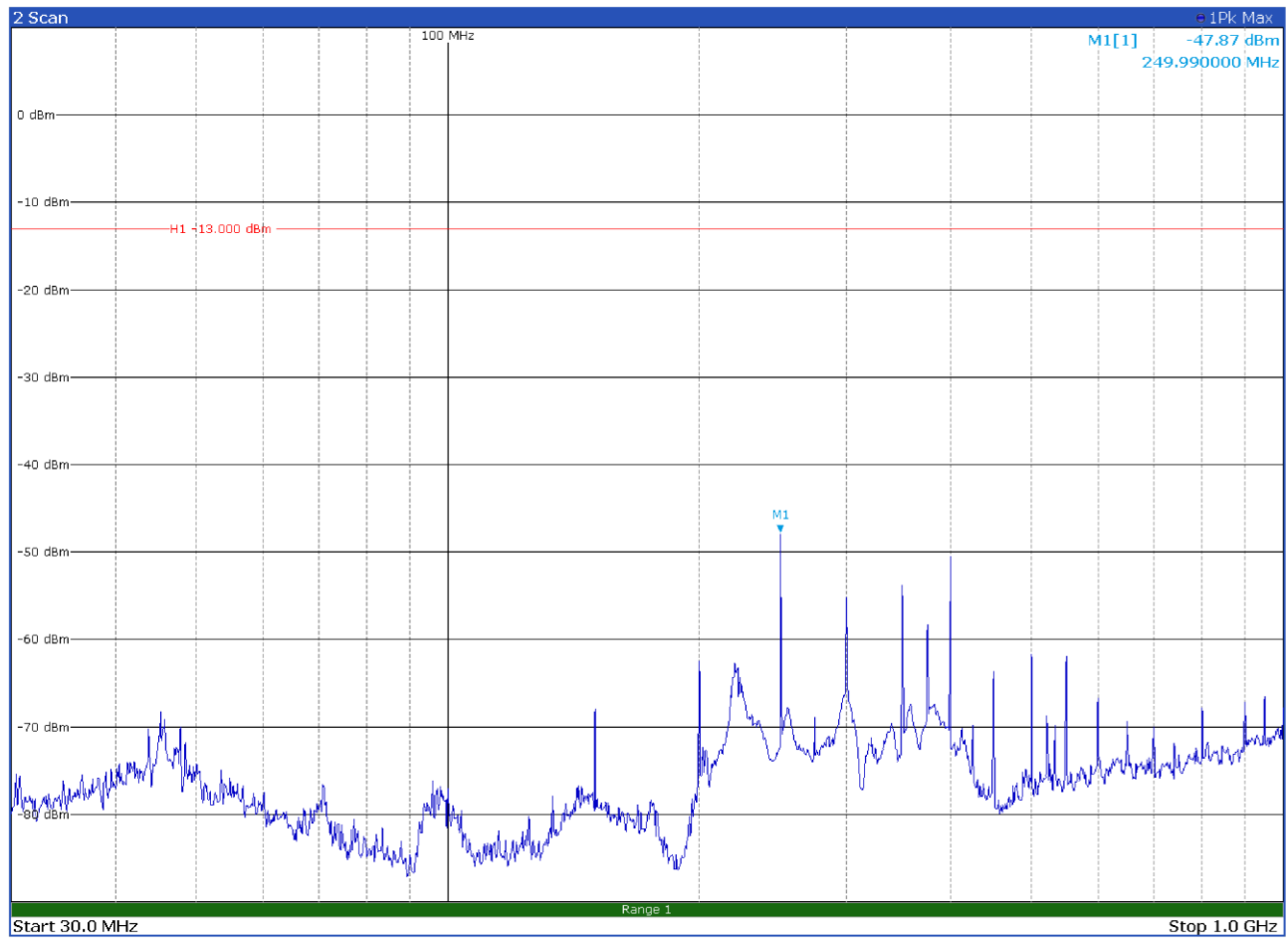


Figure 8.7-5: Radiated spurious emissions below 1 GHz with antenna in horizontal polarization – up link

Test data, continued

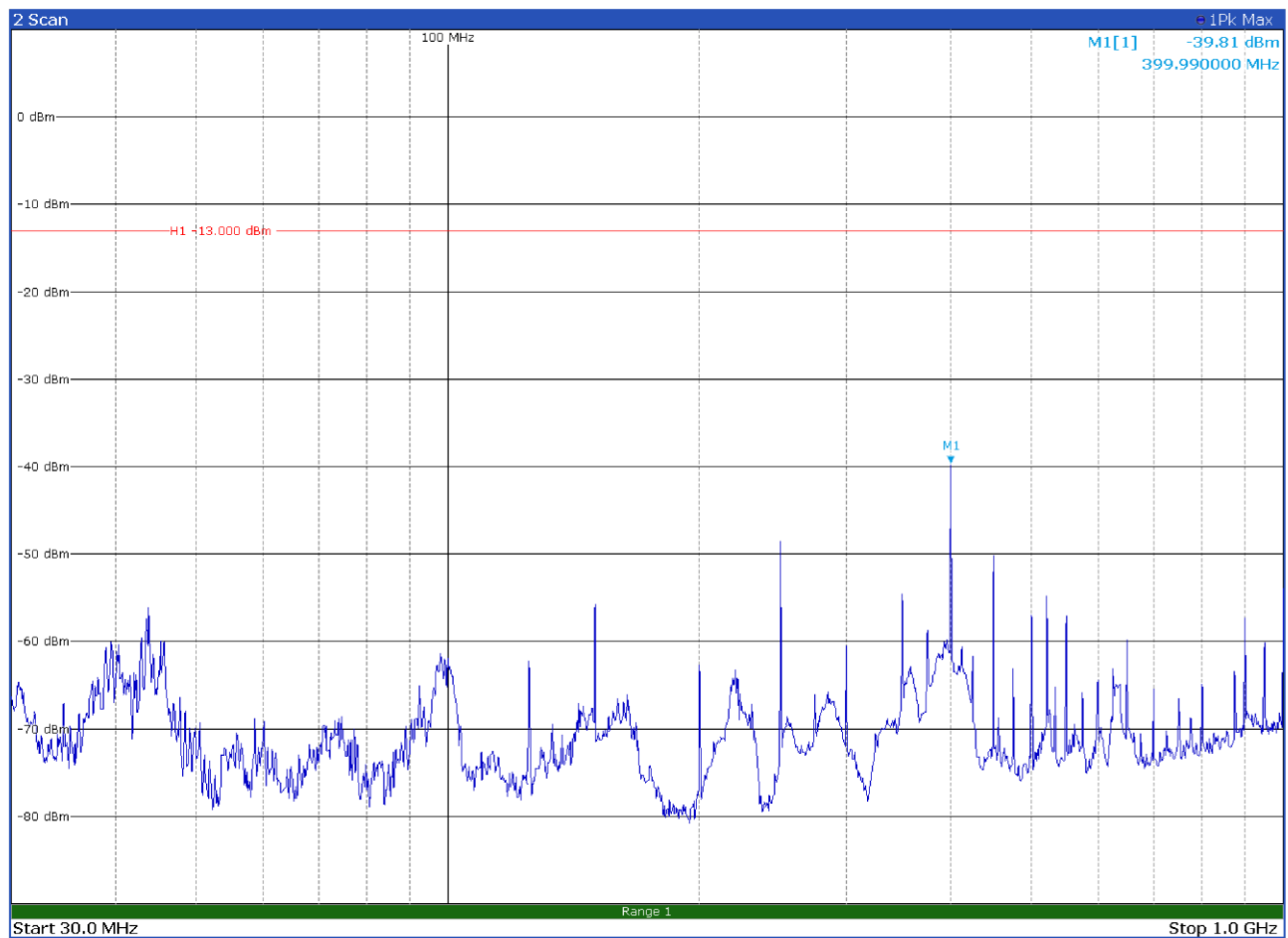


Figure 8.7-6: Radiated spurious emissions below 1 GHz with antenna in vertical polarization – up link

Test data, continued

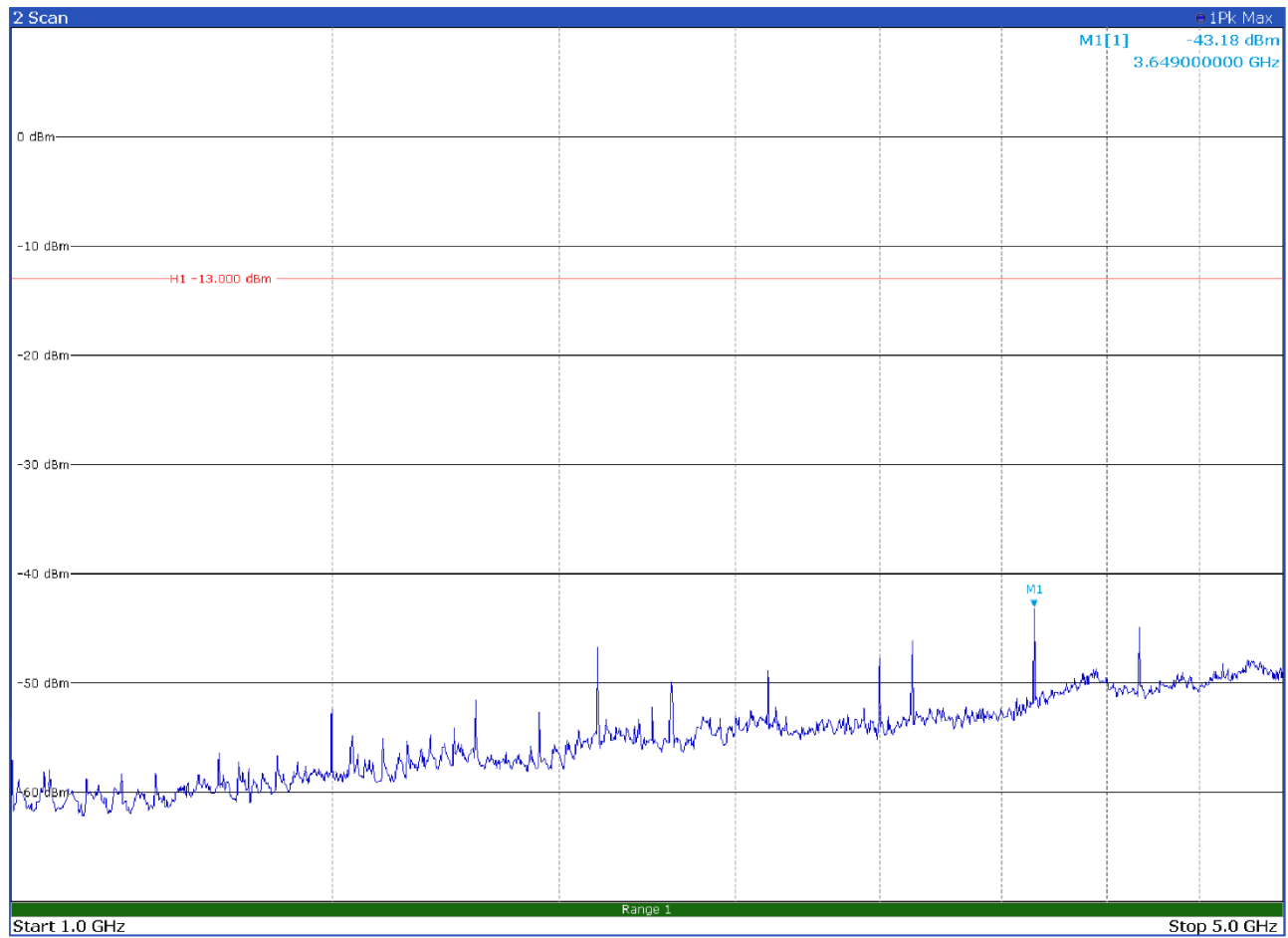


Figure 8.7-7: Radiated spurious emissions above 1 GHz with antenna in horizontal polarization – up link

Test data, continued

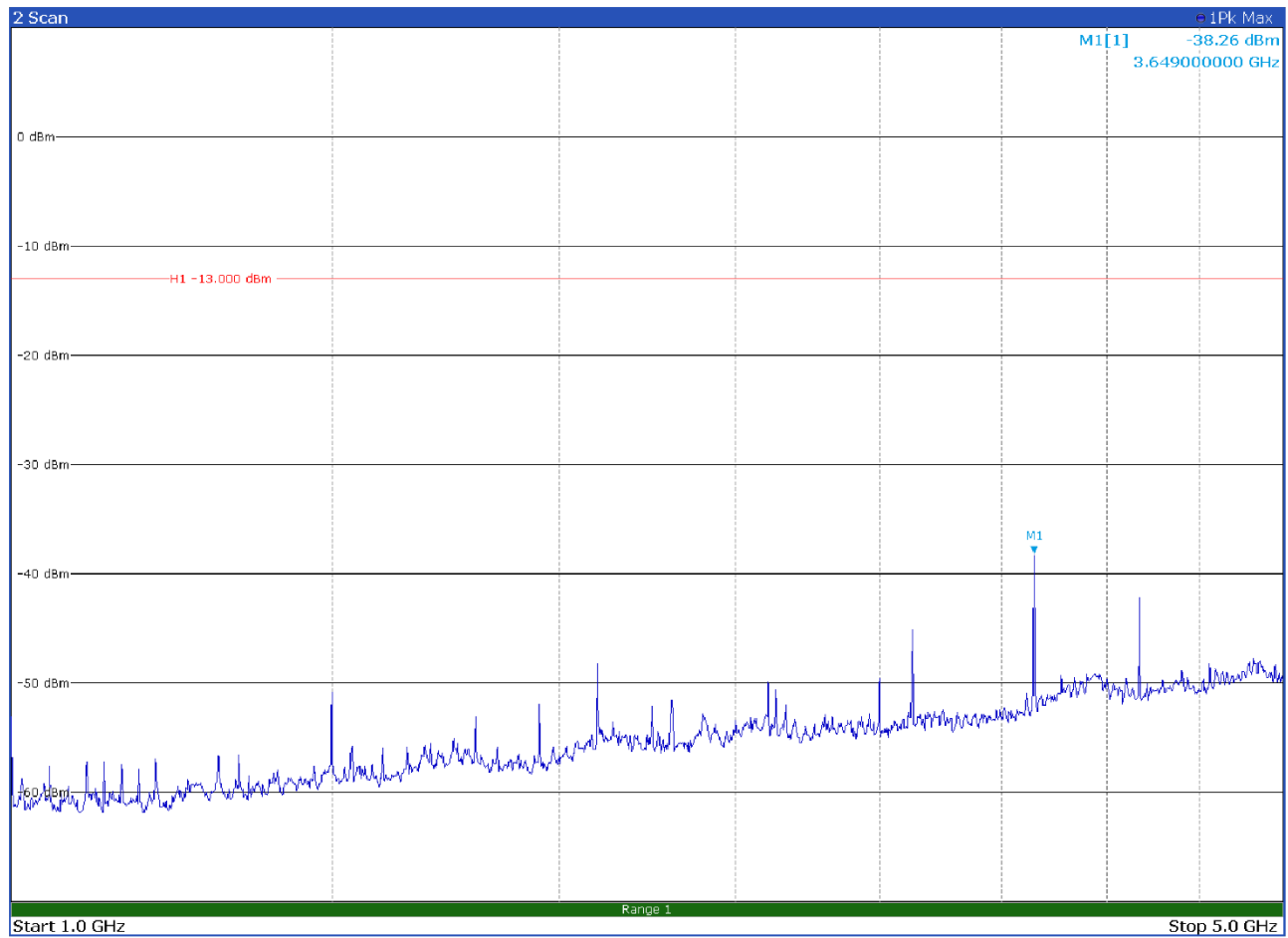


Figure 8.7-8: Radiated spurious emissions above 1 GHz with antenna in vertical polarization – up link

8.8 Frequency stability measurements

8.8.1 References, definitions and limits

FCC § 90.213(a)

- (a) Unless noted elsewhere, transmitters used in the services governed by this part must have a minimum frequency stability as specified in the following table.

Frequency range (MHz)	Fixed and base stations	Mobile stations	
		Over 2 watts output power	2 watts or less output power
421-512	^{7 11 14} 2.5	^{8 5}	^{8 5}

⁷ In the 421-512 MHz band, fixed and base stations with a 12.5 kHz channel bandwidth must have a frequency stability of 1.5 ppm. Fixed and base stations with a 6.25 kHz channel bandwidth must have a frequency stability of 0.5 ppm.

⁸ In the 421-512 MHz band, mobile stations designed to operate with a 12.5 kHz channel bandwidth must have a frequency stability of 2.5 ppm. Mobile stations designed to operate with a 6.25 kHz channel bandwidth must have a frequency stability of 1.0 ppm.

¹¹ Paging transmitters operating on paging-only frequencies must operate with frequency stability of 5 ppm in the 150-174 MHz band and 2.5 ppm in the 421-512 MHz band.

¹⁴ Control stations may operate with the frequency tolerance specified for associated mobile frequencies.

8.8.2 Test summary

Verdict	Pass		
Tested by	P. Barbieri	Test date	July 11, 2022

8.8.3 Observations, settings and special notes

Test performed with a CW input signal.

Input signal frequency

Down link	451.25 MHz
Up link	456.25 MHz

8.8.4 Test equipment used

Equipment	Manufacturer	Model no.	Asset no.
EMI Receiver	Rohde & Schwarz	ESU8	100202
RF Vector Signal Generator	Rohde & Schwarz	SMBV100A	263254
Climatic chamber	Espec	ARS-1100	4100000067

Notes: NCR - no calibration required, VOU - verify on use

8.8.5 Test data

Table 8.8-1: Transmitter frequency stability results for down link

Test conditions	Frequency, Hz	Drift, Hz	Drift, ppm	Limit ±ppm	Margin, ±ppm
+50 °C, Nominal	451249897	0	0	2.5	2.5
+40 °C, Nominal	451249897	0	0	2.5	2.5
+30 °C, Nominal	451249897	0	0	2.5	2.5
+20 °C, -15% voltage	451249897	0	0	2.5	2.5
+20 °C, Nominal	451249897	Reference	Reference	Reference	Reference
+20 °C, +15% voltage	451249897	0	0	2.5	2.5
+10 °C, Nominal	451249897	0	0	2.5	2.5
0 °C, Nominal	451249897	0	0	2.5	2.5
-10 °C, Nominal	451249897	0	0	2.5	2.5
-20 °C, Nominal	451249897	0	0	2.5	2.5
-30 °C, Nominal	451249897	0	0	2.5	2.5

Table 8.8-2: Transmitter frequency stability results for up link

Test conditions	Frequency, Hz	Drift, Hz	Drift, ppm	Limit ±ppm	Margin, ±ppm
+50 °C, Nominal	456249901	0	0	2.5	2.5
+40 °C, Nominal	456249901	0	0	2.5	2.5
+30 °C, Nominal	456249901	0	0	2.5	2.5
+20 °C, -15% voltage	456249901	0	0	2.5	2.5
+20 °C, Nominal	456249901	Reference	Reference	Reference	Reference
+20 °C, +15% voltage	456249901	0	0	2.5	2.5
+10 °C, Nominal	456249901	0	0	2.5	2.5
0 °C, Nominal	456249901	0	0	2.5	2.5
-10 °C, Nominal	456249901	0	0	2.5	2.5
-20 °C, Nominal	456249901	0	0	2.5	2.5
-30 °C, Nominal	456249901	0	0	2.5	2.5

8.9 Noise figure measurements

8.9.1 References, definitions and limits

FCC § 90.219(e)(2)

(2) The noise figure of a signal booster must not exceed 9 dB in either direction.

8.9.2 Test summary

Verdict	Pass		
Tested by	P. Barbieri	Test date	July 13, 2022

8.9.3 Observations, settings and special notes

A noise figure analyzer and an excess noise ratio (ENR) calibrated noise source have been used to perform this test.

Input signal frequency

Down link	451.25 MHz
Up link	456.25 MHz

8.9.4 Test equipment used

Equipment	Manufacturer	Model no.	Asset no.
Spectrum Analyzer	Rohde & Schwarz	FSW43	101767
Noise generator	Rohde & Schwarz	FS-SNS26	112614

Notes: NCR - no calibration required, VOU - verify on use

8.9.5 Test data

Table 8.9-1: Noise figure results

Antenna port	Frequency, MHz	Noise figure, dB	Limit, dB	Margin, dB
Down link	451.25	3.7	9.0	-5.3
Up link	456.25	3.8	9.0	-5.2

Test data, continued



Figure 8.9-1: Noise figure for down link

Test data, continued

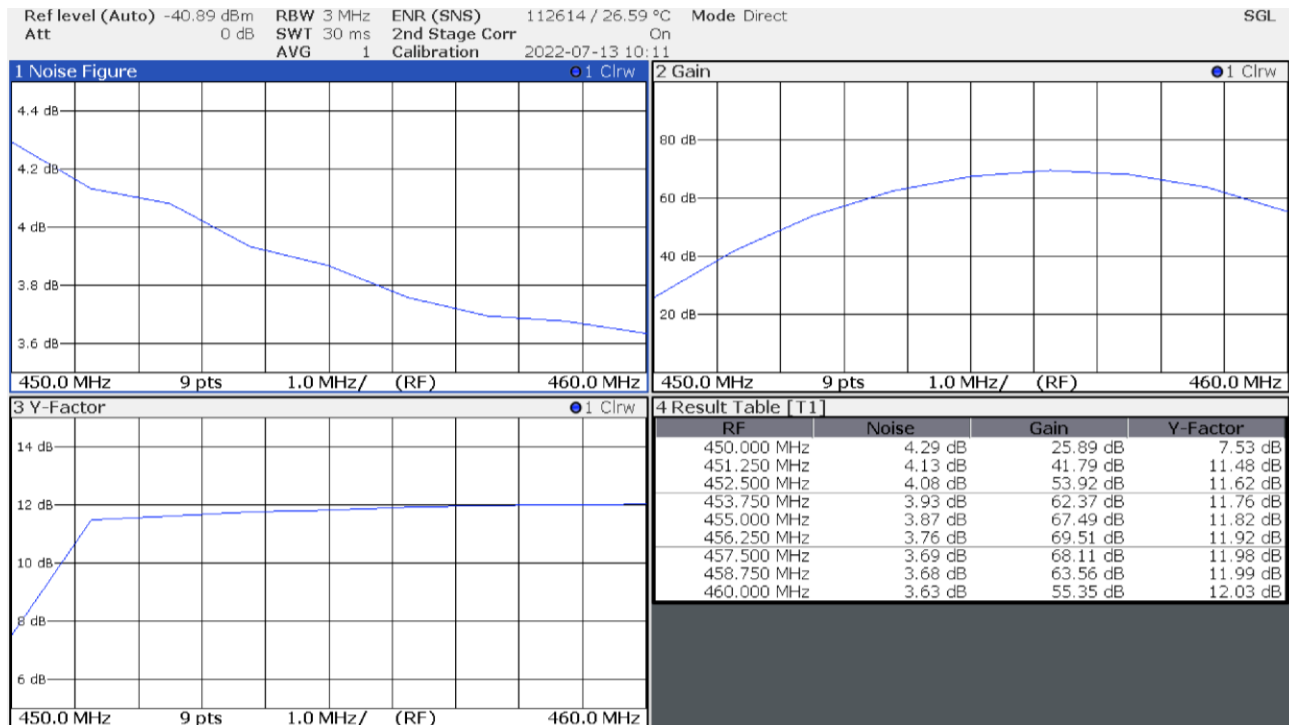


Figure 8.9-2: Noise figure for up link

Section 9 EUT photos

9.1 Set-up photos

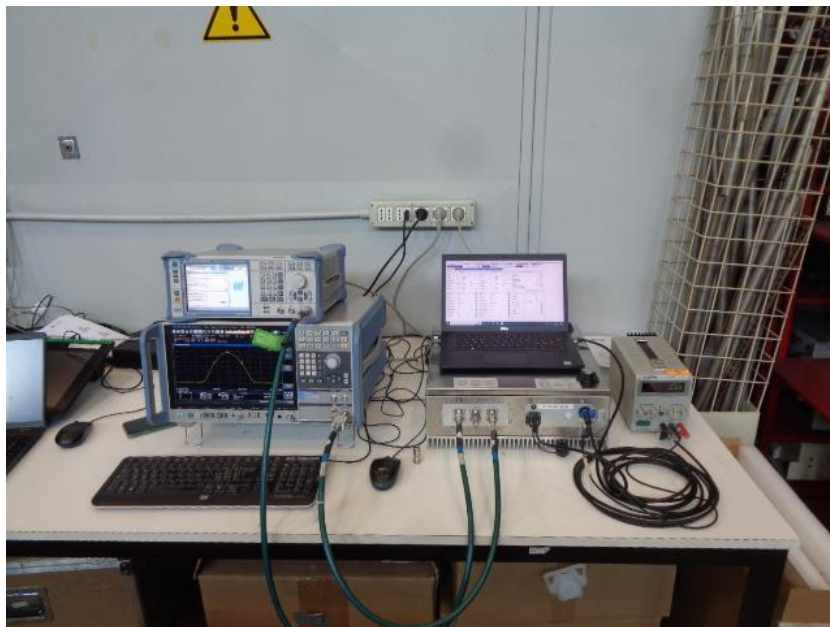


Figure 9.1-1: Antenna port testing set-up



Figure 9.1-2: Antenna port testing set-up in climatic chamber

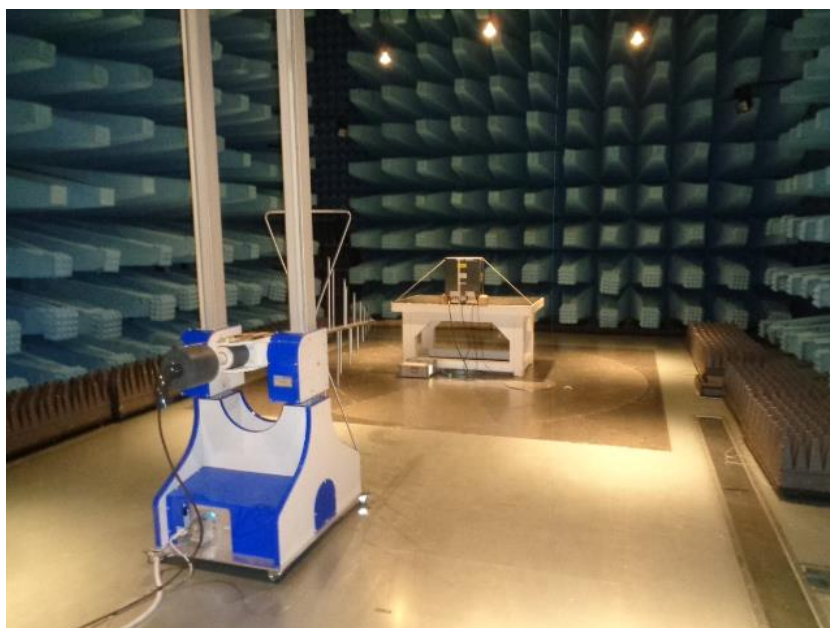


Figure 9.1-3: Radiated emissions set-up for frequencies below 1 GHz

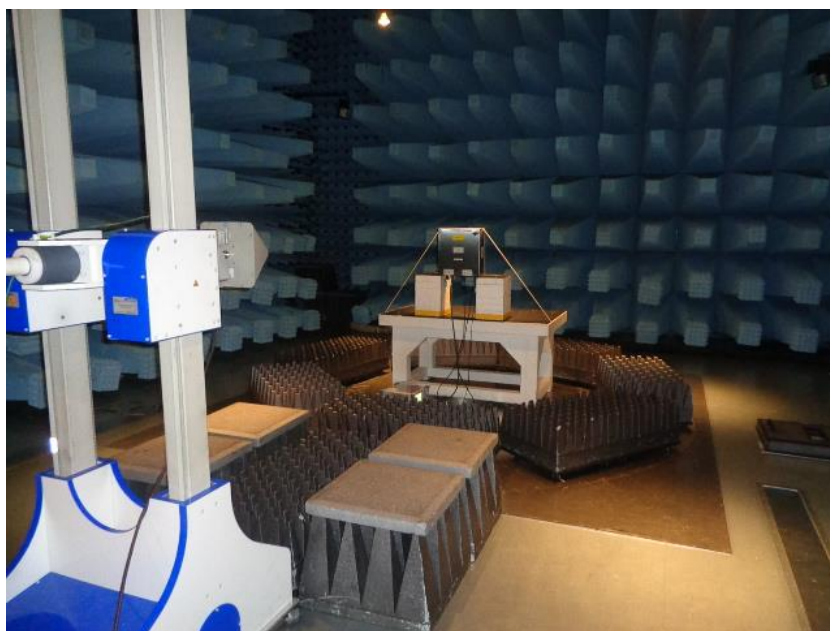


Figure 9.1-4: Radiated emissions set-up for frequencies above 1 GHz

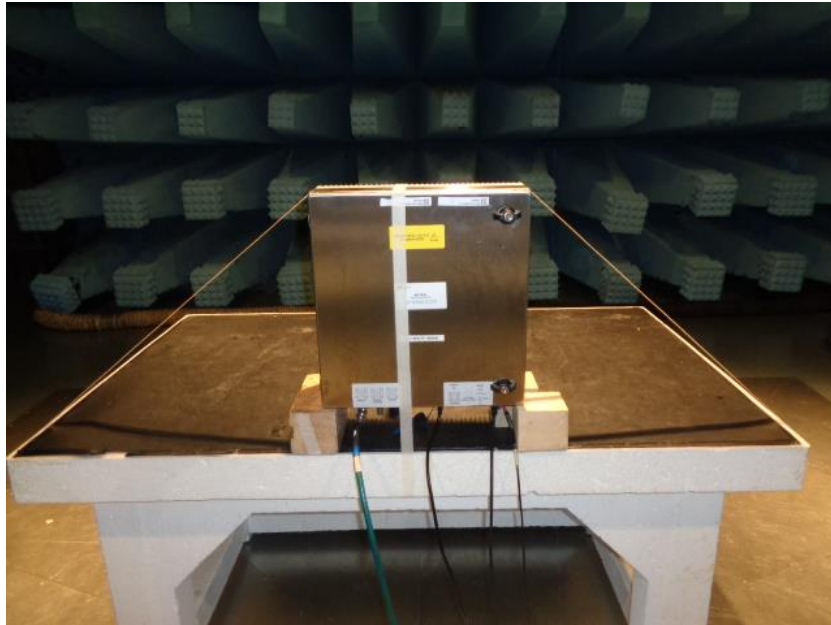


Figure 9.1-5: Radiated emissions EUT set-up

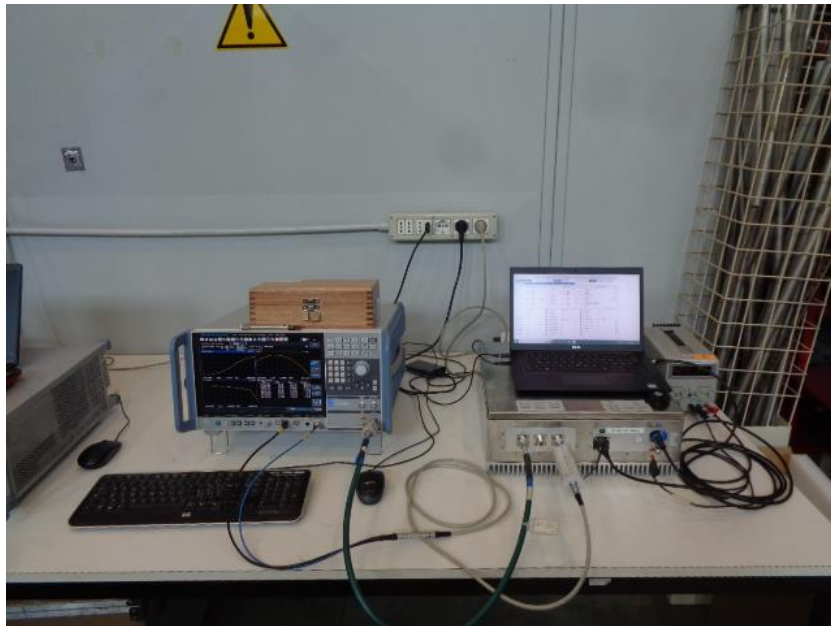


Figure 9.1-6: Noise figure testing set-up

9.2 External photos



Figure 9.2-1: EUT photo – external view



Figure 9.2-2: EUT photo – external view



Figure 9.2-3: EUT photo – connector side



Figure 9.2-4: EUT photo – internal view

End of the test report