## Clause 90.210 and 22.359 Field strength of spurious radiation

**§90.210 Emission masks.**

Except as indicated elsewhere in this part, transmitters used in the radio services governed by this part must comply with the emission masks outlined in this section. Unless otherwise stated, per paragraphs (d)(4), (e)(4), and (o) of this section, measurements of emission power can be expressed in either peak or average values provided that emission powers are expressed with the same parameters used to specify the unmodulated transmitter carrier power. For transmitters that do not produce a full power unmodulated carrier, reference to the unmodulated transmitter carrier power refers to the total power contained in the channel bandwidth. Unless indicated elsewhere in this part, the table in this section specifies the emission masks for equipment operating under this part.

**APPLICABLE EMISSION MASKS**

| Frequency band (MHz) | Mask for equipment with audio low pass filter | Mask for equipment without audio low pass filter |
|---|---|---|
| Below 25[1] | A or B | A or C |
| 25-50 | B | C |
| 72-76 | B | C |
| 150-174[2] | B, D, or E | C, D or E |
| 150 paging only | B | C |
| 220-222 | F | F |
| 421-512[2 5] | B, D, or E | C, D, or E |
| 450 paging only | B | G |
| 806-809/851-854[6] | B | H |
| 809-824/854-869[35] | B, D | D, G. |
| 896-901/935-940 | I | J |
| 902-928 | K | K |
| 929-930 | B | G |
| 4940-4990 MHz | L or M | L or M |
| 5850-5925[4] | | |
| All other bands | B | C |

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:

(4) 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.

(5) 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.

(6) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.

Emission Mask D — 12.5 kHz channel bandwidth equipment. 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:

(9) On any frequency from the center of the authorized bandwidth $f_0$ to 5.625 kHz removed from $f_0$: Zero dB.

(10) On any frequency removed from the center of the authorized bandwidth by a displacement frequency ($f_d$ in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least 7.27(fd−2.88 kHz) dB.

(11) 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.

(12) The reference level for showing compliance with the emission mask shall be established using a resolution bandwidth sufficiently wide (usually two or three times the channel bandwidth) to capture the true peak emission of the equipment under test. In order to show compliance with the emission mask up to and including 50 kHz removed from the edge of the authorized bandwidth, adjust the resolution bandwidth to 100 Hz with the measuring instrument in a peak hold mode. A sufficient number of sweeps must be measured to insure that the emission profile is developed. If video filtering is used, its bandwidth must not be less than the instrument resolution bandwidth. For emissions beyond 50 kHz from the edge of the authorized bandwidth, see paragraph (o) of this section. If it can be shown that use of the above instrumentation settings do not accurately represent the true interference potential of the equipment under test, an alternate procedure may be used provided prior Commission approval is obtained.

**§22.359 Emission limitations.**

The rules in this section govern the spectral characteristics of emissions in the Public Mobile Services, except for the Air-Ground Radiotelephone Service (see §22.861, instead) and the Cellular Radiotelephone Service (see §22.917, instead).

(a) Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log (P) dB.

(b) Measurement procedure. Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 30 kHz or more. In the 60 kHz bands immediately outside and adjacent to the authorized frequency range or channel, a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full required measurement bandwidth (i.e., 30 kHz or 1 percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

(c) Alternative out of band emission limit. Licensees in the Public Mobile Services may establish an alternative out of band emission limit to be used at specified frequencies (band edges) in specified geographical areas, in lieu of that set forth in this section, pursuant to a private contractual arrangement of all affected licensees and applicants. In this event, each party to such contract shall maintain a copy of the contract in their station files and disclose it to prospective assignees or transferees and, upon request, to the FCC.

(d) Interference caused by out of band emissions. If any emission from a transmitter operating in any of the Public Mobile Services results in interference to users of another radio service, the FCC may require a greater attenuation of that emission than specified in this section.

**§2.1053 Measurements required: Field strength of spurious radiation.**

(a) Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of §2.1049, as appropriate. For equipment operating on frequencies below 890 MHz, an open field test is normally required, with the measuring instrument antenna located in the far-field at all test frequencies. In the event it is either impractical or impossible to make open field measurements (e.g. a broadcast transmitter installed in a building) measurements will be accepted of the equipment as installed. Such measurements must be accompanied by a description of the site where the measurements were made showing the location of any possible source of reflections which might distort the field strength measurements. Information submitted shall include the relative radiated power of each spurious emission with reference to the rated power output of the transmitter, assuming all emissions are radiated from halfwave dipole antennas.
(b) The measurements specified in paragraph (a) of this section shall be made for the following equipment:

(1) Those in which the spurious emissions are required to be 60 dB or more below the mean power of the transmitter.
(2) All equipment operating on frequencies higher than 25 MHz.
(3) All equipment where the antenna is an integral part of, and attached directly to the transmitter.

Other types of equipment as required, when deemed necessary by the Commission.

Test date: 2023-05-25 / 2023-05-26

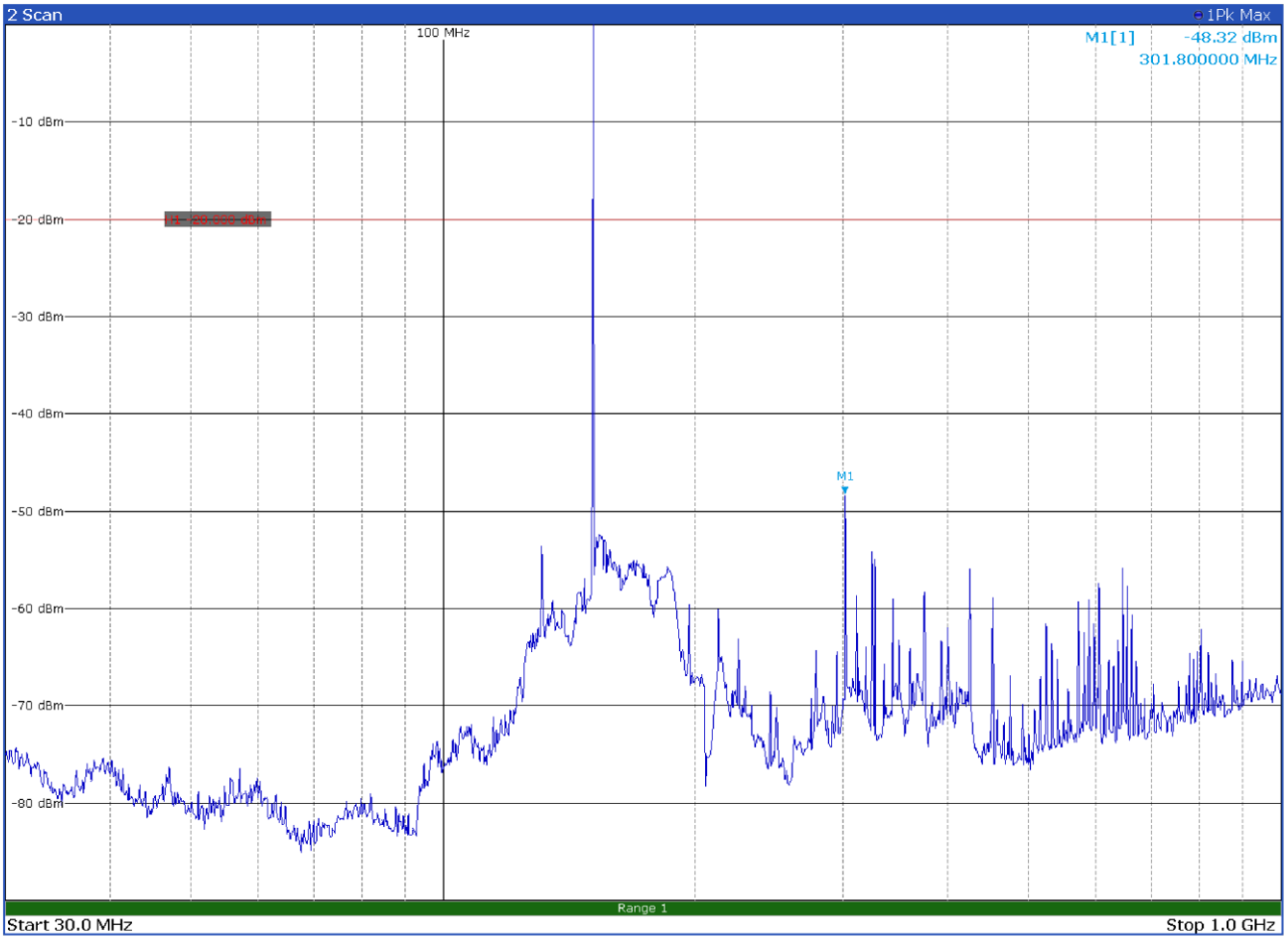
Test results: Pass

Modulation used: 16K0F3E, 11K0F3E, 7K60FXE, 8K0F1E

Test equipment used

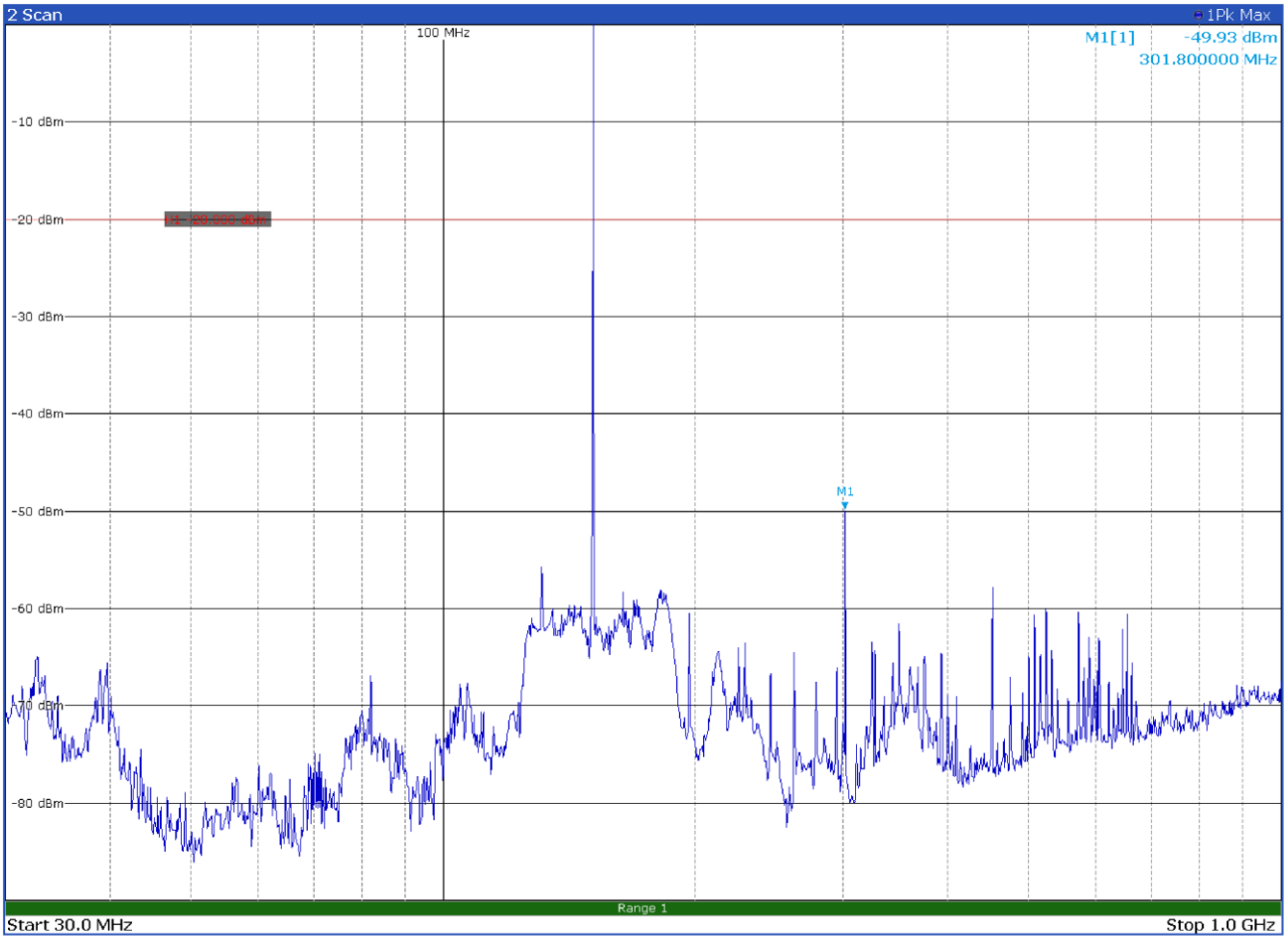
| Description | Manufacturer | Model | Identifier |
|---|---|---|---|
| EMI Receiver | Rohde & Schwarz | ESW44 | 101620 |
| EMI Receiver | Rohde & Schwarz | ESU8 | 100202 |
| Antenna Trilog 25 MHz – 8 GHz | Schwarzbeck Mess-Elektronik | VULB9162 | 9162-025 |
| Antenna 1 - 18 GHz | Schwarzbeck Mess-Elektronik | STLP9148 | STLP 9148-152 |
| Broadband Amplifier | Schwarzbeck Mess-Elektronik | BBV9718C | 00121 |
| SAC | Nemko Spa | 10m SAC | 530 |
| SAC | Comtest | 3m SAC | 1711-150 |
| Controller for turntable and antenna mast | Maturo | FCU3.0 | 10041 |
| Tilt antenna mast | Maturo | TAM4.0-E | 10042 |
| Turntable 4.5 t | Maturo | TT4.0-5T | 2.527 |

## Test data



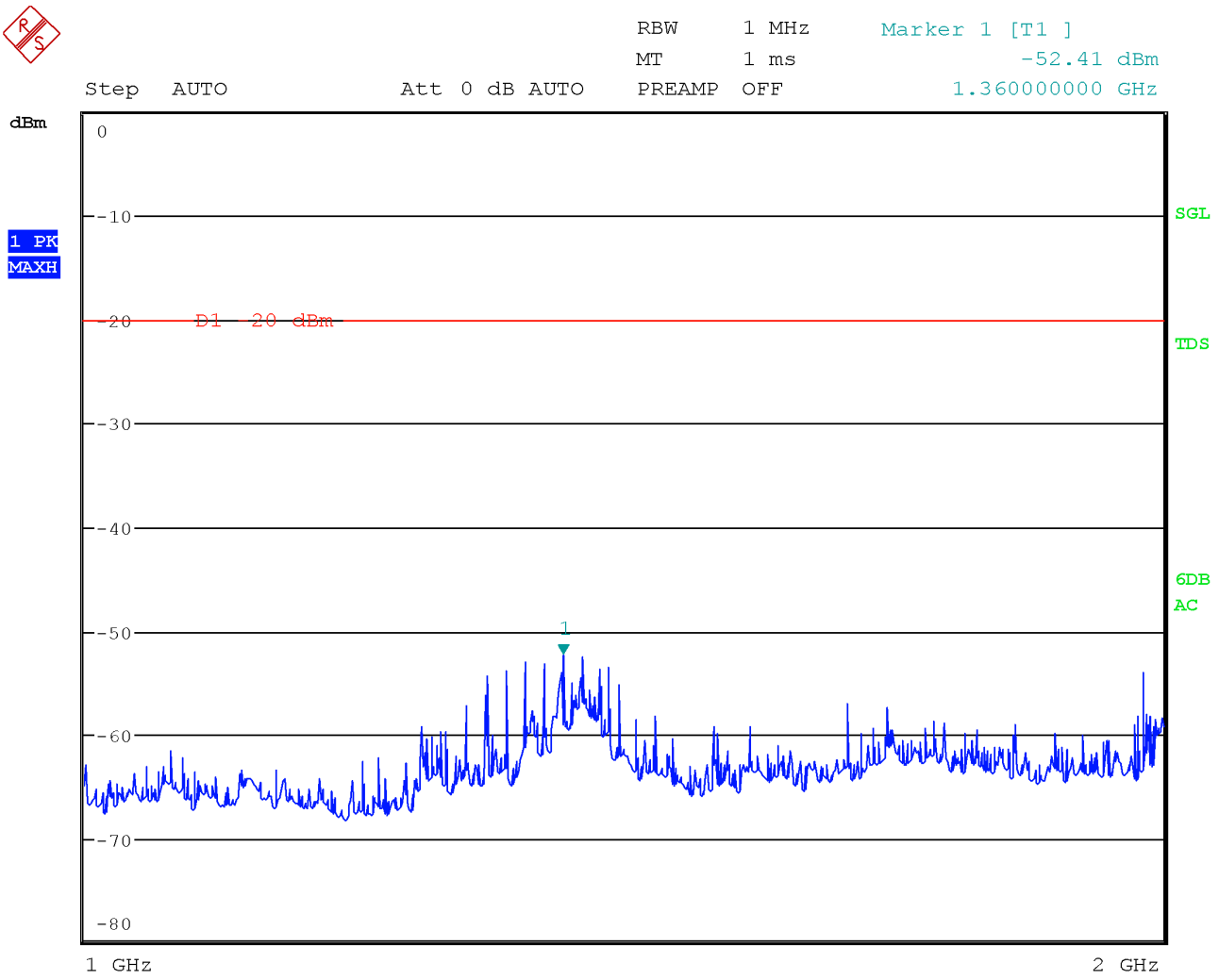

Limit exceeds by the carrier
Channel LOW – FM modulation with 12.5 kHz channel bandwidth
Frequency range 30 MHz to 1000 MHz with antenna in horizontal polarization

## Test data




Channel LOW – FM modulation with 12.5 kHz channel bandwidth
Frequency range 30 MHz to 1000 MHz with antenna in vertical polarization

## Test data




Channel LOW – FM modulation with 12.5 kHz channel bandwidth
Frequency range 1000 MHz to 2000 MHz with antenna in vertical polarization

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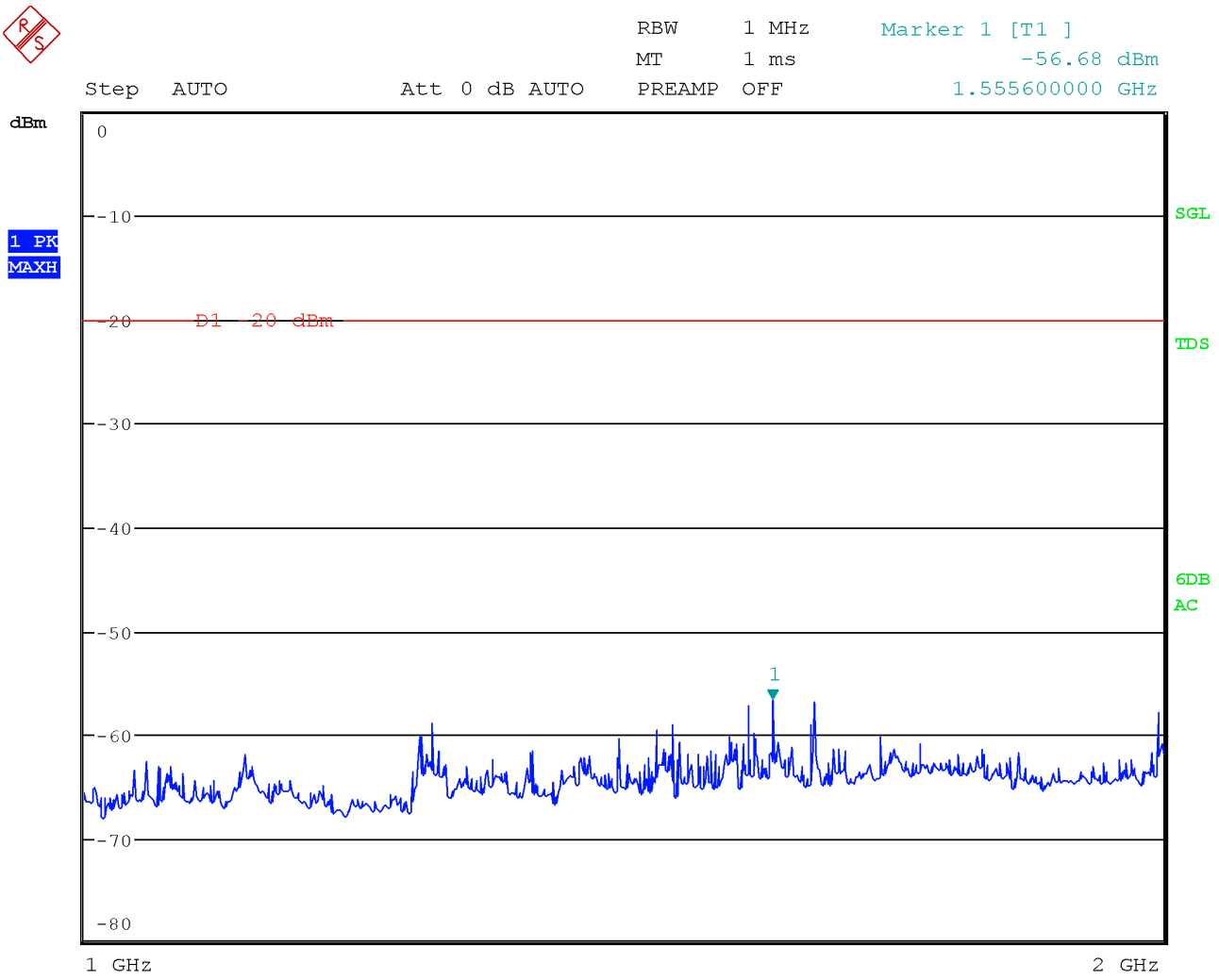
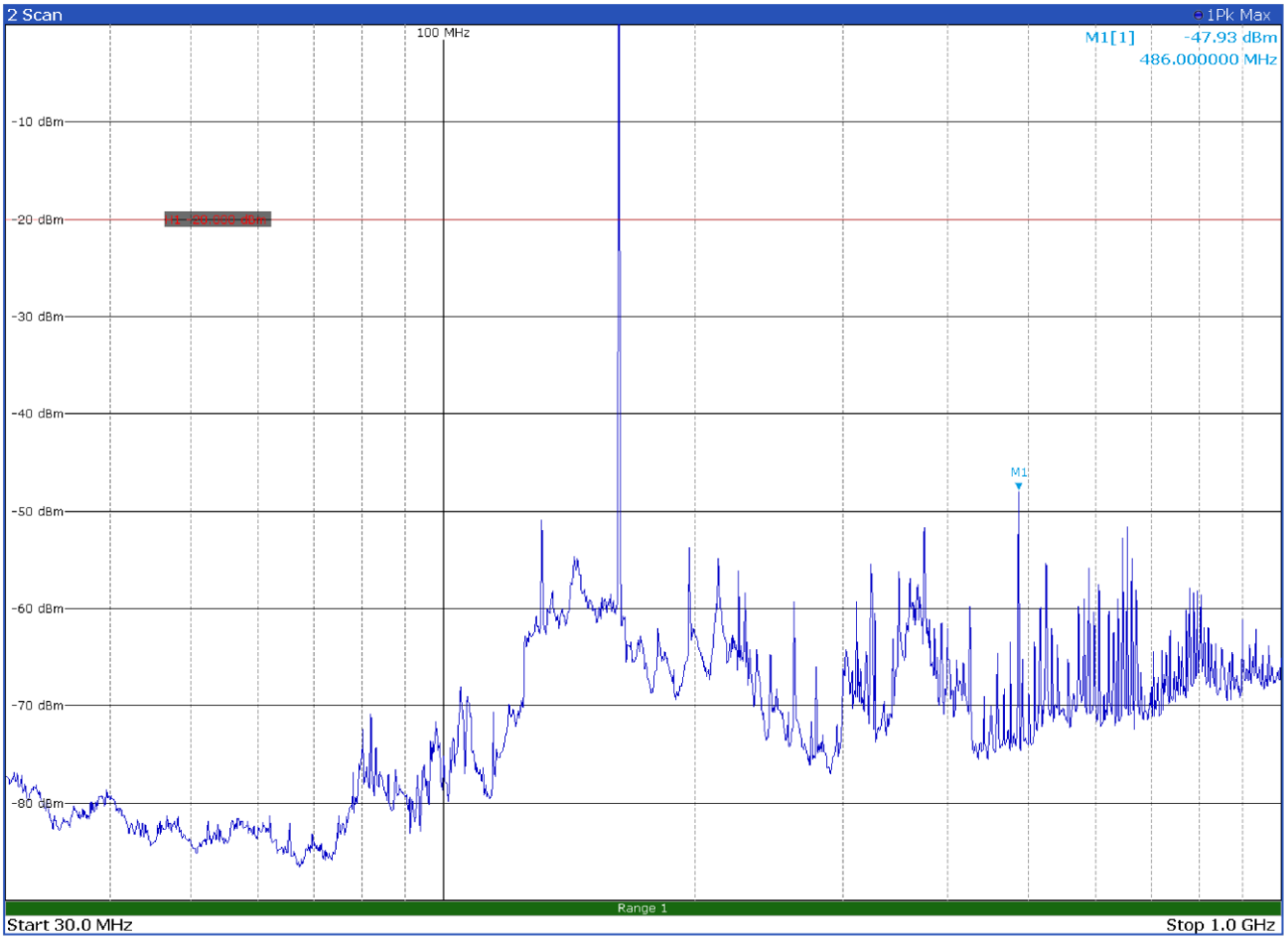


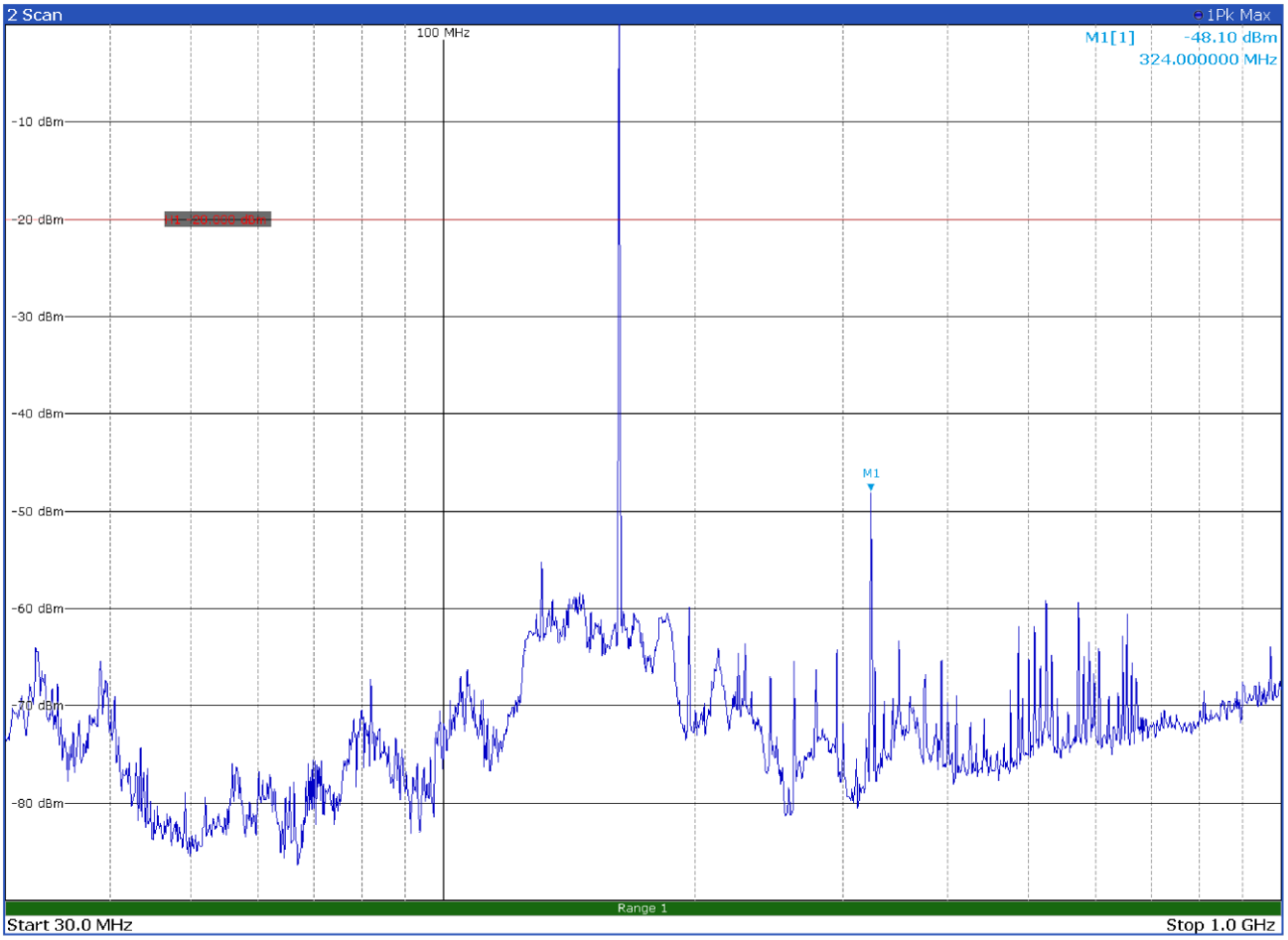

Limit exceeds by the carrier
Channel LOW – FM modulation with 12.5 kHz channel bandwidth
Frequency range 1000 MHz to 2000 MHz with antenna in horizontal polarization

## Test data



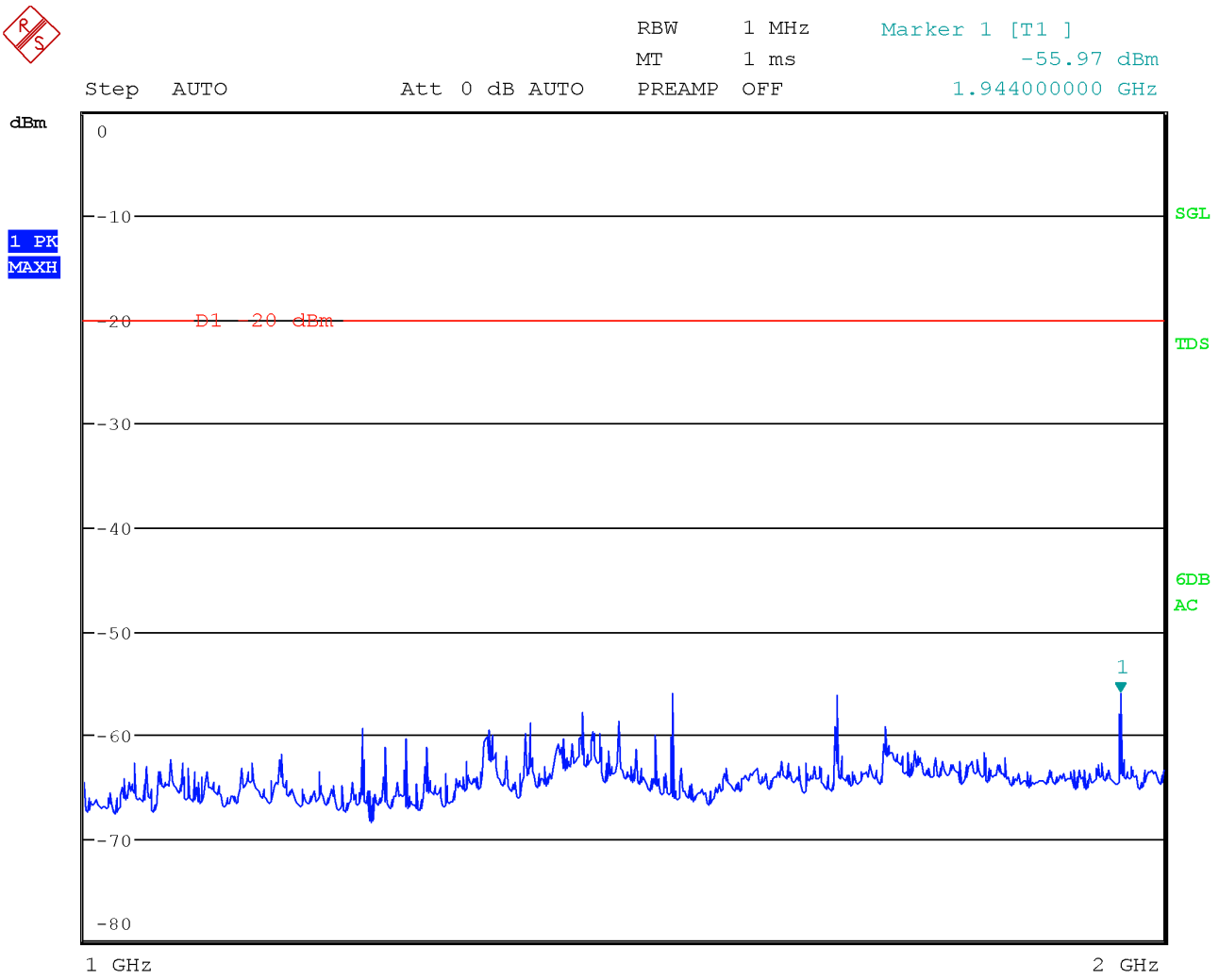

Limit exceeds by the carrier
Channel MID – FM modulation with 12.5 kHz channel bandwidth
Frequency range 30 MHz to 1000 MHz with antenna in horizontal polarization

## Test data



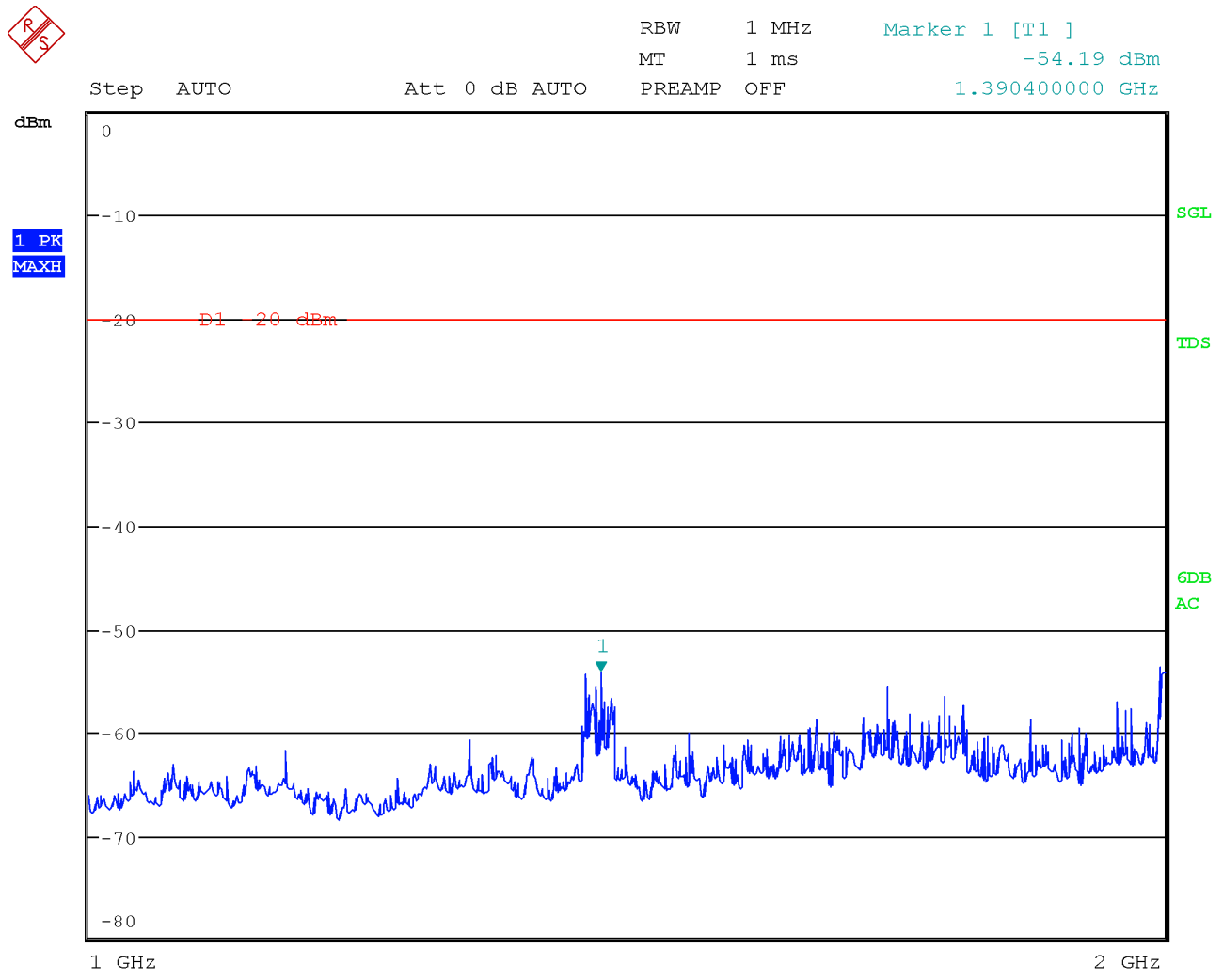

Limit exceeds by the carrier
Channel MID – FM modulation with 12.5 kHz channel bandwidth
Frequency range 30 MHz to 1000 MHz with antenna in vertical polarization

## Test data



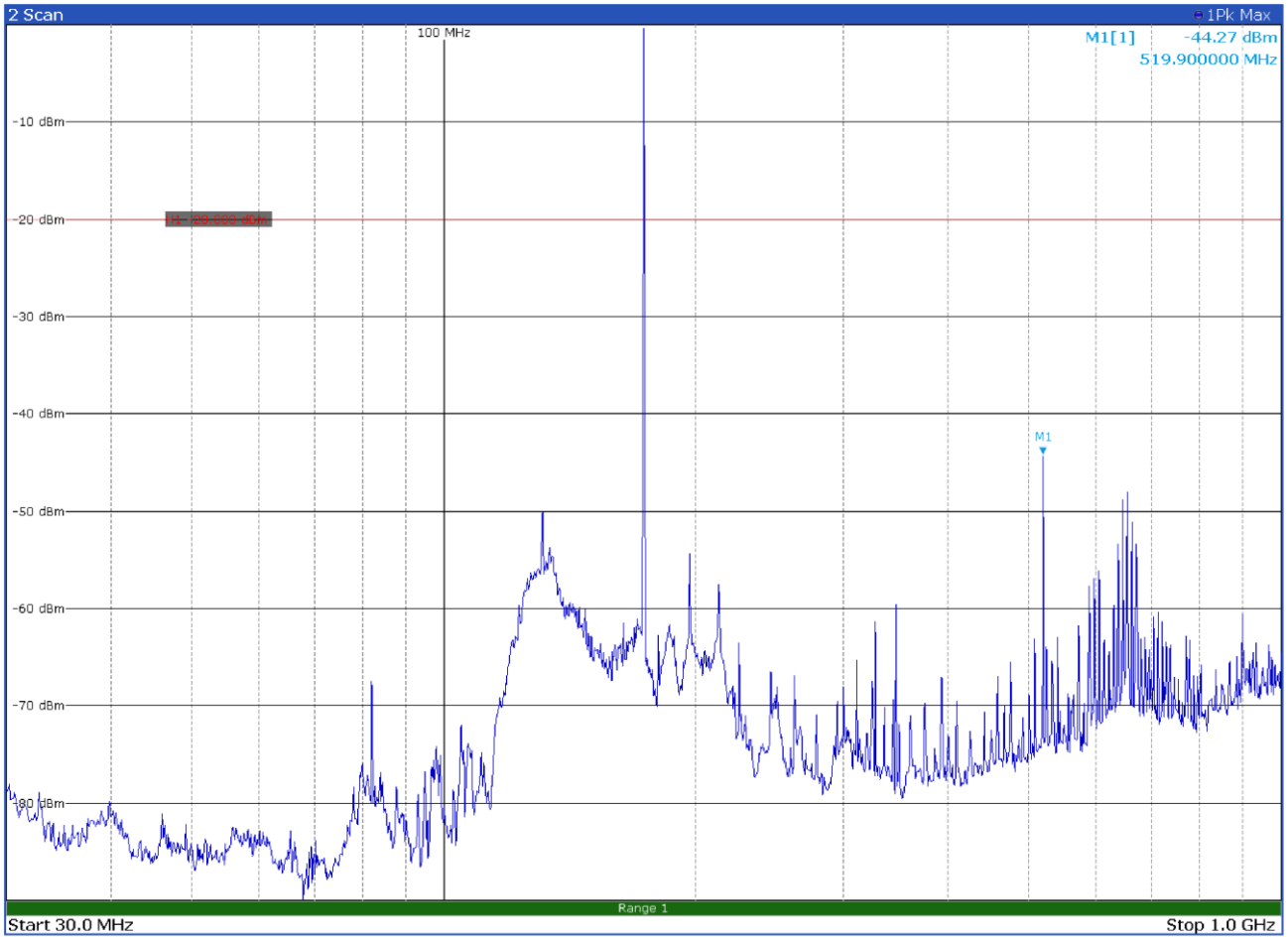

Channel MID – FM modulation with 12.5 kHz channel bandwidth
Frequency range 1000 MHz to 2000 MHz with antenna in vertical polarization

## Test data



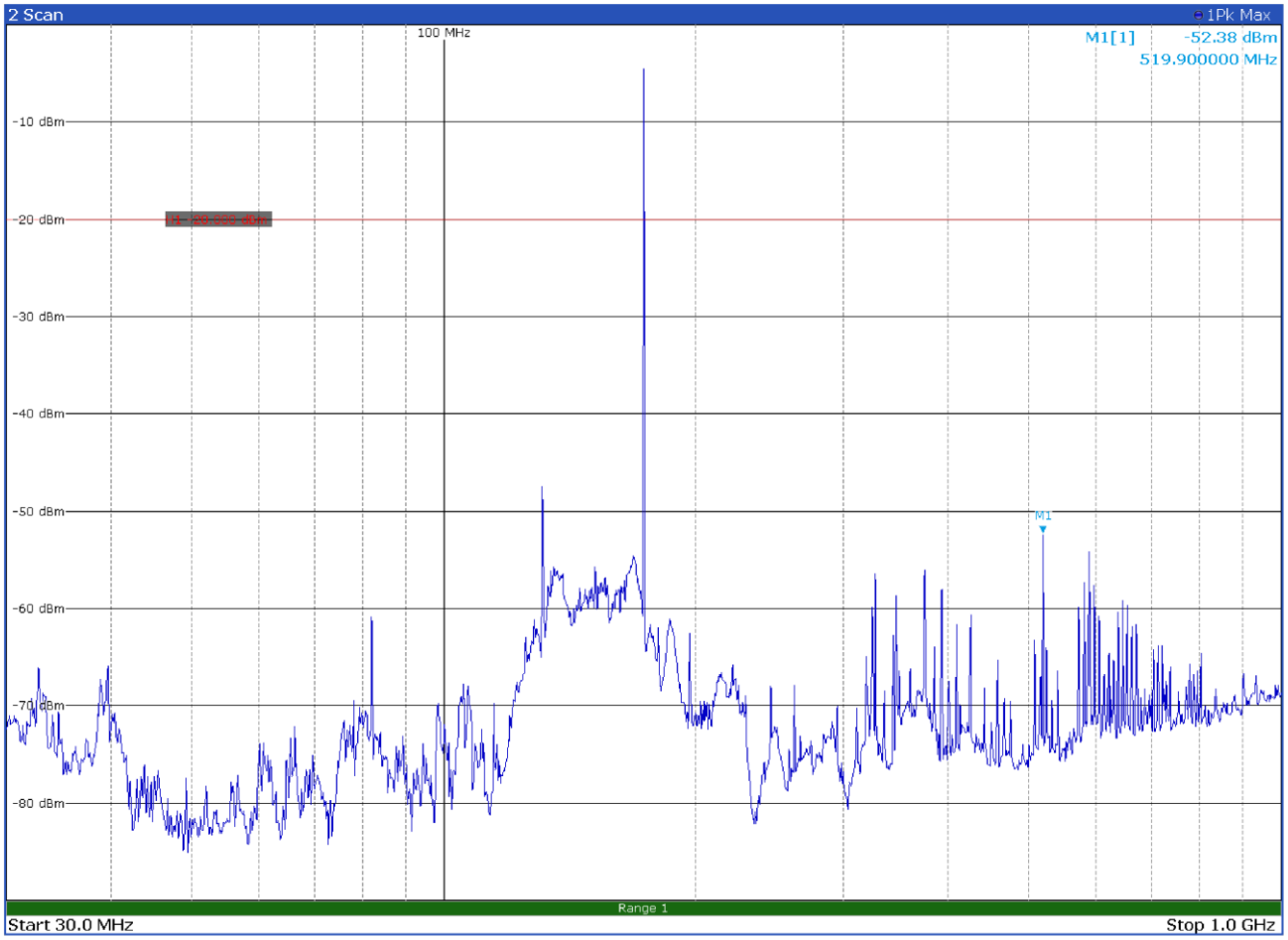

Channel MID – FM modulation with 12.5 kHz channel bandwidth
Frequency range 1000 MHz to 2000 MHz with antenna in horizontal polarization

## Test data



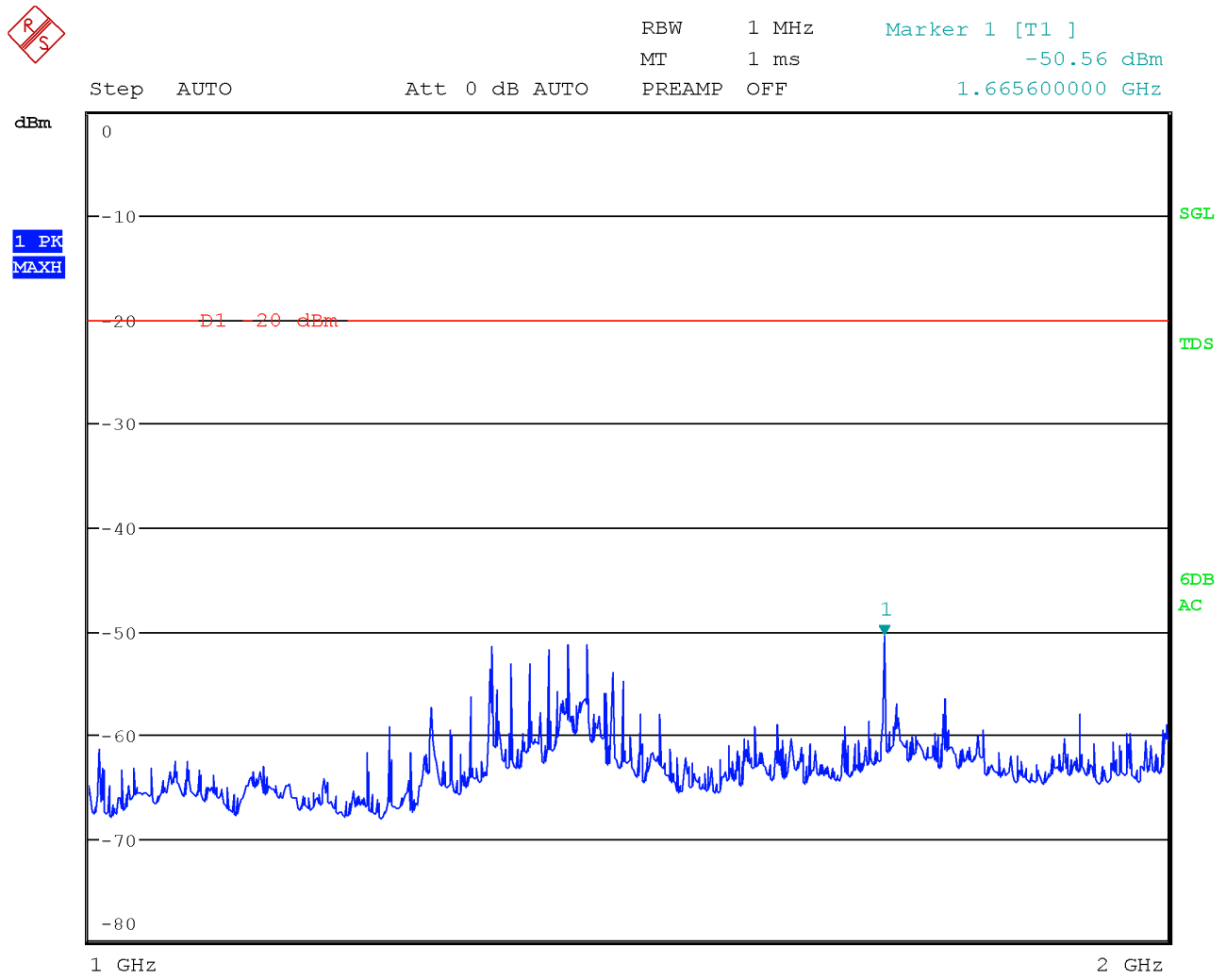

Limit exceeds by the carrier
Channel HIGH – FM modulation with 12.5 kHz channel bandwidth
Frequency range 30 MHz to 1000 MHz with antenna in horizontal polarization

## Test data



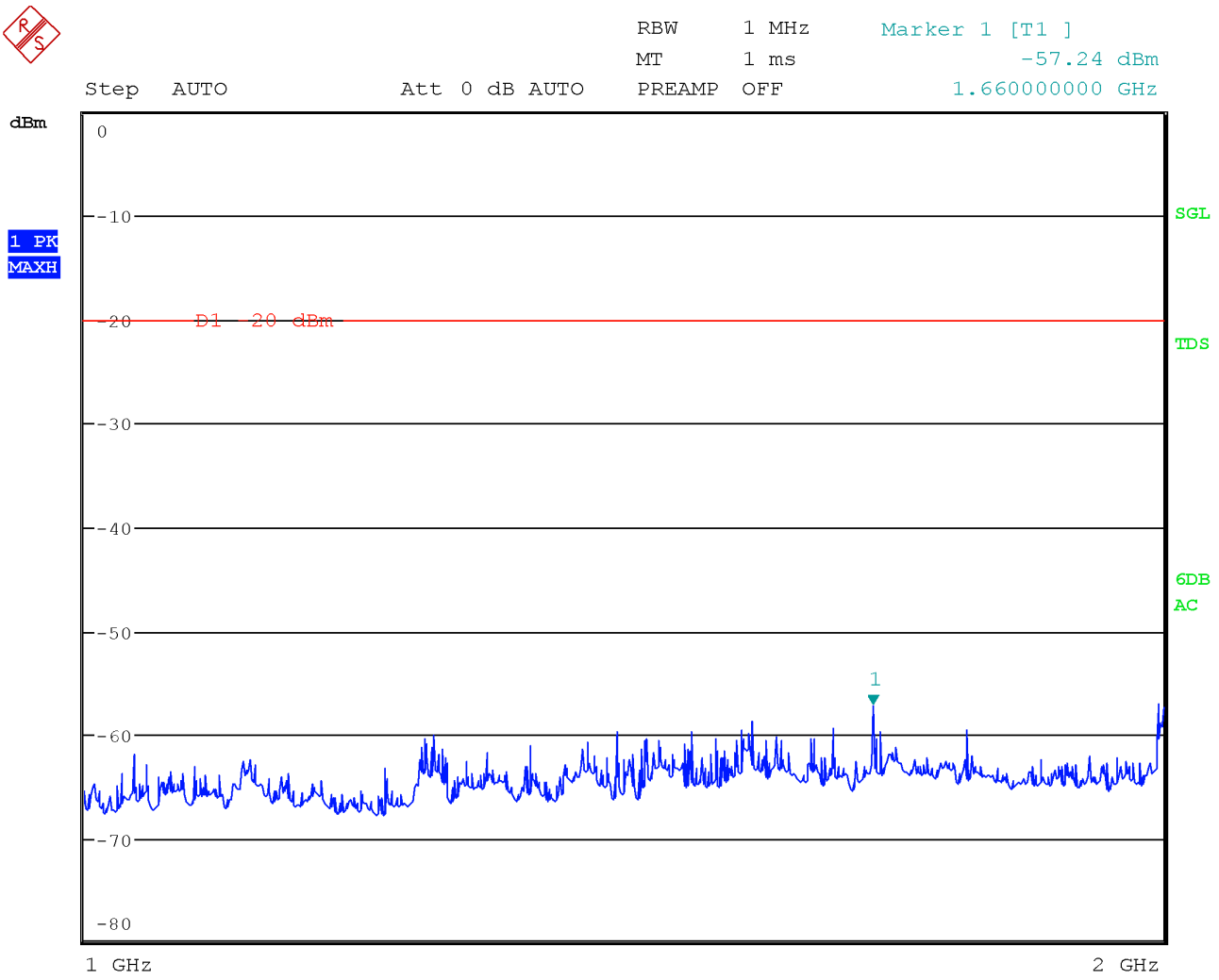

Limit exceeds by the carrier
Channel HIGH – FM modulation with 12.5 kHz channel bandwidth
Frequency range 30 MHz to 1000 MHz with antenna in vertical polarization

## Test data



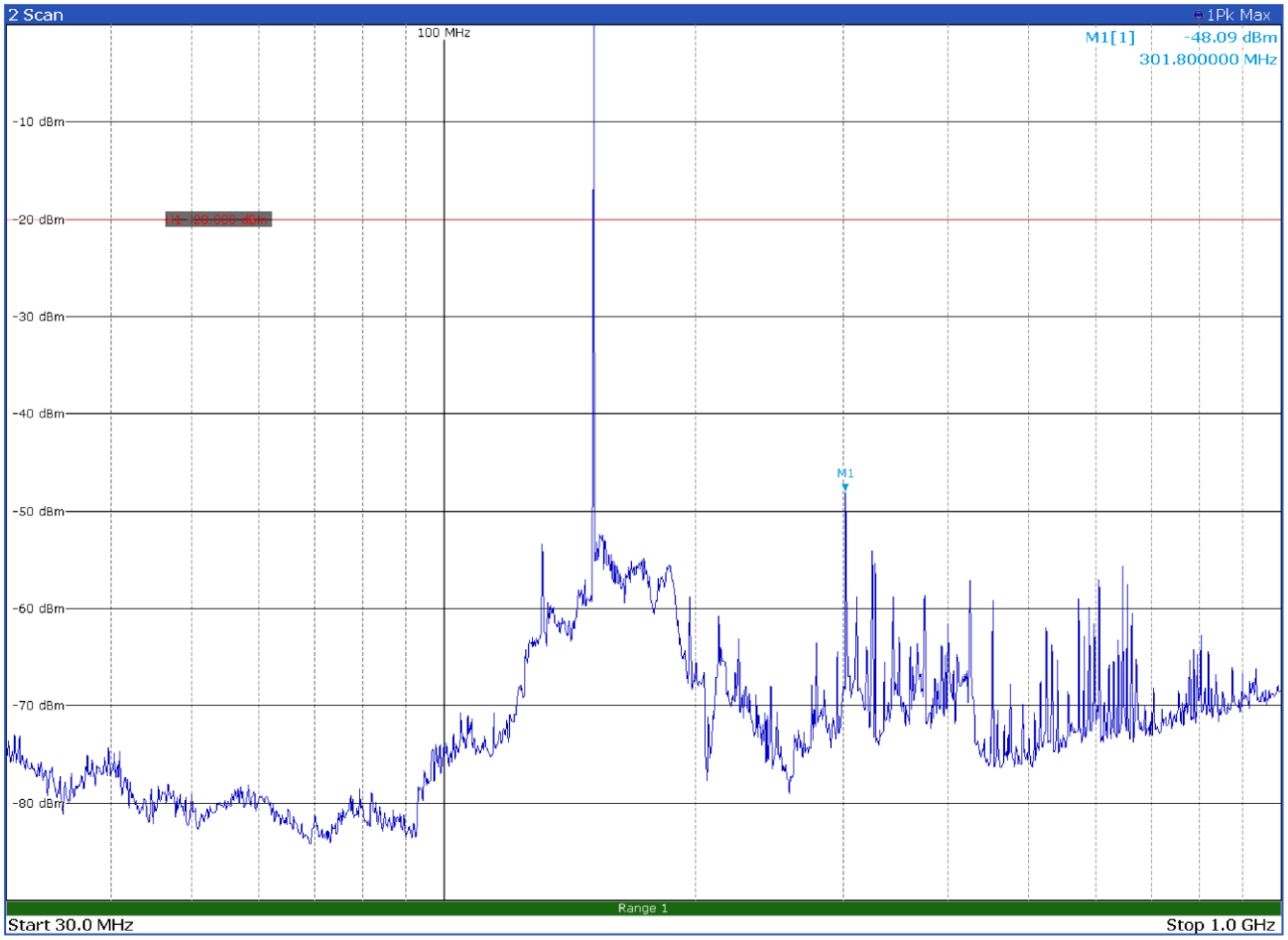

Channel HIGH – FM modulation with 12.5 kHz channel bandwidth
Frequency range 1000 MHz to 2000 MHz with antenna in vertical polarization

## Test data



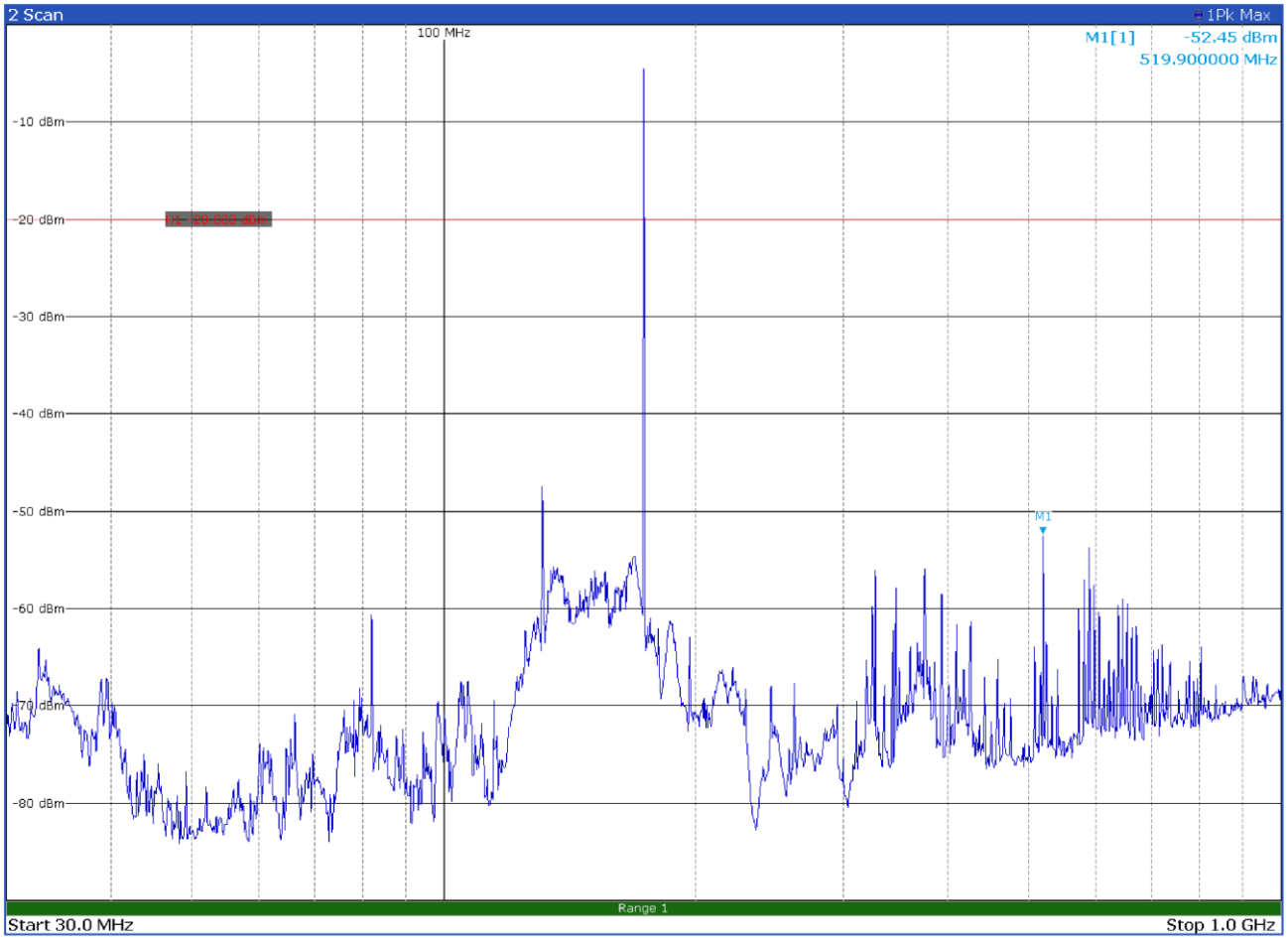

Channel HIGH – FM modulation with 12.5 kHz channel bandwidth
Frequency range 1000 MHz to 2000 MHz with antenna in horizontal polarization

## Test data



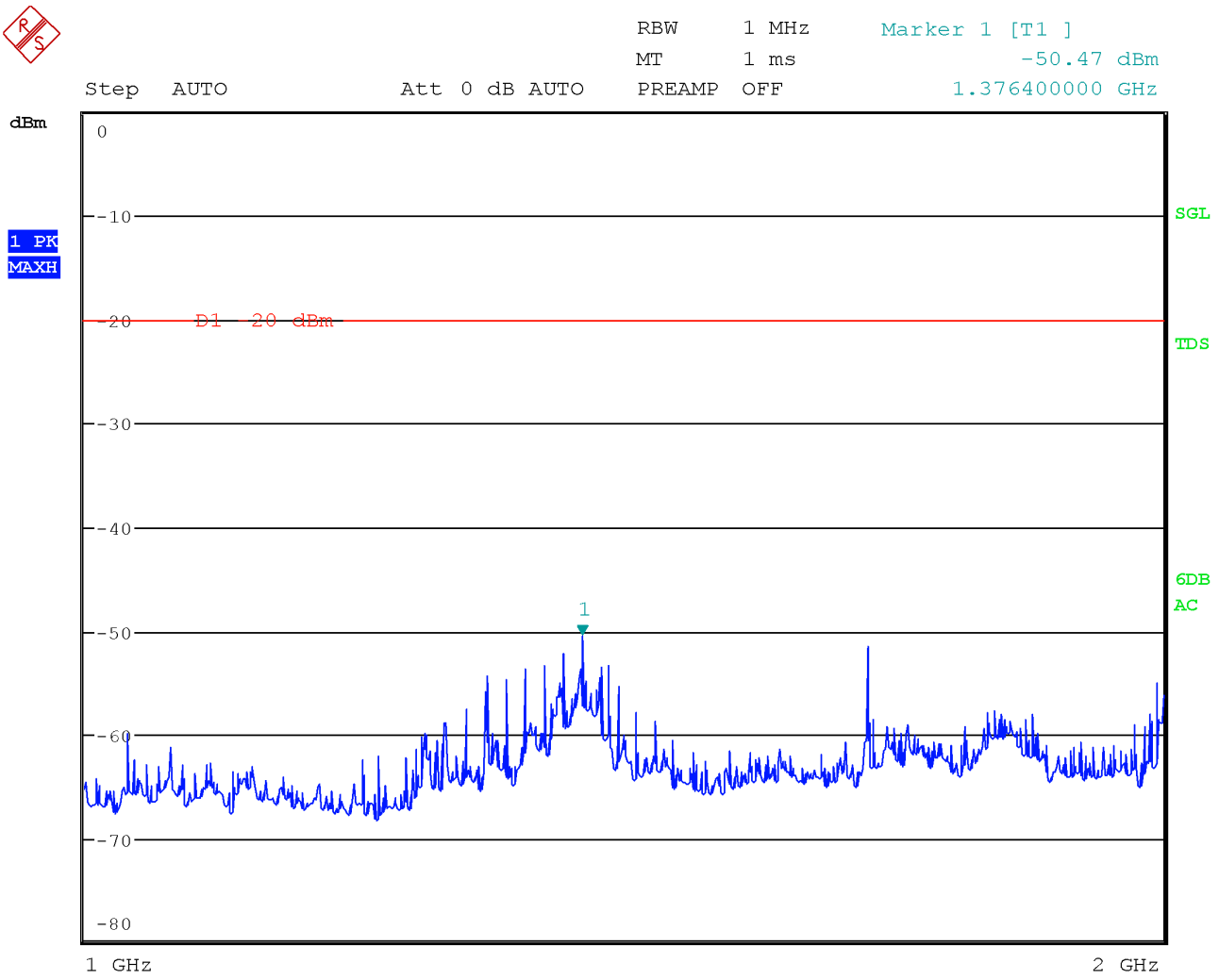

Limit exceeds by the carrier
Channel LOW – FM modulation with 25 kHz channel bandwidth
Frequency range 30 MHz to 1000 MHz with antenna in horizontal polarization

## Test data




Limit exceeds by the carrier
Channel LOW – FM modulation with 25 kHz channel bandwidth
Frequency range 30 MHz to 1000 MHz with antenna in vertical polarization

## Test data




Channel LOW – FM modulation with 25 kHz channel bandwidth
Frequency range 1000 MHz to 2000 MHz with antenna in vertical polarization

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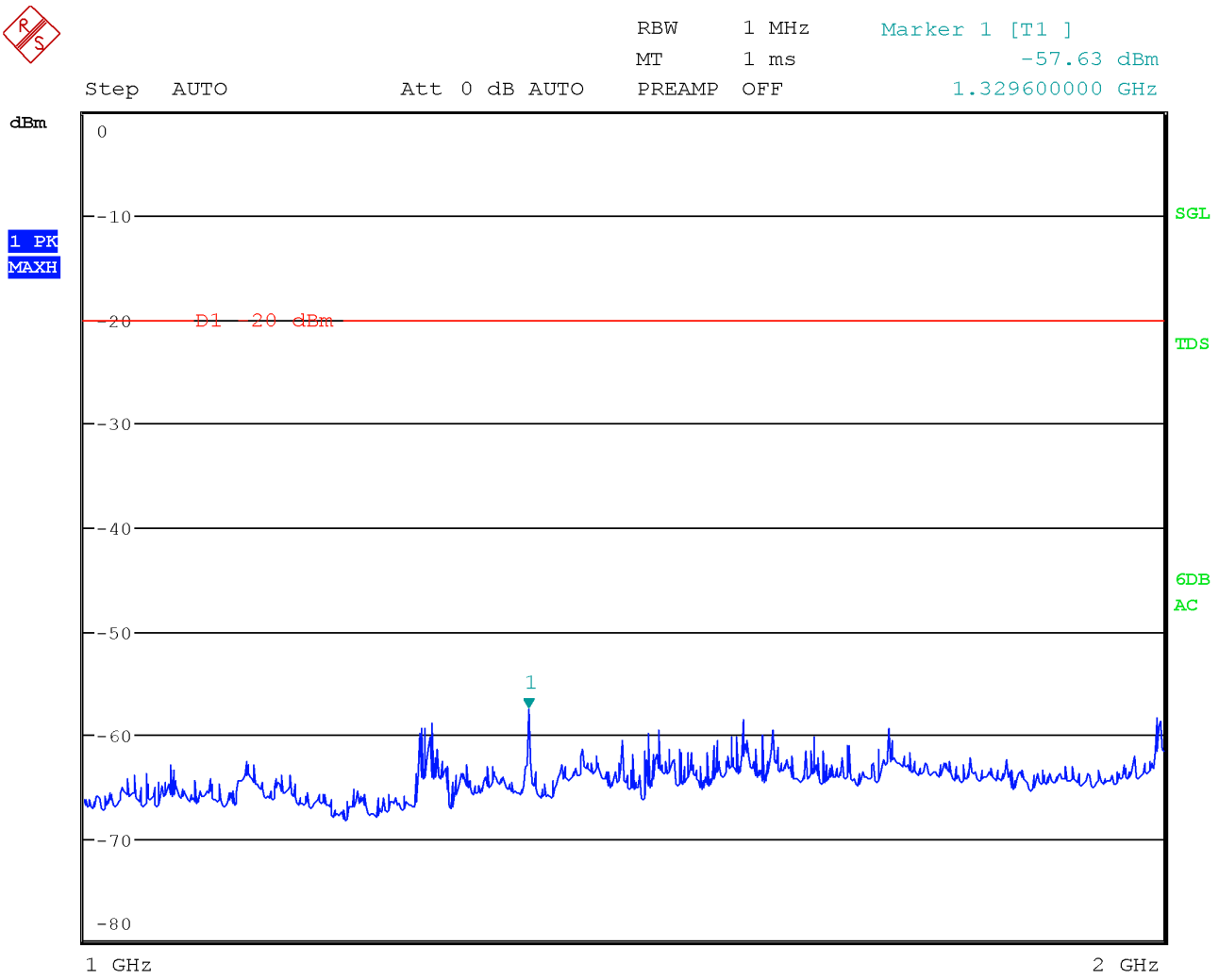


Channel LOW – FM modulation with 25 kHz channel bandwidth
Frequency range 1000 MHz to 2000 MHz with antenna in horizontal polarization

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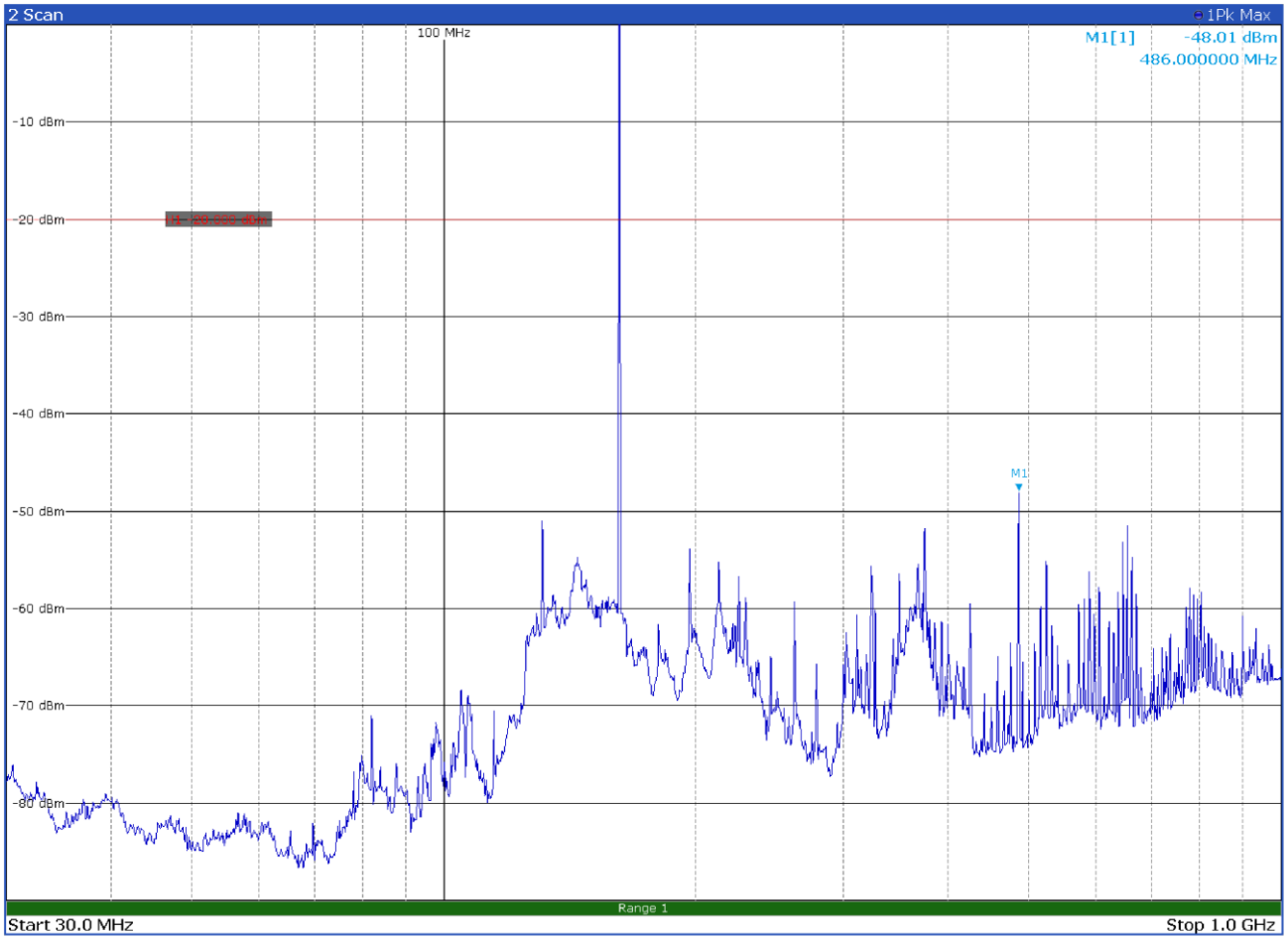
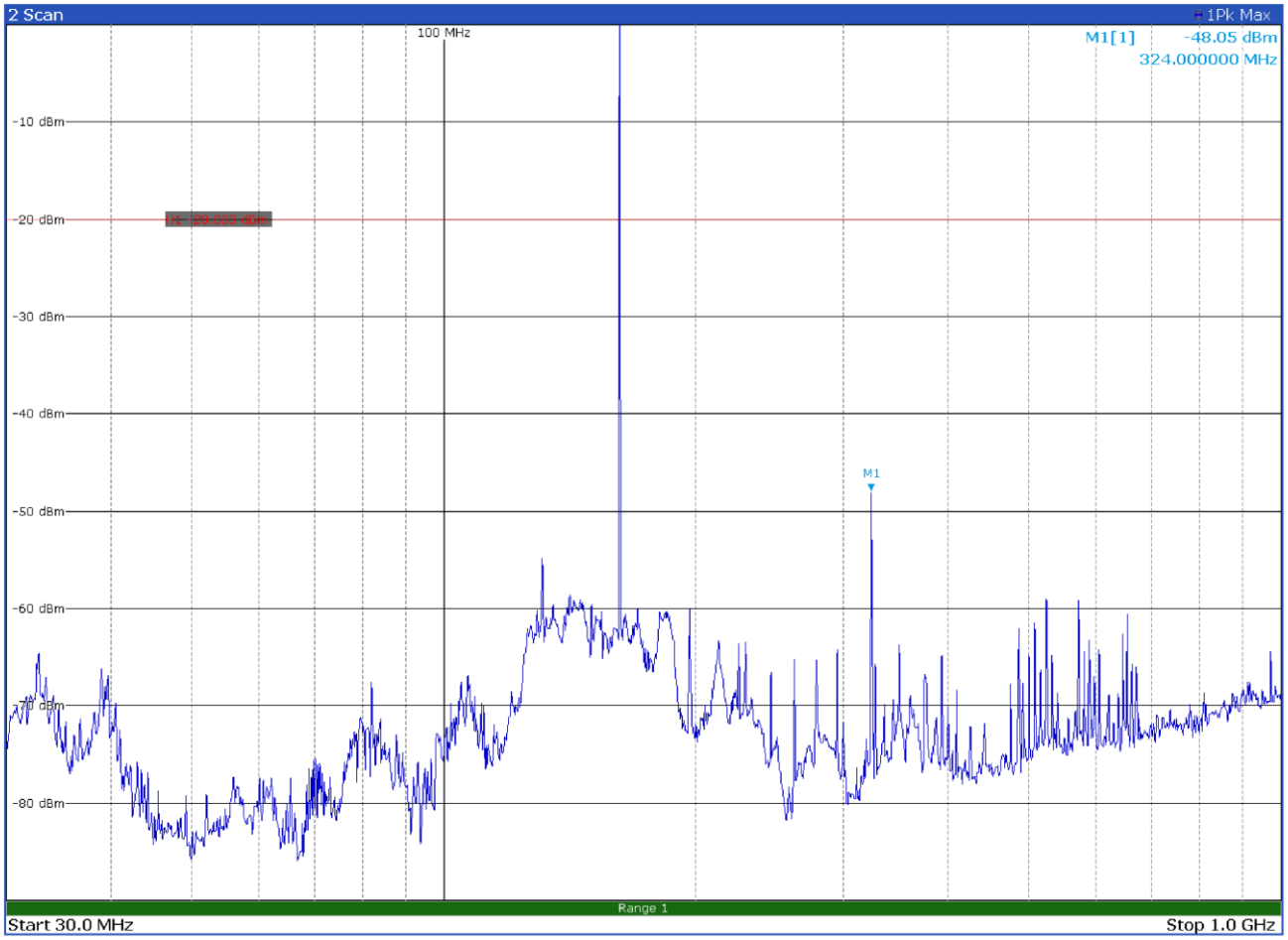



Limit exceeds by the carrier
Channel MID – FM modulation with 25 kHz channel bandwidth
Frequency range 30 MHz to 1000 MHz with antenna in horizontal polarization

## Test data




Limit exceeds by the carrier
Channel MID – FM modulation with 25 kHz channel bandwidth
Frequency range 30 MHz to 1000 MHz with antenna in vertical polarization

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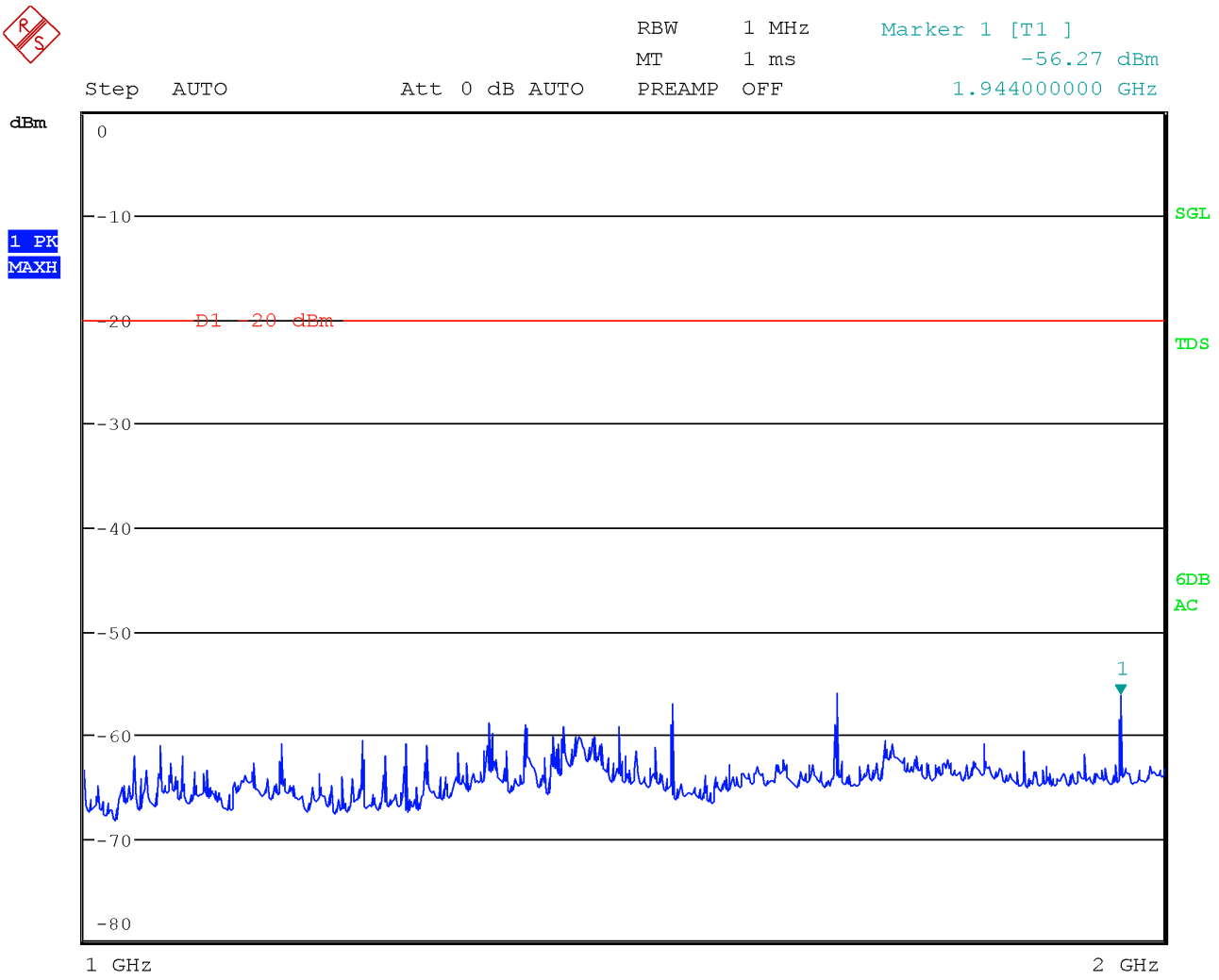
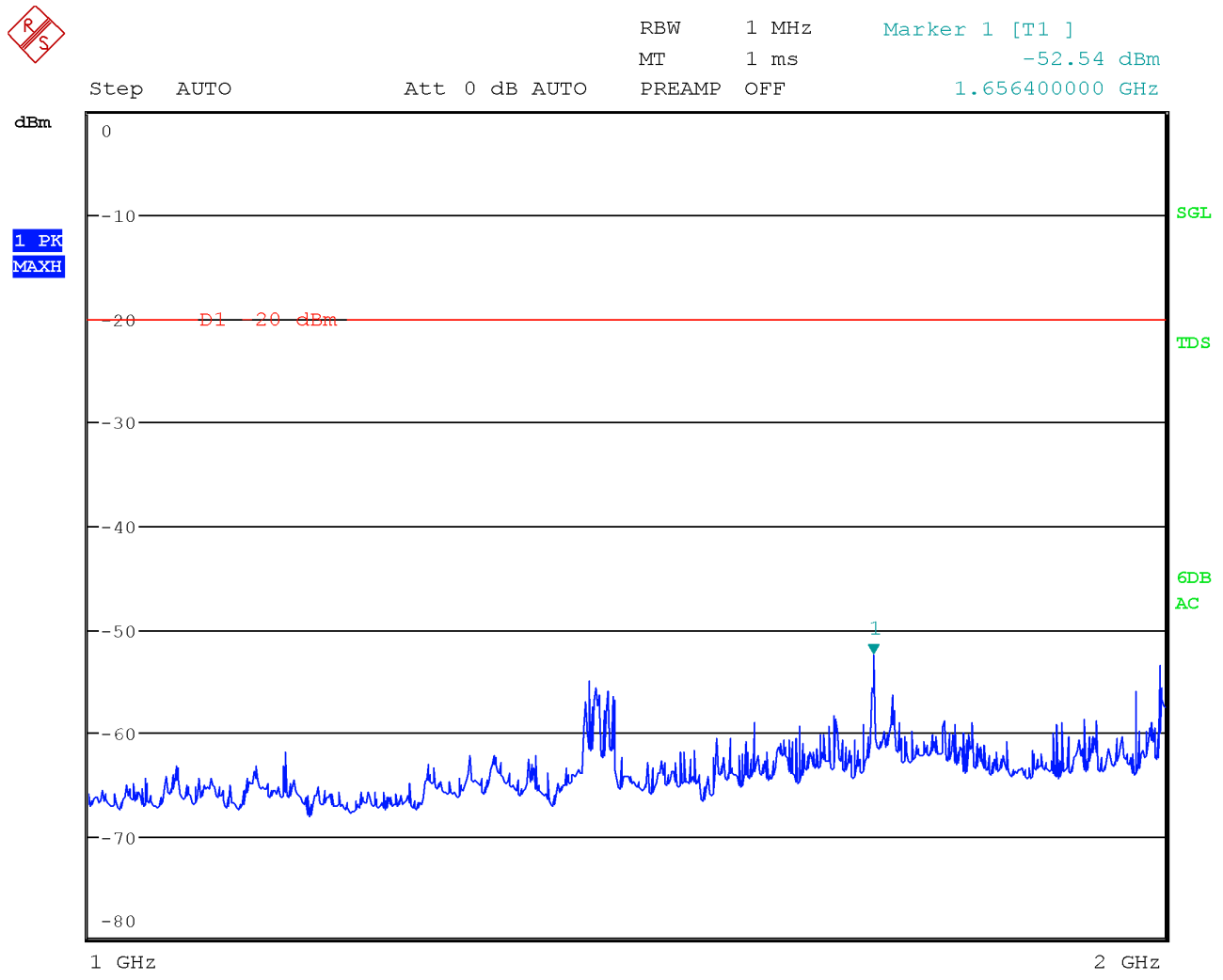



Channel MID – FM modulation with 25 kHz channel bandwidth
Frequency range 1000 MHz to 2000 MHz with antenna in vertical polarization

## Test data




Channel MID – FM modulation with 25 kHz channel bandwidth
Frequency range 1000 MHz to 2000 MHz with antenna in horizontal polarization

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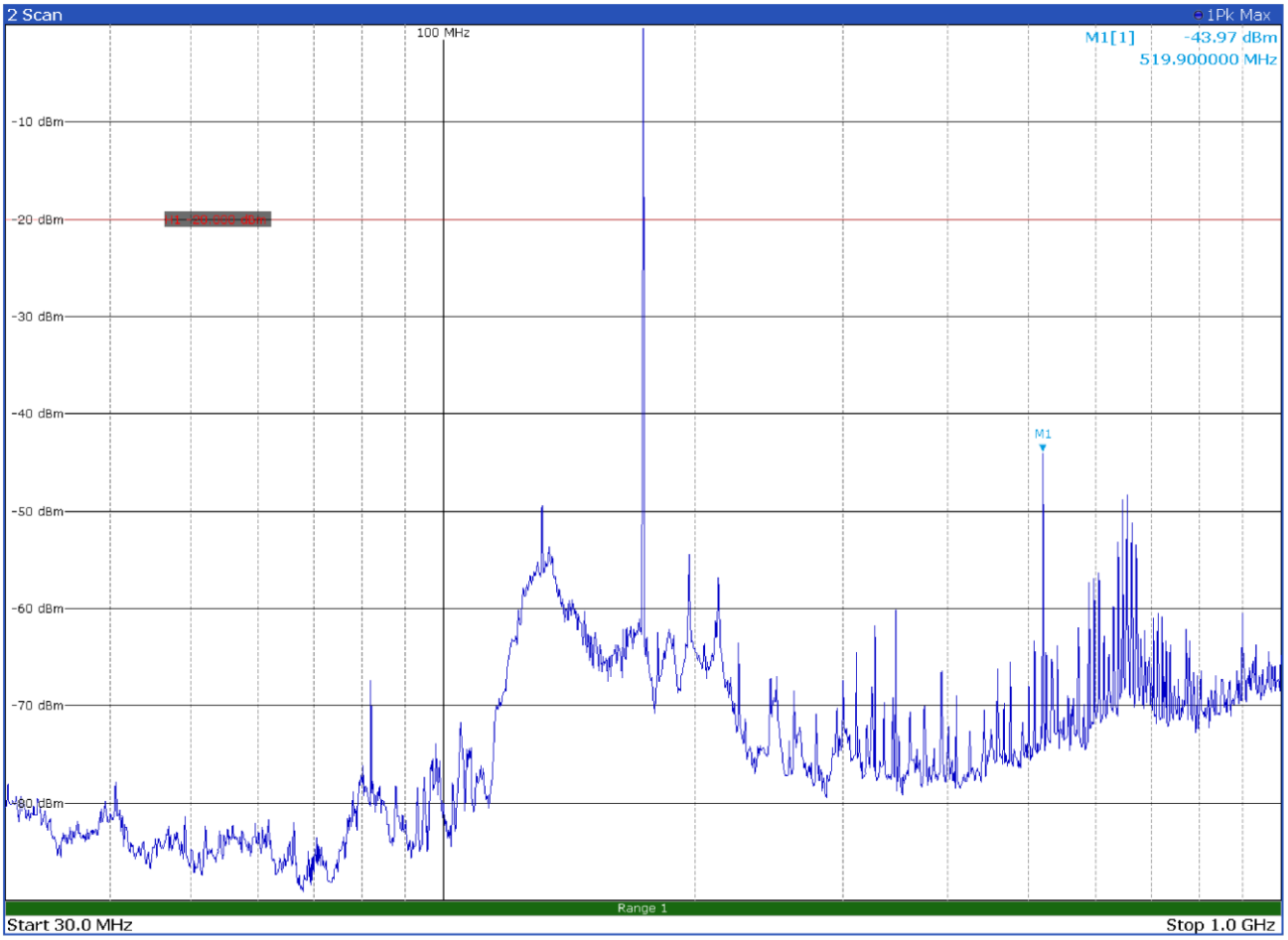
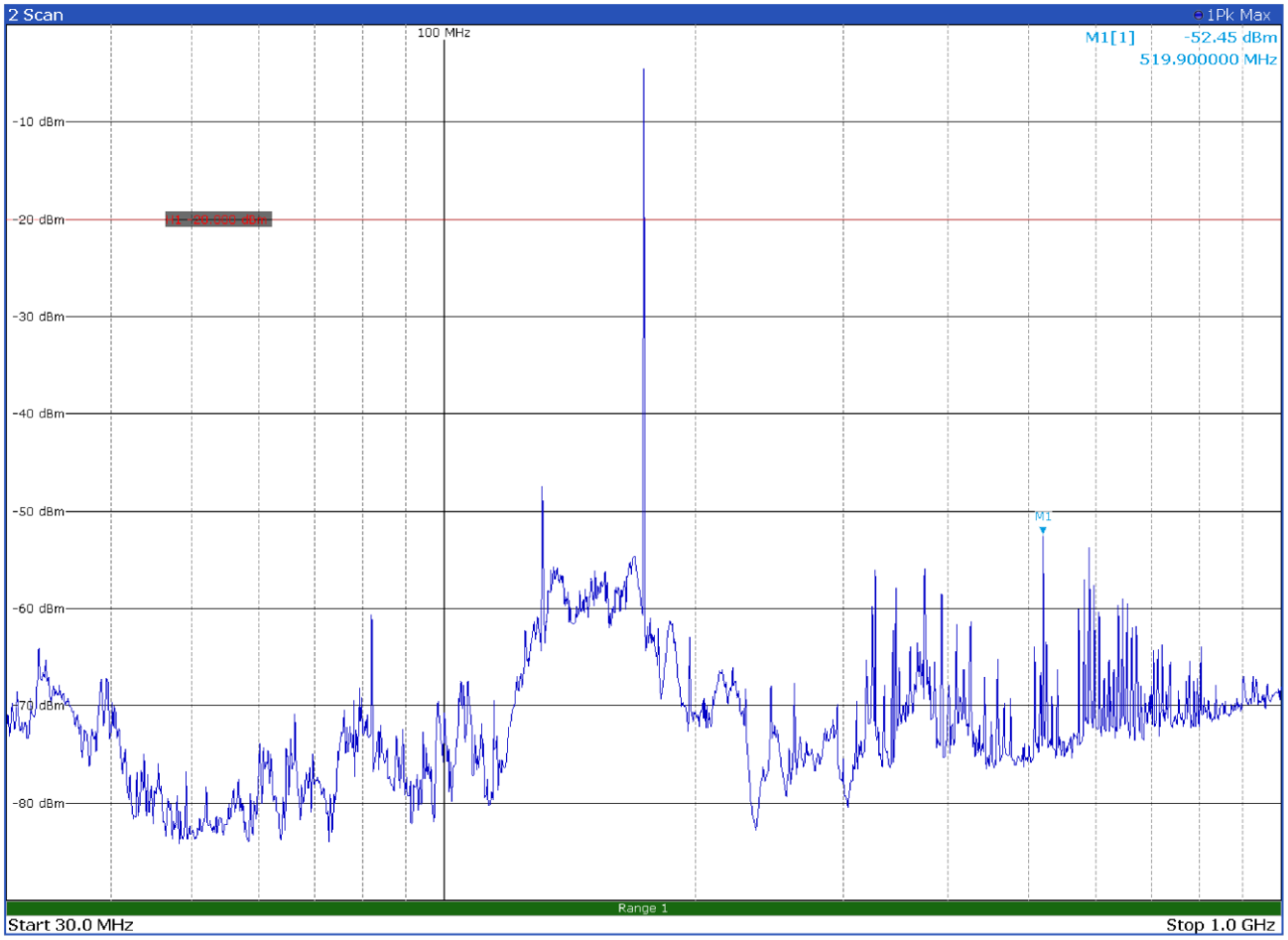


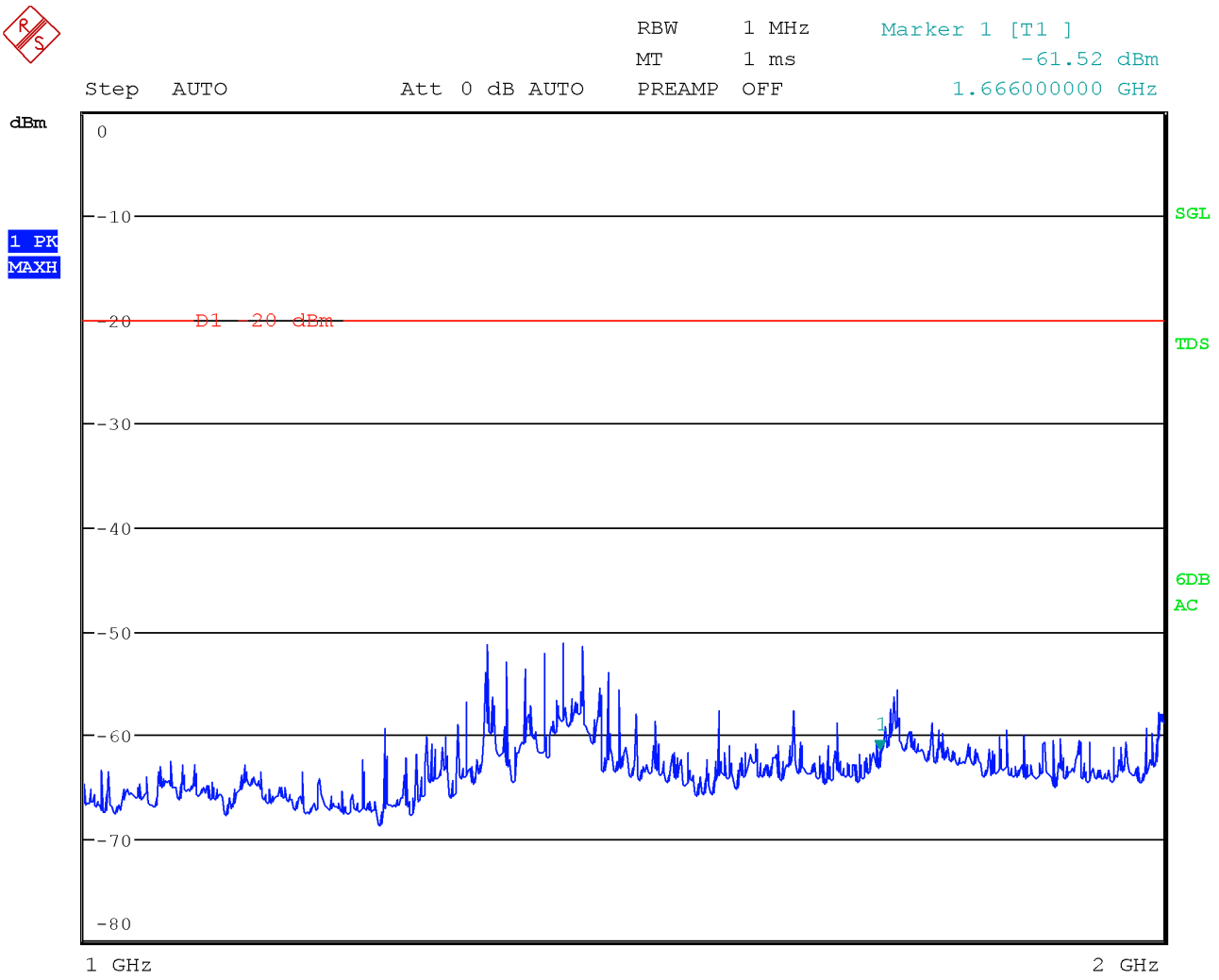

Limit exceeds by the carrier
Channel HIGH – FM modulation with 25 kHz channel bandwidth
Frequency range 30 MHz to 1000 MHz with antenna in horizontal polarization

## Test data



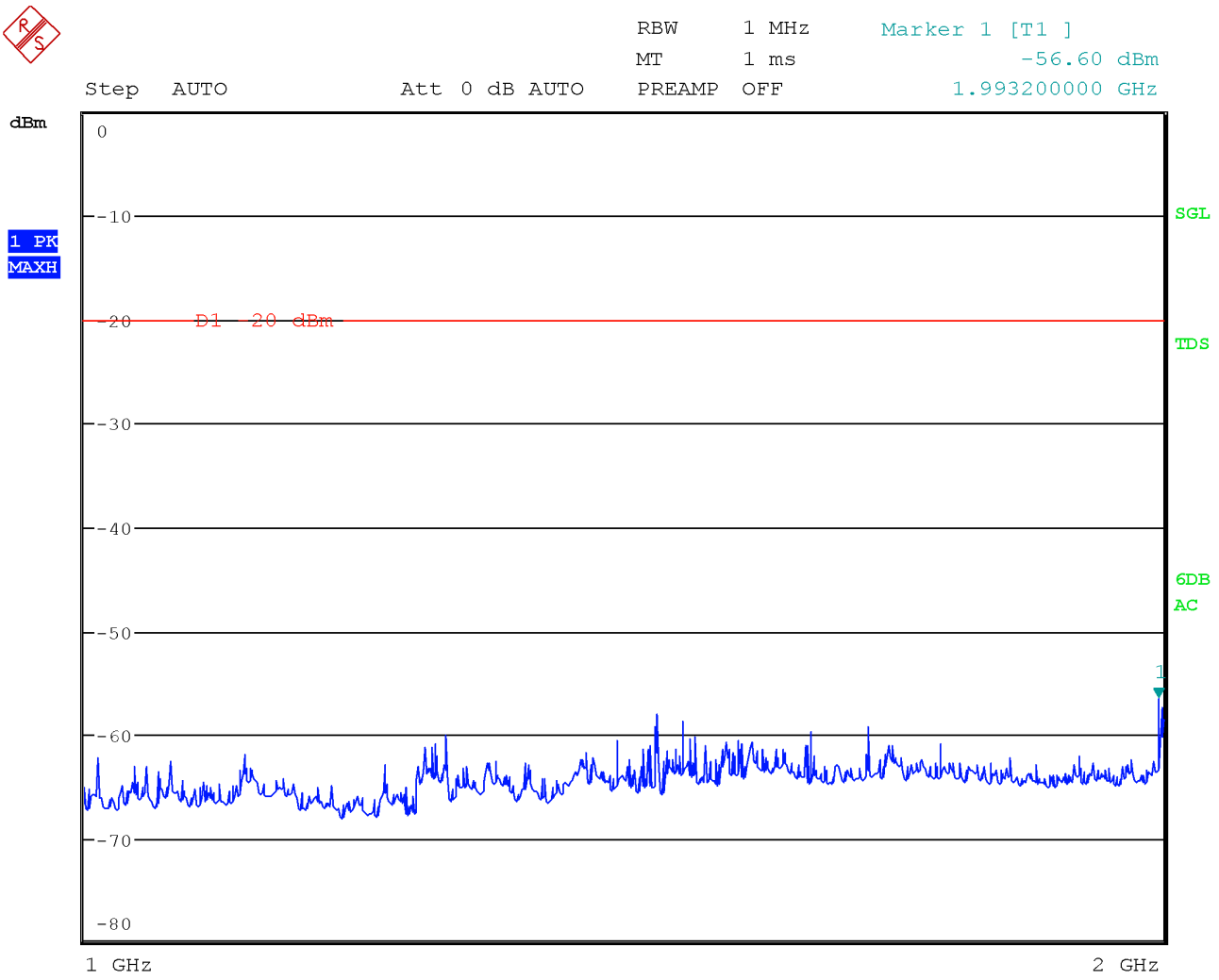

Limit exceeds by the carrier
Channel HIGH – FM modulation with 25 kHz channel bandwidth
Frequency range 30 MHz to 1000 MHz with antenna in vertical polarization

## Test data




Channel HIGH – FM modulation with 25 kHz channel bandwidth
Frequency range 1000 MHz to 2000 MHz with antenna in vertical polarization

## Test data




Channel HIGH – FM modulation with 25 kHz channel bandwidth
Frequency range 1000 MHz to 2000 MHz with antenna in horizontal polarization

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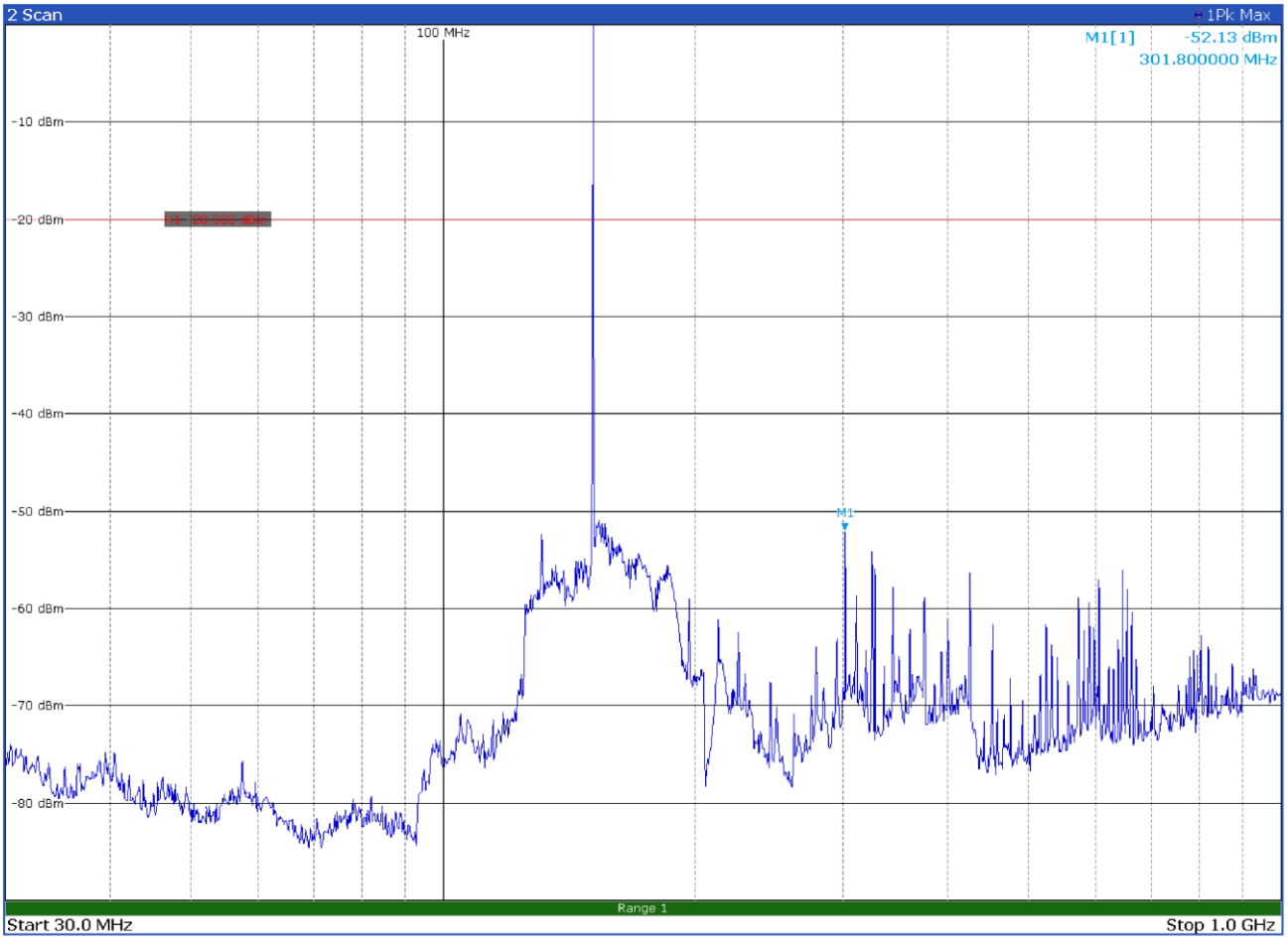
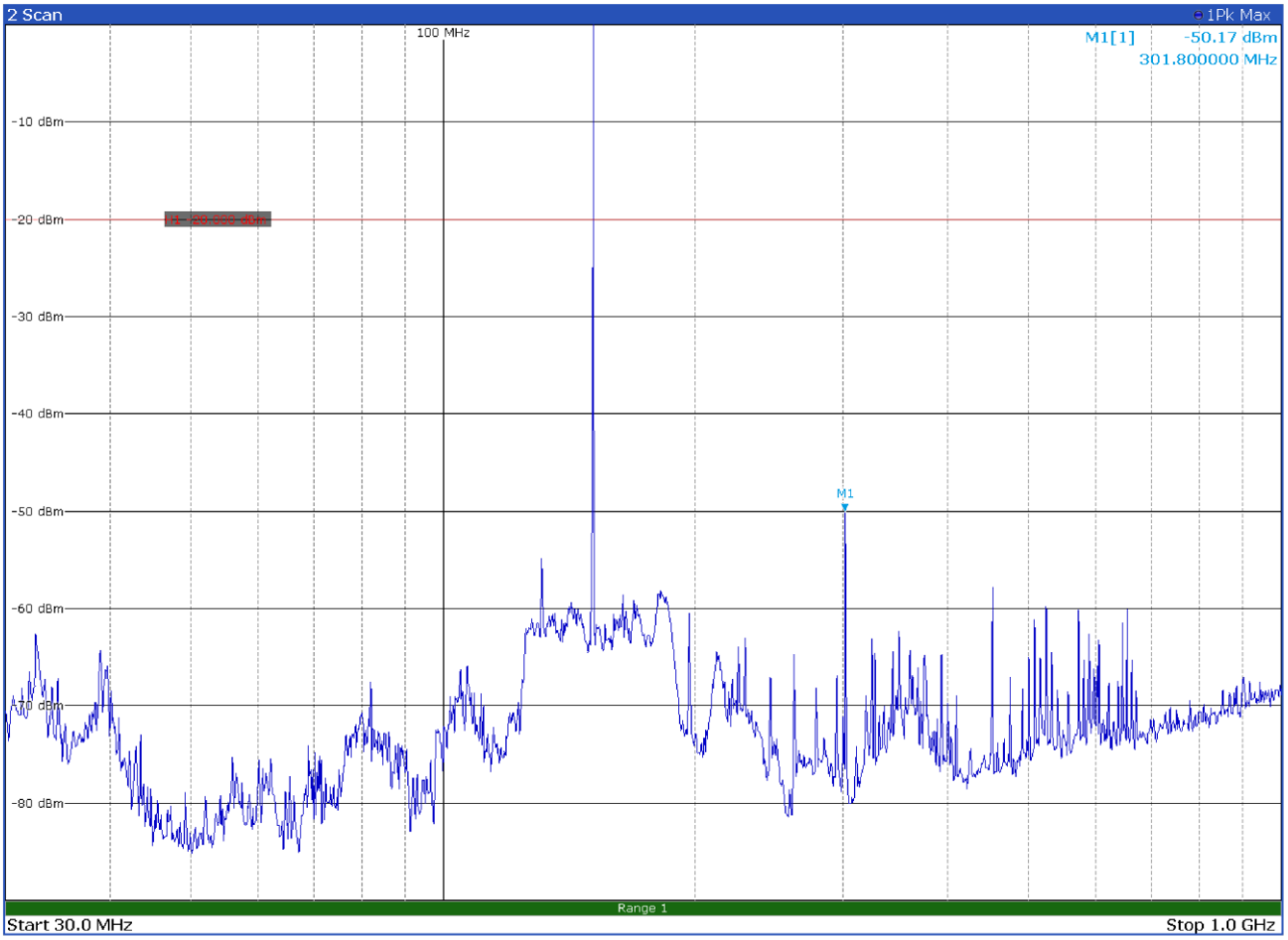


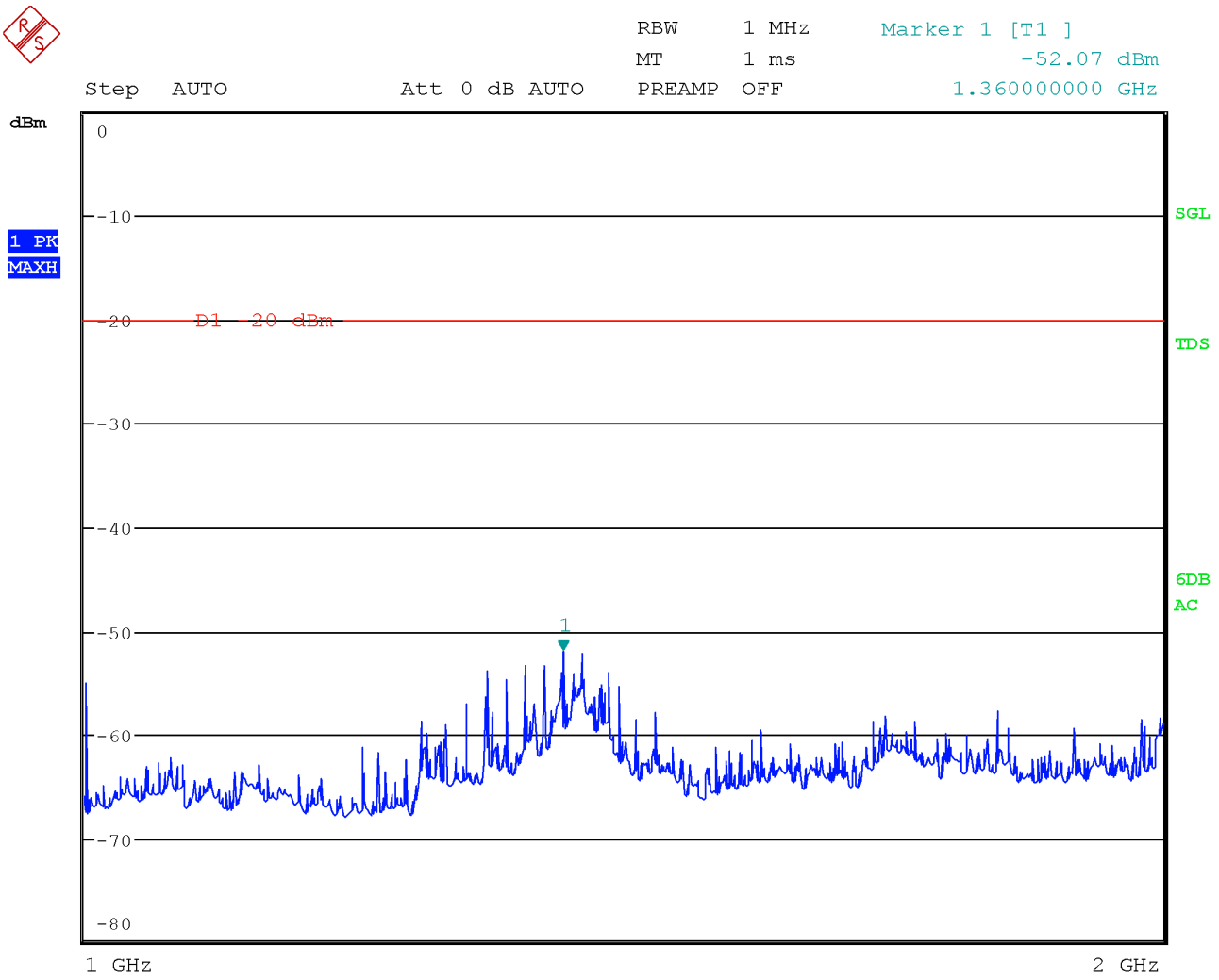

Limit exceeds by the carrier
Channel LOW – 4FSK modulation with 12.5 kHz channel bandwidth
Frequency range 30 MHz to 1000 MHz with antenna in horizontal polarization

## Test data



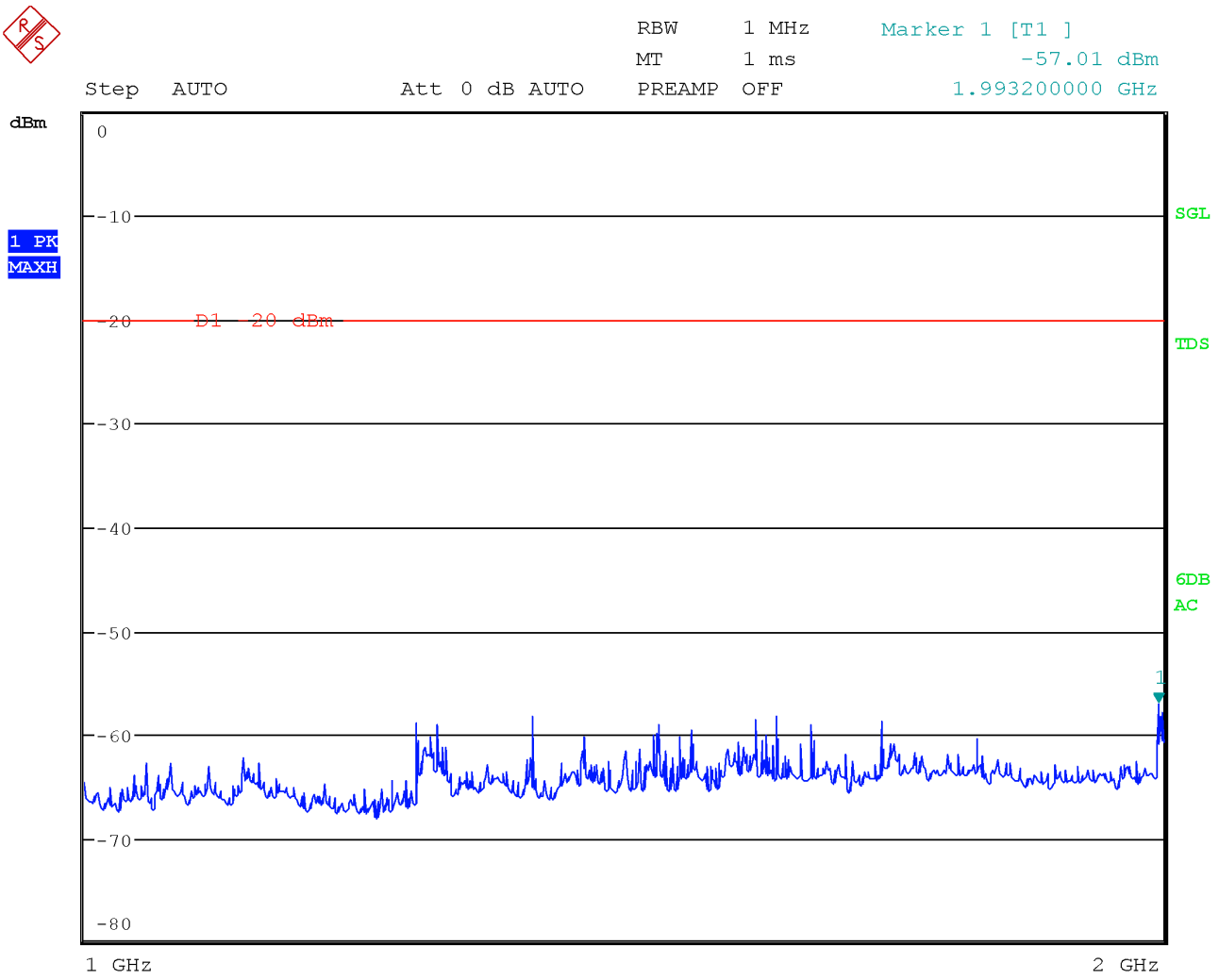

Limit exceeds by the carrier
Channel LOW – 4FSK modulation with 12.5 kHz channel bandwidth
Frequency range 30 MHz to 1000 MHz with antenna in vertical polarization

## Test data



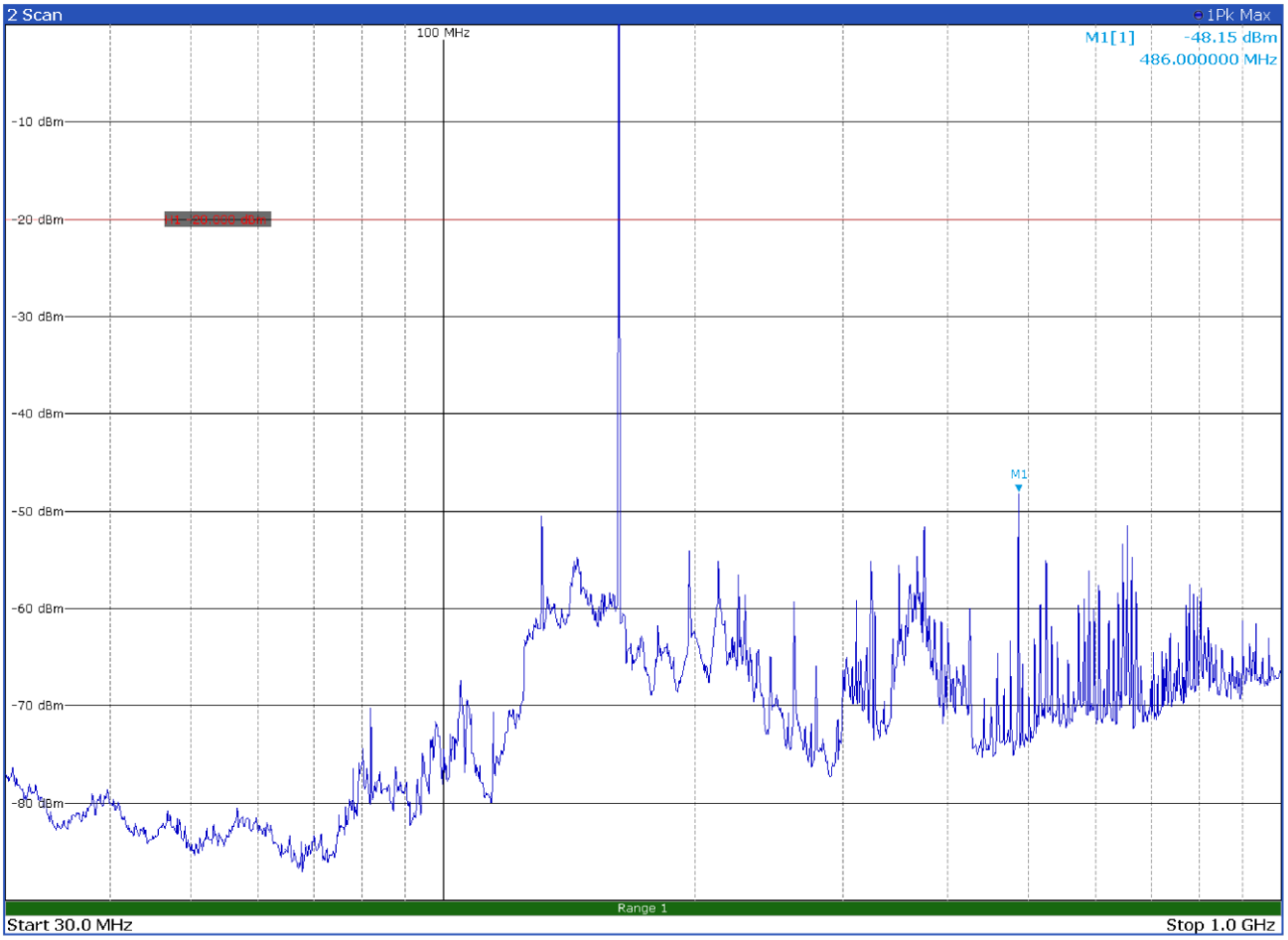

Channel LOW – 4FSK modulation with 12.5 kHz channel bandwidth
Frequency range 1000 MHz to 2000 MHz with antenna in vertical polarization

## Test data



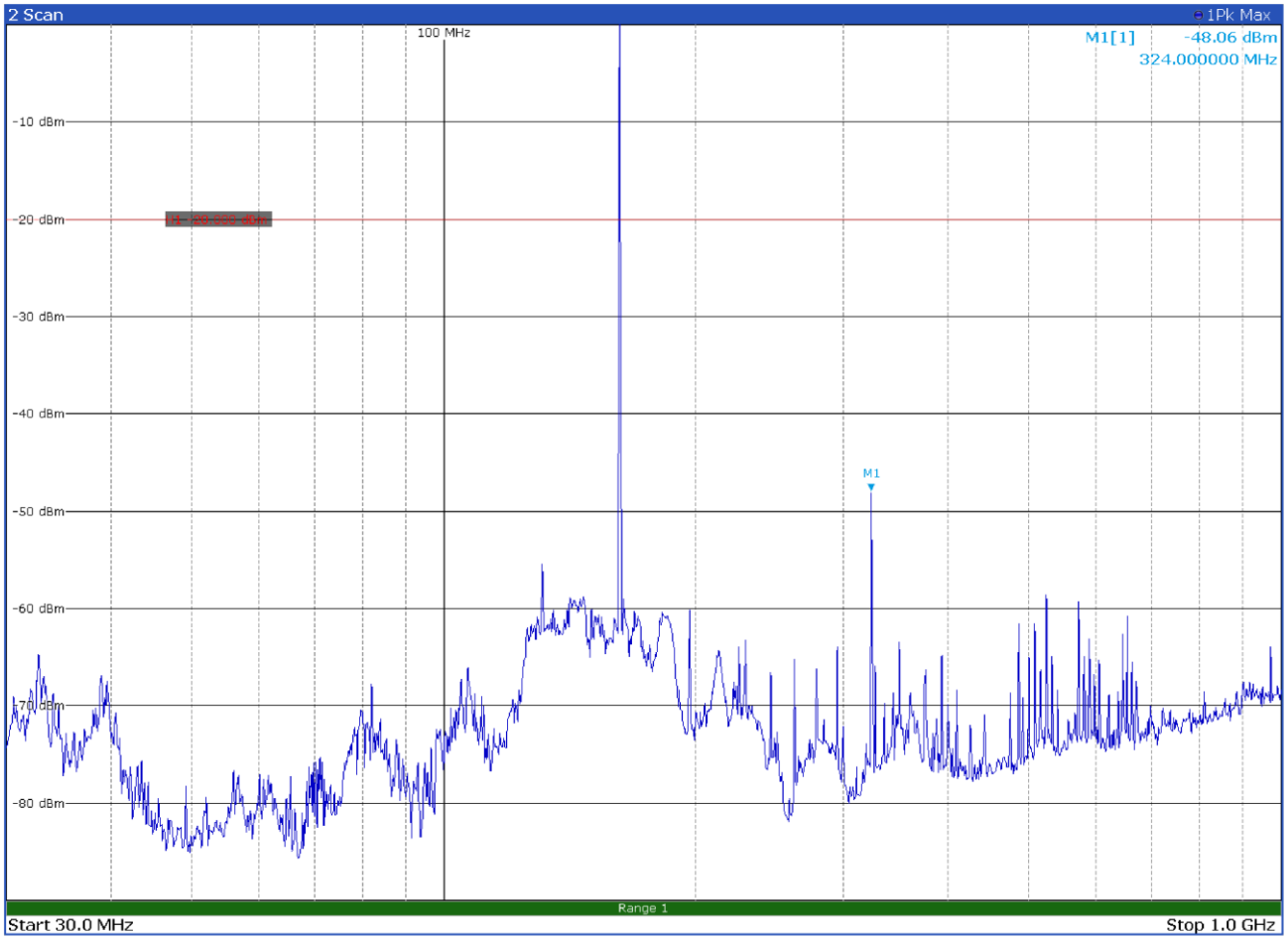

Channel LOW – 4FSK modulation with 12.5 kHz channel bandwidth
Frequency range 1000 MHz to 2000 MHz with antenna in horizontal polarization

## Test data



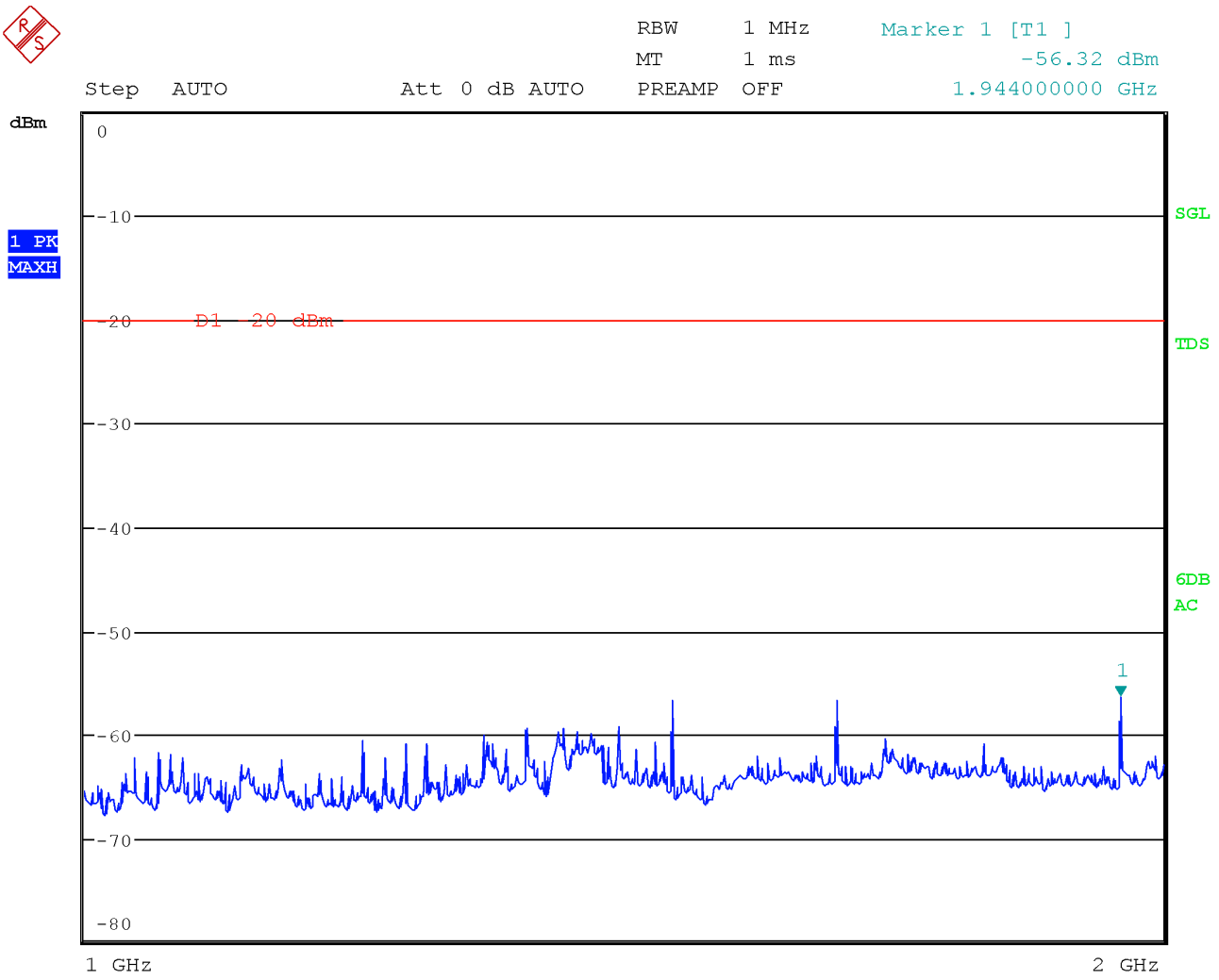

Limit exceeds by the carrier
Channel MID – 4FSK modulation with 12.5 kHz channel bandwidth
Frequency range 30 MHz to 1000 MHz with antenna in horizontal polarization

## Test data



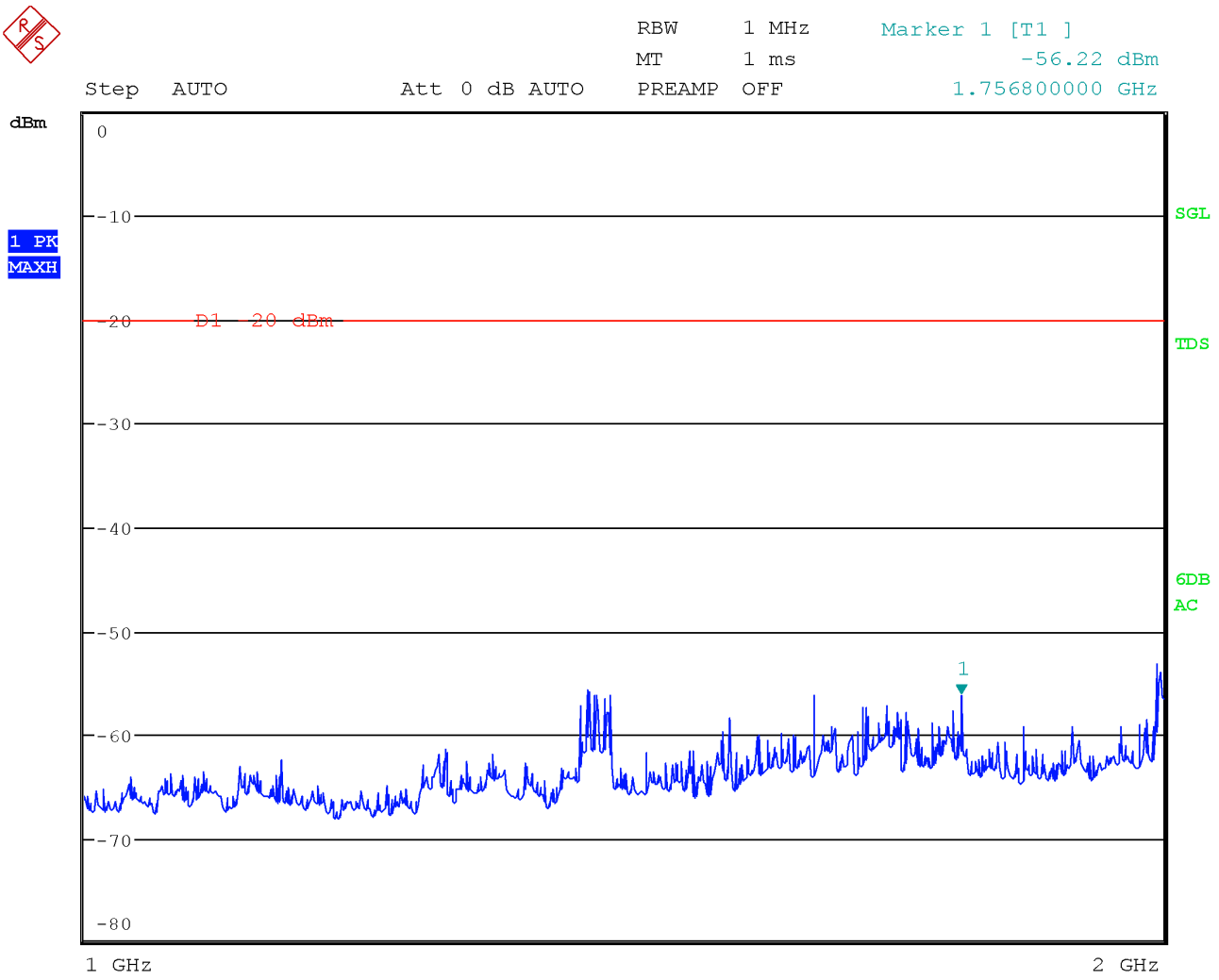

Limit exceeds by the carrier
Channel MID – 4FSK modulation with 12.5 kHz channel bandwidth
Frequency range 30 MHz to 1000 MHz with antenna in vertical polarization

## Test data



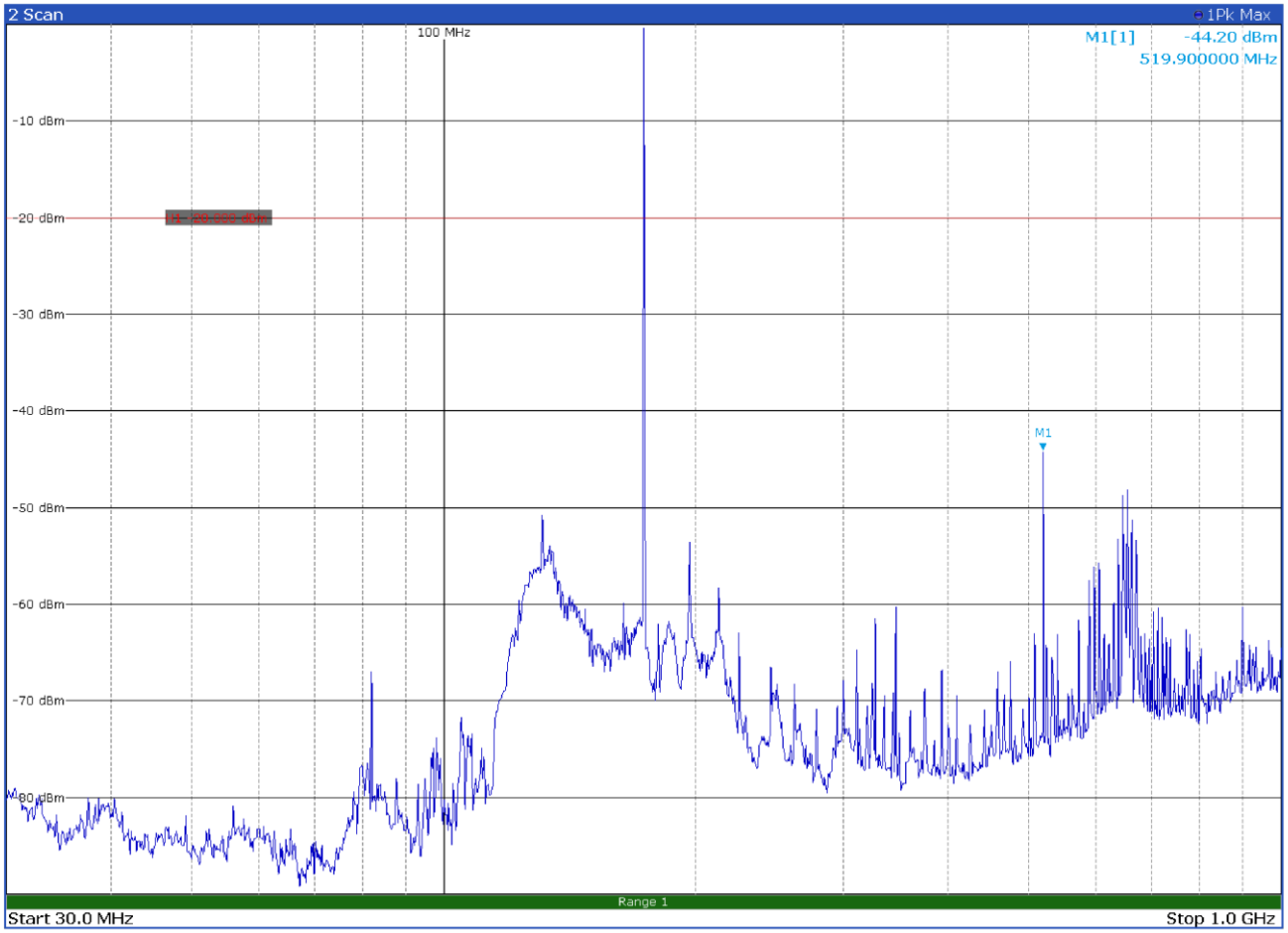

Channel MID – 4FSK modulation with 12.5 kHz channel bandwidth
Frequency range 1000 MHz to 2000 MHz with antenna in vertical polarization

## Test data



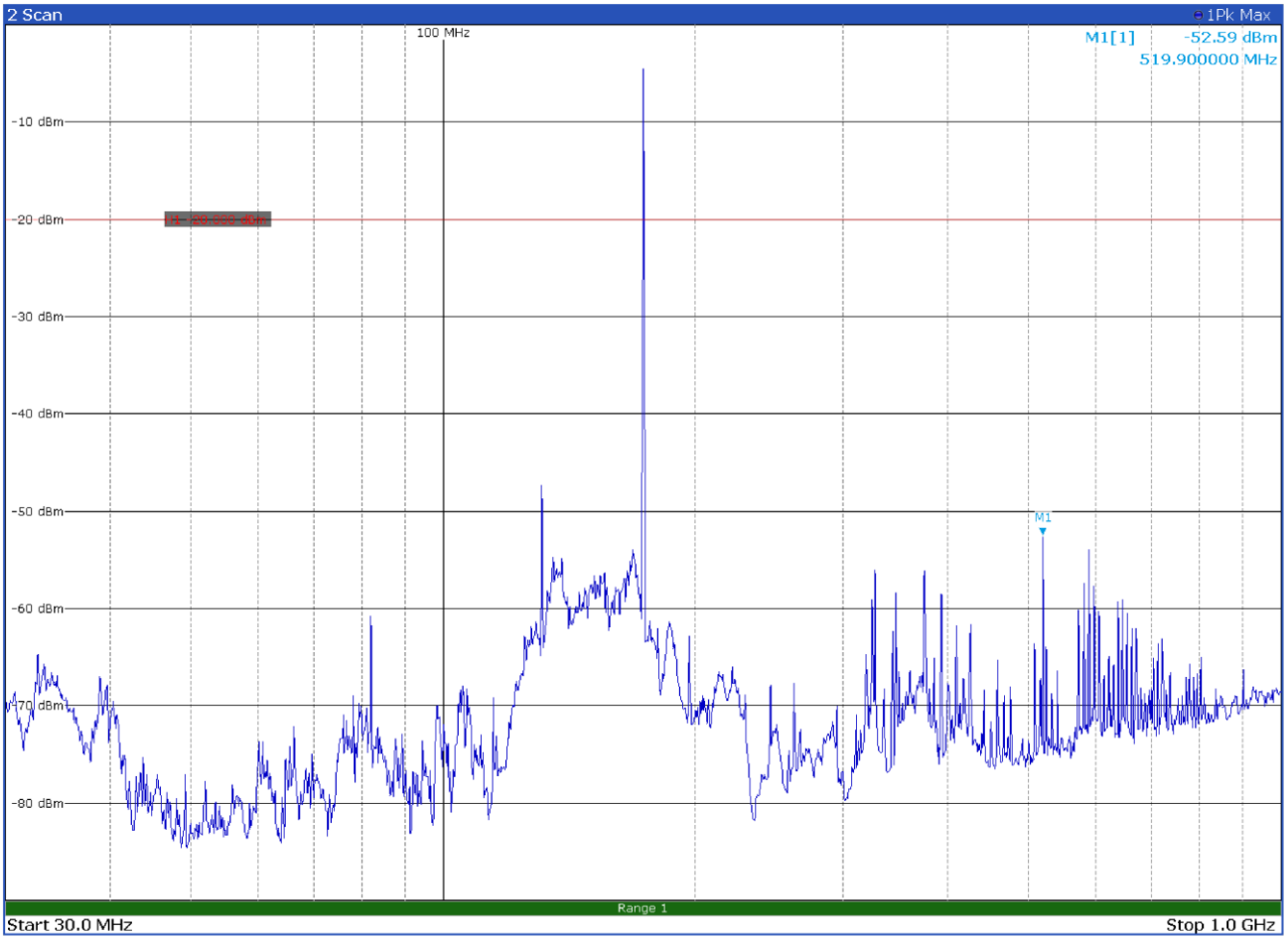

Channel MID – 4FSK modulation with 12.5 kHz channel bandwidth
Frequency range 1000 MHz to 2000 MHz with antenna in horizontal polarization

## Test data



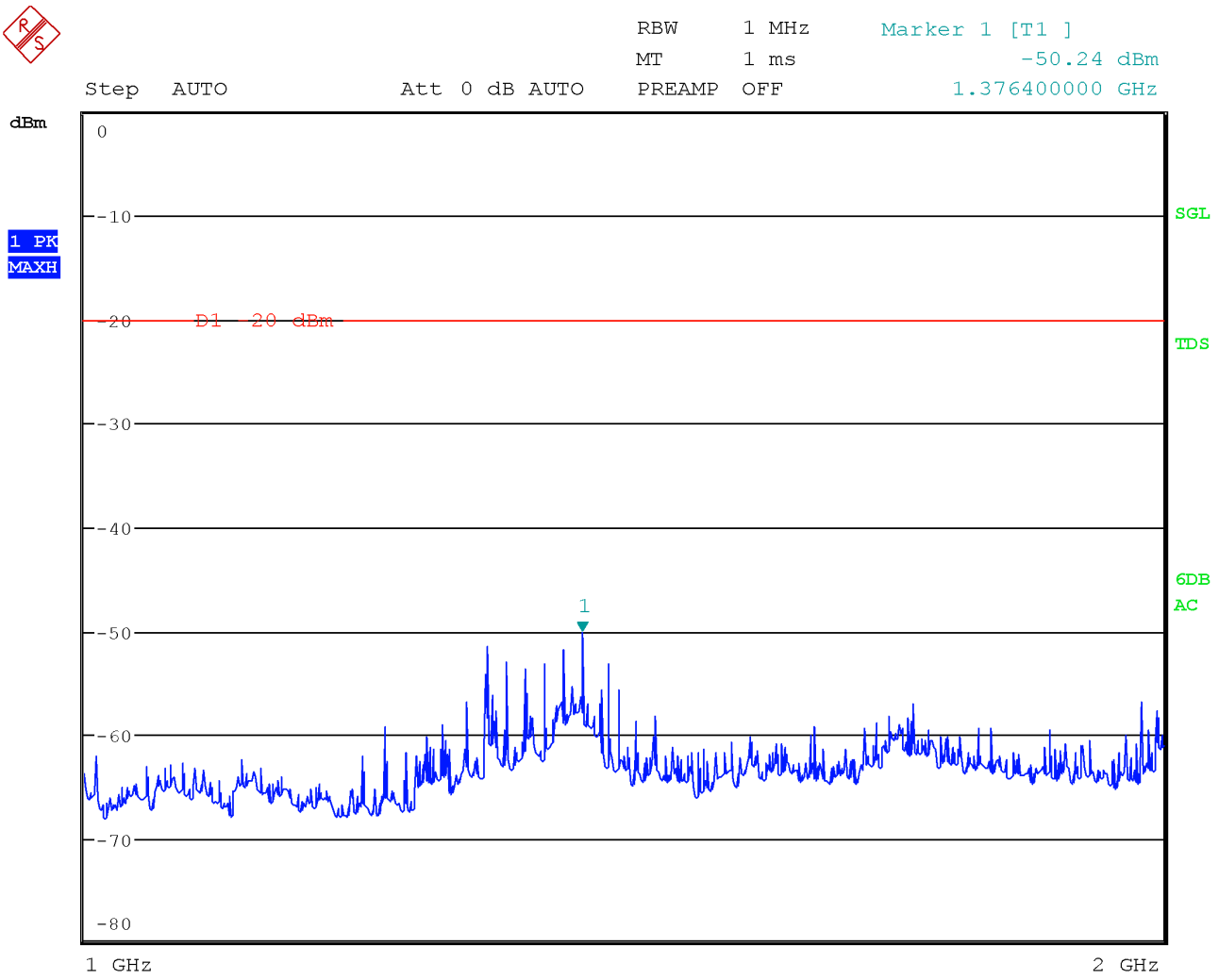

Limit exceeds by the carrier
Channel HIGH – 4FSK modulation with 12.5 kHz channel bandwidth
Frequency range 30 MHz to 1000 MHz with antenna in horizontal polarization

## Test data



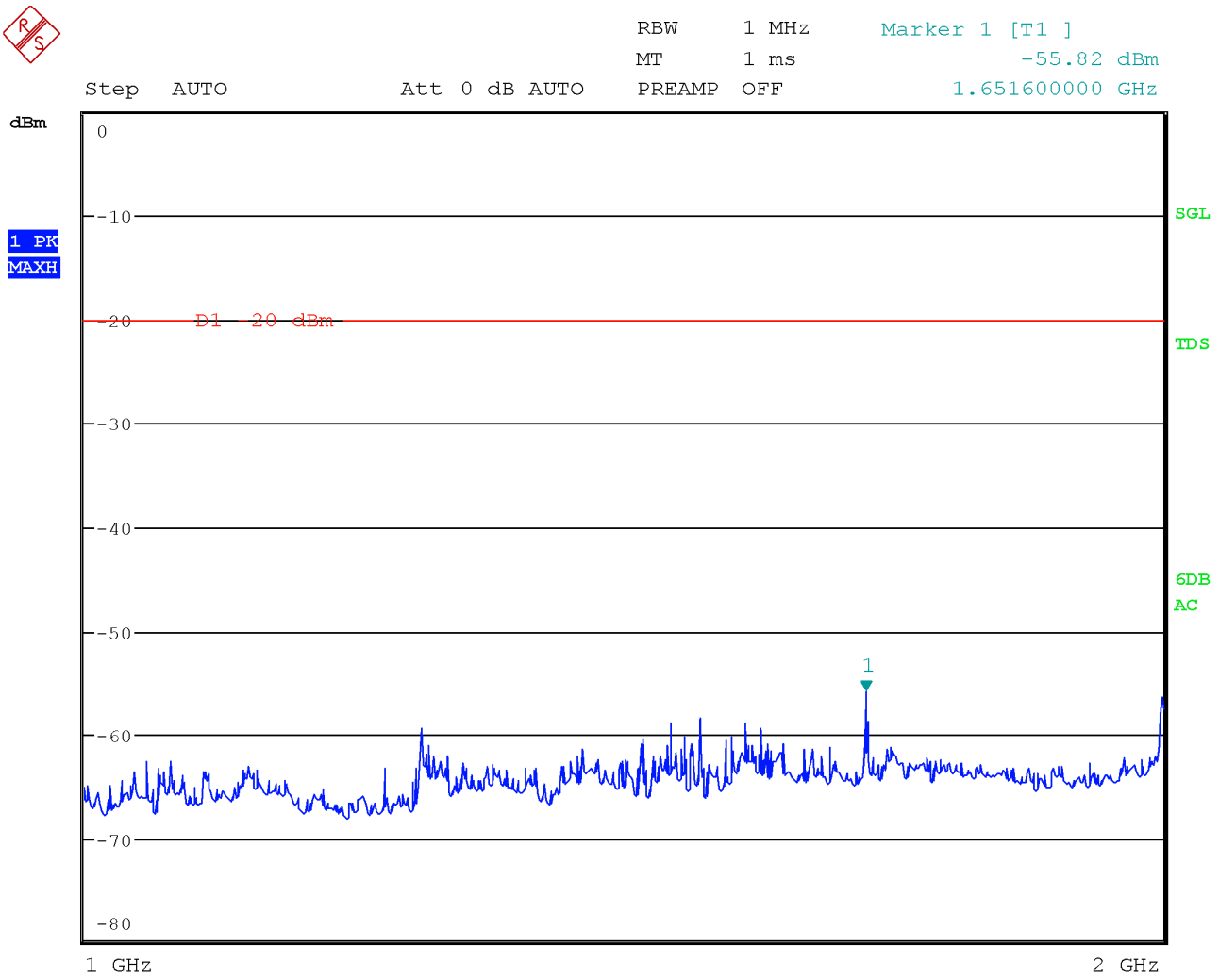

Limit exceeds by the carrier
Channel HIGH – 4FSK modulation with 12.5 kHz channel bandwidth
Frequency range 30 MHz to 1000 MHz with antenna in vertical polarization

## Test data



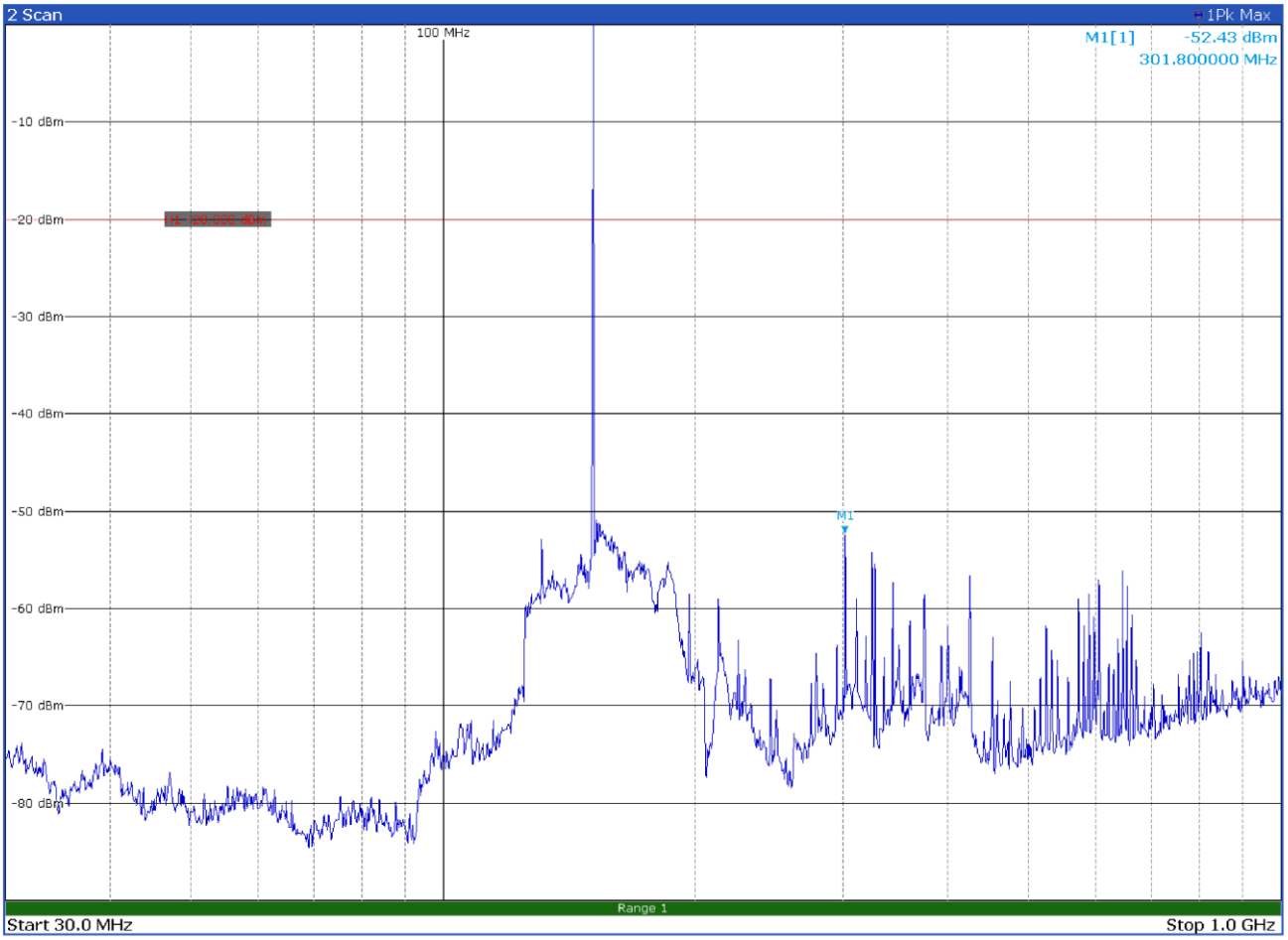

Channel HIGH – 4FSK modulation with 12.5 kHz channel bandwidth
Frequency range 1000 MHz to 2000 MHz with antenna in vertical polarization

## Test data



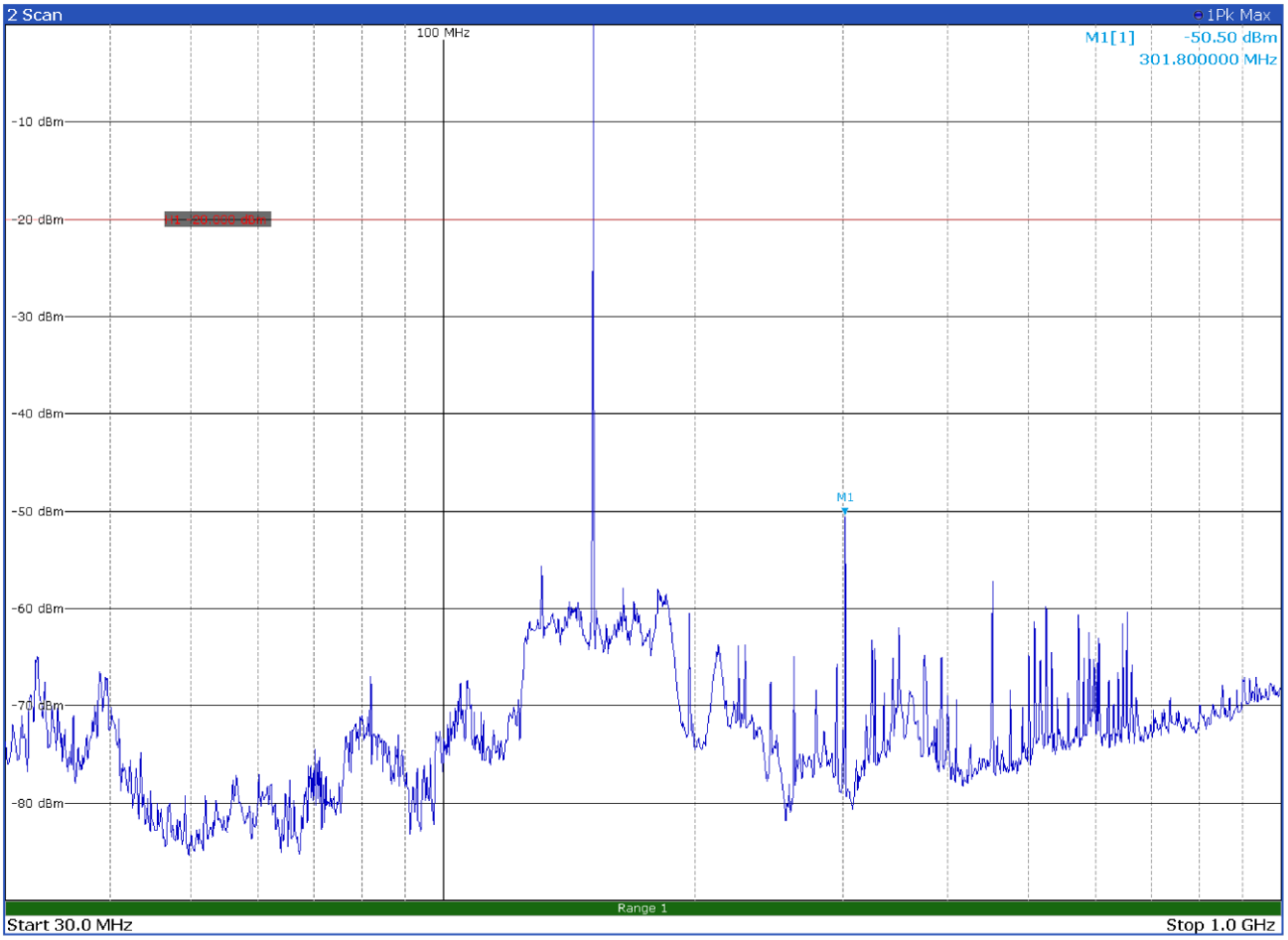

Channel HIGH – 4FSK modulation with 12.5 kHz channel bandwidth
Frequency range 1000 MHz to 2000 MHz with antenna in horizontal polarization

## Test data



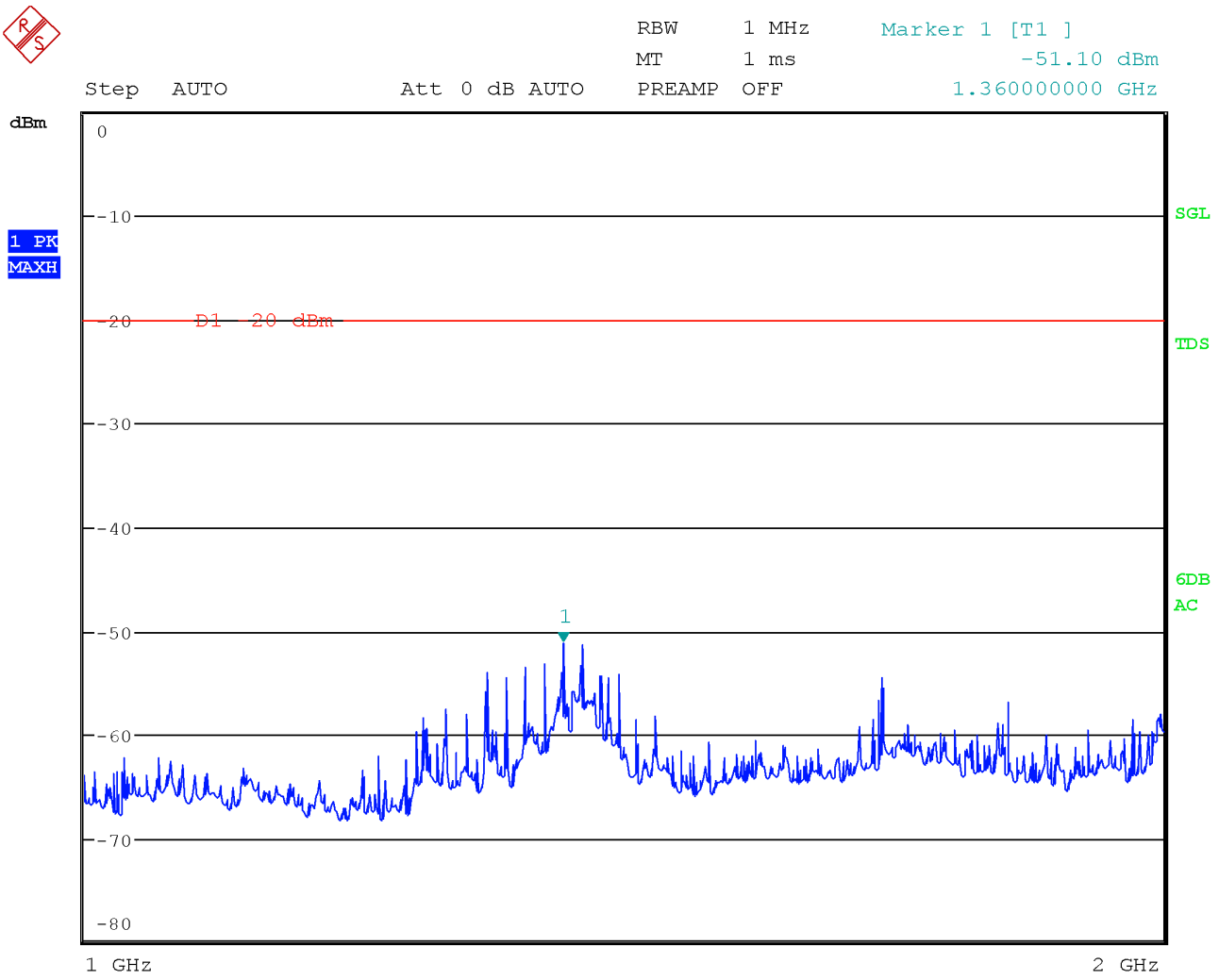

Limit exceeds by the carrier
Channel LOW – C4FM modulation with 12.5 kHz channel bandwidth
Frequency range 30 MHz to 1000 MHz with antenna in horizontal polarization

## Test data



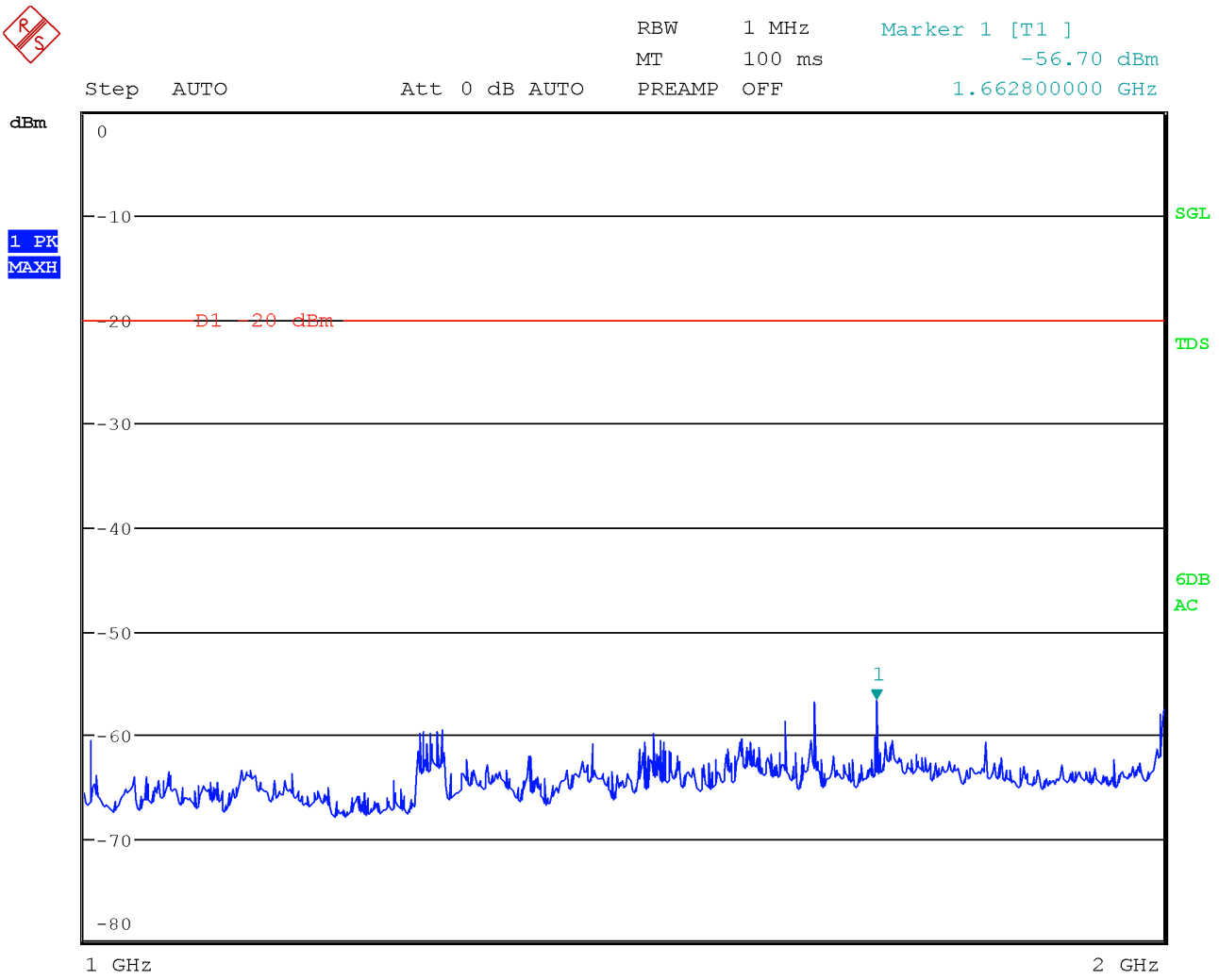

Limit exceeds by the carrier
Channel LOW – C4FM modulation with 12.5 kHz channel bandwidth
Frequency range 30 MHz to 1000 MHz with antenna in vertical polarization

## Test data



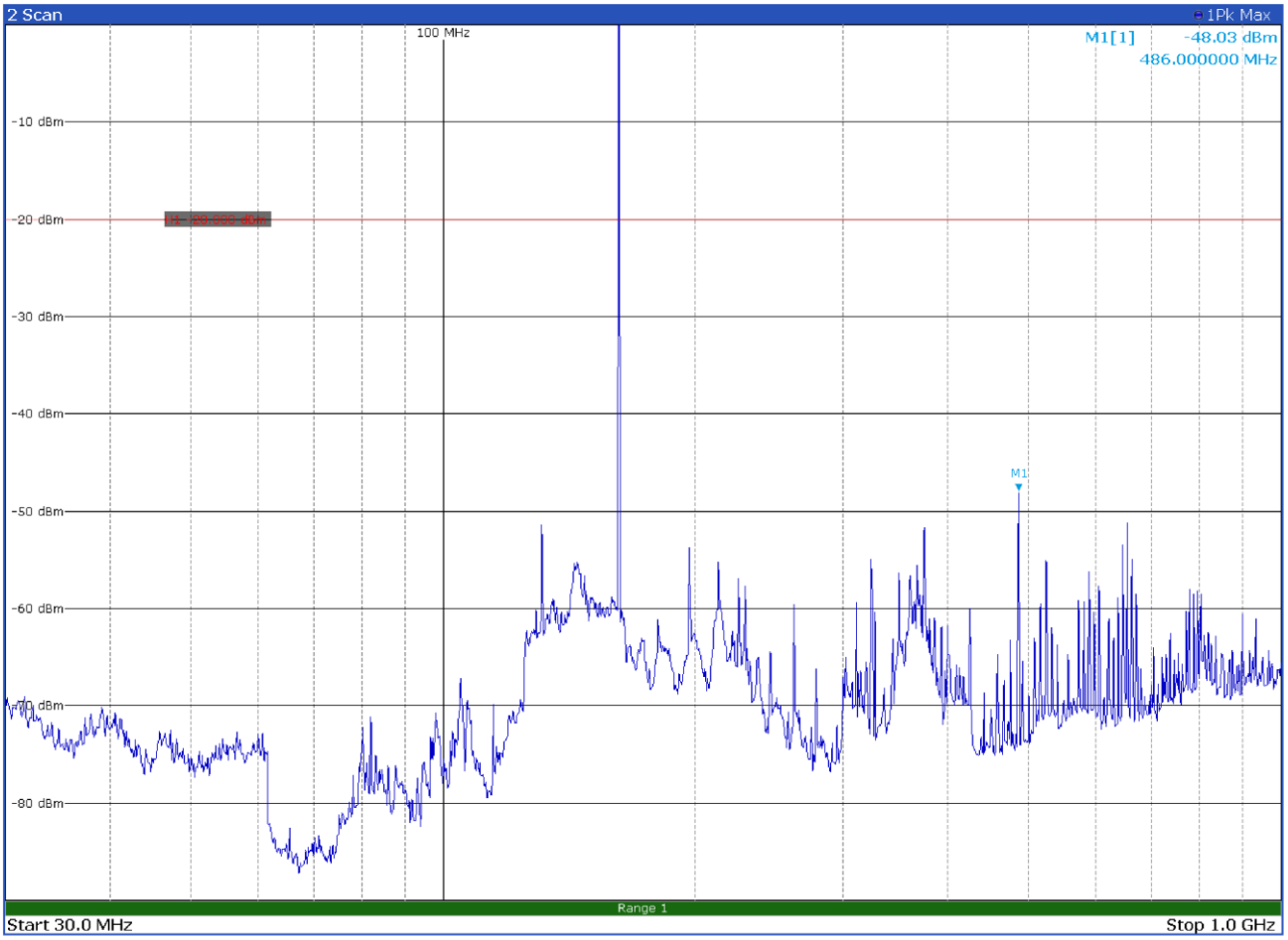

Channel LOW – C4FM modulation with 12.5 kHz channel bandwidth
Frequency range 1000 MHz to 2000 MHz with antenna in vertical polarization

## Test data



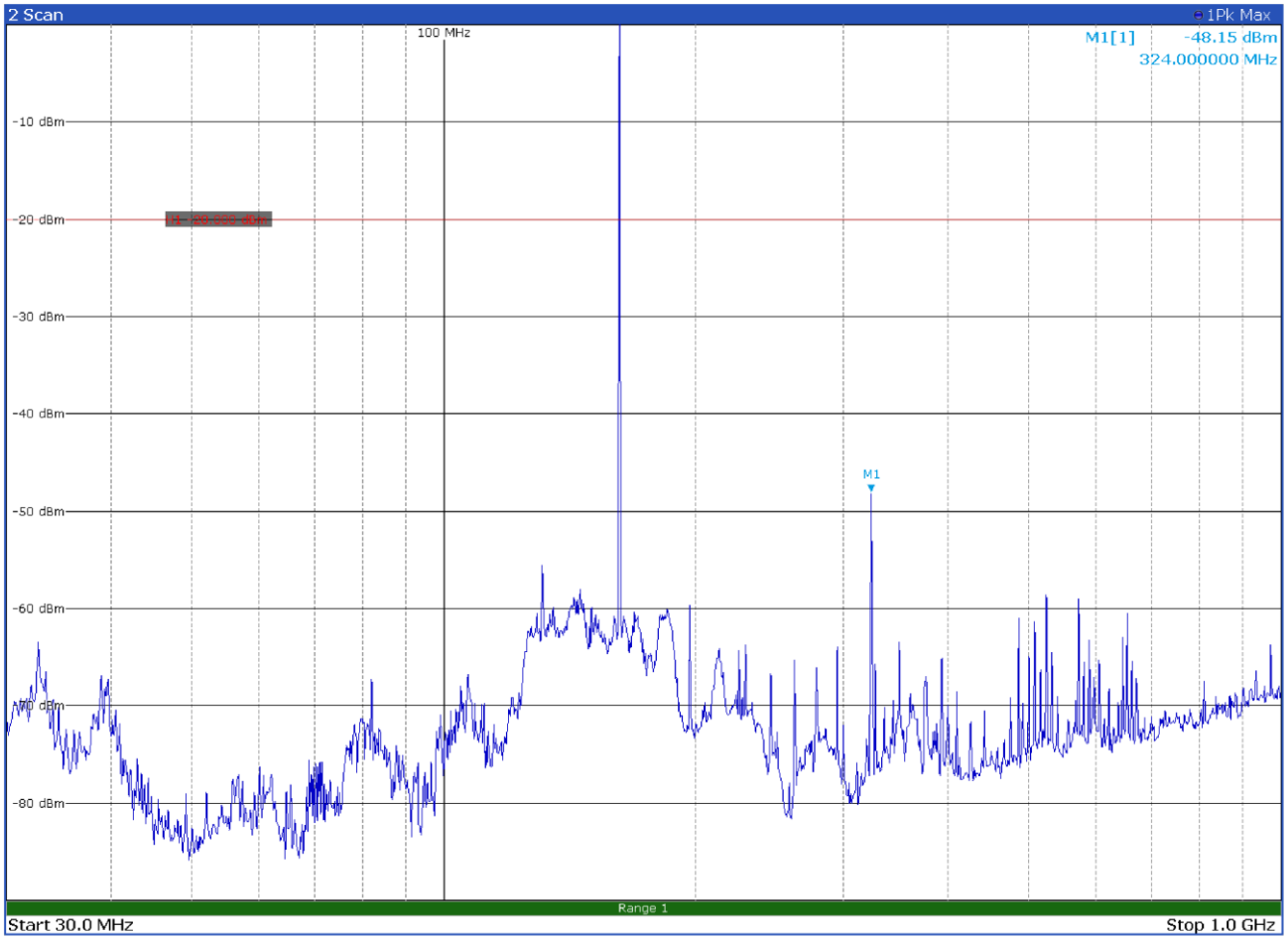

Channel LOW – C4FM modulation with 12.5 kHz channel bandwidth
Frequency range 1000 MHz to 2000 MHz with antenna in horizontal polarization

## Test data



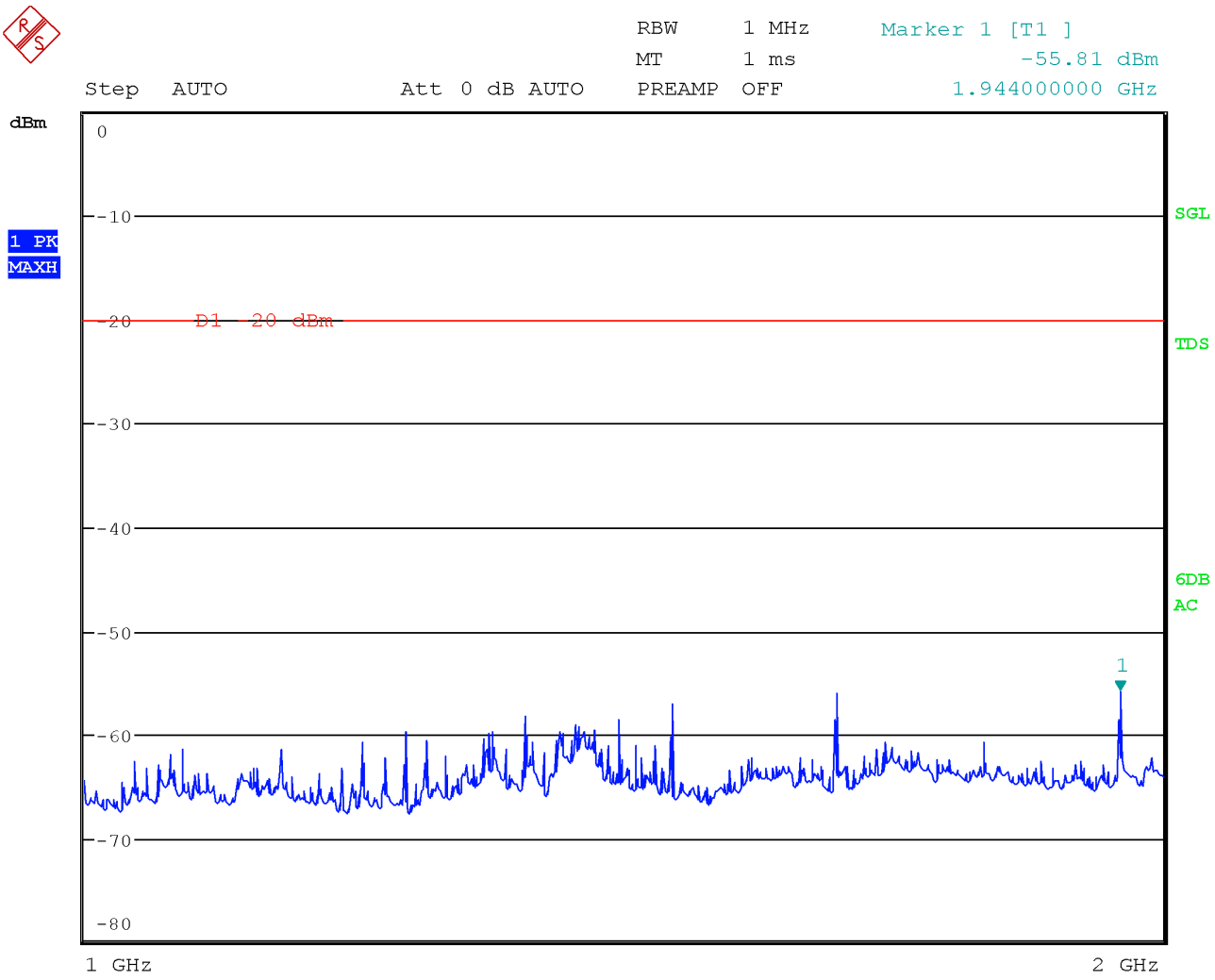

Limit exceeds by the carrier
Channel MID – C4FM modulation with 12.5 kHz channel bandwidth
Frequency range 30 MHz to 1000 MHz with antenna in horizontal polarization

## Test data



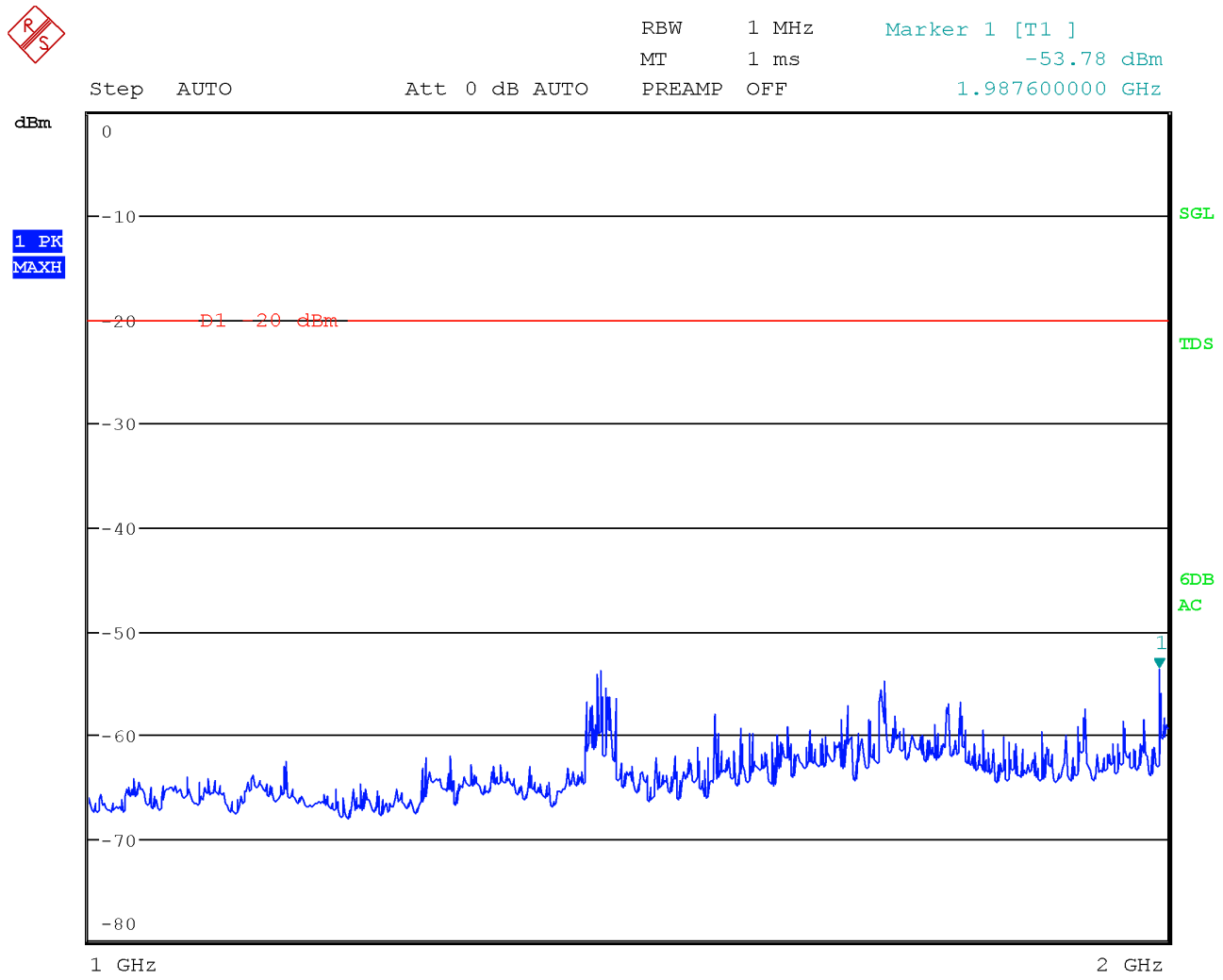

Limit exceeds by the carrier
Channel MID – C4FM modulation with 12.5 kHz channel bandwidth
Frequency range 30 MHz to 1000 MHz with antenna in vertical polarization

## Test data



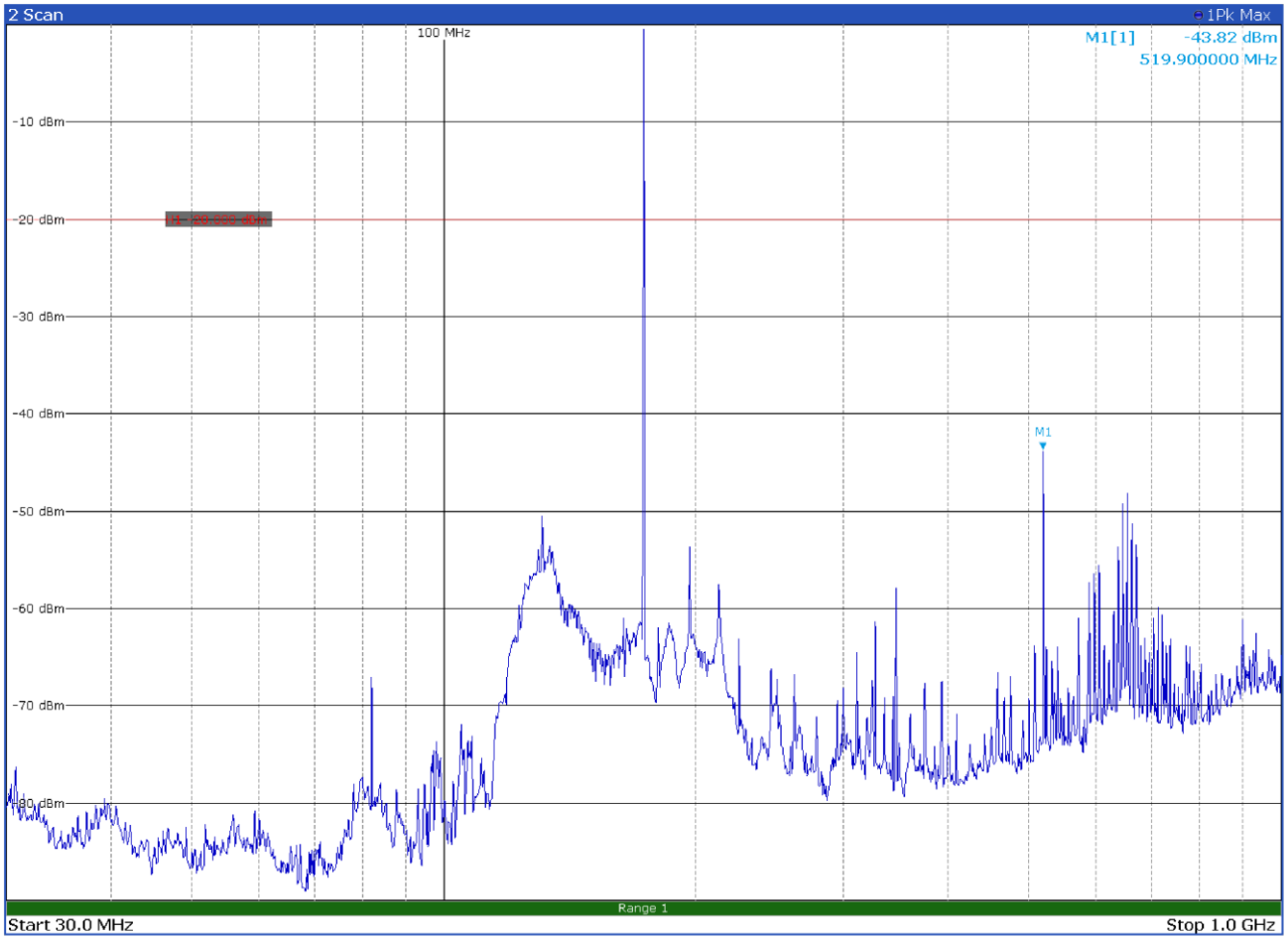

Channel MID – C4FM modulation with 12.5 kHz channel bandwidth
Frequency range 1000 MHz to 2000 MHz with antenna in vertical polarization

## Test data



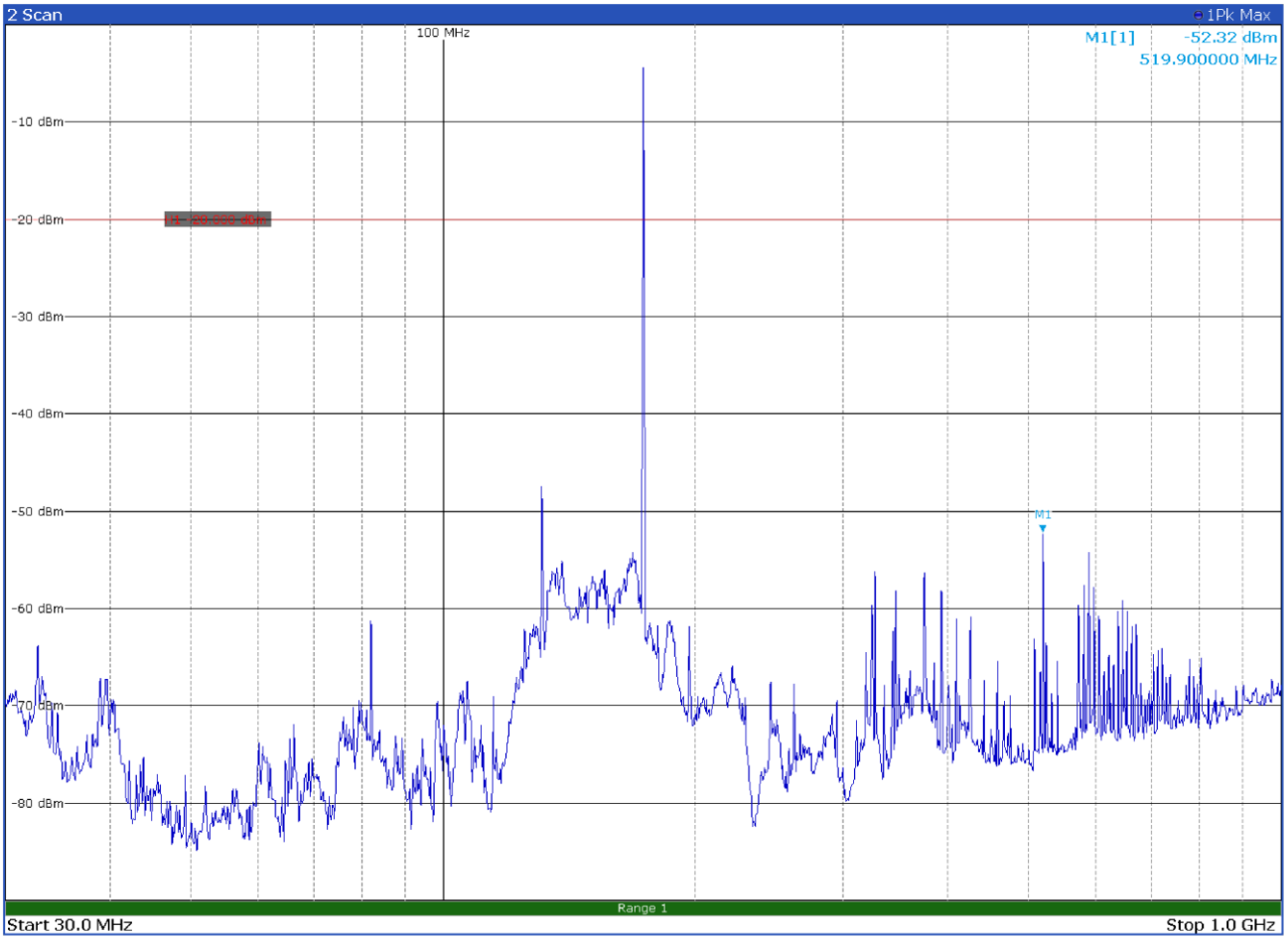

Channel MID – C4FM modulation with 12.5 kHz channel bandwidth
Frequency range 1000 MHz to 2000 MHz with antenna in horizontal polarization

## Test data



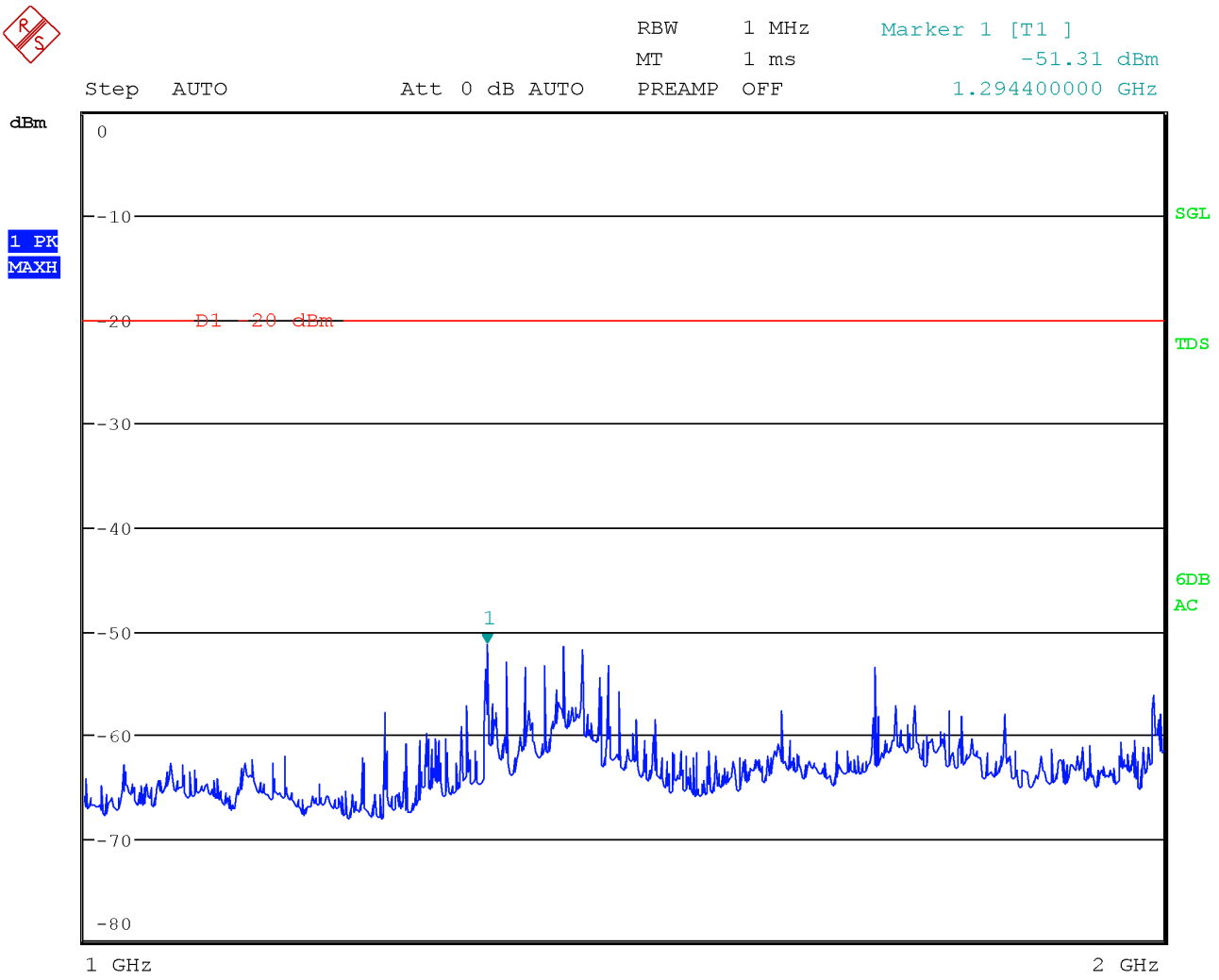

Limit exceeds by the carrier
Channel HIGH – C4FM modulation with 12.5 kHz channel bandwidth
Frequency range 30 MHz to 1000 MHz with antenna in horizontal polarization

## Test data



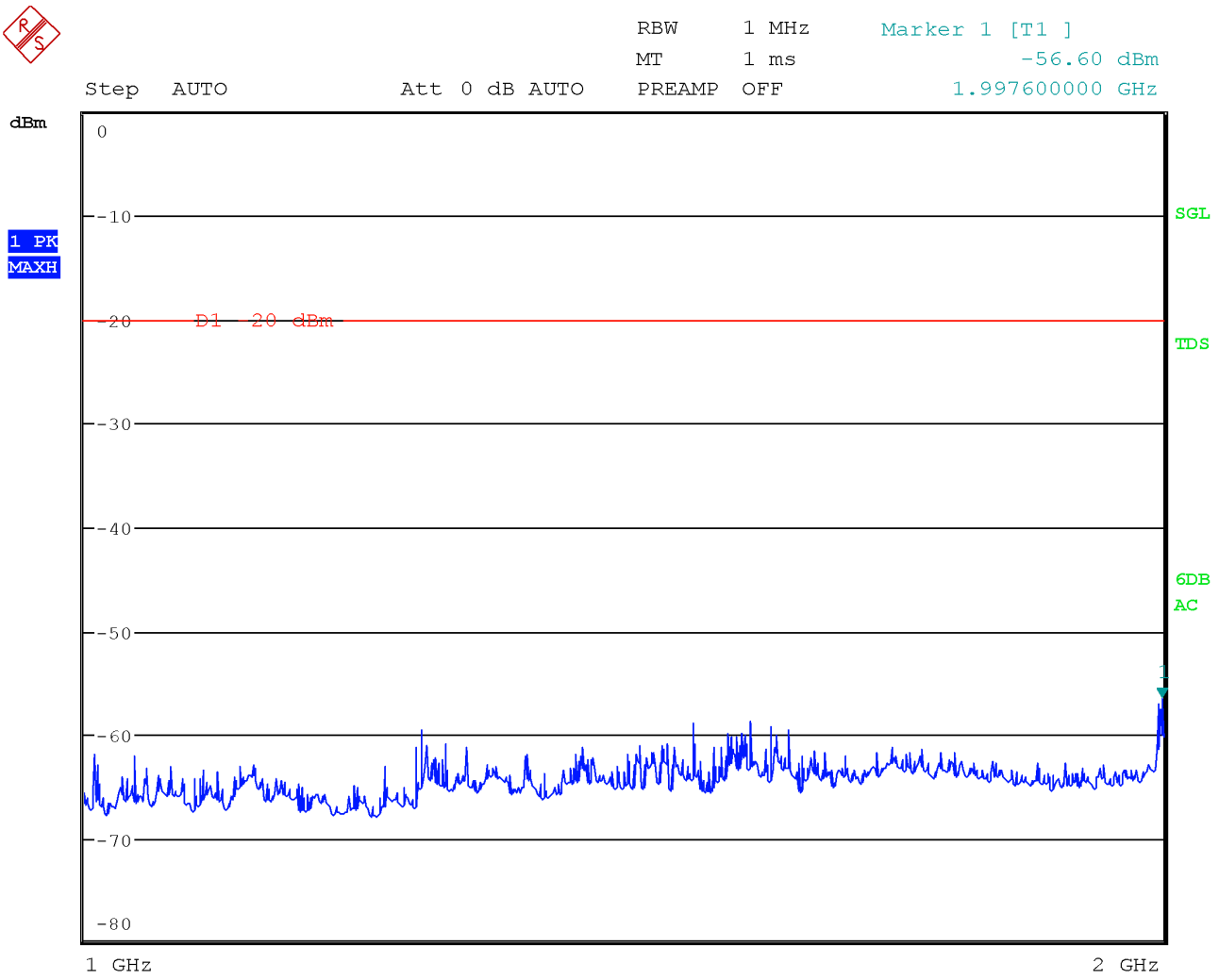

Limit exceeds by the carrier
Channel HIGH – C4FM modulation with 12.5 kHz channel bandwidth
Frequency range 30 MHz to 1000 MHz with antenna in vertical polarization

## Test data




Channel HIGH – C4FM modulation with 12.5 kHz channel bandwidth
Frequency range 1000 MHz to 2000 MHz with antenna in vertical polarization

## Test data




Channel HIGH – C4FM modulation with 12.5 kHz channel bandwidth
Frequency range 1000 MHz to 2000 MHz with antenna in horizontal polarization

## Clause 90.213 and 22.355 Frequency stability

**§90.213 Frequency stability.**

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

[Parts per million (ppm)]

| Frequency range (MHz) | Fixed and base stations | Mobile stations | |
|---|---|---|---|
| | | Over 2 watts output power | 2 watts or less output power |
| Below 25 | [1 2 3]100 | 100 | 200 |
| 25-50 | 20 | 20 | 50 |
| 72-76 | 5 | | 50 |
| 150-174 | [5 11]5 | [6]5 | [4 6]50 |
| 216-220 | 1.0 | | 1.0 |
| 220-222[12] | 0.1 | 1.5 | 1.5 |
| 421-512 | [7 11 14]2.5 | [8]5 | [8]5 |
| 806-809 | [14]1.0 | 1.5 | 1.5 |
| 809-824 | [14]1.5 | 2.5 | 2.5 |
| 851-854 | 1.0 | 1.5 | 1.5 |
| 854-869 | 1.5 | 2.5 | 2.5 |
| 896-901 | [14]0.1 | 1.5 | 1.5 |
| 902-928 | 2.5 | 2.5 | 2.5 |
| 902-928[13] | 2.5 | 2.5 | 2.5 |
| 929-930 | 1.5 | | |
| 935-940 | 0.1 | 1.5 | 1.5 |
| 1427-1435 | [9]300 | 300 | 300 |
| Above 2450[10] | | | |

[4]Stations operating in the 154.45 to 154.49 MHz or the 173.2 to 173.4 MHz bands must have a frequency stability of 5 ppm.
[5]In the 150-174 MHz band, fixed and base stations with a 25 kHz channel bandwidth must have a frequency stability of 2.5 ppm. Fixed and base stations with a 6.25 kHz channel bandwidth must have a frequency stability of 1.0 ppm.
[6]In the 150-174 MHz band, mobile stations designed to operate with a 25 kHz channel bandwidth or designed to operate on a frequency specifically designated for itinerant use or designed for low-power operation of two watts or less, must have a frequency stability of 5.0 ppm. Mobile stations designed to operate with a 6.25 kHz channel bandwidth must have a frequency stability of 2.0 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.

**§22.355 Frequency tolerance.**

Except as otherwise provided in this part, the carrier frequency of each transmitter in the Public Mobile Services must be maintained within the tolerances given in Table C-1 of this section.

| Frequency range (MHz) | Base, fixed (ppm) | Mobile >3 watts (ppm) | Mobile ≤3 watts (ppm) |
|---|---|---|---|
| 25 to 50 | 20.0 | 20.0 | 50.0 |
| 50 to 450 | 5.0 | 5.0 | 50.0 |
| 450 to 512 | 2.5 | 5.0 | 5.0 |
| 821 to 896 | 1.5 | 2.5 | 2.5 |
| 928 to 929 | 5.0 | n/a | n/a |
| 929 to 960 | 1.5 | n/a | n/a |
| 2110 to 2220 | 10.0 | n/a | n/a |

**§2.1055 Measurements required: Frequency stability.**

(a) The frequency stability shall be measured with variation of ambient temperature as follows:
- (1) From −30° to + 50° centigrade for all equipment except that specified in paragraphs (a) (2) and (3) of this section.
- (2) From −20° to + 50° centigrade for equipment to be licensed for use in the Maritime Services under part 80 of this chapter, except for Class A, B, and S Emergency Position Indicating Radiobeacons (EPIRBS), and equipment to be licensed for use above 952 MHz at operational fixed stations in all services, stations in the Local Television Transmission Service and Point-to-Point Microwave Radio Service under part 21 of this chapter, equipment licensed for use aboard aircraft in the Aviation Services under part 87 of this chapter, and equipment authorized for use in the Family Radio Service under part 95 of this chapter.
- (3) From 0° to + 50° centigrade for equipment to be licensed for use in the Radio Broadcast Services under part 73 of this chapter.

(b) Frequency measurements shall be made at the extremes of the specified temperature range and at intervals of not more than 10° centigrade through the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. The short term transient effects on the frequency of the transmitter due to keying (except for broadcast transmitters) and any heating element cycling normally occurring at each ambient temperature level also shall be shown. Only the portion or portions of the transmitter containing the frequency determining and stabilizing circuitry need be subjected to the temperature variation test.

(c) In addition to all other requirements of this section, the following information is required for equipment incorporating heater type crystal oscillators to be used in mobile stations, for which type acceptance is first requested after March 25, 1974, except for battery powered, hand carried, portable equipment having less than 3 watts mean output power.

(1) Measurement data showing variation in transmitter output frequency from a cold start and the elapsed time necessary for the frequency to stabilize within the applicable tolerance. Tests shall be made after temperature stabilization at each of the ambient temperature levels; the lower temperature limit, 0° centigrade and + 30° centigrade with no primary power applied.

(2) Beginning at each temperature level specified in paragraph (c)(1) of this section, the frequency shall be measured within one minute after application of primary power to the transmitter and at intervals of no more than one minute thereafter until ten minutes have elapsed or until sufficient measurements are obtained to indicate clearly that the frequency has stabilized within the applicable tolerance, whichever time period is greater. During each test, the ambient temperature shall not be allowed to rise more than 10° centigrade above the respective beginning ambient temperature level.

(3) The elapsed time necessary for the frequency to stabilize within the applicable tolerance from each beginning ambient temperature level as determined from the tests specified in this paragraph shall be specified in the instruction book for the transmitter furnished to the user.

When it is impracticable to subject the complete transmitter to this test because of its physical dimensions or power rating, only its frequency determining and stabilizing portions need be tested.

(d) The frequency stability shall be measured with variation of primary supply voltage as follows:

(1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.

(2) For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.

(3) The supply voltage shall be measured at the input to the cable normally provided with the equipment, or at the power supply terminals if cables are not normally provided. Effects on frequency of transmitter keying (except for broadcast transmitters) and any heating element cycling at the nominal supply voltage and at each extreme also shall be shown.

(e) When deemed necessary, the Commission may require tests of frequency stability under conditions in addition to those specifically set out in paragraphs (a), (b), (c), and (d) of this section. (For example measurements showing the effect of proximity to large metal objects, or of various types of antennas, may be required for portable equipment.)

Test date: 2023-05-29

Test results: Pass

Modulation used: CW

Test equipment used

| Description | Manufacturer | Model | Identifier |
|---|---|---|---|
| EMI Receiver | Rohde & Schwarz | ESU8 | 100202 |
| Climatic Chamber | MSL | EC500DA | 15022 |

Test data

| Test conditions | Frequency (MHz) | ppm |
|---|---|---|
| +50 °C, Nominal | 162.0000254 | 0.03 |
| +40 °C, Nominal | 162.0000269 | 0.02 |
| +30 °C, Nominal | 162.0000286 | 0.01 |
| +20 °C, +15 % | 162.0000305 | 0 |
| +20 °C, Nominal | 162.0000305 | *Reference* |
| +20 °C, −15 % | 162.0000305 | 0 |
| +10 °C, Nominal | 162.0000320 | 0.01 |
| 0 °C, Nominal | 162.0000385 | 0.05 |
| −10 °C, Nominal | 162.0000442 | 0.08 |
| −20 °C, Nominal | 162.0000538 | 0.14 |
| −30 °C, Nominal | 162.0000617 | 0.19 |
| Limit applied: 2.5 ppm | | |

## Clause 90.214 Transient frequency behaviour

Transmitters designed to operate in the 150-174 MHz and 421-512 MHz frequency bands must maintain transient frequencies within the maximum frequency difference limits during the time intervals indicated:

| Time intervals[1 2] | Maximum frequency difference[3] | All equipment | |
|---|---|---|---|
| | | 150 to 174 MHz | 421 to 512 MHz |
| Transient Frequency Behavior for Equipment Designed to Operate on 25 kHz Channels | | | |
| $t_1$[4] | ±25.0 kHz | 5.0 ms | 10.0 ms |
| $t_2$ | ±12.5 kHz | 20.0 ms | 25.0 ms |
| $t_3$[4] | ±25.0 kHz | 5.0 ms | 10.0 ms |
| Transient Frequency Behavior for Equipment Designed to Operate on 12.5 kHz Channels | | | |
| $t_1$[4] | ±12.5 kHz | 5.0 ms | 10.0 ms |
| $t_2$ | ±6.25 kHz | 20.0 ms | 25.0 ms |
| $t_3$[4] | ±12.5 kHz | 5.0 ms | 10.0 ms |
| Transient Frequency Behavior for Equipment Designed to Operate on 6.25 kHz Channels | | | |
| $t_1$[4] | ±6.25 kHz | 5.0 ms | 10.0 ms |
| $t_2$ | ±3.125 kHz | 20.0 ms | 25.0 ms |
| $t_3$[4] | ±6.25 kHz | 5.0 ms | 10.0 ms |

[1] on is the instant when a 1 kHz test signal is completely suppressed, including any capture time due to phasing.
t1 is the time period immediately following ton.
t2 is the time period immediately following t1.
t3 is the time period from the instant when the transmitter is turned off until toff.
toff is the instant when the 1 kHz test signal starts to rise.

[2] During the time from the end of t2 to the beginning of t3, the frequency difference must not exceed the limits specified in §90.213.

[3] Difference between the actual transmitter frequency and the assigned transmitter frequency.

[4] If the transmitter carrier output power rating is 6 watts or less, the frequency difference during this time period may exceed the maximum frequency difference for this time period.

Test date: 2023-05-25

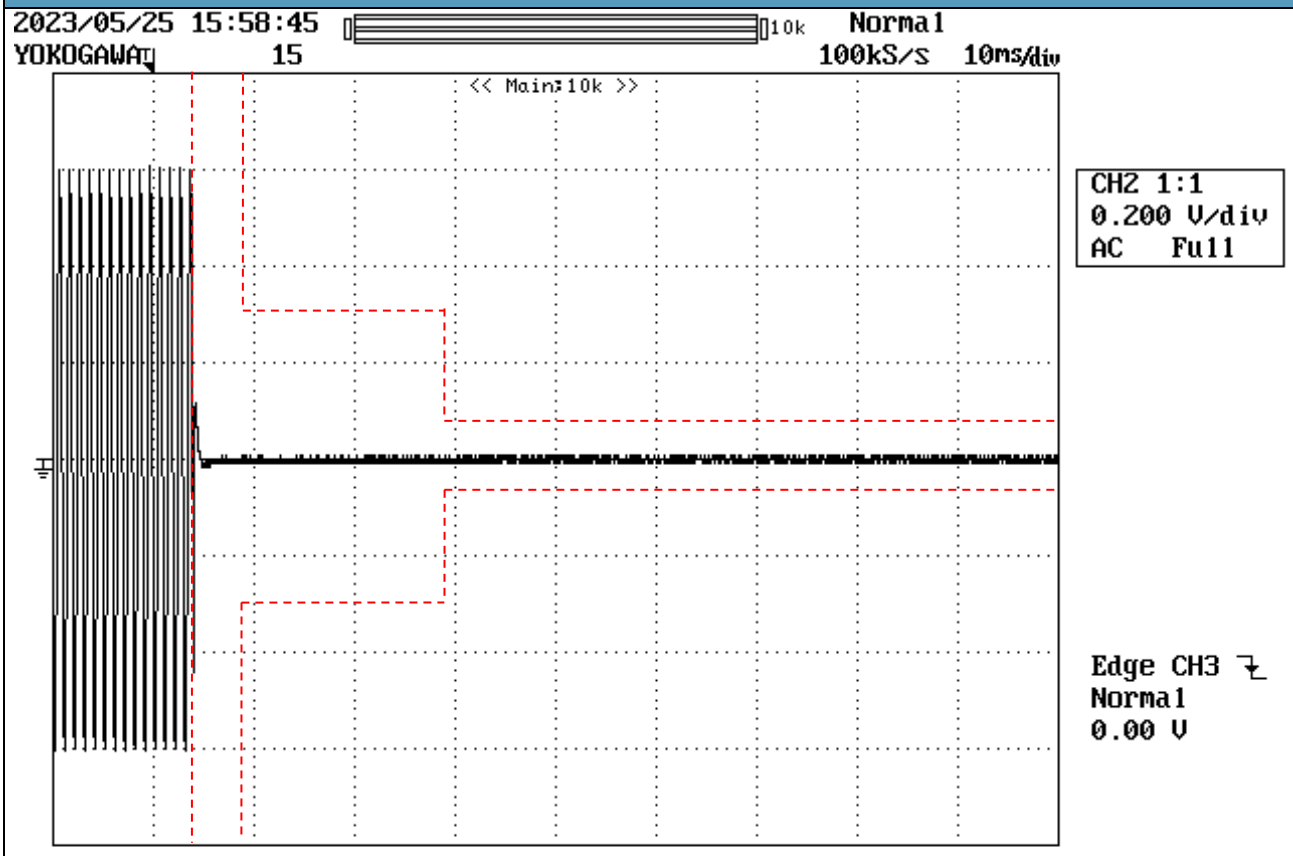
Test results: Pass

Modulation used: 11K0F3E

Test equipment used

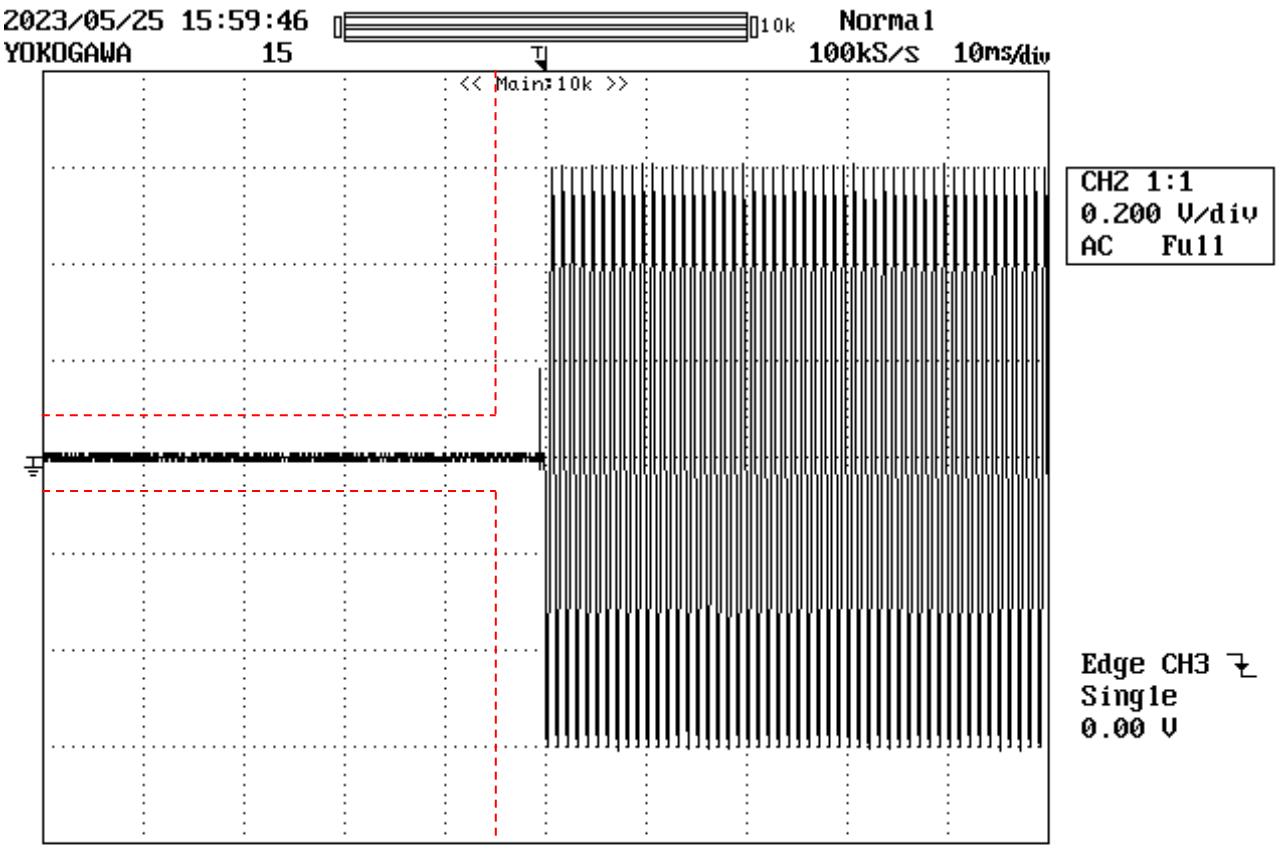
| Description | Manufacturer | Model | Identifier |
|---|---|---|---|
| EMI Receiver | Rohde & Schwarz | ESW44 | 101620 |
| Oscilloscope | Yokogawa | DL1740£ | 27D904989 |
| Radiocommunication Tester | R&S | CMT | 883152/001 |

Test data




Switch on condition, $t_1$=5 ms, $t_2$=20 ms, 162 MHz, channel separation ± 25 kHz

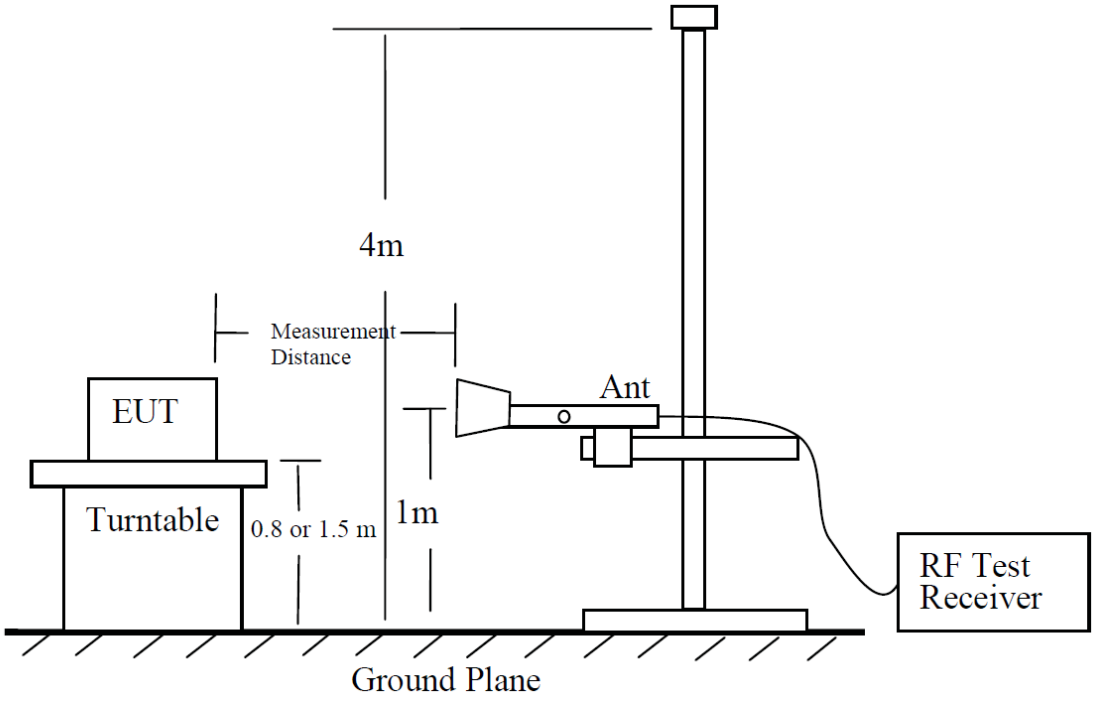
## Test data



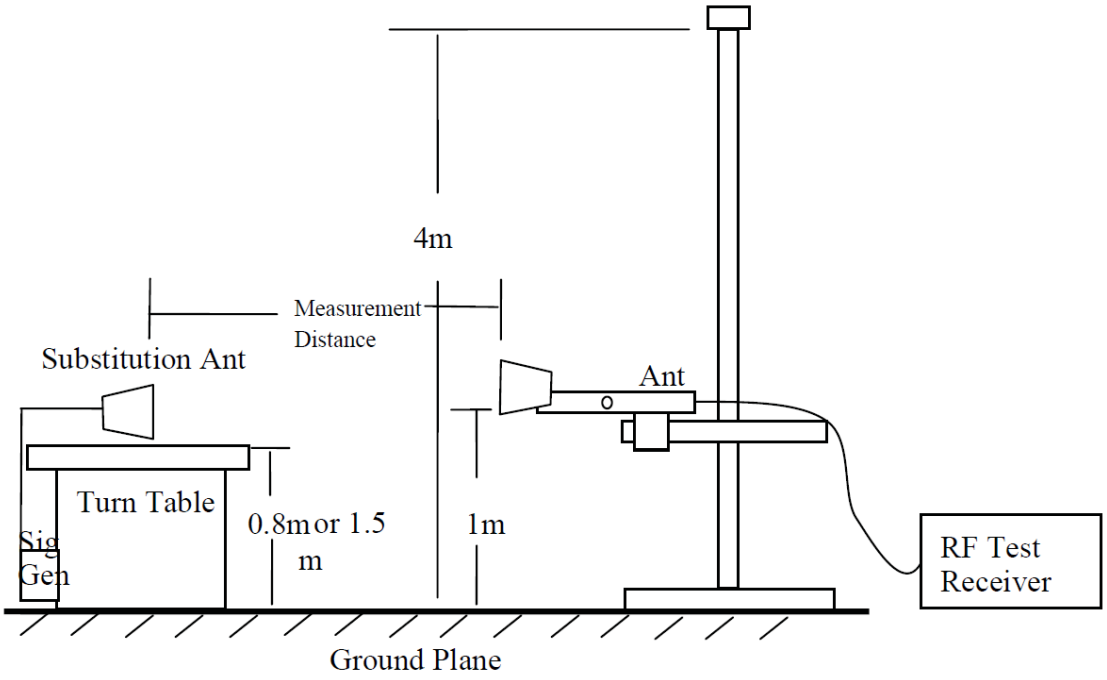

Switch off condition, $t_3$=5 ms, 162 MHz, channel separation ± 25 kHz

# Appendix B: Block diagrams of test set-ups

## Radiated emissions set-up




## Substitution method set-up for radiated emission



End of report