

ON Semiconductor®



APPLICATION NOTE AND9315/D

AX5043

**Use in Compliance with ETSI
EN 300 220-1**

Revision 2



Table of Contents

1. General	4
Frequency Error ETSI EN 300 220-1 V2.3.1 (2010-02), Sub-clause 7.1	4
2. Wireless M-Bus T Mode Transmitter (868 MHz wide band, 100 kbps)	5
2.1. Setup	5
2.2. Regulatory Requirements	6
2.3. Measurements	6
Output Power ETSI EN 300 220-1 V2.3.1 (2010-02), Subclause 7.2	6
Modulation Bandwidth EN 300 220-1 V2.3.1 (2010-02), Subclause 7.7	7
Unwanted Emissions in Spurious Domains EN 300 220-1 V2.3.1 (2010-02), Subclause 7.8	10
3. Wireless M-Bus S Mode Transmitter (868 MHz wide band, 32.768 kbps) ..	12
3.1. Setup	12
3.2. Regulatory Requirements	13
3.3. Measurements	13
Output Power ETSI EN 300 220-1 V2.3.1 (2010-02), Subclause 7.2	13
Modulation Bandwidth EN 300 220-1 V2.3.1 (2010-02), Subclause 7.7	14
Unwanted Emissions in Spurious Domains EN 300 220-1 V2.3.1 (2010-02), Subclause 7.8	16
4. 169 MHz narrow band, 12.5 kHz channel spacing, 4.8 kbps	17
4.1. Setup	17
4.2. Regulatory Requirements	18
4.3. Measurements	18
Output Power ETSI EN 300 220-1 V2.3.1 (2010-02), Subclause 7.2	18
Adjacent Channel Power EN 300 220-1 V2.3.1 (2010-02), Subclause 7.6	19
Unwanted Emissions in Spurious Domains EN 300 220-1 V2.3.1 (2010-02), Subclause 7.8	20
5. 169 MHz narrow band, 25 kHz channel spacing, 9.6 kbps	25
5.1. Setup	25



5.2. Regulatory Requirements	25
5.3. Measurements.....	25
Output Power ETSI EN 300 220-1 V2.3.1 (2010-02), Subclause 7.2	25
Adjacent Channel Power EN 300 220-1 V2.3.1 (2010-02), Subclause 7.6.....	26
Unwanted Emissions in Spurious Domains EN 300 220-1 V2.3.1 (2010-02), Subclause 7.8.....	27
6. 433 MHz wide band, 100 kbps	28
6.1. Setup.....	28
6.2. Regulatory Requirements	29
6.3. Measurements.....	29
Output Power ETSI EN 300 220-1 V2.3.1 (2010-02), Subclause 7.2	29
Modulation Bandwidth EN 300 220-1 V2.3.1 (2010-02), Subclause 7.7.....	30
Unwanted Emissions in Spurious Domains EN 300 220-1 V2.3.1 (2010-02), Subclause 7.8.....	33
7. 433 MHz narrow band, 25 kHz channel spacing, 9.6 kbps	36
7.1. Setup.....	36
7.2. Regulatory Requirements	37
7.3. Measurements.....	37
Output Power ETSI EN 300 220-1 V2.3.1 (2010-02), Subclause 7.2	37
Adjacent Channel Power EN 300 220-1 V2.3.1 (2010-02), Subclause 7.6.....	38
Unwanted Emissions in Spurious Domains EN 300 220-1 V2.3.1 (2010-02), Subclause 7.8.....	39
8. 868 MHz narrow band, 25 kHz channel spacing, 9.6 kbps	40
8.1. Setup.....	40
8.2. Regulatory Requirements	41
8.3. Measurements.....	41
Output Power ETSI EN 300 220-1 V2.3.1 (2010-02), Subclause 7.2	41
Adjacent Channel Power EN 300 220-1 V2.3.1 (2010-02), Subclause 7.6.....	42
Unwanted Emissions in Spurious Domains EN 300 220-1 V2.3.1 (2010-02), Subclause 7.8.....	43



1. General

Frequency Error

ETSI EN 300 220-1 V2.3.1 (2010-02), Sub-clause 7.1

The frequency error of the **AX5043** is given by the frequency error of the frequency source XTAL or TCXO.

ETSI EN 300 220-1 requirements are

- +/- 100 ppm for 868 MHz wide band systems,
- +/- 14.4 ppm for 868 MHz narrow band systems,
- +/- 27 ppm for 433 MHz narrow band systems,
- +/- 59 ppm for 169 MHz narrow band systems.

Narrow band refers to channel widths smaller ≤ 25 kHz.

EN 13 757-4 2005 which applies for wireless M-Bus devices, requires stricter frequency errors. 60 or 25 ppm for the center frequency.

Although this is achievable with normal crystals, we do recommend use of a TCXO for optimal performance in narrow band systems.



2. Wireless M-Bus T Mode Transmitter (868 MHz wide band, 100 kbps)

2.1. Setup

Module	AX5043 DVK-1 with 48 MHz XTAL Differential antenna interface Internal VCO & internal synthesizer loop filter
Measurement equipment	0.5 m RG-58 cable from SMA to R&S FSEB spectrum analyzer (note 1)
Mainboard and debug adapter	DVK-2
Setup software	AX-RadioLab V1.1
Carrier Frequency	868.3 MHz
Bit rate	100 kbps
Modulation	GFSK BT=0.3
FSK half deviation	50 kHz
Changes to setup software default register settings	AX5043_PLLCPI_(TX) = 0x01 AX5043_PLLVCOI_(TX) = 0x87 AX5043_0xF00_(TX) = 0x4F AX5043_REF_(TX) = 0x02
Changes to hardware default configuration	Short between pins L2 and L1 48 MHz XTAL
Power level for which module meets ETSI EN 300 220-1 V2.3.1 (2010-02)	14.45 dBm

Notes:

- Values presented are the spectrum analyzer readings. Cable losses are not compensated
- Unless otherwise stated spectrum analyzer settings are:
 - detector function: RMS
 - trace: clear/write



2.2. Regulatory Requirements

ETSI EN 300 220-1 V2.3.1 (2010-02) in frequency band 868.0 - 868.6 MHz.

2.3. Measurements

Output Power

ETSI EN 300 220-1 V2.3.1 (2010-02), Subclause 7.2

AX5043 is outputting CW for this measurement. The ETSI limit for the 868.0 – 868.6 MHz band is 25 mW (14 dBm). Measured output power is 14.45 dBm, all the following measurements are done at this power level.

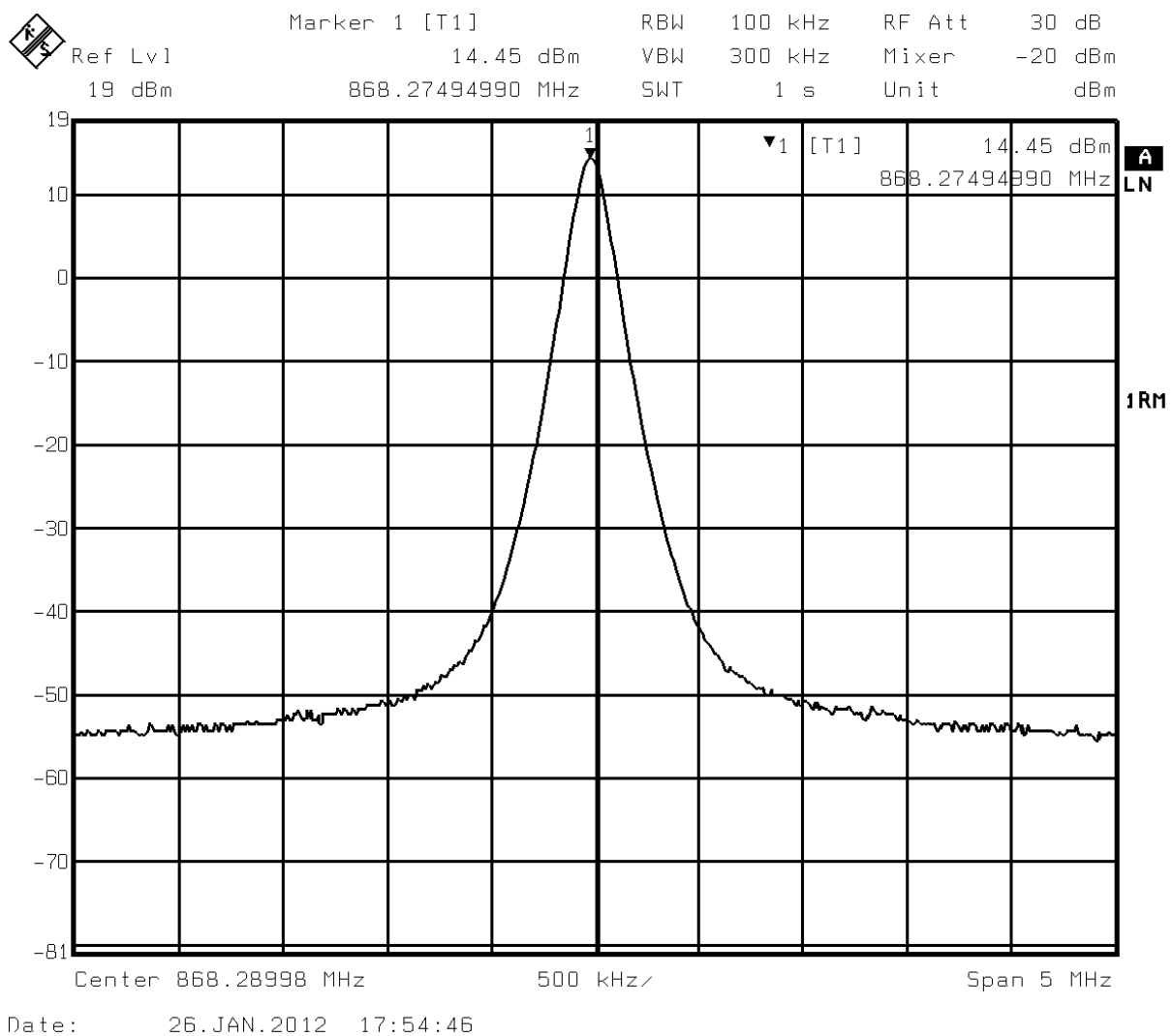


Figure 1: Transmit spectrum, 868.3 MHz, CW

Modulation Bandwidth

EN 300 220-1 V2.3.1 (2010-02), Subclause 7.7

The following three plots show the modulated output at different resolution bandwidths with the corresponding ETSI limit lines.

Spectrum analyzer settings for all three measurements are:

- detector function: max peak
- trace: max hold

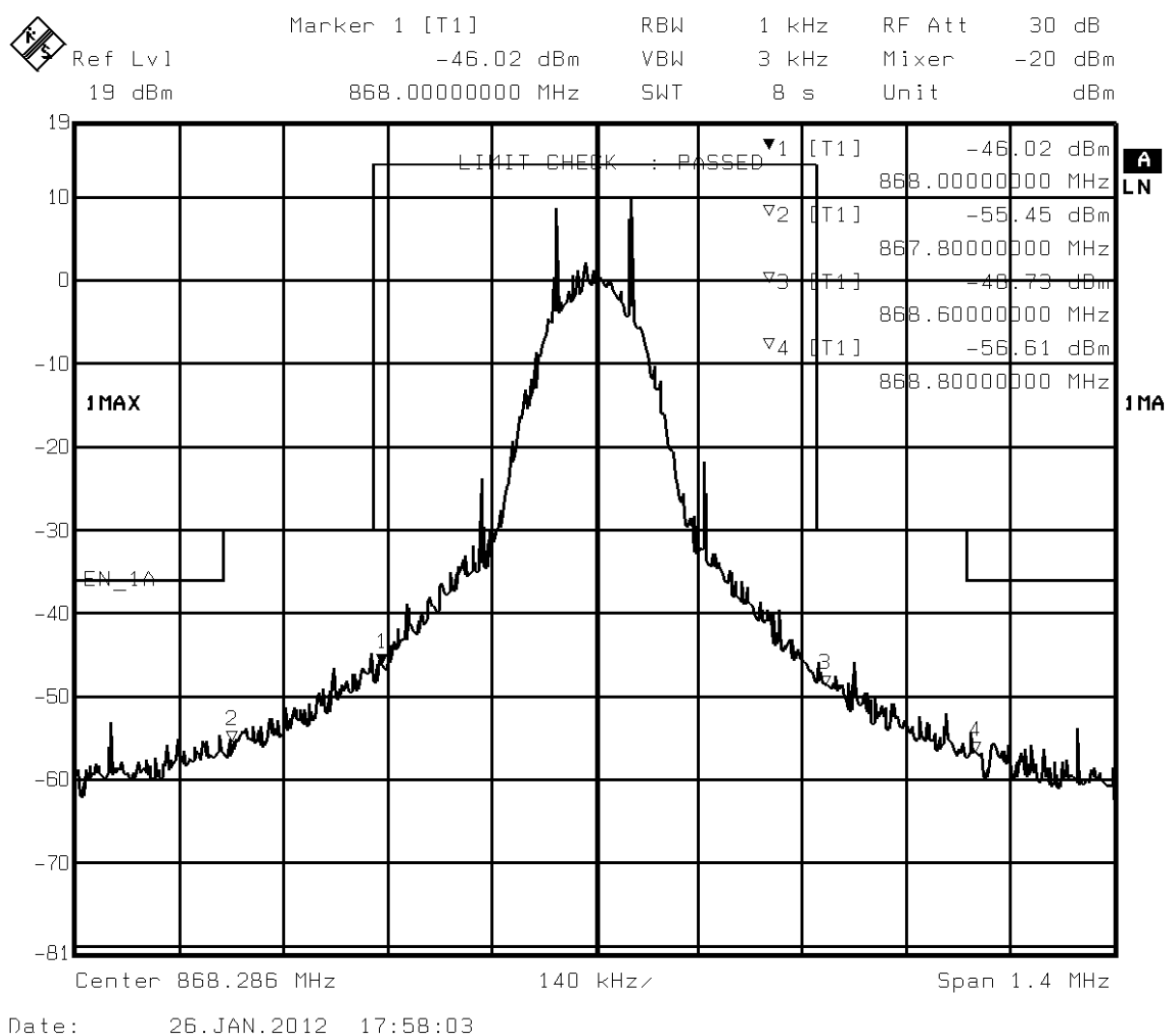


Figure 2: Transmit spectrum, 868.3 MHz, GFSK BT=0.3, 100 kbps, 50 kHz half deviation, RBW=1 kHz, detector max peak, trace max hold

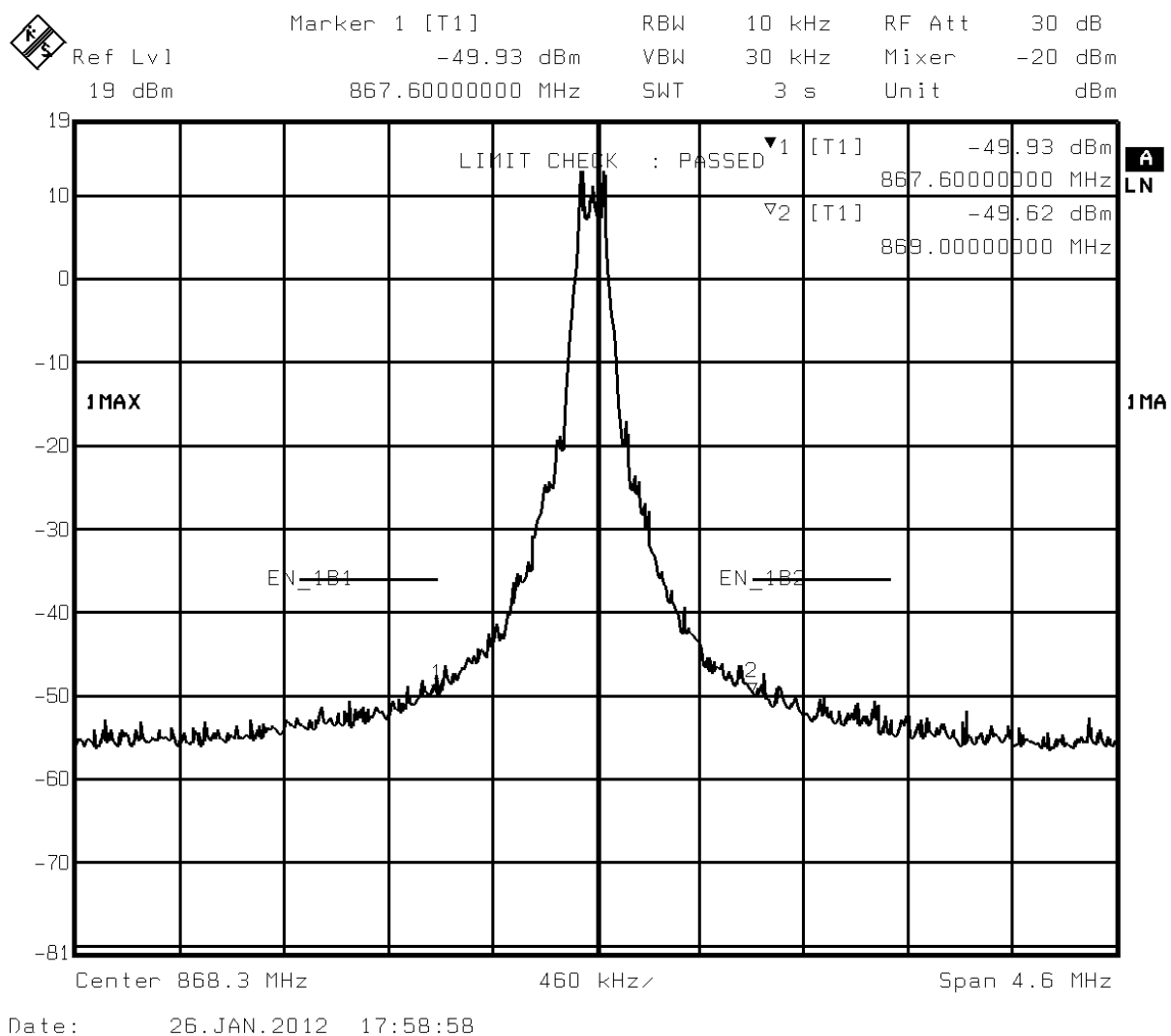


Figure 3: Transmit spectrum, 868.3 MHz, GFSK BT=0.3, 100 kbps, 50 kHz half deviation, RBW=10 kHz, detector max peak, trace max hold

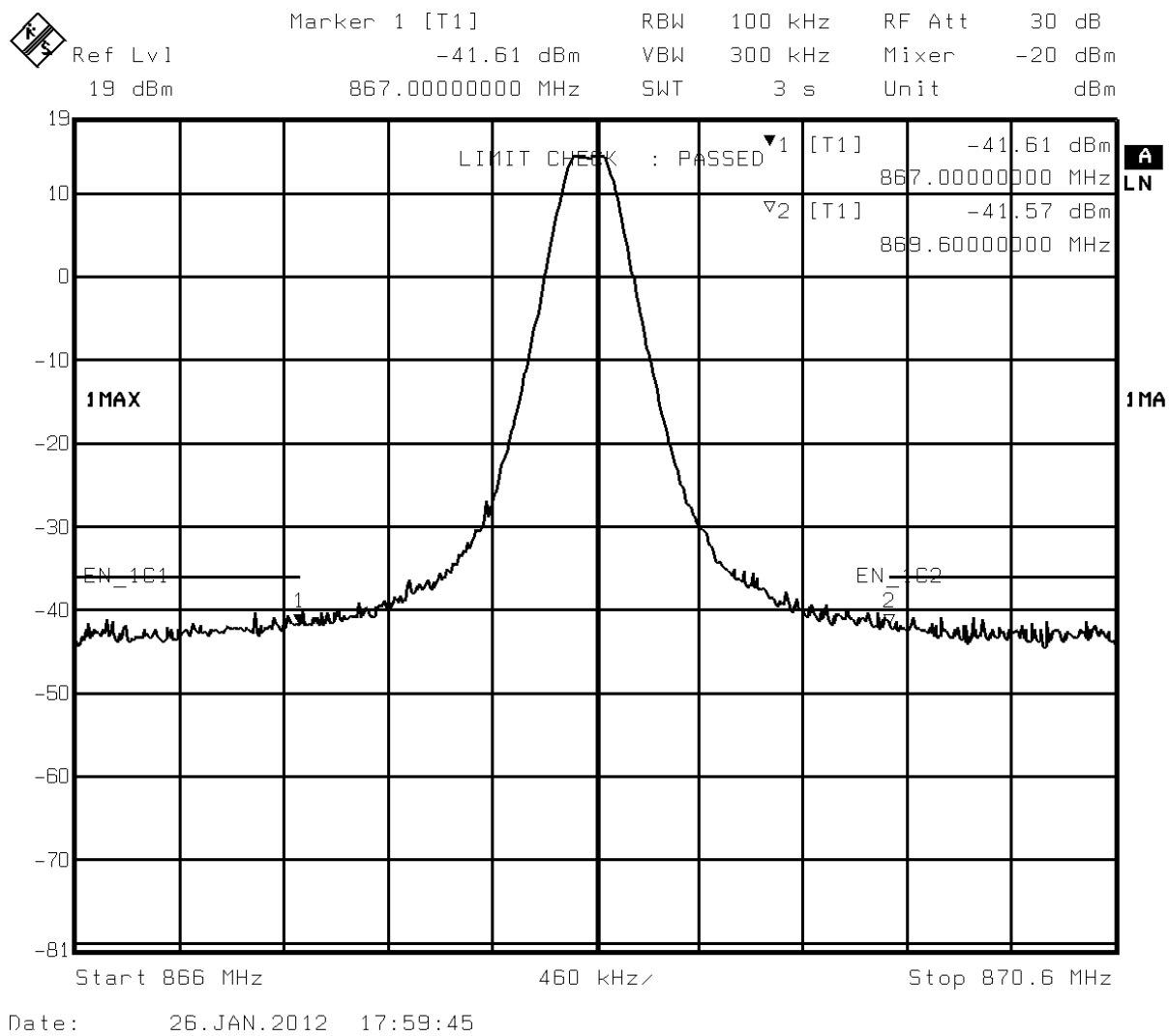


Figure 4: Transmit spectrum, 868.3 MHz, GFSK BT=0.3, 100 kbps, 50 kHz half deviation, RBW=100 kHz, detector max peak, trace max hold



Unwanted Emissions in Spurious Domains EN 300 220-1 V2.3.1 (2010-02), Subclause 7.8

Unwanted emissions are shown for the most critical cases.

470 – 862 MHz

From 470 – 862 MHz the ETSI limit is -54 dBm for an RBW of 100 kHz. The highest measured spur is at -58 dBm

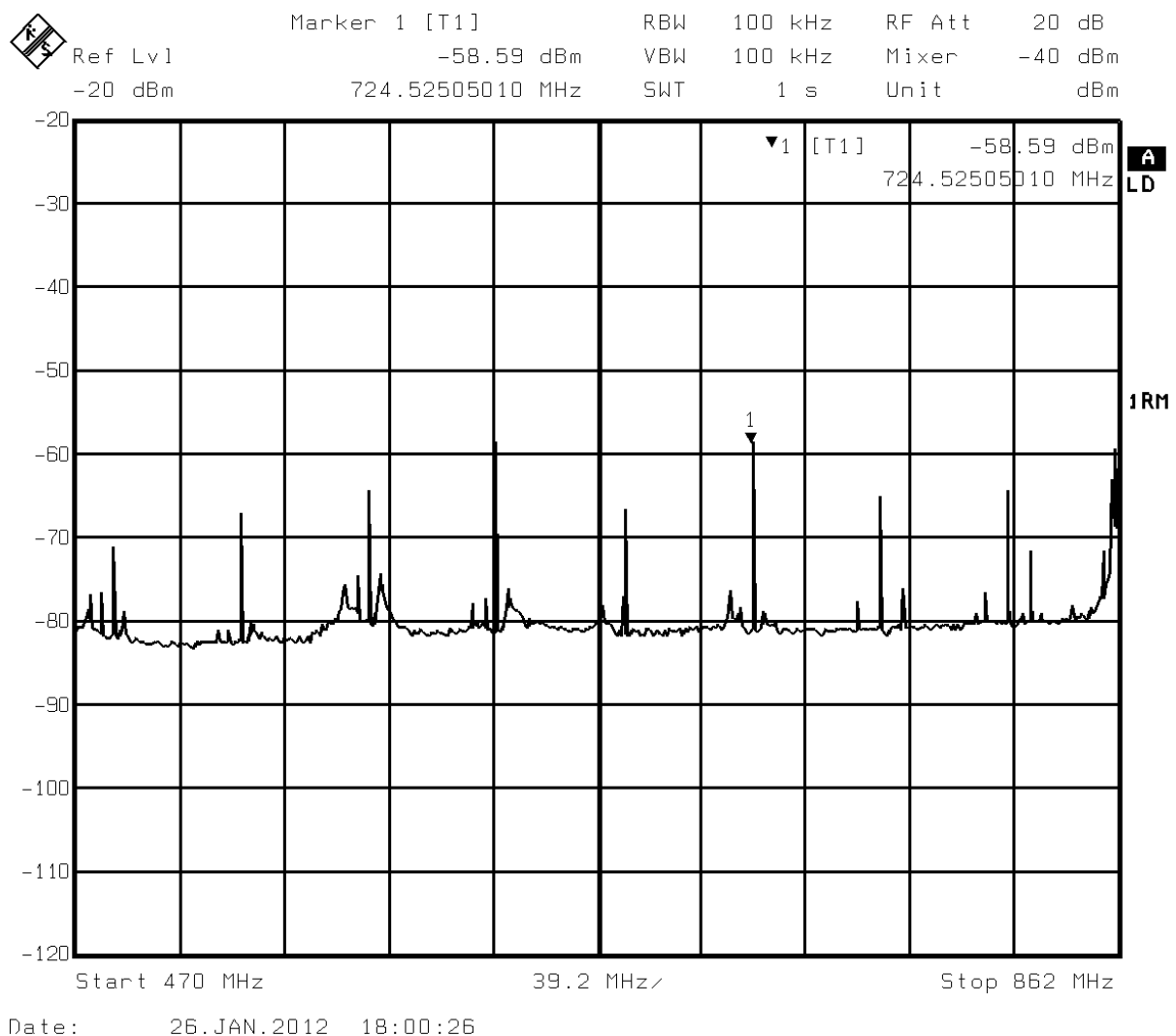


Figure 5: Spurious emission 470 – 862 MHz



HARMONICS

Above 1 GHz the ETSI limit is -30 dBm for an RBW of 1 MHz. Here the harmonics of the wanted signal are most critical.

Spectrum analyzer settings for this measurement are:

- detector function: max peak
- trace: max hold

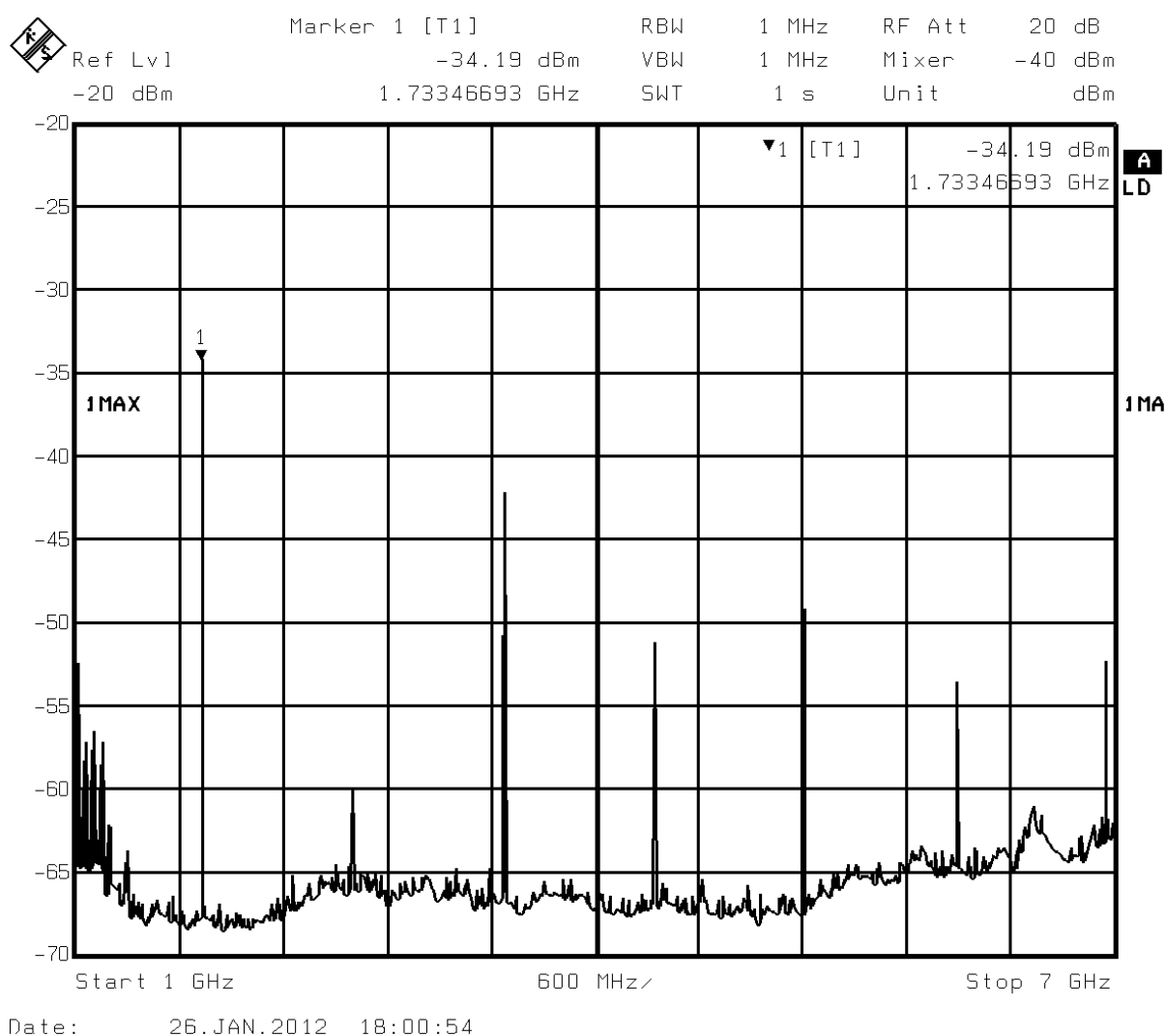


Figure 6: Spurious emission above 1 GHz, detector max peak, trace max hold



3. Wireless M-Bus S Mode Transmitter (868 MHz wide band, 32.768 kbps)

3.1. Setup

Module	AX5043 DVK-1 Module with 48 MHz XTAL Differential antenna interface Internal VCO & internal synthesizer loop filter
Measurement equipment	0.5 m RG-58 cable from SMA to R&S FSEB spectrum analyzer (note 1)
Mainboard and debug adapter	DVK-2
Setup software	AX-RadioLab V1.1
Carrier Frequency	868.3 MHz
Bit rate	32.768 kbps
Modulation	GFSK BT=0.5
FSK half deviation	50 kHz
Changes to setup software default register settings	AX5043_PLLCPI_(TX) = 0x01 AX5043_PLLVCOI_(TX) = 0x87 AX5043_0xF00_(TX) = 0x4F AX5043_REF_(TX) = 0x02
Changes to hardware default configuration	Short between pins L2 and L1 48 MHz XTAL
Power level for which module meets ETSI EN 300 220-1 V2.3.1 (2010-02)	14.45 dBm

Notes:

- Values presented are the spectrum analyzer readings. Cable losses are not compensated
- Unless otherwise stated spectrum analyzer settings are:
 - detector function: RMS
 - trace: clear/write



3.2. Regulatory Requirements

ETSI EN 300 220-1 V2.3.1 (2010-02) in frequency band 868.0 - 868.6 MHz.

3.3. Measurements

Output Power

ETSI EN 300 220-1 V2.3.1 (2010-02), Subclause 7.2

For this measurement plot please see the equivalent section for 100 kbps instead of 32.768 kbps.



Modulation Bandwidth

EN 300 220-1 V2.3.1 (2010-02), Subclause 7.7

The following three plots show the modulated output at different resolution bandwidths with the corresponding ETSI limit lines.

Spectrum analyzer settings for all three measurements are:

- detector function: max peak
- trace: max hold

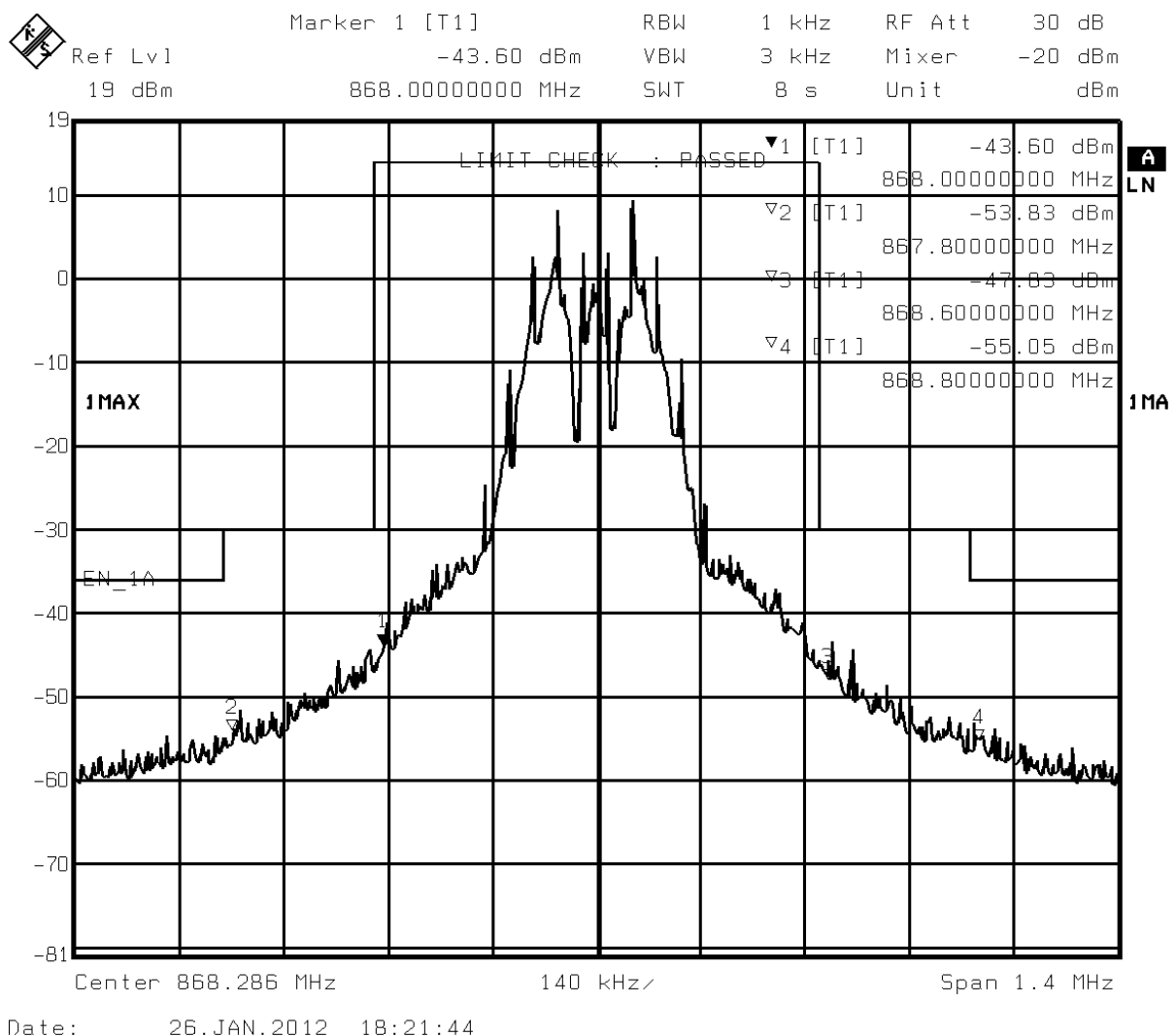


Figure 7: Transmit spectrum, 868.3 MHz, GFSK BT=0.5, 32.768 kbps, 50 kHz half deviation, RBW=1 kHz, detector max peak, trace max hold

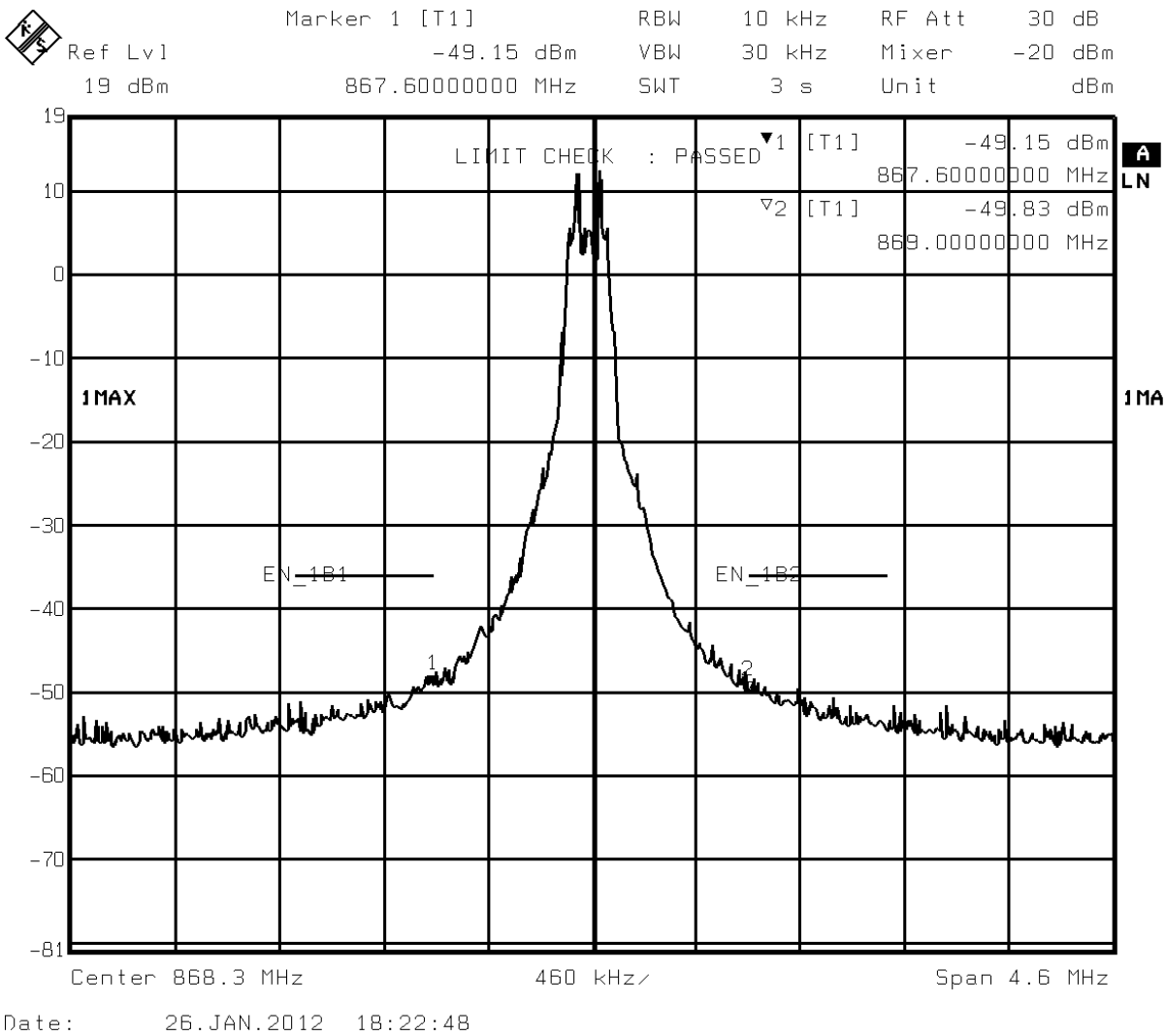


Figure 8: Transmit spectrum, 868.3 MHz, GFSK BT=0.5, 32.768 kbps, 50 kHz half deviation, RBW=10 kHz, detector max peak, trace max hold

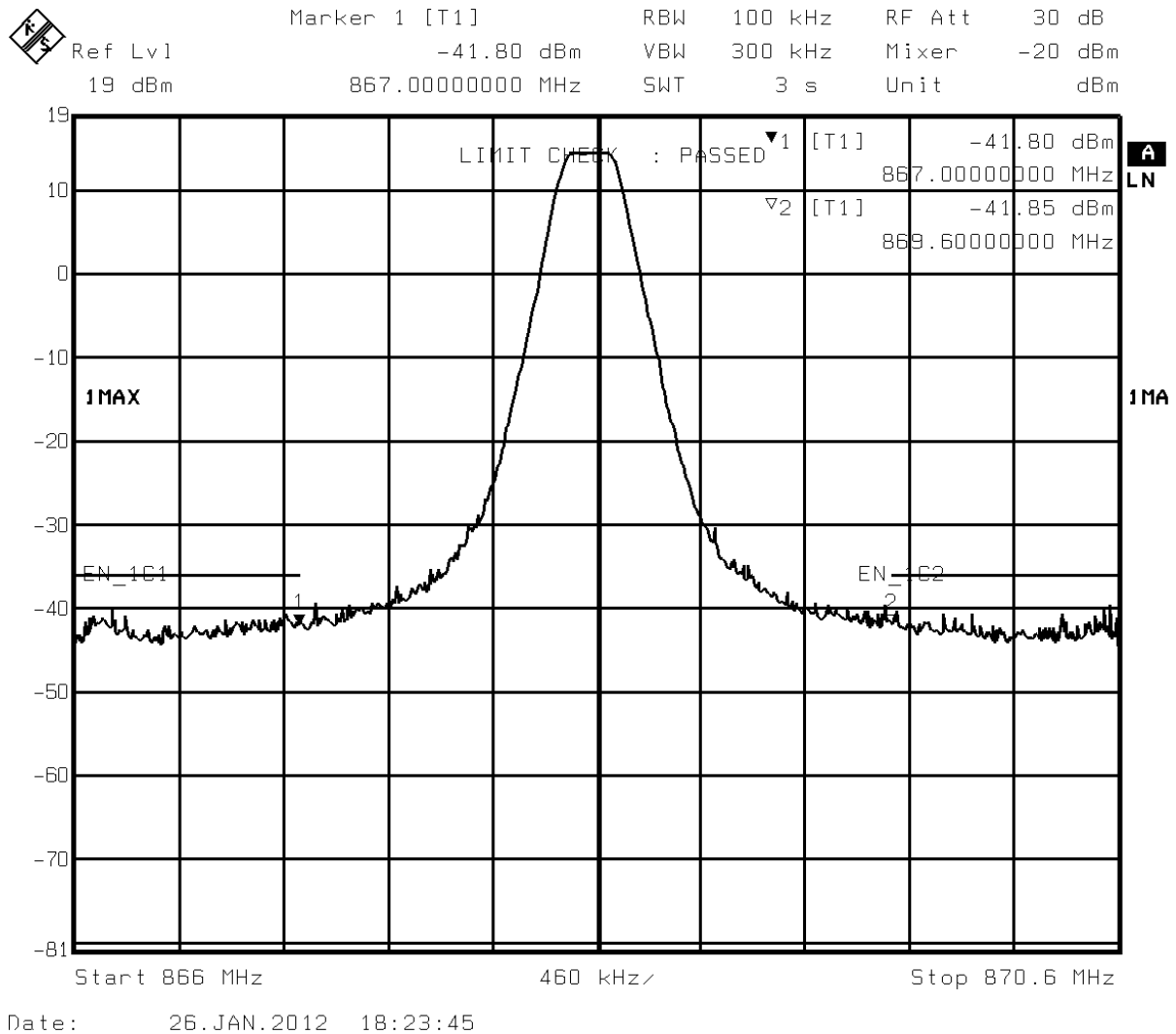


Figure 9: Transmit spectrum, 868.3 MHz, GFSK BT=0.5, 32.768 kbps, 50 kHz half deviation, RBW=100 kHz, detector max peak, trace max hold

Unwanted Emissions in Spurious Domains EN 300 220-1 V2.3.1 (2010-02), Subclause 7.8

For these measurement plots please see the equivalent section for 100 kbps instead of 32.768 kbps.



4. 169 MHz narrow band, 12.5 kHz channel spacing, 4.8 kbps

4.1. Setup

Module	AX5043 DVK-2 Module with 16 MHz TCXO Differential antenna interface Internal VCO with external inductor & internal synthesizer loop filter
Measurement equipment	0.5 m RG-58 cable from SMA to R&S FSEB spectrum analyzer (note 1)
Mainboard and debug adapter	DVK-2
Setup software	AX-RadioLab V1.1
Carrier Frequency	169.438 MHz
Bit rate	4.8 kbps
Modulation	GFSK BT=0.3
FSK half deviation	1.6 kHz
Channel	12.5 kHz spacing, 8.5 kHz width
Changes to setup software default register settings	AX5043_PLLCPI_(TX) = 0x08 AX5043_PLLVCOI_(TX) = 0x88
Changes to hardware default configuration	none
Power level for which module meets ETSI EN 300 220-1 V2.3.1 (2010-02)	15.45 dBm

Notes:

- Values presented are the spectrum analyzer readings. Cable losses are not compensated
- Unless otherwise stated spectrum analyzer settings are:
 - detector function: RMS
 - trace: clear/write



4.2. Regulatory Requirements

ETSI EN 300 220-1 V2.3.1 (2010-02) in frequency band 169.4 – 169.475 MHz.

4.3. Measurements

Output Power

ETSI EN 300 220-1 V2.3.1 (2010-02), Subclause 7.2

AX5043 is outputting modulated data in the following plot. The ETSI limit for the 169.4 – 169.475 MHz band is 500 mW (27 dBm). **AX5043** outputs just over 15.45 dBm. All the following measurements are done at this power level.

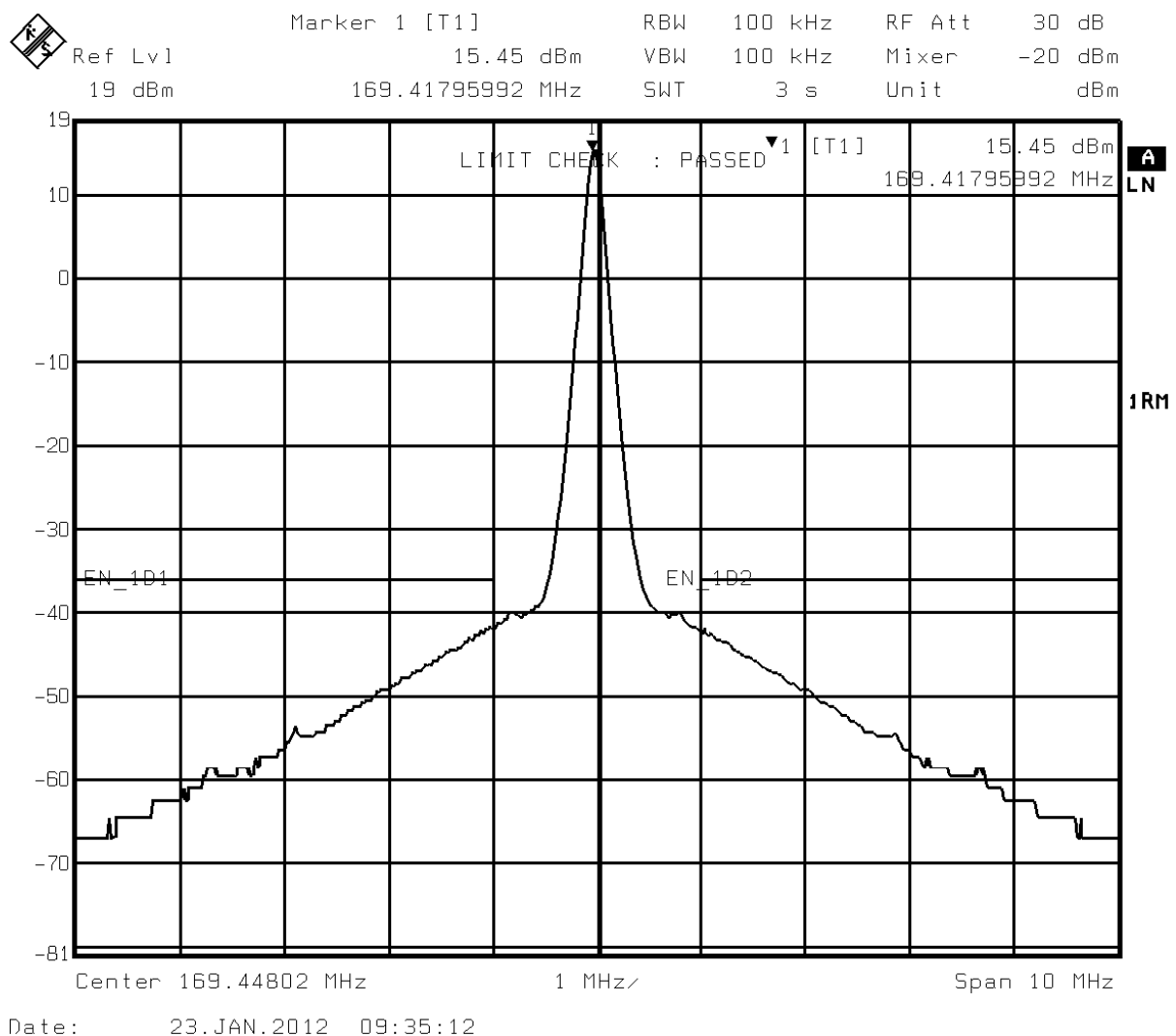


Figure 10: Transmit spectrum, 169.4 MHz, 4.8 kbps, GFSK BT=0.3

Adjacent Channel Power

EN 300 220-1 V2.3.1 (2010-02), Subclause 7.6

The following plots show the modulated spectrum with measurements of adjacent channel power in channels of 16 kHz width and with 25 kHz spacing. The ETSI limit for adjacent channel power is 200nW (-37 dBm). The measurement for **AX5043** is -46 dBm.

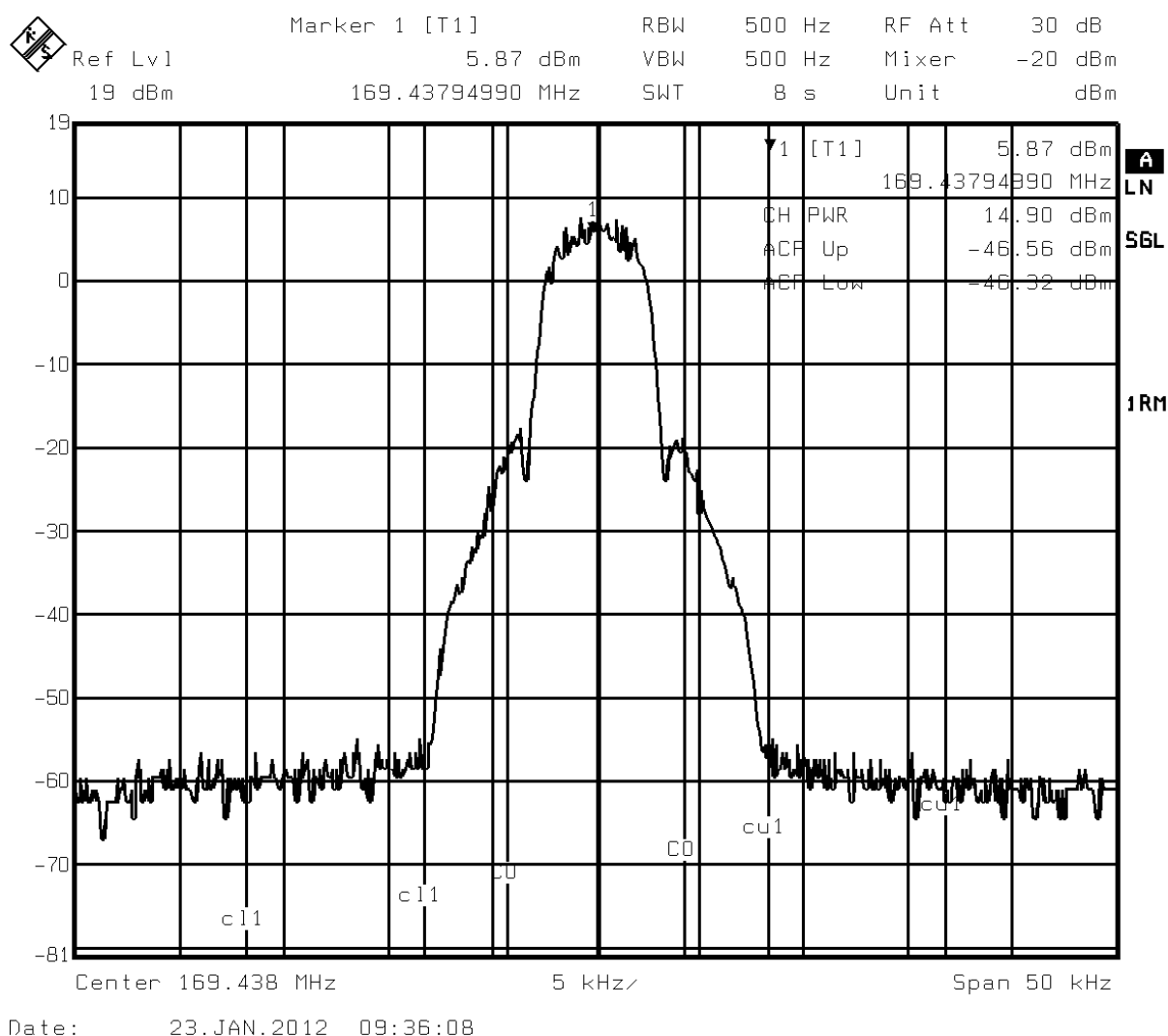


Figure 11: Transmit spectrum, 169.438 MHz, GFSK BT=0.3, 4.8 kbps, 1.6 kHz half deviation with adjacent channel power measurement for 12.5 kHz spaced channels



Unwanted Emissions in Spurious Domains

EN 300 220-1 V2.3.1 (2010-02), Subclause 7.8

Unwanted emissions are shown for the most critical cases.

From 174 – 230 MHz and 470 – 862 MHz the ETSI limit is –54 dBm for an RBW of 100 kHz. These frequency ranges are both shown, especially as several harmonics of 169.4 MHz fall into these frequency ranges.

For all other frequencies from 174 MHz to 1 GHz the ETSI limit is –36 dBm for an RBW of 100 kHz. This limit is valid up to a distance of 2.5 times the channel bandwidth to the carrier (adjacent and alternate channels are excepted). These frequency ranges are shown if they contain significant harmonics or other spurs. A measurement close to the carrier is also shown, as this is one of the most critical areas.

Above 1 GHz the ETSI limit is –30 dBm for an RBW of 1 MHz. No plot of this area is shown, as all spurs are far away from the limit.



CLOSE TO 169.438 MHZ

The following plot shows a power measurement of a 100 kHz bandwidth just beside the adjacent channel (center of measurement is at 81.25 kHz from the carrier). These are measurements “ALT2 Up” and “ALT2 Low”. Please note that the other channel power measurements plotted are irrelevant in an ETSI context.

The ETSI limits are -36 dBm. The measurement for **AX5043** is -37 dBm.

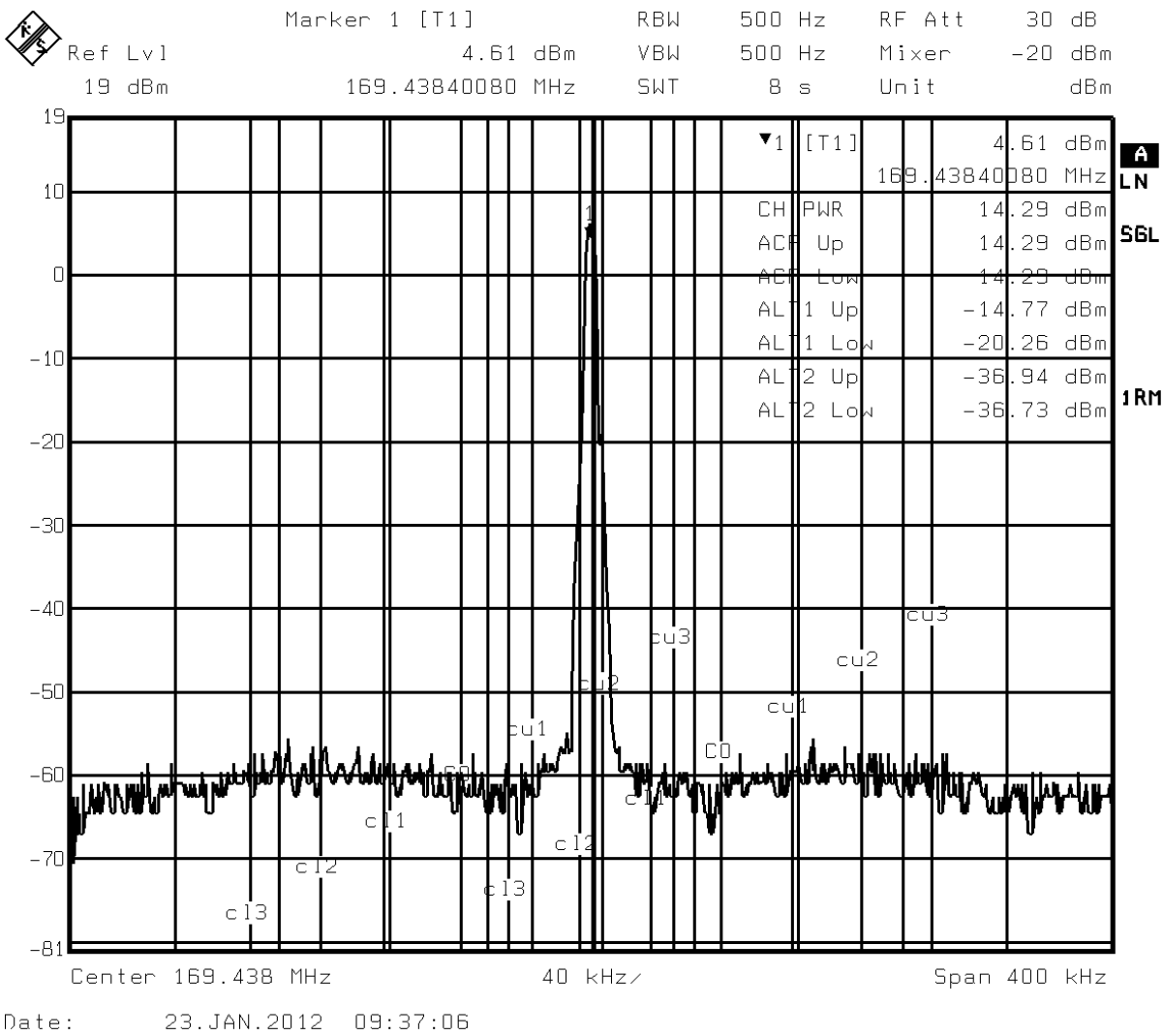


Figure 12: Transmit spectrum, 169.438 MHz, GFSK BT=0.3, 4.8 kbps, 1.6 kHz half deviation with measurement in 100 kHz bandwidth beside the alternate channel (clause 7.8.2.1)



174 – 230 MHz

Spurious emission in this frequency range is below the ETSI limit of -54 dBm. The highest spur at -57 dBm is at a distance of the reference frequency (16 MHz) from the carrier.

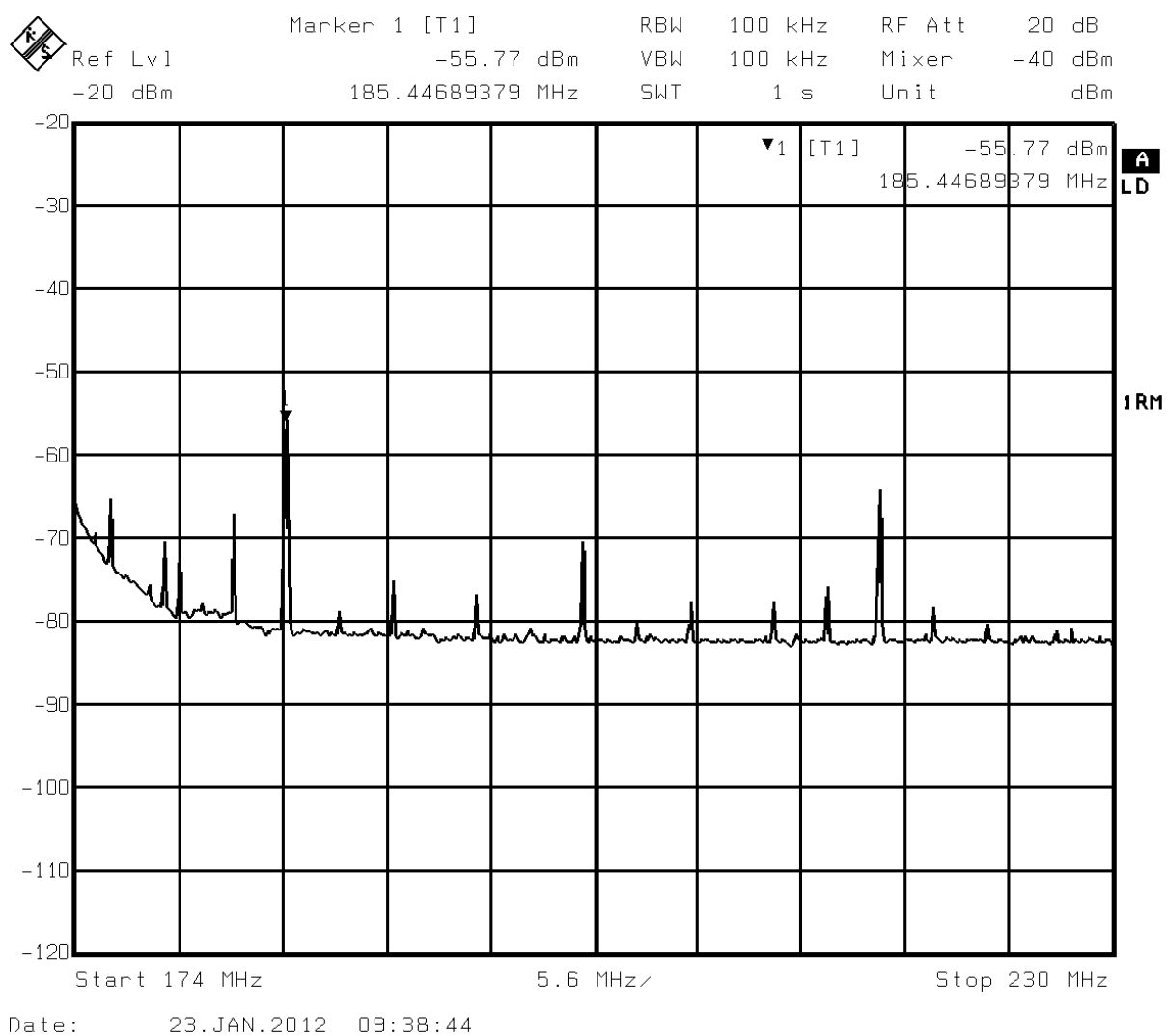


Figure 13: Spurious emission 174 – 230 MHz

230 – 470 MHz

Spurious emission in this frequency range is below the ETSI limit of -36 dBm. The highest spur at -39 dBm is a harmonic of the carrier frequency.

Spectrum analyzer setting for this measurement is:

- detector function: max peak

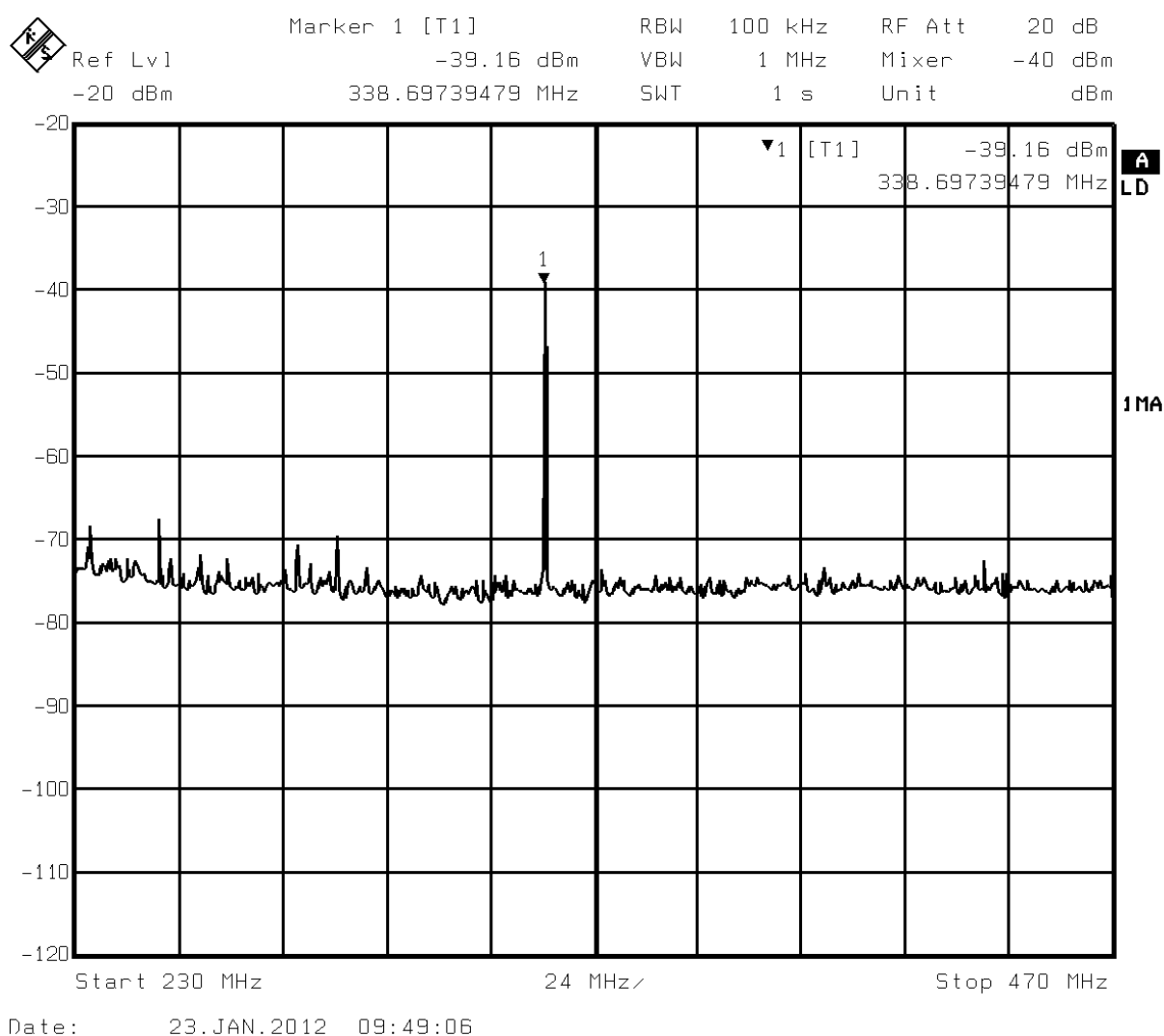


Figure 14: Spurious emission 230 – 470 MHz, detector function max peak



470 – 862 MHz

Spurious emission in this frequency range is below the ETSI limit of -54 dBm. The highest spur at -59 dBm is a harmonic of the carrier frequency

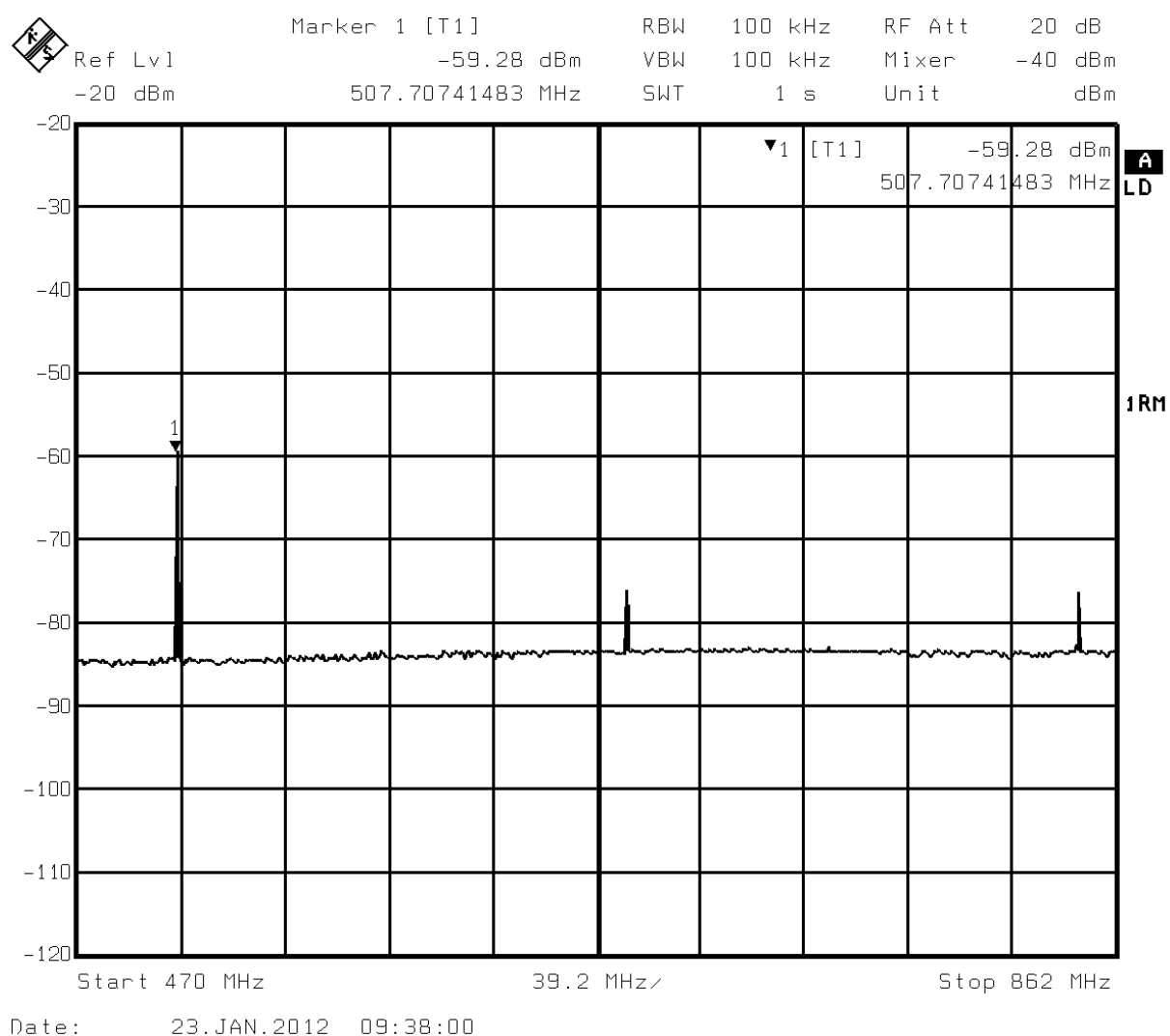


Figure 15: Spurious emission 470 – 862 MHz



5. 169 MHz narrow band, 25 kHz channel spacing, 9.6 kbps

5.1. Setup

Module	AX5043 DVK-2 Module with 16 MHz TCXO Differential antenna interface Internal VCO with external inductor & internal synthesizer loop filter
Measurement equipment	0.5 m RG-58 cable from SMA to R&S FSEB spectrum analyzer (note 1)
Mainboard and debug adapter	DVK-2
Setup software	AX-RadioLab V1.1
Carrier Frequency	169.438 MHz
Bit rate	9.6 kbps
Modulation	GFSK BT=0.3
FSK half deviation	3.2 kHz
Channel	25 kHz spacing, 16 kHz width
Changes to setup software default register settings	AX5043_PLLCPI_(TX) = 0x08 AX5043_PLLVCOI_(TX) = 0x88
Changes to hardware default configuration	none
Power level for which module meets ETSI EN 300 220-1 V2.3.1 (2010-02)	15.45 dBm

Notes:

- Values presented are the spectrum analyzer readings. Cable losses are not compensated
- Unless otherwise stated spectrum analyzer settings are:
 - detector function: RMS
 - trace: clear/write

5.2. Regulatory Requirements

ETSI EN 300 220-1 V2.3.1 (2010-02) in frequency band 169.4 – 169.475 MHz.

5.3. Measurements

Output Power

ETSI EN 300 220-1 V2.3.1 (2010-02), Subclause 7.2

For this measurement plot please see the equivalent section for 12.5 kHz channels instead of 25 kHz channels.



Adjacent Channel Power

EN 300 220-1 V2.3.1 (2010-02), Subclause 7.6

The following plots show the modulated spectrum with measurements of adjacent channel power in channels of 16 kHz width and with 25 kHz spacing. The ETSI limit for adjacent channel power is 200 nW (-37 dBm). The measurement for **AX5043** is -45 dBm.

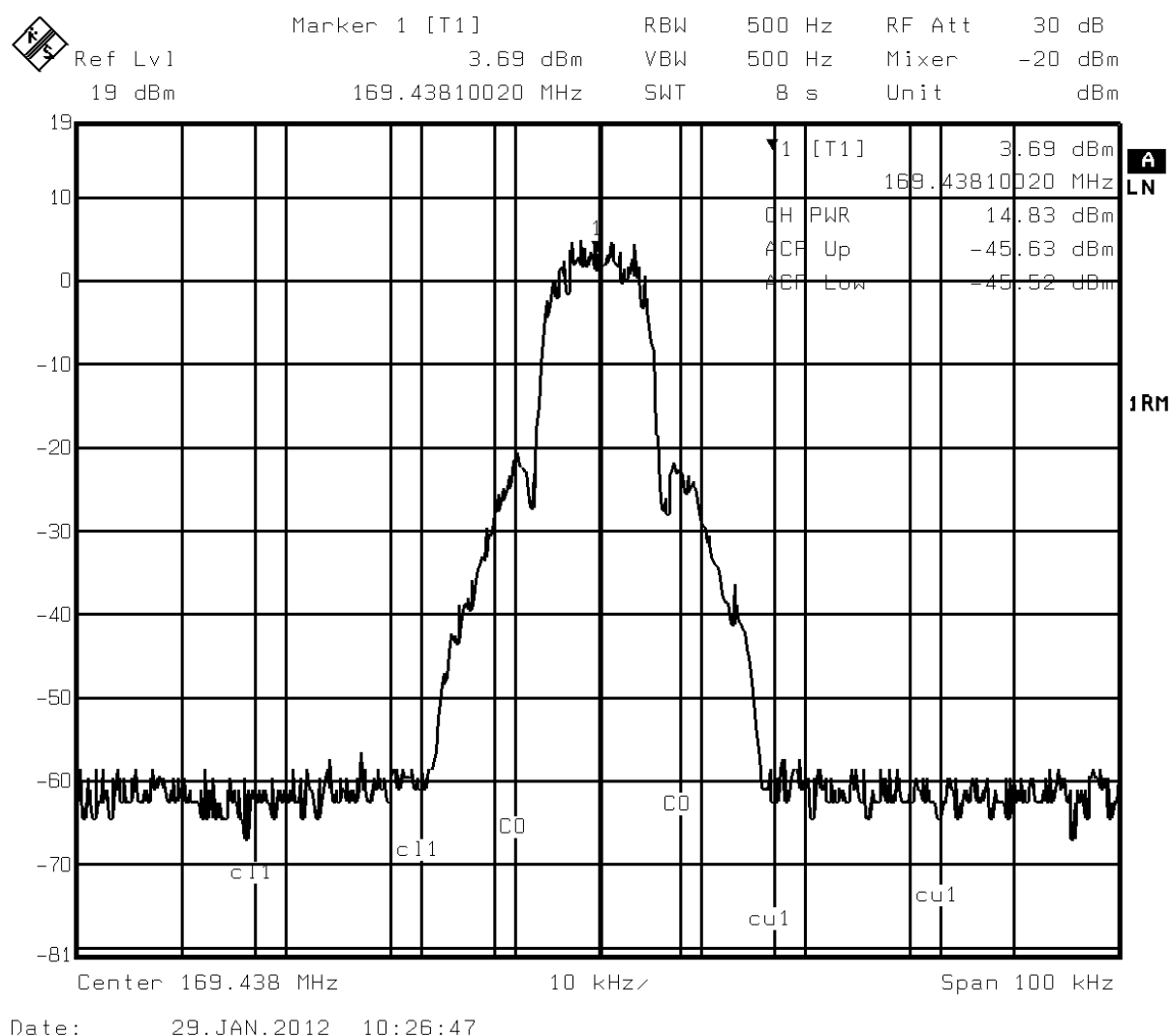


Figure 16: Transmit spectrum, 169.438 MHz, GFSK BT=0.3, 9.6 kbps, 3.2 kHz half deviation with adjacent channel power measurement for 25 kHz spaced channels

Unwanted Emissions in Spurious Domains

EN 300 220-1 V2.3.1 (2010-02), Subclause 7.8

Emission spectra for the 25 kHz spaced channels do not differ from those for the 12.5 kHz spaced channel case, except close to 169.4 MHz. This case is shown in the next section. For all others see the equivalent section for 12.5 kHz channels instead of 25 kHz channels.

CLOSE TO 169.438 MHZ

The following plot shows a power measurement of a 100 kHz bandwidth just beside the adjacent channel (center of measurement is at 112.5 kHz from the carrier). These are measurements "ALT2 Up" and "ALT2 Low". Please note that the other channel power measurements plotted are irrelevant in an ETSI context. The ETSI limits are -36 dBm. The measurement for **AX5043** is -37 dBm.

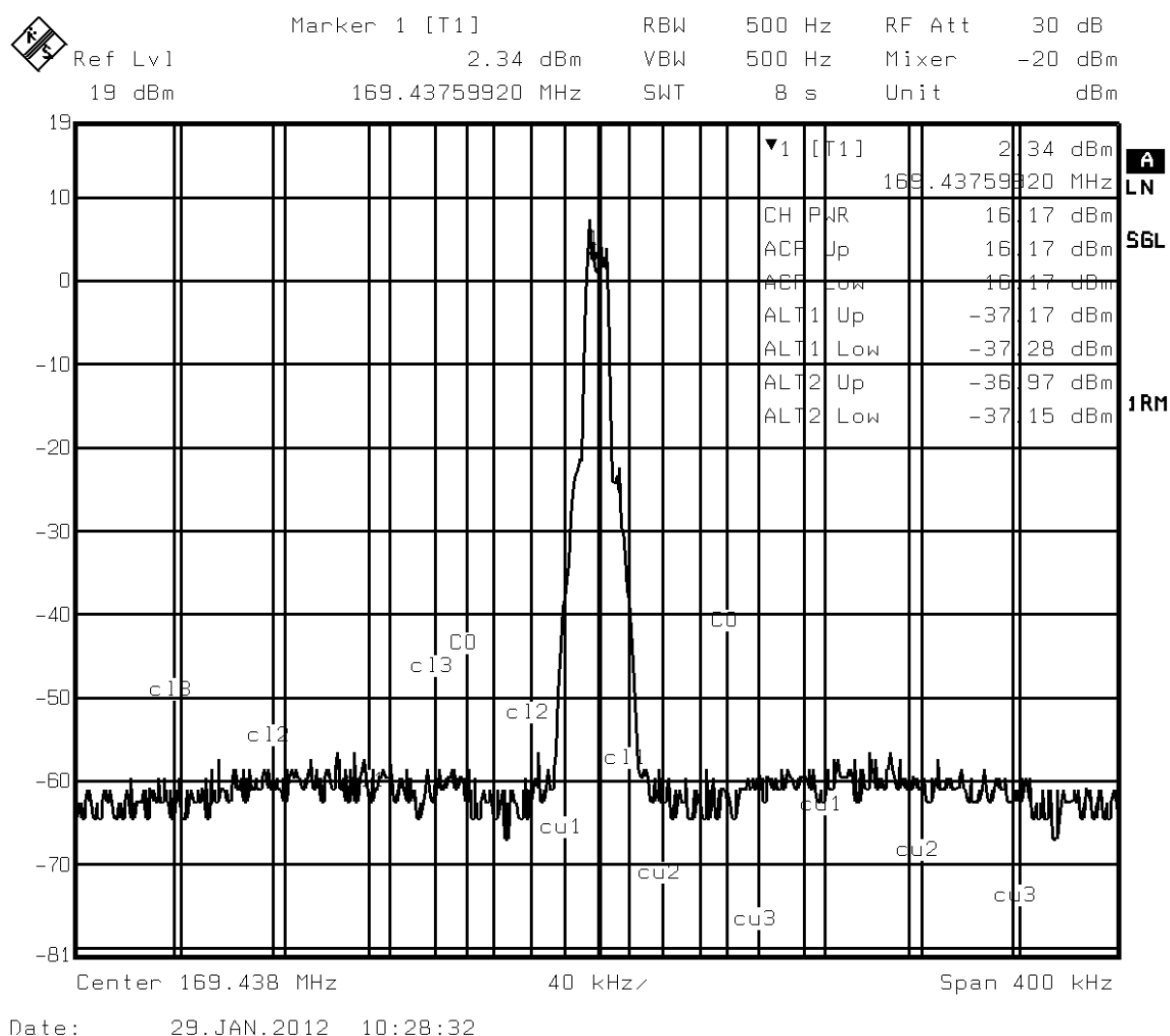


Figure 17: Transmit spectrum, 169.438 MHz, GFSK BT=0.3, 9.6 kbps, 3.2 kHz half deviation with measurement in 100 kHz bandwidth beside the alternate channel (clause 7.8.2.1)



6. 433 MHz wide band, 100 kbps

6.1. Setup

Module	AX5043 DVK-1 Module with 48 MHz XTAL Differential antenna interface Internal VCO & internal synthesizer loop filter
Measurement equipment	0.5 m RG-58 cable from SMA to R&S FSEB spectrum analyzer (note 1)
Mainboard and debug adapter	DVK-2
Setup software	AX-RadioLab V1.1
Carrier Frequency	433.77 MHz
Bit rate	100 kbps
Modulation	GFSK BT=0.5
FSK half deviation	25 kHz
Changes to setup software default register settings	AX5043_PLLCPI_(TX) = 0x02 AX5043_PLLVCOI_(TX) = 0x87 AX5043_0xF00_(TX) = 0x4F AX5043_REF_(TX) = 0x02
Changes to hardware default configuration	Short between pins L2 and L1 48 MHz XTAL
Power level for which module meets ETSI EN 300 220-1 V2.3.1 (2010-02)	14.9 dBm

Notes:

1. Values presented are the spectrum analyzer readings. Cable losses are not compensated

2. Unless otherwise stated spectrum analyzer settings are:

- detector function: RMS
- trace: clear/write

6.2. Regulatory Requirements

ETSI EN 300 220-1 V2.3.1 (2010-02) in frequency band 433.05 – 434.79 MHz.

6.3. Measurements

Output Power

ETSI EN 300 220-1 V2.3.1 (2010-02), Subclause 7.2

AX5043 is outputting CW for this measurement. The ETSI limit for the 433.05 – 434.79 MHz band is 10 mW (10 dBm). Even though the measured 14.9 dBm are over the ETSI limit, the following measurements were done at this power level.

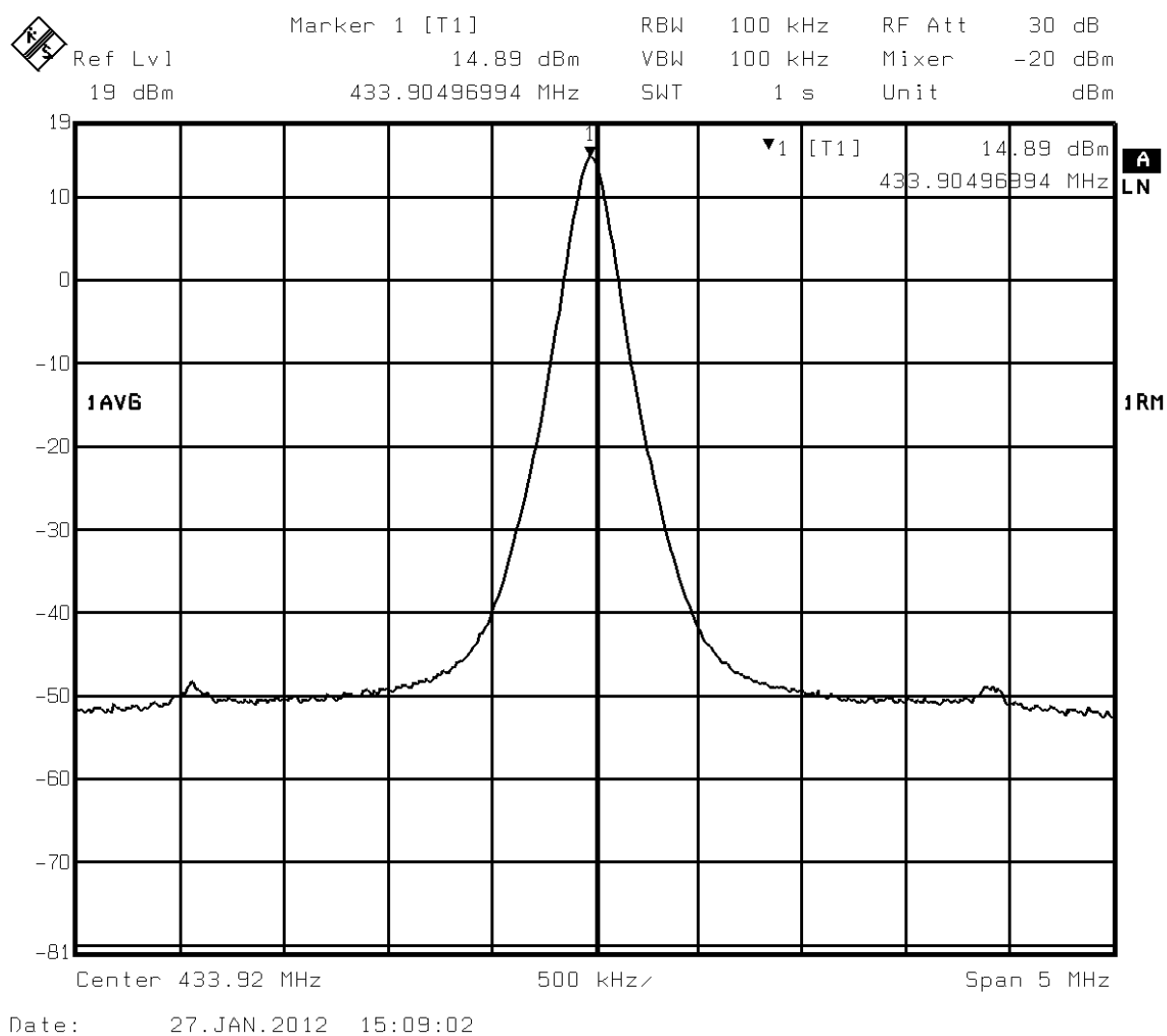


Figure 18: Transmit spectrum, 433.77 MHz, CW



Modulation Bandwidth

EN 300 220-1 V2.3.1 (2010-02), Subclause 7.7

The following three plots show the modulated output at different resolution bandwidths with the corresponding ETSI limit lines.

Spectrum analyzer settings for all three measurements are:

- detector function: max peak
- trace: max hold

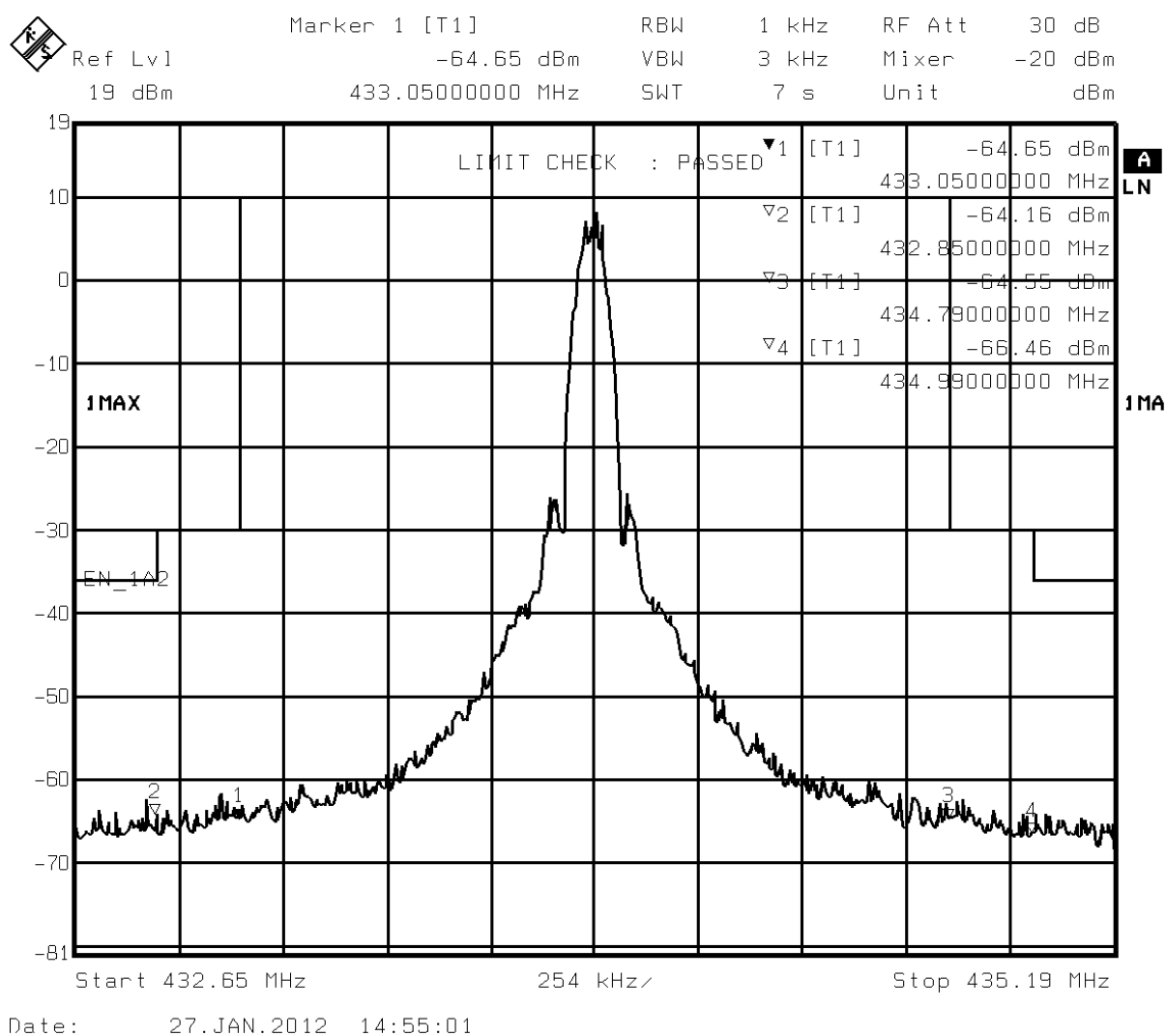


Figure 19: Transmit spectrum, 433.77 MHz, GFSK BT=0.5, 100 kbps, 25 kHz half deviation, RBW=1 kHz, ETSI limit lines, detector max peak, trace max hold

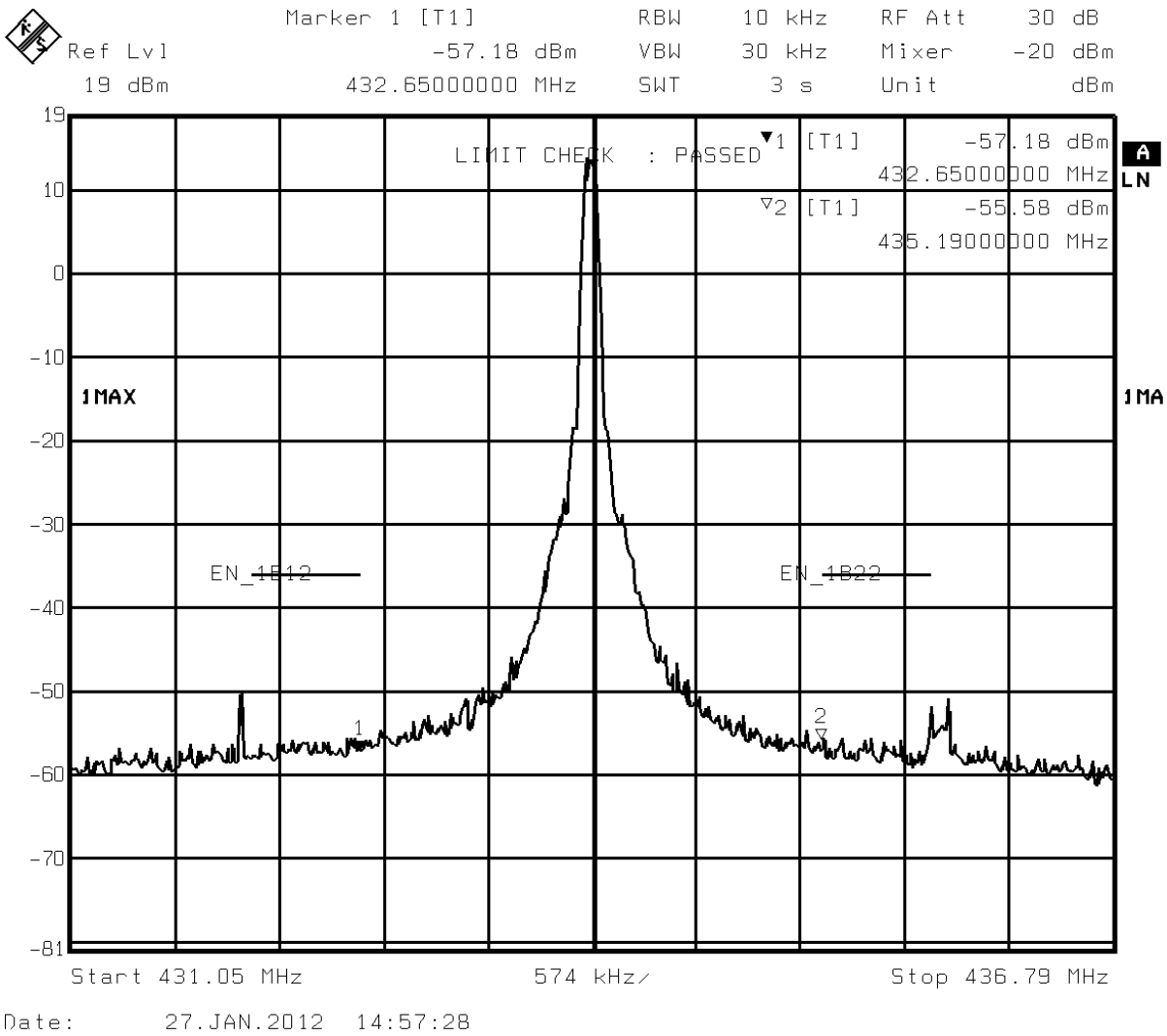


Figure 20: Transmit spectrum, 433.77 MHz, GFSK BT=0.5, 100 kbps, 25 kHz half deviation, RBW=10 kHz, ETSI limit lines, detector max peak, trace max hold

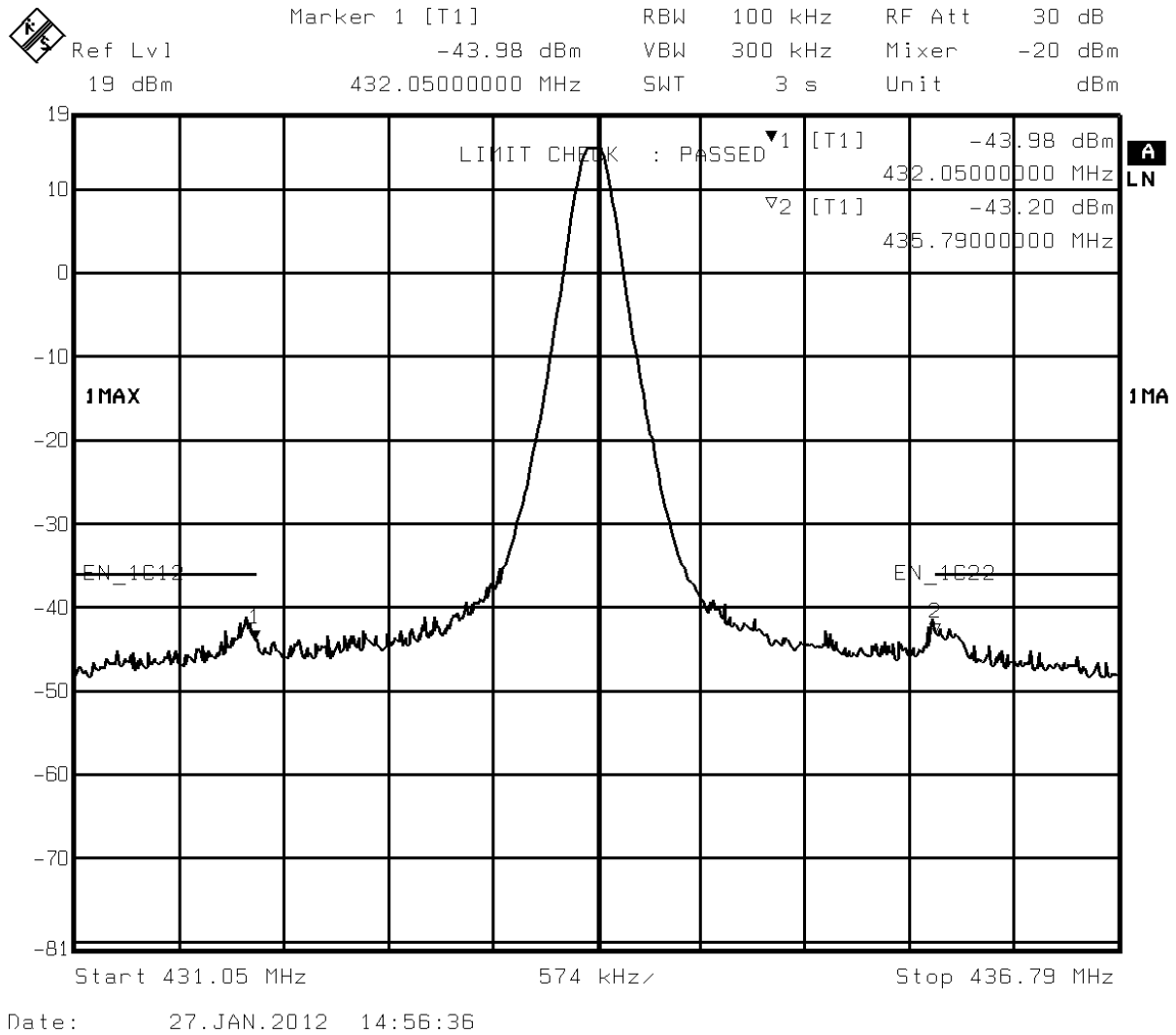


Figure 21: Transmit spectrum, 433.77 MHz, GFSK BT=0.5, 100 kbps, 25 kHz half deviation, RBW=100 kHz, ETSI limit lines, detector max peak, trace max hold

Unwanted Emissions in Spurious Domains

EN 300 220-1 V2.3.1 (2010-02), Subclause 7.8

Unwanted emissions are shown for the most critical cases.

From 470 – 862 MHz the ETSI limit is –54 dBm for an RBW of 100 kHz. From 862 MHz to 1 GHz the ETSI limit is –36 dBm for an RBW of 100 kHz.

Above 1 GHz the ETSI limit is –30 dBm for an RBW of 1 MHz. Here the harmonics of the wanted signal are most critical.

470 – 862 MHz

Spurious emission in this frequency range is below the ETSI limit of –54 dBm. The highest spur is at –62 dBm.

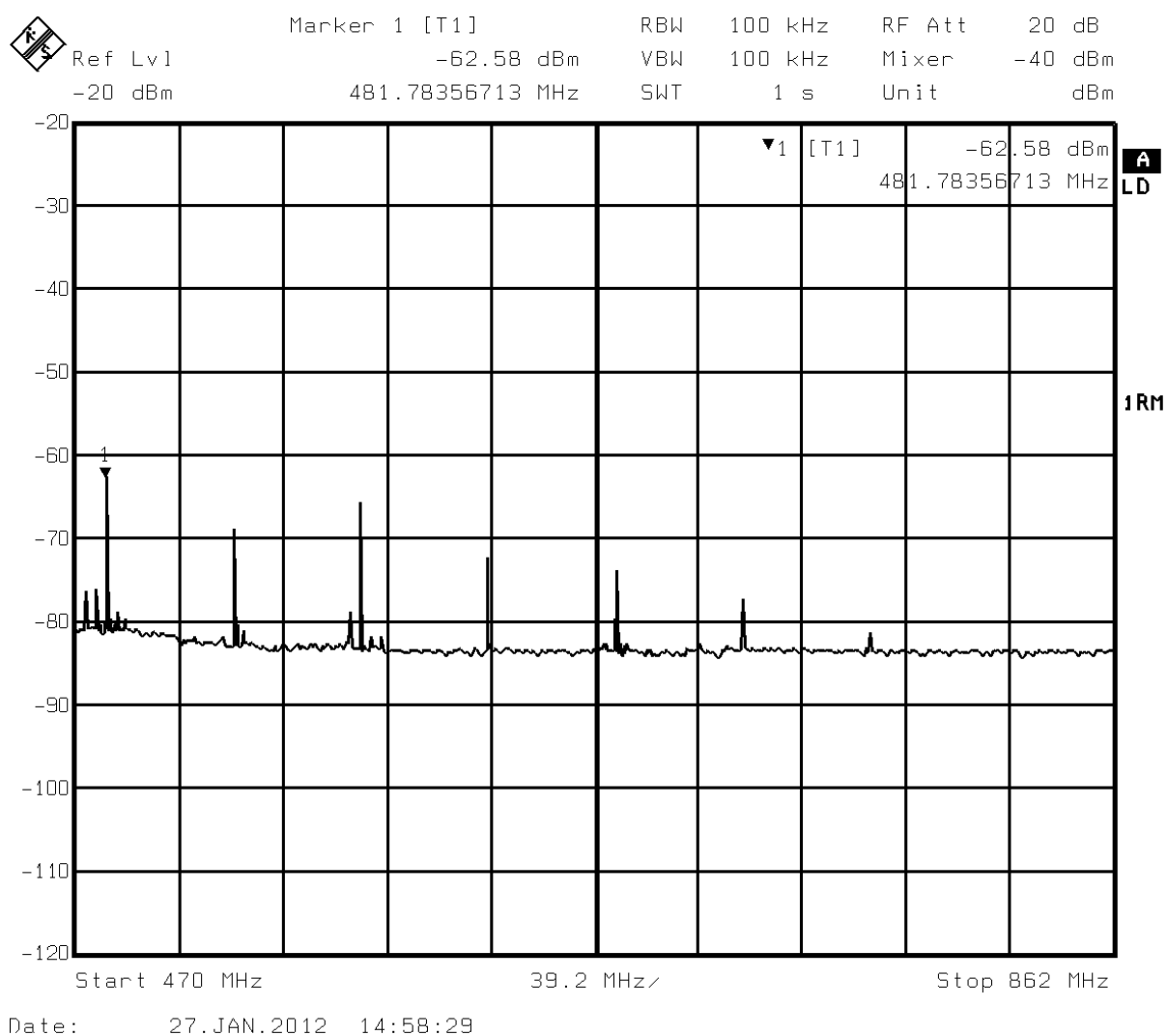


Figure 22: Spurious emission 470 – 862 MHz



HARMONICS

The second harmonic at 867 MHz is on the ETSI limit of -36 dBm. Harmonics above 1 GHz are well below the ETSI limit of -30 dBm.

Spectrum analyzer settings for this measurement is:

- detector function: max peak

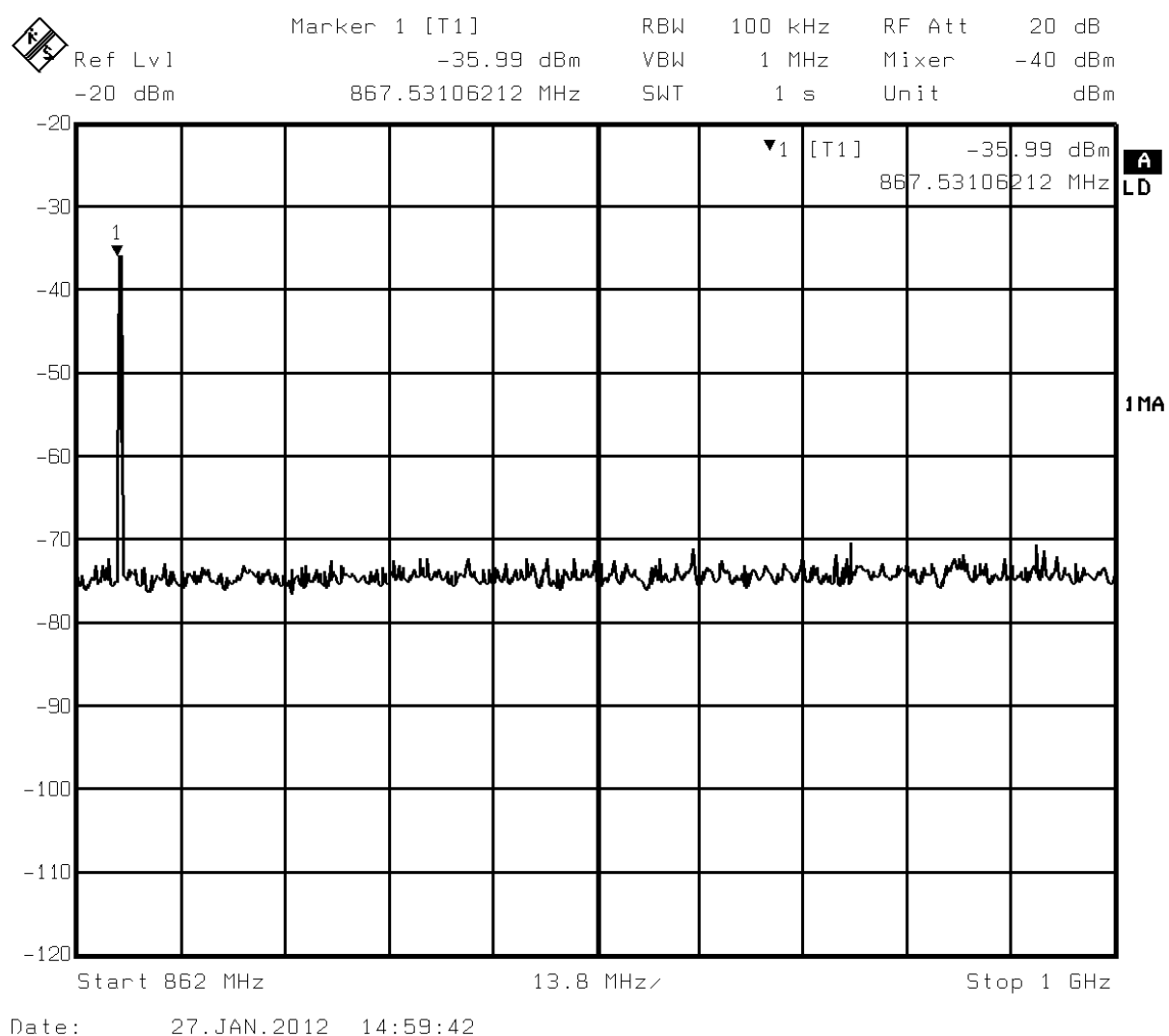


Figure 23: Spurious emission 862 MHz – 1 GHz, detector function max peak

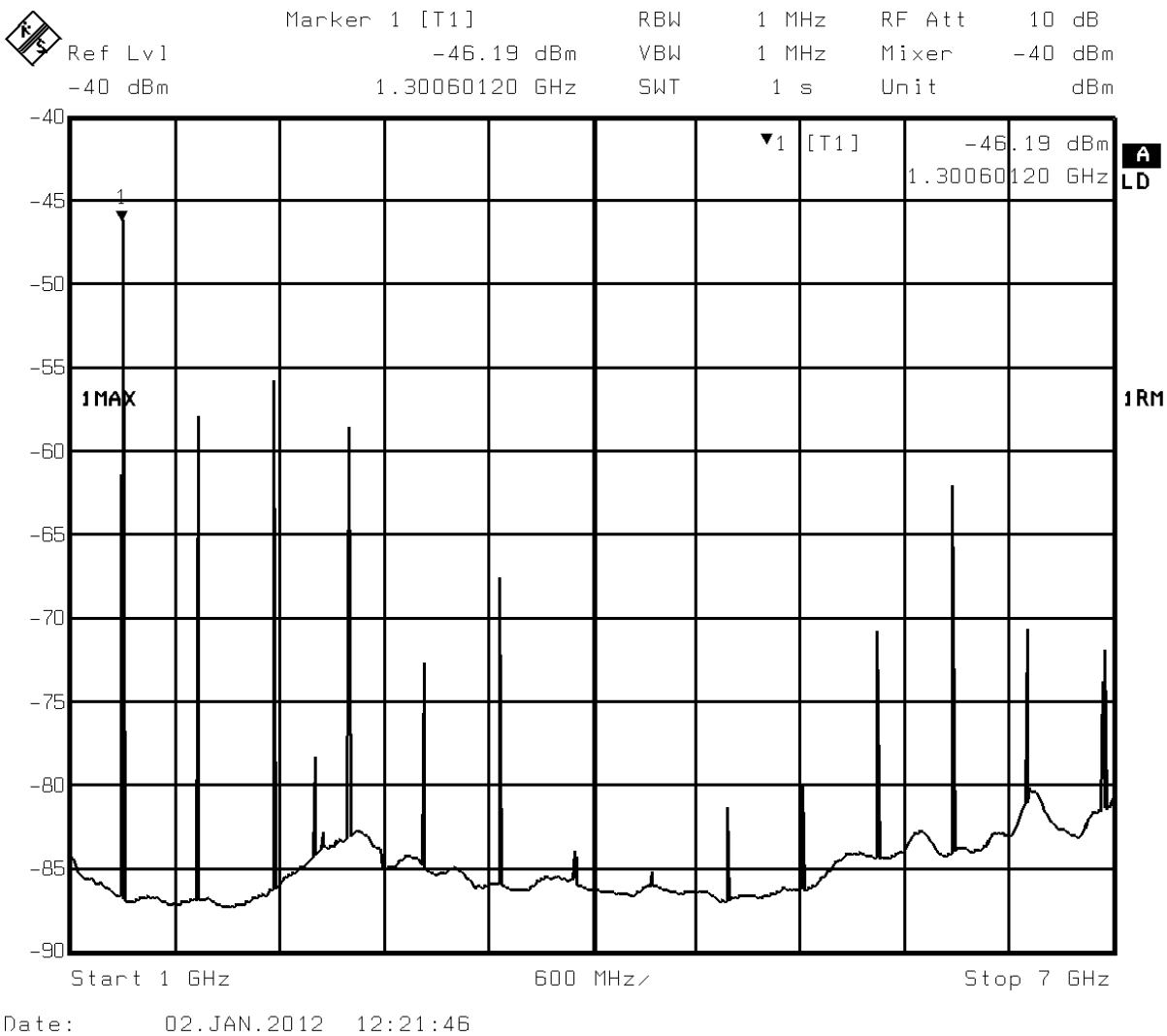


Figure 24: Spurious emission above 1 GHz



7. 433 MHz narrow band, 25 kHz channel spacing, 9.6 kbps

7.1. Setup

Module	AX5043 DVK-1 Module with 48 MHz XTAL Differential antenna interface Internal VCO & internal synthesizer loop filter
Measurement equipment	0.5 m RG-58 cable from SMA to R&S FSEB spectrum analyzer (note 1)
Mainboard and debug adapter	DVK-2
Setup software	AX-RadioLab V1.1
Carrier Frequency	434.415 MHz
Bit rate	9.6 kbps
Modulation	GFSK BT=0.3
FSK half deviation	3.2 kHz
Channel	25 kHz spacing, 16 kHz width
Changes to setup software default register settings	AX5043_PLLLOOP_(TX) = 0x0B AX5043_PLLCPI_(TX) = 0x08 AX5043_PLLVCOI_(TX) = 0x87 AX5043_0xF00_(TX) = 0x4F AX5043_REF_(TX) = 0x02
Changes to hardware default configuration	Short between pins L2 and L1 48 MHz XTAL
Power level for which module meets ETSI EN 300 220-1 V2.3.1 (2010-02)	14.75 dBm

Notes:

1. Values presented are the spectrum analyzer readings. Cable losses are not compensated

2. Unless otherwise stated spectrum analyzer settings are:

- detector function: RMS
- trace: clear/write

7.2. Regulatory Requirements

ETSI EN 300 220-1 V2.3.1 (2010-02) in frequency band 434.040 – 434.790 MHz.

7.3. Measurements

Output Power

ETSI EN 300 220-1 V2.3.1 (2010-02), Subclause 7.2

AX5043 is outputting modulated data in the following plot. The ETSI limit for the 434.040 – 434.790 MHz band is 10 mW (10 dBm). **AX5043** outputs 14.75 dBm. All the following measurements were done at this power setting.

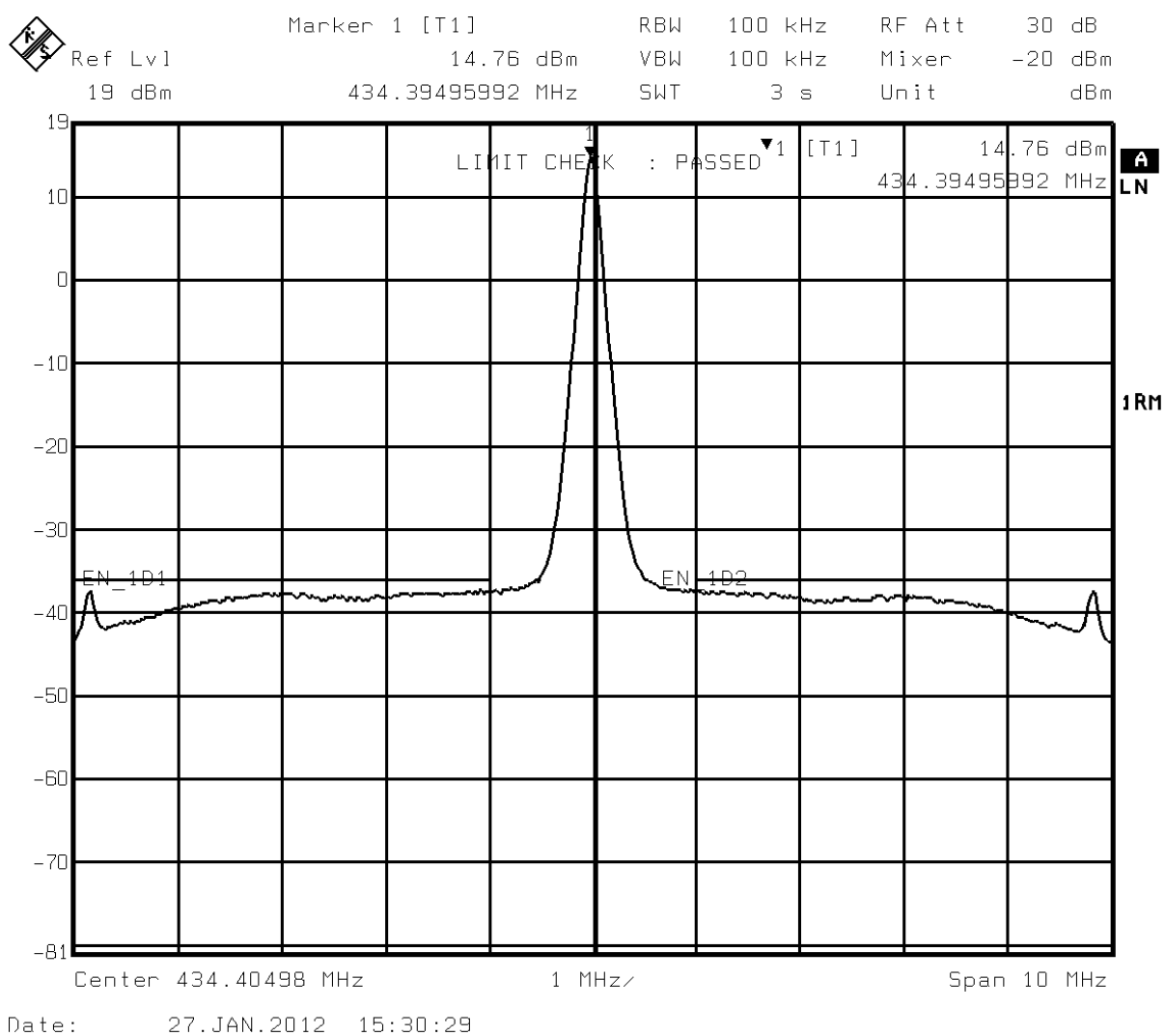


Figure 25: Transmit spectrum, 434.415 MHz, 9.6 kbps, GFSK BT=0.3



Adjacent Channel Power

EN 300 220-1 V2.3.1 (2010-02), Subclause 7.6

The following plots shows the modulated spectrum. Adjacent channel power is measured in channels of 16 kHz width and with 25 kHz spacing. The ETSI limit for adjacent channel power is 200 nW (-37 dBm). The measurement for **AX5043** is -51.8 dBm.

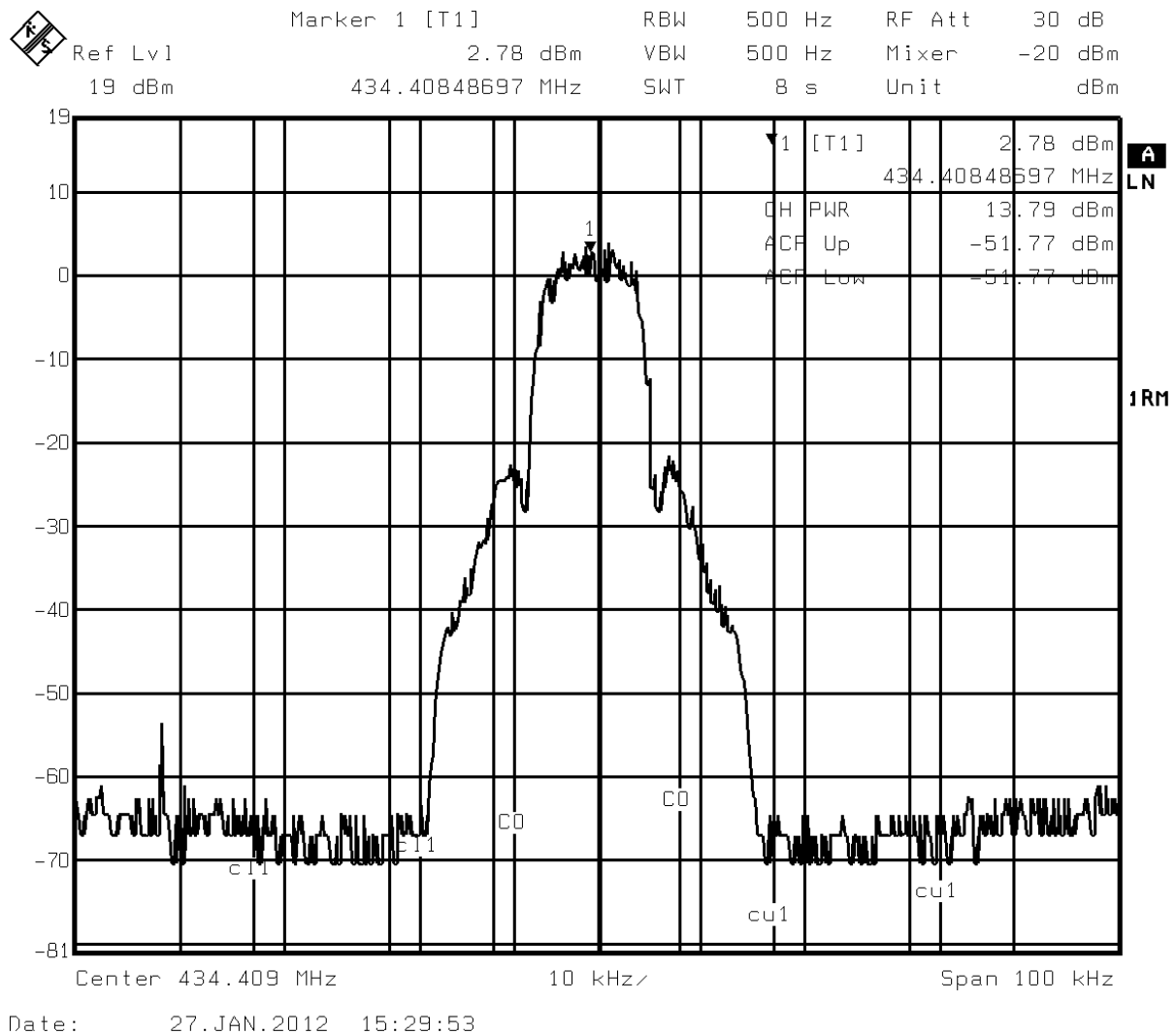


Figure 26: Transmit spectrum, 434.415 MHz, GFSK BT=0.3, 9.6 kbps, 3.2 kHz half deviation with adjacent channel power measurement for 25 kHz spaced channels



Unwanted Emissions in Spurious Domains
EN 300 220-1 V2.3.1 (2010-02), Subclause 7.8

Unwanted emissions are only shown in the following for the most critical area, which is close to the 434.415 MHz carrier frequency. The other spurious emission measurements are not significantly different from the 433 MHz wide-band case.

CLOSE TO 434.415 MHz

The following plot shows a power measurement of a 100 kHz bandwidth just beside the adjacent channel (center of measurement is at 112.5 kHz from the carrier). These are measurements "ALT2 Up" and "ALT2 Low". Please note that the other channel power measurements plotted are irrelevant in an ETSI context. The ETSI limits are -36 dBm. The measurement for **AX5043** is below -37 dBm.

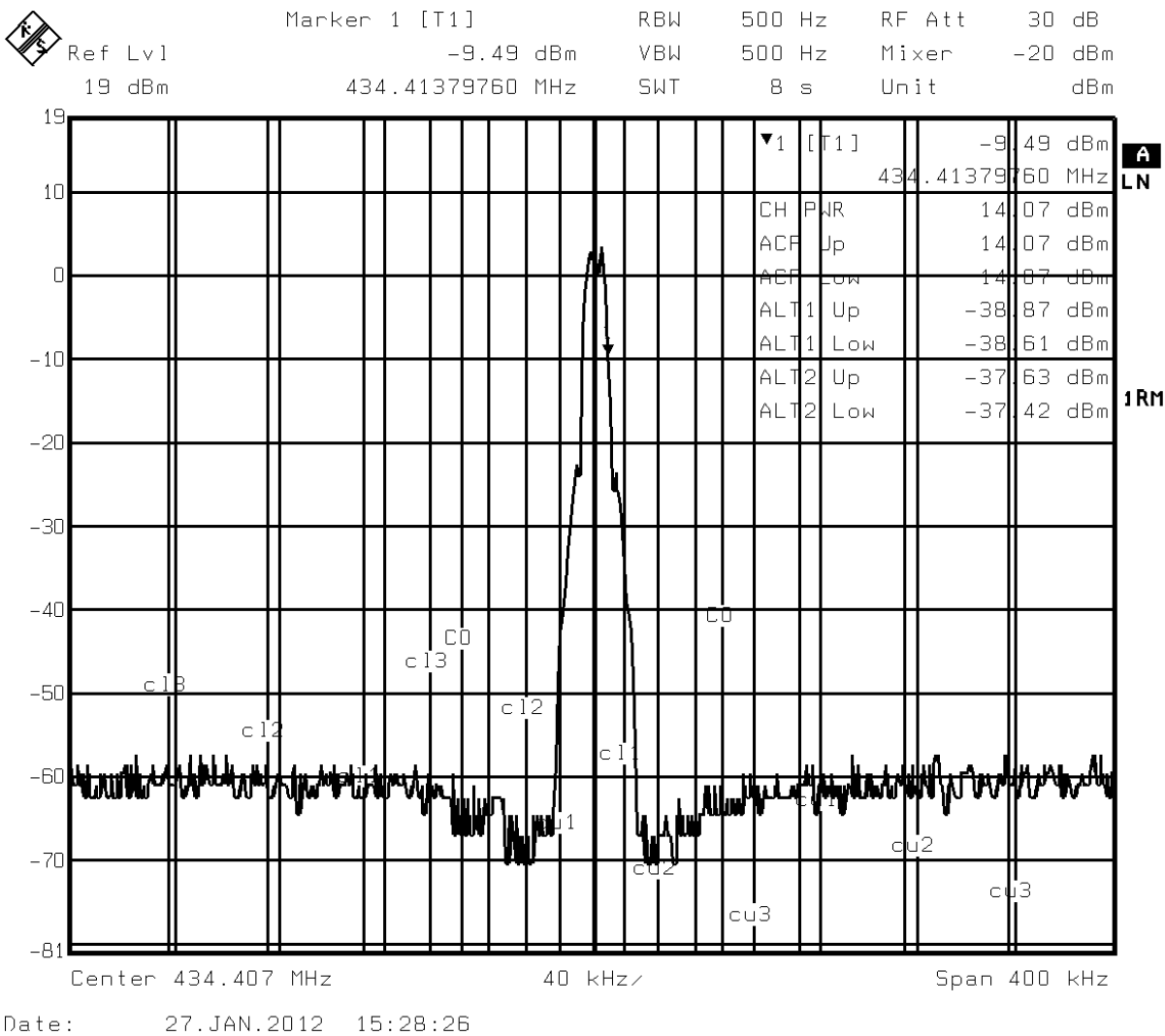


Figure 27: Transmit spectrum, 434.415 MHz, GFSK BT=0.3, 9.6 kbps, 3.2 kHz half deviation with measurement in 100 kHz bandwidth beside the alternate channel (clause 7.8.2.1)



8. 868 MHz narrow band, 25 kHz channel spacing, 9.6 kbps

8.1. Setup

Module	AX5043 DVK-1 Module with 48 MHz XTAL Differential antenna interface Internal VCO & combined internal/external synthesizer loop filter
Measurement equipment	0.5 m RG-58 cable from SMA to R&S FSEB spectrum analyzer (note 1)
Mainboard and debug adapter	DVK-2
Setup software	AX-RadioLab V1.0c
Carrier Frequency	868.3 MHz
Bit rate	9.6 kbps
Modulation	GFSK BT=0.3
FSK half deviation	3.2 kHz
Channel	25 kHz spacing, 16 kHz width
Changes to setup software default register settings	AX5043_0xF10 = 0x0F AX5043_PLLLOOP_(TX) = 0x07 AX5043_PLLCPI_(TX) = 0x08 AX5043_PLLVCOI_(TX) = 0x87 AX5043_0xF00_(TX) = 0x4F AX5043_REF_(TX) = 0x02
Changes to hardware default configuration	Short between pins L2 and L1 48 MHz XTAL 39 pF between pin FILT and GND
Power level for which module meets ETSI EN 300 220-1 V2.3.1 (2010-02)	13.44 dBm

Notes:

- Values presented are the spectrum analyzer readings. Cable losses are not compensated
- Unless otherwise stated spectrum analyzer settings are:
 - detector function: RMS
 - trace: clear/write

8.2. Regulatory Requirements

ETSI EN 300 220-1 V2.3.1 (2010-02) in frequency band 868.0 – 868.6 MHz or 868.6 – 868.7 MHz.

8.3. Measurements

Output Power

ETSI EN 300 220-1 V2.3.1 (2010-02), Subclause 7.2

AX5043 is outputting modulated data in the following plot. The ETSI limit for the 868.0 – 868.6 MHz band is 25 mW (14 dBm), for the 868.6 – 868.7 MHz band it is 10 mW (10 dBm). **AX5043** outputs 13.44 dBm. All the following measurements were done at this power.

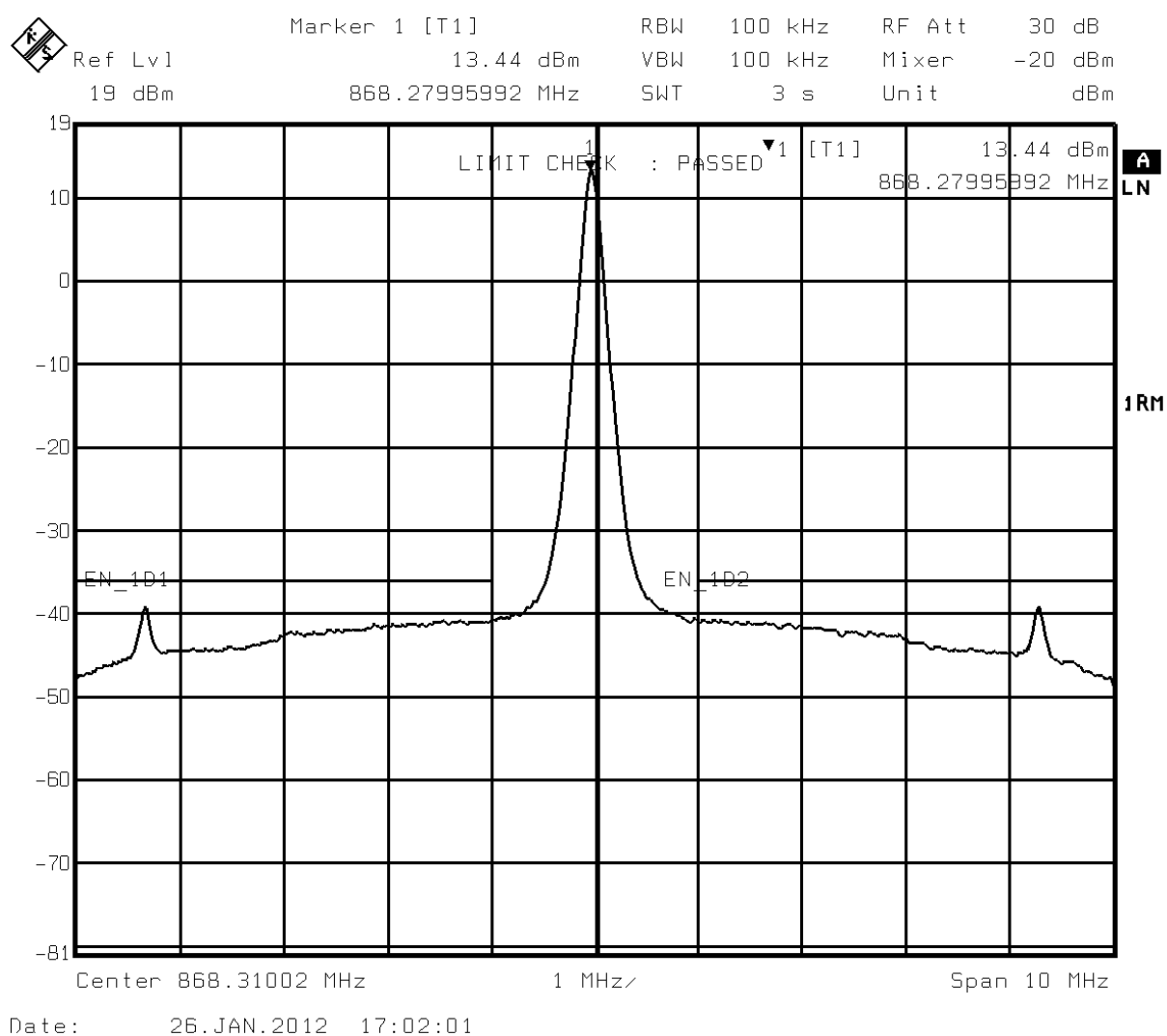


Figure 28: Transmit spectrum, 868.3 MHz, 9.6 kbps, GFSK BT=0.3



Adjacent Channel Power

EN 300 220-1 V2.3.1 (2010-02), Subclause 7.6

The following plots show the modulated spectrum with measurements of adjacent channel power in channels of 16 kHz width and with 25 kHz spacing. The ETSI limit for adjacent channel power is 200nW (-37 dBm). The measurement for **AX5043** is below -44 dBm.

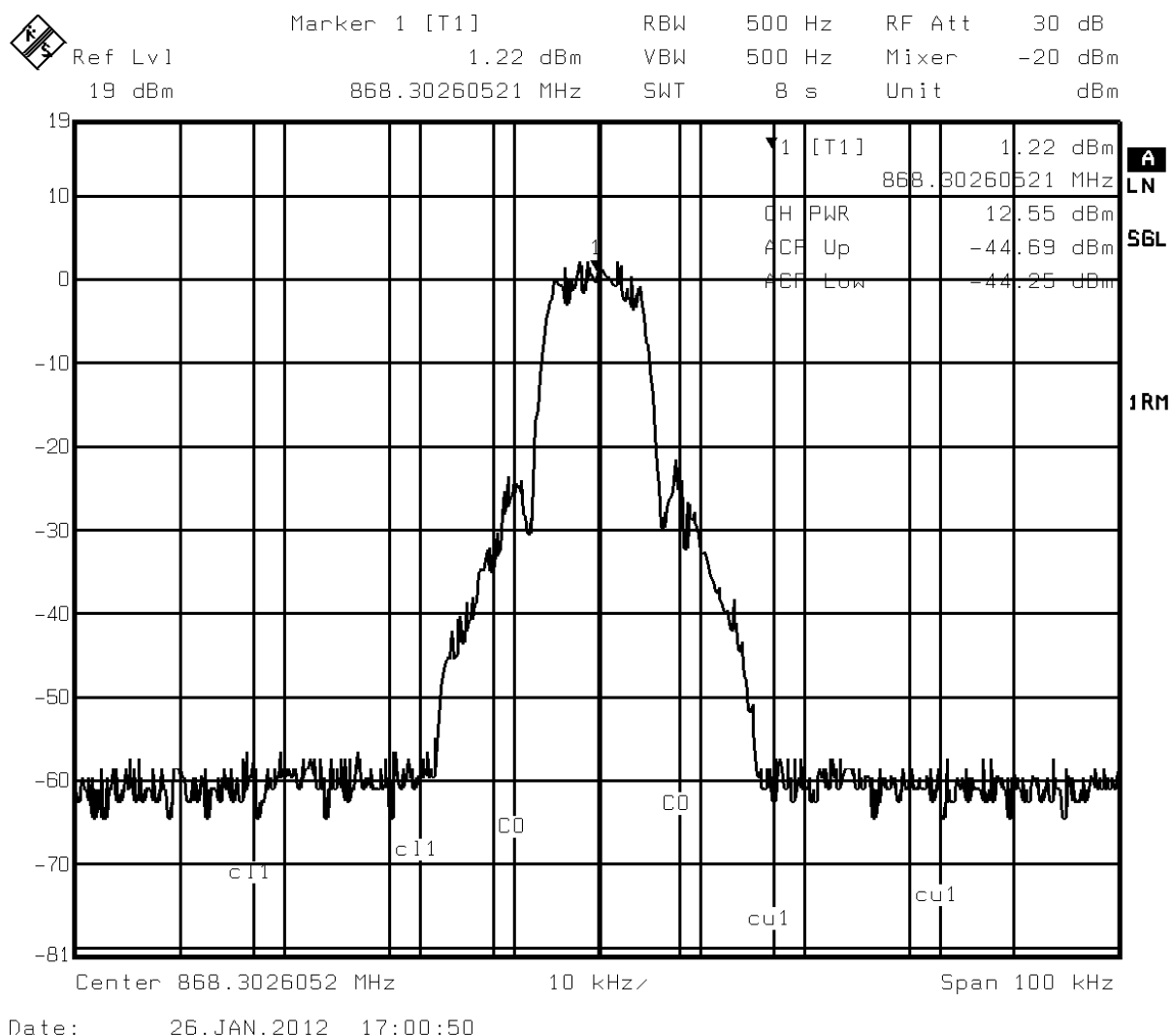


Figure 29: Transmit spectrum, 868.3 MHz, GFSK BT=0.3, 9.6 kbps, 3.2 kHz half deviation with adjacent channel power measurement for 25 kHz spaced channels



Unwanted Emissions in Spurious Domains
EN 300 220-1 V2.3.1 (2010-02), Subclause 7.8

Spurious emission is shown close to the 868.3 MHz carrier frequency and for the 470 – 862 MHz frequency range. For other frequency ranges, see the section on 868.3 MHz wide band performance as well as the plot in this section shown for power measurement (subclause 7.2).

CLOSE TO 868.3 MHZ

The following plot shows a power measurement of a 100 kHz bandwidth just beside the adjacent channel (center of measurement is at 112.5 kHz from the carrier). These are measurements “ALT2 Up” and “ALT2 Low”. Please note that the other channel power measurements plotted are irrelevant in an ETSI context. The ETSI limits are –36 dBm. The measurement for **AX5043** is below –37 dBm.

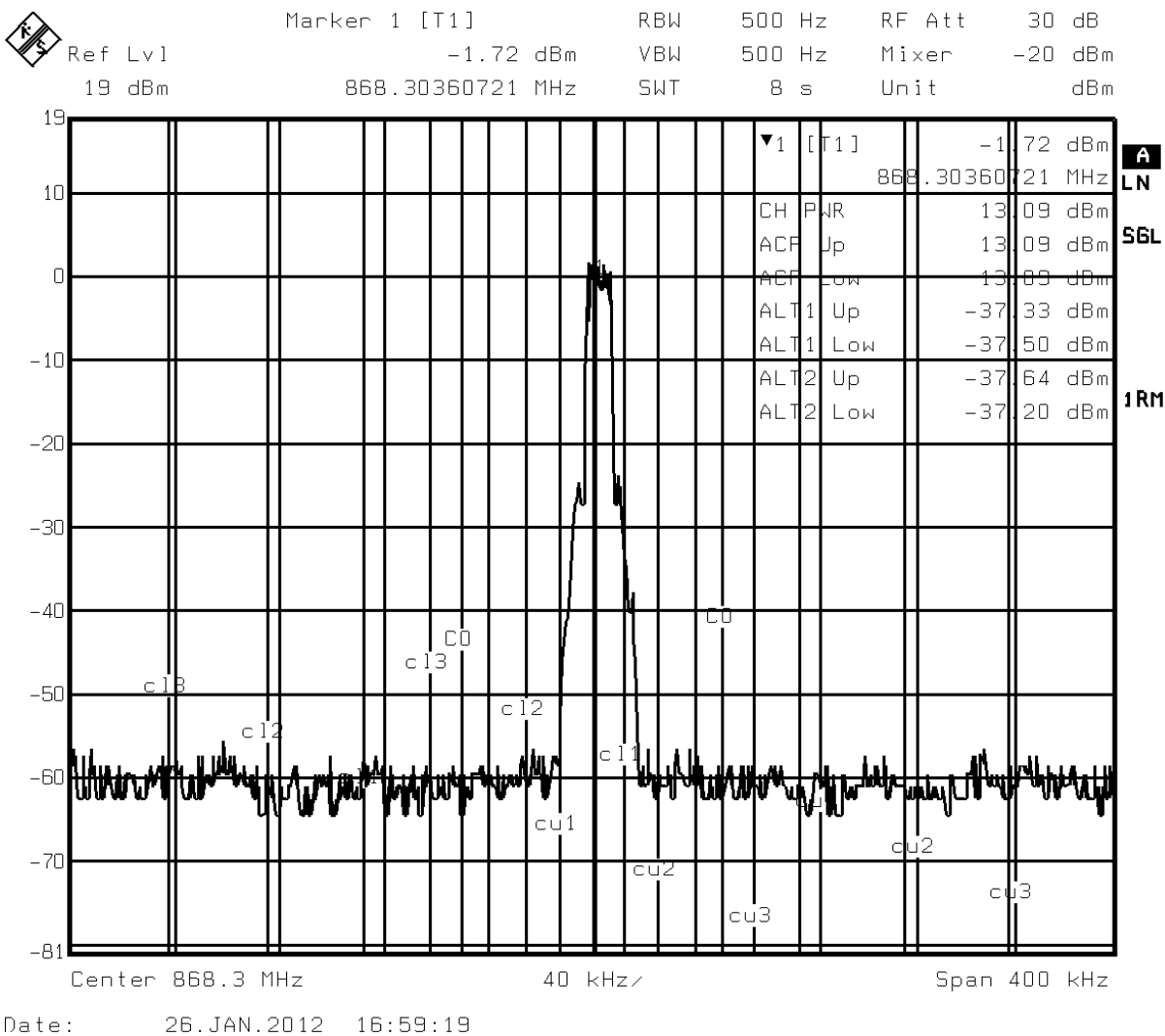


Figure 30: Transmit spectrum, 868.3 MHz, GFSK BT=0.3, 9.6 kbps, 3.2 kHz half deviation with measurement in 100 kHz bandwidth beside the alternate channel (clause 7.8.2.1)



470 – 862 MHz

From 470 – 862 MHz the ETSI limit is -54 dBm for an RBW of 100 kHz. The measurement for **AX5043** is below -56 dBm. The most critical frequency is at the edge of the frequency range closest to the carrier frequency.

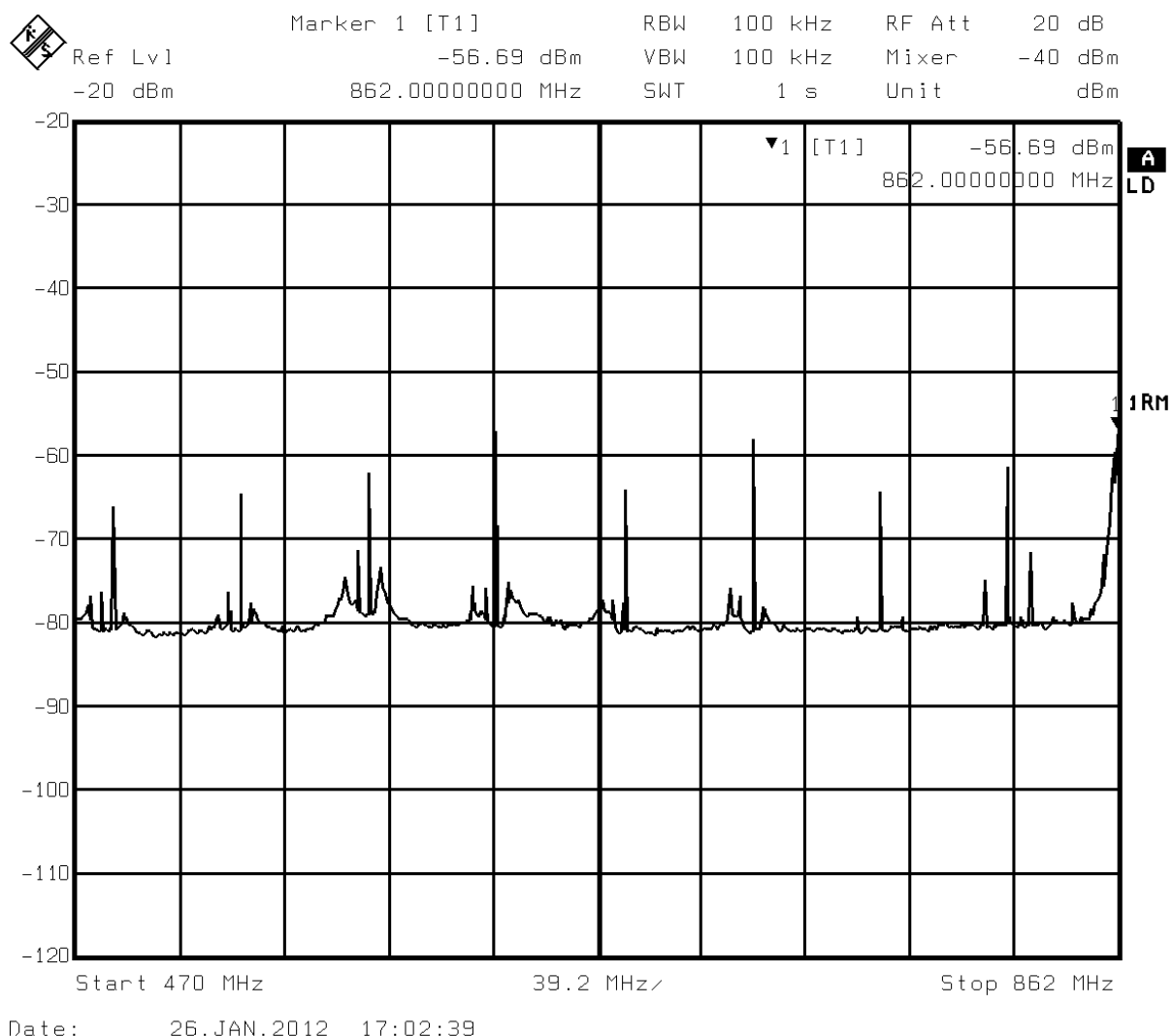



Figure 31: Spurious emission 470 – 862 MHz



ON Semiconductor and the  are registered trademarks of Semiconductor Components Industries, LLC (SCILLC) or its subsidiaries in the United States and/or other countries. SCILLC owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of SCILLC's product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. SCILLC reserves the right to make changes without further notice to any products herein. SCILLC makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does SCILLC assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. "Typical" parameters which may be provided in SCILLC data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. SCILLC does not convey any license under its patent rights nor the rights of others. SCILLC products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the SCILLC product could create a situation where personal injury or death may occur. Should Buyer purchase or use SCILLC products for any such unintended or unauthorized application, Buyer shall indemnify and hold SCILLC and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that SCILLC was negligent regarding the design or manufacture of the part. SCILLC is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:

Literature Distribution Center for ON Semiconductor
19521 E. 32nd Pkwy, Aurora, Colorado 80011 USA
Phone: 303-675-2175 or 800-344-3860 Toll Free USA/Canada
Fax: 303-675-2176 or 800-344-3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

N. American Technical Support: 800-282-9855 Toll Free
USA/Canada

Europe, Middle East and Africa Technical Support:
Phone: 421 33 790 2910

Japan Customer Focus Center
Phone: 81-3-5817-1050

ON Semiconductor Website: www.onsemi.com

Order Literature: <http://www.onsemi.com/orderlit>

For additional information, please contact your local
Sales Representative