Si4010 ARIB STD T-93 Test Results (315 MHz)

1. Introduction

This document provides Si4010 ARIB STD T-93 test results when operating in the 315 MHz frequency band. The results demonstrate full compliance under the ARIB STD T-93. All tests are performed using a 4010-DKPB434-BS with a matching network modified for 315 MHz. The results can be duplicated by using the same configuration. Two kinds of test signals were used for testing: OOK mode with 4.8 kbps data rate and FSK mode with 100 kbps data rate and 50 kHz frequency deviation.

All settings were used directly from the Excel Register Calculator for Si4010, version si4010_calc_regs_100830.xls. The latest version of the calculator is available on the Silicon Labs website. For measurement results with different RF parameters, contact customer support.

2. Relevant Measurements Limits

ARIB STD T-93 standard only pertains to radiated power, frequency tolerance, occupied bandwidth and unwanted emission measurements. Limits for these tests are shown below in the Test Results section “4.2. Test Items and Results” .

3. 4010-DKPB434-BS Schematic and Layout

Figures 1–5 show the modifications necessary for 315 MHz operation.

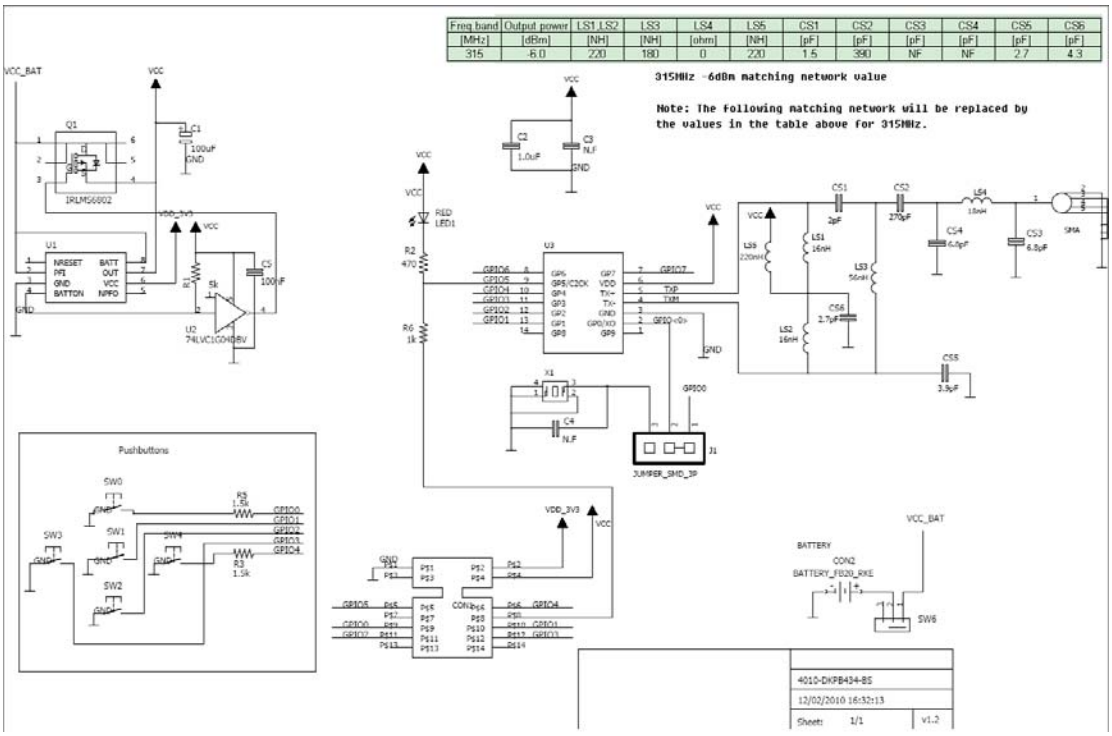

Figure 1. 4010-DKPB434-BS Schematic

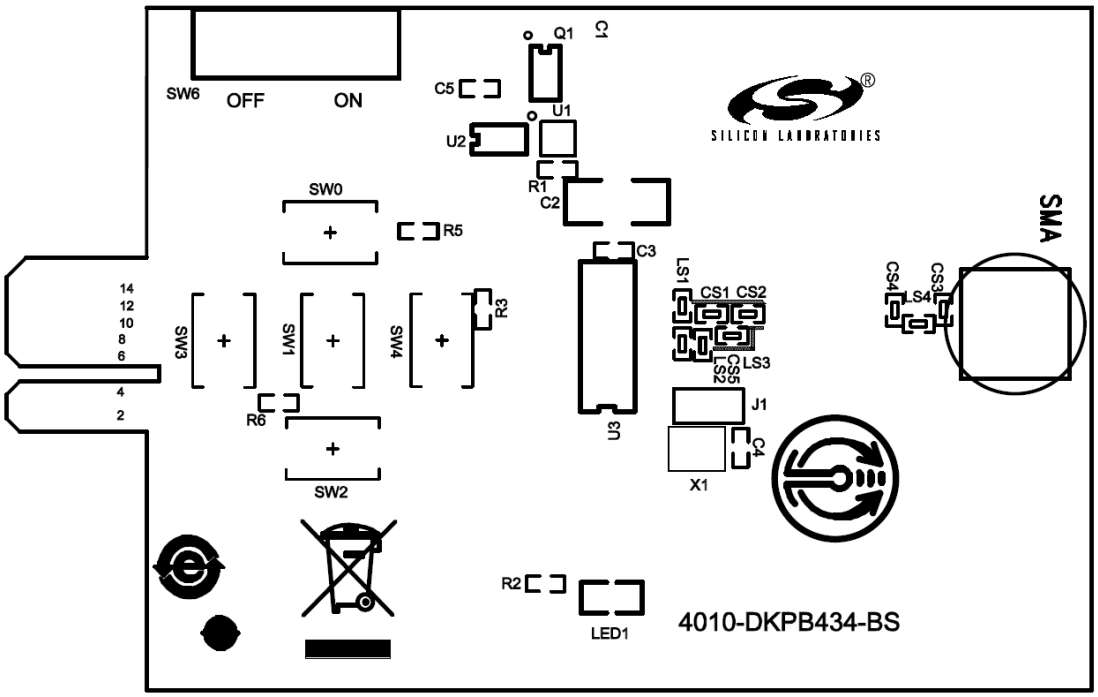

Figure 2. 4010-DKPB434-BS Layout—Top Layer Silk

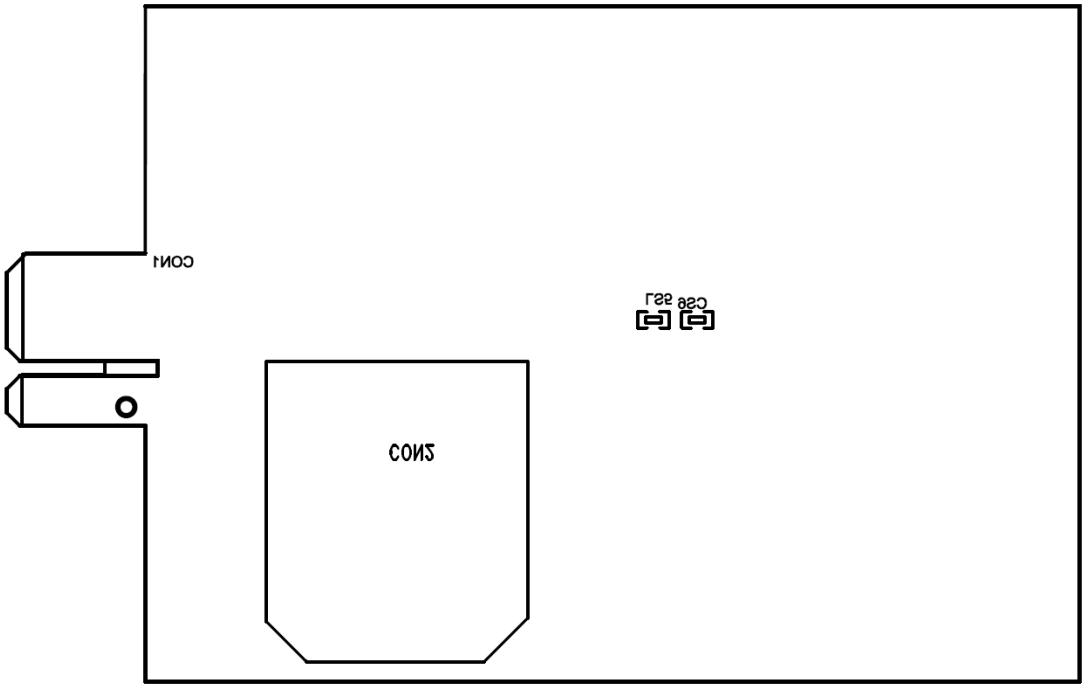

Figure 3. 4010-DKPB434-BS Layout—Bottom Layer Silk

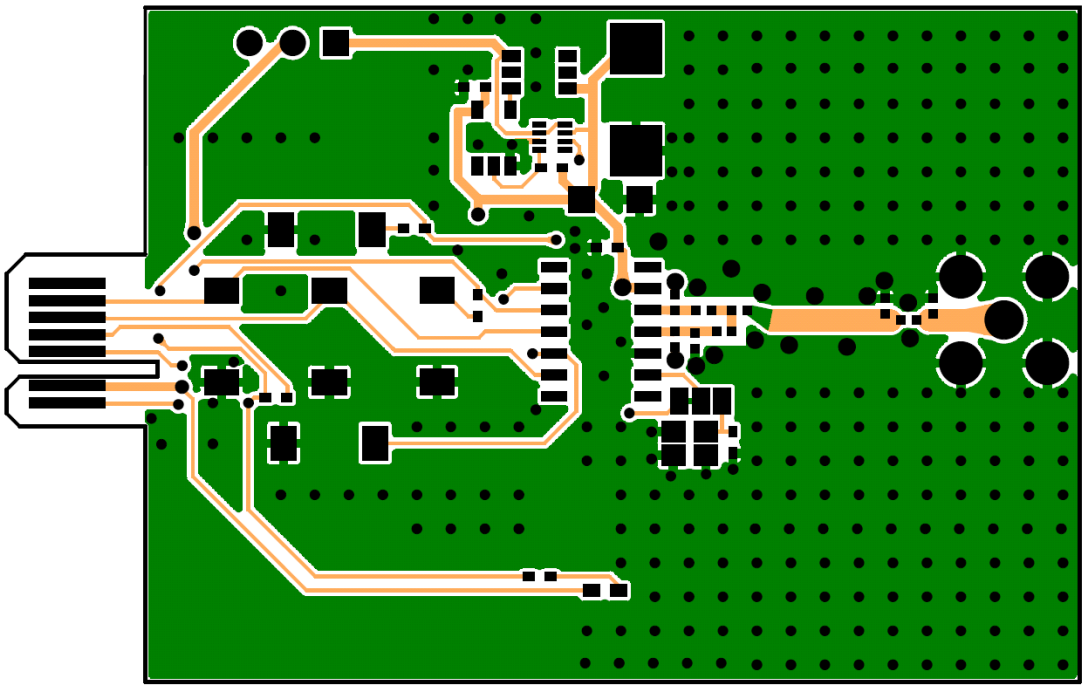

Figure 4. 4010-DKPB434-BS Layout—Top Layer Routing

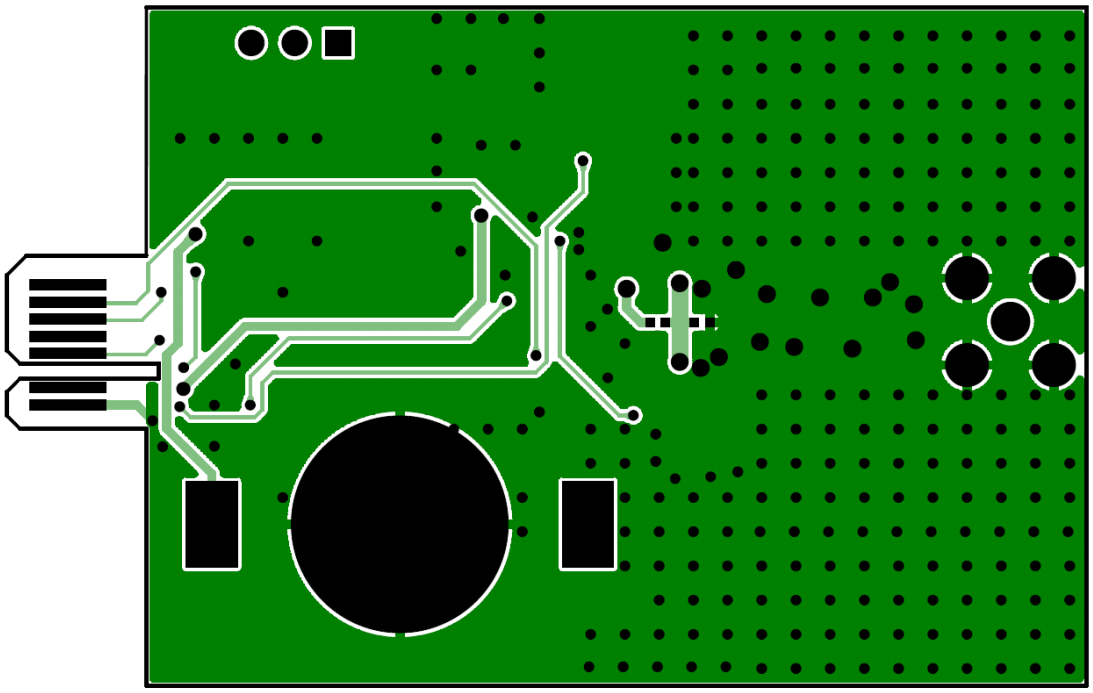

Figure 5. 4010-DKPB434-BS Layout—Bottom Layer Routing

4. ARIB STD T-93 Compliance Results

Silicon Labs has tested the Si4010 chip and 4010-DKPB434-BS with a 315 MHz, –6 dBm matching network test card for ARIB STD T-93 compliance. These ARIB compliance tests were performed in a conducted method by Silicon Labs.

Note: Although the specification for ARIB T-93 covers radiated emissions, we show that we achieve compliance in a conducted test and so can easily meet the specification for radiated limits. This is of course dependant on antenna design and some other factors which are beyond the scope of this document and should be reviewed carefully during board design.

4.1. Test Conditions

Temperature:	15–35° C
Humidity:	30–60 %
Atmospheric pressure:	950–1050 mbar
Test voltage:	DC 3 V

4.2. Test Items and Results

Below are test results showing that the Si4010 passed all tests.

1. **Radiated Power**

Limits:

Radiated Power should be less than 250 µW e.i.r.p (312 to 315.25 MHz).

Note: Radiated Power should be less than 250 µW e.i.r.p when the center frequency of occupied bandwidth and frequency tolerance (sum of these) ranges from 312 to 315.25 MHz.

a. OOK MODE (4.8 Kbps)

i. The result is –6.79 dBm, less than 250 µW; PASSED

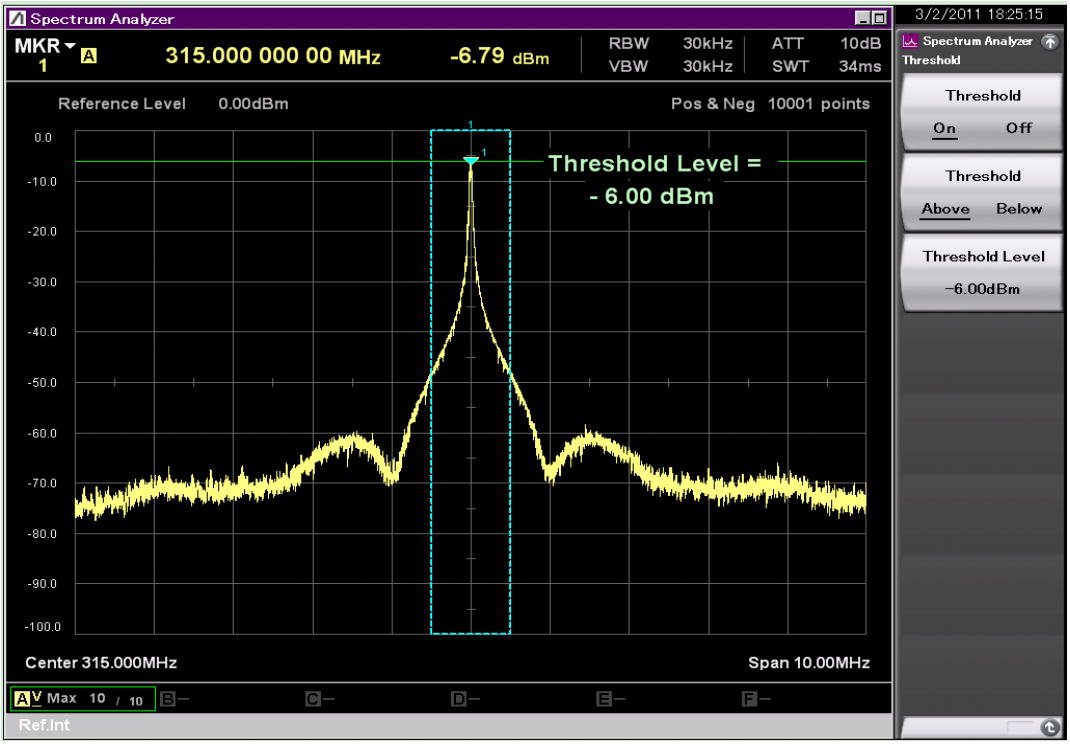

Figure 6. OOK Transmit Power

b. FSK MODE (100 Kbps, 50 kHz frequency deviation)
    i. The result is –6.54 dBm, less than 250 µW; PASSED

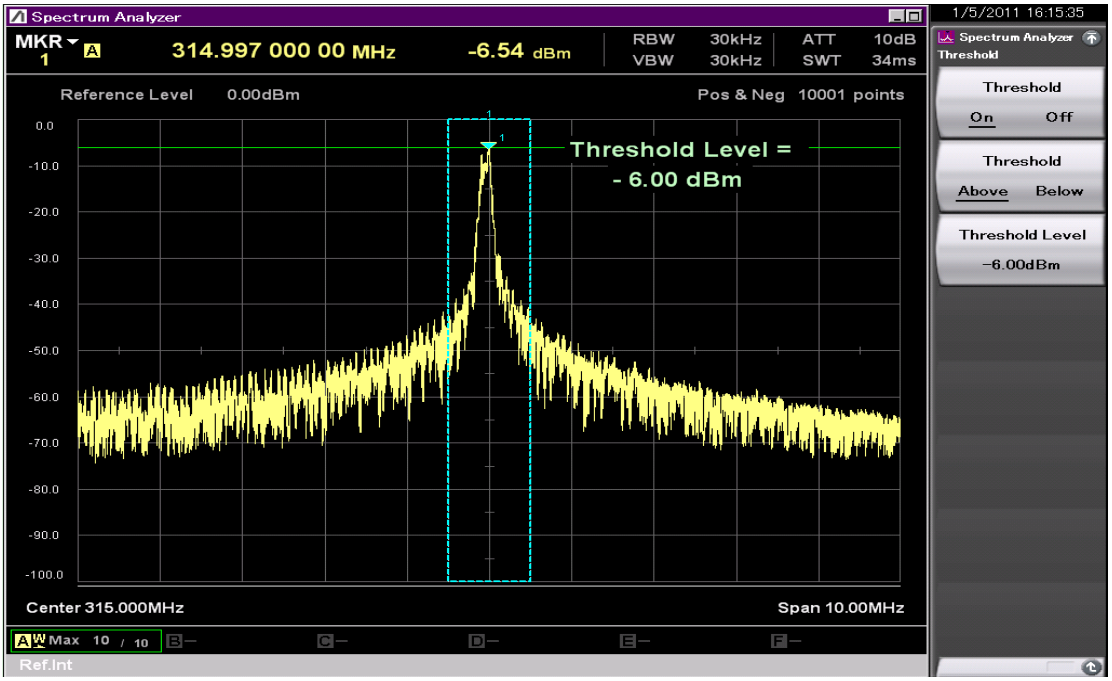

Figure 7. FSK Transmit Power

2. **Tolerance of Radiated Power**

Limits:

Variation from rated power is only defined for upper side as +20% (maximum). Lower side is not defined.

a. Maximum radiated power variation is within the limits of +20% as seen in the results above.

3. **Tolerance of Frequency**

Limits:

The transmitted frequency should be entirely between 312 and 315.25 MHz.

a. OOK mode
    i. Test frequency is 315.0006 MHz. It is inside the "specific band". PASSED

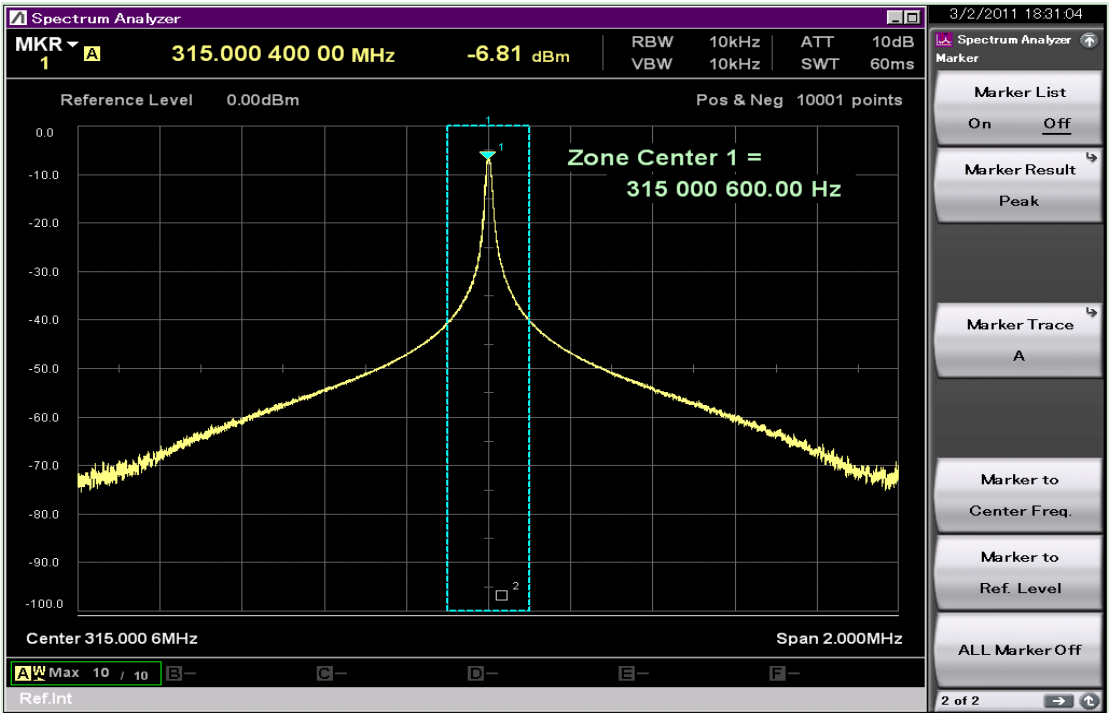

Figure 8. OOK Transmit Frequency

b. FSK mode

i. Tested frequency is 314.95560 MHz which is inside "specific band". PASSED

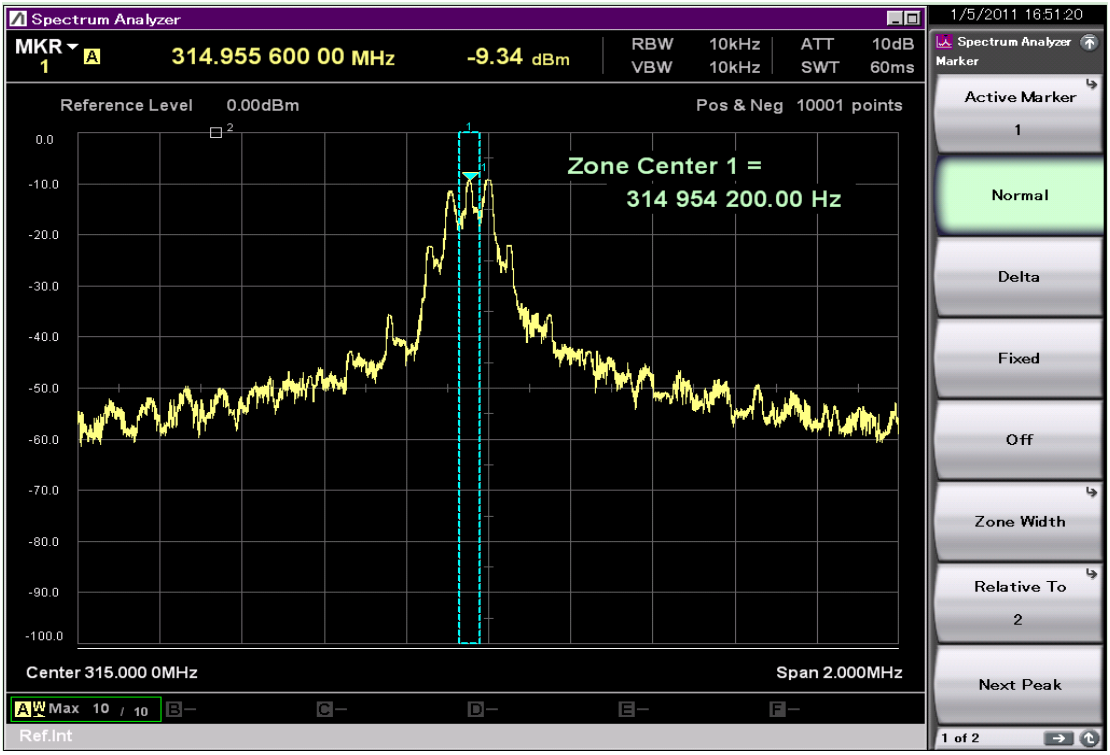

Figure 9. FSK Transmitting Frequency

4. **Occupied Bandwidth**

Limits:

1 MHz (when PN9 is applied at the actual transmission speed)

Note: When PN9 is not possible to use as a modulation source, it is acceptable to use actual system data as a source.

a. OOK mode

i. Tested OBW is 277 kHz, less than 1 MHz; PASSED

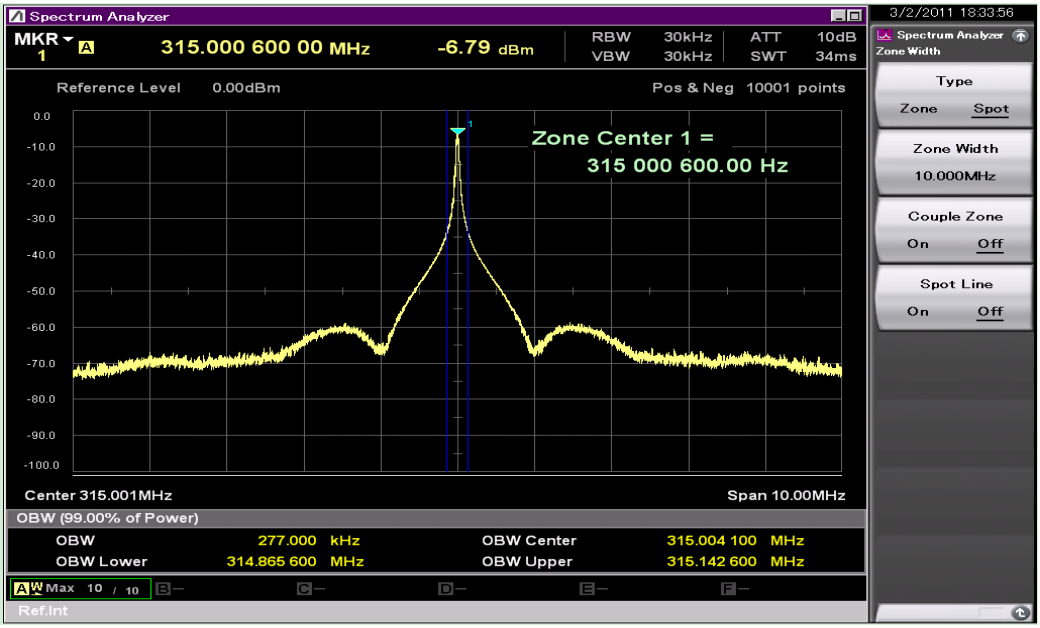

Figure 10. OBW in OOK Mode

b. FSK mode

i. Tested OBW is 230 kHz, less than 1 MHz; PASSED

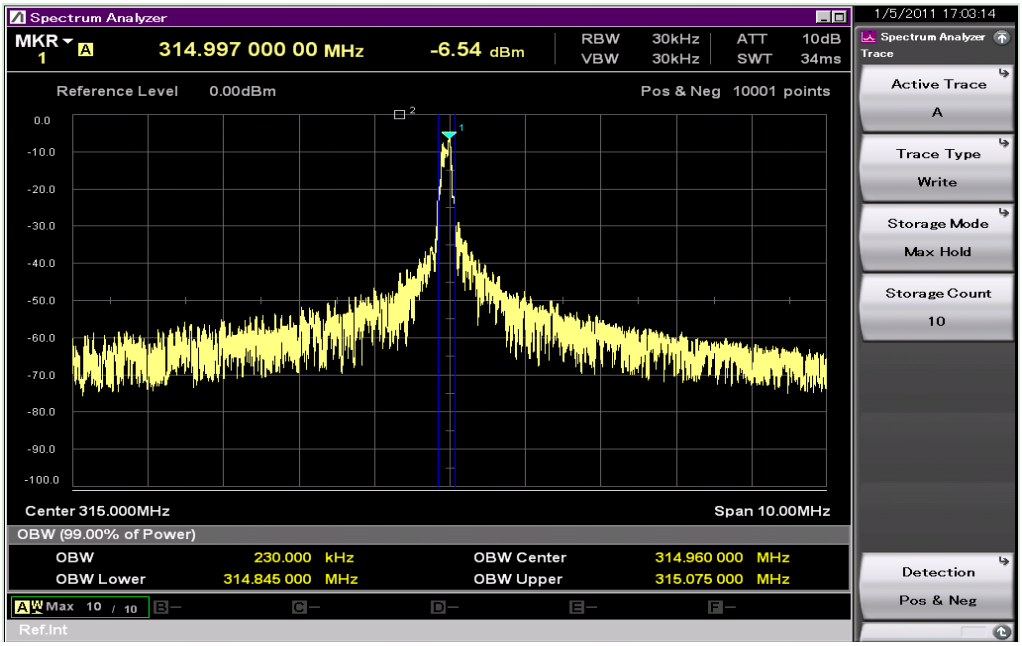

Figure 11. OBW in FSK Mode

5. **Unwanted emission (spurious emissions and out of band emissions)**

Limits:

Less than 1 GHz: 250 nW e.i.r.p (RBW: 100 kHz)

Above1 GHz: 1 µW e.i.r.p (RBW: 1 MHz)

a. OOK mode

i. The maximum emission below 1 GHz is –45.86 dBm, less than 250 nW; PASSED

ii. The maximum emission above 1 GHz is –44.55 dBm, less than 1 µW; PASSED

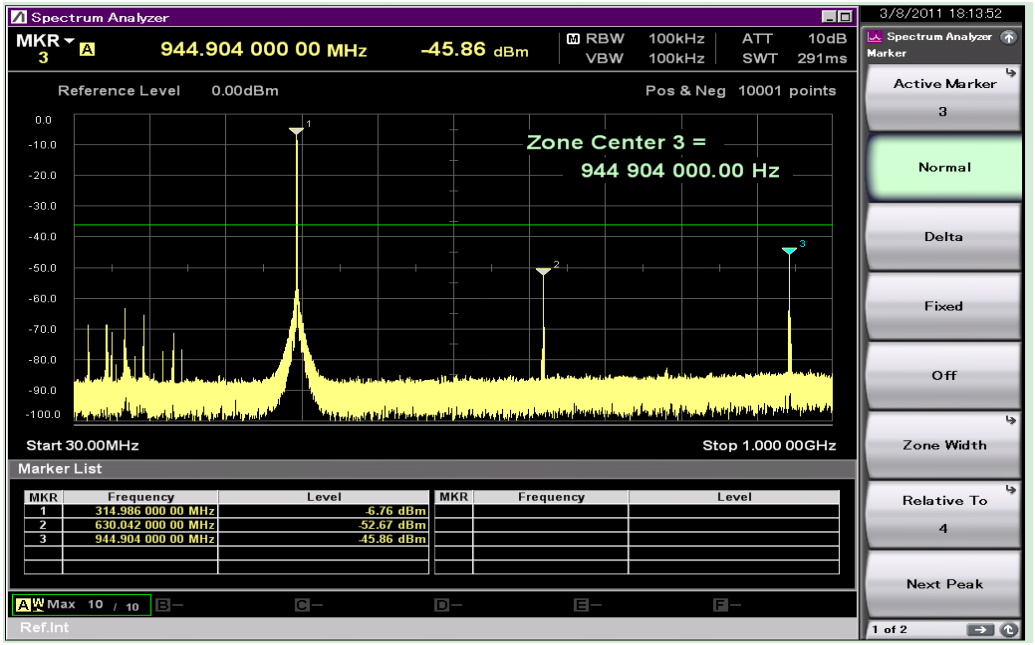

Figure 12. Emissions below 1 GHz in OOK Mode

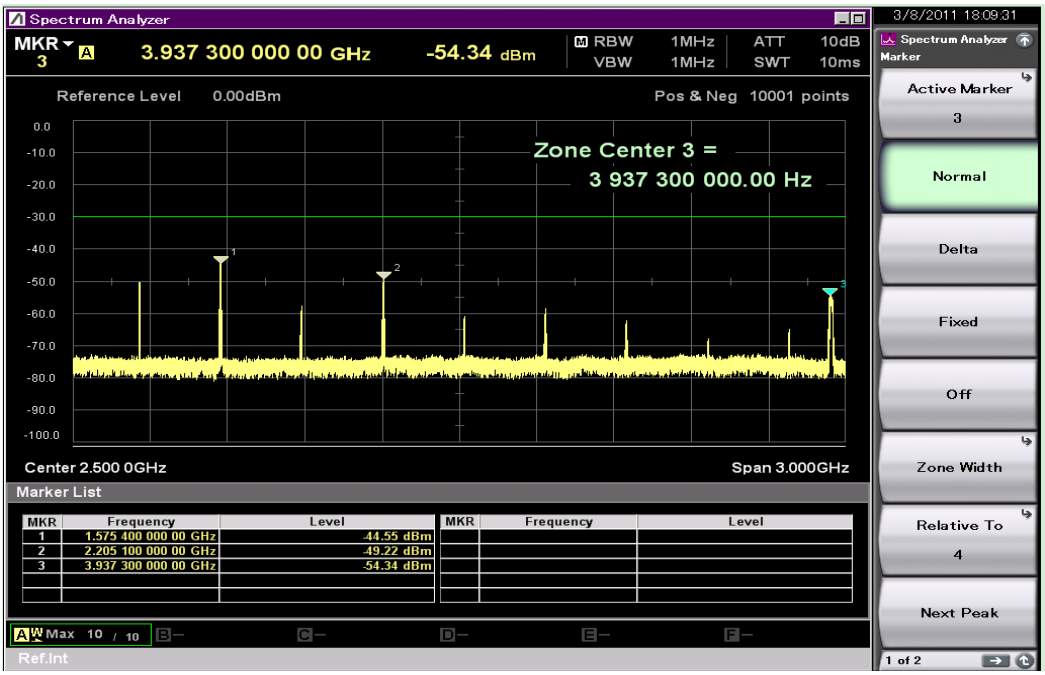

Figure 13. Emissions above 1 GHz in OOK Mode

b. FSK mode

i. The maximum emission below 1 GHz is –47.96 dBm, less than 250 nW; PASSED

ii. The maximum emission above 1 GHz is –44.26 dBm, less than 25 µW; PASSED

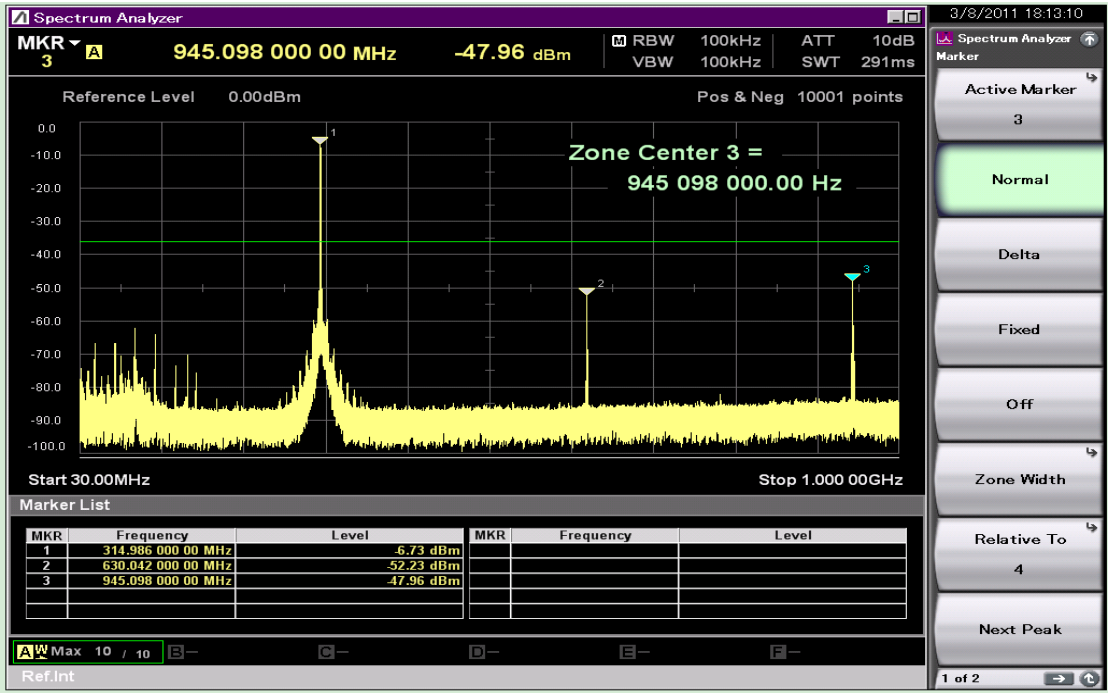

Figure 14. Emissions below 1 GHz in FSK Mode

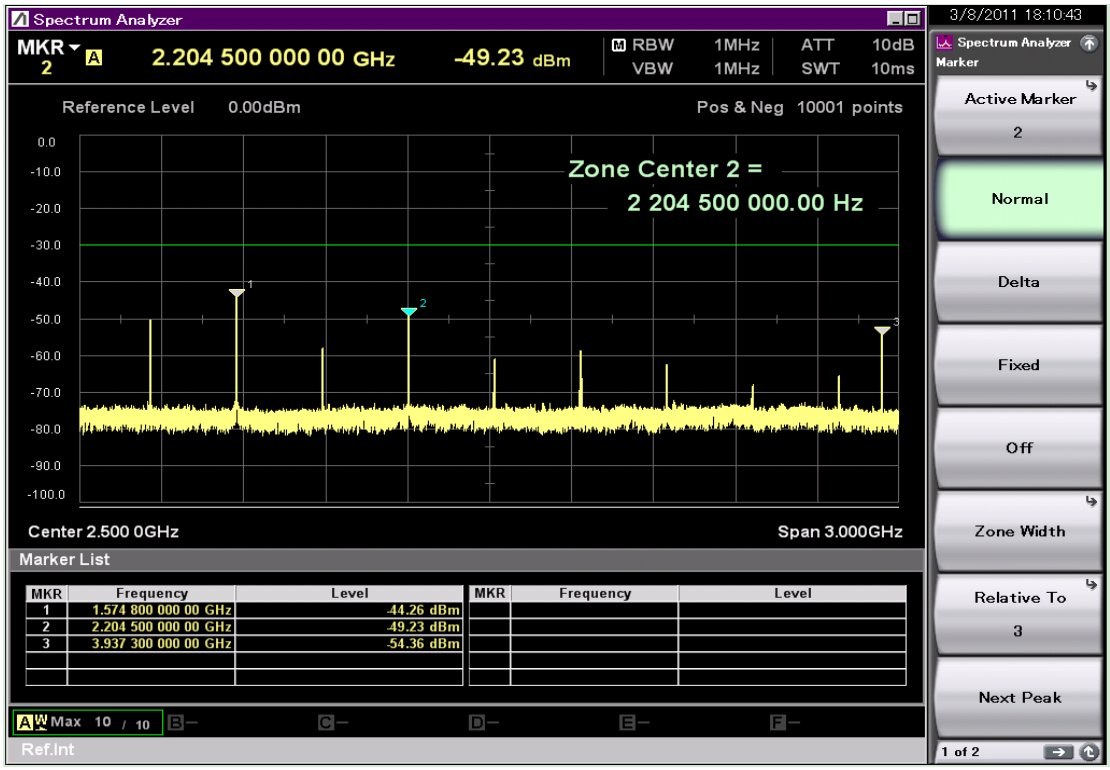

Figure 15. Emissions above 1 GHz in FSK Mode

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