Application Note

Anritsu

Vector Signal Generator Adjacent Channel Leakage Ratio (ACLR)

MG3710A

Vector Signal Generator

Introduction

The Adjacent Channel Leakage Ratio (ACLR) is an important characteristic of wireless transmitters and is defined as an important wireless standard by national laws regulating radio standards as well as by 3GPP and IEEE.

Generally, ACLR is defined as the ratio between the transmitted in-band power and the power of the adjacent upper and lower channel bands.

The major component determining the ACLR is distortion. As a result, ACLR is measured when evaluating the performance of devices that are affected by the distortion performance of wireless transmitters.

When evaluating devices with both input and output such as amplifiers, the output signal from a signal generator with known performance is input to the device and the output signal of the device is measured using a signal analyzer or a spectrum analyzer. The output signal of the signal generator must be significantly better than the performance of the device being measured so that its impact on the device evaluation can be ignored. Similarly the signal analyzer or spectrum analyzer measuring equipment must have sufficiently better performance than the output signals of the signal generator and the device so the input signal can be observed correctly.

To determine whether or not the measuring instruments meet the required performance, their specifications must be confirmed beforehand. The measuring instrument specifications require a fixed margin for the required performance. Capturing the instrument-specific unique performance data of the prepared measuring instruments confirms the effect on the actual margin and measurement results.

This application note explains the methods for examining the specifications and evaluating the performance for the adjacent channel leakage power ratio of a vector signal generator as an example of evaluating wireless devices such as amplifiers.

Measurement Equipment Specifications

To evaluate the performance of the measuring instrument, it is necessary to accurately understand the specifications. The instrument's specifications differ according to the conditions, making it necessary to refer to the evaluation objectives as well as to the signal type, frequency, level, and options.

When the Anritsu MG3710A Vector Signal Generator (without Reverse Power Protection option) is used to evaluate the adjacent channel leakage power ratio using W-CDMA downlink Test Model 1 64DPCH x 1 carrier signal with other center frequency of 2110 MHz, the specifications are defined as follows:

At 18° to 28°C using W-CDMA (Test Model 1, 64DPCH) signal:
1.8 GHz ≤ Output Frequency < 2.2 GHz
Output level ≤ –2 dBm (without High Power Extension option)
Output level ≤ +5 dBm (with High Power Extension option)
  5 MHz offset: ≤ –71 dBc/3.84 MHz
  10 MHz offset: ≤–71 dBc/3.84 MHz

These values take into account measured value uncertainty and are assured by the measuring instrument maker. If these specifications are not met using the correct measurement method, the instrument is either faulty or requires calibration.

Actual Performance

The instrument's actual performance is confirmed under the specified conditions.
This application note uses the Anritsu MG3710A Vector signal Generator (without Reverse Power Protection option and with High Power Extension option) as the signal generator and measures the signal using the Anritsu MS2690A/MS2691A/MS2692A Signal Analyzer as the spectrum analyzer.

The vector signal generator and spectrum analyzer are connected as shown in Figure 1.

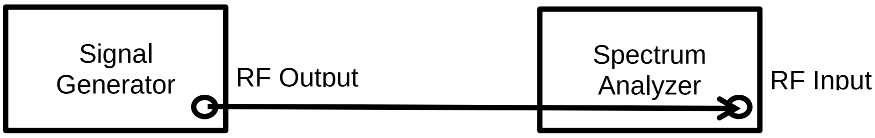

Figure 1. Measurement System

[Procedure]
Set the Anritsu MG3710A Vector Signal Generator and output a W-CDMA downlink signal as follows:

1. Press [Preset] → [F1: Preset] to initialize the settings.
2. Press [Load].
3. Move the cursor to “W-CDMA (BS Tx test)” in the “Package Name” row.
4. Press [F2: Focus] and set the cursor focus to the table at the “Pattern Name” row.
5. Move the cursor at the “Pattern Name” row to “TestModel_1_64DPCH”.
6. Press [F6: Load Pattern] and to load the selected waveform data into the waveform memory.
7. Press [Select].
8. Move the cursor at the “Package Name” row to “W-CDMA (BS Tx test)”.
9. Press [F2: Focus] and set the cursor focus to the table at the “Pattern Name” row.
10. Move the cursor at the “Pattern Name” row to “TestModel_1_64DPCH”.
11. Press [F6: Select] to replay the selected waveform data.
12. Press [Mod On/Off] to set the modulation to On.
13. Press [Frequency] and set the center frequency of the output RF signal to 2110 MHz.
14. Press [Level] and set the power of the output RF signal to +5 dBm.
15. Next, set the spectrum analyzer. So as not to input an excessive power to the spectrum analyzer, press [On/Off] after setting the spectrum analyzer and then set the signal generator output to On.

Actual Performance (continued)

[Procedure] (continued)

Next, use spectrum analyzer function of the MS2690A/MS2691A/MS2692A Signal Analyzer to perform measurements. To ensure that these measurements are unaffected by internal noise from the spectrum analyzer, enable the noise cancel function.

16. Press [Application Switch] and select “Spectrum Analyzer” from the function menu.
17. Press [Preset] → [F1: Preset] to initialize the spectrum analyzer function settings.
18. Press [Cal] → [F1: SIGANA All].
19. Press [F8: Close] after calibration is completed.
20. Press [Frequency] and set the center frequency of the measured RF signal to 2110 MHz.
21. Press [Amplitude] and set the reference level to –10 dBm.
22. Press [Measure] → [F8: Standard].
23. Select [W-CDMA Downlink].
24. Press [F1: ACP].
25. Press [F6: Noise Cancel] to set On.
26. Set [Time/Sweep] → [F2: Sweep Time] to 2 s.
27. Then, press [On/Off] of the signal generator to set the output to On.
28. Press the [Single] key of the spectrum analyzer to start measurement.

Actual Performance (continued)

The following results are obtained using the MG3710A Vector Signal Generator described in this application note:
These values are measured results (sample) and have not been statistically processed.
(They are measured results and are not guaranteed values.)

5-MHz offset (Lower side)	–73.23 dBc/3.84 MHz (measured)
5-MHz offset (Upper side)	–74.59 dBc/3.84 MHz (measured)
10-MHz offset (Lower side)	–75.26 dBc/3.84 MHz (measured)
10-MHz offset (Upper side)	–74.99 dBc/3.84 MHz (measured)

Fig 2. ACLR (measured) for W-CDMA Test Model 1, 64DPCH

When using under conditions other than those specified in the recommendations, determine the differences from defined specifications and evaluate whether or not they can be used at evaluation. If the instrument can be obtained beforehand, check the performance of the instrument under the actual evaluation conditions.
Figure 3 and 5 show measured ACLR values for the MG3710A Vector Signal Generator (without Reverse Power Protection option and with High Power Extension option) for several important wireless standards.

Fig. 3. ACLR (measured) for W-CDMA Test Model 1, 64DPCH x 4 Carrier
(Output Level: + 5 dBm)

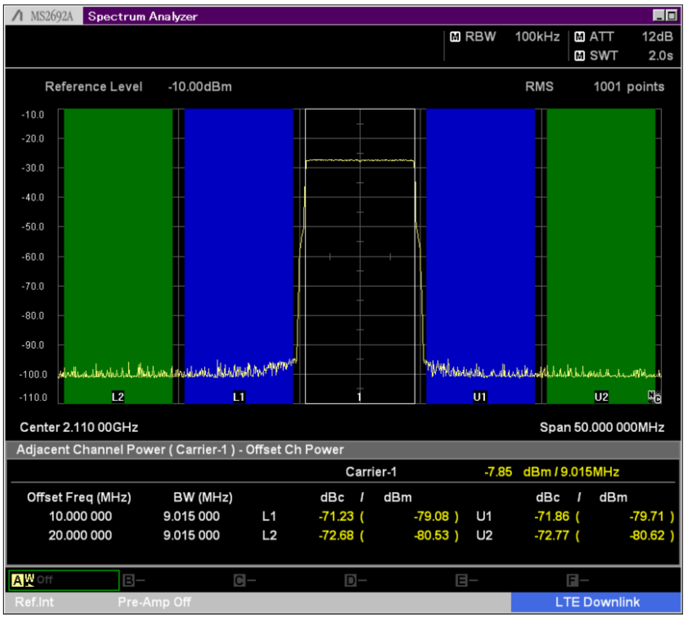

Fig. 4. ACLR (measured) for LTE FDD E-TM1.1 10MHz (Output Level: –7 dBm)

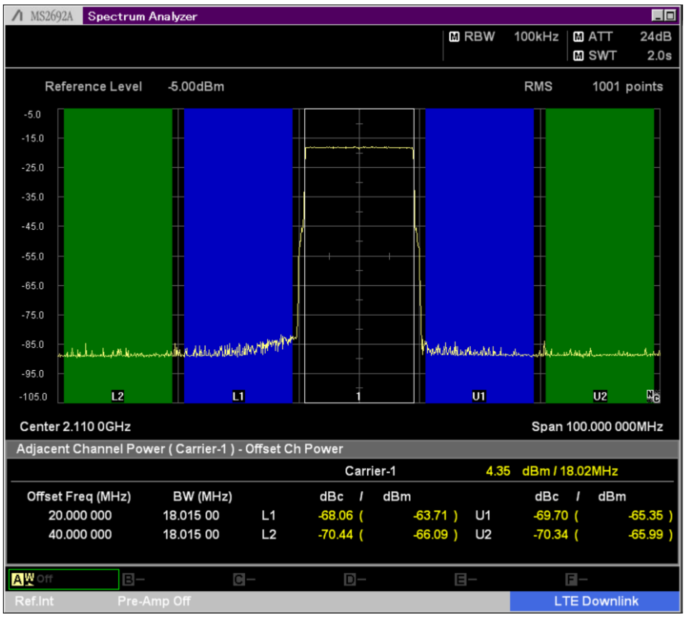

Fig. 5. ACLR (measured) for LTE FDD E-TM1.1 20 MHz (Output Level: +5 dBm)

When ACLR Deteriorates

When the expected ACLR value is not obtained, the major causes are distortion and degraded S/N.
In measurement systems for evaluating amplifiers, distortion is caused by the sum of the vector signal generator used as the signal source, the amplifier being measured, and saturation of the spectrum analyzer. One of the three will have the greatest effect but when the deterioration of the ACLR depends on the test signal, test signals with a high crest factory are a cause (peak power ratio based on effective power).

Take the following precautions when setting the instruments:

- Ensure that there are no overflow warnings displayed at the vector signal generator DAC (digital to analog converter).
- Ensure that the spectrum analyzer attenuator setting is not too high (or too low).

The vector signal generator overflow warning indicates insufficient operand bits at digital processing and if it occurs frequently, it indicates that that the input level t the DAC is too high, causing distortion and spurious in the output signal. When using the MG3710A Vector Signal Generator, reduce the value of the RMS Value Tuning parameter. If the value is too low, the S/N drops too low which also causes deterioration of the ACLR.
Distortion is also cause when the spectrum analyzer attenuator setting is too low and the S/N deteriorates when it is too high.

Summary

The validity of the device evaluation results can be assessed by determining the actual performance of the measuring instruments being used. If the performance of the measuring instruments is worse than the DUT, the results are not those of the device and have possibly been affected by the measuring instrument performance. The Anritsu MG3710A Vector Signal Generator has very low distortion and is ideal for generating a vector modulation signal for measuring ACLR. It is the perfect solution for evaluating the performance of devices used in wireless transmitters.

Definitions

Measured: Performance not warranted. Data actually measured by randomly selected measuring instruments.

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Specifications are subject to change without notice.

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