

# **NXDN Tx Test Solution**

**MS2830A**  
Signal Analyzer

# **NXDN**

## **Tx Test Solution**

### **NXDN Technical Specifications**

#### **Common Air Interface**

**NXDN TS 1-A Version 1.3 (Nov 2011)**

#### **Common Air Interface Type. D**

**NXDN TS 2-A Version 1.1 (Mar 2012)**

#### **Transceiver Performance Test**

**NXDN TS 1-E Version 1.1 (Jun 2012)**

***Note: For details, refer to the NXDN standard.***

**Version 2.00**

**Oct. 2014**

**Anritsu Corporation**

# [Anritsu] NXDN Tx Test Solution

## Tx Evaluation

**Multi-functions supported with one unit!**

Unit, Module \*



\*Output in Test Mode

MS2830A  
Signal Analyzer



Spectrum Analyzer

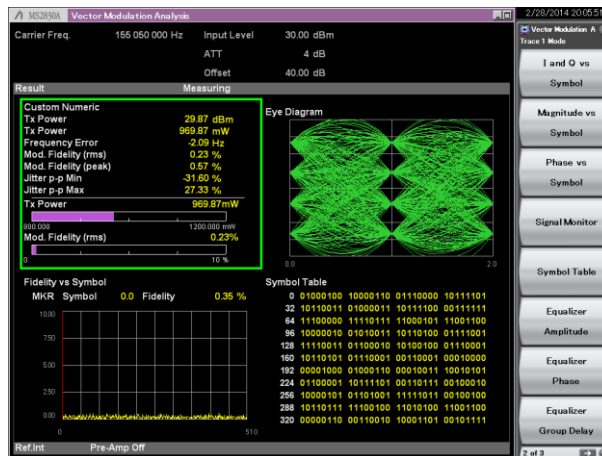
Frequency Counter

Modulation Analyzer  
(MX269017A)

Test Receiver  
(MX269018A)

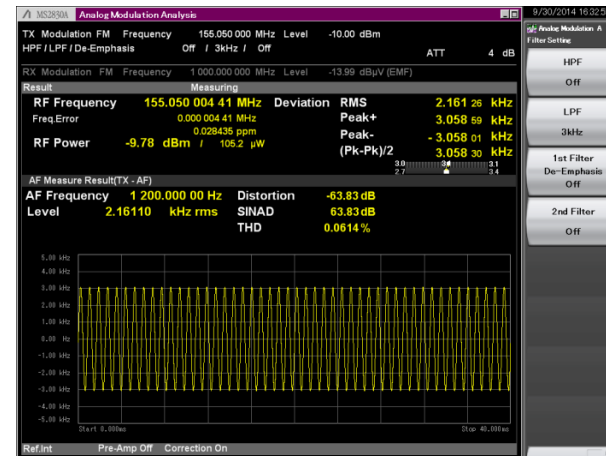
MX269017A

Vector Modulation Analysis Software



MX269018A

Analog Modulation Analysis Software



# [Anritsu] NXDN Tx Test Solution

*Note: For details, refer to the NXDN standard.*

| NXDN<br>TS 2-A | Transmitter test items          | Signal Analyzer  | Other            |
|----------------|---------------------------------|------------------|------------------|
|                |                                 | MS2830A          |                  |
| 5.2.1          | Transmitter Power               | ---              | Power Meter      |
| 5.2.2          | Frequency Error (CW)            | $\sqrt{\quad}$   | ---              |
|                | Frequency Error (1/3 deviation) | $\sqrt{\quad}^2$ | ---              |
| 5.2.3          | Transmit Behavior               | $\sqrt{\quad}^1$ | ---              |
| 5.2.4          | Spectrum Mask                   | $\sqrt{\quad}$   | ---              |
| 5.2.5          | Radiated Spurious Emission      | $\sqrt{\quad}$   | ---              |
| 5.2.6          | Conductive Spurious Emission    | $\sqrt{\quad}$   | ---              |
| 5.2.7          | Adjacent Channel Power Ratio    | $\sqrt{\quad}$   | ---              |
| 5.2.8          | Intermodulation Attenuation     | $\sqrt{\quad}$   | Signal Generator |
| 5.2.9          | Transmitter Attack Time         | ---              | Power Meter      |
| 5.2.10         | Maximum Frequency Deviation     | $\sqrt{\quad}^2$ | ---              |
| 5.2.11         | 1/3 Frequency Deviation         | $\sqrt{\quad}^2$ | ---              |
| 5.2.12         | Modulation Accuracy             | $\sqrt{\quad}^3$ | ---              |
| 5.2.13         | Modulation Symbol Speed         | $\sqrt{\quad}^2$ | ---              |

1. Requires MS2830A-006 Analysis Bandwidth 10 MHz for Frequency vs. Time function
2. Requires MX269018A Analog Measurement Software with A0086A USB Audio
3. Requires MX269017A Vector Modulation Analysis Software with MS2830A-006

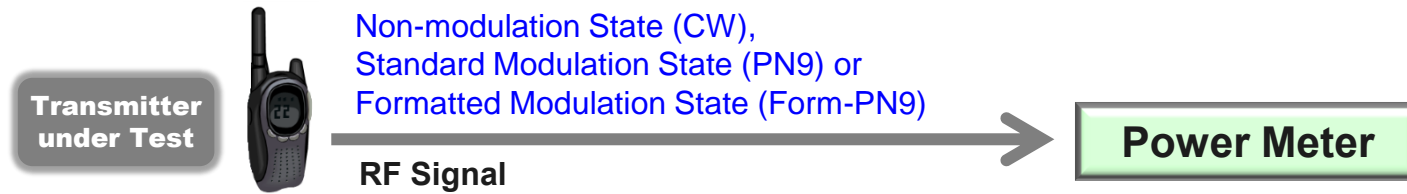
# Transmitter Performance Measurement Methods

## Transmitter Power

*Note: For details, refer to the NXDN standard.*

Measures transmitter **power**

Limits: (**Specified by manufacturer**)



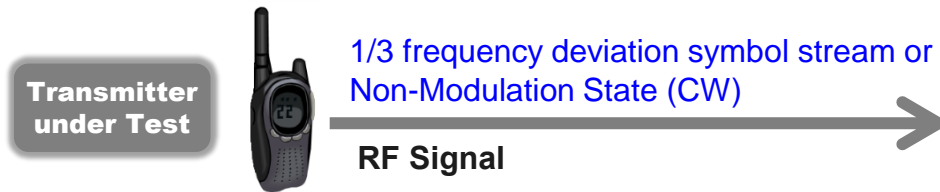
# Transmitter Performance Measurement Methods

## Frequency Error

*Note: For details, refer to the NXDN standard.*

Measures transmitter transmit frequency deviation

Limits: (Specified by 47 CFR 90.213)



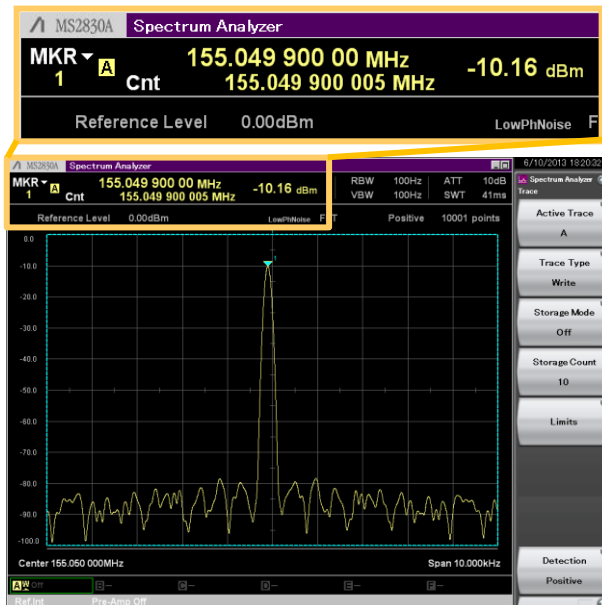
**Frequency Counter**



MX269018A

Frequency Counter Function [pre-installed]

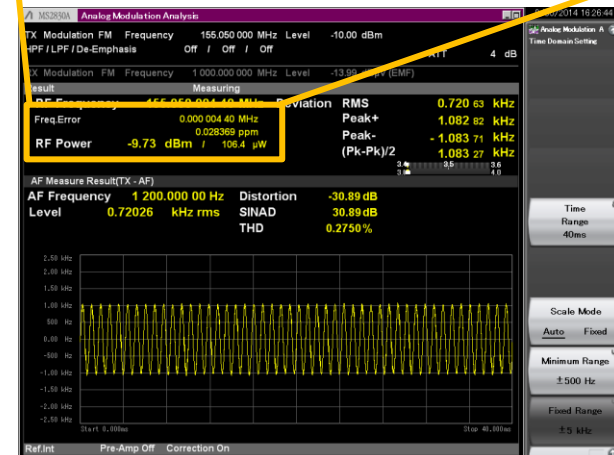
For Non-Modulation State (CW)



**RF Frequency 155.050 004 40 MHz**

**Freq.Error 0.000 004 40 MHz**

**0.028369 ppm**



# Transmitter Performance Measurement Methods

## Frequency Error

*Note: For details, refer to 47 CFR.*

### §90.213 Frequency stability.

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

#### MINIMUM FREQUENCY STABILITY

[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              | 100                     | 100                       | 200                          |
| 25-50                 | 20                      | 20                        | 50                           |
| 72-76                 | 5                       |                           | 50                           |
| 150-174               | 5                       | 5                         | 50                           |
| 216-220               | 1.0                     |                           | 1.0                          |
| 220-222               | *1 0.1                  | 1.5                       | 1.5                          |
| 421-512               | 2.5                     | 5                         | 5                            |
| 806-809               | 1.0                     | 1.5                       | 1.5                          |
| 809-824               | 1.5                     | 2.5                       | 2.5                          |
| 851-854               | 1.0                     | 1.5                       | 1.5                          |
| 854-869               | 1.5                     | 2.5                       | 2.5                          |
| 896-901               | *1 0.1                  | 1.5                       | 1.5                          |
| 902-928               | 2.5                     | 2.5                       | 2.5                          |
| 902-928               | 2.5                     | 2.5                       | 2.5                          |
| 929-930               | 1.5                     |                           |                              |
| 935-940               | *1 0.1                  | 1.5                       | 1.5                          |
| 1427-1435             | 300                     | 300                       | 300                          |
| Above 2450            |                         |                           |                              |

\*1. Requires "External Reference Clock" or "High Stability Reference Oscillator (Opt.002)"

47CFR: [http://www.ecfr.gov/cgi-bin/text-idx?SID=8fbed58a5723510d7268832815998bfb&tpl=/ecfrbrowse/Title47/47cfr90\\_main\\_02.tpl](http://www.ecfr.gov/cgi-bin/text-idx?SID=8fbed58a5723510d7268832815998bfb&tpl=/ecfrbrowse/Title47/47cfr90_main_02.tpl)

# Transmitter Performance Measurement Methods

## Transient Behavior

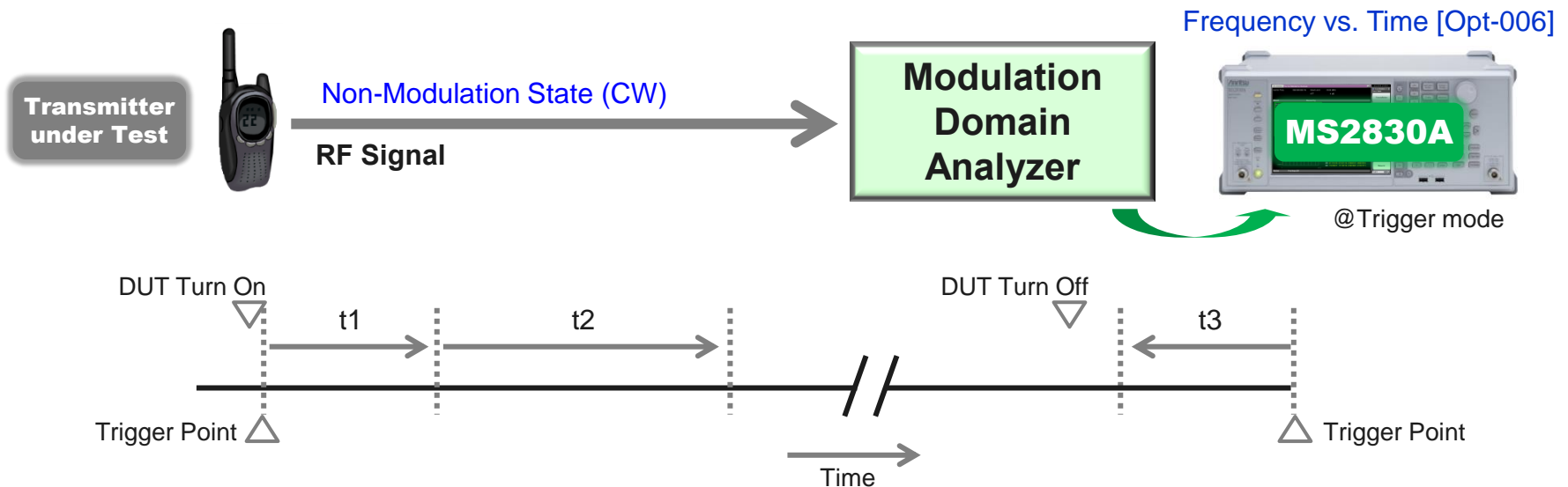
*Note: For details, refer to the NXDN standard.*

Measures deviation of transmit frequency (Maximum Frequency Difference) for specified period when the transmit power switched on or off

Limits:

| Time Intervals | 6.25 kHz Ch. Spacing | Frequency Range (MHz) |         |         |
|----------------|----------------------|-----------------------|---------|---------|
|                | 12.5 kHz Ch. Spacing | 30~174                | 406~512 | 806~940 |
| t1 *           | +/- 6.25 kHz         | 5ms                   | 10ms    | 20ms    |
|                | +/- 12.5 kHz         |                       |         |         |
| t2             | +/- 3.125 kHz        | 20ms                  | 25ms    | 50ms    |
|                | +/- 6.25 kHz         |                       |         |         |
| t3 *           | +/- 6.25 kHz         | 5ms                   | 10ms    | 10ms    |
|                | +/- 12.5 kHz         |                       |         |         |

\*If the transmit power rating is  $\leq 6$  W, the frequency differences during t1 and t3 are not specified.





# Transmitter Performance Measurement Methods

## Transient Behavior

*Note: For details, refer to 47 CFR.*

### §90.214 Transient frequency behavior.

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 <sup>1 2</sup>   | Maximum frequency difference <sup>3</sup> | All equipment  |                |
|---|---|----------------|----------------|
|   |   | 150 to 174 MHz | 421 to 512 MHz |
| Transient Frequency Behavior for Equipment Designed to Operate on 25 kHz Channels   |   |                |                |
| t <sub>1</sub> <sup>4</sup>   | ±25.0 kHz                                 | 5.0 ms         | 10.0 ms        |
| t <sub>2</sub>  | ±12.5 kHz                                 | 20.0 ms        | 25.0 ms        |
| t <sub>3</sub> <sup>4</sup>   | ±25.0 kHz                                 | 5.0 ms         | 10.0 ms        |
| Transient Frequency Behavior for Equipment Designed to Operate on 12.5 kHz Channels |   |                |                |
| t <sub>1</sub> <sup>4</sup>   | ±12.5 kHz                                 | 5.0 ms         | 10.0 ms        |
| t <sub>2</sub>  | ±6.25 kHz                                 | 20.0 ms        | 25.0 ms        |
| t <sub>3</sub> <sup>4</sup>   | ±12.5 kHz                                 | 5.0 ms         | 10.0 ms        |
| Transient Frequency Behavior for Equipment Designed to Operate on 6.25 kHz Channels |   |                |                |
| t <sub>1</sub> <sup>4</sup>   | ±6.25 kHz                                 | 5.0 ms         | 10.0 ms        |
| t <sub>2</sub>  | ±3.125 kHz                                | 20.0 ms        | 25.0 ms        |
| t <sub>3</sub> <sup>4</sup>   | ±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.  
t<sub>1</sub> is the time period immediately following ton.  
t<sub>2</sub> is the time period immediately following t<sub>1</sub>.  
t<sub>3</sub> 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 t<sub>2</sub> to the beginning of t<sub>3</sub>, 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 W, the frequency difference during this time period may exceed the maximum frequency difference for this time period.

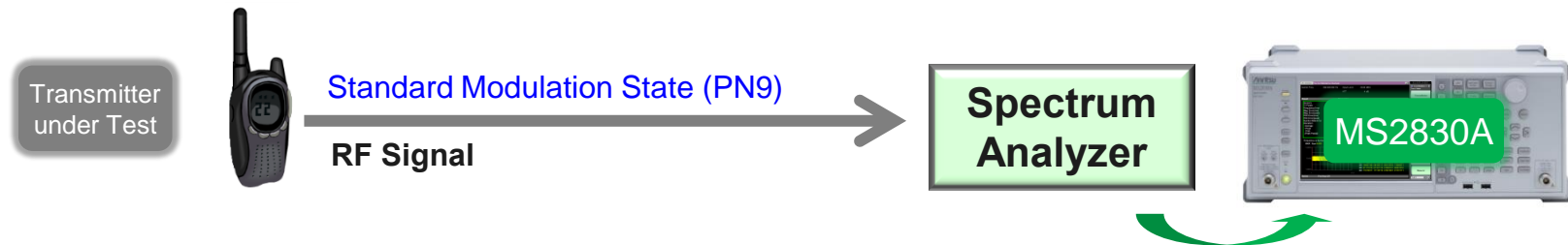
# Transmitter Performance Measurement Methods

## Spectrum Mask

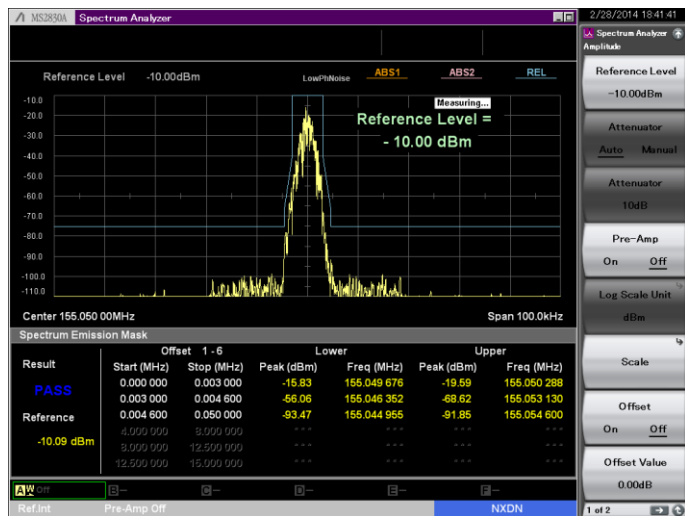
*Note: For details, refer to the NXDN standard.*

Measures spectrum of emitted modulation signal

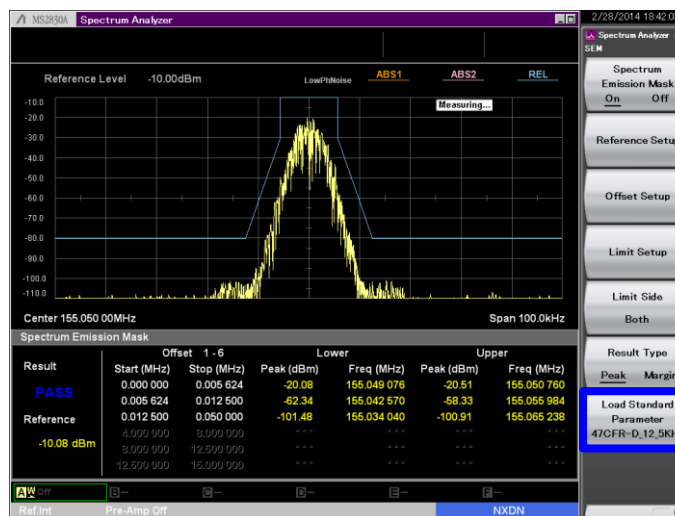
Limits: (Specified by 47 CFR 90.210)



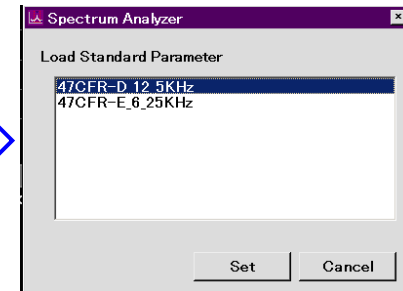
Spectrum Emission Mask Function [pre-installed]



Channel Spacing: 6.25 kHz



Channel Spacing: 12.5 kHz



# Transmitter Performance Measurement Methods

## Spectrum Mask

*Notes: For details, refer to 47 CFR.*

§90.210 Emission masks.

APPLICABLE EMISSION MASKS

| Frequency band (MHz)           | Mask for equipment with audio low pass filter | Mask for equipment without audio low pass filter |
|--------------------------------|---|--|
| Below 25 <sup>1</sup>          | A or B  | A or C   |
| 25-50                          | B   | C  |
| 72-76                          | B   | C  |
| → 150-174 <sup>2</sup>         | B, D, or E                                    | C, D or E  |
| 150 paging only                | B   | C  |
| 220-222                        | F   | F  |
| → 421-512 <sup>2 5</sup>       | B, D, or E                                    | C, D, or E                                       |
| 450 paging only                | B   | G  |
| 806-809/851-854                | B   | H  |
| 809-824/854-869 <sup>3 5</sup> | B   | 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 <sup>4</sup>         |   |  |
| All other bands                | B   | C  |

2. Equipment designed to operate with a 25 kHz channel bandwidth must meet the requirements of Emission Mask B or C, as applicable. Equipment designed to operate with a [12.5 kHz channel bandwidth must meet the requirements of Emission Mask D](#), and equipment designed to operate with a [6.25 kHz channel bandwidth must meet the requirements of Emission Mask E](#).

# Transmitter Performance Measurement Methods

## Spectrum Mask

*Notes: For details, refer to 47 CFR.*

### §90.210 Emission masks.

- (d) **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:
- (1) On any frequency from the center of the authorized bandwidth  $f_0$  to 5.625 kHz removed from  $f_0$ : Zero dB.
  - (2) 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  $7.27(f_d - 2.88 \text{ kHz})$  dB.
  - (3) 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.
  - (4) 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.
- (e) **Emission Mask E—6.25 kHz or less channel bandwidth equipment.** For transmitters designed to operate with a 6.25 kHz or less bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:
- (1) On any frequency from the center of the authorized bandwidth  $f_0$  to 3.0 kHz removed from  $f_0$ : Zero dB.
  - (2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency ( $f_d$  in kHz) of more than 3.0 kHz but no more than 4.6 kHz: At least  $30 + 16.67(f_d - 3 \text{ kHz})$  or  $55 + 10 \log(P)$  or 65 dB, whichever is the lesser attenuation.
  - (3) On any frequency removed from the center of the authorized bandwidth by more than 4.6 kHz: At least  $55 + 10 \log(P)$  or 65 dB, whichever is the lesser attenuation.
  - (4) 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.

# Transmitter Performance Measurement Methods

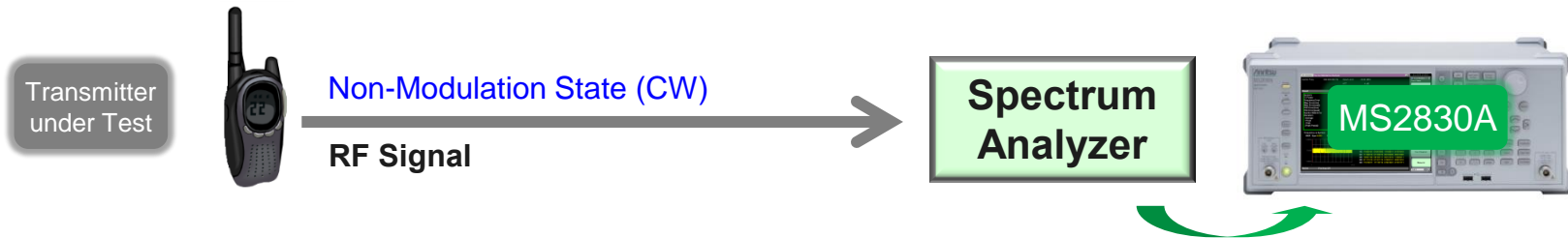
## Radiated Spurious Emission

Measures **power of spurious signals** radiated from chassis when transmitter antenna terminal connected to standard load

Limits: (Specified by 47 CFR 90.210)

*Note: For details, refer to the NXDN standard.*

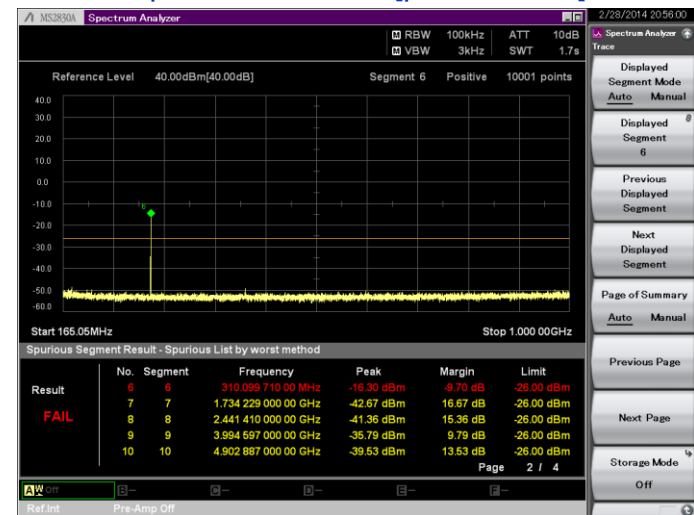
*Note: For details, refer to 47 CFR.*



### §90.210 Emission masks.

(o) Instrumentation. The reference level for showing compliance with the emission mask shall be established, except as indicated in § 90.210 (d), (e), and (k), using standard engineering practices for the modulation characteristic used by the equipment under test. When measuring emissions in the 150-174 MHz and 421-512 MHz bands the following procedures will apply. 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 frequencies more than 50 kHz removed from the edge of the authorized bandwidth a resolution of at least 100 kHz must be used for frequencies below 1000 MHz. Above 1000 MHz, the resolution bandwidth of the instrumentation must be at least 1 MHz. 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, then an alternate procedure may be used provided prior Commission approval is obtained.

### Spurious Function [pre-installed]



# Transmitter Performance Measurement Methods

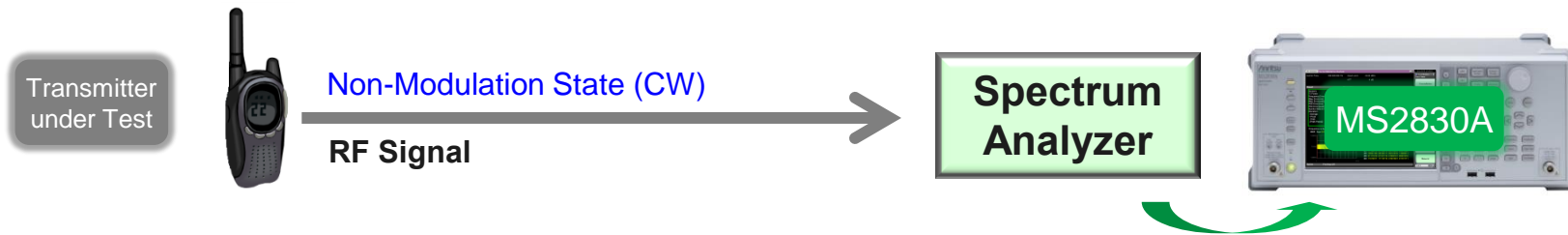
## Conductive Spurious Emission

Measures **power of spurious signals** radiated from transmitter antenna terminal

Limits: (**Specified by 47 CFR 90.210**)

*Note: For details, refer to the NXDN standard.*

*Notes: For details, refer to 47 CFR.*



*The detailed measurement procedure will be checked.*

# Transmitter Performance Measurement Methods

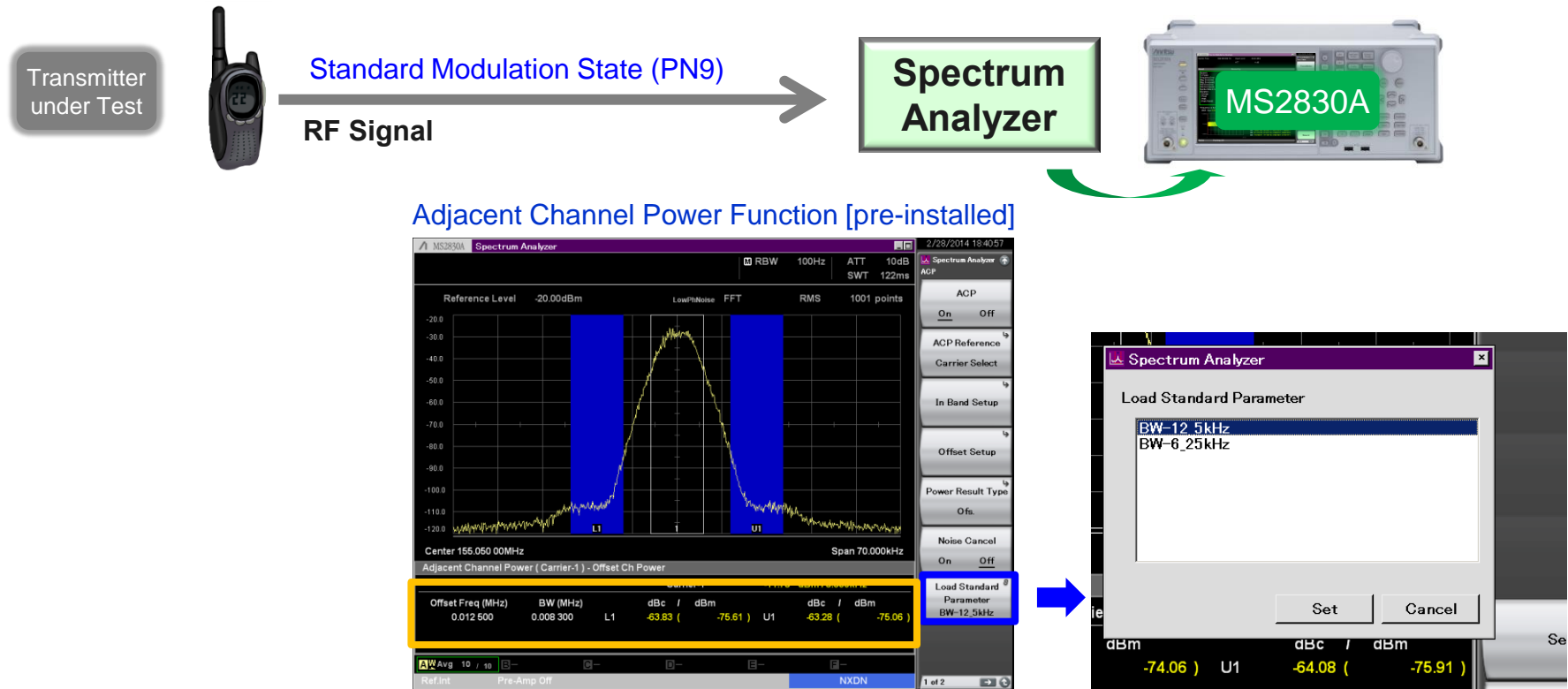
## Adjacent Channel Power Ratio

*Notes: For details, refer to the NXDN standard.*

Measures **ratio of total power** of transmitter in the standard modulation state to **leakage power** within bandwidth of adjacent channels

Limits:

| Channel Spacing | Measurement Bandwidth | Adjacent Channel Power Ratio |
|-----------------|-----------------------|------------------------------|
| 6.25 kHz        | 4.0 kHz               | 55dB                         |
| 12.5 kHz        | 8.3 kHz               | 55dB                         |



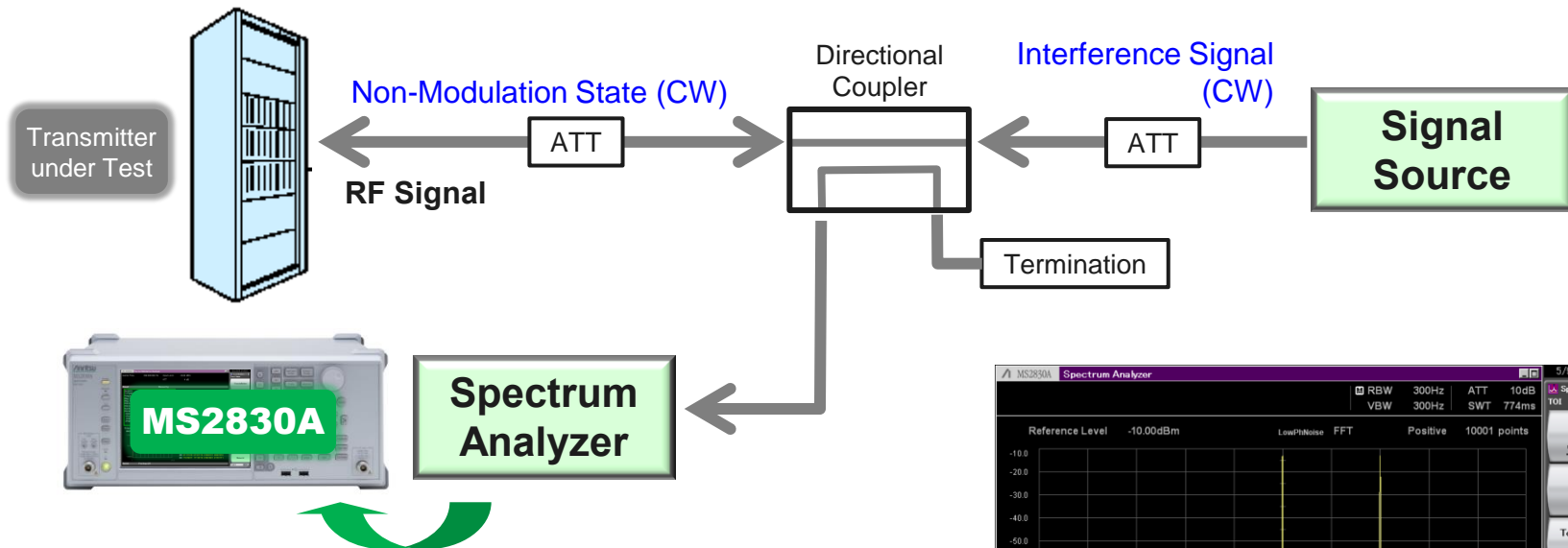
Example: Ch-BW = 12.5 kHz

# Transmitter Performance Measurement Methods

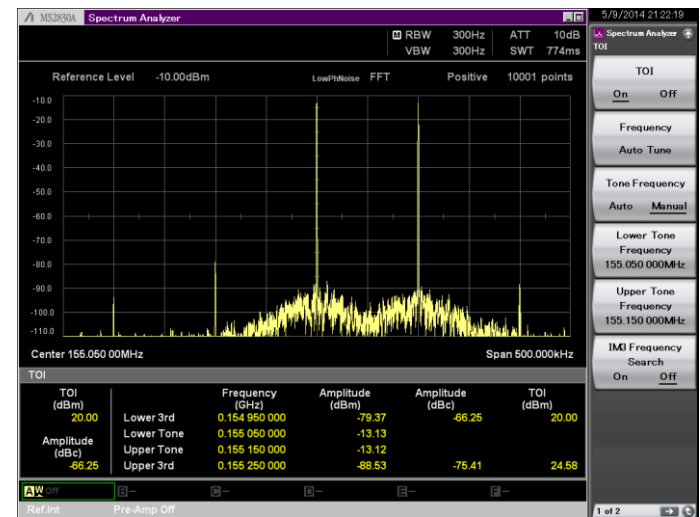
## Intermodulation Attenuation

*Note: For details, refer to the NXDN standard.*

Measures ability of transmitter to withstand generation of intermodulation components caused by carrier signal and interfering signal entering transmitter antenna of BE (RU).



Limits: 40 dB max.



TOI Function [pre-installed]



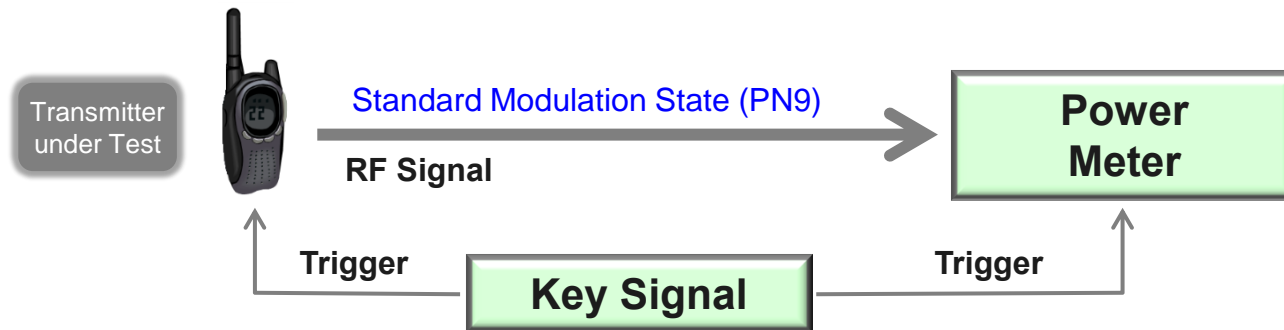
# Transmitter Performance Measurement Methods

## Transmitter Attack Time

*Note: For details, refer to the NXDN standard.*

Measures **rise time** of transmit power after changing transmitter state **from standby to transmit**.

Limits: **100 ms max.**



# Transmitter Performance Measurement Methods

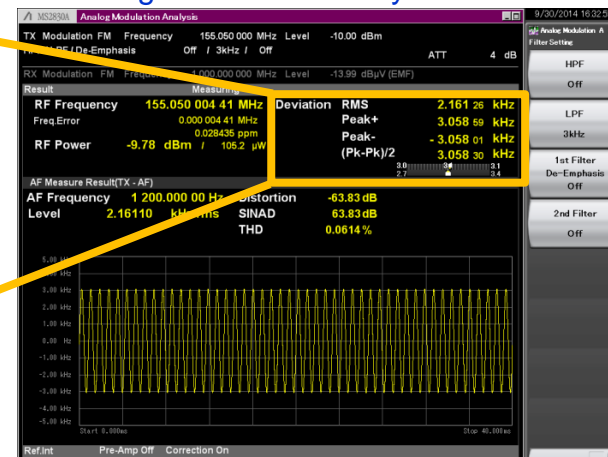
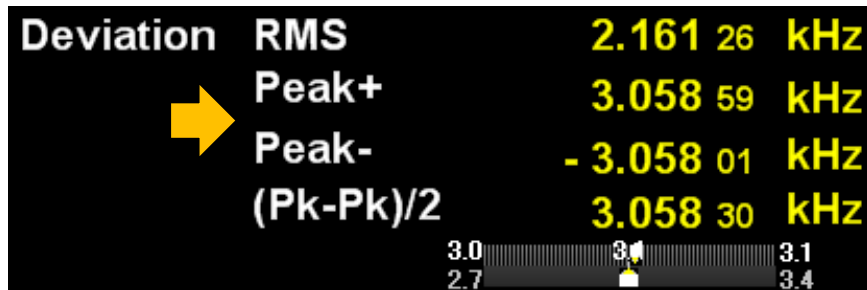
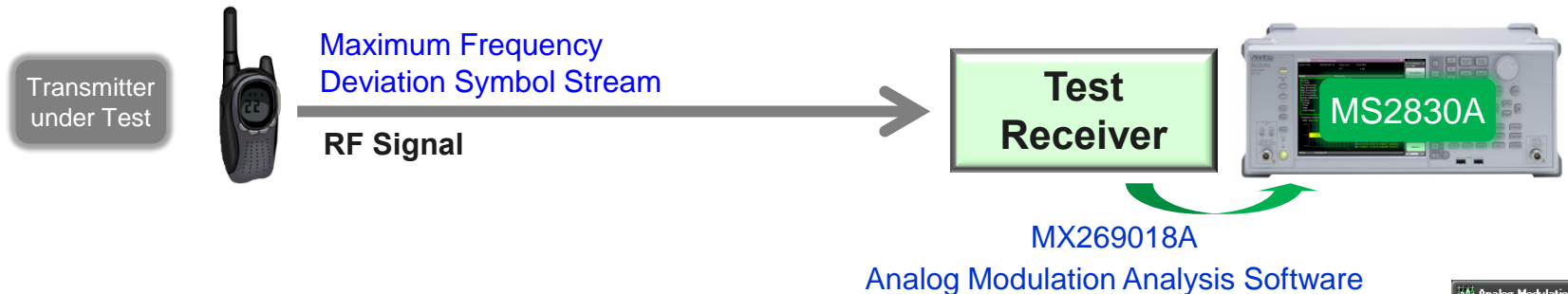
## Maximum Frequency Deviation

*Note: For details, refer to the NXDN standard.*

Measures **frequency deviation** when modulating with **maximum frequency deviation symbol stream**  
Set the audio bandwidth of the test receiver so that the **high-pass corner frequency is  $\leq 15$  Hz** and the **low-pass corner frequency is  $\geq 3$  kHz**. Turn the **De-emphasis** function off.

Limits:

| Symbol Rate | Maximum Frequency Deviation Limit |                       |
|-------------|-----------------------------------|-----------------------|
|             | Positive Peak (+Peak)             | Negative Peak (-Peak) |
| 2400 sps    | 1203 Hz to 1471 Hz                | -1203 Hz to -1471 Hz  |
| 4800 sps    | 2750 Hz to 3362 Hz                | -2750 Hz to -3362 Hz  |



# Transmitter Performance Measurement Methods

## 1/3 Frequency Deviation

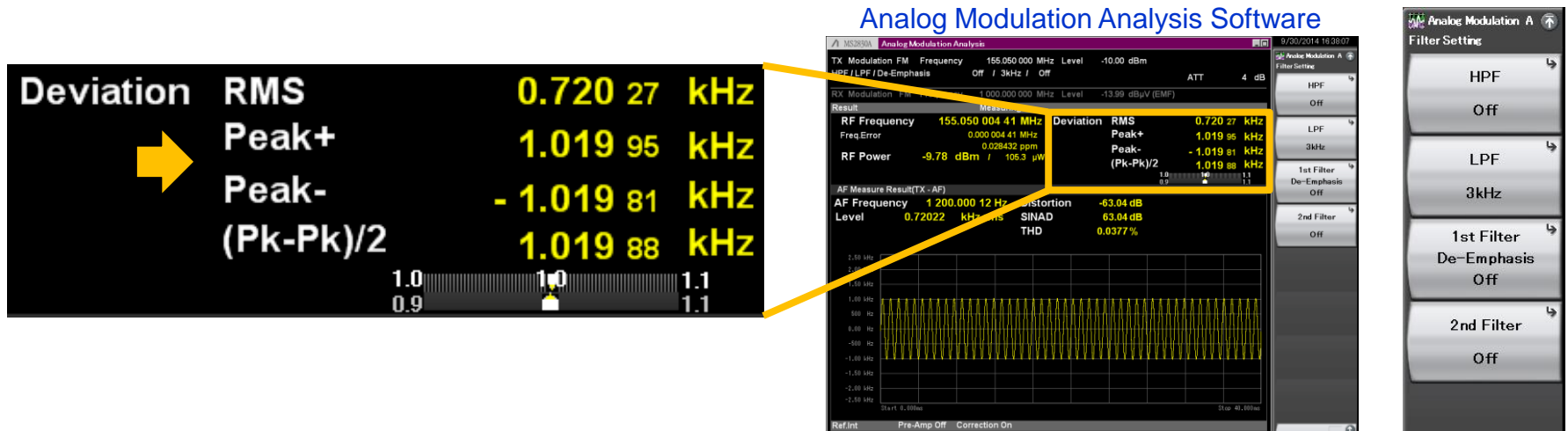
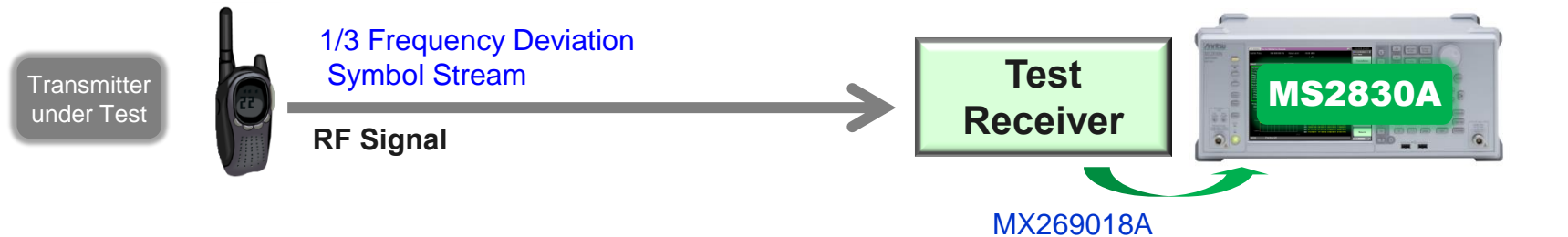
*Notes: For details, refer to the NXDN standard.*

Measures **frequency deviation** when modulating with **1/3 frequency deviation symbol stream**

Set the audio bandwidth of the test receiver so that the **high-pass corner frequency is  $\leq 15$  Hz** and the **low-pass corner frequency is  $\geq 3$  kHz**. Turn the **De-emphasis** function off.

Limits:

| Symbol Rate | 1/3 Frequency Deviation Limit |                       |
|-------------|-------------------------------|-----------------------|
|             | Positive Peak (+Peak)         | Negative Peak (-Peak) |
| 2400 sps    | 401 Hz to 490 Hz              | -401 Hz to -490 Hz    |
| 4800 sps    | 917 Hz to 1121 Hz             | -917 Hz to -1121 Hz   |



# Transmitter Performance Measurement Methods

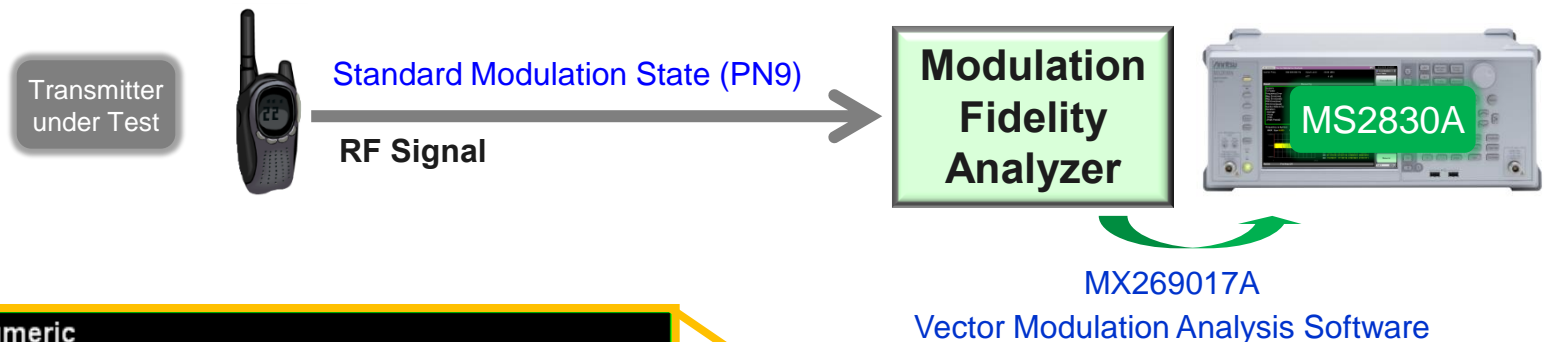
## Modulation Accuracy

*Note: For details, refer to the NXDN standard.*

Measures **rms FSK error** of modulated signal with standard modulation state.

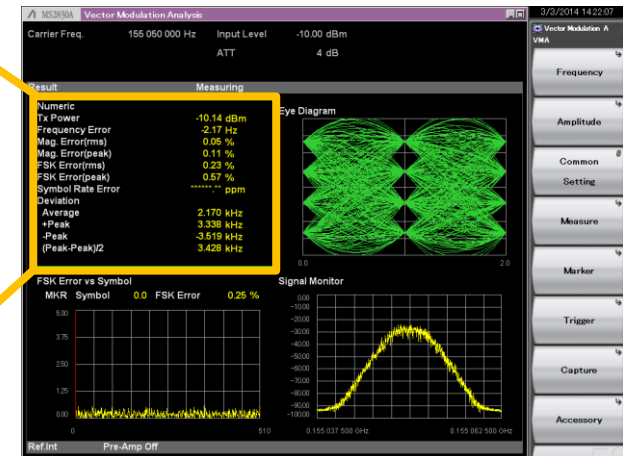
Limits:

| Class | Modulation Accuracy |
|-------|---------------------|
| A     | 5%                  |
| B     | 10%                 |



**Numeric**

|                   |             |
|-------------------|-------------|
| Tx Power          | -10.14 dBm  |
| Frequency Error   | -2.17 Hz    |
| Mag. Error(rms)   | 0.05 %      |
| Mag. Error(peak)  | 0.11 %      |
| FSK Error(rms)    | 0.23 %      |
| FSK Error(peak)   | 0.57 %      |
| Symbol Rate Error | ***** . ppm |
| Deviation         |             |
| Average           | 2.170 kHz   |
| +Peak             | 3.338 kHz   |
| -Peak             | -3.519 kHz  |
| (Peak-Peak)/2     | 3.428 kHz   |



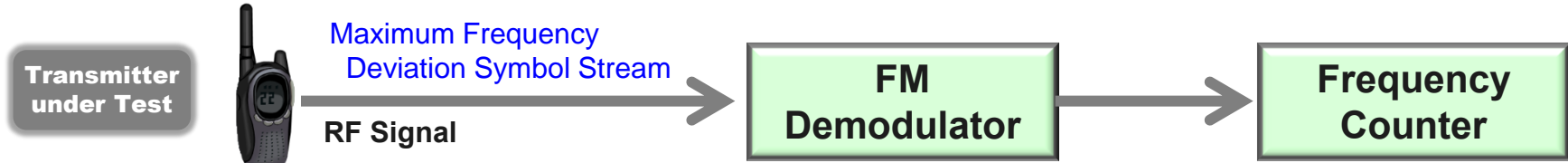
# Transmitter Performance Measurement Methods

## Modulation Symbol Speed

*Note: For details, refer to the NXDN standard.*

Measures **accuracy of modulation speed** of transmitter.

Limits: **within  $\pm 10$  ppm**



MX269018A

Analog Modulation Analysis Software

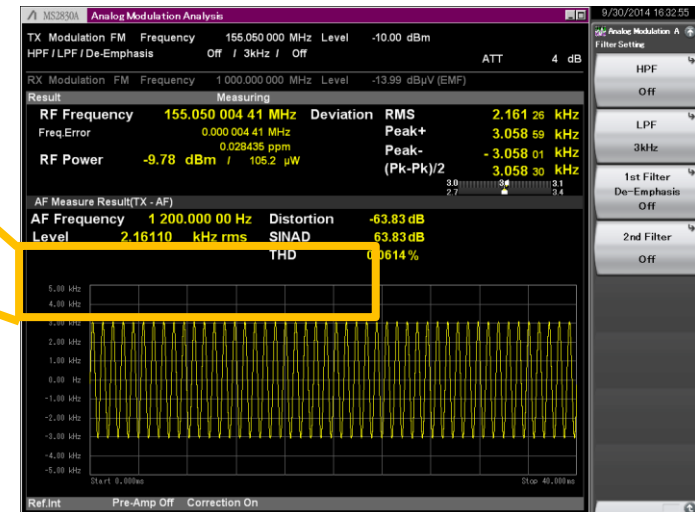
AF Measure Result(TX - AF)  
→ **AF Frequency 1 200.000 00 Hz**  
**Level 2.16110 kHz rms**

$$\text{ppm error} = \left[ \frac{\text{Frequency}_{\text{Hz}}}{1200} - 1 \right] \times 10^6$$

Note)  $1200 \text{ Hz} \times 10 \text{ ppm} = 0.012 \text{ Hz}$

Enable when "Time Range" set to " $\geq 21\text{ms}$ ".

[Trace] > [F2: Time Domain Setting] > [F4: Time Range]



# Ordering Information

## ► Recommended Configuration

| Model       | Product Name                        | Recommended Set |           |
|-------------|-------------------------------------|-----------------|-----------|
|             |                                     | Basic           | Extension |
| MS2830A     | Signal Analyzer                     | √               | √         |
| MS2830A-040 | 3.6GHz Signal Analyzer              | √               | √         |
| MS2830A-002 | High Stability Reference Oscillator | √               | √         |
| MS2830A-006 | Analysis Bandwidth 10 MHz           |                 | √         |
| MS2830A-066 | Low Phase Noise Performance         | √               | √         |
| MX269017A   | Vector Modulation Analysis Software |                 | √         |
| MX269018A   | Analog Measurement Software         |                 | √         |
| A0086A      | USB Audio                           |                 | √         |

| NXDN<br>TS 2-A | Transmitter test items          | MS2830A        |                | Other            |
|----------------|---------------------------------|----------------|----------------|------------------|
|                |                                 | Basic          | Extension      |                  |
| 5.2.1          | Transmitter Power               |                |                | Power Meter      |
| 5.2.2          | Frequency Error (CW)            | √              | √              | ---              |
|                | Frequency Error (1/3 deviation) | √ <sup>1</sup> | √ <sup>1</sup> | ---              |
| 5.2.3          | Transmit Behavior               | √ <sup>1</sup> | √ <sup>1</sup> | ---              |
| 5.2.4          | Spectrum Mask                   | √              | √              | ---              |
| 5.2.5          | Radiated Spurious Emission      | √              | √              | ---              |
| 5.2.6          | Conductive Spurious Emission    | √              | √              | ---              |
| 5.2.7          | Adjacent Channel Power Ratio    | √              | √              | ---              |
| 5.2.8          | Intermodulation Attenuation     | √              | √              | Signal Generator |
| 5.2.9          | Transmitter Attack Time         |                |                | Power Meter      |
| 5.2.10         | Maximum Frequency Deviation     | N/A            | √ <sup>2</sup> | ---              |
| 5.2.11         | 1/3 Frequency Deviation         | N/A            | √ <sup>2</sup> | ---              |
| 5.2.12         | Modulation Accuracy             | N/A            | √ <sup>3</sup> | ---              |
| 5.2.13         | Modulation Symbol Speed         | N/A            | √ <sup>2</sup> | ---              |

1. Requires MS2830A-006 Analysis Bandwidth 10 MHz for Frequency vs. Time function
2. Requires MX269018A Analog Measurement Software with A0086A USB Audio
3. Requires MX269017A Vector Modulation Analysis Software with MS2830A-006

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