

# **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 1.00**

**May 2014**

**Anritsu Corporation**

# [Anritsu] NXDN Tx Test Solution

## Tx Evaluation

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

Unit, Module \*



MS2830A  
Signal Analyzer



Spectrum Analyzer

Frequency Counter

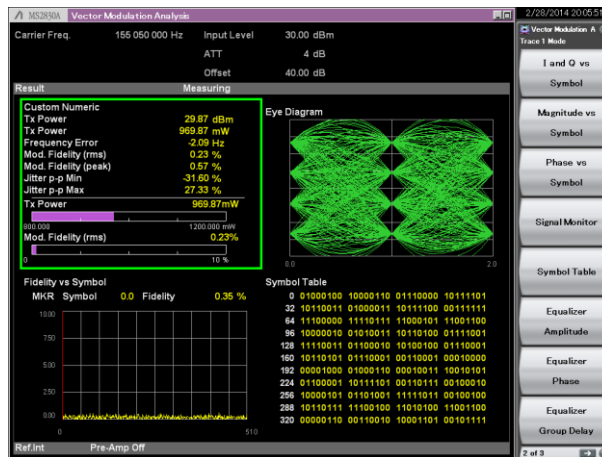
Modulation Analyzer  
(MX269017A)

Test Receiver  
(MX269018A)

\*Output in Test Mode

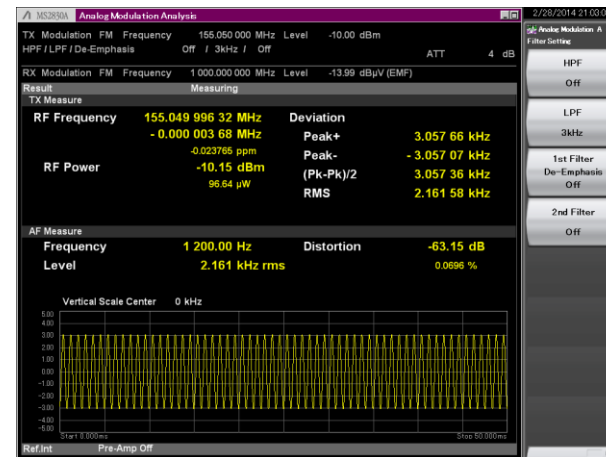
MX269017A

Vector Modulation Analysis Software



MX269018A

Analog Modulation Analysis Software



# [Anritsu] NXDN Tx Test Solution

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

NXDN 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

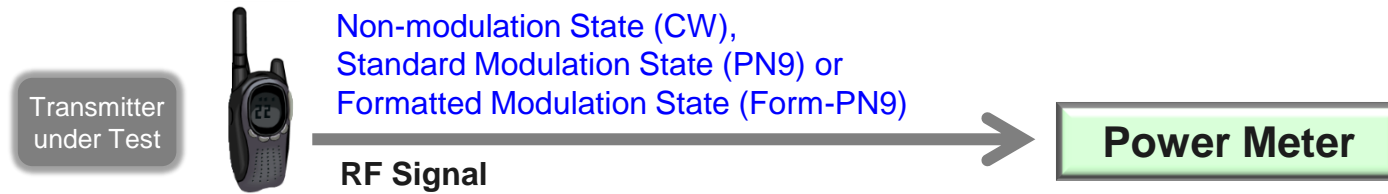
# Transmitter Performance Measurement Methods

## Transmitter Power

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

Measures transmitter **power**

Limits: (**Specified by manufacturer**)



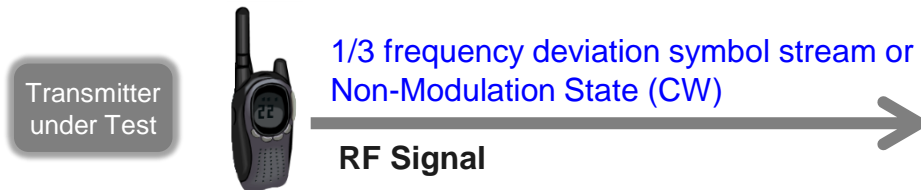
# Transmitter Performance Measurement Methods

## Frequency Error

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

Measures transmitter transmit frequency deviation

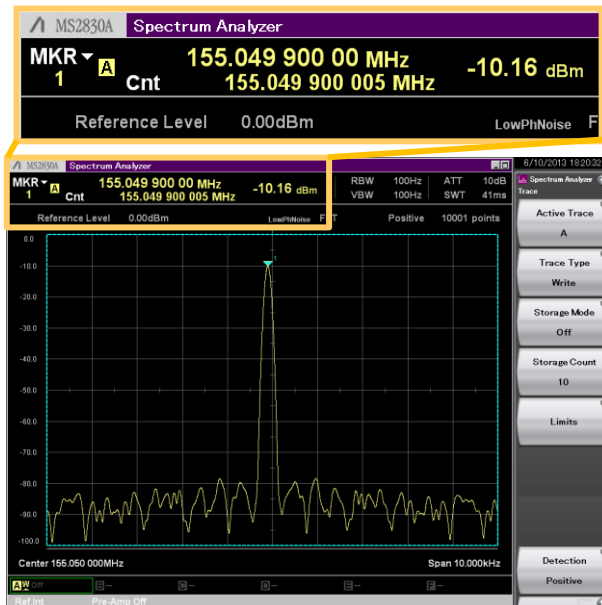
Limits: (Specified by 47 CFR 90.213)



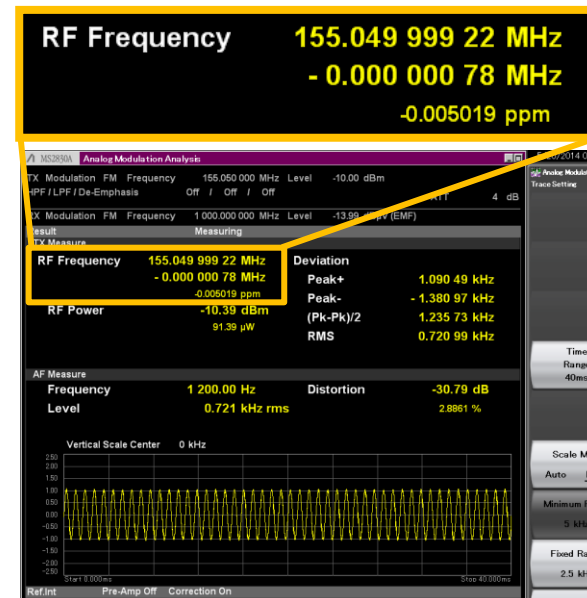
MX269018A

Frequency Counter Function [pre-installed]

For Non-Modulation State (CW)



Analog Modulation Analysis Software  
For 1/3 frequency deviation symbol stream



# 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

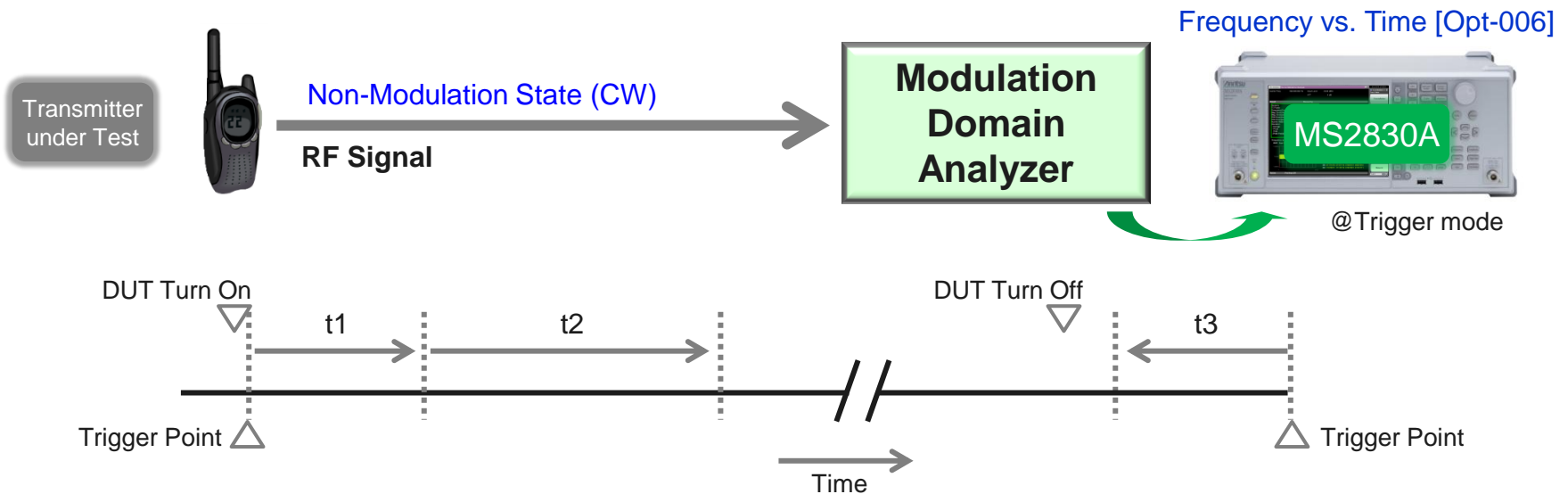
*Note: For details, refer to the NXDN standard.*

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.

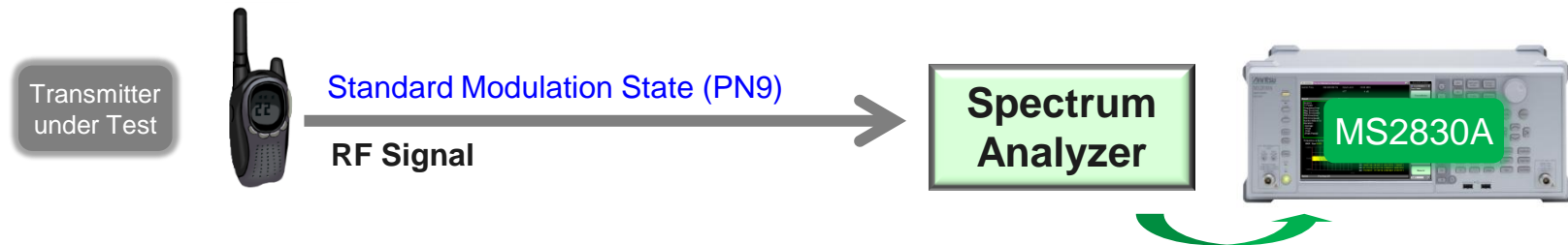
# Transmitter Performance Measurement Methods

## Spectrum Mask

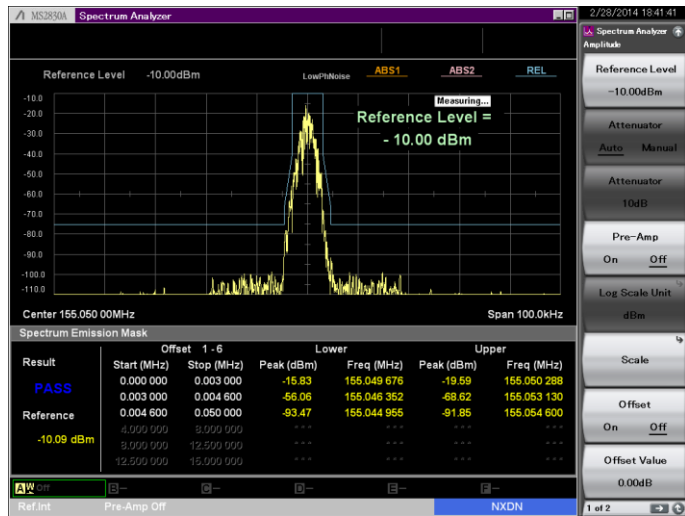
*Note: For details, refer to the NXDN standard.*

Measures spectrum of emitted modulation signal

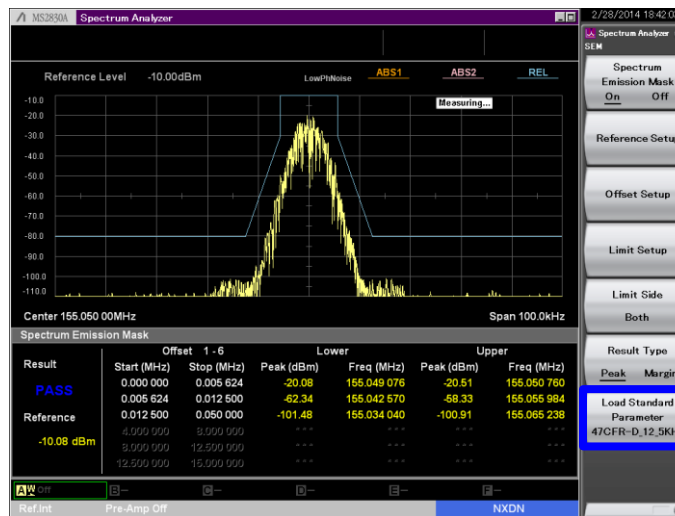
Limits: (Specified by 47 CFR 90.210)



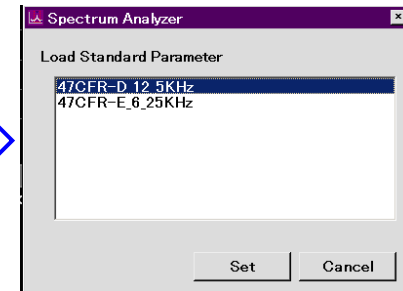
Spectrum Emission Mask Function [pre-installed]



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

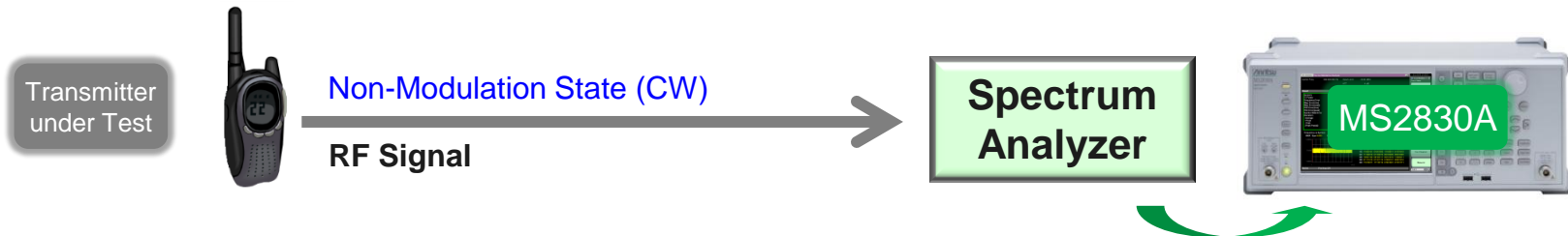
## Radiated Spurious Emission

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.*

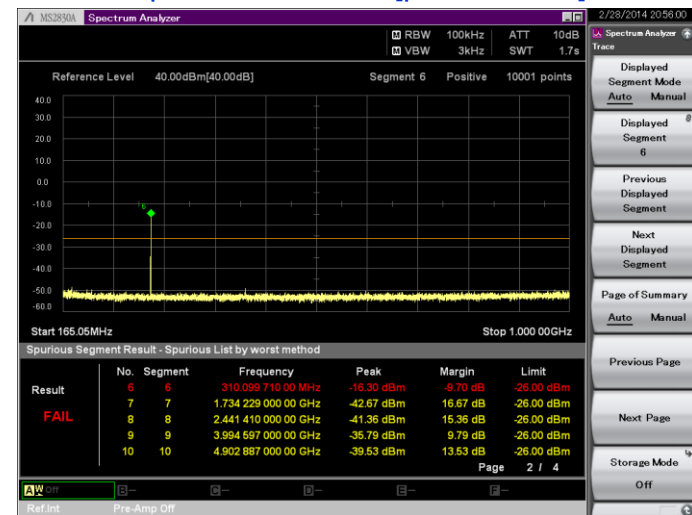
*Note: For details, refer to 47 CFR.*



### §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

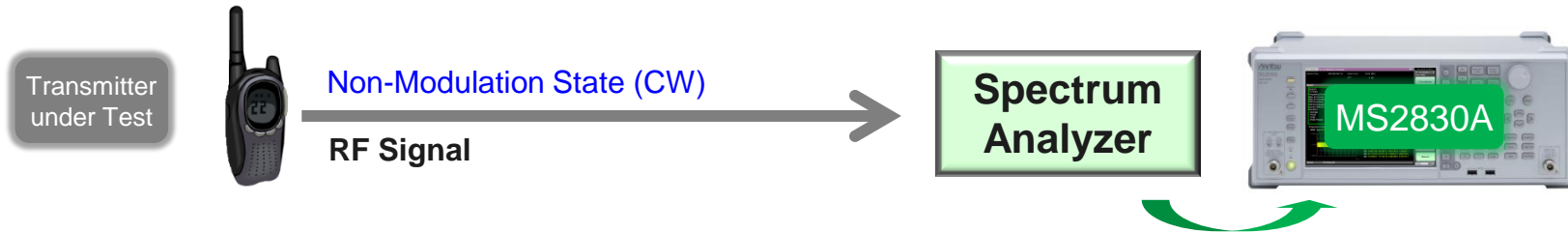
## Conductive Spurious Emission

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

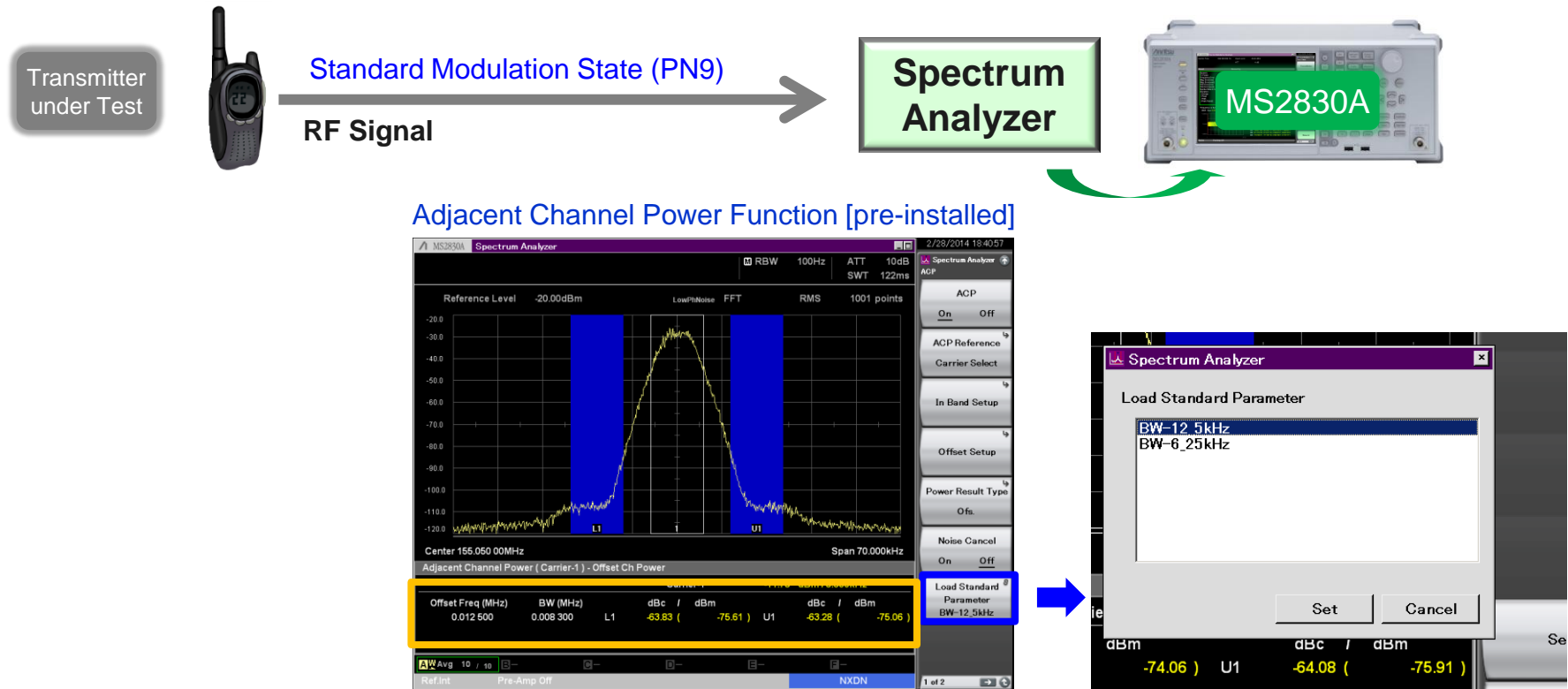
## Adjacent Channel Power Ratio

*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

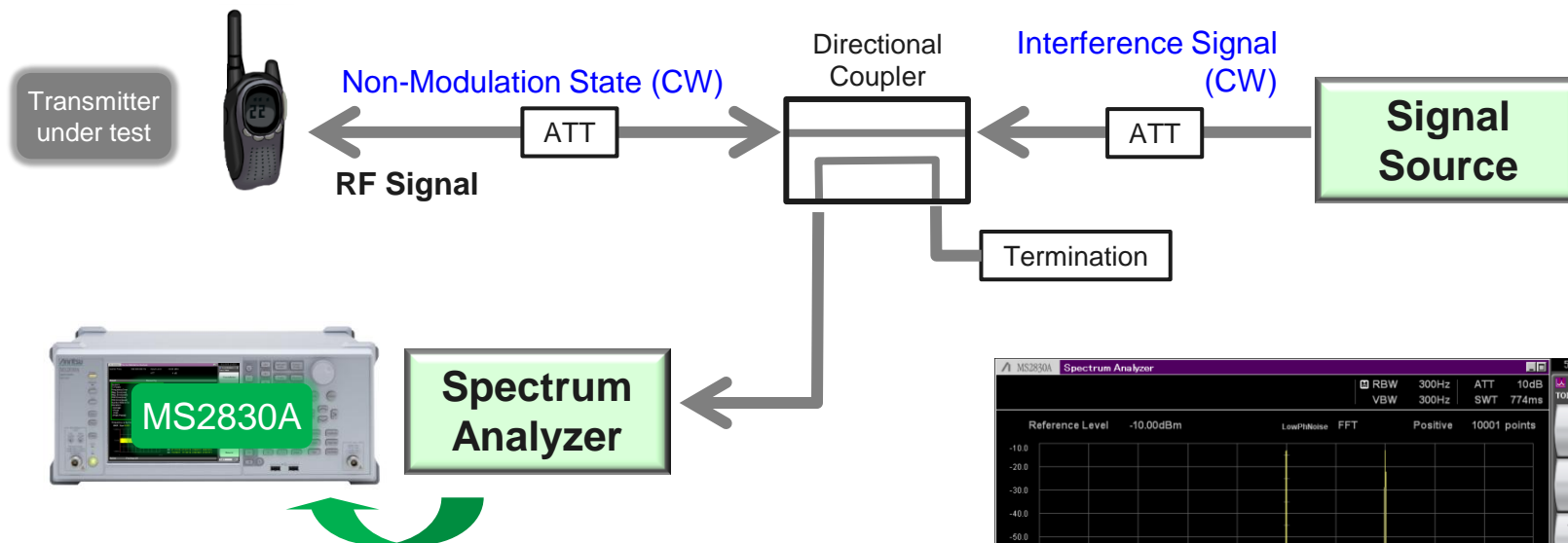


# Transmitter Performance Measurement Methods

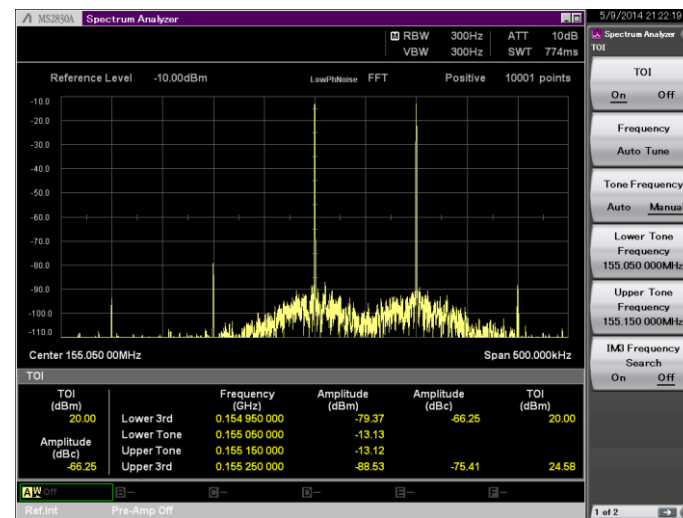
## Intermodulation Attenuation

*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]



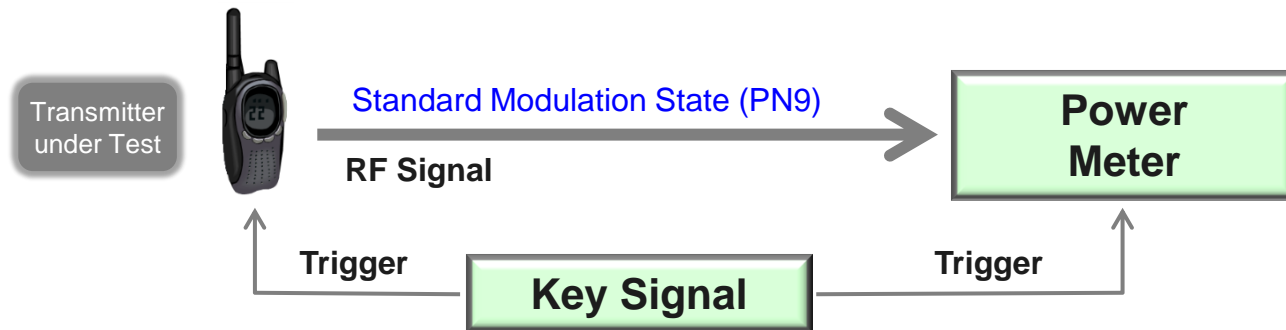
# Transmitter Performance Measurement Methods

## 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

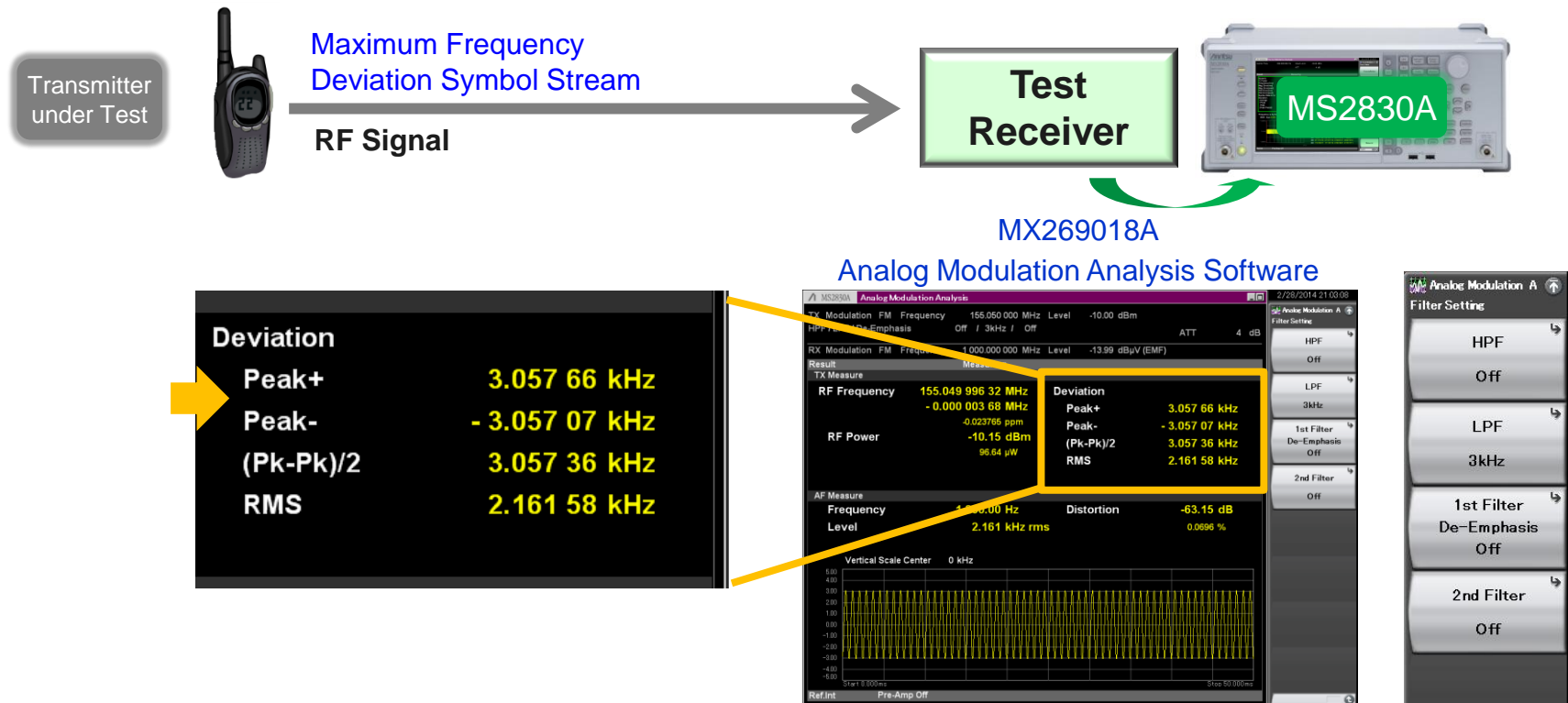
## Maximum Frequency Deviation

*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

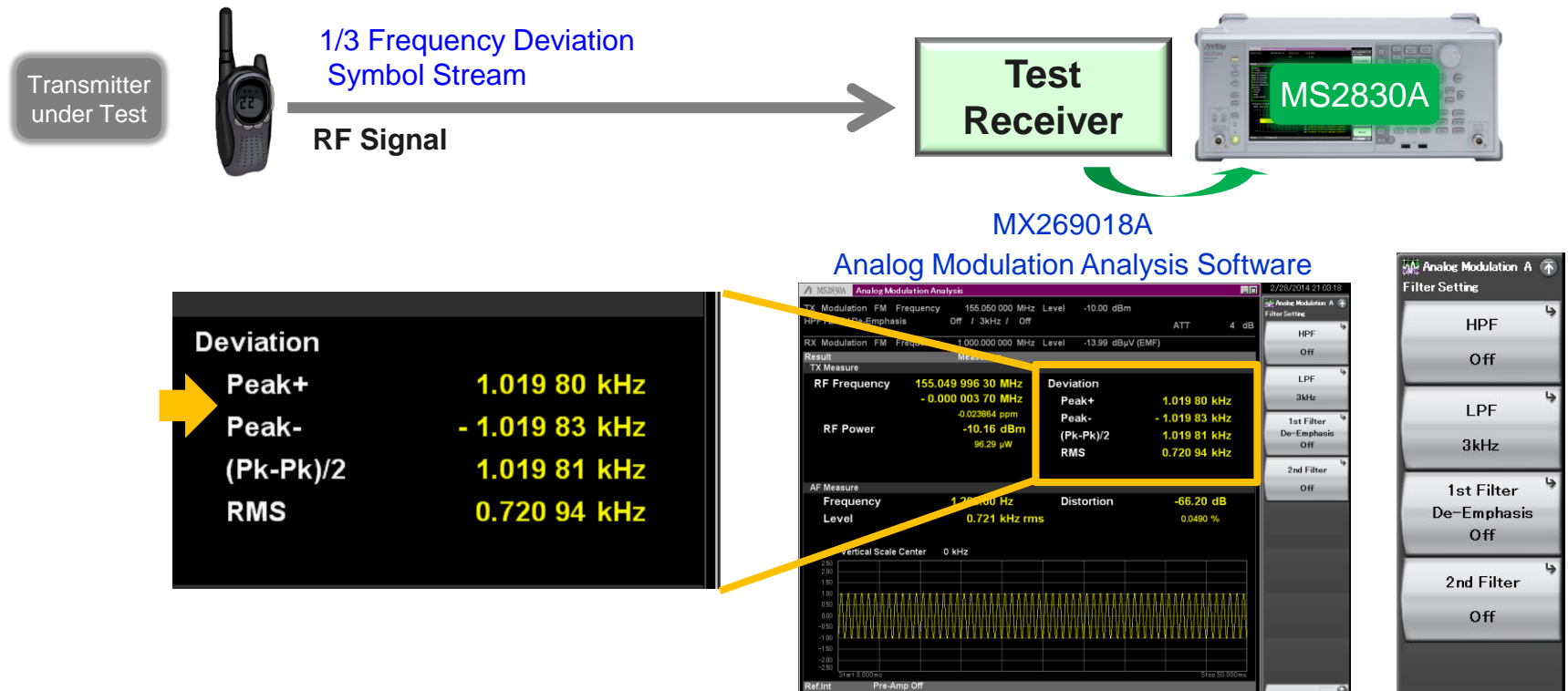
*Notes: For details, refer to the NXDN standard.*

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  $\leq 15\text{Hz}$**  and the **low-pass corner frequency is  $\geq 3\text{kHz}$** . 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

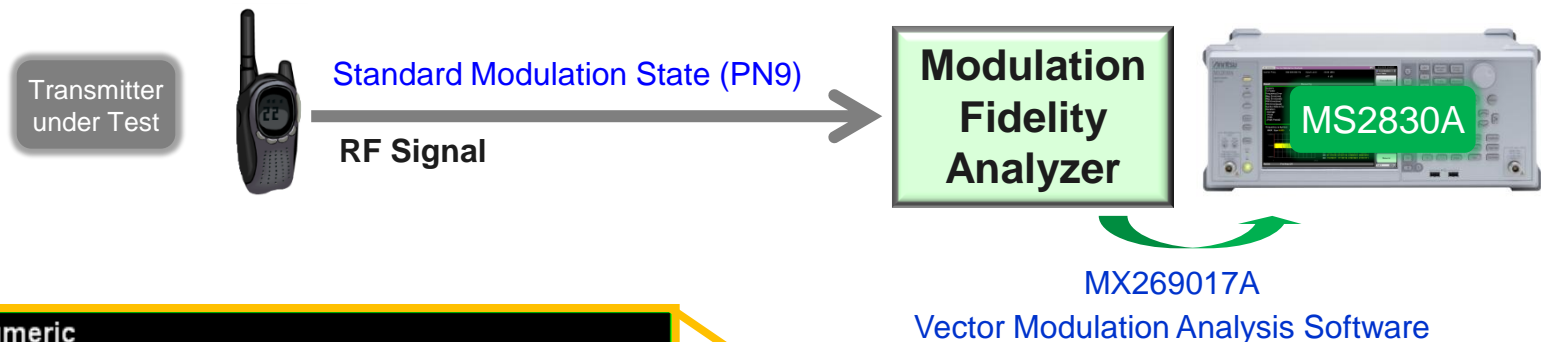
## Modulation Accuracy

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

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

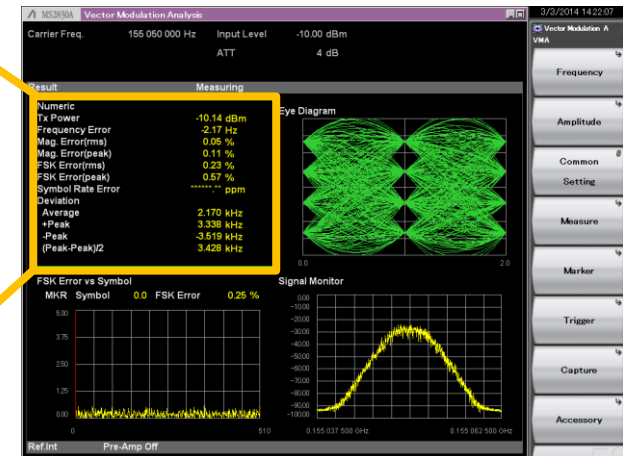
Limits:

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



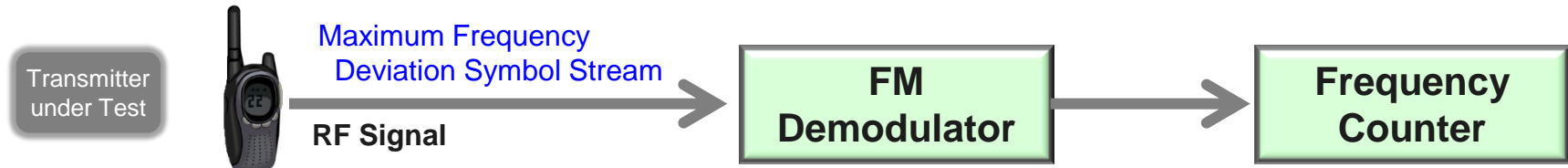
# Transmitter Performance Measurement Methods

## Modulation Symbol Speed

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

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

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



MX269018A

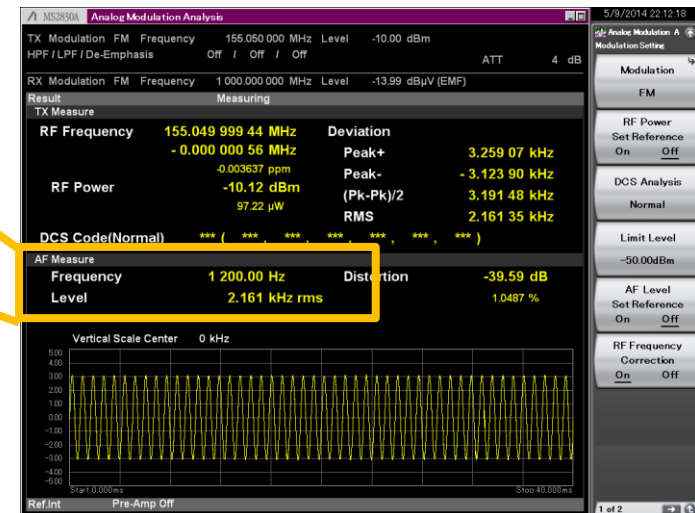
Analog Modulation Analysis Software



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

Note)  $1200 \text{ Hz} \times 10 \text{ ppm} = 0.012 \text{ Hz}$   
*Resolution performance is insufficient*

*=> Under development: The number of digits will be increased.*



# 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 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	Rediated 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

# Note

## ● United States

### Anritsu Company

1155 East Collins Blvd., Suite 100, Richardson,  
TX 75081, U.S.A.  
Toll Free: 1-800-267-4878  
Phone: +1-972-644-1777  
Fax: +1-972-671-1877

## ● Canada

### Anritsu Electronics Ltd.

700 Silver Seven Road, Suite 120, Kanata,  
Ontario K2V 1C3, Canada  
Phone: +1-613-591-2003  
Fax: +1-613-591-1006

## ● Brazil

### Anritsu Eletrônica Ltda.

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01327-010 - Bela Vista - São Paulo - SP - Brazil  
Phone: +55-11-3283-2511  
Fax: +55-11-3288-6940

## ● Mexico

### Anritsu Company, S.A. de C.V.

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11520 México, D.F., México  
Phone: +52-55-1101-2370  
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## ● United Kingdom

### Anritsu EMEA Ltd.

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## ● France

### Anritsu S.A.

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91140 VILLEBON SUR YVETTE, France  
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Fax: +33-1-64-46-10-65

## ● Germany

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