Anritsu Advancing beyond

For Verifying Transmission Characteristics at Pulse Radar Installation

Pulse Radar Measurement Function

Signal Analyzer MS2840A

Pulse Radar Measurement Function MX284059A

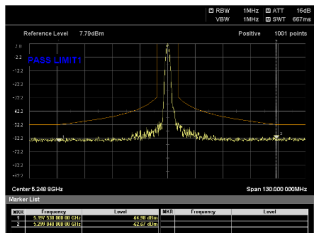
USB Peak Power Sensor MA24418A

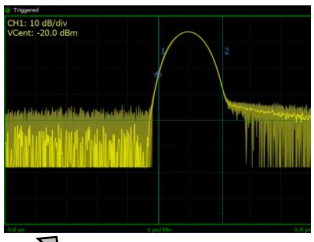
The Pulse Radar Measurement Function MX284059A is combined with the Signal Analyzer MS2840A to automatically measure the transmission characteristics of devices, such as meteorological and marine radars, using pulse modulation and chirp signals. The numerical and graphical measurement results are displayed on-screen.

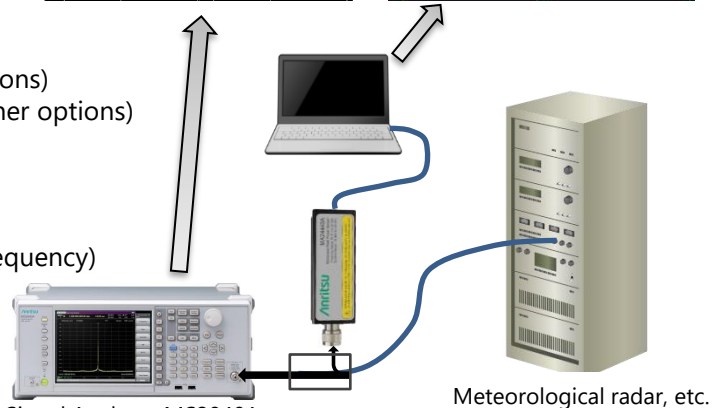
What is Pulse Radar Measurement Function MX284059A?

MS2840A and MX284059A Features

- Verifies radar transmission, including calculation of 40 dB bandwidth and out-of-band emissions (selectable from 20, 30, and 40 dB/decade)
- Measures for each signal condition, including short pulse, long pulse, mixed short/long pulse
- Supports control from pulse radar measurement function installed in MS2840A or from external PC
- On-site portability
- Dimensions: 426(W) x 177 (H) x 390 (D) mm (excluding protrusions)
  Mass: ≤15.3 kg (with either MS2840A-044 or 046, excluding other options)







MX284059A Functional Overview

- Tx power*1
- Tx frequency
- Pulse time*1 (pulse width, rise time, fall time, pulse repetition frequency)
- Frequency deviation (FM chirp)
- 40 dB bandwidth*2
- Emissions (out-of-band, spurious)
- Occupied bandwidth
- Graph display
  - Out-of-band mask & 40 dB bandwidth & Limit
  - Spurious missions & Limit
  - Occupied bandwidth

USB Peak Power Sensor Advantages

Power and time measurements

Measures shorter pulses than MX284059A

Sampling: 10 Gs/s (0.1 ns)

Guaranteed rise/fall value: 5 ns

- ☐ Short pulse power measurement
- ☐ Replaces oscilloscope + detector
- ☐ Splitting RF signal with coupler cuts work for changing connections during measurement

Automatic Measurement Advantages

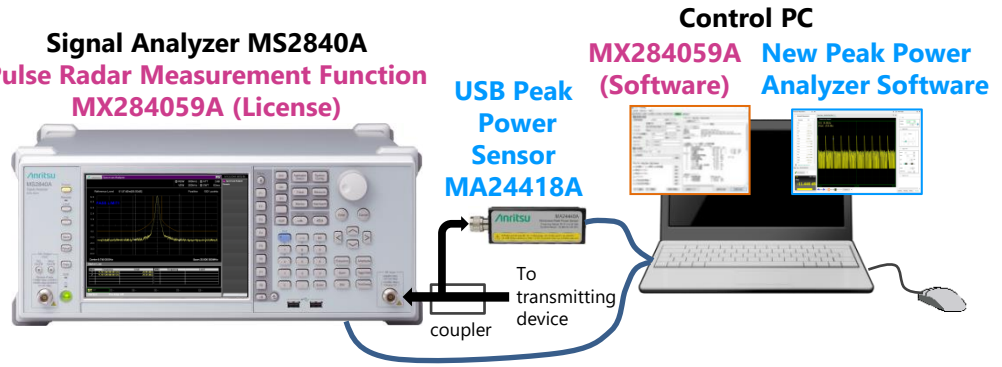
- ☐ Saves/loads verification conditions for each maintenance site and product model
  - ➢ **Cuts risk of instrument operation/setting errors**
- ☐ Verifies transmission automatically without complex setup or operation
- ☐ Records screens while measuring automatically and saves numerical results
  - ➢ **Reduces work time**
- ☐ Eliminates external PC because installed in signal analyzer
  - ➢ **Cuts on-site equipment carrying burden**
  - ➢ **Support strict security conditions forbidding PC use**
- ☐ Supports control and measurement from external PC
  - ➢ **Manages parameter setting and measurement results from managers' PCs**
  - ➢ **Controls multiple main units**

*1: When evaluating previously using power meter/oscilloscope + detector, use USB Peak Power Sensor MA24418A.

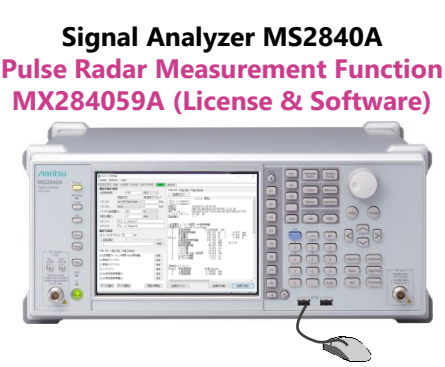
*2: Supports 40 dB bandwidth calculation formula (39) for Non-FM Pulse Radars and (44) for FM Pulse Radars described in ITU-R SM.1541-6 (08/2015) standard and Public Notice of Japan MIC No. 1232, October 2005.
Does not support formula (40) for FM Pulse Radars described in ITU-R SM.1541-6 (08/2015) standard and Public Notice of Japan MIC No. 67, June 2019.

Pulse Radar Measurement Function MX284059A: Overview

Controlling MS2840A + MX269059A and MA24418A using external PC with dedicated software

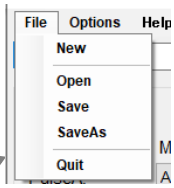


Running MX284059A from MS2840A without external PC



MX284059A Specifications

Item		Standard Value
Carrier wave	Frequency range	MS2840A-044: 300 MHz to 26,500 MHz MS2840A-046: 300 MHz to 36,000 MHz
	Amplitude range	–5 to +30 dBm High input level required for measuring emissions
Spurious	Frequency range	MS2840A-044: 30 MHz to 26,500 MHz MS2840A-046: 30 MHz to 44,500 MHz
Frequency measurement accuracy (standard)		±2.2 × 10^{-8} (18˚ to 28˚C, 1 hour after power-on)
Measurement signal conditions	Pulse types	Two types (Pulse A, Pulse B)
	Modulation method	Non-FM Pulse Radar/FM Pulse Radar
	Pulse width	0.5 to 500 µs
	Pulse repetition interval	0.05 to 5 ms (PRF = 200 Hz to 20,000 kHz)
	Frequency Deviation	0 to 31 MHz



Reduces risk of instrument operation/setting errors by saving/reading verification conditions for each maintenance site and product model

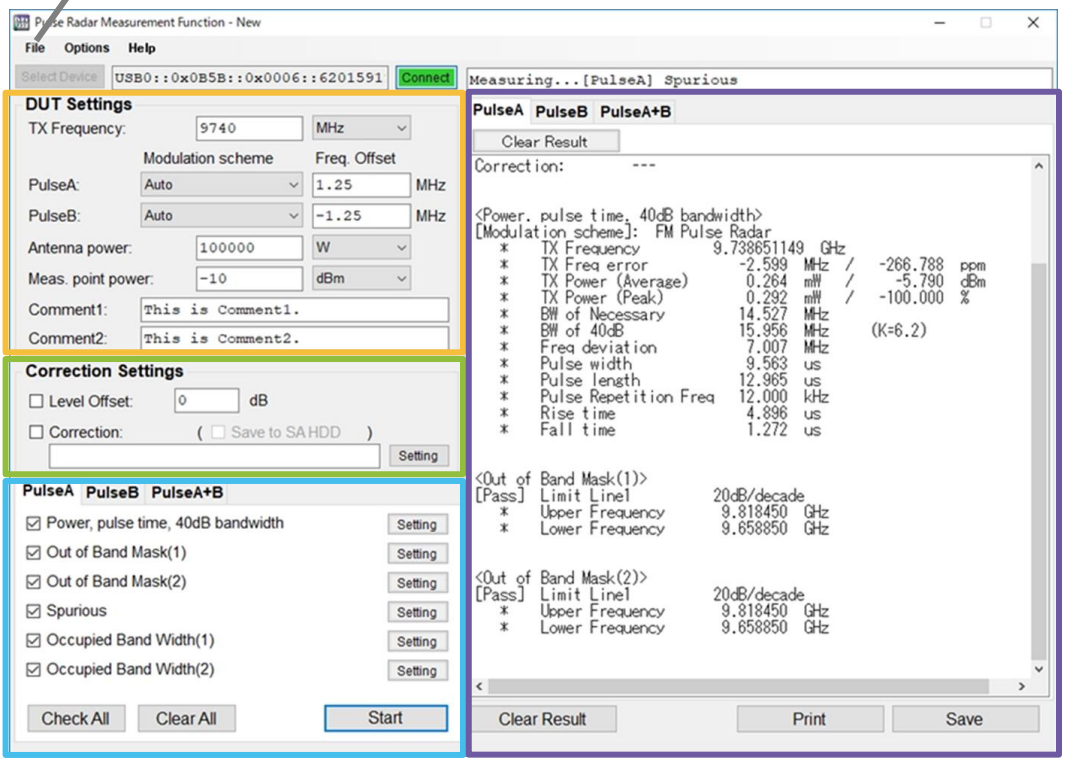
Sets frequency and Tx power used as measurement reference. Three pulse types: A only, B only, and A & B.

Comment 1, 2 are reflected in the results display (max. 70 characters).

Compensates for level offset and path loss at measured monitor terminal

Selects any of three measurement types: A/B/A & B.

[Settings] button sets tolerance, spectrum analyzer measurement parameters, etc.



Displays measured numerical results on screen right side

Saves measurement screen automatically in MS2840A main unit (Choose save or not save option.)

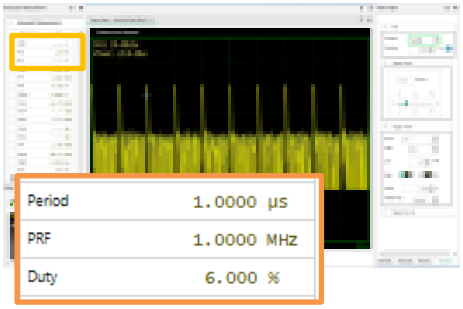
[Save] button saves numerical results and measurement screen, etc.

Transfers numerical results and measurement screens, etc., to external PC controller

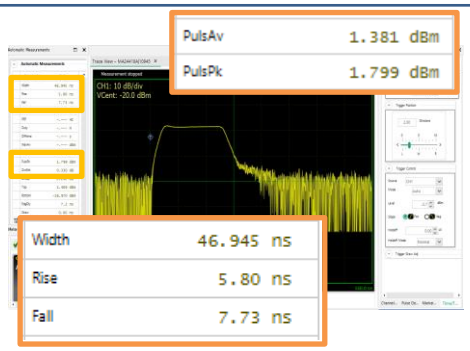
Pulse Radar Measurement Function MX284059A
Settings and Numerical Results Screen

Introduction to Pulse Radar Verification Items and Measurement Functions

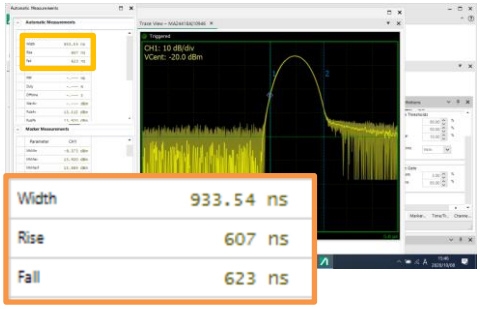
First, not only can the USB Peak Power Sensor MA24418A simultaneously measure both average/peak power and average power of pulses, but pulse width, pulse period, and rise/fall time can be measured as well. *Sampling 10 Gs/s (0.1 ns)
Previous evaluation required a power meter, oscilloscope, and wave detector in addition to a spectrum analyzer, but the MA24418A replaces all these test instruments.
The automatic level trigger function automatically detects and measures pulses at signal insertion.



Pulse width, period, etc.



Example of measurement with pulse width of approx. 50 ns (Sampling 10 Gs/s)



Example of meteorological radar-like signal measurement (Pulse width: approx. 1 µs)

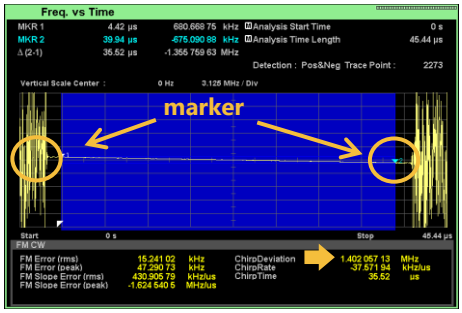
MA24418A Screen Examples: Pulse Interval/Period/Duty, Pulse Width/Rising Edge/Falling Edge, Pulse Power (Average/Peak)

MA24418A measurements are input to the MX284059A, which automatically calculates the 40 dB bandwidth and measures out-of-band emissions, etc. The MS2840A also has the signal analyzer function with an FFT analysis bandwidth of 31.25 MHz as a standard. This function supports measurement of frequency deviation width and other parameters that are difficult to capture with a general sweep spectrum analyzer.

Example: Meteorological Radar Verification Items and Measurement Methods

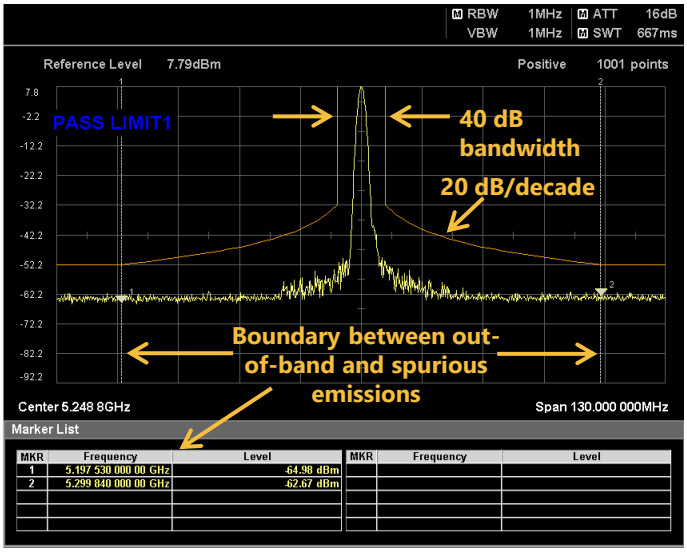
Verification Item	Conventional Measurement	New Measurement
Transmission power	Power meter	**USB Peak Power Sensor MA24418A**
Pulse duration (pulse width, rise/fall)	Oscilloscope + Detector	
Frequency error	Frequency counter	**(FFT analysis function)**
Frequency deviation	(Not measurable)	
40 dB bandwidth calculation*	**MS2840A + MX284059A (Spectrum analyzer function)**	
Out-of-band emissions		
Spurious emissions		
Occupied bandwidth		

*: MX284059A calculates automatically from value measured by USB Peak Power Sensor MA24418A.

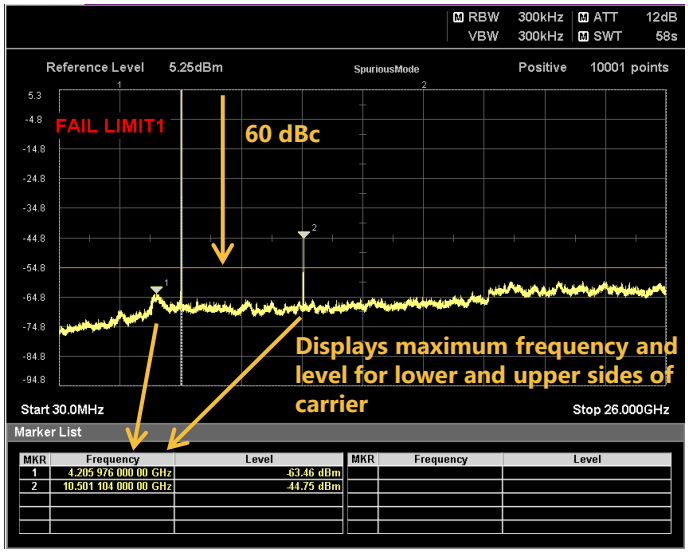


MS2840A Screen Example
Frequency Deviation Width
The standard FFT analysis function captures the radar signals. The FMCW function in the Freq vs. Time measurement mode measure the frequency deviation width.

The MS2840A spectrum analyzer function measures the out-of-band and spurious emissions.
These mask, limit and evaluation result are displayed on-screen.



MS2840A Screen Example
Out-of-band Emissions, 40 dB Bandwidth
(Example: 20 dB/decade)
Selectable from 20, 30, and 40 dB/decade



MS2840A Screen Example
Spurious Emissions (NG Evaluation)
Divisible into max. six frequency ranges (segments)

Required Test Equipment Performance for Measuring Unwanted Spurious Emissions

At emissions measurements, the key test equipment performance is the Display Average Noise Level (DANL).
Generally, with spectrum analyzers, the higher the frequency, the higher the DANL. DANL is difficult to determine because it is displayed in terms of power per hertz (dBm/Hz) and the conditions of the test equipment defining the standard are different from actual measurement settings.
The following is an example of the performance calculation required to measure spurious emissions.

Displayed Average Noise Level (DANL) From MS2840A data sheet

18˚C to 28˚C; Detector: Sample; VBW: 1 Hz (Video Average); Input attenuator: 0 dB

MS2840A-044/046

Frequency range	Without MS2840A-067, Frequency Band Mode: Normal			
	Without MS2840A-068/069		With MS2840A-068/069 and Preamp turned off	
	MS2840A-044/046	With MS2840A-046 MS2840A-019	MS2840A-044/046	With MS2840A-046 MS2840A-019
MS2840A-044/046				
30 MHz ≤ frequency < 1 GHz	–153 dBm/Hz	–153 dBm/Hz	–153 dBm/Hz	–153 dBm/Hz
1 GHz ≤ frequency < 2.4 GHz	–150 dBm/Hz	–150 dBm/Hz	–150 dBm/Hz	–150 dBm/Hz
2.4 GHz ≤ frequency ≤ 3.5 GHz	–147 dBm/Hz	–147 dBm/Hz	–147 dBm/Hz	–147 dBm/Hz
3.5 GHz < frequency ≤ 4 GHz	–144 dBm/Hz	–144 dBm/Hz	–144 dBm/Hz	–144 dBm/Hz
4 GHz < frequency ≤ 6 GHz	–144 dBm/Hz	–144 dBm/Hz	–144 dBm/Hz	–144 dBm/Hz
6 GHz < frequency ≤ 13.5 GHz	–151 dBm/Hz	–150 dBm/Hz	–147 dBm/Hz	–146 dBm/Hz
13.5 GHz < frequency ≤ 18.3 GHz	–149 dBm/Hz	–149 dBm/Hz	–145 dBm/Hz	–145 dBm/Hz
18.3 GHz < frequency ≤ 26.5 GHz	–146 dBm/Hz	–146 dBm/Hz	–141 dBm/Hz	–141 dBm/Hz
MS2840A-046				
26.5 GHz < frequency ≤ 34 GHz	–146 dBm/Hz	–146 dBm/Hz	–141 dBm/Hz	–140 dBm/Hz
34 GHz < frequency ≤ 40 GHz	–144 dBm/Hz	–142 dBm/Hz	–135 dBm/Hz	–135 dBm/Hz
40 GHz < frequency ≤ 44.5 GHz	–140 dBm/Hz	–137 dBm/Hz	–132 dBm/Hz	–130 dBm/Hz

Calculation of DANL of spectrum analyzer required for measuring emissions

Permissible level: –60 dBc
RBW (1 MHz): –60 dB (1 Hz/1 MHz)
Attenuator: –10 dB*
Detection (Positive): –8 dB*
Margin: –6 dB*
Required performance: –144 dBm/Hz*

*This calculation example does not clearly specify performance.

For older spectrum analyzers with insufficient DANL performance, the carrier wave must be attenuated with a notch filter and without an attenuator (0 dB). The MS2840A's high DANL performance (see purple rectangles above) reduces these requirements.

Ordering Information

Signal Analyzer MS2840A

Model	Name	Remarks
MS2840A	Signal Analyzer	Main unit
MS2840A-044	26.5 GHz Signal Analyzer	Upper frequency range (lower limit: 9 kHz) Select one of the following.
MS2840A-046	44.5 GHz Signal Analyzer	
MX284059A	Pulse Radar Measurement Function	Installed in main unit; also supports control from external PC
MX2840A-019	2 dB Step Attenuator	For MS2840A-046 only; required for spurious measurement
Standard function	High Stability Reference Oscillator	Aging rate $\pm 1 \times 10^{-7}$/year
Standard function	Analysis Bandwidth 31.25MHz	FFT (Fast Fourier Transform) analysis function

Note: DANL is higher when the following options are installed. It is better not to install these options for emissions measurement.
MS2840A-067: Microwave Preselector Bypass
MS2840A-068: Microwave Band Preamplifier (MS2840A-046 only)
MS2840A-069: 26.5 GHz Microwave Band Preamplifier (for MS2840A-044 only)

USB Peak Power Sensor MA24418A

Model	Name	Remarks
MA24418A	USB Peak Power Sensor	50 MHz to 18 GHz; requires control PC

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