Q89401A

Precision Signal Analyzer (PSA)

Datasheet

Rev.1

Q Precision Instruments

Overview of Q89401A PSA

Q89401A Precision Signal Analyzer (PSA) is a measurement equipment for analyzing electric signals and noise in laboratories and/or production lines. The main features of Q89401A PSA are as follows:

- Spectrum analysis from DC to 1MHz
- Selectable Y-axis units such as V_{RMS}, dBm, W/Hz, that include spectral density
- Battery operation (four AA-size batteries) for isolating electric noise from the outside
- DC- or AC-coupling selectable signal input
- Low noise amplifier (LNA) included for small signal measurement
- Flexible interfaces: electrically isolated USB 2.0, and Bluetooth 2.1+EDR Serial Port Profile
- Controllable by user programs using easy-to-read SCPI like command set
- Nominal 1MΩ of input impedance
- Flexible configurable measurement parameters such as center frequency, frequency span, resolution bandwidth (RBW), and so on
- Input level indicators
- Protection circuit against over stress input (however, it is not intended to guarantee preventing failure of Q89401A PSA against input signals which exceed absolute maximum ratings)

For these features, Q89401A PSA is suitable for validation of audio circuits, analyzing power supply noise that can affect sensitive circuit such as RF or sensor systems, and characterizing semiconductor devices.

Absolute Maximum Ratings

The absolute maximum ratings are rated values exceeding which the product could suffer permanent physical damage, and must not be reached simultaneously by any two of the quantities.

Specifications

Specifications describe warranted performance shown as Minimum and Maximum over the temperature range of +5°C to +45°C and include a five-minute warm-up from ambient conditions. If the input coupling is set as DC-coupling, all specifications are guaranteed under the 0V DC offset input condition.

Supplemental characteristics identified as "typical," provide useful information by giving non-warranted performance parameters. Typical performance is applicable from +18°C to +28°C. More than 85% of all products are expected having better characteristic than typical performance.

Nominal values indicate expected performance, or designed value that is useful in the application of the product, but is not covered by the product warranty.

Absolute Maximum Ratings

Description	Maximum
Maximum input voltage range	
(between center conductor and outer conductor of the input connector)	$\pm 6V_{PEAK}$
(to the ground)	$\pm 42V_{PEAK}$

Input Range

Description	Minimum	Typical	Maximum
Maximum regular range (orange lamp is not indicated)			
(f≤1MHz sinusoidal input, LNA OFF)	$4.0V_{PP}$	-	$4.5V_{PP}$
ADC overflow level			
(f≤1MHz sinusoidal input, LNA OFF)	$8.0V_{PP}$	-	-
Input protection trip level			
(f≤1MHz sinusoidal input, LNA OFF)	$8.1V_{PP}$	-	-
Maximum regular range (orange lamp is not indicated)			
(f≤1MHz sinusoidal input, LNA ON)	$85mV_{PP}$	-	$100mV_{PP}$
ADC overflow level			
(f≤1MHz sinusoidal input, LNA ON)	$175mV_{PP}$	-	-
Input protection trip level			
(f≤1MHz sinusoidal input, LNA ON)	$182mV_{PP}$	-	-

Amplitude Accuracy

Description	Minimum	Typical	Maximum
Amplitude accuracy (100Hz≤f≤300kHz, 3mV$_{PP}$ ≤amplitude ≤4.5V$_{PP}$ sinusoidal input, LNA OFF, FlatTop Window, RBW≤30kHz)	-0.14dB	-	+0.14dB
Amplitude accuracy (300kHz<f≤1MHz, 3mV$_{PP}$ ≤amplitude≤4.5V$_{PP}$ sinusoidal input, LNA OFF, FlatTop Window, RBW≤30kHz)	-0.18dB	-	+0.18dB
Amplitude accuracy (100Hz<f≤1MHz, 4.5V$_{PP}$ <amplitude≤8V$_{PP}$ sinusoidal input, LNA OFF, FlatTop Window, RBW≤30kHz)	-	< ±0.18dB	-
Amplitude accuracy (100Hz≤f≤300kHz, 65μV$_{PP}$ ≤amplitude≤100mV$_{PP}$ sinusoidal input, LNA ON, FlatTop Window, RBW≤30kHz)	-0.14dB	-	+0.14dB
Amplitude accuracy (300kHz<f≤1MHz, 65μV$_{PP}$ ≤amplitude≤100mV$_{PP}$ sinusoidal input, LNA ON, FlatTop Window, RBW≤30kHz)	-0.16dB	-	+0.16dB
Amplitude accuracy (100Hz<f≤1MHz, 100mV$_{PP}$ <amplitude≤175mV$_{PP}$ sinusoidal input, LNA ON, FlatTop Window, RBW≤30kHz)	-	< ±0.16dB	-
Linearity (f=1kHz, 3mV$_{PP}$ ≤amplitude≤8V$_{PP}$ sinusoidal input, LNA OFF, FlatTop Window, RBW≤30kHz, relative to 1.56V$_{PP}$ input)	-	< ±0.03dB	-
Linearity (100Hz<f≤1MHz, 3mV$_{PP}$ ≤amplitude≤8V$_{PP}$ sinusoidal input, LNA OFF, FlatTop Window, RBW≤30kHz, relative to 1.56V$_{PP}$ input)	-	< ±0.08dB	-
Linearity (f=1kHz, 65μV$_{PP}$ ≤amplitude≤175mV$_{PP}$ sinusoidal input, LNA ON, FlatTop Window, RBW≤30kHz, relative to 79mV$_{PP}$ input)	-	< ±0.03dB	-
Linearity (100Hz<f≤1MHz, 65μV$_{PP}$ ≤amplitude≤175mV$_{PP}$ sinusoidal input, LNA ON, FlatTop Window, RBW≤30kHz, relative to 79mV$_{PP}$)	-	< ±0.08dB	-

Spurious

Description	Minimum	Typical	Maximum
Residual spurious (100Hz≤f≤1MHz, LNA OFF, input shorted)	-	-	$10\mu V_{RMS}$
Residual spurious (100Hz≤f≤1MHz, LNA ON, input shorted)	-	-	$1\mu V_{RMS}$
Second harmonic distortion (f=1kHz, $4.5V_{PP}$ sinusoidal input, LNA OFF)	-	-105dBc	-100dBc
Third harmonic distortion (f=1kHz, $4.5V_{PP}$ sinusoidal input, LNA OFF)	-	-105dBc	-100dBc
Second harmonic distortion (f=20kHz, $4.5V_{PP}$ sinusoidal input, LNA OFF)	-	-90dBc	-85dBc
Third harmonic distortion (f=20kHz, $4.5V_{PP}$ sinusoidal input, LNA OFF)	-	-90dBc	-85dBc
Second harmonic distortion (f=333kHz, $4.5V_{PP}$ sinusoidal input, LNA OFF)	-	-63dBc	-60dBc
Third harmonic distortion (f=333kHz, $4.5V_{PP}$ sinusoidal input, LNA OFF)	-	-63dBc	-60dBc
Second harmonic distortion (f=499kHz, $4.5V_{PP}$ sinusoidal input, LNA OFF)	-	-63dBc	-60dBc
Spurious free dynamic range (100Hz<f≤1MHz, $4.5V_{PP}$ sinusoidal input, LNA OFF)	-	-63dB	-
Second harmonic distortion (f=1kHz, $100mV_{PP}$ sinusoidal input, LNA ON)	-	-75dBc	-
Third harmonic distortion (f=1kHz, $100mV_{PP}$ sinusoidal input, LNA ON)	-	-80dBc	-
Second harmonic distortion (f=20kHz, $100mV_{PP}$ sinusoidal input, LNA ON)	-	-75dBc	-
Third harmonic distortion (f=20kHz, $100mV_{PP}$ sinusoidal input, LNA ON)	-	-75dBc	-
Second harmonic distortion (f=333kHz, $100mV_{PP}$ sinusoidal input, LNA ON)	-	-55dBc	-
Third harmonic distortion (f=333kHz, $100mV_{PP}$ sinusoidal input, LNA ON)	-	-55dBc	-
Second harmonic distortion (f=499kHz, $100mV_{PP}$ sinusoidal input, LNA ON)	-	-50dBc	-
Spurious free dynamic range (100Hz<f≤1MHz, $100mV_{PP}$ sinusoidal input, LNA ON)	-	-50dB	-

Noise(at 23°C of ambient temperature)

Description	Minimum	Typical	Maximum
Input referred voltage noise density (f=100Hz, LNA OFF, input shorted)	-	90nV/$\sqrt{\text{Hz}}$	98nV/$\sqrt{\text{Hz}}$
Input referred voltage noise density (1kHz≤f≤1MHz, LNA OFF, input shorted)	-	85nV/$\sqrt{\text{Hz}}$	90nV/$\sqrt{\text{Hz}}$
Input referred voltage noise density (f=100Hz, LNA ON, input shorted)	-	7.5nV/$\sqrt{\text{Hz}}$	8.5nV/$\sqrt{\text{Hz}}$
Input referred voltage noise density (1kHz≤f≤1MHz, LNA ON, input shorted)	-	5.7nV/$\sqrt{\text{Hz}}$	6.5nV/$\sqrt{\text{Hz}}$
Residual SSB phase noise (f=1MHz, 3.5V_{PP} sinusoidal input, LNA OFF, Gaussian Window, 100Hz Offset)	-	-125dBc/Hz	-

Frequency

Description	Minimum	Typical	Maximum
Analysis frequency range	0Hz	-	1MHz
Frequency span	7.63Hz	-	1MHz
Frequency accuracy (effects of rounding to the nearest data point are excluded)	-35ppm	-	+35ppm

Input Interface

Description	Specification
Input connector	BNC-Female (50Ω type)
Input impedance	1MΩ//25pF nominal
Lower -3dB cutoff in AC-coupling	0.3Hz nominal

Analysis Functions

Description	Specification
Window functions	Uniform (nominal WS: 1.0, nominal sidelobe: -13.3dB, nominal amplitude error: +0dB/-3.9dB), Hann (nominal WS=1.5, nominal sidelobe: -31.5dB, nominal amplitude error: +0dB/-1.5dB), GaussianTop (nominal WS: 2.215350, nominal sidelobe: -125dB, nominal amplitude error: +0dB/-0.68dB), FlatTop (nominal WS: 3.770246, nominal sidelobe: -95dB, nominal amplitude error: +0.0024dB/-0.0098dB), BH3 (3-Term Blackman-Harris) (nominal WS: 1.703712, nominal sidelobe: -71dB, nominal amplitude error: +0dB/-1.2dB), BH4 (4-Term Blackman-Harris) (nominal WS: 2.004351, nominal sidelobe: -92dB, nominal amplitude error: +0dB/-0.83dB), HDR GaussianTop (nominal WS: 2.433903, nominal sidelobe: -153dB, nominal amplitude error: +0dB/-0.57dB) (WS: Window Shape Factor)
Data points	51, 101, 201, 401, 801, 1601, 3201
Y-unit	V_{PEAK}, V_{RMS}, V^2_{PEAK}, V^2_{RMS}, dBV_{PEAK}, dBV_{RMS}, dBm, W, $V_{PEAK}/\sqrt{Hz}$, $V_{RMS}/\sqrt{Hz}$, V^2_{PEAK}/Hz, V^2_{RMS}/Hz, $dBV_{PEAK}/\sqrt{Hz}$, $dBV_{RMS}/\sqrt{Hz}$, dBm/Hz, W/Hz
RBW setting range	Minimum： (Frequency Span)÷((Data Points)-1)×WS Maximum： The smaller value of (Frequency Span)÷6.25×WS and (Frequency Span)×0.3
User defined frequency response	Can be registered up to eight user defined frequency responses into the non-volatile memory, and can be applied up to eight of them simultaneously
Band marker function	Can be calculated in-band integral value for arbitrarily defined frequency ranges
Post data processing	Average, Peak hold (Peak hold is performed on the Windows GUI software)

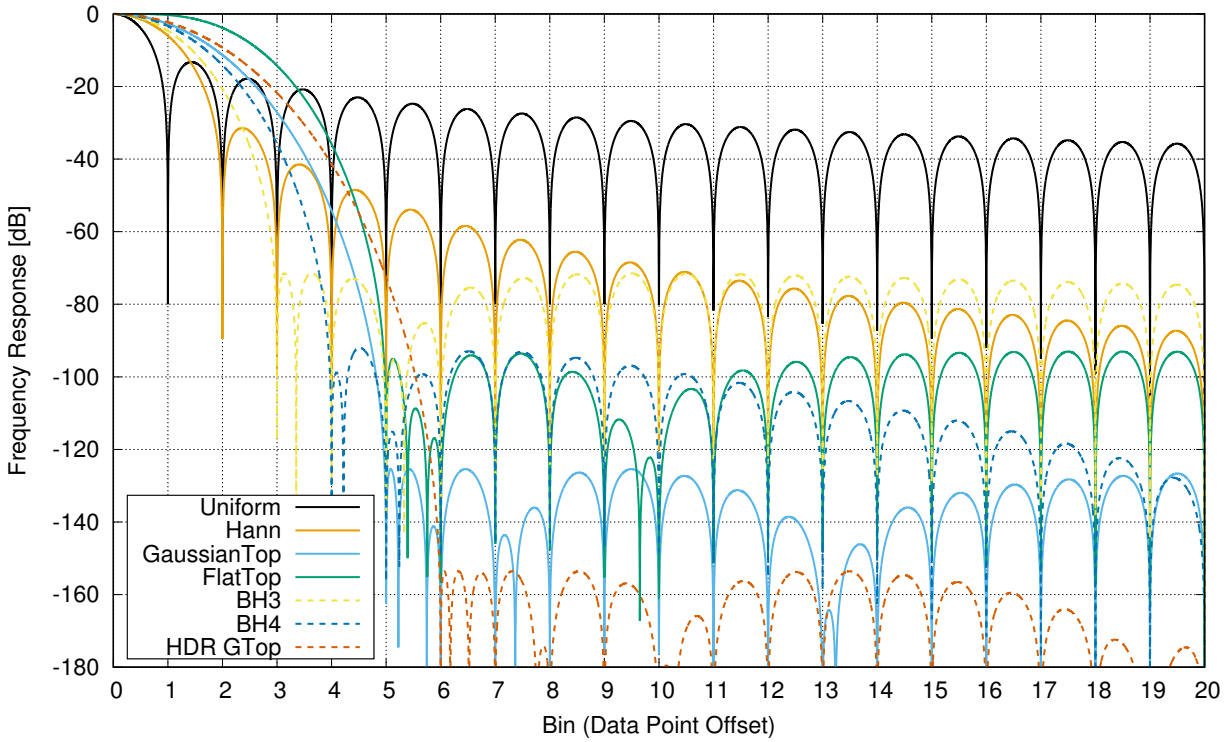

Fig.1 Nominal sidelobe of each window function

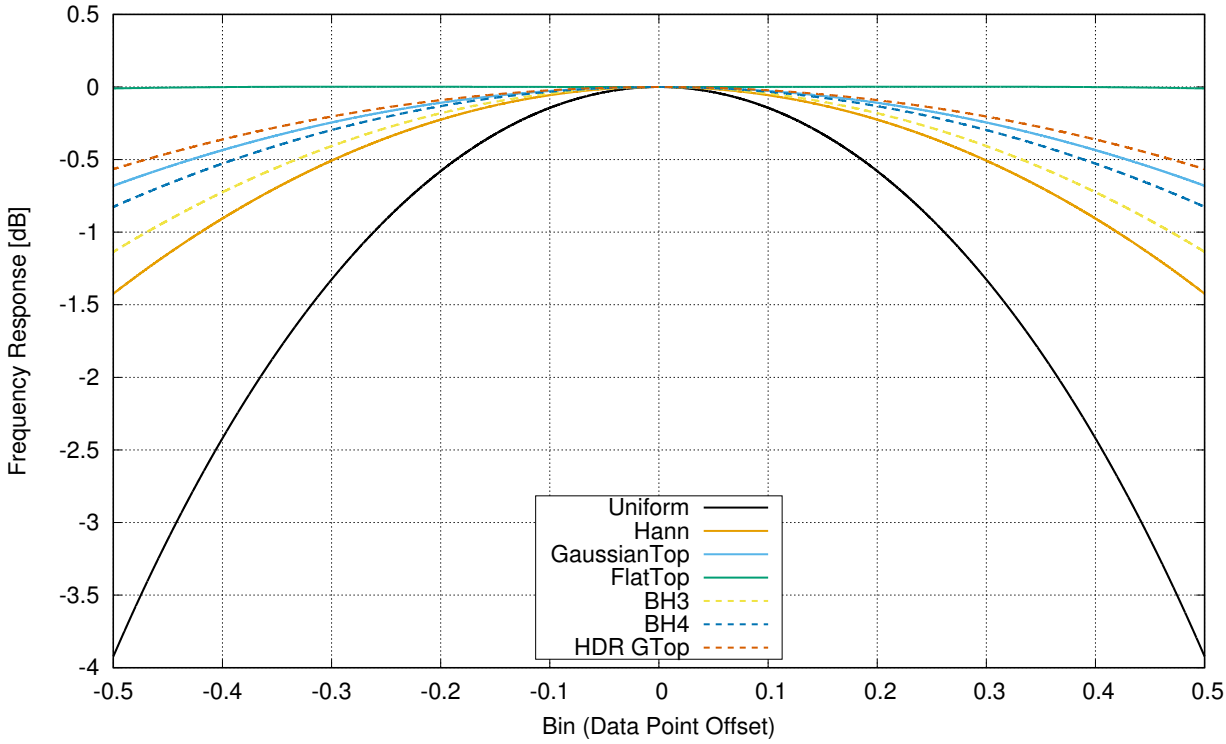

Fig.2 Nominal amplitude error of each window function

Power Supply and Warm-up

Description	Specification
Battery	Four AA-size Ni-MH batteries
Continuous operation time (using four 1900mAh AA-size Ni-MH batteries)	approximately 5 hours (Typical)
Auto power off setting range	180 seconds∼3600 seconds, ∞
Warm-up time	5 minits

Interfaces

Description	Specification
Isolated USB	Work as USB 2.0 Full Speed Device (12Mbps) Standard CDC ACM (Note: Most operating systems recognize it as a virtual COM port) USB Type B Female コネクタ
Bluetooth	Work as Bluetooth 2.1+EDR Serial Port Profile (SPP) (Note: Most operating systems recognize it as a virtual COM port) 工事設計認証 (Japan)　工事設計認証番号:204-320077 FCC(USA) certification　ID:PI4411B

Enviroment

Description	Minimum	Typical	Maximum
Operating temperature range (no dew condensation)	+5°C	-	+45°C
Storage temperature range	-25°C	-	+60°C

Calibration

Recommended calibration period	2 years

Supported Operating Systems

These operating systems shown as below support the Q89401A PSA USB interface without any additional device driver.

- Windows 10 (32bit/64bit)
- FreeBSD 9.2/10.3/11.0 (amd64)
- ubuntu 14.04 LTS (Linux-based, x86_64)
- Raspbian Jessie (Linux-based, Raspberry Pi 3, arm)
- (Please contact us for other operating systems)

This operating system shown as below supports the Q89401A PSA USB interface with installing the device driver from the product CD-R.

- Windows 7 (32bit/64bit)

These operating systems shown as below **DON'T** currently support the Q89401A PSA USB interface. Please contact us for support plan for these operating systems.

- Windows 8, Windows 8.1

To use the Q89401A PSA Bluetooth interface, the host computer is required a Bluetooth adapter and operating system that supports standard Bluetooth 2.1+EDR Serial Port Profile (SPP).

The dedicated GUI software runs on these operating systems shown as below. The GUI software requires Microsoft .NET Framework 4 Client Profile or upper version of it. The GUI software and Microsoft .NET Framework are contained in the product CD-R.

- Windows 7 (32bit/64bit)
- Windows 10 (32bit/64bit)

Q Precision Instruments
4-1-15-103 Naka-shinden, Ebina, Kanagawa 243-0422, Japan
http://q-prec.com/

Online Support
e-mail: support-j@q-prec.com

All contents are subject to change without notice.

Q89401A Precision Signal Analyzer (PSA) Datasheet Rev.1b(en) Printed in Japan, January 2, 2018