DATA SHEET

Keysight Streamline Series USB Vector Network Analyzer

P500xA 2-port, 9 kHz to 20 GHz

Compact Form. Zero Compromise.

P5000A 9 kHz to 4.5 GHz
P5001A 9 kHz to 6.5 GHz
P5002A 9 kHz to 9 GHz
P5003A 9 kHz to 14 GHz
P5004A 9 kHz to 20 GHz

KEYSIGHT TECHNOLOGIES

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Keysight P500xA Streamline Series USB VNA

The freedom of portable network analysis doesn't have to mean a compromise in performance. The P50xxA series brings high-end performance and flexibility to the portable Keysight Streamline Series. Gain confidence in your measurements with best-in-class performance offering fast, reliable, and repeatable results. Explore the complete characterization of your devices with a rich portfolio of software applications that transform the compact network analyzer into a complete RF measurement solution.

The P500xA Series, a member of Keysight's Streamline Series offers the performance required for testing passive components, amplifiers, mixers or frequency converters. The vector network analyzer (VNA) provides best-in-class key specifications such as dynamic range, measurement speed, trace noise and temperature stability. The VNA is packaged in a compact chassis and controlled by an external computer with powerful data processing capabilities and functionalities. The P500xA has the ability to extend the number of test ports by cascading two USB instruments; This flexibility makes an ideal solution to meet a wide range of applications. It is portable, easy to use, and there is zero compromise in performance.

The P500xA utilizes the same measurement science as other Keysight VNAs such as the PNA, ENA and USB VNA. A common software platform makes it easy to choose the right level of performance to match budget and measurement needs. This commonality guarantees measurement consistency, repeatability, and a common remote-programming interface across multiple instruments in R&D and manufacturing.

Definitions

Specifications (spec)[1]

Warranted performance. Specifications include guardbands to account for the expected statistical performance distribution, measurement uncertainties, and changes in performance due to environmental conditions. All specifications and characteristics apply over a 25 °C ±5 °C range (unless otherwise stated).

The following conditions must be met:

- Instrument temperature is between 37 to 50 °C.
- Instrument has been turned on for 60 minutes with VNA application running.
- Instrument is within its calibration cycle.
- Instrument remains at a stable surrounding environment temperature (between -10 °C to 55 °C) for 60 minutes prior to turn-on.

Characteristics (char.)

A performance parameter that the product is expected to meet before it leaves the factory, but that is not verified in the field and is not covered by the product warranty. A characteristic includes the same guardbands as a specification.

Typical (typ.)

Expected performance of an average unit at a stable temperature between 25°C ±5°C for 60 minutes prior to turn-on and during operation; does not include guardbands. It is not covered by the product warranty. The instrument must be within its calibration cycle.

Nominal (nom.)

A general, descriptive term or design parameter. It is not tested, and not covered by the product warranty.

Supplemental Information

A performance parameter that is tested on sampled product during design validation. It does not include guardbands and is not covered by the product warranty.

Calibration

The process of measuring known standards to characterize an instrument's systematic (repeatable) errors.

Corrected (residual)

Indicates performance after error correction (calibration). It is determined by the quality of calibration standards and how well "known" they are, plus system repeatability, stability, and noise.

Uncorrected (raw)

Indicates instrument performance without error correction. The uncorrected performance affects the stability of a calibration.

1. For all tables in this data sheet, the specified performance at the exact frequency of a break is the better value of the two specifications at that frequency.

Dynamic Range

The specifications in this section apply to measurements made with the Keysight P500xA vector network analyzer under the following conditions:

- No averaging applied to data

Table 1. System Dynamic Range at Test Port (dB)[1]

Description	Specification	Typical
9 kHz to 100 kHz	97	110
100 kHz to 1 MHz	117	126
1 MHz to 10 MHz	130	139
10 MHz to 50 MHz[2]	137	147
50 MHz to 3 GHz	140	150
3 GHz to 4.5 GHz	140	149
4.5 GHz to 6 GHz	138	147
6 GHz to 9 GHz	136	146
9 GHz to 14 GHz	133	142
14 GHz to 16 GHz	130	140
16 GHz to 20 GHz	125	137

1. System dynamic range = source maximum output power minus receiver noise floor at 10 Hz IF bandwidth. Does not include crosstalk effects.
2. It may typically be degraded at 25 MHz.

Corrected System Performance

This section provides specifications for the corrected performance of the P500xA USB VNA using either the 85032F Standard Mechanical Calibration Kit, 85052D Mechanical Calibration Kit or the N4691D electronic Calibration (ECal) Module. To determine transmission and reflection uncertainty curves with other calibration kits, please download Uncertainty Calculator from http://www.keysight.com/find/na_calculator to generate the curves for your specific calibration kit.

Measured with 10 Hz IF bandwidth, no averaging applied to data, environmental temperature = 23 °C

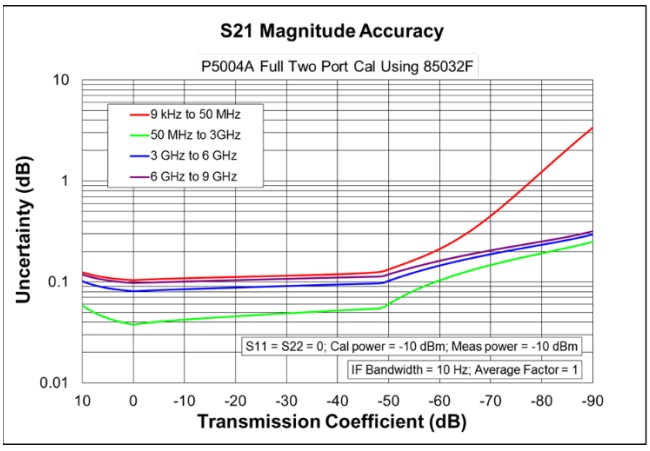
(± 3 °C) with < 1 °C deviation from calibration temperature.

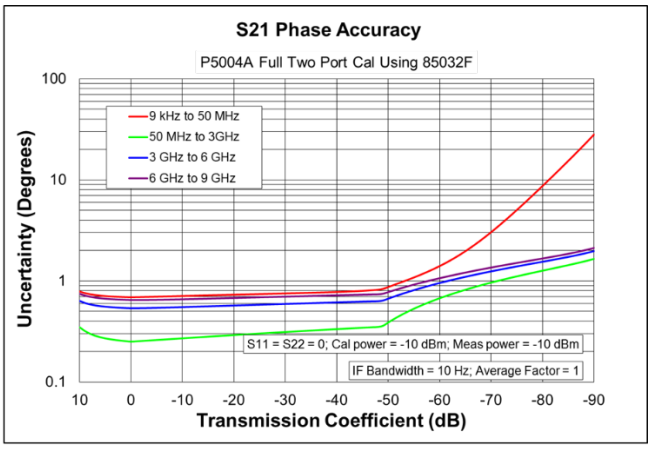
Table 2. With 85032F Standard Mechanical Calibration Kit

Corrected error terms (dB) – Specifications

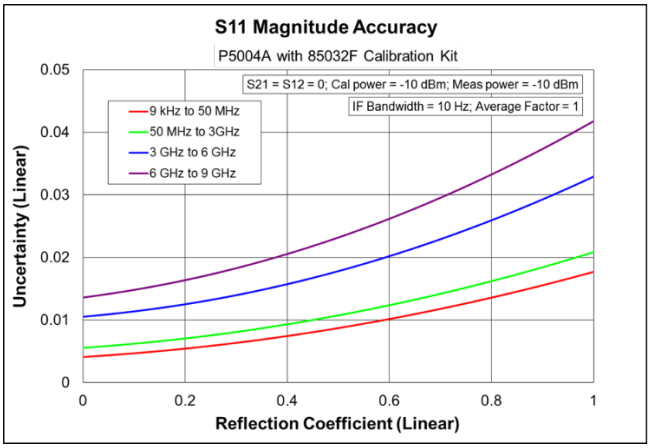
Description	9 kHz to 50 MHz	50 MHz to 3 GHz	3 GHz to 6 GHz	6 GHz to 9 GHz
Directivity	49	46	40	38
Source match	41	40	36	35
Load Match	47	46	40	38
Reflection tracking	± 0.011	± 0.021	± 0.032	± 0.054
Transmission tracking	± 0.082	± 0.021	± 0.063	± 0.074

Transmission Uncertainty (magnitude and phase)





Reflection Uncertainty (magnitude and phase)



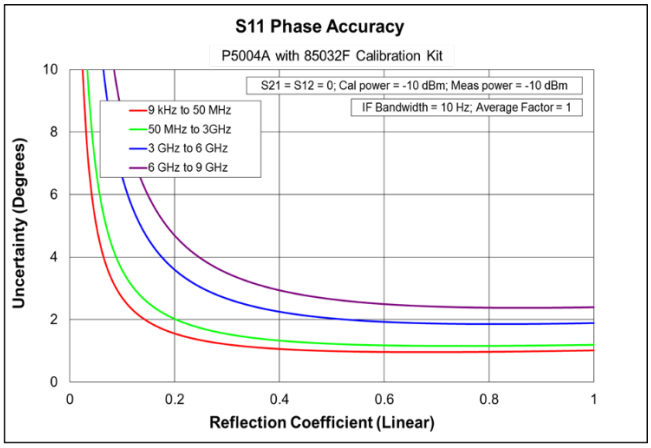
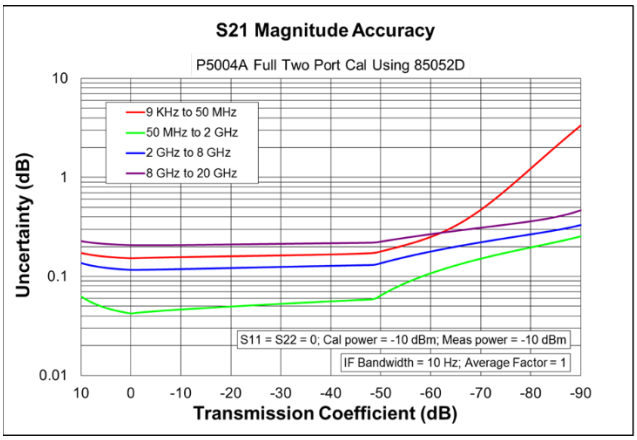


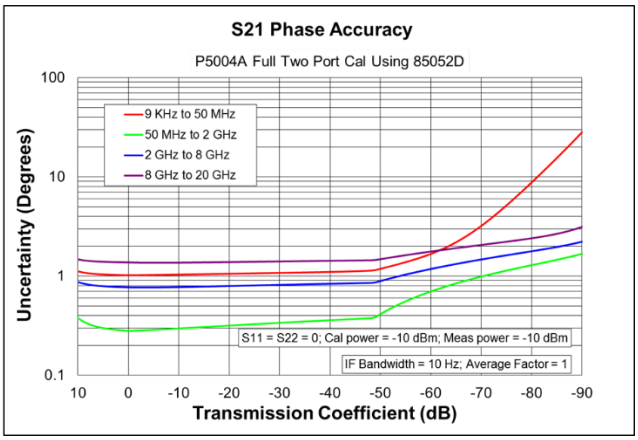
Table 3. With 85052D Economy Mechanical Calibration Kit

Corrected error terms (dB) – Specifications

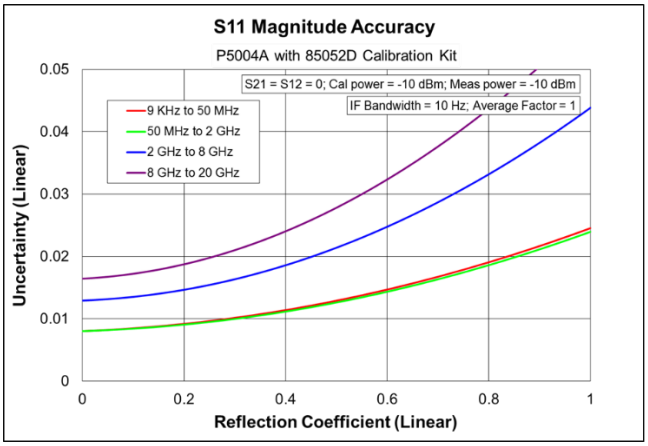
Description	9 kHz to 50 MHz	50 MHz to 2 GHz	2 GHz to 8 GHz	8 GHz to 20 GHz
Directivity	42	42	38	36
Source match	37	37	31	28
Load Match	42	42	38	36
Reflection tracking	± 0.003	± 0.003	± 0.004	± 0.008
Transmission tracking	± 0.136	± 0.03	± 0.1	± 0.185

Transmission Uncertainty (magnitude and phase)





Reflection Uncertainty (magnitude and phase)



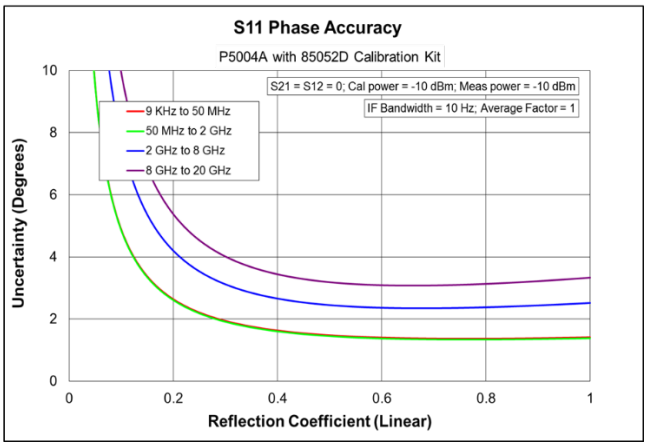
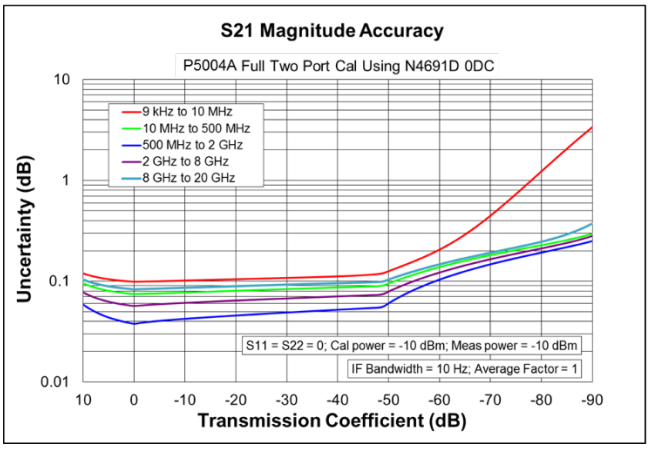


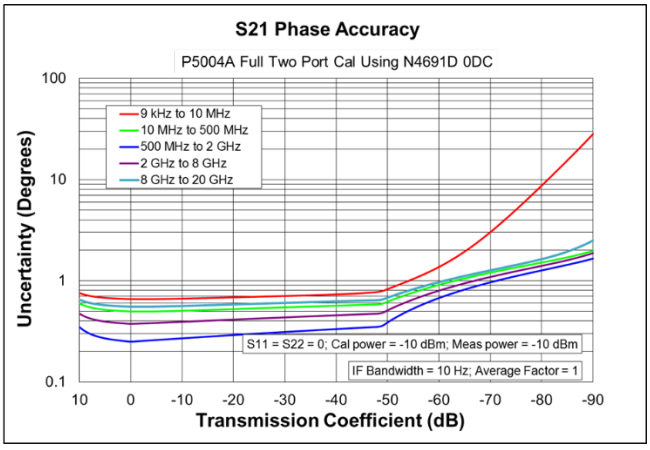
Table 4. With N4691D Electronic Calibration (ECal) Module

Corrected Error Terms (dB) – Specifications

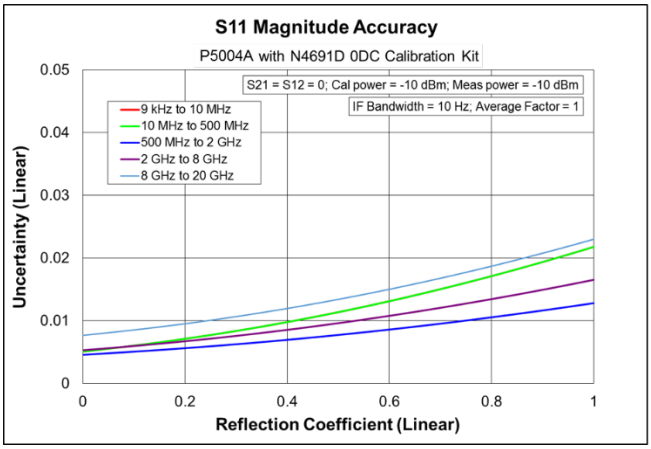
Description	9 kHz to 10 MHz	10 MHz to 500 MHz	500 MHz to 2 GHz	2 GHz to 8 GHz	8 GHz to 20 GHz
Directivity	46	46	47	46	43
Source match	41	41	47	45	42
Load Match	38	40	46	44	40
Reflection tracking	± 0.05	± 0.05	± 0.02	± 0.03	± 0.04
Transmission tracking	± 0.081	± 0.056	± 0.026	± 0.042	± 0.064

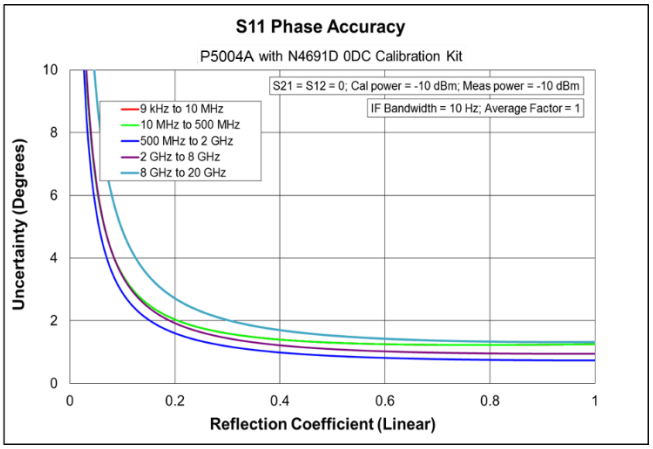
Transmission Uncertainty (magnitude and phase)





Reflection Uncertainty (magnitude and phase)





Uncorrected System Performance

Table 5. Uncorrected Error Terms (dB) – Specification[1]

Description	Directivity	Source Match	Load Match	Transmission Tracking	Reflection Tracking	Crosstalk
9 kHz to 300 kHz	-	-	-	-	-	-
300 kHz to 10 MHz	20	20	15	-	-	-
10 MHz to 1.5 GHz	25	25	17	-	-	-
1.5 GHz to 3 GHz	25	25	16	-	-	-
3 GHz to 6 GHz	25	25	11	-	-	-
6 GHz to 10 GHz	20	20	11	-	-	-
10 GHz to 16 GHz	15	15	11	-	-	-
16 GHz to 20 GHz	15	15	8	-	-	-

1. Specification apply to following conditions: Factory correction is turned on. Cable loss not included in transmission tracking.

Table 6. Uncorrected Error Terms (dB) – Typical

Description	Directivity	Source Match	Load Match	Transmission Tracking	Reflection Tracking	Crosstalk
9 kHz to 30 kHz	40	40	5	0.5	0.5	110
30 kHz to 100 kHz	40	40	10	0.5	0.5	110
100 kHz to 300 kHz	40	40	18	0.2	0.2	126
300 kHz to 1 MHz	40	40	23	0.2	0.2	126
1 MHz to 10 MHz	40	40	23	0.2	0.2	139
10 MHz to 50 MHz	40	40	23	0.2	0.2	147[1]
50 MHz to 1.5 GHz	40	40	23	0.2	0.2	150
1.5 GHz to 3 GHz	40	40	20	0.2	0.2	150
3 GHz to 4.5 GHz	40	40	15	0.2	0.2	149
4.5 GHz to 6 GHz	40	40	15	0.2	0.2	147
6 GHz to 9 GHz	35	35	15	0.3	0.3	146
9 GHz to 10 GHz	35	35	15	0.3	0.3	142
10 GHz to 13 GHz	35	35	15	0.5	0.5	142
13 GHz to 16 GHz	35	35	15	0.5	0.5	140
16 GHz to 20 GHz	35	35	12	0.5	0.5	137

1. It may typically be degraded at 25 MHz.

Test Port Output

Table 7. Frequency Resolution, Accuracy, Stability

Description	Specification	Typical
Frequency resolution	1 Hz	-
Frequency accuracy	± 7 ppm (25 ± 5 ºC)	-
Frequency stability	-	± 7 ppm (0 to 50 ºC)
	-	± 3 ppm/year maximum

Table 8. Maximum Output Port Power (dBm)

Description	Specification	Typical
9 kHz to 100 kHz	0	+2
100 kHz to 10 MHz	+5	+7
10 MHz to 4.5 GHz	+10	+13
4.5 GHz to 6 GHz	+10	+12
6 GHz to 9 GHz	+9	+12
9 GHz to 16 GHz	+7	+10
16 GHz to 20 GHz	+4	+7

Table 9. Power Sweep Range (dBm)[1]

Description	Specification	Typical
9 kHz to 100 kHz	-60 to 0	-60 to +2
100 kHz to 10 MHz	-60 to +5	-60 to +7
10 MHz to 4.5 GHz	-60 to +10	-60 to +13
4.5 GHz to 6 GHz	-60 to +10	-60 to +12
6 GHz to 9 GHz	-60 to +9	-60 to +12
9 GHz to 16 GHz	-60 to +7	-60 to +10
16 GHz to 20 GHz	-60 to +4	-60 to +7

1. When set to source power below -50 dBm, spurious related to LO signal may be observed.

Table 10. Power Level Accuracy (dB)[1]

Description	Specification	Typical
9 kHz to 100 kHz	± 4.0	± 1.0
100 kHz to 15 GHz	± 1.5	± 0.2
15 GHz to 20 GHz	± 2.0	± 0.3

1. At nominal power of 0 dBm, stepped sweep mode.

Table 11. Power Level Linearity (dB)

Description	Specification [1]	Typical [2,3]
9 kHz to 10 GHz	± 0.75	± 1.0
10 GHz to 20 GHz	± 1.0	± 1.0

1. Reference to nominal power of 0 dBm, stepped sweep mode. -20 dBm ≤ P ≤ maximum specified power.
2. Reference to nominal power of 0 dBm, stepped sweep mode. -60 dBm ≤ P < -20 dBm.
3. Reference to nominal power of 0 dBm, swept sweep mode. -60 dBm ≤ P ≤ maximum specified power.

Table 12. Source Harmonics (dBc)[1]

Description	Specification	Typical
9 kHz to 10 MHz	-	-20
10 MHz to 20 GHz	-	-25

1. At power of 0 dBm.

Table 13. Non-harmonic Spurs (dBc)[1]

Description	Specification	Typical
9 kHz to 20 GHz	-	-30

1. At power of 0 dBm, includes sub-harmonics.

Table 14. Nominal Power (Preset Power Level)

Description	Specification
All models	0 dBm

Table 15. Power Resolution, Maximum/minimum Settable Power

Description	Specification	Typical
Settable resolution	-	0.01 dB
Maximum settable power	-	+20 dBm
Minimum settable power	-	-100 dBm

Test Port Input

Table 16. Test Port Noise Floor (dBm)[1]

Description	Specification	Typical
9 kHz to 100 kHz	-97	-108
100 kHz to 1 MHz	-112	-119
1 MHz to 10 MHz	-125	-132
10 MHz to 50 MHz[2]	-127	-134
50 MHz to 3 GHz	-130	-137
3 GHz to 4.5 GHz	-130	-136
4.5 GHz to 6 GHz	-128	-135
6 GHz to 9 GHz	-127	-134
9 GHz to 14 GHz	-126	-132
14 GHz to 16 GHz	-123	-130
16 GHz to 20 GHz	-121	-130

1. Noise floor in a 10 Hz IF Bandwidth. Measured with 1 kHz IF bandwidth for 9 kHz to <100 kHz, and 30 kHz IF bandwidth for 100 kHz to 20 GHz. Test port terminated.
2. It may typically be degraded at 25 MHz.

Table 17. Receiver Compression at Test Port Power (Maximum Specified Power)

	Specification		Typical	
Description	Magnitude (dB)	Phase (°)	Magnitude (dB)	Phase (°)
9 kHz to 100 kHz	0.5	5	0.10	1.5
100 kHz to 20 GHz	0.2	5	0.05	1.0

Table 18. Trace Noise Magnitude (dB rms)[1]

Description	Specification	Typical
9 kHz to 30 kHz	0.005	0.0025
30 kHz to 100 kHz	0.003	0.001
100 kHz to 6 GHz [2]	0.0015	0.0005
6 GHz to 10 GHz	0.002	0.0006
10 GHz to 20 GHz	0.003	0.001

1. Transmission and reflection trace noise in a 1 kHz IF bandwidth for < 10 MHz, 10 kHz IF bandwidth ≥ 10 MHz. At maximum specified power.
2. It may typically be degraded at particular frequencies such as 25 MHz ,54 MHz, 58.5 MHz, 156 MHz, 108 MHz, 120 MHz or 132 MHz.

Table 19. Trace Noise Phase (degree rms)[1]

Description	Specification	Typical
9 kHz to 30 kHz	0.07	0.025
30 kHz to 100 kHz	0.05	0.017
100 kHz to 300 kHz	0.035	0.006
300 kHz to 6 GHz[2]	0.01	0.003
6 GHz to 10 GHz	0.02	0.006
10 GHz to 13.5 GHz	0.03	0.006
13.5 GHz to 20 GHz	0.03	0.01

1. Transmission and reflection trace noise in a 1 kHz IF bandwidth for < 10 MHz, 10 kHz IF bandwidth ≥ 10 MHz. At maximum specified power.
2. It may typically be degraded at particular frequencies such as 25 MHz ,54 MHz, 58.5 MHz, 156 MHz, 108 MHz, 120 MHz or 132 MHz.

Table 20. Temperature Stability - Typical

Description	Magnitude (dB/°C)	Phase (degree/°C)
9 kHz to 300 kHz	0.03	0.2
300 kHz to 4.5 GHz	0.005	0.1
4.5 GHz to 6 GHz	0.01	0.1
6 GHz to 6.5 GHz	0.01	0.2
6.5 GHz to 10 GHz	0.015	0.2
10 GHz to 14 GHz	0.015	0.3
14 GHz to 20 GHz	0.02	0.4

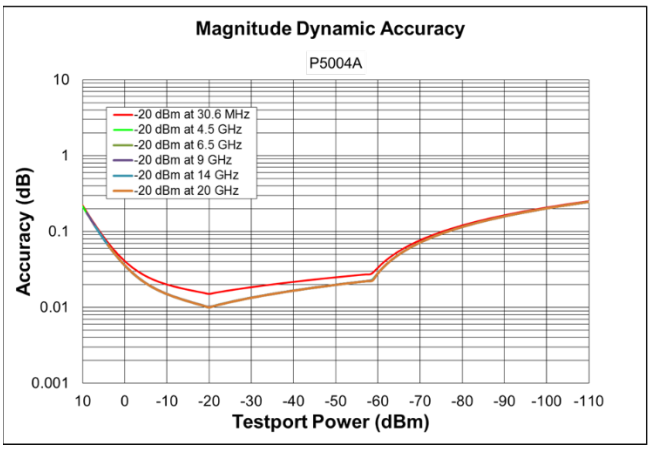
Table 21. Damage Input Level

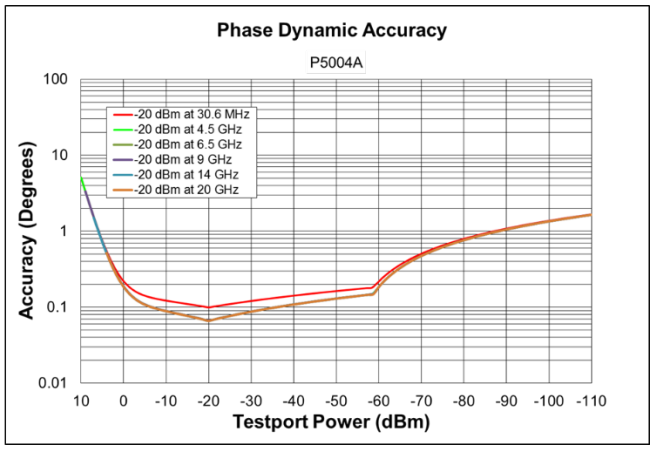
Description	Specification	Typical
	-	+27 dBm or ± 35 VDC

Dynamic Accuracy

Accuracy of the test port input power relative to the reference input power level. Measured with 10 Hz IF bandwidth. Although labeled "P5004A", these graphs apply to P5000A, P5001A, P5002A, P5003A and P5004A.

Dynamic Accuracy[1] – specification





1. Dynamic accuracy is verified with the following measurements:
   - Compression over frequency
   - IF linearity at three single frequencies (30.6MHz, 49.6MHz and 99.6MHz) using a reference level of -20 dBm for an input power range of 0 to -60 dBm. For values below -60 dBm, refer to VNA Receiver Dynamic Accuracy Specifications and Uncertainties.

Spectrum Analysis (with Option 090 and S97090A)

This section provides specifications for the spectrum analysis Option 090 on the P500xA USB VNA. The S97090A Software is required to enable spectrum analysis functions of the P500xA.

Table 22. Frequency Specifications

Description	Specification	Supplemental Information
Frequency Reference[1]		
Accuracy	-	±[(time since last adjustment x aging rate) + temperature stability + calibration accuracy], typical
Aging Rate	-	± 3 ppm/year maximum, typical
Temperature Stability	-	± 7 ppm (0 to 50 °C)
Achievable Initial Calibration Accuracy	±7 ppm (25 ± 5 °C)	-
Frequency Readout Accuracy (Start, Stop, Center, Marker)	-	±[(readout frequency x frequency reference accuracy) + (<1% x RBW)], nominal
Frequency Span		
Minimum/Maximum	Analyzer's full span	-
Resolution	1 Hz	-
Sweep (Trace) Point Range	11 to 100,001	-
Resolution Bandwidth (RBW)		
Range (-3 dB Bandwidth)	10 Hz to 3 MHz in 10% steps	-
Bandwidth Range Accuracy	-	± 1%, all RBW, except below 100 MHz with 3 MHz RBW
Selectivity (-60 dB/-3 dB)	-	Gaussian: 4.5:1, Flat top: 2.47:1, Kaiser: 3.82:1, Blackman: 3.58:1
Video Bandwidth (VBW)		
Range	10 Hz to 3 MHz	-

1. Frequency reference accuracy can be improved by using external frequency reference with better accuracy.

Table 23. Time Specifications

Description	Specification	Supplemental Information
Sweep Time and Triggering		
Sweep Time Range	Auto	-
Trigger Types	Continuous, Single, Group, Manual, External	-
Trigger Delay Range	0 to 3s	-
Trigger Delay Resolution	1 us	-
Measuring and Display Update Rate (milliseconds)[1]		
20 MHz Span, 3 kHz RBW, 3 kHz VBW	-	26.6
100 MHz Span, Auto RBW, Auto VBW	-	17.5
1 GHz Span, 3 kHz RBW, 3 kHz VBW	-	178.1
1 GHz Span, 300 kHz RBW, 300 kHz VBW	-	44.9
10 GHz Span, 3 kHz RBW, 3 kHz VBW	-	1589.5
10 GHz Span, 300 kHz RBW, 300 kHz VBW	-	330.1
10 MHz to 20 GHz, RBW/VBW = Preset (300 kHz)	-	717.7

1. Measured with a 2-port module.

Table 24. Amplitude Accuracy and Range Specifications

Description	Specification
Amplitude Range	
Measurement Range	DANL to maximum input level
Input Attenuator Range	High attenuation or Low attenuation
Maximum Safe Input Level	+27 dBm
Display Range	
Log Scale	0.001 to 500 dB/div in 0.001 steps
Linear Scale	10 divisions (default)
Scale Units	dBm, mW
Trace Detectors Types	Average, Sample, Peak, Normal, Negative Peak, Peak sample, Peak average

Table 25. SA Detector Accuracy (dB)[1] - Specifications

Description	Specification (dB)
9 kHz to 10 MHz	± 0.15
10 MHz to 20 GHz	± 0.1

1. With high attention. SA detector accuracy is residual error of IF response calibration. IF response is characterized with P500xA's standard measurement class after power and S-parameter calibration. Therefore, the SA total absolute amplitude accuracy includes power meter, S-parameter and SA detector accuracies. Add input attenuation switching uncertainty if receiver attenuator is changed after user calibration.

Table 26. Input Attenuation Switching Uncertainty (dB) – Supplemental Information

Description	Supplemental Information
9 kHz to 50 MHz	± 0.5
50 MHz to 20 GHz	± 1.0

Table 27. Input VSWR – Specifications

Description	Specifications
9 kHz to 30 kHz	5.848
30 kHz to 100 kHz	2.323
100 kHz to 10 MHz	1.433
10 MHz to 1.5 GHz	1.329
1.5 GHz to 3 GHz	1.377
3 GHz to 10 GHz	1.785
10 GHz to 16 GHz	1.785
16 GHz to 20 GHz	2.323

Table 28. Other Amplitude Accuracy – Supplemental Information

Description	Supplemental Information
RBW Switching Uncertainty	0.02 dB
Display Scale Fidelity	See dynamic accuracy specification. Specification applied to SA measurement class with user calibration between -10 dBm and -40 dBm input power and measurement between +10 dBm and -120 dBm input power.

Table 29. Spurious Response – Supplemental Information

Description	Supplemental Information
Image Response	Mostly eliminated. Intermittent image response may be seen when making multi-tone or modulated signal measurements.
LO Related Spurious	Eliminated

Table 30. Displayed Average Noise Level (DANL) at Test Ports with Low Attenuation (dBm/Hz)[1] – Specifications

Description	Specifications	Typical
9 kHz to 100 kHz	-110	-121
100 kHz to 1 MHz	-125	-132
1 MHz to 10 MHz	-138	-145
10 MHz to 100 MHz	-140	-147
100 MHz to 4.5 GHz	-144	-150
4.5 GHz to 6 GHz	-142	-149
6 GHz to 9 GHz	-141	-148
9 GHz to 14 GHz	-140	-146
14 GHz to 16 GHz	-137	-144
16 GHz to 20 GHz	-135	-144

1. Tested with 1 kHz RBW for 9 kHz to 50 MHz and 10 kHz RBW for above 50 MHz, test port terminated, average detector, averaging type = Log, IF gain = Auto, image rejection = normal, random LO OFF.

Table 31. Displayed Average Noise Level (DANL) at Test Ports with High Attenuation (dBm/Hz)[1] – Specifications

Description	Specifications	Typical
9 kHz to 100 kHz	-	-99
100 kHz to 1 MHz	-	-110
1 MHz to 10 MHz	-	-116
10 MHz to 100 MHz	-	-116
100 MHz to 4.5 GHz	-	-127
4.5 GHz to 6 GHz	-	-127
6 GHz to 9 GHz	-	-126
9 GHz to 14 GHz	-	-124
14 GHz to 16 GHz	-	-122
16 GHz to 20 GHz	-	-122

1. Tested with 1 kHz RBW for 9 kHz to 50 MHz and 10 kHz RBW for above 50 MHz, test port terminated, average detector, averaging type = Log, IF gain = Auto, image rejection = normal, random LO OFF.

Table 32. Second Harmonic Distortion with High Attenuation[1] – Supplemental Information

Description	SHI (dBm)
50 MHz to 1 GHz	+30
1 GHz to 4 GHz	+38
4 GHz to 10 GHz	+47

1. Tested with 0 dBm input at test port, 10 MHz tone separations.

Table 33. Second Harmonic Distortion with Low Attenuation[1] – Supplemental Information

Description	SHI (dBm)
50 MHz to 1 GHz	+10
1 GHz to 4 GHz	+20
4 GHz to 10 GHz	+30

1. Tested with -25 dBm input at test port, 10 MHz tone separations.

Table 34. Third Order Intermodulation Distortion with High Attenuation[1] – Characteristic

Description	Distortion (dBc)	TOI (dBm)
50 MHz to 200 MHz	-40	+20
200 MHz to 2 GHz	-44	+22
2 GHz to 5 GHz	-46	+23
5 GHz to 10 GHz	-50	+25
10 GHz to 15 GHz	-60	+25
15 GHz to 20 GHz	-54	+22

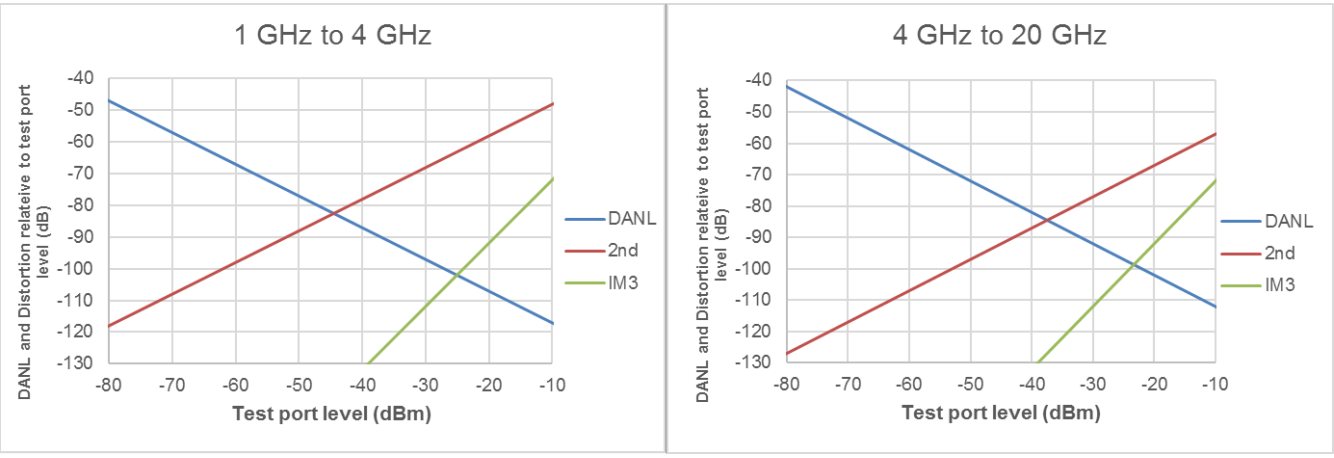
1. Tested with 0 dBm for 50 MHz to 10 GHz and -5 dBm for 10 GHz to 20 GHz input at test port, 10 MHz tone separations.

Table 35. Third Order Intermodulation Distortion with Low Attenuation[1] – Characteristic

Description	Distortion (dBc)	TOI (dBm)
50 MHz to 5 GHz	-56	+3
5 GHz to 10 GHz	-52	+1
10 GHz to 20 GHz	-66	+8

1. Tested with -25 dBm input at test port, 10 MHz tone separations.

DANL and Distortion Relative to Test Port Level (dB)[1] – Nominal



1. With High Attenuation. 2nd harmonic distortion applies up to 10 GHz.

Table 36. Receiver Phase Noise (dBc/Hz)[1] – Typical

Offset	1 kHz	10 kHz	100 kHz	1 MHz	10 MHz
CF = 1 GHz	-103	-103	-103	-130	-130
CF = 3 GHz	-96	-96	-96	-120	-130
CF = 10 GHz	-83	-83	-83	-116	-127
CF = 20 GHz	-76	-76	-76	-110	-121

1. At maximum specified power. Spurious signals are excluded.

Pulsed-RF Measurements (with Option 021 and S97025A)

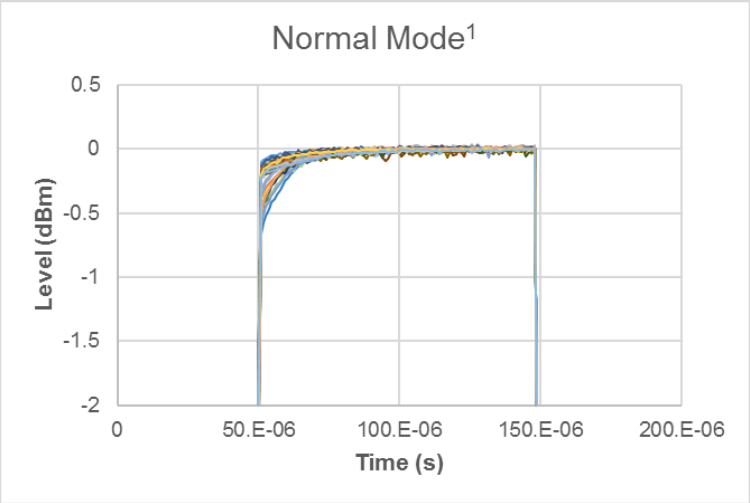
This section provides specifications for the pulse modulation hardware (Option 021) on the P500xA Series USB VNA. The S97025A Software is required to enable pulsed-RF measurement functions of the P500xA.

Table 37. Pulse Modulation On/Off Ratio (dB) - Typical

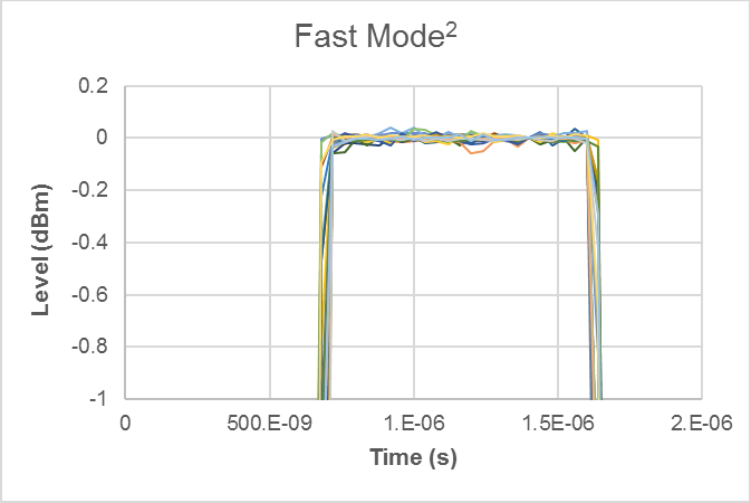
Description	Normal Mode [1]	Fast Mode
9 kHz to 4.5 GHz	80	50
4.5 GHz to 15 GHz	70	40
15 GHz to 20 GHz	70	35

1. At power of > -20 dBm.

Pulse Modulation Shape Examples



1. With 100 us pulse width setting. 50 usec/div.



2. With 1 us pulse width setting. 500 nsec/div.

Multi-instrument Measurements with S97551A Software

When the S97551A software is installed, the P500xA USB VNA have the ability to be configured into a multiport network analyzer with multiple USB VNAs. Adding a second USB VNA would provide additional test ports to the VNA. This configuration provides a full featured multiport vector network analyzer capability with full crossbar S-parameter measurement capability. Configurations of up to two instruments with four test ports have been evaluated.

For multi-instrument operation, all single-instrument specifications apply except trace noise, test port noise floor and system dynamic range. The other performance of multi-instrument configurations will meet the single-instrument specifications in the data sheet.

The guidance provided here is given as general reference based on Keysight's internal evaluation of multi-instrument configurations. Not all multiport setups using multiple USB VNAs are tested as a multiport instrument in the factory. Interconnect cables included in the Y1701A must be used for connection between two P500xA VNAs.

Table 38. Multi-instrument Performance

- A check mark, ✓, indicates the performance parameter is the same as the corresponding single-instrument performance.
- An empty diamond, ◊, indicates that the performance parameter may be degraded as the number of instruments increases.

Description	Setups with 2 USB VNAs
System Dynamic Range	◊ (see table 39)
Frequency Accuracy	✓
Uncorrected Directivity	✓
Uncorrected Load Match	✓
Uncorrected Source Match	✓
Maximum Output Port Power	✓
Power Level Accuracy	✓
Power Level Linearity	✓
Noise Floor	◊ (see table 40)
Receiver Compression	✓
Trace Noise	◊ (see table 41 and 42)
Dynamic Accuracy	✓

Table 39. System Dynamic Range of Multi-instrument Configurations (dB)[1]

	Setups with 2 USB VNAs	
Description	**Char.**	**Typical**
9 kHz to 100 kHz	97	110
100 kHz to 1 MHz	117	126
1 MHz to 10 MHz	130	139
10 MHz to 50 MHz [2]	137	147
50 MHz to 3 GHz	140	150
3 GHz to 4.5 GHz	140	149
4.5 GHz to 6 GHz	138	147
6 GHz to 9 GHz	136	146
9 GHz to 14 GHz	133	142
14 GHz to 16 GHz	127	140
16 GHz to 20 GHz	124	137

1. System dynamic range = source maximum output power minus receiver noise floor at 10 Hz IF bandwidth. Does not include crosstalk effects.
2. It may typically be degraded at 25 MHz.

Table 40. Test Port Noise Floor of Multi-instrument Configurations (dBm)[1]

	Setups with 2 USB VNAs	
Description	**Char.**	**Typical**
9 kHz to 100 kHz	-97	-108
100 kHz to 1 MHz	-112	-119
1 MHz to 10 MHz	-125	-132
10 MHz to 50 MHz [2]	-127	-134
50 MHz to 3 GHz	-130	-137
3 GHz to 4.5 GHz	-130	-136
4.5 GHz to 6 GHz	-128	-135
6 GHz to 9 GHz	-127	-134
9 GHz to 14 GHz	-126	-132
14 GHz to 16 GHz	-120	-130
16 GHz to 20 GHz	-120	-130

1. Noise floor in a 10 Hz IF Bandwidth. Measured with 1 kHz IF bandwidth for 9 kHz to <100 kHz, and 30 kHz IF bandwidth for 100 kHz to 20 GHz. Test port terminated.
2. It may typically be degraded at 25 MHz.

Table 41. Trace Noise Magnitude of Multi-instrument Configurations (dB rms)[1]

	Setups with 2 USB VNAs	
Description	**Char.**	**Typical**
9 kHz to 30 kHz	0.005	0.0025
30 kHz to 100 kHz	0.003	0.001
100 kHz to 10 MHz	0.0025	0.0005
10 MHz to 6 GHz[2]	0.002	0.0005
6 GHz to 10 GHz	0.002	0.0006
10 GHz to 13.5 GHz	0.003	0.001
13.5 GHz to 20 GHz	0.004	0.001

1. Reflection trace noise in a 1 kHz IF bandwidth for < 10 MHz, 10 kHz IF bandwidth ≥ 10 MHz. At maximum specified power.
2. It may typically be degraded at particular frequencies such as 25 MHz ,54 MHz, 58.5 MHz, 156 MHz, 108 MHz, 120 MHz or 132 MHz.

Table 42. Trace Noise Phase of Multi-instrument Configurations (degree rms)[1]

	Setups with 2 USB VNAs	
Description	**Char.**	**Typical**
9 kHz to 30 kHz	0.07	0.025
30 kHz to 100 kHz	0.05	0.017
100 kHz to 300 kHz	0.035	0.006
300 kHz to 10 MHz	0.015	0.003
10 MHz to 6 GHz [2]	0.015	0.003
6 GHz to 10 GHz	0.025	0.006
10 GHz to 13.5 GHz	0.036	0.006
13.5 GHz to 20 GHz	0.045	0.01

1. Reflection trace noise in a 1 kHz IF bandwidth for < 10 MHz, 10 kHz IF bandwidth ≥ 10 MHz. At maximum specified power.
2. It may typically be degraded at particular frequencies such as 25 MHz ,54 MHz, 58.5 MHz, 156 MHz, 108 MHz, 120 MHz or 132 MHz.

Multi-site Operation

Multi-site operation is the ability to configure multiple independent USB VNAs to operate independently on a single controller via USB connection. Up to two independent USB VNA instances per PC have been evaluated, allowing parallel testing of devices. Each instance of and independent USB VNA can have different measurement parameters, and can be triggered synchronously, or asynchronously.

General Information

Table 43. External PC System Requirements

PC System Requirement	
Hardware Requirements	M9037A PXIe High performance embedded controller recommended
Operating Systems	Windows 7 SP1 and Windows 10 (64-bit only)
Processor Speed	Intel i5 6th generation or newer / Intel Xeon 3E v3 or newer
Available Memory	16 GB recommended; 4 GB minimum
Available Disk space	2 GB available disk space minimum
Display resolution	1024 x 768 minimum
USB	USB 3.0 port directly connected to Intel chipset
Instrument Drivers	
Keysight IO Libraries	IO Libraries Suite 2018 Update 1 (18.1.23218) or later

Table 44. Environmental and Physical Specifications

Descriptions	Samples of this product have been type tested in accordance with the Keysight Environmental Test Manual and verified to be robust against the environmental stresses of Storage, Transportation and End-use; those stresses include, but are not limited to, temperature, humidity, shock, vibration, altitude, and power line conditions. Test Methods are aligned with IEC 60068-2 and levels are similar to MIL-PRF-28800F Class 3.	
Temperature	Operating	0 to 50 °C ambient 10 to 70 °C instrument temperature
	Non-operating	-40 to 70 °C
Humidity	Operating	Type tested at 20 to 80 %, wet bulb temperature < 29 °C (non-condensing)
	Non-operating	Type tested at 20 to 90 %, wet bulb temperature < 40 °C (non-condensing)
Altitude	Operating	Up to 2,000 meters (6,561 feet)
	Non-operating	Up to 4,572 meters (15,000 feet)
Vibration	Operating	0.3 G maximum, 5 Hz to 500 Hz
	Non-operating	0.75 G maximum, 5 Hz to 500 Hz
Instrument protection		IP 30 IEC/EN 60529
Warm-up time		60 minutes

Table 45. Regulatory and Safety Compliance

EMC CE ISM 1-A	European Council Directive 2014/30/EC IEC 61326-1:2012 EN 61326-1:2013 CISPR 11:2009 +A1:2010 EN 55011: 2009 +A1:2010 Group 1, Class A IEC 61000-4-2:2008 EN 61000-4-2:2009 4 kV CD / 8 kV AD IEC 61000-4-3:2006 +A1:2007 +A2:2010 EN 61000-4-3:2006 +A1:2008 +A2:2010 3 V/m, 80MHz-6GHz, 80% AM IEC 61000-4-4:2004 +A1:2010 EN 61000-4-4:2004 +A1:2010 2 kV power lines / 0.5 kV signal lines IEC 61000-4-5:2005 EN 61000-4-5:2006 1 kV line-line / 2 kV line-ground IEC 61000-4-6:2008 EN 61000-4-6:2009 3 V, 0.15-80 MHz, 80% AM IEC 61000-4-8:2009 EN 61000-4-8:2010 30A/m, 50/60Hz IEC 61000-4-11:2004 EN 61000-4-11:2004 0.5-300 cycle, 0% / 70%
ICES/NMB-001	ICES-001:2006 Group 1, Class A AS/NZS CISPR11:2004
	Group 1, Class A
	KN11, KN61000-6-1 and KN61000-6-2 Group 1, Class A
Instrument calibration cycle	1 year

Table 46. Physical Size and Weight

Dimensions / Weight	P500xA	Note
Width	176 mm (6.9 in.)	
Height	48 mm (1.9 in.)	
Depth	333 mm (13.1 in.)	
Weight	1.88 kg (4.14 lbs)	

Table 47. Electrical Power

Description	Dissipation
Wall Outlet	120 V, 72 W (maximum) 240 V, 85 W (maximum)
Rear Panel DC Connector	15 V, 58 W

Table 48. Front Panel Information

Description	General Characteristics	Typical
Test Port		
Connector	3.5 mm female	
Impedance	50 ohm (nominal)	
External Reference Input		
Connector	MCX	
Input amplitude range	-	-3 to +10 dBm
Input frequency	-	10 MHz ± 10 ppm
Impedance	-	50 Ω (nominal)
External Reference Output		
Connector	MCX	
Output amplitude range	-	0 to ± 3 dBm
Output frequency	-	10 MHz ± 7 ppm
Impedance	-	50 Ω (nominal)

Table 49. Rear Panel Information

Description	General Characteristics
USB Ports	Type A female (USB 2.0 only, Downstream-facing) Type C female (USB 3.0 only, Upstream-facing)
Power Connector	Kycon KPJX-4S-S DC power connector (4 pins)
10 MHz In (SMB)	10 MHz ± 25 ppm (not used by P500xA)
10 MHz Out (SMB)	10 MHz ± 25 ppm (not used by P500xA)
Trig 1	3.3 V CMOS (TTL compatible, 5 V tolerant)
Trig 2	3.3 V CMOS (TTL compatible, 5 V tolerant)

Table 50. Measurement Speed (milliseconds)[1] - Typical

Description			
10 MHz – 9 GHz frequency span, 1 MHz IF bandwidth			
Number of Points	201	401	1601
Uncorrected	26.3	39.0	105.0
2-port Calibration	42.3	66.4	193.0
10 MHz – 20 GHz frequency span, 1 MHz IF bandwidth			
Number of Points	201	401	1601
Uncorrected	25.4	36.0	98.9
2-port Calibration	46.0	67.2	193.8
800 MHz – 1 GHz frequency span, 1 MHz IF bandwidth			
Number of Points	201	401	1601
Uncorrected	19.2	29.8	84.6
2-port Calibration	33.1	54.1	164.2
9 GHz – 10 GHz frequency span, 1 MHz IF bandwidth			
Number of Points	201	401	1601
Uncorrected	19.2	30.1	85.8
2-port Calibration	32.6	54.2	165.1

1. Measured using a host PC with Intel core i3-5005U 2.00 GHz CPU and 4 GB RAM running Windows 10 (64 bit), with Keysight VNA firmware version A.13.40.00. Data transfer includes real and imaginary pair and includes transferring one S-parameter (S11). Uncorrected measurements are for one sweep direction and transferring the corresponding S-parameter.

Table 51. Software

Description	Information
Keysight IO library	The IO library suite offers a single entry point for connection to the most common instruments including AXIe, PXI, GPIB, USB, Ethernet/LAN, RS-232, and VXI test instrument from Keysight and other vendors. It automatically discovers interfaces, chassis, and instruments. The graphical user interface allows you to search for, verify, and update IVI instrument and soft front panel drivers for modular and traditional instruments. The IO suite safely installs in side-by-side mode with NI I/O software. Free software download at www.keysight.com/find/iosuite
Keysight soft front panel	The USB VNA includes a soft front panel (SFP), a software based graphical user interface (GUI) which enables the instrument's capabilities from your PC.
Command Expert	Assists in finding the right instrument commands and setting correct parameters. A simple interface includes documentation, examples, syntax checking, command execution, and debug tools to build sequences for integration in Excel, MATLAB, LabVIEW, VEE, and System VUE. Free software download at www.keysight.com/find/commandexpert
Example programs	Setting up a measurement Guided calibration Data acquisition Data transfer
Example programming languages	C, C++, C#, VB, LabVIEW

Literature Information

Keysight Streamline Series USB Vector Network Analyzer Configuration Guide	5992-2823EN
Keysight Network Analyzer Selection Guide	5989-7603EN
Electronic Calibration (ECal) Modules for Network Analyzer Technical Overview	5963-3743E

Web Resources

www.keysight.com/find/usb-vna

www.keysight.com/find/na

www.keysight.com/find/ecal

Learn more at: www.keysight.com

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