

## Product Datasheet - Technical Specifications



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1465-V series signal generators has excellent vector modulation performance within the frequency range of 100kHz-67GHz. It has 200MHz internal modulation bandwidth and 2GHz external modulation real-time bandwidth, which can meet various modulation needs of wideband signals. The generator has excellent spectrum purity and output power specifications. The phase noise of 10GHz carrier @10kHz frequency offset can be reached to  $-126\text{dBc}/\text{Hz}$ , to meet high-level test needs which have strict requirements of testing signals. The generator also has excellent vector modulation accuracy and at the full frequency range the EVM is less than  $1.4\%$ (4Msps), which makes the generator be used in metrology purpose. The baseband signal generator can be set easily with flexible performance and many modulation formats. More than 20 kinds of common modulation formats are supported, such

as PSK, QAM, FSK, ASK and so on. The arbitrary wave modulation support 5 kinds of download file format, users can edit and download the waveform according to their own requirement. Thus various signal modulation can be accomplished and complex signals can be generated. Besides, the "airspace capsule" operation interface design and 10.1 inch high-brightness touch screen can bring a brand-new operation experience to users.

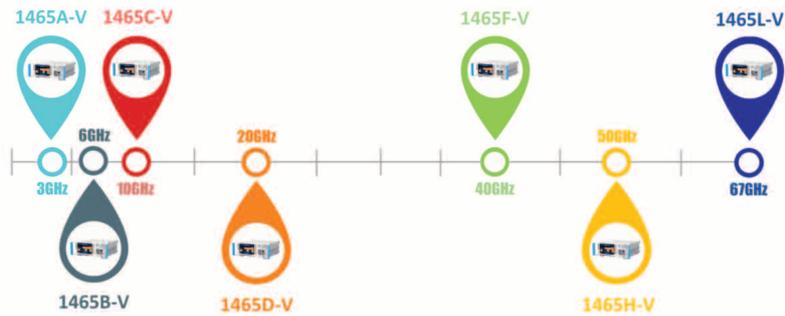
With wide frequency band and modulation bandwidth, 1465-V series signal generator can not only provide user with analog and vector modulated signal with great spectrum purity and modulation types, but also can help user edit arbitrary waves flexibly. It's an ideal choice for performance test of components, modules, communications, navigation, radar, and other electronic systems.

# Main Characteristics

- Broadband vector signal generation
- Large vector modulation bandwidth
- High compatible arbitrary wave data format download
- High purity spectrum
- Broadband and high-power output
- Metrology grade vector modulation accuracy
- Complete universal digital modulation format
- Convenient touch screen control
- Multiple control and function extension interfaces

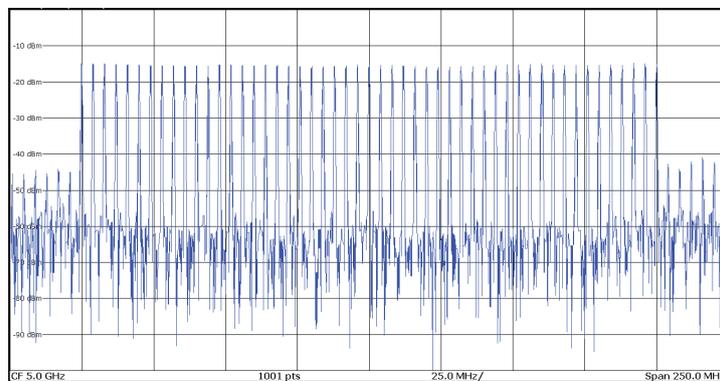
## Broadband vector signal generation

1465-V series signal generators can provide various signal testing solutions covering 3GHz/6GHz/10GHz/20GHz/40GHz/50GHz/67GHz to meet user's specific needs in different fields. Especially, 1465L-V signal generator with 100kHz~67GHz frequency range meets the test needs of most users.

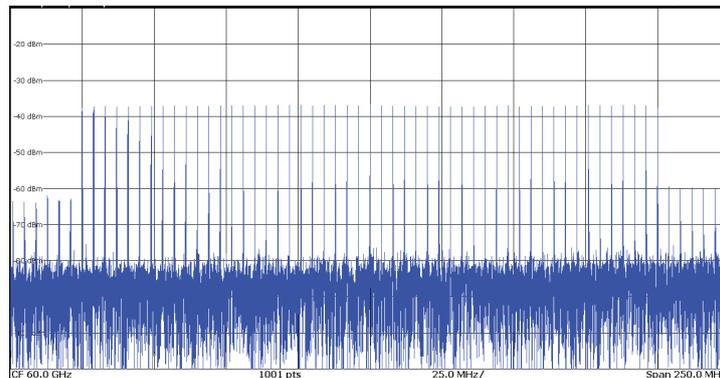


## Large Vector Modulation Bandwidth

1465-V series signal generators can provide 200MHz internal modulation bandwidth and 2GHz external modulation bandwidth (above 3.2GHz carrier) vector signal generation function.



Multi-tone signal using 5GHz carrier and 200MHz modulation bandwidth

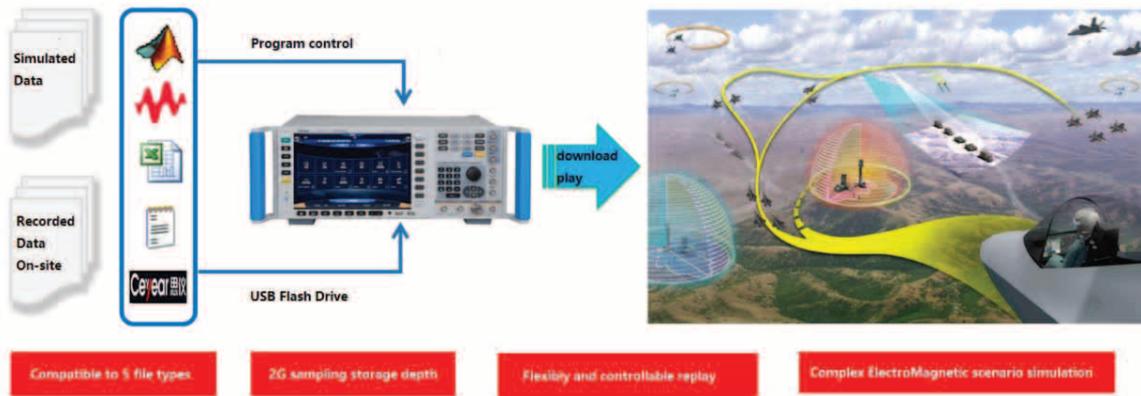


Multi-tone signal using 5GHz carrier and 200MHz modulation bandwidth

## High Compatible Arbitrary Wave Data Format Download

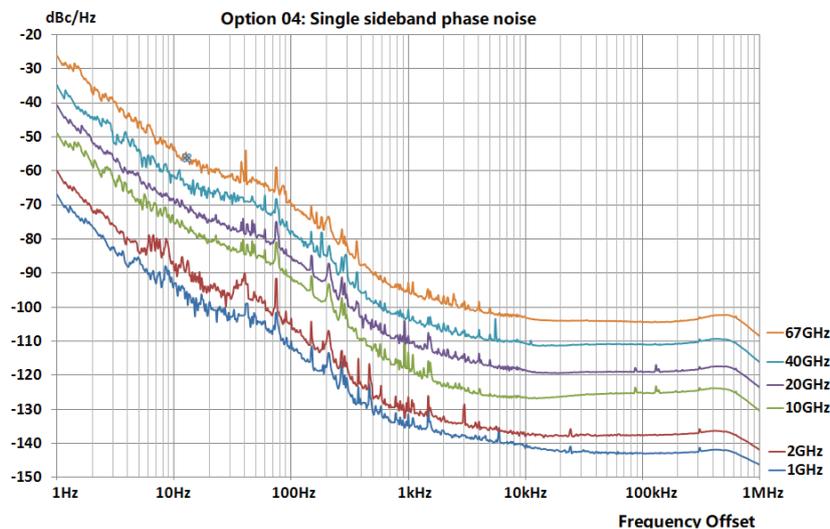
1465-V series signal generators support direct download and display of arbitrary waveforms. The file formats include Mat-File 5, ASCII, Binary, cap and csv. The generator has a 2GSa storage depth.

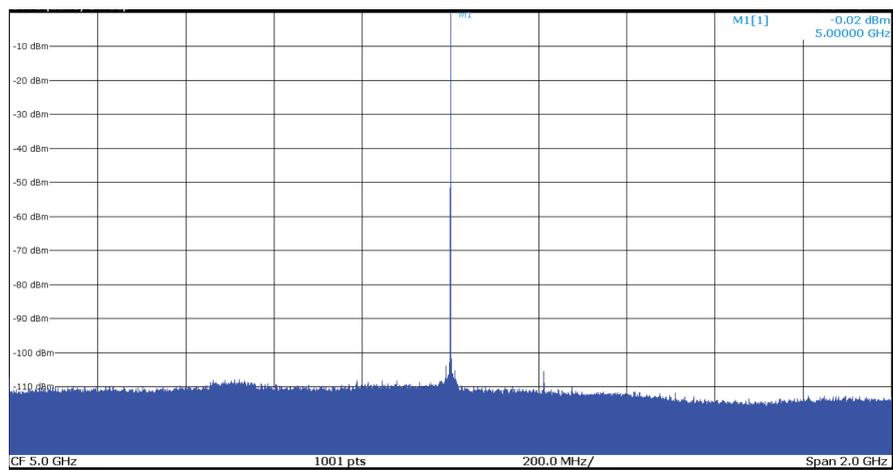
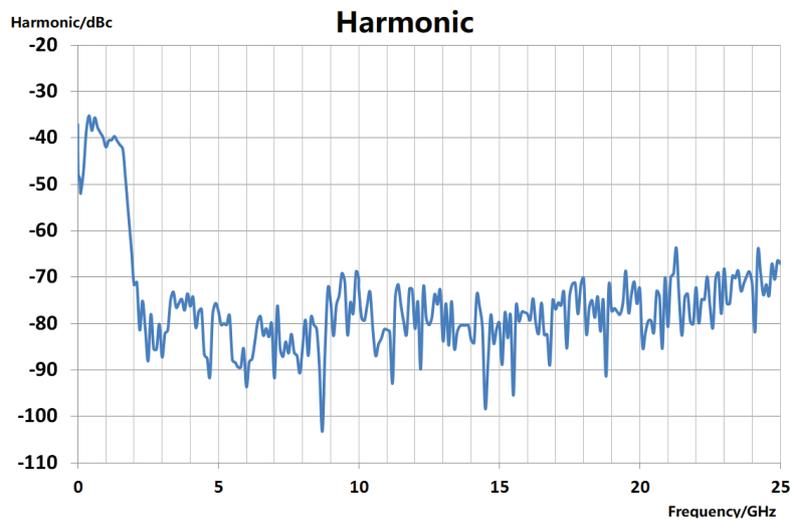
1465-V series signal generators support direct download and display of arbitrary waveforms. The file formats include Mat-File 5, ASCII, Binary, cap and csv. The generator has a 2GSa storage depth.



## High purity spectrum

1465-V series signal generators are able to output extremely pure signal spectrum. The single side band phase noise of 10GHz carrier and 10kHz frequency offset has a typical value of  $-126\text{dBc}/\text{Hz}$  and 1GHz carrier and 10kHz frequency offset typically reaches  $-142\text{dBc}/\text{Hz}$ . It can be used for Doppler radar as well as high-performance receiver block and adjacent channel selectivity test. It also can be an ideal alternative device for local oscillator and low jitter timer.

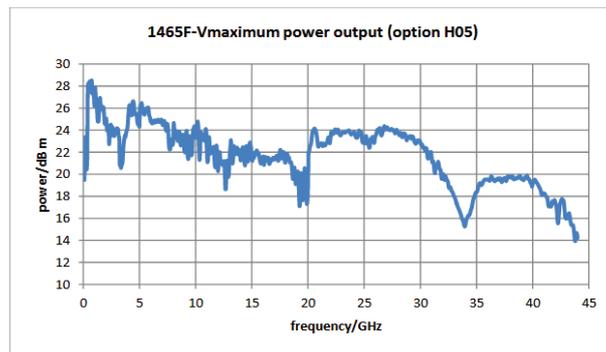
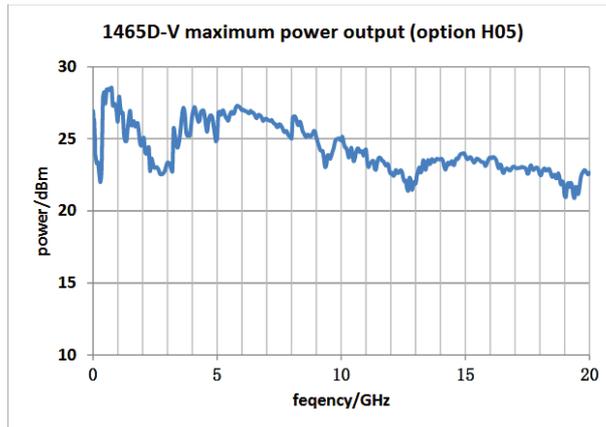




2GHz sweep width non-harmonic curve

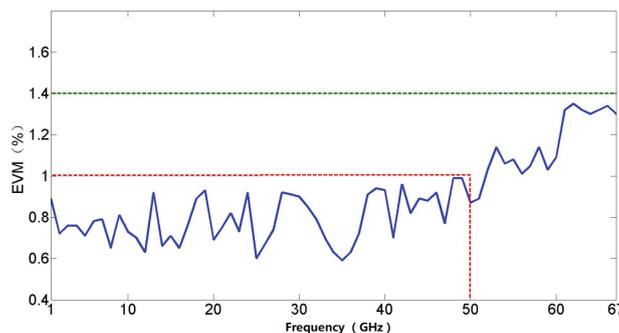
## Broadband and high-power output

For high-power option H05, typical values for the maximum output power are +22dBm at 20GHz and +16dBm at 40GHz. There's no need for an external amplifier when you need high power stimulus signal during test. And what's more, the power accuracy and stability are better.



## Metrology Grade Vector Modulation Accuracy

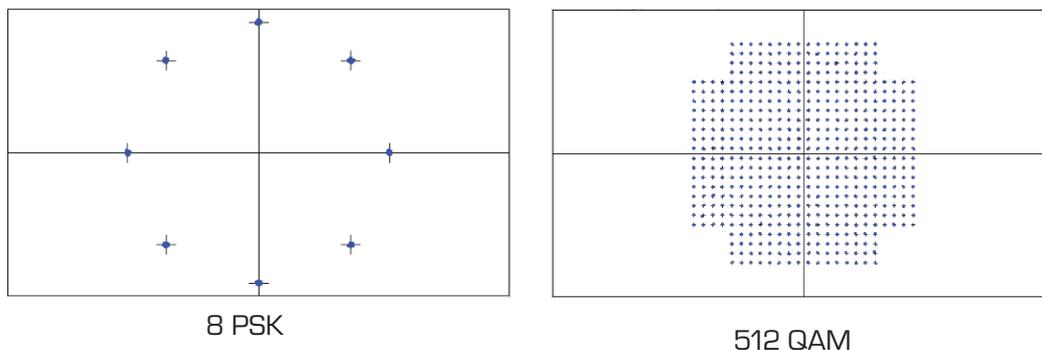
1465-V series signal generators has excellent vector modulation accuracy. The EVM is less than 1.4% (typical value < 1.0%) at the frequency range 100kHz-40GHz, and EVM < 2.5% (typical value < 1.5%) at the frequency range 40GHz-67GHz.



Symbol rate: 4Msps, root-Nyquist filter,  $\alpha=0.3$ , EVM test under QPSK

## Complete Universal Digital Modulation Format

1465-V series signal generators can provide real-time generation of universal digital modulation signals, including more than 20 kinds of modulations, such as PSK, QAM, FSK, MSK etc.



## Convenient touch screen control

A 10.1-inch LED display screen of 1280×800 resolution shows the instrument states information clearly. Conspicuous color matching, proper function division and various function panel buttons provide a fresh sight of vision, easy operation and higher test efficiency for you. Besides with the panel buttons, the instrument can be controlled independently by operating with enter knob, sliding or clicking on the touch screen, and using external keyboard or mouse.

## Multiple Control and Function Extension Interfaces

Support various auxiliary interfaces such as USB, LAN, GPIB, Monitor. The USB interface can be used for data transmission and external keyboard/mouse. LAN and GPIB can be used for programmable control. The monitor connector can be used for external display when using a CRT or LCD.

## High-reliability Communication System Test

1465-V series signal generator generates a high-performance user-defined modulation and basic digital modulation signal within a frequency range of 100kHz~67GHz. The instrument provides repeatable and reliable test signals for satellite communication. Its external wide bandwidth vector modulation and user-defined data features as well as additive noise function create a real-world signal and help users to make product performance confirmation

- **Simulate Various Application Scenes for Radar and EM Environment**

1465-V series signal generator has a wide frequency range and high resolution (16bit) as well as a powerful signal simulation function. It generates complex sequences of various modulation formats by editing waveform segment under different scenes. Together with an abundant functional synchronous trigger interface, it simulates a complex interference signal under actual environment and accomplishes an anti-interference test of radar equipment.

- **Provide Accurate Arbitrary Wave Modulation Signal**

1465-V series signal generator has a 2G sampling point waveform storage capacity. This feature allows designers to generate long-time test data, which may be closer to reality. Users can create one of the kinds of arbitrary wave data using the third party tools or software.

- **High-performance Receiver Test**

1465-V series signal generator has a 140dB output dynamic range and extremely high frequency stability as well as a 0.001Hz frequency resolution. It outputs a high-accuracy standard test signal which solves parameter test problems such as sensitivity, dynamic range and channel selectivity to accomplish a test of high-performance receiver used in radar, electronic warfare and communication equipment.

- **Local Oscillator Substitution**

1465-V series signal generator has an extremely high signal quality, thus may be used as an ideal device to substitute LO when testing transmitter and receiver and other systems. It will guarantee your test accuracy and creditability by avoiding negative influences that low-quality LO brings in.

# Technical Specifications

Frequency properties			
Frequency range	1465A-V:100kHz~3GHz (Min. frequency of 9kHz)	Frequency	N (Internal YO harmonic order)
		100kHz≤f≤250MHz	1/8
	1465B-V:100kHz~6GHz (Min. frequency of 9kHz)	250MHz<f≤500MHz	1/16
		500MHz<f≤1GHz	1/8
	1465C-V:100kHz~10GHz	1GHz<f≤2GHz	1/4
	1465D-V:100kHz~20GHz	2GHz<f≤3.2GHz	1/2
	1465E-V:100kHz~20GHz	3.2GHz<f≤10GHz	1
	1465F-V:100kHz~40GHz (Max. frequency of 44GHz)	10GHz<f≤20GHz	2
		20GHz<f≤28.5GHz	3
		28.5GHz<f≤50GHz	5
1465H-V:100kHz~50GHz	50GHz<f≤67GHz	10	
1465L-V:100kHz~67GHz			
Frequency resolution	0.001Hz		
Frequency switching time	<20ms		
Time-base aging rate (Typical value2)	5×10 <sup>-10</sup> /day (after 30-day continuous power-on)		
Reference output	Frequency	10MHz	
	Power	>+4dBm, to 50Ω	
Reference input	Frequency	1-50MHz, 1Hz step	
	Power	-5dBm-+10dBm, 50Ω impedance	
Sweep properties			
Sweep mode	Step sweep, List sweep, Analog sweep, Power sweep		
Analog sweep (option H03)	Max. sweep speed	100kHz≤f≤500MHz	25MHz/ms
		500MHz<f≤1GHz	50MHz/ms
		1GHz<f≤2GHz	100MHz/ms
		2GHz<f≤3.2GHz	200MHz/ms
		3.2GHz<f	400MHz/ms
	Sweep accuracy	0.05 % Sweep width (for 100m, within the maximum width of 100ms as specified)	
Power properties			
Min. power	Model	Standard package	Option H01A/B
	1465A/B/C/D/F-V	-20dBm	-110dBm [-135dBm configurable]
	1465H/LV	-20dBm	-90dBm [-110dBm configurable]

# Technical Specifications

Max. power (25±10°C)	Frequency range	Standard package	H01A/B programmable step attenuator option		H05 high power output option	Options H01A/B+H05
	1465A/B/C/D-V					
	100kHz≤f≤20GHz	15dBm	15dBm		20 <sup>3</sup> dBm	20 <sup>3</sup> dBm
	1465F-V					
	100kHz≤f≤9GHz	10dBm	10dBm		18dBm	18dBm
	9GHz<f≤30GHz	10dBm	10dBm		15dBm	15dBm
	30GHz<f≤40GHz	10dBm	10dBm		12dBm	12dBm
	1465H/L-V					
	100kHz≤f≤15GHz	5dBm	5dBm		15dBm	15dBm
	15GHz<f≤30GHz	5dBm	5dBm		12dBm	12dBm
	30GHz<f≤60GHz	5dBm	4dBm		8dBm	6dBm
	60GHz<f≤67GHz	4dBm	3dBm		6dBm	4dBm
	Power accuracy (25±10°C)	Standard				
Power Frequency (dBm)		>10~20	>-10~10		-20~-10	
100kHz≤f≤2GHz		±0.8dB	±0.6dB		±1.5dB	
2GHz<f≤20GHz		±0.8dB	±0.8dB		±1.5dB	
20GHz<f≤40GHz		±1.0dB	±0.9dB		±1.8dB	
40GHz<f≤50GHz		—	±1.3dB		±1.8dB	
50GHz<f≤67GHz		—	±1.5dB		±2.0dB	
H01A/B programmable step attenuator option						
Power Frequency (dBm)		>10~20	>-10~10	>-70~-10	-90~-70	
100kHz≤f≤2GHz		±0.8dB	±0.6dB	±0.7dB	±1.5dB	
2GHz<f≤20GHz		±0.8dB	±0.8dB	±0.9dB	±1.8dB	
20GHz<f≤40GHz		±1.0dB	±0.9dB	±1.0dB	±2.0dB	
40GHz<f≤50GHz		—	±1.3dB	±1.5dB	±2.5dB	
50GHz<f≤67GHz		—	±1.5dB	±1.8dB	±3.0dB	
Power resolution		0.01dB				
Power temperature stability	0.02dB/°C (typical value)					
Output Impedance	50Ω (Rating4)					
VSWR (Internal fixed amplitude) (typical Value)	100kHz≤f≤20GHz	<1.6				
	20GHz<f≤40GHz	<1.8				
	40GHz<f≤67GHz	<2.0				
Max. reverse power	0.5W (0V DC) (rating)					

# Technical Specifications

Spectrum purity <sup>5</sup>										
Harmonic (at +10dBm or Max. specified output power, whichever is lower)	Frequency			Standard package						
	100kHz≤f≤10MHz			<-25dBc						
	10MHz<f≤2GHz			<-30dBc						
	2GHz<f≤6GHz			<-30dBc						
	(1465B)									
	2GHz<f≤20GHz			<-55dBc						
Sub-Harmonic (at +10dBm or Max. specified output power, whichever is lower)	100kHz≤f≤10GHz			None						
	10GHz<f≤20GHz			<-60dBc						
	20GHz<f≤67GHz			<-45dBc						
Non-harmonic (at 0dBm, beyond 3kHz offset)	Frequency			Standard package		Option H04				
	100kHz≤f≤250MHz			<-58dBc		<-58dBc				
	250MHz<f≤3.2GHz			<-74dBc		<-80dBc				
	3.2GHz<f≤10GHz			<-62dBc		<-70dBc				
	10GHz<f≤20GHz			<-56dBc		<-64dBc				
	20GHz<f≤28.5GHz			<-52dBc		<-52dBc				
	28.5GHz<f≤40GHz			<-45dBc		<-45dBc				
Single side band phase noise (dBc/Hz, +10dBm or Max. output power, whichever is smaller)	Frequency			1Hz	10Hz	100Hz	1kHz	10kHz	100kHz	
	100kHz≤f≤250MHz			--	--	-104	-121	-128	-130	
	250MHz<f≤500MHz			--	--	-108	-126	-132	-136	
	0.5 GHz<f≤1GHz			--	--	-101	-121	-130	-130	
	1GHz<f≤2GHz			--	--	-96	-115	-124	-124	
	2GHz<f≤3.2GHz			--	--	-92	-111	-120	-120	
	3.2GHz<f≤10GHz			--	--	-81	-101	-110	-110	
	10GHz<f≤20GHz			--	--	-75	-95	-104	-104	
	20GHz<f≤28.5GHz			--	--	-69	-89	-98	-98	
	28.5GHz<f≤50GHz			--	--	-64	-84	-92	-92	
	50GHz<f≤67GHz			--	--	-57	-77	-86	-86	
	H04 ultra low phase noise option									
	100kHz≤f≤250MHz <sup>6</sup>			-64	-92	-105	-123	-138	-141	
	250MHz<f≤500MHz			-67	-93	-111	-126	-138	-142	
	0.5GHz<f≤1GHz			-62	-91	-105	-123	-138	-138	
	1GHz<f≤2GHz			-57	-86	-100	-117	-133	-133	
	2GHz<f≤3.2GHz			-52	-81	-96	-113	-128	-128	
	3.2GHz<f≤10GHz			-43	-72	-85	-105	-120	-120	
	10GHz<f≤20GHz			-37	-66	-79	-98	-114	-114	
	20GHz<f≤28.5GHz			-31	-60	-73	-91	-108	-108	
28.5GHz<f≤50GHz			-26	-54	-68	-85	-102	-102		
50GHz<f≤67GHz			-20	-48	-62	-79	-96	-96		

# Technical Specifications

Modulation properties			
Frequency Modulation (option HO2A)	Maximum deviation: $N \times 16\text{MHz}$ (N: YO harmonic number) Accuracy (at 1kHz, $N \times 20\text{kHz} \leq \text{deviation} < N \times 800\text{kHz}$ ): Modulation rate (3dB bandwidth, $N \times 500\text{kHz}$ frequency offset): DC-10MHz Distortion (at 1kHz, $N \times 20\text{kHz} \leq \text{deviations} < N \times 800\text{kHz}$ ): $< 1\%$		
Phase Modulation (option HO2A)	Maximum deviation: Normal mode: $N \times 16\text{rad}$ (N: YO harmonic number) Broadband mode: $N \times 1.6\text{rad}$ (N is YO harmonic number) Accuracy (at 1kHz, $N \times 0.2\text{rad} \leq \text{deviations} < N \times 8\text{rad}$ , normal mode) $< \pm [5\% \text{ of deviation} + 0.01 \text{ rad}]$ Modulation rate (3dB bandwidth, Broadband mode): DC ~ 10MHz (typical value) Distortion (at 1kHz, $N \times 0.8\text{rad} \leq \text{deviations} < N \times 8\text{rad}$ , THD): $< 1\%$		
Amplitude modulation (option HO2A)	Max. depth: $> 90\%$ Modulation rate (3 dB bandwidth, 30% modulation depth): DC ~ 100kHz Accuracy (1kHz modulation rate, 30% modulation depth): $\pm [6\% \text{ of setting} + 1\%]$ Distortion (1kHz modulation rate, linear mode, THD, 30% modulation depth): $< 1.5\%$		
Pulse Modulation (option HO2B)		500MHz-3.2GHz	$> 3.2\text{GHz}$
	Switch ratio	$> 80\text{dB}$	$> 80\text{dB}$
	Rise and fall time	$< 20\text{ns}$	$< 20\text{ns}$
	Min. pulse width with ALC on	1 $\mu\text{s}$	1 $\mu\text{s}$
	Min. pulse width with ALC off	0.1 $\mu\text{s}$	0.1 $\mu\text{s}$
Narrow pulse Modulation (option HO2C)		50MHz-3.2GHz	$> 3.2\text{GHz}$
	Switch ratio	$> 80\text{dB}$	$> 80\text{dB}$
	Rise and fall time	$< 15\text{ns}$	$< 10\text{ns}$
	Min. pulse width with ALC on	1 $\mu\text{s}$	1 $\mu\text{s}$
	Min. pulse width with ALC off	30ns	20ns
Internal modulation signal generator (option HO2A/B/C)	There are 3 independent signals respectively for frequency/phase modulation, amplitude modulation and low frequency output signals. Waveform: sine, square, triangle, Sawtooth, noise, double sine, sweep sine. Frequency range: DC ~ 10MHz for sine, double sine, sweep sine; 0.1Hz ~ 100kHz for square, triangle, sawtooth. Frequency resolution: 0.1Hz Low frequency output: Amplitude: 0-5V <sub>peak</sub> (rating), to 50 $\Omega$ load. Pulse modulation signal: pulse width: 20ns-(42s-10ns); pulse period: 100ns-42s; resolution: 10ns.		
Vector modulation accuracy (after calibration, 25°C $\pm$ 10°C) (4Msps, root-Nyquist, a=0.3, QPSK, 0dBm)	1465A/B/C/D/F-V	50MHz-40GHz (or max. frequency)	EVM(RMS%) $< 1.4\%$
	1465H/LV	50MHz-40GHz	EVM(RMS%) $< 1.4\%$
		40GHz-67GHz (or max. frequency)	EVM(RMS%) $< 2.5\%$

# Technical Specifications

Internal modulation bandwidth	(Carrier 900MHz, 1.8GHz, 2.4GHz, 6GHz, 18GHz, 35GHz, 50GHz) Standard package: 120MHz(Multi-tone, Tone quantity: 51, Frequency space: 2.4MHz,±3dB bandwidth); H3 large modulation bandwidth option: 200MHz (Multi-tone, Tone quantity: 51, Frequency space: 4MHz, ±3dB bandwidth).
External modulation Bandwidth	(Carrier 900MHz, 1.8GHz, 2.4GHz, 6GHz, 18GHz, 35GHz, 50GHz) 200MHz(ALC OFF, input 100mVrms sine to channel I, ±4dB bandwidth)
External wide modulation Bandwidth (option H33)	(6GHz, 18GHz, 35GHz, 50GHz) 2GHz(ALC OFF, input 100mVrms sine to channel I, ±4dB bandwidth)
Internal baseband signal generator	Channel quantities: 2(I and Q) Max. symbol rate: standard package: 60Msps(Max. 4bit/symbol) option H31: 125Msps(Max. 4bit/symbol) Baseband waveform internal memory: standard package: 1GSa option H32: 2GSa Modulation format: PSK: BPSK, QPSK, OQPSK, $\pi/4$ DQPSK, D8PSK, 16PSK; QAM: 4, 16, 32, 64, 128, 256, 512, 1024; FSK: 2, 4, 8, 16; ASK;MSK; Arbitrary wave modulation. Dual-tone mode max. frequency offset: 200MHz EVM: <1.0% (typical value) (RMS%, Symbol rate 4Msps, root-Nyquist, a=0.3, QPSK)
<b>General properties</b>	
RF output port	1465A/B/C-V: N (female), impedance 50Ω. 1465D-V: 3.5mm (male), N(female)(option H91), impedance 50Ω. 1465F-V: 2.4mm (male), impedance 50Ω.
Max. Physical Dimension	W×H×D: 517mm×192mm×550mm
Weight	<28 kg (as per model and option configuration)
Power Supply	100-120VAC, 50-60Hz; or 200-240VAC, 50~60Hz (self-adaptive)
Power Consumption	<400W
Temperature Range	Working temperature: 0°C~+50°C; Storage temperature: -40°C~+70°C

## Notes:

1. When 1465-V series signal generator is under environment temperature for 2 hours, attenuator is automatically coupling (or ALC power>5dBm) after 30 minutes warm-up time. The generator meets every parameter performance within given working temperature.
2. Typical value is a supplementary characteristic just for user's reference. These specifications are not guaranteed.
3. 1465B-V is +16dBm.
4. Rating value is an expected performance, or used to describe the product performance which is useful but not included in product performance warranty.
5. Spectral purity parameter is tested in a certain frequency without any modulation.
6. The single sideband phase noise of 100kHz≤f≤250MHz is tested a output power of +15dBm. The working frequency range of option H06 is greater than 100MHz, so there's no tested specification under 100MHz.

Main unit: 1465A-V signal generator, 100kHz~3GHz

Main unit: 1465B-V signal generator, 100kHz~6GHz

Main unit: 1465C-V signal generator, 100kHz~10GHz

Main unit: 1465D-V signal generator, 100kHz~20GHz

Main unit: 1465F-V signal generator, 100kHz~40GHz

Main unit: 1465H-V signal generator, 100kHz~50GHz

Main unit: 1465L-V signal generator, 100kHz~67GHz

### Standard Package

S/N	Description	Remarks
1	Power cable assembly	Standard three-core power cable
2	User manual	—
3	Programming manual	—
4	Certificate of conformity	—

## Options

Model	Description	Function	Match
1465-H01A	115dB	To expand output power dynamic range	Optional for A/B/C/D/F-V
1465-H01B	programmable step attenuator	To expand output power dynamic range	Optional for H/LV
1465-H02A	90dB programmable step attenuator	Add analog modulation function	Optional for all models
1465-H02B	Analog modulation	Add pulse modulation function, 100ns min. pulse width	Optional for all models
1465-H02C	Pulse modulation	Add pulse modulation function, 20ns min. pulse width	Optional for all models, including H02B
1465-H03	Narrow pulse modulation	Add analog sweep frequency function (slope sweep)	Optional for all models
1465-H04	Analog sweep frequency	Optimize phase noise, 10GHz@10kHz: -120dBc/Hz	Optional for all models
1465-H05	Ultra-low phase noise	Improve max. output power	Optional for all models
1465-H31	Large power output	Expand internal modulation bandwidth to 200MHz	Optional for all models
1465-H32	Large modulation bandwidth	Expand internal baseband memory to 8GB	Optional for all models
1465-H33	Internal baseband large capacity memory	Add wideband external IQ input function	Optional for 1465C/D/F-V
1465-H80	Wideband external IQ input	For power measurement and calibration (50MHz-6GHz)	Optional for all models
1465-H81	87230 USB power sensor	For power measurement and calibration (50MHz-18GHz)	Optional for all models
1465-H82	87231 USB power sensor	For power measurement and calibration (50MHz-26.5GHz)	Optional for all models
1465-H83	87232 USB power sensor	For power measurement and calibration (50MHz-40GHz)	Optional for all models
1465-H90	87233 USB power sensor	Meet GJB-151A EMC regulation (without touch screen function)	Optional for all models
1465-H91	GJB EMC	Change RF output port to N type (female), only optional for 1465D-V	Optional for 1465D-V
1465-H92	N type RF output interface	Move RF output port to rear panel	Optional for all models
1465-H94	Rear panel RF output	Mount kit for rack	Optional for all models
1465-H95	Rack mount kit	Entrust metering institute to meter the instrument	Optional for all models
1465-H96	Commercial calibration certificate	Extend warranty to 5 years	Optional for all models

## Options

1465-H97	5 years extended warranty	User manual and programming manual are color printed	Optional for all models
1465-H98	Color printing user manual	Panel, software interface, user manual and programming manual are English version	Optional for all models
1465-H99	English options	High-intensity portable aluminum alloy transport case, with carrying handle and omni-directional wheel, convenient for transportation	Optional for all models
	Aluminum alloy transport case		