



S1465A/B/C/D/F/H/L-V Signal Generators

100kHz-3GHz/6GHz/10GHz/20GHz/40GHz/50GHz/67GHz



Saluki Technology Inc.

The document applies to the Signal Generators of the following models:

S1465A-V signal generator, 100kHz - 3GHz

S1465B-V signal generator, 100kHz - 6GHz

S1465C-V signal generator, 100kHz - 10GHz

S1465D-V signal generator, 100kHz - 20GHz

S1465F-V signal generator, 100kHz - 40GHz

S1465H-V signal generator, 100kHz - 50GHz

S1465L-V signal generator, 100kHz - 67GHz

Signal generator Standard pack and accessories:

No.	Item
1	Power cable assembly
2	User manual

Options of the S1465 series Signal Generator in addition to standard accessories:

Option ID	Description	Function	Match
S1465V-H01A	115dB programmable step attenuator	To expand output power dynamic range	Only A/B/C/D/E/F-V options
S1465V-H01B	90dB programmable step attenuator	To expand output power dynamic range	Only H/L-V options
S1465V-H02A	Analog modulation	Additional analog modulation, including AM, FM, ΦM, and low-frequency output	All models
S1465V-H02B	Pulse modulation	Additional pulse modulation, with the minimum pulse width of 100ns	All models
S1465V-H02C	Narrow pulse modulation	Additional pulse modulation, with the minimum pulse width of 20ns	All models, including H02B
S1465V-H03	Analog sweep	Additional analog sweep (slope sweep)	All models
S1465V-H04	Ultra low phase noise	To reduce phase noise, 10GHz@10kHz: -120dBc/Hz	All models
S1465V-H05	High-power output	To increase the maximum output power	All models
S1465V-H31	Large modulation bandwidth	Extend built-in modulation bandwidth to 200MHz	All models

S1465V-H32	Internal baseband external IQ input	Extend built-in baseband memory to 8GB	ALL models
S1465V-H33	Broadband external IQ input	Add broadband external IQ input function	Only 1465C/D/F-V options
S1465-H80	87230 USB power probe	For power measurement and calibration (9kHz-6GHz)	All models
S1465-H81	87231 USB power probe	For power measurement and calibration (10MHz-18GHz)	All models
S1465-H82	87232 USB power probe	For power measurement and calibration (50MHz-26.5GHz)	All models
S1465-H83	87233 USB power probe	For power measurement and calibration (50MHz-40GHz)	All models
S1465-H91	N RF output port	To change RF output port to N (female)	Only S1465D option
S1465-H92	Back panel RF output	To move RF output port to rear panel	All models
S1465-H94	Machine frame	/	All models
S1465-H95	Calibration report	/	All models

Preface

Thank you for choosing S1465V series signal generators produced by Saluki Technology Inc.

We devote ourselves to meeting your demands, providing you high-quality measuring instrument and the best after-sales service. We persist with "superior quality and considerate service", and are committed to offering satisfactory products and service for our clients.

Document No.

S1465V series signal generators

Version

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Saluki Technology

Document Authorization

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Product Quality Assurance

The warranty period of the product is 36 months from the date of delivery. The instrument manufacturer will repair or replace damaged parts according to the actual situation within the warranty period.

Product Quality Certificate

The product meets the indicator requirements of the document at the time of delivery. Calibration and measurement are completed by the measuring organization with qualifications specified by the state, and relevant data are provided for reference.

Quality/Settings Management

Research, development, manufacturing and testing of the product comply with the requirements of the quality and environmental management system.

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1. Overview

S1465V series signal generators have a frequency range of 100kHz - 67GHz, excellent spectrum purity and output power, with SSB phase at 10GHz carrier and 10kHz frequency offset is -126dBc/Hz. The maximum output power reaches up to 1W at 20GHz carrier, and the dynamic output power range gets 150dB. All these specifications can meet the high-end requirements of electromagnetic signal tests. It also features high-precision analog sweep function, excellent simulation modulation, pulse modulation and vector modulation; the baseband signal generator is easily set up and flexible, and supports multiple modulation formats, allowing users to edit and download the required waveform for signal simulation based on individual needs; the internal and external vectors have wide modulation bandwidth (internal 200MHz and external 2GHz) which can meet the needs of broadband signal simulation; the internal modulation signal generator has frequency up to 10MHz and multiple signal waveforms, pulse modulation supports minimum PW of 20ns and generates flexible pulse trains that can satisfy the needs for testing various complex signals; the product has a 10.1" large display with resolution of 1280×800 and can be operated by keys, a mouse or screen touch, improving the operating experience while enhancing the testing efficiency. The 1465 series generates high-quality signals in both continuous wave and modulation, making it an ideal local oscillator and clock source, and a high-performance simulation signal source. It is mainly used for comprehensive assessment of radar performance, high-performance receiver testing and component parameter testing, applicable for many fields such as aerospace, radar, communication, navigation equipment, etc.

2. Main characteristics

- Broadband vector signal generation
- Broadband and high-power output
- Excellent purity spectrum
- Convenient touch screen control
- Super high power dynamic range
- High performance pulse modulation
- Multiple control and function extension interfaces
- High stability frequency and broadband power output
- CW, sweep and digital modulation signal output modes
- High-precision analog sweep and excellent analog modulation

3. Advantage Characteristics

3.1 High purity spectrum

S1465V series signal generators are able to output extremely pure signal spectrum, typical single side band phase noise at

10GHz carrier and 10kHz frequency offset of -126dBc/Hz, and at 1GHz carrier and 10kHz frequency offset of -142dBc/Hz. This performance can be used in Doppler radar, high-performance receiver blocking and adjacent channel selectivity tests, and are ideal alternatives to local oscillator and low-jitter clock.

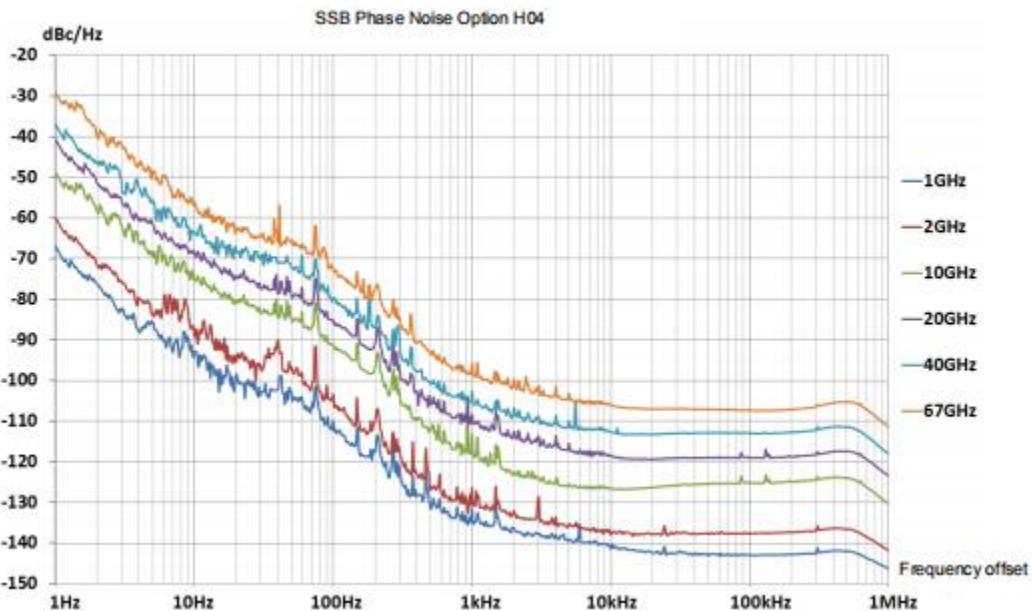


Fig. 3.1 SSB Phase Noise

3.2 Broadband high power output

For H05 high-power options, typical values for the maximum output power are +22dBm for 20GHz, +20dBm for 40GHz, and +10dBm for 67GHz. For H06 enhanced high-power option, the output power is +30dBm (1W). When high-power input signals are required in your test, the required test signals can be obtained, with no external amplifier, and higher power accuracy and stability will be achieved.



Fig. 3.2 Max. Output Power of 1465F-V+H05

3.3 High vector modulation bandwidth

S1465V series can generate vector signals of modulation bandwidth 200MHz and 2GHz external (> 3.2GHz carrier).

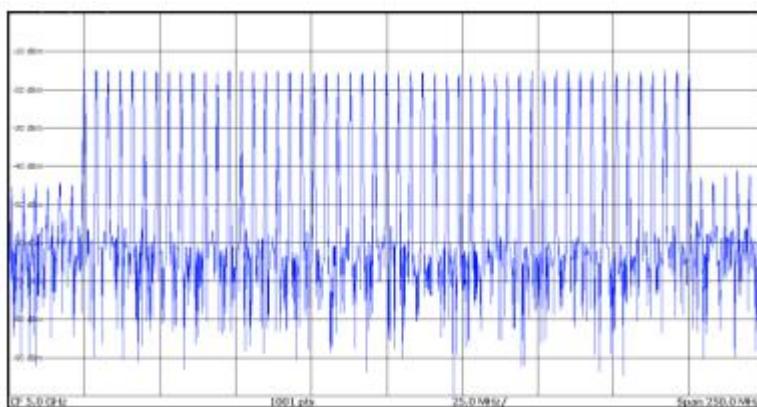


Fig. 3.3 5GHz Carrier 200MHz Modulation Bandwidth Multi-tone Signal

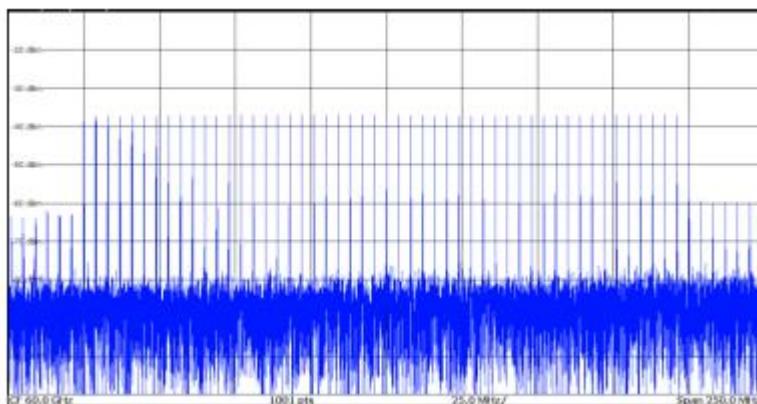


Fig. 3.4 60GHz Carrier 200MHz Modulation Bandwidth Multi-tone Signal

3.4 Download of high-compatibility arbitrary waveform data format

S1465V series supports downloading and playing of arbitrary waveform data in storage formats of Mat-File 5, ASCII, Binary, cap, csv and up to the depth of 2G sampling point.

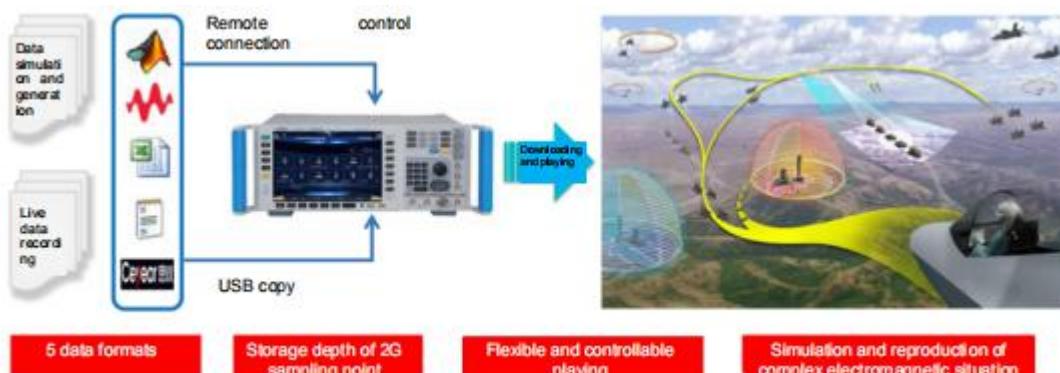


Fig. 3.5 Downloading and Playing of Arbitrary Waveform Data

3.5 Vector modulation accuracy

S1465V series has high vector modulation accuracy of EVM<1.4% (test value<1.0% for 100kHz - 40GHz) and EVM<2.5% (test value<1.5% for 40GHz - 67GHz).

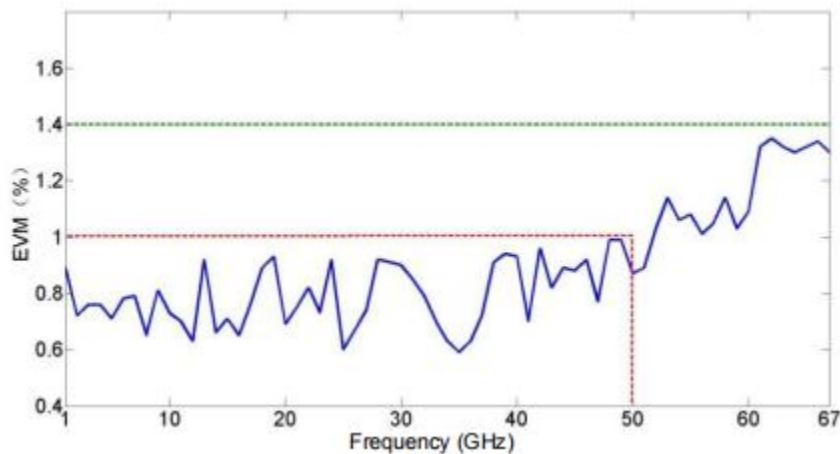


Fig.3.6 Vector Modulation Accuracy

3.6 Universal digital modulation in complete formats

S1465V series supports real-time generation of universal digital modulation signals in more than 20 formats including PSK, QAM, FSK, MSK, etc.

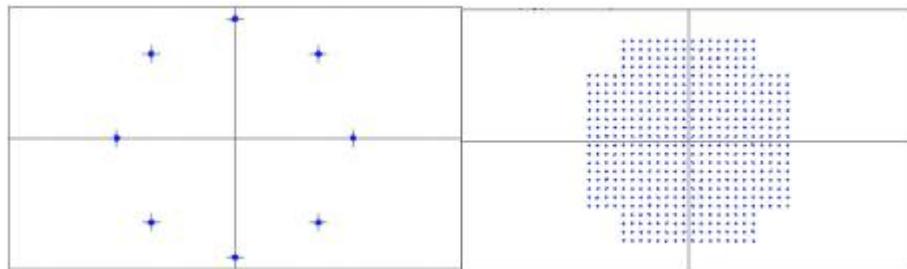


Fig.3.7 8PSK and 512QAM

3.7 Complete series of frequency band

Based on specific demands of different users, the 1465 series signal generator can provide various test plans for upper frequency limits of 3GHz/6GHz/10GHz/20GHz/40GHz/50GHz/67GHz, and there are signal generators of common type and with vector modulation function (-V series) for each frequency band, i.e. totally 14 types of this series. Each type has many options for function and performance extensions. From measuring-level solutions to basic types, whether you only need test signals of RF band or of MMW frequency, we guarantee a suitable one for you.

3.8 Convenient touch screen control

A 10.1-inch LED display screen of 1280×800 resolution shows the instrument status 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.

3.9 High-performance pulse modulation

The depth of modulation is more than 80dB, with the rise and fall time of less than 10ns and the minimum pulse width of 20ns. Clock gate and various external trigger modes are supported. A standard internal pulse generator, with 6 pulse modes, pulse width from 20ns to 42s, and 10ns step, has the function of pulse train required in radar test.

3.10 Multiple control and function extension interfaces

There are USB, LAN, GPIB, monitor interface and other auxiliary interfaces, in which USB is used to transmit data, and connect with keyboard/mouse etc., while LAN and GPIB are used for program control, and monitor interface for external display.

4. Typical Applications

4.1 Building a solid basis for high-reliability satellite communication equipment testing

S1465V series can generate high-quality user-defined and basic digital modulation signals within the frequency range of 100kHz ~ 67GHz, and provide repeatable and reliable tests for satellite communication system. The high-bandwidth external vector modulation, self-defined data source and additive noise functions enable users to produce true test signals for product tests.

4.2 Providing radar equipment and electronic countermeasures system with test signals for different application scenarios

S1465V series has wide frequency range, high resolution (16bit) and excellent signal simulation. In combination with synchronous trigger port with rich functions, it produces complex sequences in various modulation formats by editing waveform segments for different scenarios, in order to simulate complex interference signals in real combat environment to test the radar ECCM performance.

4.3 Providing accurate arbitrary waveform modulation signals for invisible aircraft systems, high-capacity communication equipment systems and electronic warfare systems (EWS) to meet the current and future market demands

S1465V series has waveform storage up to 2G sampling point to allow designers to obtain long-time test scheme closer to reality. It supports five arbitrary waveform data formats that meet the design requirements of main tool software.

4.4 High-performance receiver test

S1465V series signal generators, with extremely low single side band phase noise and excellent non-harmonic suppression, can output perfect pure signals, used in phase noise, block and adjacent channel selectivity test for a high-performance receiver in the radar, electronic warfare system or communication equipment.

4.5 High-power device test

S1465 series signal generators, with the maximum output power of 1W, can test a high-power device, with no external amplifier, and overcome the loss of test system, with higher signal power accuracy and stability.

4.6 Excitation signal and local oscillator substitution

S1465V series signal generators, with extremely pure signal quality and high output power, can be used for signal excitation for amplifiers, and as an ideal alternative for local oscillator in the tested equipment, such as transmitter and receiver etc..

5. Technical specifications¹

5.1 Frequency properties			
Frequency range	S1465A-V: 100kHz-3GHz (Min. frequency 9kHz)	Frequency	N (internal YO harmonic number)
	100kHz ≤ f ≤ 250MHz	1/8	
	250MHz < f ≤ 500MHz	1/16	
	500MHz < f ≤ 1GHz	1/8	
	1GHz < f ≤ 2GHz	1/4	
	2GHz < f ≤ 3.2GHz	1/2	
	3.2GHz < f ≤ 10GHz	1	
	10GHz < f ≤ 20GHz	2	
	20GHz < f ≤ 28.5GHz	3	
	28.5GHz < f ≤ 50GHz (Max. frequency of 70GHz)	5	
	40GHz < f ≤ 67GHz	10	
Frequency resolution	0.001Hz		
Frequency switching time	<20ms		
Timebase aging rate (typical value²)	5×10 ⁻¹⁰ /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	

5.2 Sweep properties

Sweep mode	Step sweep, list sweep, analog sweep, power sweep		
High-precision analog sweep (option H03)	Max. 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% span (sweep time is 100ms, within the maximum width of 100ms as maximum specified)	

5.3 Power properties

Min. power	Model	Standard package	Option H01A/B		
	S1465A/B/C/D/F-V	-20dBm	-110dBm (-135dBm configurable)		
	S1465H/L-V	-20dBm	-90dBm (-110dBm configurable)		
Max. power (25±10°C)	Frequency range	Standard package	Programmable step attenuator option H01A/B	High-power output option H05	Options H01A/B+H05
	S1465A/B/C/D-V				
	100kHz≤f≤20GHz	15dBm	15dBm	20 ³ dBm	20 ³ dBm
	S1465F-V				
	100kHz≤f≤9GHz	10dBm	10dBm	18dBm	18dBm
	9GHz<f≤30GHz	10dBm	10dBm	15dBm	15dBm
	30GHz<f≤40GHz	10dBm	10dBm	12dBm	12dBm
	S1465H/L-V				
	100kHz≤f≤15GHz	5dBm	5dBm	15dBm	15dBm
	15GHz<f≤30GHz	5dBm	5dBm	12dBm	12dBm
Power accuracy (25±10°C)	30GHz≤f≤60GHz	5dBm	4dBm	8dBm	6dBm
	60GHz≤f≤67GHz	4dBm	3dBm	6dBm	4dBm
	Standard				
	Power (dBm)	>10 to 20	>-10 to 10	-20 to -10	
	Frequency				
	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 (dBm) Frequency	>10 to 20	>-10 to 10	>-70 to -10			
	100kHz≤f≤2GHz	±0.8dB	±0.6dB	±0.7dB			
	2GHz<f≤20GHz	±0.8dB	±0.8dB	±0.9dB			
	20GHz<f≤40GHz	±1.0dB	±0.9dB	±1.0dB			
	40GHz<f≤50GHz	---	±1.3dB	±1.5dB			
	50GHz<f≤67GHz	---	±1.5dB	±1.8dB			
Power resolution	0.01dB						
Power temperature stability	0.02dB/°C (typical value)						
Output impedance	50Ω (Rating ⁴)						
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) (nominal)						
5.4 Spectrum purity⁵							
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 (S1465B)	<-30dBc					
	2GHz<f≤20GHz	<-55dBc					
	20GHz<f≤67GHz	<-45dBc (typical)					
Sub-harmonic (at +10dBm or Max.)	100kHz≤f≤10GHz	None					
	10GHz<f≤20GHz	<-60dBc					

specified output power, whichever is lower)	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		
	40GHz<f≤67GHz	<-42dBc			<-42dBc		
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
	250 MHz<f≤500MHz	---	---	-108	-126	-132	-136
	0.5GHz<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≤40GHz	---	---	-69	-89	-98	-98
	40GHz<f≤67GHz	---	---	-64	-84	-92	-92
	H04 ultra low phase noise option						
	100kHz≤f≤250MHz	-64	-92	-105	-123	-138	-141
	250 MHz<f≤500MHz	-67	-93	-111	-126	-138	-142
	0.5 GHz<f≤1GHz	-62	-91	-105	-123	-138	-138
	1 GHz<f≤2GHz	-57	-86	-100	-117	-133	-133
	2 GHz<f≤3.2GHz	-52	-81	-96	-113	-128	-128
	3.2 GHz<f≤10GHz	-43	-72	-85	-105	-120	-120
	10 GHz<f≤20GHz	-37	-66	-79	-98	-114	-114
	20 GHz<f≤40GHz	-31	-60	-73	-91	-108	-108

	40 GHz<f≤67GHz	-26	-54	-68	-85	-102	-102
5.5 Modulation properties							
Modulation type	PSK, MSK, FSK, QAM, ASK, User I/Q, User FSK						
Frequency modulation (option H02A)	<p>Maximum deviation: N×16MHz (N: YO harmonic number)</p> <p>Accuracy (at 1kHz, N×20kHz≤deviations<N×800kHz): $<\pm (3.5\% \times \text{set frequency offset} + 20\text{Hz})$</p> <p>Modulation rate (3dB band width, 500kHz frequency offset): DC-10MHz</p> <p>Distortion (at 1kHz, N×20kHz≤ distortion <N×800kHz): <1%</p>						
Phase modulation (option H02A)	<p>Maximum deviation:</p> <p>Normal mode: N×16rad (N: YO harmonic number)</p> <p>Broadband mode: N×1.6rad (N: YO harmonic number)</p> <p>Accuracy (at 1kHz, N×0.2rad≤deviations<N×8rad, normal mode): $<\pm (5\% \text{ of deviation} + 0.01 \text{ rad})$</p> <p>Modulation rate (3dB bandwidth):</p> <p>Narrowband mode DC - 1MHz (typical value)</p> <p>Broadband mode DC - 10MHz (typical value)</p> <p>Distortion (at 1kHz, N×0.8rad≤deviations<N×8rad, THD): <1%</p>						
Amplitude modulation (option H02A)	<p>Max. depth: >90%</p> <p>Modulation rate (3 dB bandwidth, 30% modulation depth): DC-100kHz</p> <p>Accuracy (1kHz modulation rate,30% modulation depth): $\pm (6\% \text{ of setting} + 1\%)$</p> <p>Distortion (1kHz modulation rate, linear mode, THD, 30% modulation depth): <1.5%</p>						
Pulse modulation (option H02B)		500MHz - 3.2GHz	> 3.2GHz				
	One-off ratio	>80dB	>80dB				
	Rise and fall time	<20ns	<20ns				
	Internal amplitude level control minimum pulse width	1μs	1μs				
	INon-amplitude level control minimum pulse width	0.1μs	0.1μs				
Narrow Pulse modulation (option H02C)		50MHz~3.2GHz	More than 3.2GHz				
	On-off ratio	>80dB	>80dB				
	Rise and fall time	<15ns	<10ns				
	Internal amplitude level control	1μs	1μs				

	minimum pulse width		
	I Non-amplitude level control minimum pulse width	30ns	20ns
Internally modulated signal generator (option H02A/B/C)		<p>Provide 3 independent signals respectively for frequency/phase modulation, amplitude modulation and low frequency output signals.</p> <p>Waveform: Sine, square, triangle, sawtooth, noise, double sine, sweep sine.</p> <p>Frequency range: DC -10MHz for sinusoidal wave, double sine, sweep sine wave; 0.1Hz-100kHz for square wave, triangular wave and sawtooth wave.</p> <p>Frequency resolution: 0.1Hz</p> <p>Low frequency output: Amplitude: 0-5Vpeak (rating), to 50Ω load.</p> <p>Pulse modulation signal: Pulse width: 20ns - (42s-10ns), pulse period: 100ns-42s, resolution: 10ns</p>	
Vector modulation accuracy (after calibration, 25±10°C)		S1465A/B/C/D/F-V	50MHz-40GHz (or max. frequency) EVM (RMS%) <1.4%
		S1465H/L-V	50MHz-40GHz EVM (RMS%) <1.4% 40GHz-67GHz (or max. frequency) EVM (RMS%) <2.5%
5.6 General properties			
RF output port		S1465A/B/C-V: N (female), impedance: 50Ω S1465D-V: 3.5mm (male), N (female) (option H91), impedance: 50Ω S1465F-V: 2.4mm (male), impedance: 50Ω S1465H/L-V: 1.85 mm (male), impedance: 50Ω	
Dimensions		W×H×D=435mm×178mm×498mm (excluding handle, foot mat and footing) W×H×D=517mm×192mm×550mm (including handle (option H93), foot mat and footing)	
Weight		<28kg (as per model and option configuration)	
Power supply		100-120VAC, 50-60Hz; or 200-240VAC, 50-60Hz (self-adaptive)	
Power consumption		less than 350W	
Temperature range		Operating temperature: 0 - +50°C; storage temperature: -40 - +70°C	
5.7 Option Information			
Internal modulation bandwidth		(Carriers 900MHz, 1.8GHz, 2.4GHz, 6GHz, 18GHz, 35GHz, 50GHz) Standards: 120MHz (multi-tone, number of tones 51, frequency interval 2.4MHz, ± 3dB bandwidth); H31 large modulation bandwidth option: 200MHz (multi-tone, number of tone 51, frequency interval 4MHz, ± 3dB bandwidth)	
External modulation bandwidth		(Carriers 900MHz, 1.8GHz, 2.4GHz, 6GHz, 18GHz, 35GHz, 50GHz) 200MHz (ALC open loop, input 100mVrms sinc in channel I, ± 4dB bandwidth)	
External broadband		(7GHz, 18GHz, 35GHz, 50GHz)	

bandwidth (option H33)	2GHz (ALC open loop, input 100mVrms sinc in channel I, $\pm 6\text{dB}$ bandwidth)
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Notes:

1. S1465V series signal generators, after stored for 2h at the ambient temperature and preheated for 30min, meet all performance indexes, within the given operating range.
2. Typical value is a supplementary item given with a set value, only for reference by users.
3. +16dBm for S1465B-V
4. Rating is a predicated performance, which is useful in product description, but not covered by product warranty.
5. Spectrum purity index is in dot frequency non modulation mode.
6. The test power is set to +15dBm for SSB phase noise of $100\text{kHz} \leq f \leq 250\text{MHz}$. For option H06, the frequency range is $100\text{MHz} \leq f \leq 250\text{MHz}$, and the frequency range less than 100MHz is not guaranteed.

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