FLUKE®

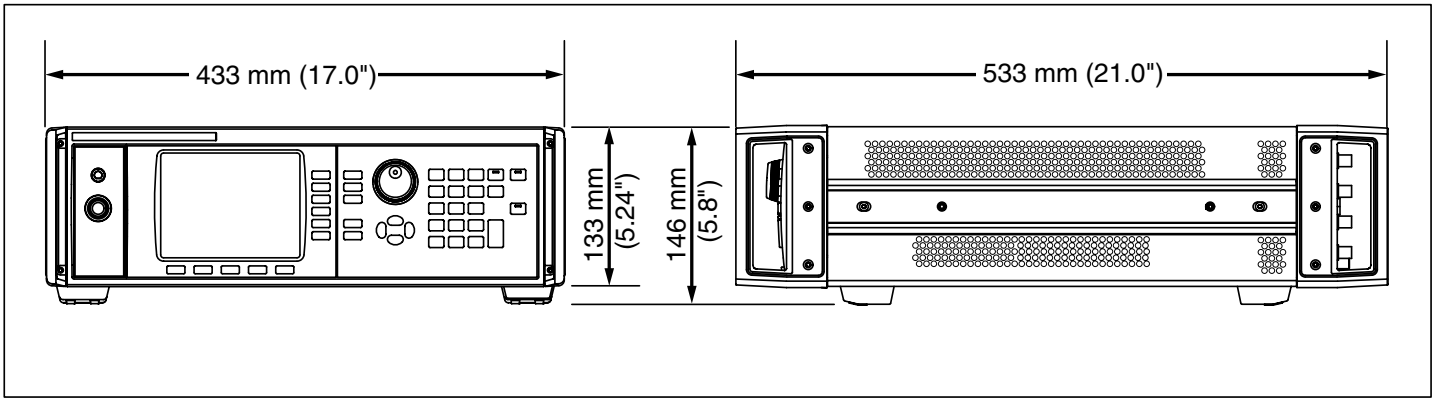
Calibration

9640A-LPNX RF Reference Source

Extended specifications

General Specifications

Performance	All specifications apply to a 1 year calibration interval at an ambient temperature of Tcal ±5 °C. Nominal factory Tcal calibration temperature 23 °C. Applicable to instruments fitted with firmware Issue 3 or later.
Standard Interfaces	IEEE488.2 (GPIB)
Warmup Time	60 minutes
Temperature	Operating: 0 °C to 50 °C Specified Operation: 5 °C to 40 °C Storage: –20 °C to +70 °C
Relative Humidity	Operating or Storage: Non-condensing, 5 °C to 30 °C <95 %, <40 °C <75 %, <50 °C <45 %
Altitude	Operating: ≤2,000 m Non-operating: ≤12,000 m
Safety	EN 61010-1:2001, CAN/CSA 22.2 No. 61010-1:2004 and UL 61010-1:2004, indoor use only, pollution degree 2, installation category II.
EMC	EN 61326:2006 Class B.
Line Power	Rating: 115 V/ 230 V nominal [1]
Power Consumption	≤250 VA
Dimensions	433 mm (17.0 in) wide, 146 mm (5.8 in) high and 533 mm (21.0 in) deep. Mounts within industry-standard 483 mm (19 in) rack-mount frames when fitted with Y9600 rack mounting kit.
Weight	18 kg (40 lb)
[1] Type tested for operation and functionality 90 to 132 V rms and 180 to 264 V rms at 47 to 63 Hz.	



9640A Dimensions

Frequency Reference Input/Output Specifications

Frequency Reference Input	Rear panel Reference Frequency Input BNC connector
Frequency	9640A: 1 MHz to 20 MHz in 1 MHz steps ±30 ppm 9640A-LPNX: 1 MHz to 20 MHz in 1 MHz steps ±0.3 ppm, typical
Level	1 V pk nominal into 50 Ω, ±5 V pk max.

Frequency Reference Output	Rear panel Reference Frequency Output BNC connector
Frequency	1 MHz or 10 MHz, user selectable
Level	1.5 V pk-pk into 50 Ω, 3 V pk-pk into 1 kΩ, TTL compatible
Accuracy [1] [2]	±0.05 ppm
Ageing Rate and Stability [2]	After 24 hr warmup: $\pm 5 \times 10^{-10}$/day, typical Continuous operation: ≤ $\pm 2 \times 10^{-8}$/month typical, ≤ $\pm 5 \times 10^{-8}$ over 1 year

[1] Includes all stability effects for the 1 year calibration interval and Tcal ± 5 °C temperature range applicable to all specifications.

[2] Specifications apply only if Internal Frequency Reference operation is selected. With External Frequency Reference operation selected, the frequency of the Frequency Reference Output is locked to the signal applied to the Frequency Reference Input.

Leveled Sine Specifications

Frequency	
Range	1 mHz to 4 GHz
Resolution	Standard: <100 MHz: 0.001 Hz (1 mHz), >100 MHz: 11 digits Enhanced: 0.000 01 Hz (10 µHz)
Accuracy	Internal Frequency Reference: ±0.05 ppm ±5 µHz External Frequency Reference: Ext Freq Ref Accuracy ±5 µHz

Amplitude	**50 Ω output**	**75 Ω output**
Output Connector	Precision 50 Ω N-Series male	Precision 75 Ω N-Series male
Range	-130 dBm to +24 dBm (0.2 µV to 10 V pk-pk) >125 MHz: +20 dBm >1.4 GHz: +14 dBm	-130 dBm to +18 dBm (0.13 µV to 6.3 V pk-pk) >125 MHz: +14 dBm >1.4 GHz: +8 dBm
Resolution	0.001 dB	0.001 dB
VSWR	≤500 MHz: ≤1.1 ≤1 GHz: ≤1.2 ≤3 GHz: ≤1.3 ≤4 GHz: ≤1.4	≤500 MHz: ≤1.1 ≤1 GHz: ≤1.2 ≤2 GHz: ≤1.3

Attenuation	50 Ω output	75 Ω output
Attenuation 10 Hz [1] to 128 MHz	Relative to +16 dBm output 0 – 55 dB ±0.02 dB 55 – 64 dB ±0.03 dB 64 – 74 dB ±0.05 dB 74 – 100 dB ±0.07 dB 100 – 116 dB [1] ±0.15 dB	Relative to +10 dBm output 0 – 33 dB ±0.035 dB 33 – 64 dB ±0.05 dB 64 – 100 dB ±0.15 dB 100 – 110 dB [1] ±0.3 dB
Cumulative and Incremental Attenuation To determine the attenuation specification between any two output levels, apply an RSS [2] summation of the dB values listed for each output level.	Relative to any level between +16 dBm and –100 dBm, 10 Hz to 128 MHz +16 to –39 dBm ±0.02 dB –39 to –48 dBm ±0.03 dB –48 to –58 dB ±0.05 dB –58 to –84 dBm ±0.07 dB –84 to –100 dBm ±0.15 dB	Relative to any level between +10 dBm and –100 dBm, 10 Hz to 128 MHz +10 to –23 dBm ±0.035 dB –23 to –54 dBm ±0.05 dB –54 to –90 dBm ±0.15 dB –90 to –100 dBm ±0.3 dB

[1] Specifications are typical at attenuation of more than 64 dB up to 20 kHz, at more than 96 dB up to 100 kHz, and at more than 100 dB at all frequencies.

[2] Root Sum Square.

Absolute Amplitude Accuracy	50 Ω Output							
Amplitude								
dBm	10 Hz to 20 kHz	>20 kHz to 100 kHz	>100 kHz to <10 MHz	10 MHz to 128 MHz	>128 MHz to 300 MHz	>300 MHz to 1.4 GHz	>1.4 GHz to 3 GHz	>3 GHz to 4 GHz
>+20 to +24	±0.03 dB	±0.03 dB	±0.05 dB	±0.05 dB	Output not available			
>+14 to +20	±0.03 dB	±0.03 dB	±0.05 dB	±0.05 dB	±0.07 dB	±0.2 dB		
–17 to +14	±0.03 dB	±0.03 dB	±0.05 dB	±0.05 dB	±0.07 dB	±0.2 dB	±0.3 dB	±0.3 dB
–48 to <–17	±0.03 dB	±0.03 dB	±0.05 dB	±0.05 dB	±0.07 dB	±0.2 dB	±0.3 dB	±0.5 dB
>–74 to <–48	Not Specified		±0.2 dB [1]	±0.1 dB	±0.1 dB	±0.4 dB	±0.5 dB	±0.5 dB
>–84 to –74			±0.5 dB [1]	±0.1 dB	±0.3 dB	±0.5 dB	±1.0 dB	±1.0 dB
>–94 to –84			±0.5 dB [1]	±0.3 dB	±0.5 dB	±1.0 dB	±1.0 dB	Not Spec'd
–130 to –94				±0.7 dB	±1.5 dB	±1.5 dB	±1.5 dB	

[1] Specification applies at 100 kHz

Absolute Amplitude Accuracy	**75 Ω Output**							
Amplitude								
dBm	10 Hz to 20 kHz	>20 kHz to <100 kHz	100 kHz to <10 MHz	10 MHz to 125 MHz	>125 MHz to 300 MHz	>300 MHz to 1.4 GHz	>1.4 GHz [1] to 3 GHz	>3 GHz [1] to 4 GHz
>+14 to +18	±0.06 dB	±0.06 dB	±0.06 dB	±0.06 dB	Output not available			
>+8 to +14	±0.06 dB	±0.06 dB	±0.06 dB	±0.06 dB	±0.15 dB	±0.25 dB		
-23 to +8	±0.06 dB	±0.06 dB	±0.06 dB	±0.06 dB	±0.15 dB	±0.25 dB	±0.3 dB	±0.5 dB
-54 to <-23	±0.15 dB	±0.15 dB	±0.15 dB	±0.15 dB	±0.15 dB	±0.5 dB	±0.5 dB	±0.5 dB
>-80 to <-54	Not Specified		±0.2 dB	±0.2 dB	±0.2 dB	±0.5 dB	±0.5 dB	±0.5 dB
>-90 to -80			±0.7 dB	±0.7 dB	±0.7 dB	±1.0 dB	±1.0 dB	±1.0 dB
>-100 to -90			±0.7 dB	±0.7 dB	±0.7 dB	±1.0 dB	±1.0 dB	Not Specified
-120 to -100				±1.5 dB	±1.5 dB	±1.5 dB	±1.5 dB	

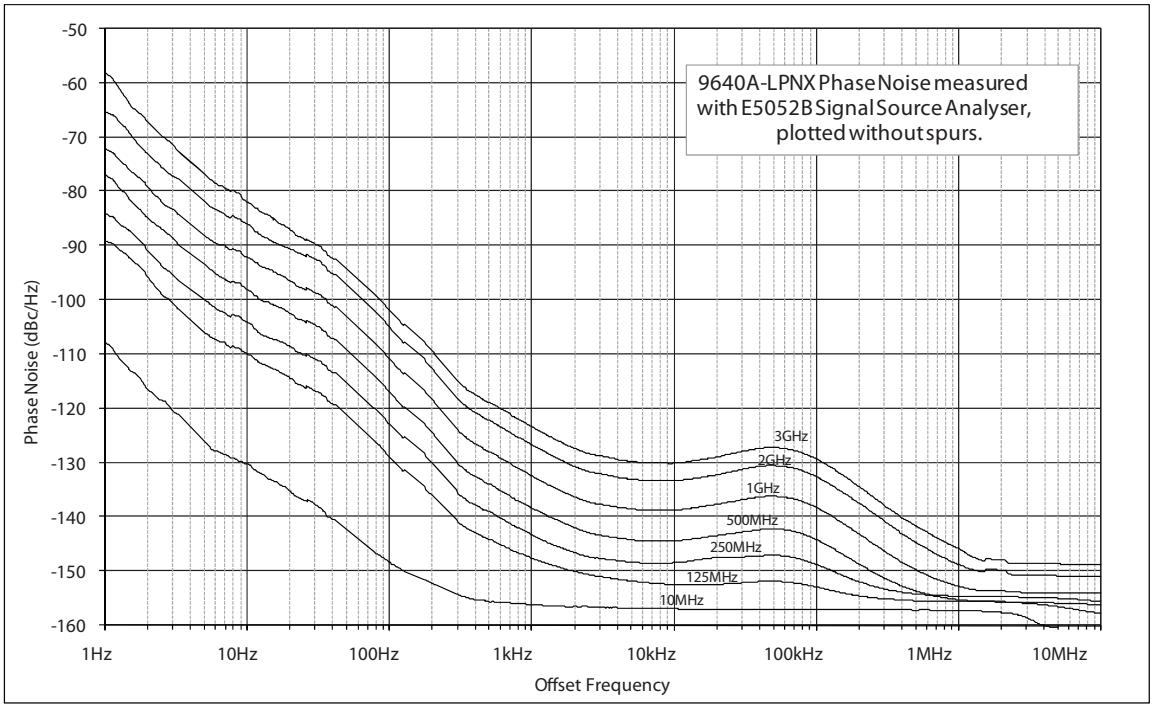
[1] Specifications are typical for frequencies >2 GHz.

Signal Purity	At maximum output level
Harmonics	≤1 GHz: <-60 dBc, >1 GHz: <-55 dBc
Spurious ≥3 kHz offset and Sub-harmonics	≤500 MHz: <-75 dBc, ≤1 GHz: <-70 dBc, ≤2 GHz: <-65 dBc, ≤4 GHz: <-60 dBc
SSB AM Noise	10 MHz to 1.4 GHz, <0.015 % rms, in 50 Hz to 3 kHz bandwidth, typical
Residual FM	9640A: <0.5 Hz rms at <125 MHz, in 50 Hz to 3 kHz bandwidth, typical 9640A-LPNX: <0.4 Hz rms at <125 MHz, in 50 Hz to 3 kHz bandwidth, typical

SSB Phase Noise 9640A	At maximum output level, Internal Freq Ref, (dBc/Hz)				
Frequency	Offset from Carrier				
	1 kHz Spec (Typ)	10 kHz Spec (Typ)	100 kHz Spec (Typ)	1 MHz Spec (Typ)	10 MHz Spec (Typ)
1 GHz	-97 (-102)	-118 (-122)	-118 (-122)	-124 (-130)	-142 (-144)

RMS Jitter 9640A-LPNX	Typical, at +10 dBm output level, Internal Freq Ref.		
Output Frequency	Integration Bandwidth	Phase (mdeg rms)	Time (fs rms)
155 MHz	100 Hz – 1.5 MHz	1.8	33
622 MHz	1 kHz – 5 MHz	4.2	18
2488 MHz	5 kHz – 20 MHz	20.7	23

SSB Phase Noise of 9640A-LPNX (dBc / Hz) [1]	At output level +13dBm, internal frequency reference							
Carrier Frequency	Offset from Carrier and Tolerance [1]							
	1 Hz	10 Hz	100 Hz	1 kHz	10 kHz	100 kHz	1 MHz	10 MHz
	+ 10 dB	+ 6 dB	+ 6 dB	+ 5 dB	+ 4 dB	+ 4 dB	+ 4 dB	+ 2 dB
10 MHz	-106	-123	-139	-153	-155	-156	-156	Not Spec'd
125 MHz	-88	-107	-128	-146	-151	-152	-155	-156
250 MHz	-82	-102	-124	-143	-148	-148	-154	-155
500 MHz	-76	-96	-117	-137	-143	-143	-154	-155
1 GHz	-69	-90	-111	-131	-138	-138	-152	-153
2 GHz	-64	-84	-106	-125	-132	-132	-149	-151
3 GHz	-58	-79	-99	-123	-129	-129	-145	-147
4 GHz	-54	-80	-100	-117	-123	-125	-145	-150
Typical SSB Phase Noise at 1GHz with 9600FLT [2] wide offset phase noise filter [3]							-152	-168



9640A-LPNX SSB Phase Noise at +10dBm output level (measured).

[1] Phase noise figures quoted in the table are nominal (typical) values. To obtain the maximum phase noise at any carrier/offset combination add the corresponding tolerance value. For example at 1 GHz output, 10 kHz offset: maximum (guaranteed) phase noise = -138 +4 = -134 dBc/Hz.

[2] The 9600FLT Wide Offset Phase Noise Filter accessory is a narrow bandwidth 1 GHz bandpass filter for use with 9640A models to reduce phase noise levels at high offset frequencies when operating at an output frequency of 1 GHz.

[3] Typical values only, tolerance addition not applicable with 9600FLT.

External Frequency Control Input	Rear panel Modulation, Leveling, Frequency Pull and Counter BNC connector, 10 kΩ nominal input impedance
Frequency Pull Range	±5 ppm
Frequency Pull Sensitivity	User-adjustable between 0.0001 ppm/V to 1.0000 ppm/V, positive or negative polarity
Maximum Input	±5 V

Modulation Specifications

Amplitude Modulation	**50 Ω output**	**75 Ω output**
Waveform	Sinusoidal, Triangle, or External signal	
Carrier Frequency	50 kHz to 4 GHz	
Carrier Level	<1.4 GHz: ≤+14 dBm >1.4 GHz: ≤+8 dBm	<1.4 GHz: ≤+8 dBm >1.4 GHz: ≤+2 dBm
Carrier Level Accuracy [1]	As Leveled Sine ±0.5 dB, typical	
Carrier Harmonics	≤ 50 dBc typical	
Rate	≤125.75 MHz, 1 Hz to 220 kHz, ≤ 1 % of carrier frequency >127.75 MHz, 1 Hz to 100 kHz	
Rate Resolution	0.1 Hz, 5 digits	
Rate Accuracy	≥1 kHz: ±1 digit, <1 kHz: ±10 mHz	
Depth	0.1 % to 99 %	
Depth Resolution	0.1 %	
Carrier Frequency and Level Range for Specified Depth Accuracy and Distortion	≤1 GHz, -56 dBm to +14 dBm	≤1 GHz, -62 dBm to +8 dBm
AM Sine Depth Accuracy [2]	±3 % of setting ±0.1 %, for >5 % depth Typically ±0.75 % of setting ±0.1 %, for 10 % to 90 % depth, ≤75 MHz carrier frequency	
AM Sine Distortion [2] [3]	≤-40 dBc,10 % to 80 % depth, for ≤ 20 kHz rate, or for > 20 kHz rate at ≤75 MHz carrier frequency Typically ≤-50 dBc, 10 % to 80 % depth, ≤75 MHz carrier frequency	

[1] Signal content at carrier frequency only, excluding sidebands.

[2] Applies to demodulated signal content at rate fundamental frequency. Specifications are typical for modulation rates <20 Hz.

[3] Includes harmonic distortion and noise up to 5 times rate frequency.

AM External	
Input	Rear panel Modulation, Leveling, Frequency Pull and Counter BNC connector, 10 kΩ nominal input impedance
Bandwidth (–3 dB) [1]	DC coupled:[2] DC to 220 kHz typical AC coupled: 10 Hz to 220 kHz typical
Depth Sensitivity	User–adjustable, 0.5 %/V to 400 %/V
Input Level	±2 V pk maximum operating, ±5 V pk absolute maximum
Carrier Level Accuracy	As AM Internal Sine ±20 mV x depth/V setting, typical
Depth Accuracy [3]	±3 % of setting ±0.1 %, for >5 % depth, 1 Vpk input, dc or 200 Hz to 20 kHz
Residual Distortion [4]	As AM Internal Sine, for 1 Vpk input, ≤100 kHz

[1] Maximum input frequency 100 kHz for carrier frequency >125 MHz.

[2] DC coupled External Modulation permits DC control of carrier level or the offsetting of the modulation waveform. Note that at rates from 0.5 Hz to 10 Hz interaction with carrier leveling may occur, resulting in modulation distortion.

[3] Applies to demodulated signal content at rate fundamental frequency.

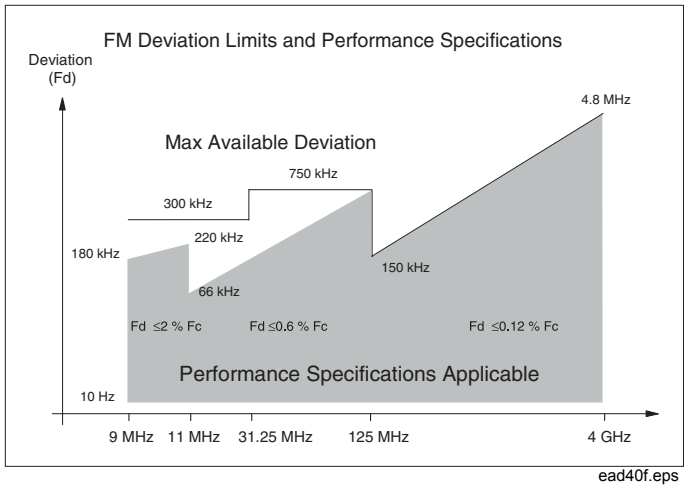
[4] Includes harmonic distortion and noise up to 5 times rate frequency.

Frequency and Phase Modulation [1]	
Waveform	FM: Sinusoidal, or External signal PM: Sinusoidal, or External signal
Carrier Frequency (Fc)	9 MHz to 4 GHz
Carrier Frequency Accuracy	Internal Frequency Reference: ±0.04 ppm ±240 mHz External Frequency Reference: Ext Freq Ref Accuracy ±240 mHz
Rate (Fr)	1 Hz to 300 kHz
Rate Resolution	0.1 Hz, 5 digits
Rate Accuracy	≥1 kHz: ±1 digit, <1 kHz: ±10 mHz
Deviation (Fd) [2]	Fc 9 MHz to 31.25 MHz: FM: 10Hz to 300 kHz, PM: ≤1000 rad Fc 31.25 MHz to 125 MHz: FM: 10 Hz to 750 kHz, PM: ≤1000 rad Fc 125 MHz to 4 GHz: FM: 10 Hz to 0.12 % Fc, PM: ≤1000 rad or 0.12 %Fc/Fr
Deviation Resolution	FM: 0.1 Hz, 5 digits. PM: 0.0001 rad, 5 digits
FM/PM Sine Deviation Accuracy [2]	±3 % of setting ±240 mHz Typically ±0.25 % of setting ±240 mHz, for ≤50 kHz rate
FM/PM Sine Distortion [2] [3]	≤–40 dBc (1 %) +20 dB/decade above 10 kHz (see chart) Typically ≤–65 dBc +20 dB/decade above 1 kHz

[1] Phase modulation is generated by applying sinusoidal frequency modulation with peak deviation derived from the phase deviation and rate settings (Fd = ϕd x Frate).

[2] See chart showing maximum available deviation, and maximum deviation for which deviation accuracy and distortion specifications apply. Applies to demodulated signal content at rate fundamental frequency. Specifications are typical for modulation rates <20Hz.

[3] Includes harmonic distortion and noise up to 5 times rate frequency.



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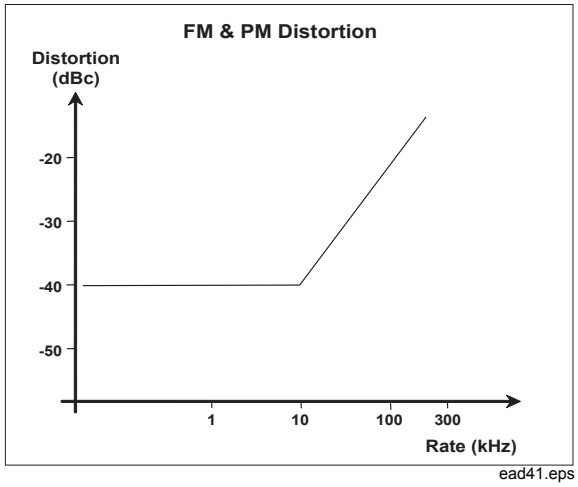

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FM External	
Input	Rear panel Modulation Leveling, Frequency Pull and Counter BNC connector, 10 kΩ nominal input impedance
Bandwidth (–3 dB)	DC coupled: dc to 1 MHz typical AC coupled: 10 Hz to 1 MHz typical
Deviation Sensitivity	User–adjustable, 500 Hz/V to 19 MHz/V, carrier frequency dependent
Input Level	±2 V pk maximum operating, ±5 V pk absolute maximum
Carrier Frequency Accuracy	As FM Internal Sine ±20 mV x deviation/V setting, typical
Deviation Accuracy [1]	3 % of setting + 240 mHz, for 1 Vpk input, dc or 200 Hz to 20 kHz rate, deviation >0.01 % Fc
Residual Distortion [1] [2]	As FM Internal Sine, for 1 Vpk input, deviation >0.01 % Fc Typically ≤ –55 dBc +20 dB/decade above 10 kHz, for 1 Vpk input, deviation >0.01 % Fc

[1] See chart showing maximum available deviation, and maximum deviation for which deviation accuracy and residual distortion specifications apply.

[2] Includes harmonic distortion and noise up to 5 times rate frequency.

PM External [1]	
Input	Rear panel Modulation Leveling Frequency Pull and Frequency Counter BNC connector, 10 kΩ nominal input impedance
Bandwidth (–3 dB)	DC coupled: dc to 1 MHz AC coupled: 10 Hz to 1 MHz, typical
Deviation Sensitivity	User–adjustable, 0.001 rad/V to 96 rad/V, carrier frequency dependent
Input Level	±2 V pk maximum operating, ±5 V pk absolute maximum
Carrier Frequency Accuracy	As FM Internal Sine ±20 mV x deviation/V setting, typical
Deviation Accuracy [2]	±3 % of setting ±240 mHz/Frate rad, for 1 Vpk input, dc or 200 Hz to 20 kHz rate, deviation >0.01 % Fc, typical

[1] External phase modulation deviates the phase of the carrier, applying the set deviation sensitivity to the modulation input signal.

[2] See chart showing maximum available equivalent frequency deviation and equivalent maximum frequency deviation for which phase deviation accuracy specifications apply for sinusoidal inputs ($\phi d = Fd / Frate$). Applies to demodulated signal content at rate fundamental frequency.

Modulation Trigger Output	Rear panel Trigger I/O BNC connector
Level	TTL compatible logic output, selectable as rising or falling edge
Timing Alignment	±500 ns typical, from modulation waveform zero crossing for sinusoidal or positive peak for triangle

Frequency Sweep Specifications

Sweep Frequency Range	1 mHz to 4 GHz Sweeps are generated as a sequence of discrete synthesized frequencies.
Sweep Modes	Stop – Start and Center – Span Linear or Logarithmic Sawtooth or Triangular Repetitive, Single Shot, Triggered and Manual Sweep Squelch or Non Squelch at frequency transitions
Start, Stop and Step Frequency Setting Resolution	<100 MHz: 0.1 Hz >100 MHz: 11 digits
Frequency Steps	5 million maximum
Step Size	1 mHz to 4 GHz
Step Dwell Time	20 ms to 10 s, 2 ms to 10 s for narrow range–locked sweep [1]
Sweep Duration	100 hrs maximum, calculated from Step Dwell x Number of Steps
Squelch Duration [2]	<20 ms
Trigger Input/Sync Output	Rear panel Trigger I/O BNC connector, selectable as sweep trigger input or sweep sync output
Trigger Input	TTL compatible logic input, selectable as rising or falling trigger to start sweep. Typically ≤1 ms delay from trigger to sweep start
Sync Output	TTL compatible logic output, selectable as rising or falling sync pulse coincident with sweep start. Typical pulse duration 250 µs. Typical time alignment +14 to +16 ms from sweep start when dwell time ≥20ms, +1 ms when dwell time <20 ms (delay ensures settled signal at the trigger point).

[1] Narrow range–locked sweep provides phase continuous constant amplitude frequency sweep without hardware boundaries when sweep range setting <0.03 % of centre frequency and centre frequency >15.625 MHz.

[2] When selected, Squelch is active between all frequency transitions. When deselected, Squelch is active only at hardware range boundaries. Squelch is not active in narrow range–locked sweep.

Frequency Counter Specifications [1]

Input	Rear panel Modulation Leveling, Frequency Pull and Frequency Counter BNC connector, 10 kΩ nominal input impedance. AC coupled.		
Frequency Range	0.9 MHz to 50.1 MHz for specified accuracy. Functional to 10 Hz, typical		
Gate Times and Resolutions [2] (in displayed digits)	0.2 s: 7 / 8 digits, 2 s: 8 / 9 digits, 20 s: 9 / 10 digits, 80 s: 10 / 11 digits		
Input Level	±0.5 V pk minimum operating, ±5 V pk absolute maximum		
Accuracy	Gate Time	Internal Frequency Reference	External Frequency Reference
	0.2, 2, 20 s	±0.05 ppm ±0.5 count	Ext Freq Ref Accuracy ±0.5 count
	80 s	±0.05 ppm ±1.25 counts	Ext Freq Ref Accuracy ±1.25 counts

[1] Feature available when Option 9600FC fitted.

[2] Frequencies are automatically displayed in units of Hz, kHz, or MHz. Number of digits depends on gate time selected and display auto-ranging points, arranged in decades at 1 099 999 9(99 9) / 1 100 000 (000).

FLUKE®
Calibration

GPIB Command Emulation Mode Specifications

9640A	HP3335A
9640A-LPNX 9640A-LPNX + Option 8662/8663 GPIB	HP3335A HP3335A, HP8662A, HP8663A [1]
[1] Only one instrument emulation mode may be selected at any one time.	

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