

# 9500B Oscilloscope Calibrator

**The world's highest performance, fully automated, upgradeable oscilloscope calibration workstation.**

- Full automation provides totally hands-free oscilloscope calibration. even on today's ultra-high performance, multi-channel, feature rich instruments.
- Continuous upgradeability helps you protect your investment in the tools you need to manage ever changing workload demands.
- Leveled sinewaves to 6 GHz and edges to 70 ps provide all the performance and flexibility you need to fully calibrate today's and tomorrow's high performance oscilloscopes.
- Fluke's unique Active Head Technology™ generates calibration signals right at the oscilloscope input. now there is no doubt whether waveform aberrations are down to connecting leads or the oscilloscope itself.



Oscilloscope calibration can be complex, time consuming and expensive. A significant amount of in oscilloscope technology make it difficult to keep skilled operator interaction and interpretation is up with performance trends without substantial often required to complete the job, and today's re-investment on a regular basis.

multi-channel instruments frequently mean that The Fluke 9500B Oscilloscope

Calibration a great deal of lead switching is required.

Even Workstation breaks that paradigm. It means that the automated systems require significant manual benefits of hands-free, fully-automated, accurate intervention to complete elements of the most oscilloscope calibration are readily available to simple calibration procedures. Worse still, switching everyone at a price and

performance level that your systems or multiplexers used to enable a degree needs and budget can support, while ensuring that, of automation often contribute more errors and through performance upgrades, future needs will aberrations than the instrument being calibrated. be met when the time demands it.



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## Full automation

Automating oscilloscope calibration is possibly one of the biggest productivity enhancements that can be realised in many calibration labs. Performed manually, this work requires skilled operators to spend a substantial amount of time performing what are essentially repetitive tasks. Semi, or partial automation solutions apparently address this issue and free skilled technicians to perform more valuable tasks. However, in practice, these partial solutions present their own problems.

Over the last decade, the oscilloscope of choice has migrated from a two-channel instrument to a more complex four-channel device.

When calibrating these instruments, it is necessary to move the calibrating signal from channel to channel as the

procedure progresses.

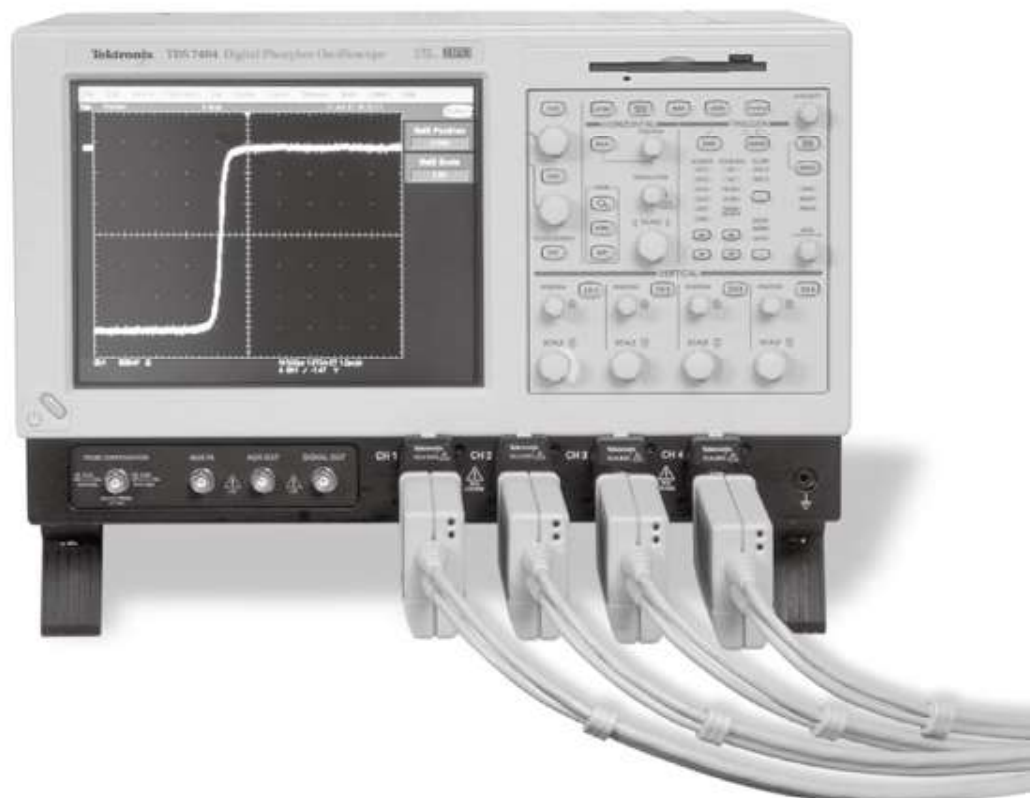
This can be achieved by physically moving cables, though this requires operator intervention. In high performance instruments, this may introduce additional measurement uncertainties as cables and connectors are handled. An alternative is to introduce a switching matrix to route signals, though this may result in problems with signal reflections, poor contacts and path differences that materially impact calibration uncertainties.

## Active heads

The Fluke 9500B addresses these issues, and provides true, full automation through the use of its unique active heads. With the 9500B, all the signals required to fully calibrate the oscilloscope are generated in detachable heads,

remote from the calibrator mainframe.

The heads are connected directly to the oscilloscope input without the need for additional cables. All control and switching of waveforms are performed under the control of the mainframe, yet within the head itself—typically only a matter of millimeters away from the oscilloscope input and amplifiers. With each 9500B mainframe able to control up to five heads, all the signals required to calibrate a 4-channel oscilloscope with an external trigger can be supplied, controlled and switched without operator intervention or the need for external switching.



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## MET/CAL® Plus Calibration Management Software

The final link in the chain of full automation is software. The 9500B Oscilloscope Calibrator can be used with Fluke's powerful IEEE-488 (GPIB) based MET/CAL Plus automated calibration management software.

While allowing you to automate the calibration process, MET/CAL also documents results, manages your calibration inventory, and allows you to develop new oscilloscope calibration procedures.

If you want to use the same system to calibrate 14 other categories of test equipment (ranging from handheld DMMs to frequency counters and chart recorders), the software will also drive Fluke's 5500A, 5520A and 9100 Multi-Product Calibrators.

Running under Microsoft Windows® and supporting multi-user networking, the software implements advanced features such as ISO 9000 and ISO 17025 compliant traceability, custom certificate and report generation, and high-level procedure programming.

The result is higher workload throughput, better calibration consistency, minimization of human error, and less requirement for operator training— in short, higher quality calibration at lower cost.

## Procedure support

We know that any automated calibration system is only as good as the calibration procedures that can run on it. That's why every procedure is written by a skilled calibration engineer and checked against the oscilloscope manufacturer's specifications—ensuring you get plug&play convenience and guaranteed results.

## Gold Support Program

To keep pace with the fast changing oscilloscope market, Fluke is continuously writing new calibration procedures. For a one-off, low-cost payment (less than it would cost you to have three or four DSO oscilloscope calibration procedures written), you can buy into our MET/SUPPORT Gold Software Support Program which gives you access to every new procedure written by Fluke's software support team during the next 12 months.

On current performance, that's upwards of 100 new oscilloscope calibration procedures per year.

And you won't have to request updates or wait for delivery; every new procedure we write is available for download from our web site ([www.calibration.fluke.com](http://www.calibration.fluke.com)).

In addition to the free procedures library, you will receive 60 days priority support to get you up and running with MET/SUPPORT Gold. You also have the option to buy into our MET/SUPPORT Gold program which offers you various advantages, including the opportunity to download new procedures from our web site or even obtain custom written procedures.

If the oscilloscope calibration procedure you require is not available and you need it quickly, we can write it for you at very competitive rates as part of our fast-track procedure writing scheme.



# 9500B Oscilloscope Calibrator

## Protecting your investment

Over recent years, oscilloscope technology and performance levels have changed dramatically, a trend set to continue. What was considered to be a cutting edge instrument only a few years ago may now be relegated to the general purpose pool. The challenge for those chartered with maintaining a calibration facility to support these instruments is how to keep up with this rapid progress.

The Fluke 9500B offers the perfect solution—full upgradability. Today you can invest in a 9500 oscilloscope cal solution with performance at a modest 600 MHz. As your workload changes, and higher performance instruments become more important, you can upgrade performance to 1.1 GHz, 3.2 GHz and right up to 6 GHz.

If you already need to work with higher performance instruments, you can jump right in at any point.

If full automation is not something you need right away, begin with just a few active heads, or just one. As needs change, add more heads until you have the degree of automation and the level of performance that perfectly match your organization's daily oscilloscope calibration needs.

Only Fluke's 9500 and 9500B Oscilloscope Calibration Workstations, with their unique 'Active Head Technology™', can provide the upgrade path to secure your investment in calibration equipment.

## A range of mainframes

highest levels of performance to maintain our undisputed leadership in the field of oscilloscope calibration. However, we also realise that not everyone needs this ultimate level of performance – not yet at least. To meet the needs of calibration labs who need more mainstream performance, Fluke offers a range of 9500B products. These are:

**9500B/600** 600 MHz High-Performance Oscilloscope Calibration Workstation

**9500B/1100** 1100 MHz High-Performance Oscilloscope Calibration Workstation

**9500B/3200** 3.2 GHz High-Performance Oscilloscope Calibration Workstation

Fluke appreciates that your needs will almost certainly change in the future, and that completely replacing a fully operational piece of equipment simply to improve performance levels is not your desired approach. Therefore, any of the models listed above can be upgraded to higher performance at any time, an option which also applies if you already own one of our existing 9500 Series calibrators. We will make every effort to ensure that any future developments will also fit this upgrade philosophy.

## Active head range

Four different active heads further expand upgradeability options of the 9500B family. Their addition can improve performance, extend frequency range or increase automation possibilities of the 9500B Oscilloscope Calibration Workstation.

### 9510 1.1 GHz Active Head with 500 ps pulse risetime

Compatible with all 9500B mainframes the 9510 will supply leveled sine to 1.1 GHz (or maximum frequency of the mainframe, whichever is lower). It will output pulse risetimes of 500 ps when used with any mainframe.

### 9530 3.2 GHz Active Head with 150 ps and 500 ps pulse risetime

Compatible with all 9500B mainframes, the 9530 will supply leveled sine to 3.2 GHz (or maximum frequency of the mainframe, whichever is lower). It will output pulse risetimes selectable between 150 ps and 500 ps when used in any mainframe.

### 9550 ultra-fast Active Head with 25 ps pulse capability

The 9550 provides pulses with rise and fall times of 25 ps that can be used for calibration of sampling oscilloscopes to 14 GHz.

### 9560 extended 6 GHz bandwidth Active Head

The 9560 provides the 9500B with the unique ability to accurately calibrate with leveled sine function to 6 GHz, performance unmatched by any other oscilloscope calibrator. The 9560 will only generate 6 GHz when used with a 9500B/3200 mainframe or an upgraded 9500/3200. Contact Fluke if you have an existing 9500 mainframe you would like upgraded to this performance level.



# 9500B Oscilloscope Calibrator

## Active Head Technology™

Active heads are lightweight modules measuring only 14 x 6.5 x 3 cm which connect to the 9500B mainframe through two cables—a single coaxial cable and a control umbilical. Within the head is all the circuitry needed to supply all the signals necessary to calibrate a modern, high-performance oscilloscope. This includes precision dc levels up to  $\pm 220$  V; calibrated amplitude squarewaves up to 210 V pk-pk from 10 Hz to 100 kHz; leveled sinewaves from 0.1 Hz to 6 GHz (depending on head); and four different styles of timing marker from 0.2 ns to 50 s. The hybrid within the head can route even a high frequency, externally generated calibration signal to the active head output. The hybrid also contains sinewave amplitude sensing circuits, wideband attenuator networks, a pulse generator, an edge generator and output signal multiplexing.

Key to delivering absolute performance is the proximity of the head's output circuit to the input of the oscilloscope's amplifier.

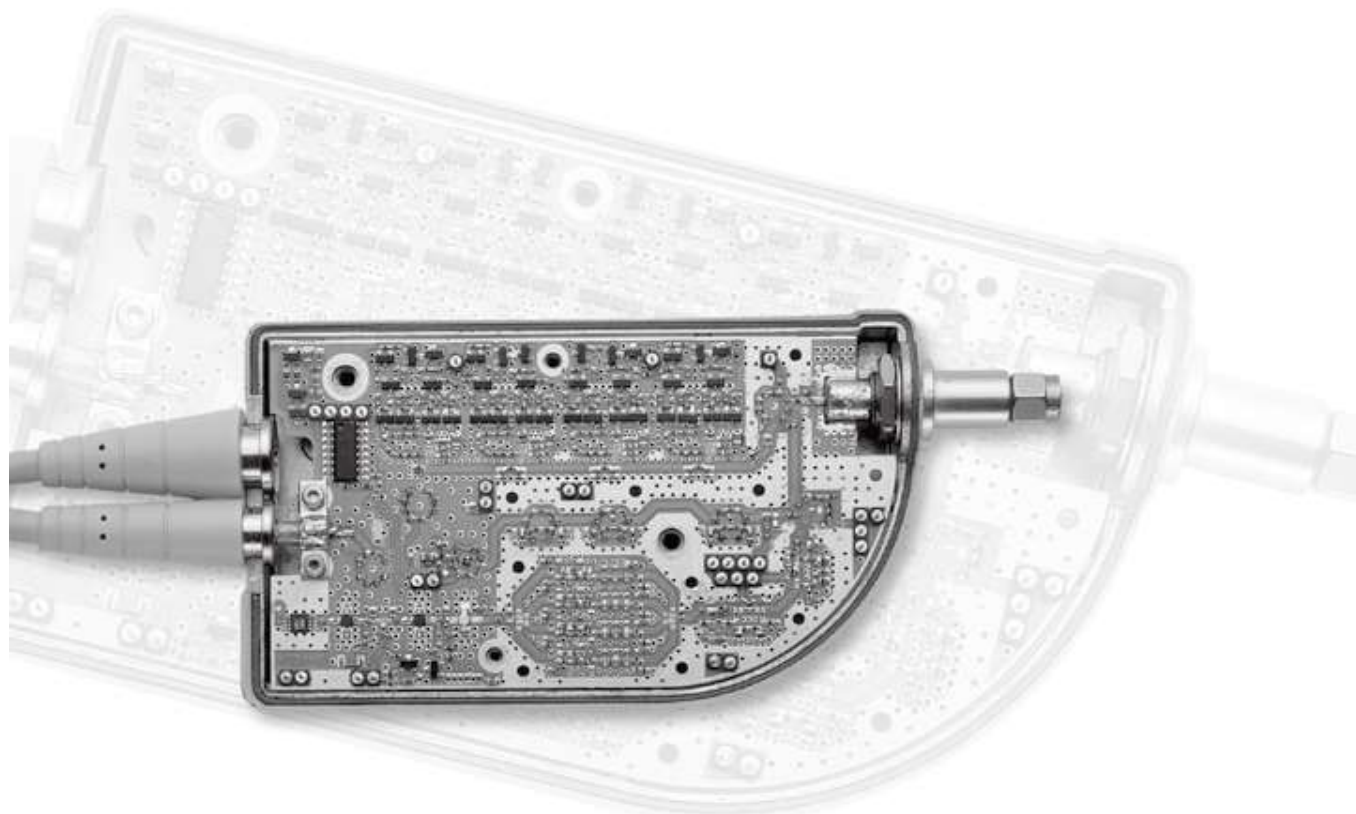
In a conventional, cabled environment, mismatches, unknown or unpredictable cable transmission properties and less than perfect connections all contribute to degradation of the signal between the calibrator output and the oscilloscope input. When using active heads, the calibrator output and the oscilloscope input are literally millimeters apart.

This short distance comprises matched impedance, micro-strip transmission line and high quality BNC or SMA connectors to all but eliminate sources of degradation, distortion and uncertainty of calibration signals. An automatic internally switched 50 W termination eliminates the need for external terminators when connecting to high impedance oscilloscope inputs.

## 9560—for ultimate performance

The introduction of the latest member of the active head family, 9560, once again underlines our commitment to oscilloscope calibration. With our continued focus on securing your investment, the 9560 Active Head is the latest product to fulfill this promise, allowing current users of the 9500 to upgrade their equipment to any 9500B status and take advantage of more recent product and performance enhancements. The 9560 is able to deliver 6 GHz leveled sine wave and pulse edges of only 70 ps.

Unlike other oscilloscope calibrators, you're not restricted to fixed amplitude pulses. Active Head Technology™ lets you adjust output amplitude between 4.44 mV and 3.1 V, allowing you to check an oscilloscope's amplifiers right down to their most sensitive ranges. Whatever amplitude you choose, controlled waveshape filtering ensures that all high-speed edges have an accurately defined harmonic energy distribution.



# 9500B Oscilloscope Calibrator

Enhanced by Active Head Technology™ and supported by full automation, the complementary pair of head and workstation come together to provide unrivalled functionality. This allows the user to confidently increase throughput, without compromising accuracy or stability.

## Vertical and horizontal deflection bandwidth

Fast return-to-ground edges with amplitudes between 4.44 mV and 3.1 V and rise/fall times of 70 ps, 150 ps or 500 ps check the pulse response and bandwidth of an oscilloscope's vertical deflection/acquisition amplifiers.

High level edges up to 210 V pk-pk check the dynamic performance of input attenuators.

Leveled sinewaves up to 600 MHz, 1.1 GHz, 3.2 GHz or 6 GHz with an amplitude range of 4.44 mV to 5.56 V pk-pk into 50  $\Omega$  (8.88 mV to 5.56 V pk-pk into 50  $\Omega$  when using the 9560 Active Head) allow direct calibration of oscilloscope bandwidth. They also calibrate Z-axis and horizontal deflection bandwidth. Dual sine outputs calibrate the oscilloscope's trigger sensitivity and any other functions that normally require the insertion of a splitter into the connecting cable.

## Vertical deflection gain

DC levels and 10 Hz to 100 kHz squarewaves are adjustable up to 220 V with 5-digit amplitude resolution at 0.025 % accuracy for dc and 0.05 % for squarewaves—more than sufficient to calibrate the vertical deflection ranges of 12-bit digitizing and 14-bit interpolating oscilloscopes.

The 9500B even checks the oscilloscope's input impedance before applying high voltages in order to protect 50  $\Omega$  input terminations.

Automatic switching to 50  $\Omega$  output impedance provides the same waveforms at amplitudes up to 5.56 V (except 9560 where source impedance is compensated for by re-scaling the minimum amplitude i.e., 8.88 mV to 5.56 V pk-pk into 50  $\Omega$ ).

## Timebase accuracy

Timing markers cover the calibration of timebase ranges from 0.2 ns to 50 s per division. A choice of four styles, plus the ability to highlight every tenth marker by increasing its amplitude, provides optimum visibility on analog and digital storage oscilloscopes.

The square and pulse markers can also be used to calibrate timebase jitter.

Complete with high-stability crystal reference, the 9500B calibrators have timing accuracy of  $\pm 0.25$  ppm—the level required to calibrate the latest DSOs.

## Auxiliary calibration functions

The 9500B Auxiliary Function capabilities calibrate oscilloscope functions often overlooked on other calibrators.

- DC and squarewave currents up to 100 mA calibrate current probes
- Composite video signals test TV sync separator functions
- Linear ramps calibrate trigger level markers and check DSOs for missing bits
- High current 5 V to 20 V pulses test 50 W terminator protection
- Zero skew accurately aligns pulse edges to evaluate channel delays in multi-channel scopes
- AUX IN routes external calibration waveforms to an active head's BNC/SMA connector
- Resistance and capacitance functions directly measure oscilloscope input impedance
- Short/open circuit outputs allow testing of oscilloscope input leakage current

# 9500B Oscilloscope Calibrator

**FLUKE**®

Calibration

## Specifications

All Specifications TCal  $\pm 5^\circ\text{C}$ , 1 year,  
99 % where Factory TCal =  $23^\circ\text{C}$   
(Except frequency accuracies 5 year)  
Uncertainties are fully inclusive of  
instrument errors, resolution, stability,  
regulation and traceability to National

Standards.

In general, nothing further needs to  
be added to determine test uncertainty  
ratio against the equipment under  
calibration.

### Voltage function (Not available via 9550 Active Head)

	DC Into 1 M $\Omega$	DC Into 50 $\Omega$	Square Wave Into 1 M $\Omega$	Square Wave Into 50 $\Omega$
Amplitude	$\pm 1\text{ mV to } \pm 200\text{ V}$	$\pm 1\text{ mV to } \pm 5\text{ V}$	40 $\mu\text{V to } 200\text{ V pk-pk}$	40 $\mu\text{V to } 5\text{ V pk-pk}$
Accuracy	$\pm(0.025\% + 25\text{ }\mu\text{V})$		$\geq 1\text{ mV } \pm(0.1\% + 10\text{ }\mu\text{V})$ , $< 1\text{ mV } \pm(1\% + 10\text{ }\mu\text{V})$ @ $\leq 10\text{ KHz}$	
Ranging	Volt/div factors of 1, 2, 5 or 1, 2, 2.5, 4, 5; or continuously variable			
Deviation	$\pm 11.2\%$ (Including over and under-range)			
Rise/fall time			$< 100\text{ V pk-pk } < 150\text{ ns}$ ; $\geq 100\text{ V pk-pk } < 200\text{ ns}$	
Aberrations			$< 2\%$ peak for first 500 ns	
Frequency			10 Hz to 100 kHz	
DC into 1 MW available at all heads without specification degradation.				

DC into 1 MW available at all heads without specification degradation.

### Edge function (9550 Active Head supports 25 ps Fast Edge only)

	500 ps Edge Pulse Into 50 W or 1 M $\Omega$	HV Edge Pulse Into 1 M $\Omega$	150 ps Fast-Edge (9530 Head Only) Into 50 $\Omega$	70 ps Fast-Edge (9560 Head Only) Into 50 $\Omega$	25 ps Fast-Edge (9550 Head Only) Into 50 $\Omega$
Amplitude	5 mV to 3 V pk-pk	1 mV to 200 V pk-pk*	5 mV to 3 V pk-pk	25 mV to 2 V pk-pk	425 mV to 575 mV pk-pk
Polarity	Rising & Falling Return to Ground	Rising & Falling Return to Ground	Rising & Falling Return to Ground	Rising Rising & Falling	Rising & Falling Return to Ground
Rise/fall time (10 % to 90 %)	500 ps	$< 100\text{ V pk-pk } < 150\text{ ns}$ ** $\geq 100\text{ V pk-pk } < 200\text{ ns}$ **	150 ps	70 ps	25 ps
Accuracy	+50 ps to -150 ps	NA	$\pm 25\text{ ps}$	$\pm 12\text{ ps}$	$\pm 3\text{ ps}$
Accuracy (displayed value)	$\pm 35\text{ ps}$	NA	$\pm 12\text{ ps}$	$\pm 8\text{ ps}$	$\pm 1.5\text{ ps}$
Duty cycle	10 %	50 %	10 %	10 %	10 %
Aberrations (Into VSWR 1.2:1)	$< \pm 2\%$ pk in 8 GHz $< \pm 1.5\%$ pk in 3 GHz (first 10 ns)	$< \pm 2\%$ pk (first 500 ns)	$< \pm 3\%$ pk in 8 GHz $< \pm 2\%$ pk in 3 GHz (first 1 ns)	$< \pm 4\%$ pk in 20 GHz $< \pm 3\%$ pk in 8 GHz $< \pm 1\%$ pk in 3 GHz (first 700 ps)	$< \pm 5\%$ pk in 20 GHz $< \pm 3\%$ pk in 10 GHz $< \pm 1\%$ pk in 3 GHz (first 200 ps)
Frequency	10 Hz to 2 MHz	10 Hz to 100 kHz	10 Hz to 2 MHz	10 Hz to 1 MHz	10 Hz to 1 MHz
Trigger to edge delay	25 ns (typical)				
Trigger to edge jitter	5 ps pk-pk				

\* 1 mV to 5 V pk-pk into 50 W

\*\* into 50 W  $< 100\text{ ns}$

Edge speeds faster than 500 ps are not recommended for 1 MW input applications. 9560 and 9550 50 W only.

### Timing marker function (Not available via 9550 Active Head)

Styles	Square	Sine	Pulse	Narrow Triangle
Period	9.0091 ns to 55 s	450.5 ps to 9.009 ns 9500/600 (909.1 ns min) 9560 (180.19 ps min)	900.91 ns to 55 s	900.91 ns to 55 s
Ranging	Time/div ranging 1, 2, 5 or 1, 2, 2.5, 4, 5 or continuously variable			
Deviation	$\pm 45\%$ (Including over-range)			
Rise/fall times	1 ns typ.	NA	1 ns typ.	2.5 % of period
Timing accuracy	$< 83\text{ }\mu\text{s } \pm 0.25\text{ ppm}$ , $\geq 83\text{ }\mu\text{s } \pm 3\text{ ppm}$			
Amplitude	100 mV to 1 V pk-pk			
Sub-division	Every tenth marker can be set to higher amplitude for periods $\geq 1\text{ }\mu\text{s}$ for all waveshapes			

Line frequency timing markers are available in Square waveform, Jitter wrt Line zero crossing  $\pm 20\text{ }\mu\text{s pk-pk}$ .

Periods below 2 ns are not recommended for 1 M $\Omega$  input applications. 9560 50  $\Omega$  only.

# 9500B Oscilloscope Calibrator

## Leveled sine function (Not available via 9550 Active Head)

	9500B/600	9500B/1100	9500B/3200 & 9530	9500B/3200 & 9560
Frequency range	0.1 Hz to 600 MHz	0.1 Hz to 1.1 GHz	0.1 Hz to 3.2 GHz	0.1 Hz to 6.4 GHz
Amplitude (pk-pk) (into 50 W)	0.1 Hz to 550 MHz 5 mV to 5 V	0.1 Hz to 550 MHz 5 mV to 5 V	0.1 Hz to 550 MHz 5 mV to 5 V	0.1 Hz to 550 MHz 5 mV to 5 V
	550 MHz-600 MHz 5 mV to 3 V	550 MHz to 1.1 GHz 5 mV to 3 V	550 MHz to 2.5 GHz 5 mV to 3 V	550 MHz to 2.5 GHz 5 mV to 3 V
			2.5 GHz to 3.2 GHz 5 mV to 2 V	2.5 GHz to 3.2 GHz 5 mV to 2 V
				3.2 GHz to 6.4 GHz 25 mV to 2 V
Accuracy	± 1.5 % at single Ref Frequency (50 kHz to 10 MHz)			
Flatness wrt ref frequency Into VSWR of 1.6:1 (1.2:1)	0.1 Hz to 300 MHz ± 2.0 %	0.1 Hz to 300 MHz ± 2.0 %	0.1 Hz to 300 MHz ± 2.0 %	0.1 Hz to 300 MHz ± 2.0 %
	300 MHz to 550 MHz ± 3 % (± 2.5 %)	300 MHz to 550 MHz ± 3 % (± 2.5 %)	300 MHz to 550 MHz ± 3 % (± 2.5 %)	300 MHz to 550 MHz ± 2.5 % (± 2.5 %)
	550 MHz to 600 MHz ± 4 % (± 3.5 %)	550 MHz to 1.1 GHz ± 4 % (± 3.5 %)	550 MHz to 1.1 GHz ± 4 % (± 3.5 %)	550 MHz to ± 3.5 % (± 3.0 %)
			1.1 GHz to 3.2 GHz ± 5 % (± 4 %)	3.0 GHz to 6.0 GHz ± 5.0 % (± 4.0 %)
Harmonic	purity 2nd Harmonic <-35 dBc, 3rd Harmonic <-40 dBc in 12 GHz			
Non and sub harmonic purity	<-40 dBc			<-35 dBc
Periods below 2 ns are not recommended for 1 MΩ input applications. 9560 50 Ω only.				

## Dual sine function (Not available via 9550 Active Head and specification limited to heads of the same type)

	DC Into 1 M $\Omega$	DC Into 50 $\Omega$	Square Wave Into 1 M $\Omega$	Square Wave Into 50 $\Omega$
	9500B/600	9500B/1100	9500B/3200 & 9530	9500B/3200 & 9560
Frequency range	0.1 Hz to 600 MHz	0.1 Hz to 1.1 GHz	0.1 Hz to 3.2 GHz	0.1 Hz to 3.2 GHz
Time alignment	$\pm 25$ ps any channel to any channel			
Periods below 2 ns are not recommended for 1 M $\Omega$ input applications. 9560 50 $\Omega$ only.				

## Input impedance functions (Not available via 9550 Active Head)

Resistance measurement	10 $\Omega$ to 40 $\Omega$	40 $\Omega$ to 90 $\Omega$	90 $\Omega$ to 150 $\Omega$	50 k $\Omega$ to 800 k $\Omega$	800 k $\Omega$ to 1.2 M $\Omega$	1.2 M $\Omega$ to 12 M $\Omega$
Accuracy	$\pm 0.5\%$	$\pm 0.1\%$	$\pm 0.5\%$	$\pm 0.5\%$	$\pm 0.1\%$	$\pm 0.5\%$
(Not available via 9550 and 9560 Active Head)						
Capacitance measurement	1 pF to 35 pF	35 pF to 95 pF				
Accuracy	$\pm 2\% \pm 0.25$	$\pm 3\% \pm 0.25$				

## Pulse width function (Not available via 9550 Active Head)

Pulse width	1 n to 100 ns
Accuracy	$< \pm 5\% \pm 200$ ps
Adjustment resolution	1 ns to 4 ns, < 50 ps 4 ns to 20 ns < 250 ps 20 ns to 100 ns < 1 n
Rise/fall time	< 450 ps
Aberrations	$< \pm 5\%$ pk (typical)
Width stability	< 10 ps pk-pk 10 mins/1 $^{\circ}$ C
Pulse jitter (wrt trigger)	< 5 ps pk-pk
Frequency	1 kHz to 1 MHz
Amplitude	1 V pk-pk into 50 W



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**FLUKE**®

Calibration

## Other output functions (Not available via 9550 Active Head)

Current	DC	Square wave
Amplitude	± 100 µA to ± 100 mA	± 100 µA to ± 100 mA pk-pk
Accuracy	±(0.25 % + 0.5 µA)	
Duty cycle and symmetry		50 %, symmetrical about ground
Rise time and aberrations		< 150 ns and <± 2 % pk
Requires 9530 or 9510 Head and BNC Current Adapter		
Composite video output		
Amplitude	1.0 V pk-pk	
Pattern (full raster)	White, grey or black	
Sync polarity	Positive or negative	
Standards	625-line 50 Hz, 525-line 60 Hz	
Trigger output	Composite Sync or Odd Field Start	
9560 50 W only		
Auxiliary input		
Signal routing	Rear SMA input, passive and switched 50 W path to any active head	
Maximum input	± 40 V pk-pk, ± 400 mA pk-pk	
Insertion loss (Into 50 W)	to 100 MHz < 2.5 dB, to 500 MHz < 4 dB, to 1 GHz < 6 dB	
Reference frequency	Input (BNC)	Output (BNC)
Frequency range	1 MHz to 20 MHz in 1 MHz steps	1 MHz or 10 MHz
Level (typical)	90 mV to 1 V pk-pk	Into 50 W 1 V pk-pk, Into 1 MW 2 V pk-pk
Lock range	± 50 ppm	

## General specifications

Environmental	Operating	Storage
Temperature	5 °C to 40 °C	0 °C to 50 °C Transit <100 hours -20 °C to 60 °C
Humidity (non-condensing)	<90 % 5 °C to 30 °C <75 % 30 °C to 40 °C	<95 % 0 °C to 50 °C
Safety	Designed to and documented to EN610101-11993/A21995CE and ETL marked	
EMC (including options)		
Radiated emissions	EN55011/22 FCC Rules part 15 sub-part J class B	
Radiated immunity	EN50082-1	
Conducted emissions	EN55011 1991 Class B	
Conducted immunity	EN50082-1	
Harmonics	EN61000-3-2	
Shock and vibration	MIL-T-28800 type III, class 5, style E.	
Line voltage	95 V to 132 V rms 209 V to 264 V rms Installation Cat II	
Line frequency	48 Hz to 63 Hz	
Power consumption	<400 VA	
Warm-up	20 minutes	
	9500 Base Unit	95xx Active Heads
Dimensions (HxWxD)	133 mm x 427 mm x 440 mm (5.24 in x16.8 in x 17.3 in)	65 mm x 31 mm x 140 mm (2.56 in x1.22 in x 5.51 in)
Weight (approx.)	12 kg (27 lb)	0.45 kg (1 lb)
Warranty period	One-year	Three-year ActivePlus CarePlan

## Other output functions

Overload pulse	
Amplitude	5 V to 20 V into 50 $\Omega$
Polarity	Positive/negative
Duration	0.2 s to 100 s (subject to pulse energy limits)
Energy power in 50 $\Omega$	1.6 J to 50 J 0.5 W to 8 W
Trigger	Manual max. rep rate 0.3 Hz (Internally limited)
Zero skew	
Unadjusted skew	$\leq \pm 25 \text{ ps ch to ch}$
Adjusted skew	$\leq \pm 5 \text{ ps ch to ch}$
Skew temp. coef.	< 0.2 ps/°C
Rise/fall time	450 ps typ
Relative jitter	< 7 ps pk-pk
Input leakage function	
Open circuit output	Leakage < $\pm 50 \text{ pA}$
Short circuit output	Offset < $\pm 15 \mu\text{V}$
LF linear ramp	
Waveforms	1 V pk-pk triangle symmetrical about ground
Linearity	$\leq \pm 0.1 \% \text{ deviation over } 10 \text{ to } 90 \%$
Ramp time	1 ms, 10 ms, 100 ms or 1 s