9500

9500

OSCILLOSCOPE
CALIBRATOR

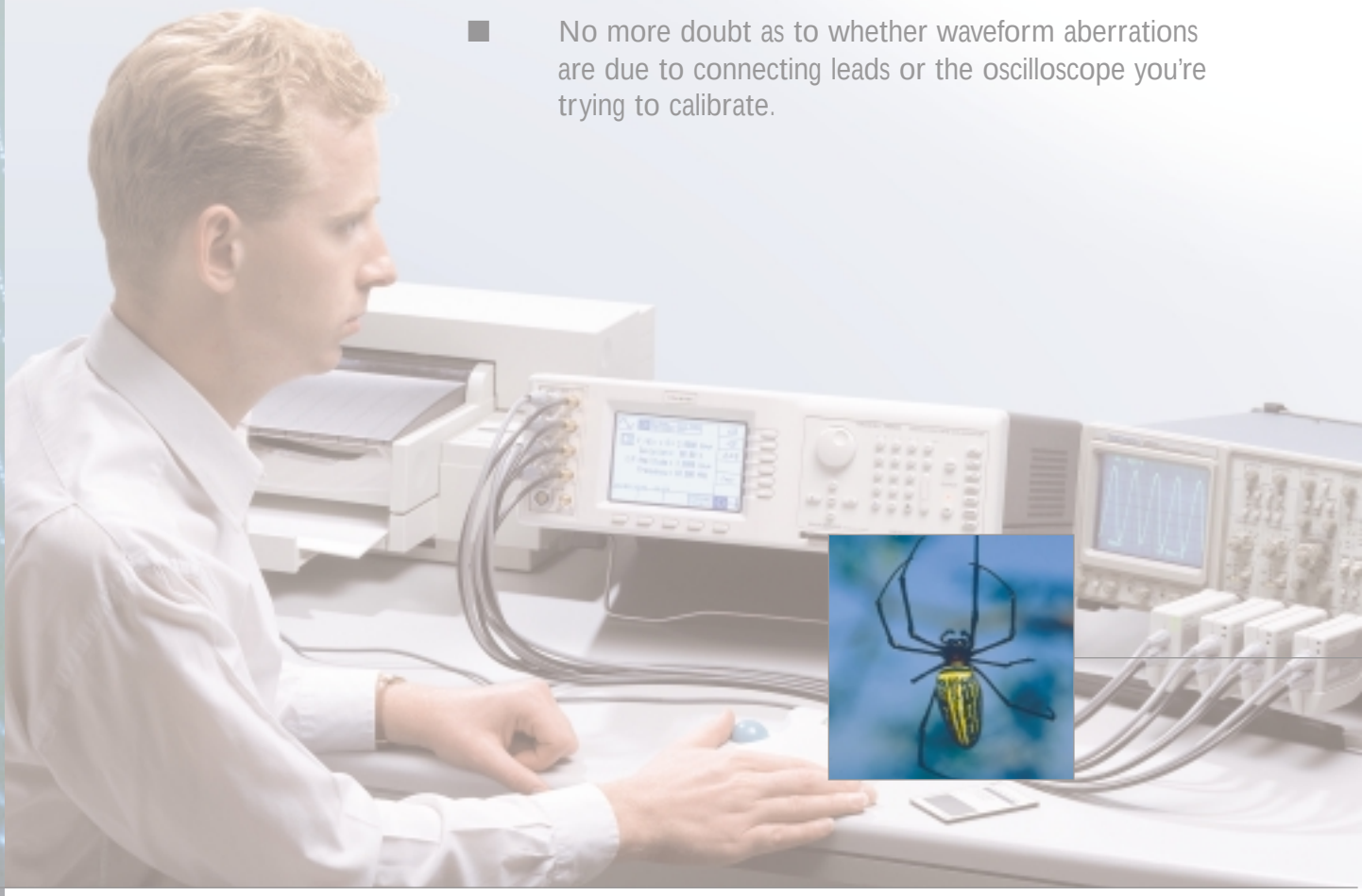
Scope Calibration

– untangled by the Leader in Scope Calibration.

W

The integrated solution to Oscilloscope Calibration

- No more complicated test systems, full capability up to 14GHz oscilloscopes
- No more complex lead changes.
- No more complicated signal multiplexers or impedance matching networks.
- No more doubt as to whether waveform aberrations are due to connecting leads or the oscilloscope you're trying to calibrate.



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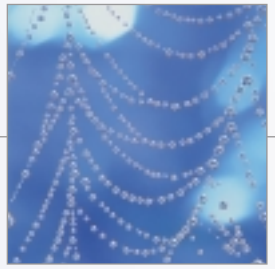
9500 Calibrator

Depending on the configuration you choose, the Model 9500 Calibrator can calibrate analog and digital-storage oscilloscopes up to 3.2 GHz and when combined with the 9550 Active Head, the capability is increased to 14GHz. And with full upgradeability from 400 MHz right through to 3.2 GHz, the investment you make today won't be obsolete tomorrow.

The range of outputs they produce includes precision sine, square, fast-edge, DC level and timing marker waveforms — all the signals required to calibrate any scope calibration workload up to your chosen bandwidth. Wavetek's unique Active Head TechnologyTM delivers these calibration waveforms directly to the oscilloscope's input connectors without the need for connecting leads. The ability to drive as many as five Active Heads, combined with integral 50Ω termination and sophisticated Dual Sine and Zero Skew features, allows the calibration process to be fully automated — even on multi-channel oscilloscopes. As a result, you'll enjoy the twin benefits of greater throughput and higher confidence levels.



Minimum Cost, Maximum Throughput

All Model 9500 Scope Calibrators provide you with two ways of achieving automated calibration. Firstly, every 9500 can be combined with automated calibration software that's based on our powerful Windows™ compatible Portocal-II System. This software allows you to run semi-automated calibration procedures on analog oscilloscopes, and fully automated calibration procedures on digital-storage types that can transfer trace information over the IEEE-488 bus. High performance DSOs that used to take hours to calibrate can now be calibrated in minutes.

In addition to the free library of fully tested scope calibration procedures supplied with every workstation, you have the option to buy into our *Option 10* or *Fast-Track* schemes, so that you can download new procedures from our World Wide Web Site or get custom procedures written at highly competitive rates.

Even if you operate a Model 9500 calibrator stand-alone, without a PC, you can still run semi-automated procedures contained on plug-in PCMCIA cards. Each procedure guides the operator through the entire calibration process — from connecting Active Heads to the oscilloscope inputs, to printing out an ISO9000 compliant calibration certificate.

Model 9500 Calibrators will even run procedures written for the oscilloscope calibration options of Wavetek's Model 9100 Multi-Product calibrator*.

Coupled with their lightweight portability (they weigh in at a mere 12kg or 27 lbs), Model 9500 Calibrators are the ideal solution to on-site oscilloscope calibration.

Exceptional Usability

As far as their user-interface is concerned, they share much in common with Wavetek's other highly acclaimed 9000-Series calibration systems.

Major output functions are selected with single key-strokes, and all output parameters are displayed clearly on a 12 x 8 cm flat-panel LCD. The numeric keypad offers calculator style value entries, the display cursor and spin wheel allow you to increment or decrement output values a digit at a time, and the spin wheel and multiply/divide softkeys allow you to perform standard oscilloscope range sequences or decade ranging.

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Total System Control

For systems use, Model 9500 Scope Calibrators feature a SCPI-compatible IEEE-488 interface that allows them to be fully computer controlled. They even include emulation modes that minimize the software effort required to mimic existing calibration systems designed around Tektronix CG5011 and SG5030 calibrators.

Best in Class

With their comprehensive range of calibration waveforms, automated procedure modes and ease-of-use, no other Scope Calibration systems on the market gives you the power or flexibility of Model 9500 Scope Calibrator. And, as all our existing customers know, no other manufacturer gives you the same level of hardware or software support.

Active Head Technology™

Generating high-speed edges, squarewaves and leveled sinewaves within millimetres of an oscilloscope's input connectors, Wavetek's unique Active Head Technology™ eliminates any possibility of connecting leads affecting the waveshape or amplitude of calibration signals.

By utilizing the latest Step-Recovery and Schottky Diode switching devices, coupled with proprietory surface-mount hybrid-circuit construction techniques, Active Head Technology™ faithfully delivers the 150-picosecond edges needed for pulse response testing.

And unlike other oscilloscope calibrators on the market, you're not restricted to fixed amplitude pulses. Active Head Technology™ lets you adjust the output amplitude between 4.44mV and 3.1V, allowing you to check an oscilloscope's input 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 energy distribution.

Precision Matching for Waveform Integrity

A matched impedance micro-strip transmission line delivers high-speed edges the short distance across the hybrid to the Active Head's BNC output connector. An internally switched 50Ω termination eliminates the need for external terminators when connecting to high impedance oscilloscope inputs.

The hybrid also contains sinewave amplitude sensing circuits, wideband attenuator networks, a 500 ps pulse generator and output signal multiplexing.

In addition to delivering fast edges, these circuits allow the same Active Head to deliver precision DC levels up to ±220 V, calibrated amplitude squarewaves up to 210 Vpk-pk from 10 Hz to 100 kHz, leveled sinewaves from 0.1 Hz to 3.2 GHz, and three different styles of timing marker from 0.5 ns to 50 s. The hybrid can even route a high frequency, externally generated calibration signal to the Active Head output.

In total, Wavetek's *Active Head Technology*™ achieves an incredible 134 dB dynamic range and a bandwidth of over 5 GHz — levels of performance unsurpassed by any other oscilloscope calibrator.

Equally as impressive, it delivers all this through a single BNC connector from a lightweight module measuring only 14 x 6.5 x 3 cm.

Ruggedized for Hard Use

As much care and effort has been put into the mechanical design of Wavetek's Active Heads as has been put into their electrical design.

The internal circuit boards are resiliently mounted inside die-cast aluminum headshells that protect them from hard knocks and rough use. Even the BNC output connector is replaceable without soldering operations.

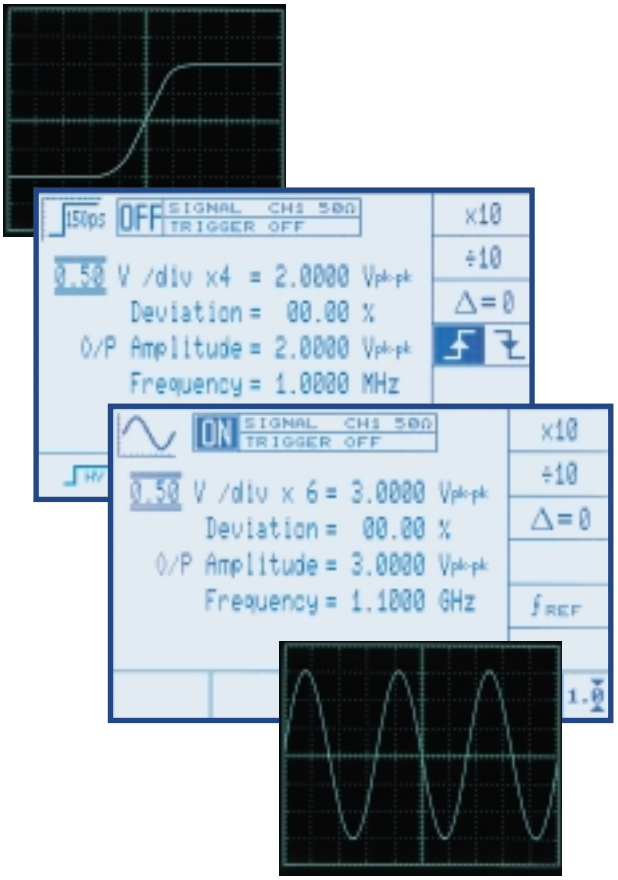
We are so confident in the reliability of our Active Heads that they come with a 3-year *Active Plus CarePlan* warranty as standard.

Giving You the Edge

Currently there are three types of Active Head available for the Model 9500 Scope Calibrators — the Model 9510 which delivers 500 picosecond edges, the Model 9530 (3.2 GHz), which generates 500 picosecond and 150 picosecond edges and the 9550 which is able to generate 25ps edges. In addition to fast edges the 9510 and 9530 Active Heads deliver all the other waveforms required for oscilloscope calibration.

Although 500 picosecond edges will calibrate the majority of high bandwidth oscilloscopes currently on the market, choosing the 150 picosecond heads will enable you to test them to their performance limits. The 25ps module will enable the test and verification of 14GHz digital storage oscilloscopes

As ultra high-speed A/D conversion changes the face of oscilloscope design, the Model 9500 keeps you one step ahead.



Vertical and Horizontal Deflection Bandwidth

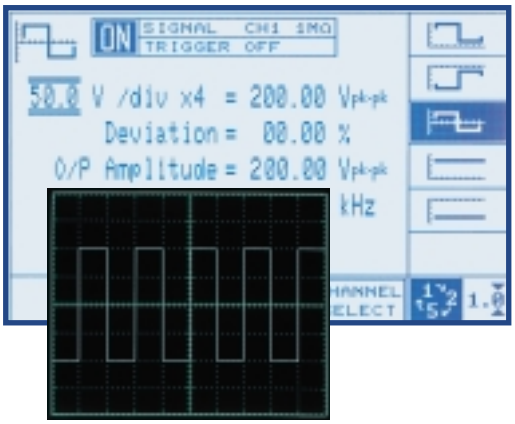
Fast return-to-ground edges with amplitudes between 4.44 mV and 3.1 V and rise/fall times of 150 ps or 500 ps check the pulse response and bandwidth of an oscilloscope's vertical deflection/acquisition amplifiers.

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

Leveled sinewaves up to 400 MHz, 600 MHz, 1.1 GHz or 3.2 GHz with an amplitude range of 4.44mV to 5.56V pk-pk into 50Ω allow direct calibration of scope 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

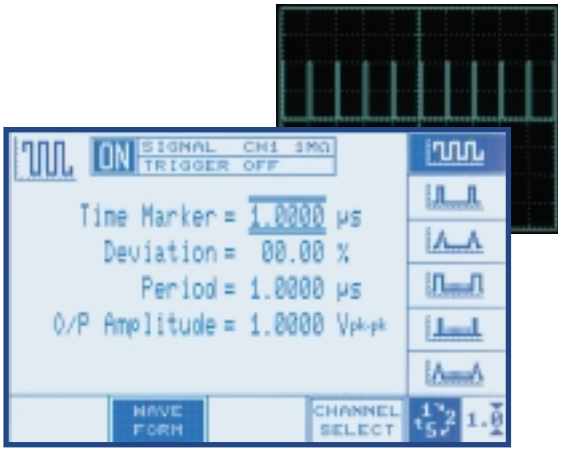
DC levels and 10 Hz to 100 kHz squarewaves are adjustable up to 220 V with 5-digit amplitude resolution at 0.025% accuracy for DC and 0.05% for squarewaves — more than sufficient to calibrate the vertical deflection ranges of the latest 12-bit digitizing and 14-bit interpolating oscilloscopes. Model 9500 Scope Calibrators even check the oscilloscope's input impedance before applying high voltages in order to protect 50Ω input terminations. Switching to 50Ω output impedance provides the same waveforms at amplitudes up to 5.56 V.



Timebase Accuracy

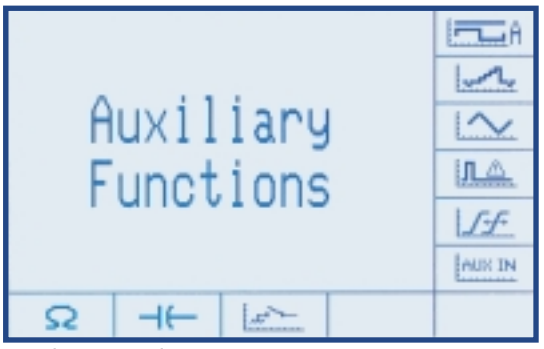
Timing markers cover the calibration of timebase ranges from 0.5 ns to 50 seconds per division. A choice of three styles, plus the ability to highlight every tenth marker by increasing its amplitude, provides optimum visibility on analog and digital storage oscilloscopes. The square and pulse markers can also be used to calibrate timebase jitter.

By adding the high-stability crystal reference option, the Model 9500 Calibrator' basic timing accuracy of ±10 ppm can be improved to the ±0.25 ppm level required to calibrate the latest DSOs.



Auxiliary Calibration Functions

The Model 9500 Auxiliary Function capabilities calibrate scope functions often overlooked on other calibrators.



Resistance and Capacitance functions directly measure oscilloscope input impedance

Short/Open-circuit outputs allow testing of oscilloscope input leakage current

- 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 50Ω 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 connector

* Requires at least two Active Heads.

Calibration Software

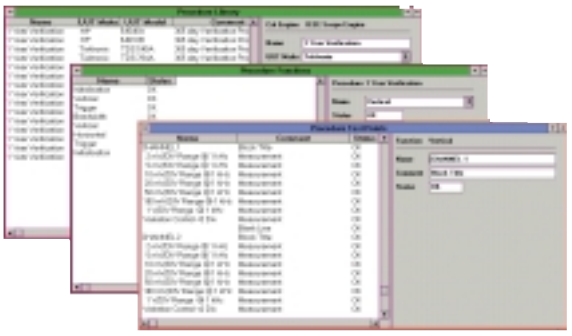
The Model 9500 Oscilloscope Calibrators can be used with Wavetek's powerful IEEE-488 (GPIB) based Automated Calibration Software.

This not only allows you to automate the calibration process, it also documents results, manages your calibration inventory, and allows you to develop new scope calibration procedures. If you want to use the same system to calibrate 14 other categories of test equipment (ranging from hand-held DMMs to frequency counters and chart recorders), the software will also drive a Wavetek Model 9100 Multi-Product Calibrator.

What's more, you can upgrade to a full Portocal-II System — allowing you to control other calibrators (such as Wavetek's Model 4808 Multi-Function Calibrator).

Running under Windows™ and supporting multi-user networking, the software implements advanced features such as ISO9000 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.



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Procedure Support

We know that any automated calibration system is only as good as the calibration procedures you can run on it. That's why the software we ship with every Model 9500 calibrator includes comprehensive libraries of procedures for popular oscilloscopes. Every one of these procedures has been written by a skilled calibration engineer and checked against the scope manufacturer's specifications — ensuring you get plug&play convenience and guaranteed results.

To keep pace with the fast changing oscilloscope market, Wavetek 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 Scope Calibration procedures written) you can buy into our Option 10 Software Support Program, giving you access to every new procedure written by Wavetek's Software Support Team during the next 12-months. On current performance, that's upwards of 100 new scope 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.wavetek-precision.com).

If the Scope Calibration procedure you require still isn't available and you need it in a hurry, we can write it for you at very competitive rates as part of our Fast-Track Procedure Writing scheme.

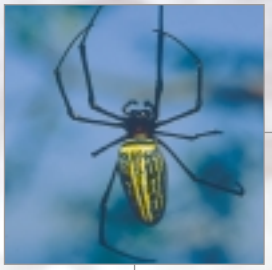
* Only accessible to Software Option 10 subscribers.

Unique Support

Wavetek's Model 9500 Scope calibrator are not only easy to use, they're also easy to support. For a start, their accuracy specifications are based around a 1-year recalibration interval. And when they do need recalibration, you won't have to lose the entire system while it's being performed.

In addition to being supported by traditional scope calibration standards, the Model 9500 mainframe and its Active Heads can be calibrated separately. The mainframe unit defines the DC and LF traceability, so it's easily calibrated on-site using a long-scale DMM or our Model 4950 Multifunction Transfer Standard, and a counter.

All high-frequency calibrations (such as the leveled sinewave and pulse outputs) are confined to the Active Heads, which can therefore be calibrated independently. Measuring 14x6.5x3 cms and weighing only 450 grams, they're small enough and light enough to be sent by regular mail services to a cal lab. Wavetek's global network of Service Centers provides a fast turnaround Active Head recalibration service.



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Ultra Fast Active Head with 25ps pulse capability

As oscilloscope manufacturers push forward the forefronts of modern technology, new oscilloscopes are continually arriving on the market with greater functionality and performance capabilities. At Wavetek we continue to develop the technology necessary to allow oscilloscope manufacturers and calibration service providers to develop the calibration systems to support the latest digital sampling oscilloscopes.

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

The Model 9550 Active Head provides pulses with rise and fall times of 25ps that can be used for calibration of sampling oscilloscopes to 14GHz. Our Active Head design generates this signal right at the terminals of the unit-under-test, thereby guaranteeing the integrity of the signal.

The 9550 Active Head can also be use to verify fast A to D converters and EMI receivers .

With the new Model 9550 Active Head - you not only get the best quality fastest edge available, but also the ability to import traceability of fast edge into your laboratory.

Wavetek also stand-by the reliability of the 9550 by offering a standard 3 year warranty.

It's all part of the comprehensive range of oscilloscope calibration solutions available from Wavetek, - the Leader in Scope Calibration.

Specifications

(Total Uncertainties for 1 year, T_{cal} ± 5°C. Frequency specifications valid for 5 years)

DC Voltage

Amplitude: ±1mV to ±200V into 1MΩ
±1mV to ±5V into 50Ω
Accuracy: ±(0.025% + 25µV)
Ranging: 1, 2, 5 or 1, 2, 2.5, 4, 5 or continuous
Deviation: ±11.2%

Squarewave

Amplitude:
- Range: 40µV to 200V pk-pk into 1MΩ
  40µV to 5V pk-pk into 50Ω
- Polarity: Positive, negative or symmetrical about ground
- Accuracy (10Hz to 10kHz):
  - <1mV ±(1% + 10µV)
  - 1mV-21mV ±(0.10% + 20µV)
  - 21mV-556mV ±(0.10% + 1µV)
  - 556mV-210V ±(0.05% + 1µV)
- Ranging: 1, 2, 5 or 1, 2, 2.5, 4, 5 or continuous
- Deviation: ±11.2%

Rise/Fall Time:
- <100V <150ns
- ≥100V <200ns

Aberrations: <2% peak for first 500ns
Frequency:
- Range: 10Hz to 100kHz
- Accuracy: ±10ppm (±0.25ppm with Option 100)
- Ranging: 1, 2, 5 or 1, 2, 2.5, 4, 5 or continuous

Low-Edge Pulse

Amplitude:
- Range: 5mV to 3V pk-pk into 50Ω
- Accuracy: ±3%
- Ranging: 1, 2, 5 or 1, 2, 2.5, 4, 5 or continuous
- Deviation: ±11.2%

Rise/Fall Time: 500ps return to ground
Mk/Sp Ratio: 1:9
Aberrations: <2% peak for first 10ns
<0.25% peak 10 ns to 1µs
<0.1% peak beyond 1µs
Frequency:
- Range: 10Hz to 2MHz
- Accuracy: ±10ppm (±0.25ppm with Option 100)
- Ranging: 1, 2, 5 or 1, 2, 2.5, 4, 5 or continuous

High-Edge Pulse

Amplitude:
- Range: 1V to 200V pk-pk into 1MΩ
  1V to 5V pk-pk into 50Ω
- Accuracy: ±3%
- Ranging: 1, 2, 5 or 1, 2, 2.5, 4, 5 or continuous
- Deviation: ±11.2%

Rise/Fall Time:
- <100V <150ns
- >=100V <200ns

Mark/Space Ratio: 1:1
Aberrations: <2% peak for first 500ns
<0.1% peak 500ns to 100µs
<0.01% peak beyond 100µs
Frequency: 10Hz to 100kHz
- Accuracy: ±10ppm (±0.25ppm with Option 100)
- Ranging: 1, 2, 5 or 1, 2, 2.5, 4, 5 or continuous

Fast-Edge

(only available on 9530 Active Heads)

Amplitude:
- Range: 5mV to 3V pk-pk into 50Ω
- Accuracy: ±3%
- Ranging: 1, 2, 5 or 1, 2, 2.5, 4, 5 or continuous
- Deviation: ±11.2%

Rise/Fall Time: 150ps return to ground
Mk/Sp Ratio: 1:9
Aberrations: <3% peak for first 1ns
<2% peak 1 ns to 10ns
<0.25% peak 10 ns to 50ns
Frequency:
- Range: 10Hz to 2MHz
- Accuracy: ±10ppm (±0.25ppm with Option 100)
- Ranging: 1, 2, 5 or 1, 2, 2.5, 4, 5 or continuous

25pS Fast-Edge

(only available on Models 9550 Active Heads)

Amplitude:
- Range: 425 to 575mV pk-pk into 50Ω
- Accuracy: ±2%

Rise/Fall Time: 25ps return to ground
Mark/Space Ratio: 1:9

Other Edge Function Specifications

Frequency Range: 10Hz to 1MHz
Ranging: 1, 2, 5 or 1, 2, 2.5, 4, 5 or continuous
Frequency Accuracy: 10ppm (Reduced to 0.25ppm with Option 100)
Trigger to Edge delay: 25ns (typical)
Trigger to Edge jitter 5ps pk-pk

Timing Markers

Styles: Square/Sine, Pulse or Narrow Triangle
Square/Sine:
- Period Square: 10ns to 50s
- Period Sine:
  - 9500/400 2.0ns to 10ns
  - 9500/600 1.0ns to 10ns
  - 9500/1100 0.5ns to 10ns

Pulse:
- Period: 1µs to 50s
- Rise/Fall Time: <700ps

Narrow Triangle:
- Period: 1µs to 50s
- Rise/Fall Time: 2.5% of period

Ranging: 1, 2, 5 or 1, 2, 2.5, 4, 5 or continuous for period of all waveshapes
Timing Accuracy:
- Normal: ±10ppm
- With Opt 100: ±0.25ppm

Timing Jitter: ≤10ps pk-pk
Deviation: ±45% for period
Amplitude: 100mV to 1V pk-pk
Sub-Division: Every 10th marker can be set to higher amplitude for periods ≥1µs for all waveshapes

Leveled Sine and Dual Sine

Frequency
- Range:
  - 9500/400 0.1 Hz to 400 MHz
  - 9500/600 0.1 Hz to 600 MHz
  - 9500/1100 0.1 Hz to 1.1 GHz
  - 9500/3200 0.1 Hz to 3.2 GHz
- Accuracy:
  - Normal: ±12ppm
  - With Opt 100: ±0.25ppm for f ≥ 12kHz

±3ppm max for f < 12kHz
Deviation: ±11.2%

Amplitude (Leveled Sine into 50Ω):
0.1Hz - 550MHz 4.44mV to 5.560V pk-pk
550MHz-2.5GHz 4.44mV to 3.336V pk-pk
2.5GHz - 3.2GHz 4.44mV to 2.224V pk-pk
Accuracy ±1.5% at 50 kHz

Flatness (Leveled Sine relative to 50kHz):
0.1Hz - 100MHz ±1.5%
100MHz - 550MHz ±3%
550MHz - 1.1GHz ±4%
1.1GHz - 3.2GHz ±5%

Ranging: 1, 2, 5 or 1, 2, 2.5, 4, 5 or continuous

Sine Purity:
2nd Harmonic <-35dBc
3rd Harmonic <-40dBc
All Other Spurious Signals <-40dBc (typical)

Input Impedance

Resistance Measurement:
Range: 10Ω-150Ω and 50kΩ-12MΩ
Accuracy:
10-40 (Ω) ±0.5%
40-90 ±0.1%
90-150 ±0.5%
50k-800k ±0.5%
800k-1.2M ±0.1%
1.2M-12M ±0.5%

Capacitance Measurement:
Range: 1pF to 95pF
Accuracy:
1pF - 35pF 2% ± 0.25pF
35pF - 95pF 3% ± 0.25pF

Current

Amplitude:
DC: ±100µA to ±100mA
Squarewave: 100µA to 100mA pk-pk
Accuracy: ±(0.25% + 0.5µA)
Frequency: 10Hz to 100kHz
Accuracy: ±10ppm (±0.25ppm with Option 100)
Ranging: 1, 2, 5 or 1, 2, 2.5, 4, 5 or continuous

sComposite Video Output

Amplitude: 1.0V, 0.7V, 0.3V
Pattern: White, Grey or Black
Sync Polarity: Positive or negative
Standards: 625-line 50Hz or 525-line 60Hz

LF Linear Ramp

Waveforms: 1V pk-pk sym. triangle
Ramp Time: 1ms to 1s

Overload Pulse

Amplitude: 5V to 20V into 50Ω
Polarity: Positive or negative
Duration: 0.2s to 100s
Trigger: Manual

Zero Skew

Unadjusted Skew: ±50ps ch to ch
Adjusted Skew: ±5ps ch to ch
Frequency Range: 10Hz to 100MHz

Short/Open Output

Output Leakage:
Open Circuit: ±50pA
Short Circuit: ±15µV

Auxiliary Input

Signal Routing: Rear i/p to any Active Head
Maximum Input:
Voltage: ±40V pk-pk
Current: ±400mA pk-pk

Trigger

Amplitude: ≥1V pk-pk into 50Ω
Risetime: <700ps
Rate:
User Selectable: f (up to 120 MHz), f/10 or f/100
Free Run: 100Hz

Reference Frequency Input

Frequency Range: 1MHz to 20MHz in 1MHz steps
Level: 90 mV to 1V pk-pk typ.
Lock Range: ±50ppm

Reference Frequency Output

Frequency: 1MHz or 10MHz
Level:
Into 50Ω: 1V pk-pk (typical)
Into 1MΩ: 2V pk-pk (typical)

Environment

Temperature:
Operating: 5°C to 40°C
Storage: 0°C to 50°C
Humidity: (non-condensing)
Operating: <90% over 5°C to 30°C
<75% over 30°C to 40°C
Storage: <95% over 0°C to 50°C

Power

Voltage: 95V to 132V rms or 209V to 264V rms
Frequency: 48Hz to 63Hz
Consumption: 400 VA
Warm-up: 20 minutes

Dimensions

Model 9500 Mainframe:
H x W x D 133 x 427 x 440 mm (5.24 x 16.8 x 17.3 ins)
Weight: 12 kg (27 lbs) approx.

Module 9510: 9530: 9550
H x W x D 65 x 31 x 140 mm (2.56 x 1.22 x 5.51 ins)
Weight: 0.45 kg (1 lb) approx.

Safety

Designed to UL3111 and EN61010-1-1:1993/A2:1995.

CE Marked

EMC (including options)

Emissions: EN55011:1991
Immunity: EN50082-1:1992
FCC Rules part 15 sub-part J class B

Warranty

Period:
Mainframe 1-year
Active Heads 3-year Active Plus CarePlan

Specifications may be subject to change without notice.

7000-Series
Volt Maintenance System

Model 4808
Multi-Function Calibrator

Model 1281
Precision Digital Multimeter

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Fax: (1) 858-450-0325

Web Site www.wavetek-precision.com

Ordering Information

Model 9500/400	400MHz High-Performance Oscilloscope Calibrator. A Certificate of Traceable Calibration and a Trigger Lead are also included. (Note: Requires one 9510 or 9520 Output Module)
Model 9500/600	600MHz High-Performance Oscilloscope Calibrator (otherwise as above)
Model 9500/1100	1.1GHz High-Performance Oscilloscope Calibrator (otherwise as above)
Model 9500/3200	3.2 GHz High-Performance Oscilloscope Calibrator (otherwise as above)
Model 9510	1.1 GHz Active Head with 500 ps pulse risetime (3-year Active Plus CarePlan warranty)
Model 9530	3.2 GHz Active Head with 150 ps and 500 ps pulse risetime (3-year Active Plus CarePlan warranty)
Model 9550	25ps Fixed edge pulse output module (3-year Active Plus CarePlan warranty)
Option 5	5-Channel Output (allows any mix of 9510/9520 Output Modules up to a total of five)
Option 10	Blank 256-Kbyte FLASH PCMCIA card (for procedure mode procedures)
Option 30	Blank 256-Kbyte battery-backed SRAM PCMCIA card (for procedure mode results)
Option 40	PCMCIA Read/Write Module (for desktop or tower PC)
Option 50	Tracker Ball
Option 60	Soft Carrying Case
Option 90	Rack Mounting Kit
Option 100	High-Stability Crystal Reference

Software Option10 Software Support Program (access to all procedures, software updates and enhancements produced by Wavetek's Software Support Group over a 12-month period.)

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