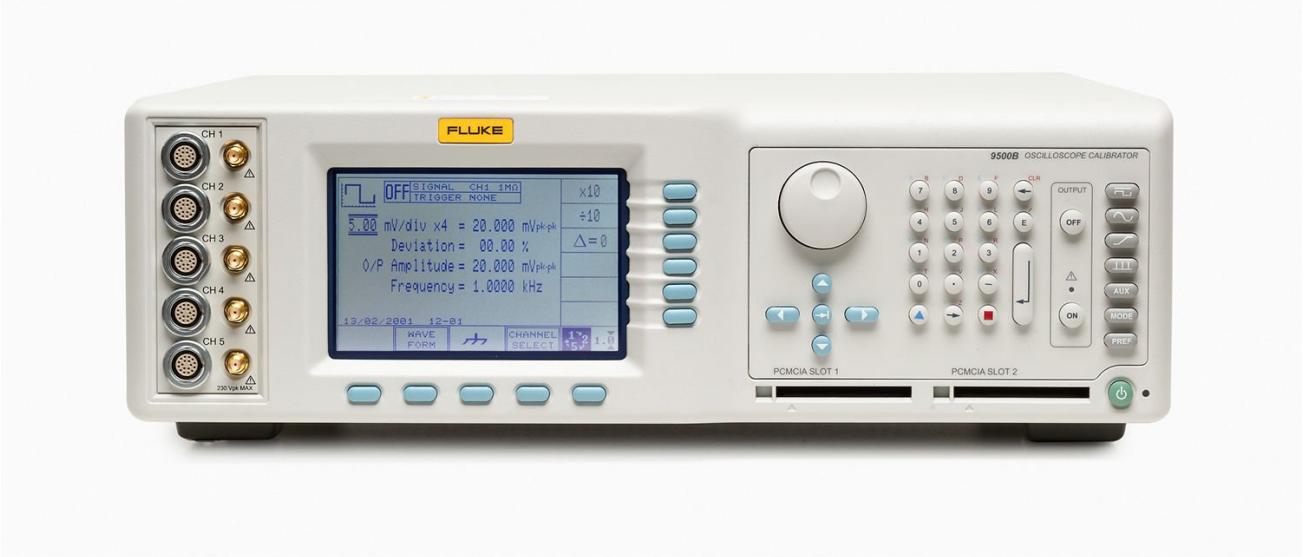
TECHNICAL DATA

9500B Oscilloscope Calibrator



Key features

- Fully automated, upgradeable calibration tool, offering hands-free, accurate oscilloscope calibration at a cost-effective price and performance level.
- Ultimate leveled sine performance up to 6.0 GHz with pulse edges of only 70 ps.
- Active Head Technology™ enables adjustable output amplitude between 4.44 mV and 3.1V.
- Controlled waveshape filtering ensures accurate energy distribution regardless of chosen amplitude.
- Simultaneous output on 5 channels,no need for lead changing and complex signal multiplexers or impedance matching network.

Product overview: 9500B Oscilloscope Calibrator

The 9500B Oscilloscope Calibrator features

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 and full automation

The Fluke Calibration 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.

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 Calibration'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. Running under Microsoft Windows® and supporting multi-user networking, the software implements advanced features such as ISO 9000 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.

Gold Support Program

To keep pace with the fast changing oscilloscope market, Fluke Calibration 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. 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.

Upgradeability

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 Calibration 9500B offers the perfect solution – full upgradeability. 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 organisation's daily oscilloscope calibration needs. Only Fluke Calibration's 9500 and 9500B Oscilloscope Calibration Workstations, with their unique 'Active Head Technology™', can provide the technology upgrade path to secure your investment in calibration equipment.

A range of mainframes

At Fluke Calibration, we recognise that we must address the 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 Calibration 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 Calibration 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 risetim - 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 Calibration if you have an existing 9500 mainframe you would like upgraded to this performance level.

Performance

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 ±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 50Ωtermination 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 3.1V, 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.

Complete Functionality

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 50W (8.88 mV - 5.56 V pk-pk into 50W 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 220V 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 50W input terminations. Automatic switching to 50Ω 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 - 5.56 V pk-pk into 50Ω).

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 ± 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 50W 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

Specifications: 9500B Oscilloscope Calibrator

DC Voltage	
Amplitude	± 1 mV to ± 200V into 1M Ω ± 1 mV to ± 5V into 50 Ω
Accuracy	± (0.025% + 25 µV)
Ranging	1, 2, 5 or 1, 2, 2.5, 4, 5 or continuous
Deviation	± 11.2%
Squarewave	
Amplitude	Range: 40 µV to 200V pk-pk into 1MΩ 40 µV to 5V pk-pk into 50Ω Polarity: Positive, negative or symmetrical about ground Accuracy (10 Hz to 10 kHz): <1 mV ± (1% + 10 µV) 1 mV-21 mV ± (0.10% + 10 µV) Ranging: 1, 2, 5 or 1, 2, 2.5, 4, 5 or continuous Deviation: ± 11.2%
Rise/Fall Time	<100V <150 ns >=100V <200 ns
Aberrations	<2% peak for first 500 ns
Frequency	Range: 10 Hz to 100 kHz Accuracy: ± 0.25 ppm Ranging: 1, 2, 5 or 1, 2, 2.5, 4, 5 or continuous

Low-Edge Pulse	
Amplitude	Range: 5 mV to 3V pk-pk into 50Ω Accuracy: +50 ps to -150 ps Ranging: 1, 2, 5 or 1, 2, 2.5, 4, 5 or continuous
Rise/Fall Time	500 ps retu to ground
Mk/Sp Ratio	1:9
Aberrations (into VSWR 1.2:1)	<± pk in 8Ghz <± 1.5% pk in 3Ghz (First 10ns)
Frequency	Range: 10 Hz to 2 Mhz Accuracy: ± 0.25 ppm Ranging: 1, 2, 5 or 1, 2, 2.5, 4, 5 or continuous
High-Edge Pulse	
Amplitude	Range: 1mV to 200V pk-pk into 1 MΩ 1mV to 5V pk-pk into 50Ω Accuracy: ± 3% Ranging: 1, 2, 5 or 1, 2, 2.5, 4, 5 or continuous
Rise/Fall Time	<100V <150 ns >=100V <200 ns
Mk/Sp Ratio	1:1
Aberrations	<2% peak for first 500ns
Frequency	Range: 10 Hz to 100 kHz Accuracy: ± 0.25 ppm Ranging: 1, 2, 5 or 1, 2, 2.5, 4, 5 or continuous
Fast-Edge (only available on 9530 Active Heads)	
Amplitude	Range: 5 mV to 3V pk-pk into 50Ω Accuracy: ± 3% Ranging: 1, 2, 5 or 1, 2, 2.5, 4, 5 or continuous
Rise/Fall Time	150 ps retu to ground
Mk/Sp Ratio	1:9
Aberrations	<3% peak in 8 Ghz <2% peak in 3 Ghz (First Ins)
Frequency	Range: 10 Hz to 2 Mhz Accuracy: ± 0.25 ppm Ranging: 1, 2, 5 or 1, 2, 2.5, 4, 5 or continuous
70ps Fast-Edge (only available on 9560 Active Heads)	
Amplitude	Range: 25 mV to 2V pk-pk Accuracy: ± 3% Ranging: 1, 2, 5 or 1, 2, 2.5, 4, 5 or continuous
Rise/Fall Time	70 ps retu to ground
Mk/Sp Ratio	1:9

Aberrations	<± 4% peak in 20 Ghz <3% peak in 8 Ghz <1% peak in 3 Ghz (First 700 ps)
Frequency	Range: 10 Hz to 1 Mhz Accuracy: ± 0.25 ppm Ranging: 1, 2, 5 or 1, 2, 2.5, 4, 5 or continuous

25ps Fast-Edge (only available on 9550 Active Heads)	
Amplitude	Range: 425 to 575 mV pk-pk into 50Ω Accuracy: ± 2%
Rise/Fall Time	25 ps retu to ground
Mk/Sp Ratio	1:9

Timing Markers	
Styles	Square/Sine, Pulse or Narrow Triangle
Square/Sine	Period Square: 10 ns to 55s Period Sine: 450 ps to 10ns 9500/600 = 1ns to 10ns 9560 = 180ps to 10ns
Pulse	Period: 1 µs to 55s Rise/Fall Time: 2.5% of period
Narrow Triangle	
Ranging	1, 2, 5 or 1, 2, 2.5, 4, 5 or continuous for period of all waveshapes
Timing Accuracy	Normal: ± 0.25 ppm
Timing Jier	10 ps pk-pk
Deviation	± 45% for period
Amplitude	100 mV to 1V pk-pk
Sub-Division	Every 10th marker can be set to higher amplitude for periods ± 1 µs for all waveshapes

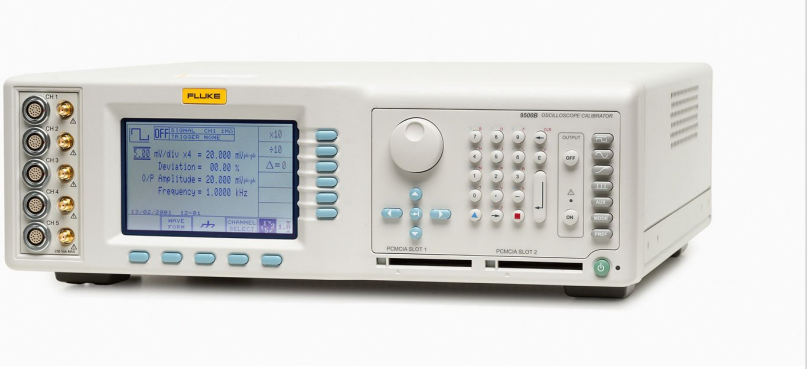
Leveled Sine and Dual Sine	
Frequency	Range: 9500B/600 0.1 Hz to 600 MHz 9500B/1100 0.1 Hz to 1.1 GHz 9500B/3200 0.1 Hz to 3.2 GHz 9500B/2200+9560 0.1Hz to 6.4 GHz
Amplitude (Leveled Sine into 50Ù)	0.1 Hz - 550 MHz 4.44 mV to 5.560V pk-pk 550 MHz - 2.5 GHz 4.44 mV to 3.336V pk-pk 2.5 GHz - 3.2 GHz 4.44 mV to 2.224V pk-pk 3.2 GHz - 6.4 GHz 25mV to 2 V pk-pk Accuracy: ± 1.5% at 50 kHz
Flatness (Leveled Sine relative to 50kHz)	0.1 Hz - 300 MHz ± 2% 300 MHz - 550 MHz ± 3% 550 MHz - 1.1 GHz ± 4% 1.1 GHz - 3.2 GHz ± 5% 3 GHz - 6.0 GHz ± 5%
Ranging	1, 2, 5 or 1, 2, 2.5, 4, 5 or continuous

Sine Purity	2nd Harmonic <-35 dBc 3rd Harmonic <-40 dBc All Other Spurious Signals <-40 dBc (typical)
Input Impedance	
Resistance Measurement (not available on 9550)	Range: 10Ω - 150Ω and 50 kΩ - 12 MΩ Accuracy: 10 - 40 (W) ± 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 (not available on 9550 or 9560 heads)	Range: 1 pF to 95 pF Accuracy: 1 pF - 35 pF 2% ± 0.25 pF 35 pF - 95 pF 3% ± 0.25 pF
Current	
Amplitude	DC: ± 100 µA to ± 100 mA Squarewave: 100 µA to 100 mA pk-pk
Accuracy	± (0.25% + 0.5 µA)
Frequency	10 Hz to 100 kHz Accuracy: ± 0.25 ppm Ranging: 1, 2, 5 or 1, 2, 2.5, 4, 5 or continuous
Composite Video Output	
Amplitude	1.0V, 0.7V and 0.3V
Pae	White, gray or black
Sync Polarity	Positive or negative
Standards	625-line 50 Hz or 525-line 60 Hz
LFLinear Ramp	
Waveforms	1V pk-pk sym. triangle
Ramp Time	1 ms 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	± 25 ps ch to ch
Adjusted Skew	± 5 ps ch to ch
Frequency Range	10 Hz to 100 MHz
Short/Open Output	
Output Leakage	Open Circuit: ± 50 pA Short Circuit: ± 15 µV

Auxiliary Input	
Signal Routing	Rear i/p to any Active Head
Maximum Input	Voltage: ± 40V pk-pk Current: ± 400 mA pk-pk
Rate	User Selectable: f (up to 120 MHz), f/10 or f/100 Free Run: 100 Hz
Reference Frequency Input	Frequency Range: 1 MHz to 20 MHz in 1 MHz steps Level: 90 mV to 1V pk-pk typ. Lock Range: ± 50 ppm
Reference Frequency Output	Frequency: 1 MHz or 10 MHz Level: Into 50W: 1V pk-pk (typical)

General Specifications	
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, baery life	Voltage: 95V to 132V rms or 209V to 264V rms Frequency: 48 Hz to 63 Hz Consumption: 400 VA
Warm up Time	20 minutes
Calibration Documentation	17025 accredited report of calibration included
Dimensions	Model 9500B 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. Modules 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: EN55011/22 Immunity: EN50082-1:1992 FCC Rules part 15 sub-part J class B
Warranty Period	Mainframe: 1-year Active Heads: 3-years

Ordering information



9500B/600
600 MHz High-Performance Oscilloscope Calibrator Workstation

9500B/1100
1100 MHz High-Performance Oscilloscope Calibrator Workstation

9500B/3200
3.2 GHz High-Performance Oscilloscope Calibrator Workstation

9510
Active Head with 1.1 GHz and 500 ps pulse capability

9530
Active Head with 3.2 GHz and 150 ps/500 ps pulse capability

9550
Active Head with 25 ps pulse capability

9560
Active Head with 6 GHz and 70 ps pulse capability

Requires 9500B/3200 or upgraded 9500/3200

Fluke. *Keeping your world up and running.®*

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