FLUKE®

Calibration

Electrical Calibration Equipment and Services


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Perform manual measurements with push-button simplicity with the new Fluke 8808A DMM
With the Fluke 8808A 5.5 digit multimeter, you can save the most frequently used manual measurements to the front panel setup buttons. Then operators simply push the appropriate button for a consistent setup and measurement every time.
In addition to measuring volts, ohms, and amps, the 8808A offers:
• 0.01 % basic V dc accuracy
• Dual display
• i-leakage, a sensitive low dc current, Ω impedance range for measuring device standby currents
• Unique patented split terminal jacks to perform 4-wire measurements using two leads
Fluke. Keeping your world up and running.
To find out how easily you can standardize your production line testing, go to www.fluke.com for more details. Or contact your local Fluke representative.
For automated R&D and service applications, see the Fluke 8.5 digit 8845A/46A DMMs with:
• 8.5 digit resolution
• Up to 0.0004 % basic V dc accuracy
• Advanced measurements and multiple connectivity options
Standardize your production line testing with the push of a button.


New
Get more mileage out of your calibrator.
Introducing the new easily transportable Fluke 5522A Multi-Product Calibrator with tough protection inside and out.
Whether you calibrate in the lab or on the road, the Fluke 5522A Multi-Product Calibrator handles more workload with less work. Its superior accuracy and easy transportability boost efficiency. And its rugged design gives you more protection inside and out with:
• Robust reverse power protection and quick disconnect circuits that prevent costly damage from operator connection errors either in or out of the lab
• Ergonomic carrying handles that make it easy to move short distances
• An optional rugged carrying case with built-in handles and wheels for easy transport and removable front and rear access doors so you can quickly get to work without unpacking the calibrator.
To find out how the tough new Fluke 5522A will help you cover more workload at a remarkably affordable price, visit www.fluke.com/5522A
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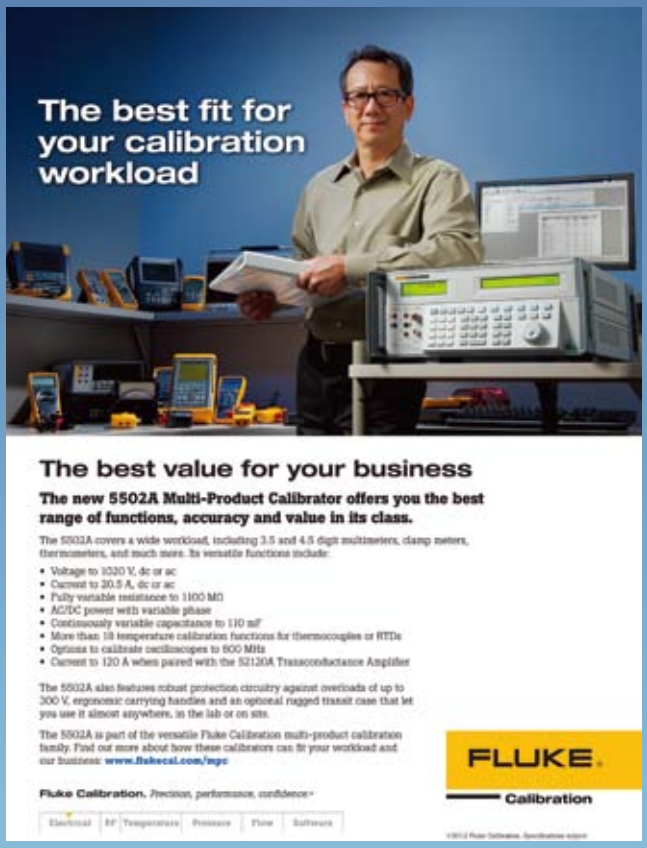
Calibration
Fluke Calibration. Precision, performance, confidence.
Electrical | RF | Temperature | Pressure | Flow | Software


The best fit for your calibration workload
The best value for your business
The new 5502A Multi-Product Calibrator offers you the best range of functions, accuracy and value in its class.
The 5502A covers a wide workload, including 3.5 and 4.5 digit multimeters, clamp meters, thermometers, and much more. Its versatile functions include:
• Voltage to 1020 V, dc or ac
• Current to 20.5 A, dc or ac
• Fully variable resistance to 1100 MΩ
• AC/DC power with variable phase
• Continuously variable capacitance to 110 mF
• More than 18 temperature calibration functions for thermocouples or RTDs
• Options to calibrate oscilloscopes to 800 MHz
• Current to 120 A when paired with the 5212OA Transconductance Amplifier
The 5502A also features robust protection circuitry against overloads of up to 300 V, ergonomic carrying handles and an optional rugged transit case that let you use it almost anywhere, in the lab or on site.
The 5502A is part of the versatile Fluke Calibration multi-product calibration family. Find out more about how these calibrators can fit your workload and our business: www.flukecal.com/mpc
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Better accuracy for a broader workload
The 52120A Transconductance Amplifier lets you accurately test and calibrate a broad workload at full current range
The 52120A expands your calibration capabilities to a broad workload of power and energy meters, clamp meters, CTs and Rogowski coils—up to 6000 A. Use it with all Fluke Calibration calibrators, including the 5080A, 9100, 5520A and 5720A Series. For enhanced accuracy, use it closed-loop with the 6105A Electrical Power Standards.
• Output ranges: 2 A, 20 A, 120 A
• Frequency to 10 kHz
• Generate 3,000 or 6,000 amps with accessory coils
• Industry-leading amplifier accuracy
Get the details: www.flukecal.com/52120A
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Table of Contents

5700A/5720A
Multifuntion Calibrator

Growing global trade is causing manufacturers to pay close attention to controlling, improving, and measuring quality in all processes from design through manufacturing. While this is good for product quality, it also increases your calibration workload.

Fluke offers a wide range of calibration solutions to help you handle that workload. choices that fit your budget and your business.

High performance plus a choice of confidence levels

Since 1988, the fluke 5700A has set the standard for multifunction calibrator performance. The fluke 5700A Ⅱ and 5720A set even higher standards, calibration your high performance workload up to 8½ digit system DMMs. Both models now state specifications to the standard fluke 99% confidence level as well as the 95% confidence level to support easy measurement comparisons according to international quality standards including ISO 9000 and ISO Guide 25. All specifications are absolute and include the uncertainty of the calibration standards used. No additional analysis is required analysis is required. Relative specifications are also available.

Dramatically improved performance specifications

The new high performance 5720A offers an unprecedented accuracy level that delivers the lowest uncertainties available. It calibrates more of your precision meter workload, more easily and cost effectively than ever before.

Intuitive easy-to-use design

The 5700A Series Ⅱ and the 5720A are remarkably easy to use. All readouts appear in plain language rather than in cryptic error codes. Just enter values on the numeric keypad and press the ENTER key.

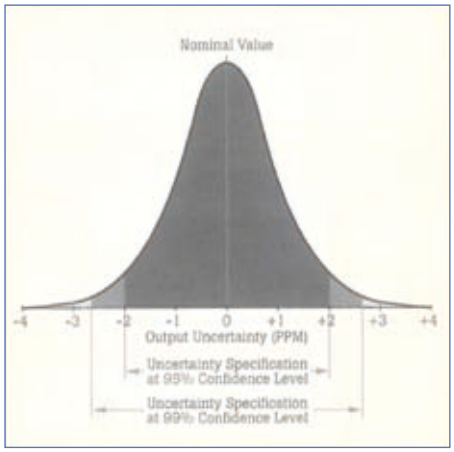
5700A/5720A
Multifuntion Calibrator

FLUKE ®
Calibration

Both the 5700A Series II and the 5720A feature RS-232 and IEEE-488 interfaces, and can control Fluke 5725A, 5220A, and 5205A/5215A Amplifiers, so they are compatible with your existing equipment. Both also feature Artifact Calibration which helps keep support costs low while providing confidence that your instrument is performing as you expect it to.

The rugged 5700A/5720A Calibrators operate over a wide temperature range so they're a good choice for on-site work as well as in the lab.

Understanding confidence intervals



A Critical factor in specified Calibrator performance is the difference between the actual output value and the nominal output value. The confidence interval is a statistical expression of the likelihood that any output of any instrument will deviate beyond this specified difference or uncertainty.

At Fluke we state calibrator specifications with better than 99% confidence to minimize the risk for the user. However, because international metrology standards require using a 95% confidence interval in all measurements, the 5700A Series II and 5720A new offer both 99% and 95% confidence level specifications. This makes it easier to make valid comparisons of measurements, and permits you to accept a slightly higher statistical risk in return for lower instrument uncertainty. In addition, both absolute and relative specifications are provided.

5700A/5720A
Multifuntion Calibrator

The 5700A/5720A Calibrators feature Artifact Calibration. Only three artifact standards–a 10V dc reference and 1Ω and 10 kΩ resistance references–are required to calibrate all ranges and functions to full specifications. front panel instructions prompt the operator to make connections and inputs each step of the way. The calibrator controls the process which takes only about an hour, compared to several hours using traditional methods.

In addition to saving time and equipment costs, Artifact Calibration extends the need for external verification to two years or longer as required by your standards and procedures. And, because the 5700A Series II and 5720A can tolerate operating temperatures between 15°C they can be calibrated where they're used, rather than having to be recalled to the standards laboratory for calibration.

Cal Check monitors performance between calibrations

For extra confidence that 5700A/5720A Calibrators stay within specifications between calibrations, the built-in automated Cal Check function checks each range and function against internal standards to see that all functions and ranges are within specification. These Cal Check results can also be downloaded to a computer via the IEEE-488 or RS-232 port to develop control charts that predict the calibrator's long-term performance. Or you can print the results directly.

5700A/5720A
Multifuntion Calibrator

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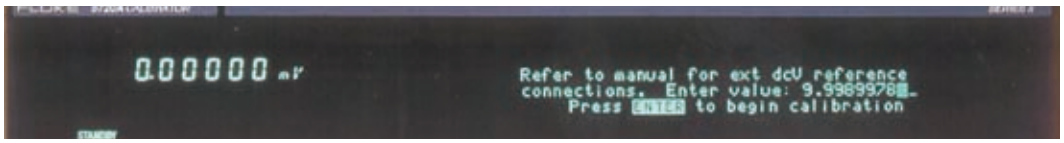
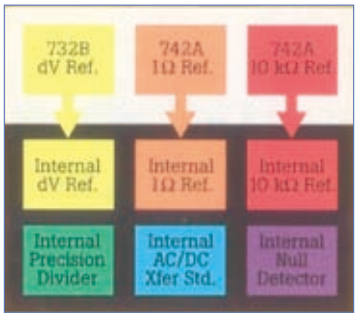
Calibration

Save time and support costs with Artifact Calibration

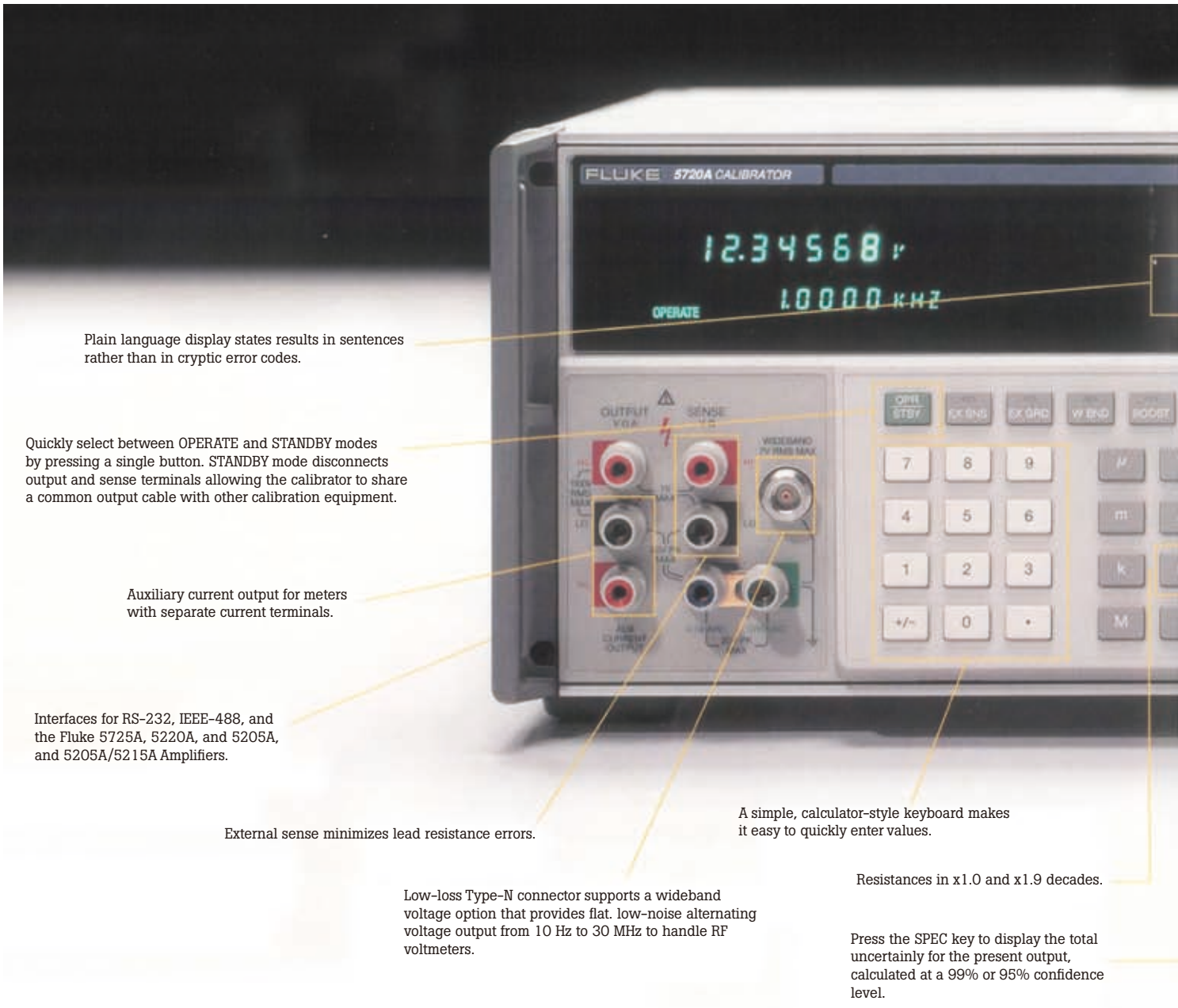


Artifact Calibration transfers the assigned values of an external artifact to a large array of multidimensional parameters within an instrument. The instrument takes over the manual metrology functions of establishing ratios and making comparisons, as well as controlling the measuring process.

As a result, Artifact Calibration requires just three standards to transfer external traceable values into the instrument. At that point, the calibrator measures, verifies, and adjusts itself, reducing an eight-hour job to about one hour. Thousands of 5700A calibrators in service around the world prove Artifact Calibration delivers fast, easy, and inexpensive calibration along with the confidence that your instrument is performing as expected between calibration.



5700A/5720A
Multifuntion Calibrator



The 5720A pushes accuracy standards for multifunction calibrators to a new level, yet is designed to be remarkably easy to use.

Works with what you have

Both the 5700A Series II and 5720A are designed to protect your investment in existing Fluke instruments and procedures. For example, you can connect a Fluke 5220A Transconductance Amplifier or 5205A Voltage Amplifiers directly to dedicated ports on either calibrator. In automated systems, you can configure both the 5700A Series II and 5720A to emulate the popular 5100AB Calibrator, minimizing the need to rewrite tour procedures. In addition, the 5700A Series II and 5720A can emulate the Fluke 5200A AC Voltage Calibrator, and their remote programming interface remains fully compatible with previous versions of the 5700A.

Designed to go the distance

The 5700A/5720A Calibrators are designed for long, reliable, trouble-

5700A/5720A
Multifuntion Calibrator

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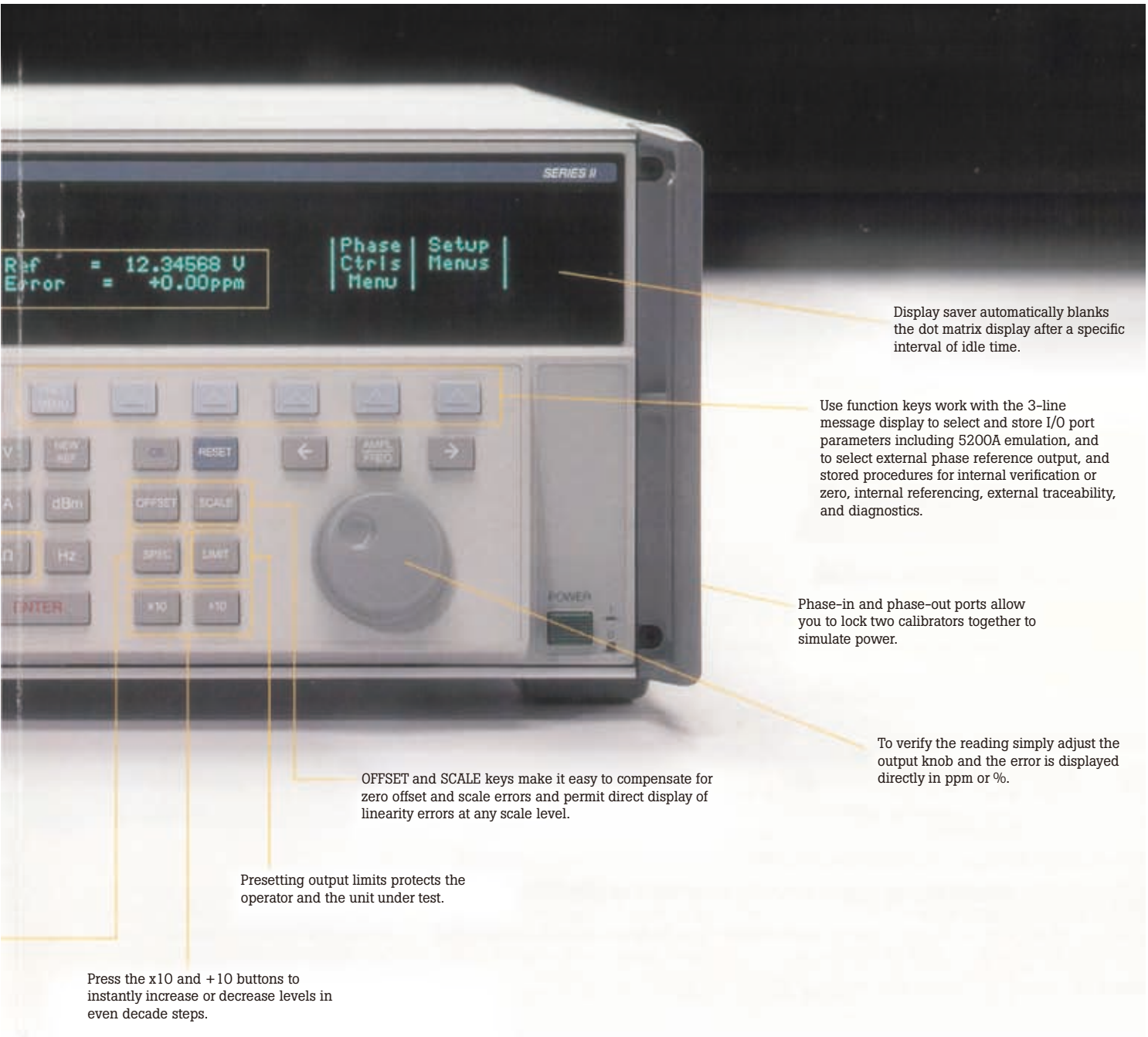

Display saver automatically blanks the dot matrix display after a specific interval of idle time.

Use function keys work with the 3-line message display to select and store I/O port parameters including 5200A emulation, and to select external phase reference output, and stored procedures for internal verification or zero, internal referencing, external traceability, and diagnostics.

Phase-in and phase-out ports allow you to lock two calibrators together to simulate power.

To verify the reading simply adjust the output knob and the error is displayed directly in ppm or %.

OFFSET and SCALE keys make it easy to compensate for zero offset and scale errors and permit direct display of linearity errors at any scale level.

Presetting output limits protects the operator and the unit under test.

Press the x10 and +10 buttons to instantly increase or decrease levels in even decade steps.

free operation, Statistical process control techniques assure that quality is continuously maintained and improved from component test though final assembly. Every instrument is subjected to 2g of random vibration to prevent subtle imperfections from causing failures later.

Both the 5700A Series II and 5720A feature a rugged, modular design that minimizes failures and makes it easy to find and repair any faukts that may occur. Internal diagnostics exercise both digital and analog functions and can isolate problems to the borad level, so repair often requires nothing more than replacing a plug-in module. And their rugged chassis are built to go to the workload with minimal risk of damage. DIN connectors seal out potential contaminants while keeping circuit boards firmly connected.

You can also count on Fluke's worldwide network of service and calibration centers which offer quality work and fast turnaround at competitive prices.

5700A/5720A
Multifuntion Calibrator

5720A Multifunction Calibrator

The 5720A calibrator raises the performance of the world standard 5700A to the next level. The 5720A covers the most demanding workload, covering DMMs up to 8½ digits and delivering the highest level of performance of any calibrator on the market. It states specifications to both 99% and 95% confidence levels and includes powerful internal features, such as Artifact Calibration and Cal Check, to simplify support and dramatically reduce your cost of ownership.

5700A Series II Multifunction Calibrator

In service since 1988, the 5700A has undergone continuous improvements to become the 5700A Series II , one of the most tested and reliable high precision calibrators Fluke has ever produced. Considered the calibration standard worldwide, the 5700A Series II delivers high value as well as accuracy, covering 5½ to 7½ digit DMMs. Plus it offers the same ease of use, low cost of ownership, rugged design, simplified support, and confidence building features as the 5720A.

5500A Multi-product Calibrator

The 5500A covers an unprecedented range of dc and low-frequency electrical calibration workload, including digital and analog multimeters, thermometers, handheld wattmeters, current clamps, oscilloscopes, process calibrators, power harmonics analyzers, and much more at an extremely affordable price.

5790A AC Measurement Standard

The 5790A is a complete automated ac measurement standard designed for the most demanding calibration applications. It provides a 24 ppm total uncertainty and covers a wide 700 µV to 1000V voltage range and a 10 Hz to 1 MHz frequency range with the option to extend it to 30 MHz.

732B Direct Voltage reference Standard

The 732B is a small, rugged, solid-

5700A/5720A Multifuntion Calibrator

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state, direct voltage reference standard. Designed for reliable convenient transfers, it features very predictable performance and long battery life.

742A Resistance Standards

These high-accuracy working standards for precision on-site resistance calibration feature a rugged design and can be used over a wide temperature range.

792A AC/DC Transfer Standard

The 792A offers extraordinary transfer accuracy with total uncertainties to ± 10 ppm traceable through Fluke. Its robust input protection and fast settling times enable you to make measurements covering voltages form 2 mV to 1000V, and frequencies from 10 Hz to 1 HMz–in just 30 seconds.

5725A Amplifier

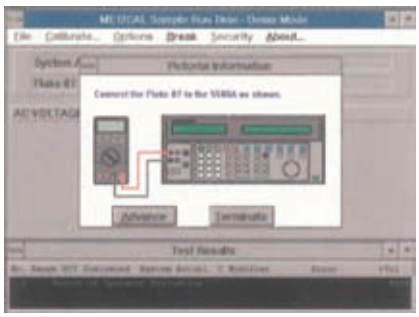
The 5725A Amplifier increases maximum direct and alternating current to 11A for calibrating the high current ranges of popular low–cost, handheld DMMs. It also extends the calibrator's alternating Volt–Hertz product to 1100V at 30 kHz and 750V at 100 kHz to cover the calibration requirements of high–accuracy bench and system meters. It is compatible with the 5700A, and 5500A.

The 5700A/5720A Multifunction calibrators at a glance

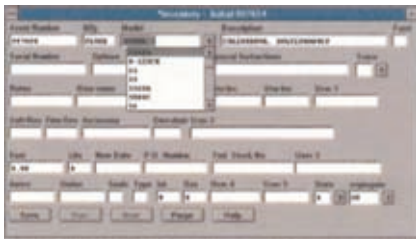
Functions	Ranges	output	5720A Best traceable uncertainty (95% 180 Days)	5700A Best traceable uncertainty (95% 180 Days)
DC Voltage	0 - ± 1100V	10V	± 3.25 ppm	± 6.4 ppm
AC Voltage	220 µV - 1100V	1V	± 55 ppm	± 87 ppm
Resistance	0 - 100 MΩ	10 kΩ	± 9 ppm	± 12 ppm
DC Voltage	0 - ± 2.2A	10 mA	± 37 ppm	± 65 ppm
AC Voltage	9 A - 2.2A	100 mA	± 140 ppm	± 190 ppm

5700A/5720A Multifuntion Calibrator

Today's quality standards are imposing more and more stringent requirements for documentation and reporting. Fluke calibration software provides an easy, affordable solution.



MET/CAl is a powerful environment for creating, editing, testing, and documenting calibration procedures, and for performing automated calibration. It supports a wide variety of standards and includes more than 300 procedures.



MET/TRACK is a powerful metrology property management package designed to help you document and report on all aspects of your measurement assets, including inventory, calibration history, results, location and repair.

Its powerful client-server design makes it ideal for applications form single-user installations up to enterprise-wide networks. Plus its industry-standard SQL database offers easy data access form a variety of applications and operating systems. Crystal Reports™ Professional is included with every server package to provide virtually unlimited reporting capabilities.

Calibration service, repair, and support

Fluke provides extensive calibration support and service to maximize the value of your calibration investment. Our worldwide network of Calibration Centers has traceability to national standards. Service and support are just a telephone call or fax away. We offer fast, quality repair and calibration services including a module exchange program, comprehensive training, and full support in setting up your wide range of technical information and training, even a Software User's Support Group.

Fluke Calibration: the power and flexibility you need to Measure up

When you examine our calibrators, standards, software, service, and support, you'll see why Fluke Calibration products are the worldwide leaders.

Fluke can help you meet just about any electrical calibration challenge, including meeting ISO 9000 or other safety, nuclear regulatory or environ-mental quality standards.

We also offer a wide variety of other instruments to help meet your specific application requirements. Just contact your local Fluke representative for expert advice.

For more information

For more information on the 5700A Series II and 5720A Calibrators, other Fluke calibrators, or MET/TRACK or MET/CAL software call your local Fluke representative.

For more information on confidence intervals and the development of calibrator specifications, see:

- Calibration: Philosophy and Practice
- Application note BO254, Understanding and Comparing Instrument Specifications.

For more information on Artifact Calibration ask for:

- Artifact Calibration: Theory and Application – outlines the design, verification and testing behind the concept.
- An Evaluation of Artifact Calibration by respected metrologist Les Huntley – looks at hundreds of 5700As at their two-year verification to assess the effectiveness of the concept.

5700A/5720A Series II Multifunction Calibrators

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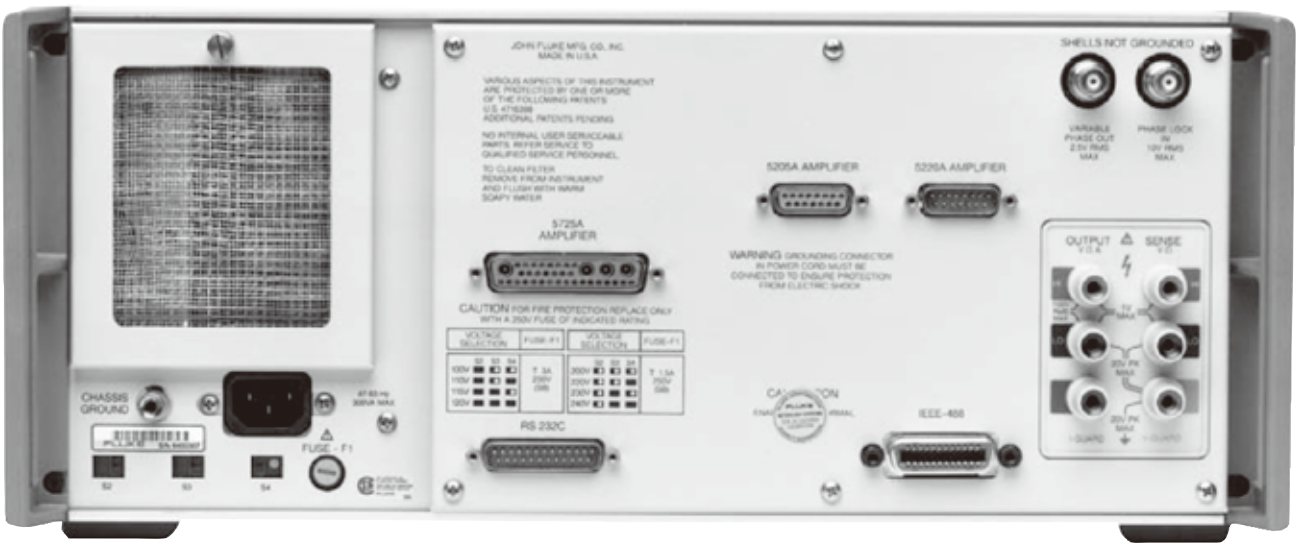
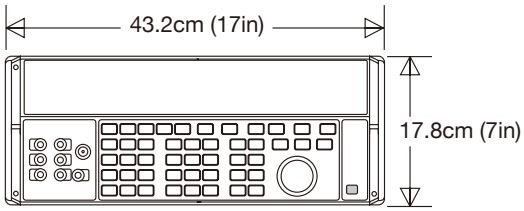
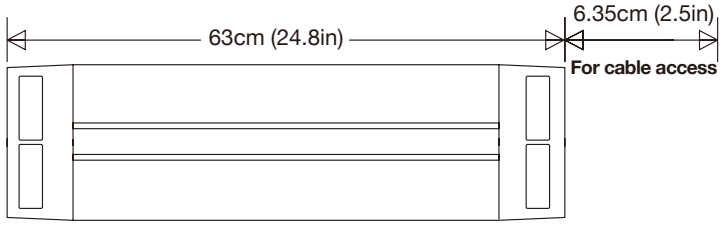






5700A/5720A Series II Multifunction Calibrators

General Specifications

Warm-Up Time..... Twice the time since last warmed up, to a maximum of 30 minutes.
System Installation ..... Rear output configuration and rack- mount kit available.
Standard Interfaces ..... IEEE-488, RS-232, 5725A, 5205A or 5215A, 5220A, phase lock in (BNC), phase reference out (BNC).
Temperature Performance
- Operating ..... 0 °C to 50 °C
- Calibration..... 15 °C to 35 °C
- Storage ..... -40 °C to 75 °C

Relative Humidity
- Operating ..... <80 % to 30 °C, <70 % to 40 °C, <40 % to 50 °C
- Storage ..... <95 %, non-condensing. A power stabilization period of four days may be required after extended storage at high temperature and humidity.

Safety..... Complies with IEC61010-1, (2nd Edition), CAN/CSA-C22.2 No. 610101-04, and UL Std. No. 61010-1 (2nd Edition)
Operating Altitude ..... 2000 m
Pollution Degree..... 2
Guard Isolation ..... 20 V
EMI/RFI ..... Designed to comply with FCC Rules Part 15, Subpart B, Class B; EN50081-1, EN50082-1
ElectroStatic Discharge ..... This instrument meets criteria C for ESD requirements per EN61326 Line Power
- Line Frequency ..... 47 to 63 Hz; ±10 % 100 V, 110 V, 115 V, 120 V, 200 V, 220 V, 230 V, 240 V
- Maximum Power
  - 5700A/5720A ..... 300 VA
  - 5725A ..... 750 VA

Weight
- 5700A/5720A ..... 27 kg (62 lb)
- 5725A..... 32 kg (70 lb)

Size
- 5700A/5720A
  - Height ..... 17.8 cm (7 in), standard rack increment, plus 1.5 cm (0.6 in) for feet
  - Width ..... 43.2 cm (17 in), standard rack width
  - Depth ..... 63.0 cm (24.8 in), overall; 57.8 cm (22.7 in), rack depth
- 5725A
  - Height ..... 13.3 cm (5.25 in)
  - Width and Depth..... Same as 5700A/5720A. Both units project 5.1 cm (2 in) from rack front.

Artifact Calibration Standards Requirements

Calibrating the 5700A Series II and 5720A to full specified absolute uncertainty requires using the following external standards, each with an uncertainty that is within the stated uncertainty limit.

Fluke Standard	Traceable Quantity	Nominal Value	Uncertainty Limit	5700A/5720A Series II Specifications Susceptible to Uncertainty Limit
732B	Voltage	10 V	±1.5 ppm	dc volts, ac volts, dc current, ac current
742A-1	Resistance	1 Ω	±10 ppm	1 Ω, 1.9 Ω
742A-10k	Resistance	10 kΩ	±4 ppm	ac current, dc current 10 Ω to 100 MΩ

Electrical Specifications

Note: Fluke guarantees performance verification using specifications stated to 99% confidence level.

DC Voltage Specifications

5720A Series II DC Voltage Specifications

Range	Resolution	Absolute Uncertainty ± 5 °C from calibration temperature [1]				Relative Uncertainty± 1 °C	
		24 Hours	90 Days	180 Days	1 Year	24 Hours	90 Days
		± (ppm output + µV)					
99 % Confidence Level							
220mV	10nV	5 + 0.5	7 + 0.5	8 + 0.5	9 + 0.5	2 + 0.4	2.5 + 0.4
2.2V	100nV	3.5 + 0.8	4 + 0.8	4.5 + 0.8	6 + 0.8	2 + 0.8	2.5 + 0.8
11V	1µV	2.5 + 3	3 + 3	3.5 + 3	4 + 3	1 + 3	1.5 + 3
22V	1µV	2.5 + 5	3 + 5	3.5 + 5	4 + 5	1 + 5	1.5 + 5
220V	10µV	3.5 + 50	4 + 50	5 + 50	6 + 50	2 + 50	2.5 + 50
1100V	100µV	5 + 500	6 + 500	7 + 500	8 + 500	2.5 + 400	3 + 400
95% Confidence Level							
220mV	10nV	4 + 0.4	6 + 0.4	6.5 + 0.4	7.5 + 0.4	1.6 + 0.4	2 + 0.4
2.2V	100nV	3 + 0.7	3.5 + 0.7	4 + 0.7	5 + 0.7	1.6 + 0.7	2 + 0.7
11V	1µV	2 + 2.5	2.5 + 2.5	3 + 2.5	3.5 + 2.5	0.8 + 2.5	1.2 + 2.5
22V	1µV	2 + 4	2.5 + 4	3 + 4	3.5 + 4	0.8 + 4	1.2 + 4
220V	10µV	3 + 40	3.5 + 40	4 + 40	5 + 40	1.6 + 40	2 + 40
1100V	100µV	4 + 400	4.5 + 400	6 + 400	6.5 + 400	2 + 400	2.4 + 400

Notes: DC Zeros calibration required every 30 days.
1. For fields strengths >1 V/m but ≤3 V/m, in the band of 80 MHz to 1 GHz, add 0.01 % of range.

5700A Series II DC Voltage Specifications

Range	Resolution	Absolute Uncertainty ± 5 °C from calibration temperature [1]				Relative Uncertainty± 1 °C	
		24 Hours	90 Days	180 Days	1 Year	24 Hours	90 Days
		± (ppm output + µV)					
99 % Confidence Level							
220mV	10nV	6.5 + .75	7 + .75	8 + .75	9 + .8	2.5 + .5	4 + .5
2.2V	100nV	3.5 + 1.2	6 + 1.2	7 + 1.2	8 + 1.2	2.5 + 1.2	4 + 1.2
11V	1µV	3.5 + 3	5 + 4	7 + 4	8 + 4	1.5 + 3	3.5 + 4
22V	1µV	3.5 + 6	5 + 8	7 + 8	8 + 8	1.5 + 6	3.5 + 8
220V	10µV	5 + 100	6 + 100	8 + 100	9 + 100	2.5 + 100	4 + 100
1100V	100µV	7 + 600	8 + 600	10 + 600	11 + 600	3 + 600	4.5 + 600
95% Confidence Level							
220mV	10nV	5.5 + 0.6	6 + 0.6	7 + 0.6	8 + 0.6	2 + 0.4	3.5 + 0.4
2.2V	100nV	3.5 + 1	5 + 1	6 + 1	7 + 1	2 + 1	3.5 + 1
11V	1µV	3 + 3.5	4 + 3.5	6 + 3.5	7 + 3.5	1.2 + 3	3 + 3.5
22V	1µV	3 + 6.5	4 + 6.5	6 + 6.5	7 + 6.5	1.2 + 6	3 + 7
220V	10µV	4 + 80	5 + 80	7 + 80	8 + 80	2 + 80	3.5 + 80
1100V	100µV	6 + 500	7 + 500	8 + 500	9 + 500	2.4 + 500	4 + 500

Notes: DC Zeros calibration required every 30 days.
1. For fields strengths >1 V/m but ≤3 V/m, in the band of 80 MHz to 1 GHz, add 0.01 % of range.

DC Voltage Secondary Performance Specifications and Operating Characteristics

Range	Stability [1] ± 1 °C 24 Hours	Temperature Coefficient Adder [2]		Linearity ± 1 °C	Noise	
		10 - 40 °C	0 -10 °C and 40 - 50 °C		Bandwidth 0.1-10 Hz pk-pk	Bandwidth 10 Hz-10 kHz RMS
	± (ppm output + µV)	± (ppm output + µV) / °C		± (ppm output + µV)		µV
220 mV	0.3 + 0.3	0.4 + 0.1	1.5 + 0.5	1 + 0.2	0.15 + 0.1	5
2.2 V	0.3 + 1	0.3 + 0.1	1.5 + 2	1 + 0.6	0.15 + 0.4	15
11 V	0.3 + 2.5	0.15 + 0.2	1 + 1.5	0.3 + 2	0.15 + 2	50
22 V	0.4 + 5	0.2 + 0.4	1.5 + 3	0.3 + 4	0.15 + 4	50
220 V	0.5 + 40	0.3 + 5	1.5 + 40	1 + 40	0.15 + 60	150
1100 V	0.5 + 200	0.5 + 10	3 + 200	1 + 200	0.15 + 300	500

Notes: 1. Stability specifications are included in the Absolute Uncertainty values in the primary specification tables.
2. Temperature coefficient is an adder to uncertainty specifications that does not apply unless operating more than ±5 °C from calibration temperature.

Minimum Output ..... 0 V for all ranges, except 100 V for 1100 V range
Maximum Load ..... 50 mA for 2.2 V through 220 V ranges; 20 mA for 1100 V range; 50 Ω output impedance on 220 mV range; all ranges <1000 pF, >25 Ω
Load Regulation ..... <(0.2 ppm of output + 0.1 ppm of range), full load to no load
Line Regulation ..... <0.1 ppm change, ± 10 % of selected nominal line
Settling Time ..... 3 seconds to full accuracy; + 1 second for range or polarity change; + 1 second for 1100 V range
Overshoot ..... <5 %
Common Mode Rejection ... 140 dB, DC to 400 Hz
Remote Sensing ..... Available 0 V to ±1100 V, on 2.2 V through 1100 V ranges

5700A/5720A Series II Multifunction Calibrators

AC Voltage Specifications

5720A Series II AC Voltage Specifications: 99% Confidence Level

Range	Resolution	Frequency (Hz)	Absolute Uncertainty ± 5 °C from calibration temperature				Relative Uncertainty ± 1 °C	
			24 Hours	90 Days	180 Days	1 Year	24 Hours	90 Days
			± (ppm output + µV)					
2.2 mV	1 nV	10 - 20 20 - 40 40 - 20 k 20 k - 50 k 50 k - 100 k 100 k - 300 k 300 k - 500 k 500 k - 1 M	250 + 5 100 + 5 85 + 5 220 + 5 500 + 6 1000 + 12 1400 + 25 2900 + 25	270 + 5 105 + 5 90 + 5 230 + 5 540 + 6 1200 + 12 1500 + 25 3100 + 25	290 + 5 110 + 5 95 + 5 240 + 5 570 + 6 1250 + 12 1600 + 25 3250 + 25	300 + 5 115 + 5 100 + 5 250 + 5 600 + 6 1300 + 12 1700 + 25 3400 + 25	250 + 5 100 + 5 60 + 5 85 + 5 200 + 6 350 + 12 800 + 25 2700 + 25	270 + 5 105 + 5 65 + 5 95 + 5 220 + 6 400 + 12 1000 + 25 3000 + 25
22 mV	10 nV	10 - 20 20 - 40 40 - 20 k 20 k - 50 k 50 k - 100 k 100 k - 300 k 300 k - 500 k 500 k - 1 M	250 + 5 100 + 5 85 + 5 220 + 5 500 + 6 1000 + 12 1400 + 25 2900 + 25	270 + 5 105 + 5 90 + 5 230 + 5 540 + 6 1200 + 12 1500 + 25 3100 + 25	290 + 5 110 + 5 95 + 5 240 + 5 570 + 6 1250 + 12 1600 + 25 3250 + 25	300 + 5 115 + 5 100 + 5 250 + 5 600 + 6 1300 + 12 1700 + 25 3400 + 25	250 + 5 100 + 5 60 + 5 85 + 5 200 + 6 350 + 12 800 + 25 2700 + 25	270 + 5 105 + 5 65 + 5 95 + 5 220 + 6 400 + 12 1000 + 25 3000 + 25
220 mV	100 nV	10 - 20 20 - 40 40 - 20 k 20 k - 50 k 50 k - 100 k 100 k - 300 k 300 k - 500 k 500 k - 1 M	250 + 15 100 + 8 85 + 8 220 + 8 500 + 20 850 + 25 1400 + 30 2700 + 60	270 + 15 105 + 8 90 + 8 230 + 8 540 + 20 900 + 25 1500 + 30 2900 + 60	290 + 15 110 + 8 95 + 8 240 + 8 570 + 20 1000 + 25 1600 + 30 3100 + 60	300 + 15 115 + 8 100 + 8 250 + 8 600 + 20 1100 + 25 1700 + 30 3300 + 60	250 + 15 100 + 8 60 + 8 85 + 8 200 + 20 350 + 25 800 + 30 2600 + 60	270 + 15 105 + 8 65 + 8 95 + 8 220 + 20 400 + 25 1000 + 30 2800 + 60
2.2 V	1 µV	10 - 20 20 - 40 40 - 20 k 20 k - 50 k 50 k - 100 k 100 k - 300 k 300 k - 500 k 500 k - 1 M	250 + 50 95 + 20 45 + 10 80 + 12 120 + 40 380 + 100 1000 + 250 1600 + 400	270 + 50 100 + 20 47 + 10 85 + 12 125 + 40 420 + 100 1100 + 250 1800 + 600	290 + 50 105 + 20 50 + 10 87 + 12 127 + 40 460 + 100 1150 + 250 1900 + 400	300 + 50 110 + 20 52 + 10 90 + 12 130 + 40 500 + 100 1200 + 250 2000 + 400	250 + 50 95 + 20 30 + 10 70 + 12 100 + 40 270 + 100 900 + 250 1200 + 400	270 + 50 100 + 20 40 + 10 75 + 12 105 + 40 290 + 100 1000 + 250 1300 + 400
22 V	10 µV	10 - 20 20 - 40 40 - 20 k 20 k - 50 k 50 k - 100 k 100 k - 300 k 300 k - 500 k 500 k - 1 M	250 + 500 95 + 200 45 + 70 80 + 120 110 + 250 300 + 800 1000 + 2500 1500 + 4000	270 + 500 100 + 200 47 + 70 85 + 120 115 + 250 310 + 800 1100 + 2500 1600 + 4000	290 + 500 105 + 200 50 + 70 87 + 120 117 + 250 320 + 800 1150 + 2500 1700 + 4000	300 + 500 110 + 200 52 + 70 90 + 120 120 + 250 325 + 800 1200 + 2500 1800 + 4000	250 + 500 95 + 200 30 + 70 70 + 120 100 + 250 270 + 800 900 + 2500 1300 + 4000	270 + 500 100 + 200 40 + 70 75 + 120 105 + 250 290 + 800 1000 + 2500 1400 + 4000
			± (ppm output + mV)					
220 V [2]	100 µV	10 - 20 20 - 40 40 - 20 k 20 k - 50 k 50 k - 100 k 100 k - 300 k 300 k - 500 k 500 k - 1 M	250 + 5 95 + 2 57 + 0.7 90 + 1.2 160 + 3 900 + 20 5000 + 50 8000 + 100	270 + 5 100 + 2 60 + 0.7 95 + 1.2 170 + 3 1000 + 20 5200 + 50 9000 + 100	290 + 5 105 + 2 62 + 0.7 97 + 1.2 175 + 3 1050 + 20 5300 + 50 9500 + 100	300 + 5 110 + 2 65 + 0.7 100 + 1.2 180 + 3 1100 + 20 5400 + 50 10,000 + 100	250 + 5 95 + 2 45 + 0.7 75 + 1.2 140 + 3 600 + 20 4500 + 50 8000 + 100	270 + 5 100 + 2 50 + 0.7 80 + 1.2 150 + 3 700 + 20 4700 + 50 8500 + 100
1100 V [1]	1 mV	15 - 50 50 - 1 k	300 + 20 70 + 4	320 + 20 75 + 4	340 + 20 80 + 4	360 + 20 85 + 4	300 + 20 50 + 4	320 + 20 55 + 4
5725A Amplifier:								
1100 V	1 mV	40 - 1 k 1 k - 20 k 20 k - 30 k	75 + 4 105 + 6 230 + 11	80 + 4 125 + 6 360 + 11	85 + 4 135 + 6 440 + 11	90 + 4 165 + 6 600 + 11	50 + 4 85 + 6 160 + 11	55 + 4 105 + 6 320 + 11
750 V		30 k - 50 k 50 k - 100k	230 + 11 600 + 45	360 + 11 1300 + 45	440 + 11 1600 + 45	600 + 11 2300 + 45	160 + 11 380 + 45	320 + 11 1200 + 45

Notes:
1. Maximum output 250 V from 15-50 Hz.
2. See Volt-Hertz capability in Figure A.

5720A Series II AC Voltage Specifications: 95 % Confidence Level

Range	Resolution	Frequency (Hz)	Absolute Uncertainty ± 5 °C from calibration temperature				Relative Uncertainty ± 1 °C	
			24 Hours	90 Days	180 Days	1 Year	24 Hours	90 Days
			± (ppm output + µV)					
2.2 mV	1 nV	10 - 20 20 - 40 40 - 20 k 20 k - 50 k 50 k - 100 k 100 k - 300 k 300 k - 500 k 500 k - 1 M	200 + 4 80 + 4 70 + 4 170 + 4 400 + 5 300 + 10 1100 + 20 2400 + 20	220 + 4 85 + 4 75 + 4 180 + 4 460 + 5 900 + 10 1200 + 20 2500 + 20	230 + 4 87 + 4 77 + 4 190 + 4 480 + 5 1000 + 10 1300 + 20 2600 + 20	240 + 4 90 + 4 80 + 4 200 + 4 500 + 5 1050 + 10 1400 + 20 2700 + 20	200 + 4 80 + 4 50 + 4 70 + 4 160 + 5 280 + 10 650 + 20 2100 + 20	220 + 4 85 + 4 55 + 4 80 + 4 180 + 5 320 + 10 800 + 20 2400 + 20
22 mV	10 nV	10 - 20 20 - 40 40 - 20 k 20 k - 50 k 50 k - 100 k 100 k - 300 k 300 k - 500 k 500 k - 1 M	200 + 4 80 + 4 70 + 4 170 + 4 400 + 5 300 + 10 1100 + 20 2400 + 20	220 + 4 85 + 4 75 + 4 180 + 4 460 + 5 900 + 10 1200 + 20 2500 + 20	230 + 4 87 + 4 77 + 4 190 + 4 480 + 5 1000 + 10 1300 + 20 2600 + 20	240 + 4 90 + 4 80 + 4 200 + 4 500 + 5 1050 + 10 1400 + 20 2700 + 20	200 + 4 80 + 4 50 + 4 70 + 4 160 + 5 280 + 10 650 + 20 2100 + 20	220 + 4 85 + 4 55 + 4 80 + 4 180 + 5 320 + 10 800 + 20 2400 + 20
220 mV	100 nV	10 - 20 20 - 40 40 - 20 k 20 k - 50 k 50 k - 100 k 100 k - 300 k 300 k - 500 k 500 k - 1 M	200 + 12 80 + 7 70 + 7 170 + 7 400 + 17 700 + 20 1100 + 25 2400 + 45	220 + 12 85 + 7 75 + 7 180 + 7 420 + 17 750 + 20 1200 +25 2500 + 45	230 + 12 87 + 7 77 + 7 190 + 7 440 + 17 800 + 20 1300 + 25 2600 + 45	240 + 12 90 + 7 80 + 7 200 + 7 460 + 17 900 + 20 1400 + 25 2700 + 45	200 + 12 80 + 7 50 + 7 70 + 7 160 + 17 280 + 20 650 + 25 2100 + 45	220 + 12 85 + 7 55 + 7 80 + 7 180 + 17 320 + 20 800 + 25 2400 + 45
2.2 V	1 µV	10 - 20 20 - 40 40 - 20 k 20 k - 50 k 50 k - 100 k 100 k - 300 k 300 k - 500 k 500 k - 1 M	200 + 40 75 + 15 37 + 8 65 + 10 100 + 30 300 + 80 800 + 200 1300 + 300	220 + 40 80 + 15 40 + 8 70 + 10 105 + 30 340 + 80 900 + 200 1500 + 300	230 + 40 85 + 15 42 + 8 73 + 10 107 + 30 380 + 80 950 + 200 1600 + 300	240 + 40 90 + 15 45 + 8 75 + 10 110 + 30 420 + 80 1000 + 200 1700 + 300	200 + 40 75 + 15 25 + 8 55 + 10 80 + 30 230 + 80 700 + 200 1000 + 300	220 + 40 80 + 15 35 + 8 60 + 10 85 + 30 250 + 80 800 + 200 1100 + 300
22 V	10 µV	10 - 20 20 - 40 40 - 20k 20k - 50k 50k - 100k 100k - 300k 300k - 500k 500k - 1M	200 + 400 75 + 150 37 + 50 65 + 100 90 + 200 250 + 600 800 + 2000 1200 + 3200	220 + 400 80 + 150 40 + 50 70 + 100 95 + 200 260 + 600 900 + 2000 1300 + 3200	230 + 400 85 + 150 42 + 50 73 + 100 97 + 200 270 + 600 900 + 2000 1400 + 3200	240 + 400 90 + 150 45 + 50 75 + 100 100 + 200 275 + 600 1000 + 2000 1500 + 3200	200 + 400 75 + 150 25 + 50 55 + 100 80 + 200 250 + 600 700 + 2000 1100 + 3200	220 + 400 80 + 150 35 + 50 60 + 100 85 + 200 270 + 600 800 + 2000 1200 + 3200
			± (ppm output + mV)					
220 V [2]	100 µV	10 - 20 20 - 40 40 - 20 k 20 k - 50 k 50 k - 100 k 100 k - 300 k 300 k - 500 k 500 k - 1 M	200 +4 75 + 1.5 45 + 0.6 70 + 1 120 + 2.5 700 + 16 4000 + 40 6000 + 80	220 + 4 80 + 1.5 47 + 0.6 75 + 1 130 + 2.5 800 + 16 4200 + 40 7000 + 80	230 + 4 85 + 1.5 50 + 0.6 77 + 1 140 + 2.5 850 + 16 4300 + 40 7500 + 80	240 + 4 90 + 1.5 52 + 0.6 80 + 1 150 + 2.5 900 + 16 4400 + 40 8000 + 80	200 + 4 75 + 1.5 35 + 0.6 60 + 1 110 + 2.5 500 + 16 3600 + 40 6500 + 80	220 + 4 80 + 1.5 40 + 0.6 65 + 1 120 + 2.5 600 + 16 3800 + 40 7000 + 80
1100 V [1]	1 mV	15 - 50 50 - 1 k	240 + 16 55 + 3.5	260 + 16 60 + 3.5	280 + 16 65 + 3.5	300 + 16 70 + 3.5	240 + 16 40 + 3.5	260 + 16 45 + 3.5
5725A Amplifier:								
1100 V	1 mV	40 - 1 k 1 k - 20 k 20 k - 30 k	75 + 4 105 + 6 230 + 11	80 + 4 125 + 6 360 + 11	85 + 4 135 + 6 440 + 11	90 + 4 165 + 6 600 + 11	50 + 4 85 + 6 160 + 11	55 + 4 105 + 6 320 + 11
750 V		30 k - 50 k 50 k - 100 k	230 + 11 600 + 45	360 + 11 1300 + 45	440 + 11 1600 + 45	600 + 11 2300 + 45	160 + 11 380 + 45	320 + 11 1200 + 45

Notes:
1. Maximum output 250 V from 15-50 Hz.
2. See Volt-Hertz capability in Figure A.

5700A/5720A Series II Multifunction Calibrators

5700A Series II AC Voltage Specifications: 99 % Confidence Level

Range	Resolution	Frequency (Hz)	Absolute Uncertainty ± 5 °C from calibration temperature				Relative Uncertainty ± 1 °C	
			24 Hours	90 Days	180 Days	1 Year	24 Hours	90 Days
			± (ppm output + µV)					
2.2 mV	1 nV	10 - 20 20 - 40 40 - 20 k 20 k - 50 k 50 k - 100 k 100 k - 300 k 300 k - 500 k 500 k - 1 M	500 + 5 200 + 5 100 + 5 340 + 5 800 + 8 1100 + 15 1500 + 30 4000 + 40	550 + 5 220 + 5 110 + 5 370 + 5 900 + 8 1200 + 15 1700 + 30 4400 + 40	600 + 5 230 + 5 120 + 5 390 + 5 950 + 8 1300 + 15 1700 + 30 4700 + 40	600 + 5 240 + 5 120 + 5 410 + 5 950 + 8 1300 + 15 1800 + 30 4800 + 40	500 + 5 200 + 5 60 + 5 100 + 5 220 + 8 400 + 15 1000 + 30 400 + 30	550 + 5 220 + 5 65 + 5 110 + 5 240 + 8 440 + 15 1100 + 30 4400 + 30
22 mV	10 nV	10 - 20 20 - 40 40 - 20 k 20 k - 50 k 50 k - 100 k 100 k - 300 k 300 k - 500 k 500 k - 1 M	500 + 6 200 + 6 100 + 6 340 + 6 800 + 8 1100 + 15 1500 + 30 4000 + 40	550 + 6 220 + 6 110 + 6 370 + 6 900 + 8 1200 + 15 1700 + 30 4400 + 40	600 + 6 230 + 6 120 + 6 390 + 6 950 + 8 1300 + 15 1700 + 30 4700 + 40	600 + 6 240 + 6 120 + 6 410 + 6 950 + 8 1300 + 15 1800 + 30 4800 + 40	500 + 6 200 + 6 60 + 6 100 + 6 220 + 8 400 + 15 1000 + 30 4000 + 30	550 + 6 220 + 6 65 + 6 110 + 6 240 + 8 440 + 15 1100 + 30 4400 + 30
220 mV	100 nV	10 - 20 20 - 40 40 - 20 k 20 k - 50 k 50 k - 100 k 100 k - 300 k 300 k - 500 k 500 k - 1 M	500 + 16 200 + 10 95 + 10 300 + 10 750 + 30 940 + 30 1500 + 40 3000 + 100	550 + 16 220 + 10 100 + 10 330 + 10 800 + 30 1000 + 30 1700 + 40 3300 + 100	600 + 16 230 + 10 110 + 10 350 + 10 850 + 30 1100 + 30 1700 + 40 3500 + 100	600 + 16 240 + 10 110 + 10 360 + 10 900 + 30 1100 + 30 1800 + 40 3600 + 100	500 + 16 200 + 10 60 + 10 100 + 10 220 + 30 400 + 30 1000 + 40 3000 + 100	550 + 16 220 + 10 65 + 10 110 + 10 240 + 30 440 + 30 1100 + 40 3300 + 100
2.2 V	1 µV	10 - 20 20 - 40 40 - 20 k 20 k - 50 k 50 k - 100 k 100 k - 300 k 300 k - 500 k 500 k - 1 M	500 + 100 150 + 30 70 + 7 120 + 20 230 + 80 400 + 150 1000 + 400 2000 + 1000	550 + 100 170 + 30 75 + 7 130 + 20 250 + 80 440 + 150 1100 + 400 2200 + 1000	600 + 100 170 + 30 80 + 7 140 + 20 270 + 80 470 + 150 1200 + 400 2300 + 1000	600 + 100 180 + 30 85 + 7 140 + 20 280 + 80 480 + 150 1200 + 400 2400 + 1000	500 + 100 150 + 30 40 + 7 100 + 20 200 + 80 400 + 150 1000 + 400 2000 + 1000	550 + 100 170 + 30 45 + 7 110 + 20 220 + 80 440 + 150 1100 + 400 2200 + 100
22 V	10 µV	10 - 20 20 - 40 40 - 20 k 20 k - 50 k 50 k - 100 k 100 k - 300 k 300 k - 500 k 500 k - 1 M	500 + 1000 150 + 300 70 + 70 120 + 200 230 + 400 500 + 1700 1200 + 5000 2600 + 9000	550 + 1000 170 + 300 75 + 70 130 + 200 250 + 400 550 + 1700 1300 + 5000 2800 + 9000	600 + 1000 170 + 300 80 + 70 140 + 200 270 + 400 550 + 1700 1300 + 5000 2900 + 9000	600 + 1000 180 + 300 85 + 70 140 + 200 280 + 400 600 + 1700 1400 + 5000 3000 + 9000	500 + 1000 150 + 300 40 + 70 100 + 200 200 + 400 500 + 1700 1200 + 5000 2600 + 9000	550 + 1000 170 + 300 45 + 70 110 + 200 220 + 400 550 + 1700 1300 + 5000 2800 + 9000
			± (ppm output + mV)					
220 V [2]	100 µV	10 - 20 20 - 40 40 - 20 k 20 k - 50 k 50 k - 100 k 100 k - 300 k 300 k - 500 k 500 k - 1 M	500 + 10 150 + 3 75 + 1 200 + 4 500 + 10 1500 + 110 5000 + 110 12,000 + 220	550 + 10 170 + 3 80 + 1 220 + 4 550 + 10 1500 + 110 5200 + 110 12,500 + 220	600 + 10 170 + 3 85 + 1 240 + 4 600 + 10 1600 + 110 5300 + 110 12,500 + 220	600 + 10 180 + 3 90 + 1 250 + 4 600 + 10 1600 + 110 5400 + 110 13,000 + 220	500 + 10 150 + 3 45 + 1 100 + 1 300 + 10 1500 + 110 5000 + 110 12,000 + 220	550 + 10 170 + 3 50 + 1 110 + 1 330 + 10 1500 + 100 5200 + 110 12,000 + 220
1100 V [1]	1 mV	15 - 50 50 - 1 k	400 + 20 75 + 4	420 + 20 80 + 4	440 + 20 85 + 4	460 + 20 90 + 4	400 + 20 50 + 4	420 + 20 55 + 4
5725A Amplifier:								
1100 V	1 mV	40 - 1 k 1 k - 20 k 20 k - 30 k	75 + 4 105 + 6 230 + 11	80 + 4 125 + 6 360 + 11	85 + 4 135 + 6 440 + 11	90 + 4 165 + 6 600 + 11	50 + 4 85 + 6 160 + 11	55 + 4 105 + 6 320 + 11
750 V		30 k - 50 k 50 k - 100k	230 + 11 600 + 45	360 + 11 1300 + 45	440 + 11 1600 + 45	600 + 11 2300 + 45	160 + 11 380 + 45	320 + 11 1200 + 45

Notes:
1. Maximum output 250 V from 15-50 Hz.
2. See Volt-Hertz capability in Figure A.

5700A Series II AC Voltage Specifications: 95% Confidence Level

Range	Resolution	Frequency (Hz)	Absolute Uncertainty ± 5 °C from calibration temperature				Relative Uncertainty ± 1 °C	
			24 Hours	90 Days	180 Days	1 Year	24 Hours	90 Days
			± (ppm output + µV)					
2.2 mV	1 nV	10 - 20 20 - 40 40 - 20 k 20 k - 50 k 50 k - 100 k 100 k - 300 k 300 k - 500 k 500 k - 1 M	400 + 4.5 170 + 4.5 85 + 4.5 300 + 4.5 700 + 7 900 + 13 1300 + 25 2800 + 25	500 + 4.5 190 + 4.5 95 + 4.5 330 + 4.5 750 + 7 1000 + 13 1500 + 25 3100 + 25	530 + 4.5 200 + 4.5 100 + 4.5 350 + 4.5 800 + 7 1050 + 13 1600 + 25 3300 + 25	550 + 4.5 210 + 4.5 105 + 4.5 370 + 4.5 850 + 7 1100 + 13 1700 + 25 3400 + 25	400 + 4.5 170 + 4.5 55 + 4.5 90 + 4.5 210 + 7 380 + 13 900 + 25 2900 + 25	500 + 4.5 190 + 4.5 60 + 4.5 100 + 4.5 230 + 7 420 + 13 1000 + 25 3200 + 25
22 mV	10 nV	10 - 20 20 - 40 40 - 20 k 20 k - 50 k 50 k - 100 k 100 k - 300 k 300 k - 500 k 500 k - 1 M	400 + 5 170 + 5 85 + 5 300 + 5 700 + 7 900 + 12 1300 + 25 2800 + 25	500 + 5 190 + 5 95 + 5 330 + 5 750 + 7 1000 + 12 1500 + 25 3100 + 25	530 + 5 200 + 5 100 + 5 350 + 5 800 + 7 1050 + 12 1600 + 25 3300 + 25	550 + 5 210 + 5 105 + 5 370 + 5 850 + 7 1100 + 12 1700 + 25 3400 + 25	400 + 5 170 + 5 55 + 5 90 + 5 210 + 7 380 + 12 900 + 25 2900 + 25	500 + 5 190 + 5 60 + 5 100 + 5 230 + 7 420 + 12 1000 + 25 3200 + 25
220 mV	100 nV	10 - 20 20 - 40 40 - 20 k 20 k - 50 k 50 k - 100 k 100 k - 300 k 300 k - 500 k 500 k - 1 M	400 + 13 170 + 8 85 + 8 250 + 8 700 + 25 900 + 25 1300 + 35 2800 + 80	500 + 13 190 + 8 95 + 8 280 + 8 750 + 25 1000 + 25 1500 + 35 3100 + 80	530 + 13 200 + 8 100 + 8 300 + 8 800 + 25 1050 + 25 1600 + 35 3300 + 80	550 + 13 210 + 8 105 + 8 320 + 8 850 + 25 1100 + 25 1700 + 35 3400 + 80	400 + 13 170 + 8 55 + 8 90 + 8 210 + 25 380 + 25 900 + 35 2900 + 80	500 + 13 190 + 8 60 + 8 100 + 8 230 + 25 420 + 25 1000 + 35 3200 + 80
2.2 V	1 µV	10 - 20 20 - 40 40 - 20 k 20 k - 50 k 50 k - 100 k 100 k - 300 k 300 k - 500 k 500 k - 1 M	400 + 80 130 + 25 60 + 6 105 + 16 190 + 70 350 + 130 850 + 350 1700 + 850	450 + 80 140 + 25 65 + 6 110 + 16 210 + 70 390 + 130 950 + 350 1900 + 850	480 + 80 150 + 25 70 + 6 115 + 16 230 + 70 420 + 130 1000 + 350 2100 + 850	500 + 80 160 + 25 75 + 6 120 + 16 250 + 70 430 + 130 1050 + 350 2200 + 850	400 + 80 130 + 25 35 + 6 85 + 16 170 + 70 340 + 130 850 + 350 1700 + 850	450 + 80 140 + 25 40 + 6 95 + 16 190 + 70 380 + 130 950 + 350 1900 + 850
22 V	10 µV	10 - 20 20 - 40 40 - 20 k 20 k - 50 k 50 k - 100 k 100 k - 300 k 300 k - 500 k 500 k - 1 M	400 + 800 130 + 250 60 + 60 105 + 160 190 + 350 400 + 1500 1050 + 4300 2300 + 8500	450 + 800 140 + 250 65 + 60 110 + 160 210 + 350 450 + 1500 1150 + 4300 2500 + 8500	480 + 800 150 + 250 70 + 60 115 + 160 230 + 350 470 + 1500 1200 + 4300 2600 + 8500	500 + 800 160 + 250 75 + 60 120 + 160 250 + 350 500 + 1500 1250 + 4300 2700 + 8500	400 + 800 130 + 250 35 + 60 85 + 160 170 + 350 400 + 1500 1000 + 4300 2200 + 8500	450 + 800 140 + 250 40 + 60 95 + 160 190 + 350 450 + 1500 1100 + 4300 2400 + 8500
			± (ppm output + mV)					
220 V [2]	100 µV	10 - 20 20 - 40 40 - 20 k 20 k - 50 k 50 k - 100 k 100 k - 300 k 300 k - 500 k 500 k - 1 M	400 + 8 130 + 2.5 65 + 0.8 170 + 3.5 400 + 8 1300 + 90 4300 + 90 10,500 + 190	450 + 8 140 + 2.5 70 + 0.8 190 + 3.5 450 + 8 1400 + 90 4500 + 90 11,000 + 190	480 + 8 150 + 2.5 75 + 0.8 210 + 3.5 480 + 8 1450 + 90 4600 + 90 11,300 + 190	500 + 8 160 + 2.5 80 + 0.8 220 + 3.5 500 + 8 1500 + 90 4700 + 90 11,500 + 190	400 + 8 130 + 2.5 40 + 0.8 85 + 3.5 270 + 8 1200 + 90 4200 + 90 10,500 + 190	450 + 8 140 + 2.5 45 + 0.8 95 + 3.5 300 + 8 1300 + 90 4500 + 90 11,000 + 190
1100 V [1]	1 mV	15 - 50 50 - 1 k	340 + 16 65 + 3.5	360 + 16 70 + 3.5	380 + 16 75 + 3.5	400 + 16 80 + 3.5	340 + 16 45 + 3.5	360 + 16 50 + 3.5
5725A Amplifier:								
1100 V	1 mV	40 - 1 k 1 k - 20 k 20 k - 30 k	75 + 4 105 + 6 230 + 11	80 + 4 125 + 6 360 + 11	85 + 4 135 + 6 440 + 11	90 + 4 165 + 6 600 + 11	50 + 4 85 + 6 160 + 11	55 + 4 105 + 6 320 + 11
750 V		30 k - 50 k 50 k - 100k	230 + 11 600 + 45	360 + 11 1300 + 45	440 + 11 1600 + 45	600 + 11 2300 + 45	160 + 11 380 + 45	320 + 11 1200 + 45

Notes:
1. Maximum output 250 V from 15-50 Hz.
2. See Volt-Hertz capability in Figure A.

5700A/5720A Series II Multifunction Calibrators

AC Voltage Secondary Performance Specifications and Operating Characteristics

Range	Frequency (Hz)	Stability± 1 °C [1] 24 Hours	Temperature Coefficient		Output Impedance (Ω)	Maximum Distortion Bandwidth 10 Hz-10 MHz
			10 - 40 °C	0 -10 °C and 40 -50 °C		
		± µV	± µV / °C			± (% output + µV)
2.2 mV	10 -20 20 - 40 40 - 20 k 20 k - 50 k 50 k - 100 k 100 k - 300 k 300 k - 500 k 500 k - 1 M	5 5 2 2 3 3 5 5	0.05 0.05 0.05 0.1 0.2 0.3 0.4 0.5	0.05 0.05 0.05 0.1 0.2 0.3 0.4 0.5	50	0.05 + 10 0.035 + 10 0.035 + 10 0.035 + 10 0.035 + 30 0.3 + 30 0.3 + 30 2 + 50
22 mV	10 -20 20 - 40 40 - 20 k 20 k - 50 k 50 k - 100 k 100 k - 300 k 300 k - 500 k 500 k - 1 M	5 5 2 2 3 5 10 15	0.2 0.2 0.2 0.4 0.5 0.6 1 1	0.3 0.3 0.3 0.5 0.5 0.6 1 1	50	0.05 + 11 0.035 + 11 0.035 + 11 0.035 + 11 0.035 + 30 0.3 + 30 0.3 + 30 2 + 30
		± (ppm output + µV)	± (ppm output µV) / °C			
220 mV	10 -20 20 - 40 40 - 20 k 20 k - 50 k 50 k - 100 k 100 k - 300 k 300 k - 500 k 500 k - 1 M	150 + 20 80 + 15 12 + 2 10 + 2 10 + 2 20 + 4 100 + 10 200 + 20	2 + 1 2 + 1 2 + 1 15 + 2 15 + 4 80 + 5 80 + 5 80 + 5	2 + 1 2 + 1 2 + 1 15 + 2 15 + 4 80 + 5 80 + 5 80 + 5	50	0.05 + 16 0.035 + 16 0.035 + 16 0.035 + 16 0.035 + 30 0.3 + 30 0.3 + 30 1 + 30
					Load Regulation ± (ppm output + µV)	
2.2 V	10 -20 20 - 40 40 - 20 k 20 k - 50 k 50 k - 100 k 100 k - 300 k 300 k - 500 k 500 k - 1 M	150 + 20 80 + 15 12 + 4 15 + 5 15 + 5 30 + 10 70 + 20 150 + 50	50 + 10 15 + 5 2 + 1 10 + 2 10 + 4 80 + 15 80 + 40 80 + 100	50 + 10 15 + 5 5 + 2 15 + 4 20 + 4 80 + 15 80 + 40 80 + 100	10 + 2 10 + 2 10 + 4 30 + 10 120 + 16 300 ppm 600 ppm 1200 ppm	0.05 + 80 0.035 + 80 0.035 + 80 0.035 + 80 0.035 + 110 0.3 + 110 0.5 + 110 1 + 110
22 V	10 -20 20 - 40 40 - 20 k 20 k - 50 k 50 k - 100 k 100 k - 300 k 300 k - 500 k 500 k - 1 M	150 + 20 80 + 15 12 + 8 15 + 10 15 + 10 30 + 15 70 + 100 150 + 100	50 + 100 15 + 30 2 + 10 10 + 20 10 + 40 80 + 150 80 + 300 80 + 500	50 + 100 15 + 40 4 + 15 20 + 20 20 + 40 80 + 150 80 + 300 80 + 500	10 + 20 10 + 20 10 + 30 30 + 50 80 + 80 100 + 700 200 + 1100 600 + 3000	0.05 + 700 0.035 + 700 0.035 + 700 0.035 + 700 0.05 + 800 0.3 + 800 0.3 + 800 2 + 800
220 V	10 -20 20 - 40 40 - 20 k 20 k - 50 k 50 k - 100 k 100 k - 300 k 300 k - 500 k 500 k - 1 M	150 + 200 80 + 150 12 + 80 15 + 100 15 + 100 30 + 400 100 + 10,000 200 + 20,000	50 + 1000 15 + 300 2 + 80 10 + 100 10 + 500 80 + 600 80 + 800 80 + 1000	50 + 1000 15 + 300 4 + 80 20 + 100 20 + 500 80 + 600 80 + 800 80 + 1000	10 + 200 10 + 200 10 + 300 30 + .600 80 + 3,000 250 + 25,000 500 + 50,000 1000 + 110,000	0.05 + 10,000 0.05 + 10,000 0.05 + 10,000 0.05 + 10,000 0.2 + 50,000 1.5 + 50,000 1.5 + 50,000 3.5 + 100,000
		± (ppm output + mV)	± (ppm output) / °C		± (ppm output + mV)	± (% output)
1100 V	15 -50 50 - 1 k	150 + 0.5 20 + 0.5	50 2	50 5	10 + 2 10 + 1	0.15 0.07

5725A Amplifier:

Range	Frequency (Hz)	Stability ± 1 °C [1] 24 Hours	Temperature Coefficient Adder		Load Regulation [2]	Distortion Bandwidth 10 Hz -10 MHz ± (% output)	
			10 - 40 °C	0 - 10 °C and 40 - 50 °C			
		± (ppm output + mV)	± (ppm output) / °C		± (ppm output + mV)	150 pF	1000 pF
1100 V	40 - 1 k 1 k - 20 k 20 k - 50 k 50 k - 100 k	10 + .5 15 + 2 40 + 2 130 + 2	5 5 10 30	5 5 10 30	10 + 1 90 + 6 275 + 11 500 + 30	0.10 0.10 0.30 0.40	0.10 0.15 0.30 0.40

Notes:
1. Stability specifications are included in Absolute Uncertainty values for the primary specifications.
2. The 5725A will drive up to 1000 pF of load capacitance. Uncertainty specifications include loads to 300 pF and 150 pF as shown under "Load Limits." For capacitances up to the maximum of 1000 pF, add "Load Regulation."

Voltage Range	Maximum Current Limits		Load Limits
2.2 V [2] 22 V 220 V	50 mA, 0 °C-40 °C 20 mA, 40 °C-50 °C		>50 Ω, 1000 pF
1100 V	6 mA		600 pF
5725A Amplifier:			
1100 V	40 Hz-5 kHz	50 mA	1000 pF [1]
	5 kHz-30 kHz	70 mA	300 pF
	30 kHz-100 kHz	70 mA [3]	150 pF

Notes:
1. The 5725A will drive up to 1000 pF of load capacitance. Uncertainty specifications include loads to 300 pF and 150 pF as shown under "Load Limits." For capacitances up to the maximum of 1000 pF, add "Load Regulation."
2. 2.2 V Range, 100 kHz-1.2 MHz only: uncertainty specifications cover loads to 10 mA or 1000 pF. For higher loads, load regulation is added.
3. Applies from 0 °C to 40 °C.

Output Display Formats ..... Voltage or dBm, dBm reference 600 Ω.
Minimum Output..... 10 % on each range
External Sense ..... Applicable for 2.2 V, 22 V, 220 V, and 1100 V ranges; 5700A/5720A <100 kHz, 5725A <30 kHz. Specifications are the same as internal sense.

Settling Time to Full Accuracy

Frequency (Hz)	Settling Time (seconds)
<20	7
120-120 k	5
>120 k	2

Notes: Plus 1 second for amplitude or frequency range change
Plus 2 seconds for 5700A/5720A 1100 V range
Plus 4 seconds for 5725A 1100 V range

Overshoot..... <10 %
Common Mode Rejection 140 dB, DC to 400 Hz
Frequency
Ranges (Hz) ..... 10.000 - 119.99
..... 0.1200 k - 1.1999 k
..... 1.200 k - 11.999 k
..... 12.00 k - 119.99 k
..... 120.0 k - 1.1999 M
Uncertainty ..... ±0.01 %
Resolution..... 11.999 counts
Phase Lock (Selectable Rear Panel BNC Input)
Phase Uncertainty (except 1100 V range) >30 Hz: ±1 ° + 0.05 °/kHz), <30 Hz: ±3 °
Input Voltage..... 1 V to 10 V rms sine wave (do not exceed 1 V for mV ranges)
Frequency Range ..... 10 Hz to 1.1999 MHz
Lock Range ..... ±2 % of frequency
Lock-In Time..... Larger of 10/frequency or 10 msec
Phase Reference (Selectable Rear Panel BNC Output)
Range ..... ±180 °
Phase Uncertainty (except 1100 V range) ±1 ° at quadrature points (0 °, ±90 °, ±180 °) elsewhere ±2 °
Stability ..... ±0.1 °
Resolution..... 1 °
Output Level ..... 2.5 V rms ±0.2 V
Frequency Range ..... 50 kHz to 1 kHz, usable 10 Hz to 1.1999 MHz

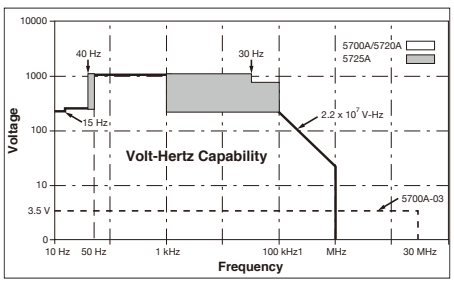


Figure A.

5700A/5720A Series II Multifunction Calibrators

Resistance Specifications

5720A Series II Resistance Specifications

Nominal Value (Ω)	Absolute Uncertainty of Characterized Value ± 5 °C from calibration temperature [1]				Relative Uncertainty ± 1 °C	
	24 Hours	90 Days	180 Days	1 Year	24 Hours	90 Days
	±ppm					
99 % Confidence Level						
0	50µΩ	50µΩ	50µΩ	50µΩ	50µΩ	50µΩ
1	85	95	100	110	32	40
1.9	85	95	100	110	25	33
10	23	25	26	27	5	8
19	23	25	26	27	4	7
100	10	11	11.5	12	2	4
190	10	11	11.5	12	2	4
1k	8	9	9.5	10	2	3
1.9k	8	9	9.5	10	2	3
10k	8	9	9.5	10	2	3
19k	9	9	9.5	10	2	3
100k	9	11	12	13	2	3
190k	9	11	12	13	2	3
1M	16	18	20	23	2.5	5
1.9M	17	19	21	24	3	6
10M	33	37	40	46	10	14
19M	43	47	50	55	20	24
100M	100	110	115	120	50	60
95 % Confidence Level						
0	40µΩ	40µΩ	40µΩ	40µΩ	40µΩ	40µΩ
1	70	80	85	95	27	35
1.9	70	80	85	95	20	26
10	20	21	22	23	4	7
19	20	21	22	23	3.5	6
100	8	9	9.5	10	1.6	3.5
190	8	9	9.5	10	1.6	3.5
1k	6.5	7.5	8	8.5	1.6	2.5
1.9k	6.5	7.5	8	8.5	1.6	2.5
10k	6.5	7.5	8	8.5	1.6	2.5
19k	7.5	7.5	8	8.5	1.6	2.5
100k	7.5	9	10	11	1.6	2.5
190k	7.5	9	10	11	1.6	2.5
1M	13	15	17	20	2	4
1.9M	14	16	18	21	2.5	4
10M	27	31	34	40	8	12
19M	35	39	42	47	16	20
100M	85	95	100	100	40	50

Note:
1. Specifications apply to displayed value. 4-wire connections, except 100 MΩ.

5700A Series II Resistance Specifications

Nominal Value (Ω)	Absolute Uncertainty of Characterized Value ± 5 °C from calibration temperature [1]				Relative Uncertainty ± 1 °C	
	24 Hours	90 Days	180 Days	1 Year	24 Hours	90 Days
	±ppm					
99 % Confidence Level						
0	50µΩ	50µΩ	50µΩ	50µΩ	50µΩ	50µΩ
1	85	95	100	110	32	40
1.9	85	95	100	110	25	33
10	26	28	30	33	5	8
19	24	26	28	31	4	7
100	15	17	18	20	2	4
190	15	17	18	20	2	4
1k	11	12	13	15	2	3.5
1.9k	11	12	13	15	2	3.5
10k	9	11	12	14	2	3.5
19k	9	11	12	14	2	3.5
100k	11	13	14	16	2	3.5
190k	11	13	14	16	2	3.5
1M	16	18	20	23	2.5	5
1.9M	17	19	21	24	3.5	6
10M	33	37	40	46	10	14
19M	43	47	50	55	20	24
100M	110	120	125	130	50	60
95 % Confidence Level						
0	50µΩ	50µΩ	50µΩ	50µΩ	50µΩ	50µΩ
1	70	80	85	95	32	40
1.9	70	80	85	95	25	33
10	21	23	27	28	5	8
19	20	22	24	27	4	7
100	13	14	15	17	2	4
190	13	14	15	17	2	4
1k	9	10	11	13	2	3.5
1.9k	9	10	11	13	2	3.5
10k	7.5	9.5	10.5	12	2	3.5
19k	7.5	9.5	10.5	12	2	3.5
100k	9	11	12	14	2	3.5
190k	9	11	12	14	2	3.5
1M	13	15	17	20	2.5	5
1.9M	14	16	18	21	3	6
10M	27	31	34	40	10	14
19M	35	39	42	47	20	24
100M	90	100	105	110	50	60

Note:
1. Specifications apply to displayed value. 4-wire connections, except 100 MΩ.

Resistance Secondary Performance Specifications and Operating Characteristics

Nominal Value (Ω)	Stability ± 1 °C [1] 24 Hours	Temperature Coefficient Adder [2]		Full Spec Load Range [3] IL -IU (mA)	Maximum Peak Current IMAX (mA)	Maximum Difference of Characterized to Nominal Value	Two-Wire Adder Active Compensation [4]	
		10 - 40 °C	0 - 10 °C and 40 - 50 °C				Lead Resistance	
	±ppm	±ppm/°C				±ppm	0.1 Ω	1 Ω
							±mΩ	
0	-	-	-	8 -500	500	-	$2 + \frac{4\mu V}{I_m}$	$4 + \frac{4\mu V}{I_m}$
1	32	4	5	8 -100	700	500	$2 + \frac{4\mu V}{I_m}$	$4 + \frac{4\mu V}{I_m}$
1.9	25	6	7	8 -100	500	500	$2 + \frac{4\mu V}{I_m}$	$4 + \frac{4\mu V}{I_m}$
10	5	2	3	8 -11	220	300	$2 + \frac{4\mu V}{I_m}$	$4 + \frac{4\mu V}{I_m}$
19	4	2	3	8 -11	160	300	$2 + \frac{4\mu V}{I_m}$	$4 + \frac{4\mu V}{I_m}$
100	2	2	3	8 -11	70	150	$2 + \frac{4\mu V}{I_m}$	$4 + \frac{4\mu V}{I_m}$
190	2	2	3	8 -11	50	150	$2 + \frac{4\mu V}{I_m}$	$4 + \frac{4\mu V}{I_m}$
1 k	2	2	3	1 -2	22	150	10	15
1.9 k	2	2	3	1 -1.5	16	150	10	15
10 k	2	2	3	100 - 500 µA	7	150	50	60
19 k	2	2	3	50 - 250 µA	5	150	100	120
100 k	2	2	3	10 - 100 µA	1	150	I_m = Current produced by Ohmmeter (A)	
190 k	2	2	3	5 - 50 µA	500 µA	150		
1 M	2.5	2.5	6	5 - 20 µA	100 µA	200		
1.9 M	3.5	3	10	2.5 - 10 µA	50 µA	200		
10 M	10	5	20	0.5 - 2 µA	10 µA	300		
19 M	20	8	40	0.25 - 1 µA	5 µA	300		
100 M	50	12	100	50 - 200 nA	1 µA	500		

Notes:
1. Stability specifications are included in the Absolute Uncertainty values in the primary specification tables.
2. Temperature coefficient is an adder to uncertainty specifications that does not apply unless operated more than 5 °C from calibration temperature, or calibrated outside the range 19 °C to 24 °C. Two examples:
   - Calibrate at 20 °C: Temperature coefficient adder is not required unless operated below 15 °C or above 25 °C.
   - Calibrate at 26 °C: Add 2 °C temperature coefficient adder. Additional temperature coefficient adder is not required unless operated below 21 °C or above 31 °C.
3. Refer to current derating factors table for loads outside of this range.
4. Active two-wire compensation may be selected for values less than 100 kΩ, with either the front panel or the meter input terminals as reference plane. Active compensation is limited to 11 mA load, and to 2 V burden. Two-wire compensation can be used only with Ωmeters that source continuous (not pulsed) dc current.

Current Derating Factors

No Minal Value (Ω)	Value of Derating Factor k for Over or Under Current		
	Two-Wire Co Mp I < IL [1]	Four-Wire I < IL [1]	Four-Wire IU < I < IMA x [2]
SHORT	4.4	0.3	-
1	4.4	300	4 x 10-5
1.9	4.4	160	1.5 x 10-4
10	4.4	30	1.6 x 10-3
19	4.4	16	3 x 10-3
100	4.4	3.5	1 x 10-2
190	4.4	2.5	1.9 x 10-2
1 k	4.4	0.4	0.1
1.9 k	4.4	0.4	0.19
10 k	5000	50	2.0
19 k	5000	50	3.8
100 k	-	7.5	2 x 10-5
190 k	-	4.0	3.8 x 10-5
1 M	-	1.0	1.5 x 10-4
1.9 M	-	0.53	2.9 x 10-4
10 M	-	0.2	1 x 10-3
19 M	-	0.53	1.9 x 10-3
100 M		0.1	-

Notes:
1. For I < I L, errors occur due to thermally generated voltages within the 5720A. Use the following equation to determine the error, and add this error to the corresponding uncertainty or stability specification.
   Error = K(I_L - I)/(I_L x I)
   Where: Error is in mΩ for all two-wire comp alues and four-wire short, and in ppm for the remaining four-wire values.
   K is the constant from the above table;
   I and IL are expressed in mA for short to 1.9 kΩ;
   I and IL are expressed in. µA for 10 kΩ to 100 MΩ
2. For IU < I < IMAX errors occur due to self-heating of the resistors in the calibrator. Use the following equation to determine the error in ppm and add this error to the corresponding uncertainty or stability specification.
   Error in ppm = K(I^2-I_U^2)
   Where: K is the constant from the above table;
   I and I_U are expressed in mA for short to 19 kΩ;
   I and I_U are expressed in. µA for 100 kΩ to 100 MΩ

5700A/5720A Series II Multifunction Calibrators

DC Current Specifications

5720A Series II DC Current Specifications

Range	Resolution	Absolute Uncertainty ± 5 °C from calibration temperature [2] [3]				Relative Uncertainty ± 1 °C	
		24 Hours	90 Days	180 Days	1 Year	24 Hours	90 Days
	nA	± (ppm output + nA)					
99 % Confidence Level							
220 µA 2.2 mA 22 mA	0.1 1 10	40 + 7 30 + 8 30 + 50	42 + 7 35 + 8 35 + 50	45 + 7 37 + 8 37 + 50	50 + 7 40 + 8 40 + 50	24 + 2 24 + 5 24 + 50	26 + 2 26 + 5 26 + 50
	µA	± (ppm output + µA)					
220 mA [1] 2.2 A [1]	0.1 1	40 + 0.8 60 + 15	45 + 0.8 70 + 15	47 + 0.8 80 + 15	50 + 0.8 90 + 15	26 + 0.3 40 + 7	30 + 0.3 45 + 7
5725A Amplifier:							
11 A	10	330 + 470	340 + 480	350 + 480	360 + 480	100 + 130	110 + 130
95 % Confidence Level							
	nA	± (ppm output + nA)					
220 µA 2.2 mA 22 mA	0.1 1 10	32 + 6 25 + 7 25 + 40	35 + 6 30 + 7 30 + 40	37 + 6 33 + 7 33 + 40	40 + 6 35 + 7 35 + 40	20 + 1.6 20 + 4 20 + 40	22 + 1.6 22 + 4 22 + 40
	µA	± (ppm output + µA)					
220 mA [1] 2.2 A [1]	0.1 1	35 + 0.7 50 + 12	40 + 0.7 60 + 12	42 + 0.7 70 + 12	45 + 0.7 80 + 12	22 + 0.25 32 + 6	25 + 0.25 40 + 6
5725A Amplifier:							
11 A	10	330 + 470	340 + 480	350 + 480	360 + 480	100 + 130	110 + 130

Note:
Maximum output from the calibrator's terminals is 2.2 A. Uncertainty specifications for 220 mA and 2.2 mA ranges are increased by a factor of 1.3 when supplied through 5725A terminals. Specifications are otherwise identical for all output locations.

1. Add to uncertainty specifications:
   ±200 x I^2 ppm for >100 mA on 220 mA range
   ±10 x I^2 ppm for >1 A on 2.2 A range
2. For fields strengths >0.4 V/m but ≤3 V/m, in the band of 80 MHz to 1 GHz, add 1 % of range.
3. For conducted immunity levels >=1 V in the band of 150 kHz to 80 MHz on 2.2 mA range, add 0.01 % of range.

5700A Series II DC Current Specifications

Range	Resolution	Absolute Uncertainty ± 5 °C from calibration temperature [2] [3]				Relative Uncertainty ± 1 °C	
		24 Hours	90 Days	180 Days	1 Year	24 Hours	90 Days
	nA	± (ppm output + nA)					
99 % Confidence Level							
220 µA 2.2 mA 22 mA	0.1 1 10	45 + 10 45 + 10 45 + 100	50 + 10 50 + 10 50 + 100	55 + 10 55 + 10 55 + 100	60 + 10 60 + 10 60 + 100	24 + 2 24 + 5 24 + 50	26 + 2 26 + 5 26 + 50
	µA	± (ppm output + µA)					
220 mA [1] 2.2 A [1]	0.1 1	55 + 1 75 + 30	60 + 1 80 + 30	65 + 1 90 + 30	70 + 1 95 + 30	26 + 0.3 40 + 7	30 + 0.3 45 + 7
5725A Amplifier:							
11 A	10	330 + 470	340 + 480	350 + 480	360 + 480	100 + 130	110 + 130
95 % Confidence Level							
	nA	± (ppm output + nA)					
220 µA 2.2 mA 22 mA	0.1 1 10	35 + 8 35 + 8 35 + 80	40 + 8 40 + 8 40 + 80	45 + 8 45 + 8 45 + 80	50 + 8 50 + 8 50 + 80	20 + 1.6 20 + 4 20 + 40	22 + 1.6 22 + 4 22 + 40
	µA	± (ppm output + µA)					
220 mA [1] 2.2 A [1]	0.1 1	45 + 0.8 60 + 25	50 + 0.8 65 + 25	55 + 0.8 75 + 25	60 + 0.8 80 + 25	22 + 0.25 35 + 6	25 + 0.25 40 + 6
5725A Amplifier:							
11 A	10	330 + 470	340 + 480	350 + 480	360 + 480	100 + 130	110 + 130

Note:
Maximum output from the calibrator's terminals is 2.2 A. Uncertainty specifications for 220 mA and 2.2 mA ranges are increased by a factor of 1.3 when supplied through 5725A terminals. Specifications are otherwise identical for all output locations.

1. Add to uncertainty specifications:
   ±200 x I^2 ppm for >100 mA on 220 mA range
   ±10 x I^2 ppm for >1 A on 2.2 A range
2. For fields strengths >0.4 V/m but ≤3 V/m, in the band of 80 MHz to 1 GHz, add 1 % of range.
3. For conducted immunity levels >=1 V in the band of 150 kHz to 80 MHz on 2.2 mA range, add 0.01 % of range.

DC Current Secondary Performance Specifications and Operating Characteristics

Range	Stability ± 1 °C [1] 24 Hours	Temperature Coefficient [2]		Compliance Limits	Burden Voltage Adder [3] (±nA/V)	Maximum Load for Full Accuracy [4] (Ω)	Noise	
		10 - 40 °C	0 - 10 °C and 40 - 50 °C				Bandwidth 0.1-10 Hz	Bandwidth 10 Hz-10 kHz
							pk-pk	RMS
	± (ppm output + nA)	± (ppm output + nA) / °C					ppm output + nA	nA
220 µA 2.2 mA 22 mA 220 mA 2.2 A	5 + 1 5 + 5 5 + 50 8 + 300 9 + 7 µA	1 + 0.40 1 + 2 1 + 20 1 + 200 1 + 2.5 µA	3 + 1 3 + 10 3 + 100 3 + 1 µA 3 + 10 µA	10 10 10 10 3 [5]	0.2 0.2 10 100 2 µA	20k 2k 200 20 2	6 + .9 6 + 5 6 + 50 9 + 300 12 + 1.5 µA	10 10 50 500 20 µA
5725A	± (ppm output + µA)	± (ppm output + µA) / °C					ppm output + µA	µA
11 A	25 + 100	20 + 75	30 + 120	4	0	4	15 + 70	175

Notes:
Maximum output from the calibrator's terminals is 2.2 A. Uncertainty specifications for 220 mA and 2.2 mA ranges are increased by a factor of 1.3 when supplied through 5725A terminals.
1. Stability specifications are included in the Absolute Uncertainty values for the primary specifications.
2. Temperature coefficient is an adder to uncertainty specifications. It does not apply unless operating more than ±5 °C from calibration temperature.
3. Burden voltage adder is an adder to uncertainty specifications that does not apply unless burden voltage is greater than 0.5 V.
4. For higher loads, multiply uncertainty specification by: $1+\frac{0.1x \text{ actual load}}{\text{maximum load for full accuracy}}$
5. The calibrator's compliance limit is 2 V for outputs from 1 A to 2.2 A. 5725A Amplifier may be used in range-lock mode down to 0 A.

Minimum Output: ..... 0 for all ranges, including 5725A.
Settling Time: ..... 1 second for mA and mA ranges; 3 seconds for 2.2 A range; 6 seconds for 11 range; + 1 second for range or polarity change
Overshoot: ..... <5 %

5700A/5720A Series II Multifunction Calibrators

AC Voltage Specifications

5720A Series II AC Current Specifications: 99 % Confidence Level

Range	Resolution	Frequency (Hz)	Absolute Uncertainty ± 5 °C from calibration temperature [1]				Relative Uncertainty ± 1 °C	
			24 Hours	90 Days	180 Days	1 Year	24 Hours	90 Days
			± (ppm output + nA)					
220 µA	1 nA	10 - 20 20 - 40 40 - 1 k 1k - 5 k 5k - 10 k	260 + 20 170 + 12 120 + 10 300 + 15 1000 + 80	280 + 20 180 + 12 130 + 10 320 + 15 1100 + 80	290 + 20 190 + 12 135 + 10 340 + 15 1200 + 80	300 + 20 200 + 12 140 + 10 350 + 15 1300 + 80	260 + 20 130 + 12 100 + 10 250 + 15 900 + 80	280 + 20 150 + 12 110 + 10 280 + 15 1000 + 80
2.2 mA	10 nA	10 - 20 20 - 40 40 - 1 k 1k - 5 k 5k - 10 k	260 + 50 170 + 40 120 + 40 210 + 130 1000 + 800	280 + 50 180 + 40 130 + 40 220 + 130 1100 + 800	290 + 50 190 + 40 135 + 40 230 + 130 1200 + 800	300 + 50 200 + 40 140 + 40 240 + 130 1300 + 800	260 + 50 130 + 40 100 + 40 190 + 130 900 + 800	280 + 50 150 + 40 110 + 40 220 + 130 1000 + 800
22 mA	100 nA	10 - 20 20 - 40 40 - 1 k 1k - 5 k 5k - 10 k	260 + 500 170 + 400 120 + 400 210 + 700 1000 + 6000	280 + 500 180 + 400 130 + 400 220 + 700 1100 + 6000	290 + 500 190 + 400 135 + 400 230 + 700 1200 + 6000	300 + 500 200 + 400 140 + 400 240 + 700 1300 + 6000	260 + 500 130 + 400 100 + 400 190 + 700 900 + 6000	280 + 500 150 + 400 110 + 400 220 + 700 1000 + 6000
			± (ppm output + µA)					
220 mA	1 µA	10 - 20 20 - 40 40 - 1 k 1k - 5 k 5k - 10 k	260 + 5 170 + 4 120 + 3 210 + 4 1000 + 12	280 + 5 180 + 4 130 + 3 220 + 4 1100 + 12	290 + 5 190 + 4 135 + 3 230 + 4 1200 + 12	300 + 5 200 + 4 140 + 3 240 + 4 1300 + 12	260 + 5 130 + 4 100 + 3 190 + 4 900 + 12	280 + 5 150 + 4 110 + 3 220 + 4 1000 + 12
2.2 A	10 µA	20 - 1 k 1 k - 5 k 5 k - 10 k	290 + 40 440 + 100 6000 + 200	300 + 40 460 + 100 7000 + 200	310 + 40 480 + 100 7500 + 200	320 + 40 500 + 100 8000 + 200	260 + 40 420 + 100 6000 + 200	280 + 40 440 + 100 7000 + 200
5725A Amplifier:								
11 A	100 µA	40 - 1 k 1 k - 5 k 5 k - 10 k	370 + 170 800 + 380 3000 + 750	400 + 170 850 + 380 3300 + 750	440 + 170 900 + 380 3500 + 750	460 + 170 950 + 380 3600 + 750	300 + 170 700 + 380 2800 + 750	330 + 170 800 + 380 3200 + 750

Note:
Maximum output from the calibrator's terminals is 2.2 A. Uncertainty specifications for 220 µA and 2.2 mA ranges are increased by a factor of 1.3 plus 2 µA when supplied through 5725A terminals. For the 5720A 220 µA range, 1 kHz through 5 kHz and 5 kHz through 10 kHz, when the output is coming from the AUX current terminal, use the 5700A Absolute Uncertainty Specifications. Specifications are otherwise identical for all output locations.
1. For fields strengths >0.4 V/m but ≤3 V/m, in the band of 80 MHz to 1 GHz, add 1 % of range.

5720A Series II AC Current Specifications: 95% Confidence Level

Range	Resolution	Frequency (Hz)	Absolute Uncertainty ± 5 °C from calibration temperature [1]				Relative Uncertainty ± 1 °C	
			24 Hours	90 Days	180 Days	1 Year	24 Hours	90 Days
			± (ppm output + nA)					
220 µA	1 nA	10 - 20 20 - 40 40 - 1 k 1k - 5 k 5k - 10 k	210 + 16 130 + 10 100 + 8 240 + 12 800 + 65	230 + 16 140 + 10 110 + 8 250 + 12 900 + 65	240 + 16 150 + 10 115 + 8 270 + 12 1000 + 65	250 + 16 160 + 10 120 + 8 280 + 12 1100 + 65	210 + 16 110 + 10 80 + 8 200 + 12 700 + 65	230 + 16 130 + 10 90 + 8 230 + 12 800 + 65
2.2 mA	10 nA	10 - 20 20 - 40 40 - 1 k 1k - 5 k 5k - 10 k	210 + 40 130 + 35 100 + 35 170 + 110 800 + 650	230 + 40 140 + 35 110 + 35 180 + 110 900 + 650	240 + 40 150 + 35 115 + 35 190 + 110 1000 + 650	250 + 40 160 + 35 120 + 35 200 + 110 1100 + 650	210 + 40 110 + 35 80 + 35 160 + 110 700 + 650	230 + 40 130 + 35 90 + 35 170 + 110 800 + 650
22 mA	100 nA	10 - 20 20 - 40 40 - 1 k 1k - 5 k 5k - 10 k	210 + 400 130 + 350 100 + 350 170 + 550 800 + 5000	230 + 400 140 + 350 110 + 350 180 + 550 900 + 5000	240 + 400 150 + 350 115 + 350 190 + 550 1000 + 5000	250 + 400 160 + 350 120 + 350 200 + 550 1100 + 5000	210 + 400 110 + 350 80 + 350 160 + 550 700 + 5000	230 + 400 130 + 350 90 + 350 170 + 550 800 + 5000
			± (ppm output + µA)					
220 mA	1 µA	10 - 20 20 - 40 40 - 1 k 1k - 5 k 5k - 10 k	210 + 4 130 + 3.5 100 + 2.5 170 + 3.5 800 + 10	230 + 4 140 + 3.5 110 + 2.5 180 + 3.5 900 + 10	240 + 4 150 + 3.5 115 + 2.5 190 + 3.5 1000 + 10	250 + 4 160 + 3.5 120 + 2.5 200 + 3.5 1100 + 10	210 + 4 110 + 3.5 80 + 2.5 160 + 3.5 700 + 10	230 + 4 130 + 3.5 90 + 2.5 170 + 3.5 800 + 10
2.2 A	10 µA	20 - 1 k 1 k - 5 k 5 k - 10 k	230 + 35 350 + 80 5000 + 160	240 + 35 390 + 80 6000 + 160	250 + 35 420 + 80 6500 + 160	260 + 35 450 + 80 7000 + 160	200 + 35 300 + 80 5000 + 160	230 + 35 350 + 80 6000 + 160
5725A Amplifier:								
11 A	100 µA	40 - 1 k 1 k - 5 k 5 k - 10 k	370 + 170 800 + 380 3000 + 750	400 + 170 850 + 380 3300 + 750	440 + 170 900 + 380 3500 + 750	460 + 170 950 + 380 3600 + 750	300 + 170 700 + 380 2800 + 750	330 + 170 800 + 38 3200 + 750

Note:
Maximum output from the calibrator's terminals is 2.2 A. Uncertainty specifications for 220 µA and 2.2 mA ranges are increased by 1.3 plus 2 µA when supplied through 5725A terminals. For the 5720A 220 µA range, 1 kHz through 5 kHz and 5 kHz through 10 kHz, when the output is coming from the AUX current terminal, use the 5700A Absolute Uncertainty Specifications. Specifications are otherwise identical for all output locations.
1. For fields strengths >0.4 V/m but ≤3 V/m, in the band of 80 MHz to 1 GHz, add 1 % of range.

5700A Series II AC Current Specifications: 99 % Confidence Level

Range	Resolution	Frequency (Hz)	Absolute Uncertainty ± 5 °C from calibration temperature [1]				Relative Uncertainty ± 1 °C	
			24 Hours	90 Days	180 Days	1 Year	24 Hours	90 Days
			± (ppm output + nA)					
220 µA	1 nA	10 - 20 20 - 40 40 - 1 k 1k - 5 k 5k - 10 k	650 + 30 350 + 25 120 + 20 500 + 50 1500 + 100	700 + 30 380 + 25 140 + 20 600 + 50 1600 + 100	750 + 30 410 + 25 150 + 20 650 + 50 1700 + 100	800 + 30 420 + 25 160 + 20 700 + 50 1800 + 100	450 + 30 270 + 25 110 + 20 450 + 50 1400 + 100	500 + 30 300 + 25 120 + 20 500 + 50 1500 + 100
2.2 mA	10 nA	10 - 20 20 - 40 40 - 1 k 1k - 5 k 5k - 10 k	650 + 50 350 + 40 120 + 40 500 + 500 1500 + 1000	700 + 50 380 + 40 140 + 40 600 + 500 1600 + 1000	750 + 50 410 + 40 150 + 40 650 + 500 1700 + 1000	800 + 50 420 + 40 160 + 40 700 + 500 1800 + 1000	450 + 50 270 + 40 110 + 40 450 + 500 1400 + 1000	500 + 50 300 + 40 120 + 40 500 + 500 1500 + 1000
22 mA	100 nA	10 - 20 20 - 40 40 - 1 k 1k - 5 k 5k - 10 k	650 + 500 350 + 400 120 + 400 500 + 5000 1500 + 10,000	700 + 500 380 + 400 140 + 400 600 + 5000 1600 + 10,000	750 + 500 410 + 400 150 + 400 650 + 5000 1700 + 10,000	800 + 500 420 + 400 160 + 400 700 + 5000 1800 + 10,000	450 + 500 270 + 400 110 + 400 450 + 5000 1400 + 10,000	500 + 500 300 + 400 120 + 400 500 + 5000 1500 + 10,000
± (ppm output + µA)								
220 mA	1 µA	10 - 20 20 - 40 40 - 1 k 1k - 5 k 5k - 10 k	650 + 5 350 + 4 120 + 4 500 + 50 1500 + 100	700 + 5 380 + 4 150 + 4 600 + 50 1600 + 100	750 + 5 410 + 4 170 + 4 650 + 50 1700 + 100	800 + 5 420 + 4 180 + 4 700 + 50 1800 + 100	450 + 5 280 + 4 110 + 4 450 + 50 1400 + 100	500 + 5 300 + 4 130 + 4 500 + 50 1500 + 100
2.2 A	10 µA	20 - 1 k 1 k - 5 k 5 k - 10 k	600 + 40 700 + 100 8000 + 200	650 + 40 750 + 100 9000 + 200	700 + 40 800 + 100 9500 + 200	750 + 40 850 + 100 10,000 + 200	600 + 40 650 + 100 7500 + 200	650 + 40 750 + 100 8500 + 200
5725A Amplifier:								
11 A	100 µA	40 - 1 k 1 k - 5 k 5 k - 10 k	370 + 170 800 + 380 3000 + 750	400 + 170 850 + 380 3300 + 750	440 + 170 900 + 380 3500 + 750	460 + 170 950 + 380 3600 + 750	300 + 170 700 + 380 2800 + 750	330 + 170 800 + 380 3200 + 750

Note:
Maximum output from the calibrator's terminals is 2.2 A. Uncertainty specifications for 220 µA and 2.2 mA ranges are increased by a factor of 1.3 plus 2 µA when supplied through 5725A terminals. Specifications are otherwise identical for all output locations.
1. For field strengths >0.4 V/m but ≤3 V/m, in the band of 80 MHz to 1 GHz, add 1 % of range.

5700A Series II AC Current Specifications: 95 % Confidence Level

Range	Resolution	Frequency (Hz)	Absolute Uncertainty ± 5 °C from calibration temperature [1]				Relative Uncertainty ± 1 °C	
			24 Hours	90 Days	180 Days	1 Year	24 Hours	90 Days
			± (ppm output + nA)					
220 µA	1 nA	10 - 20 20 - 40 40 - 1 k 1k - 5 k 5k - 10 k	550 + 25 280 + 20 100 + 16 400 + 40 1300 + 80	600 + 25 310 + 20 120 + 16 500 + 40 1400 + 80	650 + 25 330 + 20 130 + 16 550 + 40 1500 + 80	700 + 25 350 + 20 140 + 16 600 + 40 1600 + 80	375 + 25 220 + 20 90 + 16 375 + 40 1200 + 80	400 + 25 250 + 20 100 + 16 400 + 40 1200 + 80
2.2 mA	10 nA	10 - 20 20 - 40 40 - 1 k 1k - 5 k 5k - 10 k	550 + 40 280 + 35 100 + 35 400 + 400 1300 + 800	600 + 40 310 + 35 120 + 35 500 + 400 1400 + 800	650 + 40 330 + 35 130 + 35 550 + 400 1500 + 800	700 + 40 350 + 35 140 + 35 600 + 400 1600 + 800	375 + 40 220 + 35 090 + 35 375 + 400 1200 + 800	400 + 40 250 + 35 100 + 35 400 + 400 1200 + 800
22 mA	100 nA	10 - 20 20 - 40 40 - 1 k 1k - 5 k 5k - 10 k	550 + 400 280 + 350 100 + 350 400 + 4000 1300 + 8000	600 + 400 310 + 350 120 + 350 500 + 4000 1400 + 8000	650 + 400 330 + 350 130 + 350 550 + 4000 1500 + 8000	700 + 400 350 + 350 140 + 350 600 + 4000 1600 + 8000	375 + 400 220 + 350 090 + 350 375 + 4000 1200 + 8000	400 + 400 250 + 350 100 + 350 400 + 4000 1200 + 8000
± (ppm output + µA)								
220 mA	1 µA	10 - 20 20 - 40 40 - 1 k 1k - 5 k 5k - 10 k	550 + 4 280 + 3.5 100 + 3.5 400 + 40 1300 + 80	600 + 4 310 + 3.5 120 + 3.5 500 + 40 1400 + 80	650 + 4 330 + 3.5 130 + 3.5 550 + 40 1500 + 80	700 + 4 350 + 3.5 140 + 3.5 600 + 40 1600 + 80	375 + 4 220 + 3.5 90 + 3.5 375 + 40 1200 + 80	400 + 4 250 + 3.5 100 + 3.5 400 + 40 1200 + 80
2.2 A	10 µA	20 - 1 k 1 k - 5 k 5 k - 10 k	500 + 35 600 + 80 6500 + 160	550 + 35 650 + 80 7500 + 160	600 + 35 700 + 80 8000 + 1600	650 + 35 750 + 80 8500 + 160	500 + 35 550 + 80 6000 + 160	550 + 35 650 + 80 7000 + 160
5725A Amplifier:								
11 A	100 µA	40 - 1 k 1 k - 5 k 5 k - 10 k	370 + 170 800 + 380 3000 + 750	400 + 170 850 + 380 3300 + 750	440 + 170 900 + 380 3500 + 750	460 + 170 950 + 380 3600 + 750	300 + 170 700 + 380 2800 + 750	330 + 170 800 + 380 3200 + 750

Note:
Maximum output from the calibrator's terminals is 2.2 A. Uncertainty specifications for 220 A and 2.2 mA ranges are increased by a factor of 1.3 plus 2 µA when supplied through 5725A terminals. Specifications are otherwise identical for all output locations.
1. For fields strengths >0.4 V/m but ≤3 V/m, in the band of 80 MHz to 1 GHz, add 1 % of range.

AC Current Secondary Performance Specifications and Operating Characteristics

Range	Frequency (Hz)	Stability ± 1 °C [1] 24 Hours	Temperature Coefficient [2]		Compliance Limits (V rms)	Maximum Resistive Load For Full Accuracy [3] (Ω)	Noise and Distortion (Bandwidth 10 Hz - 50 kHz <0.5V Burden)
			10 - 40 °C	0 - 10 °C and 40 - 50 °C			
		± (ppm output + nA)	± (ppm output + nA)/°C				± (% output + µA)
220 µA	10 - 20 20 - 40 40 - 1 k 1 k - 5 k 5 k - 10 k	150 + 5 80 + 5 30 + 3 50 + 20 400 + 100	50 + 5 20 + 5 4 + 0.5 10 + 1 20 + 100	50 + 5 20 + 5 10 + 0.5 20 + 1 20 + 100	7	2 k [6]	0.05 + 0.1 0.05 + 0.1 0.05 + 0.1 0.25 + 0.5 00.5 + 1
2.2 mA	10 - 20 20 - 40 40 - 1 k 1 k - 5 k 5 k - 10 k	150 + 5 80 + 5 30 + 3 50 + 20 400 + 100	50 + 5 20 + 4 4 + 1 10 + 100 50 + 400	50 + 5 20 + 4 10 + 2 20 + 100 50 + 400	7	500	0.05 + 0.1 0.05 + 0.1 0.05 + 0.1 0.25 + 0.5 00.5 + 1
22 mA	10 - 20 20 - 40 40 - 1 k 1 k - 5 k 5 k - 10 k	150 + 50 80 + 50 30 + 30 50 + 500 400 + 1000	50 + 10 20 + 10 4 + 10 10 + 500 50 + 1000	50 + 10 20 + 10 10 + 20 20 + 400 50 + 1000	7	150	0.05 + 0.1 0.05 + 0.1 0.05 + 0.1 0.25 + 0.5 00.5 + 1
	Hz	± (ppm output + µA)	± (ppm output + µA) / °C				
220 mA	10 - 20 20 - 40 40 - 1 k 1 k - 5 k 5 k - 10 k	150 + 0.5 80 + 0.5 30 + 0.3 50 + 3 400 + 5	50 + 0.05 20 + 0.05 4 + 0.1 10 + 2 50 + 5	50 + 0.05 20 + 0.05 10 + 0.1 20 + 2 50 + 5	7	15	0.05 + 10 0.05 + 10 0.05 + 10 0.25 + 50 00.5 + 100
2.2 A	20 - 1 k 1 k - 5 k 5 k - 10 k	50 + 5 80 + 20 800 + 50	4 + 1 10 + 5 50 + 10	10 + 1 20 + 5 50 + 10	1.4 [4]	0.5	0.5 + 100 0.3 + 500 0 1 + 1 mA
5725A Amplifier:							± (% output)
11 A	40 - 1 k 1 k - 5 k 5 k - 10 k	75 + 100 100 + 150 200 + 300	20 + 75 40 + 75 100 + 75	30 + 75 50 + 75 100 + 75	3	3	0.05 [5] 0.12 [5] 0.5 [5]

Notes:
Maximum output from 5720A terminals is 2.2 A. Uncertainty specifications for 220µA and 2.2 mA ranges are increased by a factor of 1.3, plus 2µA when supplied through 5725A terminals. Specifications are otherwise identical for all output locations.
1. Stability specifications are included in the Absolute Uncertainty values for the primary specifications.
2. Temperature coefficient is an adder to uncertainty specifications that does not apply unless operating more than ±5 °C from calibration temperature.
3. For larger resistive loads multiply uncertainty specifications by: $\left(\frac{\text{actual load}}{\text{maximum load for full accuracy}}\right)^2$
4. 1.5 V compliance limit above 1 A. 5725A Amplifier may be used in range-lock mode down to 1 A.
5. For resistive loads within rated compliance voltage limits.
6. For outputs from the Aux Current terminals, the maximum resistive load for full accuracy is 1 kΩ. For larger resistive loads, multiply the uncertainty as described in Note 3.

Minimum Output..... 9 µA for 220 µA range, 10 % on all other ranges. 1 A minimum for 5725A.
Inductive Load Limits ..... 400 µH (5700A/5720A, or 5725A). 20 µH for 5700A/5720A output >1 A.
Power Factors..... 5700A/5720A, 0.9 to 1; 5725A, 0.1 to 1. Subject to compliance voltage limits.
Frequency:
Range (Hz) ..... 10.000 - 11.999, 12.00 - 119.99, 120.0 - 1199.9, 1.200 k - 10.000 k
Uncertainty..... ±0.01 %
Resolution ..... 11,999 counts
Settling Time..... 5 seconds for 5700A/5720A ranges; 6 seconds for 5725A 11 A range; +1 second for amplitude or frequency range change.
Overshoot ..... <10 %

Wideband AC Voltage (Option 5700-03) Specifications

Specifications apply to the end of the cable and 50 Ω termination used for calibration.

Range		Resolution	Absolute Uncertainty ± 5 °C from calibration temperature 30 Hz -500 kHz			
Volts	dBm		24 Hours	90 Days	180 Days	1 Year
			± (% output + µV)			
1.1mV	-46	10nV	0.4 + 0.4	0.5 + 0.4	0.6 + 0.4	0.8 + 2
3mV	-37	10nV	0.4 + 1	0.45 + 1	0.5 + 1	0.7 + 3
11mV	-26	100nV	0.2 + 4	0.35 + 4	0.5 + 4	0.7 + 8
33mV	-17	100nV	0.2 + 10	0.3 + 10	0.45 + 10	0.6 + 16
110mV	-6.2	1µV	0.2 + 40	0.3 + 40	0.45 + 40	0.6 + 40
330mV	+ 3.4	1µV	0.2 + 100	0.25 + 100	0.35 + 100	0.5 + 100
1.1V	+ 14	10µV	0.2 + 400	0.25 + 400	0.35 + 400	0.5 + 400
3.5V	+ 24	10µV	0.15 + 500	0.2 + 500	0.3 + 500	0.4 + 500

Frequency (Hz)	Frequency Resolution (Hz)	Amplitude Flatness, 1 kHz Reference Voltage Range			Temperature Coefficient ± ppm/°C	Settling Time To Full Accuracy (Seconds)	Harmonic Distortion (dB)
		1.1 mV	3 mV	> 3 mV			
		± (% output + floor indicated)					
10 - 30	0.01	0.3	0.3	0.3	100	7	-40
30 - 120	0.01	0.1	0.1	0.1	100	7	-40
120 - 1.2k	0.1	0.1	0.1	0.1	100	5	-40
1.2k - 12k	1	0.1	0.1	0.1	100	5	-40
12k - 120k	10	0.1	0.1	0.1	100	5	-40
120k - 1.2M	100	0.2 + 3µV	0.1 + 3µV	0.1 + 3µV	100	5	-40
1.2M - 2M [1]	100k	0.2 + 3µV	0.1 + 3µV	0.1 + 3µV	100	0.5	-40
2M - 10M	100k	0.4 + 3µV	0.3 + 3µV	0.2 + 3µV	100	0.5	-40
10M - 20M	1M	0.6 + 3µV	0.5 + 3µV	0.4 + 3µV	150	0.5	-34
20M - 30M	1M	1.5 + 15µV	1.5 + 3µV	1 + 3µV	300	0.5	-34

Note:
For output voltages < 50 % of full range in the 33 mV, 110 mV, 330 mV, 1.1 V, and 3.5 V ranges, add 0.1 % to the amplitude flatness specification.
Additional Operating Information:
dBm reference = 50Ω
Range boundaries are at voltage points, dBm levels are approximate.
dBm = 10 log ($\frac{\text{Power}}{1\text{mW}}$) ;
0.22361 V across 50 Ω = 1 mW or 0 dBm

Minimum Output ..... 300 µV (.57 dBm)
Frequency Uncertainty ..... ± 0.01 %
Frequency Resolution ..... 11,999 counts to 1.1999 MHz, 119 counts to 30 MHz
Overload Protection ..... A short circuit on the wideband output will not result in damage. After settling time, normal operation is restored upon removal.

Auxiliary Amplifier Specifications
For complete specifications, see the 5205A and 5220A Operators Manuals.

5205A (220V - 1100 V ac, 0 V - 1100 V dc)
Overshoot: < 10 %
Distortion (bandwidth 10 Hz - 1 MHz):
10 Hz - 20 kHz ..... 0.07 %
20 kHz - 50 kHz ..... 0.2 %
50 kHz - 100 kHz ..... 0.25 %

Frequency (Hz)	90 Day Accuracy at 23 ± 5 °C ± (% output + % range)	Temperature Coefficient for 0 - 18 °C and 28 - 50 °C ± (ppm output + ppm range) / °C
0 dc	0.05 + 0.005	15 + 3
10 - 40	0.15 + 0.005	45 + 3
40 - 20 k	0.04 + 0.004	15 + 3
20 k - 50 k	0.08 + 0.006	50 + 10
50 k - 100 k	0.1 + 0.01	70 + 20

5220A (AC Current, 180-day specifications):
Accuracy:
20 Hz - 1 kHz ..... 0.07 % + 1 mA
1 kHz - 5 kHz ..... (0.07 % + 1mA) x frequency in kHz
Temperature Coefficient (0 - 18 °C and 28 - 50 °C): (0.003 % + 100A) / °C
Distortion (bandwidth 300 kHz):
20 Hz - 1 kHz ..... 0.1% + 1 mA
1 kHz - 5 kHz ..... (0.1% + 1 mA) x frequency in kHz
Note: 5700A/5720A combined with 5220A is not specified for inductive loads.

8508A Reference Multimeter

Metrology

Metrology, of course, is the scienceof measurement. A science where the only certainty is uncertainty.

As metrologists, much of our timeand effort is spent characterizing, understanding and trying toreduce or remove some of those uncertainties. Most times, characterizing is about as far as we get.

New tools often promise to help, but rarely deliver. Little understooddisclaimers, footnotes or specification compromises only obscuremeasurement integrity and getin the way of understanding therealities of the measurement.

Compounding the problem is thescarcity of products designedspecifically for metrologists. Toooften we must use products intended for general purpose use, and struggle to use them effectivelyin the demanding science in which we engage.

At Fluke Calibration, we are metrologists and understand theseissues thoroughly. The 8508AReference Multimeter is designedspecifically to address thesechallenges. Not only does it providethe performance you need, it isspecified in a way that lets youreally understand the uncertaintiesof those measurements. Add to that a revolutionary range of featuresand capabilities, a user interfacethat works the way you do, andyou have a truly remarkableinstrument. One that can only helpyou perform better measurements, more efficiently, and with lessuncertainty than ever before.

Fluke Calibration heritage

Fluke invented the digital multimeterin 1969, and has three decades of experience in developing theseproducts. Fluke also "wrote the book" on calibration, and has providedcountless solutions to metrologistsworld-wide. With this background, the name Fluke has become virtuallysynonymous with both digitalmultimeters and with the science of metrology. Small wonder then that itwould be Fluke who finally steps upto the challenge producing adigital multimeter specifically formetrology applications.

Over the years Fluke Calibration hasgained additional expertise in dc andlf measurements with the acquisitionof Wavetek-Datron. The acquisitionof Hart Scientific, the undisputedleader in temperature measurement, has added skills and knowledge inthis important area. Development ofthe 8508A has drawn on all of these capabilities to provide not only thebest performing instrument available today, but also the most highlyfunctional and versatile.

Metrologydefinitions

Accuracy(Measurement Accuracy)

A number which indicates the closeness of a measured value to the true value, or the ability of an instrumentto make measurements with small uncertainty. Metrologists prefer touse the uncertainty of ameasurement (e.g., anuncertainty of +/- 12ppm), instead of accuracy(e.g., accurate to99.9988 %).

Confidence Level

The percentage of thearea of the nominal curve that lies above the confidence interval. A confidence level of 95 % is obtained when the range of the confidenceis from minus two standard deviations, to plus two standarddeviations.

Confidence Interval

A range of valuesunder the normal curve for which a specificconfidence level applies.
The range of valuesis normally extendedsymmetrically from thecenter of the curve, in standard deviations, to a limiting value, typicallyplus and minus standarddeviations.

1948 - The company is founded by John Fluke

8508A Reference Multimeter

FLUKE ®
Calibration

Engineers know that three sidedobjects are the most solid shapepossible. We know that a threelegged stool is the most securedevice on which to sit on virtuallyany surface. It seems clear thenthat a base of three elements is a highly effective platform. Design ofthe 8508A followed this principleand addressed three key areas of performance: Accuracy andStability; Functionality andVersatility and Ease of Use.

In focusing on these three vitalissues, like the triangle or the threelegged stool, the 8508A providesthe most solid, dependable andreliable measurement instrument available today.

Accuracy and stability

The 8508A features 8.5 digitresolution, exceptional linearityand extraordinarily low noiseand stability, producing whatare arguably the most accuratemeasurements to be had from any commercially availableproduct today.

But that's only part of the story. Measurements must be repeatabletoday, tomorrow, next week, evennext year. That's why stability mustbe treated with the same priority asaccuracy. The 8508A demonstrates365 day stability as low as 2.7 ppm, with a 24–hour stability of 0.5 ppm, ensuring that confidence in today'smeasurement can be the same as it was yesterday or last year.

Full analog design

In these days of digital everything, the temptation is to digitize as soonas possible, then correct, adjust, orotherwise massage data digitally tocorrect for problems and producethe "right" answer. The 8508Adisregards this approach entirely, and focuses on good analog designand correct measurement practiceto achieve measurements in which you can have total confidence, andthe stability you need to rely onday in, day out.

Importantly, this stability isachieved without the need for anykind of auto-cal or self calibration routines. While this technique mayproduce specifications which onpaper demonstrate good stability, it means that measurement traceability and history arecompromised. While this maybe acceptable within someenvironments, it does not fulfil the exacting needs of the metrologist.

Understanding specifications

An important part of understandingwhat accuracy and stabilitynumbers really mean with respectto real measurements, is to understand how those accuracyand stability numbers are stated.

It is common practice to publishspecifications which are absolutein nature. This provides the userwith uncertainty information ofproduct performance at the time ofmanufacture. Further down the line, those uncertainty figures are nolonger true, but depend substantially on uncertaintiesavailable from the laboratory thatcalibrated the instrument, as well as the instrument itself.

To ensure that total uncertainties of measurements are fullyunderstood, 8508A uncertainties are published in both relative termsand 365 day absolute terms insidethis brochure, and in more detail, separately on the WorldWide Web.

Metrologydefinitions

Error

Deviation from the true or nominal value. Different types of error includeoffset, linearity, random, retrace, reversal, scale, systematic and transfer error.

Measurement Uncertainty

An estimate of the rangeof values within which the true value of a measurand lies, usuallycentered on the nominal value.

Stability

The ability of aninstrument to have a response or output that isconstant with time.

Test UncertaintyRatio (TUR)

The Test UncertaintyRatio (TUR) for ameasurand is the specified uncertainty ofthe instrument under test divided by thespecified uncertaintyof the calibrator or standard used to test it. The specifications for theinstruments must have the same coverage factor.

Uncertainty

An estimate of the possible error in ameasurement. More precisely, an estimateof the range of valueswhich contains the true value of a measured quantity. Uncertainty isusually reported in theterms of probability thatthe true value lies within a stated range of values.

1949 - Fluke introduces its first product, a highly accurate benchtop power meter

8508A Reference Multimeter

Functionality and versatility

Metrologists need to make manydiverse measurements as part oftheir complex duties. To achievethis frequently requires a complexarray of instruments. The Fluke8508A provides an extraordinarilybroad range of measurement capability. This means you canundertake a wider range ofapplications, and perform most ofyour measurement requirementswith a single instrument, providingreal economies in time and money.

Voltage measurement

With DC and AC ranges from200 mV to 1 kV, the 8508A covers all your voltage measurement needs. Full 8.5 digit resolution is availableon all ranges to provide resolutiondown to 1 nV. Bandwidth for AC measurements extends to 1 MHz. Excellent linearity, coupled withRatio measurement capability, meansthat the 8508A can replace KelvinVarley dividers and AC/DC voltagetransfer standards, improving yourmeasurement efficiency in onesimple, single box solution.

Current measurements

The 8508A features a remarkable new current measurement system. For the first time, resistance at the input is virtually zero. This meansthat measurements can be much less invasive, and present virtuallyzero burden to the measurement points. It also offers the advantagethat complex guarding schemesare now largely unnecessary, andmeasurements can be made more reliably, more repeatably and withgreater confidence.

Ranges from 200 µA to 20 A andfrequencies from 1 Hz to 100kHz, again ensure that all of yourmeasurement needs are covered including the high currentsencountered when calibratingmulti-function calibrators.

Resistance measurement

With ranges from 2 W to 20 GW and resolution as low as 10 nW the 8508A can truly be describedas the ultimate resistance measurement system. Add to thata high compliance of 200 V and ahigh measurement current of100 mA and you can begin tounderstand how the 8508A can help extend the range of yourresistance measurements.

But performance of the resistance measurement system doesn't endwith just specifications. Attention tomeasurement technique helps furtherimprove your results. When makingratio measurements, the same current is forced through both resistances, and only the measurement isswitched. Measurement current is reversible to eliminate errors due to thermal effects.

Temperature measurement

To further extend your range ofmeasurements, the 8508A offers temperature measurement through2, 3, or 4-wire PRT's or SPRT's, with a temperature range from -200 °Cto 660 °C. With simultaneous temperature and resistancereadout, ITS-90 and Callendar van Dusen Linearization's the 8508A is an ideal tool for both temperaturemeasurement and PRT calibration applications. As with resistance, current reversal is used to remove thermal emf errors. This greater flexibility providesthe means to increase the overall range of your scope of precisionmeasurements, and to realize better uncertainty on many ofthe measurements you mightalready perform with less than idealequipment.

"Relative" versus "Absolute" specifications

Uncertainty specificationsmust be evaluated as 'relative' or 'absolute'. Relative uncertaintydoes not include the additional uncertaintyof the reference standards used to calibrate the instrument.

For example, whena digital multimeter's uncertainty is specifiedas 'relative' to calibration standards, this covers only the uncertainty inthe digital multimeter. This is an incompletestatement regardingthe instrument's total uncertainty. 'Absolute'(or total) uncertaintyincludes all uncertainties in the traceabilitychain: the 'relative' uncertainty of the unit, plus the uncertaintyof the equipment usedto calibrate it. This is the true specificationof available instrument performance.

A standards laboratorycan provide theuncertainties in their calibration standards.

These uncertainties must be combined with the specifications'relative' to calibration standards to determine the performance which isactually achieved.

1955 - Fluke introduces differential voltmeters

8508A Reference Multimeter

FLUKE ®
Calibration

Easy to use

Human error and misunderstandingof measurement setups often havesevere impact on measurementaccuracy. Such errors are often dueto impenetrable or complex userinterfaces and lack of user familiarity. The Fluke 8508A'sclear control structure, with Dual ParamatrixTM displays and contextsensitive menus, provides atransparent, logical and intuitivemechanism with which to interact with the instrument.

Consistent with the philosophy ofdesigning a product specificallyfor metrologists, the command andmenu configuration is constructedto ensure rapid, error free accessto complex measurement setups. Itmeans that you can focus ongetting the best possible results, without needing complexsequential or multi-instrumentsetups, or the need to performcomplex mental arithmetic or mathto achieve the desired result.

Two inputs

As well as conventional front input terminals, the 8508A canoptionally be equipped with aduplicate set of rear input terminals.

This can be invaluable in making ratio measurements, which are available on the voltageand resistance functions. They alsoprovide the mechanism for forcingthe same current through tworesistances to improve resistanceratio measurements.

1969 - Fluke invents a new product, the digital voltmeter

8508A Reference Multimeter

Performance highlights

DC Volts
- Ranges: 5, From 200 mV to 1000 V
- Maximum Measurement: 1050 V
- Resolution: user selectable from 5.5 to 8.5 digits
- Maximum Sensitivity: 1 nV

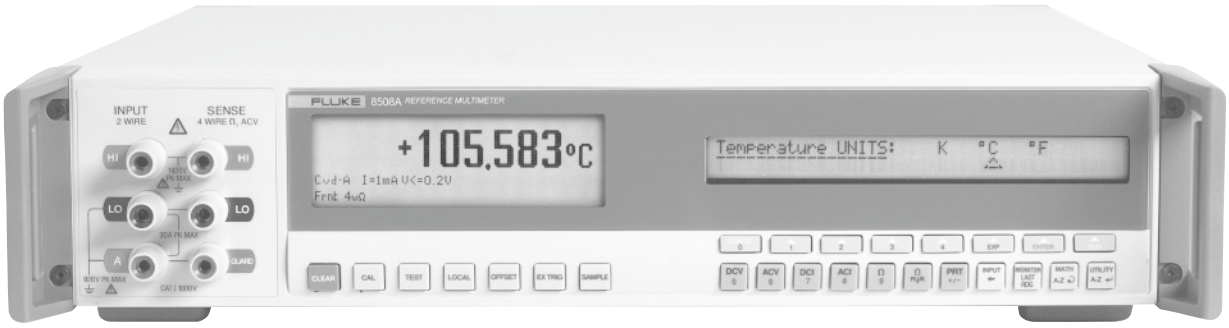
DC Current
- Ranges: 6, From 200 µA to 20 A
- Maximum Measurement: 19.999999 A
- Resolution: user selectable from 5.5 to 7.5 digits
- Maximum Sensitivity: l0 pA

AC Volts
- Ranges: 5, from 200 mV to 1000 V
- Resolution: user selectable from 5.5 to 6.5 digits
- Maximum Bandwidth: 1 MHz
- Maximum Sensitivity: 100 nV

AC Current
- Ranges: 6, from 200 µA to 20 A
- Resolution: user selectable from 5.5 to 6.5 digits
- Maximum Bandwidth: 100 kHz
- Maximum Sensitivity: l00 pA

Ohms
- Ranges: 10, 2 W to 20 GW.Resolution: user selectable from 5.5 to 8.5 digits
- Maximum Sensitivity: l0 nW.Maximum Compliance Voltage: 200 V
- Maximum Measurement Current: 100 mA

Temperature
- Two-wire, three-wire and four-wire Ohms with current reversal
- Range: From -200 °C to 660 °C
- Resolution user selectable from 5.5 to 8.5 digits
- ITS-90 linearization
- Readout: °C, °F, K or Ω



1972 - Fluke introduces the 8000A, the first portable bench digital multimeter

8508A Reference Multimeter

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Calibration

specifications

The specifications stated here reflect a 95 % confidence level. For full and complete specifications, see the 8508A Extended Specifications or the instrument manual.

DC Voltage [1] [2] [3]

Range	Full Scale	Uncertainty Relative to Cal Stds			Absolute Uncertainties	Temp Coefficient 15 °C-30 °C (ppm/°C)
		± (ppm Reading + ppm Range) TCal ± 1 °C [4]				
		24 hour	90 day	365 day	365 day	
200 mV	199.999 999	0.7 + 0.5	1.4 + 0.5	2.7 + 0.5	4.5 + 0.5	0.4
2 V	1.999 999 99	0.5 + 0.2	1.4 + 0.2	2.7 + 0.2	3.0 + 0.2	0.3
20 V	19.999 999 9	0.5 + 0.2	1.4 + 0.2	2.7 + 0.2	3.0 + 0.2	0.3
200 V	199.999 999	1.0 + 0.2	2.6 + 0.2	4.0 + 0.2	4.5 + 0.2	0.7
1000 V	1050.000 00	1.0 + 0.5	2.6 + 0.5	4.0 + 0.5	4.5 + 0.5	0.7

Type ..... Multi-slope, multi-cycle A-D Converter
CMRR (1 kW unbalance) [5] ... 140 dB at DC and 1 - 60 Hz
NMRR [5]
Filter Out ..... 60 dB at 50/60 Hz ± 0.09 %
Filter In ..... 110 dB at 50/60 Hz ± 0.09 %
Protection (All ranges) ..... 1 kV rms
Input Impedance
200 mV to 20 V Ranges ..... > 100 GW
200 V & 1000 V Ranges ..... 10.1 MW ± 1 %
Max Input Current ..... 50 pA
Ratio Accuracy ..... ± (Net Front Input Accuracy + Net Rear Input Accuracy)
Settling Time (to 10 ppm step size)
Filter Out ..... < 50 ms
Filter In ..... < 1 s

DC Current [1] [2] [3]

Range	Full Scale	Uncertainty Relative to Cal Stds			Absolute Uncertainties	Temp Coefficient 15 °C-30 °C (ppm/°C)
		± (ppm Reading + ppm Range) TCal ± 1 °C [4]				
		24 hour	90 day	365 day	365 day	
200 µA	199.999 99	5.5 + 2.0	6.0 + 2.0	6.5 + 2.0	12 + 2.0	0.4
2 mA	1.999 999 9	5.5 + 2.0	6.0 + 2.0	6.5 + 2.0	12 + 2.0	0.4
20 mA	19.999 999	6.5 + 2.0	7.0 + 2.0	8.0 + 2.0	13 + 2.0	1.2
200 mA	199.999 99	28 + 4.0	30 + 4.0	33 + 4.0	36 + 4.0	6.0
2 A	1.999 999 9	80 + 8.0	125 + 8.0	170 + 8.0	170 + 8.0	8.0
20 A	19.999 999	200 + 20	290 + 20	380 + 20	380 + 20	8.0

Type ..... Multi-slope, multi-cycle A-D Converter
Protection
Front Input ..... 20 A rms
Rear Input ..... 2 A rms, Rear Panel Fuse
Settling Time ..... Up to 2 A range as DCV, 20 A range < 30 s to 100 ppm step size

1988 - Fluke introduces the 5700A MultiFunction Calibrator

8508A Reference Multimeter

specifications

AC Voltage [1] [2] [6] [7]

Range	Full Scale	Frequency (Hz)	Uncertainty Relative to Cal Stds			Absolute Uncertainties	Temp Coefficient 15 °C-30 °C (ppm/°C)
			± (ppm Reading + ppm Range) TCal ± 1 °C [4]				
			24 hour	90 day	365 day	365 day	
200 mV	199.999 9	1 - 10	80 + 70	120 + 70	120 + 70		5
		10 - 40	80 + 20	120 + 20	120 + 20	130 + 20	5
		40 - 100	60 + 20	100 + 20	100 + 20	110 + 20	5
		100 - 2k	40 + 10	100 + 10	100 + 10	105 + 10	5
		2k - 10k	60 + 20	100 + 20	100 + 20	105 + 20 12	
		10k - 30k	250 + 30	300 + 40	300 + 40	305 + 40 15	
		30k - 100k	400 + 100	700 + 100	700 + 100	705 + 100 40	
2 V, 20 V & 200 V	1.999 999 19.999 99 199.999 9	1 - 10	70 + 60	100 + 60	100 + 60		5
		10 - 40	70 + 10	100 + 10	100 + 10	105 + 10	5
		40 - 100	50 + 10	80 + 10	80 + 10	85 + 10	5
		100 - 2k	30 + 10	60 + 10	60 + 10	65 + 10	5
		2k - 10k	50 + 10	80 + 10	80 + 10	85 + 10	10
		10k - 30k	100 + 20	200 + 20	200 + 20	205 + 20	12
		30k - 100k	250 +100	500 + 100	500 + 100	505 + 100	40
		100k - 300k	0.15 % + 0.1 %	0.3 % + 0.1 %	0.3 % + 0.1 %	0.3 + 0.1 %	60
		300k - 1M	1 % + 0.5 %	1 % + 1 %	1 % + 1 %	1 % + 1 %	80
1000 V [8]	1050.000	1 - 10	70 + 70	100 + 70	100 + 70	5	
		10 - 40	70 + 20	100 + 20	100 + 20	110 + 20	5
		40 - 10k	50 + 20	80 + 20	80 + 20	95 + 20	10
		10k - 30k	100 + 40	200 + 40	200 + 40	205 + 40	12
		30k - 100k	250 + 200	500 + 200	500 + 200	510 + 200	40

Type ..... True RMS, AC coupled measures AC component with up to 1000 V DC bias on any range. DC coupled gives $\sqrt{(AC^2 + DC^2)}$
CMRR (1 kW unbalance) [5] ..... > 90 dB DC - 60 Hz
Crest Factor
200 mV to 200 V ranges ..... 10:1 at 12 % of range, 5:1 at 50 % of range, 2.5:1 at full range
1000 V range..... 10:1 at 25 % of range, 5:1 at full range
Protection (All ranges) ..... 1 kV rms
Input Impedance ..... 1 MW in parallel with 150 pF
DC Accuracy (DC Coupled) [15] ... Add ±(50 ppm Reading + 50 ppm Range + 20 µV)
Ratio Accuracy ..... ±(Net Front Input Accuracy + Net Rear Input Accuracy)
Settling Time (to 100 ppm step size)
100 Hz ..... < 0.5 s
40 Hz ..... < 1.25 s
10 Hz ..... < 5 s
1 Hz ..... < 50 s
Frequency Measurement
Signal Amplitude Range ..... 5 % of range to limit set by maximum V.Hz

Normal Gate Mode:
Resolution ..... 6.5 digits
Frequency Range 10 Hz - 1 MHz
Accuracy (1 year, 13 ºC - 33 ºC) ... ± (10 ppm of Reading + 2 digits)
Sample Interval..... 1 s

Fast Gate Mode:
Resolution ..... 4.5 digits
Frequency Range..... 200 Hz - 1 MHz
Accuracy (1 year, 13 ºC - 33 ºC) ... ± 2 digits
Sample Interval..... 50 ms

1993 - Fluke were the first in their field in the U.S to receive ISO 9001 Registration

8508A Reference Multimeter

FLUKE ®
Calibration

specifications

AC Current [1] [2] [9]

Range	Full Scale	Frequency (Hz)	Uncertainty Relative to Cal Stds			Absolute Uncertainties	Temp Coefficient 15 °C-30 °C (ppm/°C)
			± (ppm Reading + ppm Range) TCal ± 1 °C [4]				
			24 hour	90 day	365 day	365 day	
200 µA	199.999 9	1 - 10	200 + 100	250 + 100	290 + 100	475 + 100	10
		10 - 10k	200 + 100	250 + 100	280 + 100	475 + 100	10
		10k - 30k	500 + 100	600 + 100	600 + 100	650 + 100	12
		30k - 100k	0.35 % + 100	0.4 % + 100	0.4 % + 100	0.4 % + 100	40
2 mA & 20 mA	1.999 999 19.999 99	10 - 10k	200 + 100	250 + 100	280 + 100	280 + 100	10
		10k - 30k	500 + 100	600 + 100	600 + 100	650 + 100	12
		30k - 100k	0.35 % + 100	0.4 % + 100	0.4 % + 100	0.4 % + 100	40
200 mA	199.999 9	1 - 10	200 + 100	250 + 100	250 + 100		10
		10 - 10k	200 + 100	250 + 100	250 + 100	250 + 100	15
		10k - 30k	500 + 100	600 + 100	600 + 100	600 + 100	15
2 A	1.999 999	10 - 2k	500 + 100	600 + 100	600 + 100	600 + 100	10
		2k - 10k	600 + 100	700 + 100	700 + 100	700 + 100	15
		10k - 30k	0.25 % + 100	0.3 % + 100	0.3 % + 100	0.3 % + 100	20
20 A	19.999 99	10 - 2k	700 + 100	800 + 100	800 + 100	800 + 100	10
		2k - 10k	0.2 % + 100	0.25 % + 100	0.25 % + 100	0.25 % + 100	15

Type ..... AC coupled. DC coupled gives $\sqrt{(AC^2 + DC^2)}$
Crest Factor ..... 3:1 at 50 % of range, 1.5:1 at full range
Protection
Front Input ..... 20 A rms
Rear Input ..... 2 A rms, Rear Panel Fuse
Settling Time ..... Up to 2 A range as ACV. 20 A range, 40 Hz filter andabove, < 30 s to 100 ppm step size

Resistance [1] [2] [3] [10]

Range [9]	Full Scale	Uncertainty Relative to Cal Stds			Absolute Uncertainties	Temp Coefficient 15 °C-30 °C (ppm/°C)
		± (ppm Reading + ppm Range) TCal ± 1 °C [4]				
		24 hour	90 day	365 day	365 day	
2 W [11]	1.999 999 99	5.0 + 2.0	8.0 + 2.0	10 + 2.0	15 + 2.0	1.5
20 W [11]	19.999 999 9	2.5 + 0.7	4.5 + 0.7	7.0 + 0.7	9.0 + 0.7	0.6
200 W [11]	199.999 999	1.5 + 0.25	4.0 + 0.25	7.0 + 0.25	7.5 + 0.25	0.5
2 kW [11]	1.999 999 99	1 + 0.25	3.5 + 0.25	7.0 + 0.25	7.5 + 0.25	0.5
20 kW [11]	19.999 999 9	1 + 0.25	3.5 + 0.25	7.0 + 0.25	7.5 + 0.25	0.5
200 kW [11]	199.999 999	1 + 0.25	3.5 + 0.25	7.0 + 0.25	7.5 + 0.25	0.5
2 MW [11]	1.999 999 99	2 + 0.5	4.0 + 0.5	7.0 + 0.5	8.5 + 0.5	0.6
20 MW [12]	19.999 999 9	2 + 0.5	4.0 + 0.5	7.0 + 0.5	15 + 0.5	0.6
200 MW [12]	199.999 999	3.5 + 5.0	6.0 + 5.0	9.0 + 5.0	60 + 5.0	2.0
2 GW [12]	1.999 999 99	20 + 50	25 + 50	30 + 50	150 + 50	20
20 GW [12]	19.999 999 9	250 + 500	350 + 500	500 + 500	525 + 500	200

Type ..... True 4-wire with Ohms guard. 2 wire selectable
Max Lead Resistance ..... 10 W in any or all leads, 1 W on 2 W range
Protection (All ranges) ..... 250 V rms, 360 V pk
Ratio Accuracy ..... ± (Net Front Input Accuracy + Net Rear Input Accuracy)
Settling Time ..... Up to 200 kW range generally the same as DCV Filter In butdepends on external connections

1995 - Fluke introduces the 860 Series Graphical Multimeter

8508A Reference Multimeter

specifications

Temperature Readout [1] [2] [3]

Resistance Range	Absolute Resistance Measurement Uncertainty [13] 365 day TCal ± 1 °C [4] ± (ppm Reading + mΩ)	Typical Equivalent Temperature Measurement Uncertainty [14]			
		Probe Type	Nominal Temp (ºC)	Resistance (Ω)	Accuracy ± (ºC)
0 - 199.999 999 Ω	7.5 + 0.14	25 Ω PRT/SPRT	-200	5	0.0085
		25 Ω PRT/SPRT	0	25	0.0035
		25 Ω PRT/SPRT	660	84	0.0025
		100 Ω PRT/SPRT	-200	20	0.0035
		100 Ω PRT/SPRT	0	100	0.0025
		100 Ω PRT/SPRT	232	185	0.0020
200 - 1999.999 99 Ω	7.5 + 0.5	100 Ω PRT/SPRT	400	250	0.0025

Type ..... 4-wire current reversal resistance measurement with readout of equivalent temperature. 2-wire and 3-wireselectable without current reversal. Refer to resistance specifications for additional details

Temperature Range ..... -200 ºC to 660 ºC, readout also available in ºF or K

Linearization ..... ITS-90 or Callendar van Dusen. Entry and storage ofcoefficients and nominal resistance for up to 100 probes

Current Source ..... 1 mA

Read Rate and Additional Uncertainty Specifications

Function	Resolution	Filter Frequency (Hz)	Read Rate (readings/second)		Additional Errors [15] ± (ppm Reading + ppm Full Scale)	
			Normal	Fast	Normal	Fast
DCV, DCI & Ohms [10]	8		1/25	1/6	0 + 0	0 + 0.1
	7		1/6	1/2	0 + 0.1	0 + 0.5
	6		2	35	0 + 0.5	0 + 2.5
	5		35	150	0 + 5	0 + 25
ACV & ACI [6]	6	1	1/50		0 + 0	
		10	1/5		0 + 0	
		40	1/2		0 + 0	
		100	1		0 + 0	
	5	1	1/50		0 + 5	
		10	1/5		0 + 5	
		40	1/2		0 + 5	
		100	2		0 + 5	
PRT & Tru Ohms	8		1/90		0 + 0	
	7		1/30		0 + 0.1	
	6		1/4		0 + 0.5	
	5		1/3		0 + 5	

2001 - Fluke acquires Wavetek Precision Measurement of Norwich, UK, becoming the unquestioned global leader in calibration

8508A Reference Multimeter

FLUKE ®
Calibration

specifications

General Specifications

Power	
Voltage	100 V to 120 V ±10 % or 200 V to 240 V ±10 %
Frequency	47 Hz to 63 Hz
Consumption	80 VA
Dimensions	
Height	88 mm (3.5 inches)
Width	427 mm (16.8 inches)
Depth	487 mm (19.2 inches)
Weight	11.5 kg (25.5 lbs)
Environment Temperature	
Operating	0 °C to +50 °C, performance specified 5 °C to 40 °C
Storage	-20 °C to +70 °C
Relative Humidity	(non condensing)
Operating	<90 % (5 °C to 40 °C)
Storage	<95 % (0 °C to 70 °C)
Warm Up	4 hours to full uncertainty specification
Safety	Designed and tested to EN61010-1-2001, UL 61010-1A1, CAN/CSA 22.2 no. 61010.1CE and ETL marked.
EMC	EN50081-1 Class B, EN55011/22, EN61326-1:1998, EN50082-1, EN55011:1991 Class B, EN61000-6-1:2001, FCC Rules part 15sub-part J class B.
Guarenteed Performance	Instrument performance is guaranteed for specifications quoted at the 99 % confidence level. See the Extended Specifications orinstrument manual for full details.
Warranty	One year warranty standard; extended warranties/calibrationCarePlans of up to five years are available

[1] Specifications apply for max resolution in each function, normal read mode. Specifications stated in this document are at coverage factor k=2, equivalent to 95 % confidence level, in accordance with accepted metrology practices.
[2] Assumes 4 hour warm-up period.
[3] Input zero or offset null required whenever the temperature moves more than ±1 °C from the temperature at which the previous null/zero was performed.
[4] TCal = Ambient calibration temperature. Factory calibration temperature 23 ºC.
[5] Integration time > 1 Power Line cycle.
[6] Valid for signals >1 % Full Scale, Transfer mode on. Signal must be DC coupled <40 Hz.
[7] Maximum Volt.Hertz 3 x 10^7.
[8] >300 V, <10 kHz add ±0.0004 $(R-300)^2$ ppm.
>300 V, 10 kHz - 30 kHz add ±(0.0004 + (F-10000) x 10^{-7}) $(R-300)^2$ ppm.
>300 V, >30 kHz add ±0.0024 (R-300)2 ppm.
[9] Typical above 10 kHz for ACI and above 2 GW for resistance.
[10] Tru Ohms mode available on 2 W to 20 kW ranges. Read rate reduced in Tru Ohms mode. Specifications for Tru Ohms same as corresponding normal Ohms range.
[11] Normal Ohms mode.
[12] High Voltage Ohms mode.
[13] Valid for 4-wire sensor.
[14] Not including sensor uncertainty.
[15] Assume Range and Full Scale = 2000 V when calculating for 1000 V Range. For DCI additional errors only apply in 5 digit resolution.

2002 - Fluke introduces the ALL NEW 8508A Digital Multimeter,
providing reference standard accuracy and stability, in one functionally versatile, easy to use solution

5522A Multi-Product Calibrator

5522A features at a glance

- Calibrates a wide variety of electrical test equipment
- Robust protection circuits prevent costly damage from operator error
- Redesigned carrying handles make the 5522A easy to transport
- Rugged carrying case with built-in handles and wheels and removable front/rear access doors for in-situ calibration in almost any environment
- Remarkably affordable

5522A Multi-Product Calibrator

FLUKE®
Calibration

Multiple calibrators in one

The 5522A Multi-Product Calibrator addresses a wide calibration workload and comes with internal and external protection features that protect it against damage and make it easier to transport for on-site or mobile calibration.

The 5522A can also be fully automated with MET/CAL® Plus Calibration Management Software.

It is the ideal calibrator for metrology professionals who need to calibrate many different types of electronic equipment and want a transportable instrument that offers them a high return on investment. The 5522A sources direct voltage and current, alternating voltage and current with multiple waveforms and harmonics, two simultaneous voltage outputs or voltage and current to simulate dc and ac power with phase control, resistance, capacitance, thermocouples and RTDs. The 5522A can also measure thermocouple temperature and pressure using one of 29 Fluke 700 Series pressure modules. Two options add the capability to calibrate oscilloscopes up to either 600 MHz or 1.1 GHz. And the 5520A-PQ Power Quality Option enables the 5522A to calibrate power quality instrumentation to the standards of the IEC and other regulatory agencies.

The 5522A calibrator covers many of the electronic test tools you use to keep your company up and running, including:

- Handheld and bench meters (analog and digital) up to 6½ digits
- Current clamps and clamp meters
- Thermocouple and RTD thermometers
- Process calibrators
- Data loggers
- Strip and chart recorders
- Watt meters
- Power harmonics analyzers
- Panel meters
- Graphical multimeters
- Power quality analyzers (with option)
- Analog or digital handheld and bench oscilloscopes to 600 MHz or 1.1 GHz (with options)
- …and more, including pressure gauges and transducers and three-phase power meters

5522A Multi-Product Calibrator

Internal circuitry offers “mistake proof” protection

The 5522A provides reverse power protection, immediate output disconnection, and/or fuse protection on the output terminals for all functions. This protection is for applied external voltages up to ±300 V peak.

Rugged carrying case enables safe transport and efficient onsite calibration

An innovative carrying case accessory makes it easier than ever to calibrate outside of the calibration laboratory, as well as inside. The shock-mounted case features built-in handles and wheels, enabling you to move the calibrator from place to place easily and safely.

The front and rear access doors are removable, so you can calibrate with the 5522A while its top, bottom and side panels remain protected.and avoid having to completely unpack and then re-pack the calibrator.

A redesigned front panel and ergonomic carrying handles make it easy to transport the calibrator short distances within the cal lab.

5522A Multi-Product Calibrator

FLUKE®
Calibration

5522A Multi-Product Calibrator

The Fluke 5522A Multi-Product Calibrator makes it easy to get more work done.

It's intuitive design makes learning to operate it easy even for less experienced technicians, reducing references to the manual. For most tasks, your hand moves from left to right, keeping you from having to make long, illogical or uncomfortable movements. Most functions require minimal keystrokes.

The bright, backlit LCD display is easy to read from all angles and under a variety of light conditions.

Ergonomically designed, rugged handles make the 5522A easy to transport.

Temperature measurement modes calibrates thermocouple simulators and can also document environmental conditions present at the time of calibration, as required by all quality standards.

Spec menu lets you view the uncertainty for the present value.

Phase lock makes it easy to simulate threephase power and enables current summing for high-current tests.

Internal circuitry plus overcurrent fuses protect against costly damage caused by electrical overloads accidently applied to the calibrator's input terminals.

A rugged carrying case makes it easy to do onsite calibration. The front and back panels remove so you can use the calibrator without unpacking it.

An interface for Fluke 700 Series Pressure Modules, which are used to make precision measurements to calibrate pressure transducers and related instrumentation. Modules span various pressure ranges, as low as 0 to 10" H20 (0 to 2.5 kPa), or as high as 0 to 10,000 psi (0 to 70,000 kPA).

5522A Multi-Product Calibrator

FLUKE®
Calibration

Conntrol output by pre ssing STBY and OPR R keys.

Press the SCOPE key for on-demand oscilloscope calibration (optional).

The control window displays a variety of status messages, softkey menus, and status and other auxiliary information.

Edit knob allows you to vary the output. When editing, the difference between the original output and the edited output is automatically computed and displayed in the control window.

Calculator-style keypad makes it easy to enter values.

Soft keys allow access to the menus in the control windows, letting you select parameters such as offset, waveforms, phase, thermocouple or RTD type. PREV MENU lets you step backward through these menus.

MULT [X] and DIV[÷] keys simplify stepping up and down in decade multiples of any output setting, and let you step up or down to the next range in a 1–2–5 sequence for oscilloscope calibration.

5522A Multi-Product Calibrator

Automate to increase throughput and efficiency

Quality standards impose stringent requirements for documenting, reporting, and controlling calibration processes and results.

Using MET/CAL Plus Calibration Management Software can help you meet these requirements

easily while also enabling you to increase throughput and streamline your calibration processes.

MET/CAL Plus is a powerful application for creating, editing and testing calibration procedures and collecting and reporting results on a wide variety of instruments.

It includes MET/CAL2®—the industry-leading software for automated calibration and MET/TRACK2®—.a dedicated system to manage your test and measurement assets.

It is the most complete software solution available to calibration professionals.

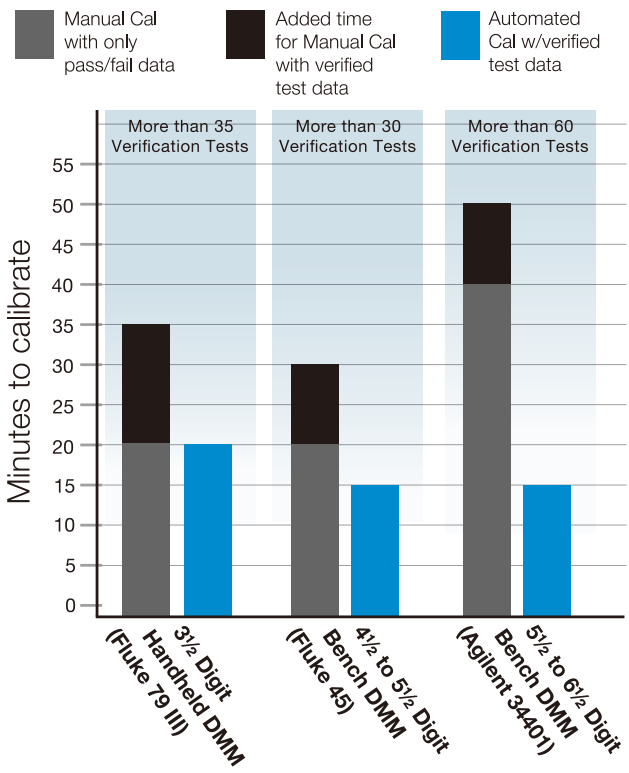
Priority software support helps you stay productive

MET/SUPPORT Gold is an annual membership program offering premium support and services to help you stay as productive as possible with MET/CAL Plus software. Services include free software updates and upgrades, free access to the Fluke MET/CAL Warranted Procedures Library, plus discounts on training and custom procedure development. Members also receive invitations to regular calibration software web seminars and user group meetings. Use only a few of the Gold services and you can easily recover more than the cost of your membership fee.

Calibration and repair service

Fluke Calibration offers extensive calibration support and service to ensure your long-term satisfaction and return on investment in calibration equipment. Our worldwide network of calibration centers offers accredited calibrations traceable to national standards. We also offer fast, quality repair and calibration services including a module exchange program and full support in setting up your lab.

Time comparison for manual and automated calibration methods



5522A Multi-Product Calibrator

FLUKE® Calibration

Summary specifications

Function and range

Direct volts	0 to ± 1020 V
Direct current	0 to ± 20.5 A
Alternating volts	1 mV to 1020 V 10 Hz to 500 kHz
Volt/hertz	1000 V@10 kHz/330 V@100 kHz
Alternating current	29 µA to 20.5 A 10 Hz to 30 kHz
Waveforms	Sine, square, triangle, truncated sine
Resistance	0 MΩ to 1100 MΩ
Capacitance	220 pF to 110 mF
Power (phantom loads)	20.9 kW
Phase control	0.01°
Thermocouple (source and measure temperature)	B, C, E, J, K L N R, S, T, U 10 µV/°C
RTD (source temperature)	Pt 385-100 Ω, Pt 3926-100 Ω Pt 3916-100 Ω, Pt 385-200 Ω, Pt 385-500 Ω, Pt 385 1000 Ω, PtNi 385-120 Ω (Ni120), Cu 427 10 Ω
Interfaces	RS-232, IEEE 488
Phase lock	Yes
Frequency uncertainty	< 2.5 ppm
External frequency reference (10 MHz)	Yes
Oscilloscope calibrator (options)	Levelled sine wave from 5 mV to 5.5 Vpp max, frequencies 50 kHz to 600 kHz and 3.5 Vpp max to 1100 MHz; edge rise times of < 300ps, multiple trigger functions, lowest dc, square wave and timing uncertainty
Power Calibrator (options)	Composite harmonic, flicker simulation, sags and swells simulation modes and swells simulation modes

Metrology training increases skill levels
Calibration and metrology training from Fluke can help you and your staff become more knowledgeable in a wide variety of disciplines. Instructor-led classroom training is available for general topics in metrology, as well as for calibration software. On-site training can also be scheduled if you have a number of people in your organization who would benefit.

Fluke Calibration also offers other educational events such as web seminars and road shows on a wide variety of topics. The best way to stay informed about these events is to register to receive email and direct mail from Fluke Calibration. You can register online at **www.fluke.com**.

5522A Multi-Product Calibrator

Innovation from the leader in calibration

Fluke Calibration pioneered the multi-product calibrator concept, creating a family of instruments that allow you to calibrate the widest range of today's electronic test tools with a single instrument. These calibrators offer simple, portable, cost-effective solutions that allow you to match your calibrator to your workload and your budget.

Fluke is also recognized for its offerings in temperature, pressure, power, process, and rf calibration. Fluke provides the calibrators, standards, software, service, support and training you need for a complete solution in your cal lab.

5500A Multi-Product Calibrator

Calibration solutions that match your workload and budget

The 5500A is a versatile product that addresses a wide cross-section of your electrical calibration work load. It sources direct voltage and current, alternating voltage and current with multiple waveforms and harmonics, two simultaneous voltage outputs or voltage and current, and simulates power with phase control, resistance, capacitance, thermocouples and RTDs. The 5500A's Oscilloscope Calibration options provide level sine wave, fast edge, time mark and amplitude signals for calibration of oscilloscopes up to 600 MHz.

The 5500A was designed to cover a very wide range of medium accuracy electrical measurement devices including:

- Handheld and bench multimeters
- Oscilloscopes and ScopeMeter2® Test Tools
- Wattmeters
- Analog volt/ohm/amp/watt instruments
- Electronic thermometers
- Data loggers
- Strip chart recorders
- XY Recorders
- Power harmonics analyzers
- Process calibrators
- Current clamps
- And related instruments

5522A Multi-Product Calibrator

FLUKE ®
Calibration

9100A Universal Calibration System

The world's best value multi-product calibrator

The 9100 is a multifunction calibrator with a wide breadth and depth of outputs. In addition to dc and ac voltage to 1050 V, variable resistance to 400 MΩ and dc and ac current to 20 A (1000 A via the optional current coils), the 9100 delivers continuously variable capacitance values to 40 mF and conductance values to 2.5 milliSiemens. It also generates digitally synthesized and phase-locked sine, square, triangle, impulse and trapezoidal waveforms, variable amplitude pulses to 10 MHz, pulse widths to 2 seconds, and duty cycles between 0.05 % and 99.95 %.

Add one of the two oscilloscope calibration options and it generates all the waveforms required to calibrate oscilloscopes up to 250 MHz or 600 MHz.

Fit the insulation/continuity tester option and it synthesizes resistance values as high as 2 GΩ at test voltages up to 1000 V. Fit the power meter option and it simultaneously generates variable phase angle voltages and currents that allow you to calibrate power meters up to 1 MW or 1 MVAR.

9100 features:

- Calibrates over 15 different categories of general-purpose test equipment
- Options for power meter, insulation/continuity tester and oscilloscope calibration – internally installed and retrofittable
- Semi-automated and fully automated procedure modes for maximum calibration throughput
- Fully supported by MET/CAL Plus software and procedure libraries
- Rapid return on investment
- Intuitive front panel operation for ease of use

5080A High Compliance Multi-Product Calibrator

Calibration solutions for your analog and digital workload

The 5080A Multi-Product Calibrator calibrates your analog and digital workload accurately and economically. Its high voltage and current compliance makes analog workload calibration easy and precise. Built-in protection circuitry protects it against damaging input voltages.

This easy-to-use instrument calibrates a wide workload that includes:

- Analog meters
- Panel meters
- Digital multimeters
- Watt meters
- Clamp meters (with coil accessory)
- Megohm meters (optional)
- Oscilloscopes to 200 MHz (optional)
- …and more

Versatile software applications enable you to record paperless results, and more.

Options and accessories expand workload coverage

Options and accessories enable you to use the 5080A to calibrate an even broader workload, including:

- Clamp meters. The 9100-200 10/50 turn coil and 5500A/COIL 50-turn current coil enables the 5080A to calibrate most popular clamp meters at currents up to 1000 A rms amps.
- Oscilloscopes. Calibrate oscilloscopes to 200 MHz quickly, easily, and cost effectively.
- Megohm meters. This option sources high ohms, high voltage resistors up to 18 G ohms. It also measures high voltage outputs.

5522A Multi-Product Calibrator Extended specifications

General Specifications

The following tables list the 5522A specifications. All specifications are valid after allowing a warm-up period of 30 minutes, or twice the time the 5522A has been turned off. (For example, if the 5522A has been turned off for 5 minutes, the warm-up period is 10 minutes.)
All specifications apply for the temperature and time period indicated. For temperatures outside of tcal ±5 °C (tcal is the ambient temperature when the 5522A was calibrated), the temperature coefficient as stated in the General Specifications must be applied.
The specifications also assume the Calibrator is zeroed every seven days or whenever the ambient temperature changes more than 5 °C. The tightest ohms specifications are maintained with a zero cal every 12 hours within ±1 °C of use.
Also see additional specifications later in this chapter for information on extended specifications for ac voltage and current.

Warmup Time ..... Twice the time since last warmed up, to a maximum of 30 minutes.
Settling Time ..... Less than 5 seconds for all functions and ranges except as noted.
Standard Interfaces ..... IEEE-488 (GPIB), RS-232
Temperature
Operating ..... 0 °C to 50 °C
Calibration (tcal) ..... 15 °C to 35 °C
Storage ..... -20 ° to +70 °C; The DC current ranges 0 to 1.09999 A and 1.1 A to 2.99999 A are sensitive to storage temperatures above 50 °C. If the 5522A is stored above 50 °C for greater than 30 minutes, these ranges must be re-calibrated. Otherwise, the 90 day and 1 year uncertainties of these ranges double.
Temperature Coefficient ..... Temperature coefficient for temperatures outside tcal +5 °C is 0.1/X/°C of the 90-day specification (or 1-year, as applicable) per °C
Relative Humidity
Operating ..... <80 % to 30 °C, <70 % to 40 °C, <40 % to 50 °C
Storage ..... <95 %, non-condensing. After long periods of storage at high humidity, a drying-out period (with power on) of at least one week may be required.
Altitude
Operating ..... 3,050 m (10,000 ft) maximum
Non-operating ..... 12,200 m (40,000 ft) maximum
Safety..... Complies with EN/IEC 61010-1:2001, CAN/CSA-C22.2 No. 61010-1-04, ANSI/UL 61010-1:2004;
Output Terminal Electrical Overload Protection Provides reverse-power protection, immediate output disconnection, and/or fuse protection on the output terminals for all functions. This protection is for applied external voltages up to ±300 V peak.
Analog Low Isolation..... 20 V normal operation, 400 V peak transient
EMC ..... Complies with EN/IEC 61326-1:2006, EN/IEC 61326-2-1:2006 for controlled EM environments under the following conditions. If used in areas with Electromagnetic fields of 1 to 3 V/m from 0.08-1GHz, resistance outputs have a floor adder of 0.508 Ω Performance not specified above 3 V/m. This instrument may be susceptible to electrostatic discharge (ESD) to the binding posts. Good static awareness practices should be followed when handling this and other pieces of electronic equipment. Additionally this instrument may be susceptible to electrical fast transients on the mains terminals. If any disturbances in operation are observed, it is recommended that the rear panel chassis ground terminal be connected to a known good earth ground with a low inductance ground strap. Note that a mains power outlet while providing a suitable ground for protection against electric shock hazard may not provide an adequate ground to properly drain away conducted rf disturbances and may in fact be the source of the disturbance. This instrument was certified for EMC performance with data I/O cables not in excess of 3m.
Line Power ..... Line Voltage (selectable): 100 V, 120 V, 220 V, 240 V Line Frequency: 47 Hz to 63 Hz Line Voltage Variation: ±10 % about line voltage setting For optimal performance at full dual outputs (e.g. 1000 V, 20 A) choose a ling voltage setting that is ±7.5 % from nominal.
Power Consumption ..... 600 VA
Dimensions (HxWxL) ..... 17.8 cm x 43.2 cm x 47.3 cm (7 in x 17 in x 18.6 in) Standard rack width and rack increment, plus 1.5 cm (0.6 in) for feet on bottom of unit.
Weight (without options) ..... 22 kg (49 lb)
Absolute Uncertainty Definition..... The 5522A specifications include stability, temperature coefficient, linearity, line and load regulation, and the traceability of the external standards used for calibration. You do not need to add anything to determine the total specification of the 5522A for the temperature range indicated.
Specification Confidence Level ..... 99 %

Detailed Specifications

DC Voltage

Range	Absolute Uncertainty, tcal ±5 °C ±(ppm of output +µV)		Stability	Resolution µV	Max Burden [1]
	90 days	1 year	24 hours, ±1 °C ±(ppm of output +µV)		
0 to 329.9999 mV	15 + 1	20 + 1	3 + 1	0.1	65 Ω
0 to 3.299999 V	9 + 2	11 + 2	2 + 1.5	1	10 mA
0 to 32.99999 V	10 + 20	12 + 20	2 + 15	10	10 mA
30 to 329.9999 V	15 + 150	18 + 150	2.5 + 100	100	5 mA
100 to 1020.000 V	15 + 1500	18 + 1500	3 + 300	1000	5 mA
Auxiliary Output (dual output mode only) [2]					
0 to 329.9999 mV	300 + 350	400 + 350	30 + 100	1	5 mA
0.33 to 3.299999 V	300 + 350	400 + 350	30 + 100	10	5 mA
3.3 to 7 V	300 + 350	400 + 350	30 + 100	100	5 mA
TC Simulate and Measure in Linear 10 µV/°C and 1 mV/°C modes [3]					
0 to 329.9999 mV	40 + 3	50 + 3	5 + 2	0.1	10 Ω

[1] Remote sensing is not provided. Output resistance is <5 mΩ for outputs ≥0.33 V. The AUX output has an output resistance of <1 Ω.
TC simulation has an output impedance of 10 Ω ±1 Ω.
[2] Two channels of dc voltage output are provided.
[3] TC simulating and measuring are not specified for operation in electromagnetic fields above 0.4 v/m.

Range	Noise	
	Bandwidth 0.1 Hz to 10 Hz p-p ±(ppm of output + floor)	Bandwidth 10 Hz to 10 kHz rms
0 to 329.9999 mV	0 + 1 µV	6 µV
0 to 3.299999 V	0 + 10 µV	60 µV
0 to 32.99999 V	0 + 100 µV	600 µV
30 to 329.9999 V	10 + 1 mV	20 mV
100 to 1020.000 V	10 + 5 mV	20 mV
Auxiliary Output (dual output mode only) [1]		
0 to 329.9999 mV	0 + 5 µV	20 µV
0.33 to 3.299999 V	0 + 20 µV	200 µV
3.3 to 7 V	0 + 100 µV	1000 µV

[1] Two channels of dc voltage output are provided.

DC Current

Range	Absolute Uncertainty, tcal ±5 °C ±(ppm of output +µA)		Resolution	Max Compliance Voltage V	Max Inductive Load mH
	90 days	1 year			
0 to 329.999 µA	120 + 0.02	150 + 0.02	1 nA	10	400
0 to 3.29999 mA	80 + 0.05	100 + 0.05	0.01 µA	10	
0 to 32.9999 mA	80 + 0.25	100 + 0.25	0.1 µA	7	
0 to 329.999 mA	80 + 2.5	100 + 2.5	1 µA	7	
0 to 1.09999 A	160 + 40	200 + 40	10 µA	6	
1.1 to 2.99999 A	300 + 40	380 + 40	10 µA	6	
0 to 10.9999 A (20 A Range)	380 + 500	500 + 500	100 µA	4	
11 to 20.5 A [1]	800 + 750 [2]	1000 + 750 [2]	100 µA	4	

[1] Duty Cycle: Currents <11 A may be provided continuously. For currents >11 A, see Figure 1. The current may be provided Formula 60-T-I minutes any 60 minute period where T is the temperature in °C (room temperature is about 23 °C) and I is the output current in amperes. For example, 17 A, at 23 °C could be provided for 60-23-17 = 20 minutes each hour. When the 5522A is outputting currents between 5 and 11 amps for long periods, the internal self-heating reduces the duty cycle. Under those conditions, the allowable "on" time indicated by the formula and Figure 1 is achieved only after the 5522A is outputting currents <5 A for the "off" period first.
[2] Floor specification is 1500 µA within 30 seconds of selecting operate. For operating times >30 seconds, the floor specification is 750 µA.

Range	Noise	
	Bandwidth 0.1 Hz to 10 Hz p-p	Bandwidth 10 Hz to 10 kHz rms
0 to 329.999 µA	2 nA	20 nA
0 to 3.29999 mA	20 nA	200 nA
0 to 32.9999 mA	200 nA	2.0 µA
0 to 329.999 mA	2000 nA	20 µA
0 to 2.99999 A	20 µA	1 mA
0 to 20.5 A	200 µA	10 mA

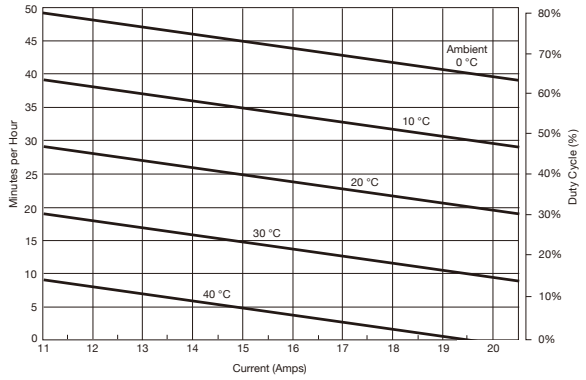


Figure 1. Allowable Duration of Current >11 A

5522A Multi-Product Calibrator Extended specifications

Resistance

Range [1]	Absolute Uncertainty, tcal ±5 °C ±(ppm of output +floor) [2]				Resolution Ω	Allowable Current [3]
	ppm of output		Floor (Ω) Time and temp since ohms zero cal			
	90 days	1 year	12 hrs ±1 °C	7 days ±5 °C		
0 to 10.9999 Ω	35	40	0.001	0. 01	0.0001	1 mA to 125 mA
11 to 32.9999 Ω	25	30	0.0015	0.015	0.0001	1 mA to 125 mA
33 to 109.9999 Ω	22	28	0.0014	0.015	0.0001	1 mA to 70 mA
110 Ω to 329.9999 Ω	22	28	0.002	0.02	0.0001	1 mA to 40 mA
330 Ω to 1.099999 kΩ	22	28	0.002	0.02	0.001	1 mA to 18 mA
1.1 to 3.299999 kΩ	22	28	0.02	0.2	0.001	100 µA to 5 mA
3.3 to 10.99999 kΩ	22	28	0.02	0.1	0.01	100 µA to 1.8 mA
11 to 32.99999 kΩ	22	28	0.2	1	0.01	10 µA to 0.5 mA
33 to 109.9999 kΩ	22	28	0.2	1	0.1	10 µA to 0.18 mA
110 to 329.99999 kΩ	25	32	2	10	0.1	1 µA to 0.05 mA
330 kΩ to 1.099999 MΩ	25	32	2	10	1	1 µA to 0.018 mA
1.1 to 3.299999 MΩ	40	60	30	150	1	250 nA to 5 µA
3.3 to 10.99999 MΩ	110	130	50	250	10	250 nA to 1.8 µA
11 to 32.99999 MΩ	200	250	2500	2500	10	25 nA to 500 nA
33 to 109.9999 MΩ	400	500	3000	3000	100	25 nA to 180 nA
110 to 329.9999 MΩ	2500	3000	100000	100000	1000	2.5 nA to 50 nA
330 to 1100 MΩ	12000	15000	500000	500000	10000	1 nA to 13 nA

[1] Continuously variable from 0 Ω .to 1.1 GΩ.
[2] Applies for 4-WIRE compensation only. For 2-WIRE and 2-WIRE COMP, add an additional amount to the floor specification as calculated by: (5 µV divided by the stimulus current in amps). For example, in 2-WIRE mode, at 1 kΩ the floor specification within 12 hours of an ohms zero cal for a measurement current of 1 mA is: 0.002 Ω + (5 µV / 1 mA) = (0.002 + 0.005) Ω = 0.007 Ω.
[3] For currents lower than shown, the floor adder increases by $Floor_{(new)} = Floor_{(old)} \times I_{min}/I_{actual}$. For example, a 50 µA stimulus measuring 100 Ω has a floor specification of: 0.0014 Ω x 1 mA/50 µA = 0.028 Ω assuming an ohms zero calibration within 12 hours.

AC Voltage (Sine Wave)

Range	Frequency	Absolute Uncertainty, tcal ±5 °C ±(ppm of output + µV)		Resolution	Max Burden	Max Distortion and Noise 10 Hz to 5 MHz Bandwidth ±(% of output + floor)
		90 days	1 year			
Normal Output						
1.0 mV to 32.999 mV	10 Hz to 45 Hz	600 + 6	800 + 6	1 µV	65 Ω	0.15 + 90 µV
	45 Hz to 10 kHz	120 + 6	150 + 6			0.035 + 90 µV
	10 kHz to 20 kHz	160 + 6	200 + 6			0.06 + 90 µV
	20 kHz to 50 kHz	800 + 6	1000 + 6			0.15 + 90 µV
	50 kHz to 100 kHz	3000 + 12	3500 + 12			0.25 + 90 µV
	100 kHz to 500 kHz	6000 + 50	8000 + 50			0.3 + 90 µV [1]
33 mV to 329.999 mV	10 Hz to 45 Hz	250 + 8	300 + 8	1 µV	65 Ω	0.15 + 90 µV
	45 Hz to 10 kHz	140 + 8	145 + 8			0.035 + 90 µV
	10 kHz to 20 kHz	150 + 8	160 + 8			0.06 + 90 µV
	20 kHz to 50 kHz	300 + 8	350 + 8			0.15 + 90 µV
	50 kHz to 100 kHz	600 + 32	800 + 32			0.20 + 90 µV
	100 kHz to 500 kHz	1600 + 70	2000 + 70			0.20 + 90 µV [1]
0.33 V to 3.29999 V	10 Hz to 45 Hz	250 + 50	300 + 50	10 µV	10 mA	0.15 + 200 µV
	45 Hz to 10 kHz	140 + 60	150 + 60			0.035 + 200 µV
	10 kHz to 20 kHz	160 + 60	190 + 60			0.06 + 200 µV
	20 kHz to 50 kHz	250 + 50	300 + 50			0.15 + 200 µV
	50 kHz to 100 kHz	550 + 125	700 + 125			0.20 + 200 µV
	100 kHz to 500 kHz	2000 + 600	2400 + 600			0.20 + 200 µV [1]
3.3 V to 32.9999 V	10 Hz to 45 Hz	250 + 650	300 + 650	100 µV	10 mA	0.15 + 2 mV
	45 Hz to 10 kHz	125 + 600	150 + 600			0.035 + 2 mV
	10 kHz to 20 kHz	220 + 600	240 + 600			0.08 + 2 mV
	20 kHz to 50 kHz	300 + 600	350 + 600			0.2 + 2 mV
	50 kHz to 100 kHz	750 + 1600	900 + 1600			0.5 + 2 mV
33 V to 329.999 V	45 Hz to 1 kHz	150 + 2000	190 + 2000	1 mV	5 mA, except 20 mA for 45 Hz to 65 Hz	0.15 + 10 mV
	1 kHz to 10 kHz	160 + 6000	200 + 6000			0.05 +10 mV
	10 kHz to 20 kHz	220 + 6000	250 + 6000			0.6 + 10 mV
	20 kHz to 50 kHz	240 + 6000	300 + 6000			0.8 + 10 mV
	50 kHz to 100 kHz	1600 + 50000	2000 + 50000			1.0 + 10 mV
330 V to 1020 V	45 Hz to 1 kHz	250 + 10000	300 + 10000	10 mV	2 mA, except 6 mA for 45 Hz to 65 Hz	0.15 + 30 mV
	1 kHz to 5 kHz	200 + 10000	250 + 10000			0.07 + 30 mV
	5 kHz to 10 kHz	250 + 10000	300 + 10000			0.07 + 30 mV

[1] Max Distortion for 100 kHz to 200 kHz. For 200 kHz to 500 kHz, the maximum distortion is 0.9 % of output + floor as shown.
Note
Remote sensing is not provided. Output resistance is <5 mΩ for outputs ≥0.33 V. The AUX output resistance is <1 Ω. The maximum load capacitance is 500 pF, subject to the maximum burden current limits

5522A Multi-Product Calibrator Extended specifications

FLUKE® Calibration

AC Voltage (Sine Wave) (cont.)

Range	Frequency [1]	Absolute Uncertainty, tcal ±5 °C ±(% of output + µV)		Resolution	Max Burden	Max Distortion and Noise 10 Hz to 5 MHz Bandwidth ±(% of output + floor)
		90 days	1 year			
AUX Output						
10 mV to 329.999 mV	10 Hz to 20 Hz	0.15 + 370	0.2 + 370	1 µV	5 mA	0.2 + 200 µV
	20 Hz to 45 Hz	0.08 + 370	0.1 + 370			0.06 + 200 µV
	45 Hz to 1 kHz	0.08 + 370	0.1 + 370			0.08 + 200 µV
	1 kHz to 5 kHz	0.15 + 450	0.2 + 450			0.3 + 200 µV
	5 kHz to 10 kHz	0.3 + 450	0.4 + 450			0.6 + 200 µV
	10 kHz to 30 kHz	4.0 + 900	5.0 + 900			1 + 200 µV
0.33 V to 3.29999 V	10 Hz to 20 Hz	0.15 + 450	0.2 + 450	10 µV	5 mA	0.2 + 200 µV
	20 Hz to 45 Hz	0.08 + 450	0.1 + 450			0.06 + 200 µV
	45 Hz to 1 kHz	0.07 + 450	0.09 + 450			0.08 + 200 µV
	1 kHz to 5 kHz	0.15 + 1400	0.2 + 1400			0.3 + 200 µV
	5 kHz to 10 kHz	0.3 + 1400	0.4 + 1400			0.6 + 200 µV
	10 kHz to 30 kHz	4.0 + 2800	5.0 + 2800			1 + 200 µV
3.3 V to 5 V	10 Hz to 20 Hz	0.15 + 450	0.2 + 450	100 µV	5 mA	0.2 + 200 µV
	20 Hz to 45 Hz	0.08 + 450	0.1 + 450			0.06 + 200 µV
	45 Hz to 1 kHz	0.07 + 450	0.09 + 450			0.08 + 200 µV
	1 kHz to 5 kHz	0.15 + 1400	0.2 + 1400			0.3 + 200 µV
	5 kHz to 10 kHz	0.3 + 1400	0.4 + 1400			0.6 + 200 µV

[1] There are two channels of voltage output. The maximum frequency of the dual output is 30 kHz.

Note

Remote sensing is not provided. Output resistance is <5 mΩ for outputs ≥0.33 V. The AUX output resistance is <1 Ω. The maximum load capacitance is 500 pF, subject to the maximum burden current limits

AC Current (Sine Wave)

Range	Frequency	Absolute Uncertainty, tcal ±5 °C ±(% of output + µA)		Compliance adder ±(µA/V)	Max Distortion & Noise 10 Hz to 100 kHz BW ±(% of output + floor)	Max Inductive Load µH
		90 days	1 year			
LCOMP Off						
29.00 to 329.99 µA	10 to 20 Hz	0.16 + 0.1	0.2 + 0.1	0.05	0.15 + 0.5 µA	200
	20 to 45 Hz	0.12 + 0.1	0.15 + 0.1	0.05	0.1 + 0.5 µA	
	45 Hz to 1 kHz	0.1 + 0.1	0.125 + 0.1	0.05	0.05 + 0.5 µA	
	1 to 5 kHz	0.25 + 0.15	0.3 + 0.15	1.5	0.5 + 0.5 µA	
	5 to 10 kHz	0.6 + 0.2	0.8 + 0.2	1.5	1.0 + 0.5 µA	
	10 to 30 kHz	1.2 + 0.4	1.6 + 0.4	10	1.2 + 0.5 µA	
0.33 to 3.29999 mA	10 to 20 Hz	0.16 + 0.15	0.2 + 0.15	0.05	0.15 + 1.5 µA	200
	20 to 45 Hz	0.1 + 0.15	0.125 + 0.15	0.05	0.06 + 1.5 µA	
	45 Hz to 1 kHz	0.08 + 0.15	0.1 + 0.15	0.05	0.02 + 1.5 µA	
	1 to 5 kHz	0.16 + 0.2	0.2 + 0.2	1.5	0.5 + 1.5 µA	
	5 to 10 kHz	0.4 + 0.3	0.5 + 0.3	1.5	1.0 + 1.5 µA	
	10 to 30 kHz	0.8 + 0.6	1.0 + 0.6	10	1.2 + 0.5 µA	
3.3 to 32.9999 mA	10 to 20 Hz	0.15 + 2	0.18 + 2	0.05	0.15 + 5 µA	50
	20 to 45 Hz	0.075 + 2	0.09 + 2	0.05	0.05 + 5 µA	
	45 Hz to 1 kHz	0.035 + 2	0.04 + 2	0.05	0.07 + 5 µA	
	1 to 5 kHz	0.065 + 2	0.08 + 2	1.5	0.3 + 5 µA	
	5 to 10 kHz	0.16 + 3	0.2 + 3	1.5	0.7 + 5 µA	
	10 to 30 kHz	0.32 + 4	0.4 + 4	10	1.0 + 0.5 µA	
33 to 329.999 mA	10 to 20 Hz	0.15 + 20	0.18 + 20	0.05	0.15 + 50 µA	50
	20 to 45 Hz	0.075 + 20	0.09 + 20	0.05	0.05 + 50 µA	
	45 Hz to 1 kHz	0.035 + 20	0.04 + 20	0.05	0.02 + 50 µA	
	1 to 5 kHz	0.08 + 50	0.10 + 50	1.5	0.03 + 50 µA	
	5 to 10 kHz	0.16 + 100	0.2 + 100	1.5	0.1 + 50 µA	
	10 to 30 kHz	0.32 + 200	0.4 + 200	10	0.6 + 50 µA	
0.33 to 1.09999 A	10 to 45 Hz	0.15 + 100	0.18 + 100		0.2 + 500 µA	2.5
	45 Hz to 1 kHz	0.036 + 100	0.05 + 100		0.07 + 500 µA	
	1 to 5 kHz	0.5 + 1000	0.6 + 1000	[2]	1 + 500 µA	
	5 to 10 kHz	2.0 + 5000	2.5 + 5000	[3]	2 + 500 µA	
1.1 to 2.99999 A	10 to 45 Hz	0.15 + 100	0.18 + 100		0.2 + 500 µA	2.5
	45 Hz to 1 kHz	0.05 + 100	0.06 + 100		0.07 + 500 µA	
	1 to 5 kHz	0.5 + 1000	0.6 + 1000	[2]	1 + 500 µA	
	5 to 10 kHz	2.0 + 5000	2.5 + 5000	[3]	2 + 500 µA	
3 to 10.9999 A	45 to 100 Hz	0.05 + 2000	0.06 + 2000		0.2 + 3 mA	1
	100 Hz to 1 kHz	0.08 + 2000	0.10 + 2000		0.1 + 3 mA	
	1 to 5 kHz	2.5 + 2000	3.0 + 2000		0.8 + 3 mA	
11 to 20.5 A [1]	45 to 100 Hz	0.1 + 5000	0.12 + 5000		0.2 + 3 mA	1
	100 Hz to 1 kHz	0.13 + 5000	0.15 + 5000		0.1 + 3 mA	
	1 to 5 kHz	2.5 + 5000	3.0 + 5000		0.8 + 3 mA	

[1] Duty Cycle: Currents <11 A may be provided continuously. For currents >11 A, see Figure 1. The current may be provided 60T- I minutes any 60 minute period where T is the temperature in °C (room temperature is about 23 °C) and I is the output current in Amps. For example, 17 A, at 23 °C could be provided for 60-23-17 = 20 minutes each hour. When the 5520A is outputting currents between 5 and 11 amps for long periods, the internal self-heating reduces the duty cycle. Under those conditions, the allowable "on" time indicated by the formula and Figure 1 is achieved only after the 5520A is outputting currents <5 A for the "off" period first.

[2] For compliance voltages greater than 1 V, add 1 mA/V to the floor specification from 1 to 5 kHz.

[3] For compliance voltages greater than 1 V, add 5 mA/V to the floor specification from 5 to 10 kHz.

5522A Multi-Product Calibrator Extended specifications

AC Current (Sine Wave) (cont.)

Range	Frequency	Absolute Uncertainty, tcal ±5 °C ±(% of output + µA)		Max Distortion & Noise 10 Hz to 100 kHz BW ±(% of output + floor)	Max Inductive Load µH
		90 days	1 year		
LCOMP On					
29.00 to 329.99 µA	10 to 100 Hz	0.2 + 0.2	0.25 + 0.2	0.1 + 1.0 µA	400
	100 Hz to 1 kHz	0.5 + 0.5	0.6 + 0.5	0.05 + 1.0 µA	
0.33 to 3.29999 mA	10 to 100 Hz	0.2 + 0.3	0.25 + 0.3	0.15 + 1.5 µA	
	100 Hz to 1 kHz	0.5 + 0.8	0.6 + 0.8	0.06 + 1.5 µA	
3.3 to 32.9999 mA	10 to 100 Hz	0.07 + 4	0.08 + 4	0.15 + 5 µA	
	100 Hz to 1 kHz	0.18 + 10	0.2 + 10	0.05 + 5 µA	
33 to 329.999 mA	10 to 100 Hz	0.07 + 40	0.08 + 40	0.15 + 50 µA	
	100 Hz to 1 kHz	0.18 + 100	0.2 + 100	0.05 + 50 µA	
0.33 to 2.99999 A	10 to 100 Hz	0.1 + 200	0.12 + 200	0.2 + 500 µA	
	100 to 440 Hz	0.25 + 1000	0.3 + 1000	0.25 + 500 µA	
3 to 20.5 A [1]	45 to 100 Hz	0.1 + 2000 [2]	0.12 + 2000 [2]	0.1 + 0 µA	400 [4]
	100 to 440 Hz	0.8 + 5000 [3]	1.0 + 5000 [3]	0.5 + 0 µA	

[1] Duty Cycle: Currents <11 A may be provided continuously. For currents >11 A, see Figure 1. The current may be provided Formula 60-T-I minutes any 60 minute period where T is the temperature in °C (room temperature is about 23 °C) and I is the output current in Amps. For example, 17 A, at 23 °C could be provided for 60-23-17 = 20 minutes each hour. When the 5522A is outputting currents between 5 and 11 amps for long periods, the internal self-heating reduces the duty cycle. Under those conditions, the allowable "on" time indicated by the formula and Figure 1 is achieved only after the 5522A is outputting currents <5 A for the "off" period first.
[2] For currents >11 A, Floor specification is 4000 µA within 30 seconds of selecting operate. For operating times >30 seconds, the floor specification is 2000 µA.
[3] For currents >11 A, Floor specification is 10000 µA within 30 seconds of selecting operate. For operating times >30 seconds, the floor specification is 5000 µA.
[4] Subject to compliance voltages limits.

Range	Resolution µA	Max Compliance Voltage V rms [1]
0.029 to 0.32999 mA	0.01	7
0.33 to 3.29999 mA	0.01	7
3.3 to 32.9999 mA	0.1	5
33 to 329.999 mA	1	5
0.33 to 2.99999 A	10	4
3 to 20.5 A	100	3

[1] Subject to specification adder for compliance voltages greater than 1 V rms.

Capacitance

Range	Absolute Uncertainty, tcal ±5 °C ±(% of output + floor) [1] [2] [3]		Resolution	Allowed Frequency or Charge-Discharge Rate		
	90 days	1 year		Min and Max to Meet Specification	Typical Max for <0.5 % Error	Typical Max for <1 % Error
220.0 to 399.9 pF	0.38 + 10 pF	0.5 + 10 pF	0.1 pF	10 Hz to 10 kHz	20 kHz	40 kHz
0.4 to 1.0999 nF	0.38 + 0.01 nF	0.5 + 0.01 nF	0.1 pF	10 Hz to 10 kHz	30 kHz	50 kHz
1.1 to 3.2999 nF	0.38 + 0.01 nF	0.5 + 0.01 nF	0.1 pF	10 Hz to 3 kHz	30 kHz	50 kHz
3.3 to 10.9999 nF	0.19 + 0.01 nF	0.25 + 0.01 nF	0.1 pF	10 Hz to 1 kHz	20 kHz	25 kHz
11 to 32.9999 nF	0.19 + 0.1 nF	0.25 + 0.1 nF	0.1 pF	10 Hz to 1 kHz	8 kHz	10 kHz
33 to 109.999 nF	0.19 + 0.1 nF	0.25 + 0.1 nF	1 pF	10 Hz to 1 kHz	4 kHz	6 kHz
110 to 329.999 nF	0.19 + 0.3 nF	0.25 + 0.3 nF	1 pF	10 Hz to 1 kHz	2.5 kHz	3.5 kHz
0.33 to 1.09999 µF	0.19 + 1 nF	0.25 + 1 nF	10 pF	10 to 600 Hz	1.5 kHz	2 kHz
1.1 to 3.29999 µF	0.19 + 3 nF	0.25 + 3 nF	10 pF	10 to 300 Hz	800 Hz	1 kHz
3.3 to 10.9999 µF	0.19 + 10 nF	0.25 + 10 nF	100 pF	10 to 150 Hz	450 Hz	650 Hz
11 to 32.9999 µF	0.30 + 30 nF	0.40 + 30 nF	100 pF	10 to 120 Hz	250 Hz	350 Hz
33 to 109.999 µF	0.34 + 100 nF	0.45 + 100 nF	1 nF	10 to 80 Hz	150 Hz	200 Hz
110 to 329.999 µF	0.34 + 300 nF	0.45 + 300 nF	1 nF	0 to 50 Hz	80 Hz	120 Hz
0.33 to 1.09999 mF	0.34 + 1 µF	0.45 + 1 µF	10 nF	0 to 20 Hz	45 Hz	65 Hz
1.1 to 3.29999 mF	0.34 + 3 µF	0.45 + 3 µF	10 nF	0 to 6 Hz	30 Hz	40 Hz
3.3 to 10.9999 mF	0.34 + 10 µF	0.45 + 10 µF	100 nF	0 to 2 Hz	15 Hz	20 Hz
11 to 32.9999 mF	0.7 + 30 µF	0.75 + 30 µF	100 nF	0 to 0.6 Hz	7.5 Hz	10 Hz
33 to 110 mF	1.0 + 100 µF	1.1 + 100 µF	10 µF	0 to 0.2 Hz	3 Hz	5 Hz

[1] The output is continuously variable from 220 pF to 110 mF.
[2] Specifications apply to both dc charge/discharge capacitance meters and ac RCL meters. The maximum allowable peak voltage is 3 V. The maximum allowable peak current is 150 mA, with an rms limitation of 30 mA below 1.1 µF and 100 mA for 1.1 µF and above.
[3] The maximum lead resistance for no additional error in 2-wire COMP mode is 10 Ω.

5522A Multi-Product Calibrator
Extended specifications

FLUKE ®
Calibration

Temperature Calibration (Thermocouple)

TC Typo [1]	Range °C [2]	Absolute Uncertainty Source/Measure tcal ±5 °C ± °C [3]	
		90 days	1 year
B	600 to 800	0.42	0.44
	800 to 1000	0.34	0.34
	1000 to 1550	0.30	0.30
	1550 to 1820	0.26	0.33
C	0 to 150	0.23	0.30
	150 to 650	0.19	0.26
	650 to 1000	0.23	0.31
	1000 to 1800	0.38	0.50
	1800 to 2316	0.63	0.84
E	-250 to -100	0.38	0.50
	-100 to -25	0.12	0.16
	-25 to 350	0.10	0.14
	350 to 650	0.12	0.16
	650 to 1000	0.16	0.21
J	-210 to -100	0.20	0.27
	-100 to -30	0.12	0.16
	-30 to 150	0.10	0.14
	150 to 760	0.13	0.17
	760 to 1200	0.18	0.23
K	-200 to -100	0.25	0.33
	-100 to -25	0.14	0.18
	-25 to 120	0.12	0.16
	120 to 1000	0.19	0.26
	1000 to 1372	0.30	0.40
L	-200 to -100	0.37	0.37
	-100 to 800	0.26	0.26
	800 to 900	0.17	0.17
N	-200 to -100	0.30	0.40
	-100 to -25	0.17	0.22
	-25 to 120	0.15	0.19
	120 to 410	0.14	0.18
	410 to 1300	0.21	0.27
R	0 to 250	0.48	0.57
	250 to 400	0.28	0.35
	400 to 1000	0.26	0.33
	1000 to 1767	0.30	0.40
S	0 to 250	0.47	0.47
	250 to 1000	0.30	0.36
	1000 to 1400	0.28	0.37
	1400 to 1767	0.34	0.46
T	-250 to -150	0.48	0.63
	-150 to 0	0.18	0.24
	0 to 120	0.12	0.16
	120 to 400	0.10	0.14
U	-200 to 0	0.56	0.56
	0 to 600	0.27	0.27

[1] Temperature standard ITS-68 is selectable. TC simulating and measuring are not specified in electromagnetic fields above 0.4 V/m.
[2] Resolution is 0.01 °C
[3] Does not include thermocouple error

Temperature Calibration (RTD)

RTD Type	Range °C [1]	Absolute Uncertainty tcal ±5 °C ± °C [2]	
		90 days	1 year
Pt 385, 100 Ω	-200 to -80	0.04	0.05
	-80 to 0	0.05	0.05
	0 to 100	0.07	0.07
	100 to 300	0.08	0.09
	300 to 400	0.09	0.10
	400 to 630	0.10	0.12
	630 to 800	0.21	0.23
Pt 3926, 100 Ω	-200 to -80	0.04	0.05
	-80 to 0	0.05	0.05
	0 to 100	0.07	0.07
	100 to 300	0.08	0.09
	300 to 400	0.09	0.10
	400 to 630	0.10	0.12
Pt 3916, 100 Ω	-200 to -190	0.25	0.25
	-190 to -80	0.04	0.04
	-80 to 0	0.05	0.05
	0 to 100	0.06	0.06
	100 to 260	0.06	0.07
	260 to 300	0.07	0.08
	300 to 400	0.08	0.09
	400 to 600	0.08	0.10
	600 to 630	0.21	0.23
Pt 385, 200 Ω	-200 to -80	0.03	0.04
	-80 to 0	0.03	0.04
	0 to 100	0.04	0.04
	100 to 260	0.04	0.05
	260 to 300	0.11	0.12
	300 to 400	0.12	0.13
	400 to 600	0.12	0.14
	600 to 630	0.1	0.16
Pt 385, 500 Ω	-200 to -80	0.03	0.04
	-80 to 0	0.04	0.05
	0 to 100	0.05	0.05
	100 to 260	0.06	0.06
	260 to 300	0.07	0.08
	300 to 400	0.07	0.08
	400 to 600	0.08	0.09
	600 to 630	0.09	0.11
Pt 385, 1000 Ω	-200 to -80	0.03	0.03
	-80 to 0	0.03	0.03
	0 to 100	0.03	0.04
	100 to 260	0.04	0.05
	260 to 300	0.05	0.06
	300 to 400	0.05	0.07
	400 to 600	0.06	0.07
	600 to 630	0.22	0.23
PtNi 385, 120 Ω (Ni120)	-80 to 0	0.06	0.08
	0 to 100	0.07	0.08
	100 to 260	0.13	0.14
Cu 427 10 Ω [3]	-100 to 260	0.3	0.3

[1] Resolution is 0.003 °C
[2] Applies for COMP OFF (to the 5522A Calibrator front panel NORMAL terminals) and 2-wire and 4-wire compensation.
[3] Based on MINCO Application Aid No. 18

5522A Multi-Product Calibrator Extended specifications

DC Power Specification Summary

	Voltage Range	Current Range		
		0.33 to 329.99 mA	0.33 to 2.9999 A	3 to 20.5 A
		Absolute Uncertainty, tcal ±5 °C, ±(% of watts output) [1]		
90 days	33 mV to 1020 V	0.021	0.019 [2]	0.06 [2]
1 year	33 mV to 1020 V	0.023	0.022 [2]	0.07 [2]

[1] To determine dc power uncertainty with more precision, see the individual "DC Voltage Specifications," "DC Current Specifications," and "Calculating Power Uncertainty."
[2] Add 0.02 % unless a settling time of 30 seconds is allowed for output currents >10 A or for currents on the highest two current ranges within 30 seconds of an output current >10 A.

AC Power (45 Hz to 65 Hz) Specification Summary, PF=1

	Voltage Range	Current Range			
		3.3 to 8.999 mA	9 to 32.999 mA	33 to 89.99 mA	90 to 329.99 mA
		Absolute Uncertainty, tcal ±5 °C, ±(% of watts output) [1]			
90 days	33 to 329.999 mV	0.13	0.09	0.13	0.09
	330 mV to 1020 V	0.11	0.07	0.11	0.07
1 year	33 to 329.999 mV	0.14	0.10	0.14	0.10
	330 mV to 1020 V	0.12	0.08	0.12	0.08
	Voltage Range	Current Range [2]			
		0.33 to 0.8999 A	0.9 to 2.1999 A	2.2 to 4.4999 A	4.5 to 20.5 A
		Absolute Uncertainty, tcal ±5 °C, ±(% of watts output) [1]			
90 days	33 to 329.999 mV	0.12	0.10	0.12	0.10
	330 mV to 1020 V	0.1	0.08	0.11	0.09
1 year	33 to 329.999 mV	0.13	0.11	0.13	0.11
	330 mV to 1020 V	0.11	0.09	0.12	0.10

[1] To determine ac power uncertainty with more precision, see the individual "AC Voltage Specifications" and "AC Current Specifications" and "Calculating Power Uncertainty."
[2] Add 0.02 % unless a settling time of 30 seconds is allowed for output currents >10 A or for currents on the highest two current s of an output current >10 A.

Power and Dual Output Limit Specifications

Frequency	Voltages (NORMAL)	Currents	Voltages (AUX)	Power Factor (PF)
dc	0 to ±1020 V	0 to ±20.5 A	0 to ±7 V	-
10 to 45 Hz	33 mV to 32.9999 V	3.3 mA to 2.99999 A	10 mV to 5 V	0 to 1
45 to 65 Hz	33 mV to 1020 V	3.3 mA to 20.5 A	10 mV to 5 V	0 to 1
65 to 500 Hz	330 mV to 1020 V	33 mA to 2.99999 A	100 mV to 5 V	0 to 1
65 to 500 Hz	3.3 to 1020 V	33 mA to 20.5 A	100 mV to 5 V	0 to 1
500 Hz to 1 kHz	330 mV to 1020 V	33 mA to 20.5 A	100 mV to 5 V	0 to 1
1 to 5 kHz	3.3 to 500 V	33 mA to 2.99999 A	100 mV to 5 V	0 to 1
5 to 10 kHz	3.3 to 250 V	33 to 329.99 mA	1 to 5 V	0 to 1
10 to 30 kHz	3.3 V to 250 V	33 mA to 329.99 mA	1 V to 3.29999 V	0 to 1

Notes
The range of voltages and currents shown in "DC Voltage Specifications," "DC Current Specifications," "AC Voltage (Sine Wave) Specifications," and "AC Current (Sine Wave) Specifications" are available in the power and dual output modes (except minimum current for ac power is 0.33 mA). However, only those limits shown in this table are specified. See "Calculating Power Uncertainty" to determine the uncertainty at these points. The phase adjustment range for dual ac outputs is 0 ° to ±179.99 °. The phase resolution for dual ac outputs is 0.01 degree.

Phase

1-Year Absolute Uncertainty, tcal ±5 °C, (ΔΦ°)					
10 to 65 Hz	65 to 500 Hz	500 Hz to 1 kHz	1 to 5 kHz	5 to 10 kHz	10 to 30 kHz
0.10 °	0.25 °	0.5 °	2.5 °	5 °	10 °

Note
See Power and Dual Output Limit Specifications for applicable outputs.

Phase (Φ) Watts	Phase (Φ) VARs	PF	Power Uncertainty Adder due to Phase Error					
			10 to 65 Hz	65 to 500 Hz	500 Hz to 1 kHz	1 to 5 kHz	5 to 10 kHz	10 to 30 kHz
0 °	90 °	1.000	0.00 %	0.00 %	0.00 %	0.10 %	0.38 %	1.52 %
10 °	80 °	0.985	0.03 %	0.08 %	0.16 %	0.86 %	1.92 %	4.58 %
20 °	70 °	0.940	0.06 %	0.16 %	0.32 %	1.68 %	3.55 %	7.84 %
30 °	60 °	0.866	0.10 %	0.25 %	0.51 %	2.61 %	5.41 %	11.54 %
40 °	50 °	0.766	0.15 %	0.37 %	0.74 %	3.76 %	7.69 %	16.09 %
50 °	40 °	0.643	0.21 %	0.52 %	1.04 %	5.29 %	10.77 %	22.21 %
60 °	30 °	0.500	0.30 %	0.76 %	1.52 %	7.65 %	15.48 %	31.60 %
70 °	20 °	0.342	0.48 %	1.20 %	2.40 %	12.08 %	24.33 %	49.23 %
80 °	10 °	0.174	0.99 %	2.48 %	4.95 %	24.83 %	49.81 %	100.00 %
90 °	0 °	0.000	-	-	-	-	-	-

To calculate exact ac Watts power adders due to phase uncertainty for values not shown, use the following formula:

$$\text{Adder}(\%)=100\left(1-\frac{\cos(\Phi+\Delta\Phi)}{\cos(\Phi)}\right)$$

For example: At 60 Hz, for a PF of .9205 (Φ = 23) and a phase uncertainty of $\Delta\Phi$= 0.10, the ac Watts power adder is:

$$\text{Adder}(\%)=100\left(1-\frac{\cos(23+.10)}{\cos(23)}\right)=0.074\%$$

5522A Multi-Product Calibrator Extended specifications

FLUKE ® Calibration

Calculating Power Uncertainty

Overall uncertainty for power output in Watts (or VARs) is based on the root sum square (rss) of the individual uncertainties in percent for the selected voltage, current, and power factor parameters:

Watts uncertainty

$$U_{power} = \sqrt{U^2_{voltage} + U^2_{current} + U^2_{PFadder}}$$

VARs uncertainty

$$U_{VARs} = \sqrt{U^2_{voltage} + U^2_{current} + U^2_{VARsadder}}$$

Because there are an infinite number of combinations, you should calculate the actual ac power uncertainty for your selected parameters. The method of calculation is best shown in the following examples (using 1 year specifications):

Example 1

Output: 100 V, 1 A, 60 Hz, Power Factor = 1.0 (Φ=0).
Voltage Uncertainty Uncertainty for 100 V at 60 Hz is 190 ppm + 2 mV, totaling:
100 V x 190 x 10-6 = 19 mV added to 2 mV = 21 mV.
Expressed in percent:
21 mV/100 V x 100 = 0.021 % (see “AC Voltage (Sine Wave) Specifications”).
Current Uncertainty Uncertainty for 1 A is 0.05 %.100 µA, totaling:
1 A x 0.0005 = 500 µA added to 100 µA = 0.6 mA.
Expressed in percent:
0. 6 mA/1 A x 100 = 0.06 % (see “AC Current (Sine Waves) Specifications”).
PF Adder Watts Adder for PF = 1 (Φ=0) at 60 Hz is 0 % (see “Phase Specifications”).
Total Watts Output Uncertainty =

$$U_{power} = \sqrt{0.021^2 + 0.06^2 + 0^2} = 0.064\%$$

Example 2

Output: 100 V, 1 A, 400 Hz, Power Factor = 0.5 (Φ=60)
Voltage Uncertainty Uncertainty for 100 V at 400 Hz is, 190 ppm + 2 mV, totaling:
100 V x 190 x 10-6 = 19 mV added to 2 mV = 21 mV.
Expressed in percent:
21 mV/100 V x 100 = 0.021 % (see “AC Voltage (Sine Wave) Specifications”).
Current Uncertainty Uncertainty for 1 A is 0.05 %.
100 µA, totaling:
1 A x 0.0005 = 500 µA added to 100 µA = 0.6 mA.
Expressed in percent:
0.6 mA/1 A x 100 = 0.06 % (see “AC Current (Sine Waves) Specifications”).
PF Adder Watts Adder for PF = 0.5 (Φ=60) at 400 Hz is 0.76 % (see “Phase Specifications”).
Total Watts Output Uncertainty =

$$U_{power} = \sqrt{0.021^2 + 0.06^2 + 0.76^2} = 0.76\%$$

VARs When the Power Factor approaches 0.0, the Watts output uncertainty becomes unrealistic because the dominant characteristic is the VARs (volts-amps-reactive) output. In these cases, calculate the Total VARs Output Uncertainty, as shown in example 3:

Example 3

Output: 100 V, 1 A, 60 Hz, Power Factor = 0.174 (Φ=80)
Voltage Uncertainty Uncertainty for 100 V at 60 Hz is, 190 ppm + 2 mV, totaling:
100 V x 190 x 10-6 = 19 mV added to 2 mV = 21 mV.
Expressed in percent:
21 mV/100 V x 100 = 0.021 % (see “AC Voltage (Sine Wave) Specifications”).
Current Uncertainty Uncertainty for 1 A is 0.05 %.
100 µA, totaling:
1 A x 0.0005 = 500 µA added to 100 µA = 0.6 mA.
Expressed in percent:
0.6 mA/1 A x 100 = 0.06 % (see “AC Current (Sine Waves) Specifications”).
VARs Adder VARs Adder for Φ=80 at 60 Hz is 0.03 % (see “Phase Specifications”).
Total VARS Output Uncertainty =

$$U_{VARS} = \sqrt{0.021^2 + 0.06^2 + 0.03^2} = 0.070\%$$

Additional Specifications

The following paragraphs provide additional specifications for the 5522A Calibrator ac voltage and ac current functions.
These specifications are valid after allowing a warm-up period of 30 minutes, or twice the time the 5522A has been turned off. All extended range specifications are based on performing the internal zero-cal function at weekly intervals, or when the ambient temperature changes by more than 5 °C.

Frequency

Frequency Range	Resolution	1-Year Absolute Uncertainty, tcal ±5 °C	Jitter
0.01 to 119.99 Hz	0.01 Hz	2.5 ppm +5 µHz [1]	100 ns
120.0 to 1199.9 Hz	0.1 Hz		
1.200 to 11.999 kHz	1.0 Hz		
12.00 to 119.99 kHz	10 Hz		
120.0 to 1199.9 kHz	100 Hz		
1.200 to 2.000 MHz	1 kHz		

[1] With REF CLK set to ext, the frequency uncertainty of the 5522A is the uncertainty of the external 10 MHz clock ±5 µHz. The amplitude of the 10 MHz external reference clock signal should be between 1 V and 5 V p-p.

Harmonics (2nd to 50th)

Fundamental Frequency [1]	Voltages NORMAL Terminals	Currents	Voltages AUX Terminals	Amplitude Uncertainty
10 to 45 Hz	33 mV to 32.9999 V	3.3 mA to 2.99999 A	10 mV to 5 V	Same % of output as the equivalent single output, but twice the floor adder.
45 to 65 Hz	33 mV to 1020 V	3.3 mA to 20.5 A	10 mV to 5 V	
65 to 500 Hz	33 mV to 1020 V	33 mA to 20.5 A	100 mV to 5 V	
500 Hz to 5 kHz	330 mV to 1020 V	33 mA to 20.5 A	100 mV to 5 V	
5 to 10 kHz	3.3 to 1020 V	33 to 329.9999 mA	100 mV to 5 V	
10 to 30 kHz	3.3 to 1020 V	33 to 329.9999 mA	100 mV to 3.29999 V	

[1] The maximum frequency of the harmonic output is 30 kHz (10 kHz for 3.3 to 5 V on the Aux terminals). For example, if the fundamental output is 5 kHz, the maximum selection is the 6th harmonic (30 kHz). All harmonic frequencies (2nd to 50th) are available for fundamental outputs between 10 Hz and 600 Hz (200 Hz for 3.3 to 5 V on the Aux terminals).

Phase Uncertainty ..... Phase uncertainty for harmonic outputs is 1 degree or the phase uncertainty shown in “Phase Specifications” for the particular output, whichever is greater. For example, the phase uncertainty of a 400 Hz fundamental output and 10 kHz harmonic output is 5 ° (from “Phase Specifications”). Another example, the phase uncertainty of a 50 Hz fundamental output and a 400 Hz harmonic output is 1 degree.

Example of determining Amplitude Uncertainty in a Dual Output Harmonic Mode What are the amplitude uncertainties for the following dual outputs?

NORMAL (Fundamental) Output:
100 V, 100 Hz ..... From “AC Voltage (Sine Wave) 90 Day Specifications” the single output specification for 100 V, 100 Hz, is 0.015 % + 2 mV. For the dual output in this example, the specification is 0.015 % +4 mV as the 0.015 % is the same, and the floor is twice the value (2 x 2 mV).

AUX (50th Harmonic) Output:
100 mV, 5 kHz ..... From “AC Voltage (Sine Wave) 90 Day Specifications” the auxiliary output specification for 100 mV, 5 kHz, is 0.15 % + 450 mV. For the dual output in this example, the specification is 0.15 % 900 mV as the 0.15 % is the same, and the floor is twice the value (2 x 450 mV).

5522A Multi-Product Calibrator Extended specifications

AC Voltage (Sine Wave) Extended Bandwidth

Range	Frequency	1-Year Absolute Uncertainty tcal ±5 °C	Max Voltage Resolution
Normal Channel (Single Output Mode)			
1.0 to 33 mV	0.01 to 9.99 Hz	±(5.0 % of output +0.5 % of range)	Two digits, e.g., 25 mV
34 to 330 mV			Three digits
0.4 to 33 V			Two digits
0.3 to 3.3 V	500.1 kHz to 1 MHz	-10 dB at 1 MHz, typical	Two digits
	1.001 to 2 MHz	-31 dB at 2 MHz, typical	
Auxiliary Output (Dual Output Mode)			
10 to 330 mV	0.01 to 9.99 Hz	±(5.0 % of output +0.5 % of range)	Three digits
0.4 to 5 V			Two digits

AC Voltage (Non-Sine Wave)

Triangle Wave & Truncated Sine Range, p-p [1]	Frequency	1-Year Absolute Uncertainty, tcal ±5 °C, ±(% of output + % of range) [2]	Max Voltage Resolution
Normal Channel (Single Output Mode)			
2.9 to 92.999 mV	0.01 to 10 Hz	5.0 + 0.5	Two digits on each range
	10 to 45 Hz	0.25 + 0.5	Six digits on each range
	45 Hz to 1 kHz	0.25 + 0.25	
	1 to 20 kHz	0.5 + 0.25	
	20 to 100 kHz [3]	5.0 + 0.5	
93 to 929.999 mV	0.01 to 10 Hz	5.0 + 0.5	Two digits on each range
	10 to 45 Hz	0.25 + 0.5	Six digits on each range
	45 Hz to 1 kHz	0.25 + 0.25	
	1 to 20 kHz	0.5 + 0.25	
	20 to 100 kHz [3]	5.0 + 0.5	
0.93 to 9.29999 V	0.01 to 10 Hz	5.0 + 0.5	Two digits on each range
	10 to 45 Hz	0.25 + 0.5	Six digits on each range
	45 Hz to 1 kHz	0.25 + 0.25	
	1 to 20 kHz	0.5 + 0.25	
	20 to 100 kHz [3]	5.0 + 0.5	
9.3 to 93 V	0.01 to 10 Hz	5.0 + 0.5	Two digits on each range
	10 to 45 Hz	0.25 + 0.5	Six digits on each range
	45 Hz to 1 kHz	0.25 + 0.25	
	1 to 20 kHz	0.5 + 0.25	
	20 to 100 kHz [3]	5.0 + 0.5	
Auxiliary Output (Dual Output Mode)			
29 to 929.999 mV	0.01 to 10 Hz	5.0 + 0.5	Two digits on each range
	10 to 45 Hz	0.25 + 0.5	Six digits on each range
	45 Hz to 1 kHz	0.25 + 0.25	
	1 to 10 kHz	5.0 + 0.5	
0.93 to 9.29999 V	0.01 to 10 Hz	5.0 + 0.5	Two digits on each range
	10 to 45 Hz	0.25 + 0.5	Six digits on each range
	45 Hz to 1 kHz	0.25 + 0.25	
	1 to 10 kHz	5.0 + 0.5	
9.3 to 14.0000 V	0.01 to 10 Hz	5.0 + 0.5	Two digits on each range
	10 to 45 Hz	0.25 + 0.5	Six digits on each range
	45 Hz to 1 kHz	0.25 + 0.25	
	1 to 10 kHz	5.0 + 0.5	

[1] To convert p-p to rms for triangle wave, multiply the p-p value by 0.2886751. To convert p-p to rms for truncated sine wave, multiply the p-p value by 0.2165063.
[2] Uncertainty is stated in p-p. Amplitude is verified using an rms-responding DMM.
[3] Uncertainty for Truncated Sine outputs is typical over this frequency band.

5522A Multi-Product Calibrator Extended specifications

FLUKE ® Calibration

AC Voltage (Non-Sine Wave) (cont.)

Square Wave Range (p-p) [1]	Frequency	1-Year Absolute Uncertainty, tcal ±5 °C, ±(% of output + % of range) [2]	Max Voltage Resolution
Normal Channel (Single Output Mode)			
2.9 to 65.999 mV	0.01 to 10 Hz	5.0 + 0.5	Two digits on each range
	10 to 45 Hz	0.25 + 0.5	Six digits on each range
	45 Hz to 1 kHz	0.25 + 0.25	
	1 to 20 kHz	0.5 + 0.25	
	20 to 100 kHz	5.0 + 0.5	
66 to 659.999 mV	0.01 to 10 Hz	5.0 + 0.5	Two digits on each range
	10 to 45 Hz	0.25 + 0.5	Six digits on each range
	45 Hz to 1 kHz	0.25 + 0.25	
	1 to 20 kHz	0.5 + 0.25	
	20 to 100 kHz	5.0 + 0.5	
0.66 to 6.59999 V	0.01 to 10 Hz	5.0 + 0.5	Two digits on each range
	10 to 45 Hz	0.25 + 0.5	Six digits on each range
	45 Hz to 1 kHz	0.25 + 0.25	
	1 to 20 kHz	0.5 + 0.25	
	20 to 100 kHz	5.0 + 0.5	
6.6 to 66.0000 V	0.01 to 10 Hz	5.0 + 0.5	Two digits on each range
	10 to 45 Hz	0.25 + 0.5	Six digits on each range
	45 Hz to 1 kHz	0.25 + 0.25	
	1 to 20 kHz	0.5 + 0.25	
	20 to 100 kHz	5.0 + 0.5	
Auxiliary Output (Dual Output Mode)			
29 to 659.999 mV	0.01 to 10 Hz	5.0 + 0.5	Two digits on each range
	10 to 45 Hz	0.25 + 0.5	Six digits on each range
	45 Hz to 1 kHz	0.25 + 0.25	
	1 to 10 kHz [3]	5.0 + 0.5	
0.66 to 6.59999 V	0.01 to 10 Hz	5.0 + 0.5	Two digits on each range
	10 to 45 Hz	0.25 + 0.5	Six digits on each range
	45 Hz to 1 kHz	0.25 + 0.25	
	1 to 10 kHz [3]	5.0 + 0.5	
6.6 to 14.0000 V	0.01 to 10 Hz	5.0 + 0.5	Two digits on each range
	10 to 45 Hz	0.25 + 0.5	Six digits on each range
	45 Hz to 1 kHz	0.25 + 0.25	
	1 to 10 kHz [3]	5.0 + 0.5	

[1] To convert p-p to rms for square wave, multiply the p-p value by 0.5.
[2] Uncertainty is stated in p-p. Amplitude is verified using an rms-responding DMM.
[3] Limited to 1 kHz for Auxiliary outputs ≥6.6 V p-p.

AC Voltage, DC Offset

Range [1] (Normal Channel)	Offset Range [2]	Max Peak Signal	1-Year Absolute Uncertainty, tcal ±5 °C [3] ±(% of dc output + floor)
Sine Waves (rms)			
3.3 to 32.999 mV	0 to 50 mV	80 mV	0.1 + 33 µV
33 to 329.999 mV	0 to 500 mV	800 mV	0.1 + 330 µV
0.33 to 3.29999 V	0 to 5 V	8 V	0.1 + 3300 µV
3.3 to 32.9999 V	0 to 50 V	55 V	0.1 + 33 mV
Triangle Waves and Truncated Sine Waves (p-p)			
9.3 to 92.999 mV	0 to 50 mV	80 mV	0.1 + 93 µV
93 to 929.999 mV	0 to 500 mV	800 mV	0.1 + 930 µV
0.93 to 9.29999 V	0 to 5 V	8 V	0.1 + 9300 µV
9.3 to 93.0000 V	0 to 50 V	55 V	0.1 + 93 mV
Square Waves (p-p)			
6.6 to 65.999 mV	0 to 50 mV	80 mV	0.1 + 66 µV
66 to 659.999 mV	0 to 500 mV	800 mV	0.1 + 660 µV
0.66 to 6.59999 V	0 to 5 V	8 V	0.1 + 6600 µV
6.6 to 66.0000 V	0 to 50 V	55 V	0.1 + 66 mV

[1] Offsets are not allowed on ranges above the highest range shown above.
[2] The maximum offset value is determined by the difference between the peak value of the selected voltage output and the allowable maximum peak signal. For example, a 10 V p-p square wave output has a peak value of 5 V, allowing a maximum offset up to ± 50 V to not exceed the 55 V maximum peak signal. The maximum offset values shown above are for the minimum outputs in each range.
[3] For frequencies 0.01 to 10 Hz, and 500 kHz to 2 MHz, the offset uncertainty is 5 % of output, ±1 % of the offset range.

5522A Multi-Product Calibrator Extended specifications

AC Voltage, Square Wave Characteristics

Risetime @ 1 kHz Typical	Settling Time @ 1 kHz Typical	Overshoot @ 1 kHz Typical	Duty Cycle Range	Duty Cycle Uncertainty
<1 µs	<10 µs to 1 % of final value	<2 %	1 % to 99 % <3.3 V p-p. 0,01 Hz to 100 kHz	±(0.02 % of period + 100 ns), 50 % duty cycle ±(0.05 % of period + 100 ns), other duty cycles from 10 % to 90 %

AC Voltage, Triangle Wave Characteristics (typical)

Linearity to 1 kHz	Aberrations
0.3 % of p-p value, from 10 % to 90 % point	<1 % of p-p value, with amplitude >50 % of range

AC Current (Non-Sine Wave)

Triangle Wave & Truncated Sine Wave Range p-p	Frequency	1-Year Absolute Uncertainty tcal ±5 °C ±(% of output + % of range)	Max Current Resolution	
0.047 to 0.92999 mA [1]	10 to 45 Hz	0.25 + 0.5	Six digits	[1] Frequency limited to 1 kHz with LCOMP on. [2] Frequency limited to 440 Hz with LCOMP on.
	45 Hz to 1 kHz	0.25 + 0.25		
	1 to 10 kHz	10 + 2		
0.93 to 9.29999 mA [1]	10 to 45 Hz	0.25 + 0.5	Six digits	
	45 Hz to 1 kHz	0.25 + 0.25		
	1 to 10 kHz	10 + 2		
9.3 to 92.9999 mA [1]	10 to 45 Hz	0.25 + 0.5	Six digits	
	45 Hz to 1 kHz	0.25 + 0.25		
	1 to 10 kHz	10 + 2		
93 to 929.999 mA [1]	10 to 45 Hz	0.25 + 0.5	Six digits	
	45 Hz to 1 kHz	0.25 + 0.5		
	1 to 10 kHz	10 + 2		
0.93 to 8.49999 A [2]	10 to 45 Hz	0.5 + 1.0	Six digits	
	45 Hz to 1 kHz	0.5 + 0.5		
	1 to 10 kHz	10 + 2		
8.5 to 57 A [2]	45 to 500 Hz	0.5 + 0.5		
	500 Hz to 1 kHz	1.0 + 1.0		

AC Current (Non-Sine Wave)

Square Wave Range p-p	Frequency	1-Year Absolute Uncertainty tcal ±5 °C ±(% of output + % of range)	Max Current Resolution	
0.047 to 0.65999 mA [1]	10 to 45 Hz	0.25 + 0.5	Six digits	[1] Frequency limited to 1 kHz with LCOMP on. [2] Frequency limited to 440 Hz with LCOMP on.
	45 Hz to 1 kHz	0.25 + 0.25		
	1 to 10 kHz	10 + 2		
0.66 to 6.59999 mA [1]	10 to 45 Hz	0.25 + 0.5	Six digits	
	45 Hz to 1 kHz	0.25 + 0.25		
	1 to 10 kHz	10 + 2		
6.6 to 65.9999 mA [1]	10 to 45 Hz	0.25 + 0.5	Six digits	
	45 Hz to 1 kHz	0.25 + 0.25		
	1 to 10 kHz	10 + 2		
66 to 659.999 mA [1]	10 to 45 Hz	0.25 + 0.5	Six digits	
	45 Hz to 1 kHz	0.25 + 0.5		
	1 to 10 kHz	10 + 2		
0.66 to 5.99999 A [2]	10 to 45 Hz	0.5 + 1.0		
	45 Hz to 1 kHz	0.5 + 0.5		
	1 to 10 kHz	10 + 2		
6 to 41 A [2]	45 to 500 Hz	0.5 + 0.5		
	500 Hz to 1 kHz	1.0 + 1.0		

AC Current, Square Wave Characteristics (typical)

Range	LCOMP	Risetime	Settling Time	Overshoot
I <6 A @ 400 Hz	off	25 µs	40 µs to 1 % of final value	<10 % for <1 V Compliance
3 A & 20 A Ranges	on	100 µs	200 µs to 1 % of final value	<10 % for <1 V Compliance

AC Current, Triangle Wave Characteristics (typical)

Linearity to 400 Hz	Aberrations
0.3 % of p-p value, from 10 % to 90 % point	<1 % of p-p value, with amplitude >50 % of range

5502A Multi-Product Calibrator

FLUKE® Calibration

A full-functioned calibrator that covers a wide range of common workload

The 5502A Multi-Product Calibrator addresses common workload items like 3.5 and 4.5 digit digital multimeters and more. It comes with internal and external protection features that enable you to transport it easily and perform on-site or mobile calibration. The 5502A can also be fully automated with MET/CAL2® Plus Calibration Management Software. It is the ideal calibrator for metrology professionals who need a solution for calibrating low-to-medium accuracy electrical instrumentation.

The 5502A sources direct voltage and current; alternating voltage and current with multiple waveforms and harmonics; simultaneous voltage and current outputs or dual voltage outputs to simulate dc and ac power with phase control; as well as resistance, capacitance, thermocouples and RTDs. The 5502A can also measure thermocouples and thermocouple simulators. Two options add the capability to calibrate oscilloscopes to either 300 MHz or 600 MHz.

Using the Fluke Calibration 52120A Transconductance Amplifier, the 5502A's output current can be extended from 20.5 to 120 A; and with the use of 25 and 50 turn coils, it can calibrate instruments requiring up to 6000 A.

The 5502A calibrator covers many of the most common items in your workload, including:

- Handheld and bench meters (analog and digital) to 4.5 digits
- Current clamps and clamp meters
- Panel meters
- Electronic thermometers
- Chart recorders
- Oscilloscope recorders
- XY recorders
- Data loggers

	Fluke Calibrators				
	Multi-Product Calibrators			Multifunction Calibrators	
Workload	**5080A**	**5502A**	**5522A**	**5700A**	**5720A**
Analog/Panel meters					
High burden meters					
Low burden meters					
DMMs					
Basic dc V accuracy	100 ppm	50 ppm	11 ppm	6.4 ppm	3.25 ppm
3.5 digits (typ. ± 0.3 % dc V)					
4.5 digits (typ. ± 0.025 % dc V)					
5.5 digits (typ. ± 0.015 % dc V)					
6.5 digits (typ. ± 0.0024 % dc V)					
7.5 digits (typ. ± 12 ppm dc V)					
8.5 digits (typ. ± 3.9 ppm dc V)					
Temperature/Pressure					
RTD simulate					
RTD measure					
Thermocouple simulate					
Thermocouple measure					
Pressure modules			opt		
Oscilloscopes	1 channel				
200 MHz to 600 MHz	200 MHz opt	300 MHz or 600 MHz opt	600 MHz opt		
1.1 GHz			opt		
2.1 GHz					
3.2 GHz					
6 GHz					
25 ps fast edge					
Safety testers					
Hipot					
Megohm meters	opt				
Installation					
PATs					
Continuity	opt				
Power/Energy					
Wattmeters					
Harmonic analyzers					
Flicker meters PQ			opt		
Phase angle meters PQ			opt		
Power analyzers PQ			opt		
Power recorders					
Other					
Clamp meters					
LCR meters		CR only	CR only		
Process calibrators					
Data acquisition					
Non sine waveforms					
RF millivolt meters				opt	opt
# of calibrator functions	8	11	11	5	5

5502A Multi-Product Calibrator

Internal circuitry protects against user error

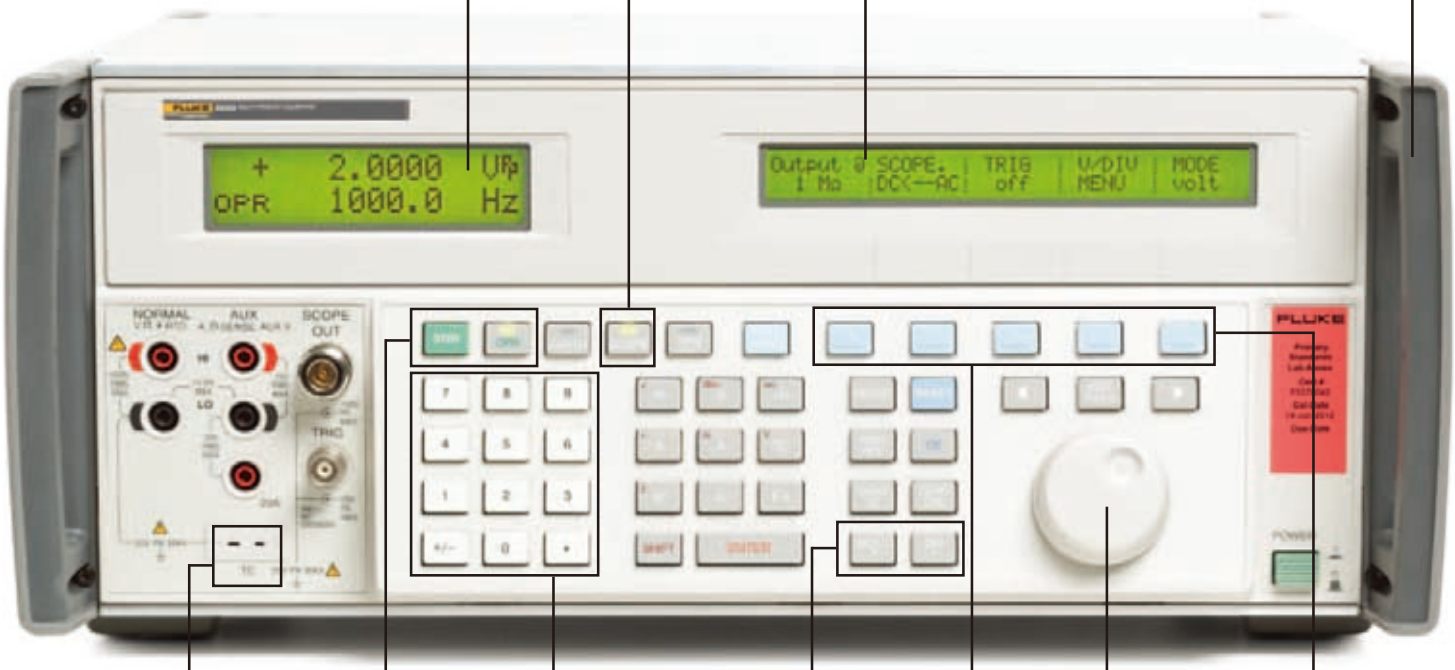
Reverse power protection, check before connect, immediate output disconnection, and fuse protection on the output terminals offers "mistake proof" protection against common user errors.
This protection is for applied external voltages up to ± 300 V peak.

The bright, backlit **LCD display** is easy to read from all angles and under a variety of light conditions.

Ergonomically designed, rugged **handles** make the 5502A easy to transport.

Press the **SCOPE key** for on-demand oscilloscope calibration (optional).

The **control window** displays a variety of status messages, soft key menus, and status and other auxiliary information.



Control output by pressing **STBY** and **OPR** keys.

Calculator-style **keypad** makes it easy to enter values.

MULT [X] and **DIV [÷]** keys simplify stepping up and down in decade multiples of any output setting, and let you step up or down to the next range in a 1–2–5 sequence for oscilloscope calibration.

Edit knob allows you to vary the output. When editing, the difference between the original output and the edited output is computed automatically and displayed in the control window.

Using **soft keys** you can access a "SPEC" menu lets you view the uncertainty for the present value.

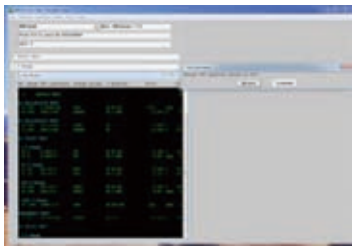
Temperature measurement modes calibrate thermocouple simulators and can also document environmental conditions present at the time of calibration, as required by all quality standards.

Soft keys allow access to the menus in the control windows, letting you select parameters such as offset, waveforms, phase, thermocouple or RTD type. PREV MENU lets you step backward through these menus.

5502A Multi-Product Calibrator

Automate with MET/CAL® Plus software for consistent and efficient calibration

MET/CAL Plus software is a powerful application for creating, editing and testing calibration procedures and collecting and reporting results on a wide variety of instruments. It includes MET/CAL software—the industry leading software for automated calibration, and MET/TEAM™ Express—a dedicated system to manage your test and measurement assets. Or choose MET/TEAM standard edition for fully-featured enterprise calibration asset management, with optional modules for on-site calibration, commerce management, and customer web portal.



Using MET/CAL Plus Calibration Management Software can help you meet the requirements for documented processes, procedures and reports mandated by most quality standards. Automating with MET/CAL software also helps you increase throughput and streamline your calibration processes.

Priority software support helps you stay productive

MET/SUPPORTSM Gold is an annual membership program offering premium support and services to help you stay as productive as possible with MET/CAL Plus software. Services include free software updates and upgrades, free access to the MET/CAL Warranted Procedures Library, plus discounts on training and custom procedure development. Members also receive invitations to regular calibration software web seminars and user group meetings. Use only a few of the Gold services and you can easily recover more than the cost of your membership fee.

Calibration and repair service

Fluke Calibration offers extensive calibration support and service to ensure your long-term satisfaction and return on investment in calibration equipment. Our worldwide network of calibration centers offers accredited calibrations traceable to national standards. We also offer fast, quality repair and calibration services including a module exchange program and full support in setting up your lab.

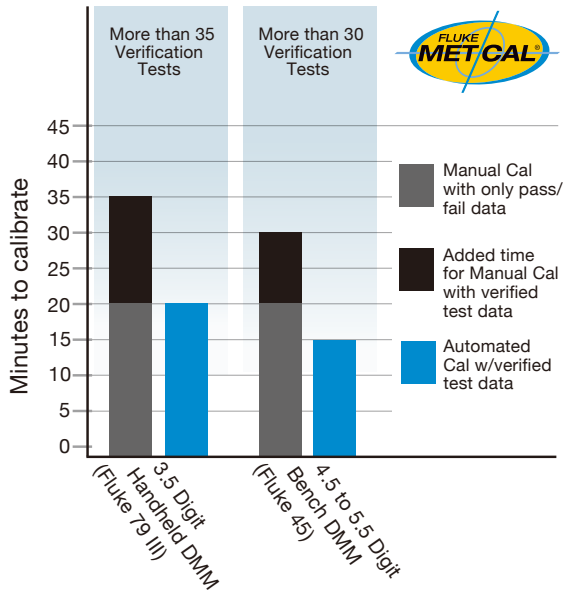
Metrology training increases skill levels

Calibration and metrology training from Fluke Calibration can help you and your staff become more knowledgeable in a wide variety of disciplines. Instructor-led classroom training is available for general topics in metrology, as well as for calibration software. On-site training can also be scheduled if you have a number of people in your organization who would benefit.

Fluke Calibration also offers other educational events such as web seminars and road shows on a wide variety of topics.

The best way to stay informed about these events is to register to receive email and direct mail from Fluke Calibration. You can register online at **www.flukecal.com.**

Time comparison for manual and automated calibration methods



5502A Multi-Product Calibrator

Summary specifications

AC Current, Triangle Wave Characteristics (typical)

Function and range	
Direct volts	0 to ± 1020 V
Direct current	0 to ± 20.5 A
Alternating volts	1 mV to 1020 V 10 Hz to 500 kHz
Volt/hertz	1000 V@ 10 kHz/330 V@100 kHz
Alternating current	29 µA to 20.5 A 10 Hz to 30 kHz
Waveforms	Sine, square, triangle, truncated sine
Resistance	0 Ω to 1100 MΩ
Capacitance	220 pF to 110 mF
Power (phantom loads)	20.9 kW
Phase control	0.01°
Thermocouple (source and measure temperature)	B, C, E, J, K L N R, S, T, U
	10 µV/°C and 1 mV/°C
RTD (source temperature)	Pt 385-100 Ω, Pt 3926-100 Ω Pt 3916-100 Ω, Pt 385-200 Ω, Pt 385-500 Ω, Pt 385 1000 Ω, PtNi 385-120 Ω (Ni120), Cu 427 10 Ω
Interfaces	RS-232, IEEE 488
Frequency uncertainty	< 25 ppm
Oscilloscope calibrator (options)	Levelled sine wave from 5 mV to 5.5 Vpp max, frequencies 50 kHz to 600 kHz; edge rise times of < 300 ps, multiple trigger functions, lowest dc, square wave and timing uncertainty
Amplified current (accessory amplifier)	Extend from 20.5 A to a maximum of 100 A dc and 120 A ac from 10 Hz to 10 k Hz

Calibrate almost anywhere

Rugged transit case makes on-site calibration safe, easy, convenient
An optional shock-mounted transit case featuring built-in handles and wheels gives you the option of taking the calibrator to the workload for on-site or mobile applications.

Once at the site, just remove the front and rear doors from the case for access to the 5502A's front and rear panels.the top, bottom and sides of the calibrator remain protected, and you don't need to fully unpack the calibrator for each use.

5502A Multi-Product Calibrator

FLUKE ®
Calibration

5522A Multi-Product Calibrator

Robust, transportable wide workload coverage

The 5522A Multi-Product Calibrator is the most accurate model in this calibrator family. It calibrates digital multimeters into the 5.5 and 6.5 digit category. The 5522A addresses the widest calibration workload with optional power quality capabilities and oscilloscope calibration for scopes with bandwidths to 1100 MHz. It comes with internal and external protection features that protect it against damage and make it easier to transport for onsite or mobile calibration.

The 5522A can be fully automated with MET/CAL Plus Calibration Management Software. It is the ideal calibrator for metrology professionals who need to calibrate many different types of electronic equipment and want a transportable instrument that offers them a high return on investment.

5080A High Compliance Multi-Product

Calibrator Calibration solutions for your analog and digital workload

The 5080A Multi-Product Calibrator calibrates your analog and digital workload accurately and economically.

Its high voltage and current compliance makes analog workload calibration easy and precise. With maximum burden up to 800 mA for ac/dc voltage, and voltage up to 50 V for ac/dc current, 5080A calibrators can drive a wide range of analog meters.

Built-in protection circuitry protects the 5080A against damaging input voltages. Versatile software applications enable you to record paperless results and more.

Options and accessories enable you to use the 5080A to calibrate an even broader workload, including clamp meters, oscilloscopes, and megohm meters.

Innovation from the leader in calibration

Fluke Calibration pioneered the multiproduct calibrator concept, creating a family of instruments that allow you to calibrate the widest range of today's electronic test tools with a single instrument. These calibrators offer simple, portable, cost-effective solutions that allow you to match your calibrators to your workload and your budget.

5502A Multi-Product Calibrator

General Specifications

The following tables list the 5502A specifications. All specifications are valid after allowing a warm-up period of 30 minutes, or twice the time the 5502A has been turned off. (For example, if the 5502A has been turned off for 5 minutes, the warm-up period is 10 minutes.)
All specifications apply for the temperature and time period indicated. For temperatures outside of tcal ±5 °C (tcal is the ambient temperature when the 5502A was calibrated), the temperature coefficient as stated in the General Specifications must be applied.
The specifications also assume the Calibrator is zeroed every seven days or whenever the ambient temperature changes more than 5 °C. The tightest ohms specifications are maintained with a zero cal every 12 hours within ±1 °C of use.
Also see additional specifications later in this chapter for information on extended specifications for ac voltage and current.

Warmup Time ..... Twice the time since last warmed up, to a maximum of 30 minutes.
Settling Time ..... Less than 5 seconds for all functions and ranges except as noted.
Standard Interfaces ..... IEEE-488 (GPIB), RS-232
Temperature
Operating ..... 0 °C to 50 °C
Calibration (tcal) ..... 15 °C to 35 °C
Storage ..... -20 °C to +70 °C; The DC current ranges 0 to 1.09999 A and 1.1 A to 2.99999 A are sensitive to storage temperatures above 50 °C. If the 5502A is stored above 50 °C for greater than 30 minutes, these ranges must be re-calibrated. Otherwise, the 90 day and 1 year uncertainties of these ranges double.
Temperature Coefficient ..... Temperature coefficient for temperatures outside of tcal ±5 °C is 10 % of the stated specification per °C.
Relative Humidity
Operating ..... <80 % to 30 °C, <70 % to 40 °C, <40 % to 50 °C
Storage ..... <95 %, non-condensing. After long periods of storage at high humidity, a drying-out period (with power on) of at least one week may be required.
Altitude
Operating ..... 3,050 m (10,000 ft) maximum
Non-operating ..... 12,200 m (40,000 ft) maximum
Safety..... Complies with EN/IEC 61010-1:2001, CAN/CSA-C22.2 No. 61010-1-04, ANSI/UL 61010-1:2004;
Output Terminal Electrical Overload Protection Provides reverse-power protection, immediate output disconnection, and/or fuse protection on the output terminals for all functions. This protection is for applied external voltages up to ±300 V peak.
Analog Low Isolation..... 20 V normal operation, 400 V peak transient
EMC ..... Complies with EN/IEC 61326-1:2006, EN/IEC 61326-2-1:2006 for controlled EM environments under the following conditions. If used in areas with Electromagnetic fields of 1 to 3 V/m from 0.08- 1GHz, resistance outputs have a floor adder of 0.508 Ω Performance not specified above 3 V/m. This instrument may be susceptible to electro-static discharge (ESD) to the binding posts.
Good static awareness practices should be followed when handling this and other pieces of electronic equipment.
Additionally this instrument may be susceptible to electrical fast transients on the mains terminals. If any disturbances in operation are observed, it is recommended that the rear panel chassis ground terminal be connected to a known good earth ground with a low inductance ground strap. Note that a mains power outlet while providing a suitable ground for protection against electric shock hazard may not provide an adequate ground to properly drain away conducted rf disturbances and may in fact be the source of the disturbance. This instrument was certified for EMC performance with data I/O cables not in excess of 3m.
Line Power ..... Line Voltage (selectable): 100 V, 120 V, 220 V, 240 V
Line Frequency: 47 Hz to 63 Hz
Line Voltage Variation: ±10 % about line voltage setting. For optimal performance at full dual outputs (e.g. 1000 V, 20 A) choose a line voltage setting that is ±7.5 % from nominal.
Power Consumption ..... 600 VA
Dimensions (HxWxL) ..... 17.8 cm x 43.2 cm x 47.3 cm (7 in x 17 in x 18.6 in) Standard rack width and rack increment, plus 1.5 cm (0.6 in) for feet on bottom of unit.
Weight (without options) ..... 22 kg (49 lb)
Absolute Uncertainty Definition.....The 5502A specifications include stability, temperature coefficient, linearity, line and load regulation, and the traceability of the external standards used for calibration. You do not need to add anything to determine the total specification of the 5502A for the temperature range indicated.
Specification Confidence Level .....99 %

Detailed Specifications

DC Voltage

Range	Absolute Uncertainty, tcal ± 5 °C ±(of output + µV)		Stability	Resolution (µV)	Max Burden [1]
	90 days	1 year	24 hours, ±1 °C ±(ppm of output + µV)		
0 to 329.9999 mV	0.005 + 3	0.006 + 3	5 + 1	0.1	65 Ω
0 to 3.299999 V	0.004 + 5	0.005 + 5	4 + 3	1	10 mA
0 to 32.99999 V	0.004 + 50	0.005 + 50	4 + 30	10	10 mA
30 to 329.9999 V	0.0045 + 500	0.0055 + 500	4.5 + 300	100	5 mA
100 to 1020.000 V	0.0045 + 1500	0.0055 + 1500	4.5 + 900	1000	5 mA
Auxiliary Output (dual output mode only) [2]					
0 to 329.999 mV	0.03 + 350	0.04 + 350	30 + 100	1	5 mA
0.33 to 3.29999 V	0.03 + 350	0.04 + 350	30 + 100	10	5 mA
3.3 to 7 V	0.03 + 350	0.04 + 350	30 + 100	100	5 mA
TC Simulate and Measure in Linear 10 µV/°C and 1 mV/°C modes [3]					
0 to 329.9999 mV	0.005 + 3	0.006 + 3	5 + 1	0.1	10 Ω

[1] Remote sensing is not provided. Output resistance is < 5 mΩ for outputs ≥ 0.33 V. The AUX output has an output resistance of <1 Ω.
TC simulation has an output impedance of 10 Ω ± 1 Ω.
[2] Two channels of dc voltage output are provided.
[3] TC simulating and measuring are not specified for operation in electromagnetic fields above 0.4 V/m.

5502A Multi-Product Calibrator

Range	Noise	
	Bandwidth 0.1 Hz to 10 Hz p-p ±(ppm of output + floor in µV)	Bandwidth 10 Hz to 10 kHz rms
0 to 329.9999 mV	0 + 1	6 µV
0 to 3.299999 V	0 + 10	60 µV
0 to 32.99999 V	0 + 100	600 µV
30 to 329.9999 V	10 + 1000	20 mV
100 to 1020.000 V	10 + 5000	20 mV
Auxiliary Output (dual output mode only) [1]		
0 to 329.999 mV	0 + 5 µV	20 µV
0.33 to 3.29999 V	0 + 20 µV	200 µV
3.3 to 7 V	0 + 100 µV	1000 µV

[1] Two channels of dc voltage output are rovided.

DC Current

Range	Absolute Uncertainty, tcal ±5 °C ±(% of output + µA)		Resolution	Max Compliance Voltage V	Max Inductive Load mH
	90 days	1 year			
0 to 329.999 .A	0.012 + 0.02	0.015 + 0.02	1 nA	10	400
0 to 3.29999 mA	0.010 + 0.05	0.013 + 0.05	0.01 µA	10	
0 to 32.9999 mA	0.008 + 0.25	0.010 + 0.25	0.1 µA	7	
0 to 329.999 mA	0.008 + 3.3	0.010 + 2.5	1 µA	7	
0 to 1.09999 A	0.023 + 44	0.038 + 44	10 µA	6	
1.1 to 2.99999 A	0.030 + 44	0.038 + 44	10 µA	6	
0 to 10.9999 A (20 A Range)	0.038 + 500	0.060 + 500	100 µA	4	
11 to 20.5 A [1]	0.080 + 750 [2]	0.10 + 750 [2]	100 µA	4	

[1] Duty Cycle: Currents <11 A may be provided continuously. For currents >11 A, see Figure 1. The current may be provided Formula 60-T-I minutes any 60 minute period where T is the temperature in °C (room temperature is about 23 °C) and I is the output current in amperes. For example, 17 A, at 23 °C could be provided for 60-23-17 = 20 minutes each hour. When the 5502A is outputting currents between 5 and 11 amps for long periods, the internal self-heating reduces the duty cycle. Under those conditions, the allowable "on" time indicated by the formula and Figure 1 is achieved only after the 5502A is outputting currents <5 A for the "off" period first.
[2] Floor specification is 1500 µA within 30 seconds of selecting operate. For operating times >30 seconds, the floor specification is 750 µA.

Range	Noise	
	Bandwidth 0.1 Hz to 10 Hz p-p	Bandwidth 10 Hz to 10 kHz rms
0 to 329.999 .A	2 nA	20 nA
0 to 3.29999 mA	20 nA	200 nA
0 to 32.9999 mA	200 nA	2.0 µA
0 to 329.999 mA	2000 nA	20 µA
0 to 2.99999 A	20 µA	1 mA
0 to 20.5 A	200 µA	10 mA

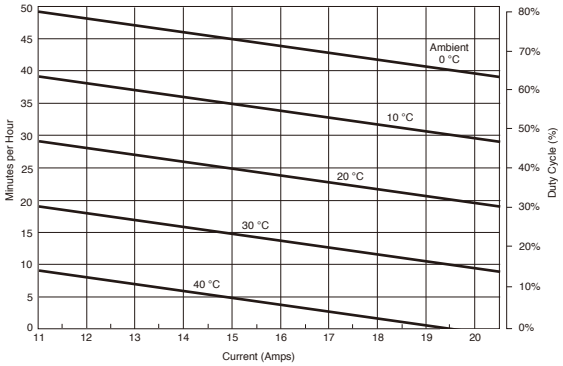


Figure 1. Allowable Duration of Current >11 A

5502A Multi-Product Calibrator

Resistance

Range [1]	Absolute Uncertainty, tcal ±5 °C ±(of output +floor) [2]				Resolution (Ω)	Allowable Current [3]
	ppm of output		Floor (Ω) Time and temp since ohms zero cal			
	90 days	1 year	12 hrs ±1 °C	7 days ±5 °C		
0 to 10.999 Ω	0.009	0.012	0.001	0. 01	0.001	1 mA to 125 mA
11 to 32.999 Ω	0.009	0.012	0.0015	0.015	0.001	1 mA to 125 mA
33 to 109.999 Ω	0.007	0.009	0.0014	0.015	0.001	1 mA to 70 mA
110 to 329.999 Ω	0.007	0.009	0.002	0.02	0.001	1 mA to 40 mA
330 to 1.09999 kΩ	0.007	0.009	0.002	0.02	0.01	1 mA to 18 mA
1.1 to 3.29999 kΩ	0.007	0.009	0.02	0.2	0.01	100 µA to 5 mA
3.3 to 10.9999 kΩ	0.007	0.009	0.02	0.1	0.1	100 µA to 1.8 mA
11 to 32.9999 kΩ	0.007	0.009	0.2	1	0.1	10 µA to .5 mA
33 to 109.999 kΩ	0.008	0.011	0.2	1	1	10 µA to 0.18 mA
110 to 329.999 kΩ	0.009	0.012	2	10	1	1 µA to 50 µA
330 k. to 1.09999 MΩ	0.011	0.015	2	10	10	1 µA to 18 µA
1.1 to 3.29999 MΩ	0.011	0.015	30	150	10	250 nA to 5 µA
3.3 to 10.9999 MΩ	0.045	0.06	50	250	100	250 nA to 1.8 µA
11 to 32.9999 MΩ	0.075	0.1	2500	2500	100	25 nA to 500 nA
33 to 109.999 MΩ	0.4	0.5	3000	3000	1000	25 nA to 180 nA
110 to 329.999 MΩ	0.4	0.5	100000	100000	1000	2.5 nA to 50 nA
330 to 1100.00 MΩ	1.2	1.5	500000	500000	10000	1 nA to 13 nA

[1] Continuously variable from 0 Ω to 1.1 GΩ.
[2] Applies for 4-WIRE compensation only. For 2-WIRE and 2-WIRE COMP, add 5 µV per amp of stimulus current to the floor specification. For example, in 2-WIRE mode, at 1 kΩ the floor specification within 12 hours of an ohms zero cal for a measurement current of 1 mA is: 0.002 Ω + 5 µV / 1 mA = (0.002 + 0.005) Ω = 0.007 Ω.
[3] Do not exceed the largest current for each range. For currents lower than shown, the floor adder increases by $Floor_{(new)} = Floor_{(old)} \times I_{min}/I_{actual}$. For example, a 50 µA stimulus measuring 100 Ω has a floor specification of: 0.0014 Ω x 1 mA/50 µA = 0.028 Ω, assuming an ohms zero calibration within 12 hours.

AC Voltage (Sine Wave)

Range	Frequency	Absolute Uncertainty, tcal ±5 °C ±(% of output + µV)		Resolution	Max Burden	Max Distortion and Noise 10 Hz to 5 MHz Bandwidth ±(% of output + floor)
		90 days	1 year			
1.0 to 32.999 mV	10 Hz to 45 Hz	0.120 + 20	0.150 + 20	1 µV	65 Ω	0.15 + 90 µV
	45 Hz to 10 kHz	0.080 + 20	0.100 + 20			0.035 + 90 µV
	10 kHz to 20 kHz	0.120 + 20	0.150 + 20			0.06 + 90 µV
	20 kHz to 50 kHz	0.160 + 20	0.200 + 20			0.15 + 90 µV
	50 kHz to 100 kHz	0.300 + 33	0.350 + 33			0.25 + 90 µV
	100 kHz to 500 kHz	0.750 + 60	1.000 + 60			0.3 + 90 µV [1]
33 mV to 329.999 mV	10 Hz to 45 Hz	0.042 + 20	0.050 + 20	1 µV	65 Ω	0.15 + 90 µV
	45 Hz to 10 kHz	0.029 + 20	0.030 + 20			0.035 + 90 µV
	10 kHz to 20 kHz	0.066 + 20	0.070 + 20			0.06 + 90 µV
	20 kHz to 50 kHz	0.086 + 40	0.100 + 40			0.15 + 90 µV
	50 kHz to 100 kHz	0.173 + 170	0.230 + 170			0.20 + 90 µV
	100 kHz to 500 kHz	0.400 + 330	0.500 + 330			0.20 + 90 µV [1]
0.33 V to 3.29999 V	10 Hz to 45 Hz	0.042 + 60	0.050 + 60	10 µV	10 mA	0.15 + 200 µV
	45 Hz to 10 kHz	0.028 + 60	0.030 + 60			0.035 + 200 µV
	10 kHz to 20 kHz	0.059 + 60	0.070 + 60			0.06 + 200 µV
	20 kHz to 50 kHz	0.083 + 60	0.100 + 60			0.15 + 200 µV
	50 kHz to 100 kHz	0.181 + 200	0.230 + 200			0.20 + 200 µV
	100 kHz to 500 kHz	0.417 + 900	0.500 + 900			0.20 + 200 µV [1]
3.3 V to 32.9999 V	10 Hz to 45 Hz	0.042 + 800	0.050 + 800	100 µV	10 mA	0.15 + 2 mV
	45 Hz to 10 kHz	0.025 + 600	0.030 + 600			0.035 + 2 mV
	10 kHz to 20 kHz	0.064 + 600	0.070 + 600			0.08 + 2 mV
	20 kHz to 50 kHz	0.086 + 600	0.100 + 600			0.2 + 2 mV
	50 kHz to 100 kHz	0.192 + 2000	0.230 + 2000			0.5 + 2 mV
33 V to 329.999 V	45 Hz to 1 kHz	0.039 + 3000	0.050 + 3000	1 mV	5 mA, except 20 mA for 45 Hz to 65 Hz	0.15 + 10 mV
	1 kHz to 10 kHz	0.064 + 9000	0.080 + 9000			0.05 +10 mV
	10 kHz to 20 kHz	0.079 + 9000	0.090 + 9000			0.6 + 10 mV
	20 kHz to 50 kHz	0.096 + 9000	0.120 + 9000			0.8 + 10 mV
	50 kHz to 100 kHz	0.192 + 80000	0.240 + 80000			1.0 + 10 mV
330 V to 1020 V	45 Hz to 1 kHz	0.042 + 20000	0.050 + 20000	10 mV	2 mA, except 6 mA for 45 Hz to 65 Hz	0.15 + 30 mV
	1 kHz to 5 kHz	0.064 + 20000	0.080 + 20000			0.07 + 30 mV
	5 kHz to 10 kHz	0.075 + 20000	0.090 + 20000			0.07 + 30 mV

[1] Max Distortion for 100 kHz to 200 kHz. For 200 kHz to 500 kHz, the maximum distortion is 0.9 % of output + floor as shown.

Note
Remote sensing is not provided. Output resistance is <5 mΩ for outputs .0.33 V. The AUX output resistance is <1 Ω. The maximum load capacitance is 500 pF, subject to the maximum burden current limits.

5502A Multi-Product Calibrator

AC Voltage (Sine Wave) (cont.)

AUX (Auxiliary Output) [dual output mode only]							
Range	Frequency [1]	Absolute Uncertainty, tcal ±5 °C ±(% of output + µV)		Resolution	Max Burden	Max Distortion and Noise 10 Hz to 5 MHz Bandwidth ±(% of output + floor)	
		90 days	1 year				
10 to 329.999 mV	10 Hz to 20 Hz	0.15 + 370	0.20 + 370	1 µV	5 mA	0.20 + 200 µV	[1] There are two channels of voltage output. The maximum frequency of the dual output is 30 kHz. Note Remote sensing is not provided. Output resistance is <5 mΩ for outputs .0.33 V. The AUX output resistance is <1 Ω. The maximum load capacitance is 500 pF, subject to the maximum burden current limits.
	20 Hz to 45 Hz	0.08 + 370	0.10 + 370			0.06 + 200 µV	
	45 Hz to 1 kHz	0.08 + 370	0.10 + 370			0.08 + 200 µV	
	1 kHz to 5 kHz	0.15 + 450	0.20 + 450			0.30 + 200 µV	
	5 kHz to 10 kHz	0.30 + 450	0.40 + 450			0.60 + 200 µV	
	10 kHz to 30 kHz	4.00 + 900	5.00 + 900			1.00 + 200 µV	
0.33 to 3.29999 V	10 Hz to 20 Hz	0.15 + 450	0.20 + 450	10 µV	5 mA	0.20 + 200 µV	
	20 Hz to 45 Hz	0.08 + 450	0.10 + 450			0.06 + 200 µV	
	45 Hz to 1 kHz	0.07 + 450	0.09 + 450			0.08 + 200 µV	
	1 kHz to 5 kHz	0.15 + 1400	0.20 + 1400			0.30 + 200 µV	
	5 kHz to 10 kHz	0.30 + 1400	0.40 + 1400			0.60 + 200 µV	
	10 kHz to 30 kHz	4.00 + 2800	5.00 + 2800			1.00 + 200 µV	
3.3 to 5 V	10 Hz to 20 Hz	0.15 + 450	0.20 + 450	100 µV	5 mA	0.20 + 200 µV	
	20 Hz to 45 Hz	0.08 + 450	0.10 + 450			0.06 + 200 µV	
	45 Hz to 1 kHz	0.07 + 450	0.09 + 450			0.08 + 200 µV	
	1 kHz to 5 kHz	0.15 + 1400	0.20 + 1400			0.30 + 200 µV	
	5 kHz to 10 kHz	0.30 + 1400	0.40 + 1400			0.60 + 200 µV	

AC Current (Sine Wave)

Range	Frequency	Absolute Uncertainty, tcal ±5 °C ±(% of output + µA)		Compliance adder ±(µA/V)	Max Distortion & Noise 10 Hz to 100 kHz BW ±(% of output + floor)	Max Inductive Load µH	
		90 days	1 year				
LCOMP Off							
29 to 329.99 µA	10 to 20 Hz	0.16 + 0.1	0.2 + 0.1	0.05	0.15 + 0.5 µA	200	[1] Duty Cycle: Currents <11 A may be provided continuously. For currents >11 A, see Figure 1. The current may be provided 60-T-I minutes any 60 minute period where T is the temperature in °C (room temperature is about 23 °C) and I is the output current in amps. For example, 17 A, at 23 °C could be provided for 60-17-23 = 20 minutes each hour. When the 5502A is outputting currents between 5 and 11 amps for long periods, the internal self-heating reduces the duty cycle. Under those conditions, the allowable "on" time indicated by the formula and Figure 1 is achieved only after the 5502A is outputting currents <5 A for the "off" period first. [2] For compliance voltages greater than 1 V, add 1 mA/V to the floor specification from 1 to 5 kHz. [3] For compliance voltages greater than 1 V, add 5 mA/V to the floor specification from 5 to 10 kHz.
	20 to 45 Hz	0.12 + 0.1	0.15 + 0.1	0.05	0.10 + 0.5 µA		
	45 Hz to 1 kHz	0.1 + 0.1	0.125 + 0.1	0.05	0.05 + 0.5 µA		
	1 to 5 kHz	0.25 + 0.15	0.3 + 0.15	1.5	0.50 + 0.5 µA		
	5 to 10 kHz	0.6 + 0.2	0.8 + 0.2	1.5	1.00 + 0.5 µA		
	10 to 30 kHz	1.2 + 0.4	1.6 + 0.4	10	1.20 + 0.5 µA		
0.33 to 3.29999 mA	10 to 20 Hz	0.16 + 0.15	0.2 + 0.15	0.05	0.15 + 1.5 µA	200	
	20 to 45 Hz	0.1 + 0.15	0.125 + 0.15	0.05	0.06 + 1.5 µA		
	45 Hz to 1 kHz	0.08 + 0.15	0.1 + 0.15	0.05	0.02 + 1.5 µA		
	1 to 5 kHz	0.16 + 0.2	0.2 + 0.2	1.5	0.50 + 1.5 µA		
	5 to 10 kHz	0.4 + 0.3	0.5 + 0.3	1.5	1.00 + 1.5 µA		
	10 to 30 kHz	0.8 + 0.6	1.0 + 0.6	10	1.20 + 0.5 µA		
3.3 to 32.9999 mA	10 to 20 Hz	0.15 + 2	0.18 + 2	0.05	0.15 + 5 µA	50	
	20 to 45 Hz	0.075 + 2	0.09 + 2	0.05	0.05 + 5 µA		
	45 Hz to 1 kHz	0.035 + 2	0.04 + 2	0.05	0.07 + 5 µA		
	1 to 5 kHz	0.065 + 2	0.08 + 2	1.5	0.30 + 5 µA		
	5 to 10 kHz	0.16 + 3	0.2 + 3	1.5	0.70 + 5 µA		
	10 to 30 kHz	0.32 + 4	0.4 + 4	10	1.00 + 0.5 µA		
33 to 329.999 mA	10 to 20 Hz	0.15 + 20	0.18 + 20	0.05	0.15 + 50 µA	50	
	20 to 45 Hz	0.075 + 20	0.09 + 20	0.05	0.05 + 50 µA		
	45 Hz to 1 kHz	0.035 + 20	0.04 + 20	0.05	0.02 + 50 µA		
	1 to 5 kHz	0.08 + 50	0.10 + 50	1.5	0.03 + 50 µA		
	5 to 10 kHz	0.16 + 100	0.2 + 100	1.5	0.10 + 50 µA		
	10 to 30 kHz	0.32 + 200	0.4 + 200	10	0.60 + 50 µA		
0.33 to 1.09999 A	10 to 45 Hz	0.15 + 100	0.18 + 100		0.20 + 500 µA	2.5	
	45 Hz to 1 kHz	0.036 + 100	0.05 + 100		0.07 + 500 µA		
	1 to 5 kHz	0.5 + 1000	0.6 + 1000	[2]	1.00 + 500 µA		
	5 to 10 kHz	2.0 + 5000	2.5 + 5000	[3]	2.00 + 500 µA		
1.1 to 2.99999 A	10 to 45 Hz	0.15 + 100	0.18 + 100		0.20 + 500 µA	2.5	
	45 Hz to 1 kHz	0.05 + 100	0.06 + 100		0.07 + 500 µA		
	1 to 5 kHz	0.5 + 1000	0.6 + 1000	[2]	1.00 + 500 µA		
	5 to 10 kHz	2.0 + 5000	2.5 + 5000	[3]	2.00 + 500 µA		
3 to 10.9999 A	45 to 100 Hz	0.05 + 2000	0.06 + 2000		0.2 + 3 mA	1	
	1100 Hz to 1 kHz	0.08 + 2000	0.10 + 2000		0.1 + 3 mA		
	1 kHz to 5 kHz	2.5 + 2000	3.0 + 2000		0.8 + 3 mA		
11 to 20.5 A [1]	45 to 100 Hz	0.1 + 5000	0.12 + 5000		0.2 + 3 mA	1	
	1100 Hz to 1 kHz	0.13 + 5000	0.15 + 5000		0.1 + 3 mA		
	1 to 5 kHz	2.5 + 5000	3.0 + 5000		0.8 + 3 mA		

AC Current (Sine Wave) (cont.)

Range	Frequency	Absolute Uncertainty, tcal ±5 °C ±(% of output + µA)		Max Distortion & Noise 10 Hz to 100 kHz BW ±(% of output + floor)	Max Inductive Load
		90 days	1 year		
LCOMP On					
29 to 329.99 µA	10 to 100 Hz	0.20 + 0.2	0.25 + 0.2	0.1 + 1.0 µA	400 µH
	100 Hz to 1 kHz	0.50 + 0.5	0.60 + 0.5	0.05 + 1.0 µA	
330 µA to 3.29999 mA	10 to 100 Hz	0.20 + 0.3	0.25 + 0.3	0.15 + 1.5 µA	
	100 Hz to 1 kHz	0.50 + 0.8	0.60 + 0.8	0.06 + 1.5 µA	
3.3 to 32.9999 mA	10 to 100 Hz	0.07 + 4	0.08 + 4	0.15 + 5 µA	
	100 Hz to 1 kHz	0.18 + 10	0.20 + 10	0.05 + 5 µA	
33 to 329.999 mA	10 to 100 Hz	0.07 + 40	0.08 + 40	0.15 + 50 µA	
	100 Hz to 1 kHz	0.18 + 100	0.20 + 100	0.05 + 50 µA	
330 mA to 2.99999 A	10 to 100 Hz	0.10 + 200	0.12 + 200	0.2 + 500 µA	
	100 to 440 Hz	0.25 + 1000	0.30 + 1000	0.25 + 500 µA	
3.3 A to 20.5 A [1]	45 to 100 Hz	0.10 + 2000 [2]	0.12 + 2000 [2]	0.1 + 0 µA	400 µH [4]
	100 to 440 Hz	0.80 + 5000 [3]	1.00 + 5000 [3]	0.5 + 0 µA	

[1] Duty Cycle: Currents <11 A may be provided continuously. For currents >11 A, see Figure 1. The current may be provided 60-T-I minutes any 60 minute period where T is the temperature in °C (room temperature is about 23 °C) and I is the output current in amps. For example, 17 A, at 23 °C could be provided for 60-17-23 = 20 minutes each hour. When the 5502A is outputting currents between 5 and 11 amps for long periods, the internal self-heating reduces the duty cycle. Under those conditions, the allowable "on" time indicated by the formula and Figure 1 is achieved only after the 5502A is outputting currents <5 A for the "off" period first.
[2] For currents >11 A, Floor specification is 4000 µA within 30 seconds of selecting operate. For operating times >30 seconds, the floor specification is 2000 µA.
[3] For currents >11 A, Floor specification is 10000 µA within 30 seconds of selecting operate. For operating times >30 seconds, the floor specification is 5000 µA.
[4] Subject to compliance voltages limits.

Range	Resolution µA	Max Compliance Voltage V rms [1]
29 to 329.99 µA	0.01	7
0.33 to 3.29999 mA	0.01	7
3.3 to 32.9999 mA	0.1	5
33 to 329.999 mA	1	5
0.33 to 2.99999 A	10	4
3 to 20.5 A	100	3

[1] Subject to specification adder for compliance voltages greater than 1 V rms.

Capacitance

Range	Absolute Uncertainty, tcal ±5 °C ±(% of output + floor) [1] [2] [3]		Resolution	Allowed Frequency or Charge-Discharge Rate		
	90 days	1 year		Min and Max to Meet Specification	Typical Max for <0.5 % Error	Typical Max for <1 % Error
220.0 to 399.9 pF	0.38 + 0.01 nF	0.5 + 0.01 nF	0.1 pF	10 Hz to 10 kHz	20 kHz	40 kHz
0.4 to 1.0999 nF	0.38 + 0.01 nF	0.5 + 0.01 nF	0.1 pF	10 Hz to 10 kHz	30 kHz	50 kHz
1.1 to 3.2999 nF	0.38 + 0.01 nF	0.5 + 0.01 nF	0.1 pF	10 Hz to 3 kHz	30 kHz	50 kHz
3.3 to 10.999 nF	0.19 + 0.01 nF	0.25 + 0.01 nF	1 pF	10 Hz to 1 kHz	20 kHz	25 kHz
11 to 32.999 nF	0.19 + 0.1 nF	0.25 + 0.1 nF	1 pF	10 Hz to 1 kHz	8 kHz	10 kHz
33 to 109.99 nF	0.19 + 0.1 nF	0.25 + 0.1 nF	10 pF	10 Hz to 1 kHz	4 kHz	6 kHz
110 to 329.99 nF	0.19 + 0.3 nF	0.25 + 0.3 nF	10 pF	10 Hz to 1 kHz	2.5 kHz	3.5 kHz
0.33 to 1.0999 µF	0.19 + 1 nF	0.25 + 1 nF	100 pF	10 to 600 Hz	1.5 kHz	2 kHz
1.1 to 3.2999 µF	0.19 + 3 nF	0.25 + 3 nF	100 pF	10 to 300 Hz	800 Hz	1 kHz
3.3 to 10.999 µF	0.19 + 10 nF	0.25 + 10 nF	1 nF	10 to 150 Hz	450 Hz	650 Hz
11 to 32.999 µF	0.30 + 30 nF	0.40 + 30 nF	1 nF	10 to 120 Hz	250 Hz	350 Hz
33 to 109.99 µF	0.34 + 100 nF	0.45 + 100 nF	10 nF	10 to 80 Hz	150 Hz	200 Hz
110 to 329.99 µF	0.34 + 300 nF	0.45 + 300 nF	10 nF	0 to 50 Hz	80 Hz	120 Hz
0.33 to 1.0999 mF	0.34 + 1 µF	0.45 + 1 µF	100 nF	0 to 20 Hz	45 Hz	65 Hz
1.1 to 3.2999 mF	0.34 + 3 µF	0.45 + 3 µF	100 nF	0 to 6 Hz	30 Hz	40 Hz
3.3 to 10.999 mF	0.34 + 10 µF	0.45 + 10 µF	1 µF	0 to 2 Hz	15 Hz	20 Hz
11 to 32.999 mF	0.7 + 30 µF	0.75 + 30 µF	1 µF	0 to 0.6 Hz	7.5 Hz	10 Hz
33 to 110.00 mF	1.0 + 100 µF	1.1 + 100 µF	10 µF	0 to 0.2 Hz	3 Hz	5 Hz

[1] The output is continuously variable from 220 pF to 110 mF.
[2] Specifications apply to both dc charge/discharge capacitance meters and ac RCL meters. The maximum allowable peak voltage is 3 V. The maximum allowable peak current is 150 mA, with an rms limitation of 30 mA below 1.1 µF and 100 mA for 1.1 µF and above.
[3] The maximum lead resistance for no additional error in 2-wire COMP mode is 10 Ω.

5502A Multi-Product Calibrator

FLUKE ® Calibration

Temperature Calibration (Thermocouple)

TC Typo [1]	Range °C [2]	Absolute Uncertainty Source/Measure tcal ±5 °C ± °C [3]	
		90 days	1 year
B	600 to 800	0.42	0.44
	800 to 1000	0.34	0.34
	1000 to 1550	0.30	0.30
	1550 to 1820	0.26	0.33
C	0 to 150	0.23	0.30
	150 to 650	0.19	0.26
	650 to 1000	0.23	0.31
	1000 to 1800	0.38	0.50
	1800 to 2316	0.63	0.84
E	-250 to -100	0.38	0.50
	-100 to -25	0.12	0.16
	-25 to 350	0.10	0.14
	350 to 650	0.12	0.16
	650 to 1000	0.16	0.21
J	-210 to -100	0.20	0.27
	-100 to -30	0.12	0.16
	-30 to 150	0.10	0.14
	150 to 760	0.13	0.17
	760 to 1200	0.18	0.23
K	-200 to -100	0.25	0.33
	-100 to -25	0.14	0.18
	-25 to 120	0.12	0.16
	120 to 1000	0.19	0.26
	1000 to 1372	0.30	0.40
L	-200 to -100	0.37	0.37
	-100 to 800	0.26	0.26
	800 to 900	0.17	0.17
N	-200 to -100	0.30	0.40
	-100 to -25	0.17	0.22
	-25 to 120	0.15	0.19
	120 to 410	0.14	0.18
	410 to 1300	0.21	0.27
R	0 to 250	0.48	0.57
	250 to 400	0.28	0.35
	400 to 1000	0.26	0.33
	1000 to 1767	0.30	0.40
S	0 to 250	0.47	0.47
	250 to 1000	0.30	0.36
	1000 to 1400	0.28	0.37
	1400 to 1767	0.34	0.46
T	-250 to -150	0.48	0.63
	-150 to 0	0.18	0.24
	0 to 120	0.12	0.16
	120 to 400	0.10	0.14
U	U -200 to 0	0.56	0.56
	0 to 600	0.27	0.27

[1] Temperature standard ITS-90 or IPTS-68 is selectable.
TC simulating and measuring are not specified for operation in electromagnetic fields above 0.4 V/m.
[2] Resolution is 0.01 °C
[3] Does not include thermocouple error

Temperature Calibration (RTD)

RTD Type	Range °C [1]	Absolute Uncertainty tcal ±5 °C ± °C [2]	
		90 days	1 year
Pt 385, 100 Ω	-200 to -80	0.04	0.05
	-80 to 0	0.05	0.05
	0 to 100	0.07	0.07
	100 to 300	0.08	0.09
	300 to 400	0.09	0.10
	400 to 630	0.10	0.12
	630 to 800	0.21	0.23
Pt 3926, 100 Ω	-200 to -80	0.04	0.05
	-80 to 0	0.05	0.05
	0 to 100	0.07	0.07
	100 to 300	0.08	0.09
	300 to 400	0.09	0.10
	400 to 630	0.10	0.12
Pt 3916, 100 Ω	-200 to -190	0.25	0.25
	-190 to -80	0.04	0.04
	-80 to 0	0.05	0.05
	0 to 100	0.06	0.06
	100 to 260	0.06	0.07
	260 to 300	0.07	0.08
	300 to 400	0.08	0.09
	400 to 600	0.08	0.10
	600 to 630	0.21	0.23
Pt 385, 200 Ω	-200 to -80	0.03	0.04
	-80 to 0	0.03	0.04
	0 to 100	0.04	0.04
	100 to 260	0.04	0.05
	260 to 300	0.11	0.12
	300 to 400	0.12	0.13
	400 to 600	0.12	0.14
	600 to 630	0.14	0.16
Pt 385, 500 Ω	-200 to -80	0.03	0.04
	-80 to 0	0.04	0.05
	0 to 100	0.05	0.05
	100 to 260	0.06	0.06
	260 to 300	0.07	0.08
	300 to 400	0.07	0.08
	400 to 600	0.08	0.09
	600 to 630	0.09	0.11
Pt 385, 1000 Ω	-200 to -80	0.03	0.03
	-80 to 0	0.03	0.03
	0 to 100	0.03	0.04
	100 to 260	0.04	0.05
	260 to 300	0.05	0.06
	300 to 400	0.05	0.07
	400 to 600	0.06	0.07
	600 to 630	0.22	0.23
PtNi 385, 120 Ω (Ni120)	-80 to 0	0.06	0.08
	0 to 100	0.07	0.08
	100 to 260	0.13	0.14
Cu 427 10 Ω [3]	-100 to 260	0.3	0.3

[1] Resolution is 0.003 °C
[2] Applies for COMP OFF (to the 5502A Calibrator front panel NORMAL terminals) and 2-wire and 4-wire compensation.
[3] Based on MINCO Application Aid No. 18

Phase

1-Year Absolute Uncertainty, tcal ±5 °C, (ΔΦ°)						Note
10 to 65 Hz	65 to 500 Hz	500 Hz to 1 kHz	1 to 5 kHz	5 to 10 kHz	10 to 30 kHz	See Power and Dual Output Limit Specifications for applicable outputs.
0.15 °	0.9 °	2 °	6 °	10 °	15 °	

Power and Dual Output Limit Specifications

Phase (Φ) Watts	Phase (Φ) VARs	PF	Power Uncertainty Adder due to Phase Error					
			10 to 65 Hz	65 to 500 Hz	500 Hz to 1 kHz	1 to 5 kHz	5 to 10 kHz	10 to 30 kHz
0 °C	90 °C	1.0	0.00 %	0.01 %	0.06 %	0.55 %	1.52 %	3.41 %
5 °C	85 °C	0.996	0.02 %	0.15 %	0.37 %	1.46 %	3.04 %	5.67 %
10 °C	80 °C	0.985	0.05 %	0.29 %	0.68 %	2.39 %	4.58 %	7.97 %
15 °C	75 °C	0.966	0.07 %	0.43 %	1.00 %	3.35 %	6.17 %	10.34 %
20 °C	70 °C	0.940	0.10 %	0.58 %	1.33 %	4.35 %	7.84 %	12.83 %
25 °C	65 °C	0.906	0.12 %	0.74 %	1.69 %	5.42 %	9.62 %	15.48 %
30 °C	60 °C	0.866	0.15 %	0.92 %	2.08 %	6.58 %	11.54 %	18.35 %
35 °C	55 °C	0.819	0.18 %	1.11 %	2.50 %	7.87 %	13.68 %	21.53 %
40 °C	50 °C	0.766	0.22 %	1.33 %	2.99 %	9.32 %	16.09 %	25.12 %
45 °C	45 °C	0.707	0.26 %	1.58 %	3.55 %	11.00 %	18.88 %	29.29 %
50 °C	40 °C	0.643	0.31 %	1.88 %	4.22 %	13.01 %	22.21 %	34.25 %
55 °C	35 °C	0.574	0.37 %	2.26 %	5.05 %	15.48 %	26.32 %	40.37 %
60 °C	30 °C	0.500	0.45 %	2.73 %	6.11 %	18.65 %	31.60 %	48.24 %
65 °C	25 °C	0.423	0.56 %	3.38 %	7.55 %	22.96 %	38.76 %	58.91 %
70 °C	20 °C	0.342	0.72 %	4.33 %	9.65 %	29.27 %	49.23 %	74.52 %
75 °C	15 °C	0.259	0.98 %	5.87 %	13.09 %	39.56 %	66.33 %	100.00 %
80 °C	10 °C	0.174	1.49 %	8.92 %	19.85 %	59.83 %	100.00 %	-
85 °C	5 °C	0.087	2.99 %	17.97 %	39.95 %	-	-	-
90 °C	0 °C	0.000	-	-	-	-	-	-

To calculate exact ac watts power adders due to phase uncertainty for values not shown, use the subsequent formula:

$$\text{Adder}(\%)=100\left(1-\frac{\cos(\Phi+\Delta\Phi)}{\cos(\Phi)}\right)$$

For example: For a PF of .9205 (Φ = 23) and a phase uncertainty of $\Delta\Phi$ = 0.15, the ac watts power adder is:

$$\text{Adder}(\%)=100\left(1-\frac{\cos(23+.15)}{\cos(23)}\right)=0.11\%$$

AC and DC Power Specifications

Power is simulated through the controlled simultaneous outputs of voltage and current from the Calibrator. While the amplitude and frequency ranges of the outputs are broad, there are certain combinations of voltage and current where the specifications are valid. In general these are for all dc voltages and currents, and AC voltages of 30 mV to 1020 V, ac currents from 33 mA to 20.5 A, for frequencies from 10 Hz to 30 kHz. Operation outside of these areas, within the overall calibrator capabilities, is possible, but it is not specified. The table and figure below illustrate the specified areas where power and dual output are possible.

Specification Limits for Power and Dual Output Operation

Frequency	Voltages (NORMAL)	Currents	Voltages (AUX)	Power Factor (PF)
dc	0 to ±1020 V	0 to ±20.5 A	0 to ±7 V	-
10 to 45 Hz	33 mV to 32.9999 V	3.3 mA to 2.99999 A	10 mV to 5 V	0 to 1
45 to 65 Hz	33 mV to 1020 V	3.3 mA to 20.5 A	10 mV to 5 V	0 to 1
65 to 500 Hz	330 mV to 1020 V	33 mA to 2.99999 A	100 mV to 5 V	0 to 1
65 to 500 Hz	3.3 to 1020 V	33 mA to 20.5 A	100 mV to 5 V	0 to 1
500 Hz to 1 kHz	330 mV to 1020 V	33 mA to 20.5 A	100 mV to 5 V	0 to 1
1 to 5 kHz	3.3 to 500 V	33 mA to 2.99999 A	100 mV to 5 V	0 to 1
5 to 10 kHz	3.3 to 250 V	33 to 329.99 mA	1 to 5 V	0 to 1
10 to 30 kHz	3.3 V to 250 V	33 mA to 329.99 mA	1 V to 3.29999 V	0 to 1

Notes
The range of voltages and currents shown in "DC Voltage Specifications," "DC Current Specifications," "AC Voltage (Sine Wave) Specifications," and "AC Current (Sine Wave) Specifications" are available in the power and dual output modes (except minimum current for ac power is 0.33 mA). Only those limits shown in this table and illustrated in the following figure are specified.
See "Calculate Power Uncertainty" to determine the uncertainty at these points.
The phase adjustment range for dual ac outputs is 0° to ±179.99°. The phase resolution for dual ac outputs is 0.01°.

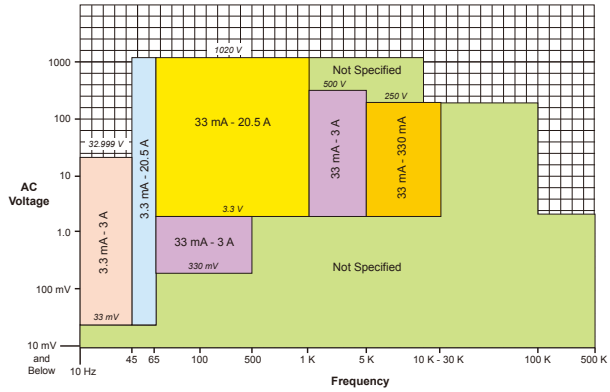


Figure 2. Permissible Combinations of AC Voltage and AC Current for Power and Dual Output

5502A Multi-Product Calibrator

Calculate the Uncertainty Specifications of Power and Dual Output Settings alculate the Uncertainty Specifications of Power and Dual Output Settings

Overall uncertainty for power output in watts (or VARs) is based on the root sum square (rss) of the individual
uncertainties in percent for the selected voltage, current, and, if AC power, the phase parameters:

Watts uncertainty

$$U_{power} = \sqrt{U^2_{voltage} + U^2_{current} + U^2_{Phase}}$$

VARs uncertainty

$$U_{VARs} = \sqrt{U^2_{voltage} + U^2_{current} + U^2_{Phase}}$$

Dual Output uncertainty

$$U_{Dual} = \sqrt{U^2_{voltage} + U^2_{AuxVoltage} + U^2_{VARsadder}}$$

Because there are an infinite number of combinations, you must calculate the actual ac power uncertainty for your selected parameters. The results of this method of calculation are shown in the subsequent example. These examples are at various selected calibrator settings (with 1-year specifications):

Calculate Power Uncertainty

Overall uncertainty for power output in watts (or VARs) is based on the root sum square (RSS) of the individual uncertainties in percent for the selected voltage, current, and phase parameters:

Watts uncertainty

$$U_{power} = \sqrt{U^2_{voltage} + U^2_{current} + U^2_{Phase}}$$

VARs uncertainty

$$U_{VARs} = \sqrt{U^2_{voltage} + U^2_{current} + U^2_{Phase}}$$

Because there are an infinite number of combinations, you must calculate the actual ac power uncertainty for your selected parameters. The method of calculation is best shown in the subsequent examples (with 1-year specifications):

Example 1

Output: 100 V, 1 A, 60 Hz, Power Factor = 1.0 (Φ=0).
Voltage Uncertainty Uncertainty for 100 V at 60 Hz is 0.050 % + 3 mV, totaling: 100 V x .0.0005 = 50 mV added to 3 mV = 53 mV. Expressed in percent: 53 mV/100 V x 100 = 0.053 % (see “AC Voltage (Sine Wave) Specifications”).
Current Uncertainty Uncertainty for 1 A at 60 Hz is 0.05 % +100 .A, totaling: 1 A x 0.0005 = 500 .A added to 100 .A = 0.6 mA. Expressed in percent: 0. 6 mA/1 A x 100 = 0.06 % (see “AC Current (Sine Waves) Specifications”).
Phase Uncertainty (Watts) Adder for PF = 1 (Φ=0) at 60 Hz is 0 % (see “Phase Specifications”).

Total Power Uncertainty =

$$U_{power} = \sqrt{0.053^2 + 0.06^2 + 0^2} = 0.080\%$$

Example 2

Output: 100 V, 1 A, 400 Hz, Power Factor = 0.5 (Φ=60)
Voltage Uncertainty Uncertainty for 100 V at 400 Hz is 0.050% + 3 mV, totaling: 100 V x .0.0005 = 50 mV added to 3 mV = 53 mV. Expressed in percent: 53 mV/100 V x 100 = 0.053 % (see “AC Voltage (Sine Wave) Specifications”).
Current Uncertainty Uncertainty for 1 A at 400 Hz is 0.05 % +100 .A, totaling: 1 A x 0.0005 = 500 .A added to 100 .A = 0.6 mA. Expressed in percent: 0. 6 mA/1 A x 100 = 0.06 % (see “AC Current (Sine Waves) Specifications”).
Phase Uncertainty (Watts) Adder for PF = 0.5 (Φ=60) at 400 Hz is 2.73 % (see “Phase Specifications”).

Total Power Uncertainty =

$$U_{power} = \sqrt{0.053^2 + 0.06^2 + 2.73^2} = 2.73\%$$

VARs When the Power Factor approaches 0.0, the Watts output uncertainty becomes unrealistic because the dominant characteristic is the VARs (volts-amps-reactive) output. In these cases, calculate the Total VARs Output Uncertainty, as shown in example 3:

Example 3

Output: 100 V, 1 A, 60 Hz, Power Factor = 0.174 (Φ=80)
Voltage Uncertainty Uncertainty for 100 V at 60 Hz is 0.050% + 3 mV, totaling: 100 V x .0.0005 = 50 mV added to 3 mV = 53 mV. Expressed in percent: 53 mV/100 V x 100 = 0.053 % (see “AC Voltage (Sine Wave) Specifications”).
Current Uncertainty Uncertainty for 1 A at 60 Hz is 0.05 % +100 µA, totaling: 1 A x 0.0005 = 500 µA added to 100 .A = 0.6 mA. Expressed in percent: 0. 6 mA/1 A x 100 = 0.06 % (see “AC Current (Sine Waves) Specifications”).
Phase Uncertainty (VARs) Adder for Φ=80 at 60 Hz is 0.05 % (see “Phase Specifications”).

Total VARS Uncertainty =

$$U_{UVARs} = \sqrt{0.053^2 + 0.06^2 + 0.05^2} = 0.094\%$$

Examples of Specified Power Uncertainties at Various Output Settings:

Selected Output Settings						Absolute Uncertainty as specified for tcal ±5 °C, ±(% of output setting)			Power Absolute Uncerainty ±(% of Watts)[1]
Voltage Setting (Volts)	Current Setting (Amps)	Frequency Hz	Phase Setting(units of PF)	Phase Setting (Degrees)	Selected Power (Watts)	$U_{Voltage}$	$U_{Current}$	U_{Phase}	U_{Power}
+10.000	+0.500.000	DC			5	0.00550 %	0.04680 %		0.047 %
15.000	+2.0000	DC			30	0.00533 %	0.03220 %		0.033 %
100.000	+20.000	DC			2000	0.00600 %	0.10375 %		0.104 %
1000.00	20.000	DC			20000	0.00565 %	0.10375 %		0.104 %
120.000	1.00000	60	1	0.0	120	0.05250 %	0.06000 %	0.000 %	0.080 %
120.000	1.00000	60	0.766	40.0	91.92	0.05250 %	0.06000 %	0.220 %	0.234 %
240.000	1.00000	50	1	0.0	240	0.05125 %	0.06000 %	0.000 %	0.079 %
240.000	1.00000	50	0.766	40.0	183.84	0.05125 %	0.06000 %	0.220 %	0.234 %
1000.00	20	55	1	0.0	20000	0.05200 %	0.14500 %	0.000 %	0.154 %
1000.00	20	55	0.766	40.0	15320	0.05200 %	0.14500 %	0.220 %	0.269 %
1000.00	20	55	-0.906	-25.0	18120	0.05200 %	0.14500 %	0.122 %	0.196 %
100	0.30	30000	1	0.0	30.0	0.12900 %	0.4667 %	3.407 %	3.442 %
100	0.30	30000	0.766	40.0	22.98	0.12900 %	0.4667 %	25.128 %	25.133 %

[1] Add 0.02 % unless a settling time of 30 seconds is allowed for output currents >10 A or for currents on the highest two current ranges within 30 seconds of an output current >10 A.

Additional Specifications

The subsequent paragraphs provide additional specifications for the 5502A Calibrator ac voltage and ac current functions. These specifications are valid after allowing a warm-up period of 30 minutes, or twice the time the 5502A has been turned off. All extended range specifications are based on performing the internal zero-cal function at weekly intervals, or when the ambient temperature changes by more than 5 °C.

Frequency

Frequency Range	Resolution	1-Year Absolute Uncertainty, tcal ±5 °C ±(ppm + mHz)	Jitter
0.01 to 119.99 Hz	0.01 Hz	25 + 1	2 µs
120.0 to 1199.9 Hz	0.1 Hz	25 + 1	2 µs
1.2 to 11.999 kHz	1 Hz	25 + 1	2 µs
12 to 119.99 kHz	10 Hz	25 + 15	140 ns
120.0 to 1199.9 kHz	100 Hz	25 + 15	140 ns
1.2 to 2.000 MHz	1 kHz	25 + 15	140 ns

Harmonics (2nd to 50th)

Fundamental Frequency [1]	Voltages NORMAL Terminals	Currents	Voltages AUX Terminals	Amplitude Uncertainty
10 to 45 Hz	33 mV to 32.9999 V	3.3 mA to 2.99999 A	10 mV to 5 V	Same % of output as the equivalent single output, but twice the floor adder.
45 to 65 Hz	33 mV to 1020 V	3.3 mA to 20.5 A	10 mV to 5 V	
65 to 500 Hz	33 mV to 1020 V	33 mA to 20.5 A	100 mV to 5 V	
500 Hz to 5 kHz	330 mV to 1020 V	33 mA to 20.5 A	100 mV to 5 V	
5 to 10 kHz	3.3 to 1020 V	33 to 329.9999 mA	100 mV to 5 V	
10 to 30 kHz	3.3 to 1020 V	33 to 329.9999 mA	100 mV to 3.29999 V	

[1] The maximum frequency of the harmonic output is 30 kHz (10 kHz for 3.3 to 5 V on the Aux terminals). For example, if the fundamental output is 5 kHz, the maximum selection is the 6th harmonic (30 kHz). All harmonic frequencies (2nd to 50th) are available for fundamental outputs between 10 Hz and 600 Hz (200 Hz for 3.3 to 5 V on the Aux terminals).

Phase Uncertainty ..... Phase uncertainty for harmonic outputs is 1 degree or the phase uncertainty shown in "Phase Specifications" for the particular output, whichever is greater. For example, the phase uncertainty of a 400 Hz fundamental output and 10 kHz harmonic output is 10 ° (from "Phase Specifications"). Another example, the phase uncertainty of a 50 Hz fundamental output and a 400 Hz harmonic output is 1 degree.

Example of determining Amplitude Uncertainty in a Dual Output Harmonic Mode What are the amplitude uncertainties for the following dual outputs?
NORMAL (Fundamental) Output:
100 V, 100 Hz ..... From "AC Voltage (Sine Wave) 90 Day Specifications" the single output specification for 100 V, 100 Hz, is 0.039 % + 3 mV. For the dual output in this example, the specification is 0.039 % + 6 mV as the 0.039 % is the same, and the floor is twice the value (2 x 3 mV).
AUX (50th Harmonic) Output:
100 mV, 5 kHz ..... From "AC Voltage (Sine Wave) 90 Day Specifications" the auxiliary output specification for 100 mV, 5 kHz, is 0.15 % + 450 .V. For the dual output in this example, the specification is 0.15 % + 900 .V as the 0.15 % is the same, and the floor is twice the value (2 x 450 µV).

AC Voltage (Sine Wave) Extended Bandwidth

Range	Frequency	1-Year Absolute Uncertainty tcal ±5 °C	Max Voltage Resolution
Normal Channel (Single Output Mode)			
1.0 to 33 mV	0.01 to 9.99 Hz	±(5.0 % of output +0.5 % of range)	Two digits, e.g., 25 mV
34 to 330 mV			Three digits
0.4 to 33 V			Two digits
0.3 to 3.3 V	500.1 kHz to 1 MHz	-10 dB at 1 MHz, typical	Two digits
	1.001 to 2 MHz	-31 dB at 2 MHz, typical	
Auxiliary Output (Dual Output Mode)			
10 to 330 mV	0.01 to 9.99 Hz	±(5.0 % of output +0.5 % of range)	Three digits
0.4 to 5 V			Two digits

5502A Multi-Product Calibrator

AC Voltage (Non-Sine Wave)

Triangle Wave & Truncated Sine Range, p-p [1]	Frequency	1-Year Absolute Uncertainty, tcal ±5 °C, ±(% of output + % of range) [2]	Max Voltage Resolution
Normal Channel (Single Output Mode)			
2.9 to 92.999 mV	0.01 to 10 Hz	5.0 + 0.5	Two digits on each range
	10 to 45 Hz	0.25 + 0.5	Six digits on each range
	45 Hz to 1 kHz	0.25 + 0.25	
	1 to 20 kHz	0.5 + 0.25	
	20 to 100 kHz [3]	5.0 + 0.5	
93 to 929.999 mV	0.01 to 10 Hz	5.0 + 0.5	Two digits on each range
	10 to 45 Hz	0.25 + 0.5	Six digits on each range
	45 Hz to 1 kHz	0.25 + 0.25	
	1 to 20 kHz	0.5 + 0.25	
	20 to 100 kHz [3]	5.0 + 0.5	
0.93 to 9.29999 V	0.01 to 10 Hz	5.0 + 0.5	Two digits on each range
	10 to 45 Hz	0.25 + 0.5	Six digits on each range
	45 Hz to 1 kHz	0.25 + 0.25	
	1 to 20 kHz	0.5 + 0.25	
	20 to 100 kHz [3]	5.0 + 0.5	
9.3 to 93 V	0.01 to 10 Hz	5.0 + 0.5	Two digits on each range
	10 to 45 Hz	0.25 + 0.5	Six digits on each range
	45 Hz to 1 kHz	0.25 + 0.25	
	1 to 20 kHz	0.5 + 0.25	
	20 to 100 kHz [3]	5.0 + 0.5	
Auxiliary Output (Dual Output Mode)			
29 to 929.999 mV	0.01 to 10 Hz	5.0 + 0.5	Two digits on each range
	10 to 45 Hz	0.25 + 0.5	Six digits on each range
	45 Hz to 1 kHz	0.25 + 0.25	
	1 to 10 kHz	5.0 + 0.5	
0.93 to 9.29999 V	0.01 to 10 Hz	5.0 + 0.5	Two digits on each range
	10 to 45 Hz	0.25 + 0.5	Six digits on each range
	45 Hz to 1 kHz	0.25 + 0.25	
	1 to 10 kHz	5.0 + 0.5	
9.3 to 14.0000 V	0.01 to 10 Hz	5.0 + 0.5	Two digits on each range
	10 to 45 Hz	0.25 + 0.5	Six digits on each range
	45 Hz to 1 kHz	0.25 + 0.25	
	1 to 10 kHz	5.0 + 0.5	

[1] To convert p-p to rms for triangle wave, multiply the p-p value by 0.2886751. To convert p-p to rms for truncated sine wave, multiply the p-p value by 0.2165063.
[2] Uncertainty is stated in p-p. Amplitude is verified using an rms-responding DMM.
[3] Uncertainty for Truncated Sine outputs is typical over this frequency band.

AC Voltage (Non-Sine Wave) (cont.)

Triangle Wave & Truncated Sine Range, p-p [1]	Frequency	1-Year Absolute Uncertainty, tcal ±5 °C, ±(% of output + % of range) [2]	Max Voltage Resolution
Normal Channel (Single Output Mode)			
2.9 to 65.999 mV	0.01 to 10 Hz	5.0 + 0.5	Two digits on each range
	10 to 45 Hz	0.25 + 0.5	Six digits on each range
	45 Hz to 1 kHz	0.25 + 0.25	
	1 to 20 kHz	0.5 + 0.25	
	20 to 100 kHz	5.0 + 0.5	
66 to 659.999 mV	0.01 to 10 Hz	5.0 + 0.5	Two digits on each range
	10 to 45 Hz	0.25 + 0.5	Six digits on each range
	45 Hz to 1 kHz	0.25 + 0.25	
	1 to 20 kHz	0.5 + 0.25	
	20 to 100 kHz	5.0 + 0.5	
0.66 to 6.59999 V	0.01 to 10 Hz	5.0 + 0.5	Two digits on each range
	10 to 45 Hz	0.25 + 0.5	Six digits on each range
	45 Hz to 1 kHz	0.25 + 0.25	
	1 to 20 kHz	0.5 + 0.25	
	20 to 100 kHz	5.0 + 0.5	
6.6 to 66.0000 V	0.01 to 10 Hz	5.0 + 0.5	Two digits on each range
	10 to 45 Hz	0.25 + 0.5	Six digits on each range
	45 Hz to 1 kHz	0.25 + 0.25	
	1 to 20 kHz	0.5 + 0.25	
	20 to 100 kHz	5.0 + 0.5	
Auxiliary Output (Dual Output Mode)			
29 to 659.999 mV	0.01 to 10 Hz	5.0 + 0.5	Two digits on each range
	10 to 45 Hz	0.25 + 0.5	Six digits on each range
	45 Hz to 1 kHz	0.25 + 0.25	
	1 to 10 kHz [3]	5.0 + 0.5	
0.66 to 6.59999 V	0.01 to 10 Hz	5.0 + 0.5	Two digits on each range
	10 to 45 Hz	0.25 + 0.5	Six digits on each range
	45 Hz to 1 kHz	0.25 + 0.25	
	1 to 10 kHz [3]	5.0 + 0.5	
6.6 to 14.0000 V	0.01 to 10 Hz	5.0 + 0.5	Two digits on each range
	10 to 45 Hz	0.25 + 0.5	Six digits on each range
	45 Hz to 1 kHz	0.25 + 0.25	
	1 to 10 kHz [3]	5.0 + 0.5	

[1] To convert p-p to rms for square wave, multiply the p-p value by 0.5.
[2] Uncertainty is stated in p-p. Amplitude is verified using an rms-responding DMM.
[3] Limited to 1 kHz for Auxiliary outputs ≥ 6.6 V p-p.

AC Voltage, DC Offset

Range [1] (Normal Channel)	Offset Range [2]	Max Peak Signal	1-Year Absolute Uncertainty, tcal ±5 °C [3] ±(% of dc output + floor)
Sine Waves (rms)			
3.3 to 32.999 mV	0 to 50 mV	80 mV	0.1 + 33 µV
33 to 329.999 mV	0 to 500 mV	800 mV	0.1 + 330 µV
0.33 to 3.29999 V	0 to 5 V	8V	0.1 + 3300 µV
3.3 to 32.9999 V	0 to 50 V	55 V	0.1 + 33 mV
Triangle Waves and Truncated Sine Waves (p-p)			
9.3 to 92.999 mV	0 to 50 mV	80 mV	0.1 + 93 µV
93 to 929.999 mV	0 to 500 mV	800 mV	0.1 + 930 µV
0.93 to 9.29999 V	0 to 5 V	8V	0.1 + 9300 µV
9.3 to 93.0000 V	0 to 50 V	55 V	0.1 + 93 mV
Square Waves (p-p)			
6.6 to 65.999 mV	0 to 50 mV	80 mV	0.1 + 66 µV
66 to 659.999 mV	0 to 500 mV	800 mV	0.1 + 660 µV
0.66 to 6.59999 V	0 to 5 V	8V	0.1 + 6600 µV
6.6 to 66.0000 V	0 to 50 V	55 V	0.1 + 66 mV

[1] Offsets are not allowed on ranges above the highest range shown above.
[2] The maximum offset value is determined by the difference between the peak value of the selected voltage output and the allowable maximum peak signal. For example, a 10 V p-p square wave output has a peak value of 5 V, allowing a maximum offset up to ± 50 V to not exceed the 55 V maximum peak signal. The maximum offset values shown above are for the minimum outputs in each range.
[3] For frequencies 0.01 to 10 Hz, and 500 kHz to 2 MHz, the offset uncertainty is 5 % of output, ±1 % of the offset range.

AC Voltage, Square Wave Characteristics

Risetime @ 1 kHz Typical	Settling Time @ 1 kHz Typical	Overshoot @ 1 kHz Typical	Duty Cycle Range	Duty Cycle Uncertainty
<1 µs	<10 µs to 1 % of final value	<2 %	1 % to 99 % <3.3 V p-p. 0,01 Hz to 100 kHz	±(0.02 % of period + 100 ns), 50 % duty cycle ±(0.05 % of period + 100 ns), other duty cycles from 10 % to 90 %

AC Voltage, Triangle Wave Characteristics (typical)

Linearity to 1 kHz	Aberrations
0.3 % of p-p value, from 10 % to 90 % point	<1 % of p-p value, with amplitude >50 % of range

AC Current (Non-Sine Wave)

Triangle Wave & Truncated Sine Wave Range p-p	Frequency	1-Year Absolute Uncertainty tcal ±5 °C ±(% of output + % of range)	Max Current Resolution
0.047 to 0.92999 mA [1]	10 to 45 Hz	0.25 + 0.5	Six digits
	45 Hz to 1 kHz	0.25 + 0.25	
	1 to 10 kHz	10 + 2	
0.93 to 9.29999 mA [1]	10 to 45 Hz	0.25 + 0.5	Six digits
	45 Hz to 1 kHz	0.25 + 0.25	
	1 to 10 kHz	10 + 2	
9.3 to 92.9999 mA [1]	10 to 45 Hz	0.25 + 0.5	Six digits
	45 Hz to 1 kHz	0.25 + 0.25	
	1 to 10 kHz	10 + 2	
93 to 929.999 mA [1]	10 to 45 Hz	0.25 + 0.5	Six digits
	45 Hz to 1 kHz	0.25 + 0.5	
	1 to 10 kHz	10 + 2	
0.93 to 8.49999 A [2]	10 to 45 Hz	0.5 + 1.0	Six digits
	45 Hz to 1 kHz	0.5 + 0.5	
	1 to 10 kHz	10 + 2	
8.5 to 57 A [2]	45 to 500 Hz	0.5 + 0.5	
	500 Hz to 1 kHz	1.0 + 1.0	

[1] Frequency limited to 1 kHz with LCOMP on.
[2] Frequency limited to 440 Hz with LCOMP on.

5502A Multi-Product Calibrator

Square Wave Range p-p	Frequency	1-Year Absolute Uncertainty tcal ±5 °C ±(% of output + % of range)	Max Current Resolution	
0.047 to 0.65999 mA [1]	10 to 45 Hz	0.25 + 0.5	Six digits	
	45 Hz to 1 kHz	0.25 + 0.25		
	1 to 10 kHz	10 + 2		
0.66 to 6.59999 mA [1]	10 to 45 Hz	0.25 + 0.5	Six digits	
	45 Hz to 1 kHz	0.25 + 0.25		
	1 to 10 kHz	10 + 2		
6.6 to 65.9999 mA [1]	10 to 45 Hz	0.25 + 0.5	Six digits	[1] Frequency limited to 1 kHz with LCOMP on. [2] Frequency limited to 440 Hz with LCOMP on.
	45 Hz to 1 kHz	0.25 + 0.25		
	1 to 10 kHz	10 + 2		
66 to 659.999 mA [1]	10 to 45 Hz	0.25 + 0.5	Six digits	
	45 Hz to 1 kHz	0.25 + 0.5		
	1 to 10 kHz	10 + 2		
0.66 to 5.99999 A [2]	10 to 45 Hz	0.5 + 1.0		
	45 Hz to 1 kHz	0.5 + 0.5		
	1 to 10 kHz	10 + 2		
6 to 41 A [2]	45 to 500 Hz	0.5 + 0.5		
	500 Hz to 1 kHz	1.0 + 1.0		

AC Current, Square Wave Characteristics (typical)

Range	LCOMP	Risetime	Settling Time	Overshoot
I <6 A @ 400 Hz	off	25 µs	40 µs to 1 % of final value	<10 % for <1 V Compliance
3 A & 20 A Ranges	on	100 µs	200 µs to 1 % of final value	<10 % for <1 V Compliance

AC Current, Triangle Wave Characteristics (typical)

Linearity to 400 Hz	Aberrations
0.3 % of p-p value, from 10 % to 90 % point	<1 % of p-p value, with amplitude >50 % of range

5080A Multi-Product Calibrator

Calibrate analog and digital meters, and much more

The Fluke 5080A Multi-Product Calibrator calibrates your analog and digital workload accurately and economically. Its high voltage and current compliance makes analog workload calibration easy and precise. And built-in protection circuitry protects it against damaging input voltages.

This easy-to-use instrument calibrates a wide workload that includes:

- Analog meters
- Digital multimeters
- Clamp meters (with coil accessory)
- Oscilloscopes to 200 MHz (optional)
- Panel meters
- Watt meters
- Megohm meters (optional)
- …and more

Versatile software applications enable you to record paperless results, and more. Best of all, the 5080A offers this versatile functionality at a price that fits nicely into your budget.

5080A Multi-Product Calibrator

FLUKE ®
Calibration

Accurate, reliable analog meter calibration

The Fluke 5080A calibrator calibrates your analog workload accurately and reliably, thanks to its high voltage and current compliance. With maximum burden up to 800 mA for voltage, and maximum compliance voltage up to 50 V for current, the 5080A can drive a wide range of analog meters.

Options and accessories expand workload coverage

Options and accessories enable you to use the 5080A to calibrate an even broader workload, including:

- Clamp meters. The Fluke 9100-200 10/50 turn coil and 5500A/COIL 50-turn current coil enables the 5080A to calibrate most popular clamp meters at currents up to 1000 A rms.
- Oscilloscopes. Calibrate oscilloscopes to 200 MHz quickly, easily, and cost effectively. Verify dynamic response, bandwidth, timing, multiple triggering functions, and input resistance.
- Megohm meters. This option sources high ohms, high voltage resistors up to 18 GΩ. It also measures voltage and current outputs.

Protective circuits prevent damage

Mains voltage inadvertently applied to a calibrator's output terminals can cause extensive damage, requiring costly repairs. Electrical protection for calibrator outputs is vital for daily operation. The 5080A calibrator's innovative protection circuitry prevents it from being damaged by reversed input voltage, so you can use it with confidence day after day.

Highest voltage and current compliance

The Fluke 5080A has the highest voltage and current compliance of any calibrator in the Fluke multi-product and multifunction families, making it an ideal solution for calibrating analog meters and other instruments requiring higher drive capability for proper operation.

Maximum burden or compliance voltage

Model	DC voltage	AC voltage	DC current	AC current*
5080A	600 mA	800 mA	50 V	44 V
9100	20 mA	20 mA	4 V	4 V
5500A	10 mA	10 mA	4.5 V	3 V
5520A	10 mA	10 mA	7 V	5 V
5700A	50 mA	50 mA	10 V	7 V
5720A	50 mA	50 mA	10 V	7 V

** With AC LCOMP ON*

Collect and report calibration data consistently and efficiently

Versatile software applications enable automated calibration as well as paperless data collection and reporting.

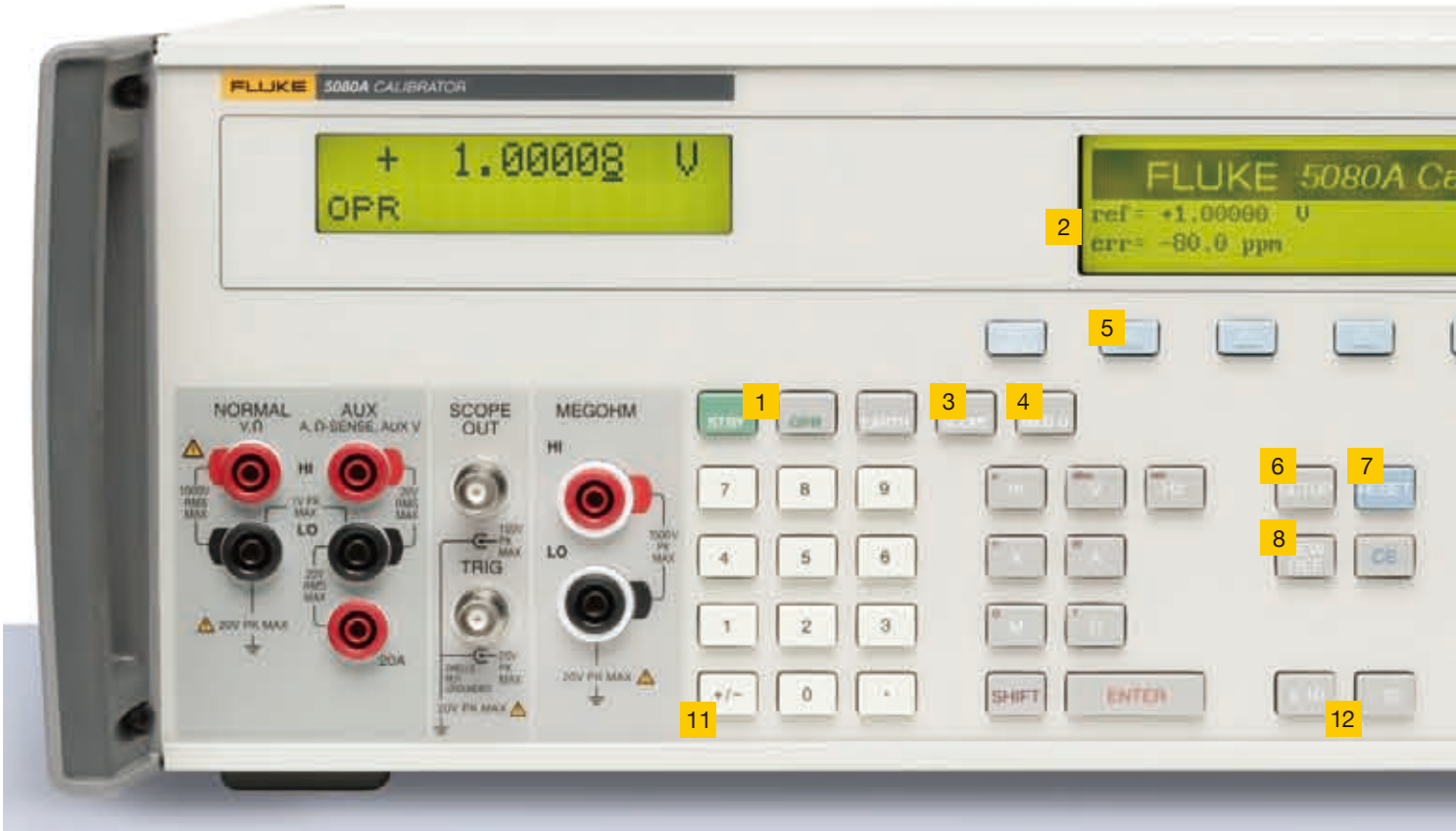
- 5080/CAL. The 5080/CAL software is designed for calibrating analog and digital workload with the 5080A calibrator. It enables you to remotely control the 5080A, manage inventory, collect data and print customized reports, easily and economically.
- MET/CAL® Lite for 5080A. MET/CAL Lite provides the power of MET/CAL Plus software in a lower cost version designed for use with the 5080A.
- MET/CAL® Plus For the full spectrum of calibration automation and asset management, choose MET/CAL Plus software. Add Manual MET/CAL software where automation is not required.

5080A features at a glance

- High compliance
- Protection circuitry
- Calibrates a wide workload, including analog meters and 3.5 and 4.5 digit DMMs
- Optional 5080/CAL software for easy-to-use, automated calibration

5080A Multi-Product Calibrator

1. Control output by pressing separate STBY and OPR Keys.
2. See the difference between the reference value you entered and the value output by the calibrator. The error difference is calculated and displayed in % or ppm.
3. Press the SCOPE key for on-demand oscilloscope calibration (optional).
4. Press the MEG Ω key for on-demand megohm meter calibration (optional).
5. Soft keys allow access to the menus in the control windows, letting you select parameters such as offset, waveforms, or phase. PREV MENU lets you step backward through these menus.
6. SETUP activates setup softkey menus that enable you to perform calibration functions, display 5080A specifications, change parameters, and initiate various utility features.
7. RESET returns the instrument to its power-up state.
8. NEW REF sets present output as the reference for calculating errors.
9. Control window displays a variety of status messages, softkey menus, and status and other auxiliary information.
10. Edit knob allows you to vary the output. When editing, the difference between the original output and the edited output is automatically computed and displayed in the control window.
11. Calculator-style keypad makes it easy to enter values.
12. MULT [x10] and DIV [÷10] keys simplify stepping up and down in decade multiples of any output setting, and let you step up or down to the next range in a 1–2–5 sequence for oscilloscope calibration.

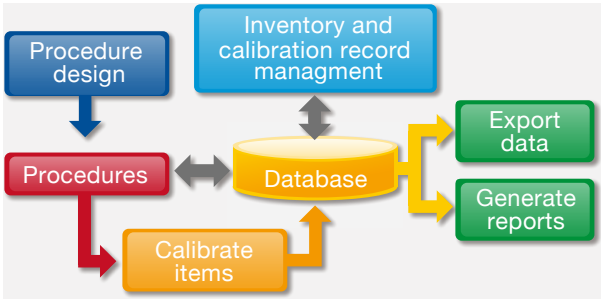


5080A Multi-Product Calibrator

FLUKE ®
Calibration

Improve calibration efficiency and throughput with 5080/CAL software

Optional 5080/CAL software is an economical application that enables 5080A remote control, procedure design, record management, data export and customized reporting. Designed for 5080A and its workload, the 5080/CAL is quick to learn and easy to use.



The solutions you need, from the leader in calibration

The Fluke brand is well known around the world for its accurate, dependable, high quality products. Long known as a leader in dc and low frequency ac calibration, Fluke is also recognized for its offerings in rf, temperature, pressure and flow calibration. Fluke provides the calibrators, standards, software, service, support and training you for a complete solution in your cal lab.

Specifications

Voltage and current specifications

Specifications are for 1 year, tcal ± 5 °C

DC voltage

Range	Specification (% of output + µV)	Resolution	Max burden
0 mV to 329.999 mV	0.013 % + 10	1 µV	60 Ω, output impedance
0 V to 3.29999 V	0.01 % + 15	10 µV	300 mA
0 V to 32.9999 V	0.01 % + 150	100 µV	600 mA
10 V to 101.999 V	0.012 % + 1500	1 mV	300 mA
30 V to 329.999 V	0.012 % + 1500	1 mV	120 mA
100 V to 1020.00 V	0.012 % + 5500	10 mV	40 mA

DC current*

Range	Specification (% of output + µA)	Resolution	Maximum compliance voltage
0 µA to 329.99 µA	0.075 % + 0.1	10 nA	9 V
0 mA to 3.2999 mA	0.065 % + 0.25	0.1 µA	9 V
0 mA to 32.999 mA	0.05 % + 1.25	1 µA	50 V
0 mA to 329.99 mA	0.05 % + 16.5	10 µA	35 V
0 A to 1.0999 A (in 3 A range)	0.15 % + 220	100 µA	6 V
1.1 A to 2.9999 A	0.19 % + 220	100 µA	6 V
0 A to 10.999 A (in 20 A range)	0.25 % + 2500	1 mA	4 V
11 A to 20.500 A	0.5 % + 3750	1 mA	4 V
*Maximum inductive load: 2.5 H			

AC voltage sine wave

Range	Frequency	Specification (% of output + µV)	Resolution	Max burden
1.00 mV to 32.99 mV	45 Hz to 65 Hz	0.33 % + 60	10 µV	60 Ω, output impedance
	65 Hz to 1 kHz	0.34 % + 60		
33 mV to 329.99 mV	45 Hz to 65 Hz	0.15 % + 60	10 µV	60 Ω, output impedance
	65 Hz to 1 kHz	0.16 % + 60		
0.33 V to 3.2999 V	45 Hz to 65 Hz	0.10 % + 180	100 µV	300 mA
	65 Hz to 1 kHz	0.11 % + 180		
3.3 V to 32.999 V	45 Hz to 65 Hz	0.10 % + 1800	1 mV	800 mA
	65 Hz to 1 kHz	0.12 % + 1800		
33 V to 101.99 V	45 Hz to 65 Hz	0.14 % + 18000	10 mV	400 mA
	65 Hz to 1 kHz	0.15 % + 18000		
102 V to 329.99 V	45 Hz to 65 Hz	0.14 % + 18000	10 mV	120 mA
	65 Hz to 1 kHz	0.15 % + 18000		
330 V to 1020.0 V	45 Hz to 65 Hz	0.14 % + 180000	100 mV	40 mA
	65 Hz to 1 kHz	0.15 % + 180000		

AC current sine wave [1]

Range	Frequency	Specifications (% of output + µA)	Maximum compliance voltage [2]
29.0 µA to 329.9 µA	45 Hz to 65 Hz	0.25 % + 0.75	3.3 V
	65 Hz to 1 kHz	0.26 % + 0.75	
0.33 mA to 3.2999 mA	45 Hz to 65 Hz	0.22 % + 0.9	6.5 V
	65 Hz to 1 kHz	0.23 % + 0.9	
3.3 mA to 32.999 mA	45 HZ to 65 Hz	0.10 % + 12	44 V
	65 Hz to 1 kHz	0.19 % + 12	
33 mA to 329.99 mA	45 Hzto 65 Hz	0.10 % + 120	25 V
	65 Hz to 1 kHz	0.19 % + 120	
0.33 A to 1.0999 A	45 Hz to 65 Hz	0.10 % + 1200	4 V
	65 Hz to 1 kHz	0.24 % + 1200	
1.1 A to 2.9999 A	45 Hz to 65 Hz	0.10 % + 1500	4 V
	65 Hz to 1 kHz	0.28 % + 1500	
3.0 A to 10.999 A	45 Hz to 65 Hz	0.25 % + 6000	3 V
	65 Hz to 1 kHz	0.40 % + 6000	
11 A to 20.500 A	45 Hz to 65 Hz	0.50 % + 15000	3 V
	65 Hz to 1 kHz	0.52 % + 15000	
[1] Maximum Inductive load: 2.5 H	[2] LCOMP ON, used to drive inductive loads, available for 45-65 Hz		

5080A Multi-Product Calibrator

FLUKE® Calibration

Resistance, power and frequency specifications

Specifications are for 1 year, tcal ± 5 °C

Resistance

Range	Specification % of output or Ω	Maximum peak current
0 Ω	0.01 Ω	220 mA
1 Ω	1.0 %	220 mA
1.9 Ω	0.5 %	220 mA
10 Ω	0.15 %	220 mA
19 Ω	0.1 %	160 mA
100 Ω	0.04 %	70 mA
190 Ω	0.04 %	50 mA
1000 Ω	0.025 %	22 mA
1.9 kΩ	0.025 %	16 mA
10 kΩ	0.025 %	3 mA
19 kΩ	0.029 %	1.6 mA
100 kΩ	0.038 %	0.3 mA
190 kΩ	0.042 %	0.16 mA
1 MΩ	0.04 %	30 µA
1.9 MΩ	0.04 %	16 µA
10 MΩ	0.1 %	3 µA
19 MΩ	0.15 %	1.6 µA
100 MΩ	0.5 %	300 nA
190 MΩ	1.0 %	160 nA

DC power

Voltage range	Current range			
	0.33 mA to 3.2999 mA	3.3 mA to 329.99 mA	0.33 A to 2.9999 A	3 A to 20.5 A
	± (% of watts output)			
33 mV to 1020 V	0.15	0.11	0.22	0.54

AC power*

Voltage range	Current range			
	3.3 mA to 8.9999 mA	9 mA to 32.999 mA	33 mA to 89.99 mA	90 mA to 329.99 mA
	Specifications, 45 Hz to 65 Hz, PF = 1, ± (% of watts output)			
33 mV to 329.999 mV	0.58	0.45	0.58	0.45
330 mV to 1020 V	0.51	0.36	0.51	0.36
Voltage range	Current range			
	0.33 A to 0.899 A	0.9 A to 2.199 A	2.2 A to 4.499 A	4.5 A to 20.5 A
	Specifications, 45 Hz to 65 Hz, PF = 1, ± (% of watts output)			
33 mV to 329.999 mV	0.59	0.46	0.56	0.72
330 mV to 1020 V	0.52	0.37	0.49	0.67

*Phase adjustment range for dual ac outputs is 0° to ± 179.9°

Frequency

Frequency range	Resolution	Specifications, tcal
45.00 Hz to 119.99 Hz	0.01 Hz	0.0050 % ± 2 mHz
120.0 Hz to 1000.0 Hz	0.1 Hz	220 mA

General specifications

Standard interfaces	RS-232 and ethernet
Temperature	Operating : 0 °C to 50 °C
	Calibration (tcal): 15 °C to 35 °C
	Storage: -20 °C to +70 °C
Relative humidity	Operating:
	<80 % to 30 °C
	<70 % to 40 °C
	<40 % to 50 °C
	Storage
	<95 %, non-condensing
Altitude	Operating:
	2,000 m (6,500 ft) maximum
	Non-operating:
	12,200 m (40,000 ft) maximum
Safety	Meets EN 61010-1:2001,
	CAN/CSA-C22.2 No. 61010-1-04,
	UL 61010-1:2004
Analog low isolation	20 V
EMC	Meets EN 61326-1:2006
Power consumption	600 VA
Dimensions (D x W x H)	53.8 cm x 43.2 cm x 44.3 cm x 19.3 cm (including handles) (21.2 in x 17 in x 17.5 in x 7.6 in)
Weight	22 kg (48 lb)

Option specifications

MegOhm option insulation resistance

Function	Range	Best one year specification
Resistance	10 kΩ to 10 GΩ, plus 18 GΩ single value	0.20 %
Voltage	0 V to 1575 V dc peak	1 %

MegOhm option continuity

Frequency range	Resolution	Specifications, tcal
Resistance	1 Ω to 5.9 kΩ (16 values)	0.1 %
Current	700 mA max	1.2 %

Oscilloscope option

Frequency range	Resolution	Specifications, tcal
DC voltage	0 V to ± 2.2 V (50 Ω)	± 0.35 %
	0 V to ± 33 V (1 MΩ)	
AC voltage squarewave	± 1.8 mV to ± 2.2 V p-p (50 Ω)	± 0.35 %
	± 1.8 mV to ± 105 V p-p (1 MΩ)	
Fast edge	4.5 mV to 2.75 V p-p (50 Ω)	<1 ns rise time
Leveled sinewave	50 kHz to 200 MHz	± 1.5 % flatness
Time markers	5 s to 2 ns	± 5 ppm

52120A Transconductance Amplifier

The new Fluke Calibration 52120A Transconductance Amplifier supplies dc and ac current up to 120 amps at accuracies to 100 ppm. Using accessory coils, it can generate 3,000 or 6,000 amps. Three 52120As connected in parallel can output up to 360 amps. Inductive drive capability of 1 mH and compliance voltage of 4.5 volts support a wide range of applications.

The 52120A is designed for users whoseability to address their calibration workload may be limited by the output current, accuracy and drive capability of their present test equipment, including:

- Calibration professionals in a calibration/ standards lab or an electrical utility
- Manufacturers of power/ energyinstrumentation and meters, power qualityanalyzers or power converters
- Users of electrical test and measurement equipment

The 52120A enables you to test and calibrate a broad workload at full current range:

- Primary and secondary power standards
- Power and energy meters
- Power quality analyzers
- Digital multimeters, analog and clamp meters
- High current clamp meters, e.g.: Fluke i3000
- Rogowski coils e.g., Fluke i6000 Flex
- Current shunts, probes and transformers
- Relay/breaker test sets

The 52120A operates as a transconductanceamplifier with:

- 5500A/5520A/5522A Multi-Product Calibrator
- 5700A/5720A Multifunction Calibrator
- 5080A Multi-Product Calibrator
- 9100 Universal Calibration System
- Any calibrator, signal generator or power supply capable of sourcing 2 V or 200 mA, dc or ac

You may also operate your 52120A in closed-loop mode, seamlessly communicating with your FlukeCalibration 6105A or 6100B Electrical Power Standard to deliver enhanced 52120A accuracy.

52120A performance at a glance

- Industry-leading amplifier accuracy:
  - 100 ppm, dc – 850 Hz (used with 61XX EPS)
  - 150 ppm dc (used with dc/lf calibrator)
  - 1000 ppm ac (used with dc/lf calibrator)
- Frequency: to 10 kHz
- Burden voltage (compliance): 4.5 V @ 120A
- Inductive drive capability: 1 mH load
- Output ranges: 2 A, 20 A, 120 A
- Input ranges: 2 V or 200 mA F.S. for 2 A and 20 A ranges, 1.2 V or 120 mA F.S. for 120 A range
- Parallel operation: 2 or 3, up to 360 A in a single phase
- Accessory coils: 25 turn coil supports 3000 A, 50 turn coil supports 6000 A
- Control communication with 6105A /6100B Electrical Power Standards
- GPIB remote operation

Coil accessories support 3000 A and 6000 A

52120A Transconductance Amplifier

FLUKE® Calibration

Specifications

Gain/Transconductance

	Output current range		
	2 A rms	**20 A rms**	**120 A rms**
Maximum Input voltage	2 V rms	2 V rms	1.2 V rms
Transconductance	1 Siemens	10 Siemens	100 Siemens
Maximum Input current	200 mA rms	200 mA rms	120 mA rms
Current Gain	10	100	1,000

Accuracy with 6105A or 6100B

Frequency	**1 year amplitude accuracy at Tcal ±5 °C ±(ppm of output + ppm of range)**		**1 year phase angle accuracy at Tcal ±5°C ± (degrees)**	**1 hour stability with 6105A/ 6100B in open loop mode ± (ppm of output + ppm of range)**
	With 6105A/6106A	**With 6100B/6101B**		
DC	100 + 50	200 + 100	n/a	50 + 10
16 Hz to 65 Hz	70 + 20	200 + 30	0.004 °	50 + 10
65 Hz to 180 Hz	75 + 20	200 + 30	0.012 °	50 + 10
180 Hz to 450 Hz	80 + 20	200 + 30	0.030 °	50 + 10
450 Hz to 850 Hz	80 + 20	200 + 30	0.050 °	50 + 10
850 Hz to 3 kHz	400 + 20	400 + 30	0.150 °	100 + 10
3 kHz to 6 kHz	400 + 20	400 + 30	0.300 °	100 + 20
6 kHz to 9 kHz	10,000 + 20	10,000 + 30	-	100 + 25

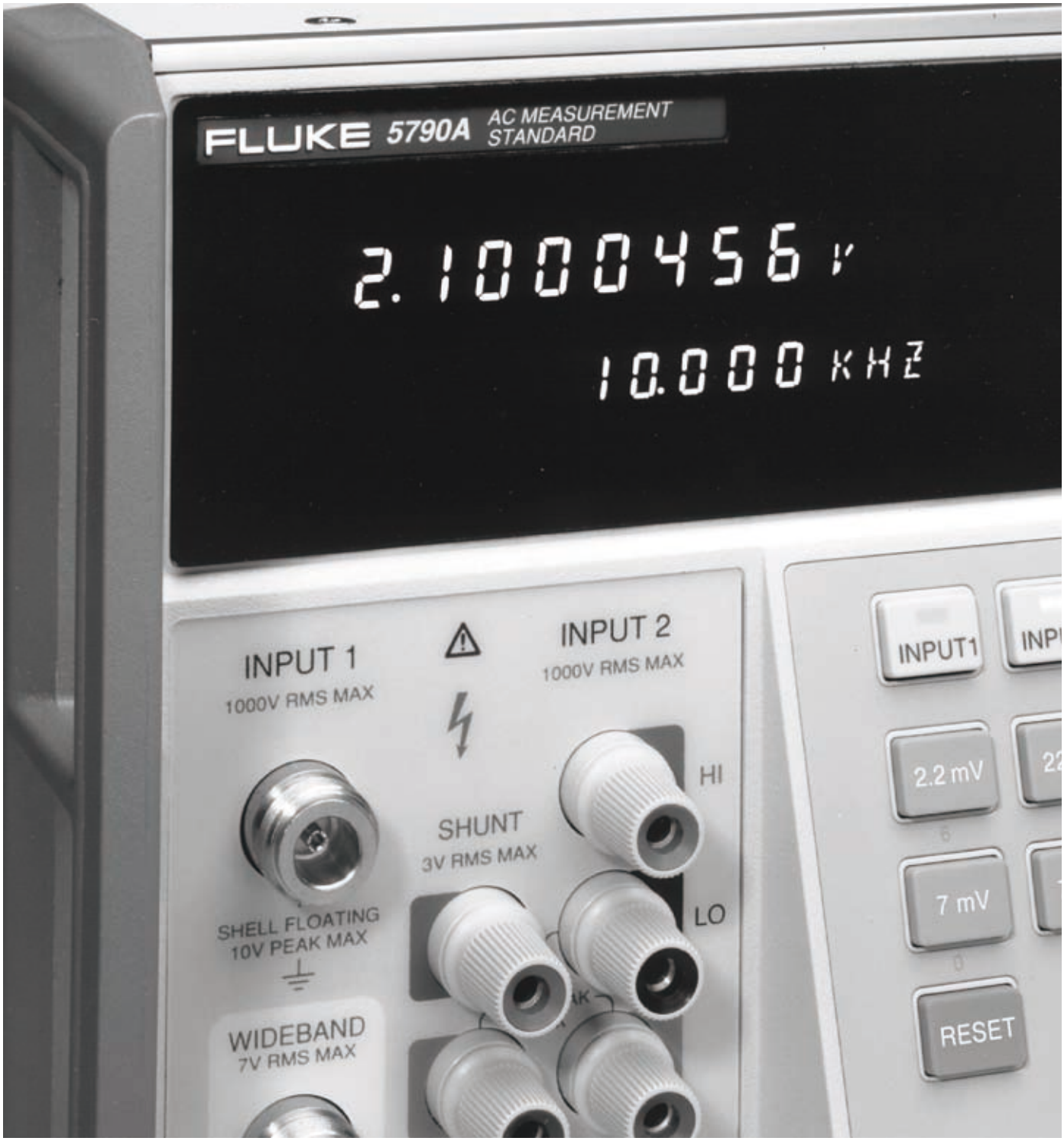
Accuracy with other devices

Frequency	**Amplitude accuracy at Tcal ±5 °C ± (ppm of output + ppm of range)**			
	LCOMP OFF		**LCOMP ON**	
	1 year	**1 hour stability**	**1 year**	**1 hour stability**
DC	150 + 50	15 + 5	150 + 50	15 + 5
< 10 Hz	1,000 + 50	100 + 50	2,000 + 50	50 + 10
10 Hz to 100 Hz	1,000 + 50	100 + 50	2,000 + 50	50 + 10
100 Hz to 300 Hz	1,000 + 50	100 + 50	2,000 + 50	50 + 10
300 Hz to 1 kHz	1,000 + 50	100 + 50	2,000 + 50	50 + 10
1 kHz to 3 kHz	1,000 + 50	100 + 50	2,000 + 50	100 + 20
3 kHz to 10 kHz	10,000 + 50	10,000 + 50	20,000 + 50	100 + 20

General specifications

Input line voltage range	100 V to 240 V with up to ±10 % fluctuations
Transient overvoltage	Impulse withstand (overvoltage) Category II of IEC 60364-4-443
Frequency	47 Hz to 63 Hz
Maximum consumption	< 1500 VA
Dimensions (HxWxD)	With feet: 192 mm x 432 mm x 648 mm (7.6 inches x 17 inches x 25.5 inches) Without feet: 178 mm x 432 mm x 648 mm (7 inches x 17 inches x 25.5 inches)
Weight	25 kg (54 lb.)
Operating temperature	5 °C - 35 °C
Operating max. relative humidity	<80 % 5 °C - 31 °C ramping linearly down to 50 % at 35 °C
Operating altitude	2,500 m (8200 ft.) maximum
Agency approvals	CE marked and CSA listed
Shock + vibration	MIL-PRF-28800F; Class 3
Design standards and compliance	Designed to IEC 61010-1 ed3: 2010
Maximum output voltage compliance	4.5V rms, 6.4 V pk

5790A Automated AC Measurement Standard



5790A Automated AC Measurement Standard

FLUKE ®
Calibration

Accuracy that's easy to use

The 5790A is a complete automated ac measurement standard designed for the most demanding calibration applications. It combines the accuracy you would expect from a thermal transfer standard with the ease of use of a digital multimeter. Absolute ac voltage measurement uncertainties are as low as ± 24 ppm (one year, 23°C ± 5°C). The 5790A is designed to meet the complete ac voltage and wideband verification requirements of the Fluke 5700A, 5500A, and 5100 Series and other calibrators, amplifiers like the 5725A and 5205A, and transfer standards and ac voltmeters.

The 5790A covers an alternating voltage range of 700 mV to 1000V, and a frequency range of 10 Hz to 1 MHz. A wideband voltage option extends frequency range to 30 MHz to meet the calibration requirements of the Fluke 5700A, and 5100 Series calibrators.

The 5790A is also compatible with Fluke A40 and A40A Current Shunts, which permit you to make ac/dc current transfer measurements up to 20A.

The 5790A may be used alone or as a transfer standard with an external dc source. In either case the normally tedious switching and calculations are performed automatically by the 5790A, and the resulting ac/dc difference is displayed directly on the easy-to-read vacuum fluorescent display.

Precision you can depend on

The 5790A is based on the patented Fluke Solid-State Thermal RMS Sensor, which has been proven since 1979 in a variety of Fluke products like the 792A AC/DC Transfer Standard. The Fluke RMS Sensor is a true thermal converter, not an electronic converter that calculates the RMS value. Because its output voltage is 2V rather than the 7 to 10 mV of traditional thermocouples, the RMS sensor exhibits excellent signal-to-noise characteristics and minimal reversal errors. With a higher output voltage, more accurate measurements can be made.

And because of its small size, the RMS sensor stabilizes quickly and operates over a wide temperature range.

The 5790A also features hermetically sealed thin-film resistor networks to minimize ac measurement errors and enhance temperature coefficient.

The RMS sensor and thin-film resistor networks are designed by Fluke to be rugged and reliable. Each is built to exacting standards by the Fluke Microelectronics Operation to maintain quality and consistency part after part.

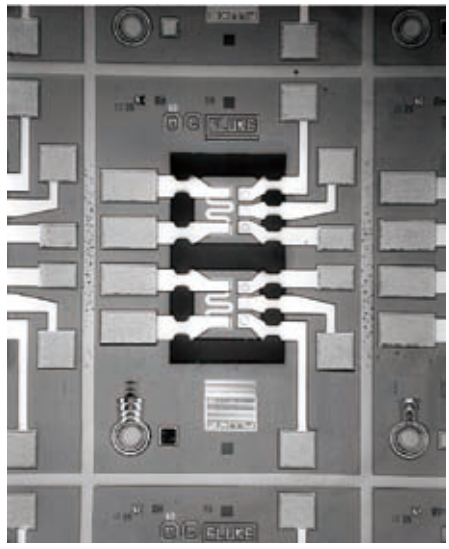
Versatility that keeps you productive

When you first power up the 5790A, diagnostics verify the instrument's integrity.

The variety of input connections allows you to use the one that best suits your application.

There are four sets of input terminals on the 5790A, two Type-N connectors and two sets of five-way binding posts. One Type-N and one set of binding posts are dedicated to the ac measurement and transfer modes. AC or dc voltages may be applied to either input connection over the 5790A's full range, allowing you to perform automated ac/dc transfer measurements.

The 5790A determines automatically whether the applied voltage is ac or dc.



The patented Fluke Solid-State RMS Sensor provides the 5790A with exceptional accuracy and stability, and fast settling time.

The 5790A is compatible with Fluke A40 and A40A Current Shunts to permit measurements to 20A.

5790A Automated AC Measurement Standard

1 Low-loss Type-N connector for the best performance above 20 kHz or as the input for the ac voltage when automated ac/dc difference measurements are made.These inputs may be used over the 5790A's full voltage range of 700 µV to 1000V.

2 Low thermal emf tellurium copper alloy binding posts for general measurements and as the dc voltage input when automated ac/dc difference measurements are made.

3 These binding posts permit the use of A40 shunts to make ac/dc current difference measurements.

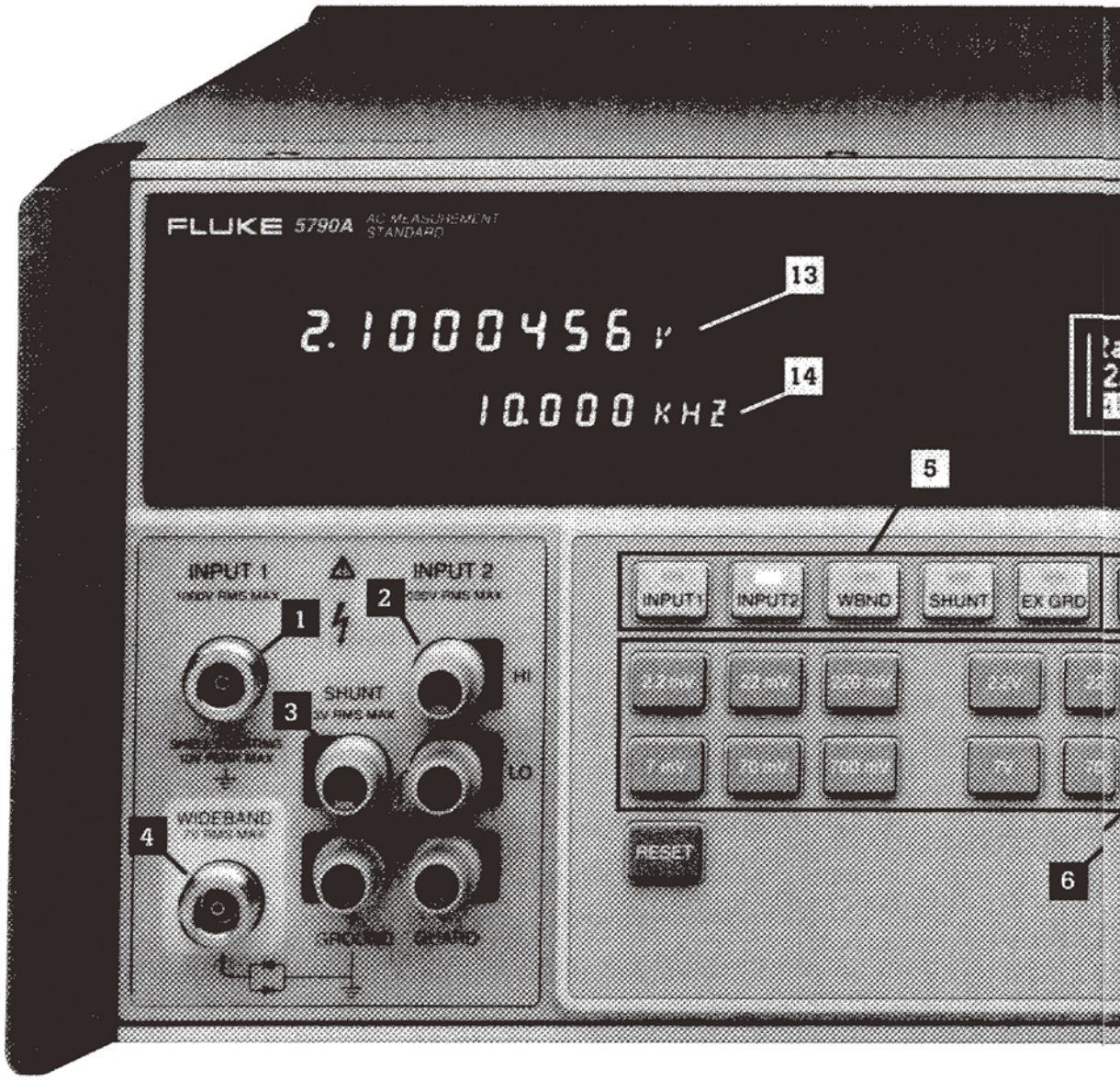
4 Low-loss Type-N connector for making wideband voltage measurements from 10 Hz to 30 MHz (Option -03).

5 These keys allow you to select one of the four inputs. An illuminated LED indicates which input has been selected.

6 These keys are used to manually select the desired voltage range for the present measurement.

7 ↑ ↓ keys allow you to select one range higher or lower.

8 These "soft" keys allow you to work with the menus displayed on the control screen above.



5790A Automated AC Measurement Standard

FLUKE ®
Calibration

9 Allows you to display the reference for an ac/dc transfer measurement.

10 Displays the instrument's utility menu. Use the "soft" keys to select the disired utility, including remote port parameters, calibration, diagnostics and general instrument set-up.

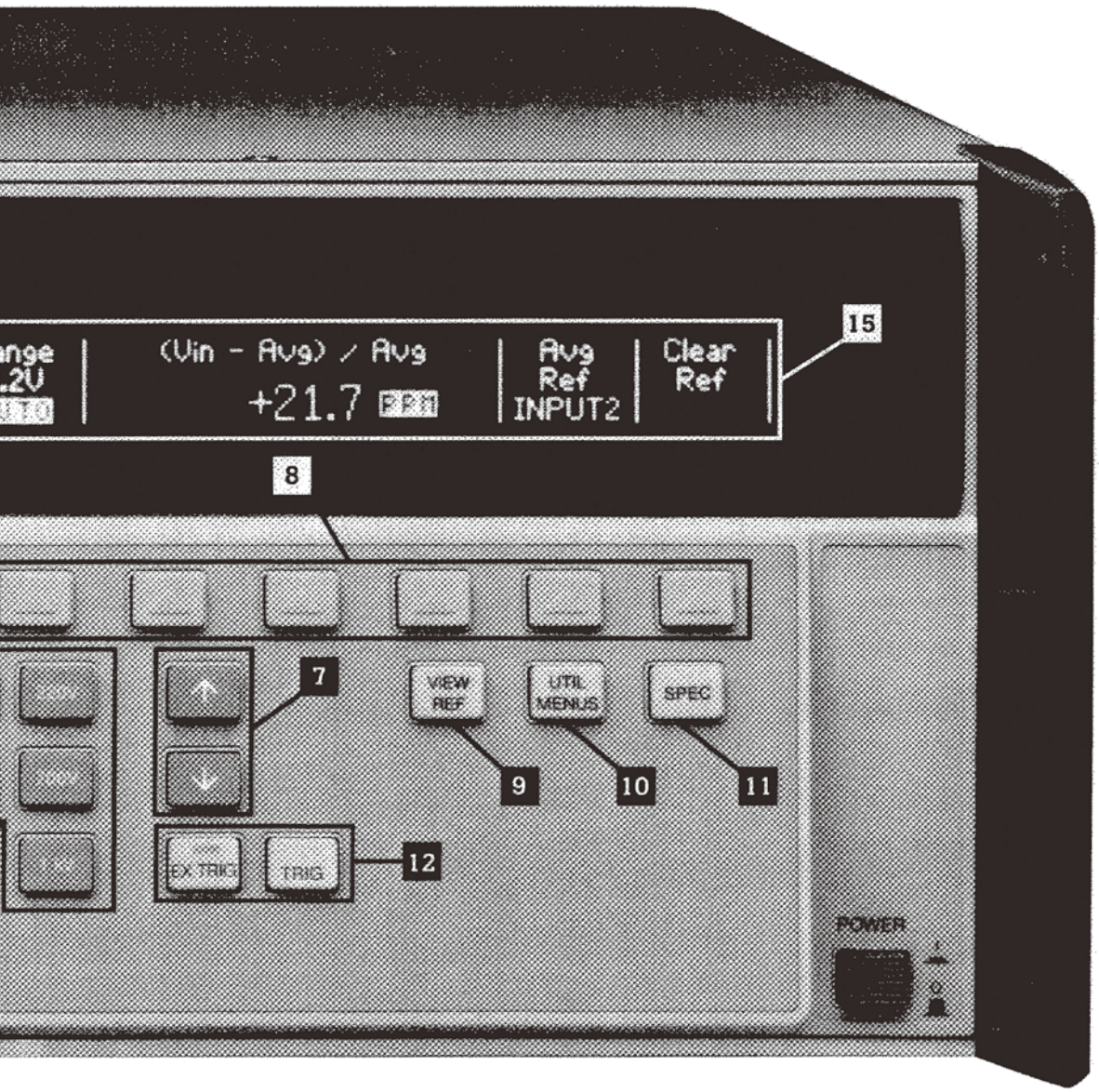
11 Displays the total uncertainty for the most recent measurement.

12 Choose between continuous measurements or single measurement.

13 The input voltage is always displayed on the upper portion of the measurement display.

14 The frequency of the applied ac voltage is displayed on the lower portion of the measurement display.

15 The control display shows information on the status of the instrument during measurements or maintenance and indicates the function of the "soft" keys directly below the display.



5790A Automated AC Measurement Standard

The second Type-N input connection supports the optional wideband mode, and the second set of binding posts are designed for Fluke A40 Series current shunts.

The input connection is selected with the touch of a key on the 5790A front panel. An LED indicates which selection is active.

Whether you are using the 5790A as a voltmeter or a transfer standard, input voltage and frequency are always indicated on the measurement display. In the transfer mode, the ac/dc or ac/ac difference is always indicated on the control display in ppm, %, volts or ratio.

The 5790A is a fully autoranging instrument and selects the best voltage range for the measurement you are making. You may also select and lock in ranges manually. Robust 1200V input protection is active on all voltage ranges.

Using the trigger keys, the 5790A can switch from continuous to single measurements of the input voltage, making it easy to take sample readings at predetermined intervals.

When using the 5790A in transfer mode, the reference voltage is stored automatically, and all ac/dc or ac/ac difference measurements are made relative to it. At any time, you can view the reference by pressing the VIEW REF key. You may also store the average of two voltages as a reference to eliminate dc reversal errors, for example.

The intuitive front panel layout of the 5790A makes manual operation fast and simple. Keys and selections are logically arranged and labelled. And messages and menus are displayed clearly on the 5790A's bright, vacuum fluorescent display.

The 5790A is designed to meet the ac verification requirements of the Fluke 5700A Calibrator. Automation using MET/CAL Calibration Software is fast and easy.

The 5790A is at home in automated systems as well. IEEE-488 and RS-232 interfaces are included and all functions of the instruments can be controlled by a variety of host computers, including PCs. The 5790A can be integrated into automated systems operating under MET/CALTM Calibration Software.

Designed with your support requirements in mind

The 5790A provides a self-contained calibration procedure designed to simplify periodic performance verification. The operator is prompted on what actions to take. To minimize the equipment required, the 5790A is designed to be supported by the Fluke 792A AC/DC Transfer Standard.

Traceability to national standards for the 5790A is supported through the Fluke 792A.

5790A Automated AC Measurement Standard

FLUKE® Calibration

Performance specifications

To simplify evaluation of how the 5790A covers your calibration workload, use the Absolute Uncertainty Specifications. **Absolute Uncertainties** include stability, temperature coefficient, linearity and traceability to external standards.
You do not need to add anything to determine the ratios between 5790A uncertainties and the uncertainties of your calibration workload when used within ± 5°C of calibration temperature. **Relative Uncertainty** specifications are provided so that absolute uncertainties may be calculated when equipment or traceability differ from what is specified in the calibration section of the 5790A manual.
Secondary Performance and Operating Characteristics are provided for special calibration requirements such as stability or operation at temperature extremes.

Absolute Uncertainty Specifications

± 5°C of Calibration Temperature

Voltage Range	Frequency Range	Absolute Uncertainty			
		AC/DC Transfer Mode	Measurement Mode		
		±PPM	±(PPM of Reading + µV)		
		2 Years	90 Days	1 Year	2 Years
2.2 mV	10 Hz -20 Hz 20 Hz -40 Hz 40 Hz -20 kHz 20 kHz -50 kHz 50 kHz -100 kHz 100 kHz -300 kHz 300 kHz -500 kHz 500 kHz -1 MHz		1700 + 1.3 740 + 1.3 420 + 1.3 810 + 2.0 1200 + 2.5 2300 + 4.0 2400 + 6.0 3200 + 6.0	1700 + 1.3 740 + 1.3 420 + 1.3 810 + 2.0 1200 + 2.5 2300 + 4.0 2400 + 8.0 3500 + 8.0	1700 + 1.3 740 + 1.3 420 + 1.3 820 + 2.0 1200 + 2.5 2300 + 4.0 2600 + 8.0 5000 + 8.0
7 mV	10 Hz -20 Hz 20 Hz -40 Hz 40 Hz -20 kHz 20 kHz -50 kHz 50 kHz -100 kHz 100 kHz -300 kHz 300 kHz -500 kHz 500 kHz -1 MHz		850 + 1.3 370 + 1.3 210 + 1.3 400 + 2.0 600 + 2.5 1200 + 4.0 1300 + 6.0 2000 + 6.0	850 + 1.3 370 + 1.3 210 + 1.3 400 + 2.0 600 + 2.5 1200 + 4.0 1300 + 8.0 2300 + 8.0	850 + 1.3 370 + 1.3 210 + 1.3 410 + 2.0 610 + 2.5 1200 + 4.0 1400 + 8.0 3600 + 8.0
22 mV	10 Hz -20 Hz 20 Hz -40 Hz 40 Hz -20 kHz 20 kHz -50 kHz 50 kHz -100 kHz 100 kHz -300 kHz 300 kHz -500 kHz 500 kHz -1 MHz		290 + 1.3 180 + 1.3 110 + 1.3 210 + 2.0 310 + 2.5 810 + 4.0 860 + 6.0 1400 + 6.0	290 + 1.3 190 + 1.3 110 + 1.3 210 + 2.0 310 + 2.5 810 + 4.0 890 + 8.0 1700 + 8.0	290 + 1.3 190 + 1.3 110 + 1.3 210 + 2.0 310 + 2.5 820 + 4.0 1000 + 8.0 2600 + 8.0
70 mV	10 Hz -20 Hz 20 Hz -40 Hz 40 Hz -20 kHz 20 kHz -50 kHz 50 kHz -100 kHz 100 kHz -300 kHz 300 kHz -500 kHz 500 kHz -1 MHz		240 + 1.5 120 + 1.5 64 + 1.5 120 + 2.0 260 + 2.5 510 + 4.0 660 + 6.0 1100 + 6.0	240 + 1.5 120 + 1.5 65 + 1.5 130 + 2.0 260 + 2.5 510 + 4.0 670 + 8.0 1100 + 8.0	240 + 1.5 130 + 1.5 69 + 1.5 130 + 2.0 260 + 2.5 530 + 4.0 680 + 8.0 1300 + 8.0
220 mV	10 Hz -20 Hz 20 Hz -40 Hz 40 Hz -20 kHz 20 kHz -50 kHz 50 kHz -100 kHz 100 kHz -300 kHz 300 kHz -500 kHz 500 kHz -1 MHz	210 82 34 67	210 + 1.5 84 + 1.5 37 + 1.5 69 + 2.0 160 + 2.5 240 + 4.0 360 + 6.0 940 + 6.0	210 + 1.5 85 + 1.5 38 + 1.5 69 + 2.0 160 + 2.5 250 + 4.0 380 + 8.0 1000 + 8.0	210 + 1.5 87 + 1.5 43 + 1.5 73 + 2.0 160 + 2.5 280 + 4.0 400 + 8.0 1200 + 8.0
700 mV	10 Hz -20 Hz 20 Hz -40 Hz 40 Hz -20 kHz 20 kHz -50 kHz 50 kHz -100 kHz 100 kHz -300 kHz 300 kHz -500 kHz 500 kHz -1 MHz	210 73 27 47	210 + 1.5 75 + 1.5 31 + 1.5 50 + 2.0 79 + 2.5 160 + 4.0 300 + 6.0 900 + 6.0	210 + 1.5 76 + 1.5 33 + 1.5 51 + 2.0 79 + 2.5 180 + 4.0 300 + 8.0 960 + 8.0	210 + 1.5 78 + 1.5 38 + 1.5 56 + 2.0 84 + 2.5 210 + 4.0 340 + 8.0 1200 + 8.0
			±(PPM of Reading)		
2.2V	10 Hz -20 Hz 20 Hz -40 Hz 40 Hz -20 kHz 20 kHz -50 kHz 50 kHz -100 kHz 100 kHz -300 kHz 300 kHz -500 kHz 500 kHz -1 MHz	200 63 18 43	200 65 22 45 70 150 250 840	200 66 24 46 71 160 260 900	200 69 29 52 76 200 310 1200

5790A Automated AC Measurement Standard

Absolute Uncertainty Specifications

± 5°C of Calibration Temperature

Voltage Range	Frequency Range	Absolute Uncertainty			
		AC/DC Transfer Mode	Measurement Mode		
		±PPM	±(PPM of Reading + µV)		
		2 Years	90 Days	1 Year	2 Years
2.2 mV	10 Hz -20 Hz 20 Hz -40 Hz 40 Hz -20 kHz 20 kHz -50 kHz 50 kHz -100 kHz 100 kHz -300 kHz 300 kHz -500 kHz 500 kHz -1 MHz		1700 + 1.3 740 + 1.3 420 + 1.3 810 + 2.0 1200 + 2.5 2300 + 4.0 2400 + 6.0 3200 + 6.0	1700 + 1.3 740 + 1.3 420 + 1.3 810 + 2.0 1200 + 2.5 2300 + 4.0 2400 + 8.0 3500 + 8.0	1700 + 1.3 740 + 1.3 420 + 1.3 820 + 2.0 1200 + 2.5 2300 + 4.0 2600 + 8.0 5000 + 8.0
7 mV	10 Hz -20 Hz 20 Hz -40 Hz 40 Hz -20 kHz 20 kHz -50 kHz 50 kHz -100 kHz 100 kHz -300 kHz 300 kHz -500 kHz 500 kHz -1 MHz		850 + 1.3 370 + 1.3 210 + 1.3 400 + 2.0 600 + 2.5 1200 + 4.0 1300 + 6.0 2000 + 6.0	850 + 1.3 370 + 1.3 210 + 1.3 400 + 2.0 600 + 2.5 1200 + 4.0 1300 + 8.0 2300 + 8.0	850 + 1.3 370 + 1.3 210 + 1.3 410 + 2.0 610 + 2.5 1200 + 4.0 1400 + 8.0 3600 + 8.0
22 mV	10 Hz -20 Hz 20 Hz -40 Hz 40 Hz -20 kHz 20 kHz -50 kHz 50 kHz -100 kHz 100 kHz -300 kHz 300 kHz -500 kHz 500 kHz -1 MHz		290 + 1.3 180 + 1.3 110 + 1.3 210 + 2.0 310 + 2.5 810 + 4.0 860 + 6.0 1400 + 6.0	290 + 1.3 190 + 1.3 110 + 1.3 210 + 2.0 310 + 2.5 810 + 4.0 890 + 8.0 1700 + 8.0	290 + 1.3 190 + 1.3 110 + 1.3 210 + 2.0 310 + 2.5 820 + 4.0 1000 + 8.0 2600 + 8.0
70 mV	10 Hz -20 Hz 20 Hz -40 Hz 40 Hz -20 kHz 20 kHz -50 kHz 50 kHz -100 kHz 100 kHz -300 kHz 300 kHz -500 kHz 500 kHz -1 MHz		240 + 1.5 120 + 1.5 64 + 1.5 120 + 2.0 260 + 2.5 510 + 4.0 660 + 6.0 1100 + 6.0	240 + 1.5 120 + 1.5 65 + 1.5 130 + 2.0 260 + 2.5 510 + 4.0 670 + 8.0 1100 + 8.0	240 + 1.5 130 + 1.5 69 + 1.5 130 + 2.0 260 + 2.5 530 + 4.0 680 + 8.0 1300 + 8.0
220 mV	10 Hz -20 Hz 20 Hz -40 Hz 40 Hz -20 kHz 20 kHz -50 kHz 50 kHz -100 kHz 100 kHz -300 kHz 300 kHz -500 kHz 500 kHz -1 MHz	210 82 34 67	210 + 1.5 84 + 1.5 37 + 1.5 69 + 2.0 160 + 2.5 240 + 4.0 360 + 6.0 940 + 6.0	210 + 1.5 85 + 1.5 38 + 1.5 69 + 2.0 160 + 2.5 250 + 4.0 380 + 8.0 1000 + 8.0	210 + 1.5 87 + 1.5 43 + 1.5 73 + 2.0 160 + 2.5 280 + 4.0 400 + 8.0 1200 + 8.0
700 mV	10 Hz -20 Hz 20 Hz -40 Hz 40 Hz -20 kHz 20 kHz -50 kHz 50 kHz -100 kHz 100 kHz -300 kHz 300 kHz -500 kHz 500 kHz -1 MHz	210 73 27 47	210 + 1.5 75 + 1.5 31 + 1.5 50 + 2.0 79 + 2.5 160 + 4.0 300 + 6.0 900 + 6.0	210 + 1.5 76 + 1.5 33 + 1.5 51 + 2.0 79 + 2.5 180 + 4.0 300 + 8.0 960 + 8.0	210 + 1.5 78 + 1.5 38 + 1.5 56 + 2.0 84 + 2.5 210 + 4.0 340 + 8.0 1200 + 8.0
			±(PPM of Reading)		
2.2V	10 Hz -20 Hz 20 Hz -40 Hz 40 Hz -20 kHz 20 kHz -50 kHz 50 kHz -100 kHz 100 kHz -300 kHz 300 kHz -500 kHz 500 kHz -1 MHz	200 63 18 43	200 65 22 45 70 150 250 840	200 66 24 46 71 160 260 900	200 69 29 52 76 200 310 1200
7V	10 Hz -20 Hz 20 Hz -40 Hz 40 Hz -20 kHz 20 kHz -50 kHz 50 kHz -100 kHz 100 kHz -300 kHz 300 kHz -500 kHz 500 kHz -1 MHz	200 63 18 44	200 66 22 46 80 180 380 1100	200 67 24 48 81 190 400 1200	200 70 29 53 88 220 470 1500
22V	10 Hz -20 Hz 20 Hz -40 Hz 40 Hz -20 kHz 20 kHz -50 kHz 50 kHz -100 kHz 100 kHz -300 kHz 300 kHz -500 kHz 500 kHz -1 MHz	200 63 21 44	200 66 25 46 80 180 380 1100	200 67 27 48 81 190 400 1200	200 70 31 53 85 220 470 1500

5790A Automated AC Measurement Standard

FLUKE® Calibration

Absolute Uncertainty Specifications (continued)

± 5°C of Calibration Temperature

Voltage Range	Frequency Range	Absolute Uncertainty			
		AC/DC Transfer Mode	Measurement Mode		
		±PPM	±(PPM of Reading)		
		2 Years	90 Days	1 Year	2 Years
70V	10 Hz -20 Hz 20 Hz -40 Hz 40 Hz -20 kHz 20 kHz -50 kHz 50 kHz -100 kHz 100 kHz -300 kHz 300 kHz -500 kHz 500 kHz -1 MHz	200 63 25 55	200 67 30 56 91 190 400 1100	200 68 32 57 94 200 410 1200	200 72 39 63 110 220 510 1500
220V	10 Hz -20 Hz 20 Hz -40 Hz 40 Hz -20 kHz 20 kHz -50 kHz 50 kHz -100 kHz 100 kHz -300 kHz 300 kHz -500 kHz	200 63 23 63	200 67 29 67 96 210 440	200 68 31 69 98 210 500	200 72 38 77 110 260 700
700V	10 Hz -20 Hz 200 20 Hz -40 Hz 40 Hz -20 kHz 20 kHz -50 kHz 50 kHz -100 kHz	200 92 36	200 96 39 120 400	200 99 41 130 500	200 110 47 150 850
1000V	10 Hz -20 Hz 20 Hz -40 Hz 40 Hz -20 kHz 20 kHz -50 kHz 50 kHz -100 kHz	200 92 33	200 96 37 120 400	200 99 38 130 500	200 110 44 150 850

Relative Uncertainty Specifications

± 5°C of Calibration Temperature

Voltage Range	Frequency Range	Relative Uncertainty			
		AC/DC Transfer Mode	Measurement Mode		
		±PPM	±(PPM of Reading + µV)		
		2 Years	90 Days	1 Year	2 Years
2.2 mV	10 Hz -20 Hz 20 Hz -40 Hz 40 Hz -20 kHz 20 kHz -50 kHz 50 kHz -100 kHz 100 kHz -300 kHz 300 kHz -500 kHz 500 kHz -1 MHz		100 + 1.3 54 + 1.3 44 + 1.3 57 + 2.0 79 + 2.5 190 + 4.0 590 + 6.0 2200 + 6.0	110 + 1.3 64 + 1.3 57 + 1.3 67 + 2.0 86 + 2.5 230 + 4.0 720 + 8.0 2600 + 8.0	110 + 1.3 68 + 1.3 61 + 1.3 110 + 2.0 120 + 2.5 390 + 4.0 1200 + 8.0 4400 + 8.0
7 mV	10 Hz -20 Hz 20 Hz -40 Hz 40 Hz -20 kHz 20 kHz -50 kHz 50 kHz -100 kHz 100 kHz -300 kHz 300 kHz -500 kHz 500 kHz -1 MHz		80 + 1.3 33 + 1.3 29 + 1.3 40 + 2.0 53 + 2.5 110 + 4.0 370 + 6.0 1600 + 6.0	83 + 1.3 39 + 1.3 36 + 1.3 44 + 2.0 57 + 2.5 130 + 4.0 450 + 8.0 2000 + 8.0	86 + 1.3 45 + 1.3 42 + 1.3 63 + 2.0 72 + 2.5 210 + 4.0 740 + 8.0 3400 + 8.0
22 mV	10 Hz -20 Hz 20 Hz -40 Hz 40 Hz -20 kHz 20 kHz -50 kHz 50 kHz -100 kHz 100 kHz -300 kHz 300 kHz -500 kHz 500 kHz -1 MHz		69 + 1.3 34 + 1.3 30 + 1.3 40 + 2.0 53 + 2.5 97 + 4.0 310 + 6.0 1200 + 6.0	72 + 1.3 40 + 1.3 36 + 1.3 45 + 2.0 57 + 2.5 110 + 4.0 380 + 8.0 1500 + 8.0	75 + 1.3 46 + 1.3 43 + 1.3 64 + 2.0 73 + 2.5 160 + 4.0 610 + 8.0 2500 + 8.0
70 mV	10 Hz -20 Hz 20 Hz -40 Hz 40 Hz -20 kHz 20 kHz -50 kHz 50 kHz -100 kHz 100 kHz -300 kHz 300 kHz -500 kHz 500 kHz -1 MHz		60 + 1.5 27 + 1.5 22 + 1.5 34 + 2.0 53 + 2.5 110 + 4.0 270 + 6.0 910 + 6.0	61 + 1.5 30 + 1.5 25 + 1.5 36 + 2.0 54 + 2.5 120 + 4.0 290 + 8.0 970 + 8.0	62 + 1.5 37 + 1.5 34 + 1.5 44 + 2.0 62 + 2.5 170 + 4.0 320 + 8.0 1200 + 8.0

5790A Automated AC Measurement Standard

Relative Uncertainty Specifications (continued)

± 5°C of Calibration Temperature

Voltage Range	Frequency Range	Relative Uncertainty			
		AC/DC Transfer Mode	Measurement Mode		
		±PPM	±(PPM of Reading + µV)		
		2 Years	90 Days	1 Year	2 Years
220 mV	10 Hz -20 Hz 20 Hz -40 Hz 40 Hz -20 kHz 20 kHz -50 kHz 50 kHz -100 kHz 100 kHz -300 kHz 300 kHz -500 kHz 500 kHz -1 MHz	55 20 17 17	60 + 1.5 27 + 1.5 22 + 1.5 22 + 2.0 51 + 2.5 100 + 4.0 260 + 6.0 890 + 6.0	61 + 1.5 29 + 1.5 24 + 1.5 24 + 2.0 52 + 2.5 120 + 4.0 290 + 8.0 950 + 8.0	62 + 1.5 35 + 1.5 31 + 1.5 33 + 2.0 59 + 2.5 170 + 4.0 310 + 8.0 1200 + 8.0
700 mV	10 Hz -20 Hz 20 Hz -40 Hz 40 Hz -20 kHz 20 kHz -50 kHz 50 kHz -100 kHz 100 kHz -300 kHz 300 kHz -500 kHz 500 kHz -1 MHz	55 20 15 15	60 + 1.5 27 + 1.5 22 + 1.5 22 + 2.0 51 + 2.5 100 + 4.0 260 + 6.0 890 + 6.0	61 + 1.5 29 + 1.5 24 + 1.5 24 + 2.0 52 + 2.5 120 + 4.0 270 + 8.0 950 + 8.0	62 + 1.5 34 + 1.5 31 + 1.5 33 + 2.0 59 + 2.5 170 + 4.0 310 + 8.0 1200 + 8.0
			±(PPM of Reading)		
2.2V	10 Hz -20 Hz 20 Hz -40 Hz 40 Hz -20 kHz 20 kHz -50 kHz 50 kHz -100 kHz 100 kHz -300 kHz 300 kHz -500 kHz 500 kHz -1 MHz	55 19 15 15	60 26 20 21 49 92 220 830	61 28 22 23 50 110 230 890	62 34 27 33 57 160 280 1200
7V	10 Hz -20 Hz 20 Hz -40 Hz 40 Hz -20 kHz 20 kHz -50 kHz 50 kHz -100 kHz 100 kHz -300 kHz 300 kHz -500 kHz 500 kHz -1 MHz	55 19 15 18	60 27 20 23 62 140 360 1100	61 29 22 26 64 150 380 1200	62 36 27 35 73 180 450 1500
22V	10 Hz -20 Hz 20 Hz -40 Hz 40 Hz -20 kHz 20 kHz -50 kHz 50 kHz -100 kHz 100 kHz -300 kHz 300 kHz -500 kHz 500 kHz -1 MHz	55 19 15 18	60 28 20 23 62 140 360 1100	61 30 22 26 64 150 380 1200	62 37 27 35 69 180 450 1500
70V	10 Hz -20 Hz 20 Hz -40 Hz 40 Hz -20 kHz 20 kHz -50 kHz 50 kHz -100 kHz 100 kHz -300 kHz 300 kHz -500 kHz 500 kHz -1 MHz	55 19 15 22	60 29 23 25 64 140 370 1100	62 31 25 27 68 150 390 1200	63 39 34 39 85 180 490 1500
220V	10 Hz -20 Hz 20 Hz -40 Hz 40 Hz -20 kHz 20 kHz -50 kHz 50 kHz -100 kHz 100 kHz -300 kHz 300 kHz -500 kHz	55 19 15 24	61 30 23 30 66 160 410	62 32 25 34 69 170 480	64 40 34 49 83 220 680
700V	10 Hz -20 Hz 20 Hz -40 Hz 40 Hz -20 kHz 20 kHz -50 kHz 50 kHz -100 kHz	55 19 19	62 31 24 100 390	63 33 25 110 500	65 41 31 140 850
1000V	10 Hz -20 Hz 20 Hz -40 Hz 40 Hz -20 kHz 20 kHz -50 kHz 50 kHz -100 kHz	55 19 19	62 31 24 100 390	63 33 25 110 500	65 41 31 140 850

5790A Automated AC Measurement Standard

FLUKE® Calibration

Secondary Performance and Operating Characteristics

Voltage Rsange	Frequency Range	24 Hour AC Stability ±1°C Slow Filter Peak-Peak	Temperature Coefficient [1]		Input Resistance [2]
			10°C to 40°C	0°C to 10°C 40°C to 50°C	
		±µV	=PPM/°C		
2.2 mV	10 Hz -20 Hz 20 Hz -40 Hz 40 Hz -20 kHz 20 kHz -50 kHz 50 kHz -100 kHz 100 kHz -300 kHz 300 kHz -500 kHz 500 kHz -1 MHz	0.4 0.4 0.4 0.4 0.8 1.5 3.0 4.5	50 50 50 50 75 100 150 200	50 50 50 50 75 100 150 200	>10 MΩ
7 mV	10 Hz -20 Hz 20 Hz -40 Hz 40 Hz -20 kHz 20 kHz -50 kHz 50 kHz -100 kHz 100 kHz -300 kHz 300 kHz -500 kHz 500 kHz -1 MHz	0.4 0.4 0.4 0.4 0.8 1.5 3.0 4.5	15 15 15 15 25 60 80 125	15 15 15 15 25 60 80 125	>10 MΩ
22 m	10 Hz -20 Hz 20 Hz -40 Hz 40 Hz -20 kHz 20 kHz -50 kHz 50 kHz -100 kHz 100 kHz -300 kHz 300 kHz -500 kHz 500 kHz -1 MHz	0.4 0.4 0.4 0.4 0.8 1.5 3.0 4.5	5 5 5 5 8 10 40 100	5 5 5 5 8 10 40 100	>10 MΩ
		±(PPM of Reading)			
70 mV	10 Hz -20 Hz 20 Hz -40 Hz 40 Hz -20 kHz 20 kHz -50 kHz 50 kHz -100 kHz 100 kHz -300 kHz 300 kHz -500 kHz 500 kHz -1 MHz	18 18 18 18 24 24 48 150	5 5 5a 5 8 10 30 75	5 5 5 5 8 10 30 75	>10 MΩ
220 mV	10 Hz -20 Hz 20 Hz -40 Hz 40 Hz -20 kHz 20 kHz -50 kHz 50 kHz -100 kHz 100 kHz -300 kHz 300 kHz -500 kHz 500 kHz -1 MHz	12 8 8 8 18 24 36 120	1.5 1.5 1.5 2.0 5.0 10.0 20.0 50.0	3.0 3.0 3.0 3.0 8.0 10.0 20.0 50.0	>10 MΩ
700 mV	10 Hz -20 Hz 20 Hz -40 Hz 40 Hz -20 kHz 20 kHz -50 kHz 50 kHz -100 kHz 100 kHz -300 kHz 300 kHz -500 kHz 500 kHz -1 MHz	8 6 6 6 12 18 36 96	1.5 1.5 1.5 2.0 5.0 10.0 20.0 50.0	3.0 3.0 3.0 3.0 8.0 10.0 20.0 50.0	>10 MΩ
2.2V	10 Hz -20 Hz 20 Hz -40 Hz 40 Hz -20 kHz 20 kHz -50 kHz 50 kHz -100 kHz 100 kHz -300 kHz 300 kHz -500 kHz 500 kHz -1 MHz	8 5 5 5 10 18 30 90	1.5 1.5 1.5 2.0 5.0 10.0 20.0 50.0	3.0 3.0 3.0 3.0 8.0 10.0 20.0 50.0	>10 MΩ
7V	10 Hz -20 Hz 20 Hz -40 Hz 40 Hz -20 kHz 20 kHz -50 kHz 50 kHz -100 kHz 100 kHz -300 kHz 300 kHz -500 kHz 500 kHz -1 MHz	8 5 5 5 10 18 30 90	1.5 1.5 1.5 2.0 5.0 15.0 30.0 65.0	3.0 3.0 3.0 3.0 8.0 15.0 30.0 65.0	50 kΩ

[1] Add to uncertainty when more than 5°C from calibration temperature.
[2] Input capacitance approximately 100 pF.

5790A Automated AC Measurement Standard

Secondary Performance and Operating Characteristics (continued)

Voltage Rsange	Frequency Range	24 Hour AC Stability ±1°C Slow Filter Peak-Peak	Temperature Coefficient [1]		Input Resistance [2]
			10°C to 40°C	0°C to 10°C 40°C to 50°C	
		±(PPM of Reading)	=PPM/°C		
22V	10 Hz -20 Hz 20 Hz -40 Hz 40 Hz -20 kHz 20 kHz -50 kHz 50 kHz -100 kHz 100 kHz -300 kHz 300 kHz -500 kHz 500 kHz -1 MHz	8 5 5 5 10 18 30 90	1.5 1.5 1.5 2.0 5.0 15.0 30.0 65.0	3.0 3.0 3.0 3.0 8.0 15.0 30.0 65.0	50 kΩ
70V	10 Hz -20 Hz 20 Hz -40 Hz 40 Hz -20 kHz 20 kHz -50 kHz 50 kHz -100 kHz 100 kHz -300 kHz 300 kHz -500 kHz 500 kHz -1 MHz	8 5 5 5 18 36 48 120	1.5 1.5 1.5 2.0 5.0 15.0 40.0 75.0	3.0 3.0 3.0 3.0 8.0 15.0 40.0 75.0	50 kΩ
220V	10 Hz -20 Hz 20 Hz -40 Hz 40 Hz -20 kHz 20 kHz -50 kHz 50 kHz -100 kHz 100 kHz -300 kHz 300 kHz -500 kHz	8 5 5 5 18 36 48	1.5 1.5 1.5 2.0 5.0 15.0 40.0	3.0 3.0 3.0 3.0 8.0 15.0 40.0	50 kΩ
700V	10 Hz -20 Hz 20 Hz -40 Hz 40 Hz -20 kHz 20 kHz -50 kHz 50 kHz -100 kHz	8 5 5 18 36	1.5 1.5 1.5 5.0 15.0	4.0 4.0 4.0 7.0 15.0	500 kΩ
1000V	10 Hz -20 Hz 20 Hz -40 Hz 40 Hz -20 kHz 20 kHz -50 kHz 50 kHz -100 kHz	8 5 5 18 36	1.5 1.5 1.5 5.0 15.0	4.0 4.0 4.0 7.0 15.0	500 kΩ

[1] Add to uncertainty when more than 5°C from calibration temperature.
[2] Input capacitance approximately 100 pF.

Voltage Range	Autorange Limits [3]		Resolution	
	Upper	Lower	Filter Fast	Filter Med/Slow
2.2 mV	2.2 mV	600 µV	0.1 µV	0.1 µV
7 mV	7 mV	1.9 mV	0.1 µV	0.1 µV
22 mV	22 mV	6 mV	0.1 µV	0.1 µV
70 mV	70 mV	19 mV	0.1 µV	0.1 µV
220 mV	220 mV	60 mV	0.1 µV	0.1 µV
700 mV	700 mV	190 mV	1.0 µV	0.1 µV
2.2 V	2.2 V	600 mV	1.0 µV	0.1 µV
7 V	7 V	1.9 V	10 µV	1.0 µV
22 V	22 V	6 V	10 µV	1.0 µV
70 V	70 V	19 V	100 µV	10 µV
220 V	220 V	60 V	100 µV	10 µV
700 V	700 V	190 V	1.0 mV	100 µV
1000 V	1050 V	600 V	1.0 mV	100 µV

[3] In locked ranges readings may be made approximately 1% beyond the autorange limits.

Maximum non-destructive input: 1200V rms
Guard isolation: 10V peak
Volt-hertz product: 1 x 10 8
Frequency accuracy:
10-120 Hz: 100 ppm + 10 digits;
>120 Hz: 100 ppm + 2 digits over 0°C to 50°C
Frequency resolution:
1.00 Hz to 119.99 Hz
0.1200 kHz to 1.1999 kHz
1.200 kHz to 11.999 kHz
12.00 kHz to 119.99 kHz
0.1200 MHz to 1.1999 MHz
1.200 MHz to 11.999 MHz, (wideband only)
12.00 MHz to 30.0 MHz, (wideband only)
Reading rate:
<40 Hz: 2 seconds per reading
2 seconds at 40 Hz decreasing
linearly to 1 second at 200 Hz
>200 Hz: 1 second per reading
Maximum settling time to full specifications
(in range lock):
Filter off:
1 sample dc: 6 seconds
<200 Hz: 8 seconds >200 Hz: 4 seconds
Filter fast:
4 averaged samples dc: 10 seconds
<200 Hz: 16 seconds >200 Hz: 8 seconds
Filter medium:
16 averaged samples dc: 22 seconds
<200 Hz: 32 seconds >200 Hz: 16 seconds
Filter slow:
32 averaged samples dc: 40 seconds
<200 Hz: 64 seconds >200 Hz: 32 seconds
Filter buffer restart limits:
Fine:
Fast: 10 counts
Medium/Slow:
<220 mV: 10 counts >220 mV: 100 counts
Medium:
Fast: 100 counts
Medium/Slow:
<220 mV: 100 counts >220 mV: 1000 counts
Course:
Fast: 1000 counts
Medium/Slow:
<220 mV: 1000 counts >220 mV: 10000 counts
Input waveform: Specified for sinewave with THD less than 1%

5790A Automated AC Measurement Standard

FLUKE® Calibration

Wideband Uncertainty Specifications (Option -03)

Voltage [1] Range	Frequency Range	Flatness [2] 1 Year ±3°C ±(% of Reading + µV)	Flatness [3] Temperature Coefficient PPM/°C	Absolute Uncertainty 0°C to 50°C [4] ±(% of Reading + µV)			Resolution
				90 Days	1 Year	2 Years	
2.2 mV	10 Hz -30 Hz 30 Hz -120 Hz 120 Hz -1.2 kHz 1.2 kHz -120 kHz 120 kHz -500 kHz 500 kHz -1.2 MHz 1.2 MHz -2 MHz 2 MHz -10 MHz 10 MHz -20 MHz 20 MHz -30 MHz	0.10 + 0 0.05 + 0 0.05 + 0 0.05 + 0 0.07 + 1 0.07 + 1 0.07 + 1 0.17 + 1 0.30 + 1 0.70 + 2	75 75 75 75 75 75 100 200 200 400	0.5 + 1.2 0.5 + 1.2 0.5 + 1.2 0.5 + 1.2 0.5 + 1.2	0.6 + 1.5 0.6 + 1.5 0.6 + 1.5 0.6 + 1.5 0.6 + 1.5	0.8 + 2 0.8 + 2 0.8 + 2 0.8 + 2 0.8 + 2	0.1 µV
7 mV	10 Hz -30 Hz 30 Hz -120 Hz 120 Hz -1.2 kHz 1.2 kHz -120 kHz 120 kHz -500 kHz 500 kHz -1.2 MHz 1.2 MHz -2 MHz 2 MHz -10 MHz 10 MHz -20 MHz 20 MHz -30 MHz	0.10 + 0 0.05 + 0 0.05 + 0 0.05 + 0 0.07 + 1 0.07 + 1 0.07 + 1 0.10 + 1 0.17 + 1 0.37 + 1	75 75 75 75 75 75 100 200 200 300	0.4 + 5 0.4 + 5 0.4 + 5 0.4 + 5 0.4 + 5	0.5 + 7 0.5 + 7 0.5 + 7 0.5 + 7 0.5 + 7	0.7 + 8 0.7 + 8 0.7 + 8 0.7 + 8 0.7 + 8	0.1 µV
		±(% of Reading)					
22 mV	10 Hz -30 Hz 30 Hz -120 Hz 120 Hz -1.2 kHz 1.2 kHz -120 kHz 120 kHz -500 kHz 500 kHz -1.2 MHz 1.2 MHz -2 MHz 2 MHz -10 MHz 10 MHz -20 MHz 20 MHz -30 MHz	0.10 0.05 0.05 0.05 0.07 0.07 0.07 0.10 0.17 0.37	75 75 75 75 75 75 75 100 100 200	0.4 + 10 0.4 + 10 0.4 + 10 0.4 + 10 0.4 + 10	0.5 + 13 0.5 + 13 0.5 + 13 0.5 + 13 0.5 + 13	0.7 + 16 0.7 + 16 0.7 + 16 0.7 + 16 0.7 + 16	0.1 µV
70 mV	10 Hz -30 Hz 30 Hz -120 Hz 120 Hz -1.2 kHz 1.2 kHz -120 kHz 120 kHz -500 kHz 500 kHz -1.2 MHz 1.2 MHz -2 MHz 2 MHz -10 MHz 10 MHz -20 MHz 20 MHz -30 MHz	0.10 0.05 0.05 0.05 0.05 0.05 0.05 0.10 0.15 0.35	40 40 40 40 40 40 75 100 100 200	0.4 + 20 0.4 + 20 0.4 + 20 0.4 + 20 0.4 + 20	0.5 + 30 0.5 + 30 0.5 + 30 0.5 + 30 0.5 + 30	0.6 + 40 0.6 + 40 0.6 + 40 0.6 + 40 0.6 + 40	1.0 µV
220 mV	10 Hz -30 Hz 30 Hz -120 Hz 120 Hz -1.2 kHz 1.2 kHz -120 kHz 120 kHz -500 kHz 500 kHz -1.2 MHz 1.2 MHz -2 MHz 2 MHz -10 MHz 10 MHz -20 MHz 20 MHz -30 MHz	0.10 0.04 0.04 0.04 0.04 0.05 0.05 0.10 0.15 0.35	40 40 40 40 40 40 75 100 100 200	0.3 + 60 0.3 + 60 0.3 + 60 0.3 + 60 0.3 + 60	0.4 + 80 0.4 + 80 0.4 + 80 0.4 + 80 0.4 + 80	0.5 + 100 0.5 + 100 0.5 + 100 0.5 + 100 0.5 + 100	1.0 µV
700 mV	10 Hz -30 Hz 30 Hz -120 Hz 120 Hz -1.2 kHz 1.2 kHz -120 kHz 120 kHz -500 kHz 500 kHz -1.2 MHz 1.2 MHz -2 MHz 2 MHz -10 MHz 10 MHz -20 MHz 20 MHz -30 MHz	0.10 0.03 0.03 0.03 0.03 0.05 0.05 0.10 0.15 0.35	40 40 40 40 40 40 75 100 100 200	0.3 + 200 0.3 + 200 0.3 + 200 0.3 + 200 0.3 + 200	0.4 + 300 0.4 + 300 0.4 + 300 0.4 + 300 0.4 + 300	0.5 + 400 0.5 + 400 0.5 + 400 0.5 + 400 0.5 + 400	10.0 µV

[1] Range limits same as INPUT1 or INPUT2.
[2] Relative 1 kHz.
[3] Add to flatness specifications when more than 3°C from calibration temperature.
[4] At input connector.

5790A Automated AC Measurement Standard

Wideband Uncertainty Specifications (Option -03) (continued)

Voltage [1] Range	Frequency Range	Flatness [2] 1 Year ±3°C ±(% of Reading)	Flatness [3] Temperature Coefficient PPM/°C	Absolute Uncertainty 0°C to 50°C [4] ±(% of Reading + µV)			Resolution
				90 Days	1 Year	2 Years	
2.2V	10 Hz -30 Hz	0.10	40	0.3 + 300	0.35 + 400	0.4 + 500	10.0 µV
	30 Hz -120 Hz	0.03	40	0.3 + 300	0.35 + 400	0.4 + 500	
	120 Hz -1.2 kHz	0.03	40	0.3 + 300	0.35 + 400	0.4 + 500	
	1.2 kHz -120 kHz	0.03	40	0.3 + 300	0.35 + 400	0.4 + 500	
	120 kHz -500 kHz	0.03	40	0.3 + 300	0.35 + 400	0.4 + 500	
	500 kHz -1.2 MHz	0.05	40	0.3 + 300	0.35 + 400	0.4 + 500	
	1.2 MHz -2 MHz	0.05	75	0.3 + 300	0.35 + 400	0.4 + 500	
	2 MHz -10 MHz	0.10	100				
	10 MHz -20 MHz	0.15	100				
	20 MHz -30 MHz	0.35	200				
7V	10 Hz -30 Hz	0.10	40	0.3 + 500	0.35 + 800	0.4 + 1000	100.0 µV
	30 Hz -120 Hz	0.03	40	0.3 + 500	0.35 + 800	0.4 + 1000	
	120 Hz -1.2 kHz	0.03	40	0.3 + 500	0.35 + 800	0.4 + 1000	
	1.2 kHz -120 kHz	0.03	40	0.3 + 500	0.35 + 800	0.4 + 1000	
	120 kHz -500 kHz	0.03	40	0.3 + 500	0.35 + 800	0.4 + 1000	
	500 kHz -1.2 MHz	0.05	40	0.3 + 500	0.35 + 800	0.4 + 1000	
	1.2 MHz -2 MHz	0.05	75	0.3 + 500	0.35 + 800	0.4 + 1000	
	2 MHz -10 MHz	0.10	100				
	10 MHz -20 MHz	0.15	100				
	20 MHz -30 MHz	0.35	200				

[1] Range limits same as INPUT1 or INPUT2.
[2] Relative 1 kHz.
[3] Add to flatness specifications when more than 3°C from calibration temperature.
[4] At input connector.

Maximum non-destructive input: 200V rms
Wideband guard isolation: 0.5V peak
Wideband input impedance:
1 kHz: 50W (± 0.5%)
30 MHz: 50W (± 5%)
Wideband VSWR with 50W source:
1 kHz: 1.005
30 MHz: 1.05

Shunt input characteristics

The shunt input was designed to allow ac/dc current transfers using the Fluke A40 Series Current Shunts. 5790A-7001 A40/A40A Current Shunt Adapter and Cable required.

Shunt model	Current range
A40	2.5 mA-5A
A40	A 5A-20A

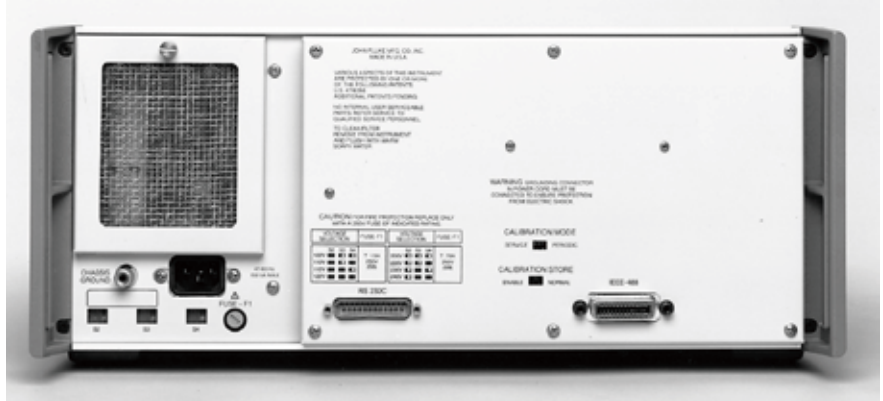
Input resistance: 91W± 1%
Operating input voltage: 250 mV to 500 mV
Maximum non-destructive input: 50V rms

General specifications

Warm-up time: 30 minutes
Relative humidity:
Operating: 45% to 50°C
75% to 45°C
95% to 30°C
Storage: <95% non-condensing
Altitude:
Operating: 3,050m (10,000 ft)
Non-operating: 12,200m (40,000 ft)
Temperature:
Operating: 0°C to 50°C
Calibration: 15°C to 35°C
Storage: -40°C to 70°C
EMI/RFI: Complies with FCC Part 15 Subpart B, Class B; EN50081-1, EN50082-1

Size:
Height: 17.8 cm (7 in) standard rackmount + 1.5 cm (0.6 in)
Width: 43.2 cm (17 in)
Depth: 63 cm (24.8 in)
Maximum power:
5790A: 95 VA
With wideband: 120 VA

Weight:
5790A: 24 kg (53 lb)
With wideband: 24.5 kg (54 lb)
Line power: 47 Hz to 63 Hz; ±10% of selectable line voltages: 100V, 110V, 115V, 120V, 200V, 220V, 230V, 240V
Safety: Designed to comply with UL3111; EN61010; CSA C22.2 No. 1010; ANSI/ISI S82.01-1994
Remote interfaces: RS-232, IEEE-488



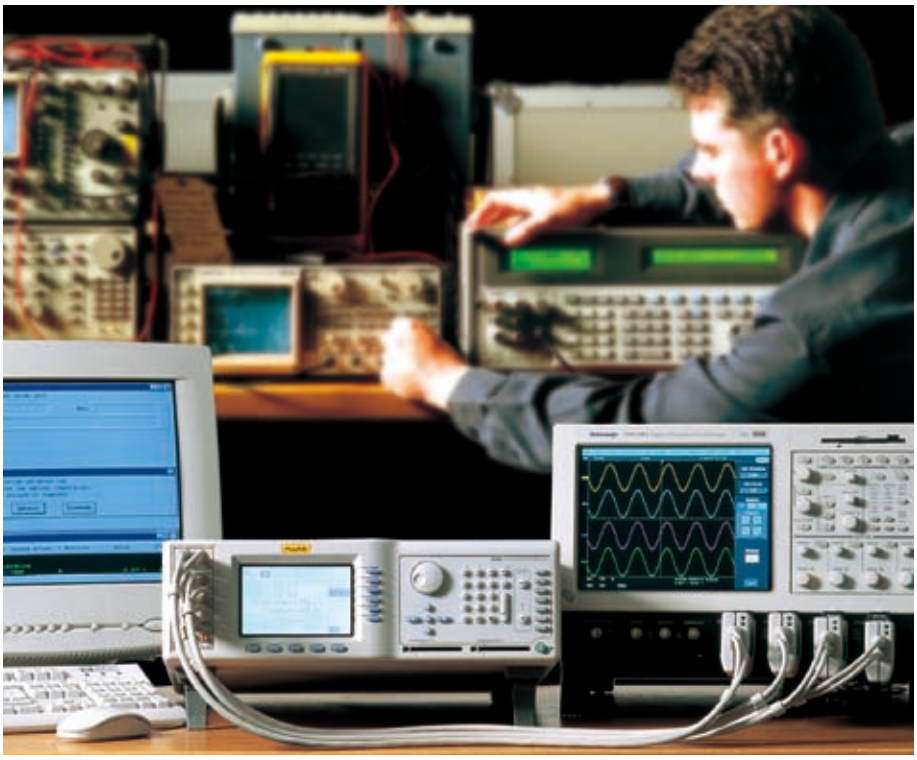
5790A rear panel.

9500B Oscilloscope Calibrator

FLUKE®
Calibration

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

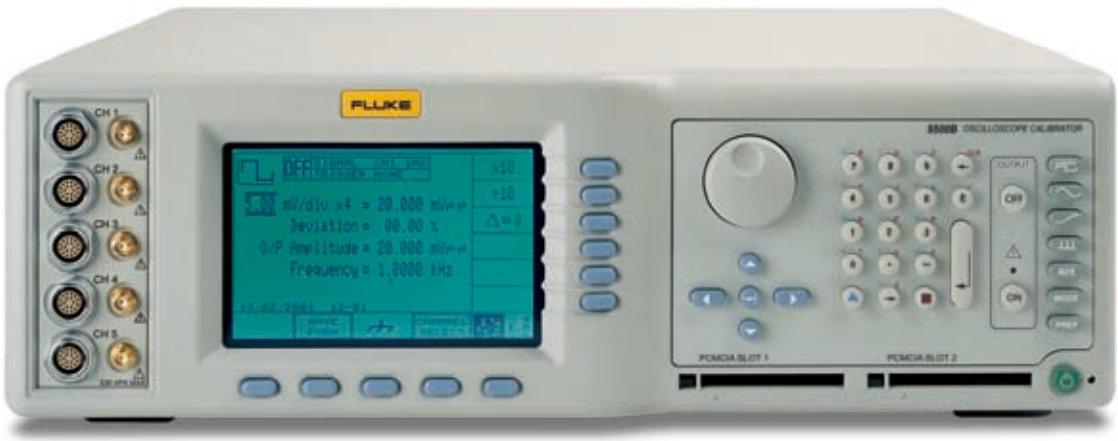
- Full automation provides totally hands-free oscilloscope calibration. even on today's ultra-high performance, multi-channel, feature rich instruments.
- Continuous upgradeability helps you protect your investment in the tools you need to manage ever changing workload demands.
- Leveled sinewaves to 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 oscilloscopeinput. now there is no doubt whether waveform aberrations are down to connecting leads or the oscilloscope itself.



Oscilloscope calibration can be complex, time To compound the problem, rapid developmentsconsuming and expensive. A significant amountof 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.



9500B Oscilloscope Calibrator

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.

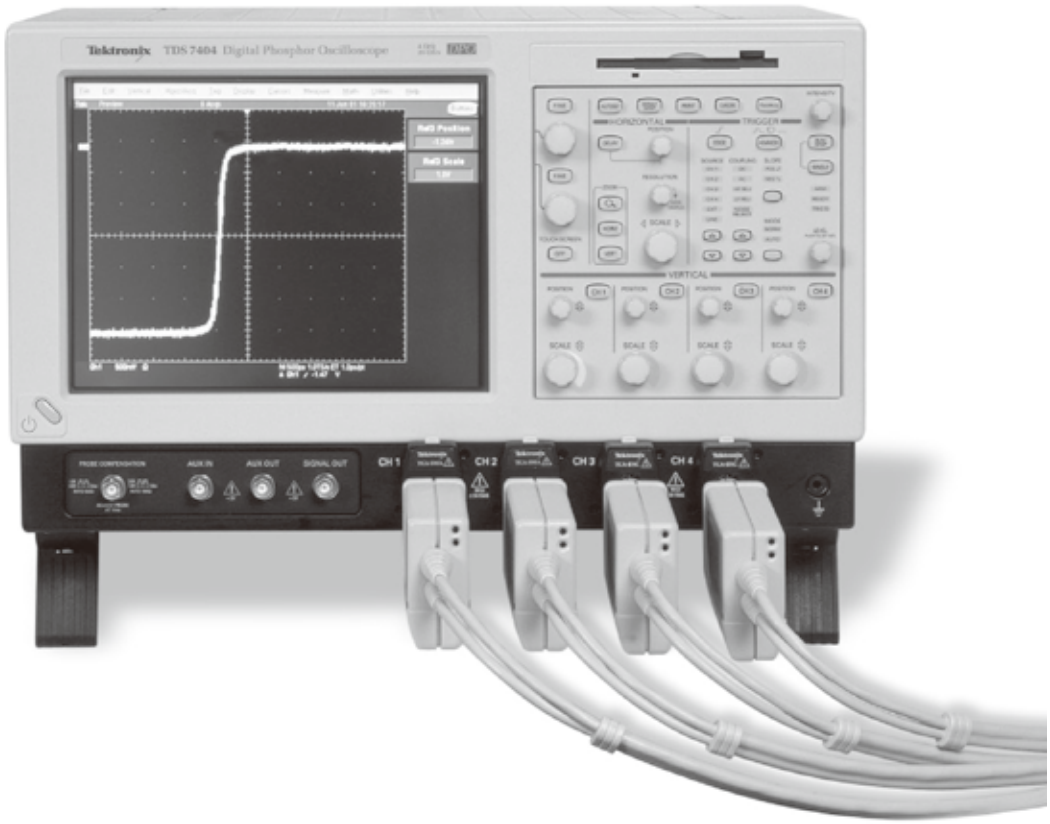
Over the last decade, the oscilloscope of choice has migrated from a two-channel instrument to a more complex four-channel device.

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.



9500B Oscilloscope Calibrator

FLUKE®
Calibration

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

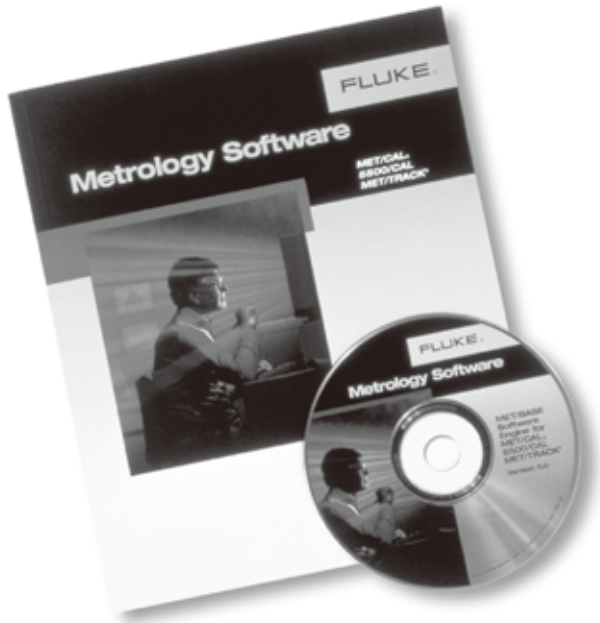
To keep pace with the fast changing oscilloscope market, Fluke is continuously writing new calibration procedures. For a one-off, low-cost payment (less than it would cost you to have three or four DSO oscilloscope calibration procedures written), you can buy into our MET/SUPPORT Gold Software Support 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).

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

FLUKE®
Calibration

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 to100 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.

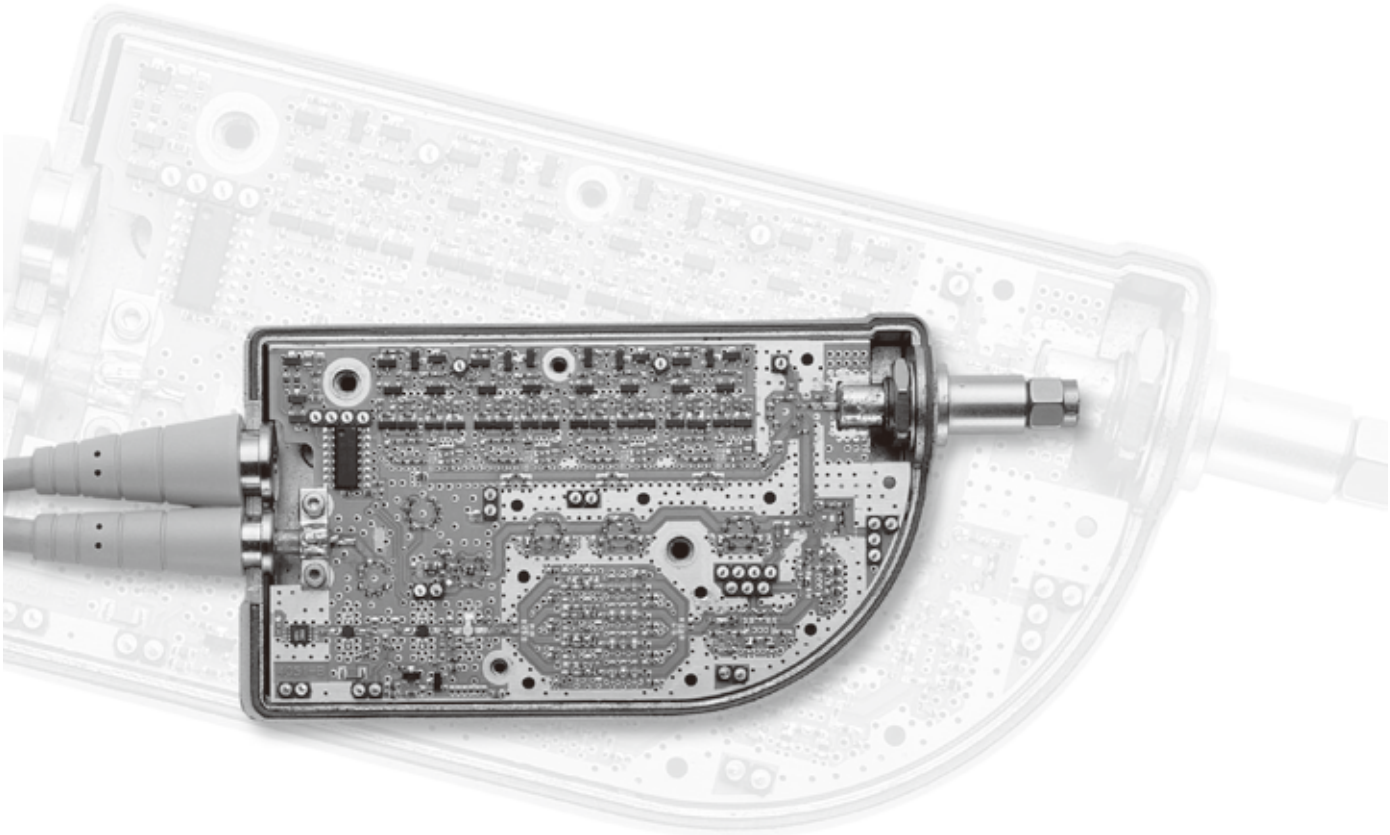
In a conventional, cabled environment, mismatches, unknown or unpredictable cable transmission properties and less than perfect connections all contribute to degradation of the signal between the calibrator output and the oscilloscope input. When using active heads, the calibrator output and the oscilloscope 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 Ω (8.88 mV to 5.56 V pk-pk into 50 Ω 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 Ω input terminations.

Automatic switching to 50 Ω 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 Ω).

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 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 ± 5 °C, 1 year, 99 % where Factory TCal = 23 °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 MΩ	DC Into 50 Ω	Square Wave Into 1 MΩ	Square Wave Into 50 Ω
Amplitude	± 1 mV to ± 200 V	± 1 mV to ± 5 V	40 µV to 200 V pk-pk	40 µV to 5 V pk-pk
Accuracy	±(0.025 % + 25 µV)		≥ 1 mV ±(0.1 % + 10 µV), < 1 mV ±(1 % + 10 µV) @ ≤ 10 KHz	
Ranging	Volt/div factors of 1, 2, 5 or 1, 2, 2.5, 4, 5; or continuously variable			
Deviation	± 11.2 % (Including over and under-range)			
Rise/fall time			< 100 V pk-pk < 150 ns; ≥ 100 V pk-pk < 200 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.

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

	500 ps Edge Pulse Into 50 W or 1 MΩ	HV Edge Pulse Into 1 MΩ	150 ps Fast-Edge (9530 Head Only) Into 50 Ω	70 ps Fast-Edge (9560 Head Only) Into 50 Ω	25 ps Fast-Edge (9550 Head Only) Into 50 Ω
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 V pk-pk < 150ns ** ≥ 100 V pk-pk < 200 ns **	150 ps	70 ps	25 ps
Accuracy	+50 ps to -150 ps	NA	± 25 ps	± 12 ps	± 3 ps
Accuracy (displayed value)	± 35 ps	NA	± 12 ps	± 8 ps	± 1.5 ps
Duty cycle	10 %	50 %	10 %	10 %	10 %
Aberrations (Into VSWR 1.2:1)	<± 2 % pk in 8 GHz <± 1.5 % pk in 3 GHz (first 10 ns)	<± 2 % pk (first 500 ns)	<± 3 % pk in 8 GHz <± 2 % pk in 3 GHz (first 1 ns)	<±4 % pk in 20 GHz <± 3 % pk in 8 GHz <± 1 % pk in 3 GHz (first 700 ps)	<±5 % pk in 20 GHz <± 3 % pk in 10 GHz <± 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 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	± 45 % (Including over-range)			
Rise/fall times	1 ns typ.	NA	1 ns typ.	2.5 % of period
Timing accuracy	< 83 µs ± 0.25 ppm, ≥ 83 µs ± 3 ppm			
Amplitude	100 mV to 1 V pk-pk			
Sub-division	Every tenth marker can be set to higher amplitude for periods ≥1 µs for all waveshapes			

Line frequency timing markers are available in Square waveform. Jitter wrt Line zero crossing ± 20 µs pk-pk.
Periods below 2 ns are not recommended for 1 MΩ input applications. 9560 50 Ω 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 MΩ	DC Into 50 Ω	Square Wave Into 1 MΩ	Square Wave Into 50 Ω
	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	± 25 ps any channel to any channel			
Periods below 2 ns are not recommended for 1 MΩ input applications. 9560 50 Ω only.				

Input impedance functions (Not available via 9550 Active Head)

Resistance measurement	10 Ω to 40 Ω	40 Ω to 90 Ω	90 Ω to 150 Ω	50 kΩ to 800 kΩ	800 kΩ to 1.2 MΩ	1.2 MΩ to 12 MΩ
Accuracy	± 0.5 %	± 0.1 %	± 0.5 %	± 0.5 %	± 0.1 %	± 0.5 %
(Not available via 9550 and 9560 Active Head)						
Capacitance measurement	**1 pF to 35 pF**	**35 pF to 95 pF**				
Accuracy	± 2 % ± 0.25	± 3 % ± 0.25				

Pulse width function (Not available via 9550 Active Head)

Pulse width	1 n to 100 ns
Accuracy	<± 5 % ± 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	< ± 5 % pk (typical)
Width stability	< 10 ps pk-pk 10 mins/1 °C
Pulse jitter (wrt trigger)	< 5 ps pk-pk
Frequency	1 kHz to 1 MHz
Amplitude	1 V pk-pk into 50 W

9500B Oscilloscope Calibrator

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 Ω
Polarity	Positive/negative
Duration	0.2 s to 100 s (subject to pulse energy limits)
Energy power in 50 Ω	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	<± 25 ps ch to ch
Adjusted skew	<± 5 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 < ± 50 pA
Short circuit output	Offset < ± 15 µV
LF linear ramp	
Waveforms	1 V pk-pk triangle symmetrical about ground
Linearity	<± 0.1 % deviation over 10 to 90 %
Ramp time	1 ms, 10 ms, 100 ms or 1 s

9640A Series

The Fluke Calibration 9640A and 9640A-LPNX RF Reference Sources are designed specifically for RF calibration, featuring a calibration- oriented user interface, precision signal level and attenuation, high signal purity and precision low distortion modulation.

This unique combination of features and performance makes them clearly superior to the general purpose signal generators and array of ancillary equipment often used in traditional RF calibration systems. The 9604A-LPNX low phase noise version provides superior phase noise performance.

The 9640A Series simplifies and speeds up calibration procedures, reduces opportunities for operator errors, and greatly simplifies RF metrology. As the core of an RF and microwave calibration system, the 9640A covers the majority of test points required for calibrating spectrum analyzers of any frequency range.

As RF calibration workload has grown more complex, often at reduced purchase cost, the pressures for greater efficiency and lower cost in RF calibration have also grown. Used manually, the 9640A models reduce complexity, errors and calibration times. Used with MET/CAL® Calibration Management Software and the extensive Fluke Calibration procedures library, the resulting automated system improves efficiency and dramatically increases capacity. With "walk-away" MET/CAL automation, the 9640A can perform the majority of tests without operator intervention, freeing highly skilled operators to perform other tasks.

Broad workload coverage

The 9640A and 9640A-LPNX Reference Sources can help you calibrate a broad range of RF test equipment:

- Spectrum analyzers
- Modulation meters and analyzers
- RF power sensors
- Measurement receivers
- Frequency counters
- Attenuators
- and more

..... all at either 50 ohm or 75 ohm impedence.

9640A Series

FLUKE ®
Calibration

A cost effective, compact solution for RF and microwave calibration systems

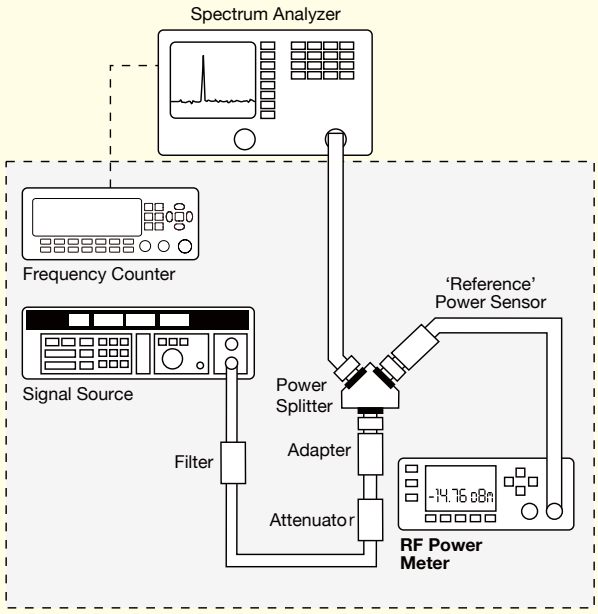
The 9640A Series takes the central role and typically halves the cost of a high capability RF calibration system. Its unique features and performance enable it to replace up to four signal sources (from audio/function generators to RF signal and low phase noise sources), power meters and power sensors, step attenuators, filters, pads, couplers, and also a frequency counter with the 9600FC integrated counter option.

For many spectrum analyzer models operating below 4 GHz, the 9640A can perform the entire calibration with a single connection and the potential for total automation.

For high performance high frequency spectrum analyzers, the 9640A can perform more than 80 percent of all the tests required. In this case, an existing RF and microwave source is also used. All can be controlled by MET/CAL calibration automation software.

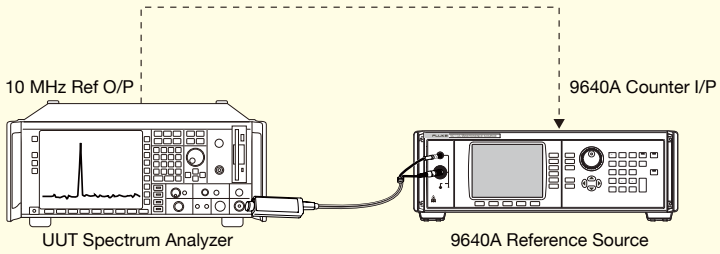
The 9640A features and performance make them ideal for calibrating other RF workload, including RF millivoltmeters, signal level meters, modulation analyzers, receivers, counter/timers and power sensor linearity. Reducing the number of instruments in a calibration system brings many benefits. Metrology is simpler with fewer error sources and uncertainty contributions to consider. System support costs are reduced, as there are fewer instruments to maintain and fewer vendors to manage. A smaller, more compact and robust system becomes a practical onsite calibration solution, with lower transport costs and setup and tear-down delays.

The 9640A models are designed to match or exceed the performance and functionality of the long obsolete HP3335A and HP8662/3A signal sources often present in existing calibration systems. HP3335A GPIB command emulation is standard in both 9640A models and HP8662/3A emulation is optional in the 9640A-LPNX. Replacing these popular but difficult-to-maintain products becomes just a plug-and-play substitution. HP8662/3A GPIB command emulation is installed on the 9640A-LPNX model as a "try before you buy" temporary license for convenient and thorough compatibility testing.



The instruments in the grey area in the above figure are typically used to deliver precision level when testing spectrum analyzer frequency response and attenuation. The Fluke Calibration 9640A Series shown in the figure below, has the level and attenuation precision, without the need for external characterization, to help simplify RF workload calibration.

Besides improving test efficiency, the multi-functional capabilities and precision leveling head attenuation of the 9640A makes it easier to use manually or automate your RF calibration system.



9640A Series

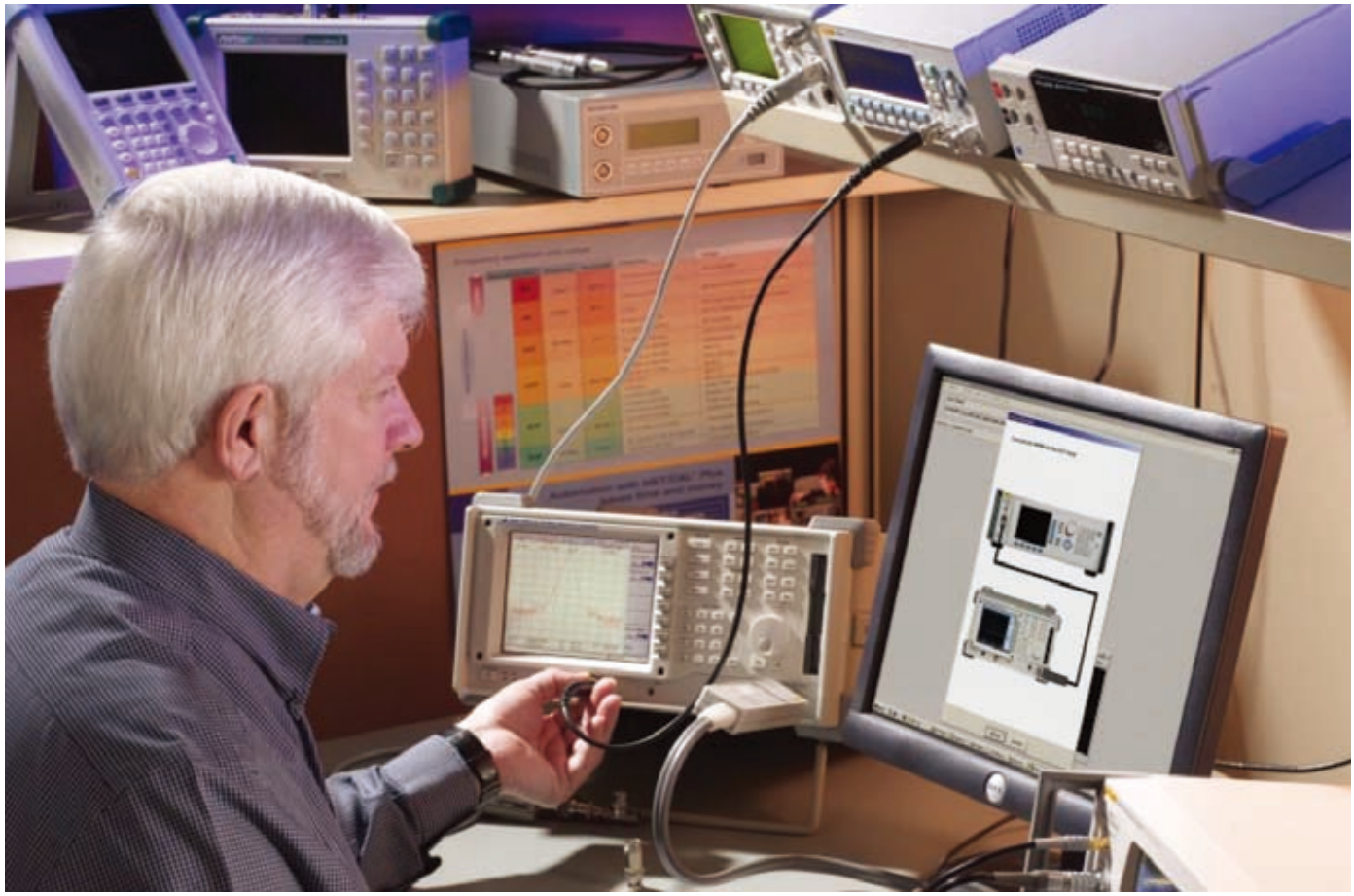
The 9640A Series provides unrivalled level and attenuation accuracy, with high signal purity, low harmonic and spurious content. A rugged, precision leveling head delivers the 9640A signals directly to the unit under test from a floating (ground isolated) signal source.

This minimizes losses, noise, interference, and mismatch errors, and maintains the integrity of low-level signals. Uniquely in RF calibration, the 9640A accurately displays the applied output level and can also calculate UUT error and display it directly. This is all achieved through a single connection, eliminating the power meters and sensors, step attenuators and filters required when using general purpose signal generators in calibration applications.

This unique "connect once, measure many" capability not only simplifies the calibration process but also greatly reduces the number of measurement error sources and uncertainty contributions. The standard 9640A and 9640A-LPNX models are supplied with a 50 ohm leveling head. The /75 models add the optional 75 ohm leveling head, bringing the same ease of use, metrology and accuracy benefits to 75 ohm calibrations, without the losses and additional uncertainties of an impedance convertor.

Each 9640A instrument is supplied with a comprehensive ISO 17025 compliant certificate of calibration with results data and uncertainties for all key parameters, including level and attenuation, output VSWR, and phase noise. In addition to providing traceability, RF metrology and uncertainty analysis become much simpler and faster. Accredited certification is available for both 9640A models and both 50 ohm and 75 ohm heads. The mainframe and heads are calibrated together as a system.

The 9640A Series user interface is designed to simplify common calibration processes for typical items in your workload, such as spectrum analyzers, RF level meters and receivers. Parameter offset, stepping, relative and UUT error readout modes allow RF calibration technicians and metrologists to work quickly, accurately and efficiently, using facilities that have long been available on dc and lf calibrators. Even in fully automated applications, the simple



calibration-oriented user interface makes troubleshooting easier.

Use MET/CAL2® software for "walk-away" automation

In a typical automated RF calibration process, the operator must frequently intervene to change test setups, thus limiting the benefits that can be realized by the automation. Walk-away automation will increase calibration system capacity by 25 % and will free up operator capacity of 50 % or more to other value-adding tasks rather than waiting for the next system setup change.

For example, the manufacturer's calibration procedure for calibrating the Agilent E4407B 26.5 GHz spectrum analyzer requires 27 different and complex test setups.

On the other hand, the 9640A Series, used with MET/CAL Calibration Management Software, performs the major core of required tests with a single setup. Only four additional setups are needed to complete the MET/CAL procedure.

MET/CAL procedures created by Fluke Calibration for the 9640A models optimize operator time and efficiency by maximizing the time available for the operator to leave the system running unattended, with any required lead changes occurring at the beginning or end of the calibration process. For example, the E4407B MET/CAL procedure for the 9640A-LPNX allows more than 90 minutes of "walk-away" time within the total two-hour runtime.

Use MET/CAL software's Flexible Standards feature to automate the other instruments in your system. This capability allows you to substitute equivalent standards within the procedures, so you aren't locked into a specific reference model.

By using MET/CAL, Fluke Calibration has been able to develop calibration procedures for a wide variety of RF instruments and calibration standards supporting a wide variety of manufacturers.

New procedures and supported Flexible Standards are released regularly. A current list of procedures and supported Flexible Standards is available on the Fluke Calibration web site at **www.flukecal.com/9640A.**

MET/CAL procedures for RF calibration

The following list shows only some of the procedures available for use with the 9640A Series. For a more complete and current list, visit the Fluke Calibration website at www.flukecal.com/9640A. If you cannot find the procedure that you need in this listing, MET/CAL software allows you to modify any procedure to meet a similar requirement. Alternatively you can now request a custom designed procedure from Fluke Calibration.

Product family	Models
Agilent & HP E4400 (ESA) series	E4401B E4402B, E4403B, E4404B, E4405B, E4407B, E4408B, E4411B
Agilent E4440A (PSA) series	E4440A, E4443A, E4445A, E4446A, E4447A & E4448A
Agilent 8490 series	8495A (Opt001), 8496A (Opt001),
HP / Agilent 8560 series	8560A/E/EC, 8561B/E/EC, 8562A/E/EC, 8563A/E/EC, 8568B
HP / Agilent 8590 series	8594E, 8590A, 8591C
R&S FSH series	FSH3, FSH6, FSH13, FSH23, FSH26
R&S FSU / FSQ series	FSU3, FSU8, FSU26, FSQ3, FSQ8, FSQ26
R&S FSP / FSV series	FSP3, FSP7, FSP13, FSV3, FSV7, FSV13
Anritsu MS2600 series	MS2661C/N
Anritsu MG3690B series	MG3691B, MG3692B, MG3694B, MG3696B
Aeroflex IFR 2390 series	2394, 2395
Tektronix RSA3000 series	3408B

MET/CAL Flexible Standards and Sensor FSCs

The following examples are available to be used with procedures developed for the 9640. Visit the Fluke Calibration website at www.flukecal.com/9640 for a more complete listing. If the microwave source that you own is not currently available, please request that it be added by contacting your local Fluke Calibration sales representative.

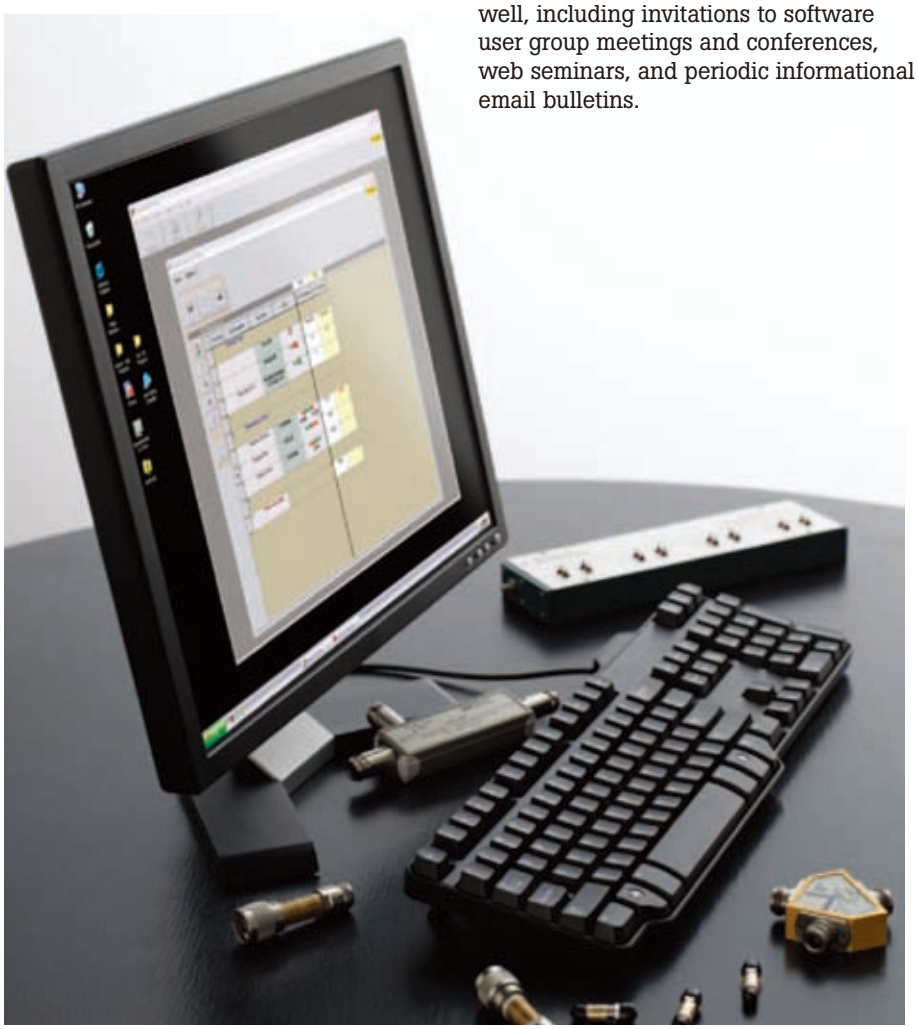
Product family	Models
HP/Agilent MW Signal Generators	8362X, 8363X, 8364X, 8365X, 8340, 8341, 8254, 8257, 8267
R&S MW Signal Generators	SMF100A
Anritsu MW Signal Generators	MG3691B, MG3692B, MG3696B

9640A Series

Not every calibration can be automated. Passive workload such as attenuators, pads, adapters, filters and cables are probably calibrated manually.

Other applications for manually entered data may be low volume workload, for which an automated procedure does not exist, or instruments that do not feature a suitable remote control interface. Manual MET/CAL software is designed for these types of applications. Manual MET/CAL software supports manual data entry, testing against limits and calibration certificate generation. Most importantly, Manual MET/CAL software interfaces this data directly to the same database used by MET/CAL software.

And it's fully compatible with Fluke Calibration MET/TRACK® asset management software.



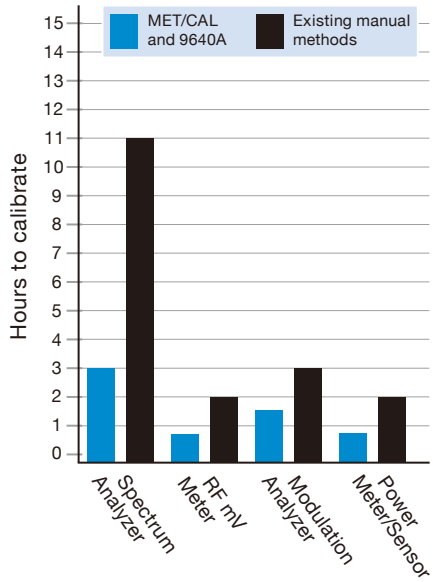
The software support you need, when you need it

Enroll in the annual MET/SUPPORT Gold program and you will receive premium support and services to help keep you as productive as possible. In addition to priority support by telephone, fax or email, you get free access to the Fluke Calibration library of Warranted Procedures, software updates and upgrades, discounts on training courses and more. Even if you use only a few of the Gold services, you can easily recover more than the cost of your membership fee.

If you need to arrange for training for yourself or your staff, Fluke Calibration can help there too, with a broad range of classes on metrology principles, lab management, software use, procedure writing and more.

The Fluke Calibration commitment to support provides additional benefits as well, including invitations to software user group meetings and conferences, web seminars, and periodic informational email bulletins.

Productivity improvements with MET/CAL® software and the 9640A.



9640A Series

FLUKE ®
Calibration

Custom 9640A RF calibration systems and MET/CAL procedures: designed, built and supported by Fluke Calibration

By basing a solution on a 9640A Series reference source and MET/CAL calibration software, Fluke Calibration can meet your RF calibration needs with a cost effective solution. Currently to a maximum frequency of 50 GHz, Fluke Calibration will specify system instruments, standards and components from the Fluke product line, as well as from other leading suppliers. We may even be able to integrate equipment that you already own.

When Fluke or partners are specified, we can supply the equipment in floor-standing, bench-top or ruggedized portable 19-inch rack frames, including convenient and secure drawers or cases for any required RF components (pads, adapters, cables, bridges, splitters, etc.also specified and supplied). Experienced Fluke Calibration technicians will even come to your site, train your staff, and install your new system for you.

RF systems can be complex to define. Sourcing instruments and components from multiple manufacturers is time consuming, and integrating everything into a working and traceable system can be tricky, especially if the system also needs to be rugged and easily transportable.

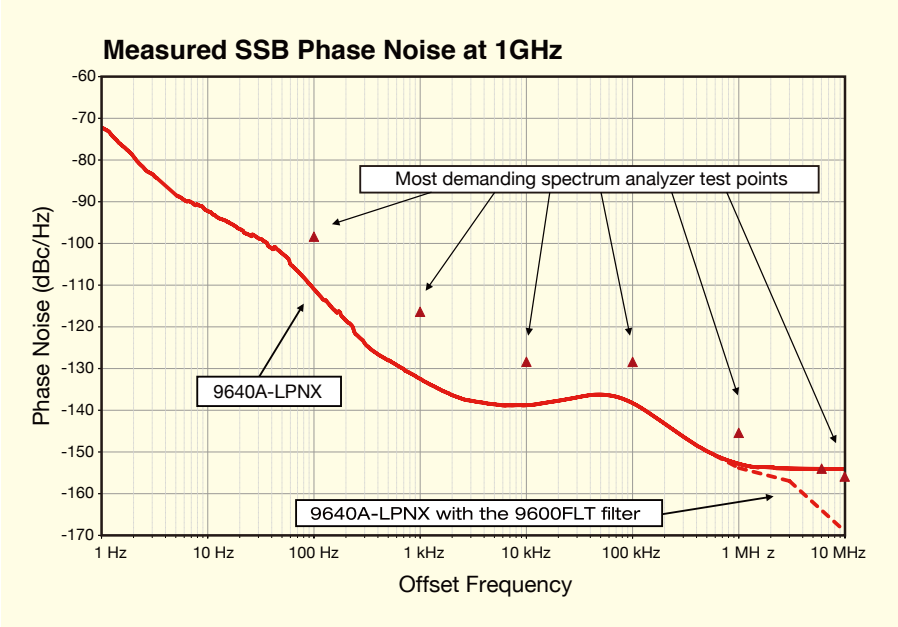
Conflicting requirements can lead you to compromise on a solution that doesn't do everything you need, or, on the other hand, cause you to spend too much. Automation, metrology and accreditation, and training has also been costly and time consuming.

- Reduce your definition cost, purchase cost, metrology and accreditation costs, plus cost of ownership.
- Automate your calibration and inventory management tasks and maximize operator "walk away" time.
- Automate to your specific requirements and for more unusual workload using custom designed MET/CAL procedures.
- Reduce human error, required training and intervention.
- Greatly improve calibration station capability-typically a 25 % improvement over other automated solutions.
- Greatly improve operator/operational efficiency-typically a 50 % improvement over other solutions.

If you would like to explore the design of a new RF calibration system and/or custom MET/CAL procedures, please contact your Fluke Calibration sales office to begin discussion of options and the specification process.

What can you calibrate with a Fluke RF calibration system?

- Measuring instruments and components to 50 GHz
- Bench and handheld spectrum analyzers (typically < 20 minutes for a modern handheld)
- High performance spectrum analyzers (typically < 2.5 hours)
- Measuring receivers, modulation analyzers or meters and signal generators
- Power Sensors
- Oscilloscopes and RF millivolt meters
- Timer and frequency counters
- RF and microwave components



9640A-LPNX state-of-the art phase noise performance

With reduced phase noise levels at low offset frequencies and now specified at offsets from 1 Hz to 10 MHz from the carrier frequency, the 9640A-LPNX offers exceptional phase noise performance right across its operating frequency range.

With more than ample capability for today's high performance spectrum analyzer workload, there is performance margin for future workload enhancements. Phase noise data is included in the 9640A certificate of calibration.

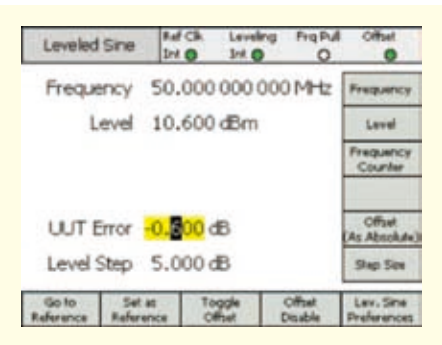
Instead of relying only on the more conservative guaranteed specifications, users have actual performance data and Fluke's measurement uncertainty for their unit.

Even with the best low phase noise signal generators, filters are occasionally used during very high performance spectrum analyzer phase noise calibration tests to reduce noise levels at wide (high) offset frequencies and improve test margins. The 9600FLT 1 GHz bandpass filter accessory is purpose-designed for high performance spectrum analyzer wide-offset phase noise testing and connects easily to 9640A models in either benchtop or rack-mounted applications.

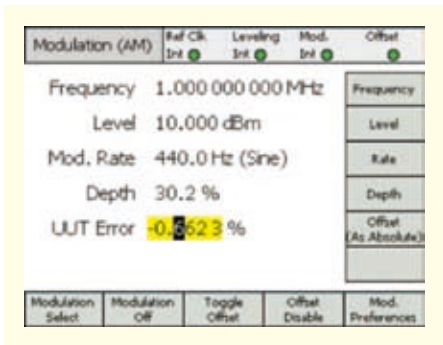
Using the 9640A Series with other automation solutions

The 9640A Series integrates easily into existing automated systems and software. The time savings and efficiency gains offered by the 9640A Series can be realized by structuring test sequences to take full advantage of its "connect once, test many" capabilities.

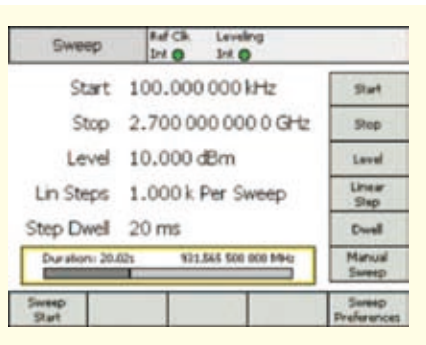
Alternatively, the 9640A Series' HP3335A and HP8662/3A emulation provides a drop-in replacement solution overcoming reliability and support problems with these obsolete products.



Leveled sine and display of calculated UUT level error.



Amplitude modulation and display of calculated UUT depth error.



Sweep frequency and sweep progress indication.

9640A Series

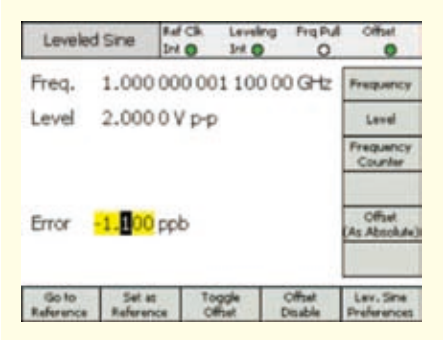
FLUKE ®
Calibration

General purpose applications

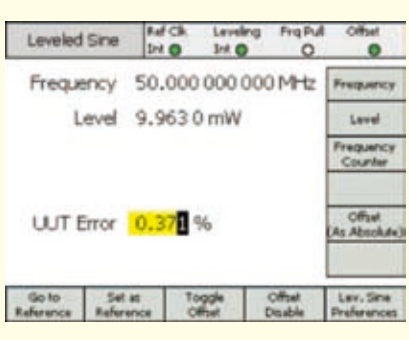
Many applications in R&D, manufacturing test and ATE need better performance than a general purpose signal generator can provide. If critical parameters include wide frequency coverage, fine frequency or sweep resolution, low harmonics and spurious content, signal level and attenuation accuracy, or dynamic range, the 9640A could very likely be the ideal solution and the 9640A–LPNX model for applications requiring frequency resolution, low phase noise, jitter or modulation residuals. Replacement of HP3335A and HP8662/3A level and signal generators in ATE systems is made easy by the 9640A Series GPIB emulation of these aging obsolete products.

New features included in the 9640A Series

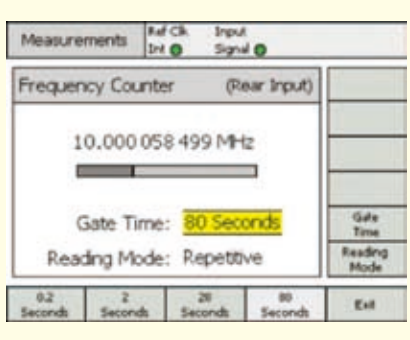
- Improved level accuracy and attenuation Specifications for better test uncertainty ratios against the most demanding workloads
- 9640A–LPNX model improved phase noise Reduced close–in phase noise and specifications to 1 Hz offsets
- Optional integrated 50 MHz frequency counter Reducing the number of instruments needed in an RF calibration system in the lab or onsite for UUT frequency reference testing
- Extended leveled sine frequency setting resolution An enhanced mode with 10 uHz resolution at all frequencies, giving a maximum display and setting resolution of 4.023 999 999 999 99 GHz.
- Leveled sine minimum output frequency of 1 mHz Replacing a function generator in many multipurpose calibration systems, enhancing the 9640A Series versatility
- External phase modulation Also with 1 MHz bandwidth for phase and frequency modulation
- Narrow range–locked sweep Enables faster, smoother frequency sweep across a narrow channel or filter characteristic.
- 9600FLT 1 GHz wide offset phase noise filter A bandpass filter designed to reduce wide offset phase noise at 1 GHz carrier frequency. Used to enhance performance margin (TUR) when calibrating the very best spectrum analyzer workload.



Leveled sine with high resolution frequency mode enabled.



Leveled sine, wutput in watts and display of UUT error in percent.



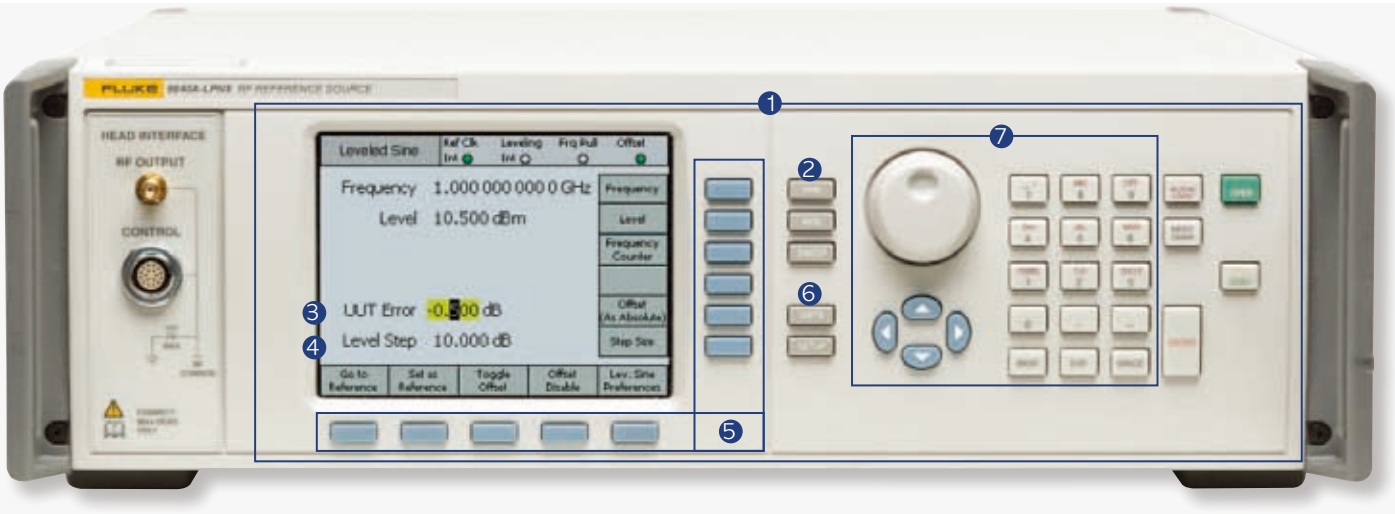
Optional frequency counter with reading progress.

9640A Series

The 9640A Series front panel is equipped with dedicated function keys, context-sensitive soft- keys, and a bright, easy-to-read color display that makes it easy to learn and operate. Output parameters may be set using multiple units; for example, output level may be set in terms of power watts (or dBm), voltage (RMS, peak to peak or dB uV) and using familiar multipliers and exponent forms. Useful as a ready reckoner, you can move easily between voltage, power and dB units without losing entered values or accuracy.

The user interface is designed by metrologists to simplify common calibration processes for typical items in your workload, such as spectrum analyzers, RF level meters and receivers.

Offset, stepping, relative and error modes allow calibration technicians and metrologists to work quickly, accurately and efficiently, following familiar calibration procedures and making it easy to determine performance and tolerances of units under test.



1. Clean, simple front panel with a large display screen makes the 9640A Series easy to learn and straightforward to use.
   The color LCD display clearly indicates output conditions and simplifies operator execution.
2. Primary function keys select sine, modulation or sweep.
3. Level offset function provides UUT error or source offset.
4. Level step function enables repetitive measurements to be performed quickly.
5. Soft menu keys adapt to required function.
6. User defined context sensitive measurement units.
7. Operator can select from spin-wheel, cursor keys or use direct numeric entry.

The 9640A system includes a 50 Ohm or optional 75 Ohm precision leveling head.
The head delivers fully floating signals directly to the UUT to ensure the accuracy and integrity of the reference generator's output signals at the device under test input.

9640A Series

FLUKE® Calibration

Support for your hardware when you need it

Fluke Calibration operates global calibration and repair facilities to keep your hardware in top working order. A variety of service programs are available, including the Priority Gold CarePlan, which features:

- Annual calibration included (standard or accredited) with guaranteed three-day in- house turnaround[1,2]
- Free repairs with guaranteed ten-day in- house repair (includes calibration)[2,3]
- Pre-paid, priority freight on return of instrument
- Special Priority Gold telephone help line or web support for member assistance
- Free product updates
- Terms: one-year, three-year and five-year plans available
- 10 % off on calibration product upgrades
- 20 % off any Fluke metrology training for any of your personnel
- Automatic 45-day and 15-day calibration due notification
- Free transit case for your instruments (Europe only)

[1] Three-day in-house turnaround not available in all countries; contact your local Fluke representative for details. Priority shipping times vary by country.

[2] One-year and three-year Priority Gold CarePlans do not cover instrument repairs in the first 30 days after plan purchase. Five-year plans are eligible for immediate repair services covered under the program.

[3] Instruments showing signs of failure due to physical abuse, improper operation or application do not qualify for free repair and will be repaired at standard repair rates.

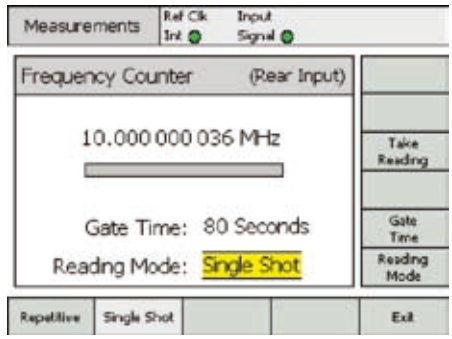
Summary specifications

Key specifications summary (Refer to the extended specifications for full and detailed specifications).		
Range	Frequency specifications	Level specifiications (50 Ω output, see extended specifications for 75 Ω)
	1 mHz to 4 GHz	-130 to +24 dBm to 128 MHz, 14 dBm at 4 GHz (leveled)
Resolution	10 uHz	0.001 dB
Accuracy	0.05 ppm + 5 uHz	**Down to -48 dBm** 0.03 dB to 100 kHz, 0.05 dB to 128 MHz, 0.3 dB at 4 GHz **10 MHz to 128 MHz** 0.05 dB to -48 dBm, 0.1 dB to -84 dBm, 0.7 dB at -130 dBm
Attenuation		0.02 dB to 55 dB, 0.15 dB at 110 dB Relative to 16 dBm and in 10 MHz to 128 MHz
VSWR		≤500 MHz: ≤1.1, ≤1 GHz: 1.2, ≤3 GHz: 1.3, ≤4 GHz: 1.4
Harmonics and spurious	-60 dBc harmonics, -70 dBc spurious to 1 GHz	
Phase noise at 1 GHz	**9640A:** -122 dBc/Hz, typical, at 10 kHz offset 9640A-LPNX: .138 dBc/Hz, typical, at 5 kHz to 100 kHz offset	
Modulation	AM, FM, PM, internal and external. Frequency pull and external leveling.	
Frequency sweep	1 mHz to 4 GHz. Linear or Logarithmic. Stop-Start or Center-Span, Sawtooth and Triangle	
Frequency counter	Optional internal 50 MHz frequency counter, 1 mHz (0.1 ppb) resolution at 10 MHz	
Temperature	**Operating:** 0 °C to 50 °C, 23 °C ± 5 °C for specified performance **Storage:** -20 °C to +70 °C	
Standard interfaces	IEEE488.2 (GPIB)	
GPIB command emulation	**9640A, 9640A-LPNX:** HP3335 **9640A-LPNX + Opt 8662/8663 GPIB:** HP3335, HP8662A, HP8663A	
Dimensions (HxWxD)	146 mm x 433 mm x and 533 mm (5.8 in x 17.0 in x 21.0 in) Industry-standard 19 in (483 mm) rack mounting when fitted with Y9600 rack mounting kit	
Weight	18 kg, (40 lbs)	

Ordering information

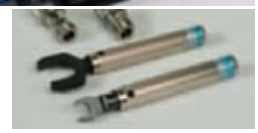
Models	Description
9640A-STD	4 GHz RF Reference Source including 50 Ω leveling head and HP 3335A GPIB command emulation
9640A-STD/75	4 GHz RF Reference Source including 50 Ω and 75 Ω leveling head and HP 3335A GPIB command emulation
9640A-LPNX	4 GHz RF Reference Source with low phase noise, including 50 Ω leveling head and HP 3335A GPIB command emulation
9640A-LPNX/75	4 GHz RF Reference Source with low phase noise, including 50 Ω and 75 Ω leveling head and HP 3335A GPIB command emulation
Options	
8662/8663 GPIB*	8662 & 8663 Emulation (not available for 9640A-STD)
9600FC*	Integrated 50 MHz Frequency Counter
*Options are License Key enabled, also available as user-installable upgrades. Contact your local Fluke sales office for information.	
Accessories	
9600FLT	1 GHz Wide Offset Phase Noise Filter
Y9600	Rack Mount Kit (slides)
9600CASE	Rugged Transit Case
9600CONN	Adaptor/Torque Kit
Upgrades	
9640A-STD->9640A-LPNX	Upgrade 9640A-STD to 9640A-LPNX
9640A-LPN->9640A-LPNX	Upgrade 9640A-LPN to 9640A-LPNX
9640A/75UPG	Upgrade any 9640A to 75 Ohm head
Software	
MET/BASE-8	Workstation or Server Based Calibration Software Database System (Requires a license to enable components)
MET/TRACK-L	License to enable MET/TRACK inventory management component only
MET/CAL-L	License to enable MET/CAL calibration automation and MET/TRACK components
MET/SUPPORT	Gold Annual subscription access to premium support services and extensive calibration procedures library
Manual MET/CAL	Manual data entry, testing to limits and certificate generation software and license for non-automated calibration workload. Pressure, Flow and Temperature automated calibration components are also available, for full details of available MET/CAL software products, license packages , upgrades and training packages; contact your local Fluke Calibration sales office.
Hardware and calibration CarePlans	
Hardware and calibration Gold CarePlans are available for the 9640A-STD or 9640A-LPNX and 9640A/75 models in one-year, three-year or five-year plans with accredited or standard calibration. Contact your local Fluke sales office for information.	

9600FLT: 1 GHz Wide Offset Phase Noise Filter



Optional 9600FC Integrated 50 MHz Frequency Counter

9600CONN: Adaptor/ Torque Kit



6105A/6100B Electrical Power Standards

FLUKE® Calibration

Deregulation and the increasingly distributed nature of today's power supply network mean that power and energy measurements must be made more frequently, with a higher degree of accuracy. At the same time, the environment in which these measurements are being made has become more hostile to good measurement practice.

Harmonic distortion, voltage fluctuations, phase imbalances and other extraneous, re-injected signal components provide an alien environment for measurement devices designed to operate primarily on sinusoidal signals.

Global moves to smart metering and smart grid technology require better measures of electricity bought and sold between generation and distribution organizations, and ultimately consumers. Smart meters and "inhome-displays" will allow consumers to better understand and control their usage of electricity and ask educated questions about their bills.

As accuracy specifications get tighter, measurement techniques become more important. For many years, energy meters have been calibrated by comparing the meter under test with a reference standard meter.

This method, sometimes called "transfer calibration," also requires a voltage source and a method of controlling the current measured by the device under test (DUT) and the standard meter.

One established method of providing the source signal is to apply the local electricity supply to a variable load, to cause approximately known currents to flow. The DUT and standard meter measure the main supply voltage and load induced current, and the results from both are compared to provide the calibration of the DUT.

A shortcoming in this method is that the main supply voltage is rarely sinusoidal. "Flat topping" of the voltage waveform is a common distortion.

For example, industrial variable speed machinery use dc rectified from the ac main supply. Rectifier capacitor charging currents cause flat topping of the voltage waveform. The flat topped waveform contains significant in-phase odd harmonics. If the test system load is linear, corresponding harmonics appear in the current waveform. If the reference standard meter and DUT had identical responses, systematic errors would not be an issue. However, this is an optimistic view. Reference standard meter and DUT bandwidth differences can give rise to significant errors. The harmonic content of the signals is not known, so it is not possible to assess the magnitude of error for any given measurement sequence.

The problem of flat topped mains voltage has been overcome by using relatively inaccurate but stable programmable voltage and current sources to produce "phantom power," where the phase angle between voltage and current and their amplitudes are independent. These sources are not meant to contribute to the measurement accuracy, and they do not if the outputs are exactly as demanded and stable. The method still has disadvantages, but the potential for error is reduced.

6100B

6105A/6100B Electrical Power Standards

In 2002, Fluke launched the 6100A and 6101A Electrical Power Standards. The 6100A/6101A combined source stability with reference accuracy in a single product.

The 6100A and 6101A have now been replaced by the 6100B and 6101B. These newer models have the same power quality and functionality as their predecessors, to comfortably meet the accuracy requirements for power quality testing standards. In addition, they feature improved accuracy to match that of the best measurement devices for sinusoidal waveforms.

Few systems can match the 0.007 % (66 ppm) one year energy accuracy provided by the 6105A for sinusoidal waveforms. Waveforms with high harmonic distortion are delivered with similar accuracy traceable to national and international standards.

Choosing between a 6100B or 6105A depends on your accuracy requirements. Both models meet all accuracy requirements of power quality testing to the IEC 61000–4 series of standards. The 6100B can also be used to type test 0.1 % to 2 % energy meters.

Choose the 6105A when you need the highest accuracy available for calibrating secondary standard meters, energy revenue meters and type test applications.

The 6100B and 6101B also include increased voltage channel current drive, for calibrating energy meters which take power from their voltage input.

6101B

6106A

The 6105A provides the accuracy required to verify the performance of secondary standards such as those produced by Radian Research, Zera, and MTE.

6105A

6105A/6100B Electrical Power Standards

FLUKE® Calibration

Who needs a 6105A or 6100B?

Validation of electrical power quality and energy measurements and the equipment that make them is required in many disciplines:

- In National Measurement Institutes (NMI) to provide precise non-sinusoidal signals and phantom power in various research applications
- In research and design to validate the function and accuracy of prototypes and first-off production units
- In manufacturing test to make certain that measurements are correct and repeatable on every unit manufactured
- In service and calibration to ensure that instruments continue to perform to specification throughout their lifetime
- In standards laboratories to calibrate secondary standards used in large scale production calibration of power quality and energy meters

The Fluke 6105A and 6100B provide the signals to allow the processes described above to be completed effectively, quickly and by lower skill operators. More importantly, it ensures that the process of validation can be completed thoroughly, accurately and with all measurements being traceable to national and international standards. The 6100A was designed to produce a comprehensive array of electrical power quality signals with exceptional accuracy over one, two, three or four phases independently and simultaneously.

Wide workload coverage

The 6105A and 6100B cover a wide workload of electrical power test instruments, including:

- AC voltmeters
- AC ammeters
- Current transformers
- Flicker Meters
- Phase angle meters
- Power factor meters
- Power analyzers
- Power recorders
- Power transducers-Relay testers
- VA meters
- VAR meters
- Voltage transformers
- Wattmeters(3- or 4-wire)
- Watthour meters
- and more











6105A/6100B Electrical Power Standards

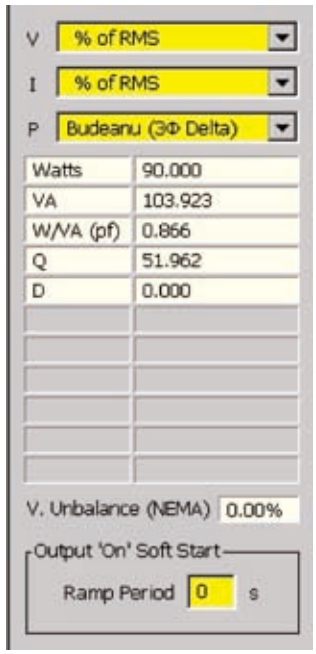
The 6105A and 6100B products add even more utility and extend capability into the calibration of energy. The new products provide even more flexibility than the 6100A.

Until now a system for three phases would require one 6100A 'Master' and two 6101A 'Auxiliary' units. The 6105A and 6100B Master units can be configured as Auxiliaries merely by reconfiguring communication cables. This gives many more options for combinations of instruments in different systems. A new 50A option has been added to the 80A already available. The 50A option can be configured so that all current ranges are available through the same terminals.

Phantom power

The 6105A and 6100B will supply pure sinusoidal voltage to 1008 V and current to 21 Amps. Up to 50 VA's of power are available from the voltage terminals to support instruments which draw power from the line on which they are measuring, or where the voltage circuits of several devices are connected in parallel. Up to 14 V peak compliance is available from the current output to ensure current is delivered in setups involving long cable runs, connectors and switches, or where the current circuits of multiple instruments are connected in series. The current output is also able to produce an auxiliary voltage in order to simulate signals that may be produced by transducers or current probes. Higher ac current outputs are available from the 50A and 80A options.

In addition to the values of V, I and phase angle set by the user, the on-screen display shows calculated values of real power (W), apparent power (VA), reactive power (VAR) and power factor (PF). Reactive power for nonsinusoidal signals is calculated by the 6105A and 6100B using any of seven user selectable methods. When 6100B or 6105A are connected to form three-phase WYE or three-phase, three-wire Delta systems, the user may elect to view—for each phase individually or the three phase total—VA, power and VAR. Three-phase unbalance is also displayed with the choice of the IEC or the NEMA calculation method.



In this mode of operation the 6100B can be used to calibrate or verify measurement of power, VA, VAR, phase angle, power factor, voltage and current on single or multi-phase instruments.

Resolution and accuracy

The Fluke 6100B sets a new benchmark for accuracy in power standards. Voltage and current are generated with up to six digits precision and accuracies less than 0.005 % (50 ppm). Phase adjustment provides for 1 milli-degree or 10 micro-radian resolutions.

Phase performance is exceptional, with accuracy to 3 milli-degrees for the 6100B, 2.3 milli-degrees for the 6105A. In multi-phase systems, phase accuracy between phase voltages is 5 milli-degrees.

Tech Tip

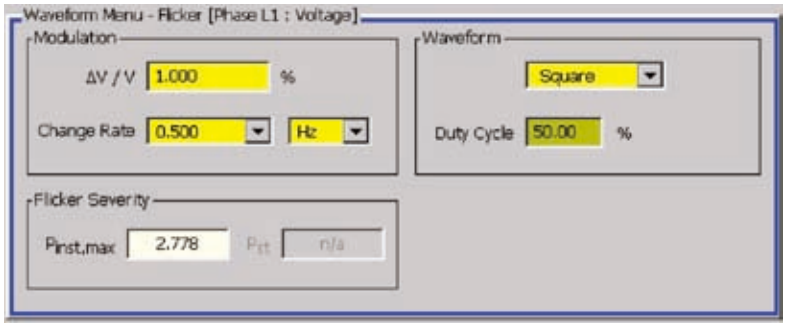
When calibrating power instruments at conditions with power factors less than one, phase accuracy errors can greatly increase the errors of the reference compared to unity power factor conditions. The unmatched performance of the 6105A/6100B phase accuracy minimizes this concern.

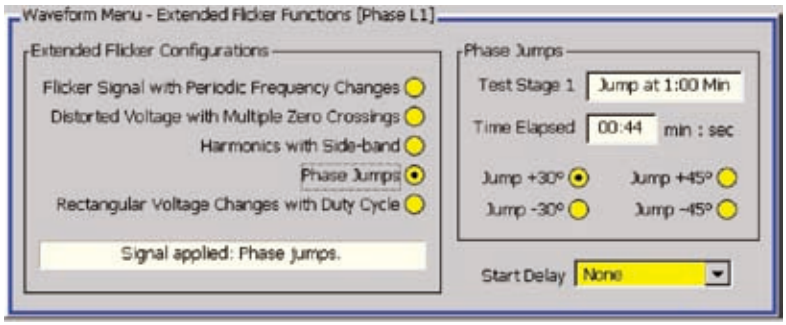
6105A/6100B Electrical Power Standards

FLUKE® Calibration

Flicker

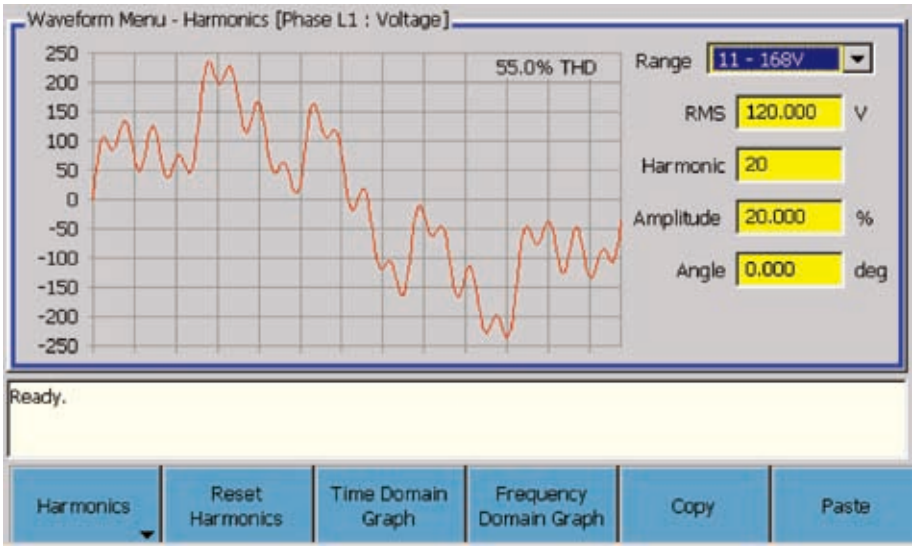
Flicker is a complex measurement which sets out to measure the "annoyance factor" of a flickering light caused by modulation on its supply voltage, most often caused by switching of large loads. There are many implementations of "flickermeter," the testing and calibration of which is defined in IEC standard IEC-61000-4-15. This standard defines the various combinations of modulation shape, depth and frequency to be used to qualify "flickermeter classifiers." The 6105A and 6100B generate all the flicker signals required for calibration by this standard and displays the resulting Pst with an accuracy of 0.25 %. This is 20 times better than required by 61000-4-15. New flicker mechanisms including frequency/amplitude changes and phase jumps are in a 61000-4-15 update under review before release. The 6105A and 6100B implement these new functions to support design groups working on new flickermeters to comply with the new standards.





Harmonics

In addition to very accurate sinusoidal voltages and currents, the 6105A and 6100B can add accurate harmonic distortion independently on the voltage and current outputs. The accuracy of the resultant non-sinusoidal waveforms is specified and is traceable to national and international standards. All of the first 100 harmonics can be set individually by the user, with levels of up to 30 % of the fundamental value. Accurate harmonically distorted waveforms are essential for type test and calibration of power and energy meters. Other instruments that require accurate non-sinusoidal waveforms include harmonic analyzers, power loggers, and disturbance analyzers. The 6105A and 6100B harmonic accuracy comfortably betters the requirements of IEC 61000-4-7 and 61000-4-13.



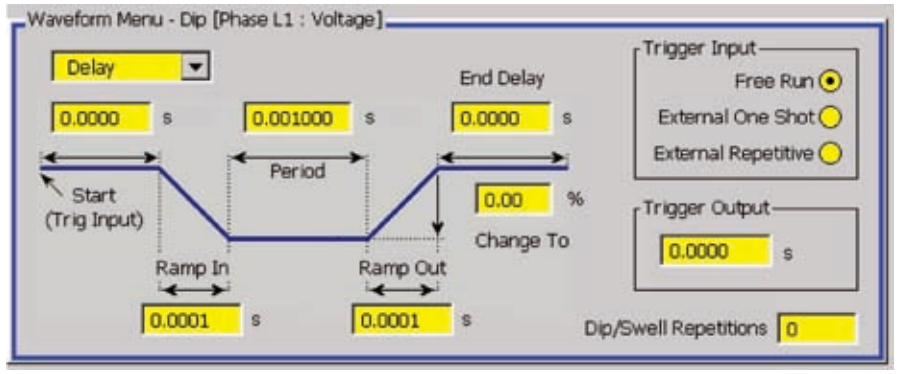
The 6105A and 6100B harmonic accuracy comfortably betters the requirements of IEC 61000-4-7 and 61000-4-13.

6105A/6100B Electrical Power Standards

The 6105A and 6100B can be used to verify the performance of equipment used for testing immunity to voltage dips, short interruptions and voltage variations as specified in IEC 61000-4-11.

Dips and swells

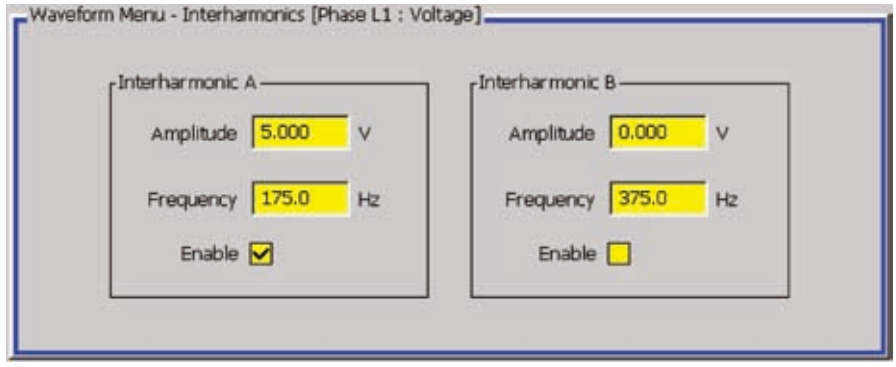
Output voltage or current can be caused to dip to a level below nominal or swell to a level above nominal for a period of between 1 ms and one minute. Ramp in and ramp out times, period, repetition delay and dip/swell level are all independently controllable. The dip or swell can be triggered internally to start at a particular phase angle or time delay set by the user; or triggered externally via a BNC connector on the rear panel. The 6105A and 6100B can be used to verify the performance of equipment used for testing immunity to voltage dips, short interruptions and voltage variations as specified in IEC 61000–4–11.



Interharmonics are a requirement to meet the multicondition testing situations in IEC 61000-4-30 and IEC 61000-4-34.

Interharmonics

Interharmonics are continuous signal elements unrelated to the fundamental frequency. For example, in a 60 Hz supply system, 180 Hz is a harmonic (the third) but 190 Hz is an interharmonic. The 6105A and 6100B can generate independent Interharmonics at a user-definable level and frequency up to 9 kHz on current or voltage outputs or both. With this function, the 6100B can simulate Interharmonics caused by imperfect loads, or deliberately induced signals such as power line carrier signals. Interharmonics are a requirement to meet the multi-condition testing situations in IEC 61000–4–30 and IEC 61000–4–34.



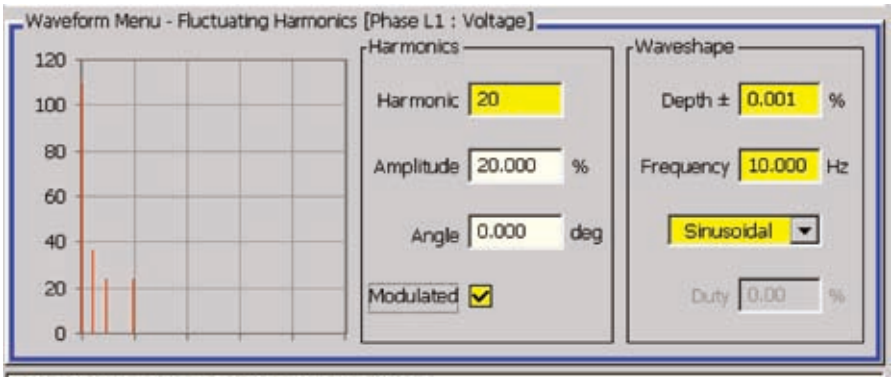
6105A/6100B Electrical Power Standards

FLUKE® Calibration

Fluctuating harmonics

Fluctuating harmonics are individual harmonics which are amplitude modulated. The 6100B is able to individually modulate from one to every currently defined harmonic at up to 30 % of its nominal amplitude with a frequency of 0.008 Hz to 30 Hz; with a sinusoidal, square or rectangular modulation wave shape. The 6105A and 6100B can be used to verify the performance of equipment used for testing immunity to fluctuating harmonics as specified in IEC 61000-4-14.

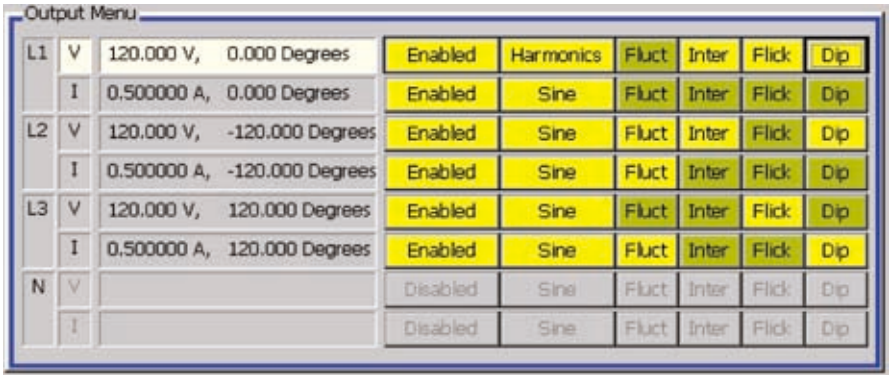
The 6105A and 6100B can be used to verify the performance of equipment used for testing immunity to fluctuating harmonics as specified in IEC 61000-4-14.



Simultaneous application

Full verification of complex measurement devices requires that complex combinations of signals are handled correctly. This fact has been recognized within the power measurement industry, and is incorporated in IEC 61000-4-30 and 61000-4-34 (testing and measurement techniques—power quality measurement methods). These standards require, among other things, that measurement instruments are tested with compound signal types (for example flicker, imbalance and harmonics all present) to ensure that performance is maintained under real world conditions. Fluke 6105A and 6100B meet all the requirements of the standards.

Fluke 6105A and 6100B testing ensures that performance is maintained under real world conditions.



6105A/6100B Electrical Power Standards

Multi-phase operation

The 6105A and 6100B Master units offer self-contained single phase operation, with one voltage and one current output. For multiphase applications, the addition of one or more 6106A or 6101B Auxiliary units provides additional phases, with identical performance but without the overhead of controls or display.

Additional phases can be added individually until a maximum of four phases is reached.

For added flexibility, the 6105A and 6100B Master units can be configured as Auxiliary devices within seconds. In multiphase systems, each phase remains totally independent and totally electrically isolated, yet synchronized with, and under the control of the master unit. This means applications where phase unbalance is required are simple and easy to arrange. Multiphase 6105A/6100B systems are necessarily connected together in four-wire, WYE configuration. Simulation of three-phase, three-wire Delta and three-phase, four-wire Delta is simply arranged by changing settings via the user interface.

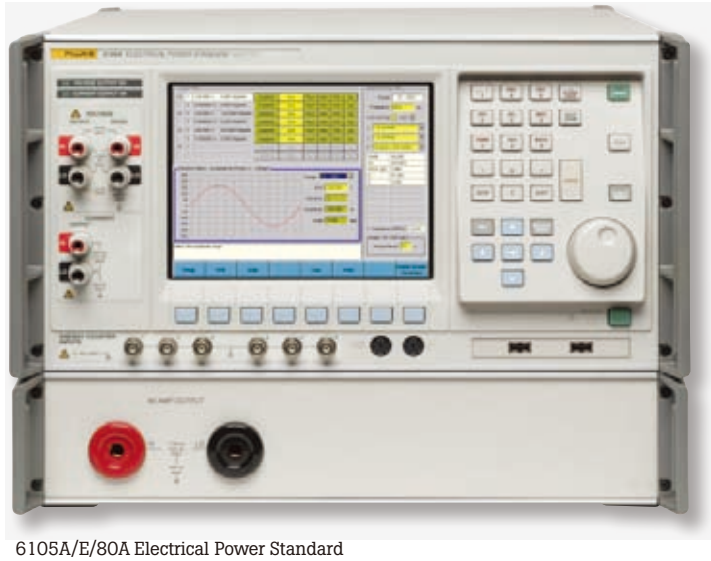
80A and 50A options

Two higher current options are available. The 80A option provides 0A to 80A through 100 mm sockets. The outputs from the standard current ranges cannot be routed via these connectors. The 50A option provides 0A to 50A also through 100 mm sockets. With the 50A option the operator can choose to route all currents through the 100 mm sockets or use the 0A to 21A range outputs through the standard terminals.

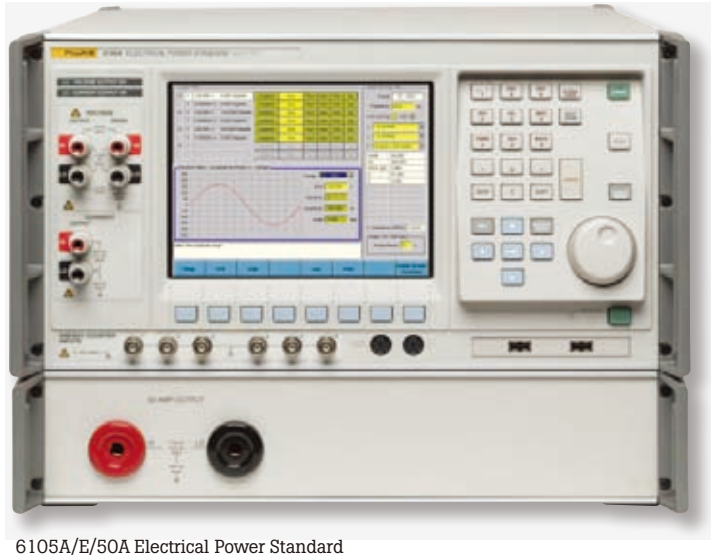
Energy option

The energy option adds a comparator to the 6105A and 6100B. Six input channels can be individually configured for "Meter Constant."

The user has the choice of reference. The 6105A energy accuracy is as good as almost any external device; but the 6100B user may choose to use an external reference standard. Measured energy is compared with the reference value and a percentage error reported for each device being tested.



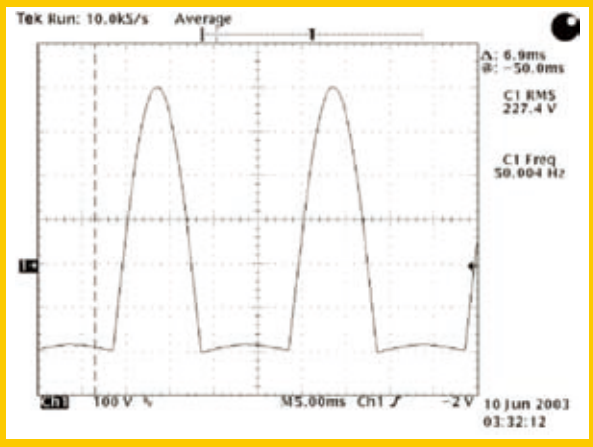
6105A/E/80A Electrical Power Standard



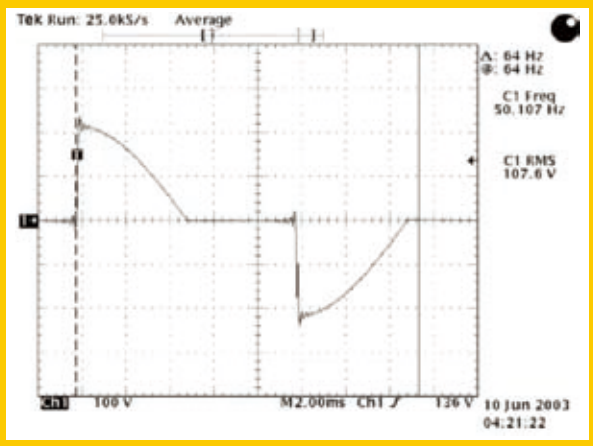
6105A/E/50A Electrical Power Standard

FLUKE® Calibration

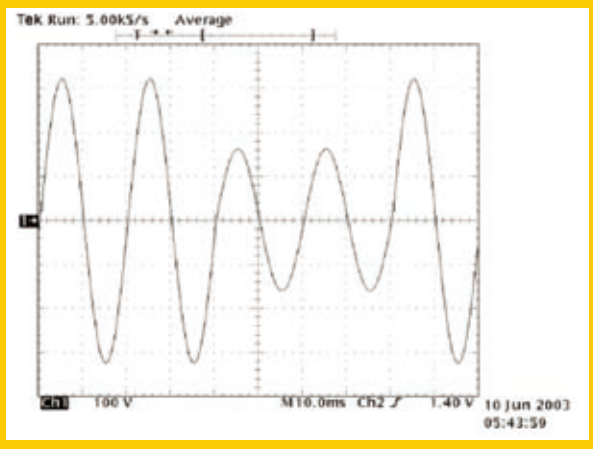
6100B current waveforms captured using Fluke A40B AC current shunts and a Tektronix oscilloscope.



Half-wave rectified waveform



Phase-fired waveform



Burst fire waveform

CLK Option

The CLK option is an additional reference signal available from the rear panel. See Reference signals below.

Reference signals

It is not unusual for systems to be synchronized by a common clock signal, particularly when sampling techniques are used. The Fluke 6105A and 6100B provide the following signals:

- The phase reference: a CMOS logic signal with rising edge coincident with the positive going zero crossing of the fundamental voltage.
- Sample reference: a CMOS logic signal synchronous with the internal sampling. Can be used to synchronize sampling devices for system calibration.
- Reference signal output (available only when the 'CLK' option is fitted): TTL compatible 10 MHz or 20 MHz reference output signal derived from the system master clock.

Soft start

To overcome the inrush current of devices taking power from the voltage signal; the user may select 0 to 10 seconds slow ramp-up of the output.

IEC 61036 and IEC 62053 waveforms

To make it more convenient to type test and calibrate watt hour meters, the waveforms required by the relevant standards are preinstalled in the 6105A and 6100B.

6105A/6100B Electrical Power Standards

A Microsoft Windows® user interface makes the 6105A and 6100B easy and simple to operate. The interface can be accessed through a combination of front panel knobs and buttons, or by connecting the user's own mouse and keyboard. Actions are then viewed on the high resolution, eight–inch TFT display. Status information of all four phases is displayed, alongside more detailed information on current parameters being set or adjusted.

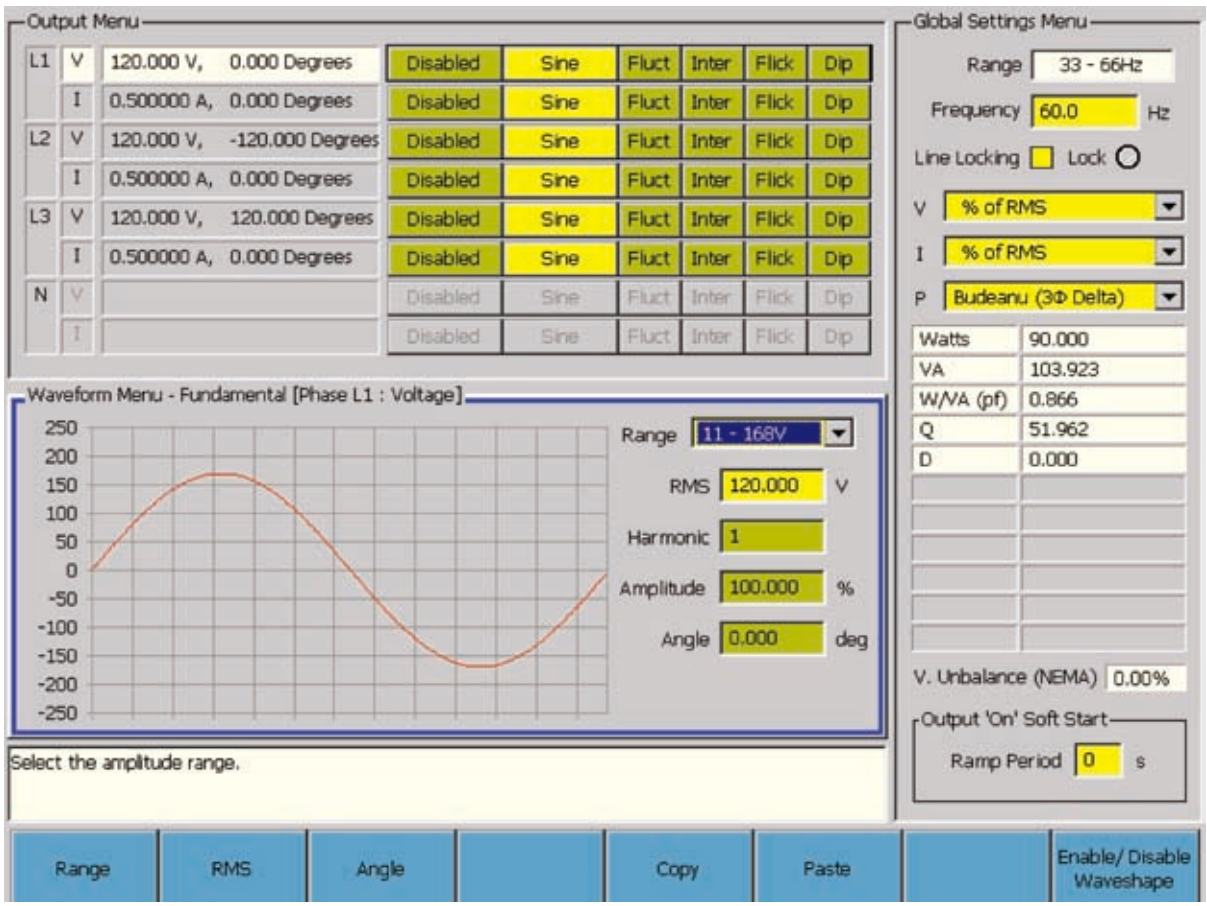
Frequency domain and time domain representation of current signal types can be displayed on the screen, so the user can evaluate the effect of control settings before applying the signal to the output terminals.

A context sensitive help window at the bottom of the screen guides the operator through instrument setup by providing control information and error messages.

The 6105A and 6100B can be operated under remote control. Where multiphase systems are operated, control of the Auxiliary devices is via the Master unit. The 6105A and 6100B conform to the IEEE 488.1 standard and supplemental standard IEEE 488.2.

The programming language complies with the Standard Commands for Programmable Instruments (SCPI).

Complex instrument setups can be saved and recalled within the instrument or saved and recalled from a USB storage device



6105A/6100B Electrical Power Standards

FLUKE® Calibration

Summary specifications

6105A and 6106A sinusoidal power accuracy at 45 Hz to 65 Hz; Power Factor 1.0 (ppm)

Current	Power with current at 90 % of range			Power with current at 50 % range		
	Voltage at 62 % to 70 % range		650 V and 1008 V ranges; 70 % to 75 %	Voltage at 7 % to 100 % range		650 V and 1008 V ranges; 70 % to 75 %
	23 V to 90 V ranges	180 V and 360 V ranges		23 V to 90 V ranges	180 V and 360 V ranges	
0 A to 2 A ranges	62	64	64	72	74	74
5 A to 50 A ranges	65	66	66	74	75	75
80 A range	147	148	148	181	181	181

6105A and 6106A sinusoidal power accuracy at 45 Hz to 65 Hz; Power Factor 0.5 (ppm)

Current	Power with current at 90 % of range			Power with current at 50 % range		
	Voltage at 62 % to 70 % range		650 V and 1008 V ranges; 70 % to 75 %	Voltage at 7 % to 100 % range		650 V and 1008 V ranges; 70 % to 75 %
	23 V to 90 V ranges	180 V and 360 V ranges		23 V to 90 V ranges	180 V and 360 V ranges	
0 A to 5 A ranges	93	94	94	100	101	101
10 A to 50 A ranges	95	96	96	102	102	102
80 A range	163	163	163	194	194	194

6100B and 6101B sinusoidal power accuracy at 45 Hz to 65 Hz; Power Factor 1.0 (ppm)

Current	Power with current at 90 % of range		Power with current at 50 % range	
	23 V to 360 V ranges; 62 % to 70 % range	1008 V range; 740 V to 850 V	23 V to 360 V ranges; 62 % to 70 % range	1008 V range; 740 V to 850 V
0 A to 2 A ranges	236	239	252	239
5 A to 50 A ranges	236	239	252	239
80 A range	322	339	404	417

6100B and 6101B sinusoidal power accuracy at 45 Hz to 65 Hz; Power Factor 0.5 (ppm)

Current	Power with current at 90 % of range		Power with current at 50 % range	
	23 V to 360 V ranges; 62 % to 70 % range	1008 V range; 740 V to 850 V	23 V to 360 V ranges; 62 % to 70 % range	1008 V range; 740 V to 850 V
0 A to 5 A ranges	246	249	262	249
10 A to 50 A ranges	246	249	262	249
80 A range	329	346	409	423

Example 6105A and 6106A non-sinusoidal power accuracy with 20 % THD at Power Factor 1.0 (ppm). Accuracy depends on harmonic order and amplitudes.

Current	Power with current at 90 % of range			Power with current at 50 % range		
	Voltage at 62 % to 70 % range		650 V and 1008 V ranges; 70 % to 75 %	Voltage at 7 % to 100 % range		650 V and 1008 V ranges; 70 % to 75 %
	23 V to 90 V ranges	180 V and 360 V ranges		23 V to 90 V ranges	180 V and 360 V ranges	
0 A to 5 A ranges	97	98	98	103	105	105
10 A to 50 A ranges	98	99	99	105	105	105
80 A range	165	165	165	196	196	196

Example 6100B and 6101B non-sinusoidal power accuracy with 20 % THD at Power Factor 1.0 (ppm). Accuracy depends on harmonic order and amplitudes.

V Range	Power with current at 90 % of range		Power with current at 50 % range	
Current (80 % to 100 % range)	23 V to 360 V ranges; 62 % to 70 % range	1008 V range; 740 V to 850 V	23 V to 360 V ranges; 62 % to 70 % range	1008 V range; 740 V to 850 V
0 A to 5 A ranges	242	255	258	255
10 A to 50 A ranges	242	255	258	255
80 A range	326	350	408	426

For energy specification add 1 ppm.

6105A/6100B Electrical Power Standards

Current to voltage phase angle accuracy

Frequency	Voltage and current components >40 % of range		
	6105A and 6106A 1-Year Accuracy, tcal ±5 °C	6100B and 6101B 1-Year Accuracy, tcal ±5 °C	Stability per hour
45 Hz to 65 Hz	0.0023 °	0.003 °	0.0002 °
16 Hz to 69 Hz	0.003 °	0.003 °	0.0002 °
69 Hz to 180 Hz	0.007 °	0.009 °	0.0002 °
180 Hz to 450 Hz	0.018 °	0.023 °	0.0005 °
450 Hz to 850 Hz	0.033 °	0.043 °	0.0008 °
850 Hz to 3 kHz	0.115 °	0.150 °	0.001 °
3 kHz to 6 kHz	0.230 °	0.300 °	0.001 °

Voltage to voltage phase angle accuracy (poly phase systems)

Frequency	Voltage components >40 % of range		
	6105A and 6106A 1-Year Accuracy, tcal ±5 °C	6100b and 6101B 1-Year Accuracy, tcal ±5 °C	Stability per hour
16 Hz to 69 Hz	0.005 °	0.005 °	0.0002 °
69 Hz to 180 Hz	0.007 °	0.007 °	0.0002 °
180 Hz to 450 Hz	0.025 °	0.025 °	0.0005 °
450 Hz to 850 Hz	0.043 °	0.050 °	0.0008 °
850 Hz to 3 kHz	0.150 °	0.170 °	0.0010 °
3 kHz to 6 kHz	0.300 °	0.350 °	0.0015 °

Primary electrical specifications

Voltage/current amplitude setting resolution	6 digits
Range of fundamental frequencies	16 Hz to 850 Hz
Line frequency locking	45 Hz to 65.9 Hz at users discretion
Frequency accuracy	10 ppm
Frequency setting resolution	0.1 Hz
Warm up time to full accuracy	1 hour or twice the time since last warmed up
Output ramp up setting range (soft start)	0 to 10 seconds
Settling time following change to the output	Soft Start setting plus 1.4 second
Nominal angle between voltage phases	120 °
Nominal angle between voltage and current of a phase	0 °
Phase angle setting	±180 °, p radians
Phase angle setting resolution	0.001 °, 0.00001 radians
Maximum number of voltage harmonics	100 including the 1st (fundamental frequency)
Maximum number of current harmonics	100 including the 1st (fundamental frequency)

Sinusoidal and Rectangular Modulation Flicker

Setting range	± 30 % of set value within range values (60 % ΔV/V)
Flicker modulation depth accuracy	0.025 %
Modulation depth setting resolution	0.001 %
Modulation shape	Sine, rectangular or square
Duty cycle (shape = rectangular)	0.01 % to 99.99 %
Modulating units either: Frequency Changes per minute	0.5 Hz to 40 Hz 1 cpm to 4800 cpm
Modulation frequency accuracy	<0.13 % (1 cpm to 4800 cpm)
Pst Inication accuracy	0.25 %

Notes as single source spec.

Other Flicker modes

Frequency changes
Distorted voltage with multiple crossings
Harmonics with side band
Phase jumps
Rectangular voltage changes with duty ratio

6105A/6100B Electrical Power Standards

FLUKE® Calibration

Dips and Swells

Dip/Swell minimum duration	1 ms
Dip/Swell maximum duration	1 minute
Dip minimum amplitude	0 % of the nominal output
Swell maximum amplitude	The least of full range value and 140 % of the nominal output
Ramp up/down period	Settable 100 µs to 30 seconds
Optional repeat with delay	0 to 60 seconds ± 31 µs
Starting level amplitude accuracy	± 0.025 % of level
Dip/Swell level amplitude accuracy	± 0.25 % of level
Trigger out	TTL falling edge co-incident with end of trigger out delay, remaining low for 10 µs to 31 µs

Voltage ranges, maximum burden 50 VA

23 V	45 V	90 V	180 V	360 V	650 V	1008 V

Sinusoidal voltage

Frequency	Voltage	6105A and 6106A 1-Year Accuracy, TCal ± 5 °C (ppm of output + ppm range)		6100B and 6101B 1-Year Accuracy, TCal ± 5 °C (ppm of output + ppm range)	
		ppm	ppmR	ppm	ppmR
45 Hz to 65 Hz	± 5 % Vcal	42	0	112	24
	0 % to 100 % range	42	9	112	24
16 Hz to 850 Hz	0 % to 100 % range	60	9	112	24

Non-sinusoidal voltage

Output	Frequency	6105A and 6106A 1-Year Accuracy,TCal ± 5 °C (ppm of output + ppm range)		6100B and 6101B 1-Year Accuracy, TCal ± 5 °C (ppm of output + ppm range)	
		ppm	ppmR	ppm	ppmR
0 % to 50 % range	DC	92	90	122	140
0 % to 30 % range	16 Hz to 850 Hz	58	24	122	24
	850 Hz to 6 kHz	451	24	512	24

Current ranges

Full Range (FR)	0.25 A	0.5 A	1 A	2 A	5 A	10 A	21 A	50 A	80 A
Maximum compliance voltage (Vrms)	10 V	10 V	10 V	10 V	10 V	10 V	8.5 V	3 V	2 V

Sinusoidal current

Frequency	Current percent of range	6105A and 6106A 1-Year Accuracy, tcal ± 5 °C ± (ppm of output + ppm Range)		6100B and 6101B 1-Year Accuracy, tcal ± 5 °C ± (ppm of output + ppm Range)	
		ppm	ppmR	ppm	ppmR
45 Hz to 65 Hz	90 %	47	0	130	24
	0 % to 100 %	47	10	139	24
16 Hz to 850 Hz	10 % to 40 %	61	20	130	24
	40 % to 100 %	61	20	139	24

Non-sinusoidal current

Frequency	Current percent of range	6105A and 6106A 1-Year Accuracy, tcal ± 5 °C ± (ppm of output + ppm Range)		6100B and 6101B 1-Year Accuracy, tcal ± 5 °C ± (ppm of output + ppm Range)	
		ppm	ppmR	ppm	ppmR
DC	0 % to 50 %	89	100	191	300
16 Hz to 850 Hz	0 % to 30 %	61	20	139	24
850 Hz to 6 kHz	0 % to 30 %	401	20	400	24

6105A/6100B Electrical Power Standards

Voltage from the current terminals

Full range (FR)	0.25 V	1.5 V	10 V
Max peak	0.353 V	2.121 V	14.14 V
Source impedance	1 Ω	6.67 Ω	40.02 Ω
Minimum load impedance to maintain specification	40 kΩ	260 kΩ	1.5 MΩ

Sinusoidal voltage from the current terminals

Range	Frequency	Output Component	6105A and 6106A 1-Year Accuracy, tcal ± 5 °C ± (ppm of output + µV)		6100B and 6101B 1-Year Accuracy, tcal [4] ± 5 °C ± (ppm of output + µV) [5]	
0.05 V to 0.25 V	45 Hz to 65 Hz	0.1 Vto 0.25 V	73	10	200	10
	16 Hz to 850 Hz	0.05 V to 0.25 V	82	10	200	10
0.15 Vto 1.5 V	45 Hz to 65 Hz	0.6 Vto 1.5 V	53	50	200	50
	16 Hz to 850 Hz	0.6 Vto 1.5 V	66	50	200	50
1 Vto 10 V	45 Hz to 65 Hz	4 Vto 10 V	52	200	200	200
	16 Hz to 850 Hz	4 Vto 10 V	66	200	200	200

Input power

Voltage	100 V to 240 V with up to ± 10 % fluctuations
Frequency	47 Hz to 63 Hz

Environment

Operating temperature	5 °C to 35 °C
Calibration temperature (tcal) range	16 °C to 30 °C
Storage temperature	0 °C to 50 °C
Warm up time	1 hour

Dimensions

	6100B, 6101B, 6105A and 6106A	With 50A or 80A options
Height	233 mm (9.17 in)	324 mm (12.8 in)
Height (without feet)	219 mm (8.6 in)	310 mm (12.2 in)
Width	432 mm (17 in)	432 mm (17 in)
Depth	630 mm (24.8 in)	630 mm (24.8 in)
Weight	23 kg (51 lb)	30 kg (66 lb)

Total solutions in calibration

Fluke Calibration provides the broadest range of calibrators and standards, software, service, support and training in electrical, temperature, pressure and flow calibration. Visit www.fluke.com/fpmcat for more information about Fluke Calibration solutions.

Pressure and flow calibration

- High performance pressure and gas flow standards
- Accredited pressure and gas flow calibration services
- Calibration process software
- Services and training

Electrical calibration

- DC/LF electrical calibration
- Power calibration
- Time and frequency
- RF calibration
- Calibration software
- Services and training

Temperature calibration

- Temperature and humidity calibration
- Calibration software
- Services and training

6105A/6100B Electrical Power Standards

FLUKE® Calibration

Ordering information

6105A model numbers

	Number of phases			
Options	**1**	**2**	**3**	**4**
Auxiliary unit	6106A			
Auxiliary unit + 50A	6106A/50A			
Auxiliary unit + 80A	6106A/80A			
Standard	6105A	6125A	6135A	6145A
50A	6105A/50A	6125A/50A	6135A/50A	6145A/50A
80A	6105A/80A	6125A/80A	6135A/80A	6145A/80A
Energy	6105A/E	6125A/E	6135A/E	6145A/E
CLK	6105A/CLK	6125A/CLK	6135A/CLK	6145A/CLK
50A + CLK	6105A/50A/CLK	6125A/50A/CLK	6135A/50A/CLK	6145A/50A/CLK
80A + CLK	6105A/80A/CLK	6125A/80A/CLK	6135A/80A/CLK	6145A/80A/CLK
Energy + CLK	6105A/E/CLK	6125A/E/CLK	6135A/E/CLK	6145A/E/CLK
Energy + 50A	6105A/E/50A	6125A/E/50A	6135A/E/50A	6145A/E/50A
Energy + 50A + CLK	6105A/50A/E/CLK	6125A/50A/E/CLK	6135A/50A/E/CLK	6145A/50A/E/CLK
Energy + 80A	6105A/E/80A	6125A/E/80A	6135A/E/80A	6145A/E/80A
Energy + 80A + CLK	6105A/80A/E/CLK	6125A/80A/E/CLK	6135A/80A/E/CLK	6145A/80A/E/CLK

6100B model numbers

	Number of phases			
Options	**1**	**2**	**3**	**4**
Auxiliary unit	6101B			
Auxiliary unit + 50A	6101B/50A			
Auxiliary unit + 80A	6101B/80A			
Standard	6100B	6120B	6130B	6140B
50A	6100B/50A	6120B/50A	6130B/50A	6140B/50A
80A	6100B/80A	6120B/80A	6130B/80A	6140B/80A
Energy	6100B/E	6120B/E	6130B/E	6140B/E
CLK	6100B/CLK	6120B/CLK	6130B/CLK	6140B/CLK
50A + CLK	6100B/50A/CLK	6120B/50A/CLK	6130B/50A/CLK	6140B/50A/CLK
80A + CLK	6100B/80A/CLK	6120B/80A/CLK	6130B/80A/CLK	6140B/80A/CLK
Energy + CLK	6100B/E/CLK	6120B/E/CLK	6130B/E/CLK	6140B/E/CLK
Energy + 50A	6100B/E/50A	6120B/E/50A	6130B/E/50A	6140B/E/50A
Energy + 50A + CLK	6100B/50A/E/CLK	6120B/50A/E/CLK	6130B/50A/E/CLK	6140B/50A/E/CLK
Energy + 80A	6100B/E/80A	6120B/E/80A	6130B/E/80A	6140B/E/80A
Energy + 80A + CLK	6100B/80A/E/CLK	6120B/80A/E/CLK	6130B/80A/E/CLK	6140B/80A/E/CLK

Accessories

6100/CASE	6100A/6101A Transit case
6100/CASE/80	6100A/6101A Transit case with 80A Option
Y6100	6100A/6101A Rack Mount Kit
6100-RMK	Rack Mount Ears only
6100/LEAD	Spare Lead set
6100RM-1H/V	Energy Optical Sensor
6100RM-DS/SM	Energy Disc Sensor

910/910R GPS Controlled Frequency Standards

The cesium controlled frequency standard that uses GPS technology and connectivity to provide primary standard traceability from any location

The 910 and 910R GPScontrolled frequency standards deliver a precision frequency and pulse-per-second time "reference which, with its many connectivity options, can be installed, monitored and managed from virtually any location.

Both models receive their longterm frequency stability from the built-in cesium standards in the GPS-satellite array, yet can also provide a very high shortterm stability from the built-in oven controlled crystal oscillator (OCXO) or rubidium oscillator (Rb).

Both the 910 and 910R are fully traceable and extremely accurate frequency standards and are ideally suited for use in many applications, including telecommunications, calibration and automatic test systems.

Unique traceability feature means no more re-calibrations

Off-air frequency standards have existed for several years.

But until now, they all have had the same internal architecture (Figure 1). The unit is, in effect, a "black box," with an antenna input and a frequency output.

The local oscillators control process (disciplining) is hidden from the user. Typically, users have used another frequency reference (for example, a rubidium standard), a timer/counter and a PC for logging the deviation between the "black box" and the frequency reference.

The concept of traceability requires an unbroken chain of comparisons to international standards, on a continuing basis, where all comparisons produce documented results with stated uncertainty.

Now, for the first time, a documenting frequency comparator and a very stable secondary standard are united within the same instrument together with the GPS receiver.

The received GPS signal is measured continuously against the local oscillator.

Phase and frequency deviation is stored internally and can at any time be transferred to any PC directly from the 910/910R or, via the optional Ethernet interface, from or to almost anywhere. Then by using the GPSViewTM software supplied with every model, a printout of the traceability record can be obtained. The unbroken calibration history chain—day by day—is maintained in the non-volatile memory for several years, with the current 24-hour mean offset being displayed continuously on the front panels LCD display.

Such unique traceability to primary standards means that the 910 and 910R never need to be away for re-calibration.

Thanks to this design, the very high stability built-in rubidium or OCXO oscillator is continuously calibrated to the primary frequency standards in the US Naval Observatory and ultimately to UTC, in both operating modes, disciplined or manual hold-over.

Two high-stability models to meet your application, and fit your budget

Fluke offers two standard models in its controlled frequency standards range; the very-high stability 910R with its built-in rubidium atomic clock as the local oscillator, and the affordable 910 with its high stability local oven controlled crystal oscillator.

Up to 13 outputs, maximizing cost efficiency Both models come with one 5 MHz and five 10 MHz sinewave outputs as standard. A one pulse-per-second output is also included.

If your application requires more outputs—for example, if several other instruments need to be supplied from

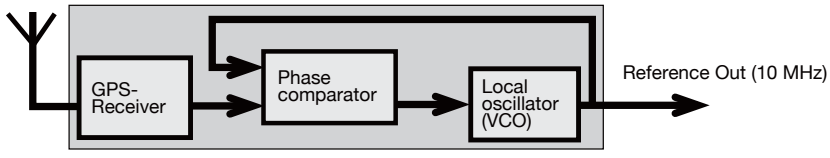


Figure 1. A typical "black box GPS receiver" (antenna in – reference out). Internal oscillator offset and adjustments are invisible to the user.

910/910R GPS Controlled Frequency Standards

FLUKE ®
Calibration

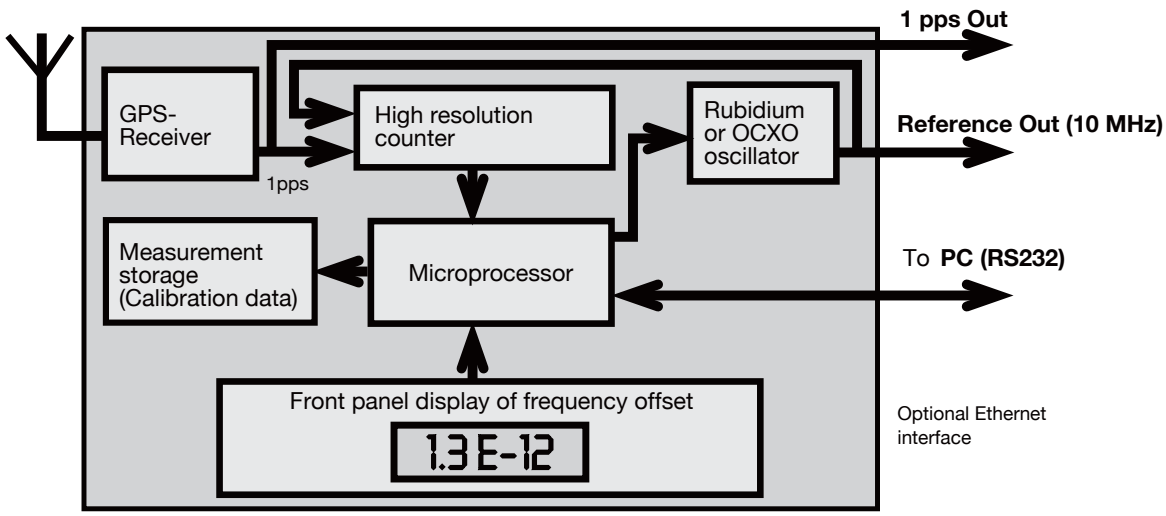


Figure 2. The Fluke 910 and 910R have built-in comparison between the GPS receiver and the internal oscillator. The frequency offset is displayed and stored and a traceability record can be produced at any time.

the same frequency standard—option 70 allows you to mount five more 10 MHz outputs. Alternatively, option 72 allows you to expand your instrument to give five extra 2.048 MHz outputs, which is particularly useful in many telecoms applications. Option 73 provides five extra 13 MHz outputs, the standard frequency for GSM base station master clocks. Another variant on output configuration is offered through option 71, which gives the instrument an additional four sine wave outputs of 10 MHz, 5 MHz, 1 MHz and 0.1 Hz, plus a 0.1 MHz square wave output.

And finally, option 75 allows you to define your own pulse frequency output.

Central or remote monitoring, management and data collection, using the 910/910R Ethernet-port

The 910 and 910R can both be fitted with an optional Ethernet communication interface (option 76) which enables on-line access. Using the GPSView TM software supplied, it is possible to monitor both instrument and GPS status, or even collect calibration data, via the internet or any Local Area Network.

With Ethernet interface connectivity, distances to which data can be transmitted become unlimited, unlike that of any standard GPIB or RS-232 interterface, thereby allowing the 910/910R to be monitored from practically anywhere.

This means that the metrologist or lab technician no longer requires a 'floating' laptop PC to directly perform instrument management tasks, as this can now be achieved from any desktop PC, from any location inside or outside the calibration laboratory. It also allows data from multiple instruments to be simultaneously viewed in real time.

Two high-stability operating modes to suit your application

Most users prefer automatic adjustment (known as disciplining) of their frequency standard, to fully eliminate long-term frequency changes (aging). This disciplined mode is also the default mode in the 910 and 910R. As long as there is a valid satellite signal, the internal local oscillator is monitored and adjusted and the mean 24-hour frequency offset is always virtually zero. However, in this mode, the inherent short-to-medium term stability of all local oscillators, except rubidium, is compromised. This is true for all GPS frequency references. The received GPS signal has relatively large short-term frequency variations, due to variations in atmospheric conditions. This means that when using the received GPS signal for disciplining the 910 (OXCO), the stability is reduced a little for averaging times of 100 s to 1000 s.

In this mode, the frequency deviation between the internal timebase oscillator and the received GPS-signal is used to continuously adjust the oscillator (disciplining). The resulting frequency offset and adjustment data is stored in non-volatile memory every 24-hours, to enable printout of the traceability record. The actual frequency offset (24h mean value) is calculated and displayed on the front panel.

Some applications demand superior short-medium term stability, especially for jitter and wander measurements in digital telecommunication networks.

The unique manual hold-over mode makes it possible to switch over temporarily from disciplined to hold-over mode during the actual measurement, thereby achieving a superior frequency accuracy at the start of the measurement and a superior stability through the measurement.

Here, the internal oscillator is not adjusted. This mode is normally automatically entered

7526A Precision Process Calibrator

- Tests pressure and thermal switches with an automated switch-test function
- Measures thermistors up to 4 kΩ
- Stores up to nine programmable setpoints for each input/output parameter
- Accepts ITS-90 coefficients for accurate SPRT measurements
- Compatible with MET/CAL® Plus Calibration Management Software

The Fluke Calibration 7526A Precision Process Calibrator offers the best balance of economy and accuracy for benchtop calibration of pressure and temperature process instrumentation.

Incorporating an isolated measurement channel, the 7526A lets you simultaneously source and measure voltage, current or resistance, making it easy to calibrate temperature and pressure transmitters, RTD and thermocouple readouts, pressure gauges, digital process simulators, data loggers, multimeters and more.

- Sources and measures dc voltage, current, resistance, RTDs and thermocouples
- Measures pressure using Fluke 700 or 525A-P Series Pressure Modules
- Measures 4–20 mA loop current
- Sources 24 V dc transmitter loop power supply

A "best fit" for your process calibration requirements

"Doing more with less" is a requirement every process manufacturer faces today. To maintain product quality, reduce waste, improve efficiency and conform to regulatory standards, instruments that measure process variables such as temperature and pressure must be calibrated at regular intervals. Selecting the right calibrator for the job, however, can be tricky—especially when attempting to balance precision and versatility with cost. Less expensive than high-end multi-product calibrators, yet more precise and versatile than handheld field calibrators, the 7526A is a "best fit" for instrument shops that value precision, versatility and economy.

Everything you need in one box

The 7526A packs a lot of capability into one box, allowing you to calibrate a wide-ranging and varied workload. One calibrator performs all of these functions:

- Simulates and measures nine RTD and thirteen thermocouple types
- Accurately measures pressure up to 10 000 PSI (69 MPa) when combined with Fluke 700 or 525A-P Series Pressure Modules
- Sources and measures dc voltage to within 0.004 % of reading
- Sources and measures dc resistance up to 4 kΩ
- Sources dc current from 0 mA to 100 mA
- Accurately measures dc current from 0 mA to 50 mA
- Sources 24 V dc loop power

7526A Precision Process Calibrator

FLUKE ®
Calibration

The user interface includes cursor controls, function keys and a ten-key keypad, making it easy to navigate through intuitive menus; store and recall up to nine setpoints for each input/output parameter; enter RTD or SPRT coefficients; and easily change display units with a key press.

With two LCD displays, you can easily view both source and measurement results simultaneously.

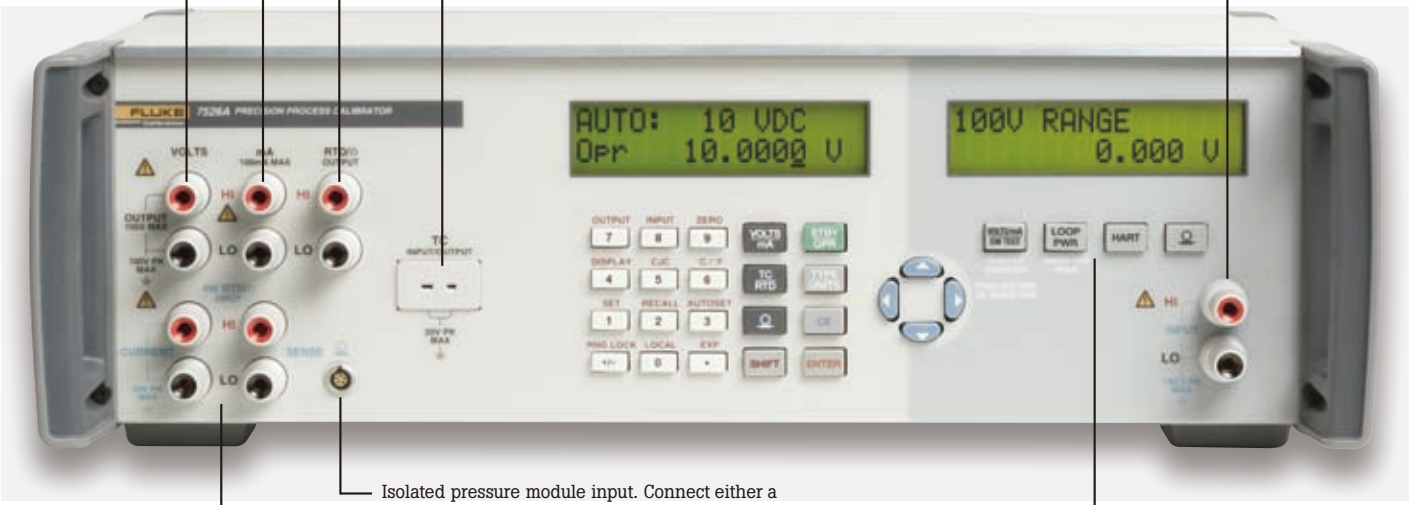
DC voltage output terminals. 0 mV to 100 V. Accuracy: 30 ppm (+3 µV), 1 year*. Five-way berylliumcopper binding posts reduce thermal EMFs and accept common cable terminations (standard single/dual pin banana plug, spade lug, pin connector, bare wire).

Isolated input terminals for dc voltage/current measurement, unique switch-test input for testing pressure and thermal switches, and a 24 V dc loop power supply for powering 4–20 mA transmitters.

DC current output terminals. 0 mA to 100 mA. Accuracy: 50 ppm, 1 year

RTD/Ω output terminals (two-wire). 5 Ω to 4 kΩ. Accuracy: ± 0.05 °C*. Accepts Pt-100 (385, 3926, 3916), Pt-200, Pt-500, Pt-1000, Ni-120, Cu-427, SPRT.

Thermocouple input/output terminal. Accuracy: ± 0.1 °C *. User selectable internal or external cold junction compensation for improved thermocouple measurement accuracy. Accepts thermocouple types: B,C,E,J,K,L,N,R,S,T,U,XK,BP



Isolated pressure module input. Connect either a Fluke 700 or 525A-P Series Pressure Module to the front panel LEMO connector and the calibrator auto-detects the type and value of the module.

Four-wire RTD/Ω input terminals. Accuracy: ± 0.02 °C*. Accepts Pt-100 (385, 3926, 3916), Pt-200, Pt-500, Pt-1000, Ni-120, Cu-427, SPRT.

Isolated input controls. A HART key enables a 250 Ω loop resistor allowing HART devices to read a digital HART signal superimposed on the 4–20 mA loop current.

* See extended specifications for more details.

7526A Precision Process Calibrator

Don't forget the sensor

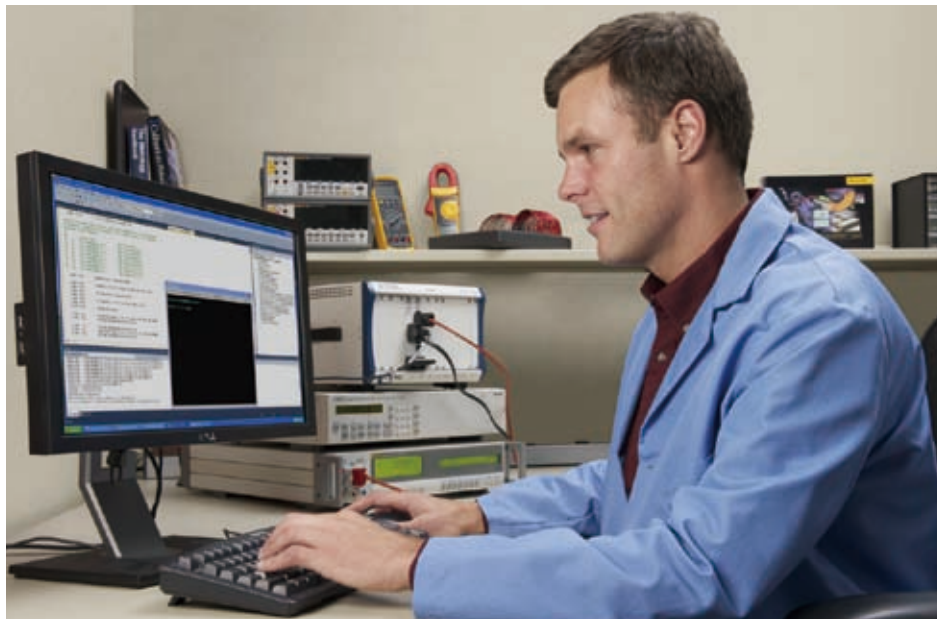
Calibrating the electronics portion of a temperature transmitter is only a part of a complete calibration. You also need to calibrate the temperature sensor itself, whether an RTD or thermocouple. Ignoring the sensor can be a mistake, because temperature sensors are responsible for more than 75 % of the output errors in temperature transmitters. You can calibrate the temperature sensor individually, or calibrate both the sensor and the transmitter as a system using a dry-block calibrator such as the Fluke Calibration 914X Series Field Metrology Wells. The Field Metrology Wells were designed specifically with process calibration in mind—optimizing speed to temperature, portability, stability and accuracy. The 7526A and a 914X dry-block calibrator make a perfect combination for calibrating just about any temperature transmitter.

Source as well as measure pressure

The P5500 Series Comparison Test Pumps can be used with the 7526A and Fluke 700 Series Pressure Modules to generate or control test pressures. The unique test port configuration allows for easy, tool-free connections of a wide variety of connection sizes and types, including NPT, BSP, and metric threads. The P5510 includes a built-in hand pump to generate vacuum or positive pressure up to 300 psi (2 MPa). The P5513 allows for precise control of pneumatic pressures up to 3000 psi (20 MPa). An external pressure supply is required. The P5514 allows for generation of hydraulic pressures up to 10 000 psi (70 MPa). The P5515 includes a built-in priming pump and screw pump that allows for pressure generation up to 20 000 psi (140 MPa). Both the P5514 and P5515 can be used with oil or water. Special versions are available with ethylene propylene seals for use with more aggressive fluids.

Calibration and repair services

Fluke Calibration offers extensive calibration support and service to ensure your long-term satisfaction and return on investment. Our worldwide network of calibration centers offers accredited calibrations traceable to national standards. We also offer fast, quality repair and calibration services including a module exchange program and full support in setting up your lab.



7526A Precision Process Calibrator

FLUKE® Calibration

Summary specifications

DC voltage, output

Range [1]	Absolute uncertainty, ± (ppm of output + µV), 1 year		Resolution
0 mV to 100 mV	30	3	1 µV
0 V to 1 V	30	10	10 µV
0 V to 10 V	30	100	100 µV
0 V to 100 V	30	1 mV	1 mV
TC output and input			
-10 mV to 75 mV	30	2	10 Ω

[1] All outputs are positive only unless otherwise noted

DC voltage, isolated input

Range	Absolute uncertainty, ± (ppm of reading + mV), 1 year		Resolution
0 V to 10 V	50	0.2	100 µV
10 V to 100 V	50	2.0	1 mV

DC current, output

Range [1]	Absolute uncertainty, ± (ppm of reading + µA), 1 year		Resolution
0 mA to 100 mA	50	1	1 µA

[1] For line voltages less than 95 V, ±100 ppm of reading

DC current, isolated input

Range	Absolute uncertainty, ± (ppm of reading + µA), 1 year		Resolution
0 mA to 50 mA	100	1	0.1 µA
0 mA to 24 mA [1] [2] (Loop Power)	100	1	0.1 µA

[1] Loop Power: 24 V ±10 % [2] HART Resistor: 250 Ω ± 3 %

Resistance, output

Range	Absolute uncertainty, tcal ± 5 °C, ± ohms, 1 year	Resolution	Nominal current
5 Ω to 400 Ω	0.015	0.001 Ω	1 mA to 3 mA
5 Ω to 4 kΩ	0.3	0.01 Ω	100 µA to 1 mA

Resistance, input

Range	Absolute uncertainty, ± (ppm of reading + Ω), 1 year		Resolution
0 Ω to 400 Ω	20	0.004	0.001 Ω
0 Ω to 4 kΩ	20	0.04	0.01 Ω

Sample thermocouple accuracy, input/output (does not include all available TC types) [1]

TC type	Temperature range (°C)		Absolute uncertainty, tcal ±5 °C, ± (°C), 1 year [2]
	Min	Max	
J	-210	1200	0.09
K	-250	1372	0.1
S	-50	1767	0.29
T	-250	400	0.11

[1] See extended specifications for all TC types (B,C,E,J,K,L,N,R,S,T,U,XK,BP).
[2] Best accuracy within specified TC temperature range.

Sample RTD and thermistor, output (does not include all available RTD types) [1]

RTD type	Temperature range (°C)		Absolute uncertainty, tcal ±5 °C, ± (°C), 1 year
	Min	Max	
Pt 385, 100 Ω	-200	630	0.05
YSI 400	15	50	0.007

[1] See extended specifications for all RTD types: Pt-100 (385, 3926, 3916), Pt-200, Pt-500, Pt-1000, Ni-120, Cu-427, SPRT.

Sample RTD and thermistor, intput (does not include all available RTD types) [1]

RTD type	Temperature range (°C)		Absolute uncertainty, tcal ±5 °C, ± (°C), 1 year
	Min	Max	
Pt 385, 100 Ω	-80	100	0.020
	100	300	0.024
YSI 400	15	50	0.007

[1] See extended specifications for all RTD types: Pt-100 (385, 3926, 3916), Pt-200, Pt-500, Pt-1000, Ni-120, Cu-427, SPRT.

General specifications

Accessories

Standard interface	RS-232, IEEE-488 (GPIB)	
Temperature performance	Operating: 0 °C to 50 °C Calibration (tcal): 18 °C to 28 °C Storage: .20 °C to 70 °C	
Electromagnetic compatibility	CE: Conforms to EN61326; operation in controlled EM environments	
Temperature coefficient	Temperature coefficient for temperatures outside tcal 5 °C is 10 % of the 90-day specification (or one year if applicable) per °C	
Relative humidity	Operating:	<80 % to 30 °C
		<70 % to 40 °C
		<40 % to 50 °C
Altitude	Operating: 3,000 m (9,800 ft) max Non-operating: 12,200 m (40,000 ft) max	
Safety	EN/IEC 61010-1:2010 3rd Edition, UL 61010-1:2012, CAN/CSA 22.2 No. 61010-1-12	
Analog low isolation	20 V	
Line power	120 V~: 100 V to 120 V 240 V~: 220 V to 240 V	
Line frequency	47 Hz to 63 Hz	
Line voltage variation	± 10 % about setting	
Power consumption	15 VA maximum	
Dimensions	Height: 14.6 cm (5.75 in) Width: 44.5 cm (17.5 in) Depth: 29.8 cm (11.75 in)	
Weight (without options)	4.24 kg (9.35 lb)	

7526A Precision Process Calibrator

700 Series Pressure Modules Specifications

	Model	Range/ resolution	Range (approx)/ resolution	Reference [1] uncertainty (23 ± 3 °C)	High[2] side media	Low[2] side media	Fitting material
Differential	Fluke 700P00	1 in. H2O/0.001	0.25 kPa/0.0002	0.300 %	Dry	Dry	316 SS
	Fluke 700P01	10 in. H2O/0.01	2.5 kPa/0.002	0.200 %	Dry	Dry	316 SS
	Fluke 700P02	1 psi/0.0001	6900 Pa/0.7	0.150 %	Dry	Dry	316 SS
	Fluke 700P22	1 psi/0.0001	6900 Pa/0.7	0.100 %	316 SS	Dry	316 SS
	Fluke 700P03	5 psi/0.0001	34 kPa/0.001	0.050 %	Dry	Dry	316 SS
	Fluke 700P23	5 psi/0.0001	34 kPa/0.001	0.025 %	316	SS Dry	316 SS
	Fluke 700P04	15 psi/0.001	103 kPa/0.01	0.025 %	Dry	Dry	316 SS
	Fluke 700P24	15 psi/0.001	103 kPa/0.01	0.025 %	316 SS	Dry	316 SS
Gage	Fluke 700P05	30 psi/0.001	207 kPa/0.01	0.025 %	316 SS	N/A	316 SS
	Fluke 700P06	100 psi/0.01	690 kPa/0.07	0.025 %	316 SS	N/A	316 SS
	Fluke 700P27	300 psi/0.01	2070 kPa/0.1	0.025 %	316 SS	N/A	316 SS
	Fluke 700P07	500 psi/0.01	3400 kPa/0.1	0.025 %	316 SS	N/A	316 SS
	Fluke 700P08	1000 psi/0.1	6900 kPa/0.7	0.025 %	316 SS	N/A	316 SS
	Fluke 700P09	1500 psi/0.1	10 M Pa/0.001	0.025 %	316 SS	N/A	316 SS
Absolute	Fluke 700PA3	5 psi/0.0001	34 kPa/0.001	0.050 %	316 SS	N/A	316 SS
	Fluke 700PA4	150 psi/0.001	103 kPa/0.001	0.050 %	316 SS	N/A	316 SS
	Fluke 700PA5	30 psi/0.001	207 kPa/0.01	0.050 %	316 SS	N/A	316 SS
	Fluke 700PA6	100 psi/0.01	690 kPa/0.001	0.050 %	316 SS	N/A	316 SS
Vacuum	Fluke 700PV3	-5 psi/0.0001	-34 kPa/0.001	0.040 %	316 SS	Dry	316 SS
	Fluke 700PV4	-15 psi/0.001	-103 kPa/0.01	0.040 %	316 SS	Dry	316 SS
Dual	Fluke 700PD2	± 1 psi/0.0001	± 6900 Pa/0.7	0.150 %	316 SS	Dry	316 SS
	Fluke 700PD3	± 5 psi/0.0001	± 34 kPa/0.001	0.040 %	316 SS	Dry	316 SS
	Fluke 700PD4	± 15 psi/0.001	± 103 kPa/0.01	0.025 %	316 SS	Dry	316 SS
	Fluke 700PD5	-15/30 psi/0.001	-100/207 kPa/0.01	0.025 %	316 SS	N/A	316 SS
	Fluke 700PD6	-15/100 psi/0.01	-100/690 kPa/0.07	0.025 %	316 SS	N/A	316 SS
	Fluke 700PD7	-15/200 psi/0.01	-100/1380 kPa/0.1	0.040 %	316 SS	N/A	316 SS
High	Fluke 700P29	3000 psi/0.1	20.7 MPa/0.001	0.050 %	C276	N/A	C276
	Fluke 700P30	5000 psi/0.1	34 MPa/0.001	0.050 %	C276	N/A	C276
	Fluke 700P31	10 000 psi/1	69 MPa/0.007	0.050 %	C276	N/A	C276

1 Total uncertainty, one year for temperature range O °C to +5O °C. Total uncertainty, 1.0 % of full span for temperature range -10 °C to O °C. For POO module only, compensated temperature range is 15 °C to 35 °C. 2 "Dry" indicates dry air or non-corrosive gas as compatible media. "316SS" indicates media compatible with Type 316 Stainless Steel. "C276" indicates media compatible with Hastelloy C276. Use of pressure zero is required prior to measurement or source. Max. overpressure specification includes common mode pressure. Modules are CE rated. Metric adapter(s): 1/4 inch NPr female-to-male BSP/ISO 1/4-19, tapered thread, included with all modules except P29, P3O, and P31, all modules include a NIST traceable certificate and test data.

525A-P Series Precision Pressure Transducers

Type	Model	Range/resolution	Range/resolution	Reference uncertainty (23 ± 3 °C)
Differential	525A-P02	1 psi/0.00001	6900 Pa/0.01	0.008 % FS
Gage	525A-P03	5 psi/0.00001	34 kPa/0.001	0.008 % FS
Gage	525A-P04	15 psi/0.001	103 kPa/0.001	0.008 % FS
Gage	525A-P05	30 psi/0.0001	207 kPa/0.001	0.008 % FS
Gage	525A-P06	100 psi/0.001	690 kPa/0.001	0.008 % FS
Gage	525A-P07	500 psi/0.001	3400 kPa/0.01	0.008 % FS
Gage	525A-P08	1000 psi/0.01	6900 kPa/0.01	0.008 % FS
Gage	525A-P29	3000 psi/0.01	20.7 M Pa/0.0001	0.008 % FS
Absolute	525A-PA4	15 psi/0.0001	103 kPa/0.001	0.008 % FS
Absolute	525A-PA5	30 psi/0.0001	207 kPa/0.001	0.008 % FS
Absolute	525A-PA6	100 psi/0.001	690 kPa/0.001	0.008 % FS
Absolute	525A-PA7	500 psi/0.001	3400 kPa/0.01	0.008 % FS
Absolute	525A-PA8	1000 psi/0.01	6900 kPa/0.01	0.008 % FS
Vacuum	525A-PV4	-15 TO 0 psi/0.0001	-34 kPa/0.001	0.008 % FS

7526A Precision Process Calibrator

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Calibration

Ordering Information

7526A Precision Process Calibrator

Model	Description
7526A	Precision Process Calibrator Includes traceable calibration report, user manual CD, getting started guide, power cord, thermocouple shorting jumper and USB-to-serial adapter cable

Recommended Accessories

Model	Description
Y7526A	Rack Mount Kit
7526A-CASE	Carrying Case
5520A-525A/LEADS	Thermocouple and Test Leads Set

Fluke 525A Series Pressure Modules

Type	Model	Range
Differential	525A-P02	1 psi (6900 Pa)
Gage	525A-P03	5 psi (34 kPa)
	525A-P04	15 psi (103 kPa)
	525A-P05	30 psi (207 kPa)
	525A-P06	100 psi (690 kPa)
	525A-P07	500 psi (3400 kPa)
	525A-P08	1000 psi (6900 kPa)
	525A-P29	3000 psi (20.7 M Pa)
Absolute	525A-PA4	15 psi (103 kPa)
	525A-PA5	30 psi (207 kPa)
	525A-PA6	100 psi (690 kPa)
	525A-PA7	500 psi (3400 kPa)
	525A-PA8	1000 psi (6900 kPa)
Vacuum	525A-PV4	-15 psi to 0 psi (-34 kPa)

Pumps and Accessories

Model	Description
FLUKE-700PTP-1	Pneumatic Test Pump
FLUKE-700LTP-1	Low-pressure Test Pump
FLUKE-700PRV-1	Pressure Relief Valve Kit

Comparison Test Pumps

Model	Description
P5510-2M	Pnuematic Test Pump, vacuum to 300 psi (2 MPa)
P5513-20M	Pneumatic Test Pump, vacuum to 3000 psi (20 MPa)
P5514-70M	Hydraulic Test Pump, 0 psi to 10 000 psi (70 MPa)
P5515-140M	Hydraulic Test Pump, 0 psi to 20 000 psi (140 MPa)

Hydraulic Test Pump

Model	Description
FLUKE-700HTH-1	Hydraulic Test Hose
FLUKE-700HTP-2	Hydraulic Test Pump, 10 000 PSI (690 bar)

Fluke 700 Series Pressure Modules

Type	Model	Range
Differential	FLUKE-700P00	1 in. H2O (0.25 kPa)
	FLUKE-700P01	10 in. H2O (2.5 kPa)
	FLUKE-700P02	1 psi (6900 Pa)
	FLUKE-700P22	1 psi (6900 Pa)
	FLUKE-700P03	5 psi (34 kPa)
	FLUKE-700P23	5 psi (34 kPa)
	FLUKE-700P04	15 psi (103 kPa)
	FLUKE-700P24	15 psi (103 kPa)
Gage	FLUKE-700P05	30 psi (207 kPa)
	FLUKE-700P06	100 psi (690 kPa)
	FLUKE-700P27	300 psi (2070 kPa)
	FLUKE-700P07	500 psi (3400 kPa)
	FLUKE-700P08	1000 psi (6900 kPa)
	FLUKE-700P09	1500 psi (10 Mpa)
Absolute	FLUKE-700PA3	5 psi (34 kPa)
	FLUKE-700PA4	15 psi (103 kPa)
	FLUKE-700PA5	30 psi (207 kPa)
	FLUKE-700PA6	100 psi (690 kPa)
Vacuum	FLUKE-700PV3	-5 psi (-34 kPa)
	FLUKE-700PV4	-15 psi (-103 kPa)
Dual	FLUKE-700PD2	±1 psi (±6900 Pa)
	FLUKE-700PD3	±5 psi (±34 kPa)
	FLUKE-700PD4	±15 psi (±103 kPa)
	FLUKE-700PD5	-15 psi to 30 psi (-100 to 207 kPa)
	FLUKE-700PD6	-15 psi to 100 psi (-100 to 690 kPa)
	FLUKE-700PD7	-15 psi to 200 psi (-100 to 1380 kPa)
High	FLUKE-700P29	3000 psi (20.7 MPa)
	FLUKE-700P30	5000 psi (34 MPa)
	FLUKE-700P31	10 000 psi (69 MPa)

700 PMP Pressure Pump

Model	Description
Fluke-71X	Hose Kit Accessory
FLUKE-700ILF	In-line Filter

Pressure Calibration Kit

Model	Description
FLUKE-700PCK	Pressure Calibration Kit

Thermocouple Plug Kit

Model	Description
FLUKE-700TC1	TC Mini-Plug Kit, Types J,K,T,E,R/S,B/Cu,L,U,C,N
FLUKE-700TC2	TC Mini-Plug Kit, Types J,K,T,E,R,S

5320A Multifunction Electrical Tester Calibrator

Test instruments that verify the safety of electrical installations, appliances, and other electrical/electronic devices are becoming more common, thanks in part to regulatory standards. For example, installation and portable appliance testing regulations such as EN 61557 (16th Edition) in the United Kingdom, and VDE 0100/0700 in Germany are designed to protect users from hazards such as electrocution and fire.

Safety standards such as CCC in China, CE in Europe, UL and CSA in North America, drive regulatory testing for new electrical and electronic products, by using electrical safety testers (hipots) in the final stages of manufacturing.

Traditionally, calibrating electrical testers requires a lot of equipment. You need one set of calibration instruments for insulation testers, another set for loop/line impedance testers, another for high voltage dielectric breakdown testers (hipots)…and yet another set of instruments for ground bond testers.

All of this equipment takes up valuable space on your workbench. But that's not the only disadvantage. You also have to maintain each item, keeping it in working order and in calibration, with the appropriate documentation and procedures. You may need to train technicians to use each instrument. And, of course, automating the calibration process becomes difficult, if not impossible, when multiple pieces of equipment are involved.

Now there is a better solution: the Fluke 5320A Multifunction Electrical Tester Calibrator. The Fluke 5320A enables you to verify and calibrate a wide range of electrical test tools with a single instrument. Using one instrument instead of many simplifies your processes, allowing you to realize efficiencies in equipment utilization and training. Automating the 5320A with MET/CAL® Plus Calibration Software adds even more efficiencies, along with better throughput and consistency. And the 5320A is easy to use, helping you to get up and running quickly.

If you are using a custom solution to calibrate electrical testers manually, you will realize significant produc-tivity improvements by using a 5320A calibrator with MET/CAL® PlusCalibration Management Software.

Multiple functions in one easy-to-use instrument

The Fluke 5320A Multifunction Electrical Tester Calibrator is an accurate, flexible instrument that allows you to calibrate many different types and models of electrical testers efficiently and effectively.

The 5320A replaces resistors, decade boxes, and other custom calibration solutions with a single instrument. It features precision high voltage, high current resistors to give you better test uncertainty ratios (TURs).

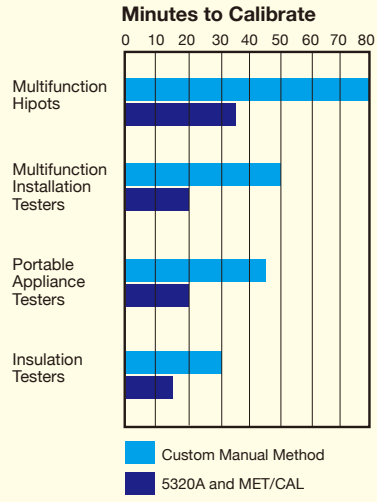
Using one multifunction instrument instead of many allows you to free up valuable bench space and simplify the processes you use for calibrating electrical testers.

You will find the 5320A calibrator remarkably easy to use. A big, bright, full-color screen displays values clearly, and shows which terminals are active in an easy-to-comprehend graphic format. An illustrated help guide is built into the instrument to provide additional assistance if you need it.

For even greater efficiency, the 5320A can be automated with MET/CAL® Plus Calibration Man-agement Software. MET/CAL Plus software has become the industry standard for automating the calibration process and managing the inventory of your cal lab. MET/CAL Plus is a complete, scalable and affordable solution.

LAN, IEEE-488 and RS-232 interfaces on the 5320A provide convenient, industry standard connectivity.

Productivity improvements with the 5320A and MET/CAL® Software



5320A Multifunction Electrical Tester Calibrator

FLUKE®
Calibration

A global network of support

No matter where you are in the world, Fluke supports your instrument investment with a range of services and training. The Fluke MET/SUPPORTSM Gold program provides priority software support.

Our developers are continuously releasing new MET/CAL procedures to help you cover your workload in the most efficient manner possible.

Training programs are offered in a variety of formats, in locations around the world, to match your learning style and budget.

The solutions you need, from the leader in calibration

Long known as a leader in dc and low frequency ac calibration, Fluke is also recognized for its offerings in temperature, pressure, power, process, and rf calibration. Fluke provides the calibrators, standards, software, service, support and training you for a complete solution in your cal lab.

Broad workload coverage

The 5320A calibrates a broad range of equipment, including:

- Hipot testers
- Insulation resistance testers (megohm meters)
- Loop/line impedance testers
- Continuity testers
- Earth resistance testers
- Ground bond testers
- Leakage current testers
- Circuit breaker testers (RCD/GFCI)
- Multifunction installation testers
- Portable appliance testers (PATs)
- Medical electrical safety testers

5320A Multifunction Electrical Tester Calibrator

The Fluke 5320A Multifunction Electrical Tester Calibrator combines many functions into a single instrument, replacing discrete resistors, decade boxes and other custom solutions commonly used to calibrate electrical testers. It's flexible and precise enough to calibrate a wide range of instrumentation.

Multifunction installation testers

The 5320A has all the functionality needed to calibrate installation testers with insulation resistance, continuity, loop, RCD and earth resistance test capabilities.

Portable appliance testers (PATs)

The 5320A has all the functionality needed to calibrate PATs, with insulation resistance, ground bond, leakage current, flash voltage and load test capabilities.

Continuity testers and earth (ground) resistance testers

To calibrate these low ohms testers, a calibrator must be able to source precision low ohms. From its low ohms precision resistors, the 5320A calibrator sources resistance values ranging from 100 mΩ to 10 kΩ, with $3\frac{1}{2}$ digits of resolution. Choose 2-wire or 4-wire modes for maximum flexibility.

Loop/line impedance testers and ground bond testers

The 5320A calibrator has 16 high power, high current resistors it can source to increase the resistance of a loop or line by a known amount. Use Scan mode to automatically determine the resistance of the loop, and use Active Loop Compensation mode (5320A/VLC) to compensate for any residual impedance in the loop or line.

Residual-current device (RCD) or ground fault current interrupter (GFCI) testers

The 5320A simulates a circuit breaker (an RCD/GFCI) to verify and calibrate trip current and trip time, without tripping the installation's current breakers. For most RCD testers, trip times are calculated to an uncertainty of 0.25 ms, to provide better than 4:1 test uncertainty ratios (TUR). Trip current uncertainty is 1 %, which also provides better than 4:1 TURs in most applications.

Insulation resistance testers

The 5320A calibrator sources highohms, high voltage resistors and measures the high voltage output of megohm meters

5320A Multifunction Electrical Tester Calibrator

FLUKE ®
Calibration

and other portable and bench insulation testers. When calibrating insulation resistance testers up to 1.5 kV, you can select a wide range of continuously variable resistance values, from 10 kΩ to 10 GΩ, with 4½ digit resolution and one single value of 100 GΩ. When calibrating 5 kV insulation testers, the external 10 kV dual function adapter extends the resistors' range up to 10 TΩ. The adapter functions both as a 1000:1 voltage divider to 10 kV, and as a x1000 resistance multiplier.

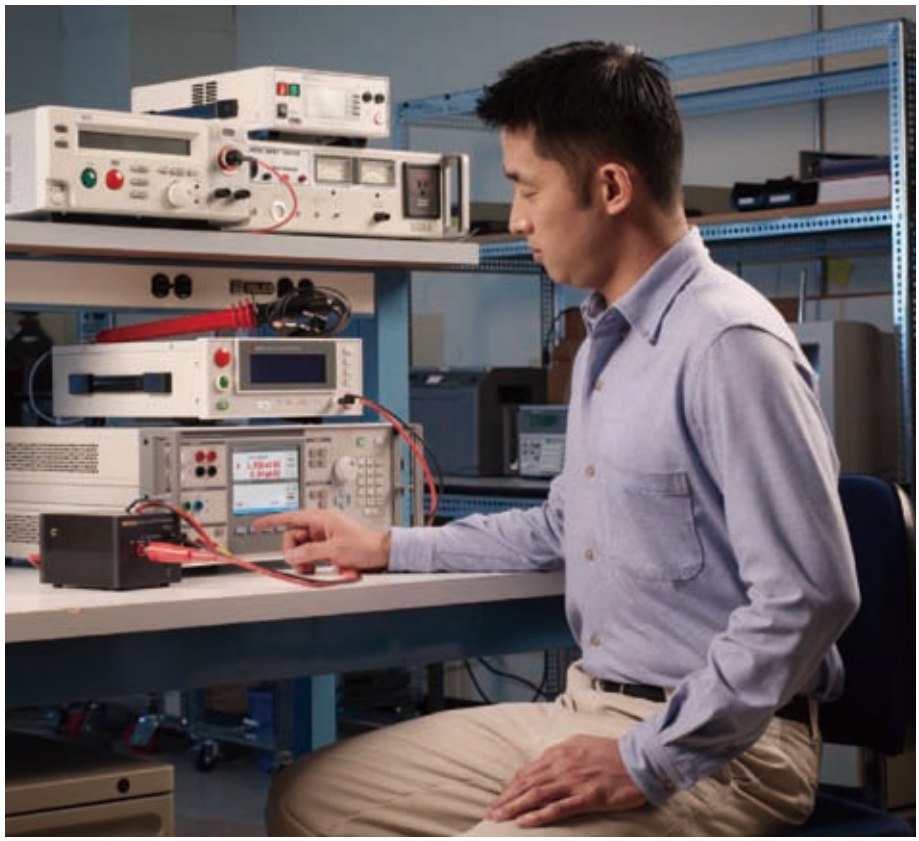
Leakage current testers

Simulate a leakage current for direct/touch, differential and substitute leakage current methods with 4½ digit resolution from 0.1 mA to 30 mA. The 5320A lets you choose the method that works best for your test, unlike other calibrators that only offer a single method.

Voltmeters

Many testers have built-in voltmeters. But you don't need an additional calibrator to test this part of the workload.

The 5320A/VLC calibrator adds a precision voltage source to 600 V with 0.1 % uncertainty, to calibrate ac/dc voltmeters.



Hipot testers

Electrical safety testing with hipots is an integral part of development and manufacturing of electronic and electrical products, ranging from refrigerators to power supplies. Such testing is often required by government regulations to ensure product safety.

The Fluke 5320A provides bestin-class hipot calibration of ac and dc voltage. The built-in 1000 V meter measures voltage and current.

For voltages over 1 kV, Fluke provides a standard 10 kV adapter or an optional 40 kV probe. With the 10 kV adapter, ac voltages to 10 kV can be calibrated with 0.5 % uncertainty.

Either item can be used with the built-in meter to measure voltage over 1000 V.

For calibration of hipot current up to 100 mA, Fluke offers a load adapter accessory. Use the load adapter in conjunction with the 5320A built-in current meter for full calibration of hipots. (Load adapter available early 2007).

Medical safety testers

With the broad functionality and high accuracy of the Fluke 5320A, calibrating medical safety testers is a snap, allowing you to add these items to your calibration workload.

5320A Multifunction Electrical Tester Calibrator

LAN, GPIB, RS-232 connectors
Makes it convenient to connect the 5320A to your PC for automation and data exchange

Large, bright full color display

A. Large readouts enable you to easily read the primary sourced or measured values. Sourced values are in blue and measured values are in red.

Active terminal display

B. Always know which calibrator terminals are active. When a function has been selected, the graphical display shows the active terminals.

Soft menu keys

C. Soft menu keys adapt to the active function, so the menu structure is intuitive and easy to learn.

Output knob, numeric keypad

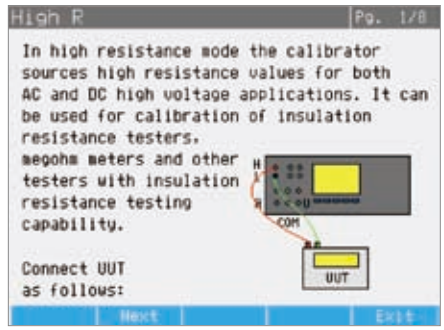
D. To select an output value or measurement range, use the numeric keypad or rotary knob.

Graphical help guide

E. Find out what connections to make in an easy-to-understand graphical format. The help guide is available through the "Mode" softkey.

Spec readout

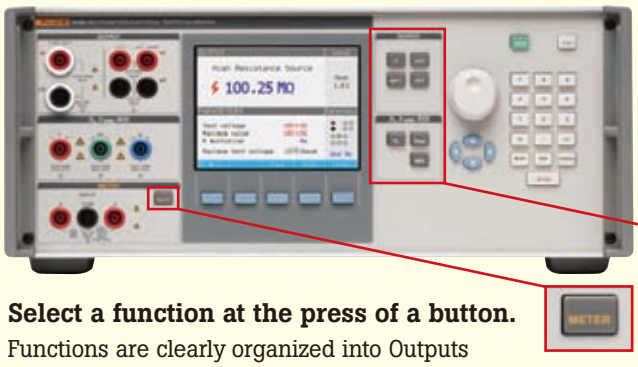
F. The spec readout lets you view the uncertainty of the sourced or measured primary value.



5320A Multifunction Electrical Tester Calibrator

FLUKE® Calibration

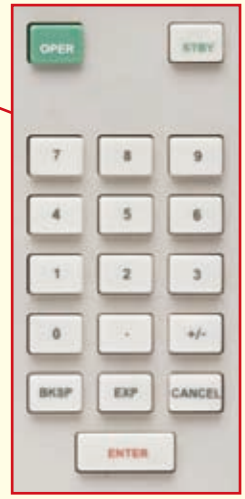
1



Select a function at the press of a button.

Functions are clearly organized into Outputs (HI Ohms, LO Ohms, Leakage Current and Voltage Source), discrete high current resistors (for loop/line impedance, ground bond and RCD/GFCI) and the meter (ac/dc voltage and current).

2



Enter values.

A calculator-style keypad makes it easy to enter values. You can also use the edit knob to vary the values entered.

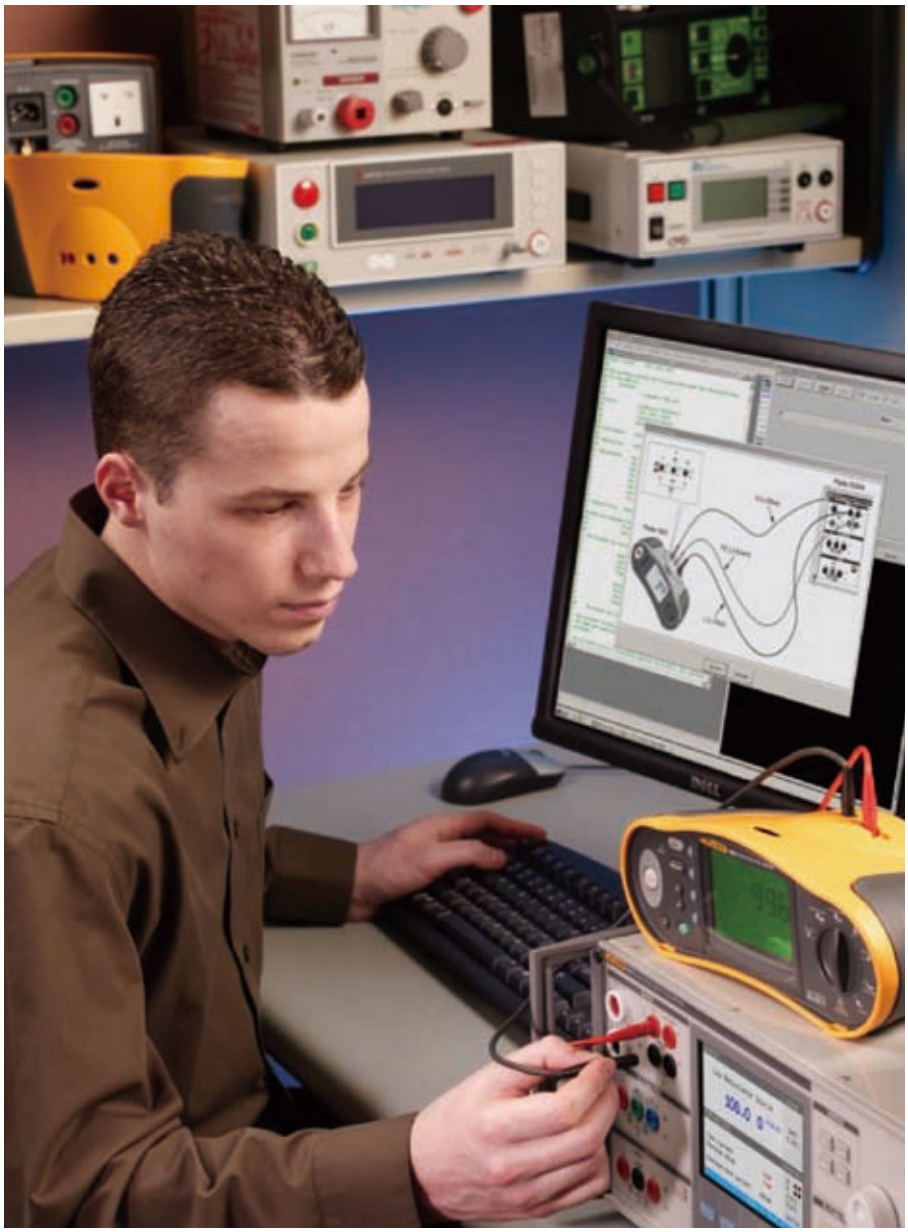
3

Connect the unit under test.

Not sure of how to connect the UUT properly? The active terminal window and the graphical help guide shows you exactly how to do it.

Just press the Operate key and you're ready to go!

5320A Multifunction Electrical Tester Calibrator



Automate the 5320A calibrator with MET/CAL® Plus Calibration Management Software

MET/CAL Plus software automates the calibration process, helping you to increase throughput and ensuring that calibrations are done consistently every time. This powerful software application documents calibration procedures, processes, and results, for greater ease in complying with ISO 17025 and similar quality standards.

MET/TRACK® software, a dedicated system to manage your test and measurement assets, is incorporated into the MET/CAL Plus application.

MET/TRACK software supports the traceability and record-keeping requirements of quality and accreditation standards.

Fluke maintains a calibration procedure library with thousands of procedures that can be used as-is or modified to meet your specific needs.

Fluke offers Warranted Procedures, warranted by Fluke Corporation to produce valid calibrations on the intended unit under test (UUT) for the specified model and revision level.

These procedures are available for purchase, but are offered free to members of the MET/SUPPORTSM Gold software support program.

A wide variety of accessory products exist to perform batch updates using bar code readers or scanners; view data over the Internet; log temperature and humidity data and import it directly into MET/CAL software.

5320A Multifunction Electrical Tester Calibrator

FLUKE ®
Calibration

The support you need, when you need it

Fluke calibrators are known for their accuracy and reliability. Fluke operates global calibration and repair facilities to keep your equipment in top working order. A variety of service programs are available.

MET/CAL software owners can get up and running quickly with the free MET/SUPPORT Silver program that includes 60 days of free support via telephone, fax, and email. But the support doesn't stop there. Enroll in the annual MET/SUPPORT Gold program and receive additional premium support and services to help keep you as productive as possible. In addition to priority support by telephone, fax or email, you get free access to the Fluke library of Warranted Procedures, software updates and upgrades, discounts on training courses and more. Even if you use only a few of the Gold services, you can easily recover more than the cost of your membership fee.

Fluke's commitment to support provides additional benefits as well, including invitations to software user group meetings and conferences, periodic e-mail bulletins and a newsletter.

A wide variety of training courses to fit multiple learning styles

If you need to arrange for training for yourself or for your staff, Fluke can help there too, with a broad range of classes on metrology principles, lab management, software use, procedure writing and more. Classes are available in traditional, instructor-led formats and also in online formats and on CD-ROM. You're sure to find a class that matches your learning style and budget.

Your Fluke representative will be happy to help you select the software, support, or training programs that best fit your needs.

5320A Multifunction Electrical Tester Calibrator

Summary Specifications

Measurement functions

Voltmeter
Range of input voltage: 0 to 1000 V RMS (ac or dc)
Resolution: 4½ digits
Frequency range: DC, 20 Hz to 2 kHz
Reading/second: 2

Range	Uncertainty (% of reading + mV)	Resolution
10 V	0.15 % + 5	1 mV
100 V	0.20 % + 50	10 mV
1100 V	0.20 % + 550	100 mV

Ammeter
Range of input current: 0 to 30 A RMS
Resolution: 4½ digits
Frequency range: DC, 20 to 400 Hz
Reading/second: 2

Range	Uncertainty (% of reading + mA)	Resolution
300 mA	0.15 % + 0.15	0.1 mA
3 A	0.15 % + 1.5	1 mA
30 A	0.30 % + 15	10 mA

VA measurement
Total range: 0 to 33 kVA
Resolution: 1 VA

10 kV Adapter (1000:1 Divider)
Range: 0 to 10 kV ac peak/dc
Uncertainty: 0.3 % of reading + 5 Vdc
0.5 % of reading + 5 Vac (at 50 or 60 Hz)

80k-40 High Voltage Probe
Range: 0 to 40 kV ac peak/dc
Uncertainty: 0.5 % of reading + 10 Vdc
0.5 % of reading + 10 Vac (at 50 or 60 Hz)

Output functions

Voltage calibrator (5320A/VLC only)
Range of output voltage: 3 V to 600 V ac or dc
Voltage Resolution: 4 digits
Frequency range: 40 Hz to 400 Hz
Frequency resolution: 3 digit
Distortion of ac output signal: 0.2 % + 10 mV

High voltage resistance (Insulation resistance test)
Total range:10 kΩ to 10 TΩ
Resolution: 4½ digits

Range	Resolution	Maximum Voltage (ac+dc) Peak	Uncertainty [1] (tcal ± 5 °C)
10.000 kΩ to 39.99 kΩ	1 Ω	55 V	0.20 %
40.00 kΩ to 99.99 kΩ	10 Ω	300 V	0.20 %
100.00 kΩ to 199.99 kΩ	10 Ω	800 V	0.20 %
200.0 kΩ to 999.9 kΩ	100 Ω	1100 V	0.20 %
1.0000 MΩ to 9.999 MΩ	100 Ω	1100 V	0.30 %
10.000 MΩ to 999.99 MΩ	1 kΩ	1575 V	0.50 %
1.0000 GΩ to 10.000 GΩ	100 kΩ	1575 V	1.00 %
100 GΩ	[2]	1575 V	3.00 %
350.0 MΩ to 10.000 TΩ [3]	100 kΩ	5500 V	[4]

[1] Uncertainty is valid at maximum test voltage to 500 V. For test voltage over 500 V add 0.1 % per each 200 V.
[2] 100 GΩ is a single value resistor.
[3] With resistance multiplier adapter.
[4] Uncertainty of resistor to be multiplied by 1000 + 1 % of displayed value to 99.99 GΩ, or + 2 % of displayed value to 999.9 GΩ, or + 3 % of displayed value to 10 TΩ.

Low voltage resistance (Continuity and earth resistance test)
Total range:100 mΩ to 10 kΩ
Resolution: 3½ digits

Range	Resolution	Maximum ac or dc Current	2-Wire Uncertainty [1] (tcal ±5 °C)	4-Wire Uncertainty (tcal ±5 °C)
100.0 mΩ to 4.99 Ω	0.1 mΩ	400 mA	0.3 % + 25 mΩ	0.3 % + 10 mΩ
5.00 Ω to 29.9 Ω	10 mΩ	250 mA	0.2 % + 25 mΩ	0.2 % + 10 mΩ
30.0 Ω to 199.9 Ω	100 mΩ	100 mA	0.2 % + 25 mΩ	0.2 % + 10 mΩ
200 Ω to 499 Ω	1 Ω	45 mA	0.20 %	0.20 %
500 Ω to 1.999 kΩ	1 Ω	25 mA	0.20 %	0.20 %
2.00 kΩ to 4.99 kΩ	10 Ω	10 mA	0.20 %	0.20 %
5.00 kΩ to 10 kΩ	10 Ω	5 mA	0.20 %	0.20 %

[1] Uncertainty is valid to 200 mΩ. For higher power rating, add 0.1 % per each 300 mΩ above 200 mΩ.

Range	Resolution	Uncertainty in ac mode (% of reading + mV)	Max. burden current in ac mode	Uncertainty in dc mode (% of reading + mV)	Max. burden current in dc mode
3 V to 29.99 V	1 mV	0.1 % + 9	500 mA	0.1 % + 9	5 mA
30 V to 99.99 V	10 mV	0.1 % + 30	300 mA	0.1 % + 45	5 mA
100 V to 299.99 V	100 mV	0.1 % + 90	150 mA	0.1 % + 180	3 mA
300 V to 600 V	100 mV	0.1 % + 180	50 mA	0.1 % + 180	2 mA

5320A Multifunction Electrical Tester Calibrator

FLUKE ® Calibration

Discrete resistors (Loop and line impedance and ground bond test)
Total range: 25 mΩ to 1.8 kΩ
Resolution: 16 discrete values

Nominal resistance value	Deviation from nominal	Calibration uncertainty	Maximum test current ac (RMS) or dc	Maximum short term test current ac (RMS) or dc*	Test current uncertainty
25 mΩ	50 %	± 5 mΩ	30 A	40 A	1.5 % + 0.7 A
50 mΩ	50 %	± 5 mΩ	28 A	40 A	1.5 % + 0.5 A
100 mΩ	30 %	± 5 mΩ	25 A	40 A	1.5 % + 0.35 A
330 mΩ	20 %	± 7 mΩ	18 A	40 A	1.5 % + 0.3 A
500 mΩ	10 %	± 8mΩ	10 A	40 A	1.5 % + 0.2 A
1 Ω	10 %	± 10 mΩ	8 A	40 A	1.5 % + 0.15 A
1.8 Ω	10 %	± 18 mΩ	6 A	30 A	5 % + 0.1 A
5 Ω	10 %	± 30 mΩ	3.2 A	16 A	1.5 % + 70 mA
10 Ω	10 %	± 60 mΩ	2.0 A	10 A	1.5 % + 50 mA
18 Ω	10 %	± 100 mΩ	1.5 A	7.5 A	1.5 % + 30 mA
50 Ω	10 %	± 300 mΩ	0.8 A	4.0 A	1.5 % + 20 mA
100 Ω	10 %	± 500 mΩ	0.5 A	2.5 A	1.5 % + 10 mA
180 Ω	10 %	± 1 Ω	0.25 A	1.25 A	1.5 % + 5 mA
500 Ω	10 %	± 2.5 Ω	0.1 A	0.5 A	1.5 % + 3 mA
1 kΩ	10 %	± 5 Ω	0.05 A	0.25 A	1.5 % + 2 mA
1.8 kΩ	10 %	± 10 Ω	0.03 A	0.15 A	1.5 % + 2 mA

* Maximum short term test current is defined as RMS value of halfwave or fullwave test current from the UUT. Maximum time of test current is 200 ms (represents 10 full waves of power line voltage at 50 Hz and 12 full waves at 60 Hz).

Leakage current (Direct/touch/contact, differential, substitute leakage current mode)
Leakage current range: 0.1 mA to 30 mA
Uncertainty: 0.3 % + 2 µA (ac+dc) RMS
Resolution: 10 µA
Test voltage: 10 to 250 V ac+dc

RCD - Residual current device (Ground fault circuit interrupter)

Trip current
Range of trip current in 0.5xI and 1xI mode: 3 to 3000 mA, in 1 mA steps
Range of trip current in 1.4xI and 2xI mode: 3 to 1500 mA, in 1 mA steps
Range of trip current in 5xI mode: 3 to 600 mA, in 1 mA steps
Uncertainty of measured trip current: 1 % RMS (0.5xI and 1xI mode), 2 % RMS (1.4xI and 2xI mode), 5 % RMS (5xI mode)

Trip time
Range of trip time: 10 to 5000 ms
Uncertainty of trip time: 0.25 ms
Output voltage on RCD terminals: Power line voltage, 115 V or 230 V

General Specifications

Environmental
Operating temperature: 18 °C to 28 °C
Calibration (Tcal): 23 °C
Storage temperature: -20 °C to 70 °C
Temperature Coefficient: Temperature coefficient for temperatures outside of Tcal ± 5 °C between +5 °C and +40 °C is 0.1/ °C
Relative humidity (operating): < 70 % to 28 °C
Altitude (operating): 3,050 meters (10,000 ft) maximum
Altitude (non-operating): 12,200 meters (40,000 ft) maximum
Specifications confidence interval: 99 %

Electromagnetic compatibility
EMI/RFI: Designed to comply with Class B per EN61326

Safety and protection
Safety: Designed to comply with EN61010
Electro static discharge: This instrument meets class 1 for ESD requirements per EN61326

Communication interfaces
Standard interfaces: LAN, IEEE 488 (GPIB), RS-232

Dimensions and weights
Dimensions: (D xWx H) 450 mm x 480 mm x 170 mm (17.7 in x 18.9 in x 6.7 in). Mounts within industry-standard 483 mm (19 in) rack-mount frames when fitted with the rack mounting kit.
Shipping weight: 25 kg, (55 lbs)
Net weight: 18 kg, (39.7 lbs)

Power
Line voltage: 115/230 V ± 10 %, 50/60 Hz nominal
Line frequency: 47 to 63 Hz
Power consumption: 150 VA maximum

Ordering information

Models	Description
5320A	Multifunction Electrical Tester Calibrator
5320A/40	Calibrator with 40 kV Probe
5320A/VLC	Calibrator with 600 V Source and Active Loop Compensator
5320A/VLC/40	5320A/VLC Calibrator with 40 kV Probe

Note: All models include the 10 kV divider/resistance multiplier adapter as standard.

Accessories

5320CASE	Rugged Transit Case
Y5320	Rack Mount Kit (Slides)
5320A-USLEAD	US Mains Plug-to-Banana Leads (available early 2007)
5320A-LOAD	Hipot Current Calibration Load Resistors (available early 2007)

A40B Series Precision Current Shunts

The Fluke A40B Precision Current Shunts simplify and improve metrology for dc and ac current. Used to measure current from 1 mA to 100 A, the shunts ensure reliable and traceable results. For many applications, improved resistor technology enables you to make accurate ac current measurements in a single step, instead of using traditional, more complex ac/dc transfer methods.

Intended for broad coverage of current measurement applications, the A40B Set consists of 14 low-inductance coaxial current shunts, leads, adapters and connectors, plus a rugged case for transit and storage. Together they cover a wide workload that includes electrical calibrators, electrical power standards, current sources, transconductance amplifiers, and more. You can purchase the entire set or individual shunts as required for your application and budget.

Designed for top performance andease of use

The physical construction and the components used in the current shunts ensure that the frequency response is very flat (amplitude displacement error relative to dc resistance). The phase displacement at 100 kHz is small enough to be neglected in all but the highest accuracy measurements. Combined with excellent dc resistance stability, the shunts can be used to directly measure current through their full bandwidth. This simplifies precision ac current measurements, so the complex ac/dc transfer measurement process will no longer be necessary for many precision current measurement applications.

The low phase shift error is critical for measurement of non sinusoidal wave shapes, as found in power quality or sampling digital wattmeter measurement applications.

The A40B current shunts feature a radial design for high performance with minimum interference from external magnetic fields. The open design maximizes air flow so the shunts have minimal power coefficient effects, enabling them to be used over a wide range of currents with stable resistance.

An external cooling fan is not required. The shunts are the first commercially available product to feature this design.

The 4-terminal design completely

A40B features at a glance

- Simplify calibration/verification of precision calibrators and current sources
- Shunts sized for currents from 1 mA to 100 A
- Usable from dc to 100 kHz
- 14 individual shunts with a 1, 2, 5 sequence over six decades of current
- Simple direct measurements, making ac/dc transfers unnecessary
- Stability typically better then ± 5.0 µΩ/Ω for one year
- Typical angular accuracy of better than ± 0.003° at 1 kHz

A40B Series Precision Current Shunts

FLUKE®
Calibration

isolates measured voltage from extraneous current path resistance. Current does not flow in the voltage circuit, allowing you to measure with the highest accuracy.

Optional adapters allow you to make connections with commonly used N connectors as well as LC connectors for high current applications.

The 1 mA shunt includes an internal battery operated buffer amplifier to isolate the voltage measurement circuit from the current circuit. This enables you to use the shunt to make low current measurements at optimal voltage levels, while eliminating the effects of input impedance of the measurement device.

Single step convenience

In the past, complex ac/dc transfer techniques were required to verify ac current functions on calibrators.

With current accuracy to 20 ppm and excellent dc resistance stability, the A40B shunts measure ac currently directly through their full bandwidth. For many applications, ac–dc transfer measurements will not be necessary. A simple measurement of the shunt, using a precision digital multimeter like the Fluke 8508A, can reduce measurement complexity by two thirds.

Versatile solutions for many applications

The shunts' output voltage is nominal at 0.8 V, making them compatible with a wide range of devices including precision digital multimeters, ac–dc transfer standards, ac measurement standards, thermal voltage converters and sampling digital multimeters.

Low inductance and low phase displacement make the A40B shunts an excellent fit for power measurement or digital sampling wattmeter measurement applications where phase accuracy and stability are critical.

The wide current range allows verification of high current transconductance amplifiers.

Report of traceable calibration included

The A40B series comes standard with a report of traceable calibration including data. An optional ISO 17025 accredited report of calibration is available.

Widest range available in commercial shunts

The A40B shunts come in four sizes and a wide range of currents:

- Four fully enclosed shunts: 1 mA, 10 mA, 20 mA, 50 mA
- Five small radial shunts: 100 mA, 200 mA, 500 mA, 1 A, 2 A
- Three medium radial shunts: 5 A, 10 A, 20 A
- Two large radial shunts: 50 A, 100 A

A40B Series Precision Current Shunts

Electrical Specifications

Absolute accuracy

The following table shows the 1-year absolute accuracy specification stated at k=2, approximately 95 % confidence for the calibrated value. The specifications include 1-year stability, temperature effects over TCal ± 1 °C, and the measurement uncertainty of the calibrated value.

Shunt Nominal Current	Nominal Resistance (Ohms)	Specification ± µA/A, TCal ±1 °C, ≤ 50 % RH [1,2,3,5]				
		DC	1 kHz	10 kHz	30 kHz	100 kHz
1 mA[4]	800	20	55	75	75	150
10 mA	80	20	26	26	26	26
20 mA	40	20	26	26	26	26
50 mA	16	20	23	23	23	23
100 mA	8	20	24	24	24	24
200 mA	4	20	26	26	26	26
500 mA	1.6	21	27	27	27	28
1 A	0.8	21	27	28	28	31
2 A	0.4	21	27	30	30	48
5 A	0.16	21	31	32	40	71
10 A	0.08	26	37	60	61	92
20 A	0.04	26	43	52	70	113
50 A	0.016	32	55	80	81	144
100 A	0.008	35	65	90	98	174

[1] The measured current is determined from: $I = (V/R_{calibrated}) \times (1 + (AC\text{-}DC_{calibrated}/1{,}000{,}000))$; where $AC\text{-}DC_{calibrated}$ is expressed in ppm.
[2] Above 1 kHz interpolate the specification (s_i) between frequencies f_{upper} and f_{lower} using:
$s_i = s_{lower} + (f_i - f_{lower}) \times (s_{upper} - s_{lower}) \div (f_{upper} - f_{lower})$
[3] Add 20 µA/A if relative humidity is outside specification limits.
[4] 1 mA specifications apply with the battery charger disconnected.
[5] Specifications assume no loading effects due to the voltage-sensing device. See Output Voltage Measurement - Loading Effects in the operating information.

Resistance

Shunt Nominal Current	Nominal Resistance (Ohms)	Maximum Deviation from Nominal Resistance (± µΩ/Ω) [2]	Uncertainty of Calibrated Value at 95 % Confidence (± µΩ/Ω) TCal ± 1 °C	12 Month Stability (± µΩ/Ω) [1,2]	Temperature Coefficient (± ppm/°C) [2]	Power Coefficient Multiplier (± ppm) [2,3]
1 mA	800	250	8.2	18	5	1
10 mA	80	250	6.8	18	2.5	1
20 mA	40	250	8.2	18	4.5	1
50 mA	16	250	8.3	18	4.5	1
100 mA	8	250	8.3	18	2.5	2
200 mA	4	250	8.6	18	3.5	4
500 mA	1.6	250	9.6	18	4.5	13
1 A	0.8	250	9.3	18	4.5	26
2 A	0.4	250	9.4	18	4.5	26
5 A	0.16	250	9.9	18	4.5	30
10 A	0.08	250	15	18	4.5	65
20 A	0.04	250	14	18	4.5	78
50 A	0.016	250	24	18	4.5	105
100 A	0.008	250	28	18	4.5	105

[1] Stability specification combines long term change due to aging (permanent) and short term fluctuation due to humidity changes when shunts are used and stored within specified humidity limits. Add 20 ppm if humidity is >50 % RH).
[2] Assume rectangular distribution when combining with other uncertainty contributions.
[3] Calibrated resistance values include the effects of power coefficient at the nominal current. For currents other than nominal,apply the correction for power coefficient from: Correction = $Power\_Coefficient\_Multiplier \times \left[1 - \left(\frac{I_{Applied}}{I_{Nominal}}\right)^2\right]$
[4] TCal = ambient temperature at calibration.

A40B Series Precision Current Shunts

FLUKE® Calibration

Maximum AC-DC difference

Shunt Nominal Current	Maximum AC-DC Difference (± ppm) [1,2]			
	1 kHz	10 kHz	30 kHz	100 kHz
1 mA[3]	53	72	72	150
10 mA	20	20	20	40
20 mA	18	18	19	30
50 mA	13	13	14	16
100 mA	14	15	17	27
200 mA	17	17	18	28
500 mA	17	17	17	21
1 A	17	19	19	23
2 A	17	22	22	44
5 A	23	24	34	69
10 A	28	55	58	98
20 A	37	51	80	150
50 A	47	75	79	180
100 A	60	90	120	300

[1] Specifications indicate the maximum flatness deviation from dc, and include both measured AC-DC difference and the uncertainty of measurement. They are stated at k=2, approximately 95 % confidence.
[2] Includes 1-year stability of the AC-DC difference.
[3] Specifications for the 1 mA current shunt are for TCal ± 1 °C.

Maximum overload current

Shunt Nominal Current	Maximum Current < 5 seconds [1]	Maximum Sustained Current [2]
1 mA	3 mA	2 mA3
10 mA	150 mA	20 mA
20 mA	250 mA	40 mA
50 mA	450 mA	100 mA
100 mA	1.2 A	200 mA
200 mA	1.7 A	400 mA
500 mA	2.7 A	1 A

Shunt Nominal Current	Maximum Current < 5 seconds [1]	Maximum Sustained Current [2]
1 A	3.9 A	1.3 A
2 A	5.5 A	2.2 A
5 A	17 A	5.5 A
10 A	24 A	11 A
20 A	42 A	22 A
50 A	95 A	55 A
100 A	190 A	110 A

[1] Longer than 5 seconds may cause permanent damage to the shunt. The output voltage may be considerably higher than 0.8 V.
[2] Exceeding maximum sustained current may cause a resistance value step change.
[3] 1 mA shunt batteries should be fully charged to ensure performance at 2 mA.

Typical phase displacement

Typical Phase Displacement			
Shunt Nominal Current	1 kHz	10 kHz	100 kHz
1 mA to 200 mA	< 0.001 °	< 0.006 °	< 0.060 °
500 mA to 2 A	< 0.003 °	< 0.030 °	< 0.300 °
2 A to 20 A	< 0.008 °	< 0.075 °	< 0.750 °
20 A to 100	A < 0.013 °	< 0.125 °	< 1.250 °

Dimensions (maximum)

Shunt Value	Height mm (inches)	Width mm (inches)	Overall Length[1] mm (inches)
1 mA to 2 A	70 (2.75)	70 (2.75)	124 (4.9)
5 A to 20 A	130 (5)	130 (5)	210 (8.25)
50 A and 100 A	200 (7.9)	200 (7.9)	343 (13.5)

[1] Includes input and output connectors; subject to change by component vendor.

Physical/mechanical parameters

Shunt Value	Weight (maximum) kg (lb)	Input Connector	Output Connecctor
1 mA to 20 A	0.7 (1.6)	Type-N (female)	Type-N (female)
50 A and 100 A	3.4 (7.5	Type-LC (female)	Type-N (female)

General specifications

Operating environment
Temperature: 13 °C to 33 °C
Calibration temperature (TCal) range: 18 °C to 28 °C
Humidity range for best specification[1,2]: ≤ 50 % RH
Altitude: 0 m to 3,000 m

[1] Resistance stability is affected by humidity, but changes are reversible.
[2] If the shunts are calibrated outside this RH, stability specifications will be met as long as the shunts are stored and used at the same relative humidity ± 10 % RH.

Storage and transit environments(for models other than the 1 mA current shunt)
Temperature to avoid damage: -20 °C to 140 °C
Temperature and humidity to maintain performance[1]: 5 °C to 45 °C; 15 % to 80 % RH
Non-operating altitude: 0 m to 12,000 m

[1] Storage at extremes of temperature or humidity will cause a temporary change of shunt resistance by up to ± 20 ppm. When subsequently stored or used within the limits of the operating environment, the shunts will recover to their original resistance value within 30 days.

Additional 1 mA current shunt specifications
Output resistance: 8 mΩMaximum safe output current: 11 mA (e.g., 1 V output into 90 Ω)
Maximum capacitive load: 800 pF
Output voltage regulation: 15 ppm/100 pF
Maximum output dc v offset: ± 100 µV (typical ± 25 µV)
Typical error @ 1 MHz: < 2 %

Battery specifications
Battery size: AAA (44.5 mm x 10.5 mm)
Battery technology: Nickel-Metal Hydride (NiMH)
Number of batteries required: 8 (in 2 groups of 4)
Nominal battery voltage: 1.2 V (4.8 V per group of 4)
Typical battery capacity: 800 mAh

Storage and transit environment to preserve the batteries
Less than 90 days: -20 °C to 40 °C
Less than one year: -20 °C to 30 °C
Charging time (from fully discharged): 100 minutes

Maximum operating time between charges
Maximum output load (11 mA): 18 hours
High impedance load: 24 hours
Recommended cooling period: 100 minutes
To prevent loss of battery capacity recharge at least twice per year.

A40B Adapters, cables and connectors

A40B-LEAD/4MM
N to 4 mm double banana connector lead

This lead permits connecting the A40B shunt's N-type connectors to instrumentation that uses dual banana plug connection terminals. Using two leads permits connecting the shunt's voltage output to a voltage measuring instrument and also connecting the shunt's current input to a UUT current source rated 20 A or less.

A40B-ADAPT/LCN
LC female to N male inter-series adapter

This adapter enables connecting the N-type input connectors of A40B shunts rated 20 A or less with sources that have male LC current connectors.

A40B-LEAD/N
N male to N male lead

This lead permits connecting the A40B shunt's N-type output connector to a voltage measurement device with a female N-type input connector.

A40B-ADAPT/LC
LC male to LC male adapter

This adapter permits connecting current sources with LC female current connectors to A40B LC female shunt input connectors (the 50 A and 100 A shunts). This can also be used with the A40B ADAPT/LCN if a female mating connector is required.

A40B Adapters, cables and connectors

FLUKE® Calibration

Recommended lead and adapter configurations for the A40B shunt input (current) connection

Output connector of the source	Input connector of the shunt (shunt rating)	
	N-type (Shunts - 20 A or less)	LC-type female (50 A or 100 A Shunts)
Dual banana plug	A40B-LEAD/4MM lead	N/A
LC-type male	A40B-ADAPT/LCN adapter plus a user-supplied cable with a female LC connector	User-supplied cable with a female LC connector
LC-type female	A40B-ADAPT/LC adapter plus a user-supplied cable with a male LC connector	A40B-ADAPT/LC adapter plus a user-supplied cable with a male LC connector
N-type	A40B-LEAD/N lead	A40B-ADAPT/LC adapter plus a user-supplied cable with a male LC connector

Recommended lead and adapter configurations for the shunt output (voltage measurement) connection

Input connector of the measurement instrument	Output connector of the shunt (N-type female)
Dual banana plug	A40B-LEAD/4MM lead
N-type	A40B-LEAD/N N lead

Specialized accessories

(Recommended When Calibrating A40B Shunts)

A40B-CAL/LC

High current adapter

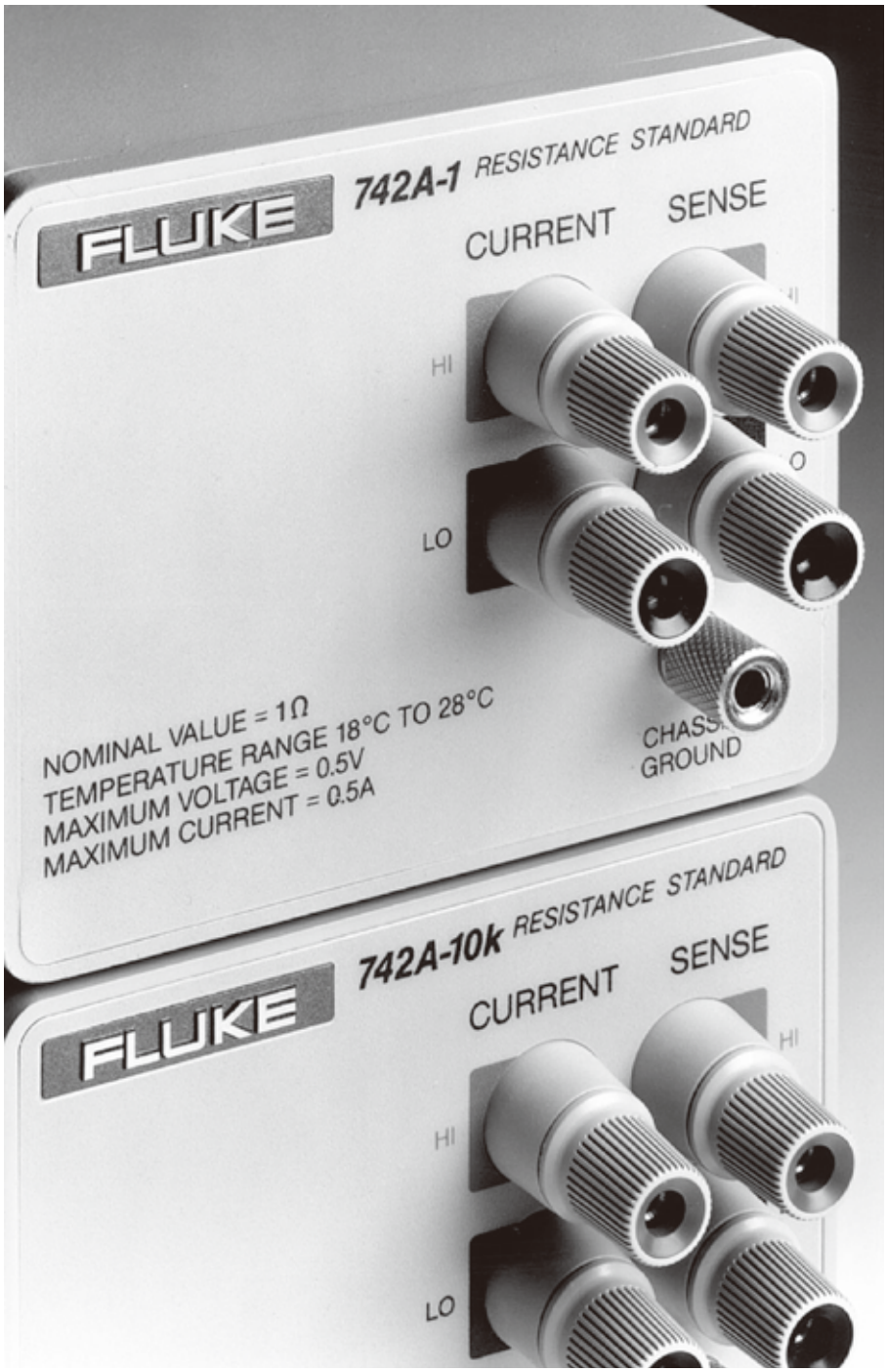
The high current adapter is used when calibrating the A40B shunts at current levels of more than 2 A. It connects together the current source and two shunts for calibration measurements. This adapter uses LC connectors. In this configuration, a certified or reference shunt is connected in series with a shunt that is being calibrated, which in turn are in series with a current source.

A40B-CAL/N

Low current adapter

The low current adapter is used to calibrate shunts at currents levels of 2 A or less. It connects together the current source and two shunts for calibration measurements. This adapter mates with N-type connectors to the shunts and a dual banana connection to the source. In this configuration, a certified or reference shunt is connected in series with a shunt that is being calibrated, which in turn are in series with a current source.

742A Four-Terminal Resistance Standards



Applications

- Working standards
- Portable transfer standards
- Supports Artifact Calibration of the Fluke 5700A and 5720A Calibrators

Features

- Small and rugged
- No oil or air baths required
- 18°C to 28°C operating range
- Supplied with temperature characterization
- Six month stability to 2.5 ppm

Fluke 742A Standard Resistors are high accuracy working standards for precision, on-site resistance calibration. Their excellent temperature stability allows them to be used from 18°C to 28°C with typically less than 2 ppm degradation. Using the calibration table supplied with the standards, which lists corrections in 0.5°C increments, this uncertainty can be reduced to near zero. No cumbersome oil or air baths are required.

Because 742A Standard Resistors are small and rugged, they are easy to transport. Care has been taken to reduce resistance changes brought about by thermal and mechanical shock. Retrace (shift in resistance) is typically less than 2 ppm after cycling between 0°C and 40°C.

The 742A-1 1Ω and 742A-10k 10 kΩ units are ideally suited for Artifact Calibration of the Fluke 5700A and 5720A Calibrators. The other values can be used to verify the calibration if you desire.

A convenient transit case, designed to hold two standards, is available as an option.

742A Four-Terminal Resistance Standards

FLUKE ® Calibration

Specifications

Model	Nominal Value (Ohms)	Deviation from Nominal (ppm)	Stability		Calibration Uncertainty 23°C (ppm)	Max Change 18-28°C (± ppm)	Max Voltage (volts)
			6 month (ppm)	12 month (ppm)			
742A-1	1.0	17	5.0	8.0	1.0	3.0	0.5
742A-1.9	1.9	17	5.0	8.0	1.0	3.0	0.38
742A-10	10.0	17	5.0	8.0	1.0	3.0	1.0
742A-25	25.0	17	5.0	8.0	1.0	3.0	1.0
742A-100	100.0	13	4.0	6.0	1.0	3.0	2.0
742A-1k	1.0k	14	4.0	6.0	1.5	2.0	10.0
742A-10k	10.0k	9	2.5	4.0	1.0	1.5	30.0
742A-19k	19.0k	10	2.5	4.0	1.5	2.0	28.5
742A-100k	100.0k	15	4.0	6.0	2.5	2.0	100.0
742A-1M	1.0M	21	6.0	8.0	5.0	2.0	100.0
742A-10M	10.0M	28	6.0	9.0	10.0	3.0	200.0
742A-19M	19.0M	40	8.0	10.0	20.0	4.0	190.0

Operating temperature range: 18°C to 28°C
Storage temperature: 0°C to 40°C
Retrace error (hysteresis):
23°C to 18°C to 23°C cycle: Negligible resistance shift
23°C to 28°C to 23°C cycle: Negligible resistance shift
23°C to 0°C to 23°C cycle: <2 ppm resistance shift
23°C to 40°C to 23°C cycle: <2 ppm resistance shift
Size: 8.6 cm H x 10.5 cm W x 12.7 cm D (3.4" x 4.15" x 5")
Weight: 1.5 lbs to 2 lbs depending on the model

Optional 742A-7002 transit case

Ordering Information

Model	
742A-1	1Ω Resistance Standard
742A-1.9	1.9Ω Resistance Standard
742A-10	10Ω Resistance Standard
742A-25	25Ω Resistance Standard
742A-100	100Ω Resistance Standard
742A-1k	1 kΩ Resistance Standard
742A-10k	10 kΩ Resistance Standard
742A-19k	19 kΩ Resistance Standard
742A-100k	100 kΩ Resistance Standard
742A-1M 1	MΩ Resistance Standard
742A-10M	10 MΩ Resistance Standard
742A-19M	19 MΩ Resistance Standard
742A-7002	Transit Case, holds two units

734A DC Reference Standard

734A: The simple way to maintain and disseminate your volt

The Fluke Calibration 734A DC Reference Standard is a direct voltage reference used to maintain the volt in primary and secondary standards laboratories. It consists of four electrically and mechanically independent 732B DC Standards and a rack-width enclosure. Individual 732Bs provide 10 V and 1.018 V outputs and may be transported easily to remote locations while the reference is maintained in the laboratory.

Stability for each output is ± 2 ppm per year (10 V) and ± 0.8 ppm per month (1.018 V). Each 10 V output can drive up to 12 mA of current to simplify use with instrumentation with low input impedance.

The 734A Reference Standard was designed for laboratories that need to maintain traceability to national standards and to distribute the volt to production, service, calibration laboratories or other remote locations. To simplify shipment, each 732B Standard is small and highly portable. And its 72-hour battery life—which can be extended to more than 130 hours with the optional external battery and charger—means it's practical to ship a 732B across town or around the world.

Because each 732B in the 734A Reference Standard is based on the same technology pioneered in the popular 732A—the first standards lab quality 10 V electronic reference—you can rely on it to provide the same high stability and predictable drift rate you've come to expect, in a smaller, more portable package.

To simplify support of your 734A, Fluke Calibration offers a variety of calibration services to assign values and predicted performance for the 10 V output, traceable to national standards and to the Fluke Calibration 10 V Josephson Array.

Why a four-cell reference?

A four-cell reference is desirable any time you need to maintain and disseminate a reference voltage. At a minimum, three cells are intercompared to detect and identify changes in the output of any one cell. A fourth cell may be used as a spare or to transport the volt to or from remote locations. When it returns to the laboratory, it can be compared to the other three to determine if its output has shifted during transport.

However, there is more to a four-cell reference than four outputs. According to NBS Technical Note 1239, published by the U.S. National Bureau of Standards (now NIST) in 1987, four to six references are required to provide measurement integrity and redundancy, and to minimize the number of measurements required. References must be completely independent of one another.

Otherwise, common elements, such as a power supply or oven, might affect the correlation of reference outputs. In addition, with frequent intercomparisons of four cells, you can detect when any

734A DC Reference Standard

one of the cells begins to drift beyond specifications or needs to be repaired.

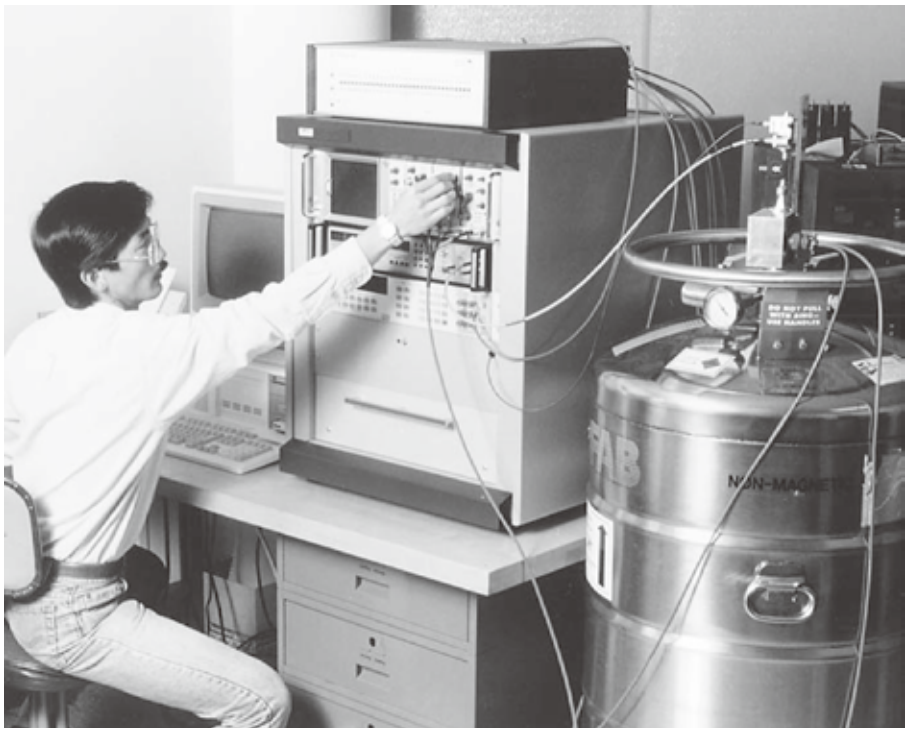
Each 732B is a stand-alone dc standard with its own power supply, oven, supporting electronics and packaging. Each may be purchased separately, or as a full 734A system, which includes four 732Bs that slide into a rack-width enclosure.

A fractional ppm 10 V reference in your lab

With the 734A, it is remarkably simple to establish and maintain a fractional part per million (ppm) primary voltage standard in your laboratory.

Over time, with frequent intercomparisons of your four cells, and regular calibrations of one or more cells, you can reduce the uncertainty of your 734A by a factor of three.

From 1984 until the acquisition of our 10 V Josephson Array, the Fluke Calibration Primary Standards Laboratory maintained its corporate volt in this manner, reducing the absolute uncertainty to ± 0.35 ppm traceable to national standards.



The Fluke Calibration Standards Laboratory offers traceability to its own 10 V Josephson Array, an intrinsic standard of voltage, and to national standards.

Taking your reference to the workload

Standards laboratory operations have changed. In the past, people brought their workload to the standards lab. Today, the functions of the standards lab are being distributed, requiring that many calibrations be performed in the field.

The 734A, and its electrically and mechanically independent 732B Standards, was designed to meet that need. The voltage reference remains undisturbed in your laboratory, while at the same time you can distribute the volt to remote locations outside the lab. When the unit is returned to the lab, comparisons can be made to the reference to determine if a shift has occured during the transfer. To maintain traceability to national standards, one cell may be transported to a national lab or other primary standards lab for calibration, again, without disturbing the reference. Each 732B Standard is relatively light, weighing just 5.9 kg, and its 72-hour battery life provides ample capacity for long shipments. An optional external battery extends that capacity to 130 hours. A special transit case, designed to hold one 732B and an external battery, simplifies transport even further.

The 732B can stand up to a lot of abuse. The inputs can be shorted indefinitely and are protected up to 1100 V dc, 25 mA, without damaging the cell or affecting its output.

Ideal support for artifact calibration
Combined with 742A-1 and 742A-10k Resistance Standards, a single 732B makes a tough and compact artifact calibration support package for instruments like the 5700A and 5720A Calibrators from Fluke Calibration or the 3458A Multimeter from Agilent.

734A DC Reference Standard

Why should you prefer the 734A?

- **Independence.** The 734A is the only standard of its type offering complete mechanical and electrical independence of each of its four standards.
- **Portability.** Each 732B Standard is designed for portability. Each is small, light, rugged and has a long operating battery life.
- **Confidence.** The 732B is based on the proven technology of the Fluke Calibration 732A. The 732A was the first standards lab quality electronic reference to gain wide acceptance as a replacement for saturated standard cells. Originally designed for internal transfers of Fluke's corporate volt to the production floor, thousands are now in service worldwide in a variety of applications—from maintaining an institutional reference to transferring values from national labs or privately-operated 10 V Josephson Arrays.

The 732B's reference amplifier and resistors are identical to those used in the 732A. But the package is now half the weight, 75 % smaller, more rugged and offers greatly extended battery life. The rack-width enclosure provides a convenient way to store cells in your lab. And the internal battery is now a common, off-the-shelf model that can be purchased from a wide range of electronic components suppliers, simplifying your support. Or you can use your own battery, connecting it to the 12 V to 15 V dc input on each 732B.

The advantages to maintaining your reference at 10 V

The primary benefits of maintaining your voltage reference at 10 V rather than 1.018 V center on efficiency and ease-of-use. At 10 V, you can intercompare standards directly with a digital voltmeter. The effects of noise and thermal EMFs are diminished by a factor of 10 compared to standard cells. And with 10 V Josephson Arrays becoming more common, working at the 10 V level further simplifies the process of establishing traceability. Finally, most modern dc instrumentation today requires a 10 V standard for calibration. When you ratio up to 10 V from 1.018 V, you lose considerable performance.

The 734A supports 1.018 V as well

In applications where saturated standard cells are still used, the 1.018 V output of each 732B Standard in the 734A Reference greatly simplifies intercomparisons of cell banks. And, like the 10 V output, each 1.018 V output is completely electrically and mechanically independent to preserve the integrity of your reference. Unlike standard cells, the 1.018 V output of the 732B may be used immediately after shipment, eliminating the need to let cells stabilize for an extended period.

Supporting your traceability requirements

Fluke Calibration provides the products and services you need to manage your traceability requirements. New 732Bs can be ordered with or without calibration certificates. The standard 732B comes

The 734A Reference and 732B Standards are a practical way to maintain and disseminate your volt and to support artifact calibration of instruments like the 5700A and 5720A Calibrators.

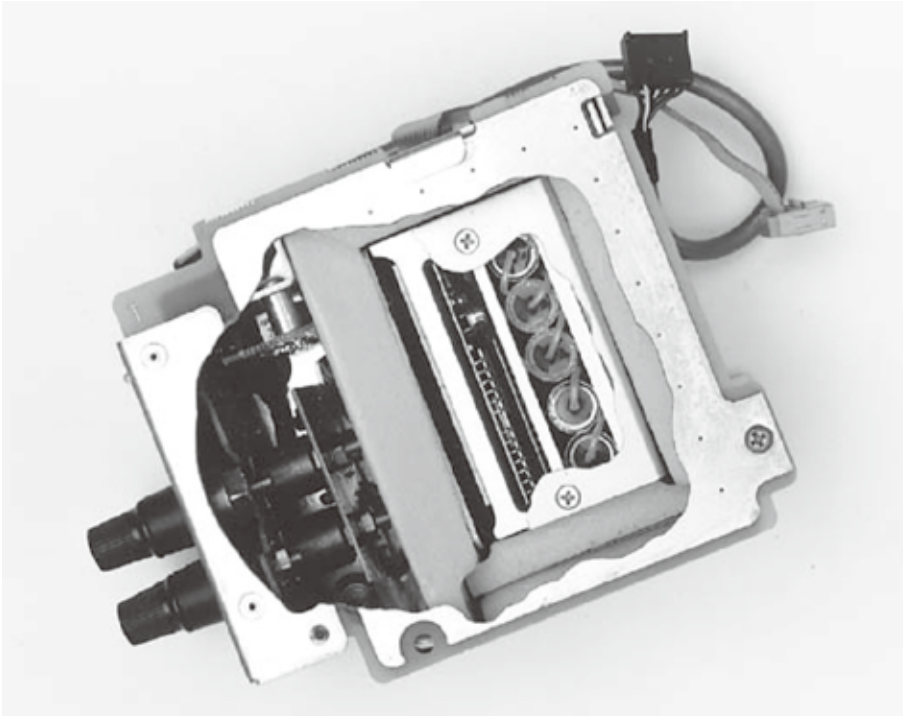
734A DC Reference Standard

without any calibration certificate, with the intention of the owner providing traceability as required locally. When delivery of a new 732B with a calibration certificate is required, then three alternatives are possible:

- **Calibration.** The 732B/H is a 732B where Fluke Calibration performs an output voltage calibration on your new standard. Before shipment, your standard is compared to direct voltage standards maintained at Fluke. Your standard, shipped under power, includes a Report of Calibration showing the deviation from nominal and the uncertainty of the calibration. This certificate is traceable to NIST via Fluke's Josephson Array, an intrinsic standard of voltage.

- **Calibration and drift characterization.** The 732B/C is similar to the 732B/H, but it adds drift rate characterization before shipment. The output voltage is compared to a Fluke standard for 90 days. Once the drift rate is known, total uncertainty as a function of time is greatly reduced. The projected output voltage is tabulated for 12 months following calibration. Uncertainty of the projection varies linearly, from + 0.5 ppm at the time of calibration to + 1.5 ppm after 12 months.

732B Standards are small, light and rugged. Their 72-hour battery life, which can be extended to 130 hours with the optional external battery and charger, make them ideal for transfer standards.



The Fluke Calibration 732B Standard uses the same specially selected zener reference technology pioneered in the popular 732A.

- **Accredited calibration.** Normally, the 732B calibration certificates are traceable to NIST but are not considered accredited calibrations. For an extra charge, an accredited calibration certificate is available. Contact your Fluke Calibration representative for details.

Both the 732B/H and 732B/C require that the standard is shipped to you under power. This continuous power on condition is required during shipment through delivery to your lab for the calibration to remain valid. If continuous power is not maintained, then the validity of the calibration certificate may be compromised. Contact your Fluke Calibration representative to determine if the 732B/H or 732B/C alternatives are available in your area.

For existing 732Bs or similar standards that are already in use, the Direct Voltage Maintenance Program is a service where Fluke Calibration can provide calibration certificates for these standards. This service consists of two calibration alternatives that can be used depending on your needs.

- **Calibrations done by Fluke.** Calibration certificate services can be easily performed on standards returned to Fluke Calibration service

facilities. Contact your Fluke Calibration representative or your local Fluke service center for details regarding these calibration certificate alternatives.

- **Calibration in your laboratory.** With the 732B-200 services, a standard owned and calibrated by Fluke Calibration, including all necessary connecting cables and clear operating instructions, is sent to your site for comparison with one or more of your own reference standards. You make a series of readings over five days and forward the standard to the next laboratory, then return the measurement results to the Fluke Calibration Standards Laboratory. A value for your reference relative to the Fluke standard is assigned. Within one week, a preliminary Report of Calibration is returned to you. Once the standard is returned to Fluke Calibration, it is compared to the Fluke Voltage Standard. A final value is assigned to your reference, and a final Report of Calibration is sent to you. The 732B-200 service provides a calibration certificate for one local standard. Each additional standard that requires a certificate can use the 732B-201 service. In this way, comparing multiple standards to a single Fluke Calibration standard will provide any required number of standards with individual calibration certificates.

Note: This service is not available in all areas. Contact your local Fluke representative for details).

specifications

Output voltages
Outputs of 10.0 V and 1.018 V are provided at separate binding-post pairs with the following characteristics:

Stability
Stability for the 732B is specified by the following at a temperature of Tcal ± 1 °C (15 °C ≤Tcal ± 35 °C):

	Stability (ppm)		
Output Voltage	**30 Days**	**90 Days**	**1 Year**
10 V	0.3	0.8	2.0
1.018 V	0.8	NA	NA

Noise at output terminals
Output noise is specified for both day-to-day observations and for short-term observations. The former is given by the standard deviation about the regression line of a 90-day regression model. The latter is terms of its rms value in a bandwidth as follows:

Output Voltage	Day-to-Day (S1) (ppm)	0.01 Hz 10 Hz (ppm)
10 V	0.065	0.06 rms
1.018 V	0.1	0.3 rms

Output current and impedance

Output Voltage	Output Current	Output Impedance
10 V	12 mA*	≤1 mW
1.018 V	NA	≤1 kW

* Output current is limited to ≤0.1 mA to realize 72-hour operation under battery power.

Output adjustment
10 V: 0.15 ppm resolution 1.018 V: Set at nominal ± 1 mV. No adjustment is provided, however the output value changes when the 10 V output is adjusted

Retrace (hysteresis) error (Constant temperature)
≤0.1 ppm, 10 minute power off ≤0.25 ppm, 1 to 24 hours power off

Stabilization time (Constant temperature)
For best results, allow a 14-day stabilization period after power has been off for an extended period of time

No power interruption
No stabilization time is required after moving into another environment
Power off <1 hour
1-hour warm up required
Power off 1 to 24 hours
24-hour warm up required

Temperature coefficient (TC) of output
In the temperature range of 15 °C to 35 °C, the magnitude of TC is bounded by the following:
10V TC ≤0.04 ppm/°C
1.018 V TC ≤0.1 ppm/°C

Load regulation
10 V output will change less than 1 ppm for a full load change from 0 to 12 mA and less than 0.1 ppm for a load change from 0 to 2 mA

Line regulation
The outputs will change no more than 0.05 ppm for any 10 % line voltage change or for the entire operating range of the battery

Output protection
All outputs can be shorted indefinitely without damage to the instrument. The 10 V output can withstand voltages from other sources as follows:
1. For voltages ≤220 V dc, the unit is protected for up to 50 mA continuous current
2. For voltage ≤1100 V dc, the unit is protected for up to 25 mA continuous current or up to 0.6 joules of energy

Environment

	Temp Relative °C	Range Humidity %	Altitude meters (feet)
Normal operation	15-35	15-80	0-1,830 (0-6,000)
Safe operation	0-50	15-90	0-3050 (0-10,000)
Storage (no batt)	-40-50	non-cond	0-12,200 (0-40,000)

Compliance with external standards
ANSI ISA-S2 IEC 348 CSA C22.2 #231
IEC 1010 UL 1244

Line power requirements

Voltage	Frequency
90 V to 132 V ac	47 Hz to 63 Hz
180 V to 264 V ac	47 Hz to 63 Hz

Battery operation
When fully charged, the batterieswill maintain the 732B for a minimum of 72 hours at 23 °C ±5 °C, with an output current <0.1 mA.
The batteries are rechargeable in less than 24 hours with a self-contained battery charger.
A rear-panel input has been provided to accept an external 12 V battery or equivalent 12 V to 15 V dc power source.

Isolation
The resistance from any 732B output terminal to earth ground or to the ac mains is at least 10,000 MΩ shunted by less than 1000 pF.

Guard and grounding
Chassis ground terminals are provided on both front and rear panels. Access to the internal guard is provided by a front-panel terminal.

734A DC Reference Standard

FLUKE ®
Calibration

Explanation of stability verification
Stability for a given period of time is defined as the output uncertainty minus the calibration uncertainty at the 99 % confidence level. When the output voltage is characterized by a regression model, stability is given by the following equation:

$$\left| b\left(\frac{P}{365}\right)\right| + S_1 t_1 \sqrt{\left[\frac{S_{ra}\, t_2}{S_1\, t_1}\right]^2 + \left(\frac{1}{n}\right) + \left[\frac{(P-\bar{x})^2}{\Sigma(Xi-\bar{x})^2}\right]}$$

where b = slope of regression in ppm/year
S_1 = standard deviation about the regression (SDEV)
Sra = SDEV.of data filtered with 7-day moving average filter (MAF)
P = period of time under consideration in days
$\bar{x}$ = mean time for regression data
n = 180 periods (typically 2 measurements per day)
Xi = ith period
t_1 = student's t statistic for (n-2) degrees of freedom (typically 2.6)
t_2 = student's t statistic for $\left[\left(\frac{n}{7}\right) + 2\right]$ degree of freedom (typically 2.81)

Each data point for the computation of the regression parameters is the average voltage of 50 readings taken in a 50-second measurement period.

Reference standard comparison selection guide

Model	732B	734A [1]
10 V output Stability (± ppm), 90 days Stability (± ppm), 1 year	 0.7 1.6	 0.7 1.2
Predictability After 5 points, 3 months apart	± 0.4 ppm/year typ.	± 0.2 ppm/year typ.
Temperature coefficient (15 °C to 35 °C)	< 0.04 ppm	
Noise 0.01 Hz to 10 Hz Std. dev. of 90 days regression	< 0.06 ppm RMS < 0.065 ppm	< 0.03 ppm RMS < 0.04 ppm RMS
Hysteresis recovery (after battery discharge)	0.2 ppm [2]	
Output current Output resistance	12 mA < 1 mΩ	
Battery type Back-up period Recharge time (typical) Half life Reference conditioning (power loss recovery)	 72 hours 24 hours No	
Temperature Operating Transit Warm-up period	 +15 °C to 35 °C -40 °C to 50 °C 1 hour (power off for less than 1 hour)	
Power	< 10 W	< 40 W
Dimensions (H x W x D)	135 x 99 x 419 mm (5.3 x 3.9 x 16.5 in)	191 x 432 x 502 mm (7.5 x 17 x 19.75 in)
Weight	5.9 kg (13 lb)	29.6 kg (65 lb)
Safety	UL1244; CE marked; CSA C22.2 # 231; IEC 348; IEC 1010	

Notes: All specifications, including 732B, are stated with 98 % confidence level.
[1] 734A specifications are using a mathematical average of four cells.
[2] Conditioning not available. Specification assumes reference remains within a temp controlled environment.
[4] Actual resistance = 500/n, where n = number of references in the Average.

Specialty Instruments from Keithley

To bring our customers the highest level of measurement capabilities, Fluke Calibration is proud to offer these precision metrology-grade products from Keithley Instruments.

6517B Electrometer/High Resistance Meter

The 5½-digit Model 6517B Electrometer/High Resistance Meter offers accuracy and sensitivity specifications unmatched by any other meter of this type. It also offers a variety of features that simplifies measuring high resistances and the resistivity of insulating materials. With reading rates of up to 425 readings/second, the Model 6517B is also significantly faster than competitive electrometers, so it offers a quick, easy way to measure low-level currents.

- Measures resistances to 1016 Ω
- 1 fA .20 mA current measurement range
- <20 µV burden voltage on lowest current ranges
- 200 TΩ input impedance
- <3 fA bias current
- Up to 125 rdgs/s
- 0.75 fA p-p noise
- Built-in ±1 kV voltage source
- Unique voltage reversal method for high resistance measurements

6487 Picoammeter/Voltage Source

The 5-1/2 digit Model 6487 Picoammeter and Voltage Source provides 10 fA resolution, superior sensitivity, voltage sweeping and alternating voltage resistance mearurements making it well suited for low level current measurements. This cost-effective instrument can measure currents from 20 fA to 20 mA, take measurements at speeds up to 1000 readings per second, and source voltage from 200 µV to 505 V.

- Resistance/relativity measurements
- 10 fA resolution
- 5-1/2 digit resolution
- <200 µV burden voltage
- Alternating voltage method ohms measurements
- Automated voltage sweeps for I-V characterization
- Floating measurements up to 500 V
- Up to 1,000 readings/second
- Analog output

Specialty Instruments from Keithley

FLUKE® Calibration

KEITHLEY **About Keithly Instruments** Keithley is renowned as a leader in low-level precision electrical measurements, and these products present an opportunity to help you further reduce uncertainties in your lab.

6220/6221 DC and DC/AC Current Sources

The 6220 DC Current Source and Model 6221 AC and DC Current Sources combine ease of use with exceptionally low-current noise. High sourcing accuracy and built-in control functions make the Models 6220 and 6221 ideal for resistance measurements using the delta mode, pulsed measurements and differential conductance measurements. These 622X sources, when linked to the Model 2182A Nanovoltmeter, provide control with excellent measurement results for low-value, low-noise resistance measurements.

6220 and 6221

- Source and sink (programmable load) 100 fA to 100 mA
- 1014 Ω output impedance ensures stable current sourcing into variable loads
- 65,000-point source memory allows executing comprehensive test current sweeps directly from the current source
- Reconfigurable triax output simplifies matching the application's guarding requirements
- Delta mode enabling of 2182A Nanovoltmeter for ultra-low noise-voltage and resistance measurement capability

6221 only

- Sourcing of ac currents from 4 pA to 210 mA up to 100 KHz
- Built-in arbitrary waveform generator with 1 mHz to 100 kHz at 10 msps update
- Four user defined waveforms plus sine, square and ramp
- Programmable pulse widths to 50 µsec (micro-seconds) for effective control of power dissipation

2182A Nanovoltmeter

The two-channel Model 2182A Nanovoltmeter is optimized for making stable, low-noise voltage measurements and for characterizing low-resistance materials and devices reliably and repeatably. It provides higher measurement speed and significantly better noise performance than alternative low-voltage measurement solutions.

- 7 1/2 digit resolution provides 1 nV sensitivity on 10 mV setting
- High accuracy: ±2 ppm rdg
- 3x lower noise than the Agilent 34420A at 1 PLC
- Make low-noise measurements at high speeds, typically just 15 nV p-p noise at 1s response time, 40-50 nV p-p noise at 60 ms
- Delta mode coordinates measurements with a reversing current source at up to 24 Hz with 30 nV p-p noise (typical) for one reading; averages multiple readings for greater noise reduction
- Synchronization to line provides 110 dB NMRR and minimizes the effect of ac common-mode currents
- Dual channels support measuring voltage, temperature, or the ratio of an unknown resistance to a reference resistor
- Built-in thermocouple linearization and cold-junction compensation

Fluke Precision Measurement

FLUKE ®

Calibration

Fluke Precision Measurement provides the broadest range available of calibrators, standards, software, service, training and support solutions.

Temperature calibration
- Temperature and humidity calibration
- Calibration software
- Services and training

Electrical calibration
- DC/LF electrical calibration
- Power calibration
- Calibration software
- Time and frequency
- RF calibration
- Services and training

Pressure and flow calibration
- Pressure and flow calibration
- Calibration software
- Services and training

For details about electrical,

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