

5200A Precision Alternating Voltage Calibrator

120 ppm point uncertainty available

Seven voltage ranges from 1 mV to 1000V

6½-digit resolution (1,199,999 counts)

Output frequencies from 10 Hz to 1 MHz

Automated characterized operation available

IEEE-488 system interface available

Phase-lock input

Completely guarded

Short and overload protected

A Proven Performer

The Model 5200A Alternating Voltage Calibrator is a precision high-performance alternating voltage source with proven reliability and exceptional stability and accuracy over a broad frequency range. It is specified over a wide 0°C to 50°C operating range for use in both laboratory and manufacturing environments. Amplitude is controlled in six ranges from 1 mV to 100V. Resolution to 1,199,999 counts yields 20% overrange capability with 1 nanovolt steps on the 1 mV range, up to 0.1 mV steps on the 100V range. Outputs from 100 μ V rms to 120V rms are provided, with up to 50 mA load current capability.

An additional 1000V range is included for front panel or remote interface control of a 5205A or 5215A Precision Power Amplifier.

Amplitude error measurement for voltmeter calibration is provided in two ranges, $\pm 3\%$ and $\pm 0.3\%$. Error measurements can be resolved to 10 ppm.

Five frequency ranges are provided from 100 Hz to 1 MHz, with 119,999 count resolution for 20% overrange capability with 0.01 Hz steps on the 100 Hz range, up to 100 Hz steps on the 1 MHz range.

The oscillator of the 5200A may be phase locked to an external source to produce synchronous signals of precision amplitude and stability. Signal phase is locked within $\pm 1^\circ$ of phase angle, $\pm 0.05^\circ/\text{kHz}$, over a $\pm 2\%$ band around the center frequency. This capability is essential for 60 Hz calibration.

A 3V pulse signal is provided for monitoring frequency with an external counter.

A quadrature output signal is provided which leads the fundamental signal phase by 90°. Amplitude varies from 1V to 10V rms, proportional to the fundamental signal output level on any range. This signal is useful for wattmeter calibration, and for research and development tasks that use the 5200A as a precision source.

External sensing may be selected, bringing rated accuracy to the load point bypassing losses in output leads.

Outputs are protected from overload by current limiting. Overload response time is typically 2 microseconds. When an overload is removed output recovers automatically to its previous level.

The 5200A is a fully guarded calibrator. This allows floating operation, and eliminates system ground loop problems. This is especially useful for calibrating non-guarded equipment.

Remote Programming (Options -01 or -05)

The 5200A is remotely programmable in all functions except Power, Remote/Local, and Vernier Voltage Error. For any programmed amplitude, the output settles to its specified uncertainty within 0.5 seconds for frequencies above 100 Hz, and within 4 seconds for frequencies below 100 Hz. Program status flags are provided to indicate settling time and current limit conditions to the controller.

Either the 5200A-01 Parallel Remote Control Interface or the 5200A-05 IEEE-488 System Interface may be installed in the 5200A, for complete remote control of both the 5200A Calibrator and a 5205A or 5215A Power Amplifier.

The 5200A-01 Parallel Remote Control Interface provides excellent isolation between external system logic and internal calibrator circuitry. This isolation is typically $10^6\Omega$ in parallel with 30 pf capacitance. This effectively attenuates external logic and ground noise better than 100:1 at 10 MHz.

Command data is segmented into 4-bit groups that can be programmed separately or simultaneously. Command data is stored both inside and outside the guard.

5200A-01 programming levels are compatible with TTL logic, and with contact closure:

Standard levels:

Logic 1 or true = 0 to +0.4 dV

Logic 0 or false = +2.8V to +5.0 dV

(For inverted logic levels, also order option 5200A-03.)

The 5200A-01 includes both standard and blank address matrix cards, and a mating connector.

The 5200A-05 IEEE-488 System Interface incorporates subsets SH1, AH1, T6, TEO, L4, LEO, SR1, RLO, PPO, DC2, and DTO of IEEE Standard 488-1980. The 5200A-05 may be addressed for a 2-byte status response or serial polled for a 1-byte response. Status information includes Remote/Local, Standby/Operate, limits, settling time, and out-of-range instruction.

5200A

Automated Characterized Operation

The established excellent stability and performance history of the 5200A Alternating Voltage Calibrator offers an opportunity for further reducing calibration uncertainty while greatly simplifying use.

Characterization is a process of measuring a particular calibrator's uncertainties at selected points using traceable transfer standards and recording those uncertainties in a table. When the selected points are used, the portion of these uncertainties not due to the transfer standards or to the characterization process can then be added to (or subtracted from) the calibrator setting. In practice, this significantly reduces calibrator uncertainty.

Mathematical interpolation methods are used for points other than those selected for characterization. While this yields a significant improvement in uncertainty specifications, it can be complex and time consuming when done manually.

Option 5200A-800 is a software package that uses a Fluke 1722A or 1752A Instrument Controller to operate a 5200A Alternating Voltage Calibrator and a 5205A or 5215A Precision Power Amplifier. This software makes use of a stored characterization table and automatically interpolates for voltages and frequencies selected between characterization points.

The 5200A-800 controls all calibrator functions in a simplified manner with the touch-sensitive display of the 1722A or 1752A.

Calibration

The 5200A is originally calibrated at the factory by instrumentation traceable to the U.S. National Bureau of Standards. Periodic traceable recalibration service is available through Fluke Technical Service Centers and Sales Representatives worldwide.

Fluke also offers 5200A characterization service as well as 540B characterization for customers doing their own 5200A characterization. The table of correction factors is supplied in written form, and on a disk compatible with the 5200A-800.

Specifications

Technical Specifications

Amplitude Uncertainty

Specified for 180 days. Characterized uncertainty requires optional 5200A-900 characterization. Both specifications are valid when operating in an ambient temperature between 18°C and 28°C after a 1-hour warmup.

Basic Instrument Absolute Uncertainty ¹			Characterized Uncertainty ²		
Voltage Ranges	Frequency Hz	±(ppm setting + μV)	Frequency Hz	±(ppm setting + μV)	
				Relative	Absolute
1 mV ³ 10 mV	10-30	1000+10			
	30-20K	200+10			
	20K-100K 100K-1M	500+20 3300+30			
100 mV	10-30	1000+10	50-100	130+10	150+10
	30-20K	200+10	100-20K	125+10	145+10
	20K-100K	500+20	20K-50K	180+20	250+20
	100K-1M	3300+30	50K-100K	200+20	470+20
		±(ppm setting + ppm range)		±(ppm setting+ppm range)	
1V 10V 100V	10-30	1000+50	50-100	130+20	150+20
	30-20K	200+20	100-20K	125+15	145+15
	20K-100K	500+50	20K-50K	180+20	250+20
	100K-1M	3300+300	50K-100K	300+30	470+30
1000V ⁴	10-30	1200+50	50-100	190+20	210+20
	30-20k	400+40	100-10k	180+20	180+20
	20k-50k	800+50	10k-20k	200+20	200+20
	50k-100k	1000+100	20k-50k	310+30	310+30

Notes:

1. Includes transfer standards, dc reference source, and allowances for techniques, 90 days
2. 180 days. Requires 5200A-900
3. On 1 mV range, specification applies for measuring instruments with less than 2 MHz bandwidth.
4. With 5205A or 5215A Power Amplifier

Characterized-Point Absolute Uncertainty, ±ppm*									
Voltage	Frequency, Hz								
	50	100	200	1k	2k	10k	20k	50k	100k
0.5	125	125	—	125	—	125	—	210	450
1	120	120	120	120	120	120	120	200	450
3	130	130	—	130	130	130	—	220	450
10	120	120	120	120	120	120	120	200	450
30	130	130	—	130	—	130	—	220	450
100	120	120	120	120	120	120	120	200	450
300	190	190	—	190	—	190	—	630	—
1000**	180	180	180	180	180	180	200	610	—

* 180 days. Requires 5200A-900. Traceable to U.S. NBS Standards. Includes transfer standards, dc reference source, and allowances for techniques

** With 5205A or 5215A Power Amplifier.

Voltage Resolution

Range	Voltage Settings	Resolution
1 mV	0.100000 mV to 1.199999 mV	1 nV
10 mV	1.000000 mV to 11.999999 mV	10 nV
100 mV	10.000000 mV to 119.999999 mV	100 nV
1V	0.1000000V to 1.1999999V	1 μV
10V	1.0000000V to 11.999999V	10 μV
100V	10.000000V to 119.99999V	100 μV
1000 ⁴	100.00000V to 1199.9999V	1 mV

⁴With 5205A or 5215A Power Amplifier

Stability

Voltage Ranges	Frequency Hz	Stability ¹	
		(ppm setting + ppm range) ²	
		10 Minutes	180 Days
1 mV 10 mV	10 - 30	70 + 40	300 + 60
	30 - 20k	70 + 3 ³	100 + 30
	20k - 100k	70 + 3	130 + 40
100 mV	10 - 30	70 + 40	300 + 60
	30 - 1k	70 + 3 ³	70 + 40
	1k - 20k	70 + 3	100 + 30
	20k - 50k	70 + 3	120 + 50
	50k - 100k	70 + 3	100 + 130
1V 10V 100V	10 - 30	70 + 40	200 + 20
	30 - 20k	35 + 5 ³	45 + 5
	20k - 50k	55 + 5	65 + 5
	50k - 100k	70 + 3	220 + 20
1000V ⁴	10 - 100	0 + 50	200 + 0
	100 - 20k	70 + 5	200 + 0
	20k - 100k	70 + 5	400 + 0

1. Constant line, load, and temperature
2. Total peak to peak random change in rms value
3. For frequencies below 50 Hz, floor is 40 ppm range
4. With 5205A or 5215A Power Amplifier

Temperature Coefficient: For 0°C to 18°C and 28°C to 50°C, add $\pm(0.025 \times \text{uncertainty})$ per °C below 18°C or above 28°C; for the 1000V range add $\pm(0.03 \times \text{uncertainty})$ per °C

Maximum Load: 1 mV, 10 mV, 100 mV ranges: minimum 6000Ω load impedance; 1V,* 10V, 100V ranges: maximum load current 50 mA; 1000V range: maximum load current 200 mA
*Minimum load impedance 50Ω above 0.1 MHz

Voltage Error Control: Switch selectable OFF, or two ranges: 0 to $\pm 0.3\%$ with 10 ppm resolution; 0 to $\pm 3\%$ with 100 ppm resolution

Settling Time

Frequency Hz	Settling Time,* Seconds
10 - 30	4 to 15
30 - 100	4
100 - 400	2
400 - 1M	1**

*To within 100 ppm of change

**Typically less than 0.5 second, except frequency range changes

External Sense: Switch selectable, internal or external, available on 1V, 10V, and 100V ranges.* Output rises to less than 2.0V rms above selected level when sense lines are disconnected in external sense mode

*Output impedance on 1 mV, 10 mV, and 100 mV ranges is less than 1.5Ω in series with 15 μH

Frequency Performance*

Range	Frequency Settings	Resolution Hz**	Uncertainty $\pm(\% \text{ of input} + \% \text{ of Range})$
100 Hz	10.00 Hz to 119.99 Hz	0.01	1.0 + 0.1
1 kHz	1.000 kHz to 1.1999 kHz	0.1	
10 kHz	1.000 kHz to 11.999 kHz	1	
100 kHz	10.00 kHz to 119.99 kHz	10	
1 MHz	1.000 MHz to 1.999 MHz	100	3.0 + 0.3

*90 days, 18°C to 28°C, after 1-hour warm-up

**100 ppm of range

Total Harmonic Distortion and Line-Related Noise*

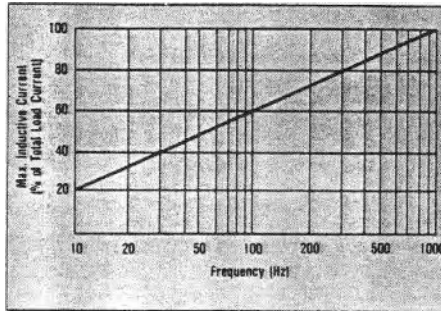
Frequency Hz	$\pm(\% \text{ of setting} + \mu\text{V rms})$
10k - 100k**	0.04% + 10
100k - 500k	0.3% + 30
500k - 1M	1.0% + 30

*Bandwidth 10 Hz to 10 MHz, and less than 15 mA output current except 1000V range. See 5205A or 5215A specifications

**1V range is $\pm 0.08\%$ from 10 Hz to 15 Hz

Maximum Capacitive Load: 1000 pF on 1 mV-100V ranges, 1500 pF on 1000V range

Maximum Inductive Load Current: (Except 1000V range)



Phase Lock Input: 1V to 10V rms, useable down to 100 mV rms

Phase Lock Accuracy: $\pm 3^\circ$ below 30 Hz, and $\pm(1^\circ + 0.05^\circ \text{ per kHz})$ over a $\pm 2\%$ band around center frequency

Quadrature Output:

Amplitude: 1V to 10V rms, $\pm 10\%$, proportional to selected output voltage

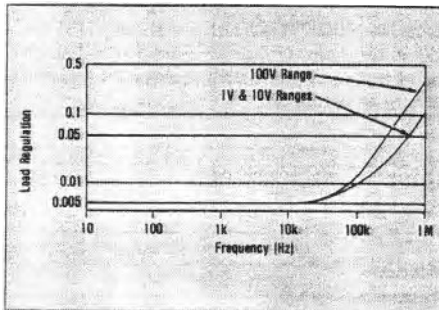
Phase: 10 Hz-40 Hz, $90^\circ \pm 3^\circ$; 40 Hz to 1.2 MHz, $90^\circ \pm(1^\circ + 0.03^\circ \text{ per kHz})$

Minimum Load: 3 kΩ impedance

Current Limit: Typical transition time, 2 μs. Recovery within specified settling time

Volt-Hertz Product: Output voltage x frequency $\leq 10^7$. Full 120V rms output is maintained up to 83.33 kHz. Maximum output voltage at 1.2 MHz is 8.33V rms

Load Regulation: 50 ppm of range, no load to full load, up to 10 kHz



General Specifications

Maximum Isolation Voltages: (dc or peak ac) 500V, GUARD to chassis; 100V, LO to GUARD

Temperature: 0°C to +50°C operating, -40°C to +75°C storage

Input Power: Switch selectable, 100V, 115V, 200V, 230V ac, 100W

Size: 17.8 cm H x 43.2 cm W x 53.3 cm D (7 in x 17 in x 22.5 in)

Weight: 24.1 kg (53 lb)

Includes: Instruction manual, mating connectors, power cord, calibration certificate

Ordering Information

Models

5200A Precision Alternating Voltage Calibrator

5205A AC/DC Precision Power Amplifier

5215A Precision Power Amplifier

5200A/5215A Precision Alternating Voltage Calibration System

1722A Instrument Controller

Options (for 5200A)

-01* Parallel Remote Control Interface

-03 Logic Level Inversion (for 5200A-01)

-05** IEEE-488 System Bus Interface

-800*** Automated Characterized Operation Software

-900 Characterization of New-Purchase 5200A and 5215A

-902 Characterization of New-Purchase 5200A

*Cannot be used with 5200A-05

**Cannot be used with 5200A-01

***Requires 1722A, 1752A or 1720A, and 5200A-900 or 5200A-902

Accessories

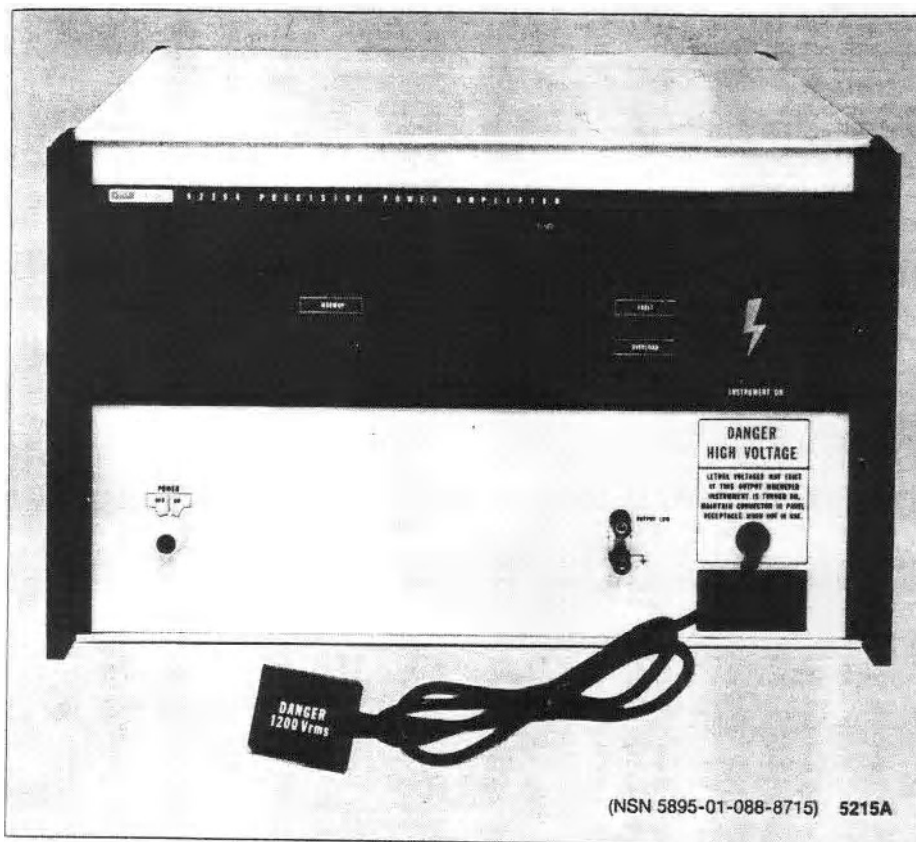
M07-205-600 Rack Mount Kit for 5200A

M10-205-600 Rack Mount Kit for 5215A

M00-280-610 24" Rack Slides for rack adapter

Y1790 Rack Mount Kit w/24" Slides for 1722A

5200A-7015K Extender Board Kit



5215A Precision Power Amplifier

Designed for use with 5200A or 5100B Calibrators

Output voltages to 1100V rms

Maximum output power 220 watts

10 Hz to 100 kHz, typical upper limit 120 kHz

420 ppm midband amplitude uncertainty at 1000V rms

200 ppm midband six-month stability

Fully programmable

Short and overload protected

The 5215A Precision Power Amplifier is an ac coupled programmable inverting amplifier with a fixed gain of 100. Output level is specified to 1100V at up to 200 mA, with a typical upper limit of 1200V before automatically tripping into standby mode.

The 5215A includes automatic-overload sensing and recovery. Upon sensing an excessive slew rate or frequency of the input signal, or a momentary output overload, output is returned to zero within 2 microseconds and held there for 6 milliseconds or until the fault is corrected. When a steady overload, shorted output, or excessive input drive level is detected, the 5215A

trips and locks into standby mode and displays a fault indicator.

An interface for a 5200A Alternating Voltage Calibrator is standard, allowing the 5215A to be controlled by the calibrator as an extension of its capabilities.

The 5215A includes a 1-meter output cable with a protective shrouded connector. Remote sensing is brought to this connection point for maximum accuracy. An insulated receptacle is provided on the front panel for safe storage of the output connector when not in use. Option 5215A-07, for system applications, moves this cable to the rear panel.

All calibration adjustments and lamp replacements can be performed without exposure to high voltage. The output amplifier and all of the printed circuit modules are easily removed for repair to exchange.

Calibration and Characterization

The 5215A is calibrated at the Fluke manufacturing facility by instrumentation traceable to the U.S. National Bureau of Standards. When ordered with a 5200A AC Calibrator, 5200A-900 characterization may be ordered including simultaneous characterization of the 5215A at points compatible with 5200A-800 software. See the 5200A Alternating Voltage Calibrator for more information.

Specifications

Absolute Uncertainty

Basic Instrument Absolute Uncertainty*		Characterized Uncertainty**		
Frequency Hz	±(ppm + ppm setting range)	Frequency Hz	±(ppm setting + ppm range)	
			Relative	Absolute
10-30	1200+50	50-100	190+20	210+20
30-20k	400+20	100-10k	180+20	200+20
20k-50k	800+50	10k-20k	200+20	220+20
50k-100k	1000+100	20k-50k	310+30	630+30

* Includes transfer standards, dc reference source, and allowances for techniques. 90 days, 18° C to 28° C, after 1-hour warm-up

** 180 days, 18° C to 28° C, after 1-hour warm-up. Requires 5200A-900

Characterized-Point Absolute Uncertainty:* ±ppm

Frequency, Hz							
50	100	200	1k	2k	10k	20k	50k
180	180	180	180	180	180	200	610

* Includes transfer standards, dc reference source, and allowances for techniques. 180 days, 18° C to 28° C, after 1-hour warm-up. Requires 5200A-900

Output Voltage Range: 100V to 1099.999V rms

Output Voltage Resolution: 1 mV with 5200A; 10 mV with 5100 Series, ac output only

Temperature Coefficient: For 0° C to 18° C and 28° C to 50° C, add ±(0.025 x uncertainty) per ° C below 18° C or above 28° C

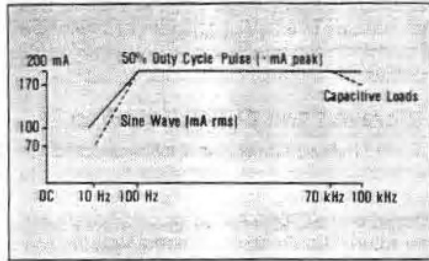
Stability

Frequency Hz	10 Minutes	24 Hours	6 Months
	±(ppm setting + ppm range)		
10 - 100	0 + 50	100 + 0	200 + 0
100 - 20k	70 + 5	100 + 0	200 + 0
20k - 100k	70 + 5	200 + 0	400 + 0

* Constant line, load, and temperature, total peak to peak random change in rms value

Maximum Isolation Voltage: Output common may be floated up to ±10V dc or rms ac from chassis to reduce common mode errors

Maximum Load Current:



Maximum Capacitive Load: 1500 pF, not to exceed rated load current. (Example: maximum capacitive load at 1000V, 100 kHz is 270 pF)
DC Offset Voltage: ± 10 mV at the output*
 *90 days, 18°C to 28°C, after 1-hour warm-up

Total Harmonic Distortion:* Resistive loads greater than 1500Ω or capacitive loads less than 1000 pF:

10 Hz to 20 kHz	0.05% of setting
20 kHz to 50 kHz	0.07% of setting
50 kHz to 100 kHz	0.1% of setting

Resistive loads less than 1500Ω or capacitive loads greater than 1000 pF:

10 Hz to 10 kHz	0.05% of setting
10 kHz to 20 kHz	0.1% of setting
20 kHz to 50 kHz	0.17% of setting
50 kHz to 100 kHz	0.25% of setting

*Bandwidth 10 Hz to 1 MHz

Overload Protection: Limit protection against input noise spikes, momentary output overloads, excessive input slew rate, and excessive input frequency. Trip protection against input overdrive, steady overloads, and short circuit.

Random Noise: Less than 50 mV rms

Line Regulation: ± 10 ppm of setting for 10% change in line voltage

Input Power: 100V, 115V, 200V, 230V ac, $\pm 10\%$, internal jumper selected, 50 Hz to 60 Hz, 1800 VA at full load. Receptacle on rear panel for calibrator power

Size: 26.7 cm H x 43.2 cm W x 62.7 cm D (10.5 in H x 17 in W x 24.7 in D)

Weight: 54.5 kg (120 lb)

Included: Instruction Manual, interface cable to 5200A, power cords, serialized and dated calibrator certificate

Ordering Information

Models

- 5215A Precision Power Amplifier
- 5215A-07 Rear Only Output

Accessories

- M10-205-600 Rack Mount Kit for 5205A
- M00-280-610 24" Rack Slides for rack adapter