

With compliments

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FLUKE 5130 A

## SPECIFICATIONS

Table 1-1 summarizes 5130A uncertainty specifications when the calibrator is used in a typical meter calibration service. The tolerances in the table are valid provided the ambient temperature is between 20 and 30°C, the relative humidity is less than 85%, and the input line voltage is within 10% of nominal. In addition, these specifications are applicable only when the instrument being calibrated is an analog voltmeter with more than 1000 $\Omega$  per volt sensitivity, a DVM with greater than 1 M $\Omega$  input impedance, or an analog or digital ammeter with less than 1V total voltage drop.

Specifications are valid after allowing a warm-up period of 30 minutes, or twice the time the 5130A has been turned off. For example, if the 5130A has been turned off for 5 minutes, the warm-up period is 10 minutes.

Tables 1-2 through 1-8 provide complete performance specifications for the Model 5130A. Refer to Table 1-2 for dc voltage, Table 1-3 for ac voltage, Table 1-4 for dc current, Table 1-5 for ac current, Table 1-6 for resistance, Table 1-7 for general specifications including environmental information, and Tables 1-8 and 1-9 for information about using the 5130A with an auxiliary amplifier.

**Table 1-1. Summary of Specifications**

<b>PROGRAMMED OUTPUT</b>	<b>RANGE</b>	<b>UNCERTAINTY ± (% OF OUTPUT + % OF RANGE+ FLOOR)</b>
DC Voltage	All	0.004 + 0.001 + 5 μV
AC Voltage	50 Hz to 1 kHz (all ranges) and 1 kHz to 10 kHz (up to 110V)	0.035 + 0.005 + 50 μV
	10 kHz to 20 kHz (up to 110V) and 20 kHz to 50 kHz (up to 19.9999V)	0.06 + 0.008 + 50 μV
DC Current	All	0.015 + 0.002 + 0.02 μA
AC Current	50 Hz to 1 kHz (all ranges)	(0.05 + 0.005) + 0.02 μA
Resistance (four-wire)	1Ω 10Ω 100Ω, 1 kΩ, and 10 kΩ	0.015% 0.01% 0.003%
Resistance (two-wire)	100 kΩ 1 MΩ 10 MΩ	0.003% 0.01% 0.03%

**Table 1-2. DC Volts Specifications**

RANGE	RESOLUTION	MAXIMUM CURRENT	RIPPLE AND NOISE (10 Hz TO 3 KHZ) NO LOAD TO MAXIMUM RATED LOAD	UNCERTAINTY (6 MONTHS) (20° to 30°C)
±(200V to 1100V)	10 mV	6 mA/400 pF	<0.05% of setting rms	±(0.004% of setting +0.001% of range +5 μV)
±(20V to 199.999V)	1 mV	10 mA/400 pF	<0.05% of setting rms (open to 20 kΩ), <0.1% of setting rms 20 kΩ to max load)	
	100 μV	25 mA/1000 pF	<0.02% of setting +50 μV rms	
±(2V to 19.9999V)	10 μV	Limited by 50Ω output resistance	<0.01% of setting +25 μV rms	
	1 μV			
±(0 to 19.9999 mV)	0.1 μV			
±(0 to 19.99999V) 50Ω OVERRIDE	100 μV	25 mA/1000 pF	<0.02% of setting +50 μV rms	

**TEMPERATURE COEFFICIENT**

Above 30°C and below 20°C add to accuracy limits ±(5 ppm of setting +1 ppm of range +1 μV)/°C. In the 200V to 100V range add ±(5 ppm of setting +2 ppm of range)/°C.

**REMOTE SENSING**

Four-wire remote sensing is available from 2V to 1100V and below 2V in 50Ω DIVIDER OVERRIDE mode. The three lowest ranges are normally internal sensed. Internal sense connections are automatically made inside the calibrator.

**TRANSIENT RECOVERY TIME**

2 seconds to settle within 50 ppm of final value following any change in output voltage of current for all ranges except 20 to 199.999V. Switching from 20 kΩ to 2 kΩ load, and switching between the two highest ranges requires 4 seconds.

**SHORT-TERM STABILITY (10 MINUTES)**

Up to 500V: ±(10 ppm of setting +2 ppm of range +5 μV) at a stable temperature from 0°C to 50°C. Above 500V: ±25 ppm of setting.

**LOAD REGULATION**

External Sense: 2V to 1100V ±10 ppm no load to full rated load. Same for 0V to 1.99999V using 50Ω DIVIDER OVERRIDE.  
Internal Sense: (At output terminals) Same as external except maximum full load is 400Ω.

**OVERCURRENT PROTECTION**

On all ranges current is limited to prevent damage due to an overload or short circuit at the output terminals. After approximately 2 seconds the calibrator goes to standby.

Table 1-3. AC Volts Specifications

RANGE	RESOLUTION	MAXIMUM CURRENT	FREQUENCY	AMPLITUDE UNCERTAINTY (6 MONTHS) (20°C to 30°C)	TOTAL HARMONIC DISTORTION AND NOISE
200V to 1100V	10 mV	6 mA/400 pF max	(1 mV to 1100V) 50 Hz to 1 kHz	50 Hz to 10 kHz: ±(0.035% of setting +0.005% of range +50 µV)	Bandwidth of 10 Hz to 200 kHz. Distortion, line interference + noise including random spikes.
20V to 19.999V	1 mV	10 mA/400 pF max	(1 mV to 110V) 50 Hz to 20 kHz (Below 20V) 50 Hz to 50 kHz		
2V to 199.99V	100 µV	25 mA/400Ω/ 1000 pF max	Accuracy: ±3% Resolution: 1 MSD	> 10 kHz to 50 kHz ±(0.06% of setting +0.008% of range +50 µV)	(20V and Higher) 50 Hz to 10 kHz: (0.08% of output) rms  (Below 20V) 50 Hz to 10 kHz: (0.05% of output +10 µV) rms 10 kHz to 50 kHz: (0.08% of output +20 µV) rms
0.2V to 1.99999V	10 µV	2 kΩ min/1000 pF max			
20 mV to 199.999 mV	1 µV	Limited by 45.0Ω source resistance <sup>(2)</sup>			
1 mV <sup>(1)</sup> to 19.9999 mV	0.1 µV	Limited by 49.5Ω source resistance <sup>(3)</sup>			

(1) 10% Lower voltage available using the Error Adjust control.

(2) When operating into loads <1 MΩ from 20 mV to 199.999, use the correction factor of  $R_L/(R_L + 45.0)$  to compensate for the loading on the 50Ω divider output.

(3) When operating into loads <1 MΩ from 1 mV to 19.9999 mV, use the correction factor of  $R_L/(R_L + 49.5)$  to compensate for the loading on the 50Ω divider output.

**Temperature Coefficient (Above 30°C and Below 20°C)**  
**AMPLITUDE:** Accuracy limits increase by ±(20 ppm of setting +2 ppm of range)/°C  
**FREQUENCY:** Accuracy limits increase by ±0.1%/°C

**Remote Sensing**  
 Four wire remote sensing is available from 2V to 1100V. The three lowest ranges are internally sensed. Internal sense connections are made automatically inside the 5130A.

**Transient Recovery Time**  
 2 seconds to settle within 100 ppm of the final value of amplitude and within 0.3% for frequency following any change in output voltage, current, or frequency. Switching between the highest ranges requires 2.2 seconds.



Table 1-4. DC Current Specifications

RANGE	RESOLUTION	COMPLIANCE VOLTAGE	UNCERTAINTY (6 months) (20°C to 20°C)	RIPPLE AND NOISE
±(0.2A to 1.99999A)	10 µA	0 to 2.1V min	±(0.015% of output +0.002% of range +0.02 µA)	(0.05% of output +0.01 µA) rms
	1 µA	0 to 10V min		
±(20 mA to 199.999 mA)	100 nA	0 to 10V min	Compliance voltage > 1V add 0.002% setting/Volt	Measured with a bandwidth of 10 Hz to 10 kHz including random spikes
	10 nA			
±(10 µA <sup>1</sup> to 199.999 µA)	1 nA			

(1) 10% lower current available using the Error Adjust control.

**Temperature Coefficient (Above 30°C and Below 20°)**  
The accuracy limits increase by ±(10 ppm of setting +2 ppm of range)/°C

**Transient Recovery Time**  
1 Second to settle to within 0.01% of final value following any change in current or compliance voltage.

**Short Term Stability (10 Minutes)**  
At any fixed temperature from 0°C to 50°C the short term stability is ±(50 ppm setting + 5 ppm of range +0.002 µA).

**Load Regulation**  
±20 ppm/volt for a change in the output voltage from 1 volt to maximum rated compliance voltage.

**Overvoltage Protection**  
On all ranges voltage is limited to not more than 2V greater than maximum rated compliance voltage due to an open circuit condition. After approximately 2 seconds the calibrator goes to standby.

Table 1-5. AC Current Specifications

RANGE	RESOLUTION	COMPLIANCE VOLTAGE	UNCERTAINTY (6 MONTHS) (20°C to 30°C)	FREQUENCY	TOTAL HARMONIC DISTORTION AND NOISE
0.2A to 1.99999A	10 $\mu$ A	0 to 1.4V rms min.	$\pm(0.05\%$ of setting + $+0.005\%$ of range $+0.02 \mu$ A)  Compliance volt- age: $>1$ V rms add $0.005\%$ of set- ting/Volt	50 Hz to 1 kHz  Accuracy: $\pm 3\%$  Resolution: 1 MSD  Although no accuracy specifications apply above 1 kHz, output is usable to 5 kHz.	Distortion, line interference + noise including random spikes  (0.05% of output $+2 \mu$ A) rms
20 mA to 199.999 mA	1 $\mu$ A				
2 mA to 19.9999 mA	100 nA				
0.2 mA to 1.99999 mA	10 nA				
10 $\mu$ A <sup>1</sup> to 199.999 $\mu$ A	1 nA	0 to 7V rms min.			

(1) 10% lower current available using the Error Adjust control.

**Temperature Coefficient (Above 30°C and Below 20°C)**  
 CURRENT: Accuracy limits increase by  $\pm(25$  ppm of setting + 10 ppm of range  $+0.2$  nA)/°C.  
 FREQUENCY: Accuracy limits increase by  $\pm 0.1\%$ /°C.

**Transient Recovery Time**  
 4 seconds to settle within 0.2% of final value for current and within 0.3% for frequency following any change in output current, voltage, or frequency.

**Short Term Stability (10 Minutes)**  
 At any fixed temperature from 0°C to 50°C, the short term stability is  $\pm(0.014\%$  of setting + 0.002% of range  $+0.4 \mu$ A).

**Load Regulation**  
 $\pm 50$  ppm  $+20$  nA/volt for a change in the output voltage from 1V to maximum rated compliance voltage. Load regulation is met with reactive loads with power factors between 0.9 and 1.0.

**Overvoltage Protection**  
 On all ranges voltage is limited to not more than 2V peak greater than maximum rated compliance voltage due to an open circuit condition. After approximately 2 seconds the calibrator goes to standby.

Table 1-6. Resistance Specifications

RANGE	POWER DISSIPATION	MAXIMUM CURRENT	PEAK VOLTAGE	UNCERTAINTY (6 Months) (20°C to 30°C)	TEMPERATURE COEFFICIENT >30°C and <20°C ACCURACY LIMITS INCREASE BY	POWER COEFFICIENT
1Ω		1A	1V	0.015%	10 ppm/°C	0.1 ppm/mW
10Ω		300 mA	3V	0.010%		
100Ω		100 mA	10V			
1.kΩ	1W	30 mA	30V	0.003%	5 ppm/°C	0.3 ppm/mW
10 kΩ		10 mA	100V			
100 kΩ		3 mA				
1 MΩ	100 mW	0.3 mA	300V	0.010%		0.2 ppm/mW
10 MΩ	10 mW	0.03 mA		0.030%	10 ppm/°C up to 40°C, 50 ppm/°C above 40°C	0.02 ppm/mW

**Two or Four Terminal Ohms Below 100 kΩ**

The maximum residual resistance that can be compensated for using the Ohms Compensation function is 0.99999Ω.

The accuracy specification given above is for a 4-terminal connection below 100 kΩ. The accuracy specification is valid if the Ohms Compensation function is performed within the last 8 hours and the instrument is continually powered during that period. The 2-terminal connection is made to the OUTPUT terminals.

RANGE	ACCURACY
10Ω	0.4%
100Ω	0.05%
1 kΩ	0.0125%
10 kΩ	0.0075%

+ Ohmmeter Error (see note)

**NOTE**

The "Ohmmeter Error" is the error the ohmmeter has in measuring the 1Ω function expressed in Ohms.



**Table 1-7. General Specifications**

**Stability/Environmental**

All specifications have been stated with the following conditions:

Time: Six months  
Temp: 25°C ±5°C  
R.H.: <85%

**Temperature Range**

Operating 0°C to +50°C  
Nonoperating -20°C to +65°C

**Humidity Range**

0°C to 35°C: 85% RH (Noncondensing)  
35°C to 40°C: 70% RH  
40°C to 50°C: 50% RH

**Shock and Vibration**

Meets requirements of MIL-T-28800 for class 5 style E equipment.

**Operating Power**

(100V to 240V ±10%: 50 - 60 Hz)  
200 VA Fully Loaded

**Warm-up**

30 minutes to rated accuracy or 1/2 the time the instrument has been off, whichever is shorter.

**Dimensions**

22.23 cm H X 43.18 cm L X 60.33 Cm W  
(8.75 in H X 17.00 in L X 23.75 in W)

**Weight**

30.4 kg (67 lbs.)

**Safety**

Protection Class 1 as defined in IEC 348.

Table 1-8. System Specifications for Power Amplifier Application (5130A, 5205A/5215A Combination)

### DC Operation (with 5205A)

**Output Voltage**  
±(100 to 1100) volts

**Output Current**  
100 mA maximum

**Accuracy**  
(90-Day) ±(0.06% of output + 20 mV)  
(180-Day) ±(0.07% of output + 20 mV)

**Maximum Capacitive Load:** <1500 pF

**Temperature Coefficient**  
±(25 ppm of output +3 mV/°C

### Ripple and Noise

Random noise, in a 1-MHz bandwidth shall not exceed 100 mV rms. Line-related noise shall be less than 50 mV rms.

### AC Operation (with 5205A or 5215A)

**Output Voltage**  
100 to 1100V rms

**Output Current**  
200 mA from 100 Hz to 50 kHz linearly decreasing to 140 mA in the region 100 Hz to 50 Hz.

**Amplitude Accuracy (180-Day, 23°C ±5°C)**  
50 Hz to 10 kHz ±(.08% of output + .1 Volt)  
10 kHz to 50 kHz ±(.12% Eo + .15 volt)

**Total Distortion and Noise, (in the band 10 Hz to 1 MHz)**  
50 Hz to 20 kHz: 0.1% of output  
20 kHz to 50 kHz: 0.2% of output

**Maximum Capacitive Load**  
1500 pF or that value which draws the maximum rated load current, whichever is less.

**Amplitude Temperature Coefficient**  
Above 30°C and below 20°C the accuracy limit increases by ±(30 ppm of output +3 mV)/°C for 50 Hz to 10 kHz; and +/- (50 ppm of output +5 mV)/°C for 10 kHz to 50 kHz.

Table 1-9. System Specifications for Transconductance Amplifier Application (5130A, 5220A Combination)

### DC Mode

**Output Range**  
 $\pm 1$  to  $\pm 19.9999A$

**Accuracy of Output**  
 $\pm(0.025\%$  of selected output + 1 mA)

**Resolution**  
 $\pm 0.1$  mA

**Temperature Coefficient**  
 $\pm(0.003\%$  of selected output + 100  $\mu A$ ) in 10 minutes, with constant line, load, and temperature.

**Line Regulation**  
Output changes less than 0.001% for a  $\pm 10\%$  in line voltage.

**Load Regulation**  
Output changes less than  $\pm(0.005\% + 100 \mu A)$  for a full load change of 4V of compliance.

### AC Mode

**Output Range**  
1A rms to 19.9999A rms

**Accuracy of Output**  
 $\pm(0.07\%$  of selected output + 1 mA rms) from 50 Hz to 1 kHz, and  $\pm(0.07\%$  of selected output + 1 mA rms)  $\times f$  from 1 kHz to 5 kHz, where  $f$  = frequency in kHz.

**Resolution**  
 $\pm 0.1$  mA rms

**Temperature Coefficient**  
 $\pm(0.003\%$  of selected output + 100  $\mu A$  rms) per degree C, above 30°C and below 20°C.

**Short Term Stability**  
Output changes less than  $\pm(0.02\% + 500 \mu A$  rms) in 10 minutes, with constant line, load, and temperature.