General Specifications

Line Power Supply

Voltage (single f):	100V/120V/220V/240V selectable from rear panel
Variation:	≤ ±10% Nominal Voltage
Line Frequency:	48Hz to 63Hz
Consumption:	450VA max. 500VA max with Option 250
Power Fuses:	220/240V: T3.15A HBC, 250V, IEC127 100/120V: T5.0A HBC, 250V, IEC127

Mechanical

Dimensions:	Height: 3U Width: 427mm (16.8 inches) Depth: 460mm (18.1 inches)
Weight:	18.5kg (41lbs). 19kg (42.1lbs) with Option 250

SAFETY

Designed to UL1244, IEC348, IEC1010-1: Pollution degree 2; installation category II; Protection class I.

Peak Terminal Voltages and Currents

	Peak Volts to Ground	Peak Current
SHi	1500V	——
Hi	1500V	90mA
SLo	15V	——
Lo	15V	90mA
I+	10V	30A
I-	——	30A
Aux Analog Output	15V	1.5A

Peak Terminal Voltages and Currents (Option 250 or 600)

	Peak Volts to Ground	Peak Current
SIG BNC Socket	140V	60mA
TRIG BNC Socket	3V	60mA

CAUTION:
Damage will result by applying a voltage >3Vpk from an external source across the inner and outer conductors. Internal trips may operate when the live SIG OUT inner and outer conductors are shorted together.

Environmental Conditions

Temperature:	Operating: 5°C to 40°C
Transit:	-20°C to 60°C <100hrs
Storage:	0°C to 50°C
Warm-up Time:	20 minutes
Max. Relative Humidity (non-condensing):	
Operating:	+5°C to +30°C: <90%,
	+30°C to +40°C: <75%,
Storage:	0°C to +50°C: <95%,
Altitude	
Operating:	0 to 2000m (6,562 ft)
Non-operating:	0 to 12,000m (40,000 ft)
Shock:	MIL-T-28800, type III, class 5, style E.
Vibration:	MIL-T-28800, type III, class 5, style E.
Enclosure:	MIL-T-28800, type III, class 5, style E.
EMC: *Designed to:*	
Generic Emissions:	EN50081.
Generic Immunity:	EN50082.
FCC Rules part 15 sub-part J class B.	

Accuracy Tables

The Meaning of 'Accuracy' when used in the Function Accuracy Tables

Accuracy includes long-term stability, temperature coefficient, linearity, load and line regulation and the traceability of factory and National calibration standards. Nothing further needs to be added to determine the Test Uncertainty Ratio over the instrument under test.

N.B. These specifications apply to both the Model 9100 output terminals and at the remote end of the Model 9105 lead kit unless otherwise stated.

DC Voltage Accuracy

Voltage Output +ve & -ve Polarities	Accuracy * ±(% of Output + Floor) **1Year** — Tcal ±5°C [1]	Compliance Current	Absolute Resolution
000.000 mV to 320.000 mV	0.006% + 4.16µV	< 20mA	1µV
0.32001 V to 3.20000 V	0.006% + 41.6µV	< 20mA	10µV
03.2001 V to 32.0000 V	0.0065% + 416µV	< 20mA	100µV
032.001 V to 320.000 V	0.0065% + 4.48mV	< 6mA	1mV
0320.01 V to 1050.00 V	0.006% + 19.95mV	< 6mA	10mV

* = For loads < 1MΩ: add load regulation error.

NOTES: [1] Tcal = temperature at calibration. Factory calibration temperature = 23°C.

Other DC Voltage Specifications

Settling Time to within 10% of accuracy:	0.08s
Load Regulation loads <1MΩ add:	$(200/R_{LOAD})$ % of output
Maximum Capacitance:	1000pF.

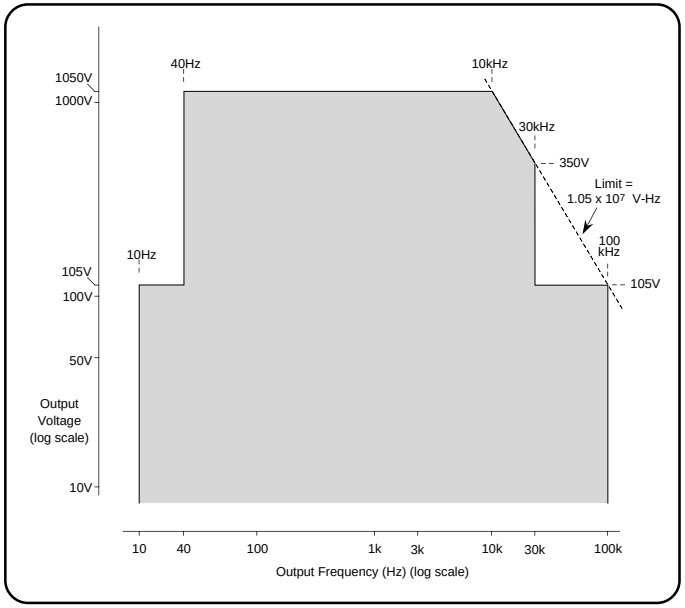
AC Voltage Accuracy (Sinusoidal Waveshape)

Voltage Output	Frequency Band [2] (Hz)	Accuracy * ± (% Output + Floor) **1 Year** - Tcal [1] ± 5°C	Current Compliance	Total Harmonic Distortion (% of Output)	Absolute Resolution
000.000 mV to 010.000 mV	10 - 3k	0.04 + 384µV	20mA	0.06	1µV
	3k - 10k	0.04 + 512µV	20mA	0.10	1µV
	10k - 30k	0.06 + 960µV	20mA	0.13	1µV
	30k - 50k	0.09 + 1.92mV	20mA	0.20	1µV
	50k - 100k	0.20 + 5.12mV	20mA	0.32	1µV
010.001 mV to 032.000 mV	10 - 3k	0.04 + 96.0µV	20mA	0.06	1µV
	3k - 10k	0.04 + 128µV	20mA	0.10	1µV
	10k - 30k	0.06 + 240µV	20mA	0.13	1µV
	30k - 50k	0.09 + 480µV	20mA	0.20	1µV
	50k - 100k	0.20 + 1.28mV	20mA	0.32	1µV
032.001 mV to 320.000 mV	10 - 3k	0.04 + 19.2µV	20mA	0.06	1µV
	3k - 10k	0.04 + 25.6µV	20mA	0.10	1µV
	10k - 30k	0.06 + 48.0µV	20mA	0.13	1µV
	30k - 50k	0.09 + 96.0µV	20mA	0.20	1µV
	50k - 100k	0.20 + 256µV	20mA	0.32	1µV
0.32001 V to 3.20000 V	10 - 3k	0.04 + 192µV	20mA	0.06	10µV
	3k - 10k	0.04 + 256µV	20mA	0.10	10µV
	10k - 30k	0.06 + 480µV	20mA	0.13	10µV
	30k - 50k	0.09 + 960µV	20mA	0.20	10µV
	50k - 100k	0.20 + 2.56mV	20mA	0.32	10µV
03.2001 V to 32.0000 V	10 - 3k	0.04 + 1.92mV	20mA	0.10	100µV
	3k - 10k	0.06 + 2.56mV	20mA	0.10	100µV
	10k - 30k	0.08 + 4.80mV	20mA	0.16	100µV
	30k - 50k	0.15 + 9.60mV	20mA	0.20	100µV
	50k - 100k	0.35 + 32.0mV	20mA	0.32	100µV
032.001 V to 105.000 V	10 - 3k	0.04 + 6.30mV	20mA	0.10	1mV
	3k - 10k	0.06 + 8.40mV	20mA	0.10	1mV
	10k - 30k	0.08 + 15.8mV	20mA	0.16	1mV
	30k - 50k	0.15 + 31.5mV	20mA	0.20	1mV
	50k - 100k	0.35 + 105mV	20mA	0.32	1mV
105.001 V to 320.000 V	40 - 100	0.05 + 19.2mV	6mA	0.50	1mV
	100 - 1k	0.05 + 19.2mV	6mA	0.32	1mV
	1k - 3k	0.08 + 19.2mV	6mA	0.32	1mV
	3k - 10k	0.08 + 32.0mV	20mA	0.32	1mV
	10k - 20k	0.12 + 48.0mV	20mA	0.32	1mV
	20k - 30k	0.15 + 64.0mV	20mA	0.32	1mV
0320.01 V to 0800.00 V	40 - 100	0.05 + 63.0mV	6mA	0.50	10mV
	100 - 1k	0.05 + 63.0mV	6mA	0.32	10mV
	1k - 3k	0.08 + 63.0mV	6mA	0.32	10mV
	3k - 10k	0.08 + 105mV	20mA	0.32	10mV
	10k - 20k †	0.12 + 158mV	20mA	0.32	10mV
	20k - 30k †	0.15 + 210mV	20mA	0.32	10mV
0800.01 V to 1050.00 V	40 - 100	0.05 + 126mV	6mA	0.50	10mV
	100 - 1k	0.05 + 126mV	6mA	0.32	10mV
	1k - 3k	0.08 + 126mV	6mA	0.32	10mV
	3k - 10k	0.08 + 210mV	20mA	0.32	10mV
	10k - 20k †	0.12 + 315mV	20mA	0.32	10mV

* = For loads < |1MΩ|: add load regulation error.
† = Availability of voltage and frequency combinations is subject to the Volt-Hertz limit (see V-Hz profile).

NOTES: [1] Tcal = temperature at calibration. Factory calibration temperature = 23°C.
[2] Frequency Accuracy: 25ppm of output frequency.

AC Voltage Volt-Hertz Profile (Sine)



Frequency Spans *vs* Frequency Resolution

Absolute Resolution	Span of Frequencies
1mHz	010.000 Hz to 320.000 Hz
10mHz	0.01000 kHz to 3.20000 kHz
100mHz	00.0100 kHz to 32.0000 kHz
1Hz	000.010 kHz to 100.000 kHz

AC Voltage Phase (Sine) *

Output Voltage Phase Span with respect to Phase Lock In = ±180°

Resolution of output voltage phase increments = 0.01°

Voltage Output	Selected Frequency f (Hz)	TTL Signals: Output Phase Error with respect to 'Phase Lock In'	TTL Signals: Output Phase Error with respect to 'Phase Lock Out'	1V to 3V RMS Sine Input †: Output Phase Error with respect to 'Phase Lock In'
0.30000 V to 105.000 V	10 - 40	±0.07°	±0.07°	±0.70°
	40 - 65	±0.07°	±0.07°	±0.14°
	65 - 1k	±(0.07 + 0.001 x f)°	±(0.07 + 0.001 x f)°	±(0.14 + 0.001 x f)°
105.001 V to 0750.00 V ♦	45 - 65	±0.16°	±0.16°	±0.23°
	65 - 1k	±(0.16 + 0.0037 x f)°	±(0.16 + 0.0037 x f)°	±(0.23 + 0.0037 x f)°

Note: An application can be employed in which the 'Slave' frequency is set to a harmonic (multiple) of the 'Master' frequency. In this case the slave frequency must not exceed 1kHz.

∗ = If two or more 9100 units are being used in a 'Master and Slave' configuration, this specification applies only when both Master and Slave are set to the same frequency. Mark/Space ratio of the input must not be less than 1:4.

† = DC-coupled input. Do not AC-couple. Up to 10mV p-p noise is rejected.

♦ = Maximum load current: 2mA; maximum load capacitance: 200pF.

AC Voltage Accuracy (Square-Wave)

Frequency Band [2] (Hz)	Output Voltage Span RMS	Output Voltage Span Peak	Accuracy * ± (% Output + Floor) 1 Year — Tcal [1] ± 5°C	Current Compliance
10 - 1k	0V - 14.08mV	0V - 14.14mV	0.12 + 450µV	20mA
10 - 1k	14.08mV - 45.08mV	14.14mV - 45.25mV	0.12 + 150µV	20mA
10 - 1k	45.08mV - 450mV	45.25mV - 452.5mV	0.12 + 40µV	20mA
10 - 1k	450mV - 4.5V	452.5mV - 4.525V	0.12 + 400µV	20mA
10 - 1k	4.5V - 45V	4.525V - 45.25V	0.12 + 4mV	20mA
10 - 1k	45V - 147.9V	45.25V - 148.4V	0.12 + 10mV	20mA
45 - 65	147.9V - 450V	148.4V - 452.5V	0.15 + 40mV	6mA
45 - 65	450V - 500V	452.5V - 502V	0.15 + 110mV	6mA

Ratios and Factors based on Square-Wave Unit-Value Peak

Peak:	1.0000
Peak to Peak:	2.0000
RMS:	0.9962
Mean:	0.9958
Crest Factor:	1.0038
Form Factor:	1.0004

* = For loads < |1MΩ|: add load regulation error.

AC Voltage Accuracy (Impulse-Wave)

Frequency Band [2] (Hz)	Output Voltage Span RMS	Output Voltage Span Peak	Accuracy * ± (% Output + Floor) 1 Year — Tcal [1] ± 5°C	Current Compliance
10 - 1k	0V - 7.43mV	0V - 14.14mV	0.30 + 1000µV	20mA
10 - 1k	7.43mV - 23.77mV	14.14mV - 45.25mV	0.30 + 500µV	20mA
10 - 1k	23.77mV - 238mV	45.25mV - 452.5mV	0.30 + 80µV	20mA
10 - 1k	238mV - 2.38V	452.5mV - 4.525V	0.30 + 800µV	20mA
10 - 1k	2.38V - 23.8V	4.525V - 45.25V	0.30 + 8mV	20mA
10 - 1k	23.8V - 78.05V	45.25V - 148.4V	0.30 + 20mV	20mA
45 - 65	78.05V - 238V	148.4V - 452.5V	0.35 + 80mV	6mA
45 - 65	238V - 500V	452.5V - 951V	0.35 + 200mV	6mA

Ratios and Factors based on Impulse-Wave Unit-Value Peak

Peak:	1.0000
Peak to Peak:	2.0000
RMS:	0.5270
Mean:	0.3333
Crest Factor:	1.8974
Form Factor:	1.5811

* = For loads < |1MΩ|: add load regulation error.

AC Voltage Accuracy (Triangular-Wave)

Frequency Band [2] (Hz)	Output Voltage Span RMS	Output Voltage Span Peak	Accuracy * ± (% Output + Floor) 1 Year — Tcal [1] ± 5°C	Current Compliance
10 - 1k	0V - 8.16mV	0V - 14.14mV	0.15 + 500µV	20mA
10 - 1k	8.16mV - 26.11mV	14.14mV - 45.25mV	0.15 + 175µV	20mA
10 - 1k	26.11mV - 261mV	45.25mV - 452.5mV	0.15 + 40µV	20mA
10 - 1k	261mV - 2.61V	452.5mV - 4.525V	0.15 + 400µV	20mA
10 - 1k	2.61V - 26.1V	4.525V - 45.25V	0.15 + 4mV	20mA
10 - 1k	26.1V - 85.7V	45.25V - 148.4V	0.15 + 10mV	20mA
45 - 65	85.7V - 261V	148.4V - 452.5V	0.18 + 40mV	6mA
45 - 65	261V - 500V	452.5V - 866V	0.18 + 120mV	6mA

Ratios and Factors based on Triangular-Wave Unit-Value Peak

Peak:	1.0000
Peak to Peak:	2.0000
RMS:	0.5774
Mean:	0.5000
Crest Factor:	1.7321
Form Factor:	1.1547

* = For loads < |1MΩ|: add load regulation error.

NOTES: [1] Tcal = temperature at calibration. Factory calibration temperature = 23°C.
[2] Frequency Accuracy: 25ppm of output frequency.

AC Voltage Accuracy (Trapezoidal-Wave)

Frequency Band [2] (Hz)	Output Voltage Span RMS	Output Voltage Span Peak	Accuracy * ± (% Output + Floor) 1 Year — Tcal [1] ± 5°C	Current Compliance
10 - 1k	0V - 12.56mV	0V - 14.14mV	0.12 + 450µV	20mA
10 - 1k	12.56mV - 40.19mV	14.14mV - 45.25mV	0.12 + 150µV	20mA
10 - 1k	40.19mV - 402mV	45.25mV - 452.5mV	0.12 + 40µV	20mA
10 - 1k	402mV - 4.02V	452.5mV - 4.525V	0.12 + 400µV	20mA
10 - 1k	4.02V - 40.2V	4.525V - 45.25V	0.12 + 4mV	20mA
10 - 1k	40.2V - 131.9V	45.25V - 148.4V	0.12 + 10mV	20mA
45 - 65	131.9V - 402V	148.4V - 452.5V	0.15 + 40mV	6mA
45 - 65	402V - 500V	452.5V - 566V	0.15 + 110mV	6mA

Ratios and Factors based on Trapezoidal-Wave Unit-Value Peak

Peak:	1.0000
Peak:	1.0000
Peak to Peak:	2.0000
RMS:	0.8819
Mean:	0.8333
Crest Factor:	1.3390
Form Factor:	1.0583

* = For loads < |1MΩ|: add load regulation error.

Waveshape Harmonic Analysis

(Peak values as a percentage of the Fundamental's Peak Value)
(Applies also to AC Current Waveshapes)

Harmonic	Square	Impulse	Triangular	Trapezoidal
1	100.00	100.00	100.00	100.00
3	-33.32	60.71	11.11	-22.22
5	19.98	14.93	4.000	4.000
7	-14.25	-7.616	2.041	2.041
9	11.07	-6.746	1.235	-2.469
11	-9.040	-0.826	0.826	0.826
13	7.626	-0.592	0.592	0.592
15	-6.590	-2.428	0.444	-0.889
17	5.795	-1.291	0.346	0.346
19	-5.165	1.034	0.277	0.277
21	4.654	1.239	0.227	-0.454
23	-4.230	0.189	0.189	0.189
25	3.872	0.160	0.160	0.160
27	-3.565	0.750	0.137	-0.274
29	3.300	0.444	0.119	0.119
31	-3.068	-0.388	0.104	0.104
33	2.862	-0.502	0.092	-0.184
35	-2.679	-0.082	0.082	0.082
37	2.515	-0.073	0.073	0.073
39	-2.368	-0.359	0.066	-0.131
41	2.230	-0.222	0.060	0.060

Other AC Voltage Specifications

Settling Time (to within 10% of accuracy)**:** ≤105V: 0.08s**;** >105V: 0.5s**.**

Load Regulation:

For loads <|1MΩ| ≤105V, add: $[(200/R_{LOAD}) + (C_{LOAD}* \times F^2 \times 0.03)]$ % of output

For loads <|1MΩ| >105V, add: $[(200/R_{LOAD}) + (C_{LOAD}* \times F^2 \times 0.19 + C_{LOAD}* \bullet 3E7)]$ % of output

***** = To calculate C_{LOAD} limit from Current compliance specification, while using 9105 lead set, allow ≈ 30pF for lead set.

Maximum Capacitance: 1000pF; subject to Output Current Limitations at HF.

DC Current Accuracy

Equivalent Current Output +ve & -ve Polarities	Accuracy ±(% of Output + Floor) 1Year — Tcal ±5°C [1]	Compliance Voltage (at 9100 terminals)	Compliance Voltage (at 9105 lead end)	Absolute Resolution
000.000µA - 320.000µA	0.014 + 11nA	4V	4V	1nA
0.32001mA - 3.20000mA	0.014 + 83nA	4V	4V	10nA
03.2001mA - 32.0000mA	0.014 + 900nA	4V	4V	100nA
032..001mA - 320.000mA	0.016 + 9.6µA	4V	4V	1µA
0.32001A - 3.20000A	0.060 + 118µA	2.2V	2.2V	10µA
03.2001A - 10.5000A	0.055 + 940µA	2.2V	2.1V	100µA
10.5001A - 20.0000A *	0.055 + 4.50mA	2.2V	2.0V	100µA

* = With output 'ON', maximum duty cycle of (>0.525FS : ≤0.525FS) is (1 : 4).
Continuous output >0.525FS will automatically reduce to <0.525FS after 2 Minutes.

Option 200 — DC Current Accuracy via Current Coils

Equivalent Current Output +ve & -ve Polarities	Accuracy † ±(% of Output + Floor) 1Year — Tcal ±5°C [1]	Absolute Resolution
10-Turn Coil:		
03.2001A - 32.0000 A	0.060 + 1.18mA	100µA
032.001A - 105.000A	0.055 + 9.40mA	1mA
105.001A - 200.000 A *	0.055 + 45.0mA	1mA
50-Turn Coil:		
016.001A - 160.000A	0.060 + 5.9mA	1mA
0160.01A - 0525.00A	0.055 + 47mA	10mA
0525.01A - 1000.00 A *	0.055 + 225mA	10mA

* = With output 'ON', maximum duty cycle of (>0.525FS : ≤0.525FS) is (1 : 4).
Continuous output >0.525FS will automatically reduce to <0.525FS after 2 Minutes.
† = Refers to accuracy at 9100 output terminals. With Option 200 coils connected, then at the output from the coils, add ±0.2% of output from coils for uncertainty of coils.

Other DC Current Specifications

Settling Time to within 10% of accuracy:			0.08s
Maximum Terminal Inductance:	0 - 3.2mA	:	50µH
	3.2mA - 320mA	:	30µH
	320mA - 3.2A	:	18µH
	3.2A - 10.5A	:	5.5µH
	10.5A - 20A	:	2.5µH
(With 10 turn or 50 turn output selected):	3.2A - 1000A	:	700µH

NOTES: [1] Tcal = temperature at calibration. Factory calibration temperature = 23°C.

Compliance Voltage at 9105 lead end)	Absolute Resolution
4V	1nA
4V	10nA
4V	100nA
4V	1µA
2.2V	10µA
2.1V	100µA
2.0V	100µA

AC Current Accuracy (Sinusoidal Waveshape)

Current Output	Frequency Band [2] (Hz)	Accuracy † ± (% Output + Floor) **1 Year** - Tcal [1] ± 5°C	Compliance Voltage (VRMS at 9100 terminals)	Compliance Voltage (VRMS at 9105 Lead End)	Total Harmonic Distortion (% Output)	Compliance Error (A/V) for Vc>0.5VRMS	Absolute Resolution
000.000µA - 032.000µA	10 - 3k	0.07 + 900nA	4V	4V	0.10	60nA/V	1nA
	3k - 10k	0.10 + 1.8µA	4V	4V	0.25	600nA/V	1nA
	10k - 20k	0.20 + 6.0µA	4V	4V	0.40	2.4µA/V	1nA
	20k - 30k	0.25 + 9.0µA	4V	4V	0.60	5.4µA/V	1nA
032.001µA - 320.000µA	10 - 3k	0.07 + 300nA	4V	4V	0.10	60nA/V	1nA
	3k - 10k	0.10 + 600nA	4V	4V	0.25	600nA/V	1nA
	10k - 20k	0.20 + 2.0µA	4V	4V	0.40	2.4µA/V	1nA
	20k - 30k	0.25 + 3.0µA	4V	4V	0.60	5.4µA/V	1nA
0.32001mA - 3.20000mA	10 - 3k	0.07 + 300nA	4V	4V	0.10	60nA/V	10nA
	3k - 10k	0.10 + 600nA	4V	4V	0.25	600nA/V	10nA
	10k - 20k	0.20 + 2.0µA	4V	4V	0.40	2.4µA/V	10nA
	20k - 30k	0.25 + 3.0µA	4V	4V	0.60	5.4µA/V	10nA
03.2001mA - 32.0000mA	10 - 3k	0.07 + 3.2µA	4V	4V	0.10	0.5µA/V	100nA
	3k - 10k	0.10 + 6.4µA	4V	4V	0.25	4µA/V	100nA
	10k - 20k	0.20 + 12.8µA	4V	4V	0.40	15µA/V	100nA
	20k - 30k	0.25 + 22.4µA	4V	4V	0.60	32µA/V	100nA
032.001mA - 320.000mA	10 - 3k	0.08 + 32.0µA	4V	4V	0.10	2µA/V	1µA
	3k - 10k	0.10 + 48.0µA	4V	4V	0.25	4µA/V	1µA
	10k - 20k	0.20 + 64.0µA	4V	4V	0.40	15µA/V	1µA
	20k - 30k	0.25 + 96.0µA	4V	4V	0.60	35µA/V	1µA
0.32001A - 3.20000A	10 - 3k	0.10 + 480µA	2.5V	2.4V	0.20	90µA/V	10µA
	3k - 10k	0.25 + 2.56mA	2.5V	2.4V	1.10	600µA/V	10µA
03.2001A - 10.5000A	10 - 3k	0.20 + 3.0mA	2.5V	2.3V	0.20	0.3mA/V	100µA
	3k - 10k	0.50 + 10.0mA	2.2V	2.0V	1.10	2.1mA/V	100µA
10.5001A - 20.0000A ♠	10 - 3k	0.20 + 6.9mA	2.5V ♦	2.2V ♦	0.30	0.3mA/V	100µA
	3k - 10k	0.50 + 23.0mA	2.1V	1.7V	1.50	2.1mA/V	100µA
03.2001A - 32.0000A ♥	10 - 100	0.20 + 5.5mA	2.5V	2.5V	0.15	---	100µA
	100 - 440	0.78 + 27mA	2.5V	2.5V	0.50	---	100µA
032.001A - 200.000A♠♥	10 - 100	0.21 + 90mA	2.5V ♦	2.3V ♦	0.15	---	1mA
	100 - 440	0.67 + 0.25A	2.5V	2.3V	0.50	---	1mA
016.001A - 160.000A ♣	10 - 100	0.20 + 28mA	2.5V	2.5V	0.15	---	1mA
0160.01A - 1000.00A♠♣	10 - 100§	0.21 + 0.45A	2.5V ♦	2.3V ♦	0.15	---	10mA

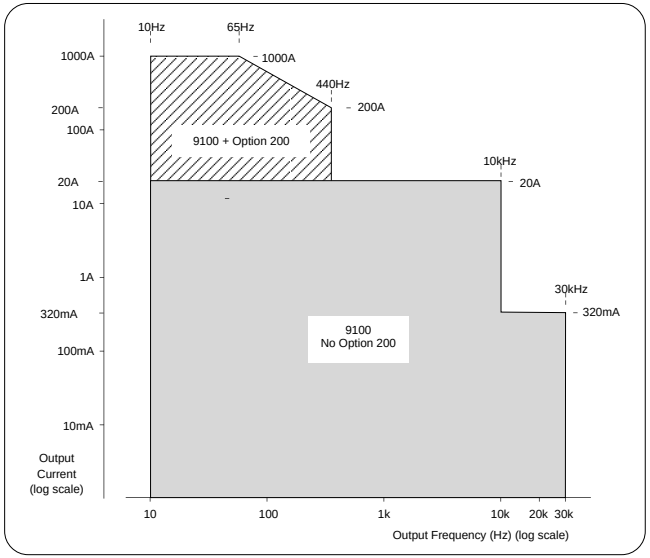
† = Total uncertainty includes compliance errors for Voltage ≤0.5VRMS. Above 0.5V, add appropriate compliance error, except for Outputs marked ♥ and ♣.
♠ = With output 'ON', maximum duty cycle of (>0.525FS : ≤0.525FS) is (1 : 4). Continuous output >0.525FS will automatically reduce to <0.525FS after 2 Minutes.
♥ = Accuracy at 9100 output terminals, option 200 10 turn coil connected. For the output from the coil, add ±0.2% of output from coil for uncertainty of coil.
♣ = Accuracy at 9100 output terminals, option 200 50 turn coil connected. For the output from the coil, add ±0.2% of output from coil for uncertainty of coil.
♦ = For frequencies <40Hz, compliance voltage is reduced by 0.5V RMS.
§ = These coils have been designed for optimum accuracy and inductance for use with the Model 9100. With some clamp meters, especially those using Hall effect, the increase in inductance due to the current clamp design will limit the obtainable 9100 Current/Hertz profile. In some cases, 1000A cannot be reached at higher frequency.

Frequency Spans *vs* Frequency Resolutions

Absolute Resolution	Span of Frequencies
1mHz	010.000 Hz to 320.000 Hz
10mHz	0.01000 kHz to 3.20000 kHz
100mHz	00.0100 kHz to 30.0000 kHz

NOTES: [1] Tcal = temperature at calibration. Factory calibration temperature = 23°C.
[2] Frequency Accuracy: 25ppm of output frequency.

AC Current Amp-Hertz Profile (Sine)



AC Current Phase (Sine) *

Output Current Phase Span with respect to Phase Lock In = ±180°

Resolution of output voltage phase increments = 0.01°

Current Output	Selected Frequency f (Hz)	TTL Signals: Output Phase Error with respect to 'Phase Lock In'	TTL Signals: Output Phase Error with respect to 'Phase Lock Out'	1V to 3V RMS Sine Input †: Output Phase Error with respect to 'Phase Lock In'
0.00000 A - 20.0000 A	10 - 40	±0.08°	±0.08°	±0.71°
	40 - 65	±0.08°	±0.08°	±0.15°
	65 - 1k	±(0.08 + 0.0008 x f)°	±(0.08 + 0.0008 x f)°	±(0.15 + 0.001 x f)°
03.2000 A - 1000.00 A ♠	10 - 40	±0.23°	±0.23°	±0.8°
	40 - 65	±0.23°	±0.23°	±0.3°
	65 - 1k	±(0.23 + 0.003 x f)°	±(0.23 + 0.003 x f)°	±(0.3 + 0.0037 x f)°

Note: An application can be employed in which the 'Slave' frequency is set to a harmonic (multiple) of the 'Master' frequency. In this case the slave frequency must not exceed 1kHz.

∗ = If two or more 9100 units are being used in a 'Master and Slave' configuration, this specification applies only when both Master and Slave are set to the same frequency. Mark/Space ratio of the input must not be less than 1:4.

† = DC-coupled input. Do not AC-couple. Up to 10mV p-p noise is rejected.

♠ = With 10-turn or 50-turn output selected (Option 200).

Other AC Current Specifications

Settling Time to within 10% of accuracy:			0.08s
Maximum Terminal Inductance:	0 - 3.2mA	:	50µH
	3.2mA - 320mA	:	30µH
	320mA - 3.2A	:	18µH
	3.2A - 10.5A	:	5.5µH
	10.5A - 20A	:	2.5µH
(With 10 turn or 50 turn output selected):	3.2A - 1000A	:	700µH

AC Current Accuracy (Square-Wave)

Frequency Band [2] (Hz)	Output Current Span RMS	Output Current Span Peak	Accuracy † ± (% Output + Floor) **1 Year** — Tcal [1] ± 5°C	Voltage Compliance (VRMS)
10 - 1k	0µA - 45.08µA	0V - 45.25µA	0.21 + 1.8µA	4.0
10 - 1k	45.08µA - 4.508mA	45.25µA - 4.525mA	0.21 + 0.6µA	4.0
10 - 1k	4.508mA - 45.08mA	4.525mA - 45.25mA	0.21 + 6.4µA	4.0
10 - 1k	45.08mA - 450.8mA	45.25mA - 452.5mA	0.24 + 64µA	4.0
10 - 100	0.4508A - 3.200A	0.4525A - 3.212A	0.30 + 960µA	2.2
10 - 100	3.200A - 18.00A*	3.212A - 18.07A	0.4 + 13.8mA	2.2 ♦
10 - 65	4.508A - 32.00A ♥	4.525A - 32.12A	1.0 + 16.8mA	2.2
10 - 65	32.00A - 180.0A*♥	32.12A - 180.7A	1.2 + 162mA	2.2 ♦
10 - 65	22.54A - 160.0A ♣	22.63A - 160.6A	1.0 + 84mA	2.2
10 - 65	160.0A - 900.0A*♣	160.6A - 903.5A	1.2 + 0.82A	2.2 ♦

Ratios and Factors based on Square-Wave Unit-Value Peak

Peak:	1.0000
Peak to Peak:	2.0000
RMS:	0.9962
Mean:	0.9958
Crest Factor:	1.0038
Form Factor:	1.0004

* = With output 'ON', maximum duty cycle of (>0.528FS : ≤0.528FS) is (1 : 4).
Continuous output >0.528FS will automatically reduce to <0.528FS after 2 Minutes.

† = Total uncertainty includes compliance errors for Voltage ≤0.5VRMS.
Above 0.5V, add appropriate compliance error, except for Outputs marked ♥ and ♣.

♥ = Refers to accuracy at 9100 output terminals. With Option 200 10 turn coil connected, then at the output from the coil, add ±0.2% of output from coil for uncertainty of coil.

♣ = Refers to accuracy at 9100 output terminals. With Option 200 50 turn coil connected, then at the output from the coil, add ±0.2% of output from coil for uncertainty of coil.

♦ = For frequencies <40Hz, compliance voltage is reduced by 0.5V RMS.

AC Current Accuracy (Impulse-Wave)

Frequency Band [2] (Hz)	Output Current Span RMS	Output Current Span Peak	Accuracy † ± (% Output + Floor) **1 Year** — Tcal [1] ± 5°C	Voltage Compliance (VRMS)
10 - 1k	0µA - 23.79µA	0V - 45.25µA	0.42 + 2.7µA	3.0
10 - 1k	23.79µA - 2.379mA	45.25µA - 4.525mA	0.42 + 0.9µA	3.0
10 - 1k	2.379mA - 23.79mA	4.525mA - 45.25mA	0.42 + 9.6µA	3.0
10 - 1k	23.79mA - 237.9mA	45.25mA - 452.5mA	0.48 + 96µA	3.0
10 - 100	0.2379A - 2.379A	0.4525A - 4.525A	0.60 + 1.44mA	1.8
10 - 100	2.379A - 15.00A*	4.525A - 28.53A	0.80 + 20.7mA	1.8 ♦
10 - 65	2.379A - 23.79A ♥	4.525A - 45.25A	0.80 + 25.2mA	1.8
10 - 65	23.79A - 150.0A*♥	45.25A - 285.3A	1.20 + 243mA	1.8 ♦
10 - 65	11.90A - 118.9A ♣	22.63A - 226.3A	0.80 + 126mA	1.8
10 - 65	118.9A - 750.0A*♣	226.3A - 1426A	1.20 + 1.23A	1.8 ♦

Ratios and Factors based on Impulse-Wave Unit-Value Peak

Peak:	1.0000
Peak to Peak:	2.0000
RMS:	0.5270
Mean:	0.3333
Crest Factor:	1.8974
Form Factor:	1.5811

* = With output 'ON', maximum duty cycle of (>0.7FS : ≤0.7FS) is (1 : 4).
Continuous output >0.525FS will automatically reduce to <0.525FS after 2 Minutes.

† = Total uncertainty includes compliance errors for Voltage ≤0.5VRMS.
Above 0.5V, add appropriate compliance error, except for Outputs marked ♥ and ♣.

♥ = Refers to accuracy at 9100 output terminals. With Option 200 10 turn coil connected, then at the output from the coil, add ±0.2% of output from coil for uncertainty of coil.

♣ = Refers to accuracy at 9100 output terminals. With Option 200 50 turn coil connected, then at the output from the coil, add ±0.2% of output from coil for uncertainty of coil.

♦ = For frequencies <40Hz, compliance voltage is reduced by 0.5V RMS.

NOTES: [1] Tcal = temperature at calibration. Factory calibration temperature = 23°C.
[2] Frequency Accuracy: 25ppm of output frequency.

AC Current Accuracy (Triangular-Wave)

Frequency Band [2] (Hz)	Output Current Span RMS	Output Current Span Peak	Accuracy † ± (% Output + Floor) 1 Year — Tcal [1] ± 5°C	Voltage Compliance (VRMS)
10 - 1k	0µA - 26.12µA	0µA - 45.25µA	0.21 + 1.8µA	3.2
10 - 1k	26.12µA - 2.612mA	45.25µA - 4.525mA	0.21 + 0.6µA	3.2
10 - 1k	2.612mA - 26.12mA	4.525mA - 45.25mA	0.21 + 6.4µA	3.2
10 - 1k	26.12mA - 261.2mA	45.25mA - 452.5mA	0.24 + 64µA	3.2
10 - 100	0.2612A - 2.612A	0.4525A - 4.525A	0.30 + 960µA	2.0
10 - 100	2.612A - 16.30A*	4.525A - 28.23A	0.40 + 13.8mA	2.0 ♦
10 - 65	2.612A - 26.12A ♥	4.525A - 45.25A	0.40 + 16.8mA	2.0
10 - 65	26.12A - 163.0A*♥	45.25A - 282.3A	0.60 + 162mA	2.0 ♦
10 - 65	13.06A - 130.6A ♣	22.62A - 226.2A	0.40 + 84mA	2.0
10 - 65	130.6A - 815.0A*♣	226.2A - 1411A	0.60 + 0.82A	2.0 ♦

Ratios and Factors based on Triangular-Wave Unit-Value Peak

Peak:	1.0000
Peak to Peak:	2.0000
RMS:	0..5774
Mean:	0.5000
Crest Factor:	1.7321
Form Factor:	1.1547

* = With output 'ON', maximum duty cycle of (>0.644FS : ≤0.644FS) is (1 : 4).
Continuous output >0.644FS will automatically reduce to <0.644FS after 2 Minutes.

† = Total uncertainty includes compliance errors for Voltage ≤0.5VRMS.
Above 0.5V, add appropriate compliance error, except for Outputs marked ♥ and ♣.

♥ = Refers to accuracy at 9100 output terminals. With Option 200 10 turn coil connected, then at the output from the coil, add ±0.2% of output from coil for uncertainty of coil.

♣ = Refers to accuracy at 9100 output terminals. With Option 200 50 turn coil connected, then at the output from the coil, add ±0.2% of output from coil for uncertainty of coil.

♦ = For frequencies <40Hz, compliance voltage is reduced by 0.5V RMS.

AC Current Accuracy (Trapezoidal-Wave)

Frequency Band [2] (Hz)	Output Current Span RMS	Output Current Span Peak	Accuracy † ± (% Output + Floor) 1 Year — Tcal [1] ± 5°C	Voltage Compliance (VRMS)
10 - 1k	0µA - 39.91µA	0V - 45.25µA	0.21 + 1.8µA	4.0
10 - 1k	39.91µA - 3.991mA	45.25µA - 4.525mA	0.21 + 0.6µA	4.0
10 - 1k	3.991mA - 39.91mA	4.525mA - 45.25mA	0.21 + 6.4µA	4.0
10 - 1k	39.91mA - 399.1mA	45.25mA - 452.5mA	0.24 + 64µA	4.0
10 - 100	0.3991A - 3.200A	0.4525A - 3.628A	0.30 + 960µA	2.3
10 - 100	3.200A - 19.20A*	3.628A - 21.77A	0.40 + 13.8mA	2.3 ♦
10 - 65	3.991A - 32.00A ♥	4.525A - 36.28A	0.40 + 16.8mA	2.3
10 - 65	32.00A - 192.0A*♥	36.28A - 217.7A	0.60 + 162mA	2.3 ♦
10 - 65	19.95A - 160.0A ♣	22.62A - 181.4A	0.40 + 84mA	2.3
10 - 65	160.0A - 960.0A*♣	181.4A - 1088A	0.60 + 0.82A	2.3 ♦

Ratios and Factors based on Trapezoidal-Wave Unit-Value Peak

Peak:	1.0000
Peak to Peak:	2.0000
RMS:	0.8819
Mean:	0.8333
Crest Factor:	1.3389
Form Factor:	1.0583

* = With output 'ON', maximum duty cycle of (>0.547FS : ≤0.547FS) is (1 : 4).
Continuous output >0.547FS will automatically reduce to <0.547FS after 2 Minutes.

† = Total uncertainty includes compliance errors for Voltage ≤0.5VRMS.
Above 0.5V, add appropriate compliance error, except for Outputs marked ♥ and ♣.

♥ = Refers to accuracy at 9100 output terminals. With Option 200 10 turn coil connected, then at the output from the coil, add ±0.2% of output from coil for uncertainty of coil.

♣ = Refers to accuracy at 9100 output terminals. With Option 200 50 turn coil connected, then at the output from the coil, add ±0.2% of output from coil for uncertainty of coil.

♦ = For frequencies <40Hz, compliance voltage is reduced by 0.5V RMS.

Waveshape Harmonic Analysis

(Refer to AC Voltage Waveshapes)

NOTES: [1] Tcal = temperature at calibration. Factory calibration temperature = 23°C.
[2] Frequency Accuracy: 25ppm of output frequency.

Resistance Accuracy

Resistance Output	Accuracy			Absolute Resolution
	(Source UUTi Low) ±(% of Output + Floor) **1Year** - Tcal ±5°C [1]	(Source UUTi High) ±(% of Output + Floor) **1Year** - Tcal ±5°C [1]	(Source UUTi Super) ±(% of Output + Floor) **1Year** - Tcal ±5°C [1]	
00.0000 Ω to 40.0000 Ω	0.025 + 10.0mΩ	0.050 + 20.0mΩ	0.100 + 50.0mΩ	0.1mΩ
040.001 Ω to 400.000 Ω	0.020 + 20.0mΩ ∗	0.015 + 20.0mΩ	0.035 + 100mΩ	1mΩ
0.40001 kΩ to 4.00000 kΩ	0.015 + 80.0mΩ	0.015 + 80.0mΩ	0.035 + 200mΩ	10mΩ
04.0001 kΩ to 40.0000 kΩ	0.020 + 800mΩ	0.015 + 800mΩ	0.025 + 2.0Ω	100mΩ
040.001 kΩ to 400.000 kΩ	0.020 + 8.0Ω	0.018 + 8.0Ω	0.025 + 20Ω	1Ω
0.40001 MΩ to 4.00000 MΩ	0.050 + 100Ω	0.020 + 100Ω	0.040 + 200Ω	10Ω
04.0001 MΩ to 40.0000 MΩ	0.150 + 2.0kΩ	0.050 + 2.0kΩ	0.050 + 2.0kΩ	100Ω
040.001 MΩ to 400.000 MΩ	0.260 + 40.0kΩ	0.060 + 40.0kΩ	---	1kΩ

∗ = Valid for UUTi ≥ 200µA.
Below 200µA: new floor = (200µA ÷ Actual UUTi) x 20mΩ.

Source Current Limits

Hardware Configuration Limits on Span of Output Resistance	Source Current Limits		
	UUTi Low	UUTi High	UUTi Super
00.0000 Ω to 40.0000 Ω	250µA to 3.5mA	2.5mA to 35mA	25mA to 350mA
040.001 Ω to 400.000 Ω	25µA to 320µA	250µA to 3.5mA	2.5mA to 35mA
0.40001 kΩ to 4.00000 kΩ	25µA to 320µA	250µA to 3.5mA	2.5mA to 35mA
04.0001 kΩ to 40.0000 kΩ	2.5µA to 32µA	25µA to 350µA	250µA to 3.5mA
040.001 kΩ to 400.000 kΩ	250nA to 3.2µA	2.5µA to 35µA	25µA to 350µA
0.40001 MΩ to 4.00000 MΩ	25nA to 320nA	250nA to 3.5µA	2.5µA to 35µA
04.0001 MΩ to 40.0000 MΩ	8nA to 32nA	25nA to 350nA	250nA to 3.5µA
040.001 MΩ to 400.000 MΩ	4nA to 32nA	25nA to 200nA	N/A

Other Resistance Specifications

Maximum Measurement Voltage: 10V; ($I_{measure}$ x R_{actual} = ≤10V)

Settling Time to within 10% of accuracy:
0 - 40kΩ : <0.08s
40kΩ - 4MΩ : <0.3s
4MΩ - 400MΩ : <1s

4-wire Lead Compensation:
Max total lead resistance: 50Ω
Nominal lead resistance rejection: 10000:1

NOTES: [1] Tcal = temperature at calibration. Factory calibration temperature = 23°C.

Conductance Accuracy

Conductance Output	Accuracy ±(% Output) 1Year — Tcal ±5°C [1]	
	UUTi Low & High	UUTi Super
2.5nS - 25.0nS	0.40	N/A
25.0nS - 250.0nS	0.20	0.45
250.0nS - 2.5µS	0.12	0.27
2.5µS - 25.0µS	0.05	0.12
25.0µS - 250.0µS	0.05	0.12
250.0µS - 2.5mS	0.04	0.09

Conductance Span *vs* Resolution

Absolute Resolution	Span of Values
0.1pS	02.5000 nS to 25.0000 nS
1pS	002.500 nS to 250.000 nS
10pS	0.00250 µS to 2.50000 µS
100pS	00.0025 µS to 25.0000 µS
1nS	000.002 µS to 250.000 µS
10nS	0.00001 mS to 2.50000 mS

Source Current Limits

Hardware Configuration Limits on Span of Output Conductance	Current Source Limits		
	UUTi Low	UUTi High	UUTi Super
02.5000 nS to 25.0000 nS	4nA to 32nA	2.5nA to 200nA	N/A
025.001 nS to 250.000 nS	8nA to 32nA	25nA to 350nA	250nA to 3.5µA
0.25001 µS to 2.50000 µS	25nA to 320nA	250nA to 3.5µA	2.5µA to 35µA
02.5001 µS to 25.0000 µS	250nA to 3.2µA	2.5µA to 35µA	25µA to 350µA
025.001 µS to 250.000 µS	2.5µA to 32µA	25µA to 350µA	250µA to 3.5mA
0.25001 mS to 2.50000 mS	25µA to 320µA	250µA to 3.5mA	2.5A to 35mA

Other Conductance Specifications

Maximum Measurement Voltage: 10V; ($I_{measure} \div \mho_{actual}$ = ≤10V)

Settling Time to within 10% of accuracy:
2.5nS - 250nS : <1s
250nS - 25µS : <0.3s
25µS - 2.5mS : <0.08s

4-wire Lead Compensation:
Max total lead resistance: 50Ω
Nominal lead resistance rejection: 10000:1

NOTES: [1] Tcal = temperature at calibration. Factory calibration temperature = 23°C.

Frequency Function Accuracy

Frequency Output	Accuracy ±(ppm of Output Frequency) **1Year** — Tcal ±5°C [1] Standard	Accuracy ±(ppm of Output Frequency) **5Year** — Tcal ±5°C [1] Option 100	Mark/Period Ratio (%)
0.5Hz - 10.0MHz	25.0	0.25	50

High and Low Voltage Limits and Voltage Accuracy

Frequency Span	Output Voltage Vo	Accuracy (±Volts) **1Year** — Tcal ±5°C [1]
0.5Hz to 2MHz	Vo ≤ 6Vpk	0.06V †
2MHz to 10MHz	Vo ≤ 6Vpk	1.0V
0.5Hz to 1kHz	6Vpk < Vo ≤ 30Vpk	0.3V

† = After first 150ns.

Frequency Spans *vs* Frequency Resolution

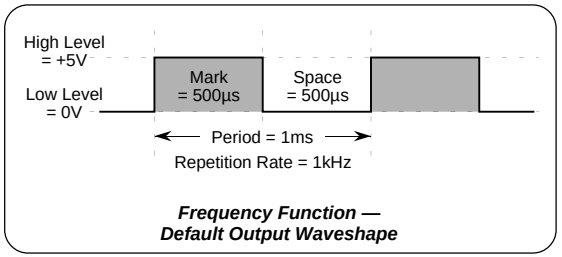
Absolute Resolution	Span of Frequencies	Output Voltage ≤6Vpk	Output Voltage >6Vpk
1mHz	000.500 Hz to 320.000 Hz	*	*
10mHz	0.00050 kHz to 1.00000 kHz	*	*
10mHz	1.00001 kHz to 3.20000 kHz	*	---
100mHz	00.0005 kHz to 32.0000 kHz	*	---
1Hz	000.001 kHz to 320.000 kHz	*	---
10Hz	0.00001 MHz to 3.20000 MHz	*	---
100Hz	00.0001 MHz to 10.0000 MHz	*	---

* = Peak outputs available at stated levels.

Rise Times

(Specified into loads R_L > 100kΩ in parallel with C_L ≤ 100pF)

For signals ≤ 6Vpk	:	<40ns.
For signals > 6Vpk	:	<1.5µs.



Frequency Function — Default Output Waveshape

NOTES: [1] Tcal = temperature at calibration. Factory calibration temperature = 23°C.

Mark/Period Function — Pulse Width and Repetition Period Intervals Accuracy

Output Voltage	Interval	Accuracy ±(ppm of Output + Floor) **1Year** — Tcal ±5°C [1]	Option 100 Accuracy ±(ppm of Output + Floor) **5Year** — Tcal ±5°C [1]
Vo ≤ 6Vpk	Pulse Width: 0.30µs to 1999.99ms Repetition Period: 0.6µs to 2000ms	25 + 10ns 25	0.25 + 10ns 0.25
6Vpk < Vo ≤ 30Vpk	Pulse Width: 10µs to 1999.99ms Repetition Period: 1ms to 2000ms	25 + 200ns 25	0.25 + 200ns 0.25

High and Low Voltage Limits and Voltage Accuracy

Output Voltage Vo	Accuracy (±Volts) **1Year** — Tcal ±5°C [1]
Vo ≤ 6Vpk	0.06V †
6Vpk < Vo ≤ 30Vpk	0.3V

† = After first 150ns.

Repetition Period Interval Spans *vs* Time Resolution

Absolute Resolution	≤6V pk	>6Vpk
100ns	000.6 µs to 999.9 µs	-----
100ns	00.0006 ms to 99.9999 ms	01.0000 ms to 99.9999 ms
1µs	000.001 ms to 999.999 ms	001.000 ms to 999.999 ms
10µs	0000.01 ms to 2000.00 ms	0001.00 ms to 2000.00 ms

Pulse Width Interval Spans *vs* Time Resolution

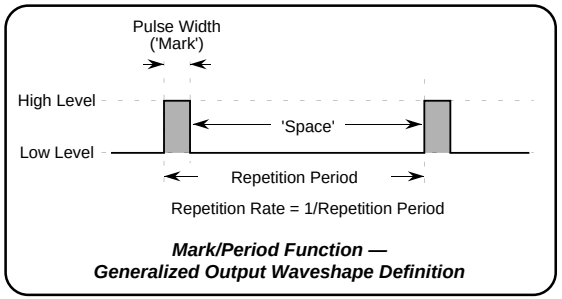
Absolute Resolution	≤6V pk	>6Vpk
100ns	000.3 µs to 999.9 µs*	010.00 µs to 990.0 µs**
100ns	00.0003 ms to 99.9999 ms*	00.0100 ms to 99.9999 ms**
1µs	000.001 ms to 999.999 ms	000.010 ms to 999.999 ms**
10µs	0000.01 ms to 1999.99 ms	0000.01 ms to 1999.99 ms

* = Max Pulse Width must be at least 0.3µs less than the Repetition Period.
** = Max Pulse Width must be at least 10µs less than the Repetition Period.

Rise Times

(Specified into loads R_L > 100kΩ in parallel with C_L ≤ 100pF)

For signals ≤ 6Vpk	:	<40ns.
For signals > 6Vpk	:	<1.5µs.



Mark/Period Function — Generalized Output Waveshape Definition

NOTES: [1] Tcal = temperature at calibration. Factory calibration temperature = 23°C.

'% Duty' Function — Repetition Period Intervals Accuracy

Output Voltage	Interval	Accuracy ±(ppm of Output) **1Year** — Tcal ±5°C [1]	Option 100 Accuracy ±(ppm of Output) **5Year** — Tcal ±5°C [1]
Vo ≤ 6Vpk	100µs to 2000ms	25	0.25
6Vpk < Vo ≤ 30Vpk	1ms to 2000ms	25	0.25

'% Duty' Value: Screen Setting Limits

00.05% ≤ % Duty ≤ 99.95%

Duty Cycle Accuracy

Output Voltage	Total Accuracy 1Year — Tcal ±5°C [1]
Vo ≤ 6Vpk	35ns
6Vpk < Vo ≤ 30Vpk ‡	225ns

‡ = Minimum Mark or Space interval: 10µs.

High and Low Voltage Limits and Voltage Accuracy

Output Voltage Vo	Accuracy (±Volts) **1Year** — Tcal ±5°C [1]
Vo ≤ 6Vpk	0.06V †
6Vpk < Vo ≤ 30Vpk	0.3V

† = After first 150ns.

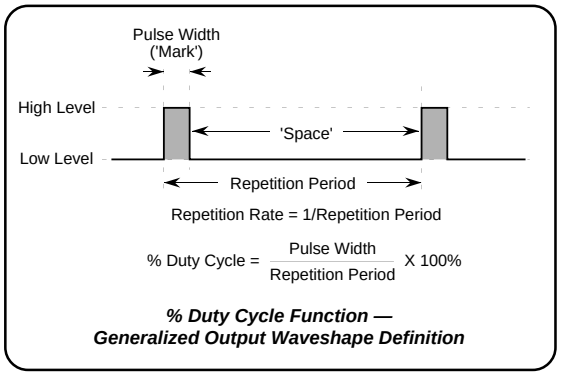
Repetition Period Interval Spans *vs* Time Resolution

Absolute Resolution	≤6V pk	>6Vpk
100ns	100.0 µs to 999.9 µs	-----
100ns	00.1000 ms to 99.9999 ms	01.0000 ms to 99.9999 ms
1µs	000.001 ms to 999.999 ms	001.000 ms to 999.999 ms
10µs	0000.01 ms to 2000.00 ms	0001.00 ms to 2000.00 ms

Rise Times

(Specified into loads R_L > 100kΩ in parallel with C_L ≤ 100pF)

For signals ≤ 6Vpk	:	<40ns.
For signals > 6Vpk	:	<1.5µs.



% Duty Cycle Function — Generalized Output Waveshape Definition

NOTES: [1] Tcal = temperature at calibration. Factory calibration temperature = 23°C.

Capacitance Accuracy

Capacitance Output	Accuracy *				Absolute Resolution
	Source UUTi Low ±(% of Output + Floor) **1Year** — Tcal ±5°C [1]		Source UUTi Super ±(% of Output + Floor) **1Year** — Tcal ±5°C [1]		
	Stim Repetition Rate ≤350Hz	Stim Repetition Rate 350Hz to 1.5kHz	Stim Repetition Rate ≤350Hz	Stim Repetition Rate 350Hz to 1.5kHz	
0.5000 nF to 4.0000 nF	0.3 + 15pF	0.6 +30.0pF	-----	-----	0.1pF
4.0001 nF to 40.000 nF	0.3 + 30pF	0.6 +60.0pF	-----	-----	1pF
40.001 nF to 400.00 nF	0.3 + 160pF	0.6 +320pF	-----	-----	10pF
400.01 nF to 4.0000 µF	0.4 + 1.6nF	0.8 +3.2nF	-----	-----	100pF
4.0001 µF to 40.000 µF	0.5 + 16.0nF	1.0 +32.0nF	-----	-----	1nF
40.001 µF to 400.00 µF	0.5 + 160nF	1.0 +320nF	0.75 + 160nF	1.0 + 320nF	10nF
400.01 µF to 4.0000 mF	0.5 + 1.6µF	1.0 +3.2µF	0.75 + 1.6µF	1.0 + 3.2µF	100nF
4.0001 mF to 40.000 mF	1.0 + 60µF	2.0 +120µF	1.0 + 60µF	2.0 + 120µF	1µF

* = Accuracy specifications apply both at the 9100 output terminals, and at the output leads of the Model 9105 leadset.

Measurement and Discharge Current

Capacitance Output	Source UUTi Low		Source UUTi Super	
	Measurement Current Range	Maximum Discharge Current	Measurement Current Range	Maximum Discharge Current
0.5000 nF to 4.0000 nF	0.02µA to 500µA	1mA	-----	-----
4.0001 nF to 40.000 nF	0.02µA to 500µA	5mA	-----	-----
40.001 nF to 400.00 nF	0.04µA to 1mA	10mA	-----	-----
400.01 nF to 4.0000 µF	0.5µA to 1mA	10mA	-----	-----
4.0001 µF to 40.000 µF	5µA to 3mA	10mA	-----	-----
40.001 µF to 400.00 µF	5µA to 3mA	10mA	50µA to 30mA	100mA
400.01 µF to 4.0000 mF	5µA to 3mA	10mA	50µA to 30mA	100mA
4.0001 mF to 40.000 mF	5µA to 3mA	10mA	50µA to 30mA	100mA

Other Capacitance Specifications

Maximum Measurement Voltage:	±3.5V (except 40µF range which is limited to ±2.5V)
Settling Time to within 10% of accuracy:	<0.08s
4-wire Lead Compensation:	Max total lead resistance: 10Ω

NOTES: [1] Tcal = temperature at calibration. Factory calibration temperature = 23°C.

Thermocouple Temperature Accuracy

Thermocouple Type	Temperature Output (Screen Resolution Shown)	Accuracy * † ‡ (±°C) **1Year** — Tcal ±5°C [1]
B	+0500.0°C - +0800.0°C	0.55
	+0800.0°C - +1000.0°C	0.41
	+1000.0°C - +1400.0°C	0.34
	+1400.0°C - +1820.0°C	0.37
C	0000.0°C - +0600.0°C	0.29
	+0600.0°C - +1000.0°C	0.27
	+1000.0°C - +1800.0°C	0.40
	+1800.0°C - +2320.0°C	0.41
E	-0250.0°C - -0200.0°C	0.45
	-0200.0°C - -0100.0°C	0.22
	-0100.0°C - +0100.0°C	0.17
	+0100.0°C - +1000.0°C	0.21
J	-0210.0°C - -0100.0°C	0.25
	-0100.0°C - +0800.0°C	0.19
	+0800.0°C - +1000.0°C	0.21
	+1000.0°C - +1200.0°C	0.23
K	-0250.0°C - -0200.0°C	0.57
	-0200.0°C - -0100.0°C	0.27
	-0100.0°C - +0100.0°C	0.19
	+0100.0°C - +0600.0°C	0.23
	+0600.0°C - +1372.0°C	0.27
L	-0200.0°C - -0050.0°C	0.26
	-0050.0°C - +0200.0°C	0.18
	+0200.0°C - +0700.0°C	0.20
	+0700.0°C - +0900.0°C	0.23
N	-0200.0°C - -0100.0°C	0.33
	-0100.0°C - +0900.0°C	0.23
	+0900.0°C - +1100.0°C	0.22
	+1100.0°C - +1300.0°C	0.24
R ♦	0000.0°C - +0100.0°C	0.52
	+0100.0°C - +0200.0°C	0.40
	+0200.0°C - +1600.0°C	0.35
	+1600.0°C - +1767.0°C	0.28
S ♦	0000.0°C - +0200.0°C	0.49
	+0200.0°C - +1000.0°C	0.37
	+1000.0°C - +1400.0°C	0.35
	+1400.0°C - +1767.0°C	0.36
T	-0250.0°C - -0200.0°C	0.59
	-0200.0°C - -0100.0°C	0.27
	-0100.0°C - 0000.0°C	0.22
	0000.0°C - +0400.0°C	0.17

* = Accuracy figures include CJC error.
† = Compensated output determined from pre-defined tables based on:
IPTS-68 Reference Table NIST Monograph 125 for Types: B, E, J, K, R, S and T.
ITS-90 Reference Table NIST Monograph 175 for Types: B, E, J, K, N, R, S and T.
IPTS-68 Reference Table DIN 43710 for Type L.
ITS-90 Reference Table DIN 43710 for Type L.
‡ = For loads <1MΩ add load regulation error.
♦ = Types R & S adjusted above 1700°C for IPTS-68 as per NIST monograph 175.

NOTES: [1] Tcal = temperature at calibration. Factory calibration temperature = 23°C.

Other Thermocouple Output Specifications

Settling Time to within 10% of accuracy:	0.08s
Load Regulation:	$(200/R_{LOAD})$ % of output
Maximum Capacitance:	1000pF.

RTD Temperature Accuracy *

Temperature Output	Accuracy * : ±(% of Output + Floor) 1Year — Tcal ±5°C [1]		
	Resistance at 0°C = 10Ω - 60Ω	Resistance at 0°C = 60Ω - 1kΩ	Resistance at 0°C = 1kΩ - 2kΩ
-200°C to -100°C	0.00 + 0.225°C	0.00 + 0.15°C	0.00 + 0.12°C
-100°C to +100°C	0.00 + 0.15°C	0.00 + 0.10°C	0.00 + 0.08°C
+100°C to +630°C	0.00 + 0.30°C	0.00 + 0.20°C	0.00 + 0.16°C
+630°C to +850°C	0.00 + 0.45°C	0.00 + 0.30°C	0.00 + 0.24°C

* = Accuracy figures apply to Output Temperature *vs* Resistance curves PT385 *or* PT392 and to Temperature Scales IPTS-68 *or* ITS-90 as selected by the user:
PT385, IPTS-68 as per IEC751.
PT392, IPTS-68 as per SAMA.
PT385, ITS-90 as per IEC751 amendment 2.
PT392, ITS-90 as per NIST monograph 175 corrections (90-68).

Spans of UUT Source Currents

Hardware Configuration Limits on Span of Output Resistance	Source Current Limits		
	UUTi Low	UUTi High	UUTi Super
00.0000 Ω to 40.0000 Ω	250µA to 3.5mA	2.5mA to 35mA	25mA to 350mA
040.001 Ω to 400.000 Ω	25µA to 320µA	250µA to 3.5mA	2.5mA to 35mA
0.40001 kΩ to 4.00000 kΩ	25µA to 320µA	250µA to 3.5mA	2.5mA to 35mA
04.0001 kΩ to 10.0000 kΩ †	2.5µA to 32µA	25µA to 350µA	250µA to 3.5mA

† = Resistance span used when the nominal operating point of the detector is raised, to give resistance values above 4kΩ for certain temperature readings.

Other RTD Temperature Specifications

Maximum Measurement Voltage:	10V;	($I_{measure}$ x R_{actual} = ≤10V)
Settling Time to within 10% of accuracy:	0 - 40kΩ :	<0.08s
4-wire Lead Compensation:	Max total lead resistance:	50Ω
	Nominal lead resistance rejection:	10000:1

NOTES: [1] Tcal = temperature at calibration. Factory calibration temperature = 23°C.

Logic Pulses Function — Pulse Width and Repetition Period Intervals Accuracy

Interval		Accuracy ±(ppm of Output + Floor) **1Year** — Tcal ±5°C [1]	Option 100 Accuracy ±(ppm of Output + Floor) **5Year** — Tcal ±5°C [1]
Pulse Width:	0.30µs to 1999.99ms	25 + 10.0ns	0.25 + 10.0ns
Repetition Period:	0.6µs to 2000.00ms	25	0.25

Fixed High/Low Levels & Voltage — Accuracy

Selected Logic	Signal Level	Voltage	Accuracy (±Volts) **1Year** — Tcal ±5°C [1]
TTL	High	+5.00 V	0.06
	Low	0.00 V	0.06
CMOS	High	+5.00 V	0.06
	Low	0.00 V	0.06
ECL	High	-0.90 V	0.06
	Low	-1.75 V	0.06

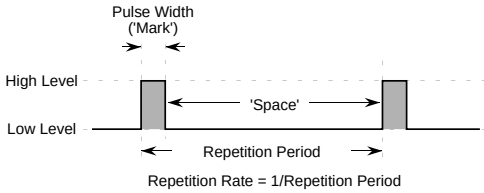
'Pulse Width' Interval *vs* Resolution

Absolute Resolution	Pulse Width
100ns	000.3 µs to 999.9 µs*
100ns	00.0003 ms to 99.9999 ms*
1µs	000.001 ms to 999.999 ms
10µs	0000.01 ms to 1999.99 ms

* = Maximum Pulse Width interval must be at least 0.3µs less than that of the set Repetition Period.

'Repetition Period' Interval *vs* Resolution

Absolute Resolution	Repetition Period
100ns	000.6 µs to 999.9 µs
100ns	00.0006 ms to 99.9999 ms
1µs	000.001 ms to 999.999 ms
10µs	0000.01 ms to 2000.00 ms



Logic-Pulses Function — Generalized Output Waveshape Definition

Logic-Levels DC Signal Voltage Boundaries

(The accuracy of each DC signal voltage is the same as that of the equivalent voltage in DC Voltage Function.)

Logic Type	Signal Level	Screen Indication	Default Value ('**H**' or '**L**')	Boundaries	Adjustment Limits
TTL	High	**HIGH LVL**	+5.00V	V > +2.00V	+5.50V
	Intermediate	— — — — —	---	+0.8V < V < +2.00V	---
	Low	**LOW LVL**	0.00V	V < 0.8V	0.00V
CMOS	High	**HIGH LVL**	+5.00V	V > +3.50V	+6.00V
	Intermediate	— — — — —	---	+1.5V < V < +3.50V	---
	Low	**LOW LVL**	0.00V	V < 1.5V	0.00V
ECL	High	**HIGH LVL**	-0.9V	V > -1.11V	0.00V
	Intermediate	— — — — —	---	-1.48V < V < -1.11V	---
	Low	**LOW LVL**	-1.75V	V < -1.48V	-5.20V

NOTES: [1] Tcal = temperature at calibration. Factory calibration temperature = 23°C.

Scope Calibration Specifications — Options 600 & 250

- Outputs available from **SIG OUT** BNC socket.
- Trigger available from **TRIG OUT** BNC socket.

Square Function Accuracy

Load Impedance	Voltage/Div Scaling Factor (pk-to-pk)	Scaling Factor Sequence	Multiplier Range Integers	Voltage Deviation % Setting	Output Voltage Range (pk-to-pk)	Voltage Accuracy 1Year % of Output Tcal ±5°C [2]	Output Frequency	Frequency Accuracy (ppm of output) Basic	Option 100
50Ω	1mV/div to 2V/div	1, 2, 5	1 to 10	±11.20	4.4400mV to 3.3360V	±0.25%	1kHz	25	0.25
1MΩ	1mV/div to 20V/div	1, 2, 5	1 to 10	±11.20	4.4400mV to 133.44V	±0.25%	1kHz	25	0.25

Other Square Function Specifications

Symmetry:	50%
Polarity:	Positive from ground
Rise/Fall time:	5µs
Aberration:	<1% in first 30µs

DC Function Accuracy

Load Impedance	Voltage/Div Scaling Factor	Scaling Factor Sequence	Multiplier Range Integers	Voltage Deviation % Setting	Output DC Voltage Range	Voltage Accuracy 1Year % of Output + Floor Tcal ±5°C [2]
50Ω	+1mV/div to +2V/div	1, 2, 5	1 to 10	±11.20	+4.4400mV to +2.7800V	±0.2% + 40µV
50Ω	-1mV/div to -2V/div	1, 2, 5	1 to 10	±11.20	-4.4400mV to -2.7800V	±0.2% + 40µV
1MΩ	+1mV/div to +20V/div	1, 2, 5	1 to 10	±11.20	+4.4400mV to +133.44V	±0.2% + 40µV
1MΩ	-1mV/div to -20V/div	1, 2, 5	1 to 10	±11.20	-4.4400mV to -133.44V	±0.2% + 40µV

NOTES: [2] Tcal = temperature at calibration. Factory calibration temperature = 23°C.

Sine Function Voltage Accuracy

Load Impedance	Output Frequency	Scaling Factor Voltage/Div (pk-to-pk)	Scaling Factor Sequence	Multiplier Range Integers	Voltage Deviation % Setting	Output Voltage Range (pk-to-pk)	1Year Tcal ±5°C [2] (% of Output) Voltage Accuracy 10Hz to 49.999kHz ‡	Flatness 50.001kHz to 100.00MHz Relative to 50kHz	Flatness 100.01 MHz to 250.00MHz Relative to 50kHz	Flatness 250.01MHz to 600.00MHz Relative to 50kHz ¶
1MΩ	10Hz to 49.999kHz	1mV to 20V	1, 2, 5	1 to 10	±11.20	4.4400mV to 133.44V	±0.25	---	---	---
50Ω	10Hz to 49.999kHz	1mV to 2V	1, 2, 5	1 to 10	±11.20	4.4400mV to 5.5600V	±0.25	---	---	---
50Ω	50kHz to 250MHz	1mV to 2V	1, 2, 5	1 to 10	±11.20	10.656mV to 5.5600V	±1.5	±1.5 †	±3 † §	---
50Ω ¶	250MHz to 600MHz	1mV to 2V	1, 2, 5	1 to 10	±11.20	10.656mV to 3.3360V	---	---	---	±5 † §

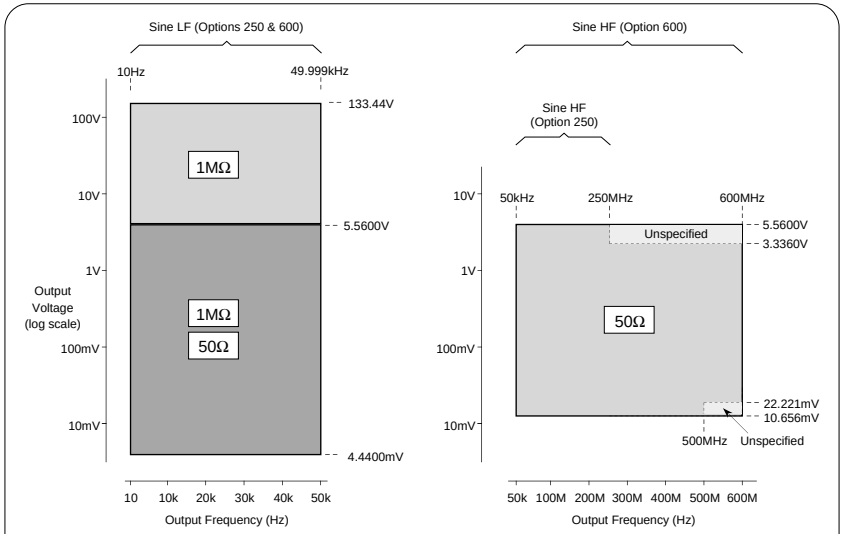
¶ = Applies only to Option 600.
† = Relative to Standards.
‡ = Includes the uncertainty of the precision in-line terminator (part no. 630447) when used.
§ = Into load VSWR 1.2 to 1.4 add 1% of output, into VSWR 1.4 to 1.6 add 2% of output.

Sine Function Frequency Accuracy

All Frequencies:	
Basic	25ppm
With Option 100	0.25ppm

Other Sine Function Specifications

Purity:	**2nd Harmonic**	< -35dBc
	3rd Harmonic	< -40dBc
	Spurious Signals	< -40dBc



Sine Function — LF & HF Volt-Hz Profiles

NOTES: [1] Specifications are valid only when the output signal is connected via the precision signal cable (Wavetek part no. 630442) into a VSWR <1.6, and subject to the peak current limits stated on page 7-1.

[2] Tcal = temperature at calibration. Factory calibration temperature = 23°C

Scope Calibration Specifications — Options 600 & 250 *(Contd.)*

- Outputs available from **SIG OUT** BNC socket.
- Trigger available from **TRIG OUT** BNC socket.

Edge Function Accuracy [1]

Load Impedance	Scaling Factor Voltage/Div (pk-to-pk)	Scaling Factor Sequence	Multiplier Range Integers	Voltage Deviation % Setting	Output Voltage Range (pk-to-pk)	Voltage Accuracy ‡ 1Year % of Output Tcal ±5°C [2]	Output Period (Fixed Values in 1, 2, 5 sequence)	Rise/Fall Time Between 10% & 90% Selectable Rise	Rise/Fall Time Between 10% & 90% Selectable Fall
Low Edge: 50Ω	20mV to 500mV	1, 2, 5	1 to 10	±11.20	88.800mV to 1.1120V	±3%	100ns to 10ms	≤ 1ns	≤ 1ns
High Edge: 1MΩ	20mV to 20V ♣	1, 2, 5	1 to 10	±11.20	888.00mV to 55.600V ♣	±3%	10µs to 10ms	≤ 100ns	---

♣ = Output Voltage extends from 888.00mV down to 88.800mV (unspecified).
‡ = Includes the uncertainty of the precision in-line terminator (part no. 630447) when used.

Edge Function Period Accuracy

Basic	25ppm
With Option 100	0.25ppm

Other Edge Function Specifications

Symmetry:	50%
Polarity:	'Rise' selected: from a negative potential to ground. 'Fall' selected: from a positive potential to ground.
Low Edge Aberration:	in first 10ns: ±2% of signal pk-pk ampliude, or 10mV, whichever is the greater.
High Edge Aberration:	in first 500ns: ±2% of signal pk-pk ampliude, or 50mV, whichever is the greater.
Low Edge Pulse-top Flatness:	after first 10ns: ±0.5%
High Edge Pulse-top Flatness:	after first 500ns: ±1%

NOTES: [1] Specifications are valid only when the output signal is connected via the precision signal cable (Wavetek part no. 630442) or similar cable of similar length.
[2] Tcal = temperature at calibration. Factory calibration temperature = 23°C

Markers Function Accuracy

Load Impedance	Scaling Factor Time/Div	Scaling Factor Sequence	Time Deviation % Setting	Output Time/Div Range ♦	Period Accuracy (ppm of Output Period) Basic	Period Accuracy (ppm of Output Period) Option 100	Output Voltage Values (pk-pk)
50Ω	5ns to 5s	1, 2, 5	±45	4.0000ns to 5.5000s	25	0.25	0.1V, 0.2V, 0.5V, 1V
50Ω ¶	2ns to 5s	1, 2, 5	±45	2.0000ns to 5.5000s	25	0.25	0.1V, 0.2V, 0.5V, 1V

¶ = Applies only to Option 600.

♦ = Max. and Min. values place upper and lower limits on Multiplier Range and Time Deviation.

Other Markers Function Specifications

Waveshape:		
(Option 250):	4.0000ns to 8.8889ns:	Sine
(Option 600):	1.6666ns to 8.8889ns:	Sine
(Options 250 & 600):	8.8888ns to 5.5000s:	Square

Trigger Out Specifications: Rising Edge — 1V into 50Ω

Function	Option 250 Trigger Repetition Rate (Signal Freq = f_{out}) *or* Trigger Period Signal Period = (τ_{out})	Option 600 Trigger Repetition Rate (Signal Freq = f_{out}) *or* Trigger Period Signal Period = (τ_{out})	Trig Out Lead ♦ Typical Delay (to Selected Edge)
MARKERS			
4.0000ns to 89.293ns	(τ_{out}) x 32		
1.6666ns to 89.293ns		(τ_{out}) x 64	
89.294ns to 5.5000s	(τ_{out})	(τ_{out})	25ns
LOW EDGE 100.00ns to 10.000ms	τ_{out}	τ_{out}	25ns
HIGH EDGE 10.000µs to 10.000ms	τ_{out}	τ_{out}	300ns
SINE			
10.000Hz to 11.199MHz	f_{out}	f_{out}	
11.200MHz to 250.00MHz	f_{out} / 32		
11.200MHz to 600.00MHz		f_{out} / 64	
SQUARE (1kHz)	f_{out}	f_{out}	
DC	64Hz Nominal	64Hz Nominal	

♦ = Valid only when the TRIG OUT is connected via the special trigger cable (Wavetek part no. 630441).

Ordering Information

9100 Universal Calibration System
Including Thermocouple Pod, 9105 Lead Kit Assembly and Traceable Calibration Certificate

- Option PLC Procedure Library Card (each). (See 'Procedure Library' on www.wavetek.com)
- Option 10 Blank 256k Byte, Programmable (FLASH) Memory Card. (Use only for procedures)
- Option 30 Blank 256k Byte, Static (SRAM) Memory Card. (Use for Results Data)
- Option 50 Tracker Ball
- Option 60 Soft Carrying Case
- Option 90 Rack Mounting Kit
- Option 100 High Stability Crystal Reference. (Recommended for use with options 250 and 600)
- Option 200 10 and 50 turn Current Coils
- Option 250 250MHz Oscilloscope Calibration Module (installs internally — includes 4 cables, tee adapter and 50 ohm terminators)

or

- Option 600 600MHz Oscilloscope Calibration Module (installs internally — includes 4 cables, tee adapter and 50 ohm terminators)

9010 Windows Automated Calibration Software and ISO 9000 Database Manager (including full networking capabilities and procedure library). Includes: CD-ROM, user handbook, R & R Report Writer package. Suitable for use with 9x00 calibrators.

Notes: To control equipment using GPIB interface you will require Option 20.
To generate procedure cards you will require Option 40.
To run an additional Networked Workstation you will require the Network Node

- Option 10 Software Support
  An Annual maintenance program which provides telephone support, software upgrades and access to new procedures released on website: www.wavetek.com, during the maintenance period (12 months from date of delivery). Customer details (i.e. contact name) must be supplied with order.
- Option 20 GPIB Interface and Security Key
- Option 40 PCMCIA Read/Write module (for desktop computer only)
- Option 60 Upgrade to version 1.6
- Option 70 Hewlett Packard™ Bar Code Reader

Network Node Additional Network Node

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