5530 Dynamic Calibrator
Introduction

5530 Dynamic Calibrator Requirements

Power Requirements

Laser Head:
100 – 240 Vac, 50/60 Hz
50W (during warmup), 33W (after warmup)

Calibrator Electronics (all +5V via USB):
E1735A 280 mA max
E1736A 120 mA (plus sensors)
E1737A 6 mA maximum, 0.3 mA typical
E1738A 6 mA maximum, 0.6 mA typical

System Requirements

Environmental
Operating Temperature: 0 – 40 °C (32 – 104 °F)
Optics temperature must be stabilized to ± 2 °C to achieve accuracy specifications.

PC Requirements Compatible with any portable computer with Windows XP, Windows Vista (32-bit), Windows 7 (32-/64-bit) or Windows 8 (32-/64-bit) and two USB 2.0 ports and a CD drive
Specifications

Laser Characteristics

- **Type:** Helium-Neon with automatically tuned Zeeman-split two-frequency output
- **Output Power:** ≥ 180 µW
  (< 1 mW per Class II Laser Product)
- **Safety Classification:** Class II Laser Product conforming to U.S. National CDRH Regulations 21CFR 1040.10 and 1040.11.
- **Warm-up Time:** Less than 10 minutes
  (4 minutes typical)

Vacuum Wavelength: 632.991354 nm

Wavelength Accuracy: ± 0.1 ppm
(± 0.02 ppm of measured wavelength
wavelength with factory calibration, Option A6J)

Wavelength Stability (typical):
short term (1 hour): ± 0.002 ppm
long term (lifetime): ± 0.02 ppm

Beam Diameter: 6 mm (0.24 in)

Beam Centerline Spacing:
11.0 mm (0.44 in) (input to output aperture)

Measurement Range

Up to 40 m (130 ft) with Linear Optics;
Up to 80 m (260 ft) with Long Range Option

Linear Distance and Diagonal Measurement Performance

<table>
<thead>
<tr>
<th>OPTICS</th>
<th>RESOLUTION</th>
<th>MAXIMUM AXIS VELOCITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear Optics (10766A)</td>
<td>1 nm (0.04 µin)</td>
<td>± 0.7 m/s (± 28 in/s)</td>
</tr>
<tr>
<td>Plane Mirror Optics (10706A/B)*</td>
<td>0.5 nm (0.02 µin)</td>
<td>± 0.35 m/s (± 14 in/s)</td>
</tr>
<tr>
<td>High Resolution Plane Mirror Optics (10716A)**</td>
<td>0.25 nm (0.01 µin)</td>
<td>± 0.18 m/s (± 7 in/s)</td>
</tr>
</tbody>
</table>

* Requires the 10724A Plane Mirror Reflector. Since alignment of these optics is much more sensitive than for linear optics, linear optics are recommended for general use.

** Aperture distance of 10716A is 12.7 mm, whereas 5519A is 11 mm.

Angle Measurement Specifications

- **Angle Measurement Accuracy**
  ± 0.2% of displayed value
  ± 0.05 arc-seconds per meter of distance traveled by the linearly moving optic.

- **Maximum Distance Between Laser Head and Reflector**
  Up to 15 m (50 ft)

Linear Distance and Diagonal Measurement Accuracy

<table>
<thead>
<tr>
<th>Temperature, °C [°F]</th>
<th>E1738A Air Sensor</th>
<th>In Vacuum†</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 40° (32° – 104°)</td>
<td>± 0.4 ppm</td>
<td>± 0.1 (± 0.02) ppm</td>
</tr>
</tbody>
</table>

Velocity Measurement Accuracy

\[
\text{Velocity} + 0.01 \% \text{ of displayed value}
\]

Angle Measurement Resolution

0.005 arc-seconds

Measurement Range

± 10° (rotated about base of optic)
± 20° (rotated about center of optic)

Measurement Type

Pitch and yaw

1. † Vacuum accuracy is ± 0.02 ppm if the laser head is calibrated to MIL-STD 45662A.
## Specifications

### Angular Position Measurement Specifications (55290A Rotary Axis Kit)

<table>
<thead>
<tr>
<th>Measurement Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotary and indexing tables or spindles</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Indexing Mode (zero-reference measurement)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy: 0.5 sec band +0.2% of displayed reading</td>
</tr>
<tr>
<td>Index Step Size: 1°</td>
</tr>
<tr>
<td>Range: multiple rotations or partial arcs</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Indexing Mode (Interferometer in fixture)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Lift: 15 mm (2 mm required for fixture)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Laser Measurement Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy: 0.2% of displayed reading. Accuracy can be improved to 0.5 sec by calibrating laser optics with the indexing table (55290A).</td>
</tr>
<tr>
<td>Range: ± 10°</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Setup Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Travel (using +2 mm, -1 mm machine axis, or manual from zero reference)</td>
</tr>
</tbody>
</table>

### Flatness and Way Straightness Measurement Specifications

<table>
<thead>
<tr>
<th>Flatness Measurement Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>± 0.2% of displayed value</td>
</tr>
<tr>
<td>± 0.05 arc-seconds per meter of distance traveled by the moving optic</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Flatness Measurement Resolution (per step)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Footspacing Dimension</td>
</tr>
<tr>
<td>50.8 mm (2 in)</td>
</tr>
<tr>
<td>101.6 mm (4 in)</td>
</tr>
<tr>
<td>152.4 mm (6 in)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Way Straightness Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>± 0.2% of displayed value</td>
</tr>
<tr>
<td>± 0.05 arc seconds per meter of distance traveled by the moving optics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Flatness and Way Straightness Maximum Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>15m (50 ft)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reference Plane Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>The uncertainty of a surface plate flatness measurement is bounded by two parallel planes separated by the values below:</td>
</tr>
</tbody>
</table>

\[
\text{Metric Units Mode: } 0.03 \, (M)^2 \, \mu\text{m} \\
\text{English Units Mode: } 0.12 \, (F)^2 \, \mu\text{in}
\]

where:

\[
M = \text{length of the surface diagonal in meters} \\
F = \text{length of the surface diagonal in feet}
\]

<table>
<thead>
<tr>
<th>Lateral Offset and Flatness Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>The combination of lateral offset and maximum flatness deviation must not displace the reflector more than ± 1.0 mm from the beam path in any direction.</td>
</tr>
</tbody>
</table>

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1. Values do not include effects of surface cleanliness or operator positioning repeatability.
Specifications

Straightness and Parallelism Measurement Specifications

Straightness Measurement Accuracy

Overall Accuracy = Optical Reference Accuracy + Measurement Accuracy

1. This is analogous to the traditional straightedge and indicator method of measuring straightness, where Optical Reference Accuracy corresponds to the straightedge accuracy, and Measurement Accuracy corresponds to the indicator accuracy.

Optical Reference Accuracy

Optical reference inaccuracy can be eliminated by using straightedge (mirror) reversal techniques.

Short Range Optics:

Metric units mode: \( \pm 0.15 \text{ (M)}^2 \mu m \)

English units mode: \( \pm 0.5 \text{ (F)}^2 \mu in \)

Long Range Optics:

Metric units mode: \( \pm 0.015 \text{ (M)}^2 \mu m \)

English units mode: \( \pm 0.05 \text{ (F)}^2 \mu in \)

where:

\( M \) = distance of travel of the moving optic in meters
\( F \) = distance of travel of the moving optic in feet

Straightness Measurement Range (Orthogonal to Axial Travel)

\( \pm 1.5 \text{ mm (0.060 in)} \)

Axial Separation (Travel)

(distance between the interferometer and the reflector, typical, with proper alignment, 15 - 25 °C):

Short Range Optics: 0.1 – 3m (4 – 120 in)

Long Range Optics: 1 – 30m (3 – 100 ft)

Measurement Accuracy

2. Measurement Accuracy specifications are not applicable to Timebase Straightness Measurements.

Straightness Measurement Resolution

3. Straightness Measurement Resolution specifications are not applicable to Timebase Straightness Measurements.

Squareness Measurement Accuracy

Short Range Optics:

Metric Units Mode:

\( \pm (1.0 + 0.01 \text{ M}) \text{ arc-seconds} \pm 0.01 \)

English Unit Mode:

\( \pm (1.0 + 0.03 \text{ F}) \text{ arc-seconds} \pm 0.01 \)

where:

\( \theta \) = calculated out-of-square angle in arc-seconds

\( M \) = distance of travel of the moving optic in meters

\( F \) = distance of travel of the moving optic in feet

Long Range Optics:

Metric Units Mode:

\( \pm (1.0 + 0.01 \text{ M}) \text{ arc-seconds} \pm 0.025 \)

English Units Mode:

\( \pm (1.0 + 0.003 \text{ F}) \text{ arc-seconds} \pm 0.025 \)

2. Measurement Accuracy specifications are not applicable to Timebase Straightness Measurements.

Temperature Range

Displayed Value

0 - 10 µm

0 - 40 °C

± 3.5%

± 1% ± 0.25 µm

10 - 1,500 µm

(0 - 60,000 µin)

0 - 40 °C

± 3.5%

(10 µin)

2. Measurement Accuracy specifications are not applicable to Timebase Straightness Measurements.

2. Measurement Accuracy specifications are not applicable to Timebase Straightness Measurements.

Temperature Range

Displayed Value

0 - 10 µm

0 - 40 °C

± 5%

± 2.5% ± 2.5 µm

100 - 1,500 µm

(4000 - 60,000 µin)

0 - 40 °C

± 3.5%

(100 µin)

2. Measurement Accuracy specifications are not applicable to Timebase Straightness Measurements.
## Specifications

### Environmental Compensation and A-quad-B Input

1. Compensation values may be manually entered by user via keyboard.

### E1738A Air Sensor

2. Refer to the E1738A Air Sensor Data Sheet, 5989-8456 for more specifications.

#### Wavelength of Light (WOL) in Air Compensation

The E1738A Air Sensor provides for the automatic display of pressure, temperature, relative humidity, and computed WOL.

**Operating Range**
- Temperature: 0 – 40 °C (32 – 104 °F)
- Relative Humidity: 10% – 90%
- Absolute Pressure: 70 – 110 kPa (10 – 16 psia)

**Heat Dissipation:** 2 mW typical

**Time Constant:** 5 min typical (temperature)

**Accuracy**
- Temperature: ± 0.1°C (± 0.2°F)
- Relative Humidity: ± 5%
- Absolute Pressure: ± 80 Pa (± 0.012 psi)

**Heat Dissipation:** 1 mW typical

4. 12 month calibration interval

### E1737A Material Temperature Sensor

3. Refer to the E1737A Material Sensor Data Sheet, 5989-8455 for more specifications.

#### Material Temperature Compensation

The E1737A Material Temperature Sensor provides for the automatic display of the temperature of the device under test. One to three sensors may be used.

**Operating Range**
- Temperature: 0 – 40°C (32 – 104°F)

**Material Expansion Coefficient:** range: -100.0 to +100.0 ppm per °C or °F, manually entered.

**Constant:** 60s typical

### Shared Sensor Characteristics

**Maximum Compensation Update Rate**
per 15s (combined WOL and material temperature compensation)

**Cable Lengths:**
- E1739A—5m (16 ft)
- E1739B—10m (33 ft)
- E1739C—15m (49 ft)
- E1739D—25m (82 ft)

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### A-quad-B Input

**Differential Input Threshold**
± 0.5V minimum, ± 7.0V maximum

**Differential Input Impedance**
100W

**Input Rate**
> 2 ns edge-to-edge, or < 10 MHz information rate
Example: at maximum speed, A and B both must be < 2.5 MHz.
System Component Dimension and Weights

**Keysight 5519A/B Laser Head**

- Height: 479.0 mm (18.86 in)
- Width: 360.0 mm (14.17 in)
- Depth: 168.0 mm (6.61 in)
- Net Wt: 5.5 kg (12 lb)

**Keysight 10753B Laser Tripod**

- Height: 686 mm (27 in)
- Cross-Slide radius: 92.7 mm (3.65 in)
- Net Wt: 8.0 kg (17.6 lbs)

**E1735A USB Axis Module**

- Height: 63 mm (2.5 in)
- Width: 24 mm (0.95 in)
- Depth: 102 mm (4.0 in)
- Net Wt: 0.20 kg (0.44 lb)

**E1736A USB Sensor Hub**

- Height: 63 mm (2.5 in)
- Width: 24 mm (0.95 in)
- Depth: 102 mm (4.0 in)
- Net Wt: 0.20 kg (0.44 lb)

**E1737A Material Sensor**

- Height: 45 mm (1.8 in)
- Width: 17.5 mm (0.7 in)
- Ø: 42 mm (1.7 in)
- Net Wt: 0.03 kg (0.063 lb)

**E1738A Air Sensor**

- Height: 45 mm (1.8 in)
- Width: 17.5 mm (0.7 in)
- Ø: 42 mm (1.7 in)
- Net Wt: 0.06 kg (0.125 lb)
# Optics and Accessories

## Linear Optics

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>30.0 mm (1.18 in)</td>
<td>M3 × 0.5 (4 Places)</td>
</tr>
<tr>
<td>20.0 mm (0.79 in)</td>
<td>Aperture Dia</td>
</tr>
<tr>
<td>90.0 mm (3.54 in)</td>
<td>M10 × 1.5</td>
</tr>
<tr>
<td>107.8 mm (4.24 in)</td>
<td>Captive Screw (2 Places)</td>
</tr>
</tbody>
</table>

**Keysight 10767A Linear Retroreflector**

Net Wt: 224g (0.5 lb)

## Angular Optics

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>40.0 mm (1.57 in)</td>
<td>M3 × 0.5 (24 Places)</td>
</tr>
<tr>
<td>20.0 mm (0.79 in)</td>
<td>Aperture Dia</td>
</tr>
<tr>
<td>72.6 mm (2.86 in)</td>
<td>M3 × 0.5 (19 Places)</td>
</tr>
<tr>
<td>19.0 mm (0.75 in)</td>
<td>Captive Screw (2 Places)</td>
</tr>
</tbody>
</table>

**Keysight 10770A Angular Interferometer**

Net Wt: 553g (1.3 lb)

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**Keysight 10785A Height Adjuster/Post, 10784A Base**

Dotted outline shows alternate 10767A retroreflector mounting position.

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**Keysight 10766A/10767A Interferometer Combination**

Net Wt: 5.36g (1.2 lb)

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**Keysight 10771A Angular Reflector**

Net Wt: 650g (1.5 lb)
Optics and Accessories

Flatness Accessories

Keysight 10773A Flatness Mirror
Net Wt: 661g (1.5 lb)

Keysight 10759A Foot Spacing Kit
Net Wt: 661g (1.5 lb)
## Optics and Accessories

### Straightness / Squareness Optics

#### Keysight 10772A Tuning Mirror
Net Wt: 510g (1.2 lb) w/Mount

#### Keysight 10774A Short Range Straightness Optics / 10775A Long Range Straightness Optics

#### Keysight 10776A Straightness Mount
Net Wt: 374g (0.82 lb)
Optics and Accessories

### Straightness / Squareness Optics

![Diagram of Keysight 10777A Optical Square](image)

**Keysight 10777A Optical Square**

Net Wt: 4.0 kg (8.9 lb) w/Mount

![Diagram of Keysight 10777-20007 Optical Square Base](image)

**Keysight 10777-20007 Optical Square Base**
Optics and Accessories

Straightness / Squareness Optics

from Keysight 10768A/10769A Measurement Kit

Keysight 10769B Turning Mirror
(Base Block Only)
Keysight 55290A Angular Position Measurement Kit

Rotary Indexing Table

Adapter Plate

Flanged Shaft
Learn more at: www.keysight.com

For more information on Keysight Technologies’ products, applications or services, please contact your local Keysight office. The complete list is available at: www.keysight.com/find/contactus