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

CAUTION
LASER LIGHT
DO NOT STARE INTO BEAM
MAXIMUM OUTPUT 1 mw
LASER MEDIUM helium neon
CLASS 1 LASER PRODUCT

Find us at www.keysight.com
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)

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</td>
<td>1 nm</td>
<td>± 0.7 m/s</td>
</tr>
<tr>
<td></td>
<td>(0.04 µin)</td>
<td>(± 28 in/s)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>± 1 m/s</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(± 40 in/s)</td>
</tr>
<tr>
<td>Plane Mirror Optics</td>
<td>0.5 nm</td>
<td>± 0.35 m/s</td>
</tr>
<tr>
<td></td>
<td>(0.02 µin)</td>
<td>(± 14 in/s)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>± 0.5 m/s</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(± 20 in/s)</td>
</tr>
<tr>
<td>High Resolution Plane Mirror Optics (10716A)**</td>
<td>0.25 nm</td>
<td>± 0.18 m/s</td>
</tr>
<tr>
<td></td>
<td>(0.01 µin)</td>
<td>(± 7 in/s)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>± 0.25 m/s</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(± 10 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.

Linear Distance and Diagonal Measurement Specifications

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 Accuracy

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

Velocity Measurement Accuracy

\[
\frac{2 \text{ mm/s}}{\text{Velocity}} + 0.01 \% \text{ of displayed value}
\]

Angular 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)

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
Specifications

Angular Position Measurement Specifications (55290A Rotary Axis Kit)

Measurement Type
Rotary and indexing tables or spindles

Indexing Mode (zero-reference measurement)
Accuracy: 0.5 sec band +0.2% of displayed reading
Index Step Size: 1°
Range: multiple rotations or partial arcs

Indexing Mode (interferometer in fixture)
Maximum Lift: 15 mm (2 mm required for fixture)

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

Setup Requirements
Travel (using +2 mm, −1 mm machine axis, or manual from zero reference)

Flatness and Way Straightness Measurement Specifications

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

Flatness Measurement Resolution (per step)
Footspacing Dimension Resolution
50.8 mm (2 in) 0.03 micron (1.0 µin)
101.6 mm (4 in) 0.05 micron (2.0 µin)
152.4 mm (6 in) 0.08 micron (3.0 µin)

Way Straightness Accuracy
± 0.2% of displayed value
± 0.05 arc seconds per meter of distance traveled by the moving optics

Flatness and Way Straightness Maximum Range
15m (50 ft)

Reference Plane Accuracy
The uncertainty of a surface plate flatness measurement is bounded by two parallel planes separated by the values below:

Metric Units Mode: 0.03 (M)^2 µm
English Units Mode: 0.12 (F)^2 µin

where:
M = length of the surface diagonal in meters
F = length of the surface diagonal in feet

Lateral Offset and Flatness Range
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.
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: ±0.15 (M)$^2$ µm
English units mode: ±0.5 (F)$^2$ µin

Long Range Optics:
Metric units mode: ±0.015 (M)$^2$ µm
English units mode: ±0.05 (F)$^2$ µin
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)
± 1.5 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

<table>
<thead>
<tr>
<th>Temperature Range</th>
<th>Displayed Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 10 µm</td>
<td>± 3.5%</td>
</tr>
<tr>
<td>(0 - 400 µin)</td>
<td>± 1% ± 0.25 µm</td>
</tr>
<tr>
<td>0 - 40 °C</td>
<td>(10 µin)</td>
</tr>
</tbody>
</table>

Long Range Optics:

<table>
<thead>
<tr>
<th>Temperature Range</th>
<th>Displayed Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 100 µm</td>
<td>± 5%</td>
</tr>
<tr>
<td>(0 - 4000 µin)</td>
<td>± 2.5% ± 2.5 µm</td>
</tr>
<tr>
<td>0 - 1500 µm</td>
<td>(100 µin)</td>
</tr>
</tbody>
</table>

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

Straightness Measurement Resolution

<table>
<thead>
<tr>
<th>Short Range</th>
<th>0.01 µm (0.4 µin)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long Range</td>
<td>0.1 µm (4 µin)</td>
</tr>
</tbody>
</table>

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

Squareness Measurement Accuracy

Short Range Optics:
Metric Units Mode:
± (1.0 + 0.01 M) arc-seconds ± 0.01
English Units Mode:
± (1.0 + 0.03 F) arc-seconds ± 0.01
where:
θ = 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:
± (1.0 + 0.01 M) arc-seconds ± 0.025
English Units Mode:
± (1.0 + 0.003 F) arc-seconds ± 0.025
Specifications

Environmental Compensation\(^1\) and A-quad-B Input

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

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**E1738A Air Sensor\(^2\)**

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\(^4\)**
- 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

**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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**E1737A Material Temperature Sensor\(^3\)**

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

4. 12 month calibration interval

**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**

- Net Wt: 5.5 kg (12 lb)

**Keysight 10753B Laser Tripod**

- Net Wt: 8.0 kg (17.6 lbs)

**E1735A USB Axis Module**

- Net Wt: 0.20 kg (0.44 lb)

**E1736A USB Sensor Hub**

- Net Wt: 0.20 kg (0.44 lb)

**E1737A Material Sensor**

- Net Wt: 0.03 kg (0.063 lb)

**E1738A Air Sensor**

- Net Wt: 0.06 kg (0.125 lb)
Optics and Accessories

Linear Optics

Keysight 10767A Linear Retroreflector
Net Wt: 224g (0.5 lb)

Keysight 10785A Height Adjuster/Post, 10784A Base

Dotted outline shows alternate 10767A retroreflector mounting position.

Keysight 10766A/10767A Interferometer Combination
Net Wt: 5.36g (1.2 lb)

Angular Optics

Keysight 10770A Angular Interferometer
Net Wt: 553g (1.3 lb)

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**

Net Weight: 800g (28.2 oz)
Angular Reflector

Net Weight: 164g (5.8 oz)
Straightness Interferometer

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

**Straightness / Squareness Optics**

Keysight 10777A Optical Square

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

Keysight 10777-20007 Optical Square Base

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