

Figure 5. Calibration process and causes for inaccuracy

The S380, S370 and S371R become fiberoptics power meters when coupled with the Model 260, 261 or 280 detectors.

The Model 260 silicon detector provides highly sensitive measurements in the 650-950 nanometer region, while the Model 261 germanium detector is capable of a wide range of measurements between 800 and 1800 nanometers. The Model 280 detector head is more sensitive than the Model 261, however, they are also more expensive. If you require optimum sensitivity at 850 nanometers you can use the Model 260, and reserve the Model 261 or 280 for longer wavelengths.

With the 280, the power meter handles measurements down to -85 dBm at 1300 nm and 1550 nm.

UDT Instruments silicon, germanium, and indium gallium arsenide detectors meet requirements for high responsivity, low noise, speed, long term stability, uniformity, and linearity over a wide dynamic range.

Detector Calibrations

Optical power measurement accuracy depends heavily on how you calibrate the test instrument. In the manufacturing process, our instruments are normally calibrated with a secondary standard, one that is directly derived from a primary standard of a national standards lab, such as the National Institute of Standards and Technology (NIST) in the United States. NIST calibrates the spectral responsivity of the secondary standard at 25°C and at a power level of about 10 μW.

Recalibration is often performed in the field. To obtain accurate measurements, it's very important that your lab has optical standards directly derived from the national standards lab, or that you return the instrument to UDT Instruments for periodic recalibration.

Figure 5 depicts the potential causes of inaccuracy in calibrating a power meter, and their maximum values. To NIST's inaccuracy of 1.0%, add 1.5% to account for transferring the calibration to a manufacturing standard. Then, add 0.5% for aging of the secondary standard, and 1.0% for transfer of the calibration to the power meter. Finally, to account for non-linearity of the meter, plus ambient temperature variation, add 1.2%. So, the maximum measurement inaccuracy is about 5.2% (0.22dB). However, these various causes of inaccuracy tend to offset one another. As such, a more typical value for calibration inaccuracy is the root sum squared (RSS) value—which is less than 3.0% (0.13dB) using the values in Figure 5.

UDT Instruments detectors are provided with a computer generated calibration. This calibration lists wavelength vs. absolute and relative responsivity and is programmed into the power meter for direct readout at any desired wavelength. Special calibrations of these as well as other UDT Instruments heads and accessories are available.

All UDT Instruments fiberoptics measurement equipment is traceable to the National Institute of Standards and Technology. We also provide prompt recalibration service through our NIST traceable metrology lab.

Integrating Minispheres

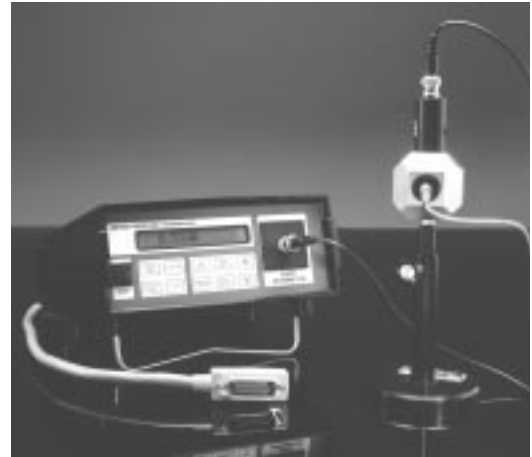
UDT Instruments' Model S2575 is a silicon photodiode/minisphere combination ideal for laser diode measurements. The S2575 reduces the error due to large beam divergence during light measurements. The diameter of the entrance port is 5 mm, which allows a direct coupling to a laser beam or fiberoptic adapter. The integrating sphere attenuates the signal thus extending the power measurement capability of the sensor. The sensitive region ranges from 1 nW to 0.5 W.

The S2575 is calibrated in mW from 360 to 1100 nm in 20-nm increments.

UDT Instruments' Model S2575GE is a germanium sensor/minisphere combination ideal for long-wavelength laser diode measurements. The S2575GE reduces imperfections due to large divergences of the measurable light.

A fiberoptic adapter can be fastened directly to the entrance port. The attenuation of the integrating sphere enables measurements of the radiation source at higher outputs.

Included with the S2575GE are two calibrations in milliwatts at 1.3 μm and 1.55 μm . The region of sensitivity extends from 1 μW to 0.5 W.

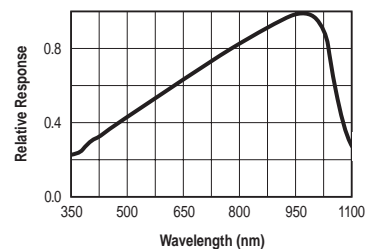


Fiberoptic Sensor Heads

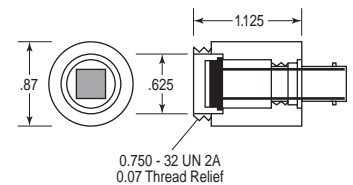
Model 260 Silicon Sensor Head

Power range (watts)	10^{-12} to 1×10^{-3} (0 to -90 dBm)
Calibration	360-1100 nm in 20 nm steps
Effective aperture	0.34 cm^2
Typical response	0.53 A/W @ 940 nm
Features	Broad spectral response

Response Chart

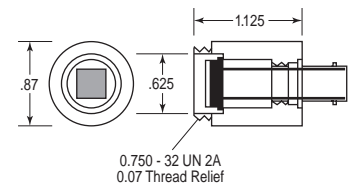
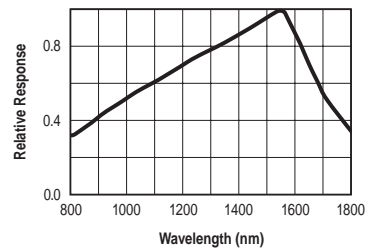


Dimensions



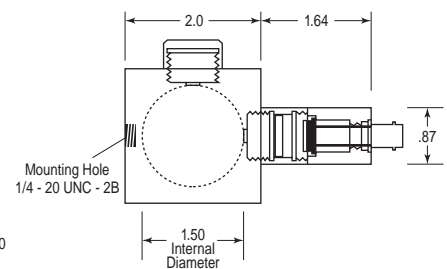
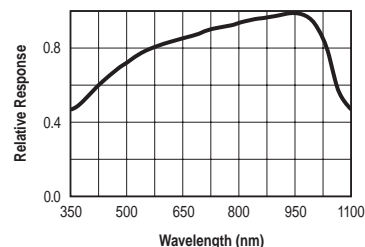
Model 261 Germanium Sensor Head

Power range (watts)	3×10^{-10} to 2×10^{-3} (+3 to -65 dBm)
Calibration	800-1800 nm in 25 nm steps
Effective aperture	0.2 cm^2
Typical response	0.7 A/W @ 1300 nm
Features	Broad spectral response



Model S2575 Silicon Sensor/Minisphere

Power range (watts)	1×10^{-9} to 0.5 (+25 to -60 dBm)
Calibration	360-1100 nm in 20 nm steps
Effective aperture	5 mm dia.
Typical response	$2.8 \times 10^{-3} \text{ A/W}$ @ 940 nm
Features	Mini integrating sphere



Fiberoptic Sensor Heads

Model S2575GE

Germanium Sensor/Minisphere

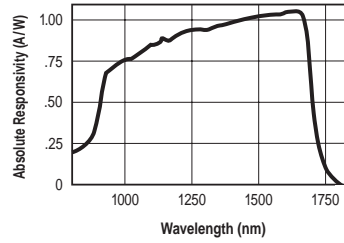
Power range (watts)	3×10^{-9} to 0.5 (+25 to -55 dBm)
Calibration	1300, 1550 nm
Effective aperture	5 mm dia.
Typical response	1.0829×10^{-3} A/W @ 1550 nm
Features	Mini integrating sphere

Model 280

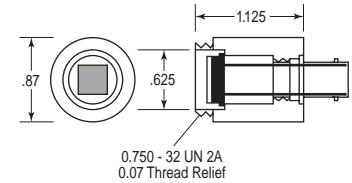
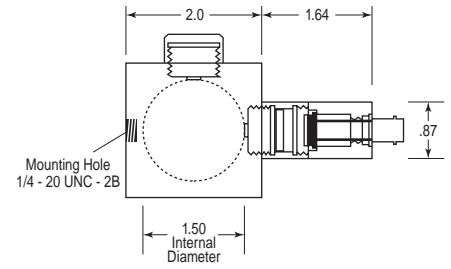
Indium Gallium Arsenide Sensor Head

Power range (watts)	10^{-12} to 2×10^{-3} (+3 to -90 dBm)
Calibration	800-1800 nm in 10 nm steps
Effective aperture	3 mm dia.
Typical response	0.8 A/W @ 1300 nm
Features	Very low noise

Response Chart



Dimensions



Sensor Detector Heads

Sensor Head Selection Guide

Model	260	261	280
Sensor	Silicon	Germanium	InGaAs
Application	General	IR Response	IR Response
Active Area (cm ²)	0.34	0.20	0.07
Range (Watts) (dBmW)	10^{-12} to 1×10^{-3} -90 to +0	320×10^{-12} to 2×10^{-3} -65 to +3	1×10^{-12} to 2×10^{-3} -90 to +3
Calibrations	360-1100 20 nm intervals	800-1800 25 nm intervals	800-1800 10 nm intervals
Calibration Accuracy	±3% (400-1100 nm)	±3%	±3%
Linearity	±0.5%	±1%	±0.5%
Responsivity (A/W)	0.55 @ 850 nm	0.7 @ 1300 nm	0.85 @ 1300 nm
Frequency Response	DC-286 kHz*	DC-1MHz**	—
Shunt Resistance	10-60 MΩ	14 kΩ	>1 MΩ
NEP (pW/1√Hz)	0.1	3.0	—
Breakdown Voltage	-5V	-5V	-2V

* At 0 Volts.

** Reversed biased into 50 ohms at 3V.

Instrument Selection Table

Instrument Model #	Detector Model #		
	260 (360-1100 nm)	261 (800-1800 nm)	280 (800-1800 nm)
S370 & S380	1 mW-1 pW 0 to -90 dBm	2 mW-320 pW +3 to -65 dBm	2 mW-1 pW +3 to -90 dBm
S371R	1 mW-10 pW 0 to 80 dBm	2 mW-320 pW +3 to -65 dBm	2 mW-10 pW +3 to -80 dBm