



## OPTICAL POWER METER WITH SMART DETECTOR HEAD

### Features

- Fast response (over 1000 readouts/s)
- Wavelengths: 440 to 900 nm for visible (VIS) and 800 to 1700 nm for infrared (IR)
- NIST traceable
- Built-in attenuator for 20 or 30 dB attenuation; automatically detects when the attenuator is engaged
- Selectable sampling rate (from 7Hz to 1800Hz)
- Optional POM-110 hand-held display unit for controlling one or two detector heads
- Analog voltage output (optional)
- Interchangeable optical receptacles
- Mounting holes on sides and bottom
- Low power consumption (<60 mA at 6 V)
- Built-in RS-232 and I<sup>2</sup>C(1) interfaces
- Selectable RS-232 baud rate (from 9600 to 115,200 bps)
- Wide dynamic range
- Can be used for free space applications

### Applications

- Automatic fiber optical alignment and collimation systems
- Multi-channel optical power measurements
- General optical power measurements such as IL measurement
- Multi-channel test set
- Network installation and maintenance

### Product Description

The Smart Detector Head incorporates the features of a full-function optical power meter (except display) in a miniature housing. This makes it ideal for applications that require multiple detectors in a small space. By using a simple RS232 interface, the device can be used alone or in parallel with other devices to measure or monitor optical power.

The Smart Detector Head has a fast response speed, wide dynamic range, and an optional analog output, making it well suited to a variety of applications. Using very simple commands, the Smart Detector Head can easily be adapted to custom requirements, such as optical alignment and collimation systems.

The Smart Detector Head can provide readings in any convenient format including watts, dBm, dB, or relative (P/Pref). More than one Smart Detector Head can be connected to a computer, with the number of units being limited only by the number of available serial ports. Multiple units can also be configured using I<sup>2</sup>C(1) interface. When used with a PC, a power supply provides power to the Smart Detector Head via an adaptor cable, which also connects the PC to the Smart Detector Head.

The Smart Detector Head has a manually activated built-in selectable attenuator that can be inserted into the light path without disturbing the rest of the setup. The Smart Detector Head automatically senses the presence of the attenuator and corrects the light measurements accordingly.

The Smart Detector Head can report the date of calibration, along with the serial number of the unit. Configuration information, including wavelength, reference power, and the units of measurement, is retained in internal, non-volatile memory when the unit is turned off.

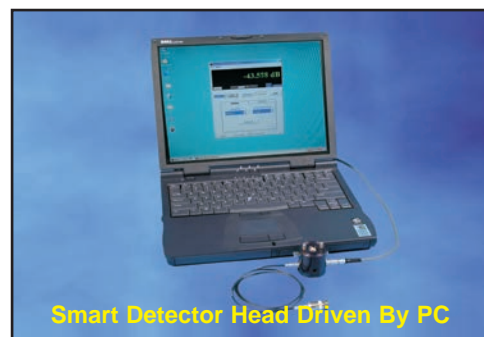
The Smart Detector Head can accommodate a variety of standard, interchangeable screw-in receptacles.



Smart Detector Head Optical Power Meter And Interchangeable Receptacles



Smart Detector Head Driven By Hand-Held Unit



Smart Detector Head Driven By PC



Smart Detector Head With Special Options Attachment

For cost-sensitive singlemode applications, operating at IR power levels below +10 dBm, the Smart Detector Head is also available without a built-in attenuator. With this design, the end of the fiber is brought closer to the detector, allowing a smaller detector to be used. This results in a significant cost saving to the purchaser.

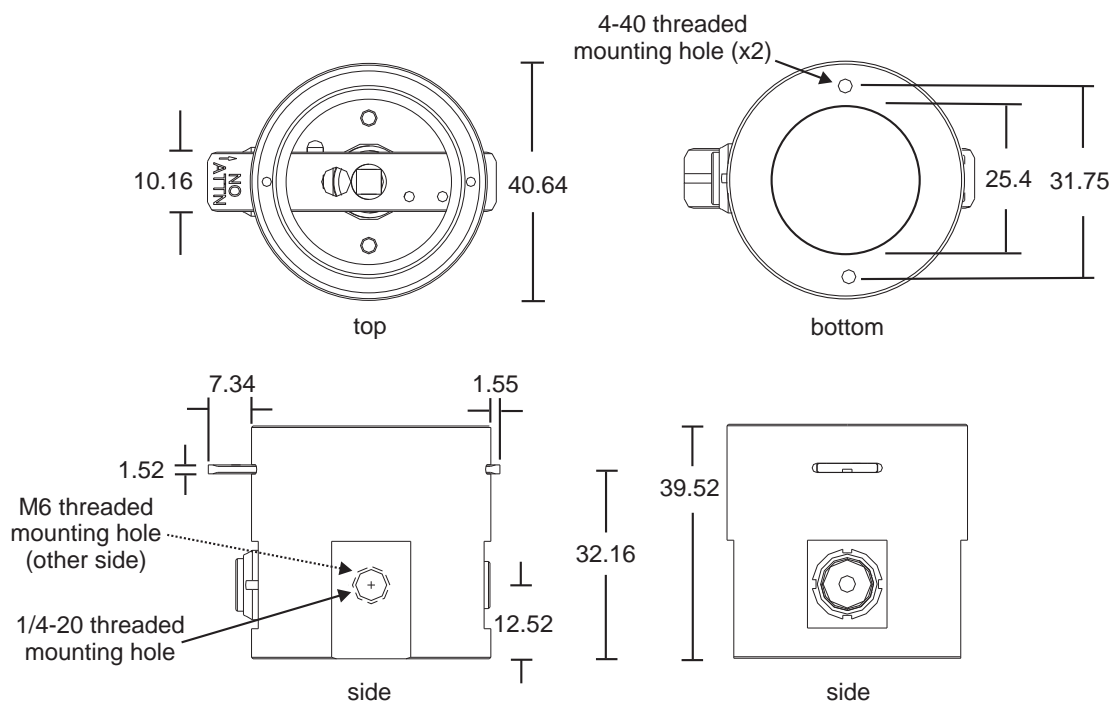
Custom optical accessories can also be provided which can directly attach to the front of the Smart Detector Head, as shown in one of the photographs on the previous page. This can include such things as high-power attenuators, optical filters, integrating spheres, or other optical components. Contact OZ Optics with your specific requirements.

The hand-held display unit (part number POM-110) can be used with the Smart Detector Head as a conventional stand alone

power meter. Using the keypad, the operator can configure the sampling rate, wavelength, format and baud rate of the readings. Two Smart Detector Heads can be used to create a dual power meter, where readings from both heads are displayed on the LCD simultaneously. The Smart Detector Heads can be connected or disconnected without turning off the hand-held unit.

The POM-110 is powered via a universal AC to DC power supply. The POM-110-B has the features of a POM-110 plus a built-in rechargeable battery pack. The POM-110 has a USB port which allows the device to be controlled via a host computer. An external RS232 to GPIB converter is also available as an optional accessory.

(1) I<sup>2</sup>C is a copyright of Koninklijke Philips N.V.



**Smart Detector Head Dimensions**

## Standard Parts

Bar Code	Part Number	Description
<b>Smart Detector Heads</b>		
12492	SDH-IR-ND=20	Smart Detector Head Optical Power Meter for infrared wavelength 800 to 1700 nm, -75 to 10 dBm measurement range without attenuator. Standard built-in 20 dB attenuator switch for up to 23 dBm measurement. Receptacle not included.
13601	SDH-IR-A-ND=20	Smart Detector Head Optical Power Meter with analog output for infrared wavelength 800 to 1700 nm, -75 to 10 dBm measurement range without attenuator. Standard built-in 20 dB attenuator switch for up to 23 dBm measurement. Receptacle not included.
13408	SDH-IR-ND=30	Smart Detector Head Optical Power Meter for infrared wavelength 800 to 1700 nm, -75 to 10 dBm measurement range without attenuator. Standard built-in 30 dB attenuator switch for high power measurement. Receptacle not included.
23372	SDH-IR-NF	Smart Detector Head Optical Power Meter for infrared wavelengths from 800 to 1700 nm, -75 to 10 dBm measurement range. No attenuator. Receptacle not included.
12493	SDH-VIS-ND=20	Smart Detector Head Optical Power Meter for visible wavelength 440 to 900 nm, -65 to 10 dBm measurement range without attenuator. Standard built-in 20 dB attenuator switch for up to 23 dBm measurement. Receptacle not included.
20776	SDH-VIS-A-ND=20	Smart Detector Head Optical Power Meter with analog output for visible wavelength 440 to 900 nm, -65 to 10 dBm measurement range without attenuator. Standard built-in 20 dB attenuator switch for up to 23 dBm measurement. Receptacle not included.
25422	SDH-VIS-ND=30	Smart Detector Head Optical Power Meter for visible wavelength 440 to 900 nm, -65 to 10 dBm measurement range without attenuator. Standard built-in 30 dB attenuator switch for high power measurement. Receptacle not included.
<b>Complete measurement kits</b>		
21298	SDH-KIT-IR-20-3A	Smart Detector Head Optical Power Meter Kit for direct PC control. The kit includes the following. (1) a Smart Detector Head for infrared wavelengths from 800 to 1700 nm, -75 to 10 dBm measurement range without attenuator. Standard built-in 20 dB attenuator switch for up to 23 dBm measurement; (2) a FC/APC receptacle, (3) a standard serial interface cable, (4) a DB-9 adaptor, (5) an AC/DC power supply adaptor and (6) a CD-ROM software package.
22330	SDH-KIT-IR-20-3	Smart Detector Head Optical Power Meter Kit for direct PC control. The kit includes the following. (1) a Smart Detector Head for infrared wavelengths from 800 to 1700 nm, -75 to 10 dBm measurement range without attenuator. Standard built-in 20 dB attenuator switch for up to 23 dBm measurement; (2) a FC/PC receptacle, (3) a standard serial interface cable, (4) a DB-9 adaptor, (5) an AC/DC power supply adaptor and (6) a CD-ROM software package.
20939	POM-KIT-IR-20-3	Optical Power Meter Kit. The kit includes the following: (1) POM-110 hand held display unit, (2) Universal power supply, (3) Smart Detector Head, for infrared wavelengths from 800 to 1700 nm, -75 to 10 dBm measurement range without attenuator, standard built-in 20 dB attenuator switch for up to 23 dBm measurement, (4) FC/PC receptacle, (5) interface cable and (6) software package.
<b>Fiber Optic Connector Adapters</b>		
12680	SDHR-2.5U	Universal receptacle for 2.5 mm ferrules for Smart Detector Head.
12675	SDHR-3	Standard flat, super, or ultra NTT-FC/PC receptacle for Smart Detector Head.
12676	SDHR-3A	Angled FC/APC receptacle for Smart Detector Head.
12679	SDHR-8	AT&T-ST receptacle for Smart Detector Head.
12677	SDHR-SC	SC receptacle for Smart Detector Head.
12678	SDHR-SCA	Angled SC receptacle for Smart Detector Head.
<b>Accessories</b>		
11458	SDHA-CAB	Standard serial interface cable, connects the Smart Detector Head to the display unit, or PC with the optional DB-9 adaptor.
12580	SDHA-DB9	DB-9 adaptor connects the serial interface cable, a DB-9 COM port on a PC, and has a power jack for the AC/DC power adaptor.
13168	AC-6VDC-MULTIPLUG-Z	Universal AC/DC adaptor, with power cord, connects to DB-9 adaptor to power the SDH.
13606	SDHA-CAX	Coaxial interface cable connects to the analog socket on the SDH, with a male BNC connector on the other end of the cable for analog output.
12886	SDHA-CDR	Smart Detector Head software package (one CD-ROM included with Smart Detector Head).
12681	POM-110	Optical Power Meter hand-held display unit. AC powered only. Universal power supply included.
15942	POM-110-B	Optical Power Meter hand-held display unit with rechargeable battery pack. Universal power supply included.

Note: This is only a partial list of our standard parts.

more...

## Ordering Examples for Standard Parts:

1. A European customer requires a hand-held meter to measure IR optical power with an FC/PC receptacle without lens. Power measurement is in the range of -75 to +20 dBm. The hand-held unit must have the ability to be controlled with a PC through a USB interface.

Bar Code	Part Number	Description
12492	SDH-IR-ND=20	Smart Detector Head Optical Power Meter for IR wavelength, with standard built-in 20 dB attenuator switch.
12675	SDHR-3	Standard flat, super, or ultra NTT-FC/PC receptacle without lens for Smart Detector Head.
12681	POM-110	Optical Power Meter hand-held display unit.

Alternatively, the customer may order the above items as a kit:

Bar Code	Part Number	Description
20939	POM-KIT-IR-20-3	Optical Power Meter Kit. The kit includes the following: (1) POM-110 hand held display unit, (2) Universal power supply, (3) Smart Detector Head, for infrared wavelengths from 800 to 1700 nm, -75 to 10 dBm measurement range without attenuator, standard built-in 20 dB attenuator switch for up to 23 dBm measurement, (4) FC/PC receptacle, (5) interface cable and (6) software package.

## Questionnaire:

1. What is your application?
2. What is the wavelength range?
3. What is the optical power level range?
4. What type of optical connector is required?
5. How many channels (optical power measurement) do you need?
6. Do you want a handheld display unit or just PC control and display?
7. Do you want a battery pack for the handheld unit?
8. Is this power meter part of your auto control/test system?
9. Is analog output useful for you?

## Standard Product Specifications:

Parameter		Specification	
Measurement range <sup>1</sup>		Without Attenuator	With Standard 20 dB Attenuator
IR		-75 to +10 dBm	Up to 23 dBm at 1480 nm
VIS		-65 to +10 dBm	Up to 30 dBm at 635 nm
Wavelength range	IR	800 to 1700 nm with IR detector	
	VIS	440 to 900 nm with VIS detector	
Resolution		0.01 dB	
Accuracy at 23°C <sup>2</sup>		±5%	
Linearity <sup>3</sup>		±0.03 dB ( ±0.4% ) ( 0 to -60 dBm) (typical)	
Measurement units		Watts, dBm, dB, relative (P/PREF)	
Available optical connector receptacles		<ul style="list-style-type: none"> <li>• Universal receptacle for 2.5 mm diameter ferrules</li> <li>• Standard receptacles: standard flat, super, or ultra NTT-FC/PC; angled NTT-FC/PC; AT&amp;T-ST; SC; or angled SC, LC, MU</li> </ul>	
Sampling rate		7, 14, 28, 56, 113, 225, 450, 900, or 1800 Hz (user selectable)	
Maximum data read-out speed		1040 read-outs/s at 115 kbps, using RS-232 in fast data mode	
Dimensions (H x D)		39.52 x 40.64 mm (1.556 x 1.60 in), without optical receptacle	
Weight		70 g (0.15 lb.) without optical receptacle 90 g (0.20 lb.) with standard flat, super, or ultra NTT FC/PC receptacle	
Communications interface		RS-232 serial port and I <sup>2</sup> C	
Baud rate (using RS-232)		9600, 19200, 38400, 56700, or 115200 bps	
Maximum I <sup>2</sup> C bit rate		400 kbps	
Analog output (optional) <sup>4</sup>	Output voltage responsivity <sup>5</sup> (typical)	IR: 190 mV per mW at peak responsivity VIS: 130 mV per mW at peak responsivity	
	Offset voltage	500 µV (maximum), 60 µV (typical)	
	Output impedance	1 KΩ	
	Dynamic range <sup>6</sup>	-45 to +10 dBm	
Power supply		+5.5 to +13V DC for SDH; Universal 110/220V AC to 12V DC adaptor for POM-110, or optional rechargeable battery pack.	
Current requirements	Normal	<60 mA at 6V	
	Sleep mode	<25 mA	
Temperature range	Operating	-10 to +55 °C (14 to 131°F); humidity: <70% RH	
	Storage	-30 to +70 °C (-22 to 158°F); humidity: <95% RH	

### Notes:

- 1) Maximum measurement range is dependent on wavelength, which is related to the responsivity of the detector and neutral density filter. Please consult OZ Optics for high power measurement. Calibration to levels below -75 dBm is also available for IR.
- 2) At calibrated wavelengths, without attenuator, at 7 samples/s, with single mode fiber and FC/PC receptacle.
- 3) Measured at 23°C with 1550 nm wavelength, using FC/PC receptacle and singlemode fiber.
- 4) Tested at 23°C. Power supply voltage = 6 V.
- 5) The output voltage is a function of optical power and depends on the responsivity of the photodetector, which varies with the wavelength of the light. For infrared detectors, the peak responsivity occurs at around 1550 nm, and the output voltage is approximately 190 mV per mW. For visible detectors, the peak responsivity occurs around 950 nm, at which point the output voltage is approximately 130 mV per mW. At all other wavelengths, the output voltage per milliwatt of optical power will be less.
- 6) The conversion of optical power to output voltage is performed with a fixed ratio of voltage to photodetector current. For digitized measurements, several gain settings allow a wider overall dynamic range to be achieved for the reported readings.

## Ordering Information for Custom Parts:

### Smart Detector Head:

**SDH-W-Z**

**W** = Wavelength: IR = 800 to 1700 nm  
VIS = 440 to 900 nm

**Z** = Other options: **-ND=20** = Standard version with 20 dB attenuator  
**-ND=30** = High power version with 30 dB attenuator  
**-A-ND=20** = Standard version with 20 dB attenuator and analog voltage output  
**-A-ND=30** = High power version with 30 dB attenuator and analog voltage output  
**-NF** = without attenuator filter

### Optical connector receptacle:

**X** = Receptacle code:  
2.5U = Universal receptacle for 2.5 mm diameter ferrules  
3 = Standard flat, super, or ultra NTT-FC/PC  
3A = Angled NTT-FC/PC  
8 = AT&T-ST  
SC = SC  
SCA = Angled SC

**SDHR-X**

## Frequently Asked Questions (FAQs)

**Q:** Is the hand-held display unit POM-110 necessary for operating the Smart Detector Heads?

**A:** No. The Smart Detector Heads can be driven by a PC.

**Q:** Is analog output a standard feature?

**A:** No. It is an option.

**Q:** I need to format the measurement data into a report. How can I do this?

**A:** Remote control of the Smart Detector Head via a computer allows direct output of the readings to a text file. The data can then be imported into a spreadsheet program to draft the report.

## Application Notes

The Smart Detector Head provides optical power measurements with high resolution, high speed, and wide dynamic range. The SDH features high optical power measurement, programmable sampling rate, optional analog voltage output, and low power consumption. Several units can be used simultaneously to create a multi-channel measurement system.

A PC can be used as a virtual instrument, to make the SDH a reliable, flexible, and effective device for automatic fiber optical alignment and collimation, fiber optic assembling and testing, quality control and measurement, network installation, component and system troubleshooting, and general optical power measurement applications.

### Automatic fiber optical alignment

In the manufacture of fiber optic components, it is often necessary to attach an optical fiber to a semiconductor device such as a laser diode, a semiconductor optical amplifier, an optical switch, or any of the other numerous types of opto-electronic devices. Coupling the light into the optical fiber is a very real problem in these applications. When the alignment tolerances are very tight, typically in the sub  $\mu\text{m}$  regime, auto alignment systems are required to achieve maximum coupling efficiency, and a power meter is needed to measure the optical power level.

OZ Optics' Smart Detector Head can communicate with a computer control system through an RS-232 or I<sup>2</sup>C interface.

Optionally, a USB to RS-232 interface may be used. The high-speed sampling rate, of up to 1800 Hz, high resolution of 0.01 dB, high dynamic range of 85 dB, and analog voltage signal output make the SDH a good choice for rapid and accurate alignment.

### High-power measurement

Except for preamplifiers, which are designed to generate a few mW at most, all optical amplifiers generate power levels that exceed the measurement range of conventional power meters. Today, the highest powers from EDFA exceed 1 W. When the output power is a key parameter, the question is: How can such large power levels be measured with good accuracy and good reliability?

The SDH attenuator provides an easy-to-use solution for high-power measurement. Attenuation between the fiber end and the photodetector can reduce the measured power level to within the specified measurement range of the power meter.

The built-in attenuator switch allows manual selection of no attenuation or attenuation of 20 dB (standard) or 30 dB (high power). The SDH detects whether the attenuator is active or not, and corrects the readout accordingly.

Always estimate the optical power level before applying optical power to the SDH. To guarantee that the measured power level does not exceed the measurement range of the power meter, always engage the attenuator before connecting the power meter.

When high power levels must be measured, the signals must be attenuated so that the optical detector is not saturated. Within the high power version of the SDH, a high loss attenuator is used for this purpose, but high power attenuators have several intrinsic problems that limit their accuracy:

- 1) Their attenuation tends to change with wavelength.
- 2) They tend to degrade over time when exposed to high optical power levels.
- 3) Any time that additional optics are included in the light path, there will always be unwanted reflections that may affect the stability of the readings.
- 4) As with most components, changes in temperature may limit the accuracy that can be achieved.

OZ Optics has strived to minimize the influence of these factors by proper mechanical design and by selecting high quality components. The calibration process takes into account the variation of attenuation with wavelength. Nonetheless, the laws of physics set constraints on the overall accuracy that can be achieved, for practical applications.

### **High Power Measurement using an Integrating Sphere**

For measuring relative power levels above the normal limits of the SDH, OZ Optics can provide an integrating sphere, which can screw directly onto a Smart Detector Head. Such an arrangement is shown in a photograph on the first page of this data sheet, as a special options attachment. This arrangement allows power levels up to 5 watts to be measured. Typically, the optical power reaching the detector would be reduced by a factor of 1000 by the integrating sphere. One must remember that the optical power will be dissipated as heat. The attachment may become quite warm. Convection currents in the surrounding air will be sufficient for cooling the attachment in most applications.

The integrating sphere is best suited for applications where relative power is to be measured. If absolute measurements are required, then it would be best to have OZ Optics calibrate the SDH with the integrating sphere attached.

### **Using a PC as a virtual instrument**

OZ Optics' Smart Detector Head can be used with or without a display unit. In the latter case, it can communicate with a personal computer directly through an optional RS-232 interface and power supply adaptor. Windows application software allows the PC to function as a virtual instrument.

### **Multi-channel optical power measurement**

The Smart Detector Head can be connected directly to an RS-232 serial port of a computer. Any number of detector heads can be controlled by a PC, limited only by the number of available serial ports, which can be increased by using a USB to RS-232 converter, assuming the PC has a USB port.

The SDH can be used with customer-designed I<sup>2</sup>C interface control. A Smart Detector Head, or multiple devices, can be connected to the I<sup>2</sup>C interface control device. Depending on requirements and applications, the interface control can be developed with up to 127 SDH units.

Since the Smart Detector Heads are interchangeable, it is possible to mix visible and infrared heads in the same system. When two heads are used with a POM-110, they may be of different types, covering different wavelengths and power ranges.

Contact OZ Optics for complete details.

### **Free Space Applications**

By removing the fiber optic receptacle from the SDH, it may be used for free-space applications. Best performance is obtained when the beam of light covers approximately 50 to 80% of the detector area. This will minimize the chances of errors being caused by microscopic defects in the detector surface, while at the same time allowing all of the light to be captured. It is preferable to make free-space measurements without using the attenuator, since this will minimize the number of optical surfaces that may interfere with the measurements.