

MIKRON PHOTRIX SERIES

Ultra accurate, digital, and precise infrared thermometers with unmatched low temperature capability. Various temperature ranges between 30 to 2600°C (86 to 4712°F).



The Mikron® PhotriX™ series of infrared thermometers offers best-in-class radiation pyrometry in a robust and flexible package designed for ease of integration. The system can be used as a single channel measurement device or multiple units can be networked together using a multi-channel interface module. These pyrometers use short wavelength, narrow bandwidth detectors that minimize the effect of emissivity errors and improve accuracy of the measurements. They also offer ambient temperature compensation to combat drift for unmatched long-term stability and reproducibility for long process cycle applications like crystal growth and for repeatable results.

PRODUCT HIGHLIGHTS

- Lowest temperature capability short wavelength pyrometer
- Five spectral response options
- Configurable collection optics (lens, lightpipe, and/or fiber optics)
- Precision optics with spot size as small as 0.5 mm
- High speed (1 ms)

TYPICAL APPLICATIONS

- Low emissivity metals
- Aluminum
- Thin-film CIGS solar deposition
- Thin-film amorphous silicon deposition
- Laser heating processes
- CZ crystal growth
- Optical fiber drawing
- Induction heating

AT A GLANCE

Temperature Ranges

Various ranges between 30 and 2600°C (86 to 4712°F)

Spectral Ranges

0.65 μm
0.88 μm
0.9 μm
1.55 μm
0.7 to 1.65 μm

Measurement Uncertainty

$\pm 1.5^\circ\text{C}$ or 0.15% oR

Repeatability

0.1°C

Optics

Configurable collection optics:
Fixed optics, lightpipe, or fiber optics with fixed optics or lightpipe

Field of View

Optics or lightpipes adapted to customer request (min 0.5 mm)

TECHNICAL DATA

Specifications

Temperature Range	See configuration tables
Accuracy	±1.5°C or 0.15% of reading
Precision	0.01°C, wavelength, speed and temperature dependent
Drift	0.15°C per year
Ambient Temperature	10 to 60°C (50 to 140°F)
Weight	Lightpipe: 310 g (~0.68 lb)
	Lens: 500 g (~1.10 lb)
Output	RS232 (standard), Modbus protocol supported, Analog Output (optional)
Power	110/220 VAC, 50 Hz and 60 Hz (also accepts 10 to 30 VDC)
Response Time	User adjustable up to 1 ms

Scope of Delivery

- Pyrometer and collection optics with user manual
- DIN-rail mount Communications Interface Module (CIM)
- Electrical cable (4 m) to connect instrument to CIM
- RS232 cable (3 m) to connect CIM to PC
- Power supply (standard system includes a universal AC/DC power supply, but CIM can be powered directly with 12 VDC) and North American line cord
- PC software included

Communication Options

- Analog: 4 to 20 mA or 0 to 10 V
- Serial: RS232 or RS422
- PC based GUI software
- Modbus
- Easy to use with LabView
- Ethernet with optional MCI module

WAVELENGTHS

The PhotriX system is available in five different spectral response ranges. Four of these ranges offer narrow spectral bandpass. Choosing the shortest wavelength possible for an application offers the following benefits:

- Better sensitivity with smaller measurement errors due to emissivity uncertainty
- Enables use of fiber optics in collection optics path
- Ability to measure silicon and other semiconductor materials that are transparent at longer wavelengths

Spectral Sensitivity		Temperature Range				Typical Applications
Code	Spectral Response	Celsius		Fahrenheit		
		Min ¹	Max ¹	Min ¹	Max ¹	
/065	0.65 µm	400	2600	752	4712	High temperature metals, solar, SiC
/088	0.88 µm	220	2600	428	4712	Compound semiconductor
/090	0.9 µm	210	2600	410	4712	Semiconductor, silicon
/155	1.55 µm	70	2600	158	4712	Metal and ceramic processes requiring highest accuracy/precision
Standard	0.7 to 1.65 µm	30	2400	86	4352	Low temperature metals, ceramics, and metal oxide processes

¹ Temperature range is configured at factory. Higher temperatures can be special ordered up to 4000°C.

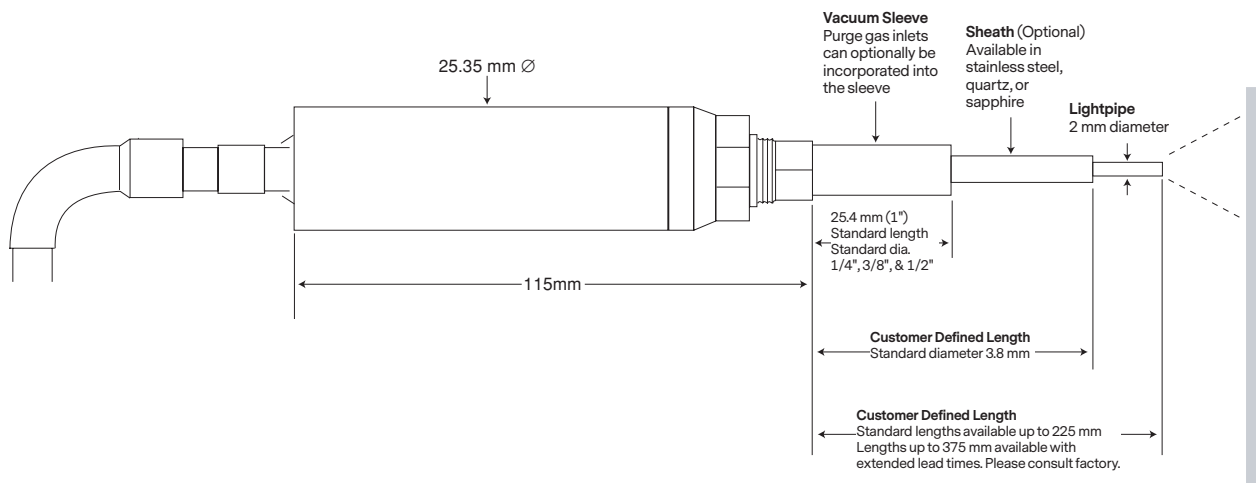
KEY FEATURES

By using both short and narrowband wavelengths, the PhotriX series of pyrometers allows Advanced Energy to push the accuracy of infrared thermometry to the natural limits. The accuracy improvement can be more than an order of magnitude moving from 8 to 14 μm to 0.9 μm (900 nm) measurement wavelengths. Further, the Photrix series' unmatched signal-to-noise ratio (SNR) allows the measurement of significantly lower temperatures compared to other commercially available sensors using the same short wavelengths.

PRODUCT SCHEMATIC

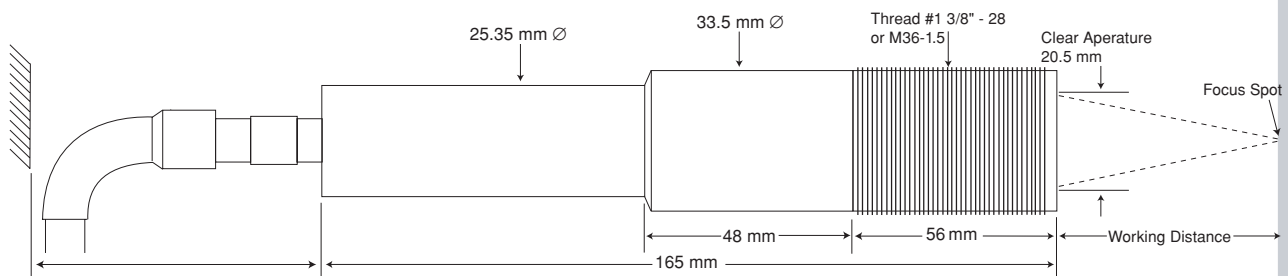
PhotriX Lightpipe Version

- Tip of lightpipe positioned close to target
- Stainless steel sleeve is used for mounting in vacuum / pressure fittings
- Sheaths of stainless steel, quartz, or sapphire are optional
- Purging gas can be used to protect against deposition onto the lightpipe optics



PhotriX Fixed Focus Lens Version

- Custom spot sizes and working distances available per OEM requirements
- Sensor mounted using integrated threads on body (English or metric threads)



65 mm Clearance Required for Straight Connector (shown).
Optional right angle connector requires 32 mm for clearance.

OPTICS

The optics capture the thermal radiation from the measurement target and deliver it to the detector. The PhotriX series collection optics can be configured in four distinct forms to better suit an application's requirements.

1 - Integrated Lens

For viewing a small spot on a target from a distance, through windows, or through viewports. Spot sizes as small as 0.5 mm with measurements as low as 65°C (0.7 to 1.65 μm) and 270°C (0.9 μm). Standard working distance between 50 and 200 mm that are factory focused to minimize spot size.

2 - Direct Lightpipe

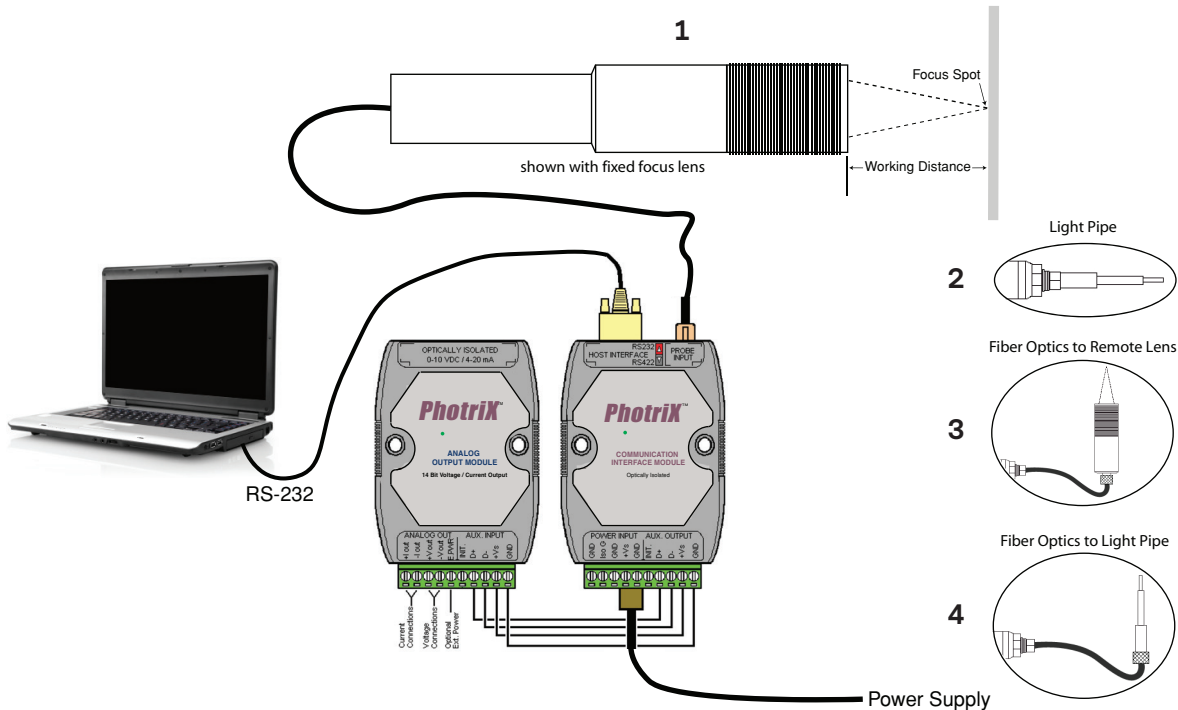
The lightpipe is an optical rod constructed of a single crystal sapphire and designed for direct insertion into process chambers through standard vacuum fittings. Lightpipes can be factory bent, inserted through small holes or vacuum fittings, and can survive harsh temperature and pressure environments. Measurements as low as 30°C (0.7 to 1.65 μm) and 210°C (0.9 μm).

3 - Fiber Optics to Lens

For applications with high ambient temperatures or flammable/combustible hazards. The fiber optics allow the electronics to be safely located separate from measurement area. If mechanical space is limited near the measurement area, then fiber optics can offer more flexible integration and mounting options. Measurements as low as 65°C (0.7 to 1.65 μm) and 270°C (0.9 μm).

4 - Fiber Optics to Lightpipe

Similar to Fiber Optics to Lens, this configuration is also considered for applications with high ambient temperatures or flammable/combustible hazards. The use of a lightpipe is usually in conjunction with a process chamber or reactor. Measurements as low as 60°C (0.7 to 1.65 μm) and 240°C (0.9 μm).



ORDERING INFORMATION

PhotriX Integrated Lens Configuration: Temperature Ranges

Configuration Part Number	Spectral Response	Collection Optics	Mounting Threads	Spot Size Chart Column	Temperature Range			
					Min (°C)	Max (°C)	Min (°F)	Max (°F)
ML-GAPX-XXX-M	0.7 to 1.65 μm	Lens, XXX working distance	M36-15	A	65	1000	149	1832
ML-GAPX-XXX-E	0.7 to 1.65 μm	Lens, XXX working distance	1-3/8" -28	A	65	1000	149	1832
ML-GAPX-HXXX-M	0.7 to 1.65 μm	Lens, XXX working distance	M36-15	B	135	2400	275	4352
ML-GAPX-HXXX-E	0.7 to 1.65 μm	Lens, XXX working distance	1-3/8" -28	B	135	2400	275	4352
ML-AAPX/088-XXX-M	0.88 μm	Lens, XXX working distance	M36-15	C	280	2150	536	3902
ML-AAPX/088-XXX-E	0.88 μm	Lens, XXX working distance	1-3/8" -28	C	280	2150	536	3902
ML-AAPX/090-XXX-M	0.9 μm	Lens, XXX working distance	M36-15	C	270	2150	518	3902
ML-AAPX/090-XXX-E	0.9 μm	Lens, XXX working distance	1-3/8" -28	C	270	2150	518	3902
ML-GAPX/155-XXX-M	1.55 μm	Lens, XXX working distance	M36-15	D	125	2600	257	4712
ML-GAPX/155-XXX-E	1.55 μm	Lens, XXX working distance	1-3/8" -28	D	125	2600	257	4712
ML-AAPX/088-HXXX-M	0.88 μm	Lens, XXX working distance	M36-15	E	310	2600	590	4712
ML-AAPX/088-HXXX-E	0.88 μm	Lens, XXX working distance	1-3/8" -28	E	310	2600	590	4712
ML-AAPX/090-HXXX-M	0.9 μm	Lens, XXX working distance	M36-15	E	300	2600	572	4712
ML-AAPX/090-HXXX-E	0.9 μm	Lens, XXX working distance	1-3/8" -28	E	300	2600	572	4712
ML-GAPX/155-HXXX-M	1.55 μm	Lens, XXX working distance	M36-15	F	180	2600	356	4712
ML-GAPX/155-HXXX-E	1.55 μm	Lens, XXX working distance	1-3/8" -28	F	180	2600	356	4712

PhotriX Integrated Lens Configuration: Spot Sizes

Working Distance		A		B		C		D		E		F	
mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
50	2.0	1.5	0.06	0.5	0.02	1.5	0.06	1.5	0.06	0.7	0.03	0.5	0.02
75	3.0	2.0	0.08	0.8	0.03	2.0	0.08	2.0	0.08	0.9	0.04	0.8	0.03
100	3.9	2.5	0.10	1.0	0.04	2.5	0.10	2.5	0.10	1.3	0.05	1.0	0.04
150	5.9	4.0	0.16	1.3	0.05	3.5	0.14	3.5	0.14	1.8	0.07	1.3	0.05
200	7.9	5.0	0.20	1.5	0.06	4.5	0.18	4.5	0.18	2.3	0.09	1.5	0.06
250	9.8	6.0	0.24	1.8	0.07	5.5	0.22	5.5	0.22	2.8	0.11	1.8	0.07
300	11.8	7.5	0.30	2.0	0.08	7	0.28	7	0.28	3.5	0.14	2.0	0.08
500	19.7	12	0.47	3.5	0.14	11	0.43	11	0.43	5.5	0.22	3.5	0.14
750	29.5	17	0.67	4.5	0.18	16	0.63	16	0.63	8	0.32	4.5	0.18
1000	39.4	24	0.95	5.5	0.22	22	0.87	22	0.87	11	0.43	5.5	0.22
2000	78.7	47	1.85	11	0.43	44	1.73	44	1.73	22	0.87	11	0.43

Ordering Information

Specify lens working distance, XXX, in mm

Available Options

- Custom spot sizes
- Custom field of views

ORDERING INFORMATION CONTINUED

PhotriX Direct Lightpipe Configuration¹

Configuration Part Number	Spectral Response	Description of 2 mm diameter Lightpipe Collection Optics ²	Temperature Range			
			Min (°C)	Max (°C)	Min (°F)	Max (°F)
ML-GAPX-LP2-XXX	0.7 to 1.65 μm	XXX mm length	30	670	86	1238
ML-GAPX-LP2-XXX-SS-YYY	0.7 to 1.65 μm	XXX mm length, with sapphire sheath YYY mm length	30	670	86	1238
ML-GAPX-LP2-XXX-SQ-YYY	0.7 to 1.65 μm	XXX mm length, with quartz sheath YYY mm length	30	670	86	1238
ML-AAPX/088-LP2-XXX	0.88 μm	XXX mm length	220	1300	428	2372
ML-AAPX/088-LP2-XXX-SS-YYY	0.88 μm	XXX mm length, with sapphire sheath YYY mm length	220	1300	428	2372
ML-AAPX/088-LP2-XXX-SQ-YYY	0.88 μm	XXX mm length, with quartz sheath YYY mm length	220	1300	428	2372
ML-AAPX/090-LP2-XXX	0.9 μm	XXX mm length	210	1300	410	2372
ML-AAPX/090-LP2-XXX-SS-YYY	0.9 μm	XXX mm length, with sapphire sheath YYY mm length	210	1300	410	2372
ML-AAPX/090-LP2-XXX-SQ-YYY	0.9 μm	XXX mm length, with quartz sheath YYY mm length	210	1300	410	2372
ML-GAPX/155-LP2-XXX	1.55 μm	XXX mm length	70	1100	158	2012
ML-GAPX/155-LP2-XXX-SS-YYY-Y	1.55 μm	XXX mm length, with sapphire sheath YYY mm length	70	1100	158	2012
ML-GAPX/155-LP2-XXX-SQ-YYY	1.55 μm	XXX mm length, with quartz sheath YYY mm length	70	1100	158	2012

¹ Directly connected lightpipes have a ~120° viewing angle

Ordering Information

- Specify length of lightpipe, XXX, in mm
- Specify length of optional sheath, YYY, in mm

Options

- Bent lightpipe tip
- Custom lightpipe and sheath diameters
- Purging gas vacuum sleeves

PhotriX Integrated Lightpipe Configuration¹

Configuration Part Number	Spectral Response	Description of 2 mm diameter Lightpipe Collection Optics ²	Temperature Range			
			Min (°C)	Max (°C)	Min (°F)	Max (°F)
ML-GAPX-LO-SZ-LP2-XXX	0.7 to 1.65 μm	XXX mm length, Z m fiber optic cable with 200 μm core	100	1400	212	2552
ML-GAPX-LO-MZ-LP2-XXX	0.7 to 1.65 μm	XXX mm length, Z m fiber optic cable with 600 μm core	65	950	149	1742
ML-GAPX-LO-LZ-LP2-XXX	0.7 to 1.65 μm	XXX mm length, Z m fiber optic cable with 1000 μm core	60	900	140	1652
ML-AAPX/088-LO-SZ-LP2-XXX	0.88 μm	XXX mm length, Z m fiber optic cable with 200 μm core	300	2600	572	4712
ML-AAPX/088-LO-MZ-LP2-XXX	0.88 μm	XXX mm length, Z m fiber optic cable with 600 μm core	265	1900	509	3452
ML-AAPX/088-LO-LZ-LP2-XXX	0.88 μm	XXX mm length, Z m fiber optic cable with 1000 μm core	250	1600	482	2912
ML-AAPX/090-LO-SZ-LP2-XXX	0.9 μm	XXX mm length, Z m fiber optic cable with 200 μm core	290	2600	554	4712
ML-AAPX/090-LO-SMZ-LP2-XXX	0.9 μm	XXX mm length, Z m fiber optic cable with 600 μm core	255	1900	491	3452
ML-AAPX/090-LO-LZ-LP2-XXX	0.9 μm	XXX mm length, Z m fiber optic cable with 1000 μm core	240	1600	464	2912
ML-GAPX/155-LO-SZ-LP2-XXX	1.55 μm	XXX mm length, Z m fiber optic cable with 200 μm core	155	2600	311	4712
ML-GAPX/155-LO-MZ-LP2-XXX	1.55 μm	XXX mm length, Z m fiber optic cable with 600 μm core	115	2400	239	4352
ML-GAPX/155-LO-LZ-LP2-XXX	1.55 μm	XXX mm length, Z m fiber optic cable with 1000 μm core	100	1800	212	3272

¹ When used with fiber optics, lightpipes have a ~45° viewing angle

Ordering Information

- Specify length of lightpipe, XXX, in mm
- Specify length of fiber optic cable, Z, in m

Options

- Bent lightpipe tip
- Custom lightpipe and sheath diameters
- Custom fiber optic cable assemblies
- Purging gas vacuum sleeves

ORDERING INFORMATION CONTINUED

Fiber Optics to Lens Configuration: Temperature Ranges

Configuration Part Number	Spectral Response	Collection Optics	Spot Size Chart Column	Temperature Range			
				Min (°C)	Max (°C)	Min (°F)	Max (°F)
ML-GAPX-LO-SZ-RPY-XXX	0.7 to 1.65 μm	XXX mm lens working distance, Z m fiber optic cable with 200 μm core	A	115	2600	239	4712
ML-GAPX-LO-MZ-RPY-XXX	0.7 to 1.65 μm	XXX mm lens working distance, Z m fiber optic cable with 600 μm core	B	80	1300	176	2372
ML-GAPX-LO-LZ-RPY-XXX	0.7 to 1.65 μm	XXX mm lens working distance, Z m fiber optic cable with 1000 μm core	C	65	1100	149	2012
ML-AAPX/088-LO-SZ-RPY-XXX	0.88 μm	XXX mm lens working distance, Z m fiber optic cable with 200 μm core	D	345	2600	653	4712
ML-AAPX/088-LO-MZ-RPY-XXX	0.88 μm	XXX mm lens working distance, Z m fiber optic cable with 600 μm core	E	300	2500	572	4532
ML-AAPX/088-LO-LZ-RPY-XXX	0.88 μm	XXX mm lens working distance, Z m fiber optic cable with 1000 μm core	F	280	2150	536	3902
ML-AAPX/090-LO-SZ-RPY-XXX	0.9 μm	XXX mm lens working distance, Z m fiber optic cable with 200 μm core	D	335	2600	635	4712
ML-AAPX/090-LO-MZ-RPY-XXX	0.9 μm	XXX mm lens working distance, Z m fiber optic cable with 600 μm core	E	290	2500	554	4532
ML-AAPX/090-LO-LZ-RPY-XXX	0.9 μm	XXX mm lens working distance, Z m fiber optic cable with 1000 μm core	F	270	2150	518	3902
ML-GAPX/155-LO-SZ-RPY-XXX	1.55 μm	XXX mm lens working distance, Z m fiber optic cable with 200 μm core	G	160	2600	320	4712
ML-GAPX/155-LO-MZ-RPY-XXX	1.55 μm	XXX mm lens working distance, Z m fiber optic cable with 600 μm core	H	145	2600	293	4712
ML-GAPX/155-LO-LZ-RPY-XXX	1.55 μm	XXX mm lens working distance, Z m fiber optic cable with 1000 μm core	I	125	2600	257	4712

Fiber Optics to Lens Configuration: Spot Sizes

Working Distance		A		B		C		D		E		F		G		H		I	
mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
50	2.0	0.8	0.03	1.3	0.05	1.5	0.06	0.4	0.016	0.9	0.035	1.5	0.06	0.4	0.016	0.9	0.035	1.5	0.06
75	3.0	1.0	0.04	1.5	0.06	2.0	0.08	0.5	0.020	1.2	0.047	2.0	0.08	0.5	0.020	1.2	0.047	2.0	0.08
100	3.9	1.2	0.05	2.0	0.08	2.5	0.10	0.6	0.024	1.5	0.06	2.5	0.10	0.6	0.024	1.5	0.06	2.5	0.10
150	5.9	1.5	0.06	2.8	0.11	4.0	0.16	0.8	0.031	2.0	0.08	3.5	0.14	0.8	0.031	2.0	0.08	3.5	0.14
200	7.9	1.8	0.07	3.3	0.13	5	0.20	1.0	0.039	2.7	0.10	4.5	0.18	1.0	0.039	2.7	0.11	4.5	0.18
250	9.8	2.0	0.08	4.0	0.16	6	0.24	1.2	0.047	3.3	0.13	5.5	0.22	1.2	0.047	3.3	0.13	5.5	0.22
300	11.8	2.5	0.10	5	0.20	7.5	0.30	1.4	0.055	4.0	0.16	7.0	0.28	1.4	0.055	4.0	0.16	7.0	0.28
500	19.7	4.0	0.16	8	0.32	12	0.47	2.2	0.087	6.5	0.26	11	0.43	2.2	0.087	6.5	0.26	11	0.43
750	29.5	5.5	0.22	12	0.47	17	0.67	3.2	0.126	9.5	0.37	16	0.63	3.2	0.126	9.5	0.37	16	0.63
1000	39.4	7.0	0.28	16	0.61	24	0.95	4.2	0.165	12.5	0.49	22	0.87	4.2	0.165	12.5	0.49	22	0.87
2000	78.7	14	0.55	30	1.18	47	1.85	8.3	0.327	25	0.98	44	1.73	8.3	0.327	25	0.98	44	1.73

Ordering Information

- Specify length of lightpipe, XXX, in mm
- Specify length of fiber optic cable, Z, in m

Options

- Custom spot sizes and field of views
- Fiber bundles
- Vacuum compatible fiber optic cables



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ABOUT ADVANCED ENERGY

Advanced Energy (AE) has devoted more than three decades to perfecting power for its global customers. AE designs and manufactures highly engineered, precision power conversion, measurement and control solutions for mission-critical applications and processes.

AE's power solutions enable customer innovation in complex semiconductor and industrial thin film plasma manufacturing processes, demanding high and low voltage applications, and temperature-critical thermal processes.

With deep applications know-how and responsive service and support across the globe, AE builds collaborative partnerships to meet rapid technological developments, propel growth for its customers and power the future of technology.

PRECISION | POWER | PERFORMANCE

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