

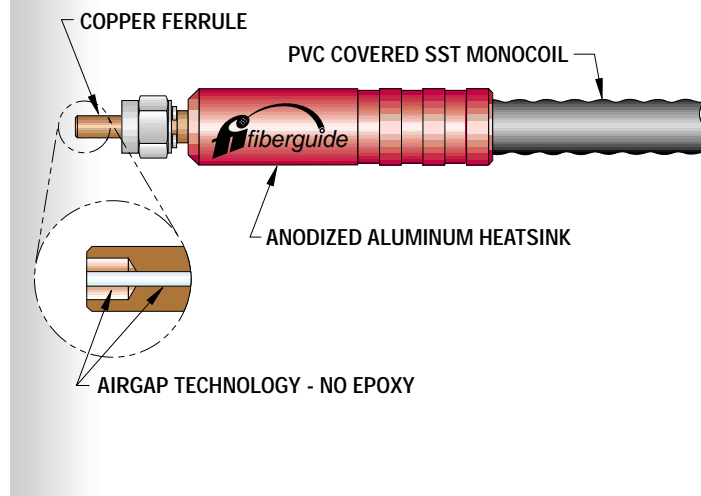
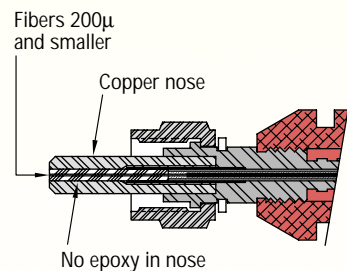
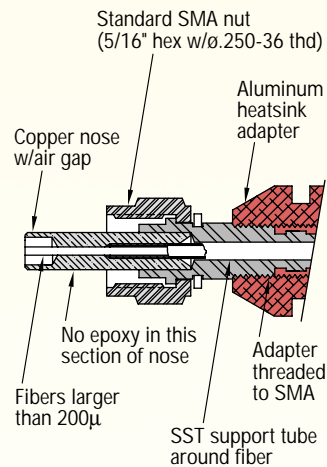
Technical Data

REFERENCE SUMMARY

Product Category:
Assembly

DESCRIPTION

Multimode, step-index fibers offer a simple, efficient way to accurately deliver high power laser beams without the use of bulky, inconvenient and often heavy articulated arms. Much care has been taken by Fiberguide Engineers in the design and assembly of our device. Our high power connectors feature an air-gap design, where the fiber extends into free space providing an epoxy-free region where thermal energy can be safely dissipated without burning the surrounding material. This is a crucial cause for failure in standard connectors. In addition we utilize a number of unique methods to finish the end of the fiber to maximize power handling, including cleaving the fiber end instead of polishing, and finally laser polishing the fiber end surface. A Fiberguide High Power Laser Delivery Assembly is light and flexible and is offered with a variety of fiber diameters as shown below. Care must be taken by the optical designer when selecting an optical system to deliver the power to the fiber assembly. The following information, plus the Nomograph, which can be found on a following page will assist the optical designer in selecting the correct fiber diameter for his specific application.



A HALMA COMPANY

Fiberguide Industries, Inc., 1 Bay Street, Stirling, NJ 07980
Phone: 908-647-6601 Fax: 908-647-8464 info@fiberguide.com www.fiberguide.com

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Technical Data

REFERENCE SUMMARY

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Assembly

FEATURES & BENEFITS

Features	Benefits
<ul style="list-style-type: none"> • Laser polished fiber ends. 	<ul style="list-style-type: none"> • Free of contaminants, scratches, digs, chips and pits.
<ul style="list-style-type: none"> • Highly conductive copper ferrule in nose connector. 	<ul style="list-style-type: none"> • Permits any heat to be conducted directly to the cooling fins.
<ul style="list-style-type: none"> • Anodized aluminum heat sink. 	<ul style="list-style-type: none"> • Pulls heat away from fiber by thermally and mechanically connected to a custom designed SMA connector. • Allows for handling ruggedness. • Prevents bending of the fiber. • Maintains beam quality.
<ul style="list-style-type: none"> • Custom design HP-SMA (High Power) connector. 	<ul style="list-style-type: none"> • Utilizing well type "air gap" ferrule technology that holds fiber tip in air to eliminate energy absorbing materials at fiber end.
<ul style="list-style-type: none"> • Cantilevered fiber end. 	<ul style="list-style-type: none"> • Enables acceptance of very high power.
<ul style="list-style-type: none"> • Small fiber diameters incorporate a pure fused silica sleeve at tip. 	<ul style="list-style-type: none"> • Supports fiber without the addition of energy absorbing materials.
<ul style="list-style-type: none"> • Standard core diameters of 100μ, 200μ, 300μ, 400μ, 600μ, 1000μ, 1500μ. 	<ul style="list-style-type: none"> • Fibers are manufactured in-house and are usually in stock.

Note:

- Standard Numerical Aperture (N.A.) 0.22
- Standard Silica/Silica Fiber with Nylon buffer
- Standard outer jacket of heavy duty PVC covered Stainless Steel Monocoil
- For non-standard designs or construction please contact Customer Service



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SOME LASER INDUCED DAMAGE THRESHOLD VARIABLES

Launch Conditions

- Beam non-uniformity
- Spot size
- Non-gaussian distribution
- Total accumulated pulses
- Alignment and focusing
- Input N.A.

End Connector Method

- Epoxy, crimp, friction
- High power connector

End Finish

- Mechanical or laser
- Cleanliness
- Cleaved

Laser Parameters

- Total power density
- Peak power and pulse width

LASER DAMAGE THRESHOLD

Continuous Wave Lasers

- For continuous wave (CW) laser the damage threshold can be calculated from the laser power and beam diameter.

For example: To calculate the power density of a 500W Nd:YAG laser at 1064nm with a 0.8mm beam diameter, one must first calculate the beam area in terms of square millimeters.

Beam area

$$= \pi r^2$$

$$= 3.14 \times (0.4\text{mm})^2$$

$$= .5024\text{mm}^2$$

Next calculate the power density for power per unit area.

Power density

$$= \text{Power/Area}$$

$$= 500\text{W}/.5024\text{mm}^2$$

$$= 995\text{W}/\text{mm}^2$$

Note: For laser beams with a gaussian intensity profile, multiply the power density by (2) for safety is essential to accommodate the peak power density at the center of the beam.

Damage threshold scales with wavelength, therefore the damage threshold at 532nm will be 1/2 that at 1064nm.

Pulse Lasers

- For pulsed lasers in the range of μsec to nsec , the energy density varies as a function of the square root of the time domain. As a rule of thumb, an optic can withstand (10) x more energy when used with a $1\mu\text{sec}$ pulsed laser than a 10nsec pulsed laser. Presume, for example, that the damage threshold is rated at $2 \text{ joules}/\text{cm}^2$ for 10nsec pulses, but your laser has a $1\mu\text{sec}$ pulse length. This means that at the $1\mu\text{sec}$ time domain ($1 \times 10^{-6} \text{ sec}$ compared to $10 \times 10^{-9} \text{ sec}$), the fiber can withstand 10 times more energy ($20 \text{ joules}/\text{cm}^2$).
- In the area in between pulsed and CW applications (in the msec range), compare both the average power with the CW threshold and the pulse energy density with the energy specification.
- In the millisecond range, there is a crossover between pulse and CW regimes where one should try to satisfy both criteria.



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APPLICATIONS

Scientific

- Laser induced breakdown spectroscopy (LIBS)
- Investigating nonlinear optic phenomena
- Holographic techniques employing lasers
- Laser (LIDAR) technology in geology, seismology, remote sensing, and atmospheric physics
- Photochemistry to analyze details of protein folding and function

- Laser cooling to slow down ions or atoms by shining particular wavelength of laser light at them
- Nuclear fusion

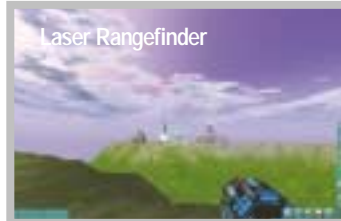
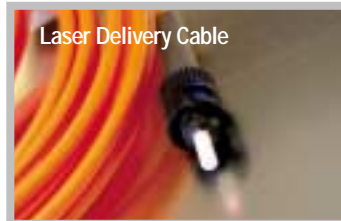
Military

- Defense counter measures from compact, low power infrared counter measures to high power, airborne laser systems (e.g.: MTHEL)
- Targeting such as laser range-finder (LIDAR)
- Target designator

Industrial and Commercial

- Cutting and peening of metals and other material, welding, marking, etc.
- Guidance systems such as ring laser gyroscopes
- Rangefinder/surveying
- LIDAR/pollution monitoring
- Holography
- Photolithography
- Optical tweezers

TYPICAL APPLICATIONS



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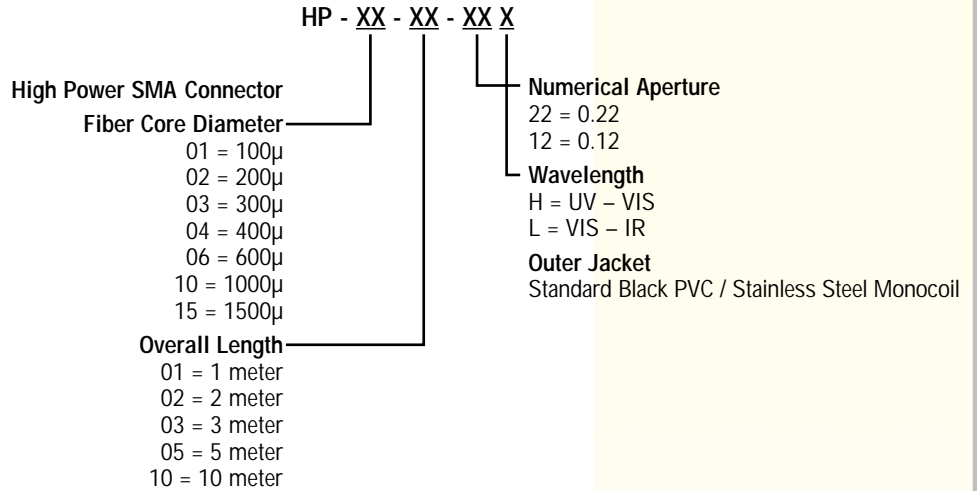
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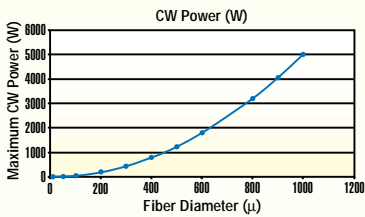
ORDERING INFORMATION



Example: HP-04-02-22H = High Power SMA connector, 400μ core diameter, 2 meters long overall, Numerical Aperture 0.22, UV – VIS wavelength

TABLE FOR MAXIMUM CW POWER POSSIBLE FOR A GIVEN FIBER SIZE

Minimum Fiber Diameter (μ)	Spot Diameter	Area (mm ²)	Maximum Density (W/mm ²)	CW Power (W)
9	80%	0.0000	10,000	0.4
50	80%	0.0013	10,000	12.6
100	80%	0.0050	10,000	50.2
200	80%	0.0201	10,000	201.0
300	80%	0.0452	10,000	452.2
400	80%	0.0804	10,000	803.8
500	80%	0.1256	10,000	1256.0
600	80%	0.1809	10,000	1808.6
800	80%	0.3215	10,000	3215.4
900	80%	0.4069	10,000	4069.4
1000	80%	0.5024	10,000	5024.0



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PRICING - DOMESTIC

Part Number	Part Number	1-4	5-9	Part Number	Part Number	1-4	5-9
HP-01-01-22H	HP-01-01-12H	\$213.00	\$194.00	HP-01-01-22L	HP-01-01-12L	\$213.00	\$194.00
HP-01-02-22H	HP-01-02-12H	\$253.00	\$230.00	HP-01-02-22L	HP-01-02-12L	\$253.00	\$230.00
HP-01-03-22H	HP-01-03-12H	\$292.00	\$265.00	HP-01-03-22L	HP-01-03-12L	\$292.00	\$265.00
HP-01-05-22H	HP-01-05-12H	\$363.00	\$330.00	HP-01-05-22L	HP-01-05-12L	\$363.00	\$330.00
HP-01-10-22H	HP-01-10-12H	\$566.00	\$514.00	HP-01-10-22L	HP-01-10-12L	\$566.00	\$514.00
HP-02-01-22H	HP-02-01-12H	\$211.00	\$192.00	HP-02-01-22L	HP-02-01-12L	\$211.00	\$192.00
HP-02-02-22H	HP-02-02-12H	\$248.00	\$225.00	HP-02-02-22L	HP-02-02-12L	\$248.00	\$225.00
HP-02-03-22H	HP-02-03-12H	\$284.00	\$258.00	HP-02-03-22L	HP-02-03-12L	\$284.00	\$258.00
HP-02-05-22H	HP-02-05-12H	\$350.00	\$318.00	HP-02-05-22L	HP-02-05-12L	\$350.00	\$318.00
HP-02-10-22H	HP-02-10-12H	\$546.00	\$496.00	HP-02-10-22L	HP-02-10-12L	\$546.00	\$496.00
HP-03-01-22H	HP-03-01-12H	\$216.00	\$196.00	HP-03-01-22L	HP-03-01-12L	\$216.00	\$196.00
HP-03-02-22H	HP-03-02-12H	\$258.00	\$234.00	HP-03-02-22L	HP-03-02-12L	\$258.00	\$234.00
HP-03-03-22H	HP-03-03-12H	\$300.00	\$272.00	HP-03-03-22L	HP-03-03-12L	\$300.00	\$272.00
HP-03-05-22H	HP-03-05-12H	\$376.00	\$341.00	HP-03-05-22L	HP-03-05-12L	\$376.00	\$341.00
HP-03-10-22H	HP-03-10-12H	\$592.00	\$538.00	HP-03-10-22L	HP-03-10-12L	\$592.00	\$538.00
HP-04-01-22H	HP-04-01-12H	\$223.00	\$203.00	HP-04-01-22L	HP-04-01-12L	\$223.00	\$203.00
HP-04-02-22H	HP-04-02-12H	\$272.00	\$247.00	HP-04-02-22L	HP-04-02-12L	\$272.00	\$247.00
HP-04-03-22H	HP-04-03-12H	\$321.00	\$292.00	HP-04-03-22L	HP-04-03-12L	\$321.00	\$292.00
HP-04-05-22H	HP-04-05-12H	\$411.00	\$374.00	HP-04-05-22L	HP-04-05-12L	\$411.00	\$374.00
HP-04-10-22H	HP-04-10-12H	\$663.00	\$603.00	HP-04-10-22L	HP-04-10-12L	\$663.00	\$603.00
HP-06-01-22H	HP-06-01-12H	\$244.00	\$221.00	HP-06-01-22L	HP-06-01-12L	\$244.00	\$221.00
HP-06-02-22H	HP-06-02-12H	\$313.00	\$284.00	HP-06-02-22L	HP-06-02-12L	\$313.00	\$284.00
HP-06-03-22H	HP-06-03-12H	\$382.00	\$347.00	HP-06-03-22L	HP-06-03-12L	\$382.00	\$347.00
HP-06-05-22H	HP-06-05-12H	\$513.00	\$466.00	HP-06-05-22L	HP-06-05-12L	\$513.00	\$466.00
HP-06-10-22H	HP-06-10-12H	\$866.00	\$788.00	HP-06-10-22L	HP-06-10-12L	\$866.00	\$788.00
HP-10-01-22H	HP-10-01-12H	\$309.00	\$281.00	HP-10-01-22L	HP-10-01-12L	\$309.00	\$281.00
HP-10-02-22H	HP-10-02-12H	\$443.00	\$403.00	HP-10-02-22L	HP-10-02-12L	\$443.00	\$403.00
HP-10-03-22H	HP-10-03-12H	\$577.00	\$525.00	HP-10-03-22L	HP-10-03-12L	\$577.00	\$525.00
HP-10-05-22H	HP-10-05-12H	\$838.00	\$762.00	HP-10-05-22L	HP-10-05-12L	\$838.00	\$762.00
HP-10-10-22H	HP-10-10-12H	\$1,517.00	\$1,379.00	HP-10-10-22L	HP-10-10-12L	\$1,517.00	\$1,379.00
HP-15-01-22H	HP-15-01-12H	\$435.00	\$396.00	HP-15-01-22L	HP-15-01-12L	\$435.00	\$396.00
HP-15-02-22H	HP-15-02-12H	\$696.00	\$633.00	HP-15-02-22L	HP-15-02-12L	\$696.00	\$633.00
HP-15-03-22H	HP-15-03-12H	\$957.00	\$870.00	HP-15-03-22L	HP-15-03-12L	\$957.00	\$870.00
HP-15-05-22H	HP-15-05-12H	\$1,472.00	\$1,338.00	HP-15-05-22L	HP-15-05-12L	\$1,472.00	\$1,338.00
HP-15-10-22H	HP-15-10-12H	\$2,784.00	\$2,531.00	HP-15-10-22L	HP-15-10-12L	\$2,784.00	\$2,531.00

Note:

HP = High Power - XX = Fiber Core Diameter - XX = Overall Length - XX X = Numerical Aperture, High OH or Standard (Low) OH. Prices shown are domestic only.

The part numbers highlighted in red are available in one business week ARO (After Receipt of Order).

All others available in three weeks ARO.

For quantities of ten or greater, please contact customer service.



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Technical Data

REFERENCE SUMMARY

Product Category:

Assembly

PRICING - INTERNATIONAL

Part Number	Part Number	1-4	5-9	Part Number	Part Number	1-4	5-9
HP-01-01-22H	HP-01-01-12H	\$237.00	\$216.00	HP-01-01-22L	HP-01-01-12L	\$237.00	\$216.00
HP-01-02-22H	HP-01-02-12H	\$281.00	\$256.00	HP-01-02-22L	HP-01-02-12L	\$281.00	\$256.00
HP-01-03-22H	HP-01-03-12H	\$325.00	\$295.00	HP-01-03-22L	HP-01-03-12L	\$325.00	\$295.00
HP-01-05-22H	HP-01-05-12H	\$403.00	\$367.00	HP-01-05-22L	HP-01-05-12L	\$403.00	\$367.00
HP-01-10-22H	HP-01-10-12H	\$629.00	\$571.00	HP-01-10-22L	HP-01-10-12L	\$629.00	\$571.00
HP-02-01-22H	HP-02-01-12H	\$234.00	\$214.00	HP-02-01-22L	HP-02-01-12L	\$234.00	\$214.00
HP-02-02-22H	HP-02-02-12H	\$276.00	\$250.00	HP-02-02-22L	HP-02-02-12L	\$276.00	\$250.00
HP-02-03-22H	HP-02-03-12H	\$315.00	\$287.00	HP-02-03-22L	HP-02-03-12L	\$315.00	\$287.00
HP-02-05-22H	HP-02-05-12H	\$389.00	\$353.00	HP-02-05-22L	HP-02-05-12L	\$389.00	\$353.00
HP-02-10-22H	HP-02-10-12H	\$607.00	\$551.00	HP-02-10-22L	HP-02-10-12L	\$607.00	\$551.00
HP-03-01-22H	HP-03-01-12H	\$240.00	\$218.00	HP-03-01-22L	HP-03-01-12L	\$240.00	\$218.00
HP-03-02-22H	HP-03-02-12H	\$287.00	\$260.00	HP-03-02-22L	HP-03-02-12L	\$287.00	\$260.00
HP-03-03-22H	HP-03-03-12H	\$334.00	\$302.00	HP-03-03-22L	HP-03-03-12L	\$334.00	\$302.00
HP-03-05-22H	HP-03-05-12H	\$418.00	\$379.00	HP-03-05-22L	HP-03-05-12L	\$418.00	\$379.00
HP-03-10-22H	HP-03-10-12H	\$658.00	\$598.00	HP-03-10-22L	HP-03-10-12L	\$658.00	\$598.00
HP-04-01-22H	HP-04-01-12H	\$248.00	\$226.00	HP-04-01-22L	HP-04-01-12L	\$248.00	\$226.00
HP-04-02-22H	HP-04-02-12H	\$302.00	\$275.00	HP-04-02-22L	HP-04-02-12L	\$302.00	\$275.00
HP-04-03-22H	HP-04-03-12H	\$357.00	\$324.00	HP-04-03-22L	HP-04-03-12L	\$357.00	\$324.00
HP-04-05-22H	HP-04-05-12H	\$457.00	\$416.00	HP-04-05-22L	HP-04-05-12L	\$457.00	\$416.00
HP-04-10-22H	HP-04-10-12H	\$737.00	\$670.00	HP-04-10-22L	HP-04-10-12L	\$737.00	\$670.00
HP-06-01-22H	HP-06-01-12H	\$271.00	\$246.00	HP-06-01-22L	HP-06-01-12L	\$271.00	\$246.00
HP-06-02-22H	HP-06-02-12H	\$348.00	\$316.00	HP-06-02-22L	HP-06-02-12L	\$348.00	\$316.00
HP-06-03-22H	HP-06-03-12H	\$425.00	\$386.00	HP-06-03-22L	HP-06-03-12L	\$425.00	\$386.00
HP-06-05-22H	HP-06-05-12H	\$570.00	\$518.00	HP-06-05-22L	HP-06-05-12L	\$570.00	\$518.00
HP-06-10-22H	HP-06-10-12H	\$962.00	\$876.00	HP-06-10-22L	HP-06-10-12L	\$962.00	\$876.00
HP-10-01-22H	HP-10-01-12H	\$343.00	\$312.00	HP-10-01-22L	HP-10-01-12L	\$343.00	\$312.00
HP-10-02-22H	HP-10-02-12H	\$492.00	\$448.00	HP-10-02-22L	HP-10-02-12L	\$492.00	\$448.00
HP-10-03-22H	HP-10-03-12H	\$641.00	\$584.00	HP-10-03-22L	HP-10-03-12L	\$641.00	\$584.00
HP-10-05-22H	HP-10-05-12H	\$931.00	\$847.00	HP-10-05-22L	HP-10-05-12L	\$931.00	\$847.00
HP-10-10-22H	HP-10-10-12H	\$1,686.00	\$1,532.00	HP-10-10-22L	HP-10-10-12L	\$1,686.00	\$1,532.00
HP-15-01-22H	HP-15-01-12H	\$483.00	\$440.00	HP-15-01-22L	HP-15-01-12L	\$483.00	\$440.00
HP-15-02-22H	HP-15-02-12H	\$774.00	\$704.00	HP-15-02-22L	HP-15-02-12L	\$774.00	\$704.00
HP-15-03-22H	HP-15-03-12H	\$1,063.00	\$967.00	HP-15-03-22L	HP-15-03-12L	\$1,063.00	\$967.00
HP-15-05-22H	HP-15-05-12H	\$1,636.00	\$1,487.00	HP-15-05-22L	HP-15-05-12L	\$1,636.00	\$1,487.00
HP-15-10-22H	HP-15-10-12H	\$3,094.00	\$2,812.00	HP-15-10-22L	HP-15-10-12L	\$3,094.00	\$2,812.00

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All others available in three weeks ARO.

For quantities of ten or greater, please contact customer service.

Fiberguide Industries Customization Program

Fiberguide Industries is a full service custom fiber and value-added assembly provider. If you have unique requirements, please contact us to discuss tailoring a product or design to optimize optical performance for your specific application.

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