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10 Attorneys for Plaintiff INNEOS LLC

11 **UNITED STATES DISTRICT COURT**
12 **CENTRAL DISTRICT OF CALIFORNIA**

13 **INNEOS LLC,**
14 A California limited liability company,
15 Plaintiff,

16 v.

17 **OPTICIS CO., LTD.,**
18 A public Korean company, and
19 **OPTICIS USA LLC,**
20 A New Jersey limited liability
21 company,

22 Defendants.

Case No.:

**COMPLAINT FOR PATENT
INFRINGEMENT**

DEMAND FOR JURY TRIAL

23
24
25
26
27 Opticis Co., Ltd
EXHIBIT 1014
IPR Petition for
28 U.S. Patent No. 7,198,416

1 Plaintiff Inneos LLC (“Inneos” or “Plaintiff”) files this Complaint for patent
2 infringement against Defendants Opticis Co., Ltd. (“Opticis Korea”) and Opticis
3 USA LLC (“Opticis USA”) (collectively, “Opticis” or “Defendants”) and alleges as
4 follows:

5 **NATURE OF THE ACTION**

6 1. This is an action for patent infringement of United States Patent
7 No. 7,198,416 (“the ’416 Patent”) under the United States Patent Laws, 35 U.S.C.
8 § 1 *et seq.* Over the past two decades, Inneos has developed innovative technologies
9 that make it possible to transmit multiple digital signals over a single strand of fiber
10 optic cable. The ’416 Patent covers one such innovation used in the optical sub-
11 assembly (“OSA”) components incorporated into a wide range of industrial and
12 consumer products. Inneos’ OSA development eliminated the need for multiple fiber
13 optic strands to transmit the same amount of data and resulted in reduced bulk and
14 cost for those implementations. Inneos sells and/or licenses its OSA components to
15 original equipment manufacturers for use in, *inter alia*, the video and data
16 networking markets. For its part, Opticis sells both standalone OSAs as well as
17 various finished products that incorporate OSA components, or “modules.” One
18 such Opticis module is the DVFX-100, One Fiber Detachable Module. Opticis’ OSA
19 components infringe one or more claims of the ’416 Patent. Opticis has known about
20 the ’416 Patent since at least 2013, when Inneos notified Opticis of the ’416 Patent.
21 It appeared that, for a time after Inneos’ notice letter, Opticis refrained from selling
22 infringing OSAs and related products in the United States. However, Opticis has
23 recently resumed its efforts to market and sell infringing OSAs and related products
24 in the United States, making this lawsuit necessary.

25 2. Inneos seeks to recover damages for Opticis’ wrongful conduct and to
26 enjoin, preliminarily and permanently, Opticis’ continuing willful infringement.

27 ///

28 ///

PARTIES

3. Inneos is a limited liability company formed under the laws of California with a principal place of business at 5700 Stoneridge Drive, Suite 200, Pleasanton, California 94588.

4. Upon information and belief, Opticis Korea is a corporation organized under the laws of the Republic of Korea and headquartered at 305 Sanseong-daero, 3rd floor of Sambournesang Park II, Sujeong-gu, Seongnam-si, Gyeonggi-do, South Korea.

5. Upon information and belief, Opticis USA is a limited liability company organized under the laws of New Jersey and with a principal place of business at 17752 Skypark Circle, Suite 230, Irvine, California 92614.

JURISDICTION AND VENUE

6. This is an action for patent infringement arising under the patent laws of the United States, 35 U.S.C. § 1 *et seq.* This Court has subject matter jurisdiction over this action under at least 28 U.S.C. §§ 1331 and 1338(a).

7. This Court has specific personal jurisdiction over Opticis Korea because, upon information and belief, Opticis Korea participates in and purposefully directs its subsidiary, Opticis USA, to infringe the '416 Patent. Additionally and/or in the alternative, upon information and belief, this Court has personal jurisdiction over Opticis Korea because of an agency relationship established between it and Opticis USA.

8. This Court has personal jurisdiction over Opticis USA because, upon information and belief, Opticis USA's principal place of business is located in this state, through which it markets and sells or has marketed or sold the infringing products described herein.

9. Additionally and/or in the alternative, this Court has personal jurisdiction over Opticis because, upon information and belief, Opticis has marketed

1 and sold infringing products described herein to customers in this State and this
2 District.

3 10. Venue is proper in this District under 28 U.S.C. § 1400(b) because,
4 upon information and belief, Opticis USA has a regular and established place of
5 business in this District at 17752 Skypark Circle, Suite 230, Irvine, California, and
6 because Opticis USA has committed acts of infringement in this District.
7 Additionally, upon information and belief, venue is proper in this District under 28
8 U.S.C. § 1400(b) because Opticis Korea directs and controls Opticis USA at its
9 regular and established place of business in this District and has caused Opticis USA
10 to commit acts of infringement in this District, and/or because Opticis Korea has
11 committed acts of infringement in this District.

12 11. Additionally, venue is proper over Opticis Korea in this District under
13 28 U.S. C. §1391(c)(3) because defendants that are not United States residents may
14 be sued in any judicial where personal jurisdiction is established.

15 **FACTS**

16 **Development of the Patented Technology**

17 12. Inneos is a U.S.-based developer and manufacturer of high-speed
18 optoelectronic modules and components marketed to original equipment
19 manufacturers and system integrators in the video and data networking markets.

20 13. Inneos began as a start-up in 1998 (then called Blaze Network Products)
21 to develop a novel, cost-effective approach to manufacture multi-channel optics.
22 Multi-channel optics transmit multiple wavelengths (*e.g.*, colors) of light down a
23 single strand of fiber optic cable, where each wavelength acts as its own channel for
24 carrying data without interference with other channels on the same strand of fiber
25 optic cable. At a time when most products in the market transmitted only one color
26 of light per fiber strand, thereby requiring the use of several strands of fiber optic
27 cable to achieve high bandwidth performance, Inneos' products enabled consumers
28

1 to use only one strand to achieve similar performance, thereby reducing the cost,
2 weight, and complexity of fiber optic cabling.

3 14. Starting in 1999, Inneos invested significantly in its research and
4 development team to develop and patent cutting-edge multi-channel technology,
5 including a way to integrate several discrete optic components into an OSA. Inneos'
6 investment resulted in an increase in the cost-effective availability of fiber optics for
7 a number of major technology industries, including medical, aerospace, and
8 consumer electronics.

9 15. In 2005, leveraging its hands-on experience in manufacturing and
10 deploying its original design, Inneos developed a new OSA design that further
11 reduced the cost of fiber optic connectors by eliminating and integrating several
12 additional optical components, including the expensive filters that helped manage
13 the different colors used in earlier versions of this multi-channel technology. Inneos
14 filed the application leading to the '416 Patent on January 27, 2005. Inneos (then
15 called Aduro) was acquired via an asset sale by Omron Network Products LLC in
16 2006; in 2013, the company, now called Inneos, spun off from Omron.

17 **The Asserted Patent**

18 16. The '416 Patent, entitled "Optical Combiner Device," issued on April
19 3, 2007. Inneos is the owner by assignment of all rights, title, and interests in and to
20 the '416 Patent, including all rights to bring actions and recover damages for
21 infringement thereof. A true and correct copy of the '416 Patent is attached as
22 **Exhibit A.**

23 17. The inventions claimed in the '416 Patent cover an efficient, compact,
24 and cost-effective optical sub-assembly device used to transmit multiple
25 wavelengths of light across a single optical fiber for use in various technologies,
26 including data communications and video systems. In particular, the '416 Patent
27 combines multiple optical signals without wasteful divergence or reflection of light,
28

1 making it possible to transmit information across a single optical fiber at a higher
2 bandwidth and a lower cost.

3 18. As a result of Inneos' investment in the invention claimed in the '416
4 Patent, fiber optics have become more accessible across industries, including in the
5 medical, aerospace, and consumer electronics industries, and demand for low-cost,
6 high-bandwidth optical fiber technology has grown substantially.

7 **Opticis' Copying and Infringing Conduct**

8 19. Like most others in the market, Opticis' primary technology for high
9 bandwidth solutions had been based on the expensive, heavy, and complex use of
10 multiple strands of single-color (or single-wavelength) fiber optics. But with Inneos'
11 new technology now available, demand migrated toward affordable and efficient
12 single fiber optic cable.

13 20. From 2007 to 2010, Opticis engaged Inneos (then operating as Omron)
14 in technical discussions about Inneos' products and technology, and procured from
15 Inneos several hundred samples of Inneos' multi-channel OSAs.

16 21. Rather than compete fairly with Inneos in the marketplace, Opticis
17 copied Inneos' innovative single-fiber optic cable technology and sold OSAs and
18 modules incorporating that technology as their own.

19 22. Consistent with this course of conduct, Opticis infringes the '416
20 Patent. The accused products in this action include Opticis' OSAs (including without
21 limitation those identified in **Exhibit B** hereto), whether offered or sold alone or
22 incorporated into modules or other products (collectively, "Accused Products"). By
23 way of example, Opticis' products incorporating the infringing OSAs include at least
24 the DVFX-100, One Fiber Detachable DVI Module and the DPFX-300.

25 23. Armed with Inneos' patented technology, including at least the
26 technology covered by the '416 Patent, Opticis began to compete directly with
27 Inneos in the same market for customers seeking cost-effective, high-speed optical
28 communications products.

1 24. Upon information and belief, Opticis began selling and/or offering for
2 sale the Accused Product before at least November 2013.

3 25. Opticis has known about the '416 Patent and its infringement thereof
4 since at least November 25, 2013, when Opticis received a letter from Inneos (doing
5 business as Omron) identifying the '416 Patent and the aspects of the Accused
6 Product that meet at least one of the claims of the '416 Patent.

7 26. On information and belief, after receiving the November 2013 letter,
8 Opticis temporarily stopped selling and marketing products in the United States that
9 include the infringing OSAs.

10 27. However, Inneos has recently learned that, on information and belief,
11 Opticis has again commenced selling and marketing the Accused Products in the
12 United States. Opticis' infringing conduct competes directly with Inneos' own
13 single-fiber OSA technology, and has caused and is causing actual, imminent, and
14 irreparable harm to Inneos.

15 28. In view of at least Opticis' ongoing infringement despite having
16 received notice thereof, Opticis' infringement is deliberate, willful, and knowing,
17 with conscious disregard of Inneos' rights, entitling Inneos to enhanced damages.

18 29. Opticis' infringement is causing irreparable harm and monetary
19 damages to Inneos, entitling Inneos to both monetary damages and preliminary and
20 permanent injunctive relief.

21 **COUNT I: INFRINGEMENT OF THE '416 PATENT**

22 **UNDER 35 U.S.C. § 271**

23 30. Inneos incorporates by reference the allegations contained in the
24 foregoing paragraphs as though fully stated herein.

25 31. Opticis and/or its customers and end users directly infringe one or more
26 claims of the '416 Patent under 35 U.S.C. § 271(a), including at least Claim 1, either
27 literally or under the doctrine of equivalents, by making, using, offering to sell,
28 selling, and/or importing the Accused Products in the United States without

1 permission or license from Inneos. A preliminary, exemplary claim chart comparing
2 exemplary Accused Products to claim 1 of the '416 Patent, is attached as **Exhibit B**.

3 32. By way of example only and not limitation, Claim 1 of the '416 Patent
4 claims:

5 1. An optical combiner usable in data communication
6 systems for multiplexing the outputs of a plurality of n
7 lasers wherein each of said n outputs has a different output
8 wavelength, for transmission into and through a stopped
9 single optical fiber, comprising:

10 a plurality of n collimating lenses, said lenses being spaced
11 apart and positioned to receive and collimate the output of
12 said n laser output beams, said n laser output beams have
13 n different wavelengths, and
14

15 focusing means for focusing said n collimated output
16 beams onto a single spot at said stopped single optical
17 fiber, said focusing means having n separate radial sectors
18 on its surface, and each of said n collimated beams passes
19 through a separate one of said n sectors of said focusing
20 means whereby said n output beams having n different
21 wavelengths are coupled into said single fiber.
22

23 33. The Accused Products meet each element in at least Claim 1 of the '416
24 Patent, as illustrated in **Exhibit B**.

25 34. A number of Opticis' modules and end products incorporate the
26 infringing OSA. For example, Opticis advertises on its website –
27 www.opticisusa.com/dvi – that the DVFX-100-TR transmits “uncompressed
28 WUXGA [widescreen ultra extended graphics array] (1920x1200) 60Hz and 2K

1 resolution of DVI [digital visual interface] signal up to 500m (1640ft) over one (1)
2 SC [square connector] multi-mode fiber.” In other words, the DVFX-100-TR is used
3 in data communication systems for transmitting a certain quality of various visual
4 data over a single optical fiber designed to carry multiple light rays. *See, e.g.,*
5 <https://www.opticisusa.com/dvfx-100-tr> (as accessed Jan. 20, 2023). *See also*

6 **Exhibit B.**

7 35. Upon information and belief, Opticis also indirectly infringes the ’416
8 Patent under 35 U.S.C. § 271(b) and/or (c). Opticis induces the infringement of the
9 ’416 Patent by its customers and end users in the United States as discussed above
10 under 35 U.S.C. § 271(b) by directing, instructing, and encouraging customers and
11 end users to use the Accused Products, for example, as instructed, described, and
12 encouraged in the “1-Fiber Detachable DVI module, DVFX-100 User’s Manual,”
13 (“DVFX-100 User Manual”) available on Opticis’ website, and attached as
14 **Exhibit C** and/or the “User’s Manual for the DPFx-300-TR” (“DPFX-300 User
15 Manual”) available on Opticis’ website, and attached as **Exhibit D**. Opticis knows
16 that the DVFX-100 and DPFx-300 infringe the ’416 Patent. Opticis has had
17 knowledge of the ’416 Patent since at least November 25, 2013, and Opticis knew
18 or should have known that the use of the Accused Products by its customers and end
19 users directly infringes the ’416 Patent.

20 36. Upon information and belief, Opticis has made and is continuing to
21 make unlawful gains and profits from its infringement of the ’416 Patent.

22 37. As detailed above, Opticis has continued its infringement despite
23 having knowledge of the ’416 Patent and Inneos’ infringement claims.

24 38. Opticis’ infringement has caused and will continue to cause Inneos
25 irreparable harm, for which there is no adequate remedy at law, unless Opticis’
26 infringing activities are preliminarily and permanently enjoined by this Court.

27 39. Opticis’ infringement has also caused monetary damages to Inneos in
28 an amount to be determined at trial.

PRAYER FOR RELIEF

WHEREFORE, Inneos respectfully requests that:

- A. Opticis be adjudged by this Court to have directly, indirectly, and/or contributorily infringed one or more claims of the Asserted Patent under 35 U.S.C. § 271;
- B. This Court enter preliminary and permanent injunctions pursuant to 35 U.S.C. § 283 preventing continuing infringement of one or more claims of the Asserted Patent by Opticis, its officers, agents, employees, attorneys, representatives, and all others acting in concert therewith;
- C. Opticis be adjudged by this Court to have willfully infringed one or more claims of the Asserted Patent from the time Opticis became aware of the infringing nature of its conduct, and that Inneos be awarded treble damages for the period of such willful infringement pursuant to 35 U.S.C. § 284;
- D. The Court find the Asserted Patent valid and enforceable;
- E. Opticis be ordered by this Court to account for and pay Inneos damages pursuant to 35 U.S.C. § 284;
- F. This case be deemed exceptional and Inneos be awarded interests, costs, expenses, and reasonable attorneys' fees for this suit as provided by 35 U.S.C. § 285; and
- G. Inneos be awarded such other and further relief as this Court may deem just and proper.

JURY DEMAND

Pursuant to Rule 38 of the Federal Rules of Civil Procedure, Inneos respectfully requests a trial by jury of any issues so triable.

Respectfully submitted,

1 Date: January 30, 2023

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Exhibit A



US007198416B2

(12) **United States Patent**
Ray et al.

(10) **Patent No.:** **US 7,198,416 B2**
(45) **Date of Patent:** **Apr. 3, 2007**

(54) **OPTICAL COMBINER DEVICE**

(75) Inventors: **Curtis A. Ray**, Alamo, CA (US); **Eric B. Grann**, San Ramon, CA (US); **Brian C. Peters**, Alamo, CA (US)

(73) Assignee: **Omron Network Products, LLC**, Pleasanton, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **11/044,475**

(22) Filed: **Jan. 27, 2005**

(65) **Prior Publication Data**
US 2005/0175347 A1 Aug. 11, 2005

Related U.S. Application Data
(60) Provisional application No. 60/541,573, filed on Feb. 4, 2004.

(51) **Int. Cl.**
G02B 6/32 (2006.01)
G02B 6/34 (2006.01)
G02B 6/36 (2006.01)

(52) **U.S. Cl.** **385/93; 385/88; 385/89; 385/92; 385/33; 385/36**

(58) **Field of Classification Search** 385/31-36, 385/88-94
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,219,476 B1 * 4/2001 Kususawa et al. 385/33
2005/0069013 A1 * 3/2005 Bhandarkar et al. 372/102

* cited by examiner

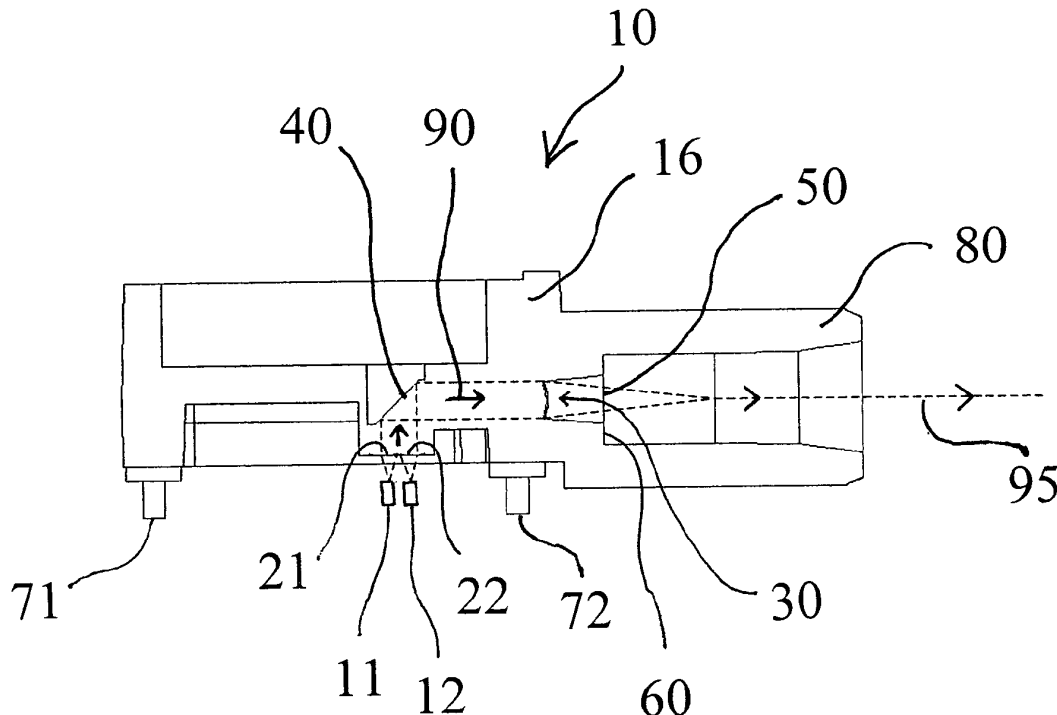
Primary Examiner—Kevin S. Wood

(74) *Attorney, Agent, or Firm*—Bruce H. Johnsonbaugh

(57) **ABSTRACT**

An optical device for combining optical signals of different wavelengths is described wherein an array of laser output beams are collimated, directed to propagate along a similar path, and coupled into an optical fiber through a single molded part. The single-part optical coupling module can be constructed in various ways to achieve the desired configuration. One example is a single plastic-injection molded part, containing mechanical alignment features, an array of collimating lenses, and a focusing lens housed within a fiber optic connector ferrule. The laser output beams are separately passed through separate radial sectors of the focusing lens.

9 Claims, 11 Drawing Sheets



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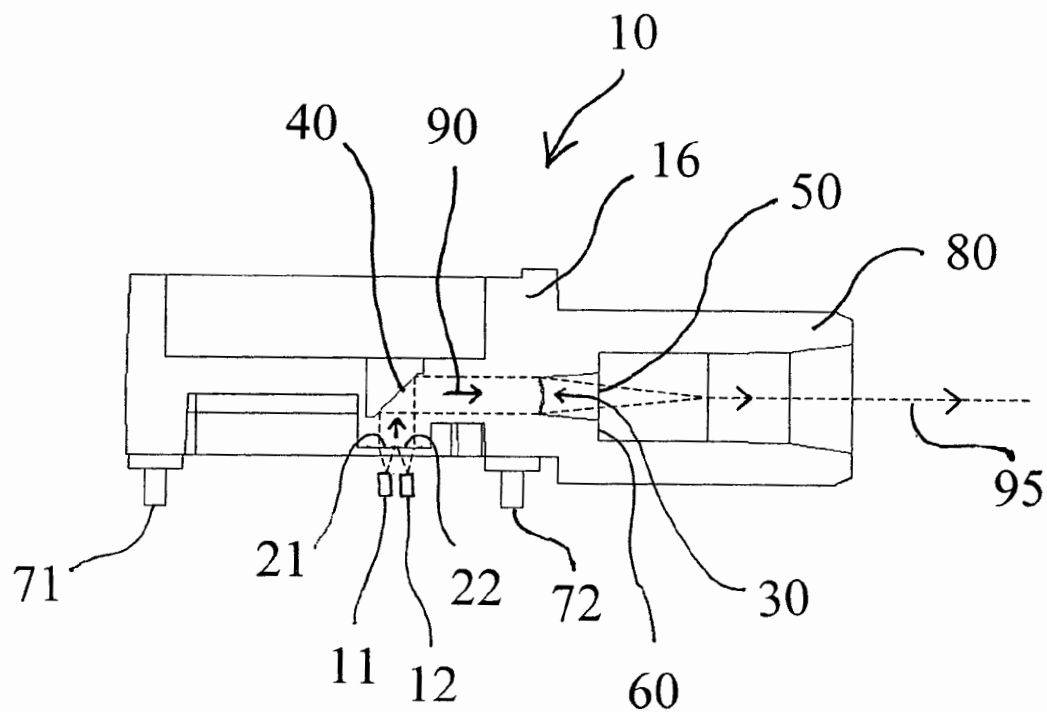


Fig. 1

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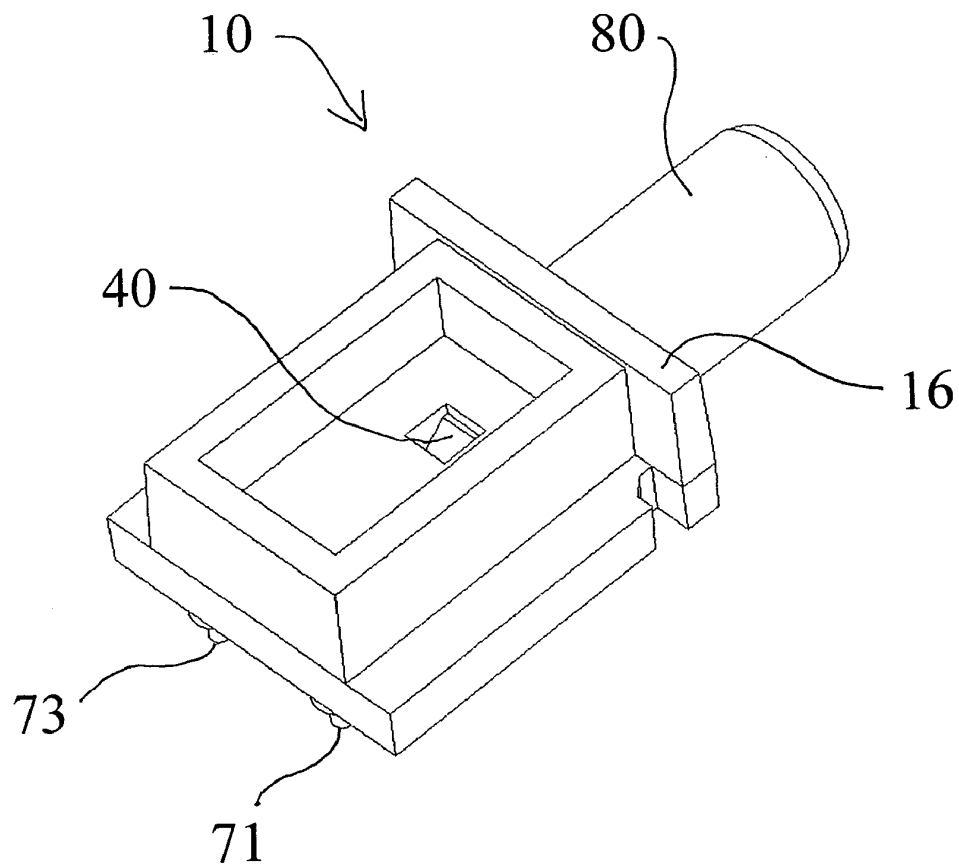


Fig. 2

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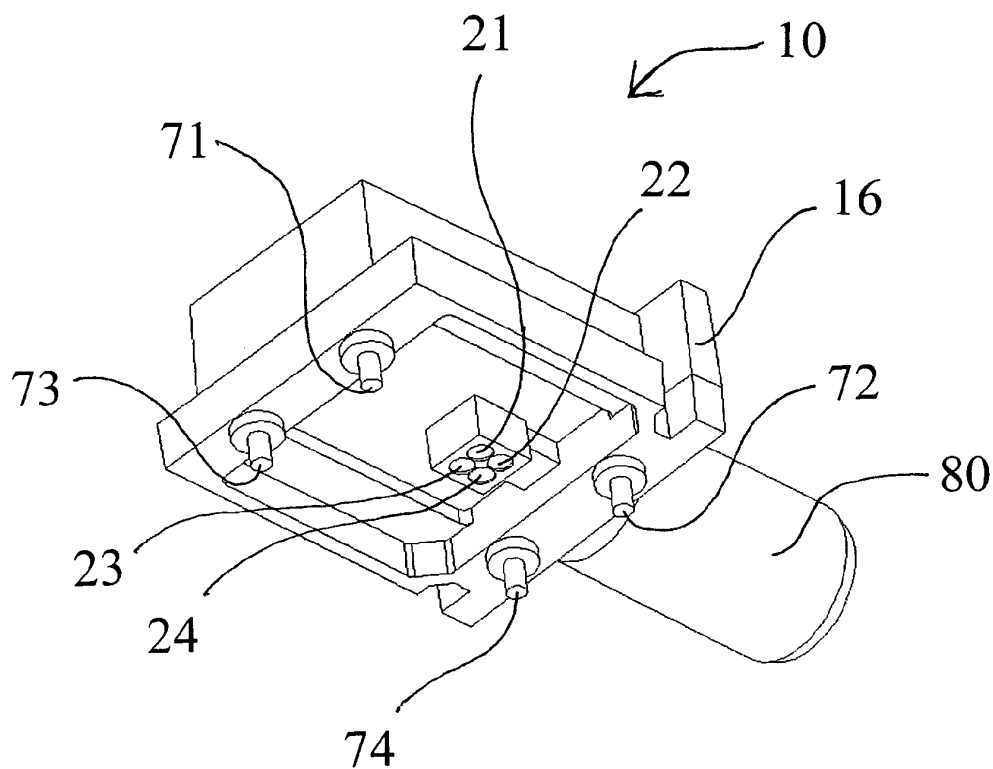


Fig. 3

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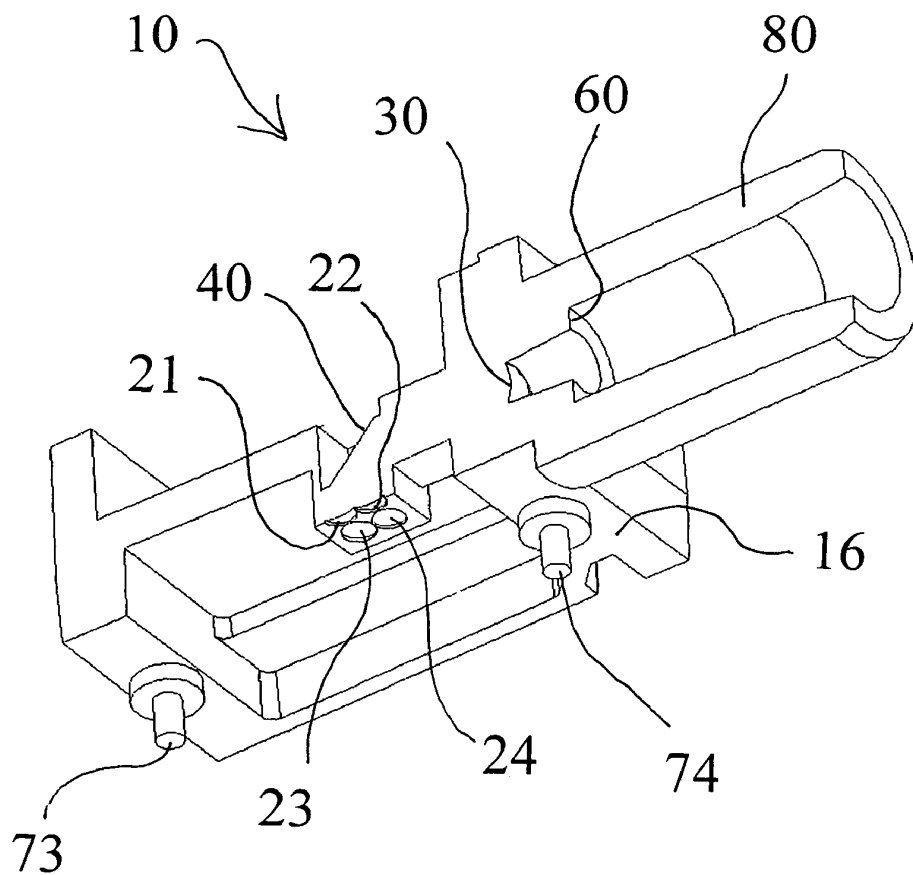


Fig. 4

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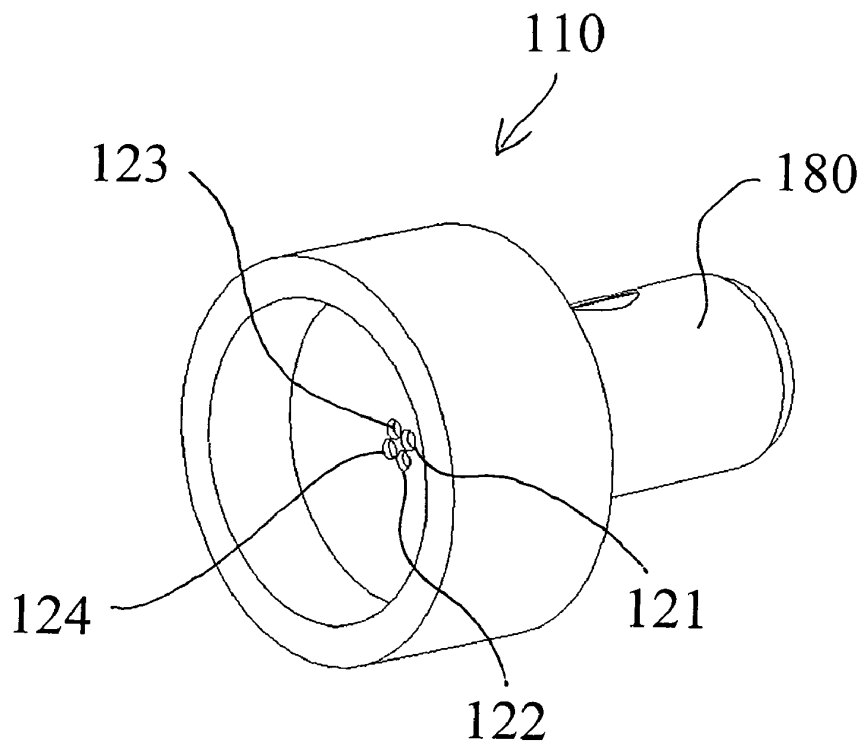


Fig. 5

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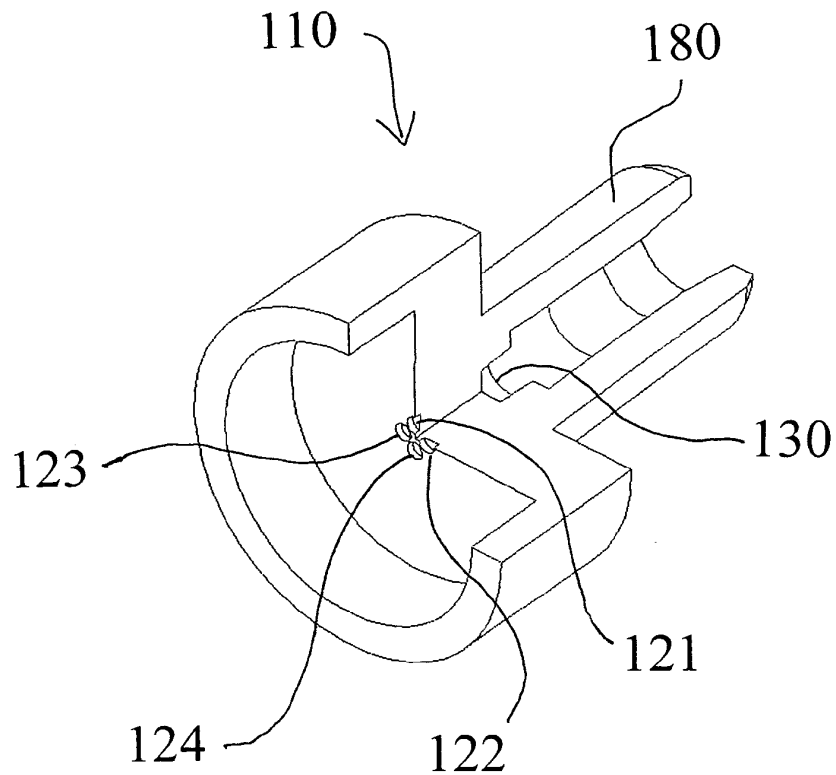


Fig. 6

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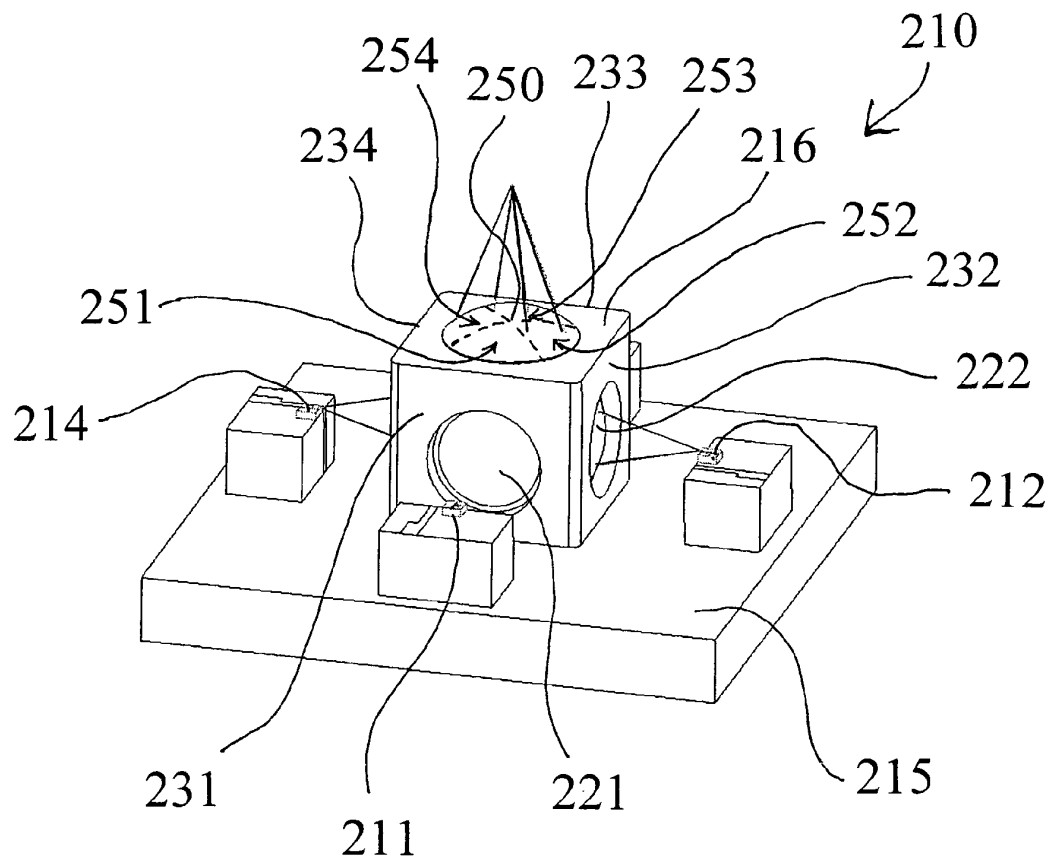


Fig. 7

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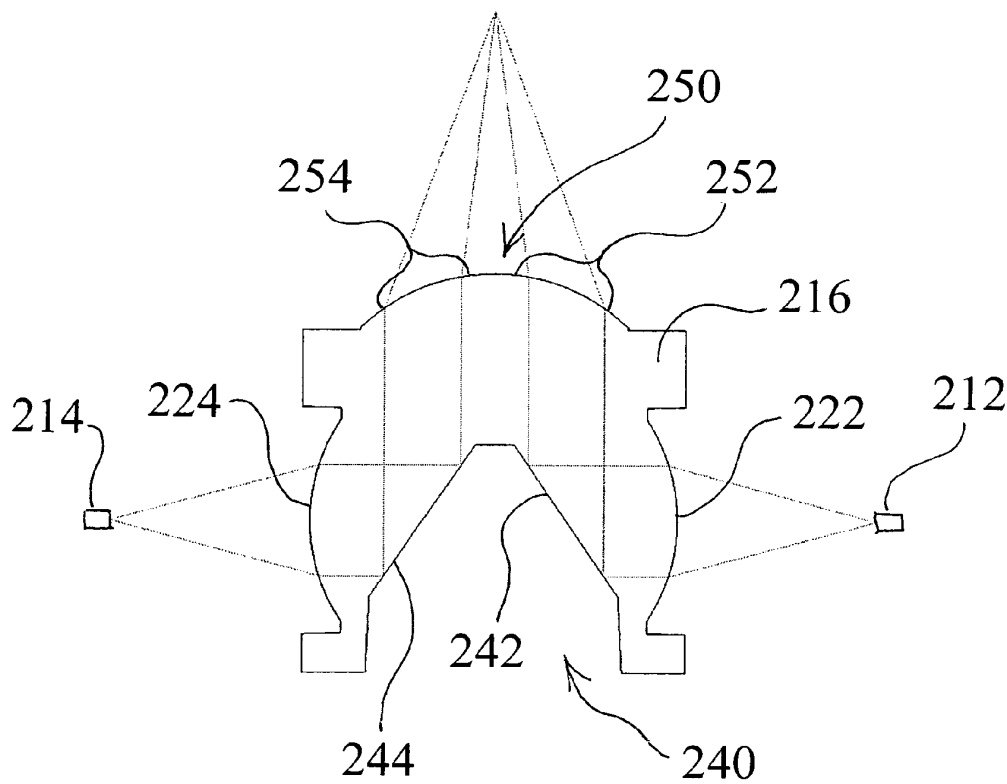


Fig. 8

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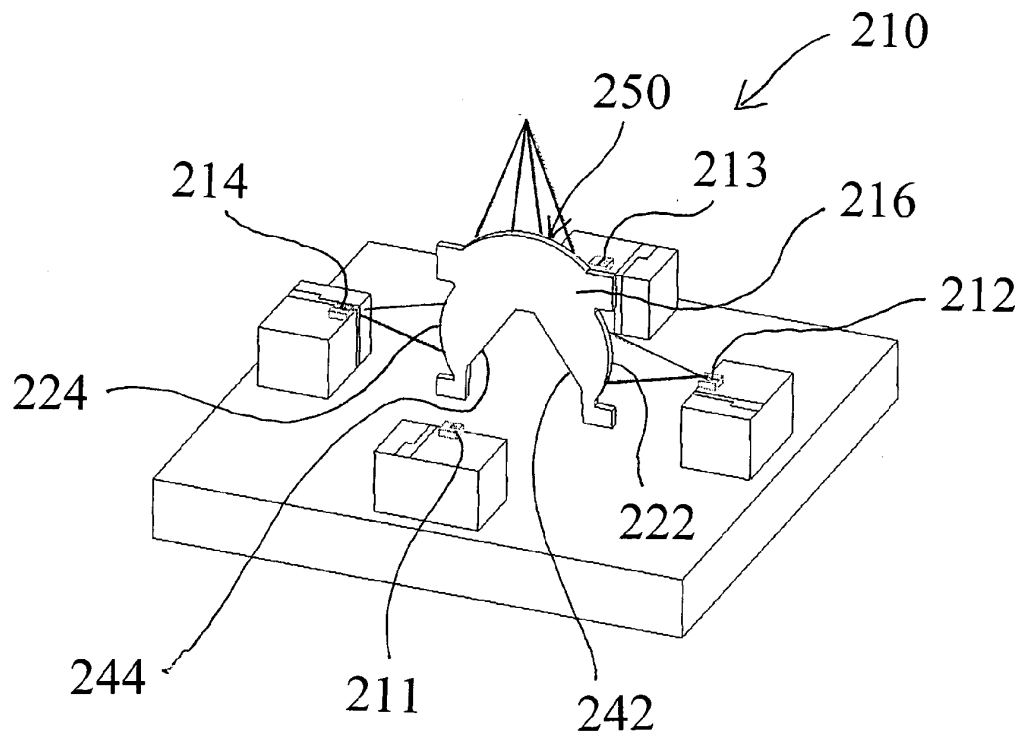


Fig. 9

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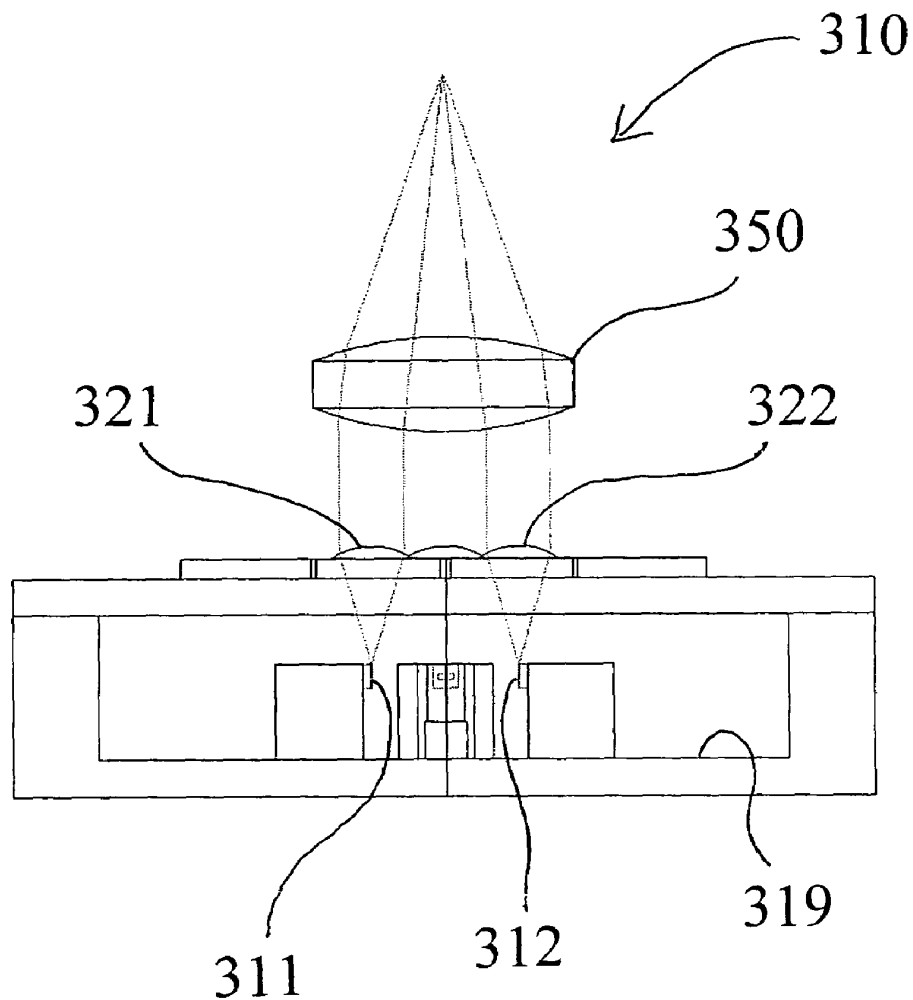


Fig. 10

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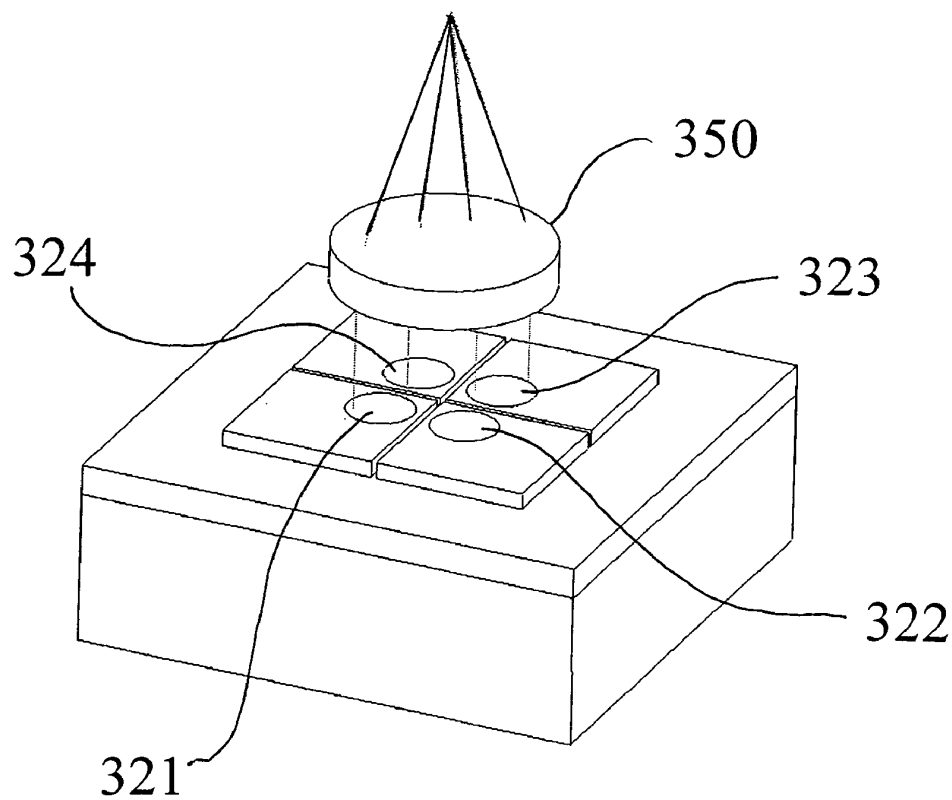


Fig. 11

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OPTICAL COMBINER DEVICE**CROSS-REFERENCE TO RELATED APPLICATION**

This application claims the benefit of and priority from United States Provisional Application Ser. No. 60/541,573 filed Feb. 4, 2004.

BACKGROUND AND BRIEF SUMMARY OF THE INVENTION

The present invention pertains to optical communications. More particularly, this invention relates to an optical multiplexing device which spatially combines multi-wavelength light from a plurality of lasers into an optical fiber. In certain preferred embodiments, the improved multiplexing device of the present invention is particularly suited for wavelength division multiplexing systems for the fiber-optic data-communications and telecommunications systems.

In prior art wavelength division multiplexed optical communication systems, many different optical wavelength carriers provide independent communication channels in a single optical fiber. Future computation and communication systems place ever-increasing demands upon communication link bandwidth. It is generally known that optical fibers offer much higher bandwidth than conventional coaxial communications; furthermore a single optical channel in a fiber waveguide uses a small fraction of the available bandwidth of the fiber (typically a few GHz out of several tens of THz). By transmitting several channels at different optical wavelengths into a fiber (i.e., wavelength division multiplexing, or WDM), this bandwidth may be more efficiently utilized.

Prior art optical multiplexing devices combine or separate multiple light signals with varying optical wavelengths. Such optical multiplexing devices have applications for both dense and course wavelength division multiplexing (DWDM & CWDM) for both multi-mode and signal-mode fiber optic data communications and telecommunications. Multiple wave-length light sources are combined into a single optical path for transmission.

The prior art includes inherent problems overcome by the present invention. Prior art wavelength division multiplexed (WDM) devices are typically designed using dielectric filters requiring alignment or expensive waveguides. The combiner/WDM device described herein utilizes plastic-mold injection to create a compact device capable of combining multiple optical signals into a single optical fiber, and which avoids the use of dielectric filters and the use of expensive waveguides. While a single molded device can be constructed to create one embodiment of the present invention, two or more parts can be combined to accomplish the same function, and may be necessary to achieve certain environmental conditions.

The prior art also includes an optical power combiner which utilizes collimators and a focusing lens to concentrate multiple output beams to increase power density; see Lee et al U.S. Pat. No. 5,377,287. The Lee et al device combines the outputs of, for example, 19 passive optical fibers arranged concentrically together with 19 collimating lenses and a Fresnel focusing lens. The Lee et al design does not achieve isolation from unwanted reflections or a uniform coupling efficiency between each fiber optic input and the single output. The present invention, in contrast, uses a separate radial sector of the focusing lens to focus each separate laser output. Each laser output beam of the present

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invention therefore has the same degree of refraction as it passes through the focusing lens; this feature simultaneously creates a uniform coupling efficiency (as shown below) and prevents unwanted reflections back through the optical pathway to the input lasers. Furthermore, the Lee et al combiner does not multiplex n different wavelength channels, as does the present invention. Therefore, for the above reasons, the Lee et al combiner simply is not effective for communication purposes, which is the primary purpose of the present invention.

The present invention provides, for the first time, an inexpensive, injection molded, one piece optical combiner capable of combining, separately collimating and focusing the output of multiple lasers into a single optical fiber with a uniform, high coupling efficiency. The invention includes optional passive alignment pins molded into the combiner. An optional two piece combiner is also provided for use in certain environments. For example, the invention in one embodiment combines the output of four lasers arranged in a two dimensional, two by two array into a single fiber.

One of the key objects of the present invention is to provide a compact and cost effective optical combiner for both single-mode or multimode fiber optic communication systems, all without requiring the use of dielectric filters and the alignment necessitated by those filters or expensive waveguides.

Another object of the present invention is to minimize optical loss due to divergence of light between the source coupling optics and the fiber optic connector coupling optics.

Another object of the present invention is to minimize reflections directly back to the same focal position from which they were emitted.

A further object is to provide an optical combiner wherein a single focusing lens is utilized to uniformly and efficiently combine n separate wavelength channels by passing each channel through a separate radial sector of the focusing lens.

Another object of the present invention is to integrate a fiber optic connector within the optical module, to passively align an optical fiber to the coupling optic.

Further objects and advantages will become apparent from the following description and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational, sectional view of a combiner of the present invention;

FIG. 2 is an isometric top view of the combiner of FIG. 1;

FIG. 3 is an isometric bottom view of the combiner of FIGS. 1 and 2;

FIG. 4 is a cross-sectional isometric side view of the combiner of FIGS. 1-3;

FIG. 5 is an isometric view of a second embodiment of the invention;

FIG. 6 is an isometric cross-sectional view of the second embodiment of FIG. 5;

FIG. 7 is a perspective view of a third embodiment of the invention;

FIG. 8 is a sectional view of a portion of the third embodiment shown in FIG. 7;

FIG. 9 is a perspective view of the third embodiment shown in FIGS. 7 and 8, wherein a slice of the molded coupling optic is shown to illustrate the invention;

FIG. 10 is a side elevational view of a fourth embodiment of the invention; and

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FIG. 11 is a top isometric view of the fourth embodiment shown in FIG. 10.

DETAILED DESCRIPTION OF THE INVENTION

FIGS. 1–4 show an optical combiner 10 that illustrates a first embodiment of the present invention. The combiner 10 in this embodiment includes four spaced apart input collimating lenses 21,22, 23,24 and output focusing lens 30. Lasers 11,12 are located at the focal points of the input lenses and the light is collimated, reflected off a prism 40 and focused by the focusing lens 30 onto a spot at which a single optical fiber (not shown) is stopped by fiber stop or seat 60 formed in ferrule 80. Pins 71,72,73,74 are located to aid in affixing the combiner device 10 to the support (not shown) for the lasers. The integrated ferrule 80 enables one to place an output fiber optic cable into the pre-aligned connector.

This combiner device has the ability to combine individual light signals into an optical path 90 that can be directed towards an optical fiber (not shown for clarity). Matching the NA of the larger focusing lens 30 and the NA of the fiber (not shown) inserted into ferrule 80, seated at the fiber stop 60, as well as the spot size 50 of the focused beam being made smaller than the fiber core couples a maximum amount of the collimated light into the fiber. Similarly, by arranging four (in this embodiment) collimating lenses 21,22,23,24 of a size small enough to fit inside the diameter of the focusing lens 30, and matching their NA to the light sources, the maximum amount of light will couple into the collimated output beam 95.

The first embodiment of the invention is a combiner 10 comprised of a single piece plastic molded coupling module 16 consisting of four collimating lenses 21–24 and one lens 30 for focusing several geometrically placed collimated beams onto the output fiber (not shown) and a prism 40 for reflecting the plurality of collimated beams for maximum coupling efficiency into the output fiber.

The plastic molded coupling module 16 is formed by integrating an aspherical on-axis, offset collimating lens array 21–24, a redirectional prism 40, a focusing lens 30, a fiber optic ferrule 80, and mechanical pins 71–74 for alignment of the optical part 16 to an array of four lasers, all within a single part 16.

The invention is usable with n lasers and n collimating lenses. The embodiment shown in FIGS. 1–4 illustrates the case of $n=4$. Furthermore, FIGS. 1–4 utilize a two-dimensional, two by two array of input lasers as well as collimating lenses.

FIGS. 5 and 6 show a second embodiment of the invention 110 which does not include a prism for translating the optical beams from one axis to another. This particular embodiment is beneficial for mating to a standard “TO” style laser chip package. Similar to the embodiment described in FIGS. 1–4, the embodiment shown here utilizes a two-dimensional array of four lenses 121,122,123,124 for collimating the input light signals from a two-dimensional, two by two, array of lasers (not shown), a single focusing lens 130, and a fiber connector 180 that allows one to place a fiber optic cable into the pre-aligned connector.

FIGS. 7, 8 and 9 illustrate a third embodiment of the invention. The combiner is shown generally as 210 and includes a circular array of four lasers 211,212,213 and 214. Each laser 211–214 has a different output wavelength. Each laser is mounted to a support 215. The lasers 211–214 are co-planar and the output beam of each of the lasers 211–214 is directed towards the center of the array. At the center of

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the array is a coupling optic 216 formed of a single monolithic optical block. Four collimating lenses (only two of which 221 and 222 are visible) are formed in the four side walls 231,232,233 and 234, respectively, of the module or coupling block 216. The focusing lens 250 is formed on the top surface of the module 216. The surface of focusing lens 250 is smooth and includes four pie-shaped radial quadrants 251–254. Each of the quadrants 251–254 transmits a separate output beam of the lasers 211–214, respectively.

As shown best in FIG. 8, the bottom surface 240 of module 216 is recessed with four separate inclined surfaces that form four separate prisms to reflect collimated light to the output lens 250. In the view shown in FIG. 8, collimating lenses 222 and 224 receive the output beams from lasers 212 and 214, respectively. Prisms 242 and 244 reflect the output beams from collimating lenses 222 and 224 and direct those beams through separate pie-shaped quadrants 252 and 254 of focusing lens 250.

It is significant to note that, as shown in FIG. 8, the output beams of lasers 212 and 214 are refracted through output lens 250 through equal angles. This is significant because the beam passing through quadrant 252 will not be reflected by the stopped single fiber optic back into laser 212. Rather, the laser output 212 passing through quadrant 252 will tend to be reflected from the stopped fiber optic back towards quadrant 254. Since the output of laser 212 is of a different wavelength than the output of laser 214, that reflection that passes back through quadrant 254 from laser 212 will not adversely affect the performance of laser 214, since it operates at a different wavelength.

FIG. 9 shows a single slice of optic 216 to more clearly illustrate the interaction with the module 216 with the circular array of lasers 211–214.

FIGS. 10 and 11 illustrate a fourth embodiment of the invention. In this embodiment, the combiner shown generally as 310 includes a two-piece molded module including a separately molded output lens 350 and separately molded collimating lenses 321–324. The collimating lenses 321–324 are preferably molded into a single but separate monolithic block of molded material so that the combiner 310 includes two separate molded optics. The focusing lens 350 is supported in its position shown in FIG. 10 by means known to those skilled in the art which are deleted in the interest of brevity. As shown in FIG. 10, an array of four lasers are supported in housing 319. In the view shown in FIG. 10, only two lasers 311 and 312 are visible. Their output beams are directed through collimating lenses 321 and 322 and in the embodiment shown in FIGS. 10 and 11 travel directly to and through focusing lens 350 without being reflected by a prism. Collimating lenses 321–324 are supported by the top of housing 319.

Key Features:

Manufacturing throughput Replication procedures are extremely fast, thus reducing the overall cost of the manufactured device.

Passive Alignment All of the optical components within the multiplexer could utilize passive alignment mechanisms.

Monolithic Coupling Optics Each optical coupling and redirectional component is integrated within a single monolithic plastic-molded device in most embodiments.

Cost Reduction Fewer parts are required such as filters and reflector blocks.

Offset Launch Spots may be focused on a section of the fiber which is offset from the center of the fiber, thus creating

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an offset launch condition, which is known by those skilled in the art to produce a better condition for resisting modal partition noise.

Potential Applications:

- 1) Wavelength division multiplexing/demultiplexing (WDM)
- 2) Optical signal routing
- 3) Spectroscopy
- 4) Biological and chemical integrated optical sensors
- 5) Optical computing

The foregoing description of the invention has been presented for purposes of illustration and description and is not intended to be exhaustive or to limit the invention to the precise form disclosed. Modifications and variations are possible in light of the above teaching. The embodiments were chosen and described to best explain the principles of the invention and its practical application to thereby enable others skilled in the art to best use the invention in various embodiments and with various modifications suited to the particular use contemplated. The scope of the invention is to be defined by the following claims.

What is claimed is:

1. An optical combiner usable in data communication systems for multiplexing the outputs of a plurality of n lasers wherein each of said n outputs has a different output wavelength, for transmission into and through a stopped single optical fiber, comprising:

a plurality of n collimating lenses, said lenses being spaced apart and positioned to receive and collimate the output of said n laser output beams, said n laser output beams have n different output wavelengths, and

focusing means for focusing said n collimated output beams onto a single spot at said stopped single optical fiber, said focusing means having n separate radial sectors on its surface, and each of said n collimated beams passes through a separate one of said n sectors of said focusing means whereby said n output beams having n different wavelengths are coupled into said single fiber.

2. The optical combiner of claim 1 wherein $n=4$ and wherein said four lasers and four collimating lenses are each formed in a two-dimensional, two by two array, wherein said focusing means is a single focusing lens, and wherein each radial sector is a pie-shaped quadrant.

3. The optical combiner of claim 2 wherein a prism is positioned between each of said collimating lenses and said focusing lens, and wherein said collimating lenses, said prism and said focusing lens are formed as a single, monolithic molded block.

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4. The optical combiner of claim 3 wherein said single monolithic block has a top surface, a bottom surface, and four side surfaces, said top surface forming said focusing lens, each of said four side surfaces forming one of said collimating lenses, and said bottom surface being formed to include four separate prisms, each of said prisms reflecting a laser output beam passing through one of said collimating lenses onto one of said quadrants of said focusing lens.

5. The optical combiner of claim 4 wherein said four lasers are positioned in a circular array with their output beams directed toward the center of said array, all of said output beams lying in a common plane, and said single monolithic block is positioned at the center of said circular array.

6. The optical combiner of claim 1 wherein said optical combiner does not require the use of dielectric filters or waveguides.

7. An optical combiner usable in data communication systems for multiplexing the outputs of a plurality of lasers wherein each of said outputs has a different wavelength, for transmission into and through a stopped single optical fiber, comprising:

an array of four lasers, formed in a two-dimensional, two by two array, each of said lasers having an output beam with a different wavelength,

an array of four collimating lenses, said lenses being formed in a two-dimensional, two by two array and positioned to receive and collimate the output of said laser output beams, and

focusing means for focusing said collimated output beams onto a single spot at said stopped single optical fiber, said focusing means having four separate quadrants on its surface, and each of said four collimated beams passes through a separate one of said quadrants of said focusing means whereby said output beams of said four lasers are coupled into said single fiber.

8. The optical combiner of claim 7 wherein a prism is positioned between each of said collimating lenses and said focusing lens, and wherein said collimating lenses, said prism and said focusing lens are formed as a single, monolithic molded block.

9. The optical combiner of claim 7 wherein said optical combiner does not require the use of dielectric filters or waveguides.

* * * * *

Exhibit B

EXHIBIT B:
Exemplary Claim Chart for US Patent No. 7,198,416

US Patent No. 7,198,416	Opticis Infringement Evidence ¹
1. An optical combiner usable in data communication systems for multiplexing the outputs of a plurality of n lasers wherein each of said n outputs has a different output wavelength, for transmission into and through a stopped single optical fiber, comprising:	The Opticis optical sub-assemblies (OSAs) are optical combiners usable in data communication systems for multiplexing the outputs of a plurality of n lasers wherein each of said n outputs has a different output wavelength, for transmission into and through a stopped single optical fiber. The image below shows an intact 6-channel Opticis OSA, which is representative of all accused Opticis OSAs. Optical combiner

¹ Three Opticis sub-assemblies (OSAs) are shown. The intact OSA shown first is a 6-channel device bearing a handwritten marking “805.X-2”. The second OSA, shown disassembled, is a 6-channel device, bearing a label marked “SV0182 CL71FK 104-0267” and further marked “6CH 1 fiber TOSA Rev03 2019.6.10.” The third OSA, also shown disassembled, is a 4-channel device, bearing a label marked “C011-707-0185”, and further marked “4CH_5004|C_Tx_R_R36 2016.03.10.”

EXHIBIT B:
Exemplary Claim Chart for US Patent No. 7,198,416

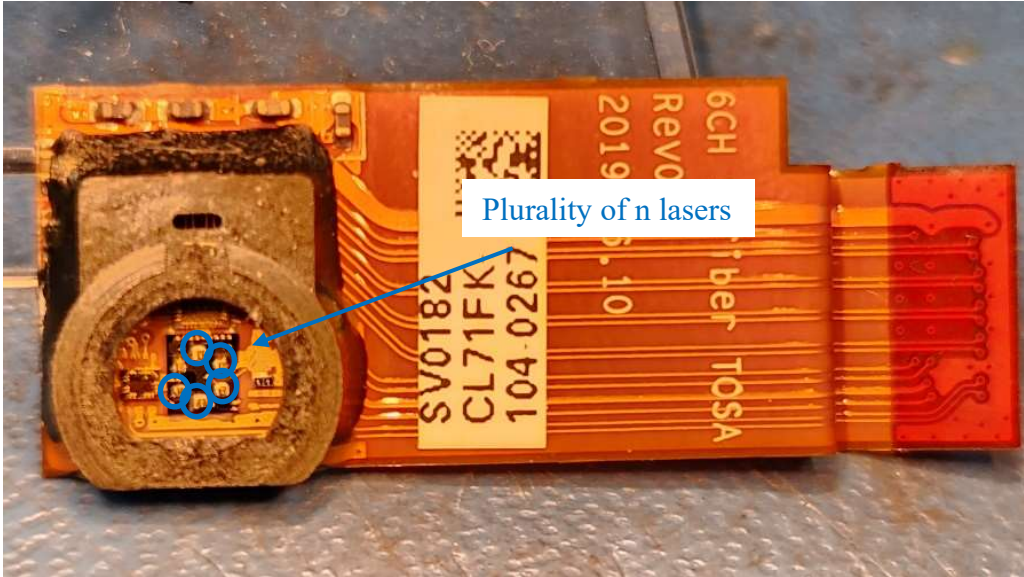
US Patent No. 7,198,416	Opticis Infringement Evidence ¹
	The image below shows a portion of a partly disassembled 4-channel Opticis OSA, indicating a plurality of n (in this instance, 5) lasers. 

EXHIBIT B:
Exemplary Claim Chart for US Patent No. 7,198,416

US Patent No. 7,198,416	Opticis Infringement Evidence ¹
	The image below shows a portion of a partly disassembled 4-channel Opticis OSA, indicating a plurality of n (in this instance, 4) lasers. Plurality of n lasers Each of the laser outputs has a different output wavelength, for transmission into and through a stopped single optical fiber. <i>See, for example</i>, DVFX-100 User Manual (“The DVFX-100-TR optical DVI module transmits four (4) optical data, Red, Green, Blue and clock ... over one (1) SC multi-mode fiber”); DVFX-100 Data Sheet (“The module has a capability to transmit 2K resolution graphic signals ... using leading-edge OPTICIS fiber optic component that transmits four (4) data channels over one multi-mode fiber.”); DPFx-300-TR User Manual (“This laser product is inside implemented by using 850, 925, 930, 990 nm LD Transceivers”).

EXHIBIT B:
Exemplary Claim Chart for US Patent No. 7,198,416

US Patent No. 7,198,416	Opticis Infringement Evidence ¹
[a] a plurality of n collimating lenses, said lenses being spaced apart and positioned to receive and collimate the output of said n laser output beams, said n laser output beams have n different output wavelengths, and	Each of the Opticis OSAs includes a plurality of n collimating lenses. Said collimating lenses are spaced apart and positioned to receive and collimate the output of the n laser output beams, with each of the n laser output beams having a different output wavelength. The images below show portions of partly disassembled 4-channel and 6-channel Opticis OSAs, indicating a plurality (4 and 5, respectively) collimating lenses. These collimating lenses are spaced apart and are positioned to receive and collimate the output of the corresponding laser outputs, each of which has a different wavelength.

EXHIBIT B:
Exemplary Claim Chart for US Patent No. 7,198,416

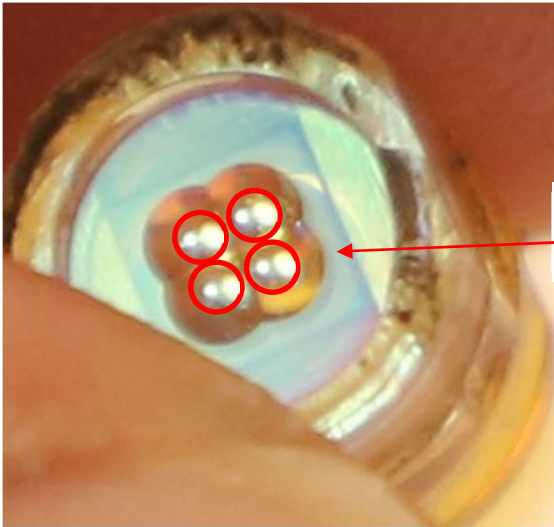
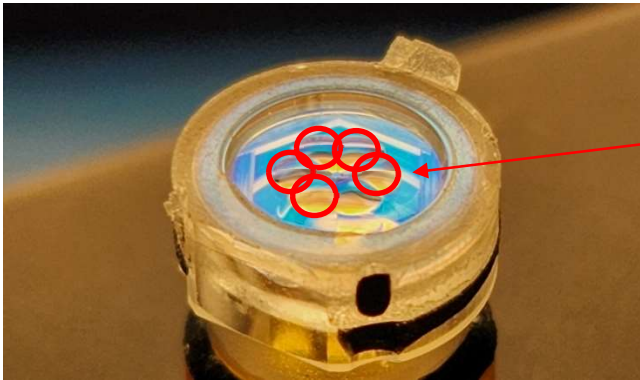
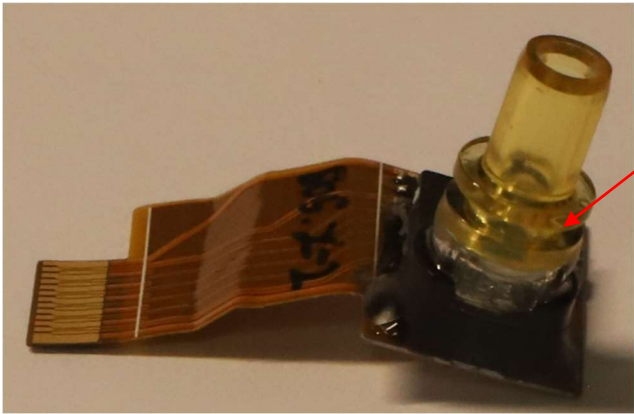
US Patent No. 7,198,416	Opticis Infringement Evidence ¹
	 Plurality of n collimating lenses spaced apart  Plurality of n collimating lenses spaced apart Each of the laser outputs has a different output wavelength. <i>See, for example</i>, DVFX-100 User Manual (“The DVFX-100-TR optical DVI module transmits four (4) optical data, Red, Green, Blue and clock ... over one (1) SC multi-mode fiber”); DVFX-100 Data Sheet (“The module has a capability to transmit 2K resolution graphic signals ...

EXHIBIT B:
Exemplary Claim Chart for US Patent No. 7,198,416

US Patent No. 7,198,416	Opticis Infringement Evidence ¹
	using leading-edge OPTICIS fiber optic component that transmits four (4) data channels over one multi-mode fiber.”) ; DPFX-300-TR User Manual (“This laser product is inside implemented by using 850, 925, 930, 990 nm LD Transceivers”).
[b] focusing means for focusing said n collimated output beams onto a single spot at said stopped single optical fiber, said focusing means having n separate radial sectors on its surface, and each of said n collimated beams passes through a separate one of said n sectors of said focusing means whereby said n output beams having n different wavelengths are coupled into said single fiber.	Each of the Opticis OSAs includes a focusing means² for focusing said n collimated output beams onto a single spot at said stopped single optical fiber, said focusing means having n separate radial sectors on its surface, and each of said n collimated beams passes through a separate one of said n sectors of said focusing means whereby said n output beams having n different wavelengths are coupled into said single fiber. The images below illustrate the location of the focusing means in a 6-channel Opticis OSA. 

² To the extent “focusing means for focusing ...” is construed to be a means-plus-function limitation under 35 U.S.C. § 112(f), the corresponding structure in the specification includes at least the following structures and equivalents thereto: Figs 1-4 and corresponding text (focusing lens 30), Figs 5-6 and corresponding text (focusing lens 130), Figs. 7-9 and corresponding text (focusing lens 250), and/or Figs 10-11 and corresponding text (focusing lens 350).

EXHIBIT B:
Exemplary Claim Chart for US Patent No. 7,198,416

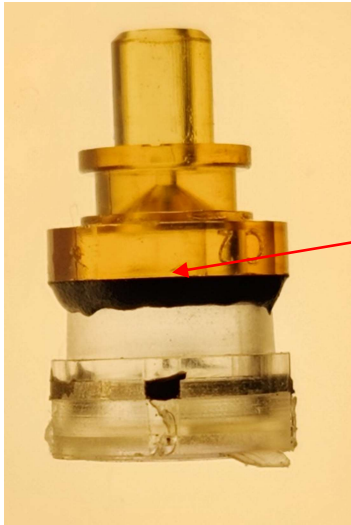
US Patent No. 7,198,416	Opticis Infringement Evidence ¹
	 Focusing means The images below provide further illustrations of the elements of the focusing means, showing said focusing means having n separate radial sectors on its surface, and each of said n collimated beams passes through a separate one of said n sectors of said focusing means whereby said n output beams having n different wavelengths are coupled into said single fiber:

EXHIBIT B:
Exemplary Claim Chart for US Patent No. 7,198,416

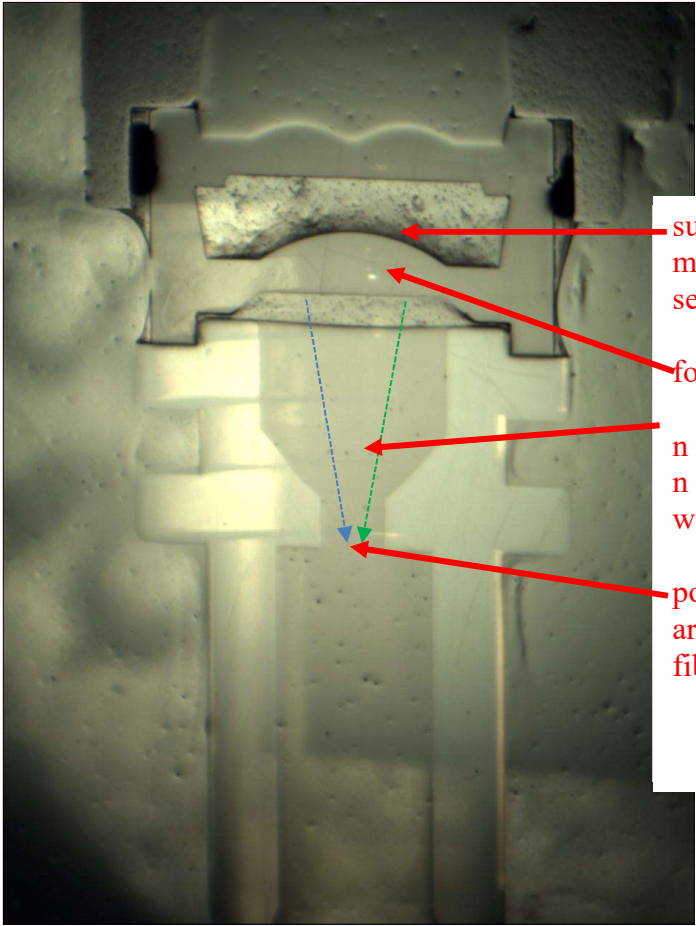
US Patent No. 7,198,416	Opticis Infringement Evidence ¹
	 The micrograph shows a cross-section of an optical device. A central fiber is visible at the bottom. Above it, a series of curved, segmented structures (focusing means) are shown. Red arrows point from text labels to specific features in the image: one points to the top curved surface, another to the segmented structure, a third to the fiber, and a fourth to a point where multiple beams converge. Dashed blue and green lines also indicate beam paths. - surface of focusing means with n radial sectors - focusing means n output beams having n different wavelengths - point at which beams are coupled into single fiber

EXHIBIT B:
Exemplary Claim Chart for US Patent No. 7,198,416

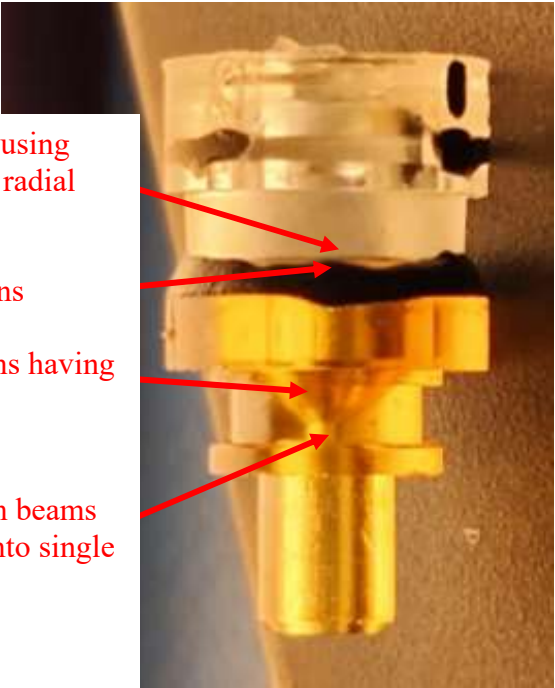
US Patent No. 7,198,416	Opticis Infringement Evidence ¹
	 surface of focusing means with n radial sectors focusing means n output beams having n different wavelengths point at which beams are coupled into single fiber Each of the laser outputs has a different output wavelength, for transmission into and through a stopped single optical fiber. <i>See, for example</i>, DVFX-100 User Manual (“The DVFX-100-TR optical DVI module transmits four (4) optical data, Red, Green, Blue and clock ... over one (1) SC multi-mode fiber”); DVFX-100 Data Sheet (“The module has a capability to transmit 2K resolution graphic signals ... using leading-edge OPTICIS fiber optic component that transmits four (4) data channels over one multi-mode fiber.”) ; DPFX-300-TR User Manual (“This laser product is inside implemented by using 850, 925, 930, 990 nm LD Transceivers”).

Exhibit C



1-Fiber Detachable DVI module, DVFX-100

User's Manual



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Welcome

Congratulations on your purchase of the **Stretch DVI™** DVFX-100-TR Optical DVI (Digital Visual Interface) Extension Module. This manual contains information that will assist you in installing and operating the product.

Product Description

The **DVFX-100-TR** optical DVI module transmits four (4) optical data, Red, Green, Blue and clock and can be extended up to 500 meters (1,640ft) over one (1) SC multi-mode fiber (50/125um) at 2K resolution or WUXGA (1920x1200) at 60Hz vertical refresh rate. The EDID (Extended Display Identification Data) in a display can be read and restored by just plugging once transmitter to the display. This **Self-EDID programming** feature makes the installation of DVFX-100-TR more easy and flexible at any variable resolution display systems. For your convenience, UXGA EDID would have been done before shipment as a default.

Shipping Group

- **DVFX-100-TR Optical DVI Extension Module:** One (1) pair
- **AC/DC power adapter:** Two (2) units of +5V, 1A
- **User's Manual**
- **Option Product:** Simplex SC Patch Cord (Multi-mode fiber)

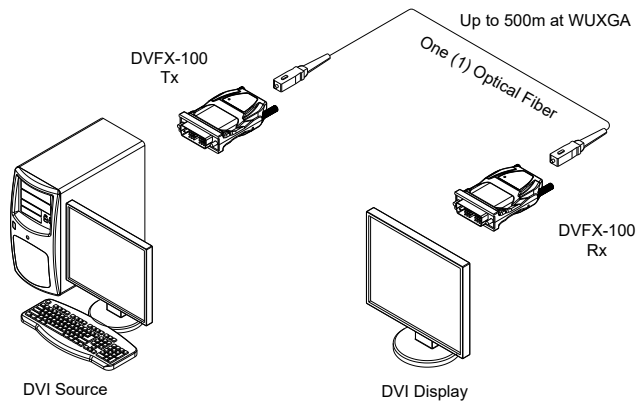


Figure 1 – Connection Diagram of Optical DVI Extension Module

System Requirements for Setup

□ Hardware requirements

- You have to have a DVI graphic controller or card having a DVI port in your PC, SUN or Mac systems. It should support the maximum graphic resolution feature of displays to be connected.
- No special requirements for memory size, CPU speed and chipsets, if you've already properly installed your DVI graphic controllers or cards.

□ Software requirements

- No special restrictions, if you've already properly installed your DVI graphic controller in your OS.

□ AC/DC Power Adapter Technical Advisory

The transmitter (Tx) module of DVFX-100-TR is designed for power protection circuit from conflict of power supply between the external AC/DC power adapter and your DVI source by #14 pin.

We strongly recommend to use external AC/DC adapter for Transmitter (Tx) for stable power supplying. In case of Receiver (Rx), power should be supplied by AC/DC adapter due to no internal power supplying from the displays.

Installation

Important: Please keep the installation procedure below. Improper or no operation may result if the start-up sequence is not correctly followed.

Step 1

Carefully unpack the contents of the shipping group.

Step 2

Plug the 5V power adapters to the power jack of the transmitter and receiver. Ensure the Power LED ON (Blue).

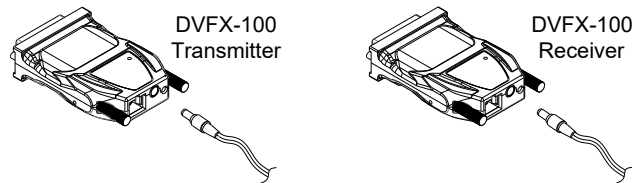


Figure 2 – Connection of power adapter to the transmitter and receiver

Step 3

Please, check if the maximum resolution of the display is UXGA (1600x1200). Otherwise, follow the instructions for **Self-EDID Programming Procedure** on page 1-5.

Step 4

Connect SC optical fiber between the transmitter and the receiver as shown in figure 3.

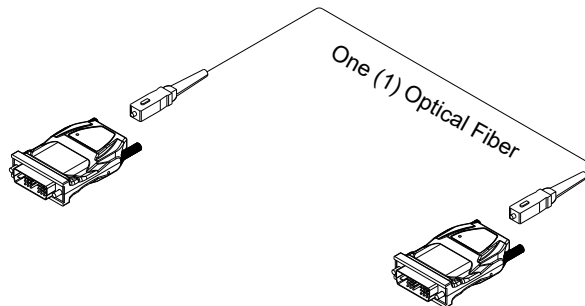


Figure 3 – Connection of optical fiber

Step 5

Plug the transmitter to the DVI receptacle of the DVI source such as PC and the receiver to the DVI receptacle of the display.

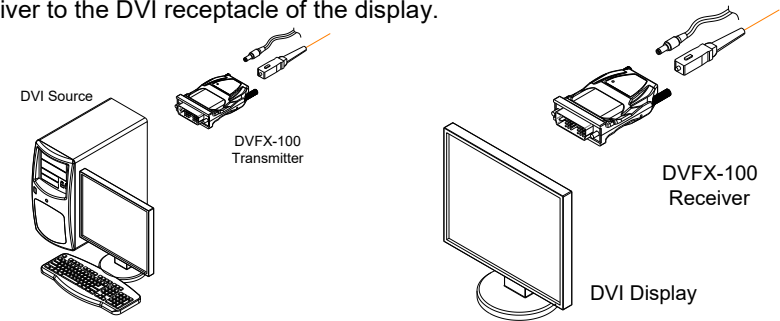


Figure 4 – Connection of the transmitter to the DVI source and receiver to the display

Note: Be recommended NOT to use any intermediate cable or adapter between them to avoid undesirable performance degradation.

Step 6

Make the PC and the display power ON. And ensure that the Status LED in transmitter and receiver turn on.

Self-EDID Programming Procedure

The graphic source equipment generally requires display information (EDID). It contains resolution and timing information of the display.

DVFX-100-TR supports Self-EDID programming. It is the procedure that reads the EDID from the display and stores it in the EEPROM of the transmitter. You have to do Self-EDID programming if the maximum resolution of the user's display is not UXGA (1600x1200). Follow the steps below to do it correctly.

Note1: If you know that EDID is not required by the user's DVI source, Self-EDID programming is not necessary.

Note2: The default EDID in factory ship-out is programmed in the VESA standard of UXGA (1600x1200), 60Hz.

Step 1

Power on the display.

Step 2

Plug the 5V power adapter to the power jack of the transmitter of DVFX-100. Ensure the Power LED ON.

Step 3

Push the EDID PRGM. button of the transmitter with a narrow pin. Then, status LED will be turned ON.

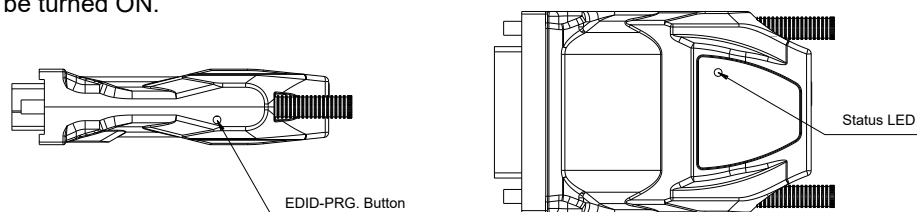


Figure 5 – Position of EDID-PRGM. button and Status LED

Step 4

Connect the transmitter to the display not to the PC. Then the status LED will begin to blink rapidly. It indicates reading the EDID from the display and storing it in the EEPROM. After 7~8 sec, the status LED turn OFF and it indicates completion of all procedure.

Step 5

Disconnect the transmitter from the display.

Troubleshooting

The display shows only black screen.

- Ensure that all plugs and jacks used by external power supplies (both Opticis and others) are firmly connected. Ensure that the Power and status LED ON.
- Ensure that the DVI ports are firmly plugged in to the PC and display.
- Ensure that the transmitter and receiver modules plugged correctly to the PC and display, respectively.
- Check if the PC and display are powered on and properly booted.
- Reset the system by de-plugging and re-plugging the transmitter DVI port or receiver DVI port, or by de-plugging and re-plugging the power plugs of transmitter and receiver modules.
- Re-boot up the system while connecting the optical DVI extension module.

Screen is distorted or displays noises.

- Check if the graphic resolution is properly set. Go to the display properties of Windows and tap the settings.
- Ensure that the resolution sets less than WUXGA (1920x1200) at 60Hz refresh ratio.
- Reset the system. Disconnect and reconnect the optical DVI cables or 5V power adapters.

Maintenance

No special maintenance is required for the optical DVI module and power adapters. Ensure that the DVI modules and power adapters are stored or used in a benign environment free from liquid or dirt contamination.

There are no user serviceable parts. Refer all service and repair issues to Opticis USA.

Technical Support and Service

General Inquires: info@opticisusa.com
Tech Support: support@opticisusa.com

Visit us at www.opticisusa.com to learn more about Opticis products.

Product Specifications**DVFX-100-TR Optical DVI Extension Modules**

- ☐ **Compliance with DVI standard:** Supports DVI1.0, fully implemented by fiber-optic communication and DDC2B by virtual DDC.
- ☐ **Extension limit:** 500meters (1640feet) over 50/125µm multi-mode fiber at WUXGA (1920x1200), 60Hz refresh rate.
- ☐ **Graphic transmission bandwidth:** 2.25Gbps bandwidth which covers WUXGA or even 2K or 1080p 36bit color depth.
- ☐ **Fiber-optic connection:** The transmitter and receiver modules of DVFX-100 have one (1) SC receptacles so as to be connected with one (1) SC simplex multi-mode fibers, having 62.5/125µm or 50/125µm core.
- ☐ **DDC connection:** Virtual DDC by Self-EDID programming.
- ☐ **Mechanical specifications of transmitter and receiver modules**
 - **Dimensions (WDH):** 39 x 56 x 14.6mm
- ☐ **Environmental Specifications**
 - Operating temperature: 0 to 40°C (Medical), 0 to 50°C (General)
 - Storage temperature: - 30°C to 70°C
 - Operating & Storage humidity: 0% to 85%

AC/DC Power Adapter (General)

- ☐ **Power Input:** AC 100-240V, 50/60Hz
- ☐ **Power Output:** +5VDC, 1A (USA, EU type), 2A (UK type) SMPS
- ☐ **Cord DC Jack:** Core is 5 V and outer is GND.

AC/DC Power Adapter (Medical)

- ☐ **Power Input:** AC 100-240V, 50/60Hz
- ☐ **Power Output:** +5 V, 2A SMPS DC-power Adapter
- ☐ **Model name:** BPM010S05FXX (Manufacturer: BridgePower Corp.)

Product Specifications**Label Specification**

- ☐ +5V  2.0A: Direct Current (Medical)
- ☐ +5V  1.0A: Direct Current (General)

Operation Condition

Operating condition	Temperature (°C)	10 ~ 40 (Medical) 0 ~ 50 (General)
	Relative humidity (%)	+30 ~ +75
	Atmospheric Pressure (hPa)	700 – 1060
Transport and storage condition	Temperature (°C)	-30 ~ +70
	Relative humidity (%)	+10 ~ +95
	Atmospheric Pressure (hPa)	500 - 1060

Warranty Information

1 (One) Year Warranty

Opticis warrants this optical DVI extension module to be free from defects in workmanship and materials, under normal use and service, for a period of one (1) year from the date of purchase from Opticis or its authorized resellers.

If a product does not work as warranted during the applicable warranty period, Opticis shall, at its option and expense, repair the defective product or part, deliver to customer an equivalent product or part to replace the defective item, or refund to customer the purchase price paid for the defective product.

All products that are replaced will become the property of Opticis.

Replacement products may be new or reconditioned.

Any replaced or repaired product or part has a ninety (90) day warranty or the remainder of the initial warranty period, whichever is longer.

Opticis shall not be responsible for any software, firmware, information, or memory data of customer contained in, stored on, or integrated with any products returned to Opticis for repair under warranty or not.

Warranty Limitation and Exclusion

Opticis shall have no further obligation under the foregoing limited warranty if the product has been damaged due to abuse, misuse, neglect, accident, unusual physical or electrical stress, unauthorized modifications, tampering, alterations, or service other than by Opticis or its authorized agents, causes other than from ordinary use or failure to properly use the product in the application for which said product is intended.

Dispose of Old Electrical & Electronic Equipment

(Applicable in the European Union and other European countries with separate systems)



This symbol on the product or on its packaging indicates that this product shall not be treated as household waste. Instead it shall be handed over to the applicable collection point for the recycling of electrical and electronic equipment. By ensuring this product is disposed of correctly, you will help prevent potential negative consequences for the environment and human health, which could otherwise be caused by inappropriate waste handling of this product.

The recycling of materials will help to conserve natural resources. For more detailed information about recycling of this product, please contact your local city office, your household waste disposal service or the shop where you purchased the product.



WARNING: Do not touch signal input, signal output of other connectors, and the patient simultaneously.



WARNING: Do not connect any accessory except provided by Opticis. Any damage caused other power adapters or accessories will not be taken any responsibility by Opticis.

Warning for Medical Usage



WARNING: External equipment intended for connection to signal input, signal output or other connectors, shall comply with relevant IEC Standard (e.g., IEC60950 for IT equipment and IEC60601-1 series for medical electrical equipment). In addition, all such combination-system shall comply with the standard IEC60601-1 and/or IEC60601-1-1 harmonized national standard or the combination. If, in doubt, contact a qualified technician or your local representative.



WARNING: (Detachable) Listed, Type SJT, min. No. 18 AWG, 3-conductor terminating in molded-on Listed "Hospital Grade", parallel blade, grounding type attachment plug rated minimum 15 A, 125 V. Maximum 4.0 m long. Making tag provided indicating "Grounding reliability can only be achieved when the equipment is connected to an equivalent receptacle marked "Hospital Only" or "Hospital Grade"

UL/EN Statement

This equipment has been tested and found to comply with the limits for medical devices in UL/EN 60601-1, 60601-1-2 and FCC/CE. These limits are designed to provide reasonable protection against harmful interference in a typical medical installation.

This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to other devices in the vicinity. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to other devices, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving device.
- Increase the separation between the equipment.
- Connect the equipment into an outlet on a circuit different from that to which the other device(s) are connected.
- Consult the manufacturer or field service technician for help.
- Type of protection against electric shock: Class I equipment
- Degree of protection against electric shock: Not classified - no applied parts
- Classification according to the degree of protection against ingress of water as detailed in the current edition of IEC 529: IPX0, ordinary equipment
- This equipment is not suitable for use in the presence of flammable anesthetics or oxygen
- Mode of operation: continuous operation

Guidance and Manufacturer's Declaration

Guidance and Manufacturer's Declaration – Electromagnetic Emissions		
This Device is intended for use in the electromagnetic environment specified below. The user of the Device should assure that it is used in such an environment.		
Emissions Test	Compliance	Electromagnetic Environment - Guidance
RF Radiated Emissions CISPR 11	Group 1	This Device uses RF energy only for its internal function. Therefore, its RF radiated emissions are very low and are not likely to cause any interference in nearby electronic equipment.
RF Conducted Emissions CISPR 11	Class A	This Device is suitable for use in all establishments other than domestic and those directly connected to a low-voltage power supply network which supplies buildings used for domestic purposes.
Harmonic Emissions IEC 61000-3-2	Class A	
Voltage Fluctuations/Flicker Emissions IEC 61000-3-3	Complies	

Guidance and Manufacturer's Declaration – Electromagnetic Immunity			
This Device is intended for use in the electromagnetic environment specified below. The user of the Device should assure that it is used in such an environment.			
Immunity Test	IEC 60601 Test Level	Compliance Level	Electromagnetic Environment - Guidance
Electrostatic Discharge (ESD) IEC 61000-4-2	±6 kV Contact ±8 kV Air	±6 kV Contact ±8 kV Air	Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrical Fast Transient/Burst IEC 61000-4-4	±2 kV for power supply lines ±1 kV for input/output lines	±2 kV for power supply lines ±1 kV for input/output lines	Mains power quality should be that of a typical commercial or hospital environment.
Surge IEC 61000-4-5	±1 kV differential mode ±2 kV common mode	±1 kV differential mode ±2 kV common mode	Mains power quality should be that of a typical commercial or hospital environment.
Voltage Dips, Short Interruptions and Voltage Variations on Power Supply Input Lines IEC 61000-4-11	<5 % UT (>95 % dip in UT) for 0.5 cycle 40 % UT (60 % dip in UT) for 5 cycles 70 % UT (30 % dip in UT) for 25 cycles <5 % UT (>95 % dip in UT) for 5 sec	<5 % UT (>95 % dip in UT) for 0.5 cycle 40 % UT (60 % dip in UT) for 5 cycles 70 % UT (30 % dip in UT) for 25 cycles <5 % UT (>95 % dip in UT) for 5 sec	Mains power quality should be that of a typical commercial or hospital environment. If the user of the device requires continued operation during power mains interruptions, it is recommended that the device be powered from an uninterruptible power source.
Power Frequency (50/60 Hz) Magnetic Field IEC 61000-4-8	3 A/m	3 A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical home or hospital environment.

Guidance and Manufacturer's Declaration

Guidance and Manufacturer's Declaration – Electromagnetic Immunity			
This Device is intended for use in the electromagnetic environment specified below. The user of the Device should assure that it is used in such an environment.			
Immunity Test	IEC 60601 Test Level	Compliance Level	Electromagnetic Environment - Guidance
Conducted RF IEC 61000-4-6 Radiated RF IEC 61000-4-3	3 Vrms 150 kHz to 80 MHz 3 V/m 80 MHz to 2.5 GHz	3 V 3 V/m	Portable and mobile RF communications equipment should be used no closer to any part of the Device, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. Recommended Separation Distance $d = 1.2\sqrt{P}$ $d = 1.2\sqrt{P}$ (80 MHz to 800 MHz) $d = 2.3\sqrt{P}$ (800 MHz to 2.5 GHz) Where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and d is the recommended separation distance in meters (m). Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey, should be less than the compliance level in each frequency range. Interference may occur in the vicinity of equipment marked with the following symbol: 
Note 1: At 80 MHz and 800 MHz, the higher frequency range applies. Note 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.			
a	Field strength from fixed transmitters such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the Device is used exceeds the applicable RF compliance level above, the Device should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as re-orienting or relocating the Device.		
b	Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 3 V/m.		

Guidance and Manufacturer's Declaration

Recommended Separation Distance Between Portable and Mobile RF Communication Equipment and the Device.			
The Device is intended for use in the electromagnetic environment in which radiated RF disturbances are controlled. The user of the Device can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communication equipment (transmitters) and the Device as recommended below, according to the maximum output power of the communications equipment.			
Rated Maximum Output Power of Transmitter (Watts)	Separation Distance According to Frequency of Transmitter (meters)		
	150 kHz to 80 MHz $d = 1.2\sqrt{P}$	80 MHz to 800 MHz $d = 1.2\sqrt{P}$	800 MHz to 2.5 GHz $d = 2.3\sqrt{P}$
0.01	0.12	0.12	0.23
0.1	0.38	0.38	0.73
1	1.2	1.2	2.3
10	3.8	3.8	7.3
100	12	12	23
For transmitters rated at a maximum output power not listed above, the recommended separation distance d in meters (m) can be estimated using the equation applicable to the frequency of the transmitter, where P is the maximum output power of the transmitter manufacturer.			
Note 1: At 80 MHz and 800 MHz, the higher frequency range applies. Note 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.			

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Exhibit D



One (1) Fiber DisplayPort 1.2 Optical Detachable Extender



User's Manual for the DPFX-300-TR

Manual Contents

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Welcome!

Congratulations on your purchase of the one (1) fiber DisplayPort extender, DPFX-300-TR. This manual contains information that will assist you in installing and operating the product.

Product Description

DisplayPort 1.2 one(1) fiber optical detachable extender, DPFX-300, extends DisplayPort 1.2 signal up to 200m (656feet) and transmits 4K UHD (4096x2160) at 60Hz over one(1) LC multi-mode fiber. Leading-edge technology of Opticis allows long distance transmission of 4K signal without any video/audio degradation.

DPFX-300-TR is designed compact enough to be fitted into various installation environments. It gives slim, light, easy installation with perfect electrical isolation, but without electrical hazard and interference.

Between Transmitter (DPFX-300-Tx) and receiver (DPFX-300-Rx), pure fiber connection by single LC fiber connector gives clean, secure and easy installation.

DPFX-300-TR can be operated by USB power without external DC power adapter with plugging micro USB(DPFX-300 module side) – USB (source/display devices side) cable which is supplied in shipping group.

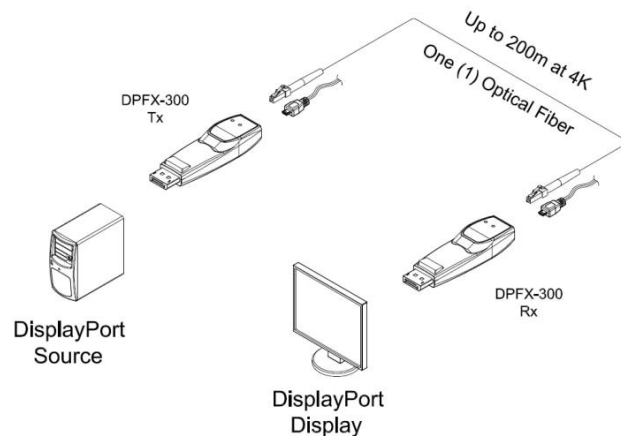


Figure 1 – Overall Connection of DPFX-300-TR

System Requirements for Setup

Hardware requirements

- You have to have a DisplayPort source and display. It should support the maximum graphic resolution feature of displays to be connected.
- No special requirements of memory size, CPU speed and chipsets, if you've already properly installed your DisplayPort systems or graphic cards.
- Proper initial trial of the entire platform with its application using a short length copper cable is recommended prior to installation with the optical link.

Software requirements

- No special restrictions, if you've already properly installed your DisplayPort systems.

Power Technical Advisory

- Enclosed Power Adaptors and USB cables supply power to both Transmitter and Receiver.

Connection Advisory

- **It is highly recommend that DisplayPort source is directly connected into DisplayPort display output via DPFX-300-TR without connection to incompatible distributor, switcher and selector.**

The Shipping Group of DPFX-300-TR;

- One (1) Transmitter (Tx) and One (1) Receiver (Rx)
- One (1) 0.2m Male to Female DisplayPort copper cable
- Two (2) Micro USB to USB cables
- Two (2) 5V 1A power adapter
- User's Manual

※ Default connection is direct connection to both source (Tx side) and display (RX side)

※ If direct connection is impracticable, 0.2m DisplayPort copper cable is strongly recommended to use on Tx(Display Source) side only

Installation

Important: Please keep the installation procedure below. Improper or no operation may result if the start-up sequence is not correctly followed.

Step 1

Carefully unpack the contents in the shipping group.

Step 2

Power on the DisplayPort source and display. Both the transmitter and receiver will be turned on by 3.3V from pin #20 of DisplayPort interface. The USB power is recommend for the stable power supply for both the transmitter and receiver.

Step 3

The Power LED will be turned on when DPFX-300-TR is connected to DisplayPort interface of signal source and display and the Status LED will blink three (3) times. Then the Status LED will blink again when the whole connection is made.

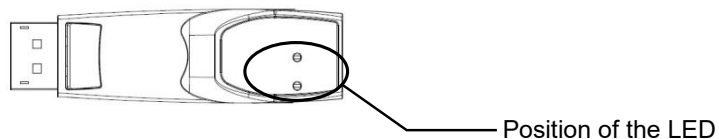


Figure 2 – Position of the LED

Step 4

Connect one (1) LC optical fiber between the transmitter and the receiver. Ensure the connectors are fully engaged and then, the top LED will begin to blink regularly.

Note1: Please DO NOT look directly into the LC receptacles of the Transmitter, while it is powered on, although this product is regulated strictly enough to operate under the LASER Class I, classified by CDRH/FDA for eye safety.

Note2: The maximum extension length by OM3 fiber is 200 meters (656ft.).

Note3: Be recommended NOT to use any intermediate cable or adapter between them to avoid undesirable performance degradation.

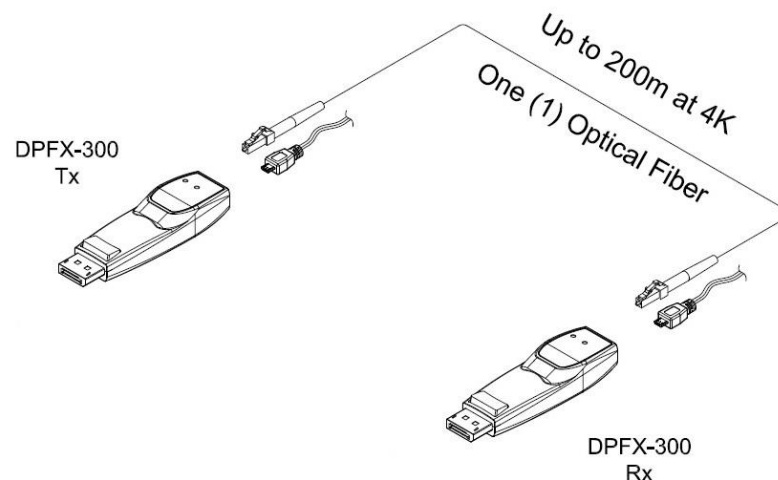


Fig Figure 3 – Connection of optical fiber

Step 5

Connect the transmitter (DPFX-300-Tx) to the DisplayPort source.

Step 6

Connect the receiver (DPFX-300-Rx) to the DisplayPort display.

Note: If the connectors are fully engaged, the bottom LED will turn on.

Step 7

If the system does not work properly, go to the page 1-5 for trouble shooting.

Troubleshooting

The display shows only black screen.

- Ensure that all plugs and jacks used by USB power supplies are firmly connected. Ensure that the LED is ON.
- Ensure that the DisplayPort is firmly plugged in to the DisplayPort source and display.
- Ensure that the transmitter and receiver modules plugged correctly to the source and display, respectively.
- Check if the DisplayPort source and display are powered on and properly booted.
- Reset the system by de-plugging and re-plugging the transmitter DisplayPort or receiver DisplayPort, or by de-plugging and re-plugging the USB power cables that are plugged of the transmitter and receiver module
- Re-boot up the system while connecting the module.

Screen is distorted or displays noises.

- Check if the graphic resolution is properly set. Go to the display properties and tap the settings. Ensure that the resolution sets less than WQUXGA (3840x2400) at 60Hz refresh ratio.
- Reset the system
- Power down, disconnect and reconnect the optical system cable or USB power adaptors, and power up

Maintenance

No special maintenance is required for the optical system cables and power supplies. Ensure that the cables and power modules are stored or used in a benign environment free from liquid or dirt contamination. There are no user serviceable parts. Refer all service and repair issues to Opticis USA or its authorized distributor.

Technical Support and Service

General Inquires: info@opticisusa.com
Tech Support: support@opticisusa.com

Visit us at www.opticisusa.com to learn more about Opticis products.

Product Specifications

- **Compliance with DisplayPort standard:** supports DisplayPort 1.2a
- **Extension limit:** 200m (656feet) for 4K (4096x2160) at 60 Hz refresh rate over one (1) LC OM3 fiber (50/125um).
- **Graphic Transmission Bandwidth:** Supports total data rate 21.6Gbps (5.4Gbps per lane).
- Supports **Dual-mode DP (DP++)**
- Supports **auxiliary I²C channel over fiber**
- Support **Multi-Stream Transport**
- **Mechanical specifications of transmitter and receiver**
 - **Dimensions(WDH):** 22mm x 67mm x 14mm
- **Environmental Specifications**
 - Operating temperature: 0°C to 50°C
 - Storage temperature: -30°C to 70°C
 - Humidity: 10% to 85%

AC/DC Power Adapter

- **Power Input:** AC 100-240V, 50/60Hz.
- **Power Output:** +5 V, 1A SMPS DC-power Adapter

Warranty Information

1 (One) Year Warranty

Opticis warrants this optical DP module to be free from defects in workmanship and materials, under normal use and service, for a period of one (1) year from the date of purchase from Opticis or its authorized resellers.

If a product does not work as warranted during the applicable warranty period, Opticis shall, at its option and expense, repair the defective product or part, deliver to customer an equivalent product or part to replace the defective item, or refund to customer the purchase price paid for the defective product.

All products that are replaced will become the property of Opticis.

Replacement products may be new or reconditioned.

Any replaced or repaired product or part has a ninety (90) day warranty or the remainder of the initial warranty period, whichever is longer.

Opticis shall not be responsible for any software, firmware, information, or memory data of customer contained in, stored on, or integrated with any products returned to Opticis for repair under warranty or not.

Warranty Limitation and Exclusion

Opticis shall have no further obligation under the foregoing limited warranty if the product has been damaged due to abuse, misuse, neglect, accident, unusual physical or electrical stress, unauthorized modifications, tampering, alterations, or service other than by Opticis or its authorized agents, causes other than from ordinary use or failure to properly use the product in the application for which said product is intended.

Dispose of Old Electrical & Electronic Equipment

(Applicable in the European Union and other European countries with separate systems)



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The recycling of materials will help to conserve natural resources. For more detailed information about recycling of this product, please contact your local city office, your household waste disposal service or the shop where you purchased the product.

Certifications

CE / FCC, Class 1 Laser Eye Safety

Certification of Eye Safety

This laser product is inside implemented by using 850, 925, 930, 990nm LD Transceivers, manufactured by Opticis Co., Ltd., which are all certified by CDRH/FDA referred as classified in Laser Class 1 (IEC60825-1).



Caution – Use of controls or adjustments or performances of procedures other than those specified herein may result in hazardous radiation exposure.



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