

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

CORNING INCORPORATED,
Petitioner,

v.

PANDUIT CORP.,
Patent Owner.

Case IPR2019-00775
Patent 8,351,027 B2

Before MICHELLE N. ANKENBRAND, *Acting Vice Chief Administrative Patent Judge*, KRISTINA M. KALAN, and DEBRA L. DENNETT, *Administrative Patent Judges*.

ANKENBRAND, *Acting Vice Chief Administrative Patent Judge*.

DECISION
Denying Institution of *Inter Partes* Review
35 U.S.C. § 314(a)

I. INTRODUCTION

Corning Incorporated (“Petitioner”) requests an *inter partes* review of claims 1–4 of U.S. Patent No. 8,351,027 B2 (“the ’027 patent,” Ex. 1001). Paper 2 (“Pet.”). Panduit Corp. (“Patent Owner”) filed a Preliminary Response. Paper 6 (“Prelim. Resp.”).

We have authority to determine whether to institute an *inter partes* review. 35 U.S.C. § 314(b); 37 C.F.R. § 42.4(a). We may not institute an *inter partes* review “unless . . . there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition.” 35 U.S.C. § 314(a). Applying that standard, and upon considering the information presented in the Petition and the Preliminary Response, we determine Petitioner does not show a reasonable likelihood that it would prevail in showing the unpatentability of at least one challenged claims. Accordingly, we do not institute an *inter partes* review as to claims 1–4 of the ’027 patent.

II. BACKGROUND

A. *Related Matters*

The parties identify the following pending litigation involving the ’027 patent: *Panduit Corp. v. Corning Incorporated*, No. 5:18-cv-229-FL (E.D.N.C.). Pet. 3; Paper 4, 2.

Petitioner filed concurrently a petition in IPR2019-00775 requesting an *inter partes* review of U.S. Patent No. 8,488,115 B2, a continuation patent of the ’027 patent. Pet. 3; see Paper 4, 2.

B. *The ’027 patent*

The ’027 patent, titled “Method and Metric for Selecting and Designing Multimode Fiber for Improved Performance,” issued on

January 8, 2013. Ex. 1001, [45], [54]. The '027 patent explains that the performance of a multimode fiber ("MMF") is largely governed by the amount of dispersion a pulse undergoes as it propagates through the fiber. *Id.* at 1:17–19. Dispersion, which the '027 patent describes as "the broadening of discrete data bits or 'symbols' as the bits propagate through a media," results in overlaps between adjacent data bits, causing an increase in the uncertainty that a bit will be interpreted as a logic 0 or 1. *Id.* at 1:19–23. This uncertainty is quantified in terms of bit error rate ("BER"), which is the number of bit errors divided by the total number of bits transmitted in a given period of time. *Id.* at 1:23–26.

The '027 patent describes two types of dispersion: modal dispersion and chromatic dispersion. *See id.* at 1:28–55. Modal dispersion results from the difference in propagation velocities between the various modes traversing the optical fibers, and as the modes spread, the optical power of the pulse disperses. *Id.* at 1:28–30. Modal dispersion is expressed in terms of Differential Modal Delay ("DMD"), which is a measure of the difference in pulse delay (ps/m) between the fastest and slowest modes traversing the fiber. *Id.* at 1:33–36.

The index of refraction of a material represents the amount by which the speed of light is reduced within the material, as compared to the speed of light in a vacuum. *Id.* at 1:37–39. The index of refraction and the velocity of light in a material are both dependent on the wavelength of the light. *Id.* at 1:39–43. Due to this wavelength dependence, a pulse of light having a finite spectral width will undergo a second type of dispersion, wavelength dispersion (also called chromatic dispersion), as it propagates through a material. *Id.* at 1:53–55. In high-bandwidth MMF, chromatic dispersion

begins to dominate over modal dispersion. *Id.* at 1:57–60. Thus, the '027 patent explains, by reducing the dispersion in MMF, the performance of the fiber will increase. *Id.* at 1:60–62.

According to the '027 patent, extensive analysis of DMD plots and BER system test results shows a good correlation between the waveform shifts in the DMD plots and BER performance, but a metric is needed to quantify the shift. *Id.* at 4:11–15. To that end, the '027 patent describes a new metric “DMD shift” that can be used as a scaling factor for industry-standard Effective Modal Bandwidth (“EMB”) and DMD metrics to yield a more accurate prediction of a MMF’s BER channel performance. *Id.* at 2:52–56. The DMD shift metric can be related to the refractive index profile in MMF and can be used to optimize the design of MMF to achieve improved performance. *Id.* at 2:56–59.

C. Illustrative Claim

Of the challenged claims, claim 1 is independent and illustrative of the claimed subject matter. Claim 1 recites:

1. A method for selecting multimode optical fiber for use in a communications network, said method comprising:
 - measuring the peak delay for pulses traveling through different radii of a number of multimode optical fibers;
 - subtracting the peak delay at a first radius of each multimode optical fiber from the peak delay at a second, larger radius of each multimode fiber; and
 - choosing for use in the communications network those optical fibers in which the result of subtracting the peak delay at the first radius from the peak delay at the second radius is a negative number.

Ex. 1001, 6:30–40.

D. The Asserted Grounds of Unpatentability

Petitioner challenges the patentability of claims 1–4 of the '027 patent based on the following grounds:

References	Statutory Basis ¹	Claims Challenged
Abbott ² in view of Schlager ³ and Caspar ⁴ , in further view of the knowledge of a person of ordinary skill in the art (“POSITA”)	§ 103	1–4
Gholami I ⁵ in view of Schlager and Caspar, in further view of the knowledge of a POSITA	§ 103	1–4
Gholami II ⁶ in view of Schlager and Caspar, in further view of the knowledge of a POSITA	§ 103	1–4

Pet. 4–5. Petitioner relies on the Declaration of Stephen E. Ralph (Ex. 1005) to support its asserted grounds of unpatentability.

¹ Because the claims at issue have an effective filing date before March 16, 2013, the effective date of the applicable provisions of the Leahy Smith America Invents Act, Pub. L. No. 112–29, 125 Stat. 284 (2011) (“AIA”), we apply the pre-AIA version of 35 U.S.C. § 103 in this decision.

² U.S. Patent No. 6,434,309 B1, issued Aug. 13, 2002 (Ex. 1006).

³ J.B. Schlager & D.L. Franzen, *Differential Mode Delay Measurements on Multimode Fibers in the Time and Frequency Domains*, Tech. Digest—Symposium on Optical Fiber Measurements (Nat’l Institute of Standards & Tech. Sept. 1998) (Ex. 1009).

⁴ Christoph Caspar et al., *Impact of Transceiver Characteristics on the Performance of 10GbE Links Applying OM–4 Multimode Fibers*, Proceedings of the 57th Int’l Wire & Cable Symposium (Nov. 2008) (Ex. 1010).

⁵ Asghar Gholami et al., *Modal and Chromatic Dispersions Interference in VCSEL & MMF based Gigabit Ethernet Link*, presented at Optical Fiber Comm’n Conference & Exhibition/Nat’l Fiber Optic Engineers Conference (Mar. 2009) (Ex. 1007).

⁶ Asghar Gholami et al., *Compensation of Chromatic Dispersion by Modal Dispersion in MMF- & VCSEL-Based Gigabit Ethernet Transmissions*, IEEE Photonics Tech. Letters J. (May 2009) (Ex. 1008).

III. ANALYSIS

A. *Level of Ordinary Skill in the Art*

Petitioner, relying on Dr. Ralph’s testimony, asserts that a person of ordinary skill in the art at the time of the invention of the ’027 patent would have “a working knowledge of fiber optic systems, a bachelor’s degree in Engineering or Physics or equivalent coursework, and approximately two years of professional experience or graduate studies involving optical fiber data transmission.” Pet. 15–16 (citing Ex. 1005 ¶ 20).

At this stage of the proceeding, Patent Owner does not propose a definition for the level of ordinary skill in the art, or otherwise dispute Petitioner’s definition. *See generally* Prelim. Resp. Petitioner’s definition appears consistent with the level of ordinary skill in the art reflected in the prior art, and we apply it for purposes of this decision. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001) (explaining that specific findings regarding ordinary skill level are not required “where the prior art itself reflects an appropriate level and a need for testimony is not shown” (quoting *Litton Indus. Prods., Inc. v. Solid State Sys. Corp.*, 755 F.2d 158, 163 (Fed. Cir. 1985))). Further, based on the information presented at this stage of the proceeding, we consider Petitioner’s declarant, Dr. Ralph, qualified to opine from the perspective of an ordinary artisan at the time of the invention. *See* Ex. 1005 ¶¶ 5–11 (Dr. Ralph’s background and qualifications); Ex. 1036 (Dr. Ralph’s curriculum vitae).

B. *Claim Construction*

We interpret a claim “using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C.

282(b).” 37 C.F.R. § 42.100(b) (2018).⁷ Under this standard, we construe the claim “in accordance with the ordinary and customary meaning of such claim as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent.” *Id.* Furthermore, at this stage in the proceeding, we expressly construe the claims only to the extent necessary to determine whether to institute *inter partes* review. *See Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co. Ltd.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (“[W]e need only construe terms ‘that are in controversy, and only to the extent necessary to resolve the controversy.’” (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999))).

Petitioner proposes that we construe the term “peak delay” recited in claim 1 of the ’027 patent. Pet. 14–15. Patent Owner does not challenge Petitioner’s proposed construction, but reserves the right to do so “at a later time.” Prelim. Resp. 10. Our resolution of the parties’ disputes does not turn on our interpretation of the term “peak delay.” Accordingly, it is not necessary to construe that term for purposes of this decision.

⁷ The Office has changed the claim construction standard in AIA proceedings to replace the broadest reasonable interpretation standard with the same claim construction standard used in a civil action in federal district court. *Changes to the Claim Construction Standard for Interpreting Claims in Trial Proceedings Before the Patent Trial and Appeal Board*, 83 Fed. Reg. 51340 (Oct. 11, 2018). The change applies to petitions filed on or after November 13, 2018. *Id.* The present Petition was filed on March 6, 2019, so we construe the claims in accordance with the federal district court standard, now codified at 37 C.F.R. § 42.100(b).

C. *Asserted Prior Art*⁸

Before turning to Petitioner's asserted grounds of unpatentability, we provide a brief summary of the asserted references.

1. *Abbott (Ex. 1006)*

Abbott relates to a MMF and method for use with telecommunication systems employing low data rates and high data rates. Ex. 1006, 1:18–21. Abbott teaches that a typical campus Local Area Network (LAN) requires three different link lengths (100 meters between offices on a floor of a building, 500 meters between floors of a building, and 2 km between buildings). Ex. 1006, 2:12–22. According to Abbott, next generation systems capable of gigabit/second and higher transmission rates cannot achieve these three link lengths with standard MMF. *Id.* at 2:23–33. Abbott discloses a MMF that is optimized for high speed laser sources capable of 1.0, 2.5, and 10 gigabit per second data transmission while maintaining sufficiently high overfilled (“OFL”) bandwidth to support transmission of information with the 1300 nm and 850 nm LED sources used in LAN systems. *Id.* at 3:46–53, 5:66–6:2. Such MMFs enable current LAN system owners to maintain LED-based systems, while also enabling transfer to an Ethernet system transmitting data at or exceeding one gigabit/second, without costly MMF upgrade. *Id.* at 3:53–61.

Abbott explains: “Alpha index of refraction profiles describe a profile shape that may vary continuously with radius.” *Id.* at 6:2–3. The index of refraction profile of Abbott's MMFs preferably includes at least two regions having at least “alpha” (α) exponents, such that the index profile changes

⁸ Unless otherwise noted, we cite to the original page numbers of the references, not to the page numbers that Petitioner added.

smoothly from an alpha or alphas optimized for one or more laser sources (at one or more wavelengths) near the center of the profile to an alpha or alphas optimized for LEDs (at one or more wavelengths) near the outside of the profile. *Id.* at 6:3–11. A MMF having such an index profile extends both distance and data rate capability beyond that documented for telecommunications systems capable of delivering information at rates equal to and exceeding one gigabit/second. *Id.* at 6:11–14.

An important characteristic of the optimized index profile is that it provides high 1300 nm OFL bandwidth with LED sources so that the adjustment to the overall profile to achieve superior performance with lasers is small and/or in areas of the profile not affecting OFL bandwidth performance. *Id.* at 6:33–36.

Abbott discloses several “DMD measurement curves indicative of 62.5µm core [MMFs] having properties sufficient to meet” the operating parameters Abbott describes. Abbott’s Figure 2 is reproduced below.

FIG. 2

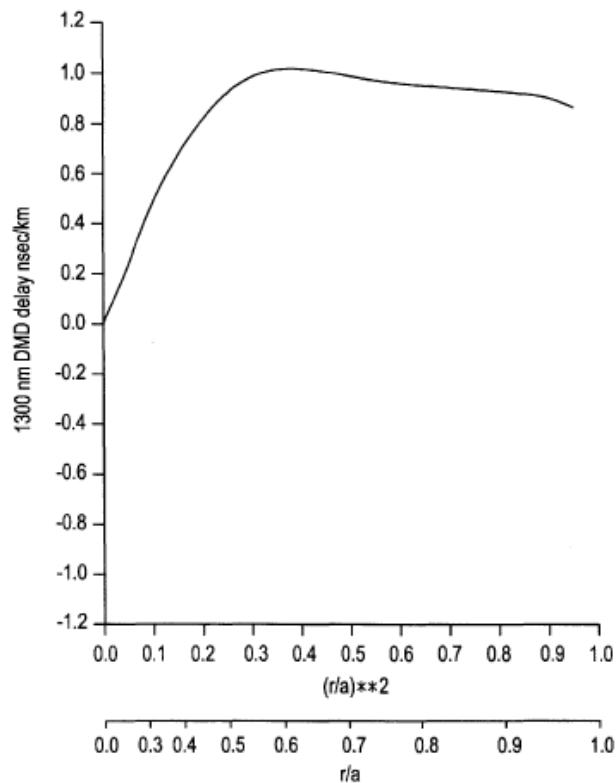


Figure 2 is a DMD profile curve of a MMF measured at 1300 nm. Ex. 1006, 5:43–44. As to Figure 2, Abbott discloses that the index profile is essentially optimized for a wavelength less than 1300 nm in the region where the DMD measurement curve slopes up, the index profile is essentially optimized for a wavelength greater than 1300 nm in the region where the DMD curve slopes down, and the index profile is essentially optimized for 1300 nm in the region where the DMD curve is nearly flat. *Id.* at 9:34–40.

Abbott's Figure 3 is reproduced below.

FIG. 3

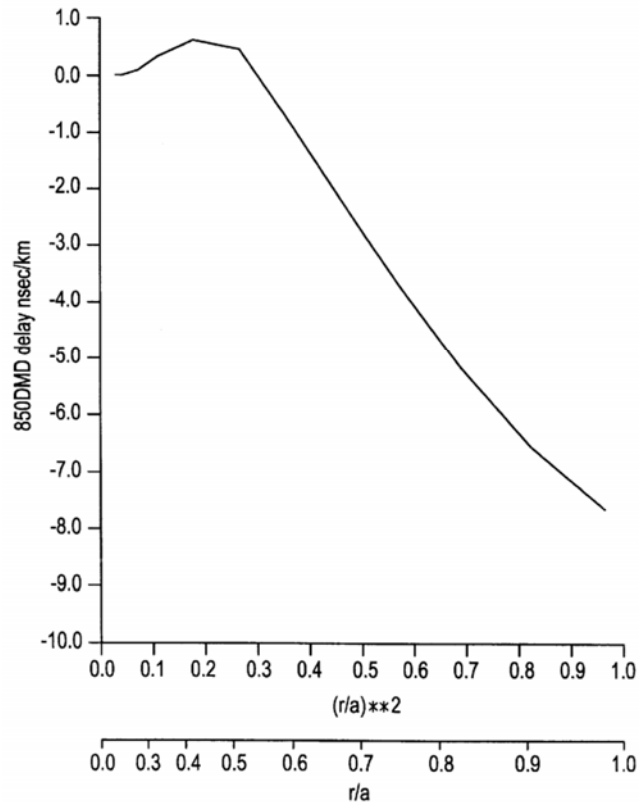


Figure 3 is a DMD profile curve of the MMF measured at 850 nm.

Ex. 1006, 5:46–47. For Figure 3, Abbott discloses that the index profile is optimized for a wavelength slightly less than 850 nm in the region where the DMD curve is slightly rising and that the index profile is optimized for a wavelength greater than 850 nm in the region where the DMD curve slopes down. *Id.* at 9:44–48.

2. Gholami I (Ex. 1007)

Gholami I describes how chromatic and modal dispersion interact and how they can compensate for each other when MMFs are used with standard

vertical cavity surface emitting lasers (“VCSELs”). Ex. 1007, 1.⁹ Gholami I discloses that the modal and chromatic dispersions limit the bandwidth of a MMF. *Id.* The modal dispersion can be minimized at a given wavelength with an optimized α value. *Id.* Modal dispersion is generally characterized using the standardized DMD measurement that consists of measuring pulse responses of the MMF for single-mode launches scanned across a fiber radius. *Id.* This measurement provides a cartography of the modal dispersion across the fiber radius, called the DMD plot, that is post-processed to get modal dispersion parameters such as DMD values and Effective Modal Bandwidth (“EMBc”), which is an estimation of the minimal modal bandwidth that can be obtained over the authorized launching conditions. *Id.*

Gholami I presents a model showing that chromatic and modal dispersions are not independent of each other. *Id.* at 2. Gholami I compares the power penalties at a given BER as a function of the EMBc for two MMFs with different α values around α_{optimum} (α_{optimum} gives zero modal dispersion). *Id.* Gholami I’s Figure 2(b) is reproduced below.

⁹ Because Gholami I does not contain original page numbers, we cite to the page numbers Petitioner added to the reference.

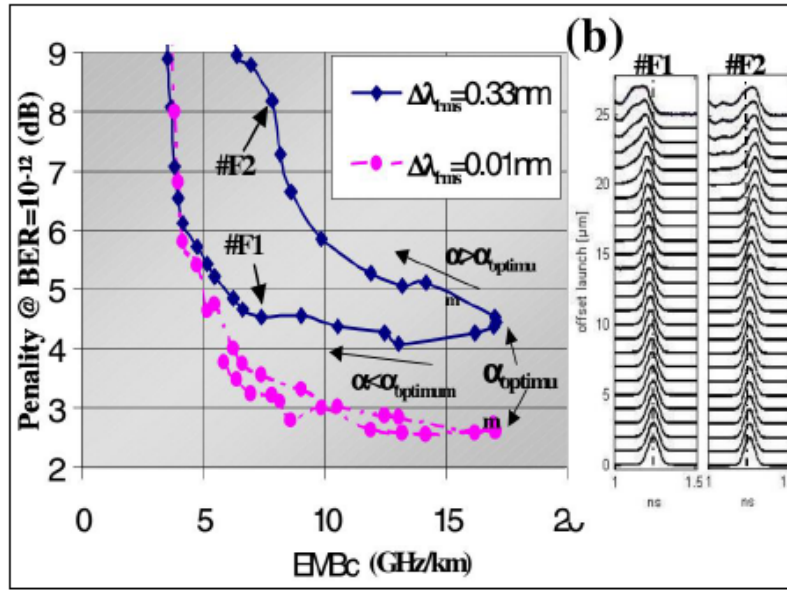


Figure 2(b) of Gholami I shows the power penalty versus EMBc for MMFs with different α values. *Id.*

Gholami I finds that MMFs with $\alpha < \alpha_{optimum}$ exhibit smaller power penalties than MMFs with $\alpha > \alpha_{optimum}$. *Id.* MMFs that exhibit the same amounts of chromatic and modal dispersions, but different α values, have different system performances, because chromatic and modal dispersions interact with each other differently as a result of the different α values. *Id.* In an optimized MMF with $\alpha = \alpha_{optimum}$, i.e., zero modal dispersion, the highest-order modes travel faster than the lowest order modes because of chromatic dispersion. *Id.* For $\alpha < \alpha_{optimum}$, the modal dispersion compensates for the chromatic dispersion, whereas for $\alpha > \alpha_{optimum}$, the modal dispersion is increased by this same chromatic dispersion. *Id.*

Gholami I provides power-penalty measurements and DMD plots for eight different MMFs. *Id.* at 3. The results are shown in Figure 3 below:

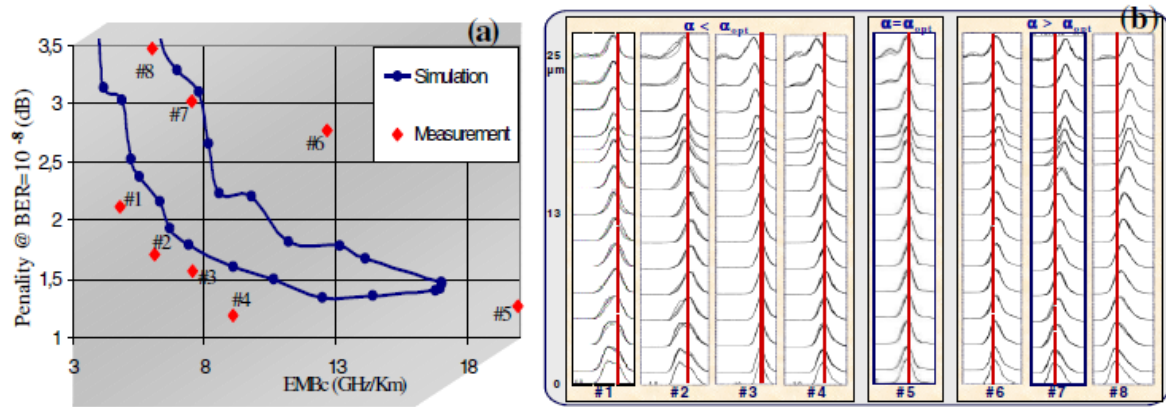


Figure 3(a) shows the power penalty versus EMBc at BER=10⁻⁸ for 750m-long MMFs with different α values, and Figure 3(b) shows DMD plots of the MMFs. *Id.* With equivalent EMBc, MMFs #1 to #4 with $\alpha < \alpha_{\text{optimum}}$ exhibit lower penalties than MMFs #6 to #8 with $\alpha > \alpha_{\text{optimum}}$. *Id.* According to Gholami I, MMF #5 with $\alpha = \alpha_{\text{optimum}}$ has the best EMBc, but does not give the best system performance, which is an illustration of the modal and chromatic dispersion interaction (“MDCI”) effect. *Id.*

Gholami I concludes that, “[f]or a particular VCSEL, it is possible to design a MMF for which the modal dispersion compensates for the chromatic dispersion, resulting in better system performances.” *Id.*

3. Gholami II (Ex. 1008)

Gholami II is a journal article, similar to Gholami I, that discloses additional calculations and figures, most of which are not relevant to the issues before us. As in Gholami I, Gholami II discusses the correlation between EMBc and power penalty at a specified BER and provides the same DMD plot. *Compare* Ex. 1007, Fig. 3(b), *with* Ex. 1008, Fig. 7. Gholami II’s Figure 7 appears to be based on much of the same experimental data as Gholami I’s Figure 3(b).

Gholami II discloses that chromatic dispersion values exhibited in MMFs used in gigabit Ethernet systems can be compensated for by modal dispersion of the MMF when the MMF is used with a standard VCSEL. Ex. 1008, 645 (Abstract).

Gholami II discusses that the bandwidth of a MMF is limited by the modal dispersion, which is minimal at α_{optimum} , as well as by the chromatic dispersion that mainly depends on the material dispersion. *Id.* Optimizing the refractive index profile reduces the modal dispersion, providing maximum bandwidth for data transmissions. *Id.* According to Gholami II, MMF with $\alpha > \alpha_{\text{optimum}}$, for which the higher order modes travel faster than the lower order modes, appears to be more suited for VCSEL-based transmission systems because the chromatic dispersion compensates for the modal dispersion of the fiber. *Id.* at 647.

Independently of the modal dispersion the highest order modes excited in the fiber exhibit an additional delay compared to the lowest order modes because of their lower wavelength and the effect of chromatic dispersion. *Id.* Gholami II considers the case of a MMF with no modal dispersion that only carries three guided modes. *Id.* The DMD plots of such a fiber at three different wavelengths close to the operating wavelength are all straight, as illustrated in Figure 5, reproduced below:

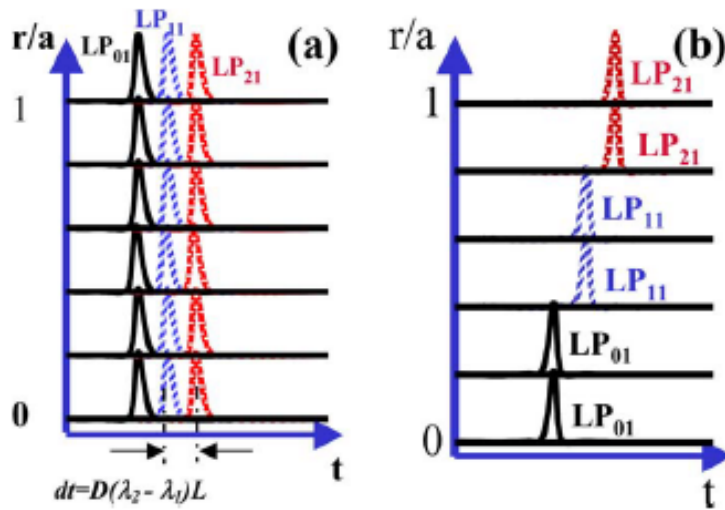


Figure 5(a) shows DMD plots of a fiber with $\alpha = \alpha_{\text{optimum}}$ at three different wavelengths (λ), LP_{01} , LP_{11} , and LP_{21} , and Figure 5(b) shows “effective” DMD plots of the same fiber when used with a VCSEL with three modes that the same wavelengths. *Id.* at 646.

Figure 6 of Gholami II, reproduced below, illustrates that chromatic dispersion introduces a delay between two DMD plots performed at different wavelengths:

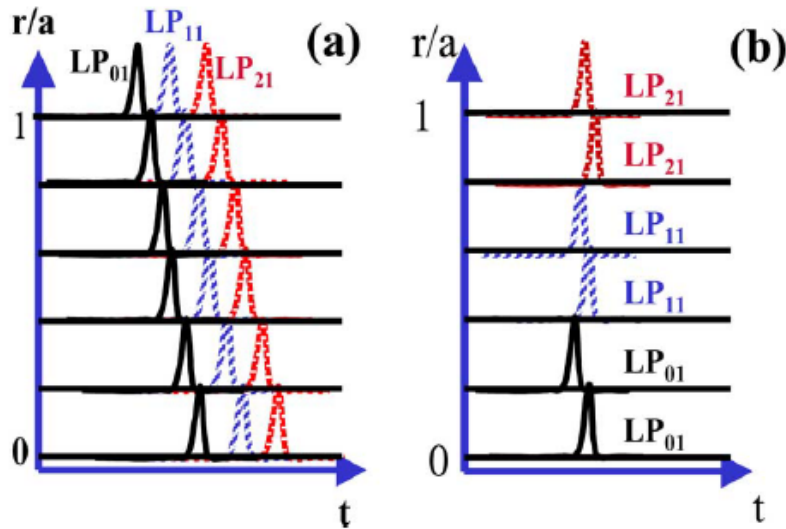


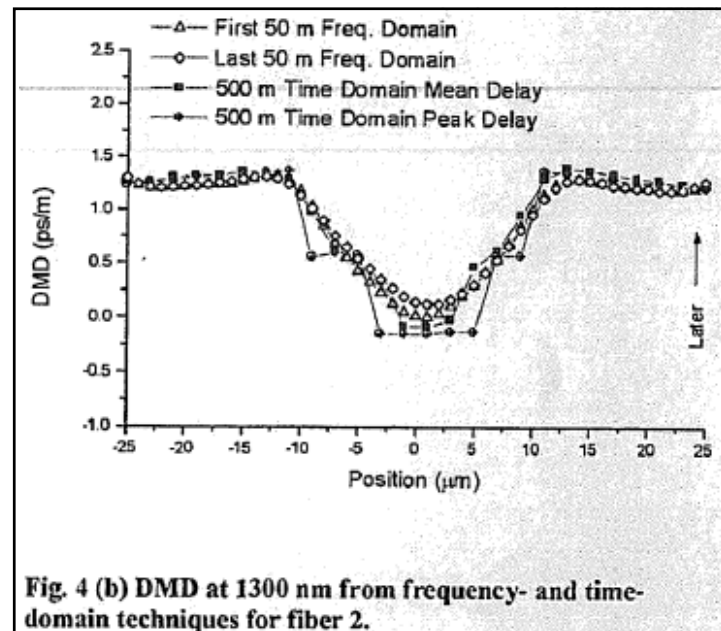
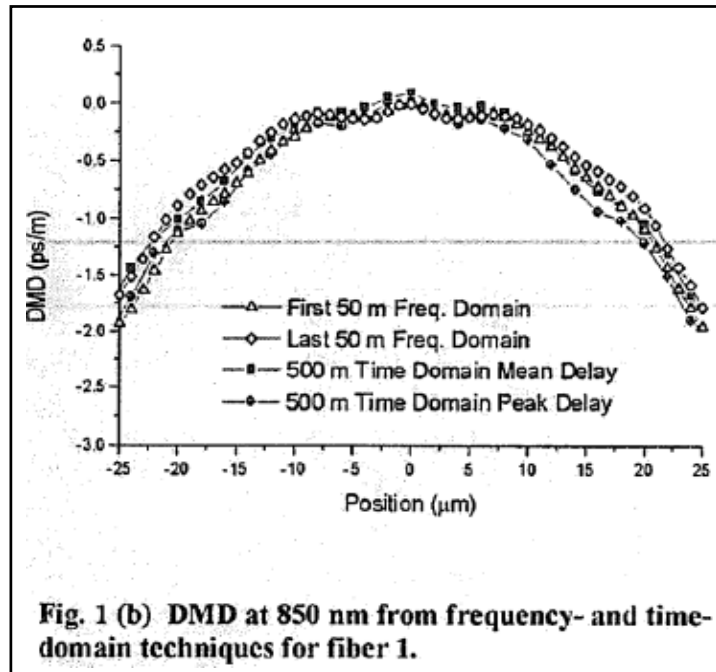
Figure 6(a) shows DMD plots of a fiber with $\alpha < \alpha_{\text{optimum}}$ at three different wavelengths (λ), LP_{01} , LP_{11} , and LP_{21} . *Id.* at 647. Figure 6(b) shows

“effective” DMD plots of the same fiber as in Figure 6(a) with three-mode VCSEL at the same wavelengths. *Id.*

Gholami II proposes that an MMF with $\alpha < \alpha_{\text{optimum}}$, for which the higher order modes travel faster than the lower order modes, appears to be more suited for VCSEL-based transmission systems because the chromatic dispersion compensates for the modal dispersion of the fiber. *Id.*

4. Schlager (Ex. 1009)

Schlager, titled “Differential Mode Delay Measurements on Multimode Fibers in the Time and Frequency Domains,” discloses a frequency-domain DMD measurement system with a temporal resolution of 0.2ps. Ex. 1009, 127. Schlager explains that the “DMD profile of a fiber is acquired by scanning the single-mode fiber across the core in 1 μm steps and recording the change in RF [radio frequency] phase.” *Id.* at 127. Schlager compares its frequency-domain DMD measurements to conventional time-domain DMD measurements. *Id.* Schlager discloses that a conventional time-domain DMD measurement system “measures time-of-flight differences for short optical pulses.” *Id.* Schlager’s Figures 1–4 depict time-domain and frequency-domain DMD data collected for two fiber samples at the source wavelengths of 850 nm and 1300 nm.” *Id.* at 128. Figures 1(b) and 4(b) are reproduced below.



Figures 1(b) and 4(b) show conventional time-domain DMD measurements as to “mean delay” and “peak delay.” *Id.* at 129–130.

5. *Caspar (Ex. 1010)*

Caspar, titled “Impact of Transceiver Characteristics on the Performance of 10 GbE Links Applying OM-4 Multimode Fibers,” describes a system test-bed for MMFs that comply with the 10GBASE-SR standard and specified for 550 m link lengths (i.e., OM-4 MMFs). Ex. 1010, 295 (Abstract).

Caspar explains that the mode power distribution is of paramount importance for the system behavior in MMF transmission systems. *Id.* at 298. “Encircled flux” in MMF transmission systems (“EF”) is the encircled power as a function of the radius from the core center and is a measure for the near field that emerges from the short launch fiber connected to the transmitter. *Id.* Usually, the EF is characterized by two points out of the full curve, i.e., the power fraction inside a 4.5 μm radius ($\eta_{4.5\mu\text{m}}$) and the radius within which 86% of the total power is encircled ($R_{86\%}$). *Id.* Caspar discloses that “the [transmitters] which comply with the 10GBASE-SR standard shall fulfill the requirement $\eta_{4.5\mu\text{m}} < 0.3$ and $R_{86\%} < 19 \mu\text{m}$.” *Id.*

D. *Asserted Obviousness over Abbott, Schlager, Casper, and the Knowledge of a POSITA*

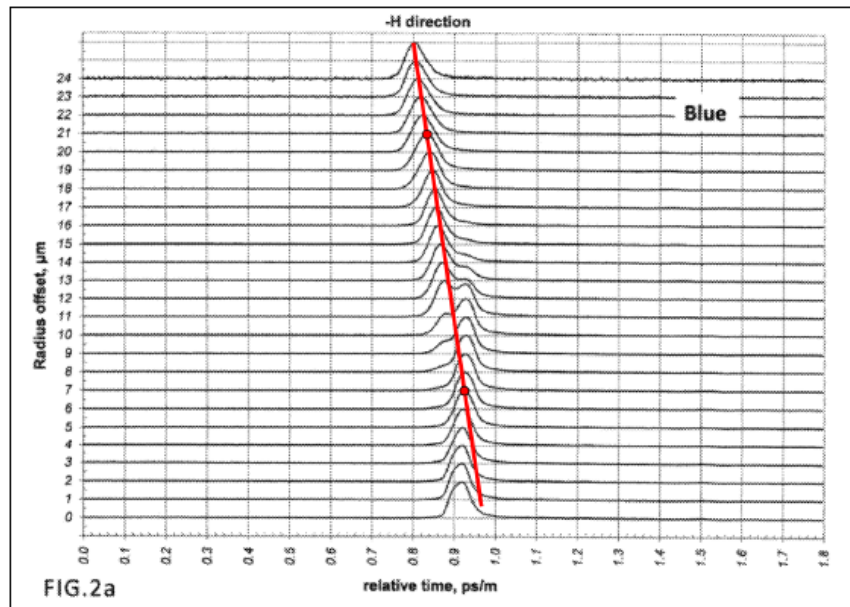
Petitioner contends that the subject matter of claim 1 of the '207 patent would have been obvious over Abbott and Schlager in view of the knowledge of a POSITA, and that the subject matter of dependent claims 2–4 of the '027 patent would have been obvious over Abbott, Schlager, and Caspar in view of the knowledge of a POSITA. Pet. 33–53. Patent Owner disagrees. Prelim. Resp. 12–16. The parties' primary dispute centers on whether the combined teachings of the prior art would have rendered

obvious the limitation of claim 1 that requires “choosing for use in a communications network those optical fibers in which the result of subtracting the peak delay at the first radius from the peak delay at the second radius is a negative number” (“the choosing step”). Accordingly, we focus our discussion on that limitation.

1. Claim 1 Analysis

Petitioner contends that the combined teachings of Abbott and Schlager disclose each limitation of claim 1, except the choosing step. Pet. 33–39. Petitioner argues that the choosing step would have been obvious to a POSITA in view of Abbott and Schlager. *Id.* at 39 (citing Ex. 1005 ¶¶ 155–165).

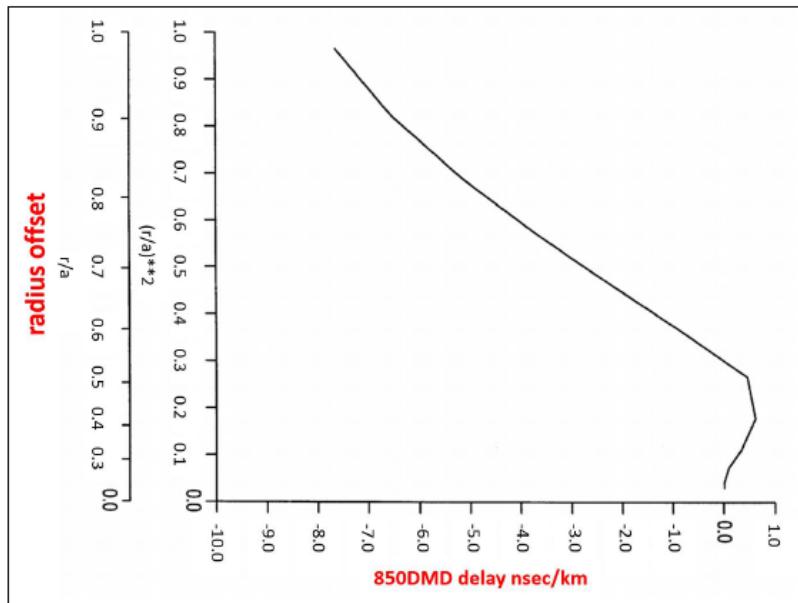
Referencing Abbott’s Figures 2 and 3, described above, and the ’027 patent’s Figure 2(a), Petitioner argues that the “negative DMD shift” described in the ’027 patent is the same as a “negative slope” depicted in Abbott’s figures. Pet. 43 (citing Ex. 1005 ¶ 161). To illustrate this point, Petitioner first produces an annotated version of Figure 2(a) of the ’027 patent:



Annotated Figure 2(a) is a plot of a DMD waveform for an OM3 MMF using the industry standard test method specified in TIA-455-220A.¹⁰ Ex. 1001, 2:24–25, 3:10–12. Petitioner annotates Figure 2(a) of the '027 patent by drawing a red line through peaks at offset values of 5 μm and 19 μm , according to the DMD shift metric the '027 patent provides. Pet. 42.

Petitioner then compares Figure 2(a) of the '027 patent to a version of Abbott's Figure 3 that Petitioner has rotated, inverted, and annotated:

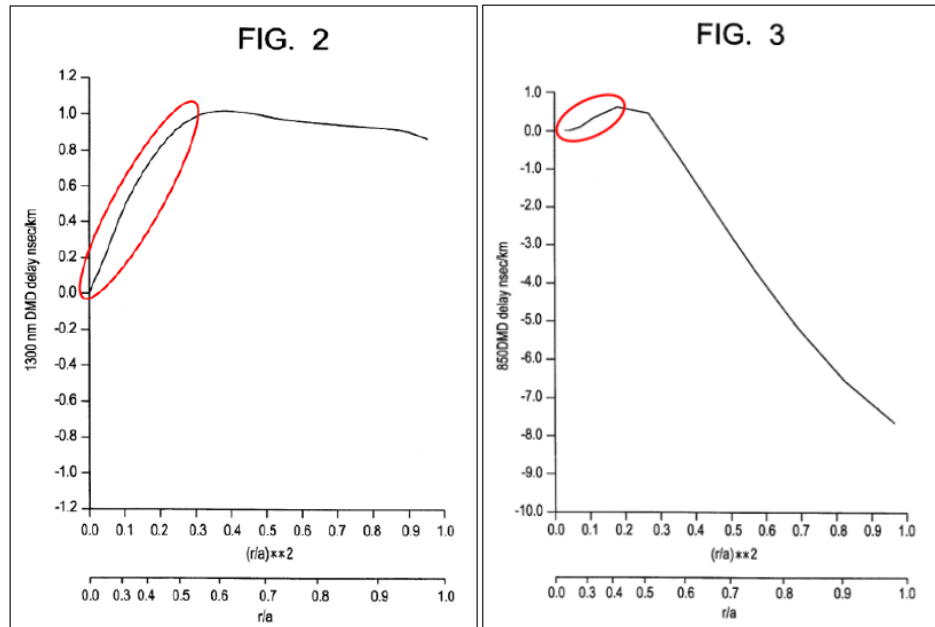
¹⁰ To generate Figure 2(a), the '027 patent explains that an optical reference pulse emitted from the end of a single-mode launch fiber is stepped across the core of a MMF under test. Ex. 1001, 3:12–14. The propagation delay is recorded for each lateral offset across the core (0 to 24 microns), and the output waveforms for each of the radial offsets are plotted along the vertical axis. *Id.* at 3:14–20. The relative pulse delay for each waveform is plotted along the horizontal axis. *Id.* at 3:21–23. The DMD is determined by first measuring the difference in pulse delay using the leading edge of the fastest pulse and the trailing edge of the slowest pulse. *Id.* at 3:23–25.



Annotated Figure 3 shows a DMD profile curve of a MMF measured at 850 nm (Ex. 1006, 5:41–46) that Petitioner has manipulated as described above. According to Petitioner, “[a]s shown, the DMD shift metric of the ’027 Patent applied to the MMF in Figure 3 of Abbott would also result in a negative DMD shift” and “the preferred embodiment of Abbott would always have a negative DMD slope when measured at a 850 nm wavelength.” Pet. 43 (citing Ex. 1005 ¶¶ 161–162; Ex. 1006, 9:25–48).

Patent Owner responds that Petitioner fails to show sufficiently how Abbott, alone or in view of the knowledge of a POSITA, would have rendered the choosing step obvious. Prelim. Resp. 11. Patent Owner contends that Petitioner recognizes the deficiency, “and attempts to overcome [it] by relying on the knowledge of a POSITA.” *Id.* In particular, Patent Owner argues that Abbott does not disclose that its new MMF must be chosen in part based on the criterion in claim 1, i.e., choosing optical fibers in which the result of subtracting the peak delay at the first radius from the peak delay at the second radius is a negative number. *Id.* at 13.

Patent Owner contends that, instead, Abbot discloses that “the DMD measurement curve’ should be nonlinear,” i.e., some portions should have an upward slope and other portions should have a downward slope in order to optimize performance for both wavelengths. *Id.* (citing Ex. 1006, 9:25–66). Patent Owner points to Abbott’s Figures 2 and 3 as illustrating DMD measurement curves with varying slopes, such that the DMD shift will not always be negative. *Id.* at 14. Patent Owner’s annotated Figures 2 and 3 are reproduced below.



In Abbott’s Figures 2 and 3, with Patent Owner’s annotations, the areas Patent Owner has encircled in red illustrate portions of the curves that have a positive DMD slope. *Id.*

On this record, we agree with Patent Owner that Petitioner fails to set forth a sufficient basis as to how an ordinarily skilled artisan would have arrived at the choosing step from Abbott’s disclosures and the knowledge of a POSITA, relying instead on conclusory statements from Dr. Ralph to bridge the gaps in Abbott. As Patent Owner highlights, and Dr. Ralph

acknowledges, Abbott does not explicitly disclose that its MMF must be chosen based on the criterion in claim 1, i.e., choosing optical fibers in which the result of subtracting the peak delay at the first radius from the peak delay at the second radius is a negative number. Prelim. Resp. 13; Ex. 1005 ¶ 164 (“Abbott does not explicitly teach choosing multimode optical fibers on the specific basis of calculating a negative DMD slope (or shift).”). Although Petitioner argues that such a choosing step would have been obvious, Petitioner does not direct us to sufficient evidence to support that argument.

For example, Petitioner argues that “[a]s exhibited by Figures 2 and 3 of Abbott, the preferred embodiment of Abbott would *always* have a negative DMD slope when measured at a 850 nm wavelength.” Pet. 43 (emphasis added). Dr. Ralph testifies similarly. Ex. 1005 ¶ 162 (“As exhibited by Figures 2 and 3 of Abbott, the preferred embodiment of Abbott would always have a negative DMD slope when measured at a 850 nm wavelength.”). However, as Patent Owner highlights with its annotation to Figure 2, some portion of Figure 2 has an upward or positive slope. Prelim. Resp. 14; see Ex. 1006, 9:44–46 (explaining that the slope is upward or positive in a certain region of the DMD curve). And Petitioner does not explain how Abbott’s Figure 3, which depicts a DMD curve at a 1300 nm wavelength, supports its negative DMD slope argument.¹¹ See Pet. 43. Thus, the record does not support Petitioner’s assertion that Abbott’s Figures 2 and 3 show that Abbott’s DMD slope would “always” be negative.

¹¹ Like Figure 2, Figure 3 also has a positive slope in a certain region of the DMD curve, as Patent Owner’s annotation to the figure indicates. See Prelim. Resp. 14; Ex. 1006, Fig. 3.

Moreover, although Petitioner argues that it would have been obvious for a POSITA to have chosen a MMF on the basis of calculating a negative DMD slope given Abbott’s disclosure, we agree with Patent Owner that Petitioner’s showing falls short on this record. Specifically, Petitioner does not direct us to a teaching or suggestion in Abbott of choosing a MMF based on the negative slope or DMD shift. Rather, Petitioner’s argument that “Abbott teaches the desirability of optical fibers exhibiting a negative DMD slope in telecommunications systems” (Pet. 44), appears to be the product of hindsight, coupled with Dr. Ralph’s conclusory testimony that the choosing step would have been obvious in view of Abbott’s teaching that its new MMF “has a variety of uses in the telecommunication industry.” Ex. 1005 ¶ 164 (quoting Ex. 1006, 4:1–6); *see Arendi S.A.R.L. v. Apple Inc.*, 832 F.3d 1355, 1361 (Fed. Cir. 2016) (in reaching a conclusion on obviousness, “the court must avoid ‘hindsight bias and must be cautious of arguments reliant upon *ex post* reasoning’” (quoting *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 421 (2007)); *Ashland Oil, Inc. v. Delta Resins & Refractories, Inc.*, 776 F.2d 281, 294 (Fed. Cir. 1985) (a lack of objective support for expert opinion “may render the testimony of little probative value in a validity determination”); 37 C.F.R. § 42.65(a) (opinion testimony that does not disclose underlying facts “is entitled to little weight”).

Accordingly, we determine that Petitioner fails to show a reasonable likelihood of prevailing in its assertion that claim 1 of the ’027 patent would have been obvious over Abbott, Schlager, and a POSITA’s knowledge.

2. Claims 2–4 Analysis

Claims 2–4 depend from claim 1 and also require the choosing step. Ex. 1001, 6:41–46. In arguing that claims 2–4 would have been obvious,

Petitioner additionally relies on Caspar. Pet. 45–53. Petitioner, however, does not assert that Caspar teaches or discloses the choosing step. Rather, Petitioner asserts that Caspar, combined with Abbott’s teachings, discloses the additional limitations recited in claims 2–4 (i.e., limitations as to the first radius and the second radius (claims 2 and 3), or the distance between the first radius and the second radius (claim 4)). See *id.* at 45, 51–52. Petitioner does not rely on Caspar to cure the deficiencies we identify for claim 1. Thus, Petitioner also fails to show a reasonable likelihood of prevailing in its assertion that claims 2–4 would have been obvious over Abbott, Schlager, Caspar, and a POSITA’s knowledge.

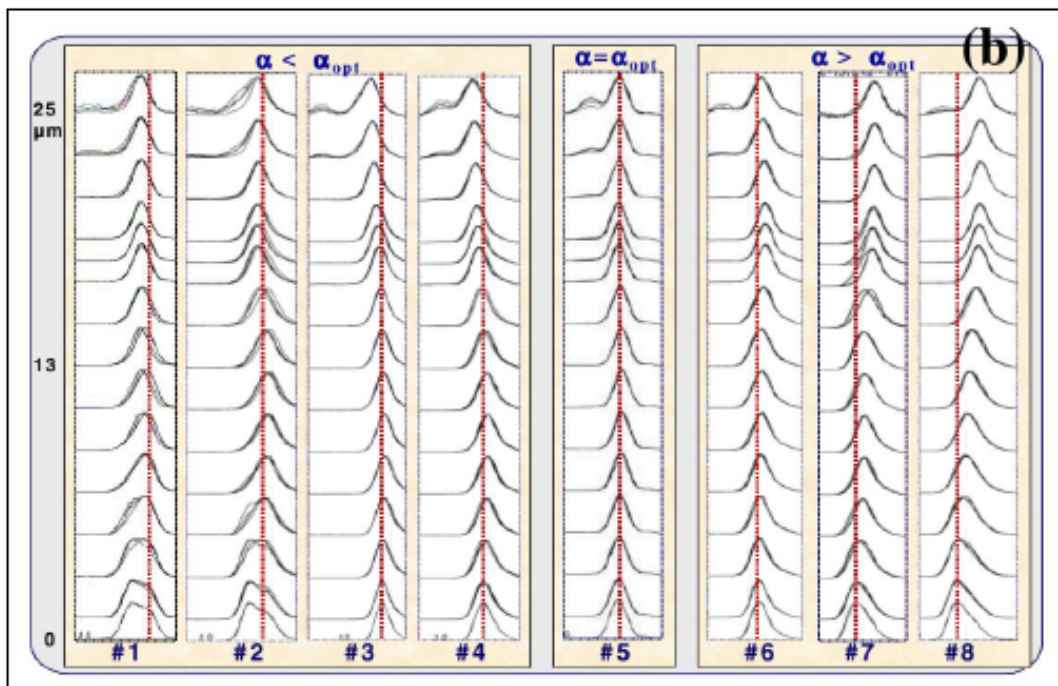
E. Asserted Obviousness over Gholami I, Schlager, Caspar, and the Knowledge of a POSITA

Petitioner contends that the subject matter of claim 1 of the ’207 patent would have been obvious over Gholami I and Schlager in view of the knowledge of a POSITA, and that the subject matter of dependent claims 2–4 of the ’027 patent would have been obvious over Gholami I, Schlager, and Caspar in view of the knowledge of a POSITA. Pet. 53–66. Patent Owner disagrees. Prelim. Resp. 17–19. As with the ground based on Abbott as the primary reference, the parties’ primary dispute centers on whether the combined teachings of the prior art would have rendered obvious the choosing step. Accordingly, we focus our discussion on that limitation.

1. Claim 1 Analysis

Petitioner argues that the choosing step would have been obvious to a POSITA in view of Gholami I and Schlager. Pet. 59 (citing Ex. 1005 ¶¶ 192–196). In particular, Petitioner argues that Gholami I teaches the relationship between the α profile and DMD slope of a MMF, identifying

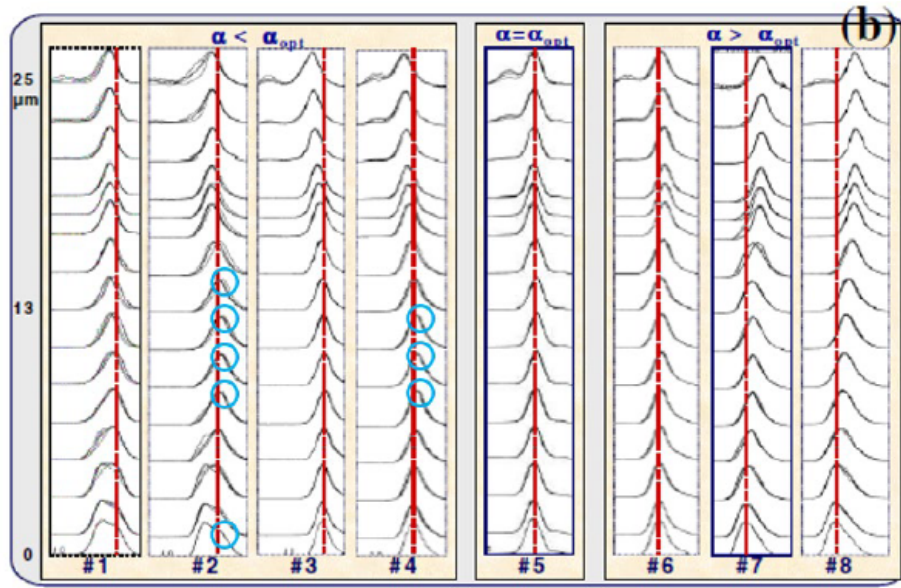
Gholami I Figure 3(b) as teaching that MMFs “having a profile $\alpha < \alpha_{\text{optimum}}$ exhibit a left-leaning DMD slope,” whereas MMFs “having a profile $\alpha > \alpha_{\text{optimum}}$ exhibit a right-leaning slope.” *Id.* at 59–60. We reproduce an enlarged version of Figure 3(b) below.



Gholami I’s Figure 3(b) depicts DMD plots of eight MMFs. In reference to Figure 3(b), Petitioner contends that “[w]hen DMD measurements are presented visually, the left-or-right leaning DMD slope is readily apparent.” Pet. 58 (citing Ex. 1005 ¶ 180). Petitioner argues that “assigning a numerical measurement to the DMD slope would necessarily involve calculating the slope, *i.e.*, by subtracting the pulse delay at a first radius from the pulse delay at a second, larger radius of each multimode optical fiber, or by some other equivalent means.” *Id.* Petitioner also argues that a POSITA would have had a reason to calculate the DMD slope, for example, to better correlate the degree of the DMD slopes of the eight MMFs in Figure 3(b) to their BER performance, as illustrated in Figure 3(a) of Gholami I. *Id.*

Petitioner also argues that Gholami I discloses that MMFs #1 to #4 with $\alpha < \alpha_{\text{optimum}}$ exhibit lower penalties than MMFs #6 to #8 with $\alpha > \alpha_{\text{optimum}}$. *Id.* at 60. Petitioner quotes Gholami I's statement that "[f]or a particular VCSEL, it is possible to design a MMF for which the modal dispersion compensates for the chromatic dispersion, resulting in better system performances." *Id.* (quoting Ex. 1007, 3). Petitioner argues this statement suggests that, in certain cases, "it is preferable to choose an MMF with . . . a negative DMD slope, for which the result of subtracting the peak delay at the first radius from the peak delay at the second radius is a negative number." Pet. 60–61 (citing Ex. 1005 ¶ 193).

Patent Owner responds that Gholami I merely discusses various performance characteristics that are exhibited for MMFs having differing α profiles, and fails to disclose choosing a MMF based on performance characteristics. Prelim. Resp. 17 (citing *generally* Ex. 1007; Ex. 1008). Patent Owner further argues that Gholami I's figures shown that MMFs with a profile of $\alpha < \alpha_{\text{optimum}}$ do not necessarily exhibit a negative slope. *Id.* at 17, 19. As support, Patent Owner provides an annotated version of Gholami I Figure 3(b), reproduced below.



Gholami I's Figure 3(b) depicts DMD plots for eight MMFs with Patent Owner's annotations. In Figure 3(b), Patent Owner draws blue circles around areas that it contends show positive, not negative slopes.

Prelim. Resp. 18. Patent Owner urges that a POSITA would not read Gholami I as teaching that MMFs should be chosen based on the MMFs exhibiting a negative slope. *Id.* at 19.

On this record, we agree with Patent Owner that Petitioner fails to set forth a sufficient basis as to how an ordinarily skilled artisan would have arrived at the choosing step from Gholami I's disclosures and the knowledge of a POSITA, relying instead on conclusory statements from Dr. Ralph to bridge the gaps in Gholami I. As Patent Owner highlights, and Dr. Ralph acknowledges, Gholami I does not explicitly disclose choosing MMFs based on the criterion in claim 1, i.e., choosing optical fibers in which the result of subtracting the peak delay at the first radius from the peak delay at the second radius is a negative number. Prelim. Resp. 16–17; Ex. 1005 ¶ 195 (“Gholami I does not explicitly teach choosing multimode optical fibers on the specific basis of calculating a negative DMD slope (or shift).”).

Although Petitioner argues that such a choosing step would have been obvious, Petitioner does not direct us to sufficient evidence to support that argument.

For example, Gholami I provides no data from which any DMD slope may be calculated. *See generally* Ex. 1007. In addition, Petitioner does not show adequately that MMFs having a profile $\alpha < \alpha_{\text{optimum}}$ in Gholami I's Figure 3(b) exhibit a left-leaning DMD slope. *See* Pet. 59–60. Compared to MMF #5 (where $\alpha = \alpha_{\text{optimum}}$), MMFs with $\alpha > \alpha_{\text{optimum}}$ appear to show a very slight to a somewhat more significant right-leaning shift. *See* Fig. 3(b) (MMFs #6–#8). However, the opposite statement—that MMFs with $\alpha < \alpha_{\text{optimum}}$ show a left-leaning shift—does not appear to describe accurately the information presented in Gholami I. In other words, we do not find support in Gholami I for Petitioner's assertion regarding the disclosures in the reference. Dr. Ralph's testimony regarding Gholami I is similarly unsupported and conclusory. *See* Ex. 1005 ¶¶ 192–193, 195. Instead, we find that Petitioner overextends Gholami I's disclosure to portray the reference as teaching that it is preferable to choose a MMF with $\alpha < \alpha_{\text{optimum}}$, “hence a negative slope, for which the result of subtracting the peak delay at the first radius from the peak delay at the second radius is a negative number.” Pet. 60–61.

Accordingly, we determine that Petitioner fails to show a reasonable likelihood of prevailing in its assertion that claim 1 of the '027 patent would have been obvious over Gholami I, Schlager, and a POSITA's knowledge.

2. Claims 2–4 Analysis

Claims 2–4 depend from claim 1 and also require the choosing step. Ex. 1001, 6:41–46. In arguing that claims 2–4 would have been obvious,

Petitioner additionally relies on Caspar. Pet. 62–66. Petitioner, however, does not assert that Caspar teaches or discloses the choosing step. Rather, Petitioner asserts that Caspar, combined with Gholami I’s teachings, discloses the additional limitations recited in claims 2–4 (i.e., limitations as to the first radius and the second radius (claims 2 and 3), or the distance between the first radius and the second radius (claim 4)). *See id.* at 62, 66. Petitioner does not rely on Caspar to cure the deficiencies we identify for claim 1. Thus, Petitioner also fails to show a reasonable likelihood of prevailing in its assertion that claims 2–4 would have been obvious over Gholami I, Schlager, Caspar, and a POSITA’s knowledge.

F. Asserted Obviousness over Gholami II, Schlager, Caspar, and the Knowledge of a POSITA

Petitioner contends that the subject matter of claim 1 of the ’207 patent would have been obvious over Gholami II and Schlager in view of the knowledge of a POSITA, and that the subject matter of dependent claims 2–4 of the ’027 patent would have been obvious over Gholami II, Schlager, and Caspar in view of the knowledge of a POSITA. Pet. 67–80. Patent Owner disagrees. Prelim. Resp. 17–19. As with the grounds based on Abbott and Gholami I as the primary references, the parties’ primary dispute centers on whether the combined teachings of the prior art would have rendered obvious the choosing step, and we focus our discussion on that limitation.

1. Claim 1 Analysis

Petitioner’s arguments as to how Gholami II and Schlager would have rendered obvious the choosing step are substantively the same as Petitioner’s arguments regarding Gholami I, and Petitioner relies upon essentially the

same disclosure to form the basis of its analysis for both grounds. *Compare* Pet. 59–62, *with id.* at 72–76. Petitioner does rely additionally on Gholami II’s Figure 6, which is not disclosed in Gholami I, to support its arguments. Specifically, Petitioner relies on Gholami II’s Figure 6 as teaching “that, in certain cases (*e.g.*, when paired with a VCSEL), it is preferable to choose an MMF with $\alpha < \alpha_{\text{optimum}}$, hence a negative DMD slope, for which the result of subtracting the peak delay at the first radius from the peak delay at the second radius is a negative number.” *Id.* at 74–75 (Gholami II ground). Petitioner, however, makes the same argument in its ground based on Gholami I. *See id.* at 60–61 (“Gholami I teaches that, in certain cases (*e.g.*, when paired with a VCSEL), it is preferable to choose an MMF with $\alpha < \alpha_{\text{optimum}}$, hence a negative DMD slope, for which the result of subtracting the peak delay at the first radius from the peak delay at the second radius is a negative number.”). Thus, although Petitioner relies on an additional figure in Gholami II, that additional figure provides no substantive basis for distinguishing Petitioner’s arguments here from the arguments made in the ground based on Gholami I.

On this record, and for the same reasons we provide above as to the ground based on Gholami I (*see supra* § III.E.1), we find that Petitioner fails to set forth a sufficient basis as to how an ordinarily skilled artisan would have arrived at the choosing step from Gholami II’s disclosures and the knowledge of a POSITA. Accordingly, Petitioner fails to establish a reasonable likelihood of prevailing in its assertion that claim 1 of the ’207 patent would have been obvious over Gholami II, Schlager, and the POSITA’s knowledge.

2. Claims 2–4 Analysis

Claims 2–4 depend from claim 1 and also require the choosing step. Ex. 1001, 6:41–46. In arguing that claims 2–4 would have been obvious, Petitioner additionally relies on Caspar. Pet. 76–80. Petitioner, however, does not assert that Caspar teaches or discloses the choosing step. Rather, Petitioner asserts that Caspar, combined with Gholami II’s teachings, discloses the additional limitations recited in claims 2–4 (i.e., limitations as to the first radius and the second radius (claims 2 and 3), or the distance between the first radius and the second radius (claim 4)). *See id.* at 76, 79–80. Petitioner does not rely on Caspar to cure the deficiencies we identify for claim 1. Thus, Petitioner also fails to show a reasonable likelihood of prevailing in its assertion that claims 2–4 would have been obvious over Gholami II, Schlager, Caspar, and a POSITA’s knowledge.

IV. CONCLUSION

Taking account of the information presented in the Petition and the Preliminary Response, and the evidence of record, we determine that Petitioner fails to demonstrate a reasonable likelihood of prevailing at trial as to any challenged claim.

V. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that the Petition is *denied*, and no trial is instituted.

IPR2019-00775
Patent 8,351,027 B2

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