

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

CANADIAN SOLAR (USA) INC.,
Petitioner,

v.

FIRST SOLAR, INC.,
Patent Owner

Case IPR2025-01432
Patent No. 9,130,074

**FIRST SOLAR, INC.’S
PATENT OWNER PRELIMINARY RESPONSE**

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LIST OF EXHIBITS

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2001	Keith R. Hummel Biography
2002	Declaration of Keith R. Hummel in Support of PHV Motion
2003	Canadian Solar White Paper, “CSI High Efficiency TOPCon Module”, canadiansolar.com (Jan. 2023)
2004	Chunduri, S.K., <i>et al.</i> , “PERC Solar Cell Technology 2016: Background, Status and Outlook”, <i>TaiyangNews</i> (2016)
2005	Fuhs, M., “TOPCon: The next big thing after PERC”, <i>PV Magazine</i> (Oct. 8, 2018)
2006	Canadian Solar Press Release, “Canadian Solar to Start Mass Production of TOPCon Modules with Power Output up to 690W” (Dec. 15, 2022)
2007	Canadian Solar Press Release, “Canadian Solar Enters into Significant Supply Contracts During the 2023 U.S. RE+ Trade Show” (Sept. 20, 2023)
2008	Canadian Solar Press Release, “Canadian Solar Releases New TOPCon 2.0 / 660 Wp N-Type Module with up to 24.4% Efficiency for Utility and C&I PV Systems” (May 6, 2025)
2009	Post-Conference Brief of China Chamber of Commerce for Import and Export of Machinery and Electronic Products, Volume I of II, ITC Inv. Nos. 701-TA-511 & 731-TA-1246-47 (Jan. 29, 2014)
2010	Zacks Equity Research, “FirstSolar to Buy TetraSun, Gives View”, <i>Yahoo! Finance</i> (Apr. 10, 2013)
2011	“First Solar to Acquire TetraSun to Expand Addressable Market Opportunity”, <i>Business Wire</i> (Apr. 9, 2013)
2012	Shepard, J., “First Solar to Acquire TetraSun to Expand Addressable Market Opportunity”, <i>EEPower</i> (Apr. 11, 2013)
2013	Glunz, S.W., <i>et al.</i> , “Silicon-based passivating contacts: The TOPCon route”, <i>Progress in Photovoltaics</i> (Dec. 20, 2021)

2014	Espacenet listing for CN114613865A
2015	Espacenet cited documents list for CN114613865A
2016	USPTO Global Dossier for CN114613865A, First Search (Sept. 8, 2023)
2017	Office of the United States Trade Representative, 2025 Special 301 Report (Apr. 2025)
2018	Gupta, K., <i>et al.</i> , “Protecting Intellectual Property for National Security”, <i>Center for Strategic and International Studies</i> (Mar. 2025)
2019	Turner, J., <i>et al.</i> , “Solar supplier switched over ‘ethical concerns’”, <i>BBC</i> (Sept. 27, 2024)
2020	Dept. of Commerce Press Release, “Department of Commerce Issues Final Determination of Circumvention Inquiries of Solar Cells and Modules from China” (Aug. 18, 2023)
2021	Canadian Solar Inc. Form 20-F (Dec. 31, 2024)
2022	Scheduling Order, D.I. 27, <i>First Solar, Inc. v. Canadian Solar Inc.</i> , C.A. No. 1:25-cv-582 (JLH) (D. Del.)
2023	Declaration of Michael Dudley, Ph.D., in Support of Patent Owner Preliminary Response

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1. INTRODUCTION

Pursuant to 35 U.S.C. § 313 and 37 C.F.R. § 42.107, First Solar, Inc. (“First Solar” or “Patent Owner”) submits this Patent Owner Preliminary Response to the Petition for *Inter Partes* Review (IPR) filed by Canadian Solar (USA) Inc. (“Petitioner” or “Canadian Solar”), challenging all claims of U.S. Patent No. 9,130,074 (“the ’074 Patent”). Because Canadian Solar has failed to meet its burden of showing a reasonable likelihood of success that the claims of the ’074 Patent are invalid, institution should be denied.

Canadian Solar’s grounds do not support institution for a simple reason: No prior art reference or combination of references contains all of the elements of the challenged claims. And while Canadian Solar tries improperly to use hindsight, its expert declaration and attorney argument to fill in the gaps of the missing elements, these efforts fall short of the showing needed for institution.

Canadian Solar does not cite any prior art references that would anticipate the claims of the ’074 Patent. Instead, Canadian Solar argues that the claims of the ’074 Patent are obvious in view of combinations of EP1732142A1 (“Froitzheim”) with Yablonovitch, Neville, Kwark and Sasaki, as alleged in Grounds 1–6. (Pet. 3, 22–86.) But Canadian Solar fails to establish a reasonable likelihood of success in showing that any challenged claim is unpatentable on any of these grounds.

First, the two main references that Canadian Solar attempts to combine in **Ground 1** are incompatible with each other. Froitzheim and Yablonovitch teach very different types of solar cells and processes for making such cells. In particular, Froitzheim teaches a rear emitter solar cell in which the order of the layers is reversed from a traditional solar cell. Yablonovitch teaches another non-traditional structure: a double-sided solar cell where the conductive layer is wrapped around a central silicon substrate. Canadian Solar fails to show why a POSA would be motivated to combine these two references, let alone why there would be a reasonable expectation of success in making such a combination.

Second, the other combinations are also unsuccessful for similar reasons. In **Ground 2**, Canadian Solar cites Neville to argue that a POSA would be motivated to swap a n-type doped layer for a p-type doped layer in the Froitzheim/Yablonovitch combination. But Canadian Solar ignores the teachings from Froitzheim about the reasons why the p-type and n-type doped layers have been selected, and cannot be merely swapped. The same is true for **Grounds 3-6**, which attempt to apply the same arguments to different combinations of references.

The Board should deny institution because Canadian Solar has not shown a reasonable likelihood of success as to *any* challenged claim.

2. THE CHALLENGED PATENT

A. The Invention

Solar cells convert sunlight into electrical energy. An emerging solar technology is known as TOPCon, which stands for “tunnel oxide passivated contact.” TOPCon solar cells exhibit reduced recombination (*i.e.*, when excited electrons combine with atoms in the solar cell rather than generating electricity) and higher bifaciality (*i.e.*, the ability to generate electricity from both sides of a solar panel), which results in higher operational efficiency as compared to other solar cell technologies.

The '074 Patent is titled “High-Efficiency Solar Cell Structures and Methods of Manufacture.” The application for the '074 Patent was filed on November 15, 2011, and claims priority to provisional patent application number 61/171,194, filed on April 21, 2009. The '074 Patent was issued on September 8, 2015. (Ex. 1001.) The claimed method of the '074 Patent was developed by the named inventors, Oliver Schultz-Wittmann and Denis DeCeuster, who co-founded TetraSun, now a fully owned subsidiary of First Solar.

The claimed method of the '074 Patent improves upon the manufacturing efficiency and performance of TOPCon solar cells.¹ As recited in claim 1, the

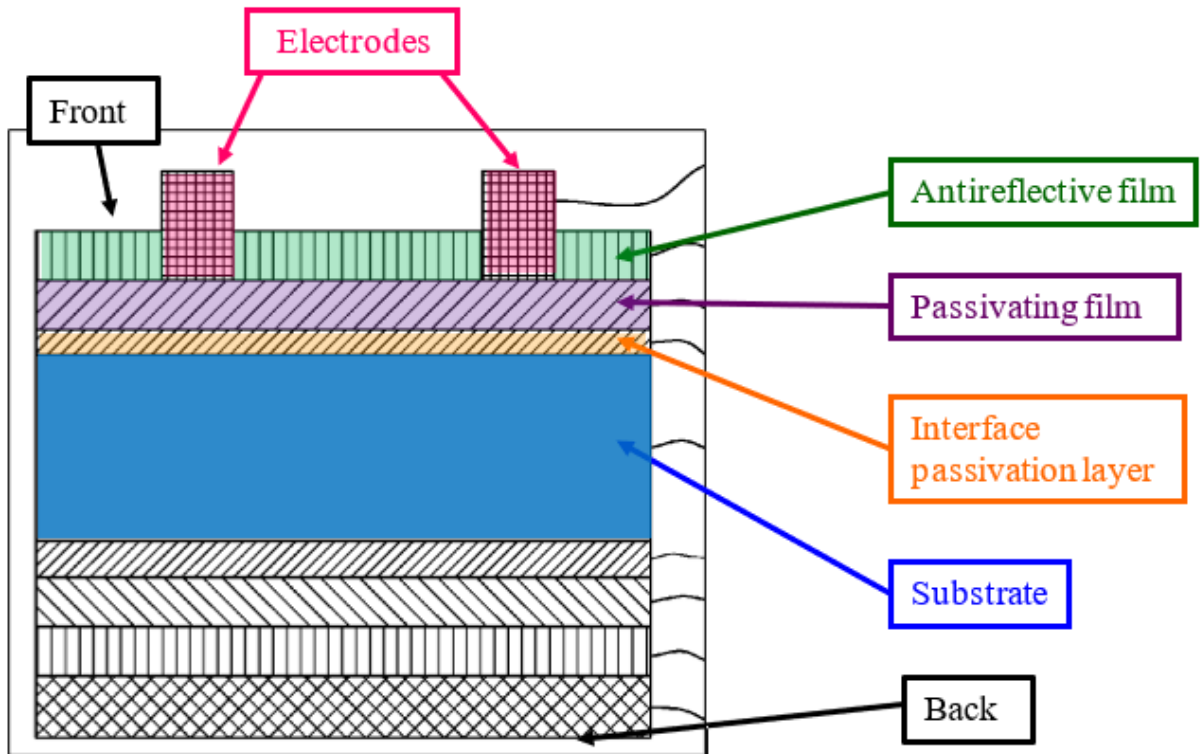
¹ Canadian Solar incorrectly contends that the examiner stated that only element of Claim 1 found to be missing from the prior art was the limitation “*there*

inventive method of manufacturing solar cells generally involves providing a silicon wafer as a central substrate, depositing or growing an interface passivation layer (or “tunneling layer”) onto the substrate, and depositing a doped conductive and passivating layer on the interface passivation layer. (Ex. 1001, 19:13–35.) According to the claimed invention, this assembly of layers is heat-treated at a temperature of about 500 °C or higher, which facilitates diffusion of the dopant material from the conductive and passivating layer through the interface passivation layer. (Ex. 1001, 2:16–21.)

The claimed steps of depositing or growing an interface passivation layer on the substrate and depositing a doped conductive and passivating silicon layer on the passivation layer, and then heat-treating these layers, result in a structure that reduces electron recombination and increase the conductivity of electrons.

is no teaching or motivation to provide metallization as electrodes which directly contact the conductive and passivation layer, as that layer supports a layer which forms the absorbing portion of the solar cell.” (Pet. at 11.) But the portion of the prosecution history that Canadian Solar cites does not state that the absence of this claim element is the “only” reason for allowance. (Ex. 1002, 485.) And it is well-settled that Reasons for Allowance recorded by the examiner are expressly non-exhaustive, according to the Manual of Patent Examining Procedure. *See* MPEP 1302.14 (“The statement is not intended to necessarily state all the reasons for allowance or all the details why claims are allowed and should not be written to specifically or impliedly state that all the reasons for allowance are set forth.”). *See also Salazar v. Procter & Gamble Co.*, 414 F.3d 1342, 1345 (Fed. Cir. 2005).

A non-limiting illustration of this structure is reproduced in the diagram below.



(Ex. 1001 ('074 Patent), Fig. 8 (annotated).)

In this assembly, when electrons are “excited” by sunlight, they move between the silicon substrate and the metal electrodes through both the interface passivation layer and the conductive and passivating layer. One step of the claimed process involves applying a thermal treatment to the assembly comprising the silicon substrate, the conductive and passivating layer, and the interface passivation layer. This thermal treatment facilitates diffusion of the dopant through the interface passivation layer and, in some embodiments, into the silicon

substrate. That diffusion of dopant creates charge carrier flow paths from the central silicon substrate to the front electrodes, thereby shortening the flow path the charge carriers (*e.g.*, electrons) must take through the substrate.

B. The Claims

The '074 Patent has eight claims, with one independent claim, Claim 1, that recites:

1. (1[pre]) A method of fabricating a solar cell, comprising;
 - (1[a]) providing a wafer as a central substrate;
 - (1[b]) depositing or growing at least one amorphous interface passivation layer over the substrate;
 - (1[c]) depositing at least one conductive and passivating layer on the at least one interface passivation layer, the at least one conductive and passivating layer comprising a dopant;
 - (1[d]) providing thermal treatment at a temperature of about 500° C. or higher, the thermal treatment crystallizing, at least in part, the at least one conductive and passivating layer and facilitating diffusion of the dopant from the at least one conductive and passivating layer through the at least one interface passivation layer; and
 - (1[e]) providing metallization as electrodes which directly contact the at least one conductive and passivating layer following the thermal treatment thereof, wherein the dopant diffused through the at least one interface passivation layer provides shortened charge carrier flow paths between the substrate and the electrodes through the at least one conductive and passivating layer and the at least one interface passivation layer.

(Ex. 1001, 19:13–35.)

While this Preliminary Response addresses the novelty of claim 1 only, the same arguments would apply to claims 2–8. This is because claims 2–8 depend

from claim 1 and contain all elements of claim 1. If the references cited by Canadian Solar do not render obvious claim 1 of the '074 Patent, they do not render obvious dependent claims 2–8 either. *Rembrandt Wireless Techs., LP v. Samsung Elecs. Co.*, 853 F.3d 1370, 1380 (Fed. Cir. 2017) (“Because substantial evidence supports [non-obviousness of the independent claim], we need not address Samsung’s additional obviousness arguments for the infringed dependent claims. *See In re Fine*, 837 F.2d 1071, 1076 (Fed. Cir. 1988) (‘Dependent claims are nonobvious under section 103 if the independent claims from which they depend are nonobvious.’).”).

3. CLAIM CONSTRUCTION

A claim subject to an IPR must be given its ordinary and customary meaning in light of the specification, *i.e.*, “the meaning that the term would have to a person of ordinary skill in the art in question at the time of the invention.” *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312-13 (Fed. Cir. 2005) (en banc); 37 C.F.R. § 42.100(b).

First Solar accepts Canadian Solar’s position that “[c]laim constructions are not necessary to resolve this Petition.” (Pet. 14.) First Solar reserves the right to present claim construction issues should the Board institute this IPR and in other proceedings involving the '074 Patent.

4. LEVEL OF ORDINARY SKILL IN THE ART

For the purposes of this Response, First Solar accepts Canadian Solar's definition of a POSA: a POSA "would have been someone with an advanced degree involving the discipline of electrical engineering, applied physics, chemistry, or materials science, and at least two years of experience designing, developing, or researching in the field. Alternatively, that person would have had a bachelor's degree in electrical engineering, applied physics, or materials science, and at least four years of experience designing, developing, or researching in the field." (Pet. 3–4.) First Solar reserves the right to present issues relating to the level of a POSA should the Board institute this IPR and in other proceedings involving the '074 Patent.

5. PETITIONER'S BURDEN

An IPR may be instituted only when "the *information presented in the petition* . . . shows that 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) (emphases added). Any IPR petition must "identif[y] . . . with particularity . . . the grounds on which the challenge to each claim is based" 35 U.S.C. § 312(a)(3). As such, it is Canadian Solar's burden to "specify where each element of the claim is found in the prior art Patents or printed publications relied upon." 37 C.F.R. § 42.104(b)(4).

The Board “will not take on the role of advocate for a party, trying to make out a case the party has not adequately stated.” (Standing Order ¶ 121.5.2 (B.P.A.I. Mar. 8, 2011.)) Rather, it is Canadian Solar’s duty to provide sufficient grounds for the institution of a review “focus[ing] on concise, well organized, easy-to-follow arguments supported by readily identifiable evidence of record.” *Cisco Sys., Inc. v. C-Cation Tech, LLC*, IPR2014-00454, Paper No. 12, at 11 (P.T.A.B. Aug. 29, 2014).

As explained below, the Petition failed to make even any showing (let alone demonstrate a reasonable likelihood) that any claim of the ’074 Patent is unpatentable. The Petition should therefore be denied. The Petition should additionally be denied for the reasons described in First Solar’s Request for Discretionary Denial. (Dkt. 7.)

**6. THE PETITION FAILS TO ESTABLISH A REASONABLE
LIKELIHOOD OF SUCCESS IN SHOWING THAT ANY
CHALLENGED CLAIM IS UNPATENTABLE**

Canadian Solar fails to establish a reasonable likelihood of success in showing that any of its asserted combinations of references render obvious any of the claims of the ’074 Patent.

A. **Ground 1: Canadian Solar has not demonstrated a reasonable likelihood of success in showing that Froitzheim and Yablonovitch render any challenged claim obvious**

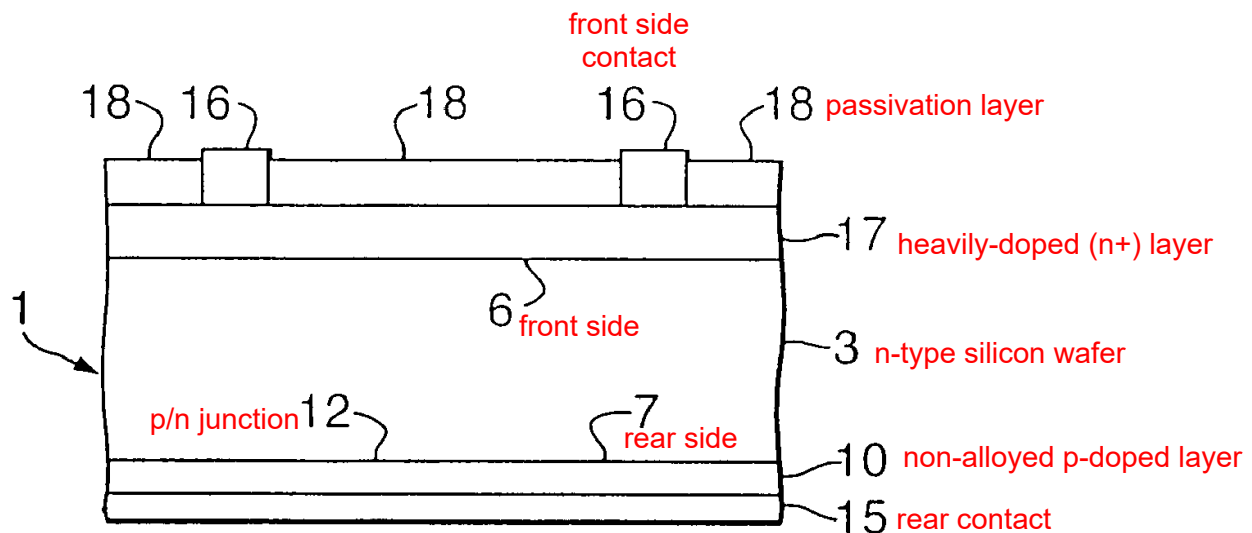
Canadian Solar fails to show that Froitzheim and Yablonovitch render obvious any of the challenged claims. As discussed below, the proposed combination of Froitzheim and Yablonovitch is improper because it is inconsistent with the alleged reason to combine, is contradictory to the teachings of Froitzheim and Yablonovitch, and there could be no reasonable expectation of success.

Froitzheim (EP1732142A1, Ex. 1008)

Froitzheim teaches a “new type of Si [*i.e.*, silicon] solar cell that *shows improved stability and good efficiency*” and “*significantly higher efficiencies* than known from cells based on an Al-Si [*i.e.*, Aluminum-Silicon] alloy.” Froitzheim, Ex. 1008, ¶¶ 9, 11 (emphases added). The main teaching of Froitzheim is that it is a “rear-junction” solar cell that places a p-doped (positively doped) layer on the *rear* (back) side of the solar cell, rather than at the front. (*Id.* ¶ 11.) Froitzheim states that its design addresses a problem faced by other solar cell designs, which experienced high degradation over their lifetimes, by creating a cell with improved stability. (*Id.* ¶¶ 8–11.) Froitzheim also teaches a method of fabricating such a solar cell in which a thin layer of doped silicon is deposited directly on the rear surface of the substrate and heated such that it adopts the same crystalline structure as the substrate (a phenomenon known as epitaxial growth). This fabrication

method results in the formation of a homojunction (wherein the adjacent layers forming the junction have the same crystalline structure).

Figure 1 from Froitzheim (reproduced below with annotations in red) shows the solar cell structure taught therein:



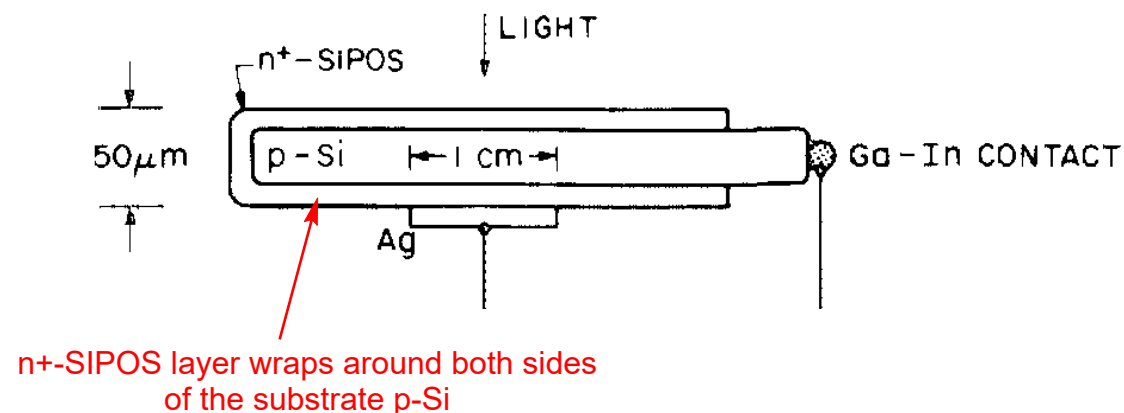
(Ex. 1008, Figure 1 (annotated).) At the center (3) is an n-type (negatively doped, for example, with phosphorus) silicon wafer with a front side (6) and a rear (7) side. Below the central substrate is a non-alloyed p-doped emitter layer (*i.e.*, positively doped, for example, with boron) (10); this emitter layer transfers electrons towards the rear metal contact (15) to create an electric current. (Ex. 1008 ¶ 2.) The interface between the rear side of the silicon wafer 7 and the non-alloyed p-doped layer 10 forms a p-n junction (12). On top of the front surface is a shallow, heavily-doped (n+) layer (17). The front side is completed with front contacts (16) and a passivation layer (18). (Ex. 1008 ¶¶ 10, 24–32.) The emitter

layer (10) is made of a highly transparent monocrystalline silicon to maximize the absorption of sunlight from the back of the solar cell. (Ex. 1008 ¶ 12.)

Yablonovitch (Ex. 1005).

Yablonovitch discloses a process for making a type of heterojunction solar cell in which an oxidized silicon substrate is located between layers of semi-insulating polycrystalline silicon (known as “SIPOS”). “Heterojunction” refers to a structure in which two adjacent layers forming the junction have different crystalline structures; in Yablonovitch the SIPOS layer is polycrystalline and the substrate is monocrystalline.

Yablonovitch teaches a “double heterostructure” design with two heterojunctions on opposite sides of the substrate. (Ex. 1005, 1211.) This design is shown on Figure 2 of Yablonovitch (reproduced below), which depicts a solar cell with a heavily (n-doped) silicon layer (“n⁺-SIPOS”) *wrapped around both sides of* a central silicon substrate (“p-Si”).



(Ex. 1005, Fig. 2 (annotations in red).)

Yablonovitch teaches that this double heterojunction design creates electrical fields on both the top and bottom of the substrate, forming a “bipolar transistor structure” that “show[s] greatly enhanced current gains.” (Ex. 1005, 1211.) In particular, Yablonovitch teaches that the double heterojunction design results in a forward current (a measure of recombination) two orders of magnitude superior to traditional homojunction solar cells. (*Id.*)

Table II of Yablonovitch, reproduced below, describes the steps for making the SIPOS solar cells. In the Yablonovitch process, in relevant part, the silicon wafer is heated to 650 °C (*step 5*) and exposed to oxygen gas for five minutes to form an oxide layer on the surface of the wafer (*step 6*). (Ex. 1005, 1212.) After the oxide layer is formed, SIPOS is deposited (*step 7*) on top of the silicon oxide. The SIPOS layer is deposited on opposite faces of the device. (*Id.* at 1211–12.) The solar cell assembly is then annealed at 900 °C (*steps 8 and 9*), causing silicon crystals to form in the SIPOS. (*Id.*)

TABLE II. Processing sequence.

1. Thin silicon wafers to 50 μm in aqueous KOH.
2. Getter in an oxidation furnace containing substantial chlorine.
3. Strip gettering oxide in HF acid.
4. Immediately load into cold APCVD furnace while purging with N_2 .
5. Ramp up to 650 $^\circ\text{C}$ while maintaining N_2 purge.
6. Oxidize for 5 min with 100 ppm O_2 .
7. Deposit SIPOS from 1000 ppm SiH_4 , 50 ppm PH_3 , and 10 ppm O_2 .
8. Ramp furnace to 900 $^\circ\text{C}$.
9. Anneal for 15 min.
10. Ramp furnace down to 450 $^\circ\text{C}$.
11. Anneal in forming gas for 2 h.
12. Pull wafers from cold furnace.

(Ex. 1005, Table II.)

- i. Canadian Solar fails to show that the method claimed in claim 1 of the '074 Patent would be obvious in view of Froitzheim and Yablonovitch.

Canadian Solar fails to show that the claimed method of the '074 Patent would be obvious in view of Froitzheim and Yablonovitch. There are several serious deficiencies in Canadian Solar's proposed combination. *First*, the Petition provides no real motivation for a POSA to make the proposed modifications to Froitzheim and Yablonovitch, particularly because the solar cell designs in each achieve high solar efficiencies on their own. *Second*, the solar cell structures of Froitzheim and Yablonovitch are radically different and are incompatible with each other. Thus, even if there were a motivation to combine them (which there is not), a POSA would not have a reasonable expectation of success in the

combination, particularly because fundamental aspects of each solar cell would need to be modified even to attempt the combination.

- (1) There is no motivation to combine Froitzheim and Yablonovitch because the proposed combination would eliminate their respective advantages

Canadian Solar states that it would be obvious to “[m]odify Froitzheim with Yablonovitch” (Pet. 24–27) because both Froitzheim and Yablonovitch “are analogous art,” “in the same field of solar cell design and fabrication” and “[e]ach is reasonably pertinent to the problems of efficiencies of solar cell designs.” (Pet. 24.) But this is insufficient. Obviousness requires that an ordinarily skilled artisan would have been motivated to make a combination, not merely that the combination *could* have been made. (*Id.*) The “fact that two references may have some technological overlap does not substitute for a motivation to combine.” *PersonalWeb Techs., LLC v. Apple, Inc.*, 848 F.3d 987, 993 -994 (Fed. Cir. 2017).

Canadian Solar also points to advantages taught by either Froitzheim and Yablonovitch as reasons why they would be combined. (Pet. 24-25.) But this does not provide a motivation to combine, and indeed, suggests the opposite. Each of Froitzheim and Yablonovitch, individually, teach that their claimed method and solar cell assemblies would result in a successful, high efficiency solar cell. Thus, a POSA would have no reason to modify either Froitzheim or Yablonovitch.

For example, Froitzheim teaches that its solar cell structure achieves “*improved stability*” and “*high efficiencies*” by making only minor adjustments to existing solar cell fabrication processes. (Ex. 1008, ¶¶ 51, 91–94.) Specifically, the changes taught in Froitzheim to achieve the “significantly higher efficiencies” are arranging the junction on the rear side of the substrate (*Id.* ¶ 11), which reduces degradation, and limiting the dopant to areas directly between electrodes and the substrate, which reduces recombination (*Id.* ¶ 21). Froitzheim touts that “a considerable advantage of the solar cell of the invention is that it can be produced with only *minor adjustments of a known and industrially applied process* for conventional p-type cells.” (*Id.* ¶¶ 51, 94 (emphasis added).) Because a POSA would need to modify Froitzheim against its teachings to achieve the combination described by Canadian Solar, a POSA would not be motivated to do so.

Similarly, Yablonovitch teaches that its double heterojunction solar cell design is “*superior*”. (Ex. 1005, 1211.) Yablonovitch teaches that the specific configuration of its solar cell, *i.e.*, a doped silicon layer (SIPOS) that *wraps around both sides of the substrate*, and the method of fabricating such a cell are responsible for the superior quality of this solar cell design. (*Id.*) Yablonovitch teaches that this “bipolar” design results in a reduction in recombination that is “*two orders of magnitude superior*” to conventional cells. (*Id.* at 1211 (emphasis added).) To make the combination Canadian Solar proposes, a POSA would again

have to modify Yablonovitch against its teaching, including removing the two side SIPOS layers that are key to its structure. Hence, Yablonovitch also teaches away from modifying its solar cell structure or its manufacturing method.

Both Froitzheim and Yablonovitch teach the importance of reducing recombination to improve efficiency of a solar cell. However, each reference achieves this reduction in a very different way. Froitzheim reduces recombination by selectively applying dopant under only the electrodes (Ex. 1008, ¶ 21), while Yablonovitch uses the bipolar design (Ex. 1005, 1211). In the combination proposed by Canadian Solar neither of these features are present. Rather, the solar cell assembly in the combination (i) has the SIPOS layer only on one side of the cell (against the teachings of Yablonovitch) which (ii) contains dopant throughout at the time of deposition and thus cannot be selectively doped (against the teachings of Froitzheim). Notably, Canadian Solar identifies the improved reduction of recombination taught in Yablonovitch as the motivation to combine (Pet. 24-25), yet eliminates the manner in which that reduction is achieved—the wrap-around SIPOS layer—in the proposed combination. A POSA motivated to reduce recombination of a solar cell would *not* combine the teachings of Froitzheim and Yablonovitch as described in the Petition because the proposed combination eliminates both Froitzheim's and Yablonovitch's features responsible for reducing recombination.

Hence, a POSA would not be motivated to modify Froitzheim with Yablonovitch to make the combination Canadian Solar proposes.

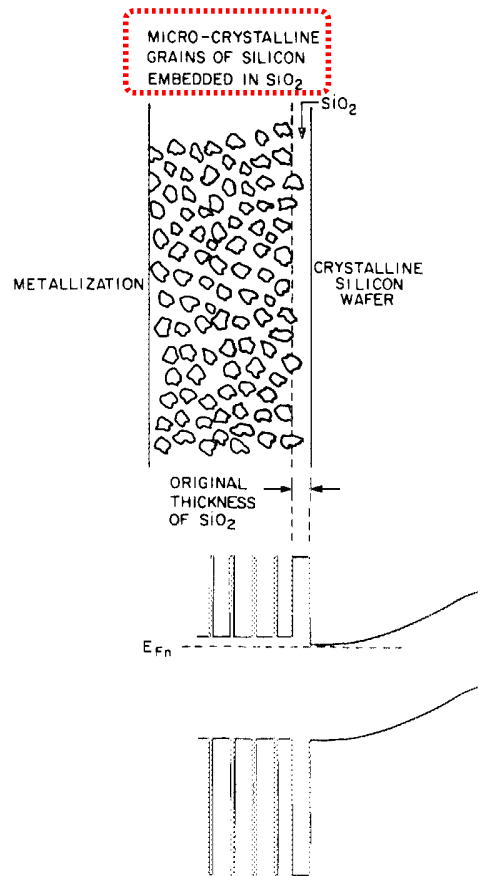
- (2) A POSA would have no reasonable expectation of success in combining Froitzheim and Yablonovitch because their designs are incompatible

The proposed combination of Froitzheim and Yablonovitch would involve a significant redesign of the solar cell taught in Froitzheim. Canadian Solar fails to provide a good reason why a POSA would expect such a combination to succeed. As noted, the proposed combination eliminates several features of the solar cells in Froitzheim and Yablonovitch that are important to achieving desirable solar cell efficiency. For example, the combination eliminates the selective doping of Froitzheim and the double bipolar heterojunction of Yablonovitch. Canadian Solar provides no reason as to why a POSA would have a reasonable expectation of success despite eliminating so many key teachings.

Canadian Solar argues that POSAs would have reasonable expectation of success because they “would have considered the Froitzheim/Yablonovitch combination to be merely an arrangement of old elements (and their corresponding fabrication steps) with each performing the same function it had been known to perform.” (Pet. 27.) But then the Petition lists multiple complicated substitutions, including: (i) replacing Froitzheim’s emitter (10) with Yablonovitch’s SIPOS layer with the addition of an interfacial oxide layer in between the SIPOS layer and

the substrate (Pet. 27–29); and (ii) reversing the polarity of layers in Yablonovitch to match the reverse-polarity in Froitzheim (n-type silicon substrate) and (p-type emitter layer) (Pet. 29–31). This is not a mere “arrangement of old elements”, but instead invention.

Nor is this combination simply an “arrangement of old elements” as Canadian Solar contends; far more is necessary to arrive at the combination. In addition to eliminating the double heterojunction design of Yablonovitch and the selective doping of Froitzheim, the proposed combination eliminates other important features of each reference as well. For example, Froitzheim teaches that rear emitter solar cells like those in its design must have transparent surfaces to absorb the limited light that enters from the rear (or bottom) of a solar module. (Ex. 1008, ¶ 12.) The proposed combination replacing the homojunction with a heterojunction drastically reduces the transparency. (Ex. 2023 ¶ 71.) Specifically, light is refracted each time it moves from one material to another. (*Id.*) The homojunction of Froitzheim is a single crystal and thus is highly transparent. As shown in Figure 3 of Yablonovitch (below), the SIPOS of the modified solar cell contains innumerable microscopic crystals with different orientations and shapes, not to mention separate silicon oxide and substrate layers. (*Id.*)



(Ex. 1005, Figure 3 (annotation in red.) Each of these different layers in Yablonovitch (with different crystalline structures) reduces transparency, akin to the difference between an intact windshield and one that has been shattered. (*Id.*; Ex. 2023 ¶ 71.) While Canadian Solar ignores this teaching of Froitzheim, a POSA would understand that transparency is a key consideration in making rear emitter solar cells that would complicate any combination of Froitzheim and Yablonovitch.

Other important material differences in Froitzheim and Yablonovitch are simply ignored by Canadian Solar. For example, the thickness of the respective

layers differs greatly between the two references. Yablonovitch teaches thicknesses that are optimized based on the spacing of the double heterojunction structure. (Ex. 1005, 1212.) Froitzheim teaches thicknesses that were selected through experimentation to optimize stability (*i.e.*, minimized degradation over time) for the specific materials used. (Ex. 1008, ¶¶ 54–56, 90.) Specifically, Yablonovitch teaches that the optimum thickness of the central wafer is 50 μm (Ex. 1005, 1212), while Froitzheim teaches the preferable thickness of the wafer is 150–250 μm (Ex. 1008, ¶ 24). The thickness of the wafer in a solar cell affects its performance and manufacturing cost; it also can affect its light absorbance. (Ex. 2023 ¶ 72.) Canadian Solar ignores the importance of layer thickness and provides no dimensions for the proposed combination. A POSA would not be able to rely on the dimensions of either reference, because the features animating those dimensions (the materials of Froitzheim and the shape of Yablonovitch) are absent from the proposed combination. Hence, a POSA would not have a reasonable expectation of success in using a thin wafer taught in Yablonovitch in making the Froitzheim solar cell assembly. (*Id.* ¶ 73.)

As another example, Yablonovitch teaches a solar cell containing a p-type silicon substrate (*e.g.*, boron-doped) and an n⁺ type SIPOS layer (*e.g.*, heavily doped with phosphorus) (Ex. 1005, 1212) while Froitzheim teaches the exact opposite: an n-type substrate (*e.g.*, phosphorus-doped) with a p-doped layer (*e.g.*,

boron doped). (Ex. 1008 ¶ 7.) Froitzheim further teaches that this specific p-doped layer has significantly higher stability than solar cells with n-doped layer over a p-doped substrate (as Yablonovitch teaches). (Ex. 1008 ¶ 7). A POSA would not have a reasonable expectation of success in using an n+ type SIPOS layer taught in Yablonovitch in making the Froitzheim solar cell assembly. (Ex. 2023 ¶ 69.)

Ultimately, the combination of Froitzheim and Yablonovitch is simply an attempt by the Canadian Solar to mix and match various elements from the prior art using the challenged claims as a roadmap, which is an after-the-fact combination driven by hindsight. (Pet. 23, 31.) As the Federal Circuit has repeatedly recognized, this is improper. “Care must be taken to avoid hindsight reconstruction by using the patent in suit as a guide through the maze of prior art references, combining the right references in the right way so as to achieve the result of the claims in suit.” *Grain Processing Corp. v. Am. Maize-Prods. Co.*, 840 F.2d 902, 907 (Fed. Cir. 1988) (internal quotations omitted); *Virtek Vision Int’l, ULC v. Assembly Guidance Sys., Inc.*, 97 F.4th 882, 886-88 (Fed. Cir. 2024) (“The mere fact that these possible arrangements existed in the prior art does not provide a reason that a skilled artisan would have substituted” elements of one cell for another and added the additional elements.)

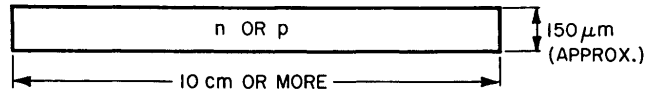
Claims 2–8 of the '074 Patent depend from claim 1. Accordingly, claims 2–8 are patentable over Froitzheim in view of Yablonovitch for at least the reasons given above with respect to claim 1.

B. **Ground 2: Canadian Solar has not demonstrated a reasonable likelihood of success in showing that Froitzheim, Yablonovitch, and Neville render any challenged claim obvious**

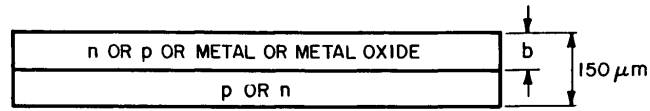
Canadian Solar states that Ground 2 is identical to Ground 1, “except that instead of using the n-type substrate in Froitzheim, the Skilled Artisan would replace it with a p-type substrate, as it is interchangeable as taught by Neville.” (Pet. 54.) However, Neville does not remedy the deficiencies of Ground 1 described in Section 6A. As discussed below, Neville’s mere acknowledgement that it is possible to use a p-type substrate in solar cells would not motivate a POSA to modify Froitzheim’s solar cell—whose teaching is to reverse the polarities to make a rear emitter solar cell—to revert back to a conventional solar cell and then combine that modified cell with Yablonovitch.

Neville (Ex. 1009)

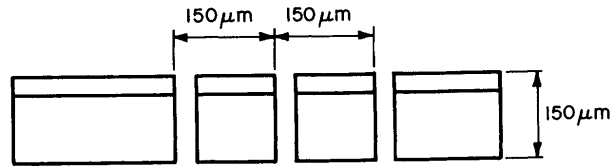
Neville is a textbook that provides general teachings on solar cell configuration and performance. Neville discloses general configurations of solar cells and generally labels the solar cell layers as “p or n” type, as shown below.



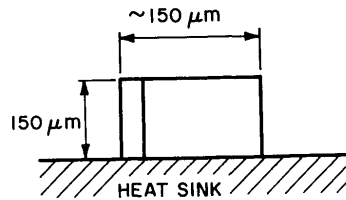
(a) A large slice, rectangular or round, of semiconductor



(b) Slice of semiconductor after junction fabrication



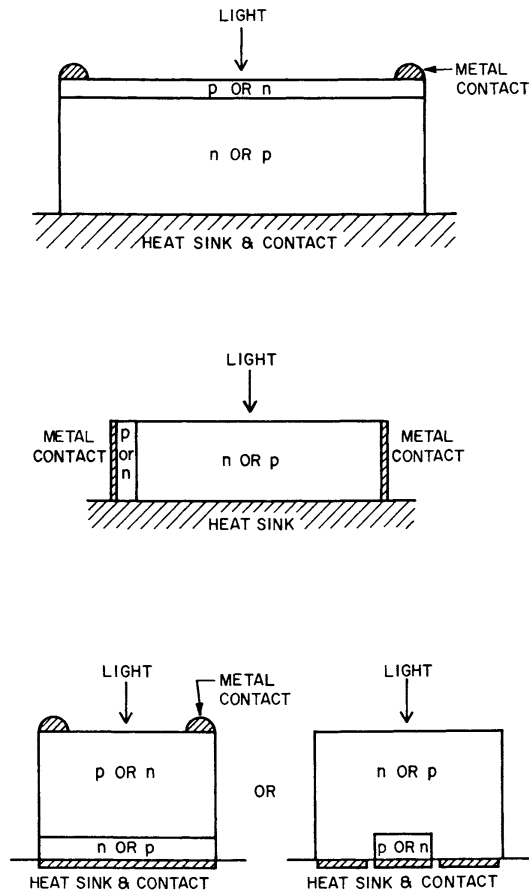
(c) Separation of slice into individual cells, two of which are detailed



(d) Attachment of vertical solar cell to heat sink

(Ex. 1009, Fig. VI.2.)

See also Figure VI.1 of Neville, general P-N and heterojunction solar cell-light configurations and also generally labeling the solar cell layers as “p or n” type:



(Ex. 1009, Fig. VI.1.)

Neville, however, does not discuss the properties of these configurations. While image (a) above labels a substrate as “n or p”, indicating that either an n-type or p-type substrate can be used in solar cells, it does not discuss the pros and cons of the two types or for which types of solar cells the two types of substrates should be used.

In Ground 2, Canadian Solar uses Neville to support its argument that “instead of using the n-type substrate in Froitzheim, the Skilled Artisan would replace it with a p-type substrate, as it is interchangeable as taught by Neville.”

(Pet. 54.) Canadian Solar relies entirely upon Neville's indication that solar cells can be made with either n-type or p-type substrates. (*Id.*) However, Froitzheim *already* acknowledges that solar cells can be made with a p-type substrate. (Ex. 1008, ¶¶ 2–3.) Froitzheim then explains that these p-type substrate solar cells experience high levels of light induced degradation, causing their efficiency to quickly decrease over their lifetimes. (*Id.*) The stated purpose of Froitzheim is teaching an *improved* solar cell design that exhibits improved efficiency and stability. (*Id.* ¶ 7.) Thus, Neville's acknowledgement that it is possible to use a p-type substrate in solar cells would be insufficient to motivate a POSA to ignore the teachings of Froitzheim to modify the solar cell in ways Froitzheim expressly teaches are less efficient and less stable. (*Id.*)

In addition, the Froitzheim/Yablonovitch/Neville combination suffers from the same serious incompatibility issues as the Froitzheim/Yablonovitch combination. For example, Neville teaches that the optimal thickness of the entire solar cell is no more than 150 μm , while Froitzheim teaches that the preferred thickness of the central silicon substrate layer (3) is between 150 μm and 250 μm (Ex. 1008, ¶ 24) and Yablonovitch teaches an optimum thickness of 50 μm (Ex. 1005, 1212). Notably, Neville teaches: “a solar cell need only be some 150 μm thick, in the direction parallel to the incoming photons, to absorb in excess of 95% of the incoming optical energy. *Any increase in thickness* beyond this value

increases construction cost with little or no corresponding increase in electrical power produced. *Any decrease in thickness* makes for substantially increased handling difficulty during fabrication, as a result of the fragile nature of semiconductors. This increases the cost of fabrication while diminishing the output power.” (Ex. 1009, 204 (emphases added).)

As discussed in section 6A, the thickness of the wafer in a solar cell affects the properties and manufacturing cost of the solar cell. (Ex. 2023 ¶ 72.) A POSA would not be able to rely on the dimensions of Neville, Froitzheim, and/or Yablonovitch because the features motivating those dimensions would be absent from the proposed combination. (*Id.* ¶¶ 72–73) For example, there would be no reasonable expectation of success when using the thickness taught in Yablonovitch (50 μm) because that is optimized for a double heterojunction solar cell (Ex. 1005, 1212), or the thickness taught in Froitzheim (150–250 μm) that is optimized for maximum stability in a rear emitter solar cell with a p-type emitter (Ex. 1008, ¶ 24). Nor does Neville provide any guidance for the appropriate wafer thickness to be used in the unusual chimeric solar cell proposed in Ground 2. (Ex. 2023 ¶¶ 80–81.)

Hence, a POSA would not have a reasonable expectation of success in combining Neville, Froitzheim and Yablonovitch.

C. **Ground 3: Canadian Solar has not demonstrated a reasonable likelihood of success in showing that Froitzheim and Kwark render any challenged claims obvious**

The Petition fails to show that Froitzheim and Kwark render obvious any of the challenged claims. Specifically, as discussed below, Kwark is duplicative of Yablonovitch and thus the proposed combination of Froitzheim and Kwark fails render claim 1 obvious for the same reasons given above in section 6A.

Kwark (Ex. 1006)

Kwark is an article titled “SIPOS Heterojunction Contacts To Silicon.” It discloses SIPOS (*i.e.*, semi-insulating polycrystalline silicon) films. Kwark focuses on the bulk properties of SIPOS films and reports experimental results of a study on the values of the emitter saturation current (J_{0e}) (the same measure of recombination used in Yablonovitch). Kwark does not disclose any assembled solar cell. Nor does Kwark disclose any method of fabricating any solar cell.

Canadian Solar admits that **Ground 3** is the same as **Ground 1**, only “Kwark, instead of Yablonovitch, supplies the elements for forming the SIPOS/polysilicon emitter and the oxide layer in between.” (Pet. 55–56.) Canadian Solar treats Kwark as duplicative of Yablonovitch and provides no additional arguments that are different from **Ground 1**. (Pet. 55–68.)

But Kwark does not address the myriad deficiencies in the proposed Froitzheim/Yablonovitch combination. Indeed, Kwark’s disclosure is even more

limited than that of Yablonovitch. Kwark merely discusses the material composition of SIPOS when used as an emitter in *semiconductor* devices. (Ex. 1006.) In its very limited references to solar cells, Kwark says that SIPOS can be used in “VLSI [very large scale integrated] *bipolar devices* and [] solar cells.” (Ex. 1006, 742 (emphasis added).) These “bipolar devices” are the same double heterojunction solar cells described in Yablonovitch. Notably, the Kwark reference authors, Kwark and Swanson, are co-authors of both the Kwark reference and the Yablonovitch reference, and the two papers were published within a year of each other. Because they describe the same solar cells, Kwark has the same flaw as Yablonovitch, in that it is directed to a materially different structure from Froitzheim and provides no reasonable expectation of success in modifying a single-sided solar cell like Froitzheim. Accordingly, claims 1–8 are patentable over Froitzheim in view of Kwark for at least the reasons given above with respect to Ground 1.

D. **Ground 4: Canadian Solar has not demonstrated a reasonable likelihood of success in showing that Froitzheim, Neville, and Kwark render any challenged claims obvious**

Ground 4 of the Petition relies on Ground 3 for all of the elements of claim 1, “except that instead of using the n-type substrate in Froitzheim, the Skilled Artisan would use a p-type substrate because they are interchangeable as taught by Neville”. (Pet. 78–79.)

However, as discussed in sections 6A (Ground 1), 6B (Ground 2), and 6C (Ground 3), Canadian Solar has not demonstrated a reasonable likelihood of success on Ground 4 at least for the reasons in these Sections.

- E. **Ground 5:** Canadian Solar has not demonstrated a reasonable likelihood of success in showing that Froitzheim (with or without Neville), Yablonovitch, and Sasaki render claim 2 obvious

Ground 5 of the Petition relies on Grounds 1 and 2 for all of the elements of claim 1. (Pet. 81.) As discussed above, Grounds 1 and 2 fail to render obvious claim 1 of the '074 Patent. *See supra* sections 6A-6B. Claim 2 depends from claim 1. Accordingly, Canadian Solar has not demonstrated a reasonable likelihood of success on Ground 5 for the reasons in sections 6A-6B.

- F. **Ground 6:** Canadian Solar has not demonstrated a reasonable likelihood of success in showing that Froitzheim (with or without Neville), Kwark, and Sasaki render claim 2 obvious

Ground 6 of the Petition relies on Grounds 3 and 4 for all of the elements of claim 1. (Pet. 85.) As discussed above, Grounds 3 and 4 fail to render obvious claim 1 of the '074 Patent. *See supra* sections 6C-6D. Claim 2 depends from claim 1. Accordingly, Canadian Solar has not demonstrated a reasonable likelihood of success on Ground 6 for the reasons in sections 6C-6D.

7. CONCLUSION

For the reasons set forth above, Canadian Solar has not met its burden of establishing a reasonable likelihood of success in arguing that any of the challenged claims of the '074 Patent are obvious under the asserted grounds.

Therefore, Patent Owner respectfully requests that the Board deny institution of *inter partes* review.

Dated: December 1, 2025

Respectfully submitted,



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CERTIFICATE OF WORD COUNT

Pursuant to 37 C.F.R. § 42.24(d), I certify that First Solar's Patent Owner Preliminary Response contains 5992 words as counted by the word processing program used to generate this document. The figures in this response contain approximately an additional 220 words. This brings the total number of words to 6212. This total does not include the table of contents, table of authorities, appendix of exhibits, certificate of service, signature, or certificate of word count.

Dated: December 1, 2025

Respectfully submitted,



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Counsel for Patent Owner

First Solar, Inc.

CERTIFICATE OF SERVICE

The undersigned certifies that a copy of the attached Request and supporting materials were served on December 1, 2025, by electronic mail, as authorized by

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