

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

IBM CORPORATION,
Petitioner,

v.

RIGETTI & COMPANY, INC.,
Patent Owner.

IPR2020-00494
Patent 9,836,699 B1

Before KEVIN F. TURNER, WESLEY B. DERRICK, and
JOHN F. HORVATH, *Administrative Patent Judges*.

DERRICK, *Administrative Patent Judge*.

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

I. INTRODUCTION

IBM Corporation (“Petitioner”) filed a Petition requesting an *inter partes* review of claims 1, 7–13, 18–20, 22–28, 30, 38, and 40–43 of U.S. Patent No. 9,836,699 B1 (“the ’699 patent,” Ex. 1001). Paper 5¹ (“Pet.”). Patent Owner Rigetti & Company, Inc., filed a Preliminary Response. Paper 10 (“Prelim. Resp.”). Petitioner also filed a second petition requesting an *inter partes* review of claims 1–6, 14–17, 21, 23–26, 29, 31–39, 41, and 43 of the ’699 patent (IPR2020-00495, Paper 1) and a Notice for Filing Two Petitions (Paper 2). We authorized additional briefing on certain issues set forth in the Preliminary Response, and Petitioner in turn filed a Reply to Patent Owner’s Preliminary Response (Paper 11, “Prelim. Reply”) and Patent Owner in turn filed a Sur-Reply to Petitioner’s Reply (Paper 12).

We have authority to determine whether to institute an *inter partes* review. 35 U.S.C. § 314; 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, for the reasons set forth below, we decline to institute an *inter partes* review because Petitioner has not shown a reasonable likelihood that it would prevail in establishing the unpatentability of any of claims 1, 7–13, 18–20, 22–28, 30, 38, and 40–43.

¹ Paper 5 is a corrected petition. Petitioner’s originally-filed petition (Paper 3), filed January 31, 2020, was accorded a filing date (Paper 4), but Petitioner was required to correct its failure to comply with the word limits for petitions within five business days (*id.* at 2). Paper 5 was timely filed, along with a reply setting forth that the corrected petition complies with the word limit requirement. Paper 6.

II. BACKGROUND

A. Related Proceedings

The parties indicate that an additional petition was filed concurrently for *inter partes* review of a different, partially overlapping subset of claims of the '699 patent, *i.e.*, in IPR2020-00495, and that there are no additional related matters known. Pet. 9; Paper 2, 1; Paper 8.

B. The '699 Patent (Ex. 1001)

The '699 patent is titled “Microwave Integrated Quantum Circuits With Interposer,” and is directed to a quantum computing apparatus including a quantum circuit device and an interposer having a connectorization layer for connecting the apparatus to a plurality of cables. Ex. 1001, [54], [57]. Figure 19, reproduced below, depicts quantum computing apparatus 1900 in which interposer 1920 also includes intermediate layer 1930 between quantum circuit device 1910 and connectorization layer 1940, and in which the interposer connects the quantum circuit device 1910 to a series of cables 1950. *Id.*, Fig. 19, 46:41–46, 47:8–18.

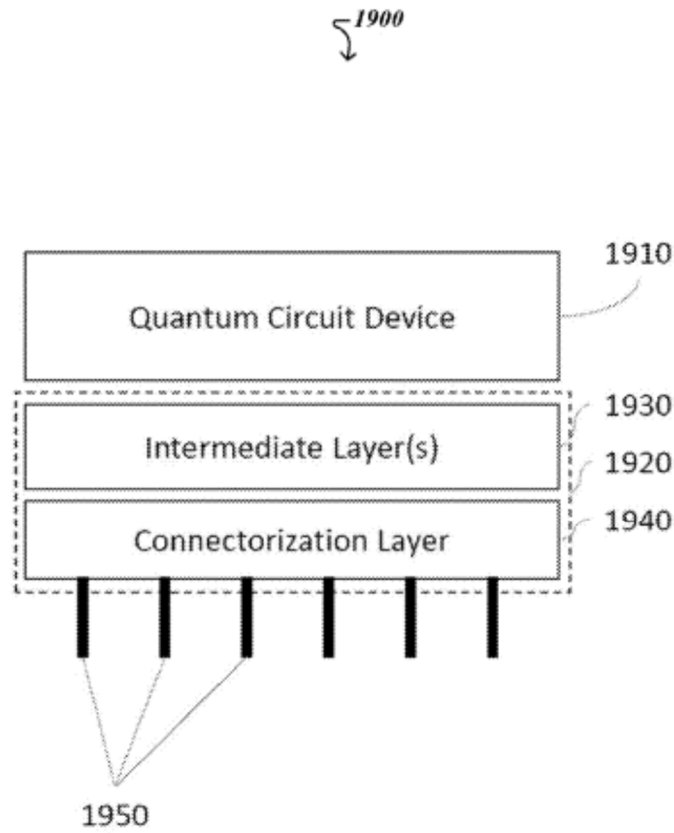


FIG. 19

Id., Fig. 19 (depicting a schematic representation of a quantum computing apparatus).

C. Claimed Subject Matter

There are two independent claims: Claims 1 and 38, reproduced below.

1. A quantum computing apparatus, comprising:
a quantum circuit device; and
an interposer comprising:
a connectorization layer comprising a plurality of terminals for
connecting the quantum computing apparatus to a

corresponding plurality of cables and a plurality of signal lines electrically coupled, via electrical contacts, to the plurality of terminals; and

at least one intermediate layer between the quantum circuit device and the connectorization layer, the at least one intermediate layer comprising an integrated circuit layer, the at least one intermediate layer being electrically coupled to the signal lines of the interposer,

wherein the interposer is configured to supply the quantum circuit device, during operation of the quantum computing apparatus, at least control signals and readout signals to and from the plurality of cables.

Ex. 1001, 54:20–36.

38. A method of forming an assembly for a quantum computing apparatus, the method comprising:

attaching an interposer to a circuit wafer for a quantum circuit device, the interposer comprising an integrated circuit layer and a connectorization layer comprising a plurality of terminals for connecting the quantum computing apparatus to a corresponding plurality of cables, the interposer being attached so that the integrated circuit layer is between the circuit wafer and the connectorization layer,

wherein the interposer comprises a plurality of signal lines electrically coupled, via electrical contacts, to the circuit wafer to supply, during operation of the quantum computing apparatus, at least control signals and readout signals to and from the plurality of cables.

Id. at 56:34–48.

D. Prior Art Relied Upon

Petitioner relies upon the references, and dates, listed below (Pet. 13–14 (citing Exs. 1004–1008, 1010, 1011, 1013)):

Reference	Date	Exhibit No.
WO 2014/163728 A2 (“Schoelkopf”)	Oct. 9, 2014	1005
Abdo et al., <i>Josephson Directional Amplifier for Quantum Measurement of Superconducting Circuits</i> , PRL 112, 167701 (2014) (“Abdo”)	May 20, 2014	1006
US 6,614,106 B2 (“Matsuo”)	Sept. 2, 2003, filed Sept. 21, 2003	1007
Frunzio et al., Fabrication and Characterization of Superconducting Circuit QED Devices for Quantum Computation, IEEE Transactions on Applied Superconductivity, Vol. 15, No. 2 (June 2005) (“Frunzio”)	Oct. 4, 2004	1008
Schmitt, Multiplexed readout of transmon qubits with Josephson bifurcation amplifiers, Physical Review A 90, 062333 (2014) (“Schmitt”)	Sept. 1, 2014	1010
US 8,937,255 B1 (“Dotsenko”)	Jan. 20, 2015, priority claim to Aug. 18, 2007	1011
US 9,231,181 B1 (“Thom”)	Jan. 5, 2016, filed Aug. 28, 2012	1013

The status of these references as prior art printed publications is not contested by Patent Owner (*see generally* Prelim. Resp.).

E. The Asserted Grounds of Unpatentability

Petitioner challenges the patentability of the claims on the following grounds, relying on the Declaration from Andrew A. Houck, Ph.D. (Ex. 1003). Pet. 13, 15–106.

Challenged Claims	35 U.S.C. § ²	Reference(s)/Basis
1, 13, 19, 20, 22, 27, 28, 38	103	Schoelkopf, Matsuo, Frunzio
7, 8, 10	103	Schoelkopf, Matsuo, Frunzio, Abdo
9	103	Schoelkopf, Matsuo, Frunzio, Schmitt
11, 12, 18, 30, 40, 42	103	Schoelkopf, Matsuo, Frunzio, Dotsenko
23–26, 41, 43	103	Schoelkopf, Matsuo, Frunzio, Thom

III. ANALYSIS

A. Level of Ordinary Skill in the Art

Petitioner contends that a person of ordinary skill in the art “would include someone who had a Master’s degree in Electrical and/or Computer Engineering, Physics, or equivalent training, and approximately three years

² The Leahy-Smith America Invents Act (“AIA”), Pub. L. No. 112–29, 125 Stat. 284, 287–88 (2011), revised 35 U.S.C. § 103 effective March 16, 2013.

of experience working in industry with a focus on quantum computing circuits,” and that a “[l]ack of work experience can be remedied by additional education, and vice versa.” Pet. 12 (citing Ex. 1003 ¶¶ 1–22, 37–41).

Patent Owner expressly “applies Petitioner’s definition of a [person of ordinary skill in the art]” in its Preliminary Response, while “reserv[ing] the right to provide its own definition” later. Prelim. Resp. 21.

On this record, we discern no error in the contended level of skill and note that it is not contested at this stage of the proceeding. Accordingly, we apply the identification of a person of ordinary skill as set forth by Petitioner.

B. Claim Construction

For petitions filed on or after November 13, 2018, a claim shall be construed using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. § 232(b), including construing 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. 37 C.F.R. § 42.100(b) (2019). Thus, we apply a district court-type claim construction.

In applying a district court-type claim construction, we are guided by the principle that the words of a claim “are generally given their ordinary and customary meaning,” as understood by a person of ordinary skill in the art at the time of the invention. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–13 (Fed. Cir. 2005) (en banc) (citation omitted). “In determining the meaning of the disputed claim limitation, we look principally to the intrinsic evidence of record, examining the claim language itself, the written

description, and the prosecution history, if in evidence.” *DePuy Spine, Inc. v. Medtronic Sofamor Danek, Inc.*, 469 F.3d 1005, 1014 (Fed. Cir. 2006) (citing *Phillips*, 415 F.3d at 1312–17). There is a “heavy presumption,” however, that a claim term carries its ordinary and customary meaning. *CCS Fitness, Inc. v. Brunswick Corp.*, 288 F.3d 1359, 1366 (Fed. Cir. 2002) (citation omitted).

We are also guided by the principle that we only construe claim terms if, and to the extent, it is necessary for the purpose of the proceeding, here, to determine whether to institute an *inter partes* review. *See, e.g., Wellman, Inc. v. Eastman Chem. Co.*, 642 F.3d 1355, 1361 (Fed. Cir. 2011) (“[C]laim terms need only be construed ‘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 contends that “no claim term requires express construction for the Board to evaluate the patentability of the claims” on the basis of “the prior art assertions presented,” and that, thus, the “Petition analyzes the claims consistent with ordinary and customary meaning as would be understood by a [person of ordinary skill in the art] in light of the specification.” Pet. 12–13 (citing Ex. 1003 ¶ 42).

Patent Owner does not set forth an express construction of any claim term, stating that “[f]or purposes of this Preliminary Response, [Patent Owner] analyzes the claim terms consistent with their plain and ordinary meaning,” while also “reserv[ing] the right to proffer its own construction . . . should the need arise.” Prelim. Resp. 21.

Based on the current record, we decline to construe any term of the ’699 patent, except to the limited extent set forth in our analysis of the

grounds, because it is not necessary to do so in reaching our decision that Petitioner has not established a reasonable certainty that it would prevail in establishing the unpatentability of at least one challenged claim.

C. Principles of Law

Petitioner has asserted that each of the challenged claims of the '699 patent is unpatentable as obvious under 35 U.S.C. § 103. A claim is unpatentable under § 103 if “the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) objective evidence of nonobviousness, i.e., secondary considerations. *See Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

“In an [*inter partes* review], the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable.” *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016) (citing 35 U.S.C. § 312(a)(3) as “requiring *inter partes* review petitions to identify ‘with particularity . . . the evidence that supports the grounds for the challenge to each claim’”); *cf. Intelligent Bio-Systems, Inc. v. Illumina Cambridge, Ltd.*, 821 F.3d 1359, 1369 (Fed. Cir. 2016) (quoting 35 U.S.C. § 312(a)(3)) (addressing “the requirement that the initial petition identify ‘with particularity’ the ‘evidence that supports the grounds for the challenge to each claim’”). This burden never shifts to Patent Owner. *See*

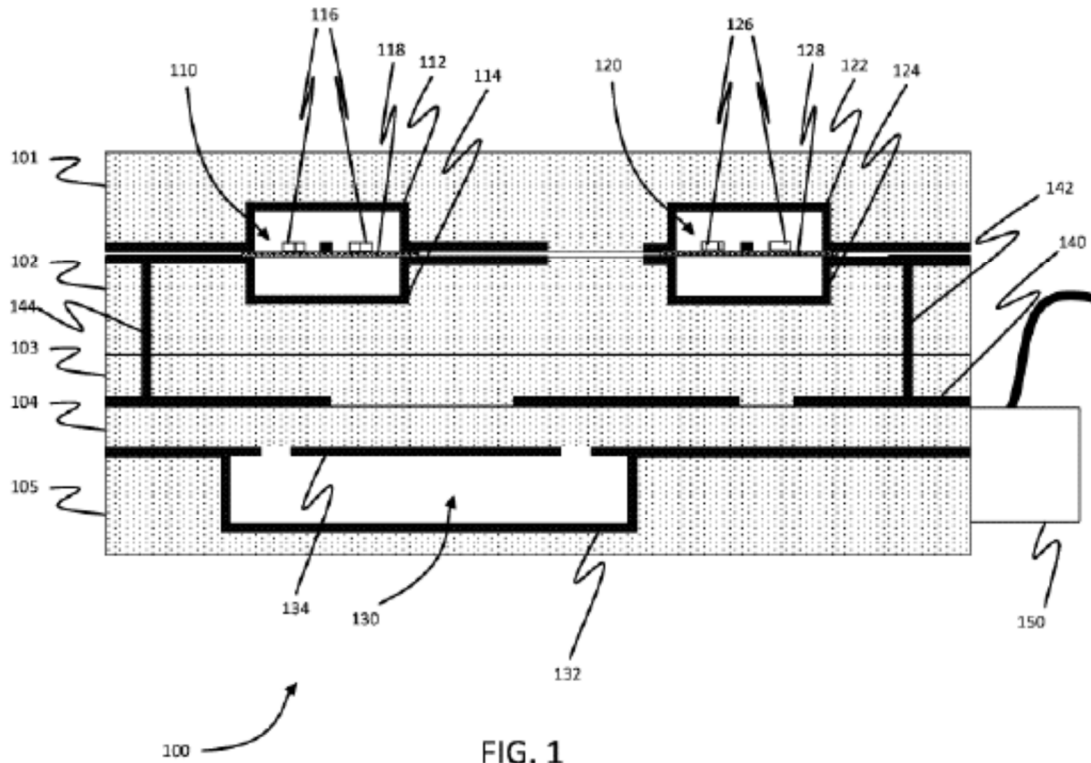
Dynamic Drinkware, LLC v. Nat'l Graphics, Inc., 800 F.3d 1375, 1378 (Fed. Cir. 2015) (citing *Tech. Licensing Corp. v. Videotek, Inc.*, 545 F.3d 1316, 1326–27 (Fed. Cir. 2008)) (discussing the burden of proof in *inter partes* review). Furthermore, Petitioner cannot satisfy its burden of proving obviousness by employing “mere conclusory statements.” *In re Magnum Oil Tools Int'l, Ltd.*, 829 F.3d 1364, 1380 (Fed. Cir. 2016).

Thus, to prevail in an *inter partes* review, Petitioner must explain how the proposed combinations and/or alterations of the prior art would render them unpatentable as obvious. At this preliminary stage, we determine whether the information in the Petition shows there is a reasonable likelihood that Petitioner would prevail in establishing that at least one of the challenged claims would have been obvious over the proposed combinations and/or alterations of the prior art.

D. Overview of Prior Art

1. Schoelkopf (Ex. 1005)

Schoelkopf discloses a “superconducting device[] formed from multiple substrates configured to exhibit quantum mechanical phenomena.” Ex. 1005, 1:16–17. Such a device is depicted in Figure 1, reproduced below:

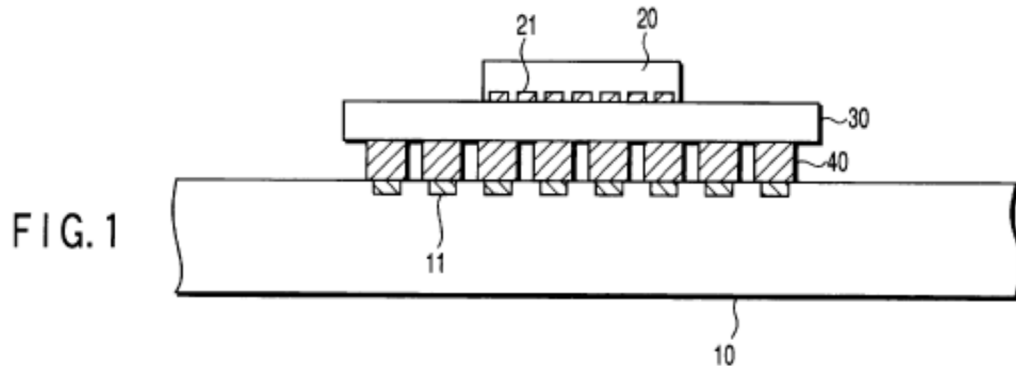


Id. at Fig. 1. Figure 1 depicts a superconducting device. *Id.* at 8:26–9:2. Schoelkopf discloses that “substrate 101 and 102 together form a bus layer,” “[s]ubstrate 104 and substrate 105 together form a cavity memory layer,” and “[s]ubstrate 103 is used as an interconnection layer used to interconnect various components within the superconducting device 100.” *Id.* at 9:4–8.

2. Matsuo (*Exhibit 1007*)

Matsuo discloses a stacked circuit device including an interposer between a large-scale integration chip and a base substrate. Ex. 1007, [57],

2:39–41, Fig. 1. Such a device is depicted in Figure 1, reproduced below:



Id. at Fig. 1. Figure 1 depicts structure of a stacked circuit device. *Id.* at 2:36–37. As depicted, “[a]n interposer 30 is arranged between a base substrate 10 (mother board, etc.) and an LSI chip 20” allowing a connection to be made between terminals 11 and terminals 21. *Id.* at 2:39–43.

3. Frunzio (Ex. 1008)

Frunzio discloses a superconducting qubit device mounted on a PC board. Ex. 1008, Fig. 2.

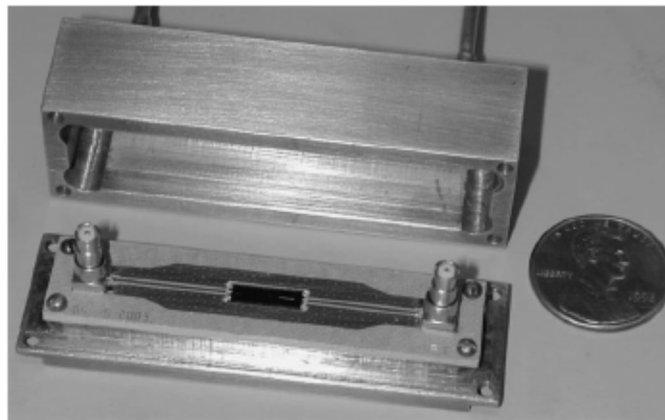


Fig. 2. Picture of the copper sample box containing a resonator mounted on the PC board.

Id. at Fig. 2. Figure 2 depicts a resonator mounted on a PC board. *Id.*

4. *Abdo (Ex. 1006)*

Abdo discloses a quantum computing device that uses a “directional coupler” and a “quantum-limited amplifier that is directional,” where the “directional coupler enables biasing the [Josephson directional amplifier] JDA.” Ex. 1006, Abstract, 2.

5. *Schmitt (Ex. 1010)*

Schmitt discloses a “multiplexed” circuit for “simultaneous readout of transmon qubits,” with a “chip [that] consists of four cells . . . coupled to a single transmission line that carries the multiple qubit control and [Josephson bifurcation amplifier] signals.” Ex. 1010, Title, Abstract, 1.

6. *Dotsenko (Ex. 1011)*

Dosenko discloses bonding substrates together in a method for electrically interconnecting two substrates having preformed electrical contacts. Ex. 1011, Abstract. An embodiment includes “a high-speed superconducting circuit.” *Id.*

7. *Thom (Ex. 1013)*

Thom discloses wiring bonding a quantum circuit with a stack of printed circuit board substrates. Ex. 1013, Abstract, 45:10–16, 45:40–50, Fig. 22.

E. Schoelkopf, Matsuo, and Frunzio

Petitioner contends that claims 1, 13, 19, 20, 22, 27, 28, and 38 are unpatentable under 35 U.S.C. § 103 over Schoelkopf, Matsuo, and Frunzio. Pet. 13, 15–66. Patent Owner disagrees, arguing that the grounds set forth

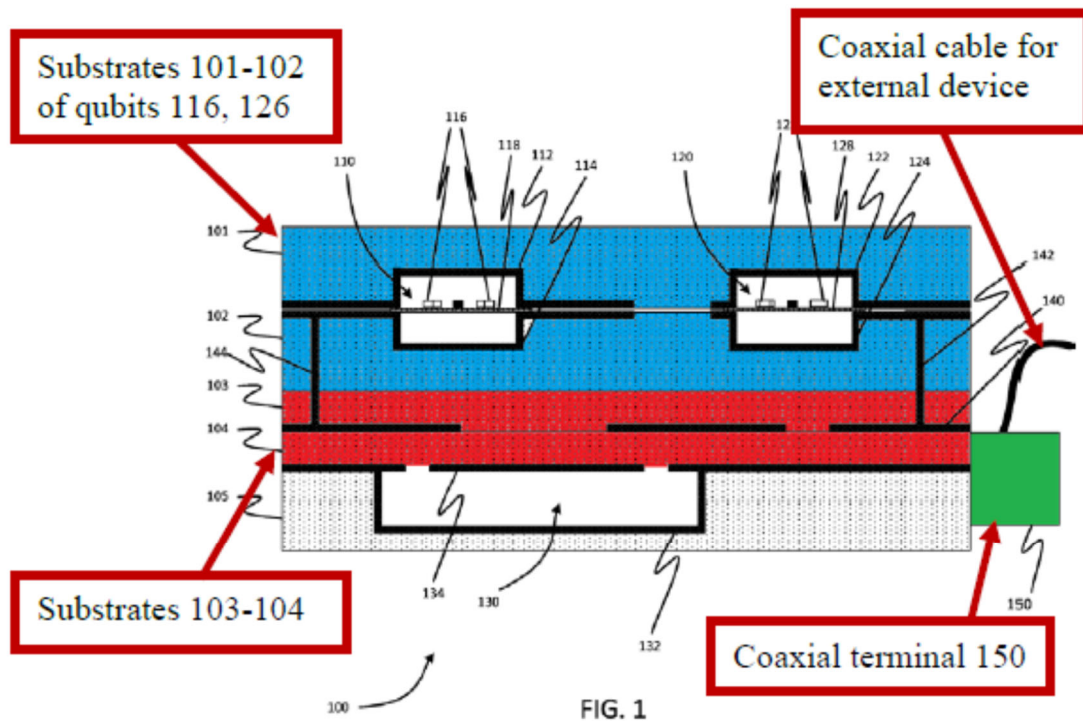
by Petitioner are deficient and do not support institution of an *inter partes* review. Prelim. Resp. 22–60.

1. Petitioner’s Contentions

Petitioner contends that Schoelkopf and Matsuo are analogous art to the ’699 patent because each is from the same field of endeavor and are reasonably pertinent to the problem of the ’699 patent. Pet. 17–28.

Petitioner similarly contends that Frunzio is analogous art “because it discloses a superconducting circuit for quantum computation” and its “teachings would produce obvious, beneficial, and predictable results.” *Id.* at 29–36.

Petitioner relies on Schoelkopf as disclosing “the substrates 103-104 . . . interposed between substrates 101-102 and the planar-to-coaxial transition component 150 to provide electronic connection between qubits 116, 126 and the external coaxial cable. *Id.* at 20 (citing Ex. 1003 ¶ 59; Ex. 1005, 9:12–29, Fig. 1). Petitioner sets forth, with reference to Schoelkopf’s Figure 1, with annotation, what it contends Schoelkopf discloses. *Id.* at 20–21.



IBM-1005, Figure 1 (annotated)

Id. at 20 (depicting a superconducting device). Petitioner contends that “Schoelkopf discloses that substrates 103 and 104 include wiring layers 134, 140, and vias 142 and 144.” *Id.* (citing Ex. 1005, 10:1–15). Petitioner contends that “Schoelkopf explains that the ‘wiring layers may be used to connect components together and or connect components to external devices’ ‘via a planar-to-coaxial transition component 150.’” *Id.* at 20–21 (citing Ex. 1003 ¶ 60; Ex. 1005, 8:4–5, 9:31–33).

Petitioner further contends that, on this basis, “a [person of ordinary skill in the art] would have understood that Schoelkopf’s wiring layers 134, 140, and vias 142 and 144, are used to connect to external devices via coaxial cables, for reading out the states of qubits 116, 126.” *Id.* at 21. Petitioner also contends that Schoelkopf “does not exclude that at least some

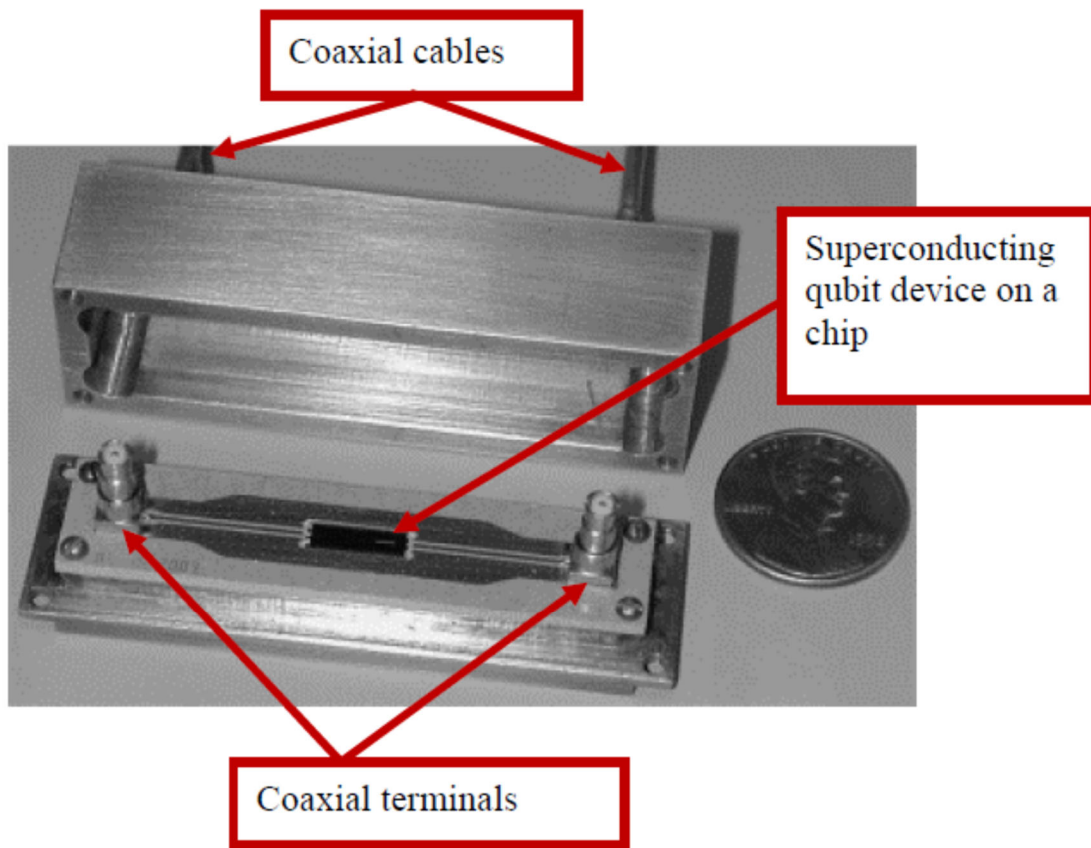
devices would be implemented within superconducting device 100, between the qubits and the coaxial cable.” *Id.* (citing Ex. 1005, 9:8, 9:10–11).

Petitioner contends that a person of ordinary skill in the art “would have understood that some devices, such as amplifiers, filters, couplers, multiplexers, and the like, were implemented in device chains between qubits and cables.” *Id.* (citing Ex. 1003 ¶ 61); *see also id.* at 21–24 (citing Ex. 1003 ¶¶ 62–64; Ex. 1006, 1, 4, Fig. 1; Ex. 1009, 1, Figs. 1(a)–(b); Ex. 1015, Abstract, 74; Ex. 1017, Title, ¶¶ 19, 42–45) (describing examples of such circuitry).

Petitioner contends that a person of ordinary skill in the art, recognizing the benefit of such circuits, “would have understood the benefit of using a circuit layer with circuits for processing qubit signals, in Schoelkopf’s superconducting device 100, and would have looked to other references regarding a suitable location to implement such a circuit layer.” *Id.* at 24 (citing Ex. 1003 ¶ 65). Petitioner contends, accordingly, that “it would have been obvious to a [person of ordinary skill in the art] to apply Matsuo’s teachings of including a circuit layer in an interposer, when implementing the interposer of Schoelkopf’s superconducting device 100,” including for the benefit of “allow[ing] for processing of qubit signals before the signals are read out over coaxial lines, while also providing a reduced area.” *Id.* at 25 (citing Ex. 1003 ¶¶ 67–68). Petitioner further explains that “placing the integrated circuit layer at Schoelkopf’s substrate 103 provides the advantage of a modular design since the integrated circuit layer of substrate 103 is separate from other substrates and can be changed or updated with minimal effect on the design of the circuits of the other substrates.” *Id.* at 26 (citing Ex. 1003 ¶ 69). Petitioner contends that, for

example, a person of ordinary skill in the art “would have known that substrate 103 may be implemented with a plurality of substrates, with at least one of them including the integrated circuit layer.” *Id.* at 27 (citing 2:24–25, 8:30–32).

Petitioner relies on Frunzio as disclosing the details of a planar-to-coaxial transition component, including coaxial terminals and coaxial cables, in its Figure 2, with annotations, reproduced below from the Petition:



IBM-1008, Fig. 2 (annotated)

Id. at 29. Figure 2 (annotated) depicts a resonator mounted on a PC board with annotations indicating coaxial cables and coaxial terminals, and identifying the resonator as a superconducting qubit device on a chip. *Id.* Petitioner contends, in particular, that “Frunzio supplements [Schoelkopf’s disclosure] and teaches a plurality of coaxial cables, where each cable is

coupled to a corresponding coaxial terminal for communicating signals between external components and qubits.” *Id.* at 30 (citing Ex. 1003 ¶ 79). Petitioner also contends that a person of ordinary skill in the art would have found it obvious “to use a plurality of coaxial terminals and a plurality of coaxial cables, as Frunzio teaches, in Schoelkopf’s superconducting device 100 because it would facilitate communicating signals (*e.g.*, control and readout) between external devices and the qubits.” *Id.* at 31–32 (citing Ex. 1005, 8:3–5, 9:31–33).

Petitioner also contends that a person of ordinary skill in the art would have found it obvious “that Schoelkopf’s planar-to-coaxial transition component 150 uses separate electrical contacts to couple wiring layers for communicating between external devices and the qubits” (*id.* at 33 (citing Ex. 1003 ¶ 84)) and that such a teaching is explicit in Frunzio’s Figure 2, “with signal lines electrically coupled to the coaxial terminals via electrical contacts” (*id.* at 33–34 (citing Ex. 1003 ¶ 85)). Petitioner contends, accordingly, that a person of ordinary skill in the art “would have been motivated to use electrical contacts, per Frunzio, when implementing Schoelkopf’s planar-to-coaxial transition component 150 with coaxial terminals per Frunzio” because it would provide “electrical continuity allow[ing] signals (*e.g.*, control and readout) to be exchanged between components of superconducting device 100 (*e.g.*, qubits) and external components via the coaxial terminals and coaxial cables.” *Id.* at 34–35 (citing Ex. 1003 ¶ 87; Ex. 1005, 8:3–5, 9:31–33).

(a) Independent Claim 1

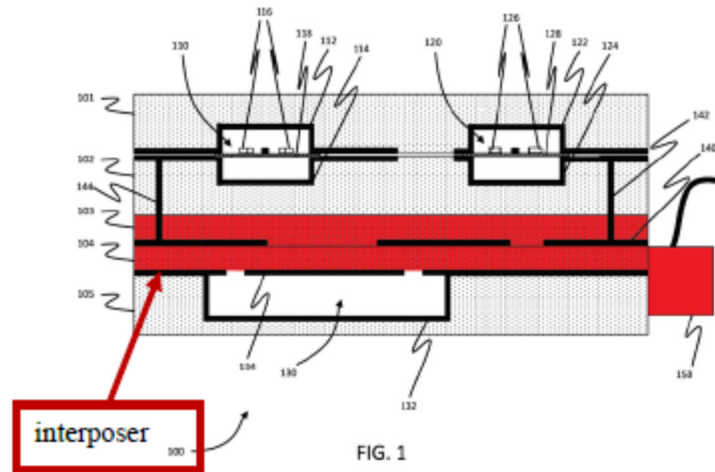
Claim 1 is directed to a quantum computing apparatus including a quantum circuit device and an interposer that includes both a

connectorization layer—for connecting the apparatus to a plurality of cables—and an intermediate layer situated between the quantum circuit device and the connectorization layer.

Petitioner contends that Schoelkopf’s superconducting device 100 that performs quantum computations discloses “[a] quantum computing apparatus.” Pet. 36 (citing Ex. 1003 ¶¶ 90–92; Ex. 1005, 1:14–2:15, 7:6–8, 8:26–27, 11:28–12:3, 12:17–19, 13:7–8).

Petitioner contends that Schoelkopf discloses “a quantum circuit device” in its disclosure of substrates 101 and 102, which “include quantum circuits (*e.g.*, qubits, 116, 126, wiring layers, and other components).” Pet. 37 (citing Ex. 1003 ¶¶ 93–96; Ex. 1005, 11:28–12:3, 12:8–23, Fig. 1).

Petitioner contends that Schoelkopf teaches an interposer in that “its superconducting device 100 includes substrates 103, 104 (with corresponding circuitry) and the planar-to-coaxial transition component 150 interposed between the quantum circuits and the coaxial line.” Pet. 38–39 (citing Ex. 1003 ¶¶ 97–102; Ex. 1005, 8:26–32, 9:5–33, 10:1–11, 11:14–12:33). Reproducing an annotated Figure 1, Petitioner further contends that substrates 103 and 104 are multiple layers with “vias and other superconducting connections fan[ning] out through substrates 103 and 104 to the electrical connector (component 150) at the bottom of substrate 104.”



IBM-1005, Figure 1 (annotated)

Id. (citing Ex. 1005, 9:13–14, 9:27–30, Fig. 1). Figure 1 (annotated) depicts a superconducting device. Petitioner also contends that “Schoelkopf . . . recognizes that ‘[a]ny number of substrates may be used’ and that its embodiments are ‘not so limited.’” *Id.* at 39 (citing Ex. 1005, 8:26–9:2).

Petitioner contends, in particular, that Schoelkopf’s interposer includes “a connectorization layer” as “substrate 104 and transition component 150 are part of the ‘interposer’” and substrate 104 includes a connectorization layer. Pet. 39–41. In particular, Petitioner contends that “Schoelkopf’s substrate 104 includes superconducting layer 134 for connecting to the planar-to-coaxial transition component 150,” that “[o]ne or more wiring layers may be used to connect components together and or connect components to external devices,” and that “[s]uperconducting device 100 may communicate to external components via a planar-to-coaxial transition component 150.” *Id.* at 39 (citing Ex. 1005, 10:22–24; quoting *id.* at 8:3–5, 9:31–33) (emphasis omitted). Petitioner further contends that “it would have been obvious to a [person of ordinary skill in the art] that the superconducting layer 134 has connections (additional wiring layers and vias

not illustrated) from the transition component 150 to the superconducting layer 140” “[b]ecause the connection path is from the coaxial cable to internal components, *e.g.*, qubits 116 and 126.” Pet. 40 (citing Ex. 1005, 10:2–8).

Petitioner further contends that the recited “plurality of terminals” and “plurality of signal lines” included in the connectorization layer would have been obvious. Pet. 41–48. Petitioner contends that the “plurality of terminals for connecting the quantum computing apparatus to a corresponding plurality of cables” would have been obvious because:

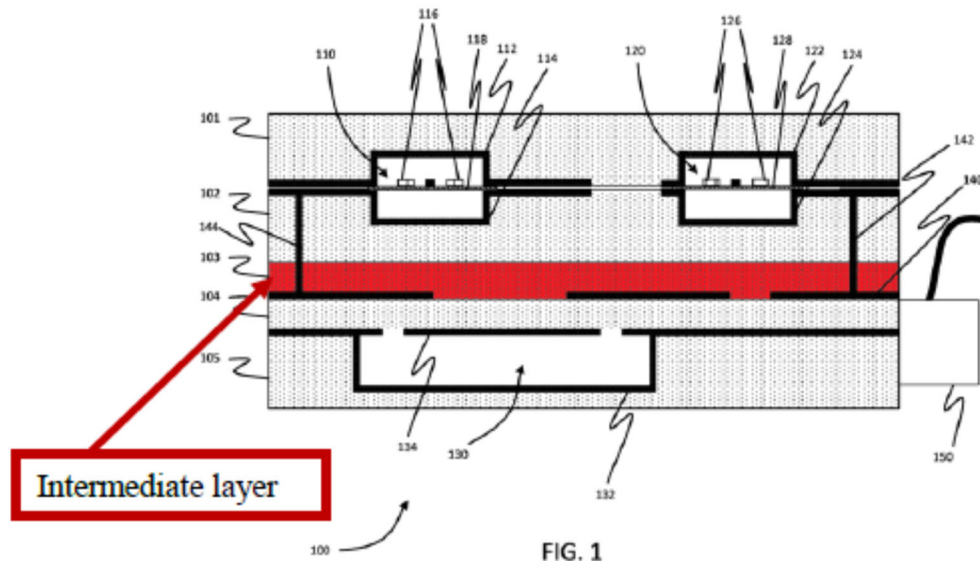
(1) the “planar-to-coaxial transition component 150 is part of the ‘connectorization layer’” in Schoelkopf’s superconducting device 100 (*id.* at 41); (2) a person of ordinary skill in the art “would have understood that each cable would have been connected to a corresponding coaxial terminal,” and “Schoelkopf’s ‘*coaxial lines*’ discloses the ‘*corresponding plurality of cables*’” (*id.* at 41–42 (citing Ex. 1005, 9:31–33, 10:1–11, 12:16–19, 13:5–10)); and (3) Frunzio “expressly teach[es] a plurality of coaxial terminals for connecting a quantum computing device to a corresponding plurality of cables” (*id.* at 42–43 (citing Ex. 1008, Fig. 2)). Petitioner also relies on the testimony of Dr. Houck. *Id.* at 43–44 (citing Ex. 1003 ¶¶ 109–115).

Petitioner contends that the “plurality of signal lines electrically coupled, via electrical contacts, to the plurality of terminals” would have been obvious because: (1) “Schoelkopf’s substrate 104 is part of the ‘connectorization layer,’ and Schoelkopf and Frunzio teach implementing planar-to-coaxial transition component 150 with a plurality of coaxial terminals” (*id.* at 44); (2) “‘substrate 104 . . . [includes] a superconducting layer 134,’ which is connected to the planar-to-coaxial transition component

150” and that “it would have been obvious to a [person of ordinary skill in the art] that signal paths (*i.e.*, superconducting layer 134, wiring layers, and vias not illustrated) of substrate 140, facilitate communication from qubits 116, 126 to the transition component 150” (*id.* at 44–45 (citing Ex. 1005, 10:1–29, Fig. 1); and (3) Frunzio teaches coupling signal lines to the coaxial terminals in that a person of ordinary skill in the art “would have understood that the electrical contacts of Frunzio are electrically and physically attached to the signal lines using solder” and that “[i]t would have been obvious . . . to implement planar-to-coaxial transition component 150 with a plurality of coaxial terminals to electrically couple each coaxial terminal with a corresponding signal line, via electrical contacts (*e.g.*, solder), for communicating signals to and from an external device and the qubits” (*id.* at 46–47 (citing Ex. 1003 ¶ 124; Ex. 1008, Fig. 2, 861)). As to the signal paths to facilitate communicating signals, Petitioner further explains that, “[f]or example, it would have been obvious to a [person of ordinary skill in the art] a via would connect layer 134 to layer 140 and that a via may be used to connect another wiring layer to layer 140 and/or a wiring layer connected to qubits 116, 126” and that, “[a]ccordingly, superconducting layer 134, and other wiring layers and vias not illustrated, separately and together, correspond to the ‘*plurality of signal lines.*’” *Id.* at 45–46. Petitioner also relies on the testimony of Dr. Houck. *Id.* at 47–48 (citing Ex. 1003 ¶¶ 116–126).

Petitioner contends that “Schoelkopf’s substrate 103 positioned between substrates 101, 102 and substrate 104, discloses ‘at least one intermediate layer between the quantum circuit device and the connectorization layer.’” Pet. 49 (citing Ex. 1003 ¶¶ 127–130) (emphasis

omitted); *see also id.* at 48–49 (citing Ex. 1005, 8:26–9:2, 9:7–11, Fig. 1). Petitioner relies, in particular, on “substrates 101 and 102 . . . disclos[ing] ‘the quantum circuit device,’ and . . . substrate 104 [as] part of ‘the connectorization layer’” and depicts layer 103 as an intermediate layer in an annotated Figure 1, reproduced below.



IBM-1005, Figure 1 (annotated)

Id. at 49 (citing *id.* at 37, 39–41). Figure 1 (annotated) depicts a superconducting device. Petitioner further contends that “[i]t would have been obvious to a [person of ordinary skill in the art] that substrate 103 includes a plurality of substrates when suitable.” *Id.*

Petitioner further contends that the “integrated circuit layer” and having an “intermediate layer being electrically coupled to the signal lines of the interposer” would have been obvious. Pet. 49–53. Petitioner contends that including “an integrated circuit layer” in the “at least one intermediate layer” would have been obvious because a person of ordinary skill in the art “would have understood that qubits utilize various circuitry . . . for processing qubit signals” and “would have looked to other references to

determine suitable locations for implementing the circuits.” *Id.* at 50.

Petitioner relies on an interposer 30 disclosed in Matsuo, that “‘has various circuit elements . . . booster circuit, etc.’” and contends that “[i]n view of Matsuo, it would have been obvious to a [person of ordinary skill in the art] to implement a circuit layer on Schoelkopf’s substrate 103.” *Id.* at 50–51 (citing Ex. 1003 ¶¶ 131–136; Ex. 1007, 2:39–47, 3:1–7, 3:43–53, 4:35–43, 4:47–55, Figs. 1, 6) (emphasis omitted).

Petitioner contends that “Schoelkopf renders obvious ‘the at least one intermediate layer being electrically coupled to the signal lines of the interposer’” (emphasis omitted) because “Figure 1 shows the qubits 116, 126 are in communication with the substrate 103 (the ‘intermediate layer’)” and “it would have been obvious to a [person of ordinary skill in the art] to provide an electrical connection between substrate 103’s vias 142, 144 (and/or other wiring layers of substrate 103) and the superconducting layer 134 (and/or other wiring layers of substrate 104) . . . to connect qubits 116, 126 to external devices through transition component 150.” Pet. 52–53 (citing *id.* at 41–51; Ex. 1003 ¶¶ 137–143; Ex. 1005, 1:25–28, 8:3–5, 9:31–33, Fig. 1).

Petitioner contends that “Schoelkopf in combination with Frunzio teaches that substrates 103, 104 are configured to supply substrates 101, 102, . . . [with] at least control and measurement signals to and from the plurality of coaxial cables” and that this “renders obvious that ‘the interposer is configured to supply the quantum circuit device, during operation of the quantum computing apparatus, at least control signals and readout signals to and from the plurality of cables.’” Pet. 55 (citing Ex. 1003 ¶¶ 144–150) (emphasis omitted). Petitioner relies on its earlier analysis as to

Schoelkopf's substrates 103, 104, and the planar-to-coaxial transition component 150 as the "interposer" and "substrates 101 and 102 (and qubits 116 and 126)" as "the quantum circuit device." *Id.* at 53 (citing *id.* at 37–39, 41–44) (emphasis omitted). Petitioner further relies, again, on it being obvious to a person of ordinary skill in the art "to provide an electrical connection between the vias 142, 144 and the superconducting layer 134 (within the 'interposer' of substrates 103, 104) to have signal continuity for communicating signals to and from the qubits 116, 126 through planar-to-coaxial transition component 150 and the coaxial cable." *Id.* at 54 (citing *id.* at 51–53).

(b) Independent Claim 38

Claim 38 is directed to "[a] method of forming an assembly for a quantum computing apparatus," and sets forth the same elements as recited in claim 1, arranged in the same manner. *Compare* Ex. 1001, 56:34–48, *with id.* at 54:20–36. Petitioner similarly relies on the same elements as depicted in Schoelkopf's Figure 1, and the same or similar reasoning, in its challenge to claim 38 as in its challenge to claim 1. *Compare* Pet. 59–66, *with id.* at 36–55. Accordingly, the challenge to claim 38 similarly falls with that for claim 1, as set forth below.

(c) Dependent Claims 13, 19, 20, 22, 27, and 28

These claims depend directly, or indirectly, from independent claim 1, and Petitioner relies on the same elements and reasoning as set forth in its challenge to claim 1, such that the grounds similarly fall with that for claim 1, as set forth below.

2. Analysis

In response to Petitioner’s contentions, Patent Owner contends the ground is deficient because relying on the structure Petitioner relies on for the connectorization layer (i.e., substrate 104) is contrary to what is actually disclosed and taught by Schoelkopf, because the proposed modification of that structure is unnecessary, and because the proposed modification would have rendered Schoelkopf’s device inoperable for its intended purpose.³ Prelim. Resp. 22–47. As explained below, we agree with Patent Owner that Petitioner’s showing is deficient.

Patent Owner contends that a person of ordinary skill in the art “would not have modified Schoelkopf to connect layer 140 with [layer] 134 using additional wiring and vias, as alleged by Petitioner.” *Id.* at 22. Patent Owner further contends that “the modification of Schoelkopf to form additional wiring or vias that are not illustrated or disclosed therein, . . . [would] render[] Schoelkopf’s device inoperable.” *Id.* at 23 (citing Ex. 2008 ¶¶ 43–49). Patent Owner argues, in particular, that a person of ordinary skill in the art “would have known that, in Schoelkopf’s Figure 1 . . . layer 140 . . . would be connected to the planar-to-coaxial transition 150.” *Id.* at 24–25 (citing Ex. 2008 ¶ 20). Patent Owner further argues that “Petitioner’s misinterpretation of layer 134 requires Petitioner to justify extensively and implausibly re-wiring Schoelkopf’s device, to electrically connect layer 134 with layer 140.” *Id.* at 32. Patent Owner explains further that “[t]here simply would have been no reason to modify Schoelkopf in this manner

³ Patent Owner raises a number of additional arguments which we decline to reach as doing so is not necessary for this decision. *See generally* Prelim. Resp.

because Schoelkopf expressly discloses that signals from wiring layer 140 are transmitted through *electromagnetic radiation* for communicating with cavity 130. *Id.* at 34 (citing Ex. 1005, 10:27–28).

Patent Owner also argues, in particular, that Petitioner’s proposed modification, which relies on electrically connecting the disclosed qubits 116, 126 by way of connections to layer 134 and then to planar-to-coaxial transition 150, would not have been obvious because of the function of layer 134 in Schoelkopf and how the proposed modification would alter its function and render the modified device inoperable for its intended purpose. Pet. 40–47. Patent Owner supports its arguments as to the intended function of layer 134, and how that function would be inoperably altered by the proposed modification, with the testimony of Dr. Choi. Ex. 2008 ¶¶ 31–49.

Patent Owner also argues, in effect, that “additional wiring and vias not illustrated” cannot support the conclusion that the particular claimed structure would have been obvious. Prelim. Resp. 22–24, 32–34.

As discussed above, Petitioner identifies substrate 104, and more particularly superconducting layer 134, as an interconnection layer that facilitates communication from qubits 116, 126 to the transition component 150. Petitioner reiterates this position in its Preliminary Reply addressing Patent Owner’s Preliminary Response. Prelim. Reply 1 (citing Pet. 30–36, 44–48). Specifically, in addressing Patent Owner’s argument that what is actually disclosed in Schoenkopf is contrary to Petitioner’s contentions, Petitioner argues that Patent Owner’s “argument is misapplied since the Petition relied on the final patent drawing of Schoelkopf—not on the provisional—to show component 150 being connected to superconducting layer 134.” *Id.* The difficulty for Petitioner, however, is that despite not

explicitly illustrating a connection between wiring layer 140 in substrate 103 and planar-to-coaxial transition 150 in Figure 1, Schoelkopf illustrates superconducting device 100 as including planar-to-coaxial transition 150 (Ex. 1005, Fig. 1), thus identifying planar-to-coaxial transition 150 as a component of superconducting device 100, and explains that “[s]ubstrate 103 is used as an interconnection layer used to interconnect various components within the superconducting device 100” (*id.* at 9:7–8), and that the interconnection layer includes a “wiring layer . . . disposed on and/or within the substrate 103 . . . configured to interconnect different components of the superconducting device 100” (*id.* at 9:8–11). Schoelkopf further identifies layer 140 as the “wiring layer,” and teaches transferring information from an *external* qubit to cavity resonator 130 via wiring layer 140. *Id.* at 11:14–18. That is, Schoelkopf teaches that wiring layer 140, rather than layer 134, is the “connectorization layer” element. Further, even though the testimony of Dr. Houck reproduces the description of Figure 1 as depicting substrate 103 as an interconnection layer that includes a wiring layer, it fails to explain why layer 103 should be understood to be an intermediate layer rather than an interconnection layer as taught by Schoelkopf. *See, e.g.,* Ex. 1003 ¶¶ 127–129 (identifying substrate 103 as an “intermediate layer,” while reproducing disclosure from Schoelkopf stating “[s]ubstrate 103 is used as an interconnection layer used to connect various components within the superconducting device 100”). Neither Petitioner nor Dr. Houck assert that the planar-to-coaxial transition 150 in Figure 1 is not a component of superconducting device 100, which it reasonably is as it is depicted as such in Figure 1. *See generally* Pet.; *see* Ex. 1005, Fig. 1. Accordingly, it follows that substrate 103 is the interconnection layer

disclosed in Schoelkopf to connect components within the superconducting device, including qubits 116, 126, and the planar-to-coaxial transition 150, rather than substrate 104 as Petitioner contends. *Id.*

As is further apparent in the Petition, and in Petitioner's Preliminary Reply, the reasoning underlying the grounds is based on the necessity of wiring and vias that are not shown in Figure 1 to establish electrical interconnections between the disclosed qubits formed in substrates 101 and 102 and an interconnection layer in substrate 104, which Petitioner contends is connected to planar-to-coaxial transition 150. *See generally* Pet.; Prelim. Reply. Having relied on Schoelkopf as disclosing an interconnection layer in substrate 104, rather than in substrate 103, on this record, Petitioner fails to meet the burden for instituting an *inter partes* review. Whether couched in terms of what Petitioner *contends* Schoelkopf discloses, or what modifications to Schoelkopf would have been necessary for the quantum computing device 100 to function *if* substrate 104 were made the connectorization/interconnection layer, Petitioner's failure to account for Schoelkopf's identification of substrate 103 as the interconnection layer undercuts the sufficiency of the grounds set forth in the Petition. As set forth, the thrust of Petitioner's grounds relies on wire layers formed on and/or in substrate layer 103 as being disposed between, *i.e.*, intermediate to, the quantum circuit device and the connectorization layer. It is not plainly evident that including additional circuitry on and/or in substrate 103, as set forth in the Petition, locates that circuitry between the quantum circuit device and the connectorization layer if substrate 103 itself is, or includes, the connectorization layer. It further follows that treating a different layer—layer 104—as an interconnection layer for establishing electrical

interconnections between qubits 116, 126 and planar-to-coaxial transition 150 requires something more than the relied on necessity for function of allowing communication asserted, particularly where Schoelkopf identifies substrate 104 and substrate 105 in the disclosed supercomputing device as together forming a cavity memory layer. Ex. 1005, 9:5–6, Fig. 1. Petitioner also fails to explain how the structure required for the cavity memory layer would otherwise require structure that includes the necessary interconnections to allow communication from qubits 116, 126 to the transition component 150 through substrate 104, or whether the cavity memory layer would work were the additional structure provided. *See generally* Pet.

In effect, having failed to establish the necessity of forming interconnections from qubits 116, 126 through wiring layer 134 to planar-to-coaxial transition 150, Petitioner’s identification of modified structures in Schoelkopf that read on claim 1 amounts to little more than an assertion of what one of ordinary skill in the art could make, rather than what one of ordinary skill in the art would have been motivated to make. *See generally* Pet.; Prelim. Reply. This is not sufficient to reasonably support a ground of obviousness. *See Belden Inc. v. Berk-Tek LLC*, 805 F.3d 1064, 1073 (Fed. Cir. 2015) (“[O]bviousness concerns whether a skilled artisan not only *could have made* but *would have been motivated to make* the combinations or modifications of prior art to arrive at the claimed invention.”). Further, “[c]are 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. American Maize-Prods. Co.*, 840 F.2d

902, 907 (Fed. Cir. 1988) (quoting *Orthopedic Equip. Co. v. United States*, 702 F.2d 1005, 1012 (Fed. Cir. 1983)). Here, absent the necessity of using wiring layer 134 to form the relied on interconnection, particularly where substrate 103 is identified as including wiring configured to interconnect different components of the device, there is an insufficient showing that the combination set forth by Petitioner is not improperly grounded on hindsight reconstruction.

Moreover, on this record, the Petition also falls short to the extent that Petitioner's proposed modification requires forming interconnections through wiring layer 134 to electrically connect qubits 116, 126 to planar-to-coaxial transition 150. *See generally* Pet. Petitioner fails to account for the role and function of cavity resonator 130 formed by layer 4 and layer 5, of which wiring layer 134 is an integral part. *Id.* Although Petitioner avers that its proposed modification would make wiring layer 134 a connectorization layer that is consistent with the description of a connectorization layer in the '699 patent (*id.* at 39–41; Ex. 1003 ¶¶ 103–108), neither the Petition nor Dr. Houck address the identified function of cavity resonator 130, which includes wiring layer 134 (Ex. 1005, 9:5–6, Fig. 1).

Patent Owner's arguments, supported by the testimony of Dr. Choi, that modifying wiring layer 134 in the proposed manner to function as a signal-carrying connectorization layer rather than a ground plane would render Schoelkopf's cavity resonator 130 inoperable, highlights the inadequacy of Petitioner's grounds. *See* Prelim. Resp. 41–47; Ex. 2008 ¶¶ 31–49; Ex. 2005, 626–630 (disclosing electroplating the wafers that form a resonant cavity with gold “to obtain a good RF ground plane”). The issue

is not whether the device could be modified to connect layer 140 to planar-to-coaxial transition 150 using wiring layer 134, or even whether a person of ordinary skill in the art would recognize that it could be. Rather, the issue is whether doing so would have been obvious given the described function of cavity resonator 130 that is made from wiring layer 134, which Petitioner failed to address in any meaningful manner in the Petition. *See generally* Pet.

Petitioner does address, in its Preliminary Reply, certain arguments raised by Patent Owner, including that the arguments are not supported by Patent Owner's own evidence. Prelim. Reply 1–3. To the extent Petitioner's arguments raise any issue as to Patent Owner's Preliminary Response, however, they still fall short of excusing the failure to sufficiently address why the modification required to Schoelkopf's quantum computing device would not alter or be contrary to its original function. *See generally* Pet. Moreover, Petitioner's reply to Patent Owner's argument against the proposed modification—that it was well known to connect both the signal and ground components of a coaxial transition at the ground plane—is inapposite. Prelim. Reply 1–3. The Petition does not identify layer 134 as a ground plane, and does not identify some unseen trace that is dielectrically isolated from layer 134 in substrate 104 as a signal-carrying wire. *See generally* Pet. Instead, the Petition identifies layer 134 itself as the signal-carrying wire that is connected to the signal-carrying component of coaxial transition 150. *See, e.g., id.* at 40 (indicating a skilled artisan would have found it obvious that “superconducting layer 134 has connections . . . from the transition component 150 to the superconducting layer 140, vias 142, 144, and the qubits 116, 126.”). But Schoelkopf describes layer 134 as an

integral part of cavity resonator 130. *See* Ex. 1005, 11:9–13, Fig. 2 (disclosing apertures 236 and 238 in layer 134 are part of cavity resonator 130). Petitioner does not resolve this discrepancy in the Petition, and does not explain how layer 134 could serve as both a grounded part of cavity resonator 130 and a signal-carrying line to carry signals between coaxial transition 150 and qubits 116 and 128.

As set forth by our reviewing court, “the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable.” *Harmonic Inc.*, 815 F.3d at 1363; *cf. Intelligent Bio-Systems*, 821 F.3d at 1369 (quoting 35 U.S.C. § 312(a)(3)) (addressing “the requirement that the initial petition identify ‘with particularity’ the evidence that supports the grounds for the challenge to each claim”). That burden never shifts to Patent Owner. *Dynamic Drinkware*, 800 F.3d at 1378. And that burden cannot be met by “mere conclusory statements.” *Magnum Oil Tools*, 829 F.3d at 1380. Moreover, our role is not to remedy the deficiencies in Petitions that fall short. *Sirona Dental Sys. GMBH v. Institut Straumann AG*, 892 F.3d 1349, 1356 (Fed. Cir. 2018) (quoting *SAS Inst. Inc. v. Iancu*, 138 S. Ct. 1348, 1356–57 (2018)) (explaining that because “‘the petitioner's contentions, not the Director's discretion, define the scope . . . [,]’ [i]t would thus not be proper for the Board to deviate from the grounds in the petition and raise its own obviousness theory” “institut[ing] a different inter partes review”); *cf. Magnum Oil Tools*, 829 F.3d at 1380–81 (rejecting an argument that the Board properly “ma[de] an obviousness argument on behalf of [petitioner]” that “could have been included in a properly drafted petition,” because “petitioner . . . bears the burden of proof”). Petitioner

fails, accordingly, to meet its burden for instituting *inter partes* review on the basis of Schoelkopf, Matsuo, and Frunzio.

F. Schoelkopf, Matsuo, Frunzio, and Abdo

Petitioner contends that claims 7, 8, and 10 are unpatentable under 35 U.S.C. § 103 over Schoelkopf, Matsuo, Frunzio, and Abdo. Pet. 66–78. Petitioner relies on Abdo for its disclosure of particular types of circuits in the integrated circuit layer of the intermediate layers. *Id.*

On this record, we discern nothing in the ground set forth relying on Abdo that remedies the deficiencies discussed above as to the combination of Schoelkopf, Matsuo, and Frunzio. *Id.*; Prelim. Reply. Accordingly, for the same or similar reasons, Petitioner again fails to meet its burden for instituting *inter partes* review.

G. Schoelkopf, Matsuo, Frunzio, and Schmitt

Petitioner contends that claim 9 is unpatentable under 35 U.S.C. § 103 over Schoelkopf, Matsuo, Frunzio, and Schmitt. Pet. 78–82. Petitioner relies on Schmitt for its disclosure of a multiplexer, and contends it would have been obvious to apply the related teachings in implementing the integrated circuits. *Id.* In doing so, Petitioner provides no further explanation as to where to incorporate such circuitry (*id.*), expressly stating that the Petition does “not [rely] on a physical incorporation of elements” (*id.* at 81).

On this record, we discern nothing in the ground set forth relying on Schmitt that remedies the deficiencies discussed above as to the combination of Schoelkopf, Matsuo, and Frunzio. *Id.* at 78–82; Prelim. Reply.

H. Schoelkopf, Matsuo, Frunzio, and Dotsenko

Petitioner contends that claims 11, 12, 18, 30, 40, and 42 are unpatentable under 35 U.S.C. § 103 over Schoelkopf, Matsuo, Frunzio, and Dotsenko. Pet. 83–86. Petitioner relies on Dotsenko for its teaching of how to bond substrates together. *Id.*

On this record, we discern nothing in the ground set forth relying on Dotsenko that remedies the deficiencies discussed above as to the combination of Schoelkopf, Matsuo, and Frunzio. *Id.*; Prelim. Reply.

I. Schoelkopf, Matsuo, Frunzio, and Thom

Petitioner contends that claims 23–26, 41, and 43 are unpatentable under 35 U.S.C. § 103 over Schoelkopf, Matsuo, Frunzio, and Thom. Pet. 94–106. Petitioner relies on Thom for its disclosure of printed circuit boards as substrates (*id.* at 95–98) and on bond wires as alternative (or additional) communication paths to facilitate control and/or readout of the qubits (*id.* at 98–101). Petitioner also contends that in making this modification, “it would have been obvious to a [person of ordinary skill in the art] that substrate 105 and the corresponding resonator may be omitted as optional.” *Id.* at 96–97, 100; Ex. 1005, 16:22–26. There is no particular explanation provided, however, how addition of bond wires, or their use as alternative connections, or omitting substrate 105 and the corresponding resonator would provide a structure differing materially in its arrangement of a quantum circuit device, an intermediate layer including an integrated circuit, and a connectorization layer. Pet. 94–106. In effect, as discussed above, there is again no sufficient basis set forth by Petitioner for why the particular combination would be made, in the manner required, to meet the claims,

while properly guarding against improper hindsight reconstruction. *Belden*, 805 F.3d at 1073; *Grain Processing Corp.*, 840 F.2d at 907.

On this record, accordingly, we discern nothing in the ground set forth relying on Thom that remedies the deficiencies discussed above as to the combination of Schoelkopf, Matsuo, and Frunzio. *Id.*; Prelim. Reply.

IV. CONCLUSION

Petitioner has not established a reasonable likelihood of prevailing on any of its assertions that claims 1, 7–13, 18–20, 22–28, 30, 38, and 40–43 of the '699 patent are unpatentable.

V. ORDER

For the reasons given, it is:

ORDERED that the Petition is *denied* as to all challenged claims of the '699 patent and no trial is instituted.

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Patent 9,836,699 B1

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