

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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DIGITAL GLOBAL SYSTEMS, INC.,  
Petitioner,

v.

DEEPSIG INC.,  
Patent Owner.

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IPR2025-00049  
Patent 10,581,469 B1

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Before WILLIAM V. SAINDON, ROBERT J. WEINSCHENK, and  
ANDREW L. NALVEN, *Administrative Patent Judges*.

WEINSCHENK, *Administrative Patent Judge*.

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

## I. INTRODUCTION

### A. *Background and Summary*

Digital Global Systems, Inc. (“Petitioner”) filed a Petition (Paper 1, “Pet.”) requesting an *inter partes* review of claims 1–8, 10, 12–15, and 17–24 (“the challenged claims”) of U.S. Patent No. 10,581,469 B1 (Ex. 1001, “the ’469 patent”). DeepSig Inc. (“Patent Owner”) filed a Preliminary Response (Paper 6, “Prelim. Resp.”) to the Petition.

An *inter partes* review may not be instituted unless “the information presented in the petition . . . and any response . . . 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). Here, Petitioner does not demonstrate a reasonable likelihood of prevailing in showing that at least one of the challenged claims is unpatentable. Thus, the Petition is denied, and no trial is instituted.

### B. *Real Parties in Interest*

The parties identify themselves as the only real parties in interest. Pet. 85; Paper 3, 1.

### C. *Related Matters*

Patent Owner indicates that a related patent, U.S. Patent No. 11,018,704 B1, is the subject of a petition for *inter partes* review in IPR2024-01358. Paper 3, 1.

### D. *The ’469 Patent*

The ’469 patent relates to “integrating nonlinear pre-distortion machine learning into radio communication systems to correct for radio signal distortion and interference.” Ex. 1001, 1:15–17. The ’469 patent states that “[r]adio communication systems include . . . various sources, e.g.,

amplifiers, which distort or interfere with radio signals being communicated by the transmitters to the receivers.” *Id.* at 1:21–25. “In conventional radio communication systems, in order to obtain acceptable linear modulation or minimally distorted or interference-free output, amplifiers are carefully designed for linearity and operated at non-maximal output powers,” which “can significantly increase cost and power consumption.” *Id.* at 4:6–14. To address this identified deficiency, the ’469 patent describes “[a] radio communication system with an integrated nonlinear pre-distortion machine learning model” that “can minimize interference and distortion while operating amplifiers at maximal or near maximal output power levels.” *Id.* at 4:16–20.

*E. Illustrative Claim*

Of the challenged claims, claims 1, 8, 21, and 23 are independent. Claim 1 is reproduced below.

1. A method for correcting distortion of radio signals, the method comprising:

obtaining a transmit radio signal corresponding to an output of a transmitting radio signal processing system;

generating a pre-distorted radio signal by processing the transmit radio signal using a nonlinear pre-distortion machine learning model, wherein the nonlinear pre-distortion machine learning model includes model parameters and at least one nonlinear function to correct radio signal distortion;

obtaining a transmit output radio signal by processing the pre-distorted radio signal through the transmitting radio signal processing system;

transmitting the transmit output radio signal to one or more radio receivers; and

updating the model parameters based on a distance metric computed between the transmit radio signal and a

received signal that is obtained from the one or more radio receivers, the received signal corresponding to the transmit output radio signal that was transmitted to the one or more radio receivers.

Ex. 1001, 14:15–35.

*F. Evidence*

Petitioner submits the following evidence:

| <b>Evidence</b>                                             | <b>Exhibit No.</b> |
|-------------------------------------------------------------|--------------------|
| Declaration of Zhi Ding, Ph.D.                              | 1003               |
| Jüschke, EP 2538553 A1, published Dec. 26, 2012 (“Jüschke”) | 1005               |
| Holt, US 10,552,738 B2, issued Feb. 4, 2020 (“Holt”)        | 1006               |
| Dzierwa, US 10,122,479 B2, issued Nov. 6, 2018 (“Dzierwa”)  | 1007               |

*G. Asserted Grounds*

Petitioner asserts that the challenged claims are unpatentable on the following grounds:

| <b>Claim(s) Challenged</b> | <b>35 U.S.C. §</b> | <b>Reference(s)/Basis</b> |
|----------------------------|--------------------|---------------------------|
| 1–8, 10, 12–15, 17–24      | 103                | Jüschke, Holt             |
| 2–5, 22, 24                | 103                | Jüschke, Holt, Dzierwa    |

## II. ANALYSIS

*A. Level of Ordinary Skill in the Art*

Petitioner argues that a person of ordinary skill in the art would have had “a bachelor’s degree in electrical engineering, computer engineering, or an equivalent degree and at least two years of experience working with . . . radio communication systems and machine learning.” Pet. 3 (citing Ex. 1003 ¶¶ 33–34). Petitioner’s description of the level of ordinary skill in the art is supported by the testimony of Petitioner’s declarant, Dr. Zhi Ding. Ex. 1003 ¶¶ 33–34. Patent Owner does not dispute Petitioner’s description

at this stage of the proceeding. We adopt Petitioner’s description for the purposes of this Decision.

*B. Claim Construction*

In an *inter partes* review proceeding, a patent claim is construed using the same standard used in a civil action under 35 U.S.C. § 282(b), including construing the claim in accordance with the ordinary and customary meaning of the 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). Neither party proposes an express construction for any claim terms. Pet. 13; Prelim. Resp. 9–10. We determine that no claim terms require express construction for purposes of this Decision.

*C. Asserted Obviousness of Claims 1–8, 10, 12–15, and 17–24 over Jüschke and Holt*

Petitioner argues that claims 1–8, 10, 12–15, and 17–24 would have been obvious over Jüschke and Holt. Pet. 13–77. For the reasons discussed below, Petitioner does not demonstrate a reasonable likelihood of prevailing in showing that any of claims 1–8, 10, 12–15, and 17–24 would have been obvious over Jüschke and Holt.

*1. Claim 1*

Claim 1 recites “generating a pre-distorted radio signal by processing the transmit radio signal using a nonlinear pre-distortion machine learning model” that “includes model parameters.” Ex. 1001, 14:19–24. Petitioner argues that Jüschke teaches processing a transmit signal using a pre-distortion neural network processor. Pet. 26–31 (citing Ex. 1005 ¶¶ 8, 13, 14, 17, 24, 39, 50, 53, 72, code (57), cl. 5, Figs. 1, 2).

Claim 1 also recites “transmitting the transmit output radio signal to one or more radio receivers,” and “updating the model parameters based on

a distance metric computed between the transmit radio signal and a received signal that is obtained from the one or more radio receivers, the received signal corresponding to the transmit output radio signal that was transmitted to the one or more radio receivers.” Ex. 1001, 14:28–35. Petitioner argues that Jüschke teaches training weight and/or bias parameters for the pre-distortion neural network processor based on a difference between a transmitter device’s input and output. Pet. 39–47 (citing Ex. 1005 ¶¶ 18, 48, 49, 72, Figs. 4, 6). Petitioner argues that Holt teaches “model training us[ing] loss functions that implement difference metrics from signals sent and received between transmitters and receivers over a communication channel.” *Id.* (citing Ex. 1006, code (57), 4:33–37, 7:30–34, 18:42–48, Fig. 2). According to Petitioner, it would have been obvious to “modify Jüschke’s training techniques using Holt’s loss function.” *Id.* at 21–22.

Patent Owner contends that Petitioner does not show sufficiently that the Jüschke and Holt combination teaches updating model parameters based on a distance metric computed between the transmit radio signal and a received signal that is obtained from the one or more radio receivers. Prelim. Resp. 10–27. Specifically, Patent Owner argues that Jüschke “us[es] the output of the transmitter device 14 to correct for distortion that results at the transmitter device,” and thus “does not train its pre or post distortion neural network processor based on any received signal from one or more radio receivers.” *Id.* at 13–16, 21 (citing Ex. 1005 ¶¶ 18, 19, 48, Fig. 4). Patent Owner argues that Holt only uses “an actual communication channel . . . for training a decoder model.” *Id.* at 17–21 (citing Ex. 1006, 5:67–6:3, 6:8–12, 9:61–63, 10:17–23, 18:40–48, 21:7–12, Figs. 3, 6). As such, according to Patent Owner, Holt “does not train its encoder model, or any

transmit signal, based on any received signal from one or more radio receivers.” *Id.* at 20–21.

On this record, we agree with Patent Owner. Claim 1 recites “generating a pre-distorted radio signal by processing the transmit radio signal using a nonlinear pre-distortion machine learning model.” Ex. 1001, 14:19–24. This portion of claim 1 requires processing a transmit signal using a machine learning model. *Id.* Claim 1 also recites “updating the model parameters based on a distance metric computed between the transmit radio signal and a received signal that is obtained from the one or more radio receivers.” *Id.* at 14:30–35. This portion of claim 1 requires updating model parameters based on a distance metric computed using a received signal obtained from a receiver. *Id.* Thus, together, these portions of claim 1 require updating parameters for a *transmit* model based on a distance metric computed using a signal obtained from a *receiver*.

For the reasons discussed below, Petitioner does not show sufficiently that the Jüschke and Holt combination teaches or suggests updating parameters for a transmit model based on a distance metric computed using a signal obtained from a receiver.

*a. Jüschke*

Jüschke teaches “training . . . parameters . . . of the pre-distortion neural network processor” based on “the transmitter device’s input - output signals.” Ex. 1005 ¶¶ 18, 48. Jüschke’s Figure 4 is reproduced below.

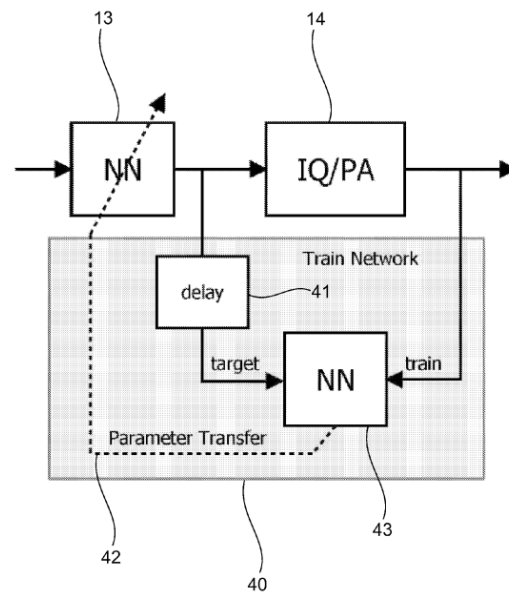


Fig. 4

Figure 4 shows how “pre-distortion neural network processor 13 may be trained at a transmitter.” *Id.* ¶ 47. Specifically, training processor 40 trains parameters for pre-distortion neural network processor 13 based on “[u]ndistorted . . . ideal digital baseband IQ samples 12a, 12b” and “[s]ampled output values of the non-ideal analog transmitter device 14.” *Id.* ¶ 48. In other words, Jüschke teaches training parameters for a transmit model based on a difference computed using a signal obtained from a transmitter. *Id.* ¶¶ 18, 48; *see* Pet. 18 (“Jüschke trains its models using ‘[s]ampled [transmitter] output values’ and ‘ideal [input] samples.’”).

As discussed above, claim 1 requires updating parameters for a transmit model based on a distance metric computed using a signal obtained from a receiver. Ex. 1001, 14:19–24, 14:30–35. The portions of Jüschke cited by Petitioner teach updating parameters for a transmit model based on a difference computed using a signal obtained from a transmitter, not from a

receiver.<sup>1</sup> Pet. 9–10, 13–24, 39–47; Ex. 1005 ¶¶ 18, 48–49, 58–60, 72, Figs. 4, 6. Further, to the extent Petitioner argues that a signal obtained from Jüschke’s transmitter is “the same” as a signal obtained from a receiver (*see* Pet. 44), the evidence of record does not support that assertion. Pet. 43; Ex. 1003 ¶ 180 (“data actually received and recovered at a receiver . . . account[s] for the actual effects of transmission and reception”). Thus, on this record, the cited portions of Jüschke do not teach or suggest updating parameters for a transmit model based on a distance metric computed using a signal obtained from a receiver.

*b. Holt*

Holt teaches a transmitter with an encoder model and a receiver with a decoder model. Ex. 1006, 4:33–39. Holt’s Figure 2 is reproduced below.

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<sup>1</sup> Petitioner appears to acknowledge that Jüschke does not use a signal obtained from a receiver and instead attempts to rely on Holt for that feature. *See* Pet. 22–23 (“Holt . . . would have improved training by sampling signals *actually received and recovered by a receiver.*”) (emphasis added); *id.* at 43 (“updating parameters using Holt’s loss functions based on *actually received transmissions* would have provided a known accuracy improvement to Jüschke’s training techniques by accounting for the *actual effects of transmission and reception*”) (emphasis added).

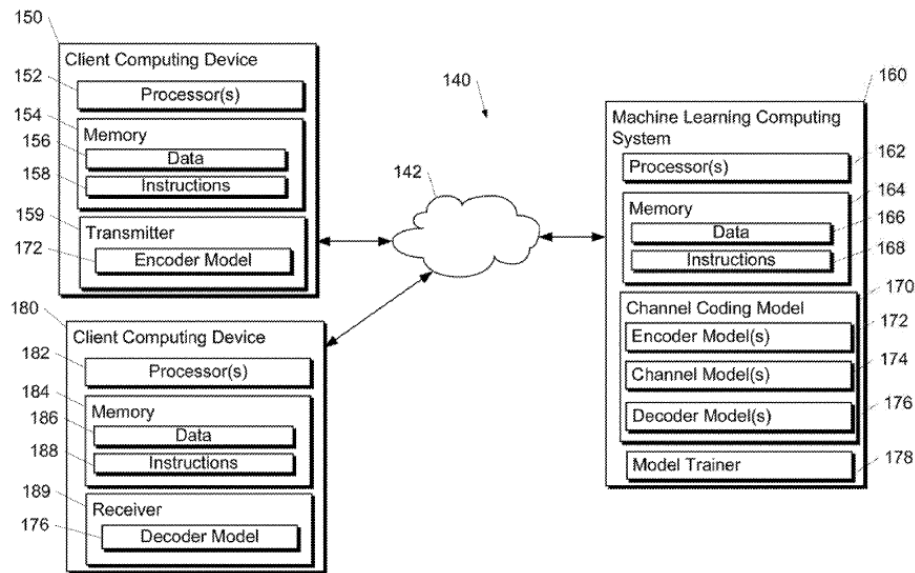


Figure 2

Figure 2 shows client computing device 150 that includes transmitter 159 with encoder model 172, as well as client computing device 180 that includes receiver 189 with decoder model 176. *Id.* at 14:49–50, 15:16–17, Fig. 2. Figure 2 also shows machine learning computing system 160 that includes model trainer 178 for training encoder model 172, channel model 174, and decoder model 176. *Id.* at 12:61–66, Fig. 2. Holt distinguishes between how it trains an encoder model and a decoder model. *Compare* Ex. 1006, code (57), 5:52–56, 9:61–63, 13:4–20, 16:60–17:10, *with id.* at 6:34–43, 10:22–23, 13:56–63, 17:62–18:3, 18:37–48.

Holt teaches training *both* an encoder model and a decoder model using a channel model. Specifically, Holt teaches that Figures 3, 4, and 7 depict “aspects associated with training an encoder model” and “a decoder model.” Ex. 1006, 9:61–63, 10:22–23. Holt’s Figure 3 is reproduced below.

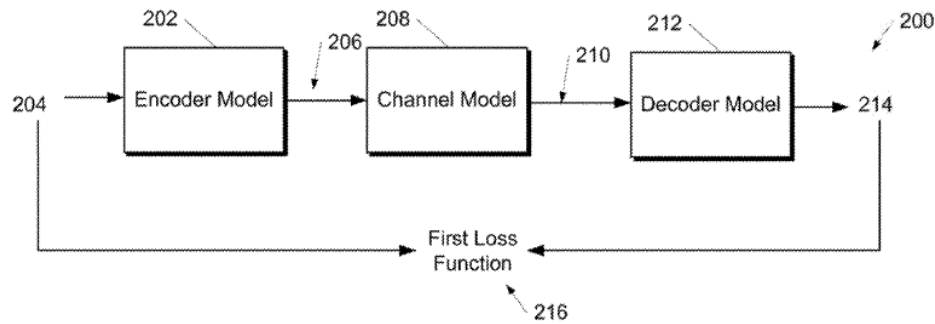


Figure 3

Figure 3 shows “an example model training technique” that includes encoder model 202, channel model 208, and decoder model 212. *Id.* at 15:43–49, 15:61–63, 16:13–14, Fig. 3. Channel model 208 “emulate[s] a communication channel” and “provides an ability to model the addition of noise to an output of the encoder model 202, such as would be present . . . when data is transmitted over a wired and/or wireless noisy communication channel before being received and evaluated by a decoder.” *Id.* at 15:61–63, 16:38–44. Holt teaches using a loss function to “train[] the encoder model *and* decoder model when the channel model is structurally provided between the encoder model and decoder model.” *Id.* at 5:52–56 (emphasis added); *see id.* at code (57), 9:61–63, 13:4–20, 16:60–17:10.

In contrast, Holt teaches training *only* a decoder model using an actual communication channel. Holt teaches that Figures 6, 10, and 11 depict “aspects associated with training a decoder model.” *Compare id.* at 9:61–63, *with id.* at 10:22–23. Holt’s Figure 6 is reproduced below.

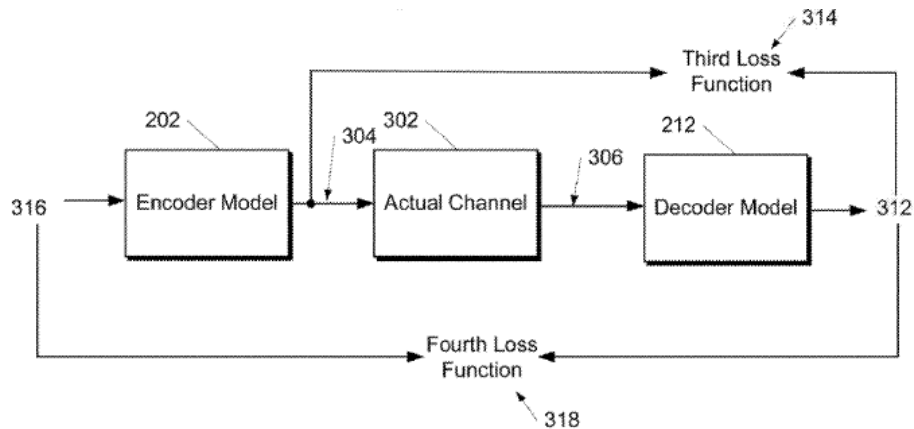


Figure 6

Figure 6 shows “an example model training technique” that includes encoder model 202, actual channel 302, and decoder model 212. *Id.* at 17:60–18:3, 18:33–37, Fig. 6. Holt teaches that in addition to training decoder model 212 based on “data coming out of the channel model 208, the decoder model 212 can be further trained . . . to learn how to decode data coming out of the communication channel 302 (e.g., the actual communication channel 302 used to train the channel model 208).” *Id.* at 17:62–18:3; *see id.* at 6:34–43, 10:22–23, 13:56–63, 18:37–48.

As discussed above, claim 1 requires updating parameters for a transmit model based on a distance metric computed using a signal obtained from a receiver. Ex. 1001, 14:19–24, 14:30–35. The ’469 patent indicates that a signal obtained from a receiver is different than a signal obtained from a model. Ex. 1001, 9:40–48 (“a modeled source of distortion or interference . . . produces a modeled received radio signal”); *id.* at 10:2–18 (“In the online tuning configuration, the receiver . . . sends the received signal . . . to the nonlinear pre-distortion system”). The portions of Holt cited by Petitioner teach training an encoder (i.e., transmit) model based on a loss function computed using a signal obtained from a model, not from a

receiver.<sup>2</sup> Pet. 10–12, 19–24, 40–43, 45–46; Ex. 1006, code (57), 4:4–7, 5:45–51, Fig. 3. The cited portions of Holt that mention using a signal obtained from a receiver only involve training a decoder (i.e., receive) model. Pet. 10–12, 19–24, 40–43, 45–46; Ex. 1006, 7:30–38, 17:62–18:3, 18:42–48, Fig. 6. Thus, on this record, Petitioner does not show sufficiently that Holt teaches or suggests updating parameters for a transmit model based on a distance metric computed using a signal obtained from a receiver.

*c. Proposed Combination of Jüschke and Holt*

Petitioner asserts that it would have been obvious to modify Jüschke to use “Holt’s loss functions based on actually received transmissions” to improve Jüschke’s “accuracy.” Pet. 43; *see id.* at 22–23 (“Holt . . . would have improved training by sampling signals actually received and recovered by a receiver.”). Even if Petitioner is correct that a person of ordinary skill in the art would have had reason to combine the cited teachings of Jüschke and Holt, the proposed combination does not teach all the limitations of claim 1. As discussed above, claim 1 requires updating parameters for a transmit model based on a distance metric computed using a signal obtained from a receiver. Ex. 1001, 14:19–24, 14:30–35. But the portions of Holt cited by Petitioner teach training an encoder (i.e., transmit) model based on a loss function computed using a signal obtained from a model, not from a receiver. *Compare* Ex. 1006, code (57), 4:4–7, 5:45–51, Fig. 3, *with id.* at 7:30–38, 17:62–18:3, 18:42–48, Fig. 6. Petitioner does not address this

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<sup>2</sup> Holt mentions training an encoder (i.e., transmit) model “in the field,” but Holt does not explain how the loss function is computed in that scenario. Ex. 1006, 8:44–48, 13:51–53. Moreover, Petitioner does not rely on those portions of Holt in the Petition. *See* Pet. 10–12, 18–24, 39–46.

distinction. *See* Pet. 10–12, 19–24, 40–43, 45–46. For example, Petitioner does not assert specifically that a person of ordinary skill in the art would have modified Holt’s techniques to train a transmit model (such as Jüschke’s) using a signal obtained from a receiver. *See id.* Thus, on this record, Petitioner’s proposed combination does not teach or suggest updating the parameters for a transmit model based on a distance metric computed using a signal obtained from a receiver.

*d. Summary*

For the foregoing reasons, on this record, Petitioner does not show sufficiently that the Jüschke and Holt combination teaches or suggests updating model parameters based on a distance metric computed between the transmit radio signal and a received signal that is obtained from the one or more radio receivers.

*2. Claims 8, 21, and 23*

Claims 8, 21, and 23 recite limitations similar to those discussed above for claim 1.<sup>3</sup> Ex. 1001, 15:26–46, 17:7–23, 18:5–22. Petitioner relies on arguments and evidence similar to that discussed above for claim 1. Pet. 61–66, 75–77. Thus, for the same reasons discussed above for claim 1, Petitioner does not show sufficiently that claims 8, 21, and 23 would have been obvious over Jüschke and Holt.

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<sup>3</sup> To the extent claim 8 (or any other claim) may be read to cover updating model parameters based on a distance metric computed using a signal obtained from a model, Petitioner does not propose modifying Jüschke to include Holt’s loss function when computed using a signal obtained from a channel model. *See* Pet. 10–12, 18–24, 39–46, 61–66. Rather, Petitioner only proposes modifying Jüschke to include “Holt’s loss functions based on actually received transmissions.” *Id.* at 43; *see id.* at 21–24.

*3. Claims 2–7, 10, 12–15, 17–20, 22, and 24*

Claims 2–7, 10, 12–15, 17–20, 22, and 24 depend from claim 1, 8, 21, or 23. Petitioner’s arguments and evidence regarding these dependent claims do not compensate for the deficiencies discussed above for claims 1, 8, 21, and 23. *See* Pet. 47–77. Thus, for the same reasons discussed above, Petitioner does not show sufficiently that claims 2–7, 10, 12–15, 17–20, 22, and 24 would have been obvious over Jüschke and Holt.

*4. Summary*

For the foregoing reasons, Petitioner does not demonstrate a reasonable likelihood of prevailing in showing that any of claims 1–8, 10, 12–15, and 17–24 would have been obvious over Jüschke and Holt.

*D. Asserted Obviousness of Claims 2–5, 22, and 24 over Jüschke, Holt, and Dzierwa*

Petitioner argues that claims 2–5, 22, and 24 would have been obvious over Jüschke, Holt, and Dzierwa. Pet. 78–83. Claims 2–5, 22, and 24 depend from claim 1, 21, or 23. Petitioner’s arguments and evidence regarding these dependent claims do not compensate for the deficiencies discussed above for claims 1, 21, and 23. *See id.* Thus, for the same reasons discussed above for claims 1, 21, and 23, Petitioner does not demonstrate a reasonable likelihood of prevailing in showing that any of claims 2–5, 22, and 24 would have been obvious over Jüschke, Holt, and Dzierwa.

III. CONCLUSION

Petitioner does not demonstrate a reasonable likelihood of prevailing in showing that at least one of the challenged claims of the ’469 patent is unpatentable.

#### IV. ORDER

It is hereby

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

IPR2025-00049  
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