NOTE: This disposition is nonprecedential.

# United States Court of Appeals for the Federal Circuit

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**PARKERVISION, INC., A FLORIDA CORPORATION,**
*Plaintiff-Appellant*

**v.**

**QUALCOMM INCORPORATED, A DELAWARE CORPORATION,**
*Defendant-Cross-Appellant*

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2014-1612, 2014-1655

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Appeals from the United States District Court for the Middle District of Florida in No. 3:11-cv-00719-RBD-JRK, Judge Roy B. Dalton, Jr.

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Decided: July 31, 2015

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Before LOURIE, BRYSON, and CHEN, *Circuit Judges.*

BRYSON, *Circuit Judge.*

In this patent infringement action, ParkerVision, Inc., alleged that Qualcomm Inc. infringed ParkerVision's patented technology relating to "down-converting" electromagnetic signals. At issue are U.S. Patent Nos. 6,061,551 ("the '551 patent"), 6,266,518 ("the '518 patent"), 6,370,371 ("the '371 patent"), and 7,496,342 ("the '342 patent"), all owned by ParkerVision.

"Down-converting" refers to converting a modulated high-frequency electromagnetic signal into a low-frequency or "baseband" signal in an electronic device such as a wireless receiver. ParkerVision claims methods, systems, and apparatuses for down-converting a high-frequency signal using a technique called "energy sampling." That technique differs from the technique of "voltage sampling," which was used in conventional down-converting systems.

ParkerVision's energy sampling system uses the same circuit configuration as a voltage sampling system. At the most basic level, the energy sampling system consists of an electronic switch connected on one end to an input electromagnetic signal and on the other end to a storage capacitor followed by a load device or resistor. *See, e.g.*, '551 patent, Figs. 82A, 82B. ParkerVision designed its down-converting system to perform energy sampling, rather than voltage sampling, by increasing the size of the capacitor, increasing the duration of the period that the switch is closed, and decreasing the impedance value of the load.

Claim 23 of the ’551 patent is representative of the asserted claims. It recites:

> 23. An apparatus for down-converting a carrier signal to a lower frequency signal, comprising:
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> an energy transfer signal generator;
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> a switch module controlled by said energy transfer signal generator; and
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> a storage module coupled to said switch module;
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> wherein said storage module receives non-negligible amounts of energy transferred from a carrier signal at an aliasing rate that is substantially equal to a frequency of the carrier signal plus or minus a frequency of the lower frequency signal, divided by n where n represents a harmonic or sub-harmonic of the carrier signal, wherein a lower frequency signal is generated from the transferred energy.

Other asserted claims use slightly different language. The parties agree that the differences in the claim language do not materially affect the issues on appeal.

ParkerVision developed energy sampling in 1996 and 1997, and it applied for its first patent relating to that technology in October 1998. Before any patent issued, ParkerVision approached Qualcomm to license its invention. No agreement was reached, however.

In 2011 ParkerVision filed this action against Qualcomm, alleging that Qualcomm had been infringing its energy-sampling patents since 2006. The district court bifurcated the trial. The first phase dealt with validity and infringement, and the second phase dealt with damages and willfulness. At the conclusion of the validity and infringement phase, the jury returned a verdict rejecting Qualcomm’s invalidity claims and finding that Qualcomm directly and indirectly infringed claims 23, 25, 161, 193, and 202 of the ’551 patent; claims 27, 82, 90, and 91 of the ’518 patent; claim 2 of the ’371 patent; and claim 18 of the ’342 patent. At the conclusion of the damages and willfulness phase, the jury awarded ParkerVision $172.7 million in damages but found that Qualcomm’s infringement was not willful.

Following the trial, Qualcomm filed motions for judgment as a matter of law (“JMOL”) and for a new trial on both invalidity and infringement. The court granted Qualcomm’s motion for JMOL of non-infringement but denied Qualcomm’s motions relating to invalidity. This appeal and cross-appeal followed.

I

At trial, ParkerVision accused 19 Qualcomm products of infringing the asserted claims.[1] To prove infringement, ParkerVision called Paul Prucnal, its technical expert, and David Sorrells, one of the inventors. Dr. Prucnal’s testimony focused on Qualcomm’s Magellan product, but he stated that his opinion regarding the Magellan product applied to each of Qualcomm’s accused products.[2] Mr. Sorrells testified with regard to only one of the 19 accused products, the Solo product.

The district court based its non-infringement ruling on two grounds. First, the court found that the accused products did not practice the limitation that recites “gen-

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[1] The verdict form erroneously listed 20 Qualcomm products, including the “Marimba” product. The jury found that all 20 products infringed, even though ParkerVision had presented no evidence regarding the Marimba product at trial.

[2] Qualcomm did not present an infringement expert of its own at trial, but called a fact witness to testify as to the design of certain accused products.

erating a lower frequency signal," which is present in each asserted claim. The court held that ParkerVision's infringement expert conceded that in the accused products the baseband signal was created before, or "upstream from," the storage capacitor. That concession, the court concluded, was fatal to ParkerVision's claim under the "generating" limitation. Second, the court concluded that Qualcomm's "50% duty cycle" products did not practice the "sampling" limitation, which is found in claims 27, 82, 90, and 91 of the '518 patent, and in claim 2 of the '371 patent.[3] We agree with the district court on both grounds.

A

The generating limitation in each of the asserted claims requires that the accused products produce a low-frequency baseband signal using energy that has been transferred from a high-frequency carrier signal into a storage medium, such as a capacitor or set of capacitors.

Dr. Prucnal testified that the accused products satisfy the generating limitation by using a specific type of circuitry called a "double-balanced mixer" combined with a pair of capacitors connected to the output ports of the mixer. It is undisputed that double-balanced mixers existed prior to ParkerVision's invention and that a double-balanced mixer by itself (i.e., without the addition of output capacitors) can be used to convert high-frequency carrier signals into low-frequency baseband signals. ParkerVision argues that Qualcomm implements the double-balanced mixer in an infringing configuration because it uses storage capacitors to interact with the

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[3] Claims 90 and 91 of the '518 patent and claim 2 of the '371 patent use the term "sub-sampling" or "sub-sample," which the court construed to mean "sampling at an aliasing rate."

mixer in producing the baseband signal. According to Dr. Prucnal, the mixer and the capacitors in Qualcomm's circuit collectively function to convert the high-frequency carrier signal into the low-frequency baseband signal. In doing so, Dr. Prucnal testified, the mixer-capacitor combination satisfies the generating limitation.

Qualcomm contends that the mixer alone converts the carrier signal into the baseband signal and that the capacitors identified by ParkerVision do not generate the baseband signal. According to Qualcomm, those capacitors are used to filter out unwanted high-frequency signals known as "jammers." Because the capacitors are not involved in the down-converting function, the baseband signal necessarily comes from "somewhere other than . . . energy that has been stored in the capacitor." For that reason, Qualcomm contends, its products do not infringe.

The parties' dispute thus centers on whether the capacitors immediately downstream from the mixer are involved in generating the baseband signal. In order for ParkerVision to prevail under its infringement theory, it was required to show that the baseband signal is generated from the energy stored in those capacitors.

Dr. Prucnal testified that the identified capacitors in the accused products contribute to the generation of the baseband signal by going through a "charging and discharging" cycle, which is controlled by a switch inside the mixer circuit. Closing the switch allows energy from the carrier signal to flow into the capacitor and accumulate there ("charging"); opening the switch allows the capacitor to release the accumulated energy into the rest of the circuit ("discharging"). Dr. Prucnal testified that the charging and discharging cycle results in an accumulation of energy from the carrier signal, which is then used "to generate the baseband signal following the capacitor."

On cross-examination, however, Dr. Prucnal admitted that the baseband signal in the accused products has already been created before the signal reaches the identified capacitors. He also testified that the "output" of the double-balanced mixer "is the baseband," and that the double-balanced mixer "in fact" creates the baseband signal.[4]

Dr. Prucnal's testimony is internally inconsistent. He testified that energy accumulated in the storage capacitor is used to generate a baseband signal "following the capacitor" but admitted that the baseband already exists before the capacitor. He also testified that the switch inside the mixer circuit works together with the storage capacitors to generate the baseband signal, while agreeing that the mixer itself creates the baseband.

ParkerVision made no attempt to reconcile the two strands of Dr. Prucnal's testimony at trial. The only other testimony that the jury heard regarding the respective role of the mixer and the storage capacitors in the accused

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[4] The parties disagree about the location of the identified capacitors. Qualcomm asserts that the capacitors are located within a circuit module known as the "TX filter," which immediately follows the mixer module in the accused products. ParkerVision admits that some capacitors are located inside the TX filter but contends that other capacitors are located within the mixer module itself, and that the two groups of capacitors are both involved in generating the baseband signal. We need not resolve the dispute as to the location of the identified capacitors. Regardless of whether some capacitors should be considered to be within the mixer module, Dr. Prucnal acknowledged that the double-balanced mixer shown in Qualcomm's design, consisting of crisscrossed transistor pairs, generates the baseband signal and that the output of that circuit structure, which precedes both sets of capacitors identified by ParkerVision, "is the baseband."

products came from Qualcomm's witness, Jim Jaffee, an engineer who was responsible for designing the Magellan product.[5] Mr. Jaffee testified—consistent with Dr. Prucnal's admission on cross-examination—that the baseband signal is created in the crisscrossed transistors of the double-balanced mixer. He added that the capacitors immediately following the mixer "play no role" in generating the baseband and are designed to "have no effect" on the baseband; instead, the capacitors serve only to suppress the unwanted "transmit jamming" signal.

The inconsistencies in Dr. Prucnal's testimony concern matters that are at the heart of the parties' dispute. Mr. Sorrells conceded that Qualcomm would not infringe if the Qualcomm products obtain the baseband signal "somewhere other than from the . . . energy that has been stored in the capacitor." He acknowledged that to meet its burden to prove infringement, ParkerVision had to prove that "the current that has gone into the storage capacitor is then what is generating the baseband signal" in the accused products.

Dr. Prucnal's admission that the double-balanced mixer creates the baseband signal before that signal reaches the identified capacitors means that Qualcomm products obtained the baseband signal from "somewhere other than" the energy stored in the capacitors, precluding a finding of infringement. Because ParkerVision provided no explanation at trial for the inconsistencies in Dr. Prucnal's testimony, no reasonable jury could be

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[5] Mr. Sorrells did not discuss how the mixer or the storage capacitors function in Qualcomm's products in connection with the "generating" limitation.

satisfied that Dr. Prucnal's opinion, taken as a whole, provides a substantial basis for a finding of infringement.[6]

During the hearing on Qualcomm's post-trial JMOL motion, ParkerVision attempted to reconcile Dr. Prucnal's admission that the baseband signal exists at the output of the mixer and before the storage capacitors with his testimony that energy stored in the capacitors is used to generate the baseband signal following the capacitors. ParkerVision argued that what comes out of the mixer is merely a "lower frequency signal" (compared to the carrier signal), but was not the baseband. According to ParkerVision, the lower frequency signal goes into the capacitors, where it is stored as energy, and that energy is then used to generate the baseband signal—a different signal than the "lower frequency signal"—following the capacitors.

No evidence supports such a theory, however. Dr. Prucnal affirmatively identified the output of the double balanced mixer as "the baseband." He did so during both cross and redirect examination. Neither Dr. Prucnal nor any other witness alluded to the possibility that the signal that comes out of the mixer is different from the baseband. Thus, the record does not support ParkerVision's theory at the JMOL hearing that the output of the mixer is something other than the baseband signal; its effort to

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[6] On appeal, ParkerVision relies heavily on a statement made by Dr. Prucnal during cross-examination that "the actual baseband signal on the baseband path is created after the capacitor resistor." That statement does not support ParkerVision's infringement argument, however, because the statement referred to Dr. Prucnal's simulation (which did not contain a double balanced mixer), not to Qualcomm's accused circuit. Dr. Prucnal admitted that what was shown in his simulation "was not the actual output of the Qualcomm circuit."

reconcile the inconsistencies in Dr. Prucnal's testimony fails.

ParkerVision alludes to the "two baseband signals" theory in its brief, but disclaims reliance on it. *See* App. Br. 55, Reply Br. 20. Instead, ParkerVision argues on appeal that the district court misunderstood the underlying technology when it distinguished between a signal appearing upstream from the capacitor and a signal appearing downstream from the capacitor on the same electric wire. According to ParkerVision, it "makes no sense" to pinpoint a specific location along a wire where the baseband signal is generated, because all the points along the wire "are one and the same point."

ParkerVision did not present its "one and the same point" theory to the jury or explain the relevance of that theory to its infringement claim. The only evidence ParkerVision now relies on to support that theory is the testimony of Dr. Razavi, Qualcomm's invalidity expert, who testified that, in one of the prior art references the wire "right above the capacitor . . . is the same point."

Dr. Razavi's testimony, however, does not support ParkerVision's theory. In the prior art reference that Dr. Razavi was discussing, the baseband signal is represented by voltage across the capacitor. As Dr. Razavi testified, voltage is the same at all points along an electric wire. It is undisputed, however, that the accused products are not "voltage-mode" products, but are "current-mode" products, in which the baseband signal is represented by variations in current, not by variations in voltage.

At trial, Dr. Prucnal agreed that within the TX filter in Qualcomm's design, a larger current flows before the capacitor while a smaller current flows after the capacitor, which indicates that part of the incoming current has been "filtered out" by the capacitor.[7] Dr. Prucnal further explained that the relationship between the currents flowing before and after the capacitor (along the same wire) and the current going into the capacitor are governed by what is known as Kirchhoff's current law.

Dr. Prucnal's testimony demonstrates that, unlike a voltage signal, which is the same everywhere along an electric wire, currents flowing along the same wire may be different before and after a capacitor. That difference, in accordance with Kirchhoff's current law, is determined by how much current is absorbed, or filtered out, by the capacitor. Dr. Razavi's "one and the same point" testimony, which was directed to a voltage signal, is thus inapplicable to current-mode devices such as Qualcomm's accused products.

The testimony of ParkerVision's witnesses makes clear that, in order to generate the baseband signal according to ParkerVision's invention, electric current from the carrier signal first flows into the storage capacitor and is accumulated there as energy. When that energy is discharged to the rest of the circuit, a baseband signal "following the capacitor" is created. But Dr. Prucnal admitted that the double-balanced mixer creates the baseband current in the accused Qualcomm products and that the electric current upstream from the identified capacitors in those products is already "the baseband." In other words, the accused products do not require an electric current from the carrier signal to go in and out of the storage capacitors in order to create the baseband signal; instead, the baseband current is created by the double-balanced mixer before the current reaches the

[7] The evidence shows that the TX filter serves to filter out the high frequency "jamming noise" in the transceiver system that otherwise would overwhelm the baseband signal.

capacitors. The district court therefore did not err in finding Dr. Prucnal's admission to be "fatal" to ParkerVision's infringement theory.

ParkerVision argues that simply because the baseband signal appears upstream from the identified capacitors does not mean the capacitors have no role in generat-generating the signal, because the patents explain how capacitors can influence signals that appear elsewhere in the circuit. That argument misses the point. The question is not whether, as a general matter, a capacitor can affect signals appearing upstream from it; the question is whether, in Qualcomm's products, the baseband signal appearing upstream from the capacitors is affected by the capacitors in the way ParkerVision says it is. Dr. Prucnal and Mr. Sorrells testified that current from the carrier signal must go in and out of the identified capacitors in order to generate a baseband signal "following the capacitor." That a baseband current already exists before the current from the carrier signal reaches the capacitors shows that the baseband signal is not generated in the way ParkerVision asserts. We therefore agree with the district court that no reasonable jury could have found that the accused products satisfy the "generating" limitation under ParkerVision's infringement theory.

B

As an additional reason for granting Qualcomm's motion for JMOL of non-infringement, the district court also held that Qualcomm's "50% duty cycle products" could not infringe the "sampling" limitation found in certain claims. The court construed "sampling" to mean "reducing a continuous-time signal to a discrete-time signal." That construction is not disputed on appeal.

Qualcomm's accused products can be divided into the "25% duty cycle products" and the "50% duty cycle products." According to Dr. Prucnal, "duty cycle is the period of time during a cycle during which the switch is closed";

having a 50 percent duty cycle means that "the switch is closed for half of the duty cycle and open for the other half."

At trial, when asked what had led to his belief that Qualcomm's products infringed the "sampling" limitation of ParkerVision's patents, Mr. Sorrells pointed to the description in Qualcomm's design documents of "a 25 percent duty cycle" product. Mr. Sorrells distinguished his invention from the prior art on the ground that traditional double-balanced mixers are "50% duty cycle, continuous input/continuous output devices," meaning that "there is always a connection" from the input of those devices to the output of the devices. He agreed that if there exists a continuous input and continuous output, the sampling limitation is not satisfied. Mr. Sorrells added, however, that Qualcomm uses a 25% duty cycle in some of its products, which results in a "discrete on and discrete off time" in those products. In those products, he testified, there is no continuous connection from the input to the output that would preclude infringement.

Dr. Prucnal focused on Qualcomm's Magellan product, a 25% duty cycle product. According to Dr. Prucnal, the Magellan product satisfies the sampling limitation. Because he testified that his analysis regarding the Magellan product was applicable to all the other 25% duty cycle products, the jury could have found from his testimony that all the accused 25% duty cycle products satisfied the sampling limitation. With respect to the 50% duty cycle products, however, Dr. Prucnal's testimony was entirely conclusory. Despite acknowledging the existence of a "50-percent duty cycle issue" relating to the "sampling" limitation, Dr. Prucnal merely stated that the 50% duty cycle products do not have a duty cycle "that's always at 50 percent," and that their duty cycles could "vary to less than 50 percent."

The district court found Dr. Prucnal's testimony regarding the 50% duty cycle products to be insufficient to establish infringement. We agree. Mr. Sorrells' testimony highlighted the significance of the distinction between the 25% and the 50% duty cycles for purposes of determining whether the sampling limitation is satisfied. That is, traditional double-balanced mixers using a 50% duty cycle do not "sample," because there is a continuous input and continuous output in those circuits. Certain accused products, on the other hand, satisfy the sampling limitation because they use a 25% duty cycle that produces discrete on and off periods.

Dr. Prucnal's testimony that the actual duty cycles of the 50% duty cycle products could vary "to less than 50 percent" falls short of establishing infringement. Dr. Prucnal failed to explain, for instance, how the less-than-50% duty cycle helps produce discrete on and off periods, and how it prevents a continuous input and continuous output that exists in traditional double-balanced mixers using a perfect 50% duty cycle. Without any explanatory testimony or other evidence on that point, Dr. Prucnal's conclusory statement regarding the 50% duty cycle products cannot establish that those products infringe the sampling limitation.[8]

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[8] On appeal, ParkerVision complains that the district court relied on evidence outside the trial record in determining whether the 50% duty cycle products satisfy the sampling limitation. While the court noted that Dr. Prucnal's trial testimony regarding the 50% duty cycle products "fell short of that relied on by ParkerVision to avoid summary judgment," the court's ultimate finding of non-infringement rested on the vague and conclusory nature of Dr. Prucnal's testimony, not on any difference between his testimony and the evidence proffered on summary judgment.

We affirm the district court's grant of Qualcomm's motion for JMOL of non-infringement as to all asserted claims.[9]

II

In its cross-appeal, Qualcomm argues that all the asserted claims are invalid in light of two references, neither of which was previously considered by the Patent and Trademark Office. Although the district court acknowledged that Qualcomm's argument on invalidity was "compelling," it denied Qualcomm's JMOL motion and its motion for a new trial on the ground that the jury had a sufficient basis to disbelieve Dr. Razavi, Qualcomm's invalidity expert.[10]

A

Qualcomm argues that the first reference, an article by Weisskopf, anticipates all the asserted claims except claim 18 of the '342 patent. The Weisskopf reference, entitled "Subharmonic Sampling of Microwave Signal Processing Requirements," explores "the theory behind subharmonic sampling," and "the criteria for optimum sampling hardware performance." It discloses a circuit diagram similar to the one disclosed in ParkerVision's

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[9] Qualcomm also argues (1) that JMOL of non-infringement should be affirmed on the alternative ground of no induced infringement; and (2) that the district court should have granted Qualcomm's JMOL motion and its motion for a new trial on damages. Because we affirm the grant of JMOL of non-infringement on the grounds discussed above, we need not address Qualcomm's additional arguments.

[10] ParkerVision did not present an invalidity expert of its own at trial.

patents, in that it consists mainly of a switch connected to a storage capacitor.

At trial, Dr. Razavi conducted a limitation-by-limitation comparison of the Weisskopf reference and the asserted claims. He explained that Weisskopf, like the ParkerVision patents, discloses transferring a maximum amount of energy from the carrier signal to the storage capacitor and then generating a baseband signal using that transferred energy. Dr. Razavi also conducted circuit-level simulations based on Weisskopf's circuit diagram to address the claim limitation that "the transfer-transferring of energy substantially prevents accurate voltage reproduction of the carrier signal during the apertures." That limitation appears in claim 202 of the '551 patent and in substance in claim 91 of the '518 patent, but not in the other asserted claims.

ParkerVision argues that the district court correctly denied Qualcomm's motion for judgment as a matter of law of invalidity for three reasons. First, Weisskopf does not disclose transferring "non-negligible amounts of energy" from the carrier signal to the storage capacitor. Second, Weisskopf does not disclose generating a baseband signal using the transferred energy. Third, the jury was not required to accept Dr. Razavi's opinions because they were based on inaccurate simulations.

1

The asserted claims all require transferring "non-negligible amounts of energy" from the carrier signal to a storage device, such as the storage capacitor in Weisskopf. The district court construed "non-negligible amounts of energy" to mean "energy in amounts that are distinguishable from noise." That construction is not disputed on appeal.

At trial, Dr. Razavi testified that Weisskopf chooses the values of the various circuit components in order to "maximiz[e] the transfer of energy from the carrier signal . . . to the capacitor." ParkerVision replies that Weisskopf fails to disclose transferring energy from the carrier signal in amounts distinguishable from noise, and that Dr. Razavi's "conclusory" testimony cannot fill that gap in the prior art reference. We disagree.

It is true that in describing the amounts of energy transferred from the carrier signal to the storage capacitor, neither the Weisskopf reference nor Dr. Razavi referred to "amounts distinguishable from noise" in those words. We have held, however, that the failure of a reference to disclose a claim limitation in the same words used by the patentee is not fatal to a claim of invalidity. *Application of Glasser*, 363 F.2d 449, 455 (CCPA 1966); *see also Teva Pharm. Indus. Ltd. v. AstraZeneca Pharm. LP*, 661 F.3d 1378, 1384 (Fed. Cir. 2011) (a prior inventor need not "conceive of its invention using the same words as the patentee would later use to claim it.").

Mr. Sorrells explained at trial that transferring a non-negligible amount of energy into the storage capacitor means "that you have to transfer enough energy to overcome the noise in the system to be able to meet your specifications." He further testified that the fact that the accused Qualcomm products meet "all of the cellular/cellphone specifications" is proof that a "non-negligible" amount of energy is transferred to the storage element in those products.

Mr. Sorrells' testimony thus establishes that to determine whether or not energy in amounts distinguishable from noise has been transferred from the carrier signal, one may look to whether the down-converting circuit functions in practice. If a circuit successfully down-converts, that is proof that enough energy has been transferred to overcome the noise in the system.

The Weisskopf reference discloses such a down-converting system. Weisskopf touts the ability of the disclosed circuit to down-convert a high frequency carrier signal to a baseband "with great efficiency and without loss of fidelity." Dr. Razavi testified, without contradiction, that the Weisskopf system is designed to maximize the amount of energy transferred from the carrier signal. The fact that Weisskopf transfers as much energy as possible from the carrier signal, resulting in a commercially viable down-converting system is proof that the system successfully distinguishes the transferred energy from noise. No reasonable jury could have concluded otherwise.

ParkerVision faults Dr. Razavi for not adding noise to his circuit simulation in connection with his testimony that Weisskopf satisfied the "non-negligible amounts of energy" limitation. But Dr. Razavi did not rely on simulations with regard to the "non-negligible amounts of energy" limitation; he used simulations only to prove that the different claim limitation was met: "prevent[ing] accurate voltage reproduction of the carrier signal." The trial record (and in particular Mr. Sorrells' testimony) established that performing a noise-added computer simulation is not the only way to ascertain whether "non-negligible amounts of energy" are transferred. Thus, Dr. Razavi's failure to conduct a noise-added simulation does not affect the probative force of his testimony regarding the "non-negligible amounts of energy" limitation.

2

ParkerVision next contends that the Weisskopf reference does not disclose generating a baseband signal using the transferred energy. It is undisputed that Weisskopf generates a baseband signal, and that the baseband signal is generated by measuring the voltage across the storage capacitor. ParkerVision points out, however, that Weisskopf advises against using a low-impedance load in the down-converting circuit on the ground that it "would cause energy to leak out of the capacitors," i.e., it would cause the capacitors to discharge. At trial, ParkerVision distinguished its claims from the Weisskopf reference by noting that Weisskopf generates the baseband signal "without discharging energy from the [storage] capacitor." ParkerVision's position on invalidity thus turns on whether the generating limitation requires that energy be discharged from the storage capacitors.

The record shows that it does not. In the initial claim construction order, the district court adopted the plain and ordinary meaning of the term "generating." In its subsequent order on ParkerVision's motion for summary judgment of no invalidity, the court explicitly rejected ParkerVision's assertion that the plain and ordinary meaning of "generating" requires discharging energy from a storage device. The court found that the "generating" limitation is not restricted to the generation of a baseband signal by discharging energy from a storage device, but encompasses the generation of a baseband signal by other means as well. ParkerVision does not challenge that interpretation of the "generating" limitation on appeal.

Because the generating limitation does not require that the baseband signal be created by discharging energy from a storage device, ParkerVision cannot rely on the absence of that feature from Weisskopf to defeat Qualcomm's anticipation claim. *See Ecolab, Inc. v. FMC Corp.*, 569 F.3d 1335, 1347 (Fed. Cir. 2009) (the argument that prior art did not anticipate the claim "is unpersuasive because claim 7 is written broadly and is not limited to PAA treatment in a meat processing plant."); *Verdegaal Bros. v. Union Oil Co.*, 814 F.2d 628, 632 (Fed. Cir. 1987) ("[T]here is no limitation in the subject claims with respect to the rate at which sulfuric acid is added, and, therefore, it is inappropriate for Verdegaal to rely on that distinction [against a claim of anticipation.]").

Although the generating limitation does not require discharging energy from the storage device, claim 27 of the ’518 patent, which recites “a method for down-converting a carrier signal to a baseband signal,” contains an explicit, additional step of “transferring energy to a load during off-time.” ’518 patent, claims 1, 27. At trial, Dr. Razavi testified that the “transferring energy” limitation means that “when the switch is turned off . . . energy is coming out of the [storage] capacitor going to a load,” i.e., energy is “leaking away” from the storage capacitor. Thus, in order for Weisskopf to anticipate this additional claim limitation, it must be shown that Weisskopf teaches discharging energy from the storage capacitor.

Dr. Razavi testified that Weisskopf teaches two scenarios in which a baseband signal may be generated. In one scenario, energy is not discharged from the storage capacitor, while in the second scenario, energy is discharged. Dr. Razavi admitted, however, that Weisskopf “doesn’t put [the second scenario] in a positive light.” In particular, he acknowledged that Weisskopf explicitly taught that discharging energy from the storage capacitor (e.g., by using a “low impedance load”) may result in “poor hold duration,” which “manifests itself as an increasing inability of the sample-and-hold circuit to isolate the periodic sampling function . . . from the output of the sample-and-hold circuit.”

Based on that evidence, a reasonable jury could conclude that Weisskopf does not teach discharging the storage capacitor as part of “a method for down-converting a carrier signal to a baseband signal,” which claim 27 of the ’518 patent requires. That is because discharging the storage capacitor in Weisskopf’s system may cause “inability” of the system to successfully produce a baseband signal at the output. Therefore, a reasonable jury could have discredited Dr. Razavi’s testimony that Weisskopf teaches “transferring energy to a load during off-time,” as required by claim 27 of the ’518 patent, and accordingly could have found claim 27 not to be anticipated by Weisskopf. The district court’s denial of

Qualcomm's motion for JMOL of invalidity is thus proper as to that claim. And because the jury's finding that claim 27 of the '518 patent was not anticipated was not against the great weight of the evidence, we uphold the district court's determination that a new trial on that issue is not warranted.

3

ParkerVision further challenges Dr. Razavi's opinions regarding the Weisskopf reference on the ground that his opinions are based on inaccurate simulations. As noted above, Dr. Razavi relied on the simulations only with respect to the claim limitation that "accurate voltage reproduction" of the carrier signal is prevented, which appears in claim 202 of the '551 patent and in claim 91 of the '518 patent.

ParkerVision asserts first that the jury was not required to accept Dr. Razavi's simulations, because Dr. Razavi admitted that his simulations did not account for noise, even though it would have been possible to design a simulation that would have done so.

At trial, Dr. Razavi testified that, in order to determine whether accurate voltage reproduction of the carrier signal is prevented, he looked to the simulated waveform of the voltage signal "going into the switch." A waveform representing a "distorted" replica of the source signal, according to Dr. Razavi, is proof that "accurate voltage reproduction" has been prevented.

ParkerVision cross-examined Dr. Razavi regarding the lack of noise in his simulations, asking him to confirm that the court's claim construction requires transferring "energy [in] amounts distinguishable from noise"—a limitation for which Dr. Razavi did not rely on his simulations. With respect to the "preventing accurate voltage reproduction" limitation, for which Dr. Razavi did rely on simulations, ParkerVision asked Dr. Razavi no questions relating to noise. Nothing in the trial record connects noise to the "preventing accurate voltage reproduction" claim limitation, much less suggests that adding noise to simulations is necessary to prove that limitation.[11] Because nothing in the trial record suggests that omitting noise in the simulations would affect Dr. Razavi's testimony regarding the "preventing accurate voltage reproduction" limitation, no reasonable jury could reject Dr. Razavi's simulations on the basis that they did not include noise.

ParkerVision's second complaint regarding Dr. Razavi's simulations is that Dr. Razavi "omitted certain elements and picked values that were not actually disclosed." In particular, ParkerVision points to Dr. Razavi's acknowledgement that in his circuit model he omitted a resistor that is placed in front of the buffer in Weisskopf's circuit diagram. ParkerVision also asserts that Dr. Razavi "made up" the value of a source resistor in his circuit model that is not disclosed in Weisskopf.

Regarding the omitted resistor, Dr. Razavi explained that the omission is "immaterial" because the "high impedance buffer [following the resistor] . . . doesn't draw any current," regardless of whether the resistor is included in the simulations. Dr. Razavi further testified that he had not "made up" the value of the source resistor but had taken that value from the Weisskopf reference.

ParkerVision's criticism of Dr. Razavi's computer simulations for omitting the identified resistor suffers from the same flaw as its earlier argument that the simulation does not account for noise: It fails to tie the

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[11] When Dr. Prucnal testified as to how the "preventing accurate reproduction" limitation is met in the accused products, he relied on the period of time during which the switch is closed.

alleged defect in the simulation to the claim limitation that Dr. Razavi was addressing at trial, i.e., "prevent[ing] accurate voltage reproduction of the carrier signal." Dr. Razavi testified that, because the buffer immediately following the resistor in Weisskopf is a "high impedance buffer," omission of the resistor from the simulations was immaterial to the result. ParkerVision failed to offer any explanation of how the omitted resistor would undermine the validity of Dr. Razavi's simulation results. Without any such explanation, a reasonable jury would have had no basis to disbelieve Dr. Razavi's testimony or to reject his simulations based on the omitted resistor.

Finally, there is no force to ParkerVision's contention that Dr. Razavi "made up" the value of the source resistor in his simulation. Dr. Razavi used a 50 ohm source resistor in his simulation; he did so in accordance with Weisskopf's explicit disclosure of a 50 ohm "source impedance." Thus, there is no evidence that any of the alleged defects with Dr. Razavi's computer simulations would undermine the validity of his simulation results.

We conclude that ParkerVision has failed to point to any basis on which a reasonable jury could have rejected Dr. Razavi's opinions that Weisskopf anticipates claims 23, 25, 161, 193, and 202 of the '551 patent, claims 82, 90, and 91 of the '518 patent, and claim 2 of the '371 patent. We reverse the district court's denial of Qualcomm's motion for JMOL of invalidity as to those claims. As noted above, however, we affirm the district court's denial of Qualcomm's motions for JMOL and for a new trial of invalidity as to claim 27 of the '518 patent.

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At trial, Qualcomm sought to invalidate claim 18 of the '342 patent through a second prior art reference—an excerpt from a book entitled "Practical RF Design Manual" by Doug DeMaw.

Claim 18 of the ’342 patent recites a “method for down-converting an electromagnetic signal” based on a “differential” configuration of ParkerVision’s energy sampling system. Figure 16H of the ’342 patent is an embodiment of the differential energy sampling system used in claim 18. It consists of a pair of input signals representing carrier information and “inverted” carrier information, respectively; a first and a second switch; a first and a second capacitor connected to the first and second switch, respectively; and a first and a second impedance device following the capacitors. *See* ’342 patent, Fig. 16H; claim 18.

Qualcomm asserts that the DeMaw reference, and in particular a circuit diagram disclosed in DeMaw (“Figure 6.7 Dual FET balanced mixer using a Siliconix U430 device”), teaches every element of claim 18 of the ’342 patent. At trial, Dr. Razavi first conducted a component-by-component comparison between the circuit diagram described in Figure 16H of the ’342 patent and that described in Figure 6.7 of DeMaw. He concluded that DeMaw discloses all the components of Figure 16H. According to Dr. Razavi, the transistors designated as Q1 and Q2 in DeMaw correspond to the first and second switches in Figure 16H, and the two signals at the input of Q1 and Q2 in DeMaw, which represent the carrier signal and an “inverted” copy of the carrier signal, correspond to the “carrier plus” and “carrier minus” signals shown in Figure 16H. The pair of capacitors that are shown immediately next to the outputs of Q1 and Q2 correspond to the first and second capacitors in Figure 16H. And Dr. Razavi identified the two additional capacitors shown to the right of the first pair of capacitors as the first and second impedance devices, noting that an “impedance can be a capacitor.” ParkerVision does not challenge that part of Dr. Razavi’s testimony.

Dr. Razavi next explained how DeMaw teaches each limitation of claim 18. In doing so, he showed the jury the results of computer simulations that he had performed according to the circuit diagram disclosed in Figure 6.7 of DeMaw and explained how the simulation results supported his conclusions.

Only one claim limitation is in dispute here: "performing a plurality of charging and discharging cycles of the first and second capacitors to generate first and second down-converted information signals across first and second impedance devices, respectively."[12] ParkerVision contends that DeMaw does not anticipate claim 18 because it does not expressly teach the claim limitation of "charging and discharging" capacitors to generate a baseband signal. Anticipation, however, "can occur when a claimed limitation is 'inherent' or otherwise implicit in the relevant reference," even though the reference does not expressly teach that limitation. *Standard Havens Prods., Inc. v. Gencor Indus., Inc.*, 953 F.2d 1360, 1369 (Fed. Cir. 1991), citing *Tyler Refrigeration v. Kysor Indus. Corp.*, 777 F.2d 687, 689 (Fed. Cir. 1985).

Dr. Razavi testified that "charging and discharging of the first and second capacitors" occurs when the first and second switches (Q1 and Q2) "are turned on and off at a certain rate." As the capacitors are charged and discharged, he explained, the down-converted information signal first appears at the outputs of Q1 and Q2, although at that point the down-converted signal is mixed with other high frequency signals, such as the local oscillator signal and the RF, or carrier, signal. He added that the signals appearing at the outputs of Q1 and Q2 propagate further down the remainder of the circuit where the high

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[12] ParkerVision also cross-examined Dr. Razavi regarding "sampling," but the "sampling" limitation is not found in claim 18 of the '342 patent.

frequency components are removed, resulting in a "clean" down-converted signal appearing across the first and second impedance devices located at the far end of the DeMaw circuit. Dr. Razavi's computer simulations illustrated the waveforms of the "information signal" as that signal travels through the various components of the DeMaw circuit, changing from a high-frequency signal at the input of the switch to a down-converted, low-frequency signal appearing across the identified impedance device.

Thus, even though Figure 6.7 of DeMaw does not expressly state that the capacitors engage in "charging and discharging" to generate a baseband signal, Dr. Razavi's detailed testimony regarding the DeMaw circuit established that charging and discharging is "implicit" in that reference. ParkerVision sought to challenge Dr. Razavi's testimony in various respects on cross-examination, but none of its questioning undermined Dr. Razavi's explanation of the operation of the DeMaw circuit and how Figure 6.7 of DeMaw corresponds to Figure 16H of the '342 patent.

ParkerVision also challenged Dr. Razavi's computer simulations at trial, faulting him for assigning values to certain components of the DeMaw circuit that were not provided in DeMaw itself. Dr. Razavi admitted that DeMaw does not disclose the values of certain capacitor and inductor components; he explained, however, that he used simulations only to "illustrate one or two effects [of the DeMaw circuit]," and that the component values he picked for the simulations did not affect his conclusion that "DeMaw exactly matches the claim language."

Again, ParkerVision asserted that Dr. Razavi's computer simulations were defective, but it did not provide any suggestion as to how any alleged defects in the simulations undermined Dr. Razavi's uncontradicted testimony. Because there is no basis on which a reasonable jury could reject the evidence that DeMaw anticipates claim 18 of the '342 patent, we reverse the district court's denial of Qualcomm's motion for JMOL of invalidity regarding claim 18.

Costs to Qualcomm.

**AFFIRMED IN PART and REVERSED IN PART**