IN THE UNITED STATES DISTRICT COURT
FOR THE MIDDLE DISTRICT OF FLORIDA
JACKSONVILLE DIVISION

PARKERVISION, INC.,	§	**Civil Action No. 3:11-cv-719-37TEM**
	§	
Plaintiff,	§	**Jury Trial Demanded**
	§	
v.	§	
	§	
QUALCOMM INC.,	§	
	§	
Defendant.	§	
	§	
	§	
	§	

REBUTTAL EXPERT REPORT OF PETER WEISSKOPF

1. INTRODUCTION

1.1. Retention

I understand that ParkerVision, Inc. ("ParkerVision") has asserted that Qualcomm Inc. ("Qualcomm") has infringed and continues to infringe U.S. Patent No. 6,061,551 ("the '551 Patent"), U.S. Patent No. 6,266,518 ("the '518 Patent"), U.S. Patent No. 6,370,371 ("the '371 Patent"), U.S. Patent No. 6,963,734 ("the '734 Patent"), U.S. Patent No. 7,496,342 ("the '342 Patent"), and U.S. Patent No. 7,724,845 ("the '845 Patent") (collectively the "Patents-in-Suit"). Specifically, ParkerVision asserts that Qualcomm has infringed and continues to infringe the following claims: (a) the '551 Patent Claims 1, 2, 3, 8, 9, 12, 16, 20, 23, 24, 25, 26, 31, 32, 39, 41, 50, 54, 55, 57, 92, 108, 113, 126, 135, 161, 192, 193, 195, 196, 198, 202, and 203; (b) the '518 Patent Claims 1, 2, 3, 12, 17, 24, 27, 77, 81, 82, 90, and 91; (c) the '845 Patent Claims 1, 3, 4, 5, 6, 7, 8, 9, 12, 13, 17, 18, 19, 20, 22, 23, and 24; (d) the '342 Patent Claims 18, 19, 20, 21, 22, and 23; (e) the '734 Patent Claims 1, 4, 5, 6, 9, 12, 13, 14, and 15; and (f) the '371 Patent Claims 1, 2, 22, 23, 25, and 31 (collectively the "Asserted Claims").

I have been retained by ParkerVision, and its counsel, McKool Smith P.C., as an expert in ParkerVision's lawsuit as captioned above against Qualcomm. I am being compensated $350 per hour for my time spent working in connection with this case.

1.2. Scope of this Rebuttal Expert Report

This rebuttal expert report has been prepared in response to the opinions set forth in the Expert Report of Dr. Behzad Razavi (the "Razavi Report") dated March 4, 2013. While I have not been permitted to review the Razavi Report due to confidentiality restrictions, it is my understanding that Dr. Razavi asserts that a paper I published in the May 1992 Microwave Journal, "Subharmonic Sampling of Microwave Signal Processing Requirement" ("my paper"),

anticipates or renders obvious the Asserted Claims of the ’551, ’518, ’371 and ’845 patents. Dr. Razavi has not asserted that my paper anticipates or renders obvious the Asserted Claims of the ’342 and ’734 patents. Herein, I respond to Dr. Razavi’s assertions about my paper and the Asserted Claims of the ’551, ’518, ’371 and ’845 patents.

1.3. Qualifications and Experience

After receiving a BSEE from George Mason University in 1988 I took a position with M/A-COM Active Assemblies Division in Tempe, AZ where I engaged in both manufacturing and IRAD work on microwave sub-harmonic sampling phase detectors used in frequency synthesis. In 1989 I delivered a report on “The Optimization of Microwave Sampling” at a division-wide M/A-COM Engineering Conference. I later went on to form Merit Microwave Inc. where I was engaged in full time development of microwave and mm-wave sampling down converter and sampling frequency synthesis products. My customers included the Department of Defense, NASA and companies worldwide. Of interest was a 28 GHz sub-sampled down converter developed for a NASA JPL Deep-Space Transponder. I have written several articles on the topic of microwave signal processing techniques that employ sub-sampled sample and hold circuitry. In recent years, I have applied sub-sampling to software based radio designs.

1.4. Summary of Opinion Formed

As set forth herein, Dr. Razavi has misunderstood numerous aspects of my paper, and I endeavor to correct his misunderstanding. My paper does not anticipate or render obvious any Asserted Claim of the ’551, ’518, ’371 and ’845 patents.

2. RELEVANT LEGAL PRINCIPLES

2.1. Presumption of Validity

It is my understanding that the claims of an issued patent are presumed to be valid. It is my further understanding that the basis for that presumption of validity is the fact that allowed claims have passed through a rigorous examination process at the U.S. Patent Office. My understanding is that this presumption applies to Dr. Razavi's opinions that my paper anticipates or renders obvious the Asserted Claims of the Patents-in-Suit.

2.2. Burden of Proving Invalidity

It is my further understanding that Dr. Razavi has the burden of proving invalidity through facts supported by clear and convincing evidence. I further understand that the "clear and convincing evidence" standard means evidence which produces in the mind of the judge or the jury, as the case may be, an abiding conviction that the truth of a factual contention is highly probable.

2.3. Independent and Dependent Claims

The Asserted Claims include claims which depend on another claim (or claims). In that case the dependent claims incorporate the limitations of the independent claim upon which they depend, and if a reference fails to disclose any of the limitations of that independent claim, the claims which depend on that claim cannot be made invalid by that reference. As a result, if my paper fails to disclose all of the limitations of an independent claim, it also necessarily fails to disclose all of the limitations of the Asserted Claims which depend on that claim.

2.4. Claim Construction

I understand that an initial step in determining either validity or infringement is to properly construe the claims. The properly construed claims are then compared to the alleged prior art to determine validity.

I understand that the Court has construed a number of terms found in the claims at issue in this litigation. The parties have also agreed to the construction of several terms found in the claims at issue in this litigation. I have used those claim constructions in forming my opinions in this report. For claim language not construed by the Court and not agreed upon by the parties, I understand that such claim language is to be given its ordinary and accustomed meaning as understood by one of skill in the art.

I have reviewed the Court's Claim Construction Order [dkt. 243] issued on February 20, 2013. I have applied the Court's constructions to my analysis in this report. For claim language that Judge Dalton has not interpreted or construed, I understand that such claim language is to be given its ordinary and accustomed meaning as understood by one of skill in the art. The Court has construed the claims of the Patents-in-Suit, including the '342 and '734 patents (which are not relevant to my analysis), as follows:

Claim Term	Construction
"sampling"	"reducing a continuous-time signal to a discrete-time signal"
"under-sampling," "sub-sampling," and "sub-samples"	"sampling at an aliasing rate"
"transferring non-negligible amounts of energy from the carrier signal," "sampling the carrier signal . . . to transfer energy," and "transferring a . . . portion of the energy . . . of the carrier signal	"transferring energy in amounts that are distinguishable from noise"
"receives non-negligible amounts of energy transferred from a carrier signal" "sub-sampling the first signal . . . to transfer energy"	"receives energy from the carrier signal in amounts that are distinguishable from noise"
"sub-sampling the first signal . . . to transfer energy"	"transferring energy in amounts that are distinguishable from noise
"lower frequency signal"	"a signal with a frequency below the carrier signal frequency"
"where n represents a harmonic or sub-harmonic of the carrier signal" and "wherein N indicates a harmonic or sub-harmonic of the carrier signal"	"n is 0.5 or an integer greater than or equal to 1"
"integrating the . . . energy"	"accumulating the energy"

"energy is . . . integrated"	"energy is accumulated"
"integrates the . . . energy"	"accumulates the energy"
"integrates . . . energy"	"accumulates energy"
"the integrated energy"	"the accumulated energy"
"finite time integrating operation"	"convolving a portion of the carrier signal with an impulse response that is rectangular, triangular, half sine, nearly sinusoidal, or a step function"
"finite time integrating module"	"circuitry that can perform a finite time integrating operation"
"impedance matching"	"transferring the desired power "
"output impedance match circuit"	"a circuit configured to transfer desired power from the energy sampling circuitry"
"substantially impedance matched input path"	"circuitry configured to transfer desired power to the input path of the energy sampling circuitry"
"input impedance match circuit"	"circuitry configured to transfer desired power to the input of the energy sampling circuitry"
"first impedance match coupled to said . . . input terminal"	"first circuitry configured to transfer desired power to said input terminal"
"second impedance match coupled to said . . . input terminal"	"second circuitry configured to transfer desired power to said input terminal"
"differential frequency down-conversion module"	"circuitry for frequency down-converting a carrier signal by differentially combining a positive and negative transferred energy samples"
"differentially down-converting"	"down-converting a carrier signal by differentially combining positive and negative transferred energy samples"
"interpolation filter"	"circuitry used to reconstruct a continuous signal, either approximately or exactly, from a set of samples"
"asynchronous energy transfer signal"	"an energy transfer signal with a phase that varies with respect to the phase of the carrier signal"
"universal frequency down converter"	"circuitry that generates a down converted output signal from an input signal"
"means for operating a UFD to perform at least frequency translation operations"	"[T]he function of this limitation is 'operating said UFD to perform at least frequency translation operations for at least one of (a)-(l).' The corresponding structure is 'a control signal of the UFD disclosed as signal 108 of Figures 1A-1C, 2006 of Figures 20A and 20A-1, or equivalents thereof.'"
"means for integrating the energy over the aperture periods"	"The function associated with th[is] means-plus-function limitation . . . is 'integrating the

	energy over the aperture periods.' The structure that corresponds to that function is 'one or more of energy storage circuitry disclosed in Figures 68C, 68F, or equivalents thereof.'"
"means for integrating the transferred energy over the aperture periods"	"The function associated with th[is] means-plus-function limitation . . . is 'integrating the transferred energy over the aperture periods.' The structure that corresponds to that function is 'one or more of energy storage circuitry disclosed in Figures 68C, 68F, or equivalents thereof.'"
"means for generating the baseband signal from the integrated energy"	"The function associated with th[is] means-plus-function limitation . . . is 'generating the baseband from the integrated energy.' The structure that corresponds to that function is 'any arrangement of (i) one or more of the switch circuitry controlled by any one of pulse generators and (ii) one or more of the energy storage circuitry disclosed or described in Figures 63, 64A, 64B, 65, 67A, 68G, 69, 74, 76A-E, 77A-C, 82A, 82B, 86, 88, 90, 92, 94A, 95, 101, 110, 111, or equivalents thereof.'"
"means for generating the second signal from the integrated energy"	"The function associated with th[is] means-plus-function limitation . . . is 'generating the second signal from the integrating energy.' The structure that corresponds to that function is 'any arrangement of (i) one or more of the switch circuitry controlled by any one of pulse generators and (ii) one or more of the energy storage circuitry disclosed or described in Figures 63, 64A, 64B, 65, 67A, 68G, 69, 74, 76A-E, 77A-C, 82A, 82B, 86, 88, 90, 92, 94A, 95, 101, 110, 111, or equivalents thereof.'"

The parties have also agreed to the following constructions:

"carrier signal"	"an electromagnetic wave that is capable of carrying information via modulation"
"aliasing rate"	"sampling rate that is less than or equal to twice the frequency of the carrier signal"
"aperture periods"	"the durations of time over which energy is transferred from the carrier signal"
"electrically coupling"	"indirectly or directly connecting such that an electric signal can flow between the coupled

	points"
"modulated carrier signal"	"a carrier signal that is modulated by a baseband signal"
"baseband signal"	"any generic information signal desired for transmission and/or reception"
"DC offset voltage"	"a DC voltage level that is added to a signal of interest by related circuitry"

3. REBUTTAL TO DR. RAZAVI'S ALLEGATIONS OF ANTICIPATION AND OBVIOUSNESS IN LIGHT OF MY PAPER

My paper describes what is commonly known as a voltage sample and hold circuit. As a voltage sample and hold circuit, my paper does not teach or suggest the transfer of energy from a carrier signal to a storage device and the use of that energy to generate a lower frequency signal or the baseband. This is a core concept of each of the Asserted Claims of the '551, '518, '371 and '845 patents, which is entirely absent from my paper.

My paper actually teaches as an objective, hypothetically and through simulations, the benefits that can be realized through a judicious choice of sampling capacitor, chosen to optimize and maintain the stored voltage on the hold capacitor and its effects on improving the lower frequency signal response and only when combined with a high-impedance energy-blocking buffer stage that works to maintain the stored voltage during the hold cycle. And in fact, because my paper is directed to a voltage sample and hold circuit, my paper actually teaches away from the transfer of energy from a carrier signal to a storage device and the use of that energy to generate a lower frequency signal or the baseband. Therefore, at least the following elements of the Asserted Claims of the '551, '518, '371 and '845 patents are not taught by my paper:

- "generating a lower frequency signal from the transferred energy" (as required by '551, independent claim 1, and its dependents, claims 2, 3, 8, 9, 12, 16, 20, 39, 41, 50, 54, 55, 57, 92, 108, 113, and 126);

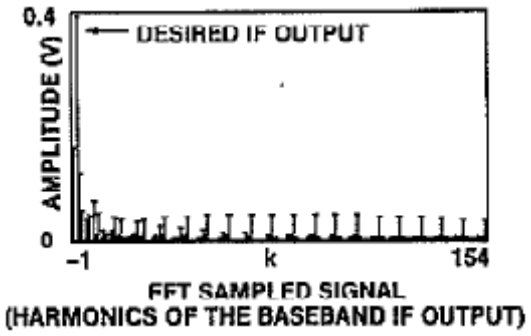
- "wherein a lower frequency signal is generated from the transferred energy" (as required by '551 independent claim 23, and its dependents, claims 24, 25, 26, 31, 32, 135, 161, 192, 193, 195, 196, 198, 202, and 203);
- "generating the baseband signal from the integrated energy" (as required by '518 independent claim 1, and its dependents, claims 2, 3, 12, 17, 24, and 27);
- "generating the second signal from the integrated energy" (as required by '518 independent claim 77, as its dependent, claim 81);
- "means for generating the baseband signal from the integrated energy (as required by '518 independent claim 82);
- "means for generating the second signal from the integrated energy" (as required by '518 independent claim 90, and its dependent claim 91);
- "whereby the accumulation results from a down-converted signal" and "a finite time integrating module" (as required by '845 independent claim 1, and its dependents, claims 3-9 and 12);
- "a finite time integrating module" (as required by '845 independent claim 13, and its dependents, claims 17, 18, 19, 20, 22, 23, and 24);
- "wherein the lower frequency signal is generated from the transferred energy" (as required by '371 independent claim 1); and
- "wherein the lower frequency signal is generated from the transferred energy" (as required by '371 independent claim 2, and its dependents, claims 22, 23, 25, and 31).

My paper teaches voltage sampling. As my paper says:

> *"An ideal sample-and-hold buffer should be capable of measuring the voltage stored on the hold capacitor for the duration of the hold cycle without discharging the hold capacitor. The advantage of the buffer circuitry, which can*

> *as nearly as possible meet this ideal requirement, is evident in the FFT of the ideal subharmonic sample-and-hold simulation, as shown in* Figure 1.b"

Weisskopf at 245. This is shown in Fig. 1(b), reproduced here:



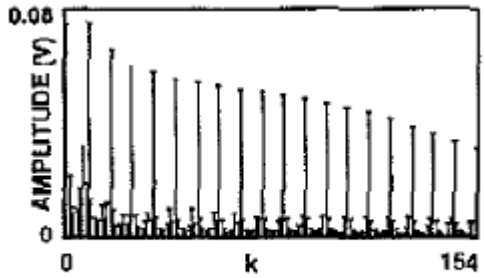
The lower signal response shown in the above is described to be the result when: *"the buffer can be made to have a high impedance"*.

Additionally, as taught by my paper, "[t]he voltage stored on the capacitor is equal to $V_c = q^2/ C_h$." Weisskopf at p. 242. Moreover, my paper stresses maximizing V_c when it is said that "by increasing the incident power on the original sampling circuit by 3dB, the original voltage will be restored . . . " and when kinetic energy is transferred to C_h, the voltage given by V_c "decreases by the square root of the impedance ratio or by the square root of two." Weisskopf at p. 242. As this discussion shows, my paper is directed to voltage sampling.

My paper also teaches that discharging energy from the hold capacitor during the hold time destroys the efficiency of the conversion to a lower frequency signal and/or baseband:

> "*A sample-and-hold circuit that has a low impedance load, as shown in Figure 5. The resulting poor hold duration manifests itself as an increasing inability of the sample-and-hold circuit to isolate the periodic sampling function discrete-line spectra from the output of the sample-and-hold circuit."*

Weisskopf at 242-243. This is shown in Fig. 5, reproduced here:

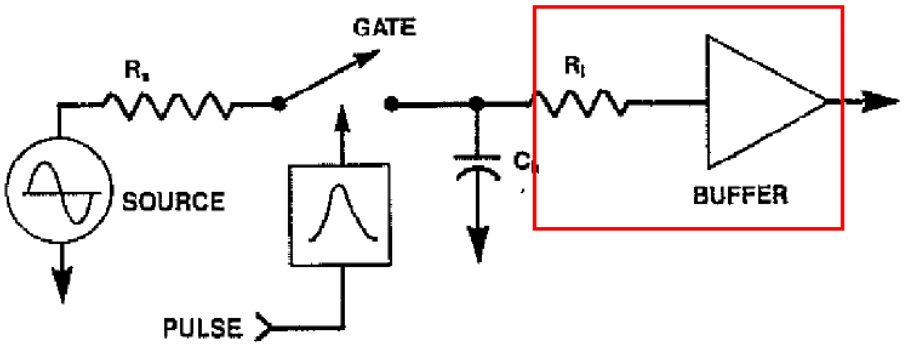


In other words, my paper expressly teaches that transitioning energy to the output will result in poor performance—this is precisely the opposite of what is required by the Asserted Claims of the '551, '518, '371 and '845 patents.

My paper teaches that the output (*i.e.* the lower frequency signal and/or baseband) should have "little harmonic energy." As my paper teaches:

> *"on the other hand, if the buffer can be made to have high impedance, the output will contain little harmonic energy and a much stronger baseband downconverted spectrum of the sampled signal."*

Weisskopf at p. 243. To further my paper's goal of transferring as little energy as possible to the output (*i.e.* the goal of my paper is to expressly exclude the use of energy in the generation of the lower frequency signal and/or baseband), my paper shows a high value of series resistance between the input of "a high impedance op-amp" and the capacitor. *"In a subharmonic sampling phase detector application, a 50 K ohm series input resistance connect[s] the hold capacitor to a high impedance op-amp."* Weisskopf at p. 243. The addition of this series resistance is shown in figures 2, 4 and 9. The purpose of "series input resistance" and "high impedance op-amp" is to block any energy in the capacitor C_h from making it into the output. This is shown in Fig. 2, with the energy blocking "series resistance" and "high impedance op-amp" enclosed within the red square, and positioned between capacitor C_h and the output:



Further, as my paper teaches:

> *"In a subharmonic sampling phase detector application (zero IF), a 50 K ohm series input resistance connecting the hold capacitor to a high impedance op-amp with 3 p*F *of stray input capacitance would create a low pass filter with a corner frequency at 1 MH. This limited frequency response is adequate for phase lock loops that have bandwidths of less than 100 KHz."*

Weisskopf at p. 243. As this explains, the "hold capacitor" (C_h) is connected to a series resistor with the opposite end connected to a "high impedance op-amp" for the purpose of blocking any stray input capacitance on the buffer. As explained "[this stray capacitance] *if connected in parallel with the hold capacitor would destroy the efficiency of the circuit."* The overall effect of the series 50K ohm resistor and the high input impedance op-amp is to the block the flow of energy to the output—precisely the opposite goal of the Asserted Claims of the '551, '518, '371 and '845 patents.

That the goal of my paper was to prevent the discharge of energy to the lower frequency signal and/or baseband is further emphasized by my paper's disclosure that:

> *"An ideal sample-and-hold buffer should be capable of measuring the voltage stored on the hold capacitor for the duration of the hold cycle without discharging the hold capacitor. The advantage of the buffer circuitry, which can as nearly as possible meet this ideal requirement, is evident in the FFT of the ideal subharmonic sample-and-hold simulation as shown in* Figure 1.b"

Weisskopf at 242. In other words, the "buffer circuitry" is used to prevent the "discharge[e] of the hold capacitor." I then expressly contrast the poor performance of a sample-and-hold circuit

that has a low impedance load (*i.e.* one where energy is allowed to transition to the output), with the superior performance of a voltage sample-and-hold circuit, which, like my paper has a high impedance load designed to block energy transfer to the output:

> *"Next, one may compare this to the output of a sample-and-hold circuit that has a low impedance load, as shown in Figure 5. The resulting poor hold duration manifests itself as an increasing inability of the sample-and-hold circuit to isolate the periodic sampling function discrete-line spectra from the output of the sample-and-hold circuit. On the other hand, if the buffer can be made to have a high impedance, the output signal will contain little harmonic energy and a much stronger baseband down-converted spectrum of the sampled signal."*

Weisskopf at p. 242-243.

Finally, my paper does not teach or suggest a convolution operation. The asserted claims of the '845 patent all require "a finite time integrating module" which the Court has construed to mean "circuitry that can perform a finite time integrating operation." The Court in turn has construed "finite time integrating operation" to mean "convolving a portion of the carrier signal with an impulse response that is rectangular, triangular, half sine, nearly sinusoidal, or a step function." One of ordinary skill in the art understands that a convolution is a very particular type of mathematical operation. In some references, an asterisk symbol (*i.e.*, "*") can refer to a convolution. However, in other references, and as is the case in the equations set forth on page 240 of my paper, the asterisk symbol used therein refers to a multiplication, and not a convolution. In fact, my paper never uses the word "convolution," nor does my paper disclose any type of convolution operation, and certainly not a convolution that involves "convolving a portion of the carrier signal" to generate a lower frequency signal or baseband.

The simulations performed in my paper to solve for the charge on the hold capacitor are conducted over a singular half period of the RF carrier and as such could never be confused with convolution or more precisely a "finite time integration operation" which requires multiple

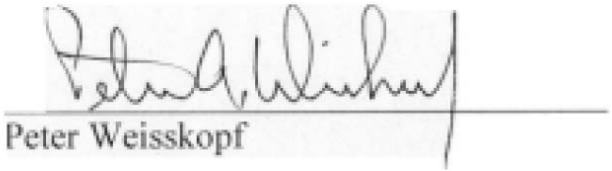
simulations as directed in time by a windowing operation. No such windowing operation as required for the mathematical computations needed for convolution is presented in my paper.

4. CONCLUSION: MY PAPER DOES NOT TEACH OR SUGGEST THE ASSERTED CLAIMS OF THE '551, '518, '371 AND '845 PATENTS.

In summary, my paper teaches a voltage sample-and-hold circuit having a sufficiently high impedance load such that the voltage on the storage capacitor can be measured *without* discharging energy from the capacitor. This is contrary to the teachings of the Patents-in-Suit, and in particular is contrary to the specific claim language of the Asserted Claims of the '551, '518, '371 and '845 patents contained in the bullet list above.

As the claim language in the bullet list above makes clear, in the patented inventions—in direct contrast to the teachings of my paper—not only must energy be transferred into a hold capacitor, but energy transferred from the carrier signal into the hold capacitor must be discharged from the capacitor and used to generate the lower frequency signal or baseband. Because the goal of my paper is to measure the voltage on the capacitor, without discharging the capacitor, the lower frequency and/or baseband output signal of my paper *is not* produced by energy transferred from the input carrier signal.

Signed this 1st **day of April, 2013, by:**



Peter Weisskopf