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**IN THE UNITED STATES DISTRICT COURT  
FOR THE DISTRICT OF PENNYSTON**

**BALLISTIC HOLDINGS, INC. and  
BALLISTIC MEMORY, INC.,**

**Plaintiffs,**

**v.**

**CONSUMERCAM, LLC**

**Defendant.**

**Civil Action No.  
1:16-GSR-10814**

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**ORDER ON CONSUMERCAM’S MOTION FOR SUMMARY JUDGMENT**

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Before the Court is ConsumerCam, LLC’s (“ConsumerCam”) Motion for Summary Judgment against Ballistic Holdings, Inc. and Ballistic Memory, Inc. (collectively “Ballistic”). This dispute arises out of an agreement between Ballistic and ConsumerCam relating to products covered under Ballistic’s ’314 patent. The Court has held that the claims of the ’314 patent do not require construction.

ConsumerCam contends that (1) Ballistic’s ’314 Patent is invalid under 35 U.S.C. § 112(a) for a lack of enablement, and (2) Ballistic’s rights in the ’314 Patent exhausted under *Impression Prods. v. Lexmark Int’l*, 137 S. Ct. 1523 (2017). For the reasons articulated below, I find that while the ’314 patent is not invalid under 35 U.S.C. § 112(a), Ballistic exhausted its patent rights when it sold its semiconductor devices to ConsumerCam.

### **Standard of Review**

Summary judgment is proper only if the movant shows that there is no genuine dispute as to any material fact and the movant is entitled to judgment as a matter of law. Fed. R. Civ. P. 56(a). An issue is genuine if the evidence is sufficient for a reasonable jury to return a verdict for the non-moving party. In considering a motion for summary judgment, the evidence of the non-movant is to be believed, and all justifiable inferences are to be drawn in his favor.

### **Enablement**

A patent is valid only if its specification “contain[s] a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same . . . .” *See* 35 U.S.C. § 112(a). This is known as the “enablement” requirement. An enablement inquiry typically begins with a construction of the claims. Pursuant to the Court’s February 22, 2018, *Markman* order, the claims at issue here do not require construction because their plain and ordinary meaning is readily apparent.

ConsumerCam contends that Ballistic’s ’314 patent does not enable a POSITA to practice the claimed invention for two reasons. Neither argument is persuasive. I address each argument in turn.

First, ConsumerCam points out that claim 1 recites graphene nanoribbons having widths of 5 to 35 nm and switching speeds of 1.0 to 1.2 T Hz, but Fig. 2 shows that only graphene nanoribbons having widths of 5 to 15 nm achieve switching speeds of 1.0 to 1.2 T Hz. According to ConsumerCam, this discrepancy proves that the specification does not enable the full scope of claim 1. Ballistic disagrees, contending that the declaration of Professor Robert Hendricks and the specification make clear that the results presented in Fig. 2 are the results of but a single

experiment. Professor Hendricks further explains that these results depict worst-case results (i.e., slowest switching speeds) and that it is known to a POSITA that graphene nanoribbons having widths up to 35 nm can achieve switching speeds of 1.0 to 1.2 T Hz. Based on this evidence, a reasonable jury could find that the specification enables claim 1 notwithstanding the data shown in Fig. 2.

Second, ConsumerCam argues that the results depicted in Fig. 2 pertain only to graphene nanoribbons having lengths of 22 nm, but claim 1 recites graphene nanoribbons having *any* length. Professor Hendricks's declaration, however, explains that it would be obvious to a POSITA that it is not practicable to manufacture graphene nanoribbons having lengths significantly greater than 22nm. Professor Hendricks's declaration also states that graphene nanoribbons having lengths less than 22nm would achieve faster switching speeds than those depicted in Fig. 2. A reasonable jury could find, therefore, that although the claim does not recite limits on the length of the graphene nanoribbon, a POSITA would recognize an inherent range of about 22nm or less, which the specification clearly teaches.

For these reasons, I find that ConsumerCam has failed to show that there is no genuine dispute as to any material fact concerning the validity of claim 1 under 35 U.S.C. § 112(a). Furthermore, because claims 2-3 depend from, and therefore have a narrower scope than, claim 1, I also find that ConsumerCam has failed to make the same showing with respect to claims 2-3. Accordingly, I deny ConsumerCam's motion for summary judgment of non-enablement.

### **Patent Exhaustion**

A patentee's rights in a patent are said to be "exhausted" when the patentee sells an item that practices the patented invention. After the sale, the patent owner can no longer control the downstream use of that item through the patent laws. *Impression Prods. v. Lexmark Int'l, Inc.*, 137

S. Ct. 1523, 1529 (2017). An authorized sale outside the United States will also serve to exhaust the patent holder's patent rights. *Id.* at 1538.

ConsumerCam contends that its licensing agreement with Ballistic was in reality a disguised sale, which thus exhausted Ballistic's patent rights. Ballistic disagrees, maintaining that the transaction with ConsumerCam was a license agreement, not a sale. Ballistic contends that ConsumerCam has breached that license agreement and is liable under 35 U.S.C. 271(b) for inducing OffTheBlockChain to infringe the '314 patent.

I agree with ConsumerCam that its deal with Ballistic was a sale and that Ballistic's patent rights were thus exhausted. The evidence overwhelmingly shows that Ballistic sold ConsumerCam the semiconductor devices, while framing the sale agreement as a license to attempt to preserve their patent enforcement rights. Firstly, Ballistic's own press release states that ConsumerCam purchased "semiconductor devices," not a license. *See* Press Rel. at 1 ("ConsumerCam will purchase 2,000,000 semiconductor devices from Ballistic Memory and use the devices to manufacture its cameras, which are increasingly popular with social media influencers."). Further, Ballistic employees even characterized the agreement as a sale. *See* Tinny Dep. at 12 ("We were selling the semiconductor devices to ConsumerCam."). The deposition testimony makes it clear that Ballistic called the agreement a "license" merely to attempt to preserve its patent rights. *See id.* at 14 ("I think [upper management] said something about making sure that the patent rights aren't tired or expired or something like that."); *see also id.* ("It is definitely a license. I know that is what [upper management] called it.").

For these reasons, I find that Ballistic's patent rights were exhausted when they sold the semiconductor devices to ConsumerCam. Accordingly, ConsumerCam's Motion for Summary Judgment is **GRANTED**.

Dated: Jan. 12, 2018

/s/ Oliver S. Rango  
UNITED STATES DISTRICT JUDGE

**Inventors:** John Tinny et al.

**Assignee:** Ballistics Holdings, Inc.

**Filed:** April 2, 2013

**Granted:** January 5, 2014

## GRAPHENE NANORIBBON FIELD-EFFECT TRANSISTOR

An example of a graphene nanoribbon field-effect transistor 100 (GNRFET) described herein can be seen in FIG. 1. The GNRFET 100 includes a source terminal 102, a drain terminal 104, a gate terminal 106, and a graphene nanoribbon 108 channel. The graphene nanoribbon functions as a semiconducting channel for charge carriers in the GNRFET 100. Current flows from the source 102 to the drain 104, as marked by an arrow labeled with an “e<sup>-</sup>” charge carrier symbol. An amount of current can be controlled by a voltage applied to the gate 106.

[...]

The graphene nanoribbon 108 connects the source terminal 102 to the drain terminal 104. The graphene nanoribbon forms a heterojunction with each of the source terminal 102 and the drain terminal 104. The gate 106 is insulated from the graphene nanoribbon 108 and each of the source terminal 102 and the drain terminal 104. In some implementations, a conventional dielectric (not shown) is inserted between the gate 106 and each of the source terminal 102, drain terminal 104, and the graphene nanoribbon 108.

The geometry of the graphene nanoribbon 108 enables near-ballistic or ballistic conduction of charge carriers from the source terminal 102 to the drain terminal 104 in two ways. First, edges 110a, 110b of the graphene nanoribbon 108 are of an “armchair” geometry. The armchair geometry of the graphene nanoribbon 108 causes a non-zero bandgap in the nanoribbon. The graphene material is thus able to operate as a semiconducting material, depending on the voltage of the gate terminal 106. Second, the width (marked by axis “W” in FIG. 1) and the length (marked by axis “L” in FIG. 1) of the graphene nanoribbon 108 are tuned to specific values. The values of L and W of the graphene nanoribbon 108 enable the graphene nanoribbon to have near-zero resistance at particular voltages of the gate terminal 106, while also having switching speeds of over 1 Terahertz (T Hz) as gate terminal 106 voltage is changed. Measured switching speeds for selected geometries are provided in graph 200 of FIG. 2. In some implementations, the measured switching speeds exceeded 1.048 T Hz, a critical frequency milestone in the semiconductors industry.

In some implementations, the width of the graphene nanoribbon 108 is between 5 nanometers (nm) and 35 nanometers. In some implementations, the length L of the graphene nanoribbon 108 is between 15 nanometers and 25 nanometers. Due to current manufacturing limitations, it may not always be practicable to manufacture graphene nanoribbons having lengths less than 20nm. It is foreseeable that these limitations will be overcome in the near future. Tests of switching speeds exceeding 1 T Hz were measured with a graphene nanoribbon 108 width W of 7nm +/- 1nm and a length of 22nm +/- 1nm. At this geometry, the graphene nanoribbon 108 exhibits

ballistic (e.g., superconducting) properties and produces almost no waste heat. Operating voltages for the gate terminal 106 ranged from .5V-1.5V for each geometry.

As seen in graph 200 of FIG. 2, as the width W of the graphene nanoribbon 108 increased over 15 nm, switching speeds dropped from approximately 1 T Hz to less than 200 G Hz. These data were obtained with graphene nanoribbon 108 length fixed at 22nm +/- 1nm. However, the GNR-FET still exhibited semiconducting properties indicative of non-ballistic conduction in the channel at widths that were greater than 15 nm, and the transistor was still functional at these speeds.

[...]

Thus, at certain geometries described above, the GNR-FET 100 exhibits ballistic conduction in the graphene nanoribbon 108 channel. Ballistic conduction in the graphene nanoribbon 108 channel enables the GNR-FET 100 to operate at switching speeds above 1 T Hz. Switching speeds above 1 T Hz provide for many advantages in the computing industry, such as faster and more efficient processors, memory devices, etc.

What is claimed is:

1. A semiconductor device, comprising:
  - a gate terminal;
  - a source terminal;
  - a drain terminal; and
  - a graphene nanoribbon channel connecting the source terminal and the drain terminal, wherein the graphene nanoribbon channel is configured for ballistic conduction of charge carriers at switching speeds between 1 T Hz and 1.2 T Hz, and wherein a width of graphene nanoribbon is between 5 nanometers and 35 nanometers.
2. The semiconductor device of claim 1, wherein the width of the graphene nanoribbon is less than 15 nanometers.
3. The semiconductor device of claim 1, wherein the length of the graphene nanoribbon is approximately 22nm.



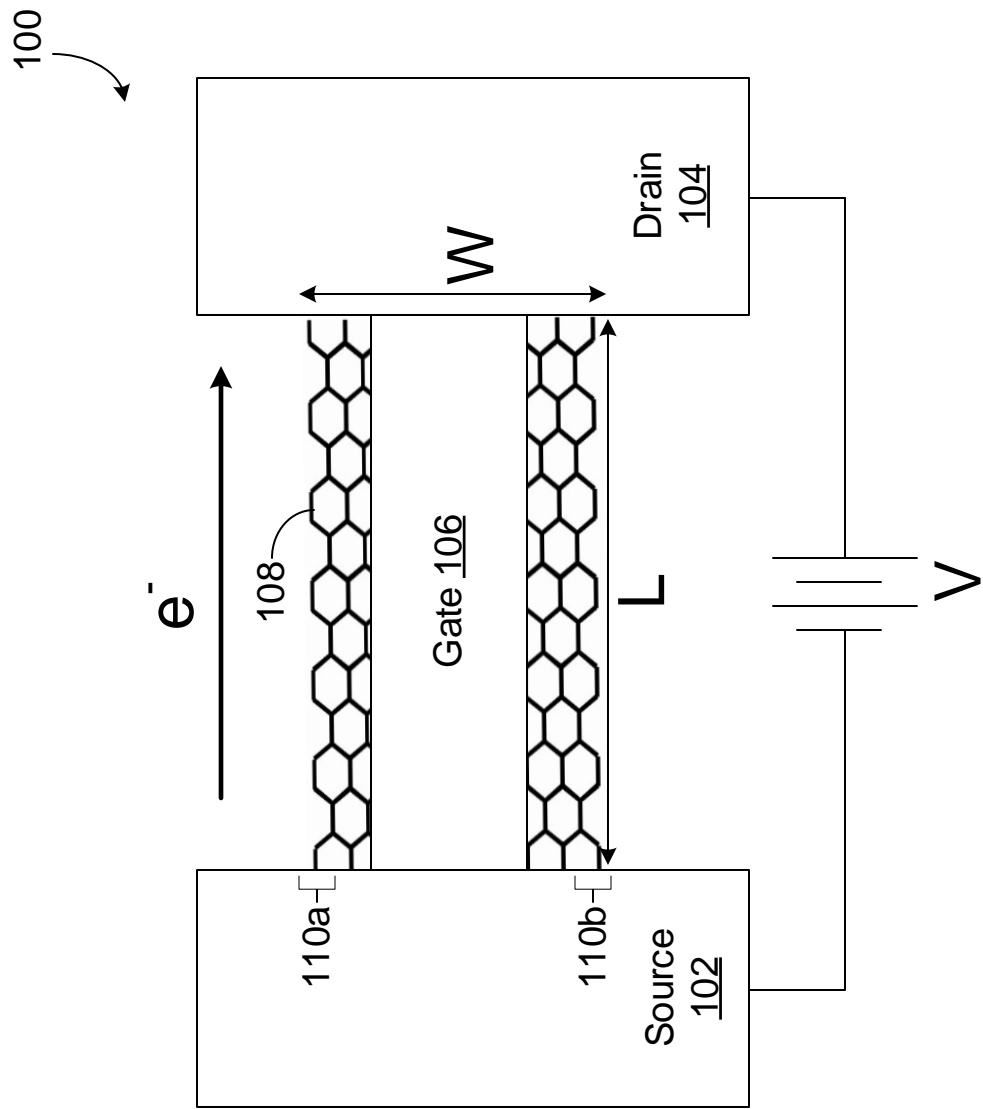


FIG. 1

200

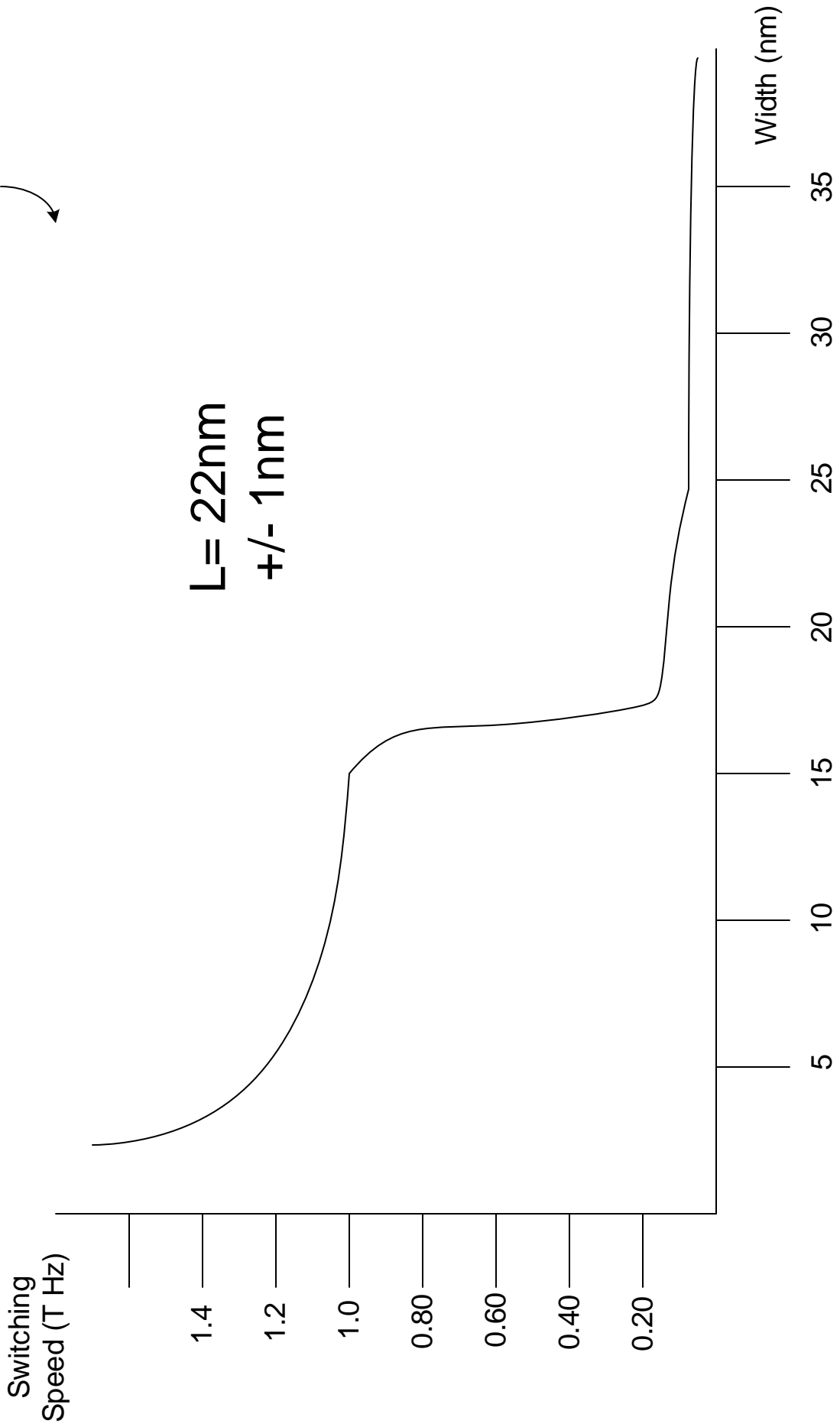


FIG. 2

**Michael Toto**

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**From:** Henry Gale  
**Sent:** Monday, June 18, 2015 1:18 PM  
**To:** Michael Toto  
**Subject:** RE: Ballistic Memory Agreement

Thanks. Just make sure the engineers know about that blockchain thing.

**Henry Gale** — General Counsel — ConsumerCam, LLC  
100 Main Street, Emerald City, PE 00500-1234  
(555) 555 1145 direct — [gale@ConsumerCam.com](mailto:gale@ConsumerCam.com)

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**From:** Michael Toto  
**Sent:** Monday, June 18, 2015 1:00 PM  
**To:** Henry Gale <[gale@ConsumerCam.com](mailto:gale@ConsumerCam.com)>  
**Subject:** RE: Ballistic Memory Agreement

Hank,

Good news. We reached an agreement with Ballistic. We just had to agree not to use the devices in products with blockchain technology without Ballistic's permission, which is fine since we aren't planning to get involved in blockchain anyway. The engineers will receive the first shipment of the devices on July 6th.

**Michael Toto** — Assistant General Counsel — ConsumerCam, LLC  
100 Main Street, Emerald City, PE 00500-1234  
(555) 555 1188 direct — [toto@ConsumerCam.com](mailto:toto@ConsumerCam.com)

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**From:** Michael Toto  
**Sent:** Tuesday, June 12, 2015 10:05 AM  
**To:** Henry Gale <[gale@ConsumerCam.com](mailto:gale@ConsumerCam.com)>  
**Subject:** RE: Ballistic Memory Agreement

Thanks, Hank. I will keep negotiating with Ballistic and try to work this out. I know the engineers really want these devices, so I don't want to disappoint them.

**Michael Toto** — Assistant General Counsel — ConsumerCam, LLC  
100 Main Street, Emerald City, PE 00500-1234  
(555) 555 1188 direct — [toto@ConsumerCam.com](mailto:toto@ConsumerCam.com)

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**From:** Henry Gale  
**Sent:** Tuesday, June 12, 2015 10:02 AM  
**To:** Michael Toto <[toto@ConsumerCam.com](mailto:toto@ConsumerCam.com)>  
**Subject:** RE: Ballistic Memory Agreement

Mike,

That's absurd—Ballistic can't restrict what we do with the devices after we buy them. Don't agree to anything less than all the rights. I don't want Ballistic controlling how we conduct our business. If they won't agree to all the rights, we can go buy semiconductor devices from someone else or keep buying them from Conductors-R-Us.

**Henry Gale** — General Counsel — ConsumerCam, LLC  
100 Main Street, Emerald City, PE 00500-1234  
(555) 555 1145 direct — [gale@ConsumerCam.com](mailto:gale@ConsumerCam.com)

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**From:** Michael Toto  
**Sent:** Monday, June 11, 2015 6:07 PM  
**To:** Henry Gale <[gale@ConsumerCam.com](mailto:gale@ConsumerCam.com)>  
**Subject:** Ballistic Memory Agreement

Hank,

I am negotiating the agreement for us to buy the Ballistic Memory semiconductor devices that we want to use in our microprocessors. I know we talked about this purchase agreement briefly at our department meeting last week, but Ballistic is saying that they want to limit how we can use and resell the devices—they are worried about blockchain technology—so can you tell me exactly which rights we need in the agreement?

Thanks,  
Mike

**Michael Toto** — Assistant General Counsel — ConsumerCam, LLC  
100 Main Street, Emerald City, PE 00500-1234  
(555) 555 1188 direct — [toto@ConsumerCam.com](mailto:toto@ConsumerCam.com)



**BALLISTIC MEMORY, INC.**  
*Semiconductor Innovation*

**FOR IMMEDIATE RELEASE**

**Contact:** Glinda Goode  
goode@ballistic.com

**BALLISTIC MEMORY TO SELL TWO MILLION SEMICONDUCTOR DEVICES TO CONSUMERCAM FOR USE IN HIGH-END CAMERAS**

**EMERALD CITY, PE** (June 20, 2015) — BALLISTIC MEMORY, INC., the maker of innovative semiconductor devices, has reached an agreement with CONSUMERCAM, LLC, the maker of high-end consumer-grade cameras. ConsumerCam will purchase 2,000,000 semiconductor devices from Ballistic Memory and use the devices to manufacture its cameras, which are increasingly popular with social media influencers. ConsumerCam will receive the first shipment of Ballistic Memory semiconductor devices on July 6, 2015 and plans to roll out the first lot of cameras with the new devices this fall.

**About Ballistic Memory, Inc.**

Ballistic Memory, Inc. is a United States company that manufactures memory hardware and semiconductor devices contained within them. Ballistic Memory holds exclusive licenses for several patents related to ballistic conduction in semiconductor devices, allowing it to manufacture the best and most innovative semiconductor devices available on the market today.

**About ConsumerCam, LLC**

ConsumerCam, LLC is a United States company that manufactures microprocessors for use in high-end consumer-grade cameras. ConsumerCam also manufactures and sells the cameras themselves. ConsumerCam's cameras are some of the most popular on the market today because of their quality and accessible price points.

**Contact**

For further information, please contact

Glinda Goode  
Chief Marketing Officer, Ballistic Memory, Inc.  
One Yellow Brick Road, Emerald City, PE 00500-1234  
(555) 555-2235 — goode@ballistic.com

**Henry Gale**

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**From:** Michael Toto  
**Sent:** Tuesday, May 29, 2015 3:05 PM  
**To:** Henry Gale  
**Subject:** RE: Buying new semiconductor devices

Hank,

I got the information from the engineers. The company is called Ballistic Memory. The engineers are really excited about the new devices. I will reach out to Ballistic tomorrow morning to start working on a purchase agreement.

Best,  
Mike

**Michael Toto** — Assistant General Counsel — ConsumerCam, LLC  
100 Main Street, Emerald City, PE 00500-1234  
(555) 555 1188 direct — [toto@ConsumerCam.com](mailto:toto@ConsumerCam.com)

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**From:** Henry Gale  
**Sent:** Monday, May 28, 2015 5:10 PM  
**To:** Michael Toto <[toto@ConsumerCam.com](mailto:toto@ConsumerCam.com)>  
**Subject:** Buying new semiconductor devices

Mike,

I just got out of a meeting with Leo in engineering. The engineering department wants to buy new semiconductor devices manufactured by some company that I have never heard of—I think they are called Ballistic Memory. Apparently Ballistic's devices are much better than the ones we have been buying from Conductors-R-Us, but I don't know how much more expensive they are. If the devices are going to cost too much, I think finance will push back against the engineers. I need you to get Ballistic's information from the engineers and start working on an agreement to buy the devices. I don't know how soon the engineers need the devices, so get the timeline from them also.

**Henry Gale** — General Counsel — ConsumerCam, LLC  
100 Main Street, Emerald City, PE 00500-1234  
(555) 555 1145 direct — [gale@ConsumerCam.com](mailto:gale@ConsumerCam.com)

EMERALD CITY, PENNSYTON; WEDNESDAY, DECEMBER 19, 2016

10:12 A.M.

\* \* \*

JOHN TINNY,

employee of the Plaintiff herein, having been first  
duly sworn, testified as follows:

EXAMINATION

BY MS. BILLINA:

Q Good morning, Mr. Tinny. Can you please state your  
full name and address for the record.

A My full name is John Hartmann Tinny. I go by Jack.  
My address is 14 Guild Road, Munchland, Pennsyton, and  
the zip code is 00400.

Q Have you ever been deposed before?

A No.

Q Okay. I am going to explain the deposition  
procedures to you. Do you understand that the oath you  
just took is the same oath that you would take if you  
were appearing in court?

A Yes.

Q Is there any reason why you cannot give truthful testimony today?

A No.

Q If your counsel objects to any of my questions, those objections are to preserve the record. Unless your counsel instructs you not to answer a question, you need to answer the question after the objection. Do you understand?

A Yes.

Q If you do not understand any of my questions, you can ask me for clarification. Do you understand?

A Yes.

Q Okay. First, I will ask you some questions about your background, like your education and work experience. Then, I will ask you questions about your work at Ballistic Memory and the lawsuit between Ballistic Memory and ConsumerCam. Okay?

A Yes.

Q What is your title at Ballistic Memory?



A I am an engineering manager.

(Brief Recess Taken)

BY MS. BILLINA:

Q Mr. Tinny, are you familiar with the licensing agreement between Ballistic Memory and ConsumerCam for semiconductor devices?

A Yes. I am.

Q I am going to show you a document that has been marked Exhibit 1. Do you recognize this document?

(Whereupon Defendant's Exhibit 1 was marked for identification by the Court Reporter.)

A Yes.

Q What is this document?

A The licensing agreement between Ballistic and ConsumerCam for the semiconductor devices.

Q How many times have you seen this document?

A Just once.

Q When was that?

A After ConsumerCam signed it. So, that must have been sometime in late June 2015.

Q Who showed you the document?

A Our in-house counsel, Mira Gulch.

Q When you say "our in-house counsel," you mean Ballistic Memory's in-house counsel, right?

A Yes.

Q Why did Ms. Gulch show you the agreement?

A When she was negotiating the agreement with ConsumerCam, she asked me and another engineer who was an inventor on the '314 patent, Steven Crow, about the semiconductor devices. So, once they reached an agreement, she sent us the agreement to share the good news that we would be selling a lot of the devices to ConsumerCam.

Q What did you, Ms. Gulch, and Mr. Crow talk about regarding the '314 patent when Ms. Gulch was negotiating the agreement with ConsumerCam?

A Mira wanted to understand the technology better so that she knew exactly what we were selling ConsumerCam. Steve and I explained the invention in simple layperson terms since Mira isn't an engineer.

Q When you discussed the agreement with Ms. Gulch, did she refer to it as a license or a sale?

A I think Mira called it a licensing agreement.

Q Did you ever hear anyone at Ballistic Memory refer to the agreement as a sale?

A Well, yes, all the time. We were selling the semiconductor devices to ConsumerCam, so obviously we used the word "sale" a lot. It was a licensing agreement to sell the semiconductor devices to ConsumerCam.

Q Are you aware of whether the agreement grants ConsumerCam rights like using and selling the semiconductor devices?

A Yes.

Q What do you know about those rights?

A The agreement limits ConsumerCam's use and sale of the devices so that they cannot use the devices with blockchain technology without permission from Ballistic.

Q How do you know about this limitation?

A I told Mira to add it to the agreement.

Q You said earlier that you only saw the agreement once. When did you see the agreement and ask for this addition?

A Oh. That's right. I saw the agreement another earlier time. I forgot about that. It must have been sometime earlier in June.

Q Why did you ask Mira to add the limitation the agreement?

A Our CEO, Mark Marvel, is concerned about blockchain technology, so he told me to make sure that the limitation got put in the agreement. Then, I told Mira.

Q Did Mr. Marvel refer to the agreement as a license or a sale?

A He called it a license. But isn't it a license to sell the devices? Anyway, it is a license--Mark and Mira both told me it was a license. They said something about it needing to be a license so that ConsumerCam wouldn't have some patent rights or something like that.

Q Do you remember anything else they said about the license and patent rights?

A Not really. It was something about ConsumerCam not having certain rights. I think they said something about making sure that the patent rights aren't tired or expired or something like that. I can't remember the word they used. You keep asking me about licenses and sales, can you clarify what you mean?

MS. BILLINA: A license and a sale are two different things, and it is either a license or a sale, but not both.

MR. TINNY: Okay. It is definitely a license. I know that is what Mark and Mira called it.

Q So, your testimony is that the agreement between Ballistic Memory and ConsumerCam is a license?

A Yes.

MS. BILLINA: Okay. Mr. Tinny, thank you for your time. I have no further questions.

(Whereupon, at 1:03 p.m., the deposition of JOHN HARTMANN TINNY was concluded.)

**IN THE UNITED STATES DISTRICT COURT  
FOR THE DISTRICT OF PENNYSYTON**

**BALLISTIC HOLDINGS, INC. and  
BALLISTIC MEMORY, INC.,**

**Plaintiffs,**

**v.**

**CONSUMERCAM, LLC**

**Defendant.**

**Civil Action No.  
1:16-GSR-10814**

**DECLARATION OF ROBERT HENDRICKS**

I, Dr. Robert Hendricks, declare as follows:

1. I was contacted by counsel for Ballistic in this proceeding and asked to opine on matters of enablement in a dispute with ConsumerCam. Specifically, I was asked to review the asserted '314 patent, including the claims and the specification, and determine whether it satisfies 35 U.S.C. § 112(a).

2. I am being compensated at my standard rate of \$200 per hour for my work on this case. Expenses are billed at cost. My compensation does not depend in any way on the content of my testimony or the outcome of the case. I own no shares nor do I have any other ownership interest in Ballistic or ConsumerCam. I have no financial ties to either party, and I will not financially benefit from any outcome in this case beyond my hourly consulting fee.

**I. Qualifications**

3. I received my bachelor's degree and my PhD in electrical engineering from Penntech in 1987 and 1991, respectively. After working for two years in the R&D department of

Pennyston Instruments, I joined the faculty of the Pennyston Institute of Technology, where I have taught semiconductor design for the past 25 years.

4. I have received numerous honors and awards for my scientific accomplishments, as listed in my curriculum vitae attached hereto as Exhibit A. Among these is election to the National Academy of Engineering, often described as one of the most significant honors for an engineer. I am a licensed Professional Engineer in Pennyston in the field of electrical engineering.

## **II. Relevant Law**

5. I am not a lawyer. Counsel for Ballistic has, however, informed me of the legal principles that courts use to determine whether a patent satisfies the enablement requirement.

6. I understand that a patent must contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same.

7. I further understand that a written description of an invention is sufficiently enabling if it teaches those skilled in the art how to make and use the full scope of the claimed invention without undue experimentation.

8. I understand that issued patents are presumed valid. Accordingly, an issued patent is presumed to satisfy the enablement requirement. To overcome this presumption, a person challenging the validity of the patent must present clear and convincing evidence of invalidity.

9. To determine whether the amount of experimentation is undue, I understand that courts consider eight factors: (1) the quantity of experimentation necessary, (2) the amount of direction or guidance presented, (3) the presence or absence of working examples, (4) the nature



of the invention, (5) the state of the prior art, (6) the relative skill of those in the art, (7) the predictability or unpredictability of the art, and (8) the breadth of the claims.

### **III. Materials Considered**

10. In forming my opinion, I have considered the following:

- The '314 patent, including its claims, specification, and file history
- The parties' summary judgment briefs and attachments thereto

### **IV. Opinions and Basis**

11. The '314 patent discloses a graphene nanoribbon field-effect transistor (“GNRFET”) with a specific geometry. In particular, the '314 patent discloses a GNRFET wherein: (1) the edges of the graphene nanoribbon are of an “armchair” geometry; and (2) the width (W) and length (L) of the graphene nanoribbon are tuned to specific values. In some implementations, W is 5-35 nm and L is 15-25 nm. The specification notes, however, that then-current manufacturing limitations render lengths less than 20 nm impracticable.

12. The specification explains that GNRFETs with the disclosed geometry exhibit near-ballistic or ballistic conduction of charge carriers from the source terminal to the drain terminal, as well as switching speeds of over 1 T Hz. The test results shown in Figure 2 confirm this. Figure 2 shows switching speed as a function of W for GNRFETs having W between 7 nm and 20 nm, and L = 22 nm. Based on these data, a GNRFET with L = 22 nm and  $W < 15$  nm exhibits switching speeds greater than 1 T Hz.

#### **A. Claim 1**

13. Claim 1 recites a GNRFET having W between 5 nm and 35 nm that is “configured for ballistic conduction of charge carriers at switching speeds between 1 T Hz and 1.2 T Hz.” I understand from its summary judgment briefing that ConsumerCam argues claim 1 is not enabled for two reasons. I address each reason in turn.

14. First, ConsumerCam notes that claim 1 recites switching speeds of 1-1.2 T Hz and a graphene nanoribbon width of 5-35 nm, but Figure 2 of the patent shows that these switching speeds are achievable only at graphene nanoribbon widths of 5-15 nm. Therefore, the argument goes, the specification does not enable the full scope of claim 1. I disagree. ConsumerCam is correct about Figure 2, but the data in Figure 2 pertain only to GNRFETs having  $L = 22$  nm. At the time of the invention, a person of skill in the art would have recognized that switching speed increases as  $L$  is decreased. Thus, a person of skill in the art would have recognized that switching speeds of 1-1.2 T Hz could be achieved over the full range of  $5 < W < 35$  nm by simply experimenting with different values for  $L$ . This would require minimal, routine experimentation.

15. Second, ConsumerCam argues that the specification does not enable claim 1 because it teaches only a limited range of  $L$  (15-25 nm), but claim 1 covers GNRFETs with *any*  $L$ . I agree with ConsumerCam's recitation of the facts; however, I do not agree with its ultimate conclusion that these facts render claim 1 non-enabled. Although the claim does not recite any limits on  $L$ , a person of skill in the art would have recognized certain inherent limits. For example, Figure 2 of the patent shows that if  $5 < W < 15$  nm,  $L$  must be  $22 \pm 1$  nm to achieve switching speeds of 1-1.2 T Hz. Thus, for a portion of the claimed range of  $W$  (5-15 nm), a person of skill in the art would have recognized inherent limits on  $L$  (21-23 nm). As for  $15 < W < 35$  nm, a person of skill in the art would have been able to find the operative range of  $L$  through routine experimentation.

16. For the foregoing reasons, it is my professional opinion that the '314 patent teaches a person of skill in the art how to make and use the GNRFET recited in claim 1.

**B. Claim 2**

17. Claim 2 depends from claim 1 and further requires that  $W$  is less than 15 nm. Thus, claim 2 recites a GNR-FET having  $W$  between 5 nm and 15 nm that is “configured for ballistic conduction of charge carriers at switching speeds between 1 T Hz and 1.2 T Hz.”

18. The specification clearly enables this claim. In particular, Figure 2 shows that when  $5 < W < 15$  nm, switching speeds of 1-1.2 T Hz can be achieved with  $L = 22 \pm 1$  nm. That claim 2 does not recite any limits for  $L$  does not change the calculus because a person of skill in the art would have understood from Figure 2 that  $L$  must be  $22 \pm 1$  nm. Therefore, it is my professional opinion that the '314 patent teaches a person of skill in the art how to make and use the GNR-FET recited in claim 2.

**C. Claim 3**

19. Claim 3 depends from claim 1 and further requires that  $L$  is approximately 22 nm. Thus, claim 3 recites a GNR-FET that is “configured for ballistic conduction of charge carriers at switching speeds between 1 T Hz and 1.2 T Hz” wherein  $W$  is 5-35 nm and  $L$  is approximately 22 nm.

20. The specification clearly enables this claim. In particular, Figure 2 shows that switching speeds of 1-1.2 T Hz can be achieved when  $W$  is 5-15 nm and  $L$  is  $22 \pm 1$  nm. And when  $W$  is 15-35 nm, a person of skill in the art would have recognized that switching speeds of 1-1.2 T Hz could be achieved simply by slightly decreasing  $L$  (recall from ¶ 14 that switching speed increases as  $L$  is decreased).

**V. Reservation of Rights**

21. The opinions I express above are based on the information currently available to me. Should I subsequently receive additional information in the future, I reserve my rights to re-evaluate my opinions accordingly.

I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct to the best of my knowledge. Executed on September 14, 2017.

/s/ Robert Hendricks

Robert Hendricks