UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION

AKOUSTIS TECHNOLOGIES, INC. AND AKOUSTIS, INC., Plaintiff, v. QORVO, INC., Defendant.	Civil Action No. 2:23-cv-180 **JURY TRIAL DEMANDED**

DEFENDANT QORVO, INC.'S INVALIDITY CONTENTIONS AND DOCUMENT PRODUCTION

Pursuant to the Court's Local Patent Rules and First Amended Docket Control Order (Dkt. No. 46), Defendant Qorvo, Inc. ("Qorvo" or "Defendant") hereby provides its *Invalidity Contentions* under P.R. 3-3 and related document production under P.R. 3-4 with respect to the claims that Plaintiffs Akoustis Technologies, Inc. and Akoustis, Inc. ("Akoustis" or "Plaintiffs") identified in their *Disclosure of Asserted Claims and Infringement Contentions* under P.R. 3-1 ("*Infringement Contentions*") dated July 6, 2023, as set forth in the table below:

Asserted Patent Number	Asserted Claims
U.S. Patent No. 7,250,360 ("the '360 Patent")	1-4, 6, 7, 9-14

In these *Invalidity Contentions*, pursuant to P.R. 3-3 (a)-(d) and with respect to the patent identified above (the "Patent-in-Suit" or "Asserted Patent") and the asserted claims identified by Akoustis from the Patent-in-Suit (the "Asserted Claims"), Defendant: (i) identifies each currently known item of prior art that anticipates, renders obvious or otherwise invalidates each Asserted Claim under pre-AIA 35 U.S.C. § 102 and/or § 103; (ii) specifies whether each such item of prior art anticipates and/or renders obvious the applicable Asserted Claim; (iii) submits charts for

illustrative prior art references identifying where each limitation of each Asserted Claim is disclosed or rendered obvious by the prior art; (iv) identifies combinations and illustrative reasons to combine prior art references where a combination of prior art references makes an Asserted Claim obvious, and (v) identifies grounds for invalidating Asserted Claims based on indefiniteness, enablement, and/or written description under pre-AIA 35 U.S.C. § 112.

I. RESERVATION OF RIGHTS

Defendant reserves its right to amend, modify, and/or supplement these *Invalidity Contentions*, including the charts attached hereto, pursuant to P.R. 3-6 or any other applicable mechanism.

Defendant also reserves the right to amend these *Invalidity Contentions* given the deficient and ambiguous nature of the *Infringement Contentions* that Akoustis has served in this case. As a result of the deficiencies in the *Infringement Contentions*, it is impossible for Qorvo to understand Akoustis's assertions as to the scope of the Asserted Claims and perform a complete prior art search to prepare these *Invalidity Contentions*. In particular, the *Infringement Contentions* fail to provide adequate notice of Akoustis's allegations of infringement at least because they: (i) do not identify the manufacturing process(es) alleged to infringe the asserted claims; (ii) fail to provide any contentions as to how the elements of the asserted claims are practiced with respect to 1,014 of the Accused Instrumentalities; (iii) fail to identify what Akoustis alleges to qualify as an "elevated growth temperature." Defendant specifically reserves the right to amend these *Invalidity Contentions* to the extent Akoustis's theories of infringement are subsequently disclosed in this case and the Court permits Akoustis to pursue such theories despite the deficiencies in Akoustis's *Infringement Contentions*. For example, to the extent Akoustis later asserts any manufacturing process infringes the Asserted Claims, Qorvo reserves the right to supplement these *Invalidity Contentions* to include prior art related to any such allegation. Further, to the extent Akoustis later

discloses how the elements of the asserted claims are practiced in connection with the 1,014 Accused Instrumentalities improperly failed to chart as part of its *Infringement Contentions*, Qorvo reserves the right to supplement these *Invalidity Contentions* to identify prior art in view of such disclosure. Further, to the extent Akoustis later identifies what it contends qualifies as an "elevated growth temperature," Qorvo reserves the right to supplement these *Invalidity Contentions* to identify prior art related to any such alleged "elevated growth temperature."

Additionally, these *Invalidity Contentions* are based on information obtained by Defendant to date. Discovery in this case is on-going. In particular, fact discovery is not complete, the Asserted Claims have not been construed, and expert discovery has not begun. Defendant intends to seek discovery from Akoustis and third parties regarding public use and/or the on-sale bar under pre-AIA 35 U.S.C. § 102, additional prior art under pre-AIA 35 U.S.C. §§ 102 and 103, applicant's failure to comply with pre-AIA 35 U.S.C. § 112, and/or other grounds of invalidity and/or unenforceability. Based on discovery, Defendant may identify additional prior art and invalidity arguments that may require that Defendant supplement or amend these *Invalidity Contentions*. Accordingly, Defendant reserves the right to revise and/or supplement these Contentions as this case proceeds. Moreover, Defendant reserves the right to supplement and/or amend these Contentions based on any findings as to the priority date of the Asserted Claims, and/or positions that Akoustis or its expert witnesses may take concerning claim interpretation, infringement, and/or invalidity issues. In addition, nothing in these *Invalidity Contentions* constitutes an admission concerning the proper construction of the claims.

Prior art not included in this disclosure, whether known or unknown to Defendant, may become relevant. For example, Defendant is currently unaware of the extent, if any, to which Akoustis will contend that any of the identified references do not qualify as prior art under pre-

AIA 35 U.S.C. § 102. The identification of any patents and/or patent publications as prior art herein shall be deemed to refer to the application that was submitted for the same and to include identification of any foreign counterpart patents and applications as well as international applications. Defendant reserves the right to substitute any of these related references for those cited herein. As another example, Defendant is currently unaware of the extent, if any, to which Akoustis will contend that limitations of the Asserted Claims are not disclosed in the prior art that Defendant identifies. While Defendant's claim charts submitted as part of these *Invalidity Contentions* cite to particular teachings and disclosures of the prior art as applied to features of the Asserted Claims, persons having ordinary skill in the art, however, are understood to view an item of prior art generally in the context of other publications, literature, products, and understanding. Accordingly, the cited portions are only examples, and Defendant reserves the right to rely on uncited portions of the prior art references and on other publications and expert testimony as aids in understanding and interpreting the cited portions, as providing context thereto, and as additional evidence that a claim limitation is known or disclosed. Defendant's further reservations with respect to the claim charts attached hereto and the exemplary motivations to combine the identified references discussed below are included in the appropriate sections below.

Lastly, nothing stated herein shall be treated as an admission or suggestion that Defendant's Accused Instrumentalities meet any limitation of any Asserted Claim. Defendant denies that any Accused Instrumentality infringes any claim of the Patent-in-Suit.

II. IDENTIFICATION OF PRIOR ART

Subject to Defendant's reservations of rights set out above, Defendant identifies the following references on which it may rely as invalidating one or more of the Asserted Claims of the Patent-in-Suit. Defendant further incorporates by reference the prior art cited on the face of the Patent-in-Suit, any admitted prior art in the specification of the Patent-in-Suit, the prior art

referenced during prosecution of the Patent-in-Suit, and any other prior art identified during discovery in this matter, including without limitation all prior art produced by or otherwise known to Plaintiff and all prior art known to the named inventors, any past or current owner, or any individual substantively involved in the prosecution of the Patent-in-Suit.

The prior art references, systems, and/or products listed below (along with those incorporated by reference above) disclose the elements of the Asserted Claims either explicitly or inherently, or otherwise teach or suggest the elements alone or via an obvious combination, and may also be relied upon to show the state of the art in the relevant timeframes.

The Asserted Claims are method claims. Defendant contends that at least some of the methods disclosed in one or more of the prior art references identified here or in the attached exhibits anticipate or render obvious the Asserted Claims under pre-AIA 35 U.S.C. §§ 102 and/or 103. Defendant's reference to any particular process, method, step, operation, component, device, machine, or other product in these *Invalidity Contentions* (including the attached charts) should also be interpreted as a reference to the method itself and any corresponding patents, publications, or product literature cited here or in the attached exhibits that relate to the cited process, method, step, operation, component, device, machine, or other product.

It is understood that a person of ordinary skill in the art reads a prior art reference as a whole and in the context of other publications, literature, and general knowledge in the field. To understand and interpret any specific statement or disclosure in a prior art reference, a person of ordinary skill in the art also relies upon other information including other publications and general scientific, engineering or other relevant knowledge. Defendant reserves the right to rely upon the general scientific, engineering or other relevant knowledge in the field in interpreting the disclosure of the prior art references. In addition, Defendant reserves the right to rely upon other

publications and on expert testimony to provide context and to aid in the understanding of the prior art references. For example, Defendant reserves the right to rely on well-known prior art publications to demonstrate the state of the art at the relevant time period. Defendant also reserves the right to rely upon other portions of the prior art references, other publications, and the testimony of experts to establish that the alleged invention would have been obvious to a person of ordinary skill in the art, including the basis for modifying or combining the prior art references. Furthermore, Defendant reserves the right to rely upon any admissions relating to prior art found in the intrinsic evidence for the Patent-in-Suit.

A. Prior Art Concerning Manufacturing of Semiconductor Devices Generally

As noted in the Reservation of Rights, above, it is impossible to decipher from Akoustis's *Infringement Contentions* just what process(es) Akoustis accuses of infringing the method steps recited in the Asserted Claims. Akoustis has made a number of statements on the record suggesting sweeping theories of infringement that would encompass every manufacturing process for (i) any gallium nitride ("GaN") semiconductor devices; (ii) any bulk acoustic wave ("BAW") filter; and (iii) any surface acoustic wave ("SAW") filter. For example, Akoustis has asserted in multiple pleadings that it accuses Qorvo of infringing the Asserted Patent because Qorvo has a facility for manufacturing GaN semiconductors and BAW filters. *See* Dkt. No. 28 at 12 (asserting that Qorvo infringes because "Qorvo manufactures accused GaN products and has a GaN manufacturing facility in Richardson"); Dkt. No. 53 at 6 ("Qorvo itself advertises that 'Qorvo has a 'Design, Sales, Support & GaAs / GaN / BAW Manufacturing facility in Richardson, Texas."); *id*. at 9-10 (arguing that infringement allegations are sufficient because "Qorvo publicly states that it performs GaN manufacturing"). Akoustis has also alleged that GaN, BAW, and SAW devices infringe. *See, e.g.*, Dkt. No. 53 at 3 ("In total, GaN, BAW, and SAW products account for more than 900 of the

Accused Instrumentalities."). Akoustis has even suggested that any devices that "have epitaxial layers" were made in an infringing manner. *See* Dkt. No. 53 at 10.

The Asserted Patent did not invent GaN semiconductor devices, BAW filters, or SAW filters. These processes were well known long before the Asserted Patent. To the extent Akoustis is alleging (or alleges in the future) that Qorvo infringes the Asserted Claims merely by manufacturing GaN semiconductor devices, BAW filters, or SAW filters, the Asserted Claims would be invalid based on a large volume of prior art concerning methods of manufacturing such devices, including various patent documents and publications produced with these *Invalidity Contentions* and/or other prior art referred to therein. Similarly, to the extent Akoustis is alleging (or alleges in the future) that Qorvo infringes the Asserted Claims merely by using processes for growing an epitaxial layer for a semiconductor device, the Asserted Claims would be invalid based on a large volume of prior art concerning such processes, including various patent documents and publications produced with these *Invalidity Contentions* and/or other prior art referred to therein. Qorvo reserves the right to provide claim charts for such prior art to the extent Akoustis seeks to move forward on the sweeping theories of infringement suggested in statements made on the record in this matter.

B. Patent References

Defendant contends that the following patent references anticipate and/or render obvious, alone or in combination, one or more of the Asserted Claims. Furthermore, Defendant reserves the right to rely on any of the following references to show the state of the art and the knowledge of one of ordinary skill in the art at the time of the alleged invention of the Asserted Claims. The following references are identified by patent/publication number, country of origin and issue date. Each reference became prior art at least as early as the dates provided on the face of the document.

Defendant reserves the right to rely upon earlier prior art dates for the identified references (or related documents or information) to the extent such information is uncovered during discovery.

No.	Number and Name	Country of Origin	Filing/Priority Date	Issue Date/Date of Publication
01	6,630,692 to Goetzet al.	US	May 29, 2001	October 7, 2003
02	7,115,896 to Guo et al.	US	November 25, 2003	October 3, 2006
03	7,161,227 to Lempkowski et al.	US	August 14, 2001	January 9, 2007
04	2004/0232430 to Lempkowski et al.	US	August 14, 2001	November 25, 2004
05	2004/0119063 to Guo et al. ("*Guo*")	US	November 25, 2003	June 24, 2004
06	1508284 to Tong et al.	CN	December 20, 2002	June 30, 2004
07	1178278 to Qi et al.	CN	June 28, 2002	December 1, 2004
08	03/073514 to Yoshida ("*Yoshida*")	WO	February 21, 2003	September 4, 2003
09	6,852,161 to Urashima et al.	US	August 17, 2001	February 8, 2005
10	H02-221196 to Mori	JP	February 21, 1989	September 4, 1990
11	H07-283436 to Iechika et al.	JP	April 8, 1994	October 27, 1995
12	2002/0158258 to Chyi	US	January 4, 2002	October 31, 2002
13	2002/0155712 to Urashima et al. ("*Urashima*")	US	August 17, 2001	October 24, 2002
14	2004/0200406 to Peczalski et al. ("*Peczalski*")	US	April 10, 2003	October 14, 2004
15	H05-63305 to Nagata et al.	JP	March 26, 1991	March 12, 1993

No.	Number and Name	Country of Origin	Filing/Priority Date	Issue Date/Date of Publication
16	6,064,078 to Northrup et al.	US	May 22, 1998	May 16, 2000
17	2002/0090816 to Ashby et al.	US	January 3, 2001	July 11, 2002

C. Prior Art Publications

Defendant contends that the following publication references anticipate and/or render obvious, alone or in combination, one or more of the Asserted Claims. Furthermore, Defendant reserves the right to rely on any of the following references to show the state of the art and the knowledge of one of ordinary skill in the art at the time of the alleged invention of the Asserted Claims. The following references are identified by title, publication date, author, and publisher. Each reference became prior art at least as early as the identified publication date. Defendant reserves the right to rely upon earlier prior art dates for the identified references (or related documents or information) to the extent such information is uncovered during discovery.

No.	Title	Date of Publication	Author	Publisher
18	Initial growth effects on the properties of GaN buffer layer and subsequent GaN overlayer by MOCVD	July 2000	Wuu et al.	Proceedings of SPIE - The International Society for Optical Engineering
19	Epitaxial Growth and Processing of Compound Semiconductors	1996	Kolodziejski et al.	
20	Characteristics of InGaN/AlGaN light-emitting diodes on sapphire substrates	December 1, 1997	Egawa et al.	Journal Of Applied Physics

No.	Title	Date of Publication	Author	Publisher
21	III-V Nitride Semiconductors for High-Performance Blue and Green Light-Emitting Devices	1997	Steigerwald et al.	The Journal of The Minerals, Metals & Materials Society (TMS)
22	Light Emitting Diodes (LEDs) for General Illumination	November 2002	Tsao et al.	Optoelectronics Industry Development Association
23	Structural analysis of metalorganic chemical vapor deposited AlN nucleation layers on Si (111)	August 2004	Zang et al.	Journal of Crystal Growth
24	High quality GaN grown on Si(111) by gas source molecular beam epitaxy with ammonia ("*Nikishin 1999*")	October 4, 1999	Nikishin et al.	Applied Physics Letters
25	Growth of AlGaN on Si(111) by gas source molecular beam epitaxy ("*Nikishin 2000*")	May 22, 2000	Nikishin et al.	Applied Physics Letters
26	Growth of high quality GaN layers with AlN buffer on Si(111) substrate ("Chen")	May 2001	Chen et al.	Journal of Crystal Growth
27	Metalorganic chemical vapor deposition of GaN on Si(111): Stress control and application to field-effect transistors	June 15, 2001	Marchand et al.	Journal Of Applied Physics

D. Prior Art Manufacturing Processes

Akoustis has identified 1,015 products that it contends to have been made (in some undisclosed way) according to the method recited in the Asserted Claims. As noted above in the Reservation of Rights, it is impossible to decipher from Akoustis's *Infringement Contentions* just what process(es) Akoustis accuses of infringing the Asserted Claims, and Akoustis has charted

only a single product to allegedly support its accusations. In any event, however, many of the instrumentalities accused of infringement by Akoustis were manufactured prior to the March 2, 2005 filing date of the Asserted Patent, including at least the instrumentalities identified in the list following this paragraph (hereinafter "prior art accused instrumentalities"). In its *Infringement Contentions*, Akoustis has asserted that the processes used to make the prior art accused instrumentalities practiced the limitations of the asserted claims. To the extent Akoustis's contentions about these products advanced in Exhibit B of its *Infringement Contentions* are correct, the processes used to manufacture the prior art accused instrumentalities must also invalidate each of the Asserted Claims under 35 U.S.C. §§ 102 and/or 103 for the same reasons. Thus, Defendant incorporates Exhibit B of Akoustis's *Infringement Contentions* by reference as an additional Invalidity Chart.

<u>List of Prior Art Accused Instrumentalities</u>

- 854651
- 854652
- 854653
- 854654
- 854655
- 854656
- 854657
- 854658
- 854659
- 854660
- 854661

- 854662
- 854663
- 854664
- 854665
- 854666
- 854667
- 854668
- 854669
- 854670
- 854671
- 854672
- 854673
- 854674
- 854675
- 854678
- 854680
- 854823
- 854909
- 854913
- 854916
- 854917
- 854919
- 854920

- 854923
- 854927
- 855049
- 855068
- 855104
- 855107
- 855131
- 855271
- 855377
- 855394
- 855395
- 855399
- 855444
- 855500
- 855529
- 855530
- 855559
- 855561
- 855590
- 855625
- 855653
- 855659
- 855677

- 855678
- 855679
- 855713
- 855728
- 855729
- 855730
- 855731
- 855735
- 855736
- 855737
- 855738
- 855739
- 855740
- 855741
- 855742
- 855743
- 855744
- 855745
- 855748
- 855753
- 855770
- 855780
- 855782

- 855817
- 855821
- 855832
- 855849
- 855869
- 855884
- 855885
- 855896
- 855898
- 855912
- 855914
- 855915
- 855916
- 855954
- 855958
- 855969
- 855975
- 855991
- 855992
- 856019
- 856020
- 856048
- 856059

- 856062
- 856063
- 856064
- 856065
- 856066
- 856067
- 856068
- 856069
- 856070
- 856071
- 856072
- 856073
- 856074
- 856096
- 856111
- 856129
- 856151
- 856187
- 856256
- 856278
- 856288
- 856298
- 856314

- 856327
- 854550-1
- 854733-1
- 854747-1
- 854833-1
- AG201-63G
- AG201-86G
- AG203-63G
- AG203-86G
- AG302-63G
- AG302-86G
- AG303-63G
- AG402-86G
- AG402-89G
- AG403-86G
- AG403-89G
- AG503-86G
- AG602-89G
- AG603-89G
- AG604-86G
- AG604-89G
- AH114-89G
- AH118-89G

- AH215-S8G
- AH312-S8G
- CV110-3AF
- CV111-3AF
- EC1019B-G
- ECG001B-G
- ECG001F-G
- ECG002B-G
- ECG002F-G
- ECG003B-G
- ECG004B-G
- ECG005B-G
- ECG008B-G
- ECG040B-G
- ECG055B-G
- ECG055C-G

E. Other Prior Art

Discovery into the existence of prior art sales, public disclosures, and prior art products or systems is ongoing. Defendant reserves the right to identify and rely upon as prior art any relevant sale, disclosure, system, product, public knowledge or public use identified during discovery.

F. Invalidity Charts

Each Asserted Claim is anticipated and/or rendered obvious by one or more of the prior art references identified herein. Defendant has attached to these *Invalidity Contentions* the accompanying exemplary charts for the Asserted Claims listed in the table below showing specifically where in each item of prior art each element of each Asserted Claim is found, including for each element governed by pre-AIA 35 U.S.C. § 112, sixth paragraph, the identity of the structure(s), act(s), or material(s) in each item of prior art that performs the claimed function.[1] "Prior Art No." corresponds to the number of the prior art reference identified in the tables above. "A" indicates that the chart shows how one or more of the Asserted Claims are anticipated. "O" indicates that the chart shows how one or more of the Asserted Claims are obvious, and "A/O" indicates that the chart shows both. "Chart" refers to the identification number of the attached chart.

In the charts, where Defendant cites to a particular figure in a prior art reference, the citation should be understood to encompass the caption and description of the figure and any text in the reference relating to the figure. Similarly, where Defendant cites to particular text referring to a figure, the citation should be understood to include the figure and caption as well. Further, where Defendant cites to portions of a reference with respect to an element of a dependent claim, these citations should be understood to include the relevant citations provided in the claim(s) from which that dependent claim depends, and vice versa.

Prior Art No.	Prior Art Reference	Anticipation/ Obviousness	Chart
14	US 2004/0200406 to Peczalski et al. ("*Peczalski*")	A/O	01
05	US 2004/0119063 to Guo et al. ("*Guo*")	A/O	02

[1] Defendant also incorporates by reference Exhibit B of Akoustis's *Infringement Contentions* as an additional chart in the manner discussed above.

Prior Art No.	Prior Art Reference	Anticipation/ Obviousness	Chart
08	WO 03/073514 to Yoshida ("*Yoshida*")	A/O	03
13	US 2002/0155712 to Urashima et al. ("*Urashima*")	A/O	04
24	Nikishin et al., "High quality GaN grown on Si(111) by gas source molecular beam epitaxy with ammonia," APL 1999 ("*Nikishin 1999*")	A/O	05
25	Nikishin et al., " Growth of AlGaN on Si(111) by gas source molecular beam epitaxy," APL 2000 ("*Nikishin 2000*")	A/O	06
26	Chen et al. " Growth of high quality GaN layers with AlN buffer on Si(111) substrate," JCG 2001 ("*Chen*")	A/O	07

Each individual claim chart provides example citations of where each element of each Asserted Claim can be found in the charted prior art. To the extent that any example is provided to show anticipation but does not explicitly describe a particular element, Defendant contends that the element is inherently found in the prior art and/or that the element would have been obvious in view of the prior art alone or in combination with the other prior art charted or otherwise identified herein.

By mapping the elements of the Asserted Claims to the prior art, Defendant does not imply or admit that the claim language satisfies pre-AIA 35 U.S.C. § 112 or that it meets all other standards and requirements for patentability. Nor is the mapping a ratification or acceptance of the manner in which Akoustis applies particular claim elements to the features and functions of the Accused Instrumentalities (and, as discussed above, Akoustis's chart is clearly deficient). The mapping is instead intended to demonstrate that, if certain claim elements are applied against the prior art in the same manner as Akoustis applies them in its *Infringement Contentions* (to the extent Akoustis's chart can be understood) then the charted prior art discloses (and/or teaches or suggests) those claim elements to the same extent. The prior art may also disclose (and/or teach or suggest)

these same claim elements if the claim elements are applied differently than in the *Infringement Contentions*. Nothing in these *Invalidity Contentions* is in any way an admission that the *Infringement Contentions* have construed or applied the Asserted Claims correctly.

For all of the reasons stated herein, Defendant reserves the right to supplement the charts, and the above tables. Additionally, Defendant reserves the right to substitute one reference for a similar reference based on the results of discovery.

G. Obviousness

To the extent Plaintiff argues that any limitation of any Asserted Claim is not explicitly shown in one of the attached Charts 01-07, any purported differences are such that the claimed subject matter as a whole would have been obvious to one skilled in the art at the time of the alleged invention in view of the state of the art and knowledge of those skilled in the art. The item of prior art would, therefore, render the relevant claims invalid as obvious under Pre-AIA 35 U.S.C. § 103.

Furthermore, it would have been obvious to combine any of the teachings of *Peczalski*, *Guo*, *Yoshida*, *Urashima*, *Nikishin 1999*, *Nikishin 2000*, and *Chen* identified in Charts 01-07 with each other because each reference relates to similar methods of processing epitaxial layers on lattice mismatched substrates and teaches similarly applicable processing parameters, materials, steps, and methodologies that a person of ordinary skill in the art would have found to have been obvious to utilize with the methods of processing epitaxial layers taught by the remaining references. A person of skill would have made such combinations (including each of the combinations discussed below) with knowledge of the charted references, the other references cited herein, and the further technical background described in the following section.

To the extent that any of *Peczalski*, *Guo*, *Yoshida*, *Urashima*, *Nikishin 1999*, *Nikishin 2000*, and *Chen* are determined not to disclose "providing a substrate" (element [1.a] in the charts) or

that the "substrate is selected from the group consisting of silicon, sapphire and SiC." (element [2.a]), it would have been obvious to modify the teachings of any of these references to utilize the substrate teachings of any of the remaining references. A person of ordinary skill in the art reviewing any of these references (and in view of the technical background knowledge described below) would have understood that providing a substrate was the first step in growing epitaxial layers thereon and would have considered it obvious to reference and utilize the substrate structure and composition teachings of any of the remaining references in combination to provide an improved or alternative process. Thus, a person of skill would have been motivated to modify any of the charted references with each other to arrive at the claim elements above.

To the extent that any of *Peczalski*, *Guo*, *Yoshida*, *Urashima*, *Nikishin 1999*, *Nikishin 2000*, and *Chen* are determined not to disclose "pre-treating a surface of the substrate with at least one group III reactant or at least one group II reactant at an elevated growth temperature prior to introducing a group V reactant or a group VI reactant" (element [1.b]), that the "group III reactant is selected from the group consisting of a gallium reactant, an aluminum reactant, a boron reactant, and an indium reactant" (element [3.a]), that the "group III reactant is selected from the group consisting of triethyl gallium, trimethyl gallium, triethylaluminum, trimethyl aluminum, triethylboron, trimethylboron, triethylindium and trimethylindium" (element [4.a]), that the "step of pre-treating includes pre-treating the surface of the substrate with an aluminum reactant and a gallium reactant" (element [6.a]), "preheating said substrate in hydrogen prior to pre-treating the surface of the substrate with at least one group III reactant or at least one group II reactant" (element [10.a], or that the "elevated growth temperature is 900 to 1100° C" (element [11.a]), it would have been obvious to modify the teachings of any of these references to utilize the pre-treating teachings of any of the remaining references. A person of ordinary skill in the art reviewing

any of these references (and in view of the technical background knowledge described below) would have understood that pre-treating a substrate was a common processing step utilized in growing epitaxial layers thereon and would have considered it obvious to reference and utilize the pre-treatment teachings, including teachings as to pre-treatment reactants and applicable parameters such as temperature and/or preheating, of any of the remaining references in combination to provide an improved or alternative process. Thus, a person of skill would have been motivated to modify any of the charted references with each other to arrive at the claim elements above.

To the extent that any of *Peczalski*, *Guo*, *Yoshida*, *Urashima*, *Nikishin 1999*, *Nikishin 2000*, and *Chen* are determined not to disclose "introducing a group V reactant or a group VI reactant to grow a nucleation layer on the surface of the substrate" (element [1.c]), that the "nucleation layer is AlN or AlGaN" (element [7.a]), that "the step of introducing a group V reactant or a group VI reactant includes growing a nucleation layer at a growth temperature of 900 to 1100° C and the step of growing a buffer layer includes growing a buffer layer at a growth temperature of 900 to 1100° C" (element 12.a]), that the "group V reactant is a group V hydride" (element [13.a]), or that the "group V hydride is selected from the group consisting of ammonia, arsine, and phosphine" (element [14.a]), it would have been obvious to modify the teachings of any of these references to utilize the nucleation layer growth teachings of any of the remaining references. A person of ordinary skill in the art reviewing any of these references (and in view of the technical background knowledge described below) would have understood that growing a nucleation layer was a common processing step utilized in growing epitaxial layers on substrates and would have considered it obvious to reference and utilize the nucleation layer growth teachings, including teachings as to particular reactants used during this process and applicable parameters such as

temperature, of any of the remaining references in combination to provide an improved or alternative process. Thus, a person of skill would have been motivated to modify any of the charted references with each other to arrive at the claim elements above.

To the extent that any of *Peczalski*, *Guo*, *Yoshida*, *Urashima*, *Nikishin 1999*, *Nikishin 2000*, and *Chen* are determined not to disclose "growing a buffer layer on said nucleation layer, said buffer layer providing a surface upon which said epitaxial layer is grown" (element [1.d]) or that the "epitaxial layer includes a compound selected from the group comprising AlN, GaN, AlGaN, BGaN, BInN, BAlN, CdTe, and ZnS (element [9.a]), it would have been obvious to modify the teachings of any of these references to utilize the buffer and epitaxial layer growth teachings of any of the remaining references. A person of ordinary skill in the art reviewing any of these references (and in view of the technical background knowledge described below) would have understood that growing a buffer layer was a common processing step utilized in growing epitaxial layers on substrates that various epitaxial layer compositions could be grown, and would have considered it obvious to reference and utilize the buffer and epitaxial layer growth teachings, including teachings as to parameters used to grow these layers and their ultimate composition, of any of the remaining references in combination to provide an improved or alternative process. Thus, a person of skill would have been motivated to modify any of the charted references with each other to arrive at the claim elements above.

In addition to the specific rationale above, motivation to combine the teachings of the prior art references disclosed herein is also found in the references themselves and in: (1) the nature of the problem being solved; (2) the express, implied and inherent teachings of the prior art; (3) the knowledge of persons having ordinary skill in the art; (4) the predictable results obtained in combining the different elements of the prior art; (5) the predictable results obtained in simple

substitution of one known element for another; (6) the use of a known technique to improve similar devices, methods, or products in the same way; (7) the predictable results obtained in applying a known technique to a known device, method, or product ready for improvement; (8) the finite number of identified predictable solutions that had a reasonable expectation of success; and (9) known work in various technological fields that could be applied to the same or different technological fields based on design incentives or other market forces. *KSR International Co. v. Telefax Inc.*, 550 U.S, 398, 415-21 (2007). *See also Q.I. Press Controls*, 732 F.3d at 1379; *Randall Mfg. v. Rea*, 733 F.3d 1355, 1363 (Fed. Cir. 2013); *Sanofi-Aventis Deutschland GmbH v. Glenmark Pharms. Inc., USA*, 748 F.3d 1354, 1360 (Fed. Cir. 2014); *Comaper Corp. v. Antec, Inc.*, 596 F.3d 1343, 1352 (Fed. Cir. 2010); *In re Kubin*, 561 F.3d 1351, 1359 (Fed. Cir. 2009); and *InTouch Techs., Inc. v. VGO Comms., Inc.*, 751 F.3d 1327, 1347 (Fed. Cir. 2014). *See also KSR* at 420-421 (a person of ordinary skill is "a person of creativity, not an automaton" and "in many cases a person of ordinary skill will be able to fit the teachings of multiple patents together like pieces of a puzzle").

With regard to the above combinations, all of the prior art identified above are directed to the same technical field of epitaxially growing semiconductor layers on substrates, and thus are analogous art to each other and the Asserted Patent.

Accordingly, the teachings of the individual prior art references disclosed in these *Invalidity Contentions*, combined with the industry knowledge of a person of ordinary skill in the art at the time of the alleged invention of the Asserted Patent, would render obvious the Asserted Claims.

H. Further Technical Background Knowledge

The Asserted Claims relate to a process/method for growing an epitaxial layer on a lattice mismatched substrate. *See* the Asserted Patent at col. 1, ll. 21-24 ("Heteroepitaxial growth of GaN

and related alloys on severely mismatched substrates such as sapphire, SiC and silicon requires thin nucleation layers to provide nucleation sites to initiate crystal growth."). To grow an epitaxial layer on a lattice mismatched substrate, it was well known long before the Asserted Patent that a buffer layer should be grown between the substrate and the epitaxial layer to reduce defects and thermal expansion stress in the epitaxial layer because defects and stress would lead to poor device performance. A person of ordinary skill in the art long before the filing date of the Asserted Patent would have possessed at least the following technical background knowledge as to such processes.

By the early 1990s, researchers had discovered that GaN is a good material for many products, such as blue light LEDs. *See, e.g.*, Egawa et al., "Characteristics of InGaN/AlGaN light-emitting diodes on sapphire substrates," J. Appl. Phys. 82(11), 1 December 1997. Thus, researchers began focusing on methods to epitaxially grow GaN. But they encountered problems due to a lack of suitable substrates that matched the GaN lattice constant and thermal expansion coefficient. While it would be ideal to grow GaN layers on a GaN substrate to resolve these issues, GaN substrates are expensive and difficult to grow compared to other substrates, such as Si, GaAs, SiC, sapphire, etc. For this reason, researchers long prior to filing date of the '360 patent addressed ways to grow epitaxial GaN layers with a low defect density on lattice mismatched substrates. Their methods were to employ one or more buffer layers between the substrate and the GaN growth layer.

Ordinary artisans commonly used GaN, AlN, AlGaN, and AlGaInN as the buffer layer between the substrate and the GaN growth layer. By the late 1990s, ordinary artisans also commonly passivated the substrate with group III materials, such as Al, Ga, and/or In, before introducing a nitrogen source to grow the GaN, AlN, AlGaN, and AlGaInN buffer layers directly on the substrate. This process was well-known to suppress the formation of SiN_x on the Si substrate

that was found to disrupt crystal growth of the buffer layer. Ordinary artisans understood that cracking of GaN growth layer can be completely eliminated by suppressing the formation of SiNx islands and assuring uniform nucleation of AlN at the Si–AlN interface. *See* above Prior Art Nos. 24, 25; Charts 05, 06.

Another well-understood advantage for pre-treating the surface of the substrate with a group III material before introducing nitrogen source to grow the GaN, AlN, AlGaN, and AlGaInN buffer layer is that the group III material has good affinity with the group-III nitride semiconductor that is formed next. *See* above Prior Art No. 13; Chart 04.

Before pre-treating the surface of the substrate with a group III material, it was also well known that the surface of the substrate should be thoroughly cleaned to promote good growth of the buffer layer on the substrate with low detect density and low impurities. *See* above Prior Art Nos. 13, 14, 24-26; Charts 01, 04-07. The well-known cleaning methods commonly included chemical cleaning, thermo-vacuum cleaning, and/or plasma cleaning. For example, when the epitaxial growth was conducted in a gas source molecular beam epitaxy (GSMBE), the wafer/substrate can be chemical etched to form a hydrogen-terminate surface before being loaded into the growth chamber of the GSMBE equipment. The substrate is further cleaning by being heated to a high temperature (e.g., 1100 K) in high vacuum to evaporate the impurities attached to the surface of the substrate. *See* above Prior Art Nos. 24, 25; Charts 05, 06.

Finally, prior to the application for the Asserted Patent, scientists commonly used metallo-organic chemical vapor deposition (MOCVD) to grow buffer layers and GaN growth layers. It was quite common to clean the substrate by heating the substrate to a temperature up to 1100° C (or more) in a hydrogen ambient to clean the surface of the substrate for growing buffer layers and GaN growth layers on the substrate. *See* above Prior Art Nos. 13, 14, 26; Charts 01, 04, 07.

I. Secondary Considerations of Obviousness

Plaintiff has not identified any secondary consideration or other objective evidence of non-obviousness. Defendant reserves its right to submit contentions and evidence to rebut any secondary consideration or other objective or purportedly objective evidence that Plaintiff may later identify.

III. Invalidity Contentions Based on Pre-AIA 35 U.S.C. § 112

Defendant provides below an identification of asserted claims that are—at least as apparently construed by Akoustis in its *Infringement Contentions*—invalid pursuant to pre AIA 35 U.S.C. § 112 as indefinite, not enabled, and/or lacking a sufficient written description. A more detailed basis for Defendant's indefiniteness and lack of enablement and/or written description defenses will be set forth in its expert report(s) on invalidity, to be served in accordance with the Court's Scheduling Order. Defendant has not yet taken any depositions related to these issues. Defendant reserves the right to amend and/or supplement these contentions based on further discovery, in view of the Court's claim construction, and based on any theories of infringement that Akoustis ultimately discloses in this case. No invalidity basis under 35 U.S.C. § 112 identified below is meant to suggest that a particular claim term cannot be at least partially understood for the purpose of determining invalidity in view of prior art as set forth elsewhere herein or to the extent advanced in any review proceeding before the USPTO, such as in an *inter partes* review.

A. "providing a substrate" (claim 1)

Asserted Claim 1 (and any claims dependent therefrom) are invalid under 35 U.S.C. § 112, 2nd ¶ because the claim language, when read in light of the intrinsic record, fails to inform a person of ordinary skill in the art the scope of "providing a substrate." For example, one of ordinary skill in the art cannot know with reasonable certainty the outer metes and bounds of a "substrate." It is unclear whether a substrate means a homogeneous substrate or a substrate having one or more

growth layers grown on a homogeneous substrate, and how or whether "substrate" relates to "lattice mismatched substrate" in the preamble of claim 1. Additionally, the claims are invalid under 35 U.S.C. § 112, 1st ¶ because the specification and claims fail to enable one of skill in the art to implement, and because the patent lacks adequate written description of, "substrate" contemplated by the claim language (at least to the extent "substrate" is not properly limited). For example, the full compositional scope of this term (at least as apparently asserted by Akoustis) is not enabled by the specification. *Amgen v. Sanofi*, 598 U.S. (2023), slip. op. at 13.

B. "pre-treating a surface of the substrate with at least one group III reactant or at least one group II reactant at an elevated growth temperature prior to introducing a group V reactant or a group VI reactant" (claim 1)

Asserted Claim 1 (and any claims dependent therefrom) are invalid under 35 U.S.C. § 112, 2nd ¶ because the claim language, when read in light of the intrinsic record, fails to inform a person of ordinary skill in the art the scope of "pre-treating." For example, one of ordinary skill in the art cannot know with reasonable certainty the outer metes and bounds of what constitutes "pre-treating" in a temporal or substantive amount context. Additionally, the claims are invalid under 35 U.S.C. § 1st ¶ because the specification and claims fail to enable one of skill in the art to implement, and because the patent lacks adequate written description of, "pre-treating" contemplated by the claim language (at least to the extent "pre-treating" is not properly limited). For example, the full temporal and amount scope of this term (at least as apparently asserted by Akoustis) is not enabled by the specification. *Amgen v. Sanofi*, 598 U.S. (2023), slip. op. at 13.

Asserted Claim 1 (and any claims dependent therefrom) are invalid under 35 U.S.C. § 112, 2nd ¶ because the claim language, when read in light of the intrinsic record, fails to inform a person of ordinary skill in the art the scope of "a surface of the substrate." For example, one of ordinary skill in the art cannot know with reasonable certainty the outer metes and bounds of what constitutes the surface of the substrate or even the substrate such that infringement can be

determined. Nor can one of ordinary skill in the art know how much of "a surface" is pre-treated. Additionally, the claims are invalid under 35 U.S.C. § 112, 1st ¶ because the specification and claims fail to enable one of skill in the art to implement, and because the patent lacks adequate written description of, "a surface of the substrate" contemplated by the claim language (at least to the extent "a surface of the substrate" is not properly limited). For example, the full location scope of this term (at least as apparently asserted by Akoustis) is not enabled by the specification. *Amgen v. Sanofi*, 598 U.S. (2023), slip. op. at 13.

Asserted Claim 1 (and any claims dependent therefrom) are invalid under 35 U.S.C. § 112, 2nd ¶ because the claim language, when read in light of the intrinsic record, fails to inform a person of ordinary skill in the art the scope of the claimed invention with respect to claim limitations that include the terms "Group II reactant;" "Group III reactant;" Group IV reactant;" Group V reactant" as the compositional scope of these terms is undefined by claim 1. Additionally, the claims are invalid under 35 U.S.C. § 112, 1st ¶ because the specification and claims fail to enable one of skill in the art to implement, and because the patent lacks adequate written description of, the terms "Group II reactant;" "Group III reactant;" Group IV reactant;" Group V reactant" contemplated by the claim language (at least to the extent these terms are not properly limited). For example, the full compositional scope of these terms (at least as apparently asserted by Akoustis) is not enabled by the specification. *Amgen v. Sanofi*, 598 U.S. (2023), slip. op. at 13.

Asserted Claim 1 (and any claims dependent therefrom) are invalid under 35 U.S.C. § 112, 2nd ¶ because the claim language, when read in light of the intrinsic record, fails to inform a person of ordinary skill in the art the scope of the claimed invention with respect to claim limitations that include the term "elevated growth temperature." For example, one of ordinary skill in the art cannot know with reasonable certainty the outer metes and bounds of what constitutes "elevated"

such that infringement can be determined. Additionally, the claims are invalid under 35 U.S.C. § 112, 1st ¶ because the specification and claims fail to enable one of skill in the art to implement, and because the patent lacks adequate written description of, "elevated growth temperature" contemplated by the claim language (at least to the extent "elevated growth temperature" is not properly limited). For example, the full scope of what is "elevated" in this term (at least as apparently asserted by Akoustis) is not enabled by the specification. *Amgen v. Sanofi*, 598 U.S. (2023), slip. op. at 13.

Asserted Claim 1 (and any claims dependent therefrom) are invalid under 35 U.S.C. § 112, 2nd ¶ because the claim language, when read in light of the intrinsic record, fails to inform a person of ordinary skill in the art the scope of "prior to." For example, one of ordinary skill in the art cannot know with reasonable certainty the outer metes and bounds of what constitutes "prior to" in a temporal context. Additionally, the claims are invalid under 35 U.S.C. § 112, 1st ¶ because the specification and claims fail to enable one of skill in the art to implement, and because the patent lacks adequate written description of, "prior to" contemplated by the claim language (at least to the extent "prior to" is not properly limited). For example, the full temporal scope of this term (at least as apparently asserted by Akoustis) is not enabled by the specification. *Amgen v. Sanofi*, 598 U.S. (2023), slip. op. at 13.

C. "introducing a group V reactant or a group VI reactant to grow a nucleation layer on the surface of the substrate" (claim 1)

Asserted Claim 1 (and any claims dependent therefrom) are invalid under 35 U.S.C. § 112, 2nd ¶ because the claim language, when read in light of the intrinsic record, fails to inform a person of ordinary skill in the art the scope of the claimed invention with respect to claim limitations that include the terms "a group V reactant" and "group VI reactant" because it is unclear whether these reactants are the same reactants that are referred to in the previous element or not and just what

the composition of these reactants is. Additionally, the claims are invalid under 35 U.S.C. § 112, 1st ¶ because the specification and claims fail to enable one of skill in the art to implement, and because the patent lacks adequate written description of, the terms "a group V reactant" and "a group VI reactant" contemplated by the claim language (at least to the extent these terms are not properly limited). For example, the full compositional and relational scope of these terms (at least as apparently asserted by Akoustis) is not enabled by the specification. *Amgen v. Sanofi*, 598 U.S. (2023), slip. op. at 13.

Asserted Claim 1 (and any claims dependent therefrom) are invalid under 35 U.S.C. § 112, 2nd ¶ because the claim language, when read in light of the intrinsic record, fails to inform a person of ordinary skill in the art the scope of the claimed invention with respect to claim limitations that include the term "grow a nucleation layer on the surface of the substrate." For example, one of ordinary skill in the art cannot know with reasonable certainty the outer metes and bounds of what constitutes the substrate such that infringement can be determined. For example, when the substrate is not defined, it is impossible to know where the surface of the substrate is. Moreover, one of ordinary skill in the art cannot know with reasonable certainty the outer metes and bounds of the term "nucleation layer." First, the term contemplates layer function rather than a composition and does not define how much "nucleation" is necessary for a layer to be a "nucleation layer." Moreover, it is unclear what the "nucleation layer" is providing nuclei for (e.g., is it provides nuclei for the later grown "buffer layer" or "epitaxial layer"). Further, it is unclear whether "introducing" has a causal link to the step of "to grow a nucleation layer." Additionally, the claims are invalid under 35 U.S.C. § 112, 1st ¶ because the specification and claims fail to enable one of skill in the art to implement, and because the patent lacks adequate written description of, "grow a nucleation layer on the surface of the substrate" contemplated by the claim language (at least to the extent

"grow a nucleation layer on the surface of the substrate" is not properly limited). For example, the full location, compositional, and relational scope of this term (at least as apparently asserted by Akoustis) is not enabled by the specification. *Amgen v. Sanofi*, 598 U.S. (2023), slip. op. at 13.

D. "growing a buffer layer on said nucleation layer, said buffer layer providing a surface upon which said epitaxial layer is grown" (claim 1)

Asserted Claim 1 (and any claims dependent therefrom) are invalid under 35 U.S.C. § 112, 2nd ¶ because the claim language, when read in light of the intrinsic record, fails to inform a person of ordinary skill in the art the scope of the claimed invention with respect to claim limitations that include the term "growing a buffer layer." For example, one of ordinary skill in the art cannot know with reasonable certainty the outer metes and bounds of what constitutes the buffer layer such that infringement can be determined. First, the term contemplates layer function rather than a composition and does not define how much "buffering" is necessary for a layer to be a "buffer layer." Moreover, it is unclear what the layer is a buffer between (e.g., is it a buffer between the substrate and the epitaxial layer, or between the nucleation layer and the epitaxial layer, or something else). Additionally, the claims are invalid under 35 U.S.C. § 112, 1st ¶ because the specification and claims fail to enable one of skill in the art to implement, and because the patent lacks adequate written description of, "growing a buffer layer" contemplated by the claim language (at least to the extent "growing a buffer layer" is not properly limited). For example, the full scope of the composition of a buffer layer (at least as apparently asserted by Akoustis) is not enabled by the specification. *Amgen v. Sanofi*, 598 U.S. (2023), slip. op. at 13.

E. "wherein said step of pre-treating includes pre-treating the surface of the substrate with an aluminum reactant and a gallium reactant" (claim 6)

Asserted claim 6 is invalid under 35 U.S.C. § 112, 2nd ¶ because the claim language, when read in light of the intrinsic record, fails to inform a person of ordinary skill in the art the scope of the claimed invention with respect to claim limitations that include the terms

"aluminum reactant" and "gallium reactant," as the composition of these elements are undefined in the claims. Additionally, claim 6 is invalid under 35 U.S.C. § 112, 1st ¶ because the specification and claims fail to enable one of skill in the art to implement, and because the patent lacks adequate written description of, the terms "aluminum reactant" and "gallium reactant" contemplated by the claim language (at least to the extent these terms are not properly limited). For example, the full compositional scope of these terms (at least as apparently asserted by Akoustis) is not enabled by the specification. *Amgen v. Sanofi*, 598 U.S. (2023), slip. op. at 13.

F. "further comprising the step of preheating said substrate in hydrogen prior to pre-treating the surface of the substrate with at least one group III reactant or at least one group II reactant" (claim 10)

Asserted claim 10 is invalid under 35 U.S.C. § 112, 2nd ¶ because the claim language, when read in light of the intrinsic record, fails to inform a person of ordinary skill in the art the scope of the claimed invention with respect to claim limitations that include the term "preheating" in a temporal context and as to what amount of "preheating" is contemplated. Additionally, claim 10 is invalid under 35 U.S.C. § 112, 1st ¶ because the specification and claims fail to enable one of skill in the art to implement, and because the patent lacks adequate written description of, "preheating" contemplated by the claim language (at least to the extent "preheating" is not properly limited). For example, the full temporal and amount scope of this term (at least as apparently asserted by Akoustis) is not enabled by the specification. *Amgen v. Sanofi*, 598 U.S. (2023), slip. op. at 13.

VI. UNENFORCEABILITY CONTENTIONS

Defendant reserves its right to assert inequitable conduct and any other enforceability defense as fact discovery progresses.

VII. DOCUMENT PRODUCTION ACCOMPANYING INITIAL INVALIDITY CONTENTIONS

Contemporaneously with these *Invalidity Contentions* and according to P.R. 3-4 (b), Defendant produces a copy of "each item of prior art identified pursuant to P. R. 3-3(a) which does not appear in the file history of the patent(s) at issue." Defendant further provides translations of any relied upon portions of non-English language references. These documents are produced at Bates label EDTX_QORVO_00019711 - EDTX_QORVO_00020434.

SHEPPARD MULLIN RICHTER & HAMPTON, LLP

September 14, 2023

By: */s/ Robert M. Masters*

JENNIFER KLEIN AYERS (Texas Bar No. 24069322)
SHEPPARD, MULLIN, RICHTER & HAMPTON LLP
2200 Ross Ave, 20th Floor
Dallas, TX 75201
Telephone: 469.391.7400
Facsimile: 469.391.7401
jayers@sheppardmullin.com

ROBERT M. MASTERS (MD State Bar No. 14770)
JONATHAN DEFOSSE (VA State Bar No. 48220)
SHEPPARD, MULLIN, RICHTER & HAMPTON LLP
2099 Pennsylvania Ave, NW, Suite 100
Washington, DC 20006
Telephone: 202.747.1900
Facsimile: 202.747.3369
rmasters@sheppardmullin.com
jdefosse@sheppardmullin.com

Attorneys for Defendant Qorvo, Inc.

CERTIFICATE OF SERVICE

I hereby certify that on September 14, 2023, I served the foregoing via e-mail to all counsel of record.

/s/ Melissa R. Patrick
Melissa R. Patrick