

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent of: Elenga et al.
U.S. Patent No.: 9,941,830 Attorney Docket No. 50095-0179IP1
Issue Date: April 10, 2018
Appl. Serial No.: 15/181,249
Filing Date: June 13, 2016
Title: LINEAR VIBRATION MODULES AND LINEAR-RESONANT
VIBRATION MODULES

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**PETITION FOR *INTER PARTES* REVIEW OF UNITED STATES PATENT
NO. 9,941,830 PURSUANT TO 35 U.S.C. §§ 311–319, 37 C.F.R. § 42**

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LIST OF EXHIBITS

APPLE-1001	U.S. Patent No. 9,941,830
APPLE-1002	U.S. Patent No. 9,941,830 File History
APPLE-1003	Declaration of Blake Hannaford
APPLE-1004	U.S. Patent No. 7,843,277 to Pedro Gregorio, et al. ("Gregorio")
APPLE-1005	U.S. Patent No. 7,005,811 to Hiroshi Wakuda, et al. ("Wakuda")
APPLE-1006	U.S. Patent Application Publication. No. 2008/0294984 to Erin B. Ramsay, et al. ("Ramsay")
APPLE-1007	U.S. Patent Application Publication No. 2006/0109256 to Danny A. Grant, et al. ("Grant")
APPLE-1008	U.S. Patent Application Publication No. 2005/0134561 to Kollin M. Tierling, et al. ("Tierling")
APPLE-1009	U.S. Patent Publication No. 2008/0246532 ("Cospers")
APPLE-1010	U.S. Patent Application Publication No. 2008/0198139 to Robert Andre Lacroix, et al. ("Lacroix")
APPLE-1011	U.S. Patent Application Publication No. 2005/0134562 to Danny Grant, et al.
APPLE-1012	C. McLyman, <i>Chapter 1 – Fundamentals of Magnetics in Transformer and Inductor Design Handbook</i> , Marcel Dekker, Third Edition, Revised and Expanded, 2004
APPLE-1013	U.S. Patent No. 6,088,017 to Mark R. Tremblay, et al.

APPLE-1014	U.S. Patent No. 8,686,952 to Bobby Burrough, et al.
APPLE-1015	U.S. Patent No. 8,207,832 to Jue Byung Yun, et al.
APPLE-1016	U.S. Patent No. 8,203,640 to Jong Hwan Kim, et al.
APPLE-1017	U.S. Patent Application Publication No. 2007/0285216 to Kollin M. Tierling, et al.
APPLE-1018	Thorsten A. Kern, <i>Engineering Haptic Devices: A Beginner's Guide for Engineers</i> , Springer, 2009
APPLE-1019	U.S. Patent No. 6,982,696 to Erik J. Shahoian
APPLE-1020	U.S. Patent No. 4,879,641 to Domenico Rossi, et al. (“Rossi”)
APPLE-1021	Jack Aldrich, et al, <i>Controller for Driving a Piezoelectric Actuator at Resonance</i> , NASA Tech Briefs, April 2008 (“Aldrich”)
APPLE-1022	Declaration of June Munford re Aldrich
APPLE-1023	U.S. Patent No. 7,027,032 to Louis B. Rosenberg, et al. (“Rosenberg”)
APPLE-1024	U.S. Patent No. 5,736,797 to Ryo Motohashi, et al. (“Motohashi”)
APPLE-1025	U.S. Patent No. 5,955,799 to Hidetoshi Amaya, et al. (“Amaya”)
APPLE-1026	J. Peckol, <i>Embedded Systems, A contemporary Design Tool</i> , 2008 (“Peckol”)
APPLE-1027	Corrosion - two case studies: aluminium and iron, Primary Connections: Linking science with literacy, available at https://www.primaryconnections.org.au/themes/custom/connect

[ions/assets/SBR/data/Chem/sub/corrosion/corrosion.htm#:~:tex
t=When%20it%20starts%20to%20corrode,keep%20attacking%
20the%20underlying%20iron](https://www.monroeengineering.com/blog/how-to-protect-aluminum-from-corrosion/) (retrieved 2/12/2024)

- APPLE-1028 How to Protect Aluminum From Corrosion, OneMonroe, available at <https://monroeengineering.com/blog/how-to-protect-aluminum-from-corrosion/> (retrieved 2/12/2024)
- APPLE-1029 Electrical Conductivity of Materials, Blue Sea Systems, https://www.blueseasystems.com/resources/108/Electrical_Conductivity_of_Materials (retrieved 2/12/2024)
- APPLE-1030 Thermal Conductivity, available at hyperphysics.phy-astr.gsu.edu/hbase/Tables/thrcn.html (retrieved 2/12/2024)
- APPLE-1031 U.S. Patent No. 8,134,437 to Elliot Brooks
- APPLE-1032 Magnetic Materials, Phys 251; archived at Wayback Machine; citing a capture dated March 23, 2002 (https://web.archive.org/web/20020323183824/http://webphysics.iupui.edu/webscience/physics_archive/magneticmaterials.html)
- APPLE-1033 Resonant Systems Proposed Claim Constructions, 7-23-cv-00077 (WDTX) (Feb. 15, 2024)
- APPLE-1034 Apple, Inc. Proposed Claim Constructions, 7-23-cv-00077 (WDTX) (Feb. 15, 2024)
- APPLE-1035 Types of Magnetism, DoITPoMS, Department of Materials Science and Metallurgy, University of Cambridge; archived at Wayback Machine; citing a capture dated October 9, 2006 (https://web.archive.org/web/20061015000000*/https://www.doitpoms.ac.uk/tlplib/ferromagnetic/types.php)
- APPLE-1036 Motion to Transfer Venue, 7-23-cv-00077 (WDTX)

APPLE-1037	Moskowitz, B.M. (1991). Hitchhiker’s Guide to Magnetism. In Environmental Magnetism Workshop, pp. 1–38. Minneapolis: The Institute for Rock Magnetism and the Global Paleorecords Research Training Group
APPLE-1038	Resistance and Ohm’s Law; archived at Wayback Machine; citing a capture dated February 18, 1999 (https://web.archive.org/web/19990218085938/https://physics.bu.edu/~duffy/PY106/Resistance.html)
APPLE-1039	[RESERVED]
APPLE-1040	U.S. Patent Publication No. 2011/0133682 (“Egger”)
APPLE-1041	U.S. Patent Publication No. 2008/0001484 (“Fuller”)
APPLE-1042	U.S. Patent Publication No. 2006/0145547 (“Kraus”)
APPLE-1043	U.S. Patent Publication No. 2005/0275294 (“Izumi”)
APPLE-1044	Resonant Systems Preliminary Infringement Contentions, 7-23-cv-00077 (WDTX) (October 5, 2023)
APPLE-1045	Resonant Systems Opening Claim Construction Brief, <i>Resonant Systems, Inc. v. Samsung Electronics Co., Ltd. et al.</i> , 2-22-cv-00423 (EDTX) (December 21, 2023)
APPLE-1046	Apple, Inc. Opening Claim Construction Brief, 7-23-cv-00077 (WDTX) (March 21, 2024)
APPLE-1047	Resonant Systems, Inc.’s Responsive Claim Construction Brief, 7-23-cv-00077 (WDTX) (April 11, 2024)

LISTING OF CLAIMS

Claim 1	
[1pre]	A vibration module comprising:
[1a]	a housing;
[1b]	a moveable component;
[1c]	a power supply;
[1d]	user-input features;
[1e]	a driving component that drives the moveable component to oscillate within the housing; and
[1f]	a control component that controls supply of power from the power supply to the driving component to cause the moveable component to oscillate at a frequency and an amplitude specified by one or more stored values.
Claim 2	
[2]	The vibration module of claim 1 wherein the control component is one of: an variable oscillator circuit with additional control circuitry; and a control component that includes a microprocessor, a control program, stored in an electronic memory within, or separate from, the microprocessor, the control program executed by the microprocessor to control supply of power from the power supply to the driving component to cause the moveable component to oscillate at a frequency and an amplitude specified by the one or more stored values.
Claim 3	
[3]	The vibration module of claim 1 wherein the control component receives output signals from sensors within the vibration module during operation of the vibration module and adjusts one or more operational control outputs of the control component according to the received output signals from the sensors.

Claim 4	
[4]	The vibration module of claim 1 wherein the control component adjusts the one or more operational control outputs of the control component according to the received output signals from the sensors in order that subsequent operation of the vibration module produces desired outputs from the one or more sensors corresponding to one or more operational control parameters.
Claim 5	
[5a]	The vibration module of claim 4 wherein the one or more operational control parameters is a strength of vibration produced by the oscillation of the moveable component; and
[5b]	wherein the one or more operational control outputs is a frequency at which the control component drives the moveable component to oscillate, the control component dynamically adjusting the power supplied to the driving component to produce oscillation of the movable component at a resonant frequency for the vibration module.
Claim 6	
[6a]	The vibration module of claim 4 wherein the one or more operational control parameters include both a strength of vibration produced by the oscillation of the moveable component and a current operational mode; and
[6b]	wherein the one or more operational control outputs is a control output that determines a current supplied by the power supply to the driving component and a frequency at which the control component drives the moveable component to oscillate.
Claim 7	
[7]	The vibration module of claim 1 wherein the driving component comprises one or more electromagnetic coils that generate magnetic fields parallel to the directions in which the moveable component is driven by the driving component.

Claim 8	
[8a]	The vibration module of claim 1 wherein the housing is a tube, capped at both ends by movable-component-repelling components selected from one of mechanical springs and magnets;
[8b]	wherein the movable component is a magnet shaped to slide within the tube; and
[8c]	wherein the driving component is an electromagnetic coil.
Claim 14	
[14]	The vibration module of claim 1 further including flux paths comprising a paramagnetic material that is shaped and positioned to reduce the reluctance of one or more magnetic circuits within the vibration module.
Claim 15	
[15]	The vibration module of claim 1 wherein the control component drives simultaneous oscillation of the moveable component at two or more frequencies to generate complex vibration modes.
Claim 16	
[16]	The vibration module of claim 15 wherein the complex vibration modes include: a primary oscillation frequency modulated by a modulating oscillation frequency; a beat frequency; and an aperiodic oscillation waveform.
Claim 17	
[17]	The vibration module of claim 1 wherein the control component controls supply of power from the power supply to the driving component to cause the moveable component to oscillate at a frequency and an amplitude that are independently specified by user input received from the user-input features.
Claim 19	

[19pre]	A vibration module comprising:
[19a]	a housing;
[19b]	a moveable component;
[19c]	a power supply;
[19d]	user-input features;
[19e]	a driving component that drives the moveable component to oscillate within the housing;
[19f]	a control component that controls supply of power from the power supply to the driving component to cause the moveable component to oscillate at a frequency and an amplitude specified by one or more stored values; and
[19g]	flux paths comprising a paramagnetic material that is shaped and positioned to reduce the reluctance of one or more magnetic circuits within the vibration module.
Claim 20	
[20pre]	A vibration module comprising:
[20a]	a housing;
[20b]	a moveable component;
[20c]	a power supply;
[20d]	user-input features;
[20e]	a driving component that drives the moveable component to oscillate within the housing; and
[20f]	a control component that controls supply of power from the power supply to the driving component to cause the moveable component to oscillate at a frequency and an amplitude specified by one or more stored values,

[20g]	wherein the control component drives simultaneous oscillation of the moveable component at two or more frequencies to generate complex vibration modes.
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I. INTRODUCTION

Apple Inc. (“Apple” or “Petitioner”) petitions for IPR of claims 1-8, 14-17, 19, and 20 (“Challenged Claims”) of U.S. Patent No. 9,941,830 (“the ’830 patent”).

II. REQUIREMENTS FOR IPR

A. Grounds

Apple certifies that the ’830 patent is available for IPR and Petitioner is not barred or estopped from requesting this review of the Challenged Claims on the below-identified grounds.

B. Challenge and Relief Requested

The Challenged Claims are invalid based on the grounds below. Dr. Hannaford provides supporting testimony (APPLE-1003).

Ground	Claims	§103
1A	1-7	Gregorio
1B	8, 14, 19	Gregorio, Wakuda
1C	15, 16, 20	Gregorio, Tierling
1D	1-7, 15, 17, 20	Gregorio, Ramsay
1E	8, 14, 19	Gregorio, Ramsay, Wakuda
1F	15, 16, 20	Gregorio, Ramsay, Tierling
2A	1-7, 15, 17, 20	Gregorio, Ramsay, Rossi, Aldrich
2B	8, 14, 19	Gregorio, Ramsay, Rossi, Aldrich, Wakuda
2C	15, 16, 20	Gregorio, Ramsay,

Ground	Claims	§103
		Rossi, Aldrich, Tierling

Each applied reference predates U.S. provisional application 61/179,109, filed on May 18, 2009 (“Critical Date”), which is the earliest filed application from which the ’830 patent claims priority. Petitioner does not concede that the Critical Date is the priority date of May 18, 2009, but has applied references that predate the Critical Date and qualify as prior art as shown below.

Reference	Date	Pre-AIA Section
Gregorio	12/16/2008 (filed), 11/30/2010 (published)	§102(e)
Wakuda	2/28/2006	§102(b)
Tierling	6/23/2005	§102(b)
Ramsay	11/27/2008	§102(a)
Rossi	11/7/1989	§102(b)
Aldrich	4/2008	§102(b)

C. Claim Construction

All claim terms should be construed according to the *Phillips* standard. The Board has repeatedly explained that “claim terms need only be construed to the extent necessary to resolve the controversy.” *Wellman, Inc. v. Eastman Chem. Co.*, 642 F.3d 1355, 1361 (Fed. Cir. 2011). As the prior art discloses the claims under each of the constructions offered in the Petition, the Board need not construe the claims to resolve unpatentability. *Id.*

1. Means-Plus-Function Terms

Certain claims recite “driving component” and “control component” as discussed below. These terms do not recite “means for” and thus a presumption exists that these terms are not subject to 35 U.S.C. §112(¶6). Although Patent Owner currently agrees in co-pending litigation that the terms “control component” and “driving component” (as discussed below) should be interpreted according to the means-plus-function construction, Patent Owner initially asserted that these terms are under the plain-and-ordinary meaning interpretation and, even now, Patent Owner’s indication of corresponding structures under the means-plus-function construction does not align with its position in parallel litigation against Samsung Electronics (2:22-cv-00423). APPLE-1033, 1-4; APPLE-1045, 14-22. In view of Patent Owner’s inconsistent positions, this Petition demonstrates unpatentability by applying both the plain-and-ordinary meaning and the means-plus-function meaning of these terms. Indeed, the Petition’s plain-and-ordinary meaning interpretation (Grounds 1A-1F) and means-plus-function interpretation (Grounds 2A-2C) cover all of Patent Owner’s various means-plus-function treatments of the terms.

The corresponding analysis and construction under 35 U.S.C. §112(¶6) for each term is provided below. Regardless of the interpretation adopted, the instant record demonstrates that the implicated terms are plainly satisfied in view of the

overlap between the prior art cited herein and the '830 patent specification.

General Electric Co., IPR2018-00928, Paper 9, 12-16 (“the rule does not prohibit a petitioner from submitting more than one construction”); *Intel Corp.*, IPR2018-01340, Paper 8, 11-13; APPLE-1003, [21]-[32].

(a) “control component”

Claims 1 and 19 recite that the “control component” performs a specified function (“controls supply of power from the power supply to the driving component to cause the moveable component to oscillate at a frequency and an amplitude specified by one or more stored values”). This Petition treats “control component” in claims 1 and 19 as including one of the switches shown in Figures 5A-6 and described at 5:52-6:5, 6:9-16, and the processor (also referred to as microprocessor, microcontroller, or CPU) that performs the algorithm shown in Figures 7A-7C and described at 6:52-8:40. APPLE-1046, 13; APPLE-1034, 6; APPLE-1003, [24]. The Petition treats this structure and its equivalents as the corresponding structure for the “control component” in claims 1 and 19.

Claim 20 recites that the “control component” performs a specified function (“controls supply of power from the power supply to the driving component to cause the moveable component to oscillate at a frequency and an amplitude specified by one or more stored values” and “drives simultaneous oscillation of the moveable component at two or more frequencies to generate complex vibration

modes”). This Petition treats “control component” in claim 20 as including one of the switches shown in Figures 5A-6 and described at 5:52-6:5, 6:9-16, and the processor (also referred to as microprocessor, microcontroller, or CPU) that performs the algorithm shown in Figures 7A-7C and described at 6:52-8:40 and 13:20-59. APPLE-1046, 12-13; APPLE-1034, 6; APPLE-1003, [25]. The Petition treats this structure and its equivalents as the corresponding structure for the “control component.”

While agreeing on the means-plus-function treatment in co-pending litigation, Patent Owner identifies an alternative means-plus-function construction that only includes some unspecified part of the disclosed algorithm of the ’830 patent. APPLE-1046, 12-13; APPLE-1047, 19-23. In related litigation against Samsung Electronics, Patent Owner similarly identified alternative means-plus-function constructions that only employ an oversimplified version of the ’830 patent’s algorithm. APPLE-1045, 14-22.

Regardless, the claims are unpatentable. Specifically, the claims are demonstrated unpatentable in Grounds 2A-2C that apply the means-plus-function interpretation of the recited control component. As Grounds 2A-2C demonstrate how the prior art addresses the claims according to the narrower means-plus-function interpretation, Grounds 2A-2C likewise address Patent Owner’s broader

means-plus-function position as to the “control component.”¹ The claims are also demonstrated unpatentable in Grounds 1A-1F under the plain-and-ordinary meaning and Patent Owner’s alternative means-plus-function construction. APPLE-1003, [26]-[30].

(b) “driving component”

As agreed by Patent Owner in co-pending litigation, the term “driving component that drives the moveable component to oscillate within the housing” is a means-plus-function limitation because it uses a non-structural generic placeholder (“component”) defined only by functional limitations (“driv[ing] the moveable component to oscillate within the housing”). The ’830 patent describes the following structures that perform the recited function when they receive alternating current: “a coil of conductive wire 420” (Figures 4A-4G); “coil 514”

¹ Patent Owner argued in the Samsung litigation that the term “control component” in claims 3-5 are means-plus-function limitations. APPLE-1045, 22-28. Notably, Patent Owner’s positions are the same as its position with respect to claim 1 in that litigation, or fall squarely within this Petition’s means-plus-function interpretations. *Id.* Therefore, the Grounds in this Petition also demonstrate that claims 3-5 are unpatentable under Patent Owner’s means-plus-function positions offered in the Samsung case.

(Figures 5A-5B); “coil 626” (Figure 6); “electromagnet” (Figures 10-11); “additional coils 1202 and 1204” (Figure 12); “coils 1302 and 1304” (Figure 13); “driving coils 1412 and 1414” (Figure 14); “coil 1510” (Figures 15-17); “stator coils” (Figures 24A-25). APPLE-1001, 5:7-41, 5:61-66, 6:40-44, 9:22-64, 10:9-34, 14:24-28. APPLE-1003, [31]-[32]. For the purpose of analyzing the prior art grounds, the Petition treats these structures and their equivalents as the corresponding structure.

Regardless of means-plus-function or plain-and-ordinary meaning interpretation, all Grounds demonstrates unpatentability of the claims.

III. '830 PATENT

A. Brief Description

The '830 patent provides “vibration modules that can be incorporated into a wide variety of different types of electromechanical devices and systems to produce vibrations of selected amplitudes and frequencies over a wide range of amplitude/frequency space.” APPLE-1001, 1:16-21; APPLE-1003, [39]-[48]. Such vibration modules “can be incorporated in a wide variety of appliances, devices, and systems to provide vibrational forces.” *Id.*, Abstract. For example, “the vibrational forces are produced by a linear oscillation of a weight or component within the LVM [linear vibration module].” *Id.*, 4:21-36.

B. Prosecution History

The Examiner issued one office action with prior art rejections. APPLE-1002, 32-37. Applicant traversed this rejection without amendment. *Id.*, 22-25. A notice of allowance was issued without reasons for allowance. *Id.*, 10-16; APPLE-1003, [49]-[59].

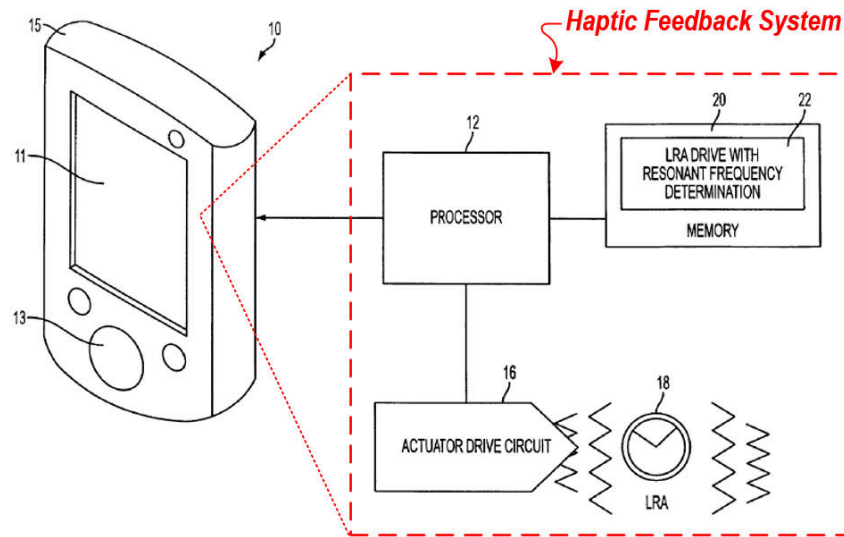
IV. APPLICATION OF PRIOR ART

A. GROUND 1A: Gregorio Renders Obvious Claims 1-7 (Plain-and-Ordinary Meaning and Patent Owner's Means-Plus-Function Construction)

1. Gregorio

Gregorio's system "drives an LRA [Linear Resonant Actuator] to generate vibrotactile haptic feedback on a user interface." APPLE-1004, 2:3-5; APPLE-1003, [60]-[66]. Because "each LRA may have a different resonant frequency" and such a resonant frequency may change "due to different uses of a device or due to manufacturing tolerances," Gregorio's system determines "the resonant frequency of the LRA ... during a drive period and the drive signal can be adjusted to maximize the haptic feedback based on the determined resonant frequency." *Id.*, 3:1-11, 3:58-64, 2:5-9.

Gregorio's "haptically-enabled system 10" can be "a handheld device, such as a cellular telephone, PDA, computer tablet, etc." APPLE-1004, 3:1-4. The system 10 "includes a touch sensitive surface 11 or other type of user interface mounted within a housing 15." *Id.*, 2:10-14, Figure 1.



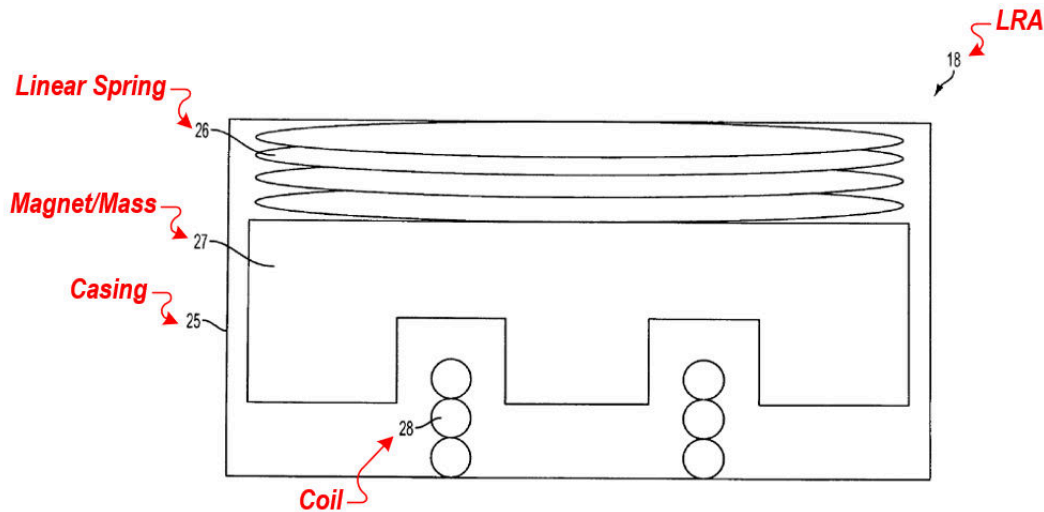
APPLE-1004, Figure 1²

Referring to Figure 1 above, “[i]nternal to system 10 is a haptic feedback system that generates vibrations on system 10.” APPLE-1004, 2:14-17. The haptic feedback system includes “processor 12,” “memory 20,” “actuator drive circuit 16,” and “LRA actuator 18.” *Id.*, 2:18-20. “Processor 12 can decide what haptic effects are to be played and the order in which the effects are played based on high level parameters,” and “output[] the control signals to drive circuit 16 which includes electronic components and circuitry used to supply LRA 18 with the required electrical current and voltage to cause the desired haptic effects.” *Id.*, 2:25-28, 2:36-39. “[M]emory 20 includes an LRA Drive with Resonant Frequency Determination module 22 which are instructions that, when executed by processor

² All annotations in the figures herein are added unless otherwise indicated.

12, generate drive signals for LRA 18 while also determining the resonant frequency of LRA 18 and adjusting the drive signals accordingly.” *Id.*, 2:44-50.

The LRA includes “casing 25, a magnet/mass 27, a linear spring 26, and an electric coil 28.” APPLE-1004, 3:12-14, Figure 2 (below). “[W]hen current flows thru coil 28 a magnetic field forms around coil 28 which in interaction with the magnetic field of magnet 27 pushes or pulls on magnet 27. One current flow direction/polarity causes a push action and the other a pull action.” *Id.*, 3:17-21.



APPLE-1004, Figure 2

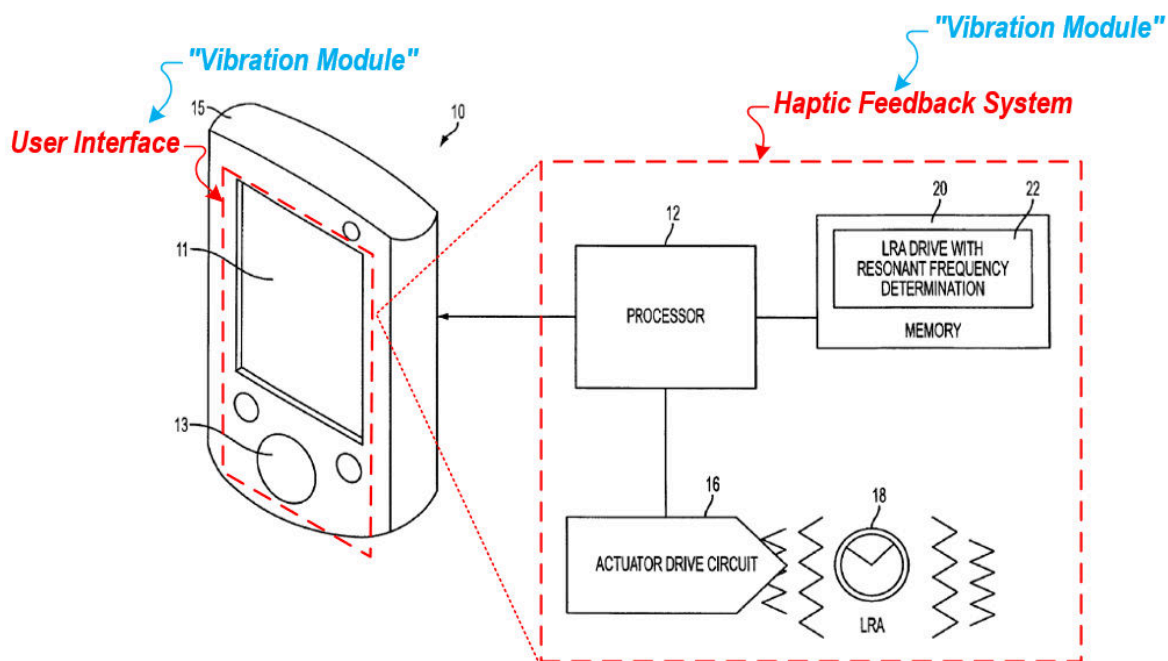
Gregorio’s system performs “a continuous loop during a drive cycle that includes a drive period and a monitoring period.” APPLE-1004, 4:15-20. The system “constantly and dynamically determines the resonant frequency of LRA 18 while during a monitoring period of a drive signal cycle.” *Id.*, 3:65-67. “[D]uring the monitoring period (approximately 10%) of the drive cycle, drive circuit 16

‘listens’ or monitors and receives magnetic back EMF (i.e., the voltage generated by the internal motion inside LRA 18) from LRA 18.” *Id.*, 4:24-28. The received back EMF is “used to determine the resonant frequency of the LRA.” *Id.*, 4:2-5. “The subsequent drive pulses are then adjusted to account for the resonant frequency.” *Id.*, 6:8-9. Gregorio’s system also uses “sensing coil, Hall sensor, optical sensor or other type of sensing device that is located in proximity to mass 27 for detecting the position of mass 27.” *Id.*, 4:7-14.

2. Analysis

[1pre]

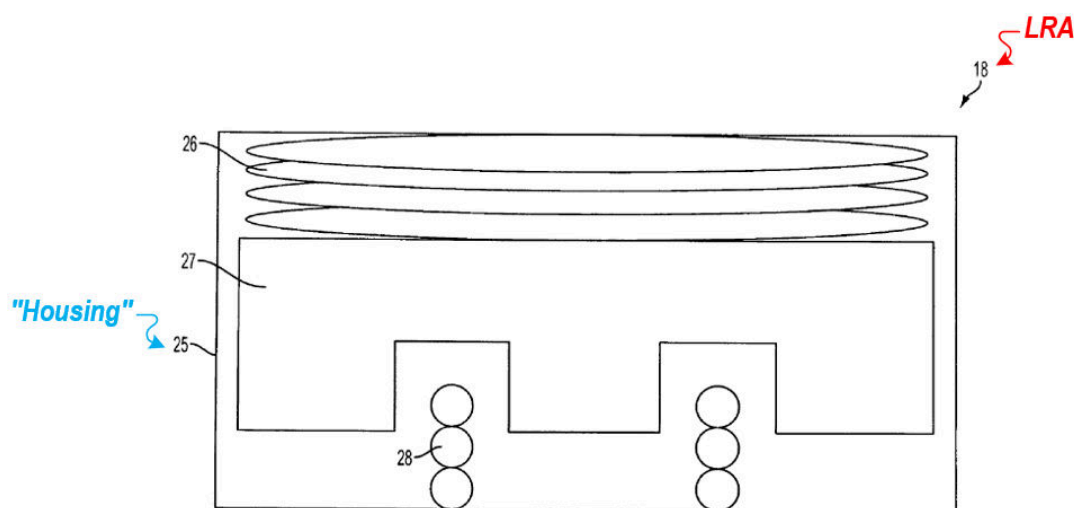
Gregorio discloses a vibration module, such as the combination of the “haptic feedback system” including “processor 12,” “actuator drive circuit 16,” “LRA 18,” and “memory 20” and the “user interface” including “touch sensitive surface 11” and “mechanical keys/buttons 13.” APPLE-1003, [92]-[93]; APPLE-1004, 2:10-20.



APPLE-1004, Figure 1

[1a]

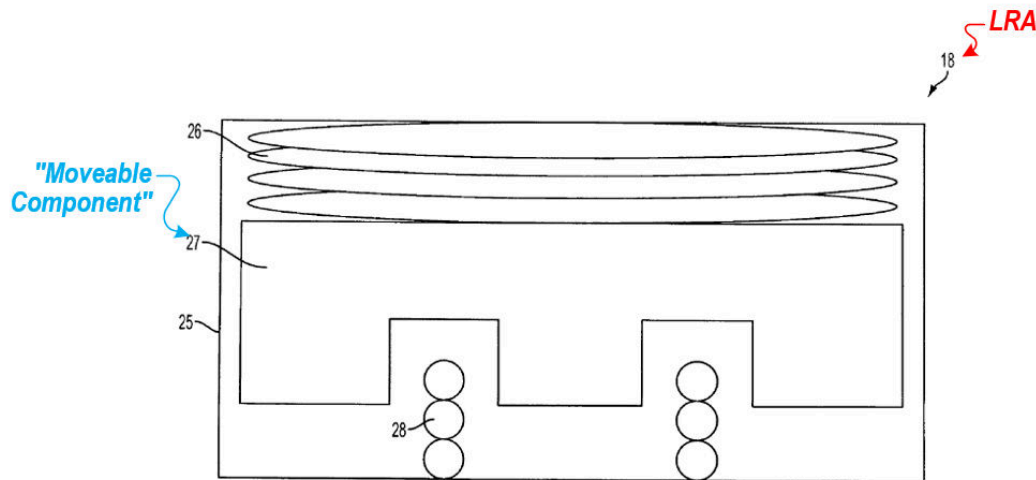
Gregorio’s vibration module includes a housing (“casing 25”). APPLE-1004, 3:13-15, Figure 2; APPLE-1003, [94]-[95].



APPLE-1004, Figure 2

[1b]

Gregorio's vibration module includes a moveable component ("magnet/mass 27"). APPLE-1004, 3:12-14; APPLE-1003, [96]. Like the movable component in the '830 patent, magnet/mass 27 can be pushed or pulled by the interaction between the magnetic field of the magnet 27 and the magnetic field around the coil 28. APPLE-1004, 3:17-21.

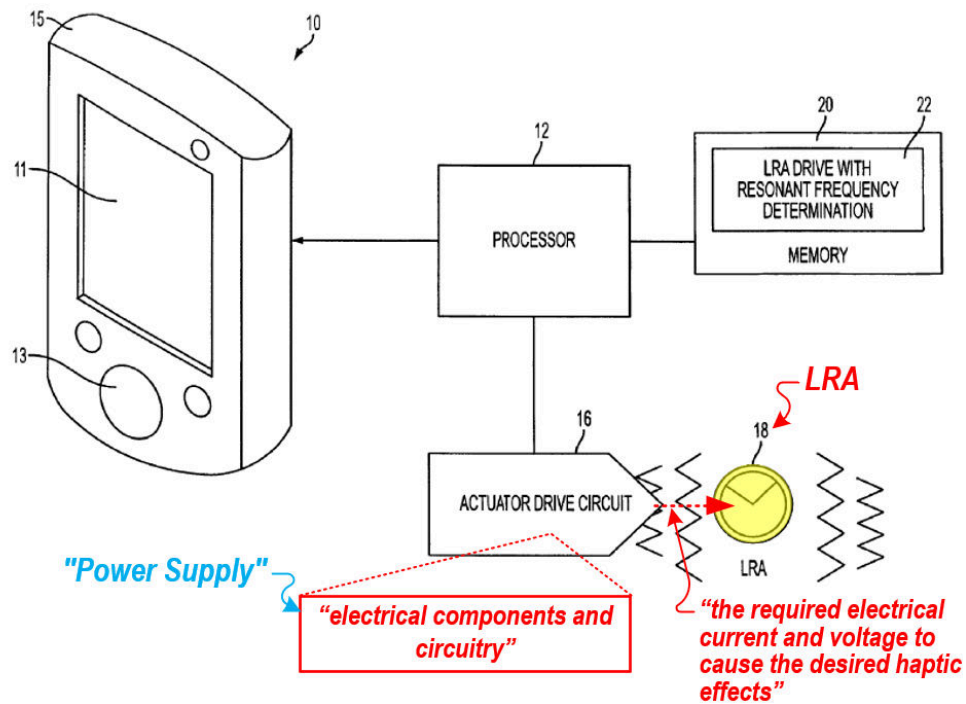


APPLE-1004, Figure 2

[1c]

Gregorio's vibration module includes a power supply ("actuator drive circuit 16"), "which includes electronic components and circuitry used to supply LRA 18 with the required electrical current and voltage to cause the desired haptic effects." APPLE-1004, 2:18-20-39, 3:17-20; APPLE-1003, [97]. Because electric power is

defined by current and voltage, a person of ordinary skill in the art (POSITA)³ would have understood that actuator drive circuit 16 corresponds to, or is coupled to, a power supply. APPLE-1003, [97]; APPLE-1038, 1-2. Gregorio also describes “current generator 422” as a power supply to convert a pulse to current that flows into LRA 18. *Id.*, 5:49-53; APPLE-1003, [98]-[99] (citing APPLE-1007).



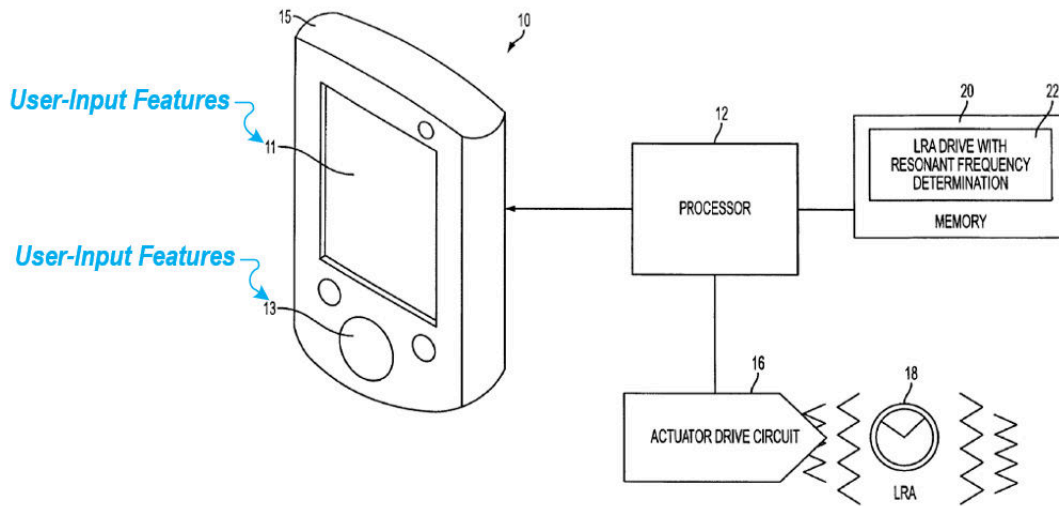
APPLE-1004, Figure 1

[1d]

Gregorio’s vibration module includes user-input features (“touch sensitive surface 11” that “generates and displays images for the user to interact with, such

³ APPLE-1003, [33]-[34] (defining a POSITA).

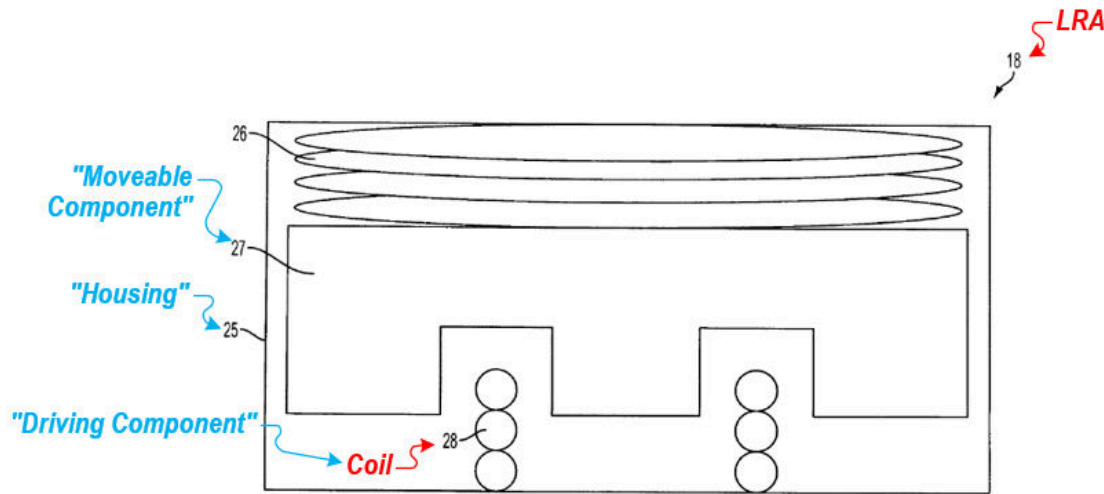
as keys, dials, etc.” and/or “mechanical keys/buttons 13”). APPLE-1004, 2:10-14, 2:64-67; APPLE-1003, [100].



APPLE-1004, Figure 1

[1e]

Gregorio’s vibration module includes a driving component (“electric coil 28”) that drives the moveable component (“movement/oscillation of magnet 27”) to oscillate within the housing (“casing 25”) “when current flows thru coil 28 [and] a magnetic field forms around coil 28.” APPLE-1004, 3:12-28, 2:10-20; APPLE-1003, [101]-[102].

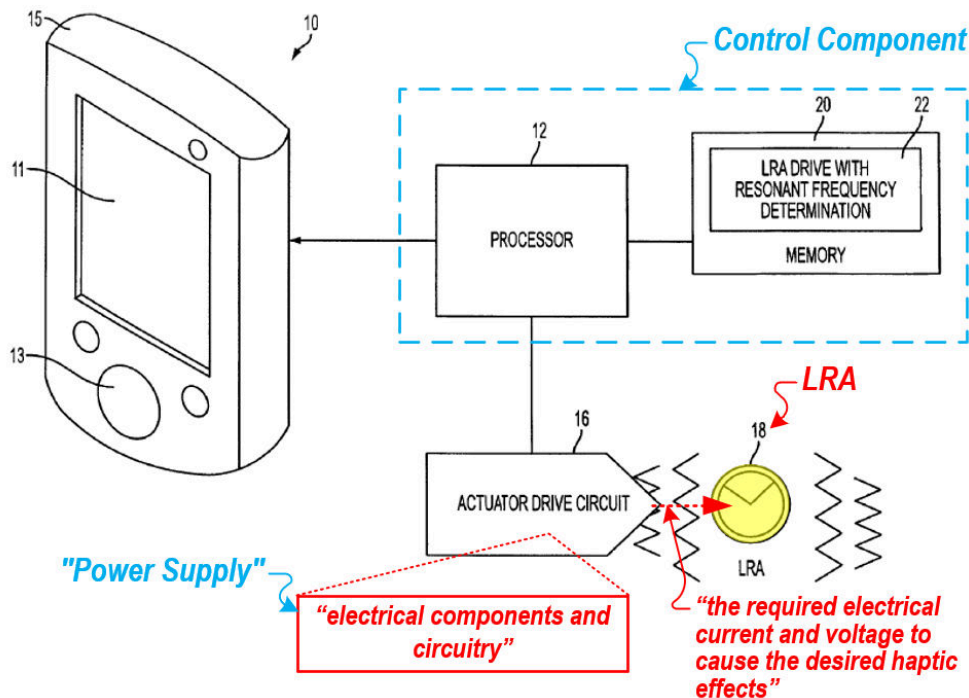


APPLE-1004, Figure 2

[1f]

Gregorio's vibration module includes a control component (combination of "processor 12," "memory 20," and either "LRA Drive with Resonant Frequency Determination module 22" or circuit 400) that controls the supply of power from the power supply ("actuator drive circuit 16") to the driving component ("coil 28") to cause the moveable component ("movement/oscillation of magnet 27") to oscillate at a frequency (high-level frequency, assumed resonance frequency, or determined resonance frequency) and an amplitude (high level "magnitude," "desired amplitude," or "present amplitude") specified by one or more corresponding values ("high level parameters that define a particular haptic effect" or "instructions that, when executed by processor 12, generate drive signals for LRA 18") stored in memory 20. APPLE-1004, 2:18-2:50, 4:20-65; APPLE-1003, [103].

Gregorio's "processor 12," coupled to "memory 20," controls "actuator drive circuit 16" to provide desired haptic effects via LRA 18. APPLE-1004, 2:18-20. In providing the haptic effects, the processor controls supply of power from the power supply to the driving component. APPLE-1003, [104]. According to the control signals from the processor, the "electronic components and circuitry" of the actuator drive circuit 16 (power supply) supplies the "required electrical current and voltage" (power) to the coil 28 (driving component) of LRA 18, thereby causing the magnet 27 (moveable component) to oscillate. *Id.*; APPLE-1004, 2:36-39, 3:12-28.



APPLE-1004, Figure 1

In Gregorio, "[m]emory 20 stores instructions executed by processor 12 ...

include[ing] an LRA Drive with Resonant Frequency Determination module 22 which are instructions that, when executed by processor 12, generate drive signals for LRA 18.” APPLE-1004, 2:44-50, 4:28-31. These instructions include the assumed resonant frequency, the “desired amplitude,” and the “present amplitude,” which are stored in memory at least when “the desired amplitude is compared to the present amplitude.” APPLE-1004, 4:20-22, 4:49-65; APPLE-1003, [105].

Gregorio’s “high level parameters,” including magnitude and frequency, are also part of the instructions stored in memory 20. APPLE-1004, 2:25-28 (“Processor 12 can decide what haptic effects are to be played and the order in which the effects are played based on high level parameters.”); APPLE-1003, [106]. Indeed, Gregorio’s processor 12 would not “decide what haptic effects are to be played ... based on high level parameters” without access to the high level parameters and Gregorio’s vibration module already includes memory 20 for storing instructions executed by processor 12. It also would have been obvious to store Gregorio’s high-level parameters in memory 20. APPLE-1003, [106] (citing APPLE-1006). A POSITA would have been motivated to store the high level parameters in memory 20 to facilitate the decision of what haptic effects are to be played, and such modification would have been reasonably expected to be successful at least because it merely requires software implementation. *Id.*, [106]-[110].

Notably, Gregorio's disclosure also satisfies one of Patent Owner's means-plus-function constructions of "control component" alleged in litigation against Samsung Electronics. APPLE-1003, [111]; APPLE-1045, 20-21 (Patent Owner identifies "oscillator circuit; microcontroller with internal or external memory; processor; CPU; [and] microprocessor" as the corresponding structure). Gregorio describes that "[p]rocessor 12 may be any type of general purpose processor, or could be a processor specifically designed to provide haptic effects, such as an application-specific integrated circuit (ASIC)," and that its processor can be "specifically designed to provide haptic effects, such as an application-specific integrated circuit ('ASIC')." APPLE-1004, 2:20-23, 4:31-36.

[2]

As discussed in [1f] above, Gregorio's control component includes a microprocessor ("processor 12"), a control program ("instructions executed by processor 12" including "LRA Drive with Resonant Frequency Determination Module 22"), stored in electronic memory ("memory 20") within, or separate, the microprocessor. APPLE-1004, 2:42-44, 2:52-53; APPLE-1003, [112]. As also discussed in [1f] above, Gregorio's control program is executed by the microprocessor to control supply of power from the power supply to the driving component to cause the moveable component to oscillate at a frequency and an amplitude specified by one or more stored values. APPLE-1003, [113]-[115].

[3]

Gregorio's control component (including processor 12 and memory 20) receives output signals (back EMF or position measurements) from sensors (as suggested by Gregorio's coil 28, sensing coil, Hall sensor, optical sensor, or other type of sensing device in each of one or more LRAs) within the vibration module ([1pre]) and adjusts one or more operational control outputs (the frequency of "drive signals"/"drive pulses") of the control component according to the received output signals from the sensors. APPLE-1003, [116]; APPLE-1004, 2:45-50, 2:5-8, 4:7-14.

For example, based on the monitored EMF or the mass position, Gregorio's system adjusts the frequency and amplitude of the "drive signal" to achieve the determined resonant frequency of LRA and the desired amplitude of vibration. APPLE-1004, 2:5-8, 4:5-7, 4:15-5:67, 6:5-9. As such, Gregorio's control component adjusts one or more operational control outputs of the control component according to the received output signals from the sensors. APPLE-1003, [117]-[120].

Further, Gregorio contemplates "embodiments with more than one LRA, each [of which] may have a different resonant frequency in order to create a wide range of haptic effects on the device." APPLE-1004, 3:8-11. A POSITA would have understood that, at least in these embodiments, the vibration module includes

multiple sensors, one for each of respective LRAs working independently, which generate and transmit output signals to the control component within the vibration module respectively. APPLE-1003, [121].

Additionally, it would have been obvious that a plurality of sensors would be beneficially used for improving accuracy and reliability of measurements where a single sensor is used in such a case as Gregorio's measuring EMF or the position of mass. APPLE-1003, [122]-[123] (citing APPLE-1009). Indeed, the '830 patent does not describe any criticality of using multiple sensors, and simply attributes the described functionality to "one or more sensors" without distinguishing the use of a single sensor from multiple sensors. APPLE-1001, 6:15-16, 6:37, 6:44-51, cls. 3-4 (reciting "sensors" and "the one or more sensors," respectively).

*[4]*⁴

⁴ The terms "the one or more operational control outputs," "the received output signals," "the sensors," and "the one or more sensors" lack antecedent basis.

Petitioner has made a best effort to interpret the claim for the present proceeding, but reserves the right to raise the issue of indefiniteness in other proceedings involving the '830 patent. Further, the term "desired" is ambiguous, rendering claim 4 indefinite. Yet, unpatentability of claim 4 can be determined here because

As discussed in [3] above, Gregorio's control component adjusts the one or more operational control outputs of the control component according to the received output signals from the sensors. As a result, subsequent operation of the vibration module produces desired outputs (EMF or position measurements, which will result from "desired haptic effect") from the sensors corresponding to one or more operational control parameters ("desired amplitude" and "resonant frequency"). APPLE-1003, [124]-[125]; APPLE-1004, 2:5-50, 3:8-11, 4:7-6:9.

[5a]

As discussed in [4] above, one of Gregorio's operational control parameters is a strength of vibration ("vibration amplitude") produced by oscillation of the movable component. APPLE-1003, [126]; APPLE-1004, 4:44, 4:49-65. The '830 patent aligns with this understanding, describing "a strength of vibration, which corresponds to the current applied to the coil." APPLE-1001, 6:30-31. The current applied to the coil was well-known to determine the amplitude of the oscillation. APPLE-1003, [127], [87]-[89] (citing APPLE-1025).

[5b]

the prior art expressly describes such features in its feedback control system. APPLE-1003, [124]-[125].

As explained in [3] above, one of Gregorio's operational control outputs is a frequency of the drive pulse at which the control component drives the moveable component to oscillate. APPLE-1003, [128]. Gregorio's control component dynamically adjusts the power supplied from the power supply ("actuator drive circuit 16") to the driving component ("coil 28") to thereby produce oscillation of the movable component ("magnet/mass 27") at that frequency, which is a resonant frequency for the vibration module. *Id.*; APPLE-1004, 3:65-67 ("constantly and dynamically determines the resonant frequency of LRA 18"), 2:5-8, 2:45-50 ("determining the resonant frequency of LRA 18 and adjusting the drive signals accordingly"), 4:15-6:9. Gregorio's adjustment of the drive signal is dynamic because the drive signal is constantly changed based on the variable resonant frequency determined during a drive period. APPLE-1003, [128]-[133].

[6a]

As discussed in [5a] above, one of Gregorio's operational control parameters is a strength of vibration ("magnitude," "amplitude") produced by the oscillation of the movable component. APPLE-1003, [134]; APPLE-1004, 2:28-30, 4:44-65.

Further, Gregorio's operation control parameters also include a current operational mode ("forward drive mode" or "braking mode"). APPLE-1003, [135]. In Gregorio, "the LRA amplitude is measured" and "the desired amplitude is compared to the present amplitude." APPLE-1004, 4:42-57, Figure 3. If the

desired amplitude is greater than the present amplitude, the “functionality proceeds to forward drive mode ... because the amplitude of the mass needs to be increased.” *Id.* If the desired amplitude is less than the present amplitude, the functionality proceeds to “braking mode ... because the amplitude of the mass needs to be decreased.” *Id.*

Moreover, Gregorio’s system contemplates multiple different “haptic effects,” each corresponding an operational mode. APPLE-1004, 2:25-39; APPLE-1003, [136]. Indeed, providing a haptic device with multiple different operational modes in terms of operational control parameters (e.g., frequencies) was well-known. *Id.*, [136]-[137] (citing APPLE-1011, [0036]).

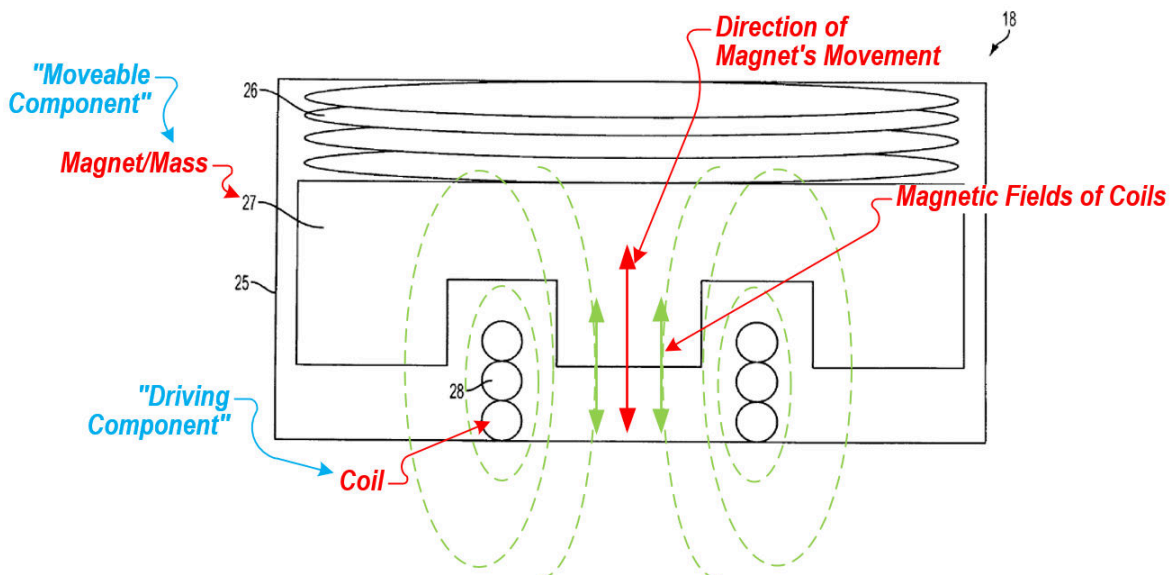
[6b]

Gregorio’s one or more operational control outputs (“control signals” output from processor 12 to drive circuit 16 and/or the resulting “drive signals”/“drive pulses”) is a control output that determines a current supplied by the power supply (“actuator drive circuit 16” or “current generator 422”) to the driving component (“coil 28”) and a frequency (the determined “resonant frequency” and the high-level frequency parameter of the haptic effect) at which the control component drives the moveable component to oscillate. APPLE-1003, [138]-[141]; APPLE-1004, 2:5-2:50, 3:65-6:9. The amplitude and duration of the drive signals/pulses determine the amount of current supplied by the power supply to the driving

component. APPLE-1003, [138]; APPLE-1004, 2:36-39 (confirming that drive circuit 16 supplies “the required electrical current and voltage” in response to the “control signals”), 5:49-50, Figures 4, 6. And the frequency of the signals/pulses is the frequency at which the control component drives the moveable component to oscillate. *Supra*, [1f].

[7]

As discussed in [1e] above, Gregorio’s driving component comprises one or more electromagnetic coils (“electric coil 28”). APPLE-1003, [142]. As illustrated below, Gregorio’s coil 28 generates magnetic fields parallel to the directions in which magnet 27 (moveable component) is driven by the driving component. *Id.*; APPLE-1004, 3:12-21, Figure 2.

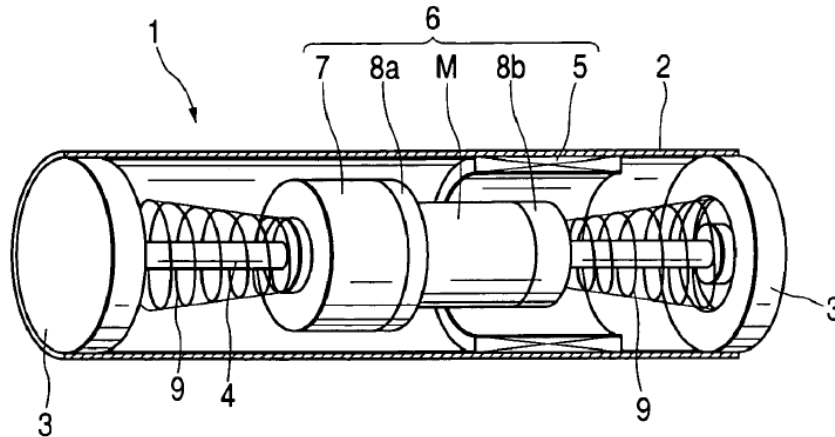


APPLE-1004, Figure 2

B. GROUND 1B: Gregorio-Wakuda Renders Obvious Claims 8, 14, 19 (Plain-and-Ordinary Meaning and Patent Owner’s Means-Plus-Function Construction)

1. Wakuda

Wakuda provides “a vibration generator system, which can generate vibrations at a frequency that can be bodily sensed by humans.” APPLE-1005, 2:13-17; APPLE-1003, [67]-[69]. Wakuda’s “vibration generator means 1” includes “cylindrical-shaped casing 2,” “covers 3,” “coil 5,” “movable body 6” including weight 7 and magnet M, and “energizing members 9” (e.g., “cone coil springs”) “provided between both ends of the movable body 6 and inner surfaces of the covers 3.” *Id.*, 4:30-5:24.



APPLE-1005, Figure 1A

2. Gregorio-Wakuda

In the predictable combination, Gregorio’s LRA is implemented based on Wakuda’s “vibration generating means” structure. APPLE-1003, [143]-[144]. The modified LRA is operated in a manner described in Wakuda, like Gregorio’s

operation. *Id.*; APPLE-1005, 5:51-6:10; APPLE-1004, 3:17-28. For example, in the resulting system, Gregorio's system including "casing 25," "coil 28," "magnet/mass 27," and "spring 26" is implemented according to Wakuda's "cylindrical-shaped casing 2," "coil 5," "movable body 6," and "energizing members 9," respectively. APPLE-1003, [144]; APPLE-1004, 3:12-28, Figure 2; APPLE-1005, 4:33-5:64, Figure 1B.

Several reasons would have motivated a POSITA to implement Gregorio's haptic feedback system (e.g., LRA), according to Wakuda's vibration generator system (e.g., vibration generator means). APPLE-1003, [145]. While Gregorio describes the main components of the LRA, the description is only at a high level. A POSITA, looking at Gregorio's disclosure, would have naturally looked to other references like Wakuda for implementation details. *Id.* Wakuda provides an implementation of vibration generator components similar to the components of Gregorio's LRA. *Id.*; APPLE-1004, 3:12-28, Figure 2; APPLE-1005, 4:33-5:64, Figure 1B. The operations are also similar based on the interaction between the magnetic fields of coil and magnet. *Id.*

A POSITA would have readily recognized that the resulting system maintains Gregorio's benefits in implementing Gregorio's system based on Wakuda's similar teachings. APPLE-1003, [146]. Gregorio contemplates its system as "a handheld device, such as a cellular telephone, PDA, computer tablet."

APPLE-1004, 3:1-2. Wakuda's vibration generating means are "mountable on small-sized information terminal devices, such as portable telephones, PDA."

APPLE-1005, 1:11-14. Therefore, a POSITA would have readily recognized that Gregorio's system directly benefits from Wakuda's teachings and would have been naturally motivated for the combination. APPLE-1003, [146]-[147].

This evidence is consistent with the law, which confirms that a POSITA would have been prompted to combine Gregorio and Wakuda when doing so was the application of known techniques (Wakuda's vibration generator) to a known system (Gregorio's similar haptic feedback system) ready for improvement to yield predictable results (benefits articulated above). *KSR Int'l Co. v. Teleflex Inc.* 550 U.S. 398, 417 (2007). A POSITA would have had a reasonable expectation of success in making the proposed modifications based on the similarity of Gregorio's and Wakuda's system architectures. APPLE-1003, [148].

A POSITA would have appreciated that the Gregorio-Wakuda combination does not change the hallmark aspects of either reference because the combination would modify Gregorio-Wakuda's actuator only to the extent that it is necessary to implement Wakuda's actuator, and Gregorio's techniques would otherwise remain unchanged and perform intended operations. APPLE-1003, [149]. Again, Wakuda's system is compatible with Gregorio's entire disclosure so that the resulting system still can perform monitoring a variable resonant frequency and

adjusting the haptic feedback accordingly, as disclosed in Gregorio. *Id.*

3. Analysis

[8a]

The Gregorio-Wakuda combination renders obvious that Gregorio's housing in the resulting system is the tube, as taught by Wakuda. APPLE-1003, [150]. The combination system would have a tube ("cylindrical-shaped casing") and "covers ... being mountable on both ends of the casing" (thus capped at both ends), as taught by Wakuda. APPLE-1005, 4:34-38. Further, the resulting system would include movable-component-repelling components ("[e]nergizing members") that are mechanical springs ("cone coil springs") and are "provided between both ends of the movable body 6 and inner surfaces of the covers." *Id.*, 5:14-18, 5:25-28.

[8b]

In the resulting system, the magnet (e.g., Gregorio's "magnet/mass" implemented by Wakuda's "magnet" as "movable body") slides within the tube ("cylindrical-shaped casing") in accordance with Wakuda. APPLE-1003, [151]; APPLE-1004, 3:12-14; APPLE-1005, 3:30-33, 4:48-4:63, 5:8-9, 5:32-35, 6:52-53.

[8c]

The resulting system includes an electromagnetic coil as the driving component according to the teachings of Gregorio and Wakuda. APPLE-1003, [152]. As discussed in [1e] above, Gregorio's LRA 18 includes the electric coil 28

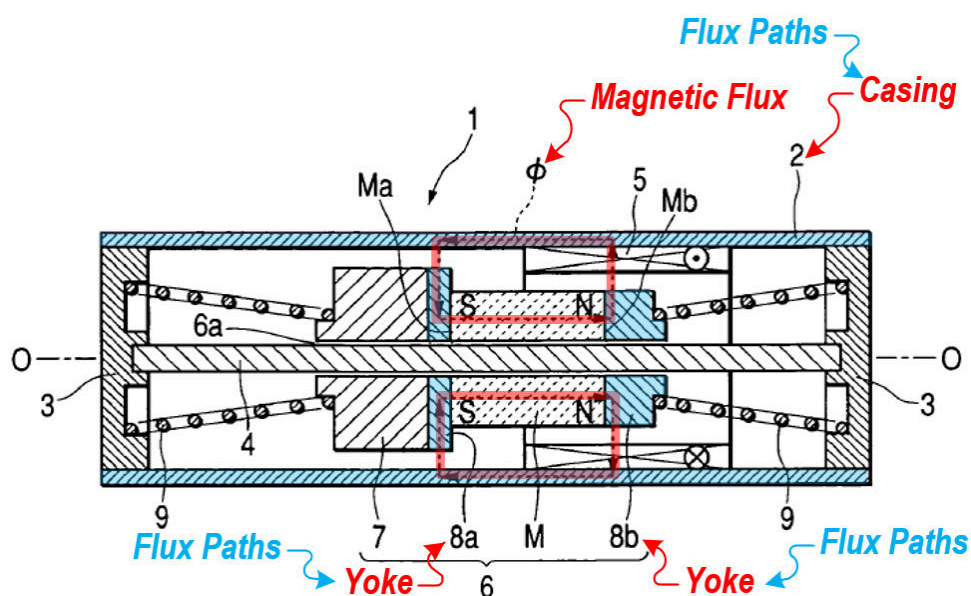
such that “when current flows thru coil 28 a magnetic field forms around coil 28.”

APPLE-1004, 3:12-28, 2:10-20. Similarly, Wakuda’s vibration generating means includes the coil 5, which is “formed by winding a length of covered copper wire.”

APPLE-1005, 4:42-44, 5:8-9.

[14]

Gregorio-Wakuda vibration module includes the flux paths, as taught by Wakuda. APPLE-1003, [153]. Wakuda renders obvious a magnetic flux created in the resulting actuator—Gregorio’s LRA implemented by Wakuda’s “vibration generating means” structure. §IV.B.2. Referring to Figure 1B below, Wakuda describes that “magnetic flux ϕ generated by the magnet M” defines a magnetic path through the yoke members 8a, 8b and the casing 2. APPLE-1005, 5:56-64. Notably, to create this magnetic path, Wakuda requires that the casing 2 and the yoke members 8a, 8b of the Gregorio-Wakuda’s actuator be “made of a magnetic substance.” *Id.*, 4:34-36, 4:51-54.

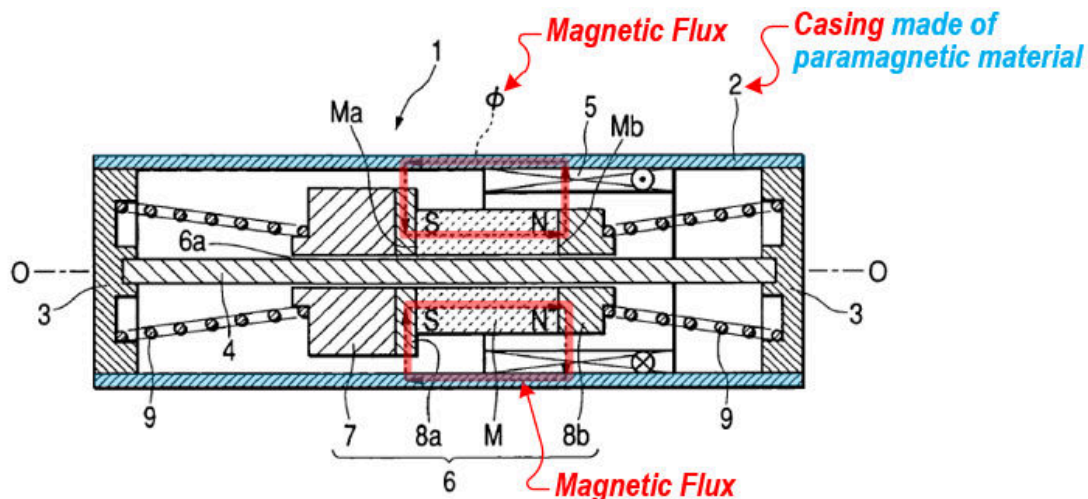


APPLE-1005, Figure 1B

A POSITA would have understood and found obvious that, in the resulting actuator, the casing, alone or along with the yoke members, corresponds to the flux paths because the casing and the yoke members are made of magnetic material, thereby reducing the reluctance of the magnetic path defined at the actuator (i.e., magnetic circuits within the vibration module) despite air gaps between the actuator components (e.g., casing 2 and movable body 6 in Wakuda). APPLE-1003, [154]; APPLE-1005, 4:34-4:54. Indeed, the concept that air gap increases the reluctance of a magnetic circuit was well-known. APPLE-1003, [154] (citing APPLE-1012). Therefore, it was well-known and obvious to shape and position the components of an actuator (or the materials thereof) that define a magnetic path such that the components reduce magnetic reluctance and increase magnetic flux.

Id.

Additionally, a POSITA would have understood and found obvious that a paramagnetic material would be beneficially used for Wakuda's "magnetic material" for the casing and the yoke members of the Gregorio-Wakuda's actuator. APPLE-1003, [155]; APPLE-1005, 4:34-4:54, 5:56-64. Indeed, paramagnetic materials are one of a few categorical options for magnetic materials. APPLE-1003, [155] (citing APPLE-1032 (describing paramagnets as one of four types of magnetic material), APPLE-1035, APPLE-1037). For example, a POSITA would have readily recognized that aluminum was a known example of a paramagnetic material, and that aluminum was widely used for housings of haptic feedback actuators or housings of user devices employing the actuators, which can be involved in creating a magnetic path. APPLE-1003, [155] (citing APPLE-1031, APPLE-1013).



APPLE-1005, Figure 1B

Several reasons would have motivated a POSITA to implement the casing of Gregorio-Wakuda's LRA using a paramagnetic material (e.g., aluminum).

APPLE-1003, [156]. As described above, Wakuda describes that the casing in the Gregorio-Wakuda combination is "made of a magnetic substance." APPLE-1005, 4:34-36, 5:59-64. Therefore, a POSITA would have investigated example magnetic materials for the casing such that the casing defines a part of the magnetic flux, as taught by Wakuda. APPLE-1003, [156]-[157]. As described above, a paramagnetic material was a well-known type of "magnetic substance" mentioned in Wakuda and provided adequate permeability to define the magnetic flux as identified in Wakuda. *Id.* (citing APPLE-1032, APPLE-1035, APPLE-1037).

Further, well-known paramagnetic materials (e.g., aluminum) were lighter than other popular magnetic materials like iron and steel, making it a superior choice for applications where weight matters, such as Gregorio-Wakuda's portable handheld device. APPLE-1003, [158]. Therefore, a POSITA would have been motivated to use paramagnetic materials in the resulting system to better serve the objectives of Gregorio and Wakuda—namely, making portable handheld devices of small form factor. *Id.*; APPLE-1004, 3:1-2; APPLE-1005, 1:11-14.

Moreover, paramagnetic materials (e.g., aluminum) were well-known to be

naturally resistant to rust and corrosion, giving it a longer lifespan in harsh environments compared to other popular magnetic materials like iron and steel. APPLE-1003, [159] (citing APPLE-1027, APPLE-1028). Therefore, a POSITA would have been motivated to choose such paramagnetic materials for the casing of the resulting system, such as portable handheld devices, which are intended to be frequently exposed to various daily environments (e.g., high/low temperature, humidity, etc.). *Id.*

Additionally, paramagnetic materials (e.g., aluminum) were excellent conductors of electricity and heat, making it suitable for various electrical applications such as the Gregorio-Wakuda's actuator system. APPLE-1003, [160] (citing APPLE-1029, APPLE-1030).

Lastly, the implementation of Gregorio-Wakuda's actuator to use paramagnetic materials would have been predictable because doing so was the application of known techniques (known materials for actuator elements) to a known device (Gregorio-Wakuda's actuator) ready for improvement to yield predictable results (benefits articulated above). *KSR*, 550 U.S. 417. A POSITA would have had a reasonable expectation of success in making the proposed modifications because the modifications would have been implemented by merely applying paramagnetic materials to Gregorio-Wakuda's actuator. APPLE-1003, [161]. The combination would modify Gregorio-Wakuda's actuator only to the

extent that it is necessary to implement the material of the actuator casing, and Gregorio-Wakuda's actuator would otherwise remain unchanged and perform intended operations. *Id.*

A POSITA would have readily understood that Wakuda's "magnetic path, along which the flux pass inside the casing 2 made of a magnetic substance" would achieve the same function as the '830 patent's "paramagnetic flux paths." APPLE-1003, [162]; APPLE-1005, 5:59-64; APPLE-1001, 14:3-19 ("lower-resistance path for magnetic flux, providing that they have adequate permeability and size to avoid saturation"); *In re Kuhle*, 526 F.2d 553, 555 (CCPA 1975) (use of claimed feature solves no stated problem and presents no unexpected result and "would be an obvious matter of design choice within the skill of the art"); *Ex parte Maeda*, Appeal No. 2010-009814 (Oct. 23, 2012) (informative). In fact, the '830 patent offers no evidence of unexpected results or a difference in function when using paramagnetic materials to define flux paths, other than what has been already achieved by Gregorio-Wakuda's solution ("magnetic substance" for the casing). APPLE-1003, [162]; *In re Chu*, 66 F.3d 292, 298-99 (Fed. Cir. 1995) ("design choice" is appropriate where the applicant fails to set forth any reasons why the differences between the claimed invention and the prior art would result in a different function); *Ex parte Spangler*, Appeal No. 2018-003800 (Feb. 20, 2019) (informative) (affirming the examiner's obviousness rejection, which determined

that claimed relative lengths and locations of two claimed components were a matter of obvious design choice because the specification did not suggest that the relative lengths or locations were critical to the claimed invention).

[19pre]-[19f]

See Ground 1A, [1pre]-[1f] (explaining that Gregorio discloses the same limitations in claim 1); APPLE-1003, [163]-[176].

Additionally, Wakuda describes the vibration generator system, which corresponds to the vibration module ([19pre]); the casing, which corresponds to the housing ([19a]); the weight and magnet, which correspond to the movable component ([19b]); the coil as the driving component ([19e]); the control means as the control component ([19f]). APPLE-1003, [163]-[176].

[19g]

Supra, [14] (explaining that the Gregorio-Wakuda combination discloses this limitation); APPLE-1003, [177].

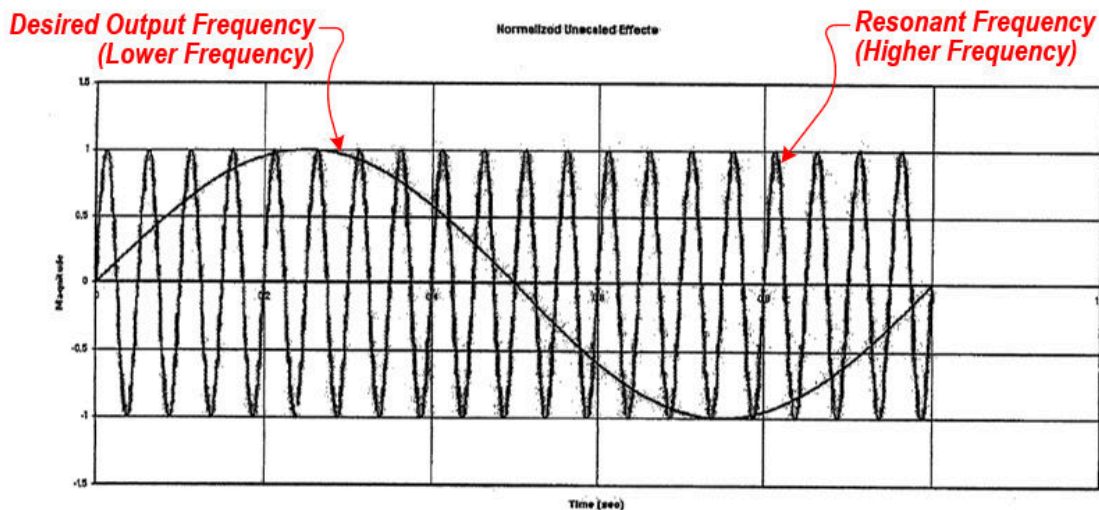
C. GROUND 1C: Gregorio-Tierling Renders Obvious Claims 15, 16, 20 (Plain-and-Ordinary Meaning and Patent Owner’s Means-Plus-Function Construction)

1. Tierling

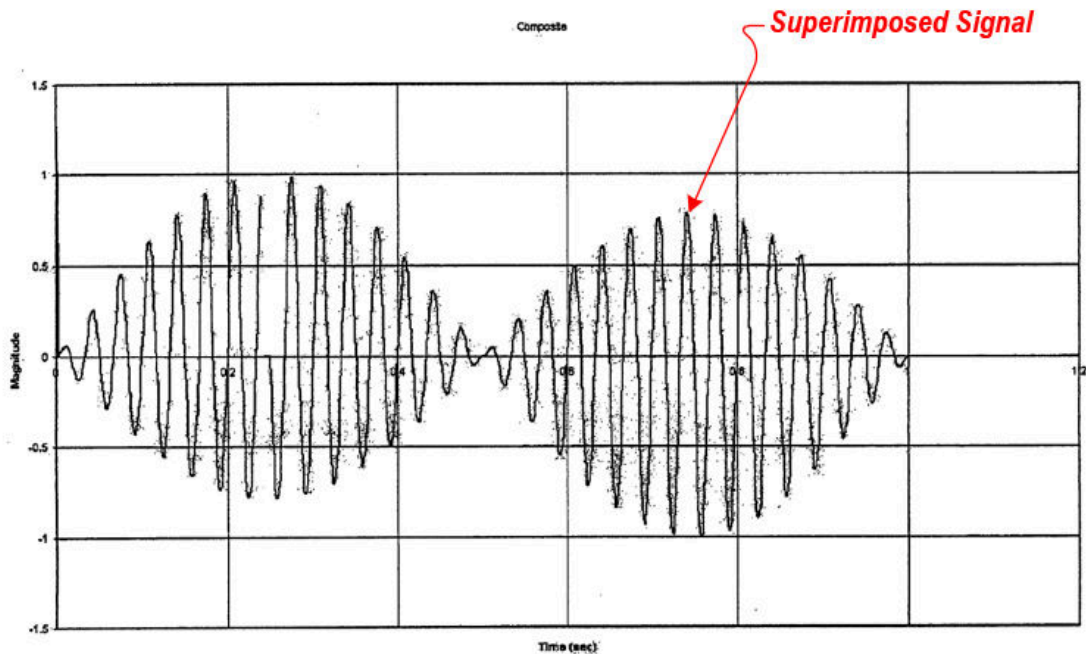
Tierling provides “mapping drive signals to haptic sensations” at user interface devices, such as wireless phone. APPLE-1008, [0002]-[0003]; APPLE-1003, [70]-[72]. Tierling’s “[e]ffect mappings ... can alter or control effect

components or parameters of a haptic sensation, such as amplitude, waveshape, frequency, phase, duration, or delay of the haptic feedback to be output by a haptic device.” *Id.*, [0031]. Such effect parameters can be controlled “by way of synthesis or other combination” and “output simultaneously or in sequence.” *Id.* “In cases where haptic feedback components are synthesized, the frequency of a first component can be modulated by the frequency of a second component.” *Id.*

In one implementation, Tierling’s system operates at both “a desired output frequency and a resonant frequency of a haptic device,” which are superimposed on each other. APPLE-1008, [0110]-[0112], Figures 9-10. Therefore, Tierling’s harmonic haptic device can be driven “without losing the low-frequency components.” *Id.*



APPLE-1008, Figure 9



APPLE-1008, Figure 10

2. Gregorio-Tierling

In the predictable combination, Gregorio's system plays Tierling's haptic effects using Tierling's effect mapping functionalities. APPLE-1003, [178]-[179].

A POSITA would have been motivated to play Tierling's haptic effects using Gregorio's system because Gregorio refers to haptic effects, which are based on the resonance frequency and high-level parameters such as magnitude, frequency, duration, but provides no specific examples of a desired haptic effect. *Id.*

Accordingly, a POSITA would have naturally investigated other references like Tierling (from the same assignee as Gregorio's) for examples of desired haptic effects that are based on the resonance frequency and high-level parameters.

APPLE-1003, [179]; APPLE-1008, [0031]. A POSITA would have understood

that Tierling's example haptic effects were applicable to Gregorio's system.

APPLE-1003, [179].

The resulting system would have benefited from Tierling's effect mapping technique, which "can drive a harmonic haptic device," like Gregorio's LRA, "without losing the low-frequency components" "by multiplying the low frequency desired output sinusoidal waveform with the higher frequency resonant mode waveform." APPLE-1008, [0110], [0030]-[0031]; APPLE-1003, [180] (citing APPLE-1017).

The Gregorio-Tierling combination was the application of a known technique (Tierling's effect mapping) to a known system (Gregorio's haptic feedback system) ready for improvement to yield predictable results (benefits articulated above). *KSR*, 550 U.S. at 417. A POSITA would have appreciated that the Gregorio-Tierling combination does not change the relevant features of either reference. APPLE-1003, [181].

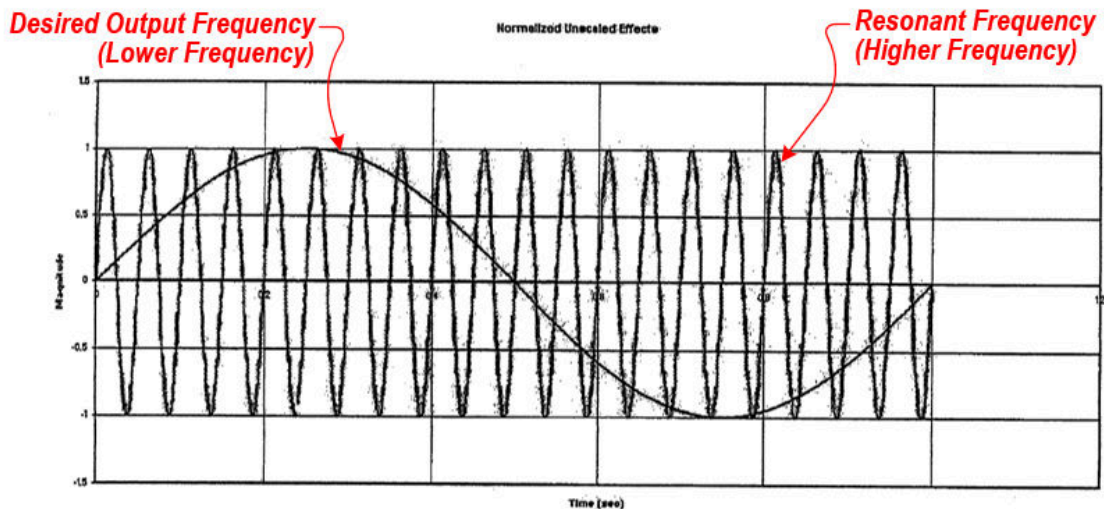
A POSITA would have had a reasonable expectation of success in making these modifications based on the structural similarity in Gregorio and Tierling (owned by the same company) and because the modifications would have been implemented largely through incorporating software instructions for executing Tierling's functionalities. APPLE-1003, [182]. Furthermore, the combination modifies Gregorio's system only to the extent that it is necessary to implement the

software functionalities of Tierling. *Id.* Accordingly, Gregorio's system otherwise remains unchanged and performs its intended operations. *Id.*

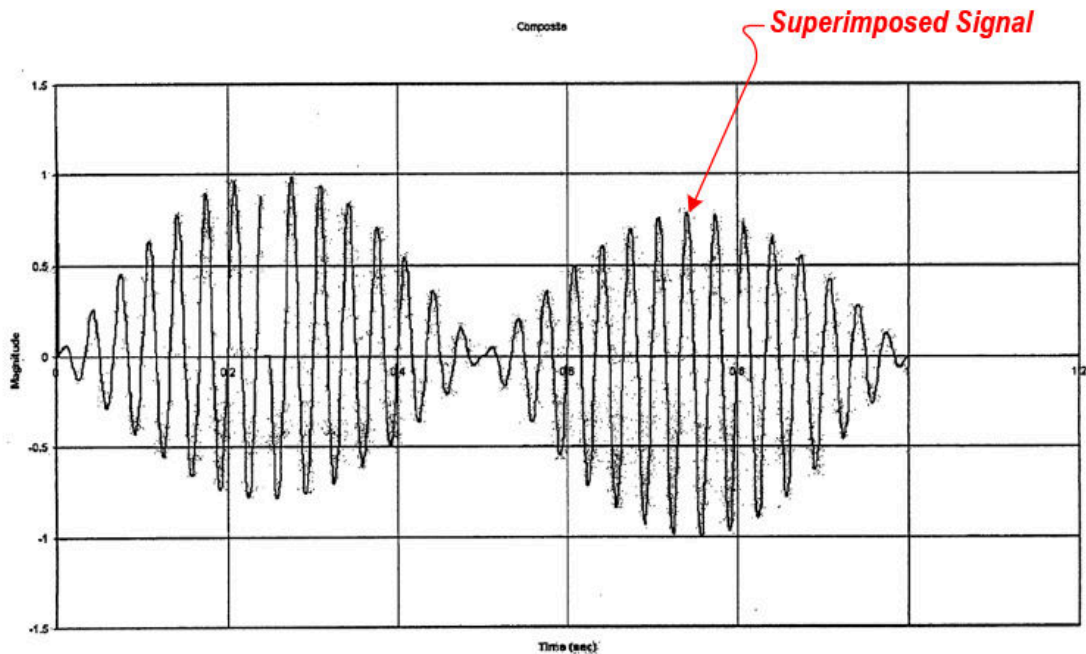
3. Analysis

[15]

Gregorio-Tierling's control component (Gregorio's control component modified to include Tierling's effect mapping functionality) drives simultaneous oscillation of the movable component (Gregorio's magnet/mass) at two or more frequencies (the resonance frequency and a frequency lower than the resonant frequency) to generate complex vibration modes (shown below). APPLE-1003, [183].



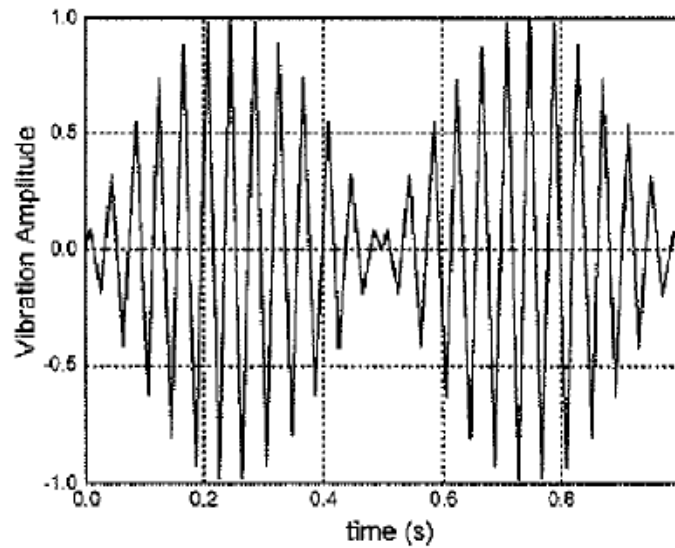
APPLE-1008, Figure 9



APPLE-1008, Figure 10

For example, Tierling describes “a desired output sinusoidal response having a frequency of approximately 1 Hz superimposed on a higher frequency resonant mode of a harmonic haptic device 124.” APPLE-1008, [0108] (“multiplying the low-frequency desired output sinusoidal waveform with the higher frequency resonant mode waveform ... in real-time”), [0031]; APPLE-1003, [184].

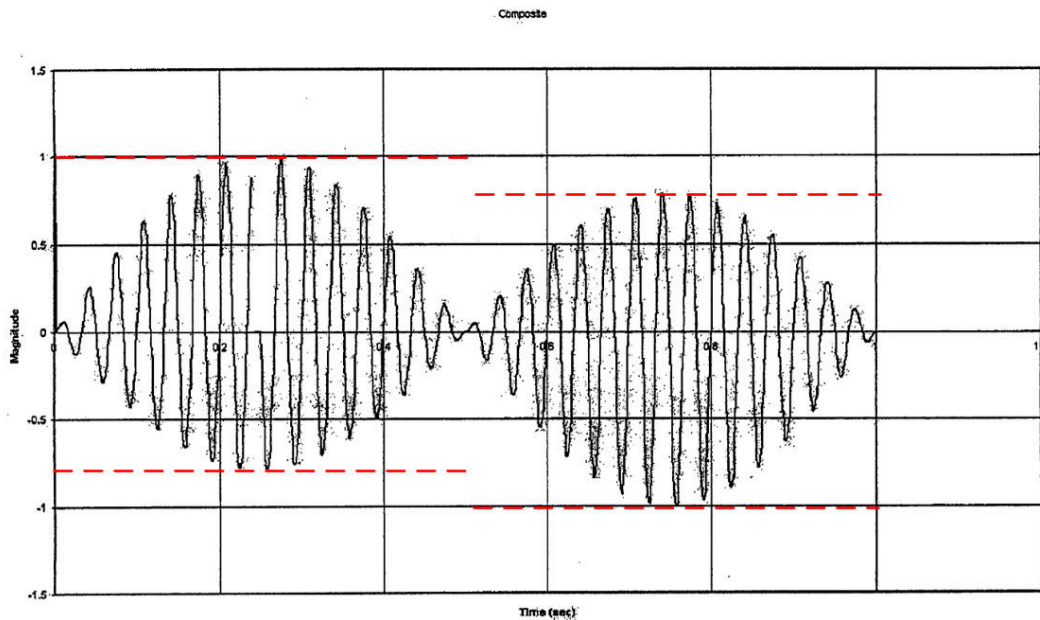
Notably, Tierling’s superimposed signal matches the ’830 patent’s “complex vibrational mode in which two driving frequencies combine to produce a lower-frequency beat-wave form,” as illustrated in Figures 22B-23. APPLE-1001, 13:31-59; APPLE-1003, [185].



APPLE-1001, Figure 22B

[16]

Gregorio-Tierling's complex vibration modes include a primary oscillation frequency (the resonance frequency) modulated by a modulating oscillation frequency (a lower desired frequency in [15]); a beat frequency (the difference between the resonance frequency and the lower desired frequency, which is illustrated in Tierling's Figure 10 below); and an aperiodic oscillation waveform (the waveform having an irregular amplitude as illustrated in Tierling's Figure 10). APPLE-1003, [186].



APPLE-1008, Figure 10

As discussed in [15] above, “the frequency of a first component [a higher resonance frequency] can be modulated by the frequency of a second component [a lower, desired frequency].” APPLE-1008, [0031], [0110]-[0112] (“frequency domain envelope modulation”); Figures 9-10. As in the ’830 patent, the difference between the higher resonance frequency and the lower, desired frequency is the beat frequency. APPLE-1003, [187] (comparing APPLE-1008, Figure 10, [0110]-[0112] with APPLE-1001, 13:46-49, Figure 23).

Further, as shown in Figure 10 above, the amplitude of the beat frequency (indicated by red dashed lines) is irregular and therefore aperiodic. APPLE-1003, [188]. Additionally, Tierling’s effect mapper 306 uses three different transformation matrices 504, 506, 508—(1) “an initiation transformation matrix” to

provide “initiation transformed effect instructions, such as a lead-in effect,” (2) “a sustaining transformation matrix that transforms the incoming effect instructions 502 into transformed effect instructions,” providing “the middle portion of each of the transformed effect instructions,” and (3) “a termination transformation matrix that transforms the effect instructions into termination transformed effect instructions,” providing “such termination effects as a braking pulse, or the like.” APPLE-1008, [0096]-[0098]. A POSITA would have readily understood that Tierling’s three different transformation matrices were designed to provide different haptic effects during each cycle (based on different amplitudes and frequencies, etc.), thereby generating an aperiodic oscillation waveform. APPLE-1003, [188].

Further, Gregorio’s resonance determination methods would have been advantageously used to generate complex vibration modes that include additional aperiodic waveforms wherein the resonance frequency changes irregularly over time. APPLE-1003, [189]. In Gregorio, LRA’s resonant frequency changes depending on various factors, such as a user’s interaction with a haptic-enabled device. For example, “when an LRA is mounted to a floating device (i.e., system 10 held softly in a hand), the LRA resonant frequency shifts up significantly. Further, significant frequency shifts can occur due to external factors affecting the apparent mounting weight of LRA 18 in system 10, such as a cell phone flipped

open/closed or the phone held tightly.” APPLE-1004, 3:50-55. Therefore, Gregorio’s system “constantly and dynamically determines the resonant frequency of [the] LRA” and adjusts the drive signal “to maximize the haptic feedback based on the determined resonant frequency.” APPLE-1004, 3:65-4:5, 2:5-9. As a result, the resonant frequency of the Gregorio-Tierling system’s complex vibration mode would accordingly vary when, for example, the user aperiodically changes the position of the device, how the device is held, and/or the shape of the device. APPLE-1003, [189]. The resulting waveform would have been an aperiodic waveform because the resonance frequency would change irregularly. *Id.*

[20pre]-[20f]

See Ground 1A, [1pre]-[1f] (explaining that Gregorio discloses the same limitations in claim 1); APPLE-1003, [190].

[20g]

Supra, [15] (explaining that the Gregorio-Tierling combination discloses this limitation); APPLE-1003, [191].

D. GROUND 1D: Gregorio-Ramsay Renders Obvious Claims 1-7, 15, 17, 20 (Plain-and-Ordinary Meaning and Patent Owner’s Means-Plus-Function Construction)

1. Ramsay

Ramsay provides techniques for “enabling a regular user of an end user device, such as a cellular telephone, to customize parameters associated with haptic

effects applied to the user by the end user device.” APPLE-1006, Abstract; APPLE-1003, [73]-[76]. For example, “the user may access programmable haptic design software 30 via GUI 24” to modify “parameters or characteristics of a haptic output or haptic track” that “include a frequency of vibration and amplitude of vibration.” *Id.*, [0030]-[0035], [0046], [0053], Figure 4. Ramsay also can “enable[] the user to enter one or more frequencies for the haptic track or even continually changing frequencies to be played along the length of the haptic track.” *Id.*, [0046], [0037]. Users can also “combine or mix different haptic tracks together if desired to provide a fuller haptic experience.” *Id.*, [0015], [0030], [0047].

Further, Ramsay’s “ROM 28 may be configured to store a library of preset haptic tracks,” and “also store haptic track files created or modified by the user.” APPLE-1006, [0028], [0034], [0042], [0049], [0058], [0065].

2. Gregorio-Ramsay

In the predictable combination, Gregorio’s system is implemented to enable a user to customize parameters associated with haptic effects, as taught by Ramsay. APPLE-1003, [192]-[193]. The resulting system stores the customized haptic effects to be selected and used in generating desired haptic feedback. *Id.* Ramsay would have modified Gregorio’s haptically-enabled system to embed “[s]oftware and systems” “according to the teachings [of Ramsay], to lead a user through the

process of entering and/or modify parameters and characteristics of haptic tracks.”

APPLE-1006, [0015]; APPLE-1003, [193]. Particularly, Gregorio-Ramsay’s memory device (e.g., Gregorio’s memory device 20 or Ramsay’s memory 16) would store “a software program for enabling an end user to create and/or modify haptic effects, the software program of which can be executed by processor,” and would “also store haptic track files created or modified by the user and can also store mixed track files, which include multiple haptic tracks combined together.” APPLE-1006, [0025]-[0028]; APPLE-1003, [193]. Further, the resulting system allows users to “access[] programmable haptic design software 30 via GUI 24 and open[] a file to be edited,” and to “interact with programmable haptic design software 30 by input and output mechanisms of GUI,” as taught by Ramsay. APPLE-1006, [0037]; APPLE-1003, [193].

A POSITA would have been motivated and found it obvious to modify Gregorio’s haptic feedback system to be user-configurable as described in Ramsay for several reasons. As recognized in Ramsay, the capability of modifying characteristics of haptic feedback was known to be limited to professional haptics designers, and that end users “typically [did] not have the option on the device itself to modify characteristics of haptic feedback.” APPLE-1006, [0014]-[0015]; APPLE-1003, [194]. Therefore, a POSITA would have looked for references like Ramsay to expand the functionalities of haptic devices and allow end users to

freely create and customize haptic effects. APPLE-1003, [194]. With Ramsay's teachings, a POSITA would have been motivated to provide Gregorio's system with Ramsay's user tools to offer flexibility in customizing haptic effects by allowing users to conveniently "create or modify the haptic effect files directly on the device." *Id.* The resulting system would also benefit from Ramsay's GUI that displays haptic tracks and offers various, easy-to-use mechanisms for adjusting haptic parameters. *Id.*; APPLE-1006, [0053]-[0057].

Further, the Gregorio-Ramsay combination would enable the resulting system to "provide a fuller haptic experience" by allowing users to "combine or mix different haptic tracks together if desired" in accordance with Ramsay. APPLE-1006, [0030], [0047]. A POSITA would have recognized that vibrant and interesting haptic effects result from the combination that enables independent controlling of the frequency and amplitude for oscillation. APPLE-1003, [195] (citing APPLE-1018).

Additionally, a POSITA would have been prompted to implement Gregorio's haptic feedback system to store haptic effects, in accordance with Ramsay's teachings, so that the haptic effect parameters, such as frequency and amplitude, are specified in the stored values. APPLE-1003, [196]. Storing haptic effects in the resulting system would further achieve Gregorio's purposes of "maximizing the haptic feedback" and generating haptic effects in "most effective

and efficient” manners, as opposed to an alternative approach of “real-time generated haptic effects.” *Id.*; APPLE-1004, 2:5-9, 1:32-36; APPLE-1010, [0008]. Generating haptic effects in real-time would require more processing power, and, in contrast, the local storage of haptic effects can “reduce[] the required processing power.” APPLE-1003, [196]; APPLE-1010, [0008].

A POSITA would have had a reasonable expectation of success in making the proposed modifications given that Gregorio and Ramsay describe the same techniques for controlling a linear actuator to produce desired output. APPLE-1003, [197]; APPLE-1004, 2:3-9; APPLE-1006, [0026]. The Gregorio-Ramsay combination requires only routine knowledge of software implementation techniques, which were well within the POSITA’s skill. APPLE-1003, [197]. The modification to Gregorio based on Ramsay’s teachings merely involves implementing Ramsay’s software solutions in Gregorio’s hardware setup without substantially changing Gregorio’s other structures. *Id.* The combination would modify Gregorio’s system only to the extent that it is necessary to implement Ramsay’s software tools, and Gregorio’s system would otherwise remain unchanged and perform its intended operations. *Id.*, [198]. Indeed, Gregorio and Ramsay, assigned to the same company, share similar structures and operations that are compatible. *Id.* For example, while Gregorio already discloses or renders obvious the frequency and amplitude being specified by the stored values (*supra*,

Ground 1A, [1f]), Ramsay similarly discloses that “the customized haptic effects created by a user can be stored on the device for use by the user.” APPLE-1006, [0017], [0027]-[0028]. Further, a POSITA would have recognized that Gregorio’s and Ramsay’s purposes (e.g., providing haptic feedback) are compatible, and the Gregorio-Ramsay combination would have accomplished those in a similar way that each of Gregorio and Ramsay achieves. APPLE-1003, [198]. The intended operations in each of Gregorio and Ramsay would be achievable in parallel to receive the benefits described by each reference. *Id.* Therefore, combining Gregorio and Ramsay was merely the application of known techniques (Ramsay’s software solution for user’s customization of haptic effects) to a known device (Gregorio’s haptically-enabled system) ready for improvement to yield predictable results (benefits articulated above). *KSR*, 550 U.S. 417.

3. Analysis

[1]-[7]

See Ground 1A, [1]-[7] (explaining that Gregorio discloses the same limitations in claim 1); APPLE-1003, [199].

Further, with respect to element [1d], the Gregorio-Ramsay combination’s user input features further include “input/output device” and “a graphical user interface (GUI)” providing a menu option, as taught by Ramsay. APPLE-1003, [200]; APPLE-1006, [0024], [0032], [0053], [0015].

With respect to element [1f], the Gregorio-Ramsay combination's high-level frequency and amplitude parameters are further specified by one or more stored values in "a library of preset haptic tracks" or "haptic track files" as taught by Ramsay. APPLE-1003, [201]; APPLE-1006, [0028], [0034], [0042], [0049], [0058], [0065].

[15]

The Gregorio-Ramsay combination renders obvious that the control component ([1f]) causes the moveable component to simultaneously oscillate at multiple frequencies to thereby generate complex vibration modes. APPLE-1003, [202]. For example, Ramsay describes that "one or more frequencies" can be entered for each haptic track. APPLE-1006, [0046]. Further, Ramsay enables users to "combine or mix different haptic tracks together if desired to provide a fuller haptic experience," and such mixed track files can be stored in memory. *Id.*, [0030], [0027]. When multiple haptic tracks are mixed to overlap with one another in time, "two or more haptic tracks can be programmed to be simultaneous or partially overlapping in time in any desirable manner." *Id.*, [0047]. Through these, a POSITA would have understood and found obvious that the Gregorio-Ramsay system would drive simultaneous oscillation of the movable component at two or more frequencies, as included in a single haptic track or in a mixed track that combines multiple haptic tracks having different frequencies. APPLE-1003,

[202]. A POSITA would also have recognized and found obvious that Ramsay's single haptic track having multiple frequencies or mixed haptic tracks with different frequencies combined would generate complex vibration modes, which would results in "a fuller haptic experience." *Id.*; APPLE-1006, [0030].

[17]

Gregorio's control component controls supply of power from the power supply to the driving component to cause the moveable component to oscillate at a frequency and an amplitude specified by one or more stored values. *See* Ground 1A ([1f]); APPLE-1003, [203]. In the Gregorio-Ramsay combination, those high-level frequency and amplitude parameters are independently specified by user input received from the user-input features (Ramsay's on-device user interface that allows the user to separately input frequency and amplitude). APPLE-1003, [203]; APPLE-1006, [0005], [0015].

Particularly, the Gregorio-Ramsay vibration module includes "on-device" "graphical user interface (GUI)" with a menu option, as taught by Ramsay. APPLE-1006, [0015], [0024], [0032], [0053]; APPLE-1003, [204]. Ramsay describes that, through GUI, "[c]ertain parameters or characteristics of a haptic output or haptic track can be created, entered, changed, modified, etc." and that such "modifiable parameters may include a frequency of vibration and amplitude of vibration." APPLE-1006, [0030], [0033], [0046], [0053]-[0055]. Therefore, a

POSITA would have understood and found obvious that, through the GUI, the user can independently set and modify various parameters including “a frequency of vibration and amplitude of vibration.” *Id.*; APPLE-1003, [204].

[20pre]-[20f]

See Ground 1A, [1pre]-[1f] (explaining that Gregorio discloses the same limitations in claim 1); APPLE-1003, [205].

[20g]

Supra, [15] (explaining that the Gregorio-Ramsay combination discloses this limitation); APPLE-1003, [206].

E. GROUNDS 1E-1F: Modifications to Gregorio-Ramsay Over Remaining Claims (Plain-and-Ordinary Meaning and Patent Owner’s Means-Plus-Function Construction)

Grounds 1E and 1F closely track Grounds 1B-1C with respect to claims 8, 14-16, 19, and 20.

In case Patent Owner argues Gregorio does not explicitly disclose “a frequency and an amplitude specified by one or more stored values” in [1f], Ramsay was added to each of the combinations of Grounds 1B-1C to provide such additional disclosure and form Grounds 1E-1F. APPLE-1003, [207]-[208]. Other than such addition to demonstrate how the combinations disclose the “stored values” limitation, all other analysis of the respective combinations remains the same as Grounds 1B-1C. A POSITA would have been prompted to apply the

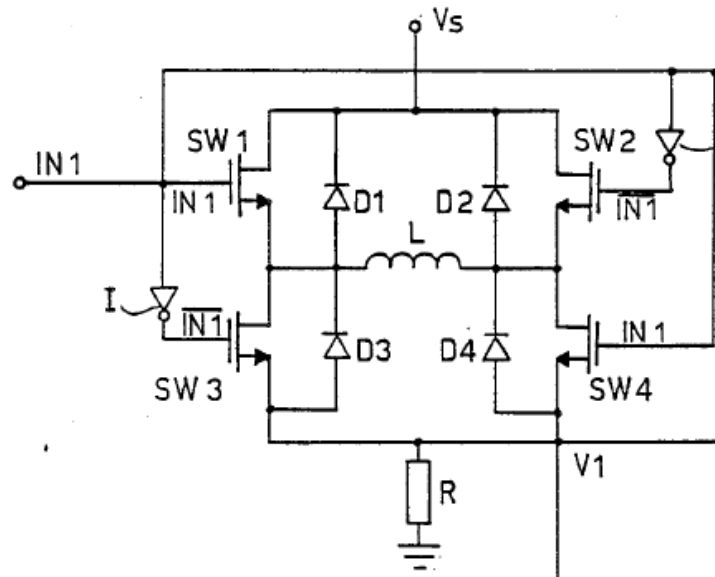
teachings of Wakuda and Tierling to Gregorio-Ramsay in the same manner and for the same reasons as discussed in Grounds 1B-1C.

F. GROUND 2A: Gregorio-Ramsay-Rossi-Aldrich Renders Obvious Claims 1-7, 15, 17, 20 (Both Parties' Means-Plus-Function Constructions)

If the Board applies the means-plus-function construction described above (*supra*, §II.C), claims 1-7, 15, 17, and 20 are obvious based on the Gregorio-Ramsay-Rossi-Aldrich combination. A POSITA would have found it obvious to combine Gregorio and Ramsay for the reasons described above. *Supra*, §IV.D (Gregorio-Ramsay combination). As discussed below, a POSITA would have further found it obvious to implement the combination in accordance with Rossi's switch circuit and Aldrich's suggestions of a "hill-climbing" control algorithm to tune the frequency input to maintain oscillation at a resonant frequency. APPLE-1003, [209]-[210].

1. Rossi

Rossi's H-bridge switching circuit includes "two pairs of analog switches arranged in a bridge configuration." APPLE-1020, Abstract; 1:65-3:55, Figures 4, 6, cls. 1, 3, 4. The H-bridge circuit includes a "driving signal IN1" input, which is split and a portion passed through an "inverter I" to generate an internal "driving signal IN1" and an "inverted signal thereof $\overline{\text{IN1}}$." *Id.*; APPLE-1003, [77]-[80].



APPLE-1020, Figure 6 (partial)

2. Aldrich

Aldrich describes a feedback control algorithm to drive an actuator to “one of the resonance peaks and eventually to oscillate about the peak.” APPLE-1021, 2. The drive frequency is incremented or decremented. *Id.* If the increment/decrement results in an increased output (e.g., current/voltage ratio), the direction of change (increase or decrease) of frequency is accepted and another such change (increment or decrement) is made during the following sampling period. *Id.* If, on the other hand, the increment/decrement results in a decrease in output, the direction of change of frequency during the following sampling period is reversed. *Id.* This process is repeated during oscillation to maintain oscillation about a resonant frequency. *Id.*; APPLE-1003, [81]-[84].

3. Gregorio-Ramsay-Rossi-Aldrich

(a) Gregorio-Ramsay-Rossi

In the predictable combination, Gregorio-Ramsay's actuator system includes a switch (e.g., H-bridge switch circuit) having a control signal input, splitter and control signal inverter, in accordance with Rossi, that receives the control signal from the processor, in accordance with Gregorio-Ramsay's feedback control. APPLE-1003, [211]. Such a configuration would have yielded the predictable result of oscillating the actuator's magnet by switching the polarity of drive signals generated based on Gregorio-Ramsay closed-loop concepts for feedback control.

Id.

Several reasons would have motivated a POSITA to modify Gregorio-Ramsay's system based on Rossi's teachings of switch. Indeed, Gregorio describes applying current through the coil in opposite directions to "push[] or pull[] on magnet." APPLE-1004, 3:17-21. Further, an H-bridge switch was a well-known example circuit to implement a change in "current flow direction/polarity" for "push" and "pull" actions in a system, like Gregorio-Ramsay's. APPLE-1003, [212]; APPLE-1023, 7:47-50 ("well-known H-bridge circuit"). Although Gregorio-Ramsay does not explicitly describe complete implementation details of a switching circuit, prior art systems such as Rossi demonstrated the conventional knowledge of implementing such a circuit to

provide oscillating power. APPLE-1003, [213]-[214]; APPLE-1020, 1:65-2:11, 3:43-55, Figures 4, 6.

A POSITA would have been motivated to implement Rossi's switch in the Gregorio-Ramsay system for several reasons. APPLE-1003, [215]. First, as discussed above, Gregorio does not expressly disclose implementation specifics for switching the "current flow direction/polarity," and therefore a POSITA would have looked toward other teachings like Rossi for implementation details in furtherance of Gregorio's objectives. *Id.*, [216]; APPLE-1004, 3:17-21. A POSITA would have recognized the benefits from Rossi's straightforward teachings of providing complementary drive signals for respective sets of the four H-bridge transistors, such that current/voltage is applied in one of two opposite directions through the coil. APPLE-1003, [216]; APPLE-1020, Abstract, 1:65-3:54; Figures 4, 6. Rossi explicitly indicates the predictable benefit of a configuration that is effective to "functionally switch the load L between the supply node Vs, and virtual ground nodes," thereby reliably driving the movable magnet head of the actuator. APPLE-1020, 2:4-12.

Second, a POSITA would have been motivated to combine Gregorio-Ramsay and Rossi to avail the system of a simple, cost-effective, and reliable circuit design. APPLE-1003, [217]. A POSITA would have recognized that Rossi's controlling the four transistors of the H-bridge using a control signal from

the “processor” that is split and inverted would reliably result in complementary internal signals, which promotes simplicity in the control signal generation and the circuit to deliver the drive signal to the coil. *Id.*

Third, a POSITA would have recognized that combining Rossi and Gregorio-Ramsay was the application of known techniques (Rossi’s H-bridge circuit implementation) to a known device (Gregorio-Ramsay’s system that switches polarity of current) ready for improvement to yield predictable results (benefits articulated above). *KSR*, 550 U.S. at 417. A POSITA would have had a reasonable expectation of success in making the proposed modifications based on the similarity of the function of the H-Bridge switch circuit in Rossi and Gregorio-Ramsay, and because the modifications would have been implemented largely through routine circuit design considerations and software instructions for generating the control signal. *APPLE-1003*, [218].

(b) Gregorio-Ramsay-Rossi-Aldrich

In the predictable combination, Aldrich’s control algorithm is implemented in Gregorio-Ramsay-Rossi’s system that utilizes sensor feedback to control vibration output about a resonant frequency. *APPLE-1003*, [219]. In the combined system, sensor outputs would be processed using Aldrich’s control algorithm techniques, which replace Gregorio’s operation based on “monitoring period.” *Id.*; *APPLE-1004*, 4:22-28, 5:53-55; *Intel Corporation v. PACT XPP*

Schweiz AG, 61 F.4th 1373, 1381 (Fed. Cir. March 13, 2023) (reversing Board and finding that Petitioner “just had to show that [secondary reference’s feature] was a ‘suitable option’ to replace [primary reference’s feature],” and not that it was an “‘improvement’ in the categorical sense”). For example, to generate control signals that maintain oscillation at/near resonance, the drive frequency would be incremented or decremented, and a currently measured vibration strength parameter, such as the measured “LRA vibration amplitude” (APPLE-1004 at 4:42-48), would be compared with a previously measured vibration strength parameter. APPLE-1003, [219]; APPLE-1021, 2. According to Aldrich, if the increment or decrement results in an increased vibration strength, the direction of change (increase or decrease, respectively) of frequency is accepted and another such change (increment or decrement, respectively) is made during the following sampling period. *Id.* If the increment or decrement results in a decrease in vibration strength, then the direction of frequency change during the following sampling period is reversed. *Id.*

Further, the resulting system would implement Aldrich’s hill-climb technique using a Boolean value to indicate whether the frequency was being increased. APPLE-1003, [220]. The use of Boolean values to track such a parameter was conventional, and would have been selected as a matter of routine implementation based on Aldrich’s switching between incrementing and

decrementing frequency. *Id.* (citing APPLE-1026, 29). Indeed, based on Aldrich's description of reversing the direction of frequency change, a POSITA would have predictably utilized a Boolean variable to track the direction of frequency change. *Id.*; APPLE-1021, 2.

Additionally, the resulting system would implement Aldrich's hill-climb technique in a feedback control loop in which local variables are set to default variables. APPLE-1003, [221]. A POSITA would have recognized and found it obvious to set local variables to default values so that the control signal is generated to produce oscillation, which is then adjusted as appropriate through feedback control. *Id.* A POSITA would have been motivated to set default values for these specific local variables to facilitate initiation of the actuator close to expected and/or user-selected operating parameters. *Id.*

Further, a POSITA would have been prompted to utilize integer values when processing sensor signals. APPLE-1003, [222]. In the combined system, the sensor signals are an integer value, which facilitates digitally processing the signals, and efficient computation and processing of the force values represented by the sensor signals. *Id.*; APPLE-1021, 2. The use of integer values amounted to a mere design choice (between integer or non-integer values). *Id.* Moreover, a POSITA would have readily recognized the efficiency and effectiveness of utilizing an integer value associated with the sensor signals. *Id.*

Multiple reasons would have prompted a POSITA to implement Aldrich's "hill-climbing" control algorithm in the Gregorio-Ramsay-Rossi system. APPLE-1003, [223]-[224].

First, a POSITA would have combined Gregorio-Ramsay-Rossi and Aldrich to avail the system of a known feedback algorithm for targeting a resonant frequency, thereby improving Gregorio-Ramsay-Rossi's system with the known benefits from the algorithm. APPLE-1003, [225]. Although Gregorio already describes a technique of monitoring sensor outputs to determine a resonant frequency and adjusting the control signal to maintain oscillation at/near resonance (APPLE-1004, 3:65-5:55), Gregorio's technique introduces a "monitoring period (approximately 10%) of the drive cycle," during which "drive circuit 16 'listens' or monitors and receives magnetic back EMF (i.e., the voltage generated by the internal motion inside LRA 18) from LRA 18." APPLE-1004, 4:22-28. During the monitoring period, a drive pulse is not applied to the actuator. *Id.*; *see also* 5:53-55. Therefore, a POSITA would have readily recognized that the monitoring period would create a period as part of the drive cycle where a user receives no or reduced haptic feedback depending on the duration of the period. APPLE-1003, [226]. Further, a POSITA would have understood that Gregorio's monitoring period would only receive weak EMF signals of the moving mass because the movement of the mass significantly decreases in amplitude during the monitoring

period. *Id.*; APPLE-1004, 5:63-65. Understanding these shortcomings and attempting to improve Gregorio-Ramsay-Rossi's monitoring/adjusting method in an alternative way, a POSITA would have looked to other teachings like Aldrich for such details, especially where Aldrich explicitly describes driving an actuator at/near resonance using such control algorithm techniques. APPLE-1003, [226]; APPLE-1021, 1-3.

Second, a POSITA would have combined Gregorio-Ramsay-Rossi and Aldrich to implement feedback control according to Aldrich's technique that continuously updates the control outputs throughout operation of the system. APPLE-1003, [227]. Aldrich's algorithm continuously facilitates comparison of current and previous parameters throughout device operation (without interruption by Gregorio's monitoring period) so that the control outputs (e.g., frequency of the control signal) can be adjusted to maintain oscillation at/near resonance frequency, furthering the explicit objectives of Gregorio-Ramsay-Rossi and Aldrich. *Id.*

Third, this combination was the application of known techniques (Aldrich's "hill-climbing" algorithm) to a known system (Gregorio-Ramsay-Rossi's feedback control system) ready for improvement to yield predictable results (benefits articulated above). *KSR*, 550 U.S. at 417; APPLE-1003, [228].

Moreover, a POSITA would have had a reasonable expectation of success in making the proposed modifications based on the applicability of Aldrich's method

to the resonant system architectures in Gregorio-Ramsay-Rossi, and because the modifications would be largely implemented via software executed by the microprocessor. APPLE-1003, [229]. In the combined system, sensor outputs would have been received and processed by Gregorio's processor using at least a "hill-climbing control algorithm" "to find and remain within the vicinity of the resonance," in accordance with Aldrich's suggestions. APPLE-1021, 2. For example, it would have been obvious to a POSITA to modify Gregorio's processor to include a control program based on Aldrich's algorithm. APPLE-1003, [229]. The control program would have been included with existing "instructions executed by processor" of Gregorio. APPLE-1004, 2:44-50. Implementing Aldrich's algorithm as a control program for applying continuous feedback control would have been a routine software change, requiring application of known coding techniques. APPLE-1003, [229].

4. Analysis

[1pre]-[1e]

See Ground 1A, [1pre]-[1e] (explaining that Gregorio discloses the same limitations in claim 1); APPLE-1003, [230]-[232].

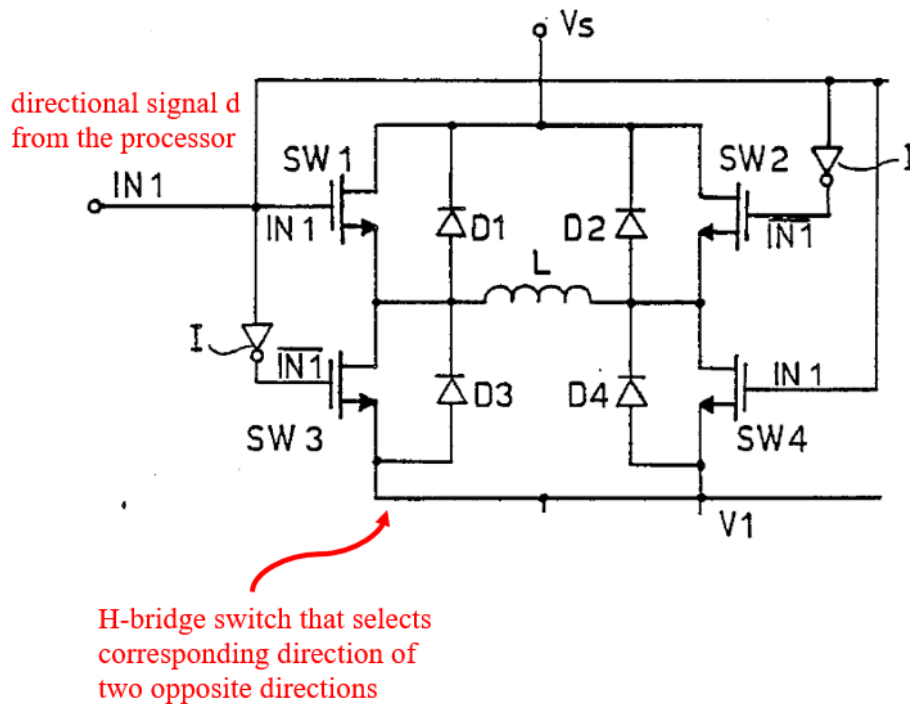
[1f]

Under the means-plus-function construction (§II.C.1), the Gregorio-Ramsay-Rossi-Aldrich combination's vibration module includes the recited control

component. APPLE-1003, [233].

As shown in [1pre], the resulting system would include “processor 12” coupled to memory, as in Gregorio’s “haptic feedback system.” Ground 1A; APPLE-1004, 2:18-21; APPLE-1003, [234].

Further, the combination includes a switch (e.g., H-bridge switch) according to Rossi. APPLE-1003, [235]. A POSITA would have found obvious that, based on the Gregorio-Ramsay-Rossi-Aldrich combination, the microprocessor is programmed to provide a control output to the H-bridge switch for controlling the direction of the drive signal through the coil. *Id.* For example, a control signal is output from the microprocessor to a transistor of the H-bridge switch to control whether the transistor is in an open or closed state, providing the direction signal. *Id.* In the resulting system, the switch receives a directional signal (e.g., at “IN1”) that selects a corresponding direction of the two opposite directions in which the driving component drives the moveable component. *Id.*; APPLE-1020, 1:65-2:15, 3:44-55.



APPLE-1020, Figure (partial)

Moreover, the Gregorio-Ramsay-Rossi-Aldrich combination provides that the processor is programmed with the algorithm described in Figures 7A-7C of the '830 patent under the means-plus-function construction. §II.C.1; APPLE-1003, [236].

Step 702 of the '830 patent's algorithm begins execution upon a power-on event. APPLE-1001, 6:57-60. In the combined system, the software instructions of the processor similarly begins execution upon a power-on event invoked by a user through a power button or other user control. APPLE-1003, [237]. Indeed, the combined system includes user-input features as taught by Gregorio ([1d]),

which a POSITA would have readily recognized included a power on/off button and were used to power on/off the system. *Id.*

In the '830 patent's step 702, "various local variables are [then] set to default values." APPLE-1001, 6:60-7:3. Similarly, the software of the processor in the combined system sets the same local variables to default values. APPLE-1003, [238]-[240], [85]-[86] (citing APPLE-1024, APPLE-1006); §IV.F.3.(b) (describing the POSITA's motivation for this implementation).

Moreover, in the combined system, the set-point values include variables consistent with the seven variables recite by the '830 patent, according to the means-plus-function construction. APPLE-1003, [241]-[242].

For example, the combination includes a current operational *mode* of the device. APPLE-1003, [243]. Indeed, the combined system uses multiple different "haptic effects" (operational modes) based on "high level parameters" including "magnitude, frequency and duration" as taught by Gregorio and Ramsay. APPLE-1004, 2:25-30; APPLE-1003, [243]; §IV.A.2 & D.3 ([6a]). Particularly, Gregorio describes that "[p]rocessor 12 can decide what haptic effects are to be played." APPLE-1004, 2:25-30. Further, Ramsay describes "ROM 28 may be configured to store a library of preset haptic tracks." APPLE-1006, [0028]. Accordingly, the combined system would operate based on one of the stored pre-defined haptic effects (*default operational mode*), such as an effect in which feedback control

maintains oscillation at the mechanical resonant frequency, when initialized.

APPLE-1003, [243]-[245] (describing predictable benefits of a variable to indicate to the control program the operational mode). Additionally, the combined system includes one or more alternative or complex modes of operation that systematically and/or periodically alter the frequency or produce various complex, multi-component vibrational modes. APPLE-1003, [245] (describing example multi-component vibrational techniques that “combine haptic tracks” and/or that systematically/periodically alter the output over time); APPLE-1006, [0035]-[0039], [0047], [0057]-[0059]. For example, as discussed above, Ramsay describes multiple haptic tracks being mixed to drive simultaneous oscillation of the movable component at two or more frequencies. Ground 1D, [15]. Ramsay also describes “a library of preset haptic tracks” having different haptic parameters and/or that are combined. APPLE-1006, [0028].

The combination includes a *strength* variable (magnitude). APPLE-1003, [246]. For example, Gregorio describes a magnitude variable as one of the “high level parameters that define a particular haptic effect.” APPLE-1004, 2:28-30. Further, Ramsay describes that a magnitude variable is user-configurable through GUI. APPLE-1006, [0022]-[0026], [0030]-[0033], [0046], [0053]-[0055]; Ground 1D, [17]; APPLE-1003, [246], [87]-[89] (citing APPLE-1023, APPLE-1025). Accordingly, the combined system would operate based on one of the strength

settings (as part of the predefined haptic effects) when it is powered on. APPLE-1003, [246]-[247].

The combination also includes *sensed values* that include previously-sensed (lv0) and currently-sensed (lv1) vibrational strength values. The combined system includes a currently sensed vibration strength value and a previously sensed vibration strength value that are compared in carrying out the control algorithm. APPLE-1003, [248]; APPLE-1021, 2 (describing evaluation of frequency change results in increase or decrease of vibration output). The variables are initialized with default values that provide a starting point for operation (e.g., zero). APPLE-1003, [248].

The combination includes a *frequency* (freq) at which current is changed in the coil, and the directional *control signal* (d) from the microprocessor. APPLE-1003, [249]; APPLE-1004, 4:20-22; APPLE-1021, 1-3 (“excitation frequency”). In the combination, the frequency variable is initialized with default values to provide a starting point for operation (e.g., based on the stored “haptic effect”/“haptic track,” or assumed resonant frequency). APPLE-1003, [249]. For example, Gregorio describes use of a default frequency value upon initialization based on an “assumed” resonant frequency. APPLE-1004, 4:20-22. Further, the directional signal, for example, is initialized with a default value (e.g., high or low), which is then reversed during operation to induce oscillation according to the

feedback control program. APPLE-1003, [249] (describing obvious design choice of initialize direction signal d as high or low) (citing APPLE-1019, APPLE-1020).

The combination includes a ***Boolean value*** (inc) that indicates that the frequency is being increased. APPLE-1003, [250]. The Boolean value tracks the status of frequency increase/decrease to implement the comparison in accordance with Aldrich's control algorithm, as a matter of routine implementation. *Id.*

In the '830 patent's step 704, the control program "waits for the next event." APPLE-1001, 7:3-7. In the combined system, the software executing on the microprocessor waits for the next event, such as a sensor input to be used in determining the control signal, or a user input to power down the device or modify haptic effect characteristics. APPLE-1003, [251]; APPLE-1006, [0022]-[0026], [0030]-[0033], [0046], [0053]-[0055]; Ground 1D, [17]. When sensor signals are received by the microprocessor, the control outputs are adjusted accordingly. APPLE-1003, [251]; APPLE-1004, 3:65-4:14, 6:5-9. Indeed, use of a loop or event handler in a feedback control system were known and a conventional technique readily implemented by a POSITA to operate in accordance with the respective event. APPLE-1003, [252] (citing APPLE-1026).

In the '830 patent's step 712, the control program algorithm calls a "monitor" routine," which is illustrated in Figure 7B. APPLE-1001, 7:29-31. The "monitor" routine is a simple and known routine for implementing a feedback loop

to maintain operation of a vibration module at or near resonance. APPLE-1003, [253]. The combined system executes the same algorithm. *Supra*, §IV.F.3 (Gregorio-Ramsay-Rossi-Aldrich combination). Particularly, a POSITA would have found it obvious, especially based on Aldrich's feedback control to operate at a resonant frequency, to compare vibration parameters while incrementing or decrementing the drive frequency. APPLE-1003, [253].

The combined system includes one or more sensors, as taught by Gregorio. APPLE-1003, [254]. In particular, Gregorio describes detecting a back electromagnetic field (EMF) or the position of the mass, and then determining the "LRA vibration amplitude" "based on the derivative of the speed of the mass (dv/dt)" or the position. APPLE-1004, 4:7-10 ("sensing coil, Hall sensor, optical sensor or other type of sensing device that is located in proximity to mass"), 4:42-48. Therefore, the software executed by the microprocessor in the combined system receives signals from the sensors, indicative of vibrational strength, and compares a current sensed vibration strength value and a previous sense vibration strength value to tune the input frequency about a resonant frequency, consistent with steps 736-750 of Figure 7B of the '830 patent. APPLE-1003, [254]; APPLE-1021, 1-3.

For example, in accordance with Aldrich's suggestions, a current sensed vibration strength value at an incrementally increased control signal frequency is

compared with a previous sensed vibration strength value. APPLE-1003, [255].

When the vibration strength has increased with increased frequency input, “then the direction of change . . . of frequency is accepted and another such change . . . is made during the following sampling period.” APPLE-1021, 2. This is the same as steps 738-740 of the ’830 patent.

Similarly, when the vibration strength has not increased with increased frequency input, the control program determines that the resonant frequency has been exceeded. APPLE-1003, [256]; APPLE-1021, 2. The “direction of change of frequency during the following sampling period is reversed,” such that the frequency is decremented, and the process continues. APPLE-1021, 2. This is the same as steps 742-744 of the ’830 patent. APPLE-1003, [256]. The combined system proceeds in a similar manner when decrementing the input frequency, following steps 746-752 of the ’830 patent. *Id.*, [257].

In the combined system, the currently and previously sensed sensor signals are processed and stored as integer values. As discussed above, the use of integer values amounts to a known technique and a mere design choice (e.g., between integer or non-integer values). §IV.F.3 (Gregorio-Ramsay-Rossi-Aldrich combination); APPLE-1003, [258].

In the ’830 patent’s step 714, the control program calls a “control” routine, which is illustrated in Figure 7C, “when the event corresponds to a change in the

user input through the user interface.” APPLE-1001, 7:31-34, 8:20-32. In the combined system, the user input provides a change in vibration strength (e.g., in accordance with Ramsay), and the user input is received during a monitoring period so that the input is processed and implemented. APPLE-1003, [259]-[261]. Particularly, the software executing on the microprocessor outputs a corresponding control signal to the power supply in accordance with the user input. *Id.*

In the '830 patent's step 718, the control program determines whether there has been a power down event. APPLE-1001, 7:34-38. Similar to the power on event described above, a POSITA would have readily recognized that the combined system executes a power-down event in response to user input (e.g., Gregorio's user-input features) that turns the device “off.” APPLE-1003, [262].

In the co-pending litigation, Patent Owner alleged the “control component” as a means-plus-function limitation and identified the corresponding structure as “oscillator circuit; microcontroller with internal or external memory; processor; CPU; microprocessor; and equivalents thereof,” and “[w]here the corresponding structure is a processor, CPU, or microprocessor, the processor/CPU/microprocessor is programmed with an algorithm comprising the following steps: (a) set the mode and strength to default values or values representing selections made by user input to the user input features; and (b) provide a corresponding output to the power supply so that the power supply

provides a corresponding output to the driving component.” APPLE-1046, 13; APPLE-1047, 19-23. Similarly, in litigation against Samsung Electronics, Patent Owner alleged the “control component” as a means-plus-function limitation and identified the corresponding structure as “[if an algorithm is required] . . . a processor, CPU, or microprocessor, the processor/CPU/microprocessor is programmed with an algorithm comprising the following steps: (a) set the mode and strength to [default values or] values representing selections made by user input to the user input features; and (b) provide a corresponding output to the power supply so that the power supply provides a corresponding output to the driving component” or “[i]n the alternative, if the Court finds that a three-step algorithm is necessary, . . . (1) set the mode and strength to [default values or] values represented by selections made by user input to the user input features, (2) provide a corresponding output to the power supply, and (3) provide a corresponding output to an H-bridge switch.” APPLE-1045, 14-15, 19-22. Notably, these means-plus-function interpretations are subsumed within this Petition’s mapping in Ground 2A, which identifies the narrowest disclosure of the ’830 patent as the corresponding structure. *Supra*, §II.C.1; APPLE-1003, [263].

[2]-[7], [15], and [17]

The Gregorio-Ramsay-Rossi-Aldrich combination renders obvious claims 2-7, 15, and 17 obvious, as taught by Gregorio or Gregorio-Ramsay. *Supra*, Grounds

1A, 1D; APPLE-1003, [264].

[20]

As discussed in §II.C.1, under the means-plus-function construction, the corresponding structure for “control component” in claim 20 is identical to the corresponding structure for “control component” in claims 1 and 19, except that the algorithm is further designed for the additional function of “driving simultaneous oscillation of the moveable component at two or more frequencies to generate complex vibration modes.” Such additional algorithm is described at column 13 of the ’830 patent. APPLE-1001, 13:20-59; APPLE-1003, [265].

As discussed in [1f] above, the Gregorio-Ramsay-Rossi-Aldrich combination provides the additional algorithm for the “complex vibration modes.” APPLE-1003, [266]. For example, the resulting system includes one or more alternative or complex modes of operation that systematically and/or periodically alter the frequency or produce various complex, multi-component vibrational modes. *Id.*; Ground 2A ([1f], [15]); APPLE-1006, [0035]-[0039], [0047], [0057]-[0059].

Additionally, the Gregorio-Ramsay-Rossi-Aldrich combination provides the other limitations of claim 20, as taught by Gregorio-Ramsay. *Supra*, Grounds 1D; APPLE-1003, [267].

In the co-pending litigation, Patent Owner alleged the “control component”

in claim 20 as a means-plus-function limitation and identified the same corresponding structure as in claims 1 and 19 (except for oscillator circuit and default values). APPLE-1046, 12-13; APPLE-1047, 19-23. Patent Owner further identifies that, as the corresponding structure, “the algorithm comprises the following additional step: (c) drive simultaneous oscillation of the moveable component at two or more frequencies.” *Id.* Notably, this means-plus-function interpretation is covered by this Petition’s mapping based on the Gregorio-Ramsay-Rossi-Aldrich combination above because Patent Owner’s interpretation is a broader version of the ’830 patent’s disclosed algorithm. *Supra*, §II.C.1; APPLE-1003, [268].

G. GROUNDS 2B-2C (Both Parties’ Means-Plus-Function Constructions)

Except for the means-plus-function construction discussed above in Ground 2A, Grounds 2B-2C are substantially the same as Grounds 1E-1F. *Supra*, Grounds 1E-1F; APPLE-1003, [269]-[270].

Additionally, under the means-plus-function construction, the Gregorio-Ramsay-Rossi-Aldrich-Tierling combination provides the additional algorithm for the “complex vibration modes” in claim 20, in accordance with Tierling’s teachings as discussed in Ground 1C. APPLE-1003, [271]; *supra*, Ground 1C ([15]); APPLE-1008, [0108], [0031], Figures 9-10. Similarly, the Gregorio-

Ramsay-Rossi-Aldrich-Tierling combination covers Patent Owner’s identification of means-plus-function limitation because Patent Owner’s interpretation is a broader version of the ’830 patent’s disclosed algorithm. *Supra*, §II.C.1; Ground 2A ([20]); APPLE-1003, [271].

V. DISCRETIONARY CONSIDERATIONS

A. The *General Plastic* Factors Favor Institution—§314(a)

The ’830 patent is currently being challenged in instituted IPR2023-00993 filed by Samsung Electronics Co., Ltd., et al. (“Samsung”), and also in pre-instituted IPR2024-00570 filed by Sony Interactive Entertainment Inc. et al. (“Sony”). The instant petition is entirely distinct—it is being filed by an entirely separate party, and this petition uses completely different prior art, claim construction, and priority date treatment than were used in the earlier petitions by Samsung and Sony. *Compare* IPR2023-00993, Paper 2, 3-4 *with* §II.B-C, *supra*; *compare* IPR2024-00570, Paper 1, 8-12 *with* §II.B-C. For these reasons, the *General Plastic* factors favor institution. *General Plastic Industrial Co. v. Canon Kabushiki Kaisha*, IPR2016-01357, Paper 19, 16 (PTAB Sept. 6, 2017) (precedential as to section II.B.4.i).

1. Factors 1, 2, 4, and 5: Apple Never Petitioned This Patent

Apple is a separate company from Samsung and Sony sued separately by Patent Owner in separate Courts. The Apple and Samsung/Sony products Patent

Owner accuses of infringing the '830 patent are not related to one another.

Moreover, Apple and Samsung/Sony did not cooperate in any way in preparing either the previously filed IPR2023-00993 and IPR2024-00570 or this petition.

Unlike in *Valve I* and *II*, Apple is a wholly separate and unrelated entity from Samsung and Sony, and the record is devoid of evidence that the companies share accused products—or even suppliers or components. *See Valve Corp. v. Elec.*

Scripting Prods., Inc., No. IPR2019-00062, Paper 11, at 9-10 (PTAB Apr. 2, 2019) (“*Valve I*”); *Valve Corp. v. Elec. Scripting Prods., Inc.*, No. IPR2019-00064, Paper 10, at 10 (PTAB May 1, 2019) (“*Valve II*”). In fact, these facts are nearly opposite facts to those present in the Board’s precedential *Valve* decision.

Because the evidence does not show a significant relationship between Apple and Samsung or between Apple and Sony, “*General Plastic* factors 1, 2, 4, and 5 weigh against discretionary denial.” *Volkswagen Group of America, Inc. v. Neo Wireless LLC*, IPR2022-01537, Paper 8 at 11 (PTAB May 5, 2023). Where, as here, “there is no indication of a significant relationship under *Valve* and factor 1 between Petitioner and the” prior petitioner, “Petitioner did not file a second petition following-on to a first petition under factors 2, 4, and 5.” *Id.* “In other words, this is not a case where we need to address concerns that Petitioner is ‘strategically stag[ing] [its] prior art and arguments in multiple petitions’ in order to refine its positions based on lessons learned from Petitioner’s filing of an earlier

petition.” *Id.* (citing *General Plastic*, Paper 19 at 17; *Code200, UAB v. Bright Data, Ltd.*, IPR2022- 00861, Paper 18 at 5 (PTAB Aug. 23, 2022) (precedential)).

While developing defenses against three other patents in the co-pending litigation (§VIII.B), Apple has independently uncovered at least Rossi and Aldrich, which supply non-cumulative evidence supporting strong motivation rationales with Gregorio and Ramsay under different claim constructions than Samsung’s or Sony’s.

During the pendency of Samsung’s petition in IPR2023-00993, which was filed on June 14, 2023, Petitioner was still vetting the prior art and worked diligently on refining Grounds 1-2 in the intervening months. Rossi and Aldrich were only discovered by the IPR counsel in December 2023. In the litigation between Apple and Patent Owner, both sides argue that means-plus-function constructions should be employed. Aldrich is critical to address the corresponding structure disclosed in the specification. Yet, Petitioner did not uncover Aldrich until the very end of 2023. Petitioner’s timing and diligence was reasonable under the circumstances and did not result in unfair tactical advantages. Sony’s petition in IPR2024-00570 was filed on February 16, 2024, less than two months before the instant petition is filed.

2. Factor 3: The Different Prior Art at Issue Between the Proceedings Ensures No Advantage Is Gained

Patent Owner filed its POPR in IPR2023-00993 on October 16, 2023.

However, as noted above, the prior art references relied upon in IPR2023-00993 are entirely distinct from the prior art references that form the basis for this Petition. Thus, knowledge of the arguments raised in the POPR of IPR2023-00993 does not confer any advantage to Apple. No POPR has been filed in IPR2024-00570.

3. Factors 6 and 7: The Distinct Grounds and Lack of Significant Relationship Ensure the Board's Resources and Ability to Render a Decision Within the Statutory Timeframe Are Not Significantly Impacted

There are no common prior art references between this petition and IPR2023-00993 or IPR2024-00570. Moreover, because Apple and Samsung/Sony share no significant relationship, the rights of Apple to pursue this petition will not in any way be impacted by the outcome of IPR2023-00993 or IPR2024-00570. Thus, any Final Written Decision in IPR2023-00993 or IPR2024-00570 is unlikely to have a significant impact on the merits or conduct of an instituted IPR from this petition. And while the Board will expend resources necessary to hear this alternative petition, the expenditure of those resources is justified by Apple's independent and distinct basis under §314 to file an IPR petition and the fees that Apple is paying to have this petition heard on the merits.

Furthermore, it's entirely possible for Patent Owner to settle with Samsung

or Sony and seek termination of IPR2023-00993 or IPR2024-00570 at any time during its pendency, after Apple's statutory bar date. Apple's basis under §314 to have the Board consider the patentability of the '830 patent should not be put in tension with and potentially curtailed by Patent Owner and Samsung's or Sony's distinct right to settle their dispute outside of Apple's control.

B. The *Advanced Bionics* Test Favors Institution—§325(d)

Each of the Petition's references was not considered during prosecution and is not cumulative of the references considered. This Petition thus does not involve the same or substantially the same art or arguments previously presented, ending the *Advanced Bionics* inquiry in favor of institution. *Advanced Bionics, LLC v. MED-EL Elektromedizinische Geräte GmbH*, IPR2019-01469, Paper 6 at 8-9 (precedential).

C. The *Fintiv* Factors Favor Institution—§314(a)

This Petition's merits are compelling, and the evidence presented herein is substantial, counseling against discretionary denial under *Fintiv*.

Factor 1 is neutral or favors institution. Apple has requested a stay pending resolution of a Motion to Transfer to the Northern District of California. While the PTAB does not infer how the district court would rule should a stay be requested, the pending motion at least increases the likelihood of a stay. *Hulu LLC v. SITO Mobile R&D IP, LLC*, IPR2021-00298, Paper 11, 10-11 (May 19, 2021).

Factor 2 favors institution. The Board will likely issue its Final Written Decision by October/November 2025, within about two months of the currently-scheduled trial date (August 4, 2025) and likely before the media time-to-trial in WDTX (October 2025, based on median time of 28.3 months). The currently-scheduled trial date is uncertain and subject to change due to a number of factors. Indeed, the case was recently transferred from the docket of Judge Counts to the docket of Judge Albright, with the impact on the schedule not yet resolved. Moreover, a Motion to Transfer to the Northern District of California, and a Motion to Stay while the transfer motion is considered, both remain pending. APPLE-1036.

Factor 3 favors institution because Petitioner has diligently filed this Petition nearly two months ahead of the one-year time bar, while the litigation remains in its early stages. By the anticipated institution deadline in October 2024, the co-pending litigation will still be in early stages—expert and fact discovery will be months away from concluding. *Id.* Moreover, a Motion to Transfer Venue is still pending. APPLE-1036.

Factors 4 and 5 are neutral. Resolution is expected around the time of a decision in the District Court, which mitigates against duplication of effort and serves efficiency and integrity goals. The same parties are in the co-pending litigation.

Factor 6 favors institution because this petition's merits are compelling for the reasons described herein, demonstrating unpatentability of the claims based on multiple grounds and claim constructions.

VI. PAYMENT OF FEES

Petitioner authorizes the Office to charge any fees to Deposit Account No. 06-1050.

VII. CONCLUSION

Petitioner respectfully requests institution of IPR.

VIII. MANDATORY NOTICES UNDER 37 C.F.R. § 42.8(a)(1)

A. Real Party-In-Interest Under 37 C.F.R. § 42.8(b)(1)

Apple Inc. is the petitioner and real party-in-interest.

B. Related Matters Under 37 C.F.R. § 42.8(b)(2)

Petitioner is not aware of any disclaimers, reexamination certificates or petitions for *inter partes* review for the '830 patent. The '830 patent is the subject of *Resonant Systems, Inc. d/b/a Revel HMI v. Apple, Inc.*, 7-23-cv-00077 (WDTX) filed June 1, 2023. The '830 patent is the subject of *Resonant Systems, Inc. v. Samsung Electronics Co., Ltd. et al.* 2-22-cv-00423 (EDTX) filed October 26, 2022, *Resonant Systems, Inc. v. Sony Group Corporation (Japan) et al.* 2-22-cv-00424 (EDTX) filed October 26, 2022. The '830 patent is the subject of *Samsung Electronics Co., Ltd. et al v. Resonant Systems, Inc.* IPR2023-00993 (PTAB) filed

June 14, 2023; *Samsung Electronics Co., Ltd. et al v. Resonant Systems, Inc.*

IPR2023-01025 (PTAB) filed June 14, 2023; and *Sony Interactive Entertainment Inc. et al. v. Resonant Systems, Inc.*, IPR2024-00570 (PTAB) filed February 16, 2024.

C. Lead And Back-Up Counsel Under 37 C.F.R. § 42.8(b)(3)

Petitioner provides the following designation of counsel.

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D. Service Information

Please address all correspondence and service to the address listed above.

Petitioner consents to electronic service by email at IPR50095-0179IP1@fr.com.

Respectfully submitted,

Dated: April 12, 2024

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CERTIFICATION UNDER 37 CFR § 42.24

Under the provisions of 37 CFR § 42.24(d), the undersigned hereby certifies that the word count for the foregoing Petition for *Inter Partes* Review totals 13,991 words, which is less than the 14,000 allowed under 37 CFR § 42.24.

Dated: April 12, 2024

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CERTIFICATE OF SERVICE

Pursuant to 37 CFR §§ 42.6(e)(4)(i) *et seq.* and 42.105(b), the undersigned certifies that on April 12, 2024, a complete and entire copy of this Petition for *Inter Partes* Review and all supporting exhibits were provided via Federal Express, to the Patent Owner by serving the correspondence address of record as follows:

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