

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG ELECTRONICS CO., LTD. and
SAMSUNG ELECTRONICS AMERICA, INC.

Petitioner

v.

RESONANT SYSTEMS, INC.,

Patent Owner

IPR2023-00993

U.S. Patent No. 9,941,830

**SUPPLEMENTAL DECLARATION OF ANDREW WOLFE, PH.D.
IN SUPPORT OF PETITION FOR *INTER PARTES* REVIEW
OF U.S. PATENT NO. 9,941,830**

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I, Andrew Wolfe, declare as follows:

I. BACKGROUND AND QUALIFICATIONS

1. I filed a declaration in support of Samsung Electronics Co., Ltd. and Samsung Electronics America, Inc.'s IPR petition in the above captioned case (EX1003, the "Opening Declaration").

2. My background and qualifications are set forth in the Opening Declaration.

3. In forming my opinions, I have relied on my education and experience as described in my Opening Declaration. A copy of my *curriculum vitae* has been filed as EX1004.

II. MATERIALS REVIEWED

1. In my Opening Declaration, I identified the materials I reviewed in forming my opinions. Since submitting my Opening Declaration, I have reviewed the following:

- Patent Owner's Response ("POR") (Paper 28) and accompanying exhibits (EX2008-2014)
- Transcript of Deposition of Dr. Keith Goossen (EX1048)
- *The Authoritative Dictionary of IEEE Standards Terms*, Seventh Edition, IEEE Press, at 703 (2000) (EX1049)

- *The American Heritage Science Dictionary*, Houghton Mifflin Company, at 408 (2005) (EX1050)
- J. Edward Carryer, R. Matthew Ohline, and Thomas W. Kenny, *Introduction to Mechatronic Design*, Pearson Education, Inc., at 121-124, 561-570 (2011) (EX1051)
- Paul Horowitz and Winfield Hill, *The Art of Electronics*, 2nd Edition, Cambridge University Press, at 898-902 (1989) (EX1052)

2. I have been asked to render my opinion regarding certain positions in Patent Owner's Response.

III. OPINIONS

A. The Term “modulated by” Is Not Limited To Multiplying Signals

3. I understand that Patent Owner's expert Dr. Keith Goossen asserts that the plain and ordinary meaning to a POSITA of the term ‘modulated by’ in claim 16 is “mixing or multiplying one signal with another.” EX2008, ¶158. Dr. Goossen's subsequent analysis suggests that this claim construction would exclude adding signals. EX2008, ¶¶158-159. In my opinion, Dr. Goossen's interpretation of claim 16 is not supported by the intrinsic or extrinsic evidence.

4. Dr. Goossen cites to the '830 patent's disclosure of “a primary operational frequency of 25 Hz with an added modulating 1 Hz operational frequency.” EX2008, ¶158 (citing EX1001, 13:41-46, Fig. 22B). While the '830

patent does contemplate multiplying these two frequencies, this is just one embodiment of frequency modulation. The '830 patent further explains that the alleged invention “allows for an essentially limitless number of different vibrational behaviors and modes to be configured” and “[b]y varying the number, relative amplitudes, and frequencies of two or more driving signals, a microprocessor-controlled or microcontroller-controlled linear-resonance vibration module can be controlled to produce any number of complex vibrational patterns and modes, including periodic modes, modes with multiple different periods, various modulated vibration modes, and even fully aperiodic vibration modes that do not repeat time.” EX1001, 13:20-59. Nothing in the specification indicates an intent to limit the term “modulating” to specific signal processing techniques.

5. Dr. Goossen also cites to the '830 patent's disclosure that modulation can produce “interesting vibrational modes.” EX2008, ¶159 (citing EX1001, 13:31-34). PO asserts that this is “the opposite” of Saiki's teaching of maintaining a “relatively large vibration output [] continuously.” *Id.*, (citing EX1013, 15:33-36). But to a POSITA, multiplying frequencies does not produce results that are any more “interesting” than other signal mixing techniques, such as adding signals or switching signal patterns. In fact, the waveform disclosed in Figure 17A of Saiki is remarkably similar to the “interesting” waveform of Figure 22B of the '830 patent. *Compare* EX1013, Fig. 17A *with* EX1001, Fig. 22B:

FIG. 17A

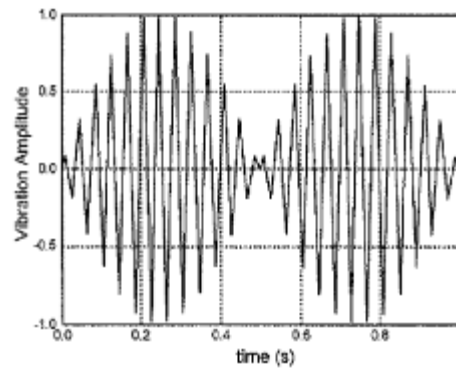
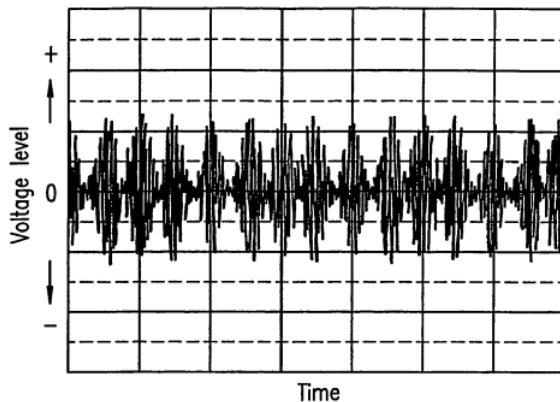


FIG. 22B

6. This argument, that the '830 patent is directed to only producing “interesting” waveforms, is also contradicted by the '830 patent’s broad disclosure of a device allegedly capable of an “essentially limitless number of different vibrational behaviors,” interesting or not. EX1001, 13:20-26.

7. Extrinsic evidence also demonstrates that the term “modulated by” is not limited to mixing or multiplying two signals. It is my experience and opinion that the term “modulated by” as used in the claims has had a consistent meaning since at least 1981 when I first entered an Electrical Engineering program. That meaning is accurately reflected in technical dictionaries that I consulted in preparing this declaration. The seventh edition of the Authoritative Dictionary of IEEE Standards Terms defines “modulation” to mean:

modulation (1) (A) (data transmission) (*Carrier*). (i) The process by which some characteristic of a carrier is varied in accordance with a modulating wave. (ii) The variation of some characteristic of a carrier. *See also:* angle modulation; modulation index. **(B) (data transmission) (*Signal transmission system*).** (i) A process whereby certain characteristics of a wave, often called the carrier, are varied or selected in accordance with a modulating function. (ii) The result of such a process. *See also:* angle modulation; modulation index.

EX1049. This is a broader definition than provided by Dr. Goossen.

8. Similarly, the American Heritage Science Dictionary defines modulate in broad terms:

modulate (mŏj'ə-lāt') To vary the amplitude, frequency, or some other characteristic of a signal or power source. *See also* **amplitude modulation, frequency modulation.**

EX1050.

9. Textbooks and product data sheets also disclose specific forms of modulation that are not limited to the mixing or multiplying of two signals. EX1037, referenced in my earlier declaration, discusses the use of frequency modulation in which three different output signals are modulated in frequency according to an input voltage:

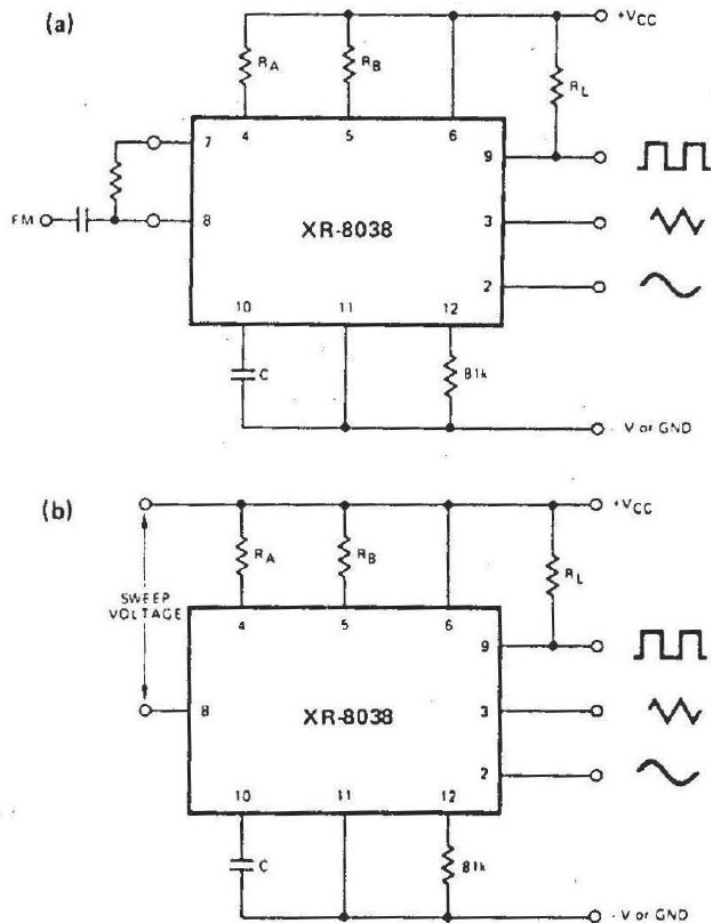
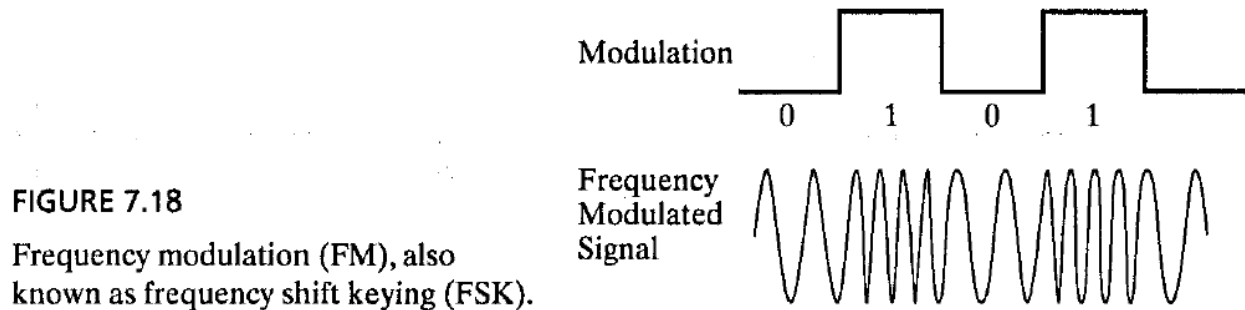


Figure 4. Connections for Frequency Modulation (a) and Sweep (b).

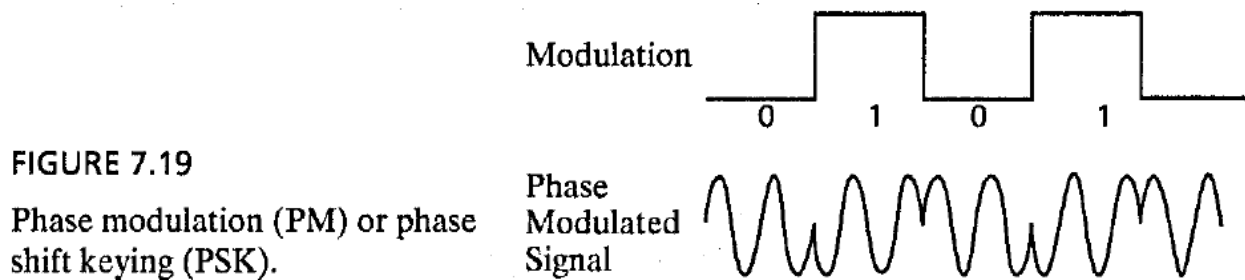
EX1037, p.7.

10. Dr. Goossen cites “amplitude modulation (AM), frequency modulation (FM), [and] phase modulation (PM)” as examples of modulations that mix or multiply one signal with another. EX2008, ¶158. But at least FM and PM modulation do not require mixing or multiplying one signal with another. Introduction to Mechatronic Design, a textbook I have used for teaching, discusses FM and PM modulation. FM modulation does not necessarily involve mixing or multiplying

signals; instead the modulating signal can simply cause the carrier to increase and decrease in frequency:



EX1051, p.122. Likewise, PM modulation does not necessarily involve mixing or multiplying signals; instead the modulating signal causes the carrier to periodically reverse phase:



EX1051, p.122.

11. Introduction to Mechatronic Design also discusses other kinds of modulation that do not involve mixing or multiplying signals, including quadrature amplitude modulation and IR remote control modulation (which works through switching or selection of a carrier).

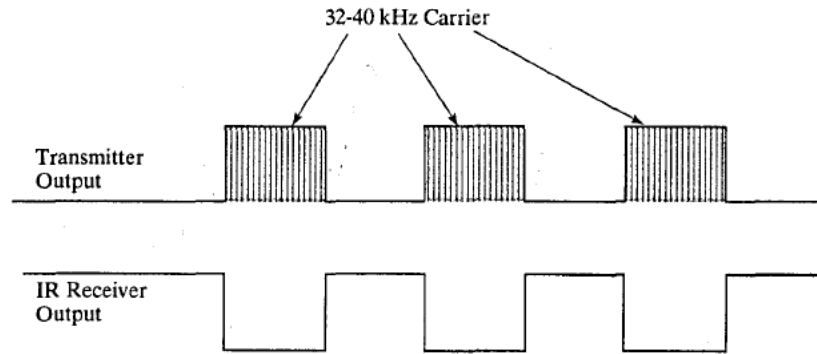


FIGURE 7.22
IR remote control modulation of the carrier.

EX1051, p.123-24.

12. The Mechatronics textbook also provides an extensive discussion of bidirectional control of motors using an H-bridge. Ex1051, p.561-570. As part of this discussion, the control of speed and direction can be implemented with pulse-width modulation. The textbook explains that “This is a control technique where power to the motor is switched on and off rapidly, at rates high enough that the effects of the switching are negligible. The resulting effective voltage is then the average fraction of the time the power is on.” EX1051, p.567. This is another form of modulation that is not mixing or multiplying two signals.

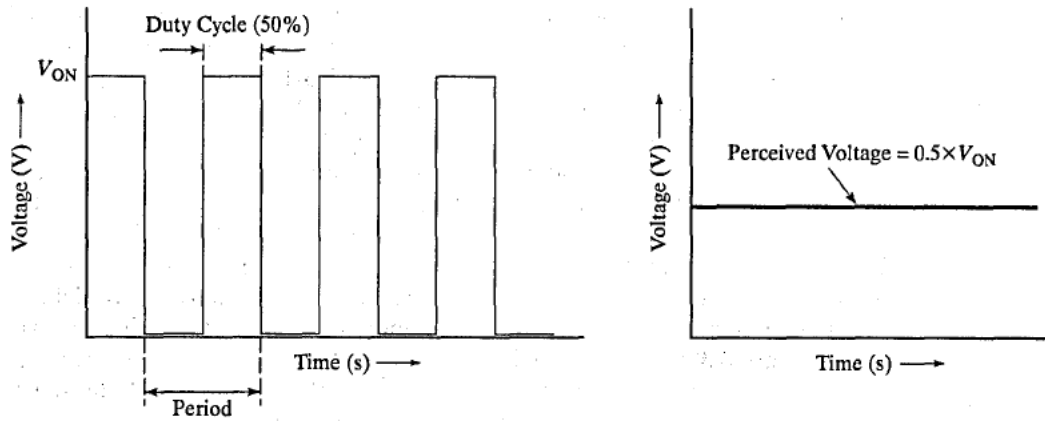


FIGURE 23.17
PWM with 50% duty cycle.

Changing the duty cycle of a PWM signal changes the average, or perceived, voltage level. For instance, adjusting the duty cycle shown in Figure 23.17 so that it is in the “on” state for 80% of the period will change the resulting perceived voltage as shown in Figure 23.18.

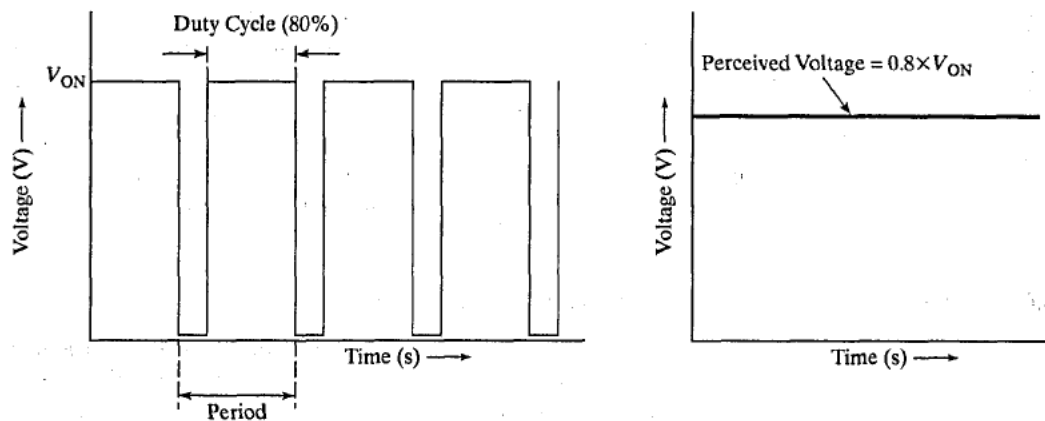
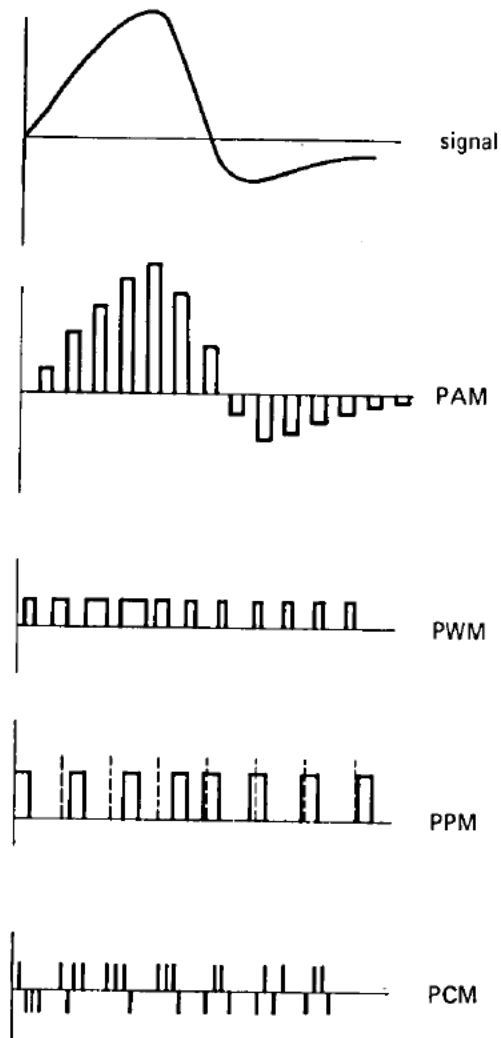


FIGURE 23.18
PWM with 80% duty cycle.

EX1051, p.568.

13. Another textbook, the Art of Electronics, similarly describes modulation techniques that are not limited to mixing or multiplying two signals. These include frequency modulation, phase modulation, frequency-shift keying,

pulse amplitude modulation, pulse width modulation, pulse position modulation, and pulse code modulation.



Instead of modulating the amplitude of a carrier, as in AM, DSBSC, and SSB, it is possible to send information by modulating the frequency or phase of the carrier:

$$\text{signal} = \cos[\omega_c t + k \int f(t) dt]$$

frequency modulation (FM)

$$\text{signal} = \cos[\omega_c t + k f(t)]$$

phase modulation (PM)

Figure 13.46. Pulse-modulation schemes.

EX1052, p.898-902.

14. These publications are consistent with the understanding of a POSITA that “modulated by” is not limited to mixing or multiplying two signals, but includes other techniques for combining frequencies.

B. The Combination of Fukumoto and Ueda Teaches Converting A Received Output Signal Into An Integer

15. From my review of Dr. Goossen’s declaration and deposition transcript, I understand that Dr. Goossen asserts that Ueda does not teach converting a received output signal into an integer, which is required by Samsung’s means-plus-function claim construction of the “control component” in claim 3. EX2008, ¶¶109, 184. In particular, Dr. Goossen asserts that the comparisons disclosed in Ueda are comparisons between analog signals, not digital values. *See* EX1048, 78:17-79:4.

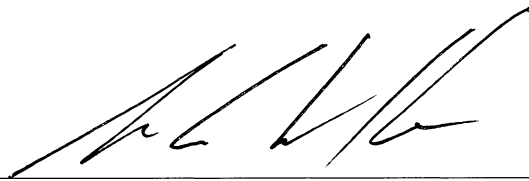
16. Dr. Goossen fails to acknowledge that the asserted grounds for unpatentability are the combinations of Ueda with Fukumoto or Ogusu-Fukumoto. Petition, 46, 92. As I explained in my Opening Declaration, the combined Fukumoto-Ueda and Ogusu-Fukumoto-Ueda systems “include[] a processor programmed with an algorithm” to perform the algorithmic steps disclosed in Ueda. EX1003, ¶¶241, 337. Given that the combined system implements Ueda’s algorithm in a general-purpose processor, a POSITA would have understood that the raw sensor input from the “output detector 4” and the “position detector 5” of Ueda must be converted to digital values to be processed and compared.

17. Furthermore, as a POSITA would have understood, the only viable formats for digitally representing the signals from the output detector and the position detector would be either (1) an integer or (2) a fraction. And in the context of converting analog to digital signals, an integer would almost always be the preferred choice. Converting sensor outputs to integers under these circumstances would amount to choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success.

I, Andrew Wolfe, declare that all statements made herein of my knowledge are true, and that all statements made on information and belief are believed to be true, and that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Dated: July 31, 2024

Respectfully submitted,

A handwritten signature in black ink, appearing to be 'A. Wolfe', written over a horizontal line.

Andrew Wolfe, Ph.D.