

U.S. Patent No. 9,369,081 (“’081 Patent”)

Accused Instrumentalities

Samsung products with linear vibration motor technology, including without limitation the products listed below (“Accused Products”), infringe at least Claims 1, 2, 3, 4, 5, 6, 7, 8, and 17 of the ’081 Patent. Each Accused Product infringes the claims in substantially the same way, and the evidence shown in this chart is similarly applicable to each Accused Product. For example, each Accused Product includes a linear vibration motor and supports substantially the same haptic feedback features. Each claim limitation is literally infringed by each Accused Product. However, to the extent any claim limitation is not met literally, it is nonetheless met under the doctrine of equivalents because the differences between the claim limitation and each Accused Product would be insubstantial, and each Accused Product performs substantially the same function, in substantially the same way, to achieve the same result as the claimed invention. Notably, Samsung has not yet articulated which, if any, particular claim limitations it believes are not met by the Accused Products, listed below:

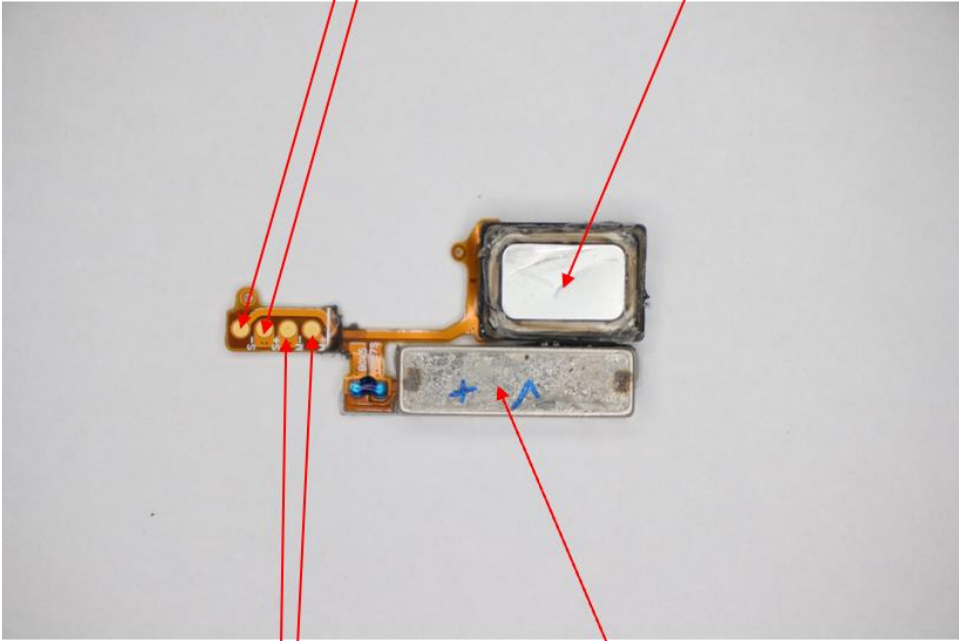
- Galaxy S20+
- Galaxy S20 Ultra
- Galaxy S21+
- Galaxy S21 Ultra
- Galaxy S22
- Galaxy S22+
- Galaxy S22 Ultra
- Galaxy S23
- Galaxy S23+
- Galaxy S23 Ultra
- Galaxy Fold 1
- Galaxy Z Fold 2
- Galaxy Z Fold 3
- Galaxy Z Fold 4
- Galaxy Note10+
- Galaxy Note20 Ultra

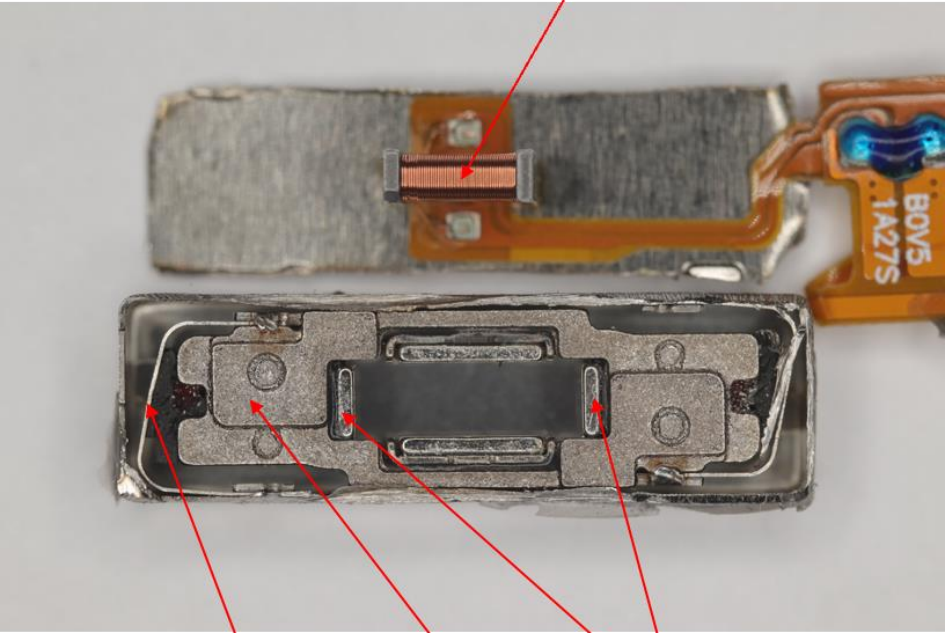
Claim 1

Claim 1	Accused Products
[1pre]. A linear vibration module comprising:	To the extent the preamble is limiting, each Accused Product comprises a vibration module as claimed. For example, even if this preamble were interpreted to require all of the components recited in the body of claim 1 to be part of a single linear vibration module, each Accused Product would still meet that requirement because it is a vibration module as claimed. For example, Galaxy S22 Ultra includes a linear motor and associated controller(s), including the haptic controller (<i>e.g.</i>, Cirrus Logic CS40L26), application processor (<i>e.g.</i>, Snapdragon 8 Gen 1 SoC), power supply circuits, and connected user-input features such as a touchscreen. These components together form a vibration module as claimed, as described in connection with the claim limitations below. <i>See, e.g.:</i>

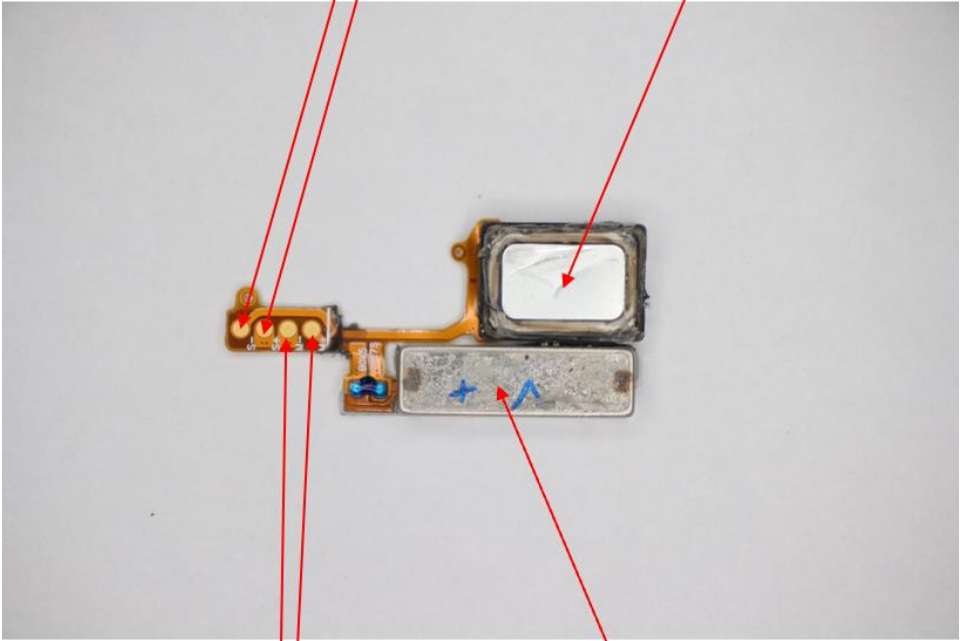
Claim 1	Accused Products
	A photograph of the back of a black Samsung Galaxy S22 Ultra. The phone is oriented horizontally. On the left side, the S Pen is attached. In the center is a large, dark rectangular area, likely the fingerprint sensor. On the right side, there is a camera module with four lenses arranged in a 2x2 grid. The top-left lens is the largest. The top-right lens is slightly smaller. The bottom-left lens is the smallest. The bottom-right lens is also small. There is a small white dot between the bottom two lenses. The phone is set against a plain white background. Photograph of Samsung Galaxy S22 Ultra.

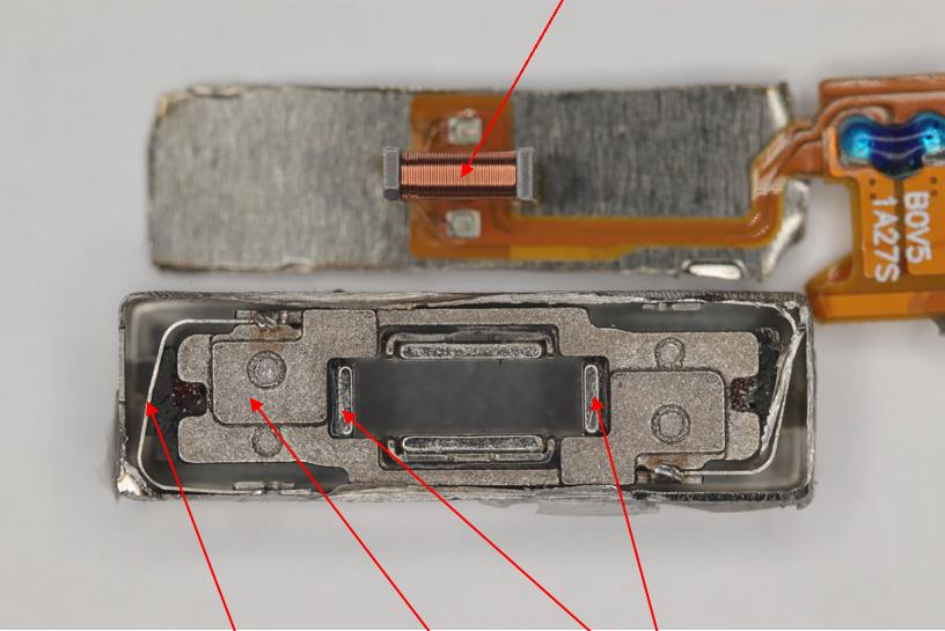
Claim 1	Accused Products
	A photograph of the internal components of a Samsung Galaxy S22 Ultra. The image shows the battery, camera module, and other internal parts. A red rectangular box is drawn on the left side of the device, highlighting a specific area of the internal frame. This area contains a small, dark, rectangular component, which is the linear motor/speaker assembly. The box is positioned vertically along the left edge of the device's internal frame. Photograph of Samsung Galaxy S22 Ultra, annotated to identify location of linear motor/speaker assembly.

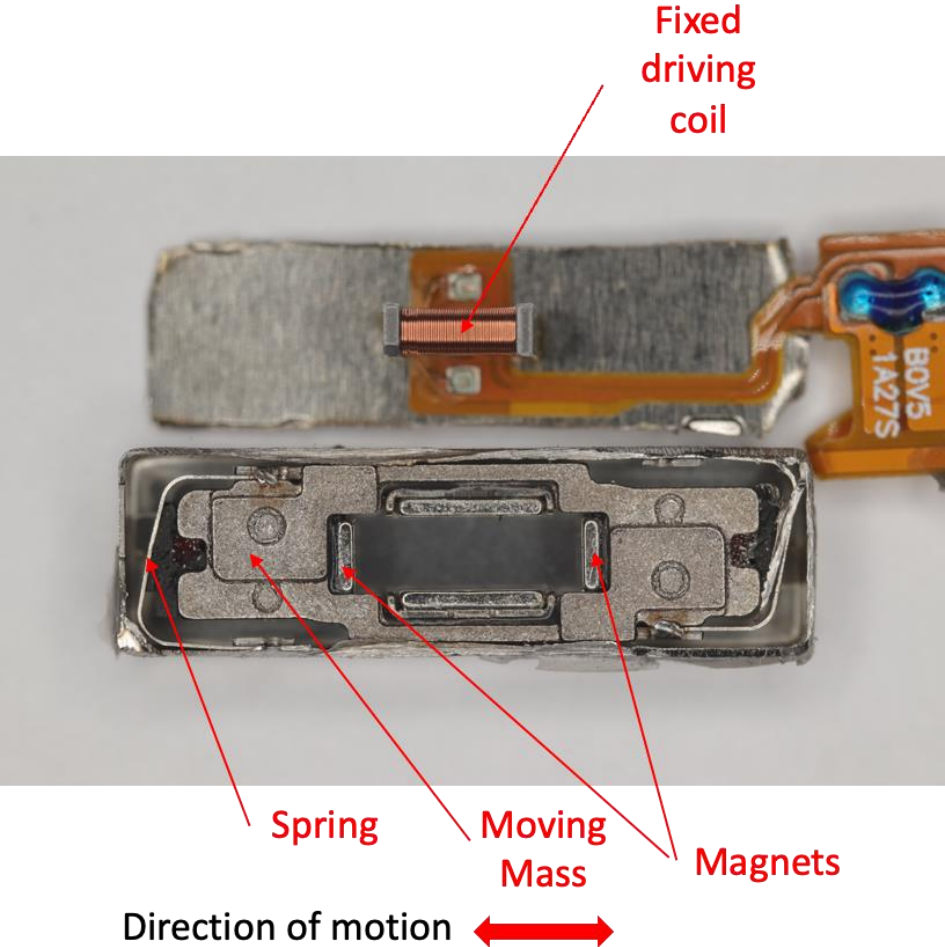
Claim 1	Accused Products
	 Speaker terminals Speaker Motor terminals Linear motor Photograph of Galaxy S22 Ultra linear motor/speaker assembly with components annotated.

Claim 1	Accused Products
	 Fixed driving coil Spring Moving Mass Magnets Direction of motion ↔ Photograph of Galaxy S22 Ultra linear motor with components annotated.

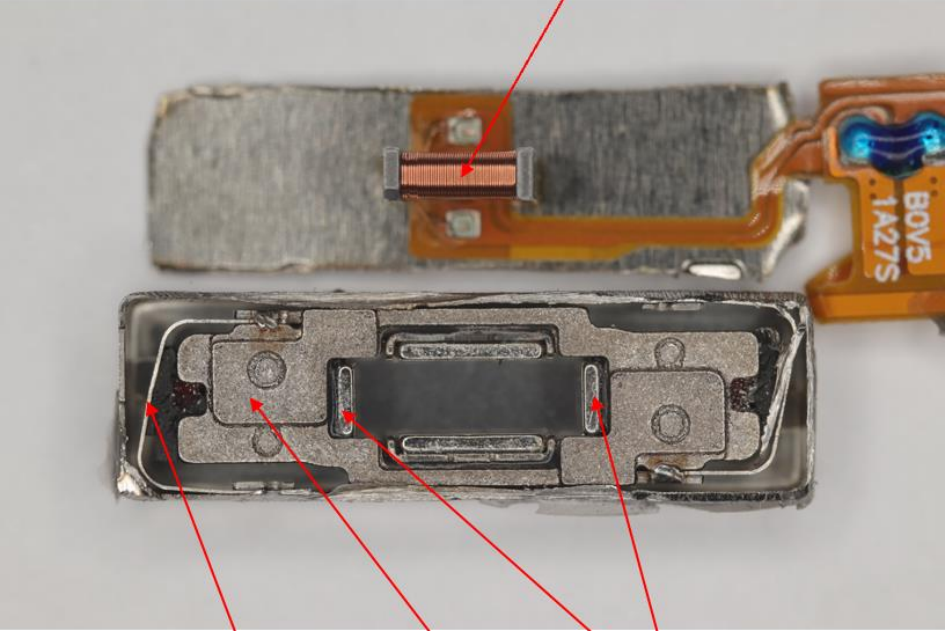
Claim 1	Accused Products
[1a] a housing;	Each Accused Product comprises a housing. For example, the linear motor assembly in the Galaxy S22 Ultra contains a metal box that is is soldered together to form a housing surrounding the moving mass, magnets, and driving coil therein. <i>See, e.g.:</i>

Claim 1	Accused Products
	 Speaker terminals Speaker Motor terminals Linear motor Photograph of Galaxy S22 Ultra linear motor/speaker assembly with components annotated.

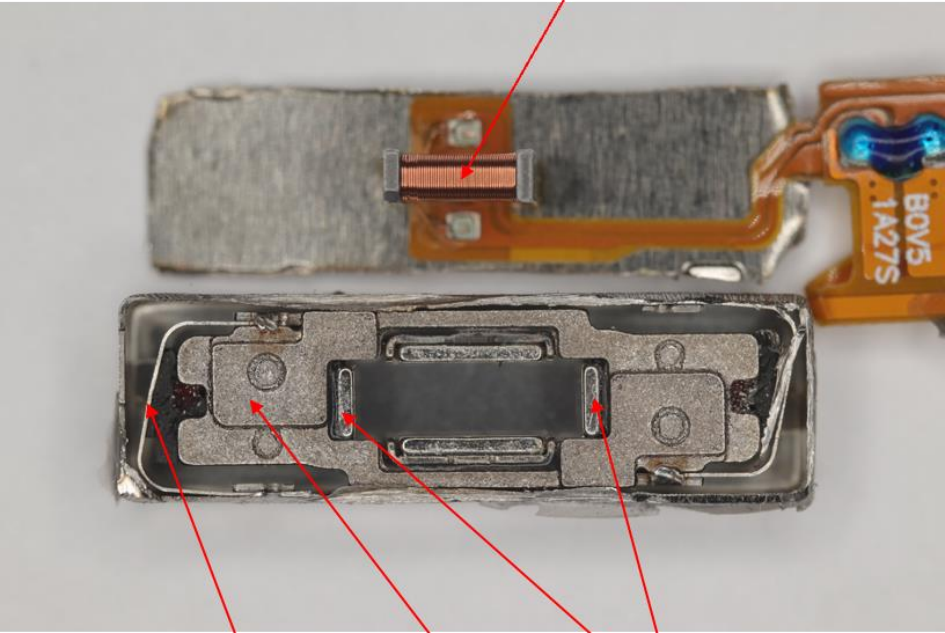
Claim 1	Accused Products
	 Fixed driving coil Spring Moving Mass Magnets Direction of motion  Photograph of Galaxy S22 Ultra linear motor with components annotated. In this image, the housing has been split apart, with the top of the housing visible behind the fixed driving coil and the rest of the housing enclosing the spring, moving component, and magnets.

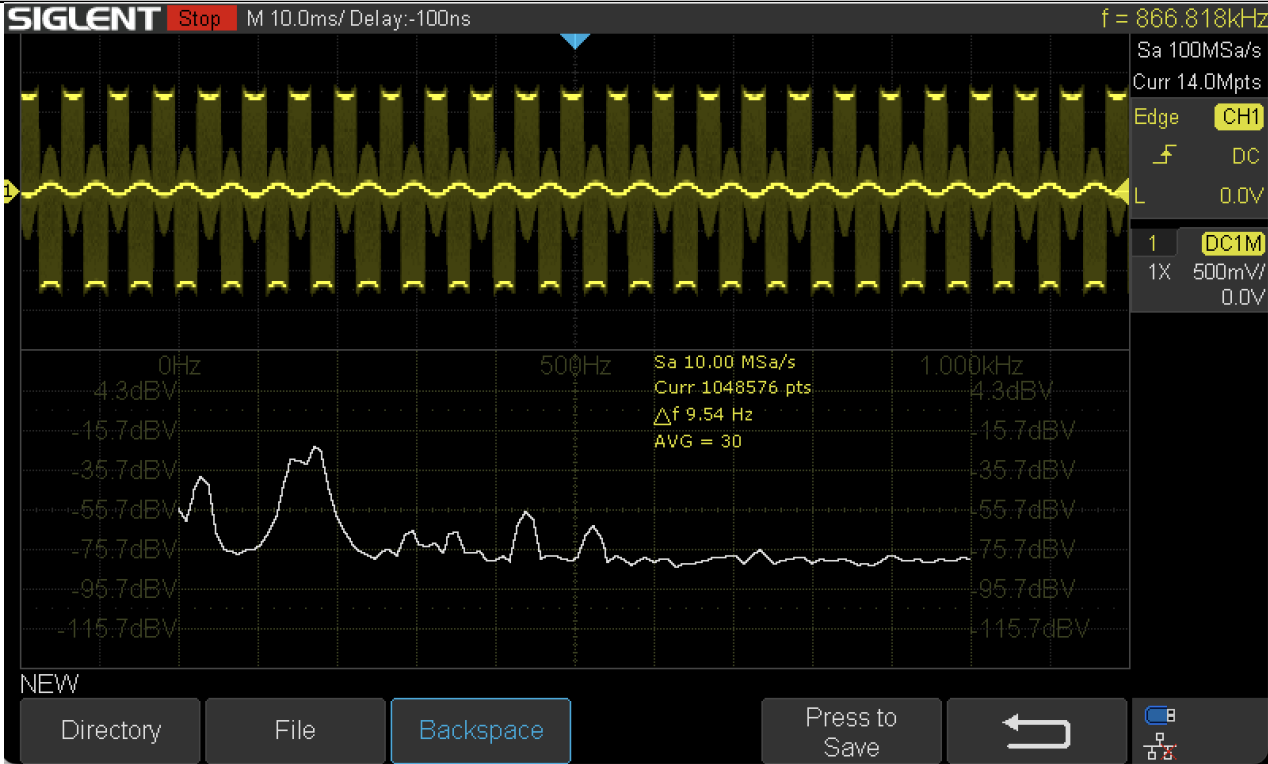
Claim 1	Accused Products
[1b] a moveable component;	Each Accused Product comprises a moveable component. For example, the linear motor assembly includes a moving mass to produce a vibration effect. <i>See, e.g.:</i>  The photograph shows a linear motor assembly. At the top, a copper-colored coil is labeled 'Fixed driving coil'. Below it, a metal housing contains a 'Moving Mass' (a black rectangular component) flanked by 'Magnets' (circular components). 'Spring' elements are indicated by arrows pointing to the sides of the moving mass. A red double-headed arrow at the bottom is labeled 'Direction of motion'.

Claim 1	Accused Products
	Photograph of Galaxy S22 Ultra linear motor with components annotated. The moveable component includes both a mass and magnets, fixed together so that they can move as one component linearly within the housing.
[1c] a power supply;	Each Accused Product comprises a power supply. For example, the linear motor driving coil (described below) receives power from one or more voltage regulators within the Accused Product, which supply power to the coil over wires. <i>See, e.g.:</i>

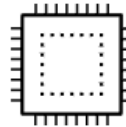
Claim 1	Accused Products
	 Fixed driving coil Spring Moving Mass Magnets Direction of motion  Photograph of Galaxy S22 Ultra linear motor with components annotated (wires supplying power depicted at top right). <i>See also</i> claim elements below.

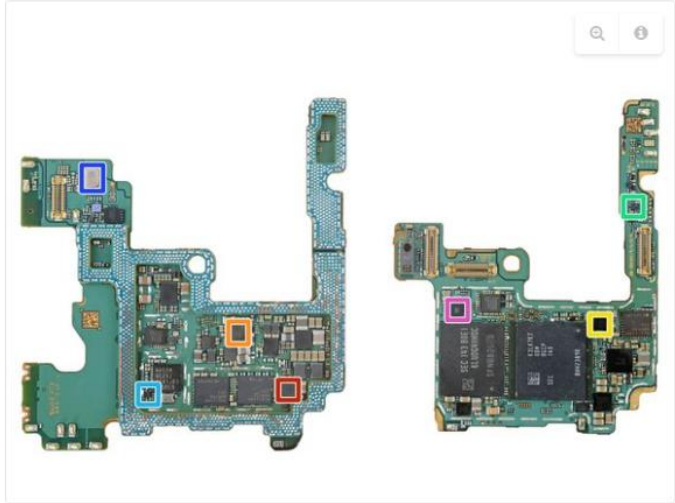
Claim 1	Accused Products
[1d] user-input features;	Each Accused Product comprises user-input features. For example, the Samsung Galaxy S22 Ultra comprises a touchscreen, a microphone, cameras, and other user-input features.
[1e] a driving component that drives the moveable component to oscillate within the housing; and	Each Accused Product includes a driving component that drives the moveable component to oscillate within the housing. For example, the linear motor includes a driving coil that is fixed in place and forms electromagnetic fields for driving a magnetic moving mass in an oscillating motion. <i>See, e.g.:</i>

Claim 1	Accused Products
	 Fixed driving coil Spring Moving Mass Magnets Direction of motion ↔ Photograph of Galaxy S22 Ultra linear motor with components annotated.

Claim 1	Accused Products
	 Oscilloscope trace of voltage across coil driving pins, showing positive and negative voltages for driving the mass in each of two opposite directions, resulting in an oscillating motion.
[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 user	Each Accused Product comprises 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 user input received from the user-input features.

Claim 1	Accused Products
input received from the user-input features.	For example, the haptic controller (<i>e.g.</i>, Cirrus Logic CS40L26) receives serial or other data from the application processor (<i>e.g.</i>, Snapdragon 8 Gen 1 SoC) to control the intensity and pattern of the desired oscillation. In one non-limiting example, the control component as claimed corresponds to the combination of physical circuits within the haptic controller and the application processor. In another non-limiting example, the control component as claimed corresponds to physical circuits within the haptic controller. The haptic controller and/or application processor may implement the claimed functionality in hardware circuits and/or with firmware. These control signals are sent and received using a protocol for commanding haptic patterns. Software executable on the application processor provided by Samsung (<i>e.g.</i>, Android kernel, operating system, and user-space software), including its own system software, allows the user to directly and/or indirectly select frequencies and amplitudes. This application software configures the vibrational behaviors and modes. In one non-limiting example, the application software forms part of the control component as claimed. In another non-limiting example, the existence and use of the application software is probative of the structure and configuration of the control component as claimed but does not form a part of the control component. In one non-limiting example, selecting different vibration patterns or creating a custom vibration pattern in the “Sounds and vibration” settings menu causes the movable component to oscillate at a frequency and amplitude dictated by the selected pattern. <i>See, e.g.:</i>

Claim 1	Accused Products
	Samsung Galaxy S22 Ultra Processor  Snapdragon 8 Gen 1 https://www.samsung.com/us/smartphones/galaxy-s22-ultra/compare/?device-1=samsung-galaxy-s22-ultra&device-2=samsung-galaxy-s22%2B&device-3=samsung-galaxy-s22

Claim 1	Accused Products
	Step 2  Edit  ● IC Identification, pt. 2: ● Cirrus Logic CS40L26 Haptic Driver ● Qualcomm PMR735A Power Management ● Qualcomm PM3003 Power Management ● Diodes Incorporated AP7340D-30FS4-7 150 mA / 3.0 V LDO Regulator ● Diodes Incorporated AP7340D-33FS4-7 150 mA / 3.3 V LDO Regulator ● Knowles MEMS Microphone ● Qualcomm Clock Generator  Add a comment Screenshot of https://www.ifixit.com/Guide/Samsung+Galaxy+S22+Ultra+Chip+ID/148073 showing Cirrus Logic haptic driver IC.

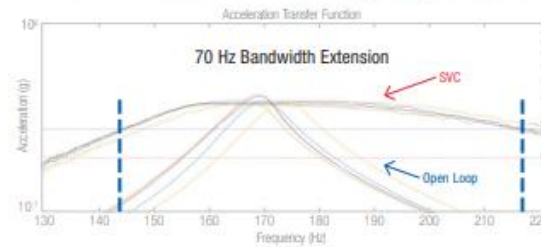
Claim 1	Accused Products
	Products ▾ / CS40L26/26B Smart Haptic Driver Enables HD Haptics on Mobile Devices for Enhanced Gaming, Videos and Music  Request Data Sheet Purchase Help Contact sales and support The CS40L26/CS40L26B is the industry's leading self-contained haptic driver IC that integrates a DSP and Class D digital boost converter to enable advanced closed-loop control of the actuator, HD enabled haptics and audio generated haptics for use in smartphones, tablets and wearables. Advanced sensor-less velocity control (SVC) provides real-time braking and consistent acceleration of the LRA, plus wider bandwidth and broader frequency range – essential features for gaming UX. CIRRUS ROCKS® CIRRUS® ENGINEERED TO ROCK® INNOVATION THAT ROCKS® Technology Haptic Drivers Application Categories Mobile Audio Devices, Wearables Screenshot of Cirrus Logic haptic driver description, available at https://www.cirrus.com/products/cs40l26-26b/.

Sensor-Less Velocity Control (SVC) Delivers Dynamic Haptic Performance

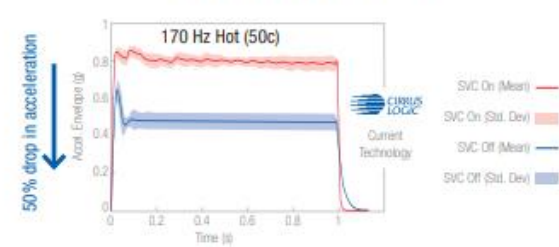
Why SVC Matters – Closed-Loop Feedback Ensures Gaming Consistency

- Dynamically adapts to the LRA in real time – a key performance enhancement for gaming and streamed haptics
- Widens the LRA bandwidth for consistent acceleration, as well as crisp performance when in overdrive and braking

SVC Widens the LRA Bandwidth, Enabling HD Haptic Effects

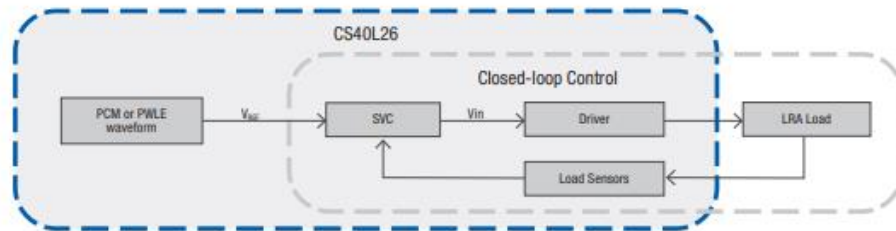


SVC Generates Consistent Acceleration



How SVC Works

- SVC senses the load condition and adapts the signal V_{in} to drive for the back-emf to follow V_{REF}



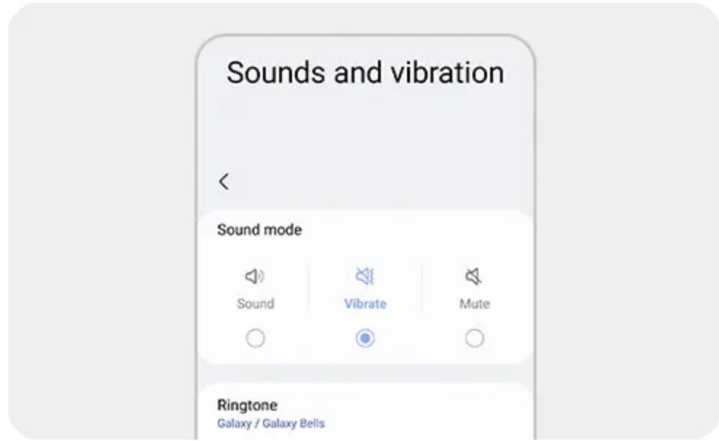
Screenshot of haptic driver datasheet, available at

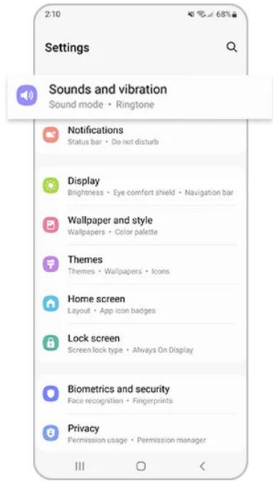
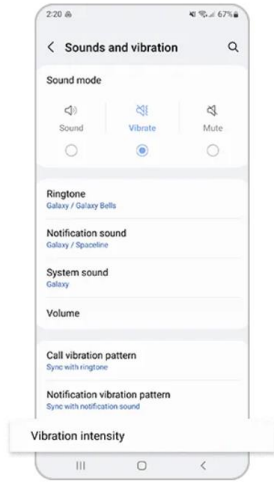
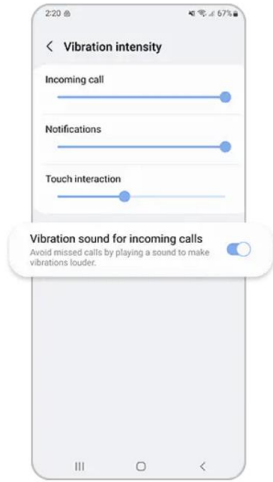
https://statics.cirrus.com/pubs/proBulletin/CS40L26_B_Smart_Haptics_Driver_Product_Bulletin.pdf.

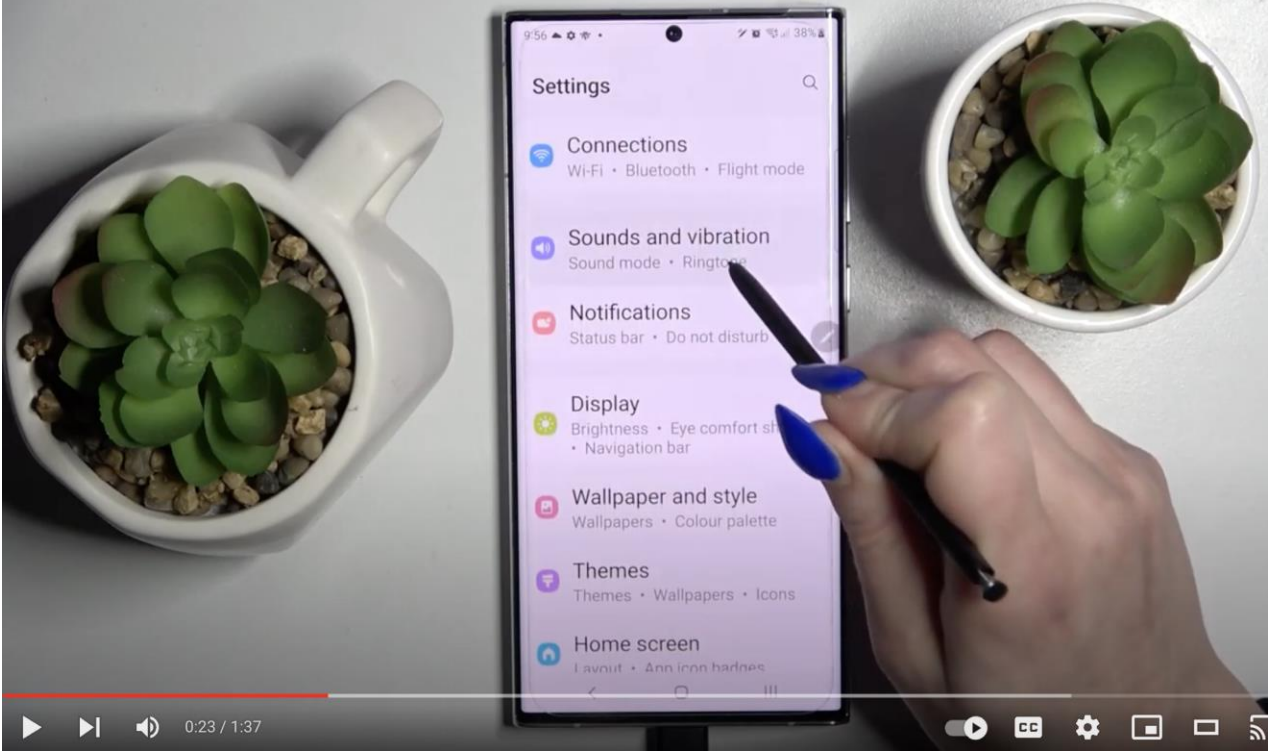
Claim 1	Accused Products
	Real-time, Automated Audio-2-Haptics Feel What You Hear with “On-the-Fly” Audio-2-Haptics Audio Generated Haptics — Complex Signal Processing Generates Textured HD Haptic Effects for Gaming, Videos and Music Generates haptic drive signals from the audio stream for ringtones, YouTube videos and games tuned for the LRA Audio Input, LRA Output, Magnitude, Threshold, Gain Important Notice: No license to any intellectual property right is included with this component, and certain uses or product designs, including certain haptics-related uses or haptics-system designs, may require an intellectual property license from one or more third parties. Cirrus Logic, Inc. 800 West Sixth Street Austin, Texas 78701 United States T+1-512-851-4000 Sales Support North America +1-800-888-5016 Asia Pacific +852 2376-0801 Japan +81-(3)-5782-8180 Europe/UK +44-(0)-131-272-7000 cirrus.com NOVEMBER 2021 © 2021 Cirrus Logic, Inc. All rights reserved. Cirrus Logic, Cirrus, the Cirrus Logic logo design, and SoundClear are trademarks of Cirrus Logic, Inc. Other brand and product names in this document may be trademarks or service marks of their respective owners. This product is covered by issued and pending patents of Cirrus Logic. Product features, capabilities, and operations described here are for illustrative purposes only and do not constitute instructions or suggestions regarding any particular implementation or design choice. Customers are solely responsible for their specific design, implementation, and end product and, if required, obtaining any related third-party intellectual property licenses. Screenshot of haptic driver datasheet, available at https://statics.cirrus.com/pubs/proBulletin/CS40L26_B_Smart_Haptics_Driver_Product_Bulletin.pdf.

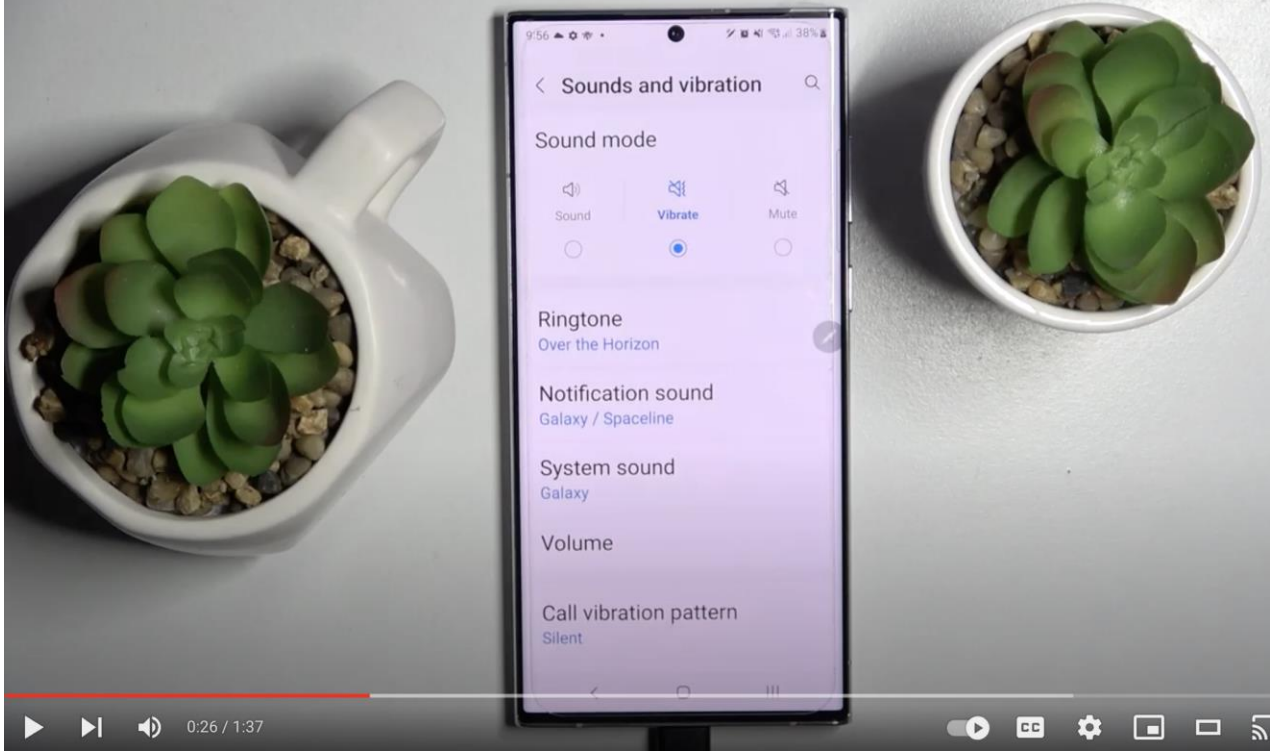
Claim 1	Accused Products
	Android 12 simplified integration • Audio coupled haptics with I²S support • Open wave table and chirp with scalability supports haptics APIs, with on-the-fly haptic generation Screenshot of haptic driver datasheet, available at https://statics.cirrus.com/pubs/proBulletin/CS40L26_B_Smart_Haptics_Driver_Product_Bulletin.pdf, indicating support for Android 12 haptic APIs and audio coupled haptics.

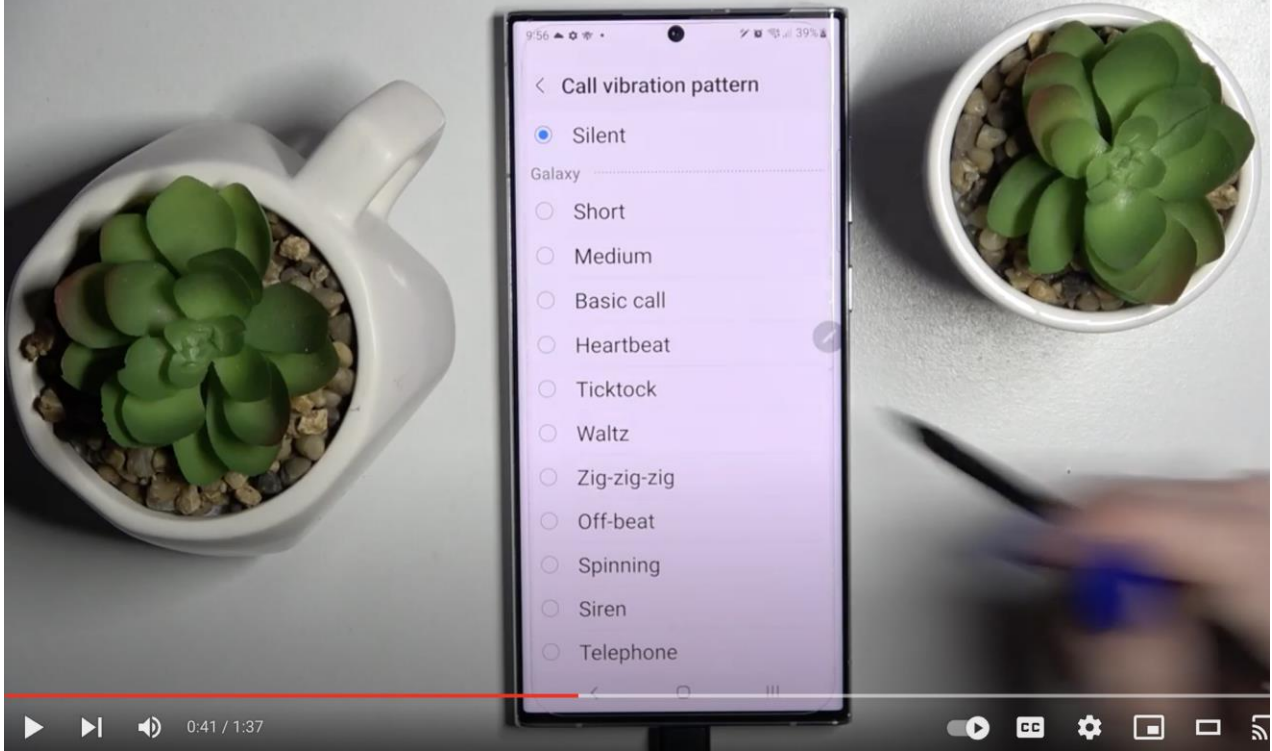
Claim 1	Accused Products
	Samsung Galaxy S22 / Galaxy S22 Ultra - Vibrate Mode 1. From a Home screen, swipe up from the center of the display to access the apps screen. → These instructions only apply to <u>Standard mode</u> and the default <u>Home screen layout</u>. 2. Navigate: Settings  > Sounds and vibration. 3. From the 'Sound mode' section, tap Vibrate. → Selected when a blue dot is present. 4. Tap Vibration intensity. 5. Adjust intensity for any of the following: → Drag the slider left or right to adjust the level. ▪ Incoming call ▪ Notifications ▪ Touch interaction Screenshot of https://www.verizon.com/support/knowledge-base-300923/ describing vibration settings.

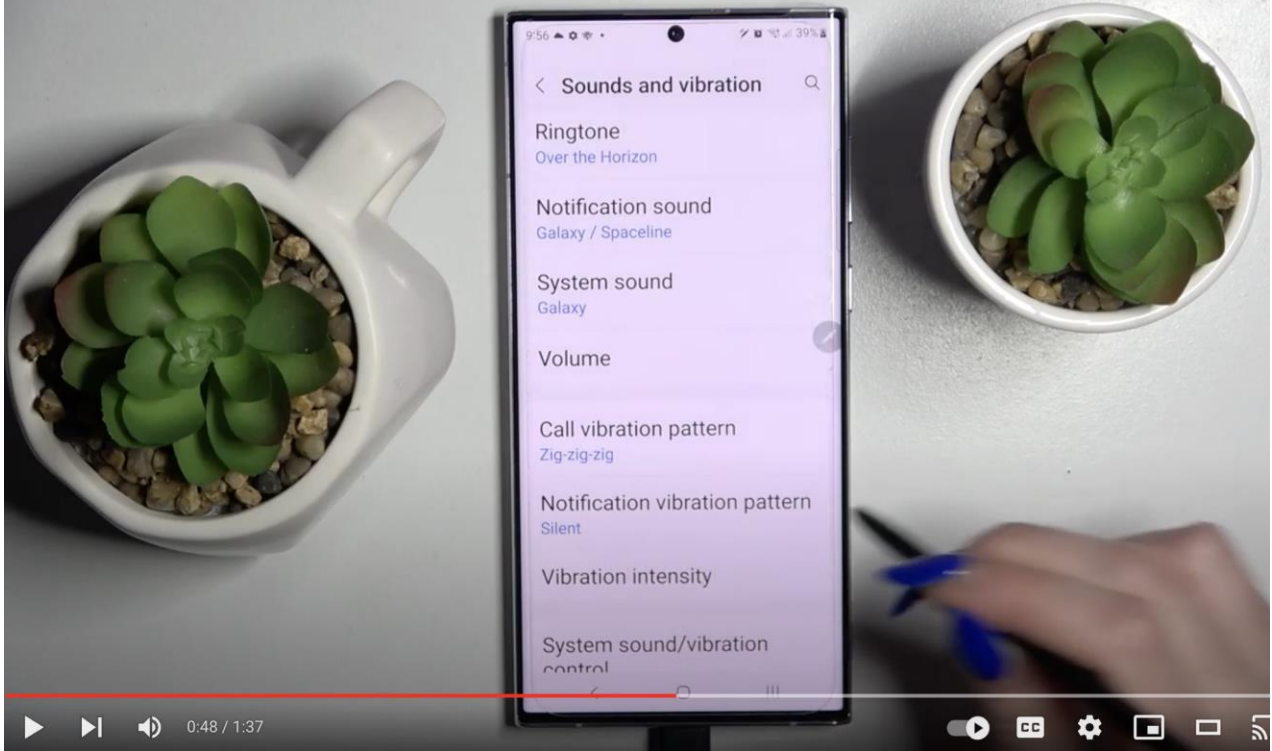
Claim 1	Accused Products
	How to improve the vibration of your Galaxy S22 device Last Update date : May 26, 2022 Galaxy S22 series has added a new feature to provide a vibration sound from the speaker when the device receives an incoming call in vibration mode.  Screenshot of https://www.samsung.com/za/support/mobile-devices/how-to-improve-the-vibration-of-your-galaxy-s22-device/ describing vibration settings.

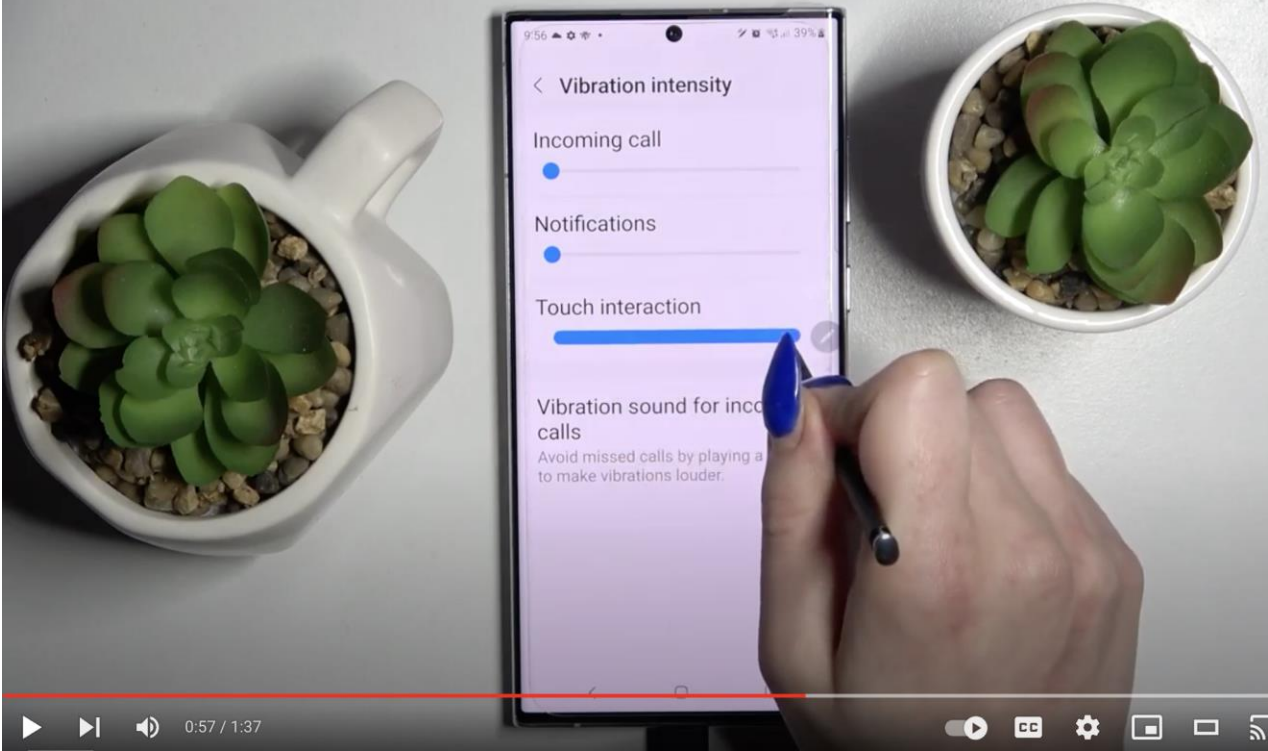
Claim 1	Accused Products
	To enable the vibration sound for incoming calls, please follow the steps below:  This screenshot shows the 'Settings' application on a smartphone. The 'Sounds and vibration' option is highlighted with a white box and a blue callout bubble containing a magnifying glass icon. Step 1. Tap Settings then select "Sounds and vibration".  This screenshot shows the 'Sounds and vibration' settings page. The 'Vibration intensity' option at the bottom is highlighted with a white box and a blue callout bubble. Step 2. Tap "Vibration intensity".  This screenshot shows the 'Vibration intensity' settings page. The 'Vibration sound for incoming calls' toggle switch is highlighted with a white box and a blue callout bubble. Step 3. Enable "Vibration sound for incoming calls". If you still do not have sufficient vibration on your device after enabling the vibration sound for incoming calls, you should consider the following: • If the mobile device is connected to other devices such as Watch/Buds/Headset/BT Speaker, Vibration sound mode will not work. • Vibration sound mode works on the basic 'Samsung Phone app' but on alarms or 3rd party apps it will not work. Screenshot of https://www.samsung.com/za/support/mobile-devices/how-to-improve-the-vibration-of-your-galaxy-s22-device/ describing vibration settings.

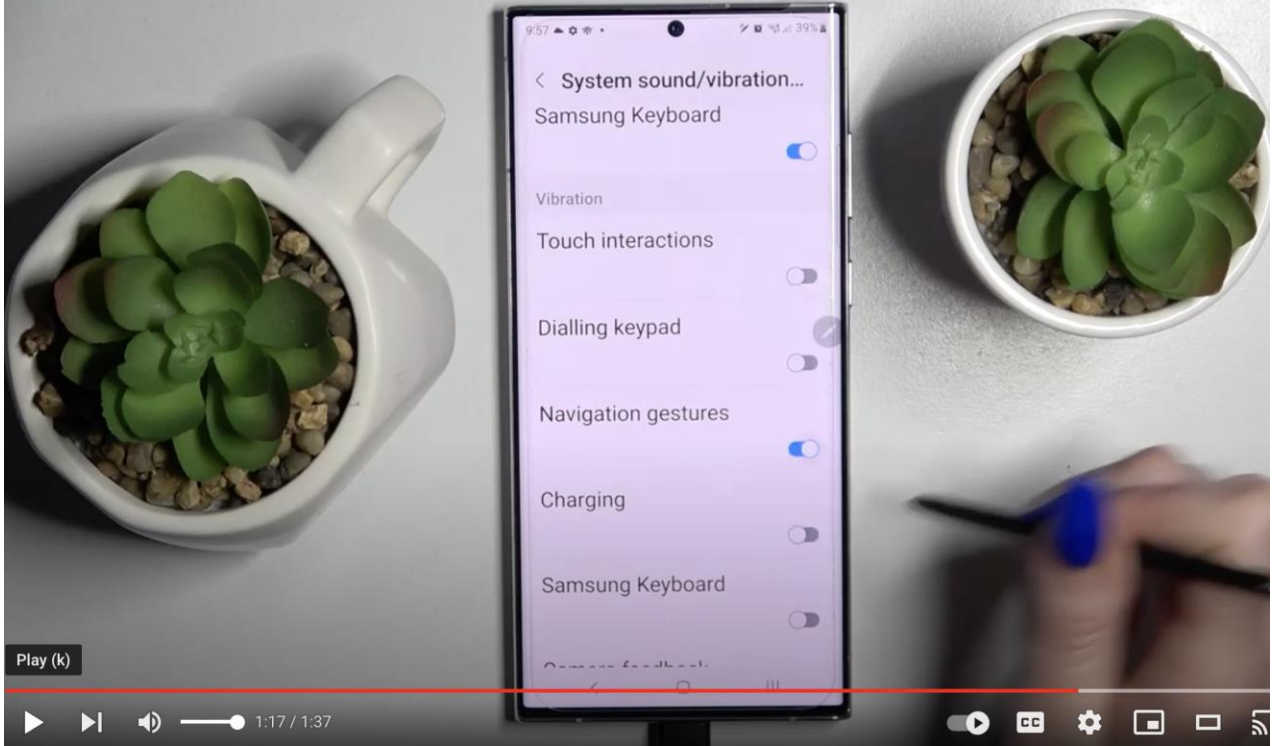
Claim 1	Accused Products
	 Screenshot of video entitled “How to Enter Vibration Settings in SAMSUNG Galaxy S22 Ultra – Find Vibration Options,” available at https://www.youtube.com/watch?v=BhIw8-yQhXM.

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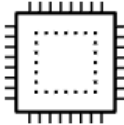
Claim 1	Accused Products
	Usage of haptic primitives Android includes several haptics <i>primitives</i> that vary in both amplitude and frequency. You may use one primitive alone or multiple primitives in combination to achieve rich haptic effects. Screenshot from Android API documentation at https://developer.android.com/develop/ui/views/haptics/custom-haptic-effects indicating one non limiting example where the Android operating system is configurable to associate “both amplitude and frequency” with user input.

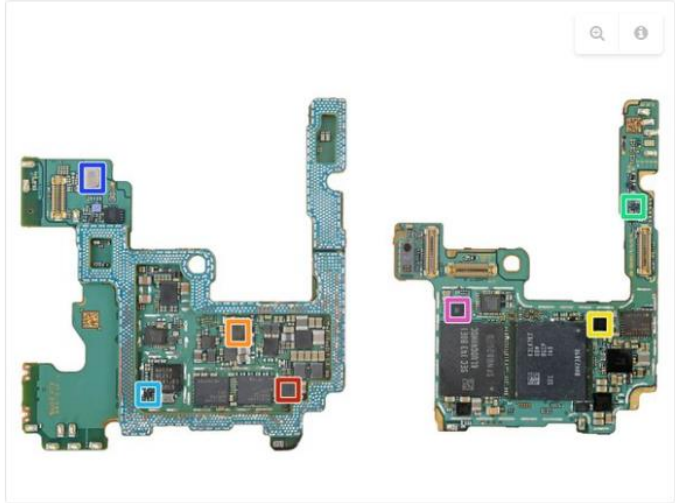
Claim 1	Accused Products																		
	<table> <tr> <th colspan="2">Constants</th></tr> <tr> <td>int</td><td> PRIMITIVE_CLICK This effect should produce a sharp, crisp click sensation. </td></tr> <tr> <td>int</td><td> PRIMITIVE_LOW_TICK This very short low frequency effect should produce a light crisp sensation intended to be used repetitively for dynamic feedback. </td></tr> <tr> <td>int</td><td> PRIMITIVE_QUICK_FALL A haptic effect that simulates quick downwards movement with gravity. </td></tr> <tr> <td>int</td><td> PRIMITIVE_QUICK_RISE A haptic effect that simulates quick upward movement against gravity. </td></tr> <tr> <td>int</td><td> PRIMITIVE_SLOW_RISE A haptic effect that simulates slow upward movement against gravity. </td></tr> <tr> <td>int</td><td> PRIMITIVE_SPIN A haptic effect that simulates spinning momentum. </td></tr> <tr> <td>int</td><td> PRIMITIVE_THUD A haptic effect that simulates downwards movement with gravity. </td></tr> <tr> <td>int</td><td> PRIMITIVE_TICK This very short effect should produce a light crisp sensation intended to be used repetitively for dynamic feedback. </td></tr> </table> Screenshot from Android API documentation at	Constants		int	PRIMITIVE_CLICK This effect should produce a sharp, crisp click sensation.	int	PRIMITIVE_LOW_TICK This very short low frequency effect should produce a light crisp sensation intended to be used repetitively for dynamic feedback.	int	PRIMITIVE_QUICK_FALL A haptic effect that simulates quick downwards movement with gravity.	int	PRIMITIVE_QUICK_RISE A haptic effect that simulates quick upward movement against gravity.	int	PRIMITIVE_SLOW_RISE A haptic effect that simulates slow upward movement against gravity.	int	PRIMITIVE_SPIN A haptic effect that simulates spinning momentum.	int	PRIMITIVE_THUD A haptic effect that simulates downwards movement with gravity.	int	PRIMITIVE_TICK This very short effect should produce a light crisp sensation intended to be used repetitively for dynamic feedback.
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Claim 1	Accused Products
	https://developer.android.com/reference/android/os/VibrationEffect.Composition showing individual haptics primitives independently representing both amplitude and frequency

Claim 2

Claim 2	Accused Products
[2pre] The linear vibration module of claim 1 wherein the control component is one of:	Each Accused Product comprises the linear vibration motor of claim 1 wherein the control component is as claimed in claim 2. <i>See analysis and evidence for claim 1 and remainder of claim 2.</i>
[2a] an variable oscillator circuit with additional control circuitry; and	This alternative portion of claim 2 is not asserted at this time. If any Accused Product(s) include a variable oscillator circuit as claimed, information regarding that circuit would be within the sole possession of Defendant and/or relevant third parties, and Revel reserves the right to assert this alternative portion if fact discovery uncovers such a circuit.
[2b] a control component that includes a microprocessor,	Each Accused Product comprises a control component that includes a microprocessor. For one example, in the Galaxy S22 Ultra, the control component includes a processor in the form of the device's application processor. For another example, the Cirrus Logic haptic driver IC in the Galaxy S22 Ultra includes a microprocessor, including at least a digital signal processor (DSP). <i>See, e.g.:</i>

Claim 2	Accused Products
	Samsung Galaxy S22 Ultra ▼ Processor  Snapdragon 8 Gen 1 https://www.samsung.com/us/smartphones/galaxy-s22-ultra/compare/?device-1=samsung-galaxy-s22-ultra&device-2=samsung-galaxy-s22%2B&device-3=samsung-galaxy-s22

Claim 2	Accused Products
	Step 2  Edit  ● IC Identification, pt. 2: ● Cirrus Logic CS40L26 Haptic Driver ● Qualcomm PMR735A Power Management ● Qualcomm PM3003 Power Management ● Diodes Incorporated AP7340D-30FS4-7 150 mA / 3.0 V LDO Regulator ● Diodes Incorporated AP7340D-33FS4-7 150 mA / 3.3 V LDO Regulator ● Knowles MEMS Microphone ● Qualcomm Clock Generator  Add a comment Screenshot of https://www.ifixit.com/Guide/Samsung+Galaxy+S22+Ultra+Chip+ID/148073 showing Cirrus Logic haptic driver IC.

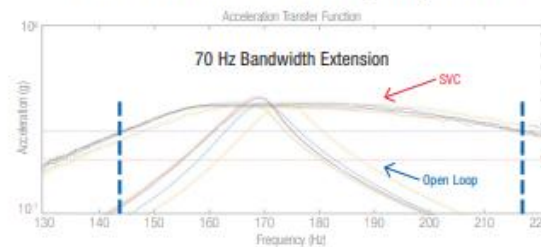
Claim 2	Accused Products
	Products ▾ / CS40L26/26B Smart Haptic Driver Enables HD Haptics on Mobile Devices for Enhanced Gaming, Videos and Music  Request Data Sheet Purchase Help Contact sales and support The CS40L26/CS40L26B is the industry's leading self-contained haptic driver IC that integrates a DSP and Class D digital boost converter to enable advanced closed-loop control of the actuator, HD enabled haptics and audio generated haptics for use in smartphones, tablets and wearables. Advanced sensor-less velocity control (SVC) provides real-time braking and consistent acceleration of the LRA, plus wider bandwidth and broader frequency range – essential features for gaming UX. CIRRUS ROCKS® CIRRUS® ENGINEERED TO ROCK® INNOVATION THAT ROCKS® Technology Haptic Drivers Application Categories Mobile Audio Devices, Wearables Screenshot of Cirrus Logic haptic driver description, available at https://www.cirrus.com/products/cs40l26-26b/.

Sensor-Less Velocity Control (SVC) Delivers Dynamic Haptic Performance

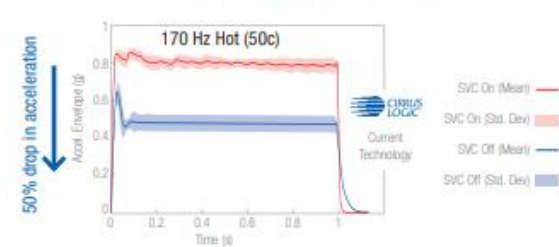
Why SVC Matters – Closed-Loop Feedback Ensures Gaming Consistency

- Dynamically adapts to the LRA in real time – a key performance enhancement for gaming and streamed haptics
- Widens the LRA bandwidth for consistent acceleration, as well as crisp performance when in overdrive and braking

SVC Widens the LRA Bandwidth, Enabling HD Haptic Effects

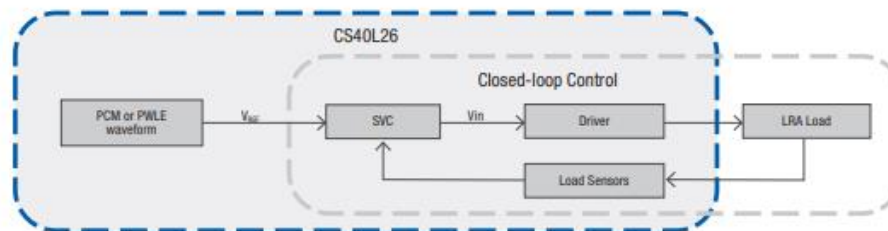


SVC Generates Consistent Acceleration



How SVC Works

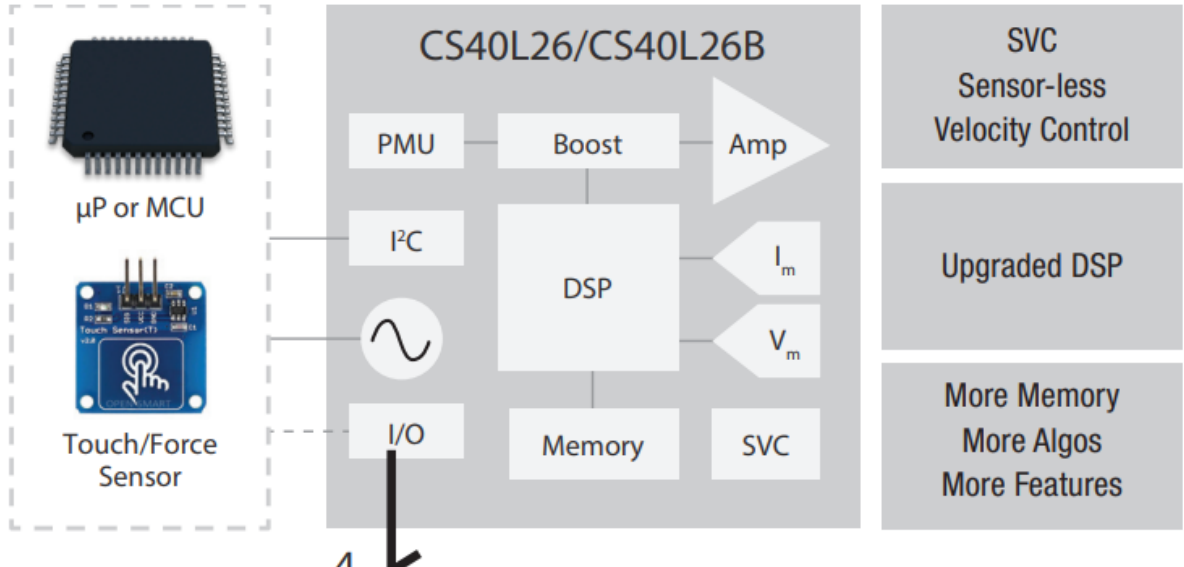
- SVC senses the load condition and adapts the signal V_{in} to drive for the back-emf to follow V_{REF}



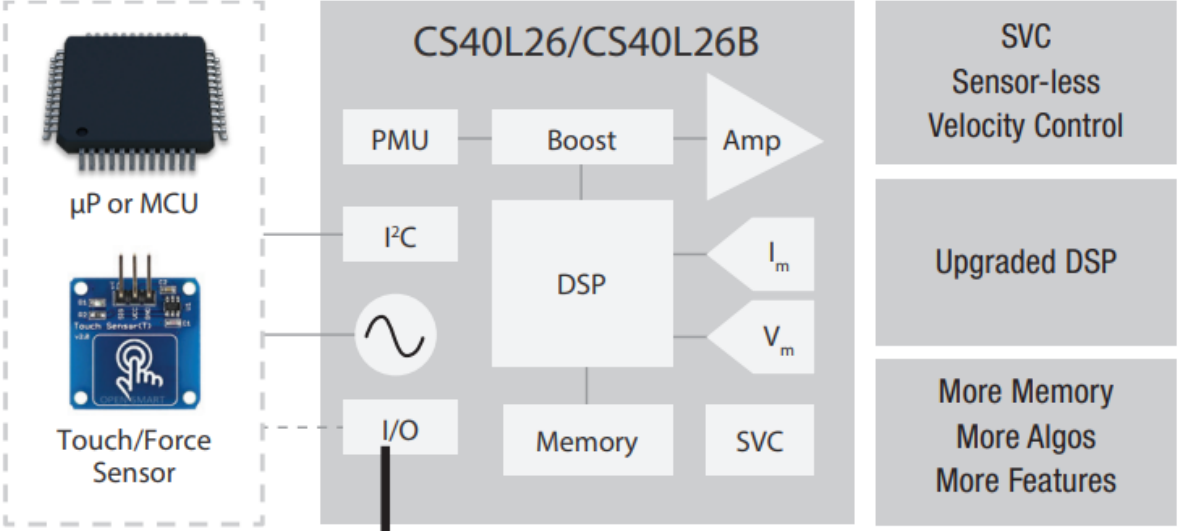
Screenshot of haptic driver datasheet, available at

https://statics.cirrus.com/pubs/proBulletin/CS40L26_B_Smart_Haptics_Driver_Product_Bulletin.pdf.

Claim 2	Accused Products
	Real-time, Automated Audio-2-Haptics Feel What You Hear with “On-the-Fly” Audio-2-Haptics Audio Generated Haptics — Complex Signal Processing Generates Textured HD Haptic Effects for Gaming, Videos and Music Generates haptic drive signals from the audio stream for ringtones, YouTube videos and games tuned for the LRA Audio Input, LRA Output, Magnitude, Threshold, Gain Important Notice: No license to any intellectual property right is included with this component, and certain uses or product designs, including certain haptics-related uses or haptics-system designs, may require an intellectual property license from one or more third parties. Cirrus Logic, Inc. 800 West Sixth Street Austin, Texas 78701 United States T+1-512-851-4000 Sales Support North America +1-800-888-5016 Asia Pacific +852 2376-0801 Japan +81-(3)-5782-8180 Europe/UK +44-(0)-131-272-7000 cirrus.com NOVEMBER 2021 © 2021 Cirrus Logic, Inc. All rights reserved. Cirrus Logic, Cirrus, the Cirrus Logic logo design, and SoundClear are trademarks of Cirrus Logic, Inc. Other brand and product names in this document may be trademarks or service marks of their respective owners. This product is covered by issued and pending patents of Cirrus Logic. Product features, capabilities, and operations described here are for illustrative purposes only and do not constitute instructions or suggestions regarding any particular implementation or design choice. Customers are solely responsible for their specific design, implementation, and end product and, if required, obtaining any related third-party intellectual property licenses. Screenshot of haptic driver datasheet, available at https://statics.cirrus.com/pubs/proBulletin/CS40L26_B_Smart_Haptics_Driver_Product_Bulletin.pdf.

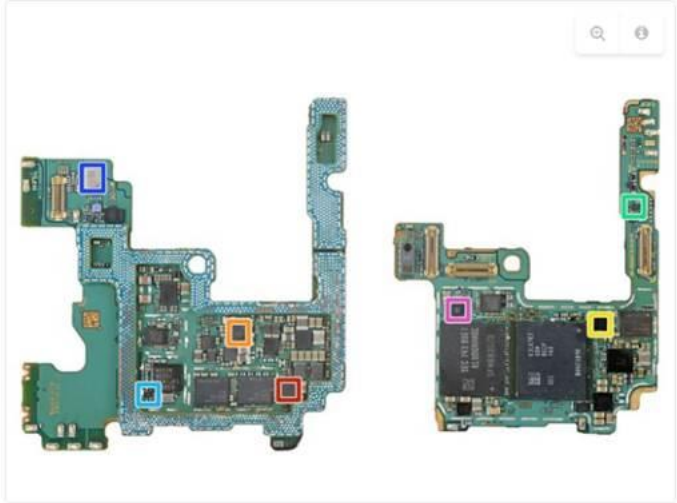
Claim 2	Accused Products
	 Screenshot of haptic driver datasheet, available at https://statics.cirrus.com/pubs/proBulletin/CS40L26_B_Smart_Haptics_Driver_Product_Bulletin.pdf.
[2c] a control program, stored in an electronic memory within, or separate from, the microprocessor, the control program executed 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 user	Each Accused Product comprises 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 user input received from the user-input features. For example, the application processor (e.g., Snapdragon 8 Gen 1 SoC) transmits serial or other data using control programs stored within the Application Processor's cache or RAM and/or nonvolatile memory. For another example, on information and belief the microprocessor within the haptic IC (e.g., Cirrus Logic CS40L26) stores and executes a control program (e.g. firmware). In either case, the control program directly or indirectly causes the driving component to cause the movable component to oscillate at a frequency and an amplitude

Claim 2	Accused Products
input received from the user-input features.	specified by user input received from the user-input features. <i>See</i> claim elements [1f] and [2a] above. <i>See also, e.g.:</i> Programmable DSP, faster processing – 130 MHz • Easily design new haptics effects for UI/alerts/ button replacement with state-of-the-art tools • 18 Kb storage Screenshot of haptic driver datasheet, available at https://statics.cirrus.com/pubs/proBulletin/CS40L26_B_Smart_Haptics_Driver_Product_Bulletin.pdf.

Claim 2	Accused Products
	 Screenshot of haptic driver datasheet, available at https://statics.cirrus.com/pubs/proBulletin/CS40L26_B_Smart_Haptics_Driver_Product_Bulletin.pdf.

Claim 3

Claim 3	Accused Products
3. The linear vibration module of claim 1 wherein the control component receives output signals from sensors within the linear vibration module during operation of the linear vibration module and adjusts one or more operational control outputs of the control component according to the received output signals from the sensors.	Each Accused Product comprises the linear vibration module of claim 1 (<i>see</i> claim 1 above) wherein the control component receives output signals from sensors within the linear vibration module during operation of the linear vibration module and adjusts one or more operational control outputs of the control component according to the received output signals from the sensors. For example, in the case of the Galaxy S22 Ultra and its Cirrus Logic CS40L26 haptic IC, the driver coil (<i>e.g.</i>, the “LRA load” in the Cirrus data sheet) forms a sensor responsive to the position, velocity, and other aspects of the vibration of the movable component (<i>e.g.</i> the “load condition” described in the Cirrus data sheet). The haptic IC, using a closed-loop control program, “[d]ynamically adjusts to the LRA in real time” and “adapts the signal Vin” using this sensor data. The signal Vin, as described in the Cirrus data sheet, corresponds to one non-limiting example of an operational control output as claimed. <i>See, e.g.:</i>

Claim 3	Accused Products
	Step 2  Edit  ● IC Identification, pt. 2: ● Cirrus Logic CS40L26 Haptic Driver ● Qualcomm PMR735A Power Management ● Qualcomm PM3003 Power Management ● Diodes Incorporated AP7340D-30FS4-7 150 mA / 3.0 V LDO Regulator ● Diodes Incorporated AP7340D-33FS4-7 150 mA / 3.3 V LDO Regulator ● Knowles MEMS Microphone ● Qualcomm Clock Generator  Add a comment Screenshot of https://www.ifixit.com/Guide/Samsung+Galaxy+S22+Ultra+Chip+ID/148073 showing Cirrus Logic haptic driver IC.

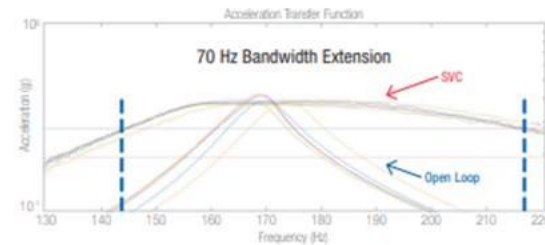
Claim 3	Accused Products
	Products ▾ / CS40L26/26B Smart Haptic Driver Enables HD Haptics on Mobile Devices for Enhanced Gaming, Videos and Music  Request Data Sheet Purchase Help Contact sales and support The CS40L26/CS40L26B is the industry's leading self-contained haptic driver IC that integrates a DSP and Class D digital boost converter to enable advanced closed-loop control of the actuator, HD enabled haptics and audio generated haptics for use in smartphones, tablets and wearables. Advanced sensor-less velocity control (SVC) provides real-time braking and consistent acceleration of the LRA, plus wider bandwidth and broader frequency range – essential features for gaming UX. CIRRUS ROCKS® CIRRUS® ENGINEERED TO ROCK® INNOVATION THAT ROCKS® Technology Haptic Drivers Application Categories Mobile Audio Devices, Wearables Screenshot of Cirrus Logic haptic driver description, available at https://www.cirrus.com/products/cs40l26-26b/.

Sensor-Less Velocity Control (SVC) Delivers Dynamic Haptic Performance

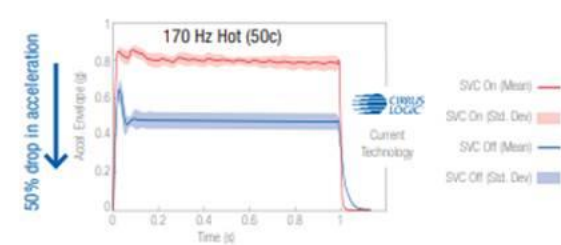
Why SVC Matters – Closed-Loop Feedback Ensures Gaming Consistency

- Dynamically adapts to the LRA in real time – a key performance enhancement for gaming and streamed haptics
- Widens the LRA bandwidth for consistent acceleration, as well as crisp performance when in overdrive and braking

SVC Widens the LRA Bandwidth, Enabling HD Haptic Effects

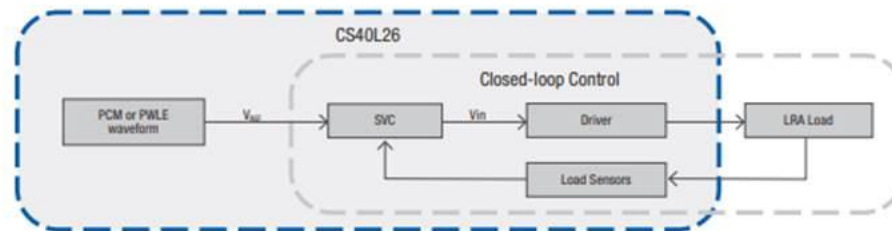


SVC Generates Consistent Acceleration



How SVC Works

- SVC senses the load condition and adapts the signal V_{in} to drive for the back-emf to follow V_{REF} .

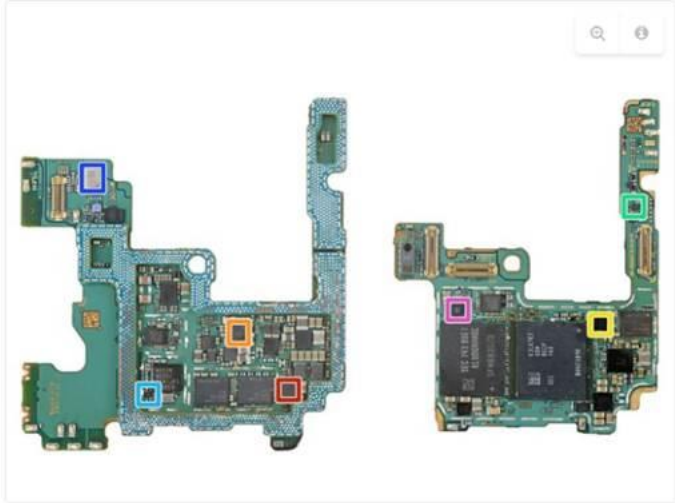


Screenshot of haptic driver datasheet, available at

https://statics.cirrus.com/pubs/proBulletin/CS40L26_B_Smart_Haptics_Driver_Product_Bulletin.pdf.

Claim 4

Claim 4	Accused Products
4. The linear 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 linear vibration module produces desired outputs from the one or more sensors corresponding to one or more operational control parameters.	Each Accused Product comprises the linear vibration module of claim 1 (see claim 1 above) 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 linear vibration module produces desired outputs from the one or more sensors corresponding to one or more operational control parameters. For example, in the case of the Galaxy S22 Ultra and its Cirrus Logic CS40L26 haptic IC, the driver coil (<i>e.g.</i>, the “LRA load” in the Cirrus data sheet) forms a sensor responsive to the position, velocity, and other aspects of the vibration of the movable component (<i>e.g.</i> the “load condition” described in the Cirrus data sheet). The haptic IC, using a closed-loop control program, “[d]ynamically adjusts to the LRA in real time” and “adapts the signal V_{in}” using this sensor data. Because it is a closed-loop control program, it is designed to adjust and/or adapt its control outputs (<i>e.g.</i>, “V_{in}” in the Cirrus Logic datasheet and/or another signal corresponding to amplitude and/or frequency) so that the subsequently received output signals correspond to the operational control parameter(s) specifying a desired result (<i>e.g.</i> “V_{REF}” in the Cirrus Logic datasheet, a desired amplitude, and/or a desired frequency). In another non-limiting example, the operation control parameter(s) may be specified by software running on the application processor, <i>e.g.</i> through an Android API. <i>See, e.g.:</i>

Claim 4	Accused Products
	Step 2  Edit  ● IC Identification, pt. 2: ● Cirrus Logic CS40L26 Haptic Driver ● Qualcomm PMR735A Power Management ● Qualcomm PM3003 Power Management ● Diodes Incorporated AP7340D-30FS4-7 150 mA / 3.0 V LDO Regulator ● Diodes Incorporated AP7340D-33FS4-7 150 mA / 3.3 V LDO Regulator ● Knowles MEMS Microphone ● Qualcomm Clock Generator  Add a comment Screenshot of https://www.ifixit.com/Guide/Samsung+Galaxy+S22+Ultra+Chip+ID/148073 showing Cirrus Logic haptic driver IC.

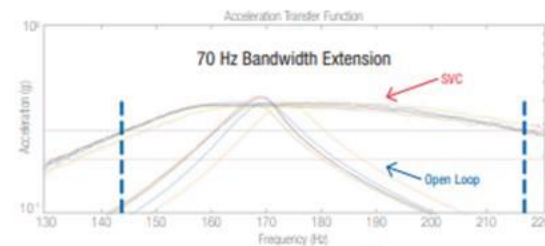
Claim 4	Accused Products
	Products ▾ / CS40L26/26B Smart Haptic Driver Enables HD Haptics on Mobile Devices for Enhanced Gaming, Videos and Music  Request Data Sheet Purchase Help Contact sales and support The CS40L26/CS40L26B is the industry's leading self-contained haptic driver IC that integrates a DSP and Class D digital boost converter to enable advanced closed-loop control of the actuator, HD enabled haptics and audio generated haptics for use in smartphones, tablets and wearables. Advanced sensor-less velocity control (SVC) provides real-time braking and consistent acceleration of the LRA, plus wider bandwidth and broader frequency range – essential features for gaming UX. CIRRUS ROCKS® CIRRUS® ENGINEERED TO ROCK® INNOVATION THAT ROCKS® Technology Haptic Drivers Application Categories Mobile Audio Devices, Wearables Screenshot of Cirrus Logic haptic driver description, available at https://www.cirrus.com/products/cs40l26-26b/.

Sensor-Less Velocity Control (SVC) Delivers Dynamic Haptic Performance

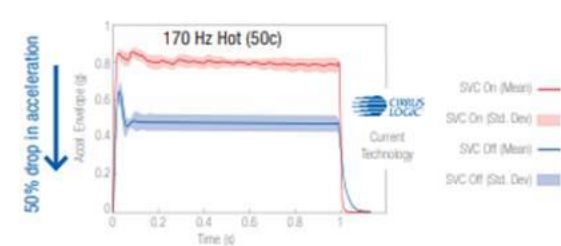
Why SVC Matters – Closed-Loop Feedback Ensures Gaming Consistency

- Dynamically adapts to the LRA in real time – a key performance enhancement for gaming and streamed haptics
- Widens the LRA bandwidth for consistent acceleration, as well as crisp performance when in overdrive and braking

SVC Widens the LRA Bandwidth, Enabling HD Haptic Effects

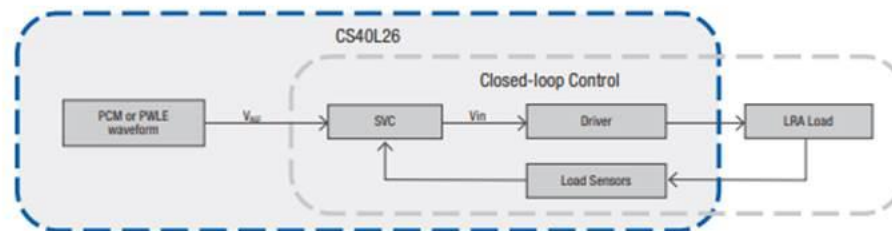


SVC Generates Consistent Acceleration



How SVC Works

- SVC senses the load condition and adapts the signal V_{in} to drive for the back-emf to follow V_{REF}



Screenshot of haptic driver datasheet, available at

https://statics.cirrus.com/pubs/proBulletin/CS40L26_B_Smart_Haptics_Driver_Product_Bulletin.pdf.

Claim 4	Accused Products
	Usage of haptic primitives Android includes several haptics <i>primitives</i> that vary in both amplitude and frequency. You may use one primitive alone or multiple primitives in combination to achieve rich haptic effects. Screenshot from Android API documentation at https://developer.android.com/develop/ui/views/haptics/custom-haptic-effects indicating one non limiting example where the Android operating system can provide operational control parameters representing strength of vibration and frequency.

Claim 5

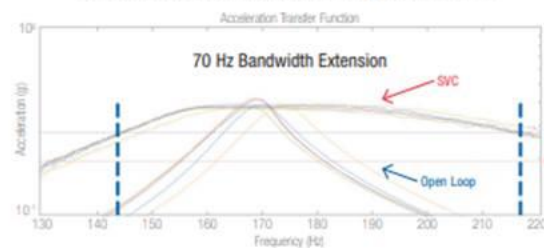
Claim 5	Accused Products
[5a] The linear vibration module of claim 4 wherein the one or more operational control parameters is a strength of vibration produced by the linear oscillation of the moveable component; and	Each Accused Product comprises the linear vibration module of claim 4 wherein the one or more operational control parameters is a strength of vibration produced by the linear oscillation of the moveable component. For example, in the case of the Galaxy S22 Ultra, the haptic IC “dynamically adapts to the LRA in real time” and “senses the load condition and adapts the signal V_{in} to drive for the back-emf to follow V_{REF}.” <i>See, e.g.:</i>

Sensor-Less Velocity Control (SVC) Delivers Dynamic Haptic Performance

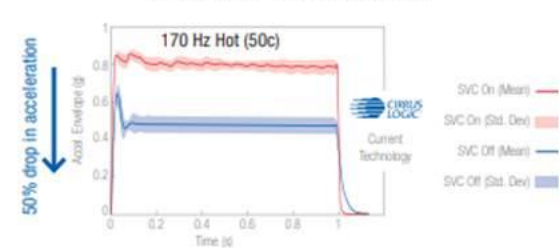
Why SVC Matters – Closed-Loop Feedback Ensures Gaming Consistency

- Dynamically adapts to the LRA in real time – a key performance enhancement for gaming and streamed haptics
- Widens the LRA bandwidth for consistent acceleration, as well as crisp performance when in overdrive and braking

SVC Widens the LRA Bandwidth, Enabling HD Haptic Effects

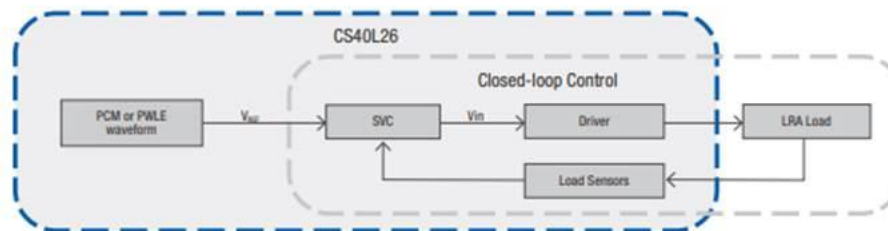


SVC Generates Consistent Acceleration



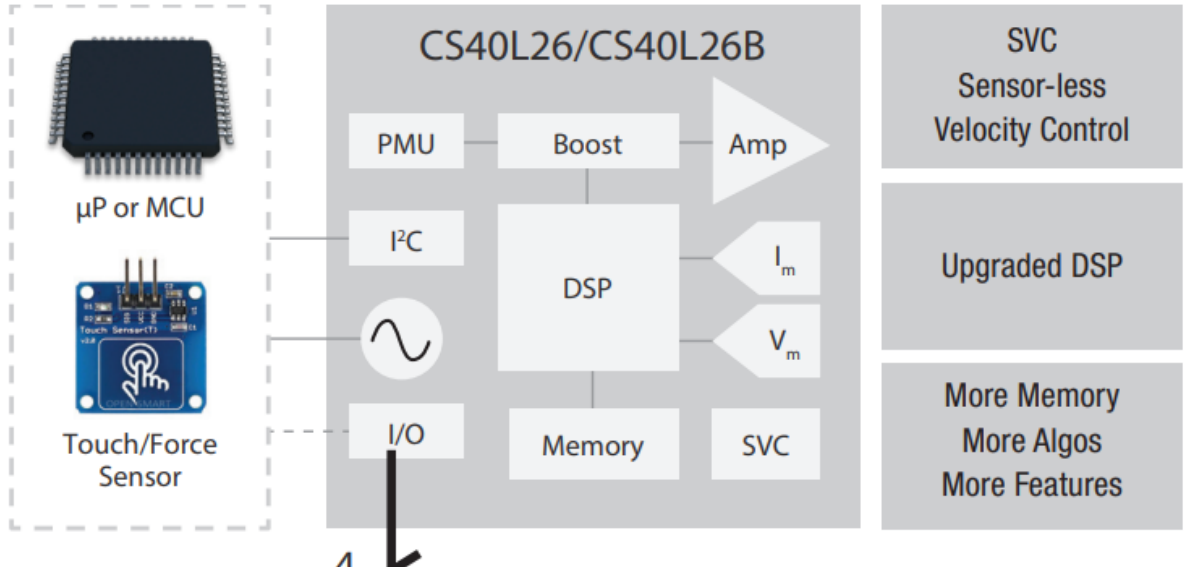
How SVC Works

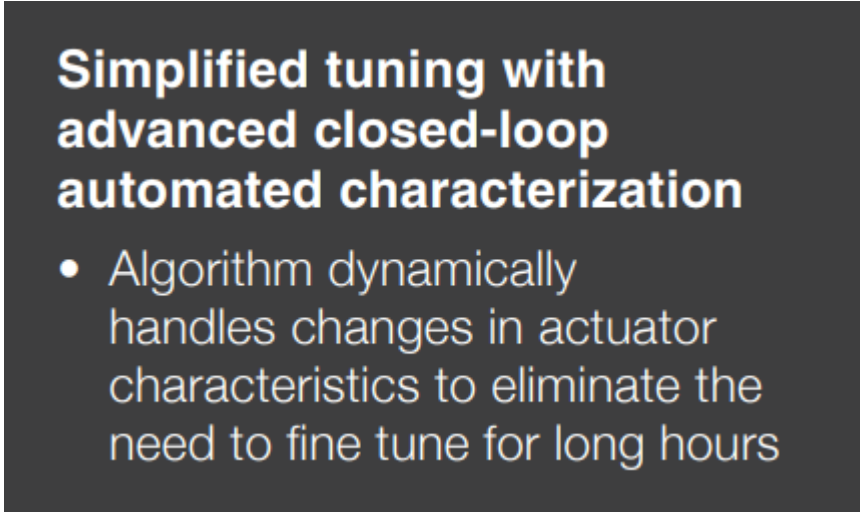
- SVC senses the load condition and adapts the signal V_{in} to drive for the back-emf to follow V_{REF}



Screenshot of haptic driver datasheet, available at

https://statics.cirrus.com/pubs/proBulletin/CS40L26_B_Smart_Haptics_Driver_Product_Bulletin.pdf, showing that the SVC system is designed to maximize the strength of vibration (measured as “acceleration”), indicating that the operational control parameter(s) correspond to the strength of vibration.

Claim 5	Accused Products
	 Screenshot of haptic driver datasheet, available at https://statics.cirrus.com/pubs/proBulletin/CS40L26_B_Smart_Haptics_Driver_Product_Bulletin.pdf.
[5b] wherein the one or more operational control outputs is a frequency at which the control component drives the moveable component to linearly oscillate, the control component dynamically adjusting the power supplied to the driving component to produce linear oscillation of the movable component at a	Each Accused Product includes a linear vibration module wherein the one or more operational control outputs is a frequency at which the control component drives the moveable component to linearly oscillate, the control component dynamically adjusting the power supplied to the driving component to produce linear oscillation of the movable component at a resonant frequency for the linear vibration module. For example, in the case of the Galaxy S22 Ultra, the haptic IC performs “dynamic tuning with advanced closed-loop automated characterization” in order to “handle[] changes in actuator characteristics to eliminate the need to fine tune for long hours.” On information and belief, this explicit discussion of “closed-loop” refers to using a closed-loop control program in order to determine the resonant frequency for the linear vibration module, as claimed. <i>See, e.g.</i>, element [2c] and claim 4 above.

Claim 5	Accused Products
resonant frequency for the linear vibration module.	See, e.g.:  Screenshot of haptic driver datasheet, available at https://statics.cirrus.com/pubs/proBulletin/CS40L26_B_Smart_Haptics_Driver_Product_Bulletin.pdf.

Claim 6

Claim 6	Accused Products
[6a] The linear vibration module of claim 4 wherein the one or more operational control parameters include both a strength of vibration produced by the linear oscillation of the moveable	Each Accused Product comprises the linear vibration module of claim 4 wherein the one or more operational control parameters include both a strength of vibration produced by the linear oscillation of the moveable component and a current operational mode. For example, in the case of the Galaxy S22 Ultra, the haptic IC “dynamically adapts to the LRA in real time” and “senses the load condition and adapts the signal V_{in} to drive for the back-emf to follow V_{REF} .” The operational control parameters as claimed include, for example, V_{REF} , the waveform input to the haptic controller, control parameters regarding the operation of the haptic controller (e.g., a parameter enabling SVC) and/or control parameters provided by software running on the

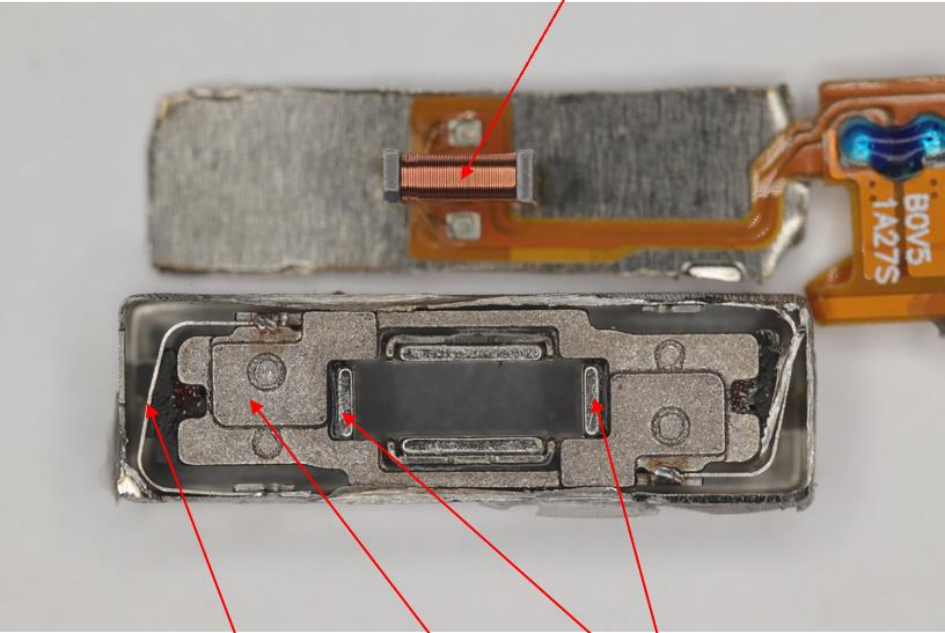
Claim 6	Accused Products
component and a current operational mode; and	application processor (<i>e.g.</i> via the user selection of a particular vibration pattern, or via an Android API selecting a particular haptic effect). <i>See, e.g.</i>, element [1f]. <i>See also, e.g.:</i> Sensor-Less Velocity Control (SVC) Delivers Dynamic Haptic Performance Why SVC Matters – Closed-Loop Feedback Ensures Gaming Consistency • Dynamically adapts to the LRA in real time – a key performance enhancement for gaming and streamed haptics • Widens the LRA bandwidth for consistent acceleration, as well as crisp performance when in overdrive and braking SVC Widens the LRA Bandwidth, Enabling HD Haptic Effects SVC Generates Consistent Acceleration How SVC Works • SVC senses the load condition and adapts the signal V_{in} to drive for the back-emf to follow V_{REF} Screenshot of haptic driver datasheet, available at https://statics.cirrus.com/pubs/proBulletin/CS40L26_B_Smart_Haptics_Driver_Product_Bulletin.pdf.

Claim 6	Accused Products
	VibrationEffect  Added in API level 26 Kotlin Java <pre>public abstract class VibrationEffect extends Object implements Parcelable</pre> java.lang.Object ↳ android.os.VibrationEffect A VibrationEffect describes a haptic effect to be performed by a Vibrator. These effects may be any number of things, from single shot vibrations to complex waveforms. Screenshot of Android API documentation, available at https://developer.android.com/reference/android/os/VibrationEffect, describing API for defining haptic effect operational modes.
[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	Each Accused Product includes a vibration module 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 linearly oscillate. For example, in the case of the Galaxy S22 Ultra, the haptic IC performs “dynamic tuning with advanced closed-loop automated characterization” in order to “handle[]

Claim 6	Accused Products
component and a frequency at which the control component drives the moveable component to linearly oscillate.	changes in actuator characteristics to eliminate the need to fine tune for long hours.” See claim 4 above. On information and belief, the control output determines, directly or indirectly, the current supplied to the driving coil and the frequency at which the movable component is driven to oscillate. For example, even if the non-limiting example control output labeled “Vin” in the Cirrus Logic data sheet is itself a voltage, that voltage directly or indirectly dictates the current supplied by the “driver” to the magnetic coil due to the specific architecture of the closed-loop control system described in the Cirrus Logic datasheet. Similarly, based on the specific architecture of the closed-loop control system described in the Cirrus Logic datasheet, Vin must directly or indirectly determine the driving frequency (e.g., through the frequency of Vin itself). <i>See also, e.g.:</i> Simplified tuning with advanced closed-loop automated characterization • Algorithm dynamically handles changes in actuator characteristics to eliminate the need to fine tune for long hours Screenshot of haptic driver datasheet, available at https://statics.cirrus.com/pubs/proBulletin/CS40L26_B_Smart_Haptics_Driver_Product_Bulletin.pdf.

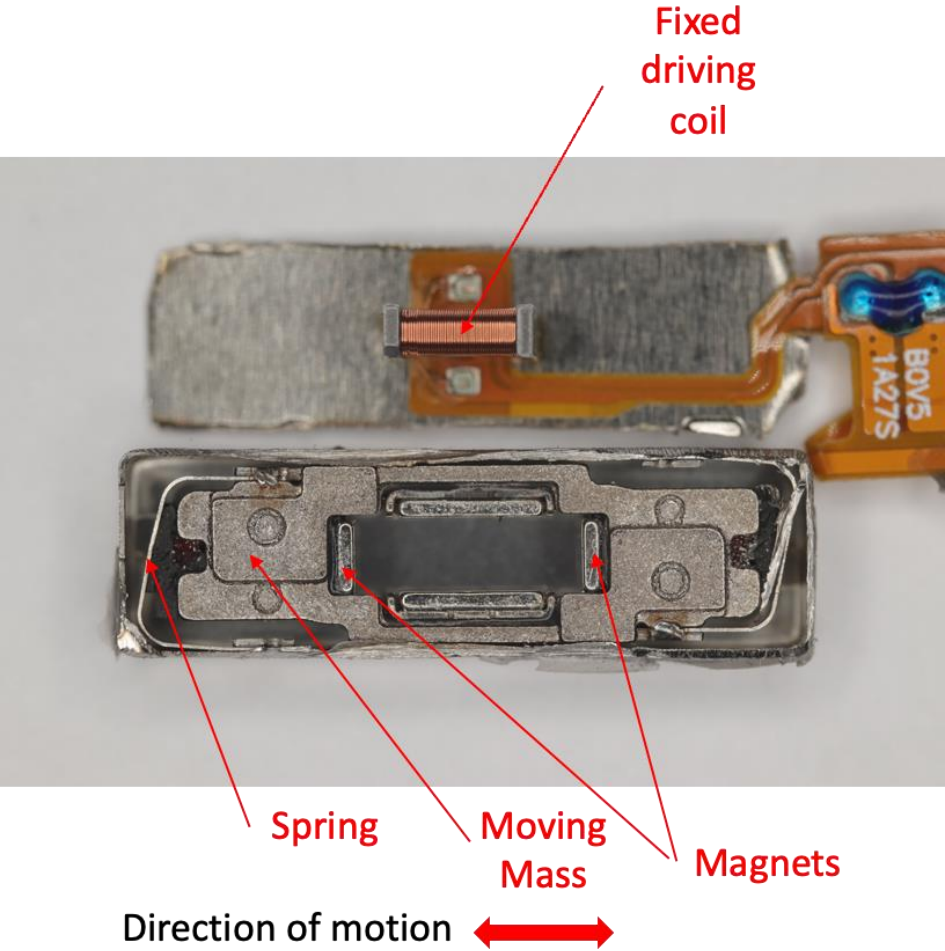
Claim 7

Claim 7	Accused Products
7. The linear 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.	Each Accused Product comprises the linear 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. For example, in the case of the Galaxy S22 Ultra, the driving component comprises one electromagnetic coil that generates a magnetic field parallel to the direction in which the moving mass moves. <i>See, e.g.:</i>

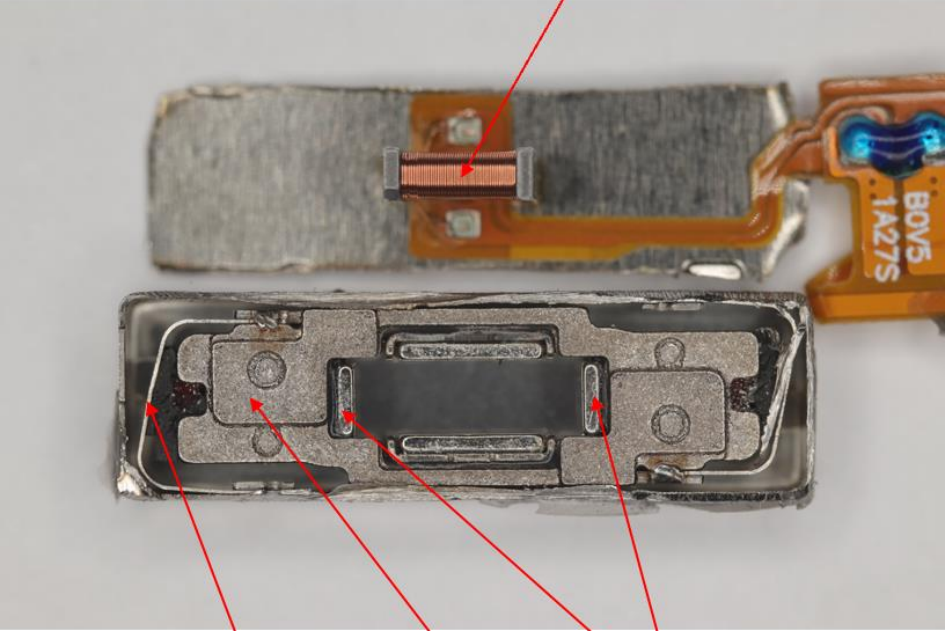
Claim 7	Accused Products
	 Fixed driving coil Spring Moving Mass Magnets Direction of motion  Photograph of Galaxy S22 Ultra linear motor with components annotated.

Claim 8

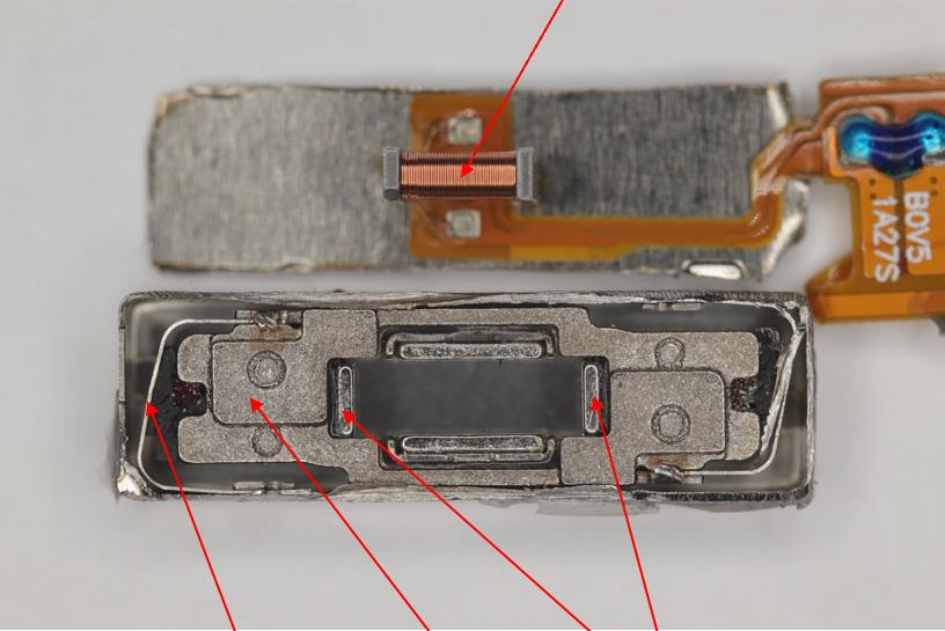
Claim 8	Accused Products
[8pre] The linear vibration module of claim 1	See analysis and evidence for claim 1 and remainder of claim 8.
[8a] wherein the housing is a linear tube, capped at both ends by movable-component-repelling components selected from one of mechanical springs and magnets;	Each Accused Product comprises the linear vibration module of claim 1 wherein the housing is a linear tube, capped at both ends by movable-component-repelling components selected from one of mechanical springs and magnets. For example, the housing of the LVM in the Galaxy S22 Ultra is a linear tube, rectangular in cross-section, with mechanical springs capping each end. <i>See, e.g.:</i>

Claim 8	Accused Products
	 Fixed driving coil Spring Moving Mass Magnets Direction of motion ↔ Photograph of Galaxy S22 Ultra linear motor with components annotated.
[8b] wherein the movable component is a magnet shaped	Each Accused Product comprises the linear vibration module of claim 1 wherein the movable component is a magnet shaped to slide within the linear tube. For example, the movable

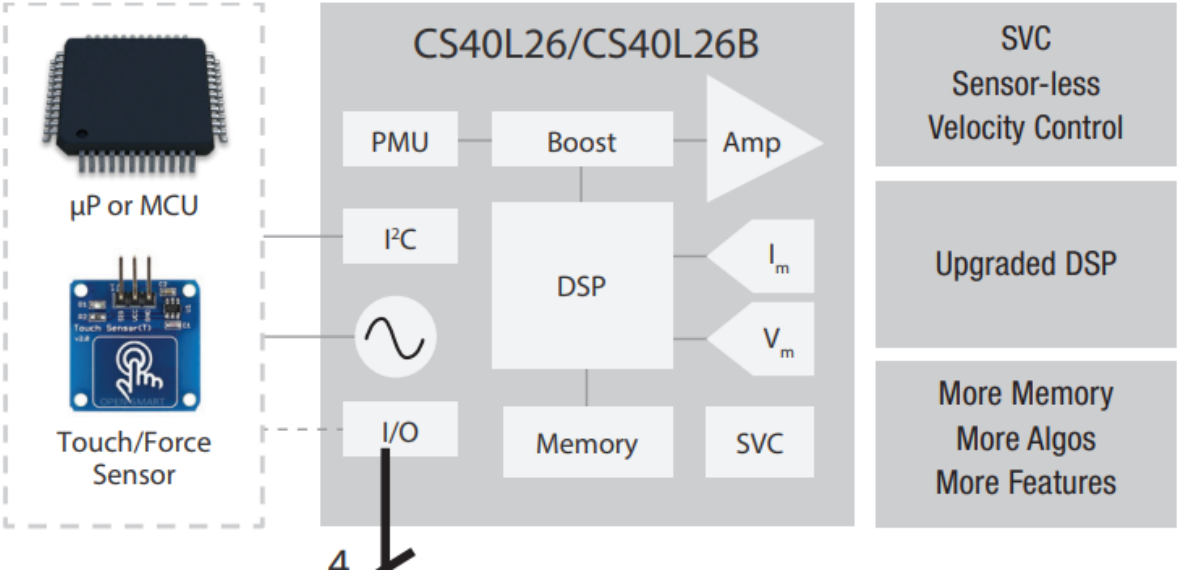
Claim 8	Accused Products
to slide within the linear tube; and	component of the LVM in the Galaxy S22 Ultra comprises magnets shaped to slide within the linear tube. <i>See, e.g.:</i>

Claim 8	Accused Products
	 Fixed driving coil Spring Moving Mass Magnets Direction of motion ↔ Photograph of Galaxy S22 Ultra linear motor with components annotated.

Claim 8	Accused Products
[8c] wherein the driving component is an electromagnetic coil.	Each Accused Product comprises the linear vibration module of claim 1 wherein the driving component is an electromagnetic coil. For example, in the case of the Galaxy S22 Ultra, the driving component is an electromagnetic coil. <i>See, e.g.:</i>

Claim 8	Accused Products
	 Fixed driving coil Spring Moving Mass Magnets Direction of motion ↔ Photograph of Galaxy S22 Ultra linear motor with components annotated.

Claim 17

Claim 17	Accused Products
17. The linear 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.	Each Accused Product comprises the linear 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. For example, in the case of the Galaxy S22 Ultra, the haptic IC controls the supply of power from a power management unit (PMU) through a boost circuit and an amplifier to the drive coil, to cause the movable component to oscillate at a frequency and an amplitude that are independently specified by user input received from the user-input features. <i>See element [1f] above.</i> <i>See also, e.g.:</i>  Screenshot of Galaxy S22 Ultra haptic driver datasheet, available at https://statics.cirrus.com/pubs/proBulletin/CS40L26_B_Smart_Haptics_Driver_Product_Bulletin.pdf.

Claim 17	Accused Products
	Usage of haptic primitives Android includes several haptics <i>primitives</i> that vary in both amplitude and frequency. You may use one primitive alone or multiple primitives in combination to achieve rich haptic effects. Screenshot from Android API documentation at https://developer.android.com/develop/ui/views/haptics/custom-haptic-effects indicating that Android haptic primitives independently specify amplitude and frequency.

Claim 17	Accused Products																		
	<table> <tr> <th colspan="2">Constants</th></tr> <tr> <td>int</td><td> PRIMITIVE_CLICK This effect should produce a sharp, crisp click sensation. </td></tr> <tr> <td>int</td><td> PRIMITIVE_LOW_TICK This very short low frequency effect should produce a light crisp sensation intended to be used repetitively for dynamic feedback. </td></tr> <tr> <td>int</td><td> PRIMITIVE_QUICK_FALL A haptic effect that simulates quick downwards movement with gravity. </td></tr> <tr> <td>int</td><td> PRIMITIVE_QUICK_RISE A haptic effect that simulates quick upward movement against gravity. </td></tr> <tr> <td>int</td><td> PRIMITIVE_SLOW_RISE A haptic effect that simulates slow upward movement against gravity. </td></tr> <tr> <td>int</td><td> PRIMITIVE_SPIN A haptic effect that simulates spinning momentum. </td></tr> <tr> <td>int</td><td> PRIMITIVE_THUD A haptic effect that simulates downwards movement with gravity. </td></tr> <tr> <td>int</td><td> PRIMITIVE_TICK This very short effect should produce a light crisp sensation intended to be used repetitively for dynamic feedback. </td></tr> </table> Screenshot from Android API documentation at	Constants		int	PRIMITIVE_CLICK This effect should produce a sharp, crisp click sensation.	int	PRIMITIVE_LOW_TICK This very short low frequency effect should produce a light crisp sensation intended to be used repetitively for dynamic feedback.	int	PRIMITIVE_QUICK_FALL A haptic effect that simulates quick downwards movement with gravity.	int	PRIMITIVE_QUICK_RISE A haptic effect that simulates quick upward movement against gravity.	int	PRIMITIVE_SLOW_RISE A haptic effect that simulates slow upward movement against gravity.	int	PRIMITIVE_SPIN A haptic effect that simulates spinning momentum.	int	PRIMITIVE_THUD A haptic effect that simulates downwards movement with gravity.	int	PRIMITIVE_TICK This very short effect should produce a light crisp sensation intended to be used repetitively for dynamic feedback.
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Claim 17	Accused Products
	https://developer.android.com/reference/android/os/VibrationEffect.Composition showing individual haptics primitives independently representing both amplitude and frequency. <i>See also</i> analysis and evidence for claim 1.

U.S. Patent No. 9,941,830 (“’830 Patent”)

Accused Instrumentalities

Samsung products with linear vibration motor technology, including without limitation the products listed below (“Accused Products”), infringe at least Claims 1, 2, 3, 4, 5, 6, 7, 8, and 17 of the ’830 Patent. Each Accused Product infringes the claims in substantially the same way, and the evidence shown in this chart is similarly applicable to each Accused Product. For example, each Accused Product includes a linear vibration motor and supports substantially the same haptic feedback features. Each claim limitation is literally infringed by each Accused Product. However, to the extent any claim limitation is not met literally, it is nonetheless met under the doctrine of equivalents because the differences between the claim limitation and each Accused Product would be insubstantial, and each Accused Product performs substantially the same function, in substantially the same way, to achieve the same result as the claimed invention. Notably, Samsung has not yet articulated which, if any, particular claim limitations it believes are not met by the Accused Products, listed below:

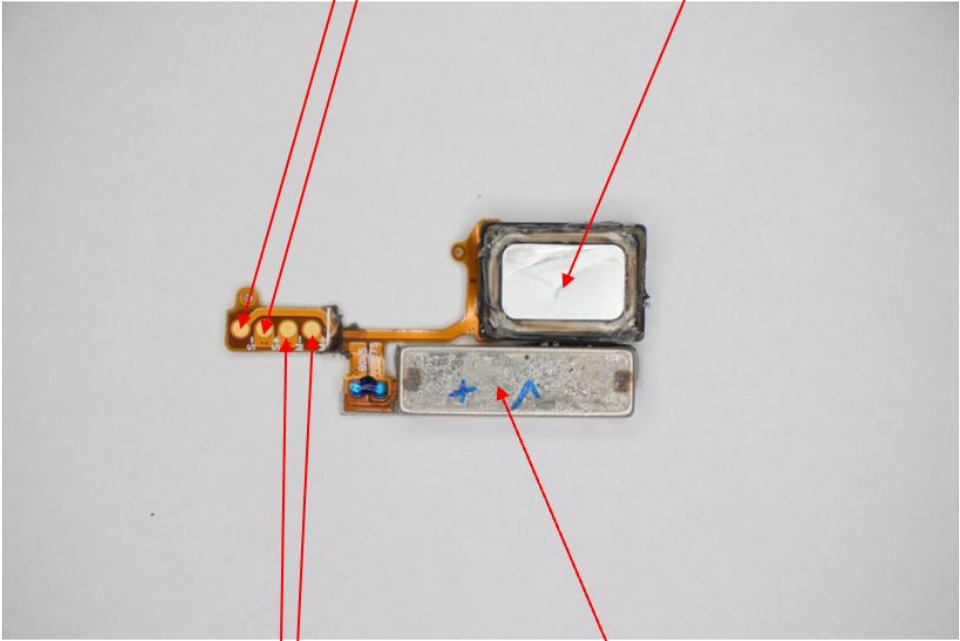
- Galaxy S20+
- Galaxy S20 Ultra
- Galaxy S21+
- Galaxy S21 Ultra
- Galaxy S22
- Galaxy S22+
- Galaxy S22 Ultra
- Galaxy S23
- Galaxy S23+
- Galaxy S23 Ultra
- Galaxy Fold 1
- Galaxy Z Fold 2
- Galaxy Z Fold 3
- Galaxy Z Fold 4
- Galaxy Note10+
- Galaxy Note20 Ultra

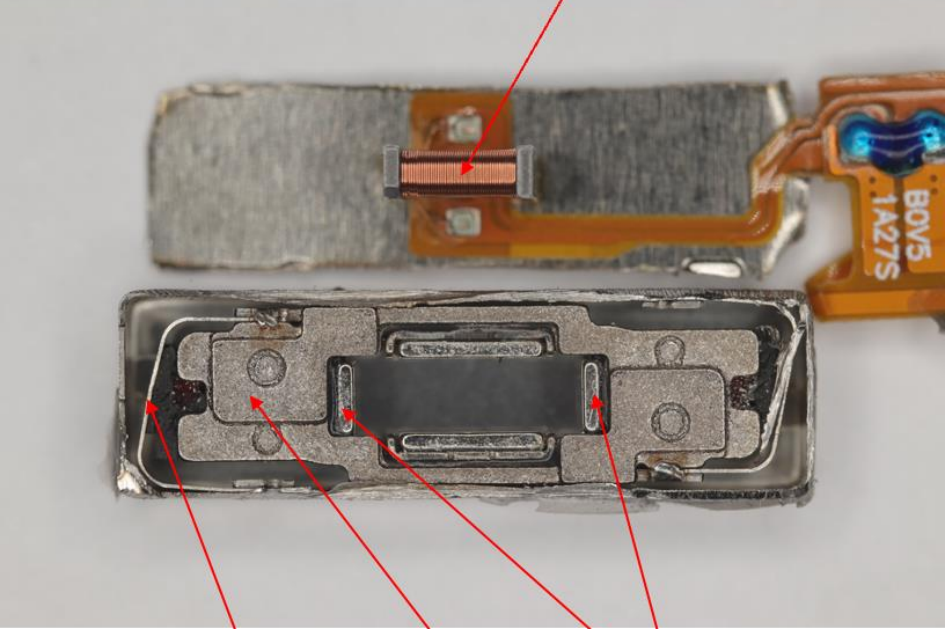
Claim 1

Claim 1	Accused Products
[1pre]. A vibration module comprising:	To the extent the preamble is limiting, each Accused Product comprises a vibration module as claimed. For example, even if this preamble were interpreted to require all of the components recited in the body of claim 1 to be part of a single vibration module, each Accused Product would still meet that requirement because it is a vibration module as claimed. For example, Galaxy S22 Ultra includes a linear motor and associated controller(s), including the haptic controller (<i>e.g.</i>, Cirrus Logic CS40L26), application processor (<i>e.g.</i>, Snapdragon 8 Gen 1 SoC), power supply circuits, and connected user-input features such as a touchscreen. These components together form a vibration module as claimed, as described in connection with the claim limitations below. <i>See, e.g.:</i>

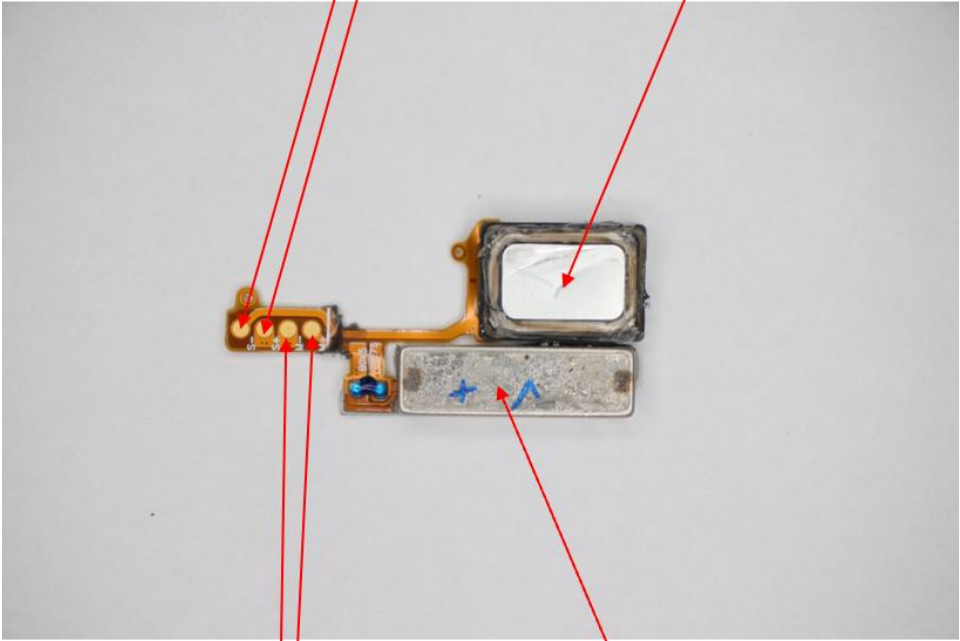
Claim 1	Accused Products
	A photograph of the back of a black Samsung Galaxy S22 Ultra. The phone is oriented horizontally. On the left side, the S Pen is attached. In the center is a large, dark rectangular area, likely the fingerprint sensor. On the right side, there is a camera module with four lenses arranged in a 2x2 grid. The top-left lens is the largest. The top-right lens is slightly smaller. The bottom-left lens is the smallest. The bottom-right lens is also small. There is a small white dot between the bottom-left and bottom-right lenses. The phone is set against a plain white background. Photograph of Samsung Galaxy S22 Ultra.

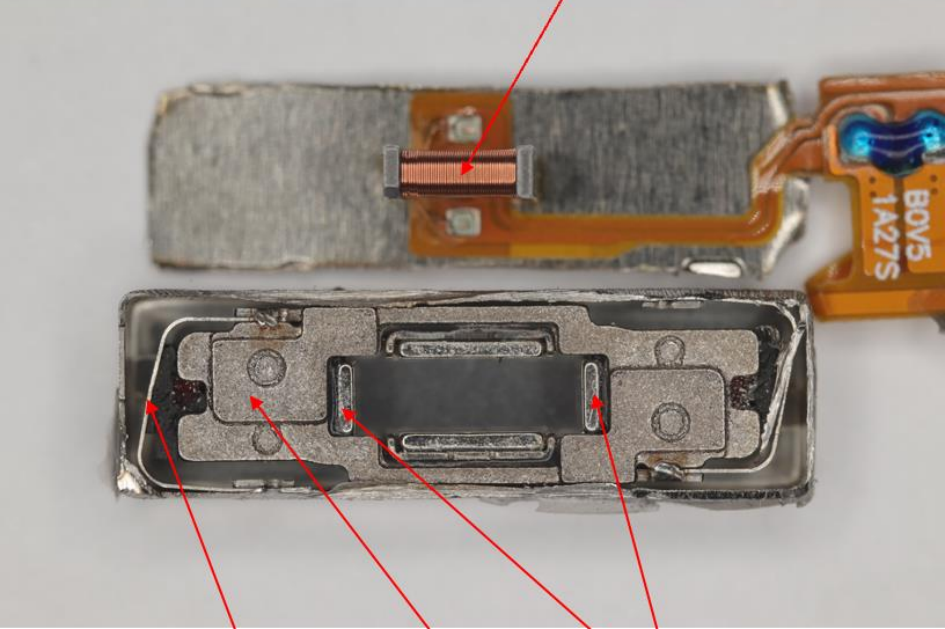
Claim 1	Accused Products
	A photograph of the internal components of a Samsung Galaxy S22 Ultra. The image shows the back of the phone with the rear cover removed, revealing the internal frame and various components. A red rectangular box is drawn on the left side of the phone, highlighting a specific area. This area contains a small, dark, rectangular component, which is the linear motor/speaker assembly. Other visible components include the camera module on the right, the battery cover, and various electronic components and connectors. Photograph of Samsung Galaxy S22 Ultra, annotated to identify location of linear motor/speaker assembly.

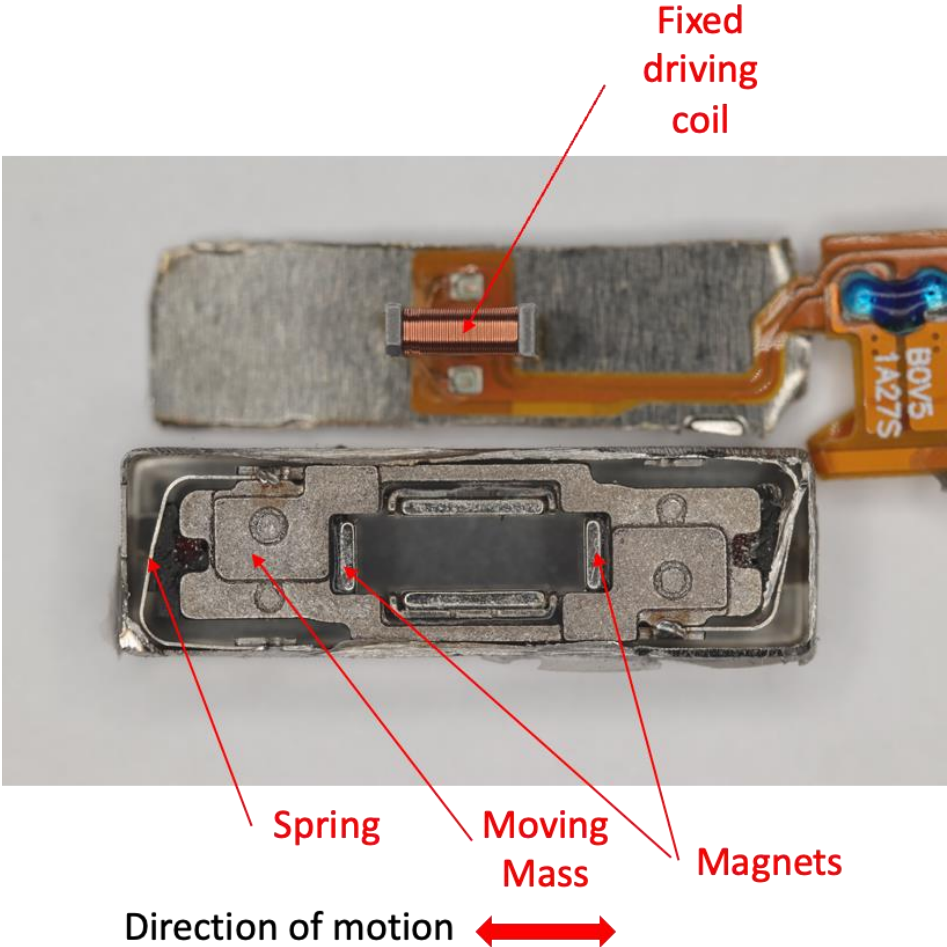
Claim 1	Accused Products
	 Speaker terminals Speaker Motor terminals Linear motor Photograph of linear motor/speaker assembly with components annotated.

Claim 1	Accused Products
	 Fixed driving coil Spring Moving Mass Magnets Direction of motion Photograph of linear motor with components annotated.

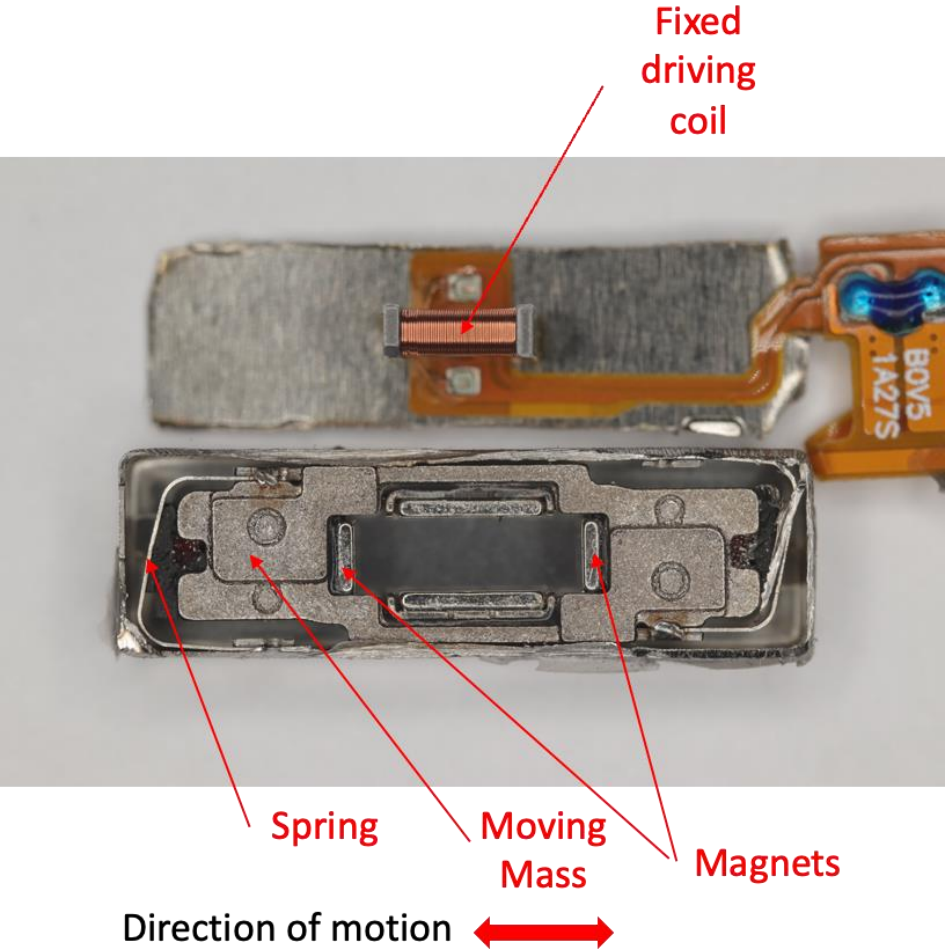
Claim 1	Accused Products
[1a] a housing;	Each Accused Product comprises a housing. For example, the linear motor assembly in the Galaxy S22 Ultra contains a metal box that is soldered together to form a housing surrounding the moving mass, magnets, and driving coil therein. <i>See, e.g.:</i>

Claim 1	Accused Products
	 Speaker terminals Speaker Motor terminals Linear motor Photograph of linear motor/speaker assembly with components annotated.

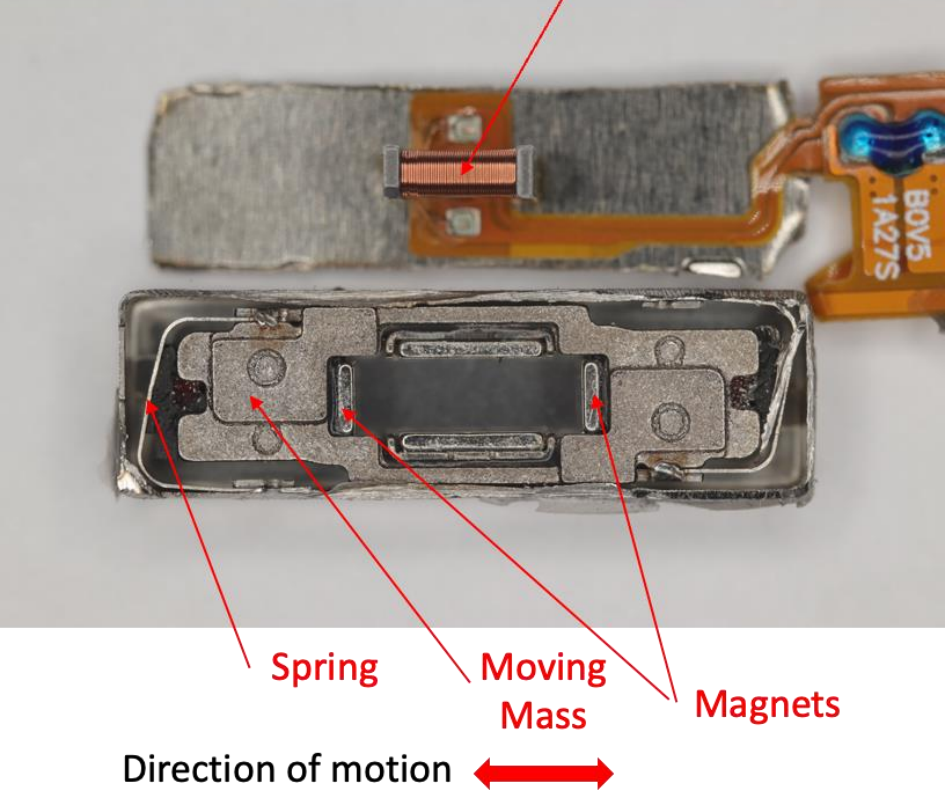
Claim 1	Accused Products
	 Fixed driving coil Spring Moving Mass Magnets Direction of motion  Photograph of linear motor with components annotated. In this image, the housing has been split apart, with the top of the housing visible behind the fixed driving coil and the rest of the housing enclosing the spring, moving component, and magnets.

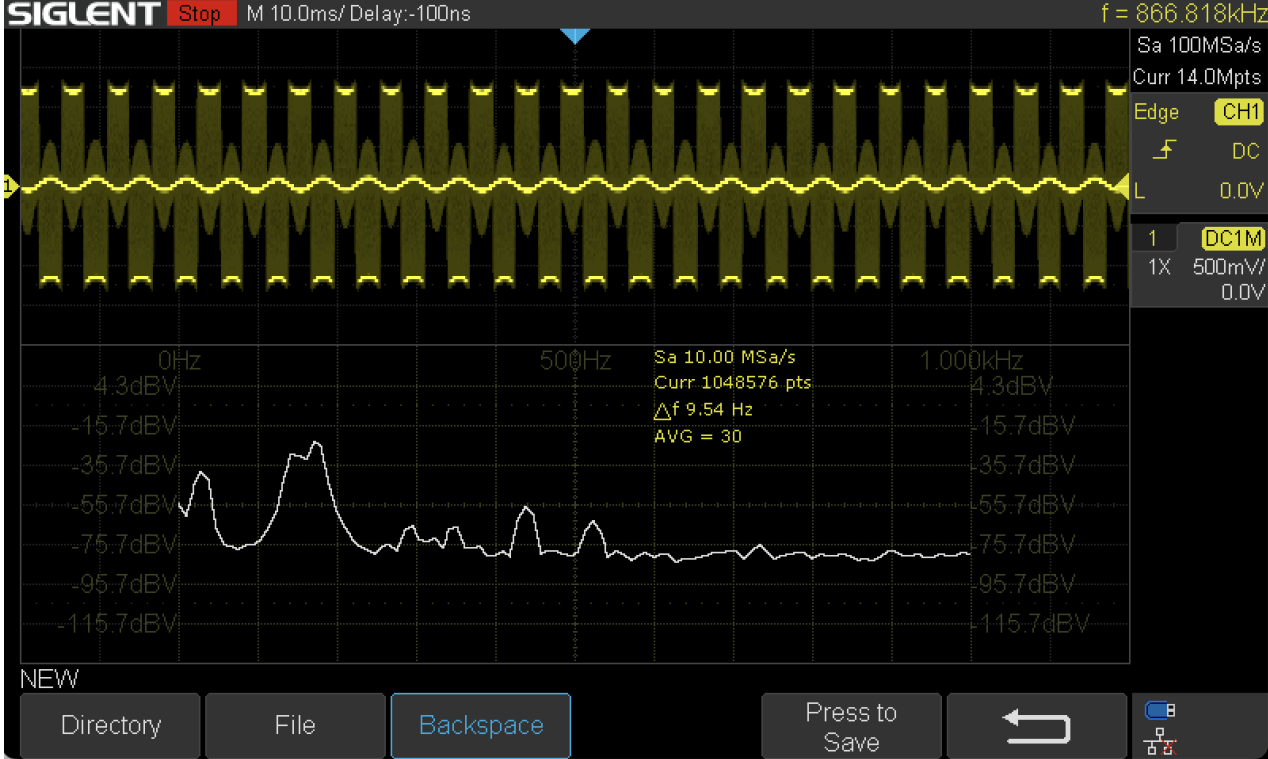
Claim 1	Accused Products
[1b] a moveable component;	Each Accused Product comprises a moveable component. For example, the linear motor assembly includes a moving mass to produce a vibration effect. <i>See, e.g.:</i>  The photograph shows a linear motor assembly. At the top, a copper-colored coil is labeled 'Fixed driving coil'. Below it, a metal housing contains a 'Moving Mass' (a black rectangular component) flanked by 'Magnets' (circular components). 'Spring' elements are indicated by arrows pointing to the sides of the moving mass. A red double-headed arrow at the bottom is labeled 'Direction of motion'.

Claim 1	Accused Products
	Photograph of linear motor with components annotated. The moveable component includes both a mass and magnets, fixed together so that they can move as one component linearly within the housing.
[1c] a power supply;	Each Accused Product comprises a power supply. For example, the linear motor driving coil (described below) receives power from one or more voltage regulators within the Accused Product, which supply power to the coil over wires. <i>See, e.g.:</i>

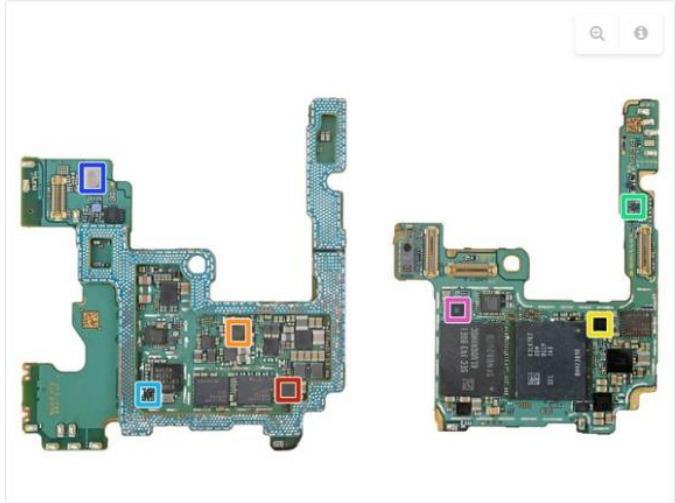
Claim 1	Accused Products
	 Fixed driving coil Spring Moving Mass Magnets Direction of motion Photograph of linear motor with components annotated (wires supplying power depicted at top right). <i>See also</i> claim elements below.

Claim 1	Accused Products
[1d] user-input features;	Each Accused Product comprises user-input features. For example, the Samsung Galaxy S22 Ultra comprises a touchscreen, a microphone, cameras, and other user-input features.
[1e] a driving component that drives the moveable component to oscillate within the housing; and	Each Accused Product includes a driving component that drives the moveable component to oscillate within the housing. For example, the linear motor includes a driving coil that is fixed in place and forms electromagnetic fields for driving a magnetic moving mass in an oscillating motion. <i>See, e.g.:</i>

Claim 1	Accused Products
	 Fixed driving coil Spring Moving Mass Magnets Direction of motion Photograph of linear motor with components annotated.

Claim 1	Accused Products
	 Oscilloscope trace of voltage across coil driving pins, showing positive and negative voltages for driving the mass in each of two opposite directions, resulting in an oscillating motion.
[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.	Each Accused Product comprises 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 1	Accused Products
	For example, the haptic controller (<i>e.g.</i>, Cirrus Logic CS40L26) receives serial or other data from the application processor (<i>e.g.</i>, Snapdragon 8 Gen 1 SoC) to control the intensity and pattern of the desired oscillation. In one non-limiting example, the control component as claimed corresponds to the combination of physical circuits within the haptic controller and the application processor. In another non-limiting example, the control component as claimed corresponds to physical circuits within the haptic controller. The haptic controller and/or application processor may implement the claimed functionality in hardware circuits and/or with firmware. These control signals are sent and received using a protocol for commanding haptic patterns. Software executable on the application processor provided by Samsung (<i>e.g.</i>, Android kernel, operating system, and user-space software), including its own system software, specifies stored frequencies and amplitudes. This application software configures the vibrational behaviors and modes. In one non-limiting example, the application software forms part of the control component as claimed. In another non-limiting example, the existence and use of the application software is probative of the structure and configuration of the control component as claimed but does not form a part of the control component. In one non-limiting example, selecting different vibration patterns or creating a custom vibration pattern in the “Sounds and vibration” settings menu causes the movable component to oscillate at a frequency and amplitude dictated by stored values of the selected pattern. In one non-limiting example, the “stored values” as claimed are values stored on the application processor or associated volatile or non-volatile memory representing intended frequency and/or amplitude values. In another non-limiting example, the “stored values” as claimed are design, configuration, or tuning values stored in the haptic controller. <i>See, e.g.:</i>

Claim 1	Accused Products
	Step 2  Edit  ● IC Identification, pt. 2: ● Cirrus Logic CS40L26 Haptic Driver ● Qualcomm PMR735A Power Management ● Qualcomm PM3003 Power Management ● Diodes Incorporated AP7340D-30FS4-7 150 mA / 3.0 V LDO Regulator ● Diodes Incorporated AP7340D-33FS4-7 150 mA / 3.3 V LDO Regulator ● Knowles MEMS Microphone ● Qualcomm Clock Generator  Add a comment Screenshot of https://www.ifixit.com/Guide/Samsung+Galaxy+S22+Ultra+Chip+ID/148073 showing Cirrus Logic haptic driver IC.

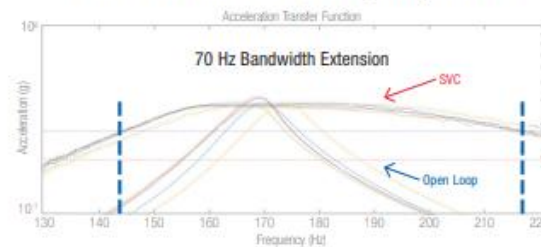
Claim 1	Accused Products
	Products ▾ / CS40L26/26B Smart Haptic Driver Enables HD Haptics on Mobile Devices for Enhanced Gaming, Videos and Music  Request Data Sheet Purchase Help Contact sales and support The CS40L26/CS40L26B is the industry's leading self-contained haptic driver IC that integrates a DSP and Class D digital boost converter to enable advanced closed-loop control of the actuator, HD enabled haptics and audio generated haptics for use in smartphones, tablets and wearables. Advanced sensor-less velocity control (SVC) provides real-time braking and consistent acceleration of the LRA, plus wider bandwidth and broader frequency range – essential features for gaming UX. CIRRUS ROCKS® CIRRUS® ENGINEERED TO ROCK® INNOVATION THAT ROCKS® Technology Haptic Drivers Application Categories Mobile Audio Devices, Wearables Screenshot of Cirrus Logic haptic driver description, available at https://www.cirrus.com/products/cs40l26-26b/.

Sensor-Less Velocity Control (SVC) Delivers Dynamic Haptic Performance

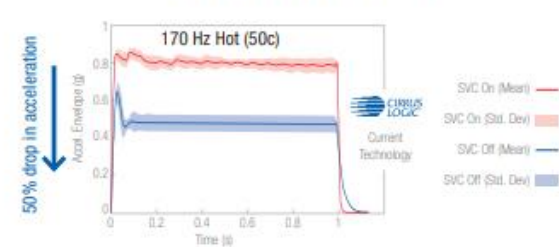
Why SVC Matters – Closed-Loop Feedback Ensures Gaming Consistency

- Dynamically adapts to the LRA in real time – a key performance enhancement for gaming and streamed haptics
- Widens the LRA bandwidth for consistent acceleration, as well as crisp performance when in overdrive and braking

SVC Widens the LRA Bandwidth, Enabling HD Haptic Effects

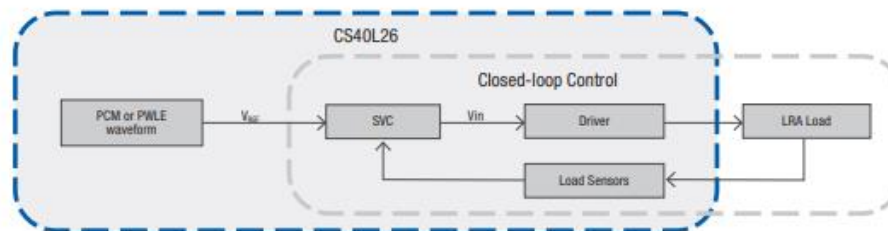


SVC Generates Consistent Acceleration



How SVC Works

- SVC senses the load condition and adapts the signal V_{in} to drive for the back-emf to follow V_{REF}



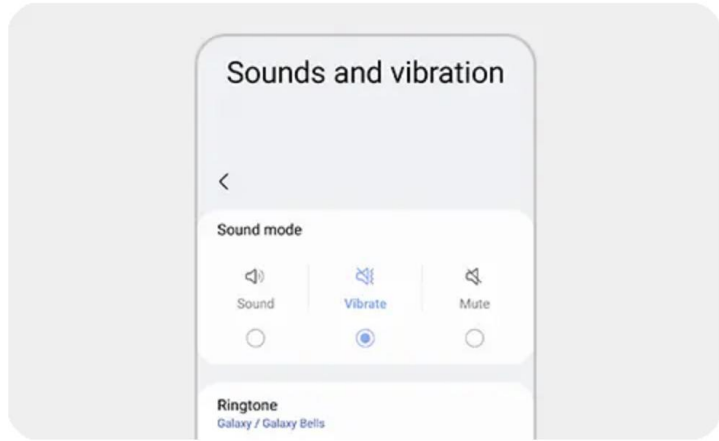
Screenshot of haptic driver datasheet, available at

https://statics.cirrus.com/pubs/proBulletin/CS40L26_B_Smart_Haptics_Driver_Product_Bulletin.pdf.

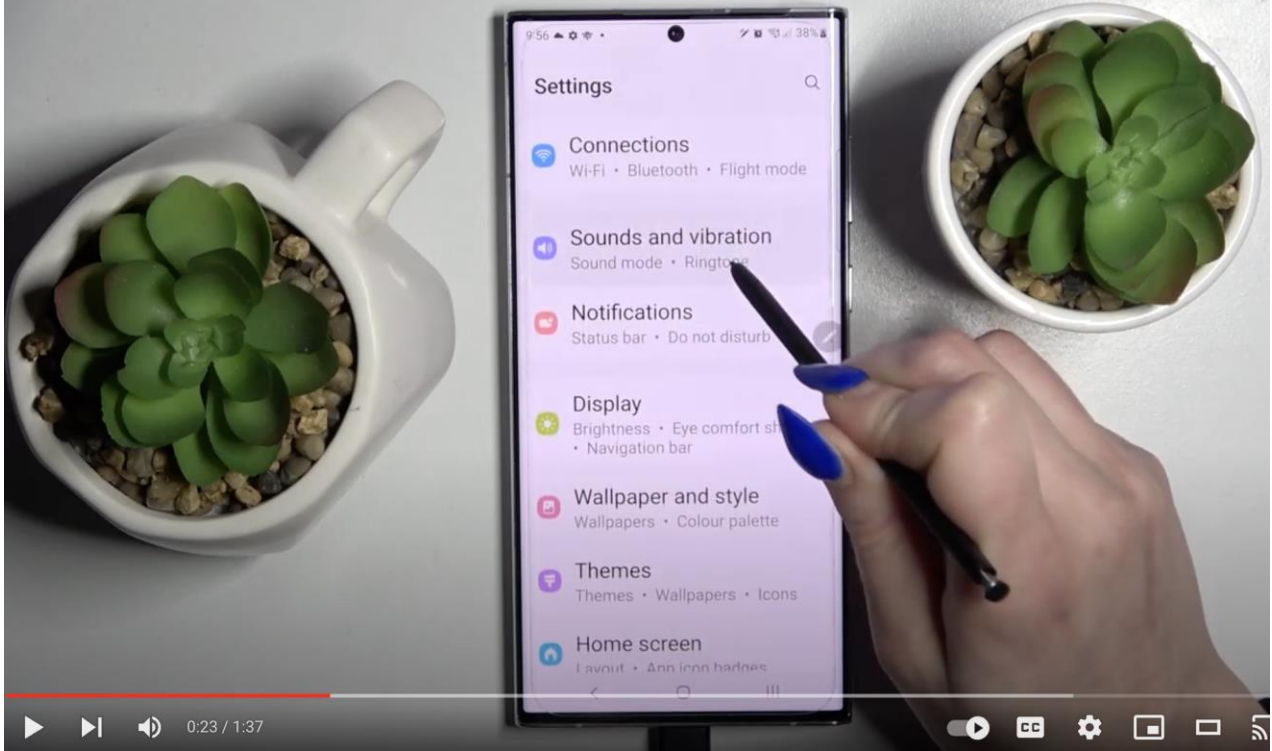
Claim 1	Accused Products
	Real-time, Automated Audio-2-Haptics Feel What You Hear with “On-the-Fly” Audio-2-Haptics Audio Generated Haptics — Complex Signal Processing Generates Textured HD Haptic Effects for Gaming, Videos and Music Generates haptic drive signals from the audio stream for ringtones, YouTube videos and games tuned for the LRA Audio Input, LRA Output, Magnitude, Threshold, Gain Important Notice: No license to any intellectual property right is included with this component, and certain uses or product designs, including certain haptics-related uses or haptics-system designs, may require an intellectual property license from one or more third parties. Cirrus Logic, Inc. 800 West Sixth Street Austin, Texas 78701 United States T+1-512-851-4000 Sales Support North America +1-800-888-5016 Asia Pacific +852 2376-0801 Japan +81-(3)-5782-8180 Europe/UK +44-(0)-131-272-7000 cirrus.com NOVEMBER 2021 © 2021 Cirrus Logic, Inc. All rights reserved. Cirrus Logic, Cirrus, the Cirrus Logic logo design, and SoundClear are trademarks of Cirrus Logic, Inc. Other brand and product names in this document may be trademarks or service marks of their respective owners. This product is covered by issued and pending patents of Cirrus Logic. Product features, capabilities, and operations described here are for illustrative purposes only and do not constitute instructions or suggestions regarding any particular implementation or design choice. Customers are solely responsible for their specific design, implementation, and end product and, if required, obtaining any related third-party intellectual property licenses. Screenshot of haptic driver datasheet, available at https://statics.cirrus.com/pubs/proBulletin/CS40L26_B_Smart_Haptics_Driver_Product_Bulletin.pdf.

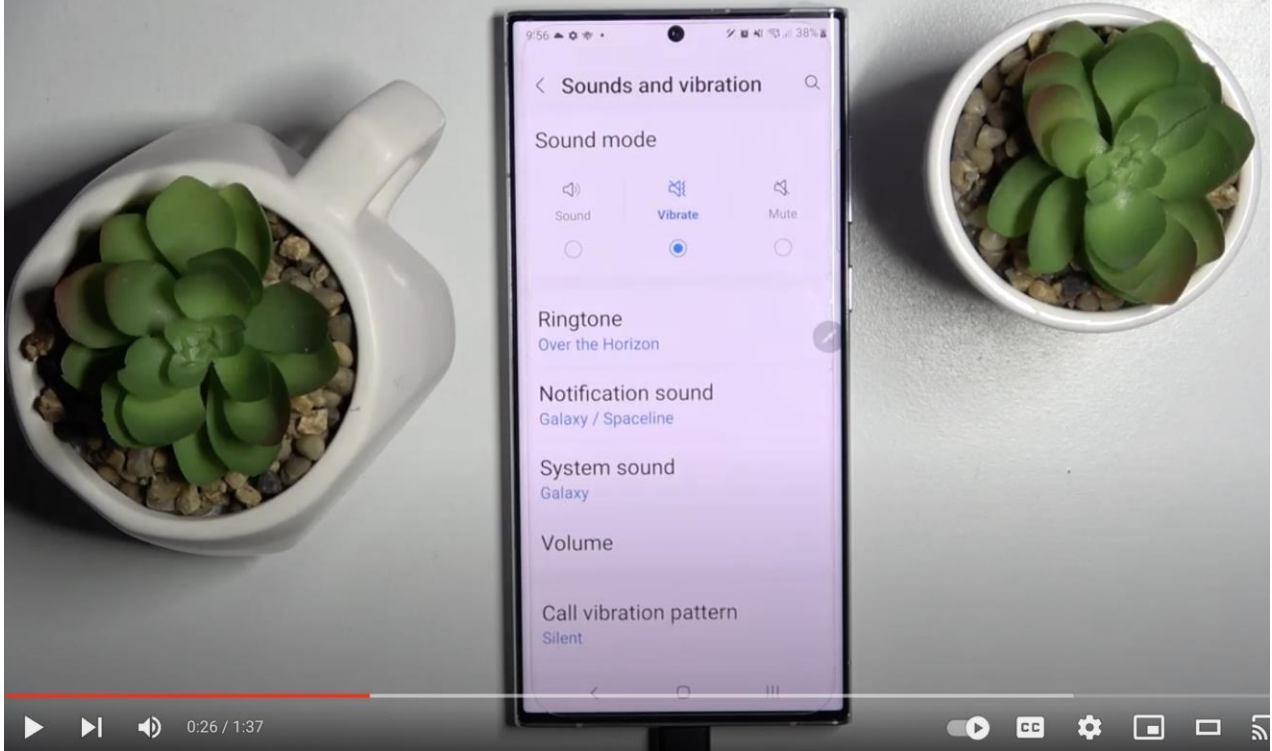
Claim 1	Accused Products
	Android 12 simplified integration • Audio coupled haptics with I²S support • Open wave table and chirp with scalability supports haptics APIs, with on-the-fly haptic generation Screenshot of haptic driver datasheet, available at https://statics.cirrus.com/pubs/proBulletin/CS40L26_B_Smart_Haptics_Driver_Product_Bulletin.pdf, indicating support for Android 12 haptic APIs and audio coupled haptics.

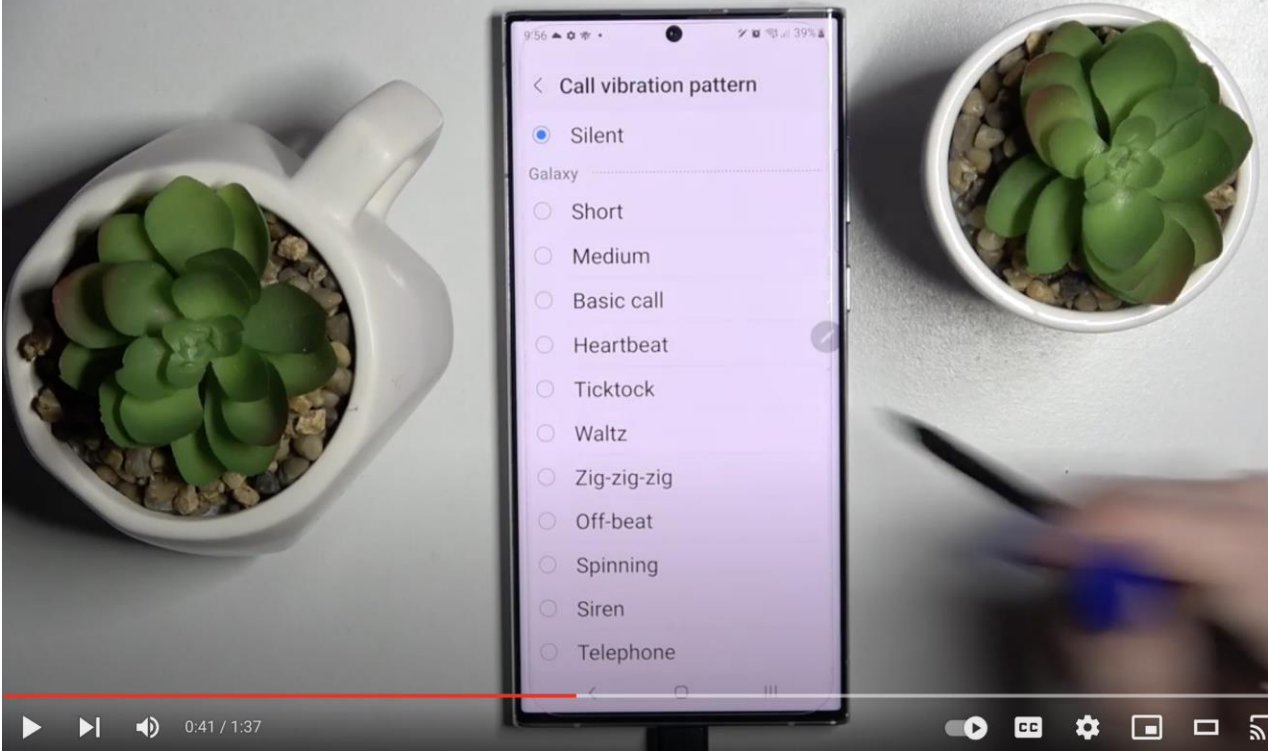
Claim 1	Accused Products
	Samsung Galaxy S22 / Galaxy S22 Ultra - Vibrate Mode 1. From a Home screen, swipe up from the center of the display to access the apps screen. → These instructions only apply to <u>Standard mode</u> and the default <u>Home screen layout</u>. 2. Navigate: Settings ⚙️ › Sounds and vibration. 3. From the 'Sound mode' section, tap Vibrate. → Selected when a blue dot is present. 4. Tap Vibration intensity. 5. Adjust intensity for any of the following: → Drag the slider left or right to adjust the level. ▪ Incoming call ▪ Notifications ▪ Touch interaction Screenshot of https://www.verizon.com/support/knowledge-base-300923/ describing vibration settings.

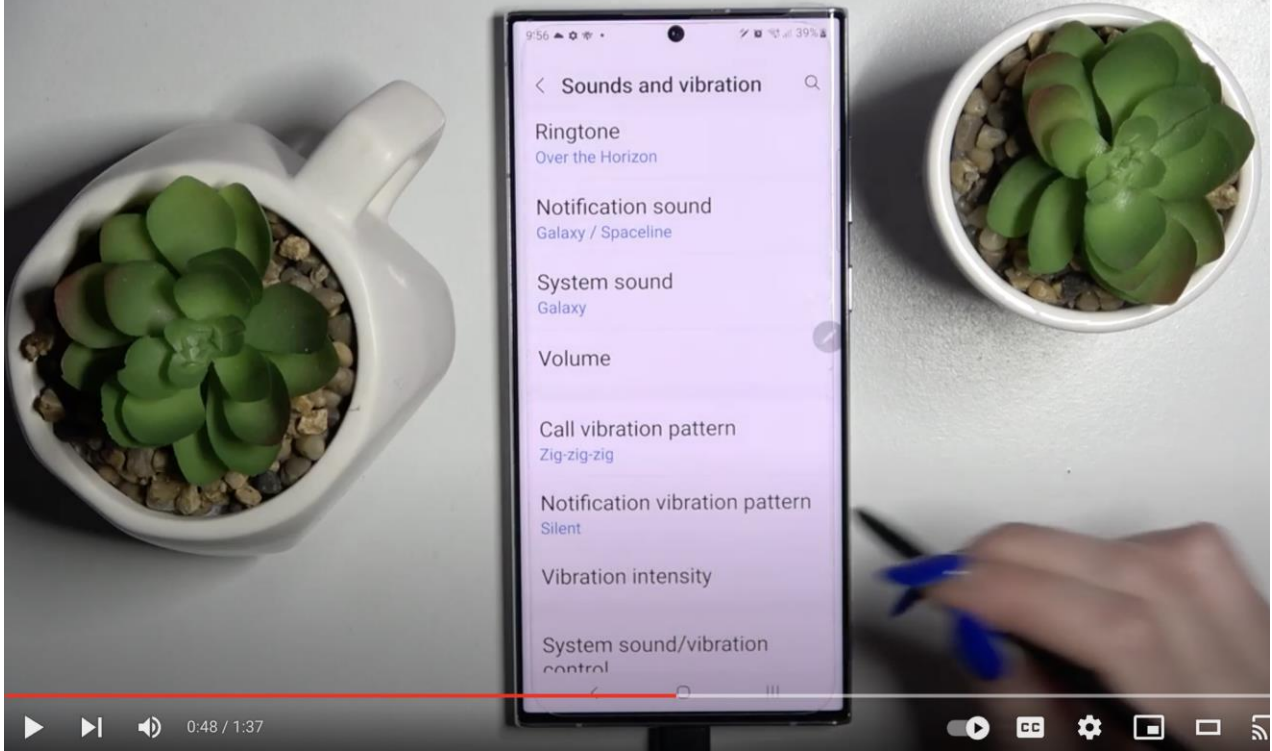
Claim 1	Accused Products
	How to improve the vibration of your Galaxy S22 device Last Update date : May 26, 2022 Galaxy S22 series has added a new feature to provide a vibration sound from the speaker when the device receives an incoming call in vibration mode.  Screenshot of https://www.samsung.com/za/support/mobile-devices/how-to-improve-the-vibration-of-your-galaxy-s22-device/ describing vibration settings.

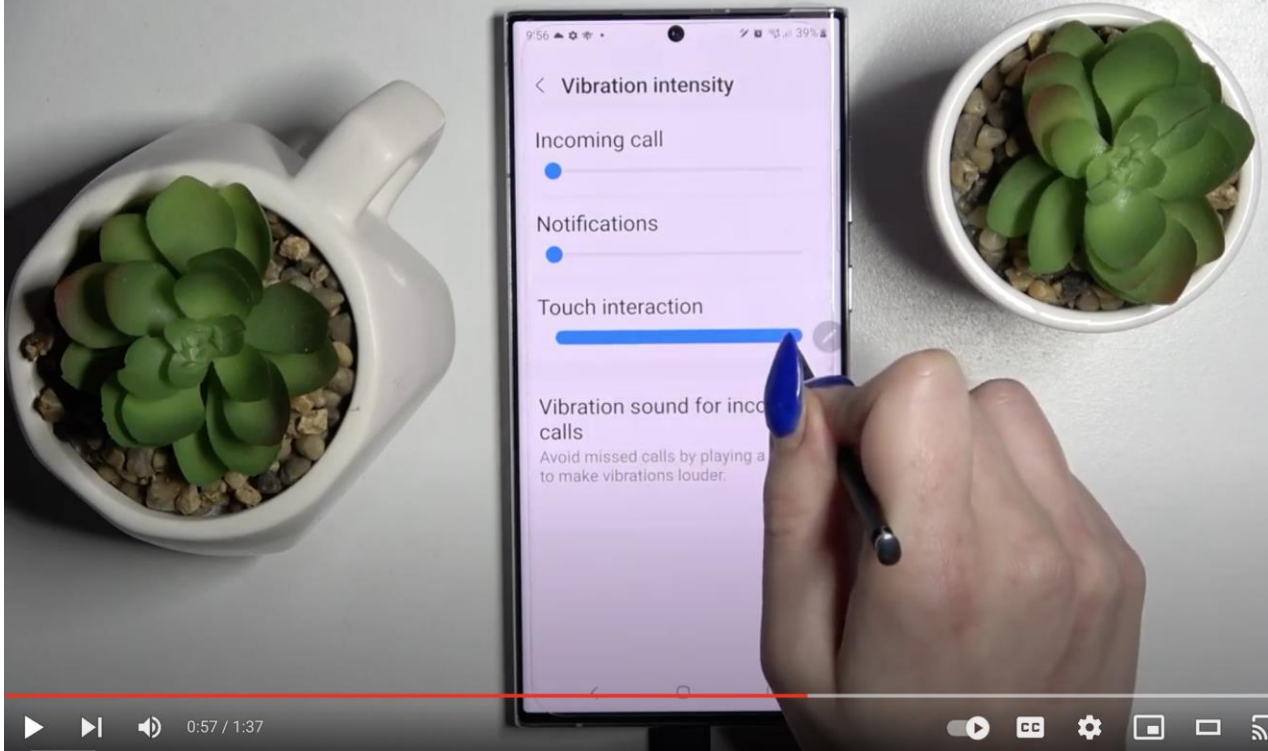
Claim 1	Accused Products
	To enable the vibration sound for incoming calls, please follow the steps below: This screenshot shows the 'Settings' app on a Samsung device. The 'Sounds and vibration' option is highlighted with a white box and a blue callout bubble containing a magnifying glass icon. Step 1. Tap Settings then select "Sounds and vibration". This screenshot shows the 'Sounds and vibration' settings page. The 'Vibration intensity' option at the bottom is highlighted with a white box and a blue callout bubble. Step 2. Tap "Vibration intensity". This screenshot shows the 'Vibration intensity' settings page. The 'Vibration sound for incoming calls' toggle switch is turned on (blue) and is highlighted with a white box and a blue callout bubble. Step 3. Enable "Vibration sound for incoming calls". If you still do not have sufficient vibration on your device after enabling the vibration sound for incoming calls, you should consider the following: • If the mobile device is connected to other devices such as Watch/Buds/Headset/BT Speaker, Vibration sound mode will not work. • Vibration sound mode works on the basic 'Samsung Phone app' but on alarms or 3rd party apps it will not work. Screenshot of https://www.samsung.com/za/support/mobile-devices/how-to-improve-the-vibration-of-your-galaxy-s22-device/ describing vibration settings.

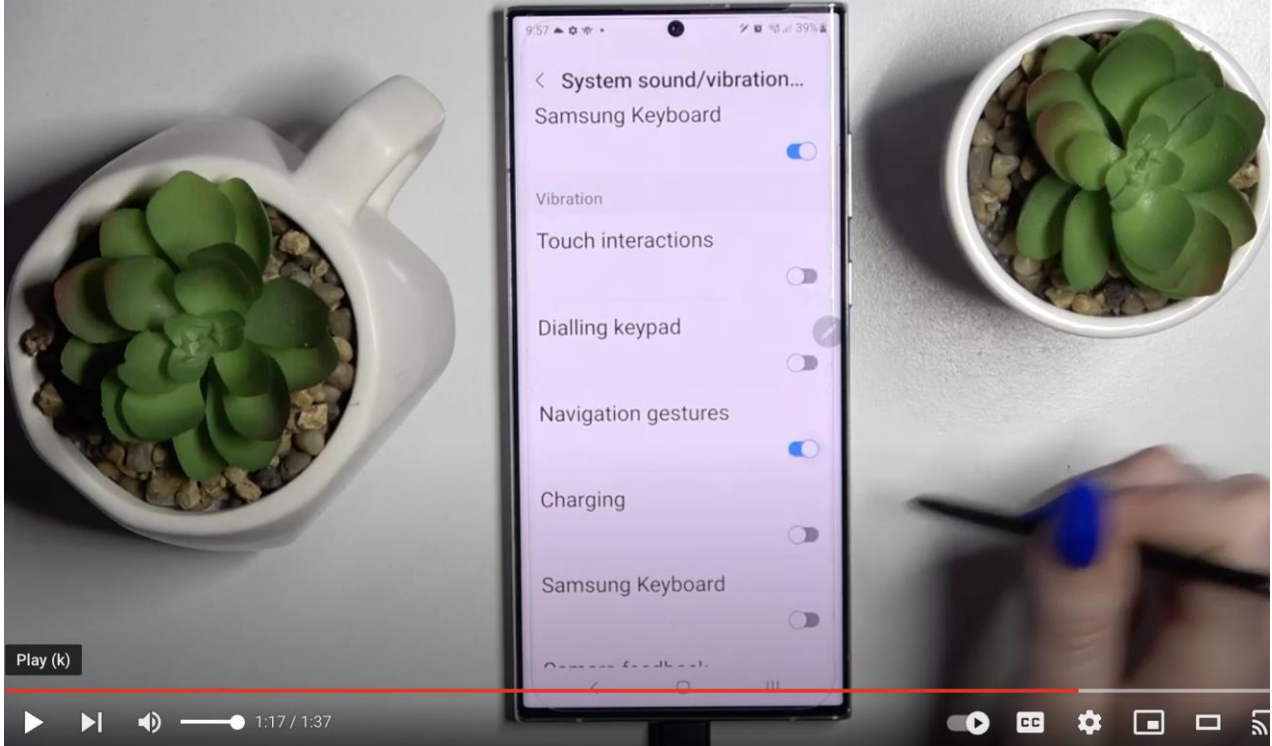
Claim 1	Accused Products
	 Screenshot of video entitled “How to Enter Vibration Settings in SAMSUNG Galaxy S22 Ultra – Find Vibration Options,” available at https://www.youtube.com/watch?v=BhIw8-yQhXM.

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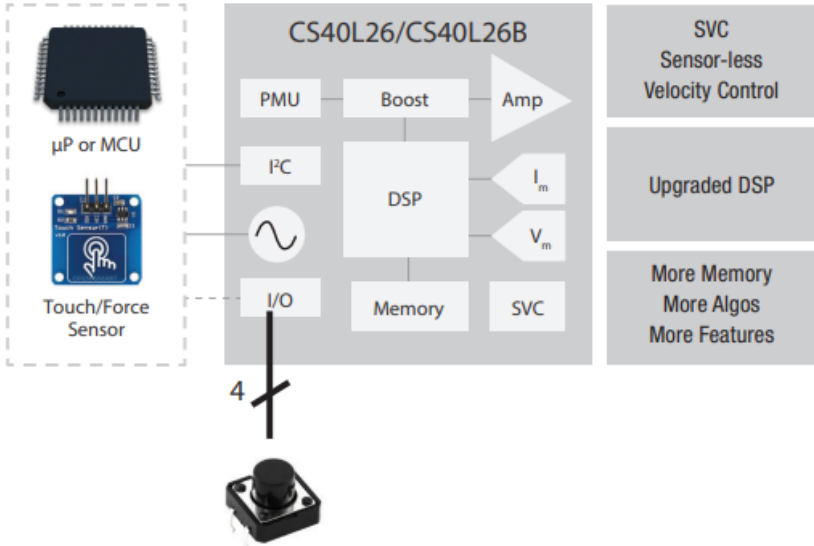
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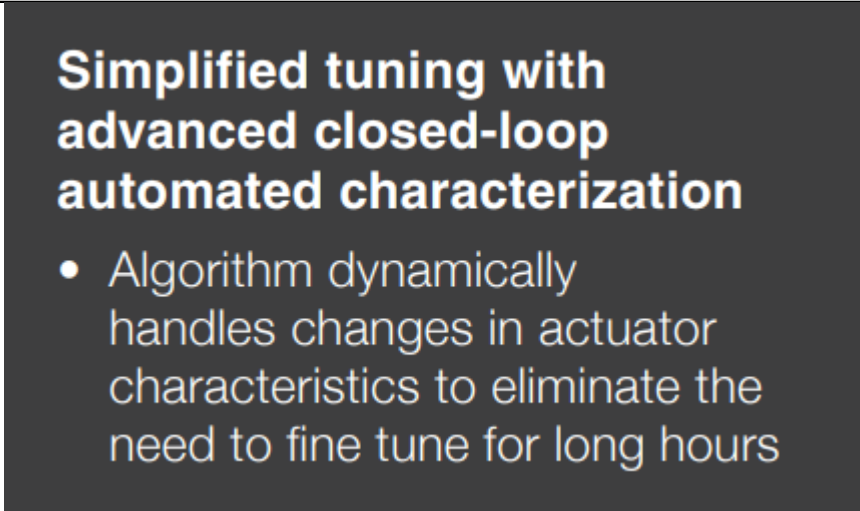
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Claim 1	Accused Products
	Usage of haptic primitives Android includes several haptics <i>primitives</i> that vary in both amplitude and frequency. You may use one primitive alone or multiple primitives in combination to achieve rich haptic effects. Screenshot from Android API documentation at https://developer.android.com/develop/ui/views/haptics/custom-haptic-effects indicating one non limiting example where the Android operating system includes stored values representing “both amplitude and frequency”

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int	PRIMITIVE_THUD A haptic effect that simulates downwards movement with gravity.																		
int	PRIMITIVE_TICK This very short effect should produce a light crisp sensation intended to be used repetitively for dynamic feedback.																		

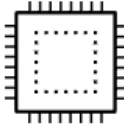
Claim 1	Accused Products
	https://developer.android.com/reference/android/os/VibrationEffect.Composition showing individual haptics primitives independently representing both amplitude and frequency Programmable DSP, faster processing – 130 MHz • Easily design new haptics effects for UI/alerts/button replacement with state-of-the-art tools • 18 Kb storage Screenshot of haptic driver datasheet, available at https://statics.cirrus.com/pubs/proBulletin/CS40L26_B_Smart_Haptics_Driver_Product_Bulletin.pdf, showing “storage” for stored values.

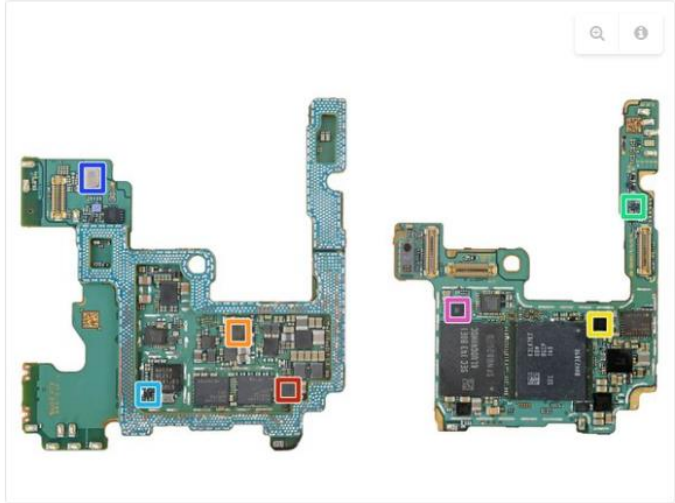
Claim 1	Accused Products
	Visual Block Diagram  Screenshot of haptic driver datasheet, available at https://statics.cirrus.com/pubs/proBulletin/CS40L26_B_Smart_Haptics_Driver_Product_Bulletin.pdf, showing “memory” for stored values.

Claim 1	Accused Products
	 Screenshot of haptic driver datasheet, available at https://statics.cirrus.com/pubs/proBulletin/CS40L26_B_Smart_Haptics_Driver_Product_Bulletin.pdf, showing tuning process that can generate stored values.

Claim 2

Claim 2	Accused Products
[2pre] The vibration module of claim 1 wherein the control component is one of:	Each Accused Product comprises the linear vibration motor of claim 1 wherein the control component is as claimed in claim 2. See analysis and evidence for claim 1 and remainder of claim 2.
[2a] an variable oscillator circuit with additional control circuitry; and	This alternative portion of claim 2 is not asserted at this time. If any Accused Product(s) include a variable oscillator circuit as claimed, information regarding that circuit would be within the sole possession of Defendant and/or relevant third parties, and Revel reserves the right to assert this alternative portion if fact discovery uncovers such a circuit.

Claim 2	Accused Products
[2b] a control component that includes a microprocessor,	Each Accused Product comprises a control component that includes a microprocessor. For one example, in the Galaxy S22 Ultra, the control component includes a processor in the form of the device's application processor. For another example, the Cirrus Logic haptic driver IC in the Galaxy S22 Ultra includes a microprocessor, including at least a digital signal processor (DSP). <i>See, e.g.:</i> Samsung Galaxy S22 Ultra  Processor  Snapdragon 8 Gen 1 https://www.samsung.com/us/smartphones/galaxy-s22-ultra/compare/?device-1=samsung-galaxy-s22-ultra&device-2=samsung-galaxy-s22%2B&device-3=samsung-galaxy-s22

Claim 2	Accused Products
	Step 2  Edit  ● IC Identification, pt. 2: ● Cirrus Logic CS40L26 Haptic Driver ● Qualcomm PMR735A Power Management ● Qualcomm PM3003 Power Management ● Diodes Incorporated AP7340D-30FS4-7 150 mA / 3.0 V LDO Regulator ● Diodes Incorporated AP7340D-33FS4-7 150 mA / 3.3 V LDO Regulator ● Knowles MEMS Microphone ● Qualcomm Clock Generator  Add a comment Screenshot of https://www.ifixit.com/Guide/Samsung+Galaxy+S22+Ultra+Chip+ID/148073 showing Cirrus Logic haptic driver IC.

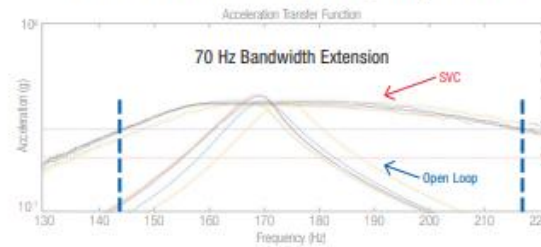
Claim 2	Accused Products
	Products ▾ / CS40L26/26B Smart Haptic Driver Enables HD Haptics on Mobile Devices for Enhanced Gaming, Videos and Music  Request Data Sheet Purchase Help Contact sales and support The CS40L26/CS40L26B is the industry's leading self-contained haptic driver IC that integrates a DSP and Class D digital boost converter to enable advanced closed-loop control of the actuator, HD enabled haptics and audio generated haptics for use in smartphones, tablets and wearables. Advanced sensor-less velocity control (SVC) provides real-time braking and consistent acceleration of the LRA, plus wider bandwidth and broader frequency range – essential features for gaming UX. CIRRUS ROCKS® CIRRUS® ENGINEERED TO ROCK® INNOVATION THAT ROCKS® Technology Haptic Drivers Application Categories Mobile Audio Devices, Wearables Screenshot of Cirrus Logic haptic driver description, available at https://www.cirrus.com/products/cs40l26-26b/.

Sensor-Less Velocity Control (SVC) Delivers Dynamic Haptic Performance

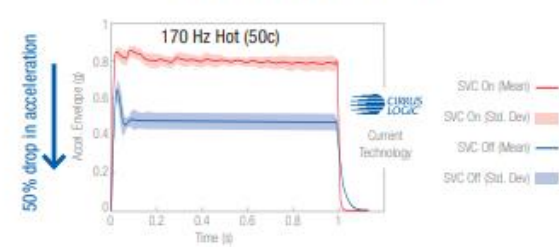
Why SVC Matters – Closed-Loop Feedback Ensures Gaming Consistency

- Dynamically adapts to the LRA in real time – a key performance enhancement for gaming and streamed haptics
- Widens the LRA bandwidth for consistent acceleration, as well as crisp performance when in overdrive and braking

SVC Widens the LRA Bandwidth, Enabling HD Haptic Effects

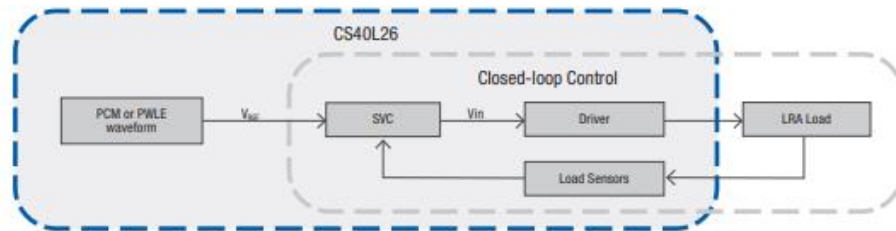


SVC Generates Consistent Acceleration



How SVC Works

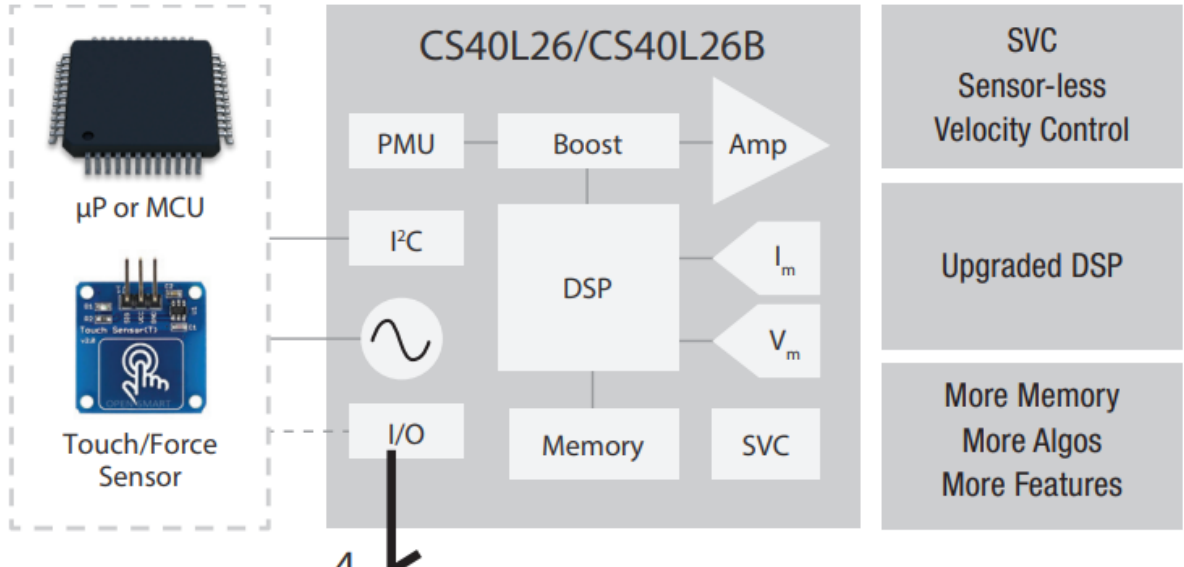
- SVC senses the load condition and adapts the signal V_{in} to drive for the back-emf to follow V_{REF}



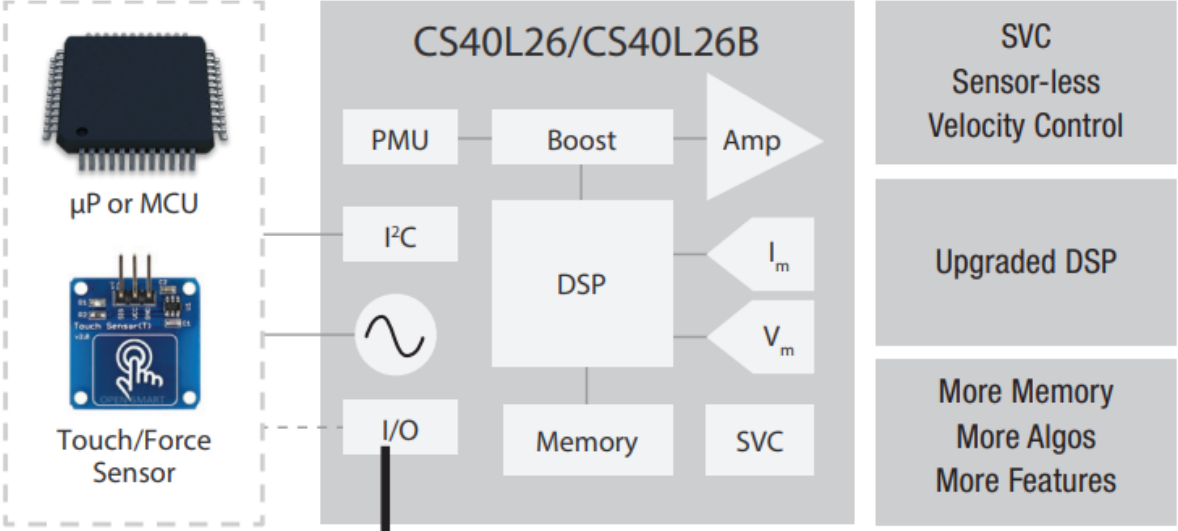
Screenshot of haptic driver datasheet, available at

https://statics.cirrus.com/pubs/proBulletin/CS40L26_B_Smart_Haptics_Driver_Product_Bulletin.pdf.

Claim 2	Accused Products
	Real-time, Automated Audio-2-Haptics Feel What You Hear with “On-the-Fly” Audio-2-Haptics Audio Generated Haptics — Complex Signal Processing Generates Textured HD Haptic Effects for Gaming, Videos and Music Generates haptic drive signals from the audio stream for ringtones, YouTube videos and games tuned for the LRA Audio Input, LRA Output, Magnitude, Threshold, Gain Important Notice: No license to any intellectual property right is included with this component, and certain uses or product designs, including certain haptics-related uses or haptics-system designs, may require an intellectual property license from one or more third parties. Cirrus Logic, Inc. 800 West Sixth Street Austin, Texas 78701 United States T+1-512-851-4000 Sales Support North America +1-800-888-5016 Asia Pacific +852 2376-0801 Japan +81-(3)-5782-8180 Europe/UK +44-(0)-131-272-7000 cirrus.com NOVEMBER 2021 © 2021 Cirrus Logic, Inc. All rights reserved. Cirrus Logic, Cirrus, the Cirrus Logic logo design, and SoundClear are trademarks of Cirrus Logic, Inc. Other brand and product names in this document may be trademarks or service marks of their respective owners. This product is covered by issued and pending patents of Cirrus Logic. Product features, capabilities, and operations described here are for illustrative purposes only and do not constitute instructions or suggestions regarding any particular implementation or design choice. Customers are solely responsible for their specific design, implementation, and end product and, if required, obtaining any related third-party intellectual property licenses. Screenshot of haptic driver datasheet, available at https://statics.cirrus.com/pubs/proBulletin/CS40L26_B_Smart_Haptics_Driver_Product_Bulletin.pdf.

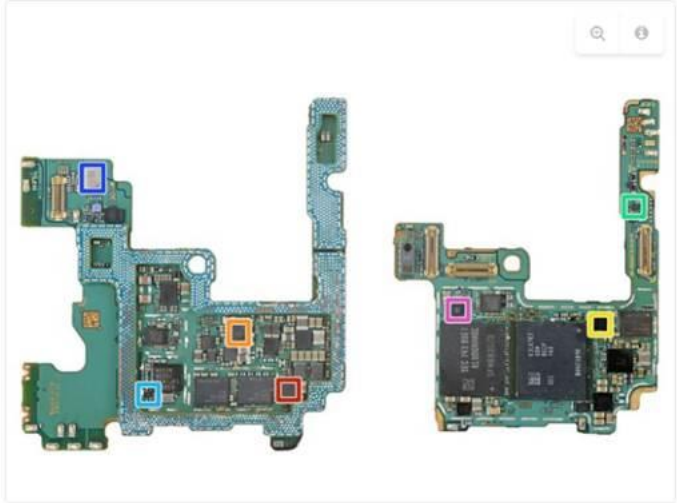
Claim 2	Accused Products
	 Screenshot of haptic driver datasheet, available at https://statics.cirrus.com/pubs/proBulletin/CS40L26_B_Smart_Haptics_Driver_Product_Bulletin.pdf.
[2c] a control program, stored in an electronic memory within, or separate from, the microprocessor, the control program executed 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	Each Accused Product comprises 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. For example, the application processor (<i>e.g.</i>, Snapdragon 8 Gen 1 SoC) transmits serial or other data using control programs stored within the Application Processor's cache or RAM and/or nonvolatile memory. For another example, on information and belief the microprocessor within the haptic IC (<i>e.g.</i>, Cirrus Logic CS40L26) stores and executes a control program (<i>e.g.</i> firmware). In either case, the control program directly or indirectly causes the driving component to cause the movable component to oscillate at a frequency and an amplitude specified by the one or more stored values. See claim elements [1f] and [2a] above.

Claim 2	Accused Products
amplitude specified by the one or more stored values.	<i>See also, e.g.:</i> Programmable DSP, faster processing – 130 MHz • Easily design new haptics effects for UI/alerts/ button replacement with state-of-the-art tools • 18 Kb storage Screenshot of haptic driver datasheet, available at https://statics.cirrus.com/pubs/proBulletin/CS40L26_B_Smart_Haptics_Driver_Product_Bulletin.pdf.

Claim 2	Accused Products
	 Screenshot of haptic driver datasheet, available at https://statics.cirrus.com/pubs/proBulletin/CS40L26_B_Smart_Haptics_Driver_Product_Bulletin.pdf.

Claim 3

Claim 3	Accused Products
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.	Each Accused Product comprises the vibration module of claim 1 (<i>see</i> claim 1 above) 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. For example, in the case of the Galaxy S22 Ultra and its Cirrus Logic CS40L26 haptic IC, the driver coil (<i>e.g.</i>, the “LRA load” in the Cirrus data sheet) forms a sensor responsive to the position, velocity, and other aspects of the vibration of the movable component (<i>e.g.</i> the “load condition” described in the Cirrus data sheet). The haptic IC, using a closed-loop control program, “[d]ynamically adjusts to the LRA in real time” and “adapts the signal Vin” using this sensor data. The signal Vin, as described in the Cirrus data sheet, corresponds to one non-limiting example of an operational control output as claimed. <i>See, e.g.:</i>

Claim 3	Accused Products
	Step 2  Edit  ● IC Identification, pt. 2: ● Cirrus Logic CS40L26 Haptic Driver ● Qualcomm PMR735A Power Management ● Qualcomm PM3003 Power Management ● Diodes Incorporated AP7340D-30FS4-7 150 mA / 3.0 V LDO Regulator ● Diodes Incorporated AP7340D-33FS4-7 150 mA / 3.3 V LDO Regulator ● Knowles MEMS Microphone ● Qualcomm Clock Generator  Add a comment Screenshot of https://www.ifixit.com/Guide/Samsung+Galaxy+S22+Ultra+Chip+ID/148073 showing Cirrus Logic haptic driver IC.

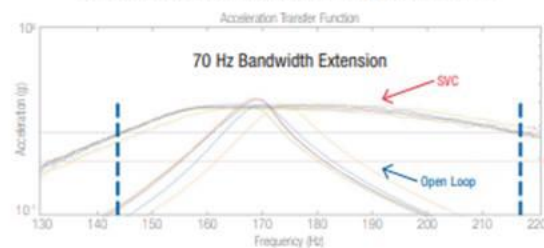
Claim 3	Accused Products
	Products ▾ / CS40L26/26B Smart Haptic Driver Enables HD Haptics on Mobile Devices for Enhanced Gaming, Videos and Music  Request Data Sheet Purchase Help Contact sales and support The CS40L26/CS40L26B is the industry's leading self-contained haptic driver IC that integrates a DSP and Class D digital boost converter to enable advanced closed-loop control of the actuator, HD enabled haptics and audio generated haptics for use in smartphones, tablets and wearables. Advanced sensor-less velocity control (SVC) provides real-time braking and consistent acceleration of the LRA, plus wider bandwidth and broader frequency range – essential features for gaming UX. CIRRUS ROCKS® CIRRUS® ENGINEERED TO ROCK® INNOVATION THAT ROCKS® Technology Haptic Drivers Application Categories Mobile Audio Devices, Wearables Screenshot of Cirrus Logic haptic driver description, available at https://www.cirrus.com/products/cs40l26-26b/.

Sensor-Less Velocity Control (SVC) Delivers Dynamic Haptic Performance

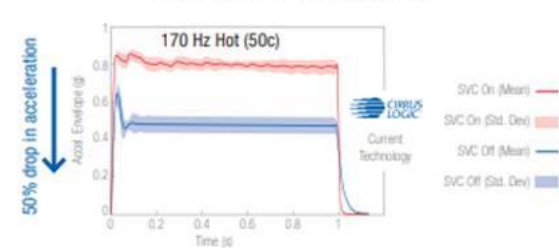
Why SVC Matters – Closed-Loop Feedback Ensures Gaming Consistency

- Dynamically adapts to the LRA in real time – a key performance enhancement for gaming and streamed haptics
- Widens the LRA bandwidth for consistent acceleration, as well as crisp performance when in overdrive and braking

SVC Widens the LRA Bandwidth, Enabling HD Haptic Effects

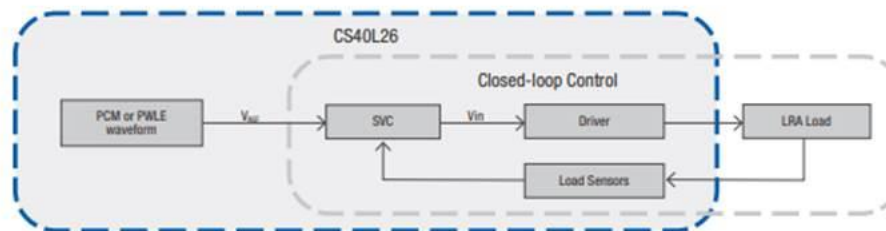


SVC Generates Consistent Acceleration



How SVC Works

- SVC senses the load condition and adapts the signal V_{in} to drive for the back-emf to follow V_{REF} .

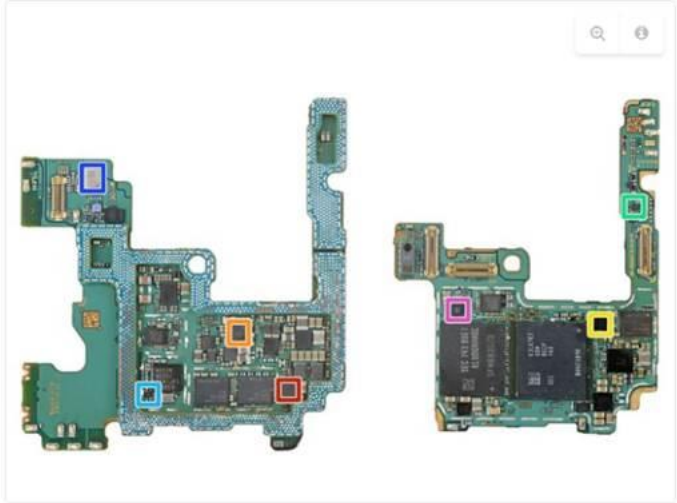


Screenshot of haptic driver datasheet, available at

https://statics.cirrus.com/pubs/proBulletin/CS40L26_B_Smart_Haptics_Driver_Product_Bulletin.pdf.

Claim 4

Claim 4	Accused Products
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.	Each Accused Product comprises the vibration module of claim 1 (<i>see</i> claim 1 above) 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. For example, in the case of the Galaxy S22 Ultra and its Cirrus Logic CS40L26 haptic IC, the driver coil (<i>e.g.</i>, the “LRA load” in the Cirrus data sheet) forms a sensor responsive to the position, velocity, and other aspects of the vibration of the movable component (<i>e.g.</i> the “load condition” described in the Cirrus data sheet). The haptic IC, using a closed-loop control program, “[d]ynamically adjusts to the LRA in real time” and “adapts the signal V_{in}” using this sensor data. Because it is a closed-loop control program, it is designed to adjust and/or adapt its control outputs (<i>e.g.</i>, “V_{in}” in the Cirrus Logic datasheet and/or another signal corresponding to amplitude and/or frequency) so that the subsequently received output signals correspond to the operational control parameter(s) specifying a desired result (<i>e.g.</i> “V_{REF}” in the Cirrus Logic datasheet, a desired amplitude, and/or a desired frequency). In another non-limiting example, the operation control parameter(s) may be specified by software running on the application processor, <i>e.g.</i> through an Android API. <i>See, e.g.:</i>

Claim 4	Accused Products
	Step 2  Edit  ● IC Identification, pt. 2: ● Cirrus Logic CS40L26 Haptic Driver ● Qualcomm PMR735A Power Management ● Qualcomm PM3003 Power Management ● Diodes Incorporated AP7340D-30FS4-7 150 mA / 3.0 V LDO Regulator ● Diodes Incorporated AP7340D-33FS4-7 150 mA / 3.3 V LDO Regulator ● Knowles MEMS Microphone ● Qualcomm Clock Generator  Add a comment Screenshot of https://www.ifixit.com/Guide/Samsung+Galaxy+S22+Ultra+Chip+ID/148073 showing Cirrus Logic haptic driver IC.

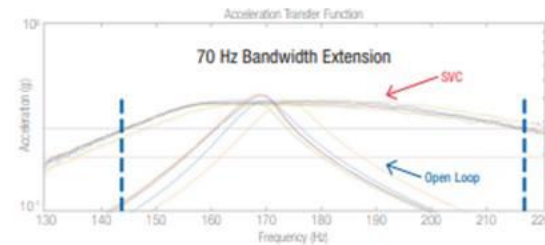
Claim 4	Accused Products
	Products ▾ / CS40L26/26B Smart Haptic Driver Enables HD Haptics on Mobile Devices for Enhanced Gaming, Videos and Music  Request Data Sheet Purchase Help Contact sales and support The CS40L26/CS40L26B is the industry's leading self-contained haptic driver IC that integrates a DSP and Class D digital boost converter to enable advanced closed-loop control of the actuator, HD enabled haptics and audio generated haptics for use in smartphones, tablets and wearables. Advanced sensor-less velocity control (SVC) provides real-time braking and consistent acceleration of the LRA, plus wider bandwidth and broader frequency range – essential features for gaming UX. CIRRUS ROCKS® CIRRUS® ENGINEERED TO ROCK® INNOVATION THAT ROCKS® Technology Haptic Drivers Application Categories Mobile Audio Devices, Wearables Screenshot of Cirrus Logic haptic driver description, available at https://www.cirrus.com/products/cs40l26-26b/.

Sensor-Less Velocity Control (SVC) Delivers Dynamic Haptic Performance

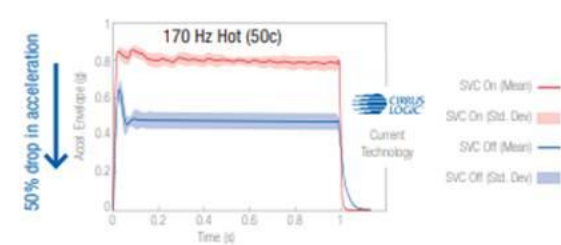
Why SVC Matters – Closed-Loop Feedback Ensures Gaming Consistency

- Dynamically adapts to the LRA in real time – a key performance enhancement for gaming and streamed haptics
- Widens the LRA bandwidth for consistent acceleration, as well as crisp performance when in overdrive and braking

SVC Widens the LRA Bandwidth, Enabling HD Haptic Effects

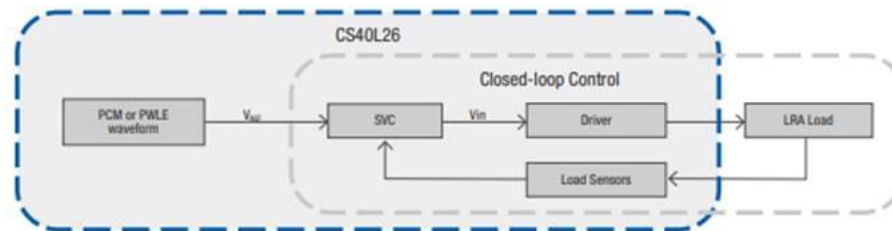


SVC Generates Consistent Acceleration



How SVC Works

- SVC senses the load condition and adapts the signal V_{in} to drive for the back-emf to follow V_{REF}



Screenshot of haptic driver datasheet, available at

https://statics.cirrus.com/pubs/proBulletin/CS40L26_B_Smart_Haptics_Driver_Product_Bulletin.pdf.

Claim 4	Accused Products
	Usage of haptic primitives Android includes several haptics <i>primitives</i> that vary in both amplitude and frequency. You may use one primitive alone or multiple primitives in combination to achieve rich haptic effects. Screenshot from Android API documentation at https://developer.android.com/develop/ui/views/haptics/custom-haptic-effects indicating one non limiting example where the Android operating system can provide operational control parameters representing strength of vibration and frequency.

Claim 5

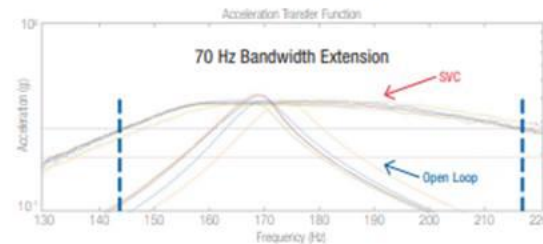
Claim 5	Accused Products
[5a] The vibration module of claim 4 wherein the one or more operational control parameters is a strength of vibration produced by the oscillation of the moveable component; and	Each Accused Product comprises the vibration module of claim 4 wherein the one or more operational control parameters is a strength of vibration produced by the oscillation of the moveable component. For example, in the case of the Galaxy S22 Ultra, the haptic IC “dynamically adapts to the LRA in real time” and “senses the load condition and adapts the signal V_{in} to drive for the back-emf to follow V_{REF}.” <i>See, e.g.:</i>

Sensor-Less Velocity Control (SVC) Delivers Dynamic Haptic Performance

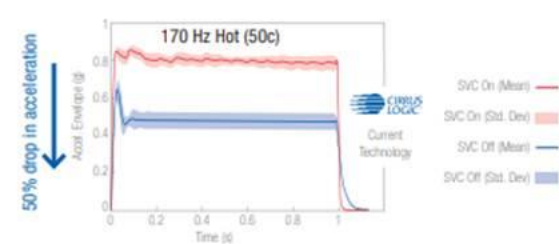
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SVC Widens the LRA Bandwidth, Enabling HD Haptic Effects

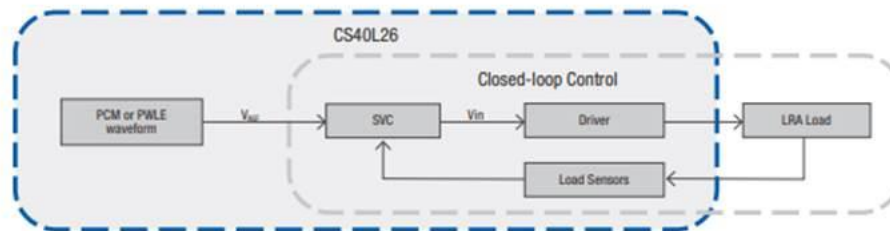


SVC Generates Consistent Acceleration



How SVC Works

- SVC senses the load condition and adapts the signal V_{in} to drive for the back-emf to follow V_{REF}



Screenshot of haptic driver datasheet, available at

https://statics.cirrus.com/pubs/proBulletin/CS40L26_B_Smart_Haptics_Driver_Product_Bulletin.pdf, showing that the SVC system is designed to maximize the strength of vibration (measured as “acceleration”), indicating that the operational control parameter(s) correspond to the strength of vibration.

Claim 5	Accused Products
[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.	Each Accused Product includes a vibration module 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. For example, in the case of the Galaxy S22 Ultra, the haptic IC performs “dynamic tuning with advanced closed-loop automated characterization” in order to “handle[] changes in actuator characteristics to eliminate the need to fine tune for long hours.” On information and belief, this explicit discussion of “closed-loop” refers to using a closed-loop control program in order to determine the resonant frequency for the vibration module, as claimed. <i>See, e.g.</i>, element [2c] and claim 4 above. <i>See also, e.g.:</i> The image is a screenshot of a haptic driver datasheet. It features a dark grey background with white and yellow text. The title 'Simplified tuning with advanced closed-loop automated characterization' is prominently displayed in a large, bold, sans-serif font. Below the title, there is a single bullet point in a smaller font, which reads: 'Algorithm dynamically handles changes in actuator characteristics to eliminate the need to fine tune for long hours'. Screenshot of haptic driver datasheet, available at https://statics.cirrus.com/pubs/proBulletin/CS40L26_B_Smart_Haptics_Driver_Product_Bulletin.pdf.

Claim 6

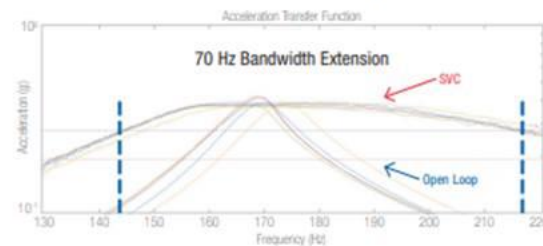
Claim 6	Accused Products
[6a] The vibration module of claim 4 wherein the one or more operational control parameters include both a strength of vibration produced by the oscillation of the moveable component and a current operational mode; and	Each Accused Product comprises the vibration module of claim 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. For example, in the case of the Galaxy S22 Ultra, the haptic IC “dynamically adapts to the LRA in real time” and “senses the load condition and adapts the signal V_{in} to drive for the back-emf to follow V_{REF}.” The operational control parameters as claimed include, for example, V_{REF}, the waveform input to the haptic controller, control parameters regarding the operation of the haptic controller (<i>e.g.</i>, a parameter enabling SVC) and/or control parameters provided by software running on the application processor (<i>e.g.</i> via the user selection of a particular vibration pattern, or via an Android API selecting a particular haptic effect). <i>See, e.g.</i>, element [1f]. <i>See also, e.g.:</i>

Sensor-Less Velocity Control (SVC) Delivers Dynamic Haptic Performance

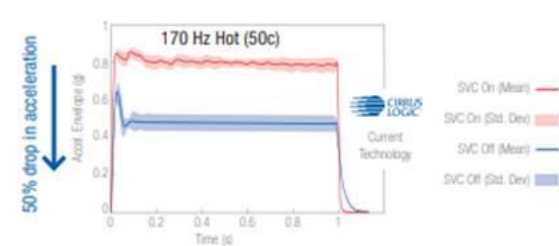
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SVC Widens the LRA Bandwidth, Enabling HD Haptic Effects

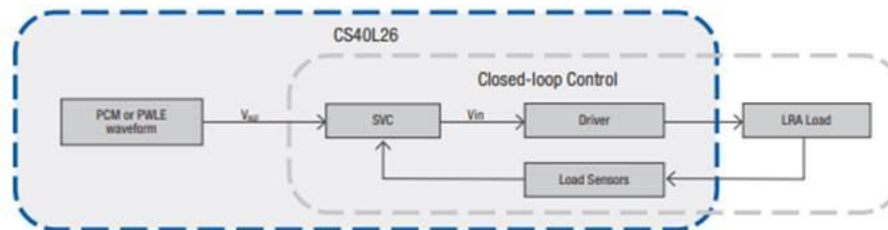


SVC Generates Consistent Acceleration



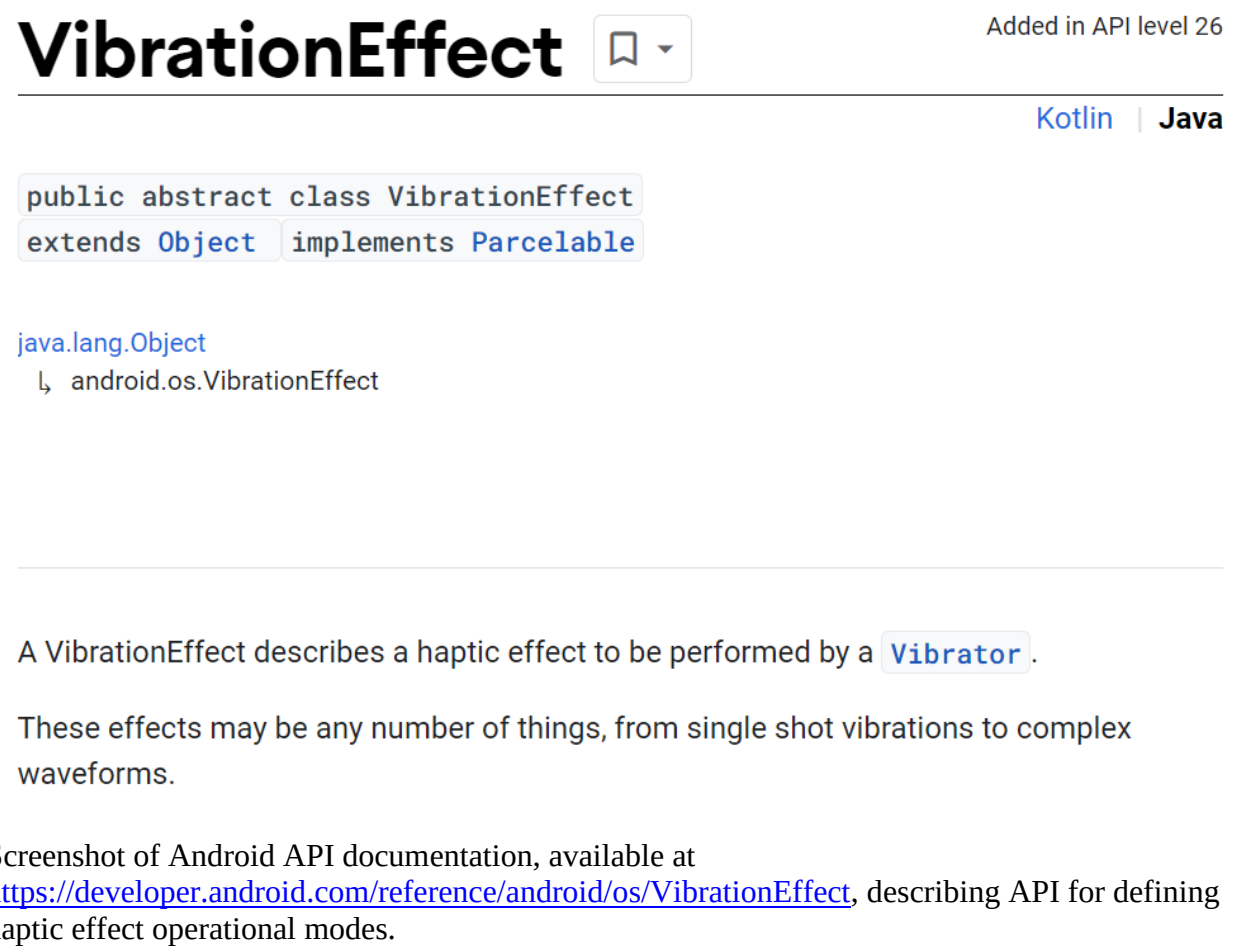
How SVC Works

- SVC senses the load condition and adapts the signal V_{in} to drive for the back-emf to follow V_{REF}



Screenshot of haptic driver datasheet, available at

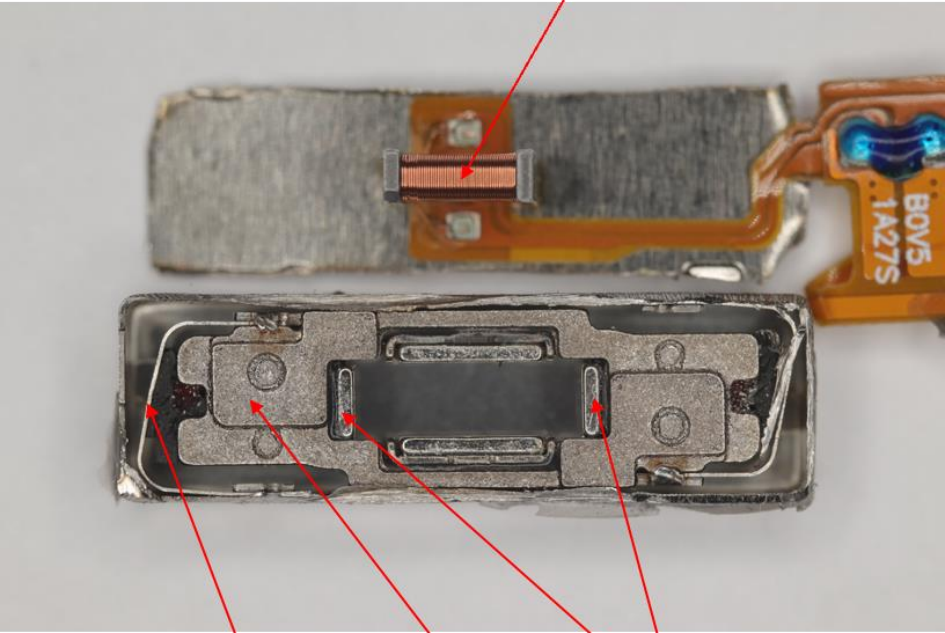
https://statics.cirrus.com/pubs/proBulletin/CS40L26_B_Smart_Haptics_Driver_Product_Bulletin.pdf.

Claim 6	Accused Products
	 The screenshot shows the Android API documentation for the VibrationEffect class. At the top, it says "Added in API level 26" and provides links for "Kotlin" and "Java". The code snippet shows: <code>public abstract class VibrationEffect</code> <code>extends Object</code> <code>implements Parcelable</code>. Below the code, it shows the inheritance hierarchy: <code>java.lang.Object</code> <code>↳ android.os.VibrationEffect</code>. A description states: "A VibrationEffect describes a haptic effect to be performed by a Vibrator." It further explains: "These effects may be any number of things, from single shot vibrations to complex waveforms." At the bottom, it mentions: "Screenshot of Android API documentation, available at https://developer.android.com/reference/android/os/VibrationEffect, describing API for defining haptic effect operational modes."
[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	Each Accused Product includes a vibration module 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. For example, in the case of the Galaxy S22 Ultra, the haptic IC performs “dynamic tuning with advanced closed-loop automated characterization” in order to “handle[] changes in

Claim 6	Accused Products
component and a frequency at which the control component drives the moveable component to oscillate.	actuator characteristics to eliminate the need to fine tune for long hours.” See claim 4 above. On information and belief, the control output determines, directly or indirectly, the current supplied to the driving coil and the frequency at which the movable component is driven to oscillate. For example, even if the non-limiting example control output labeled “Vin” in the Cirrus Logic data sheet is itself a voltage, that voltage directly or indirectly dictates the current supplied by the “driver” to the magnetic coil due to the specific architecture of the closed-loop control system described in the Cirrus Logic datasheet. Similarly, based on the specific architecture of the closed-loop control system described in the Cirrus Logic datasheet, Vin must directly or indirectly determine the driving frequency (e.g. through the frequency of Vin itself). <i>See also, e.g.:</i> Simplified tuning with advanced closed-loop automated characterization • Algorithm dynamically handles changes in actuator characteristics to eliminate the need to fine tune for long hours Screenshot of haptic driver datasheet, available at https://statics.cirrus.com/pubs/proBulletin/CS40L26_B_Smart_Haptics_Driver_Product_Bulletin.pdf.

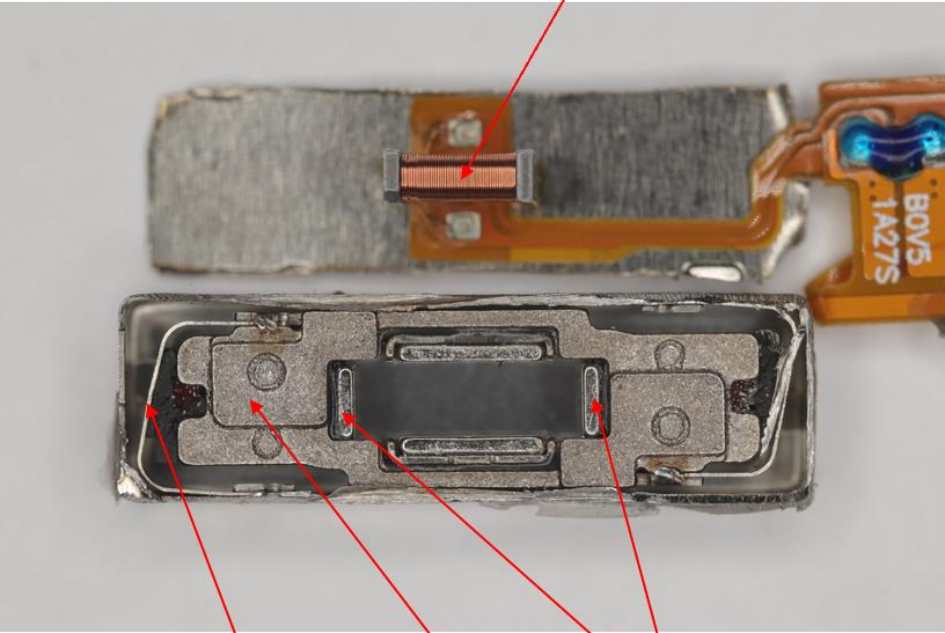
Claim 7

Claim 7	Accused Products
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.	Each Accused Product comprises 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. For example, in the case of the Galaxy S22 Ultra, the driving component comprises one electromagnetic coil that generates a magnetic field parallel to the direction in which the moving mass moves. <i>See, e.g.:</i>

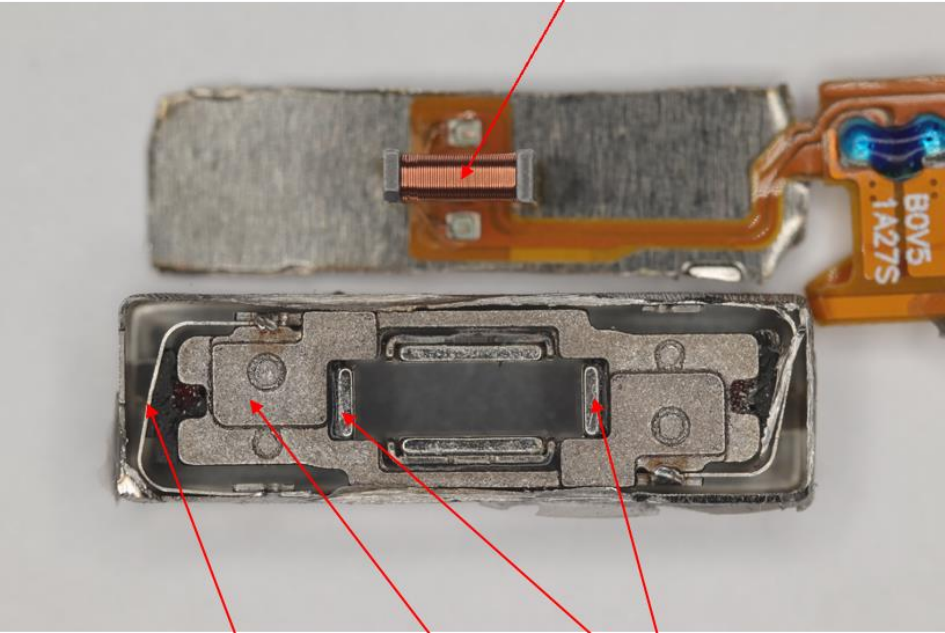
Claim 7	Accused Products
	 Fixed driving coil Spring Moving Mass Magnets Direction of motion ↔ Photograph of Galaxy S22 Ultra vibration motor with components annotated.

Claim 8

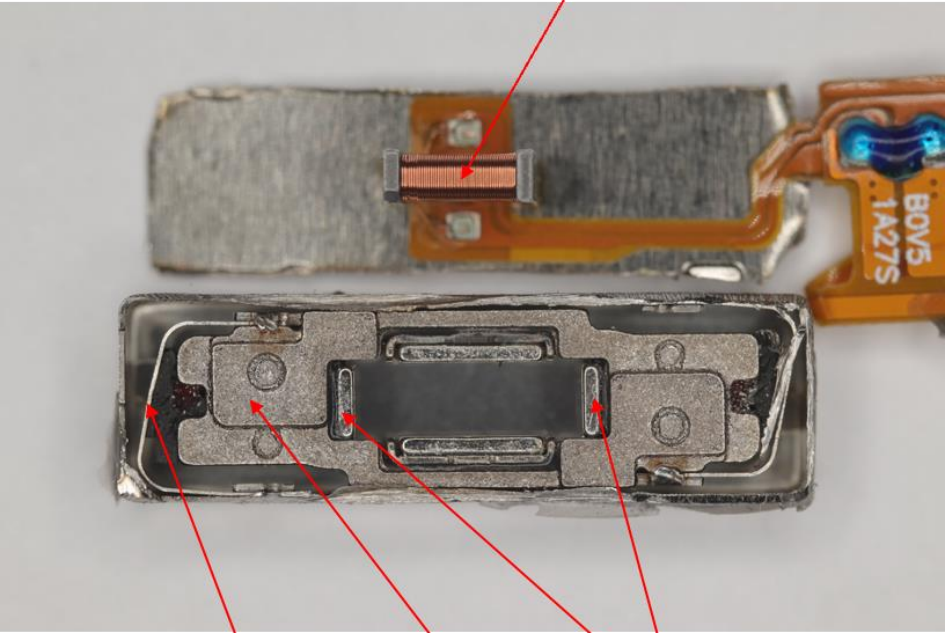
Claim 8	Accused Products
[8pre] The vibration module of claim 1	See analysis and evidence for claim 1 and remainder of claim 8.
[8a] wherein the housing is a tube, capped at both ends by movable-component-repelling components selected from one of mechanical springs and magnets;	Each Accused Product comprises 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. For example, the housing of the LVM in the Galaxy S22 Ultra is a tube, rectangular in cross-section, with mechanical springs capping each end. <i>See, e.g.:</i>

Claim 8	Accused Products
	 Fixed driving coil Spring Moving Mass Magnets Direction of motion  Photograph of Galaxy S22 Ultra vibration motor with components annotated.

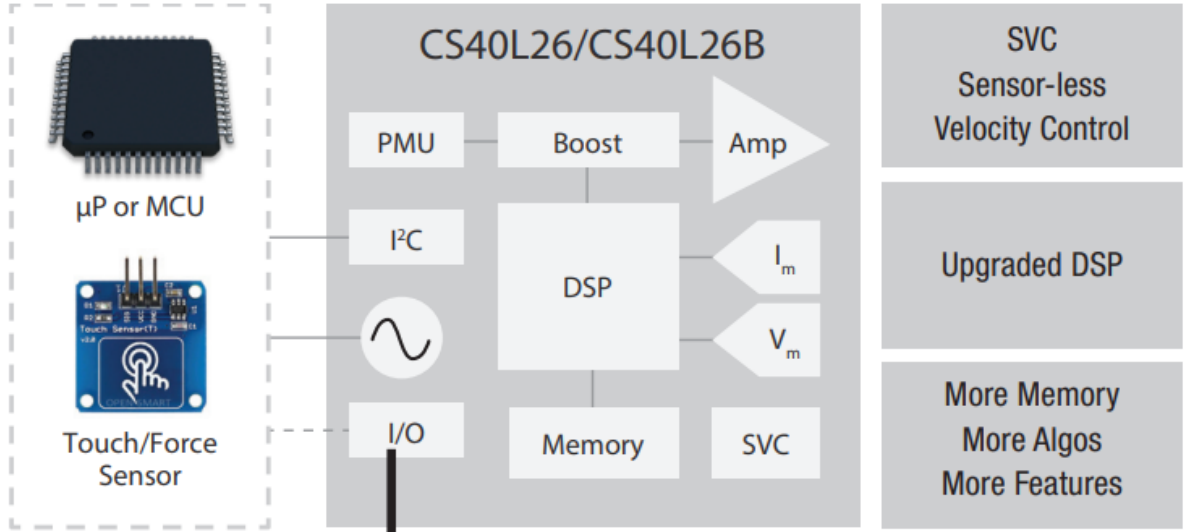
Claim 8	Accused Products
[8b] wherein the movable component is a magnet shaped to slide within the tube; and	Each Accused Product comprises the vibration module of claim 1 wherein the movable component is a magnet shaped to slide within the tube. For example, the movable component of the LVM in the Galaxy S22 Ultra comprises magnets shaped to slide within the tube. <i>See, e.g.:</i>

Claim 8	Accused Products
	 Fixed driving coil Spring Moving Mass Magnets Direction of motion ↔ Photograph of Galaxy S22 Ultra vibration motor with components annotated.

Claim 8	Accused Products
[8c] wherein the driving component is an electromagnetic coil.	Each Accused Product comprises the vibration module of claim 1 wherein the driving component is an electromagnetic coil. For example, in the case of the Galaxy S22 Ultra, the driving component is an electromagnetic coil. <i>See, e.g.:</i>

Claim 8	Accused Products
	 Fixed driving coil Spring Moving Mass Magnets Direction of motion ↔ Photograph of Galaxy S22 Ultra vibration motor with components annotated.

Claim 17

Claim 17	Accused Products
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.	Each Accused Product comprises 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. For example, in the case of the Galaxy S22 Ultra, the haptic IC controls the supply of power from a power management unit (PMU) through a boost circuit and an amplifier to the drive coil, to cause the movable component to oscillate at a frequency and an amplitude that are independently specified by user input received from the user-input features. <i>See element [1f] above.</i> <i>See also, e.g.:</i>  Screenshot of Galaxy S22 Ultra haptic driver datasheet, available at https://statics.cirrus.com/pubs/proBulletin/CS40L26_B_Smart_Haptics_Driver_Product_Bulletin.pdf.

Claim 17	Accused Products
	Usage of haptic primitives Android includes several haptics <i>primitives</i> that vary in both amplitude and frequency. You may use one primitive alone or multiple primitives in combination to achieve rich haptic effects. Screenshot from Android API documentation at https://developer.android.com/develop/ui/views/haptics/custom-haptic-effects indicating that Android haptic primitives independently specify amplitude and frequency.

Claim 17	Accused Products																		
	<table> <tr> <th colspan="2">Constants</th></tr> <tr> <td>int</td><td> PRIMITIVE_CLICK This effect should produce a sharp, crisp click sensation. </td></tr> <tr> <td>int</td><td> PRIMITIVE_LOW_TICK This very short low frequency effect should produce a light crisp sensation intended to be used repetitively for dynamic feedback. </td></tr> <tr> <td>int</td><td> PRIMITIVE_QUICK_FALL A haptic effect that simulates quick downwards movement with gravity. </td></tr> <tr> <td>int</td><td> PRIMITIVE_QUICK_RISE A haptic effect that simulates quick upward movement against gravity. </td></tr> <tr> <td>int</td><td> PRIMITIVE_SLOW_RISE A haptic effect that simulates slow upward movement against gravity. </td></tr> <tr> <td>int</td><td> PRIMITIVE_SPIN A haptic effect that simulates spinning momentum. </td></tr> <tr> <td>int</td><td> PRIMITIVE_THUD A haptic effect that simulates downwards movement with gravity. </td></tr> <tr> <td>int</td><td> PRIMITIVE_TICK This very short effect should produce a light crisp sensation intended to be used repetitively for dynamic feedback. </td></tr> </table> Screenshot from Android API documentation at	Constants		int	PRIMITIVE_CLICK This effect should produce a sharp, crisp click sensation.	int	PRIMITIVE_LOW_TICK This very short low frequency effect should produce a light crisp sensation intended to be used repetitively for dynamic feedback.	int	PRIMITIVE_QUICK_FALL A haptic effect that simulates quick downwards movement with gravity.	int	PRIMITIVE_QUICK_RISE A haptic effect that simulates quick upward movement against gravity.	int	PRIMITIVE_SLOW_RISE A haptic effect that simulates slow upward movement against gravity.	int	PRIMITIVE_SPIN A haptic effect that simulates spinning momentum.	int	PRIMITIVE_THUD A haptic effect that simulates downwards movement with gravity.	int	PRIMITIVE_TICK This very short effect should produce a light crisp sensation intended to be used repetitively for dynamic feedback.
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Claim 17	Accused Products
	https://developer.android.com/reference/android/os/VibrationEffect.Composition showing individual haptics primitives independently representing both amplitude and frequency. <i>See also</i> analysis and evidence for claim 1.