ST offering in Wearable

Analog and Mixed Signal Portfolio

March 2014

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Wearable devices attributes

Devices being worn for an extended period of time
with the user experience significantly enhanced as a result

- Always on
- Low power
- Compact
- Environment aware
- Intelligent
- Connected

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Market and Applications

- **Fitness and Wellness** – monitor activity and emotions
  - Activity monitors, foot pods and pedometers, sleep sensors, heart rate monitors
  - Emotional measurement
  - Smart clothing, smart watches, heads-up displays

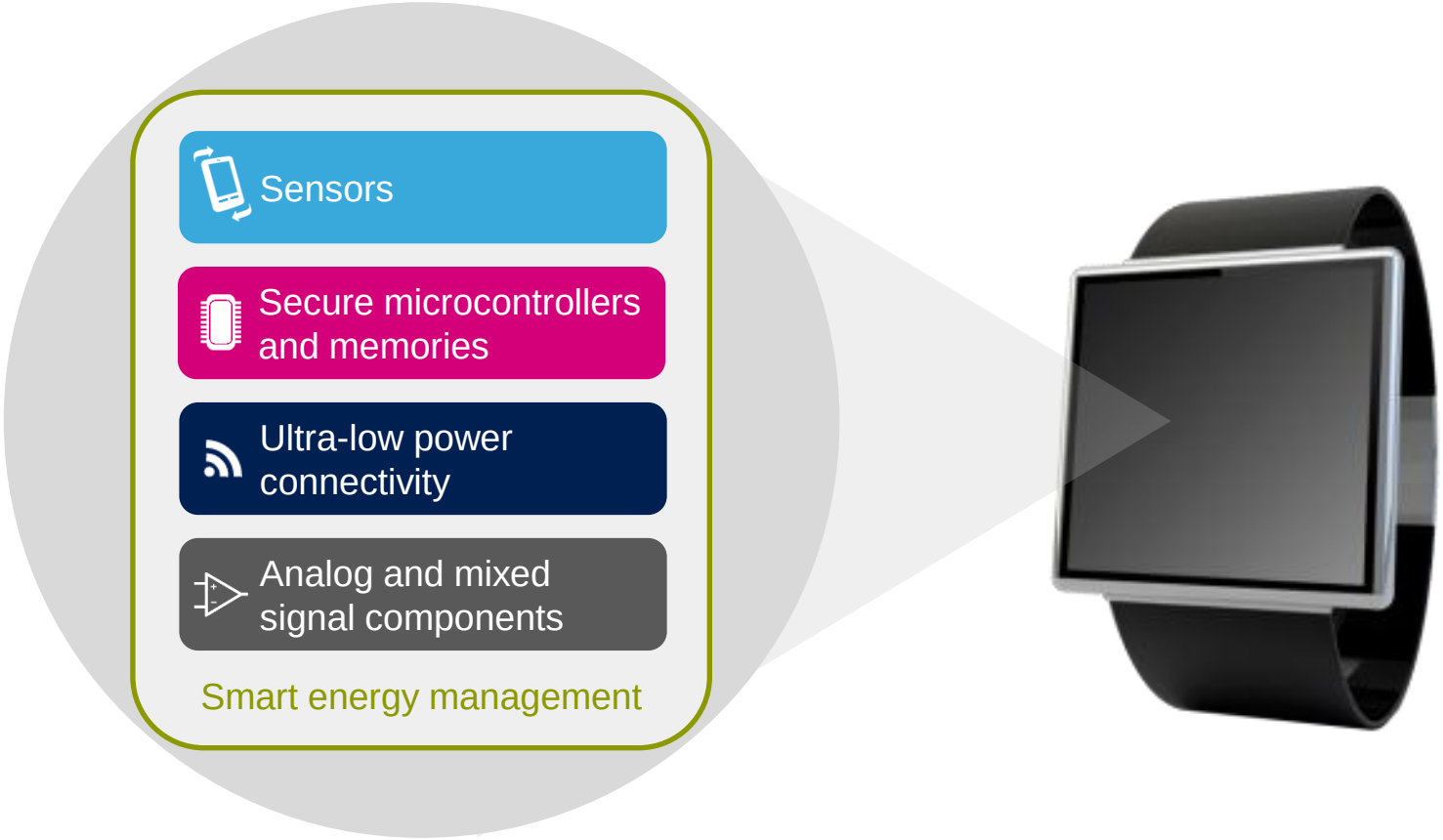
- **Healthcare and Medical** – monitor vital signs
  - Blood pressure monitors, ECG monitors, continuous glucose monitoring
  - Insulin pumps, drug delivery products

- **Infotainment** – entertain and enhance lifestyle
  - Headsets
  - Smart glasses, smart watches

- **Industrial** – receive/transmit real-time data
  - Hand-worn terminals, heads-up displays, smart clothing, wearable detection devices

ST Offering for Wearable

The only company to offer a complete smart system



ST Analog and Mixed signal portfolio
for wearable devices

The most complete set of building blocks for wearable devices

Operational amplifiers
Large portfolio of highly power-efficient op amp in tiny packages

Smart reset
Customizable products providing safe and convenient reset

Analog switches
Compact single and dual switches for audio and USB

Audio amplifiers
High-efficiency Class D and G amplifiers for headsets and speakers

BlueNRG
Bluetooth® smart solution with best-in-class power consumption

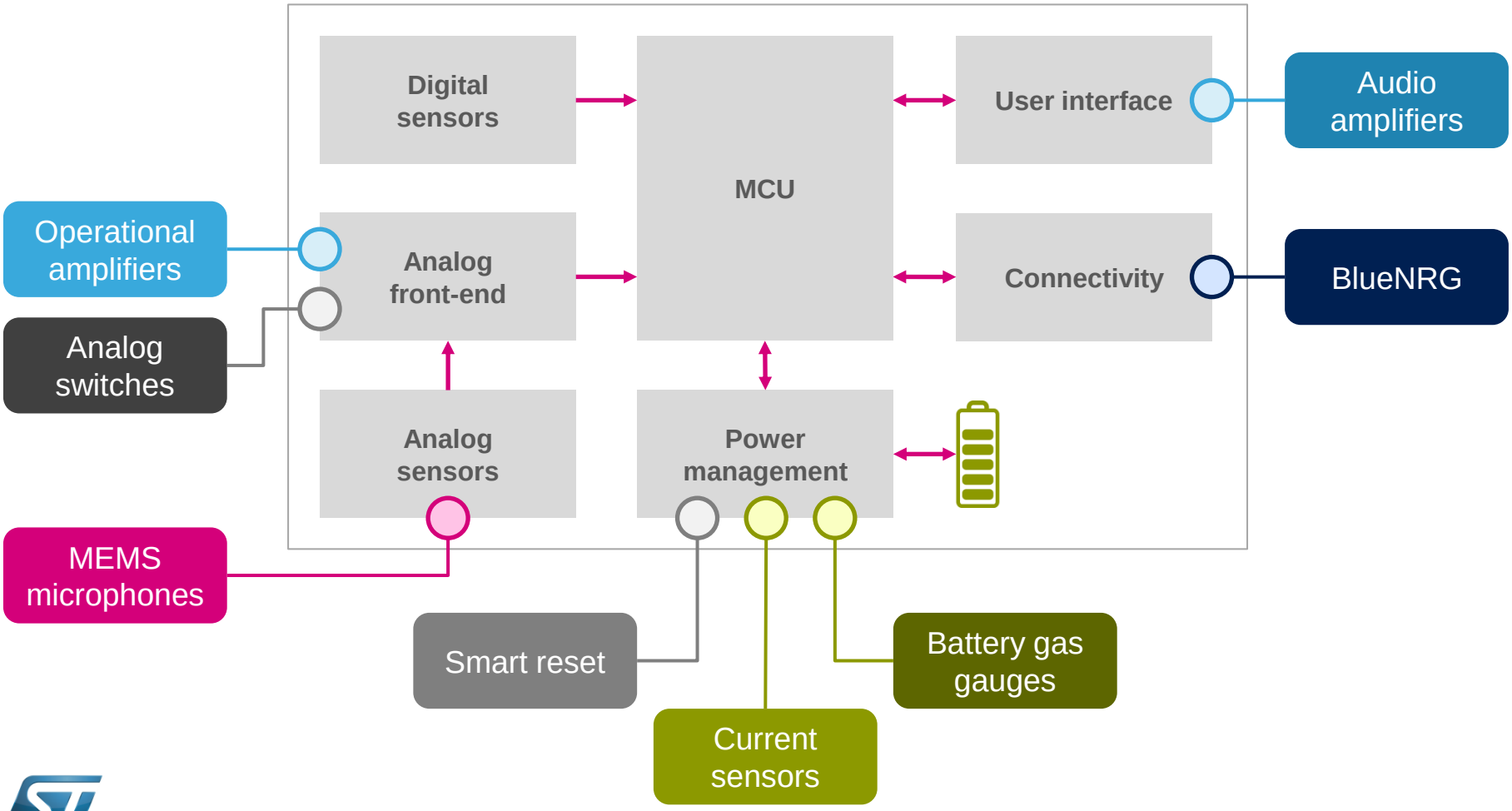
Current sensors
High accuracy current measurement for contactless battery chargers

Battery gas gauges
Low-power gas gauge providing very accurate battery life indicators

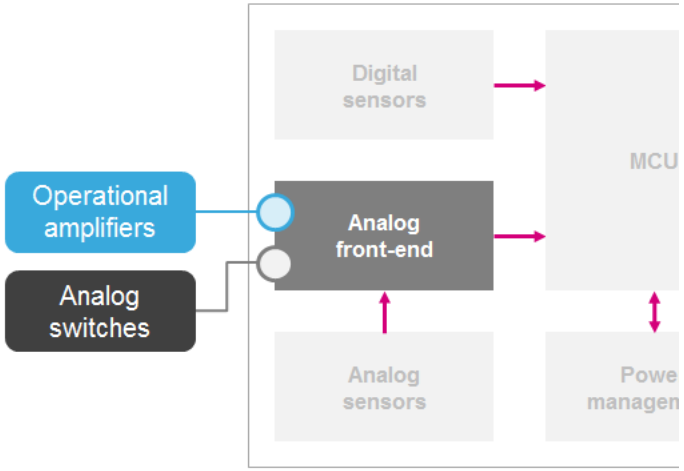
MEMS microphone
Power-efficient microphone solutions for smarter voice-controlled devices

Wearable devices

Analog and mixed signal products partitioning



Solutions for Analog Front-End



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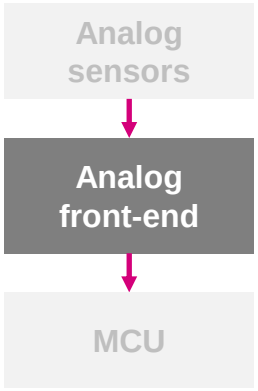
Analog Front-End

Analog transducers, getting the best from your sensor



Analog sensors need signal transducers to deliver the information to the MCU

- **Accurate and stable** to guarantee the maximum precision of the information
- **Low power** to guarantee a longer user experience
- **Small** to be integrated in the most stylish and thin designs

ST offers a **dedicated set** of op amp to deliver **the best match** of current consumption and precision, for a wide range of applications

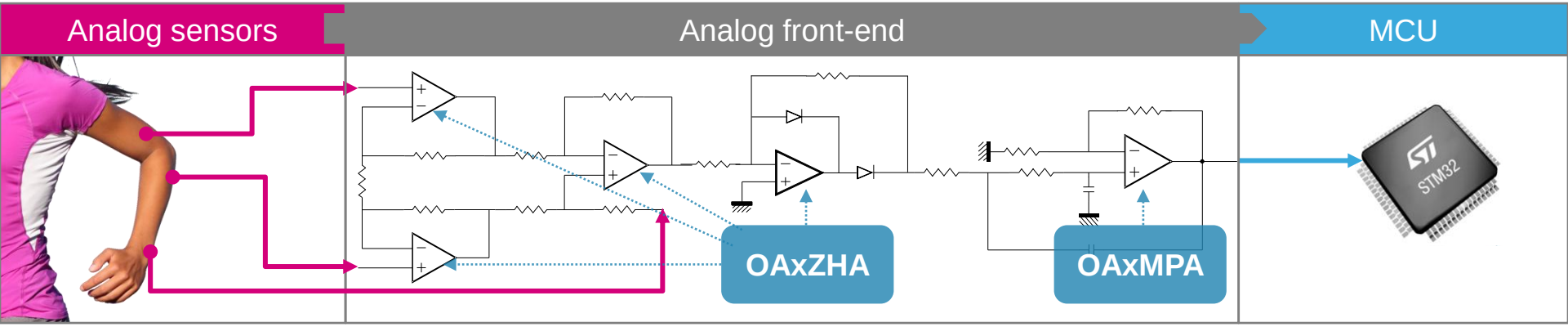
	Input offset voltage [µV]	Input offset voltage drift [µV]	Supply current [µA]	GBP [kHz]	Supply voltage [V]
OAxNP Very low power	100	5	**0.6**	8	1.5 – 5.5
OAxMPA Low power precision	**50**	10	**9**	120	1.5 – 5.5
OAxZHA High precision zero drift	**1**	**0.01**	28	400	1.8 – 5.5

http://www.st.com/web/en/catalog/sense_power/FM123/SC61

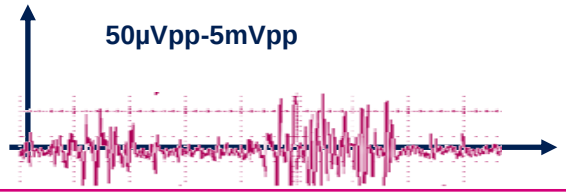
Application example

Analog Front-End

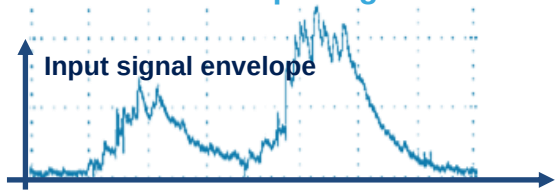
Signal transducers application: electromyography



Raw input signal



Conditioned output signal



A **low input offset voltage with zero drift** amplifier is mandatory. Otherwise the electrodes information would be less accurate or lost

OAxZHA family is the perfect match offering:

- V_{IO}= 1µV
- $\Delta V_{IO}/\Delta T$ = 0.010µV

Once the signal dynamic has been restored **precision** and **micro power consumption** amplifiers are needed before the signal is fed to the MCU

OAxMPA is the perfect match offering:

- V_{IO}= 50µV
- I_{CC} = 9µA

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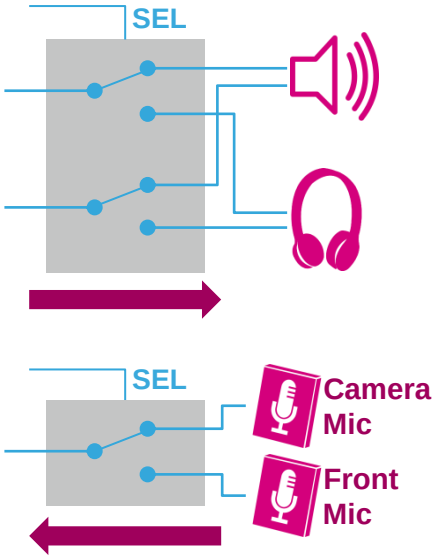
Analog Front-End

Switches



In portable applications, switches are used to route a great variety of signal – audio to the speaker or the headphones, or other signal from and towards sensors

- Guarantee a **simple** yet **efficient** system implementation
- Compatibility with **high-speed** signals, for USB 2.0 applications

ST analog switches line up is meant **to cover all the possible signal** typologies from audio to USB, to fit most of the applications

	Supply voltage [V]	Supply current [µA]	Off isolation [dB]	X-Talk [dB]	Bandwidth [MHz]
AS11P2TLRQ SPDT single	1.65 - 4.5	0.1 (max)	-75 @ 100Hz	-80 @100Hz	150
AS21P2TLRQ SPDT dual	1.65 - 4.3	0.05	-72 @ 100 Hz	-66 @100 Hz	55
AS21P2THBQ SPDT Dual	1.65 - 4.3	0.2 (max)	-78 @ 1 MHz	-78 @1 MHz	800

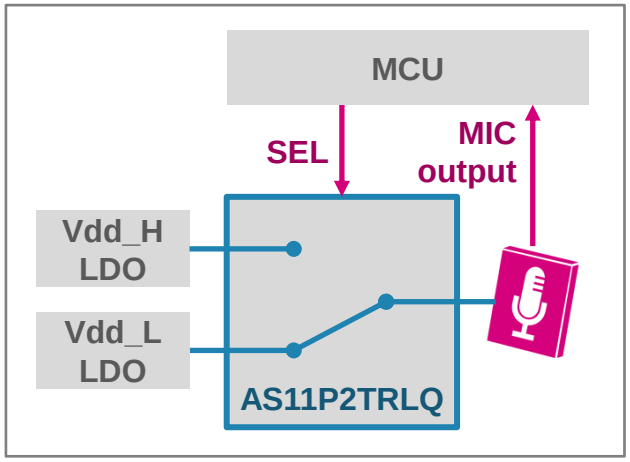
http://www.st.com/web/catalog/sense_power/FM1961/SC650

Application example

Analog Front-End

Switches application: dual mode microphones

AS11P2TLRQ analog switch can be used to **supply the mic with different voltage** level so to enable the **different operating modes** depending on the MCU needs thus enabling **voice activity detection** features

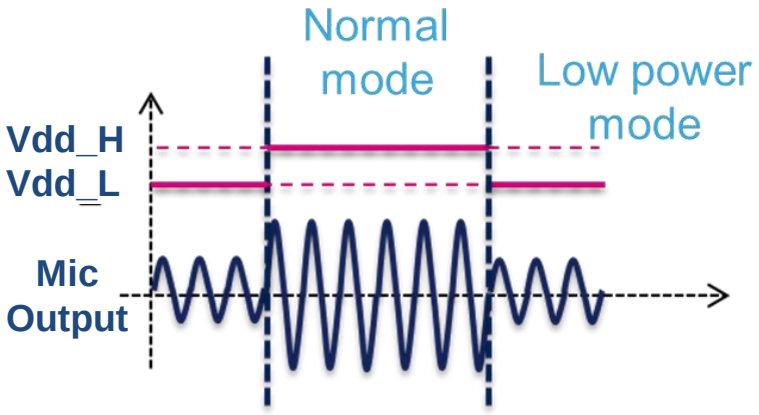


High Supply voltage Vdd_H

Normal mode: the acoustical parameters are set to the optimal level for voice control applications

Low power voltage Vdd_L

Sniffing mode: the device reduces the power consumption at minimum whilst guaranteeing an adequate set of performances for voice activity detection



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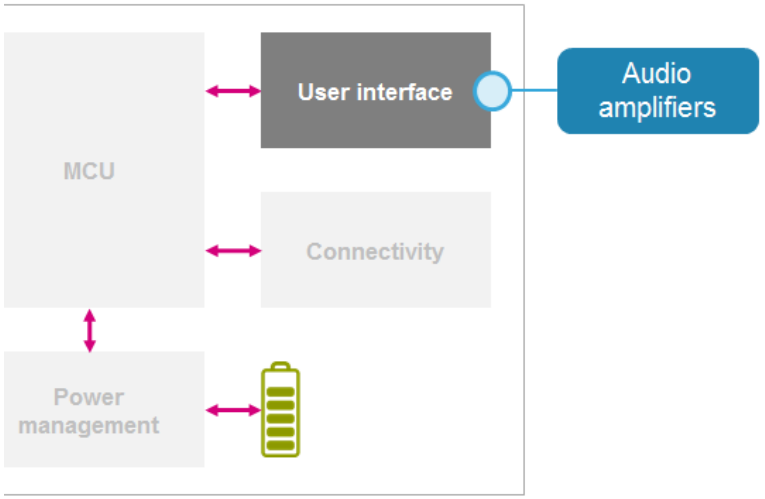
Solutions for User Interface



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User Interface

Answering the user

ST offers **highly-efficient** devices capable of delivering **high quality** audio into **small**, **low power** solutions

CLASS G HEADPHONE AMPLIFIER

A22H165
A22H165M (µ-less)

- Power supply range **2.3 V - 4.8 V**
- Low stand by current 0.6 µA
- Vout = **0.8 Vrms into 16 Ω**, *at 1 % THD+N, VCC = 3.6 V*
- SNR = **100 dB** @ 1 kHz
- Reduced external BOM
- Flip-chip package

Low power

High quality

Small size

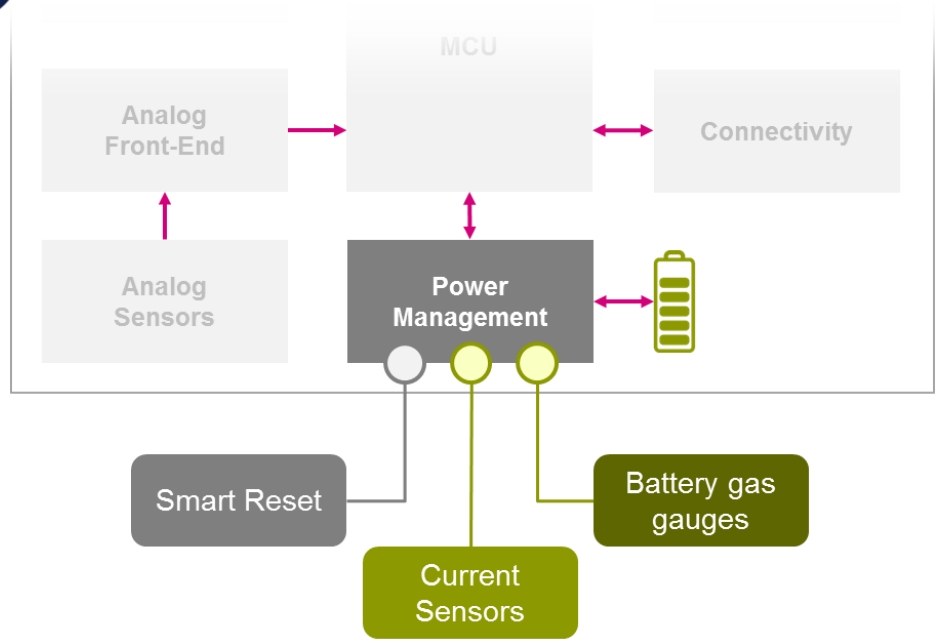
3W CLASS D MONO SPEAKER AMPLIFIER

A21SP16J

- Power supply range **2.4 V - 5.5 V**
- Low stand by current **<1 µA**
- Pout = **0.8 W into 8 Ω**, *at 10 % THD+N, VCC = 3 V*
- SNR = **85 dB** @ 1 kHz
- Reduced external BOM
- Small flip-chip package

http://www.st.com/web/catalog/sense_power/FM125/CL1503/SC977

Solutions for Power Management



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Power Management

Intelligent battery monitoring

ST offers an **integrated** solution combining **current integration** and **voltage variation** over the time thus providing **the most accurate** battery status measurement

	GG25LJ - Gas gauge IC with alarm output for wearable devices
Accuracy	• Coulomb counter mode, voltage mode and mixed mode operations • 0.25 % accuracy battery voltage monitoring
Robustness	• Analog and temperature compensation • Internal temperature sensor
Flexibility	• Low battery level alarm output with programmable thresholds • Custom battery OCV curve
Low power	• 2 µA in standby, 45 µA in operating
Small size	• Flip chip, 2.01 x 1.37 x 0.6 mm, 10 bumps, 0.4 mm pitch

http://www.st.com/web/catalog/sense_power/FM142/CL848/SC274

Power Management

Current sensing

Power management in wearable devices

Wired or wireless battery chargers

Precision current sources from sensors

Photovoltaic systems

ST current sensing ICs portfolio cover most of the application needs

- Independent supply and common mode voltages
- Wide supply voltage range
- Selectable gains
- Low power solutions

	Independent V_{IO} and V_{CC}	Common mode operating range [V]	Supply voltage range [V]	Supply current [µA]	Gain [V/V]
CS30	√	2.8 - 30.0	4.0 - 24.0	165	20. 50, 100 fixed internally
CS70	√	2.9 - 70.0 -2.1 - 65.0	2.7 - 5.5	200	20, 50, 100 pin selectable

http://www.st.com/web/en/catalog/sense_power/FM123/SC1264

Application example

Power Management

Current sensing application: wireless battery charging

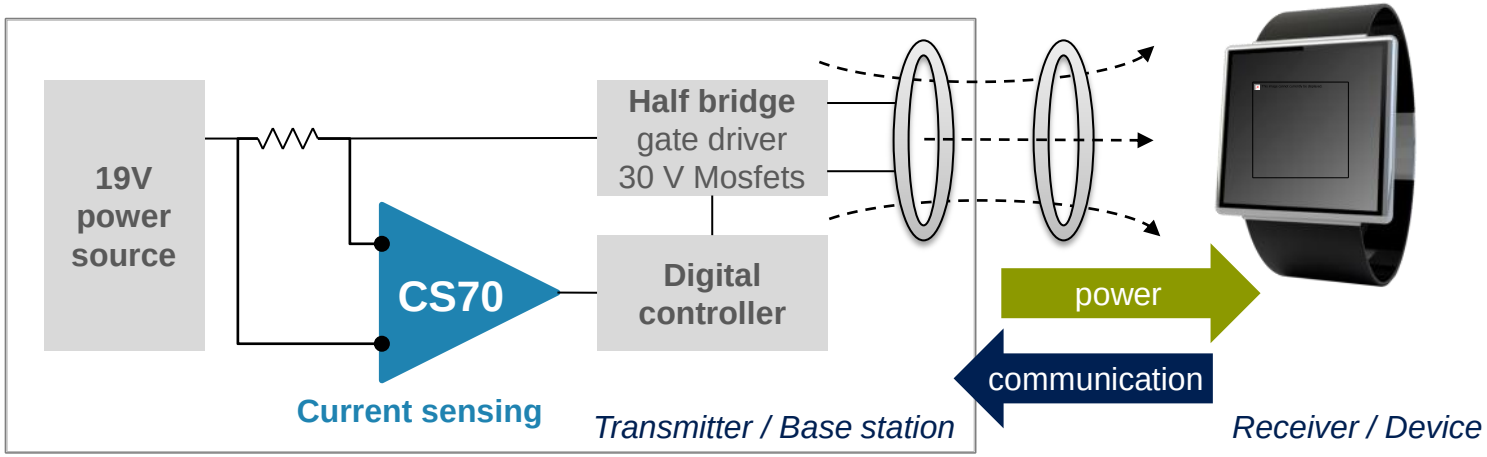
When swimming water pressure can reach up to 5 atm

Wearable technology **needs to be sealed**. All the electrical connections with the external have to be removed

Wireless battery charging is mandatory

High side current sensing through the transmitter coil

to dynamically regulate the charger power output



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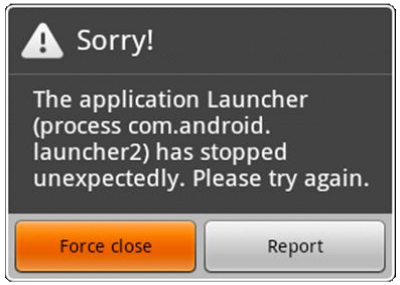
Power Management

Smart resetting



Wearable devices getting **smarter**, software **complexity grows** exponentially

The possibility of and **end-user misuse** of the product **increases accordingly**

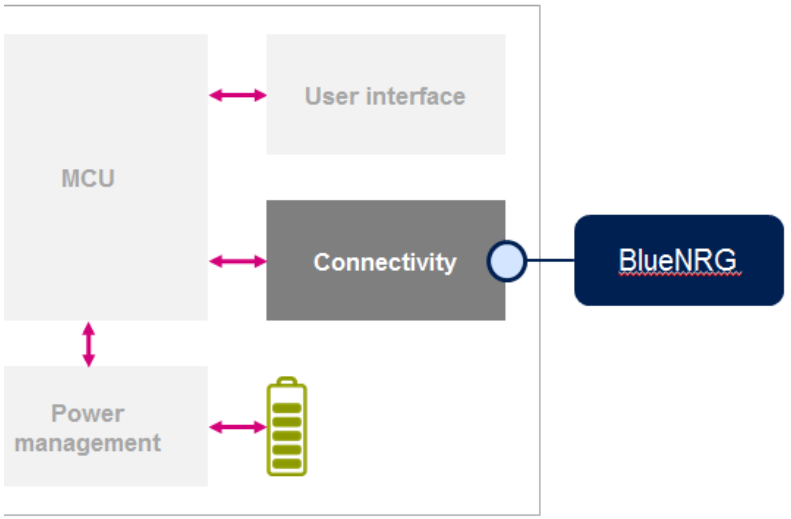
System crashes are likely to **happen** and it is mandatory **to provide an escape sequence** to restart the application **and** maintain a perception of **quality**

ST **smart reset** IC line up provide a full set of functionalities **guaranteeing an escape sequence** from OS or application failures

	# of RST button	# of PWR button	Supply voltage range [V]	Supply current [µA]	RST assertion time
SR1 Smart reset	1	-	2.0 - 5.5	0.4	fixed at factory
SR2 Smart reset	2	-	1.65 - 5.5	1.1	fixed at factory
SRC0 Smart power and reset	1	1	1.6 - 5.5	0.6	selectable via ext condenser

http://www.st.com/web/en/catalog/sense_power/FM1946/SC1296
http://www.st.com/web/catalog/sense_power/FM1946/SC1753

Solutions for Connectivity



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Connectivity

BlueNRG the Bluetooth® SMART solution

Single mode Bluetooth® SMART wireless network processor

Integration

- 2.4 GHz RF transceiver
- Cortex-M0 microcontroller (running the BT single mode protocol)
- AES 128-bit co-processor

Flexibility

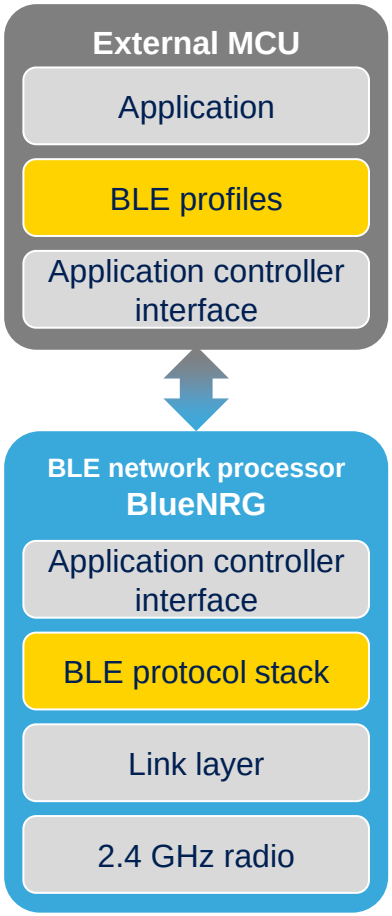
- Master and slave single mode BLE (4.0) network processor
- On chip non-volatile Flash memory allows OTA BLE-stack upgrade. Stack qualified

Low power

- I_{CC}RX 7.3 mA
- I_{CC}TX 8.2 mA @ 0 dBm
- I_{CC}Sleep 1.7 µA
- I_{CC}Shutdown 2.5 nA

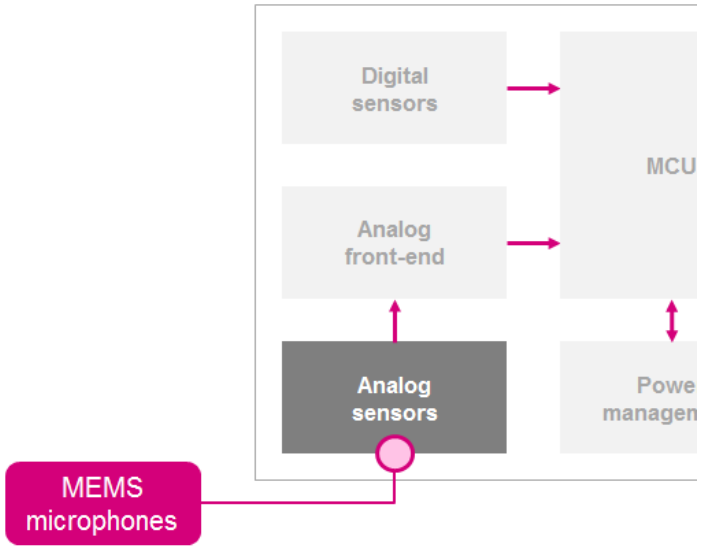
Small size

- Package: QFN32, 5 x 5 x 1 mm
- Flip-chip



http://www.st.com/web/catalog/sense_power/FM1968/CL1976/SC1898

Solutions for Analog Sensors



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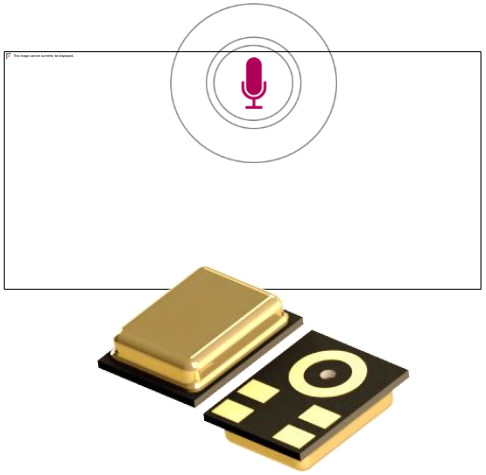
MEMS microphones

The voice control enablers



Voice control is a wide spreading trend across many portable applications, making the interaction easier, faster and smoother

It enables fashionable designs by reducing the number of button.

Next microphones trend is to allow dual mode operations:

Normal mode: the acoustical parameters are set to the optimal level for voice control applications

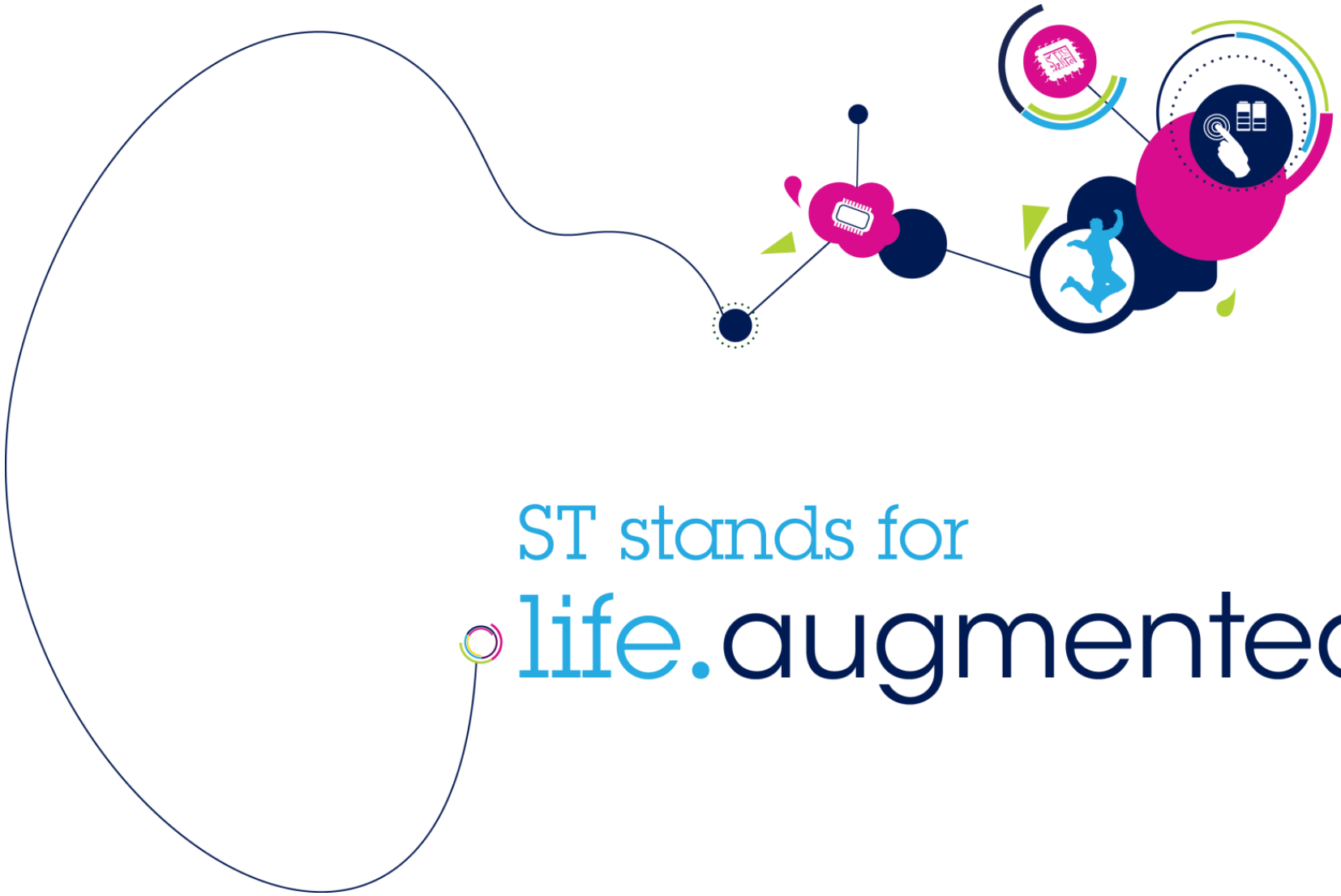
Sniffing mode: the device reduces the power consumption at minimum whilst guaranteeing an adequate set of performances for voice activity detection

ST MEMS Microphones pave the road toward **smarter** and **efficient voice-controlled** devices combining performances, small size and low power consumption

	Sensitivity [dBV]	SNR [dB]	AOP [dB]	Supply voltage range [V]	Supply current [µA]	Dual mode
MP23AB02B	-38±3	64	125	1.6 - 3.6	150	-
MP23ABE03 *	-38±1	64	125		140	-
MP23ABE03DM *	-38±1	64	125	1.6 - 3.6	140 (normal) 26 (sniff)	√

* Q3 2014

http://www.st.com/web/en/catalog/sense_power/FM89/SC1922



ST stands for

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