dialog
SEMICONDUCTOR

IoT

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CONNECTED
CONSUMER

Wearable Solutions

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Market leading Custom PMICs and Mixed-Signal ASICs deliver customized solutions to optimize efficiency, size, performance and system cost

Connectivity

Bluetooth® low energy

Family of SoCs optimized for the wearable application including integrated PMU - Power Management Unit, sensor hub, display controller and haptic driver

Power Conversion

AC/DC powering your wearable using digital control technology to eliminate the optocouplers - smallest size and highest efficiency solution

Application overview

In most people's minds, the term "wearable" and the technological aspects associated with it, usually refer to devices such as smart watches and wristbands. However, wearable technology goes far beyond this. Wearable devices come in various shapes and forms including activity trackers, sports watches, smart watches, smart glasses, pedometers, health monitors, smart clothing, and so on. Nowadays, wearable technology is being developed and used to change more than just our social habits: it will improve our everyday lives, healthcare and safety.

Wearable systems usually consist of the following main components:

Microcontroller unit (MCU):

Selection of the embedded processor is based on the device's computing and signal processing requirements. ARM® Cortex®-M class microcontrollers are popular in wearable SoC devices as they provide best in class computing performance and energy efficiency. Some high-end wearables may have a separate microcontroller to offload the processing of sensor data from the main processor. This is required when the wearable has many sensors generating lots of data to be analyzed in real time.

Wireless connectivity:

Important for wearable devices as they need to interact with one or more other devices. Depending on the type and features offered, the device may need to support different wireless protocols such us Wi-Fi or Bluetooth low energy (BLE). Typically, a wrist-worn wearable device uses BLE to transfer information collected from its various sensors such as a heart rate monitor (HRM) to an application on a smartphone.

Sensors:

Can include activity monitoring sensors like 3-axis accelerometers to track movement in every direction. Some devices also come with gyroscopes to measure orientation and rotation, and biosensors to monitor biometric data (e.g. HRM modules).

Other peripherals:

GPS functionality for tracking outdoor activities and sports; NFC capability for mobile payments; vibrator / buzzer for notifications; microphone for voice commands, etc.

User interface:

Consisting of LCDs, touchpads and mechanical buttons.

Application	Solution
Basic wearables	Including activity trackers. The devices are featured with a simple or no display, health and fitness tracking, such as step counting and sleep monitoring.
Advanced wearables	Besides the features supported by basic wearables, these type of devices normally have a larger color display. GPS is often included to support standalone outdoor tracking activities.

| Application	MCUs	Wireless SoCs	PMIC	Wireless charging	Power conversion	Reference design
Basic wearables	DA14691/ DA14695	DA1468x		DA4100/DA2210	iW1700	DA14681 wearable development kit
Advanced wearables	ARM® Cortex® based	DA14585/6 DA14531	DA9230/1		iW1700	
	DA1469x		DA1469x			

Basic wearables

Basic wearables include activity trackers, pedometers, and other simple devices. These have the capability to connect and communicate to a network usually by a BLE connection.

Activity trackers account for the majority of the shipments in the basic wearable category. They lack the advanced features and user interface (UI) found in advanced wearables. As they usually have a simple or even no display, most of the sensor readings are transmitted via BLE to a smartphone for visual representation.

Dialog addresses the basic and advanced wearable markets using a common platform. SmartBond wireless SoCs are at the heart of the system, not only handling wireless communication but also taking care of application tasks such as user interface, operating system, and processing of the fitness algorithms.

In addition, Dialog provides a portfolio of ICs which can be combined to complete your system:

- External PMICs for higher efficiency DC/DC conversion
- Wireless charging
- AC/DC power conversion at the smallest and lowest BoM cost
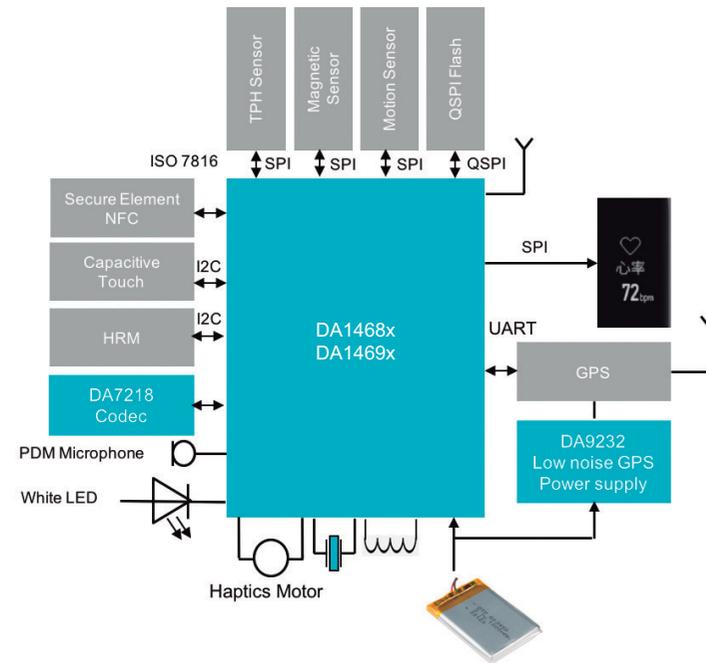

Advanced wearables

Besides the function offered by basic wearables, advanced wearable products offer more comprehensive features. Two typical advanced wearables are smart watches and sports watches.

Smart watches can be connected to a smartphone and notify the user about missed calls, messages, and usually email and social media.

High end sport watches are ideal for users who enjoy sporting activities such as running, cycling, swimming or hiking. These devices are equipped with sensors for tracking fitness such as a HRM, as well as GPS functionality.

Due to the complexity of advanced wearables, a separate microcontroller is normally selected to handle application tasks. Dialog addresses the advanced wearable market with a portfolio of ICs which can be combined to complete a customer's system such as:

- Bluetooth low energy SoCs
- PMICs for higher efficiency with lower quiescent currents
- AC/DC power conversion with practically zero current consumed at no load conditions
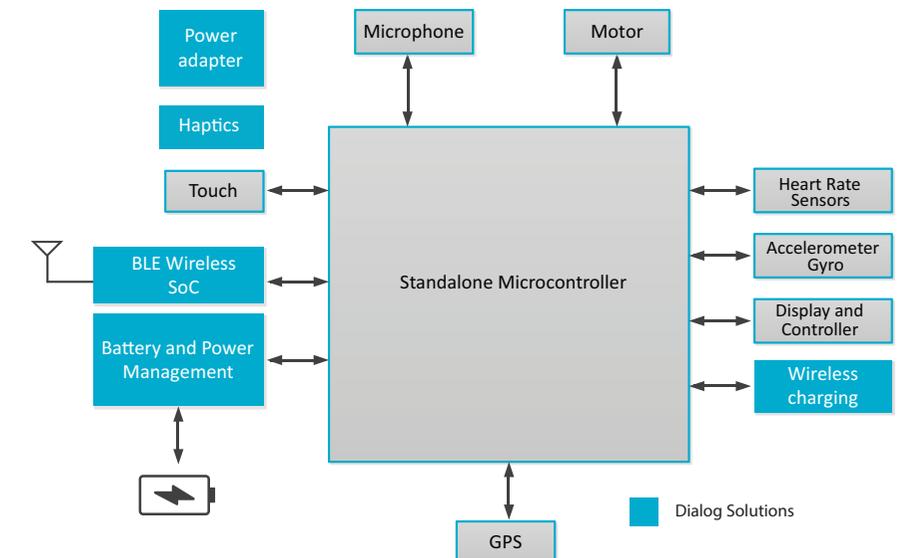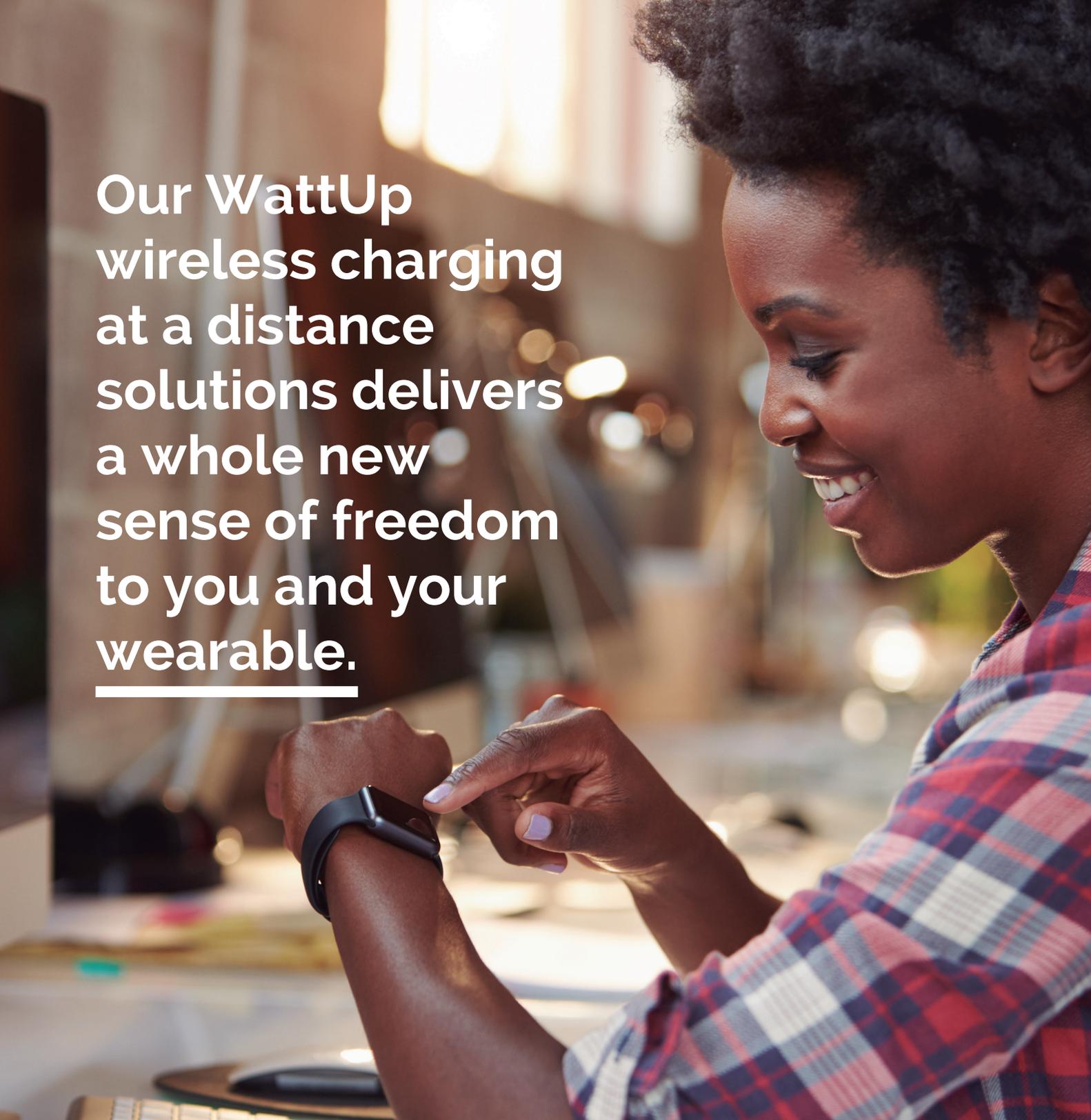
Our WattUp wireless charging at a distance solutions delivers a whole new sense of freedom to you and your wearable.

Bluetooth low energy wireless SoCs

Device	Why it benefits this application
DA1469x DA14682/3 DA14585/6 DA14531	Adds BLE connectivity to wearables with a minimum of external components and system requirements

DA1469x: The wearable-on-chip solution

Create next-generation Bluetooth low energy solutions without compromising functionality or battery life with the SmartBond™ DA1469x, that provides most integrated connectivity for wearable devices. DA1469x delivers the highest performance, lowest power consumption, smallest footprint and lowest system cost.

This highly integrated solution supports the Bluetooth 5 standard. An ARM Cortex M33F processor, with various embedded memory options, delivers flexible processing power when you need it and saves power when you don't, enabling the management of multi-sensor arrays and always-on sensing with its onboard sensor hub. Its integrated PMU can efficiently power up to three external devices in addition to an on-chip charger, allowing the DA1469x to recharge batteries over a USB interface, while a dedicated hardware crypto engine delivers banking-level security with end-to-end encryption to safeguard personal data. Displays can be directly driven by the display controller and audio support is available via the audio interface and powerful MCU for voice command or audio processing. Direction finding and distance measurement can even be supported with this product family.

Features

- Bluetooth 5 (core and optional specification)
- Cortex M33F application processor, 144DMIPs available on demand
- Configurable MAC with embedded Cortex M0+ ->M0+ to support protocol tasks
- Flexible memory architecture: 512kB Data SRAM, 16kB Cache SRAM, 128kB ROM, execution from external QSPI Flash up to 64MB
- Dedicated hardware crypto engine
- Integrated battery charger and system PMIC
- Power supply 2.4 – 4.75 V
- 1 or 2 Mbps radio with up to +6 dBm output
- Rich set of analog and digital peripherals including display controllers and haptic motor driver

Benefits

- Supports complex applications with ultra-low power consumption
- Unlimited memory space. Display controller supports color displays
- Integrated power management and charger can power a complete wearable system
- Advanced interfaces for voice commands and audio support
- World-class radio performance
- Provides banking-level security for application, data and communication
- Lowest industry BoM
- Smallest industry footprint - saves up to 38 mm^2 of PCB space

Applications

- Single chip solution for activity trackers
- Single chip solution for mid-low end smart watches
- Other rechargeable wearable devices

DA145xx: Smarter, more flexible, and even lower power

Connected wearable devices are constantly evolving. New generations continue to appear that are smarter, fuller featured and require longer battery lifetimes. To enable this, SmartBond has evolved too, offering customers all the benefits of Dialog's prior generations but with even greater flexibility to create more advanced applications at the smallest footprint and with the smallest power budget.

As part of the Dialog SmartBond family, the DA14531 is the smallest, lowest power Bluetooth solution available. The DA14585/6, combines very low power with more available integrated memory for more demanding applications. All DA145xx versatile SoCs are ideal for adding Bluetooth low energy connectivity to products like activity trackers, pedometers and system MCUs for a variety of applications including sports/smart watches. It supports all Bluetooth developments up to Bluetooth 5.1 and provides flexibility in terms of batteries to work with or available integrated memory, 48 kB RAM in the DA14531 and 96 kB of RAM in the DA14585/6. The wide supply voltage range (0.9 – 3.6V) will allow operation with 1 V battery technology like alkaline buttons, silver oxide or printed batteries next to 3 V cells like coin cells providing full design flexibility.

Features

- Complies with the Bluetooth 5 core specification
- Integrated One-Time-Programmable memory
- 48kB and 96kB user RAM
- Low operating voltage (0.9 V to 3.6 V)
- DC-DC current limit control for working batteries with high internal resistance
- Simple, single pin antenna interface
- PDM/I^{2}S audio interfaces for voice command support

Benefits

- Large memory to build complex applications
- Longest battery life
- Low system BoM cost

Applications

- Activity trackers
- Pedometers
- BLE connectivity and coprocessor for sports/smart watches
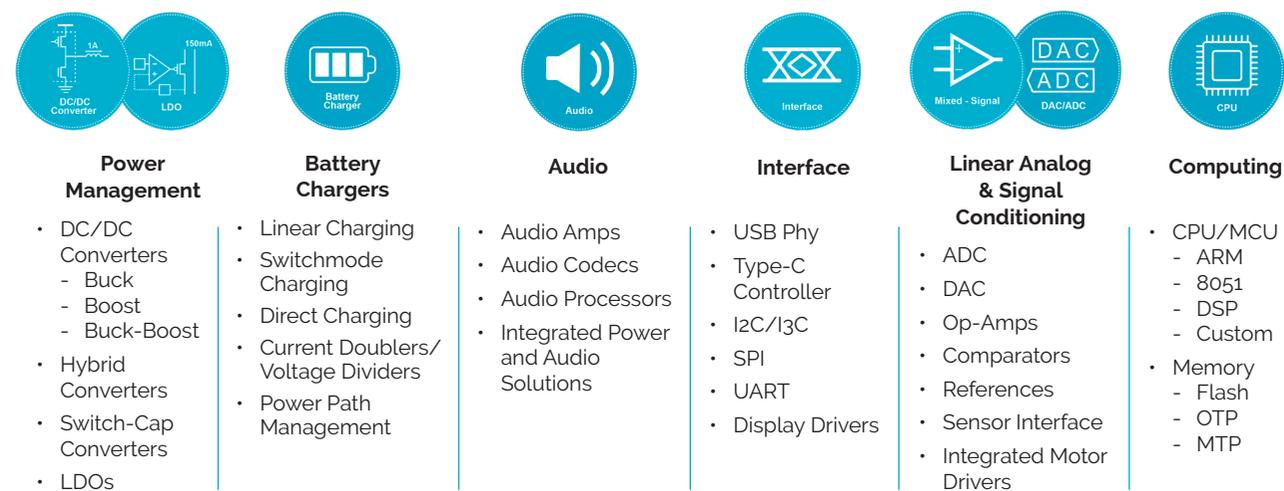- Voice command support
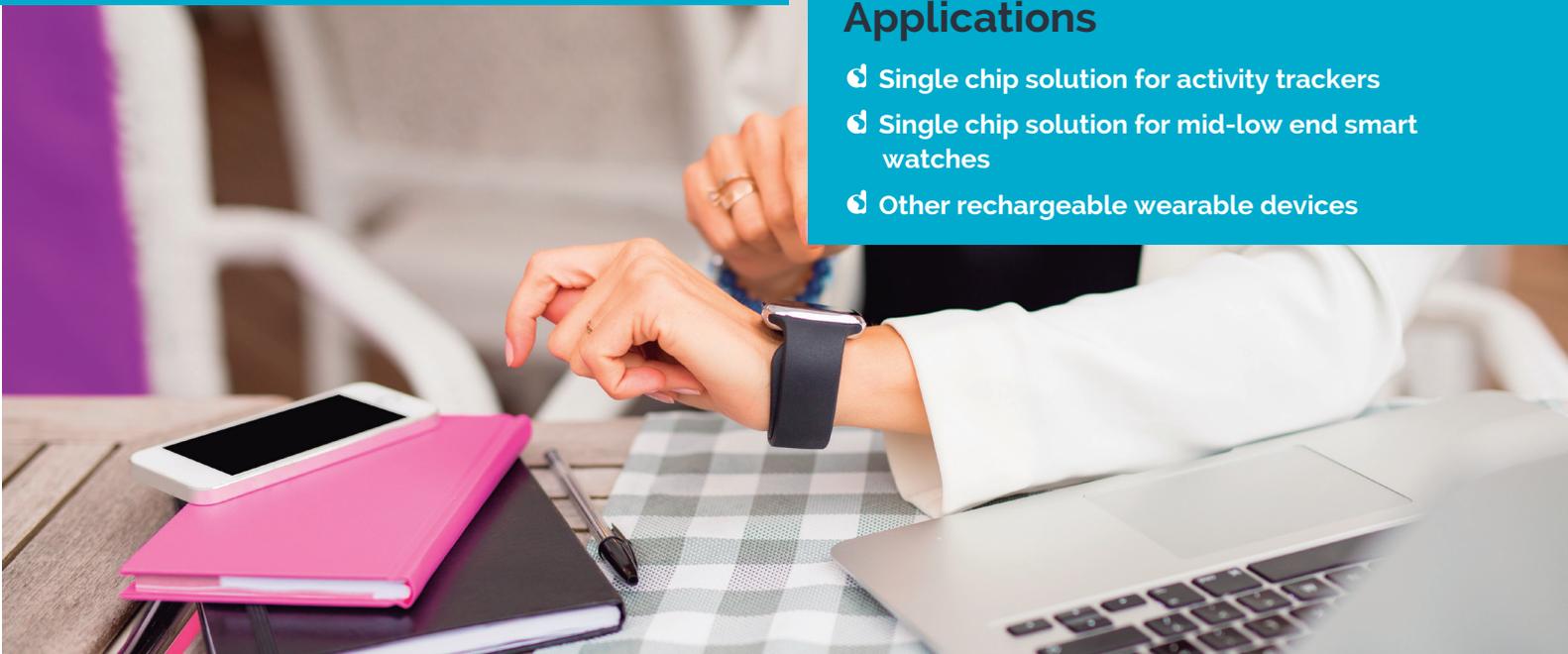
Custom Mixed-Signal Solutions

Dialog Semiconductor, a market leader in custom Power Management ICs (PMICs) and Mixed-Signal ASICs solutions for the wearable market, has a proven track record developing advanced solutions for industry leaders. The company's exemplary record has resulted in multi-generational partnerships which have firmly established Dialog as a trusted partner of choice.

Integrate to Differentiate

Dialog enables many of the most unique and advanced wearable products on the market today. Its broad, mixed-signal portfolio ranges from advanced power conversion topologies, battery chargers, audio solutions, digital and analog interfaces to linear analog and signal conditioning technologies. Dialog's digital capabilities include embedded computing as well as memory to empower next generation solutions. Advanced packaging technologies co-developed with the company's packaging experts and vendor partners continue to deliver leading edge solutions in the mixed-signal market.

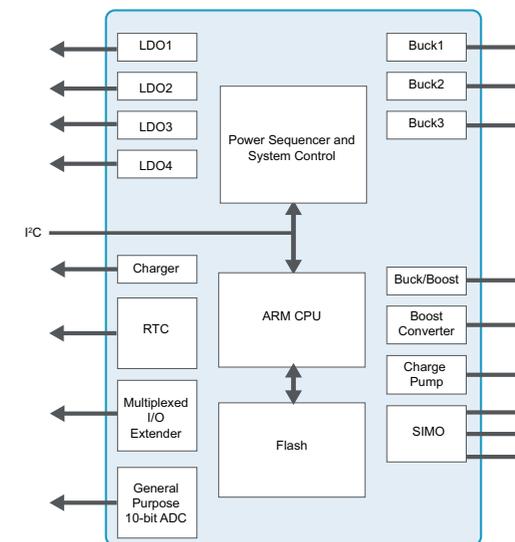| **Power Management**	**Battery Chargers**	**Audio**	**Interface**	**Linear Analog & Signal Conditioning**	**Computing**
• DC/DC Converters – Buck – Boost – Buck-Boost • Hybrid Converters • Switch-Cap Converters • LDOs	• Linear Charging • Switchmode Charging • Direct Charging • Current Doublers/ Voltage Dividers • Power Path Management	• Audio Amps • Audio Codecs • Audio Processors • Integrated Power and Audio Solutions	• USB Phy • Type-C Controller • I2C/I3C • SPI • UART • Display Drivers	• ADC • DAC • Op-Amps • Comparators • References • Sensor Interface • Integrated Motor Drivers	• CPU/MCU – ARM – 8051 – DSP – Custom • Memory – Flash – OTP – MTP

Time-to-Market

Dialog is now the leading pure play provider of advanced Power Management ICs. This level of success was achieved through absolute attention to detail. Dialog ensures that all IP is proven to perform as designed. Its accumulated library of leading-edge technologies enables Dialog to execute flawlessly and deliver "First Time Right" solutions.

Operational Excellence

Dialog's long-standing relationships with world-class manufacturing partners for wafer fabrication back-end assembly and test provide access to advanced mixed signal process nodes. Expertise in mixed-signal ASIC design and development from concept to production guarantees the highest levels of quality.

Dialog's unparalleled high-volume production ramp capability (from zero to 80 M units within a quarter) empowers its customers to rapidly deliver new products to market. The internal supply chain team at Dialog has delivered 99%+ on-time-delivery (OTD) while working closely to react to today's dynamic and volatile market conditions.

A representative example of a high-performance Custom ASIC in production

Haptics

Haptics technology recreates the sense of touch to the user by applying forces and vibrations in the form of touch feedback in displays, touch surfaces and buttons.

The DA728x - High definition, low power and flexible:

The DA728x family of High-Definition (HD) Haptic Drivers, combine custom drive sequences, on- and off resonance, at up to 1kHz. The device can drive both ERM and LRA (narrow and wideband) actuators and track resonance up to 300Hz to drive the most complex click/vibration touch effects in a wide range of applications.

Saving power when idle:

As haptic drivers spend the majority of their time in standby/idle mode, the DA728x family was designed to utilize very low idle current consumption (360nA) to maximize battery life.

The DA7282 has an additional standby mode where current consumption drops to 5nA, making it an ideal driver for systems where the highest priority is current consumption when not in use.
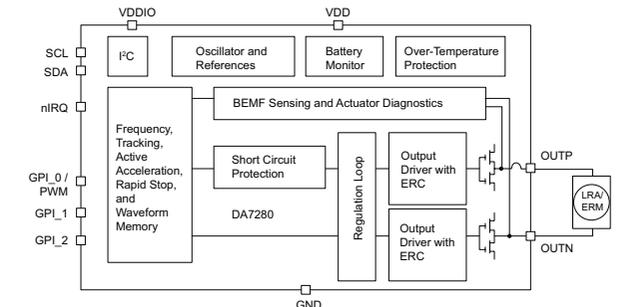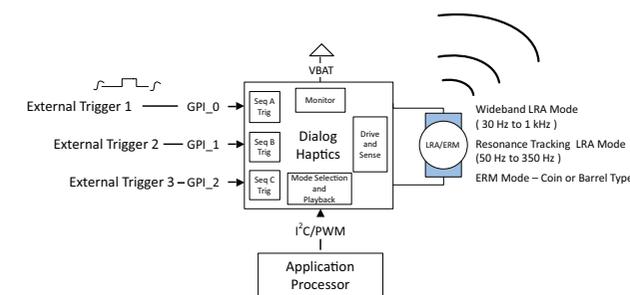
The DA728x family combines very low idle current consumption with low-latency trigger inputs to minimize system power consumption. Integrated trigger inputs allow haptic operation without waking the application processor, and latency times at sub-1ms give real switch behavior - 10x better than any other solution available today.

Simplifying usage in touchscreen and capacitive touch systems:

Product	Market Focus	Control Method	# of input trigger pins	Lowest power mode	I²C Addresses
DA7280	General Market	I²C, PWM, GPI	3	360nA Idle	1
DA7281	Multi-LRA Systems	I²C, PWM, GPI	1	360nA Idle	4
DA7282	Wearables	I²C, PWM, GPI	3	5nA Standby	1

DA728x Family Overview

- **Wideband LRA driver: 25Hz to 1kHz with resonant mode Frequency tracking support up to 300Hz**

  Drives LRAs off-resonance for custom effects, or dual resonant systems for two-dimensional vibration

- **Up to 500mA output current**

  Drive large or small LRAs and ERMs for the best haptic experience

- **360nA idle power mode with full I²C control and memory retention**

  Ultra-low power consumption means longer battery life

  Only 0.75ms latency when responding from ultra-low idle power state

- **On-the-fly diagnostics**

  Detect issues with the LRA/ERM Automatically and generate interrupts

- **Three methods of drive for ease of use**

  I²C, PWM and General Purpose Inputs (GPIs)

- **5nA standby mode enabled in the DA7282**

Optimizing Wearable Designs through Configurable Mixed-signal ICs

Included are: asynchronous state machines, timing delays counters, pulse width modulators, comparators, voltage monitors, voltage references, A/D converters, glue logic, and level shifters.

Designers can drag and drop these resources and 'wire up' their design in a schematic capture tool or emulate the design with the Hardware Development Kit. When satisfied, they can program the GreenPAK's OTP or MTP Non-Volatile Memory.

GreenPAKs offer designers and manufacturers of wearable devices multiple advantages, including: optimized board space; a lower cost BoM; reduced power consumption; convenient innovation and prototyping; hard to copy designs; and a less complex and less stressful supply chain.

See a full list of GreenPAK parts at:

www.dialog-semiconductor.com/configurable-mixed-signal

STEP 1	STEP 2	STEP 3	STEP 4	
Place unprogrammed GreenPAK into socket	Design your IC with GreenPAK GUI	Click program to freeze GreenPAK's OTV NVM Program		Your custom IC is ready for use

Dialog's Integrated Power Switches

Using proprietary technology to extend battery life and protect your wearable devices

Extending battery life is critical for wearable devices having small batteries and sophisticated designs with multiple sources of leakage.

To enable designers to reduce current leakage, Dialog offers GreenFET3, an elite family of integrated power switches using proprietary MOSFET IP and advanced assembly techniques.

The devices are able to achieve world class performance, ultra-low RDSON and highest current carrying capability per square mm. GreenFET3 products are available in ultra-small PCB footprints from 0.64 mm² to 4 mm² and exhibit low thermal resistances for high-current operation.

Built on a standard CMOS process, they are also able to integrate a comprehensive suite of control and protection circuits to enable a robust wearable design.
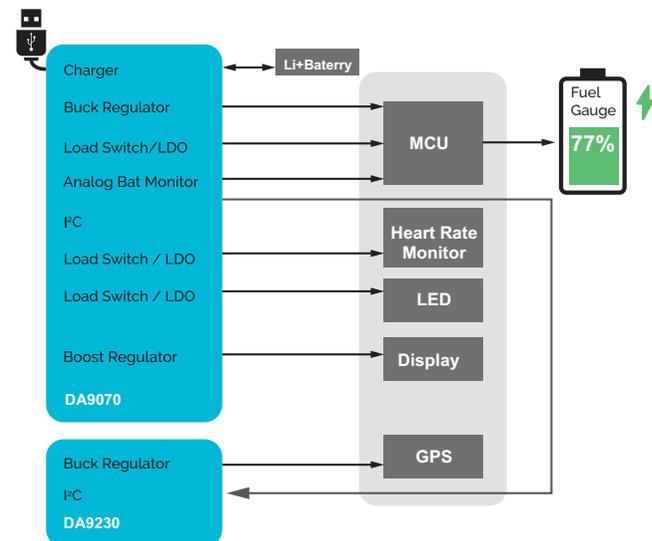
See full list of Dialog's Integrated Power Switches at:

www.dialog-semiconductor.com/power-switching

Power management ICs

Driven by the needs of the rapidly growing wearable markets devices for small and efficient power solutions, Dialog offers the DA9070, DA9073, DA9230 and DA9231 Nanopower PMICs, which extend the battery life of these systems while fitting into a compact form factor.

DA9070 / 73 is a highly integrated PMIC that includes the most common needs in these applications including a linear charger with Power Path management, 300 mA high efficiency buck regulator and three 150 mA LDO/Load Switches, wide output voltage boost regulator, as well as watchdog and protection features. The DA9070 also integrates battery voltage and current monitors which enables the ability to create an efficient battery fuel gauge solution. The devices are offered in a compact 42-pin 2.97 mm x 2.66 mm WLCSP package.
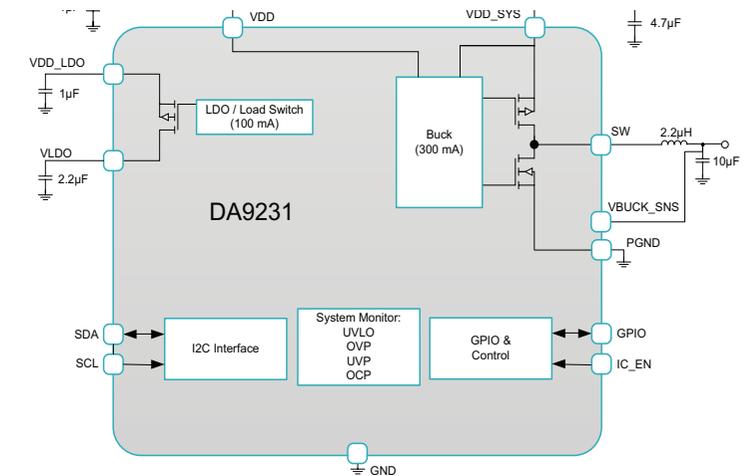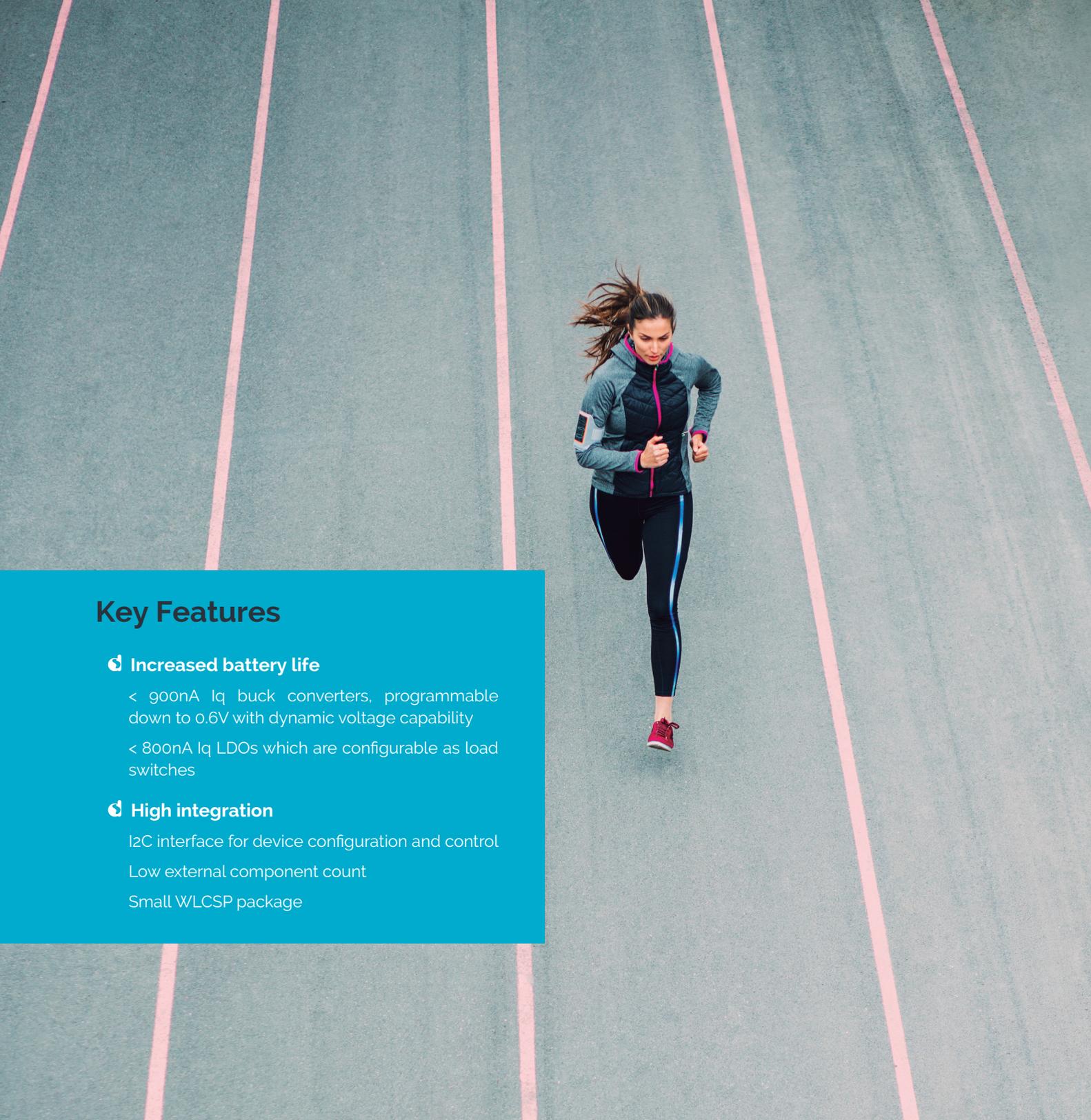

DA9231 is a configurable PMIC with a 300 mA high efficiency buck converter and 100 mA LDO/ load switch with ultra-low Iq, while the DA9230 is a standalone buck converter. The devices are offered in a compact 12-pin 1.65 mm x 1.25 mm WLCSP package.

DA9232 is a configurable PMIC with a 60mA high efficiency buck converter with < 10mV output ripple. The DA9233 uses the same buck converter and adds a 110mA LDO / load switch. The devices are offered in a compact 12-pin 1.65 x 1.25 mm WLCSP package.

Device	Why it benefits this application
DA9070	Complete Nano-amp Iq power management solution supports ultra low-power fuel gauge
DA9073	Complete Nano-amp Iq power management solution extends battery life and reduces PCB area
DA9230	Nano-amp Iq DC/DC buck converter: Increases efficiency over SoC integrated DC/DC solution for longer battery life
DA9231	Nano-amp Iq DC/DC Buck Converter with additional LDO with uncommitted pins
DA9232	Nano-amp Iq DC/DC buck converter with ultra low output ripple for GPS & RF applications
DA9233	Ultra low ripple Nano-amp Iq DC/DC buck converter with additional LDO

The battery life of wearable applications is significantly improved due to the low quiescent current delivered by the buck regulator in Dialog's Nanopower PMICs during operation and standby modes. The buck regulator extends high light-load efficiency down to 10 uA load current and features Dynamic Voltage Control (DVC) that optimizes system power modes providing further improvement in system efficiency and battery life. The LDO's uncommitted inputs can be connected to either the battery or the buck output. Efficiency improvement versus DC/DC converters typically found in highly integrated SoCs, can be as high as 15%, significantly conserving battery life. The regulators (Buck and LDO) can be individually enabled and configured using I2C control for dynamic power savings.

Wireless charging ICs

The wearable device can be charged wirelessly by using WattUp technology developed by Energous, which is an innovative RF-based charging solution that delivers intelligent and scalable power via RF bands.

Device	Why it benefits this application
DA4100	Fully integrated WattUp power transmitter IC which operates directly from 3.3 V, and only requires an external crystal, power amplifier and transmit antenna to complete a Near Field WattUp power transmitter design
DA2210 / DA2223	Wireless power RF-to-DC receivers which can be connected to up to 4 antennas
DA3210	Single channel high efficiency CMOS RF power amplifier

WattUp Near Field transmitter design

Representing the smallest and lowest cost WattUp transmitter option, the Near Field WattUp transmitter design is intended to be an in-box solution for wearables, ultimately replacing the USB cable and power adapter typically included in the box. This solution provides the convenience and waterproofing benefits of wireless charging without significantly affecting the overall BoM cost. The Near Field WattUp transmitter technology can also be embedded into laptops, furniture, and other devices.
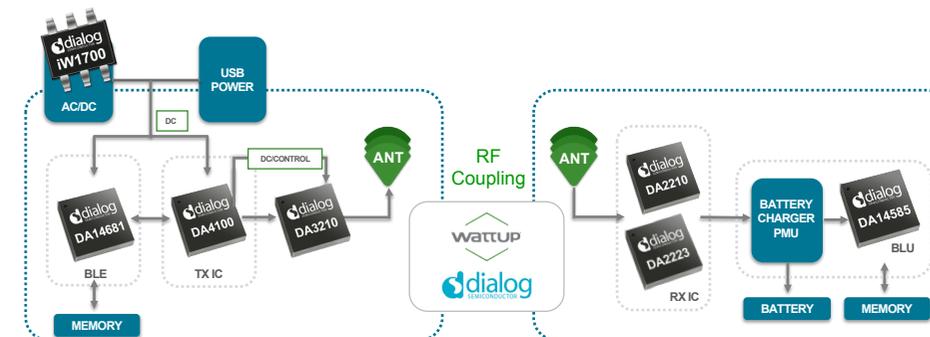
WattUp Mid Field transmitter design

The Mid Field transmitter reference design represents a desktop or close-distance charging solution for up to 2 to 3 feet (~60-90 cm). For example, wearables can be charged without having to be plugged in, while sitting at your desk, or in your car. The Mid Field WattUp transmitter technology can be designed into the bezel of a monitor, as part of a small sound bar, desktop speaker, standalone design or cabin of your car.

Key Features

♦ **Increased battery life**

< 900nA Iq buck converters, programmable down to 0.6V with dynamic voltage capability

< 800nA Iq LDOs which are configurable as load switches

♦ **High integration**

I2C interface for device configuration and control

Low external component count

Small WLCSP package

energous®

World's First RF Power Receiver IC

The WattUp® Receiver Technology can be embedded into a virtually limitless number of different devices

DA2210 / DA2223 WattUp wireless power RF-to-DC receivers

DA2210 and DA2223 are wireless power RF-to-DC receivers which can be connected to up to 4 antennas. Antennas can be small enough to fit into in-the-ear hearing aids.

Power conversion solutions

dialog iW1700

Zero Standby Power Controller

Dialog's AC/DC converter product portfolio includes both stand-alone digital controllers and digital controllers with integrated power devices to be used in AC/DC power adapters for wearable applications. Dialog's AC/DC products incorporate PrimAccurate technology which enables accurate control of the secondary-side voltage from the primary side of an isolated power supply without the need for an opto-isolater - improving reliability, reducing size and lowering total BoM cost.

Device	Why it benefits this application
iW1700	Zero standby power PWM controller reduces no-load standby power consumption to < 5 mW at no load. No "vampire power" consumption when the wearable isn't charging

iW1700 Key Features

Reduces no-load standby power consumption to < 5mW at no load [1]

This ultra-low level of standby power typically involves a relay switch controlled by MCU

iW1700 uses proprietary digital algorithms to switch between PWM and PFM modes

Eliminates audible noise

Reduces switching losses to a minimum

Meets stringent global energy efficiency standards including U.S. DOE; EU CoC Version 5, Tier 2

120V/230VAC offline power adapters to 5 W

(1) The IEC 62301 standard rounds standby power usage of 5 mW or less to zero.

Audio Solutions

LEADING AUDIO SOLUTIONS

Dialog audio solutions are optimized for today's latest consumer trends; low-power small size headsets, earbuds, speakers and hearables, whether they are powered via USB-Type C or by small batteries. Dialog products are designed from the ground up to solve power and efficiency challenges in a world that demands high audio fidelity performance and long battery life from all devices. Dialog's solution covers the entire system, from the audio signal path with embedded audio algorithms, through to power delivery, charging, the radio and digital control.

Development Support

Throughout the customer product development period, Dialog provides quick and expert application support. Dialog's local field application engineers are always on hand to provide dedicated advice and guidance during the critical design phase.

Contents

Mixed Signal

PMICs
Power management ICs featuring ultra-low quiescent current buck converters

CODECs & Class D Amps
High performance, low noise CODECs and Class D amplifier standard products

Wireless charging ICs

WattUp®
RF wireless charging solution including out of band control using Bluetooth low energy

Haptics

Low-power, wide-bandwidth haptic driver for ERM (eccentric rotating mass motor) and LRA (linear resonant actuator) applications

Connectivity

Bluetooth® low energy or 1.9GHz DECT
Family of SoCs addressing both wireless standards

USB-Type C connectivity offered in latest SmartBeat™ product family

Custom Mixed-Signal Solutions

Market leading Custom PMICs and Mixed-Signal ASICs deliver customized solutions to optimize efficiency, size, performance and system cost

Power Conversion

AC/DC powering your application using digital control, eliminating optocouplers

Application overview

Application	Solution
Headsets, Headphones	USB-Type C, Bluetooth or DECT based System on Chips (SoCs), featuring Ambient Noise Cancellation (ANC), DSP technology, optimized power management and lowest power HiFi CODECs. Dialog's connectivity radio solutions whether at 1.9 or 2.4 GHZ deliver highest audio quality with interference-free communication
Smart speakers	Smart speaker systems can be configured with Dialog's audio processor SoCs including advanced features like far field beam forming or activation with key-word trigger. Additionally, the company's powerful, highly efficient, low EMI, switched mode mono Class D audio amplifiers can power a variety of two-cell portable applications
Hearables	Utilizing wireless charging and Bluetooth low energy for out of band control, WattUp RF-based charging can be integrated to provide wire-free charging for hearing aid, audio buds or similar applications

Headsets, Headphones & Hearables

The majority of new USB and DECT headsets, headphones and earbuds now include features such as Active Noise Cancellation (ANC), Acoustic Echo Cancellation (AEC), Noise Reduction (NR), Hotword wake-up as well as traditional audio features, such as Equalizers (EQ), Dynamic Range Controls (DRCs) etc.

Dialog Semiconductor addresses these markets using a common platform, using its SmartBeat SoCs as the heart of the system, and augmenting it with a portfolio of ICs which can be combined to complete a customer's system such as:

- Radios for interference-free Bluetooth low energy or 1.9 GHz DECT transmission
- High performance, low power, low noise CODECs
- External PMICs for highest efficiency DC/DC conversion
- RF Based Wireless charging
- AC/DC power conversion with lowest BOM

SmartBeat DA14x95 family SoC
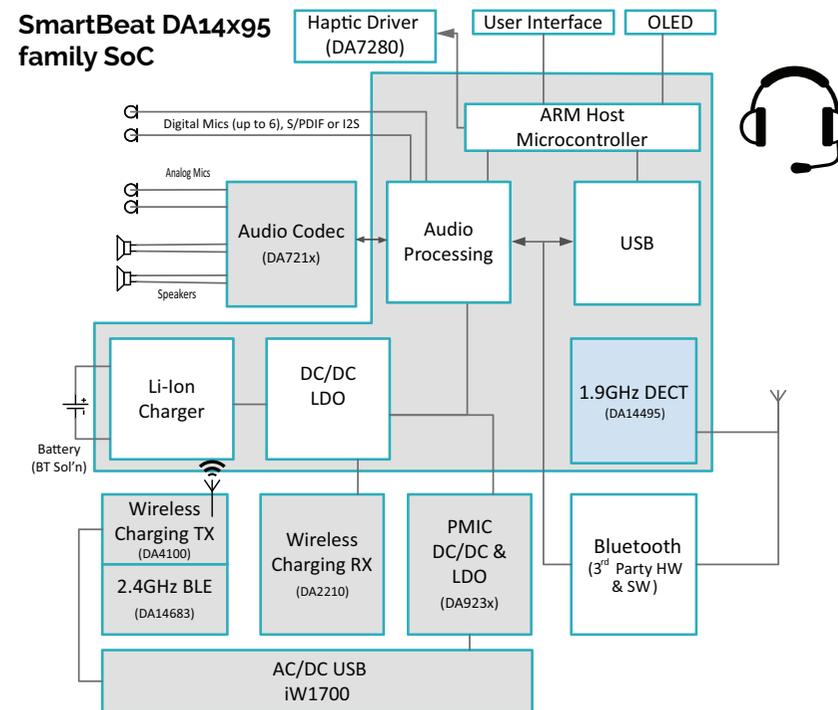
Hearing aid

Charging hearing aids requiring the insertion of a charging cable, or the replacement of a battery is often a challenge for hearing aid users today. Dialog addresses this with its wire free wireless charging solution. Hearing aid devices can be charged wirelessly by using WattUp technology developed by Energous, which is an innovative RF-based charging solution that delivers intelligent and scalable power via RF bands. WattUp differs from earlier inductive or resonant wireless charging systems in that it can deliver power at a distance, to multiple devices – thus resulting in a wire-free experience that saves users from having to plug in their hearing aid or other device to a power source, or having to carefully align it over a charging mat. Completing the system Dialog's SmartBond™ Bluetooth low energy devices are utilized to communicate the charge and set up control protocol between transmitter and receiver sub-system.
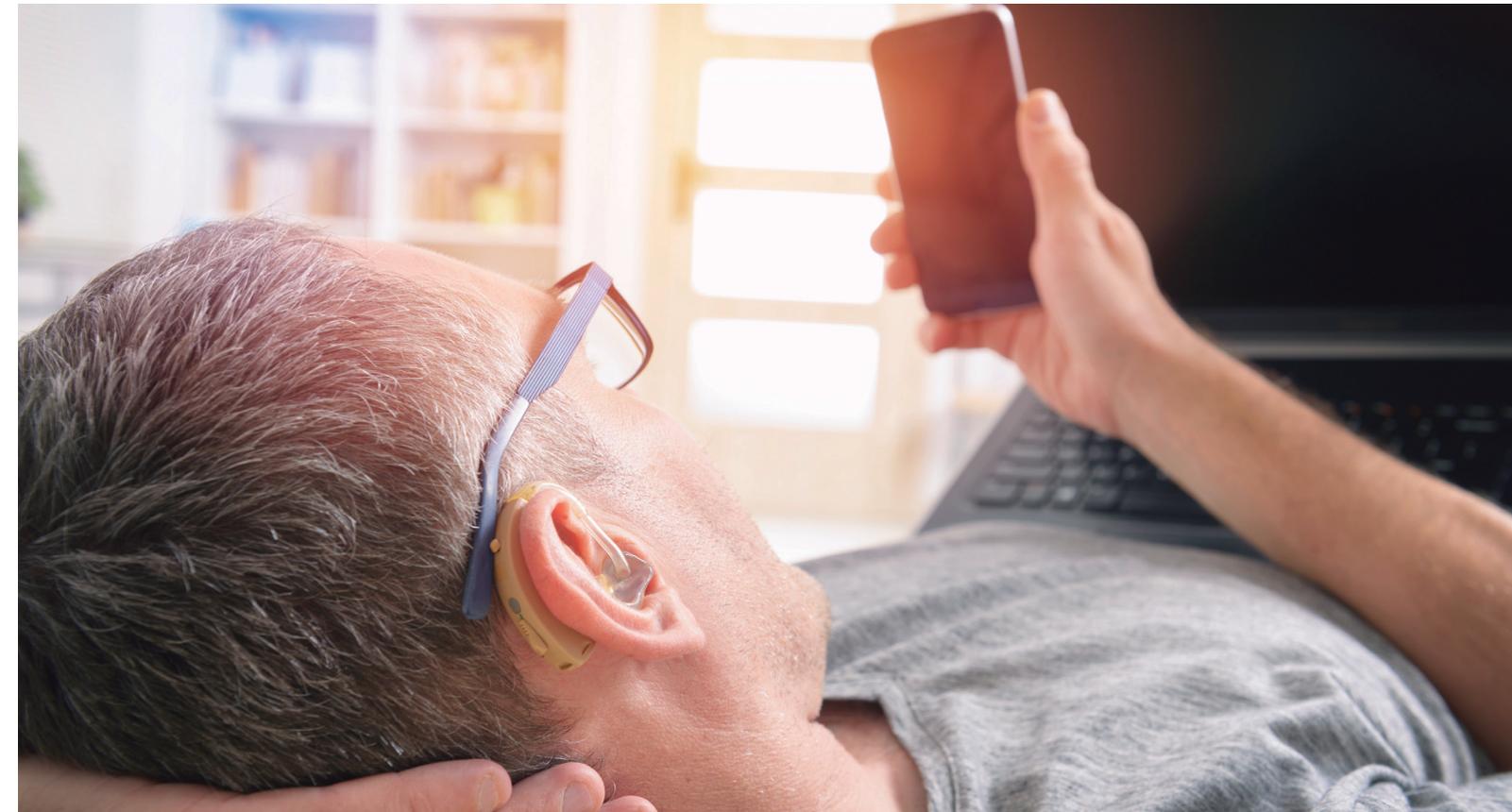
Bluetooth® low energy and 1.9 GHz DECT ICs

Device	Why it benefits this application
DA14531	Smallest form factor, lowest power BLE for audio control
DA14585	Ideal BLE solution for a host of audio applications, including an integrated microphone interface enabling voice activation
DA14495	Integrated 1.9 MHz DECT radio gives an interference free and low latency radio connection to the audio processor
3rd Party BLT	3rd party Bluetooth classic devices can be connected by HCI or proprietary interface to the audio processor
SC14WAMDECT	This Audio module is a FTTM solution, having all RF related certifications

DA14531: The world's smallest and lowest power Bluetooth 5.1 System-on-Chip, ideal for ultra-low power audio control

Next-generation audio applications incorporating Bluetooth low energy connectivity without compromise on functionality or battery lifetime. The SmartBond DA14531 delivers optimum performance according to the latest Bluetooth 5.1 core standard, with lowest power consumption, smallest footprint (1.7 x 2.0 mm) and lowest system cost. This versatile SoC is ideal for adding Bluetooth low energy connectivity to audio applications for easy user interfacing and control. For low power voice command remote control, a DA14585 based full solution reference design is available. It offers a very robust audio link for voice command with automatic adjustment of bit rate, depending on the amount of interference present.

SmartBond solutions, are easy to design-in and support standalone as well as hosted applications. They are supported by a complete development environment and Dialog's SmartSnippets™ software that helps significantly optimize software for lowest power consumption.

Interference free and ultra-reliable, low-latency communication

Dialog's SmartBeat DA14495, developed for the 1.9 GHz DECT standard, enables significant improvements in new application fields from microphones to enterprise handsets and headsets. The DA14495's low power consumption and processing capacity for sensor fusion makes it perfect for consumer applications looking for the professional audio experience. The DA14495 architecture ensures a highly versatile and easily extendable software platform. It provides the building blocks for customers to be able to create highly differentiated solutions.
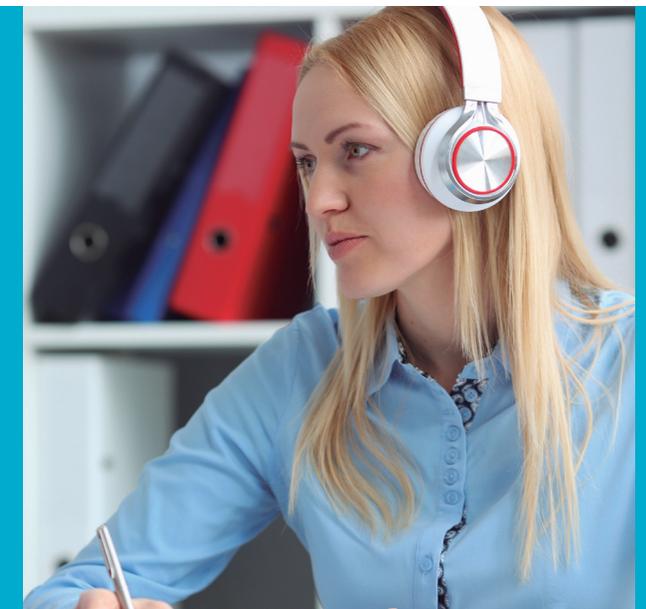
Audio processor SmartBeat™ SoCs

Dialog offers a simple route to active headsets with built-in audio processing using the SmartBeat range of audio SoCs.

Device	Why it benefits this application
DA14195	Ideal for USB type C headsets, the ARM microcontroller, 32-bit audio DSP, USB, DC/DC, chargers and more are integrated
DA14196	Optimized for Bluetooth, with specific power domains

Dialog's SmartBeat SoCs offer a simple route to active headphones with built-in audio processing. Based on industry-standard IP, this powerful SoC family enables headphones that control ambient noise and enhance content for truly immersive listening - anywhere. Dialog audio processors enable development of attractive looking headphones that deliver top-end features such as ambient noise / echo cancellation, virtual surround sound and voice control. They support up to 6 microphones for beam forming and position-aware applications. In addition, they can handle high-end audio signals such as 192 kHz, 32-bit Pulse Code Modulation (PCM) for the ultimate sound quality.

Key Benefits

- Enables ambient noise cancellation
- Supports high voice quality Noise reduction
- Supports high-end audio up to 192 kHz, 32-bit PCM
- Supports voice control for hands-free calling

Efficient processing power

SmartBeat audio processors integrate an efficient 32-bit ARM® Cortex™-M0 microcontroller (MCU) and C-programmable 32-bit Cadence® (Tensilica®) HiFi 3 DSP. This combination ensures a small, low-power solution with all the performance necessary – and more - for high-end headphones offering outstanding sound quality and ambient noise cancellation. Moreover, the MCU operating frequency can be scaled to further reduce power consumption, while the DSP is supported by a wide range of 3rd-party audio algorithms.

Flexible memory architecture

The audio processor's shared memory architecture comprises onboard cache, system RAM and DSP RAM. For maximum design flexibility, the MCU code (executed in place) and DSP code is stored in external QSPI Flash memory so that memory costs can be tailored to suit application requirements.

Versatile power management

With its integrated step-down converter, the audio processor can be powered directly from USB or by batteries ranging from 1.9 to 5 V. A high-precision fuel gauge maximizes battery lifetime so users always know how much music playtime remains. Meanwhile the dead battery wake-up feature ensures the display works no matter how long the product has been on the shelf – so buyers don't confuse a flat battery for a faulty product.

Consumer-friendly connections

SmartBeat audio processors integrate a USB 2.0 FS/HS port which supports USB charging specifications 1.2. It offers data rates up to 480 Mbps for excellent voice and music quality, and is fully compatible with USB-Type C – an emerging smartphone connectivity option. Moreover, the audio processor supports two different HCI clocking schemes - easily combining with any Bluetooth HCI to create differentiated wireless applications - or simply use the version with the integrated 1.9 GHz interference-free radio.

Modular and open software architecture

Audio processor architectural layering and towering ensures a highly versatile and easily extendible software platform. It provides all the building blocks needed plus the flexibility to create custom solutions. Power management is a core component, while the flexible audio API allows you to set up multiple streams independently. Software is available as source code, so it can be fully customized. To maximize flexibility and customization, Dialog offers a powerful yet compact embedded development kit. Furthermore a host of CODECs, sound enhancements and other audio packages are available from Dialog and third parties.

Wireless Audio Module

Public address (PA) and tour guide (TG) systems share one major requirement. They both need to communicate effectively with large groups of people in acoustically challenging environments.

The audiences in these applications require crystal-clear sound and consistent quality of transmission, so that they have no difficulty in comprehending the whole message. Operators and users of PA and TG systems want a solution that's easy to install and use - whereas system developers need to maximize profit and market penetration with short product creation cycles and the flexibility to cope with all operational environments and configurations.

Dialog helps meet and exceed all these challenges with the world's first DECT-based digital wireless networking solution specifically designed for PA and TG systems. It brings high sound quality, interference-free, long-range communication together with easy system installation and expansion of DECT to the PA and TG domain.

Delivered as a complete and pre-tested wireless audio module, Dialog's solution makes system creation as simple as possible. There is no need for radio frequency (RF) expertise, resources for design and production – or expensive RF testing equipment. Additionally, to streamline the development cycle further, a complete microphone reference design is available.

Key Benefits

- Excellent voice quality built-in
- Reliable, interference-free and encrypted transmission
- Automatic channel selection
- Long range transmission: 50 m indoors and 300 m outdoors
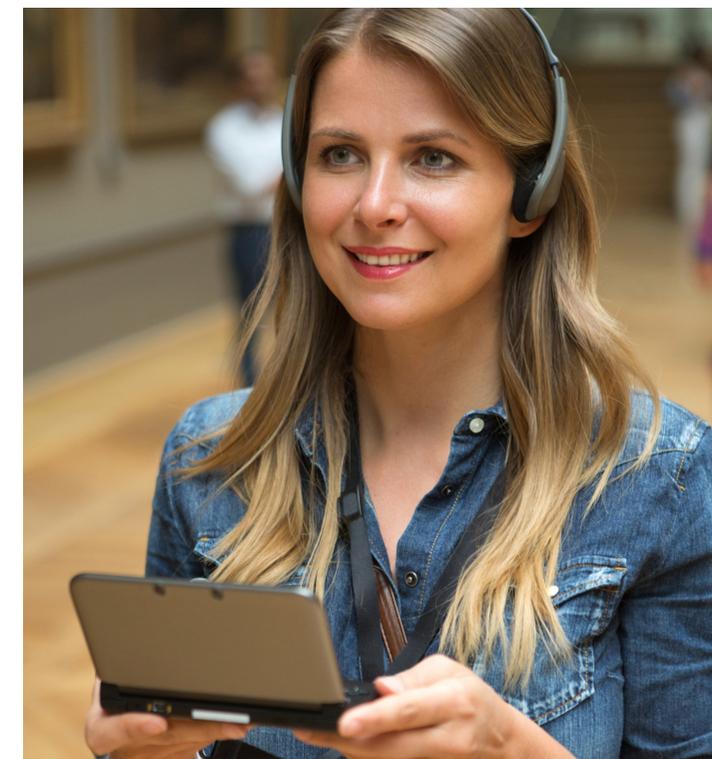
Audio Voice Data Module
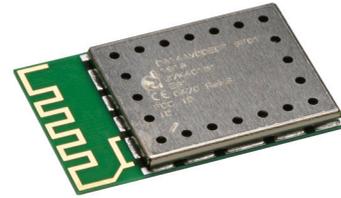
Fast Development platform for next-generation wireless applications

For the development of audio-, voice- or data-based wireless applications, the DA14AVDDECT offers the fastest and easiest route to market. It combines everything needed for world-class wireless performance in a single compact module. Fully RF tested and certified, this "plug and play" module requires no in-depth RF knowledge or resources to use.

The Dialog DA14AVDDECT Audio Voice Data module is a complete solution for next-generation wireless applications. It contains all hardware necessary, including a state-of-the-art DECT radio, a multi-core, power amplifier, stereo CODEC, battery management and onboard antenna. The module can be tailored to any target application simply by downloading and installing one of Dialog's optimized software stacks, which also supports over-the-air upgrades.

Module with Voice Data Stack

Key Features

- **Next-generation DECT radio performance**
  - Multi-level modulation
  - Zero blind slot support - maximizes radio throughout utilization
- **Extensive processing power**
- **Hi-Fi audio support**
- **Integrated antenna and support for optional external antenna**
- **Battery management with charger and fuel gauge**
- **Choice of voice and data or audio and data software stacks**

Typical Applications

- **Conferencing systems**
- **Intercom systems**
  - Door entry
  - Elevator communication
 - Fire rescue communication
- **Elderly care pendants with voice**

Module with Audio Data Stack

Key Features

- **Supports up to 4 microphones (PP) on one receiver (FP)**
- **16kHz audio bandwidth high end voice / audio quality**
- **Transmitter (PP) consumes typically 46mA (LPM) when talking**
- **20kHz audio bandwidth for high end voice / audio quality**
- **One full duplex return channel with the guide to facilitate interaction**
- **Supports up to 1024 listeners in one group**
- **Receiver (PP) consumes typically 35mA (LPM) when listening**

Typical Applications

- **Public Address**
  - Outdoor Events
  - School Classrooms
  - Church Usage
- **Tour Guide**
  - Training and Collaboration
  - Language Interpretation
  - Event Production / Intercom
 - Assistive Listening
  - Group Tours
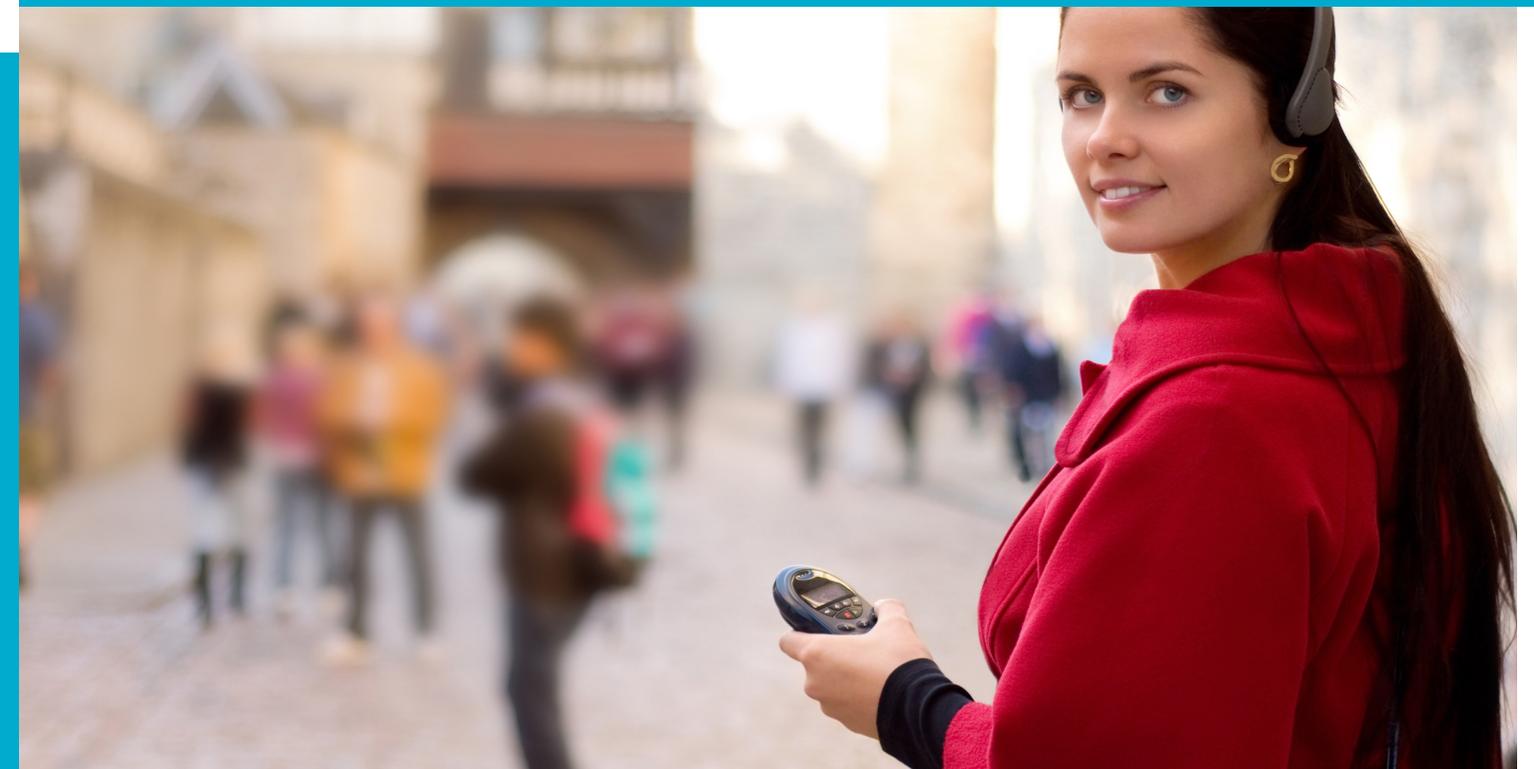
CODEC and Class D ICs

Dialog offers high-performance, low-power audio CODECs that are optimized for use in headsets and other consumer audio devices.

The DA7217 contains two analog microphone input paths, or up to four digital microphone input paths, or a combination of both. Another chip in this family, the DA7218, has single-ended headphone outputs, and has been designed with headphone detect for use in accessories. Both ICs have a special low latency path to support the Ambient Noise Canceling (ANC) functionality on Dialog audio processors.

The DA7219 includes Advanced Accessory Detection (AAD) which supports the detection and identification of 3-pole (headphone) and 4-pole (headset) jacks, and allows the automatic pin order switching of MIC/ GND on CTIA or OMTP headsets. DA7219 is on the approved vendor list for multiple Chromebook systems in addition to being used in multiple systems with 3.5 mm audio I/O jacks, and is the industry's lowest power consumption, portable audio CODEC.

DA7202 is a new high performance, low power mono Class D amplifier delivering up to 10 W of audio power to compete with traditional class AB amplifiers.

DA7219

DA7217
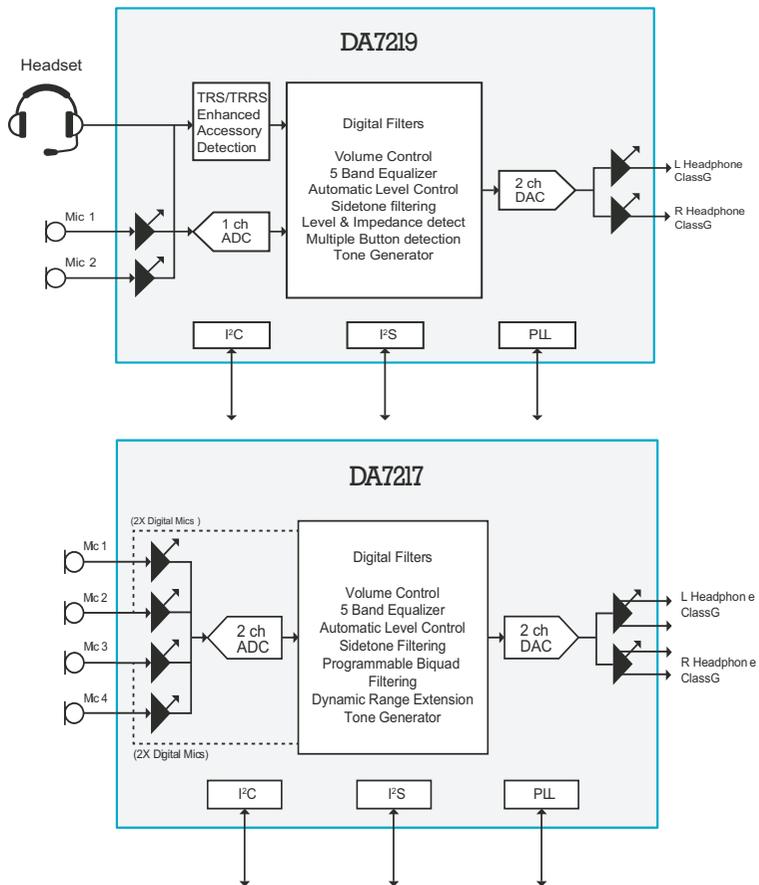
Full-range, high fidelity audio codecs

Jack Type		
Position	CTIA	OMTP
SLEEVE	MIC	GND
RING2	GND	MIC
RING1	HP_R	HP_R
TIP	HP_L	HP_L
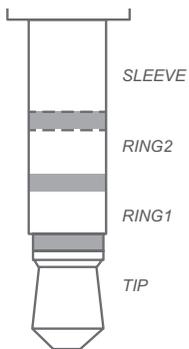
The DA740x is a family of highly-integrated audio codec devices that deliver best-in-class active noise cancellation (ANC), providing optimal audio performance in any environment to the rapidly-growing wireless headphones market.

The family consists of three devices:

· DA7400: Stereo high performance (HP) codec

· DA7401: Mono HP codec with ANC

· DA7402: Stereo high performance codec with ANC

The DA740x supports feedforward and feedback ANC topologies, in which the noise cancelling microphones are located either outside or inside the headphone cup. With its integrated custom filtering, the DA740x also enables a fully hybrid implementation which is optimized for high performance ANC while delivering maximized audio quality and battery life. The family is compatible with any type of audio interface and is effective in both wired and wireless applications.

Digital implementation and complementary software-based tuning tools for the DA740x enable Dialog customers to realize their ANC designs with far fewer external components and faster time-to-market compared to typical analog-based designs, which require significant analog circuitry and component-level tuning.

The DA7402 supports hybrid, feed-forward, and feed-back topologies, up to 35 dB suppression, and offers dedicated calibration and tuning tools, all to support digital ANC. With high performance playback and record paths, DA7402 is designed for high dynamic range and minimum latency. The DA7402 offers one of the smallest digital ANCs on the market, with half the power consumption and twice the audio performance compared to today's leading chip solutions - making it ideal for sport earbuds, hearables, true wireless stereo (TWS) earbuds, unified communication headsets and more.

As a derivative of the DA7402, the DA7401 is a high-performance mono ANC Codec designed for TWS and hearable applications. It offers a 115 dB playback dynamic range, hybrid ANC and flexible clocking architecture. The DA7400 provides similar capabilities and has been designed for consumer applications that require high resolution, high performance audio without ANC.
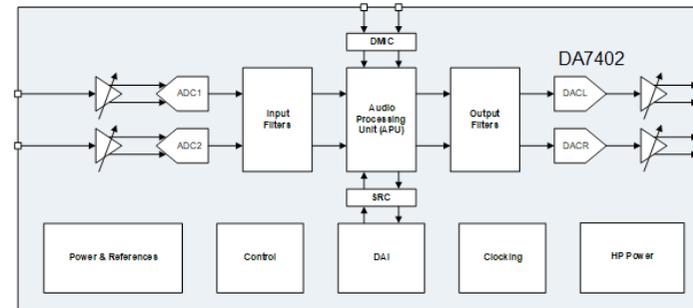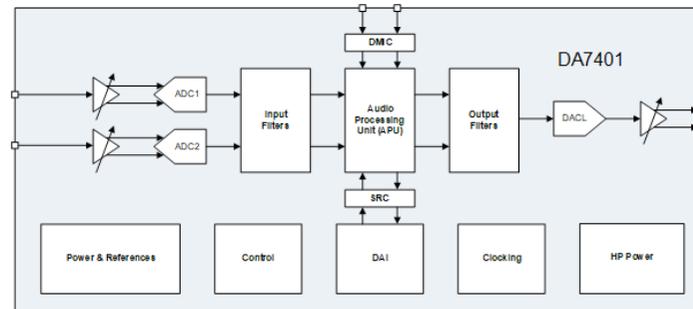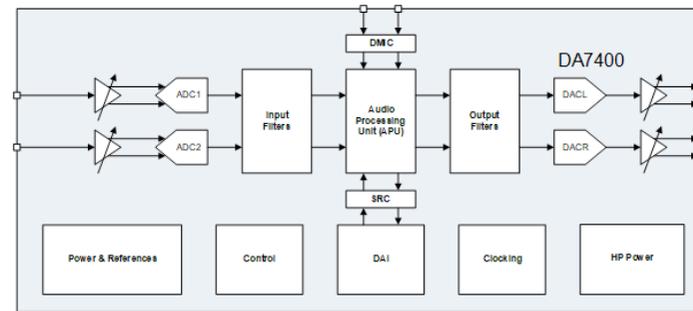
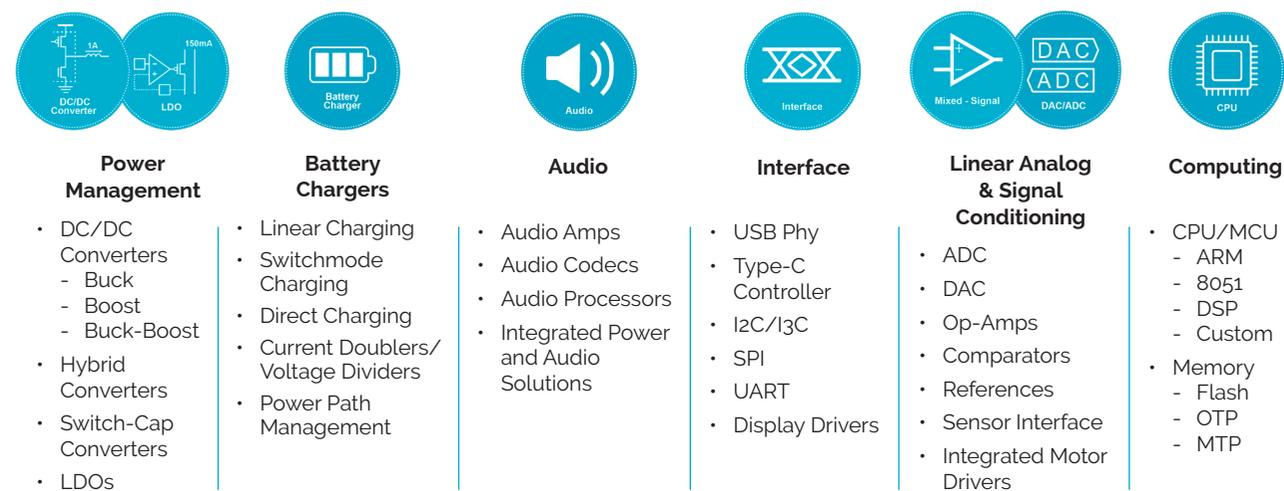| Device	Why it benefits audio applications
DA7202	Analog Input, 9 pins, 10 W, 2S battery powered amplifier with low quiescent current (Iq) and ultra-low distortion
DA7211	Ultra Low Power Stereo Audio CODEC
DA7212	Lowest power consumption CODEC on the market
DA7217	Highest performance differential output CODEC Low latency path for digital microphone inputs, excellent for ANC in combination with the DA14195, DA14196 and DA14495
DA7218	Highest performance single ended output CODEC Low latency path for digital microphone inputs, excellent for ANC in combination with the DA14195, DA14196 and DA14495
DA7219	Mono in, stereo out CODEC with advanced 3.5 mm Jack detect and button detection
DA7400	Stereo high performance (HP) CODEC
DA7401	Mono HP CODEC with ANC
DA7402	Stereo high performance CODEC with ANC
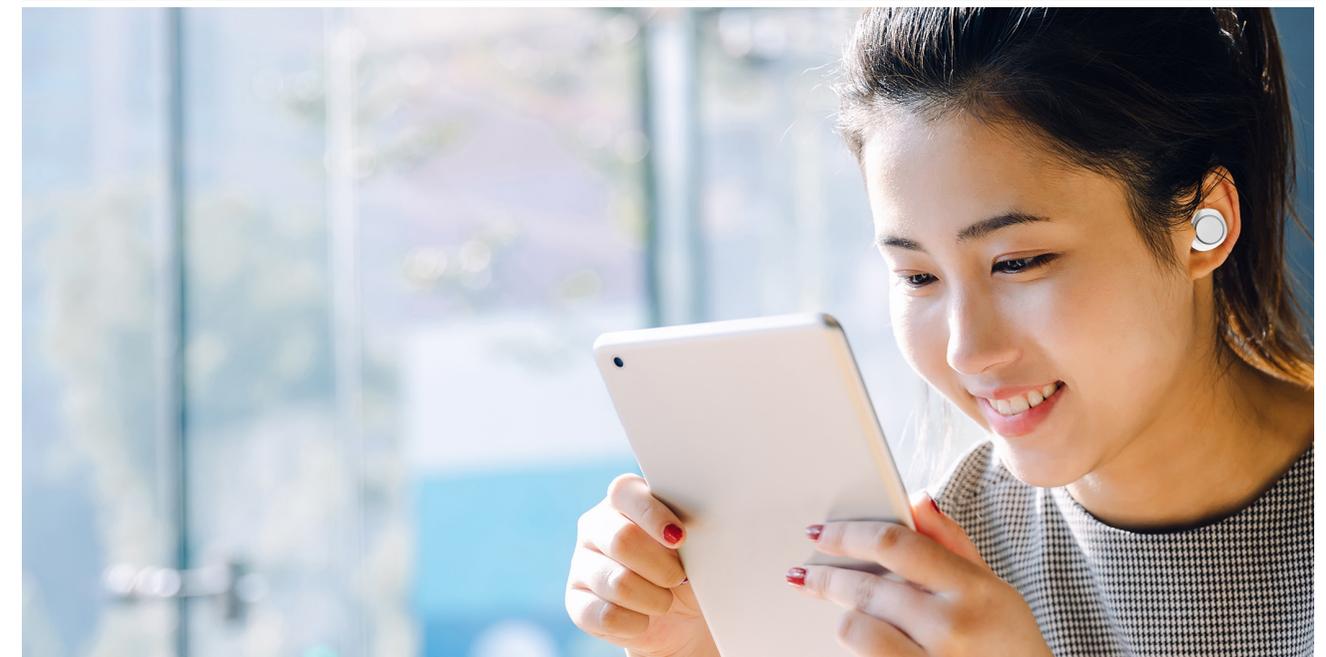
Custom Mixed-Signal Solutions

Dialog Semiconductor develops the most advanced Power Management ICs (PMICs) and Mixed-Signal ASICs solutions for the audio market, has a proven track record developing advanced solutions for industry leaders. The company's exemplary record has resulted in multi-generational partnerships which have firmly established Dialog as a trusted partner of choice.

Integrate to Differentiate

Dialog enables many of the smallest and most efficient audio products on the market today. Its broad, mixed-signal portfolio ranges from audio solutions, advanced power conversion topologies, battery chargers, digital and analog interfaces to linear analog and signal conditioning technologies. Dialog's digital capabilities include embedded computing as well as memory to empower next generation solutions. Advanced packaging technologies co-developed with the company's packaging experts and vendor partners continue to deliver leading edge solutions in the mixed-signal market.

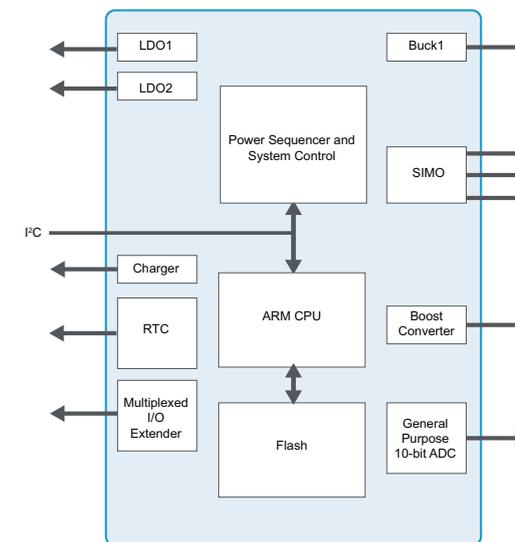| Power Management	Battery Chargers	Audio	Interface	Linear Analog & Signal Conditioning	Computing
• DC/DC Converters - Buck - Boost - Buck-Boost • Hybrid Converters • Switch-Cap Converters • LDOs	• Linear Charging • Switchmode Charging • Direct Charging • Current Doublers/ Voltage Dividers • Power Path Management	• Audio Amps • Audio Codecs • Audio Processors • Integrated Power and Audio Solutions	• USB Phy • Type-C Controller • I2C/I3C • SPI • UART • Display Drivers	• ADC • DAC • Op-Amps • Comparators • References • Sensor Interface • Integrated Motor Drivers	• CPU/MCU - ARM - 8051 - DSP - Custom • Memory - Flash - OTP - MTP

Time-to-Market

Dialog is now the leading pure play provider of advanced Power Management ICs. This level of success was achieved through absolute attention to detail. Dialog ensures that all IP is proven to perform as designed. Its accumulated library of leading-edge technologies enables Dialog to execute flawlessly and deliver "First Time Right" solutions.

Operational Excellence

Dialog's long-standing relationships with world-class manufacturing partners for wafer fabrication back-end assembly and test provide access to advanced mixed signal process nodes. Expertise in mixed-signal ASIC design and development from concept to production guarantees the highest levels of quality.

Dialog's unparalleled high-volume production ramp capability (from zero to 80 M units within a quarter) empowers its customers to rapidly deliver new products to market. The internal supply chain team at Dialog has delivered 99%+ on-time-delivery (OTD) while working closely to react to today's dynamic and volatile market conditions.

A representative example of a high-performance Custom ASIC in production

Haptics

Haptics technology recreates the sense of touch to the user by applying forces and vibrations in the form of touch feedback in displays, touch surfaces and buttons.

The DA728x - High definition, low power and flexible:

The DA728x family of High-Definition (HD) Haptic Drivers, combine custom drive sequences, on- and off resonance, at up to 1kHz. The device can drive both ERM and LRA (narrow and wideband) actuators and track resonance up to 300Hz to drive the most complex click/vibration touch effects in a wide range of applications.

Saving power when idle:

As haptic drivers spend the majority of their time in standby/idle mode, the DA728x family was designed to utilize very low idle current consumption (360nA) to maximize battery life.

The DA7282 has an additional standby mode where current consumption drops to 5nA, making it an ideal driver for systems where the highest priority is current consumption when not in use.

The DA728x family combines very low idle current consumption with low-latency trigger inputs to minimize system power consumption. Integrated trigger inputs allow haptic operation without waking the application processor, and latency times at sub-1ms give real switch behavior - 10x better than any other solution available today.

Simplifying usage in touchscreen and capacitive touch systems:

Product	Market Focus	Control Method	# of input trigger pins	Lowest power mode	I²C Addresses
DA7280	General Market	I²C, PWM, GPI	3	360nA Idle	1
DA7281	Multi-LRA Systems	I²C, PWM, GPI	1	360nA Idle	4
DA7282	Wearables	I²C, PWM, GPI	3	5nA Standby	1

DA728x Family Overview

- **Wideband LRA driver: 25Hz to 1kHz with resonant mode frequency tracking support up to 300Hz**

  Drives LRAs off-resonance for custom effects, or dual resonant systems for two-dimensional vibration

- **Up to 500mA output current**

  Drive large or small LRAs and ERMs for the best haptic experience

- **360nA idle power mode with full I²C control and memory retention**

  Ultra-low power consumption means longer battery life

  Only 0.75ms latency when responding from ultra-low idle power state
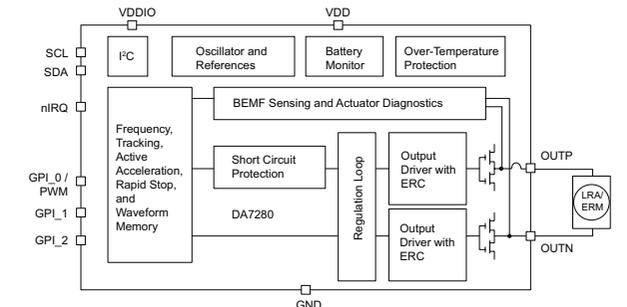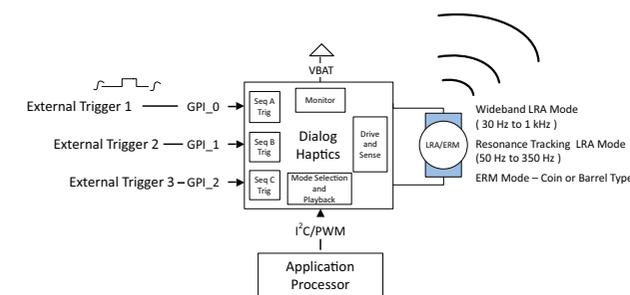
- **On-the-fly diagnostics**

  Detect issues with the LRA/ERM Automatically and generate interrupts

- **Three methods of drive for ease of use**
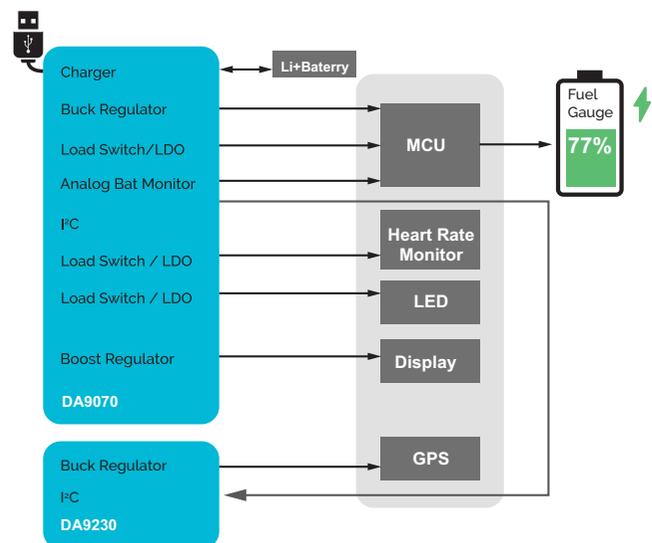
  I²C, PWM and General Purpose Inputs (GPIs)

- **5nA standby mode enabled in the DA7282**

Power management ICs

Driven by the needs of the rapidly growing hearables and smart devices for small and efficient power solutions, Dialog offers the DA9070, DA9073, DA9230 and DA9231 Nanopower PMICs, which extend the battery life of these systems while fitting into a compact form factor.

DA9070 / 73 is a highly integrated PMIC that includes the most common needs in these applications including a linear charger with Power Path management, 300 mA high efficiency buck regulator and three 150 mA LDO/Load Switches, wide output voltage boost regulator, as well as watchdog and protection features. The DA9070 also integrates battery voltage and current monitors which enables the ability to create an efficient battery fuel gauge solution. The devices are offered in a compact 42-pin 2.97 mm x 2.66 mm WLCSP package.
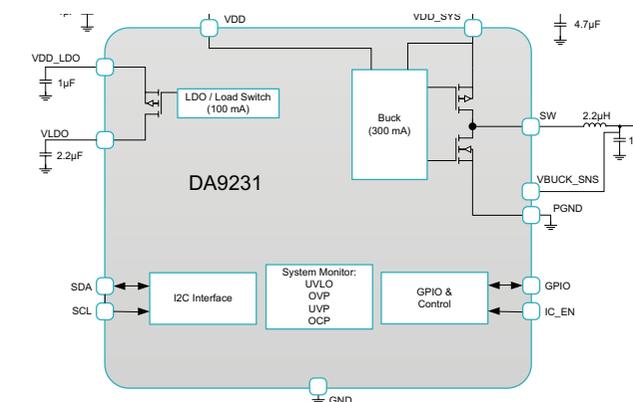

DA9231 is a configurable PMIC with a 300 mA high efficiency buck converter and 100 mA LDO/load switch with ultra-low Iq, while the DA9230 is a standalone buck converter. The devices are offered in a compact 12-pin 1.65 mm x 1.25 mm WLCSP package.

DA9232 is a configurable PMIC with a 60mA high efficiency buck converter with < 10mV output ripple. The DA9233 uses the same buck converter and adds a 110mA LDO / load switch. The devices are offered in a compact 12-pin 1.65 x 1.25 mm WLCSP package.

Device	Why it benefits this application
DA9070	Complete Nano-amp Iq power management solution supports ultra low-power fuel gauge
DA9073	Complete Nano-amp Iq power management solution extends battery life and reduces PCB area
DA9230	Nano-amp Iq DC/DC buck converter: Increases efficiency over SoC integrated DC/DC solution for longer battery life
DA9231	Nano-amp Iq DC/DC Buck Converter with additional LDO with uncommitted pins
DA9232	Nano-amp Iq DC/DC buck converter with ultra low output ripple for GPS & RF applications
DA9233	Ultra low ripple Nano-amp Iq DC/DC buck converter with additional LDO

The battery life of audio applications is significantly improved due to the low quiescent current delivered by the buck regulator in Dialog's Nanopower PMICs during operation and standby modes. The buck regulator extends high light-load efficiency down to 10 uA load current and features Dynamic Voltage Control (DVC) that optimizes system power modes providing further improvement in system efficiency and battery life. The LDO's uncommitted inputs can be connected to either the battery or the buck output. Efficiency improvement versus DC/DC converters typically found in highly integrated SoCs, can be as high as 15%, significantly conserving battery life. The regulators (Buck and LDO) can be individually enabled and configured using I2C control for dynamic power savings.

Key Features

Increased battery life

< 900nA Iq buck converters, programmable down to 0.6V with dynamic voltage capability

< 800nA Iq LDOs which are configurable as load switches

High integration

I2C interface for device configuration and control

Low external component count

Small WLCSP package

Wireless charging ICs

Device	Why it benefits this application
DA4100	Fully integrated WattUp power transmitter IC which operates directly from 3.3, and only requires an external crystal, power amplifier and transmit antenna to complete a Near Field WattUp power transmitter design
DA2210 / DA2223	Wireless power RF-to-DC receivers which can be connected to up to 4 antennas
DA3210	Single channel high efficiency CMOS RF power amplifier

WattUp Near Field transmitter design

Representing the smallest and lowest-cost WattUp transmitter option, the Near Field WattUp transmitter design is intended to be an in-box solution for many audio applications such as headsets, audio buds and hearing aids - ultimately replacing the USB cable and power adapter typically included in the box. This solution provides the convenience and waterproofing benefits of wireless charging with little effect on the overall BOM cost. The actual Near Field WattUp transmitter technology can also be embedded into laptops, tablets, furniture, and a wide variety of other devices.
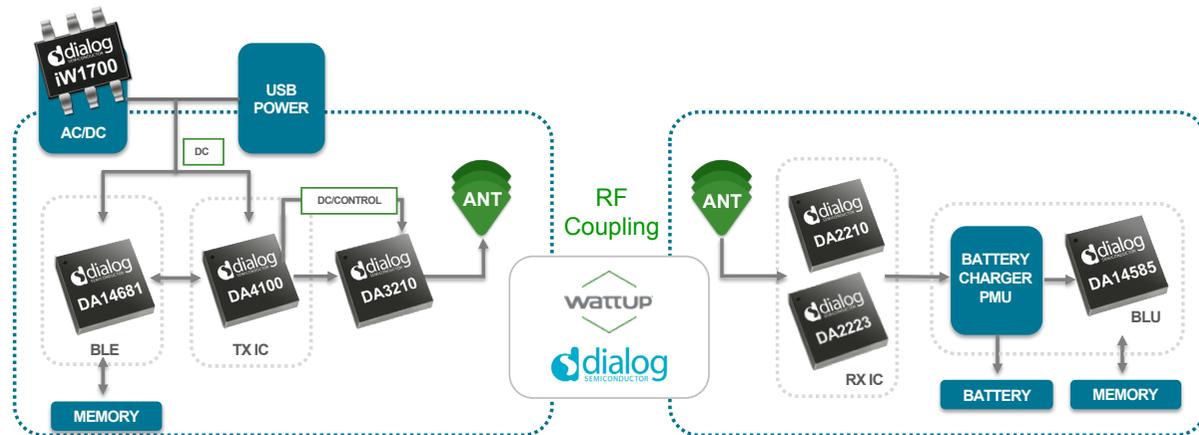
WattUp Mid Field transmitter design

The Mid Field transmitter reference design represents a desktop or close-distance charging design of up to around 3 feet (~900 mm) - enabling for example, all the small audio devices on a desk or table - all charging individually without having to be plugged in. The Mid Field WattUp transmitter technology can be designed into the bezel of a monitor, as part of a small sound bar, desktop speaker, or other similar devices as well as a standalone design. Software control allows for multiple devices to charge simultaneously at different levels with complete authorization and prioritization capability.

WattUp Far Field transmitter design

The Far Field WattUp transmitter represents the furthest distance charging. A far field transmitter may be embedded into the bezel of a TV, sound bar or may be mounted on the wall or ceiling. This design enables greatly increased coverage and allows meshed network coverage where multiple transmitters are linked together to cover larger areas. As with the Mid Field design, the Far Field transmitter is fully software controlled.

energous®

World's First RF Power Receiver IC

The WattUp® Receiver Technology can be embedded into a virtually limitless number of different devices

Power conversion solutions

Zero Standby Power Controller

Dialog's iW1700 AC/DC PWM controller is the ideal power conversion solution addressing many consumer audio applications. The device will enable your audio devices to draw zero current while in standby. They also use Dialog's PrimAccurate™ digital control technology, which enables accurate control of an isolated power supply secondary side voltage from its primary side - without the need for an optocoupler or secondary-side controller, thereby improving reliability, reducing size and lowering total BOM cost.

Device	Why it benefits this application
iW1700	Zero Standby Power PWM controller reduces no-load standby power consumption to < 5 mW at no load. Virtually eliminates "vampire power" consumption.

iW1700 Key Features

Reduces no-load standby power consumption to < 5 mW at no load[1]

This ultra-low level of standby power typically involves a relay switch controlled by an MCU

iW1700 uses proprietary digital algorithms to switch between PWM and PFM modes

Eliminates audible noise

Minimizes switching losses

Meets stringent global energy efficiency standards including U.S. DOE; EU CoC Version 5, Tier 2

120V/230 V_{AC} offline power adapters to 5 W

(1) The IEC 62301 standard rounds standby power usage of 5mW or less to zero.

Proximity Solutions

LEADER IN
PROXIMITY SOLUTIONS

Dialog proximity solutions are optimized to enable customers to develop beacons and trackers which can offer longer battery lifetime in the smallest of form factors with lowest cost of manufacture. Dialog products are designed from the ground up to optimize power efficiency - matching today's proximity application needs for a long battery life from all their devices.

Dialog solutions cover the entire system from power delivery, charging, sensor data processing through to radio and control.

Development Support

Throughout the customer product development period, Dialog provides quick and expert application support. Dialog's local field application engineers are always on hand to provide dedicated advice and guidance during the critical design phase.

## Contents

Application overview

Beacons

Beacons broadcast data that can be received by a smart device and interpreted by an associated application to provide useful information to the user – they can be thought of as QR codes that are transmitted wirelessly over Bluetooth low energy. Some beacons are fitted with sensors and can also provide the sensors' information to the application.

Beacon radio coverage is an important factor and its implementation strives to maximize its range while controlling output power dynamically to adapt to the specific requiremens of the location and application.

Additionally, a beacon will usually offer a simple user interface comprising of control buttons to activate or reset the beacon and LEDs for status indication.

Dialog offers a single chip beacon solution for coin cell and alkaline-powered implementations as well as power conversion and RF energy harvesting variants to cater for systems with these power sources:

Application	Solution
Beacons	Dialog's Smartbond Bluetooth LE SoCs provide a single-chip solution for beacons powered by battery or energy-harvesting while our power conversion devices offer an optimum solution for variants that are directly connected to the mains supply. WattUp RF-based charging can also be integrated to provide wire-free charging to battery-operated beacons.
Trackers	Trackers based on our Smartbond Bluetooth LE SoCs deliver the longest battery lifetimes in the smallest form factors. Similarly to beacons, WattUp RF-based charging can be integrated to provide wire-free charging trackers.

Application	Wireless MCUs	wireless charging	Power conversion	Reference design
Beacons	DA14531 DA14585 DA14586 DA1469x	DA4100 DA2210	iW1700	DA14585 range extender DA14585 IoT multi-sensor kit
Trackers				

- **Integrated ARM® Cortex™ M0 microcontroller for sensor data acquisition, processing and broadcasting**
- **RF Wireless charging option for zero maintenance deployment**
- **AC/DC power conversion with lowest Bill of Material for mains powered implementation**
- **Complete reference designs including the beacon application and a smartphone app to accelerate time to market and minimize development costs**
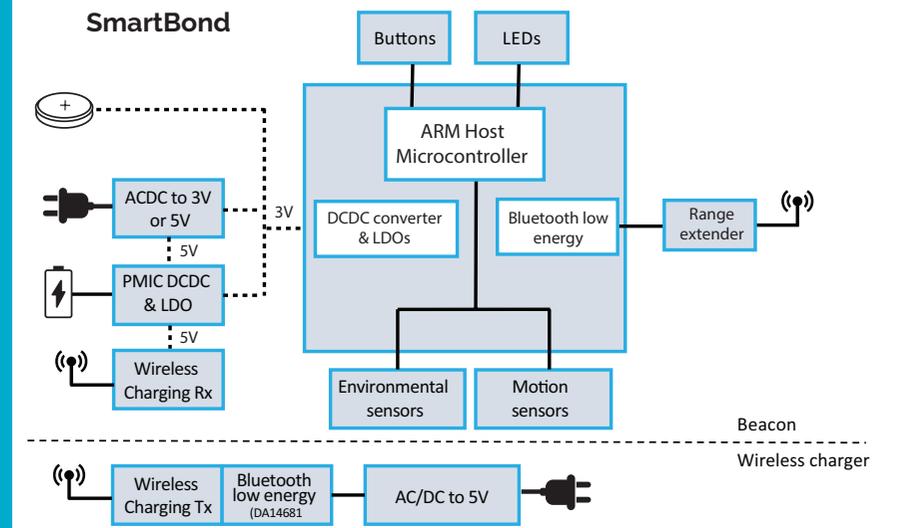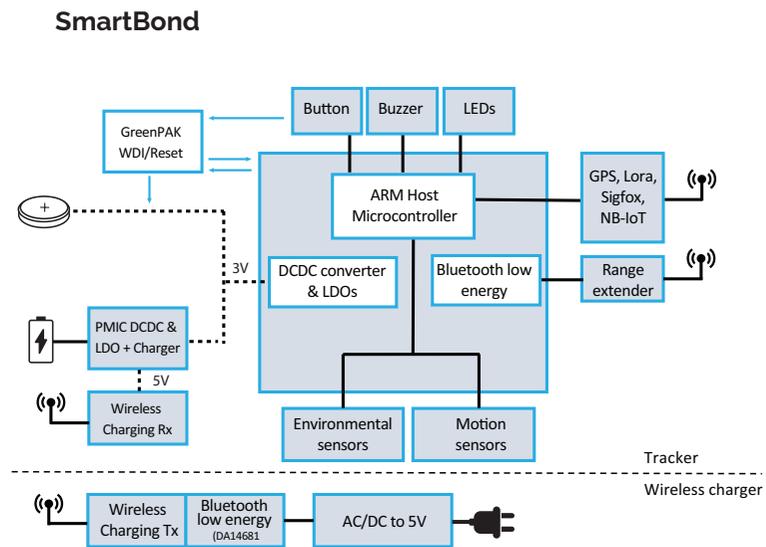
Trackers

Trackers are similar to beacons but whereas beacons are usually built to be part of a fixed infrastructure, trackers are designed to be attached to mobile objects to track their whereabouts.

Trackers are designed to be two-way communication devices such that they can transmit their data as well as be controlled or triggered to issue an alarm from the smart device - for situations where a device is lost, allowing the user to track its whereabouts.

As well as Bluetooth low energy, advanced trackers combine additional radios to help track devices over a longer distance or outdoors.

Battery lifetime is a prime requirement for all tracker applications. Dialog's proximity solutions provide a complete industry-leading low power IC portfolio:

- **Integrated ARM® Cortex™ M0 microcontroller for sensor data acquisition, processing and broadcasting**

- **RF Wireless charging option for zero maintenance deployment**

- **Complete reference designs including the proximity application and a smartphone app to accelerate time to market and minimize development costs**

SmartBond

Beacon and tracker wireless charging

The beacon and tracker device can be charged wirelessly by using WattUp® technology developed by Energous, which is an innovative RF-based charging solution that delivers intelligent and scalable power via RF bands. WattUp differs from older wireless charging convention by delivering power at a distance which can charge multiple proximity devices – enabling a completely wire-free system with no need to plug into wired chargers. Dialog Bluetooth low energy devices communicate all charge control instructions between transmitter and receiver sub-system.

Dialog Bluetooth low energy SoCs for wireless charging communicate all charge control instructions between transmitter and receiver sub-system.

Bluetooth low energy wireless SoCs

DA145xx: Smarter, more flexible and ultra-low power

Dialog's Smartbond™ Bluetooth low energy 5.1 system-on-chip DA14531 is the smallest, lowest power solution for beacon and tracker devices and is designed to work with any type of (disposable) battery, 3V coin cell or 1.5V alkaline button cells, 1.4V zinc-air cells or even printed batteries.

The DA14531 supports DC-DC peak current control, allowing operation with very low capacity (e.g. <20mAh) batteries with high internal resistance. System BOM is highly optimized to achieve lowest system cost. It supports 2.5dBm output power and a 96.5dBm link budget. Sleep current can be as low as 700nA while using a hibernation mode with external wake up trigger.

DA14531 is the perfect solution for (disposable) smart labels, beacons or trackers. DA14585/6 will support additional memory (96kB RAM) for more demanding applications in this space working from the same software development kit (SDK).

Features - DA14531

- Complies with Bluetooth 5.1 core specification
- Integrated One-Time-Programmable (OTP) memory
- 48 kB retainable system RAM
- Low operating voltage (1.1 V to 3.3 V)

Benefits

- Operates with disposable or printed batteries
- Multiple years of shelf life
- Packaged for low-cost manufacturing and smallest footprint
- Single 32 MHz crystal operation
- Dialog tools ensure shortest test time and lowest production cost

Applications

- Beacons
- Trackers
- Smart (disposable) labels

DA1469x: Enabling Advanced Proximity Solutions

The SmartBond™ DA1469x family of Bluetooth® low energy solution is Dialog's most advanced, feature rich range of multi-core microcontroller units for wireless connectivity. The DA1469x line provides developers with advanced connectivity features to future-proof their devices and fit the needs of multiple applications. With 512 kB internal RAM, Arm Cortex M33F MCU clocked at 96 MHz, configurable MAC and state of the art radio design, the DA1469x family offers immense possibility in advanced proximity applications. These wireless MCUs enable manufacturers to deploy the latest Bluetooth low energy technology, opening up new possibilities such as accurate positioning through the new Angle of Arrival and Angle of Departure features of the Bluetooth 5.1 standard.
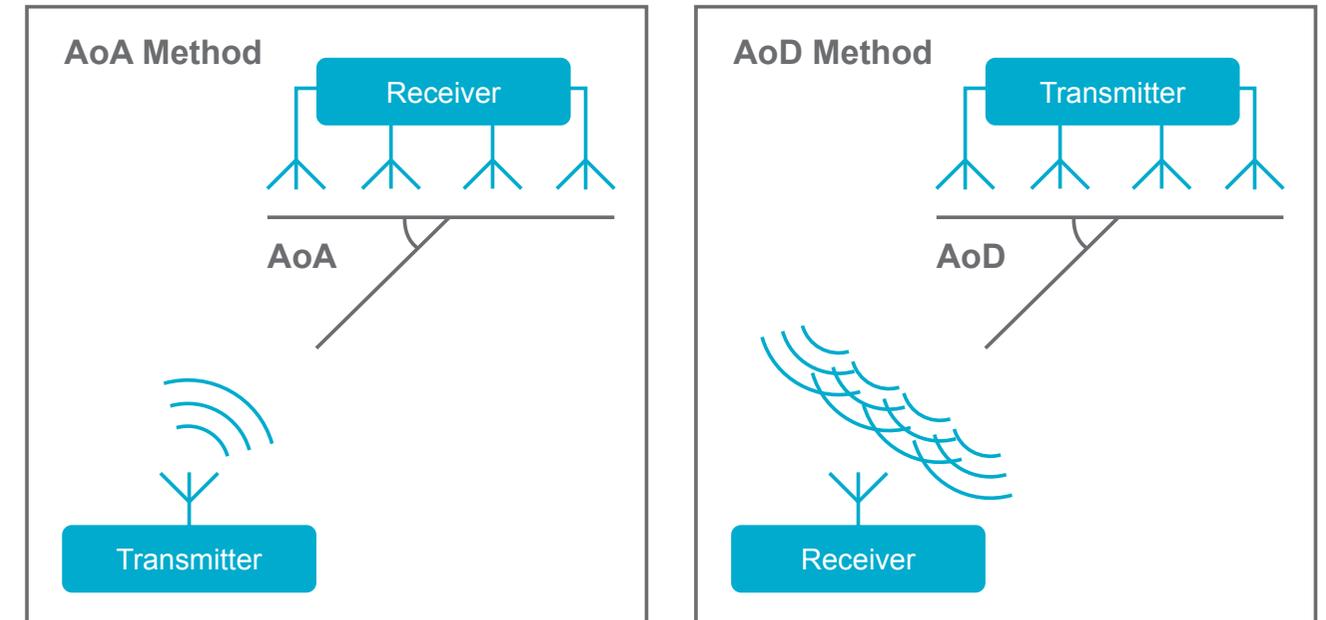
Features

- Bluetooth 5.x (core and optional specification)
- Cortex M33F application processor, 144DMIPs available on demand
- Configurable MAC with embedded Cortex M0+ to support protocol tasks
- Flexible memory architecture: 512 kB Data SRAM, 16 kB Cache SRAM, 128 kB ROM, execution from external QSPI Flash up to 64 MB
- Dedicated hardware crypto engine
- State of the art radio with up to 103 dB link budget

Benefits

- Supports complex applications with ultra-low power consumption
- SW programmable protocol engine can implement proprietary and latest Bluetooth protocol in proximity applications
- Large internal memory and world-class radio performance for increased accuracy in direction finding applications
- Provides banking-level security for application, data and communication
- Optimized for flexibility, lowest power consumption, smallest footprint and lowest system cost

Applications

- Real Time location systems (e.g. asset tracking)
- Indoor positioning Systems (e.g. way finding)

Wireless charging ICs

Device	Why it benefits this application
DA4100	Fully integrated WattUp power transmitter IC which operates directly from 3.3, and only requires an external crystal, power amplifier and transmit antenna to complete a Near Field WattUp power transmitter design
DA2210 / DA2223	Wireless power RF-to-DC receivers which can be connected to up to 4 antennas
DA3210	Single channel high efficiency CMOS RF power amplifier

WattUp Near Field transmitter design

Representing the smallest and lowest-cost WattUp transmitter option, the Near Field WattUp transmitter design is intended to be an in-box solution for many beacon and tracker devices -ultimately replacing the USB cable and power adapter typically included in the box. This solution provides the convenience and waterproofng benefts of wireless charging with little effect on the overall BOM cost. The Near Field WattUp transmitter technology can also be embedded into laptops, tablets, game consoles, furniture, and a wide variety of other devices.
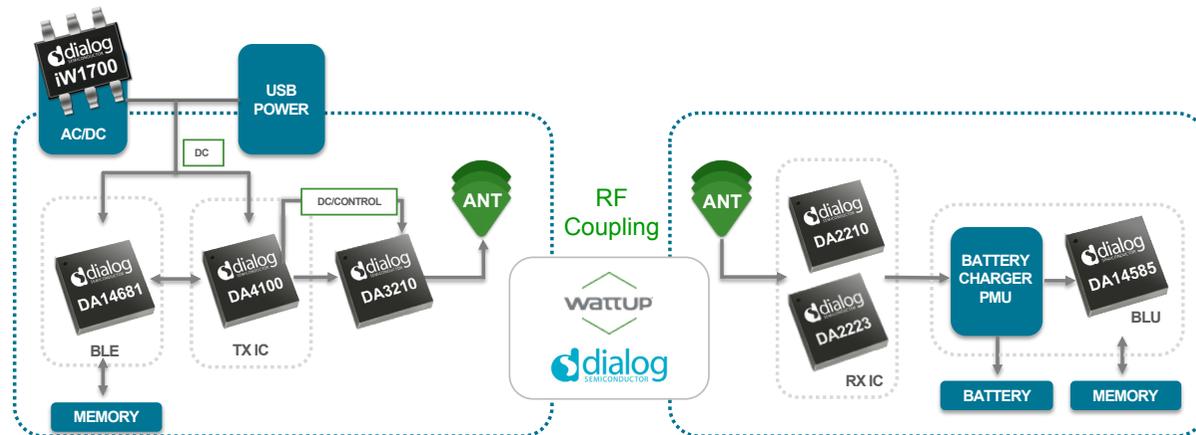
Mid and Far Field WattUp® transmitter design

WattUp transmitter reference design represents a desktop or close-distance charging solution for up to 2 to 3 feet (~60-90 cm). For example, beacons and trackers can be charged without having to be plugged in, while in close proximity to a receiver. WattUp transmitter technology can be designed into the environment where the beacon is deployed i.e. mounted on the wall or ceiling in a supermarket as well as a standalone design.

Power conversion solutions

Zero Standby Power Controller

Dialog's iW1700 AC/DC PWM controller uses PrimAccurate™ digital control technology, which enables accurate control of a secondary-side voltage from the primary side of an isolated power supply without the need for an optocoupler, improving reliability, reducing size and lowering total BOM cost.

PrimAccurate control reduces BOM cost:
  No optocoupler
  No secondary-side controller
  Eliminates many discrete components

Higher system-level MTBF and better line-surge immunity

EZ-EMI® technology improves EMI performance with minimal EMI filtering components

iW1700 Key Features

5 W output (120 V_{AC}/230 V_{AC})

Reduces no-load standby power consumption to < 5 mW at no load
  With no need for relay switch or MCU

Eliminates audible noise

Meets stringent global energy efficiency standards including U.S. DOE; EU CoC Version 5, Tier 2

Direct drive of low-cost BJT switch

Device	Why it benefits this application
iW1700	Zero Standby Power PWM controller reduces no-load standby power consumption to < 5 mW at no load. Virtually eliminates "vampire power" consumption.

(1) The IEC 62301 standard rounds standby power usage of 5 mW or less to zero.

Dialog solutions cover the entire system from power delivery, charging, sensor data processing through to radio and control.

GreenPAK Configurable Mixed-signal ICs

GreenPAK™ is a cost effective NVM programmable device that enables innovators to integrate many system functions while minimizing component count, board space, and power consumption. Using Dialog's GreenPAK Designer Software and GreenPAK Development Kit, designers can create and program a custom circuit in minutes.
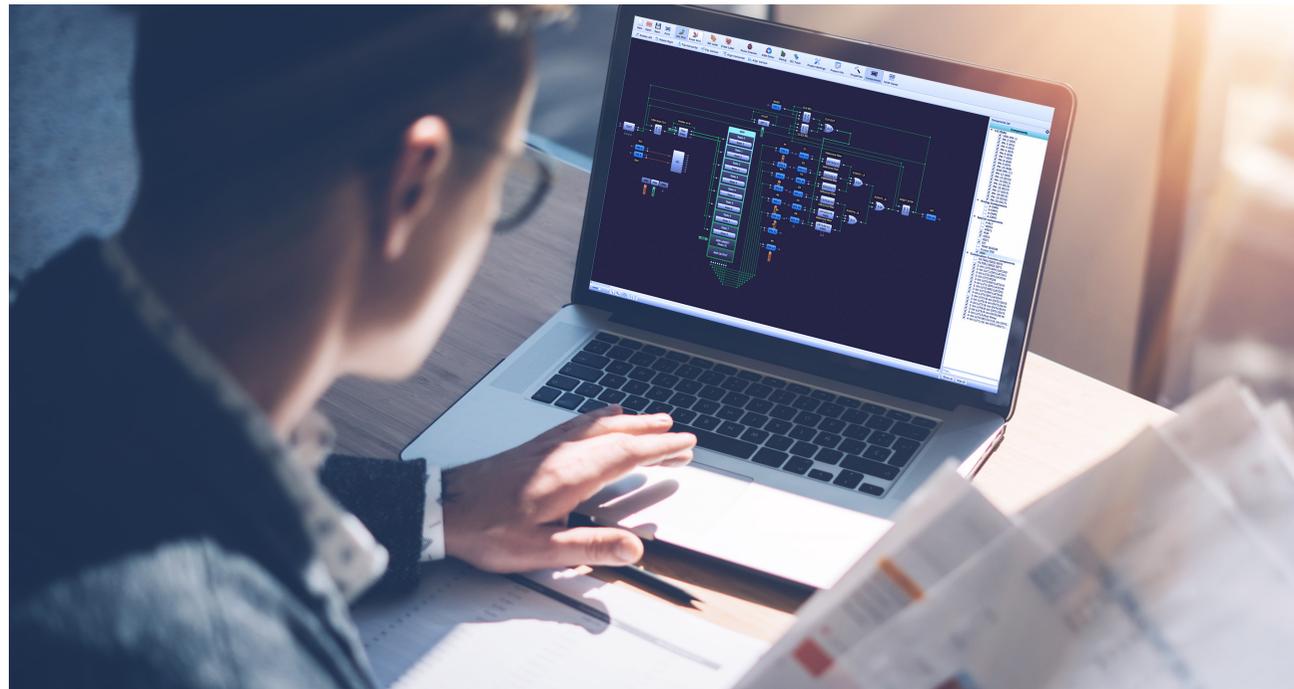
Customized Integration Enables Lower Cost

A typical GreenPAK implementation integrates ten to thirty components into a tiny custom IC, allowing product differentiation at a lower cost.

Longer Battery Life

Prolong battery life by removing discrete resistors in voltage dividers, pull ups, pull downs, etc. and replacing with low-power, integrated components. Further reduce power consumption using the sleep function.

Faster Design to Overcome Last Minute Design Issues

Develop and program devices in minutes at your desk. Quickly respond to changing design requirements and increase productivity at the design and prototype verification stages.

GreenPAK Used as a Custom Watchdog and Reset IC

STEP 1	STEP 2	STEP 3	STEP 4	
Place unprogrammed GreenPAK into socket	Design your IC with GreenPAK GUI	Click program to freeze GreenPAK's OTV NVM Program		Your custom IC is ready for use

These watchdog and reset ICs were specially designed using Dialog's GreenPAK family of products. The designs were customized to perfectly complement Dialog's BTLE ICs. They can be used as is for a quick development cycle or they can be customized. Design files are available upon request and Dialog's FAE team is available to discuss or support customization.
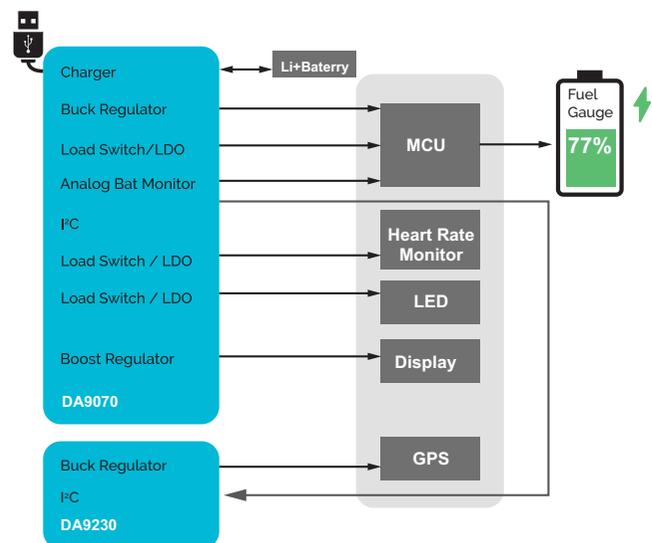
Part Number	Features	Included Functions			
		Reset Logic	Watchdog	VDD Monitor	Package Size
SLG4E42230V	Small Size	RST & /RST	✓	✓	1.0 x 1.2 mm
SLG4T42229V	General Use	RST Only	✓	✗	1.6 x 1.6 mm
SLG4AX42231V	Low Iq	RST & /RST	✓	✓	1.6 x 2.0 mm

*See full list of GreenPAK parts: https://www.dialog-semiconductor.com/configurable-mixed-signal

Power management ICs

Driven by the needs of the rapidly growing proximity and smart devices for small and efficient power solutions, Dialog offers the DA9070, DA9073, DA9230 and DA9231 Nanopower PMICs, which extend the battery life of these systems while fitting into a compact form factor.

DA9070 / 73 is a highly integrated PMIC that includes the most common needs in these applications including a linear charger with Power Path management, 300 mA high efficiency buck regulator and three 150 mA LDO/Load Switches, wide output voltage boost regulator, as well as watchdog and protection features. The DA9070 also integrates battery voltage and current monitors which enables the ability to create an efficient battery fuel gauge solution. The devices are offered in a compact 42-pin 2.97 mm x 2.66 mm WLCSP package.

DA9231 is a configurable PMIC with a 300 mA high efficiency buck converter and 100 mA LDO/load switch with ultra-low Iq, while the DA9230 is a standalone buck converter. The devices are offered in a compact 12-pin 1.65 mm x 1.25 mm WLCSP package.

DA9232 is a configurable PMIC with a 60mA high efficiency buck converter with < 10mV output ripple. The DA9233 uses the same buck converter and adds a 110mA LDO / load switch. The devices are offered in a compact 12-pin 1.65 x 1.25 mm WLCSP package.

Device	Why it benefits this application
DA9070	Complete Nano-amp Iq power management solution supports ultra low-power fuel gauge
DA9073	Complete Nano-amp Iq power management solution extends battery life and reduces PCB area
DA9230	Nano-amp Iq DC/DC buck converter: Increases efficiency over SoC integrated DC/DC solution for longer battery life
DA9231	Nano-amp Iq DC/DC Buck Converter with additional LDO with uncommitted pins
DA9232	Nano-amp Iq DC/DC buck converter with ultra low output ripple for GPS & RF applications
DA9233	Ultra low ripple Nano-amp Iq DC/DC buck converter with additional LDO

The battery life of proximity applications is significantly improved due to the low quiescent current delivered by the buck regulator in Dialog's Nanopower PMICs during operation and standby modes. The buck regulator extends high light-load efficiency down to 10 uA load current and features Dynamic Voltage Control (DVC) that optimizes system power modes providing further improvement in system efficiency and battery life. The LDO's uncommitted inputs can be connected to either the battery or the buck output. Efficiency improvement versus DC/DC converters typically found in highly integrated SoCs, can be as high as 15%, significantly conserving battery life. The regulators (Buck and LDO) can be individually enabled and configured using I2C control for dynamic power savings.

Key Features

Increased battery life
< 900nA Iq buck converters, programmable down to 0.6V with dynamic voltage capability

< 800nA Iq LDOs which are configurable as load switches

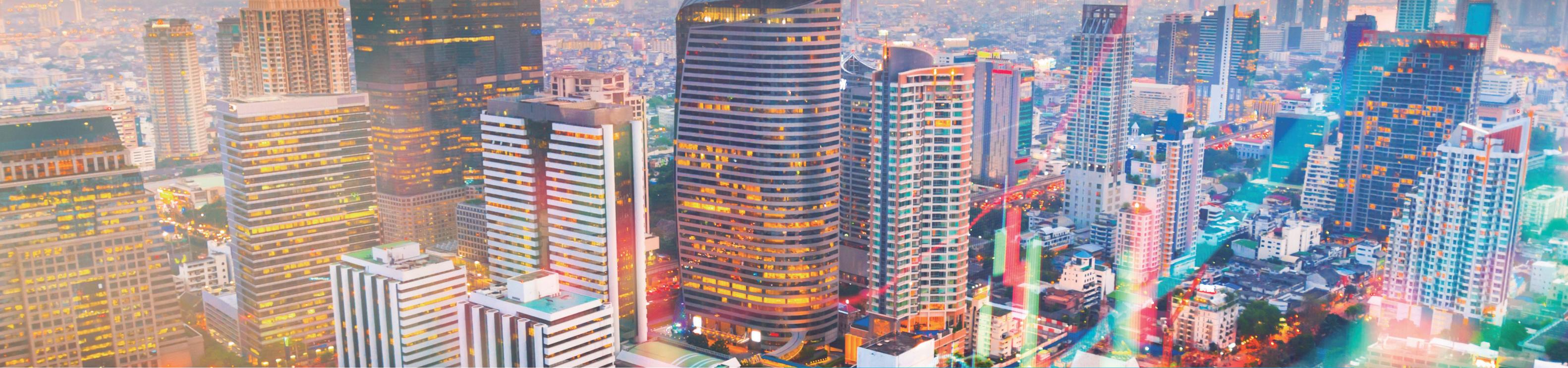### High integration
I2C interface for device configuration and control

Low external component count

Small WLCSP package

SMART
HOME

LEADER IN SMART HOME SOLUTIONS

Smart homes and buildings use home automation technologies to provide home owners with intelligent feedback and information by monitoring many aspects of a home. Our portfolio of products will do just that - making your home more connected, secure and convenient. How? We offer a vast array of solutions enabling smart locks, window sensors, smart lighting, security video cameras and temperature monitoring control while keeping up with the demand for constant improvements in reliability, cost and energy efficiency. For example, a smart home can control lighting or a refrigerator may be able to catalogue its contents, suggest menus, recommend healthy alternatives, and order replacements as food is consumed.

Development Support

Throughout the customer product development period, Dialog provides quick and expert application support. Dialog's local field application engineers are always on hand to provide dedicated advice and guidance during the critical design phase.

Contents

Application overview

Application	Solution			
Security	Door and window sensors			
	Movement detection			
	Smart door locks			
Convenience	Smart appliances	Smart buttons		
	Beacons	Smart toothbrush, plant sensors, etc.		
	Proximity tags			
Control	Smart lighting			
	Remote control			
	Smart plugs			
Energy Management	Heating and cooling	Pressure sensing		
	Temperature sensing	Air quality sensing		
	Humidity sensing	Weather stations		

Security

Smart locks have steadily increased in popularity over the last few years. When they were first introduced to the market, many homeowners and users were unsure about upgrading to smart locks because their traditional lock-and-key system still worked well. If it was a safety issue, they could very easily work on upgrading their locks. However, smart locks provide homeowners with much more than an upgrade in their security. The automated nature of these locks provides its users with an added layer of convenience and efficiency that traditional locks do not give.
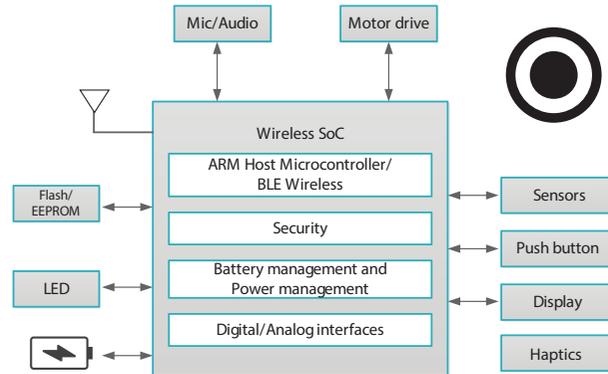
Convenience

Smart appliances are designed to make our lives more convenient. Connected appliances can monitor and maintain the home from virtually anywhere. With just the touch of a button, a smartphone can help control smart appliances—from starting wash cycles to checking a refrigerator's inventory—and even troubleshooting issues.
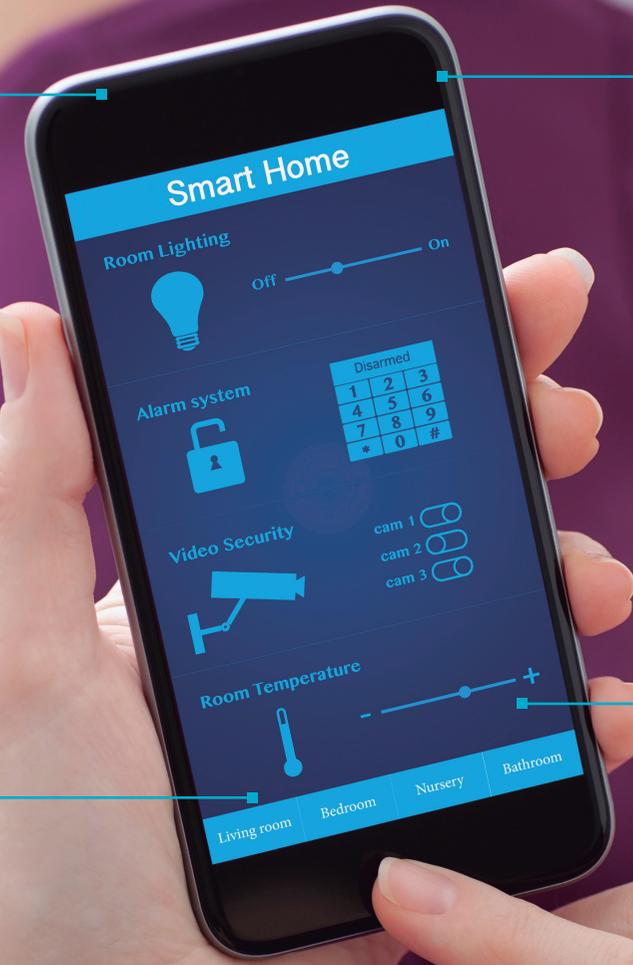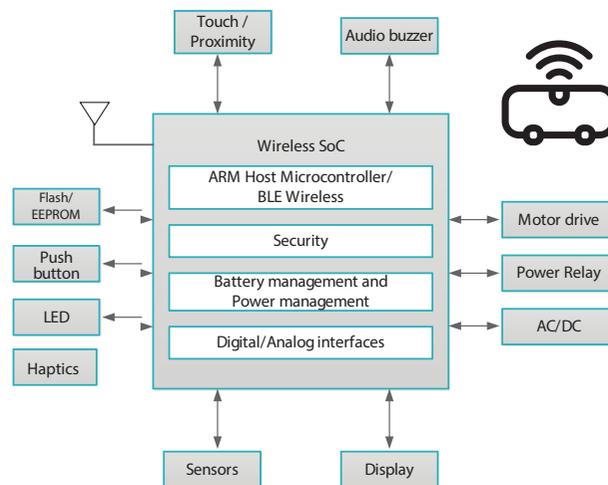

Energy management

The great appeal of the smart home is that it enables owners to remotely control parts of the home and configure time schedules for smart home-enabled devices to help control costs and be more energy-efficient (i.e. green homes) while providing added convenience and potential time savings.
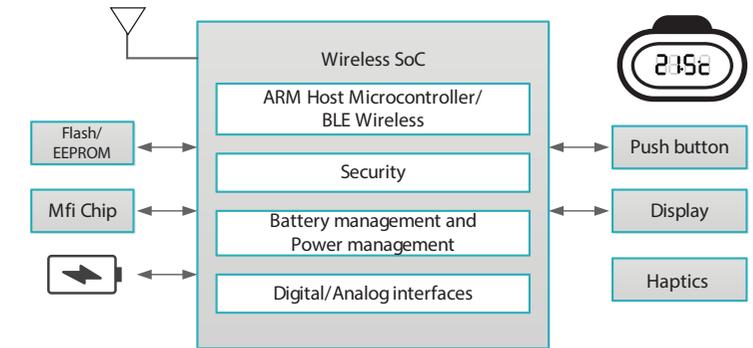
Control

Connected devices like the smart plug can turn on and off any appliance that plugs into a standard wall socket. Simply plugged into any wall socket, smart plugs can be used with a lamp, a TV, a cable box, a coffee machine—anything. Additionally, using a user friendly smartphone app, the smart plug can provide information on your usage and electricity consumption, and even shows a running total of how much that device costs to run.
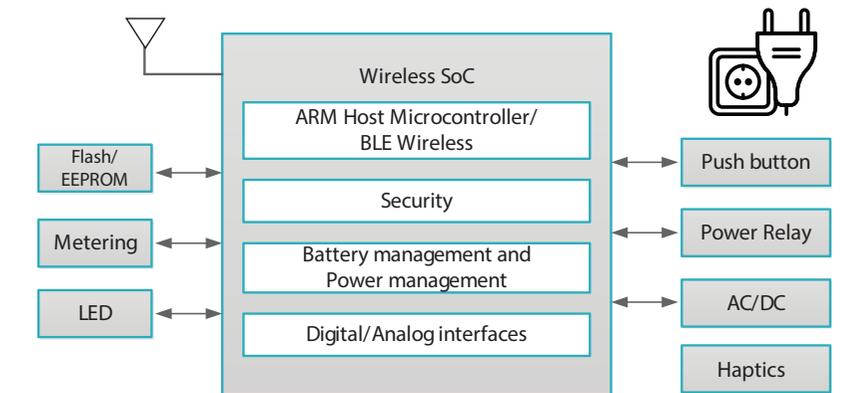
Bluetooth low energy ICs

Bluetooth low energy (BLE) is the gateway to personal connectivity and enables easy access to the cloud. Dialog's SmartBond SoC family is the simplest route to delivering the most power-friendly and flexible Bluetooth connected products to the market.

Device	Why it benefits this application
DA14531 DA1458x DA1468x DA1469x	With Bluetooth low energy prevalent on all smartphones today, the transmit and receive range offered by our products, coupled with the lowest BoM, make Dialog's BLE SoCs the perfect connectivity solution for control within the home.

Easy to use & power friendly

Highly integrated, the SmartBond SoC family delivers the smallest, most power efficient Bluetooth low energy solutions available - and enables the lowest system costs. The product family includes generic and application-optimized solutions with various memory options available, combining design flexibility with cost reduction. This is all backed up by Dialog's powerful SmartSnippets™ software tooling and extensive applications support, making it easy for designers to get the most out of their system. Dialog's innovation roadmap ensures designers will have the Bluetooth solutions they need, when they need them, as markets evolve.

SmartBond DA1458x series

Connected devices are constantly evolving. New generations continue to appear that are smarter - and SmartBond has evolved too: The DA145xx (DA14531 for smallest size, lowest power and system cost and DA14585/6 with more user memory) offer customers all the benefits of Dialog's prior generations but with even greater flexibility to create the most advanced and compact design solutions.

All DA145xx versatile SoCs are ideal for adding Bluetooth low energy connectivity to smart home products such as lighting, heating control and appliances to enable easy app-based control.

Product	Memory size	General Purpose I/O s	Package	Key Features
DA14531	32kB OTP 48kB RAM 144kB ROM	6	2.0x1.7mm WLCSP17	Bluetooth 5.1 Core Cortex M0+ at 16MHz 2.5dBm output 1.1 – 3.3V Supply Single pin RF I/O 2.2mA total Rx current 3.5mA total Tx current Buck-Boost DC-DC
		12	3.0x2.2mm FCGQFN24	
DA14585	64kBOTP 96kB RAM 128kB ROM	14	2.4x2.6mm WLCSP	Bluetooth 5.0 Cortex M0 at 16MHz 0dBm output 0.9 – 3.6V Supply Single pin RF I/O PDM/I2S interface with SRC 5.3mA total Rx current 4.9mA total Tx current
		25	5.0x5.0mm QFN40	

SmartBond DA1468x series

DA1468x is the world's first single-chip solution for smart building products and other rechargeable devices that need to meet the highest security standards. This highly integrated solution supports the Bluetooth 5.0 core specification and supplementary features and Bluetooth mesh.

Product	Memory size	General Purpose I/O s	Package	Key Features
DA14682	Flash 8 Mb RAM 144 kB OTP 64 kB ROM 128 kB	37	AQFN60 size 6x6x0.9 mm, pitch 0.55 mm	Bluetooth 5.0 Integrated ARM® Cortex™ M0 microcontroller Dedicated HW crypto engine Integrated battery and system PMU Power supply 1.7 -5.5 V Single pin RF I/O Rich set of analog and digital peripherals 8Mbit executable Flash
DA14683	RAM 144 kB OTP 64 kB ROM 128 kB	21	WL-CSP53 size 3.4x3.1x0.5 mm, pitch 0.4 mm	Bluetooth 5.0 Integrated ARM® Cortex™ M0 microcontroller Dedicated HW crypto engine Integrated battery and system PMU Power supply 1.7 -5.5 V Single pin RF I/O Rich set of analog and digital peripherals QSPI interface
		37	AQFN60 size 6x6x0.9 mm, pitch 0.55 mm	

SmartBond DA1469x series

Create next-generation smart building Bluetooth low energy solutions without compromising functionality or battery life with the SmartBond DA1469x series, that provides most integrated application processing and low power connectivity. DA1469x series delivers the highest performance, lowest power consumption, smallest footprint and lowest system cost.

This highly integrated solution supports the Bluetooth 5.0 standard. An ARM Cortex M33F application processor, with various memory options, delivers flexible processing power when you need it and saves power when you don't, enabling the management of multi-sensor arrays and always-on sensing with its on-board sensor hub. A dedicated hardware crypto engine delivers banking-level security with end-to-end encryption to safeguard sensitive data.

Direction finding and distance measurement features can be supported with this system-on-chip.

Product	Memory size	General Purpose I/O s	Package	Key Features
DA14691	Data RAM 384 kB Cache RAM 16 kB ROM 128 kB	44	BGA86, 6 x 6, 0.55 mm pitch	
DA14695	Data RAM 512 kB Cache RAM 16 kB ROM 128 kB	44	BGA86, 6 x 6 mm, 0.55 mm pitch	Bluetooth 5.0 (core and supplementary features) 32-bit ARM® Cortex®-M33 microcontroller, 144DMIPs available on demand Configurable MAC with embedded ARM® Cortex®-M0+ microcontroller Flexible memory architecture: Unlimited execution from external QSPI Flash Dedicated crypto engine
DA1697	Data RAM 512 kB Cache RAM 16 kB ROM 128 kB	55	BGA100, 5 x 5 mm, 0.475 mm pitch	Sensor Node Controller Integrated system PMIC for regulated power supply to external components Configurable transmit output power -18 to +6 dBm Very rich set of analog and digital peripherals
DA14699	Data RAM 512 kB Cache RAM 16 kB ROM 128 kB	55	BGA100, 5 x 5 mm, 0.475 mm pitch	

Features

- **Bluetooth 5.0 (core and optional specification)**
- **Cortex M33F application processor, 144DMIPs available on demand**
- **Configurable MAC with embedded Cortex M0+ to support protocol tasks**
- **Flexible memory architecture: 512kB Data SRAM, 16 kB Cache SRAM, 128 kB ROM, execution from external QSPI Flash up to 64MB**
- **Dedicated hardware crypto engine**
- **Integrated system PMIC for regulated power supply to external components**
- **Power supply 1.8 – 4.75 V**
- **1 or 2Mbps radio with up to +6dBm output**
- **Very rich set of analog and digital peripherals**

Benefits

- **Supports complex applications with ultra-low power consumption**
- **Unlimited memory space. Display controller supports color displays**
- **Integrated power management and charger can power a complete Smart Home system**
- **Advanced interfaces for voice commands and audio support**
- **World-class radio performance**
- **Provides banking-level security for application, data and communication**
- **Lowest industry BoM MCUs**
- **Smallest industry footprint - Saves up to 38mm² of PCB space**

Dialog Semiconductor offers a complete solution Bluetooth SIG mesh

Traditionally used for close-range, point-to-point communications for pairing devices, the Bluetooth® protocol has been greatly enhanced by the new mesh specification. The recently adopted Bluetooth mesh specification enables a 'many-to-many' communication topology offering both an extended range and a greater number of nodes. Mesh functionality opens up a wide range of new applications for Bluetooth in markets such as smart home, lighting, industrial automation, beaconing and asset tracking. To make the most of these new opportunities, you need to design the new mesh capabilities into your products, easily and quickly.

Dialog offers you the perfect way to achieve this with complete mesh software support for the latest SmartBond™ products, starting with the DA14682 and DA14683, including its high temperature derivatives. You can get the best match for your design requirements and capabilities, either as a turnkey solution or as a reference design.

The software include a full set of development tools for Bluetooth mesh applications, with reference schematics and layouts, tool chains and reference application source codes which are all available within our very own SmartSnippets™ development environment.

- **Reliability:** Enables inherently self-healing networks with no single points of failure
- **Scalability:** Supports hundreds of nodes in the building with industrial-grade performance
- **Security:** Provides enterprise-level security for protection against all known attacks

Apple HomeKit™

Create Apple HomeKit Smart Home accessories with the best performance and user experience

Dialog's HomeKit SDK represents a first certified solution for the HomeKit Accessory Profile (HAP), supporting all Bluetooth low energy profiles within Apple's Smart Home platform. The kit is built on Dialog's DA1468x System-on-Chip (SoC), the most integrated single-chip solution that is purpose-built for IoT development, providing connectivity to a variety of battery-powered devices. It is the first SoC on the market with dedicated hardware acceleration for HomeKit security operations which ensures end-to-end application encryption, safeguarding personal information in transit.

The DA1468x HomeKit SDK kit lowers the barriers for smart home device development. It creates the fastest response times and the best possible user experience for end devices, with initial pairing taking less than 2.8 seconds and responding faster than 250ms whenever an iOS device issues a command. This triggers an instant response whenever a user interacts with a HomeKit powered light, door lock, smoke detector or other accessory.
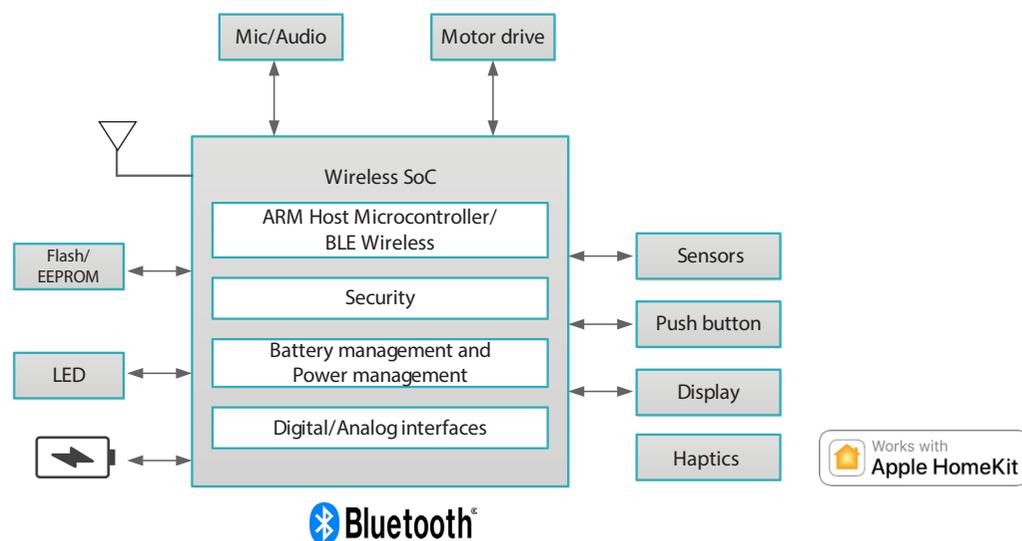
ULE 1.9 GHz SmartPulse ICs

Dialog's SmartPulse series of wireless sensors, actuators and gateway devices enable an easy development of wireless sensor networks for the smart home and building markets.

The DECT ULE standard enables the development of a wide range of new wireless consumer products that can run for up to 10 years on a single AAA battery pack. Systems running SmartPulse sensors self-configure with a home's DECT ULE enabled hub or internet gateway, allowing connected systems to be managed over the web using your smartphone.

Device	Why it benefits this application
SC14SPNODE	SmartPulse - DECT ULE, builds on an established DECT standard legacy and the simple star networks topology can enable a variety of home automation applications
SC14CVMDECT	Integrated 1.9 MHz DECT Radio

The SC14SPNODE including optional software packages, is a DECT data pump enabling ultra-low energy data transmission and also voice services. A star network topology can be made using SC14CVMDECT as a gateway and the SC14SPNODE deployed as ultra-low energy nodes. Applications can be simply defined in software, using an application that can be downloaded from Dialog's customer portal.

Features

- Complete drop-in solutions for RF networking
- Transceiver, baseband, power amplifier and antenna
- Protocol and application interface software
- Fully type approved, tested and TBR-6 / FCC certified
- Programmable via AT command set
- Ultra low power - sleep current < 3 μA
- Transmit power 23 dBm (200 mW)
- Power supply voltage 2.10 - 3.1 V

Our SmartBond™ family helps you minimize system cost and maximize node autonomy– while giving you complete design freedom.

Audio processors for smart speakers and other home automation applications

Smart speakers connecting to your smartphone or the cloud when used in the home continue to be an increasingly popular consumer application today. Integrating WiFi, Bluetooth for audio streaming - along with features such as Far Field beam forming, AEC, Hotwords or other voice control together with traditional audio features such as equalization.

Dialog addresses the smart building market using a common platform using its SmartBeat ICs as the heart of the system, and augmenting it with a portfolio of ICs which can be combined to complete a customer's system such as:

- **SmartBeat audio processor for audio effects, as well as input processing (Hotword etc)**
- **Multiple PDM inputs for multi microphone arrays**
- **Radio interface to 2.4 GHz Bluetooth HCI devices**
- **High efficiency, small and easy to use 10 Watt Class-D amplifiers**
- **External Power Management PMICs for higher efficiency DC/DC**
- **AC/DC power conversion with zero current draw at no load**
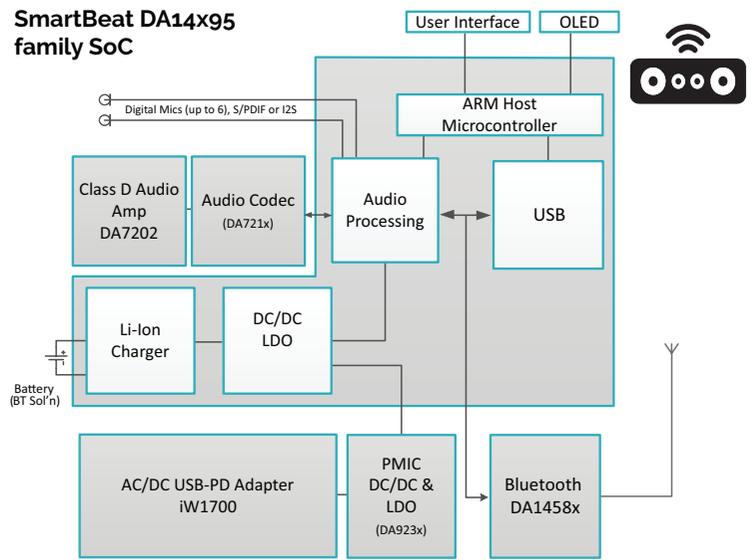
Audio Processor SmartBeat SoCs
Dialog offers a simple route to home automation audio processing using the SmartBeat range of Audio SoCs.

Device	Why it benefits this application
DA14195	Ideal for home automation applications, the ARM microcontroller, 32-bit audio DSP, USB, DC/DC, chargers and more are integrated
DA14495	Integrated 1.9 MHz DECT radio

Efficient processing power

SmartBeat audio processors integrate an efficient 32-bit ARM® Cortex™-M0 microcontroller (MCU) and a C-programmable 32-bit Cadence® (Tensilica®) HiFi 3 DSP. This combination ensures a small, low-power solution with all the performance necessary – and more - for smart speakers offering outstanding sound quality and ambient noise cancellation. Moreover, the MCU operating frequency can be scaled to further reduce power consumption, while the DSP is supported by a wide range of 3rd-party audio algorithms.

Flexible memory architecture

The audio processor's shared memory architecture comprises onboard cache, system RAM and DSP RAM. For maximum design flexibility, the MCU code (executed in place) and DSP code is stored in external QSPI Flash memory so that memory costs can be tailored to suit application requirements.

Versatile power management

With its integrated step-down converter, the audio processor can be powered directly from USB or by batteries ranging from 1.9 to 5 V. A high-precision fuel gauge maximizes battery lifetime so users always know how much music playtime remains. Meanwhile the dead battery wake-up feature ensures the display works no matter how long the product has been on the shelf – so buyers don't confuse a flat battery for a faulty product.

Consumer-friendly connections

SmartBeat audio processors integrate a USB 2.0 FS/HS port which supports USB charging specifications 1.2. It offers data rates up to 480 Mbps for excellent voice and music quality, and is fully compatible with USB-Type C – an emerging smartphone connectivity option. Moreover, the audio processor supports two different HCI clocking schemes - easily combining with any Bluetooth HCI - or simply use the version with the integrated 1.9 GHz interference-free radio.

Modular and open software architecture

Audio processor architectural layering and towering ensures a highly versatile and easily extendible software platform. It provides all the building blocks needed plus the flexibility to create custom home automation solutions. Power management is a core component, while the flexible audio API allows you to set up multiple streams independently. Software is available as source code, so it can be fully customized. To maximize flexibility and customization, Dialog offers a powerful yet compact embedded development kit. Furthermore a host of CODECs, sound enhancements and other audio packages are available from Dialog and third parties.

Low Power Wi-Fi® SoCs

Ultra-low power Wi-Fi enables battery powered IoT devices to connect easily and directly to Wi-Fi networks while delivering maximum battery life of over a year in most applications.

Dialog's DA16200 is a highly integrated ultra-low power Wi-Fi system on a chip (SoC), which contains an 802.11b/g/n radio (PHY), baseband processor, media access controller (MAC), on-chip memory and a host networking applications processor integrated onto a single silicon die. The SoC enables full offload capabilities, running the entire networking stack on chip. As a result, no external network processor, CPU, or micro-controller is required, though the SoC may be used with a microcontroller as a design option.

The deployment of breakthrough ultra-low power technologies enables highly efficient operation within the SoC: Low power algorithms shut down every micro element of the chip that is not in use, allowing a near zero level of power consumption when not actively transmitting or receiving data. Such ultra-low power operation delivers maximum battery life of over a year in most applications. Advanced sleep mode algorithms conserve battery power until the exact moment required to wake up to transmit or receive.

This advanced SoC is built specifically for IoT applications. It is ideally suited for door lock, thermostat, security camera and sensor applications - almost any device that uses Wi-Fi where highly efficient battery powered operation is desired.

Evaluation boards and a complete software development kit (SDK) are available. The SDK comprises all sample applications, provisioning apps, AT command library and power management tools required for rapid implementation.

A fully staffed, highly trained, worldwide application engineering support team is available to help customers quickly integrate the SoC or its associated module into their products.

Low Power Wi-Fi® solutions for IoT applications

Features	Benefits
Ultra Low Power	Breakthrough VirtualZero™ technology Virtually no power consumption in sleep state Enables year-plus battery life Ultra low power sensor wake-up
Superior Range	Industry leading output power and Rx sensitivity for max range
Highly Integrated SoC	802.11b/g/n radio PHY, BB/MAC, PA, LNA w/on chip SRAM Up to 72 Mbps, MCS0-7
Full Offload	SoC runs full OS & TCP/IP stack
Simple Setup & Provisioning	Automatically find & configure new devices w/ smartphone app
Complete Software Stack	Comprehensive networking software stack
Leading Security	Multiple layers of commercial, industrial, and banking grade security
OTA Firmware Update	Enables field deployed device firmware updates
Multiple I/Os	UART, SPI, SDIO, ADC, I2C, PWM, I2S, GPIOs, JTAG and SWD
eMMC/SD Expanded Memory	Data logging, memory intensive applications

| Product	Package	Key Features
DA162000	QFN 6mm x 6 mm, 48-pin	Wi-Fi 802.11n 1 x 1 Very low power Long battery life Extended Range Strong Security
DA162000	fcCSP 3.8mm x 3.8 mm, 72-pin	

DA16200 ultra-low power Wi-Fi SoC
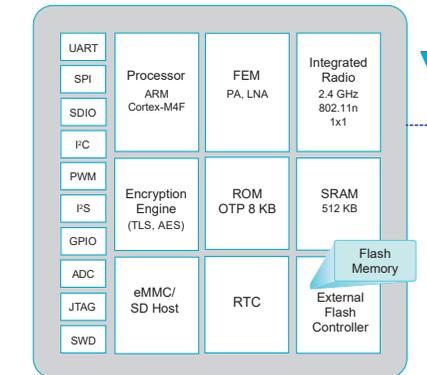
Custom Mixed-Signal Solutions

Dialog Semiconductor develops the most advanced Power Management ICs (PMICs) and Mixed-Signal ASICs. Its customized solutions help to make smart home systems smaller and improve performance. Dialog has a proven track record developing advanced solutions for industry leaders. The company's exemplary record has resulted in multi-generational partnerships which have firmly established Dialog as a trusted partner of choice.

Integrate to Differentiate

Dialog enables many of the smallest and most efficient smart home products on the market today. Its broad, mixed-signal portfolio ranges from audio solutions, advanced power conversion topologies, battery chargers, digital and analog interfaces to linear analog and signal conditioning technologies. Dialog's digital capabilities include embedded computing as well as memory to empower next generation solutions. Advanced packaging technologies co-developed with the company's packaging experts and vendor partners continue to deliver leading edge solutions in the mixed-signal market.
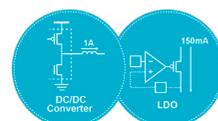
Power Management
- DC/DC Converters
  - Buck
  - Boost
  - Buck-Boost
- Hybrid Converters
- Switch-Cap Converters
- LDOs

Battery Chargers
- Linear Charging
- Switchmode Charging
- Direct Charging
- Current Doublers/Voltage Dividers
- Power Path Management

Audio
- Audio Amps
- Audio Codecs
- Audio Processors
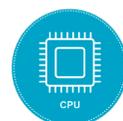- Integrated Power and Audio Solutions

Interface
- USB Phy
- Type-C Controller
- I2C/I3C
- SPI
- UART
- Display Drivers

Linear Analog & Signal Conditioning
- ADC
- DAC
- Op-Amps
- Comparators
- References
- Sensor Interface
- Integrated Motor Drivers

Computing
- CPU/MCU
  - ARM
  - 8051
  - DSP
  - Custom
- Memory
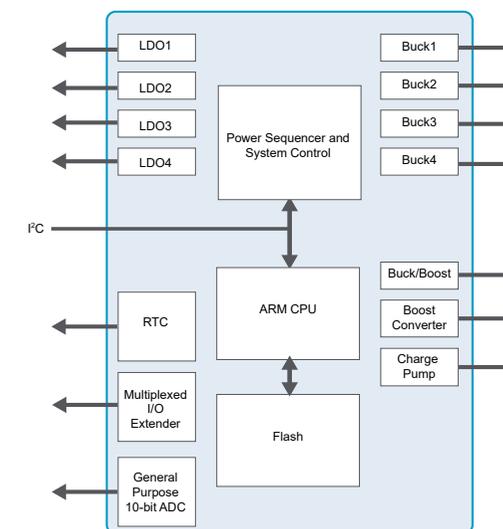 - Flash
  - OTP
  - MTP

Time-to-Market

Dialog is now the leading pure play provider of advanced Power Management ICs. This level of success was achieved through absolute attention to detail. Dialog ensures that all IP is proven to perform as designed. Its accumulated library of leading-edge technologies enables Dialog to execute flawlessly and deliver "First Time Right" solutions.

Operational Excellence

Dialog's long-standing relationships with world-class manufacturing partners for wafer fabrication back-end assembly and test provide access to advanced mixed signal process nodes. Expertise in mixed-signal ASIC design and development from concept to production guarantees the highest levels of quality.

Dialog's unparalleled high-volume production ramp capability (from zero to 80 M units within a quarter) empowers its customers to rapidly deliver new products to market. The internal supply chain team at Dialog has delivered 99%+ on-time-delivery (OTD) while working closely to react to today's dynamic and volatile market conditions.

A representative example of a high-performance Custom ASIC in production

Haptics

Haptics technology recreates the sense of touch to the user by applying forces and vibrations in the form of touch feedback in displays, touch surfaces and buttons.

The DA728x - High definition, low power and flexible:

The DA728x family of High-Definition (HD) Haptic Drivers, combine custom drive sequences, on- and off resonance, at up to 1kHz. The device can drive both ERM and LRA (narrow and wideband) actuators and track resonance up to 300Hz to drive the most complex click/vibration touch effects in a wide range of applications.

Saving power when idle:

As haptic drivers spend the majority of their time in standby/idle mode, the DA728x family was designed to utilize very low idle current consumption (360nA) to maximize battery life.

The DA7282 has an additional standby mode where current consumption drops to 5nA, making it an ideal driver for systems where the highest priority is current consumption when not in use.

The DA728x family combines very low idle current consumption with low-latency trigger inputs to minimize system power consumption. Integrated trigger inputs allow haptic operation without waking the application processor, and latency times at sub-1ms give real switch behavior - 10x better than any other solution available today.

Simplifying usage in touchscreen and capacitive touch systems:

Product	Market Focus	Control Method	# of input trigger pins	Lowest power mode	I²C Addresses
DA7280	General Market	I²C, PWM, GPI	3	360nA Idle	1
DA7281	Multi-LRA Systems	I²C, PWM, GPI	1	360nA Idle	4
DA7282	Wearables	I²C, PWM, GPI	3	5nA Standby	1

DA728x Family Overview

- **Wideband LRA driver: 25Hz to 1kHz with resonant mode Frequency tracking support up to 300Hz**

  Drives LRAs off-resonance for custom effects, or dual resonant systems for two-dimensional vibration

- **Up to 500mA output current**

  Drive large or small LRAs and ERMs for the best haptic experience

- **360nA idle power mode with full I²C control and memory retention**

  Ultra-low power consumption means longer battery life

  Only 0.75ms latency when responding from ultra-low idle power state
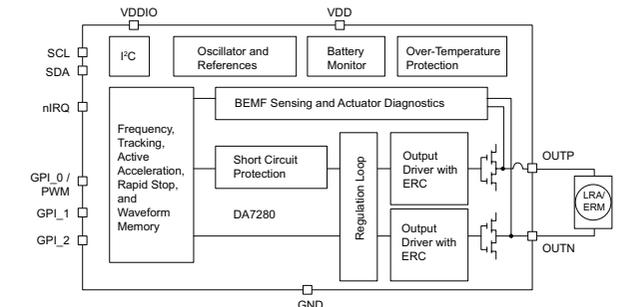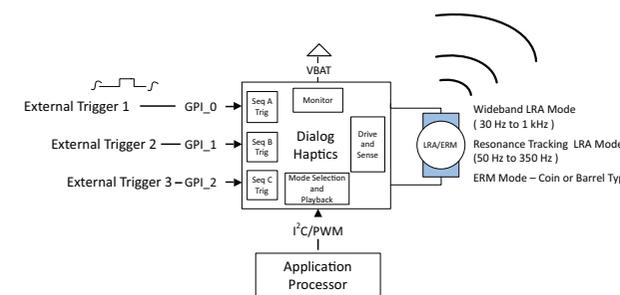
- **On-the-fly diagnostics**

  Detect issues with the LRA/ERM Automatically and generate interrupts

- **Three methods of drive for ease of use**
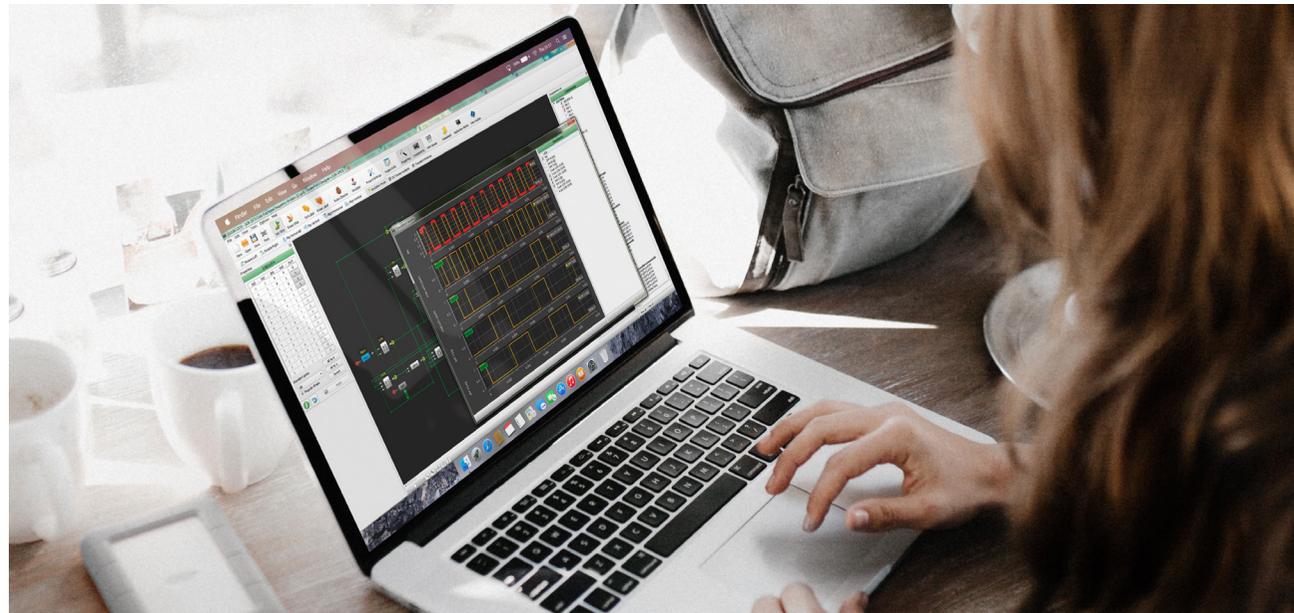
  I²C, PWM and General Purpose Inputs (GPIs)

- **5nA standby mode enabled in the DA7282**

GreenPAK Development Platform
Enabling Innovation At A Low Price

Smart home electronics continue to evolve as users desire more intelligent solutions that connect, predict, monitor, alert, and control their environment. The GreenPAK Development Platform includes an intuitive software GUI and development kit to allows designers to create custom ICs tailored to their specific smart device. Customized GreenPAK IC prototypes can be ready for use in just minutes and ready for mass production in weeks.

STEP 1
Place unprogrammed GreenPAK into socket

STEP 2
Design your IC with GreenPAK GUI

STEP 3
Click program to freeze GreenPAK's OTV NVM

Program

STEP 4
Your custom IC is ready for use

GreenPAK Configurable Mixed-signal IC

GreenPAK Configurable Mixed-signal IC (CMIC) allow designers to integrate previously separate functions into the same tiny silicon package, reducing supply chain issues, system cost and power consumption. The possible mixed-signal circuits that can be implemented using GreenPAK are endless.

Motion Sensor

Temp Control

Security System

Smart Watering System

Smart Home Devices

Automatic Door Opening and Closing System
Configure GreenPAK as a custom motor control IC

Motion Detector
GreenPAK can be easily configured to manage power-up and sensor inputs as well as drive alarms, LEDs & piezo buzzers

Temperature monitoring
Create a GreenPAK IC that monitors temperature, and drives indicator LEDs and flags when a desired temp set-point is reached

Security Door Lock with Keypad Entry
Implement a custom keypad entry code IC with GreenPAK that opens a door with a basic security code

Automatic Watering System
Configure GreenPAK into a control IC that will acknowledge user defined watering time and period via button presses and drive LED indicator lights when necessary.
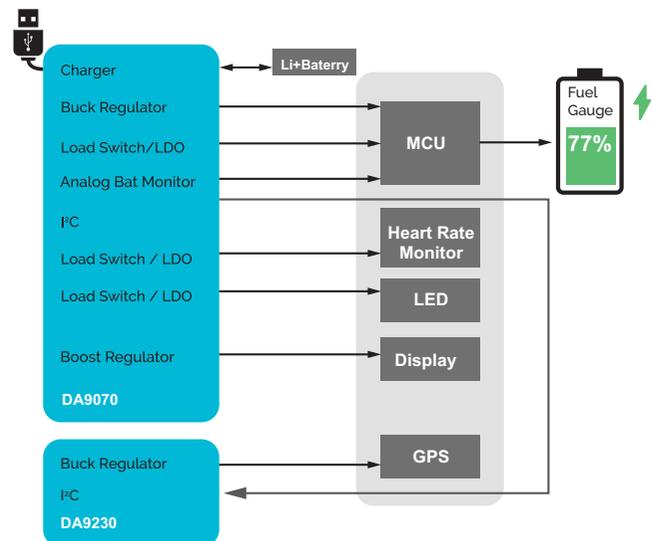
Kitchen Timer
Using GreenPAK, a designer can create the control IC for a functional kitchen timer with start/pause/reset features, as well as buzzer output and visual indicator

And much, much more....

Power management ICs

Driven by the needs of the rapidly growing beacon and tracker devices for small and efficient power solutions, Dialog offers the DA9070, DA9073, DA9230 and DA9231 Nanopower PMICs, which extend the battery life of these systems while fitting into a compact form factor.

DA9070 / 73 is a highly integrated PMIC that includes the most common needs in these applications including a linear charger with Power Path management, 300 mA high efficiency buck regulator and three 150 mA LDO/Load Switches, wide output voltage boost regulator, as well as watchdog and protection features. The DA9070 also integrates battery voltage and current monitors which enables the ability to create an efficient battery fuel gauge solution. The devices are offered in a compact 42-pin 2.97 mm x 2.66 mm WLCSP package.
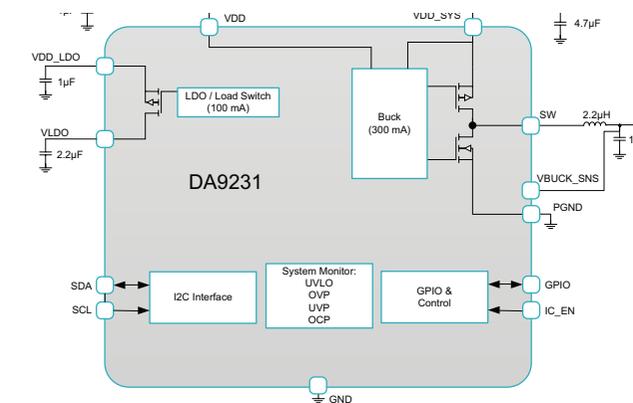

DA9231 is a configurable PMIC with a 300 mA high efficiency buck converter and 100 mA LDO/load switch with ultra-low Iq, while the DA9230 is a standalone buck converter. The devices are offered in a compact 12-pin 1.65 mm x 1.25 mm WLCSP package.

DA9232 is a configurable PMIC with a 60mA high efficiency buck converter with < 10mV output ripple. The DA9233 uses the same buck converter and adds a 110mA LDO / load switch. The devices are offered in a compact 12-pin 1.65 x 1.25 mm WLCSP package.

Device	Why it benefits this application
DA9070	Complete Nano-amp Iq power management solution supports ultra low-power fuel gauge
DA9073	Complete Nano-amp Iq power management solution extends battery life and reduces PCB area
DA9230	Nano-amp Iq DC/DC buck converter: Increases efficiency over SoC integrated DC/DC solution for longer battery life
DA9231	Nano-amp Iq DC/DC Buck Converter with additional LDO with uncommitted pins
DA9232	Nano-amp Iq DC/DC buck converter with ultra low output ripple for GPS & RF applications
DA9233	Ultra low ripple Nano-amp Iq DC/DC buck converter with additional LDO

The battery life of smart building applicaions is significantly improved due to the low quiescent current delivered by the buck regulator in Dialog's Nanopower PMICs during operation and standby modes. The buck regulator extends high light-load efficiency down to 10 uA load current and features Dynamic Voltage Control (DVC) that optimizes system power modes providing further improvement in system efficiency and battery life. The LDO's uncommitted inputs can be connected to either the battery or the buck output. Efficiency improvement versus DC/DC converters typically found in highly integrated SoCs, can be as high as 15%, significantly conserving battery life. The regulators (Buck and LDO) can be individually enabled and configured using I2C control for dynamic power savings.

Key Features

Increased battery life

< 900nA Iq buck converters, programmable down to 0.6V with dynamic voltage capability

< 800nA Iq LDOs which are configurable as load switches

High integration

I2C interface for device configuration and control

Low external component count

Small WLCSP package

Power conversion solutions

Zero Standby Power Controller

Dialog's iW1700 AC/DC PWM controller enables smart home and building devices to draw zero current while in standby. It uses the company's PrimAccurate™ digital control technology, which enables accurate control of an isolated power supply secondary side voltage from its primary side - without the need for an optocoupler or secondary-side controller, thereby improving reliability, reducing size and lowering total BOM cost.

iW1700 Key Features

- **PrimAccurate control reduces BOM cost:**
  - No optocoupler
  - No secondary-side controller
  - Eliminates many discrete components

- **Higher system-level MTBF and better line-surge immunity**

- **EZ-EMI® technology improves EMI performance with minimal EMI filtering components**

- **5 W output (120 V_{AC} /230 V_{AC})**

- **Reduces no-load standby power consumption to < 5 mW at no load [1]**
  - With no need for relay switch or MCU

- **Eliminates audible noise**

- **Meets stringent global energy efficiency standards including U.S. DOE; EU CoC Version 5, Tier 2**

- **Direct drive of low-cost BJT switch**

Device	Why it benefits this application
iW1700	Zero Standby Power PWM controller reduces no-load standby power consumption to < 5 mW at no load. Virtually eliminates "vampire power" consumption.

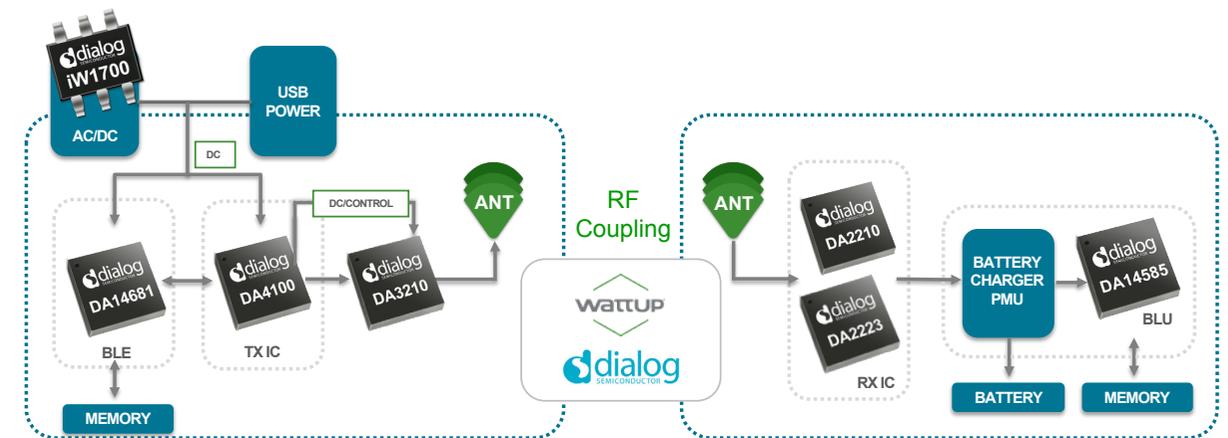(1) The IEC 62301 standard rounds standby power usage of 5 mW or less to zero.

Wireless charging ICs

Dialog and Energous

Dialog has partnered with Energous, the developer of WattUp®, an award-winning, wire-free charging technology that will transform the way devices are charged in smart homes and buildings.

WattUp is a revolutionary radio frequency (RF) based charging solution that delivers intelligent, scalable power via radio bands, similar to a WiFi router. WattUp differs from older wireless charging systems in that it delivers power at a distance to multiple devices, thus resulting in sensors and other smart home appliances being charged at a distance and not requiring a battery or having to be plugged into the mains.

Device	Why it benefits this application
DA4100	Fully integrated WattUp power transmitter IC which operates directly from 3.3, and only requires an external crystal, power amplifier and transmit antenna to complete a Near Field WattUp power transmitter design
DA2210 / DA2223	Wireless power RF-to-DC receivers which can be connected to up to 4 antennas
DA3210	Single channel high efficiency CMOS RF power amplifier

WattUp® Far Field transmitter design

The Far Field WattUp transmitter represents the furthest distance charging. A far field transmitter may be embedded into the bezel of a TV, sound bar or may be mounted on the wall or ceiling. This design enables greatly increased coverage and allows meshed network coverage where multiple transmitters are linked together to cover larger areas. As with the Mid Field design, the Far Field transmitter design is fully software controlled.

Induction Cooking

Contents

Dialog's AC/DC Technology Benefits Home Appliance Industry

The recent advances and developments in the home appliances industry are driving considerable growth and technology innovation provided by leadership companies in the semiconductor market. Consumers now have high expectations and are investing in value-added features that this technology can bring to their home appliances.

Dialog has developed a whole family of products to serve this fast-growing market.

Dialog's AC/DC Power Conversion products for this sector features the company's PrimAccurate™ Technology which ensures accurate control of voltage and current in these appliances supplying an accuracy of ±3% voltage and ±5% constant-current accuracy.

Transformer

Rectifier

Primary - Side Drive and Control

Secondary-Side Controller
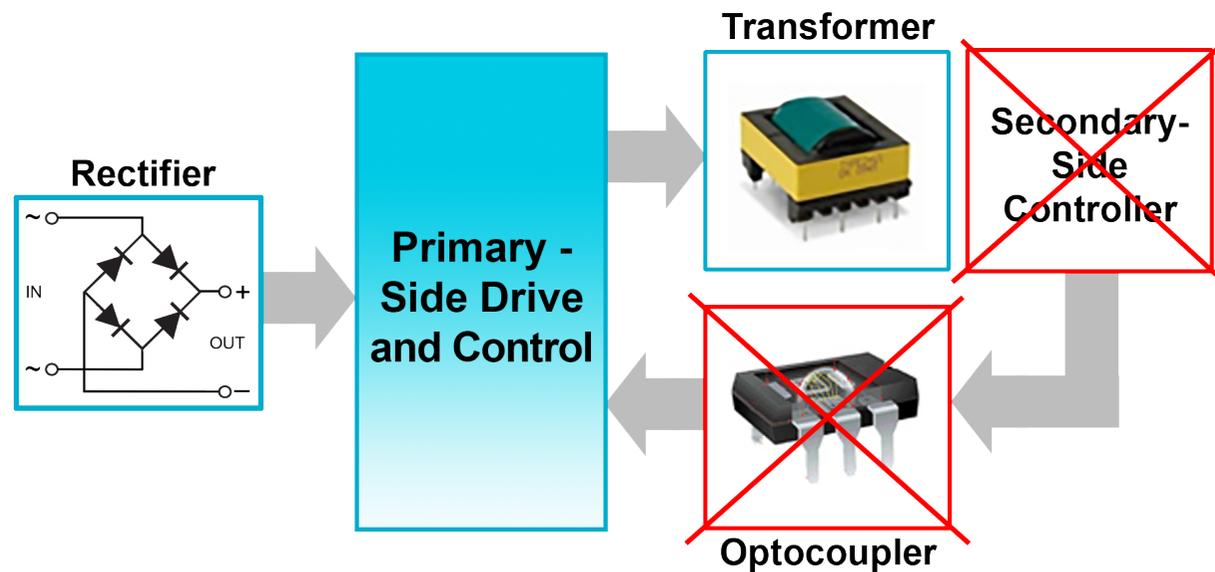
Optocoupler

Elimination of circuit elements saves BOM and board space

Dialog's innovative integrated power design approach reduces BOM cost by eliminating optocouplers, secondary-side regulator as well as mopping up many miscellaneous discrete parts which takes up less space and delivers higher reliability.

The yardstick of reliability, MTBF (Mean Time Between Failures), is a function of the total number of components and can be best understood as a series analysis where if one single component fails, the whole system fails. Dialog's integration lowers the BOM Count resulting in a higher system-level MTBF with significantly fewer solder joints and therefore less failure points.

Another important aspect in induction cooking is the reduction of electromagnetic interference (EMI) which is a legislative standard to avoid interference caused by radiation or conduction of high frequency switching products within any electronic power device.

Dialog's EZ-EMI® technology virtually eliminates these unwanted radiation products and saves board space and cost by removing the need for highly complex input filtering and snubbers to be designed in. This patented frequency dithering scheme for MOSFET and BJTs reduces overall EMI requiring far simpler input filter design, lower overall spectral noise and significantly reduced time to market.

In today's smart home – low energy connectivity in the form of Bluetooth® LE/ IoT solutions for the connected home are gaining traction as manufacturers build the IoT into their products. Here Dialog already plays an important and well-established role.

Induction Control

The design goal for induction cooking applications is to deliver highest efficiency power conversion together with differentiating features such as rapid and focused heating, operational simplicity and high reliability.

In induction cooking applications it is important that the IGBT controller, at the heart of the system, provides intelligent induction element control and gives the designer the tools and technical advantages to build a system that is efficient, reliable and integrates all required functions to simplify the design cycle and produce a volume-maufacturable design that is fast to market at a competitive cost.

Induction Heating Element Control

Power Supply for MCU. Relays, TRIACs

Bluetooth® low energy connectivity
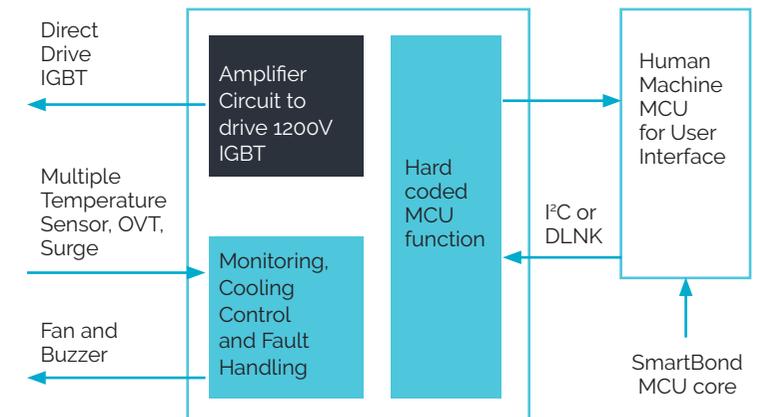
High level control functions in induction cooking

Dialog has all the necessary elements to help the designer bring a class-leading induction heating cooktop to market:

- **AC/DC – power supply controller for main electronics control board**
- **Controllers or integrated solution for ease of design**
- **State machine digital induction cooktop heating element controller with integrated analog driver blocks**
- **Smart Home – low energy connectivity**
- **Bluetooth™ LE/IoT solutions for the connected home**

Dialog's new Smart IGBT Controller – iW248

Dialog's new iW248 IGBT controller provides the designer with embedded digital and analog circuits for all hardware control in inductive cooking.

Highly integrated, the iW248 reduces the BOM count by over 35 components in a typical design, delivering high efficiency together with simpler design, faster time-to-market and lower overall production costs. This powerful device provides all the benefits of a State Machine with drivers for 2x IGBTs, fan and human interface, along with lower power continuous-mode operation, built-in protection circuitry, and 10W resolution power control.

Direct Drive IGBT

Multiple Temperature Sensor, OVT, Surge

Fan and Buzzer

Amplifier Circuit to drive 1200V IGBT

Monitoring, Cooling Control and Fault Handling

Hard coded MCU function

Human Machine MCU for User Interface

I²C or DLNK

SmartBond MCU core

GreenPAK Development Platform
Enabling Innovation At A Low Price

Smart home electronics continue to evolve as users desire more intelligent solutions that connect, predict, monitor, alert, and control their environment. The GreenPAK Development Platform includes an intuitive software GUI and development kit to allows designers to create custom ICs tailored to their specific smart device. Customized GreenPAK IC prototypes can be ready for use in just minutes and ready for mass production in weeks.

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GreenPAK Configurable Mixed-signal IC

GreenPAK Configurable Mixed-signal IC (CMIC) allow designers to integrate previously separate functions into the same tiny silicon package, reducing supply chain issues, system cost and power consumption. The possible mixed-signal circuits that can be implemented using GreenPAK are endless.

Supervisory Functions

Safety Features

Custom Logic Functions

LED Control

Supervisory Functions
GreenPAK can implement many supervisory functions that are typically required around a processing IC. Reset functionality is desirable to have in an external IC to guarantee the ability to re-start a system. Other typical functions that are also used include power rail monitoring for OVP, watchdogs, push button resets, temperature monitoring, GPIO expansion, logic multiplexing, and many others.

Safety Features
All complex systems that are consumer oriented require safety feature consideration. GreenPAK can implement many circuits that can help such as temperature monitoring, over current monitoring, port detection, over voltage control, battery monitoring, as well as other custom safety needs.

Custom Logic Functions
Each system is different and based on the desired implementation and final feature set. GreenPAK can fulfill many custom functions including boot and sleep state control, level shifting and voltage translation, power supply ORing controller, drive detection, hot plug detection, and many others!

LED Control
GreenPAK is able to offload LED control from another processing IC. Designed as a fixed function or through a simple I2C command, GreenPAK is able to implement the following LED functions: flashing, breathing, pulsing, multiple LEDs in a "chasing" pattern, etc. GreenPAK can also drive RGB LEDs using PWM for millions of possible colors.

Televisions and Set Top Boxes

Set Top Box Power Supply Solutions

## PrimAccurate™ Control for High Power Density, Low Cost Power Supplies

Set top boxes continue to move to smaller form factors with higher performance levels at lower cost. Dialog helps designers meet these challenges with AC/DC PWM controllers that use *PrimAccurate™* digital control technology to enable high power density low standby power and reduced EMI with the lowest possible bill of materials.

PrimAccurate™ control reduces BOM cost:
- No optocoupler
- No secondary-side regulator
- Eliminates many discrete components

Higher system-level MTBF and better line-surge immunity
- EZ-EMI™ technology improves EMI performance with minimal EMI filtering components
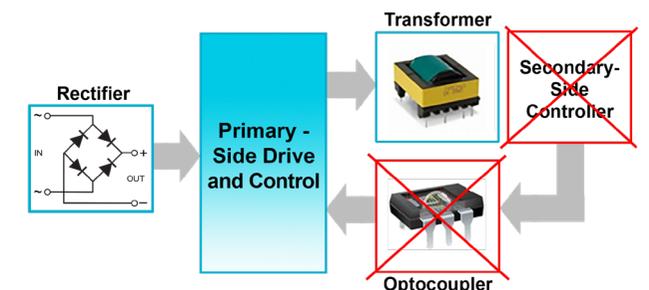
AC/DC PWM ICs

Primary Side	Secondary Side	Typical Output Power	No-Load Standby Power	Driver Type	Features	Package
iW1700		5 W	< 5 mW	BJT	Zero standby power	SOT23-6
iW1702	iW676[1]	45 W	< 75 mW	FET	Optimized for applications ≥ 9 V Option for input OVP (supports 5 V output) Configurable light load operation mode	SOT23-6 (iW1702) SOT23-6 (iW676)
iW1760B		45 W	< 50 mW	FET	Low output ripple current	SO-8

(1) iW676 synchronous rectifier for ~ 90% efficiency.

AC/DC Secondary-Side ICs

Product	Voltage Position Controller	Synchronous Rectifier Controller	Quiescent Current	Features	Package
iW676	✓	✓	< 650 µA at no load	25 V output, optimized for lowest BOM cost in applications up to 12 V	SOT23-6

High Efficiency, Low Cost 45 W Set Top Box Power Supply Solution
iW1702+iW676 AD/DC Controller Chipset

iW1702 primary-side controller

- **PrimAccurate™** primary-side current sensing eliminates secondary-side sense resistor
- Up to 45 W output
- Optimized for applications ≥ 9 V
- Configurable light load operation mode optimizes for low no-load power consumption and fast DLR[1]
- Option for input OVP
- EZ-EMI™ valley mode switching for excellent EMI performance with minimal EMI filtering components
- SOT23-6 package

iW676 secondary-side synchronous rectifier with active voltage position (AVP) controller

- High efficiency ~ 90%
- Integrated active voltage positioning (AVP) for fast DLR and < 75 mW no-load power consumption
- SOT23-6 package

Robust protection features

- Output short circuit protection
- Output over-voltage protection
- Output over-current protection
- Optional on-chip over-temperature protection

(1) DLR: Dynamic Load Response -- defined as Vout voltage deviation for load step from low to high output current.
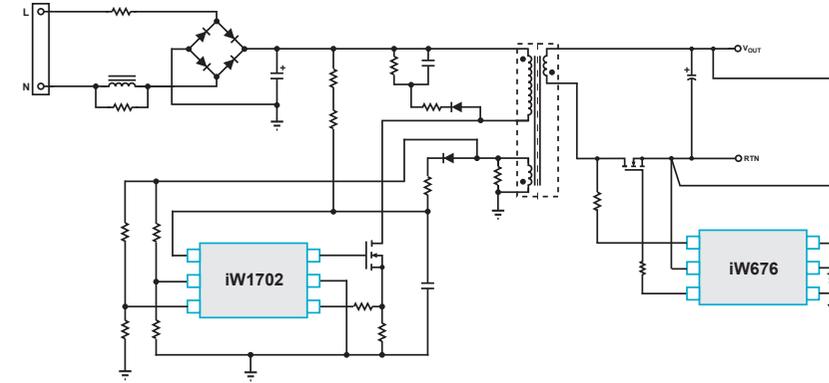
AC/DC AccuSwitch™ ICs – PWM Controllers with Integrated High-Voltage Switch

Product	Typical Output Power	No-Load Standby Power	Driver Type	Package
iW1818	12 W	< 50 mW	Integrated 800 V BJT	PDIP-7
iW1819	18 W	< 30 mW	Integrated 800 V BJT	SO-10 Batwing
iW1830	15 W	< 50 mW	Integrated 700 V MOSFET	PDIP-7

iW1818, iW1819, iW1830 – AccuSwitch™ Primary-Side Switchers Reduce Set Top Box BOM

The iW1818, iW1819 and iW1830 **AccuSwitch™** PWM ICs integrate Dialog's **PrimAccurate™** primary-side intelligent digital control and a high-voltage power switch in one IC to enable small, highly efficient set top box power supplies with very low no-load power consumption and a reduced BOM.

Key Features and Benefits

- **Integrated high-voltage internal power switch**
- **High capacitance loads (up to 6,000 μF)**
- **Meets stringent energy regulations:**

  < 50 mW no load power consumption (at 230 V_{AC})
- **EZ-EMI™ valley mode switching to reduce EMI performance with minimal EMI filtering components**
- **Robust protection features**

  Output short circuit protection

  Output over-voltage protection

  Output over-current protection

  Input voltage protection: brown-out, brown-in, unplug

  Over-temperature protection (internal sensor)

AccuSwitch™ Power Supply Evaluation Boards

Product	Output Power (max.)	Number of Outputs	AC Input	DC Output
iW1818-EVAL	10 W	Single	90 - 264 V AC	5 V / 2 A
iW1830-EVAL	15 W	Dual	90 - 264 V AC	12 V / 1 A 5 V / 500 mA
iW1830-EVAL1	15 W	Single	90 - 264 V AC	5 V / 3 A

iW1818-EVAL

iW1830-EVAL

iW1830-EVAL1

Television Backlight Driver ICs

## LED Driver ICs for LCD TV Backlighting

Product	Type	Application	LED Current (mA)	Number of Strings	Current Sinks	Max LED String Voltage	Key Features	Package
iW7027	Current Sink	Edge-Lit & Direct-Lit LED TVs	Scalable	16	External	No Constraint	2-Pin Sensing Head & Tail Mode **BroadLED™** [1] Technology	TQFP-44 QFM-48
AS3824	Current Sink	High Dynamic Range (HDR) LCD TVs	Scalable	16	External	No Constraint	2-Pin Sensing DPLL Individual Current Dimming	QFN-48
iW7038	Current Sink	High Dynamic Range (HDR) LCD TVs	200 mA	16	Internal	50 V	Head, Tail, Center Mode Individual Current Dimming **BroadLED™** [1] Technology	QFN-48

[1] **BroadLED™** technology automatically compensates for voltage mismatch of LED strings enabling the use of low-cost, loosely binned LEDs.

iW7038 LED Backlight Driver for High Dynamic Range (HDR) Displays

The vibrant visual experience of HDR TVs is achieved using direct local dimming -- and Dialog LED backlight drivers deliver the technology that makes it possible. Dialog's backlight driver ICs are used by virtually all leading TV manufacturers to enable local dimming in their 4K and 8K HDR TVs.

The iW7038 LED backlight driver brings Dialog's patented **BroadLED™** digital technology to high dynamic range (HDR) display applications to lower the solution cost, enhance thermal performance and enable longer lifetime with higher reliability. Additionally, Dialog's **AnyMode™** technology improves video picture quality, reducing motion blur and increasing contrast ratio.
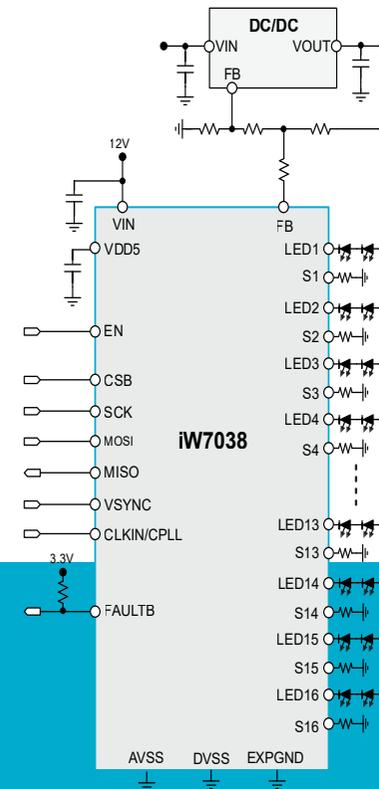
iW7038 Features and Benefits

- **16 Channels**
- **Integrated current sink MOSFETs**
- **50 V max LED string voltage**
- **Integrates 3 SPI communication protection modes**

  Password, Checksum, CRC Protection

  Safe SPI communication even in noisy AC/DC or DC/DC power boards

- **Patented BroadLED™ adaptive switch technology**

  Reduces power dissipation in the driver
  Maintains operation during LED short with minimal temperature increase
  Enables use of cheaper, loosely binned LED arrays for lower BOM cost

- **AnyMode™ technology improves video picture quality**

  User-configurable head, tail or center mode provides more options to reduce motion blur

  13-bit PWM dimming and 11-bit analog dimming improve contrast ratio in HDR displays

Dialog's backlight driver ICs are used by virtually all leading TV manufacturers
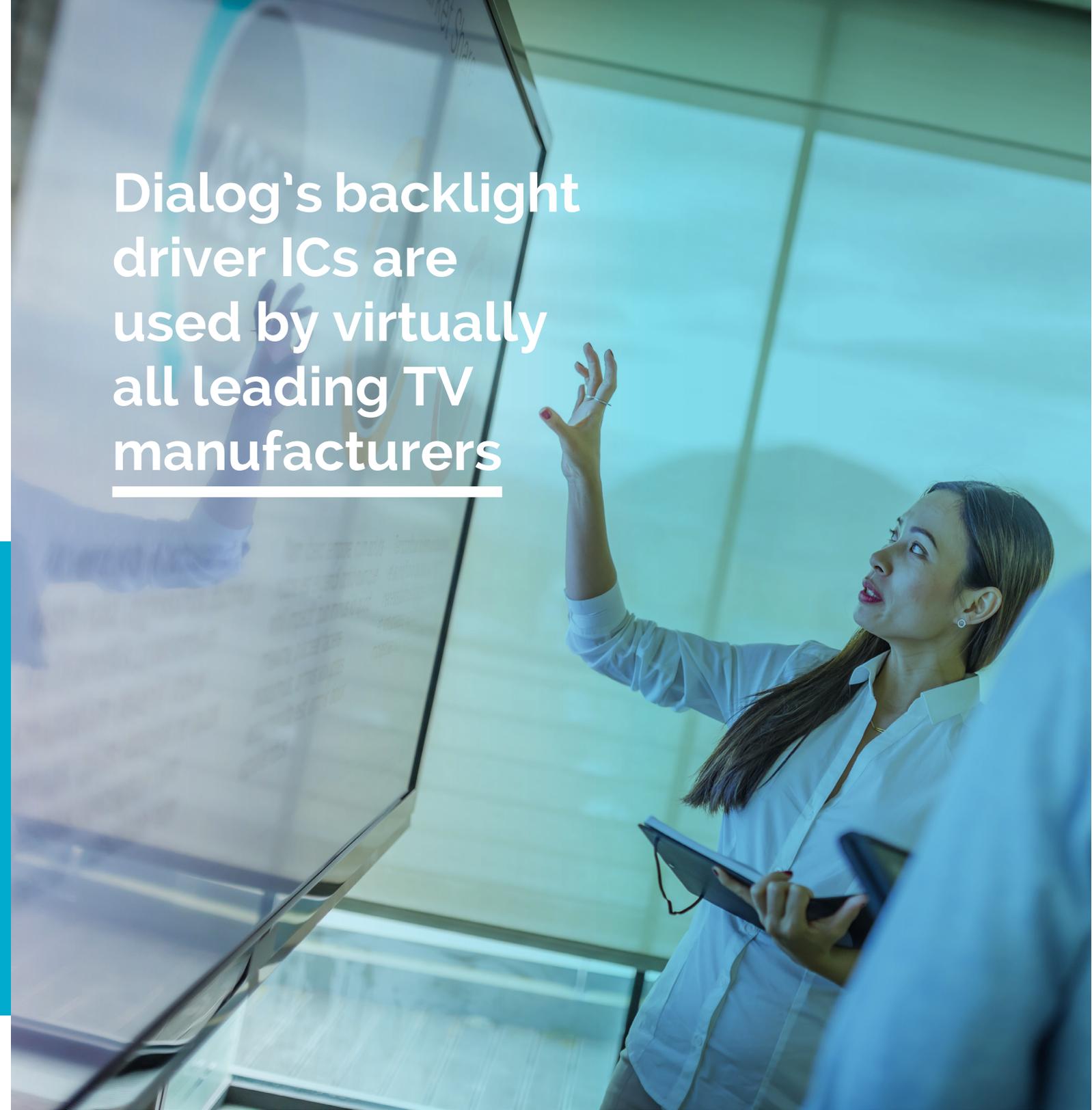
BroadLED™ Digital Technology for Higher Reliability, Lower Cost Backlighting

LED forward voltages vary from LED to LED, which means backlight driver ICs need to drive multiple LED strings, each with a different total forward voltage at the same ILED current. The difference in string voltages requires the "shorter" strings in the array to have a higher voltage drop across the current regulating driver circuits. This results in higher power dissipation and limits the number of LED strings per driver IC. One solution is to reduce the voltage offset across the drivers by selecting carefully "binned" LED arrays with similar forward voltages, but this adds cost.

Dialog's patented *BroadLED™* adaptive switch technology significantly reduces the voltage offset between mismatched LED arrays by automatically increasing current and decreasing PWM duty to keep LED brightness uniform from channel to channel. This reduces heat generation and thermal issues for higher system reliability. It also lowers BOM cost by allowing control of more LED strings per driver IC (since less heat needs to be dissipated) and by enabling the use of cheaper, loosely binned LED arrays.

BroadLED Technology Improves Reliability, Reduces BOM Cost

BroadLED™ technology automatically compensates for LED string voltage mismatch
- Maintains uniform brightness from channel-to-channel
- Reduces power dissipation
- Enables use of loosely binned LED arrays for lower BOM cost
- Maintains ± 2% channel current matching
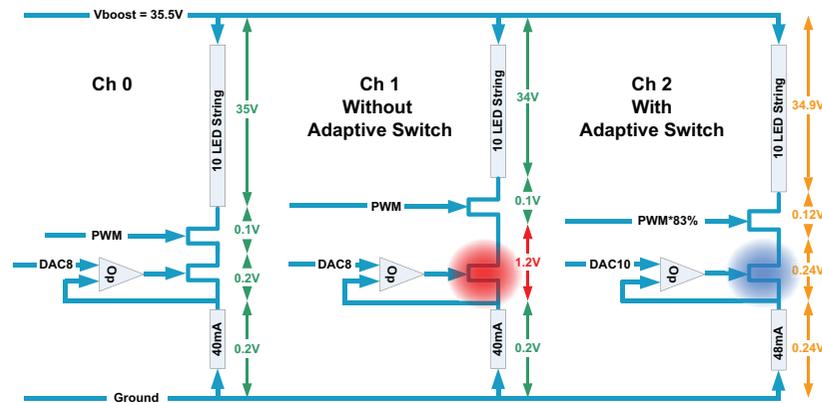
Dialog's patented *BroadLED™* adaptive switch technology

AnyMode™ Technology Improves Video Picture Quality

Dialog's patented *AnyMode™* technology offers simple, yet comprehensive, and flexible features to enhance video picture quality.

It enables the PWM duty cycle to be updated in each video frame to improve contrast ratio. Additionally, the human visual system (HVS) stretches and delays the short duration of light when viewing a display, causing motion blur. AnyMode technology generates high intensity, short duration PWM pulses, resulting in faster fade out and lessening the physiological afterimage effects of the HVS. *AnyMode™* technology also allows user-configurable head or tail delays, providing additional options to reduce motion blur.
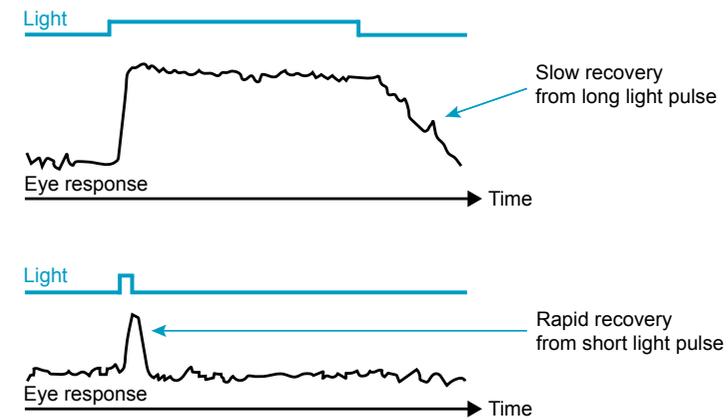
Dialog's patented *AnyMode™* technology reduces motion blur caused by the human visual system (HVS).

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