



Portable & Wearable Solutions

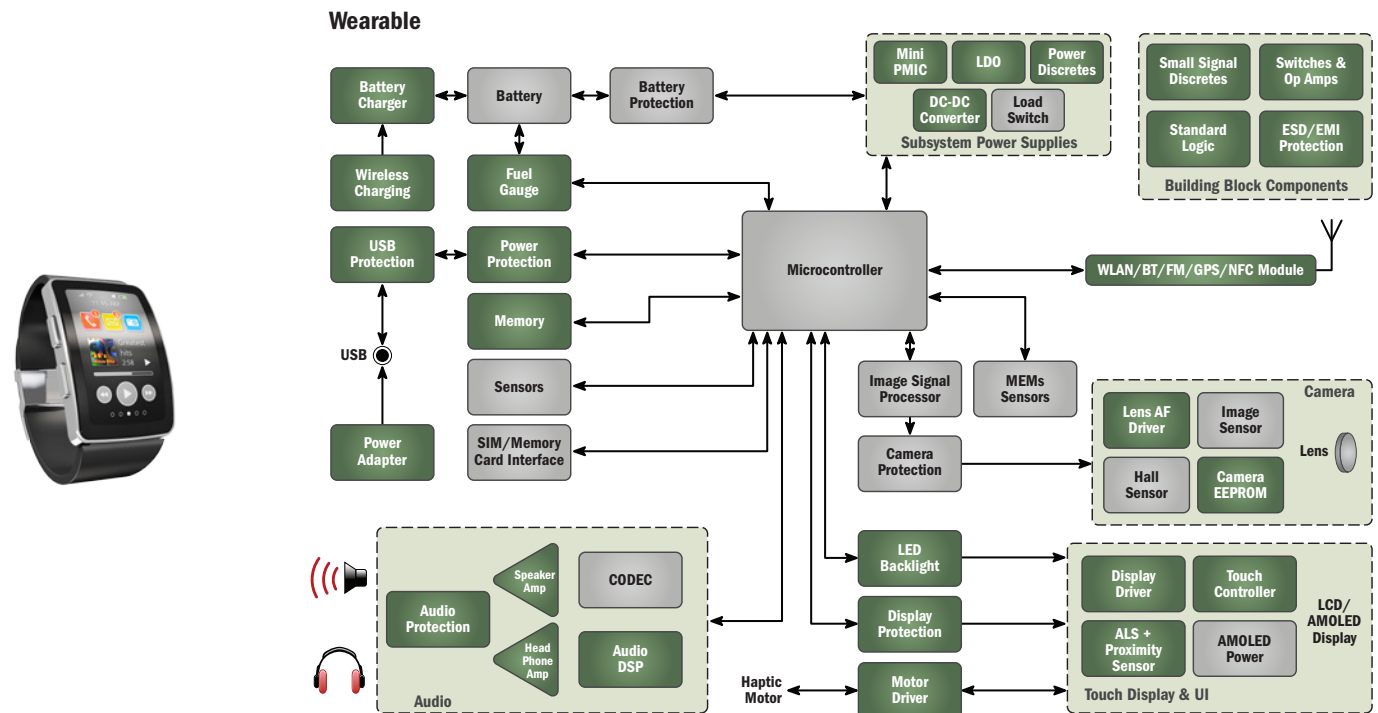
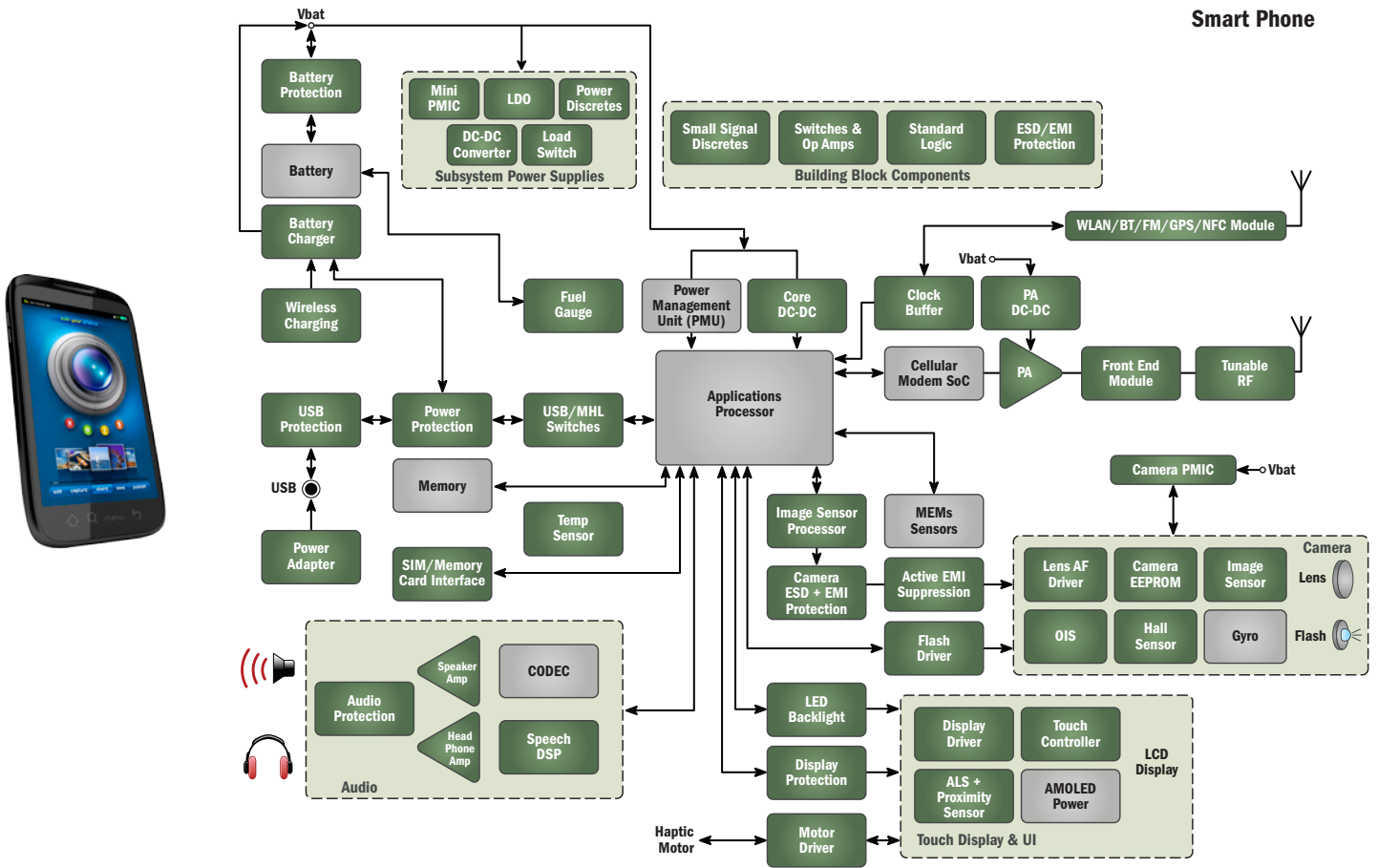


Comprehensive imaging, display, RF, audio, power management, protection, interface and memory solutions for portable and wearable devices from ON Semiconductor.

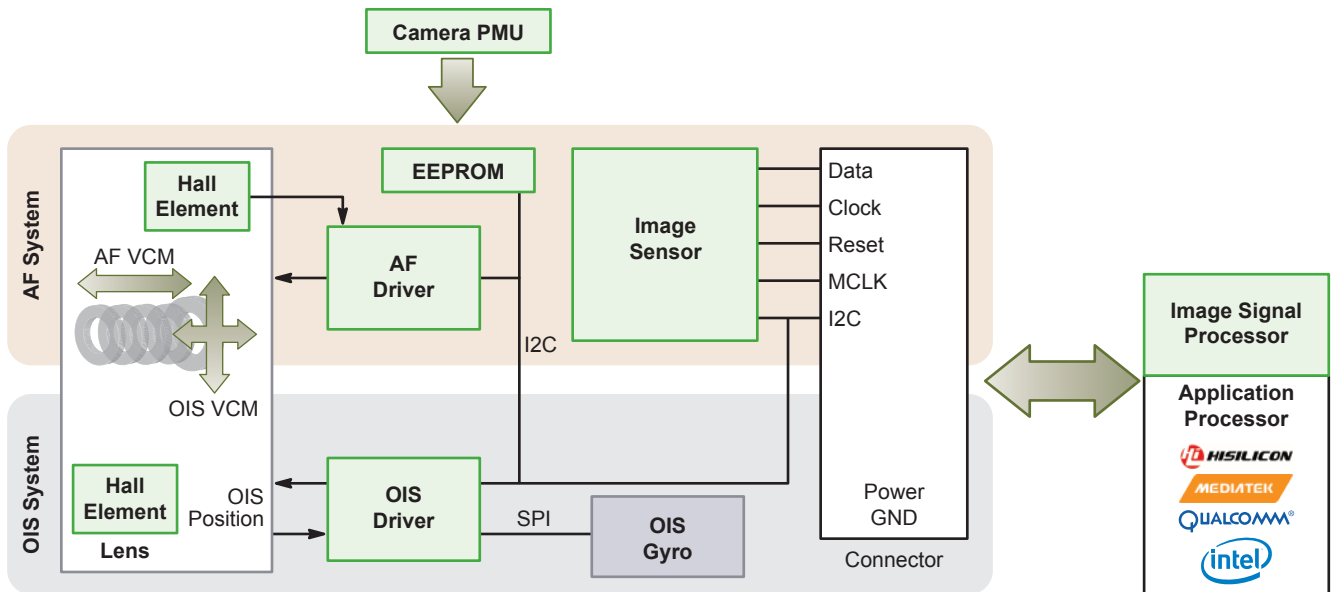
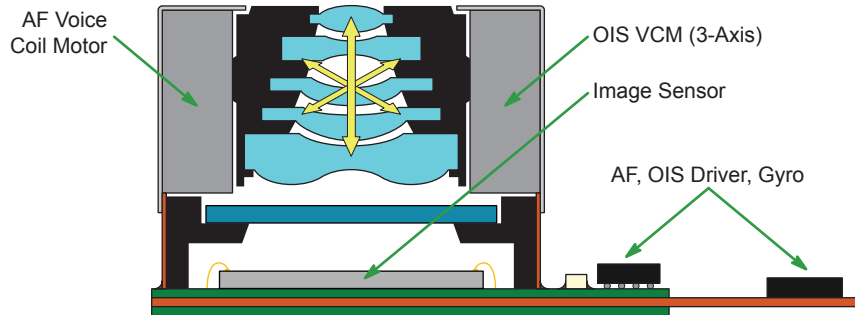


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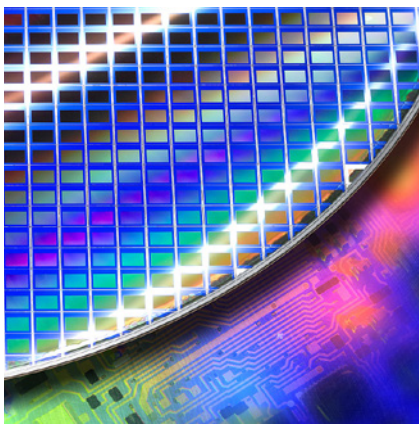


Camera Module



Mobile CMOS Imaging Sensors

The portable CMOS imaging sensor portfolio from ON Semiconductor provides options for all applications, whether a leading flagship model, a super sleek thin model, or a standard mainstream model that needs a great performing front and rear camera sensor.



Key Features

- Superior image quality with world-leading pixel technology
- Fast frame rates for the best action shots
- Low light sensitivity delivering low light image quality
- High-Definition (HD) and 4K Video

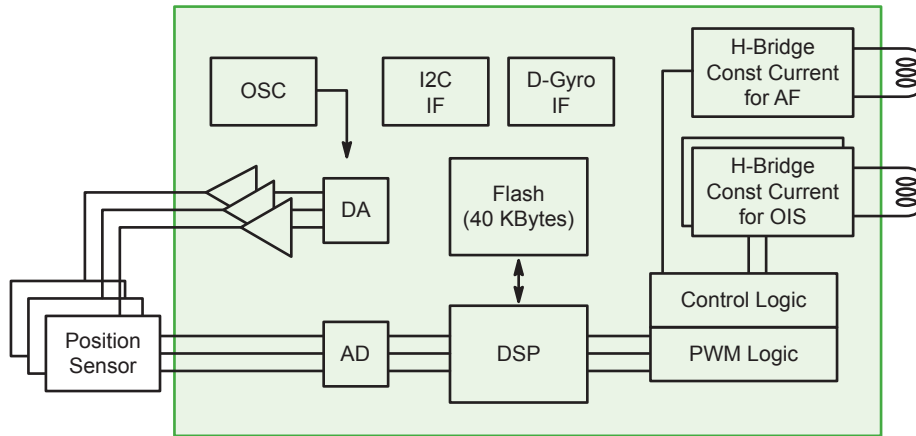
Device	Resolution (MP)	Optical Format	Pixel Size (µm)	Sensor Type	Frame Rate
MT9V115	VGA	1/13"	1.75	SOC	VGA 30 fps
ASX370	VGA	1/7"	3.0	SOC	VGA 30 fps
MT9M114	1.2	1/6"	1.9	SOC	720P 30 fps
AR0260	2.1	1/6"	1.4	SOC	1080P 30 fps
AR0261	2.1	1/6"	1.4	Raw	1080P 60 fps
AR0330	3.5	1/3"	1.75	Raw	1080P 60 fps
AR0543	5.0	1/4"	1.4	Raw	5 MP 15 fps
AR0841	8.0	1/4"	1.4	Raw	8 MP 30 fps
AR0842CP	8.0	1/4"	1.1	Raw - Clarity+	8 MP 30 fps
AR0833	8.0	1/3.2"	1.4	Raw	8 MP 30 fps
AR0835	8.0	1/3.2"	1.4	Raw	8 MP 42 fps
AR1335	13	1/3.2"	1.1	Raw	13 MP 30 fps
AR1820HS	18	1/2.3"	1.25	Raw	18 MP 24 fps

Optical Image Stabilization Drivers

LC898123F40 DSP-based Optical Image Stabilization (OIS) and Auto Focus (AF) controller/driver includes integrated Flash memory, analog circuits, H-bridge and constant current drivers. The integrated Flash enables fast wakeup and simplifies Host-side software implementation.

Key Features

- Integrated DSP software filter
- Integrated Flash memory (40 KB)
- Integrated OSC, LDO, and Hall amplifier
- Digital Gyro I/F
- 4-channel, 14-bit ADC; 3-channel, 8-bit DAC



LC898123F40 Block Diagram

Device	Type	V _{DD} Min (V)	V _{DD} Max (V)	V _M Min (V)	V _M Max (V)	Driver (mA)	CPU IF	D/A	A/D	Package(s)
LC898122/122A	Feedback	2.6	3.6	2.6	3.6	220/150	I2C	8-Bit	12-Bit	WLCSP-30
LC898123AXD	Feedback	2.6	3.6	2.6	3.6	195/120	I2C	8-Bit	12-Bit	WLCSP-35
LC898123F40*	Feedback	2.6	3.3	2.6	3.3	200/150	I2C	8-Bit	14-Bit	WLCSP-35

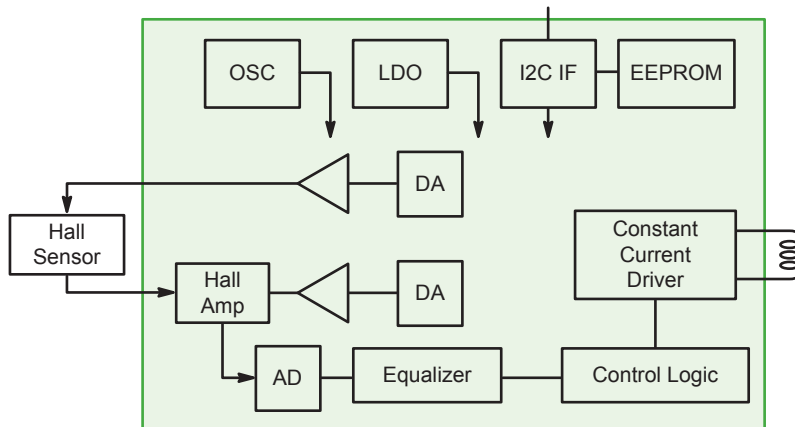
* Pending 3Q16

Closed Auto-Focus Drivers

LC898217XC closed loop auto focus driver includes integrated driver, loop digital filter, and EEPROM. System implementation requires only a Hall sensor and by-pass condenser. LC898217XC enables fast and accurate auto focusing, with low power consumption, from an extremely small footprint.

Key Features

- Integrated equalizer circuit
- Integrated EEPROM memory (128 byte)
- Integrated OSC, LDO, and Hall amplifier
- Integrated Constant Current Driver and Linear Compensation
- 1-channel, 11-bit ADC; 2-channel, 8-bit DAC



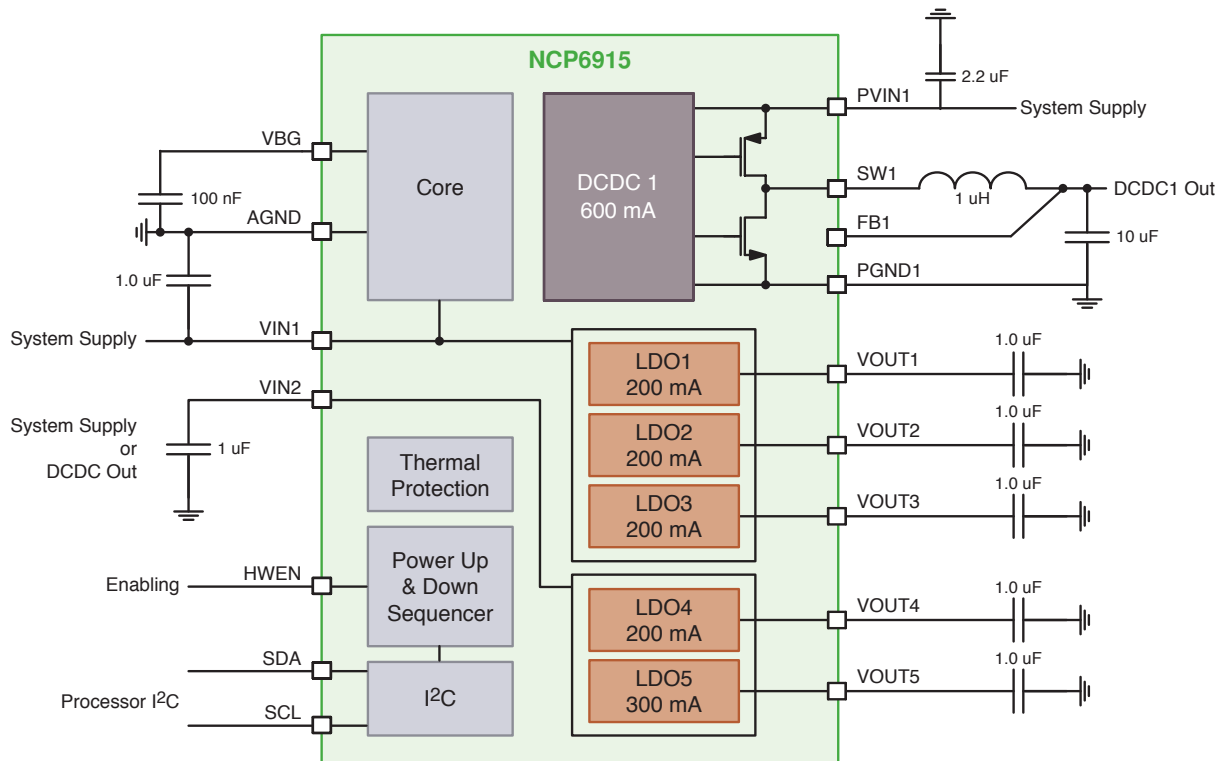
LC898217XC Block Diagram

Device	Type	V _{DD} Min (V)	V _{DD} Max (V)	V _M Min (V)	V _M Max (V)	Driver (mA)	CPU IF	D/A	A/D	Package(s)
LC898212XC/D	Feedback	2.6	3.6	2.6	3.6	130	I2C	8-Bit	10-Bit	WLCSP-12
LC898214XC/D	Feedback	2.6	3.6	–	–	120	I2C	8-Bit	10-Bit	WLCSP-8
LC898217XC	Feedback	2.6	3.3	–	–	110	I2C	8-Bit	11-Bit	WLCSP-10

Camera Module PMICs

Key Features

- Mid-size integration
 - Complements main PMU under minimum supervision
 - CSP package saves space on a flex or dedicated PCB
- High performance
 - High efficiency and low quiescent current for battery life
 - Low noise (<50 μ V_{RMS}) for high resolution performance
 - Fully programmable through I2C to adapt default output voltages and power up and down sequencing
- Modular approach
 - 5 or 6 regulators for 2D / 3D modules and back / front cameras

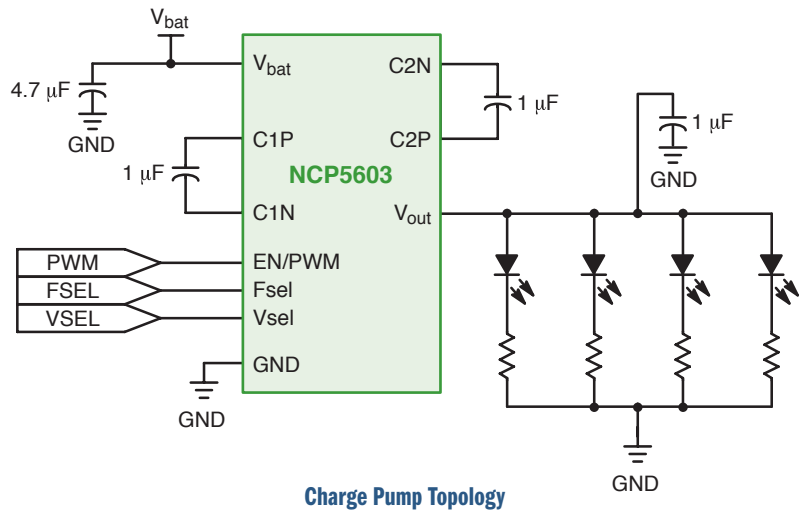
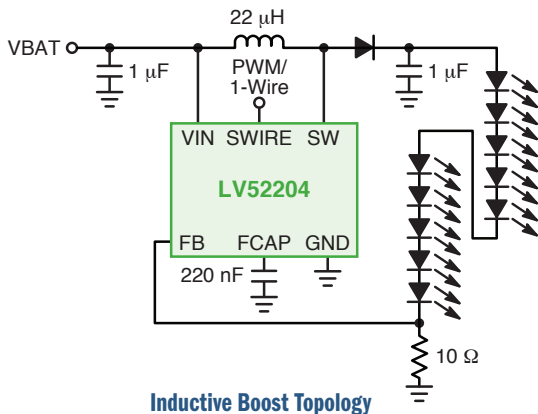


Device	DC-DC (mA)	LDO (mA)	Package (s)
NCP6925	2 x 1000	5 x 300	CSP-36
NCP6924	2 x 1000	2 x 300, 2 x 150	CSP-30
NCP6914	1 x 800	4 x 300	CSP-20
NCP6915	1 x 600	1 x 300, 4 x 150	CSP-16

Low-Voltage Portable LED Driver Topologies

White LED and RGB tricolor LEDs are widely used for backlighting small color LCD panels and keyboards, as well as indicators. High brightness LEDs are used as flash light sources in smart phones and digital cameras. These applications require optimized solutions which can maximize battery lifetime, as well as minimize the PCB area and height. ON Semiconductor has a variety of solutions using linear, inductive, and charge pump topologies. The inductive solution offers the best overall efficiency, while the charge pump solution takes up a minimal amount of space and height due to the use of low profile ceramic capacitors as the energy transfer mechanism. Linear drivers are ideal for color indicator as well as simple backlighting applications.

LCD MODULES



Charge Pump Topology

Charge Pump/White and RGB LED Drivers – for LCD Backlight, LED Flash/Torch and Indicator

Device	Input Voltage Range (V)	Number of Outputs	Total Output Current (mA)	Regulation Mode	Charge Pump Operating Mode	LED-LED Current Matching, Typ	Dimming Method	Number of Current Level/Profile	Operating Quiescent Current, Typ (mA)	Shutdown Current (µA)	Package	Notes
NCP5603	2.85 - 5.5	1	200 mA DC, 350 mA pulse	Voltage	1X, 1.5X, 2X	–	PWM	Depends on system	1	2.5 typ	DFN-10	<ul style="list-style-type: none"> Backlight 4.5 / 5 V output Short circuit protection
NCP5623B/C	2.7 - 5.5	3 (Independent)	90	Current	1X, 2X	±0.5%	I2C	32/ quasi-log	0.35	0.8 typ	LLGA-12	<ul style="list-style-type: none"> RGB illumination Backlight Built-in “gradual illumination” B & C versions have different I2C addresses

Inductive Boost and Buck Topology

Inductive-Boost White-LED Drivers – for Backlighting and Torch/Flash Applications

Device	Input Voltage Range (V)	Max Output Volt, Typ (V)	Output Current (mA)	Condition	Number of LEDs/ Configuration	Switching Mode/ Frequency	Dimming Method	Efficiency (%)	Operating Quiescent Current, Typ (mA)	Shutdown Current, Typ (µA)	Package	Notes
NCP1529	2.7 - 5.5	3.9	1	Vout 1.2 V, Vin 3.6 V	1	PWM/PFM 1.7 MHz	PWM	96	28	0.3	TSOP-5, uDFN-6	<ul style="list-style-type: none"> Flash/Torch Auto-switching between PWM and PFM mode at light load
NCP1422	1.0 - 5.0	5	800	Vout 3.3 V, Vin 2.5 V	1 for flash	PFM, up to 1.2 MHz	PWM	94	1.3 µA	0.05	DFN-10	<ul style="list-style-type: none"> Flash/Torch Internal synchronous rectification
NCP5005	2.7 - 5.5	24	40	Over 5 LED, Vin 3.6 V	2 to 5/ series	PFM, up to 2.25 MHz	PWM	90	–	0.3	TSOP-5	<ul style="list-style-type: none"> Backlight Isw = 350 mA
LV52204	2.7 - 5.5	40	30	Vout 30 V, Vin 3.7 V	2 to 10 / Series	600 kHz	1-wire & PWM	90	3	0.1	UDFN-6	<ul style="list-style-type: none"> Backlight Isw = 750 mA
LV52205	2.7 - 5.5	40	30	Vout 30 V, Vin 3.7 V	2 to 11 / Series	600 kHz	PWM	90	3	0.1	UDFN-6	<ul style="list-style-type: none"> Backlight Isw = 750 mA
LV52206	2.7 - 5.5	40	30	Vout 30 V, Vin 3.7 V	2 to 10 / Series	600 kHz/1.2 MHz	1-wire & PWM	90	3	0.1	WLP-9	<ul style="list-style-type: none"> Backlight Different pin config
LV52207	2.7 - 5.5	40	30	Vout 30 V, Vin 3.7 V	2 to 10 / Series	600 kHz/1.2 MHz	1-wire & PWM	90	3	0.1	WLP-9	<ul style="list-style-type: none"> Backlight Isw = 750 mA

Multifunction LED Drivers

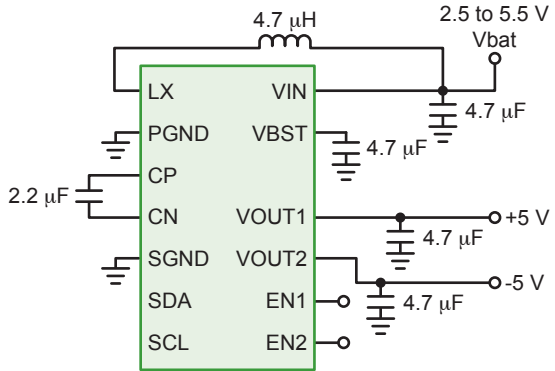
Device	Input Voltage Range (V)	Main Backlight LED Driver	RGB LED Driver 1	External Control	Topology	Serial Control	Package	Notes
LV5207LP	3.0 to 4.5	4-Ch (3-Ch Avail)	R,G,B Independent ON/OFF	✓	Charge Pump	I2C Control Bus	VCT-24	<ul style="list-style-type: none"> 7 LED channels total LED current programmable in 32 steps
LV5216	3.0 to 4.5	10-CH	R,G,B and 6 Main	✓	Charge Pump	I2C Control Bus	WLP-36	<ul style="list-style-type: none"> LED current programmable in 32 steps

LCD Display Bias

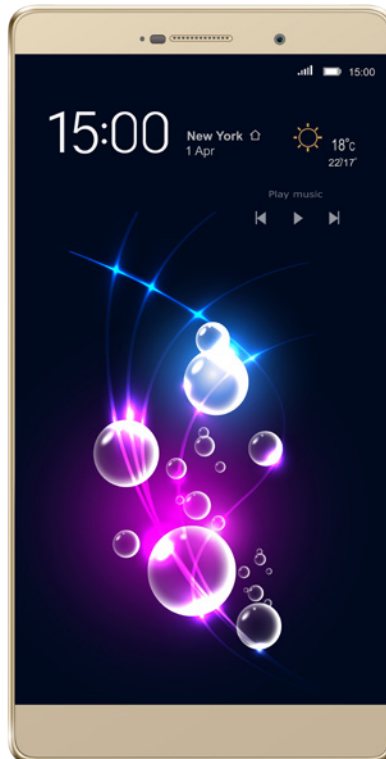
The LV52133A0XA and LV52133A5XA generate user-programmable dual-out voltages with a single inductor. Each device features short circuit protected output stages, small footprint, and ultra-low standby current.

Key Features

- Dual-outputs with single-inductor architecture
- Adjustable output voltages via I2C
- Short Circuit Protection



Device	Input Voltage Range	Default Output Voltage	Output Voltage Setting Range	Output Current	Standby Current	Package
LV52133A0XA	2.5 to 5.5 V	VOUT1 = +5.0 V VOUT2 = -5.0 V	VOUT1: +4.1 to +5.7 V VOUT2 : -4. V to -5.7 V (100 mV step)	200 mA (VOUT1); 100 mA (VOUT2)	0.3 μA	WLP-15J
LV52133A5XA		VOUT1 = +5.5 V VOUT2 = -5.5 V				



Haptic Drivers

LC898302A

The LC898302A is a haptic driver able to drive LRA and ERM. The drive frequency is automatically adjusted to the resonance frequency of the linear vibrator without external components.

Unique Features

- Drive LRAs with automatic tuning and breaking
- Drive ERM; drive voltage controlled via PWM

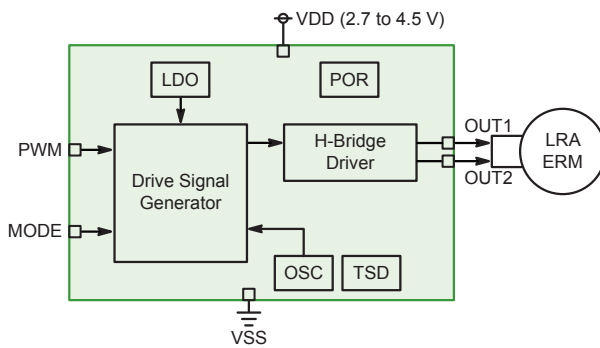
Other Features

- Supply voltage = +3.0 to +5.5 V
- $I_{out\ max} = 200\ mA$
- Bridge $R_{DS(on)} = 2 \times 2\ \Omega$ (4 x 2 Ω MOSFETs embedded)
- Low standby current

Benefits

- High efficiency
- Easy handling (no adjustment for any LRA)
- Strong vibration

Device	Description	Package
LC898302A	Haptic Driver for LRA and ERM	WLCSP-6



Block Diagram

LC898301

The LC898301 is an extended supply range version of the LC898300 LRA driver, compatible with cellular battery voltage. The architecture chosen enables strong vibration in minimal board space. Moreover, the LC898301 exhibits superior vibration performance.

Unique Features

- Automatically adjust driving frequency (ON Semiconductor patent)
- Minimized start-up and brake period (Quick stop)
- Automatically stop braking to avert counter vibration

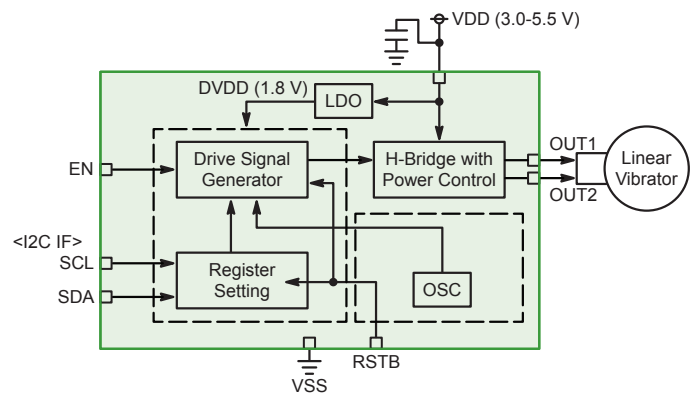
Other Features

- Supply voltage = +3.0 to +5.5 V
- $I_{out\ max} = 200\ mA$
- Bridge $R_{DS(on)} = 2 \times 2\ \Omega$ (4 x 2 Ω MOSFETs embedded)
- No peripheral component required (only 0.1 μF cap)
- Low power consumption

Benefits

- High efficiency
- Easy handling (no adjustment for any LRA)
- Strong vibration
- Fault-detection
- Battery direct supply
- Fully configurable through I2C

Device	Description	Package
LC898301XA	Haptic Driver for LRA	WLCSP-8
LC898301AXA	Haptic Driver for LRA with Immersion System	WLCSP-8

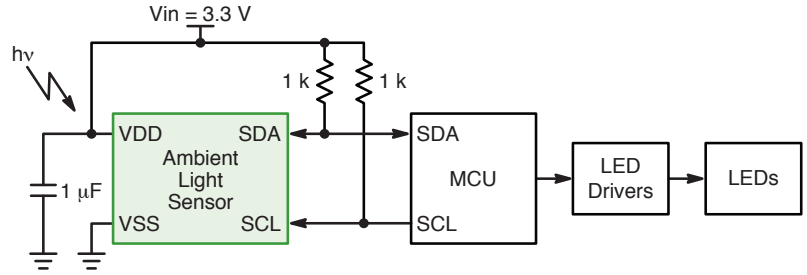


Block Diagram

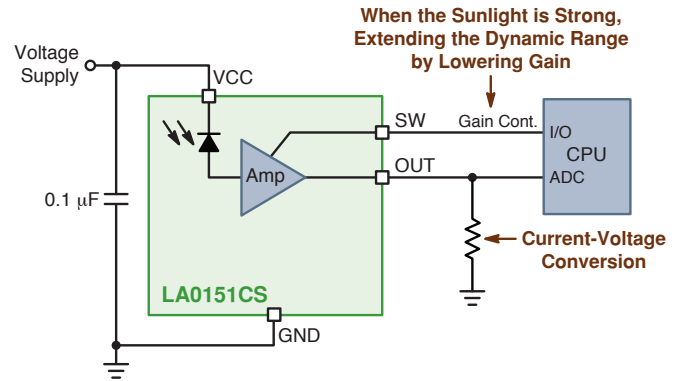
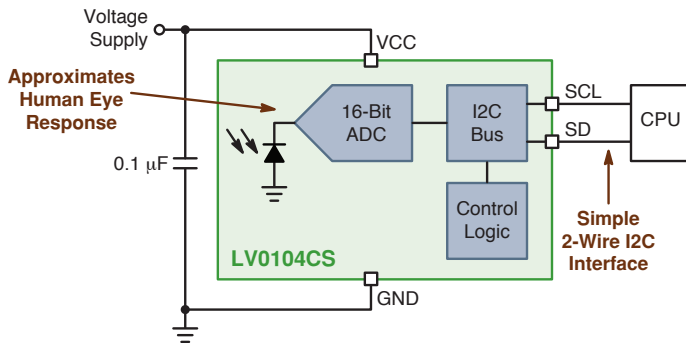
Ambient Light & Proximity Sensors

NOA1305 Features

- Design flexibility/customization (i.e., EEPROM if desired for trimming)
- 0.0125 lux detection with customizable filtering (i.e., Photopic Light Response)
- Dark current and temperature compensation
- Lowest power consumption per resolution bit
- I2C Interface (including High Speed Mode) and no effect on bus during power down



LCD MODULES

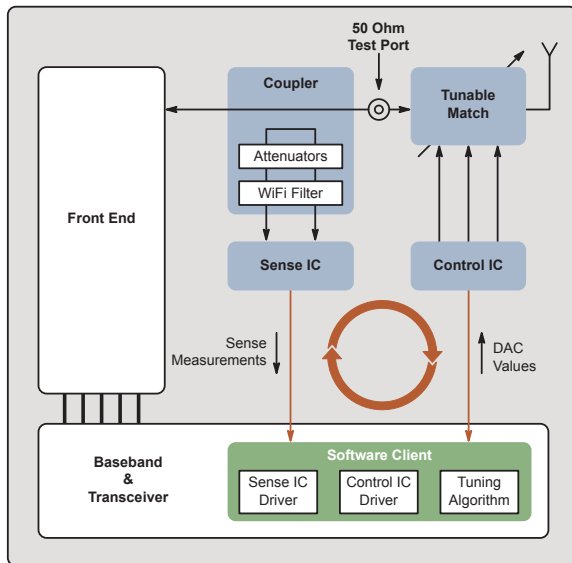
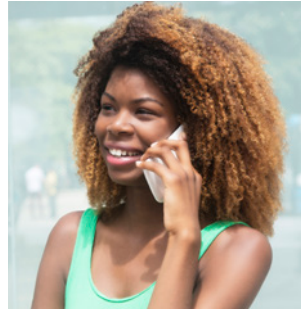


Device	Special Features	I _o Typ @ E _v = 100 Lux (µA)	Output Interface	V _{in} Range (V)	T _A Range (°C)	Package
LA0151CS	2-Stage Gain Switching	8 (high gain)	Analog, linear current	2.2 - 5.5	-30 to +85	ODCSP-4
LV0104CS	Integrated Sleep Mode	–	I2C, 16-bit ADC	2.3 - 3.6	-30 to +85	ODCSP-4
LV0111CF	Standby Function	21	Analog, logarithmic current	2.3 - 5.5	-30 to +85	ODCSP-4J
NOA1212	Dark Current Compensation	51 (high gain)	Analog, linear current	2.0 - 5.5	-40 to +85	CUDFN-6
NOA1213	Dark Current Compensation	–	Analog	2.0 - 5.5	-40 to +85	CUDFN-6
NOA1305	Dark Current Compensation	–	I2C, 16-bit ADC	2.4 - 3.6	-40 to +85	CUDFN-6
NOA3302	Proximity Sensor	–	I2C, 16-bit ADC	2.3 - 3.6	-40 to +80	CWDFN-8

RF Antenna Tuning Solutions

ON Semiconductor offers a family of dynamic tunable RF components designed to enhance antenna performance of smartphones. The devices optimally combine tuning range, RF quality factor (Q), and frequency operation, providing a superior solution to existing fixed-match approaches. These components form a flexible and comprehensive solution that can be customized to meet the RF tuning needs of any smartphone design—from open-loop matching approaches, to advanced closed-loop tuning systems. Our tunable RF solutions are ideally suited for LTE-A networks with advanced features to support, including: Carrier Aggregation, MIMO, and ASDiv functionality.

- Reduced power consumption
- Enables thinner smartphone designs
- Faster data rates
- Greater coverage area of cell sites
- Fewer dropped or missed calls



Closed-Loop Tuning

Think of the different ways in which you use your smartphone in a given day — texting a friend, typing an email, gaming, or making a phone call. Each of these use cases affect how your handset performs.

Closed-loop tuning systems provide the most advanced system for adapting to use case changes. These systems take real-time impedance measurements and optimize antenna performance to overcome the impact of various use-case effects.

Passive Tunable Integrated Circuits (PTIC)

Passive Tunable Integrated Circuits can be used to replace traditional 'fixed-match' devices for multi-band GSM/WCDMA/LTE smart phones, tunable antenna matching networks, and active antennas.

- High tuning range (5:1) and operation up to 24 V
- Frequency range from 700 MHz to 2.7 GHz
- High quality factor (Q) for low loss
- High power handling capability
- Capacitor values from 1.2 pF to 8.2 pF
- TCP Series*

PTIC Controllers

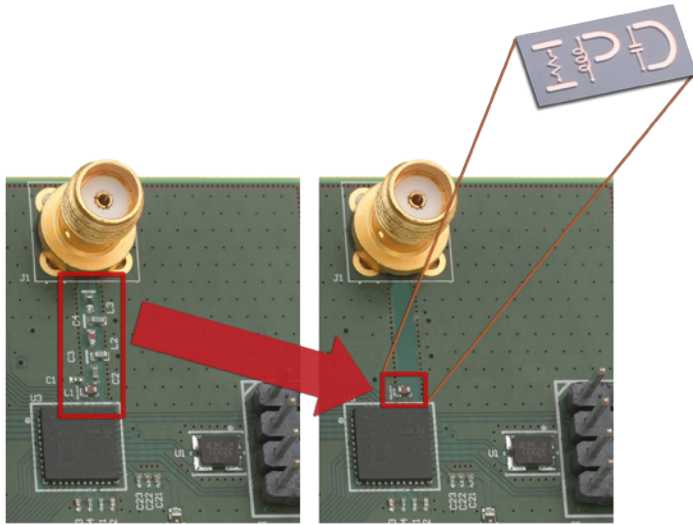
The PTIC Controller is a high-voltage digital-to-analog device specifically designed to provide control and bias in a tunable solution. It is compatible with all ON Semiconductor PTICs.

- Compliant with timing needs of cellular and other wireless system requirements
- Integrated boost converter with three to six programmable outputs (up to 24 V)
- Low power consumption
- Auto-detection of SPI (30- or 32-bit) or MIPI RFFE interfaces (1.2 V or 1.8 V)
- TCC Series*

* Pending 3Q16

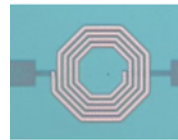
Integrated Passive Devices (IPD)

- Combines multiple resistors, capacitors and inductors onto a film substrate; typical applications include RF baluns, filters, and matching networks
- Reduces PCB footprint and component height versus discrete implementations, while also improving performance (reduced parasitics)
- Simplifies logistics, inventory management and pick-and-place assembly by elimination of multiple discrete passive SKUs

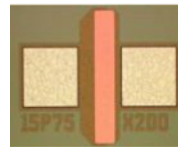


Discrete Solution **IPD Solution**
 2.4 GHz LPF Designs for ZigBee®

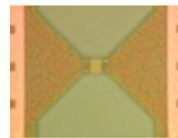
Available Components



- Copper inductors, IPD2 11 μm thick, IPD1 5 μm thick. Minimum spacing 3 μm , minimum line width 5 μm , current handling >50 mA/ μm , achieves Q-factors up to 45



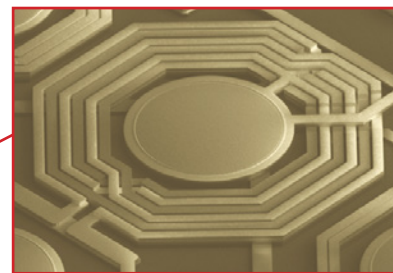
- MIM capacitors, 0.62 nF/mm², typical tolerance $\pm 5\%$



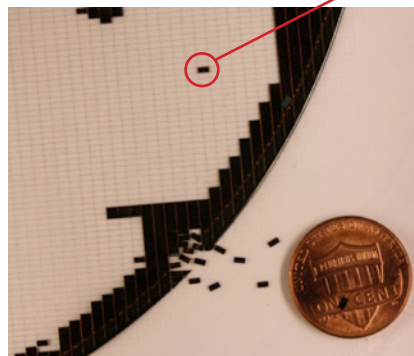
- TiN resistors, 9 Ω/sq

Sub-Micron Tolerances – Trace Spacing/Width Down to 3/5 μm

- Flip-chip or wirebond pad finish options
- Additional back-end processing available



Inductor Within IPD (SEM Photo)



Picked & Diced Wafer Edge

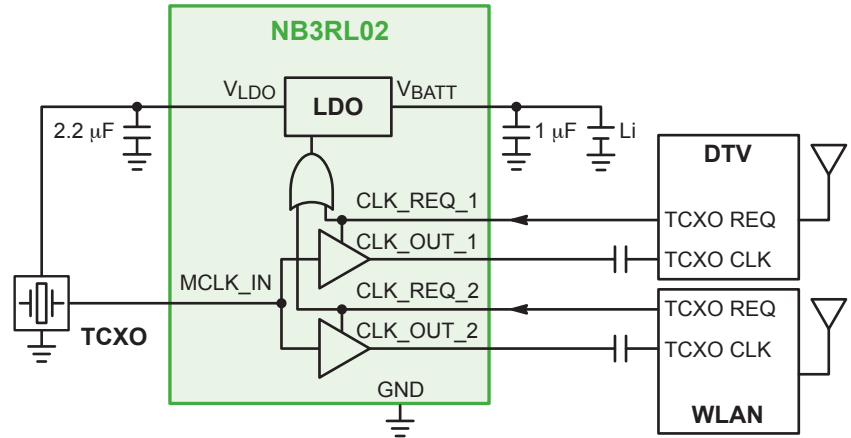
Single Ended Buffers

Clock Buffer with Integrated LDO

Key Features – NB3RL02

- Low additive noise: -149 dBc/Hz at 10 kHz offset phase noise
- 0.37 ps (rms) output jitter
- Limited output slew rate for EMI reduction (1 to 5 ns rise/fall time for 10–50 pF loads)
- Regulated 1.8 V externally available I/O supply
- ESD performance exceeds JESD 22
 - 2000 V Human–Body Model (A114–A)
 - 200 V Machine Model (A115–A)
 - 1000 V Charged–Device Model (JESD22–C101–A Level III)
- WLCSP-8 package

NB3RL02 has two CMOS outputs with clock request lines. Systems in need of TCXO clock will request clock from NB3RL02, and NB3RL02 powers the TCXO and delivers the requested clock.



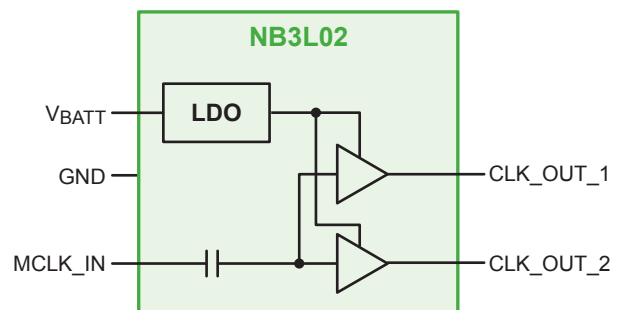
NB3RL02 Reduces Cost by Eliminating Multiple TCXOs

Clock Buffers for Wireless LAN and WiMax

Key Features – NB3L02, NB3L03

- 800 mV single ended outputs
- Low additive noise: -144 dBc/Hz at 10 kHz offset phase noise
- ESD performance exceeds JESD 22: 2 kV Human Body Model
- WLCSP-6 package

NB3L02 and NB3L03 are low-skew, low jitter, 1:2 and 1:3 clock buffers. The MCLK_IN pin has an AC coupling capacitor and will directly accept a square or sine wave clock input, such as a temperature compensated crystal oscillator (TCXO). The minimum acceptable input amplitude of the sine wave is 300 mV peak-to-peak.



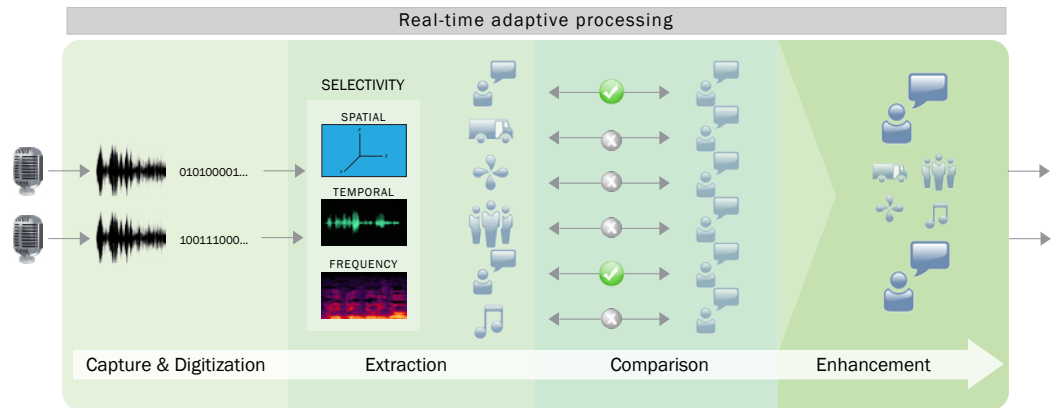
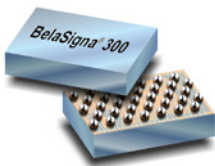
NB3L02 Simplified Block Diagram

BelaSigna® Audio Processors

The BelaSigna line of audio processors is optimized for portable applications, delivering superior audio clarity without compromising size or battery life. BelaSigna offers ultra-low power consumption, design flexibility, and a miniature package by providing a highly integrated hardware solution with a dual-core architecture featuring an open-programmable DSP core with a highly configurable coprocessor.

Features and Benefits

- Ultra-low power consumption
- Design flexibility
- Miniature size
- Computational Efficiency
- Audio fidelity
- Comprehensive development tools



Device	Description	MIPS Max	Dynamic Range (dB)	RAM (kB)	Interfaces	Power Consumption	Standby Current (µA)	Analog Audio	Package(s)
BelaSigna 300	24-bit Audio Processor for Portable Communication Devices	240	110/88	110	I2C, SPI, I2S, PCM, GPIO,	1-5 mA typical	40	4/1	WLCS-35, DFN-44
BelaSigna 250	16-bit Audio Processor, Full Stereo 2-in, 2-out	60	88	42	I2C, SPI, I2S, PCM, GPIO, UART	5 mA at 20 MHz	50	2/2	LFBGA-64, LFBGA-57

BelaSigna 300 AM with AfterMaster HD Technology

High-performance solution designed to process and enhance audio in real-time for a louder, fuller, and deeper sound. For more information, please visit aftermaster.com



BelaSigna R281 Always-Listening, Voice Trigger Solution

- Will detect a single, user-trained trigger phrase, asserting awake-up signal when this phrase is detected
- ~300 µW power consumption for true “always-on” operation without affecting battery Standby life
- Available in QFN and WLCS-35 packages



Developing a portable audio device from initial concept and design through to production can be a complex and lengthy process. Success, however, often depends on shortening product development cycles, enabling faster time-to-market.

ON Semiconductor addresses this need by providing designers with a complete solution, no matter which development path they chose. In addition to a variety of software algorithm bundles, BelaSigna audio processors are also complemented by an advanced suite of development tools. The fully integrated set of development tools enable manufacturers to quickly and easily develop, debug and test algorithm software for ON Semiconductor's audio DSP systems.

Evaluation and Development Kit Contents

Software
EDK Software and Documentation* <ul style="list-style-type: none"> Integrated Development Environment (IDE) <ul style="list-style-type: none"> Advanced Editor Debugger Project Manager Automated Build System Project Wizard EEPROM Manager Assembler Sample Applications System Libraries Documentation Set
WOLA Toolbox
SignaKlara™ Blockset
CTK Developer Kit (CTK DK)
CAA Drivers

Hardware
Evaluation and Development Board (EDB)
Communication Accelerator Adaptor (CAA)
RS-232 serial cable
USB cable
I ² C cable
Universal power supply (input 100-240 VAC, ~60/50Hz; output 9 VDC, 1.1A)

* The EDK includes one year of software updates.

Optional Hardware

Rapid Prototyping Module (RPM)	Available for Purchase
RPM Motherboard	Available for Purchase



Supplementary hardware, such as the Communication Accelerator Adaptor and Evaluation and Development Board, are also available for purchase.

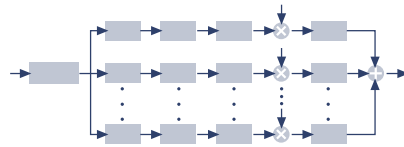
Contact your local ON Semiconductor sales office at www.onsemi.com/salesupport for information on purchasing or renewing software subscriptions.



Solution Evaluation

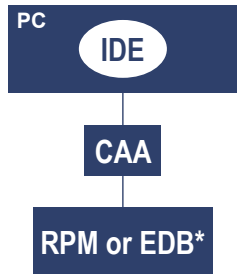
To evaluate audio processors and signal processing software, ON Semiconductor offers a solution that is easy to demonstrate, evaluate and design in. Developers can use software tools to develop their own signal processing algorithms to run on the BelaSigna hardware.

RPM



Algorithm Development

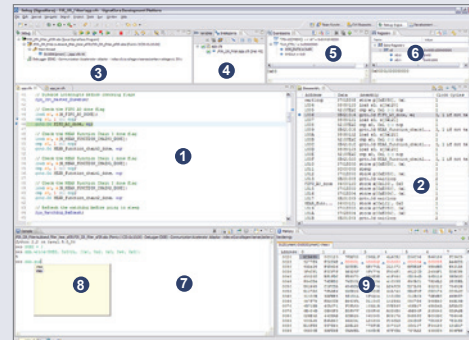
To support the algorithm development process, ON Semiconductor offers an Evaluation and Development Kit (EDK) featuring an Integrated software Development Environment (IDE) for composing, compiling and debugging algorithm code. A Communication Accelerator Adaptor (CAA) connects the IDE running on a PC to a Rapid Prototyping Module (RPM) or Evaluation and Development Board (EDB)*. Using these components, developers can implement and immediately validate the performance of their proprietary algorithms, third-party algorithms, or other software integrated with BelaSigna bundles directly on BelaSigna hardware.



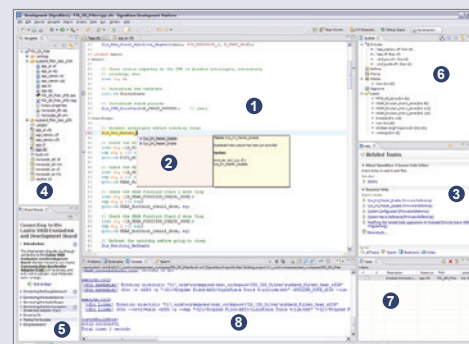
Integrated Development Environment (IDE)

ON Semiconductor's Integrated Development Environment is a fully integrated software development environment that enables developers to code, compile, debug and validate algorithms. Features include:

- **Team based programming** that greatly simplifies project management by allowing multiple developers to simultaneously work on the same design.
- **Project wizard** with templates based on sample algorithms, automatic no-maintenance project builder and system libraries to reduce development time.
- **Integrated debugger** providing full source code debugging and scriptable interface, customized expression watch, register, and memory views with changed value highlighting.
- **Sample application source code** provides complete sample algorithms plus samples of most basic application components.
- **Advanced editor** with content assist (command completion), syntax highlighting and integrated help enables context-sensitive, dynamic reference lookup.
- **Full user and reference documentation set** integrated with the IDE; dynamically searchable while editing.
- **Interactive scripting console** allowing developers to script activities within the IDE using a Python-like language, and to execute/test automated scripts that can interface with the chip and the development environment.



Debug perspective showing (1) source code, (2) disassembly, (3) debug, (4) breakpoint, (5) expression, (6) register, (7) command console, (8) content assist, and (9) memory views.

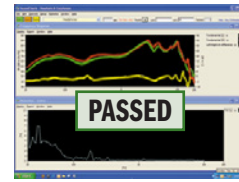
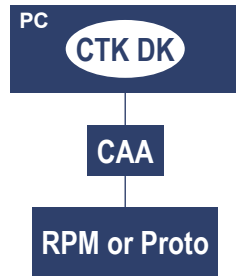


Development perspective showing (1) advanced editor with (2) content assist, (3) dynamic help, (4) workspace navigator, (5) cheat sheets for common tasks, (6) outline view, (7) tasks, and (8) console views. Console shows build output and is a tabbed overlay with search, bookmark and error views.



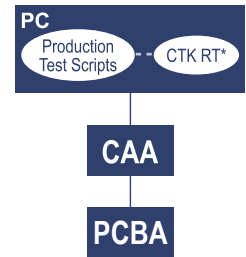
Hardware Testing & Prototyping

ON Semiconductor enables form-factor hardware testing and prototyping with an RPM, optionally attached to a motherboard, that connects directly to a CAA. The RPM's plug-in design enables developers to quickly transition from development in a simulation environment to testing a complete portable audio system. To facilitate development and testing even further, the RPM can be moved directly from the motherboard to a prototype for final hardware assessment.



Production & Final Testing

To prepare portable audio products for the market, the CTK Run-time and CAA enable manufacturers to store firmware and data on an attached EEPROM, tune parameters on a unit-by-unit basis, configure the chip, and run final tests. By attaching a CAA directly to a Printed Circuit Board Assembly (PCBA), the CTK DK can be used to develop a customized software-controlled production flow to meet the specific needs of your production environment.



⚙️ Communication Accelerator Adapter (CAA)

The Communication Accelerator Adaptor is a universal hardware adaptor that facilitates high-speed communication between host PCs (using USB 1.1 or 2.0) and ON Semiconductor development boards (EDB, RPM Motherboard). The CAA is reprogrammable and can also be used to transfer final software to products in a production or final test environment.

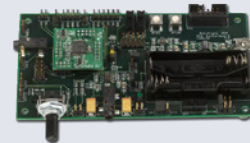


⚙️ Rapid Prototyping Module (RPM)

The Rapid Prototyping Module enables manufacturers to easily demonstrate and evaluate the audio performance and power consumption of ON Semiconductor audio processors in a real world environment. The small-footprint RPM is designed for easy attachment to existing portable audio devices while maintaining full portability. The RPM also facilitates fast and easy prototyping, and once concepts and possible configurations are tested and evaluated, the resulting integrated design will reduce risk and enable a faster time-to-market.



For added flexibility, a companion motherboard is also available that makes it easy to demonstrate and evaluate BelaSigna audio DSPs on their own, without the need for a product prototype. The motherboard also enables programming of the RPM. Full layout and schematic information for the RPM is provided with the board.



⚙️ Evaluation and Development Board (EDB)

The Evaluation and Development Board enables the development, demonstration, testing and debugging of signal processing software. The EDB provides all peripherals needed for measurement and validation, including additional sound inputs and outputs for extra testing. By facilitating early validation of developed sound processing algorithm performance, the EDB helps to reduce overall development time.



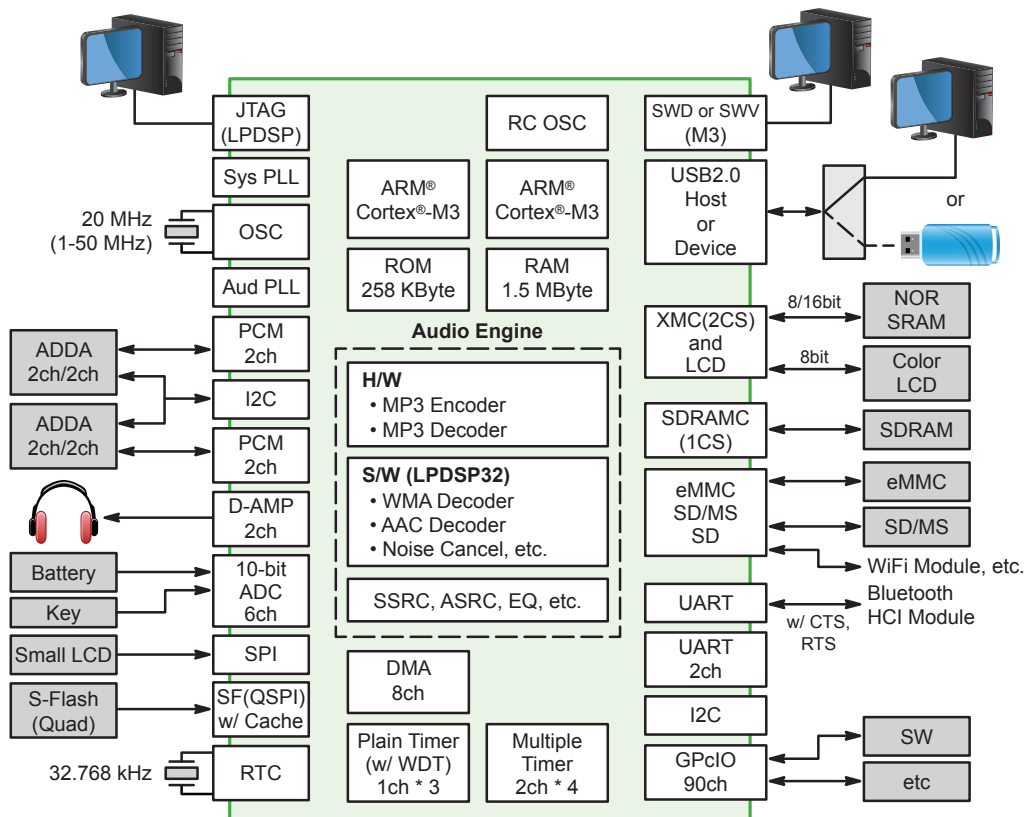
* EDB for BelaSigna 200 and 250 only.

Portable Sound Solution ASSP

LC823450 series high resolution, ultra-low power portable audio system solution

Key Features

- Ultra low power consumption
- Integrated 1656 KByte SRAM
- ARM® Cortex®-M3 Dual Core
- Proprietary 32-bit DSP Core (LPDSP32)
- DSP audio code available for MP3 codec, FLAC codec, Noise Cancel, Zoom Mic
- High resolution 32-bit & 192 KHz audio processing capability
- Integrated analog blocks for low-power Class D HP amplifier, system PLL, dedicated audio PLL
- Hard wired audio functions for MP3 encoder and decoder, EQ (6-band equalizer), ASRC (Asynchronous Sample Rate Converter)
- Integrated interfaces for USB2.0 HS device or host (not OTG), eMMC, SD card I/F
- ASRC with jitter hiding function, DSP code for SBC/AAC, UART with DMA & FIFO support for low power Bluetooth® audio



Device	Design Focus	Frequency (MHz)	RAM (KByte)	ARM Cortex-M3 Cores	SD Card I/F Channels	Features	Package
LC823450TA	Voice Recorder	160 @ 1.2 V Typ 100 @ 1.0 V Typ	1656	Single	3	Class D HP Amplifier	TQFP-128L
LC823450XC	Wearable	160 @ 1.2 V Typ 100 @ 1.0 V Typ	1656	Single	2	External LCD I/F (8-bit)	WLCS-154
LC823450XD	High End	160 @ 1.2 V Typ 100 @ 1.0 V Typ	1656	Dual	3	Class D HP Amplifier; External LCD I/F (8-bit); HW MP3 Encoder	WLCS-154

AUDIO

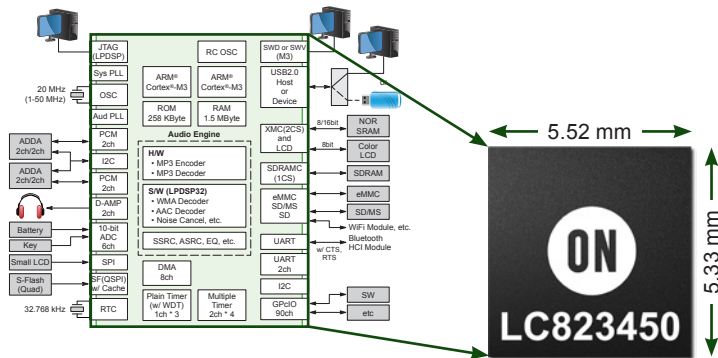
Portable Sound Solution ASSP

Ultra Low Power

- Over 120 hours playback with 2 x AAA battery (70% longer than popular portable music players)
- Advanced power management technology
- 4.8 mA @ 128 Kbps by MP3 hardware decoding
- 0.11 mW/MHz @ 1.0 V while Cortex®-M3 Single Core operation
- Integrated low power D class amplifier



Small Footprint



- 5.52 mm x 5.33 mm WLCSOP-154 suitable for portable, wearable audio
- Highly integrated SoC (CPU+DSP+AUDIO)
 - Hi-Resolution Recording/Playback capability
 - Cortex®-M3 dual core
 - Proprietary 32-bit DSP (LPDSP32)
 - 1656 Kbyte internal SRAM

Turn Key Software Support

- Suitable for portable, wearable digital music
- Support wireless synchronized stereo playback



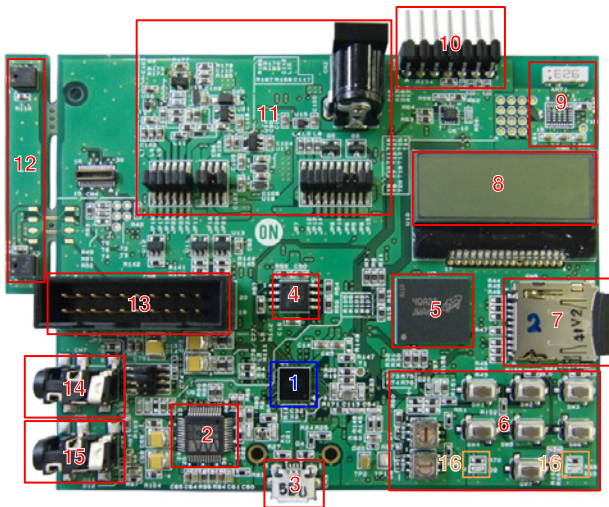
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Middleware Layer	EVT MD <input checked="" type="checkbox"/>	STG MD <input checked="" type="checkbox"/>	AUD MD <input checked="" type="checkbox"/>	SYS MD <input checked="" type="checkbox"/>	USB MD <input checked="" type="checkbox"/>
Library	Common <input checked="" type="checkbox"/>	APL DR <input checked="" type="checkbox"/>	File System <input checked="" type="checkbox"/>	DSP Lib <input checked="" type="checkbox"/>	BT Protocol Stack <input checked="" type="checkbox"/>
Driver	SD/eMMC Driver <input checked="" type="checkbox"/>	Timer Driver <input checked="" type="checkbox"/>	MTM Driver <input checked="" type="checkbox"/>	AD Converter Driver <input checked="" type="checkbox"/>	RTC Driver <input checked="" type="checkbox"/>
	SFC Driver <input checked="" type="checkbox"/>	INTC Driver <input checked="" type="checkbox"/>	UARTDR <input checked="" type="checkbox"/>	USB Driver <input checked="" type="checkbox"/>	I2C Driver <input checked="" type="checkbox"/>
	SPI Driver <input checked="" type="checkbox"/>	Audio Driver <input checked="" type="checkbox"/>	DSP Loader <input checked="" type="checkbox"/>	IO EXP <input checked="" type="checkbox"/>	
	SDIO Driver <input checked="" type="checkbox"/>	CODEC Driver <input checked="" type="checkbox"/>	Power Driver <input checked="" type="checkbox"/>		
	H/W				

MP Ready Reference Code Provide C Source Code
 User Depending Internal ROM Provide Library or Binary Code
 Further Discussion Needed Sample Application May Not Use

AUDIO

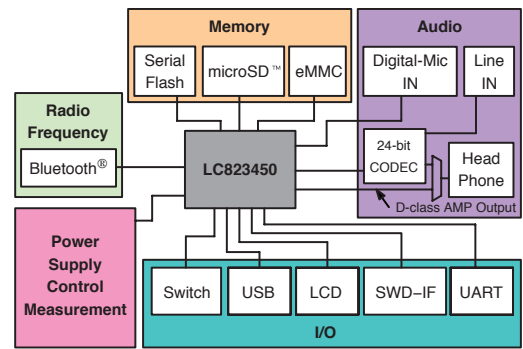
Portable Sound Solution ASSP Evaluation Kit

The LC823450XGEVK is an audio processing system Evaluation Kit used to demonstrate the LC823450. This part can record and playback, and offers high-resolution 32-bit & 192 kHz audio processing capability. It is possible to cover most of the functions necessary for portable audio with only this LSI. It has Dual CPU and DSP with high processing capability, and internal 1656K-Byte SRAM, which make it possible to implement large scale program. And it has integrated analog functions (low-power Class D HP amplifier, PLL, ADC etc.) so that PCB space and cost can be reduced, and it has various interface (USB, SD, SPI, UART, etc.) to make extensibility high. Also it is provided with various function including SBC/AAC codec by DSP and UART and ASRC (Asynchronous Sample Rate Converter) for Bluetooth audio. Low power consumption makes it suitable for portable audio devices, such as wireless headsets.



- | | |
|-----------------|-------------------------|
| 1 LC823450 | 9 Bluetooth® |
| 2 Audio CODEC | 10 UART Connector |
| 3 USB Connector | 11 Power Supply Control |
| 4 Serial Flash | 12 Digital Mic |
| 5 eMMC | 13 ICE Connector |
| 6 Switches | 14 Headphone |
| 7 microSD™ | 15 Line Input |
| 8 LCD | 16 LEDs |

LC823450XGEVK Evaluation Board



LC823450XGEVK Block Diagram

Key Features

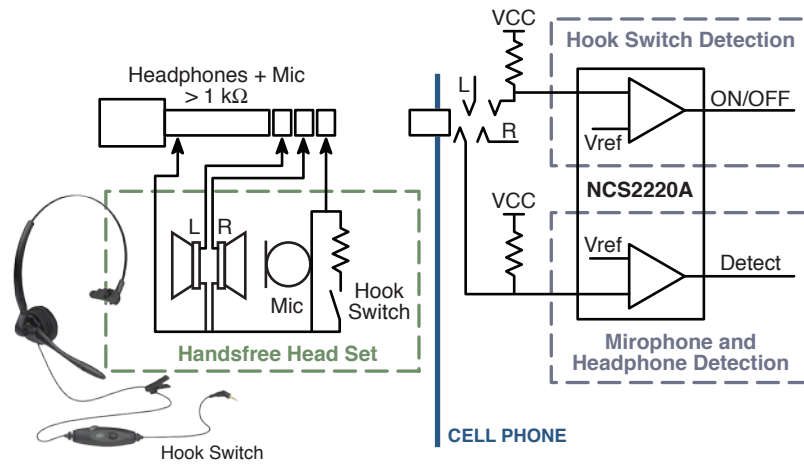
- File Transfer Connecting to PC with USB
- MP3 Recording with USB Bus Power Supply
- MP3 Playback with USB Bus Power Supply
- Measurement of Current Consumption

Audio Amplifiers

Device	Category	Description	Class	V _{IN} (V)	P _{out} (W)	I _Q (mA)	THD+N (%)	PSRR (dB)	Package(s)
NCP2820	Speaker Amplifier	2.65 W Class D Amplifier, fast start up	D	2.5 to 5.5	2.65 W, 4 W, 5 V, 1% THD	2.15	0.05	65	CSP-9
NCP2823	Speaker Amplifier	3 W Class D Amplifier	D	2.5 to 5.5	2.65 W, 4 W, 5 V, 1% THD	1.8	0.08	77	CSP-9
NCP2890	Speaker Amplifier	1.0 W Audio Power Amplifier	AB	2.2 to 5.5	1.0 W, 8 W, 5 V, 0.1% THD	1.5	0.02	72	CSP-9, Micro8
NCP2993	Speaker Amplifier	1.3 W Class AB Amplifier, fast start up, zero pop	AB	2.5 to 5.5	1.25 W, 8 W, 5 V, 1% THD	1.5	0.02	80	CSP-9
NCP4894	Speaker Amplifier	1.8 W Differential Class AB Amplifier	AB	2.5 to 5.5	1.8 W, 8 Ω, 5 V, 1% THD	1.9	0.006	85	CSP-9, Micro-10, DFN-10
NCP2811	Headphone Amplifier	63 mW Stereo Headphone Amplifier, true ground reference	AB	2.9 to 5	63 mW, 16 Ω, 1% THD	6.5	0.01	100	CSP-12, UQFN-12, TSSOP-14
NCP2817	Headphone Amplifier	31 mW Long Play Stereo Headphone Amplifier, true ground reference	AB	1.6 to 5.5	31 mW, 16 Ω, 1% THD	2.3	0.019	100	CSP-12



Low Power Comparators



Typical Detection Circuit

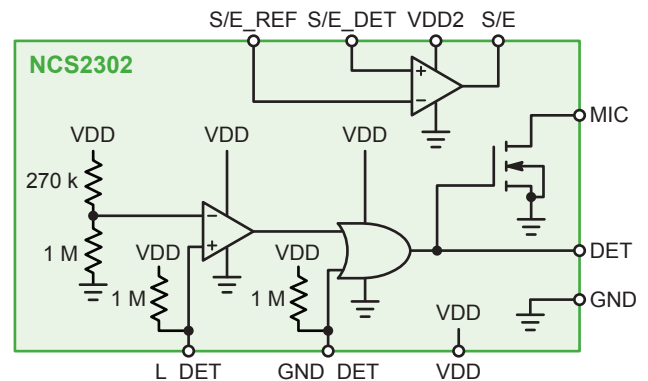
Device	Configuration	V _S Min (V)	V _S Max (V)	I _q /Channel (μA)	t _{RESP(H-L)} (μs)	I _{OUT} (mA)	Output Type	Package(s)
NCS3402	2	2.5	16	0.47	18	10	Open Drain	SOIC-8
NCS2220	2	0.85	6	7.5	0.5	60	Complementary	UDFN-8, UQFN-8
NCS2200A	1	0.85	6	9	0.46	70	Complementary	UDFN-6
NCS2202A	1	0.85	6	9	0.46	70	Open Drain	UDFN-6
NCV2393	2	2.7	16	9	0.8	20	Open Drain	SOIC-8
NCS2200	1	0.85	6	10	0.7	70	Complementary	SOT-23-5, SC-70-5, DFN-6
NCS2202	1	0.85	6	10	0.7	70	Open Drain	SOT-23-5, SC-70-5
LMV339	4	2.7	5	35	0.5	84	Open Drain	SOIC-14, TSSOP-14
LMV393	2	2.7	5	35	0.5	84	Open Drain	Micro8, SOIC-8, UDFN-8
LMV331	1	2.7	5	40	0.5	84	Open Drain	SOT-23-5, SC-70-5

Ear Jack Detection Interface

NCS2300 integrates a comparator, OR gate, and N-channel MOSFET to detect the presence of a stereo headset with a microphone. A built in resistor-divider provides an internal reference voltage for detecting the left audio channel. The logic output indicating headset presence can then be connected to the baseband GPIO. NCS2302 includes the send/end button detection functionality.

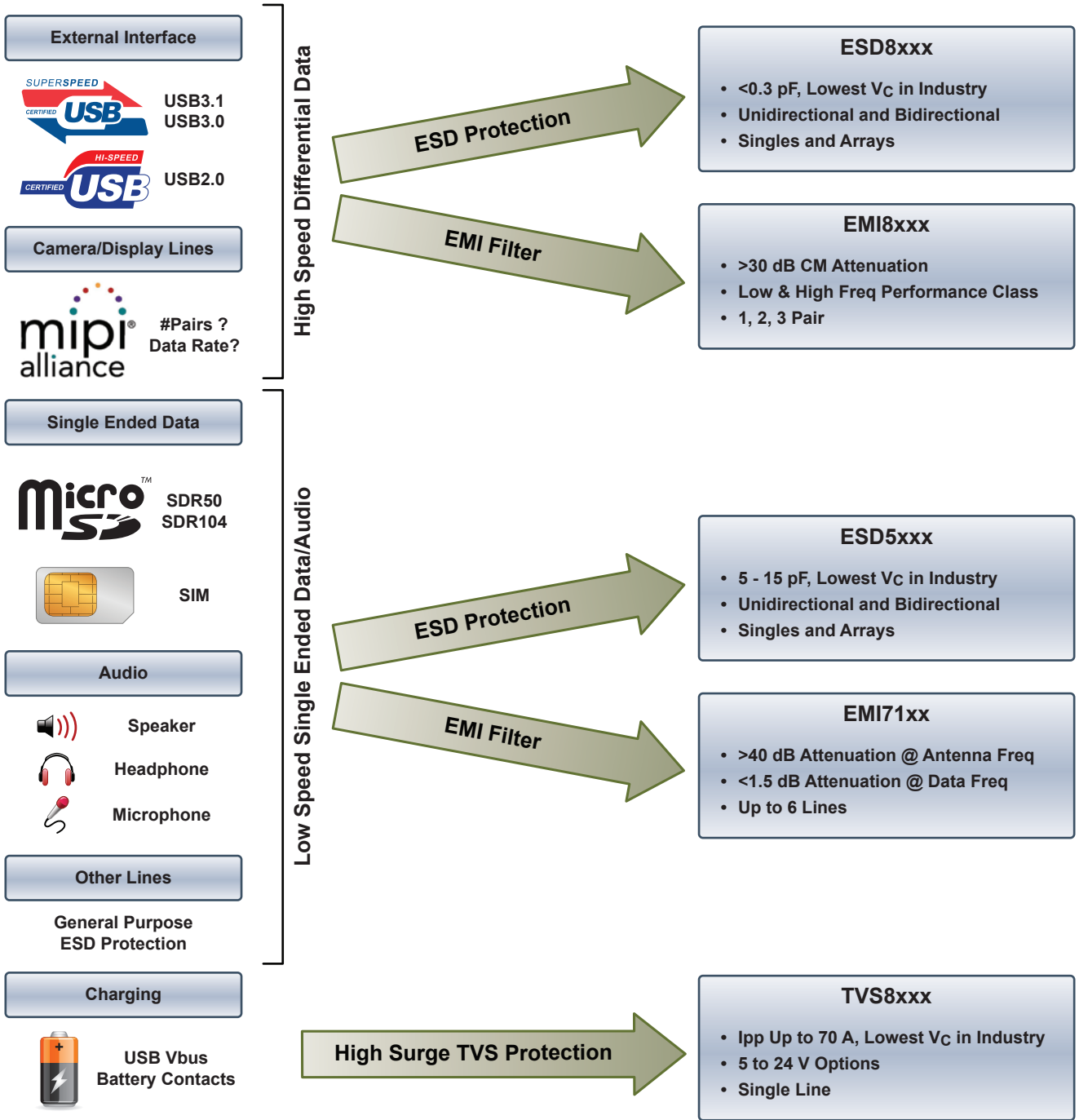
Key Features

- Supply voltage: 1.6 - 2.5V
- Low quiescent supply current: 7 μA typical
- UDFN-6 for NCS2300
UQFN-10 for NCS2302



NCS2302 Block Diagram

Protection Solutions



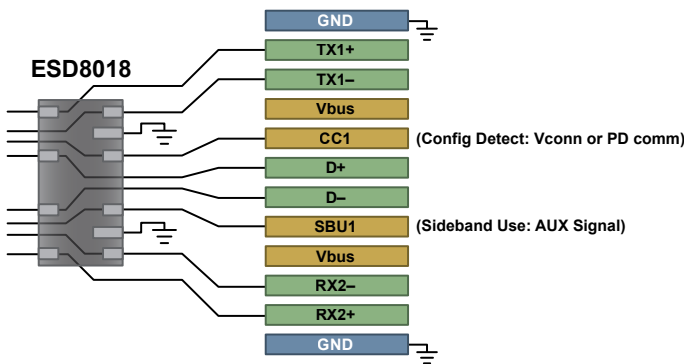
PROTECTION

USB3.1 Type-C Protection

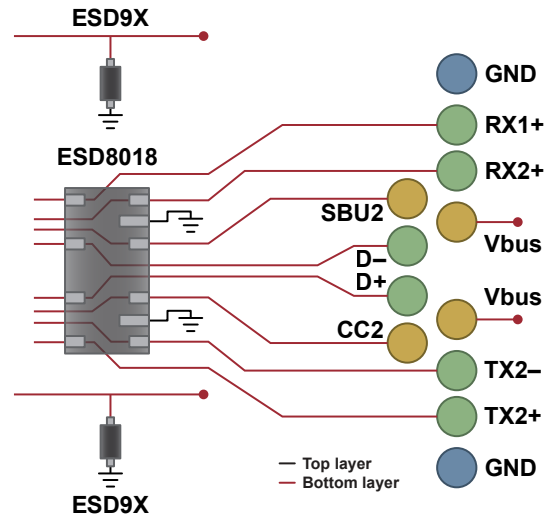
Features

- Unidirectional
- <8 V clamping voltage @ 16 A TLP (± 8 kV SED)
- ± 15 kV IEC61000-4-2 Level 4 rated, contact and air discharge

Device	Type	C Max @ 1 MHz (pF)	C Max @ 5 MHz (pF)	Package
ESD8018	8 Line Flow-Through Array	0.32	0.25	UDFN-10
ESD8106	6 Line Flow-Through Array	0.32	0.25	



Type-C Hybrid Top Mount Connector (Top Layer)



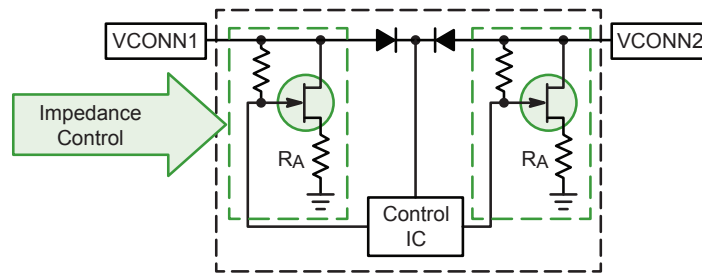
Type-C Hybrid Top Mount Connector (Bottom Layer)

USB3.1 Type-C Port Control

Features

- Current optimized for USB control
- Low capacitance enables high speed operation

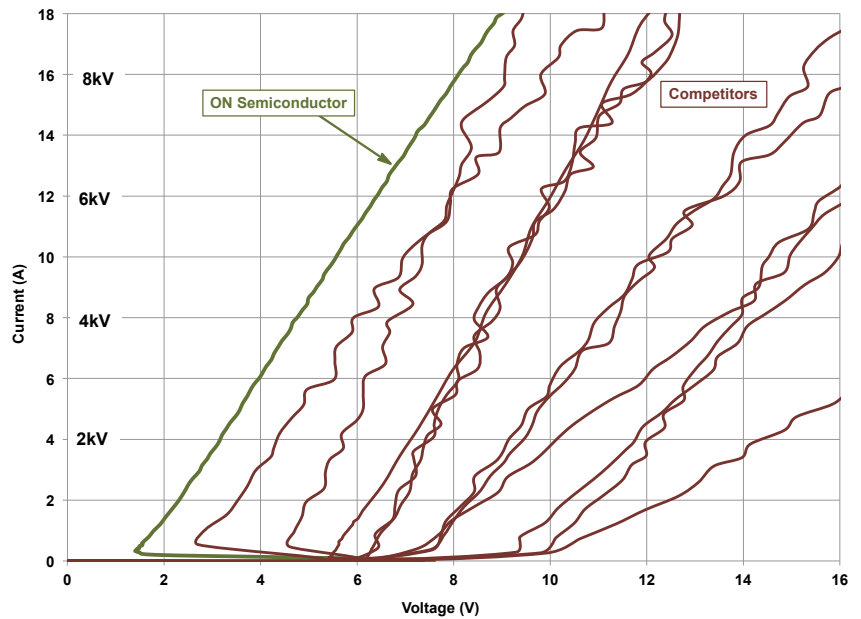
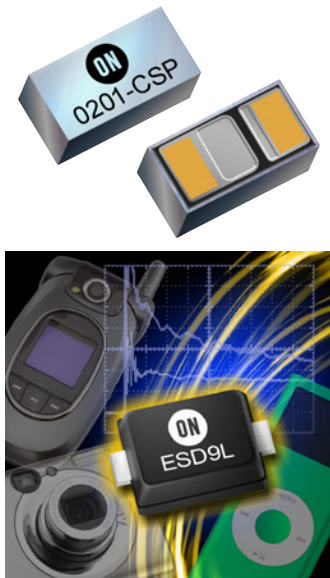
Device	V_{GDS} (V)	$V_{GS(off)}$ (V)	I_{GSS} (nA)	I_{DSS} (mA)	$ y_{sf} $ (mS)	C_{ISS} (pF)	Package
TF412S	-30	-0.18 to -1.5	1	1.2 to 3.0	5.0	4	SOT-883



Single Line Protection

ESD

Device	Type	C (pF)	V _r (V)	V _c (V)	Package
ESD8011	Bidirectional	0.2	5	19	X3DFN-2
ESD5481	Bidirectional	15	5	19	X3DFN-2
ESD9L	Unidirectional	0.9	5	17	SOD-923-2
ESD8451	Bidirectional	0.3	3.3	16	X3DFN-2
ESD9B	Bidirectional	15	5	15	SOD-923-2
ESD8351	Unidirectional	0.55	3.3	11	X3DFN-2, SOD-923-2
ESD8111	Bidirectional	0.3	3.3	10	X3DFN-2
ESD8101	Bidirectional	0.3	3.3	10	DSN-2
ESD5111	Bidirectional	5	3.3	6.5	X3DFN-2
ESD5101	Bidirectional	5	3.3	6.5	DSN-2



Low Cap ESD Protection V_c Benchmarking

TLP testing - P2P equivalent parts (same package, V_z, <0.6 pF)

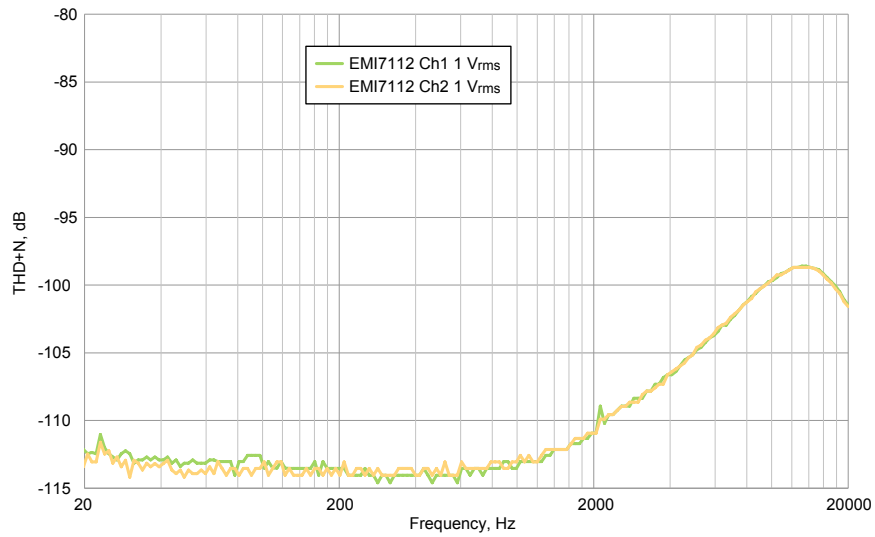
High Surge TVS

Device	V _{rw} (V)	I _{pp} (A)	Package
TVS8501	5	70	UDFN-2
TVS8501	10 - 12	60	UDFN-2

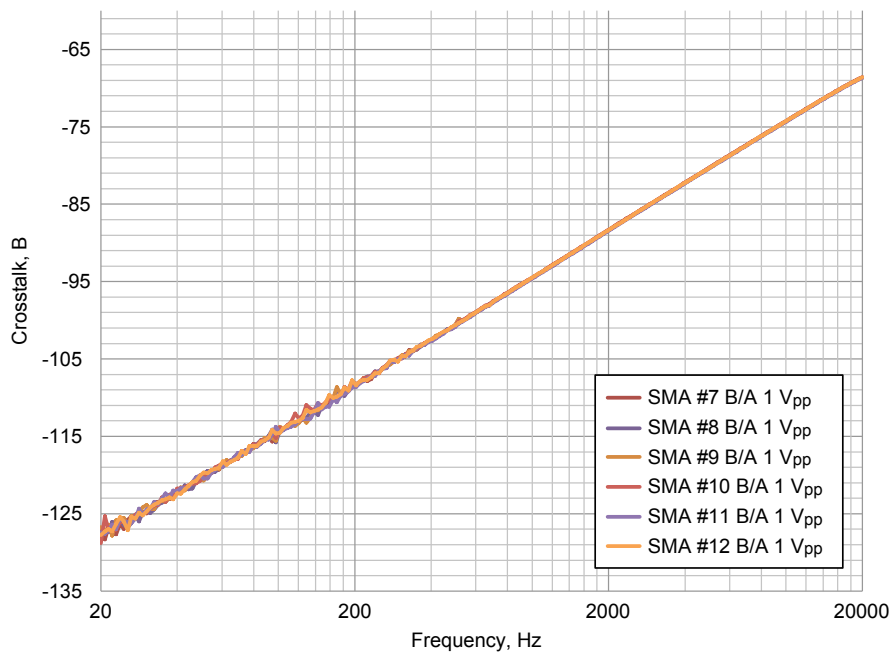
Audio Filtering for HiFi

EMI7112 Features

- >40 dB @ 750 MHz to 2.4 GHz
- Cross-talk < -65 dB, THD+N < 0.006%
- HiFi quality capable



EMI7112 THD + N

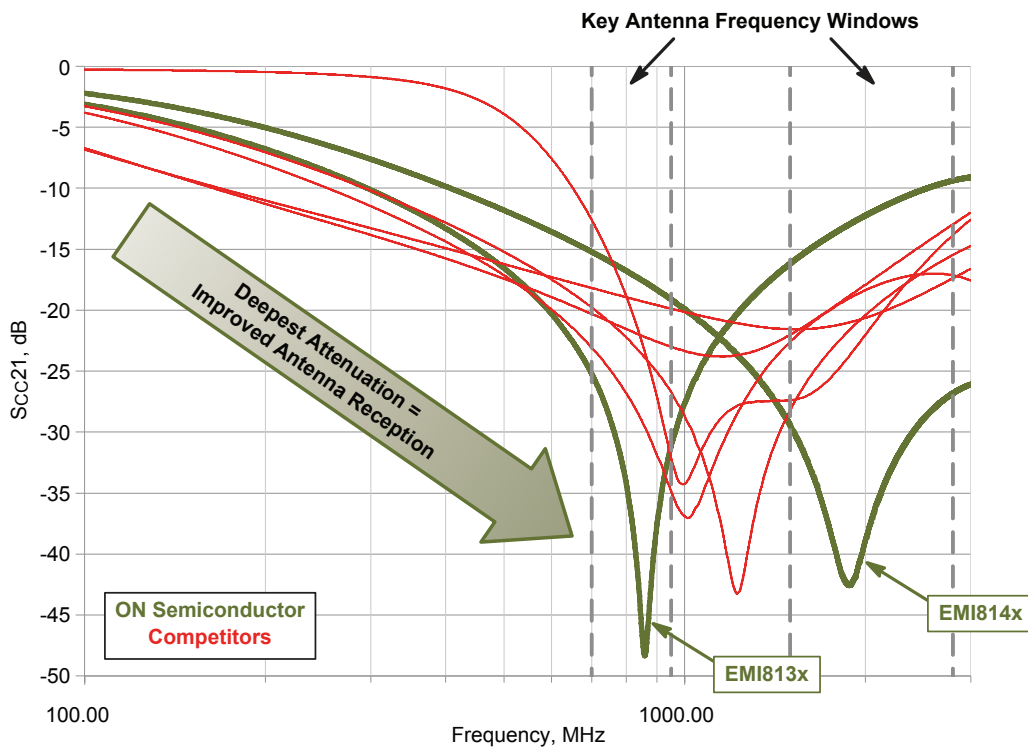


EMI7112 Crosstalk with 1 V_{pp} Input Voltage

Common Mode Filters for High Speed Interfaces

PROTECTION

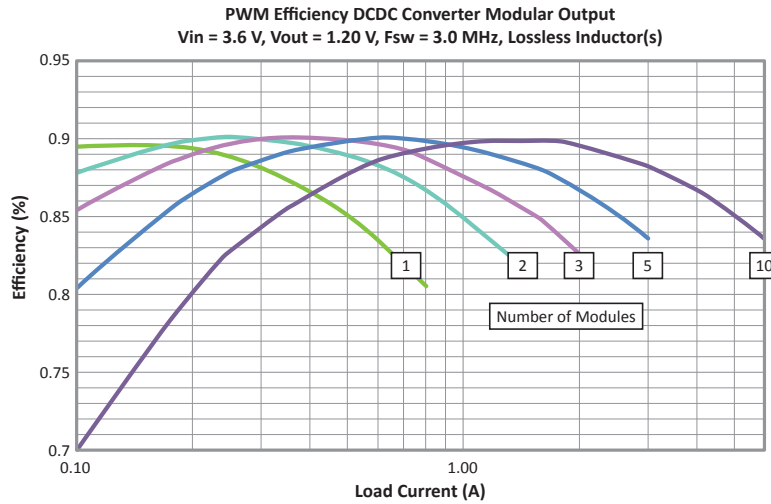
Function	Filter CM Noise		Signal Integrity		Protect Chipset	
Device Series	Attenuation > 25 dB range	RF Receivers	Maximum Data Rate	Interfaces Supported	Vc @ 8 kV (TLP)	Minimum Chipset Geometry
EMI813x	700 MHz - 1.1 GHz	LTE, GSM,	4 Gb/s	USB2.0; MHL1-2; HDMI1.3/4; MIPI CSI-2	11.6 V	14 nm
EMI814x	1.3 GHz - 3.0 GHz	LTE, WCDMA, WiFi, GPS	8 Gb/s	USB3.0; MIPI CSI-3; MHL3.0; HDMI2.0	11.6 V	14 nm



ARM® Core DC-DC Converters

Key Features

- High regulating performance from 0.6 V to 1.4 V
 - Modular efficiency with fragmented power stage
 - Dynamic voltage scaling per output steps of 6.25 mV by I2C
 - Tight accuracy of $\pm 1\%$, due to differential sensing
- Fast transient response
 - Proprietary PFM to PWM transition with equivalent performance to PWM only
 - Thermally handle high peak current demands up to 10 ms
 - Flexible design to transient handling output capacitor from 22 μF to 100 μF



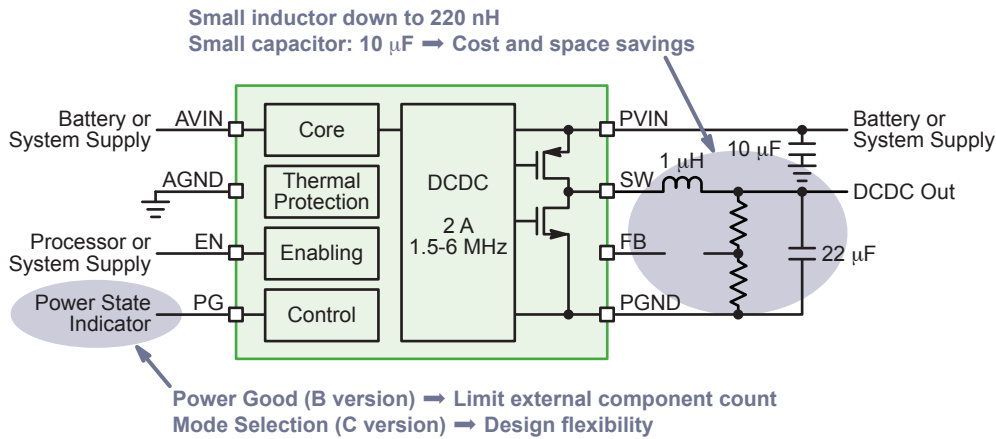
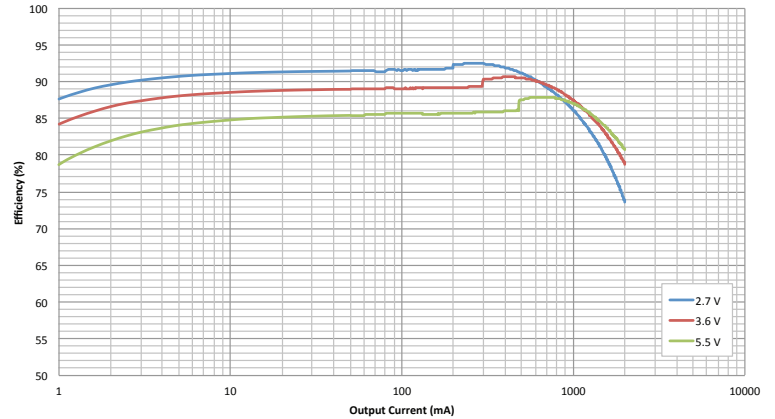
Device	V _{IN} (V)	V _{OUT} (V)	I _{OUT} (A)	f _{sw} (MHz)	Control	Features	Package
NCP6338	2.3 - 5.5	0.6 - 1.4	6.0	3.0	I ² C; VSEL	Modular power stage; Differential sensing	WLCSP-30
NCP6335	2.3 - 5.5	0.6 - 1.4	4.0	3.0	I ² C; VSEL	Transient load helper	WLCSP-20
NCP6343	2.3 - 5.5	0.6 - 1.4	3.5	3.0	I ² C	Dynamic voltage scaling	WLCSP-15

Peripheral DC-DC Converters

Key Features

- High efficiency conversion - up to 94% - over large input & output voltage range
- High switching frequency - up to 6.0 MHz - reduces external component size (inductor down to 220 nH)
- Design flexibility with adjustable resistor bridge, independent enable control, power good or mode selection pin

NCP6314C auto mode, Vout = 1.8 V

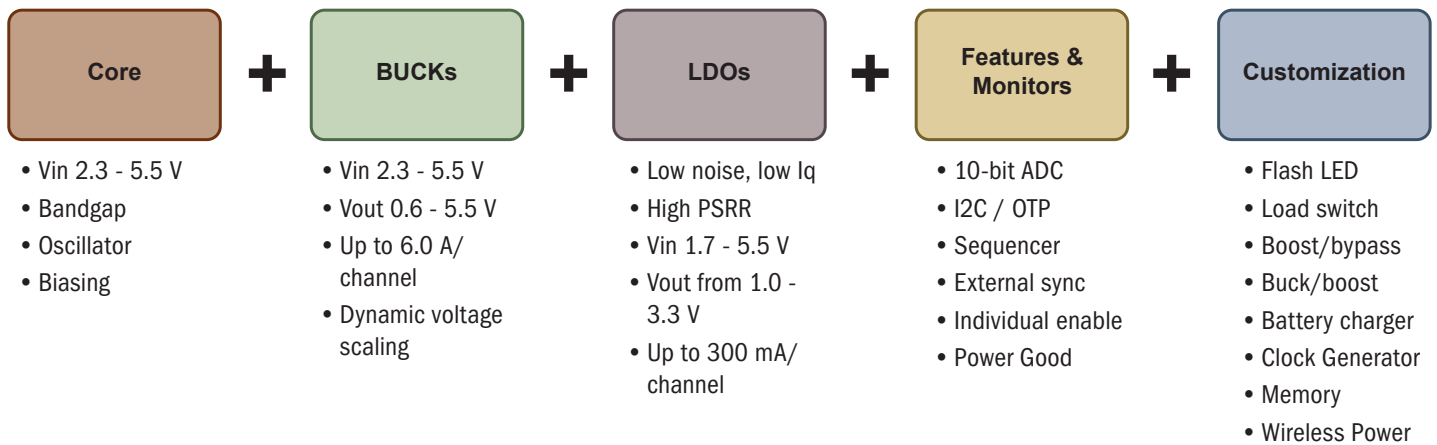


Device	V _{IN} (V)	V _{OUT} (V)	I _{OUT} (A)	f _{sw} (MHz)	Operating Mode	Features	Package(s)
NCP1521B	2.7 - 5.5	0.9 - 3.3	0.6	1.5	PFM/PWM	—	TSOP-5, UDFN-6
NCP1522B	2.7 - 5.5	0.9 - 3.3	0.6	3	PFM/PWM	—	TSOP-5, UDFN-6
NCP1529	2.7 - 5.5	0.9 - 3.3	1.0	1.7	PFM/PWM	—	TSOP-5, UDFN-6
NCP6324	2.5 - 5.5	0.6 - 5.0	2.0	3	PFM/PWM	Mode Selection	WDFN-8
NCP6332B	2.3 - 5.5	0.6 - 5.0	1.2	3	PFM/PWM	Power Good	UDFN-8
NCP6332C	2.3 - 5.5	0.6 - 5.0	1.2	3	PFM/PWM	Mode Selection	UDFN-8
NCP6334B	2.3 - 5.5	0.6 - 5.0	2.0	3	PFM/PWM	Power Good	UDFN-8
NCP6334C	2.3 - 5.5	0.6 - 5.0	2.0	3	PFM/PWM	Mode Selection	UDFN-8
NCP6354	2.3 - 5.5	0.6 - 5.0	2.0	3	PWM	Power Good	UDFN-8

Mid Scale Power Management Integration

Key Features

- Extensive IP library
- Flexibility for platforms derivatives with full programmability by I2C
- Offers real time load management with Dynamic Voltage Scaling
- High performance
 - High efficiency (up to 96%) and low quiescent current (<100 μ A) to improve battery life
 - Low noise LDO (30 μ Vrms @ 100 Hz-100 kHz) meets the latest sensors requirements
- Quick turn around and time to market solutions
- WLCSP, QFN packages



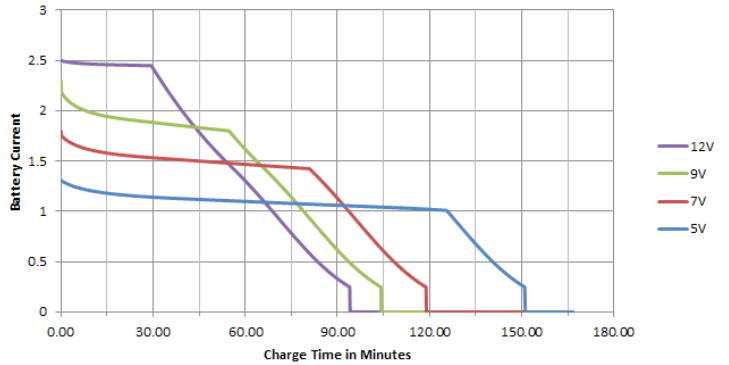
Device	DC-DC (mA)	LDO (mA)	Package(s)
NCP6925	2 x 1000	5 x 300	CSP-36
NCP6924	2 x 1000	2 x 300, 2 x 150	CSP-30
NCP6914	1 x 800	4 x 300	CSP-20
NCP6915	1 x 600	1 x 300, 4 x 150	CSP-16

Switching Battery Chargers

Key Features

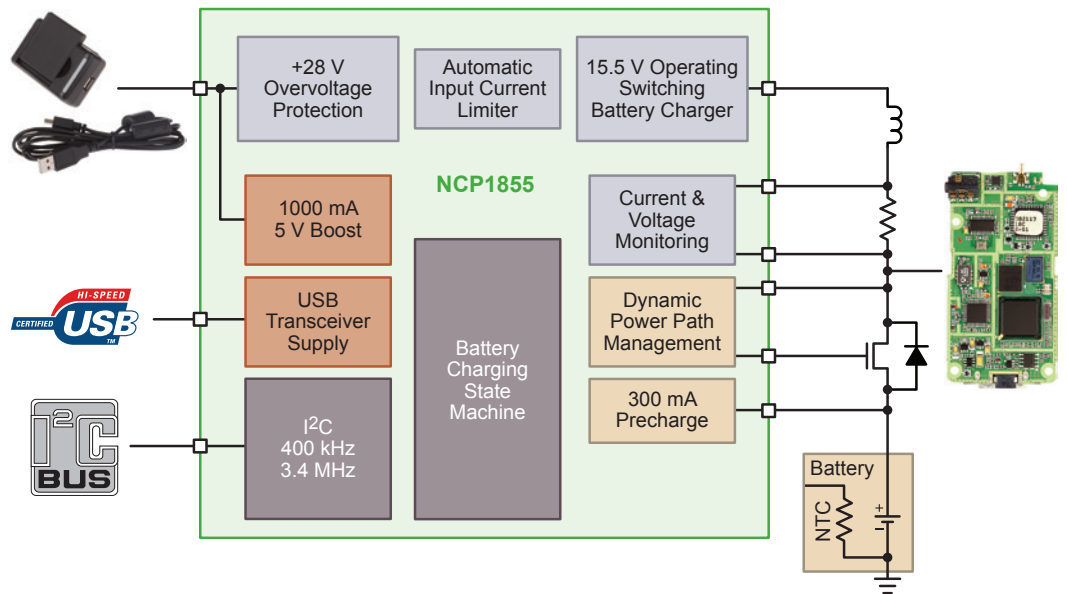
- Sized for micro USB connector (USB BC1.2) with 1.5 A, 1.6 A, 1.8 A, 2.5 A charging current
- Automatic input current limit adapts charging current to the maximum capability of the power source; proven charging time decrease by 10 minutes
- Integrated 28 V over voltage protection with unique negative voltage support
- Up to 1 A embedded boost USB OTG saves BOM cost
- Automatically disconnects battery at end of charge, with reconnect in few seconds in case of peak current activity (GSM for instance)
- Instant turn-on at cable insertion when battery is weak
- Enable smart fast charging ports with input voltage capability up to 16 V (NCP1855)

Battery Charge Time vs Adapter Voltage



NCP1855 Charging Profile for 4.2 V, 2500 mAh Battery Pack, Input Source Limited to 1 A

Device	Charging Current Max (A)	Pre-Charge Current Max (mA)	OTG Boost Current Max (mA)	Vcc Max (V)	OVP (V)	I2C	Automatic Input Current Limiting	Dual Path Management	Protected USB PHY Supply (mA)	Battery Temperature Sensing	Package
NCP1850	1.5	450	250	7	+28	400 kHz	Yes	Yes (external)	30	Threshold	WLCSP-25
NCP1851	1.6	300	500	7	+28	400 kHz / 3.4 MHz	Yes	Yes (external)	50	JEITA	Flip-Chip-25
NCP1852	1.8	300	500	7	+28/-20	400 kHz / 3.4 MHz	Yes	Yes (external)	50	JEITA	Flip-Chip-25
NCP1854	2.5	300	500	7	+28	400 kHz / 3.4 MHz	Yes	Yes (external)	50	JEITA	Flip-Chip-25
NCP1855	2.5	300	500	16	+28	400 kHz / 3.4 MHz	Yes	Yes (external)	50	JEITA	Flip-Chip-25



LC709203F High Accuracy Fuel Gauge LSI

Fuel Gauge for 1 Cell Li+ with Low Power and with No Sense Resistor

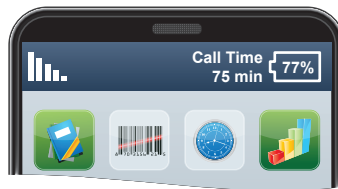
Conventional Display



With
LC709203F



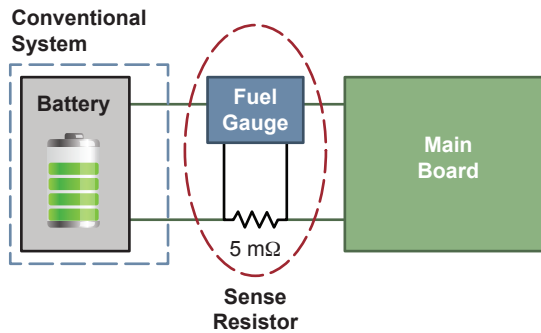
Detailed Display of Remaining Capacity



Correct Operating Time

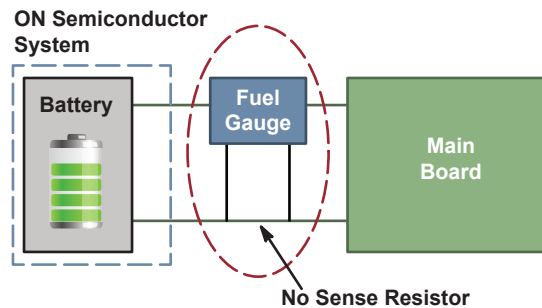
Key Features

- Accuracy of remaining capacity $\pm 2.8\%$ ($0 \sim +50^{\circ}\text{C}$)
- Active mode current of $15 \mu\text{A}$
- Hibernate mode current of $2 \mu\text{A}$
- Standby mode current (RAM retention) of $0.1 \mu\text{A}$
- No need for sense resistor for current detection



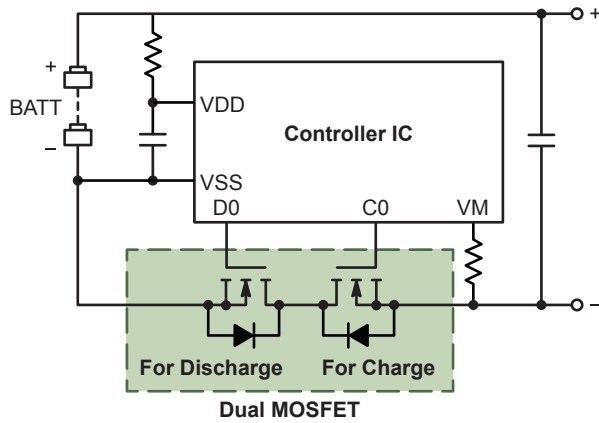
ON Semiconductor Solution (No Sense Resistor)

- No power loss
- No heat generation

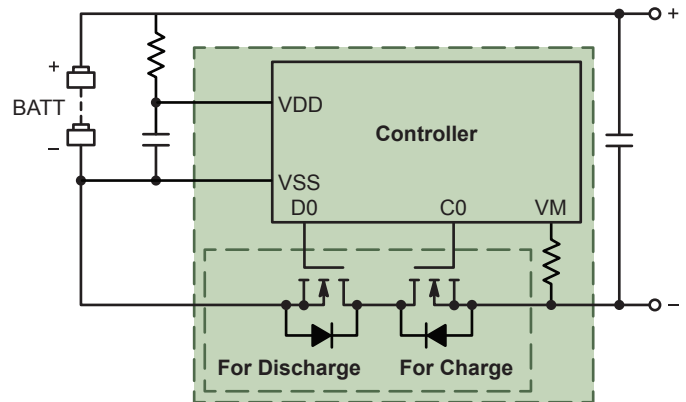


POWER MANAGEMENT

Li-ion Battery Protection



Dual MOSFET



2-in-1 Configuration
(Controller + Dual MOSFET Integrated Package)

Device	Configuration	Polarity	V _{SS} Max (V)	V _{SS} Max (V)	I _S (DC) (A)	R _{SS(ON)} @ V _{GS} = 4.5 V Min/Typ/Max (mΩ)	R _{SS(ON)} @ V _{GS} = 2.5 V Min/Typ/Max (mΩ)	Q _G Typ (V)	Package(s)
CPH6636R	Dual	N-Channel	24	±12	6	15.0/17.5/20.0	19.5/24.5/29.5	3	CPH-6
ECH8693R	Dual	N-Channel	24	±12	11	5.6/8.5/10.4	7.8/13.0/18.2	13	ECH-8
ECH8695R	Dual	N-Channel	24	±12.5	11	5.6/7.0/9.1	7.5/9.5/13.3	10	ECH-8
ECH8697R	Dual	N-Channel	24	±12	10	7.7/11.0/14.3	11.4/19.0/26.6	—	ECH-8
EFC4619R	Dual	N-Channel	24	±12	6	13.5/19.8/23.0	18.5/27.0/35.0	21.7	EFCP
EFC4621R	Dual	N-Channel	24	±12	9	10.8/15.5/18.0	14.9/23.0/30.0	29	EFCP
EFC4626R	Dual	N-Channel	24	±12	5	29.2/37.5/46.2	42.6/54.0/72.4	7.5	EFCP
EFC6601R	Dual	N-Channel	24	±12	13	6.6 / 9.5/11.5	9.0/13.0/17.0	48	EFCP
EMH2418R	Dual	N-Channel	24	±12	8.5	9.1/13.0/16.9	13.8/23.0/32.2	—	EMH
EFC3C001NUZ*	Dual	N-Channel	20	±10	6	17.0/23.0/30.0	24.5/35.0/56.0	15	EFCP
EMH2407	Dual	N-Channel	20	±12	6	13.0/19.0/25.0	16.0/28.0/39.0	6.3	EMH
EFC4627R	Dual	N-Channel	12	±10	6	18.5 / 23.9/29.5	29.3 / 37.7/50.5	13.4	EFCP
EFC6602R	Dual	N-Channel	12	±12	18	3.1 / 4.5/ 5.9	5.2/7.5/11.0	55	EFCP
EFC6604R	Dual	N-Channel	12	±12	13	6.0 / 7.5/ 9.0	10.0/12.6/17.7	29	EFCP
EFC8811R	Dual	N-Channel	12	±8	27	1.8 / 2.3/ 3.2	2.7/4.0/6.3	100	EFCP
EMH2417R	Dual	N-Channel	12	±12	8	8.7/12.4/16.1	10.8/15.4/20.0	—	EMH
LC05132C01MT	2 in 1***	N-Channel	24	±12	8	8.8/11.2/14.0	12.0/15.0/21.0	—	WDFN-6
LC05111CMT	2 in 1**	N-Channel	24	±12	8	8.8/11.2/14.0	12.0/15.0/21.0	—	WDFN-6
LC05112CMT	2 in 1	N-Channel	24	±12	8	8.8/11.2/14.0	12.0/15.0/21.0	—	WDFN-6
LC06111TMT*	2 in 1	N-Channel	12	±12	10	6.6/8.4/10.6	11.2/14.0/19.6	—	WDFN-6

* Pending 3Q16. ** Auto wakeup, 0V charge. *** Reset function. NOTE: R_{SS(ON)} = R_{DS(ON)} x 2.

Voltage and Current Protection

USB Host

Over Current Protection protects USB Host from short circuit, over load or hot plugs faults on USB device.



USB Device

Over Voltage Protection protects USB Device from overshoot, host dc-dc feedback failure, or any over voltage faults on USB host.

Device	Type	V _{IN} Min (V)	V _{IN} Max (V)	OVP (V)	UVLO (V)	Current Limit (mA)	R _{DS(on)} (mΩ)	Features	Package(s)
NCP347	Over Voltage	1.2	28	5.63; 5.85; 5.9; 7.2	2.95	–	65	Status FLAG	WDFN-10
NCP348	Over Voltage	1.2	28	6.02; 6.4	3.25	–	65	Status FLAG	WDFN-10
NCP349	Over Voltage	1.2	28	5.68; 6.02; 6.4; 6.85	2.95; 3.25	–	65	Status FLAG	DFN-6
NCP360	Over Voltage	1.2	20	5.675; 6.25; 7.07; 7.2	3	–	210	Status FLAG; Thermal SD	TSOP-5; SOT-23-5; UDFN-6
NCP361	Over Voltage and Over Current	1.2	20	5.675	3	750	300	Status FLAG; Thermal SD	TSOP-5; SOT-23-5; UDFN-6
NCP367	Over Voltage and Over Current, with battery over charged detection	1.2	28	5.85; 6.07; 6.84; 7.2	1.85	Adjustable up to 2800	50	VBAT Detect; Thermal SD	DFN-8
NCP370	Over Voltage and Over Current	-28	28	6.6	2.7	1750	130	Status FLAG; Thermal SD	LLGA-12
NCP372	Over Voltage	-30	30	6.3	2.7	–	130	Status FLAG; Thermal SD	LLGA-12
NCP373	Over Voltage, with reverse Over Current Limit	1.2	30	5.77	2.7	400; 1300	130	Status FLAG; Thermal SD	LLGA-12
NCP374	Over Voltage, with reverse Over Current Limit	1.2	30	5.77	2.7	750	80	Status FLAG; Thermal SD	TLLGA-12
NCP380	Over Current, Single Channel USB	2.5	5.5	–	2.3	Fixed or Adjustable up to 2100	55	Thermal SD; UL Listed	TSOP-5; TSOP-6; SOT-23-5; UDFN-6
NCP382	Over Current, Dual Channel USB	2.5	5.5	–	2.35	Fixed or Adjustable up to 2000	80	Thermal SD; UL Listed	DFN-8; SOIC-8
NCP383	Over Current, Dual Channel USB	2.7	5.5	–	2.45	Adjustable up to 2800	45	Thermal SD; UL Listed	UDFN-10
NCP391	Over Voltage	1.2	28	7.4	2.95	–	120	Status FLAG; Thermal SD	WLCSP-6
NCP392	Adjustable Front End Over Voltage	2.8	28	5.95; 6.8; 13.8; 15.5	2.8	–	34	100 V Surge Capability	WLCSP-12

LDO Regulators

Device	I _o Typ (mA)	I _q Typ (μA)	V _{in} Max (V)	V _o (V)	PSRR (dB)	Noise (μVrms)	Package(s)
NCP161	450	20	6	1.8, 2.5, 2.8, 2.85, 3.0, 3.3, 3.5, 4.5, 5.0, 5.14	90	10	CSP-4, XDFN-4
NCP4589	300	55	5.3	1.2, 1.8, 2.5, 2.8, 3.0, 3.3	70	90	SC-88A-5/SC-70-5/SOT-323-5; SOT-23-5; XDFN-6
NCP4683	300	50	6	1.2, 1.8, 1.85, 2.8, 2.85, 3.1, 3.3	65	65	SC-88A-5/SC-70-5/SOT-323-5; UDFN-4
NCP114	300	50	6	1.0, 1.05, 1.1, 1.2, 1.25, 1.3, 1.5, 1.8, 2.1, 2.6, 2.8, 2.85, 3.0, 3.1, 3.3, 3.45, 3.5	75	60	uDFN-4
NCP703	300	12	5.5	1.8, 1.9, 2.8, 3.0, 3.3, 3.5	68	13	TSOP-5/SOT-23-5; XDFN-6
NCP160	250	20	6	1.8, 2.5, 2.8, 2.85, 3.0, 3.3, 3.5, 4.5, 5.0, 5.14	90	10	CSP-4, XDFN-4
NCP700B	200	70	6	1.8, 2.5, 2.8, 3.0, 3.3	82	10	TSOP-5/SOT-23-5; WDFN-6
NCP702	200	10	5.5	1.8, 2.8, 3.0, 3.3	70	11	TSOP-5/SOT-23-5; XDFN-6
NCP4680	150	50	6	0.8, 0.9, 1.0, 1.2, 1.5, 1.8, 2.3, 2.5, 2.8, 3.0, 3.3	75	60	SC-88A-5/SC-70-5/SOT-323-5; XDFN-4
NCP103	150	50	6	1.0, 1.05, 1.1, 1.2, 1.25, 1.3, 1.5, 1.8, 2.1, 2.6, 2.8, 2.85, 3.0, 3.1, 3.3, 3.45, 3.5	75	60	uDFN-4
NCP170	150	0.5	5.5	1.2, 1.5, 1.8, 2.5, 2.8, 3.0, 3.3	40	85	SOT-563, XDFN-4
NCP716	80	4.7	24	1.2, 1.5, 1.8, 2.5, 2.8, 3.0, 3.3, 5.0	52	65	SC-70-5, xDFN6
NCP715	50	4.7	24	1.2, 1.5, 1.8, 2.5, 2.8, 3.0, 3.3, 5.0	52	65	xDFN-6



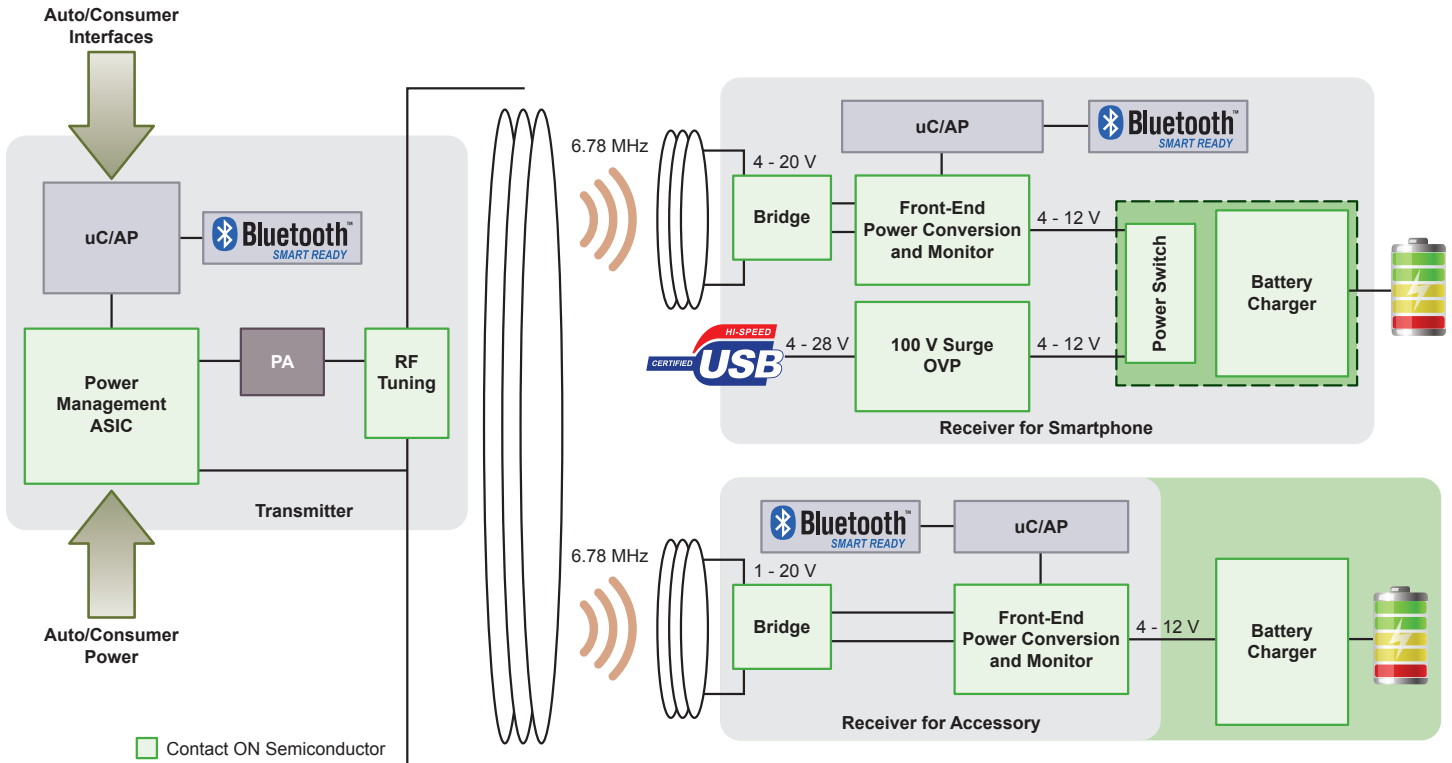
AirFuel™ Wireless Charging

Loosely Coupled Wireless Charging Features

- Spatial Freedom; no alignment or direct contact to transmitter is required
- Charge multiple devices at once through surfaces
- Can charge in the presence of metal objects such as coins or keys



POWER MANAGEMENT



AirFuel Magnetic Resonance System Blocks

Device	Type	Vcc Max (V)	Pd Max (W)	Peak Current Typ (A)	Package (s)
NSR1030Q	Full Bridge	30	30	1	UDFN-4
NSR2030Q	Full Bridge	30	60	2	UDFN-4

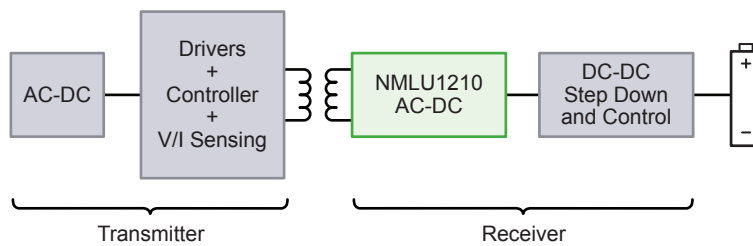
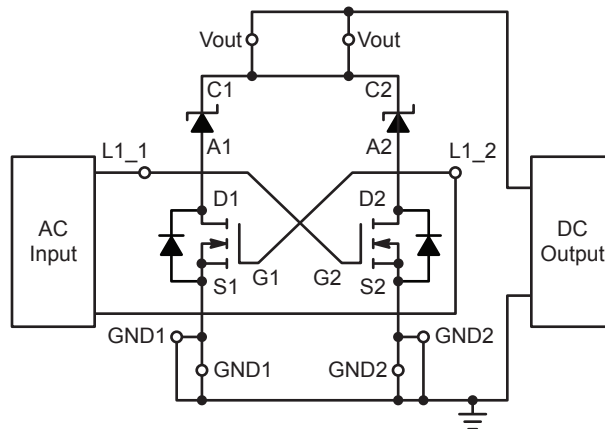
Full Bridge Rectifier for Inductive Wireless Charging

Key Features - NMLU1210

- Full Bridge Rectification block - up of 3.2 A of operation
- Low $R_{DS(ON)}$ minimizes conduction losses
- Low profile UDFN-8 package (4 x 4 x 0.55 mm)



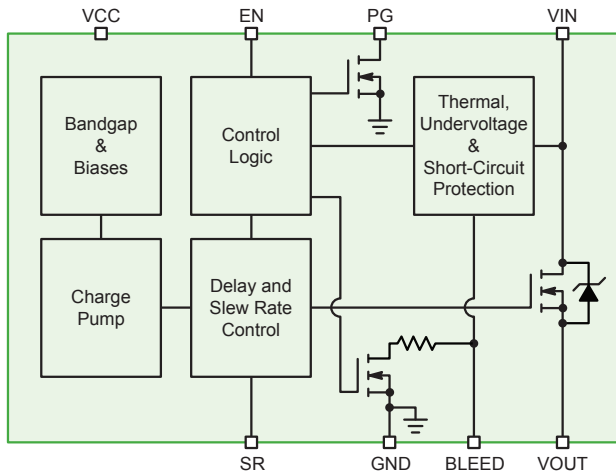
Device	MOSFET			SCHOTTKY			Package(s)
	V _{LL} (V)	I _D (A)	R _{DS(ON)} Max @ V _{GS} = 10 V (Ω)	V _R (V)	V _F (A)	I _F (A)	
NMLU1210	20	3.2	0.017	20	0.45	3.2	UDFN-8



Advanced Load Switches

ON Semiconductor provides a comprehensive range of load switches, suitable for a variety of different power trees.

- Copackaged MOSFET plus CMOS controllers – value-added features plus high performance
- Monolithic CMOS smart load switches – value added features, low cost
- Discrete MOSFETs – simple, high performance

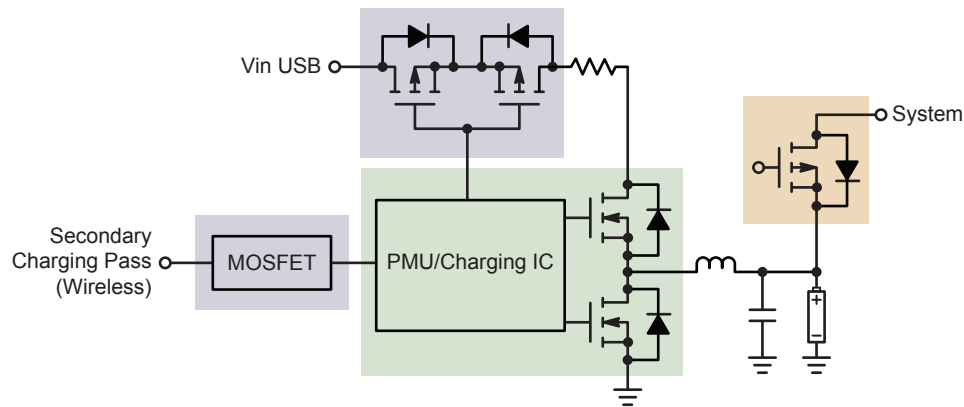


NCP45xx Integrated Load Switch Feature

- Simple/clean design
- No current consumption in standby power mode
- Small PCB footprint
- Low $R_{DS(ON)}$ due to charge pump driving NMOS
- Adjustable soft-start time (SR)
- Adjustable integrated discharge
- Fault protection
- Power rail monitoring & sequencing

Type	Device	r_{on} (mΩ)	I Max (A)	V_I Min (V)	V_I Max (V)	I_Q (μA)	Discharge	Slew Rate (μs)	Features	Package(s)
Smart Load Switch	NCP330	26 at 3.3 V	3	1.8	5.5	100	-	2000	Reverse blocking	TDFN-4
	NCP333	55 at 3.3 V	1.5	1.2	5.5	1	Auto	95	-	WLCSP-4
	NCP334	47 at 3.3 V	2	1.2	5.5	1	-	71	-	WLCSP-4
	NCP335	47 at 3.3 V	2	1.2	5.5	1	Auto	71	-	WLCSP-4
	NCP336	23 at 3.3 V	3	1.2	5.5	1	-	810	-	WLCSP-6
	NCP337	23 at 3.3 V	3	1.2	5.5	1	Auto	810	-	WLCSP-6
	NCP338	27 at 1.8 V	2	1	3.6	0.6	Auto	20	-	WLCSP-6
	NCP339	26 at 3.3 V	3	1.2	5.5	2	-	2700	Reverse blocking	WLCSP-6
	NCP432	50 at 1.8 V	1.5	1	3.6	0.6	-	20	-	WLCSP-4
	NCP433	50 at 1.8 V	1.5	1	3.6	0.6	Auto	20	-	WLCSP-4
	NCP434	43 at 1.8 V	2	1	3.6	0.6	-	61	-	WLCSP-4
	NCP435	43 at 1.8 V	2	1	3.6	0.6	Auto	61	-	WLCSP-4
	NCP436	23 at 1.8 V	3	1	3.6	1	-	27	-	WLCSP-6
	NCP437	23 at 1.8 V	3	1	3.6	1	Auto	27	-	WLCSP-6
ecoSWITCH™ Integrated Load Switch	NCP45524	18.0	6	0.5	13.5	-	Adj	-	Power good	DFN-8
	NCP45525	18.0	6	0.5	13.5	-	Adj	Adj	-	DFN-8
	NCP45560	2.4	24	0.5	13.5	-	Adj	Adj	Power good; Fault	DFN-12
	NCP45540	3.3	20	0.5	13.5	-	Adj	Adj	Power good; Fault	DFN-12
	NCP45541	3.3	20	0.5	13.5	-	Adj	Adj	Power good	DFN-12
	NCP45520	9.5	10.5	0.5	13.5	-	Adj	-	Power good; Fault	DFN-8
	NCP45521	9.5	10.5	0.5	13.5	-	Adj	Adj	Fault	DFN-8

Simple Load Switches

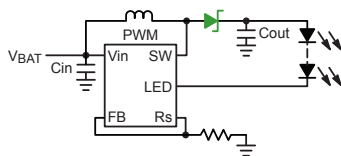
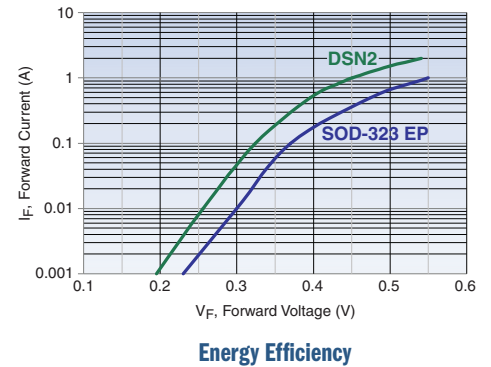
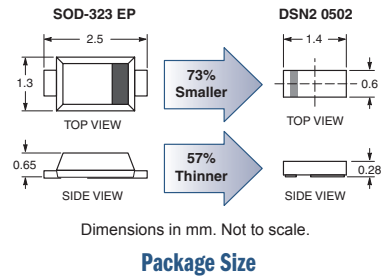
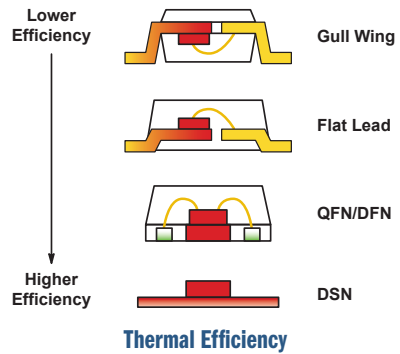


Switching Charger - Step Down

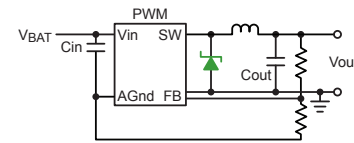
Device	Polarity	Configuration	$V_{(BR)DSS}$ Min (V)	V_{GS} Max (V)	I_D Max (A)	$R_{DS(ON)}$ Max @ $V_{GS} = 4.5$ V (Ω)	Package(s)
MCH3333A	P-Channel	Single	-30	± 10	2	0.215	MCPH-3
SCH1345	P-Channel	Single	-20	± 10	4.5	0.049	SOT-563
NTLUS3A39PZ	P-Channel	Single	-20	± 8	5.2	0.039	UDFN-6
NTLUD3A260PZ	P-Channel	Dual	-20	± 8	1.7	0.2	UDFN-6
NTLUS3A18PZ	P-Channel	Single	-20	± 8	8.2	0.018	UDFN-6
NTLUD3A50PZ	P-Channel	Dual	-20	± 8	4.5	0.048	UDFN-6
NTLJS3A18PZ	P-Channel	Single	-20	± 8	8.2	0.018	WDFN-6
NTTFS3A08PZ	P-Channel	Single	-20	± 8	15	0.067	$\mu 8$ FL
SCH1331	P-Channel	Single	-12	± 10	3	0.084	SOT-563
NTLUS3C18PZ	P-Channel	Single	-12	± 8	7	0.024	UDFN-6
MCH6351	P-Channel	Single	-12	± 10	9	0.016	MCPH-6
MCH6353	P-Channel	Single	-12	± 10	5.5	0.035	MCPH-6
EMH2314	P-Channel	Dual	-12	± 10	6	0.037	EMH-8
ECH8308	P-Channel	Single	-12	± 10	10	0.013	ECH-8
SCH1430	N-Channel	Single	20	± 12	2	0.125	SOT-563
SCH1433	N-Channel	Single	20	± 10	3.5	0.064	SOT-563
MCH6448	N-Channel	Single	20	± 9	8	0.022	MCPH-6
EMH2408	N-Channel	Dual	20	± 12	4	0.045	EMH-8
ECH8420	N-Channel	Single	20	± 12	14	0.0068	ECH-8
EMH2418R	N-Channel	Dual	24	± 12	8.5	0.0169	EMH-8
NTLUS4930N	N-Channel	Single	30	± 20	6.3	0.033	UDFN-6
NTLUS4C12N	N-Channel	Single	30	± 20	9.1	0.015	UDFN-6
NTLJS4114N	N-Channel	Single	30	± 12	6	0.035	WDFN-6
NTLJD4116N	N-Channel	Dual	30	± 12	3.7	0.07	WDFN-6
MCH6431	N-Channel	Single	30	± 20	5	0.091	MCPH-6
MCH3486	N-Channel	Single	60	± 20	2	0.192	MCPH-3

Optimized Schottky Diodes

As wireless devices become smaller and thinner, more compact, energy efficient components are necessary. Optimized DSN2 Schottky diodes offer best in class thermal efficiency, and are considerably smaller than equivalent current handling devices. A lower forward voltage - compared to similar devices - also improves energy efficiency.



DC-DC Boost Converter for LED Backlighting



DC-DC Buck Converter

Schottky Diodes in DSN2 Package

Device	I_F (A)	V_R (V)	V_F @ Rated I_F (mV)	I_R @ Rated V_R (μ A)	DSN2 Package
NSR01F30NX	0.1	30	500	50	0201
NSR01L30NX	0.1	30	530	3	0201
NSR02F30NX	0.2	30	550	50	0201
NSR02L30NX	0.2	30	580	3	0201
NSR05F20NX	0.5	20	390	75	0402
NSR05F30NX	0.5	30	400	75	0402
NSR05F40NX	0.5	40	420	75	0402
NSR10F20NX	1.0	20	430	100	0502
NSR10F30NX	1.0	30	450	100	0502
NSR10F40NX	1.0	40	490	100	0502
NSR20F20NX	2.0	20	450	150	0603
NSR20F30NX	2.0	30	480	150	0603
NSR20F40NX	2.0	40	520	150	0603

Schottky Diodes in X3DFN-2 Package

Device	I_F (A)	V_R (V)	Max V_F @ 10 mA (mV)	Max I_R @ 10 V (μ A)	Features
NSR01L30MX	100	30	460	0.2	Low Leakage
NSR01F30MX	100	30	350	5	Low V_F
NSR02F30MX	200	30	290	15	Low V_F

Schottky Diodes in SOD-923 Package

Part Number	V_R (V)	I_F (mA)	Features
NSR0620P2	20	500	Low Leakage
NSR0140P2	30	70	Low Leakage
NSR0130P2	30	100	Low Leakage
NSR0230P2	30	200	Low V_F
NSR0530P2	30	500	Low V_F
NSR0240P2	40	200	Low Leakage
NSR0340P2	40	200	Low V_F
NSR0170P2	70	70	Low Leakage

Schottky Diodes in SOD-523 Package

Device	V_R (V)	I_F (mA)	Features
NSR0520V2	20	500	Low V_F
RB520S30	30	200	Low Leakage
RB521S30	30	200	Low V_F
NSR0240V2	40	250	Low Leakage
NSR0340V2	40	250	Low V_F

Schottky Diodes in Other Packages

Device	V_R (V)	I_F (A)	Features	Package
SS2003M	30	2	Low V_F	SOT-363
SS3003CH	30	3	Low V_F	SOT-457

Bipolar Transistors and Digital Transistors

Bipolar Transistors

ON Semiconductor offers a wide portfolio of general purpose Bipolar Transistors. Below are the most common micro-packaged BJTs.

General Purpose Transistors

Device	Technology	V _{CE(max)} (V)	I _{C(max)} (mA)	Package
2SC5658M3	NPN	50	100	SOT-723
BC846BM3	NPN	65	100	SOT-723
2SA2029M3	PNP	50	100	SOT-723
BC856BM3	PNP	65	100	SOT-723
NST3904DP6	Dual NPN	40	200	SOT-963
NST3906DP6	Dual PNP	40	200	SOT-963
NST3946DP6	Comp NPN/PNP	40	200	SOT-963
NST847BDP6	Dual NPN	45	100	SOT-963
NST857BDP6	Dual PNP	45	100	SOT-963
NST847BPDP6	Comp NPN/PNP	45	100	SOT-963
NST3904F3	NPN	40	200	SOT-1123
NST3906F3	PNP	40	200	SOT-1123
NST847BF3	NPN	45	100	SOT-1123
NST857BF3	PNP	45	100	SOT-1123

Low V_{CE(sat)} BJTs

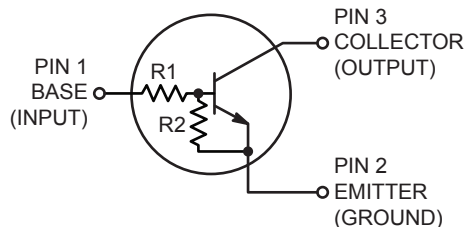
ON semiconductor is the leader in Low V_{CE(sat)} BJTs with a portfolio that includes devices up to 6 A.

Low V_{CE(sat)} BJTs

Device	Polarity	V _{CE} (V)	I _{C DC} (A)	V _{CE(sat)} 1 A, Beta 10, Typ (mV)	H _{fa} @ 5 V, 100 mA, Typ	Package
NSS12100M3	PNP	12	1	280	250	SOT-723
NSS12100XV6	PNP	12	1	280	250	SOT-563
NSS12500UW3	PNP	12	5	55	250	WDFN-3
NSS12501UW3	NPN	12	5	31	300	WDFN-3
NSS12601CF8	NPN	12	6	30	300	ChipFET
NSS20101J	NPN	20	1	220	500	SC-89
NSS20500UW3	PNP	20	5	60	250	WDFN-3
NSS20501UW3	NPN	20	5	31	300	WDFN-3
NSS20601CF8	NPN	20	6	31	300	ChipFET
NSS35200CF8	PNP	35	2	79	253	ChipFET
NSS40200UW6	PNP	40	2	100	250	WDFN-6
NSS40500UW3	PNP	40	5	65	250	WDFN-3
NSS40501UW3	NPN	40	5	38	300	WDFN-3
NSS40600CF8	PNP	40	6	50	250	ChipFET
NSS40601CF8	NPN	40	6	31	300	ChipFET

Digital Transistors

As space becomes more constrained in wireless devices, integration becomes more desirable. Incorporating bias resistors into bipolar transistors performs this integration without degrading the performance of the transistor.



Digital Transistors

Part Body Number	R1 (Ω)	R2 (Ω)	Package(s)
113E	1K	1K	SOT-723, SOT-1123
114E	10K	10K	SOT-723, SOT-963, SOT-1123
114T	10K	None	SOT-723, SOT-963, SOT-1123
114Y	10K	47K	SOT-723, SOT-963, SOT-1123
115E	100K	100K	SOT-723
115T	100K	None	SOT-723, SOT-963, SOT-1123
123E	2.2K	2.2K	SOT-723, SOT-1123
123J	2.2K	47K	SOT-723, SOT-963, SOT-1123
123T	2.2K	None	SOT-723, SOT-963, SOT-1123
124E	22K	22K	SOT-723, SOT-963, SOT-1123
124X	22K	47K	SOT-723, SOT-1123
143E	4.7K	4.7K	SOT-723, SOT-963, SOT-1123
143T	4.7K	None	SOT-723, SOT-1123
143Z	4.7K	47K	SOT-723, SOT-963, SOT-1123
144E	47K	47K	SOT-723, SOT-963, SOT-1123
144T	47K	None	SOT-723, SOT-1123
144W	47K	22K	SOT-723, SOT-963, SOT-1123

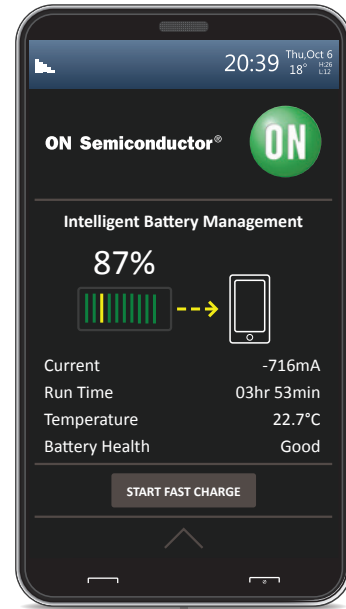
Power Bank Controller with Portable Device Communication, USB Type-C, & Quick/Fast Charge for 1-Cell Li-Ion and Li-Poly Battery

LC709501F Key Features

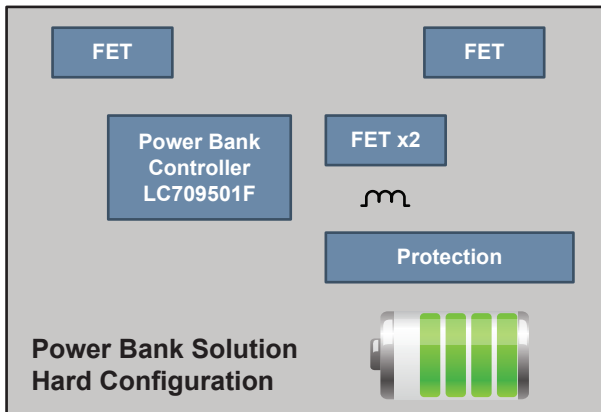
- Simple configuration (one main LSI)
- Scalability for Power (by external FETs)
- 5 V, 9 V, 12 V (cover Fast/Quick Charge)
- Smart Phone Data interface (USB Host I/F)

Base Features

- Buck Charge to Power Bank Battery
- Boost Charge to Smart Phone Battery
- Pass through Charge to smart Phone Battery
- Automatic USB detection
- Over voltage/Over current detection
- Redundant battery safety



✓ Quick Charge
✓ Data I/F via USB



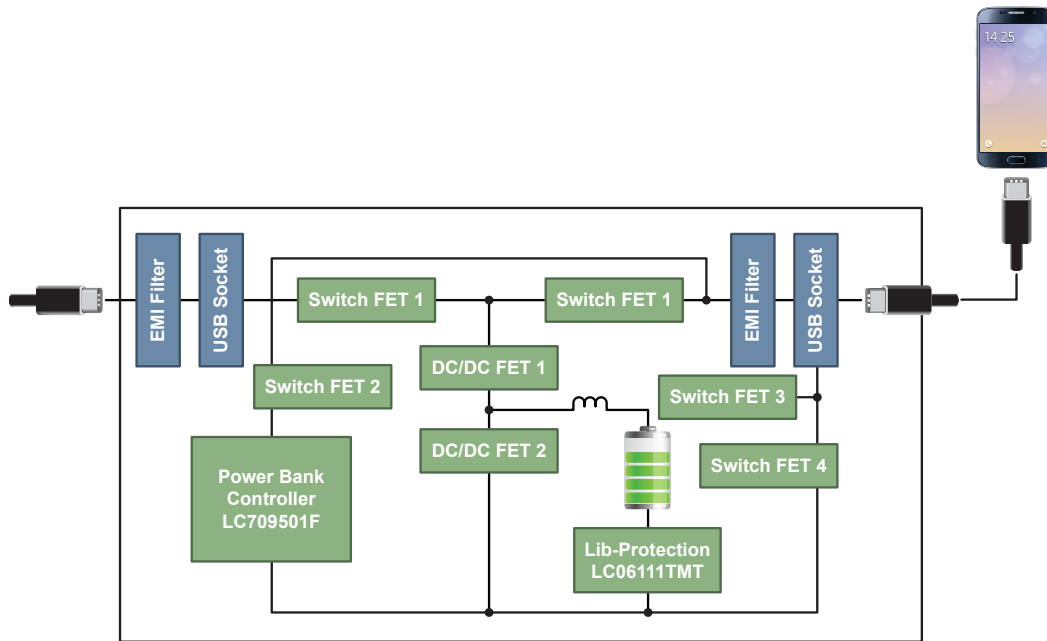
Reference Board



Device	Output for Charge (V)	Input	Output	Device Communication	Package
LC709501FQD-A01*	5/9/12	Micro B	Type A	USB2.0 FS	QFN-52
LC709501FQD-A03*	5/9/12	Type C	TypeC	-	QFN-52

* Pending 3Q16.

Support Devices for Power Bank Application



POWER MANAGEMENT

Switch MOSFETs

Function	Device	Configuration	Polarity	V _{DSS} Max (V)	V _{GSS} Max (V)	I _D Max (A)	R _{DS(ON)} @ V _{GS} = 2.5 V Typ/Max (mΩ)	R _{DS(ON)} @ V _{GS} = 4.5 V Typ/Max (mΩ)	R _{DS(ON)} @ V _{GS} = 10 V Typ/Max (mΩ)	Package(s)
Switch FET 1	ECH8310	Single	P-Channel	-30	±20	9	–	20/28	13/17	ECH-8
	ECH8315	Single	P-Channel	-30	±20	7	–	31/44	19/25	ECH-8
Switch FET 2	MCH3375	Single	P-Channel	-30	±20	1.6	–	374/523	227/295	MCPH-3
	SCH1337	Single	P-Channel	-30	±20	2	–	182/255	115/150	SCH-6
Switch FET 3	MCH3484	Single	N-Channel	20	±5	4.5	33/40	–	–	MCPH-3
	MCH3481	Single	N-Channel	20	±9	2	105/147	80/104	–	MCPH-3
Switch FET 4	ECH8420	Single	N-Channel	20	±12	14	7.5/10.5	5.2/6.8	–	ECH-8
	ECH8410	Single	N-Channel	20	±20	12	–	13/18.2	7.5/10	ECH-8

DC-DC MOSFETs

Function	Device	Configuration	Polarity	V _{SS} Max (V)	V _{GSS} Max (V)	I _D Max (A)	R _{DS(ON)} @ V _{GS} = 2.5 V Typ/Max (mΩ)	R _{DS(ON)} @ V _{GS} = 4.5 V Typ/Max (mΩ)	R _{DS(ON)} @ V _{GS} = 10 V Typ/Max (mΩ)	Package(s)
DC/DC FET 1	ECH8310	Single	P-Channel	-30	±20	9	–	20/28	13/17	ECH-8
	ECH8315	Single	P-Channel	-30	±20	7	–	31/44	19/25	ECH-8
DC/DC FET 2	NTTFS4H05N	Single	P-Channel	25	±20	94	–	–/4.8	–/3.3	WDFN-8
	ECH8410	Single	N-Channel	20	±20	12	–	13/18.2	7.5/10	ECH-8

Li-Ion Battery Protection

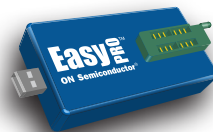
Device	Configuration	Polarity	V _{SS} Max (V)	V _{GSS} Max (V)	I _S (DC) (A)	R _{SS(ON)} @ V _{GS} = 4.5 V Min/Typ/Max (mΩ)	R _{SS(ON)} @ V _{GS} = 2.5 V Min/Typ/Max (mΩ)	Q _G Typ (V)	Package(s)
LC06111TMT*	2 in 1	N-Channel	12	±12	10	6.6/8.4/10.6	11.2/14.0/19.6	–	WDFN-6

* Pending 3Q16.

Serial EEPROM Memory

Features

- Broad density range: 1 kb to 2 Mb
- Wide operating Vcc range: 1.8/1.7 V to 5.5 V
- High endurance: 1 million program/erase cycles
- Wide temperature range: industrial and extended



EasyPRO™ is a user-friendly, portable programming tool for ON Semiconductor serial EEPROMs (I2C, SPI, Microwire)

EEPROMs

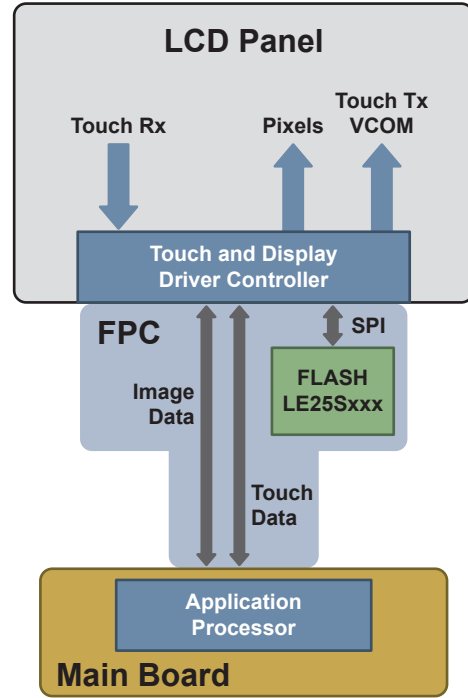
Data Transmission Standard	Device	Density	Organization*	Vcc Min (V)	Vcc Max (V)	fCLK Max (MHz)	Package(s)
I2C	CAT24M01	1 Mb	128k x 8	1.8	5.5	1	SOIC-8, TSSOP-8, UDFN-8
	CAT24C512	512 kb	64k x 8	1.8	5.5	1	SOIC-8, TSSOP-8, UDFN-8
	CAT24C256	256 kb	32k x 8	1.8	5.5	1	SOIC-8, TSSOP-8, UDFN-8
	CAT24C128	128 kb	16k x 8	1.8	5.5	1	SOIC-8, TSSOP-8, UDFN-8
	CAT24C64	64 kb	8k x 8	1.7	5.5	1	SOIC-8, TSSOP-8, UDFN-8, WLCSP-4
	LE2464CXA	64 kb	8k x 8	1.7	3.6	0.4	WLCSP-6
	CAT24C32	32 kb	4k x 8	1.7	5.5	1	SOIC-8, TSSOP-8, UDFN-8, WLCSP-4, WLCSP-5
	CAT24C16	16 kb	2k x 8	1.7	5.5	0.4	SOIC-8, TSSOP-8, UDFN-8, TSOT23-5, WLCSP-4, WLCSP-5
	LE24162LBXA	16 kb	2k x 8	1.7	3.6	0.4	WLCSP-6
	LE24163LBXA	16 kb	2k x 8	1.7	3.6	0.4	WLCSP-5
	LE2416RLBXA	16 kb	2k x 8	1.7	3.6	0.4	WLCSP-6
	CAT24C08	8 kb	1k x 8	1.7	5.5	0.4	SOIC-8, TSSOP-8, UDFN-8, TSOT23-5, WLCSP-4, WLCSP-5
	CAT24C04	4 kb	512 x 8	1.7	5.5	0.4	SOIC-8, TSSOP-8, UDFN-8, TSOT23-5, WLCSP-4, WLCSP-5
	LE24L042CS-B	4 kb	512 x 8	1.7	3.6	0.4	WLCSP-4
CAT24C02	2 kb	256 x 8	1.7	5.5	0.4	SOIC-8, TSSOP-8, UDFN-8, TSOT23-5, WLCSP-4, WLCSP-5	
SPI	CAT25M02	2 Mb	256k x 8	1.7	5.5	10	SOIC-8
	CAT25M01	1 Mb	128k x 8	1.8	5.5	10	SOIC-8, TSSOP-8
	CAT25512	512 kb	64k x 8	1.8	5.5	20	SOIC-8, TSSOP-8, UDFN-8
	CAT25256	256 kb	32k x 8	1.8	5.5	20	SOIC-8, TSSOP-8, UDFN-8
	CAT25128	128 kb	16k x 8	1.8	5.5	20	SOIC-8, TSSOP-8, UDFN-8
	CAT25640	64 kb	8k x 8	1.8	5.5	20	SOIC-8, TSSOP-8, UDFN-8
	CAT25320	32 kb	4k x 8	1.8	5.5	20	SOIC-8, TSSOP-8, UDFN-8
	CAT25160	16 kb	2k x 8	1.8	5.5	20	SOIC-8, TSSOP-8, UDFN-8
	CAT25080	8 kb	1k x 8	1.8	5.5	20	SOIC-8, TSSOP-8, UDFN-8
	CAT25040	4 kb	512 x 8	1.8	5.5	20	SOIC-8, TSSOP-8, UDFN-8
	CAT25020	2 kb	256 x 8	1.8	5.5	20	SOIC-8, TSSOP-8, UDFN-8
CAT25010	1 kb	128 x 8	1.8	5.5	20	SOIC-8, TSSOP-8, UDFN-8	
Microwire	CAT93C86	16 kb	2k x 8 & 1k x 16	1.8	5.5	3	SOIC-8
	CAT93C86B	16 kb	2k x 8 & 1k x 16	1.8 / 1.65	5.5	4	SOIC-8, TSSOP-8, UDFN-8
	CAT93C76	8 kb	1k x 8 & 512 x 16	1.8	5.5	3	SOIC-8, TSSOP-8
	CAT93C76B	8 kb	1k x 8 & 512 x 16	1.8 / 1.65	5.5	4	SOIC-8, TSSOP-8, UDFN-8
	CAT93C66	4 kb	512 x 8 & 256 x 16	1.8	5.5	2	SOIC-8, TSSOP-8
	CAT93C56	2 kb	256 x 8 & 128 x 16	1.8	5.5	2	SOIC-8, TSSOP-8
	CAT93C46	1 kb	128 x 8 & 64 x 16	1.8	5.5	2	SOIC-8, TSSOP-8
	CAT93C46B	1 kb	128 x 8 & 64 x 16	1.8 / 1.65	5.5	4	SOIC-8, TSSOP-8, UDFN-8
CAT93C46B	1 kb	128 x 8 / 64 x 16	1.8 / 1.65	5.5	4	SOIC-8, TSSOP-8, UDFN-8	

* Organization for Microwire devices is selectable.

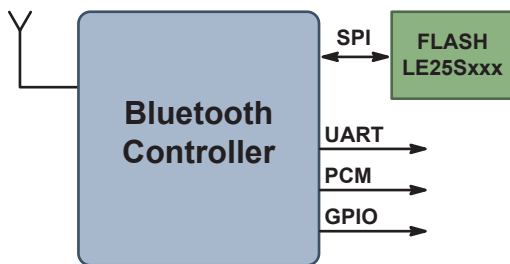
Serial NOR Flash Memory

Features

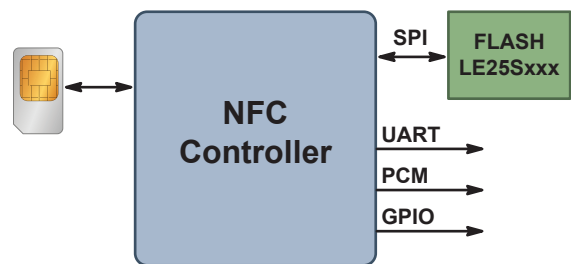
- SPI interface
- Supply voltage 1.65 to 1.95 V
- Minimum erase size (4 KB/64 KB)
- Fast write performance (Sector Erase/Page Program)
- Low standby current; support for deep standby mode



LCD Module Diagram



Bluetooth Block Diagram



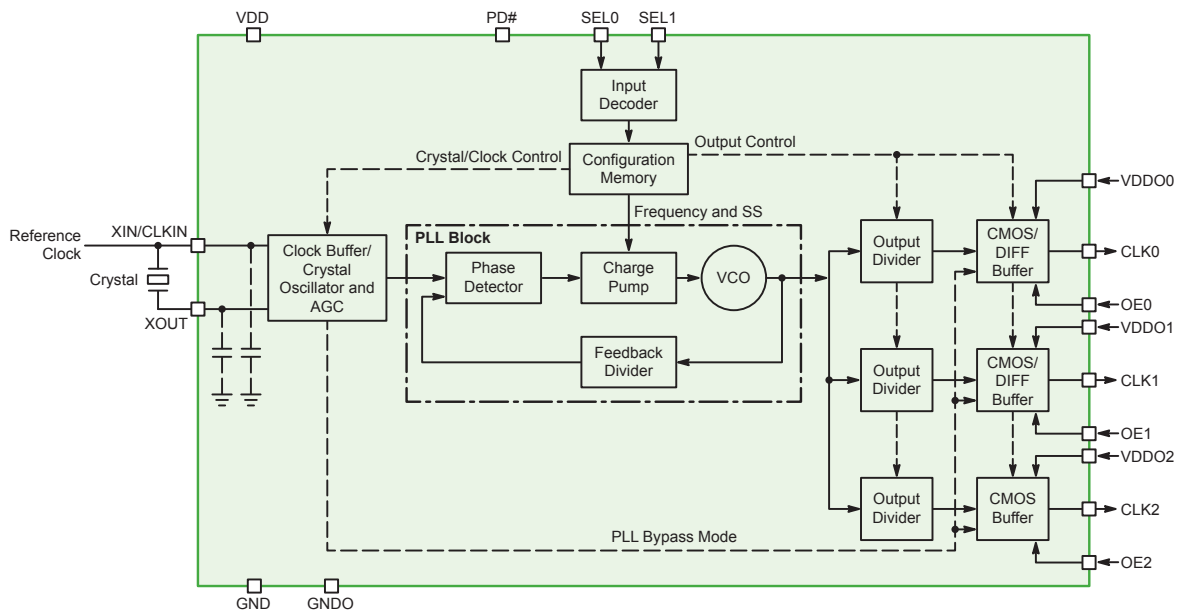
NFC Block Diagram

Device	Density	Power Supply (V)	Erase Size	Sector Erase Time (ms)	Page Program Time (ms)	Read/Write/Standby Current, Typ (mA)	Package
LE25S20	2 Mb	1.65 - 1.95	4 KB/64 KB/2 Mb	80	3.0	6.0/15.0/0.010	WLCSP-8
LE25S81	8 Mb	1.65 - 1.95	4 KB/64 KB/8 Mb	80	0.3	6.0/18.0/0.010	WLCSP-8
LE25S161	16 Mb	1.65 - 1.95	4 KB/64 KB/16 Mb	15	0.4	6.0/6.5/0.009	UDFN-8, WLCSP-8

Omnicklock Programmable Clock Synthesizers

Key Features

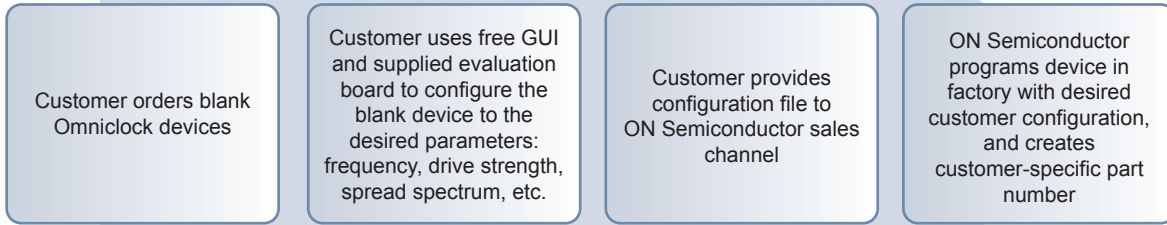
- Single PLL
- Input Frequency Range:
 - Crystal: 3 – 50 MHz (low cost ESR crystal compatible)
 - Clock: 3 – 200 MHz (single-ended only)
- Up to 3 single-ended (LVCMOS/LVTTL) outputs, or up to 1 differential (LVPECL, LVDS, HCSL or CML) output + 1 single-ended (LVCMOS/LVTTL) output
- Output Frequency Range: 8 kHz (Min), 200 MHz (Max)
- Programmable Spread Spectrum Capabilities for EMI Suppression
 - Center Spread (0.125% steps): $\pm 0.125\%$ to $\pm 3\%$
 - Down Spread (0.25% steps): -0.25% to -4%
 - Modulation Rate: 30 kHz – 130 kHz
- PLL Bypass mode
- Individual Output Enable pin for each output and Power Down Capability
- Individual Output Voltage pins per output, allowing setting of output voltage (1.8 V, 2.5 V or 3.3 V; equal to or less than VDD)
- Automatic Gain Control (Crystal Power Limiting)
- Programmable internal input crystal load capacitors
- Programmable Output Drive current
- Up to 4 independent configurations using SELx pins
- Supply Voltage: 3.3 V $\pm 10\%$; 2.5 V $\pm 10\%$; 1.8 V ± 0.1 V
- Temperature Range: -40°C to $+85^{\circ}\text{C}$
- Available in QFN-16 (3 mm x 3 mm) and WDFN-8 (2 mm x 2 mm) packages



Block Diagram

Omiclock Programmable Clock Synthesizers

Using Omniclock in Your System



Output	Output Enable	Output Disable State	Output Type	Output Frequency (MHz)	VDD=VDDO (V)	Drive Strength (mA)	Invert Output	Bypass PLL
CLK0	<input checked="" type="checkbox"/>	Low	LVCMOS	50.000000	3.3	16	<input type="checkbox"/>	<input type="checkbox"/>
CLK1	<input checked="" type="checkbox"/>	Low	LVCMOS	50.000000	3.3	16	<input type="checkbox"/>	<input type="checkbox"/>
CLK2	<input checked="" type="checkbox"/>	Low	LVCMOS	50.000000	3.3	16	<input type="checkbox"/>	<input type="checkbox"/>

Configuration GUI

Device	Individual OE	Individual V _{ddo}	Supply Voltage (V)	Number of Configurations	Number of Outputs	Package
NB3H63143G	Yes	Yes	2.5 / 3.3	4	3	QFN-16
NB3H60113G	No	No	2.5 / 3.3	1	3	DFN-8
NB3V63143G	Yes	Yes	1.8	4	3	QFN-16
NB3V60113G	No	No	1.8	1	3	DFN-8

INTERFACE & MEMORY

EMI Reduction with Spread Spectrum Clocks

Spread spectrum frequency modulator clock generators reduce electromagnetic interference (EMI) at the clock source, allowing system wide EMI reduction on all clock dependent signals.

	Frequency (MHz)	Without Spread Spectrum (dB)	With Spread Spectrum (dB)	Reduction (dB)
Fundamental	46.9	-28	-28.4	0.4
3rd Harmonic	143.9	-31.1	-36.9	5.8
5th Harmonic	238.5	40	-47.1	7.1
7th Harmonic	333.1	-50.7	-57.6	6.9
9th Harmonic	434.9	-43.7	-50.9	7.2
11th Harmonic	524.7	-41.8	-49	7.2

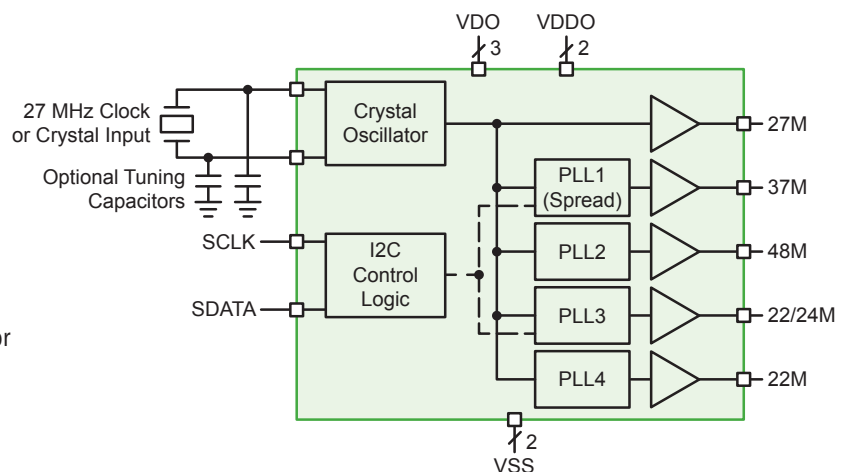


Device	V _{DD} Typ (V)	f _{in} Typ (MHz)	f _{out} Typ (MHz)	Deviation Type	Features	Package (s)
P3MS650100H	1.8; 2.5; 3.3	15-30; 15-60	15-30; 15-60	±1.4% @ 24 MHz	Power Down	WDFN-4
P3MS650103H	1.8; 2.5; 3.3	15-30; 15-60	15-30; 15-60	±0.45% @ 24 MHz	Power Down	WDFN-4
P3PS550AH	2.3-3.6	18-36	18-36	±0.4 to ±2.5	High Drive, PDB	WDFN-8
P3PSL450AH	1.8	15-60	15-60	Analog	PDB	WDFN-8
PCS3PS550A	2.3-3.6	18-36	18-36	±0.4 to ±2.5	PDB	WDFN-8

4-PLL Audio/Video Clock Generator with Spread Spectrum Clock

Key Features – P1P40167

- Eliminates multiple crystals by using one device to generate multiple clocks
- Integrated loop filter
- Input: 27 MHz crystal or external input
- Outputs:
 - 27 MHz reference output
 - Fixed output frequency of 48 MHz and 22.5792 MHz
 - Configurable spread spectrum 37 MHz output
 - Selectable audio clock frequency of 22.5792 MHz or 24.576 MHz
- LVCMOS input and outputs
- Serial interface to control output enable/disable, SS selection and PLL frequency selection
- 1.8 V supply voltage

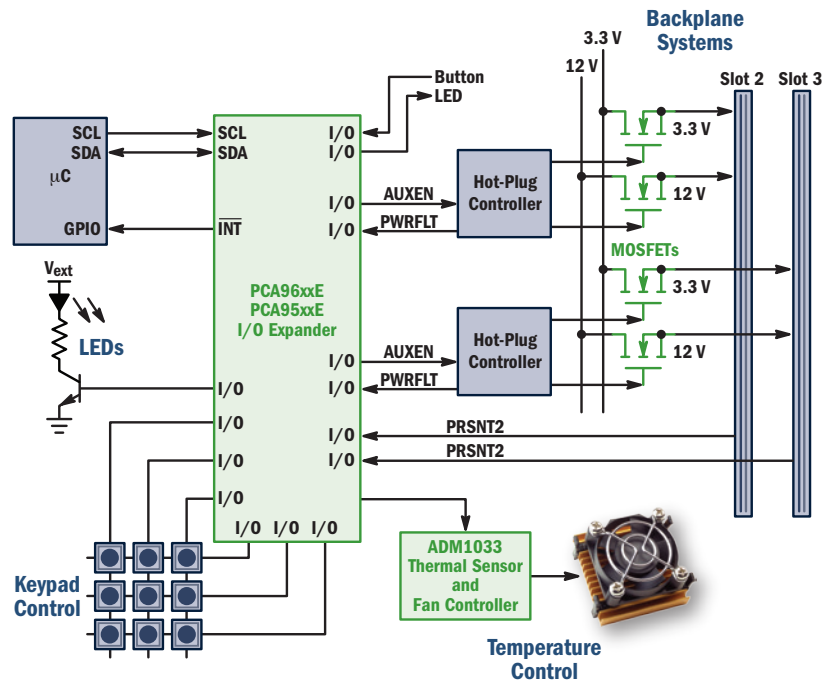


P1P40167 Block Diagram

Cascadable I/O Expanders

Features

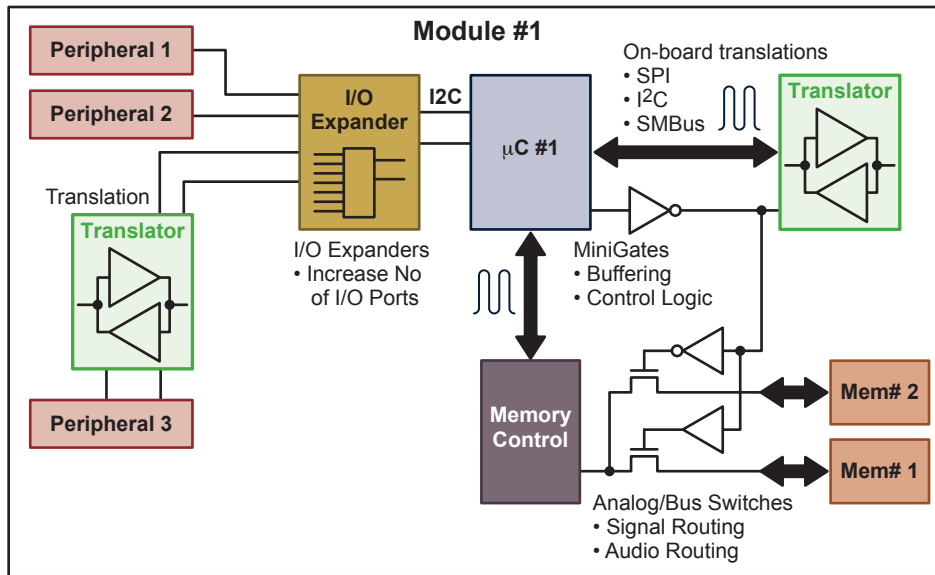
- I2C and SMBus interfaces
- 1 MHz SCL clock frequency
- 30 mA SDA sink capability



Device	I/O	Cascadable	Vcc Min (V)	Vcc Max (V)	Interrupt Output	I/O Pullups	LED Blink/ PWM	Package
PCA9535E	16	64 Programmable Slave Addresses	1.65	5.5	✓			QFN-24, SOIC-24, TSSOP-24
PCA9655E	16	64 Programmable Slave Addresses	1.65	5.5	✓			QFN-24, SOIC-24, TSSOP-24
PCA9654E	8	8 Slave ID Addresses	1.65	5.5	✓	✓		SOIC-16, WQFN-16, TSSOP-16

Logic and Digital Interfaces

- MiniGates™ and Standard Logic - condition logic signals
- Bus Switches and Analog Switches - low-cost signal routing and multiplexing
- Voltage Translators - interface sub-systems with different operating voltages
- I2C Interface - increase # of I/O ports, level shifting, repeaters
- Custom Logic Solutions - create “valued-added interface”



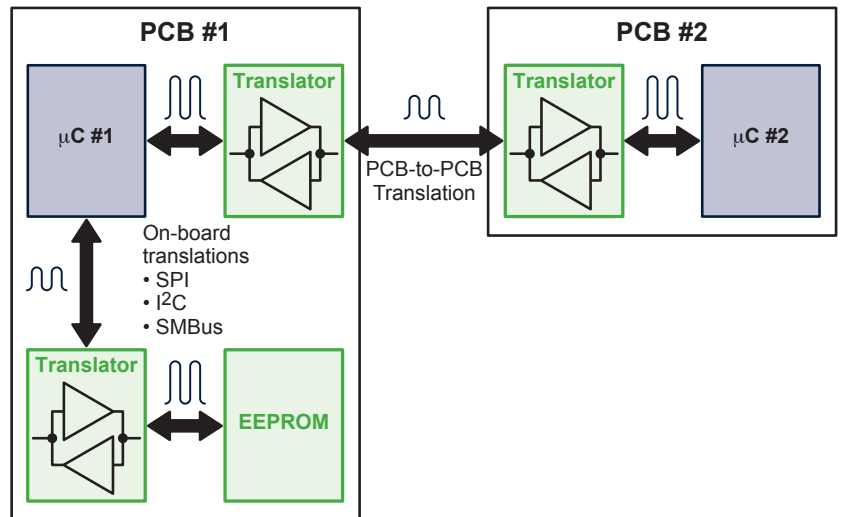
MiniGate™ Family	Operating Voltage (V)	Drive Current (mA)	Propagation Delay (ns)	SC-88	TSOP-5	SOT-553	UDFN	SOT-9
HC (High Speed CMOS)	2.0 - 6.0	5.2 @ 5 V	7	MC74HC1GxxDF	MC74HC1GxxDT			
VHC (Very High Speed CMOS)	2.0 - 5.5	8 @ 5 V	4.5	MC74VHC1GxxDF	MC74VHC1GxxDT		NLU1GxxCMU	NL17SHxxP5
LCX (Low-Voltage CMOS, Xtra Drive)	1.65 - 5.5	24 @ 5 V	2.9	NL17SZxxDF		NL17SZxxXV5	NLX1GxxCMU	NL17SZxxP5
VCX (Very High Speed CMOS, Xtra Drive)	0.9 - 3.6	24 @ 3.6 V	1.5			NL17SVxxX5		
SG (Super Low Voltage Gate)	0.9 - 3.6	8 @ 3.3 V	2.5	NL17SGxxDF			NL17SGxxMU	NL17SGxxP5

Logic Translators

Dual supply voltage logic translators connect ICs and PCBs together that operate at different supply voltages.

Key Features

- Industry's first devices with independent power supplies ($V_L < V_{CC}$, $V_L = V_{CC}$, or $V_L > V_{CC}$)
- High 100 pF capacitive drive capability
- Overvoltage tolerant enable and I/O pins
- Non-preferential power-up sequencing
- Power-off protection



	Unidirectional Translator	Autosense Bidirectional Translator (Push-Pull Output)	Autosense Bidirectional Translator (Open-Drain Output)	Bidirectional Translator (with Direction Pin)
Block Diagram				
Attributes	<ul style="list-style-type: none"> • High Data Rate • Low Power Consumption 	<ul style="list-style-type: none"> • High Data Rate • Low Power Consumption 	<ul style="list-style-type: none"> • High Data Rate • Low Power Consumption • Flexible PCB Design 	<ul style="list-style-type: none"> • High Data Rate • Low Power Consumption • Flexible PCB Design
Trade-Offs	<ul style="list-style-type: none"> • Fixed Input & Output Pins 	<ul style="list-style-type: none"> • Modest Output Current 	<ul style="list-style-type: none"> • Modest Bandwidth 	<ul style="list-style-type: none"> • Directional Control Pin Required
Applications	<ul style="list-style-type: none"> • SPI • GPIO 	<ul style="list-style-type: none"> • SPI • GPIO 	<ul style="list-style-type: none"> • I2C, SMBus, PMBus • GPIO • SDIO Cards • 1-Wire Bus 	<ul style="list-style-type: none"> • GPIO
Sample Device (I/O Channels, Package)	<ul style="list-style-type: none"> • NLSV1T34 (1-Bit, ULLGA-6) • NLSV1T240/244 (1-Bit, UDFN-6) • NLSV2T240/244 (2-Bit, UDFN-8) • NLSV4T240/244 (4-Bit, UDFN-12) • NLSV4T3234 (4-Bit, CSP-11) • NLSV8T240/244 (8-Bit, UDFN-20) 	<ul style="list-style-type: none"> • NLSX3012 (2-Bit, UDFN-8) • NLSX3014 (4-Bit, UQFN-12) • NLSX3013 (8-Bit, CSP-20) • NLSX3018 (8-Bit, UDFN-20) • NLSX4014 (4-Bit, UQFN-12) • NLSX5011 (1-Bit, ULLGA-6, UDFN-6) • NLSX5012 (2-Bit, UDFN-8) • NLSX5014 (4-Bit, UDFN-12) 	<ul style="list-style-type: none"> • NLSX3373 (2-Bit, UDFN-8) • NLSX3378 (4-Bit, CSP-12) • NLSX4373 (2-Bit, UDFN-8) • NLSX4378 (4-Bit, CSP-12) 	<ul style="list-style-type: none"> • NLSV1T45 (1-Bit, ULLGA-6) • NLSV2T245 (2-Bit, UQFN-10) • NLSV2T3236 (2-Bit, UQFN-10) • NLA16T245 (16-Bit, TSSOP-48)

Analog Switches

Device	Data Type	Configuration	Vcc Min (V)	Vcc Max (V)	R _{ON} Max (Ω)	I _{kg} Max (μA)	C (pF)	BW (MHz)	Package(s)
NLAS7213	USB 2.0/UART	DPST	1.65	4.5	10	1	5	1100	UQFN-8
NLAS4717	USB 1.1/UART	Dual SPDT	1.8	5.5	4.5	1	110	40	Flip-Chip-10, Micro-10
NLAS4717EP	USB 1.1/UART	Dual SPDT	1.8	5.5	4.5	1	38	90	WQFN-10, Flip-Chip-10
NLAS7222A	USB 2.0/UART	DPDT	3	3.6	9	1	7	500	WQFN-10
NLAS7222B	USB 2.0/UART	DPDT	1.65	4.5	8	1	8	500	UQFN-10
NLAS7222C	USB 2.0/UART	DPDT	1.65	4.5	8	1	10	500	UQFN-10
NLAS7242	USB 2.0/UART	DPDT	1.65	4.5	7.5	1	7.5	900	UQFN-10
NL3HS2222	USB 2.0/UART	DPDT	1.65	4.5	8	1	7.5	950	UQFN-10
NCN9252	USB 2.0/UART	DP3T	1.65	4.5	6	1	16	525	UQFN-12
NLAS3899B	SIM card	Dual DPDT	1.65	4.3	4	1	20	280	WQFN-16, QFN-16
NS5S1153	USB 2.0/UART/Negative Audio	DPDT	-0.5	5	4.6	35	7	900	UQFN-10
NCN1154	USB 2.0/UART/Negative Audio	DP3T	-0.5	6	3	50	9	850	UQFN-12
NCN1188	USB 2.0/MHL 1.1/Negative Audio	DP3T	-0.5	6	-	-	-	-	UQFN-12
NL3HS644	4-Lane MIPI Switch	SPDT	1.65	4.5	12	0.1	12	1050	WLCSP-36
NLAS3257	Low Capacitance	SPDT	1.65	4.5	9	1	7.5	900	XLLGA-6
NLAS3157	Low Capacitance	SPDT	1.65	4.5	9	1	7.5	900	ULLGA-6



Small Signal MOSFETs

Device	Polarity	Configuration	V _{(BR)DSS} Min (V)	V _{GS} Max (V)	I _D Max (A)	R _{DS(ON)} Max @ V _{GS} = 4.5 V (Ω)	R _{DS(ON)} Max @ V _{GS} = 2.5 V (Ω)	R _{DS(ON)} Max @ V _{GS} = 1.8 V (Ω)	Package(s)
NTNS3193NZ	Single	N-Channel	20	±8	0.23	1.4	1.9	2.2	XLLGA-3
NTNS3A91PZ	Single	P-Channel	-20	±8	0.21	1.6	2.4	3.3	XLLGA-3
NTNS3164NZ	Single	N-Channel	20	±8	0.22	0.7	1	2	SOT-883
NTNS3A65PZ	Single	P-Channel	-20	±8	0.23	1.3	2	3.4	SOT-883
NTNUS3171PZ	Single	P-Channel	-20	±8	0.15	3.5	4	5.5	SOT-1123
NTK3139P	Single	P-Channel	-20	±6	0.78	0.48	0.67	0.95	SOT-723
NTK3134N	Single	N-Channel	20	±6	0.89	0.35	0.45	0.65	SOT-723
NTK3043N	Single	N-Channel	20	±10	0.26	3.4	4.5	10	SOT-723
NTZS3151P	Single	P-Channel	-20	±8	0.9	0.142	0.2	0.24	SOT-563
NTUD3170NZ	Dual	N-Channel	20	±8	0.22	1.5	2	3	SOT-963
NTZD3152P	Dual	P-Channel	-20	±6	0.4	0.9	1.2	2	SOT-563
NTZD3154N	Dual	N-Channel	20	±6	0.5	0.55	0.7	0.9	SOT-563
NTZD5110N	Dual	N-Channel	60	±20	0.3	2.5	-	-	SOT-563
NTUD3169CZ	Complementary	N-Channel	-20	±8	0.22	1.5	2	3	SOT-963
		P-Channel	20	±8	0.25	5	6	7	
NTZD3155C	Complementary	N-Channel	20	±6	0.54	0.55	0.7	0.9	SOT-563
		P-Channel	-20	±6	0.43	0.9	1.2	2	



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