BRD8026/D
Rev. 14, Mar-2020

Energy Efficient Innovations

Portable & Wearable Solutions



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











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RSL10 Bluetooth® Low Energy Technology Radio SoCs

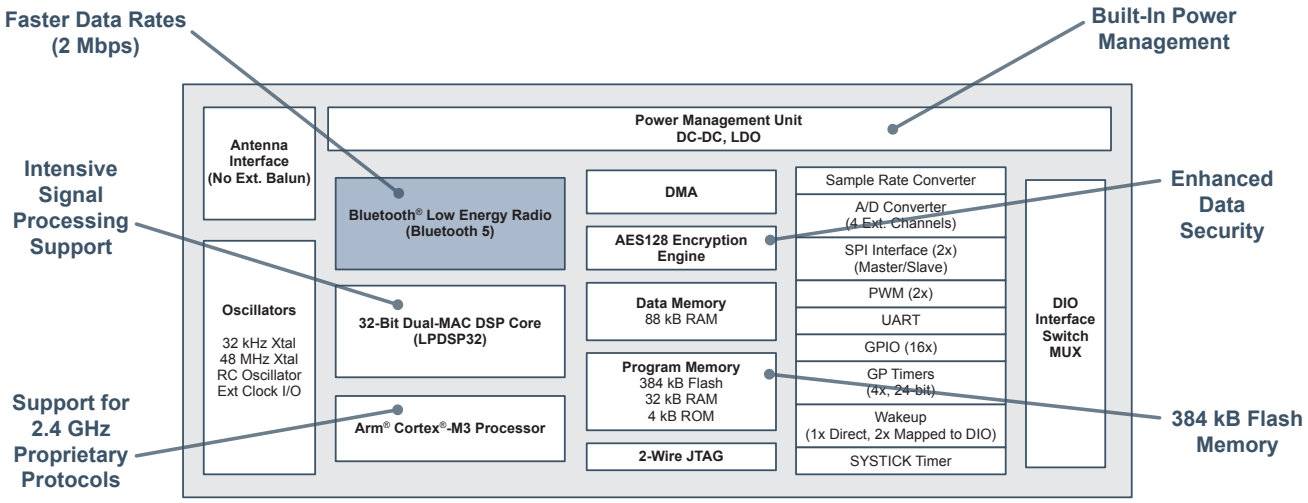
With so many options for wireless available, what sets the RSL10 radio SoC family apart? Simple. It offers the industry's lowest power Bluetooth Low Energy technology. Supporting 2 Mbps data rates provided by Bluetooth 5 (twice the speed as with previous Bluetooth generations), RSL10 enables advanced wireless functionality without compromising battery life. RSL10 can be easily integrated into any device.

SoC Features

- Industry's lowest power consumption (62 nW in Deep Sleep, 7 mW in Receive Mode)
- Supports Bluetooth Low Energy and 2.4 GHz proprietary protocols
- Flexible Voltage Supply Range (1.1 - 3.3 V)
- IP protection feature
- Available packages WLCSP-51, QFN-48

SIP Features

- All-in-one solution
  - RSL10 radio SoC
  - Integrated antenna, filtering, power management, passives
- Fully certified to worldwide regulatory standards
  - Bluetooth SIG, FCC (USA), CE (Europe), IC (Canada), KCC (Korea), MIC (Japan)



Development Tools

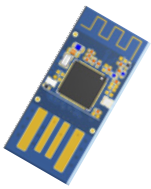
Software Development Kit (SDK)

- IDE support for Eclipse, Keil, and IAR
- Bluetooth Low Energy protocols, precompiled sample code and libraries, technical documentation
- Support for Bluetooth Mesh networking



RSL10 Development Board

- Compliance with Arduino form factor
- Integrated PCB antenna
- On-board J-link adapter for easy debugging



RSL10 USB Dongle

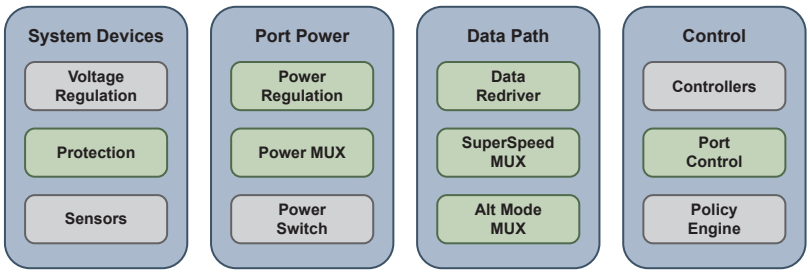
- Provided with Bluetooth Low Energy Explorer software to help verify or diagnose wireless connections during development

Mobile Apps

- Bluetooth Mesh networking for Android®
- FOTA (Firmware over the Air) for Android and iOS®

USB-C® for Smartphone

Recent adaptation of USB-C (USB Type-C®) to smartphones for data transmission, power, and video on a single connector, enables faster charging and data rates up to 10 Gbps using a USB-C charging cable. While consumer enjoys one size, one end USB-C connector and cable, implementing USB-C designs includes challenges to meet requirements for compact size, thermal efficiencies, and low power consumption. ON Semiconductor provides broad USB-C & USB Power Delivery solutions for smartphone design implementation.



Block Diagram



System Devices

Function	Device	Description
Protection	ESDL2011	High Speed Data Line Protection, Bidirectional (1 V – Thunderbolt 3.0), 0.2 pF
	ESDL1531	High Speed Data Line Protection (3.3 V - USB 3.x), (D+/–, Tx/Rx Pairs), 0.3 pF
	ESDL2031	High Speed Data Line Protection (4.0 V - USB 3.x), (D+/–, Tx/Rx Pairs), 0.4 pF
	ESD8111P	High Speed Data Line Protection (3.3 V – USB 3.x), (D+/–, Tx/Rx Pairs), 0.4 pF
	ESDM3551	ESD Protection Diode, CC and SBU Protection (5.5 V – USB 3.x), 21 pF
	NSPM2052	ESD and Surge Protection Device, Vbat and Vbus Applications, 5 V
	NSPM0061	ESD and Surge Protection, 6.3 V
	NSPM0101	ESD and Surge Protection, 10 V, 60 A
	NSPU5132	ESD and Surge Protection Device, Unidirectional, 13.5 V, 200 A
	NSPU5201	ESD and Surge Protection, Unidirectional, 20 V, 140 A
	NCS210	Current Sense Amplifier, Bidirectional Zero-Drift, 1% Max. Gain Error, 60 µV Offset
	NCS211	Current Sense Amplifier, Bidirectional Zero-Drift, 1% Max. Gain Error, 60 µV Offset
	NCS213	Current Sense Amplifier, Bidirectional Zero-Drift, 1% Max. Gain Error, 100 µV Offset
	NCS214	Current Sense Amplifier, Bidirectional Zero-Drift, 1% Max. Gain Error, 60 µV Offset
	FUSB252	High Speed Digital (HSD) Port Protection Switch with Type-C CC
	FSUSB242	USB Type-C Port Protection Switch
	NCP398	USB Type-C VCONN Overvoltage Protection IC

Port Power

Function	Device	Description
Power Regulation	NCS2202	Comparator, Low Voltage, Open Drain
	NCS2200	Comparator, Complementary, Low Voltage
	NCS210	Current Sense Amplifier, Bidirectional Zero-Drift, 1% Max. Gain Error, 60 µV Offset
	NCS211	Current Sense Amplifier, Bidirectional Zero-Drift, 1% Max. Gain Error, 60 µV Offset
	NCS213	Current Sense Amplifier, Bidirectional Zero-Drift, 1% Max. Gain Error, 100 µV Offset
	NCS214	Current Sense Amplifier, Bidirectional Zero-Drift, 1% Max. Gain Error, 60 µV Offset
Power MUX	FPF2595	Load Switch, Over-Voltage, Over-Current Protection with Adjustable Current-Limit Control, IntelliMAX™ 28 V
	FPF2895C	Current Limit Load Switch with OVP and TRCB, 28 V, 5 A

Data Path

Function	Device	Description
Data Redriver	NB7NPQ7021M	USB 3.1 Dual Channel Linear Redriver, 3.3 V
	NB7NPQ7022M	USB 3.1 Dual Channel Linear Redriver, 3.3 V
	NB7NPQ1004M	USB 3.1 Quad Channel Redriver, 3.3 V
	NB7NPQ1002M	USB 3.1 Dual Channel Redriver, 3.3 V
	NB7VPQ904M	USB-C DisplayPort® Redriver, 1.8 V
SuperSpeed Mux	FUSB340	USB 3.1 SuperSpeed Switch, 10 Gbps
Alt Mode MUX	NL3S2223	High-Speed USB 2.0 DPDT Switch
	NL3S22AH	USB 2.0 and HiFi Audio Switch
	FSA4476	Analog Audio Switch with Protection Function, USB Type-C
	FSA4480	Analog Audio Switch with Protection Function, USB Type-C

Control

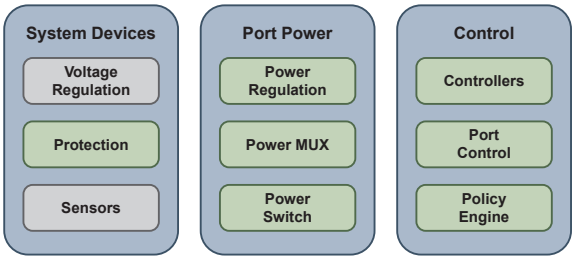
Function	Device	Description
Port Control	FUSB302B	Programmable USB Type-C Controller with PD (Default SNK)
	FUSB303	Autonomous USB Type-C Controller with I2C and GPIO Control

USB-C for Power Bank

USB-C (Type-C) is becoming the latest standard for accessories including power banks. ON Semiconductor offers both discrete and best-in-class integrated power bank solutions, which meet the latest USB-C and USB Power Delivery (PD) specifications. Our latest integrated, scalable power bank solutions enable a streamlined design process, and accelerate time to market, supporting a range of battery pack sizes.

System Devices

Function	Device	Description
Protection	ESD8704	High Speed Data Line Protection, Unidirectional (3.3 V - USB 3.x)
	ESD7104	ESD Protection, Low Capacitance, High Speed Data
	ESD8116	ESD Protection Array, USB 3.0
	ESD8118	ESD Protection Array, USB 3.0
	ESDM3551	ESD Protection Diode, CC and SBU Protection (5.5 V - USB 3.x), 21 pF, 0.6 x 0.3 mm
	NSPU3051	ESD and Surge Protection, CC, SBU and Vbus, (5.5 V - USB 3.x), 80 pF, 1.0 x 0.6 mm
	NSPM2052	ESD and Surge Protection Device, Vbat and Vbus, 5 V, 120 A, 1.6 x 1.0 mm
	NSPU5132	ESD and Surge Protection Device, Unidirectional, 13.5 V, 200 A, 2.0 x 1.8 mm
	NSPU5201	ESD and Surge Protection Device, Unidirectional, 20 V, 140 A, 2.0 x 1.8 mm
	NIS6350	Electronic Fuse, 5 V, 70 mΩ
	NIS5020	Electronic Fuse, 12 V, 14 mΩ
	LC06111TMT	Battery Protection Controller with Integrated MOSFET, 1-Cell Lithium-Ion
	LC05711ARA	Battery Protection Controller with Integrated MOSFET, 1-Cell Lithium-Ion
	LC05111CMT	Battery Protection Controller with Integrated MOSFET, 1-Cell Lithium-Ion
	FUSB252	High Speed Digital (HSD) Port Protection Switch with Type-C CC



Block Diagram





Port Power

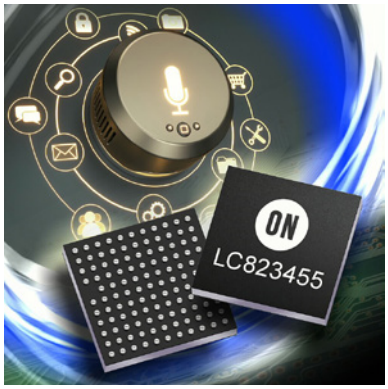
Function	Device	Description
Power Regulation	NCP81231	Buck Controller, USB Power Delivery and Type-C Applications
	NCP81239	4-Switch Buck Boost Controller, USB Power Delivery and Type C Application
Power Switch	FPF3380	Over-Voltage Protection Load Switch
	FPF2281	Over-Voltage Protection Load Switch
	FPF2286	Over-Voltage Protection Load Switch
	FPF2290	Over-Voltage Protection Load Switch
	FPF2495C	Load Switch, Over-Voltage, Over-Current Protection with Adjustable Current-Limit Control, IntelliMAX™ 28 V
	FPF2595	Load Switch, Over-Voltage, Over-Current Protection with Adjustable Current-Limit Control, IntelliMAX 28 V
	ECH8310	P-Channel Power MOSFET, -30 V, -9 A, 17 mΩ
	NTTFS4H05N	Power MOSFET, Single N−Channel, 25 V, 94 A, 3.3 mΩ
	MCH3375	Single P-Channel Power MOSFET, -30 V, 295 mΩ, -1.6 A
	BAT54AL	Schottky Diode, Dual Common Anode, 30 V
	BAT54CL	Schottky Diode, Dual Common Cathode, 30 V
	BAT54T	Schottky Barrier Diode
Power MUX	FPF2595	Load Switch, Over-Voltage, Over-Current Protection with Adjustable Current-Limit Control, IntelliMAX 28 V
	FPF2895C	Current Limit Switch with OVP and TRCB, 28 V / 5 A

Control

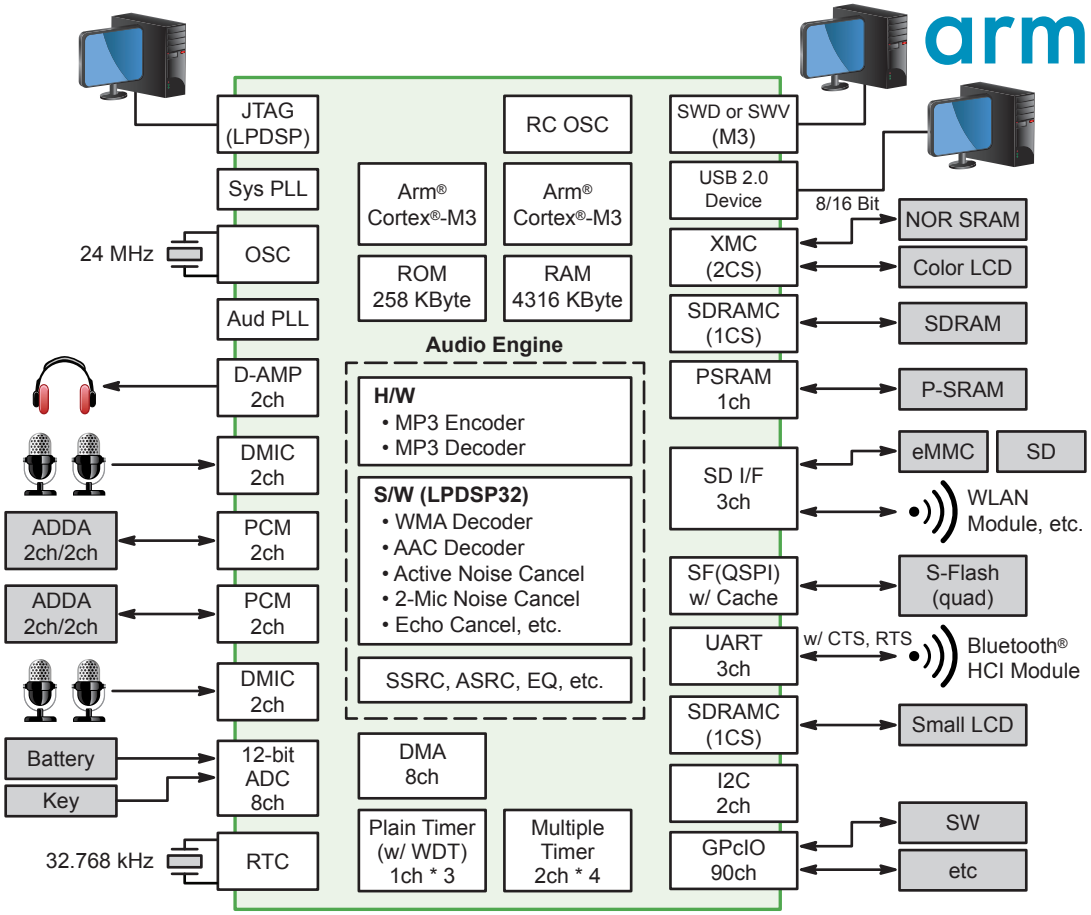
Function	Device	Description
Controllers/ Policy Engine	LC709501F	Power Bank Controller, USB Type-C & Quick Charge™ 3.0, for 1-Cell Li-Ion and Li-Poly Battery
	LC709511F	Power Bank Controller, USB Type-C & Quick Charge 3.0, for 1-Cell Li-Ion and Li-Poly Battery
Port Control	FUSB302B	Programmable USB Type-C Controller with PD (Default SNK)
	FUSB302T	Programmable USB Type-C Controller with PD (Default SRC)
	FUSB303	Autonomous USB Type-C Port Controller with I2C and GPIO Control
	FUSB307B	USB Type-C Port Controller with USB-PD

High Resolution, Low Power Audio Processing SoC

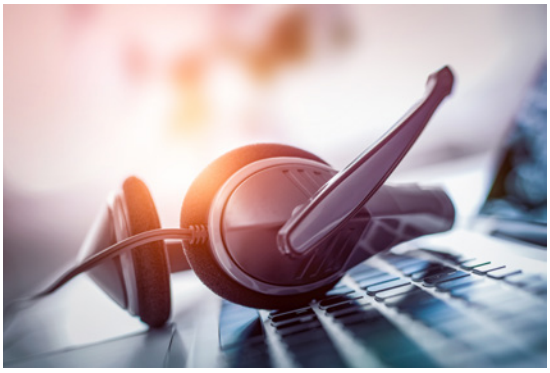
LC823455 Features



- System-on-Chip with dual Arm® Cortex®-M3 processors, and a proprietary 32-bit DSP (LPDSP) in a multi-core system
- High resolution 32-bit, 192 kHz audio processing capability
- Enabling ANC function to shorten ambient acoustic sound path
- Power saving by reducing CPU/DSP load through hard wired audio functions:
  - ASRC (Asynchronous Sample Rate Converter)
  - Hardware mixer - EQ (6 band equalizer)
- Integrated analog functions:
  - 4 channels of digital MIC PDM I/F
  - Low-power Class D HP amplifier
  - System PLL
  - Dedicated audio PLL, ADC
- Multiple interfaces:
  - USB® 2.0 HS device
  - eMMC
  - SD card
  - SPI
  - I2C



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.

BelaSigna Open-Programmable Audio Processors

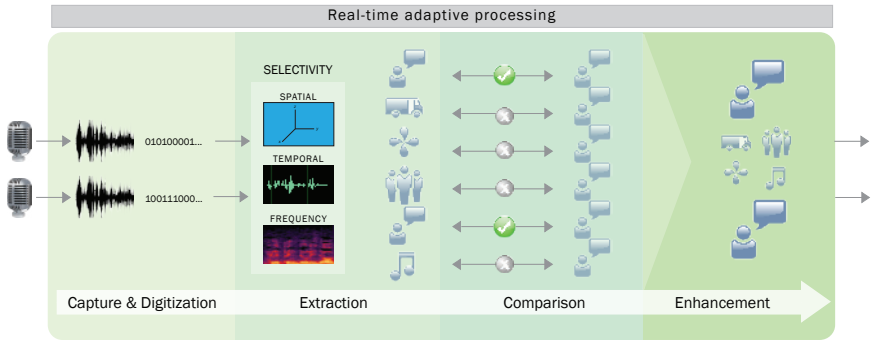
Device	Description	MIPS Max	Dynamic Range (dB)	RAM (kB)	Interfaces	Power Consumption	Standby Current (μA)	Analog Audio	Package(s)
BelaSigna 300	24-bit Audio Processor for Portable Communication Devices	240	110/88	110	I2C, SPI, I2S, PCM, GPIO,	1-5 mA typical	40	4/1	DFN-44

BelaSigna R-Series Audio Processors



BelaSigna R281
Always-Listening, Voice Trigger Solution

- Will detect a single, user-trained trigger phrase, asserting a wake-up signal when this phrase is detected
- ~300 μW power consumption for true “always-on” operation without affecting battery Standby life



BelaSigna R262
Wideband Voice Capture and Noise Reduction SoC

- Provides wideband single- or dual-microphone noise reduction
- Preserves voice naturalness for improved speech intelligibility regardless of environment

AUDIO

BelaSigna® Open-Programmable Development Tools

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

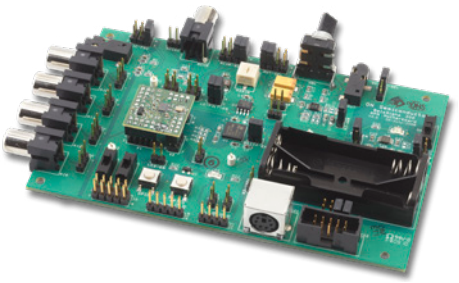
ON Semiconductor addresses this need by providing designers with a complete solution, no matter which development path they chose. In addition to a variety of software algorithm bundles, BelaSigna audio processors are also complemented by an advanced suite of development tools. The fully integrated set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

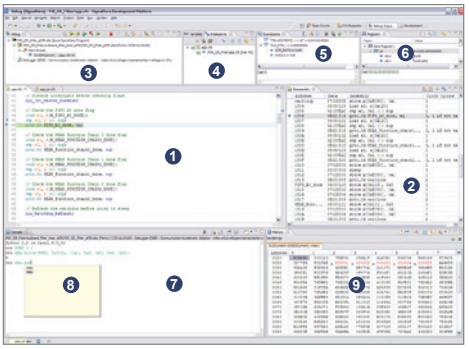
Evaluation and Development Kit Contents

Software
EDK Software and Documentation* Integrated Development Environment (IDE) 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)

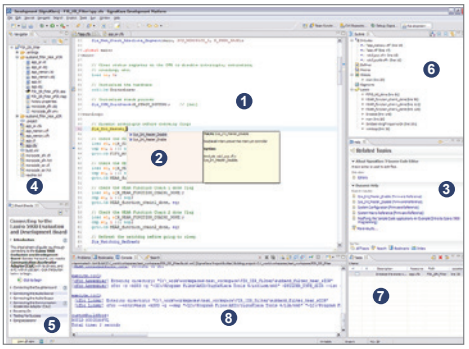
* The EDK includes one year of software updates.

Hardware
Evaluation and Development Board (EDB)





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.

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.

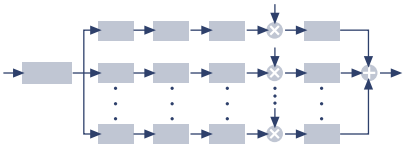
BelaSigna® Open-Programmable Development Tools



Solution Evaluation

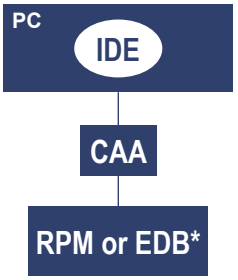
To evaluate audio processors and signal processing software, ON Semiconductor offers a solution that is easy to demonstrate, evaluate and design in. Developers can use software tools to develop their own signal processing algorithms to run on the BelaSigna hardware.





Algorithm Development

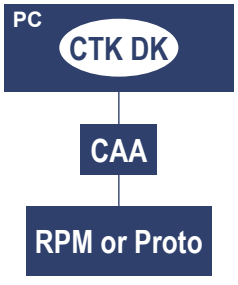
To support the algorithm development process, ON Semiconductor offers an Evaluation and Development Kit (EDK) featuring an Integrated software Development Environment (IDE) for composing, compiling and debugging algorithm code. A Communication Accelerator Adaptor (CAA) connects the IDE running on a PC 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.





Hardware Testing & Prototyping

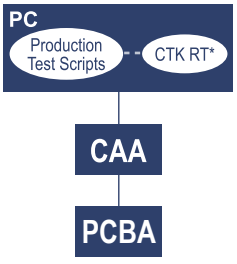
ON Semiconductor enables form-factor hardware testing and prototyping with an RPM, optionally attached to a motherboard, that connects directly to a CAA. The RPM's plug-in design enables developers to quickly transition from development in a simulation environment to testing a complete portable audio 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

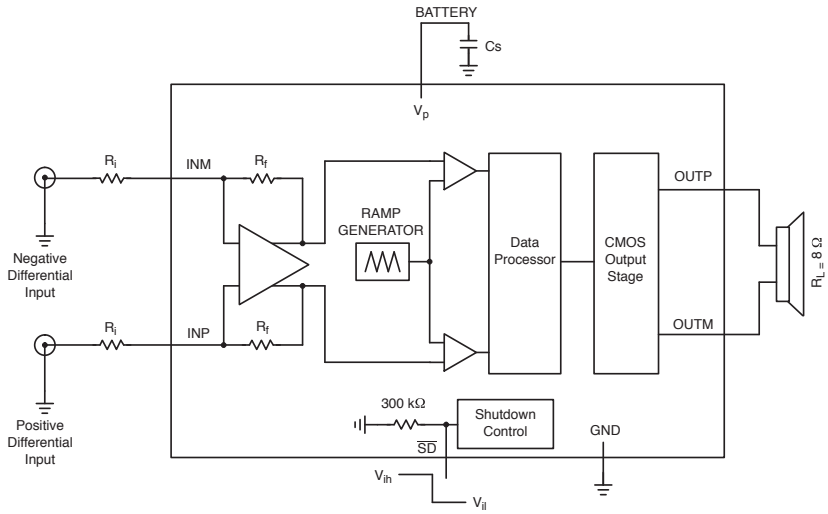
To prepare portable audio products for the market, the CTK Run-time and CAA enable manufacturers to store firmware and data on an attached EEPROM, tune parameters on a unit-by-unit basis, configure the chip, and run final tests. By attaching a CAA directly to a Printed Circuit Board Assembly (PCBA),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



Audio Amplifiers

Device	Category	Description	Class	V_{IN} (V)	P_{out} (W)	I_Q (mA)	THD+N (%)	P_{SRR} (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
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

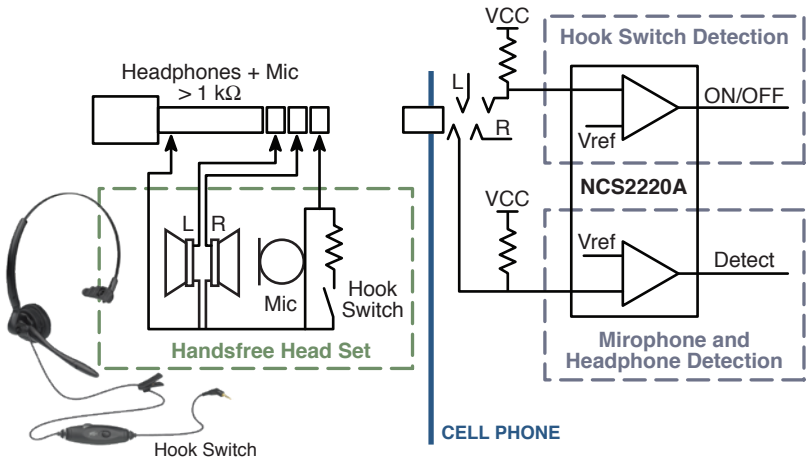




NCP2820 Application Diagram

AUDIO

Low Power Comparators

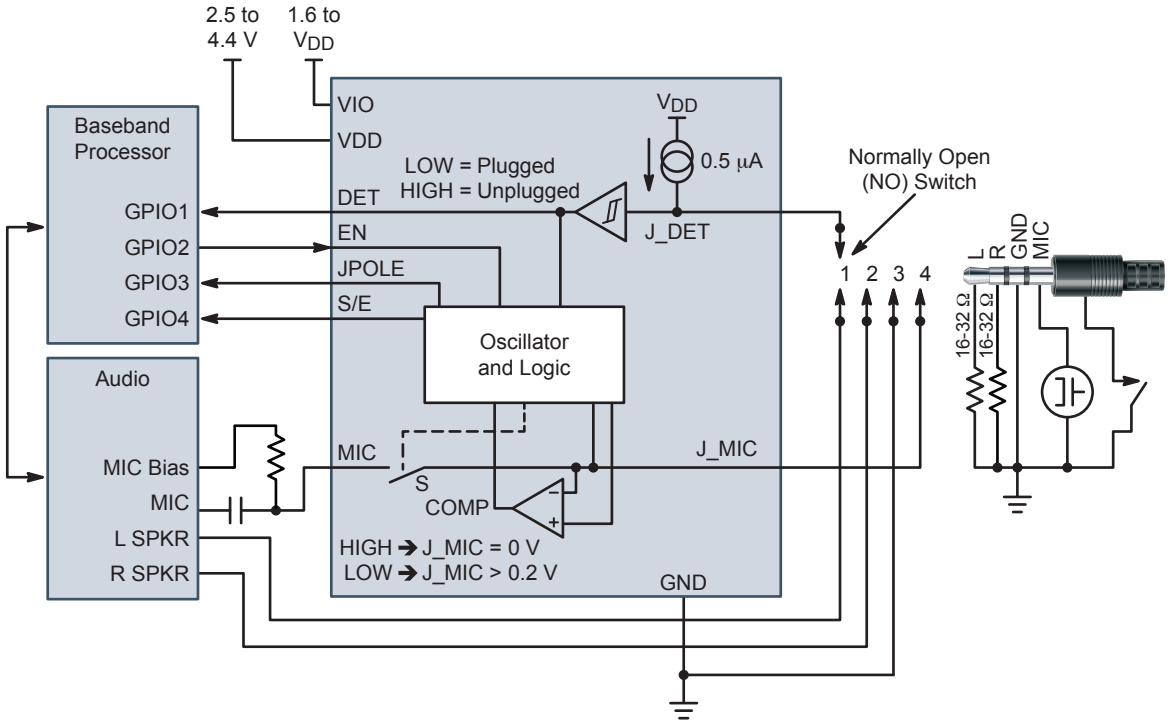


Typical Detection Circuit

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)
NCS2200A	Single	0.85	6	9	0.46	70	Complementary	UDFN-6
NCS2202A	Single	0.85	6	9	0.46	70	Open Drain	UDFN-6
NCS2200	Single	0.85	6	10	0.7	70	Complementary	SOT-23-5, SC-70-5, DFN-6
NCS2202	Single	0.85	6	10	0.7	70	Open Drain	SOT-23-5, SC-70-5
LMV331	Single	2.7	5	40	0.5	84	Open Drain	SOT-23-5, SC-70-5
NCS2250	Single	1.8	5.5	145	0.05	42	Complementary	SOT-23-5, SC-70-5
NCS2252	Single	1.8	5.5	145	0.05	42	Open Drain	SOT-23-5, SC-70-5
NCS3402	Dual	2.5	16	0.47	18	10	Open Drain	SOIC-8
NCS2220	Dual	0.85	6	7.5	0.5	60	Complementary	UDFN-8, UQFN-8
NCV2393	Dual	2.7	16	9	0.8	20	Open Drain	SOIC-8
LMV393	Dual	2.7	5	35	0.5	84	Open Drain	Micro8, SOIC-8, UDFN-8
LMV339	Quad	2.7	5	35	0.5	84	Open Drain	SOIC-14, TSSOP-14

Audio Jack Detection

ON Semiconductor offers audio jack detection solutions to simplify 3/4 pole detection, key press detection, and moisture detection, while eliminating audio pop and click. The design of each product is optimized for minimal power consumption and package size.

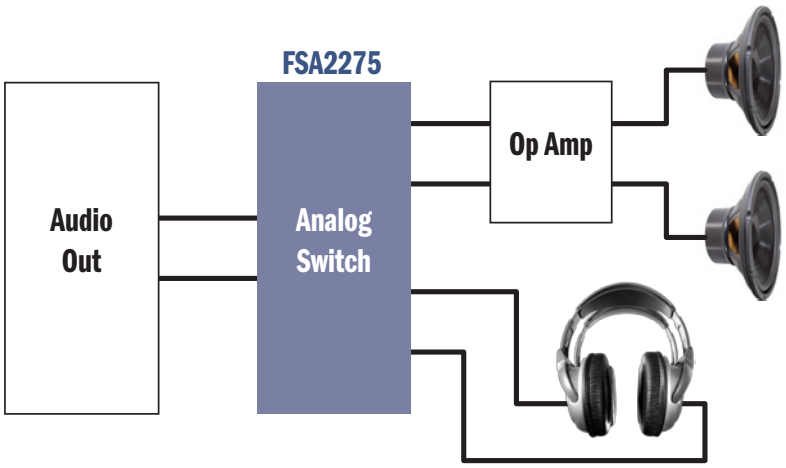


Mobile Phone Example

Audio Jack/Headset Detection

Device	Category	V_{CC} (V)	Typical I_Q (µA)	Pop/Click Elimination	Send/End Key Detection	3/4 Pole Polarity	Package
NCS2300	Audio Jack Detection	1.6 to 2.75	7		✔		UDFN-6
NCS2302	Audio Jack Detection	1.6 to 2.5	17	✔	✔		UQFN-10
FSA8008A	AJD & Config Switch	2.5 to 4.4	15	✔	✔		UQFN-10
FSA8049	AJD & Mic/GND Switch	2.5 to 4.4	0.1			✔	CSP-9

HiFi and Low Resistance Switches for Audio Signals



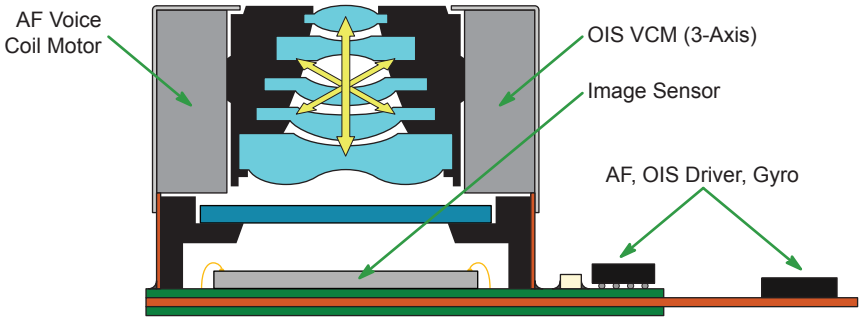
Device	Description	THD+N (dB)	V_{CC} Operating Range (V)	V_{IS} Max (V)	Packages
FSA2275/A	HiFi, Full Swing DPDT	-113	2.5 - 5.5	±3.0	µQFN-12
FSA2276	HiFi, Full Swing DPDT	-113	1.6 - 5.5	±3.0	µQFN-12
NLAS54405	HiFi, Full Swing DPDT	-108	3.3 or 5.0	-3 to VCC	WQFN-16
NLAS5157	Single SPDT	-74	1.65 - 4.5	0 to VCC	µDFN-6
NLAS5223C	Dual SPDT	-62	1.65 - 4.5	0 to VCC	µQFN-10
NLAS2750	Dual SPDT	–	1.8 - 5.5	0 to VCC	µQFN-10

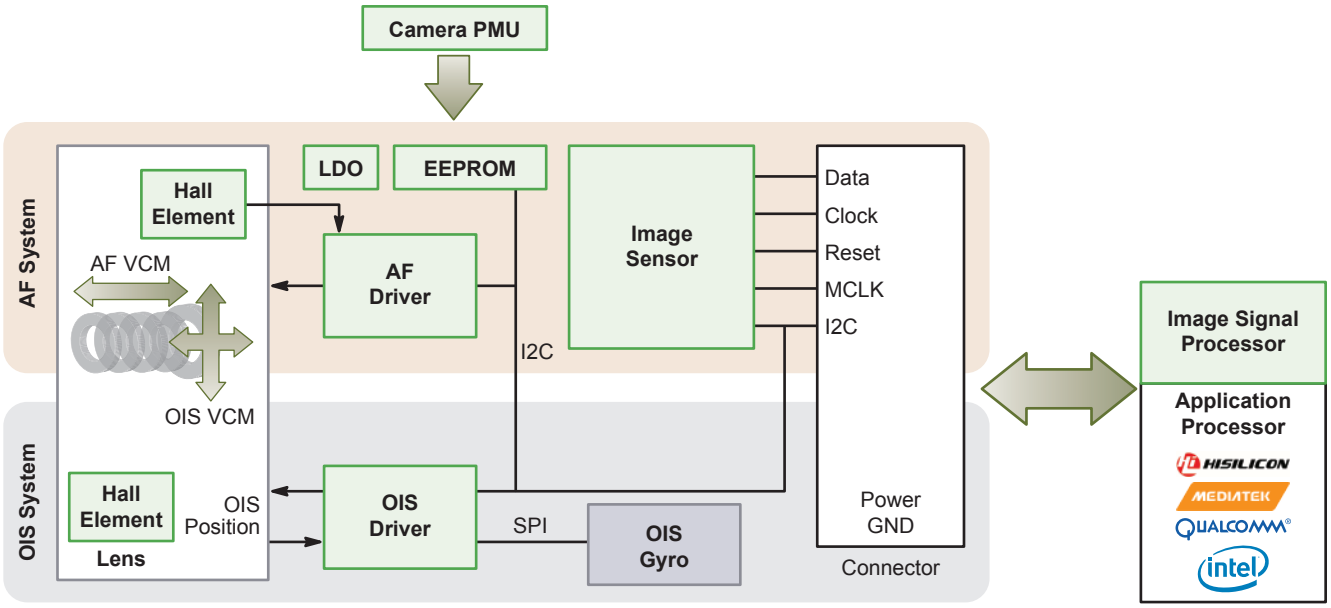


Key Performance Characteristics

- Excellent Audio Fidelity – Very Low THD to -113 dB Typical
- Wide 1.5 – 4.5 V Power Supply Range
- Extended Temperature Capable
- Low $R_{DS(on)}$, Tight Channel Matching

Camera Module

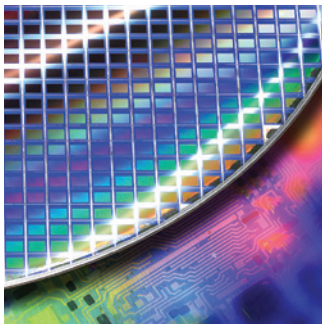






CMOS Imaging Sensors

The CMOS imaging sensor portfolio from ON Semiconductor provides options for all portable and wearable applications. Whether you're building a new AR/VR headset, a 360 degree camera, a new set of imaging glasses, or simply a new wearable device that wants to see the world around it, ON Semiconductor has an Image sensor that can help you deliver an amazing end user experience.



Features

- Superior image quality with advanced pixel technology
- Fast frame rates for action shots
- Low power for battery operation
- Great low light performance
- Resolution choice including VGA to 4K (UHD)

Device	Senor/SOC	Resolution (MP)	Optical Format	Frame Rate	Pixel Size (μm)	Shutter Type[1]	CFA	Temperature
MT9V115	SOC	VGA	1/13"	30 fps	1.8	ERS	Color	-30 to +70°C
ASX340CS	SOC	VGA	1/4"	60 fps	5.6	ERS	Color	-30 to +70°C
ASX370CS	SOC	VGA	1/7"	30 fps	3	ERS	Color	-30 to +70°C
ARX3A0	Sensor	VGA	1/10"	Up to 360 fps	2.2	PGS	Mono	-30 to +70°C
MT9V024	Sensor	WVGA	1/3"	60 fps	6	GS	Color, Mono	-40 to +105°C
MT9V034	Sensor	WVGA	1/3"	60 fps	6	GS	Color, Mono	-30 to +70°C
AR0141CS	Sensor	1.2	1/4"	1.2 45 fps, 720P 60 fps	3	ERS	Color	-30 to +85°C
AR0144CS	Sensor	1	1/4"	60 fps	3	GS	Color, Mono	-40 to +85°C
AR0130CS	Sensor	1.2	1/3"	1.2 45 fps, 720P 60 fps	3.8	ERS	Color, Mono	-30 to +70°C
AR0134CS	Sensor	1.2	1/3"	1.2 54 fps, 720 60 fps	3.8	GS	Color, Mono	-30 to +70°C
AR0135CS	Sensor	1.2	1/3"	1.2 60 fps, 720 60 fps	3.8	GS	Color, Mono	-30 to +70°C
MT9M114	SOC	1.3	1/6"	1.3 30 fps, VGA 75 fps	1.9	ERS	Color	-30 to +70°C
AR0230	Sensor	2.1	1/2.7"	60 fps	3	ERS	Color	-30 to +70°C
AR0237SR	Sensor	2.1	1/2.7"	1080P 60 fps	3	ERS	Color	-30 to +85°C
AR0237IR	Sensor	2.1	1/2.7"	1080P 60 fps	3	ERS	RGB-IR	-30 to +85°C
AR0238	Sensor	2.1	1/2.7"	1080P 60 fps	3	ERS	Color	-30 to +85°C
AR0239	Sensor	2.1	1/2.7"	1080P 90 fps	3	ERS	Color	-30 to +85°C
AR0261	Sensor	2.1	1/6"	1080p 60 fps	1.4	ERS	Color	-30 to +70°C
AS0260	SOC	2.1	1/6"	30 fps	1.4	ERS	Color	-30 to +70°C
AR0330	Sensor	3.5	1/3"	1080P 60 fps	2.2	ERS, GRR	Color	-30 to +70°C
AR0430	Sensor	4	1/3"	120 fps	2	ERS	Color	-30 to +70°C
AR0431	Sensor	4	1/3"	120 fps	2	ERS	Color	-30 to +85°C
AR0521	Sensor	5	1/2.5"	60 fps	2.2	ERS	Color, Mono	-30 to +85°C
AR0522	Sensor	5	1/2.5"	60 fps	2.2	ERS	Color, Mono	-30 to +85°C
AR1335	Sensor	13	1/3.2"	13 30 fps, 1080P 60 fps	1.1	ERS, GRR	Color	-30 to +70°C
AR1337	Sensor	13	1/3.2"	13 30 fps, 1080P 60 fps	1.1	ERS, GRR	Color	-30 to +70°C

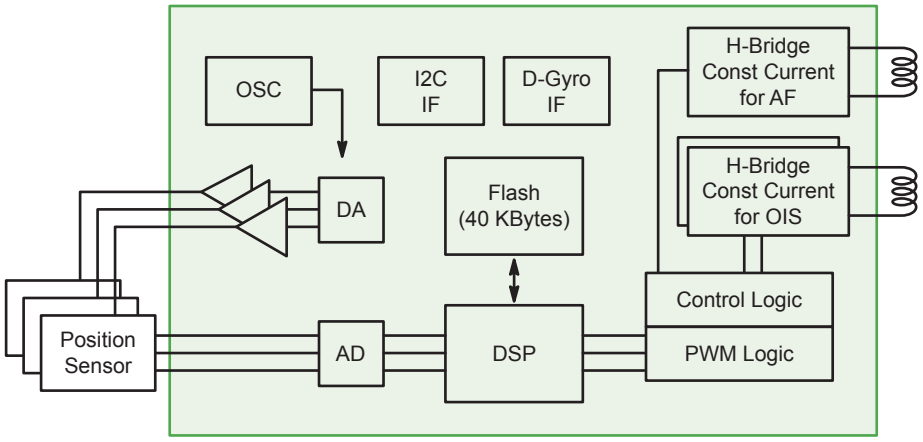
1. ERS = Electronic Rolling Shutter, GRR = Global Reset Release, GS = Global Shutter, PGS = Pseudo Global Shutter

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.

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

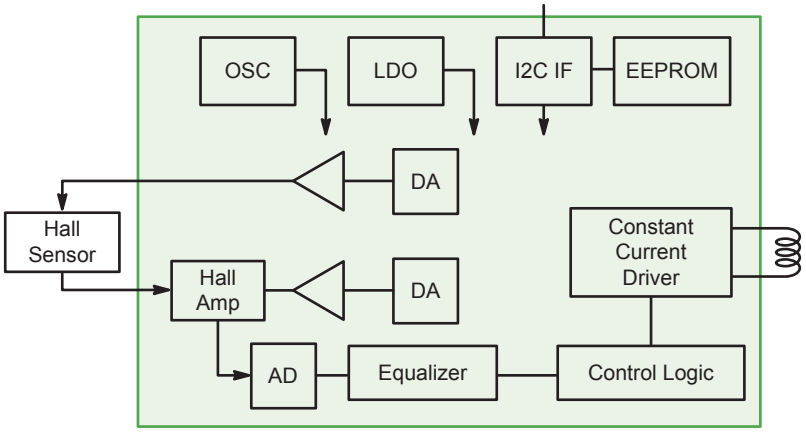
Device	Type	V_{DD} Min (V)	V_{DD} Max (V)	V_M Min (V)	V_M Max (V)	Driver (mA)	CPU IF	D/A	A/D	Package(s)
LC898123AXD	Feedback	2.6	3.6	2.6	3.6	195/120	I2C	8-Bit	12-Bit	WLCSP-35
LC898123F40	Feedback	2.6	3.3	2.6	3.3	200/150	I2C	8-Bit	14-Bit	WLCSP-35

Closed Auto-Focus Drivers

LC898217XC/XH 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/XH enables fast and accurate auto focusing, with low power consumption, from an extremely small footprint.

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



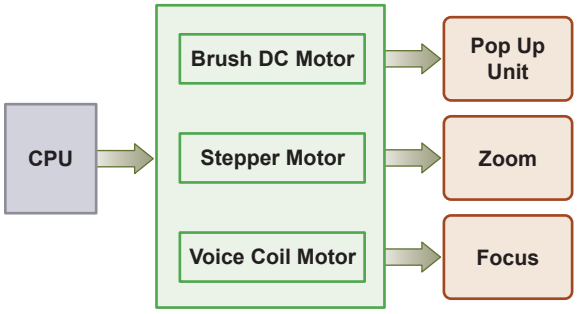
LC898217XC/XH Block Diagram

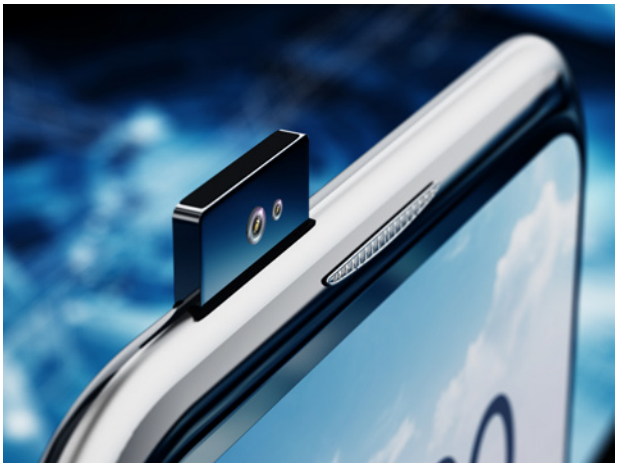
Device	Type	V_{DD} Min (V)	V_{DD} Max (V)	V_M Min (V)	V_M Max (V)	Driver (mA)	CPU IF	D/A	A/D	Package(s)
LC898214XD	Feedback	2.6	3.6	–	–	120	I2C	8-Bit	10-Bit	WLCSP-8
LC898217XC/XH	Feedback	2.6	3.3	–	–	110	I2C	8-Bit	11-Bit	WLCSP-10

Motor Drivers for Camera Modules

Features

- Low power consumption
- Low leakage
- High precision control
- PWM micro-stepping control on LV8414CS
- Small PCB footprint



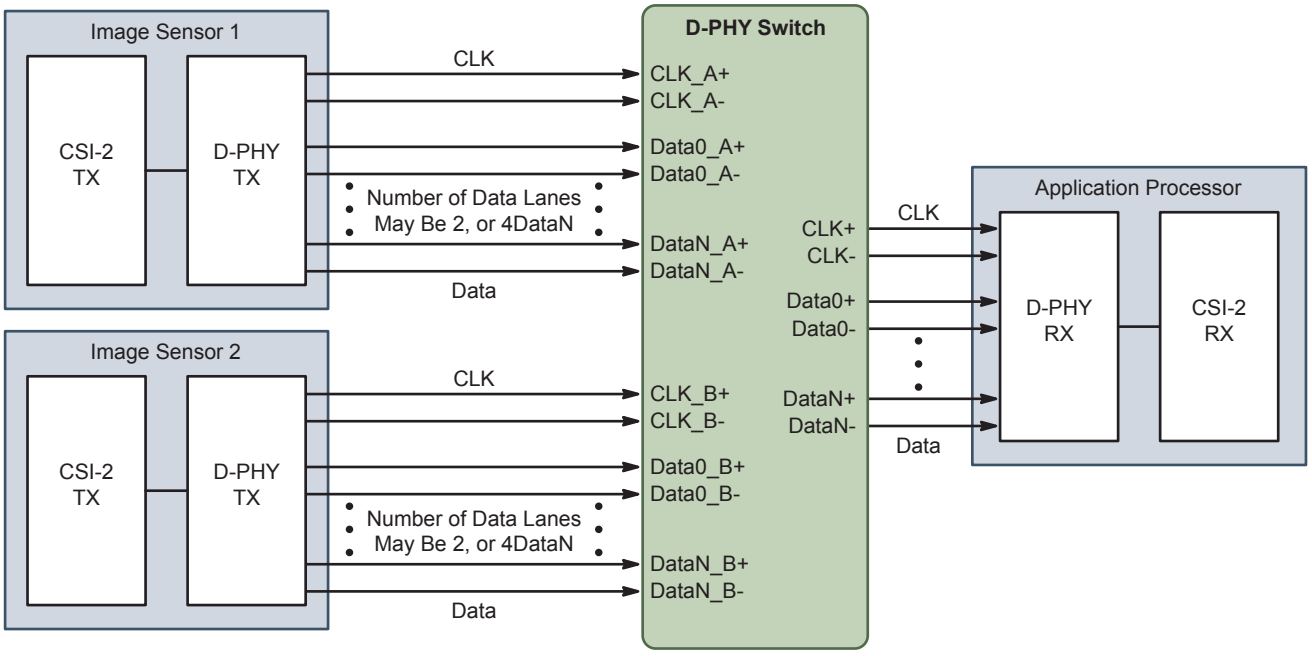


Device	Motor	V_M Max (V)	V_{CC} Max (V)	Motor Current Max (A)	Step Resolution	Control Type	PWM Constant Current	Protection	Package
LV8414CS	2 x Stepper	6	6	0.4	1/64	I2C+Clock	External Resistor	TSD, UVLO	WLCSP-32
LV8402GP	Stepper / 2 x Brush DC	16	6	1.4	Half	Parallel	None	TSD, UVLO	VCT-24
LV8411GR	2 x Stepper / 4 x Brush DC	6	6	0.4	Half	Parallel	None	TSD, UVLO	VCT-24
LV8413GP	Stepper / 2 x Brush DC	6	6	0.4	Half	Parallel	None	TSD, UVLO	VCT-16
LV8417CS	Brush DC	12.6	6	1	-	Parallel	None	TSD, UVLO	WLCSP-9
LV8498CT	Voice Coil	-	5.5	0.15	1/1024	I2C	Internal Resistor	TSD, UVLO	WLCSP-6

MIPI® Switching Devices

Features

- Optimized bandwidth for high data rate transition
- Low quiescent current consumption
- WLCSP or UMLP package



Device	Standard	Type	V_{CC} Max (V)	BW (GHz)	Quiescent Current Max (μA)	Packages
FSA646A	D-PHY & C-PHY	4-Lane	5.0	4.7	30	WLCSP-36
FSA646	D-PHY & C-PHY	4-Lane	5.0	4.1	30	WLCSP-36
FSA644	D-PHY	4-Lane	4.5	1.6	32	WLCSP-36
FSA642	D-PHY	2-Lane	4.3	1.1	1	UMLP-24
FSA660	C-PHY	1-Lane	5.0	5.0	30	UMLP-18

Camera Module PMICs

Features

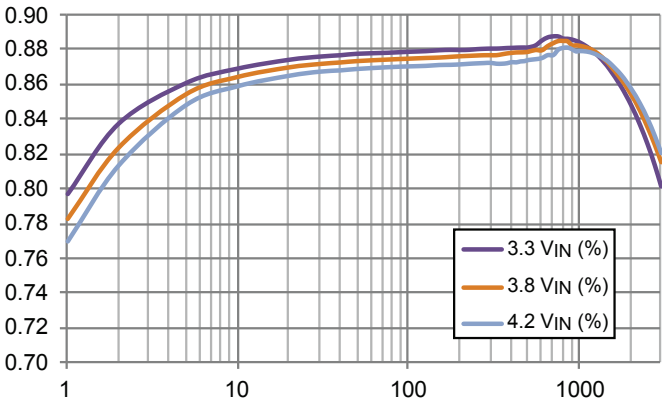
- Mid-size integration
  - 6-ouput PMIC ranging from 0.6 – 5.7 V and 0.3 – 1.2 A for camera and NFC power
  - Complements main PMU under minimum supervision
  - Reduced PCB routing and associated issues for required power management
- High performance
  - High efficiency dc-dc (96%) and low noise LDOs (<35 μV_{RMS})
  - Fully programmable through I2C for output voltages and sequencing
- Modular approach
  - 5 or 6 regulators for 2D/3D modules and back/front cameras

Device	Buck (mA)	Boost (mA)	LDO (mA)	Package
FAN53880	1 x 1200	1 x 1000	4 x 300	WLCSP-25

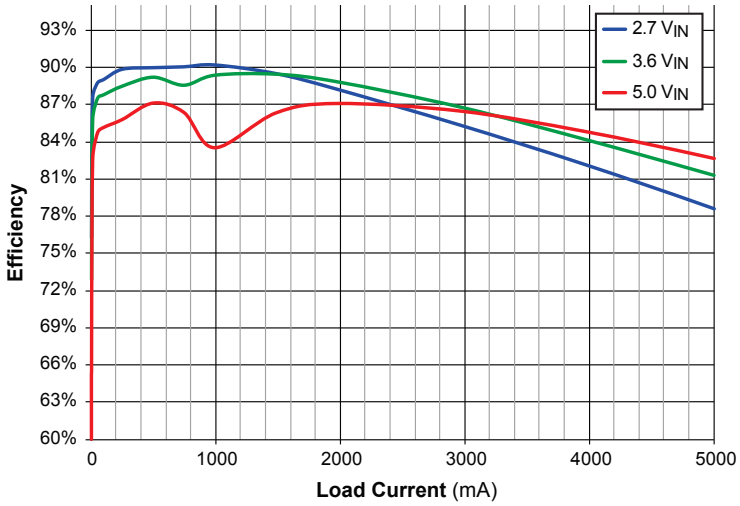
DVS (Dynamic Voltage Scaling) DC-DC Converters

Features

- High regulating performance from 0.35 to 1.4 V
  - Dynamic voltage scaling per output steps by I2C
    - FAN53526/27/28: 6.25 mV output steps
    - FAN53555: 10, 12.826, 12.5, 12.967 mV by options
- Fast transient response
  - Hysteretic architecture providing tight regulation window



FAN53526 Efficiency @ V_{OUT} = 1.15625 V



FAN53555 Efficiency @ V_{OUT} = 1.2 V

Device	V_{IN} (V)	V_{OUT} (V)	I_{OUT} (A)	f_{SW} (MHz)	Control	Features	Package
FAN53555	2.5 – 5.5	0.6 – 1.4	5	2.4	I2C	Dynamic voltage scaling, V_{SEL} based V_{OUT} change	WLCSP-20
FAN53526	2.5 – 5.5	0.6 – 1.4	3	2.4	I2C	Dynamic voltage scaling, V_{SEL} based MODE change	WLCSP-15
FAN53527	2.5 – 5.5	1.0 – 1.4	3	2.4	I2C	Dynamic voltage scaling, V_{SEL} based V_{OUT}/MODE change	WLCSP-15
FAN53528	2.5 – 5.5	0.4 – 1.1	3	2.4	I2C	Dynamic voltage scaling, V_{SEL} based V_{OUT}/MODE change	WLCSP-15

Peripheral DC-DC Converters

Device	V_{IN} (V)	V_{OUT} (V)	I_{OUT} (A)	f_{SW} (MHz)	Operating Mode	Features	Package(s)
NCP6323	2.5 – 5.5	0.6 – V_{IN}	2	3	PWM, FB Resistor	Power Good	WDFN-8
NCP6324	2.7 – 5.5	0.6 – V_{IN}	2	3	PFM/PWM, FB Resistor	Mode Selection (FPWM/PG)	WDFN-8
FAN48611	2.5 - 4.8	5.25	0.35	2.5	PFM/PWM	–	WLCSP-9
FAN48610	2.5 – 4.8	3.3, 4.5, 5.0	1	2.5	PFM/PWM	Pass-Through	WLCSP-9
FAN48615/7/9	2.5 – 5.5	5.0, 5.25, 5.4	1	2.3	PWM	Auto/Forced Pass-Through	WLCSP-9
FAN48685	2.5 – 5.5	3.6/5.0/5.45	0.8	2.3	PWM	Auto/Forced Pass-Through, Vout selection by MODE0/1 pin	WLCSP-9
FAN48630	2.35 - 5.5	3.15, 3.2, 3.33, 3.4, 3.49, 3.5, 3.7, 3.77, 4.5, 4.76, 5.0, 5.29	1.5	2.5	PWM/PFM	Auto/Forced Bypass mode, Power Good, Vout selection by VSEL pin	WLCSP-15
FAN48630J	2.35 - 5.5	3.15/3.6	1.5	2.5	PWM/PFM	Auto/Forced Bypass mode, Power Good, Vout selection by VSEL pin	WLCSP-15
FAN48632	2.35 - 5.5	3.3, 3.5, 3.7	1.5/2.0 pulsed	2.5	PWM/PFM	Auto/Forced Bypass mode, Power Good, Vout selection by VSEL pin	WLCSP-15
FAN48623	2.5 - 5.5	3.0 – 5.0	2.5	2.5	PFM/PWM	Bypass operation, VSEL based VOUT change	WLCSP-16
FAN53600	2.3 – 5.5	2.8, 3.3	0.6	3	PFM/PWM	Sync to external frequency, FPWM Mode	WLCSP-6
FAN53610	2.3 – 5.5	2.9, 3.0, 3.3	1	3	PFM/PWM	Sync to external frequency, FPWM Mode	WLCSP-6
FAN53601	2.3 – 5.5	1.0, 1.05, 1.82	0.6	6	PFM/PWM	Sync to external frequency, FPWM Mode	WLCSP-6
FAN53611	2.3 – 5.5	1.1, 1.15,1.2, 1.233 1.3, 1.35, 1.8, 2.05	1	6	PFM/PWM	Sync to external frequency, FPWM Mode	WLCSP-6
FAN53602	2.3-5.5	1.233	1.2	6	PFM/PWM	Sync to external frequency, FPWM Mode	WLCSP-6
FAN53541	2.7-5.5	0.8 V to 90% of V_{IN}	5	2.4	PFM/PWM	Sync to external frequency, Pin based MODE change (AUTO/FPWM)	WLCSP-20
FAN53741	2.3 – 5.5	0.6 – 5.5	1.3	2.5	PFM/PWM	Programmable Current limit	WLCSP-6
FAN49100	2.5 – 5.5	3.3, 3.6	2.5	1.8	PFM/PWM	Automatic step-up/down, Pass-Through, FPWM	WLCSP-20
FAN49103	2.5 – 5.5	2.8 – 4.0 (3.3, 3.4)	2.5	1.8	I2C	Automatic step-up/down, Pass-Through, FPWM	WLCSP-20
NCP1421	1.2 - 5.0	1.5 - 5.0 with external resistors	0.6	Up to 1.2	PFM/PWM, FB Resistor	–	Micro8
NCP1422	1.0 - 5.0	1.5 - 5.0 with external resistors	0.8	Up to 1.2	PFM/PWM, FB Resistor	–	DFN-10
NCP1423	0.8 - Vout	1.8 - 3.3 with external resistors	0.4	Up to 0.6	PFM/PWM, FB Resistor	–	Micro10
NCP6360	2.7 - 5.5	0.6 - 3.4	0.8	6	VCON	Voltage Control Analog Input	WLCSP-6

LDO Regulators

The LDO portfolio from ON Semiconductor provides solutions for all portable and wearable applications. Addressing the unique needs of these applications for reliable communication, low power, low quiescent current and long battery life plus small footprint, our LDOs offer 'best in class' performance, quality, and cost.

Device	I_O Typ (mA)	I_q Typ (µA)	V_{in} Min (V)	V_{in} Max (V)	V_O (V)	PSRR (dB)	Noise (µVrms)	Package(s)
NCP167	700	100	1.9	5.5	1.8, 2.8, 2.85, 3.0, 3.3, 3.5	85	8.5	CSP-4, XDFN-4
NCP133	500	80	0.8	5.5	0.9, 1.0, 1.05, 1.1, 1.15, 1.2, 1.25, 1.3, 1.5, 1.8, Adj	80	40	XDFN-6
NCP161	450	20	1.9	5.5	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
NCP114	300	50	1.7	5.5	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, TSOP-5
NCP154	300/300	55	1.9	5.25	1.5/2.8, 1.8/2.7, 1.8/2.8, 1.8/2.9, 1.8/3.0, 2.8/2.7, 2.8/2.8, 3.0/1.8, 3.0/3.0, 3.1/3.1, 3.3/1.8, 3.3/2.8, 3.3/2.85, 3.3/3.0, 3.3/3.3	75	75	XDFN-8
NCP160	250	20	1.9	5.5	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
NCP163	250	120	2.2	5.5	1.8, 1.825, 1.9, 2.6, 2.75, 2.8, 2.85, 2.9, 2.925, 3.0, 3.3, 5.0	92	6.5	WLCSP-4, XDFN-4
NCP110	200	18	1.1	5.5	0.6, 0.8, 0.85, 1.05, 1.1,1.2, 1.8, 2.8	95	8.8	WLCSP-4, XDFN-4
NCP170	150	0.5	2.2	5.5	1.2, 1.5, 1.8, 2.5, 2.8, 3.0, 3.3	40	85	SOT-563, XDFN-4
NCP171	80	0.05	1.7	5.5	0.6, 0.75, 0.8, 1.0, 1.2, 1.6, 1.65, 1.7, 1.75, 1.8, 2.45, 2.5, 2.75, 2.8, 2.95, 3.0, 3.1, 3.25, 3.3	65	54	XDFN-4

Performance Leadership



Ultra-Low V_{IN} of 1.1 V
NCP110



Ultra-Low I_Q of 50 nA
NCP171



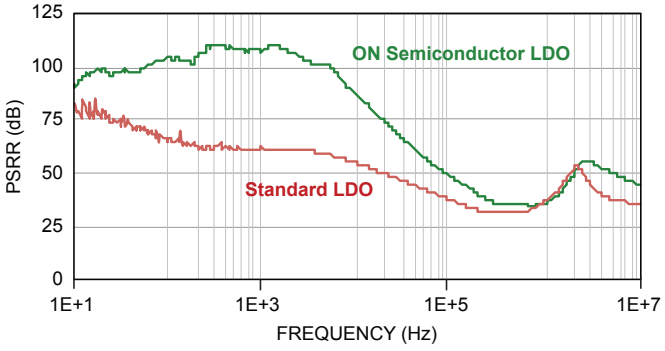
PSRR of 92 dB
NCP163



0.8 mm x 0.8 mm
XDFN-4

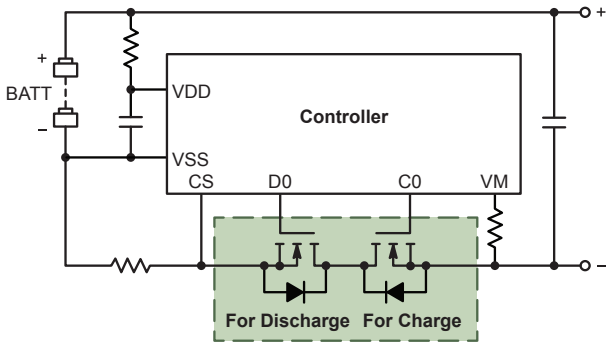


0.65 mm x 0.65 mm
CSP-4

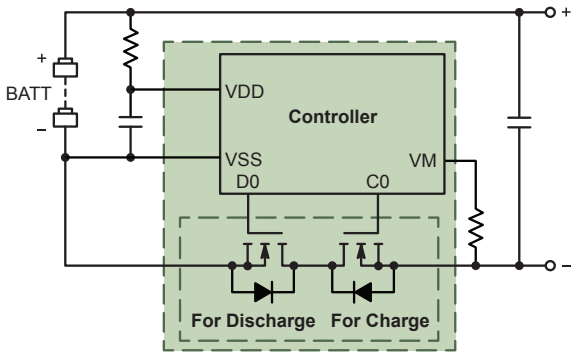


Industry Leading High PSRR Performance

Li-ion Battery Protection



Dual MOSFET Configuration



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

Dual MOSFETs

Device	Configuration	Polarity	V_{SSS} 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)	Package(s)
ECH8693R	Dual	N-Channel	24	±12	11	5.6/8.5/10.4	7.8/13.0/18.2	ECH-8
ECH8695R	Dual	N-Channel	24	±12.5	11	5.6/7.0/9.1	7.5/9.5/13.3	ECH-8
ECH8697R	Dual	N-Channel	24	±12	10	7.7/11.0/14.3	11.4/19.0/26.6	ECH-8
EFC4612R-S	Dual	N-Channel	24	±12	6	24/39/45	33.5/58/72	EFCP
EFC4619R	Dual	N-Channel	24	±12	6	13.5/19.8/23.0	18.5/27.0/35.0	EFCP
EFC4621R	Dual	N-Channel	24	±12	9	10.8/15.5/18.0	14.9/23.0/30.0	EFCP
EFC4626R	Dual	N-Channel	24	±12	5	29.2/37.5/46.2	42.6/54.0/72.4	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	EFCP
EFC3J018NUZ	Dual	N-Channel	20	±10	23	2.5/3.6/4.7	3.3/4.75/9.0	EFCP
EFC4627R	Dual	N-Channel	12	±10	6	18.5/23.9/29.5	29.3/37.7/50.5	EFCP
EFC6604R	Dual	N-Channel	12	±12	13	6.0/7.5/9.0	10.0/12.6/17.7	EFCP
EFC8811R	Dual	N-Channel	12	±8	27	1.8/2.3/ 3.2	2.7/4.0/6.3	EFCP

NOTE: $R_{SS(ON)} = R_{DS(ON)} \times 2$.

Li-ion Battery Protection

Battery Protection Controllers with Integrated MOSFETs for One-Cell Batteries

Device	Adjustable Range			V_{SSS} Max/ V_{GSS} Max (V)	$R_{SS(ON)}$ @ V_{GS} = 4.5 V Min/Typ/Max (mΩ)	$R_{SS(ON)}$ @ V_{GS} = 3.1 V Min/Typ/Max (mΩ)	Features	Package(s)
	V_{OV} Range (V)	V_{UV} Range (V)	I_{OC}/I_{OCH} Range (A)					
LC05111CMT	4.0 to 4.5	2.2 to 2.7	2 to 8	24/±12	8.8/11.2/14.0	10.4/13/18.2	Auto Wake-up, 0 V Charge	WDFN-6
LC05132C01NMT	4.0 to 4.5	2.2 to 2.8	2 to 8	24/±12	8.8/11.2/14.0	10.4/13/18.2	Reset Function **	WDFN-6
LC05732ARA	4.1 to 4.6	2.1 to 2.7	2 to 16	20/±10	3.8/4.7/5.6	4.4/5.4/6.9	Reset Function **	ECP-30

** Forced off of charge and discharge FET.

One-Cell Li-Ion Battery Protection Controllers

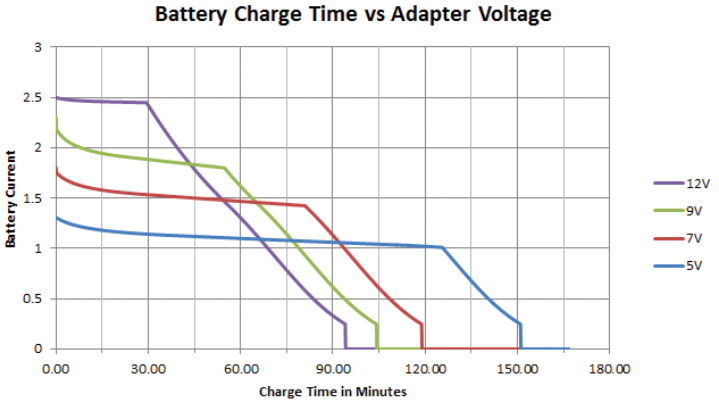
Device	Adjustable Range						Features	Package(s)
	V_{OV} Range (V)	V_{UV} Range (V)	V_{OC} Range (mV)	V_{OC2} Range (mV)	V_{SHRT} Range (mV)	C_{OCH} Range (mV)		
LC05511XA	4.1 to 4.55	2.0 to 3.3	3 to 30	3 to 30	20 to 70	-30 to -3	Auto Wake-up, 0 V Charge	WLCSP-6
LC05551XA	4.1 to 4.55	2.0 to 3.3	3 to 30	3 to 30	20 to 70	-30 to -3	Auto Wake-up, 0 V Charge , Reset Function **	WLCSP-8
LC06511DMX	4.1 to 4.55	2.0 to 3.3	3 to 70	3 to 70	50 to 150	-70 to -3	Auto Wake-up, 0 V Charge	X2DFN-6

** Forced off of charge and discharge FET.

Switching Battery Chargers

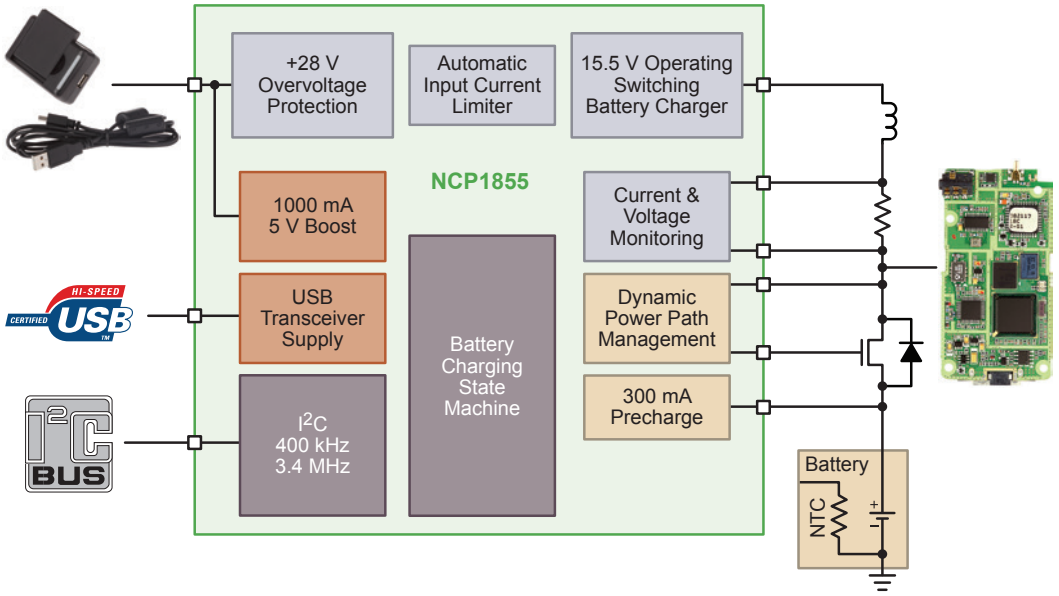
Features

- 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)



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

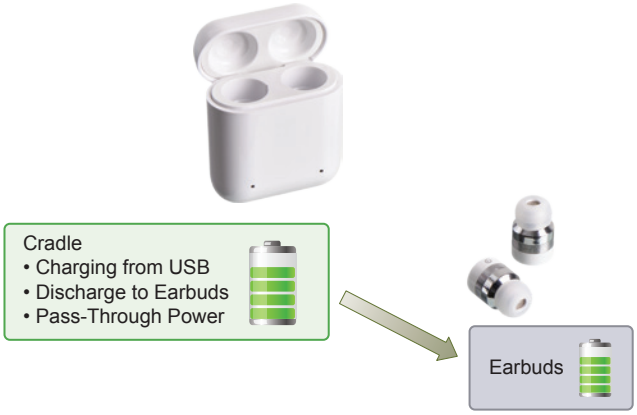
Device	Charging Current Max (A)	Pre-Charge Current Max (mA)	OTG Boost Current Max (mA)	V_{CC} Max (V)	OVP (V)	I2C	Automatic Input Current Limiting	Dual Path Management	Protected USB PHY Supply (mA)	Battery Temperature Sensing	Package
NCP1854	2.5	300	500	7	+28	400 kHz / 3.4 MHz	Yes	Yes (external)	50	JEITA	Flip-Chip-25
NCP1855	2.5	300	500	16	+28	400 kHz / 3.4 MHz	Yes	Yes (external)	50	JEITA	Flip-Chip-25

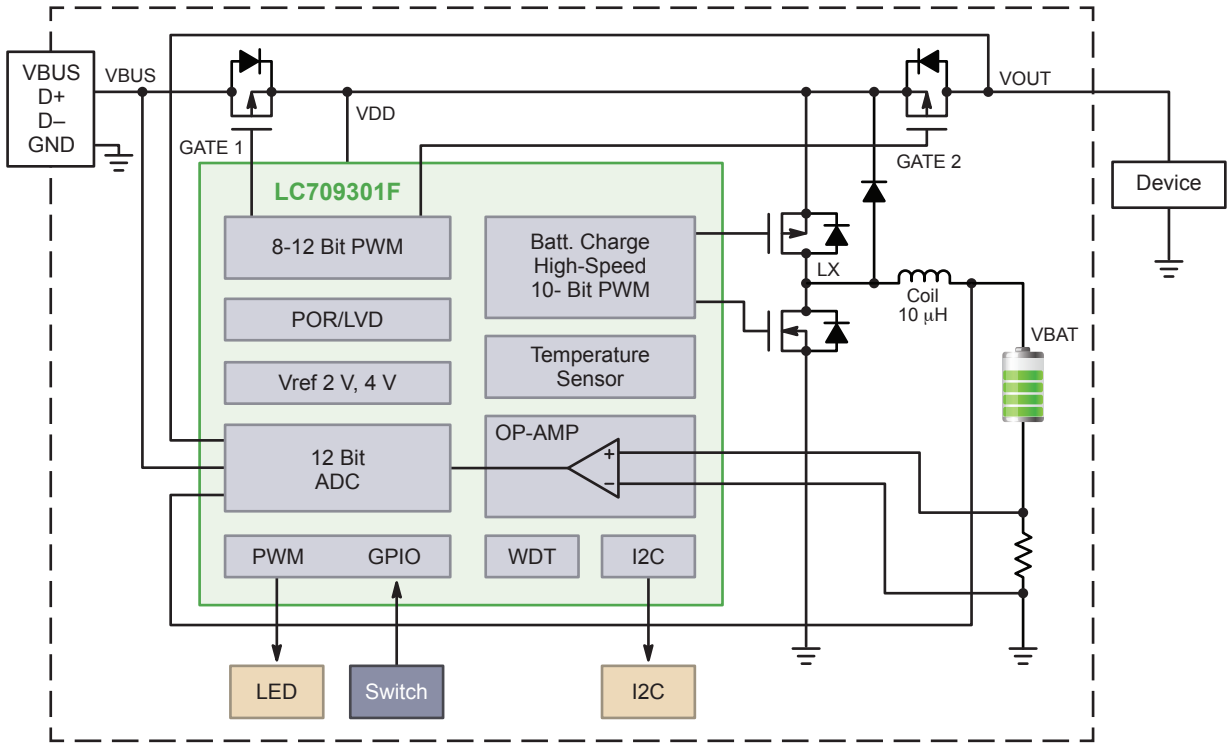


Switching Battery Charge/Discharge Controller

LC709301F Features

- 10x/20x Amplifier
- 8/10-bit high-speed PWM (150 kHz)
- Reference voltage generator circuit (2/4 V) for AD converter
- Temperature sensor for monitoring
- Internal reset circuit
- 8-channel AD converter with 12-/8-bit resolution selector
- Internal oscillation circuits (30 kHz/1 MHz/8 MHz)
- Linear charging system
- Can operate in pass-through mode
- Supports multiple Li-Ion/Polymer battery variants

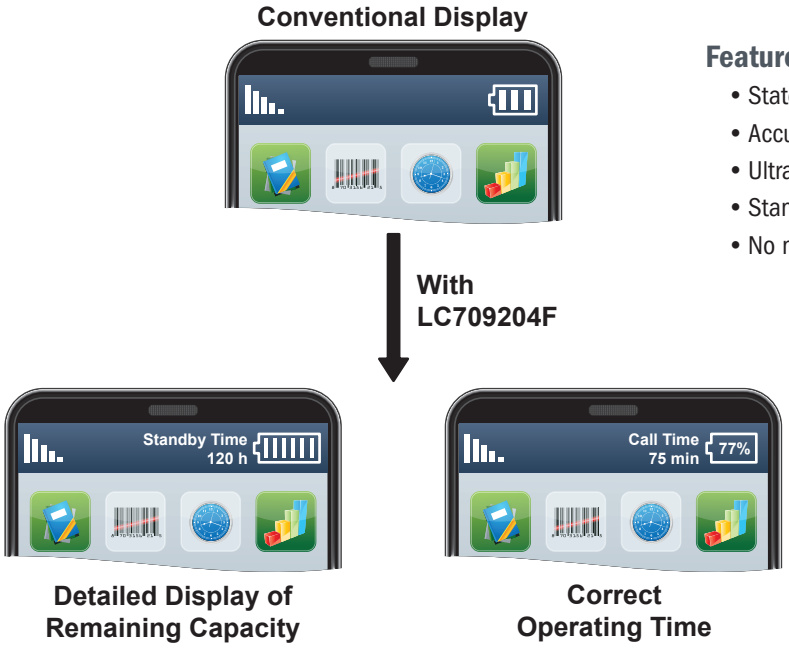




Block Diagram

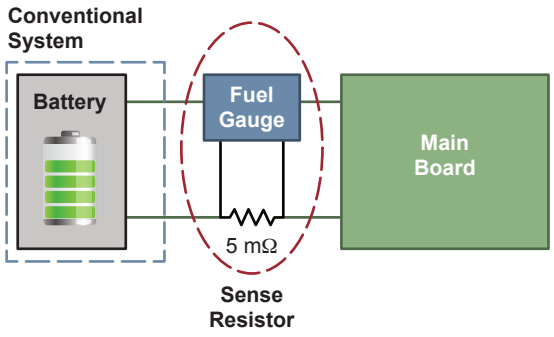
LC709204F High Accuracy Battery Fuel Gauge

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



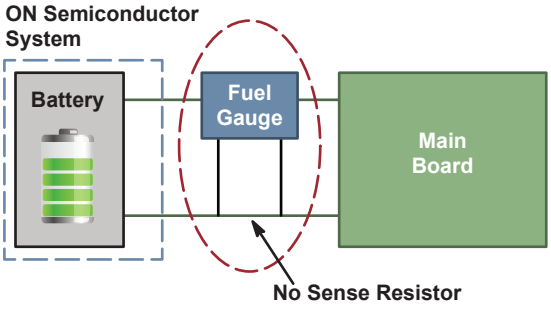
Features

- State of Health reporting
- Accuracy of remaining capacity ±2.8% (0 ~ +50°C)
- Ultra-low operating consumption current of 2 µA
- Standby mode current (RAM retention) of 0.1 µA
- No need for sense resistor for current detection



ON Semiconductor Solution (No Sense Resistor)

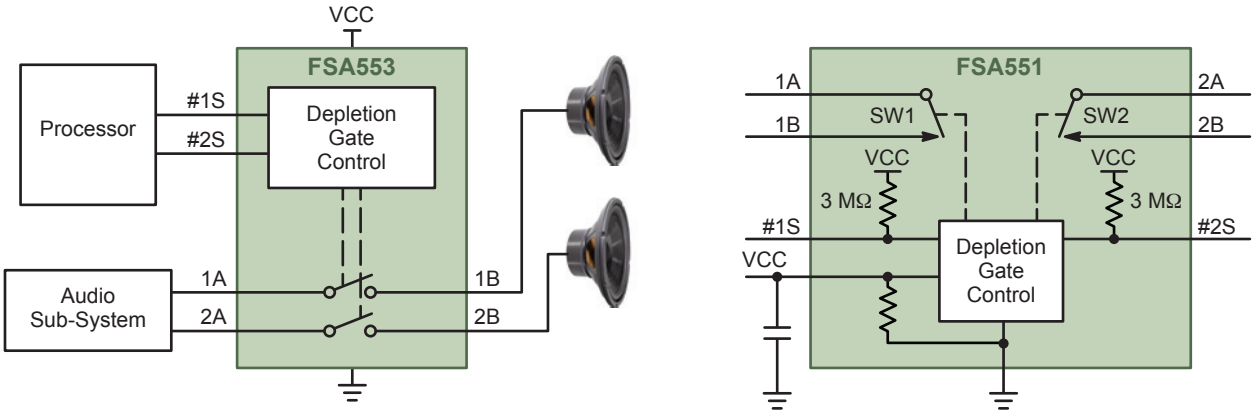
- No power loss
- No heat generation



Depletion Mode Isolation Switches

Key Performance Characteristics

- Passes ground and full swing audio signals with no power applied
- Excellent isolation when power is applied, OIRR = -75 dB
- Low power consumption when isolating, I_{CC} = 80 μA typical
- Low impedance ground path without power applied
- Independent switch select lines enable system flexibility
- Small chip scale package ideal for portable products and accessories



Depletion Mode Isolation Switches

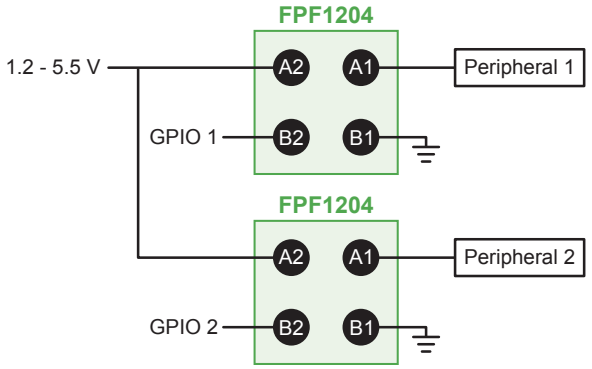
Device	Description	R_{ON} Typ (Ω)	THD+N Typ	Isolating V_{CC} Range (V)	Conducting V_{SW} Max (V)	Isolating V_{SW} Max (V)	Package
FSA515	1-Channel Depletion Isolation Switch	0.7	-93 dB	2.5 - 5.5	-3.0 - 4.7	-3.0 - 4.7	WLCSP-4
FSA550	4-Channel Depletion Isolation Switch	0.8	-114 dB	1.6 - 3.0	±2	0 - 1.4	WLCSP-12
FSA551	2-Channel Depletion Isolation Switch	0.4	-106 dB	1.5 - 3.0	-3.3	-3.3	WLCSP-9
FSA553	2-Channel Depletion Isolation Switch	0.4	-107 dB	1.5 - 3.0	±1.5	±1.5	WLCSP-9

Power Distribution Load Switches

Features

- Optimized for power sequence control and low power consumption by reducing current leakages
- Slew rate control to reduce inrush current
- Low RON as low as 11 mΩ
- Simplified layout reduces PCB footprint
- WLCSP and DFN packages, as small as 0.76 mm x 0.76 mm

ecoSWITCH™
ADVANCED LOAD MANAGEMENT



Load Switches

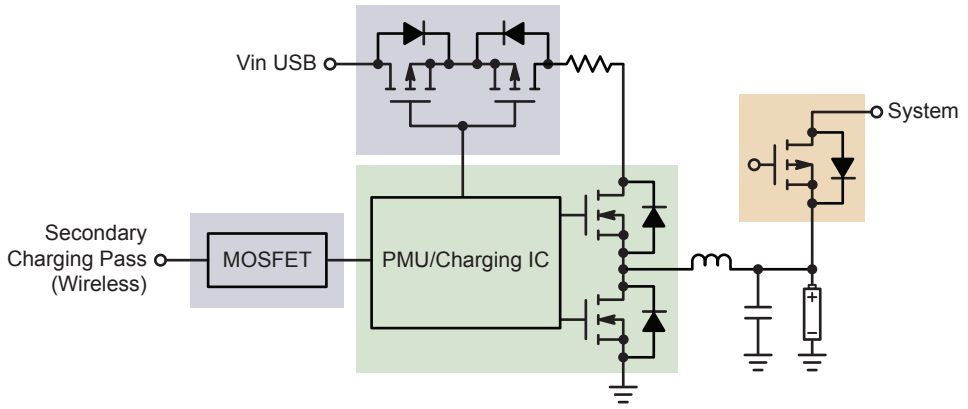
Device	Channel	V_{IN} Min (V)	V_{IN} Max (V)	$R_{DS(ON)}$ (mΩ)	I_{OUT} Max (A)	Discharge Path	RCB*	Package
NCP433	Single	1	3.6	50 @ 1.8 V	1.5	Yes	No	WLCSP-4
NCP435	Single	1	3.6	29 @ 3.3 V	2	Yes	No	WLCSP-4
FPF1203	Single	1.2	5.5	55 @ 3.3 V	2.2	No	No	WLCSP-4
FPF1204	Single	1.2	5.5	55 @ 3.3 V	2.2	Yes	No	WLCSP-4
NCP451	Single	0.75	5.5	12 @ 3.6 V	3	No	No	WLCSP-6
NCP451A	Single	0.75	5.5	12 @ 3.6 V	3	Yes	No	WLCSP-6
FPF1048	Single	1.5	5.5	23 @ 4.5 V	3	No	Yes	WLCSP-6
NCP340	Single	1.8	5.5	26 @ 3.0 V	3	No	Yes	UDFN-4
FPF1038	Single	1.2	5.5	21 @ 4.5 V	3.5	No	No	WLCSP-6
FPF1039	Single	1.2	5.5	21 @ 4.5 V	3.5	Yes	No	WLCSP-6
NCP459	Single	0.75	5.5	11 @ 3.3 V	4	Yes	No	WLCSP-8
FPF2411	Single	2.3	5.5	12 @ 3.8 V	6	No	Yes	WLCSP-12
FPF1320	DISO**	1.5	5.5	50 @ 3.3 V	1.5	No	Yes	WLCSP-6
FPF1321	DISO**	1.5	5.5	50 @ 3.3 V	1.5	Yes	Yes	WLCSP-6

* Reverse Current Block. ** Dual Input Single Output.

ecoSWITCH™ Integrated Load Switch

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)
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

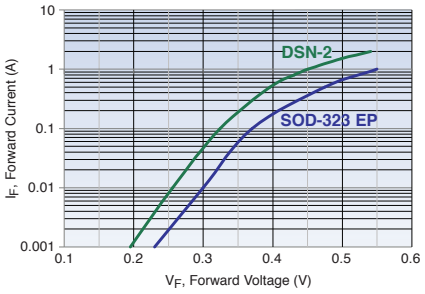


Switching Charger – Step Down

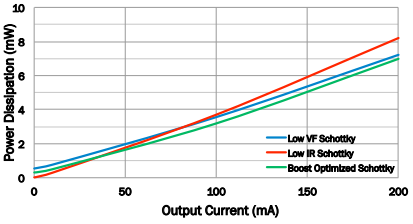
Device	Polarity	Configuration	$V_{(BR)DSS}$ Min (V)	V_{GS} Max (V)	I_D Max (A)	$R_{DS(ON)}$ Max @ V_{GS} = 4.5 V (Ω)	Package(s)
ECH8420	N-Channel	Single	20	±12	14	0.0068	ECH-8
MCH6421	N-Channel	Single	20	±12	5.5	0.038	MCPH-6
MCH6437	N-Channel	Single	20	±12	7	0.024	MCPH-6
MCH6448	N-Channel	Single	20	±9	8	0.022	MCPH-6
MCH6662	N-Channel	Dual	20	±10	2	0.16	MCPH-6
EMH2418R	N-Channel	Dual	24	±12	8.5	0.0169	EMH-8
MCH6431	N-Channel	Single	30	±20	5	0.091	MCPH-6
NTLJD4116N	N-Channel	Dual	30	±12	3.7	0.07	WDFN-6
NTLJS4114N	N-Channel	Single	30	±12	6	0.035	WDFN-6
NTLUS4C12N	N-Channel	Single	30	±20	9.1	0.015	UDFN-6
MCH3486	N-Channel	Single	60	±20	2	0.192	MCPH-3
MCH3333A	P-Channel	Single	-30	±10	2	0.215	MCPH-3
MCH6337	P-Channel	Single	-20	±10	4.5	0.049	MCPH-6
NTLUD3A260PZ	P-Channel	Dual	-20	±8	1.7	0.2	UDFN-6
NTLUD3A50PZ	P-Channel	Dual	-20	±8	4.5	0.048	UDFN-6
NTLUS3A18PZ	P-Channel	Single	-20	±8	8.2	0.018	UDFN-6
ECH8308	P-Channel	Single	-12	±10	10	0.013	ECH-8
MCH6336	P-Channel	Single	-12	±10	5	0.043	MCPH-6
MCH6353	P-Channel	Single	-12	±10	5.5	0.035	MCPH-6
NTLUS3C18PZ	P-Channel	Single	-12	±8	7	0.024	UDFN-6

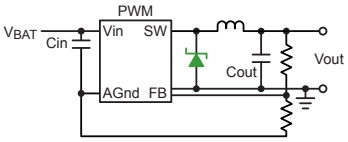
Optimized Schottky Diodes

As wireless devices become smaller and thinner, more compact, energy efficient components are necessary. Power optimized 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.

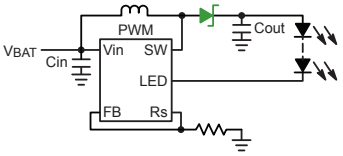


Energy Efficiency

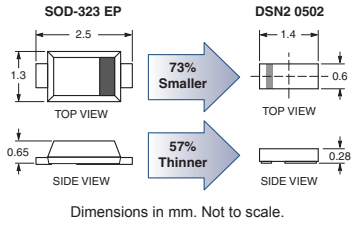




DC-DC Buck Converter



DC-DC Boost Converter for LED Backlighting



Dimensions in mm. Not to scale.

Package Size

Schottky Diodes in DSN-2 Package

Device	I_F (A)	V_R (V)	V_F @ Rated I_F (mV)	I_R @ Rated V_R (µA)	DSN2 Package
NSR01L30NX	0.1	30	460	0.3	0201 DSN
NSR01F30NX	0.1	30	430	2	0201 DSN
NSR02L30NX	0.2	30	530	0.4	0201 DSN
NSR02F30NX	0.2	30	500	2	0201 DSN
NSR05402NX	0.5	40	570	3	0201 DSN
NSR05F20NX	0.5	20	390	15	0402 DSN
NSR05F30NX	0.5	30	400	20	0402 DSN
NSR05F40NX	0.5	40	420	15	0402 DSN
NSR10404NX	1.0	40	500	10	0402 DSN
NSR15304NX	1.5	30	530	20	0402 DSN
NSR20204NX	2.0	20	540	15	0402 DSN
NSR10F20NX	1.0	20	430	25	0502 DSN
NSR10F30NX	1.0	30	450	30	0502 DSN
NSR10F40NX	1.0	40	430	10	0502 DSN
NSR15405NX	1.5	40	540	20	0502 DSN
NSR20305NX	2.0	30	550	30	0502 DSN
NSR20F30NX	2.0	30	425	40	0603 DSN
NSR15406NX	1.5	40	510	20	0603 DSN
NSR20206NX	2.0	20	450	40	0603 DSN
NSR20306NX	2.0	30	440	40	0603 DSN
NSR20406NX	2.0	40	520	35	0603 DSN

Schottky Diodes in X3DFN-2 Package

Device	I_F (A)	V_R (V)	Max V_F @ 10 mA (mV)	Max I_R @ 10 V (µA)	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 X4DFN 01005 Package

Device	I_F (A)	V_R (V)	V_F @ Rated I_F (mV)	I_R @ Rated V_R (µA)
NSR01301MX4*	0.1	30	450	2
NSR02301MX4*	0.2	30	420	25
NSR05301MX4	0.5	30	640	25
NSR05201MX4*	0.5	20	450	40

* Pending 2Q20.

Schottky Diodes in Other Packages

Device	I_F (A)	V_R (V)	V_F @ Rated I_F (mV)	I_R @ Rated V_R (µA)	Package
NSR05T40XV2	0.5	40	530	3	SOD-523
NSR05T30XV2	0.5	30	370	52	SOD-523
NSR0520V2	0.5	20	410	75	SOD-523
NSR0240V2	0.25	40	580	0.5	SOD-523
NSR0340V2	0.25	40	470	1.5	SOD-523
RB520S30	0.20	30	500	0.04	SOD-523
RB521S30	0.20	30	400	20	SOD-523
NSR10T20XV2	1.0	20	415	85	SOD-523
NSR05T40P2	0.5	40	580	2	SOD-923
NSR05T30P2	0.5	30	450	40	SOD-923
NSR0620P2	0.5	20	480	9	SOD-923
NSR0130P2	0.1	30	450	1	SOD-923
NSR0230P2	0.2	30	400	20	SOD-923
NSR0240P2	0.2	40	540	0.8	SOD-923
NSR0340P2	0.2	40	520	4	SOD-923
NSR0170P2	0.07	70	1.1	0.1	SOD-923
NSR10T406MX	1.0	40	475	2	X2DFNW-2
NSR05T404MX*	0.5	40	560	3	X2DFN-2
NSR05T304MX	0.5	30	410	40	X2DFN-2
SB2003M	2	30	450	70	SOT-363
SS2003M	2	30	350	500	SOT-363
SB3003CH	3	30	470	15	SOT-457
SS3003CH	3	30	370	550	SOT-457

* Pending 2Q20.

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

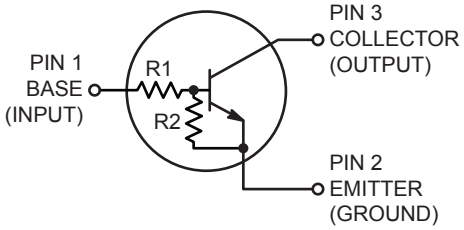
ON semiconductor is the leader in Low $V_{CE(sat)}$ BJTs with a portfolio that includes devices up to 6 A.

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.

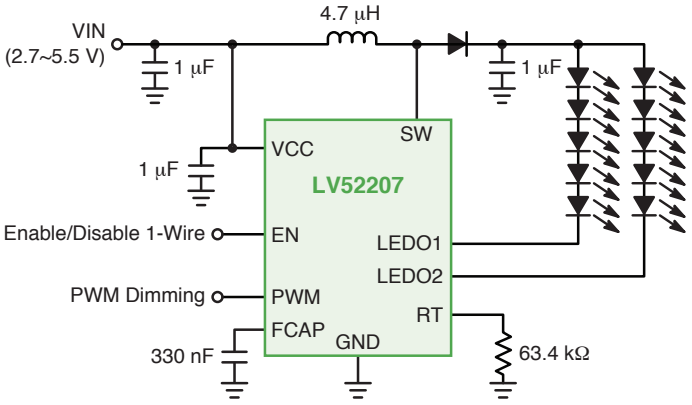


Digital Transistors

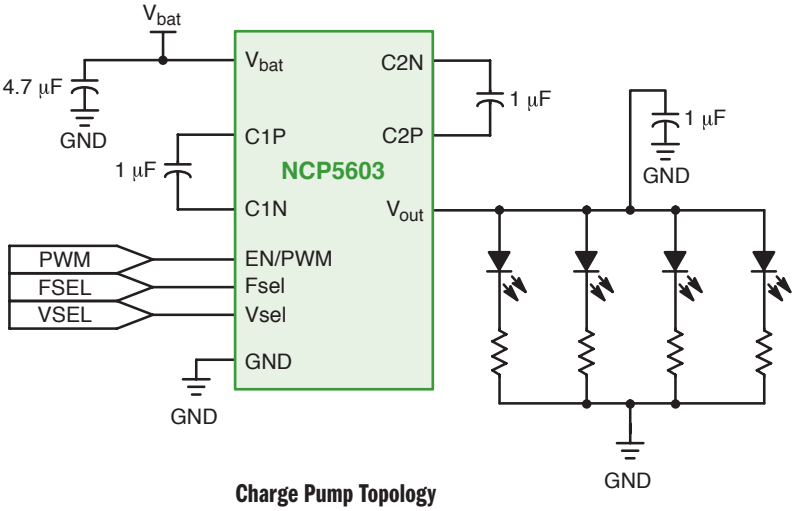
Part Body Number	R1 (Ω)	R2 (Ω)	Package(s)
113E	1K	1K	SOT-723, SOT-1123
114E	10K	10K	SOT-723, SOT-963, SOT-1123
114T	10K	None	SOT-723, SOT-963, SOT-1123
114Y	10K	47K	SOT-723, SOT-963, SOT-1123
115E	100K	100K	SOT-723
115T	100K	None	SOT-723, SOT-963, SOT-1123
123E	2.2K	2.2K	SOT-723, SOT-1123
123J	2.2K	47K	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

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.



Inductive Boost Topology



Charge Pump Topology



LED Drivers

Charge Pump Topology

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	Operating Quiescent Current, Typ	Shutdown Current (μA)	Package
NCP5603	2.85 - 5.5	1	200 mA DC, 350 mA pulse	Voltage	1X, 1.5X, 2X	–	PWM	1 mA	2.5 typ	DFN-10
NCP5623B/C	2.7 - 5.5	3	90	Current	1X, 2X	±0.5%	I2C	0.35 mA	0.8 typ	LLGA-12
FAN5702	2.7 - 5.5	6	180	Current	1X, 1.5X	0.40%	I2C	0.3 mA	2 max	WLCSP-16

Inductive Topology

Device	Input Voltage Range (V)	Max Output Volt, Typ (V)	Output Current (mA)	LED Configuration	Switching Mode/ Frequency	Dimming Method	Efficiency Max (%)	Operating Quiescent Current, Typ	Shutdown Current, Typ (μA)	Package
NCP1403	1.2 - 5.5	15	50	4 LEDs in series	PFM up to 300 kHz	FB Resistor	82	0.019 mA	0.3	TSOP-5
NCP1406	1.4 - 5.5	25	25	7 LEDs in series	PFM, up to 1 Mhz	FB Resistor	92	0.015 mA	0.3	TSOP-5
NCP1422	1.0 – 5.0	5	800	1 LED for FLASH	PFM, up to 1.2 Mhz	PWM	94	1.3 μA	0.05	DFN-10
NCP5030	2.7 – 5.5	5.5	up to 900	1 LED	700 kHz	FB Resistor or PWM Input	90	5 mA	0.3	WDFN-12
NCP5007	2.7 - 5.5	22	30	2 to 6 WLEDs in series	PFM, up to 1 Mhz	PWM	90	–	0.3	TSOP-5
FAN5331	2.7 - 5.5	20	50	5 LEDs in series	1.6 Mhz	FB Resistor	89	0.7 mA	0.1	SOT-23-5
FAN5333	1.8 – 5.5	30	65	2 to 8 WLEDs in series	1.5 MHz	PWM	90	0.6 mA	0.1	SOT-23-5

Linear Topology

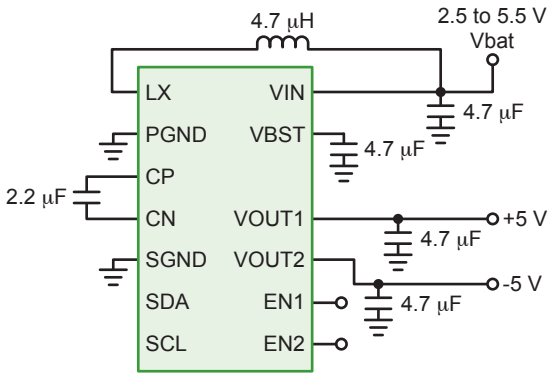
Device	Input Voltage Range (V)	Max Output Voltage, Typ (V)	Output Current / Channel (mA)	Number of LEDs	Dimming Method	Operating Quiescent Current, Typ	Shutdown Current, Typ (μA)	Package
FAN5622	2.7 - 5.5	V_{IN}	30	2	Single Wire and Resistor Programmable	0.4 mA	0.3	TSOT-23-6
FAN5624	2.7 - 5.5	V_{IN}	30	4	Single Wire and Resistor Programmable	0.6 mA	0.3	UQFN-10
FAN5626	2.7 – 5.5	V_{IN}	30	6	Single Wire and Resistor Programmable	1 mA	0.3	UQFN-10
FAN5640	6 – 20	20	25	2	Single Wire and Resistor Programmable	44 μA	5	SC-70-6
FAN5646	2.7 – 5.5	5.5	20	1	Single Wire and Resistor Programmable	35 μA	0.3	SC-70-5, WLCSP-4
NCP5623D	2.7 – 5.5	V_{IN}	90	3	I2C	0.35 mA	0.8	TSSOP-14

LCD Display Bias

The LV52133 and LV52134 generate user-programmable dual-out votages with a single inductor. Each device features short circuit protected output stages, small footprint, and ultra-low standby current.

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 LV52134A0XA	2.5 to 5.5 V	V_{OUT1} = +5.0 V V_{OUT2} = -5.0 V	V_{OUT1}: +4.1 to +5.7 V V_{OUT2} : -4. V to -5.7 V (100 mV step)	200 mA (V_{OUT1}); 100 mA (V_{OUT2})	0.3 µA	WLP-15J
LV52133A5XA LV52134A5XA		V_{OUT1} = +5.5 V V_{OUT2} = -5.5 V				

NOTE: LV52133 and LV52134 differ with respect to I2C control address.



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

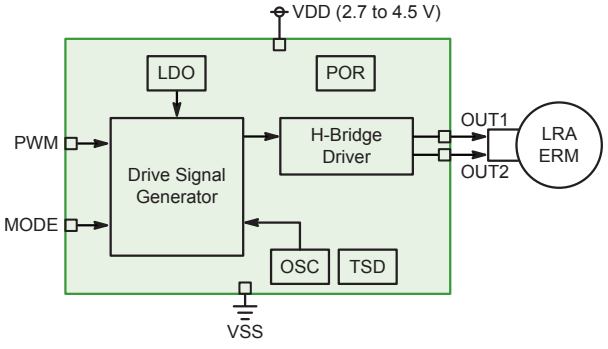
Other Features

- Supply voltage = +2.7 to +4.5 V
- I_{out} max = 200 mA
- Bridge $R_{DS(on)}$ = 2 x 2 Ω (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

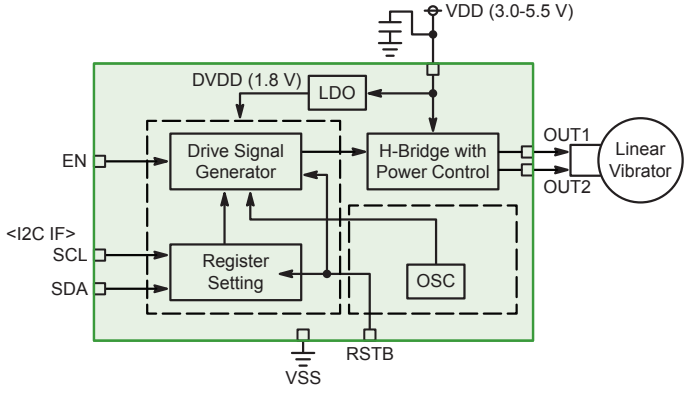
Other Features

- Supply voltage = +3.0 to +5.5 V
- I_{out} max = 200 mA
- Bridge $R_{DS(on)}$ = 2 x 2 Ω (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

Protection Solutions

External Interface

USB 3.x
USB 4.0

USB 2.0

Camera/Display Lines

High Speed Differential Data

ESD Protection

- < 0.3 pF, industry leading insertion loss
- Low clamping voltage
- Unidirectional and Bidirectional
- Singles and space efficient arrays
- Smallest footprint in the industry

EMI Filter

- > 30 dB CM Attenuation
- Support for up to 8 Gbps
- Lowest clamping voltage in its class
- 1, 2, 3 pairs available

Single Ended Data

SDR50
SDR104

SIM

Audio

Speaker

Headphone

Microphone

Other Lines

General Purpose
ESD Protection

Low Speed Single Ended Data/Audio

ESD Protection

- Industry leading power density
- > 10 A Surge capable in 0201 form factor
- Smallest footprint in the industry
- Singles and arrays

EMI Filter

- > 40 dB Attenuation at antenna frequency
- Low clamping voltage
- Extremely low cross-talk
- Small form factor

Charging

USB Vbus
Battery Contacts

High Surge Protection

- Ipp > 180 A (8x20 µs)
- Superior clamping performance
- 4.8 V to 18 V V_{RWM} options
- Unidirectional and Bidirectional

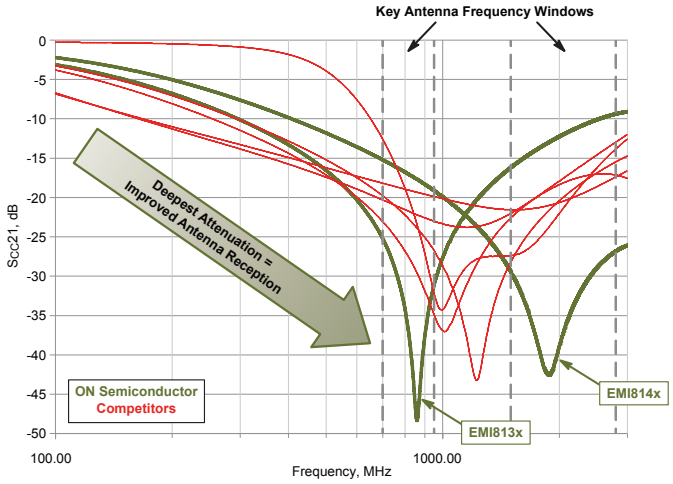
Current/Voltage Protection

- eFuses
- Power Switches

PROTECTION

Common Mode Filters for High Speed Interfaces

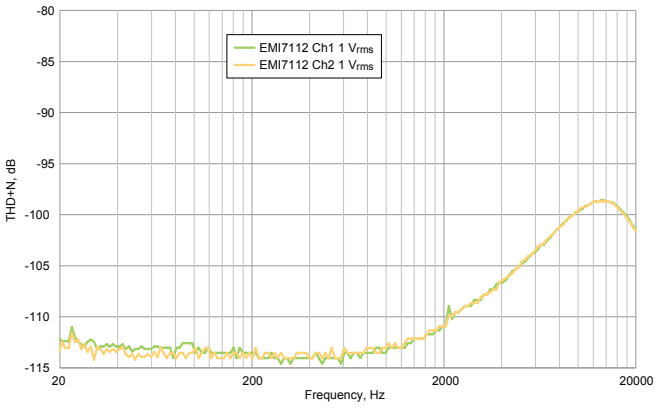
Function	Filter CM Noise		Signal Integrity		Protect Chipset	
Device Series	Attenuation > 25 dB range	RF Receivers	Maximum Data Rate	Interfaces Supported	Vc @ 8 kV (TLP)	Minimum Chipset Geometry
EMI813x	700 MHz – 1.1 GHz	LTE, GSM,	4 Gb/s	USB2.0; MHL1-2; HDMI1.3/4; MIPI CSI-2	11.6 V	14 nm
EMI814x	1.3 GHz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



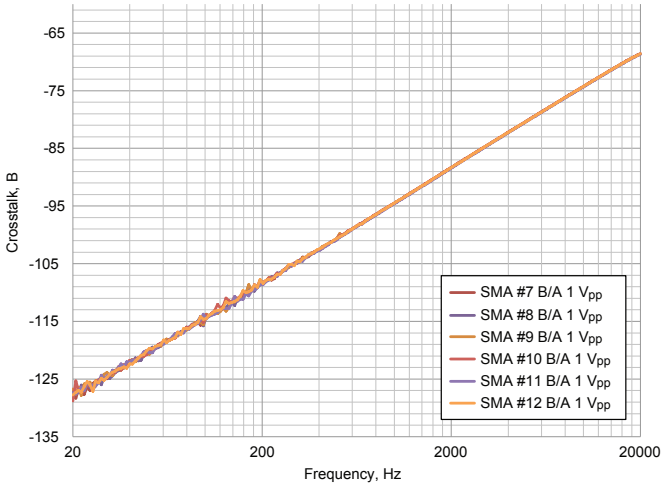
Audio Filtering for HiFi

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

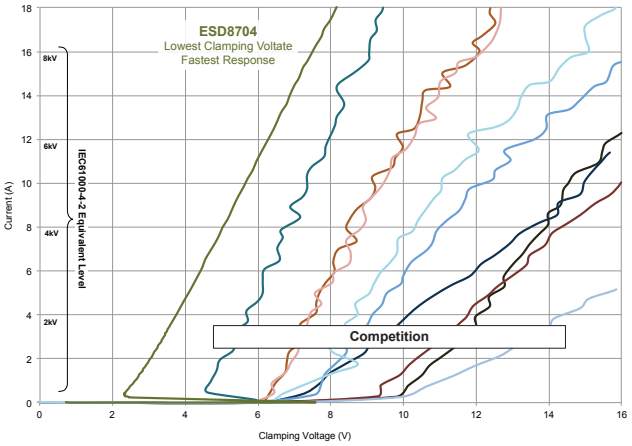
ESD Protection for High Speed Data Lines

Industry leading insertion loss with excellent clamping performance

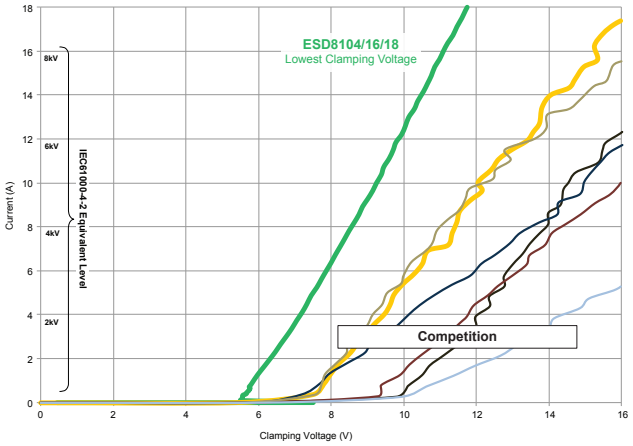
Applications

- USB 2.0/3.x/4.0
- Thunderbolt™ 2.0/3.0
- HDMI® 1.4/2.x
- MHL® 3/superMHL
- MIPI® D/M/C PHYs
- NFC™ & Wi-Fi® Antenna Protection
- DisplayPort® 1.4/2.0

Device	Polarity	V_{RWM} (V)	8 x 20 µs Surge		Capacitance (pF)	Capacitance Max (pF)	No of Lines	Package
			I_{PP} Min (A)	V_{Clamp} @ I_{PP} (V)				
ESD8011	Bidirectional	5.5	3.6	8.7	0.1	0.2	1	X3DFN-2
ESD8351	Unidirectional	3.3	5	8.2	0.37	0.55	1	X3DFN-2
ESD8111P	Bidirectional	3.3	7.1	8	0.2	0.4	1	X4DFN-2
ESD7331	Bidirectional	3.3	2.5	7.5	0.4	0.75	1	X3DFN-2
ESD7501	Bidirectional	5	2	9.9	0.45	0.75	1	X3DFN-2
ESD9L5.0	Unidirectional	5	1	9	0.5	0.9	1	SOD-923
ESD9L3.3	Unidirectional	3.3	1	9.8	0.5	0.9	1	SOD-923
ESDL3552	Bidirectional	5	2	14	0.25	0.3	2	X4DFN-3
ESD8704	Unidirectional	3.3	7.5	6.7	0.37	0.5	4	UDFN-10
ESD8104	Unidirectional	3.3	3.5	8.1	0.3	0.37	4	UDFN-10
ESD8116	Unidirectional	3.3	3.5	8	0.3	0.35	6	UDFN-8
ESD8118	Unidirectional	3.3	3.5	8.1	0.3	0.35	8	UDFN-10
ESD8008	Unidirectional	3.3	5	5	0.3	0.35	8	UDFN-14
ESD7181	Bidirectional	18.5	1	32	0.3	0.5	1	X3DFN-2
ESD7241	Bidirectional	24	2.5	37	0.55	1	1	X2DFN-2
ESDL2011	Bidirectional	1	4.3	4.6	0.15	0.2	1	X4DFN-2
ESDL2031	Bidirectional	4	8	5.5	0.37	0.55	1	X4DFN-2
ESDL1531	Bidirectional	3.3	7.5	8.6	0.15	0.3	1	X4DFN-2



SCR Arrays – 100 ns TLP



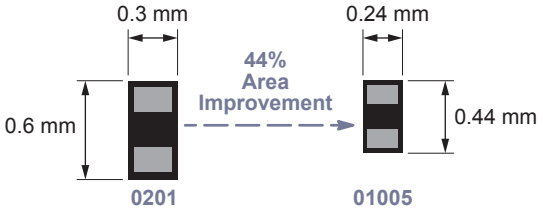
LVPT Arrays – 100 ns TLP

ESD Protection Featuring X4DFN – Smallest Package in the Industry

Ideal ESD protection solutions for space constrained applications

Industry leading X4DFN package offers

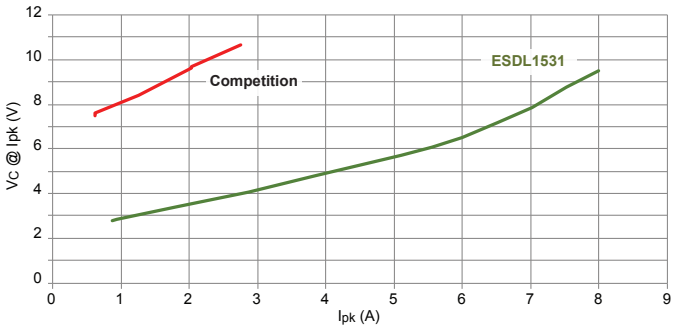
- Six side silicon encapsulation
- Best ESD protection performance in its class
- Increased reliability
  - Protective mechanical layer ➜ no chipping
  - Electrical insulation prevents short circuit conditions
  - Moisture barrier ➜ no corrosion
  - Lower reflectivity ➜ friendly to automated inspection
  - Light barrier ➜ reduces leakage caused by light sensitivity



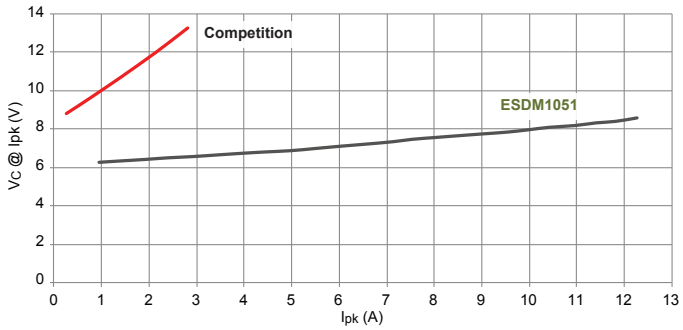


Device	ESD Contact/Air (kV)	V_{RWM} (V)	C_j Typ (pF)	C_j Max (pF)	8 x 20 µs Surge				R_{DYN} TLP (Ω)	SCR
					I_{PP} Typ (A)	V_{Clamp} Typ (V)	I_{PP} Min (A)	V_{Clamp} Max (V)		
ESDL1531	25/25	3.3	0.15	0.3	7.5	8.6	6.5	11.5	0.46	Yes
ESDM1131	16/16	3.3	4	5.5	4.25	6.2	3.5	6.6	0.125	No
ESDM1031*	30/30	3.3	36	40	13.5	9.6	9.5	10.5	0.21	No
ESDM1032*	30/30	3.3	21	23.5	12.5	8.4	11	10	0.11	No
ESDM1051	30/30	5.5	21	23.5	12	8.5	11	10	0.11	No
ESDM1121*	15/15	12	15	20	4	19.5	3	22	0.59	No

* Pending 2Q20.



High Speed Data Protection – 8 x 20 µs Surge Comparison



5 V GPIO Protection – 8 x 20 µs Surge Comparison



X4DFN USB Type-C Evaluation Board

ESD Protection for GPIO

Small form factor solutions with lowest clamping voltage in class

Applications

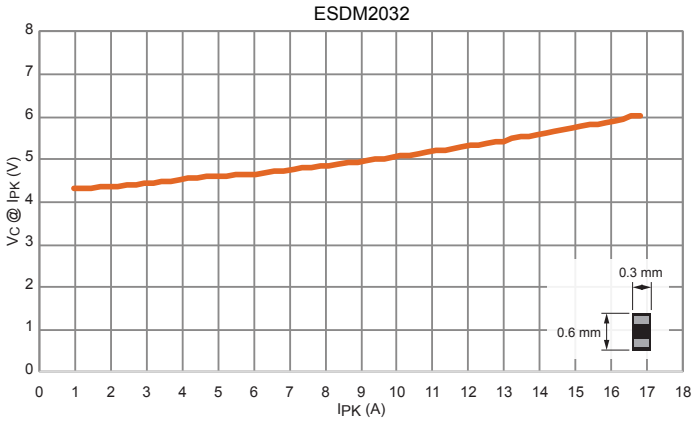
- SIM Card protection
- SD Card protection
- Biometrics/finger print sensor
- Audio In/Out
- USB Type C configuration channel
- Manufacturing test points



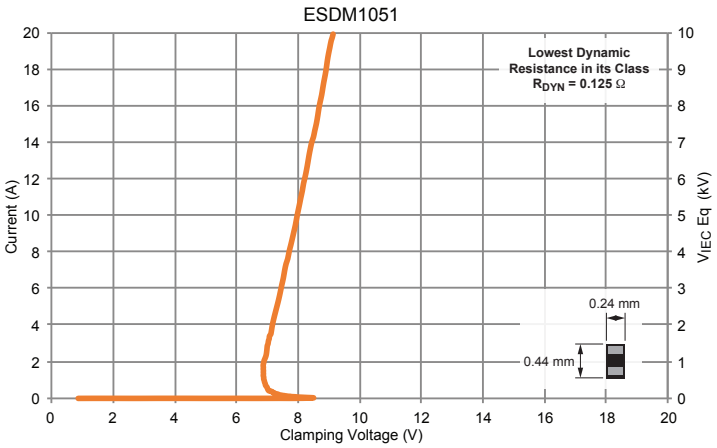
SIM | SD | Biometrics | Speaker/ Headphones | Mic | CC/SBU | Test Points

Device	Polarity	V_{RWM} (V)	8 x 20 µs Surge		Capacitance Max (pF)	No of Lines	Package
			I_{PP} Min (A)	V_{Clamp} @ I_{PP} (V)			
ESDM3031	Bidirectional	3.3	11	8.4	20	1	X3DFN-2
ESDM3051	Bidirectional	5	10	8.7	21	1	X3DFN-2
ESDM3551	Bidirectional	5.5	9.9	8.8	21	1	X3DFN-2
ESDM2032*	Bidirectional	3.3	14	5.5	20	1	X4DFN-2
ESDM3032	Bidirectional	3.3	7.5	8.5	10	1	X3DFN-2
ESD5581	Bidirectional	5	6	10.3	10	1	X3DFN-2
ESD5111P	Bidirectional	3.3	4	5.8	5.5	1	DSN-2
ESDM1131	Bidirectional	3.3	3.9	5.7	5	1	X4DFN-2
ESD5102	Bidirectional	3.3	–	–	5.5	2	DSN-3
ESD5004	Bidirectional	3.3	3	6.8	5	4	X3DFN-4
ESDM1031*	Bidirectional	3.3	9.5	10.5	40	1	X4DFN-2
ESDM1032*	Bidirectional	3.3	11	10	23.5	1	X4DFN-2
ESDM1051	Bidirectional	5.5	11	10	23.5	1	X4DFN-2
ESDM1121*	Bidirectional	12	3	19.5	20	1	X4DFN-2

* Pending 2Q20.



Clamping Voltage vs Peak Pulse Current – tp=8/20 µs



100 ns TLP I-V Curve

Surge Protection

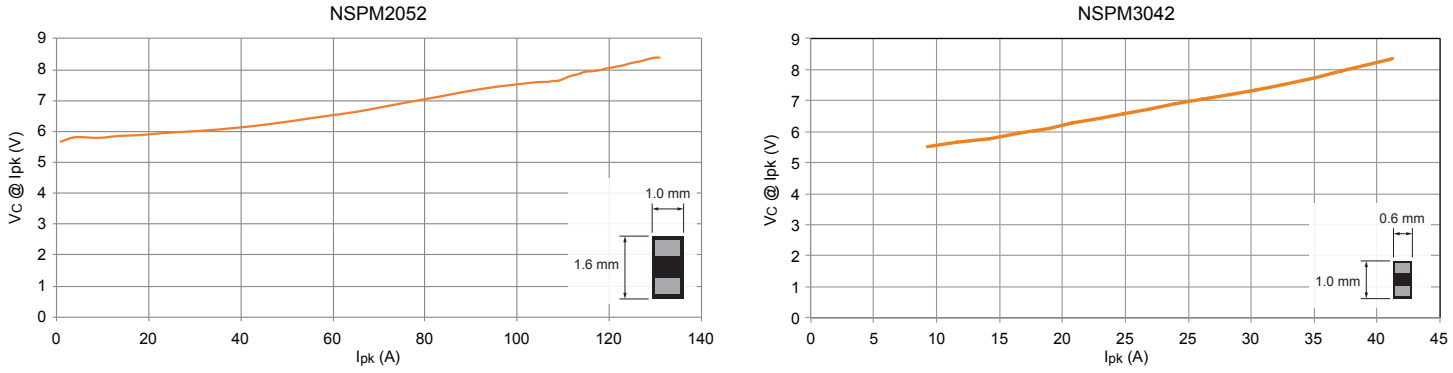
High performance, space efficient solutions

Applications

- V_{BUS} line
- Battery line
- Audio In/Out
- USB Type C Configuration Channel
- LCD power line
- RF Power Amplifier power line



Device	Polarity	V_{RWM} (V)	8 x 20 µs Surge		Package
			I_{PP} Min (A)	V_{Clamp} @ I_{PP} (V)	
NSPM0061	Unidirectional	6.3	70	11.3	UDFN-2
NSPM0101	Unidirectional	10	60	18.2	UDFN-2
NSPM8151	Unidirectional	15	100	24.5	UDFN-6
NSPM8181	Unidirectional	18	119	31.5	UDFN-6
NSPU3051	Unidirectional	5.5	36	7.5	SOD-882
NSPU3061	Unidirectional	6.3	30	7.3	SOD-882
NSPM3031	Bidirectional	3.3	45	7	SOD-882
NSPM3042	Bidirectional	4.8	43	7.4	SOD-882
NSPU5132	Unidirectional	13.5	200	22	UDFN-6
NSPU5221	Unidirectional	22	120	34	UDFN-6
NSPM2052	Unidirectional	5	120	8	UDFN-2
NSPM1042	Bidirectional	4.8	200	8.8	UDFN-2



8 x 20 µs Surge Performance – V_{BAT} Protection

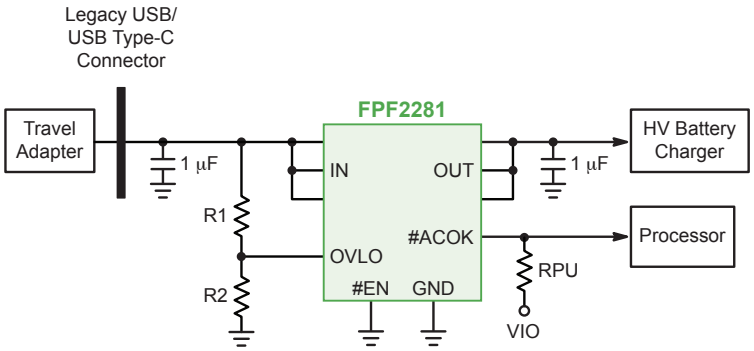
PROTECTION

Power Protection

Surge and Over-Voltage Protection Switches

Features

- Optimized for Input Power Stage with USB-C
- 100 V Surge Capable Integrated TVS
- Low RON for Low Power Loss
- Fast Over Voltage Response Time
- Design Flexibility with Adjustable/Selectable OVP
- Reverse Current Block
- Compact Packages, WLCSP and DFN



Over Voltage Protection Switches

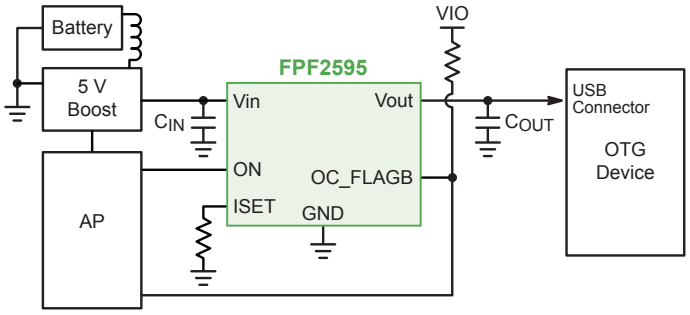
Device	Channel	V_{IN} Min (V)	V_{IN} Max (V)	OVP (V)	R_{ON} (mΩ)	I_{OUT} Max (A)	Integrated TVS	Discharge Path	Package
FPF2280	Single	2.5	28	6.8*	30 @ 5.0 V	4.5	Yes	No	WLCSP-12
FPF2281	Single	2.5	28	14*	30 @ 5.0 V	4.5	Yes	No	WLCSP-12
FPF2290	Single	2.5	28	SEL**	30 @ 5.0 V	4.5	Yes	No	WLCSP-12
FPF2498	Single	3.5	28	6.5	80 @ 5.0 V	1.75	No	No	WLCSP-6
NCP398	Single	2.9	28	5.65	190 @ 5.0 V	0.8	No	Yes	WLCSP-4
FPF3042	DISO^	4	18	14	70 @ 5.0 V	2.7	No	No	WLCSP-16
NCP367	Single	1.2	28	OPN^^	50 @ 3.5 V	3.4	No	No	DFN-8

* Default but Adjustable w/ external R. ** Selectable w/ Logic Pins. *** Single Input Dual Output. ^ Dual Input Single Output. ^^ By Option.

Over Current Protection Switches

Features

- Optimized for 5V USB-OTG and VCONN with USB-C
- Fast Over Current Response Time
- Design Flexibility with Adjustable Current Limit Set
- True Reverse Current Block
- Compact Packages, WLCSP and DFN
- UL Certified



Over Current Protection Switches

Device	Channel	V_{IN} Min (V)	V_{IN} Max (V)	R_{ON} (mΩ)	I_{LIM} Range (A)	OVP	RCB*	Package
FPF2195	Single	1.8	5.5	55 @ 3.3 V	0.1 ~ 1.5	No	Yes	WLCSP-6
FPF2495	Single	2.5	5.5	70 @ 5.0 V	0.05 ~ 2.0	Yes	Yes	WLCSP-9
FPF2496	Single	3.5	5.5	70 @ 5.0 V	0.1 ~ 2.5	Yes	Yes	WLCSP-9
FPF2595	Single	2.5	5.5	35 @ 5.0 V	0.1 ~ 3.5	Yes	Yes	WLCSP-12
FPF2895C	Single	4	22	27 @ 5.0 V	0.5 ~ 5.0	Yes	Yes	WLCSP-24
NCP380	Single	2.5	5.5	55 @ 5.0 V	0.5 ~ 2.1	No	Yes	UDFN-6
NCP382	SIDO**	2.5	5.5	80 @ 5.0 V	Fixed***	No	Yes	DFN-8
NCP383	SIDO**	2.7	5.5	45 @ 5.0 V	0.5 ~ 2.8	No	Yes	UDFN-10

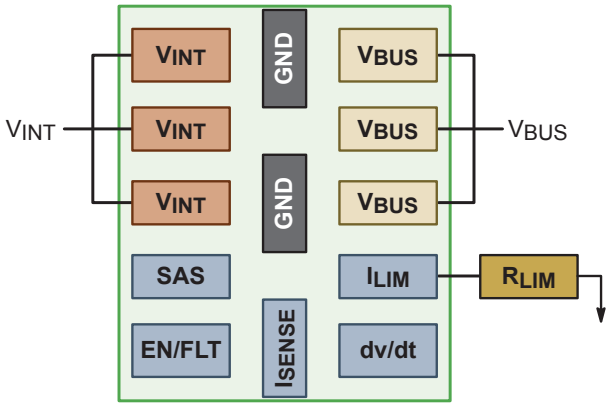
* Reverse Current Block. ** Single Input Dual Output. *** By Option.

eFuses (Electronic Fuses)

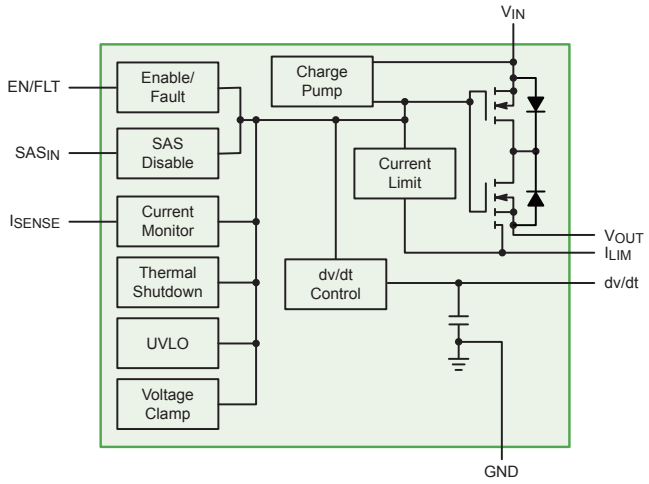
5 – 12 V Power Bus Overcurrent and Hot Plug Protection

Features

- Low $R_{DS(ON)}$, high operating and trip currents (I_{OP}, I_{TRIP})
- Overvoltage protection
- Precise I_{TRIP} control
- Slew rate control
- Thermal shut-down
- EN pin for synchronizing multiple eFuses
- Reverse current blocking to protect downstream data
- Fast-role swap capability for USB Type-C
- Surge protection per IEC 61000-4-5
- Outperforms poly-fuses:
  - Tighter spec tolerances
  - Lower resistance
  - Shorter trip-time
  - Superior repeatability
- High efficiency with high current capability
- eFuses in parallel achieve practically any desired level of I_{OP} and I_{TRIP}



Application Diagram



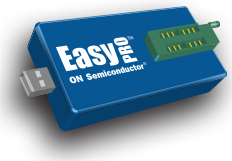
Typical Block Diagram

Device	Nominal Voltage (V)	Input Voltage (V)	Output Clamping Voltage (V)	Continuous Current (A)	Trip Current	$R_{DS(ON)}$ (mΩ)	Auto-Retry	Latching	Package
NIS5021	12	-0.3 to 20	14	12	Adjustable	14	✓	✓	WDFN-10
NIS5020	12	-0.3 to 20	14	10	Adjustable	14	✓	✓	WDFN-10
NIS5820	12	-0.3 to 20	14	8	Adjustable	24	✓	✓	WDFN-10
NIS5132	12	-0.6 to 18	15	4.2	Adjustable	44	✓	✓	DFN-10
NIS5232	12	-0.6 to 18	15	4.2	Adjustable	44		✓	DFN-10
NIS5135	5	-0.6 to 18	6.65	3.6	Adjustable	68	✓	✓	DFN-10
NIS6452	5	-0.3 to 14	7.0	3	Adjustable	60	✓	✓	WQFN-12
NIS6350	5	-0.3 to 10	6.1/6.9	3	Adjustable	70	✓	✓	WDFN-10
NIS6150	5	-0.3 to 10	6.1/6.9	1	Adjustable	190	✓	✓	WDFN-10
NIS6432	3.3	-0.3 to 14	4.4	3	Adjustable	60	✓	✓	WQFN-12

EEPROMs for Configuration and Calibration

Features

- Broad density range: 1 kb to 2 Mb
- Wide operating Vcc range: 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 (I^2C, SPI, Microwire)

EEPROMs

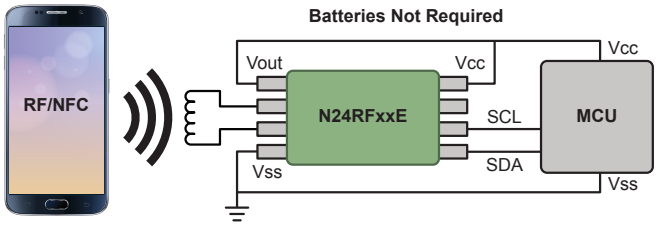
Data Transmission Standard	Density	Organization*	V_{CC} Min (V)	V_{CC} Max (V)	f_{CLK} Max (MHz)	Package(s)
I^2C	1 Mb	128k x 8	1.7, 1.8	5.5	0.4, 1	US8, SOIC-8, TSSOP-8, UDFN-8, TSOT23-5, WLCSP-4, WLCSP-5, WLCSP-8
	512 kb	64k x 8				
	256 kb	32k x 8				
	128 kb	16k x 8				
	64 kb	8k x 8				
	32 kb	4k x 8				
	16 kb	2k x 8				
	8 kb	1k x 8				
	4 kb	512 x 8				
	2 kb	256 x 8				
SPI	2 Mb	256k x 8	1.7, 1.8	5.5	10, 20	SOIC-8, TSSOP-8, UDFN-8
	1 Mb	128k x 8				
	512 kb	64k x 8				
	256 kb	32k x 8				
	128 kb	16k x 8				
	64 kb	8k x 8				
	32 kb	4k x 8				
	16 kb	2k x 8				
	8 kb	1k x 8				
	4 kb	512 x 8				
	2 kb	256 x 8				
	1 kb	128 x 8				
Microwire	16 kb	2k x 8 / 1k x 16	1.65, 1.8	5.5	2, 3, 4	SOIC-8, TSSOP-8, UDFN-8
	16 kb	2k x 8 / 1k x 16				
	8 kb	1k x 8 / 512 x 16				
	8 kb	1k x 8 / 512 x 16				
	4 kb	512 x 8 / 256 x 16				
	2 kb	256 x 8 / 128 x 16				
	1 kb	128 x 8 / 64 x 16				
	1 kb	128 x 8 / 64 x 16				

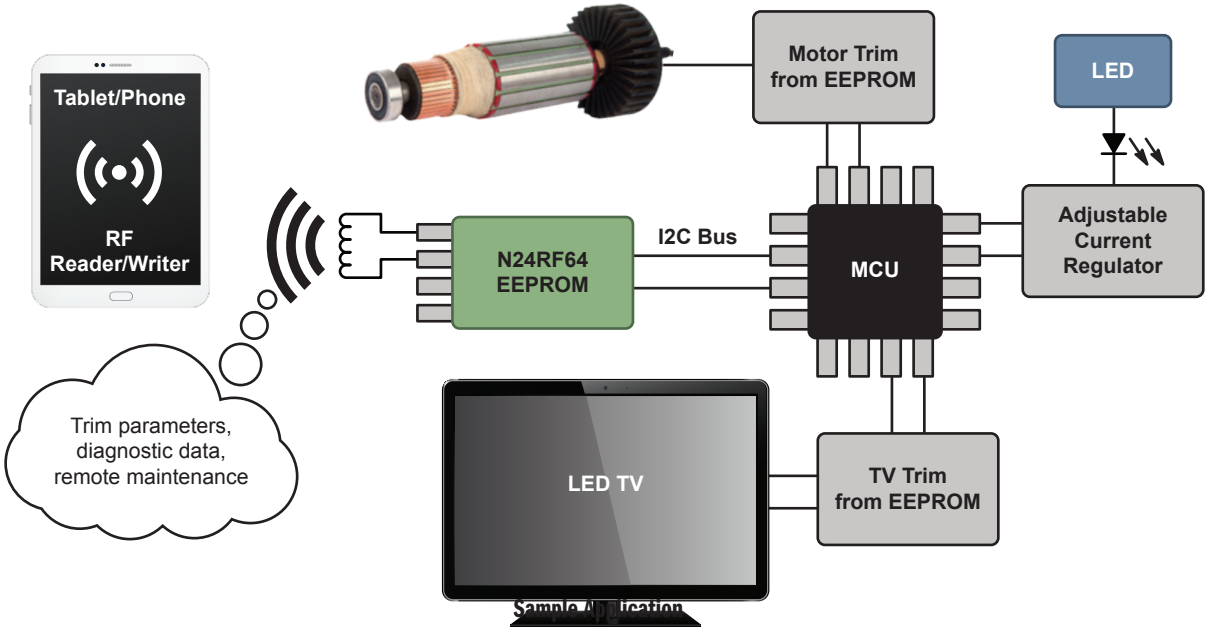
* Organization for Microwire devices is selectable.

RF/NFC EEPROM

Features

- RF/NFC interface for contactless transmission of data up to 150 cm
- ISO 15693 / ISO 18000-3 Mode 1 Compliant RF/NFC at 13.56 MHz
- 2,000,000 Program / Erase Cycles
- 200 year data retention
- 64-bit Unique Identifier (UID)
- Multiple 32-bit passwords and Lock Feature
- I2C Interface
  - 4 selectable slave addresses using pins A0 ad A1
  - 1 MHz bus speeds
- Energy harvesting output pin; able to power small peripheral or MCU





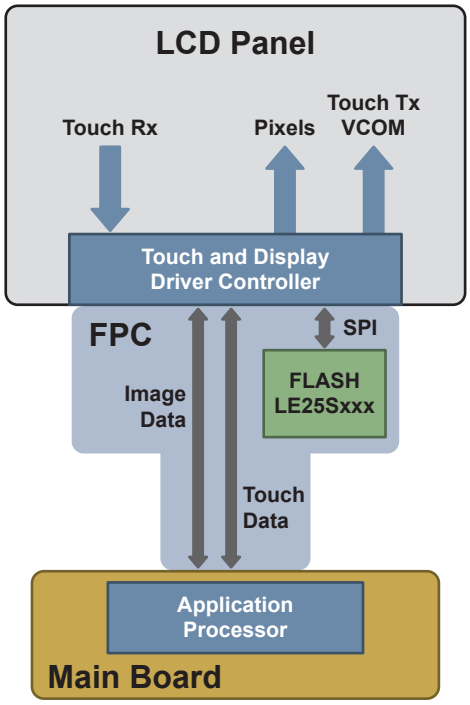
RF EEPROMs

Device	Memory Density (kb)	Energy Harvesting Output	Temperature Range	Package(s)
N24RF64E	64	Yes	-40 to +105°C	SOIC-8, TSSOP-8
N24RF64	64	No	-40 to +105°C	SOIC-8, TSSOP-8
N24RF16E	16	Yes	-40 to +105°C	SOIC-8, TSSOP-8
N24RF16	16	No	-40 to +105°C	SOIC-8, TSSOP-8
N24RF04E	4	Yes	-40 to +105°C	SOIC-8, TSSOP-8
N24RF04	4	No	-40 to +105°C	SOIC-8, TSSOP-8

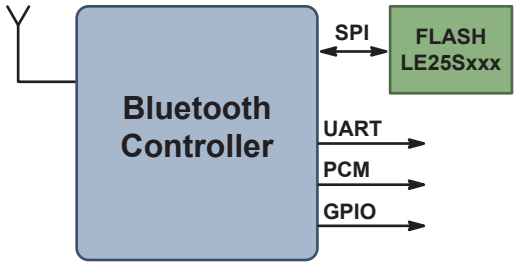
Serial NOR Flash Memory

Features

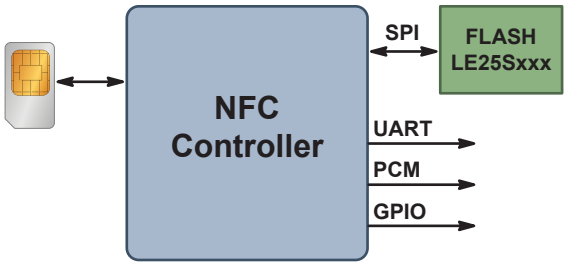
- SPI interface
- Supply voltage 1.65 to 1.95 V
- Minimum erase size (4 KB/64 KB)
- Fast write perfomance (Sector Erase/Page Program)
- Low standby current; support for deep standby mode



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

Standard Logic and MiniGate™

Available logic functions

- Logic Gates, Buffers, Flip-Flops
- Arithmetic Functions
- Bus Transceivers
- Latches and Registers
- Multiplexers and Analog Switches
- Logic Level Translators

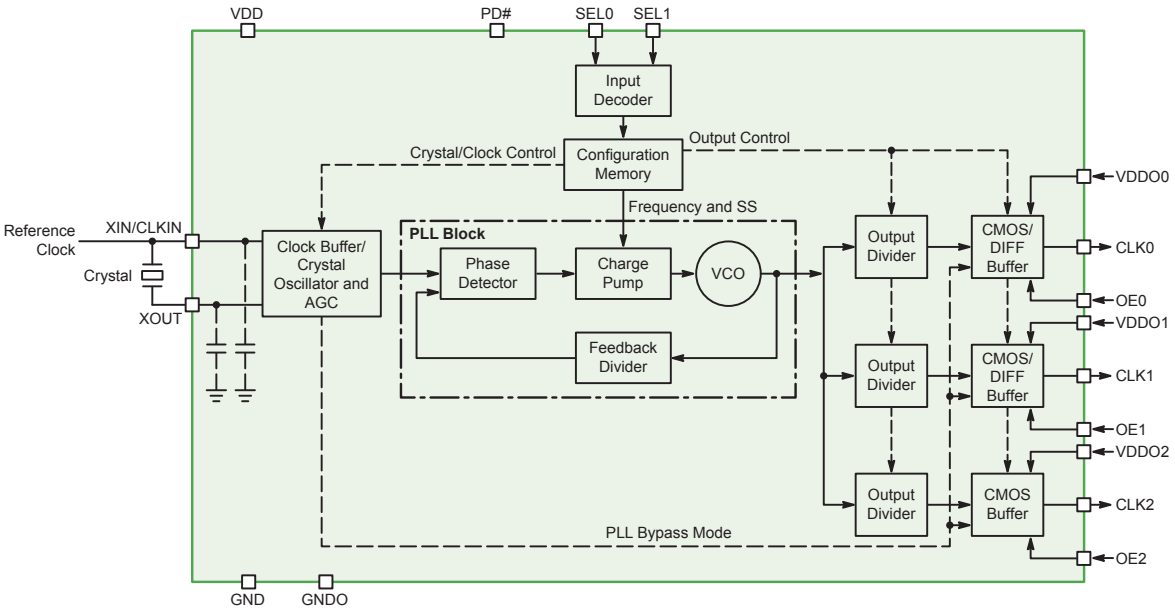
Standard Logic Family	Device Prefix	V_{CC} Min (V)	V_{CC} Max (V)	t_{PD} (nS)	I_{OUT} (mA)	Input Logic Level	Packages
Metal Gate	MC14	3	18	50 @ V_{CC} = 15 V	±4.2 @ V_{CC} = 15 V	CMOS	SOIC, TSSOP, QFN
AC	MC74AC/74AC	2	6	6 @ V_{CC} = 5 V	±24 @ V_{CC} = 4.5 V	CMOS	
ACT	MC74ACT/74ACT	4.5	5.5	5.5 @ V_{CC} = 5 V	±24 @ V_{CC} = 4.5 V	TTL	
HC	MC74HC/MM74HC	2	6	13 @ V_{CC} = 6 V	±5.2 @ V_{CC} = 6 V (Std) ±7.8 @ V_{CC} = 6 V (Bus Driver)	CMOS	
HCT	MC74HCT/MM74HCT	4.5	5.5	15 @ V_{CC} = 5 V	±4.0 @ V_{CC} = 4.5 V (Std) ±6.0 @ V_{CC} = 4.5 V (Bus Driver)	TTL	
LCX	MC74LCX/74LCX	2.3	3.6	5.5 @ V_{CC} = 3 V	±24 @ V_{CC} = 3 V	LVTTL	
LVX	MC74LVX/74LVX	2	3.6	6.6 @ V_{CC} = 3 V	±4 @ V_{CC} = 3 V	LVTTL	
VCX	MC74VCX/74VCX	1.65	3.6	3.5 @ V_{CC} = 3 V	±24 @ V_{CC} = 3 V	LVTTL	
VHC	MC74VHC/74VHC	2	5.5	5.2 @ V_{CC} = 4.5 V	±8 @ V_{CC} = 4.5 V	CMOS	
VHCT	MC74VHCT/74VHCT	4.5	5.5	3.6 @ V_{CC} = 4.5 V	±8 @ V_{CC} = 4.5 V	TTL	
LVT	74LVT	2.7	3.6	3.6 @ V_{CC} = 3.0 V	-32/64 @ V_{CC} = 3.0 V	TTL	

MiniGate Family	Number of Gates	Device Prefix	V_{CC} Min (V)	V_{CC} Max (V)	t_{PD} (nS)	I_{OUT} (mA)	Input Logic Level	Packages
HC	1	MC74HC1G/NC7S	2	6	6.5 @ V_{CC} = 5 V	±5.2 @ V_{CC} = 6 V	CMOS	TSOP, SC-88, SC-74, SOT-553, SOT-953, US8, UDFN, UQFN, MicroPak
HCT	1	NC7ST	4.5	5.5	6.5 @ V_{CC} = 5 V	±2 @ V_{CC} = 6 V	TTL	
VHC	1	MC74VHC1G/NLU1G/NL17SH	1.65	5.5	3.8 @ V_{CC} = 4.5 V	±8 @ V_{CC} = 4.5 V	CMOS	
	2	NLU2G						
	3	NLU3G						
VHCT	1	MC74VHCT1G/NLU1GT/NL17SHT	4.5	5.5	3.6 @ V_{CC} = 4.5 V	±8 @ V_{CC} = 4.5 V	TTL	
	2	NLU2GT						
	3	NLU3GT						
LCX	1	NL17SZ/NC7SZ/NLX1G	1.65	5.5	2.4 @ V_{CC} = 3 V	±24 @ V_{CC} = 3 V	CMOS	
	2	NC27WZ/NC7WZ/NLX2G						
	3	NL37WZ/NC7NZ/NLX3G						
VCX	1	NL17SV/NC7SV	0.9	3.6	1.0 @ V_{CC} = 3 V	±24 @ V_{CC} = 3 V	LVTTL	
SG	1	NL17SGxx	0.9	3.6	2.2 @ V_{CC} = 3 V	±8 @ V_{CC} = 3 V	LVTTL	
SP	1	NC7SP	0.9	3.6	3.0 @ V_{CC} = 3 V	±2.6 @ V_{CC} = 3 V	LVTTL	
	2	NC7WP						
	3	NC7NP						
AUP	1	74AUP1G	0.8	3.6	2.9 @ V_{CC} = 3 V	±4 @ V_{CC} = 3 V	Schmitt	
	1	74AUP1T	2.3	3.6	3.3 @ V_{CC} = 3 V	±4 @ V_{CC} = 3 V	Schmitt	

Omniclock Programmable Clock Synthesizers

Features

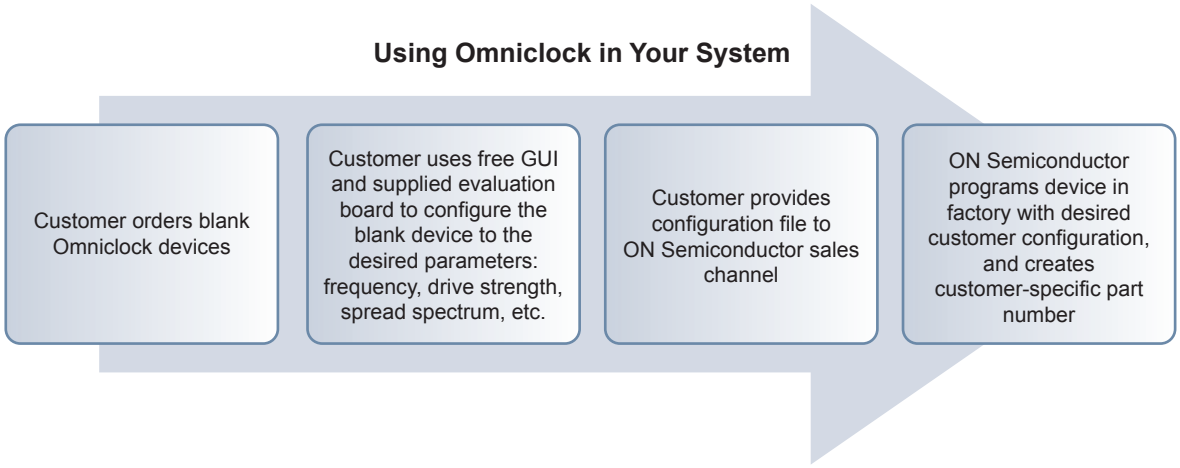
- Single PLL
- Input Frequency Range:
  - Crystal: 3 – 50 MHz (low cost ESR crystal compatible)
  - Clock: 3 – 200 MHz (single-ended only)
- Up to 3 single-ended (LVCMOS/LVTTL) outputs, or up to 1 differential (LVPECL, LVDS, HCSL or CML) output + 1 single-ended (LVCMOS/LVTTL) output
- Output Frequency Range: 8 kHz (Min), 200 MHz (Max)
- Programmable Spread Spectrum Capabilities for EMI Suppression
  - Center Spread (0.125% steps): ± 0.125% to ± 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 ±10%; 2.5 V ± 10%; 1.8 V ± 0.1 V
- Temperature Range: -40°C to +85°C
- Available in QFN-16 (3 mm x 3 mm) and WDFN-8 (2 mm x 2 mm) packages

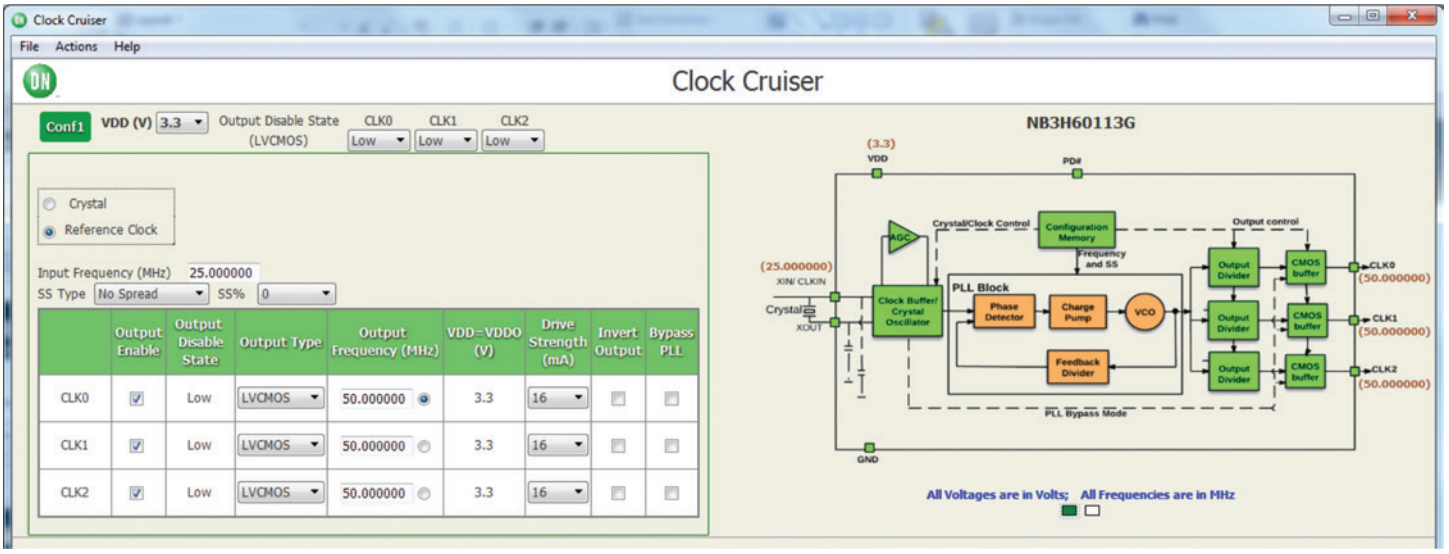


Block Diagram

Omniclock Programmable Clock Synthesizers

Using Omniclock in Your System





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

RF Antenna Tuning Solutions

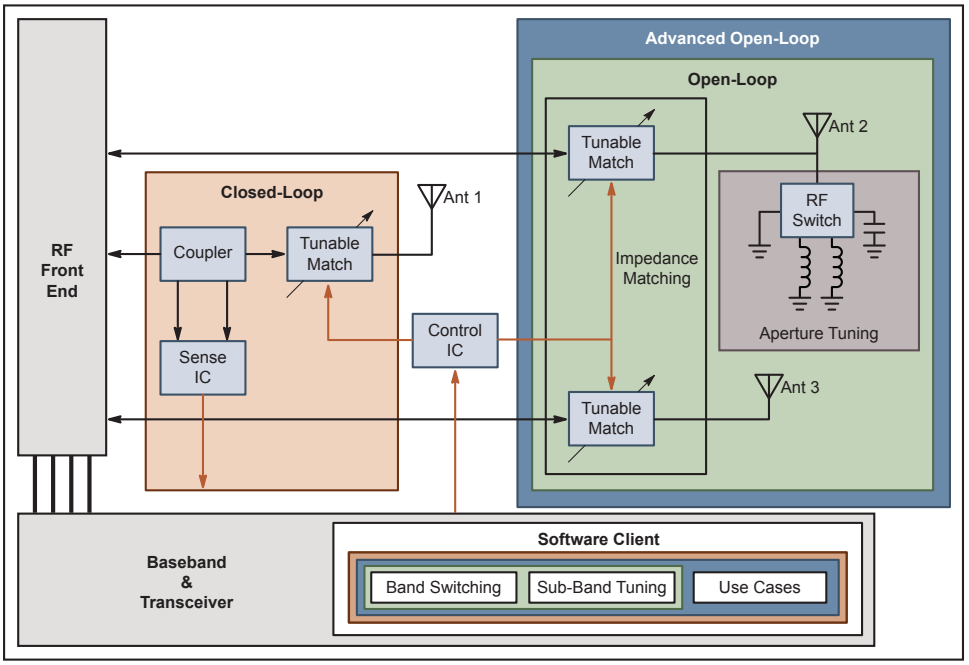
ON Semiconductor offers system-level RF antenna tuning solutions designed to enhance antenna performance of smartphones and next-generation 5G devices. The antenna tuning sub-system is comprised of software and RF/control hardware. The RF components combine broad tuning range, high RF quality factor (Q), and frequency operation up to 4 GHz to form a flexible and comprehensive solution. These can be customized to meet the RF tuning needs of any smartphone design-from open-loop to advanced closed-loop tuning systems.

Our tunable RF solutions are ideally suited for LTE-A networks with advanced features, including: Carrier Aggregation, MIMO, and ASDiv functionality. The antenna tuning system is also suitable for emerging 5G New Radio (NR), basestations, and IOT devices.

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



Tuning for Any Smartphone



Open-Loop
Provides multiple tuning states to optimize performance in each band

Advanced Open-Loop
Uses sensor input to detect and adjust performance for certain conditions (e.g., head/hand, USB connected)

Fully Adaptive (Closed-Loop)
Detects environments and conditions and optimizes antenna performance

Integrated Passive Devices (IPD)

Efficient RF System-in-Package Solutions

Integrating passive devices into our HighQ™ copper platform gives a cost-effective, space-saving solution for all RF needs.

IPD Technology Characteristics

- Target frequency: 500 MHz to 40 GHz
- Low profile, minimal footprint
- Tight tolerance

Typical Applications

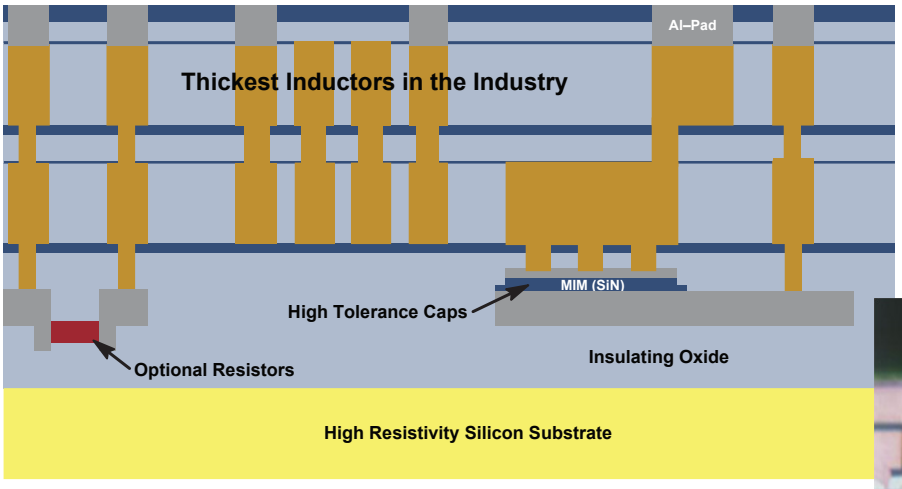
- Antenna Switch
- WiFi®/Bluetooth
- Power Amplifier
- Zigbee

Typical IPD Designs

- Baluns
- Couplers
- Diplexers
- Balanced Filters
- Splitters
- Matching networks

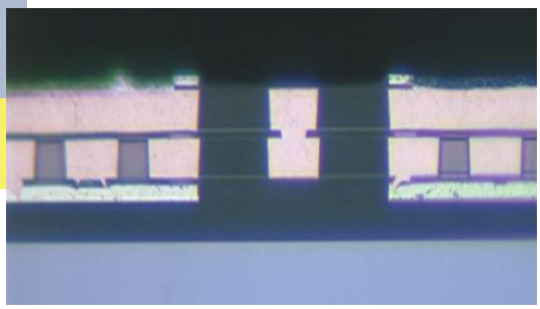


IPD Technology (R, L, C)



Performance

- Guaranteed ±5.0% capacitor tolerance
- Typical < 1% variance between capacitors on common IPD
- Dual Cu stack up of 12 μm for high Q inductors



Dual Copper Stackup with Full Length Stitched Via

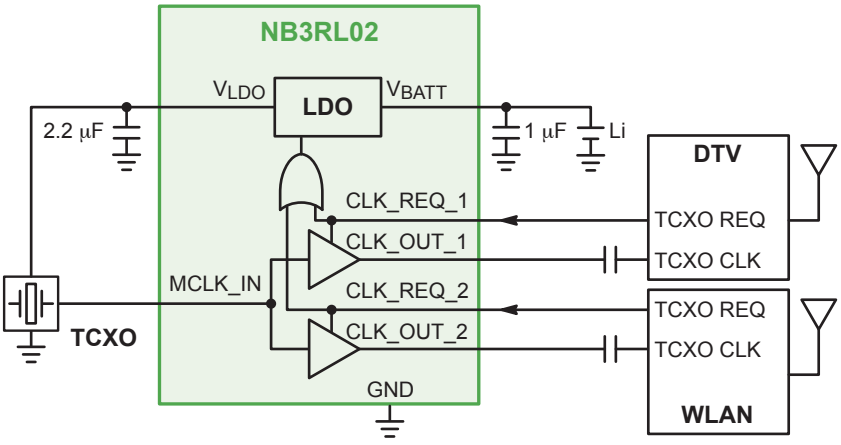
Single Ended Buffers

Clock Buffer with Integrated LDO

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.



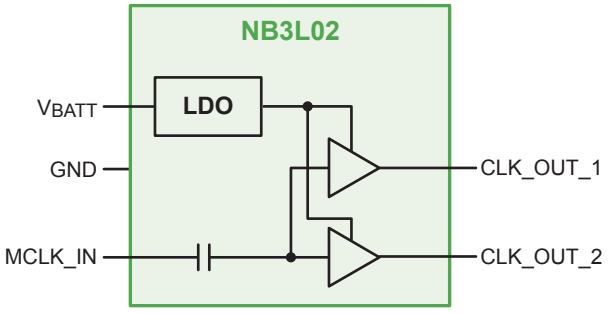
NB3RL02 Reduces Cost by Eliminating Multiple TCXOs

Clock Buffers for Wireless LAN and WiMax

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

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