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# Power management for handheld and portable





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# Introduction



## High integration combined with a broad IP portfolio, a complete system competence and state-of-the-art technology

ST is a leading supplier of power management and mixed-signal ICs for handheld and wearable applications, offering a wide range of products from simple power management ICs up to highly-integrated devices that mix power management blocks with advanced analog and digital functionality.

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### TARGET APPLICATIONS

- Smartphones and other slim-line electronics
- Handheld consoles
- Smart watches
- Wearables and fitness devices
- Tablet PCs
- Medical portable equipment

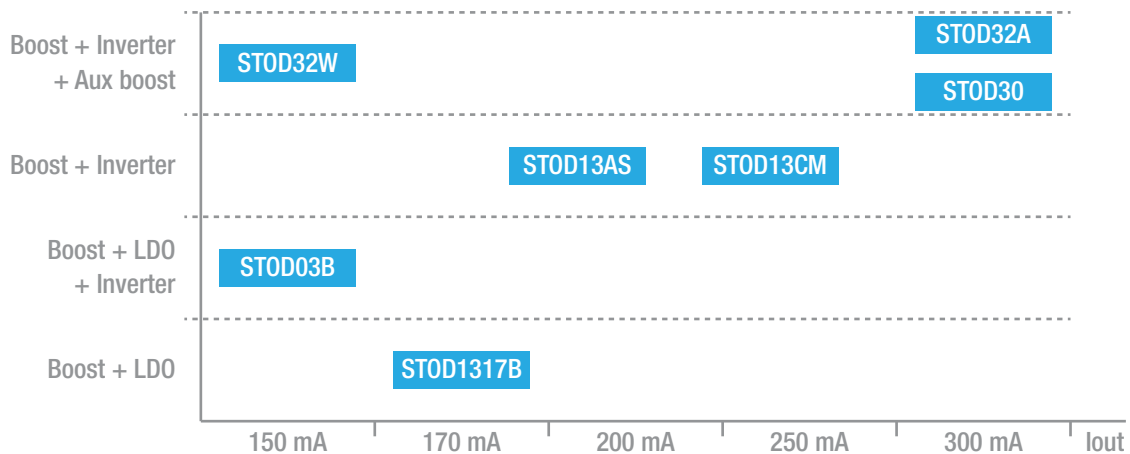




# Display power supply

ST supplies over 70% of the world's ICs used to power AMOLED displays that enable today's advanced handheld devices to deliver high-quality web and video experiences on the move.

ST's dedicated AMOLED power ICs add value to new designs by simplifying power-supply circuitry. DC-DC converters are produced using ST's innovative BCD process technology, which ensures outstanding energy efficiency and results in longer battery life. In addition, high immunity to cellphone communication noise keeps displays consistent and flicker-free.



## HIGHLIGHTS

### STOD32A

The STOD32A, our most recent and innovative chip, is particularly well-suited for battery-operated products with display panels up to 6 inches. Thanks to its high efficiency and very low ripple levels, this triple DC-DC converter satisfies the continuous demand for energy saving, noise immunity in smaller application areas.

On a single chip, the STOD32A integrates a 300 mA step-up and an inverting DC-DC converter needed to generate the positive and negative supplies to power the AMOLED display, as well as an auxiliary step-up converter to provide the supply voltage for the source driver IC.

### STOD32W

The STOD32W has the same architecture of the STOD32A, optimizing performance (system efficiency, noise immunity, etc...) in a lower output current range (100 mA max.) with a smaller package size (12-bump chip-scale package) thus making this device perfectly suitable for wearable devices with displays up to 3 inches.

### KEY FEATURES

- Advanced silicon-on-insulator manufacturing technology
- Synchronous rectification
- PFM/PWM operation for best-in-class efficiency (up to 93%)
- High frequency (1.6 MHz) for the smallest application areas
- High output voltage accuracy
- Low output ripple
- High immunity to GSM noise
- User-programmable negative output voltage
- Dynamic transistor control to optimize efficiency under any load condition

### KEY BENEFITS

- Increased battery lifetime
- Simplified power-supply circuitry
- Flicker-free displays
- Meet needs for growing AMOLED panel sizes
- Improved picture quality
- Increased ruggedness and reliability

## DEVICE SUMMARY

Part number	Package (mm)	Topology	Input voltage	Step-up output voltage	Inverting output voltage	Aux. output voltage	Maximum efficiency	Accuracy positive output voltage	Accuracy negative output voltage
<b>STOD03B</b>	VDFFPN 12L 3 x 3 x 0.6	Step-up and inverting	2.5 to 4.8 V	4.6 V	-2.4 to -5.4 V	-	87%	±0.8%	±1.5%
<b>STOD13AS</b>	VDFFPN 12L 3 x 3 x 0.6	Step-up and inverting	2.5 to 4.5 V	4.6 V	-2.4 to -6.4 V	-	89%	±0.6%	±1.4%
<b>STOD13CM</b>	VDFFPN 12L 3 x 3 x 0.6	Step-up and inverting	2.5 to 4.5 V	4.6 V	-1.4 to -4.4 V	-	89%	±0.5%	±0.8%
<b>STOD1317B</b>	VDFFPN 10L 3 x 3 x 0.8	Step-up and LDO	2.6 to 4.8 V	6.0 to 13.0 V	NA	-	85%	±1%	NA
<b>STOD30</b>	QFN 18L 3.5 x 3.5 x 0.6	Two step up and one inverting	2.5 to 4.5 V	4.6 V	-1.4 to -5.4V	6.7 to 7.6 V	90%	±0.5%	±0.8%
<b>STOD32A</b>	VFQFPN 16L 3 x 3 x 0.55	Boost + Inverting	2.9 to 4.5 V	4.6 V	-0.8 to -4.8 V	5.8 to 7.9 V	93%	±0.5%	±1%
<b>STOD32W</b>	Flip-Chip 1.6 x 1.7 12 bumps	Boost + Inverting	2.9 to 4.5 V	4.6 V	-0.8 to -4.6 V	6.6 to 7.6 V	92%	±0.5%	±1%

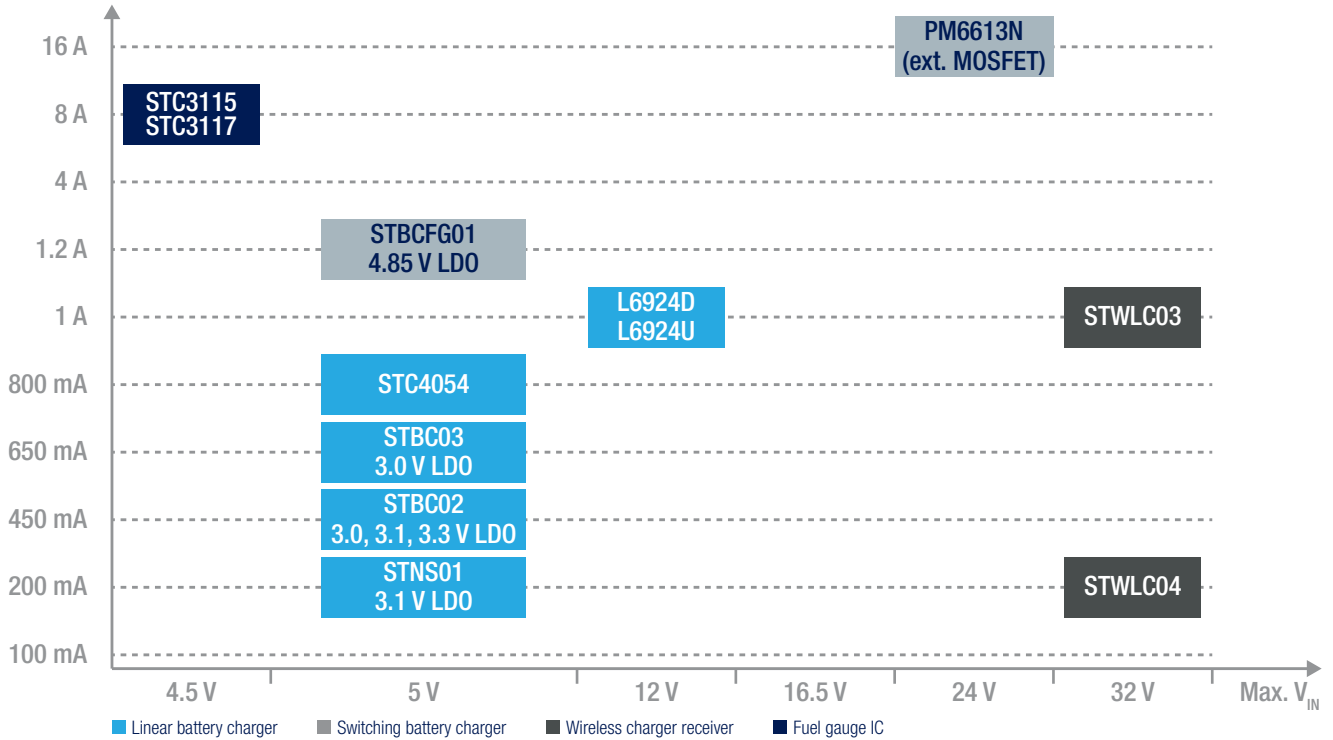




# Battery management

ST's battery management devices provide high efficiency, high power density and low standby current consumption. Our product portfolio includes complete solutions for battery chargers: switching chargers that offer charge currents up to 1.2 A, integrating in the same chip a fuel gauge function; linear chargers with charge currents from 1 mA to 1 A and wireless power ICs compliant with PMA and Qi standards. By combining wireless power technology with high efficiency and smart charging, ST creates easier, faster, innovative ways to power up smartphones, tablets and other mobile devices. ST's portfolio also includes battery fuel gauge ICs that can be located in the battery pack or in the handheld device and integrate functions to monitor the battery voltage, current and temperature.

Max. system charging current



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## BATTERY CHARGER HIGHLIGHTS

### STBC02

The STBC02 is a highly integrated power management IC, embedding a linear battery charger, a 150 mA LDO, 2 SPDT load switches, a smart reset/watchdog block and a protection circuit module (PCM) to prevent the battery from being damaged under fault conditions. The STBC02 uses a CC/CV algorithm to charge the battery; the fast charge and the pre-charge current can be both independently programmed using dedicated resistors. The STBC02 draws less than 10 nA from the connected battery in shipping mode conditions, maximizing the battery life during shelf life.

#### KEY FEATURES

- Linear battery charger
- Charge current programmable from 1 to 450 mA
- Power path
- Watchdog/smart reset
- Shipping mode

#### KEY BENEFITS

- Compact size, no inductor cost
- Tailored charge current according to battery capacity
- Longer battery life
- More robust software platform stability
- Very long shelf life

## STBCFG01

The STBCFG01 is a switching battery charger IC integrating the functions needed to charge single-cell Li-ion batteries, monitor the battery's state-of-charge and generate 5 V to supply USB OTG bus-powered devices. The IC also integrates an LDO regulator to support system boot in dead battery conditions.

Battery charge indicators, or fuel gauges, have become essential for managing devices such as smartphones, tablets and back-up battery packs. Accurate time-remaining predictions enhance the user's experience, and can be critical in certain types of portable electronics such as medical devices.

The STBCFG01 uses accurate measurements of the battery voltage to estimate the battery's state-of-charge (SOC).

### FEATURES

- Single chip solution: battery charger + fuel gauge + OTG + LDO
- Charge current up to 1.2 A
- Instant-on operation: system loads powered with deeply discharged or dead batteries
- Few external components

### BENEFITS

- High space saving thanks to integration
- Reduced BOM cost: current sensing resistor not needed

## STNS01

The STNS01 is a linear battery management IC integrating power path, battery protection, LDO and shipping mode functionality.

Shipping mode reduces battery consumption during shelf life. Power path is suitable to start up the system in dead battery conditions.

### FEATURES

- Programmable charge current up to 200 mA
- Integrated 3.1 V LDO regulator
- Automatic power path management
- Embedded protection circuit
- Very low battery leakage current (4.5  $\mu$ A typ.)

### BENEFITS

- Space saving thanks to the integration of LDO, battery protection and thin DFN12 3x3 package
- Overall system reliability improvement due to integration
- Allows user a wide choice of the battery

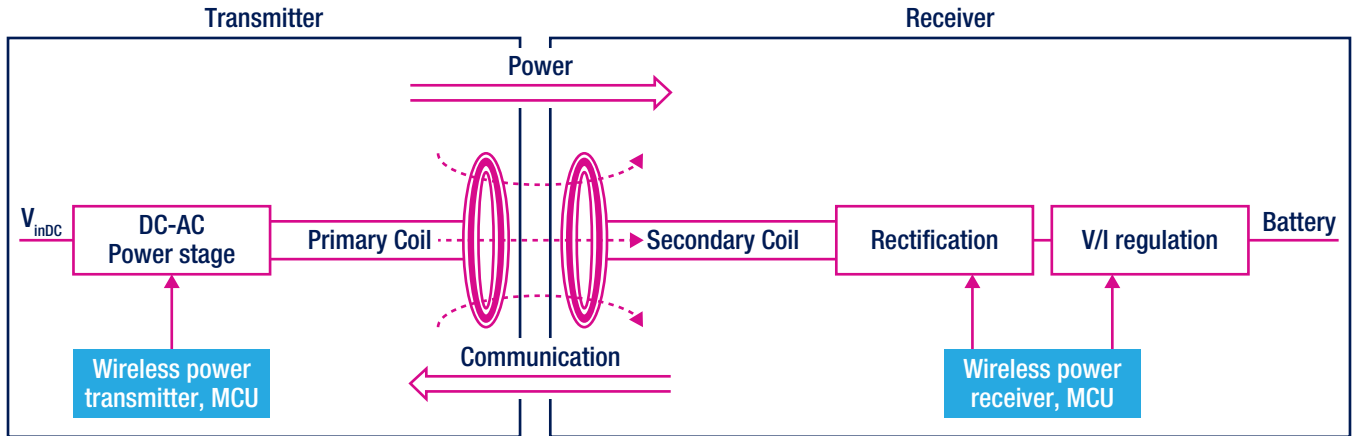
## DEVICE SUMMARY

Part number	Charge current (A)	Charge voltage (V)	Input voltage (V)	$V_{INAMR}$ (V)	$I_{PRE}$ (mA)	Package	Other functions
STBCFG01	1.2	3.52 to 4.78	3.6 to 6.3 (5 typ)	20	450 or 100 $I_{trickle} = 45$	CSP 25 2.3 x 2.2 mm <sup>2</sup>	500 mA OTG 4.85 V LDO
L6924D/U	Prog up to 1	4.1 or 4.2	2.5 to 12	15	Prog by R	VFQFPN 16 3 x 3 x 1.0	NTC, timer, flags
STC4054	Prog up to 0.8	4.2	4.25 to 6.25	7	$I_{CHG}/10$	TSOT23-5L	1 flag
STNS01	15 to 500 mA	4.2 (up to 4.45 with external resistor)	4.55 to 5.4	16	$I_{CHG}/10$	VFDFPN 12 3 x 3 x 0.75	3.1 V LDO, power path, LDO, flags, enable, NTC
STBC02	1 to 450 mA	4.2 to 4.45 V	4.55 to 5.4 V	16	1 to 450 mA	Flip-chip30	3.0, 3.1, 3.3 V LDO, power-path, NTC, smart-reset, watchdog, S-wire
STBC03	1 to 650 mA	4.2 to 4.45 V	4.5 to 5.4 V	16	1 to 650 mA	Flip-chip30	3 V LDO, power path, NTC, Sw.Matrix, Dig.Enables

## WIRELESS CHARGING

In the coming years, wireless charging applications will become more and more common for a wide range of applications starting with today's smartphone charging. ST already offers dedicated and general-purpose wireless ICs for Transmitter (Tx) and Receiver (Rx) sides able to support Qi/PMA market standards and the main topologies: STWBC-WA (Tx) and STWLC04 (Rx) for wearables, STWBC (Tx) and STWLC03 (Rx) for other mobile applications. The use of new low-voltage StripFET MOSFETs guarantees high-efficiency converters. To reduce the time to market, a complete wireless kit (Tx + Rx) for wearables and general-purpose wireless evaluation boards are available.

## BATTERY MANAGEMENT IC



### MAIN EVALUATION BOARDS



**STEVAL-ISB027V1**  
Qi A11 Wireless charger transmitter based on STWBC



**STEVAL-ISB036V1**  
Wireless charger receiver based on STWLC03



**STEVAL-ISB038V1**  
Wireless charging reference design kit for wearables based on STWBC-WA and STWLC04

### STWBC transmitter highlights

STWBC is a family of products developed to support the needs of Wireless Charging Transmitters. It includes transmitters for several types of applications ranging from wearables, mobile phones, tablets and automotive. STWBC provides consumer with Qi certified solutions, matching the requirements of safety and interoperability of the most

popular wireless charging standard. Additionally, STWBC embeds STMicroelectronics years of experience in power conversion ICs and thus offers 3 mw minimal stand-by consumption (A11 topology), superior Foreign Object Detection and an easy-to-use graphical interface for monitoring the application behaviour, debug and real-time measurements.

All STWBC products are Flash-based. In combination with a flexible, API-based firmware, this allows the user to include additional software features as well as fine tune each application parameters even during the production line. Each product comprises an IC, an evaluation board, firmware, graphical interface and support documentation.

### DEVICE SUMMARY

Part number	Application	Ptot (W)	Coils	Topology	Vinput (V)
STWBC	Consumer	5 W	1	Qi A11	5
STWBC-WA	Wearable	1 W, 2 W	1	*Not applicable	5
STWBC-MC	Automotive	5 W	3	Qi A34	5-16
ASTWBC					
STWBC-MP	Consumer	15 W	1	*In progress	5-12



## STWLC receivers highlights

STWLC is a family of products developed to support the needs of Wireless Charging Receivers.

It includes receivers for several types of applications ranging from wearables, mobile phones, and tablets.

The STWL provides consumer Wireless Power Consortium (WPC) and Power Matter Alliance (PMA) certification.

The STWLC03/STWLC04 integrate a high-efficiency synchronous full-bridge rectifier and a high efficiency programmable buck converter, it outputs a stable voltage in the 3.3 to 7 V range (programmable via I<sup>2</sup>C) for STWLC03 and fixed at 5 V for STWLC04, providing as well a simplified CC-CV charging feature for single-cell Li-Polymer/Li-Ion batteries and an input current limiter.

The STWLC03 can be supplied from a Qi- or PMA-compliant wireless power transmitter (e.g. STWBC) or from an external USB supply or adapter. The device includes a Foreign Object Detection (FOD) function according to wireless power standards; preventing over-heating of the base station when a metallic foreign object is detected. The device includes on-chip over-temperature and over-voltage protection and NTC-based coil over-temperature protection features. The chip-scale package is suitable for very compact applications.

### FEATURES

- Boost power transfers
- Adapt the transmitted power to actual load conditions
- Enables safe operation with foreign object detection (FOD)
- Embedded 32-bit core, easily accessible via the I<sup>2</sup>C interface
- Certification with the leading Qi and PMA standards

### BENEFITS

- Ideal for a wide application spectrum from low- to medium-power and different Li-ion and LiPO battery chemistries
- Support direct battery charging
- Customization and superior diagnostics

## DEVICE SUMMARY

Part number	AC input voltage (max.)	Output leakage current (direct charging mode) (max.)	Output voltage	Output power	User GPIOs	Package
STWLC03	32 Vpp	1 µA	Programmable 5 V ~ 7.5 V	5 W (Qi) 7.5 W (PMA)	4	Flip-chip77
STWLC04	32 Vpp	1 µA	Programmable 5 V ~ 7.5 V	1 W	4	Flip-chip77

## BATTERY MONITORING ICs

### STC3115/STC3117

ST's battery fuel gauge ICs can be located in the battery pack or in the handheld device and integrate functions to monitor the battery voltage, current and temperature. Using a built-in Coulomb counter, these fuel gauge ICs calculate battery charge and store the data in 16-bit register resolution for retrieval by the system controller. Access is via an industry-standard I<sup>2</sup>C interface, enabling the controller to create an accurate graphical representation of the remaining battery-operating time. Battery-monitoring fuel gauge ICs combine a small footprint with outstanding measurement accuracy and extremely low power consumption to increase battery runtime and lifespan in mobile phones, multimedia players, digital cameras, and other space-constrained portable devices.

### FEATURES

- OptimGauge™ algorithm for STC3115
- OptimGauge+™ algorithm for STC3117
- Coulomb counter and voltage gas gauge operations
- Programmable low battery alarm
- Internal temperature sensor

### BENEFITS

- 3% accuracy of battery state of charge no need for shunt resistor
- Accurate estimation of battery state of charge at power-up
- Reliable battery swap detection
- SoH and impedance tracking with OptimGauge+ algorithm (ST IP)
- Charger enable and system reset control for accurate OCV reading
- Minimum form factor

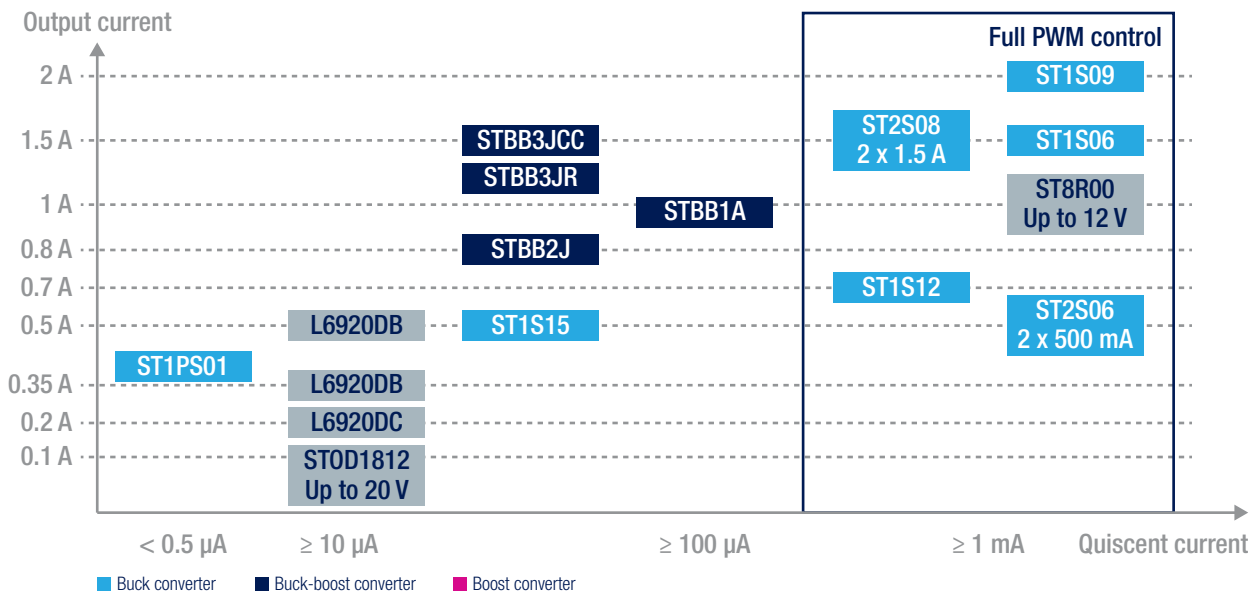
## DEVICE SUMMARY

Part number	Charging sensing voltage range	Charging sensing resistor	Typical supply current (I <sub>CC</sub> )	Supply voltage (VDD)		Comment	Package
				Min	Max		
STC3115	±40 mV	5 to 50 mΩ	0.045 µA	2.7 V	4.5 V	OptimGauge™ algorithm	1.4 x 2.0 mm 10-bump CSP 2.0 x 3.0 mm DFN10
STC3117	±40 mV	5 to 50 mΩ	0.04 µA	2.7 V	4.5 V	Patented OptimGauge™ algorithm for accurate battery capacity calculation	1.5 x 1.6 mm 9-bump CSP



# Point of load

ST's DC-DC synchronous converters are designed for wearable and portable applications. Buck, buck-boost and boost switching regulators provide low power consumption, high-efficiency power conversion, and are available in very small packages from standard leadless plastic to flip-chip pure bumped silicon. The switching frequency control loop guarantees high dynamic response with very small inductor size. All products are optimized to work with Li-ion batteries, USB sources or the latest battery chemistries.



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## HIGHLIGHTS

### ST1PS01

This 400 mA NanoQuiescent™ buck converter with deep power saving mode is designed for wearables and applications requiring high efficiency at light loads and very good transient response: 2 MHz (max.) PWM control loop. It provides digital  $V_{OUT}$  selection and power good output (PGO) monitoring. Available in a thin 8-bump flip-chip (1.4 mm x 1.1 mm) package.

### STBB3

This 2 A buck-boost converter with power-saving mode targets low quiescent current applications (<math>< 45 \mu A</math>) at light loads and high current loads up to 2.4 A. Available in a miniature 20-bump flip-chip (2.5 mm x 1.75 mm) package.

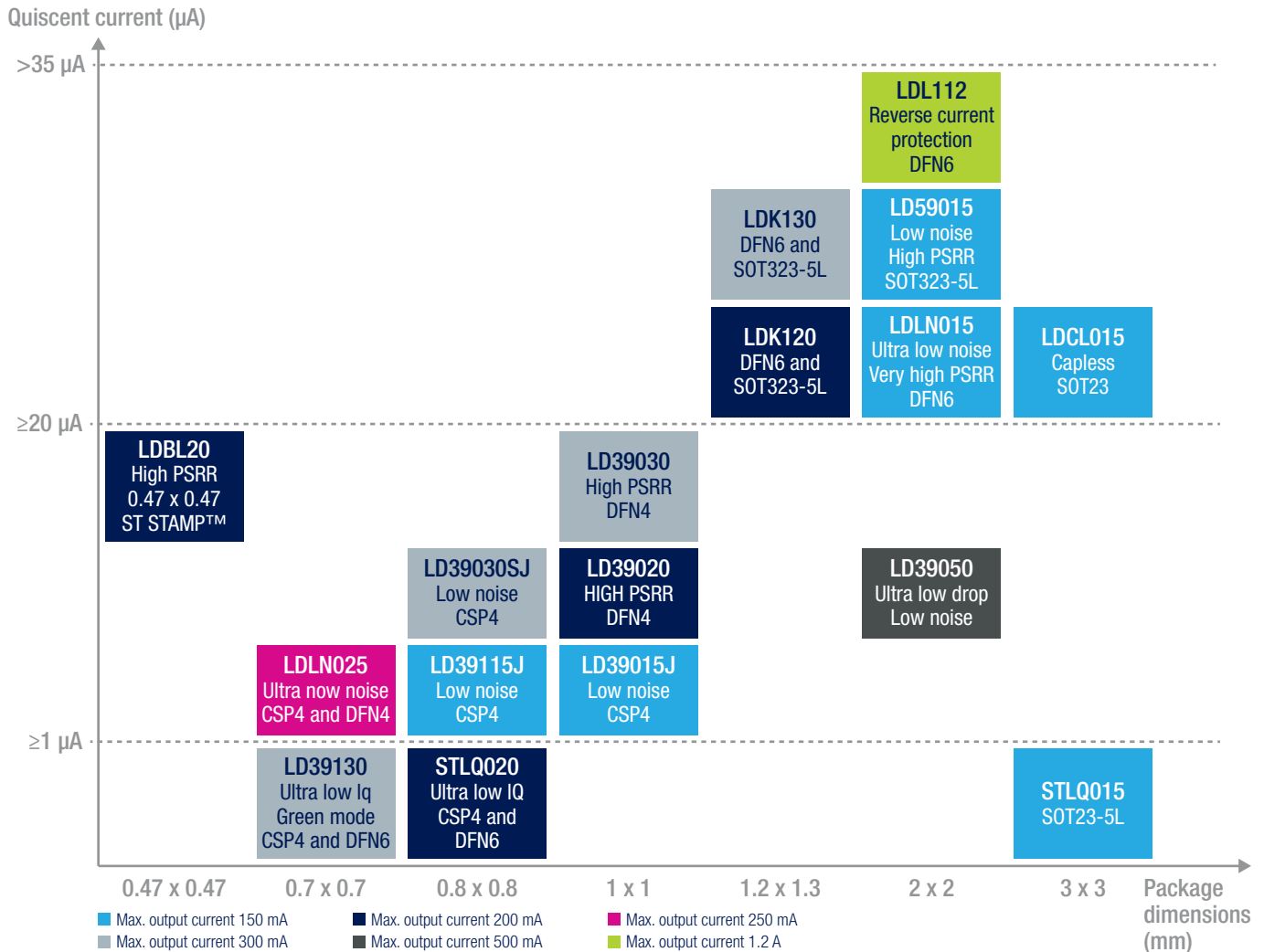
## DEVICE SUMMARY

Part number	Maximum current (mA)	Quiescent current @ no load ( $\mu A$ )	$V_{in}$ range (V)	Characteristics	Package	Package dimensions (mm)	Max. thickness (mm)
ST1S15	500	40	2.5 to 5.5	Low quiescent, 6 MHz	Flipchip6	1.19 x 0.935	0.60
					TDFN6L	2.0 x 2.0	0.60
ST1S12	700	500	2.3 to 5.5	Low quiescent, 1.7 MHz	TSOT23-5L	2.9 x 2.8	1.10
ST8R00	1000	10 mA	4.0 to 6.0	Low quiescent, 1.2 MHz	QFN8L	4.0 x 4.0	1.00
L6920	250, 350, 500	10	0.6 to 5.0	Low $V_{in}$ start-up, 1 MHz	MSOP8L	4.9 x 3.0	1.10
STBB1A	1000	200	2.2 to 5.5	Low quiescent, 1.5 MHz	QFN10L	3.0 x 3.0	1.00
STBB2J	1800	35	2.2 to 5.5	Low quiescent, 3 MHz	Flipchip20	2.1 x 1.8	0.60
STBB3JR	2100	35	1.8 to 5.5	Low quiescent, 2.2 MHz	Flipchip20	2.5 x 1.75	0.60
STBB3JCC	2100	35	1.8 to 5.5	Const. current HB-WLED	Flipchip20	2.5 x 1.75	0.60
ST1PS01	400	0.5	2.2 to 5.5	NanoQuiescent, 2 MHz (max.)	Flipchip8	1.41 x 1.11	0.60



# Low-dropout regulators (LDOs)

ST offers a complete portfolio of high-performance low-dropout regulators with state-of-the-art figures on the key merit parameters, all fitting into the smallest packages available. ST's ultra-small, high-performance LDOs are particularly suitable for the latest generation of portable devices.



## HIGHLIGHTS

### LDLN025

250 mA LDO with ultra-low noise (6.5  $\mu\text{VRMS}$ ) and very high PSRR (80 dB @ 100 Hz, 60 dB @ 100 kHz). Available in 4-bump CSP (0.63 mm x 0.63 mm) and 4-lead DFN (1 mm x 1 mm) packages.

### LDBL20

200 mA LDO with very high PSRR (80 dB @ 1 kHz). Available in a miniature ST STAMP™ (0.47 mm x 0.47 mm) package.

### LD39130

300 mA LDO with automatic green mode for ultra-low Iq (<1  $\mu\text{A}$ ) at low loads. Available in 4-bump CSP (0.69 mm x 0.69 mm) and 6-lead DFN (1.2 mm x 1.3 mm) packages.

### LD39020/LD39030

200/300 mA LDO with very high power supply rejection ratio (PSRR) (80 dB @ 1 kHz) and 0.5% precision. Available in miniature 4-lead DFN (1 mm x 1 mm and 0.8 mm x 0.8 mm) packages.

## DEVICE SUMMARY

Part number	Maximum current (mA)	Package	Package dimensions (mm)	Characteristics	Quiescent current @ no load (µA)
LD39015J	150	CSP 4-bump	1.1 x 1.1	Low noise	18
LD39115J	150	CSP 4-bump	0.8 x 0.8	Low noise	20
LDLN015	150	DFN6	2 x 2	Ultra-low noise	35
LD59015	150	SOT323-5L	2 x 2	High PSRR	31
LDCL015	150	SOT23-5L	3 x 3	Capacitor-less	140
STLQ015	150	SOT23-5L	3 x 3	Ultra-low Iq	1
STLQ020	200	CSP 4-bump DFN6	0.8 x 0.8 2 x 2	Ultra-low Iq	0.4
LD39020	200	DFN4	0.8 x 0.8 1 x 1	High PSRR	20
LDBL20	200	ST STAMP™	0.47 x 0.47	High PSRR	20
LDK120	200	SOT323-5L DFN6	2 x 2 1.2 x 1.3	Cost-effective	30
LDLN025	250	CSP 4-bump DFN4	0.63 x 0.63 1 x 1	Ultra-low noise	12
LDK130	300	SOT323-5L DFN6	2 x 2 1.2 x 1.3	Cost-effective	30
LD39030	300	DFN4	0.8 x 0.8 1 x 1	High PSRR	20
LD39030SJ	300	CSP 4-bump	0.8 x 0.8	Low noise	20
LD39130	300	CSP 4-bump DFN6	0.69 x 0.69 1.2 x 1.3	Green mode Ultra-low Iq	<1
LD39050	500	DFN6	2 x 2 3 x 3	Ultra-low drop and low noise	20
LDL112	1200	DFN6	2 x 2 3 x 3	Ultra-low drop and low Iq	35

### The new LDBL20 manages 200 mA in 0.22 mm<sup>2</sup>

ST's LDBL20 series of low-dropout voltage regulators enables a new era in the design of ultra-compact linear points of load. The LDBL20 provides up to 200 mA of current, with an input voltage ranging from 1.5 to 5.5 V.

Thanks to the new miniature ST STAMP™ chip scale package, the LDBL20 allows designing a PCB footprint that is less than half the size of competing 200 mA LDO solutions with the same performance.

The LDBL20 is a very versatile linear power supply solution for space-constrained handheld applications such as smartphones, tablets, wearables and solid-state disks.

### ST STAMP™: a step further in miniaturization

ST STAMP™ (ST Small Thickness Advanced Micro Package) is ST's trademark for our new unique and innovative bumpless CSP package.

Compared to the smallest DFN plastic packages and flip-chips, the ST STAMP™ solution provides similar package performance and reliability, reducing the total height to 200 µm or less, with a smaller footprint.

