



System Solution Guide - Preview

Battery-powered Tools



onsemi.com



Table of Contents

[Get Latest Version](#)

Overview

Applications 03

Market Information & Trends

Growing Battery-powered Tools Market and Types 04

Battery Technology & BLDC Motors vs BDC Motors 05

LV-MV Si Power MOSFET 06

System Description

Battery Charger 07

Battery Management and Power Tree 08

Motion - Power Stage 09

Solution Overview

Block Diagram - Battery-powered Tools 10

AC-DC Stage & DC-DC Stage Topologies 11

SUPERFET, Super-junction (SJ) MOSFETs 12

LDO Regulator 13

Gate Drivers 14

T10 LV-MV MOSFETs 15

Connectivity 17

Recommended Products 18

Development Tools and Resources 23

Technical Documents 24

The onsemi logo is displayed in a large, dark blue font. To its right, there is a smaller image of the 'System Solution Guide Battery-powered Tools' document, which features a yellow and black power drill on its cover.

Register now to unlock all System Solution Guides

Full Guide Preview

Get Latest
Version



1



2



3



4



5



6



7



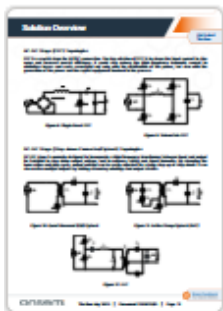
8



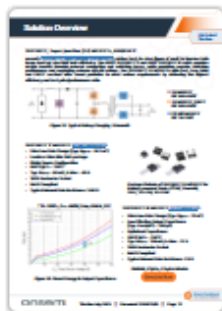
9



10



11



12



13



14



15



16



17



18



19



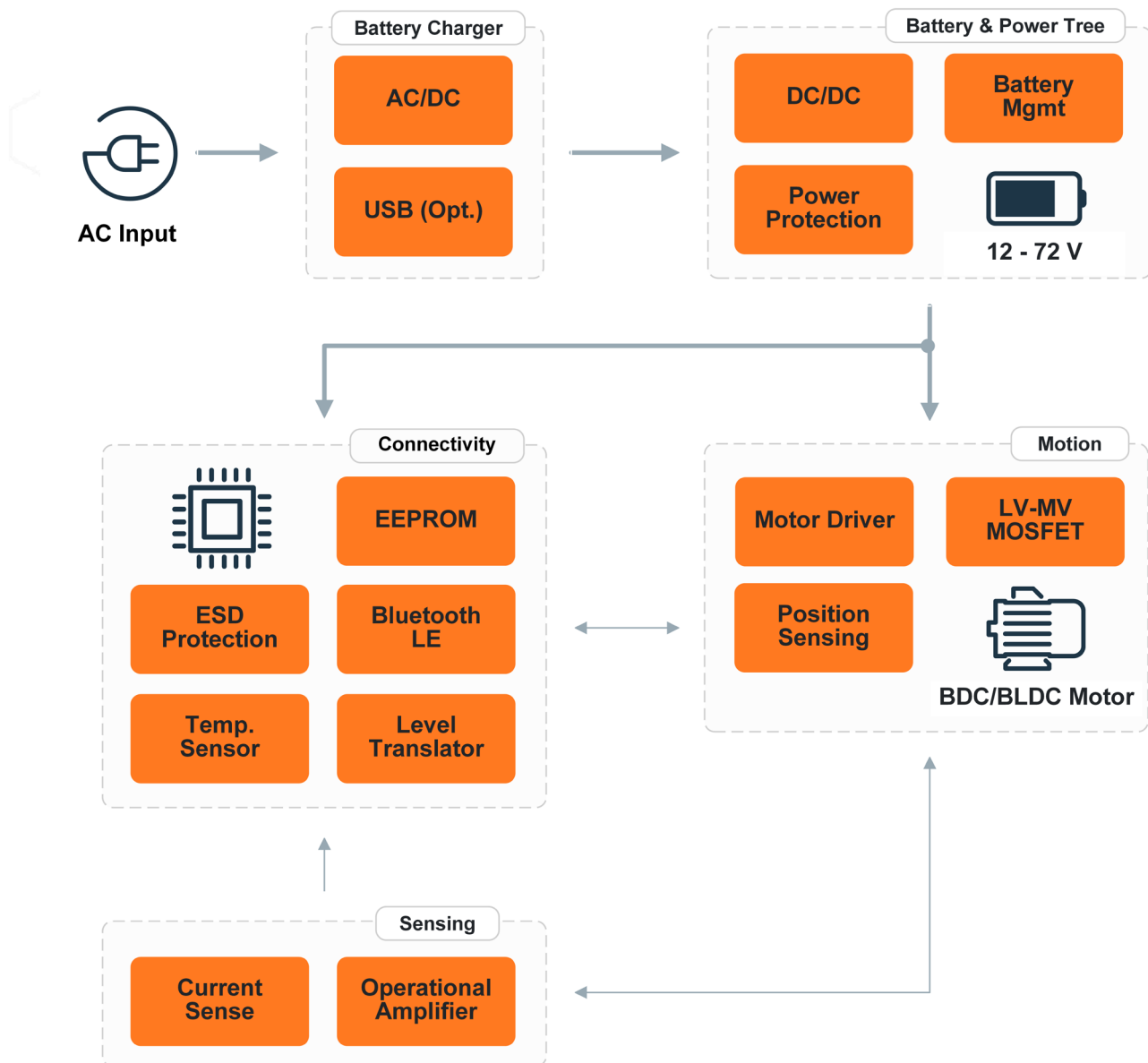
20

Block Diagram - Battery-powered Tools

Get Latest
Version

Block Diagram - Battery-powered Tools

- The block diagram below represents Battery-powered Tools solution created by **onsemi**.
- Majority of the functional blocks including power discrete devices, motor drivers, position sensors, battery management and protection products can be sourced from **onsemi's** solutions as shown in the following device tables.



Use our Interactive Block Diagrams Tool



Open IBD Tool

Battery Management and Power Tree

Get Latest
Version

Battery Management and Power Tree

Battery, Battery Management and Power Tree systems are on-board parts of the power tools.

- Battery types differ case by case. Typically, cordless power tools adopt Li-ion from NiCd & NiMH batteries. Li-ion batteries have higher energy density and longer lifespan.
- Battery capacity and voltage depend on a required payload, a distance to be driven and by its charging type. Most used are battery pack systems in range of 12-72V which can be paralleled to boost the performance
- Power Tree supplies all logic levels and low voltage power rails in the system. Typically, it does not require isolation (with battery voltages below 50 V) and is implemented as multiple parallel buck converters, in combination with Linear regulators (LDOs).

The Battery Power Tree, utilizing both SMPS and LDOs, efficiently delivers necessary voltage levels to subsystems. **onsemi's** LDOs present an optimal solution for providing precise, low-current multiple voltage levels required by various sub-components like Gate Drivers or Image Sensors.

Linear Voltage Regulators (LDO)

onsemi's wide [LDO families](#) are based on a unique combination of features – ultra-low quiescent current, fast transient response and high input and output voltage ranges. Additional features, such as high PSRR & low noise, are being added as an option as well.

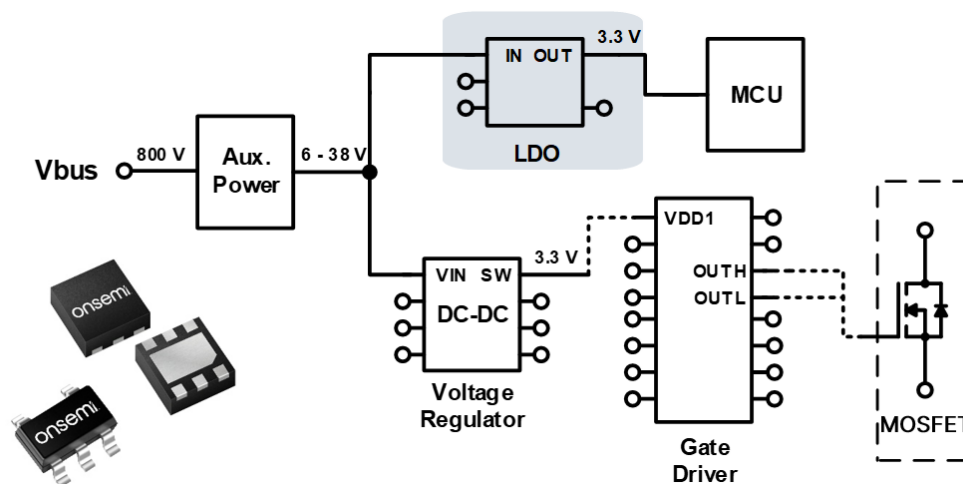
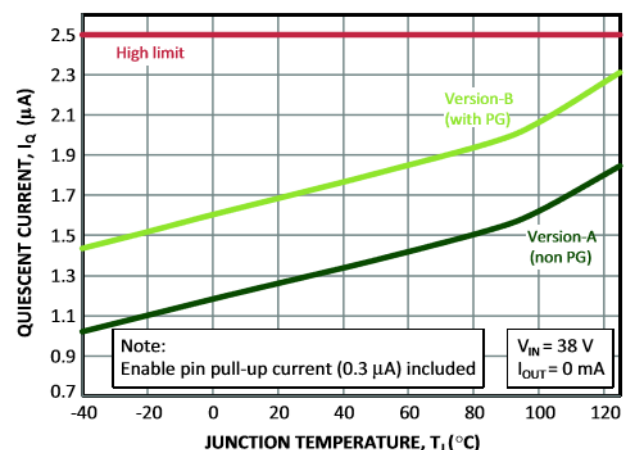


Figure 6: LDO Application Block Diagram

LDO Benefits for Power Tools

- Robust operation @ extreme condition at highest temperature
- The lowest quiescent current consumption (Typ. I_Q : 1.3uA @ 25°C) → Reduce charging time interval
- Safe Operating Area with Protection function (Thermal, Current)
- Diverse package availability, SOT-23, WDFN, DFN6
- Stable @ wide temp -40°C to 125°C
- Thermal Shutdown @ 165°C

View Product



T10 LV-MV MOSFETs

Get Latest Version

LV-MV MOSFETs

The recommended LV-MV MOSFETs are listed on Figure 18 and could be selected according to the operating voltage and drive current.

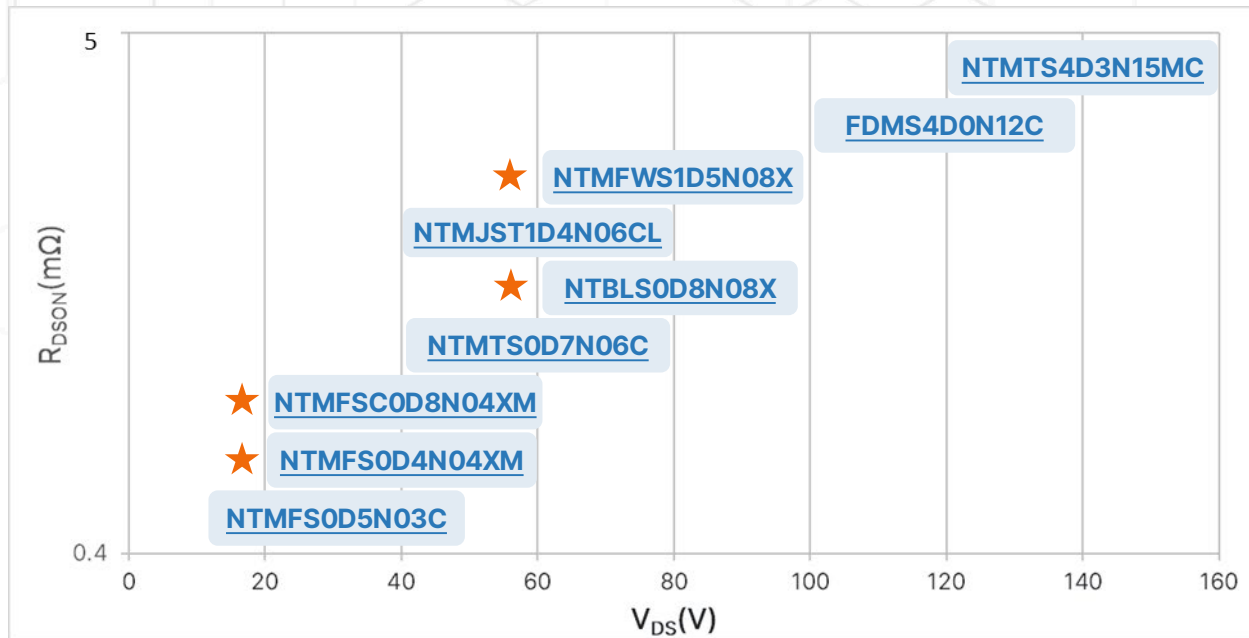


Figure 18: onsemi's MOSFETs Used in BLDC Motor Control

★ New T10 Technology

MOSFET NTMFWS1D5N08X

Best-in-class 80V MOSFET from T10 family

- **Best-in-Class FOM**
 - At least 40% less than lead competitor
- **Best-in-Class On-Resistance**
 - Eliminate paralleling in the old board
- **Smaller 5 x 6mm Package**
 - Cost-effective advantage
- **Best-in-Class Soften Recovery**
 - 18% less voltage spike than competitor

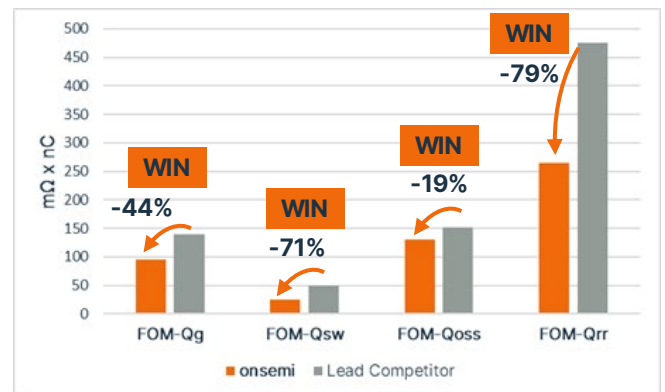
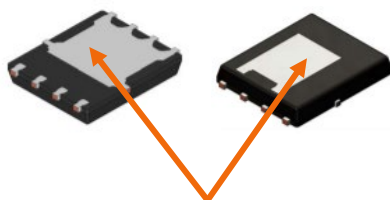


Figure 19: T10 80V MOSFET FOM Comparison

MOSFET NTMFSCOD8N04XM

Latest 40V MOSFET Technology from T10M

- Best-in-Class ultra low $R_{DS(on)}$
- **Dual Cool 5 x 6mm Package for higher thermal performance**
- Lower Gate Charge
- Superior Soften Recovery with low voltage spike reducing stress and EMI issues



Dual Cool 5 x 6 mm Package




Battery-powered Tools

Get Latest
Version

onsemi™

Intelligent Technology. Better Future.

Register now to unlock all System Solution Guides and get additional exclusive benefits!

-  Join the conversation on community forum.
-  Utilize Elite Power Simulator & other developer tools.
-  Watch exclusive webinars and seminars.

Open full System Solution Guide



onsemi, the onsemi logo, and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "onsemi" or its affiliates and/or subsidiaries in the United States and/or other countries. onsemi owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of onsemi's product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. onsemi reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as-is" and onsemi makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does onsemi assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using onsemi products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by onsemi. "Typical" parameters which may be provided in onsemi data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. onsemi does not convey any license under any of its intellectual property rights nor the rights of others. onsemi products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use onsemi products for any such unintended or unauthorized application, Buyer shall indemnify and hold onsemi and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that onsemi was negligent regarding the design or manufacture of the part. onsemi is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.