MOSFET Guide Selection for Power Tools and BLDC Motor Drives

Power Tools Types

Battery-Powered Tools

Battery Charger

Motor Unit

Battery Pack

- Mostly **BLDC**
- DC-DC, inverter
- MOSFETs, diodes, TVS
- Higher Complexity (BMS, protection)

Grid Powered Tools

- Universal / BLDC
- AC-DC, inverter
- MOSFETs, IGBTs, high speed diodes
- Lower Complexity (no battery mgmt)

Battery Powered Tools Overview by Voltage

12V
Compact

- Light-duty
- Low current and compact design

- Low Voltage MOSFET
- Schottky Diodes
- Fast Recovery Diodes
- TVS

18V-24V
Core Professional

- Medium High Power
- BLDC Motor Dominant

- Low Rds(on) MOSFET
- High Current Diodes
- Battery protection MOSFET

36V-48V
High Power

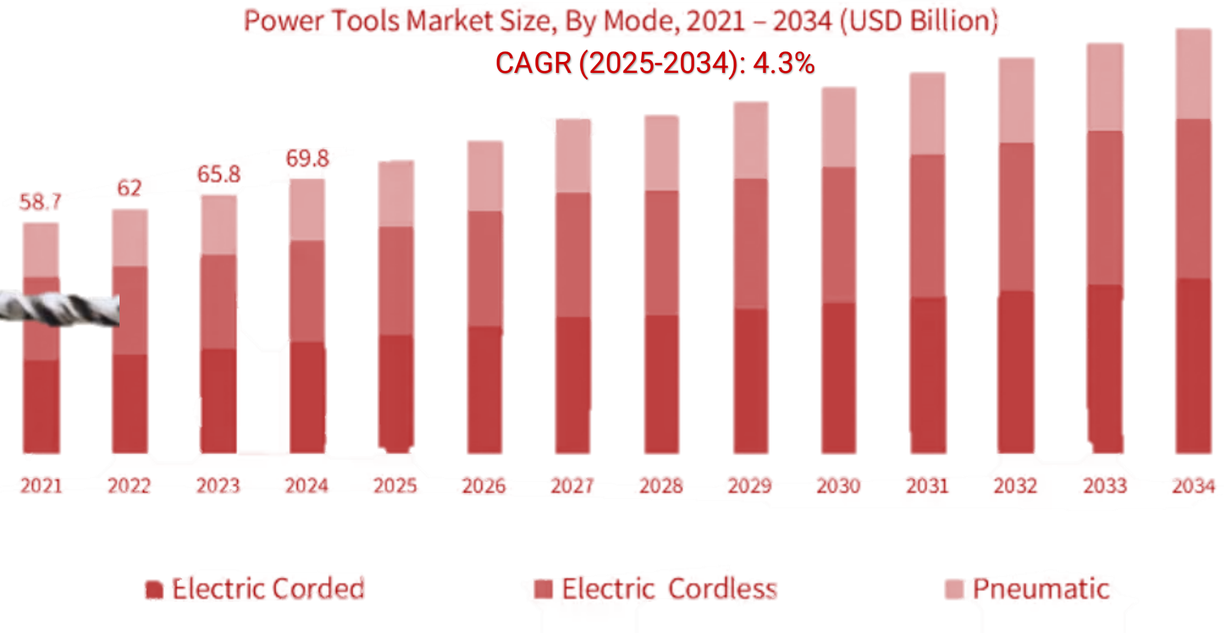
- High Current
- Thermal Performance Critical

- High-current MOSFET
- Fast Switching Diodes
- Robust Protection Device

30-40V | 40V to 80V | 80V-100V

Motor Drivers MOSFET V_{DS} Rating

Power Tools Market Outlook



Cordless penetration keeps rising, driven by battery improvements (runtime, charging, durability) and users committing to a battery ecosystem.

Platform polarization: **12V** stays strong for compact/light-duty volume, **18V** remains the mainstream "one-battery-for-many-tools" tier, while **36V-40V+ expands** into Outdoor Power Equipment and heavy-duty applications.

Higher-voltage growth pushes design requirements: more emphasis on robustness (surge/inductive stress), thermal performance, and efficiency as tools move into heavier loads and longer duty cycles.

More brushless + smarter electronics (control, protection, monitoring) becomes standard as brands differentiate performance and extend battery life.

Resources:
https://www.gminsights.com/industry-analysis/power-tools-market
https://www.futuremarketinsights.com/reports/power-tools-market
https://www.arizton.com/market-reports/cordless-power-tools-market

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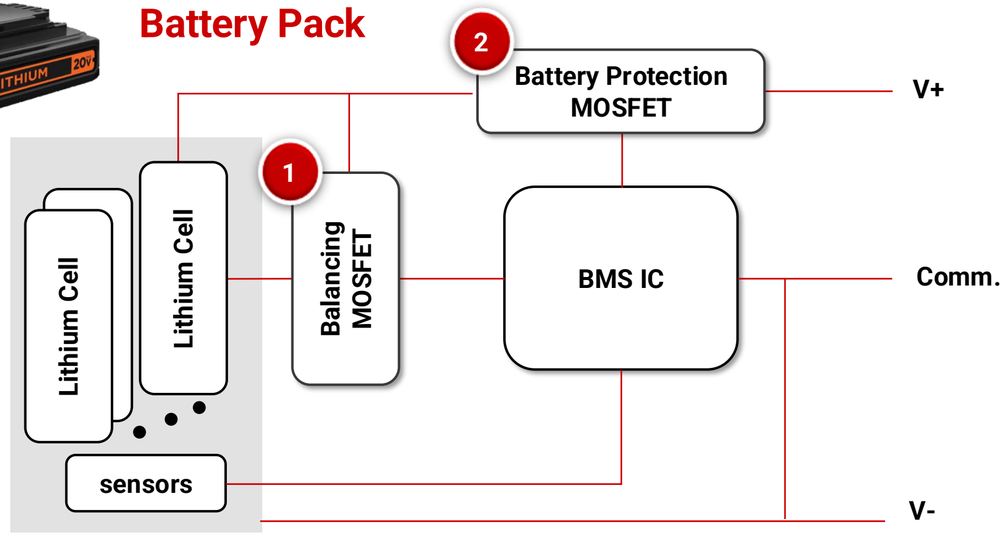
Power Tools Block Diagrams and recommendations

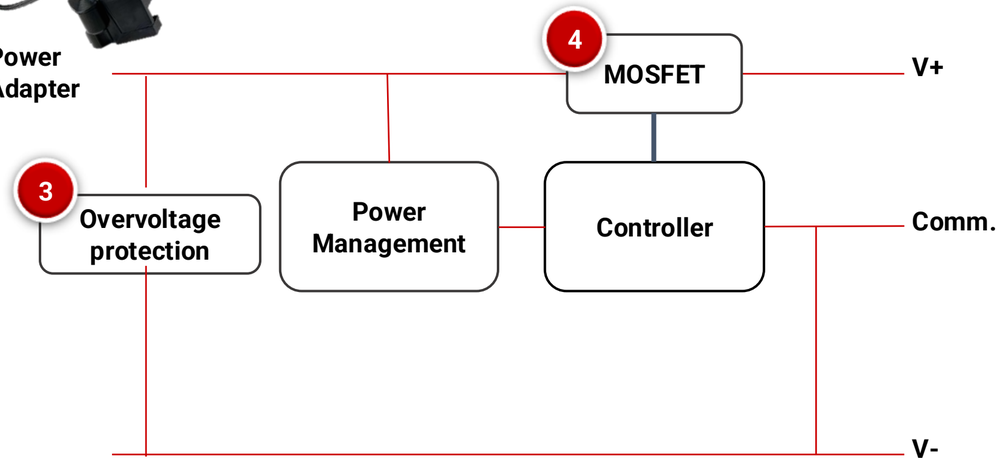
Battery-Powered Power Tools Block Diagram (1)

Battery Pack



Power Adapter

Battery Charger

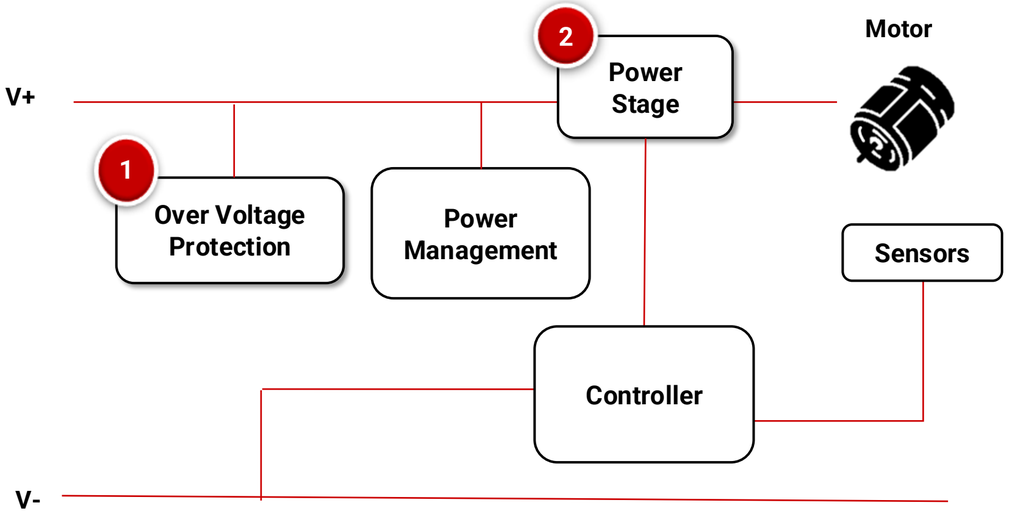


Block #	Function	Requirements	Product Family	Packages	Recommended Parts
1	Balancing MOSFET	VDS > 2x V+	P/N-Ch MOSFET 30V – 100V	SOT-23 SOT-23 SOT-23 DFN1006-3	BSS84A 2N7002A SI2306K 2N7002KL3A
2	Battery Reverse Protection	VDS > 2x V+ Low $R_{DS(on)}$ High ID Max Strong SOA	MOSFET 40V – 100V	TOLL-8 TOLL-8 PDFN5060	**MCTL2D0N10YHR** **MCTL1D0N08Y** MCACL1D7N04YH
3	OV Protection	VRWM = V+	TVS	SMA, SMA-FL SMB, SMBF	SMAJxxA series SMA6JxxA series SMBJxxA series SMBFxxA series
4	Output Switch	VDS > 2x V+	P-Ch MOSFET 40V – 100V	DFN3333 DFN5060 DPAK	MCAC25P10Y MCAC80P06Y MCG25P06Y MCU28P10Y

- Battery protection MOSFET has specific requirements. Very low RDSon for normal operation, high Id max and strong SOA to switch off reliably under fault conditions
- This is very much a low power charger view. High power / fast charge products may use discrete MOSFETs in switching stage
- Most power tool companies buy in chargers from specialist power supply companies

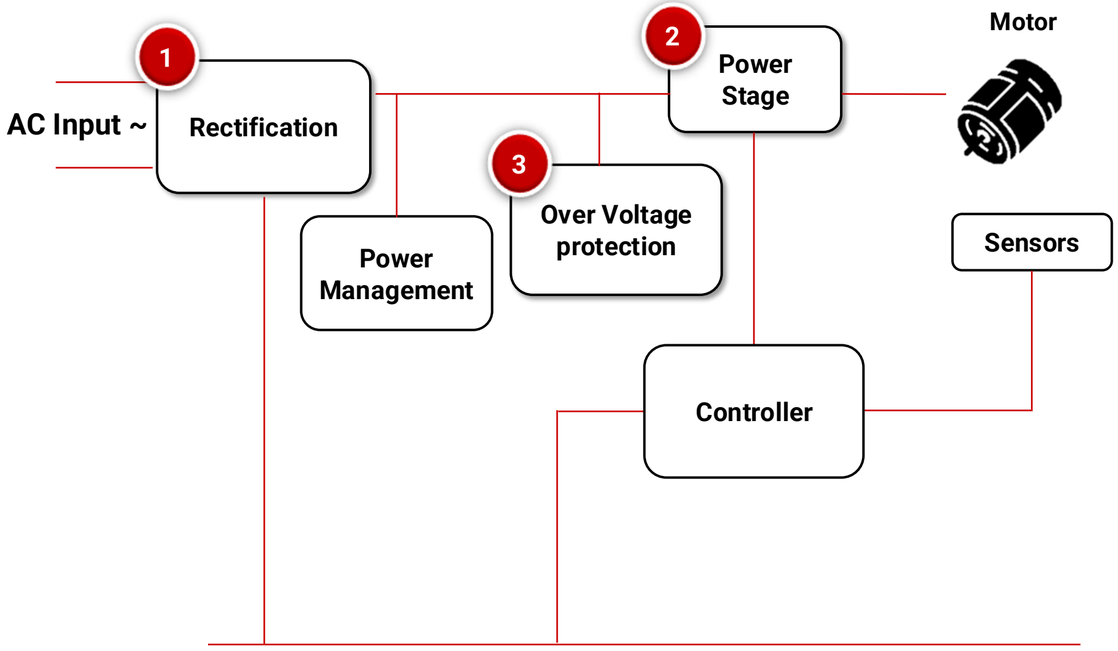
Battery-Powered Power Tools Block Diagram (2)

Motor Unit



Block #	Function	Requirements	Product Family	Packages	Recommended Parts
1	OV Protection	VRWM = V+	TVS	SMA, S MA-FL SMB SMBF	SMAJxxA series SMA6JxxA series SMBJxxA series SMBFxxA series
2	Power Stage	VDS > 2x V+ Ultra Low $R_{DS(ON)}$	MOSFET •40V – 100V	TOLL-8 TOLL-8 PDFN5060-DSC PDFN5060 TOLL-8 TOLL-8	MCTL1D0N08Y MCTLD58N04Y MCACLS1D6N06YH MCACL1D2N04Y MCACL120N10YA MCACL220N06Y

Grid Power Tools Block Diagram



Block #	Function	Requirements	Product Family	Packages	Recommended Parts
1	Rectification		Bridge / Standard Rectifiers	GBU GBJ TBL JB SMC	GBU6MS GBJ1006 KBJA608 TBL608L SMLJ60S8
2	Power Stage	>=650V	IGBT & SiC	D2PAK TO220 TO247 TO247-4	MIB10N65AT1Y MIP15N65AT1Y MIW20N65AT0Y SICWZ025N075G3
3	OV Protection	VRWM = V+	TVS	SMA, SMA-F SMB SMBF	SMAJxxA series SMA6JxxA series SMBJxxA series SMBFxxA series

And more...

MOSFET Selection for Motor Drivers

Don’t optimize for RDS(on) alone — select for total loss, transient robustness and thermal headroom.

1. **Low RDS(on) @ real gate drive**
   Minimizes conduction loss at the actual driver VGS, not just the 10V datasheet point.

2. **Low Qg / Qgd**
   Cuts switching loss, improves PWM efficiency and lowers gate-driver current demand.

3. **Low Qrr & soft body diode**
   Reduces reverse-recovery stress, commutation loss, ringing and EMI in hard switching.

4. **Voltage / current margin + SOA**
   Handles start-up, stall current, regenerative braking and line or wiring transients.

5. **Avalanche ruggedness & thermal path**
   Survives inductive stress and keeps junction temperature under control at peak load.

Efficiency × Ruggedness

MCTLD58N04Y

Tailored for motor drivers' application

V_{DS}		40V
$R_{DS(on)}$ @V_{GS}=10V	typ.	0.39mΩ
	max.	0.58mΩ
Q_g	typ.	255.7nC
Q_{gd}	typ.	47.4nC
V_{GS}		±20V
$V_{GS(th)}$	min.	2.0V
	typ.	2.9V
	max.	4.0V
I_D	@T_C=25ºC	639A
	@T_C=100ºC	452A
E_{AS}		2946mJ
T_J		-55℃ to 175℃
$R_{\theta JC}$		0.35℃/W
Package		TOLL-8L
Dimension	max.	10.10 x 11.88 x 2.40 mm

Features and Benefits

40V optimized for 18V platforms
Robust margin for Li-ion transients and regenerative braking

Ultra-low RDS(on): 0.58 mΩ max
Higher efficiency, longer runtime, and increased torque

High current capability (up to 639 A)
Handles stall, surge, and heavy-load conditions

Fast, efficient switching (Qgd=47.4nC)
Optimized gate charge for high-efficiency motor drives

High avalanche ruggedness (EAS=2964 mJ)
Strong inductive kickback protection and system reliability

12V and 18V System
MCC 30-40V MOSFETs

24V to 48V System
MCC 60-100V MOSFETs

12V and 18V System

MCC 30-40V MOSFETs

Product	Channel	Package Type	VDS (V)	ID (A)	$R_{DS(ON)}$Max @VGS=10V (mΩ)	$V_{GS(th)}$ Min (V)	$V_{GS(th)}$ Max (V)	T_j [max] (°C)	E_{AS}(mJ)	Qgd(nC)
MCACL1D2N04Y	N	PDFN5060	40	321	1.2	2	3.5	175	529	14.9
MCACL1D6N04Y	N	PDFN5060-C	40	220	1.6	2	4	175	240	12.3
MCACL1D7N04YH	N	DFN5060-C	40	180	1.7	2	4	175	506	10
MCAC180N04Y	N	DFN5060	40	180	2	2	4	175	441	5.5
MCTLD58N04Y	N	TOLL-8L	40	639	0.58	2	4	175	2964	47.4
MCTL270N04Y	N	TOLL-8L	40	270	1.3	2	4	175	1521	40.5
MCTL1D4N04YL	N	TOLL-8L	40	210	1.4	1.3	2.3	150	600	15

24V to 48V System

MCC 60V-100V MOSFETs

Product	Channel	Package Type	VDS (V)	ID (A)	$R_{DS(ON)}$ Max @VGS=10V (mΩ)	$V_{GS(th)}$ Min (V)	$V_{GS(th)}$ Max (V)	T_j [max] (°C)	E_{AS}(mJ)	Qgd (nC)
MCACL2D4N10YH	N	PDFN5060-CW	100	312	2.4	2	4	175	1000	16
MCAC4D6N10Y	N	DFN5060	100	144	4.6	2.4	3.4	150	225	8.6
MCACLS1D6N06YH	N	PDFN5060-DSC-B	60	300	1.68	2	4	175	670	17.7
MCTL1D0N08Y	N	TOLL-8L	80	320	1	2	4	175	2401	79.4
MCTL1D2N10Y	N	TOLL-8L	100	320	1.2	2	4	175	2400	33
MCTL1D4N10YH	N	TOLL-8L	100	300	1.4	2.5	4.5	150	1800	34.4
MCTL300N10Y	N	TOLL-8L	100	300	1.45	2	4	150	648	59
MCTL1D5N10YH	N	TOLL-8L	100	360	1.5	2	4	175	2016	32
MCTT1D7N10Y	N	TOLT	100	333	1.7	2	4	175	2722	49
MCTT1D9N10YH	N	TOLT	100	272	1.9	2.2	3.8	175	1225	17

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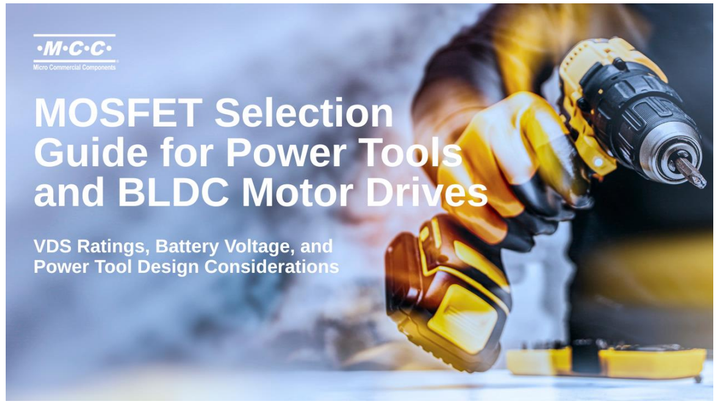
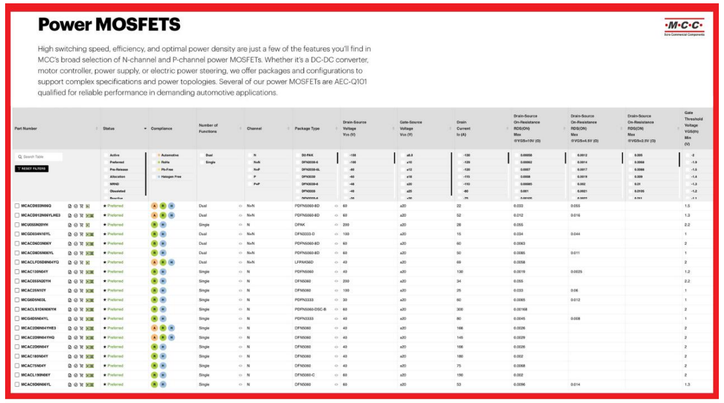
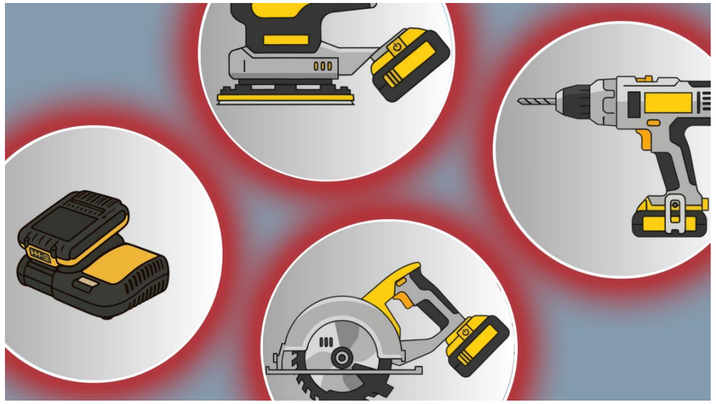
Explore the additional MOSFET resources below, or contact us at mccsemi.com.



[Selection Guide]



[Online Power MOSFET Catalog]



[Applications]

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