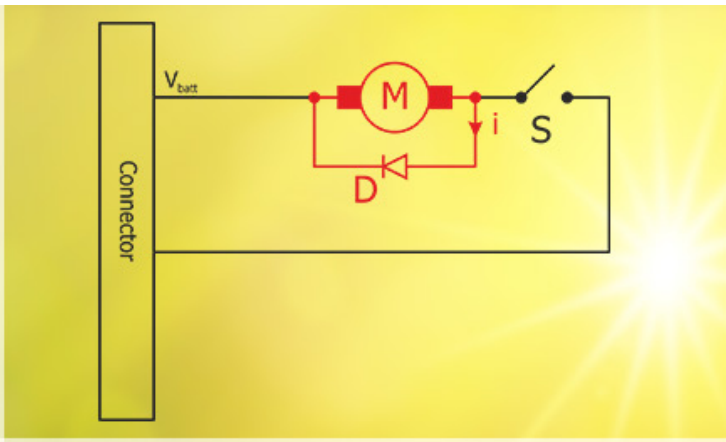
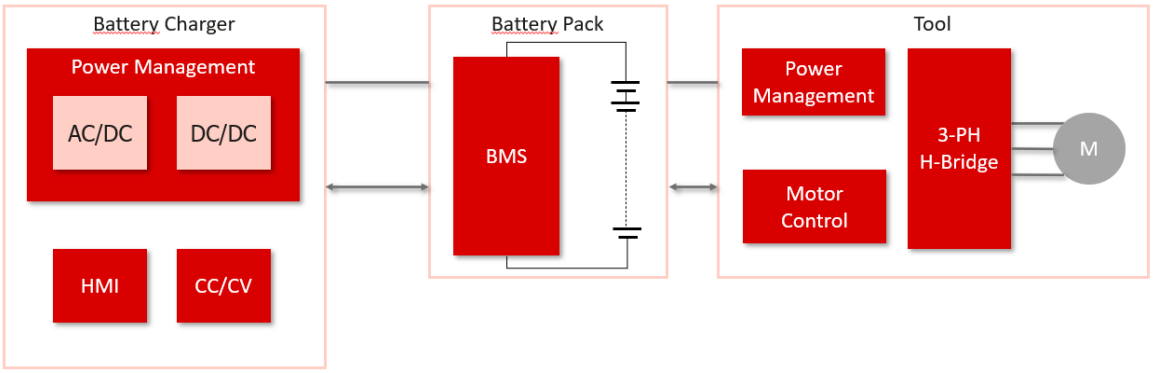
APPLICATION NOTE

Diotec Semiconductor



Cordless Power Tools

Human creativity and skill are the basic ingredients of any product and can only be amplified by the use of the right tools. Cordless power tools offer the benefit of light weight and portability, not having to depend on a power outlet at the workplace. Moreover, a standardized approach allows the use of one type of battery pack and chargers for a broad range of tools, such as drills, grinders or saws. This application note provides an overview of the electronic equipment in Power Tool Products along with Diotec's component recommendations.

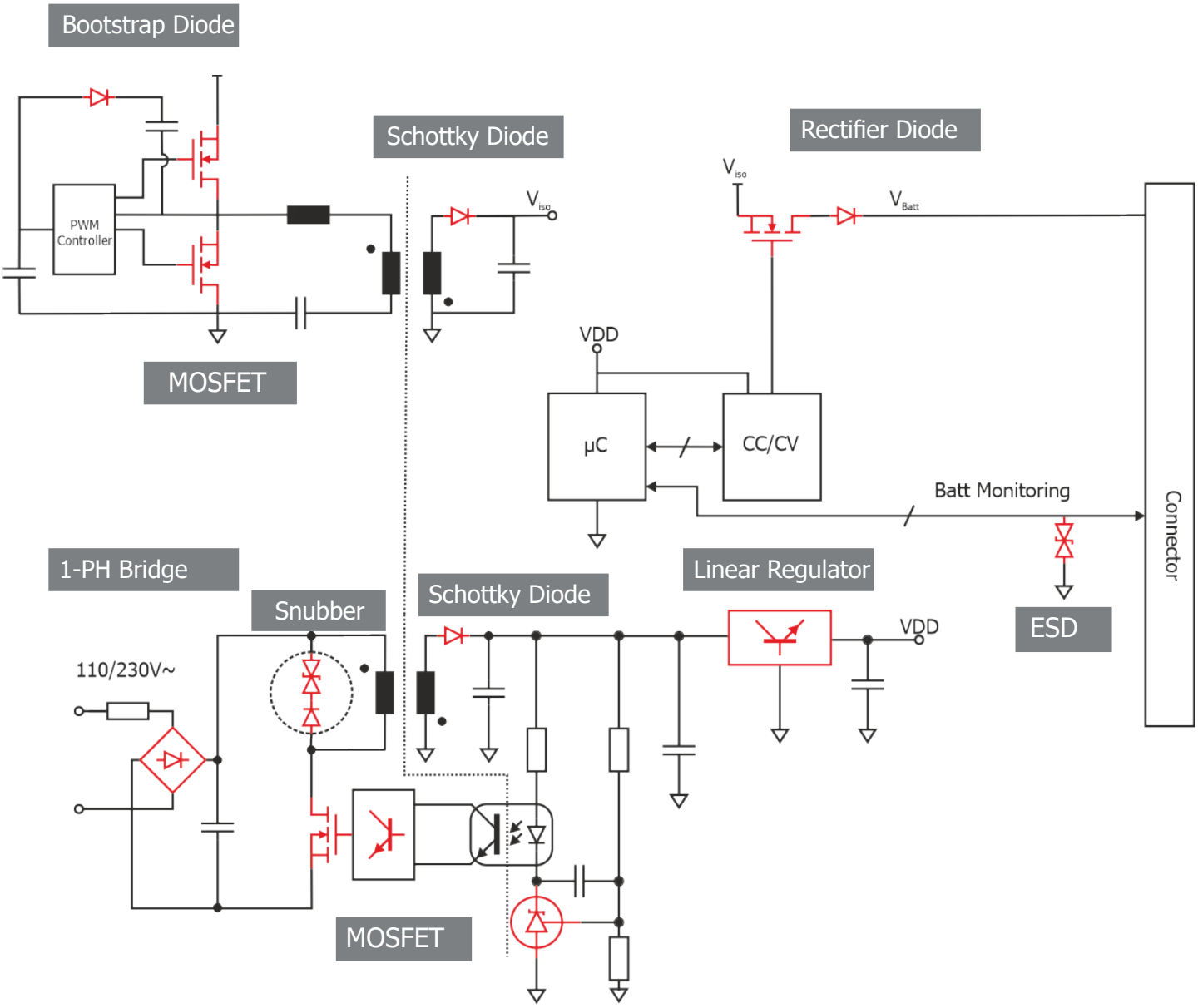


Charger

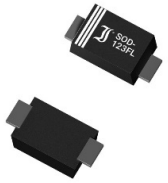
The battery charger fulfils the following main tasks:

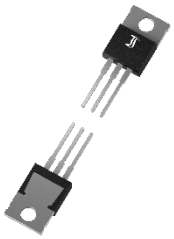
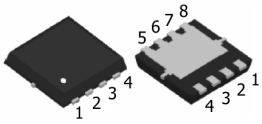
- AC-to-DC energy conversion
- Battery monitoring and charging algorithm
- User Interface

A high-power isolated converter provides the energy for charging the battery. In order to minimize power loss and heat dissipation, high efficiency silicon components with low parasitic characteristics are needed, such as low RDSON MOSFETs and low VF diodes. A low power isolated converter assures the power supply to the internal charger functions. The Controller runs the charging algorithms, battery monitoring and protection and delivers the necessary information to the user through a display or LEDs.

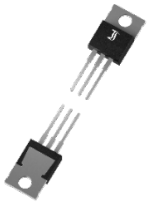


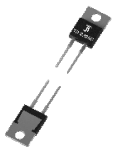
Power Tool - Battery Charger

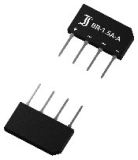
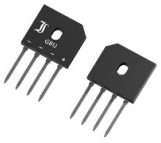
Bootstrap Diode	V_{RRM} [V]	I_{FAV} [A]	t_{rr} [ns]	Outline
ER1D	200	1	35	**DO-214AC (SMA)** 
ES1D	200	1	15	
US1D	200	1	50	
USL1D	200	1	50	**SOD-123FL** 
EAL1D	200	1	50	**DO-213AA (Plastic MiniMELF)** 
EGL1D	200	1	50	
SUF4003	200	1	50	**DO-213AB (Plastic MELF)** 
MUR120	200	1	25	**DO-41** 
FE1D	200	1	50	**DO-15** 

MOSFET	V_{DSS} [V]	I_D [A]	R_{DSON} [mΩ]	Outline
DI012N60D1*	600	12	220	D-PAK 
DI020N06D1	60	20	24	
DIT050N06	60	50	14	TO-220AB 
DI050N04PT	40	50	6.5	QFN 3x3 

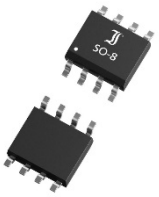
*In Development

Schottky	V_{RRM} [V]	I_{FAV} [A]	Outline
SK32 ... SK315	20 ... 150	3	DO-214AB (SMC) 
SK82 ... SK815	20 ... 150	8	
SK52 ... SK515	20 ... 150	5	DO-214AA (SMB) 
MBR20150CT	150	2 x 10	TO-220AB 
SBCT10100	100	2 x 5	

SBT10100	100	10	**TO-220AC** 
SK10100D1	100	10	**D-PAK** 
SK10100D2	100	10	**D2PAK** 

Single-Phase Bridge Rectifier	V_{RMS} [V]	I_{FAV} [A]	Outline
ABS15J	420	2	**ABS** 
B250S15A	250	1.5	**SO-DIL** 
B250C1500A	250	2.3/1.5	**19 x 10 x 3.5** 
GBU4J	420	4	**GBU** 
GBU6J	420	6	

Snubber	V_{RRM} [V]	I_{FAV} [A]	Outline
TGL200CU06 ... TGL200CU10	600 ... 1000	P_{PPM} = 300W	**DO-213AA (Plastic Mi-niMLEF)**
EGL1M	1000	1	
EAL1M	1000	1	
SUF4007	1000	1	**DO-213AB (Plastic MELF)**
US2M	1000	2	**DO-214AA (SMB)**
US1M	1000	1	**DO-214AB (SMC)**
ER1M	1000	1	**DO-214AC (SMA)**
USL1M	1000	1	**SOD-123FL**

Shunt Reference & Linear Voltage Regulator	V_{IN} [V]	I_O [A]	Outline
MMTL431A	36		SOT-23 
LDI1117xxD	15	1	SO-8 
DI78LxxDAB	40	0.1	
LDI1117xxU	15	1	SOT-89 
DI78LxxUAB	40	0.1	
DI78Mxx	35	0.5	
DI78LxxZAB	40	0.1	TO-92 

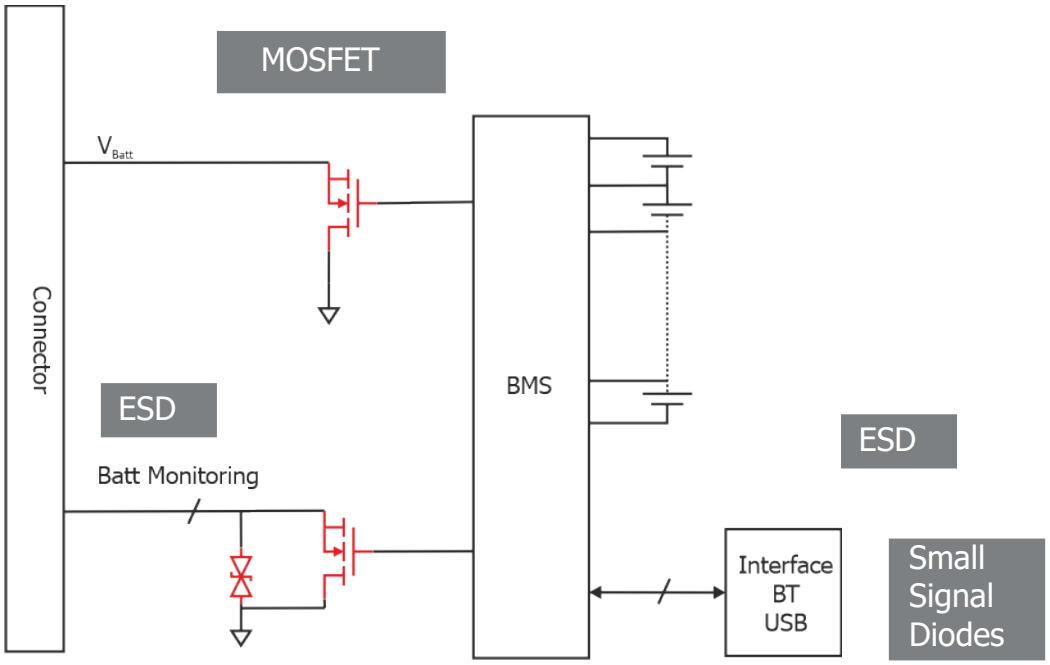
Rectifier Diode	V_{RRM} [V]	I_{FAV} [A]	Outline
S1B	100	1	DO-214AC (SMA) 
S2B	100	2	DO-214AA (SMB) 
S3B	100	3	DO-214AB (SMC) 
S5B	100	5	
S8B	100	8	

ESD Protection	V_{WM} [V]	I_D [µA]	Outline
ESD3Z12	12	1	SOD-123F 
ESD5Z12	12	0.01	SOD-523 
MMBZ18CA	14.5	0.05	SOT-23 
ESDB24C	24	0.05	
ESD36CA	36	1	

General Purpose Transistor	V_{CEO} [V]	I_C [A]	Outline
MMBT2222A	40	0.6	SOT-23 
MMBT2907A	60	0.6	
BC807	45	0.8	
BC817	45	0.8	

Li-Ion Battery Pack

The battery management circuit assures operation of the Li-Ion pack under safe conditions. Battery parameters like state of charge, state of health, temperature etc. are communicated to the charger and tool via wired interface and to other systems like mobile apps via USB or Bluetooth.



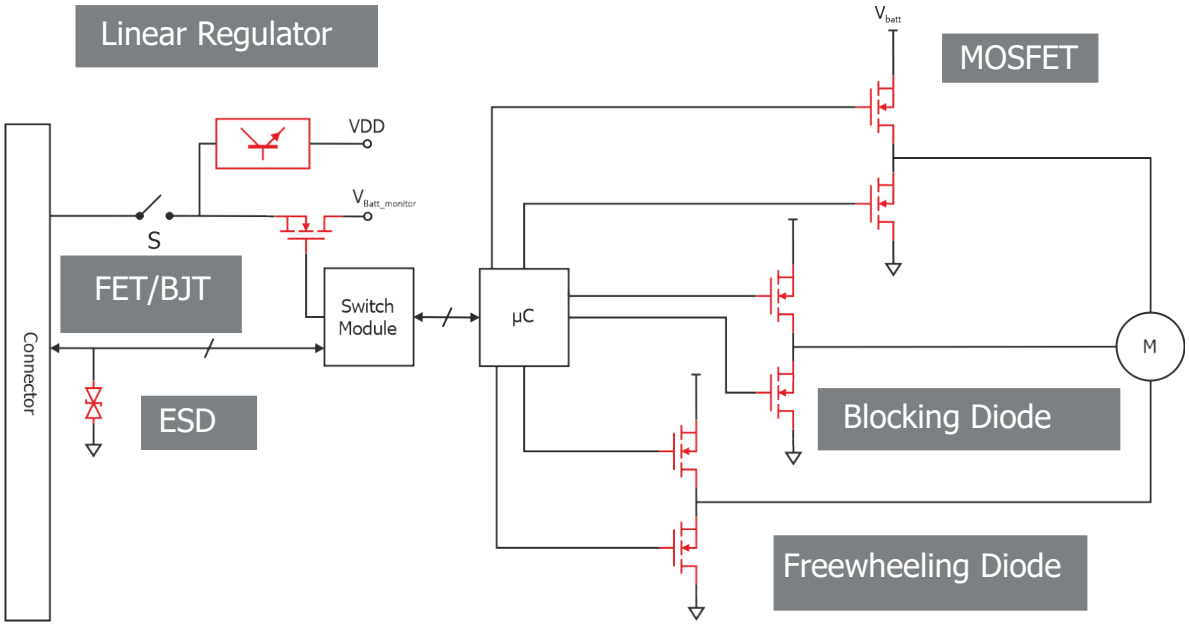
Power Tool – Li_Ion Battery Pack

MOSFET	V_{DS} [V]	I_D [A]	Outline
MMFTN3018W	30	0.1	SOT-323 
2N7002W	60	0.115	
MMFTP3401	30	4	SOT-23 

Small Signal Diode	V_{RRM} [V]	I_{FAV} [A]	Outline
BAS70	70	0.07	SOT-23 
BAS70-04	70	0.7	

Tool

The tool assures motion through spinning motors or moving elements. More professional tools will use brushless DC motors while rather simple and low-cost tools will use a brushed motor driven by an ON/OFF switch. Diotec offers dedicated solutions both for Three-Phase and Brushed DC types.



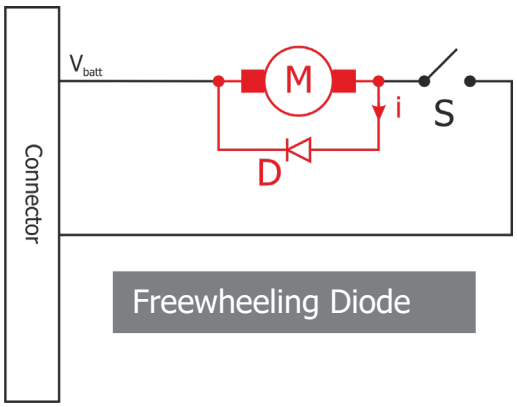
Power Tool – Brushless DC Drive

MOSFET	V_D [V]	I_D [A]	Outline
DI080N06PQ	60	80	QFN5x6 
DI100N10PQ	100	100	
DI110N04PQ	40	110	
DI110N15PQ	150	110	

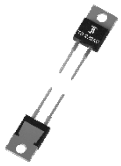
FET/BJT	V_{DS}/V_O [V]	I_D/I_O [A]	Outline
2N7002x	60	0.28	SOT-23 
MMBT7002x	60	0.3	
MMFTP84	60	0.13	
MMBTRAXX	50	0.1	
MMBTRCXX	50	0.1	
MMBTRC11X	50	0.1	
MMFTN3018W	30	0.1	SOT-323 

Freewheeling Diode	V_{RRM} [V]	I_{FAV} [A]	Outline
FX2000D	200	20	8 x 7.5 
FX2000G	400	20	

Blocking Diode	V_{RRM} [V]	I_{FAV} [A]	Outline
BAS40	40	0.2	SOT-23 
BAS70	70	0.07	
BAT54W	30	0.2	SOT-323 



Power Tool – Brushed DC Drive

Freewheeling Diode	V_{RRM} [V]	I_{FAV} [A]	Outline
FX2000	50 ... 400	20	8 x 7.5 
F12Kxx	120	12	
FT2000	50 ... 400	20	TO-220AC 
F5Kxx	120	5	DO-201 

Disclaimer
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