



Power Supply Solutions

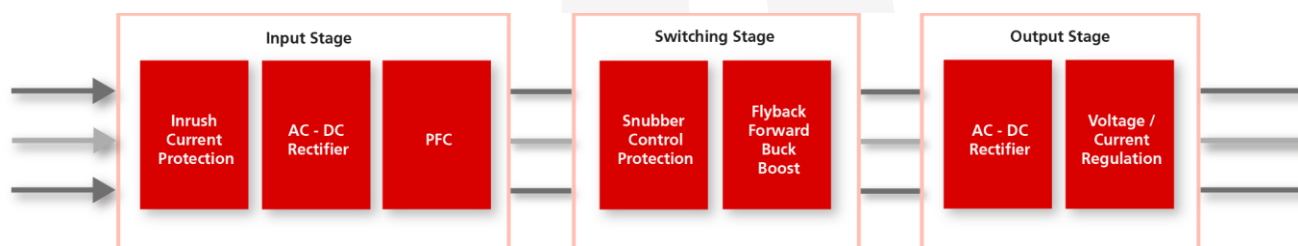
In recent decades, many efficiency standards have been developed worldwide to reduce global energy consumption and thus to lower CO₂ emissions. This rapid development of standards requires highly efficient power supplies. For that purpose, the latest energy-saving technologies and components are to be used: From the input bridge via Power Factor Correction (PFC) to the switching stage such as flyback, forward, buck or boost topology and the output stage, all including protection and control circuits.

Diotec offers a wide range of dedicated products for almost every need:

- **Three-phase Bridge Rectifiers** such as the DBI25-18A, which stay "cool" underload and meet the surge voltage requirements of EN61000-4-5
- **Controlled Avalanche Rectifiers** in SMA and Melf packages like the AM2000, for the auxiliary stage or the use at highly disturbed input mains
- **Super-Fast Efficient Rectifiers** like the MUR860 for Power Factor Correction
- Low RDS(on) and fast switching **MOSFETs** for the converter stage
- **Bootstrap diodes** for the upper gate driver supply, e. g. the SA265 or BYG23T
- The **TVS/blocking diode combination** TGL200U06 for the snubber circuit
- **3rd Generation Schottky Diodes**, which ensure lower power losses at the output stage
- **Voltage Regulators** with internal current limitation and thermal shut down
- **Shunt Regulators** such as the MMTL431A used as voltage reference and error amplifier
- Easy drive of signal LEDs with **Current Limiting Diodes**, e. g. the CL10MD

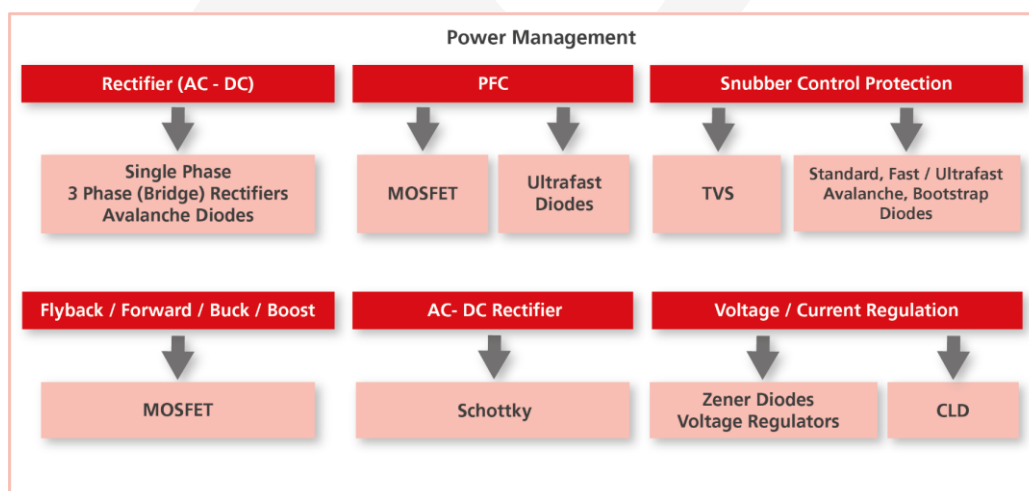
All these parts support designers in finding the best possible solutions with highest efficiency. Power losses are reduced, energy savings are increased and consequently the overall performance can be improved.

The following block diagram shows energy alteration procedure from an alternating AC voltage to a constant DC output voltage. In case of a pure DC to DC converter, the first block is omitted.



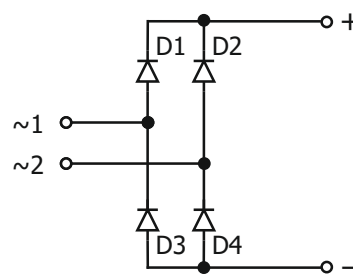
Block diagram of a typical AC to DC power supply

Typical components used in the separate function blocks are shown here:



AC – DC Rectification

Single Phase Bridge Rectifiers



Typical 1~ bridge circuit

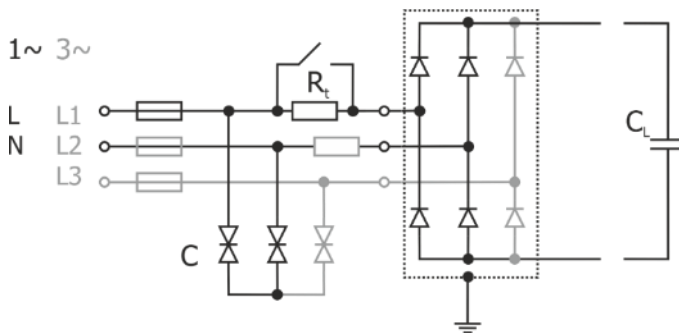
IL	Industrial Lighting
IMC	Industrial Motor Control
Con	Consumer
SM	Smart Meters
AL	Automotive Lighting
AVE	Audio, Video and Entertainment
PT	Battery Powered Tools
APS	Auxiliary Power Supply

Part Number	Package	I_{FAV}	V_{RRM}	Applications
MYS250 , MYS380	MicroDIL	0.5 A	600 ... 800 V	IL Con AVE
MB6S ... MB10S	TO-269AA/MiniDIL Slim	0.5 A	600 ... 1000 V	IL Con
S250 ... S500	TO-269AA/MiniDIL Slim	0.8 A	600 ... 1000 V	IL Con
S125K , S250K	TO-269AA/MiniDIL Slim	1 A	250 ... 600 V	IL Con PT
ABS6 ... ABS10	ABS	0.8 A	600 ... 1000 V	IL Con PT
ABS15J ... ABS15M	ABS	1.5 A	600 ... 1000 V	IL Con PT
B250S15A ... B500S15A	SO-DIL Slim	1.5 A	600 ... 1000 V	IL Con PT
B250S2A ... B380S2A	SO-DIL Slim	2.3 A	600 ... 800 V	IL Con PT
B250S ... B500S	SO-DIL Slim	1 A	600 ... 1000 V	IL Con
B250D ... B500D	DIL	1 A	600 ... 1000 V	IL Con

Part Number	Package	I_{FAV}	V_{RRM}	Applications
B250R ... 500R	D9 x 5.1 (~WOG)	2 A	600 ... 1000 V	IL

Part Number	Package	I_{FAV}	V_{RRM}	Applications
GBI Series	30 x 20 x 3.6	10 ... 40 A	50 ... 1600 V	IMC Con AVE
GBU Series	21.5 x 18.2 x 3.4	4 ... 12 A	50 ... 1000 V	IMC Con AVE
KBPC10/15/25xx Series	28.6 x 28.6 x 7.3	10/15/25 A	100 ... 1600 V	IMC
KBPC35xxFP/WP Series	28.6 x 28.6 x 7.3	35 A	100 ... 1600 V	IMC
KBPC50xxFP/WP Series	28.6 x 28.6 x 7.3	50 A	100 ... 1600 V	IMC

Three Phase Bridge Rectifiers



Typical 1~ / 3~ bridge circuit

IL	Industrial Lighting
IMC	Industrial Motor Control
Con	Consumer
SM	Smart Meters
AL	Automotive Lighting
AVE	Audio, Video and Entertainment
PT	Battery Powered Tools
APS	Auxiliary Power Supply

Part Number	Package	I _{FAV}	V _{RRM}	Applications
DBI20 Series (+~ ~ ~ ~)	35 x 25 x 4	20 A	800 ... 1600 V	IMC
DBI25 Series (-~ ~ ~ ~)	35 x 25 x 4	25 A	800 ... 1800 V	IMC
DB15/25 Series	28.5 x 28.5 x 10	15/25 A	100 ... 1600 V	IMC
DB35 Series	28.5 x 28.5 x 10	35 A	100 ... 1600 V	IMC

Single Rectifiers

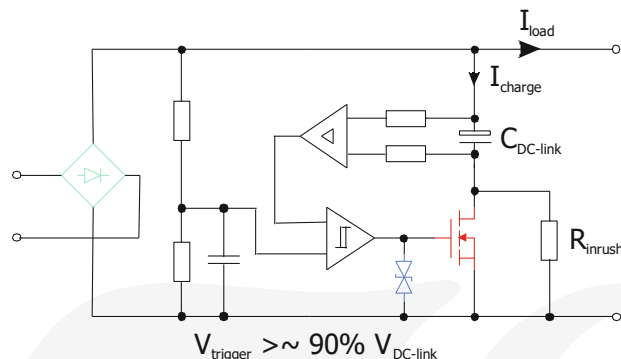
Part Number	Package	I _{FAV}	V _{RRM}	E _{RSM}	Applications
S1J ... S1Y	DO-214AC/SMA	1 A	600 ... 2000 V	N/A	IL SM
S2J ... S2Y	DO-214AA/SMB	2 A	600 ... 2000 V	N/A	IL SM
S3J ... S3Y	DO-214AB/SMC	3 A	600 ... 2000 V	N/A	IL AVE
S5J ... S3Y	DO-214AB/SMC	5 A	600 ... 2000 V	N/A	IL AVE
SM4005 ... SM2000	DO-213AB/ Melf	1 A	600 ... 2000 V	N/A	IL SM
AM2000 ¹⁾	DO-213AB/ Melf	1 A	1600 V	5 mJ	IL Con SM
BYG10J ... BYG10M ¹⁾	DO-214AB/SMA	1.5 A	600 ... 1000 V	20 mJ	IL Con
AL1J ... AL1M ¹⁾	DO-213AA/MiniMelf	1 A	600 ... 1000 V	20 mJ	IL Con
GL1J ... GL1M	DO-213AA/MiniMelf	1 A	600 ... 1000 V	N/A	IL Con
SL1J ... SL1M	SOD-123FL	1 A	600 ... 1000 V	N/A	IL Con AVE
SRL1G, SRL1J	Power SOD-323	1A	400 ... 600 V	N/A	Con

¹⁾ Controlled Avalanche

Part Number	Package	I _{FAV}	V _{RRM}	Applications
1N4005 ... 1N4007	DO-41	1 A	600 ... 1000 V	IL Con
1N5397 ... 1N5399	DO-15	1.5 A	600 ... 1000 V	IL Con
1N5061 ... 1N5062	DO-15	2 A	600 ... 800 V	IL Con
1N5406K ... 1N5408K	DO-15	3 A	600 ... 1000 V	IL Con
BY253 ... BY255	~DO-201	3 A	600 ... 1300 V	IL Con

Active Inrush Current Limitation

The below circuit shows a simple but anyway "smart" and energy saving way of inrush current limitation for all circuits having a DC link capacitor, followed by a (switching) power stage.



When the mains is turned on, the resistor is limiting the inrush current to a value which is acceptable for the input bridge and the link capacitor. If the capacitor voltage reaches approximately 90% of the minimum appearing DC voltage, the Schmitt trigger turns on the MOSFET. One has to note that the DC voltage is overlaid by an AC value; design has to consider this fluctuation.

The turned-on MOSFET is bypassing the resistor and reduces therefore significantly the power losses. The MOSFET has to carry only the repeated charging currents of the link capacitor, but not the (bigger) load current. The output of the Schmitt trigger must be able to provide the required gate charge current for the MOSFET; an additional driver circuit might be necessary. The TVS diode protects the gate against excessive voltages.

In case the mains fails and the capacitor voltage drops below 90% of the minimum appearing DC voltage, the MOSFET turns off as well. If mains is coming back, the resistor is again limiting the inrush current. This makes the shown circuit more safe than simple inrush current limitation by using an NTC, which might require up to several minutes for cooling down and to become high resistive again.

Diotec can offer the input bridge, the TVS diode and the MOSFET in above circuit.

TVS Diodes

Part Number	Package	P _{PPM}	V _{WM}	V _{BR}	Applications
TGL34-...	DO-213AA/MiniMelf	150 W	5.5 ... 171 V	6.8 ... 200 V	IL Con AVE SM
SMF...	SOD-123F	200 W	5.0 ... 220 V	6.8 ... 260 V	IL Con AVE SM
TGL41-...	DO-213AB/Melf	400 W	5.5 ... 423 V	6.8 ... 520 V	IL Con AVE SM
P4SMA...	DO-214AC/SMA	400 W	5.0 ... 495 V	6.8 ... 550 V	IL Con AVE SM
P6SMB...	DO-214AA/SMB	600 W	5.0 ... 495 V	6.8 ... 550 V	IL Con AVE SM
1.5SMC...	DO-214AB/SMC	1500 W	5.0 ... 495 V	6.8 ... 550 V	IL Con AVE SM

Power MOSFETs

Part Number	Package	I _D	V _{DS}	R _{DS(on)}	Applications				
DI001N65PTK	PowerQFN 3x3	1 A	650 V	~ 1.4 Ω	IL	Con	AVE	SM	AL
DI001N65PTK-AQ	PowerQFN 3x3			~ 1.4 Ω	IL	Con	AVE	SM	AL
DIJ2A3N65	ITO-220AB	2.3 A		< 2.6 Ω	IL	Con	AVE	SM	AL
DIJ4A5N65	ITO-220AB	4.5 A		< 1.3 Ω	IL	Con	AVE	SM	AL
DID3A2N65	TO-251/I-PAK	3.2 A		< 2.6 Ω	IL	Con	AVE	SM	AL
DI5A7N65D1K	TO-252AA/D-PAK	5.7 A		< 0.43 Ω	IL	Con	AVE	SM	AL
DI5A7N65D1K-AQ	TO-252AA/D-PAK			< 0.43 Ω	IL	Con	AVE	SM	AL
DI018N65D1	TO-252AA/D-PAK	18 A		< 0.19 Ω	IL	Con	AVE	SM	AL
DI7A5N65D2K	TO-263AB/D2PAK	7.5 A		< 0.43 Ω	IL	Con	AVE	SM	AL
DI7A5N65D2K-AQ	TO-263AB/D2PAK			< 0.43 Ω	IL	Con	AVE	SM	AL
DIW012N65	TO-247-3L	12 A		< 190 mΩ	IL	Con	AVE	SM	AL
DIW018N65	TO-247-3L	18 A		~ 155 mΩ	IL	Con	AVE	SM	AL
DIW030N65K	TO-247-3L	30 A		< 65 mΩ	IL	Con	AVE	SM	AL
DIW038N65K	TO-247-3L	38 A		< 65 mΩ	IL	Con	AVE	SM	AL

Superfast Efficient Rectifiers

Part Number	Package	I _{FAV}	V _{RRM}	T _{rr}	Applications
MUR460	DO-201	4 A	600 V	50 ns	IL
MUR860	TO-220AC	8 A	600 V	50 ns	IL
MURF2060CT	ITO-220AB	20 A	600 V	25 ns	IL
ERJ3006	ITO-220AC	30 A	600 V	50 ns	IMC

Ultrafast Diodes

Part Number	Package	I _{FAV}	V _{RRM}	Applications
ES3JSMB	DO-214AA/SMB	3 A	600 V	AVE
ES3J	DO-214AB/SMC	3 A	600 V	AVE
ER3J	DO-214AB/SMC	3 A	600 V	AVE
UGB8JT	TO-263AB/D ² PAK	8 A	600 V	AVE
UFT800J	TO-220AB	8 A	600 V	AVE

Switching Stage

Typical "isolated" converter topologies are Flyback and Forward. Here the primary and secondary side are separated by a transformer, which manages additionally the up or down conversion of the voltage. Buck and Boost converters are non-isolated circuits using a coil for voltage conditioning. All of these use typically Power MOSFETs as a high frequent switching element.

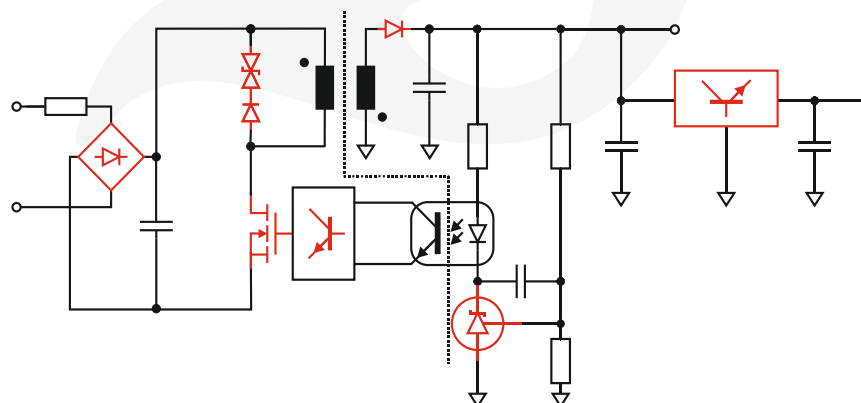
Power MOSFETs

Part Number	Package	I _D	V _{DS}	R _{DS(on)}	Applications
DIJ004N80*	ITO-220AB	4 A	800 V	2.8 Ω	IL APS
DIJ006N80*	ITO-220AB	6 A	800 V	1.4 Ω	IL APS
DIJ010N80*	ITO-220AB	10 A	800 V	0.9 Ω	IL APS
DIT050N06	TO-220AB	50 A	60 V	0.014	IL APS
DIT090N06	TO-220AB	90 A	65 V	0.0057	IL APS
DIT095N08	TO-220AB	95 A	80 V	0.0066	IL APS
DIT100N10	TO-220AB	100 A	100 V	0.0099	IL APS
DIT120N08	TO-220AB	120 A	80 V	0.0049	IL APS
DIT150N03	TO-220AB	150 A	30 V	0.0023	IL APS
DIT195N08	TO-220AB	195 A	85 V	0.0035	IL APS

*under development

Protection

Flyback converters require a special network, the so-called snubber at the primary side, in order to protect the MOSFET respectively switching IC against excessive voltage spikes. The snubber usually consists of a TVS diode and an Ultrafast rectifier; depending on switching frequency also a Fast or even Standard Recovery type might be used.



Typical Flyback circuit

TVS Diodes

Part Number	Package	P _{PPM}	V _{WM}	V _{BR}	Applications
TGL34-...	DO-213AA/MiniMelf	150 W	5.5 ... 171 V	6.8 ... 200 V	Con AVE APS
SMF...	SOD-123F	200 W	5.0 ... 220 V	6.8 ... 260 V	Con AVE APS
TGL41-...	DO-213AB/Melf	400 W	5.5 ... 423 V	6.8 ... 520 V	Con AVE APS
P4SMA...	DO-214AC/SMA	400 W	5.0 ... 495 V	6.8 ... 550 V	Con AVE APS
P6SMB...	DO-214AA/SMB	600 W	5.0 ... 495 V	6.8 ... 550 V	Con AVE APS
1.5SMC...	DO-214AB/SMC	1500 W	5.0 ... 495 V	6.8 ... 550 V	Con AVE APS
P6KE	DO-15/ DO-204AC	600 W	5.0 ... 444 V	6.8 ... 520 V	Con AVE APS

Ultrafast Diodes

Part Number	Package	I _{FAV}	V _{RRM}	Applications
USL1A ... M	SOD-123F	1 A	50 ... 1000 V	Con AVE APS
US1A ... M	DO-214AC/SMA	1 A	50 ... 1000 V	Con AVE APS
US3A ... M	DO-214AB/SMC	3 A	50 ... 1000 V	Con AVE APS

TVS and Ultrafast in ***one package***

Part Number	Package	P _{PPM}	V _R	V _{BR}	Applications
TGL200U06...10	DO-213AB/Melf	300 W	600 ... 1000V	200 V	IL APS
TGL200F08	DO-213AB/Melf	300 W	600 ... 1000V	200 V	IL APS
PKC-136	DO-15/ DO-204AC	600 W	700 V	160 V	IL APS

The TGL200U Series, by Diotec combines a 200V TVS and a Ultrafast diode with V_{rrm} of 600V to 1000V, in a single DO-213AB/Melf package. It thus helps to save board space in this usually rather tightly assembled circuits. Further available are the Fast Recovery version TGL200F08.

Output Stage

Schottky Diodes

Part Number	Package	I _{FAV}	V _{RRM}	Applications
SK1H10 (HT)	DO-214AC/SMA	1 A	100 V	AL Con SM PT APS
SGL2-40-3G	DO-213AA/MiniMelf	2 A	40 V	AL Con SM PT APS
SKL34 ... 36	SOD-123F	3 A	40 ... 60 V	AL Con SM PT APS
SMS340 ... 3100 (-3G)	DO-213AB/Melf	3 A	40 ... 100 V	AL Con SM PT APS
SK34SMA-3G ... 315SMA	DO-214AC/SMA	3 A	40 ... 150 V	AL Con SM PT APS
SK3H10SMB ... 3H15SMB (HT)	DO-214AA/SMB	3 A	100 ... 150 V	AL Con SM PT APS
SK420	DO-214AB/SMC	4 A	200 V	AL Con SM PT APS
SK54-3G ... 515 (-3G)	DO-214AA/SMB	5 A	40 ... 150 V	AL Con SM PT APS
SK84-3G ... 815 (-3G)	DO-214AB/SMC	8 A	40 ... 150 V	AL Con SM PT APS

-3G: Available in 3rd Generation Schottky Technology with low V_F and low I_R

Power Schottky Diodes

Part Number	Package	I _{FAV}	V _{RRM}	Applications
PPS1040 ... 60 (-3G)	Power SMD	10 A	40 ... 60 V	IL IMC
PPS1540 ... 60 (-3G)	Power SMD	15 A	40 ... 60 V	IL IMC
SK1040...100D1)-3G)	D-PAK	10A	40...100 V	IL IMC
SK1040...100D2 (-3G)	D2-PAK single	10A	40...100 V	IL IMC
SK2040...100CD2 (-3G)	D2-PAK dual	2x 10A	20...100 V	IL IMC AVE
SK3040...100CD2 (-3G)	D2-PAK dual	2x 15A	40...100 V	IL IMC
SK4040...45CD2 (-3G)	D2-PAK dual	2x 20A	40...45 V	IL IMC
SBT1040...100 (-3G)	TO-220AC	10A	40 ... 100 V	IL IMC
MBR10100 (HT)	TO-220AC	10A	100 V	IL IMC AL
SBCT1040...100 (-3G)	TO-220AB dual	2x 5A	40 ... 100 V	IL IMC
SBCT2040...100 (-3G)	TO-220AB dual	2x 10A	40 ... 100 V	IL IMC AVE
MBR20100CT...200CT (HT)	TO-220AB dual	2x 10A	100 ... 200 V	IL IMC AL
SBCT30100...150	TO-220AB dual	2x 15A	100 ... 150 V	IL IMC

-3G: Available in 3rd Generation Schottky Technology with low V_F and low I_R

IL	Industrial Lighting
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Voltage and Current Regulation

Linear Voltage Regulators

Part Number	Package	I _{out}	V _{out}	Applications
LDI1117 Series	SOT-89, SOT-223	1.0 A	Adjustable, Fixed: 1.2 ... 5 V	IL Con AVE PT
DI78L05 Series	SO-8, SOT-89	0.1 A	3.3 ... 24 V	IL Con AVE PT
DI79L Series	TO-92	0.1 A	5 ... 24 V	IL Con AVE PT
DI78M Series	SO8, SOT-89	0.5 A	5 ... 24 V	IL Con AVE PT
DI6206 Series	SOT-23	0.2 A	1.2 ... 5.0V	IL Con AVE

Shunt Regulators

Part Number	Package	I _k	V _{out}	Applications
MMTL431A / AR	SOT-23	1.0 ... 100 A	Adjustable: 2.495 ... 36 V	IL Con AVE
MMTV4041	SOT-23	0.1 ... 20 mA	Fixed: 1.24 V	Con AVE
MMTV431A	SOT-23	0.1 ... 20 mA	Adjustable: 1.24 ... 20 V	Con AVE

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CLD (Constant Current Regulator)

Part Number	Package	I _{Pnom}	V _{AK}	Applications
CL05M6F	SOD-123FL	5 mA	190 V	IL Con PT
CL10MD ... 30MD	DO-213AA/MiniMelf	20 ... 40 mA	90 V	IL Con PT
CL15M35 ... 40M35	DO-214AC/SMA	15 ... 40 mA	90 V	IL Con PT
CL15M45 ... 40M45	DO-214AA/SMB	15 ... 40 mA	90 V	IL Con PT

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