APPLICATION NOTE

Diotec Semiconductor

Industrial & Domestic Controls

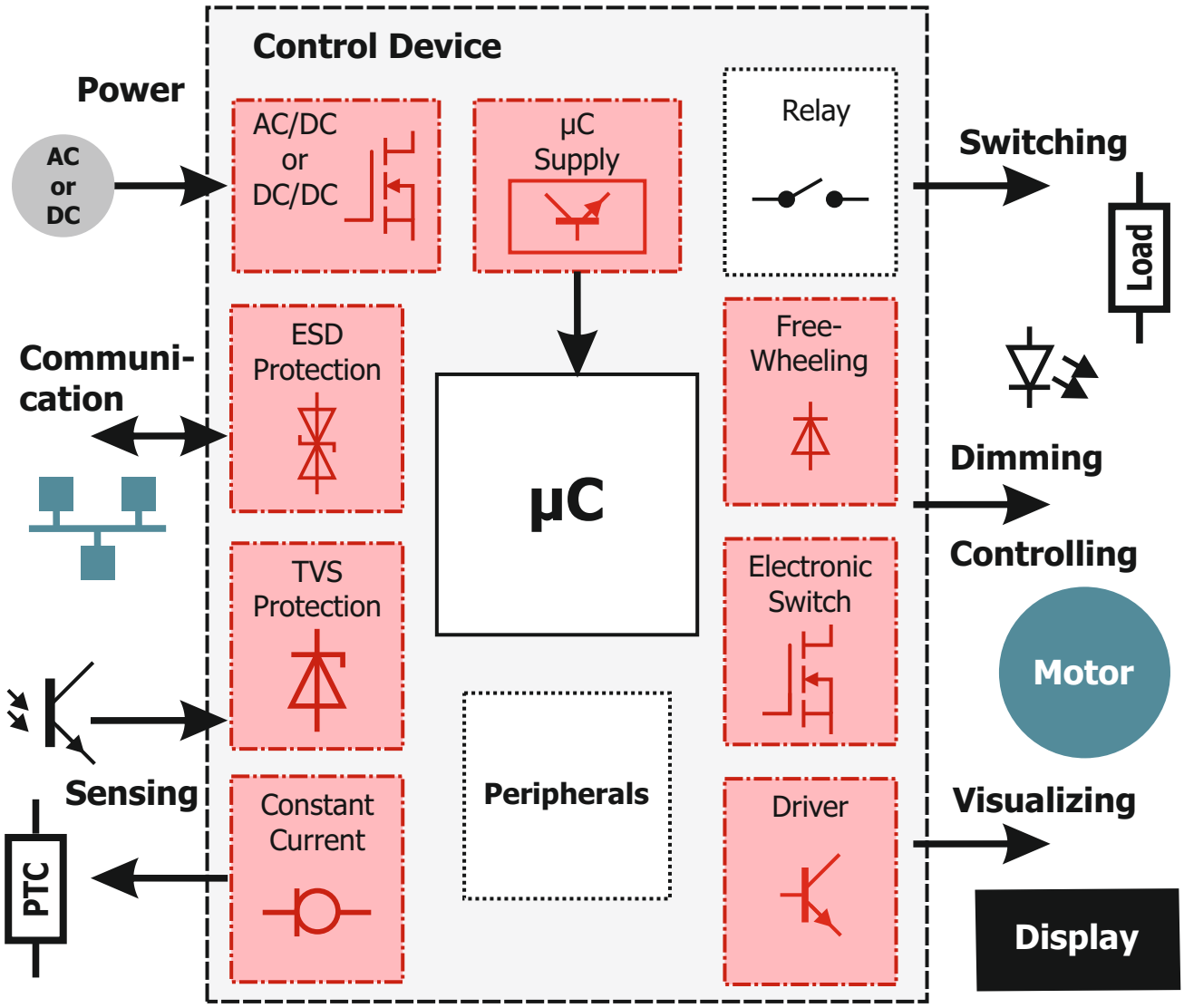
Components for

- Smart Home Systems & Industrial Field Buses
- Power Supplies & Protection
- Sensors & Actors
- Temperature Control
- Motor Soft Start
- Relay Drives

Block Diagram

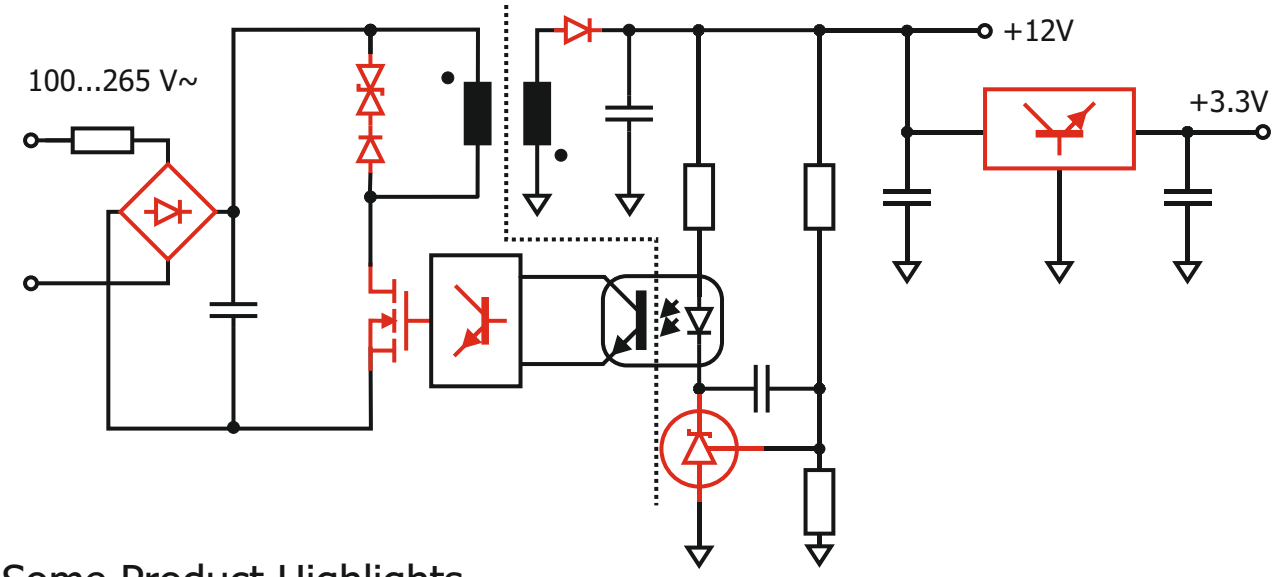
The heart of any industrial or domestic control device is either a microcontroller, a PLC (Programmable Logic Controller) or an IPC (Industrial PC). It handles the data processing, logic control, and interfacing. The latter includes digital inputs and outputs for status and PWM signals, switches or relays. Analog inputs measure variables such as temperature, brightness or frequency, while the outputs provide signal voltages or currents. Communication with other devices works via special interfaces such as Profibus, Profinet, EtherNet/IP, CANopen, Modbus or KNX. The power supply runs on typical input voltages of 24 V_{DC}, 48 V_{DC} or 110/230 V_{AC}; sometimes, communication data are transferred via the power line itself.

Diotec provides dedicated semiconductor components acting between the microcomputer device and its surrounding, shown in the red marked blocks below.



1. Universal Power Supply on 100...265 V AC Mains

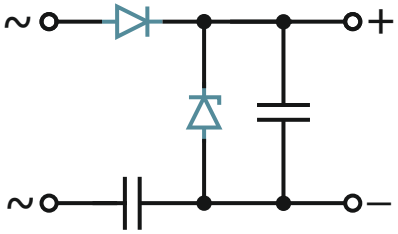
A flyback converter is state of the art when it comes to wide range input AC to DC power supplies. Low power devices at fixed AC inputs could be supplied by simple capacitive circuits using a Zener for stabilization. Common to all of these is the fact that board space is rather restricted, calling for small size SMD components.



Some Product Highlights

MYS380	**Rectifier Bridge** 0.5 A / 800 V measuring 3x3 [mm] More see https://diotec.com/en/productlist/B1.html
ABS15Y	**Rectifier Bridge** 1.5 A / 2000 V with 4 mm pitch More see https://diotec.com/en/productlist/B1.html
TGL200CU10	**Snubber** 200 V TVS + 1000 V Blocking Diode in single MELF package More see https://diotec.com/en/productlist/TVS.html
DI001N65PTK	**N-MOSFET** 1 A / 650 V with protected Gate in QFN3x3 More see https://diotec.com/en/productlist/FET.html
BC817BPN	**Dual NPN + PNP BJT** 45 V / 1 Apk in single SOT-26 More see https://diotec.com/en/productlist/T.html
SKL36	**Schottky** 3 A / 60 V in SOD-123FL More see https://diotec.com/en/productlist/SBD.html
MMTL431A	**Shunt Regulator** 2.495 V ± 0.5 % in SOT-23 More see https://diotec.com/en/productlist/SHUNT.html
LDI8119-3.3EN	**LDO** 3.3 V / 0.5 A with Enable in SOT-23-5 More see https://diotec.com/en/productlist/VR.html

2. Simple Capacitive Power Supply

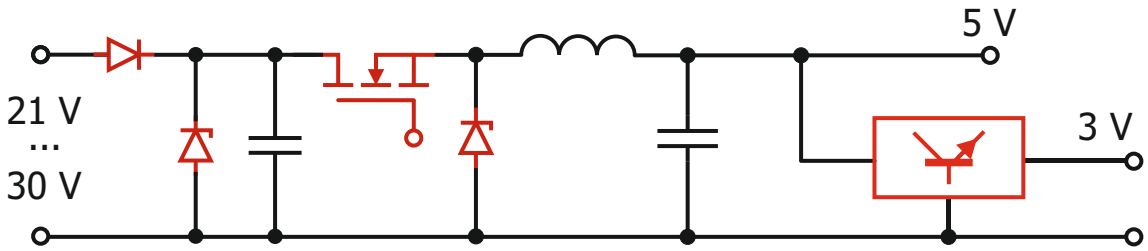


Some Product Highlights

S1Y	**Rectifier** 1 A / 2000 V in DO-214AC / SMA More see https://diotec.com/en/productlist/R.html
AM2000	**Avalanche Rectifier** 1 A / 1600 V in DO-213AB / Melf More see https://diotec.com/en/productlist/R.html
Z1SMA12	**Zener** 12 V / 1.5 W in DO-214AC / SMA More see https://diotec.com/en/productlist/Z.html

3. Power Supplies for Smart Home Systems (e. g. KNX) & Industrial Field Buses (e. g. PROFINET)

Both of this bus systems operate typically on 24 V DC. Internal circuits operate on a 5 V system, and 3 V is the supply for the µController. Board space saving is must and smallest SMD outlines are required.

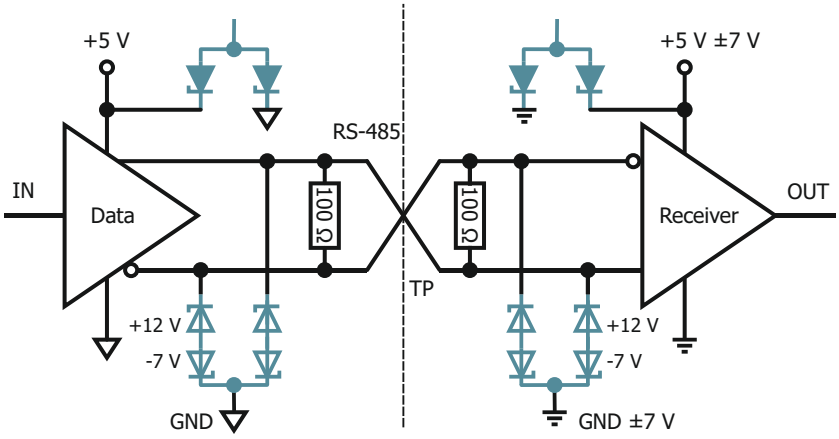


Some Product Highlights

SDB160WS	**Polarity Protection Schottky** 1 A / 60 V in SOD-323P More see https://diotec.com/en/productlist/SBD.html
SMF40A	**TVS** 40 V / 200 W in SOD-123FL More see https://diotec.com/en/productlist/TVS.html
DI0A35N06PGK	**N-MOSFET** 0.35 A / 60 V with protected Gate in DFN1006 More see https://diotec.com/en/productlist/FET.html
SDB0530WT	**Buck Diode Schottky** 0.5 A / 30 V in SOD-523 More see https://diotec.com/en/productlist/SBD.html
LDI734C3.0ENG	**Capacitor-free LDO** 3.0 V / 0.3 A with Enable in QFN1x1 More see https://diotec.com/en/productlist/VR.html

4. Protection of a RS-485 Field Bus

The RS-485 standard allows for a voltage shift of up to ±7 V between different ground levels. As such the line voltage might differ from -7 V (0 V – 7 V) to +12 V (5 V + 7 V). The ESDB712 addresses this asymmetric voltage levels by offering a negative stand-off voltage of -7 V and a positive one of +12 V. The dual device protects both lines (Twisted Pair) of an RS-485 bus system. The ESD5V0CA protects against spikes on supply voltage..

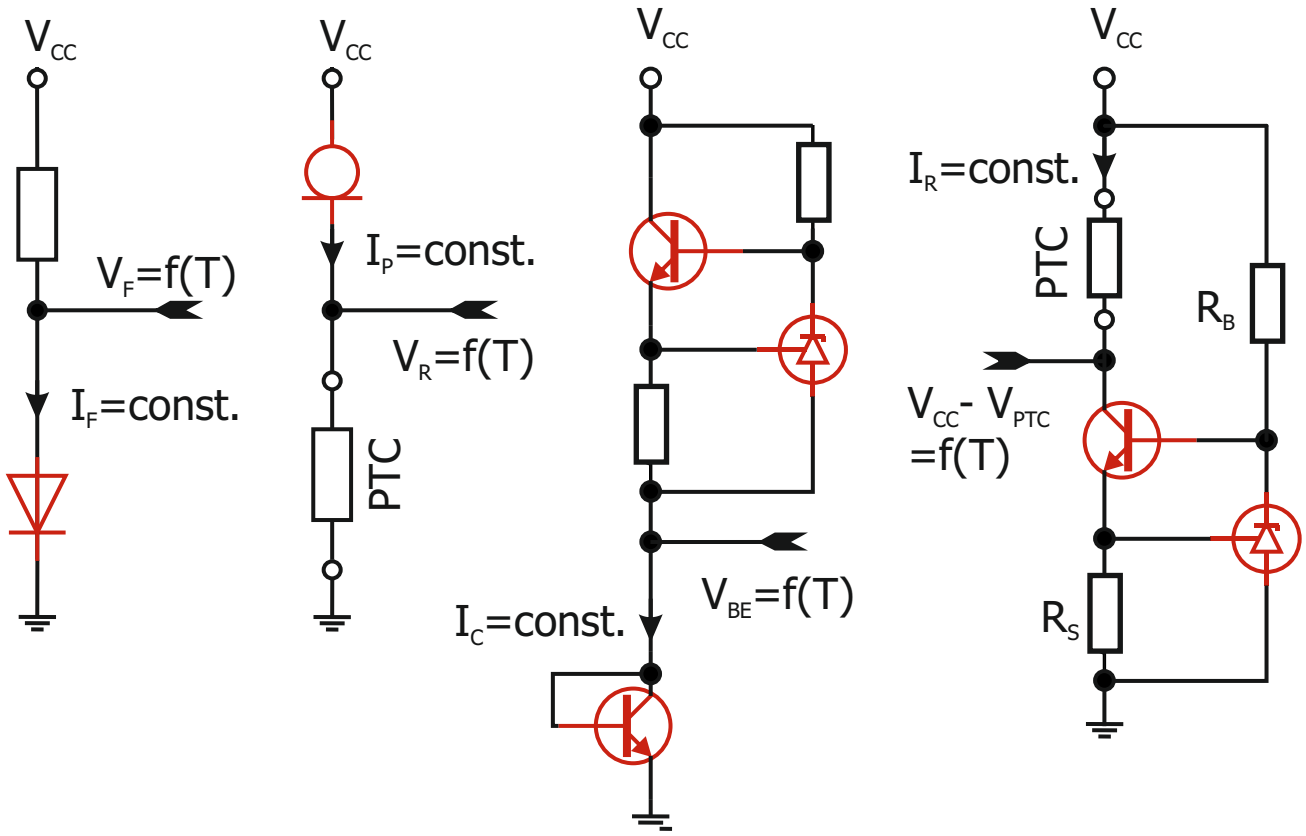


Some Product Highlights

ESD5V0CA	**Dual ESD Protection** 2x 5.0 V / ±30 kV in SOT-23 More see https://diotec.com/en/productlist/ESD.html
ESDB712	**Asymmetric ESD Protection** +12 V / - 7 V / ±30 kV in SOT-23 More see https://diotec.com/en/productlist/ESD.html

5. Temperature Sensing

If just a simple and rough temperature is required, one could use a diode out of the 4448 series (having a defined tight V_F range). Alternatively, a CLD (constant current regulator) along with an external PTC could do the job. For more accurate measurements, constant current circuits using a shunt regulator are the preferred option.



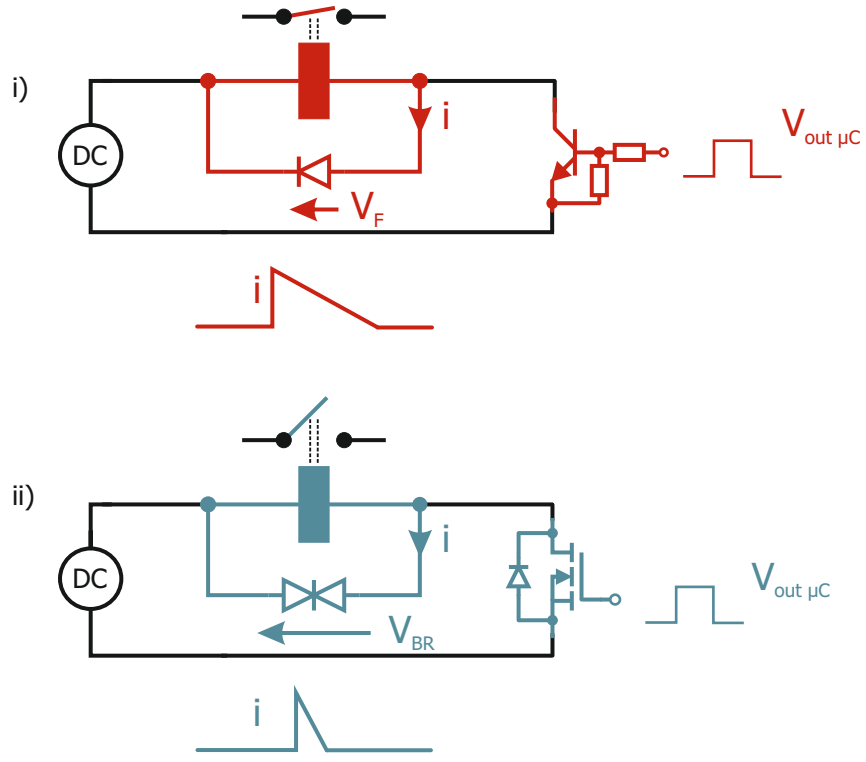
Some Product Highlights

1N4448HP	**Small Signal Diode** 250 mA / 100 V in DFN1006-2 More see https://diotec.com/en/productlist/D.html
CL05M6F	**CLD** 5 mA / 190 V in SOD-123FL More see https://diotec.com/en/productlist/C.html
BC846S	**Dual BJT** 100 mA / 65 V in SOT-363 More see https://diotec.com/en/productlist/T.html
MMTL431A	**Shunt Regulator** 100 mA / 36 V in SOT-23 More see https://diotec.com/en/productlist/SHUNT.html
BC846BP	**BJT** 100 mA / 65 V in DFN1006-3 More see https://diotec.com/en/productlist/T.html

6. Driving and Free-Wheeling of Relay Coils

Relays offer the advantage of full galvanic isolation between logic levels of the control and high voltage mains. The relay coil requires a free-wheeling diode, in order to avoid voltage peaks when drive is turned-off. A simple diode can be used, but the counter-voltage to demagnetize the coil inductance is then just the diode's forward voltage drop, see figure i). A much faster demagnetization can be achieved by using the breakdown voltage of a bidirectional TVS, as shown in figure ii).

The relay can be driven by either a digital transistor or a logic level MOSFET. Both offer the advantage to be switched directly from a digital output of the micro-controller. Either device can be used together with a diode or TVS, there is no preference as the below figures might pretend.



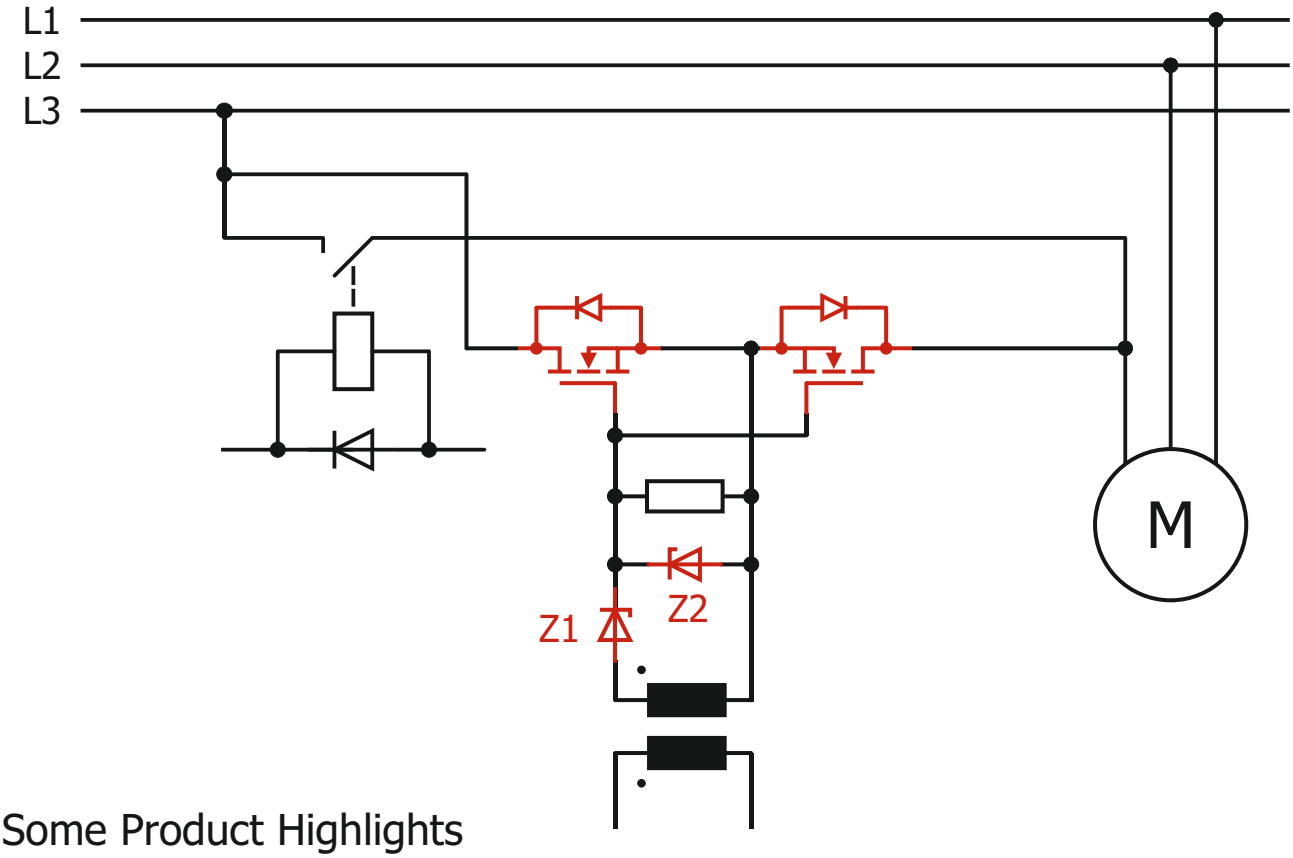
Some Product Highlights

SRL1J	**Standard Diode** 1A / 600 V in PowerSOD-323/DO-219AD More see https://diotec.com/en/productlist/R.html
MMDTA141DW	**Dual Digital PNP Transistor** -100 mA / -50 V in SOT-363 More see https://diotec.com/en/productlist/DT.html
MMDTC124EE	**Digital NPN Transistor** 30 mA / 50 V in SOT-523 More see https://diotec.com/en/productlist/DT.html
TGL34-33CA	**Bidirectional TVS** 33 V / 150 W in DO-213AA/MiniMelf More see https://diotec.com/en/productlist/TVS.html
SMF12CA	**Bidirectional TVS** 12 V / 200 W in SMF/SOD-123FL More see https://diotec.com/en/productlist/TVS.html
MMBT7002DW	**Dual N-MOSFET** 0.115 A / 60 V in SOT-363 More see https://diotec.com/en/productlist/FET.html

7. Softstart realized with MOSFET-based AC Switch

Three phase motors for fans, pumps, conveyor belts and similar are mostly operated at fixed speed. They require a soft start switch for turn-on. It controls the phase angle of just one line and ramps it up slowly. By this, a high starting current and thus mechanical torque is avoided, which leads to a smooth start of the machine and its load. State-of-the art AC switches are thyristors or triacs; in the following, a MOSFET-based solution is introduced.

Two high-voltage MOSFETs connected back-to-back at their Source contacts are operating as an AC switch. The two Gates are driven from the same input, which could be simply realized by a small pulse transformer. A short positive pulse is enough to charge-up the two Gate capacitances. The Zener or ESD protection diode Z1 avoids discharge via the transformer coil at zero output. A negative transformer pulse leads to forward biasing of Z2, which in consequence turns-off the Gates. Pulse voltage must be big enough to drive the Zener or ESD into break-down without overload. Z2 protects the Gates of the MOSFETs, while the resistor discharges it in the off-state. The MOSFET AC switch is bypassed by a relay during steady-state operation.



Some Product Highlights

DI2A2N100D1K	**N-MOSFET** 2.2 A / 1000 V with protected Gate in D-PAK/TO-252AA More see https://diotec.com/en/productlist/FET.html
DIJ006N90	**N-MOSFET** 6 A / 900 V isolated ITO-220AB More see https://diotec.com/en/productlist/FET.html
ESD5Z12	**ESD Protection** 12 V / 240 W in SOD-523 More see https://diotec.com/en/productlist/TVS.html

Do not hesitate to contact us for further questions:

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