

# Power MOSFET Stage for Boost Converters

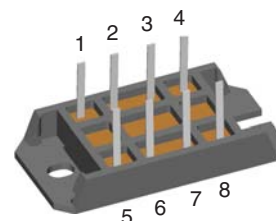
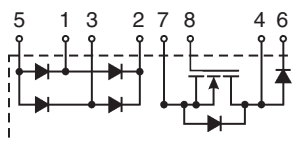
Module for Power Factor Correction

$$I_{D25} = 47 \text{ A}$$

$$V_{DSS} = 500 \text{ V}$$

$$R_{DS(on)} = 0.12 \Omega$$

| $V_{RRM}$ (Diode) | $V_{DSS}$ | Type       |
|-------------------|-----------|------------|
| V                 | V         |            |
| 600               | 500       | VUM 33-05N |



| Symbol        | Conditions                                                                             | Maximum Ratings |                    |
|---------------|----------------------------------------------------------------------------------------|-----------------|--------------------|
| $V_{DSS}$     | $T_{VJ} = 25^{\circ}\text{C}$ to $150^{\circ}\text{C}$                                 | 500             | V                  |
| $V_{DGR}$     | $T_{VJ} = 25^{\circ}\text{C}$ to $150^{\circ}\text{C}$ ; $R_{GS} = 10 \text{ k}\Omega$ | 500             | V                  |
| $V_{GS}$      | Continuous                                                                             | $\pm 20$        | V                  |
| $I_D$         | <b>MOSFET</b><br>$T_S = 85^{\circ}\text{C}$                                            | 33              | A                  |
| $I_D$         |                                                                                        | 47              | A                  |
| $I_{DM}$      |                                                                                        | 130             | A                  |
| $P_D$         | $T_S = 85^{\circ}\text{C}$                                                             | 310             | W                  |
| $I_S$         | $V_{GS} = 0 \text{ V}$ , $T_S = 25^{\circ}\text{C}$                                    | 33              | A                  |
| $I_{SM}$      | $V_{GS} = 0 \text{ V}$ , $T_S = 25^{\circ}\text{C}$ , $t_p = ①$                        | 130             | A                  |
| $V_{RRM}$     | <b>Boost Diode</b><br>$T_S = 85^{\circ}\text{C}$ , rectangular $\delta = 0.5$          | 600             | V                  |
| $I_{FAV}$     |                                                                                        | 33              | A                  |
| $I_{FSM}$     |                                                                                        |                 |                    |
|               | $T_{VJ} = 45^{\circ}\text{C}$ , $t = 10 \text{ ms}$ (50 Hz)                            | 300             | A                  |
|               | $t = 8.3 \text{ ms}$ (60 Hz)                                                           | 320             | A                  |
|               | $T_{VJ} = 150^{\circ}\text{C}$ , $t = 10 \text{ ms}$ (50 Hz)                           | 260             | A                  |
|               | $t = 8.3 \text{ ms}$ (60 Hz)                                                           | 280             | A                  |
| <b>P</b>      | $T_S = 85^{\circ}\text{C}$                                                             | 59              | W                  |
| $V_{RRM}$     | <b>Rectifier Diodes</b><br>$T_S = 85^{\circ}\text{C}$ , sinus $180^{\circ}$            | 1200            | V                  |
| $I_{dAV}$     |                                                                                        | 54              | A                  |
| $I_{FSM}$     |                                                                                        |                 |                    |
|               | $T_{VJ} = 45^{\circ}\text{C}$ , $t = 10 \text{ ms}$ (50 Hz)                            | 300             | A                  |
|               | $t = 8.3 \text{ ms}$ (60 Hz)                                                           | 320             | A                  |
|               | $T_{VJ} = 150^{\circ}\text{C}$ , $t = 10 \text{ ms}$ (50 Hz)                           | 260             | A                  |
|               | $t = 8.3 \text{ ms}$ (60 Hz)                                                           | 280             | A                  |
| <b>P</b>      | $T_S = 85^{\circ}\text{C}$                                                             | 50              | W                  |
| $T_{VJ}$      | <b>Module</b>                                                                          | -40...+150      | $^{\circ}\text{C}$ |
| $T_{JM}$      |                                                                                        | 150             | $^{\circ}\text{C}$ |
| $T_{stg}$     |                                                                                        | -40...+150      | $^{\circ}\text{C}$ |
| $V_{ISOL}$    | 50/60 Hz $t = 1 \text{ min}$                                                           | 3000            | V~                 |
|               | $I_{ISOL} \leq 1 \text{ mA}$ $t = 1 \text{ s}$                                         | 3600            | V~                 |
| $M_d$         | Mounting torque (M5)                                                                   | 2-2.5/18-22     | Nm/lb.in.          |
| <b>Weight</b> |                                                                                        | 28              | g                  |

① Pulse width limited by  $T_{VJ}$

## Features

- Package with DCB ceramic base plate
- Soldering connections for PCB mounting
- Isolation voltage 3600 V~
- Low  $R_{DS(on)}$  HDMOS™ process
- Low package inductance for high speed switching
- Ultrafast boost diode
- Kelvin source for easy drive

## Applications

- Power factor pre-conditioner for SMPS, UPS, battery chargers and inverters
- Boost topology for SMPS including 1~ rectifier bridge
- Power supply for welding equipment

## Advantages

- 3 functions in one package
- Output power up to 8 kW
- No external isolation
- Easy to mount with two screws
- Suitable for wave soldering
- High temperature and power cycling capability
- Fits easily to all available PFC controller ICs

| Symbol       | Conditions                                                                                                                               | Characteristic Values<br>( $T_{VJ} = 25^{\circ}\text{C}$ , unless otherwise specified) |      |                           |
|--------------|------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|------|---------------------------|
|              |                                                                                                                                          | min.                                                                                   | typ. | max.                      |
| $V_{DSS}$    | $V_{GS} = 0\text{ V}, I_D = 2\text{ mA}$                                                                                                 | 500                                                                                    |      | V                         |
| $V_{GS(th)}$ | $V_{DS} = 20\text{ V}, I_D = 20\text{ mA}$                                                                                               | 2                                                                                      |      | 5 V                       |
| $I_{GSS}$    | $V_{GS} = \pm 20\text{ V}, V_{DS} = 0\text{ V}$                                                                                          |                                                                                        |      | $\pm 500\text{ nA}$       |
| $I_{DSS}$    | $V_{DS} = 500\text{ V}, V_{GS} = 0\text{ V}$                                                                                             |                                                                                        |      | 2 mA                      |
| $R_{DS(on)}$ | $T_{VJ} = 25^{\circ}\text{C}$                                                                                                            |                                                                                        |      | 0.12 $\Omega$             |
| $R_{Gint}$   | $T_{VJ} = 25^{\circ}\text{C}$                                                                                                            |                                                                                        |      | 1.5 $\Omega$              |
| $g_{fs}$     | $V_{DS} = 15\text{ V}, I_{DS} = 12\text{ A}$                                                                                             |                                                                                        | 30   | S                         |
| $V_{DS}$     | $I_{DS} = 24\text{ A}, V_{GS} = 0\text{ V}$                                                                                              |                                                                                        |      | 1.5 V                     |
| $t_{d(on)}$  | $V_{DS} = 250\text{ V}, I_{DS} = 12\text{ A}, V_{GS} = 10\text{ V}$<br>$Z_{gen} = 1\text{ }\Omega, L\text{-load}$                        |                                                                                        |      | 100 ns                    |
| $t_{d(off)}$ |                                                                                                                                          |                                                                                        |      | 220 ns                    |
| $C_{iss}$    | $V_{DS} = 25\text{ V}, f = 1\text{ MHz}, V_{GS} = 0\text{ V}$                                                                            |                                                                                        | 8.5  | nF                        |
| $C_{oss}$    |                                                                                                                                          |                                                                                        | 0.9  | nF                        |
| $C_{rss}$    |                                                                                                                                          |                                                                                        | 0.3  | nF                        |
| $Q_g$        | $V_{DS} = 250\text{ V}, I_D = 12\text{ A}, V_{GS} = 10\text{ V}$                                                                         |                                                                                        | 350  | nC                        |
| $R_{thJH}$   | with heat transfer paste                                                                                                                 |                                                                                        |      | 0.21 K/W                  |
| $V_F$        | $I_F = 33\text{ A}; T_{VJ} = 25^{\circ}\text{C}$<br>$T_{VJ} = 150^{\circ}\text{C}$                                                       |                                                                                        |      | 1.75 V<br>1.5 V           |
| $I_R$        | $V_R = 600\text{ V}, T_{VJ} = 25^{\circ}\text{C}$<br>$V_R = 480\text{ V}, T_{VJ} = 25^{\circ}\text{C}$<br>$T_{VJ} = 125^{\circ}\text{C}$ |                                                                                        |      | 1.5 mA<br>0.25 mA<br>7 mA |
| $V_{T0}$     | For power-loss calculations only                                                                                                         |                                                                                        |      | 1.21 V                    |
| $r_T$        | $T_{VJ} = 125^{\circ}\text{C}$                                                                                                           |                                                                                        |      | 9 m $\Omega$              |
| $I_{RM}$     | $I_F = 30\text{ A}; -di_F/dt = 240\text{ A}/\mu\text{s}$<br>$V_R = 350\text{ V}, T_{VJ} = 100^{\circ}\text{C}$                           | 10                                                                                     | 11   | A                         |
| $R_{thJH}$   | with heat transfer paste                                                                                                                 |                                                                                        |      | 1.1 K/W                   |
| $V_F$        | $I_F = 20\text{ A}, T_{VJ} = 25^{\circ}\text{C}$<br>$T_{VJ} = 125^{\circ}\text{C}$                                                       |                                                                                        |      | 1.5 V<br>1.5 V            |
| $I_R$        | $V_R = 1200\text{ V}, T_{VJ} = 25^{\circ}\text{C}$<br>$V_R = 0.8 \cdot V_{RRM}, T_{VJ} = 125^{\circ}\text{C}$                            |                                                                                        |      | 0.25 mA<br>2 mA           |
| $V_{T0}$     | For power-loss calculations only                                                                                                         |                                                                                        |      | 1.18 V                    |
| $r_T$        | $T_{VJ} = 125^{\circ}\text{C}$                                                                                                           |                                                                                        |      | 12 m $\Omega$             |
| $R_{thJH}$   | with heat transfer paste                                                                                                                 |                                                                                        |      | 1.3 K/W                   |

Dimensions in mm (1 mm = 0.0394")

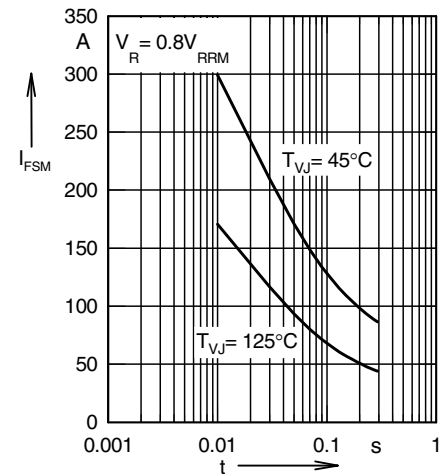
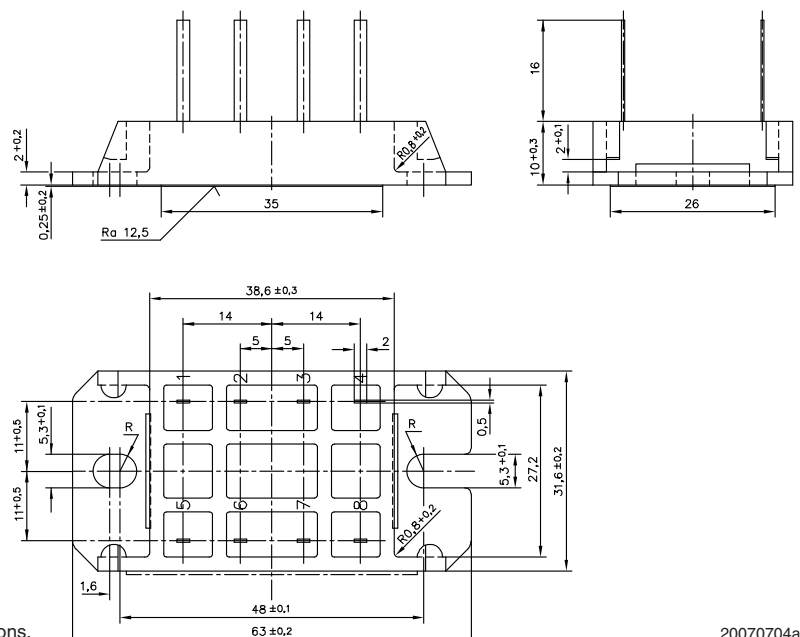


Fig. 1 Non-repetitive peak surge current (Rectifier Diodes)

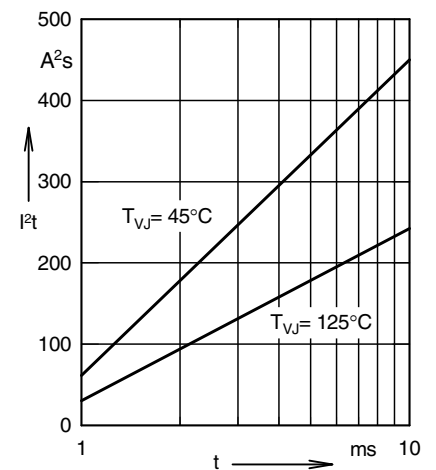


Fig. 2  $I^2t$  for fusing (Rectifier Diodes)

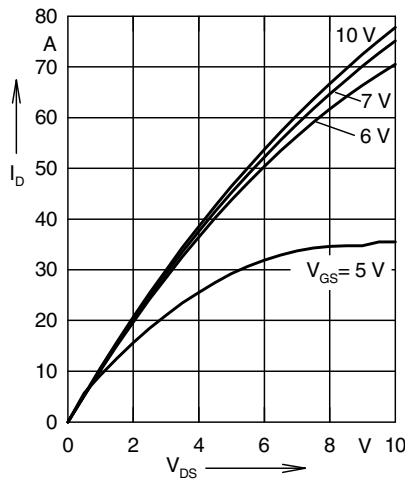


Fig. 3 Typ. output characteristic  
 $I_D = f(V_{DS})$  (MOSFET)

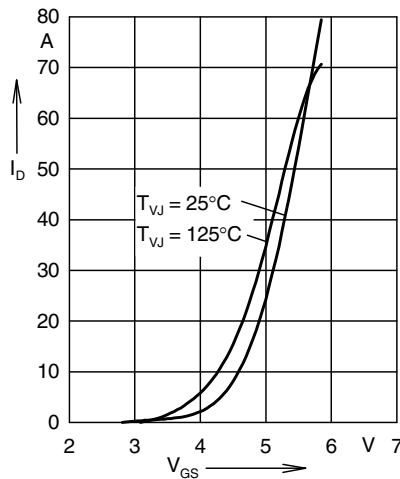


Fig. 4 Typ. transfer characteristics  
 $I_D = f(V_{GS})$  (MOSFET)

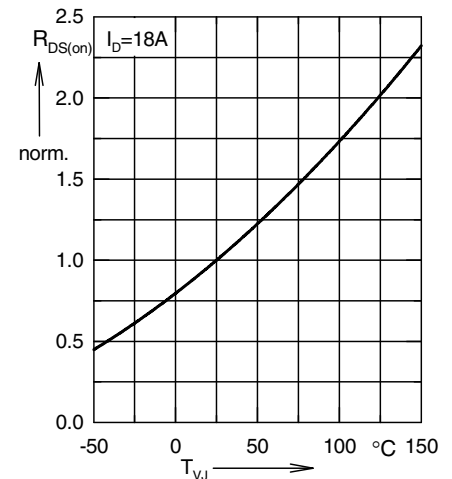


Fig. 5 Typ. normalized  
 $R_{DS(on)} = f(T_{VJ})$  (MOSFET)

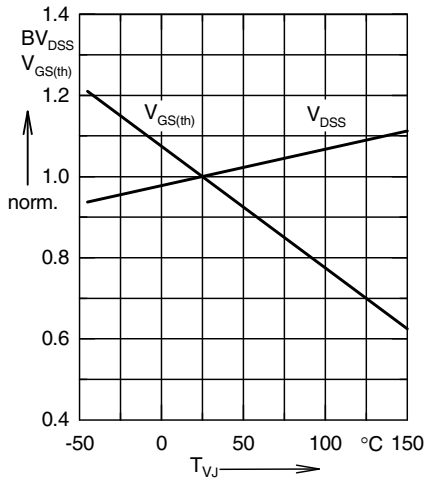


Fig. 6 Typ. normalized  $BV_{DS(sat)} = f(T_{VJ})$   
 $V_{GS(th)} = f(T_{VJ})$  (MOSFET)

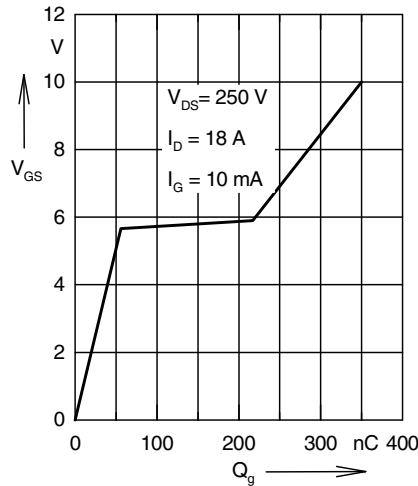


Fig. 7 Typ. turn-on gate charge  
characteristics,  $V_{GS} = f(Q_g)$  (MOSFET)

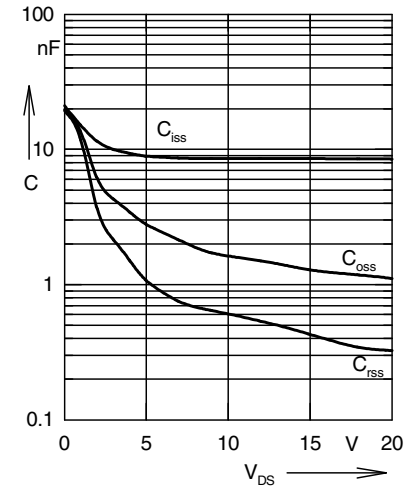


Fig. 8 Typ. capacitances  $C = f(V_{DS})$ ,  
 $f = 1 \text{ MHz}$  (MOSFET)

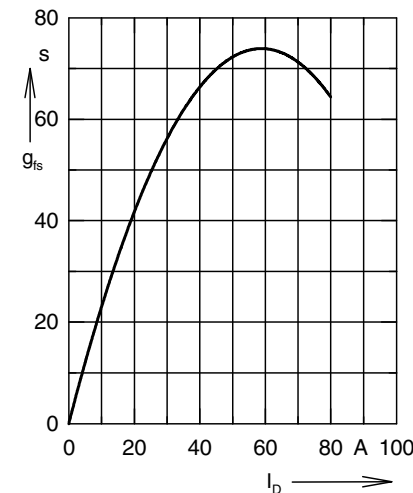


Fig. 9 Typ. transconductance,  
 $g_{fs} = f(I_D)$  (MOSFET)

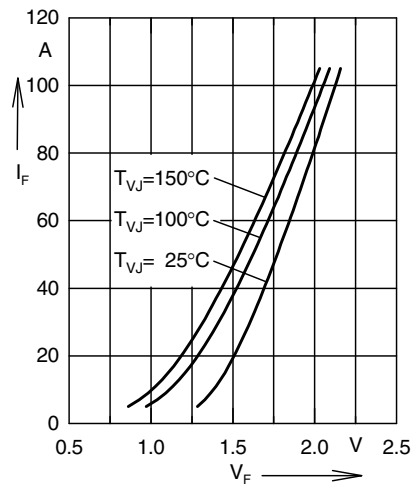


Fig. 10 Forward current versus  
voltage drop (Boost Diode)

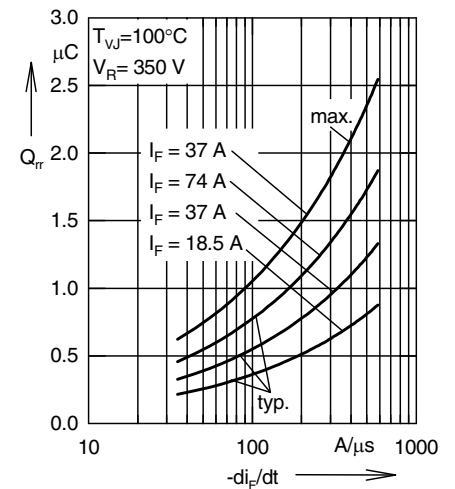


Fig. 11 Recovery charge versus  $-di_F/dt$   
(Boost Diode)

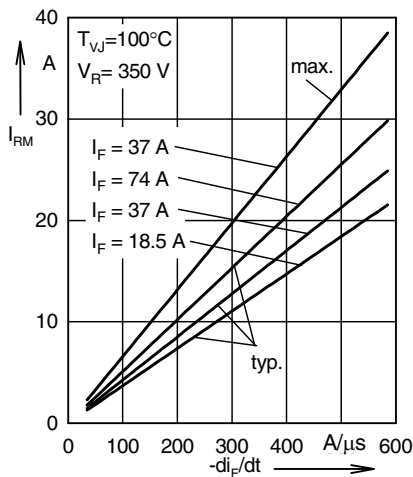


Fig. 12 Peak reverse current versus  $-di_F/dt$  (Boost Diode)

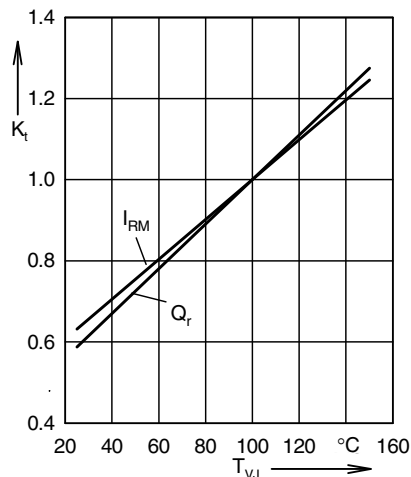


Fig. 13 Dynamic parameters versus junction temperature (Boost Diode)

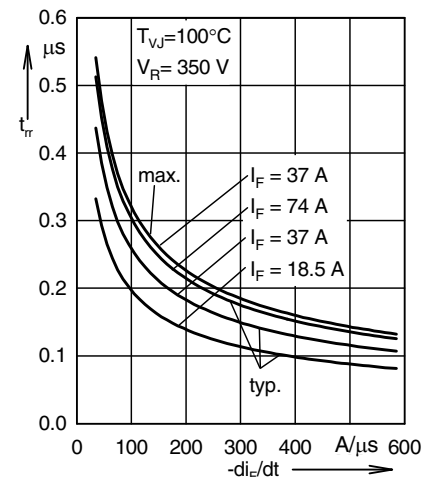


Fig. 14 Recovery time versus  $-di_F/dt$  (Boost Diode)

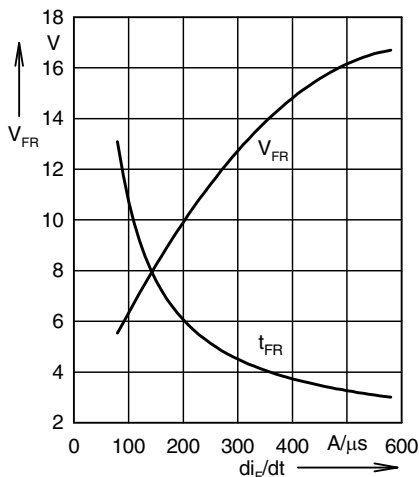


Fig. 15 Peak forward voltage versus  $-di_F/dt$  (Boost Diode)

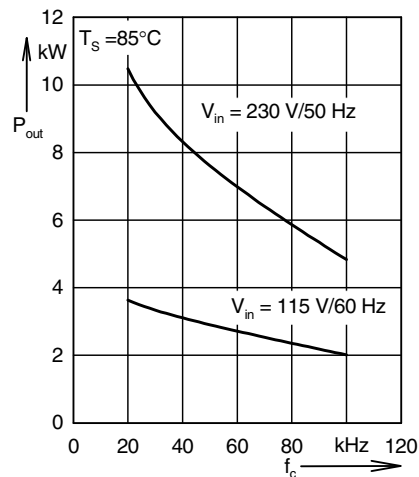


Fig. 16 Output power versus carrier frequency (Module)

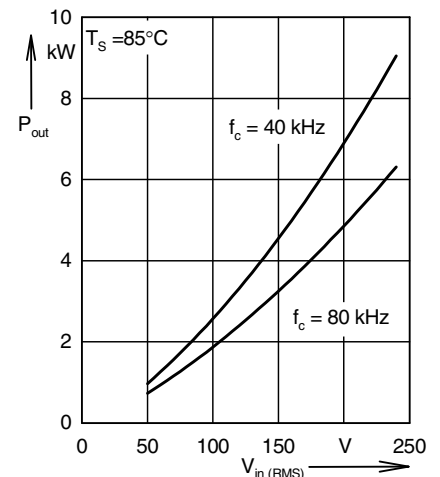


Fig. 17 Output power versus mains voltage

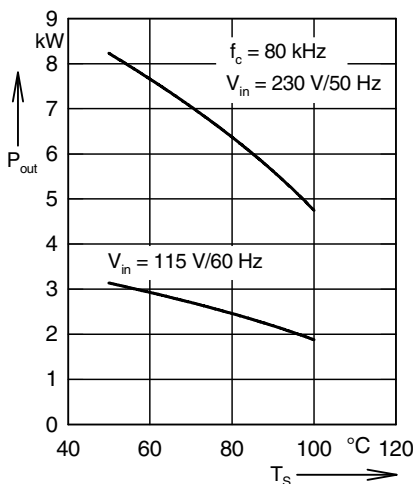


Fig. 18 Output power versus heatsink temperature (Module)

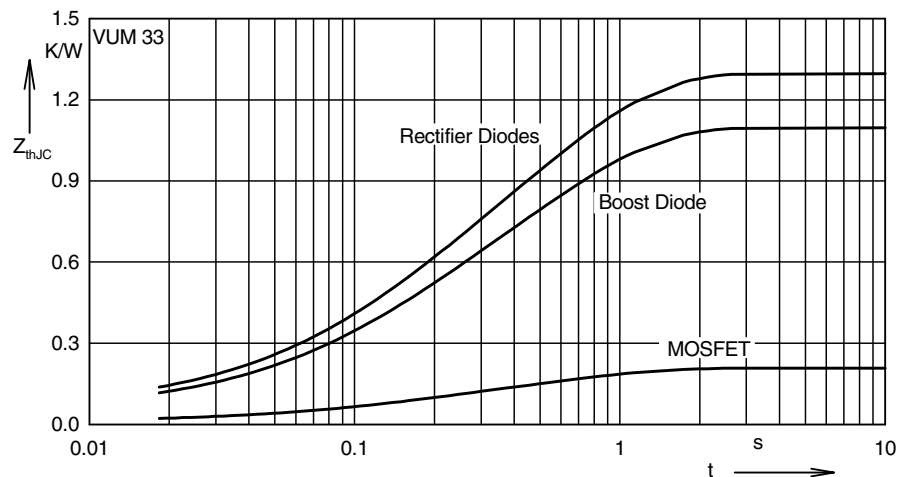


Fig. 19 Transient thermal impedance junction to case for all devices