Vincotech

10-FY12APA036MR-PB18E98Z
datasheet

***flow*PIM 1 + PFC** **1200 V / 36 mΩ**

Topology features

- Open Emitter configuration
- Temperature sensor
- Inverter
- 3ph Advanced Neutral PFC

Component features

- Easy paralleling
- Low on-resistance
- Fast switching speed
- Fast recovery body diode

Housing features

- Base isolation: Al_2O_3
- Convex shaped substrate for superior thermal contact
- Thermo-mechanical push-and-pull force relief
- Press-fit pin
- Reliable cold welding connection

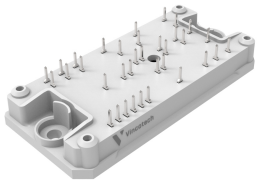
Target applications

- Embedded Drives
- Heat Pumps
- HVAC
- Industrial Drives

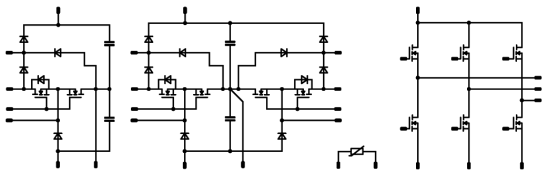
Types

- 10-FY12APA036MR-PB18E98Z

flow 1 12 mm housing



Schematic



Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Conditions	Value	Unit
Inverter Switch				
Drain-source voltage	V_{DSS}		1200	V
Drain current (DC current)	I_D	T_j = T_{jmax} T_s = 80 °C	27	A
Peak drain current	I_{DM}	t_p limited by T_{jmax}	84	A
Total power dissipation	P_{tot}	T_j = T_{jmax} T_s = 80 °C	53	W
Gate-source voltage	V_{GSS}		-4 / 21	V
		dynamic	-4 / 23	
Maximum Junction Temperature	T_{jmax}		175	°C
Positive Neutral Point Switch				
Drain-source voltage	V_{DSS}		750	V
Drain current (DC current)	I_D	T_j = T_{jmax} T_s = 80 °C	25	A
Peak drain current	I_{DM}	t_p limited by T_{jmax}	61	A
Total power dissipation	P_{tot}	T_j = T_{jmax} T_s = 80 °C	45	W
Gate-source voltage	V_{GSS}		-4 / 21	V
		dynamic	-4 / 23	
Maximum Junction Temperature	T_{jmax}		175	°C
Negative Neutral Point Switch				
Drain-source voltage	V_{DSS}		750	V
Drain current (DC current)	I_D	T_j = T_{jmax} T_s = 80 °C	25	A
Peak drain current	I_{DM}	t_p limited by T_{jmax}	61	A
Total power dissipation	P_{tot}	T_j = T_{jmax} T_s = 80 °C	45	W
Gate-source voltage	V_{GSS}		-4 / 21	V
		dynamic	-4 / 23	
Maximum Junction Temperature	T_{jmax}		175	°C

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Conditions		Value	Unit
Positive Neutral Point Diode					
Peak repetitive reverse voltage	V_{RRM}			1600	V
Forward current (DC current)	I_F	T_j = T_{jmax}	T_s = 80 °C	35	A
Surge (non-repetitive) forward current	I_{FSM}	Single Half Sine Wave, t_p = 10 ms	T_j = 150 °C	200	A
Surge current capability	I^2t			200	A^2s
Total power dissipation	P_{tot}	T_j = T_{jmax}	T_s = 80 °C	44	W
Maximum junction temperature	T_{jmax}			150	°C
Positive Boost Diode					
Peak repetitive reverse voltage	V_{RRM}			650	V
Forward current (DC current)	I_F	T_j = T_{jmax}	T_s = 80 °C	20	A
Surge (non-repetitive) forward current	I_{FSM}		T_j = 25 °C	55	A
Total power dissipation	P_{tot}	T_j = T_{jmax}	T_s = 80 °C	34	W
Maximum junction temperature	T_{jmax}			175	°C
Positive Boost Blocking Diode					
Peak repetitive reverse voltage	V_{RRM}			1600	V
Forward current (DC current)	I_F	T_j = T_{jmax}	T_s = 80 °C	35	A
Surge (non-repetitive) forward current	I_{FSM}	Single Half Sine Wave, t_p = 10 ms	T_j = 150 °C	200	A
Surge current capability	I^2t			200	A^2s
Total power dissipation	P_{tot}	T_j = T_{jmax}	T_s = 80 °C	44	W
Maximum junction temperature	T_{jmax}			150	°C

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Conditions	Value	Unit
Positive Boost Diode Protection Diode				
Peak repetitive reverse voltage	V_{RRM}		650	V
Forward current (DC current)	I_F	T_j = T_{jmax} T_s = 80 °C	21	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}	60	A
Total power dissipation	P_{tot}	T_j = T_{jmax} T_s = 80 °C	35	W
Maximum junction temperature	T_{jmax}		175	°C
Negative Boost Diode				
Peak repetitive reverse voltage	V_{RRM}		650	V
Forward current (DC current)	I_F	T_j = T_{jmax} T_s = 80 °C	20	A
Surge (non-repetitive) forward current	I_{FSM}	T_j = 25 °C	55	A
Total power dissipation	P_{tot}	T_j = T_{jmax} T_s = 80 °C	34	W
Maximum junction temperature	T_{jmax}		175	°C
Capacitor (PFC)				
Maximum DC voltage	V_{MAX}		630	V
Operation Temperature	T_{op}		-55 ... 150	°C
Module Properties				
Thermal Properties				
Storage temperature	T_{stg}		-40…+125	°C
Operation temperature under switching condition	T_{jop}		-40…+(T_{jmax} - 25)	°C
Isolation Properties				
Isolation voltage	V_{isol}	DC Test Voltage* t_p = 2 s	6000	V
Isolation voltage	V_{isol}	AC Voltage t_p = 1 min	2500	V
Creepage distance			>12,7	mm
Clearance			8,67	mm
Comparative Tracking Index	CTI		≥ 600	

*100 % tested in production

Characteristic Values

Parameter	Symbol	Conditions					Values			Unit
			V_{GE} [V] V_{GS} [V]	V_{CE} [V] V_{DS} [V] V_F [V]	I_C [A] I_D [A] I_F [A]	T_j [°C]	Min	Typ	Max	
Inverter Switch										
Static										
Drain-source on-state resistance	$r_{DS(on)}$		18		21	25 125 150		34,8 56,4 65	45(1)	mΩ
Gate-source threshold voltage	$V_{GS(th)}$				0,0111	25	2,8	3,5	4,8	V
Gate to Source Leakage Current	I_{GSS}		21	0		25			100	nA
Zero Gate Voltage Drain Current	I_{DSS}		0	1200		25		1	80	µA
Internal gate resistance	r_g							1		Ω
Gate charge	Q_g							91		
Gate to source charge	Q_{GS}		0/18	800	21	25		20		nC
Gate to drain charge	Q_{GD}							24		
Short-circuit input capacitance	C_{iss}							2335		
Short-circuit output capacitance	C_{oss}	f = 1 Mhz	0	800	0	25		70		pF
Reverse transfer capacitance	C_{rss}							5		
Diode forward voltage	V_{SD}		0		21	25		3,3		V
Thermal										
Thermal resistance junction to sink(2)	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						1,81		K/W

Characteristic Values

Parameter	Symbol	Conditions					Values			Unit
			V_{GE} [V] V_{GS} [V]	V_{CE} [V] V_{DS} [V] V_F [V]	I_C [A] I_D [A] I_F [A]	T_j [°C]	Min	Typ	Max	
Dynamic										
Turn-on delay time	$t_{d(on)}$	R_{gon} = 8 Ω R_{goff} = 8 Ω	0/15	600	30	25 125 150		25,07 20,28 19,56		ns
Rise time	t_r					25 125 150		32,72 28,78 28,2		ns
Turn-off delay time	$t_{d(off)}$					25 125 150		52,21 61,35 63,67		ns
Fall time	t_f					25 125 150		12,74 12,07 12,37		ns
Turn-on energy (per pulse)	E_{on}	Q_{rFWD}=0,152 µC Q_{rFWD}=0,197 µC Q_{rFWD}=0,238 µC				25 125 150		0,864 0,778 0,775		mWs
Turn-off energy (per pulse)	E_{off}					25 125 150		0,136 0,166 0,173		mWs
Peak recovery current	I_{RRM}	di/dt=666 A/µs di/dt=729 A/µs di/dt=910 A/µs				25 125 150		8,13 9,56 10,1		A
Reverse recovery time	t_{rr}					25 125 150		35,2 33,73 33,45		ns
Recovered charge	Q_r					25 125 150		0,152 0,197 0,238		µC
Reverse recovered energy	E_{rec}					25 125 150		0,023 0,038 0,052		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125 150		455,59 238,11 1730,75		A/µs

Characteristic Values

Parameter	Symbol	Conditions					Values			Unit
			V_{GE} [V] V_{GS} [V]	V_{CE} [V] V_{DS} [V] V_F [V]	I_C [A] I_D [A] I_F [A]	T_j [°C]	Min	Typ	Max	
Positive Neutral Point Switch										
Static										
Drain-source on-state resistance	$r_{DS(on)}$		18		17	25 125 150		39,7 59,3 66,6	57(1)	mΩ
Gate-source threshold voltage	$V_{GS(th)}$				0,00889	25	2,8	3,5	4,8	V
Gate to Source Leakage Current	I_{GSS}		21	0		25	-100		100	nA
Zero Gate Voltage Drain Current	I_{DSS}		0	750		25		1	80	µA
Internal gate resistance	r_g							4		Ω
Gate charge	Q_g							63		
Gate to source charge	Q_{GS}		18	500	17	25		14		nC
Gate to drain charge	Q_{GD}							19		
Short-circuit input capacitance	C_{iss}							1460		
Short-circuit output capacitance	C_{oss}	f = 1 Mhz	0	500	0	25		69		pF
Reverse transfer capacitance	C_{rss}							5		
Diode forward voltage	V_{SD}		0		17	25		3,3		V
Thermal										
Thermal resistance junction to sink(2)	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						2,09		K/W
Dynamic										
Turn-on delay time	$t_{d(on)}$					25 125 150		20 18,4 18,27		ns
Rise time	t_r					25 125 150		12,71 11,66 11,48		ns
Turn-off delay time	$t_{d(off)}$	R_{gon} = 4 Ω R_{goff} = 4 Ω	-1,5/18	500	15	25 125 150		47,71 53,44 55,02		ns
Fall time	t_f					25 125 150		5,25 7,32 10,12		ns
Turn-on energy (per pulse)	E_{on}	Q_{rFWD}=0,088 µC Q_{rFWD}=0,093 µC Q_{rFWD}=0,093 µC				25 125 150		0,137 0,126 0,122		mWs
Turn-off energy (per pulse)	E_{off}					25 125 150		0,061 0,075 0,077		mWs

Characteristic Values

Parameter	Symbol	Conditions					Values			Unit
			V_{GE} [V] V_{GS} [V]	V_{CE} [V] V_{DS} [V] V_F [V]	I_C [A] I_D [A] I_F [A]	T_j [°C]	Min	Typ	Max	
Negative Neutral Point Switch										
Static										
Drain-source on-state resistance	$r_{DS(on)}$		18		17	25 125 150		39,7 59,3 66,6	57(1)	mΩ
Gate-source threshold voltage	$V_{GS(th)}$				0,00889	25	2,8	3,5	4,8	V
Gate to Source Leakage Current	I_{GSS}		21	0		25	-100		100	nA
Zero Gate Voltage Drain Current	I_{DSS}		0	750		25		1	80	µA
Internal gate resistance	r_g							4		Ω
Gate charge	Q_g							63		
Gate to source charge	Q_{GS}		18	500	17	25		14		nC
Gate to drain charge	Q_{GD}							19		
Short-circuit input capacitance	C_{iss}							1460		
Short-circuit output capacitance	C_{oss}	f = 1 Mhz	0	500	0	25		69		pF
Reverse transfer capacitance	C_{rss}							5		
Diode forward voltage	V_{SD}		0		17	25		3,3		V
Thermal										
Thermal resistance junction to sink(2)	$R_{th(j-s)}$	λ_{pastc} = 3,4 W/mK (PSX)						2,09		K/W
Dynamic										
Turn-on delay time	$t_{d(on)}$					25 125 150		20 18,4 18,27		ns
Rise time	t_r					25 125 150		12,71 11,66 11,48		ns
Turn-off delay time	$t_{d(off)}$	R_{gon} = 4 Ω R_{goff} = 4 Ω				25 125 150		47,71 53,44 55,02		ns
Fall time	t_f		-1,5/18	500	15	25 125 150		5,25 7,32 10,12		ns
Turn-on energy (per pulse)	E_{on}	Q_{rFWD}=0,088 µC Q_{rFWD}=0,093 µC Q_{rFWD}=0,093 µC				25 125 150		0,137 0,126 0,122		mWs
Turn-off energy (per pulse)	E_{off}					25 125 150		0,061 0,075 0,077		mWs

Characteristic Values

Parameter	Symbol	Conditions					Values			Unit
			V_{GE} [V] V_{GS} [V]	V_{CE} [V] V_{DS} [V] V_F [V]	I_C [A] I_D [A] I_F [A]	T_j [°C]	Min	Typ	Max	
Positive Neutral Point Diode										
Static										
Forward voltage	V_F				5	25 125 150		0,928 0,813 0,784	1,1(1)	V
Reverse leakage current	I_R	V_r = 1600 V				25 150			100 1000	µA
Thermal										
Thermal resistance junction to sink(2)	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						1,6		K/W

Characteristic Values

Parameter	Symbol	Conditions					Values			Unit
			V_{GE} [V] V_{GS} [V]	V_{CE} [V] V_{DS} [V] V_F [V]	I_C [A] I_D [A] I_F [A]	T_j [°C]	Min	Typ	Max	
Positive Boost Diode										
Static										
Forward voltage	V_F				15	25 125 150		1,29 1,4 1,42	1,55[1]	V
Reverse leakage current	I_R	V_r = 650 V				25 150		3 45	300	µA
Thermal										
Thermal resistance junction to sink[2]	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						2,79		K/W
Dynamic										
Peak recovery current	I_{RM}	di/dt=1717 A/µs di/dt=1800 A/µs di/dt=1845 A/µs	-1,5/18	500	15	25 125 150		8,38 9,05 9,11		A
Reverse recovery time	t_{rr}					25 125 150		19,36 18,11 17,84		ns
Recovered charge	Q_r					25 125 150		0,088 0,093 0,093		µC
Reverse recovered energy	E_{rec}					25 125 150		0,018 0,021 0,021		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125 150		323,16 335,27 355,85		A/µs

Characteristic Values

Parameter	Symbol	Conditions					Values			Unit
			V_{GE} [V] V_{GS} [V]	V_{CE} [V] V_{DS} [V] V_F [V]	I_C [A] I_D [A] I_F [A]	T_j [°C]	Min	Typ	Max	
Positive Boost Blocking Diode										
Static										
Forward voltage	V_F				5	25 125 150		0,928 0,813 0,784	1,1(1)	V
Reverse leakage current	I_R	V_r = 1600 V				25 150			100 1000	µA
Thermal										
Thermal resistance junction to sink(2)	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						1,6		K/W
Positive Boost Diode Protection Diode										
Static										
Forward voltage	V_F				20	25 125 150		1,74 1,65 1,6	2(1)	V
Reverse leakage current	I_R	V_r = 650 V				25			20	µA
Thermal										
Thermal resistance junction to sink(2)	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						2,75		K/W

Characteristic Values

Parameter	Symbol	Conditions					Values			Unit
			V_{GE} [V] V_{GS} [V]	V_{CE} [V] V_{DS} [V] V_F [V]	I_C [A] I_D [A] I_F [A]	T_j [°C]	Min	Typ	Max	
Negative Boost Diode										
Static										
Forward voltage	V_F				15	25 125 150		1,29 1,4 1,42	1,55(1)	V
Reverse leakage current	I_R	V_r = 650 V				25 150		3 45	300	µA
Thermal										
Thermal resistance junction to sink(2)	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						2,79		K/W
Dynamic										
Peak recovery current	I_{RM}	di/dt=1717 A/µs di/dt=1800 A/µs di/dt=1845 A/µs	-1,5/18	500	15	25 125 150		8,38 9,05 9,11		A
Reverse recovery time	t_{rr}					25 125 150		19,36 18,11 17,84		ns
Recovered charge	Q_r					25 125 150		0,088 0,093 0,093		µC
Reverse recovered energy	E_{rec}					25 125 150		0,018 0,021 0,021		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125 150		323,16 335,27 355,85		A/µs

Characteristic Values

Parameter	Symbol	Conditions					Values			Unit
			V_{GE} [V] V_{GS} [V]	V_{CE} [V] V_{DS} [V] V_F [V]	I_C [A] I_D [A] I_F [A]	T_j [°C]	Min	Typ	Max	
Capacitor (PFC)										
Static										
Capacitance	C	DC bias voltage = 0 V				25		33		nF
Tolerance							-5		5	%
Thermistor										
Static										
Rated resistance	R					25		22		kΩ
Deviation of R100	$\Delta_{R/R}$	R_{100} = 1484 Ω				100	-5		5	%
Power dissipation	P					25		130		mW
Power dissipation constant	d					25		1,5		mW/K
B-value	$B_{(25/50)}$	Tol. ±1 %						3962		K
B-value	$B_{(25/100)}$	Tol. ±1 %						4000		K
Vincotech Thermistor Reference									I	

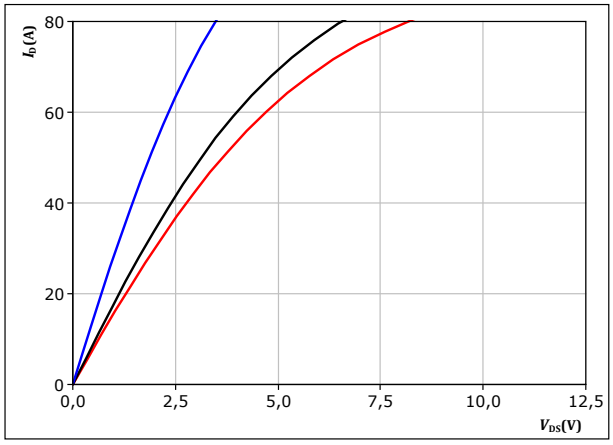
(1) Value at chip level
(2) Only valid with pre-applied Vincotech thermal interface material.

Inverter Switch Characteristics

figure 1. **MOSFET**

Typical output characteristics

$I_D = f(V_{DS})$

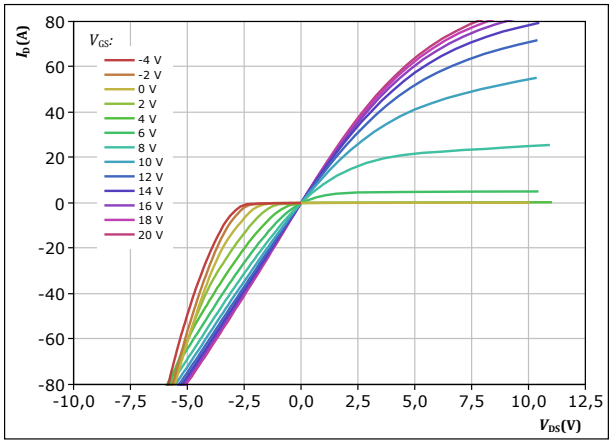


t_p =	250	µs		
V_{GS} =	18	V	T_j:	25 °C, 125 °C, 150 °C

figure 2. **MOSFET**

Typical output characteristics

$I_D = f(V_{DS})$



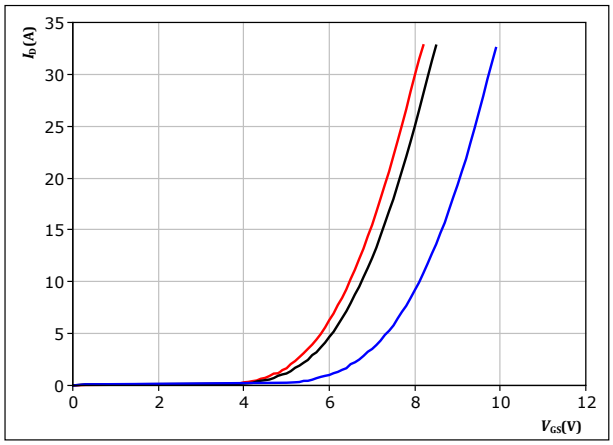
t_p =	250	µs
T_j =	150	°C

V_{GS} from -4 V to 20 V in steps of 2 V

figure 3. **MOSFET**

Typical transfer characteristics

$I_D = f(V_{GS})$

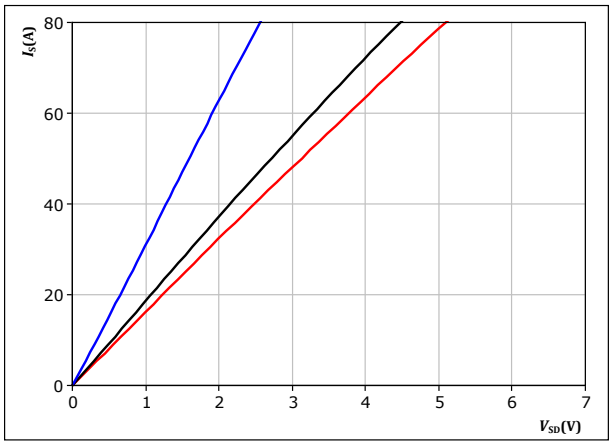


t_p =	250	µs		
V_{DS} =	10	V	T_j:	25 °C, 125 °C, 150 °C

figure 4. **MOSFET**

Typical reverse drain current characteristics

$I_{SD} = f(V_{SD})$



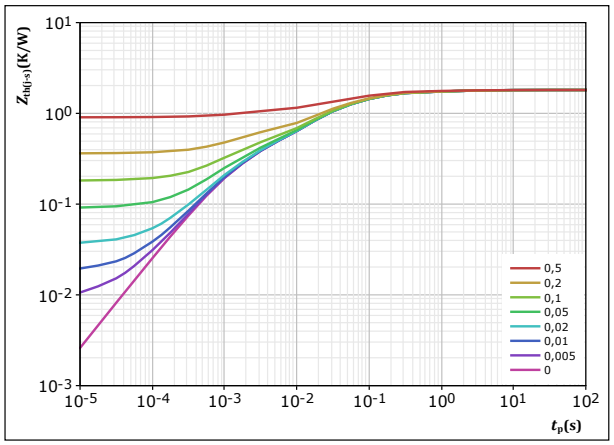
t_p =	250	µs		
V_{GS} =	18	V	T_j:	25 °C, 125 °C, 150 °C

Inverter Switch Characteristics

figure 5. MOSFET

Transient thermal impedance as a function of pulse width

$Z_{th(j-s)} = f(t_p)$



$D =$ t_p / T

$R_{th(j-s)} =$ 1,809 K/W

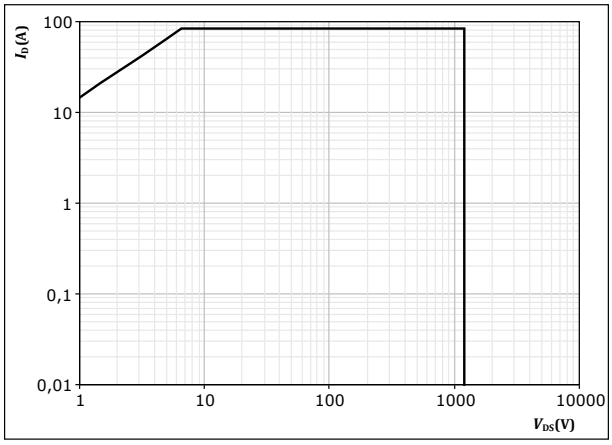
MOSFET thermal model values

R (K/W)	τ (s)
2,74E-02	5,80E+00
1,06E-01	1,15E+00
6,23E-01	1,05E-01
7,73E-01	2,03E-02
2,80E-01	1,29E-03

figure 6. MOSFET

Safe operating area

$I_D = f(V_{DS})$



$D =$ single pulse

$T_s =$ 80 °C

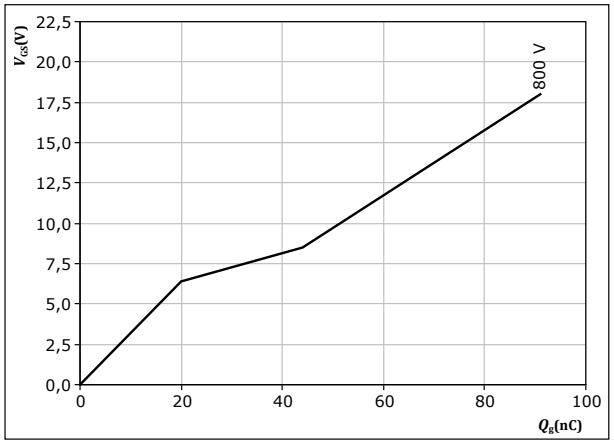
$V_{GS} =$ 18 V

$T_j =$ T_{jmax}

figure 7. MOSFET

Gate voltage vs gate charge

$V_{GS} = f(Q_g)$



$I_D =$ 21 A

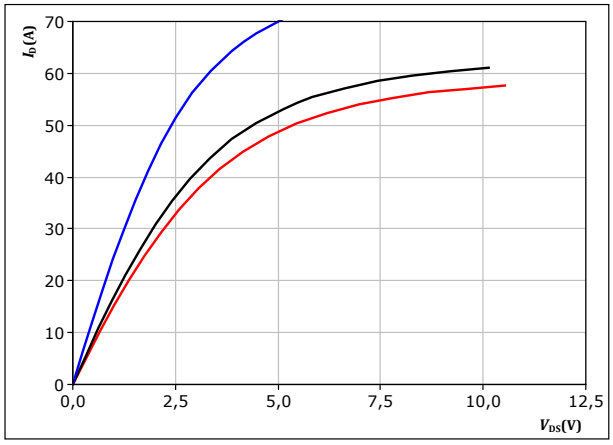
$T_j =$ 25 °C

Positive Neutral Point Switch Characteristics

figure 8. **MOSFET**

Typical output characteristics

$I_D = f(V_{DS})$

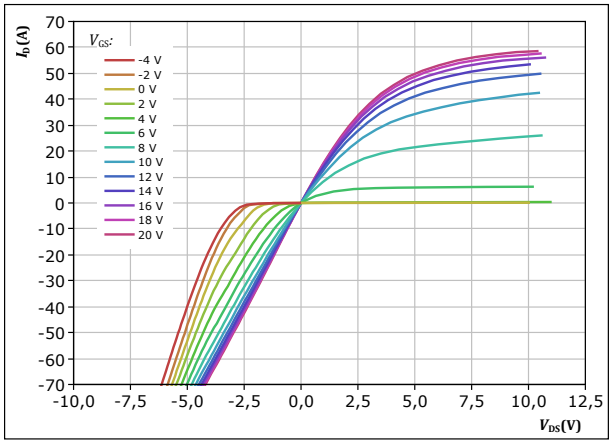


t_p =	250	µs		
V_{GS} =	18	V	T_j:	25 °C
				125 °C
				150 °C

figure 9. **MOSFET**

Typical output characteristics

$I_D = f(V_{DS})$



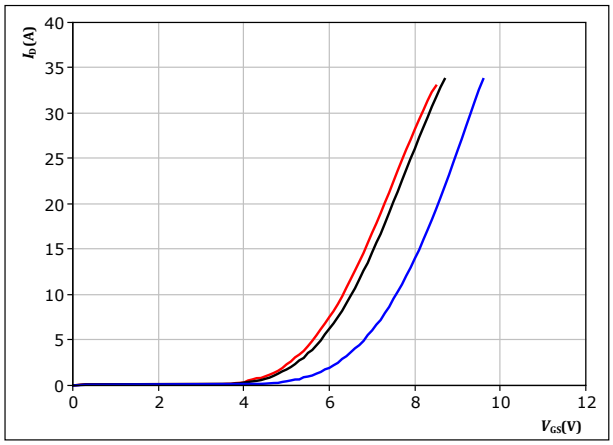
t_p =	250	µs
T_j =	150	°C

V_{GS} from -4 V to 20 V in steps of 2 V

figure 10. **MOSFET**

Typical transfer characteristics

$I_D = f(V_{GS})$

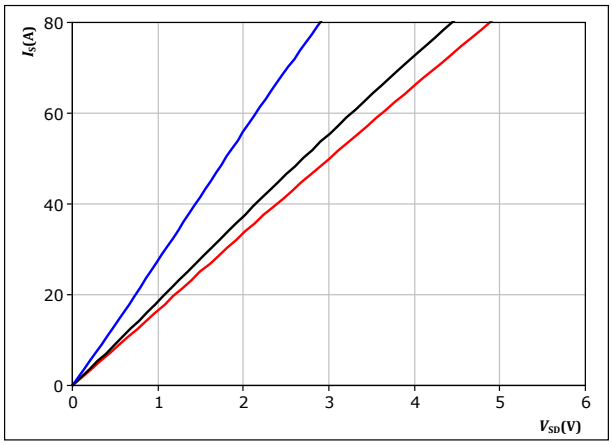


t_p =	250	µs		
V_{DS} =	10	V	T_j:	25 °C
				125 °C
				150 °C

figure 11. **MOSFET**

Typical reverse drain current characteristics

$I_{SD} = f(V_{SD})$



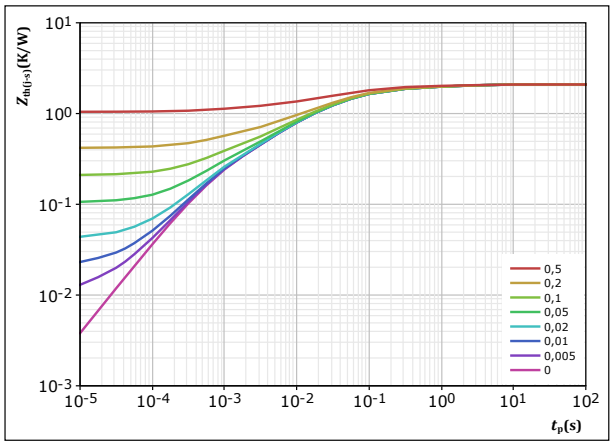
t_p =	250	µs		
V_{GS} =	18	V	T_j:	25 °C
				125 °C
				150 °C

Positive Neutral Point Switch Characteristics

figure 12. MOSFET

Transient thermal impedance as a function of pulse width

$Z_{th(j-s)} = f(t_p)$



$D =$ t_p / T

$R_{th(j-s)} =$ 2,09 K/W

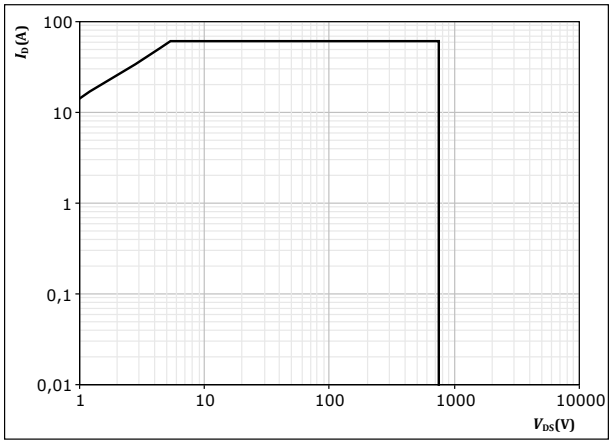
MOSFET thermal model values

R (K/W)	τ (s)
1,47E-01	2,44E+00
1,85E-01	3,77E-01
5,94E-01	7,42E-02
5,51E-01	2,46E-02
4,18E-01	6,13E-03
1,95E-01	6,90E-04

figure 13. MOSFET

Safe operating area

$I_D = f(V_{DS})$



$D =$ single pulse

$T_s =$ 80 °C

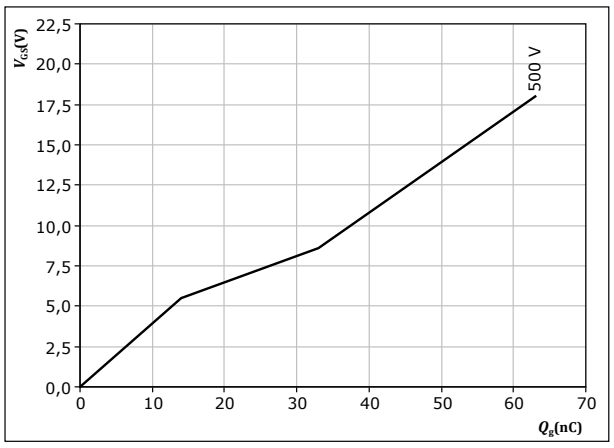
$V_{GS} =$ 18 V

$T_j =$ T_{jmax}

figure 14. MOSFET

Gate voltage vs gate charge

$V_{GS} = f(Q_g)$



$I_D =$ 17 A

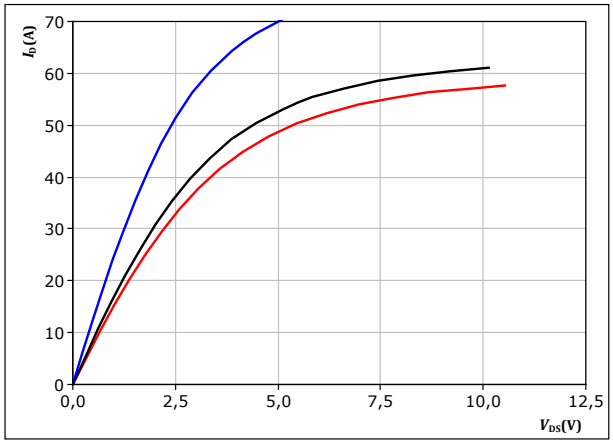
$T_j =$ 25 °C

Negative Neutral Point Switch Characteristics

figure 15. **MOSFET**

Typical output characteristics

$I_D = f(V_{DS})$

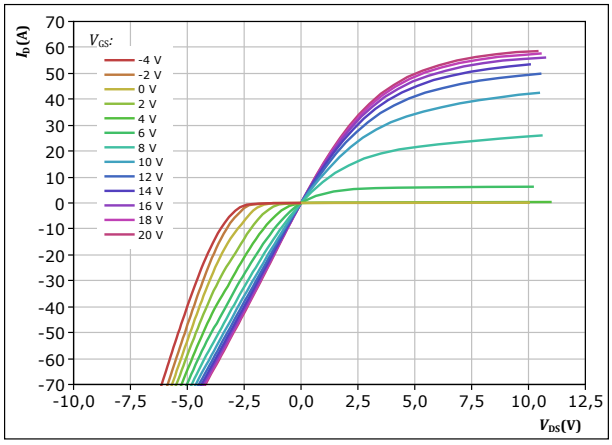


t_p =	250	µs		
V_{GS} =	18	V	T_j:	25 °C
				125 °C
				150 °C

figure 16. **MOSFET**

Typical output characteristics

$I_D = f(V_{DS})$



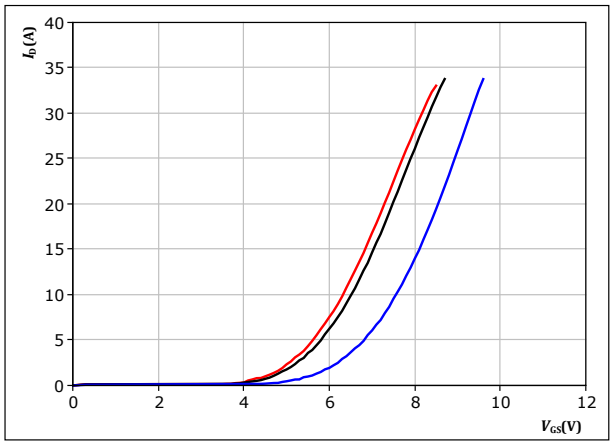
t_p =	250	µs
T_j =	150	°C

V_{GS} from -4 V to 20 V in steps of 2 V

figure 17. **MOSFET**

Typical transfer characteristics

$I_D = f(V_{GS})$

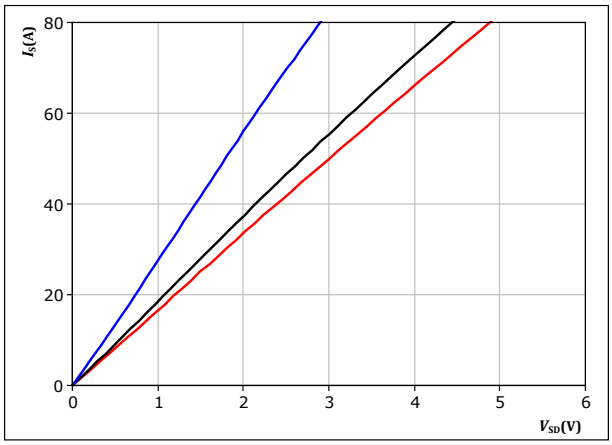


t_p =	250	µs		
V_{DS} =	10	V	T_j:	25 °C
				125 °C
				150 °C

figure 18. **MOSFET**

Typical reverse drain current characteristics

$I_{SD} = f(V_{SD})$



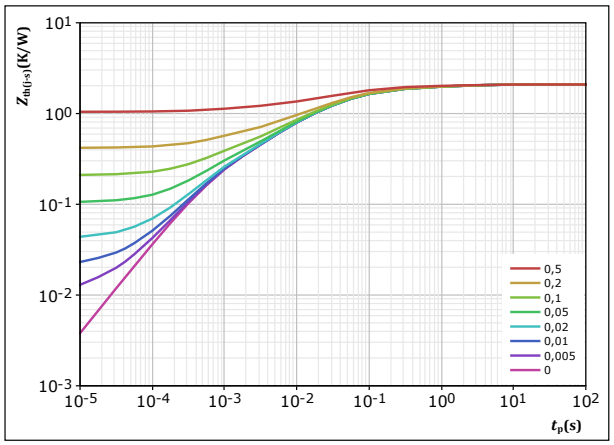
t_p =	250	µs		
V_{GS} =	18	V	T_j:	25 °C
				125 °C
				150 °C

Negative Neutral Point Switch Characteristics

figure 19. MOSFET

Transient thermal impedance as a function of pulse width

$Z_{th(j-s)} = f(t_p)$



D =	t_p / T	
$R_{th(j-s)}$ =	2,09	K/W

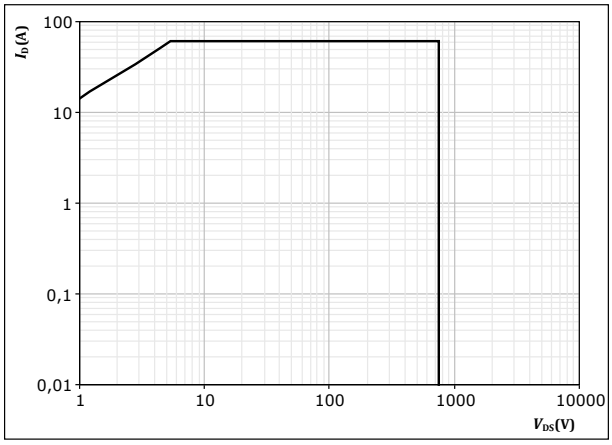
MOSFET thermal model values

R (K/W)	τ (s)
1,47E-01	2,44E+00
1,85E-01	3,77E-01
5,94E-01	7,42E-02
5,51E-01	2,46E-02
4,18E-01	6,13E-03
1,95E-01	6,90E-04

figure 20. MOSFET

Safe operating area

$I_D = f(V_{DS})$

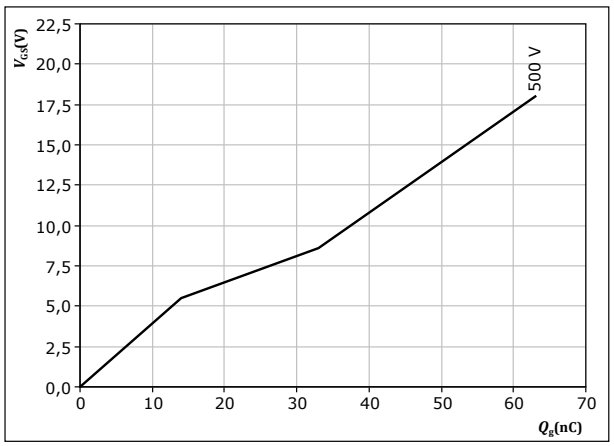


D =	single pulse	
T_s =	80	°C
V_{GS} =	18	V
T_j =	T_{jmax}	

figure 21. MOSFET

Gate voltage vs gate charge

$V_{GS} = f(Q_g)$



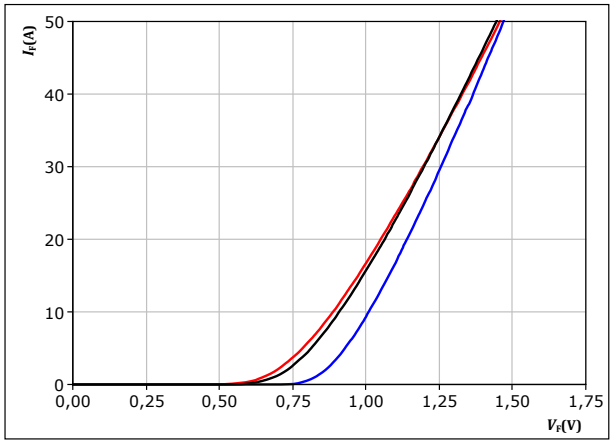
I_D =	17	A
T_j =	25	°C

Positive Neutral Point Diode Characteristics

figure 22. **Rectifier**

Typical forward characteristics

$I_F = f(V_F)$



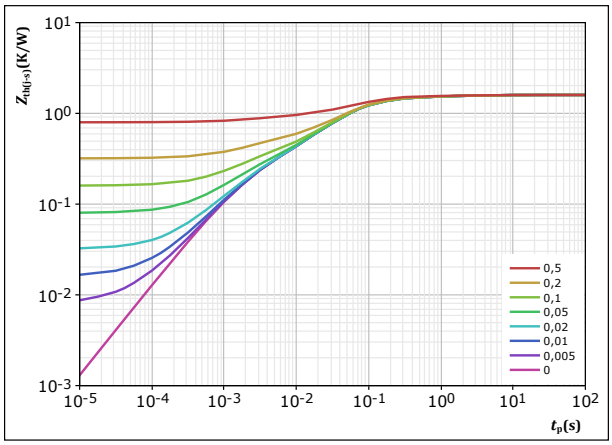
t_p = 250 µs

T_j: 25 °C, 125 °C, 150 °C

figure 23. **Rectifier**

Transient thermal impedance as a function of pulse width

$Z_{th(j-s)} = f(t_p)$



D = t_p / T

$R_{th(j-s)}$ = 1,595 K/W

Rectifier thermal model values

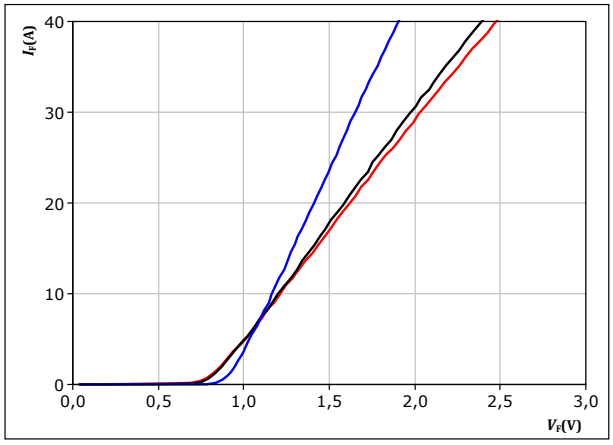
R (K/W)	τ (s)
5,74E-02	3,35E+00
1,49E-01	4,41E-01
9,92E-01	6,12E-02
2,25E-01	1,48E-02
1,72E-01	1,74E-03

Positive Boost Diode Characteristics

figure 24. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



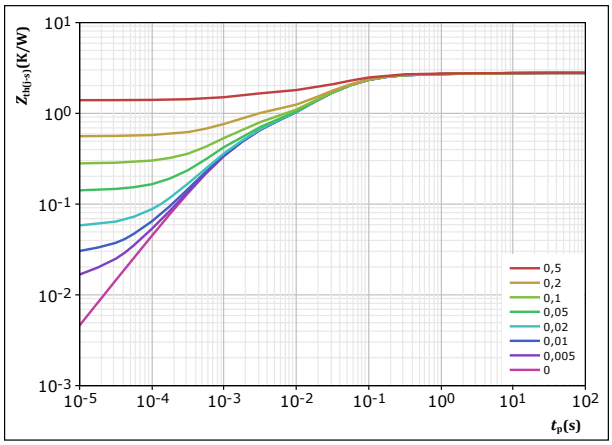
t_p = 250 µs

T_j: 25 °C, 125 °C, 150 °C

figure 25. **FWD**

Transient thermal impedance as a function of pulse width

$Z_{th(j-s)} = f(t_p)$



D = t_p / T

$R_{th(j-s)}$ = 2,792 K/W

FWD thermal model values

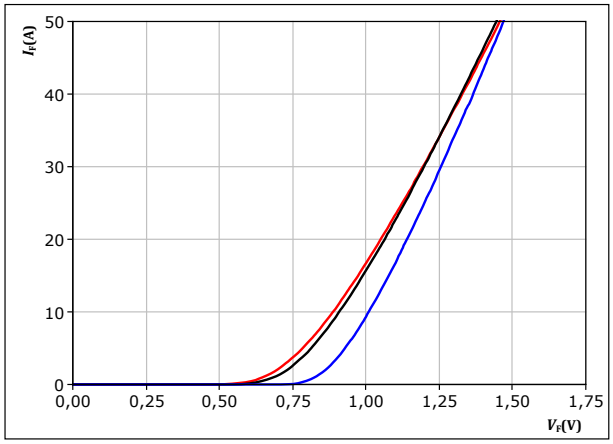
R (K/W)	τ (s)
4,96E-02	8,23E+00
9,93E-02	1,01E+00
7,66E-01	1,03E-01
1,36E+00	2,52E-02
5,19E-01	1,29E-03

Positive Boost Blocking Diode Characteristics

figure 26. **Rectifier**

Typical forward characteristics

$I_F = f(V_F)$



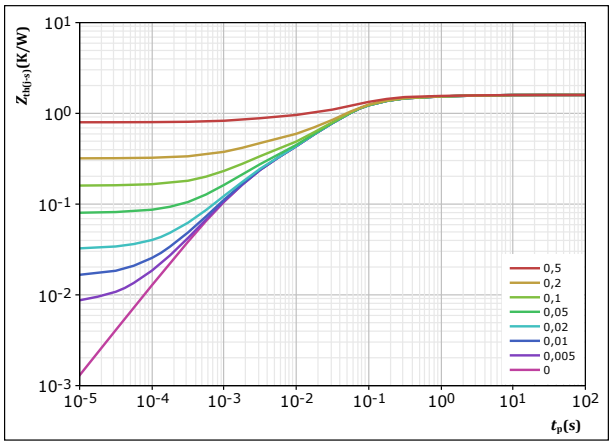
t_p = 250 µs

T_j: 25 °C, 125 °C, 150 °C

figure 27. **Rectifier**

Transient thermal impedance as a function of pulse width

$Z_{th(j-s)} = f(t_p)$



D = t_p / T

$R_{th(j-s)}$ = 1,595 K/W

Rectifier thermal model values

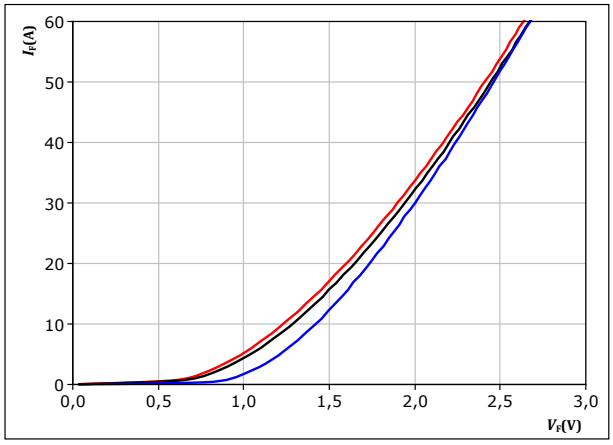
R (K/W)	τ (s)
5,74E-02	3,35E+00
1,49E-01	4,41E-01
9,92E-01	6,12E-02
2,25E-01	1,48E-02
1,72E-01	1,74E-03

Positive Boost Diode Protection Diode Characteristics

figure 28. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



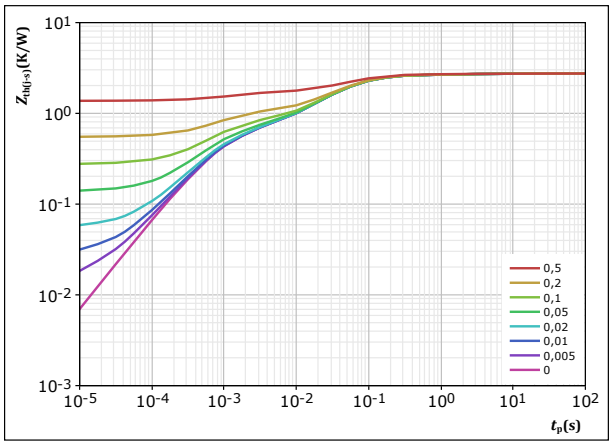
t_p = 250 µs

T_j: 25 °C, 125 °C, 150 °C

figure 29. **FWD**

Transient thermal impedance as a function of pulse width

$Z_{th(j-s)} = f(t_p)$



D = t_p / T

$R_{th(j-s)}$ = 2,747 K/W

FWD thermal model values

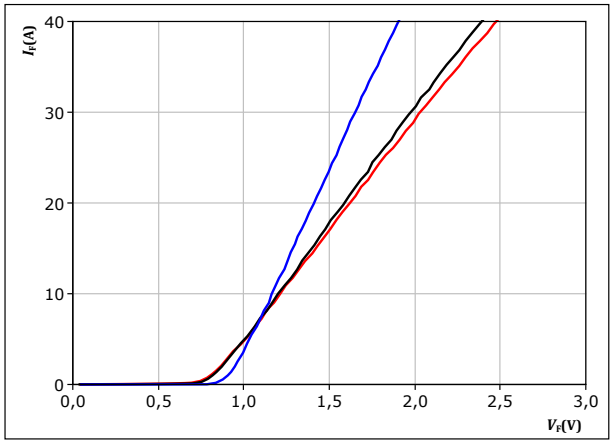
R (K/W)	τ (s)
4,84E-02	7,33E+00
8,76E-02	9,87E-01
7,71E-01	1,02E-01
1,28E+00	2,91E-02
5,58E-01	8,60E-04

Negative Boost Diode Characteristics

figure 30. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



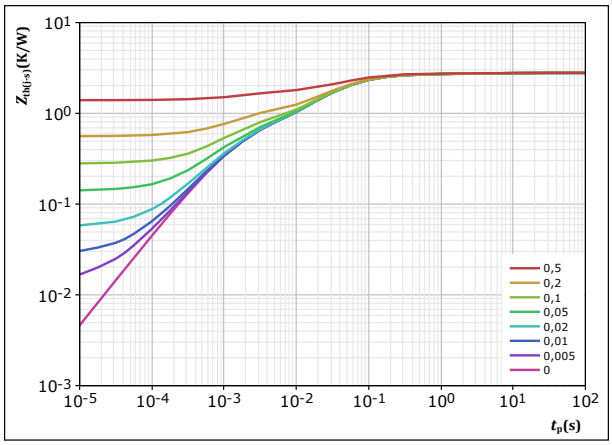
t_p = 250 µs

T_j: 25 °C, 125 °C, 150 °C

figure 31. **FWD**

Transient thermal impedance as a function of pulse width

$Z_{th(j-s)} = f(t_p)$



D = t_p / T

$R_{th(j-s)}$ = 2,792 K/W

FWD thermal model values

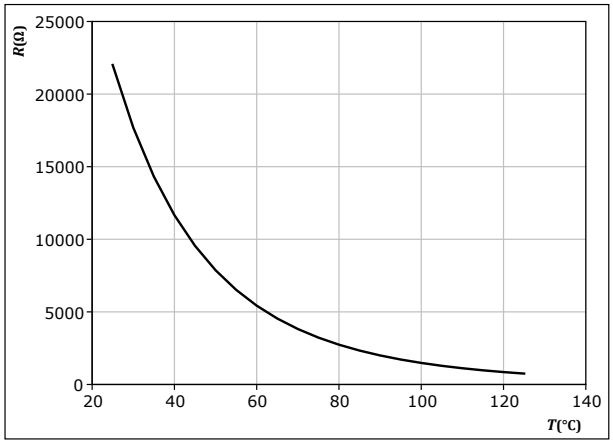
R (K/W)	τ (s)
4,96E-02	8,23E+00
9,93E-02	1,01E+00
7,66E-01	1,03E-01
1,36E+00	2,52E-02
5,19E-01	1,29E-03

Thermistor Characteristics

figure 32. **Thermistor**

Typical NTC characteristic as function of temperature

$R_T = f(T)$

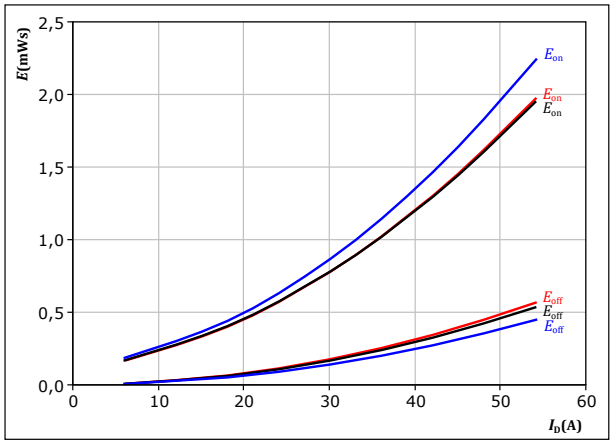


Inverter Switching Characteristics

figure 33. **MOSFET**

Typical switching energy losses as a function of drain current

$E = f(I_D)$



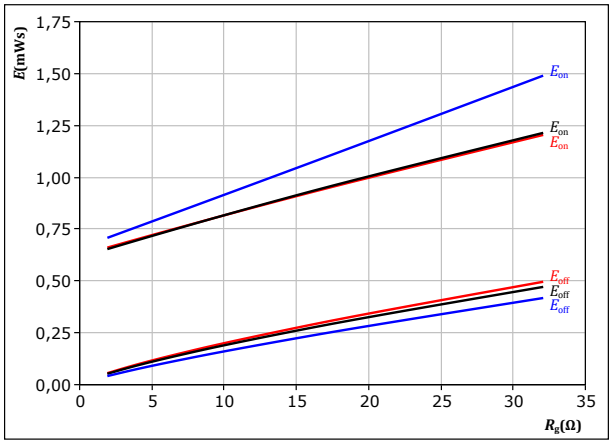
With an inductive load at

V_{DS} =	600	V	T_j:	25 °C
V_{GS} =	0/15	V		125 °C
R_{gon} =	8	Ω		150 °C
R_{goff} =	8	Ω		

figure 34. **MOSFET**

Typical switching energy losses as a function of MOSFET turn on gate resistor

$E = f(R_g)$



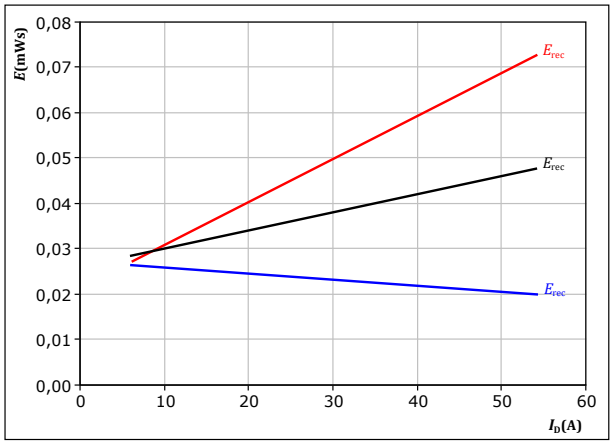
With an inductive load at

V_{DS} =	600	V	T_j:	25 °C
V_{GS} =	0/15	V		125 °C
I_D =	30	A		150 °C

figure 35. **MOSFET**

Typical reverse recovered energy loss as a function of drain current

$E_{rec} = f(I_D)$



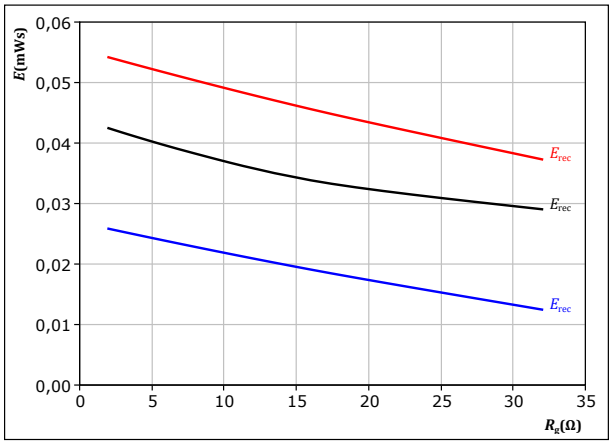
With an inductive load at

V_{DS} =	600	V	T_j:	25 °C
V_{GS} =	0/15	V		125 °C
R_{gon} =	8	Ω		150 °C

figure 36. **MOSFET**

Typical reverse recovered energy loss as a function of MOSFET turn on gate resistor

$E_{rec} = f(R_g)$



With an inductive load at

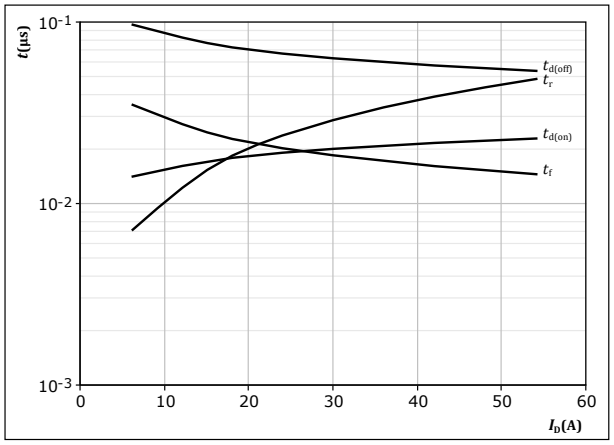
V_{DS} =	600	V	T_j:	25 °C
V_{GS} =	0/15	V		125 °C
I_D =	30	A		150 °C

Inverter Switching Characteristics

figure 37. **MOSFET**

Typical switching times as a function of drain current

$t = f(I_D)$



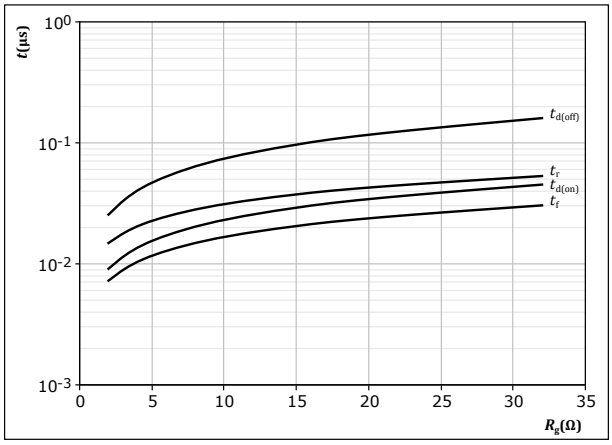
With an inductive load at

T_j =	150	°C
V_{DS} =	600	V
V_{GS} =	0/15	V
R_{gon} =	8	Ω
R_{goff} =	8	Ω

figure 38. **MOSFET**

Typical switching times as a function of MOSFET turn on gate resistor

$t = f(R_g)$



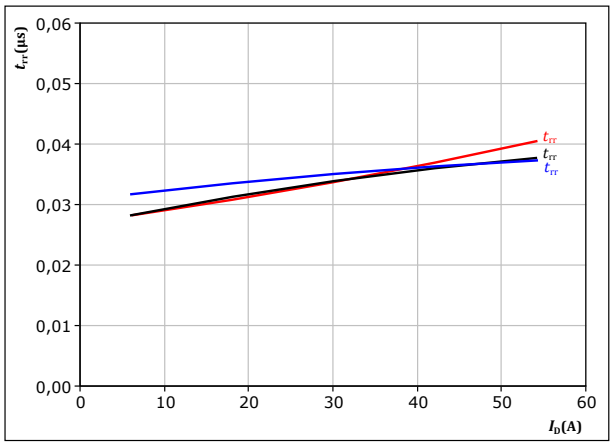
With an inductive load at

T_j =	150	°C
V_{DS} =	600	V
V_{GS} =	0/15	V
I_D =	30	A

figure 39. **MOSFET**

Typical reverse recovery time as a function of drain current

$t_{rr} = f(I_D)$



At

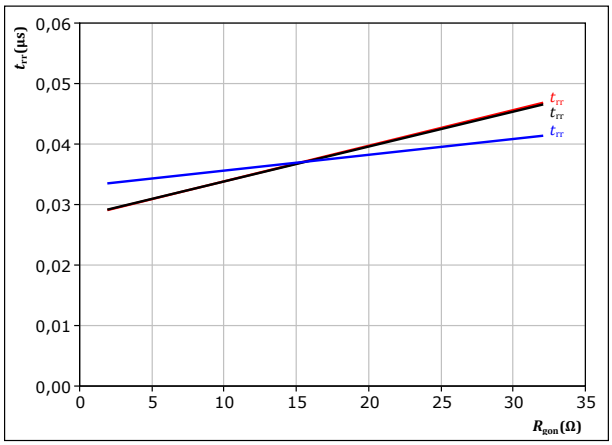
V_{DS} =	600	V
V_{GS} =	0/15	V
R_{gon} =	8	Ω

T_j: 25 °C, 125 °C, 150 °C

figure 40. **MOSFET**

Typical reverse recovery time as a function of MOSFET turn on gate resistor

$t_{rr} = f(R_{gon})$



At

V_{DS} =	600	V
V_{GS} =	0/15	V
I_D =	30	A

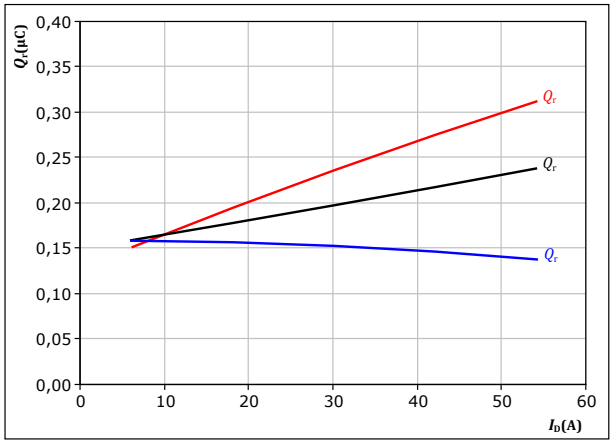
T_j: 25 °C, 125 °C, 150 °C

Inverter Switching Characteristics

figure 41. **MOSFET**

Typical recovered charge as a function of drain current

$Q_r = f(I_D)$

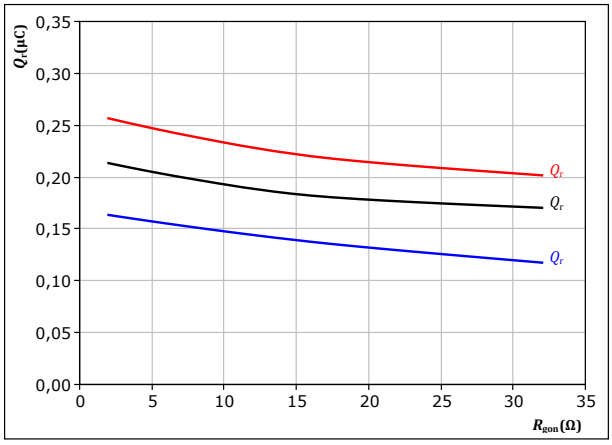


At					
V_{DS} =	600	V	T_j:	25 °C	
V_{GS} =	0/15	V		125 °C	
R_{gon} =	8	Ω		150 °C	

figure 42. **MOSFET**

Typical recovered charge as a function of MOSFET turn on gate resistor

$Q_r = f(R_{gon})$

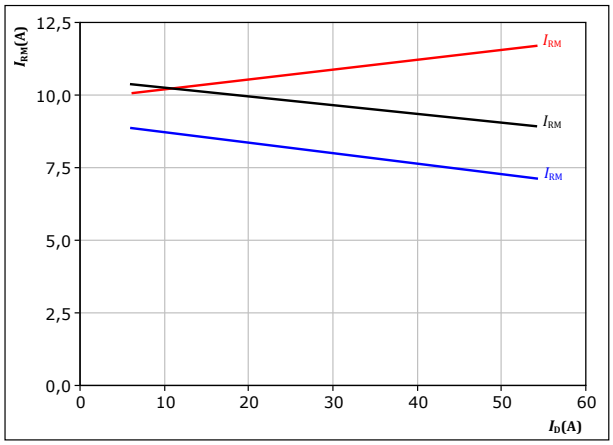


At					
V_{DS} =	600	V	T_j:	25 °C	
V_{GS} =	0/15	V		125 °C	
I_D =	30	A		150 °C	

figure 43. **MOSFET**

Typical peak reverse recovery current as a function of drain current

$I_{RM} = f(I_D)$

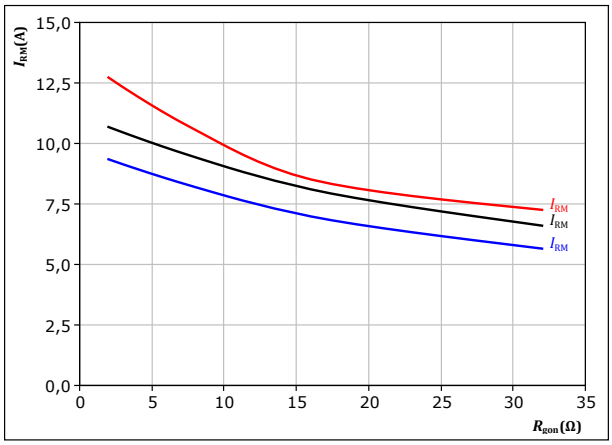


At					
V_{DS} =	600	V	T_j:	25 °C	
V_{GS} =	0/15	V		125 °C	
R_{gon} =	8	Ω		150 °C	

figure 44. **MOSFET**

Typical peak reverse recovery current as a function of MOSFET turn on gate resistor

$I_{RM} = f(R_{gon})$



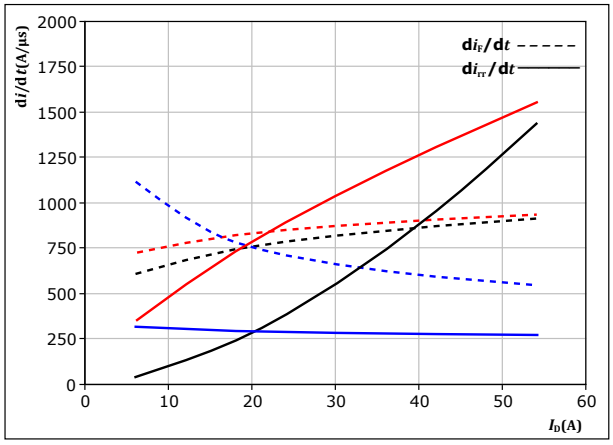
At					
V_{DS} =	600	V	T_j:	25 °C	
V_{GS} =	0/15	V		125 °C	
I_D =	30	A		150 °C	

Inverter Switching Characteristics

figure 45. **MOSFET**

Typical rate of fall of forward and reverse recovery current as a function of drain current

di_F/dt, di_{rr}/dt = f(I_D)

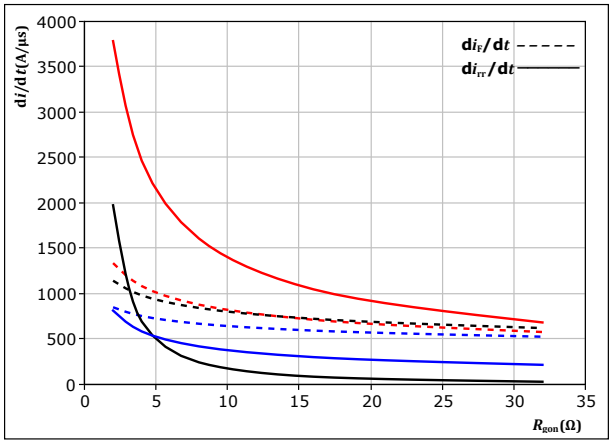


At	V_{DS} =	600	V		
	V_{GS} =	0/15	V	T_j:	25 °C
	R_{gon} =	8	Ω		125 °C
					150 °C

figure 46. **MOSFET**

Typical rate of fall of forward and reverse recovery current as a function of turn on gate resistor

di_F/dt, di_{rr}/dt = f(R_{gon})

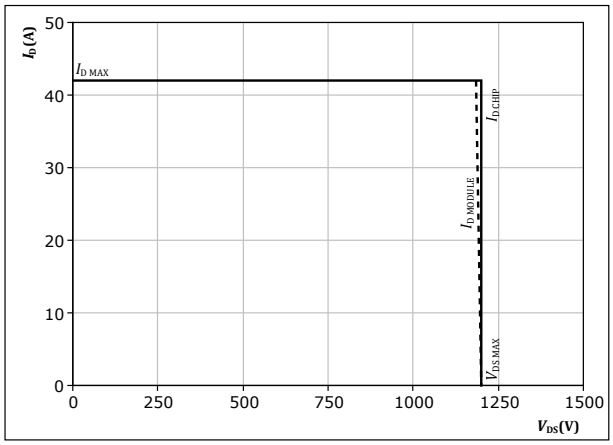


At	V_{DS} =	600	V		
	V_{GS} =	0/15	V	T_j:	25 °C
	I_D =	30	A		125 °C
					150 °C

figure 47. **MOSFET**

Reverse bias safe operating area

I_D = f(V_{DS})



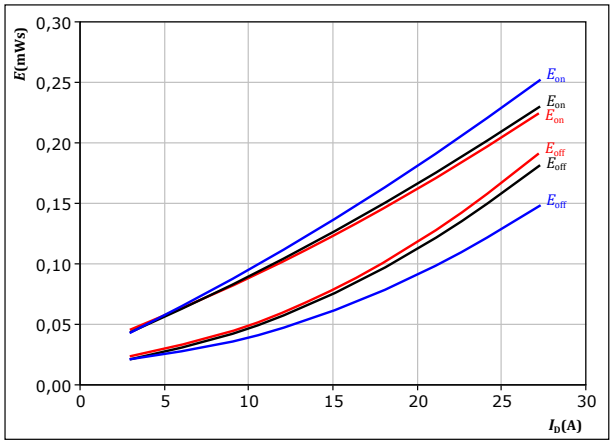
At	T_j =	150	°C
	R_{gon} =	8	Ω
	R_{goff} =	8	Ω

Positive Neutral Point Switching Characteristics

figure 48. **MOSFET**

Typical switching energy losses as a function of drain current

$E = f(I_D)$



With an inductive load at

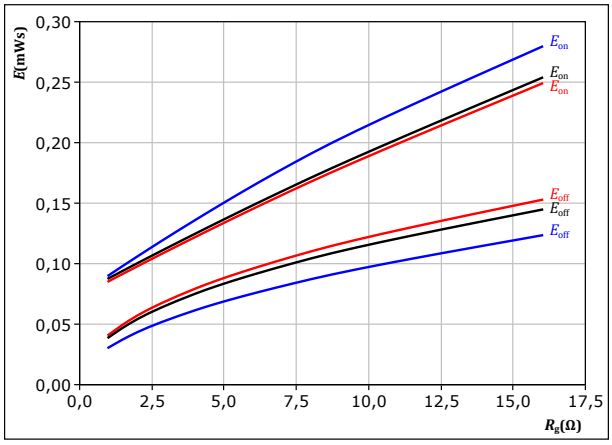
V_{DS} =	500	V
V_{GS} =	-1,5/18	V
R_{gon} =	4	Ω
R_{goff} =	4	Ω

T_j: 25 °C, 125 °C, 150 °C

figure 49. **MOSFET**

Typical switching energy losses as a function of MOSFET turn on gate resistor

$E = f(R_g)$



With an inductive load at

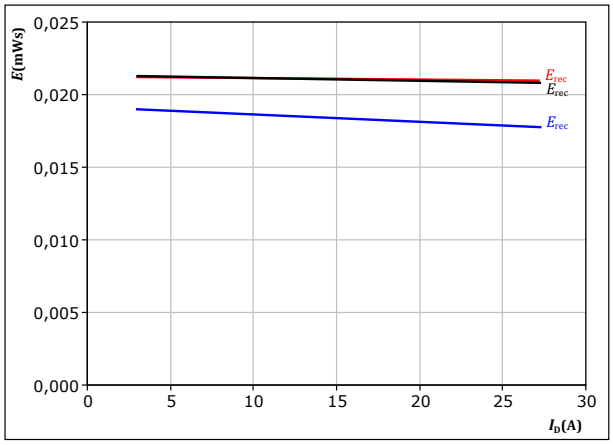
V_{DS} =	500	V
V_{GS} =	-1,5/18	V
I_D =	15	A

T_j: 25 °C, 125 °C, 150 °C

figure 50. **FWD**

Typical reverse recovered energy loss as a function of drain current

$E_{rec} = f(I_D)$



With an inductive load at

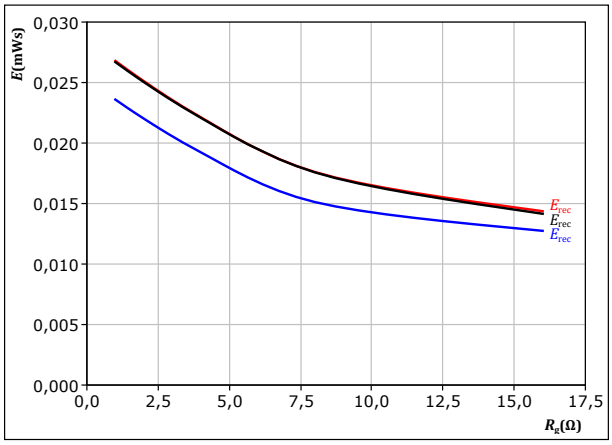
V_{DS} =	500	V
V_{GS} =	-1,5/18	V
R_{gon} =	4	Ω

T_j: 25 °C, 125 °C, 150 °C

figure 51. **FWD**

Typical reverse recovered energy loss as a function of MOSFET turn on gate resistor

$E_{rec} = f(R_g)$



With an inductive load at

V_{DS} =	500	V
V_{GS} =	-1,5/18	V
I_D =	15	A

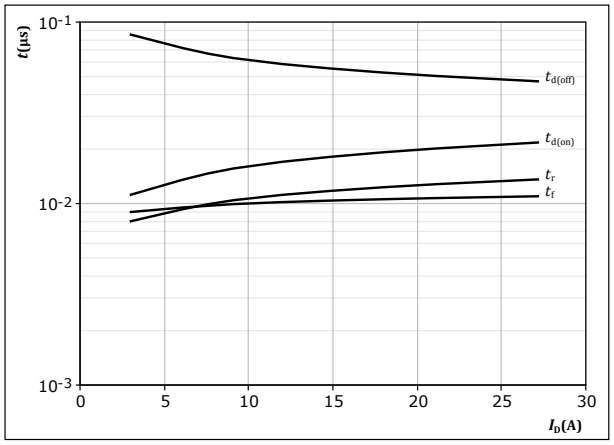
T_j: 25 °C, 125 °C, 150 °C

Positive Neutral Point Switching Characteristics

figure 52. **MOSFET**

Typical switching times as a function of drain current

$t = f(I_D)$



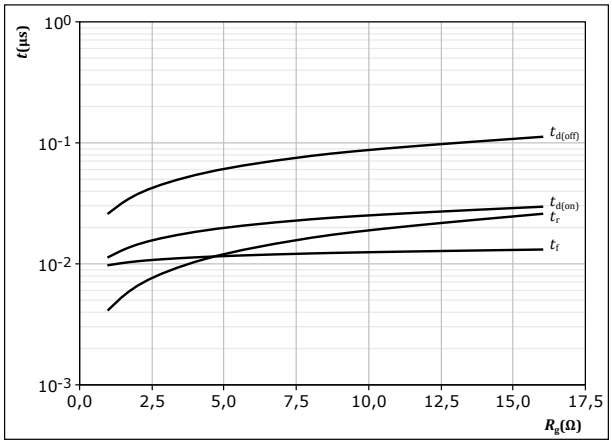
With an inductive load at

T_j =	150	°C
V_{DS} =	500	V
V_{GS} =	-1,5/18	V
R_{gon} =	4	Ω
R_{goff} =	4	Ω

figure 53. **MOSFET**

Typical switching times as a function of MOSFET turn on gate resistor

$t = f(R_g)$



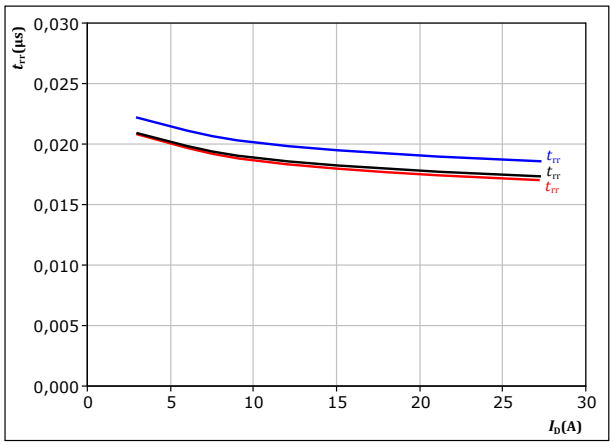
With an inductive load at

T_j =	150	°C
V_{DS} =	500	V
V_{GS} =	-1,5/18	V
I_D =	15	A

figure 54. **FWD**

Typical reverse recovery time as a function of drain current

$t_{rr} = f(I_D)$



At

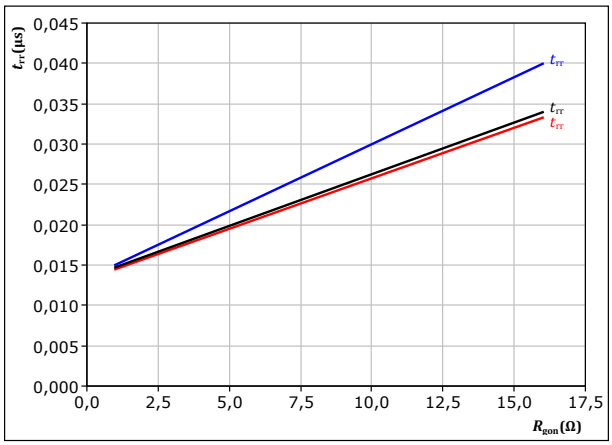
V_{DS} =	500	V
V_{GS} =	-1,5/18	V
R_{gon} =	4	Ω

T_j: 25 °C, 125 °C, 150 °C

figure 55. **FWD**

Typical reverse recovery time as a function of MOSFET turn on gate resistor

$t_{rr} = f(R_{gon})$



At

V_{DS} =	500	V
V_{GS} =	-1,5/18	V
I_D =	15	A

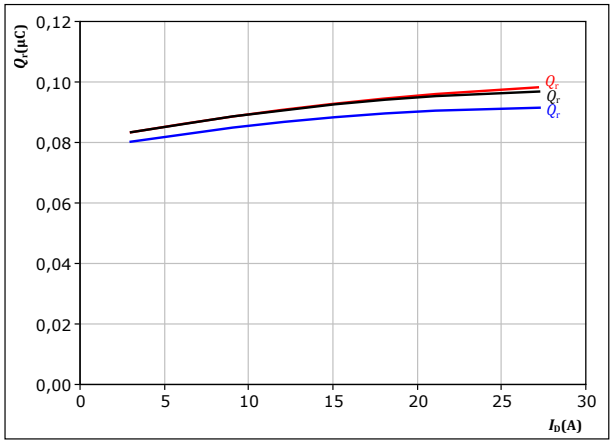
T_j: 25 °C, 125 °C, 150 °C

Positive Neutral Point Switching Characteristics

figure 56. **FWD**

Typical recovered charge as a function of drain current

$Q_r = f(I_D)$

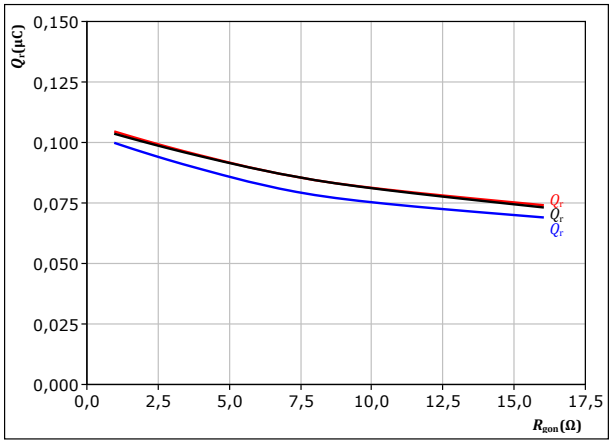


At					
V_{DS} =	500	V	T_j:	25 °C	
V_{GS} =	-1,5/18	V		125 °C	
R_{gon} =	4	Ω		150 °C	

figure 57. **FWD**

Typical recovered charge as a function of MOSFET turn on gate resistor

$Q_r = f(R_{gon})$

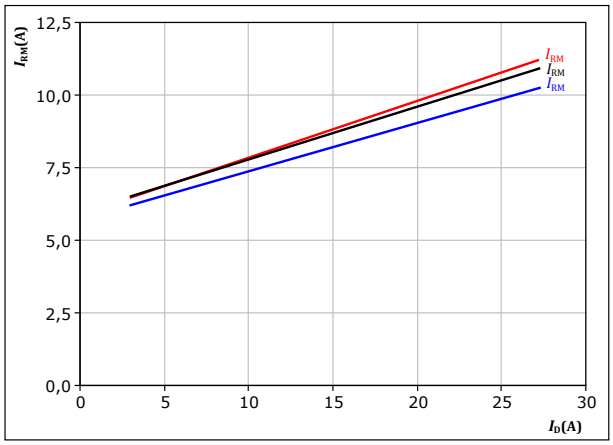


At					
V_{DS} =	500	V	T_j:	25 °C	
V_{GS} =	-1,5/18	V		125 °C	
I_D =	15	A		150 °C	

figure 58. **FWD**

Typical peak reverse recovery current as a function of drain current

$I_{RM} = f(I_D)$

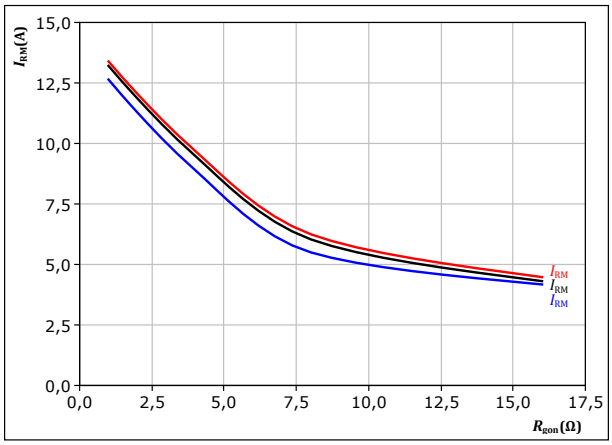


At					
V_{DS} =	500	V	T_j:	25 °C	
V_{GS} =	-1,5/18	V		125 °C	
R_{gon} =	4	Ω		150 °C	

figure 59. **FWD**

Typical peak reverse recovery current as a function of MOSFET turn on gate resistor

$I_{RM} = f(R_{gon})$



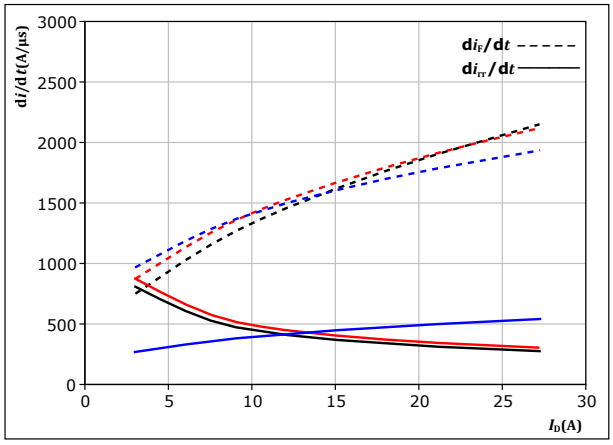
At					
V_{DS} =	500	V	T_j:	25 °C	
V_{GS} =	-1,5/18	V		125 °C	
I_D =	15	A		150 °C	

Positive Neutral Point Switching Characteristics

figure 60. **FWD**

Typical rate of fall of forward and reverse recovery current as a function of drain current

di_F/dt, di_{rr}/dt = f(I_D)

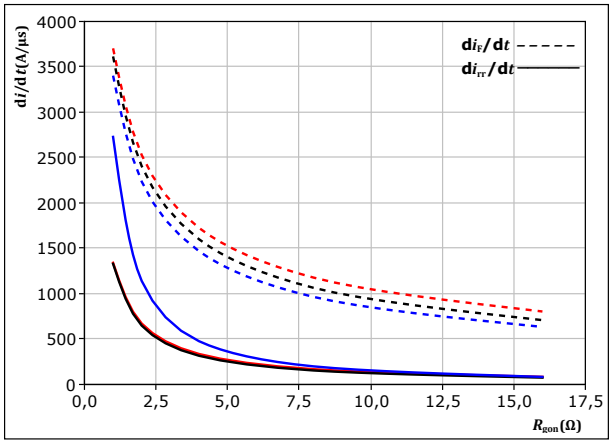


At				
	V_{DS} =	500	V	
	V_{GS} =	-1,5/18	V	
	R_{gon} =	4	Ω	
	T_j:			25 °C
				125 °C
				150 °C

figure 61. **FWD**

Typical rate of fall of forward and reverse recovery current as a function of turn on gate resistor

di_F/dt, di_{rr}/dt = f(R_{gon})

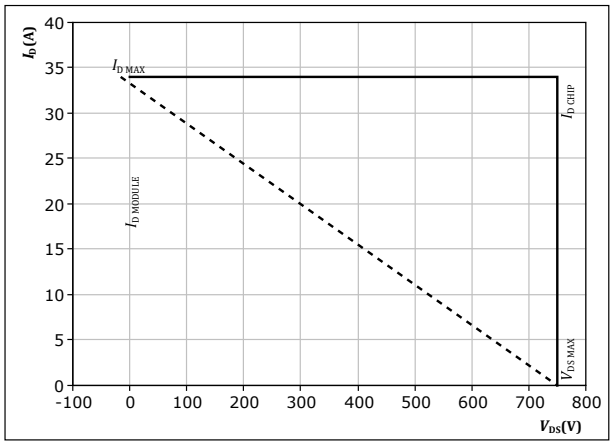


At				
	V_{DS} =	500	V	
	V_{GS} =	-1,5/18	V	
	I_D =	15	A	
	T_j:			25 °C
				125 °C
				150 °C

figure 62. **MOSFET**

Reverse bias safe operating area

I_D = f(V_{DS})



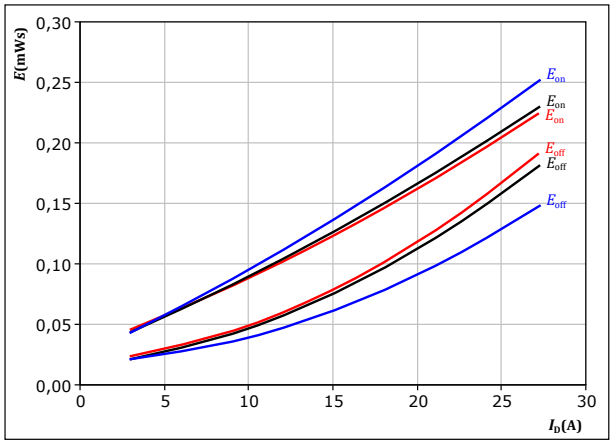
At			
	T_j =	150	°C
	R_{gon} =	4	Ω
	R_{goff} =	4	Ω

Negative Neutral Point Switching Characteristics

figure 63. **MOSFET**

Typical switching energy losses as a function of drain current

$E = f(I_D)$



With an inductive load at

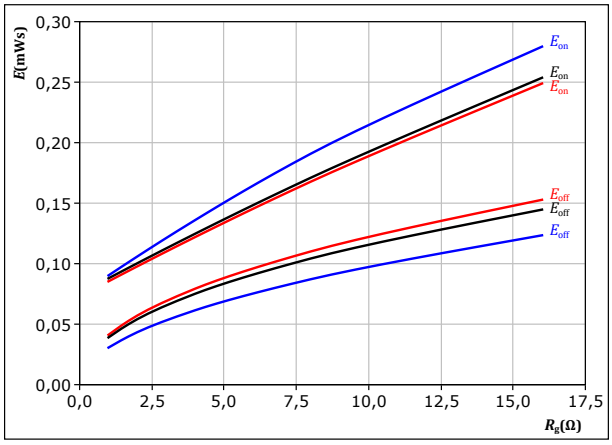
V_{DS} =	500	V
V_{GS} =	-1,5/18	V
R_{gon} =	4	Ω
R_{goff} =	4	Ω

T_j: 25 °C, 125 °C, 150 °C

figure 64. **MOSFET**

Typical switching energy losses as a function of MOSFET turn on gate resistor

$E = f(R_g)$



With an inductive load at

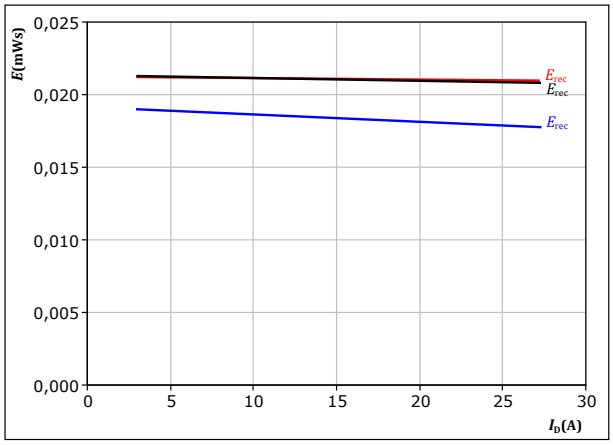
V_{DS} =	500	V
V_{GS} =	-1,5/18	V
I_D =	15	A

T_j: 25 °C, 125 °C, 150 °C

figure 65. **FWD**

Typical reverse recovered energy loss as a function of drain current

$E_{rec} = f(I_D)$



With an inductive load at

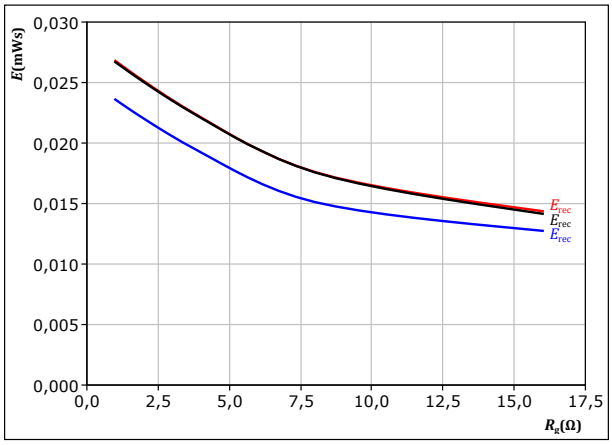
V_{DS} =	500	V
V_{GS} =	-1,5/18	V
R_{gon} =	4	Ω

T_j: 25 °C, 125 °C, 150 °C

figure 66. **FWD**

Typical reverse recovered energy loss as a function of MOSFET turn on gate resistor

$E_{rec} = f(R_g)$



With an inductive load at

V_{DS} =	500	V
V_{GS} =	-1,5/18	V
I_D =	15	A

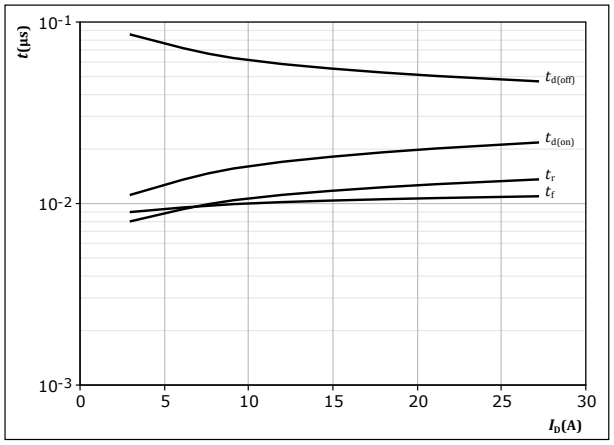
T_j: 25 °C, 125 °C, 150 °C

Negative Neutral Point Switching Characteristics

figure 67. **MOSFET**

Typical switching times as a function of drain current

$t = f(I_D)$



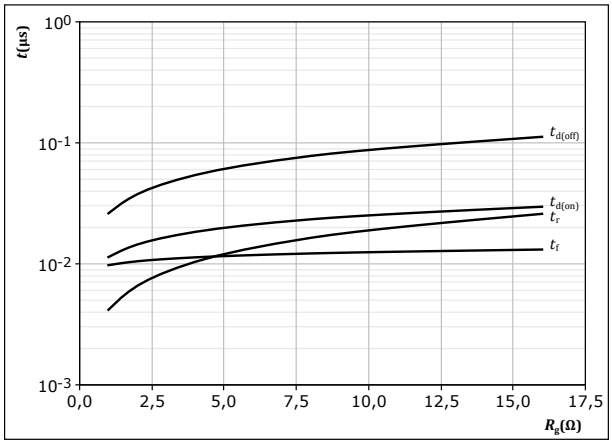
With an inductive load at

T_j =	150	°C
V_{DS} =	500	V
V_{GS} =	-1,5/18	V
R_{gon} =	4	Ω
R_{goff} =	4	Ω

figure 68. **MOSFET**

Typical switching times as a function of MOSFET turn on gate resistor

$t = f(R_g)$



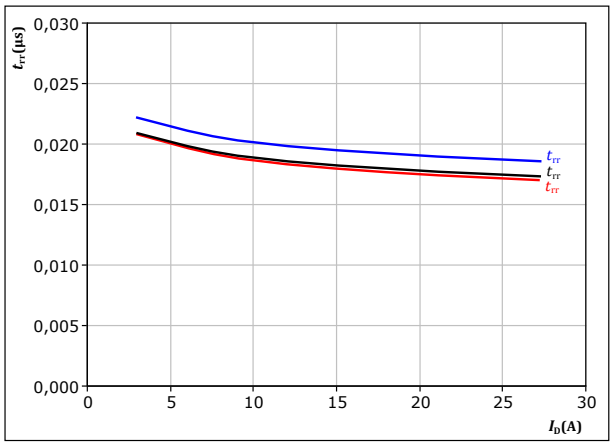
With an inductive load at

T_j =	150	°C
V_{DS} =	500	V
V_{GS} =	-1,5/18	V
I_D =	15	A

figure 69. **FWD**

Typical reverse recovery time as a function of drain current

$t_{rr} = f(I_D)$

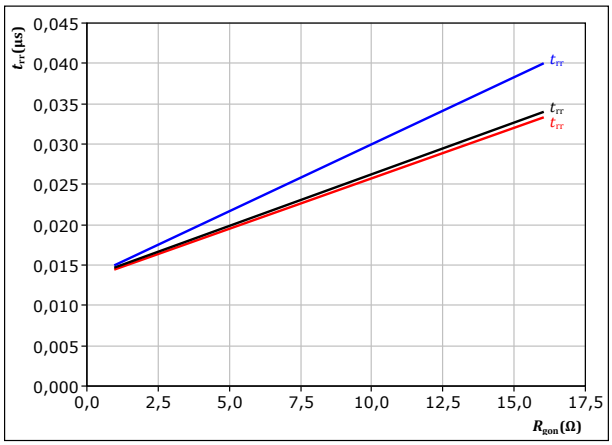


At	V_{DS} =	500	V	
	V_{GS} =	-1,5/18	V	T_j: 25 °C
	R_{gon} =	4	Ω	125 °C
				150 °C

figure 70. **FWD**

Typical reverse recovery time as a function of MOSFET turn on gate resistor

$t_{rr} = f(R_{gon})$



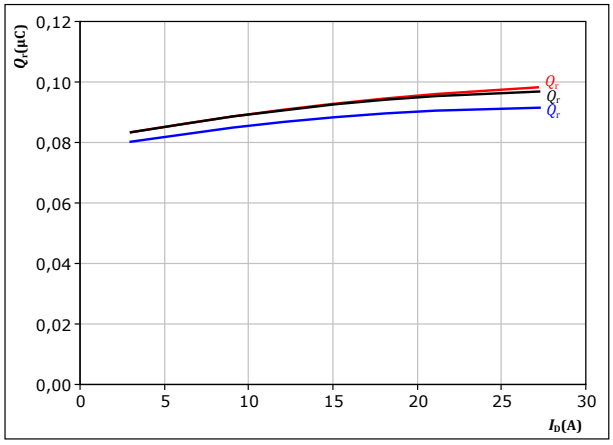
At	V_{DS} =	500	V	
	V_{GS} =	-1,5/18	V	T_j: 25 °C
	I_D =	15	A	125 °C
				150 °C

Negative Neutral Point Switching Characteristics

figure 71. **FWD**

Typical recovered charge as a function of drain current

$Q_r = f(I_D)$

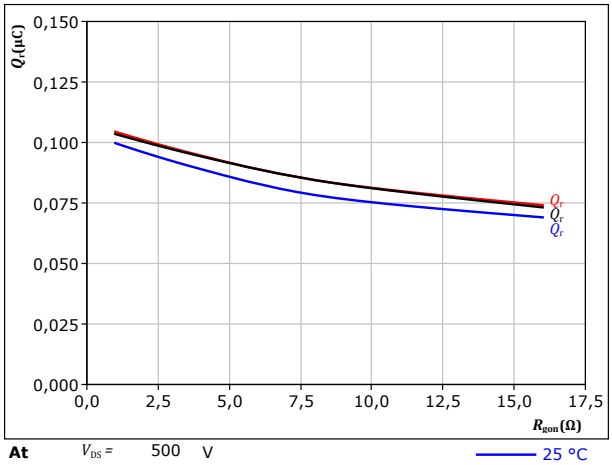


At					
V_{DS} =	500	V			
V_{GS} =	-1,5/18	V	T_j:	25 °C	
R_{gon} =	4	Ω		125 °C	
				150 °C	

figure 72. **FWD**

Typical recovered charge as a function of MOSFET turn on gate resistor

$Q_r = f(R_{gon})$

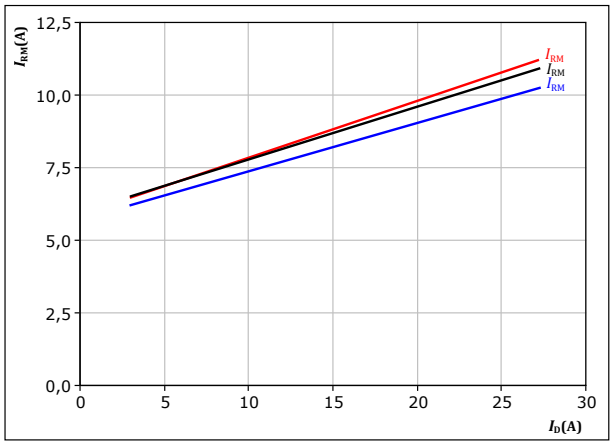


At					
V_{DS} =	500	V			
V_{GS} =	-1,5/18	V	T_j:	25 °C	
I_D =	15	A		125 °C	
				150 °C	

figure 73. **FWD**

Typical peak reverse recovery current as a function of drain current

$I_{RM} = f(I_D)$

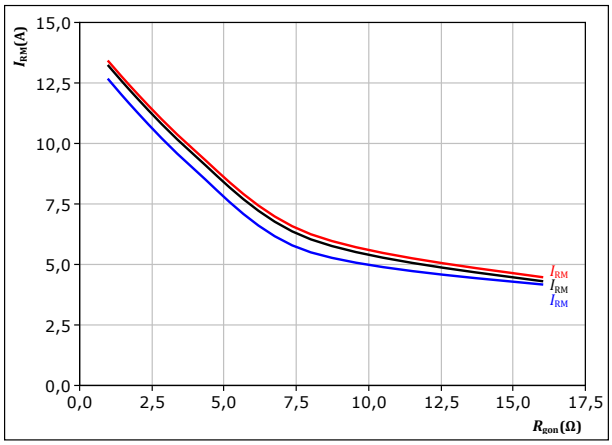


At					
V_{DS} =	500	V			
V_{GS} =	-1,5/18	V	T_j:	25 °C	
R_{gon} =	4	Ω		125 °C	
				150 °C	

figure 74. **FWD**

Typical peak reverse recovery current as a function of MOSFET turn on gate resistor

$I_{RM} = f(R_{gon})$



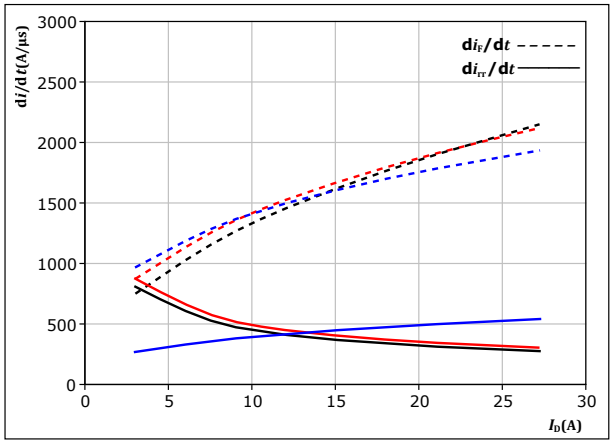
At					
V_{DS} =	500	V			
V_{GS} =	-1,5/18	V	T_j:	25 °C	
I_D =	15	A		125 °C	
				150 °C	

Negative Neutral Point Switching Characteristics

figure 75. **FWD**

Typical rate of fall of forward and reverse recovery current as a function of drain current

di_F/dt, di_{rr}/dt = f(I_D)

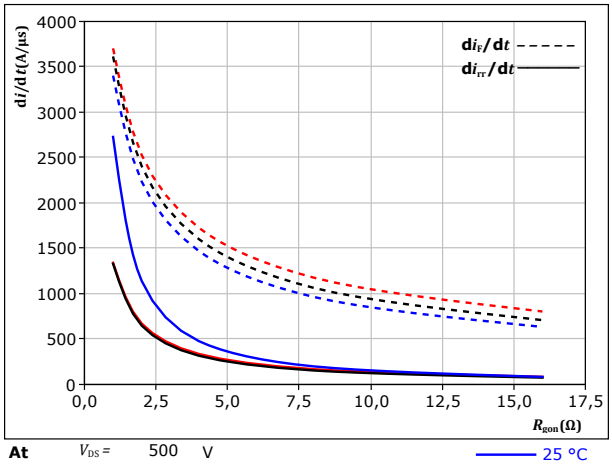


At					
	V_{DS} =	500	V	T_j:	25 °C
	V_{GS} =	-1,5/18	V		125 °C
	R_{gon} =	4	Ω		150 °C

figure 76. **FWD**

Typical rate of fall of forward and reverse recovery current as a function of turn on gate resistor

di_F/dt, di_{rr}/dt = f(R_{gon})

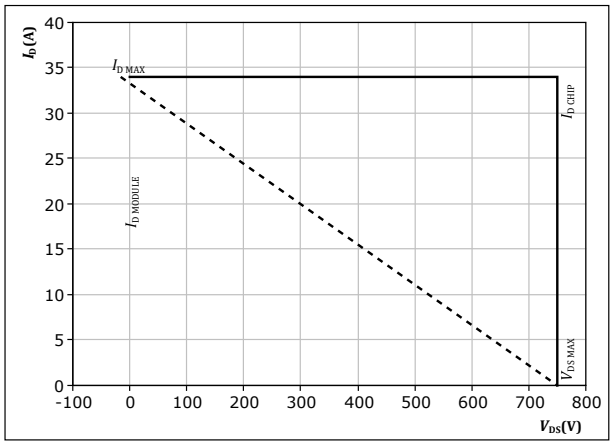


At					
	V_{DS} =	500	V	T_j:	25 °C
	V_{GS} =	-1,5/18	V		125 °C
	I_D =	15	A		150 °C

figure 77. **MOSFET**

Reverse bias safe operating area

I_D = f(V_{DS})



At			
	T_j =	150	°C
	R_{gon} =	4	Ω
	R_{goff} =	4	Ω

Switching Definitions

figure 78. **MOSFET**

Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff} (t_{Eoff} = integrating time for E_{off})

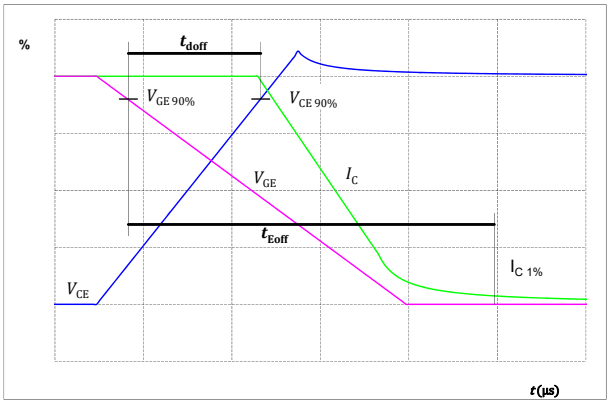


figure 79. **MOSFET**

Turn-on Switching Waveforms & definition of t_{don}, t_{Eon} (t_{Eon} = integrating time for E_{on})

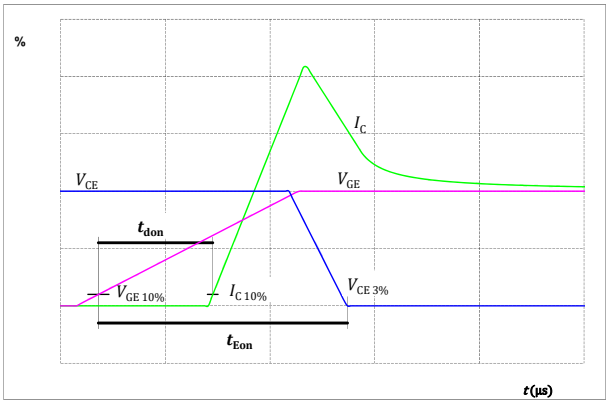


figure 80. **MOSFET**

Turn-off Switching Waveforms & definition of t_f

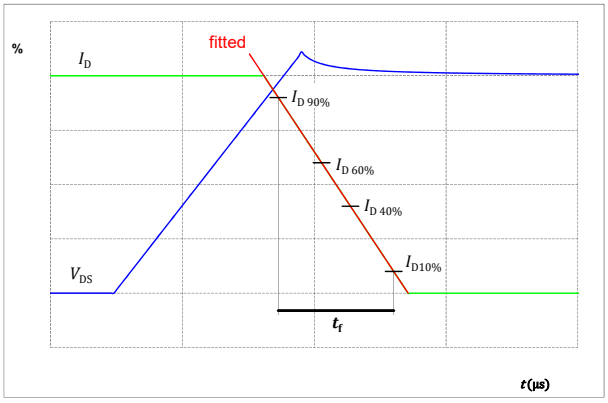
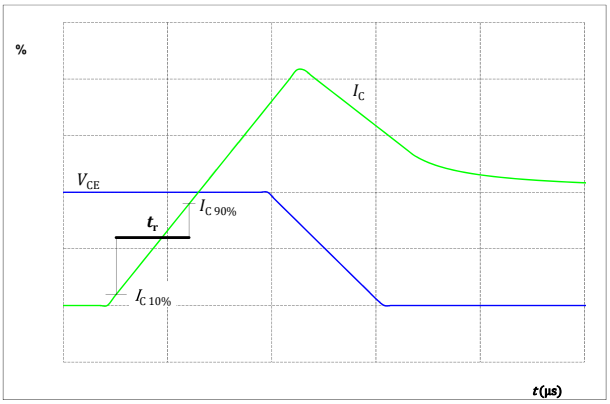


figure 81. **MOSFET**

Turn-on Switching Waveforms & definition of t_r



Switching Definitions

figure 82. **FWD**

Turn-off Switching Waveforms & definition of t_{trr}

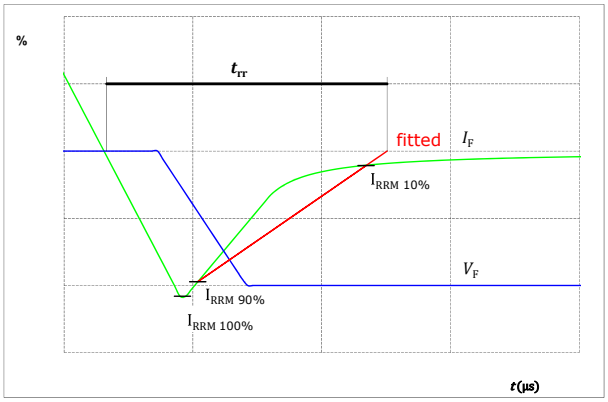


figure 83. **FWD**

Turn-on Switching Waveforms & definition of t_{Qrr} (t_{Qrr} = integrating time for Q_{rr})

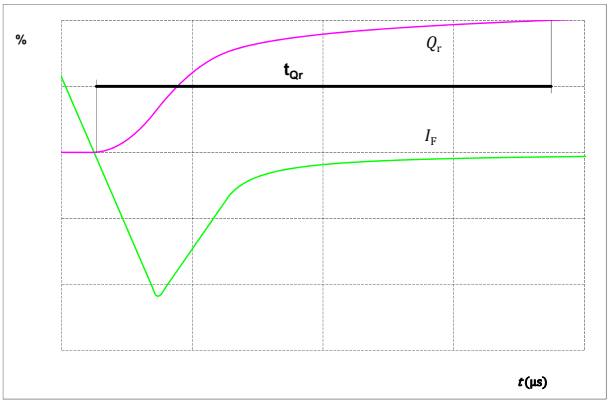
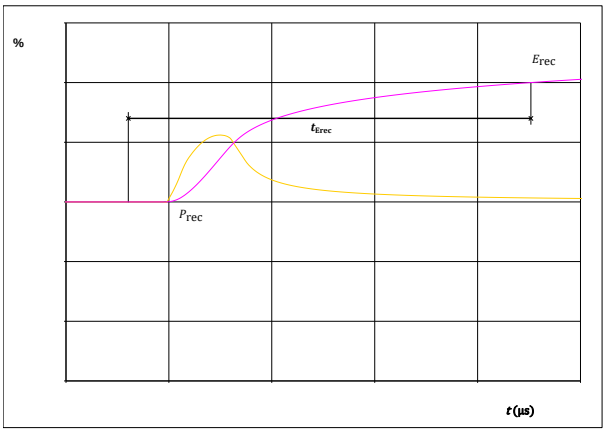


figure 84. **FWD**

Turn-on Switching Waveforms & definition of t_{Erec} (t_{Erec} = integrating time for E_{rec})



Ordering Code

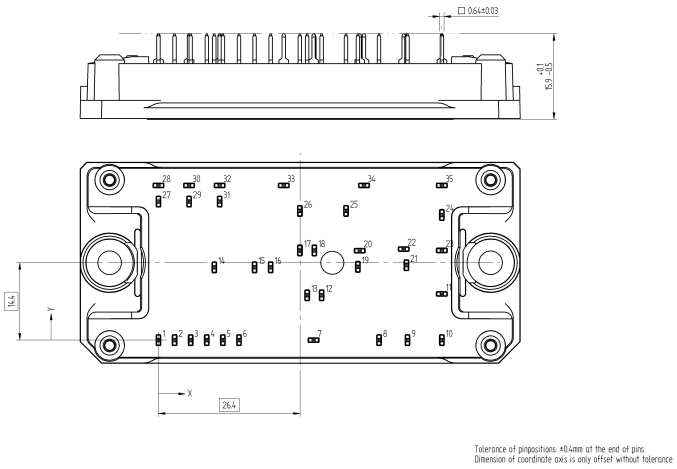
Version	Ordering Code
Without thermal paste	10-FY12APA036MR-PB18E98Z
With thermal paste (5,2 W/mK, PTM6000HV)	10-FY12APA036MR-PB18E98Z-/7/
With thermal paste (3,4 W/mK, PSX-P7)	10-FY12APA036MR-PB18E98Z-/3/

Marking

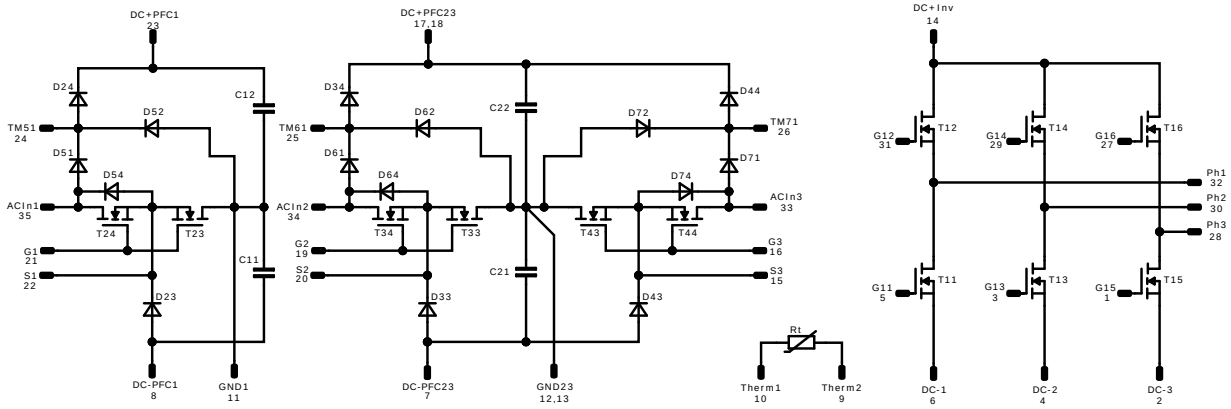
	Name		Date code	UL & VIN	Lot	Serial
Text	NN-NNNNNNNNNNNNN-TTTTTTVV		WWYY	UL VIN	LLLLL	SSSS
Datamatrix	**Type&Ver**	**Lot number**	**Serial**	**Date code**		
	TTTTTTTVV	LLLLL	SSSS	WWYY		

Outline

Pin table [mm]			
Pin	X	Y	Function
1	0	0	G15
2	3	0	DC-3
3	6	0	G13
4	9	0	DC-2
5	12	0	G11
6	15	0	DC-1
7	28,9	0	DC-PFC23
8	41,1	0	DC-PFC1
9	46,4	0	Therm2
10	52,8	0	Therm1
11	52,8	8,6	GND1
12	30,4	8,35	GND23
13	27,7	8,35	GND23
14	10,4	13,55	DC+Inv
15	17,9	13,55	S3
16	20,9	13,55	G3
17	26,35	16,7	DC+PFC23
18	29,05	16,7	DC+PFC23
19	37,15	13,65	G2
20	37,5	16,65	S2
21	46,2	13,95	G1
22	45,7	16,95	S1
23	52,8	16,7	DC+PFC1
24	52,8	23,3	TM51
25	34,95	24,05	TM61
26	26,35	24,05	TM71
27	0	25,8	G16
28	0	28,8	Ph3
29	5,7	25,8	G14
30	5,7	28,8	Ph2
31	11,4	25,8	G12
32	11,4	28,8	Ph1
33	23,35	28,8	ACin3
34	38,3	28,8	ACin2
35	52,8	28,8	ACin1



Pinout



Identification

ID	Component	Voltage	Current	Function	Comment
T24, T34, T44	MOSFET	750 V	45 mΩ	Positive Neutral Point Switch	
T23, T33, T43	MOSFET	750 V	45 mΩ	Negative Neutral Point Switch	
D54, D64, D74	Rectifier	1600 V	18 A	Positive Neutral Point Diode	
T11, T12, T13, T14, T15, T16	MOSFET	1200 V	36 mΩ	Inverter Switch	
D24, D34, D44	FWD	650 V	15 A	Positive Boost Diode	
D51, D61, D71	Rectifier	1600 V	18 A	Positive Boost Blocking Diode	
D52, D62, D72	FWD	650 V	20 A	Positive Boost Diode Protection Diode	
D23, D33, D43	FWD	650 V	15 A	Negative Boost Diode	
C11, C12, C21, C22	Capacitor	630 V		Capacitor (PFC)	
Rt	Thermistor			Thermistor	

Packaging instruction				
Standard packaging quantity (SPQ) 100	>SPQ	Standard	<SPQ	Sample

Handling instruction
Handling instructions for *flow* 1 packages see vincotech.com website.

Package data
Package data for *flow* 1 packages see vincotech.com website.

Vincotech thermistor reference
See Vincotech thermistor reference table at vincotech.com website.

UL recognition and file number
This device is certified according to UL 1557 standard, UL file number E192116. For more information see vincotech.com website.

Document No.:	Date:	Modification:	Pages
10-FY12APA036MR-PB18E98Z-D2-14	8 Dec. 2023	Additional diode at the positive neutral point	