



Vincotech

10-E112PMA060MS-L928A76Z

datasheet

flowPIM E1

1200 V / 60 mΩ

Topology features

- Open Emitter configuration
- Temperature sensor
- Converter+Inverter
- Active switch
- SiC MOSFET

Component features

- High Blocking Voltage with low drain source on state resistance
- High speed SiC-MOSFET technology
- Resistant to Latch-up

Housing features

- Base isolation: Al_2O_3
- Convex shaped substrate for superior thermal contact
- Compact housing
- CTI600 housing material
- Thermo-mechanical push-and-pull force relief
- Solder pin

Target applications

- Embedded Drives
- HVAC
- Industrial Drives

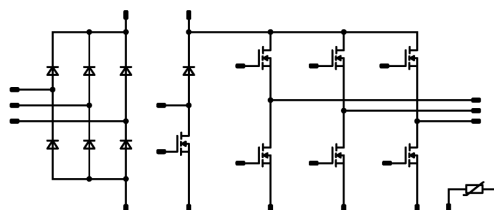
Types

- 10-E112PMA060MS-L928A76Z

flow E1 12 mm housing



Schematic





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Maximum Ratings

$T_j = 25\text{ °C}$, unless otherwise specified

Parameter	Symbol	Conditions	Value	Unit
Inverter Switch				
Drain-source voltage	V_{DS}		1200	V
Drain current (DC current)	I_D	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	27	A
Peak drain current	I_{DM}	t_p limited by T_{jmax}	80	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	66	W
Gate-source voltage	V_{GS}	static	-5 / 18	V
		dynamic	-10 / 22	V
Maximum Junction Temperature	T_{jmax}		175	°C

Active Switch

Drain-source voltage	V_{DS}		1200	V
Drain current (DC current)	I_D	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	27	A
Peak drain current	I_{DM}	t_p limited by T_{jmax}	80	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	66	W
Gate-source voltage	V_{GS}	static	-5 / 18	V
		dynamic	-10 / 22	V
Maximum Junction Temperature	T_{jmax}		175	°C

Protection Diode

Peak repetitive reverse voltage	V_{RRM}		1600	V
Forward current (DC current)	I_F	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	45	A
Surge (non-repetitive) forward current	I_{FSM}	Single Half Sine Wave, $t_p = 10\text{ ms}$ $T_j = 150\text{ °C}$	200	A
Surge current capability	$I_p t$		200	A²s
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	64	W
Maximum junction temperature	T_{jmax}		175	°C



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Maximum Ratings

$T_j = 25\text{ °C}$, unless otherwise specified

Parameter	Symbol	Conditions	Value	Unit
Rectifier Diode				
Peak repetitive reverse voltage	V_{RRM}		1600	V
Forward current (DC current)	I_F	$T_j = T_{jmax}$ $T_a = 80\text{ °C}$	45	A
Surge (non-repetitive) forward current	I_{FSM}	Single Half Sine Wave, $t_p = 10\text{ ms}$ $T_j = 150\text{ °C}$	200	A
Surge current capability	I^2t		200	A ² s
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_a = 80\text{ °C}$	64	W
Maximum junction temperature	T_{jmax}		175	°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* $t_p = 2\text{ s}$	6000	V
Creepage distance			>12,7	mm
Clearance			>12,7	mm
Comparative Tracking Index	CTI		≥ 600	

*100 % tested in production



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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		20	25 125 150		66,7 81,3 88,7	90 ⁽¹⁾	mΩ
Gate-source threshold voltage	$V_{GS(th)}$				0,002	25	1,7	2,25	2,75	V
Gate to Source Leakage Current	I_{GSS}		22	0		25			100	nA
Zero Gate Voltage Drain Current	I_{DSS}		0	1200		25			10	μA
Internal gate resistance	r_g							2		Ω
Gate charge	Q_g		-5/18	800	20	25		57		nC
Short-circuit input capacitance	C_{iss}	$f = 500$ kHz	0	800	0	25		1330		pF
Short-circuit output capacitance	C_{oss}							74		
Reverse transfer capacitance	C_{rss}							3		
Diode forward voltage	V_{SD}		0		20	25		4,1		V

Thermal

Thermal resistance junction to sink ⁽²⁾	$R_{th(j-s)}$	$\lambda_{paste} = 5,2$ W/mK (PTM)						1,44		K/W
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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	$t_{d(on)}$	$R_{gon} = 2\ \Omega$ $R_{goff} = 2\ \Omega$	-5/18	600	20	25		9,62		ns	
						125		9,04			
						150		8,97			
Rise time	t_r					25		4,27		ns	
						125		4,27			
						150		4,13			
Turn-off delay time	$t_{d(off)}$					25		20,83		ns	
						125		21,8			
						150		22,66			
Fall time	t_f					25		3,37		ns	
						125		3,36			
						150		3,5			
Turn-on energy (per pulse)	E_{on}	$Q_{rFWD}=0,17\ \mu C$ $Q_{rFWD}=0,371\ \mu C$ $Q_{rFWD}=0,426\ \mu C$	25		0,3		mWs				
			125		0,421						
			150		0,425						
Turn-off energy (per pulse)	E_{off}		25		0,021		mWs				
			125		0,021						
			150		0,022						
Peak recovery current	I_{RRM}	$di/dt=4020\ A/\mu s$ $di/dt=4170\ A/\mu s$ $di/dt=4019\ A/\mu s$	25		11,85		A				
			125		19,08						
			150		21,07						
Reverse recovery time	t_{rr}		25		26,88		ns				
			125		33,45						
			150		33,91						
Recovered charge	Q_r		25		0,17		μC				
			125		0,371						
			150		0,426						
Reverse recovered energy	E_{rec}		25		0,041		mWs				
			125		0,096						
			150		0,103						
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$	25		1999,64		A/ μs					
		125		2237,93							
		150		3469,86							



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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	

Active Switch

Static

Drain-source on-state resistance	$r_{DS(on)}$		18		20	25 125 150		66,7 81,3 88,7	90 ⁽¹⁾	mΩ
Gate-source threshold voltage	$V_{GS(th)}$				0,002	25	1,7	2,25	2,75	V
Gate to Source Leakage Current	I_{GSS}		22	0		25			100	nA
Zero Gate Voltage Drain Current	I_{DSS}		0	1200		25			10	μA
Internal gate resistance	r_g							2		Ω
Gate charge	Q_g		-5/18	800	20	25		57		nC
Short-circuit input capacitance	C_{iss}	$f = 500$ kHz	0	800	0	25		1330		pF
Short-circuit output capacitance	C_{oss}							74		
Reverse transfer capacitance	C_{rss}							3		
Diode forward voltage	V_{SD}		0		20	25		4,1		V

Thermal

Thermal resistance junction to sink ⁽²⁾	$R_{th(j-s)}$	$\lambda_{paste} = 5,2$ W/mK (PTM)						1,44		K/W
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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	

Protection Diode

Static

Forward voltage	V_F				18	25 125 150		1,12 1,06 1,05	1,5 ⁽¹⁾	V
Reverse leakage current	I_R	$V_r = 1600$ V				25 150			50 1000	μA

Thermal

Thermal resistance junction to sink ⁽²⁾	$R_{th(j-s)}$	$\lambda_{paste} = 5,2$ W/mK (PTM)						1,48		K/W
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Rectifier Diode

Static

Forward voltage	V_F				18	25 125 150		1,12 1,06 1,05	1,5 ⁽¹⁾	V
Reverse leakage current	I_R	$V_r = 1600$ V				25 150			50 1000	μA

Thermal

Thermal resistance junction to sink ⁽²⁾	$R_{th(j-s)}$	$\lambda_{paste} = 5,2$ W/mK (PTM)						1,48		K/W
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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	

Thermistor

Static

Rated resistance	R					25		5		kΩ
Deviation of R100	$\Delta_{R/R}$	$R_{100} = 499 \Omega$				100	3,2		3,3	%
Power dissipation	P					25		130		mW
Power dissipation constant	d					25		1,3		mW/K
B-value	$B_{(25/50)}$	Tol. $\pm 1 \%$						3380		K
Vincotech Thermistor Reference									V	

⁽¹⁾ Value at chip level

⁽²⁾ Only valid with pre-applied Vincotech thermal interface material.



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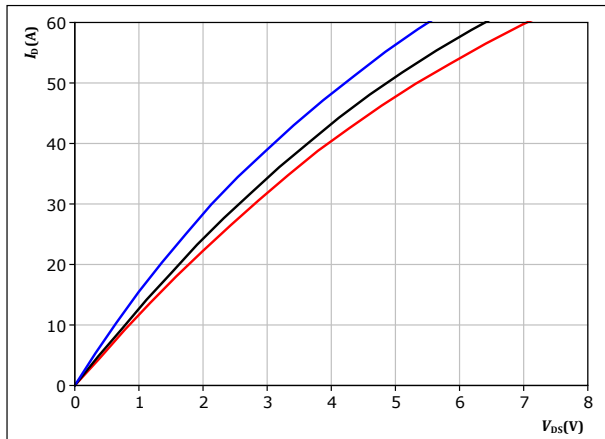
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Inverter Switch Characteristics

figure 1. MOSFET

Typical output characteristics

$$I_D = f(V_{DS})$$

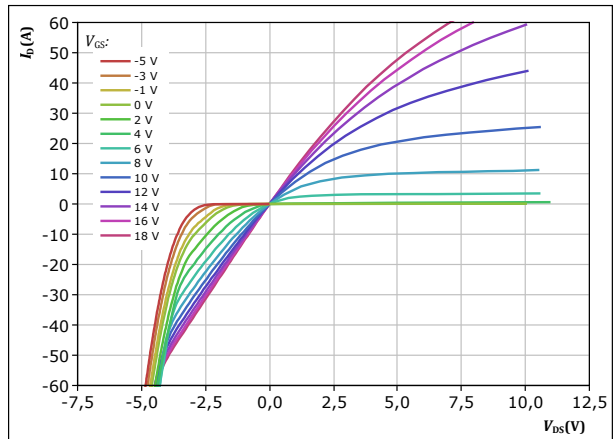


$t_p = 250 \mu s$
 $V_{GS} = 18 V$
 $T_j: 25 ^\circ C$
 $125 ^\circ C$
 $150 ^\circ C$

figure 2. MOSFET

Typical output characteristics

$$I_D = f(V_{DS})$$

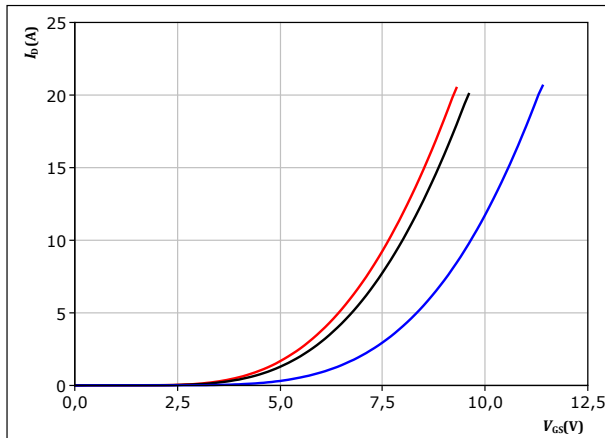


$t_p = 250 \mu s$
 $T_j = 150 ^\circ C$
 V_{GS} from -5 V to 18 V in steps of 2 V

figure 3. MOSFET

Typical transfer characteristics

$$I_D = f(V_{GS})$$

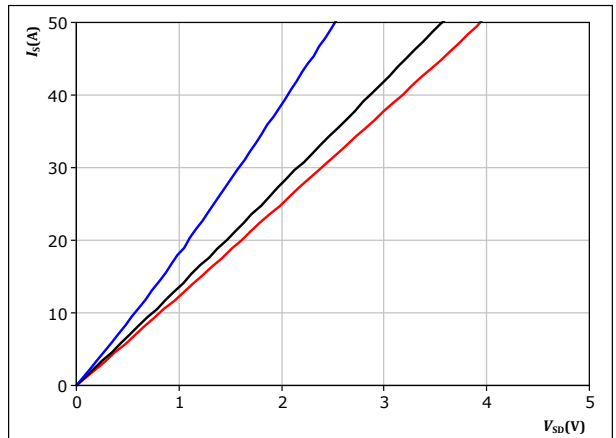


$t_p = 250 \mu s$
 $V_{DS} = 10 V$
 $T_j: 25 ^\circ C$
 $125 ^\circ C$
 $150 ^\circ C$

figure 4. MOSFET

Typical reverse drain current characteristics

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



$t_p = 250 \mu s$
 $V_{GS} = 18 V$
 $T_j: 25 ^\circ C$
 $125 ^\circ C$
 $150 ^\circ C$



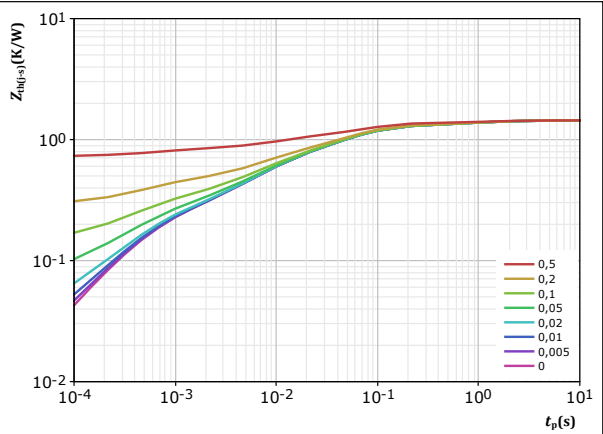
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Inverter Switch Characteristics

figure 5. MOSFET

Transient thermal impedance as a function of pulse width

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

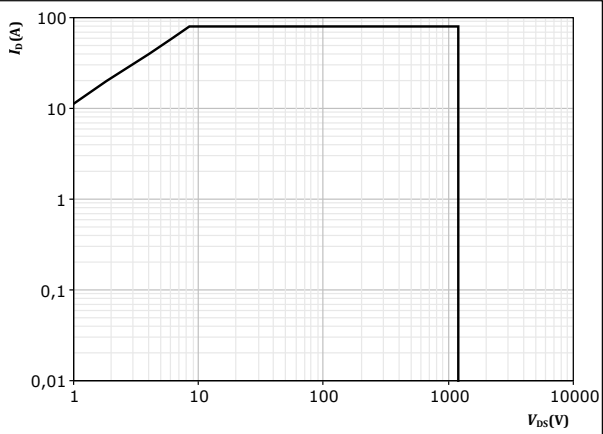


$D =$	t_p / T
$R_{th(j-a)} =$	1,442 K/W
MOSFET thermal model values	
R (K/W)	τ (s)
2,00E-02	8,17E+00
1,58E-01	8,06E-01
7,00E-01	5,19E-02
3,82E-01	7,07E-03
1,86E-01	4,65E-04

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}

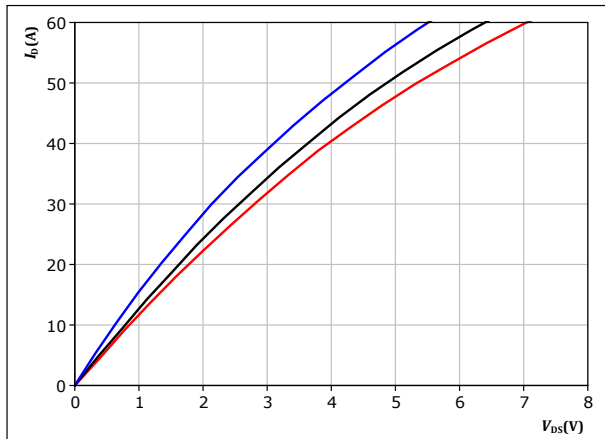


Active Switch Characteristics

figure 7. MOSFET

Typical output characteristics

$$I_D = f(V_{DS})$$

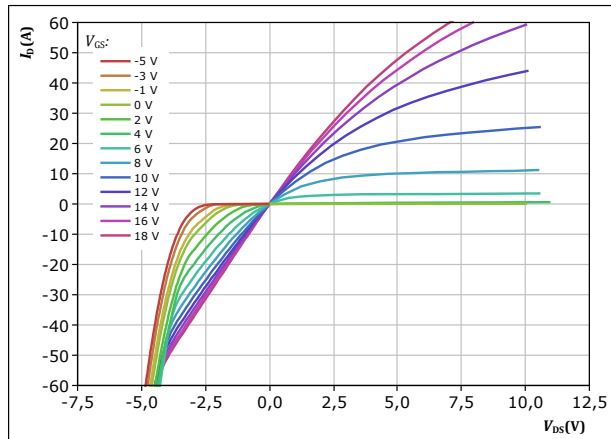


$t_p = 250 \mu s$
 $V_{GS} = 18 V$
 $T_j: 25 ^\circ C$
 $125 ^\circ C$
 $150 ^\circ C$

figure 8. MOSFET

Typical output characteristics

$$I_D = f(V_{DS})$$

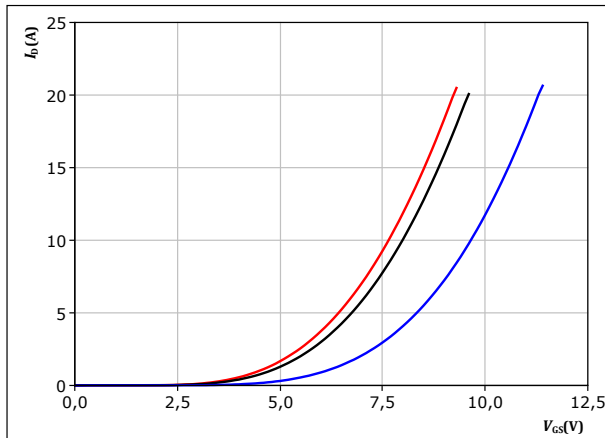


$t_p = 250 \mu s$
 $T_j = 150 ^\circ C$
 V_{GS} from -5 V to 18 V in steps of 2 V

figure 9. MOSFET

Typical transfer characteristics

$$I_D = f(V_{GS})$$

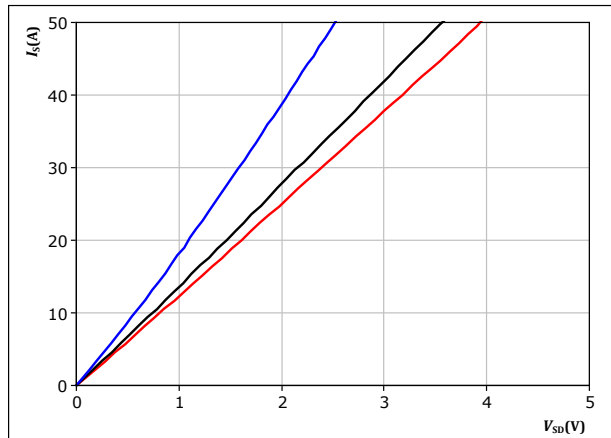


$t_p = 250 \mu s$
 $V_{DS} = 10 V$
 $T_j: 25 ^\circ C$
 $125 ^\circ C$
 $150 ^\circ C$

figure 10. MOSFET

Typical reverse drain current characteristics

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



$t_p = 250 \mu s$
 $V_{GS} = 18 V$
 $T_j: 25 ^\circ C$
 $125 ^\circ C$
 $150 ^\circ C$



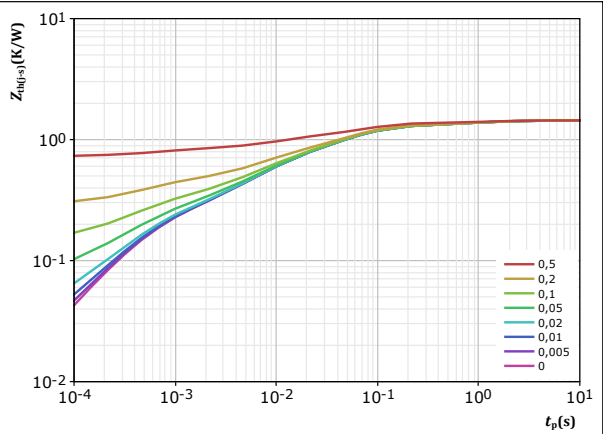
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Active Switch Characteristics

figure 11. MOSFET

Transient thermal impedance as a function of pulse width

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

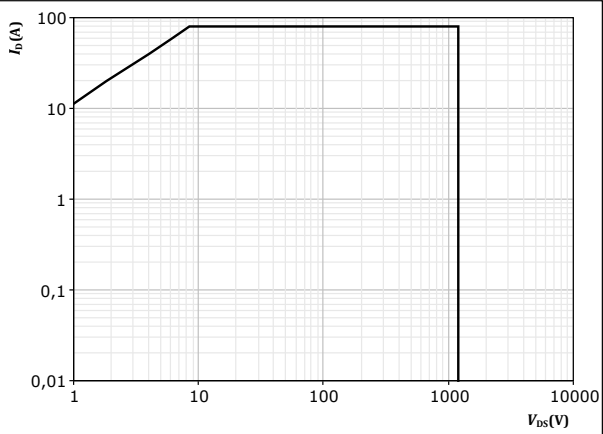


$D =$	t_p / T
$R_{th(j-a)} =$	1,442 K/W
MOSFET thermal model values	
R (K/W)	τ (s)
2,00E-02	8,17E+00
1,58E-01	8,06E-01
7,00E-01	5,19E-02
3,82E-01	7,07E-03
1,86E-01	4,65E-04

figure 12. MOSFET

Safe operating area

$I_D = f(V_{DS})$



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



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Protection Diode Characteristics

figure 13.

Rectifier

Typical forward characteristics

$$I_F = f(V_F)$$

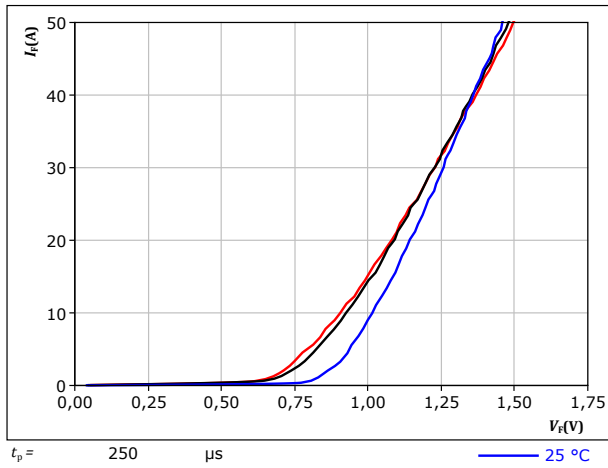
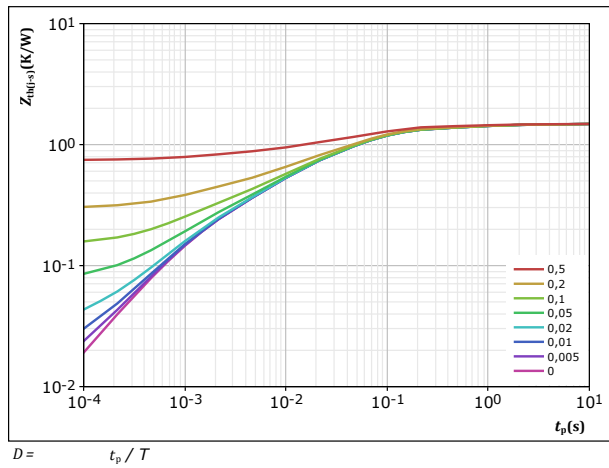


figure 14.

Rectifier

Transient thermal impedance as a function of pulse width

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





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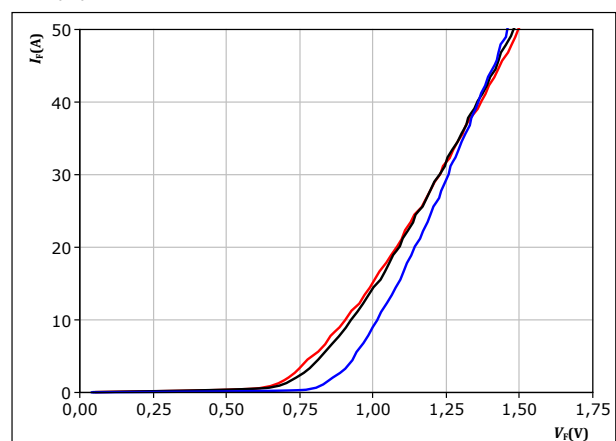
Rectifier Diode Characteristics

figure 15.

Rectifier

Typical forward characteristics

$$I_F = f(V_F)$$



$t_p = 250 \mu s$

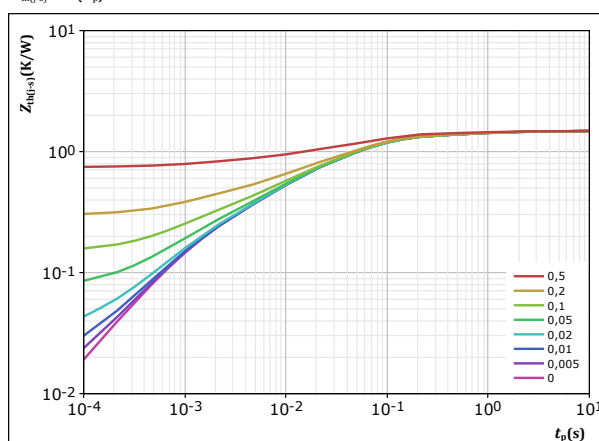
T_j :
— 25 °C
— 125 °C
— 150 °C

figure 16.

Rectifier

Transient thermal impedance as a function of pulse width

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



$D =$	t_p / T
$R_{th(j-s)} =$	1,482 K/W
Rectifier thermal model values	
R (K/W)	τ (s)
4,21E-02	5,03E+00
1,49E-01	5,66E-01
7,66E-01	5,69E-02
3,76E-01	9,10E-03
1,54E-01	1,08E-03



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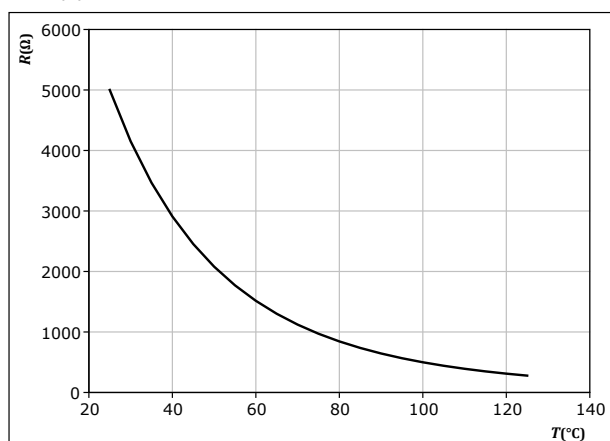
Thermistor Characteristics

figure 17.

Thermistor

Typical NTC characteristic as function of temperature

$$R_T = f(T)$$





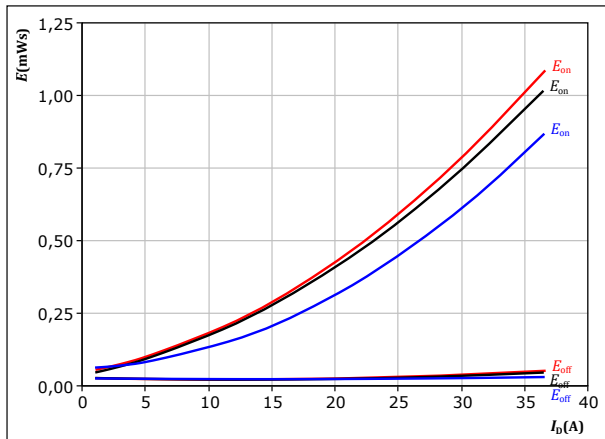
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Inverter Switching Characteristics

figure 18. MOSFET

Typical switching energy losses as a function of drain current
 $E = f(I_D)$



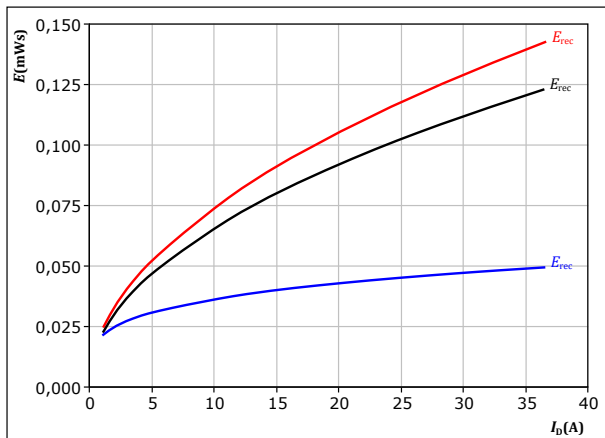
With an inductive load at

$V_{DS} = 600$ V
 $V_{GS} = -5/18$ V
 $R_{gon} = 2$ Ω
 $R_{goff} = 2$ Ω

T_j : 25 °C (blue), 125 °C (black), 150 °C (red)

figure 20. MOSFET

Typical reverse recovered energy loss as a function of drain current
 $E_{rec} = f(I_D)$



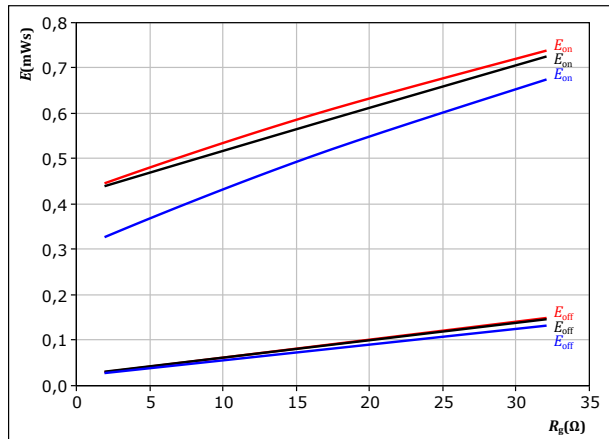
With an inductive load at

$V_{DS} = 600$ V
 $V_{GS} = -5/18$ V
 $R_{gon} = 2$ Ω

T_j : 25 °C (blue), 125 °C (black), 150 °C (red)

figure 19. MOSFET

Typical switching energy losses as a function of MOSFET turn on gate resistor
 $E = f(R_g)$



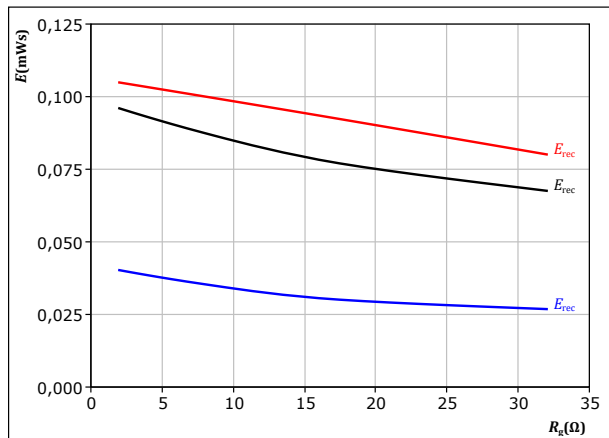
With an inductive load at

$V_{DS} = 600$ V
 $V_{GS} = -5/18$ V
 $I_D = 20$ A

T_j : 25 °C (blue), 125 °C (black), 150 °C (red)

figure 21. 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
 $V_{GS} = -5/18$ V
 $I_D = 20$ A

T_j : 25 °C (blue), 125 °C (black), 150 °C (red)



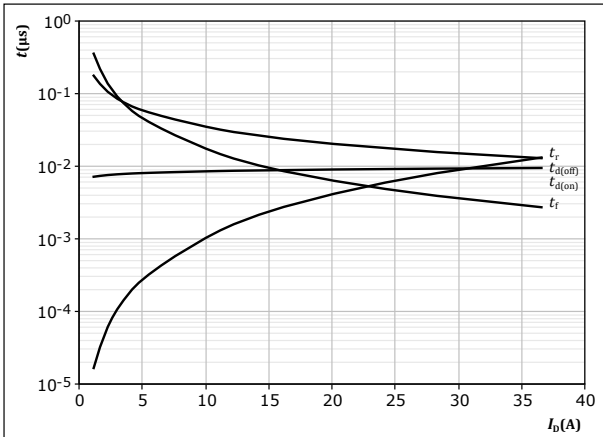
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Inverter Switching Characteristics

figure 22. MOSFET

Typical switching times as a function of drain current
 $t = f(I_D)$

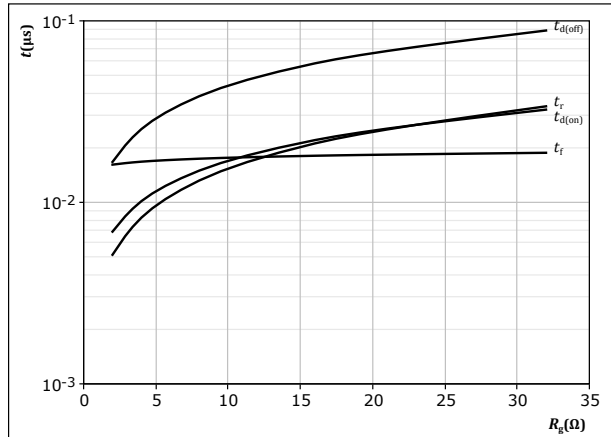


With an inductive load at

$T_j = 150$ °C
 $V_{DS} = 600$ V
 $V_{GS} = -5/18$ V
 $R_{gon} = 2$ Ω
 $R_{goff} = 2$ Ω

figure 23. MOSFET

Typical switching times as a function of MOSFET turn on gate resistor
 $t = f(R_g)$

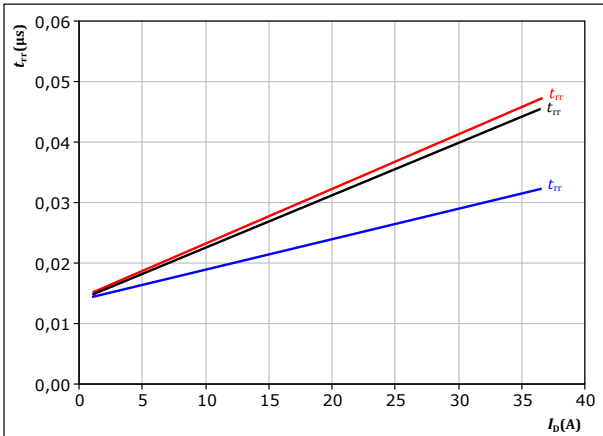


With an inductive load at

$T_j = 150$ °C
 $V_{DS} = 600$ V
 $V_{GS} = -5/18$ V
 $I_D = 20$ A

figure 24. MOSFET

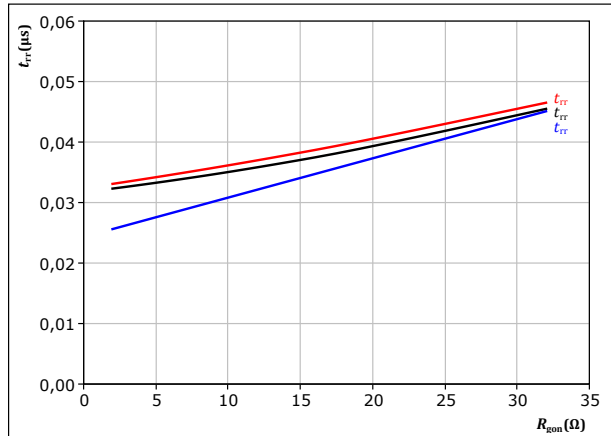
Typical reverse recovery time as a function of drain current
 $t_{rr} = f(I_D)$



At $V_{DS} = 600$ V
 $V_{GS} = -5/18$ V
 $R_{gon} = 2$ Ω
 T_j : 25 °C (blue line)
125 °C (black line)
150 °C (red line)

figure 25. MOSFET

Typical reverse recovery time as a function of MOSFET turn on gate resistor
 $t_{rr} = f(R_{gon})$



At $V_{DS} = 600$ V
 $V_{GS} = -5/18$ V
 $I_D = 20$ A
 T_j : 25 °C (blue line)
125 °C (black line)
150 °C (red line)



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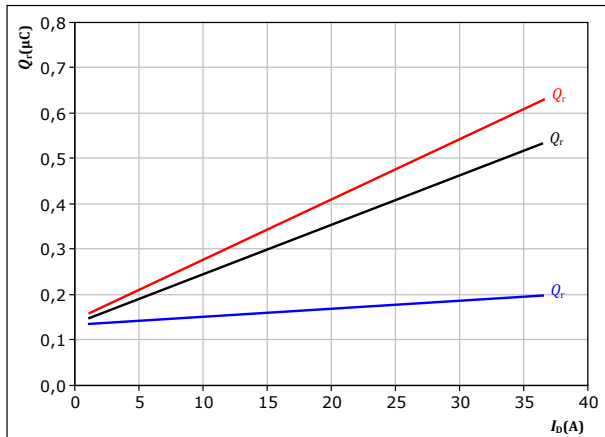
Inverter Switching Characteristics

figure 26.

MOSFET

Typical recovered charge as a function of drain current

$$Q_r = f(I_D)$$



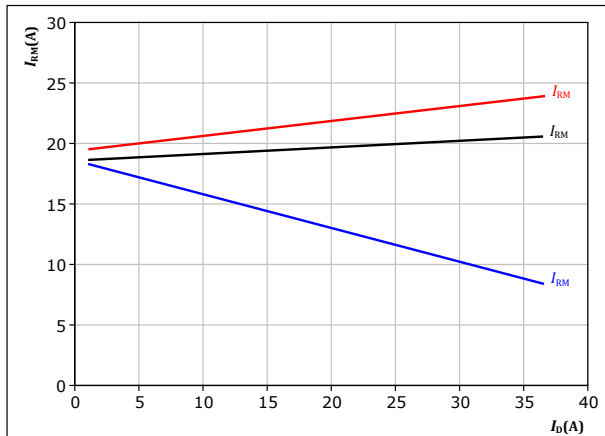
At $V_{DS} = 600$ V
 $V_{GS} = -5/18$ V
 $R_{gon} = 2$ Ω
 T_j : 25 °C
125 °C
150 °C

figure 28.

MOSFET

Typical peak reverse recovery current as a function of drain current

$$I_{RM} = f(I_D)$$



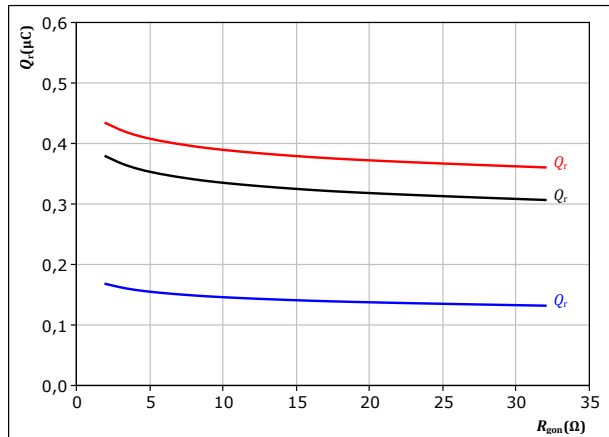
At $V_{DS} = 600$ V
 $V_{GS} = -5/18$ V
 $R_{gon} = 2$ Ω
 T_j : 25 °C
125 °C
150 °C

figure 27.

MOSFET

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

$$Q_r = f(R_{gon})$$



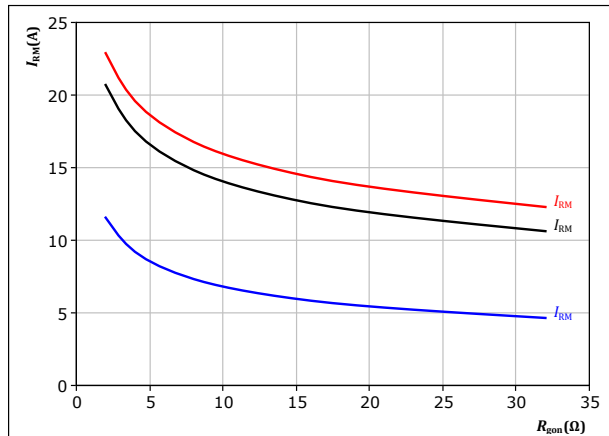
At $V_{DS} = 600$ V
 $V_{GS} = -5/18$ V
 $I_D = 20$ A
 T_j : 25 °C
125 °C
150 °C

figure 29.

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
 $V_{GS} = -5/18$ V
 $I_D = 20$ A
 T_j : 25 °C
125 °C
150 °C



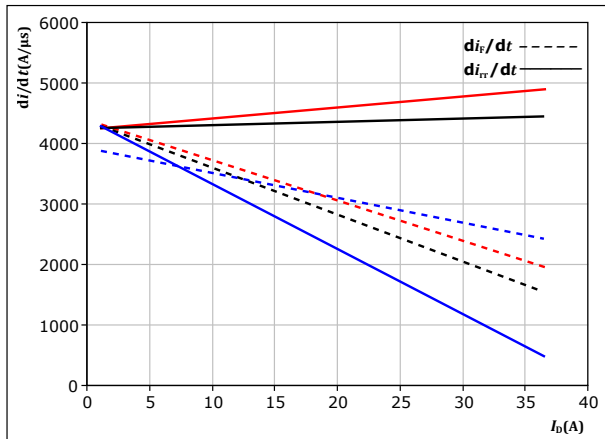
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datasheet

Inverter Switching Characteristics

figure 30. MOSFET

Typical rate of fall of forward and reverse recovery current as a function of drain current
 $di_f/dt, di_r/dt = f(I_D)$

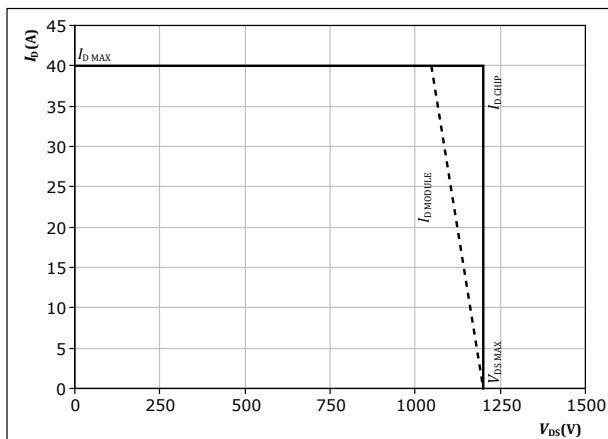


At $V_{DS} = 600$ V
 $V_{GS} = -5/18$ V
 $R_{gon} = 2$ Ω
 $T_j = 25$ °C
125 °C
150 °C

figure 32. MOSFET

Reverse bias safe operating area

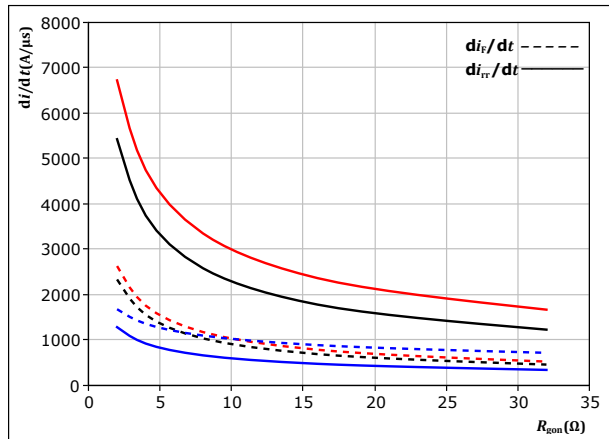
$I_D = f(V_{DS})$



At $T_j = 150$ °C
 $R_{gon} = 2$ Ω
 $R_{goff} = 2$ Ω

figure 31. MOSFET

Typical rate of fall of forward and reverse recovery current as a function of turn on gate resistor
 $di_f/dt, di_r/dt = f(R_{gon})$



At $V_{DS} = 600$ V
 $V_{GS} = -5/18$ V
 $I_D = 20$ A
 $T_j = 25$ °C
125 °C
150 °C



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Switching Definitions

figure 33. MOSFET

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

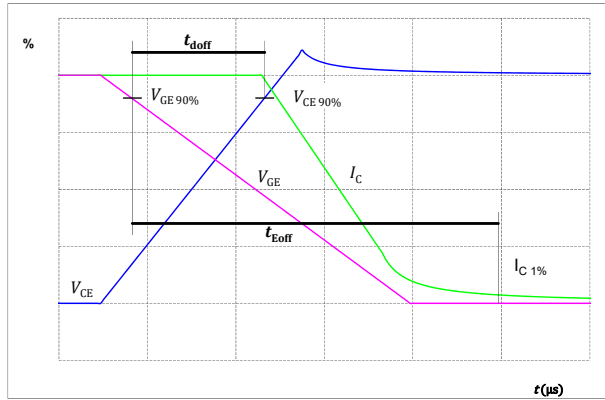


figure 34. MOSFET

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

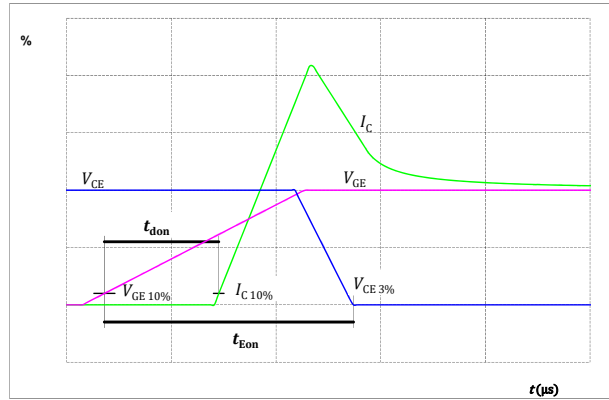


figure 35. MOSFET

Turn-off Switching Waveforms & definition of t_f

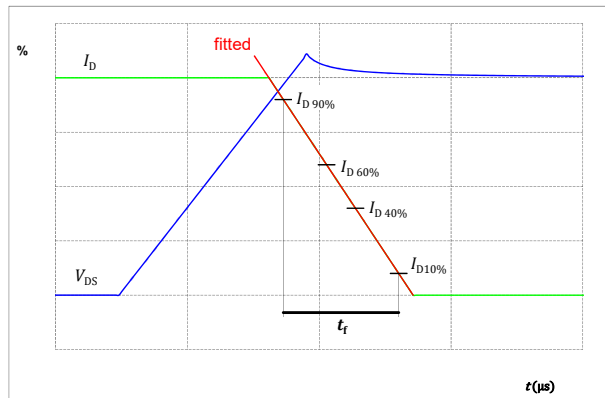
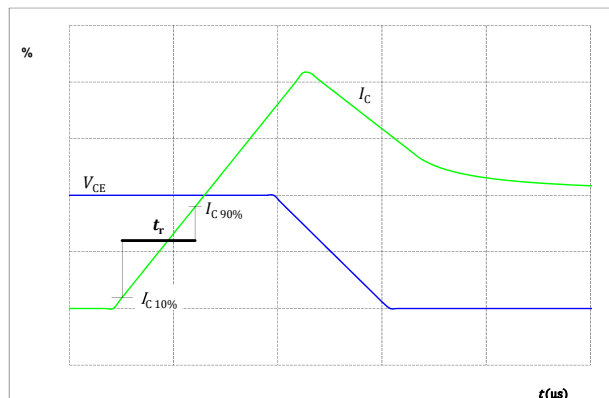


figure 36. MOSFET

Turn-on Switching Waveforms & definition of t_r





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Switching Definitions

figure 37. FWD

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

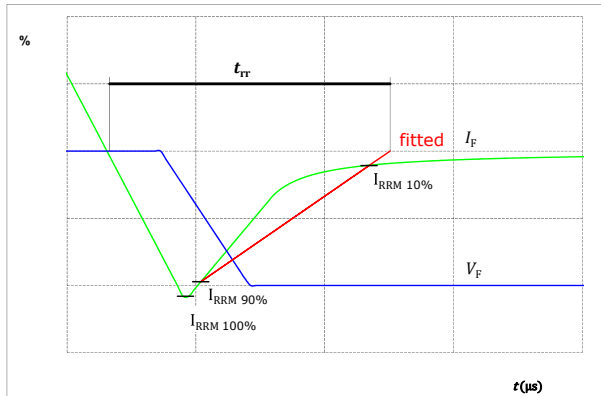


figure 38. FWD

Turn-on Switching Waveforms & definition of t_{Qr} (t_{Qr} = integrating time for Q_r)

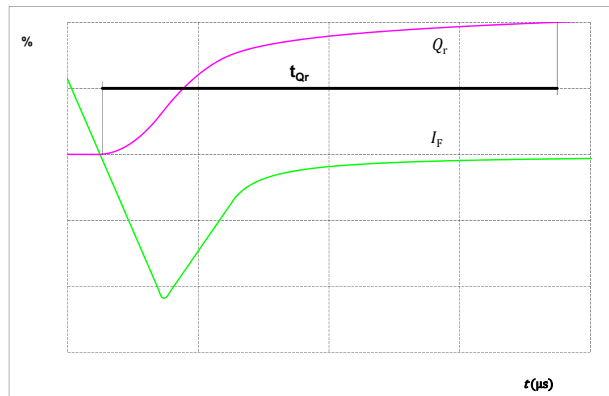
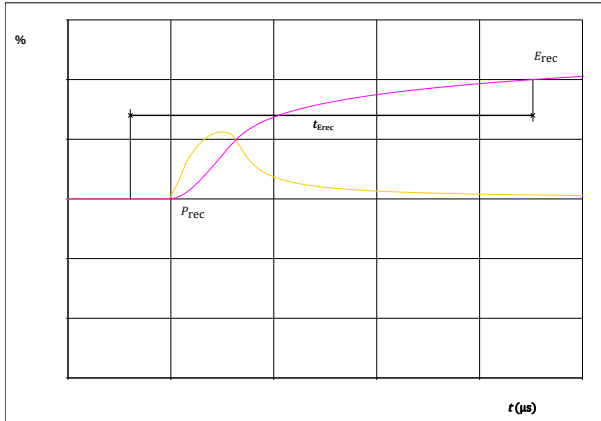


figure 39. FWD

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





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datasheet

Ordering Code	
Version	Ordering Code
Without thermal paste	10-E112PMA060MS-L928A76Z
With thermal paste (5,2 W/mK, PTM6000HV)	10-E112PMA060MS-L928A76Z-/7/

Marking						
	Text	Name	Date code	UL & VIN	Lot	Serial
		NN-NNNNNNNNNNNNNNNN- TTTTIV	WWYY	UL VIN	LLLL	SSSS
	Datamatrix	Type&Ver	Lot number	Serial	Date code	
		TTTTTIV	LLLLL	SSSS	WWYY	

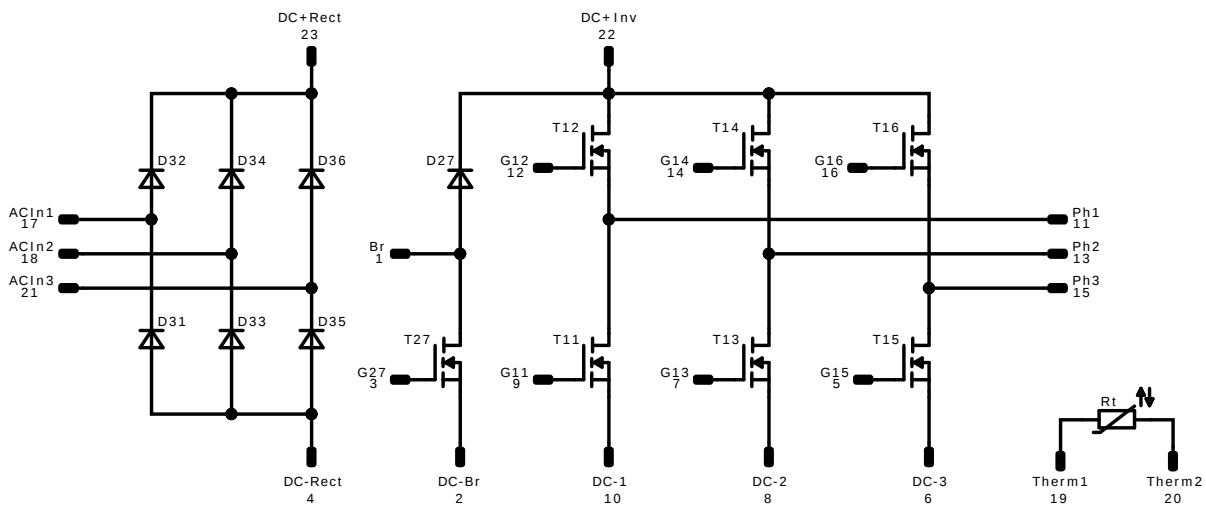
Outline			
Pin table [mm]			
Pin	X	Y	Function
1	32	0	Br
2	25,6	0	DC-Br
3	22,4	0	G27
4	19,2	0	DC-Rect
5	16	0	G15
6	12,8	0	DC-3
7	9,6	0	G13
8	6,4	0	DC-2
9	3,2	0	G11
10	0	0	DC-1
11	0	25,6	Ph1
12	3,2	25,6	G12
13	9,6	25,6	Ph2
14	12,8	25,6	G14
15	19,2	25,6	Ph3
16	22,4	25,6	G16
17	32	25,6	ACIn1
18	25,6	19,2	ACIn2
19	19,2	16	Therm1
20	16	16	Therm2
21	25,6	12,8	ACIn3
22	22,4	6,4	DC+Inv
23	25,6	6,4	DC+Rect

Tolerance of pinpositions: ±0.4mm at the end of pins
Dimension of coordinate axis is only offset without tolerance



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Pinout



Identification					
ID	Component	Voltage	Current	Function	Comment
T11, T12, T13, T14, T15, T16	MOSFET	1200 V	60 mΩ	Inverter Switch	
T27	MOSFET	1200 V	60 mΩ	Active Switch	
D27	Rectifier	1600 V	18 A	Protection Diode	
D31, D32, D33, D34, D35, D36	Rectifier	1600 V	18 A	Rectifier Diode	
Rt	Thermistor			Thermistor	



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Packaging instruction				
Standard packaging quantity (SPQ) 100	>SPQ	Standard	<SPQ	Sample
Handling instruction				
Handling instructions for <i>flow</i> E1 packages see vincotech.com website.				
Package data				
Package data for <i>flow</i> E1 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 UL 1557 recognized under E192116 up to a junction temperature under switching condition $T_{j,op}=175^{\circ}\text{C}$ and up to 3500VAC/1min isolation voltage. For more information see vincotech.com website.				

Document No.:	Date:	Modification:	Pages
10-E112PMA060MS-L928A76Z-D1-14	17 Feb. 2026	Initial Release	
10-E112PMA060MS-L928A76Z-D2-14	23 Jul. 2026	Correct Topology features and component identification Remove dynamic characteristic of Active Switch Improve Rth of the Protection and Rectifier Diode	

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2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.