



flow3xNPFC 1

650 V / 45 mΩ

**Topology features**

- 3xNeutral Boost PFC
- On-board Capacitors
- Temperature sensor

**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<sub>2</sub>O<sub>3</sub>
- Convex shaped substrate for superior thermal contact
- Compact housing
- CTI600 housing material
- Thermo-mechanical push-and-pull force relief
- Solder pin

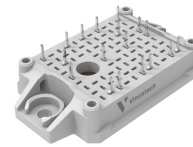
**Target applications**

- Target Applications
- Embedded Drives
  - Heat Pumps
  - HVAC
  - Industrial Drives

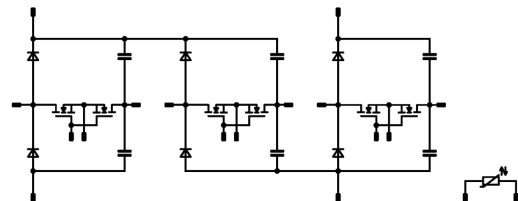
**Types**

- 10-E107L3A045ME-PM33L18Z

**flow E1 12 mm housing**



**Schematic**





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10-E107L3A045ME-PM33L18Z  
datasheet

## Maximum Ratings

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

Parameter	Symbol	Conditions	Value	Unit
<b>Boost Switch</b>				
Drain-source voltage	$V_{DSS}$		650	V
Drain current (DC current)	$I_D$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	26	A
Peak drain current	$I_{DM}$	$t_p$ limited by $T_{jmax}$	132	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	51	W
Gate-source voltage	$V_{GSS}$		-4 / 15	V
		dynamic	-8 / 19	
Maximum Junction Temperature	$T_{jmax}$		175	°C
<b>Boost Diode</b>				
Peak repetitive reverse voltage	$V_{RRM}$		1200	V
Forward current (DC current)	$I_F$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	30	A
Repetitive peak forward current	$I_{FRM}$	$t_p$ limited by $T_{jmax}$	51	A
Surge (non-repetitive) forward current	$I_{FSM}$	Single Half Sine Wave, $t_p = 10\text{ ms}$ $T_j = 110\text{ °C}$	129	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	63	W
Maximum junction temperature	$T_{jmax}$		175	°C
<b>Capacitor (PFC)</b>				
Maximum DC voltage	$V_{MAX}$		630	V
Operation Temperature	$T_{op}$		-55 ... 150	°C



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**10-E107L3A045ME-PM33L18Z**  
datasheet

## Maximum Ratings

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

Parameter	Symbol	Conditions	Value	Unit
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### Module Properties

#### Thermal Properties

Storage temperature	$T_{\text{stg}}$		-40...+125	°C
Operation temperature under switching condition	$T_{\text{jop}}$		-40...+( $T_{\text{jmax}} - 25$ )	°C

#### Isolation Properties

Isolation voltage	$V_{\text{isol}}$	DC Test Voltage* $t_p = 2\text{ s}$	6000	V
Creepage distance			>12,7	mm
Clearance			9,12	mm
Comparative Tracking Index	CTI		≥ 600	

\*100 % tested in production



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### Characteristic Values

Parameter	Symbol	Conditions					Values			Unit
		$V_{GS}$ [V]	$V_{GE}$ [V]	$V_{DS}$ [V]	$I_C$ [A]	$T_j$ [°C]	Min	Typ	Max	

#### Boost Switch

##### Static

Drain-source on-state resistance	$r_{DS(on)}$		15		17,6	25 125 150		55,6 65,3 70,4	60 <sup>(1)</sup>	mΩ
Gate-source threshold voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}$			0,00484	25	1,8	2,6	3,6	V
Gate to Source Leakage Current	$I_{GSS}$		15	0		25		10	100	nA
Zero Gate Voltage Drain Current	$I_{DSS}$		0	650		25		1	32	μA
Internal gate resistance	$r_g$							3		Ω
Gate charge	$Q_g$		-4/15	400	17,6	25		63		nC
Short-circuit input capacitance	$C_{iss}$	$f = 1 \text{ Mhz}$	0	600	0	25		1600		pF
Short-circuit output capacitance	$C_{oss}$							100		
Reverse transfer capacitance	$C_{rss}$							8		
Diode forward voltage	$V_{SD}$		0		8,8	25		4,8		V

##### Thermal

Thermal resistance junction to sink <sup>(2)</sup>	$R_{th(j-s)}$	$\lambda_{paste} = 5,2 \text{ W/mK}$ (PTM)						1,87		K/W
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##### Dynamic

Turn-on delay time	$t_{d(on)}$	$R_{gon} = 4 \Omega$ $R_{goff} = 4 \Omega$	-4/15	350	26	25		15,42		ns
Rise time	$t_r$					125		14,77		
						150		14,58		
						25		11,9		
Turn-off delay time	$t_{d(off)}$					125		10,57		
						150		10,17		
						25		37,44		
Fall time	$t_f$	125		41,12						
		150		41,84						
		25		21,81						
Turn-on energy (per pulse)	$E_{on}$	$Q_{rFWD} = 0,168 \mu\text{C}$				25		0,149		mWs
		$Q_{rFWD} = 0,183 \mu\text{C}$				125		0,139		
		$Q_{rFWD} = 0,187 \mu\text{C}$				150		0,136		
Turn-off energy (per pulse)	$E_{off}$					25		0,042		mWs
						125		0,043		
						150		0,044		



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10-E107L3A045ME-PM33L18Z  
datasheet

### 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		
<b>Boost Diode</b>										
<b>Static</b>										
Forward voltage	$V_F$				20	25 125 150		1,33 1,54 1,62	2 <sup>(1)</sup>	V
Reverse leakage current	$I_R$	$V_r = 1200$ V				25		5	500	μA
<b>Thermal</b>										
Thermal resistance junction to sink <sup>(2)</sup>	$R_{th(j-s)}$	$\lambda_{paste} = 5,2$ W/mK (PTM)						1,51		K/W
<b>Dynamic</b>										
Peak recovery current	$I_{RM}$					25 125 150		18,14 20 20,5		A
Reverse recovery time	$t_{rr}$					25 125 150		16,32 15,62 15,43		ns
Recovered charge	$Q_r$	$di/dt=2708$ A/μs $di/dt=2503$ A/μs $di/dt=2500$ A/μs	-4/15	350	26	25 125 150		0,168 0,183 0,187		μC
Reverse recovered energy	$E_{rec}$					25 125 150		0,027 0,033 0,034		mWs
Peak rate of fall of recovery current	$(di_r/dt)_{max}$					25 125 150		2947,95 3261,79 3091,98		A/μs



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### Characteristic Values

Parameter	Symbol	Conditions					Values			Unit
		$V_{GS}$ [V]	$V_{GE}$ [V]	$V_{DS}$ [V]	$V_{CE}$ [V]	$T_j$ [°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		5		kΩ
Deviation of R100	$\Delta_{RR}$	$R_{100} = 499 \Omega$				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	

<sup>(1)</sup> Value at chip level

<sup>(2)</sup> Only valid with pre-applied Vincotech thermal interface material.

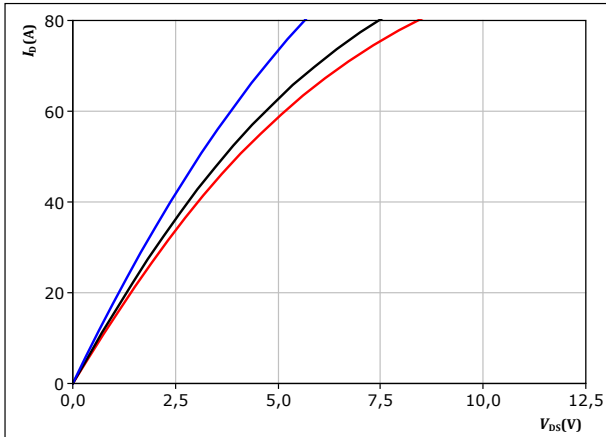


## Boost Switch Characteristics

figure 1. MOSFET

Typical output characteristics

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



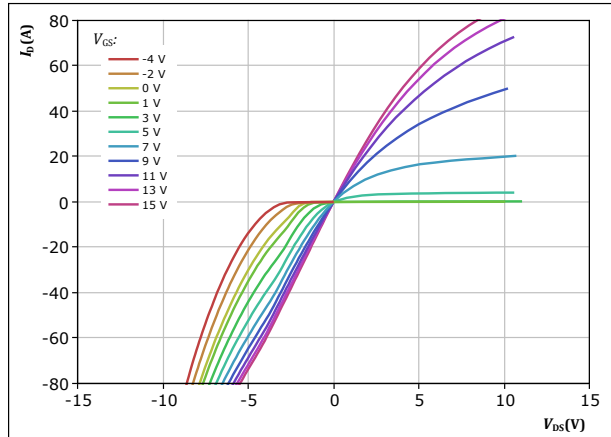
$t_p = 250 \mu s$   
 $V_{GS} = 15 V$

$T_j$ :  
— 25 °C  
— 125 °C  
— 150 °C

figure 2. MOSFET

Typical output characteristics

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

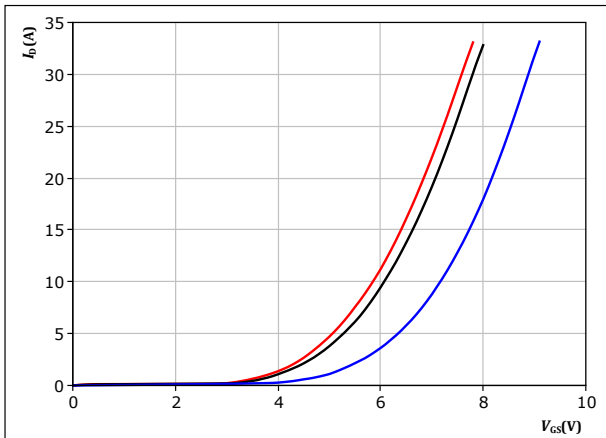


$t_p = 250 \mu s$   
 $T_j = 150 \text{ } ^\circ C$   
 $V_{GS}$  from -4 V to 15 V in steps of 2 V

figure 3. MOSFET

Typical transfer characteristics

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



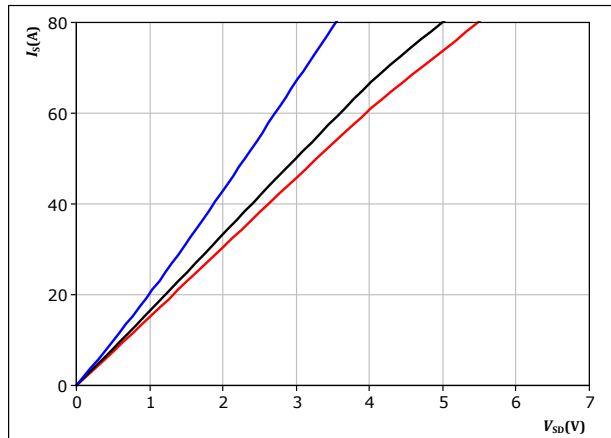
$t_p = 250 \mu s$   
 $V_{DS} = 10 V$

$T_j$ :  
— 25 °C  
— 125 °C  
— 150 °C

figure 4. MOSFET

Typical reverse drain current characteristics

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



$t_p = 250 \mu s$   
 $V_{GS} = 15 V$

$T_j$ :  
— 25 °C  
— 125 °C  
— 150 °C

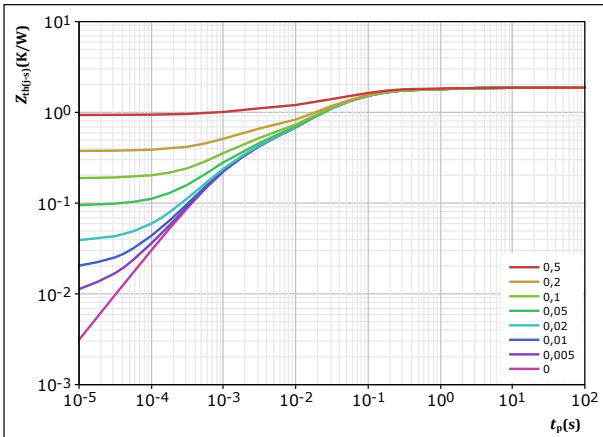


### Boost Switch Characteristics

**figure 5.** MOSFET

Transient thermal impedance as a function of pulse width

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



$$D = t_p / T$$

$$R_{th(j-c)} = 1,873 \text{ K/W}$$

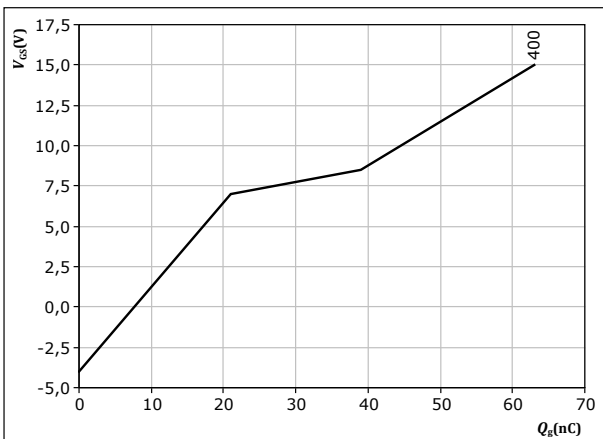
MOSFET thermal model values

R (K/W)	$\tau$ (s)
2,19E-02	7,21E+00
1,16E-01	1,19E+00
7,60E-01	7,95E-02
6,65E-01	1,79E-02
3,10E-01	1,17E-03

**figure 7.** MOSFET

Gate voltage vs gate charge

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



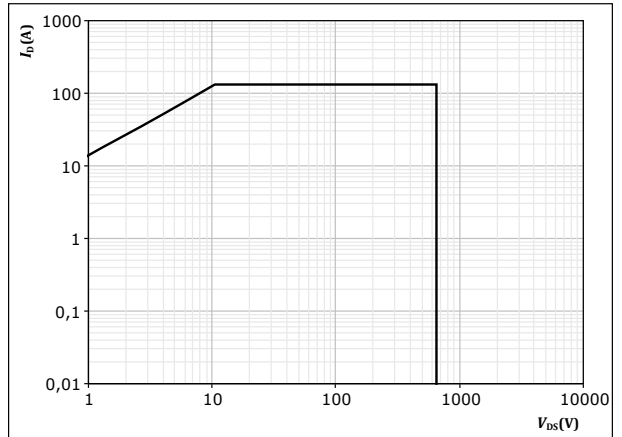
$$I_D = 17.6 \text{ A}$$

$$T_j = 25 \text{ }^\circ\text{C}$$

**figure 6.** MOSFET

Safe operating area

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



D = single pulse

$$T_s = 80 \text{ }^\circ\text{C}$$

$$V_{GS} = 15 \text{ V}$$

$$T_j = T_{jmax}$$





### Boost Diode Characteristics

figure 8. FWD

Typical forward characteristics

$$I_F = f(V_F)$$

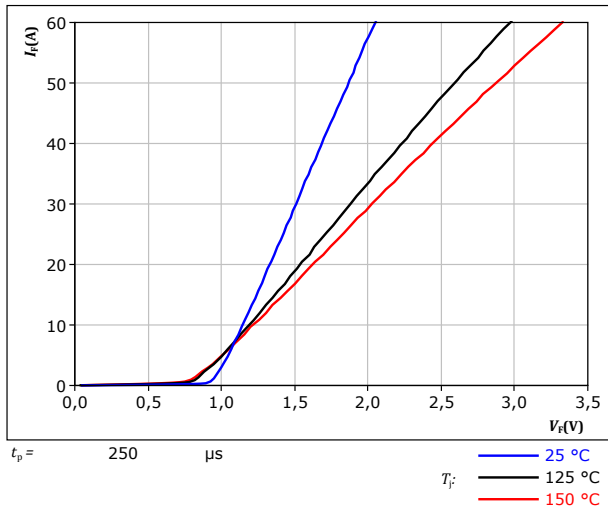
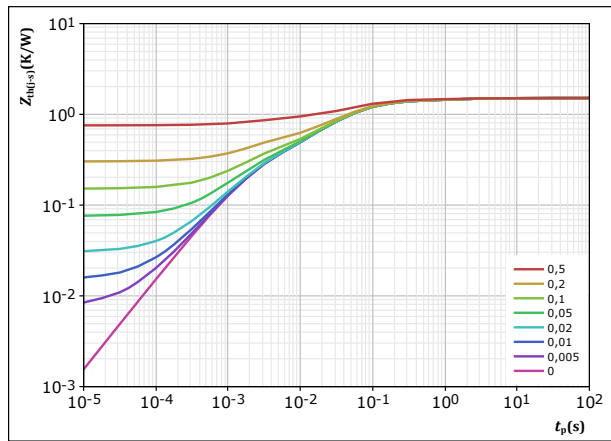


figure 9. FWD

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$   
 $R_{th(j-s)} = 1,512 \text{ K/W}$   
 FWD thermal model values

$R$ (K/W)	$\tau$ (s)
1,90E-02	7,99E+00
1,12E-01	1,12E+00
4,92E-01	9,11E-02
6,45E-01	2,72E-02
2,44E-01	1,93E-03

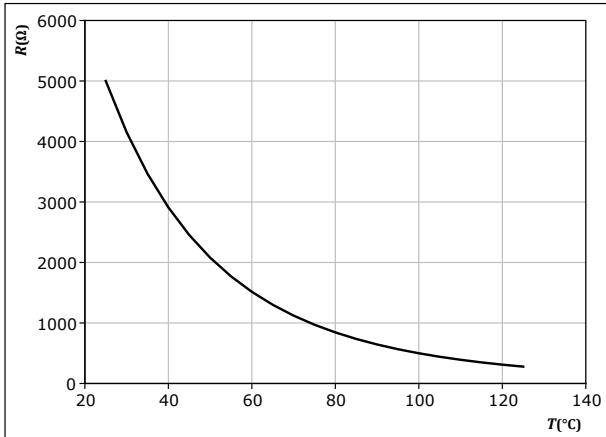


## Thermistor Characteristics

figure 10. Thermistor

Typical NTC characteristic as function of temperature

$$R_T = f(T)$$

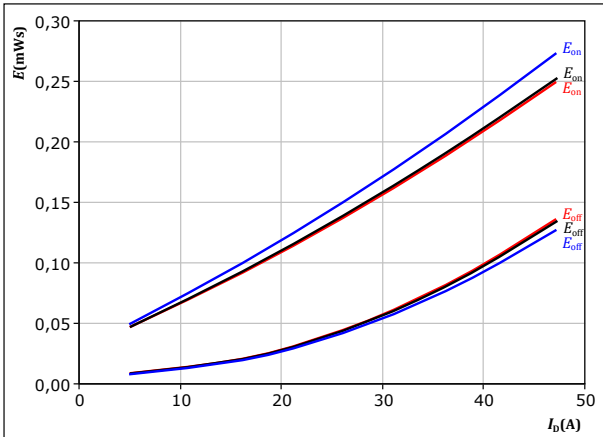




## Boost Switching Characteristics

figure 11. MOSFET

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



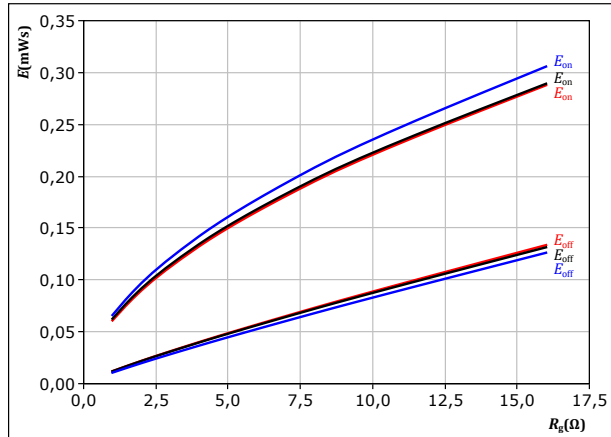
With an inductive load at

$V_{DS} = 350 \text{ V}$   
 $V_{GS} = -4/15 \text{ V}$   
 $R_{gon} = 4 \ \Omega$   
 $R_{goff} = 4 \ \Omega$

$T_j$ : — 25 °C  
 — 125 °C  
 — 150 °C

figure 12. MOSFET

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



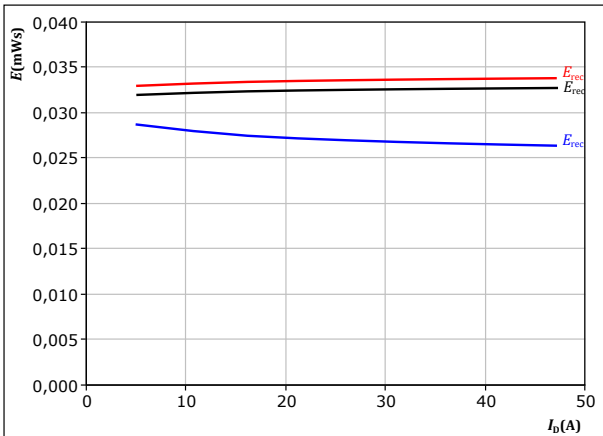
With an inductive load at

$V_{DS} = 350 \text{ V}$   
 $V_{GS} = -4/15 \text{ V}$   
 $I_D = 26 \text{ A}$

$T_j$ : — 25 °C  
 — 125 °C  
 — 150 °C

figure 13. FWD

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



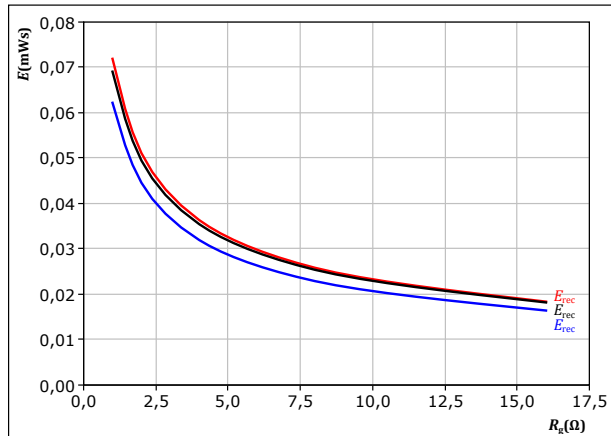
With an inductive load at

$V_{DS} = 350 \text{ V}$   
 $V_{GS} = -4/15 \text{ V}$   
 $R_{gon} = 4 \ \Omega$

$T_j$ : — 25 °C  
 — 125 °C  
 — 150 °C

figure 14. 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

$V_{DS} = 350 \text{ V}$   
 $V_{GS} = -4/15 \text{ V}$   
 $I_D = 26 \text{ A}$

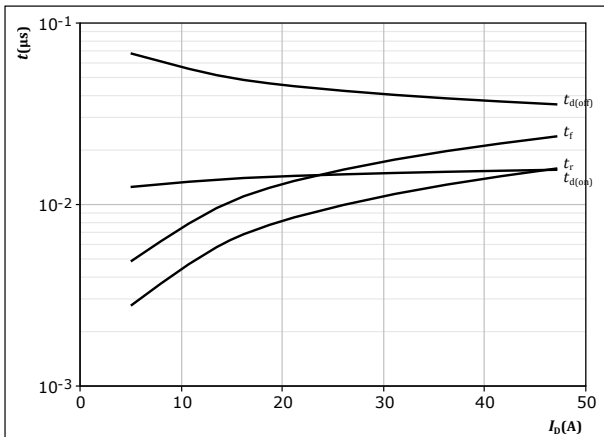
$T_j$ : — 25 °C  
 — 125 °C  
 — 150 °C



## Boost Switching Characteristics

**figure 15.** MOSFET

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

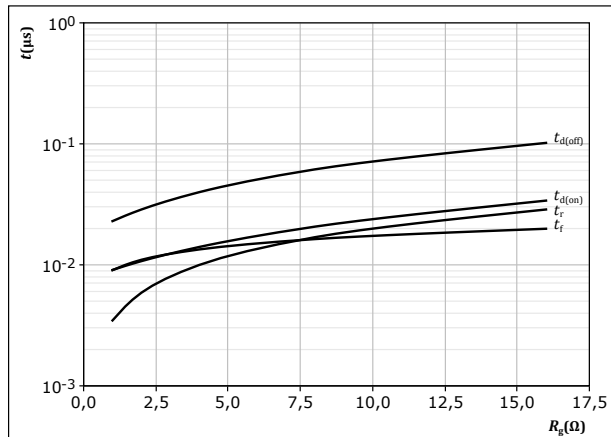


With an inductive load at

$T_j = 150 \text{ } ^\circ\text{C}$   
 $V_{DS} = 350 \text{ V}$   
 $V_{GS} = -4/15 \text{ V}$   
 $R_{gon} = 4 \text{ } \Omega$   
 $R_{goff} = 4 \text{ } \Omega$

**figure 16.** MOSFET

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

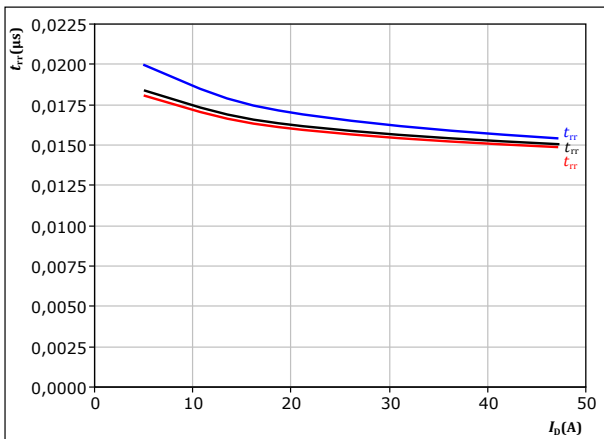


With an inductive load at

$T_j = 150 \text{ } ^\circ\text{C}$   
 $V_{DS} = 350 \text{ V}$   
 $V_{GS} = -4/15 \text{ V}$   
 $I_D = 26 \text{ A}$

**figure 17.** FWD

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

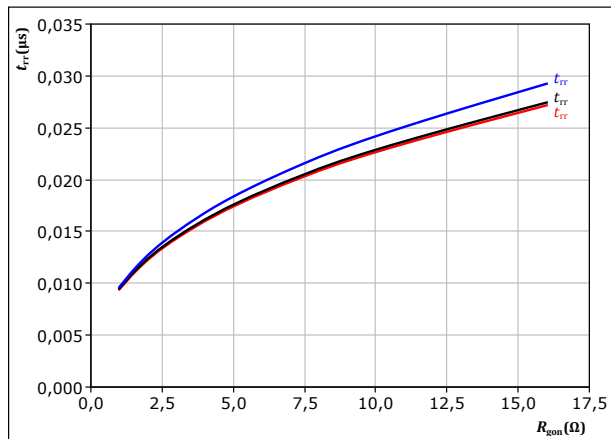


At  $V_{DS} = 350 \text{ V}$   
 $V_{GS} = -4/15 \text{ V}$   
 $R_{gon} = 4 \text{ } \Omega$

$T_j$ : — 25 °C  
— 125 °C  
— 150 °C

**figure 18.** FWD

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



At  $V_{DS} = 350 \text{ V}$   
 $V_{GS} = -4/15 \text{ V}$   
 $I_D = 26 \text{ A}$

$T_j$ : — 25 °C  
— 125 °C  
— 150 °C

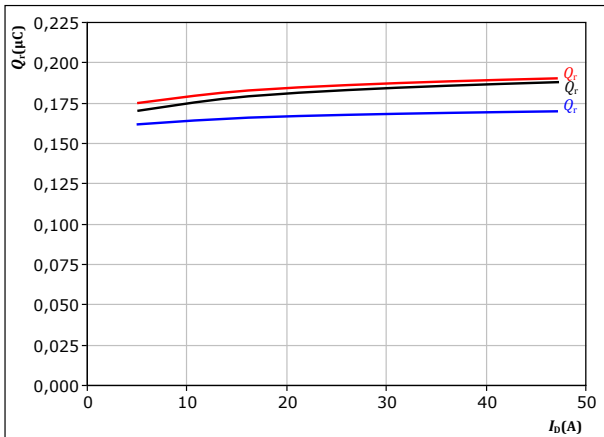


## Boost Switching Characteristics

figure 19. FWD

Typical recovered charge as a function of drain current

$$Q_r = f(I_D)$$



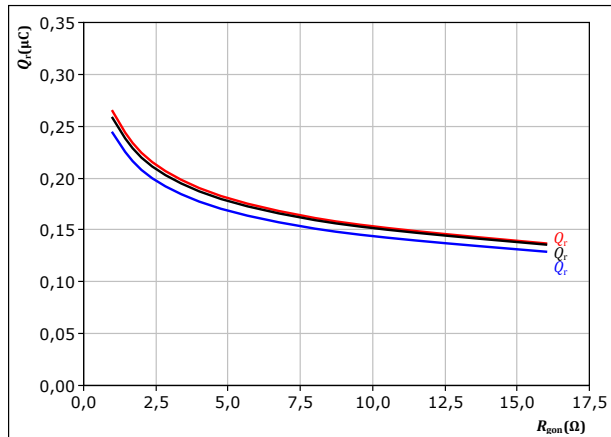
At  $V_{DS} = 350$  V  
 $V_{GS} = -4/15$  V  
 $R_{gon} = 4$   $\Omega$

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

figure 20. FWD

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

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



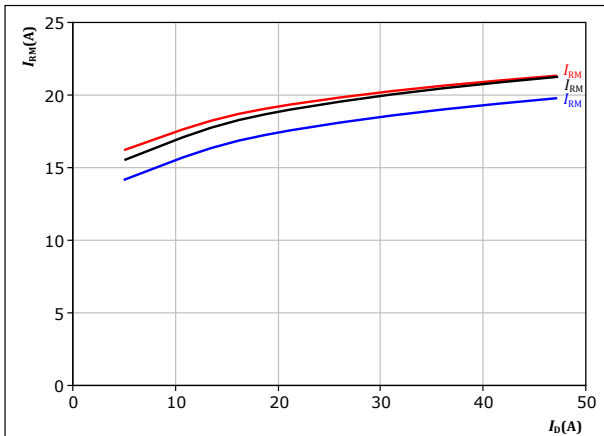
At  $V_{DS} = 350$  V  
 $V_{GS} = -4/15$  V  
 $I_D = 26$  A

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

figure 21. FWD

Typical peak reverse recovery current as a function of drain current

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



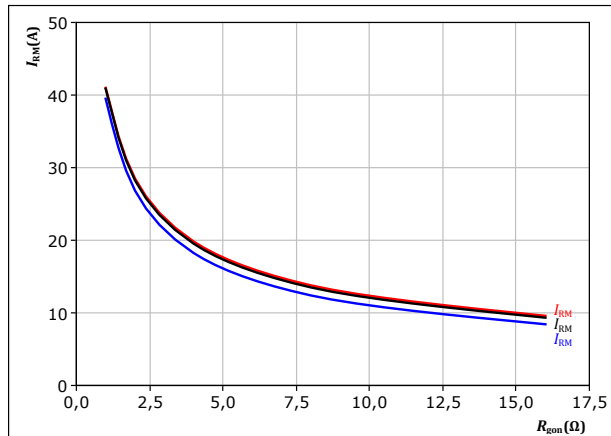
At  $V_{DS} = 350$  V  
 $V_{GS} = -4/15$  V  
 $R_{gon} = 4$   $\Omega$

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

figure 22. FWD

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

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



At  $V_{DS} = 350$  V  
 $V_{GS} = -4/15$  V  
 $I_D = 26$  A

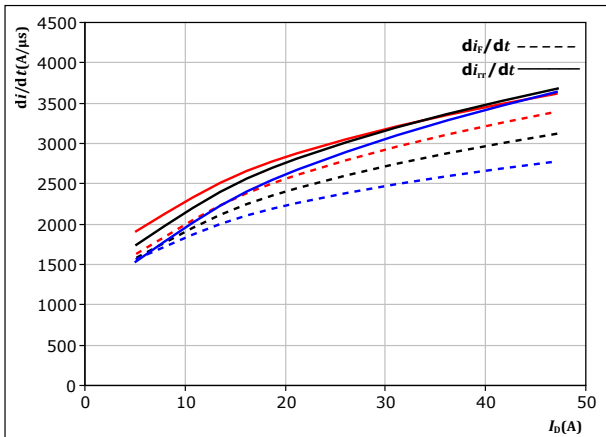
$T_j$ : 25 °C (blue), 125 °C (black), 150 °C (red)



### Boost Switching Characteristics

**figure 23.** FWD

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

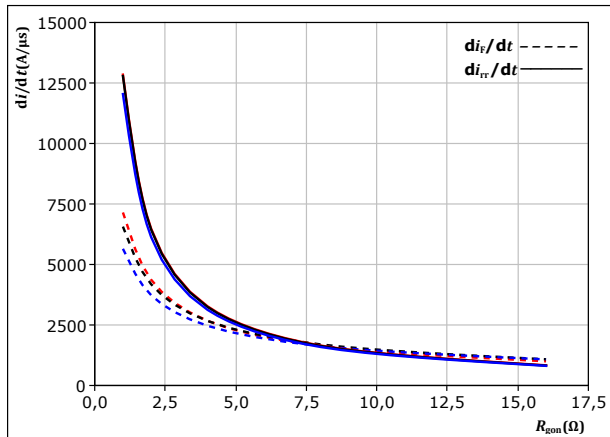


At  $V_{DS} = 350$  V  
 $V_{GS} = -4/15$  V  
 $R_{g(on)} = 4$  Ω

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

**figure 24.** FWD

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



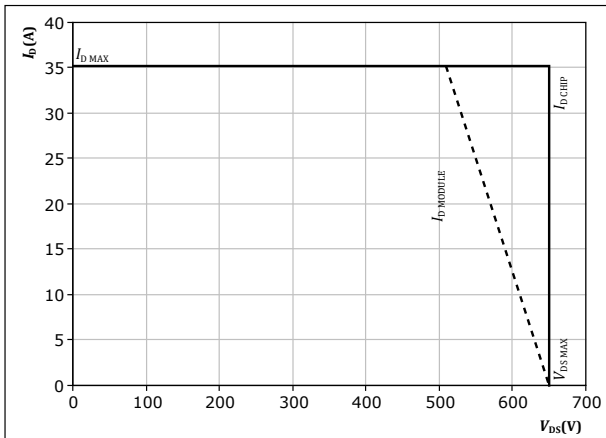
At  $V_{DS} = 350$  V  
 $V_{GS} = -4/15$  V  
 $I_D = 26$  A

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

**figure 25.** MOSFET

Reverse bias safe operating area

$I_D = f(V_{DS})$



At  $T_j = 150$  °C  
 $R_{g(on)} = 4$  Ω  
 $R_{g(off)} = 4$  Ω



## Boost Switching Definitions

figure 26. MOSFET

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

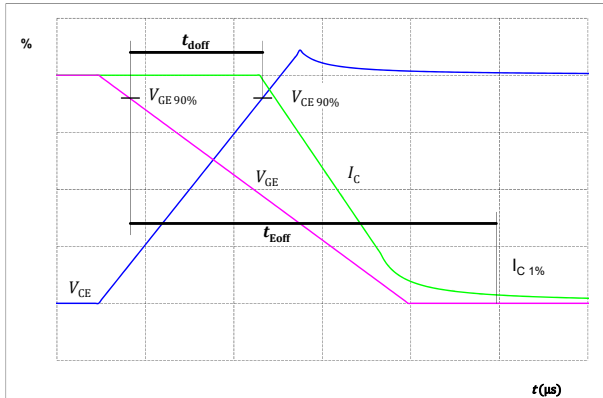


figure 28. MOSFET

Turn-off Switching Waveforms & definition of  $t_f$

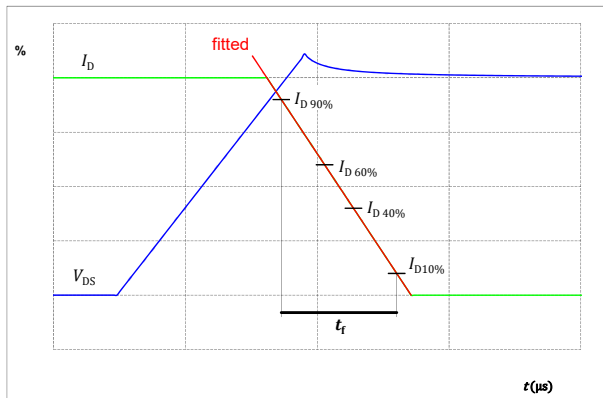


figure 27. MOSFET

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

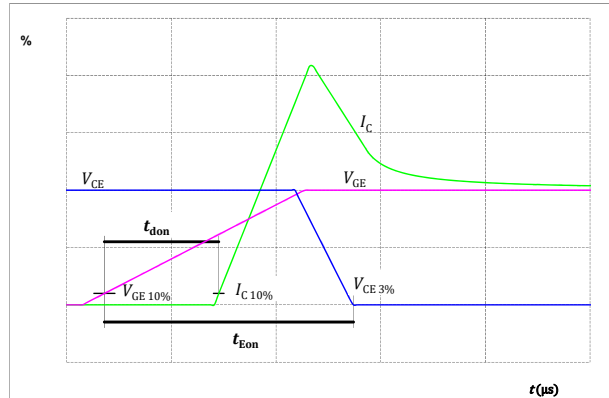
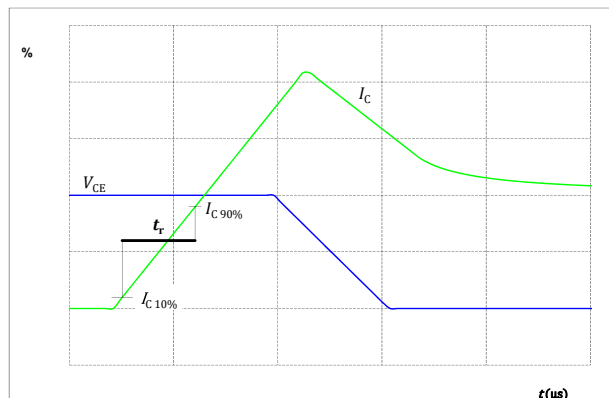


figure 29. MOSFET

Turn-on Switching Waveforms & definition of  $t_r$





### Boost Switching Definitions

figure 30. FWD

Turn-off Switching Waveforms & definition of  $t_{rr}$

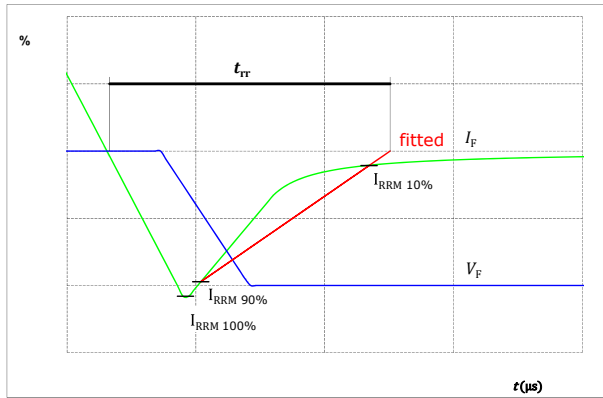


figure 31. FWD

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

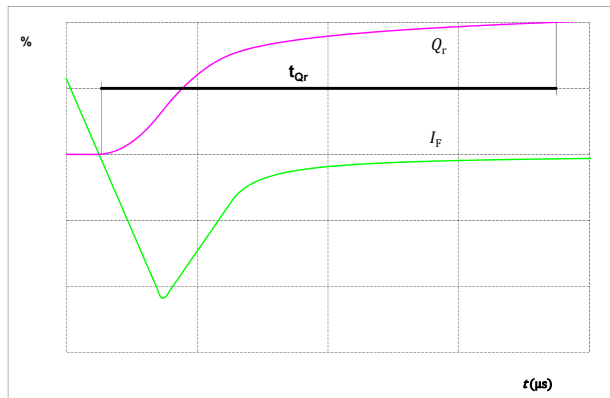
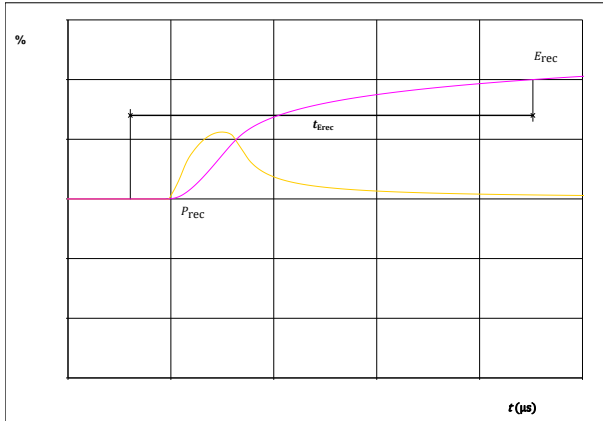


figure 32. FWD

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

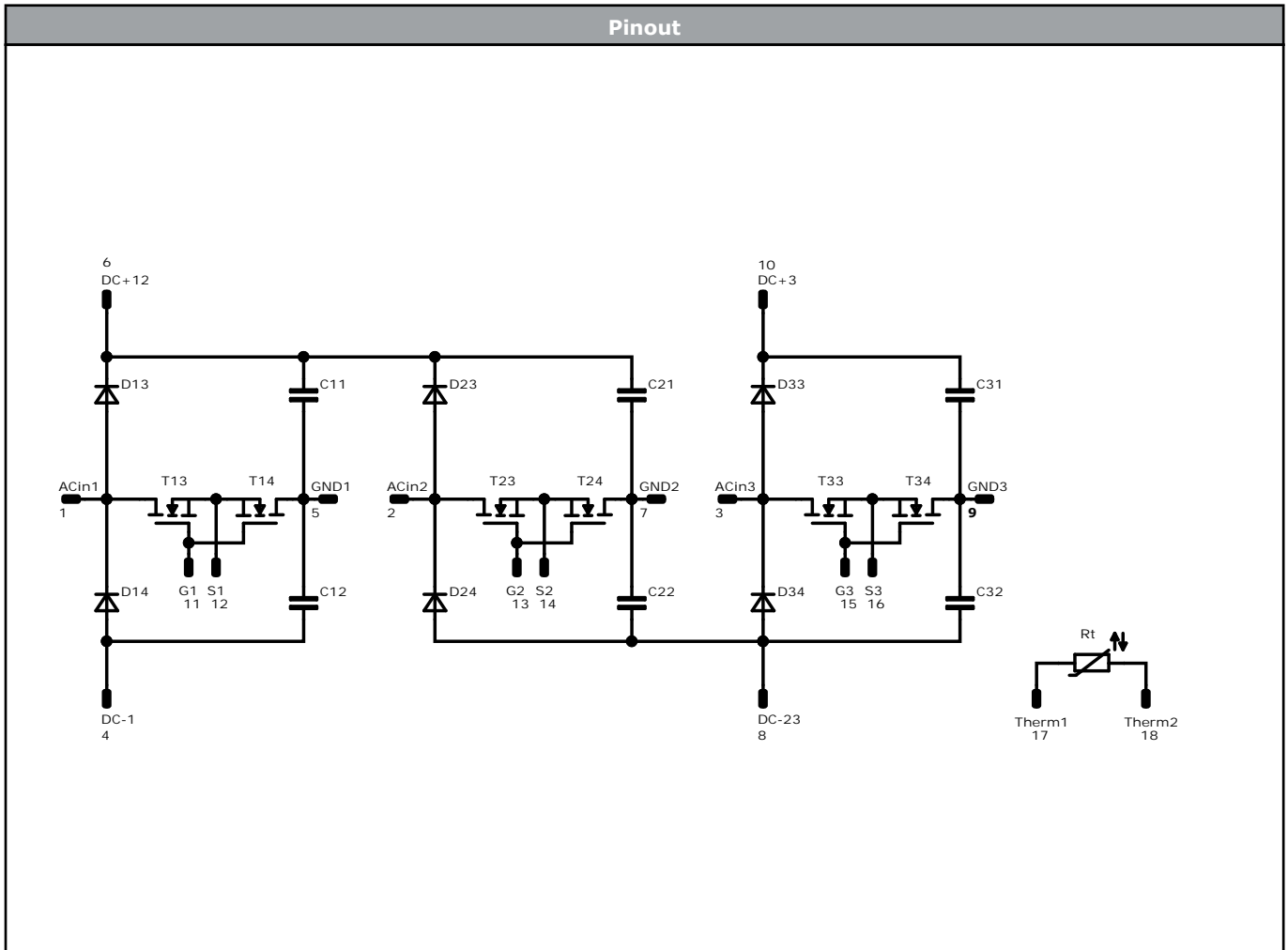








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Identification					
ID	Component	Voltage	Current	Function	Comment
C11, C12, C13, C14, C15, C16	Capacitor	630 V		Capacitor (PFC)	
T13, T14, T23, T24, T33, T34	MOSFET	650 V	45 mΩ	Boost Switch	
D13, D14, D23, D24, D33, D34	FWD	1200 V	20 A	Boost Diode	
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-E107L3A045ME-PM33L18Z-D1-14	13 Sep. 2024	Initial Release	

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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.