



**flowMNPC 1**

**1200 V / 160 A**

**Topology features**

- Kelvin Emitter for improved switching performance
- Mixed Voltage Neutral Point Clamped Topology (T-Type)
- Temperature sensor

**Component features**

- 5 $\mu$ s short circuit withstand time
- High speed switching
- Minimized tail current

**Housing features**

- Base isolation: Al<sub>2</sub>O<sub>3</sub>
- Convex shaped substrate for superior thermal contact
- Thermo-mechanical push-and-pull force relief
- Press-fit pin
- Reliable cold welding connection

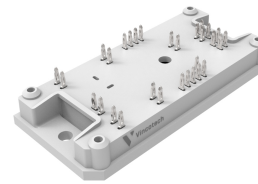
**Target applications**

- Energy Storage Systems
- Solar Inverters
- UPS

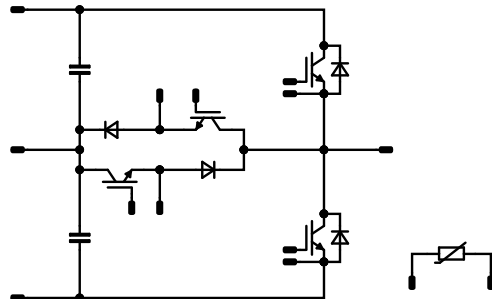
**Types**

- 10-PY12NMA160SH10-M820F08Y

**flow 1 12 mm housing**



**Schematic**





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## Maximum Ratings

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

Parameter	Symbol	Conditions	Value	Unit
<b>Buck Switch</b>				
Collector-emitter voltage	$V_{CES}$		1200	V
Collector current (DC current)	$I_C$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	128	A
Repetitive peak collector current	$I_{CRM}$	$t_p$ limited by $T_{jmax}$	480	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	302	W
Gate-emitter voltage	$V_{GES}$		$\pm 20$	V
Short circuit ratings	$t_{SC}$	$V_{GE} = 15\text{ V}$ , $V_{CC} = 600\text{ V}$ $T_j = 150\text{ °C}$	5	$\mu\text{s}$
Maximum junction temperature	$T_{jmax}$		175	$^{\circ}\text{C}$

## Buck Diode

Peak repetitive reverse voltage	$V_{RRM}$		650	V
Forward current (DC current)	$I_F$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	102	A
Surge (non-repetitive) forward current	$I_{FSM}$	Single Half Sine Wave, $t_p = 10\text{ ms}$ $T_j = 25\text{ °C}$	660	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	127	W
Maximum junction temperature	$T_{jmax}$		175	$^{\circ}\text{C}$

## Boost Switch

Collector-emitter voltage	$V_{CES}$		650	V
Collector current (DC current)	$I_C$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	90	A
Repetitive peak collector current	$I_{CRM}$	$t_p$ limited by $T_{jmax}$	450	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	137	W
Gate-emitter voltage	$V_{GES}$		$\pm 20$	V
Maximum junction temperature	$T_{jmax}$		175	$^{\circ}\text{C}$



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**10-PY12NMA160SH10-M820F08Y**  
datasheet

## Maximum Ratings

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

Parameter	Symbol	Conditions	Value	Unit
<b>Boost Diode</b>				
Peak repetitive reverse voltage	$V_{RRM}$		1200	V
Forward current (DC current)	$I_F$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	61	A
Surge (non-repetitive) forward current	$I_{FSM}$	Single Half Sine Wave, $t_p = 10\text{ ms}$ $T_j = 25\text{ °C}$	360	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	97	W
Maximum junction temperature	$T_{jmax}$		175	°C

## Capacitor (DC)

Maximum DC voltage	$V_{MAX}$		630	V
Operation Temperature	$T_{op}$		-55 ... 125	°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
Isolation voltage	$V_{isol}$	AC Voltage $t_p = 1\text{ min}$	2500	V
Creepage distance			>12,7	mm
Clearance			7,88	mm
Comparative Tracking Index	CTI		≥ 200	

\*100 % tested in production



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### Characteristic Values

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

#### Buck Switch

##### Static

Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,008	25	5	6	7	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		160	25 125 150		2,23 2,45 2,5	2,6 <sup>(1)</sup>	V
Collector-emitter cut-off current	$I_{CES}$		20	0		25			100	μA
Gate-emitter leakage current	$I_{GES}$		20	0		25			1000	nA
Internal gate resistance	$r_g$							None		Ω
Input capacitance	$C_{ies}$							12800		pF
Output capacitance	$C_{oes}$	$f = 1$ Mhz	0	25		25		880		pF
Reverse transfer capacitance	$C_{res}$							320		pF
Gate charge	$Q_g$	$V_{CC} = 960$ V	0/15		160	25		632		nC

##### Thermal

Thermal resistance junction to sink <sup>(2)</sup>	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						0,31		K/W
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##### Dynamic

Turn-on delay time	$t_{d(on)}$					25 125 150		61,26 58,39 57,61		ns
Rise time	$t_r$					25 125 150		25,32 27,43 28,21		ns
Turn-off delay time	$t_{d(off)}$					25 125 150		162,65 178,03 183,02		ns
Fall time	$t_f$					25 125 150		28,11 54,04 60,6		ns
Turn-on energy (per pulse)	$E_{on}$	$Q_{tFWD} = 2,92$ μC $Q_{tFWD} = 7,47$ μC $Q_{tFWD} = 9,02$ μC				25 125 150		1,5 2,3 2,58		mWs
Turn-off energy (per pulse)	$E_{off}$					25 125 150		2,32 3,66 4,19		mWs





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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		

#### Buck Diode

##### Static

Forward voltage	$V_F$				150	25 125 150		1,73 1,51 1,45	2,65 <sup>(1)</sup> 2,05 <sup>(1)</sup>	V
Reverse leakage current	$I_R$	$V_r = 650$ V				25 150			40 1600	μA

##### Thermal

Thermal resistance junction to sink <sup>(2)</sup>	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						0,75		K/W
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##### Dynamic

Peak recovery current	$I_{RM}$					25 125 150		71,93 96,5 102,43		A
Reverse recovery time	$t_{rr}$					25 125 150		119,83 209,08 238,21		ns
Recovered charge	$Q_r$	$di/dt=4569$ A/μs $di/dt=4119$ A/μs $di/dt=3793$ A/μs	-5/15	350	100	25 125 150		2,92 7,47 9,02		μC
Reverse recovered energy	$E_{rec}$					25 125 150		0,571 1,49 1,81		mWs
Peak rate of fall of recovery current	$(di_r/dt)_{max}$					25 125 150		3030,48 1861,89 1673,42		A/μs



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### Characteristic Values

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

#### Boost Switch

##### Static

Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,002	25	5	6	7	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		150	25 125 150		1,55 1,7 1,74	2 <sup>(1)</sup>	V
Collector-emitter cut-off current	$I_{CES}$		0	650		25			50	μA
Gate-emitter leakage current	$I_{GES}$		20	0		25	-500		500	nA
Internal gate resistance	$r_g$							None		Ω
Input capacitance	$C_{ies}$							8714		pF
Output capacitance	$C_{oes}$	$f = 1$ Mhz	0	25		25		528		pF
Reverse transfer capacitance	$C_{res}$							234		pF
Gate charge	$Q_g$	$V_{CC} = 520$ V	0/15		150	25		414		nC

##### Thermal

Thermal resistance junction to sink <sup>(2)</sup>	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						0,7		K/W
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##### Dynamic

Turn-on delay time	$t_{d(on)}$					25 125 150		46,08 45,5 45,4		ns
Rise time	$t_r$					25 125 150		16,85 17,88 17,82		ns
Turn-off delay time	$t_{d(off)}$					25 125 150		152,24 166,27 170,15		ns
Fall time	$t_f$					25 125 150		24,42 48,98 54,3		ns
Turn-on energy (per pulse)	$E_{on}$	$Q_{tFWD} = 3,25$ μC $Q_{tFWD} = 7,28$ μC $Q_{tFWD} = 8,56$ μC				25 125 150		0,378 0,621 0,694		mWs
Turn-off energy (per pulse)	$E_{off}$					25 125 150		1,26 1,94 2,13		mWs



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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	$V_F$				80	25 125 150		2,49 2,02 1,91	3,8 <sup>(1)</sup>  2,65 <sup>(1)</sup>	V
Reverse leakage current	$I_R$	$V_r = 1200$ V				25 150			40 1600	μA
<b>Thermal</b>										
Thermal resistance junction to sink <sup>(2)</sup>	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						0,98		K/W
<b>Dynamic</b>										
Peak recovery current	$I_{RM}$					25 125 150		141,04 166,68 173,81		A
Reverse recovery time	$t_{rr}$					25 125 150		41,71 139,73 163,15		ns
Recovered charge	$Q_r$	$di/dt=7098$ A/μs $di/dt=7095$ A/μs $di/dt=6510$ A/μs	-5/15	350	100	25 125 150		3,25 7,28 8,56		μC
Reverse recovered energy	$E_{rec}$					25 125 150		1,04 2,13 2,48		mWs
Peak rate of fall of recovery current	$(di_r/dt)_{max}$					25 125 150		9861,78 6875,9 6516,43		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]	$V_F$ [V]	$I_D$ [A]	$I_C$ [A]	$I_F$ [A]		$T_j$ [°C]

#### Capacitor (DC)

##### Static

Capacitance	$C$	DC bias voltage = 0 V				25		100			nF
Tolerance								-10		10	%

#### Thermistor

##### Static

Rated resistance	$R$					25		22			kΩ
Deviation of R100	$\Delta_{RR}$	$R_{100} = 1484 \Omega$				100		-5		5	%
Power dissipation	$P$					25		130			mW
Power dissipation constant	$d$					25		1,5			mW/K
B-value	$B_{(25/50)}$	Tol. $\pm 1 \%$						3962			K
B-value	$B_{(25/100)}$	Tol. $\pm 1 \%$						4000			K
Vincotech Thermistor Reference										I	

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

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

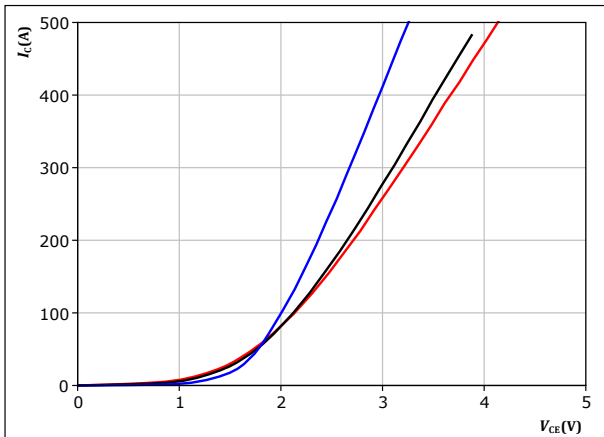


## Buck Switch Characteristics

figure 1. IGBT

Typical output characteristics

$$I_C = f(V_{CE})$$



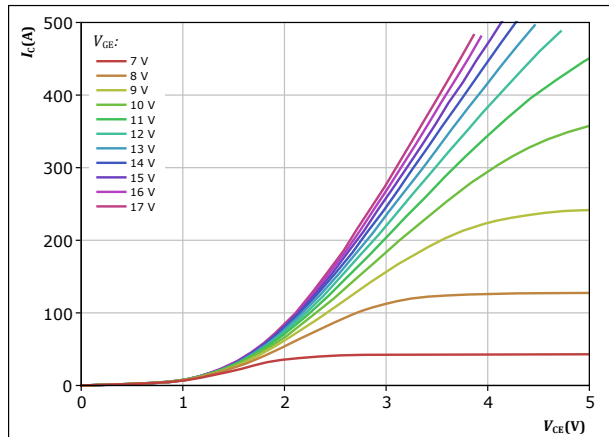
$t_p = 250 \mu s$   
 $V_{GE} = 15 V$

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

figure 2. IGBT

Typical output characteristics

$$I_C = f(V_{CE})$$

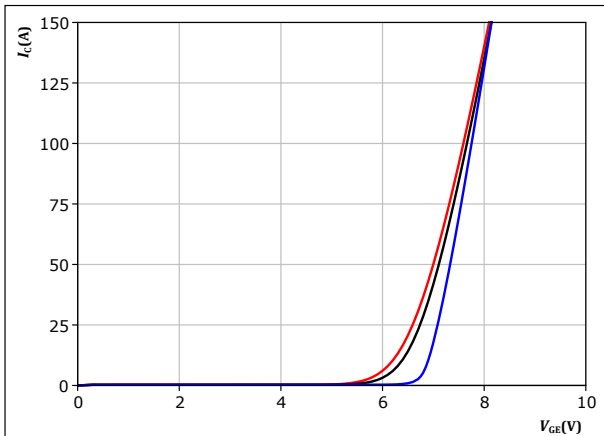


$t_p = 250 \mu s$   
 $T_j = 150 \text{ }^\circ C$   
 $V_{GE}$  from 7 V to 17 V in steps of 1 V

figure 3. IGBT

Typical transfer characteristics

$$I_C = f(V_{GE})$$



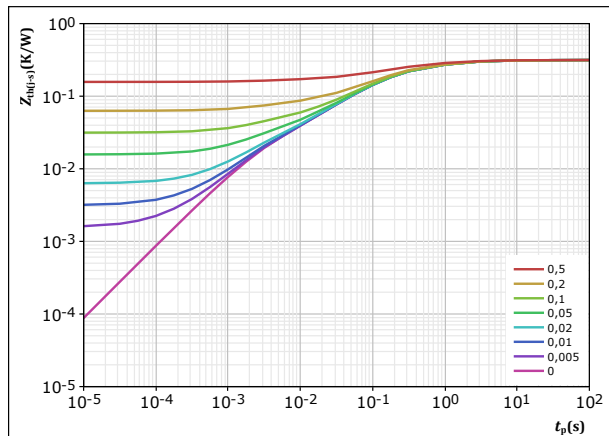
$t_p = 250 \mu s$   
 $V_{CE} = 60 V$

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

figure 4. IGBT

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$   
 $R_{th(j-s)} = 0,315 \text{ K/W}$

IGBT thermal model values

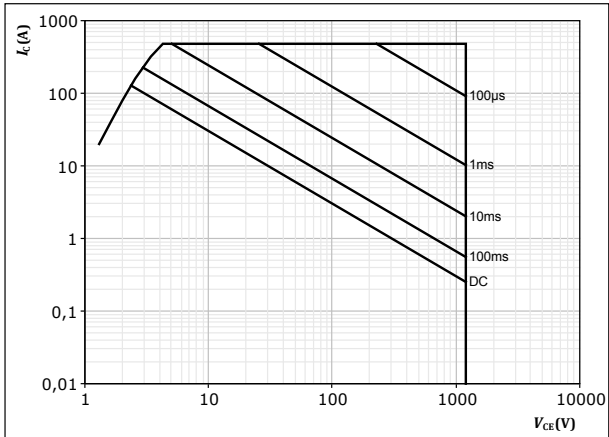
$R$ (K/W)	$\tau$ (s)
6,94E-03	1,75E+01
7,29E-02	1,39E+00
1,59E-01	1,87E-01
5,87E-02	3,74E-02
1,71E-02	2,70E-03



### Buck Switch Characteristics

figure 5. IGBT

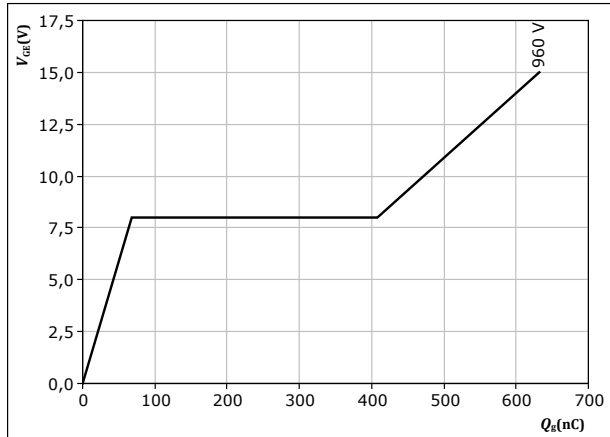
Safe operating area  
 $I_C = f(V_{CE})$



$D =$  single pulse  
 $T_s = 80$  °C  
 $V_{GE} = 15$  V  
 $T_j = T_{jmax}$

figure 6. IGBT

Gate voltage vs gate charge  
 $V_{GE} = f(Q_g)$



$I_C = 40$  A  
 $T_j = 25$  °C



### Buck Diode Characteristics

figure 7. FWD

Typical forward characteristics

$$I_F = f(V_F)$$

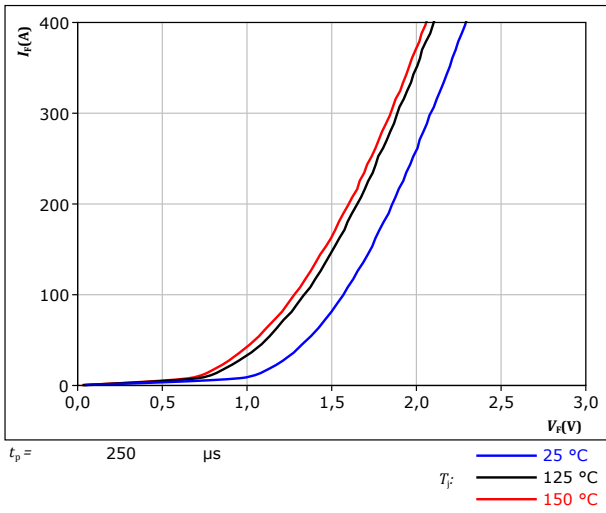
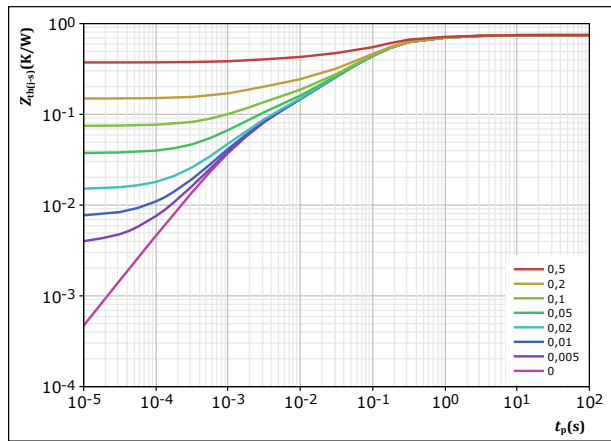


figure 8. FWD

Transient thermal impedance as a function of pulse width

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



$D = \frac{t_p}{T}$   
 $R_{th(j-s)} = 0,746 \text{ K/W}$   
 FWD thermal model values

R (K/W)	$\tau$ (s)
5,69E-02	2,19E+00
9,76E-02	4,58E-01
4,48E-01	1,05E-01
8,77E-02	1,24E-02
5,60E-02	1,58E-03

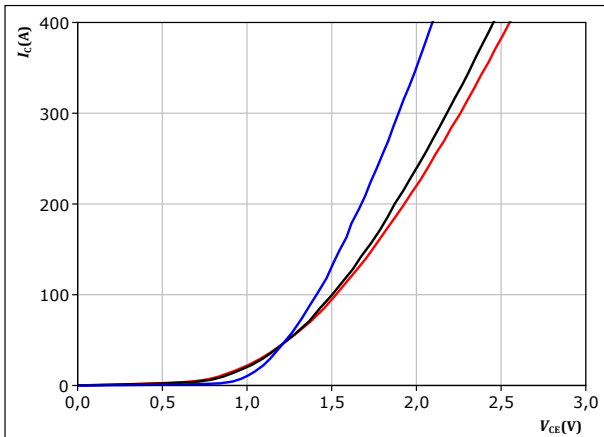


## Boost Switch Characteristics

figure 9. IGBT

Typical output characteristics

$$I_C = f(V_{CE})$$



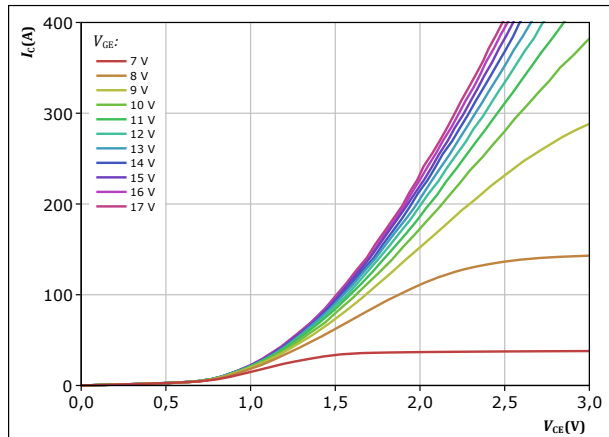
$t_p = 250 \mu\text{s}$   
 $V_{GE} = 15 \text{ V}$

$T_j:$  — 25 °C  
— 125 °C  
— 150 °C

figure 10. IGBT

Typical output characteristics

$$I_C = f(V_{CE})$$

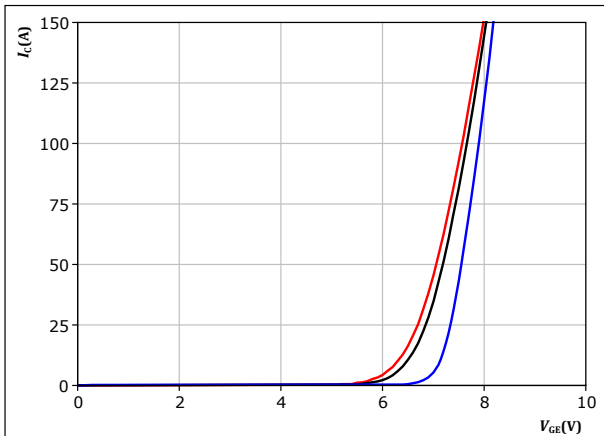


$t_p = 250 \mu\text{s}$   
 $T_j = 150 \text{ °C}$   
 $V_{GE}$  from 7 V to 17 V in steps of 1 V

figure 11. IGBT

Typical transfer characteristics

$$I_C = f(V_{GE})$$



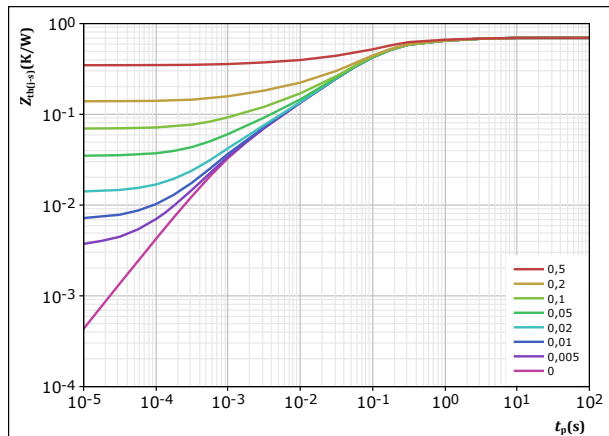
$t_p = 250 \mu\text{s}$   
 $V_{CE} = 14 \text{ V}$

$T_j:$  — 25 °C  
— 125 °C  
— 150 °C

figure 12. IGBT

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$   
 $R_{th(j-s)} = 0,696 \text{ K/W}$

IGBT thermal model values

$R$ (K/W)	$\tau$ (s)
6,31E-02	2,13E+00
9,38E-02	4,03E-01
4,16E-01	9,07E-02
8,74E-02	1,08E-02
3,56E-02	1,16E-03



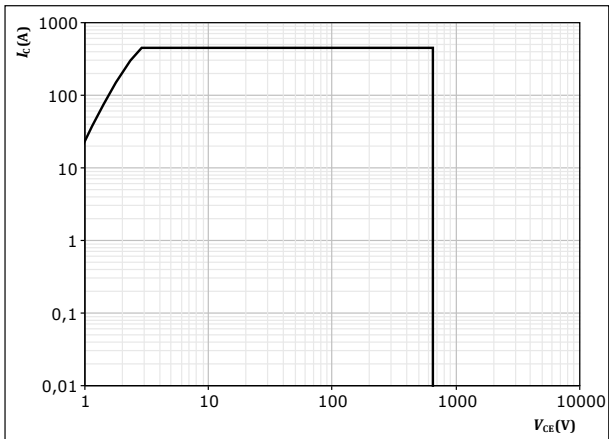


### Boost Switch Characteristics

figure 13. IGBT

Safe operating area

$$I_C = f(V_{CE})$$

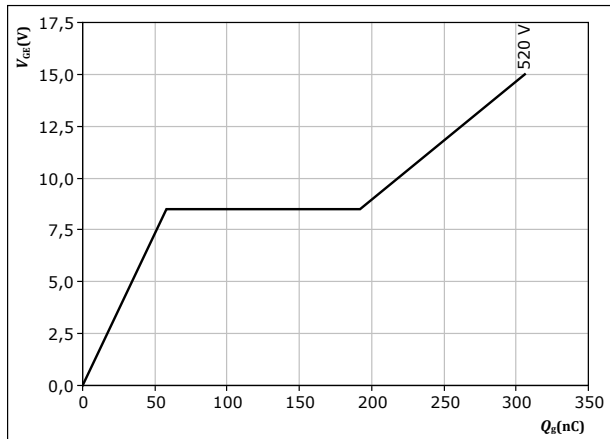


D = single pulse  
T<sub>s</sub> = 80 °C  
V<sub>GE</sub> = 15 V  
T<sub>j</sub> = T<sub>jmax</sub>

figure 14. IGBT

Gate voltage vs gate charge

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



I<sub>C</sub> = 40 A  
T<sub>j</sub> = 25 °C



### Boost Diode Characteristics

figure 15. FWD

Typical forward characteristics

$$I_F = f(V_F)$$

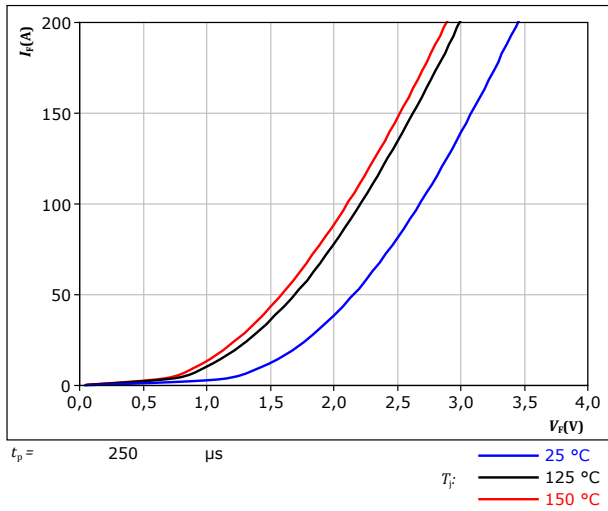
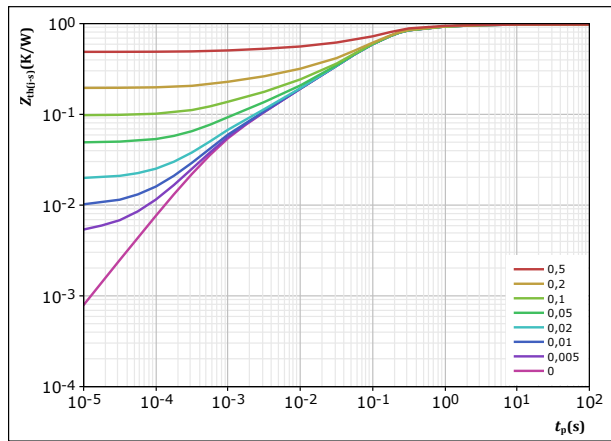


figure 16. FWD

Transient thermal impedance as a function of pulse width

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



$D = \frac{t_p}{T}$   
 $R_{th(j-s)} = 0,976 \text{ K/W}$   
 FWD thermal model values

R (K/W)	$\tau$ (s)
6,46E-02	2,00E+00
1,18E-01	3,70E-01
6,30E-01	1,00E-01
1,10E-01	8,80E-03
5,35E-02	8,84E-04

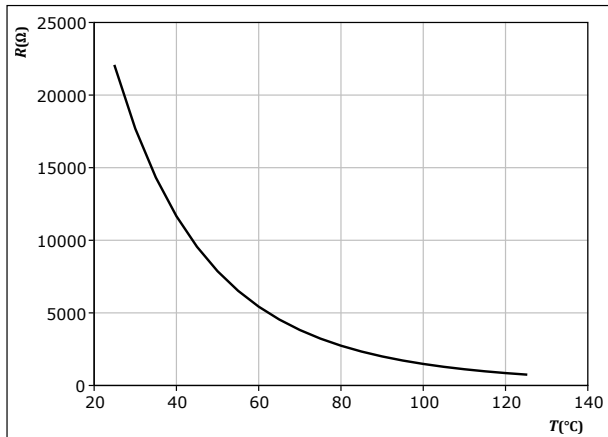


## Thermistor Characteristics

figure 17. Thermistor

Typical NTC characteristic as function of temperature

$$R_T = f(T)$$

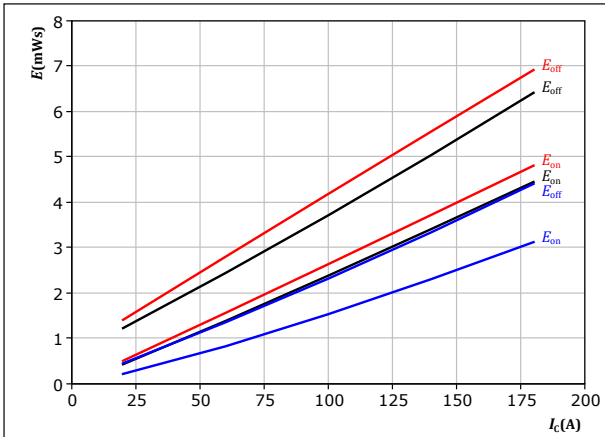




## Buck Switching Characteristics

**figure 18.** IGBT

Typical switching energy losses as a function of collector current  
 $E = f(I_c)$

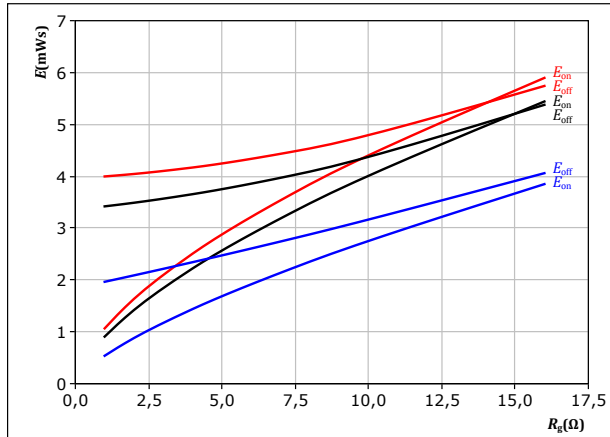


With an inductive load at  
 $V_{CE} = 350$  V  
 $V_{GE} = -5/15$  V  
 $R_{gon} = 4$  Ω  
 $R_{goff} = 4$  Ω

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

**figure 19.** IGBT

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

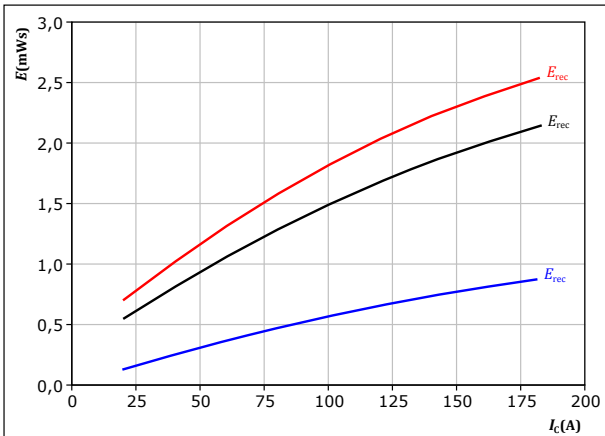


With an inductive load at  
 $V_{CE} = 350$  V  
 $V_{GE} = -5/15$  V  
 $I_c = 100$  A

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

**figure 20.** FWD

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

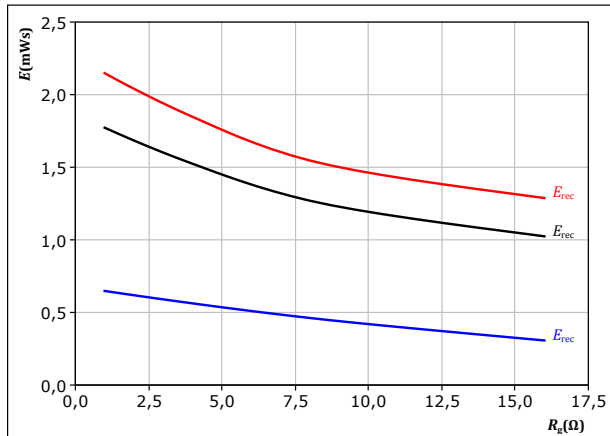


With an inductive load at  
 $V_{CE} = 350$  V  
 $V_{GE} = -5/15$  V  
 $R_{gon} = 4$  Ω

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

**figure 21.** FWD

Typical reverse recovered energy loss as a function of IGBT turn on gate resistor  
 $E_{rec} = f(R_g)$



With an inductive load at  
 $V_{CE} = 350$  V  
 $V_{GE} = -5/15$  V  
 $I_c = 100$  A

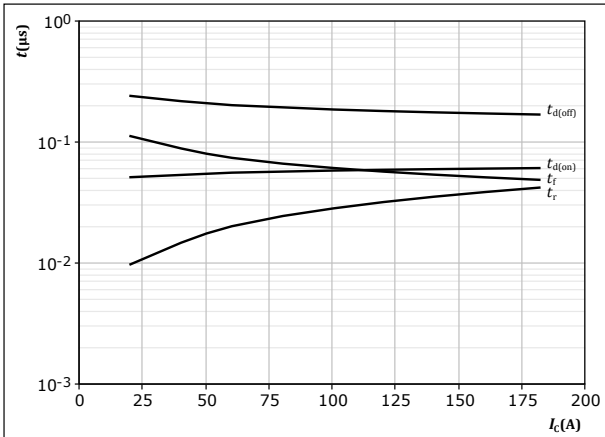
$T_j$ : — 25 °C  
 — 125 °C  
 — 150 °C



## Buck Switching Characteristics

**figure 22.** IGBT

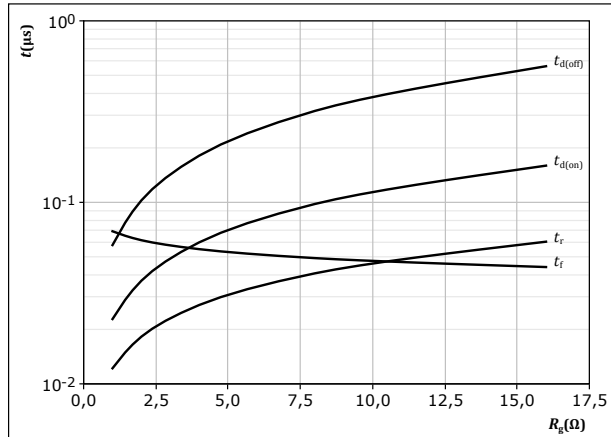
Typical switching times as a function of collector current  
 $t = f(I_c)$



With an inductive load at  
 $T_j = 150 \text{ }^\circ\text{C}$   
 $V_{CE} = 350 \text{ V}$   
 $V_{GE} = -5/15 \text{ V}$   
 $R_{gon} = 4 \text{ } \Omega$   
 $R_{goff} = 4 \text{ } \Omega$

**figure 23.** IGBT

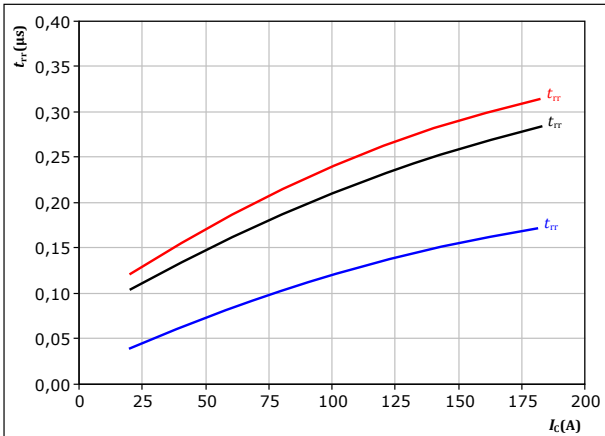
Typical switching times as a function of IGBT turn on gate resistor  
 $t = f(R_g)$



With an inductive load at  
 $T_j = 150 \text{ }^\circ\text{C}$   
 $V_{CE} = 350 \text{ V}$   
 $V_{GE} = -5/15 \text{ V}$   
 $I_c = 100 \text{ A}$

**figure 24.** FWD

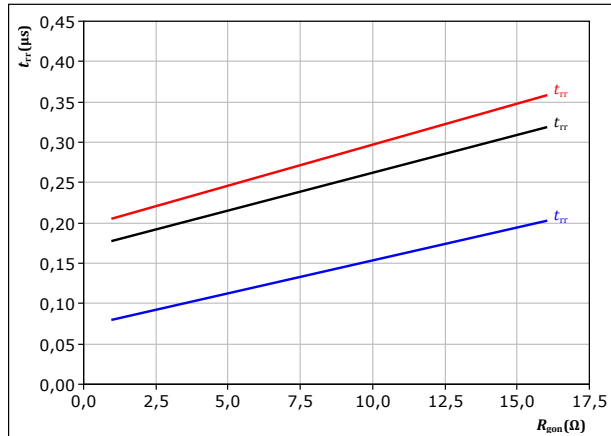
Typical reverse recovery time as a function of collector current  
 $t_{rr} = f(I_c)$



With an inductive load at  
 $V_{CE} = 350 \text{ V}$   
 $V_{GE} = -5/15 \text{ V}$   
 $R_{gon} = 4 \text{ } \Omega$   
 $T_j:$  — 25 °C  
 — 125 °C  
 — 150 °C

**figure 25.** FWD

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



With an inductive load at  
 $V_{CE} = 350 \text{ V}$   
 $V_{GE} = -5/15 \text{ V}$   
 $I_c = 100 \text{ A}$   
 $T_j:$  — 25 °C  
 — 125 °C  
 — 150 °C

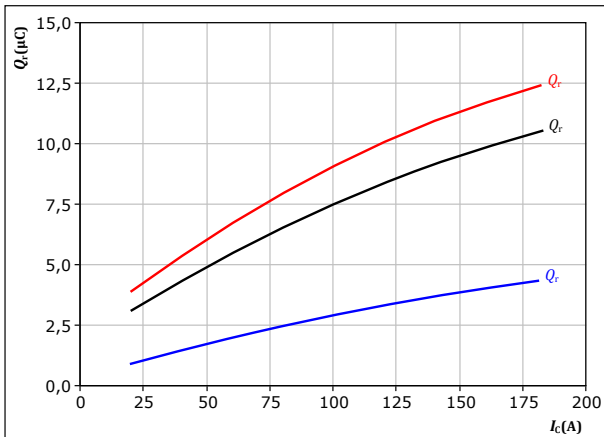


## Buck Switching Characteristics

**figure 26.** FWD

Typical recovered charge as a function of collector current

$$Q_r = f(I_c)$$



With an inductive load at

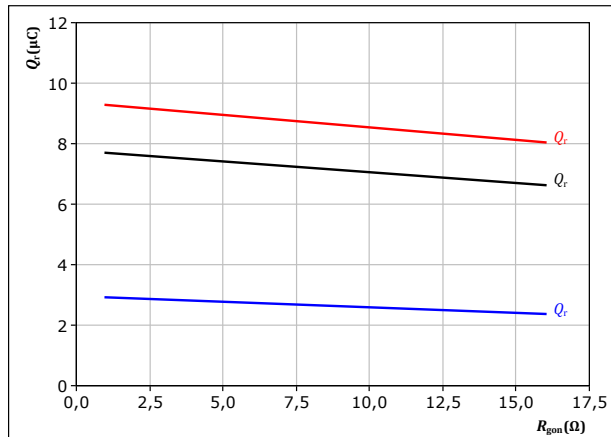
$V_{CE} = 350$  V  
 $V_{GE} = -5/15$  V  
 $R_{gon} = 4$  Ω

$T_j$ : — 25 °C  
— 125 °C  
— 150 °C

**figure 27.** FWD

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

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



With an inductive load at

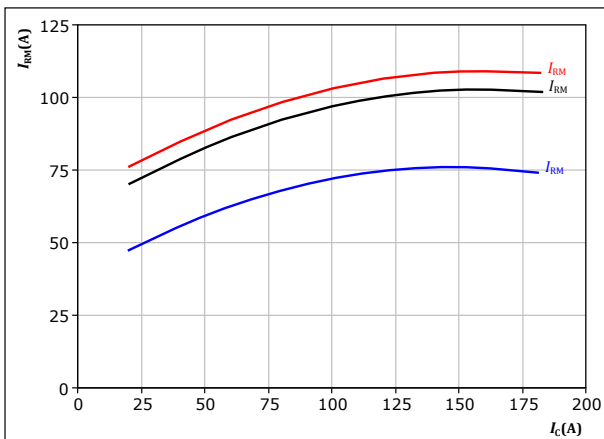
$V_{CE} = 350$  V  
 $V_{GE} = -5/15$  V  
 $I_c = 100$  A

$T_j$ : — 25 °C  
— 125 °C  
— 150 °C

**figure 28.** FWD

Typical peak reverse recovery current as a function of collector current

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



With an inductive load at

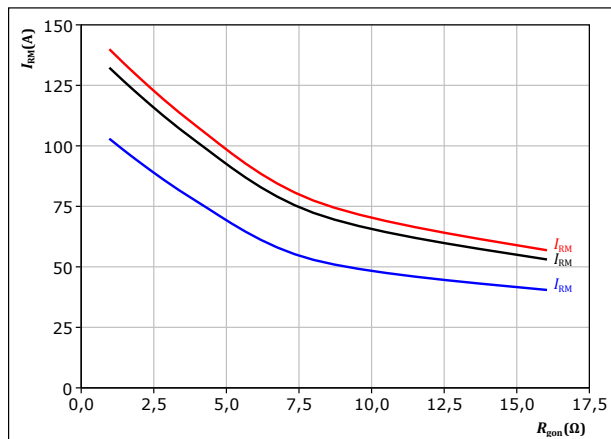
$V_{CE} = 350$  V  
 $V_{GE} = -5/15$  V  
 $R_{gon} = 4$  Ω

$T_j$ : — 25 °C  
— 125 °C  
— 150 °C

**figure 29.** FWD

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

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



With an inductive load at

$V_{CE} = 350$  V  
 $V_{GE} = -5/15$  V  
 $I_c = 100$  A

$T_j$ : — 25 °C  
— 125 °C  
— 150 °C

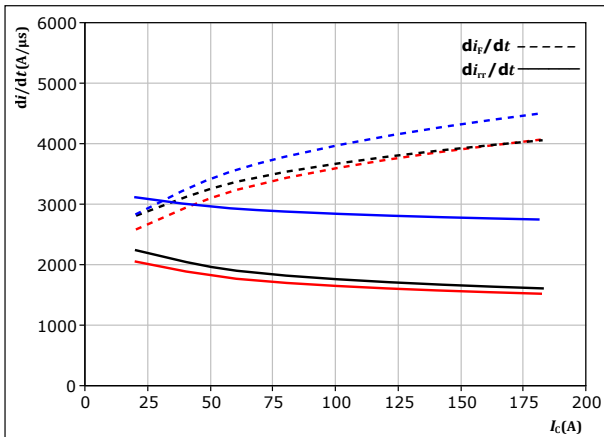


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## Buck Switching Characteristics

**figure 30.** FWD

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



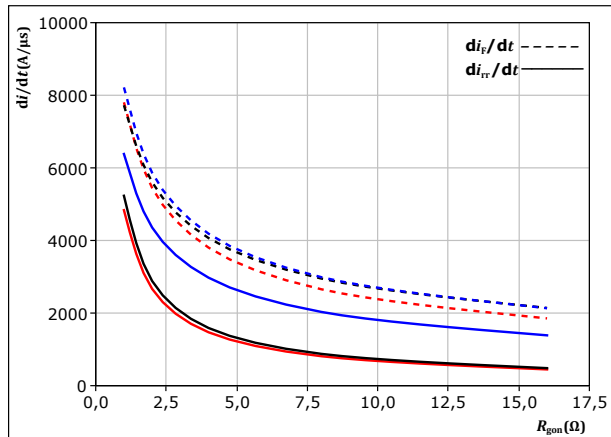
With an inductive load at

$V_{CE} = 350 \text{ V}$   
 $V_{GE} = -5/15 \text{ V}$   
 $R_{gon} = 4 \ \Omega$

$T_j = 25 \text{ }^\circ\text{C}$   
 $125 \text{ }^\circ\text{C}$   
 $150 \text{ }^\circ\text{C}$

**figure 31.** FWD

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



With an inductive load at

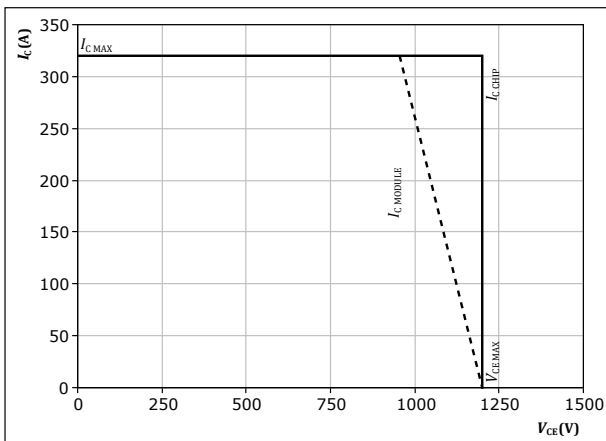
$V_{CE} = 350 \text{ V}$   
 $V_{GE} = -5/15 \text{ V}$   
 $I_c = 100 \text{ A}$

$T_j = 25 \text{ }^\circ\text{C}$   
 $125 \text{ }^\circ\text{C}$   
 $150 \text{ }^\circ\text{C}$

**figure 32.** IGBT

Reverse bias safe operating area

$I_c = f(V_{CE})$



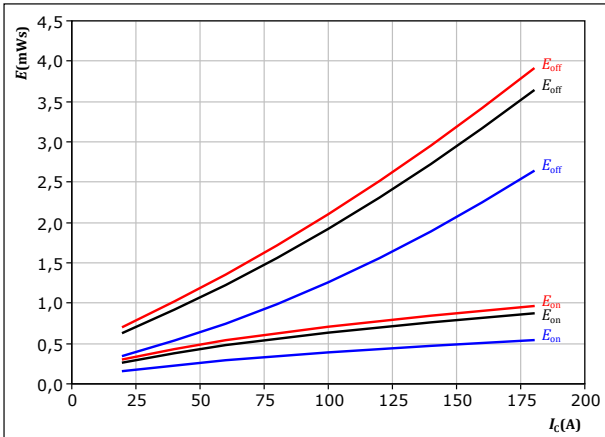
At  $T_j = 150 \text{ }^\circ\text{C}$   
 $R_{gon} = 4 \ \Omega$   
 $R_{goff} = 4 \ \Omega$



## Boost Switching Characteristics

**figure 33.** IGBT

Typical switching energy losses as a function of collector current  
 $E = f(I_c)$

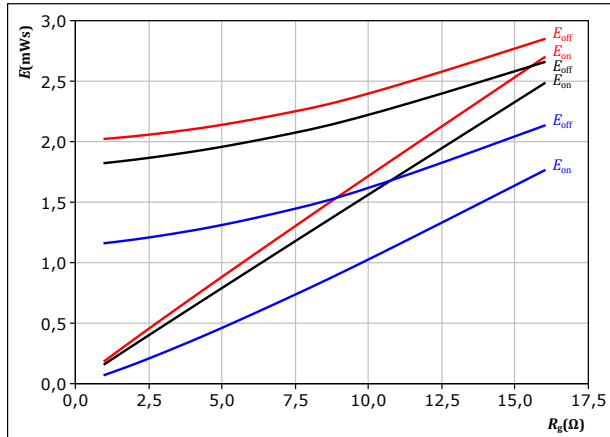


With an inductive load at  
 $V_{CE} = 350$  V  
 $V_{GE} = -5/15$  V  
 $R_{gon} = 4$   $\Omega$   
 $R_{goff} = 4$   $\Omega$

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

**figure 34.** IGBT

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

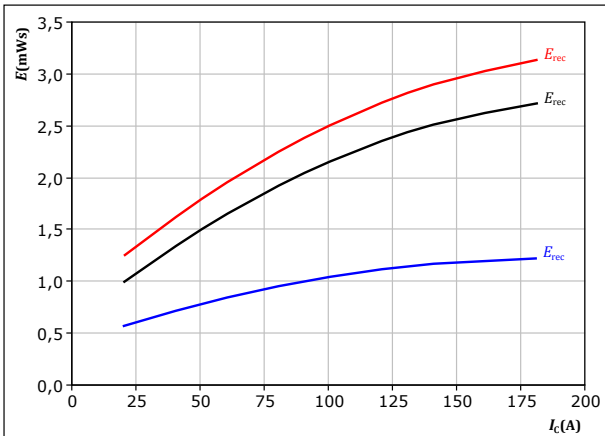


With an inductive load at  
 $V_{CE} = 350$  V  
 $V_{GE} = -5/15$  V  
 $I_c = 100$  A

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

**figure 35.** FWD

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

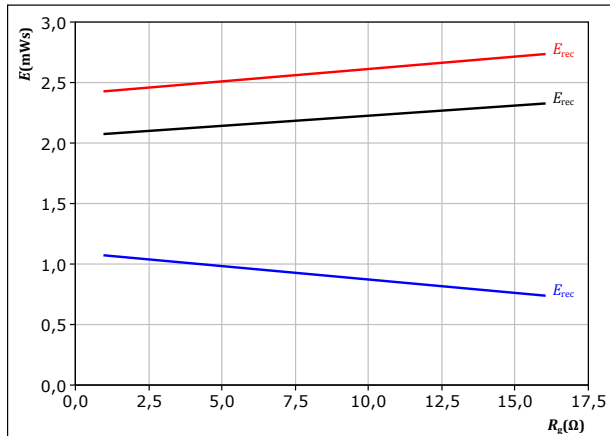


With an inductive load at  
 $V_{CE} = 350$  V  
 $V_{GE} = -5/15$  V  
 $R_{gon} = 4$   $\Omega$

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

**figure 36.** FWD

Typical reverse recovered energy loss as a function of IGBT turn on gate resistor  
 $E_{rec} = f(R_g)$



With an inductive load at  
 $V_{CE} = 350$  V  
 $V_{GE} = -5/15$  V  
 $I_c = 100$  A

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

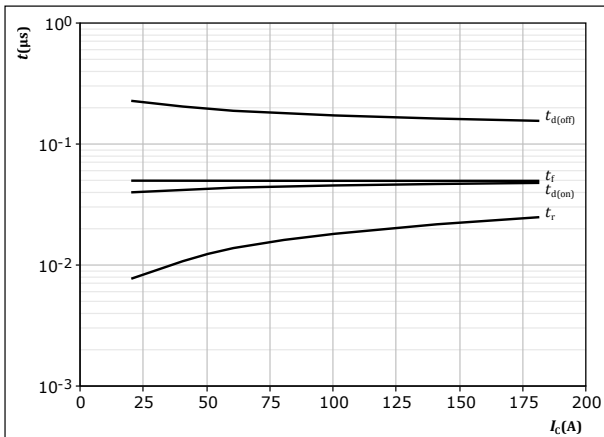




## Boost Switching Characteristics

**figure 37.** IGBT

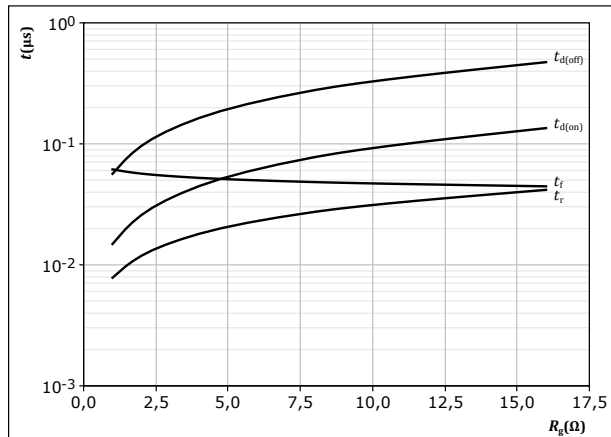
Typical switching times as a function of collector current  
 $t = f(I_c)$



With an inductive load at  
 $T_j = 150 \text{ }^\circ\text{C}$   
 $V_{CE} = 350 \text{ V}$   
 $V_{GE} = -5/15 \text{ V}$   
 $R_{gon} = 4 \text{ } \Omega$   
 $R_{goff} = 4 \text{ } \Omega$

**figure 38.** IGBT

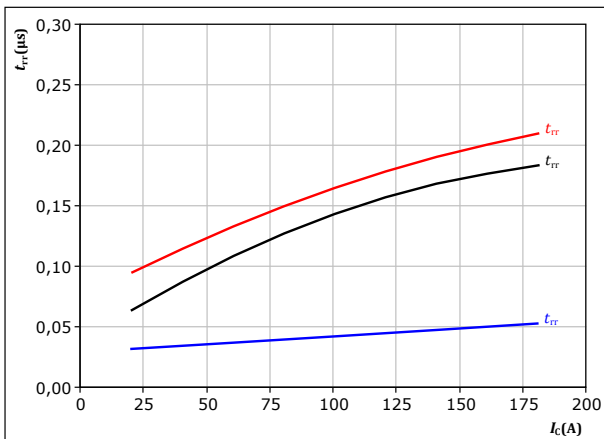
Typical switching times as a function of IGBT turn on gate resistor  
 $t = f(R_g)$



With an inductive load at  
 $T_j = 150 \text{ }^\circ\text{C}$   
 $V_{CE} = 350 \text{ V}$   
 $V_{GE} = -5/15 \text{ V}$   
 $I_c = 100 \text{ A}$

**figure 39.** FWD

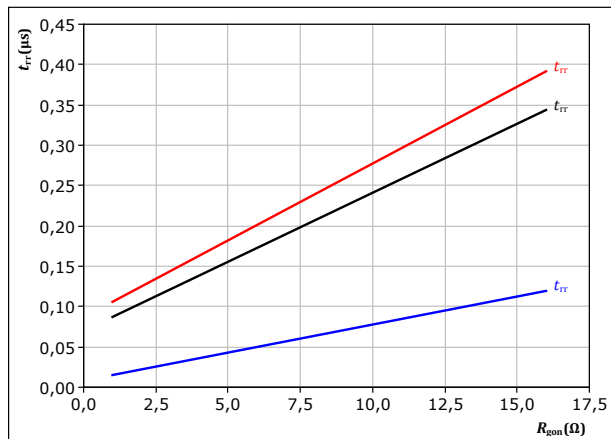
Typical reverse recovery time as a function of collector current  
 $t_{rr} = f(I_c)$



With an inductive load at  
 $V_{CE} = 350 \text{ V}$   
 $V_{GE} = -5/15 \text{ V}$   
 $R_{gon} = 4 \text{ } \Omega$   
 $T_j:$  — 25 °C  
 — 125 °C  
 — 150 °C

**figure 40.** FWD

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



With an inductive load at  
 $V_{CE} = 350 \text{ V}$   
 $V_{GE} = -5/15 \text{ V}$   
 $I_c = 100 \text{ A}$   
 $T_j:$  — 25 °C  
 — 125 °C  
 — 150 °C

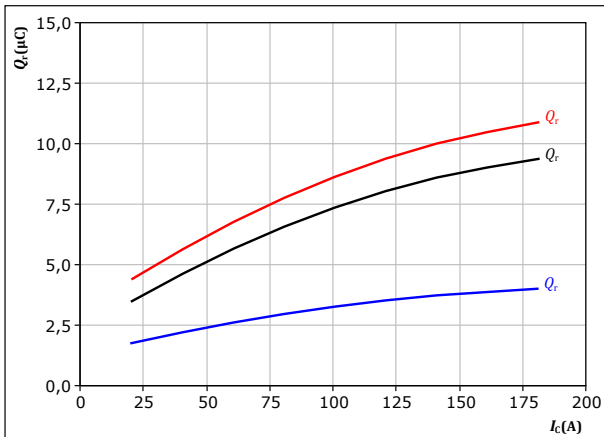


## Boost Switching Characteristics

figure 41. FWD

Typical recovered charge as a function of collector current

$$Q_r = f(I_c)$$



With an inductive load at

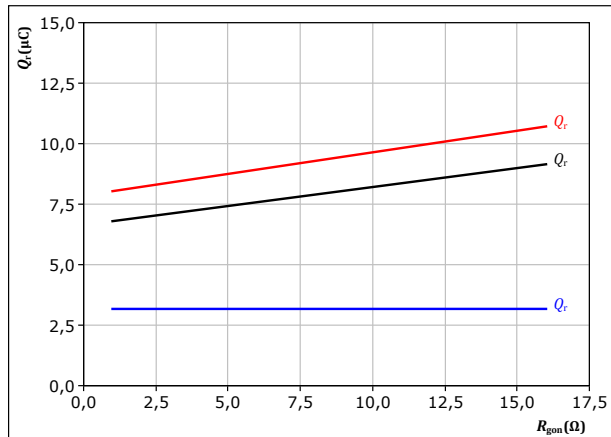
$V_{CE} = 350 \text{ V}$   
 $V_{GE} = -5/15 \text{ V}$   
 $R_{gon} = 4 \ \Omega$

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

figure 42. FWD

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

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



With an inductive load at

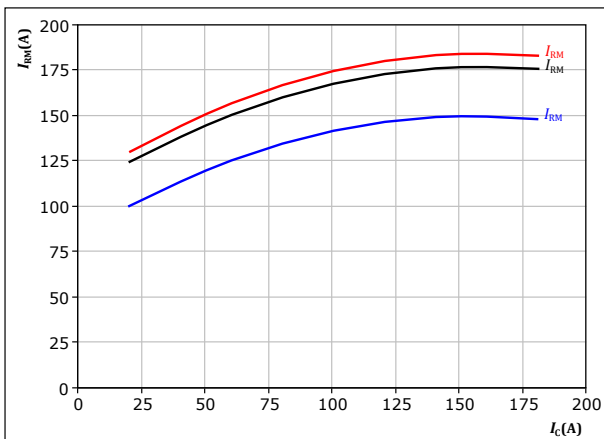
$V_{CE} = 350 \text{ V}$   
 $V_{GE} = -5/15 \text{ V}$   
 $I_c = 100 \text{ A}$

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

figure 43. FWD

Typical peak reverse recovery current as a function of collector current

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



With an inductive load at

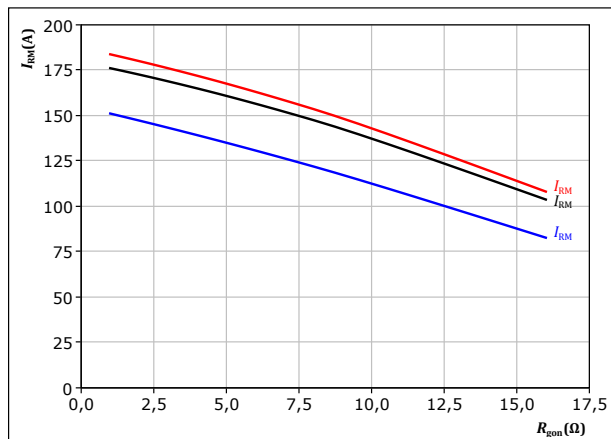
$V_{CE} = 350 \text{ V}$   
 $V_{GE} = -5/15 \text{ V}$   
 $R_{gon} = 4 \ \Omega$

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

figure 44. FWD

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

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



With an inductive load at

$V_{CE} = 350 \text{ V}$   
 $V_{GE} = -5/15 \text{ V}$   
 $I_c = 100 \text{ A}$

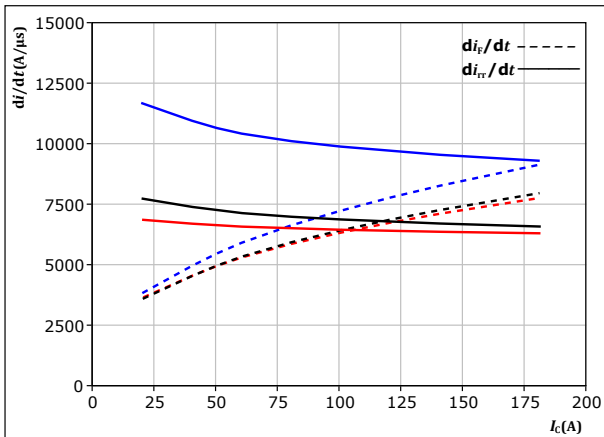
$T_j$ : — 25 °C  
 — 125 °C  
 — 150 °C



## Boost Switching Characteristics

**figure 45.** FWD

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



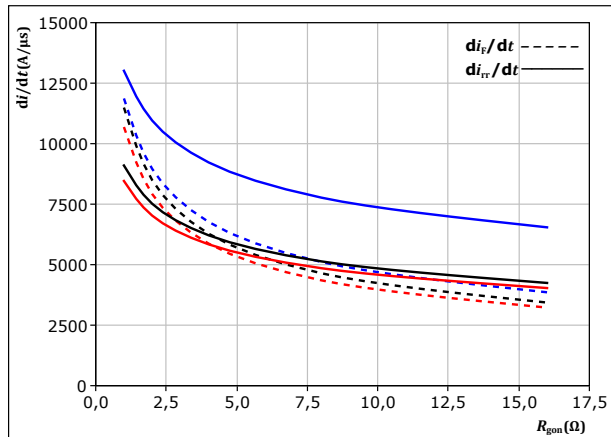
With an inductive load at

$V_{CE} = 350$  V  
 $V_{GE} = -5/15$  V  
 $R_{gon} = 4$  Ω

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

**figure 46.** FWD

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



With an inductive load at

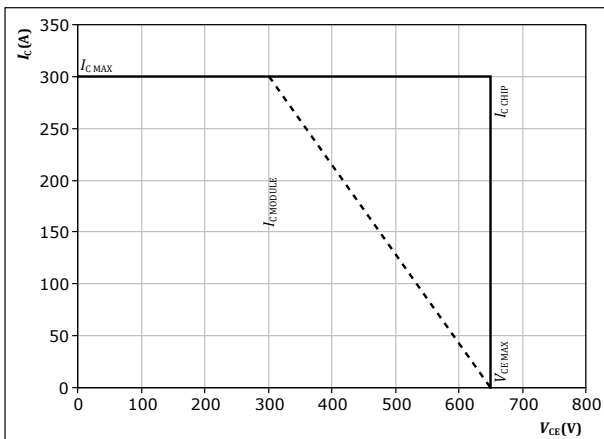
$V_{CE} = 350$  V  
 $V_{GE} = -5/15$  V  
 $I_c = 100$  A

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

**figure 47.** IGBT

Reverse bias safe operating area

$I_c = f(V_{CE})$



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



## Switching Definitions

figure 48. IGBT

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

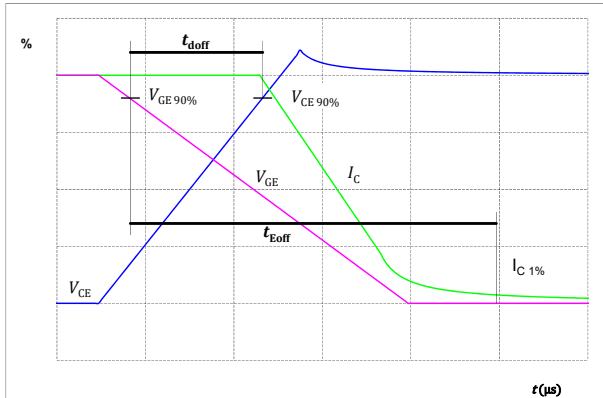


figure 49. IGBT

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

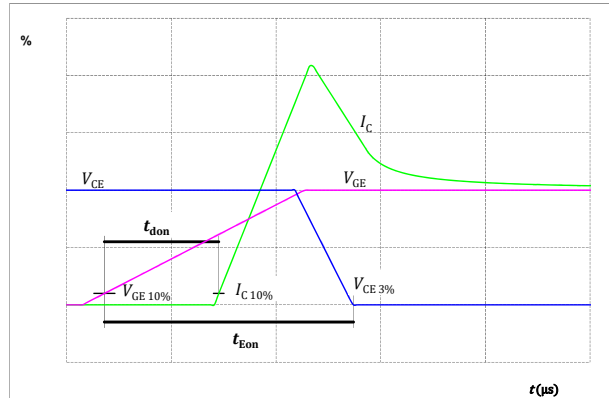


figure 50. IGBT

Turn-off Switching Waveforms & definition of  $t_f$

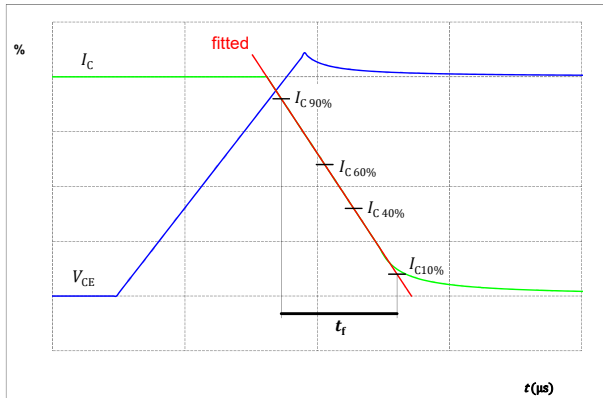
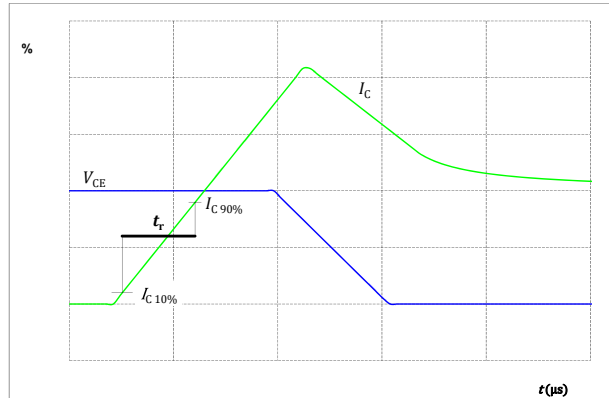


figure 51. IGBT

Turn-on Switching Waveforms & definition of  $t_r$





### Switching Definitions

figure 52. FWD

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

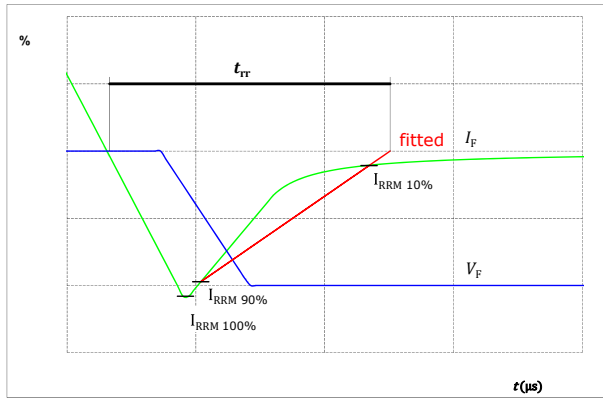
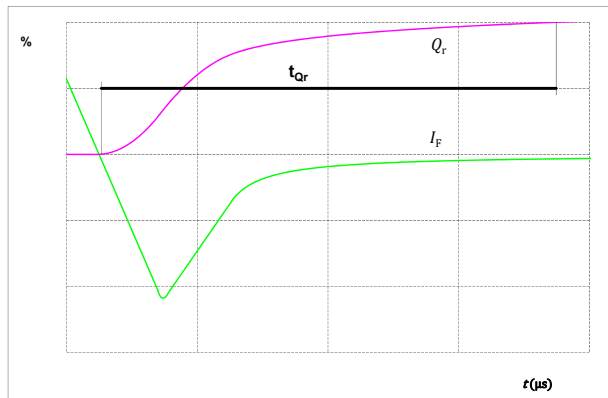


figure 53. FWD

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





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**10-PY12NMA160SH10-M820F08Y**  
datasheet

Ordering Code	
<b>Version</b>	<b>Ordering Code</b>
Without thermal paste	10-PY12NMA160SH10-M820F08Y
With thermal paste (5,2 W/mK, PTM6000HV)	10-PY12NMA160SH10-M820F08Y-7/
With thermal paste (3,4 W/mK, PSX-P7)	10-PY12NMA160SH10-M820F08Y-3/

Marking						
	<b>Text</b>	<b>Name</b> NN-NNNNNNNNNNNNNN- TTTTTIVV	<b>Date code</b> WWYY	<b>UL &amp; VIN</b> UL VIN	<b>Lot</b> LLLLL	<b>Serial</b> SSSS
	<b>Datamatrix</b>	<b>Type&amp;Ver</b> TTTTTIVV	<b>Lot number</b> LLLLL	<b>Serial</b> SSSS	<b>Date code</b> WWYY	

Outline			
Pin table [mm]			
Pin	X	Y	Function
1	34,8	2,95	G12
2	34,8	0	S12
3	32,3	0	DC-
4	29,8	0	DC-
5	27,3	0	DC-
6	24,8	0	DC-
7	15,45	2,95	GND2
8	15,45	0	GND2
9	0	0	G13
10	0	2,95	S13
11	0	8,45	Therm2
12	0	11,45	Therm1
13	0	26,05	S14
14	0	29	G14
15	18,7	26,05	GND1
16	18,7	29	GND1
17	28,1	29	DC+
18	30,6	29	DC+
19	33,1	29	DC+
20	35,6	29	DC+
21	40,1	18,9	G11
22	40,1	15,95	S11
23	50,3	16,3	Ph1
24	53	16,55	Ph1
25	50,3	13,8	Ph1
26	53	13,55	Ph1
27	50,5	9,2	Ph2
28	53	9,2	Ph2
29	50,5	6,2	Ph2
30	53	6,2	Ph2

center of press-fit pinhead  
for connection parameter see the handling instruction

12,99 ± 0,1  
± 0,2 ± 0,05

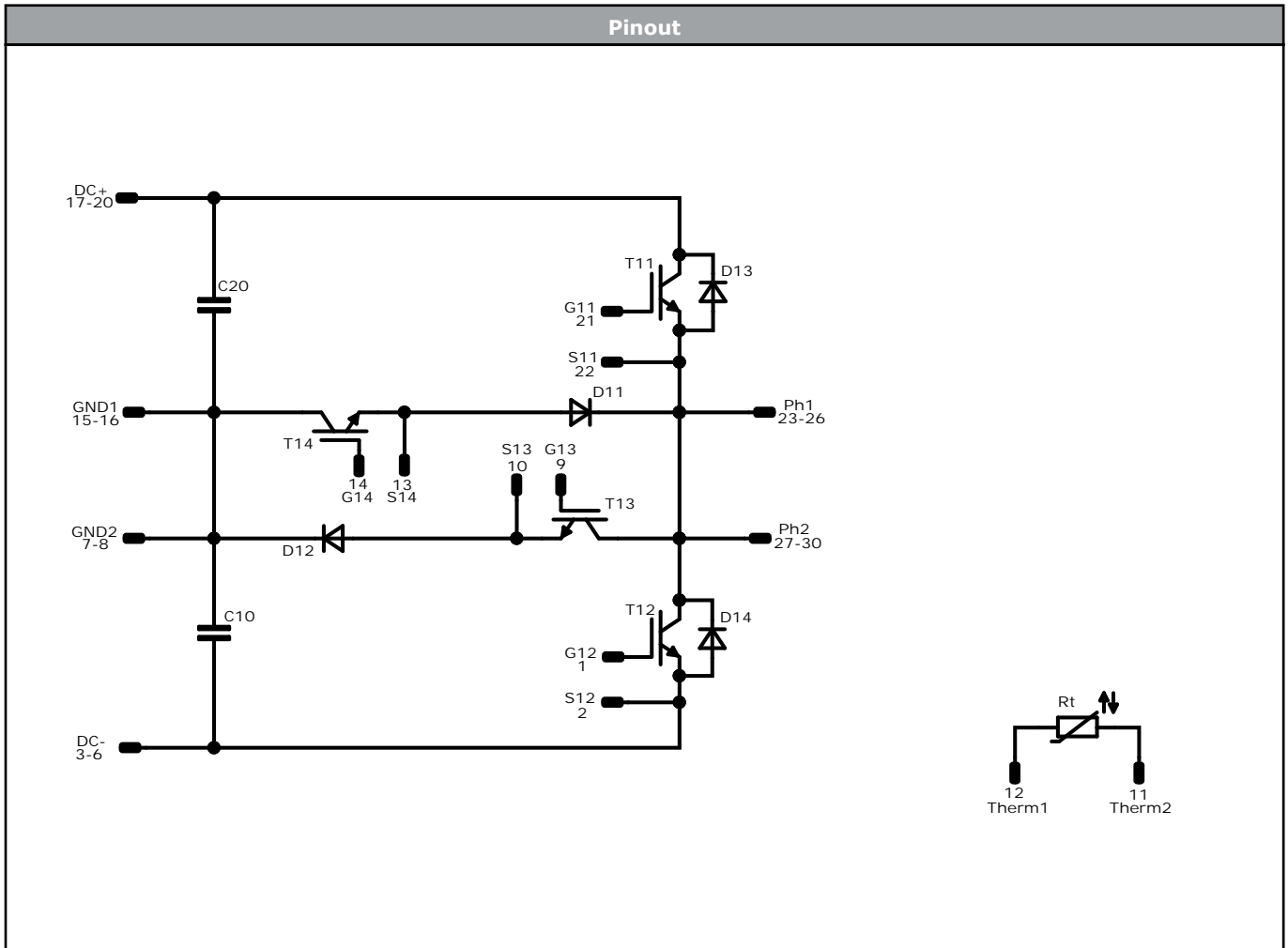
14,5

28,5

Tolerance of pinposition: ± 0,5mm at the end of pins  
Dimension of coordinate axis is only offset without tolerance



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Identification					
ID	Component	Voltage	Current	Function	Comment
T11, T12	IGBT	1200 V	160 A	Buck Switch	
D11, D12	FWD	650 V	150 A	Buck Diode	
T13, T14	IGBT	650 V	150 A	Boost Switch	
D13, D14	FWD	1200 V	80 A	Boost Diode	
C10, C20	Capacitor	630 V		Capacitor (DC)	
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 1</i> packages see vincotech.com website.

Package data
Package data for <i>flow 1</i> 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-PY12NMA160SH10-M820F08Y-D1-14	27 Apr. 2023		

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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.