



**flowMNPC 2**

**1200 V / 160 A**

**Topology features**

- Mixed Voltage Neutral Point Clamped Topology (T-Type)
- Kelvin Emitter for improved switching performance
- Split output for elimination of X-conduction at fast turn-on
- Low inductive commutation loop
- Temperature sensor

**Component features**

- Easy paralleling
- High speed switching
- Low switching losses

**Housing features**

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

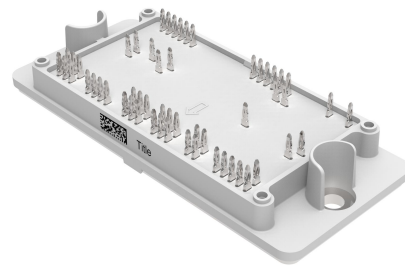
**Target applications**

- Solar inverter
- UPS
- Active frontend

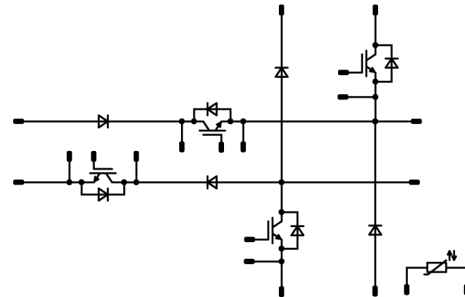
**Types**

- 30-PT12NMA160SH02-M669F28Y

**flow 2 13 mm housing**



**Schematic**





Vincotech

## 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)	$I_C$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	178	A
Repetitive peak collector current	$I_{CRM}$	$t_p$ limited by $T_{jmax}$	480	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	447	W
Gate-emitter voltage	$V_{GES}$		$\pm 20$	V
Short circuit ratings	$t_{SC}$	$V_{GE} = 15\text{ V}$ , $V_{CC} = 800\text{ V}$ $T_j = 150\text{ °C}$	10	$\mu\text{s}$
Maximum junction temperature	$T_{jmax}$		175	$^{\circ}\text{C}$

## Buck Diode

Peak repetitive reverse voltage	$V_{RRM}$		650	V
Forward current (DC current)	$I_F$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	110	A
Repetitive peak forward current	$I_{FRM}$	$t_p$ limited by $T_{jmax}$	450	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	142	W
Maximum junction temperature	$T_{jmax}$		175	$^{\circ}\text{C}$

## Buck Sw. Protection Diode

Peak repetitive reverse voltage	$V_{RRM}$		1200	V
Forward current (DC current)	$I_F$	$T_j = T_{jmax}$ $T_s \leq 80\text{ °C}$	20 <sup>(1)</sup>	A
Repetitive peak forward current	$I_{FRM}$	$t_p$ limited by $T_{jmax}$	20	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	56	W
Maximum junction temperature	$T_{jmax}$		175	$^{\circ}\text{C}$

<sup>(1)</sup> limited by  $I_{FRM}$



Vincotech

## Maximum Ratings

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

Parameter	Symbol	Conditions	Value	Unit
<b>Boost Switch</b>				
Collector-emitter voltage	$V_{CES}$		650	V
Collector current (DC current)	$I_C$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	92	A
Repetitive peak collector current	$I_{CRM}$	$t_p$ limited by $T_{jmax}$	300	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	145	W
Gate-emitter voltage	$V_{GES}$		$\pm 20$	V
Maximum junction temperature	$T_{jmax}$		175	°C

## Boost Diode

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, $t_p = 10\text{ ms}$ $T_j = 150\text{ °C}$	340	A
Surge current capability	$I^2t$		580	A <sup>2</sup> s
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	139	W
Maximum junction temperature	$T_{jmax}$		175	°C

## Boost Sw. Protection Diode

Peak repetitive reverse voltage	$V_{RRM}$		650	V
Forward current (DC current)	$I_F$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	36	A
Repetitive peak forward current	$I_{FRM}$	$t_p$ limited by $T_{jmax}$	60	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	59	W
Maximum junction temperature	$T_{jmax}$		175	°C



Vincotech

**30-PT12NMA160SH02-M669F28Y**  
datasheet

## Maximum Ratings

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

Parameter	Symbol	Conditions	Value	Unit
-----------	--------	------------	-------	------

### 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		≥ 200	

\*100 % tested in production



Vincotech

**30-PT12NMA160SH02-M669F28Y**  
datasheet

### 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	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,006	25	5,3	5,8	6,3	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		160	25 125 150	1,78	1,94 2,23 2,32	2,42 <sup>(2)</sup>	V
Collector-emitter cut-off current	$I_{CES}$		0	1200		25			20	μA
Gate-emitter leakage current	$I_{GES}$		20	0		25			480	nA
Internal gate resistance	$r_g$							None		Ω
Input capacitance	$C_{ies}$							9320		pF
Output capacitance	$C_{oes}$	$f = 1$ Mhz	0	25		25		600		pF
Reverse transfer capacitance	$C_{res}$							520		pF
Gate charge	$Q_g$	$V_{CC} = 960$ V	15		160	25		740		nC

##### Thermal

Thermal resistance junction to sink <sup>(3)</sup>	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						0,21		K/W
--	---------------	------------------------------------	--	--	--	--	--	------	--	-----

##### Dynamic

Turn-on delay time	$t_{d(on)}$					25 125 150		132,48 132,48 131,52		ns
Rise time	$t_r$					25 125 150		22,72 26,24 27,2		ns
Turn-off delay time	$t_{d(off)}$					25 125 150		215,04 293,44 311,36		ns
Fall time	$t_f$					25 125 150		41,69 97,55 114,57		ns
Turn-on energy (per pulse)	$E_{on}$	$Q_{tFWD} = 2,54$ μC $Q_{tFWD} = 5,51$ μC $Q_{tFWD} = 6,46$ μC				25 125 150		1,37 2,15 2,4		mWs
Turn-off energy (per pulse)	$E_{off}$					25 125 150		2,44 4,65 5,33		mWs



Vincotech

**30-PT12NMA160SH02-M669F28Y**  
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		1,53 1,49 1,47	1,92 <sup>(2)</sup>	V
Reverse leakage current	$I_R$	$V_r = 650$ V				25			7,6	μA

##### Thermal

Thermal resistance junction to sink <sup>(3)</sup>	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						0,67		K/W
--	---------------	---------------------------------------	--	--	--	--	--	------	--	-----

##### Dynamic

Peak recovery current	$I_{RM}$					25 125 150		61,93 88,59 94,22		A
Reverse recovery time	$t_{rr}$					25 125 150		61,9 94,72 106,85		ns
Recovered charge	$Q_r$	$di/dt=4251$ A/μs $di/dt=3763$ A/μs $di/dt=3925$ A/μs	±15	350	80	25 125 150		2,54 5,51 6,46		μC
Reverse recovered energy	$E_{rec}$					25 125 150		0,478 1,05 1,2		mWs
Peak rate of fall of recovery current	$(di_r/dt)_{max}$					25 125 150		1800 1442 1087		A/μs



Vincotech

30-PT12NMA160SH02-M669F28Y  
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 Sw. Protection Diode

##### Static

Forward voltage	$V_F$				10	25 125 150	1,35	1,79 1,77 1,73	2,05 <sup>(2)</sup>	V
Reverse leakage current	$I_R$	$V_r = 1200$ V				25			2,7	$\mu$ A

##### Thermal

Thermal resistance junction to sink <sup>(3)</sup>	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						1,68		K/W
--	---------------	---------------------------------------	--	--	--	--	--	------	--	-----



Vincotech

**30-PT12NMA160SH02-M669F28Y**  
datasheet

### 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	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,001	25	3,2	4	4,8	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		100	25 125 150		1,41 1,55 1,58	1,75 <sup>(2)</sup>	V
Collector-emitter cut-off current	$I_{CES}$		0	650		25			100	μA
Gate-emitter leakage current	$I_{GES}$		20	0		25			200	nA
Internal gate resistance	$r_g$							None		Ω
Input capacitance	$C_{ies}$							6200		pF
Output capacitance	$C_{oes}$	$f = 1$ Mhz	0	25		25		176		pF
Reverse transfer capacitance	$C_{res}$							24		pF
Gate charge	$Q_g$	$V_{CC} = 520$ V	15		100	25		240		nC

##### Thermal

Thermal resistance junction to sink <sup>(3)</sup>	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						0,65		K/W
--	---------------	---------------------------------------	--	--	--	--	--	------	--	-----

##### Dynamic

Turn-on delay time	$t_{d(on)}$					25 125 150		30,22 30,56 30,53		ns
Rise time	$t_r$					25 125 150		6,25 7,84 8,21		ns
Turn-off delay time	$t_{d(off)}$					25 125 150		107,44 129,88 136,16		ns
Fall time	$t_f$					25 125 150		9,1 24,63 33,12		ns
Turn-on energy (per pulse)	$E_{on}$	$Q_{tFWD} = 2,75$ μC $Q_{tFWD} = 4,16$ μC $Q_{tFWD} = 4,77$ μC				25 125 150		0,48 0,689 0,762		mWs
Turn-off energy (per pulse)	$E_{off}$					25 125 150		0,698 1,22 1,38		mWs





Vincotech

**30-PT12NMA160SH02-M669F28Y**  
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	$V_F$				70	25 125 150		2,28 2,41 2,37	2,62 <sup>(2)</sup> 2,62 <sup>(2)</sup>	V
Reverse leakage current	$I_R$	$V_r = 1200$ V				25 150		5400	120 11000	μA
<b>Thermal</b>										
Thermal resistance junction to sink <sup>(3)</sup>	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						0,68		K/W
<b>Dynamic</b>										
Peak recovery current	$I_{RM}$					25 125 150		158,71 178,48 188,65		A
Reverse recovery time	$t_{rr}$					25 125 150		31,75 41,02 44,88		ns
Recovered charge	$Q_r$	$di/dt=8200$ A/μs $di/dt=8120$ A/μs $di/dt=7475$ A/μs	-5/15	350	70	25 125 150		2,75 4,16 4,77		μC
Reverse recovered energy	$E_{rec}$					25 125 150		0,477 0,751 0,872		mWs
Peak rate of fall of recovery current	$(di_r/dt)_{max}$					25 125 150		14499,16 12390,67 12181,83		A/μs



Vincotech

### 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	

#### Boost Sw. Protection Diode

##### Static

Forward voltage	$V_F$				30	25 125	1,23	1,7 1,59	1,87 <sup>(2)</sup>	V
Reverse leakage current	$I_R$	$V_r = 650$ V				25			0,36	μA

##### Thermal

Thermal resistance junction to sink <sup>(3)</sup>	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						1,61		K/W
--	---------------	---------------------------------------	--	--	--	--	--	------	--	-----

#### 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	

<sup>(2)</sup> Value at chip level

<sup>(3)</sup> Only valid with pre-applied Vincotech thermal interface material.

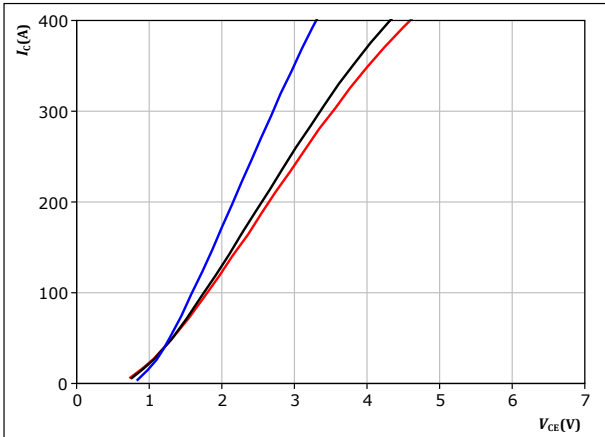


## Buck Switch Characteristics

**figure 1.** IGBT

Typical output characteristics

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

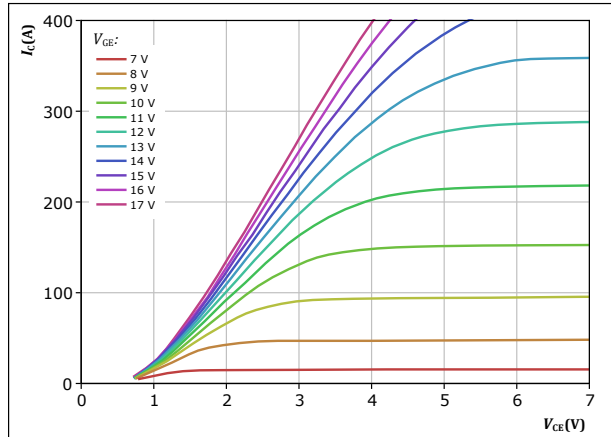


$t_p = 250\ \mu\text{s}$   
 $V_{GE} = 15\ \text{V}$   
 $T_j:$  — 25 °C  
— 125 °C  
— 150 °C

**figure 2.** IGBT

Typical output characteristics

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

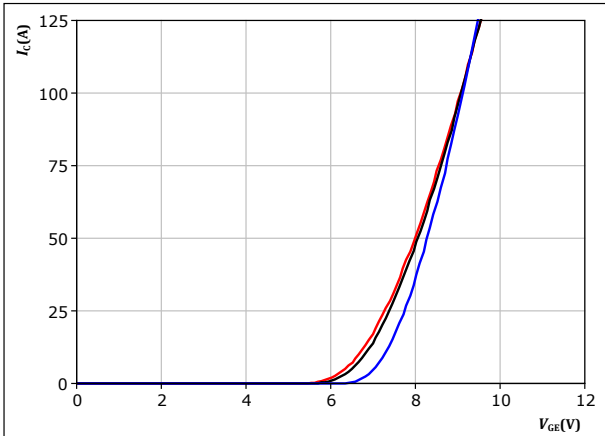


$t_p = 250\ \mu\text{s}$   
 $T_j = 150\text{ °C}$   
 $V_{GE}$  from 7 V to 17 V in steps of 1 V

**figure 3.** IGBT

Typical transfer characteristics

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

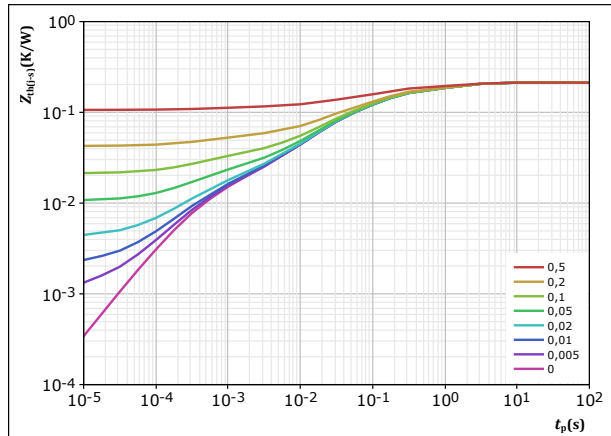


$t_p = 250\ \mu\text{s}$   
 $V_{CE} = 10\ \text{V}$   
 $T_j:$  — 25 °C  
— 125 °C  
— 150 °C

**figure 4.** IGBT

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$   
 $R_{th(j-s)} = 0,213\ \text{K/W}$   
IGBT thermal model values

$R$ (K/W)	$\tau$ (s)
5,20E-02	1,51E+00
9,57E-02	1,22E-01
4,99E-02	1,80E-02
8,04E-03	1,08E-03
7,07E-03	2,99E-04

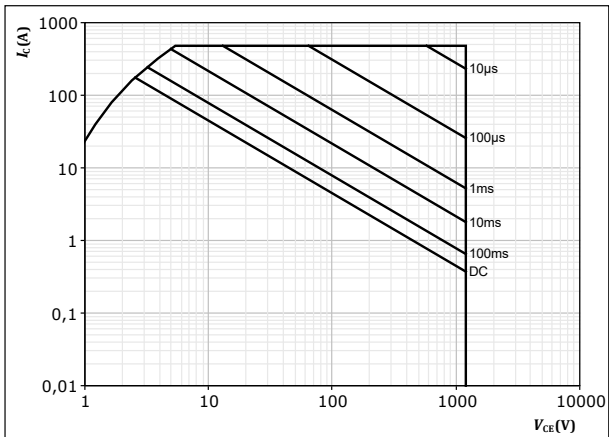


### Buck Switch Characteristics

figure 5. IGBT

Safe operating area

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



$D =$  single pulse  
 $T_s = 80 \text{ } ^\circ\text{C}$   
 $V_{CE} = 15 \text{ V}$   
 $T_j = T_{jmax}$



### Buck Diode Characteristics

figure 6. FWD

Typical forward characteristics

$$I_F = f(V_F)$$

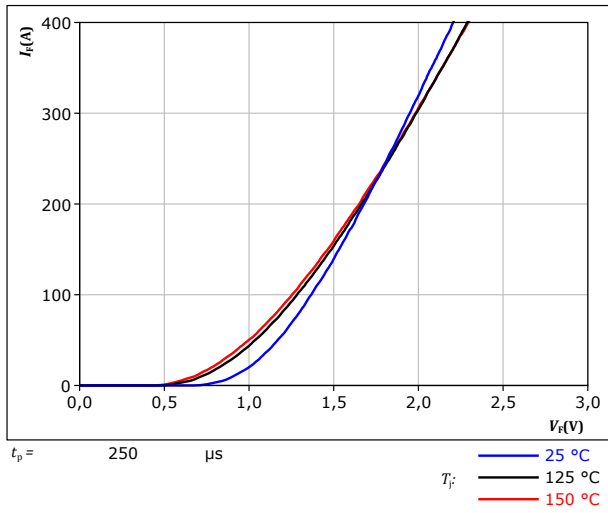
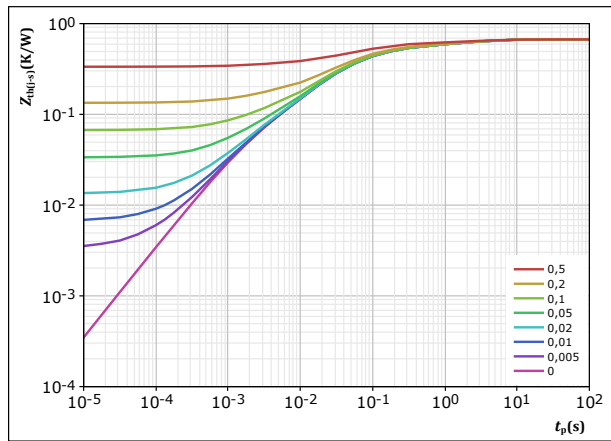


figure 7. FWD

Transient thermal impedance as a function of pulse width

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





## Buck Sw. Protection Diode Characteristics

figure 8. FWD

Typical forward characteristics

$$I_F = f(V_F)$$

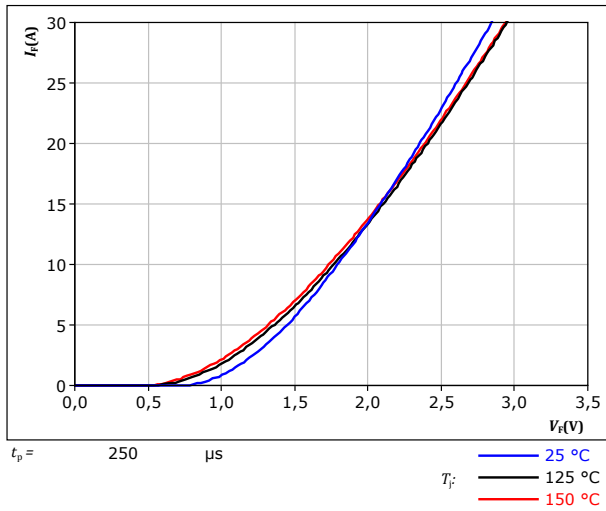
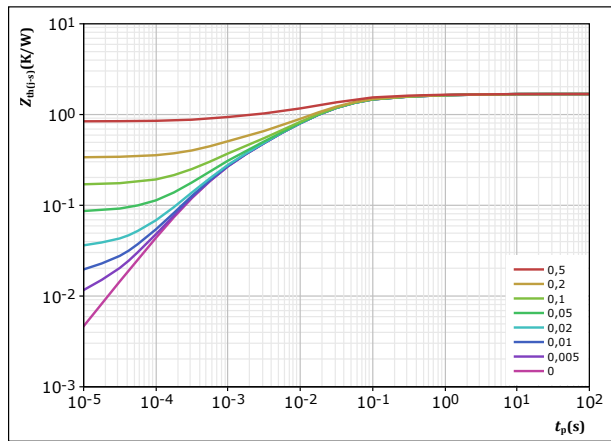


figure 9. FWD

Transient thermal impedance as a function of pulse width

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



$D = \frac{t_p}{T}$   
 $R_{th(j-s)} = 1,683 \text{ K/W}$   
 FWD thermal model values

$R$ (K/W)	$\tau$ (s)
6,27E-02	2,99E+00
1,53E-01	2,72E-01
5,57E-01	4,10E-02
4,90E-01	1,29E-02
2,45E-01	3,00E-03
1,75E-01	5,24E-04

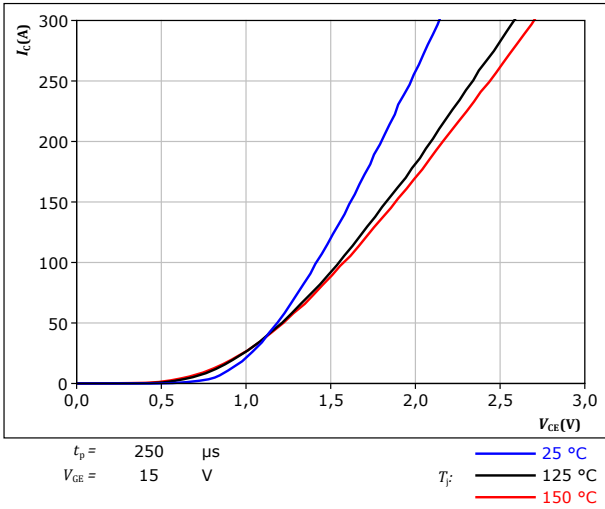


### Boost Switch Characteristics

**figure 10.** IGBT

Typical output characteristics

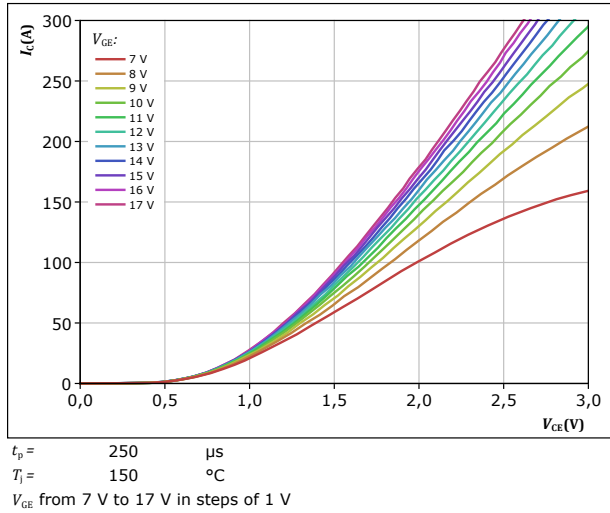
$$I_C = f(V_{CE})$$



**figure 11.** IGBT

Typical output characteristics

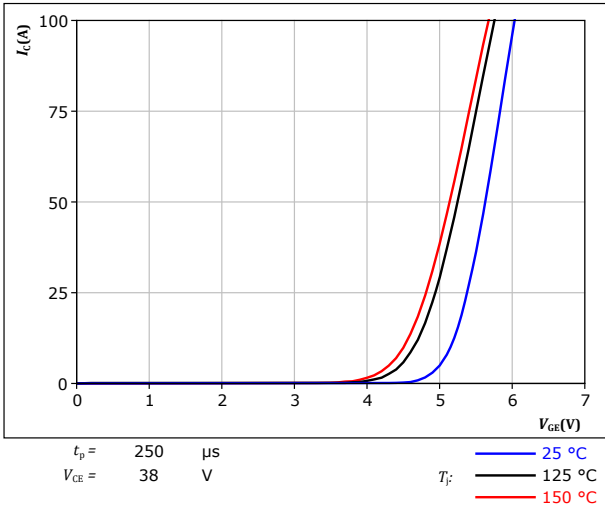
$$I_C = f(V_{CE})$$



**figure 12.** IGBT

Typical transfer characteristics

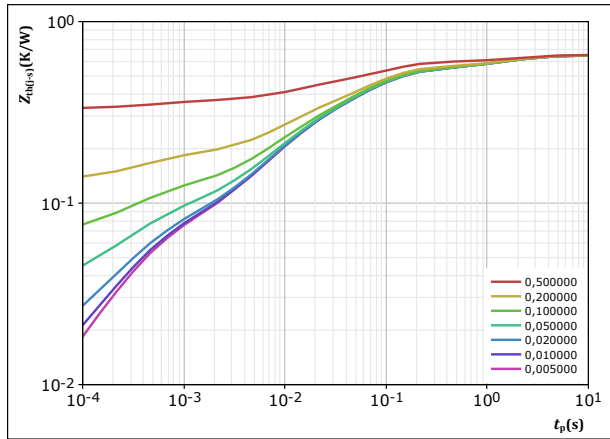
$$I_C = f(V_{GE})$$



**figure 13.** IGBT

Transient thermal impedance as a function of pulse width

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



$$D = \frac{t_p}{T}$$

$$R_{th(j-s)} = 0,655 \text{ K/W}$$

IGBT thermal model values

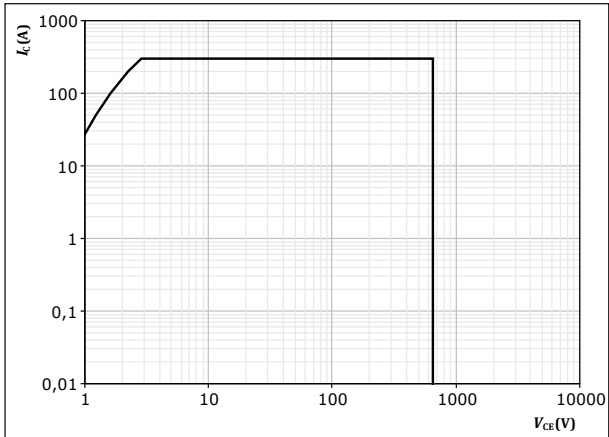
R (K/W)	$\tau$ (s)
1,17E-02	4,29E+01
1,21E-01	1,52E+00
3,07E-01	6,92E-02
1,63E-01	9,56E-03
5,75E-02	3,58E-04



### Boost Switch Characteristics

figure 14. IGBT

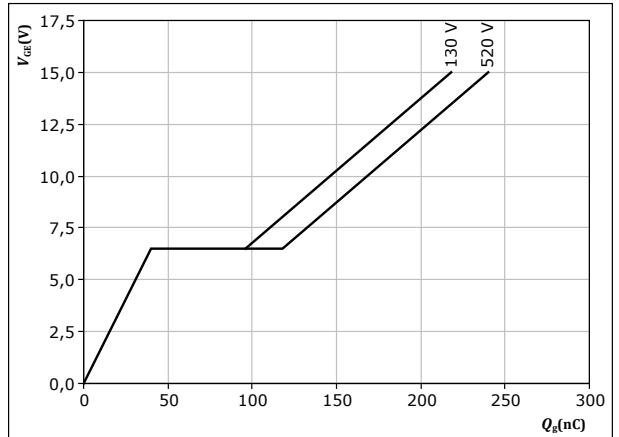
Safe operating area  
 $I_C = f(V_{CE})$



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

figure 15. IGBT

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



$I_C = 100$  A  
 $T_j = 25$  °C





### Boost Diode Characteristics

figure 16. FWD

Typical forward characteristics

$$I_F = f(V_F)$$

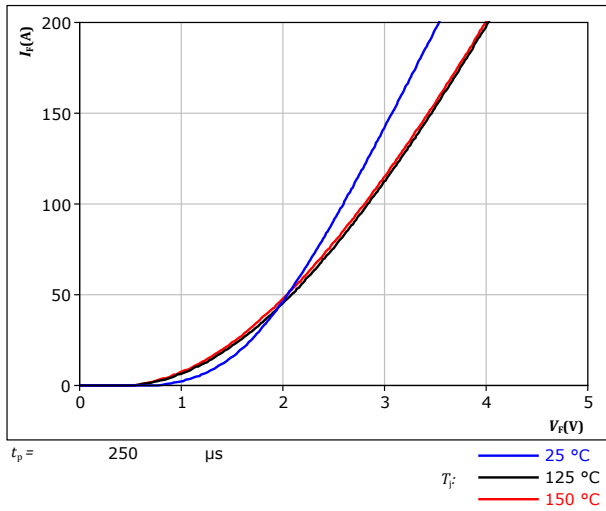
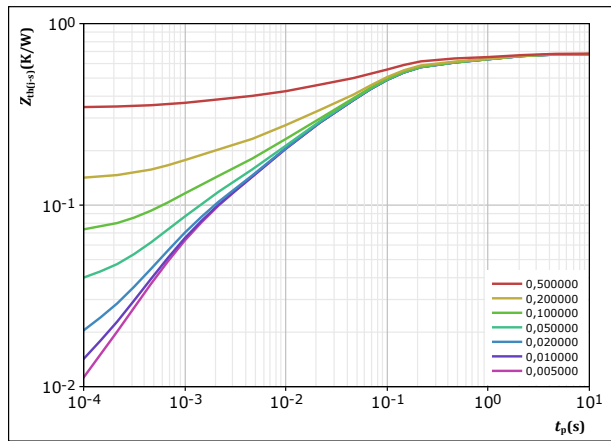


figure 17. FWD

Transient thermal impedance as a function of pulse width

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



$D = \frac{t_p}{T}$   
 $R_{th(j-s)} = 0,683 \text{ K/W}$   
 FWD thermal model values

R (K/W)	$\tau$ (s)
1,41E-02	3,15E+01
9,87E-02	1,07E+00
3,84E-01	7,20E-02
1,28E-01	8,29E-03
6,35E-02	8,88E-04

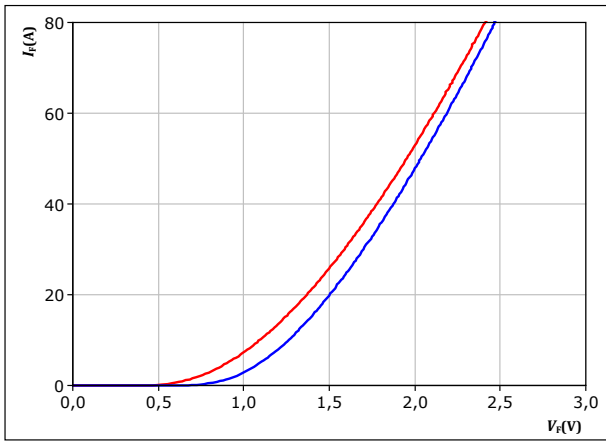


### Boost Sw. Protection Diode Characteristics

figure 18. FWD

Typical forward characteristics

$$I_F = f(V_F)$$

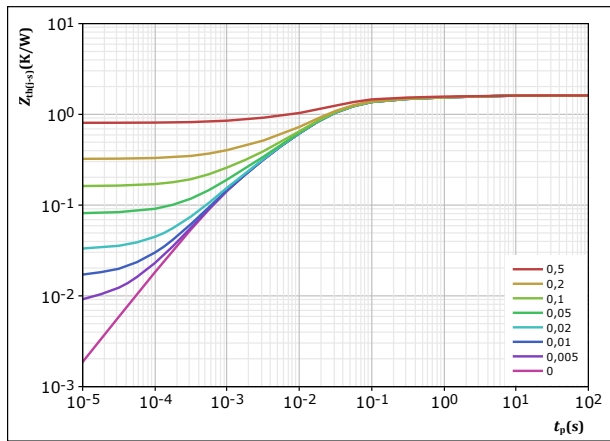


$t_p = 250\ \mu\text{s}$   
 $T_j:$  — 25 °C  
 — 125 °C

figure 19. FWD

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$   
 $R_{th(j-s)} = 1,614\ \text{K/W}$   
 FWD thermal model values

$R$ (K/W)	$\tau$ (s)
1,05E-01	3,05E+00
1,86E-01	2,04E-01
8,60E-01	3,00E-02
3,40E-01	8,15E-03
1,24E-01	1,07E-03

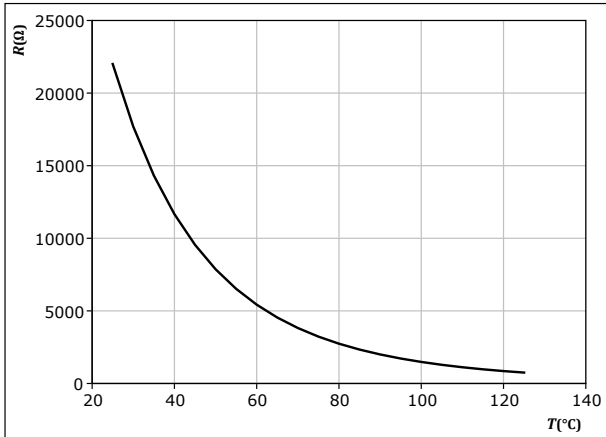


### Thermistor Characteristics

figure 20. Thermistor

Typical NTC characteristic as function of temperature

$$R_T = f(T)$$

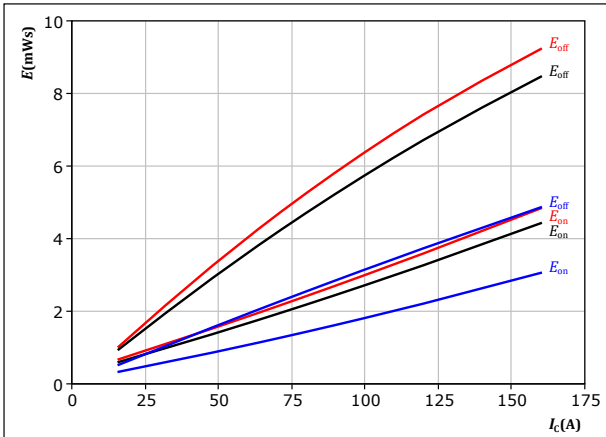




## Buck Switching Characteristics

**figure 21.** IGBT

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

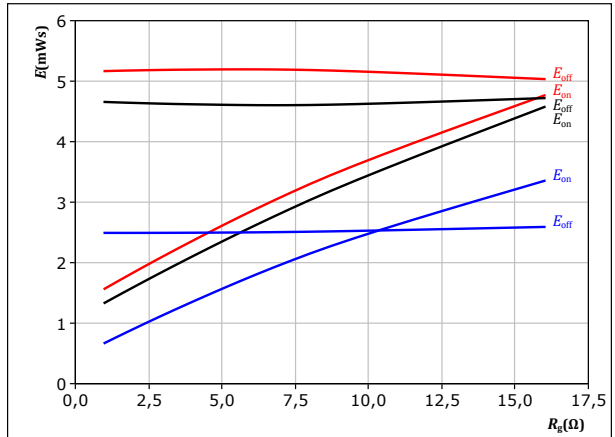


With an inductive load at  
 $V_{CE} = 350 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{gon} = 4 \ \Omega$   
 $R_{goff} = 4 \ \Omega$

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

**figure 22.** IGBT

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

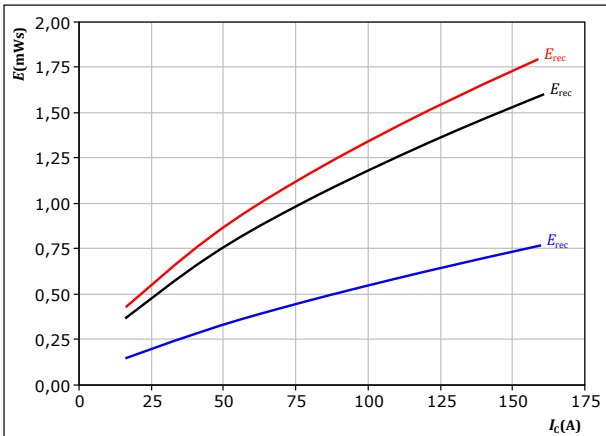


With an inductive load at  
 $V_{CE} = 350 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $I_c = 80 \text{ A}$

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

**figure 23.** FWD

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

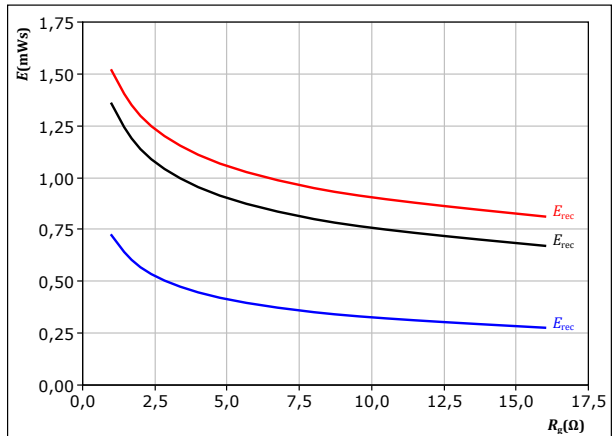


With an inductive load at  
 $V_{CE} = 350 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{gon} = 4 \ \Omega$

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

**figure 24.** 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  
 $V_{CE} = 350 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $I_c = 80 \text{ A}$

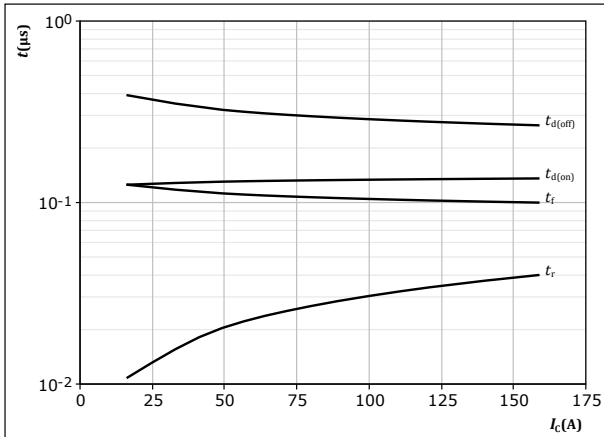
$T_j$ : 25 °C (blue), 125 °C (black), 150 °C (red)



## Buck Switching Characteristics

**figure 25.** IGBT

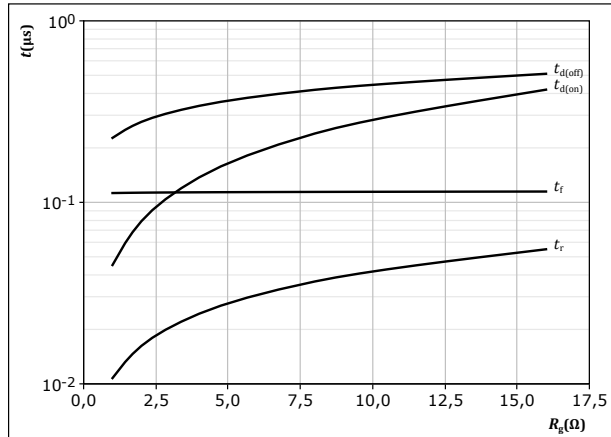
Typical switching times as a function of collector current  
 $t = f(I_c)$



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

**figure 26.** IGBT

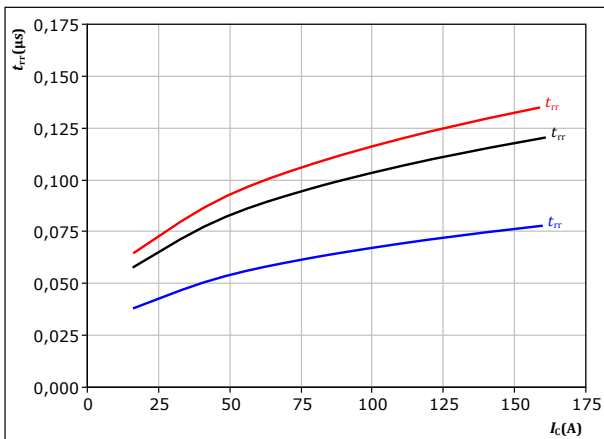
Typical switching times as a function of IGBT turn on gate resistor  
 $t = f(R_g)$



With an inductive load at  
 $T_j = 150 \text{ }^\circ\text{C}$   
 $V_{CE} = 350 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $I_c = 80 \text{ A}$

**figure 27.** FWD

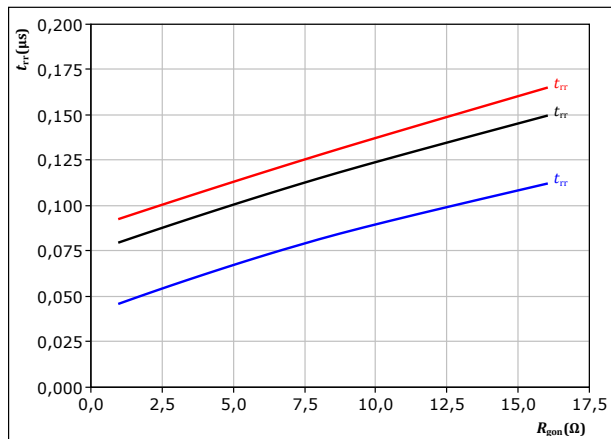
Typical reverse recovery time as a function of collector current  
 $t_{rr} = f(I_c)$



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

**figure 28.** FWD

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



With an inductive load at  
 $V_{CE} = 350 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $I_c = 80 \text{ A}$   
 $T_j:$  — 25 °C  
 — 125 °C  
 — 150 °C

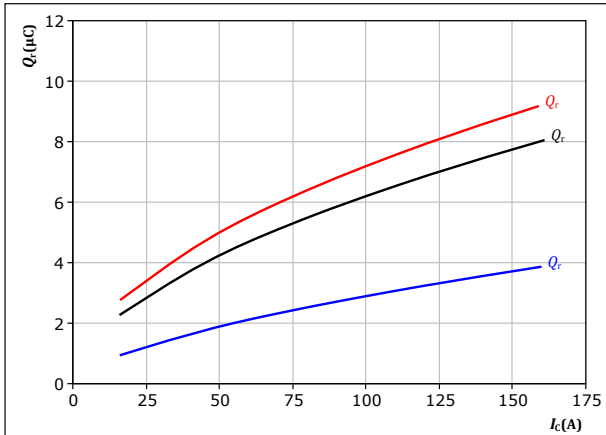


## Buck Switching Characteristics

**figure 29.** FWD

Typical recovered charge as a function of collector current

$$Q_r = f(I_c)$$



With an inductive load at

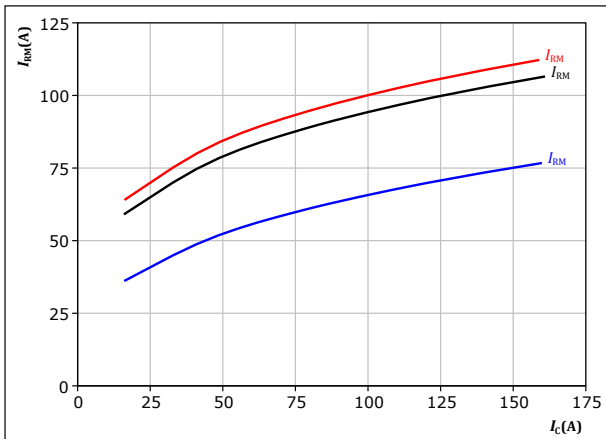
$V_{CE} = 350$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 4$   $\Omega$

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

**figure 31.** FWD

Typical peak reverse recovery current as a function of collector current

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



With an inductive load at

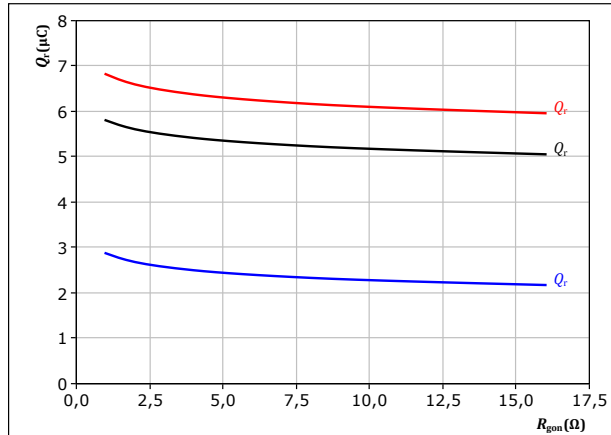
$V_{CE} = 350$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 4$   $\Omega$

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

**figure 30.** FWD

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

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



With an inductive load at

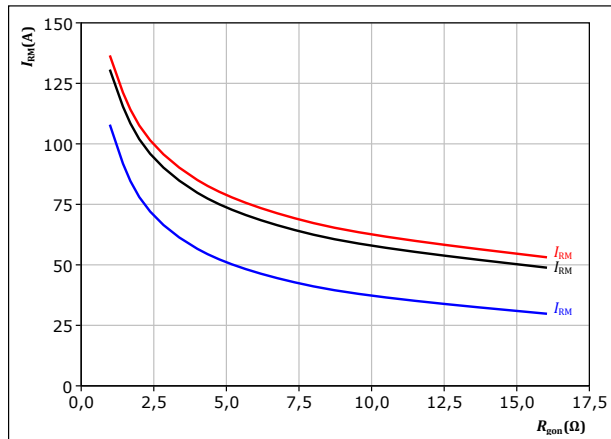
$V_{CE} = 350$  V  
 $V_{GE} = \pm 15$  V  
 $I_c = 80$  A

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

**figure 32.** 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  
 $V_{GE} = \pm 15$  V  
 $I_c = 80$  A

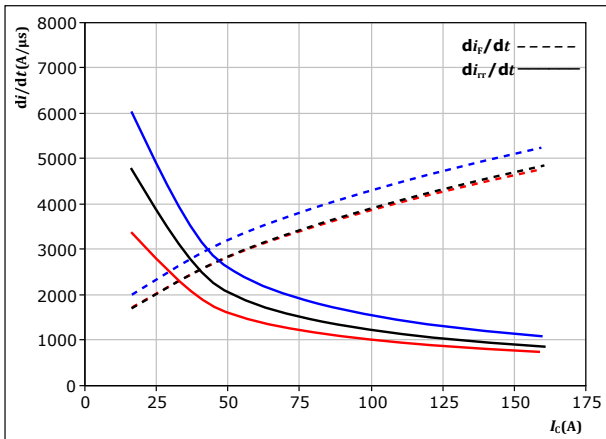
$T_j$ : — 25 °C  
 — 125 °C  
 — 150 °C



## Buck Switching Characteristics

**figure 33.** FWD

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



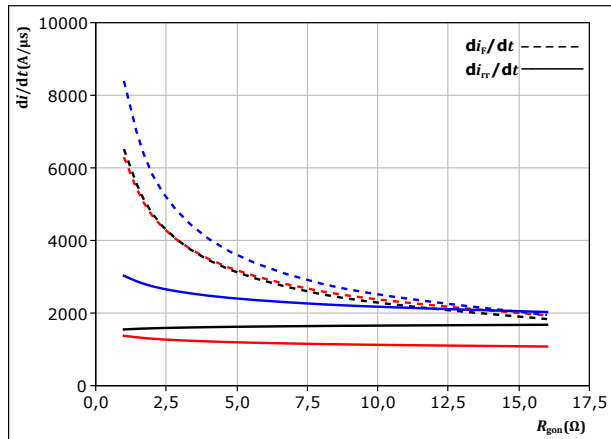
With an inductive load at

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

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

**figure 34.** 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

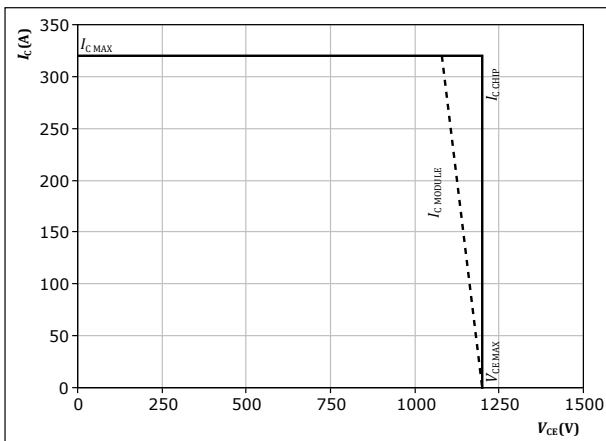
$V_{CE} = 350 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $I_C = 80 \text{ A}$

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

**figure 35.** IGBT

Reverse bias safe operating area

$I_C = f(V_{CE})$



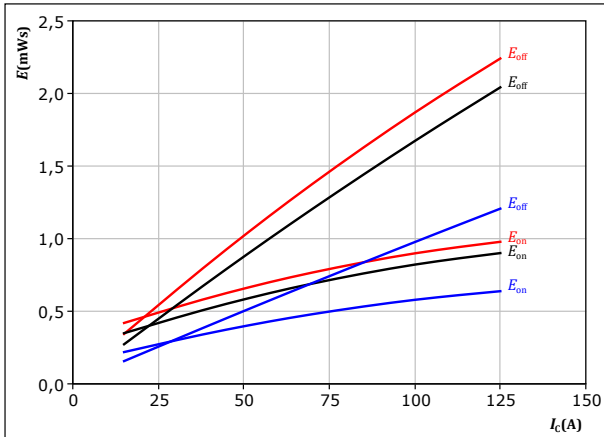
At  $T_j = 150 \text{ °C}$   
 $R_{gon} = 4 \ \Omega$   
 $R_{goff} = 4 \ \Omega$



## Boost Switching Characteristics

**figure 36.** IGBT

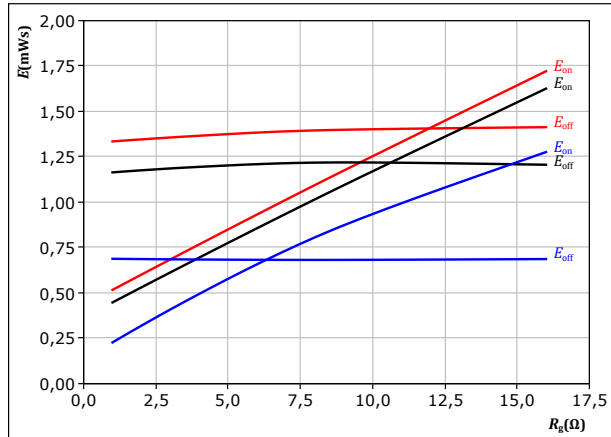
Typical switching energy losses as a function of collector current  
 $E = f(I_c)$



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 37.** IGBT

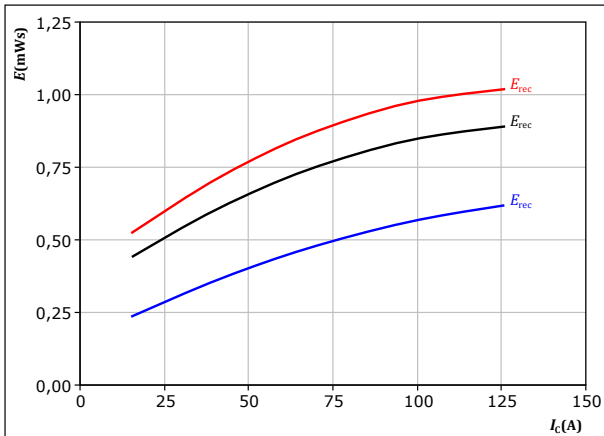
Typical switching energy losses as a function of IGBT turn on gate resistor  
 $E = f(R_g)$



With an inductive load at  
 $V_{CE} = 350$  V  
 $V_{GE} = -5/15$  V  
 $I_c = 70$  A  
 $T_j$ : 25 °C (blue), 125 °C (black), 150 °C (red)

**figure 38.** FWD

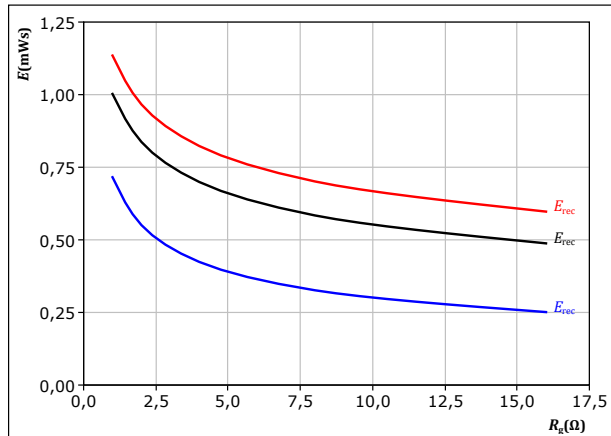
Typical reverse recovered energy loss as a function of collector current  
 $E_{rec} = f(I_c)$



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 39.** 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  
 $I_c = 70$  A  
 $T_j$ : 25 °C (blue), 125 °C (black), 150 °C (red)

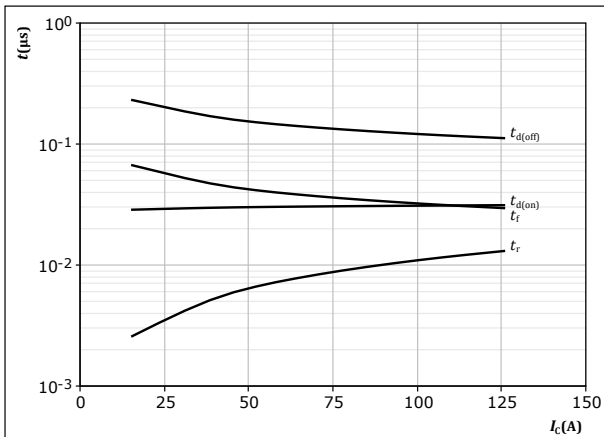




## Boost Switching Characteristics

**figure 40.** IGBT

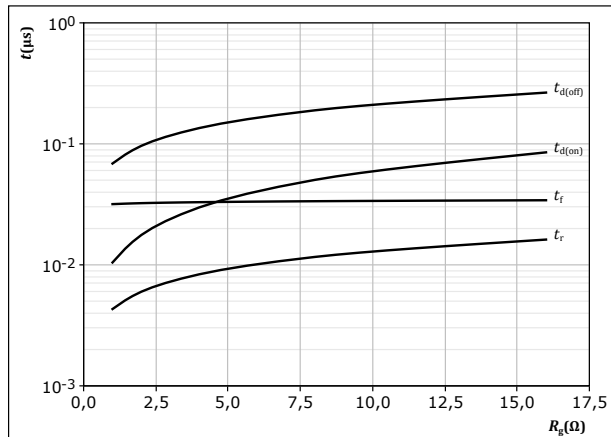
Typical switching times as a function of collector current  
 $t = f(I_c)$



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 41.** IGBT

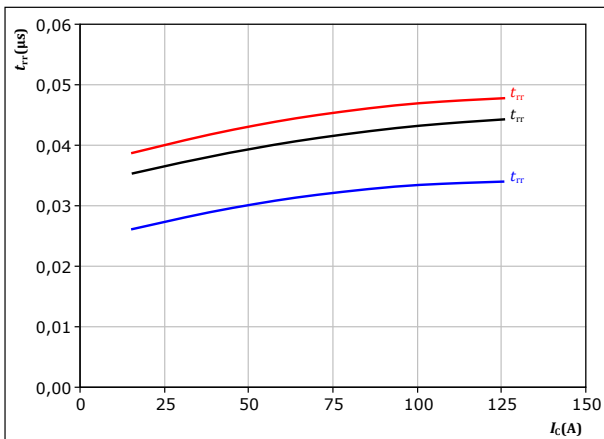
Typical switching times as a function of IGBT turn on gate resistor  
 $t = f(R_g)$



With an inductive load at  
 $T_j = 150 \text{ }^\circ\text{C}$   
 $V_{CE} = 350 \text{ V}$   
 $V_{GE} = -5/15 \text{ V}$   
 $I_c = 70 \text{ A}$

**figure 42.** FWD

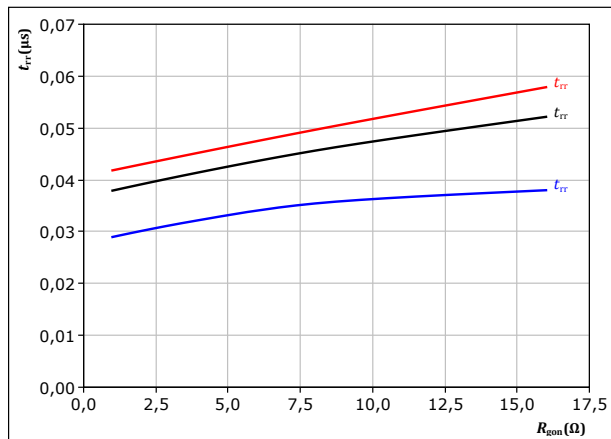
Typical reverse recovery time as a function of collector current  
 $t_{rr} = f(I_c)$



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

**figure 43.** FWD

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



With an inductive load at  
 $V_{CE} = 350 \text{ V}$   
 $V_{GE} = -5/15 \text{ V}$   
 $I_c = 70 \text{ A}$   
 $T_j:$  — 25  $^\circ\text{C}$   
           — 125  $^\circ\text{C}$   
           — 150  $^\circ\text{C}$

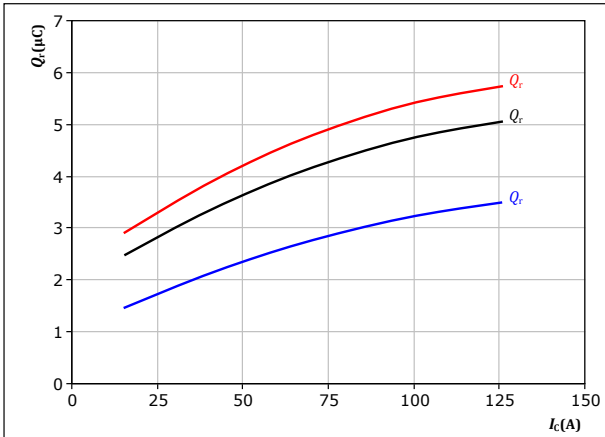


## Boost Switching Characteristics

figure 44. FWD

Typical recovered charge as a function of collector current

$$Q_r = f(I_c)$$



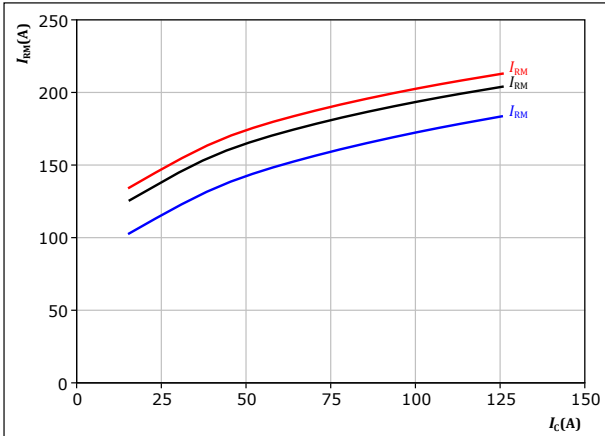
With an inductive load at

$V_{CE} = 350$  V  
 $V_{GE} = -5/15$  V  
 $R_{gon} = 4$  Ω  
 $T_j$ : 25 °C (blue), 125 °C (black), 150 °C (red)

figure 46. FWD

Typical peak reverse recovery current as a function of collector current

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



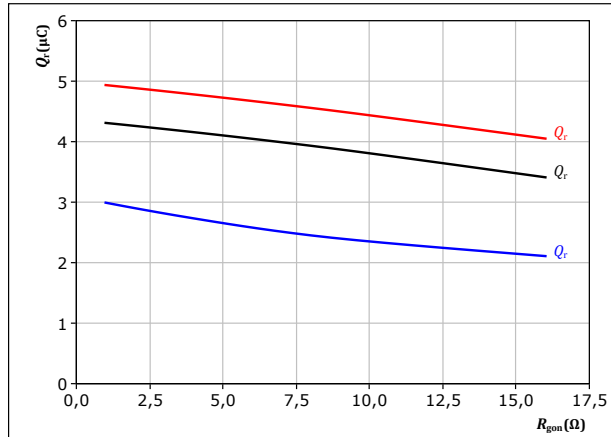
With an inductive load at

$V_{CE} = 350$  V  
 $V_{GE} = -5/15$  V  
 $R_{gon} = 4$  Ω  
 $T_j$ : 25 °C (blue), 125 °C (black), 150 °C (red)

figure 45. FWD

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

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



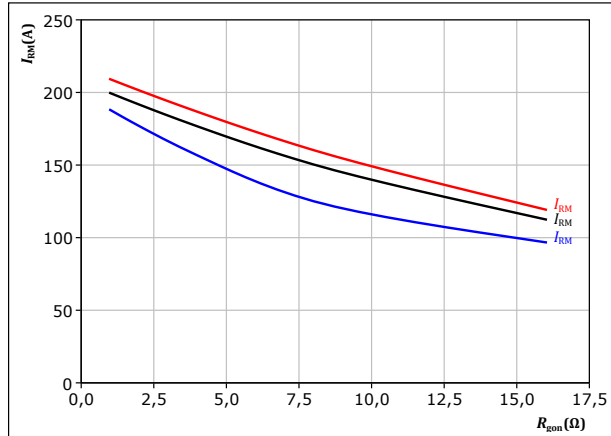
With an inductive load at

$V_{CE} = 350$  V  
 $V_{GE} = -5/15$  V  
 $I_c = 70$  A  
 $T_j$ : 25 °C (blue), 125 °C (black), 150 °C (red)

figure 47. 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

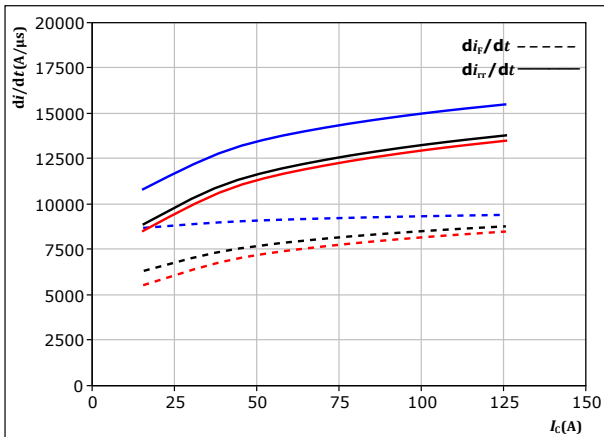
$V_{CE} = 350$  V  
 $V_{GE} = -5/15$  V  
 $I_c = 70$  A  
 $T_j$ : 25 °C (blue), 125 °C (black), 150 °C (red)



## Boost Switching Characteristics

**figure 48.** FWD

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

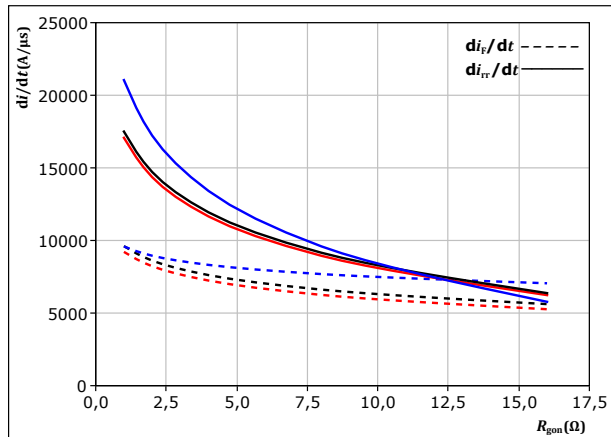


With an inductive load at

$V_{CE} =$	350	V	$T_j =$	25 °C
$V_{GE} =$	-5/15	V		125 °C
$R_{gon} =$	4	Ω		150 °C

**figure 49.** FWD

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



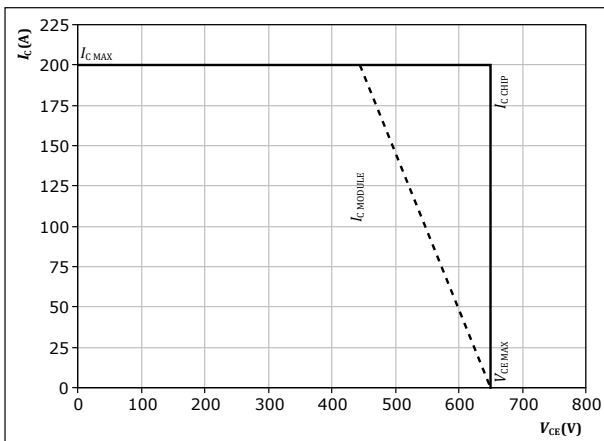
With an inductive load at

$V_{CE} =$	350	V	$T_j =$	25 °C
$V_{GE} =$	-5/15	V		125 °C
$I_C =$	70	A		150 °C

**figure 50.** 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 51. IGBT

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

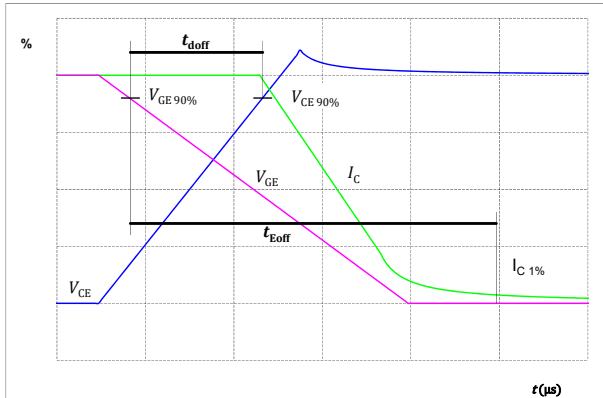


figure 52. IGBT

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

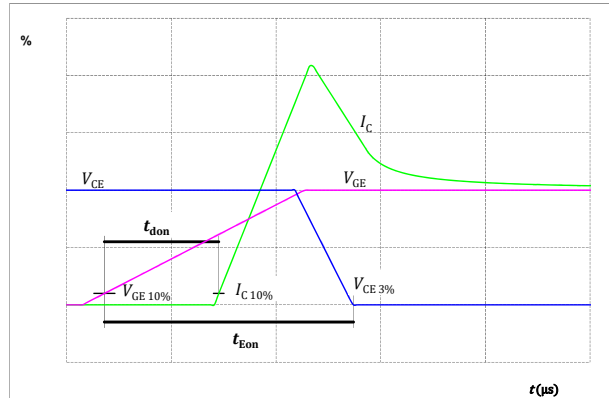


figure 53. IGBT

Turn-off Switching Waveforms & definition of  $t_f$

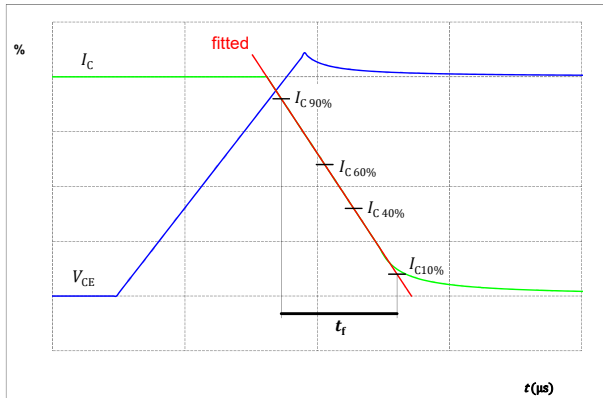
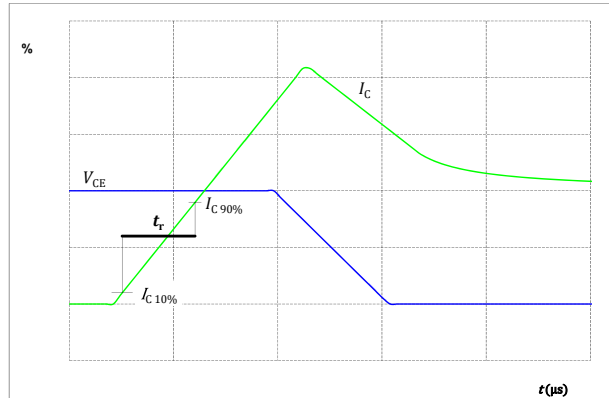


figure 54. IGBT

Turn-on Switching Waveforms & definition of  $t_r$





### Switching Definitions

figure 55. FWD

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

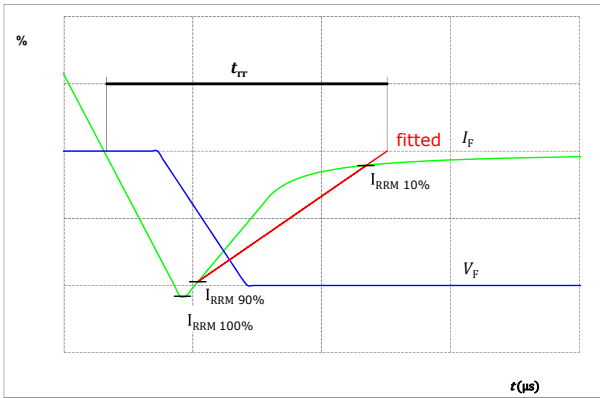
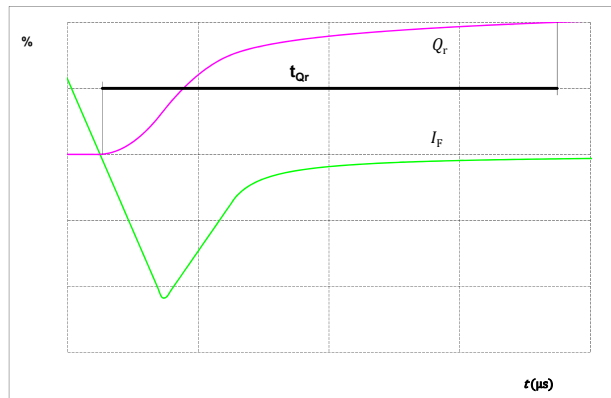


figure 56. FWD

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






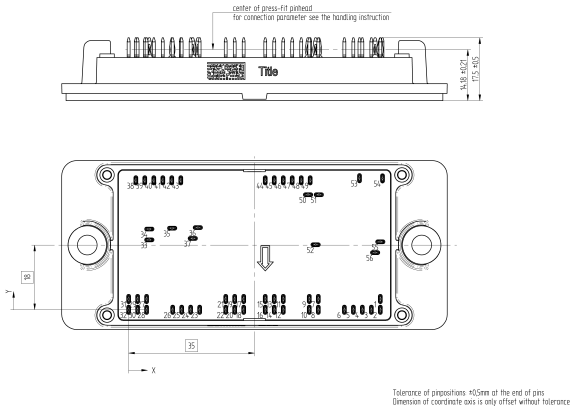
Vincotech

**30-PT12NMA160SH02-M669F28Y**  
datasheet

Ordering Code	
<b>Version</b>	<b>Ordering Code</b>
Without thermal paste	30-PT12NMA160SH02-M669F28Y
With thermal paste (3,4 W/mK, PSX-P7)	30-PT12NMA160SH02-M669F28Y-/3/

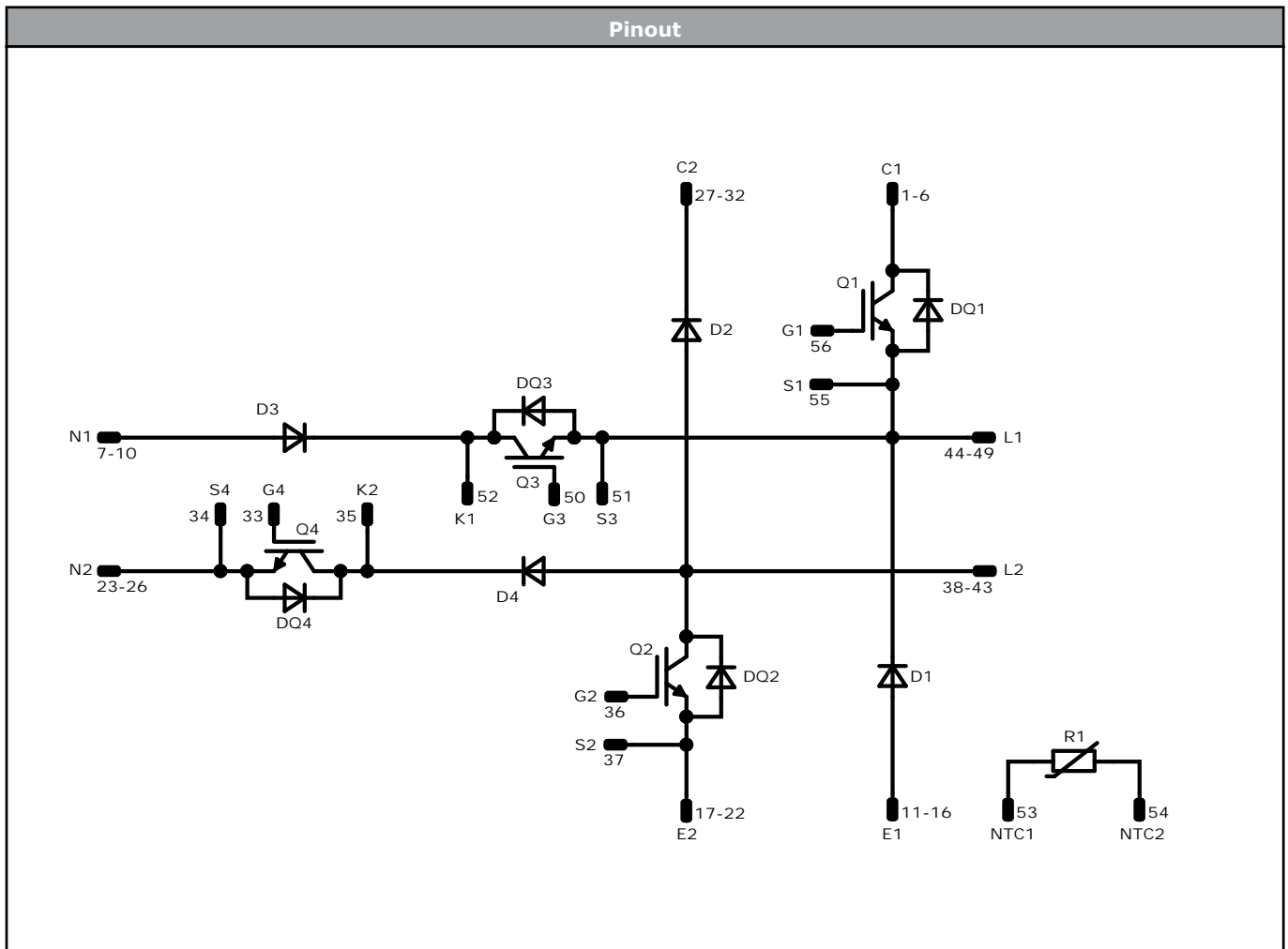
Marking						
	<b>Text</b>	<b>Name</b> NN-NNNNNNNNNNNNNN- TTTTTVV	<b>Date code</b> WWYY	<b>UL &amp; VIN</b> UL VIN	<b>Lot</b> LLLLL	<b>Serial</b> SSSS
	<b>Datamatrix</b>	<b>Type&amp;Ver</b> TTTTTTVV	<b>Lot number</b> LLLLL	<b>Serial</b> SSSS	<b>Date code</b> WWYY	

Outline							
Pin table [mm]							
Pin	X	Y	Function	29	2,5	3	C2
1	70	3	C1	30	2,5	0	C2
2	70	0	C1	31	0	3	C2
3	67,5	0	C1	32	0	0	C2
4	65	0	C1	33	5,75	19,45	G4
5	62,5	0	C1	34	5,75	22,45	S4
6	60	0	C1	35	12,1	22,7	K2
7	52,75	3	N1	36	19,25	22,85	G2
8	52,75	0	N1	37	17,85	19,85	S2
9	50,25	3	N1	38	2	36	L2
10	50,25	0	N1	39	4,5	36	L2
11	43	3	E1	40	7	36	L2
12	43	0	E1	41	9,5	36	L2
13	40,5	3	E1	42	12	36	L2
14	40,5	0	E1	43	14,5	36	L2
15	38	3	E1	44	38	36	L1
16	38	0	E1	45	40,5	36	L1
17	32	3	E2	46	43	36	L1
18	32	0	E2	47	45,5	36	L1
19	29,5	3	E2	48	48	36	L1
20	29,5	0	E2	49	50,5	36	L1
21	27	3	E2	50	49,9	32	G3
22	27	0	E2	51	52,9	32	S3
23	19,75	0	N2	52	52	18,1	K1
24	17,25	0	N2	53	64,2	36,6	NTC
25	14,75	0	N2	54	70,6	36,55	NTC
26	12,25	0	N2	55	70	18,9	S1
27	5	3	C2	56	68,55	15,9	G1
28	5	0	C2				





Vincotech



Identification					
ID	Component	Voltage	Current	Function	Comment
Q1, Q2	IGBT	1200 V	160 A	Buck Switch	
D3, D4	FWD	650 V	150 A	Buck Diode	
DQ1, DQ2	FWD	1200 V	10 A	Buck Sw. Protection Diode	
Q4, Q3	IGBT	650 V	100 A	Boost Switch	
D2, D1	FWD	1200 V	70 A	Boost Diode	
DQ4, DQ3	FWD	650 V	30 A	Boost Sw. Protection Diode	
NTC	NTC			Thermistor	



Vincotech

Packaging instruction				
Standard packaging quantity (SPQ) 36	>SPQ	Standard	<SPQ	Sample

Handling instruction
Handling instructions for <i>flow 2</i> packages see vincotech.com website.

Package data
Package data for <i>flow 2</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 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
30-PT12NMA160SH02-M669F28Y-D7-14	21 Nov. 2024	Change Boost Switch/Diode, and Buck Diode/Sw. Protection Diode (PCN-41-2023)	

**DISCLAIMER**

The information, specifications, procedures, methods and recommendations herein (together "information") are presented by Vincotech to reader in good faith, are believed to be accurate and reliable, but may well be incomplete and/or not applicable to all conditions or situations that may exist or occur. Vincotech reserves the right to make any changes without further notice to any products to improve reliability, function or design. No representation, guarantee or warranty is made to reader as to the accuracy, reliability or completeness of said information or that the application or use of any of the same will avoid hazards, accidents, losses, damages or injury of any kind to persons or property or that the same will not infringe third parties rights or give desired results. It is reader's sole responsibility to test and determine the suitability of the information and the product for reader's intended use.

**LIFE SUPPORT POLICY**

Vincotech products are not authorised for use as critical components in life support devices or systems without the express written approval of Vincotech.

As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, or (c) whose failure to perform when properly used in accordance with instructions for use provided in labelling can be reasonably expected to result in significant injury to the user.
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.