

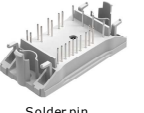

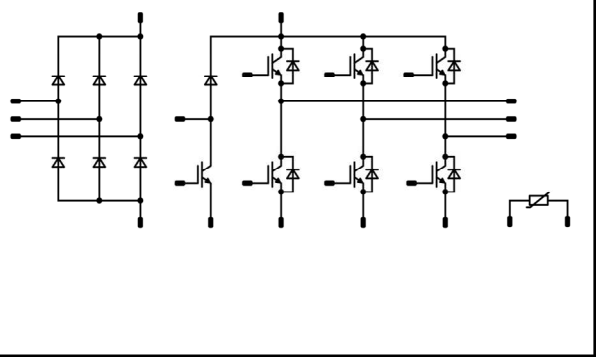




<i>flow PIM 0</i>	1200 V / 10 A
<div style="background-color: #eee; padding: 5px; margin-bottom: 5px;">Features</div> <ul style="list-style-type: none"> IGBT M7 with low V_{CEsat} and improved EMC behavior Open emitter configuration Compact and low inductive design Built-in NTC 	<div style="background-color: #eee; padding: 5px; margin-bottom: 5px;">flow 0 housing</div> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>12 mm</p>  </div> <div style="text-align: center;">  </div> </div> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>17 mm</p>  </div> <div style="text-align: center;">  </div> </div> <div style="display: flex; justify-content: space-around; font-size: small;"> Solder pin Press-fit pin </div>
<div style="background-color: #eee; padding: 5px; margin-bottom: 5px;">Target applications</div> <ul style="list-style-type: none"> Industrial Drives 	<div style="background-color: #eee; padding: 5px; margin-bottom: 5px;">Schematic</div> 
<div style="background-color: #eee; padding: 5px; margin-bottom: 5px;">Types</div> <ul style="list-style-type: none"> 10-FZ12PMA010M7-P849A28 10-F012PMA010M7-P849A29 10-PZ12PMA010M7-P849A28Y 10-P012PMA010M7-P849A29Y 	

Maximum Ratings

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

Parameter	Symbol	Condition	Value	Unit
Rectifier Diode				
Peak Repetitive Reverse Voltage	V_{RRM}		1600	V
Continuous (direct) forward current	I_F		25	A
Surge (non-repetitive) forward current	I_{FSM}	50 Hz Single Half Sine Wave $t_p = 10\text{ ms}$ $T_j = 150\text{ °C}$	200	A
Surge current capability	I^2t		200	A^2s
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	44	W
Maximum Junction Temperature	T_{jmax}		150	$^{\circ}C$



Maximum Ratings

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

Parameter	Symbol	Condition	Value	Unit
Inverter Switch				
Collector-emitter voltage	V_{CES}		1200	V
Collector current	I_C		10	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	20	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	55	W
Gate-emitter voltage	V_{GES}		± 20	V
Maximum junction temperature	T_{jmax}		175	°C
Inverter Diode				
Peak repetitive reverse voltage	V_{RRM}		1200	V
Continuous (direct) forward current	I_F		10	A
Repetitive peak forward current	I_{FRM}	T_j limited by T_{jmax}	20	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	50	W
Maximum junction temperature	T_{jmax}		175	°C
Brake Switch				
Collector-emitter voltage	V_{CES}		1200	V
Collector current	I_C		5	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	10	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	41	W
Gate-emitter voltage	V_{GES}		± 20	V
Maximum junction temperature	T_{jmax}		175	°C
Brake Diode				
Peak repetitive reverse voltage	V_{RRM}		1200	V
Continuous (direct) forward current	I_F		5	A
Repetitive peak forward current	I_{FRM}	T_j limited by T_{jmax}	10	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	27	W
Maximum junction temperature	T_{jmax}		175	°C



Maximum Ratings

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

Parameter	Symbol	Condition	Value	Unit
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Module Properties

Thermal Properties

Storage temperature	T_{stg}		-40...+125	°C
Operation temperature under switching condition	T_{top}		-40...(T _{max} - 25)	°C

Isolation Properties

Isolation voltage	V_{isol}	DC Test Voltage* $t_p = 2\text{ s}$	6000	V
		AC Voltage $t_p = 1\text{ min}$	2500	V
Creepage distance			min. 12,7	mm
Clearance		Solder pin 12 mm housing / 17 mm housing	9,29 / min. 12,7	mm
		Press-fit pin 12 mm housing / 17 mm housing	9,48 / min. 12,7	
Comparative Tracking Index	CTI		> 200	

*100 % tested in production



Characteristic Values

Parameter	Symbol	Conditions					Value			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		

Rectifier Diode

Static

Forward voltage	V_F			30	25 125		1,22 1,21	1,8	V
Reverse leakage current	I_r		1600		25 145			50 1100	μ A

Thermal

Thermal resistance junction to sink	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)					1,59		K/W
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Characteristic Values

Parameter	Symbol	Conditions					Value			Unit
		V_{GS} [V]	V_{GE} [V]	V_{DS} [V]	I_D [A]	T_j [°C]	Min	Typ	Max	
Inverter Switch										
Static										
Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{GE} = V_{CE}$			0,001	25	5,4	6	6,6	V
Collector-emitter saturation voltage	V_{CEsat}		15		10	25 125 150		1,66 1,90 1,96	1,95	V
Collector-emitter cut-off current	I_{CES}		0	1200		25			55	μA
Gate-emitter leakage current	I_{GES}		20	0		25			500	nA
Internal gate resistance	r_g							none		Ω
Input capacitance	C_{ies}							2000		pF
Output capacitance	C_{oes}		0	10		25		86		
Reverse transfer capacitance	C_{res}							23		
Gate charge	Q_g		15	600	10	25		80		nC
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	$\lambda_{paste} = 3,4 \text{ W/mK}$ (PSX)						1,72		K/W
Dynamic										
Turn-on delay time	$t_{d(on)}$					25 125 150		128 126 123		ns
Rise time	t_r	$R_{goff} = 32 \Omega$ $R_{gon} = 32 \Omega$				25 125 150		29 32 34		
Turn-off delay time	$t_{d(off)}$		±15	600	10	25 125 150		145 179 182		
Fall time	t_f					25 125 150		98 108 117		
Turn-on energy (per pulse)	E_{on}	$Q_{tFWD} = 1,1 \mu\text{C}$ $Q_{tFWD} = 1,7 \mu\text{C}$ $Q_{tFWD} = 1,8 \mu\text{C}$				25 125 150		0,883 1,125 1,189		
Turn-off energy (per pulse)	E_{off}					25 125 150		0,656 0,860 0,908		



Characteristic Values

Parameter	Symbol	Conditions					Value			Unit
		V_{GE} [V]	V_{CE} [V]	I_C [A]	T_j [°C]	Min	Typ	Max		
		V_{GS} [V]	V_{DS} [V]	I_D [A]						
			V_F [V]	I_F [A]						
Inverter Diode										
Static										
Forward voltage	V_F			10		25 125 150		1,61 1,69 1,69	2,1	V
Reverse leakage current	I_R			1200		25			25	μA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$		$\lambda_{paste} = 3,4$ W/mK (PSX)					1,91		K/W
Dynamic										
Peak recovery current	I_{RRM}					25 125 150		9 9 9		A
Reverse recovery time	t_{rr}					25 125 150		254 373 409		ns
Recovered charge	Q_r		$di/dt = 278$ A/μs $di/dt = 270$ A/μs $di/dt = 272$ A/μs	±15	600	10		1,088 1,664 1,808		μC
Reverse recovered energy	E_{rec}					25 125 150		0,374 0,620 0,680		mWs
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$					25 125 150		85 54 49		A/μs



Vincotech

10-xZ12PMA010M7-P849A28x
10-x012PMA010M7-P849A29x
 datasheet

Characteristic Values

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

Brake Switch

Static

Parameter	Symbol	$V_{GE} = V_{CE}$	V_{GS} [V]	V_{CE} [V]	I_D [A]	T_j [°C]	Min	Typ	Max	Unit
Gate-emitter threshold voltage	$V_{GE(th)}$				0,0005	25	5,4	6	6,6	V
Collector-emitter saturation voltage	V_{CESat}		15		5	25 125 150		1,62 1,83 1,89	1,95	V
Collector-emitter cut-off current	I_{CES}		0	1200		25			50	μA
Gate-emitter leakage current	I_{GES}		20	0		25			500	nA
Internal gate resistance	r_g							none		Ω
Input capacitance	C_{ies}							1100		pF
Output capacitance	C_{oes}		0	10		25		57		
Reverse transfer capacitance	C_{res}							11		
Gate charge	Q_g		15	600	5	25		40		nC

Thermal

Parameter	Symbol	Value	Unit
Thermal resistance junction to sink	$R_{th(j-s)}$	$\lambda_{paste} = 3,4 \text{ W/mK}$ (PSX)	K/W

Dynamic

Parameter	Symbol	$R_{goff} = 64 \Omega$ $R_{gon} = 64 \Omega$	V_{GS} [V]	V_{CE} [V]	I_D [A]	T_j [°C]	Min	Typ	Max	Unit
Turn-on delay time	$t_{d(on)}$		15/0	600	5	25 125 150		79		ns
Rise time	t_r						25 125 150	45 48 49		
Turn-off delay time	$t_{d(off)}$						25 125 150	234 262 270		
Fall time	t_f						25 125 150	101 114 117		
Turn-on energy (per pulse)	E_{on}						$Q_{iFWD} = 0,6 \mu\text{C}$ $Q_{iFWD} = 0,8 \mu\text{C}$ $Q_{iFWD} = 0,9 \mu\text{C}$	25 125 150	0,480 0,609 0,634	
Turn-off energy (per pulse)	E_{off}		25 125 150	0,345 0,454 0,474						



Characteristic Values

Parameter	Symbol	Conditions					Value			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		
Brake Diode										
Static										
Forward voltage	V_F			5	25 125 150		1,57 1,65 1,65	2,1		V
Reverse leakage current	I_R		1200		25			20		μA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)					3,50			K/W
Dynamic										
Peak recovery current	I_{RRM}				25 125 150		4 4 4			A
Reverse recovery time	t_{rr}				25 125 150		259 386 431			ns
Recovered charge	Q_r	$di/dt = 85$ A/μs $di/dt = 102$ A/μs $di/dt = 87$ A/μs	15/0	600	5	25 125 150	0,558 0,833 0,935			μC
Reverse recovered energy	E_{rec}				25 125 150		0,200 0,314 0,363			mWs
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$				25 125 150		37 24 20			A/μs
Thermistor										
Rated resistance	R				25		22			kΩ
Deviation of R_{100}	$\Delta_{R/R}$	$R_{100} = 1484$ Ω			100	-5		5		%
Power dissipation	P				25		5			mW
Power dissipation constant					25		1,5			mW/K
B-value	$B_{(25/50)}$	Tol. ±1 %			25		3962			K
B-value	$B_{(25/100)}$	Tol. ±1 %			25		4000			K
Vincotech NTC Reference								I		



Rectifier Diode Characteristics

figure 1. FWD
 Typical forward characteristics

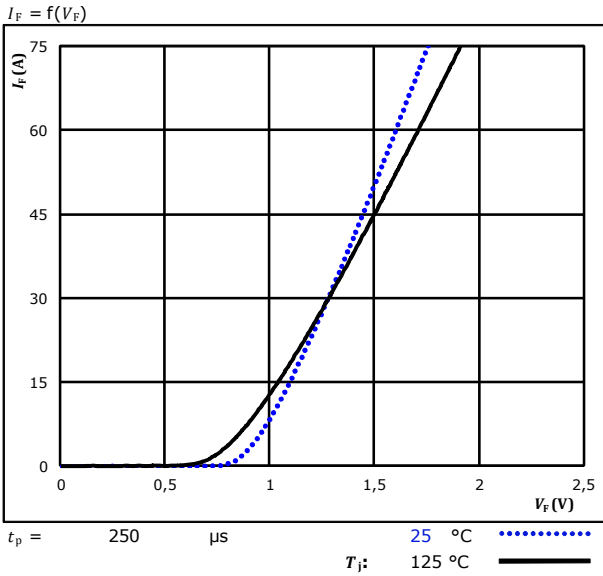
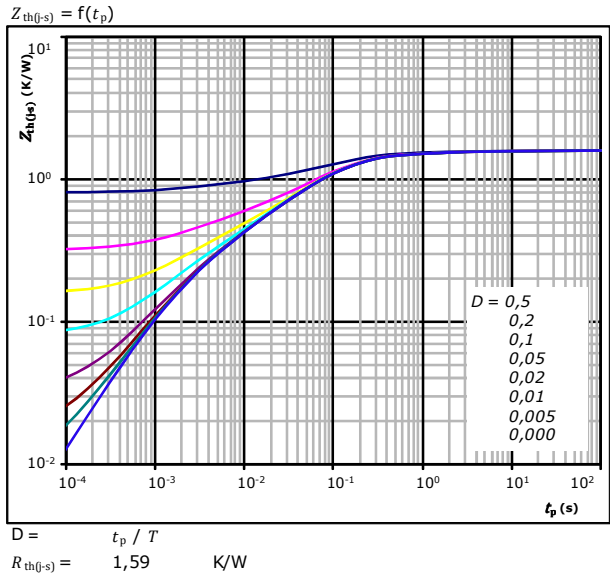


figure 2. FWD
 Transient thermal impedance as a function of pulse width



Diode thermal model values

R (K/W)	τ (s)
3,44E-02	9,66E+00
1,12E-01	1,22E+00
5,81E-01	1,45E-01
4,89E-01	5,05E-02
2,38E-01	9,26E-03
1,22E-01	1,79E-03
1,22E-01	1,79E-03

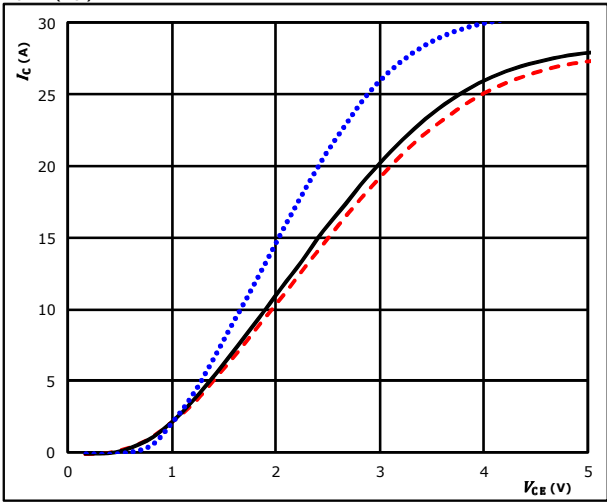


Inverter Switch Characteristics

figure 1. IGBT

Typical output characteristics

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

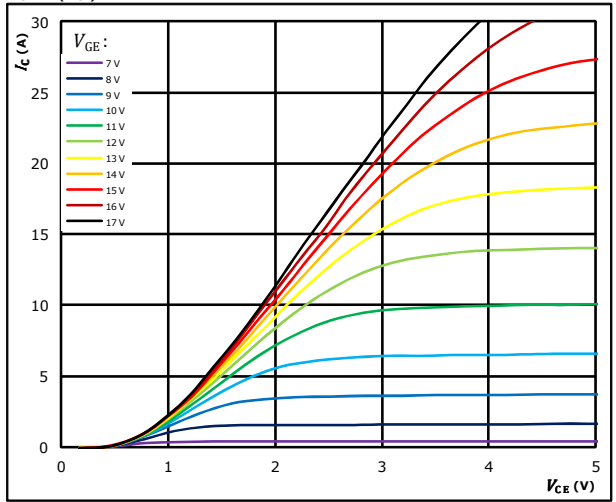


$t_p = 250 \mu\text{s}$ $T_j: 25 \text{ }^\circ\text{C}$
 $V_{GE} = 15 \text{ V}$ $T_j: 125 \text{ }^\circ\text{C}$ ———
 $T_j: 150 \text{ }^\circ\text{C}$ - - - -

figure 2. IGBT

Typical output characteristics

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

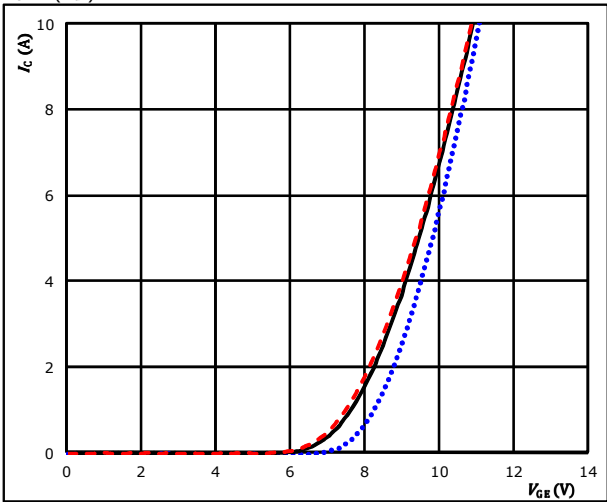


$t_p = 250 \mu\text{s}$ $T_j = 150 \text{ }^\circ\text{C}$
 V_{GE} from 7 V to 17 V in steps of 1 V

figure 3. IGBT

Typical transfer characteristics

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

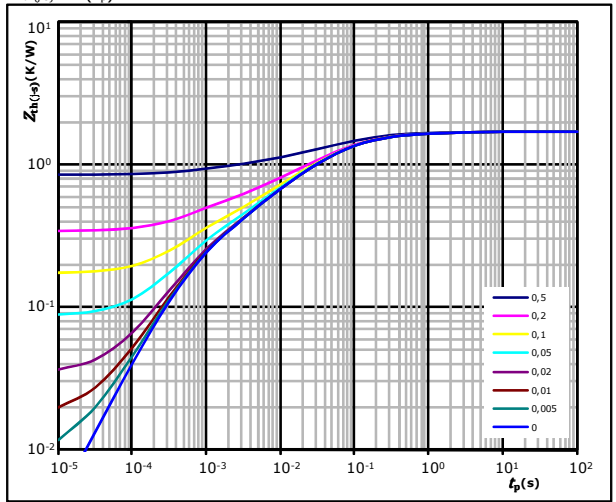


$t_p = 100 \mu\text{s}$ $T_j: 25 \text{ }^\circ\text{C}$
 $V_{CE} = 10 \text{ V}$ $T_j: 125 \text{ }^\circ\text{C}$ ———
 $T_j: 150 \text{ }^\circ\text{C}$ - - - -

figure 4. IGBT

Transient thermal impedance as function of pulse duration

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



$D = t_p / T$
 $R_{th(j-s)} = 1,72 \text{ K/W}$
 IGBT thermal model values

R (K/W)	τ (s)
8,08E-02	2,32E+00
2,21E-01	2,45E-01
6,51E-01	6,03E-02
3,93E-01	1,33E-02
1,95E-01	3,15E-03
1,82E-01	5,45E-04

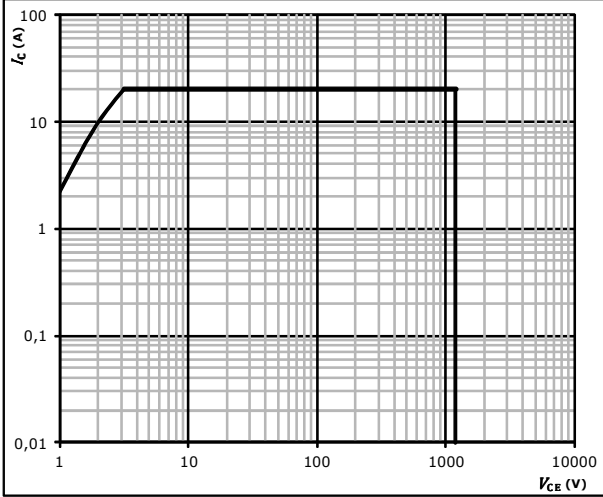


Inverter Switch Characteristics

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}

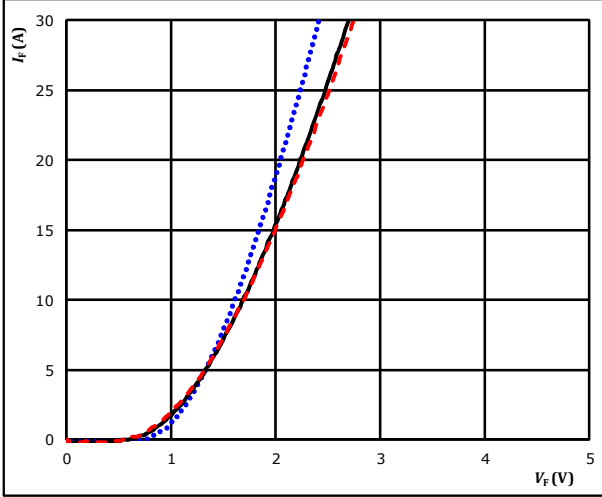


Inverter Diode Characteristics

figure 1. FWD

Typical forward characteristics

$$I_F = f(V_F)$$

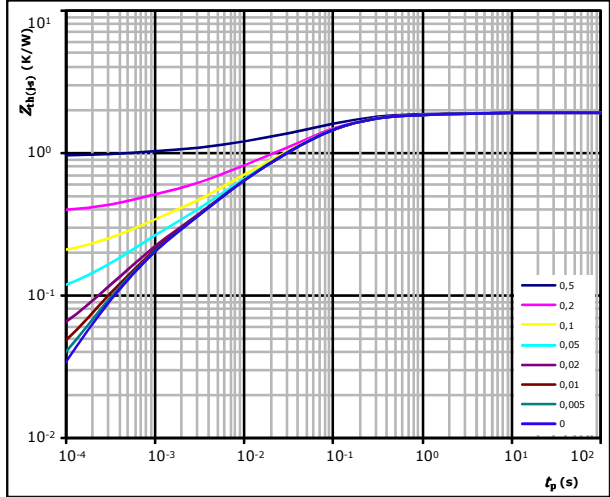


$t_p = 250 \mu s$
 T_j : 25 °C (dotted blue), 125 °C (solid black), 150 °C (dashed red)

figure 2. FWD

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$
 $R_{th(j-s)} = 1,91 \text{ K/W}$

FWD thermal model values

R (K/W)	τ (s)
9,38E-02	2,25E+00
3,43E-01	2,12E-01
8,53E-01	5,82E-02
3,59E-01	9,80E-03
1,37E-01	2,88E-03
1,26E-01	4,78E-04

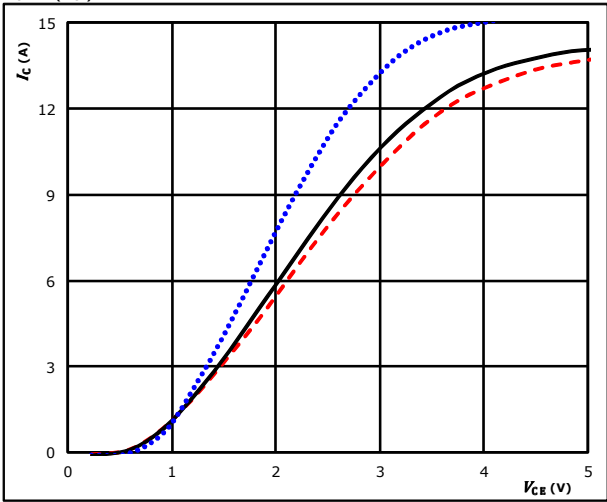


Brake Switch Characteristics

figure 1. IGBT

Typical output characteristics

$I_C = f(V_{CE})$

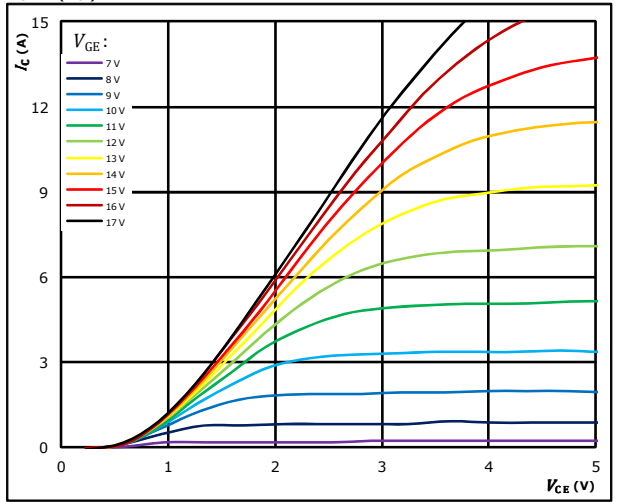


$t_p = 250 \mu s$ $T_j: 25 \text{ }^\circ C$
 $V_{GE} = 15 \text{ V}$ $T_j: 125 \text{ }^\circ C$ ———
 $T_j: 150 \text{ }^\circ C$ - - - -

figure 2. IGBT

Typical output characteristics

$I_C = f(V_{CE})$

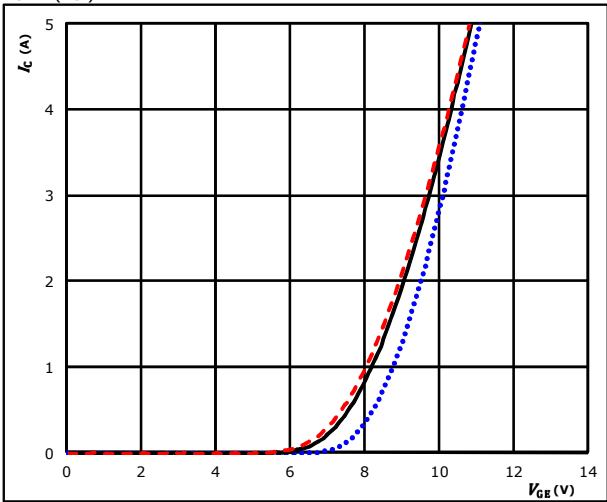


$t_p = 250 \mu s$ $T_j = 150 \text{ }^\circ C$
 V_{GE} from 7 V to 17 V in steps of 1 V

figure 3. IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$

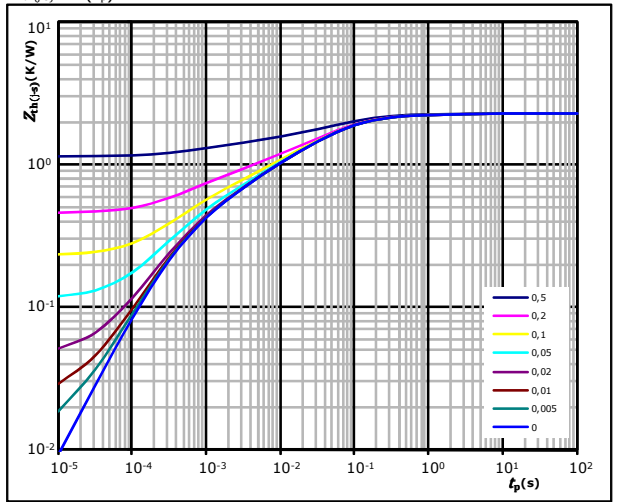


$t_p = 100 \mu s$ $T_j: 25 \text{ }^\circ C$
 $V_{CE} = 10 \text{ V}$ $T_j: 125 \text{ }^\circ C$ ———
 $T_j: 150 \text{ }^\circ C$ - - - -

figure 4. IGBT

Transient thermal impedance as function of pulse duration

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



$D = t_p / T$
 $R_{th(j-s)} = 2,30 \text{ K/W}$
 IGBT thermal model values

R (K/W)	τ (s)
6,25E-02	3,48E+00
1,37E-01	5,00E-01
7,38E-01	8,11E-02
5,28E-01	2,49E-02
3,84E-01	5,54E-03
2,39E-01	1,24E-03
2,13E-01	3,29E-04

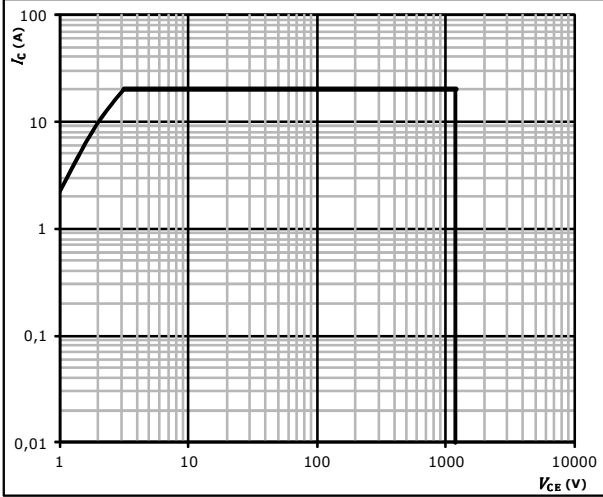


Brake Switch Characteristics

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}



Brake Diode Characteristics

figure 1. FWD
 Typical forward characteristics

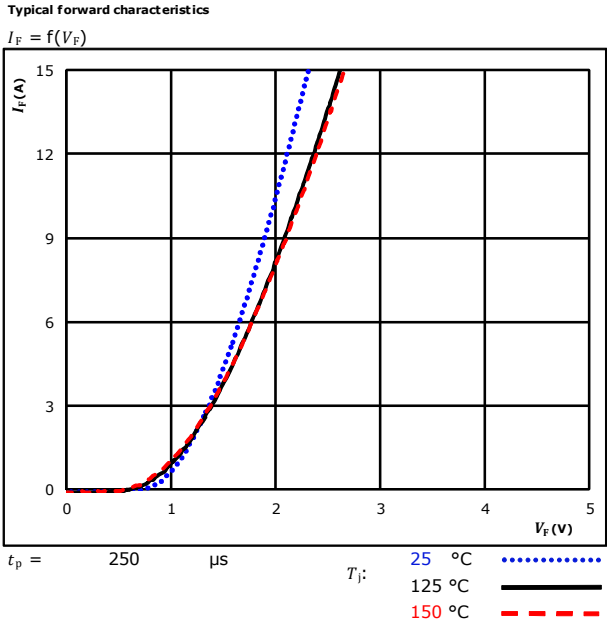
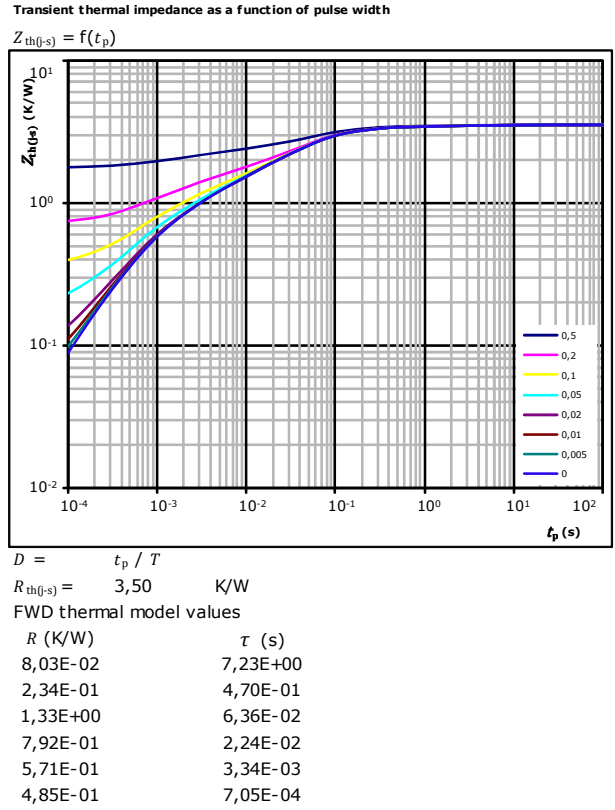
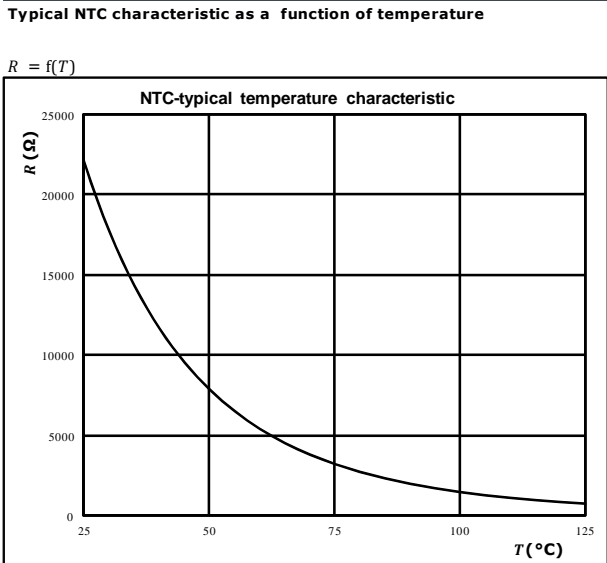


figure 2. FWD
 Transient thermal impedance as a function of pulse width



NTC Characteristics

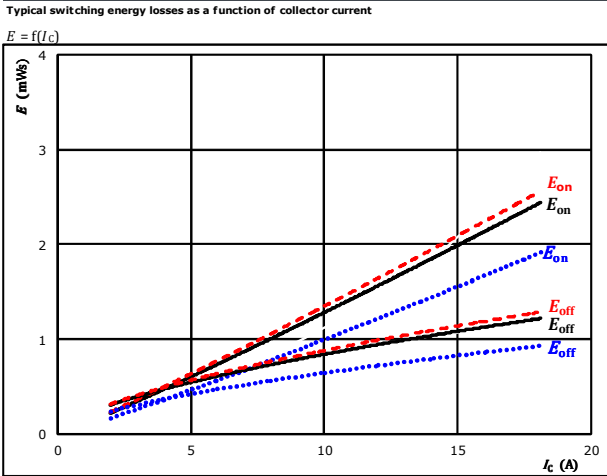
figure 1. Thermistor
 Typical NTC characteristic as a function of temperature





Inverter Switching Characteristics

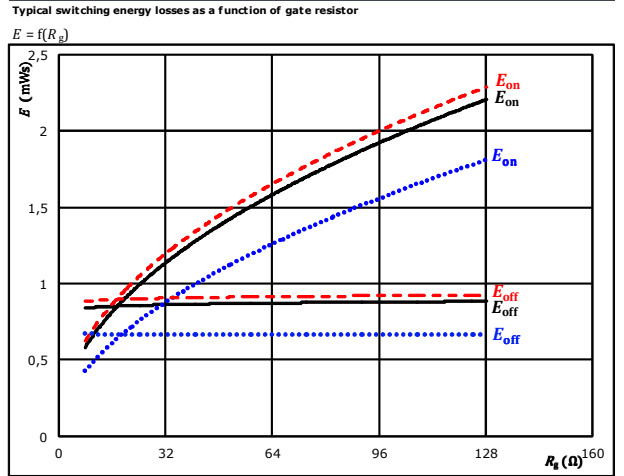
figure 1. IGBT



With an inductive load at

$V_{CE} = 600$ V	$T_j: 25$ °C
$V_{GE} = \pm 15$ V	125 °C	————
$R_{g\text{on}} = 32$ Ω	150 °C	-----
$R_{g\text{off}} = 32$ Ω		

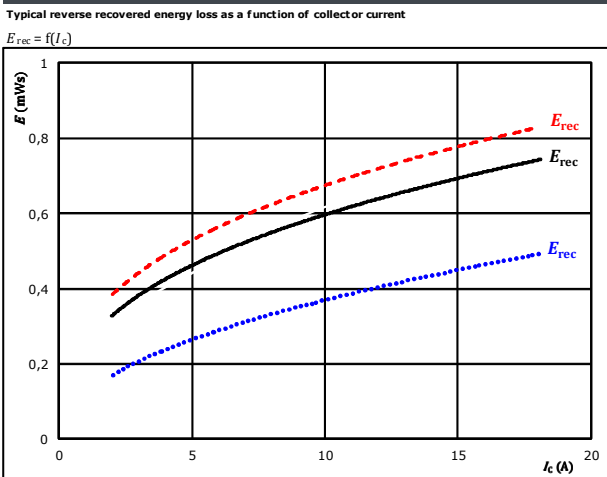
figure 2. IGBT



With an inductive load at

$V_{CE} = 600$ V	$T_j: 25$ °C
$V_{GE} = \pm 15$ V	125 °C	————
$I_C = 10$ A	150 °C	-----

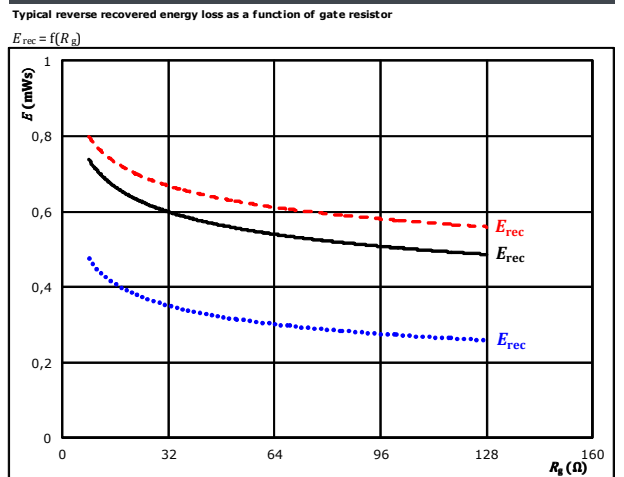
figure 3. FWD



With an inductive load at

$V_{CE} = 600$ V	$T_j: 25$ °C
$V_{GE} = \pm 15$ V	125 °C	————
$R_{g\text{on}} = 32$ Ω	150 °C	-----

figure 4. FWD



With an inductive load at

$V_{CE} = 600$ V	$T_j: 25$ °C
$V_{GE} = \pm 15$ V	125 °C	————
$I_C = 10$ A	150 °C	-----



Inverter Switching Characteristics

figure 5. IGBT
 Typical switching times as a function of collector current

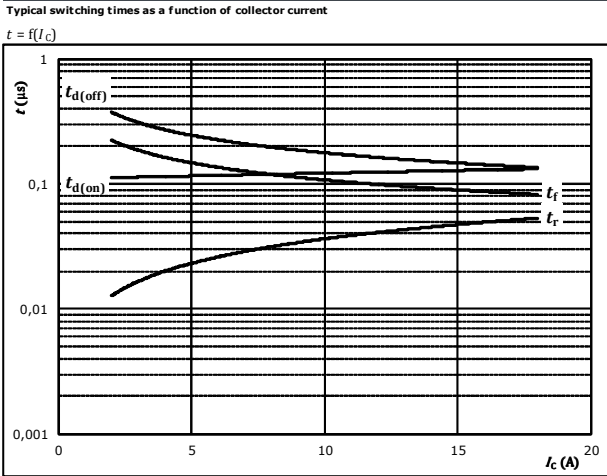


figure 6. IGBT
 Typical switching times as a function of gate resistor

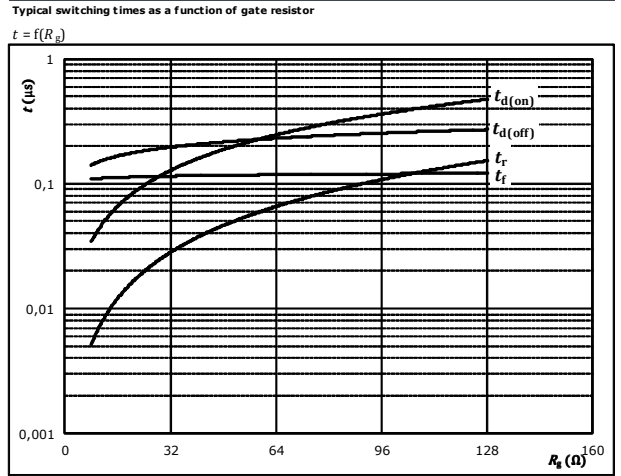


figure 7. FWD
 Typical reverse recovery time as a function of collector current

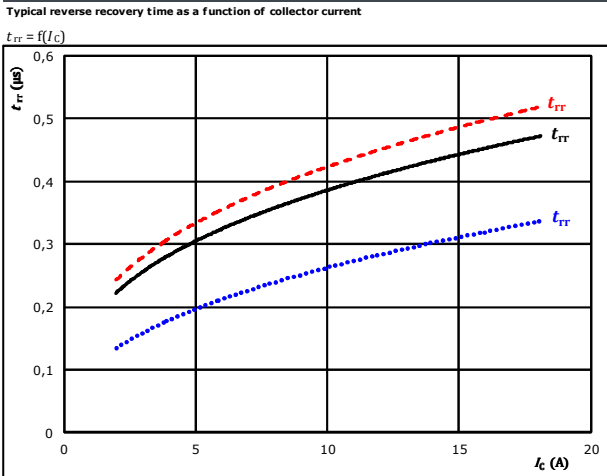
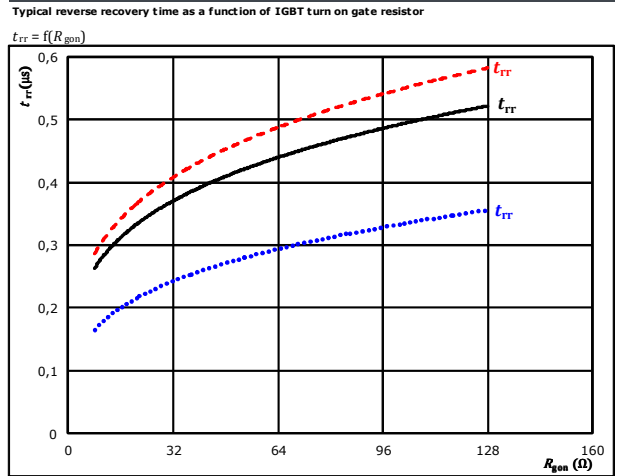


figure 8. FWD
 Typical reverse recovery time as a function of IGBT turn on gate resistor



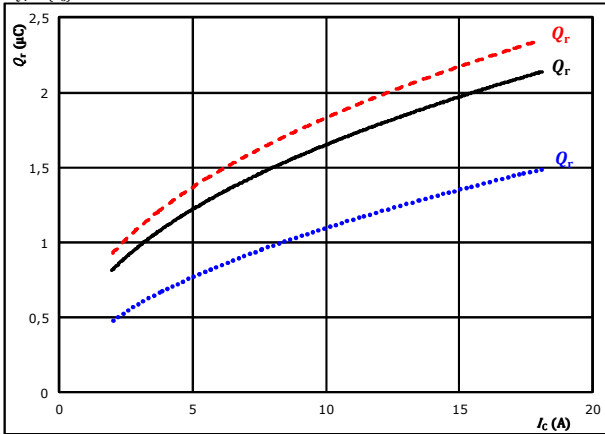


Inverter Switching Characteristics

figure 9. FWD

Typical recovered charge as a function of collector current

$$Q_r = f(I_c)$$

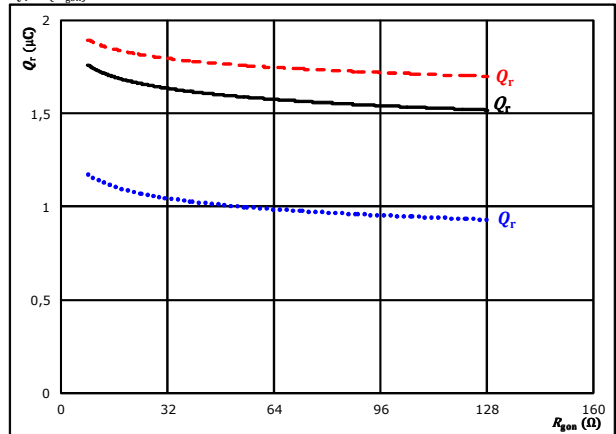


At $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 32$ Ω
 $T_j: 25$ °C (dotted blue)
 125 °C (solid black)
 150 °C (dashed red)

figure 10. FWD

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

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

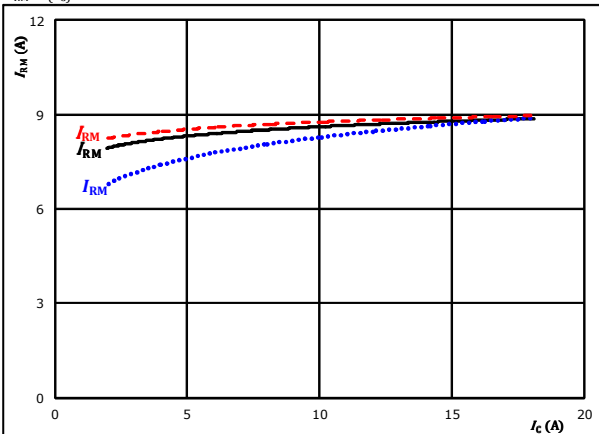


At $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $I_c = 10$ A
 $T_j: 25$ °C (dotted blue)
 125 °C (solid black)
 150 °C (dashed red)

figure 11. FWD

Typical peak reverse recovery current as a function of collector current

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

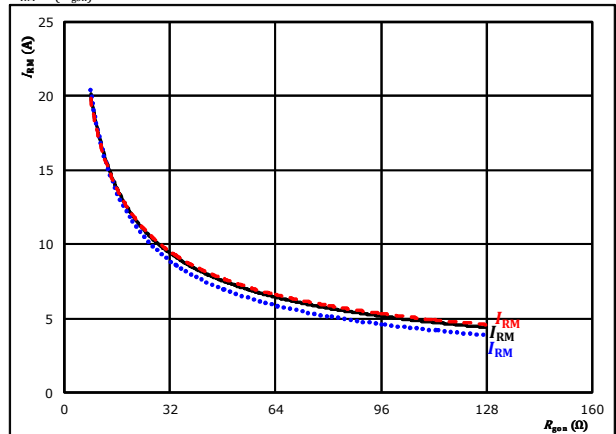


At $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 32$ Ω
 $T_j: 25$ °C (dotted blue)
 125 °C (solid black)
 150 °C (dashed red)

figure 12. FWD

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

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



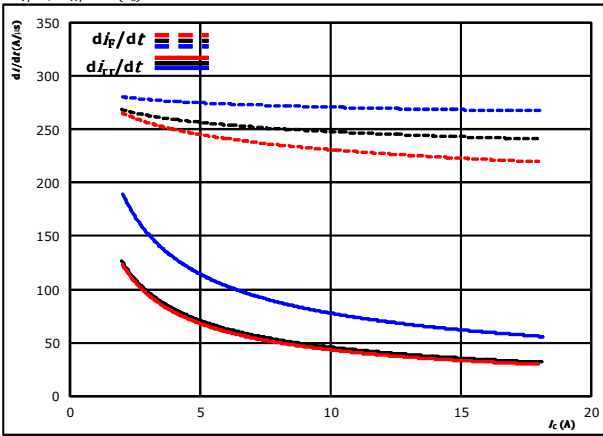
At $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $I_c = 10$ A
 $T_j: 25$ °C (dotted blue)
 125 °C (solid black)
 150 °C (dashed red)



Inverter Switching Characteristics

figure 13. FWD

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



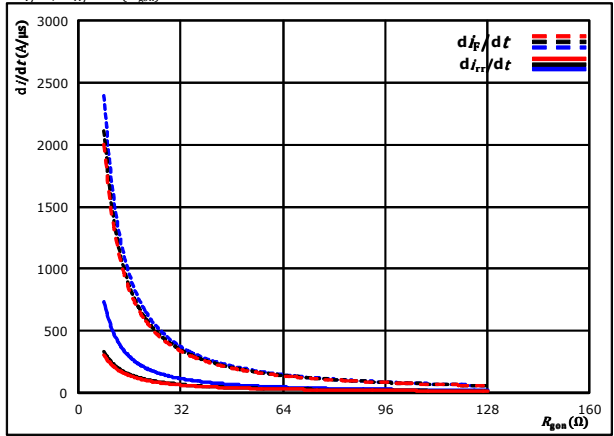
At $V_{CE} = 600$ V $T_j = 25$ °C $R_{gn} = 32$ Ω

$V_{GE} = \pm 15$ V $T_j = 125$ °C

$R_{gn} = 32$ Ω $T_j = 150$ °C

figure 14. FWD

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



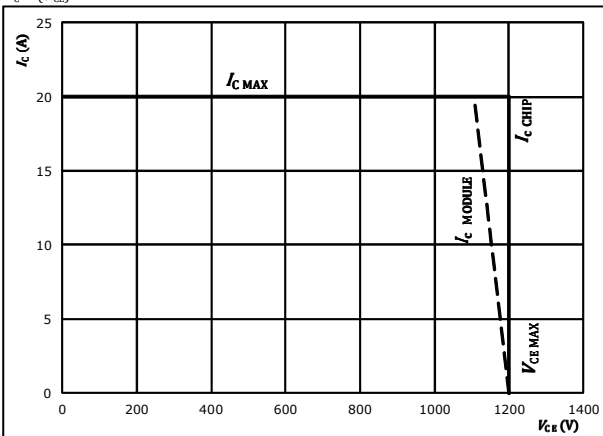
At $V_{CE} = 600$ V $T_j = 25$ °C $I_c = 10$ A

$V_{GE} = \pm 15$ V $T_j = 125$ °C

$I_c = 10$ A $T_j = 150$ °C

figure 15. IGBT

Reverse bias safe operating area
 $I_c = f(V_{CE})$



At $T_j = 175$ °C

$R_{gn} = 32$ Ω

$R_{goff} = 32$ Ω



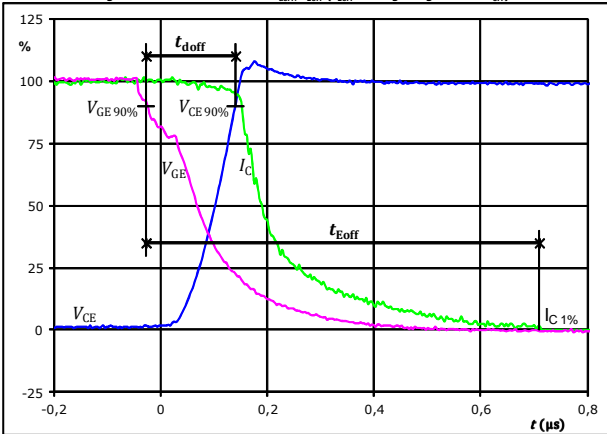
Inverter Switching Definitions

General conditions

T_j	=	125 °C
R_{gon}	=	32 Ω
R_{goff}	=	32 Ω

figure 1. IGBT

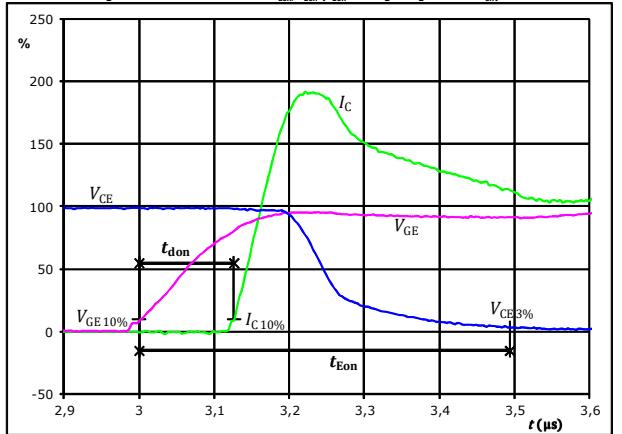
Turn-off Switching Waveforms & definition of t_{doff} , t_{Eoff} (t_{Eoff} = integrating time for E_{off})



$V_{GE}(0\%)$ =	-15	V
$V_{GE}(100\%)$ =	15	V
$V_C(100\%)$ =	600	V
$I_C(100\%)$ =	10	A
t_{doff} =	0,179	μs
t_{Eoff} =	0,737	μs

figure 2. IGBT

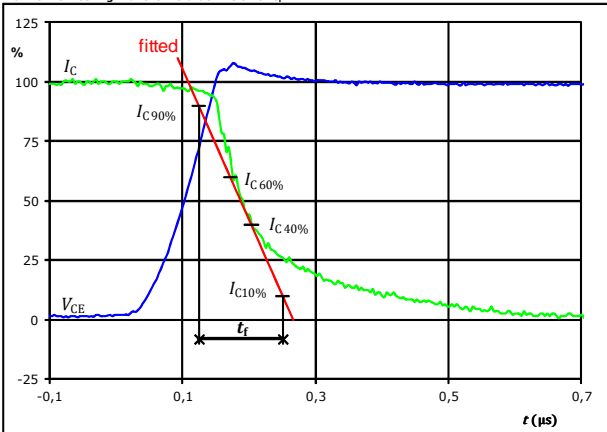
Turn-on Switching Waveforms & definition of t_{don} , t_{Eon} (t_{Eon} = integrating time for E_{on})



$V_{GE}(0\%)$ =	-15	V
$V_{GE}(100\%)$ =	15	V
$V_C(100\%)$ =	600	V
$I_C(100\%)$ =	10	A
t_{don} =	0,126	μs
t_{Eon} =	0,493	μs

figure 3. IGBT

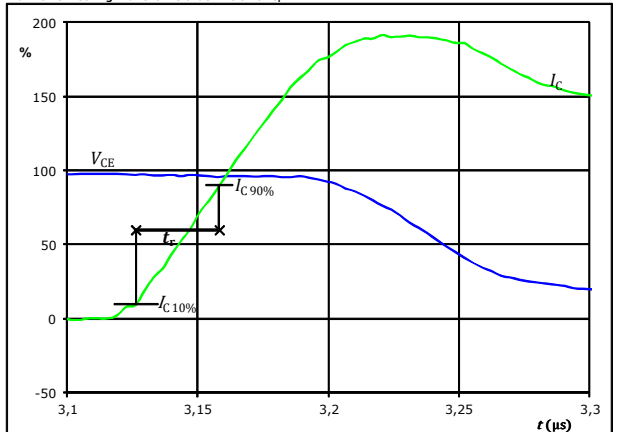
Turn-off Switching Waveforms & definition of t_f



$V_C(100\%)$ =	600	V
$I_C(100\%)$ =	10	A
t_f =	0,108	μs

figure 4. IGBT

Turn-on Switching Waveforms & definition of t_r



$V_C(100\%)$ =	600	V
$I_C(100\%)$ =	10	A
t_r =	0,032	μs

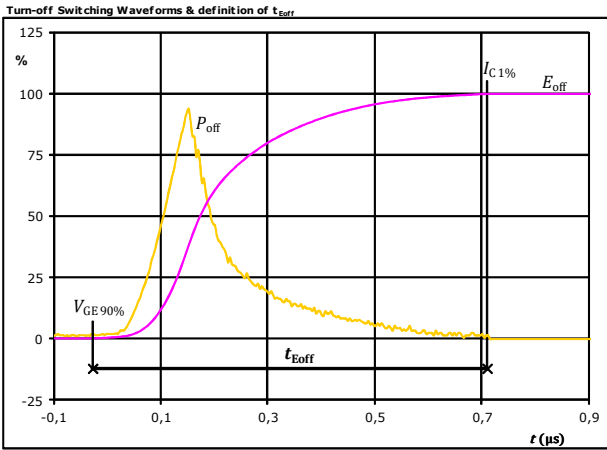


Vincotech

10-xZ12PMA010M7-P849A28x
10-x012PMA010M7-P849A29x
 datasheet

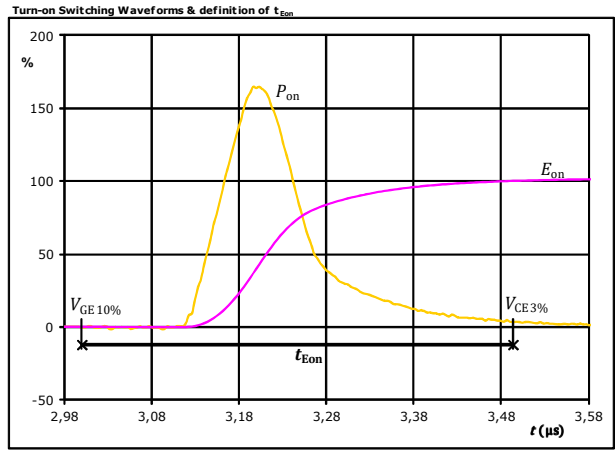
Inverter Switching Characteristics

figure 5. IGBT



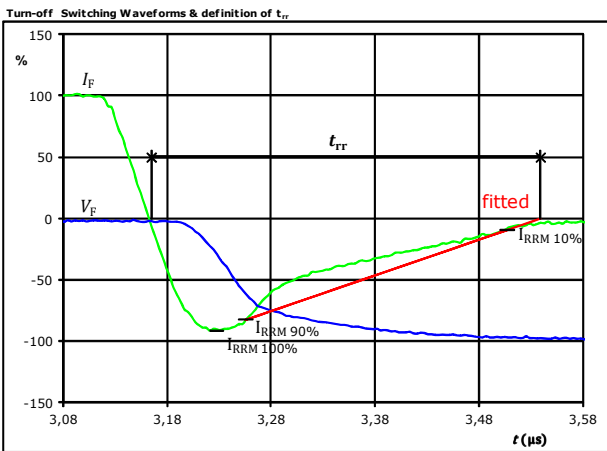
$P_{off}(100\%) = 6,02$ kW
 $E_{off}(100\%) = 0,86$ mJ
 $t_{Eoff} = 0,74$ µs

figure 6. IGBT



$P_{on}(100\%) = 6,02$ kW
 $E_{on}(100\%) = 1,13$ mJ
 $t_{Eon} = 0,49$ µs

figure 7. FWD

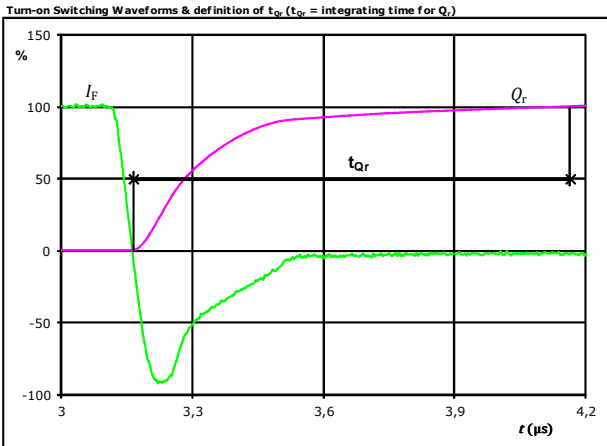


$V_F(100\%) = 600$ V
 $I_F(100\%) = 10$ A
 $I_{RRM}(100\%) = -9$ A
 $t_{rr} = 0,373$ µs



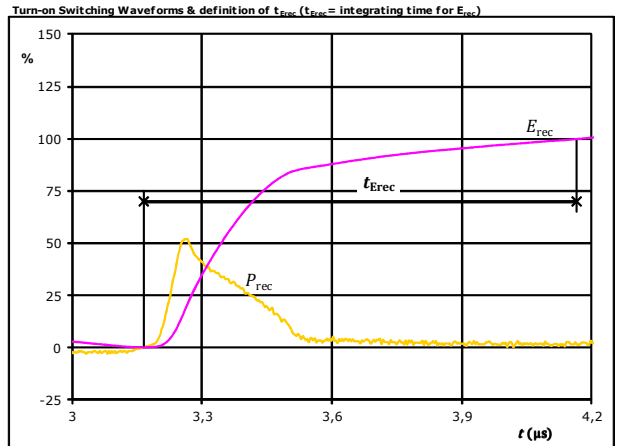
Inverter Switching Characteristics

figure 8. FWD



I_F (100%) =	10	A
Q_r (100%) =	1,66	μC
t_{Qr} =	1,00	μs

figure 9. FWD

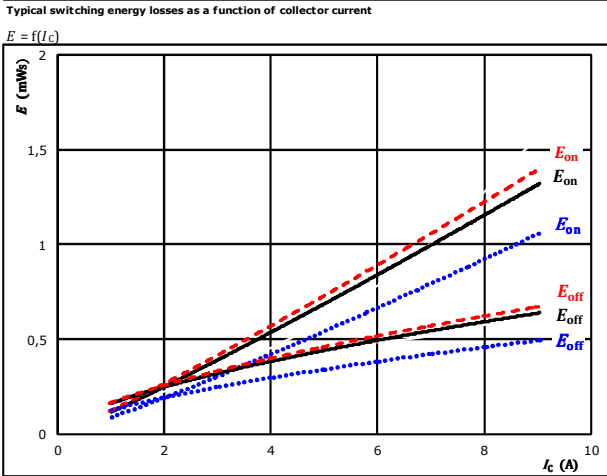


P_{rec} (100%) =	6,02	kW
E_{rec} (100%) =	0,62	mJ
t_{Erec} =	1,00	μs



Brake Switching Characteristics

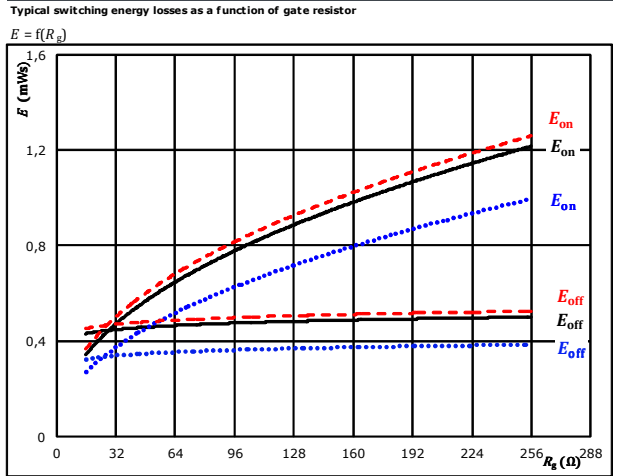
figure 1. IGBT
 Typical switching energy losses as a function of collector current



With an inductive load at
 $V_{CE} = 600$ V
 $V_{GE} = 15/0$ V
 $R_{g\text{on}} = 64$ Ω
 $R_{g\text{off}} = 64$ Ω

T_j : 25 °C (dotted blue)
 125 °C (solid black)
 150 °C (dashed red)

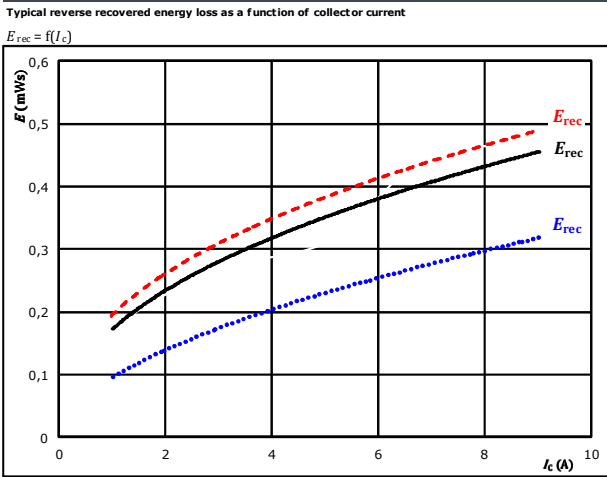
figure 2. IGBT
 Typical switching energy losses as a function of gate resistor



With an inductive load at
 $V_{CE} = 600$ V
 $V_{GE} = 15/0$ V
 $I_C = 5$ A

T_j : 25 °C (dotted blue)
 125 °C (solid black)
 150 °C (dashed red)

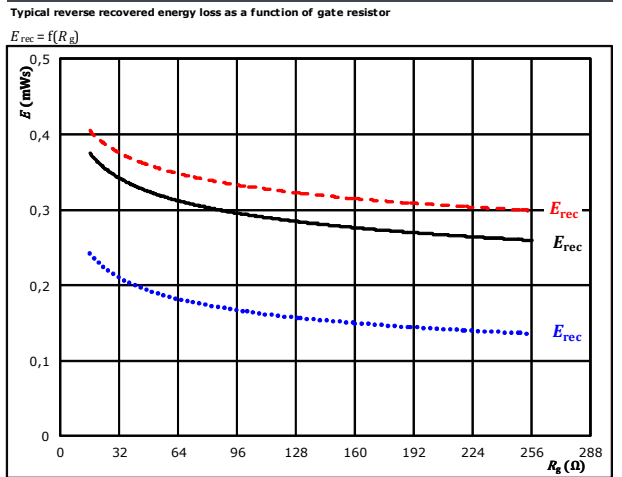
figure 3. FWD
 Typical reverse recovered energy loss as a function of collector current



With an inductive load at
 $V_{CE} = 600$ V
 $V_{GE} = 15/0$ V
 $R_{g\text{on}} = 64$ Ω

T_j : 25 °C (dotted blue)
 125 °C (solid black)
 150 °C (dashed red)

figure 4. FWD
 Typical reverse recovered energy loss as a function of gate resistor



With an inductive load at
 $V_{CE} = 600$ V
 $V_{GE} = 15/0$ V
 $I_C = 5$ A

T_j : 25 °C (dotted blue)
 125 °C (solid black)
 150 °C (dashed red)

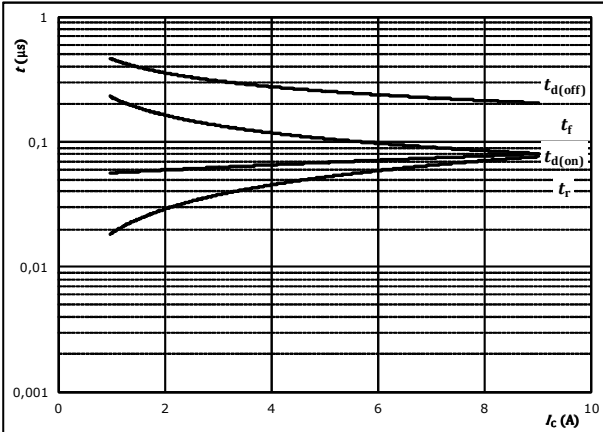


Brake Switching Characteristics

figure 5. IGBT

Typical switching times as a function of collector current

$$t = f(I_C)$$



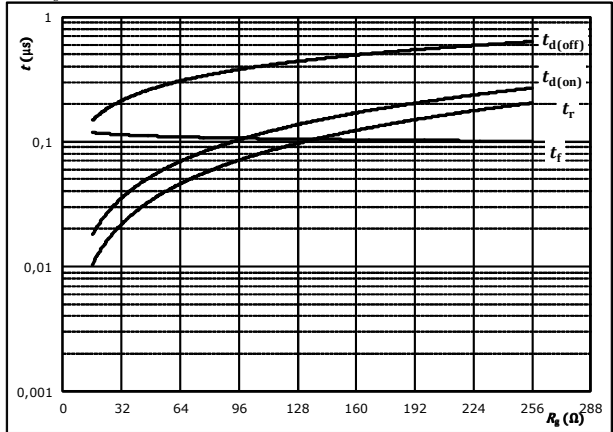
With an inductive load at

$T_j =$	150	°C
$V_{CE} =$	600	V
$V_{GE} =$	15/0	V
$R_{gon} =$	64	Ω
$R_{goff} =$	64	Ω

figure 6. IGBT

Typical switching times as a function of gate resistor

$$t = f(R_g)$$



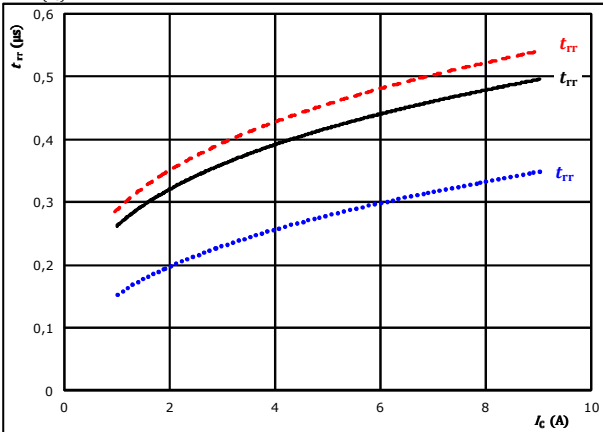
With an inductive load at

$T_j =$	150	°C
$V_{CE} =$	600	V
$V_{GE} =$	15/0	V
$I_C =$	5	A

figure 7. FWD

Typical reverse recovery time as a function of collector current

$$t_{rr} = f(I_C)$$

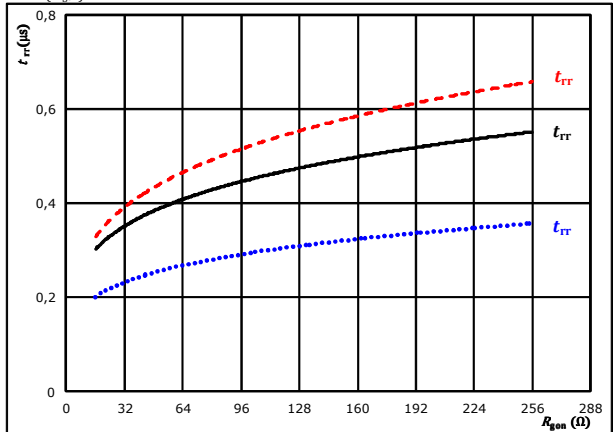


At	$V_{CE} =$	600	V	$T_j:$	25 °C
	$V_{GE} =$	15/0	V		125 °C	————
	$R_{gon} =$	64	Ω		150 °C	-----

figure 8. FWD

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

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



At	$V_{CE} =$	600	V	$T_j:$	25 °C
	$V_{GE} =$	15/0	V		125 °C	————
	$I_C =$	5	A		150 °C	-----

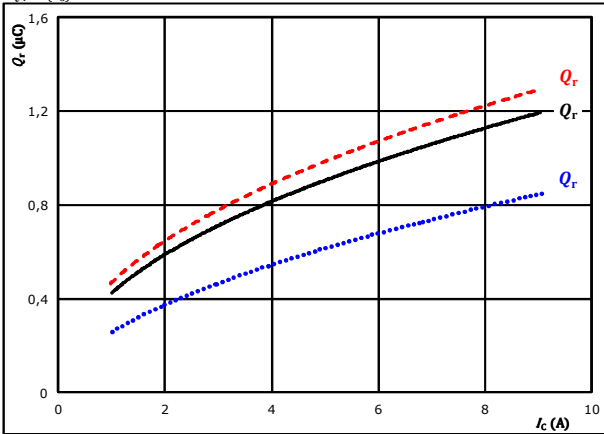


Brake Switching Characteristics

figure 9. FWD

Typical recovered charge as a function of collector current

$$Q_r = f(I_c)$$

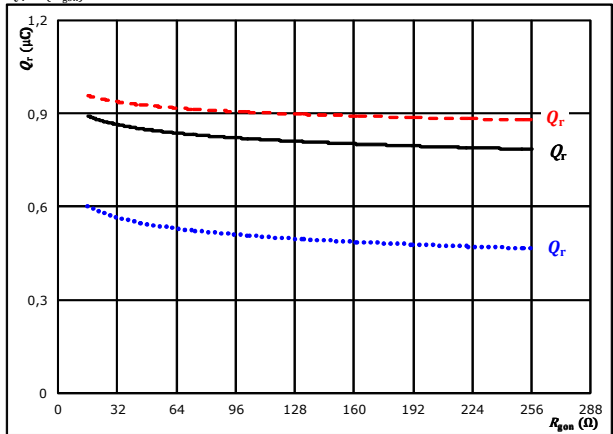


At $V_{CE} = 600$ V $T_j = 25$ °C
 $V_{GE} = 15/0$ V $T_j = 125$ °C ———
 $R_{gdn} = 64$ Ω $T_j = 150$ °C - - - -

figure 10. FWD

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

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

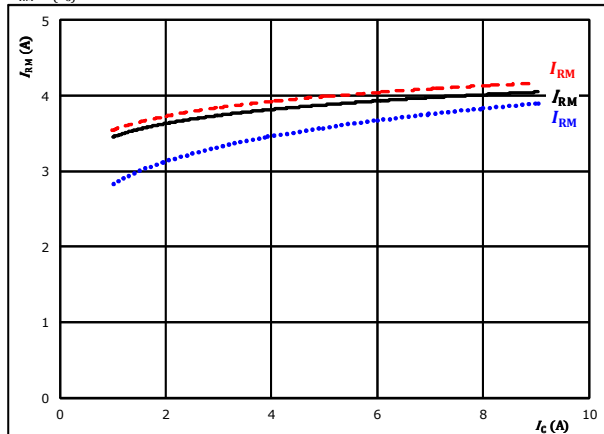


At $V_{CE} = 600$ V $T_j = 25$ °C
 $V_{GE} = 15/0$ V $T_j = 125$ °C ———
 $I_c = 5$ A $T_j = 150$ °C - - - -

figure 11. FWD

Typical peak reverse recovery current current as a function of collector current

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

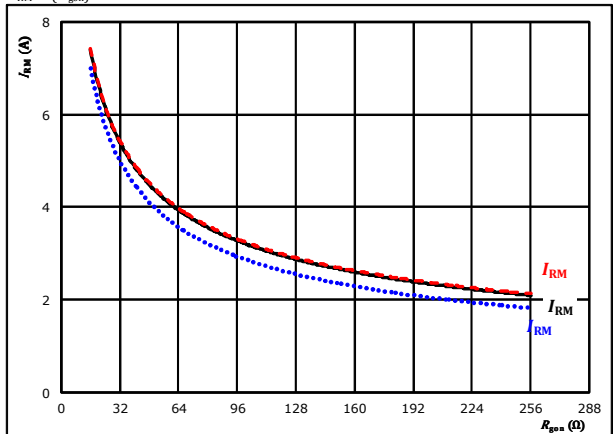


At $V_{CE} = 600$ V $T_j = 25$ °C
 $V_{GE} = 15/0$ V $T_j = 125$ °C ———
 $R_{gdn} = 64$ Ω $T_j = 150$ °C - - - -

figure 12. FWD

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

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



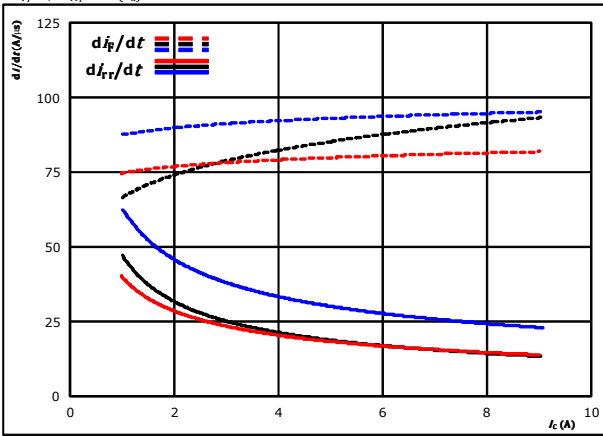
At $V_{CE} = 600$ V $T_j = 25$ °C
 $V_{GE} = 15/0$ V $T_j = 125$ °C ———
 $I_c = 5$ A $T_j = 150$ °C - - - -



Brake Switching Characteristics

figure 13. FWD

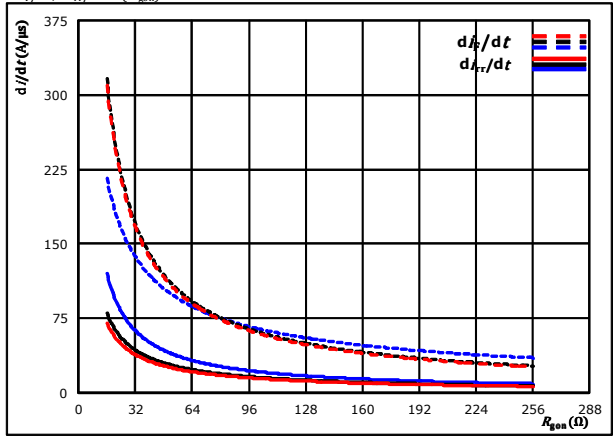
Typical rate of fall of forward and reverse recovery current as a function of collector current
 $di_f/dt, di_{rr}/dt = f(I_c)$



At $V_{CE} = 600$ V $T_j = 25$ °C
 $V_{GE} = 15/0$ V $T_j = 125$ °C ———
 $R_{g0n} = 64$ Ω $T_j = 150$ °C - - - - -

figure 14. FWD

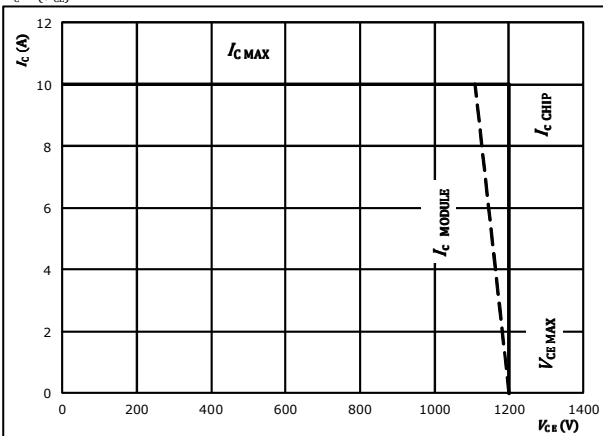
Typical rate of fall of forward and reverse recovery current as a function of IGBT turn on gate resistor
 $di_f/dt, di_{rr}/dt = f(R_{g0n})$



At $V_{CE} = 600$ V $T_j = 25$ °C
 $V_{GE} = 15/0$ V $T_j = 125$ °C ———
 $I_c = 5$ A $T_j = 150$ °C - - - - -

figure 15. IGBT

Reverse bias safe operating area
 $I_c = f(V_{CB})$



At $T_j = 175$ °C
 $R_{g0n} = 64$ Ω
 $R_{g0ff} = 64$ Ω



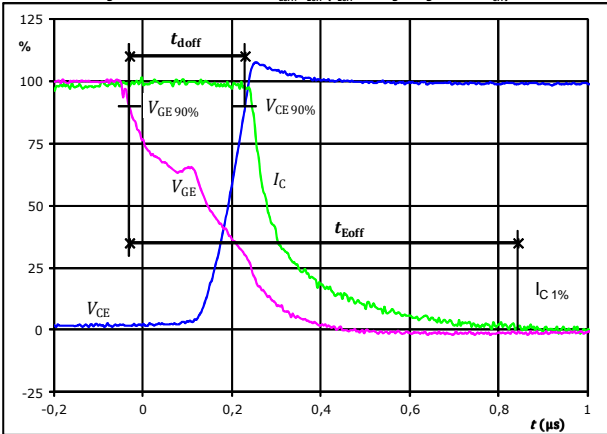
Brake Switching Definitions

General conditions

T_j	=	125 °C
R_{gon}	=	64 Ω
R_{goff}	=	64 Ω

figure 1. IGBT

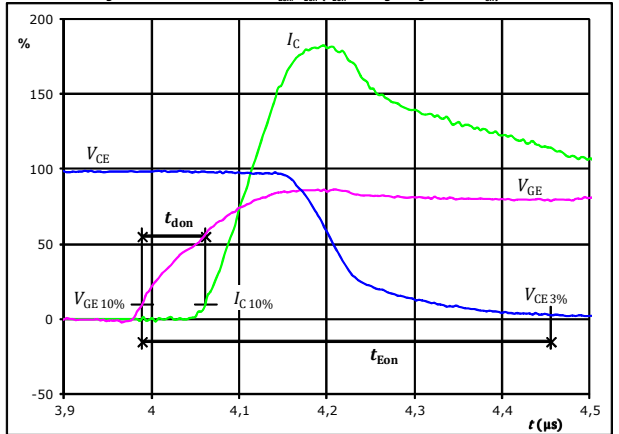
Turn-off Switching Waveforms & definition of t_{doff} , t_{Eoff} (t_{Eoff} = integrating time for E_{off})



$V_{GE}(0\%) =$	0	V
$V_{GE}(100\%) =$	15	V
$V_C(100\%) =$	600	V
$I_C(100\%) =$	5	A
$t_{doff} =$	0,262	μs
$t_{Eoff} =$	0,874	μs

figure 2. IGBT

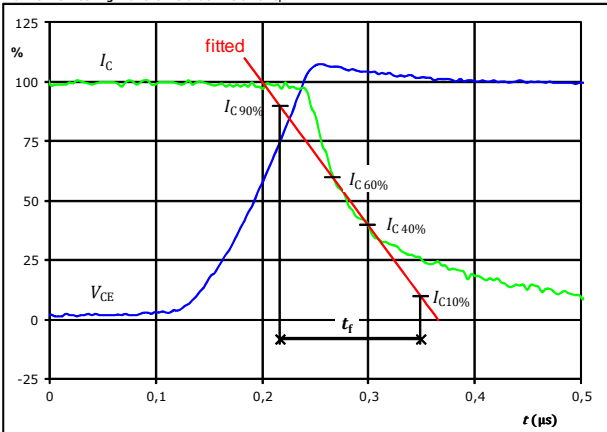
Turn-on Switching Waveforms & definition of t_{don} , t_{Eon} (t_{Eon} = integrating time for E_{on})



$V_{GE}(0\%) =$	0	V
$V_{GE}(100\%) =$	15	V
$V_C(100\%) =$	600	V
$I_C(100\%) =$	5	A
$t_{don} =$	0,073	μs
$t_{Eon} =$	0,467	μs

figure 3. IGBT

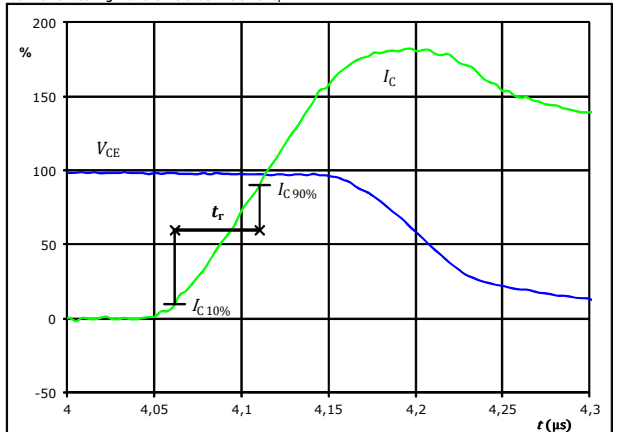
Turn-off Switching Waveforms & definition of t_f



$V_C(100\%) =$	600	V
$I_C(100\%) =$	5	A
$t_f =$	0,114	μs

figure 4. IGBT

Turn-on Switching Waveforms & definition of t_r



$V_C(100\%) =$	600	V
$I_C(100\%) =$	5	A
$t_r =$	0,048	μs

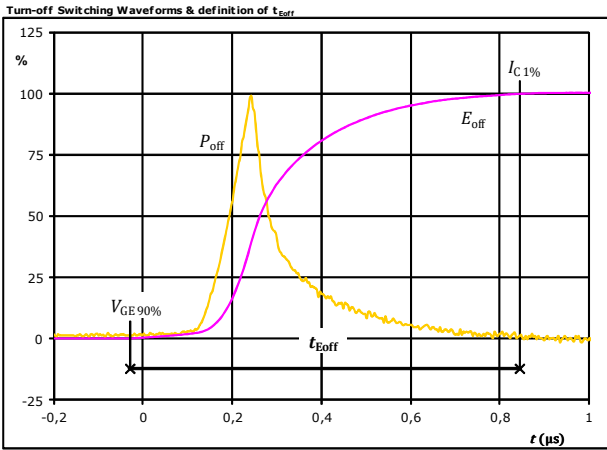


Vincotech

10-xZ12PMA010M7-P849A28x
10-x012PMA010M7-P849A29x
 datasheet

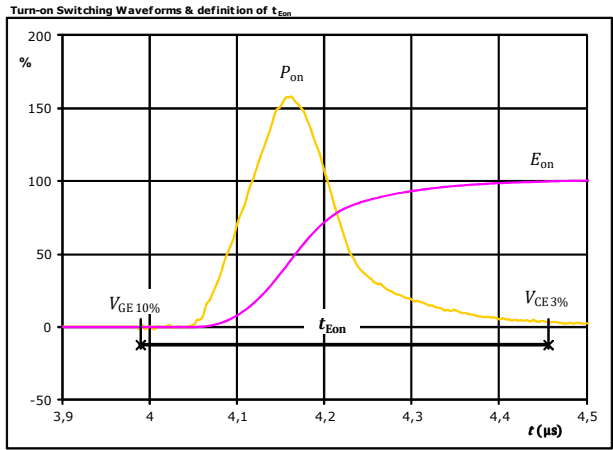
Brake Switching Characteristics

figure 5. IGBT



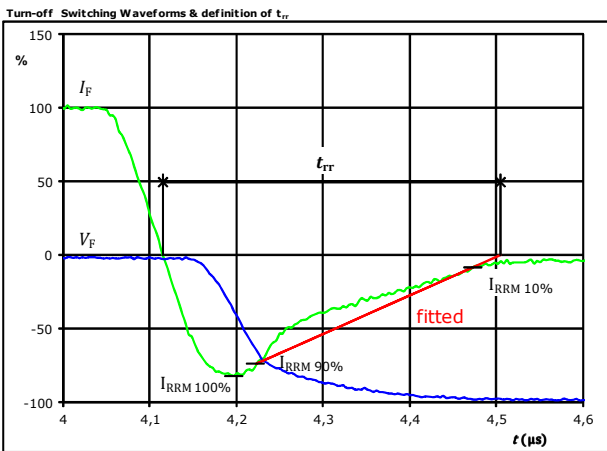
$P_{\text{off}}(100\%) = 3,03$ kW
 $E_{\text{off}}(100\%) = 0,45$ mJ
 $t_{\text{Eoff}} = 0,87$ μs

figure 6. IGBT



$P_{\text{on}}(100\%) = 3,03$ kW
 $E_{\text{on}}(100\%) = 0,61$ mJ
 $t_{\text{Eon}} = 0,47$ μs

figure 7. FWD

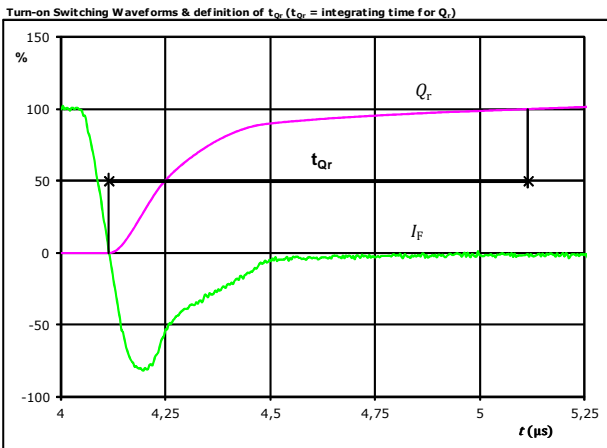


$V_{\text{F}}(100\%) = 600$ V
 $I_{\text{F}}(100\%) = 5$ A
 $I_{\text{RRM}}(100\%) = -4$ A
 $t_{\text{rr}} = 0,386$ μs



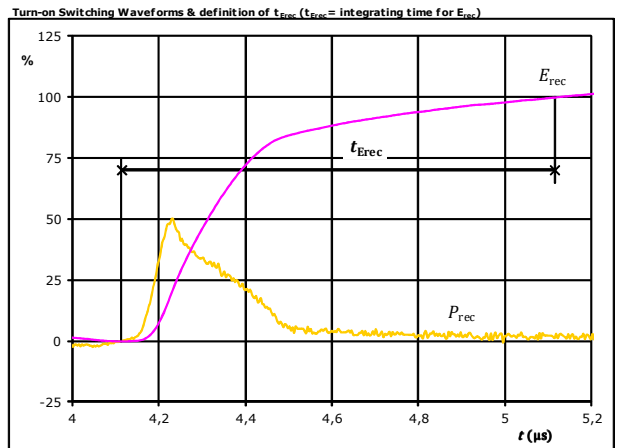
Brake Switching Characteristics

figure 8. FWD



I_F (100%) =	5	A
Q_r (100%) =	0,83	μC
t_{Qr} =	1,00	μs

figure 9. FWD



P_{rec} (100%) =	3,03	kW
E_{rec} (100%) =	0,31	mJ
t_{Erec} =	1,00	μs



10-xZ12PMA010M7-P849A28x
10-xO12PMA010M7-P849A29x
 datasheet

Vincotech

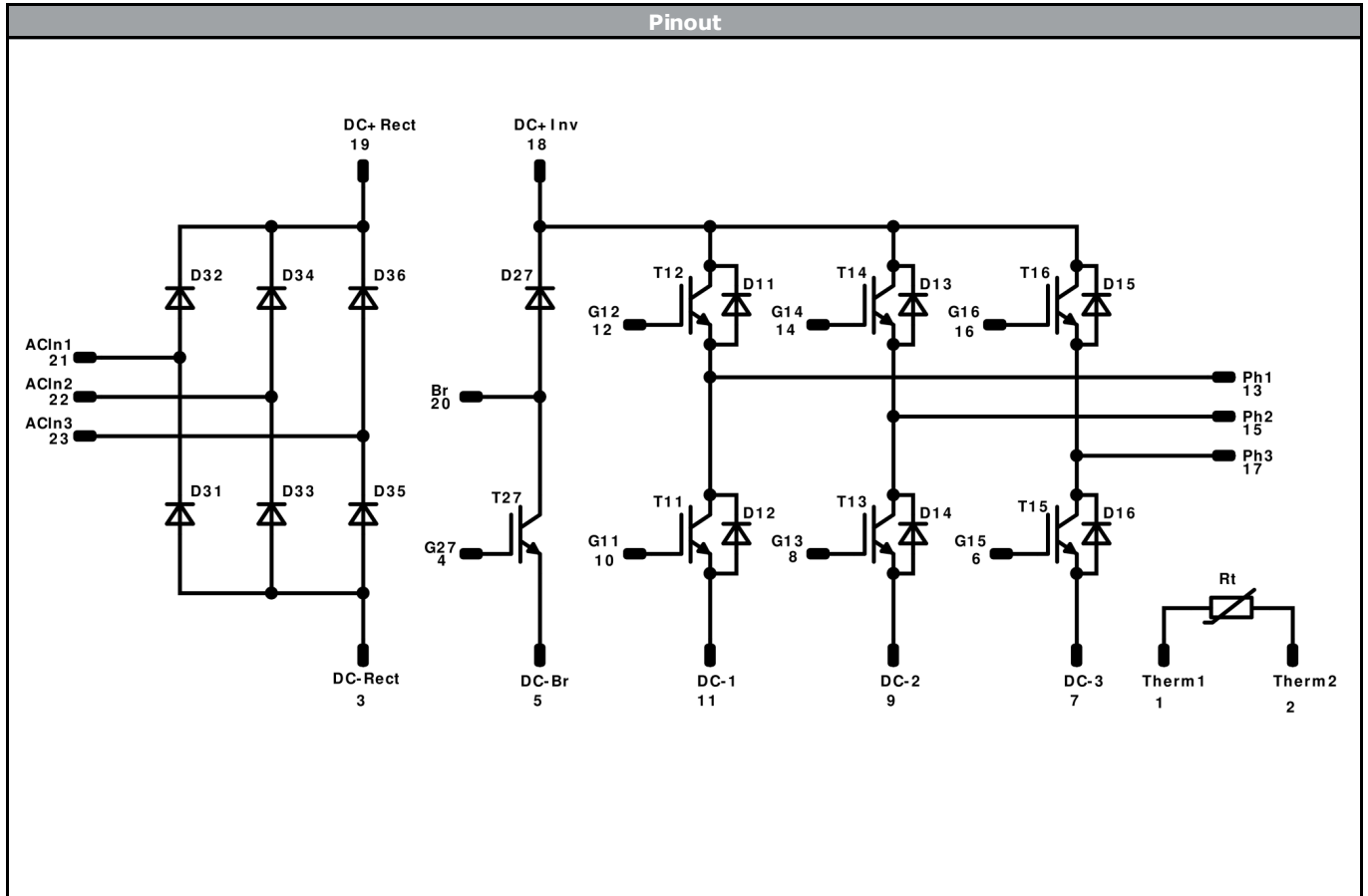
Ordering Code & Marking								
Version			Ordering Code					
without thermal paste 12 mm housing with solder pins			10-FZ12PMA010M7-P849A28					
with thermal paste 12 mm housing with solder pins			10-FZ12PMA010M7-P849A28-/3/					
without thermal paste 17 mm housing with solder pins			10-F012PMA010M7-P849A29					
with thermal paste 17 mm housing with solder pins			10-F012PMA010M7-P849A29-/3/					
without thermal paste 12 mm housing with Press-fit pins			10-PZ12PMA010M7-P849A28Y					
with thermal paste 12 mm housing with Press-fit pins			10-PZ12PMA010M7-P849A28Y-/3/					
without thermal paste 17 mm housing with Press-fit pins			10-P012PMA010M7-P849A29Y					
with thermal paste 17 mm housing with Press-fit pins			10-P012PMA010M7-P849A29Y-/3/					
NN-NNNNNNNNNNNN TTTTIV WWY UL VIN LLLLL SSSS			Text	Name	Date code	UL & VIN	Lot	Serial
			Datamatrix	NN-NNNNNNNNNNNN-TTTTIV	WWYY	UL VIN	LLLLL	SSSS
				Type&Ver TTTTIV	Lot number LLLLL	Serial SSSS	Date code WWYY	

Pin table				Outline	
Pin	X	Y	Function		
1	25,5	2,7	Therm1	P849A28	
2	25,5	0	Therm2		
3	22,8	0	DC-Rect		
4	20,1	0	G27		
5	16,2	0	DC-Br		
6	13,5	0	G15		
7	10,8	0	DC-3	P849A29	
8	8,1	0	G13		
9	5,4	0	DC-2		
10	2,7	0	G11	P849A28Y	
11	0	0	DC-1		
12	0	19,8	G12		
13	0	22,5	Ph1		
14	7,5	19,8	G14		
15	7,5	22,5	Ph2		
16	15	19,8	G16		
17	15	22,5	Ph3		
18	22,8	22,5	DC+Inv		
19	25,5	22,5	DC+Rect		
20	33,5	22,5	Br	P849A29Y	
21	33,5	15	ACIn1		
22	33,5	7,5	ACIn2		
23	33,5	0	ACIn3		

Tolerance of pin positions: ±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
D31, D32, D33, D34, D35, D36	Rectifier	1600 V	25 A	Rectifier Diode	
T11, T12, T13, T14, T15, T16	IGBT	1200 V	10 A	Inverter Switch	
D11, D12, D13, D14, D15, D16	FWD	1200 V	10 A	Inverter Diode	
T27	IGBT	1200 V	5 A	Brake Switch	
D27	FWD	1200 V	5 A	Brake Diode	
Rt	NTC			Thermistor	



Packaging instruction			
Standard packaging quantity (SPQ) 135	>SPQ	Standard	<SPQ Sample

Handling instruction
Handling instructions for <i>flow 0</i> packages see vincotech.com website.

Package data
Package data for <i>flow 0</i> packages see 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-xx12PMA010M7-P849A2xx-D3-14	11 Jan. 2019	Added thermal paste options to ordering code section	30

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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.