



flowPIM 1

1200 V / 40 A

Topology features

- Kelvin Emitter for improved switching performance
- Open Emitter configuration
- Temperature sensor
- Converter+Brake+Inverter

Component features

- Easy paralleling
- High speed switching
- Low switching losses

Housing features

- Base isolation: Al₂O₃
- Convex shaped substrate for superior thermal contact
- Thermo-mechanical push-and-pull force relief
- Press-fit pin
- Reliable cold welding connection

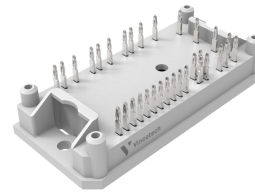
Target applications

- Embedded Drives
- Industrial Drives

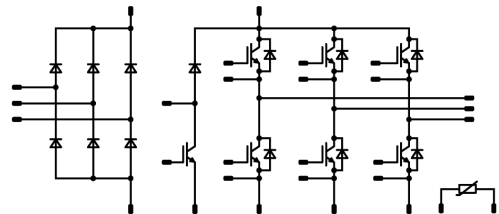
Types

- 10-P112PMA040SH02-P580A82Y

flow 1 17 mm housing



Schematic





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Maximum Ratings

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

Parameter	Symbol	Conditions	Value	Unit
Inverter Switch				
Collector-emitter voltage	V_{CES}		1200	V
Collector current (DC current)	I_C	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	46	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	120	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	110	W
Gate-emitter voltage	V_{GES}		± 20	V
Short circuit ratings	t_{SC}	$V_{GE} = 15\text{ V}$, $V_{CC} = 800\text{ V}$ $T_j = 150\text{ °C}$	10	μs
Maximum junction temperature	T_{jmax}		175	$^{\circ}\text{C}$

Inverter Diode				
Peak repetitive reverse voltage	V_{RRM}		1200	V
Forward current (DC current)	I_F	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	42	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}	70	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	81	W
Maximum junction temperature	T_{jmax}		175	$^{\circ}\text{C}$

Brake Switch				
Collector-emitter voltage	V_{CES}		1200	V
Collector current (DC current)	I_C	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	30	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	75	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	82	W
Gate-emitter voltage	V_{GES}		± 20	V
Short circuit ratings	t_{SC}	$V_{GE} = 15\text{ V}$, $V_{CC} = 800\text{ V}$ $T_j = 150\text{ °C}$	10	μs
Maximum junction temperature	T_{jmax}		175	$^{\circ}\text{C}$



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Maximum Ratings

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

Parameter	Symbol	Conditions	Value	Unit
Brake 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 ⁽¹⁾	A
Repetitive peak forward current	I_{FRM}	I_p limited by T_{jmax}	20	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	37	W
Maximum junction temperature	T_{jmax}		175	°C

⁽¹⁾ limited by I_{FRM}

Rectifier Diode

Peak repetitive reverse voltage	V_{RRM}		1600	V
Forward current (DC current)	I_F	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	38	A
Surge (non-repetitive) forward current	I_{FSM}	Single Half Sine Wave, $t_p = 10\text{ ms}$ $T_j = 150\text{ °C}$	270	A
Surge current capability	I^2t		370	A ² s
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	47	W
Maximum junction temperature	T_{jmax}		150	°C

Module Properties

Thermal Properties

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

Isolation Properties

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

*100 % tested in production



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Characteristic Values

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

Inverter Switch

Static

Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,0015	25	5,3	5,8	6,3	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		40	25 125 150	1,78	1,82 2,1	2,42 ⁽²⁾	V
Collector-emitter cut-off current	I_{CES}		0	1200		25			5	μA
Gate-emitter leakage current	I_{GES}		20	0		25			120	nA
Internal gate resistance	r_g							None		Ω
Input capacitance	C_{ies}							2330		pF
Output capacitance	C_{oes}	$f = 1$ Mhz	0	25		25		150		pF
Reverse transfer capacitance	C_{res}							130		pF
Gate charge	Q_g	$V_{CC} = 960$ V	15		40	25		185		nC

Thermal

Thermal resistance junction to sink ⁽³⁾	$R_{th(j-s)}$	$\lambda_{paste} = 5,2$ W/mK (PTM)						0,86		K/W
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Dynamic

Turn-on delay time	$t_{d(on)}$					25 125 150		70,33 70,87 71,61		ns
Rise time	t_r					25 125 150		17,72 20,21 20,48		ns
Turn-off delay time	$t_{d(off)}$					25 125 150		163,63 213,5 225,03		ns
Fall time	t_f					25 125 150		37,64 66,82 79,21		ns
Turn-on energy (per pulse)	E_{on}	$Q_{tFWD} = 2,95$ μC $Q_{tFWD} = 5,3$ μC $Q_{tFWD} = 6,1$ μC				25 125 150		1,24 1,95 2,16		mWs
Turn-off energy (per pulse)	E_{off}					25 125 150		1,49 2,36 2,53		mWs



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Characteristic Values

Parameter	Symbol	Conditions					Values			Unit				
		V_{GE} [V] V_{GS} [V]	V_{CE} [V] V_{DS} [V] V_F [V]	I_C [A] I_D [A] I_F [A]	T_j [°C]	Min	Typ	Max						
Inverter Diode														
Static														
Forward voltage	V_F				35	25 150	1,35	1,79 1,76	2,05 ⁽²⁾	V				
Reverse leakage current	I_R	$V_r = 1200$ V				25			7,7	μA				
Thermal														
Thermal resistance junction to sink ⁽³⁾	$R_{th(j-s)}$	$\lambda_{paste} = 5,2$ W/mK (PTM)						1,17		K/W				
Dynamic														
Peak recovery current	I_{RM}	$di/dt=3148$ A/μs $di/dt=2856$ A/μs $di/dt=2920$ A/μs	±15	600	40	25		69,26		A				
						125		82,81						
						150		86,53						
Reverse recovery time	t_{rr}									25		231,8		ns
										125		345,56		
										150		390,03		
Recovered charge	Q_r					25		2,95		μC				
						125		5,3						
						150		6,1						
Reverse recovered energy	E_{rec}					25		1,3		mWs				
						125		2,34						
						150		2,7						
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$					25		3665,54		A/μs				
						125		2834,98						
						150		2802,98						



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Characteristic Values

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

Brake Switch

Static

Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,00085	25	5,3	5,8	6,3	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		25	25 150	1,58	1,87 2,31	2,07 ⁽²⁾	V
Collector-emitter cut-off current	I_{CES}		0	1200		25			2,4	μA
Gate-emitter leakage current	I_{GES}		20	0		25			120	nA
Internal gate resistance	r_g							None		Ω
Input capacitance	C_{ies}	$f = 1 \text{ Mhz}$	0	25		25		1450		pF
Reverse transfer capacitance	C_{res}									
Gate charge	Q_g		±15		0	25		200		nC

Thermal

Thermal resistance junction to sink ⁽³⁾	$R_{th(j-s)}$	$\lambda_{paste} = 5,2 \text{ W/mK}$ (PTM)						1,16		K/W
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Dynamic

Turn-on delay time	$t_{d(on)}$	$R_{gon} = 32 \Omega$ $R_{goff} = 32 \Omega$	±15	600	25	25		126,6		ns
Rise time	t_r					150		128,8		ns
						25		36		ns
Turn-off delay time	$t_{d(off)}$					150		232		ns
						25		275,6		ns
Fall time	t_f					25		73,75		ns
						150		111,69		ns
Turn-on energy (per pulse)	E_{on}	$Q_{trFD} = 1,55 \mu\text{C}$			25		1,81		mWs	
		$Q_{trFD} = 3,03 \mu\text{C}$			150		2,42		mWs	
Turn-off energy (per pulse)	E_{off}				25		1,37		mWs	
					150		2,19		mWs	



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Characteristic Values

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

Brake Diode

Static

Forward voltage	V_F				10	25 150	1,35	1,85 1,77	2,05 ⁽²⁾	V
Reverse leakage current	I_R	$V_r = 1200$ V				25			2,7	μA

Thermal

Thermal resistance junction to sink ⁽³⁾	$R_{th(j-s)}$	$\lambda_{paste} = 5,2$ W/mK (PTM)						2,55		K/W
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Dynamic

Peak recovery current	I_{RM}	$di/dt=570$ A/μs $di/dt=504$ A/μs	±15	600	25	25		10,17		A
Reverse recovery time	t_{rr}					150		12,29		
						25		396,24		ns
Recovered charge	Q_r					150		624,1		
						25		1,55		μC
Reverse recovered energy	E_{rec}					150		3,03		
		25		0,631		mWs				
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$	150		1,3						
		25		35,97		A/μs				
						150		31,78		



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		

Rectifier Diode

Static

Forward voltage	V_F				28	25 125		1,15 1,1	1,5 ⁽²⁾	V
Reverse leakage current	I_R	$V_r = 1600$ V				25 150			100 1000	μA

Thermal

Thermal resistance junction to sink ⁽³⁾	$R_{th(j-s)}$	$\lambda_{paste} = 5,2$ W/mK (PTM)						1,49		K/W
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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	

⁽²⁾ Value at chip level

⁽³⁾ Only valid with pre-applied Vincotech thermal interface material.

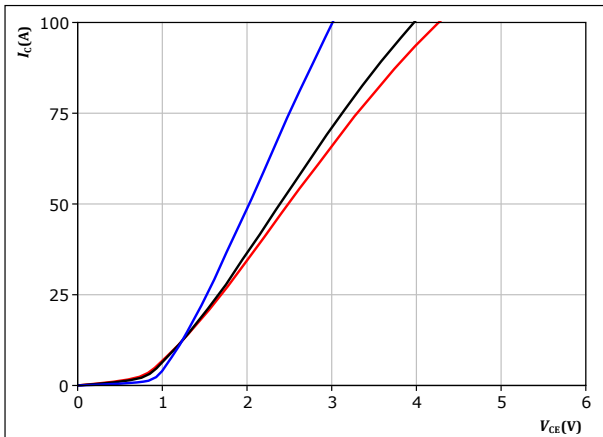


Inverter Switch Characteristics

figure 1. IGBT

Typical output characteristics

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

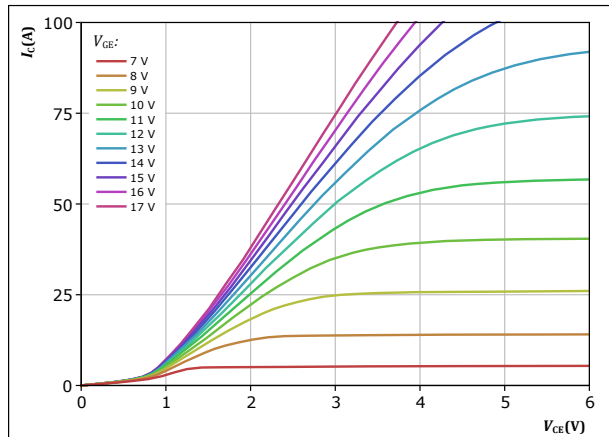


$t_p = 250 \mu s$
 $V_{GE} = 15 V$
 $T_j:$ — 25 °C
— 125 °C
— 150 °C

figure 2. IGBT

Typical output characteristics

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

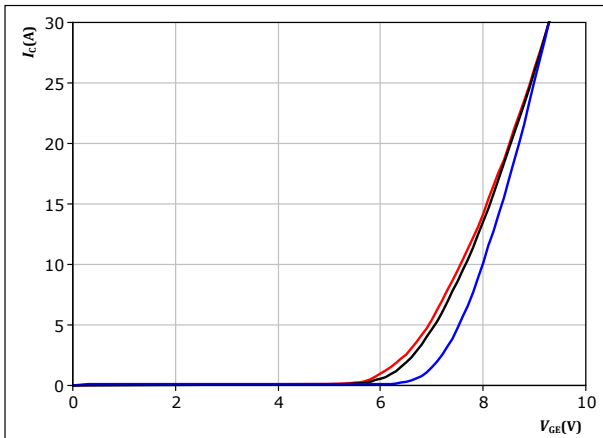


$t_p = 250 \mu s$
 $T_j = 150 \text{ °C}$
 V_{GE} from 7 V to 17 V in steps of 1 V

figure 3. IGBT

Typical transfer characteristics

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

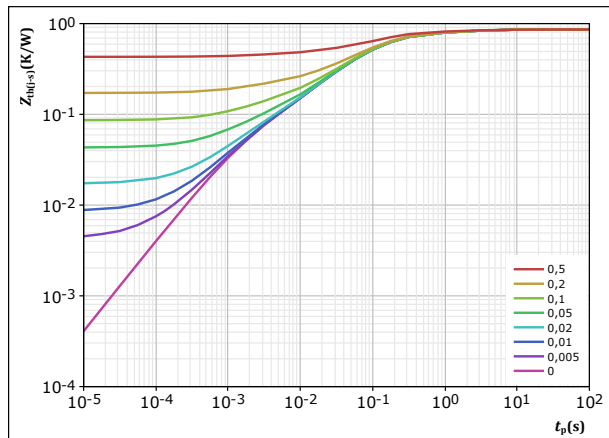


$t_p = 250 \mu s$
 $V_{CE} = 10 V$
 $T_j:$ — 25 °C
— 125 °C
— 150 °C

figure 4. IGBT

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$
 $R_{th(j-s)} = 0,86 \text{ K/W}$
IGBT thermal model values

R (K/W)	τ (s)
6,13E-02	3,19E+00
1,52E-01	4,78E-01
4,95E-01	8,87E-02
1,09E-01	1,55E-02
4,32E-02	1,55E-03



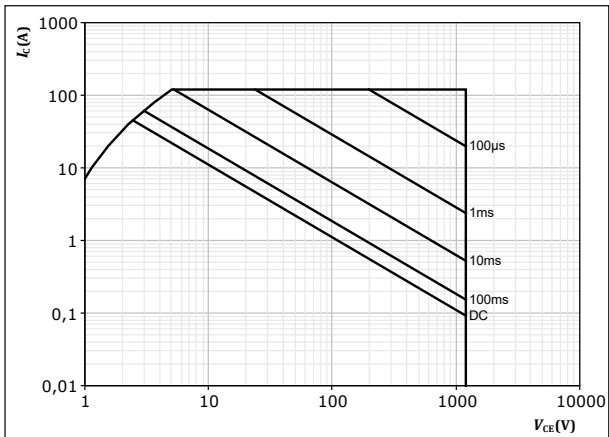
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Inverter Switch Characteristics

figure 5. IGBT

Safe operating area

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



$D =$ single pulse

$T_s = 80$ °C

$V_{CE} = 15$ V

$T_j = T_{jmax}$



Inverter Diode Characteristics

figure 6. FWD

Typical forward characteristics

$$I_F = f(V_F)$$

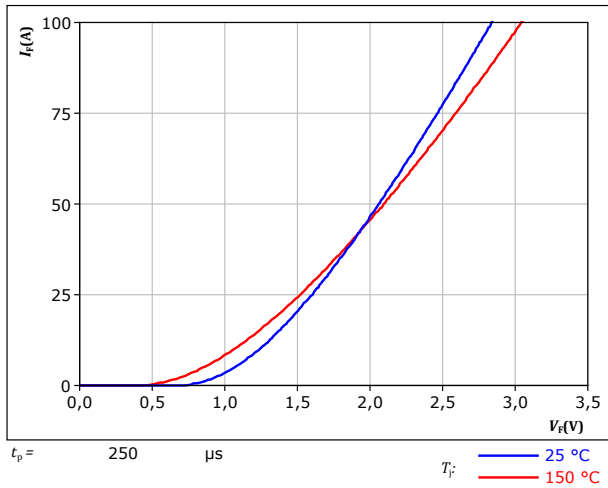
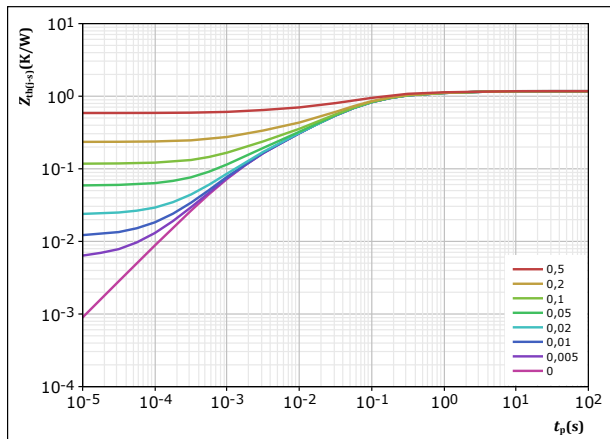


figure 7. FWD

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$

$R_{th(j-s)} = 1,173 \text{ K/W}$

FWD thermal model values

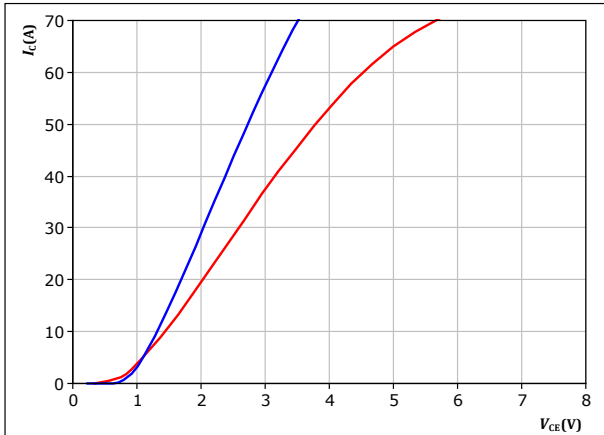
$R \text{ (K/W)}$	$\tau \text{ (s)}$
8,76E-02	2,44E+00
1,98E-01	2,84E-01
5,73E-01	6,48E-02
2,18E-01	1,20E-02
9,66E-02	1,55E-03



Brake Switch Characteristics

figure 8. IGBT

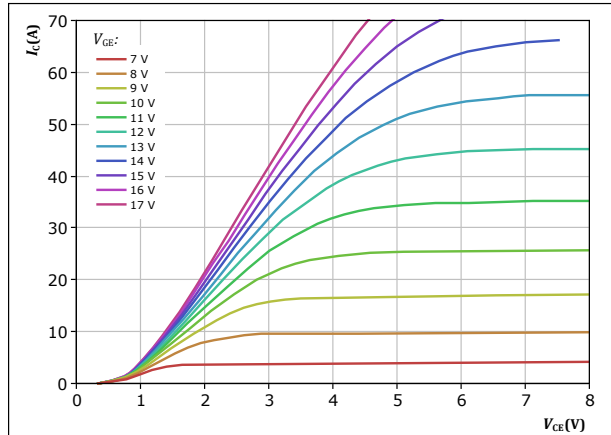
Typical output characteristics
 $I_C = f(V_{CE})$



$t_p = 250 \mu s$
 $V_{GE} = 15 V$
 $T_j: 25^\circ C$ (blue), $150^\circ C$ (red)

figure 9. IGBT

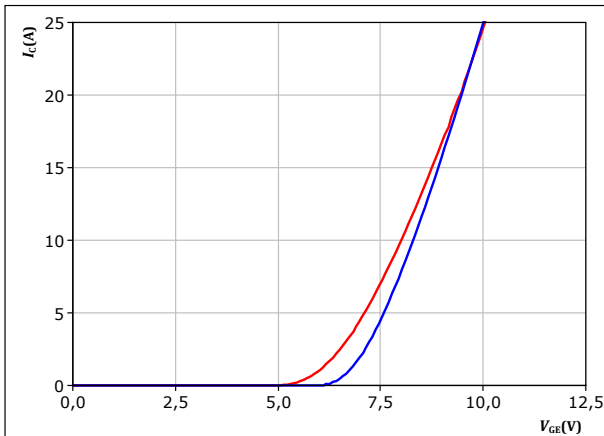
Typical output characteristics
 $I_C = f(V_{CE})$



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

figure 10. IGBT

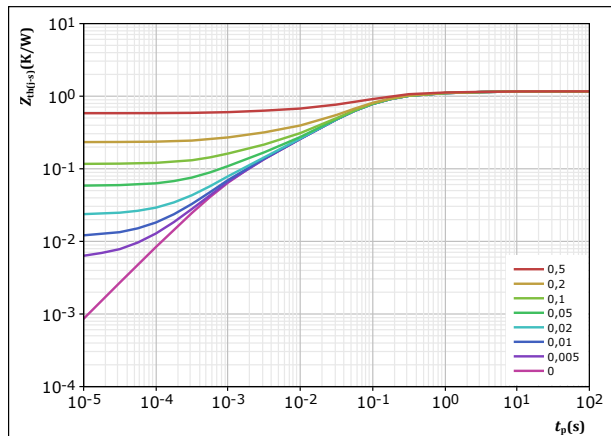
Typical transfer characteristics
 $I_C = f(V_{GE})$



$t_p = 250 \mu s$
 $V_{CE} = 10 V$
 $T_j: 25^\circ C$ (blue), $150^\circ C$ (red)

figure 11. IGBT

Transient thermal impedance as a function of pulse width
 $Z_{th(j-s)} = f(t_p)$



$D = t_p / T$
 $R_{th(j-s)} = 1,165 K/W$
IGBT thermal model values

R (K/W)	τ (s)
6,47E-02	3,29E+00
1,96E-01	3,79E-01
6,65E-01	7,32E-02
1,70E-01	1,15E-02
6,92E-02	1,12E-03

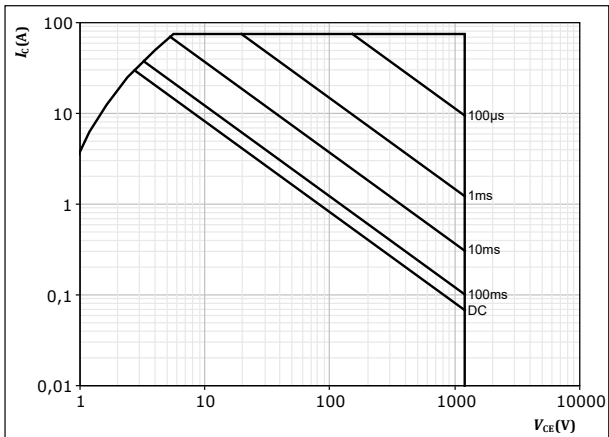


Brake Switch Characteristics

figure 12. IGBT

Safe operating area

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



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

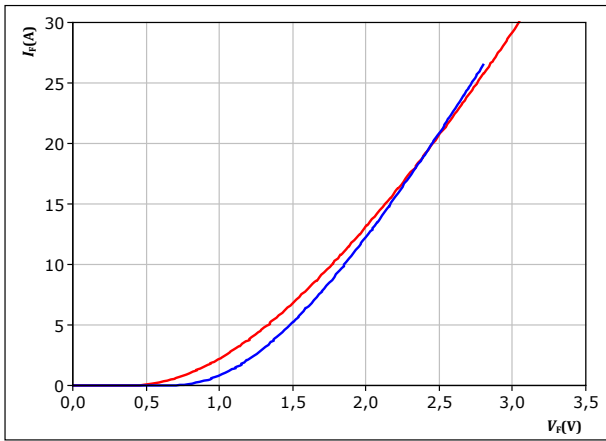


Brake Diode Characteristics

figure 13. FWD

Typical forward characteristics

$$I_F = f(V_F)$$

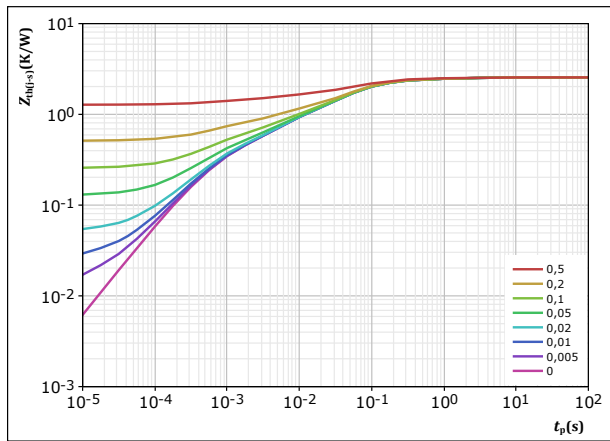


$t_p = 250 \mu s$
 T_j : — 25 °C
 — 150 °C

figure 14. FWD

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$
 $R_{th(j-s)} = 2,553 \text{ K/W}$
 FWD thermal model values

$R \text{ (K/W)}$	$\tau \text{ (s)}$
1,28E-01	2,23E+00
3,85E-01	1,97E-01
1,29E+00	5,02E-02
4,59E-01	5,44E-03
2,95E-01	5,79E-04



Rectifier Diode Characteristics

figure 15. Rectifier

Typical forward characteristics

$$I_F = f(V_F)$$

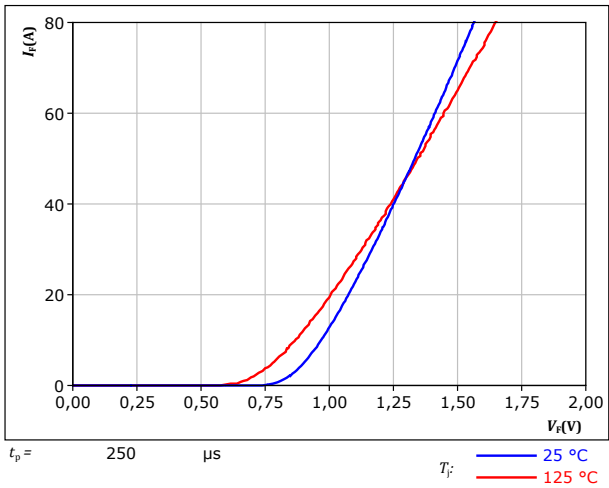
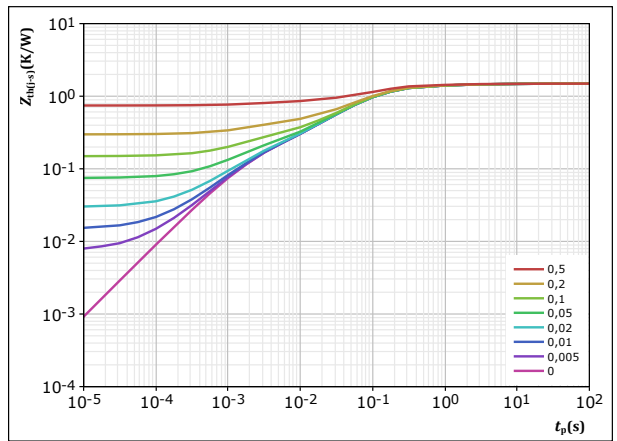


figure 16. Rectifier

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$

$R_{th(j-s)} = 1,49 \text{ K/W}$

Rectifier thermal model values

$R \text{ (K/W)}$	$\tau \text{ (s)}$
4,51E-02	7,48E+00
2,00E-01	6,61E-01
9,43E-01	8,82E-02
1,75E-01	1,86E-02
1,27E-01	1,77E-03

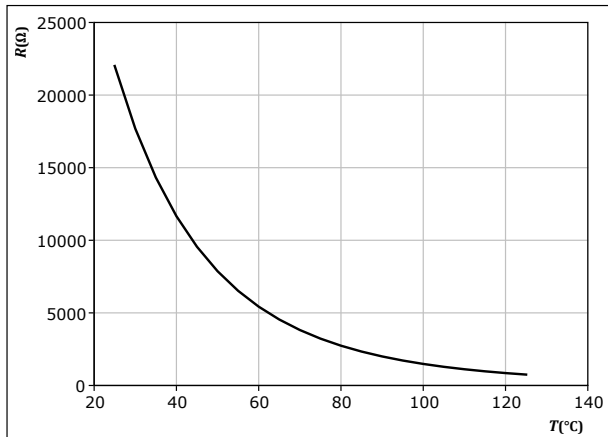


Thermistor Characteristics

figure 17. Thermistor

Typical NTC characteristic as function of temperature

$$R_T = f(T)$$

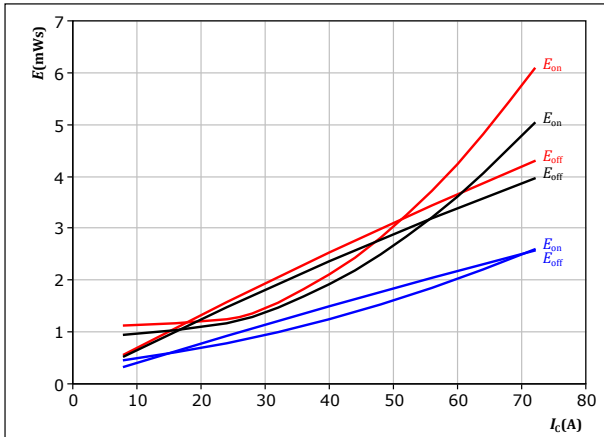




Inverter Switching Characteristics

figure 18. IGBT

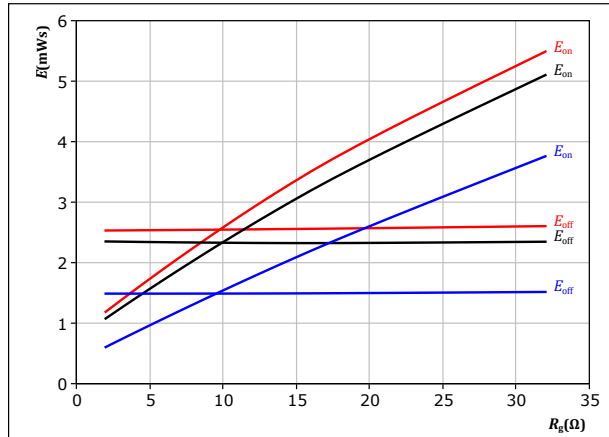
Typical switching energy losses as a function of collector current
 $E = f(I_c)$



With an inductive load at
 $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 8$ Ω
 $R_{goff} = 8$ Ω
 T_j : 25 °C, 125 °C, 150 °C

figure 19. IGBT

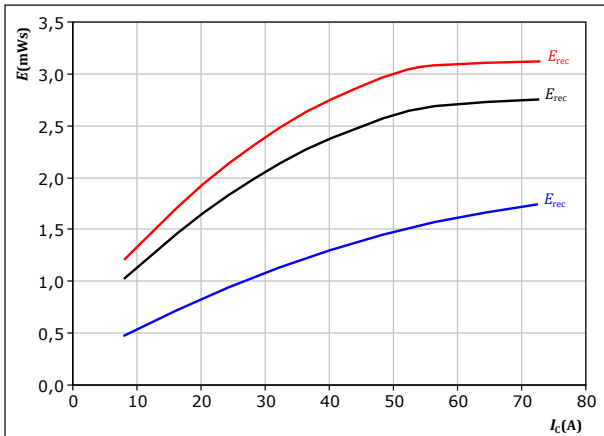
Typical switching energy losses as a function of IGBT turn on gate resistor
 $E = f(R_g)$



With an inductive load at
 $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $I_c = 40$ A
 T_j : 25 °C, 125 °C, 150 °C

figure 20. FWD

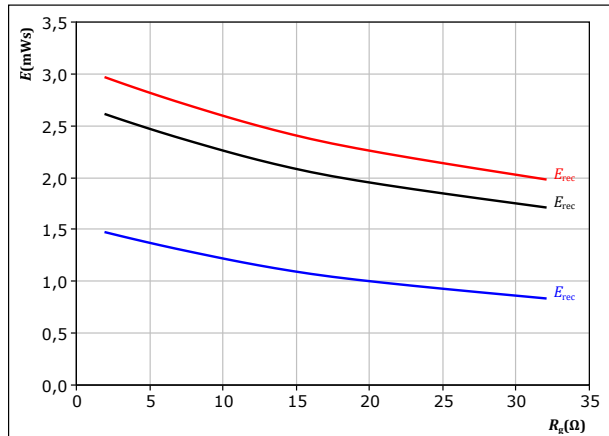
Typical reverse recovered energy loss as a function of collector current
 $E_{rec} = f(I_c)$



With an inductive load at
 $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 8$ 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
 $E_{rec} = f(R_g)$



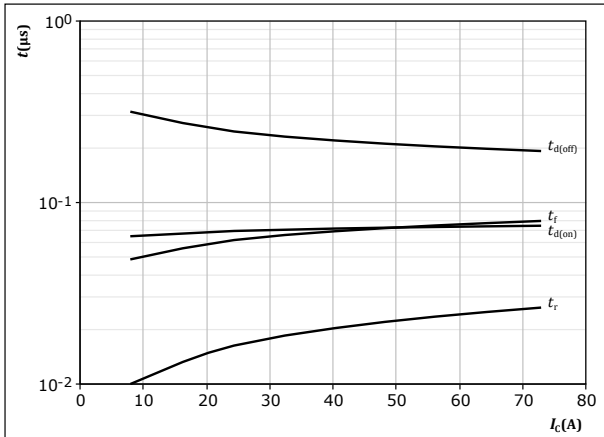
With an inductive load at
 $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $I_c = 40$ A
 T_j : 25 °C, 125 °C, 150 °C



Inverter Switching Characteristics

figure 22. IGBT

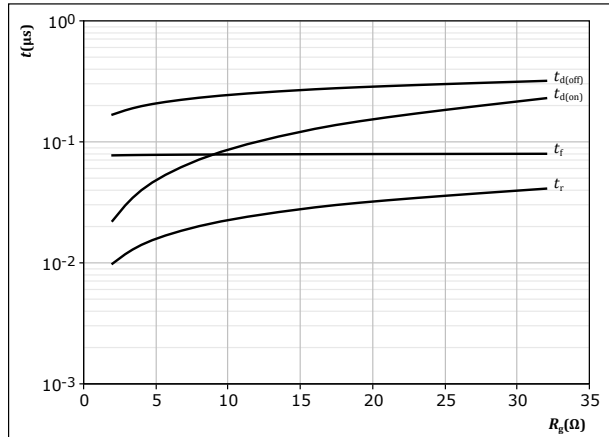
Typical switching times as a function of collector current
 $t = f(I_c)$



With an inductive load at
 $T_j = 150 \text{ }^\circ\text{C}$
 $V_{CE} = 600 \text{ V}$
 $V_{GE} = \pm 15 \text{ V}$
 $R_{gon} = 8 \text{ } \Omega$
 $R_{goff} = 8 \text{ } \Omega$

figure 23. IGBT

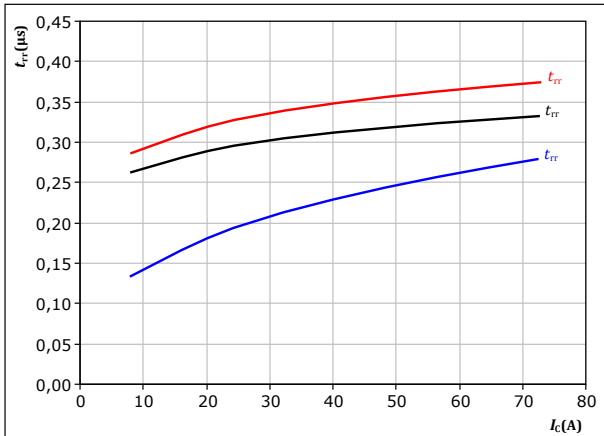
Typical switching times as a function of IGBT turn on gate resistor
 $t = f(R_g)$



With an inductive load at
 $T_j = 150 \text{ }^\circ\text{C}$
 $V_{CE} = 600 \text{ V}$
 $V_{GE} = \pm 15 \text{ V}$
 $I_c = 40 \text{ A}$

figure 24. FWD

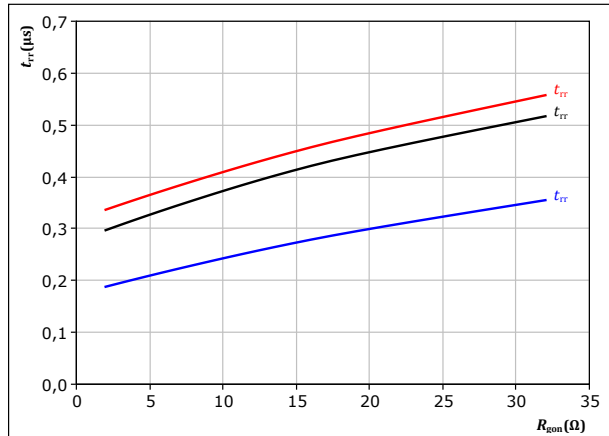
Typical reverse recovery time as a function of collector current
 $t_{rr} = f(I_c)$



With an inductive load at
 $V_{CE} = 600 \text{ V}$
 $V_{GE} = \pm 15 \text{ V}$
 $R_{gon} = 8 \text{ } \Omega$
 $T_j: \text{ } \text{---} 25 \text{ }^\circ\text{C}$
 $\text{---} 125 \text{ }^\circ\text{C}$
 $\text{---} 150 \text{ }^\circ\text{C}$

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
 $V_{CE} = 600 \text{ V}$
 $V_{GE} = \pm 15 \text{ V}$
 $I_c = 40 \text{ A}$
 $T_j: \text{ } \text{---} 25 \text{ }^\circ\text{C}$
 $\text{---} 125 \text{ }^\circ\text{C}$
 $\text{---} 150 \text{ }^\circ\text{C}$

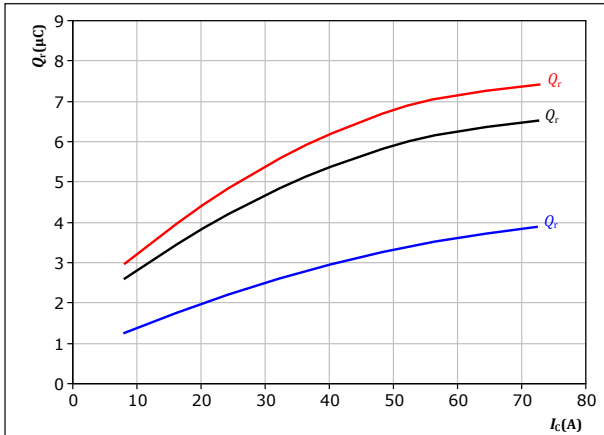


Inverter Switching Characteristics

figure 26. FWD

Typical recovered charge as a function of collector current

$$Q_r = f(I_c)$$



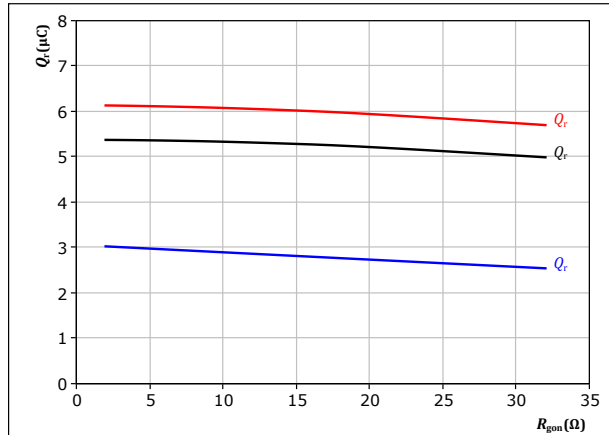
With an inductive load at

$V_{CE} = 600 \text{ V}$	$T_j: 25 \text{ }^\circ\text{C}$
$V_{GE} = \pm 15 \text{ V}$	$125 \text{ }^\circ\text{C}$
$R_{gon} = 8 \text{ } \Omega$	$150 \text{ }^\circ\text{C}$

figure 27. FWD

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

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



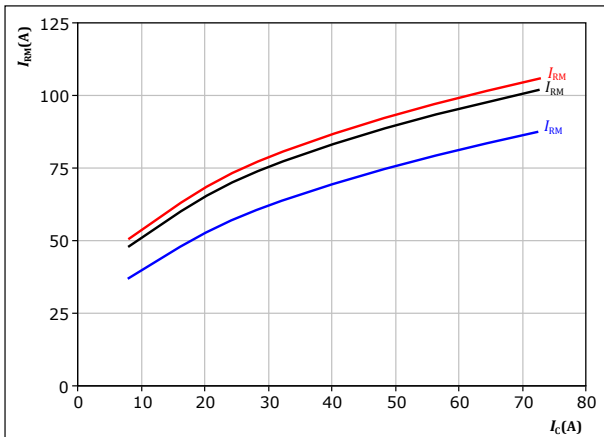
With an inductive load at

$V_{CE} = 600 \text{ V}$	$T_j: 25 \text{ }^\circ\text{C}$
$V_{GE} = \pm 15 \text{ V}$	$125 \text{ }^\circ\text{C}$
$I_c = 40 \text{ A}$	$150 \text{ }^\circ\text{C}$

figure 28. FWD

Typical peak reverse recovery current as a function of collector current

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



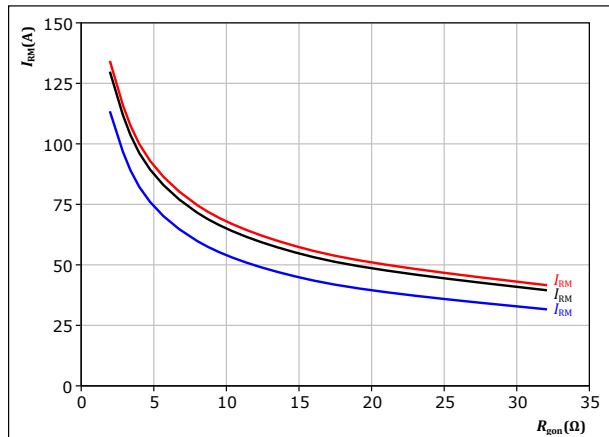
With an inductive load at

$V_{CE} = 600 \text{ V}$	$T_j: 25 \text{ }^\circ\text{C}$
$V_{GE} = \pm 15 \text{ V}$	$125 \text{ }^\circ\text{C}$
$R_{gon} = 8 \text{ } \Omega$	$150 \text{ }^\circ\text{C}$

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

$V_{CE} = 600 \text{ V}$	$T_j: 25 \text{ }^\circ\text{C}$
$V_{GE} = \pm 15 \text{ V}$	$125 \text{ }^\circ\text{C}$
$I_c = 40 \text{ A}$	$150 \text{ }^\circ\text{C}$

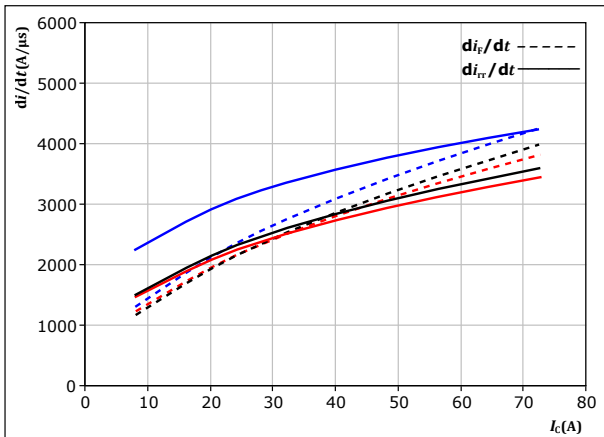


Vincotech

Inverter Switching Characteristics

figure 30. FWD

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



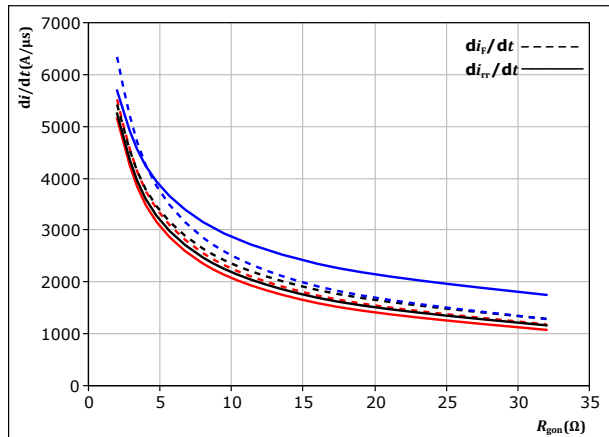
With an inductive load at

$V_{CE} = 600 \text{ V}$
 $V_{GE} = \pm 15 \text{ V}$
 $R_{gon} = 8 \text{ } \Omega$

T_j : — 25 °C
 — 125 °C
 — 150 °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

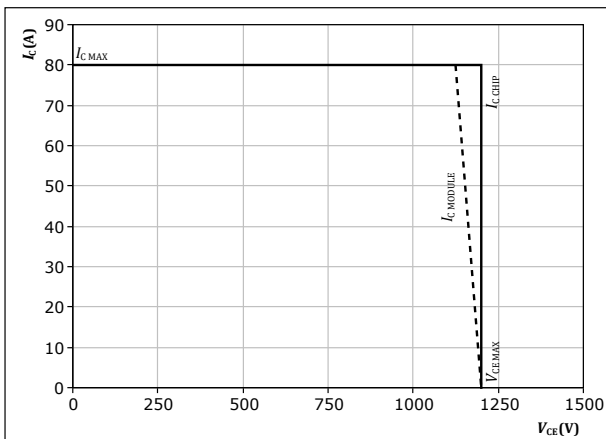
$V_{CE} = 600 \text{ V}$
 $V_{GE} = \pm 15 \text{ V}$
 $I_c = 40 \text{ A}$

T_j : — 25 °C
 — 125 °C
 — 150 °C

figure 32. IGBT

Reverse bias safe operating area

$I_c = f(V_{CE})$



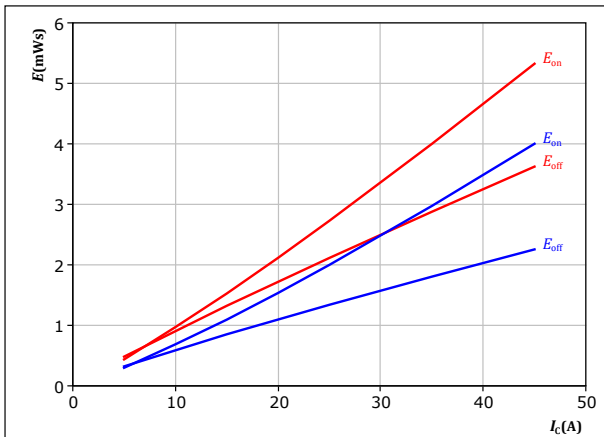
At $T_j = 150 \text{ } ^\circ\text{C}$
 $R_{gon} = 8 \text{ } \Omega$
 $R_{goff} = 8 \text{ } \Omega$



Brake Switching Characteristics

figure 33. IGBT

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



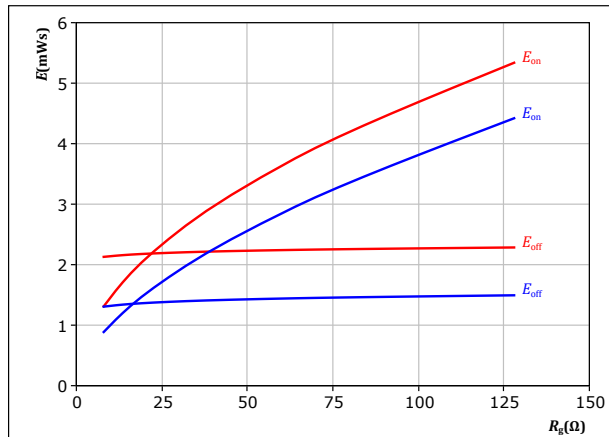
With an inductive load at

$V_{CE} = 600 \text{ V}$
 $V_{GE} = \pm 15 \text{ V}$
 $R_{gon} = 32 \text{ } \Omega$
 $R_{goff} = 32 \text{ } \Omega$

T_j : — 25 °C
 — 150 °C

figure 34. IGBT

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



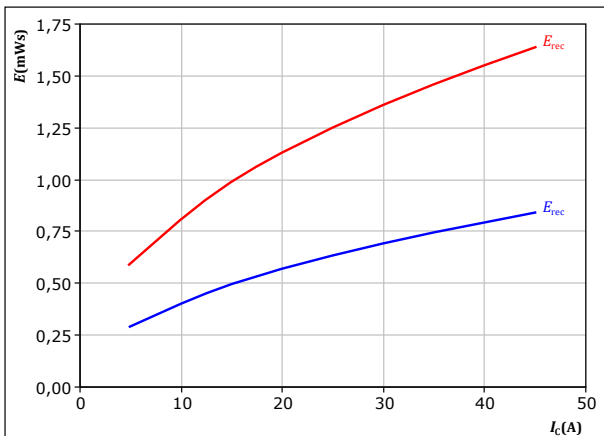
With an inductive load at

$V_{CE} = 600 \text{ V}$
 $V_{GE} = \pm 15 \text{ V}$
 $I_c = 25 \text{ A}$

T_j : — 25 °C
 — 150 °C

figure 35. FWD

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



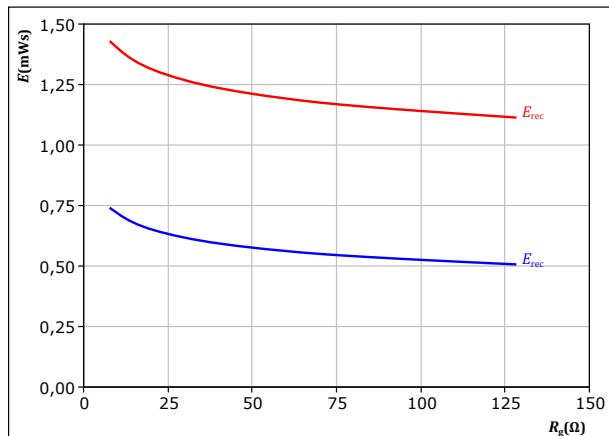
With an inductive load at

$V_{CE} = 600 \text{ V}$
 $V_{GE} = \pm 15 \text{ V}$
 $R_{gon} = 32 \text{ } \Omega$

T_j : — 25 °C
 — 150 °C

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

$V_{CE} = 600 \text{ V}$
 $V_{GE} = \pm 15 \text{ V}$
 $I_c = 25 \text{ A}$

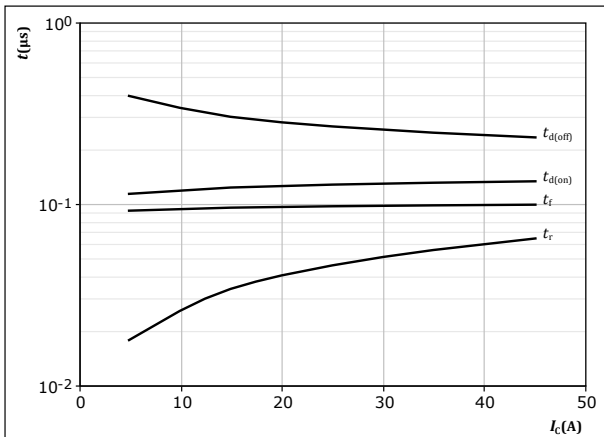
T_j : — 25 °C
 — 150 °C



Brake Switching Characteristics

figure 37. IGBT

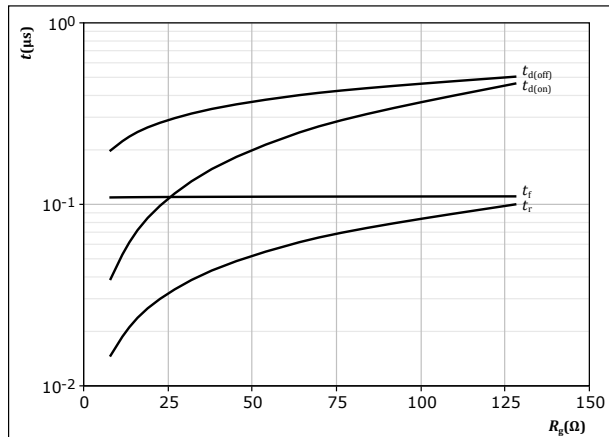
Typical switching times as a function of collector current
 $t = f(I_c)$



With an inductive load at
 $T_j = 150 \text{ } ^\circ\text{C}$
 $V_{CE} = 600 \text{ V}$
 $V_{GE} = \pm 15 \text{ V}$
 $R_{gon} = 32 \text{ } \Omega$
 $R_{goff} = 32 \text{ } \Omega$

figure 38. IGBT

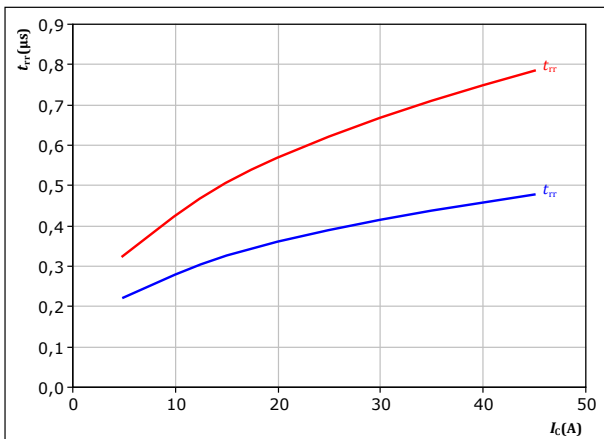
Typical switching times as a function of IGBT turn on gate resistor
 $t = f(R_g)$



With an inductive load at
 $T_j = 150 \text{ } ^\circ\text{C}$
 $V_{CE} = 600 \text{ V}$
 $V_{GE} = \pm 15 \text{ V}$
 $I_c = 25 \text{ A}$

figure 39. FWD

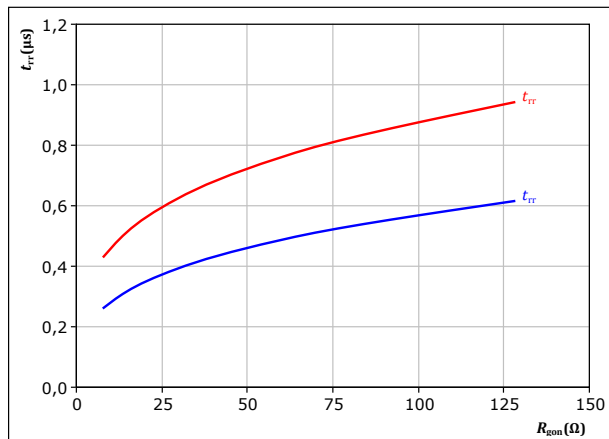
Typical reverse recovery time as a function of collector current
 $t_{rr} = f(I_c)$



With an inductive load at
 $V_{CE} = 600 \text{ V}$
 $V_{GE} = \pm 15 \text{ V}$
 $R_{gon} = 32 \text{ } \Omega$
 $T_j: \text{ — } 25 \text{ } ^\circ\text{C}$
 $\text{ — } 150 \text{ } ^\circ\text{C}$

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
 $V_{CE} = 600 \text{ V}$
 $V_{GE} = \pm 15 \text{ V}$
 $I_c = 25 \text{ A}$
 $T_j: \text{ — } 25 \text{ } ^\circ\text{C}$
 $\text{ — } 150 \text{ } ^\circ\text{C}$

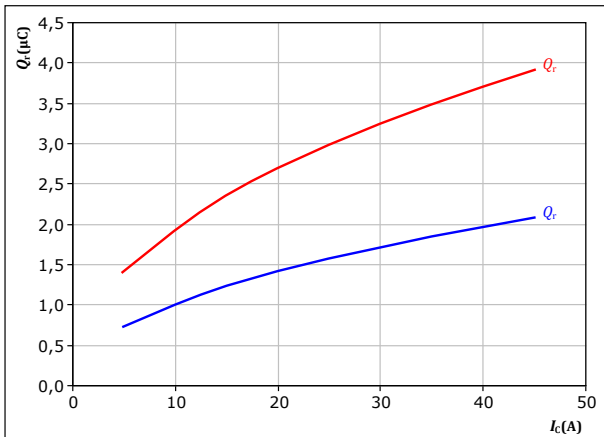


Brake Switching Characteristics

figure 41. FWD

Typical recovered charge as a function of collector current

$$Q_r = f(I_c)$$



With an inductive load at

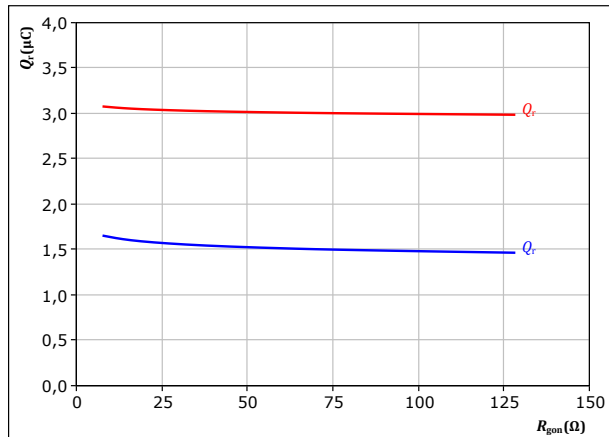
$V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 32$ Ω

T_j : — 25 °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

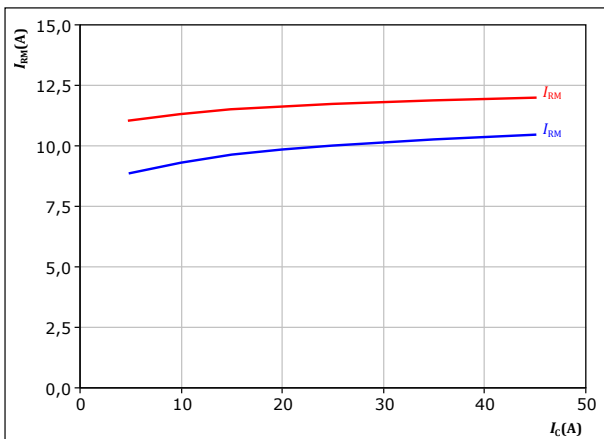
$V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $I_c = 25$ A

T_j : — 25 °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

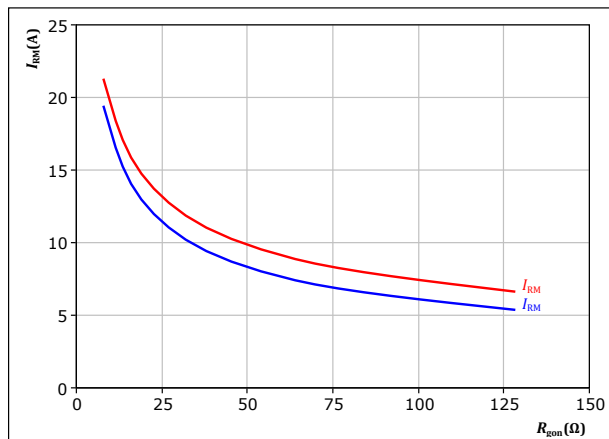
$V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 32$ Ω

T_j : — 25 °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

$V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $I_c = 25$ A

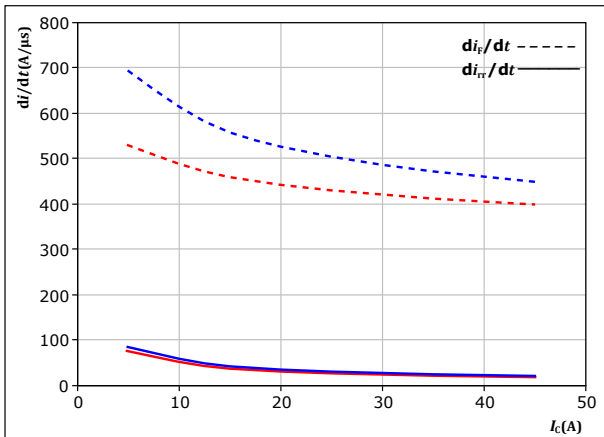
T_j : — 25 °C
— 150 °C



Brake Switching Characteristics

figure 45. FWD

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



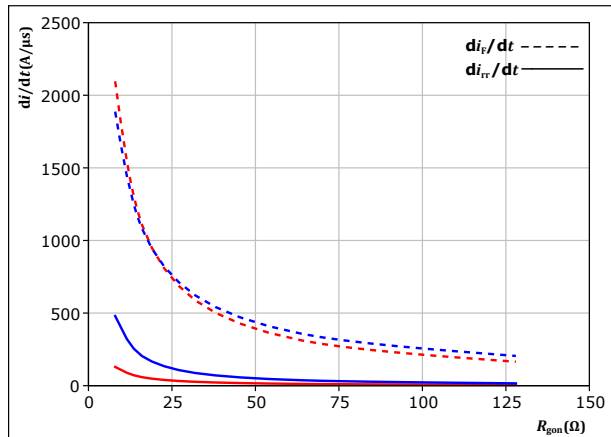
With an inductive load at

$V_{CE} = 600 \text{ V}$
 $V_{GE} = \pm 15 \text{ V}$
 $R_{gon} = 32 \ \Omega$

T_j : — 25 °C
 — 150 °C

figure 46. FWD

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



With an inductive load at

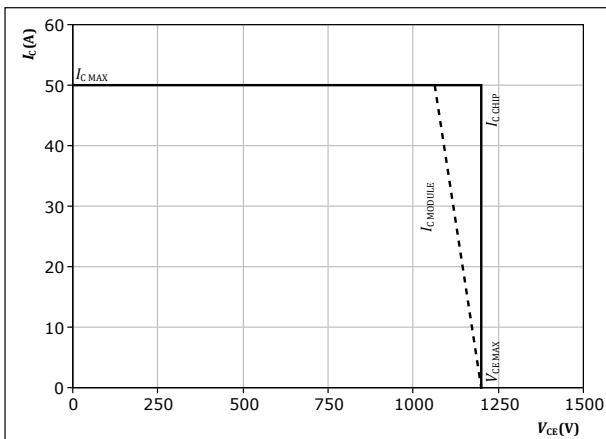
$V_{CE} = 600 \text{ V}$
 $V_{GE} = \pm 15 \text{ V}$
 $I_c = 25 \text{ A}$

T_j : — 25 °C
 — 150 °C

figure 47. IGBT

Reverse bias safe operating area

$I_c = f(V_{CE})$



At $T_j = 150 \text{ °C}$
 $R_{gon} = 32 \ \Omega$
 $R_{goff} = 32 \ \Omega$



Switching Definitions

figure 48. IGBT

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

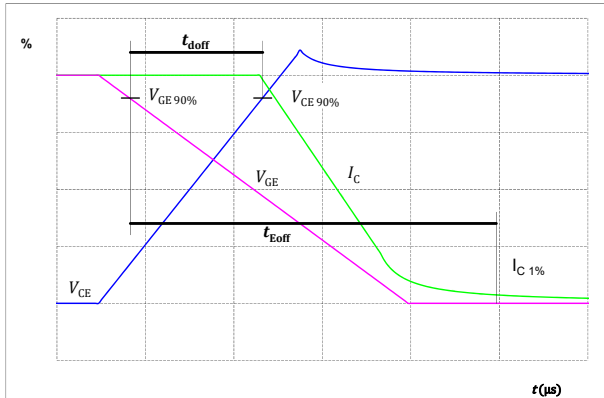


figure 49. IGBT

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

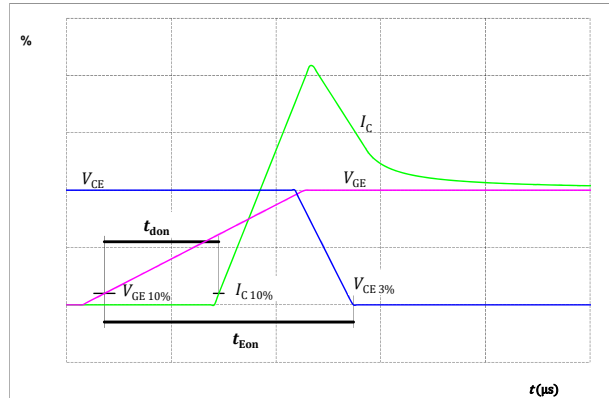


figure 50. IGBT

Turn-off Switching Waveforms & definition of t_f

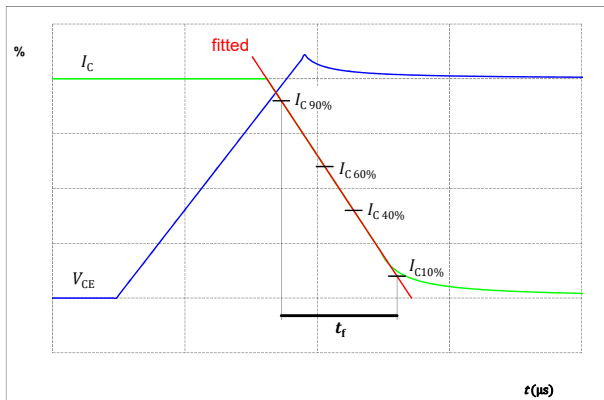
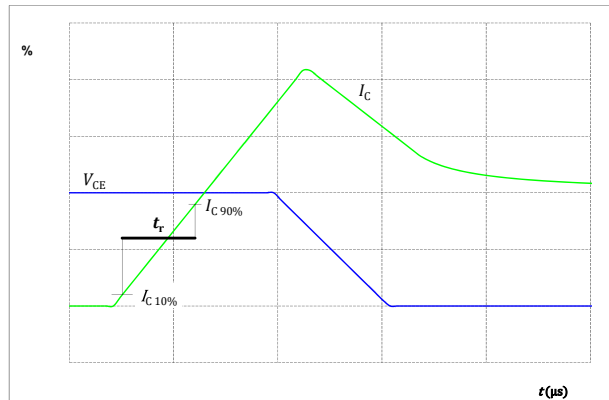


figure 51. IGBT

Turn-on Switching Waveforms & definition of t_r





Switching Definitions

figure 52. FWD

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

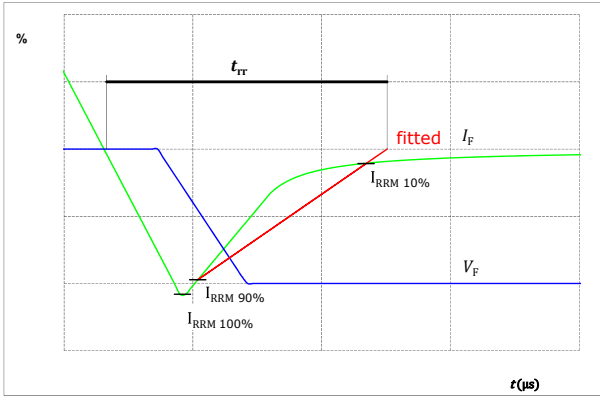
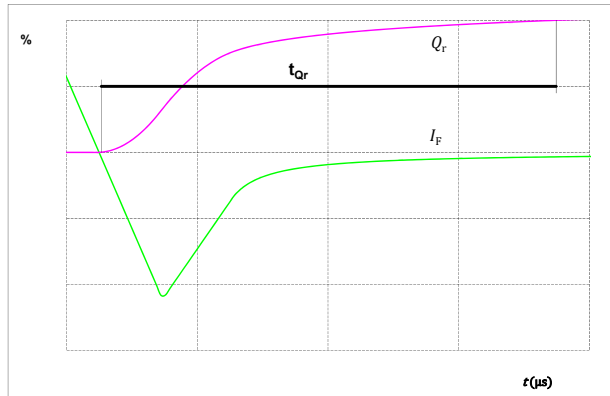


figure 53. FWD

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





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10-P112PMA040SH02-P580A82Y
datasheet

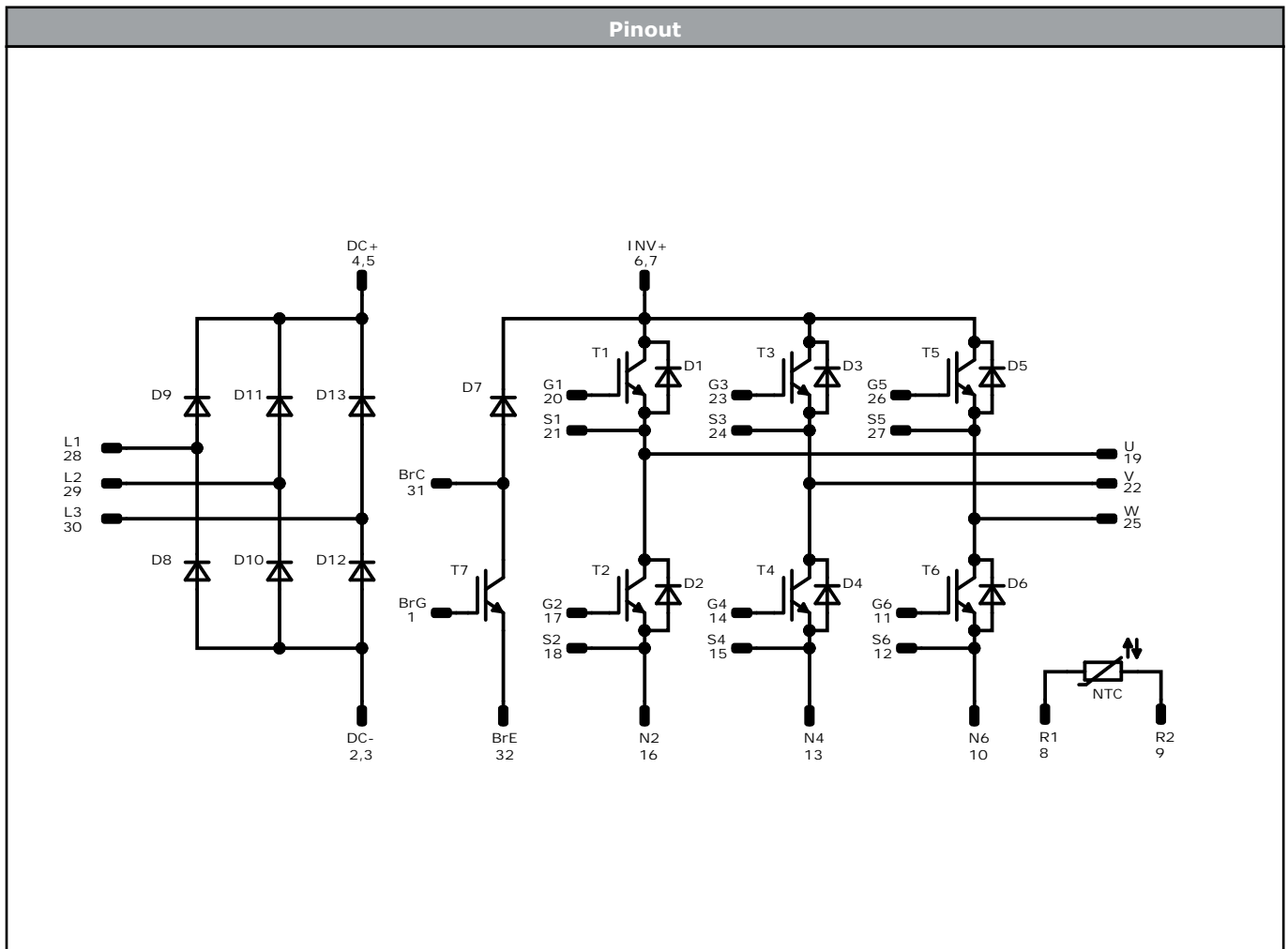
Ordering Code	
Version	Ordering Code
Without thermal paste	10-P112PMA040SH02-P580A82Y
With thermal paste (5,2 W/mK, PTM6000HV)	10-P112PMA040SH02-P580A82Y-/7/

Marking							
	Text	VIN	Date code	Type&Ver	UL	Lot	Serial
		VIN	WWYY	TTTTTTVV	UL	LLLLL	SSSS
	Datamatrix	Type&Ver	Lot number	Serial	Date code		
		TTTTTTVV	LLLLL	SSSS	WWYY		

Pin table [mm]				Outline	
Pin	X	Y	Function	<p>center of press-fit pin head pin head type "H", H3 slotted through-hole Ø165 min ±0,09 / -0,06, for further H3 design rules refer to the latest bonding instruction</p> <p>Tolerance of positions: ±0,5mm at the end of pins Dimension of coordinate axis is only offset without tolerance</p>	
1	52,55	0	BrG		
2	47,7	0	DC-		
3	44,8	0	DC-		
4	37,8	0	DC+		
5	37,8	2,8	DC+		
6	35	0	Inv+		
7	35	2,8	Inv+		
8	28	0	R1		
9	25,2	0	R2		
10	22,4	0	N6		
11	19,6	0	G6		
12	16,8	0	S6		
13	14	0	N4		
14	11,2	0	G4		
15	8,4	0	S4		
16	5,6	0	N2		
17	2,8	0	G2		
18	0	0	S2		
19	0	28,5	U		
20	2,8	28,5	G1		
21	7,5	28,5	S1		
22	14,5	28,5	V		
23	17,3	28,5	G3		
24	22	28,5	S3		
25	29	28,5	W		
26	31,8	28,5	G5		
27	36,5	28,5	S5		
28	43,5	28,5	L1		
29	52,55	25	L2		
30	52,55	16,9	L3		
31	52,55	8,6	BrC		
32	52,55	2,8	BrE		



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Identification					
ID	Component	Voltage	Current	Function	Comment
T2, T1, T4, T3, T6, T5	IGBT	1200 V	40 A	Inverter Switch	
D1, D2, D3, D4, D5, D6	FWD	1200 V	35 A	Inverter Diode	
T7	IGBT	1200 V	25 A	Brake Switch	
D7	FWD	1200 V	10 A	Brake Diode	
D8, D9, D10, D11, D12, D13	Rectifier	1600 V	28 A	Rectifier Diode	
NTC	NTC			Thermistor	



Vincotech

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 UL 1557 recognized under E192116 up to a junction temperature under switching condition $T_{j,op}=175^{\circ}\text{C}$ and up to 3500VAC/1min isolation voltage. For more information see vincotech.com website.



Document No.:	Date:	Modification:	Pages
10-P112PMA040SH02-P580A82Y-D1-14	17 Jul. 2024		

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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.