Vincotech

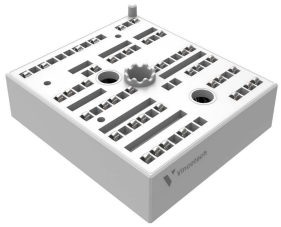
V23990-K229-A40
datasheet

MiniSKiiP®PIM 2 **1200 V / 25 A**

Features

- Solderless interconnection
- Trench Fieldstop IGBT4 technology

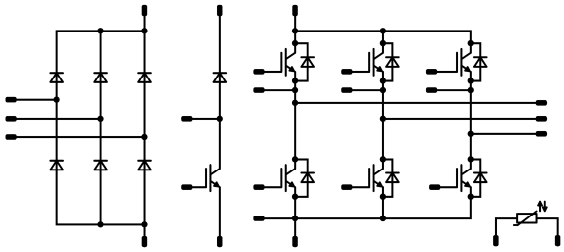
MiniSkiip®2 housing



Target applications

- Industrial Motor Drives

Schematic



Types

- V23990-K229-A40

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
Inverter Switch				
Collector-emitter voltage	V_{CES}		1200	V
Collector current	I_C		25	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 °C	113	W
Gate-emitter voltage	V_{GES}		±20	V
Short circuit ratings	t_{SC}	T_j ≤ 150 °C V_{GE} = 15 V Vcc = 800 V	10	µs
Maximum junction temperature	T_{jmax}		175	°C

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
Inverter Diode				
Peak repetitive reverse voltage	V_{RRM}		1200	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 ms, T_j = 150 °C	100	A
Surge current capability	I^2t		50	A^2s
Total power dissipation	P_{tot}	$T_j = T_{jmax}$, T_s = 80 °C	81	W
Maximum junction temperature	T_{jmax}		175	°C
Brake Switch				
Collector-emitter voltage	V_{CES}		1200	V
Collector current	I_C		25	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 °C	113	W
Gate-emitter voltage	V_{GES}		±20	V
Short circuit ratings	t_{SC}	$T_j \leq$ 150 °C, V_{GE} = 15 V, V_{CC} = 800 V	10	µs
Maximum junction temperature	T_{jmax}		175	°C
Brake Diode				
Peak repetitive reverse voltage	V_{RRM}		1200	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 ms, T_j = 150 °C	100	A
Surge current capability	I^2t		50	A^2s
Total power dissipation	P_{tot}	$T_j = T_{jmax}$, T_s = 80 °C	81	W
Maximum junction temperature	T_{jmax}		175	°C

Maximum Ratings

T_j = 25 °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		35	A
Surge (non-repetitive) forward current	I_{FSM}	50 Hz Single Half Sine Wave t_p = 10 ms T_j = 150 °C	270	A
Surge current capability	I^2t		370	A^2s
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ T_s = 80 °C	64	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 s	5500	V
		AC Voltage t_p = 1 min	2500	V
Creepage distance		With std lid For more informations see handling instructions	6,3	mm
Clearance		With std lid For more informations see handling instructions	6,3	mm
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	
Inverter Switch										
Static										
Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{GE} = V_{CE}$			0,00085	25	5,3	5,8	6,3	V
Collector-emitter saturation voltage	V_{CEsat}		15		25	25 150	1,58	1,88 2,20	2,07	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 Mhz	0	25		25		1450		pF
Reverse transfer capacitance	C_{res}							50		
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 2,5 W/mK (HPTP)						0,84		K/W
Dynamic										
Turn-on delay time	$t_{d(on)}$	R_{gon} = 16 Ω R_{goff} = 16 Ω	±15	600	25	25 150		71 72		ns
Rise time	t_r					25 150		32 36		
Turn-off delay time	$t_{d(off)}$					25 150		199 270		
Fall time	t_f					25 150		90 135		
Turn-on energy (per pulse)	E_{on}	Q_{rFWD} = 1,5 µC Q_{rFWD} = 3,9 µC				25 150		1,607 2,462		mWs
Turn-off energy (per pulse)	E_{off}					25 150		1,527 2,498		

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	
Inverter Diode										
Static										
Forward voltage	V_F				25	25 125 150		2,27 2,44 2,36	2,74	V
Reverse leakage current	I_R			1200		25 150			60 3300	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 2,5 W/mK (HPTP)						1,17		K/W
Dynamic										
Peak recovery current	I_{RRM}	di/dt = 690 A/µs di/dt = 578A/µs	±15	600	25	25 150		12 17		A
Reverse recovery time	t_{rr}					25 150		277 580		ns
Recovered charge	Q_r					25 150		1,549 3,882		µC
Reverse recovered energy	E_{rec}					25 150		0,607 1,631		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 150		111 89		A/µs

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 Switch										
Static										
Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{GE} = V_{CE}$			0,00085	25	5,3	5,8	6,3	V
Collector-emitter saturation voltage	V_{CEsat}		15		25	25 150	1,58	1,88 2,20	2,07	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 Mhz	0	25		25		1450		pF
Reverse transfer capacitance	C_{res}							50		
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 2,5 W/mK (HPTP)						0,84		K/W
Dynamic										
Turn-on delay time	$t_{d(on)}$	R_{gon} = 8 Ω R_{goff} = 8 Ω	0 / 15	700	25	25 125 150		63 59 57		ns
Rise time	t_r					25 125 150		68 68 69		
Turn-off delay time	$t_{d(off)}$					25 125 150		233 301 323		
Fall time	t_f					25 125 150		66 104 122		
Turn-on energy (per pulse)	E_{on}	Q_{rFWD} = 1,6 µC Q_{rFWD} = 3,2 µC Q_{rFWD} = 4 µC				25 125 150		2,061 2,791 3,095		mWs
Turn-off energy (per pulse)	E_{off}					25 125 150		1,655 2,633 2,978		

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				25	25 125 150		2,27 2,44 2,36	2,74	V
Reverse leakage current	I_R			1200		25 150			60 3300	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 2,5 W/mK (HPTP)						1,17		K/W
Dynamic										
Peak recovery current	I_{RRM}	di/dt = 344 A/µs di/dt = 337 A/µs di/dt = 347 A/µs	0 / 15	700	25	25 125 150		14 18 19		A
Reverse recovery time	t_{rr}					25 125 150		292 473 550		ns
Recovered charge	Q_r					25 125 150		1,562 3,203 3,965		µC
Reverse recovered energy	E_{rec}					25 125 150		0,731 1,577 1,963		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125 150		286 139 138		A/µs
Rectifier Diode										
Static										
Forward voltage	V_F				35	25 125		1,17 1,13		V
Reverse leakage current	I_R			1600		25			50	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 2,5 W/mK (HPTP)						1,10		K/W

Characteristic Values

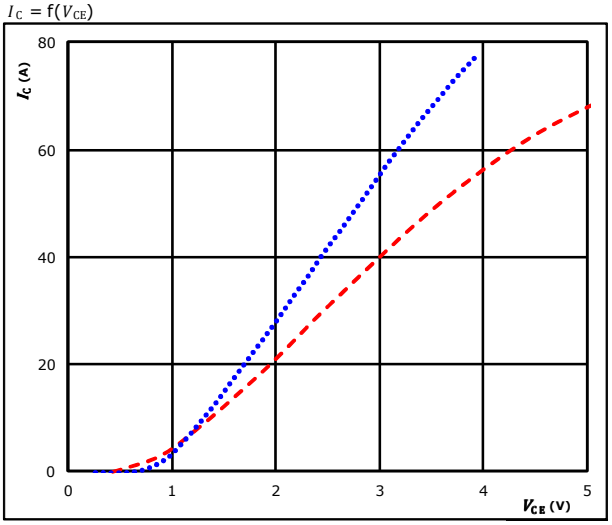
Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] V_{GS} [V]	V_{CE} [V] V_{DS} [V] V_F [V]	I_C [A] I_D [A] I_F [A]	T_j [°C]	Min	Typ	Max	
Thermistor										
Rated resistance	R					25		1		kΩ
Deviation of R_{100}	$\Delta_{R/R}$	R_{100} = 1670 Ω				100	-2		+2	%
R_{100}	R					100		1670		Ω
Power dissipation constant						25		0,76		mW/K
A-value	$A_{(25/50)}$					25		$7{,}635*10^{-3}$		1/K
B-value	$B_{(25/100)}$					25		$1{,}731*10^{-5}$		1/K²
Vincotech PTC Reference									E	

Inverter Switch Characteristics

figure 1. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

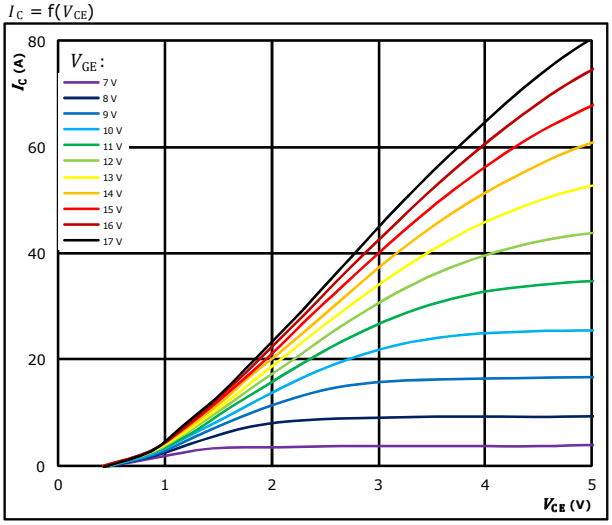


t_p =	250	µs	T_j:	25 °C	·····
V_{GE} =	15	V		150 °C	– – –

figure 2. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

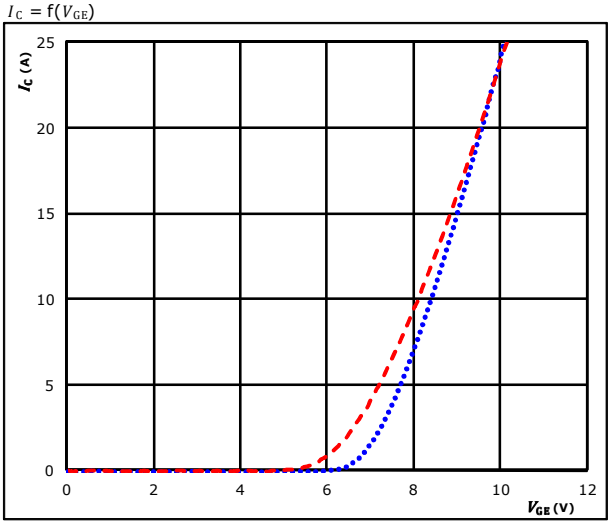


t_p =	250	µs
T_j =	150	°C
V_{GE} from	7 V to 17 V in steps of 1 V	

figure 3. **IGBT**

Typical transfer characteristics

$I_C = f(V_{GE})$

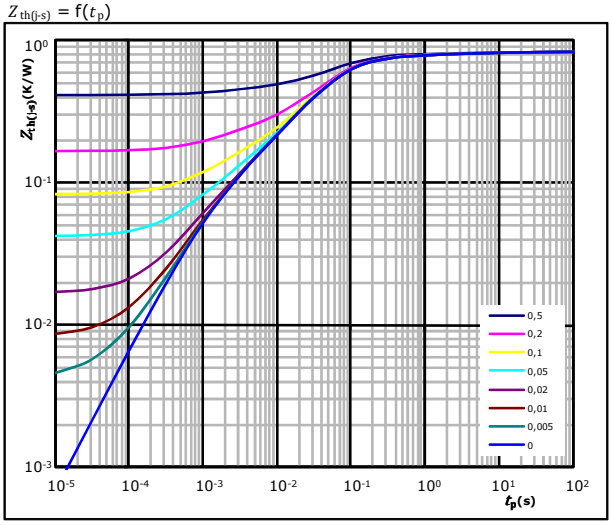


t_p =	100	µs	T_j:	25 °C	·····
V_{CE} =	10	V		150 °C	– – –

figure 4. **IGBT**

Transient thermal impedance as function of pulse duration

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



D =	t_p / T	
$R_{th(j-s)}$ =	0,84	K/W

IGBT thermal model values

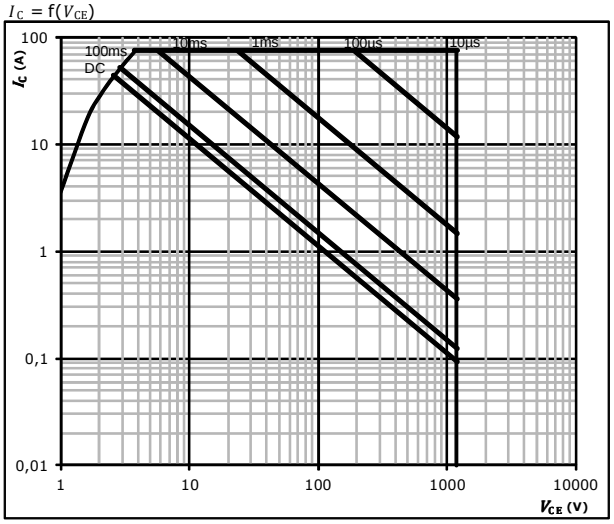
R (K/W)	τ (s)
3,13E-02	6,26E+00
5,86E-02	5,33E-01
1,55E-01	9,52E-02
4,50E-01	3,18E-02
8,39E-02	6,19E-03
5,63E-02	9,50E-04
3,88E-03	4,59E-04

Inverter Switch Characteristics

figure 5. **IGBT**

Safe operating area

$I_C = f(V_{CE})$



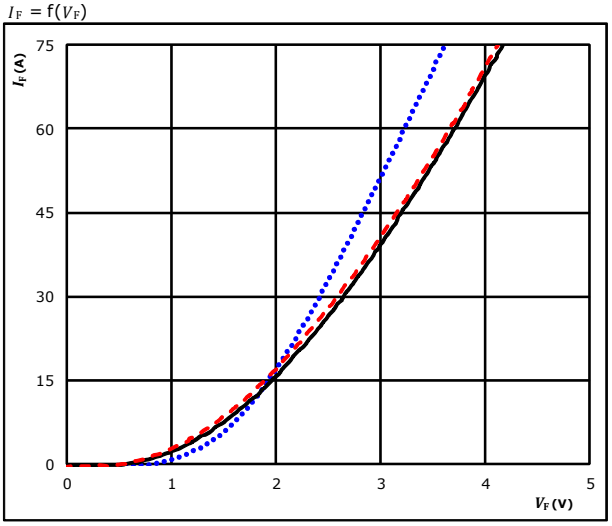
D =	single pulse	
T_s =	80	ºC
V_{GE} =	±15	V
T_j =	T_{jmax}	

Inverter Diode Characteristics

figure 1. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



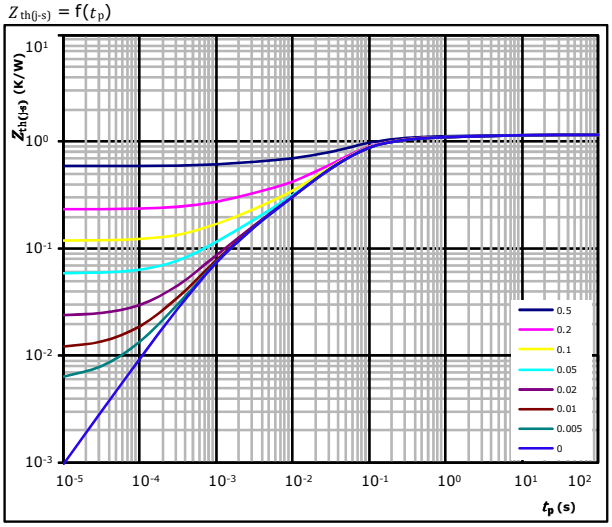
t_p = 250 µs

T_j: 25 °C
125 °C
150 °C

figure 2. **FWD**

Transient thermal impedance as a function of pulse width

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



D = t_p / T

$R_{th(j-s)}$ = 1,17 K/W

FWD thermal model values

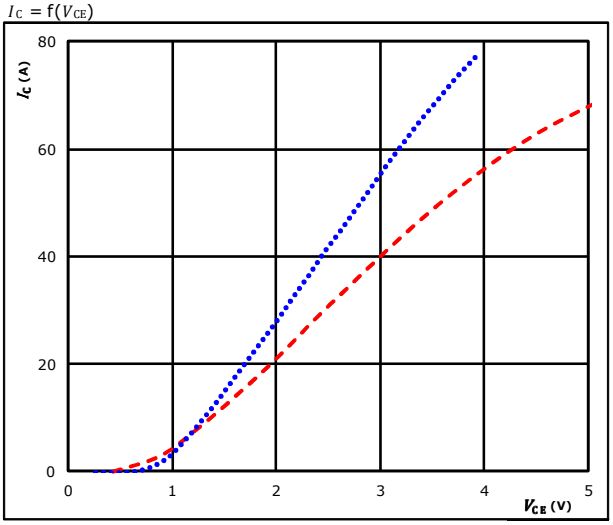
R (K/W)	τ (s)
4,37E-02	8,75E+00
8,19E-02	7,45E-01
2,17E-01	1,33E-01
6,29E-01	4,45E-02
1,17E-01	8,65E-03
7,87E-02	1,33E-03
5,43E-03	6,41E-04

Brake Switch Characteristics

figure 1. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

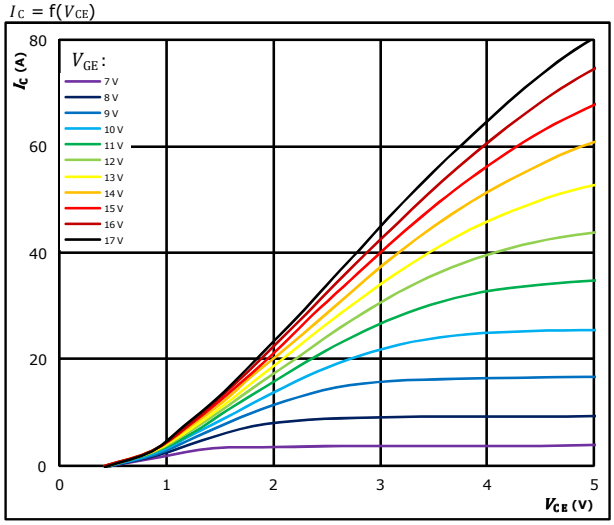


t_p =	250	µs	T_j:	25 °C	·····
V_{GE} =	15	V		150 °C	– – –

figure 2. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

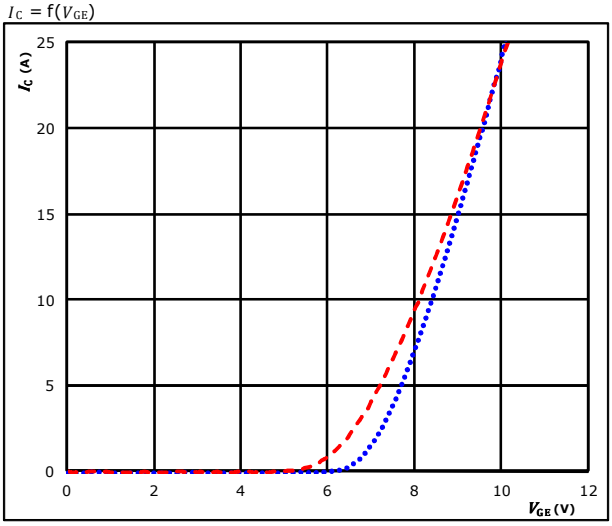


t_p =	250	µs
T_j =	150	°C
V_{GE} from	7 V to 17 V in steps of 1 V	

figure 3. **IGBT**

Typical transfer characteristics

$I_C = f(V_{GE})$

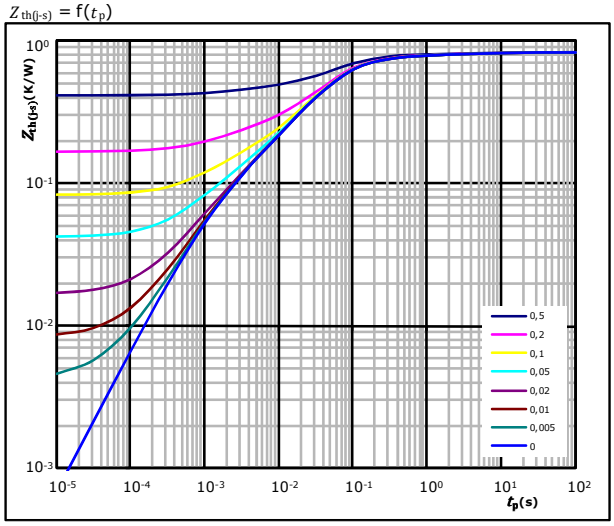


t_p =	100	µs	T_j:	25 °C	·····
V_{CE} =	10	V		150 °C	– – –

figure 4. **IGBT**

Transient thermal impedance as function of pulse duration

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



D =	t_p / T	
$R_{th(j-s)}$ =	0,84	K/W

IGBT thermal model values

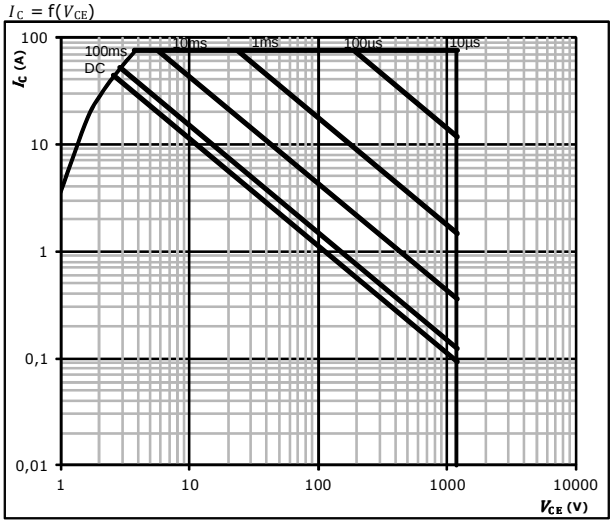
R (K/W)	τ (s)
3,13E-02	6,26E+00
5,86E-02	5,33E-01
1,55E-01	9,52E-02
4,50E-01	3,18E-02
8,39E-02	6,19E-03
5,63E-02	9,50E-04
3,88E-03	4,59E-04

Brake Switch Characteristics

figure 5. **IGBT**

Safe operating area

$I_C = f(V_{CE})$



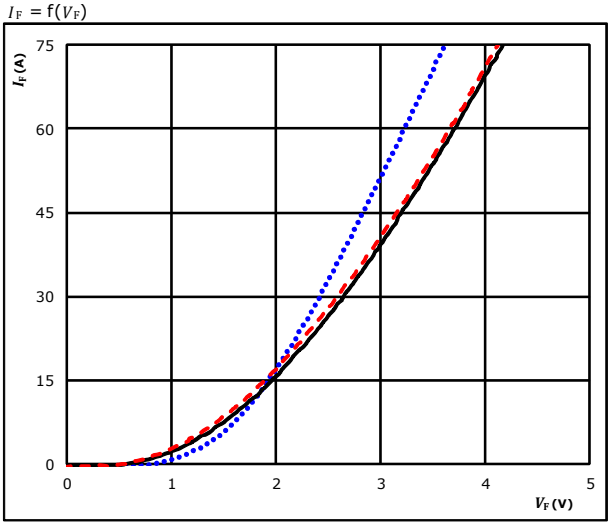
D =	single pulse	
T_s =	80	ºC
V_{GE} =	±15	V
T_j =	T_{jmax}	

Brake Diode Characteristics

figure 1. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



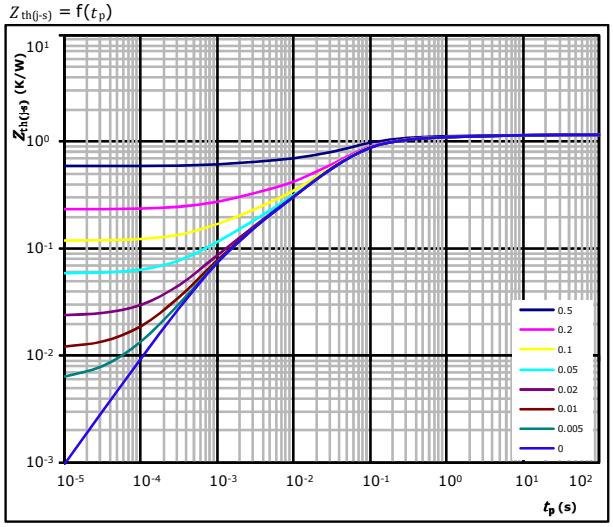
t_p = 250 µs

T_j: 25 °C
125 °C
150 °C

figure 2. **FWD**

Transient thermal impedance as a function of pulse width

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



D = t_p / T

$R_{th(j-s)}$ = 1,17 K/W

FWD thermal model values

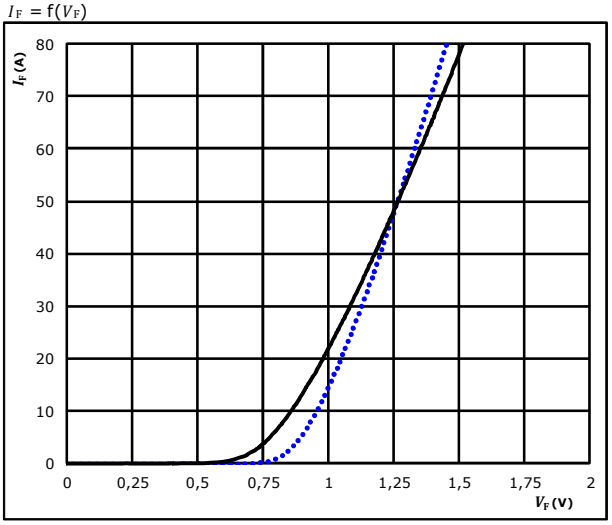
R (K/W)	τ (s)
4,37E-02	8,75E+00
8,19E-02	7,45E-01
2,17E-01	1,33E-01
6,29E-01	4,45E-02
1,17E-01	8,65E-03
7,87E-02	1,33E-03
5,43E-03	6,41E-04

Rectifier Diode Characteristics

figure 1. **Rectifier Diode**

Typical forward characteristics

$I_F = f(V_F)$



t_p = 250 µs

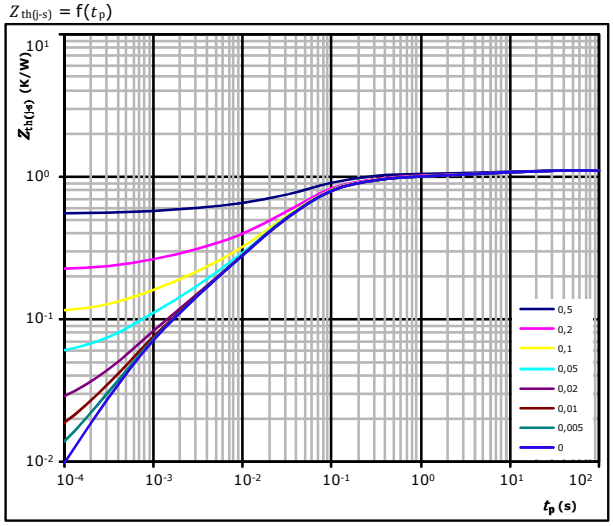
T_j: 25 °C

125 °C

figure 2. **Rectifier Diode**

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$

$R_{th(j-s)}$ = 1,10 K/W

Diode thermal model values

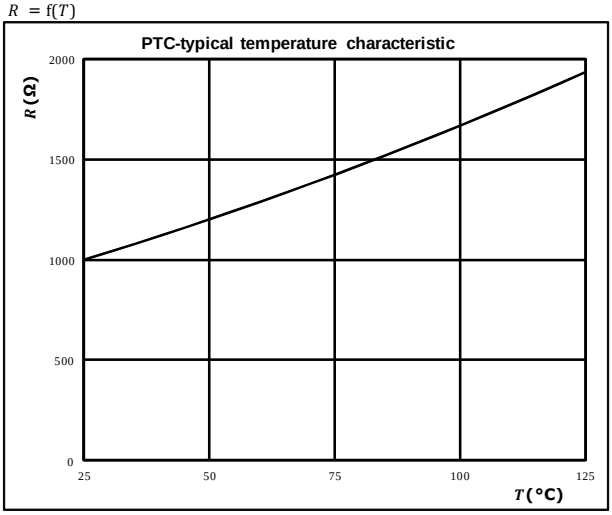
R (K/W)	τ (s)
1,03E-01	7,04E+00
1,17E-01	3,94E-01
5,19E-01	5,87E-02
2,38E-01	2,15E-02
7,64E-02	3,49E-03
4,71E-02	6,93E-04

Thermistor Characteristics

figure 1. **Thermistor**

Typical PTC characteristic
as a function of temperature

$R = f(T)$

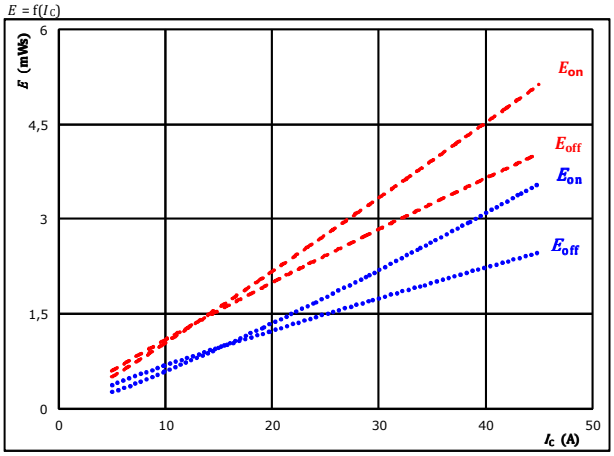


Inverter Switching Characteristics

figure 1. **IGBT**

Typical switching energy losses as a function of collector current

$E = f(I_C)$



With an inductive load at

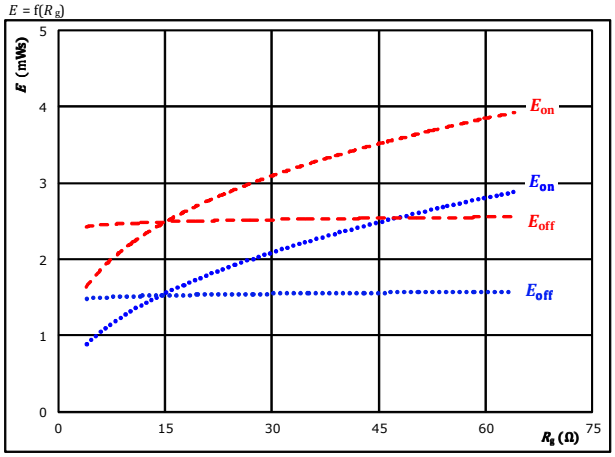
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	16	Ω
R_{goff} =	16	Ω

T_j: 25 °C, 150 °C

figure 2. **IGBT**

Typical switching energy losses as a function of gate resistor

$E = f(R_g)$



With an inductive load at

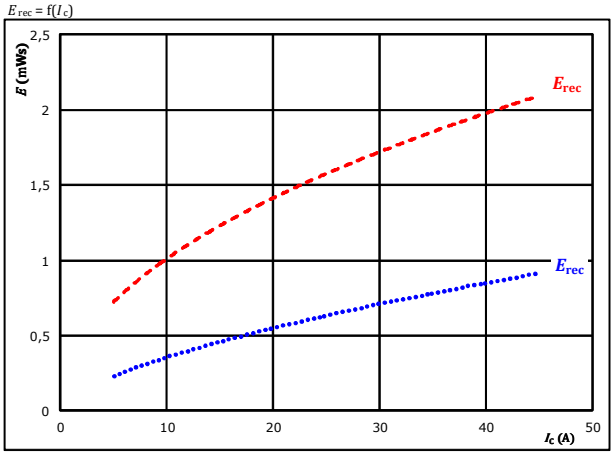
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	25	A

T_j: 25 °C, 150 °C

figure 3. **FWD**

Typical reverse recovered energy loss as a function of collector current

$E_{rec} = f(I_C)$



With an inductive load at

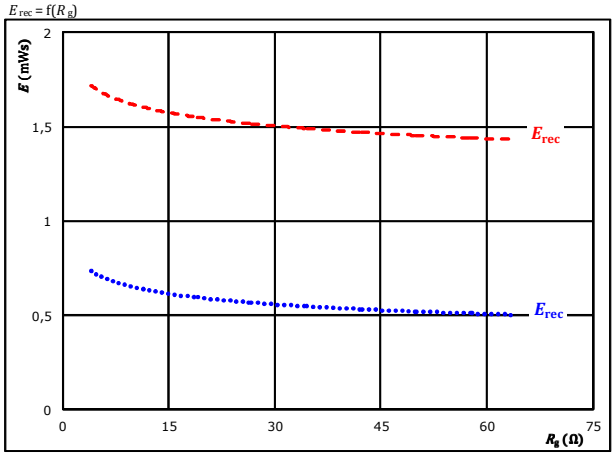
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	16	Ω

T_j: 25 °C, 150 °C

figure 4. **FWD**

Typical reverse recovered energy loss as a function of gate resistor

$E_{rec} = f(R_g)$



With an inductive load at

V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	25	A

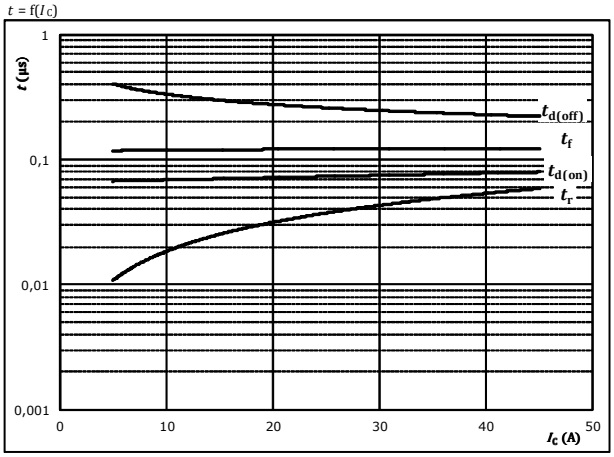
T_j: 25 °C, 150 °C

Inverter Switching Characteristics

figure 5. **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



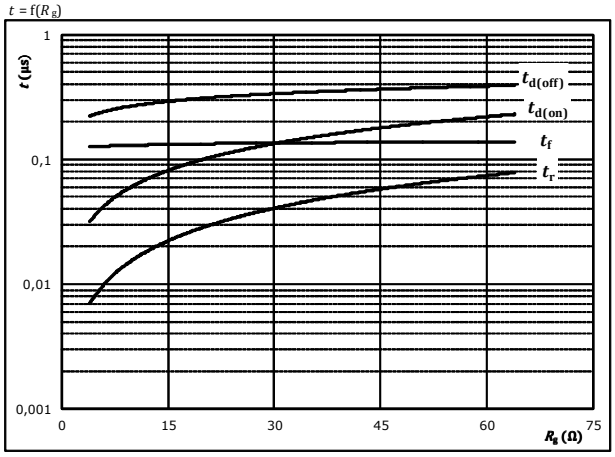
With an inductive load at

T_j =	150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	16	Ω
R_{goff} =	16	Ω

figure 6. **IGBT**

Typical switching times as a function of gate resistor

$t = f(R_g)$



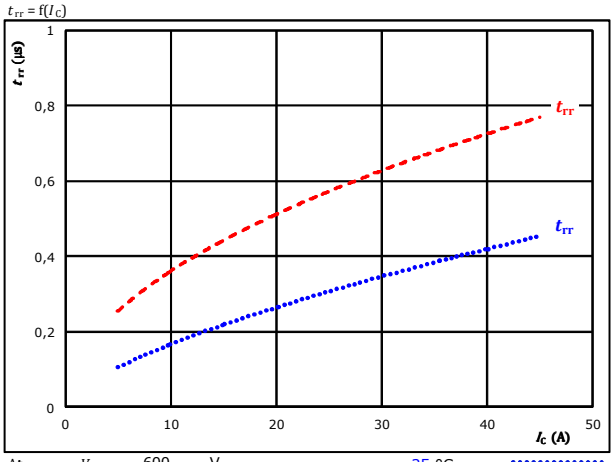
With an inductive load at

T_j =	150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	25	A

figure 7. **FWD**

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$



At

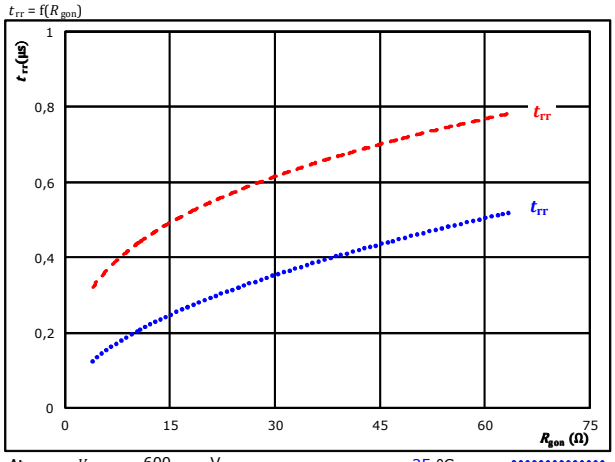
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	16	Ω

T_j: 25 °C, 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
V_{GE} =	±15	V
I_C =	25	A

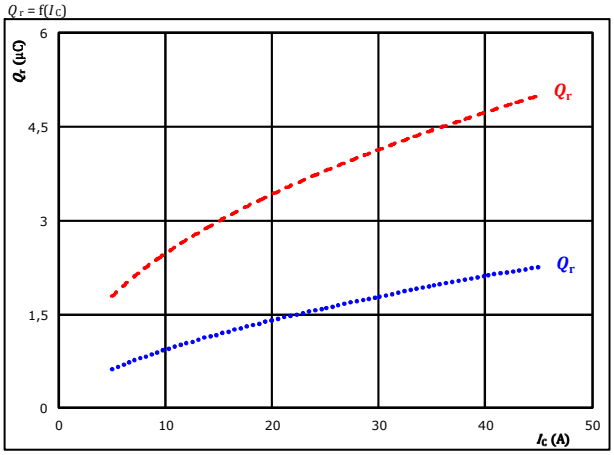
T_j: 25 °C, 150 °C

Inverter Switching Characteristics

figure 9. **FWD**

Typical recovered charge as a function of collector current

$Q_r = f(I_C)$

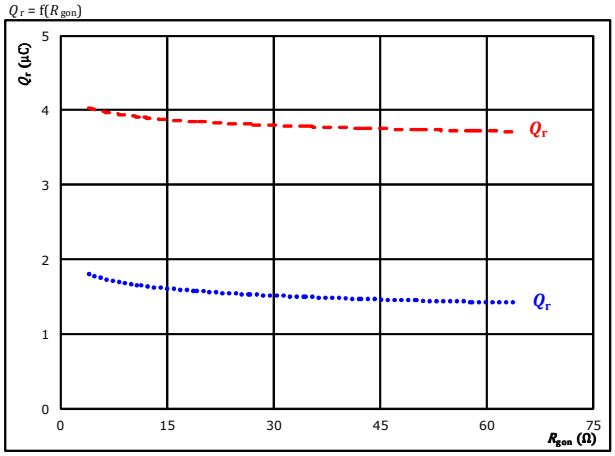


At						
	V_{CE} =	600	V	T_j:	25 °C	·····
	V_{GE} =	±15	V		150 °C	– – –
	R_{gon} =	16	Ω			

figure 10. **FWD**

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

$Q_r = f(R_{gon})$

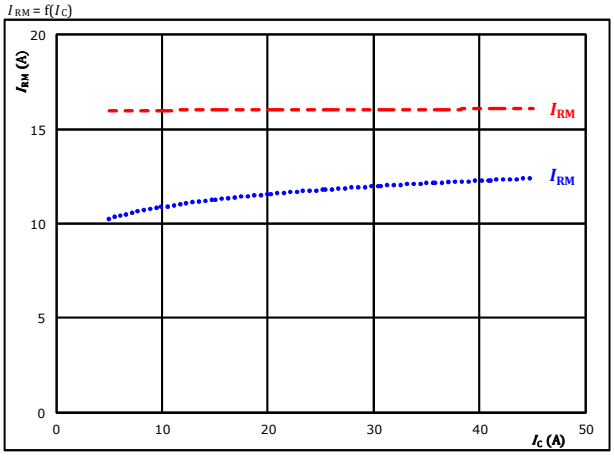


At						
	V_{CE}=	600	V	T_j:	25 °C	·····
	V_{GE} =	±15	V		150 °C	– – –
	I_C=	25	A			

figure 11. **FWD**

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

$I_{RM} = f(I_C)$

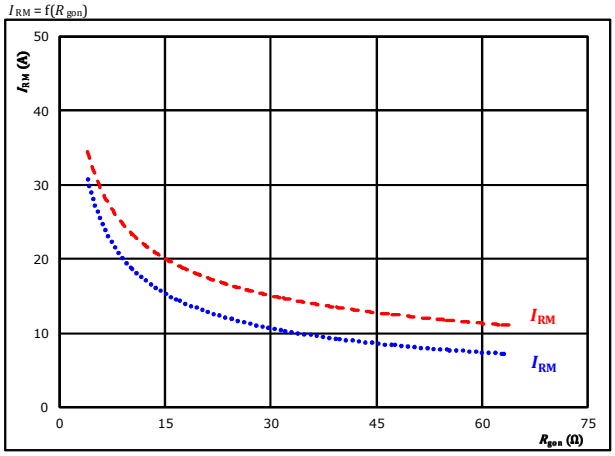


At						
	V_{CE}:	600	V	T_j:	25 °C	·····
	V_{GE} =	±15	V		150 °C	– – –
	R_{gon} =	16	Ω			

figure 12. **FWD**

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

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



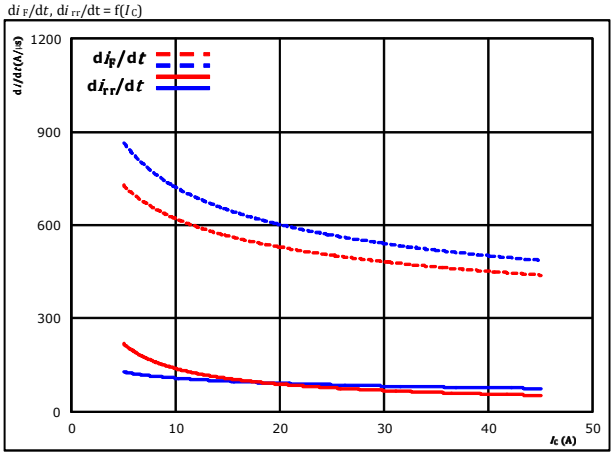
At						
	V_{CE} =	600	V	T_j:	25 °C	·····
	V_{GE} =	±15	V		150 °C	– – –
	I_C =	25	A			

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, $di_{rr}/dt = f(I_C)$

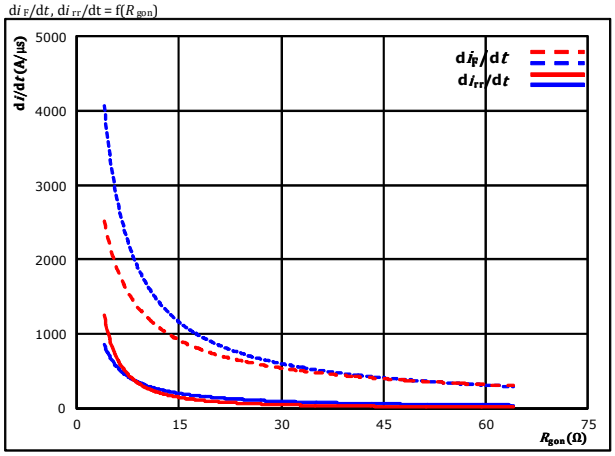


At					
	V_{CE} =	600	V		25 °C
	V_{GE} =	±15	V	T_j:	150 °C
	R_{gon} =	16	Ω		

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, $di_{rr}/dt = f(R_{gon})$

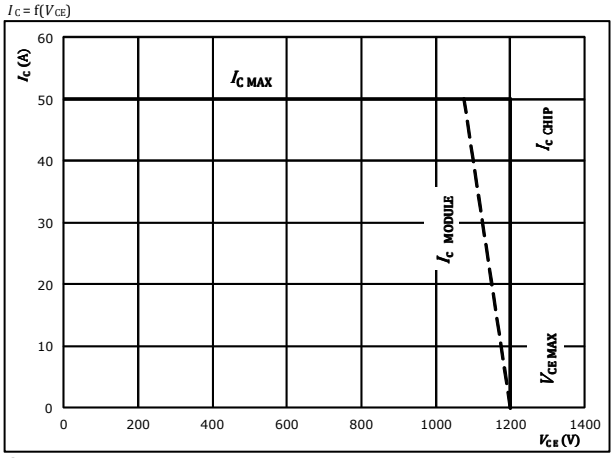


At					
	V_{CE} =	600	V		25 °C
	V_{GE} =	±15	V	T_j:	150 °C
	I_C =	25	A		

figure 15. **IGBT**

Reverse bias safe operating area

$I_C = f(V_{CE})$



At

T_j =	175	°C	
R_{gon} =	16	Ω	
R_{goff} =	16	Ω	

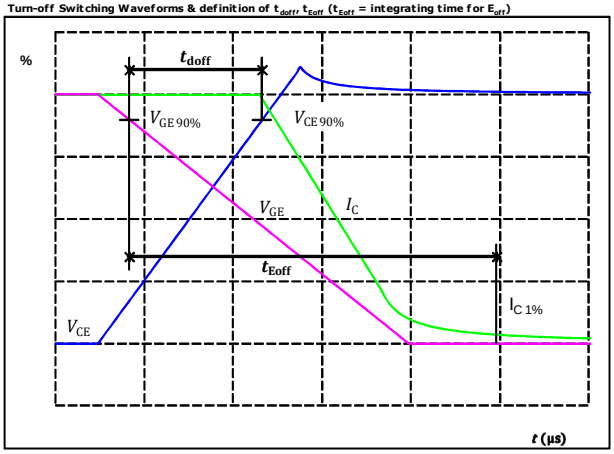
Inverter Switching Definitions

General conditions

T_j	=	**125 °C**
R_{gon}	=	**16 Ω**
R_{goff}	=	**16 Ω**

figure 1. **IGBT**

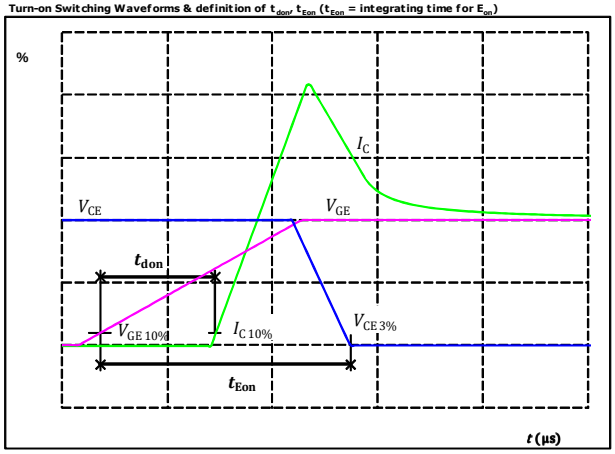
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff} (t_{Eoff} = integrating time for E_{off})



$V_{GE}(0\%)$ =	-15	V
$V_{GE}(100\%)$ =	15	V
$V_C(100\%)$ =	600	V
$I_C(100\%)$ =	25	A
t_{doff} =	270	ns

figure 2. **IGBT**

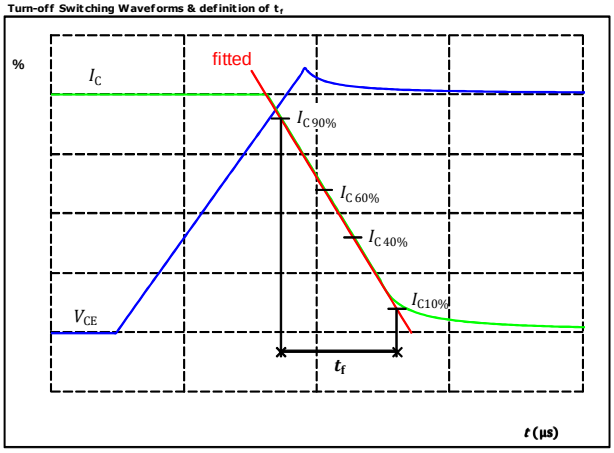
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon} (t_{Eon} = integrating time for E_{on})



$V_{GE}(0\%)$ =	-15	V
$V_{GE}(100\%)$ =	15	V
$V_C(100\%)$ =	600	V
$I_C(100\%)$ =	25	A
t_{don} =	72	ns

figure 3. **IGBT**

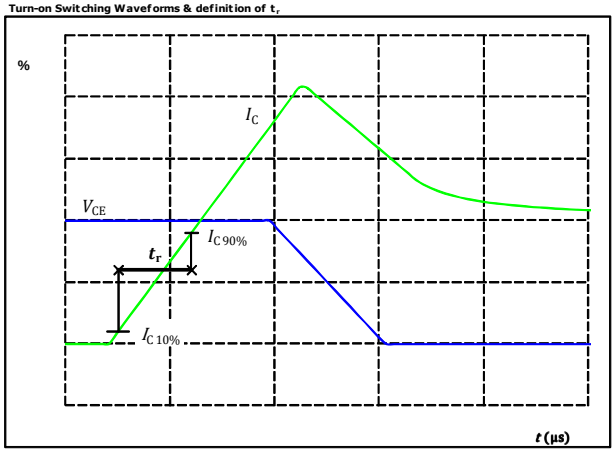
Turn-off Switching Waveforms & definition of t_f



$V_C(100\%)$ =	600	V
$I_C(100\%)$ =	25	A
t_f =	135	ns

figure 4. **IGBT**

Turn-on Switching Waveforms & definition of t_r

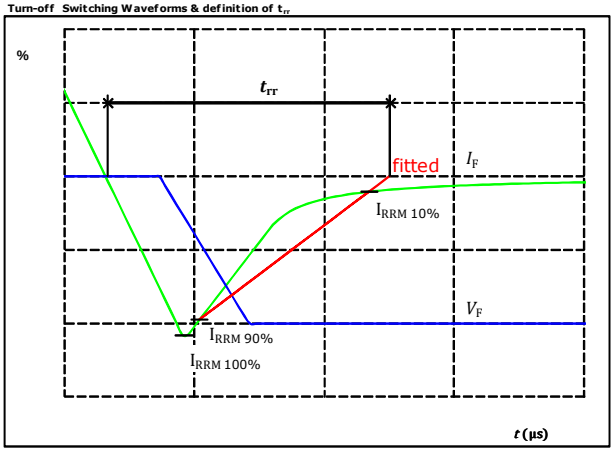


$V_C(100\%)$ =	600	V
$I_C(100\%)$ =	25	A
t_r =	36	ns

Inverter Switching Characteristics

figure 5. **FWD**

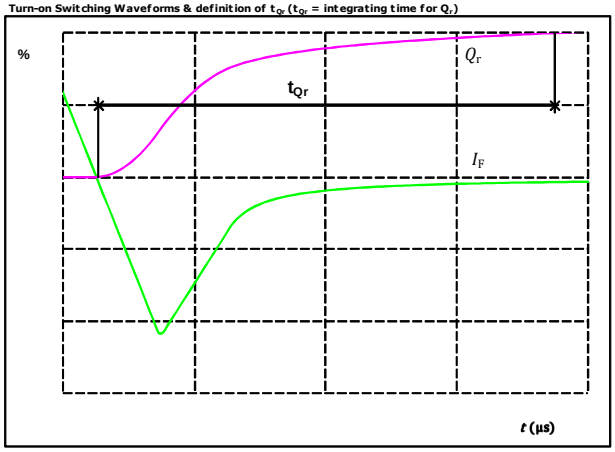
Turn-off Switching Waveforms & definition of t_{rr}



$V_F(100\%)$ =	600	V
$I_F(100\%)$ =	25	A
$I_{RRM}(100\%)$ =	17	A
t_{rr} =	580	ns

figure 6. **FWD**

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



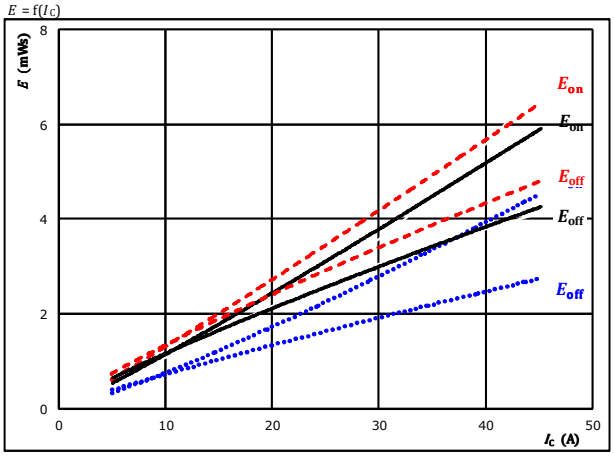
$I_F(100\%)$ =	25	A
$Q_r(100\%)$ =	3,88	µC

Brake Switching Characteristics

figure 1. **IGBT**

Typical switching energy losses as a function of collector current

$E = f(I_C)$



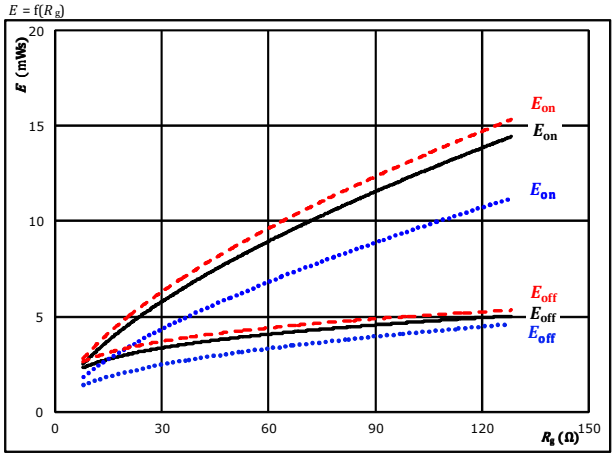
With an inductive load at

V_{CE} =	700	V	T_j:	25 °C
V_{GE} =	0 / 15	V		125 °C
R_{gon} =	8	Ω		150 °C
R_{goff} =	8	Ω		

figure 2. **IGBT**

Typical switching energy losses as a function of gate resistor

$E = f(R_g)$



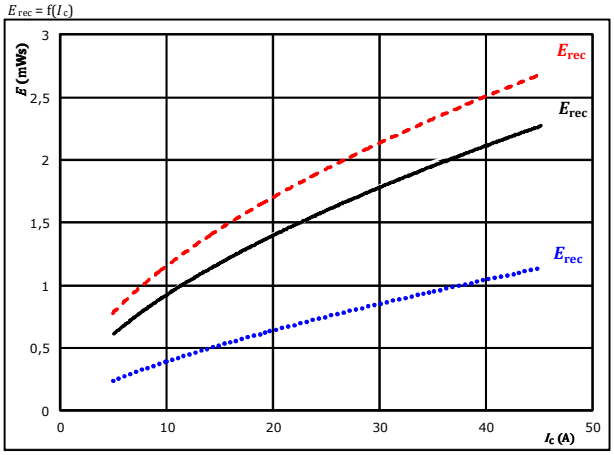
With an inductive load at

V_{CE} =	700	V	T_j:	25 °C
V_{GE} =	0 / 15	V		125 °C
I_C =	25	A		150 °C

figure 3. **FWD**

Typical reverse recovered energy loss as a function of collector current

$E_{rec} = f(I_C)$



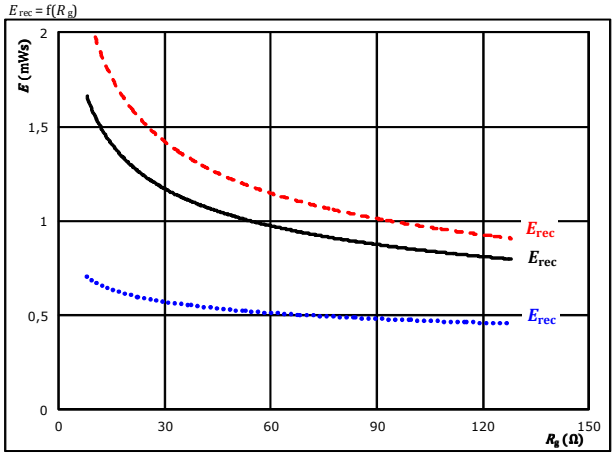
With an inductive load at

V_{CE} =	700	V	T_j:	25 °C
V_{GE} =	0 / 15	V		125 °C
R_{gon} =	8	Ω		150 °C

figure 4. **FWD**

Typical reverse recovered energy loss as a function of gate resistor

$E_{rec} = f(R_g)$



With an inductive load at

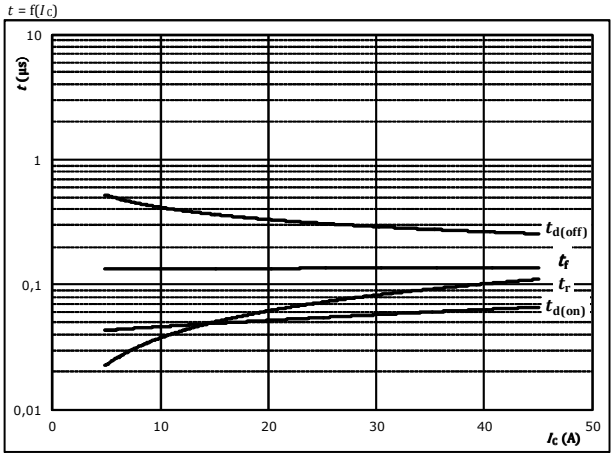
V_{CE} =	700	V	T_j:	25 °C
V_{GE} =	0 / 15	V		125 °C
I_C =	25	A		150 °C

Brake Switching Characteristics

figure 5. IGBT

Typical switching times as a function of collector current

$t = f(I_C)$



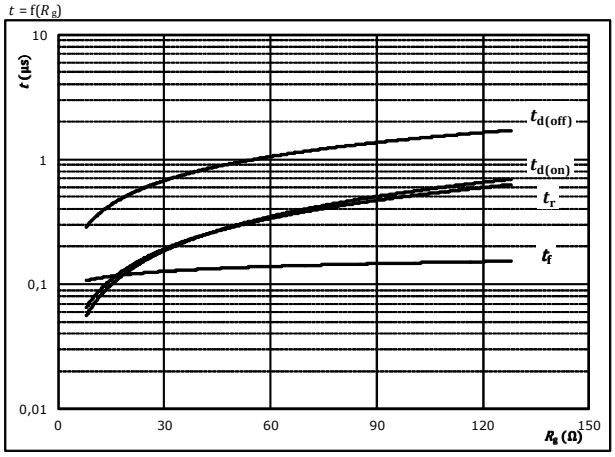
With an inductive load at

T_j =	150	°C
V_{CE} =	700	V
V_{GE} =	0 / 15	V
R_{gon} =	8	Ω
R_{goff} =	8	Ω

figure 6. IGBT

Typical switching times as a function of gate resistor

$t = f(R_g)$



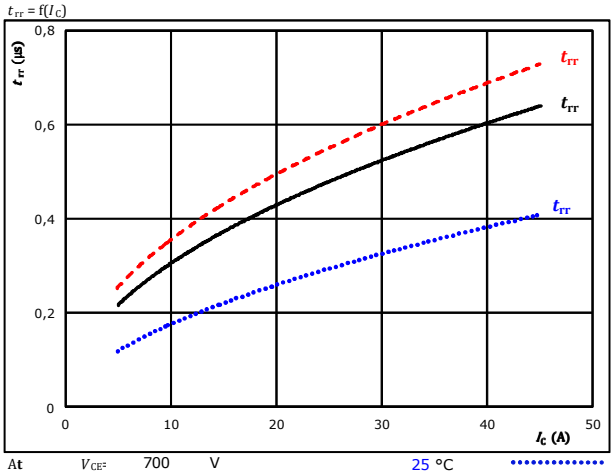
With an inductive load at

T_j =	150	°C
V_{CE} =	700	V
V_{GE} =	0 / 15	V
I_C =	25	A

figure 7. FWD

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$



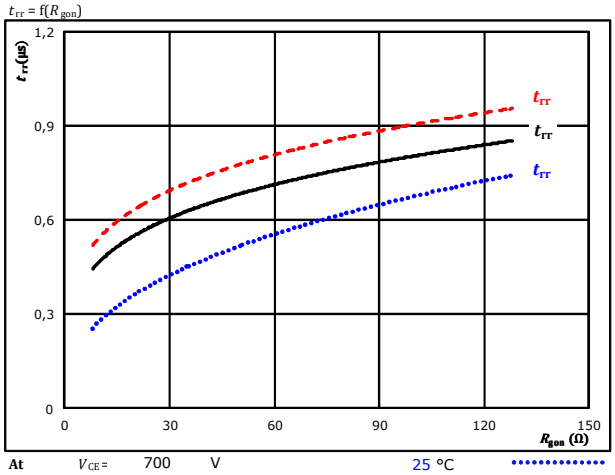
At

V_{CE} =	700	V	T_j:	25 °C
V_{GE} =	0 / 15	V		125 °C
R_{gon} =	8	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

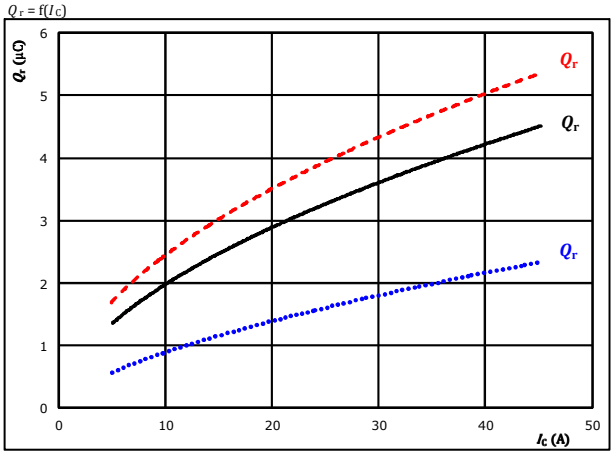
V_{CE} =	700	V	T_j:	25 °C
V_{GE} =	0 / 15	V		125 °C
I_C =	25	A		150 °C

Brake Switching Characteristics

figure 9. **FWD**

Typical recovered charge as a function of collector current

$Q_r = f(I_C)$

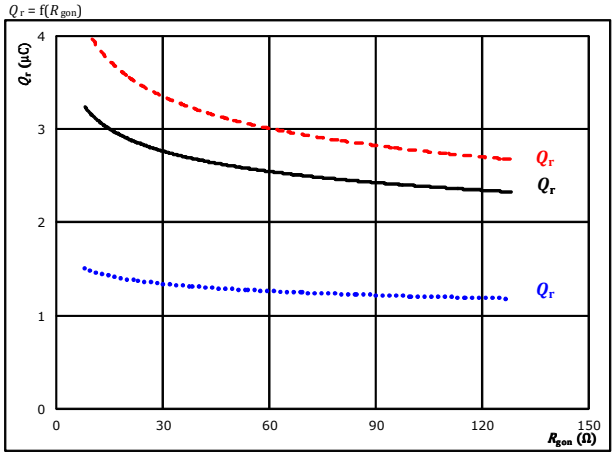


At					
V_{CE} =	700	V		25 °C	
V_{GE} =	0 / 15	V	T_j:	125 °C	
R_{gon} =	8	Ω		150 °C	

figure 10. **FWD**

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

$Q_r = f(R_{gon})$

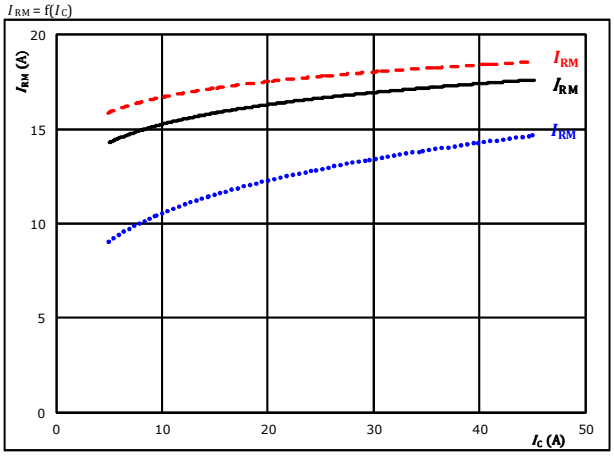


At					
V_{CE}=	700	V		25 °C	
V_{GE} =	0 / 15	V	T_j:	125 °C	
I_C=	25	A		150 °C	

figure 11. **FWD**

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

$I_{RM} = f(I_C)$

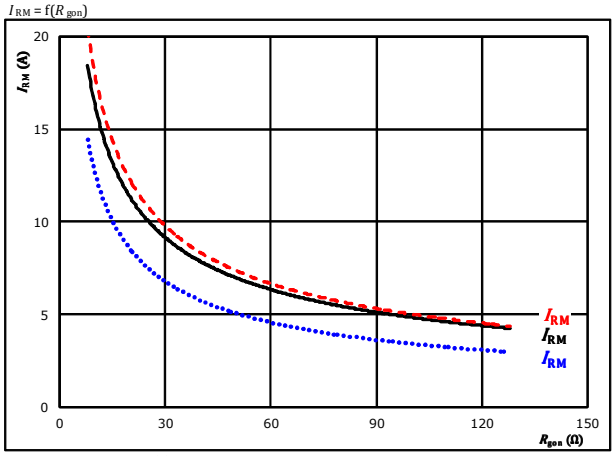


At					
V_{CE}:	700	V		25 °C	
V_{GE} =	0 / 15	V	T_j:	125 °C	
R_{gon} =	8	Ω		150 °C	

figure 12. **FWD**

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

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



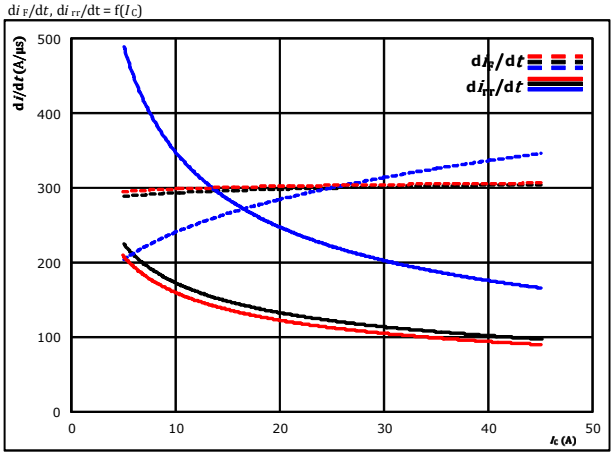
At					
V_{CE} =	700	V		25 °C	
V_{GE} =	0 / 15	V	T_j:	125 °C	
I_C =	25	A		150 °C	

Brake Switching Characteristics

figure 13. **FWD**

Typical rate of fall of forward and reverse recovery current as a function of collector current

$di_F/dt, di_{rr}/dt = f(I_C)$

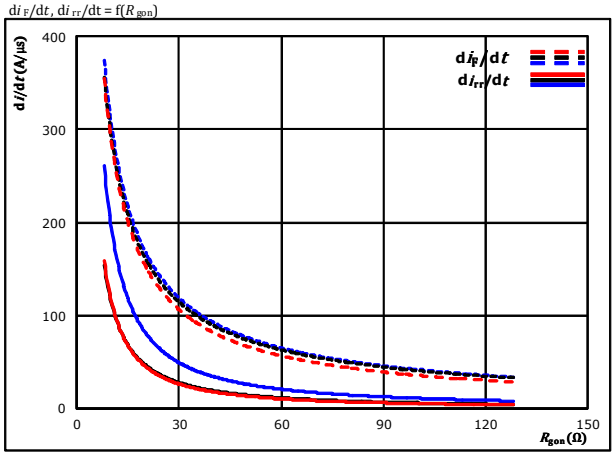


At						
	V_{CE} =	700	V		25	°C
	V_{GE} =	0 / 15	V	T_j:	125	°C
	R_{gon} =	8	Ω		150	°C

figure 14. **FWD**

Typical rate of fall of forward and reverse recovery current as a function of IGBT turn on gate resistor

$di_F/dt, di_{rr}/dt = f(R_{gon})$

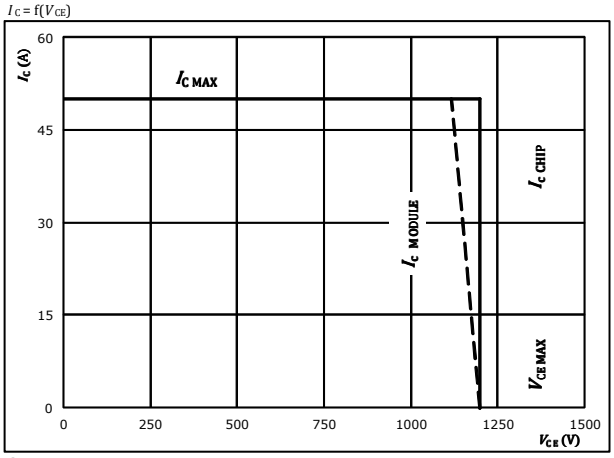


At						
	V_{CE} =	700	V		25	°C
	V_{GE} =	0 / 15	V	T_j:	125	°C
	I_C =	25	A		150	°C

figure 15. **IGBT**

Reverse bias safe operating area

$I_C = f(V_{CE})$



At

T_j =	175	°C	
R_{gon} =	8	Ω	
R_{goff} =	8	Ω	

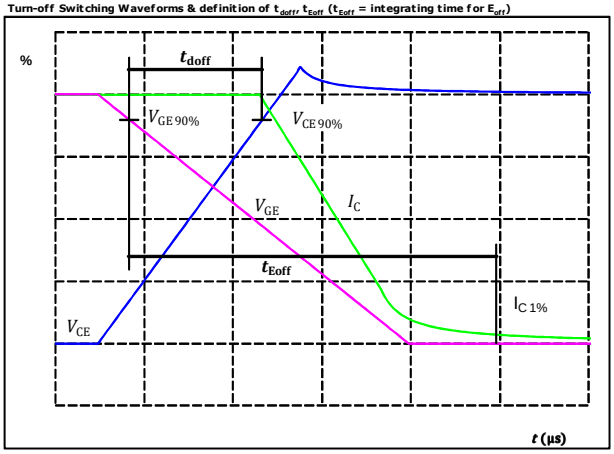
Brake Switching Definitions

General conditions

T_j	=	125 °C
R_{gon}	=	8 Ω
R_{goff}	=	8 Ω

figure 1. IGBT

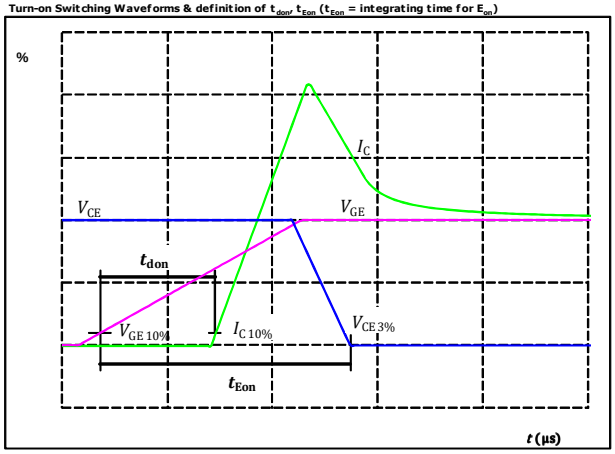
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff} (t_{Eoff} = integrating time for E_{off})



$V_{GE}(0\%)$ =	0	V
$V_{GE}(100\%)$ =	15	V
$V_C(100\%)$ =	700	V
$I_C(100\%)$ =	25	A
t_{doff} =	301	ns

figure 2. IGBT

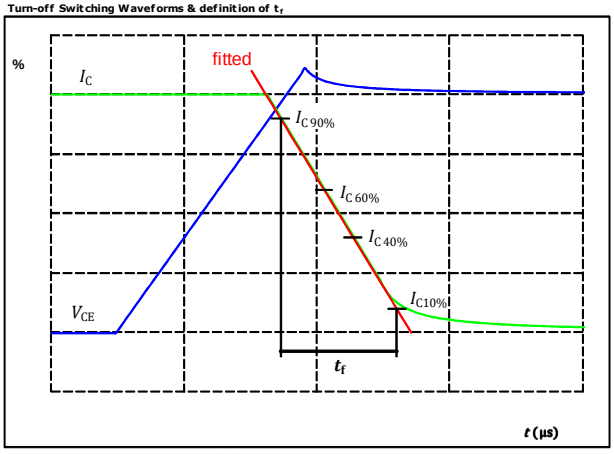
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon} (t_{Eon} = integrating time for E_{on})



$V_{GE}(0\%)$ =	0	V
$V_{GE}(100\%)$ =	15	V
$V_C(100\%)$ =	700	V
$I_C(100\%)$ =	25	A
t_{don} =	59	ns

figure 3. IGBT

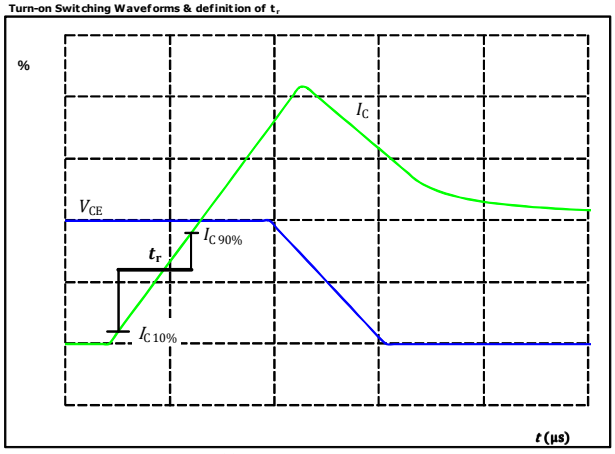
Turn-off Switching Waveforms & definition of t_f



$V_C(100\%)$ =	700	V
$I_C(100\%)$ =	25	A
t_f =	104	ns

figure 4. IGBT

Turn-on Switching Waveforms & definition of t_r

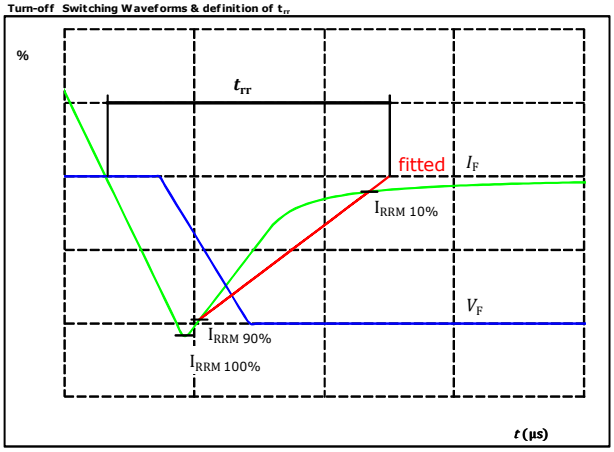


$V_C(100\%)$ =	700	V
$I_C(100\%)$ =	25	A
t_r =	68	ns

Brake Switching Characteristics

figure 5. **FWD**

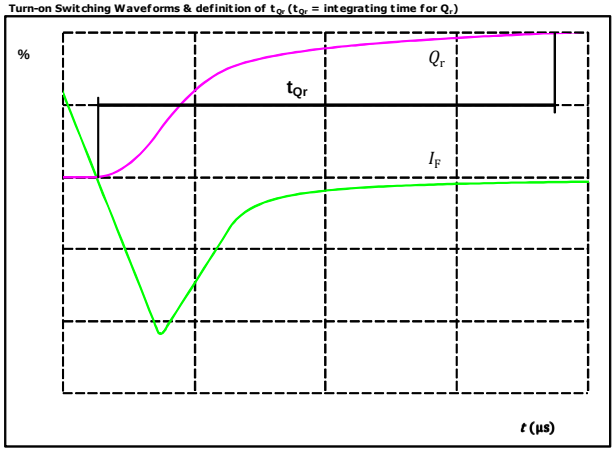
Turn-off Switching Waveforms & definition of t_{rr}



V_F (100%) =	700	V
I_F (100%) =	25	A
I_{RRM} (100%) =	18	A
t_{rr} =	473	ns

figure 6. **FWD**

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



I_F (100%) =	25	A
Q_r (100%) =	3,20	µC

Vincotech

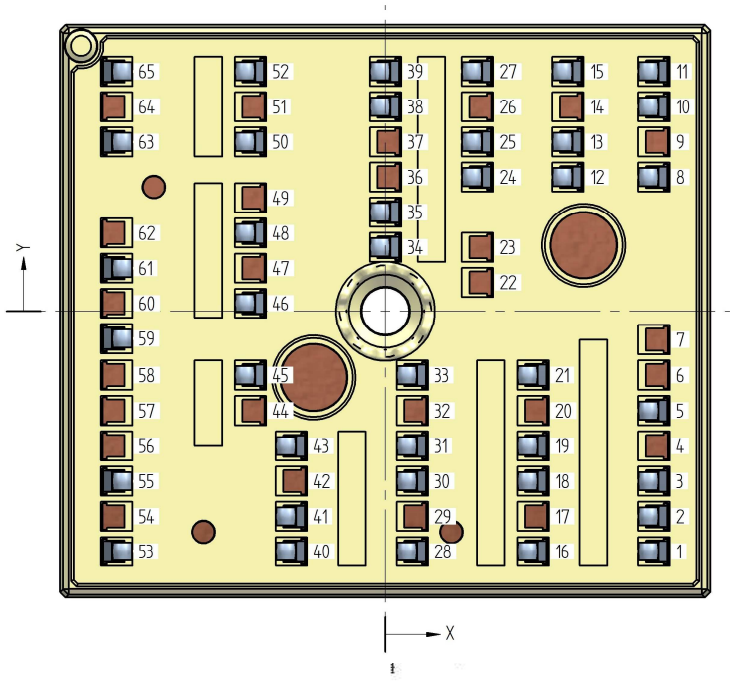
Ordering Code & Marking

Version	Ordering Code
With std lid (6.5mm height) + no thermal grease	V23990-K229-A40-/0A/
With thin lid (2.8mm height) + no thermal grease	V23990-K229-A40-/0B/
With std lid (6.5mm height) + thermal grease (0,8 W/mK, P12, silicone-based)	V23990-K229-A40-/1A/
With thin lid (2.8mm height) + thermal grease (0,8 W/mK, P12, silicone-based)	V23990-K229-A40-/1B/
With std lid (6.5mm height) + thermal grease (2,5 W/mK, TG20032, silicone-free)	V23990-K229-A40-/4A/
With thin lid (2.8mm height) + thermal grease (2,5 W/mK, TG20032, silicone-free)	V23990-K229-A40-/4B/
With std lid (6.5mm height) + thermal grease (2,5 W/mK, HPTP, silicone-based)	V23990-K229-A40-/5A/
With thin lid (2.8mm height) + thermal grease (2,5 W/mK, HPTP, silicone-based)	V23990-K229-A40-/5B/

Text	**VIN**	**Date code**	**Name&Ver**	**UL**	**Lot**	**Serial**
	VIN	WWYY	NNNNNNNVV	UL	LLLLL	SSSS
Datamatrix	**Type&Ver**	**Lot number**	**Serial**	**Date code**		
	TTTTTTTVV	LLLLL	SSSS	WWYY		

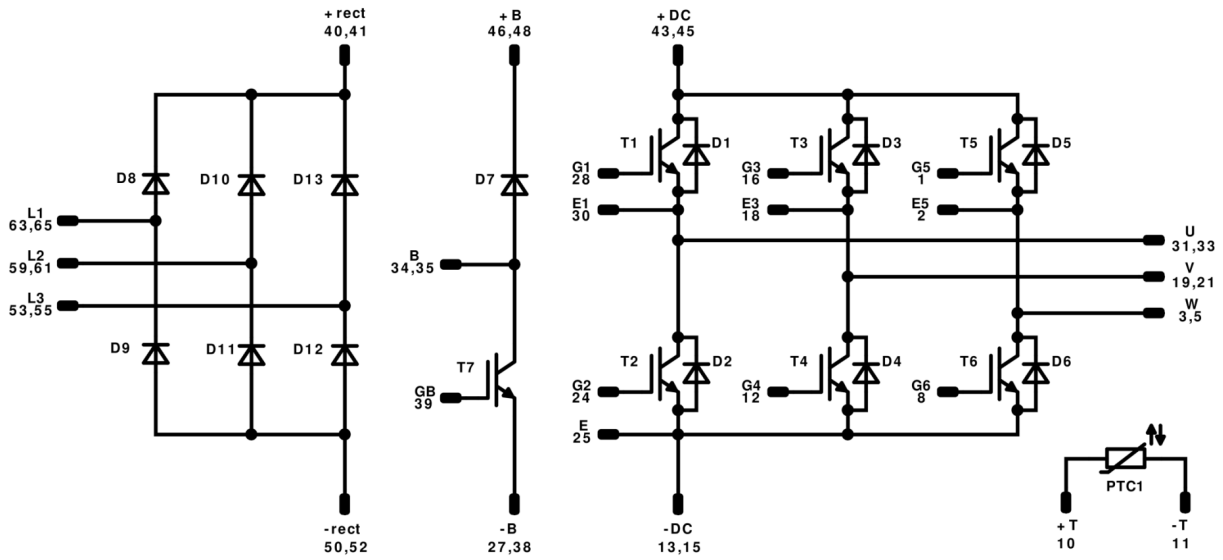
Outline

PCB pad table				PCB pad table			
Pin	X	Y	Function	Pin	X	Y	Function
1	24,38	-21,8	G5	45	-12,22	-5,8	+DC
2	24,38	-18,6	E5	46	-12,22	0,7	+B
3	24,38	-15,4	W	47	Not assembled		
4	Not assembled			48	-12,22	7,1	+B
5	24,38	-9	W	49	Not assembled		
6	Not assembled			50	-12,22	15,4	-rect
7	Not assembled			51	Not assembled		
8	24,38	12,2	G6	52	-12,22	21,8	-rect
9	Not assembled			53	-24,38	-21,8	L3
10	24,38	18,6	+T	54	Not assembled		
11	24,38	21,8	-T	55	-24,38	-15,4	L3
12	16,58	12,2	G4	56	Not assembled		
13	16,58	15,4	-DC	57	Not assembled		
14	Not assembled			58	Not assembled		
15	16,58	21,8	-DC	59	-24,38	-2,5	L2
16	13,42	-21,8	G3	60	Not assembled		
17	Not assembled			61	-24,38	3,9	L2
18	13,42	-15,4	E3	62	Not assembled		
19	13,42	-12,2	V	63	-24,38	15,4	L1
20	Not assembled			64	Not assembled		
21	13,42	-5,8	V	65	-24,38	21,8	L1
22	Not assembled						
23	Not assembled						
24	8,38	12,2	G2				
25	8,38	15,4	E				
26	Not assembled						
27	8,38	21,8	-B				
28	2,46	-21,8	G1				
29	Not assembled						
30	2,46	-15,4	E1				
31	2,46	-12,2	U				
32	Not assembled						
33	2,46	-5,8	U				
34	0,03	5,8	B				
35	0,03	9	B				
36	Not assembled						
37	Not assembled						
38	0,03	18,6	-B				
39	0,03	21,8	GB				
40	-8,5	-21,8	+rect				
41	-8,5	-18,6	+rect				
42	Not assembled						
43	-8,5	-12,2	+DC				
44	Not assembled						



Pad positions refers to center point. For more informations on pad design please see package data

Pinout



Identification

ID	Component	Voltage	Current	Function	Comment
T1, T2, T3, T4, T5, T6	IGBT	1200 V	25 A	Inverter Switch	
D1, D2, D3, D4, D5, D6	FWD	1200 V	25 A	Inverter Diode	
T7	IGBT	1200 V	25 A	Brake Switch	
D7	FWD	1200 V	25 A	Brake Diode	
D8, D9, D10, D11, D12, D13	Rectifier	1600 V	35 A	Rectifier Diode	
PTC1	PTC			Thermistor	

Packaging instruction				
Standard packaging quantity (SPQ) 72	>SPQ	Standard	<SPQ	Sample

Handling instruction
Handling instructions for MiniSkiiP® 2 packages see vincotech.com website.

Package data
Package data for MiniSkiiP® 2 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
V23990-K229-A40-D5-14	26 Feb. 2018	Update with HPTP	All

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.