Vincotech

V23990-P545-A28-PM
datasheet

***flow*PIM 0** | **600 V / 20 A**

Topology features

- Open Emitter configuration
- Temperature sensor
- Converter+Brake+Inverter

Component features

- Easy paralleling
- Low turn-off losses
- Low collector emitter saturation voltage
- Positive temperature coefficient
- Short tail current

Housing features

- Base isolation: Al_2O_3
- Clip-in, reliable mechanical connection, qualified for wave soldering
- Convex shaped substrate for superior thermal contact
- Thermo-mechanical push-and-pull force relief
- Solder pin

Extra features

- with three-phase standard rectifier

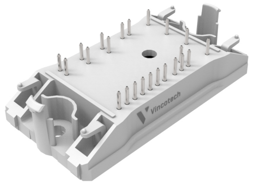
Target applications

- Industrial drives
- Embedded drives

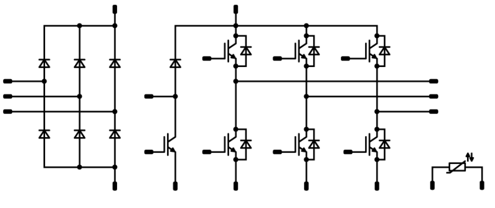
Types

- V23990-P545-A28-PM

flow 0 12 mm housing



Schematic



Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Conditions		Value	Unit
Inverter Switch					
Collector-emitter voltage	V_{CES}			600	V
Collector current (DC current)	I_C	$T_j = T_{jmax}$	T_s = 80 °C	26	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}		60	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	56	W
Gate-emitter voltage	V_{GES}			±20	V
Short circuit ratings	t_{SC}	V_{GE} = 15 V, V_{CC} = 360 V	T_j = 150 °C	6	µs
Maximum junction temperature	T_{jmax}			175	°C
Inverter Diode					
Peak repetitive reverse voltage	V_{RRM}			600	V
Forward current (DC current)	I_F	$T_j = T_{jmax}$	T_s = 80 °C	21	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}		40	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	37	W
Maximum junction temperature	T_{jmax}			175	°C
Brake Switch					
Collector-emitter voltage	V_{CES}			600	V
Collector current (DC current)	I_C	$T_j = T_{jmax}$	T_s = 80 °C	21	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}		45	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	52	W
Gate-emitter voltage	V_{GES}			±20	V
Short circuit ratings	t_{SC}	V_{GE} = 15 V, V_{CC} = 360 V	T_j = 150 °C	6	µs
Maximum junction temperature	T_{jmax}			175	°C

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Conditions		Value	Unit
Brake Diode					
Peak repetitive reverse voltage	V_{RRM}			600	V
Forward current (DC current)	I_F	$T_j = T_{jmax}$	T_s = 80 °C	18	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}		30	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	35	W
Maximum junction temperature	T_{jmax}			175	°C
Rectifier Diode					
Peak repetitive reverse voltage	V_{RRM}			1600	V
Forward current (DC current)	I_F	$T_j = T_{jmax}$	T_s = 80 °C	34	A
Surge (non-repetitive) forward current	I_{FSM}	Single Half Sine Wave, t_p = 10 ms	T_j = 150 °C	200	A
Surge current capability	I^2t			200	A^2s
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	44	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	6000	V
Isolation voltage	V_{isol}	AC Voltage	t_p = 1 min	2500	V
Creepage distance				min 12,7	mm
Clearance				9,29	mm
Comparative Tracking Index	CTI			≥ 200	

*100 % tested in production

Characteristic Values

Parameter	Symbol	Conditions	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	Unit
Inverter Switch										
Static										
Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,00029	25	5	5,8	6,5	V
Collector-emitter saturation voltage	V_{CEsat}		15		20	25 125	1,1	1,55 1,75	1,9(1)	V
Collector-emitter cut-off current	I_{CES}		0	600		25			1,1	μA
Gate-emitter leakage current	I_{GES}		20	0		25			300	nA
Internal gate resistance	r_g							None		Ω
Input capacitance	C_{ies}	f = 1 Mhz	0	25		25		1100		pF
Output capacitance	C_{oes}							71		pF
Reverse transfer capacitance	C_{res}							32		pF
Gate charge	Q_g	V_{CC} = 480 V	0/15		20	25		120		nC
Thermal										
Thermal resistance junction to sink (2)	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						1,7		K/W
Dynamic										
Turn-on delay time	$t_{d(on)}$	R_{gon} = 16 Ω R_{goff} = 8 Ω	0/15	300	20	25 125		15 14		ns
Rise time	t_r					25 125		12,2 15,5		ns
Turn-off delay time	$t_{d(off)}$					25 125		198 212		ns
Fall time	t_f					25 125		100 104		ns
Turn-on energy (per pulse)	E_{on}	Q_{rFWD}=0,454 μC Q_{rFWD}=1,35 μC				25 125		0,314 0,427		mWs
Turn-off energy (per pulse)	E_{off}					25 125		0,548 0,649		mWs

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				20	25 125	1,25	1,81 1,76	1,95(1)	V
Reverse leakage current	I_R	V_r = 600 V				25			27	µA
Thermal										
Thermal resistance junction to sink (2)	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						2,6		K/W
Dynamic										
Peak recovery current	I_{RM}	di/dt=2170 A/µs di/dt=1490 A/µs	0/15	300	20	25 125		19 21,1		A
Reverse recovery time	t_{rr}					25 125		33 192		ns
Recovered charge	Q_r					25 125		0,454 1,35		µC
Reverse recovered energy	E_{rec}					25 125		0,06 0,271		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125		1450 1050		A/µs

Characteristic Values

Parameter	Symbol	Conditions	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	Unit
Brake Switch										
Static										
Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,00021	25	5	5,8	6,5	V
Collector-emitter saturation voltage	V_{CEsat}		15		15	25 125	1,1	1,64 1,87	1,9(1)	V
Collector-emitter cut-off current	I_{CES}		0	600		25			0,85	µA
Gate-emitter leakage current	I_{GES}		20	0		25			300	nA
Internal gate resistance	r_g							None		Ω
Input capacitance	C_{ies}	f = 1 Mhz	0	25		25		800		pF
Output capacitance	C_{oes}	f = 1 Mhz	0	25		25		55		pF
Reverse transfer capacitance	C_{res}	f = 1 Mhz	0	25		25		24		pF
Gate charge	Q_g		0/15		0	25		87		nC
Thermal										
Thermal resistance junction to sink (2)	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						1,83		K/W
Dynamic										
Turn-on delay time	$t_{d(on)}$	R_{gon} = 16 Ω R_{goff} = 8 Ω	0/15	300	15	25 125		14,5 13,5		ns
Rise time	t_r	R_{gon} = 16 Ω R_{goff} = 8 Ω	0/15	300	15	25 125		10,8 13,8		ns
Turn-off delay time	$t_{d(off)}$	R_{gon} = 16 Ω R_{goff} = 8 Ω	0/15	300	15	25 125		128 145		ns
Fall time	t_f	R_{gon} = 16 Ω R_{goff} = 8 Ω	0/15	300	15	25 125		91 94,4		ns
Turn-on energy (per pulse)	E_{on}	Q_{rFWD}=0,518 µC Q_{rFWD}=1,02 µC	0/15	300	15	25 125		0,201 0,282		mWs
Turn-off energy (per pulse)	E_{off}		0/15	300	15	25 125		0,317 0,4		mWs

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				15	25 125	1,25	1,86 1,76	1,95(1)	V
Reverse leakage current	I_R	V_r = 600 V				25			27	µA
Thermal										
Thermal resistance junction to sink (2)	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						2,75		K/W
Dynamic										
Peak recovery current	I_{RM}	di/dt=1300 A/µs di/dt=1220 A/µs	0/15	300	15	25 125		13,7 15,1		A
Reverse recovery time	t_{rr}					25 125		128 201		ns
Recovered charge	Q_r					25 125		0,518 1,02		µC
Reverse recovered energy	E_{rec}					25 125		0,103 0,215		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125		1310 657		A/µs
Rectifier Diode										
Static										
Forward voltage	V_F				8	25 125		0,983 0,889	1,21(1) 1,1(1)	V
Reverse leakage current	I_R	V_r = 1600 V				25			50	µA
Thermal										
Thermal resistance junction to sink (2)	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						1,59		K/W

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	
Thermistor										
Static										
Rated resistance	R					25		22		kΩ
Deviation of R_{100}	$\Delta_{R/R}$	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	

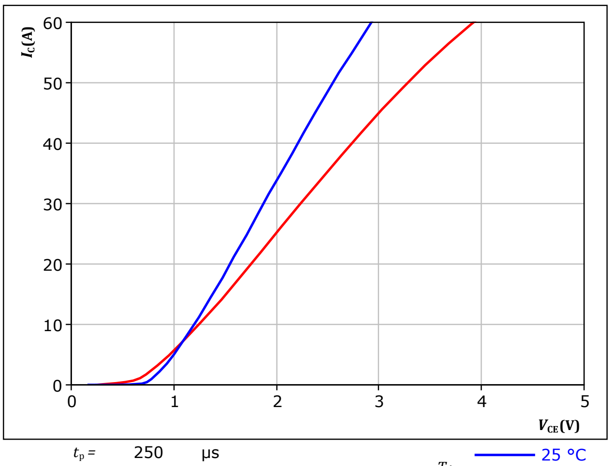
(1) Value at chip level
(2) Only valid with pre-applied Vincotech thermal interface material.

Inverter Switch Characteristics

figure 1. **IGBT**

Typical output characteristics

I_C = f(V_{CE})



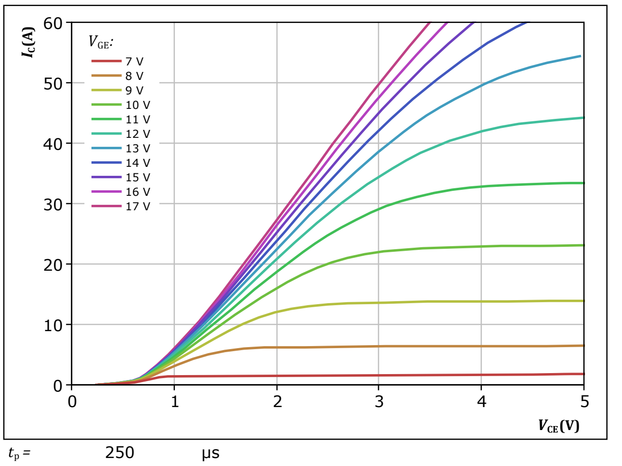
t_p =	250	µs
V_{GE} =	15	V

T_j: 25 °C, 125 °C

figure 2. **IGBT**

Typical output characteristics

I_C = f(V_{CE})



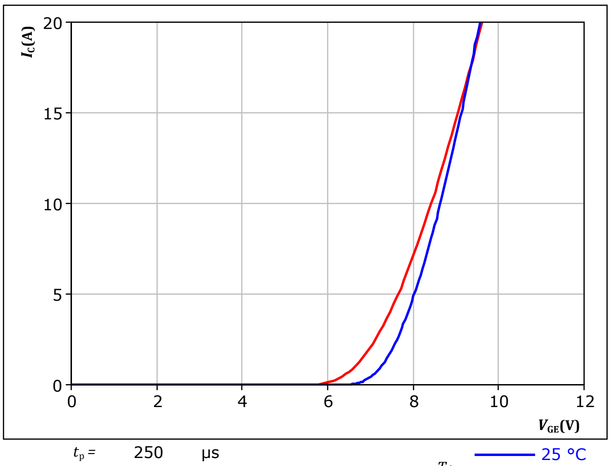
t_p =	250	µs
T_j =	125	°C

V_{GE} from 7 V to 17 V in steps of 1 V

figure 3. **IGBT**

Typical transfer characteristics

I_C = f(V_{GE})



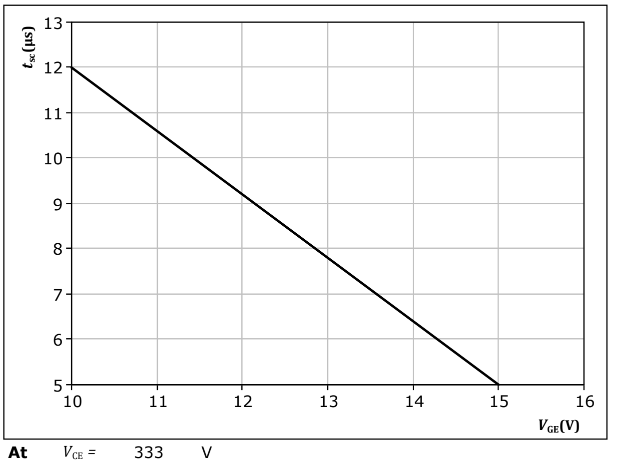
t_p =	250	µs
V_{CE} =	10	V

T_j: 25 °C, 125 °C

figure 4. **IGBT**

Short circuit withstand time as a function of V_{GE}

t_{sc} = f(V_{GE})



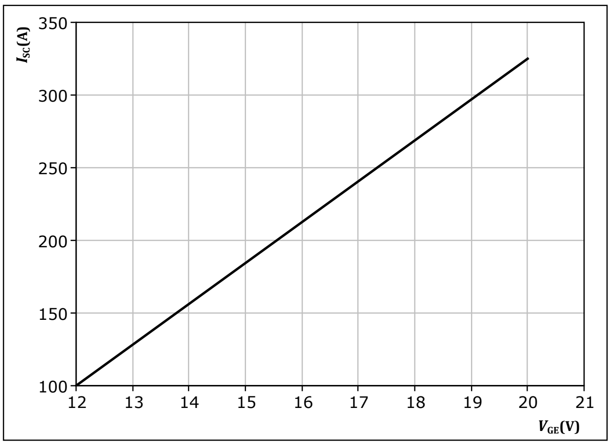
At	V_{CE} =	333	V
	$T_j \leq$	333	°C

Inverter Switch Characteristics

figure 5. **IGBT**

Typical short circuit current as a function of V_{GE}

I_{SC} = f(V_{GE})

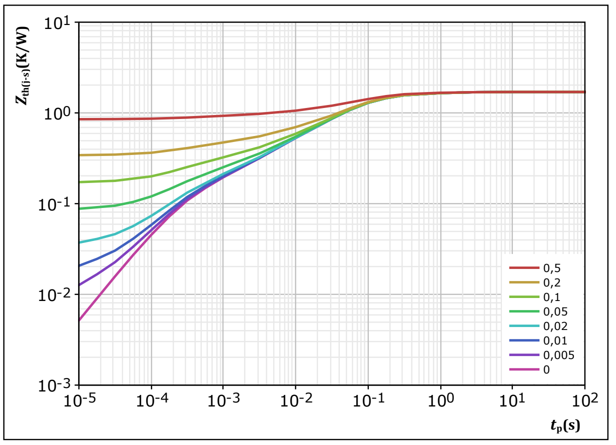


At	V_{CE} =	333	V
	T_j ≤	333	°C

figure 6. **IGBT**

Transient thermal impedance as a function of pulse width

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



D =	t_p / T	
$R_{th(j-s)}$ =	1,701	K/W

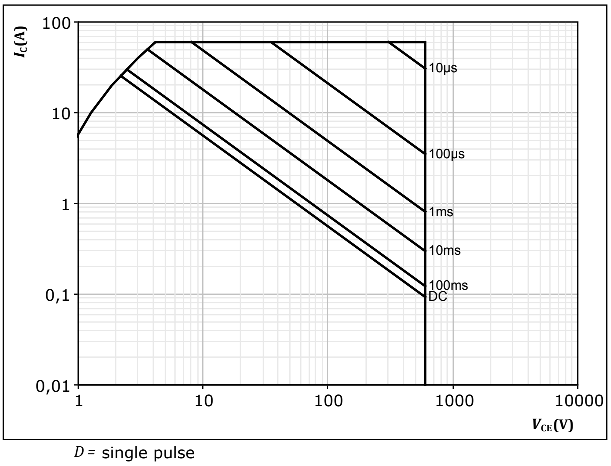
IGBT thermal model values

R (K/W)	τ (s)
9,97E-02	1,34E+00
3,46E-01	1,70E-01
8,15E-01	5,34E-02
2,54E-01	7,74E-03
7,70E-02	1,33E-03
1,09E-01	2,63E-04

figure 7. **IGBT**

Safe operating area

I_C = f(V_{CE})

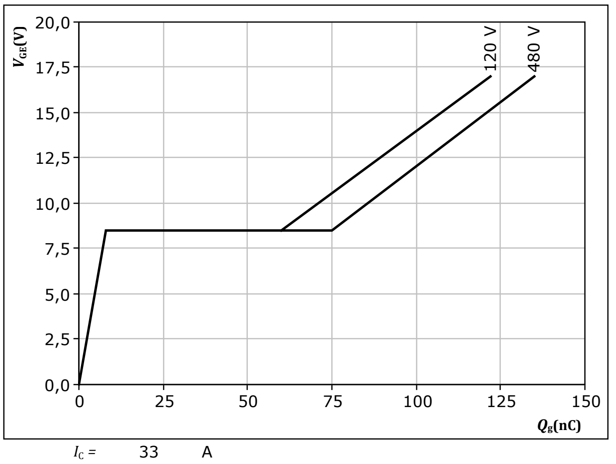


D =	single pulse	
T_s =	80	°C
V_{GE} =	15	V
T_j =	T_{jmax}	

figure 8. **IGBT**

Gate voltage vs gate charge

V_{GE} = f(Q_g)



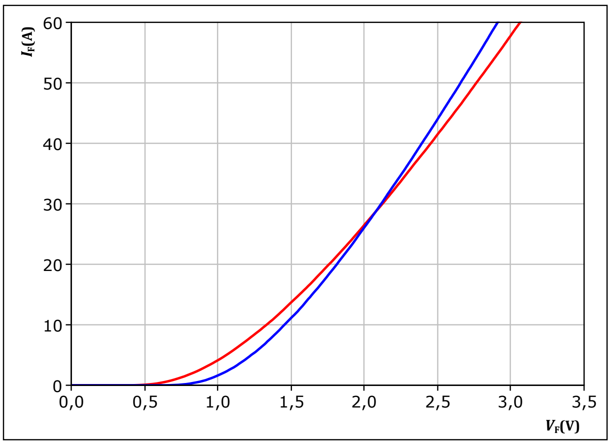
I_C =	33	A
T_j =	25	°C

Inverter Diode Characteristics

figure 9. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



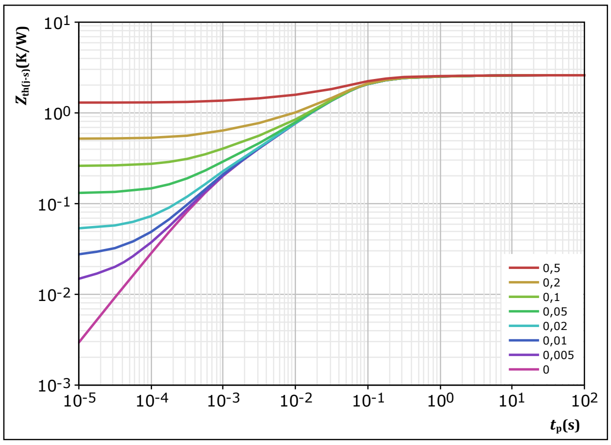
t_p = 250 µs

T_j: 25 °C, 125 °C

figure 10. **FWD**

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$

$R_{th(j-s)}$ = 2,598 K/W

FWD thermal model values

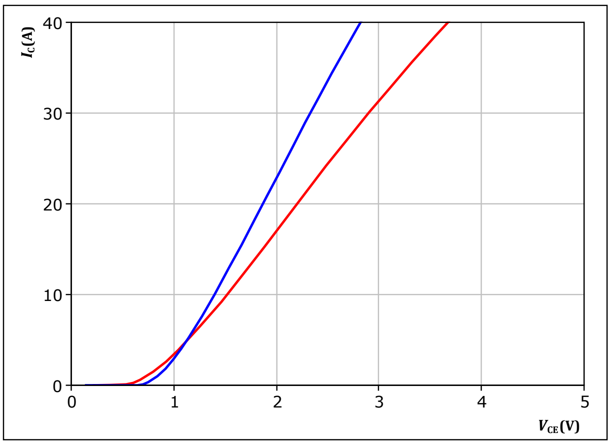
R (K/W)	τ (s)
6,56E-02	4,59E+00
1,58E-01	5,68E-01
8,97E-01	8,41E-02
1,05E+00	3,28E-02
2,75E-01	4,96E-03
1,51E-01	7,65E-04

Brake Switch Characteristics

figure 11. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$



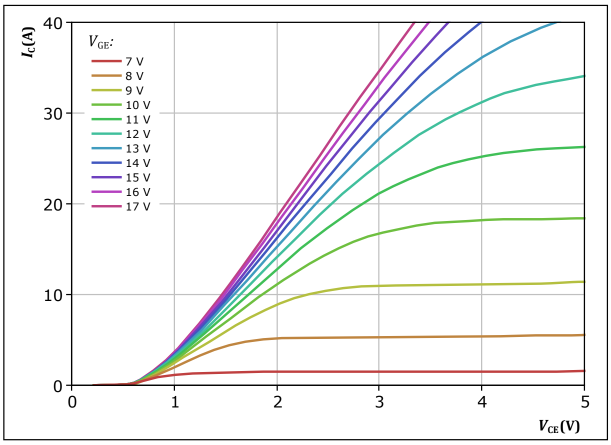
t_p = 250 µs
V_{GE} = 15 V

T_j: 25 °C / 125 °C

figure 12. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

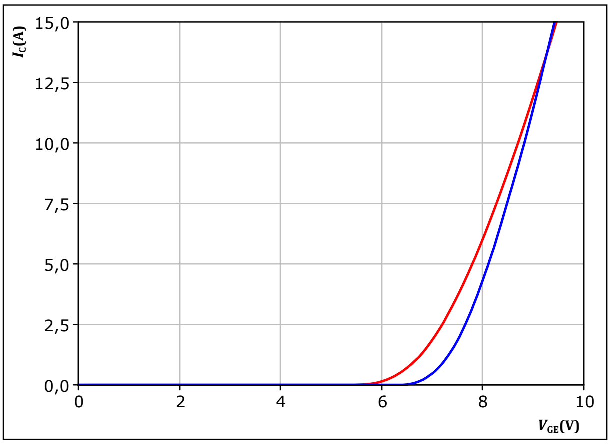


t_p = 250 µs
T_j = 125 °C
V_{GE} from 7 V to 17 V in steps of 1 V

figure 13. **IGBT**

Typical transfer characteristics

$I_C = f(V_{GE})$



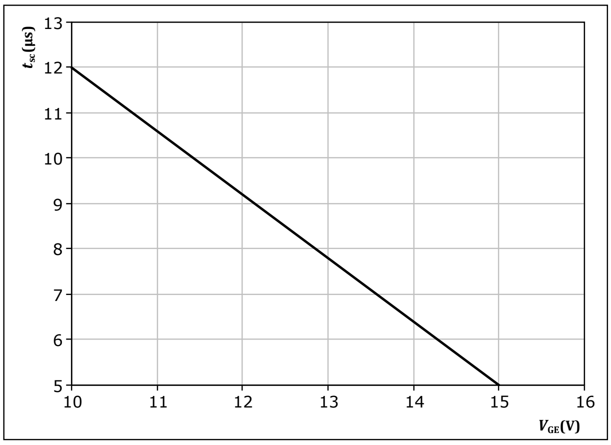
t_p = 250 µs
V_{CE} = 10 V

T_j: 25 °C / 125 °C

figure 14. **IGBT**

Short circuit withstand time as a function of V_{GE}

$t_{sc} = f(V_{GE})$



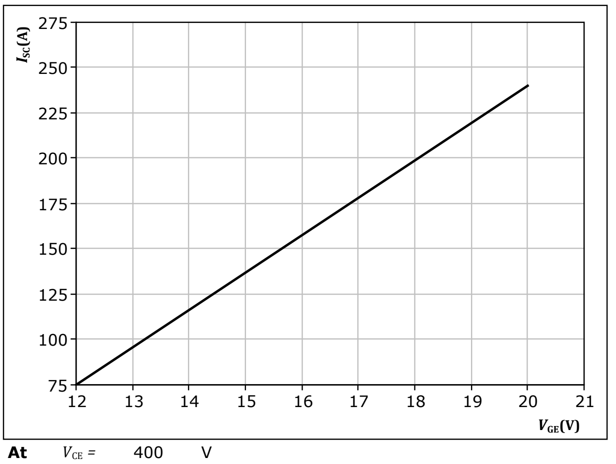
At V_{CE} = 600 V
$T_j \leq$ 25 °C

Brake Switch Characteristics

figure 15. IGBT

Typical short circuit current as a function of V_{GE}

I_{SC} = f(V_{GE})

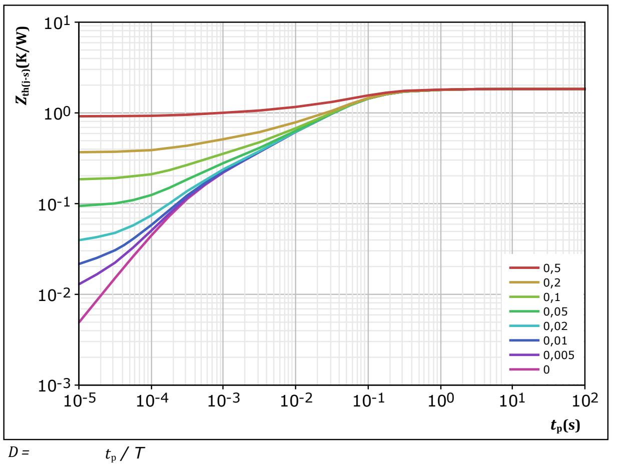


At	V_{CE} =	400	V
	T_j ≤	150	°C

figure 16. IGBT

Transient thermal impedance as a function of pulse width

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



D =	t_p / T	
$R_{th(j-s)}$ =	1,834	K/W

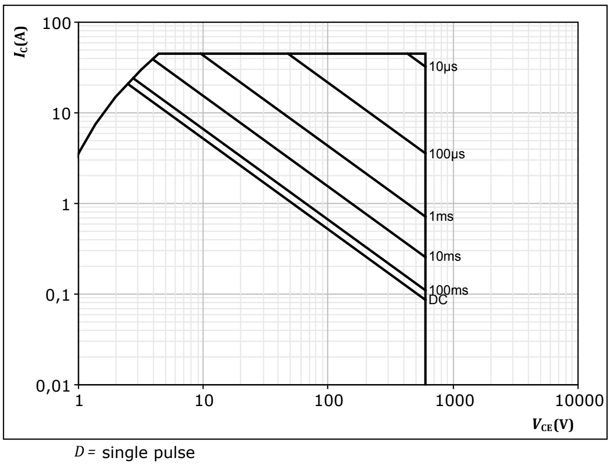
IGBT thermal model values

R (K/W)	τ (s)
8,30E-02	1,29E+00
3,76E-01	1,56E-01
8,46E-01	5,15E-02
2,81E-01	8,16E-03
1,16E-01	2,04E-03
1,32E-01	3,43E-04

figure 17. IGBT

Safe operating area

I_C = f(V_{CE})

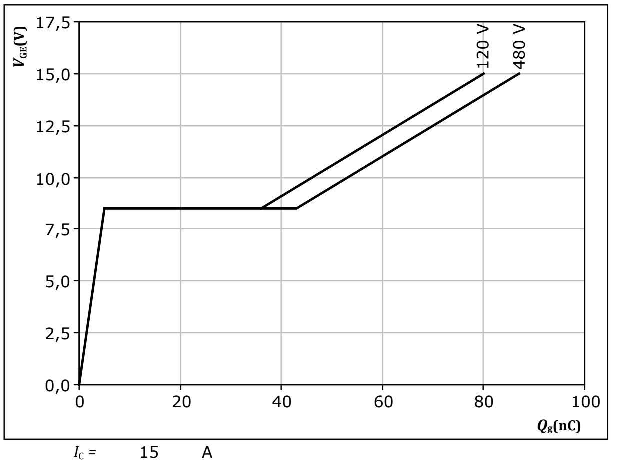


D =	single pulse	
T_s =	80	°C
V_{GE} =	15	V
T_j =	T_{jmax}	

figure 18. IGBT

Gate voltage vs gate charge

V_{GE} = f(Q_g)



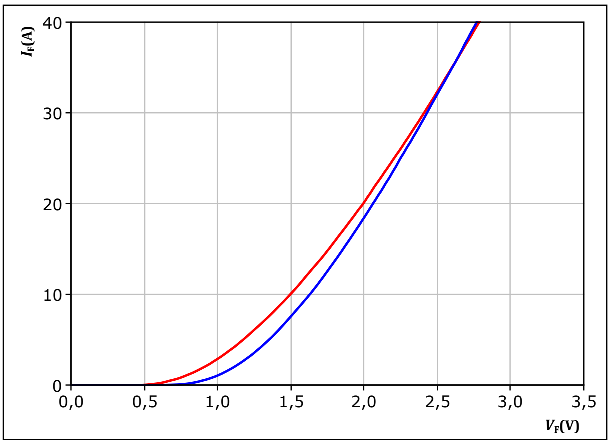
I_C =	15	A
T_j =	25	°C

Brake Diode Characteristics

figure 19. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



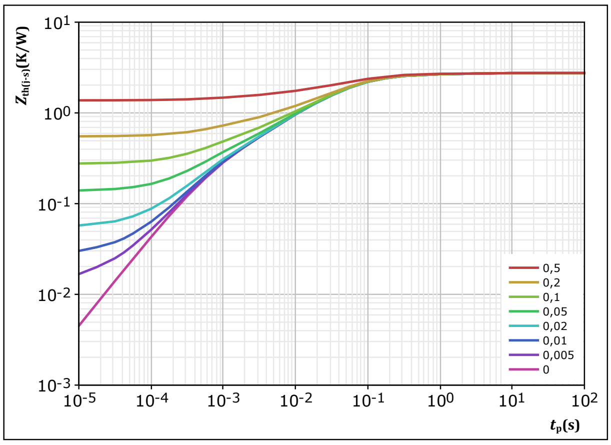
t_p = 250 μs

T_j: 25 °C; 125 °C

figure 20. **FWD**

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$

$R_{th(j-s)}$ = 2,75 K/W

FWD thermal model values

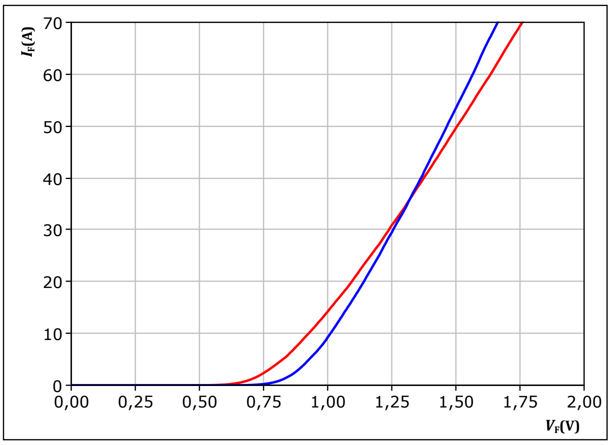
R (K/W)	τ (s)
1,03E-01	3,14E+00
3,03E-01	2,74E-01
1,23E+00	6,07E-02
5,94E-01	1,63E-02
3,18E-01	4,11E-03
2,02E-01	6,37E-04

Rectifier Diode Characteristics

figure 21. **Rectifier**

Typical forward characteristics

I_F = f(V_F)



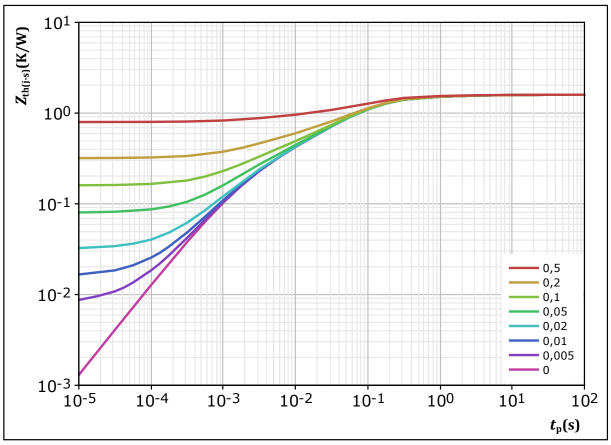
t_p = 250 µs

T_j: 25 °C, 125 °C

figure 22. **Rectifier**

Transient thermal impedance as a function of pulse width

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



D = t_p / T

$R_{th(j-s)}$ = 1,594 K/W

Rectifier thermal model values

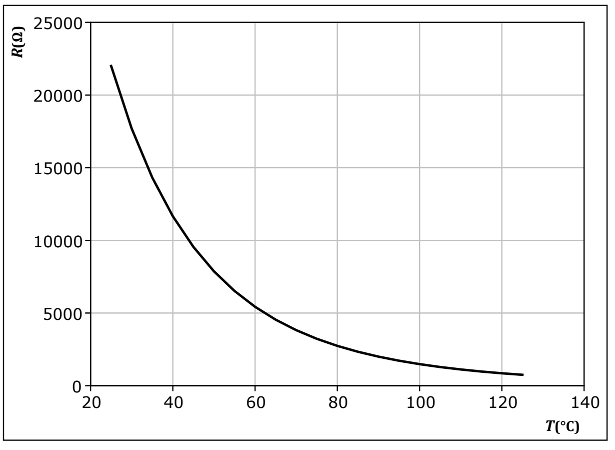
R (K/W)	τ (s)
3,44E-02	9,66E+00
1,12E-01	1,22E+00
5,81E-01	1,45E-01
4,89E-01	5,05E-02
2,38E-01	9,26E-03
1,22E-01	1,79E-03
1,81E-02	7,88E-04

Thermistor Characteristics

figure 23.	Thermistor

Typical NTC characteristic as function of temperature

R_T = f(T)

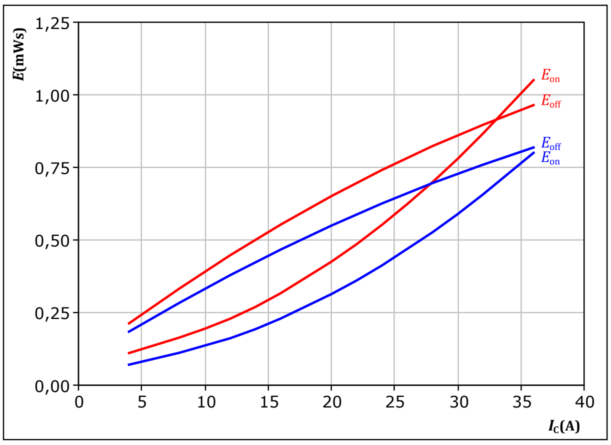


Inverter Switching Characteristics

figure 24. **IGBT**

Typical switching energy losses as a function of collector current

$E = f(I_C)$



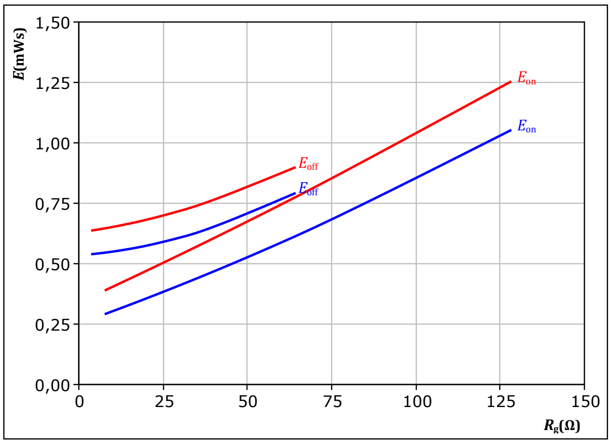
With an inductive load at

V_{CE} =	300	V	T_j:	25 °C
V_{GE} =	0/15	V		125 °C
R_{gon} =	16	Ω		
R_{goff} =	8	Ω		

figure 25. **IGBT**

Typical switching energy losses as a function of IGBT turn on gate resistor

$E = f(R_g)$



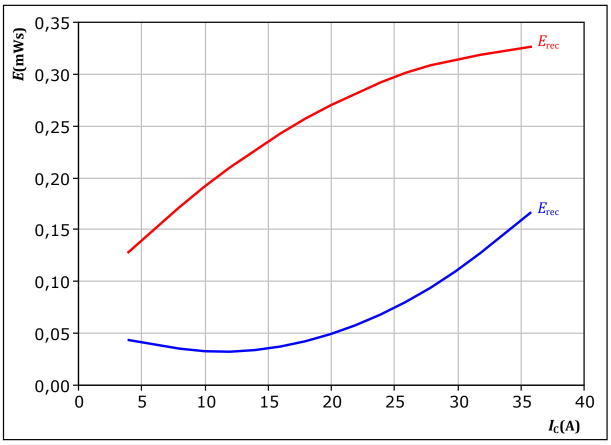
With an inductive load at

V_{CE} =	300	V	T_j:	25 °C
V_{GE} =	0/15	V		125 °C
I_C =	20	A		

figure 26. **FWD**

Typical reverse recovered energy loss as a function of collector current

$E_{rec} = f(I_C)$



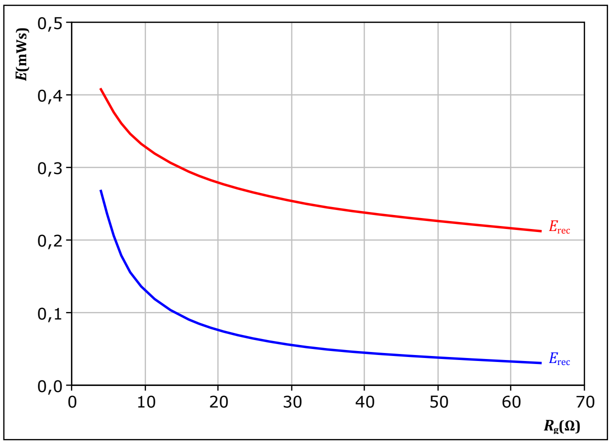
With an inductive load at

V_{CE} =	300	V	T_j:	25 °C
V_{GE} =	0/15	V		125 °C
R_{gon} =	16	Ω		

figure 27. **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

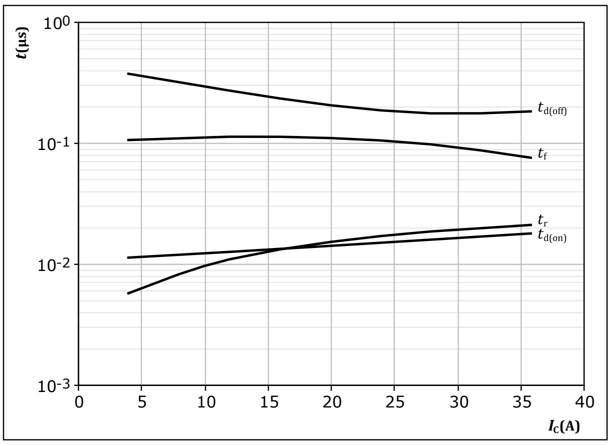
V_{CE} =	300	V	T_j:	25 °C
V_{GE} =	0/15	V		125 °C
I_C =	20	A		

Inverter Switching Characteristics

figure 28. **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



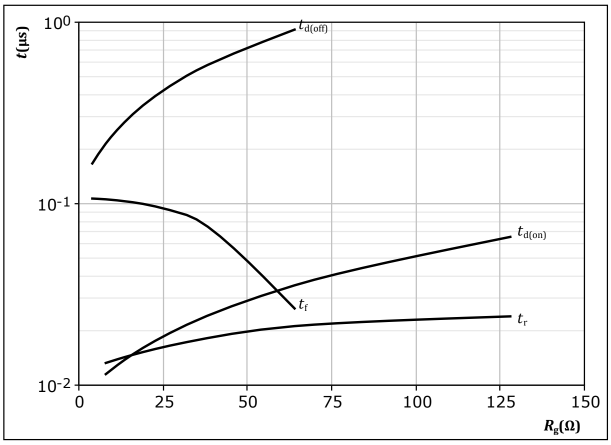
With an inductive load at

T_j =	125	°C
V_{CE} =	300	V
V_{GE} =	0/15	V
R_{gon} =	16	Ω
R_{goff} =	8	Ω

figure 29. **IGBT**

Typical switching times as a function of IGBT turn on gate resistor

$t = f(R_g)$



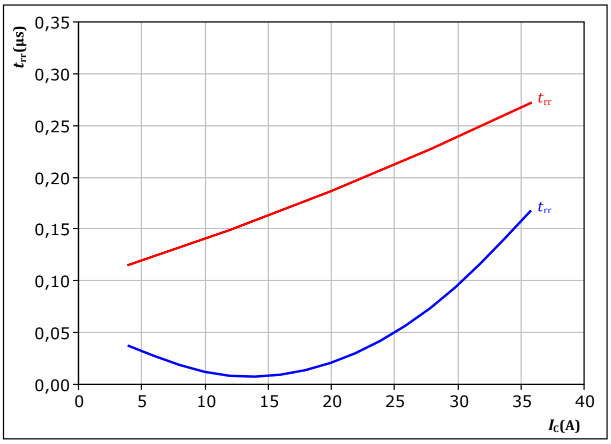
With an inductive load at

T_j =	125	°C
V_{CE} =	300	V
V_{GE} =	0/15	V
I_C =	20	A

figure 30. **FWD**

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$



With an inductive load at

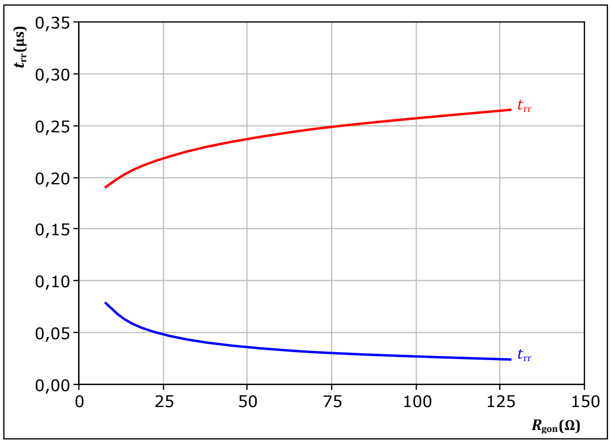
V_{CE} =	300	V
V_{GE} =	0/15	V
R_{gon} =	16	Ω

T_j: 25 °C / 125 °C

figure 31. **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} =	300	V
V_{GE} =	0/15	V
I_C =	20	A

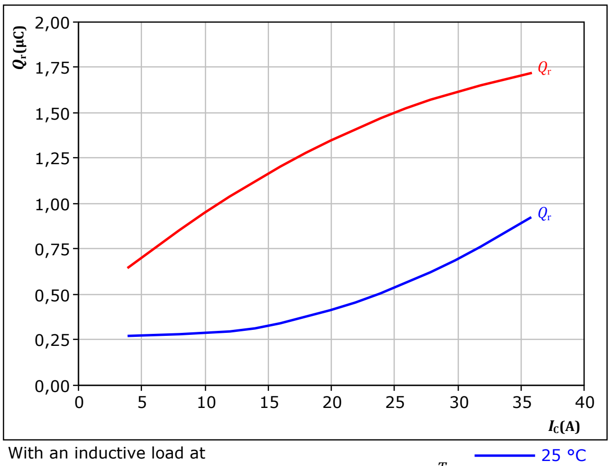
T_j: 25 °C / 125 °C

Inverter Switching Characteristics

figure 32. **FWD**

Typical recovered charge as a function of collector current

Q_r = f(I_C)



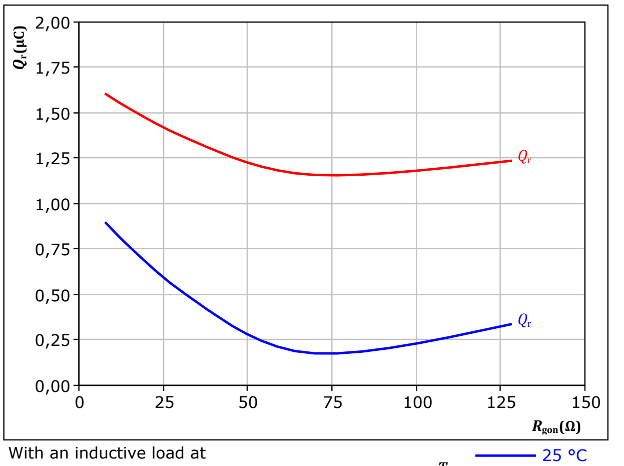
With an inductive load at

V_{CE} =	300	V	T_j: 25 °C (blue), 125 °C (red)
V_{GE} =	0/15	V	
R_{gon} =	16	Ω	

figure 33. **FWD**

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

Q_r = f(R_{gon})



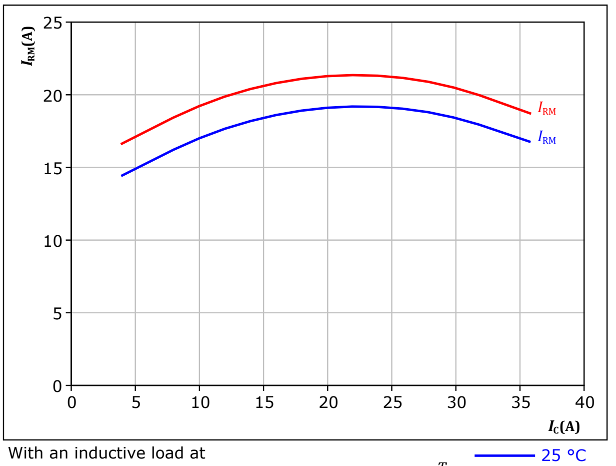
With an inductive load at

V_{CE} =	300	V	T_j: 25 °C (blue), 125 °C (red)
V_{GE} =	0/15	V	
I_C =	20	A	

figure 34. **FWD**

Typical peak reverse recovery current as a function of collector current

I_{RM} = f(I_C)



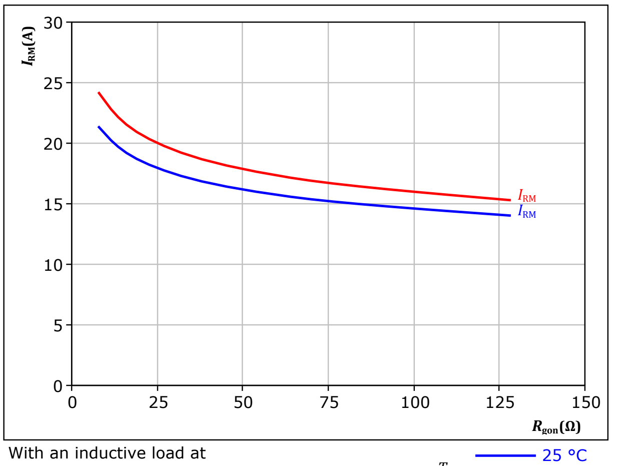
With an inductive load at

V_{CE} =	300	V	T_j: 25 °C (blue), 125 °C (red)
V_{GE} =	0/15	V	
R_{gon} =	16	Ω	

figure 35. **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

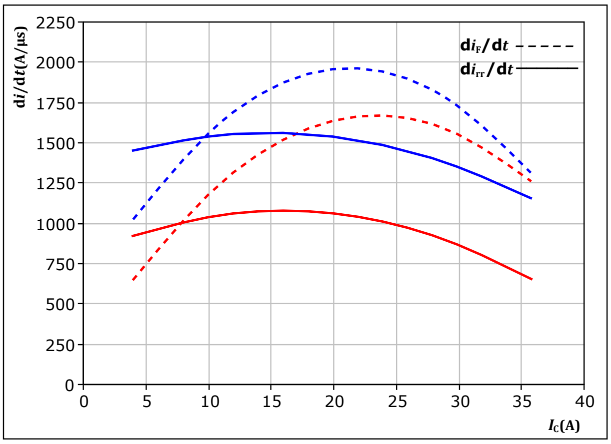
V_{CE} =	300	V	T_j: 25 °C (blue), 125 °C (red)
V_{GE} =	0/15	V	
I_C =	20	A	

Inverter Switching Characteristics

figure 36. **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

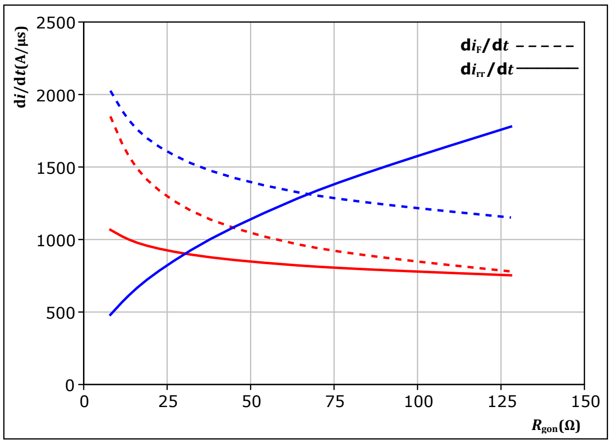
T_j: 25 °C, 125 °C

V_{CE} =	300	V
V_{GE} =	0/15	V
R_{gon} =	16	Ω

figure 37. **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

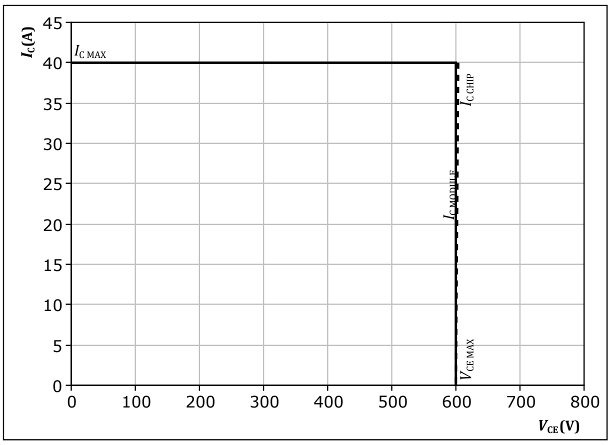
T_j: 25 °C, 125 °C

V_{CE} =	300	V
V_{GE} =	0/15	V
I_C =	20	A

figure 38. **IGBT**

Reverse bias safe operating area

I_C = f(V_{CE})



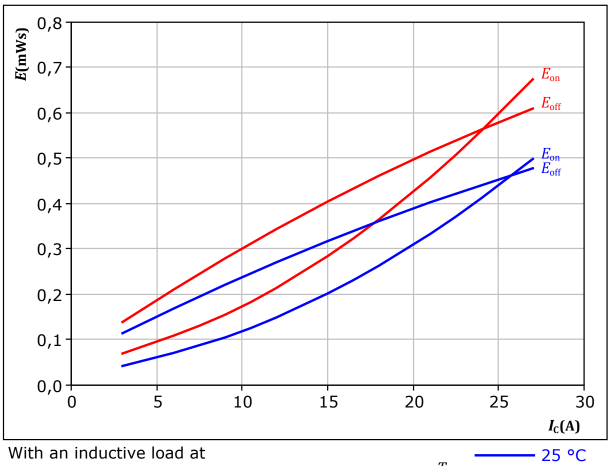
At			
	T_j =	125	°C
	R_{gon} =	16	Ω
	R_{goff} =	8	Ω

Brake Switching Characteristics

figure 39. **IGBT**

Typical switching energy losses as a function of collector current

$E = f(I_C)$



With an inductive load at

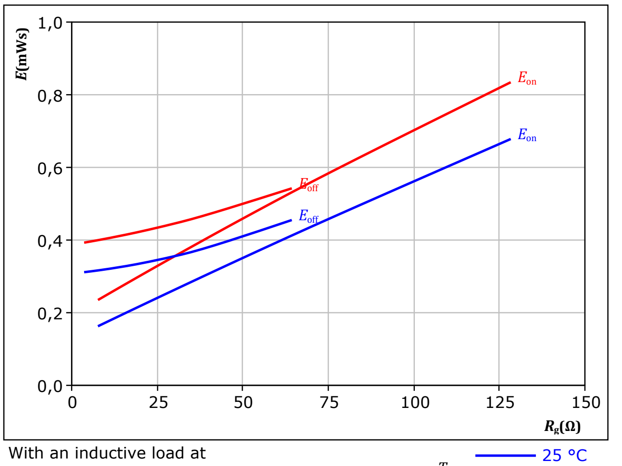
V_{CE} =	300	V	
V_{GE} =	0/15	V	
R_{gon} =	16	Ω	
R_{goff} =	8	Ω	

T_j: 25 °C (blue), 125 °C (red)

figure 40. **IGBT**

Typical switching energy losses as a function of IGBT turn on gate resistor

$E = f(R_g)$



With an inductive load at

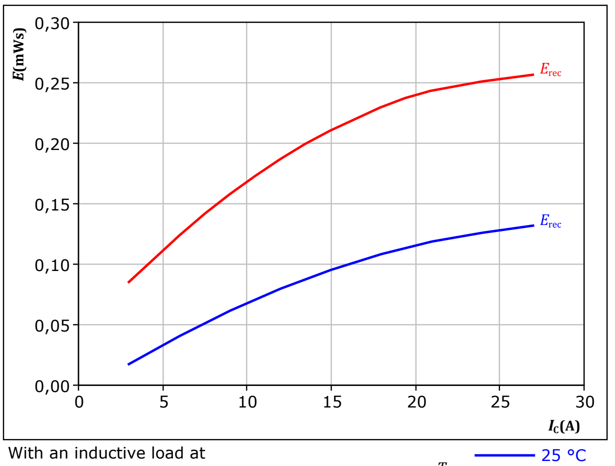
V_{CE} =	300	V
V_{GE} =	0/15	V
I_C =	15	A

T_j: 25 °C (blue), 125 °C (red)

figure 41. **FWD**

Typical reverse recovered energy loss as a function of collector current

$E_{rec} = f(I_C)$



With an inductive load at

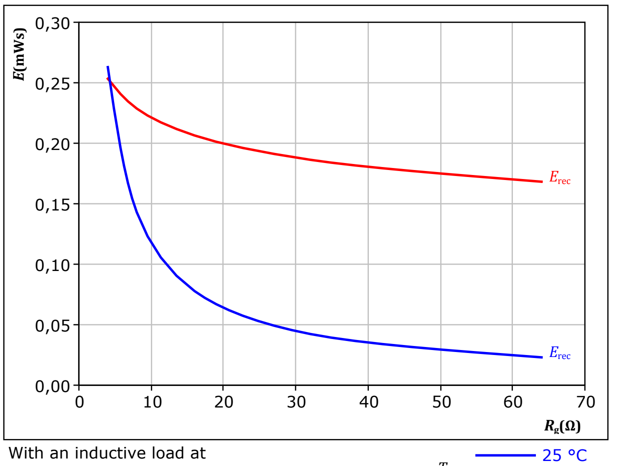
V_{CE} =	300	V
V_{GE} =	0/15	V
R_{gon} =	16	Ω

T_j: 25 °C (blue), 125 °C (red)

figure 42. **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} =	300	V
V_{GE} =	0/15	V
I_C =	15	A

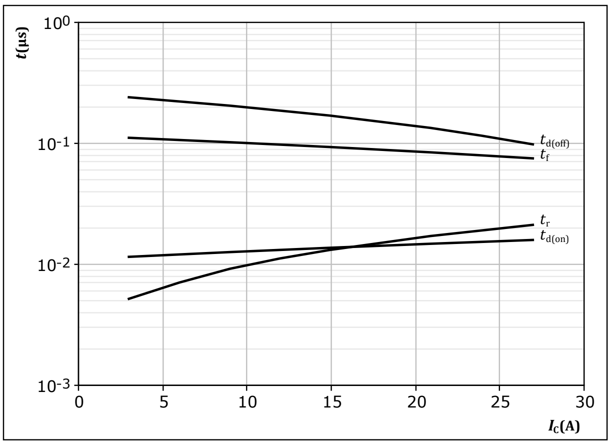
T_j: 25 °C (blue), 125 °C (red)

Brake Switching Characteristics

figure 43. **IGBT**

Typical switching times as a function of collector current

t = f(I_C)



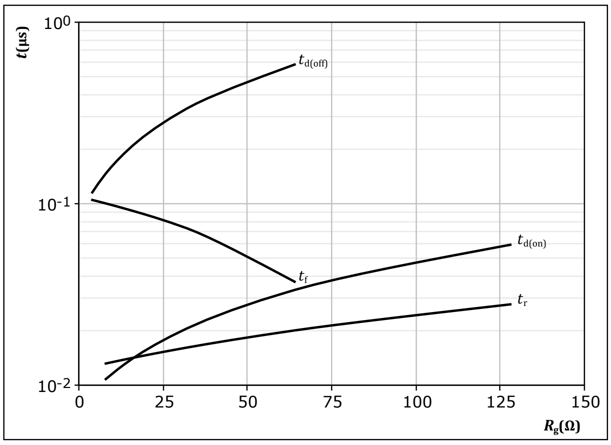
With an inductive load at

T_j =	125	°C
V_{CE} =	300	V
V_{GE} =	0/15	V
R_{gon} =	16	Ω
R_{goff} =	8	Ω

figure 44. **IGBT**

Typical switching times as a function of IGBT turn on gate resistor

t = f(R_g)



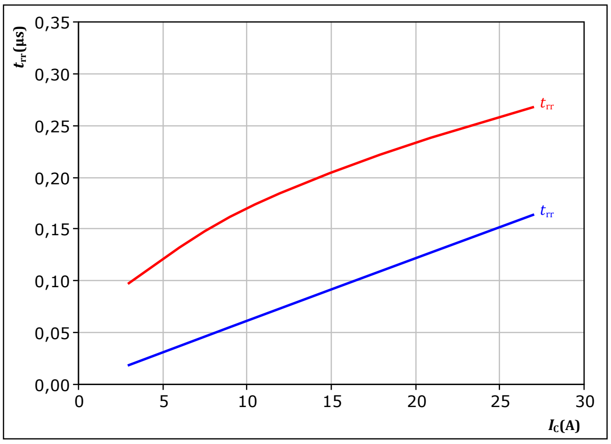
With an inductive load at

T_j =	125	°C
V_{CE} =	300	V
V_{GE} =	0/15	V
I_C =	15	A

figure 45. **FWD**

Typical reverse recovery time as a function of collector current

t_{rr} = f(I_C)



With an inductive load at

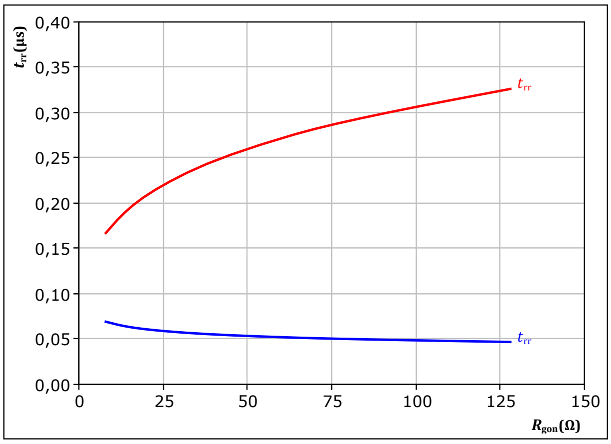
V_{CE} =	300	V
V_{GE} =	0/15	V
R_{gon} =	16	Ω

T_j: 25 °C, 125 °C

figure 46. **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} =	300	V
V_{GE} =	0/15	V
I_C =	15	A

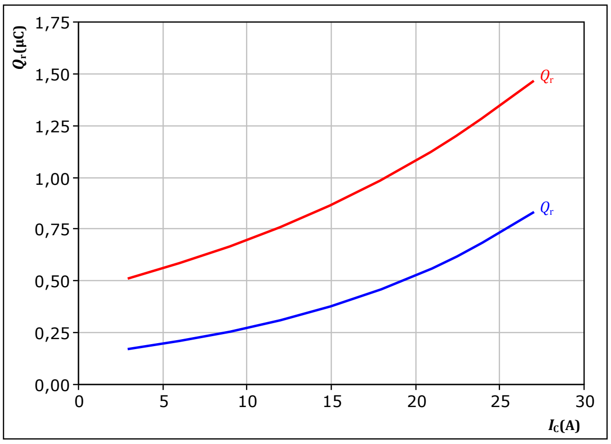
T_j: 25 °C, 125 °C

Brake Switching Characteristics

figure 47. **FWD**

Typical recovered charge as a function of collector current

Q_r = f(I_C)



With an inductive load at

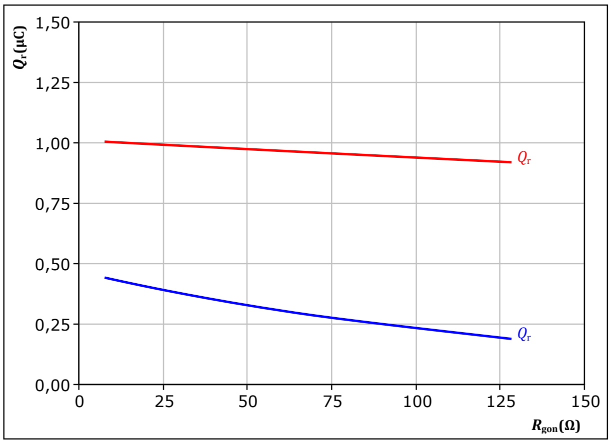
T_j: 25 °C / 125 °C

V_{CE} =	300	V
V_{GE} =	0/15	V
R_{gon} =	16	Ω

figure 48. **FWD**

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

Q_r = f(R_{gon})



With an inductive load at

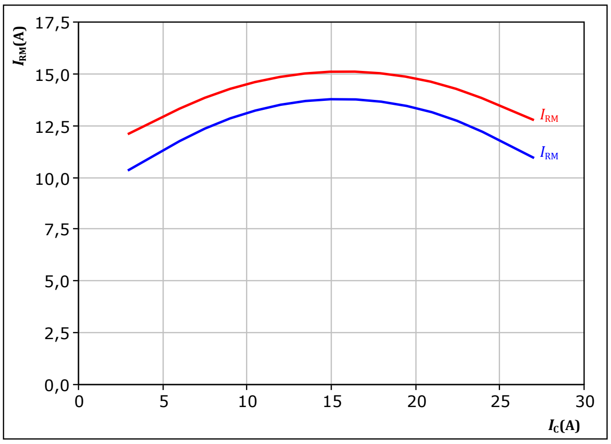
T_j: 25 °C / 125 °C

V_{CE} =	300	V
V_{GE} =	0/15	V
I_C =	15	A

figure 49. **FWD**

Typical peak reverse recovery current as a function of collector current

I_{RM} = f(I_C)



With an inductive load at

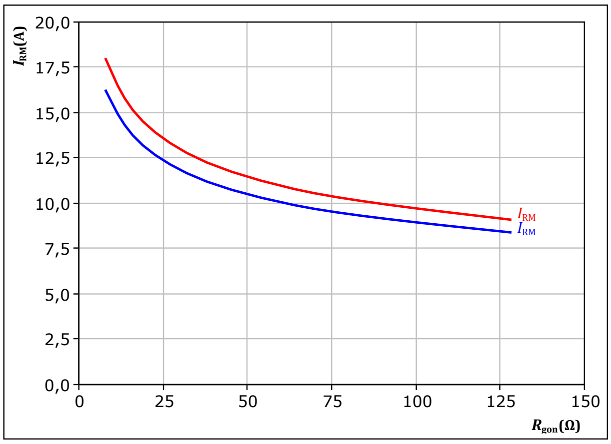
T_j: 25 °C / 125 °C

V_{CE} =	300	V
V_{GE} =	0/15	V
R_{gon} =	16	Ω

figure 50. **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

T_j: 25 °C / 125 °C

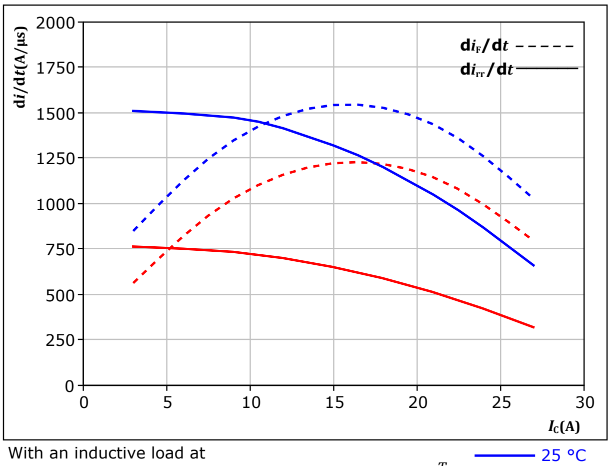
V_{CE} =	300	V
V_{GE} =	0/15	V
I_C =	15	A

Brake Switching Characteristics

figure 51. **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

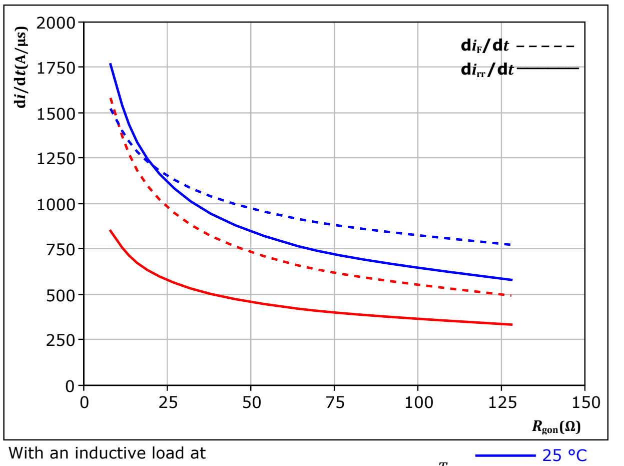
V_{CE} =	300	V	
V_{GE} =	0/15	V	
R_{gon} =	16	Ω	

T_j: 25 °C, 125 °C

figure 52. **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

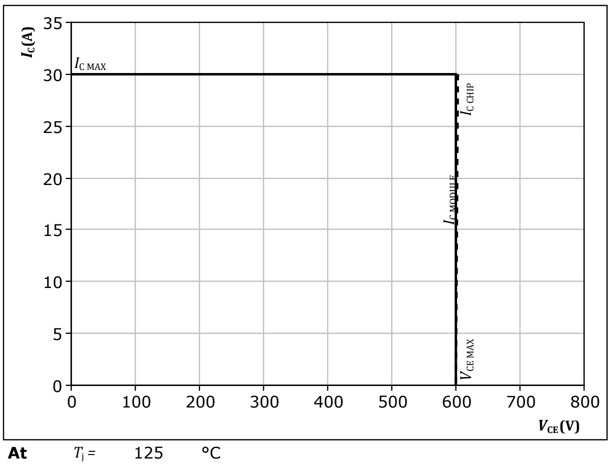
V_{CE} =	300	V
V_{GE} =	0/15	V
I_C =	15	A

T_j: 25 °C, 125 °C

figure 53. **IGBT**

Reverse bias safe operating area

I_C = f(V_{CE})



At	T_j =	125	°C
	R_{gon} =	16	Ω
	R_{goff} =	8	Ω

Switching Definitions

figure 54. **IGBT**

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

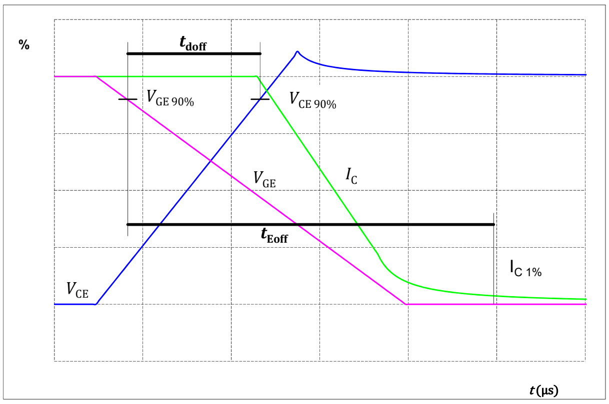


figure 55. **IGBT**

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

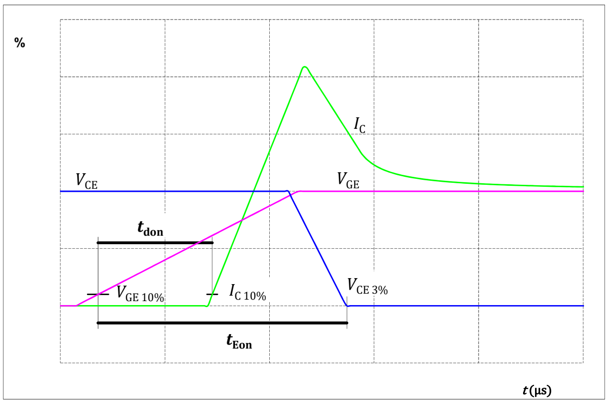


figure 56. **IGBT**

Turn-off Switching Waveforms & definition of t_f

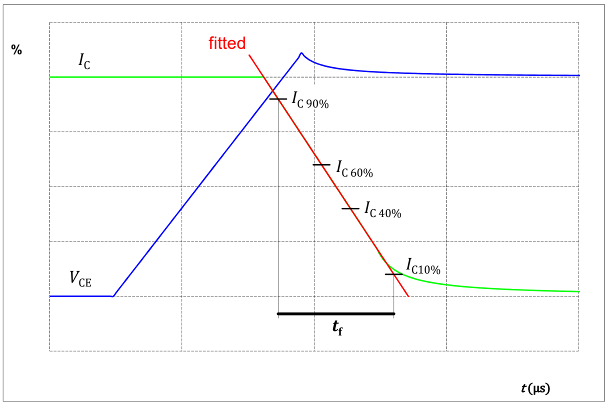
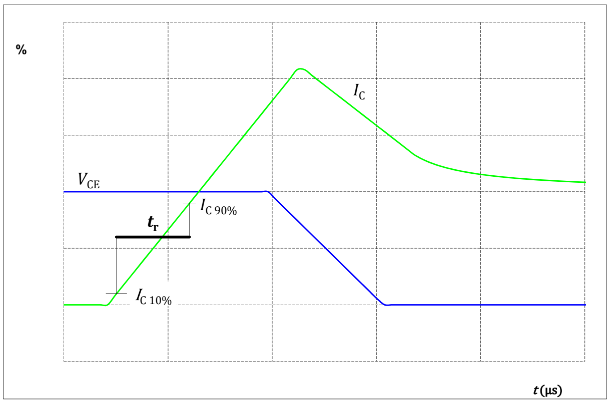


figure 57. **IGBT**

Turn-on Switching Waveforms & definition of t_r



Switching Definitions

figure 58. **FWD**

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

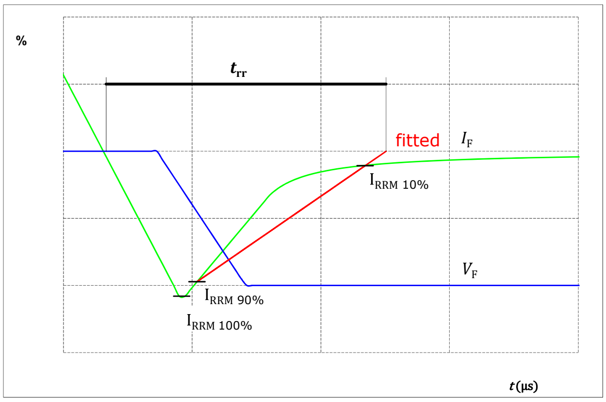
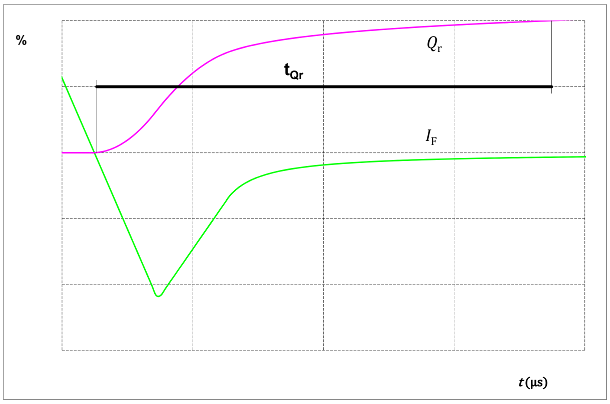


figure 59. **FWD**

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



Ordering Code

Version	Ordering Code
Without thermal paste	V23990-P545-A28-PM
With thermal paste (5,2 W/mK, PTM6000HV)	V23990-P545-A28-/7/-PM
With thermal paste (3,4 W/mK, PSX-P7)	V23990-P545-A28-/3/-PM

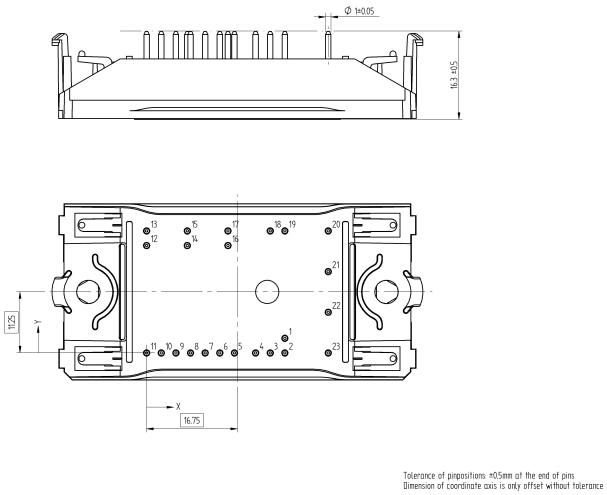
Marking

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

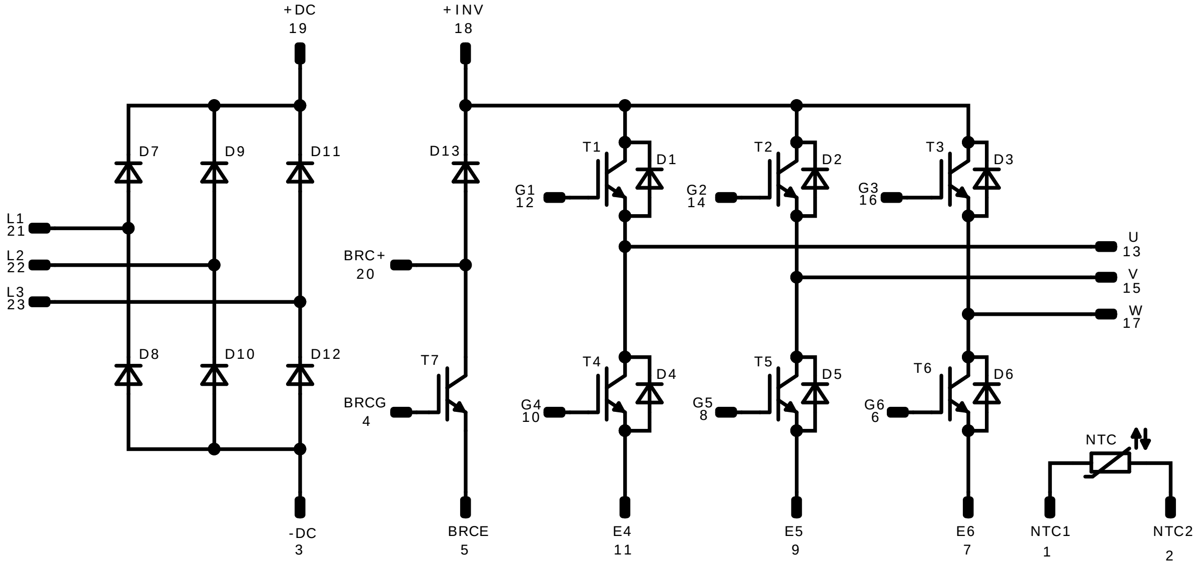
Outline

Pin table [mm]

Pin	X	Y	Function
1	25,5	2,7	NTC1
2	25,5	0	NTC2
3	22,8	0	-DC
4	20,1	0	BRCG
5	16,2	0	BRCE
6	13,5	0	G6
7	10,8	0	E6
8	8,1	0	G5
9	5,4	0	E5
10	2,7	0	G4
11	0	0	E4
12	0	19,8	G1
13	0	22,5	U
14	7,5	19,8	G2
15	7,5	22,5	V
16	15	19,8	G3
17	15	22,5	W
18	22,8	22,5	+INV
19	25,5	22,5	+DC
20	33,5	22,5	BRC+
21	33,5	15	L1
22	33,5	7,5	L2
23	33,5	0	L3



Pinout



Identification

ID	Component	Voltage	Current	Function	Comment
T4, T1, T5, T2, T6, T3	IGBT	600 V	20 A	Inverter Switch	
D1, D4, D2, D5, D3, D6	FWD	600 V	20 A	Inverter Diode	
T7	IGBT	600 V	15 A	Brake Switch	
D13	FWD	600 V	15 A	Brake Diode	
D8, D7, D10, D9, D12, D11	Rectifier	1600 V	25 A	Rectifier Diode	
NTC	Thermistor			Thermistor	

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

Handling instruction
Handling instructions for *flow* 0 packages see vincotech.com website.

Package data
Package data for *flow* 0 packages see vincotech.com website.

Vincotech thermistor reference
See Vincotech thermistor reference table at vincotech.com website.

UL recognition and file number
This device is certified according to UL 1557 standard, UL file number E192116. For more information see vincotech.com website.

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