Vincotech

10-PG12NAB009CS04-LC59F88T
10-PG12NAC009CS04-LC59F88T
datasheet

flowANPC 1 split — **2400 V / 9 mΩ**

Features

- Split Advanced NPC topology
- Ultra-high switching frequency with SiC MOSFETs
- Split topology for better thermal performance
- No x-conduction at high frequencies

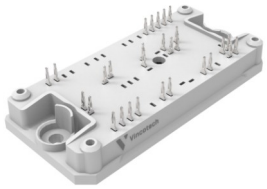
Target applications

- Solar Inverters

Types

- 10-PG12NAB009CS04-LC59F88T
- 10-PG12NAC009CS04-LC69F88T

flow 1 12 mm housing



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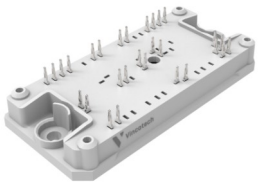
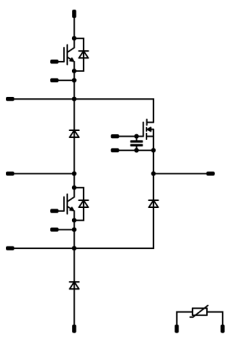


LC69F88T

Schematic



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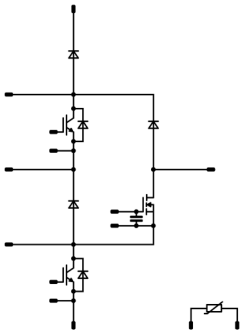


LC69F88T

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
AC Switch				
Drain-source voltage	V_{DSS}		1200	V
Drain current	I_D	$T_j = T_{jmax}$ T_s = 80 °C	141	A
Peak drain current	I_{DM}	t_p limited by T_{jmax}	800	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ T_s = 80 °C	346	W
Gate-source voltage	V_{GSS}		-10/+20	V
Maximum Junction Temperature	T_{jmax}		175	°C

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
AC Diode				
Peak repetitive reverse voltage	V_{RRM}		1200	V
Continuous (direct) forward current	I_F	T_j = T_{jmax} T_s = 80 °C	85	A
Repetitive peak forward current	I_{FRM}		252	A
Total power dissipation	P_{tot}	T_j = T_{jmax} T_s = 80 °C	243	W
Maximum junction temperature	T_{jmax}		175	°C
Neutral Point Switch				
Collector-emitter voltage	V_{CES}		1200	V
Collector current	I_C	T_j = T_{jmax} T_s = 80 °C	149	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	300	A
Total power dissipation	P_{tot}	T_j = T_{jmax} T_s = 80 °C	287	W
Gate-emitter voltage	V_{GES}		±20	V
Short circuit ratings	t_{SC}	V_{GE} = 15 V V_{cc} = 800 V T_j = 150 °C	9,5	µs
Maximum junction temperature	T_{jmax}		175	°C
DC-Link Diode				
Peak repetitive reverse voltage	V_{RRM}		1200	V
Continuous (direct) forward current	I_F	T_j = T_{jmax} T_s = 80 °C	86	A
Repetitive peak forward current	I_{FRM}		200	A
Total power dissipation	P_{tot}	T_j = T_{jmax} T_s = 80 °C	158	W
Maximum junction temperature	T_{jmax}		175	°C

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
Neutral Point Switch Prot. Diode				
Peak repetitive reverse voltage	V_{RRM}		1200	V
Continuous (direct) forward current	I_F	$T_j = T_{jmax}$ T_s = 80 °C	21	A
Surge (non-repetitive) forward current	I_{FSM}	50 Hz Single Half Sine Wave t_p = 10 ms T_j = 25 °C	65	A
Surge current capability	I^2t		21	A^2s
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ T_s = 80 °C	70	W
Maximum junction temperature	T_{jmax}		175	°C
DC-Link Switch				
Collector-emitter voltage	V_{CES}		1200	V
Collector current	I_C	$T_j = T_{jmax}$ T_s = 80 °C	149	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	300	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ T_s = 80 °C	287	W
Gate-emitter voltage	V_{GES}		±20	V
Short circuit ratings	t_{SC}	V_{GE} = 15 V V_{cc} = 800 V T_j = 150 °C	9,5	µs
Maximum junction temperature	T_{jmax}		175	°C
Neutral Point Diode				
Peak repetitive reverse voltage	V_{RRM}		1200	V
Continuous (direct) forward current	I_F	$T_j = T_{jmax}$ T_s = 80 °C	111	A
Repetitive peak forward current	I_{FRM}		300	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ T_s = 80 °C	183	W
Maximum junction temperature	T_{jmax}		175	°C

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
DC-Link Switch Prot. Diode				
Peak repetitive reverse voltage	V_{RRM}		1200	V
Continuous (direct) forward current	I_F	T_j = T_{jmax} T_s = 80 °C	86	A
Repetitive peak forward current	I_{FRM}		200	A
Total power dissipation	P_{tot}	T_j = T_{jmax} T_s = 80 °C	158	W
Maximum junction temperature	T_{jmax}		175	°C
Capacitor (GS)				
Maximum DC voltage	V_{MAX}		25	V
Operation Temperature	T_{op}		-55…+125	°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
Creepage distance			min. 12,7	mm
Clearance			8,33	mm
Comparative Tracking Index	CTI		≥ 600	

*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	
AC Switch										
Static										
Drain-source on-state resistance	$r_{DS(on)}$		15		100	25 125 150		7 9 10	12	mΩ
Gate-source threshold voltage	$V_{GS(th)}$	$V_{GS} = V_{DS}$			0,05	25	3,5	4,5	5,7	V
Gate to Source Leakage Current	I_{GSS}		-10/+20	0		25			600	nA
Zero Gate Voltage Drain Current	I_{DSS}		0	1200		25		10	1000	µA
Internal gate resistance	r_g	f= 1MHz						0,8		Ω
Gate charge	Q_g							310		
Gate to source charge	Q_{GS}		-5/+15	800	100	25		115		nC
Gate to drain charge	Q_{GD}							55		
Short-circuit input capacitance	C_{iss}	f= 1MHz	0	800		25		10000		pF
Reverse transfer capacitance	C_{rss}							65		
Reverse Diode Static										
Diode forward voltage	V_{SD}		-5		100	25		4,1	5	V
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						0,27		K/W
AC Diode										
Static										
Forward voltage	V_F				60	25 125		1,63 2,04	1,7	V
Reverse leakage current	I_R			1200		25			1200	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						0,39		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	
AC Real Open configuration										
Switch Dynamic										
Turn-on delay time	$t_{d(on)}$	R_{gon} = 2 Ω R_{goff} = 2 Ω	-5 / 16	600	100	25 125 150		50 43 46		ns
Rise time	t_r					25 125 150		14 12 13		
Turn-off delay time	$t_{d(off)}$					25 125 150		68 72 74		
Fall time	t_f					25 125 150		21 27 27		
Turn-on energy (per pulse)	E_{on}	Q_{rFWD} = 0,4 µC Q_{rFWD} = 0,6 µC Q_{rFWD} = 0,8 µC				25 125 150		0,904 0,680 0,515		mWs
Turn-off energy (per pulse)	E_{off}					25 125 150		0,601 0,687 0,702		
Diode Dynamic										
Peak recovery current	I_{RRM}	di/dt = 6405 A/µs di/dt = 9762 A/µs di/dt = 8361 A/µs	-5 / 16	600	100	25 125 150		32 47 44		A
Reverse recovery time	t_{rr}					25 125 150		21 19 21		ns
Recovered charge	Q_r					25 125 150		0,414 0,625 0,803		µC
Reverse recovered energy	E_{rec}					25 125 150		0,243 0,322 0,470		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125 150		3040 5917 4230		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	
AC Reactive Open configuration										
Switch Dynamic										
Turn-on delay time	$t_{d(on)}$	R_{gon} = 2 Ω R_{goff} = 2 Ω	-5 / 16	600	100	25 125 150		48 46 47		ns
Rise time	t_r					25 125 150		13 13 13		
Turn-off delay time	$t_{d(off)}$					25 125 150		74 77 78		
Fall time	t_f					25 125 150		22 19 20		
Turn-on energy (per pulse)	E_{on}	Q_{rFWD} = 1 µC Q_{rFWD} = 1,2 µC Q_{rFWD} = 1,1 µC				25 125 150		0,983 0,786 0,772		mWs
Turn-off energy (per pulse)	E_{off}					25 125 150		0,369 0,609 0,506		
Diode Dynamic										
Peak recovery current	I_{RRM}	di/dt = 8701 A/µs di/dt = 9380 A/µs di/dt = 7898 A/µs	-5 / 16	600	100	25 125 150		55 68 63		A
Reverse recovery time	t_{rr}					25 125 150		26 27 26		ns
Recovered charge	Q_r					25 125 150		1,02 1,19 1,09		µC
Reverse recovered energy	E_{rec}					25 125 150		0,555 0,666 0,649		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125 150		5747 5808 6338		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	
Neutral Point Switch										
Static										
Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{GE} = V_{CE}$			0,015	25	5,4	6	6,6	V
Collector-emitter saturation voltage	V_{CEsat}		15		150	25 125 150		1,57 1,80 1,86	1,85	V
Collector-emitter cut-off current	I_{CES}		0	1200		25			100	µA
Gate-emitter leakage current	I_{GES}		20	0		25			500	nA
Internal gate resistance	r_g							3		Ω
Input capacitance	C_{ies}		0	10		25		30000		pF
Output capacitance	C_{oes}							880		
Reverse transfer capacitance	C_{res}							320		
Gate charge	Q_g		15	600	150	25		1000		nC
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						0,33		K/W
Dynamic										
Turn-on delay time	$t_{d(on)}$	R_{gon} = 2 Ω R_{goff} = 2 Ω	±15	600	100	25 125 150		335 349 351		ns
Rise time	t_r					25 125 150		38 47 49		
Turn-off delay time	$t_{d(off)}$					25 125 150		304 351 363		
Fall time	t_f					25 125 150		101 139 142		
Turn-on energy (per pulse)	E_{on}	Q_{rFWD} = 10,4 µC Q_{rFWD} = 15 µC Q_{rFWD} = 16,2 µC				25 125 150		8,92 11,15 11,85		mWs
Turn-off energy (per pulse)	E_{off}					25 125 150		7,89 10,42 10,95		

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	
DC-Link Diode										
Static										
Forward voltage	V_F				100	25 125 150		1,82 1,96 1,97	2,1	V
Reverse leakage current	I_R			1200		25			40	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						0,60		K/W
Dynamic										
Peak recovery current	I_{RRM}	di/dt = 2662 A/µs di/dt = 2286 A/µs di/dt = 2159 A/µs	±15	600	100	25 125 150		83 86 88		A
Reverse recovery time	t_{rr}					25 125 150		310 419 453		ns
Recovered charge	Q_r					25 125 150		10,40 15,02 16,24		µC
Reverse recovered energy	E_{rec}					25 125 150		3,99 5,95 6,43		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125 150		507 513 504		A/µs
Neutral Point Switch Prot. Diode										
Static										
Forward voltage	V_F				15	25 125		2,37 2,47	2,71	V
Reverse leakage current	I_R			1200		25 150			60 1800	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						1,35		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	
DC-Link Switch										
Static										
Gate-emitter threshold voltage	$V_{GE(th)}$	V_{GE} = V_{CE}			0,015	25	5,4	6	6,6	V
Collector-emitter saturation voltage	V_{CEsat}		15		150	25 125 150		1,57 1,80 1,86	1,85	V
Collector-emitter cut-off current	I_{CES}		0	1200		25			100	µA
Gate-emitter leakage current	I_{GES}		20	0		25			500	nA
Internal gate resistance	r_g							3		Ω
Input capacitance	C_{ies}		0	10		25		30000		pF
Output capacitance	C_{oes}							880		
Reverse transfer capacitance	C_{res}							320		
Gate charge	Q_g		15	600	150	25		1000		nC
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						0,33		K/W
Dynamic										
Turn-on delay time	$t_{d(on)}$	R_{gon} = 2 Ω R_{goff} = 2 Ω	±15	600	100	25 125 150		317 335 350		ns
Rise time	t_r					25 125 150		36 41 45		
Turn-off delay time	$t_{d(off)}$					25 125 150		306 351 368		
Fall time	t_f					25 125 150		97 136 146		
Turn-on energy (per pulse)	E_{on}	Q_{rFWD} = 12,8 µC Q_{rFWD} = 20,8 µC Q_{rFWD} = 22,3 µC				25 125 150		9,56 13,18 13,42		mWs
Turn-off energy (per pulse)	E_{off}					25 125 150		7,12 9,90 11,12		

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	
Neutral Point Diode										
Static										
Forward voltage	V_F				150	25 125 150		1,80 1,90 1,90	2,1	V
Reverse leakage current	I_R			1200		25			40	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						0,52		K/W
Dynamic										
Peak recovery current	I_{RRM}	di/dt = 2578 A/µs di/dt = 2565 A/µs di/dt = 2545 A/µs	±15	600	100	25 125 150		117 120 118		A
Reverse recovery time	t_{rr}					25 125 150		268 406 454		ns
Recovered charge	Q_r					25 125 150		12,79 20,79 22,27		µC
Reverse recovered energy	E_{rec}					25 125 150		4,36 7,63 8,66		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125 150		865 626 632		A/µs
DC-Link Switch Prot. Diode										
Static										
Forward voltage	V_F				100	25 125 150		1,82 1,96 1,97	2,1	V
Reverse leakage current	I_R			1200		25			40	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						0,60		K/W
Capacitor (GS)										
Capacitance	C							10		nF
Tolerance							-10		+10	%
Dissipation factor		f= 1 kHz				25			0,1	%

Characteristic Values

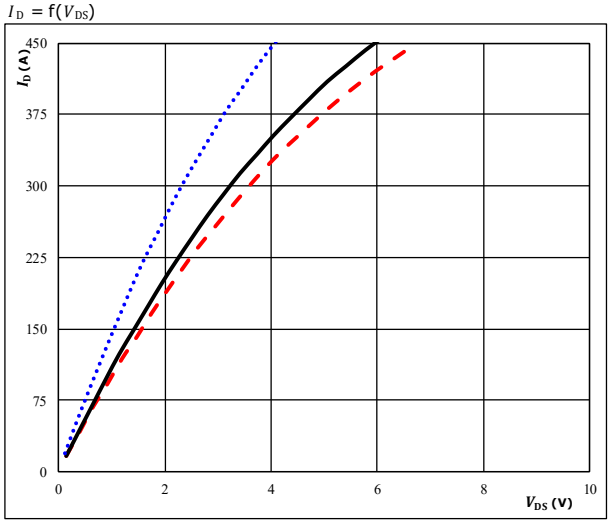
Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] V_{GS} [V]	V_{CE} [V] V_{DS} [V] V_F [V]	I_C [A] I_D [A] I_F [A]	T_j [°C]	Min	Typ	Max	
Thermistor										
Rated resistance	R					25		22		kΩ
Deviation of R_{100}	$\Delta_{R/R}$	R_{100} = 1484 Ω				100	-5		5	%
Power dissipation	P					25		5		mW
Power dissipation constant						25		1,5		mW/K
B-value	$B_{(25/50)}$	Tol. ±1 %				25		3962		K
B-value	$B_{(25/100)}$	Tol. ±1 %				25		4000		K
Vincotech NTC Reference									I	

AC Switch Characteristics

figure 1. **MOSFET**

Typical output characteristics

$I_D = f(V_{DS})$

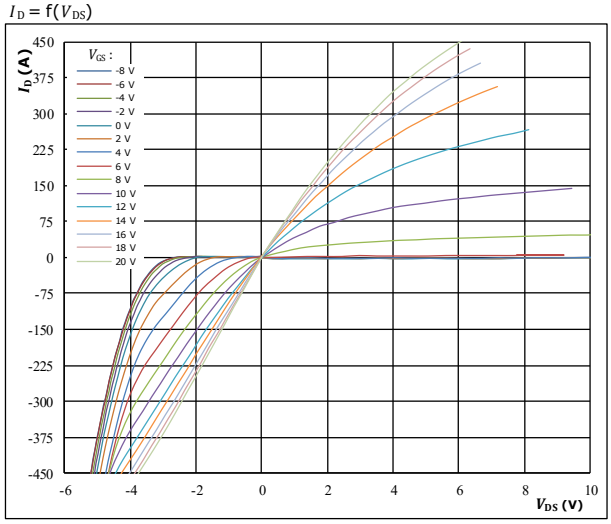


t_p =	250	µs		25 °C	
V_{GS} =	18	V	T_j:	125 °C	
				150 °C	

figure 2. **MOSFET**

Typical output characteristics

$I_D = f(V_{DS})$

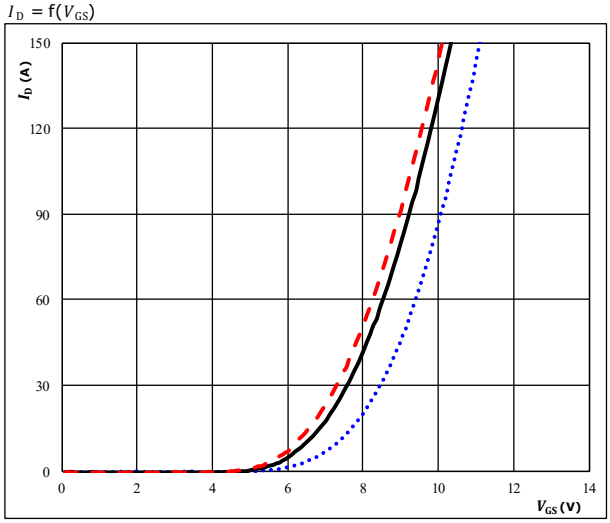


t_p =	250	µs
T_j =	150	°C
V_{GS} from	0 V to 20 V in steps of 2 V	

figure 3. **MOSFET**

Typical transfer characteristics

$I_D = f(V_{GS})$

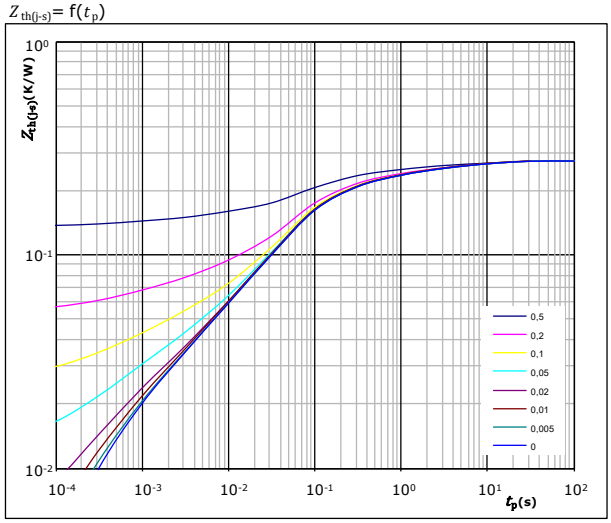


t_p =	250	µs		25 °C	
V_{DS} =	10	V	T_j:	125 °C	
				150 °C	

figure 4. **MOSFET**

Transient thermal impedance as a function of pulse width

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



D =	t_p / T	
$R_{th(j-s)}$ =	0,27	K/W

MOSFET thermal model values

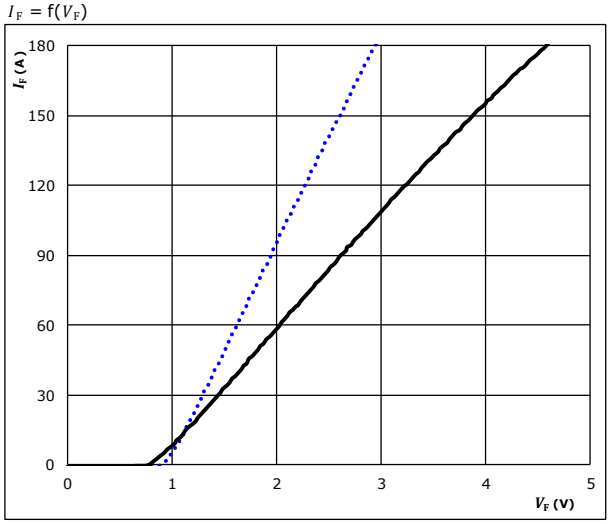
R (K/W)	τ (s)
3,03E-02	4,54E+00
4,28E-02	4,89E-01
6,79E-02	9,05E-02
9,74E-02	2,77E-02
2,42E-02	2,00E-03
1,17E-02	2,18E-04

AC Diode Characteristics

figure 1. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



t_p = 250 µs

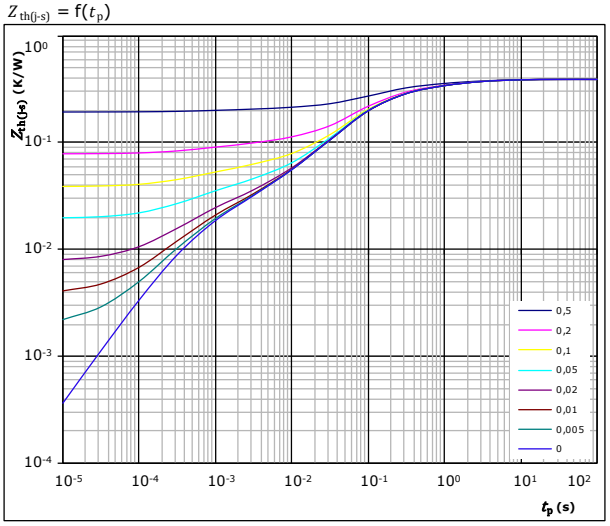
T_j: 25 °C

125 °C

figure 2. **FWD**

Transient thermal impedance as a function of pulse width

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



D = t_p / T

$R_{th(j-s)}$ = 0,39 K/W

FWD thermal model values

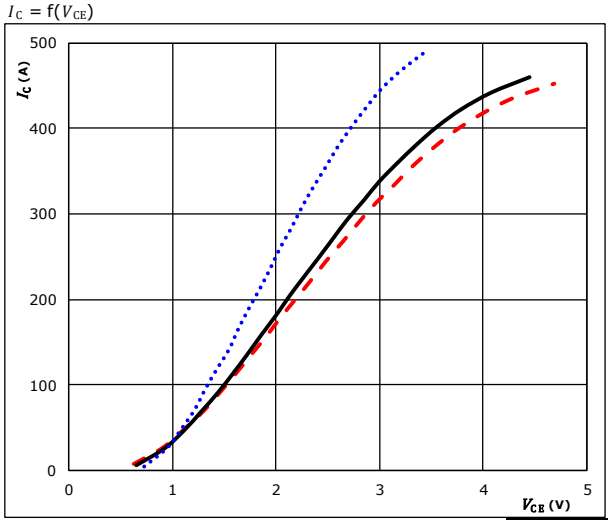
R (K/W)	τ (s)
1,95E-02	6,94E+00
6,79E-02	1,61E+00
1,06E-01	3,11E-01
1,67E-01	8,72E-02
1,08E-02	6,83E-03
8,63E-03	2,04E-03
1,10E-02	5,15E-04

Neutral Point Switch Characteristics

figure 1. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

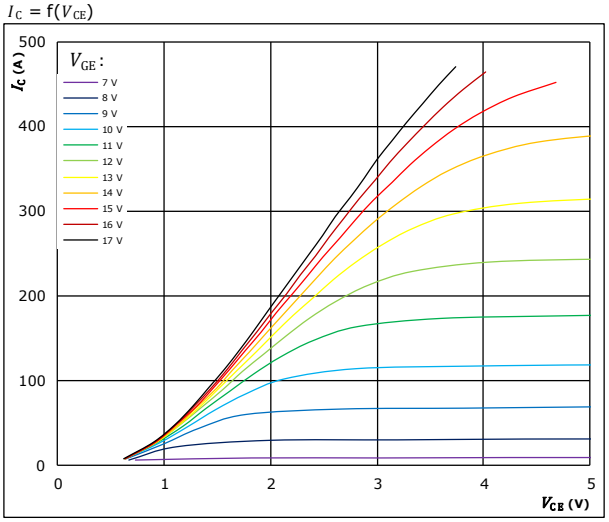


t_p =	250	µs		25 °C
V_{GE} =	15	V	T_j:	125 °C
				150 °C

figure 2. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

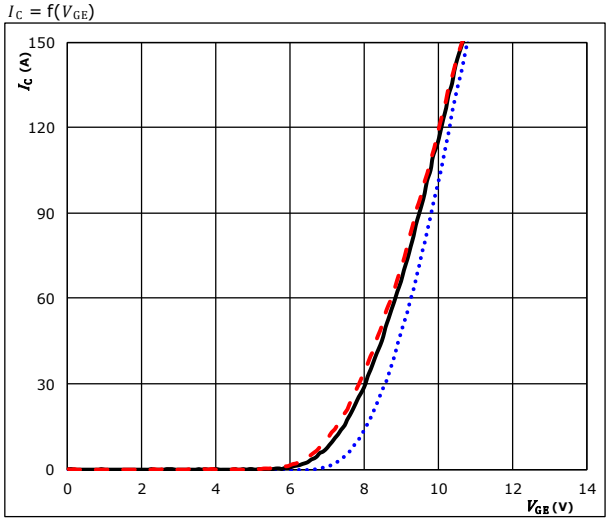


t_p =	250	µs
T_j =	150	°C
V_{GE} from	7 V to 17 V in steps of 1 V	

figure 3. **IGBT**

Typical transfer characteristics

$I_C = f(V_{GE})$

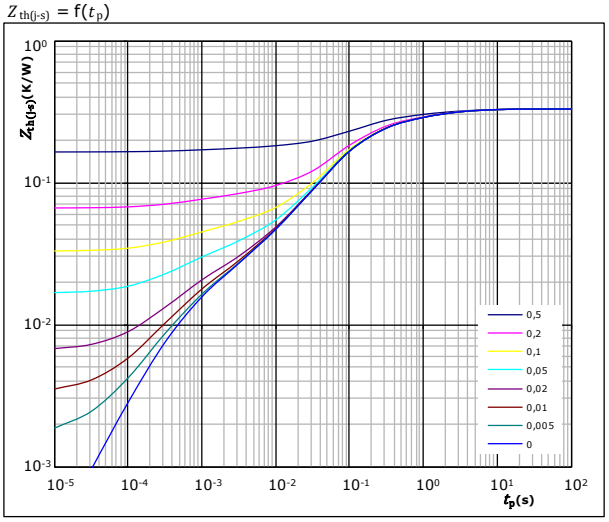


t_p =	250	µs		25 °C
V_{CE} =	10	V	T_j:	125 °C
				150 °C

figure 4. **IGBT**

Transient thermal impedance as function of pulse duration

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



D =	t_p / T	
$R_{th(j-s)}$ =	0,33	K/W

IGBT thermal model values

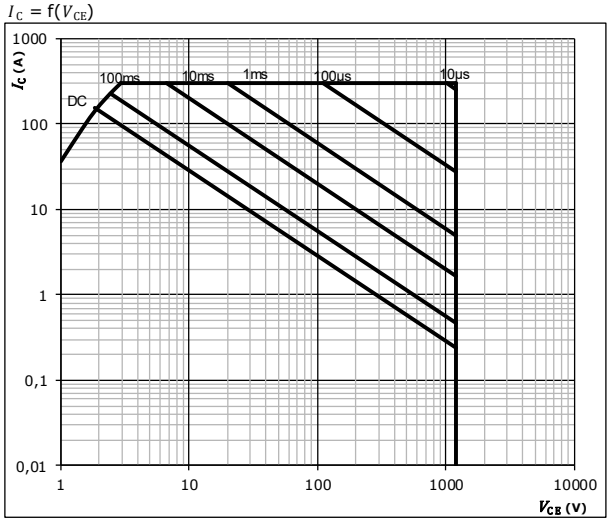
R (K/W)	τ (s)
1,65E-02	5,88E+00
5,75E-02	1,37E+00
8,96E-02	2,63E-01
1,41E-01	7,38E-02
9,17E-03	5,78E-03
7,30E-03	1,73E-03
9,30E-03	4,36E-04

Neutral Point Switch Characteristics

figure 5. **IGBT**

Safe operating area

$I_C = f(V_{CE})$



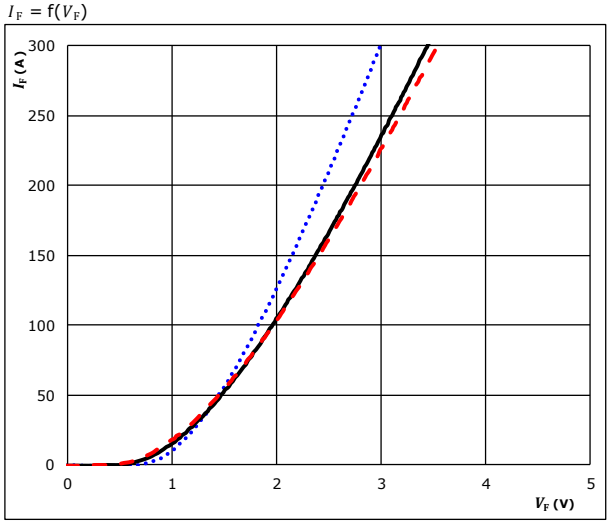
D =	single pulse	
T_s =	80	°C
V_{GE} =	±15	V
T_j =	T_{jmax}	

DC-Link Diode Characteristics

figure 1. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



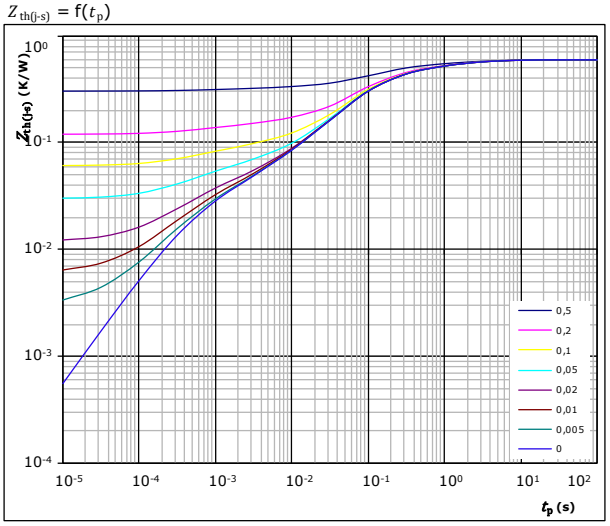
t_p = 250 µs

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

$R_{th(j-s)}$ = 0,60 K/W

FWD thermal model values

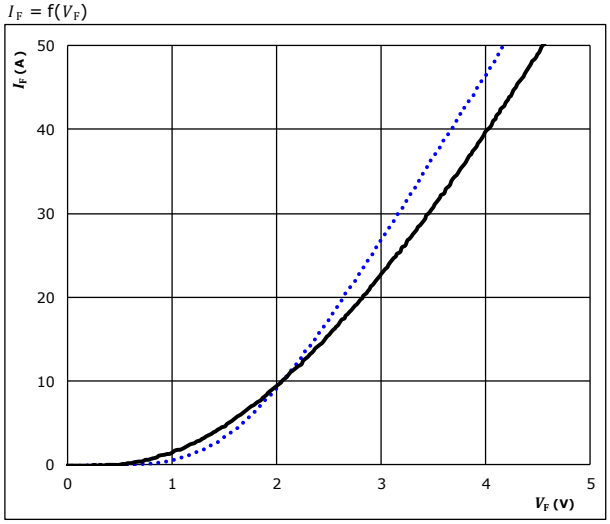
R (K/W)	τ (s)
2,99E-02	1,07E+01
1,04E-01	2,48E+00
1,63E-01	4,77E-01
2,56E-01	1,34E-01
1,66E-02	1,05E-02
1,33E-02	3,13E-03
1,69E-02	7,91E-04

Neutral Point Switch Prot. Diode Characteristics

figure 1. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



t_p = 250 µs

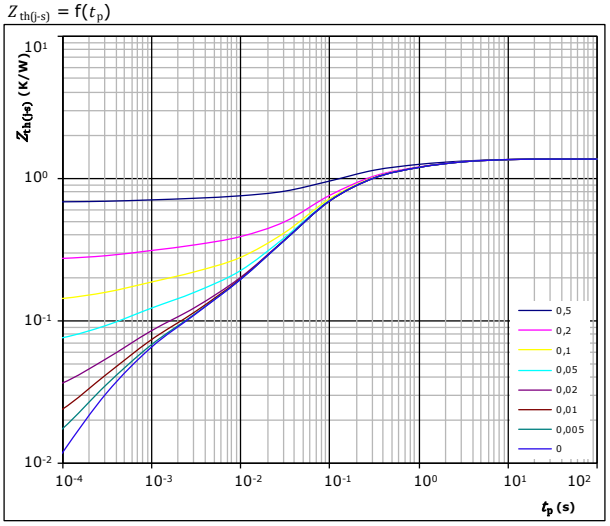
T_j: 25 °C

125 °C

figure 2. **FWD**

Transient thermal impedance as a function of pulse width

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



D = t_p / T

$R_{th(j-s)}$ = 1,35 K/W

FWD thermal model values

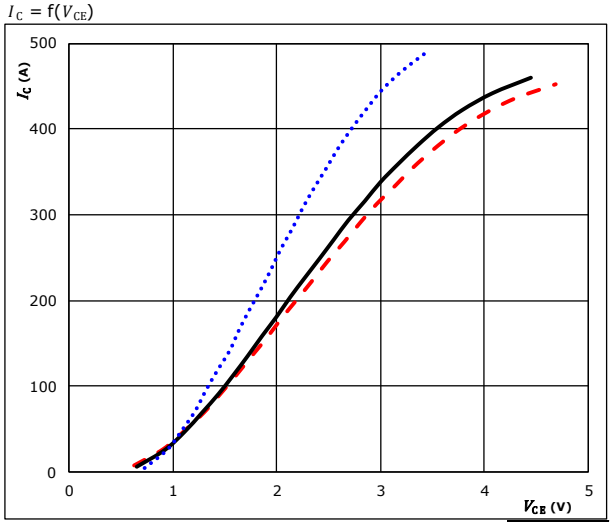
R (K/W)	τ (s)
6,72E-02	2,40E+01
2,35E-01	5,58E+00
3,66E-01	1,07E+00
5,76E-01	3,01E-01
3,74E-02	2,36E-02
2,98E-02	7,04E-03
3,80E-02	1,78E-03

DC-Link Switch Characteristics

figure 1. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

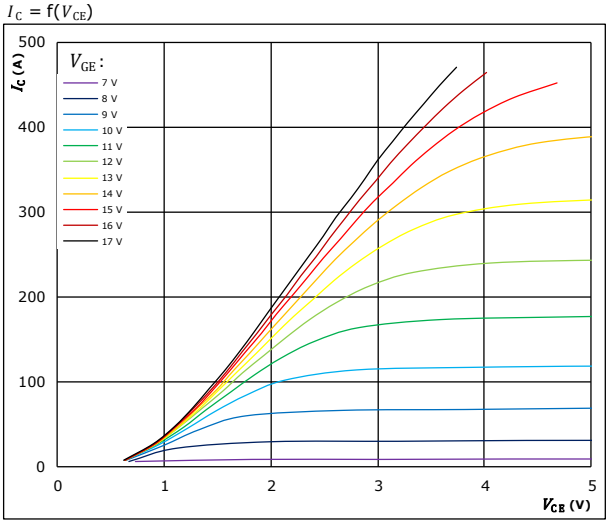


t_p =	250	µs		25 °C	
V_{GE} =	15	V	T_j:	125 °C	
				150 °C	

figure 2. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

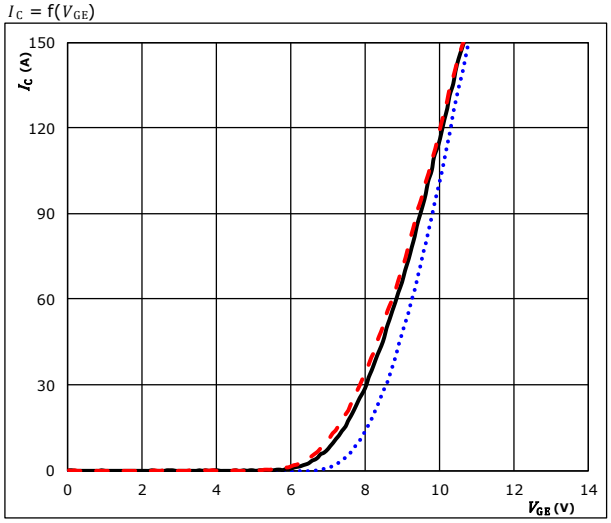


t_p =	250	µs
T_j =	150	°C
V_{GE} from	7 V to 17 V in steps of 1 V	

figure 3. **IGBT**

Typical transfer characteristics

$I_C = f(V_{GE})$

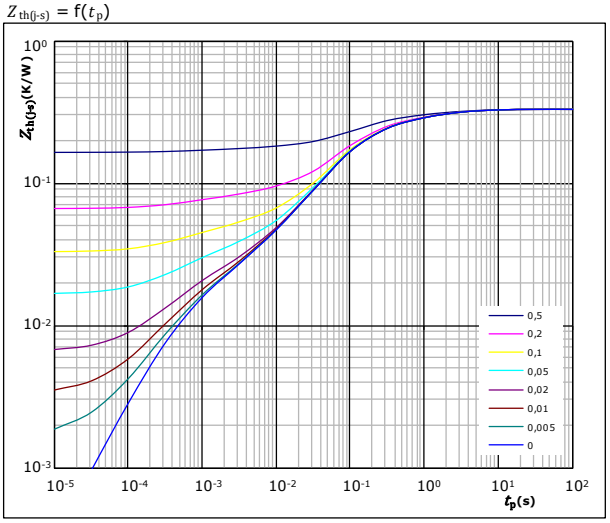


t_p =	250	µs		25 °C	
V_{CE} =	10	V	T_j:	125 °C	
				150 °C	

figure 4. **IGBT**

Transient thermal impedance as function of pulse duration

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



D =	t_p / T	
$R_{th(j-s)}$ =	0,33	K/W

IGBT thermal model values

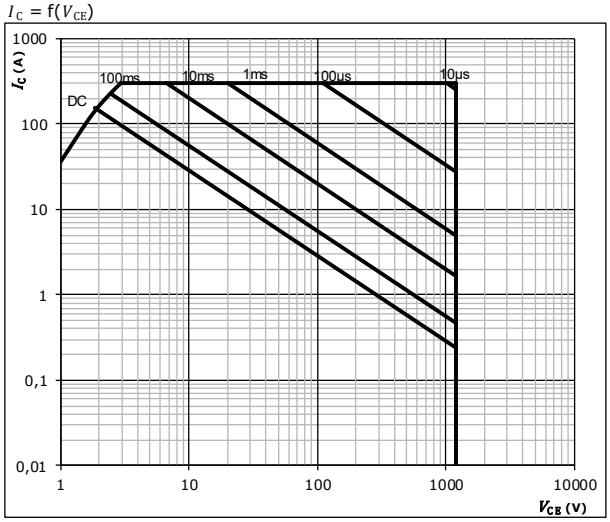
R (K/W)	τ (s)
1,65E-02	5,88E+00
5,75E-02	1,37E+00
8,96E-02	2,63E-01
1,41E-01	7,38E-02
9,17E-03	5,78E-03
7,30E-03	1,73E-03
9,30E-03	4,36E-04

DC-Link Switch Characteristics

figure 5. **IGBT**

Safe operating area

$I_C = f(V_{CE})$



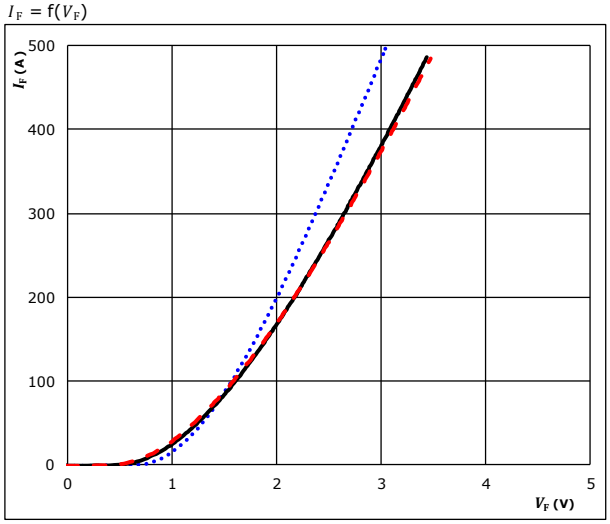
D =	single pulse	
T_s =	80	°C
V_{GE} =	±15	V
T_j =	T_{jmax}	

Neutral Point Diode Characteristics

figure 1. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



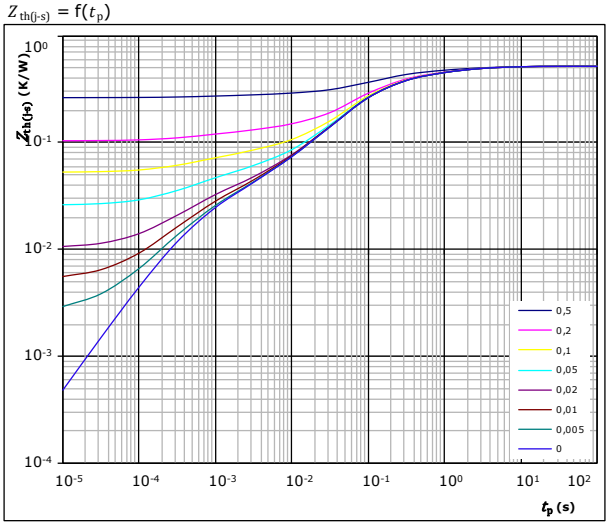
t_p = 250 µs

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

$R_{th(j-s)}$ = 0,52 K/W

FWD thermal model values

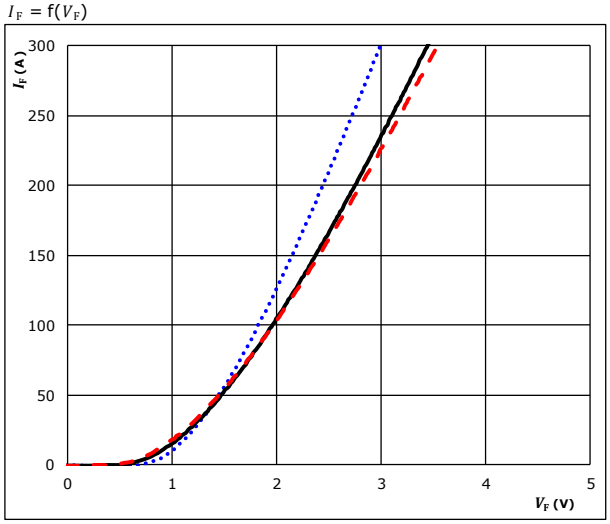
R (K/W)	τ (s)
2,59E-02	9,26E+00
9,06E-02	2,15E+00
1,41E-01	4,14E-01
2,22E-01	1,16E-01
1,44E-02	9,10E-03
1,15E-02	2,72E-03
1,46E-02	6,86E-04

DC-Link Switch Prot. Diode Characteristics

figure 1. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



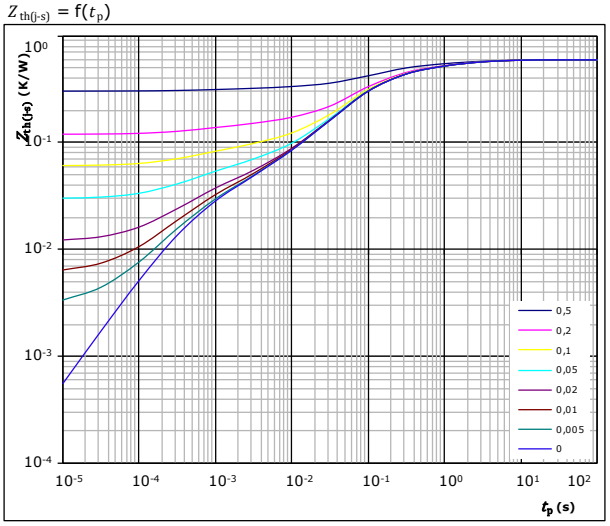
t_p = 250 µs

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

$R_{th(j-s)}$ = 0,60 K/W

FWD thermal model values

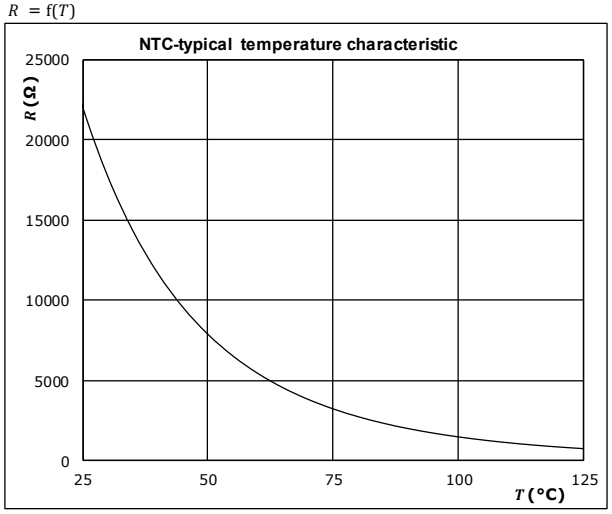
R (K/W)	τ (s)
2,99E-02	1,07E+01
1,04E-01	2,48E+00
1,63E-01	4,77E-01
2,56E-01	1,34E-01
1,66E-02	1,05E-02
1,33E-02	3,13E-03
1,69E-02	7,91E-04

Thermistor Characteristics

figure 1. **Thermistor**

Typical NTC characteristic as a function of temperature

$R = f(T)$

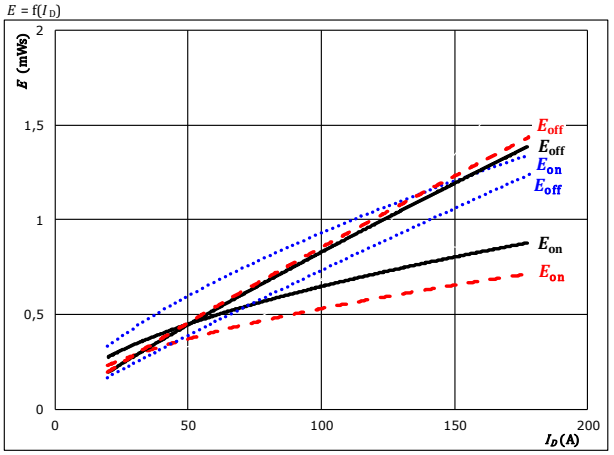


AC Real Open Switching Characteristics

figure 1. MOSFET

Typical switching energy losses as a function of drain current

$E = f(I_D)$



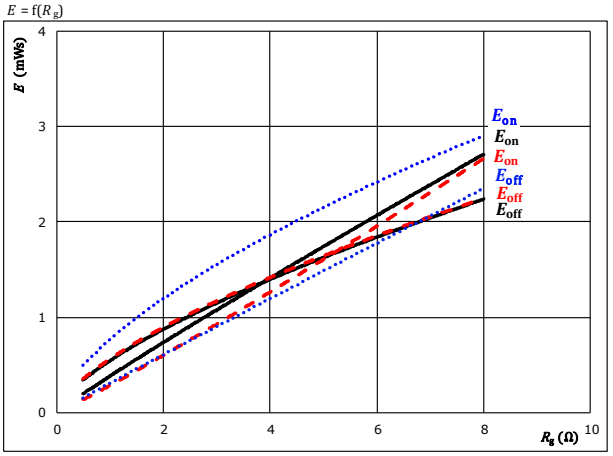
With an inductive load at

V_{DS} =	600	V	T_j:	25 °C	.....
V_{GS} =	-5 / 16	V		125 °C	———
R_{gon} =	2	Ω		150 °C	- - - -
R_{goff} =	2	Ω			

figure 2. MOSFET

Typical switching energy losses as a function of gate resistor

$E = f(R_g)$



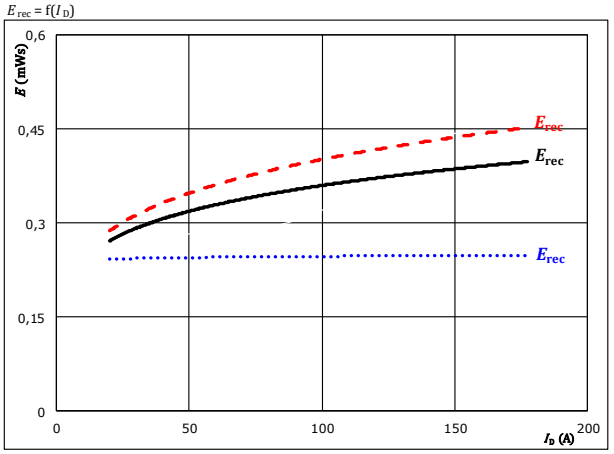
With an inductive load at

V_{DS} =	600	V	T_j:	25 °C	.....
V_{GS} =	-5 / 16	V		125 °C	———
I_D =	100	A		150 °C	- - - -

figure 3. FWD

Typical reverse recovered energy loss as a function of drain current

$E_{rec} = f(I_D)$



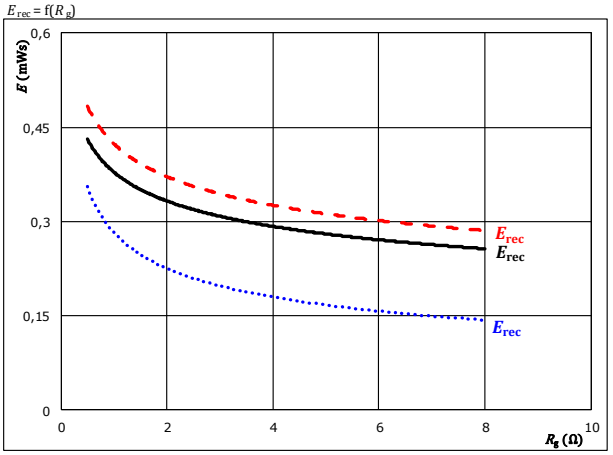
With an inductive load at

V_{DS} =	600	V	T_j:	25 °C	.....
V_{GS} =	-5 / 16	V		125 °C	———
R_{gon} =	2	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

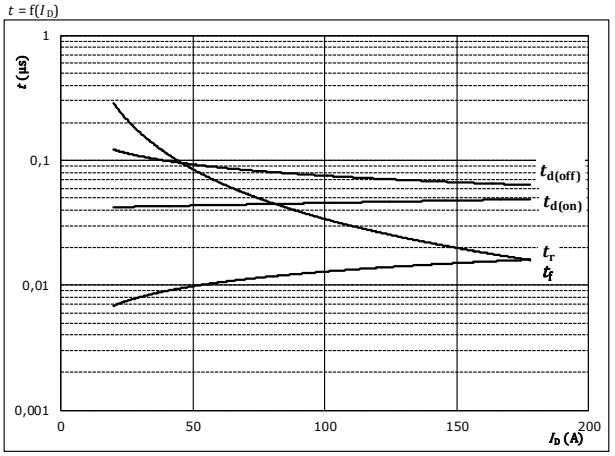
V_{DS} =	600	V	T_j:	25 °C	.....
V_{GS} =	-5 / 16	V		125 °C	———
I_D =	100	A		150 °C	- - - -

AC Real Open Switching Characteristics

figure 5. **MOSFET**

Typical switching times as a function of drain current

$t = f(I_D)$



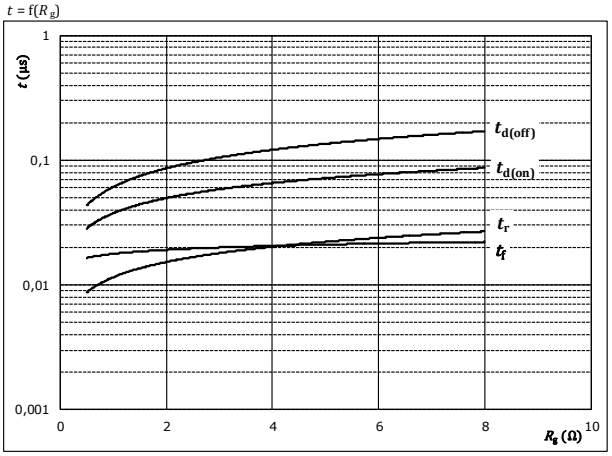
With an inductive load at

T_j =	150	°C
V_{DS} =	600	V
V_{GS} =	-5 / 16	V
R_{gon} =	2	Ω
R_{goff} =	2	Ω

figure 6. **MOSFET**

Typical switching times as a function of gate resistor

$t = f(R_g)$



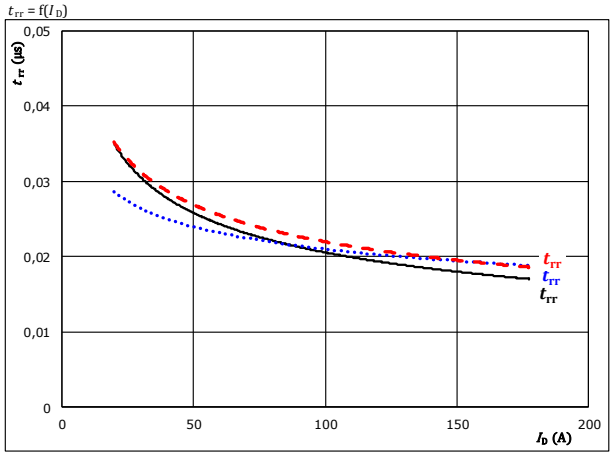
With an inductive load at

T_j =	150	°C
V_{DS} =	600	V
V_{GS} =	-5 / 16	V
I_D =	100	A

figure 7. **FWD**

Typical reverse recovery time as a function of drain current

$t_{rr} = f(I_D)$



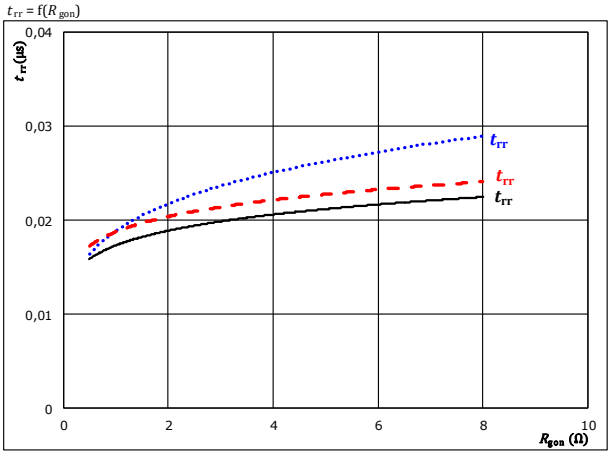
With an inductive load at

V_{DS} =	600	V	T_j:	25 °C
V_{GS} =	-5 / 16	V		125 °C
R_{gon} =	2	Ω		150 °C

figure 8. **FWD**

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

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



With an inductive load at

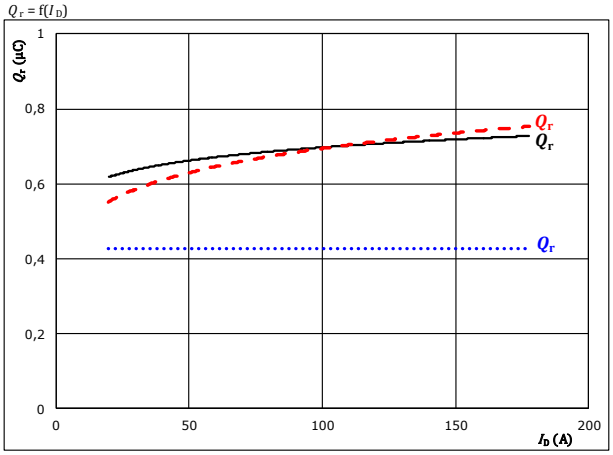
V_{DS} =	600	V	T_j:	25 °C
V_{GS} =	-5 / 16	V		125 °C
I_D =	100	A		150 °C

AC Real Open Switching Characteristics

figure 9. FWD

Typical recovered charge as a function of drain current

$Q_r = f(I_D)$



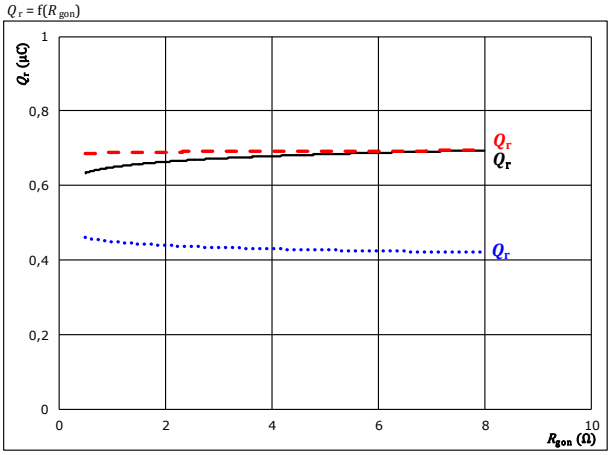
With an inductive load at

V_{DS} =	600	V	T_j:	25 °C	
V_{GS} =	-5 / 16	V		125 °C	
R_{gon} =	2	Ω		150 °C	

figure 10. FWD

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

$Q_r = f(R_{gon})$



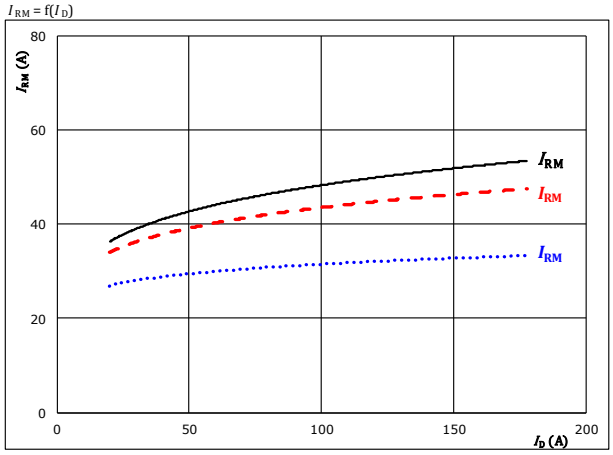
With an inductive load at

V_{DS} =	600	V	T_j:	25 °C	
V_{GS} =	-5 / 16	V		125 °C	
I_D =	100	A		150 °C	

figure 11. FWD

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

$I_{RM} = f(I_D)$



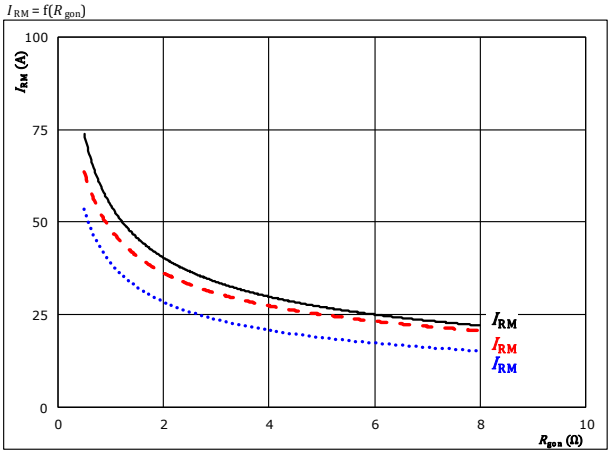
With an inductive load at

V_{DS} =	600	V	T_j:	25 °C	
V_{GS} =	-5 / 16	V		125 °C	
R_{gon} =	2	Ω		150 °C	

figure 12. FWD

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

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



With an inductive load at

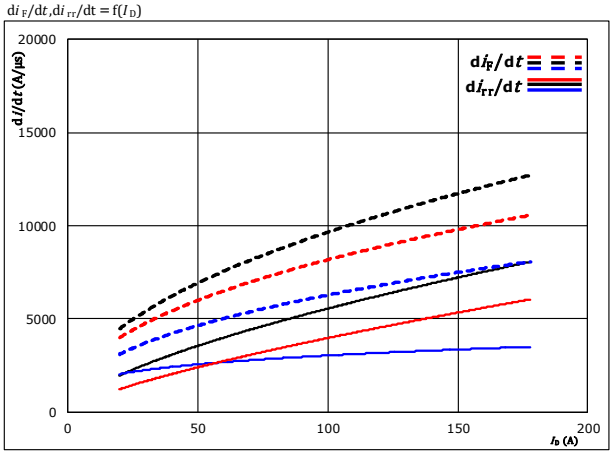
V_{DS} =	600	V	T_j:	25 °C	
V_{GS} =	-5 / 16	V		125 °C	
I_D =	100	A		150 °C	

AC Real Open Switching Characteristics

figure 13. **FWD**

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

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



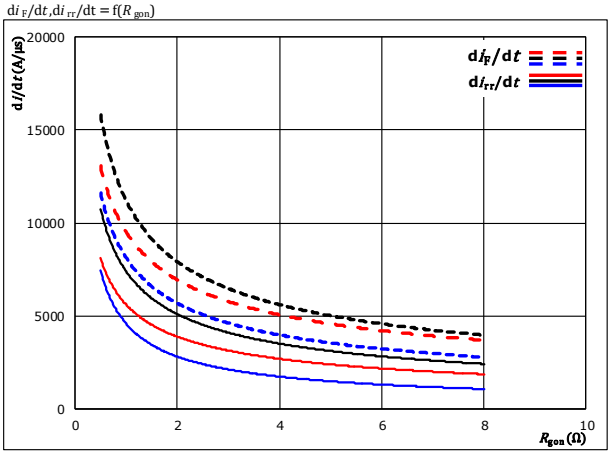
With an inductive load at

V_{DS} =	600	V	T_j:	25 °C
V_{GS} =	-5 / 16	V		125 °C
R_{gon} =	2	Ω		150 °C

figure 14. **FWD**

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

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



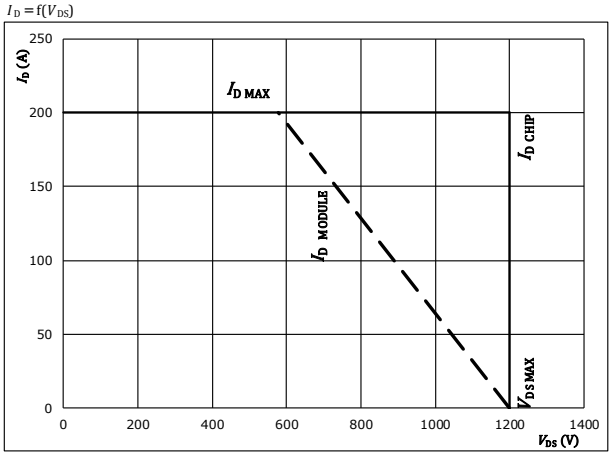
With an inductive load at

V_{DS} =	600	V	T_j:	25 °C
V_{GS} =	-5 / 16	V		125 °C
I_D =	100	A		150 °C

figure 15. **MOSFET**

Reverse bias safe operating area

$I_D = f(V_{DS})$



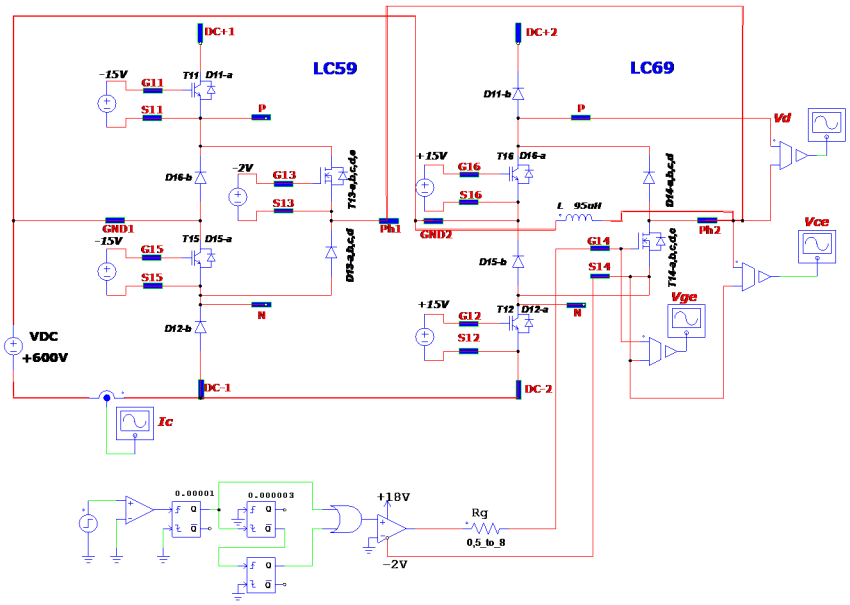
At

T_j =	125	°C
R_{gon} =	2	Ω
R_{goff} =	2	Ω

AC Real Open measurement circuit

figure 1.

AC Real PN Open Configuration

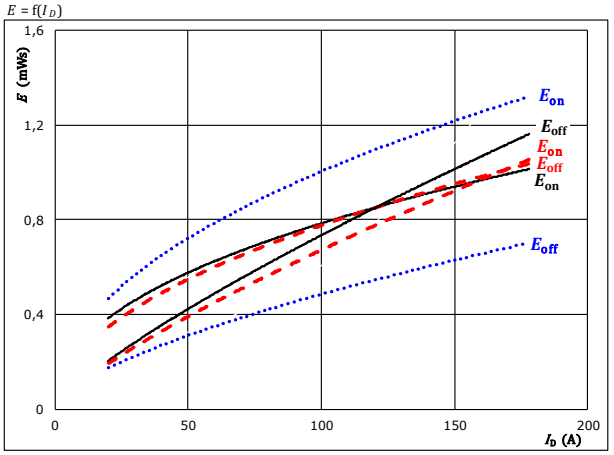


AC Reactive Open Switching Characteristics

figure 1. MOSFET

Typical switching energy losses as a function of drain current

$E = f(I_D)$



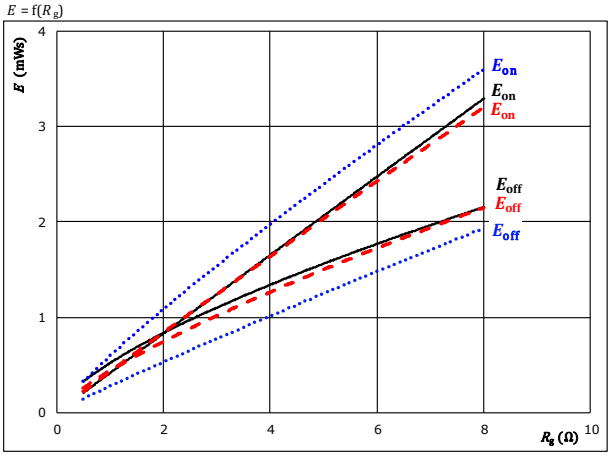
With an inductive load at

V_{DS} =	600	V	T_j:	25 °C
V_{GS} =	-5 / 16	V		125 °C
R_{gon} =	2	Ω		150 °C
R_{goff} =	2	Ω		

figure 2. MOSFET

Typical switching energy losses as a function of gate resistor

$E = f(R_g)$



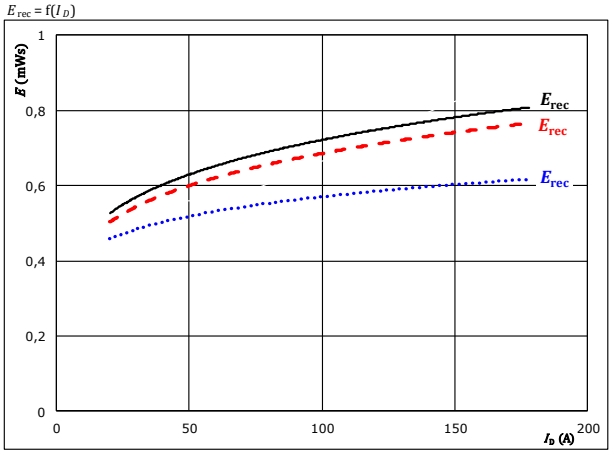
With an inductive load at

V_{DS} =	600	V	T_j:	25 °C
V_{GS} =	-5 / 16	V		125 °C
I_D =	100	A		150 °C

figure 3. FWD

Typical reverse recovered energy loss as a function of drain current

$E_{rec} = f(I_D)$



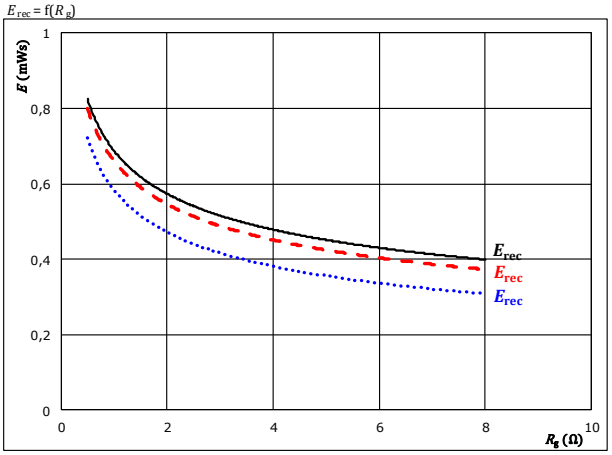
With an inductive load at

V_{DS} =	600	V	T_j:	25 °C
V_{GS} =	-5 / 16	V		125 °C
R_{gon} =	2	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

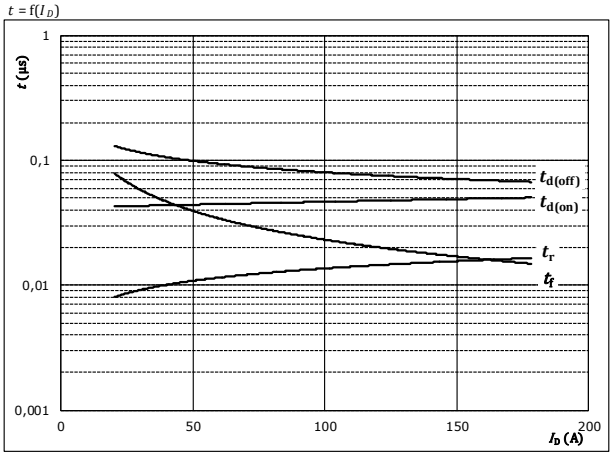
V_{DS} =	600	V	T_j:	25 °C
V_{GS} =	-5 / 16	V		125 °C
I_D =	100	A		150 °C

AC Reactive Open Switching Characteristics

figure 5. **MOSFET**

Typical switching times as a function of drain current

$t = f(I_D)$



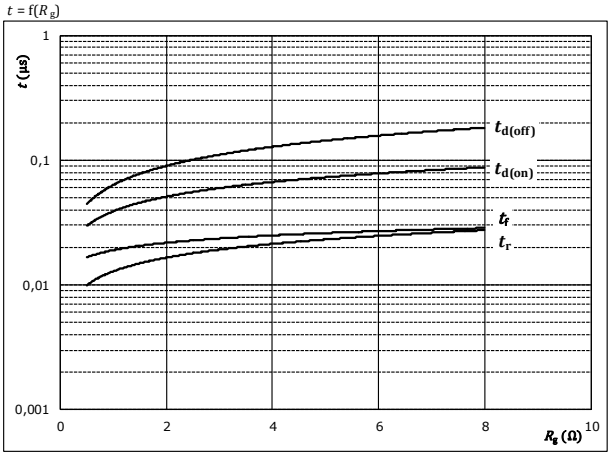
With an inductive load at

T_j =	150	°C
V_{DS} =	600	V
V_{GS} =	-5 / 16	V
R_{gon} =	2	Ω
R_{goff} =	2	Ω

figure 6. **MOSFET**

Typical switching times as a function of gate resistor

$t = f(R_g)$



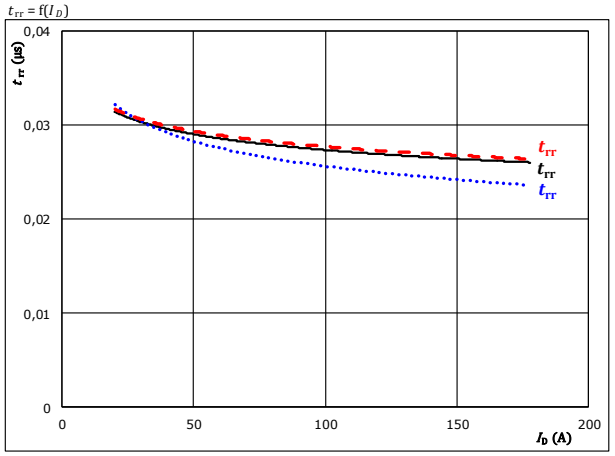
With an inductive load at

T_j =	150	°C
V_{DS} =	600	V
V_{GS} =	-5 / 16	V
I_D =	100	A

figure 7. **FWD**

Typical reverse recovery time as a function of drain current

$t_{rr} = f(I_D)$



With an inductive load at

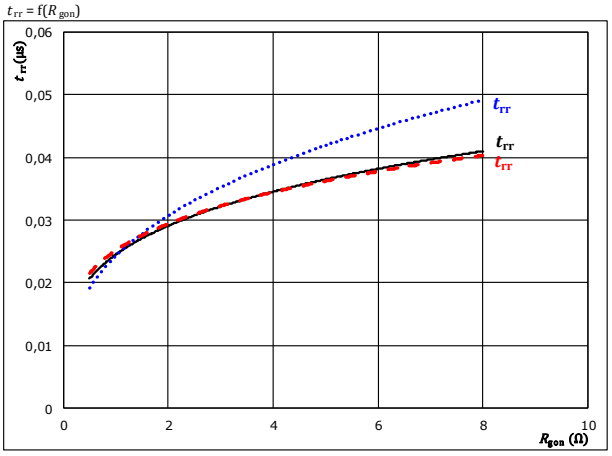
V_{DS} =	600	V
V_{GS} =	-5 / 16	V
R_{gon} =	2	Ω

T_j:	25 °C
	125 °C
	150 °C

figure 8. **FWD**

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

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



With an inductive load at

V_{DS} =	600	V
V_{GS} =	-5 / 16	V
I_D =	100	A

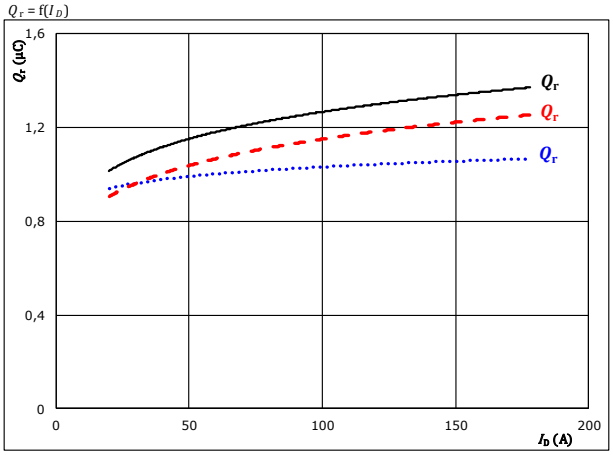
T_j:	25 °C
	125 °C
	150 °C

AC Reactive Open Switching Characteristics

figure 9. **FWD**

Typical recovered charge as a function of drain current

$Q_r = f(I_D)$



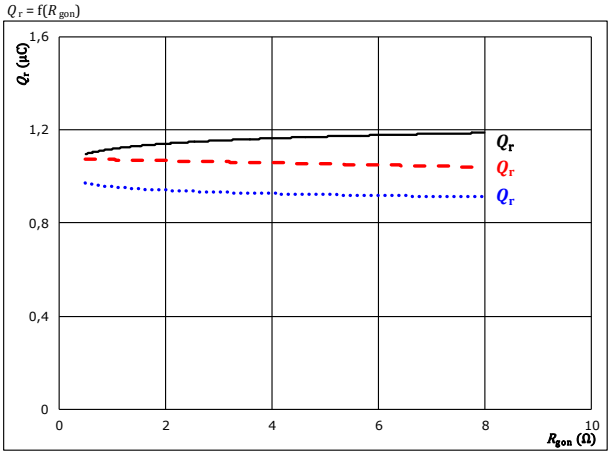
With an inductive load at

V_{DS} =	600	V	T_j:	25 °C	
V_{GS} =	-5 / 16	V		125 °C	
R_{gon} =	2	Ω		150 °C	

figure 10. **FWD**

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

$Q_r = f(R_{gon})$



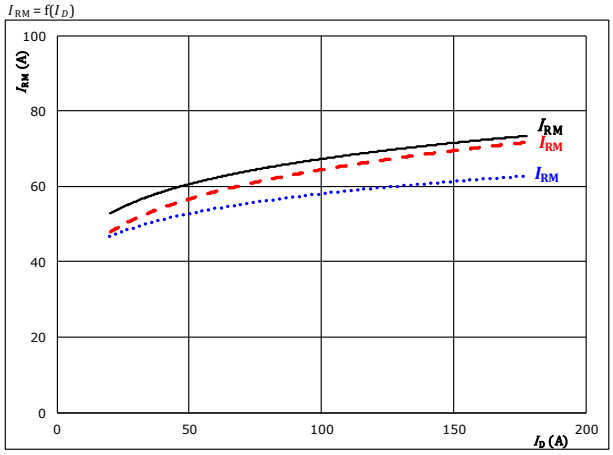
With an inductive load at

V_{DS} =	600	V	T_j:	25 °C	
V_{GS} =	-5 / 16	V		125 °C	
I_D =	100	A		150 °C	

figure 11. **FWD**

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

$I_{RM} = f(I_D)$



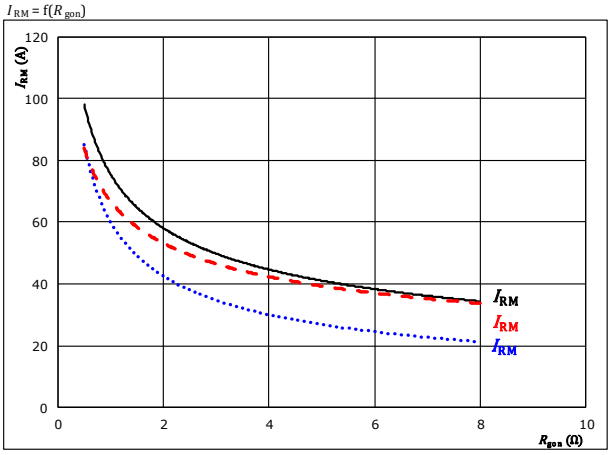
With an inductive load at

V_{DS} =	600	V	T_j:	25 °C	
V_{GS} =	-5 / 16	V		125 °C	
R_{gon} =	2	Ω		150 °C	

figure 12. **FWD**

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

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



With an inductive load at

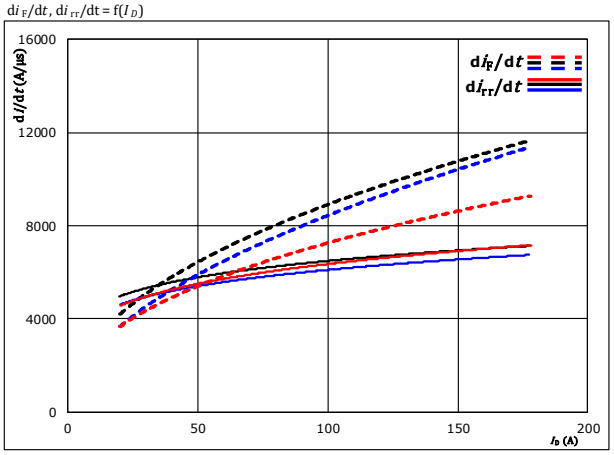
V_{DS} =	600	V	T_j:	25 °C	
V_{GS} =	-5 / 16	V		125 °C	
I_D =	100	A		150 °C	

AC Reactive Open Switching Characteristics

figure 13. **FWD**

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

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



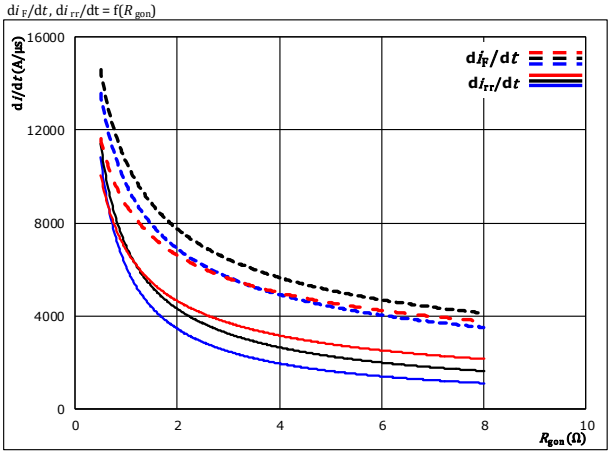
With an inductive load at

V_{DS} =	600	V	T_j:	25 °C
V_{GS} =	-5 / 16	V		125 °C
R_{gon} =	2	Ω		150 °C

figure 14. **FWD**

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

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



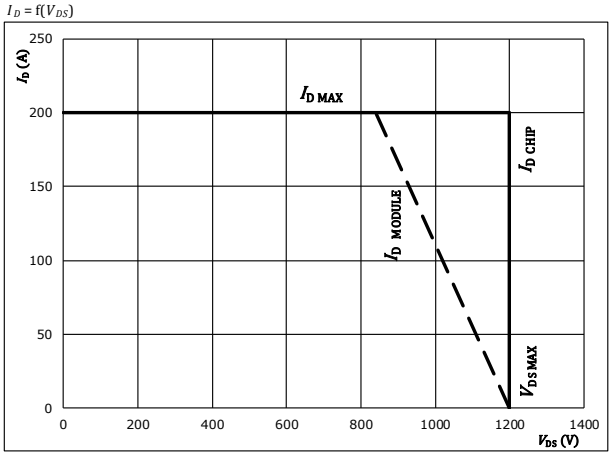
With an inductive load at

V_{DS} =	600	V	T_j:	25 °C
V_{GS} =	-5 / 16	V		125 °C
I_D =	100	A		150 °C

figure 15. **MOSFET**

Reverse bias safe operating area

$I_D = f(V_{DS})$

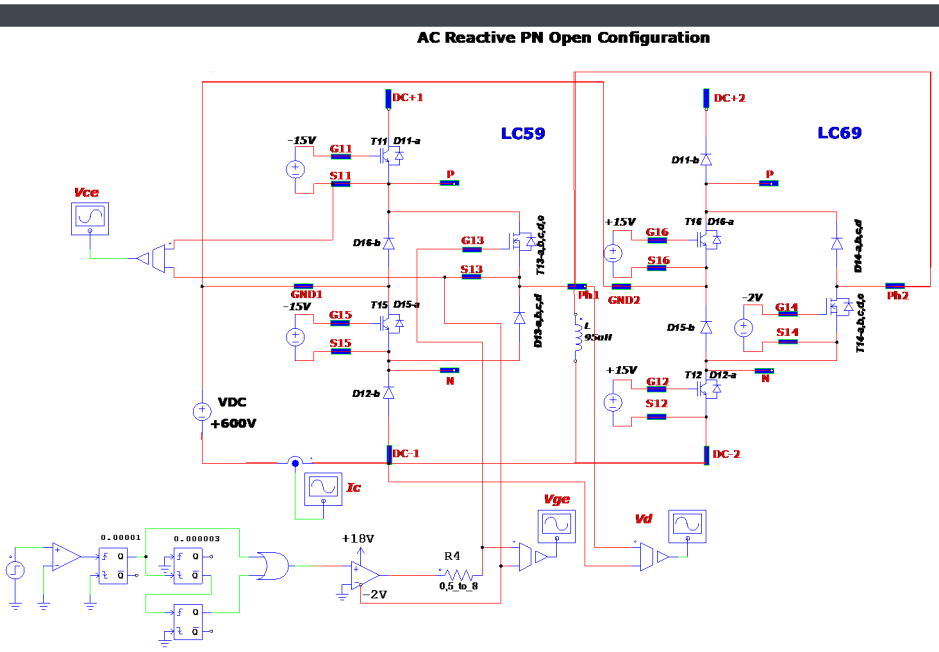


At

T_j =	125	°C
R_{gon} =	2	Ω
R_{goff} =	2	Ω

AC Reactive Open measurement circuit

figure 1.



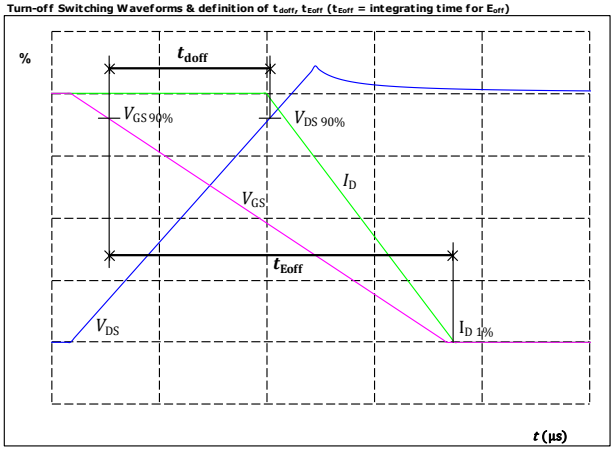
AC Switching Definitions

General conditions

T_j	=	125 °C
R_{gon}	=	2 Ω
R_{goff}	=	2 Ω

figure 1. MOSFET

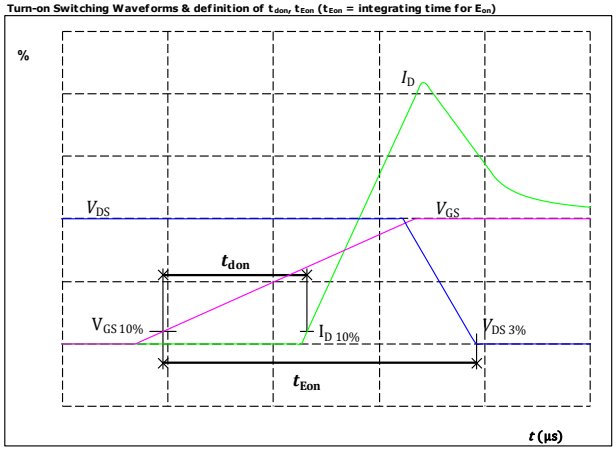
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff} (t_{Eoff} = integrating time for E_{off})



$V_{GS}(0\%)$ =	-5	V
$V_{GS}(100\%)$ =	16	V
$V_{DS}(100\%)$ =	600	V
$I_D(100\%)$ =	100	A
t_{doff} =	77	ns

figure 2. MOSFET

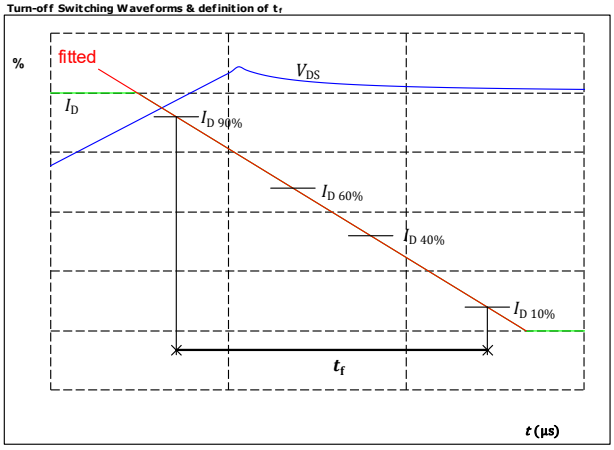
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon} (t_{Eon} = integrating time for E_{on})



$V_{GS}(0\%)$ =	-5	V
$V_{GS}(100\%)$ =	16	V
$V_{DS}(100\%)$ =	600	V
$I_D(100\%)$ =	100	A
t_{don} =	46	ns

figure 3. MOSFET

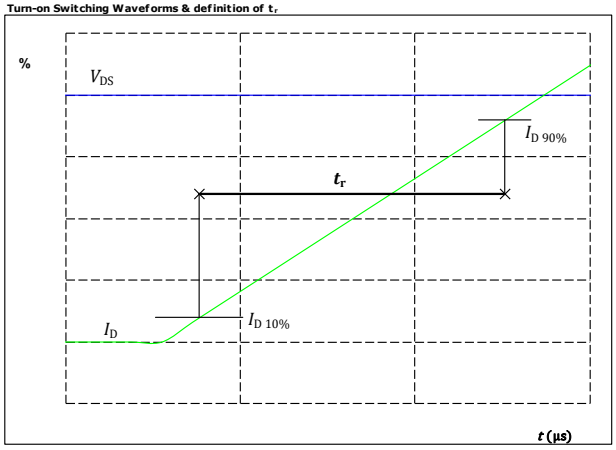
Turn-off Switching Waveforms & definition of t_f



$V_{DS}(100\%)$ =	600	V
$I_D(100\%)$ =	100	A
t_f =	19	ns

figure 4. MOSFET

Turn-on Switching Waveforms & definition of t_r

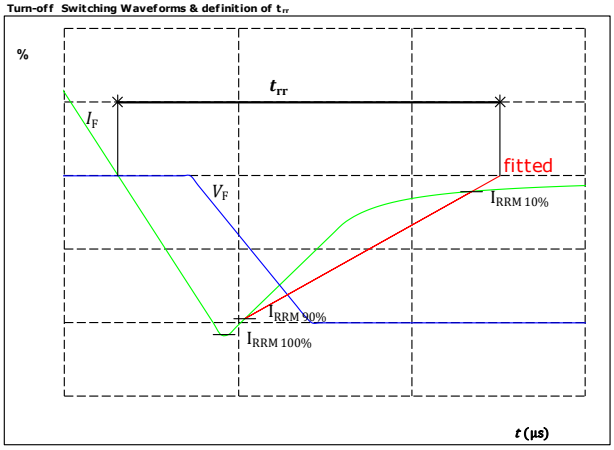


$V_{DS}(100\%)$ =	600	V
$I_D(100\%)$ =	100	A
t_r =	13	ns

AC Switching Definitions

figure 5. **FWD**

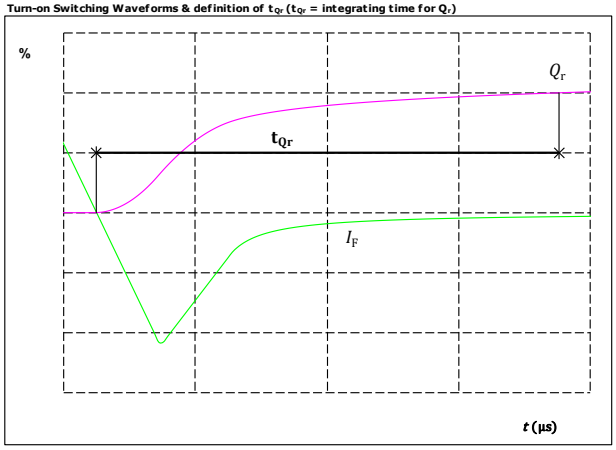
Turn-off Switching Waveforms & definition of t_{rr}



$V_F(100\%)$ =	600	V
$I_F(100\%)$ =	100	A
$I_{RRM}(100\%)$ =	68	A
t_{rr} =	27	ns

figure 6. **FWD**

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



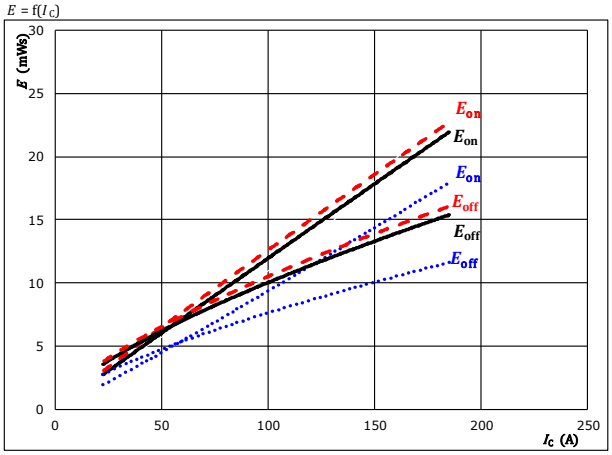
$I_F(100\%)$ =	100	A
$Q_r(100\%)$ =	1,185	µC

Neutral Switching Characteristics

figure 1. **IGBT**

Typical switching energy losses as a function of collector current

$E = f(I_C)$



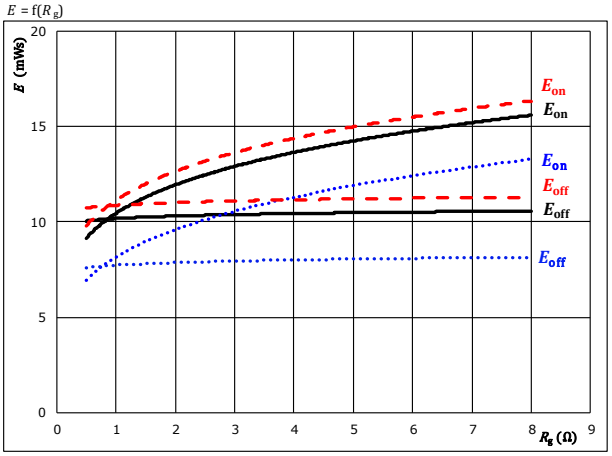
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C
V_{GE} =	±15	V		125 °C
R_{gon} =	2	Ω		150 °C
R_{goff} =	2	Ω		

figure 2. **IGBT**

Typical switching energy losses as a function of gate resistor

$E = f(R_g)$



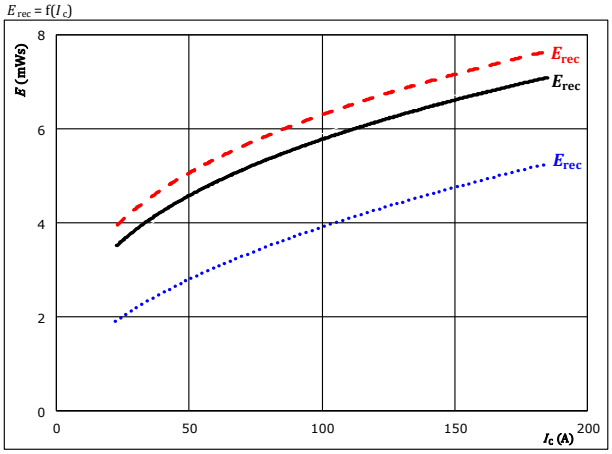
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C
V_{GE} =	±15	V		125 °C
I_C =	100	A		150 °C

figure 3. **FWD**

Typical reverse recovered energy loss as a function of collector current

$E_{rec} = f(I_c)$



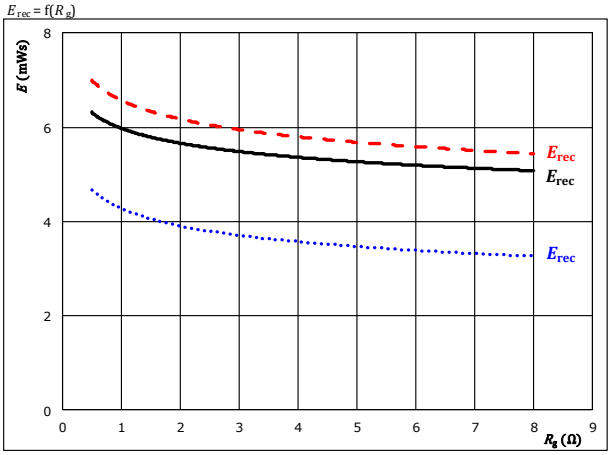
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C
V_{GE} =	±15	V		125 °C
R_{gon} =	2	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

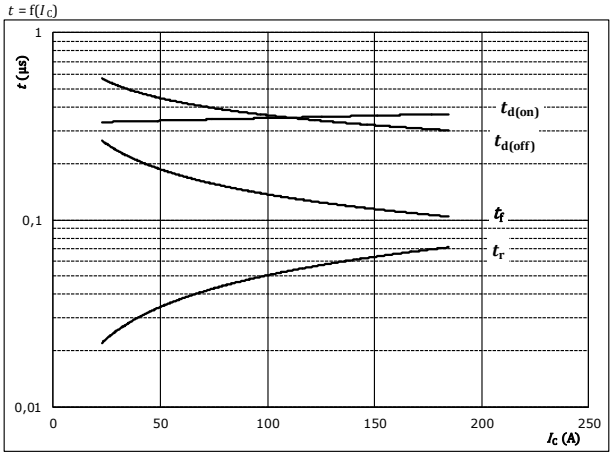
V_{CE} =	600	V	T_j:	25 °C
V_{GE} =	±15	V		125 °C
I_C =	100	A		150 °C

Neutral Switching Characteristics

figure 5. **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



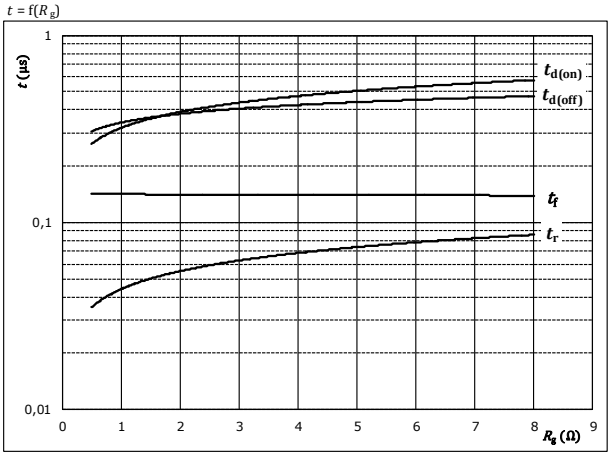
With an inductive load at

T_j =	150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	2	Ω
R_{goff} =	2	Ω

figure 6. **IGBT**

Typical switching times as a function of gate resistor

$t = f(R_g)$



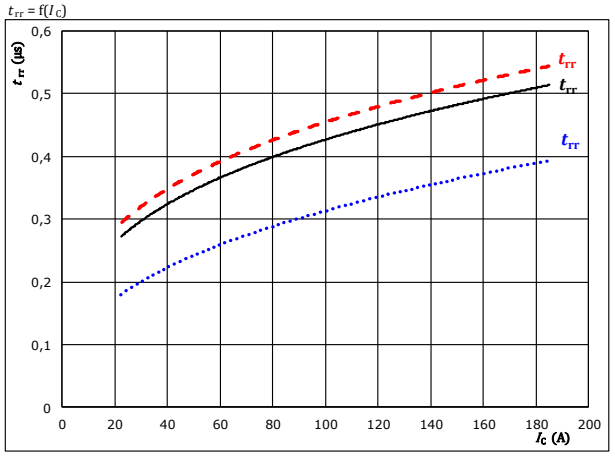
With an inductive load at

T_j =	150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	100	A

figure 7. **FWD**

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$

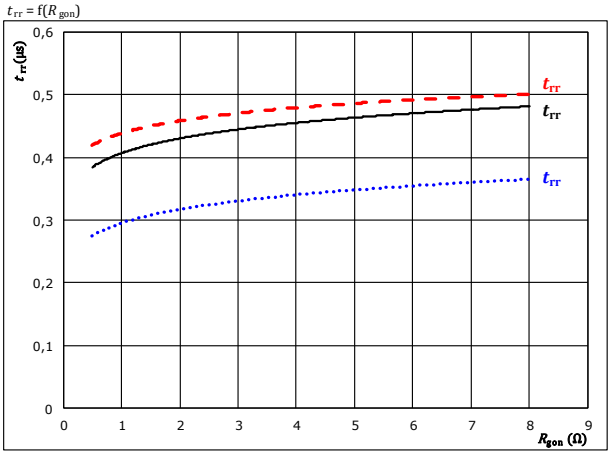


At	V_{CE} =	600	V		25 °C
	V_{GE} =	±15	V	T_j:	125 °C
	R_{gon} =	2	Ω		150 °C

figure 8. **FWD**

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

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



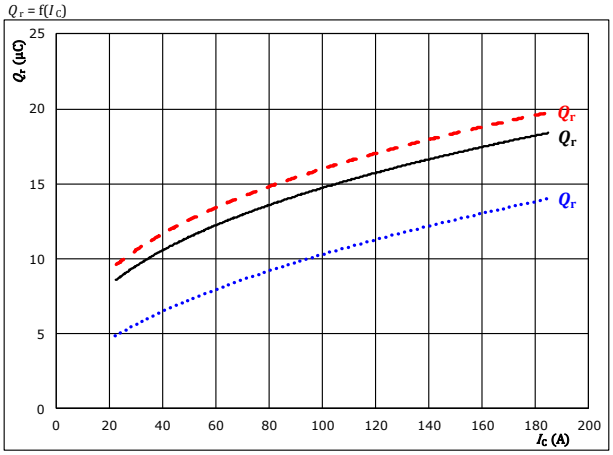
At	V_{CE} =	600	V		25 °C
	V_{GE} =	±15	V	T_j:	125 °C
	I_C =	100	A		150 °C

Neutral Switching Characteristics

figure 9. **FWD**

Typical recovered charge as a function of collector current

$Q_r = f(I_C)$

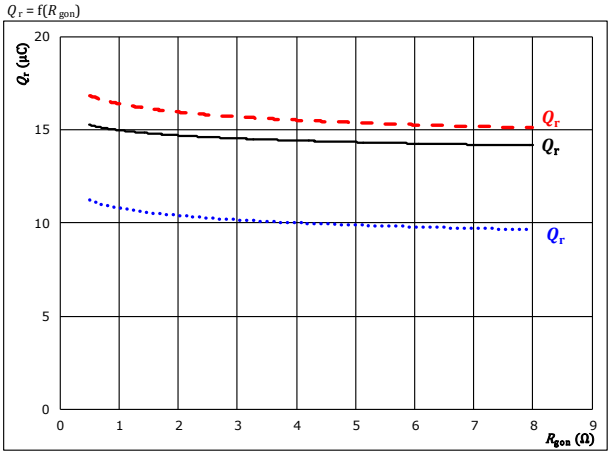


At	V_{CE} =	600	V		25 °C	
	V_{GE} =	±15	V	T_j:	125 °C	
	R_{gon} =	2	Ω		150 °C	

figure 10. **FWD**

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

$Q_r = f(R_{gon})$

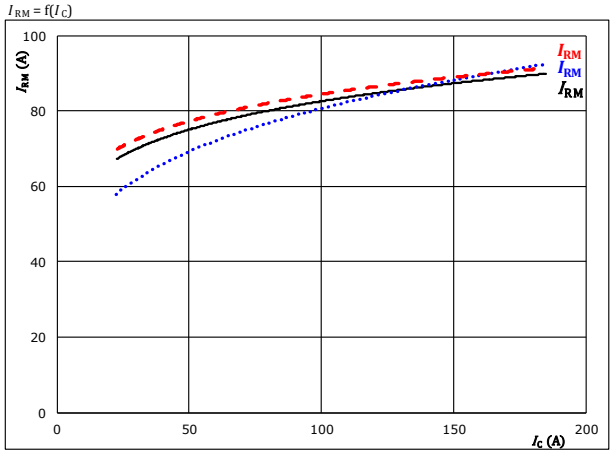


At	V_{CE} =	600	V		25 °C	
	V_{GE} =	±15	V	T_j:	125 °C	
	I_C =	100	A		150 °C	

figure 11. **FWD**

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

$I_{RM} = f(I_C)$

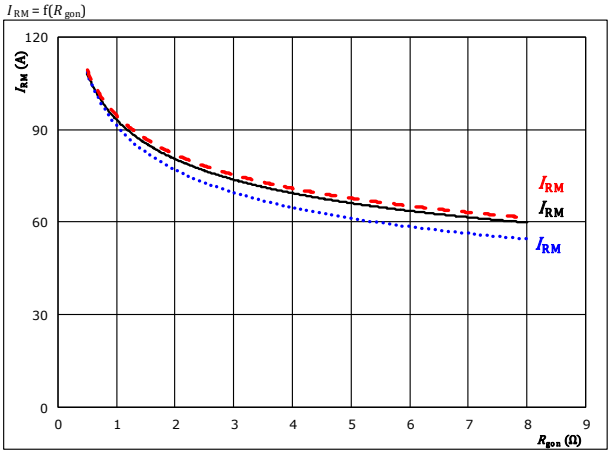


At	V_{CE} =	600	V		25 °C	
	V_{GE} =	±15	V	T_j:	125 °C	
	R_{gon} =	2	Ω		150 °C	

figure 12. **FWD**

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

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



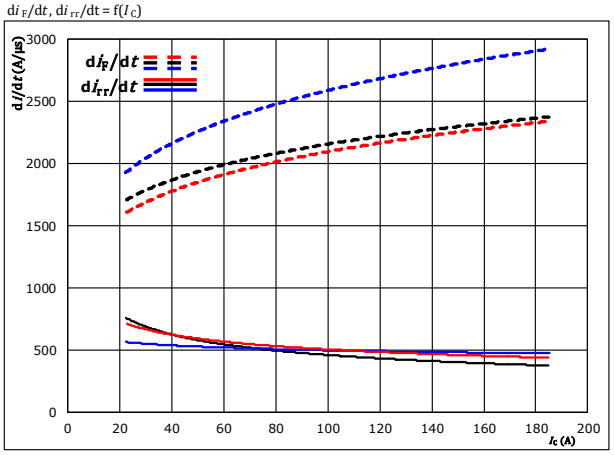
At	V_{CE} =	600	V		25 °C	
	V_{GE} =	±15	V	T_j:	125 °C	
	I_C =	100	A		150 °C	

Neutral Switching Characteristics

figure 13. **FWD**

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

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

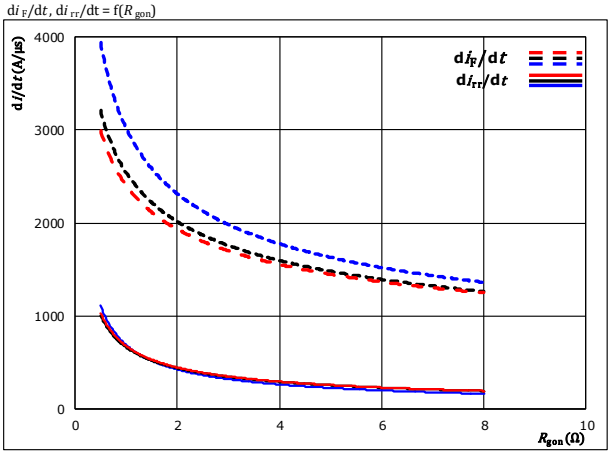


At	V_{CE} =	600	V		25	°C
	V_{GE} =	±15	V	T_j:	125	°C
	R_{gon} =	2	Ω		150	°C

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

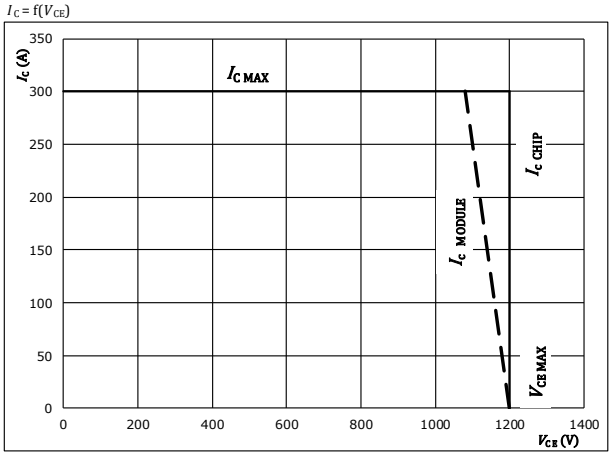


At	V_{CE} =	600	V		25	°C
	V_{GE} =	±15	V	T_j:	125	°C
	I_C =	100	A		150	°C

figure 15. **IGBT**

Reverse bias safe operating area

$I_C = f(V_{CE})$

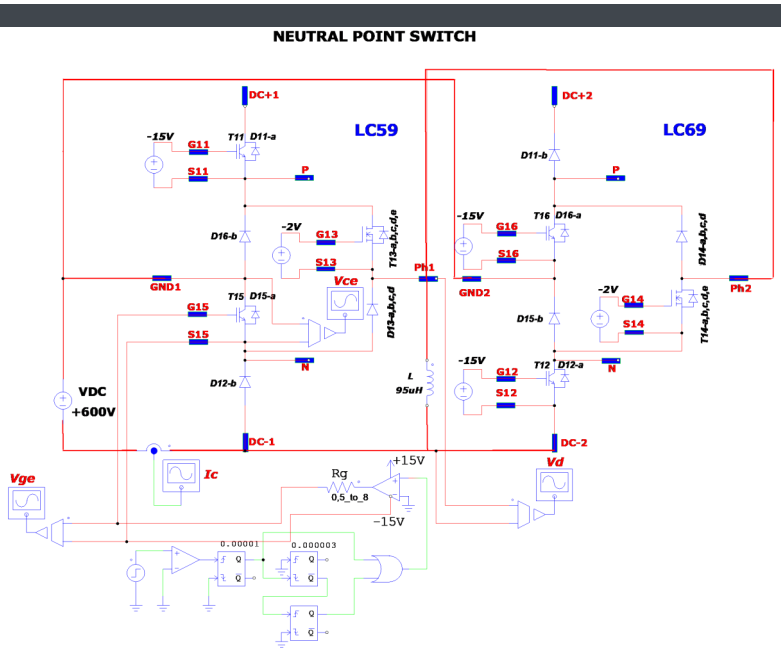


At

T_j =	125	°C
R_{gon} =	2	Ω
R_{goff} =	2	Ω

Neutral Switching measurement circuit

figure 1.



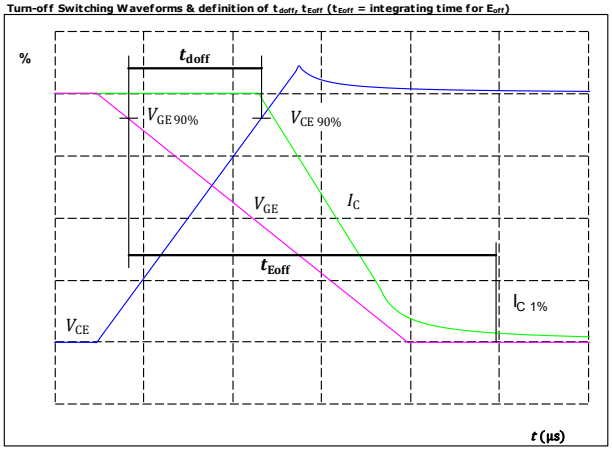
Neutral Switching Definitions

General conditions

T_j	=	125 °C
R_{gon}	=	2 Ω
R_{goff}	=	2 Ω

figure 1. IGBT

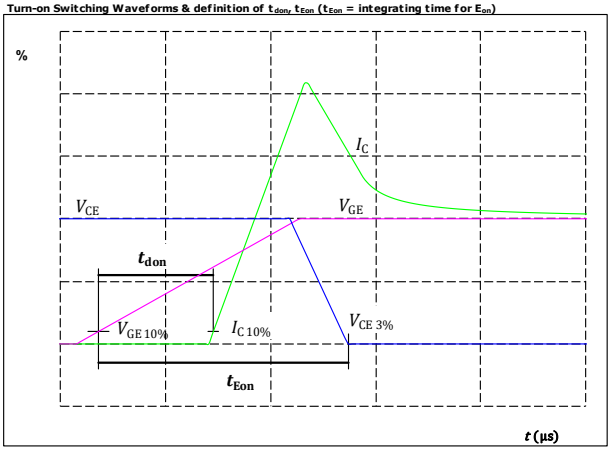
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff} (t_{Eoff} = integrating time for E_{off})



$V_{GE}(0\%)$ =	-15	V
$V_{GE}(100\%)$ =	15	V
$V_C(100\%)$ =	600	V
$I_C(100\%)$ =	100	A
t_{doff} =	351	ns

figure 2. IGBT

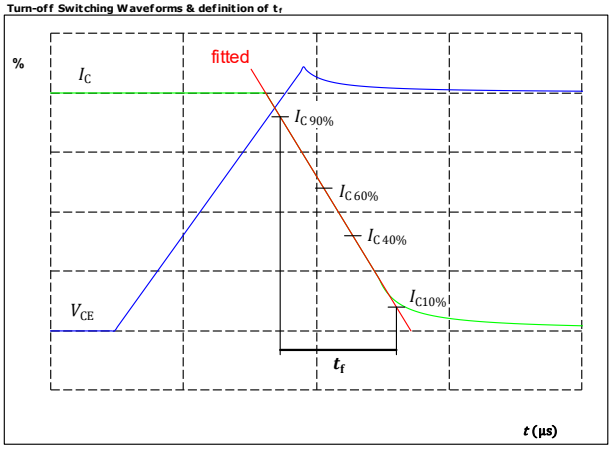
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon} (t_{Eon} = integrating time for E_{on})



$V_{GE}(0\%)$ =	-15	V
$V_{GE}(100\%)$ =	15	V
$V_C(100\%)$ =	600	V
$I_C(100\%)$ =	100	A
t_{don} =	349	ns

figure 3. IGBT

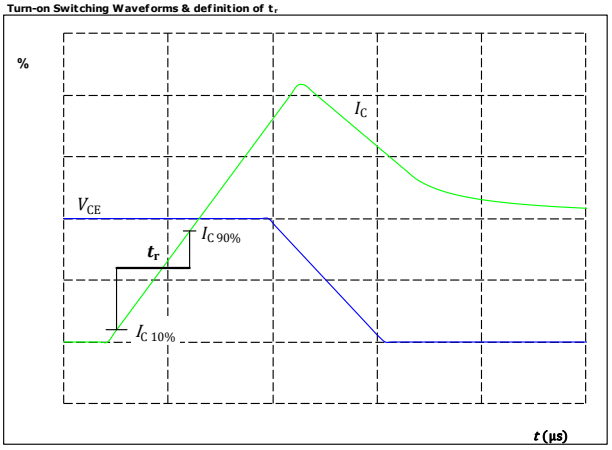
Turn-off Switching Waveforms & definition of t_f



$V_C(100\%)$ =	600	V
$I_C(100\%)$ =	100	A
t_f =	139	ns

figure 4. IGBT

Turn-on Switching Waveforms & definition of t_r

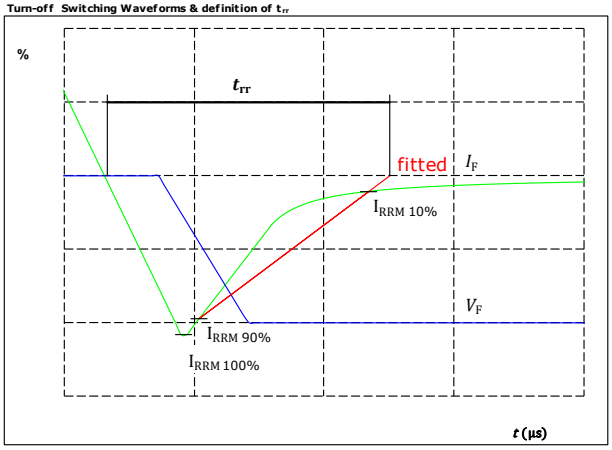


$V_C(100\%)$ =	600	V
$I_C(100\%)$ =	100	A
t_r =	47	ns

Neutral Switching Definitions

figure 5. **FWD**

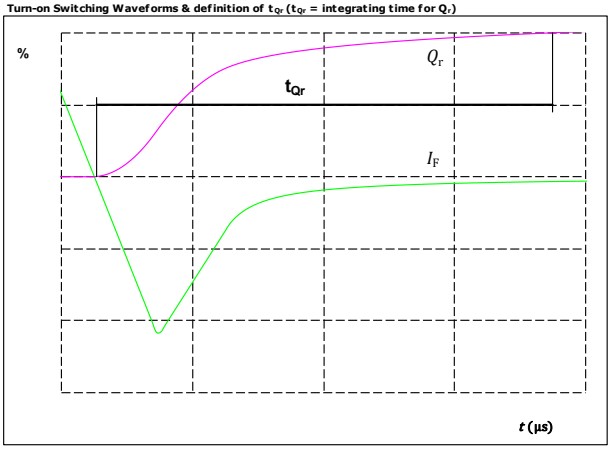
Turn-off Switching Waveforms & definition of t_{rr}



$V_F(100\%)$ =	600	V
$I_F(100\%)$ =	100	A
$I_{RRM}(100\%)$ =	86	A
t_{rr} =	419	ns

figure 6. **FWD**

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



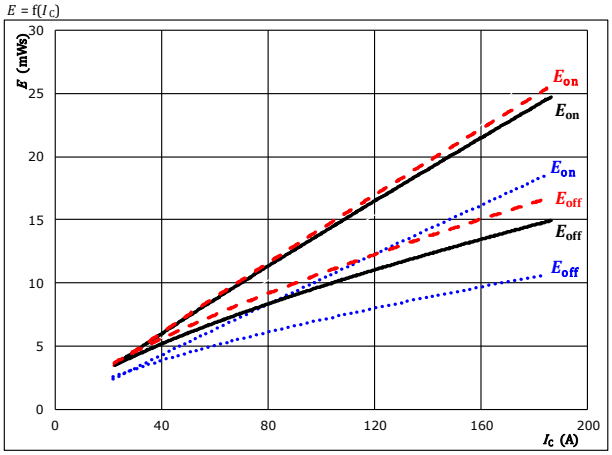
$I_F(100\%)$ =	100	A
$Q_r(100\%)$ =	15,02	µC

DC-Link Switching Characteristics

figure 1. **IGBT**

Typical switching energy losses as a function of collector current

$E = f(I_C)$



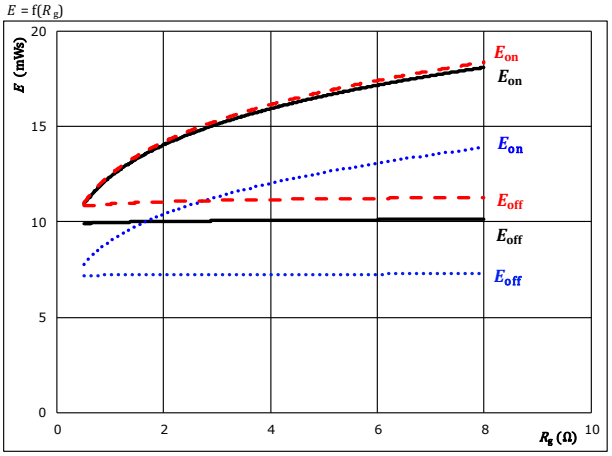
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C
V_{GE} =	±15	V		125 °C
R_{gon} =	2	Ω		150 °C
R_{goff} =	2	Ω		

figure 2. **IGBT**

Typical switching energy losses as a function of gate resistor

$E = f(R_g)$



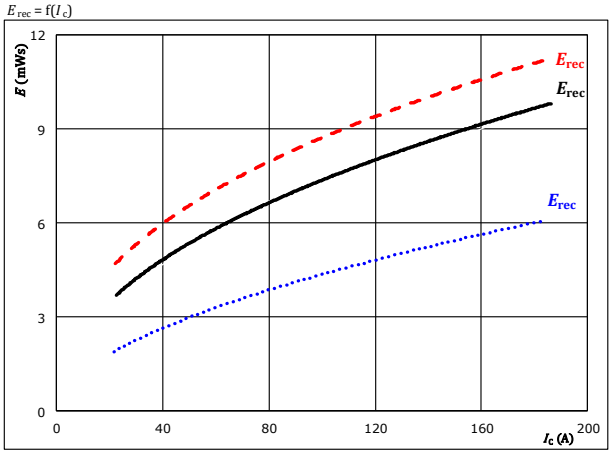
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C
V_{GE} =	±15	V		125 °C
I_C =	100	A		150 °C

figure 3. **FWD**

Typical reverse recovered energy loss as a function of collector current

$E_{rec} = f(I_c)$



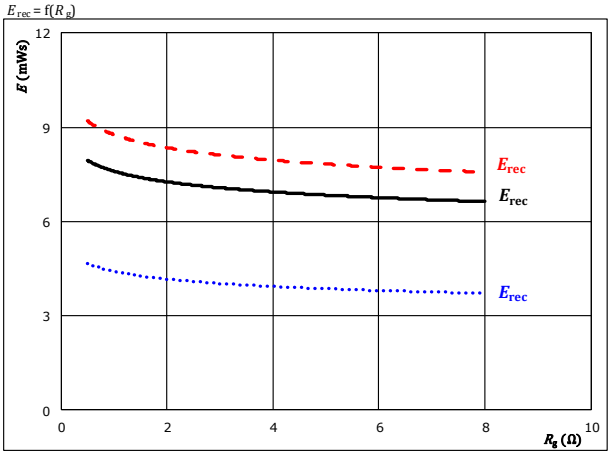
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C
V_{GE} =	±15	V		125 °C
R_{gon} =	2	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

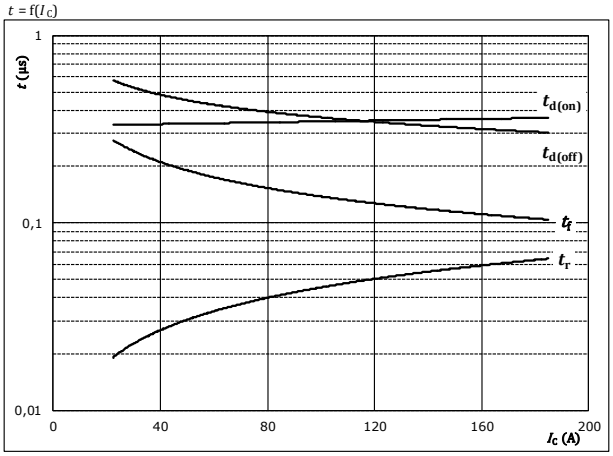
V_{CE} =	600	V	T_j:	25 °C
V_{GE} =	±15	V		125 °C
I_C =	100	A		150 °C

DC-Link Switching Characteristics

figure 5. **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



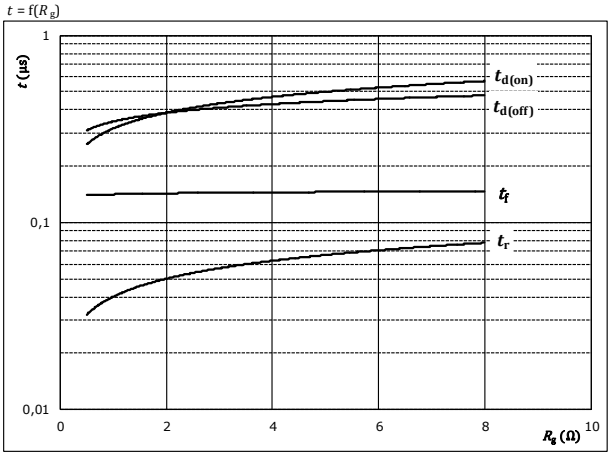
With an inductive load at

T_j =	150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	2	Ω
R_{goff} =	2	Ω

figure 6. **IGBT**

Typical switching times as a function of gate resistor

$t = f(R_g)$



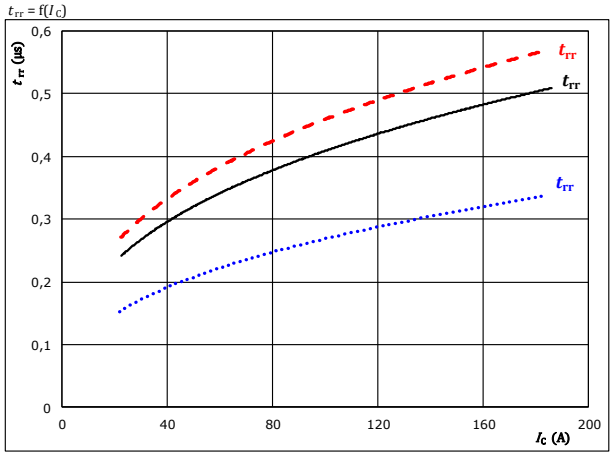
With an inductive load at

T_j =	150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	100	A

figure 7. **FWD**

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$

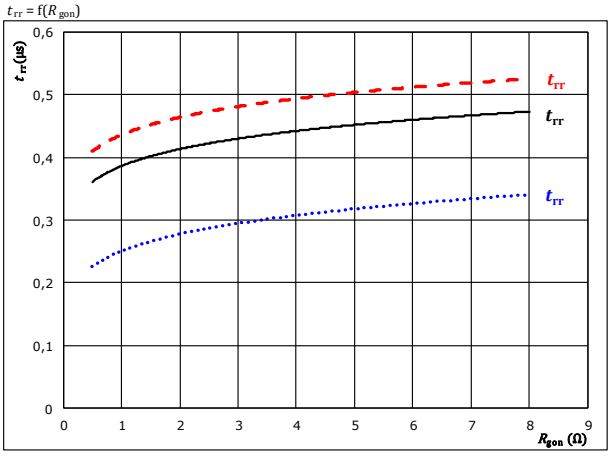


At					
	V_{CE} =	600	V		25 °C
	V_{GE} =	±15	V	T_j:	125 °C
	R_{gon} =	2	Ω		150 °C

figure 8. **FWD**

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

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



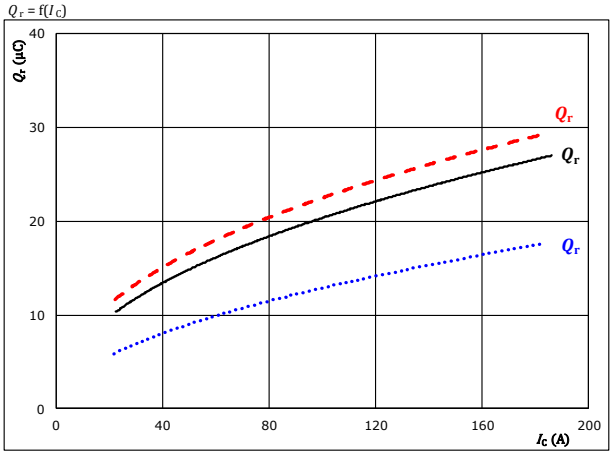
At					
	V_{CE} =	600	V		25 °C
	V_{GE} =	±15	V	T_j:	125 °C
	I_C =	100	A		150 °C

DC-Link Switching Characteristics

figure 9. **FWD**

Typical recovered charge as a function of collector current

$Q_r = f(I_C)$

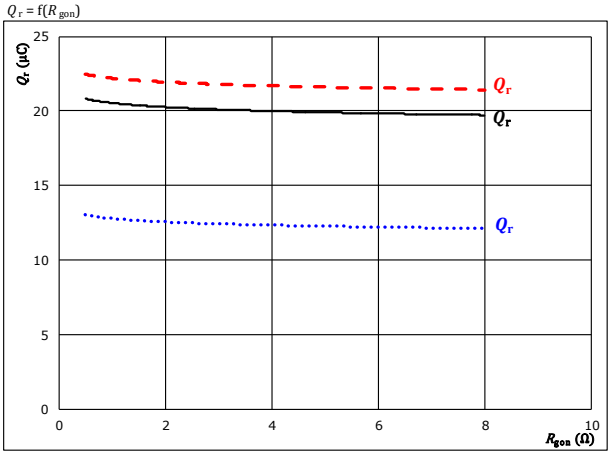


At						
	V_{CE} =	600	V		25 °C	
	V_{GE} =	±15	V	T_j:	125 °C	
	R_{gon} =	2	Ω		150 °C	

figure 10. **FWD**

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

$Q_r = f(R_{gon})$

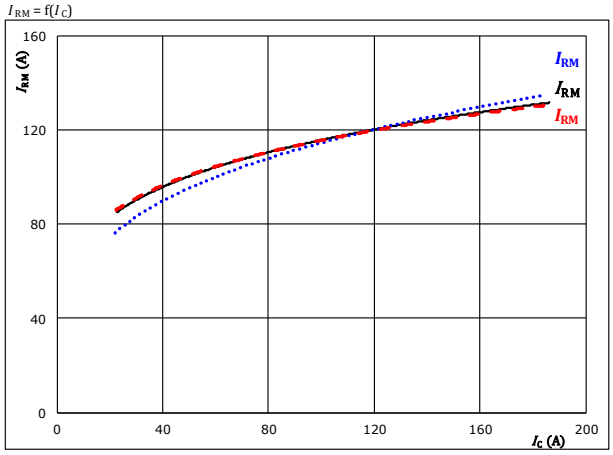


At						
	V_{CE}=	600	V		25 °C	
	V_{GE} =	±15	V	T_j:	125 °C	
	I_C=	100	A		150 °C	

figure 11. **FWD**

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

$I_{RM} = f(I_C)$

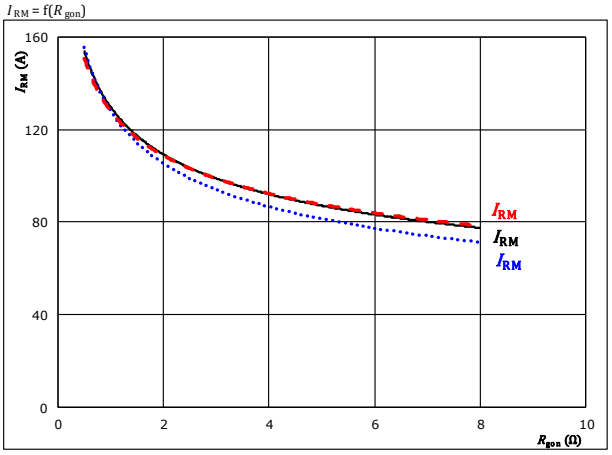


At						
	V_{CE}:	600	V		25 °C	
	V_{GE} =	±15	V	T_j:	125 °C	
	R_{gon} =	2	Ω		150 °C	

figure 12. **FWD**

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

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



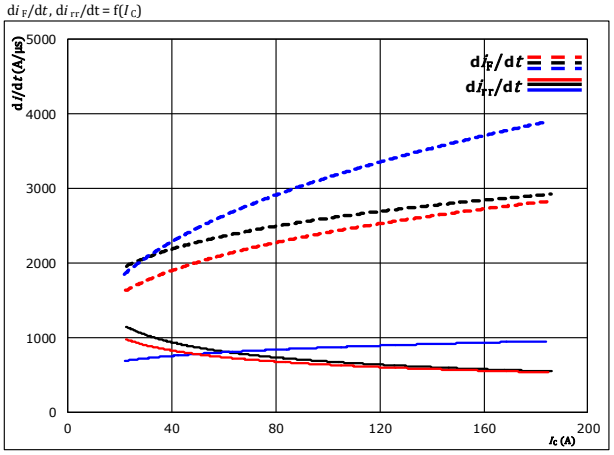
At						
	V_{CE} =	600	V		25 °C	
	V_{GE} =	±15	V	T_j:	125 °C	
	I_C =	100	A		150 °C	

DC-Link Switching Characteristics

figure 13. **FWD**

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

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

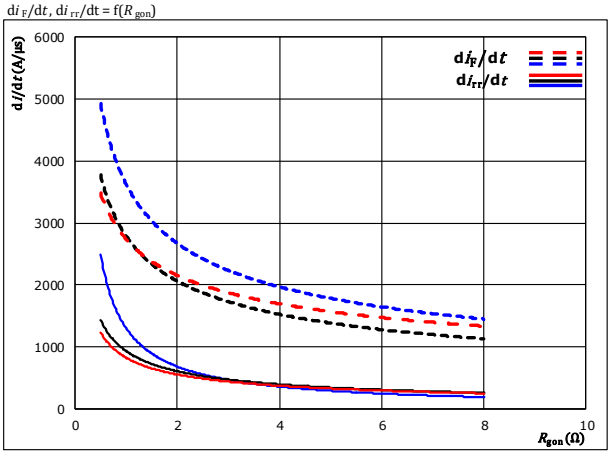


At						
	V_{CE} =	600	V		25	°C
	V_{GE} =	±15	V	T_j:	125	°C
	R_{gon} =	2	Ω		150	°C

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

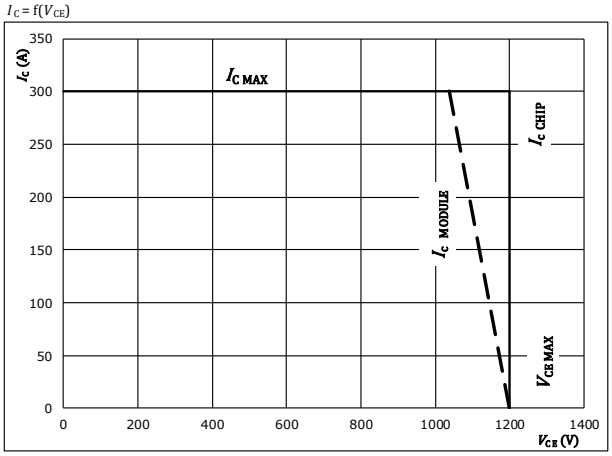


At						
	V_{CE} =	600	V		25	°C
	V_{GE} =	±15	V	T_j:	125	°C
	I_C =	100	A		150	°C

figure 15. **IGBT**

Reverse bias safe operating area

$I_C = f(V_{CE})$



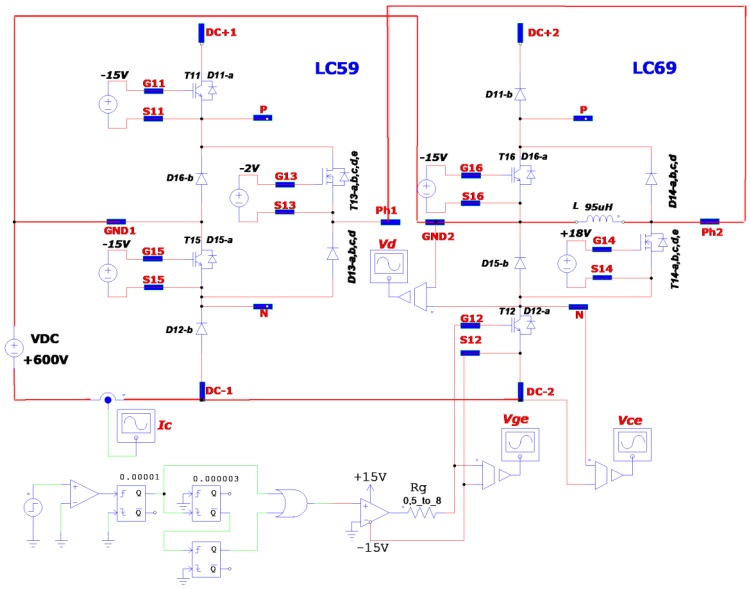
At

T_j =	125	°C
R_{gon} =	2	Ω
R_{goff} =	2	Ω

DC Open Switching Characteristics

figure 1.

DC-LINK SWITCH

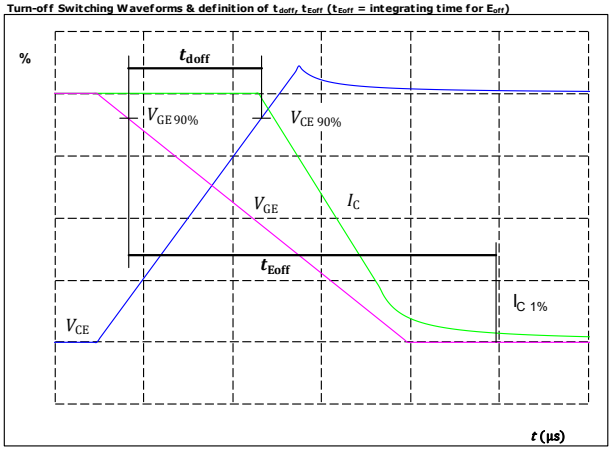


DC-Link Switching Definitions

General conditions		
T_j	=	125 °C
R_{gon}	=	2 Ω
R_{goff}	=	2 Ω

figure 1. IGBT

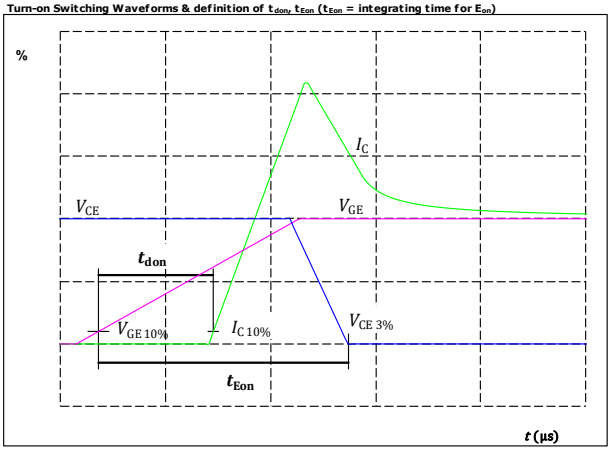
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff} (t_{Eoff} = integrating time for E_{off})



$V_{GE}(0\%)$ =	-15	V
$V_{GE}(100\%)$ =	15	V
$V_C(100\%)$ =	600	V
$I_C(100\%)$ =	100	A
t_{doff} =	351	ns

figure 2. IGBT

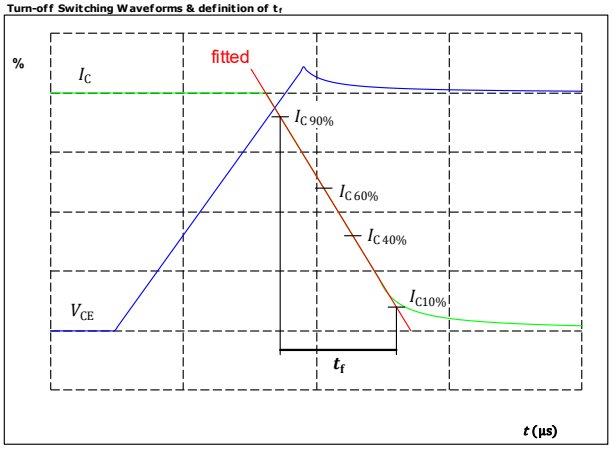
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon} (t_{Eon} = integrating time for E_{on})



$V_{GE}(0\%)$ =	-15	V
$V_{GE}(100\%)$ =	15	V
$V_C(100\%)$ =	600	V
$I_C(100\%)$ =	100	A
t_{don} =	335	ns

figure 3. IGBT

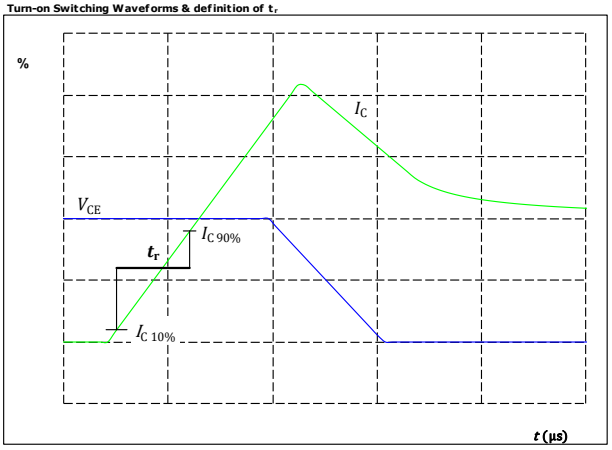
Turn-off Switching Waveforms & definition of t_f



$V_C(100\%)$ =	600	V
$I_C(100\%)$ =	100	A
t_f =	136	ns

figure 4. IGBT

Turn-on Switching Waveforms & definition of t_r

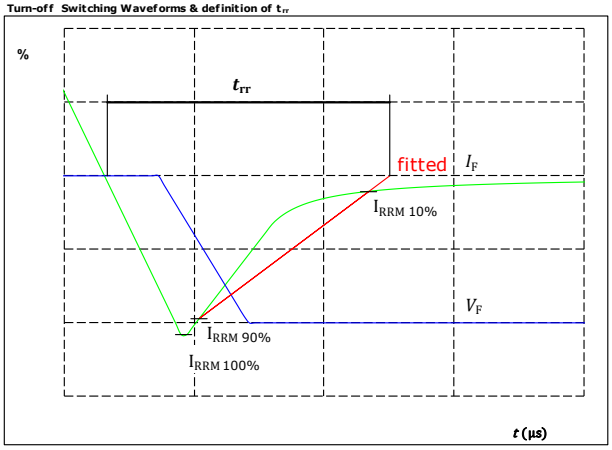


$V_C(100\%)$ =	600	V
$I_C(100\%)$ =	100	A
t_r =	41	ns

DC-Link Switching Definitions

figure 5. **FWD**

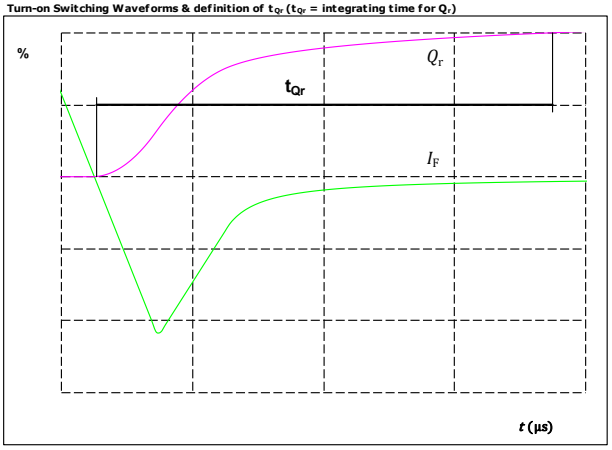
Turn-off Switching Waveforms & definition of t_{rr}



$V_F(100\%)$ =	600	V
$I_F(100\%)$ =	100	A
$I_{RRM}(100\%)$ =	120	A
t_{rr} =	406	ns

figure 6. **FWD**

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



$I_F(100\%)$ =	100	A
$Q_r(100\%)$ =	20,79	µC

Ordering Code & Marking

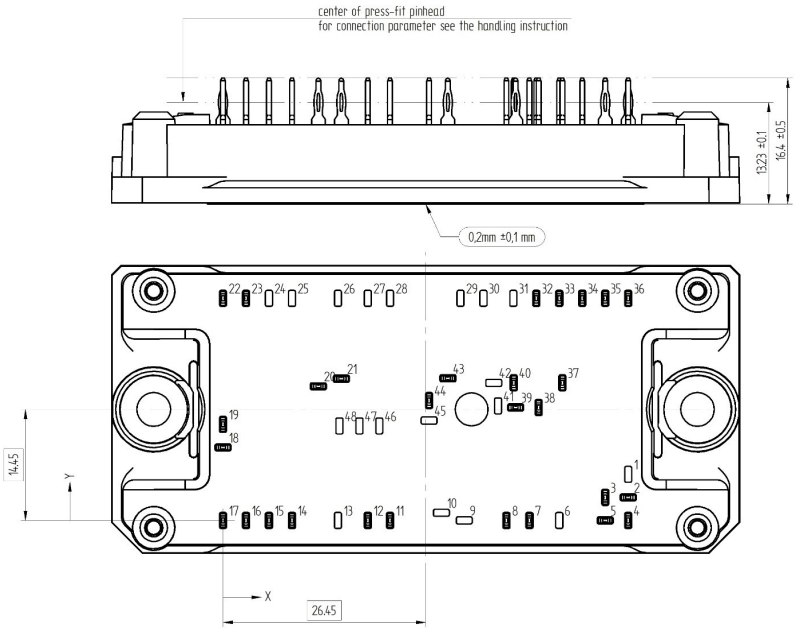
Version	Ordering Code
without thermal paste 12 mm housing with Press-fit pins	10-PG12NAB009CS04-LC59F88T
with thermal paste 12 mm housing with Press-fit pins	10-PG12NAB009CS04-LC59F88T-/3/

Text	Name		Date code	UL & VIN	Lot	Serial
	NN-NNNNNNNNNNNNNN-TTTTTTVV		WWYY	UL VIN	LLLLL	SSSS
Datamatrix	**Type&Ver**	**Lot number**	**Serial**	**Date code**		
	TTTTTTVV	LLLLL	SSSS	WWYY		

High Side Module 10-PG12NAB009CS04-LC59F88T

Outline

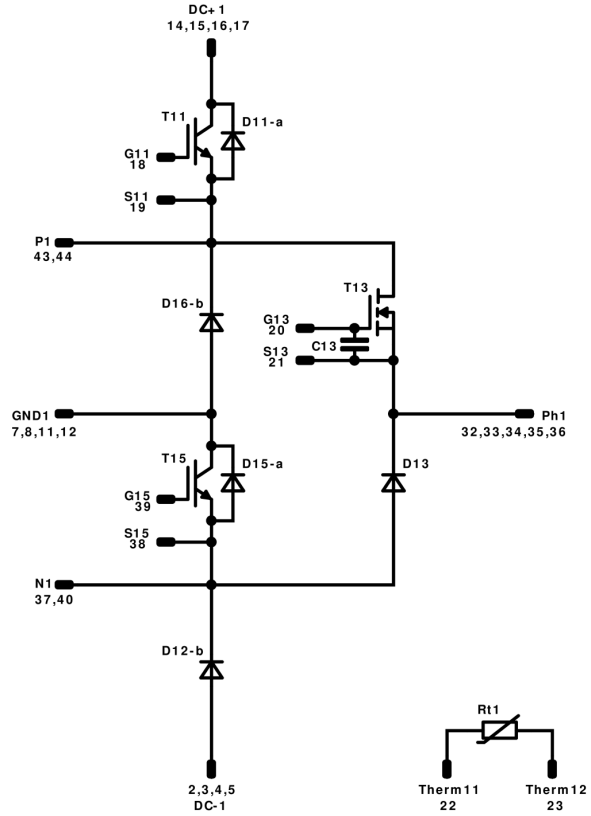
Pin table			
Pin	X	Y	Function
1	Not assembled		
2	52,9	3	DC-1
3	49,9	3	DC-1
4	52,9	0	DC-1
5	49,9	0	DC-1
6	Not assembled		
7	40	0	GND1
8	37	0	GND1
9	Not assembled		
10	Not assembled		
11	21,8	0	GND1
12	18,9	0	GND1
13	Not assembled		
14	9	0	DC+1
15	6	0	DC+1
16	3	0	DC+1
17	0	0	DC+1
18	0	9,5	G11
19	0	12,5	S11
20	12,45	17,45	G13
21	15,45	18,45	S13
22	0	28,9	Therm11
23	3	28,9	Therm12
24	Not assembled		
25	Not assembled		
26	Not assembled		
27	Not assembled		
28	Not assembled		
29	Not assembled		
30	Not assembled		
31	Not assembled		
32	40,9	28,9	Ph1
33	43,9	28,9	Ph1
34	46,9	28,9	Ph1
35	49,9	28,9	Ph1
36	52,9	28,9	Ph1
37	44,3	17,9	N1
38	41,2	14,7	S15
39	38,2	14,7	G15
40	37,95	17,9	N1
41	Not assembled		
42	Not assembled		
43	29,35	18,5	P1
44	26,9	15,6	P1
45	Not assembled		
46	Not assembled		
47	Not assembled		
48	Not assembled		



Tolerance of pinpositions ±0,4mm at the end of pins
Dimension of coordinate axis is only offset without tolerance

High Side Module 10-PG12NAB009CS04-LC59F88T

Pinout



Identification

ID	Component	Voltage	Current	Function	Comment
T13	MOSFET	1200 V	9 mΩ	AC Switch	
D13	FWD	1200 V	60 A	AC Diode	
T15	IGBT	1200 V	150 A	Neutral Point Switch	
D12-b	FWD	1200 V	100 A	DC-Link Diode	
D15-a	FWD	1200 V	15 A	Neutral Point Switch Prot. Diode	
T11	IGBT	1200 V	150 A	DC-Link Switch	
D16-b	FWD	1200 V	150 A	Neutral Point Diode	
D11-a	FWD	1200 V	100 A	DC-Link Switch Prot. Diode	
C13	Capacitor	25 V		Capacitor (GS)	
Rt1	NTC			Thermistor	

Vincotech

10-PG12NAB009CS04-LC59F88T
10-PG12NAC009CS04-LC59F88T
datasheet

Ordering Code & Marking

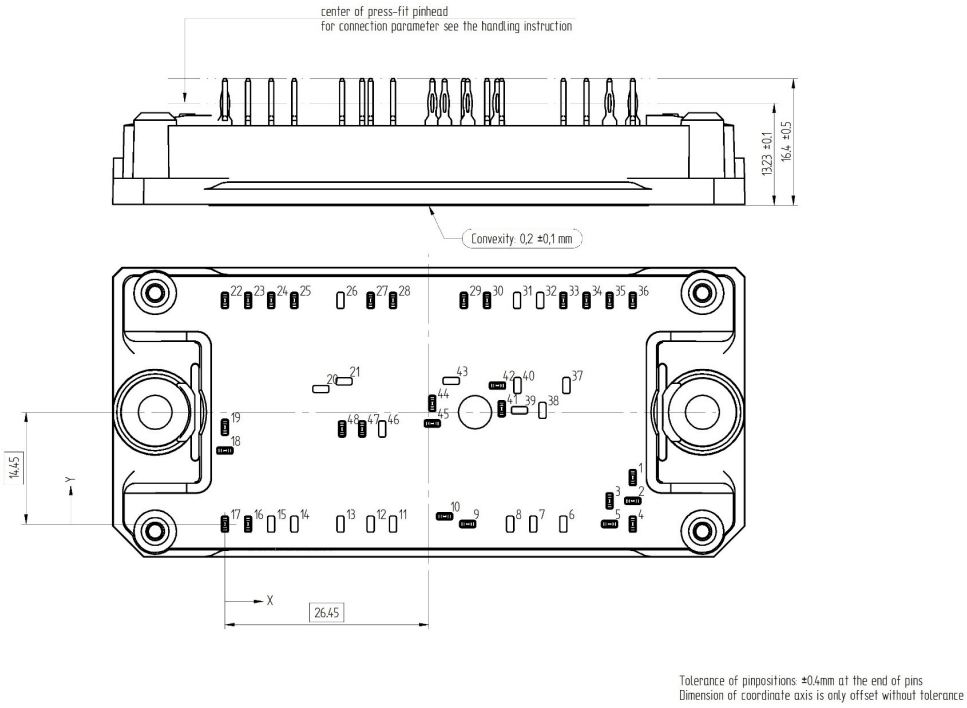
Version	Ordering Code
without thermal paste 12 mm housing with Press-fit pins	10-PG12NAC009CS04-LC69F88T
with thermal paste 12 mm housing with Press-fit pins	10-PG12NAC009CS04-LC69F88T-/3/

	Name		Date code	UL & VIN	Lot	Serial
Text	NN-NNNNNNNNNNNNNN-TTTTTTVV		WWYY	UL VIN	LLLLL	SSSS
	Type&Ver	**Lot number**	**Serial**	**Date code**		
Datamatrix	TTTTTTVV	LLLLL	SSSS	WWYY		

Low Side Module 10-PG12NAC009CS04-LC69F88T

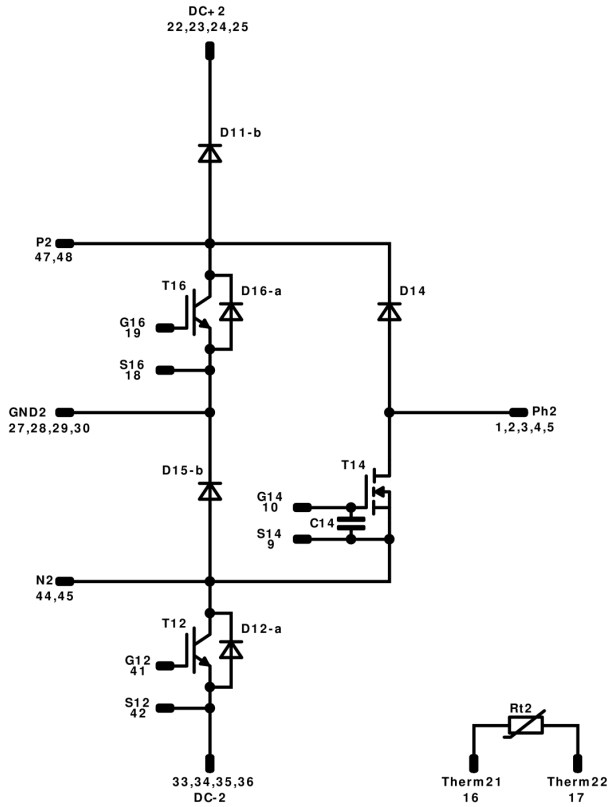
Outline

Pin table			
Pin	X	Y	Function
1	52,9	6	Ph2
2	52,9	3	Ph2
3	49,9	3	Ph2
4	52,9	0	Ph2
5	49,9	0	Ph2
6	Not assembled		
7	Not assembled		
8	Not assembled		
9	31,5	0	S14
10	28,5	1	G14
11	Not assembled		
12	Not assembled		
13	Not assembled		
14	Not assembled		
15	Not assembled		
16	3	0	Therm21
17	0	0	Therm22
18	0	9,5	S16
19	0	12,5	G16
20	Not assembled		
21	Not assembled		
22	0	28,9	DC+2
23	3	28,9	DC+2
24	6	28,9	DC+2
25	9	28,9	DC+2
26	Not assembled		
27	18,9	28,9	GND2
28	21,8	28,9	GND2
29	31	28,9	GND2
30	34	28,9	GND2
31	Not assembled		
32	Not assembled		
33	43,9	28,9	DC-2
34	46,9	28,9	DC-2
35	49,9	28,9	DC-2
36	52,9	28,9	DC-2
37	Not assembled		
38	Not assembled		
39	Not assembled		
40	Not assembled		
41	35,9	14,9	G12
42	35,35	17,9	S12
43	Not assembled		
44	26,9	15,6	N2
45	26,9	13	N2
46	Not assembled		
47	17,8	12,3	P2
48	15,2	12,3	P2



Low Side Module 10-PG12NAC009CS04-LC69F88T

Pinout



Identification

ID	Component	Voltage	Current	Function	Comment
T14	MOSFET	1200 V	9 mΩ	AC Switch	
D14	FWD	1200 V	60 A	AC Diode	
T16	IGBT	1200 V	150 A	Neutral Point Switch	
D15-b	FWD	1200 V	100 A	DC-Link Diode	
D16-a	FWD	1200 V	15 A	Neutral Point Switch Prot. Diode	
T12	IGBT	1200 V	150 A	DC-Link Switch	
D11-b	FWD	1200 V	150 A	Neutral Point Diode	
D16-a	FWD	1200 V	100 A	DC-Link Switch Prot. Diode	
C14	Capacitor	25 V		Capacitor (GS)	
Rt2	NTC			Thermistor	

Vincotech

10-PG12NAB009CS04-LC59F88T
10-PG12NAC009CS04-LC59F88T
datasheet

Packaging instruction				
Standard packaging quantity (SPQ) 100	>SPQ	Standard	<SPQ	Sample

Handling instruction
Handling instructions for *flow* 1 packages see vincotech.com website.

Package data
Package data for *flow* 1 packages see vincotech.com website.

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

Document No.:	Date:	Modification:	Pages
10-PG12NAx009CS04-LCx9F88T	25 Jun. 2019		