10-PH12NAB008MR01-LC59F28T
10-PH12NAC008MR01-LC69F28T

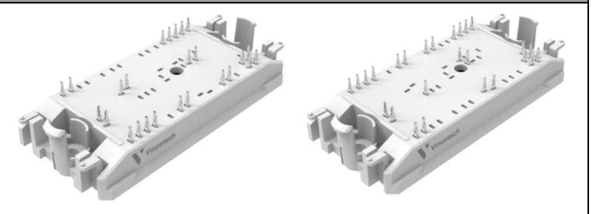
target datasheet

***flow* ANPC 1 split** **1200 V / 8 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

flow 1 12 mm housing

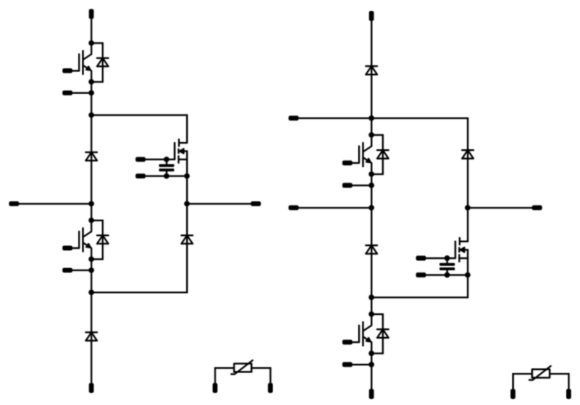


LC59F28T LC69F28T

Target applications

- Solar Inverter

Schematic



LC59F28T LC69F28T

Types

- 10-PH12NAB008MR01-LC59F28T
- 10-PH12NAC008MR01-LC69F28T

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
DC-Link Switch					
Collector-emitter voltage	V_{CES}			1200	V
Collector current	I_C	$T_j = T_{jmax}$	T_s = 80 °C	123	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	232	W
Gate-emitter voltage	V_{GES}			±20	V
Maximum junction temperature	T_{jmax}			175	°C

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
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	72	A
Repetitive peak forward current	I_{FRM}			200	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	121	W
Maximum junction temperature	T_{jmax}			175	°C
DC-Link Switch Inverse Diode					
Peak repetitive reverse voltage	V_{RRM}			1200	V
Continuous (direct) forward current	I_F	$T_j = T_{jmax}$	T_s = 80 °C	72	A
Repetitive peak forward current	I_{FRM}			200	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	121	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	123	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	232	W
Gate-emitter voltage	V_{GES}			±20	V
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	97	A
Repetitive peak forward current	I_{FRM}			300	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	151	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	15	A
Surge (non-repetitive) forward current	I_{FSM}	50 Hz Single Half Sine Wave t_p = 10 ms	T_j = 150 °C	65	A
Surge current capability	I^2t			21	A^2s
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	39	W
Maximum Junction Temperature	T_{jmax}			175	°C
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}		685	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	279	W
Gate-source voltage	V_{GSS}			-4/22	V
Maximum Junction Temperature	T_{jmax}			175	°C
AC Diode					
Peak repetitive reverse voltage	V_{RRM}			1200	V
Continuous (direct) forward current	I_F	$T_j = T_{jmax}$	T_s = 80 °C	72	A
Repetitive peak forward current	I_{FRM}			252	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	183	W
Maximum junction temperature	T_{jmax}			175	°C
GS Capacitor					
Maximum DC voltage	V_{MAX}			25	V
Operation Temperature	T_{op}			-55…+125	°C

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
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
		AC Voltage	t_p = 1 min	2500	V
Creepage distance				>12,7	mm
Clearance				8,21	mm
Comparative Tracking Index	CTI			> 200	

*100 % tested in production

Characteristic Values

Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] V_{GS} [V]	V_{CE} [V] V_{DS} [V] V_F [V]	I_C [A] I_D [A] I_F [A]	T_j [°C]	Min	Typ	Max	
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		1,70 1,97 2,02	2,05	V
Collector-emitter cut-off current	I_{CES}		0	1200		25			160	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}		0	10		25		880		pF
Reverse transfer capacitance	C_{res}		0	10		25		320		pF
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)						0,41		K/W
DC-Link Diode										
Static										
Forward voltage	V_F				100	25 125 150		1,74 1,98 1,98	2,15	V
Reverse leakage current	I_R			1200		25			60	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						0,79		K/W
DC-Link Switch Inverse Diode										
Static										
Forward voltage	V_F				100	25 125 150		1,74 1,98 1,98	2,15	V
Reverse leakage current	I_R			1200		25			60	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						0,79		K/W

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target datasheet

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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		1,70 1,97 2,02	2,05	V
Collector-emitter cut-off current	I_{CES}		0	1200		25			160	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)						0,41		K/W
Dynamic										
Turn-on delay time	$t_{d(on)}$	R_{goff} = 4 Ω R_{gon} = 4 Ω	±15	600	110	25 125 150		397 403 405		ns
Rise time	t_r					25 125 150		61 71 75		
Turn-off delay time	$t_{d(off)}$					25 125 150		307 348 360		
Fall time	t_f					25 125 150		88 119 129		
Turn-on energy (per pulse)	E_{on}	Q_{rFWD} = 10,6 µC Q_{rFWD} = 14,8 µC Q_{rFWD} = 16,5 µC				25 125 150		13,439 15,742 16,533		mWs
Turn-off energy (per pulse)	E_{off}					25 125 150		7,262 9,977 10,645		

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	2,15	V
Reverse leakage current	I_{r}			1200		25			90	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						0,63		K/W
Dynamic										
Peak recovery current	I_{RRM}	di/dt = 1592 A/µs di/dt = 1303 A/µs di/dt = 1123 A/µs	±15	600	110	25 125 150		59 61 61		A
Reverse recovery time	t_{rr}					25 125 150		347 471 513		ns
Recovered charge	Q_{r}					25 125 150		10,571 14,821 16,511		µC
Reverse recovered energy	E_{rec}					25 125 150		3,292 5,159 5,896		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125 150		210 223 208		A/µs
Neutral Point Switch Prot. Diode										
Static										
Forward voltage	V_{F}				30	25 125		2,37 2,47	2,71	V
Reverse leakage current	I_{R}			1200		25 150			120 3600	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						2,46		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 Switch										
Static										
Drain-source on-state resistance	$r_{DS(on)}$		18		100	25 125 150		8 11 12	10	mΩ
Gate-source threshold voltage	$V_{GS(th)}$			10	0,05	25	2,7		5,6	V
Gate to Source Leakage Current	I_{GSS}		-4/22	0		25			±500	nA
Zero Gate Voltage Drain Current	I_{DSS}		0	1200		25			50	μA
Internal gate resistance	r_g							1,4		Ω
Gate charge	Q_g		18	600	100	25		535		nC
Gate to source charge	Q_{GS}							110		
Gate to drain charge	Q_{GD}							205		
Short-circuit input capacitance	C_{iss}	f = 1 MHz	0	800		25		6685		pF
Short-circuit output capacitance	C_{oss}							380		
Reverse transfer capacitance	C_{rss}							135		
Reverse Diode Static										
Diode forward voltage	V_{SD}		0		100	25		3,2		V
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						0,34		K/W
Dynamic										
Turn-on delay time	$t_{d(on)}$	R_{goff} = 1 Ω R_{gon} = 1 Ω	0/16	600	99	25 125 150		30 29 27		ns
Rise time	t_r					25 125 150		14 15 15		
Turn-off delay time	$t_{d(off)}$					25 125 150		83 101 101		
Fall time	t_f					25 125 150		9 13 13		
Turn-on energy (per pulse)	E_{on}	Q_{rFWD} = 0,4 μC Q_{rFWD} = 0,8 μC Q_{rFWD} = 1,4 μC				25 125 150		1,256 1,436 1,410		mWs
Turn-off energy (per pulse)	E_{off}					25 125 150		1,016 1,421 1,482		

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target datasheet

Characteristic Values

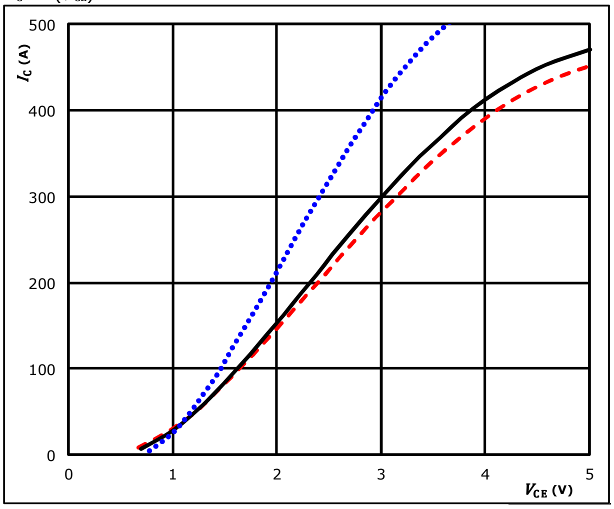
Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] V_{GS} [V]	V_{CE} [V] V_{DS} [V] V_F [V]	I_C [A] I_D [A] I_F [A]	T_j [°C]	Min	Typ	Max	
AC Diode										
Static										
Forward voltage	V_F				60	25 125		1,63 2,04	1,7	V
Reverse leakage current	I_R			1200		25			1200	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j\text{-}s)}$	λ_{paste} = 3,4 W/mK (PSX)						0,52		K/W
Dynamic										
Peak recovery current	I_{RRM}	di/dt = 7141 A/µs di/dt = 10501 A/µs di/dt = 8639 A/µs	0/16	600	99	25 125 150		59 52 54		A
Reverse recovery time	t_{rr}					25 125 150		14 15 51		ns
Recovered charge	Q_r					25 125 150		0,432 0,794 1,431		µC
Reverse recovered energy	E_{rec}					25 125 150		0,068 0,221 0,537		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125 150		13486 10799 4954		A/µs
GS Capacitor										
Capacitance	C							10		nF
Tolerance							-10		+10	%
Dissipation factor		f = 1 kHz				25			0,1	%
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	

DC-Link Switch Characteristics

figure 1. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

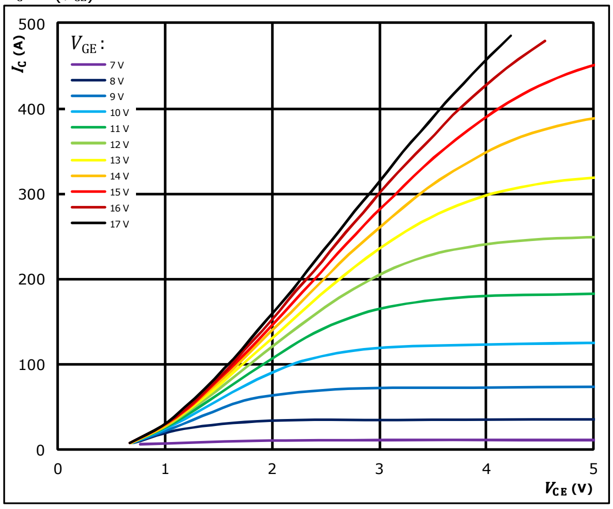


t_p =	250	µs		25 °C	
V_{GE} =	15	V	T_j:	125 °C	
				150 °C	

figure 2. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$



t_p = 250 µs

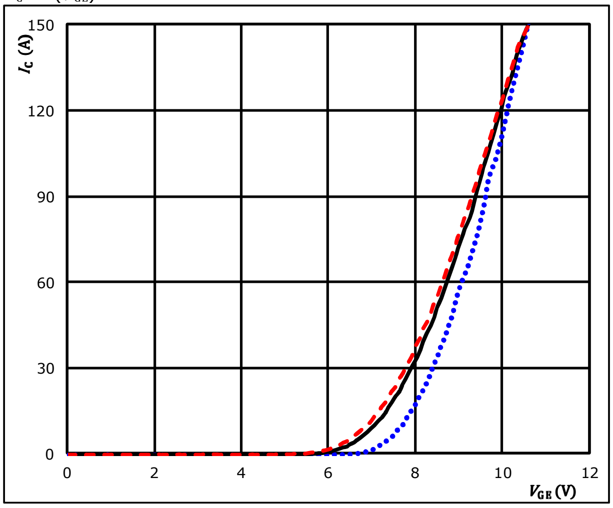
T_j = 150 °C

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

figure 3. **IGBT**

Typical transfer characteristics

$I_C = f(V_{GE})$

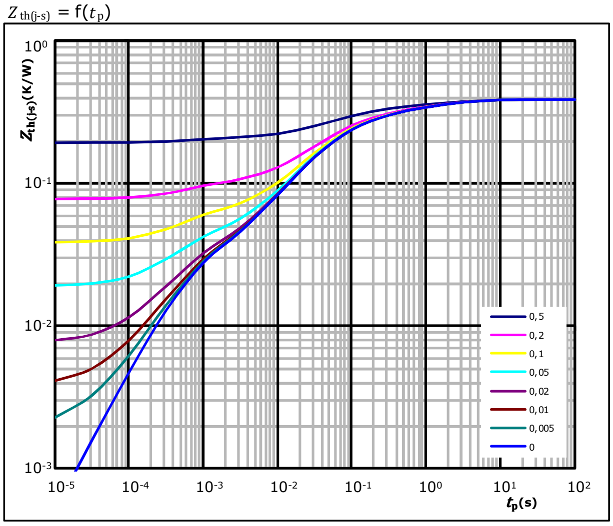


t_p =	100	µs		25 °C	
V_{CE} =	10	V	T_j:	125 °C	
				150 °C	

figure 4. **IGBT**

Transient thermal impedance as function of pulse duration

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



D = t_p / T

$R_{th(j-s)}$ = 0,41 K/W

IGBT thermal model values

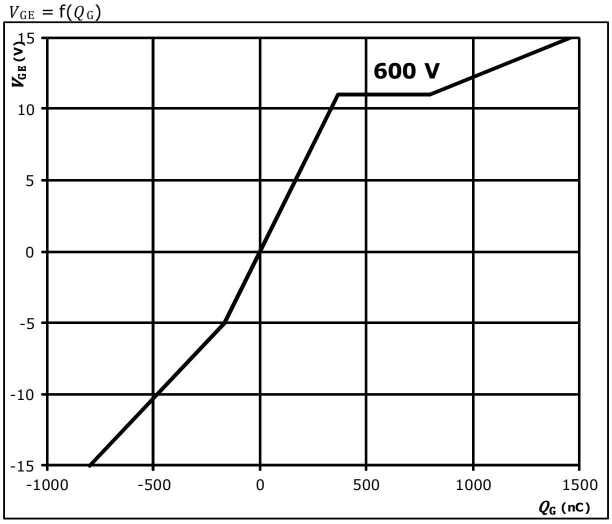
R (K/W)	τ (s)
4,47E-02	2,80E+00
9,73E-02	5,59E-01
2,47E-01	1,59E-01
3,88E-02	2,12E-02
1,13E-02	5,12E-03
1,42E-02	6,59E-04

DC-Link Switch Characteristics

figure 5. **IGBT**

Gate voltage vs gate charge

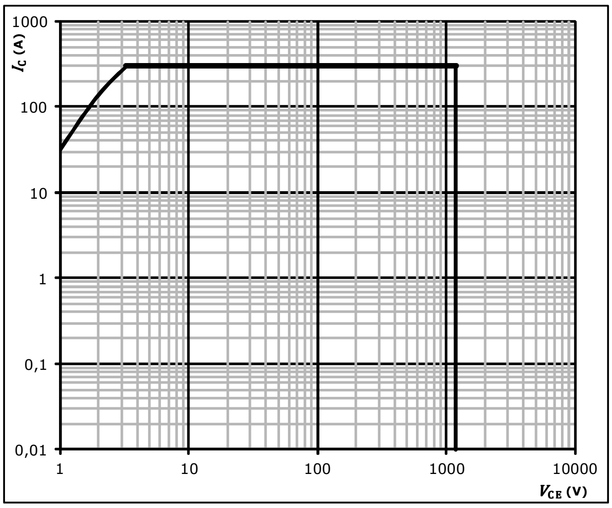
$V_{GE} = f(Q_G)$



I_C=	150	A
V_{GE} =	±15	V
V_{CC} =	600	V

figure 6. **IGBT**

Safe operating area



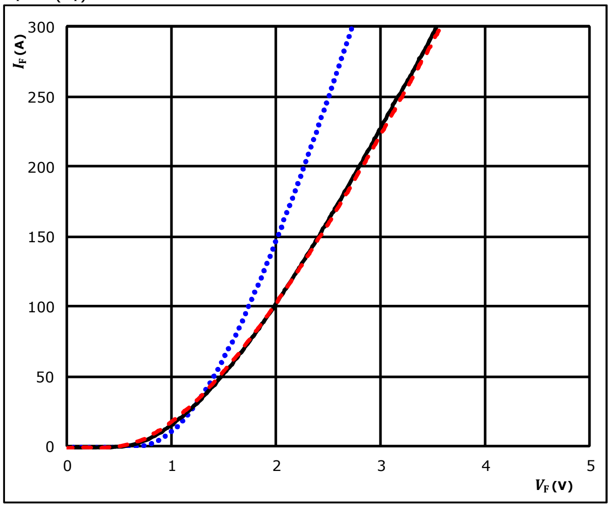
D =	single pulse	
T_s =	80	ºC
V_{GE} =	±15	V
T_j =	T_{jmax}	

DC-Link Diode Characteristics

figure 1. **FWD**

Typical forward characteristics

$I_F = f(V_F)$

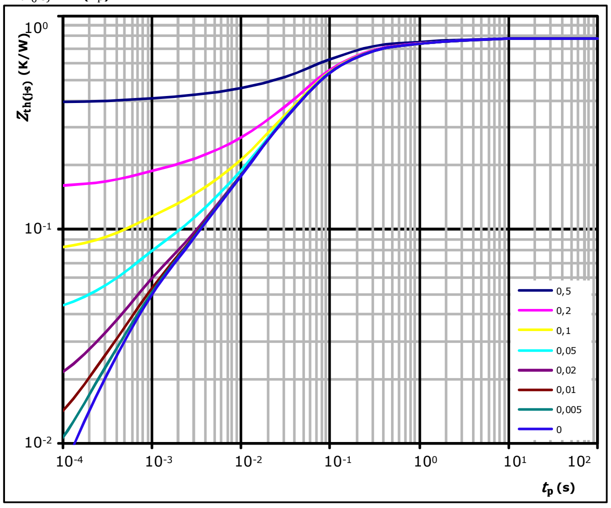


t_p =	250	µs	T_j:	25 °C
				125 °C
				150 °C

figure 2. **FWD**

Transient thermal impedance as a function of pulse width

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



D = t_p / T

$R_{th(j\text{-}s)}$ = 0,79 K/W

FWD thermal model values

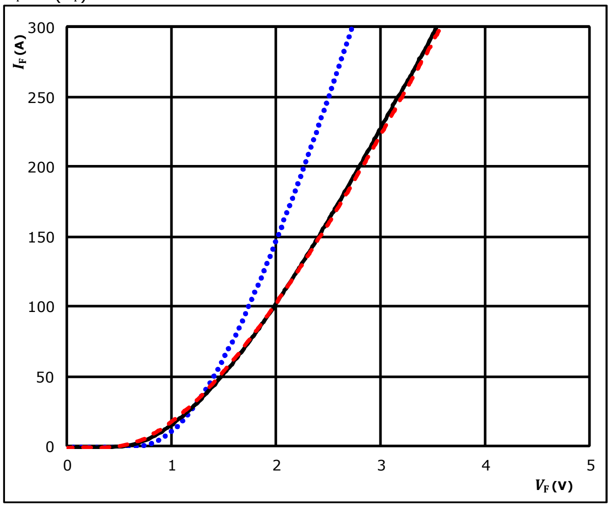
R (K/W)	τ (s)
4,05E-02	3,25E+00
9,02E-02	5,38E-01
3,71E-01	8,95E-02
1,97E-01	3,04E-02
5,23E-02	4,59E-03
3,58E-02	6,26E-04

DC-Link Switch Inverse Diode Characteristics

figure 1. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



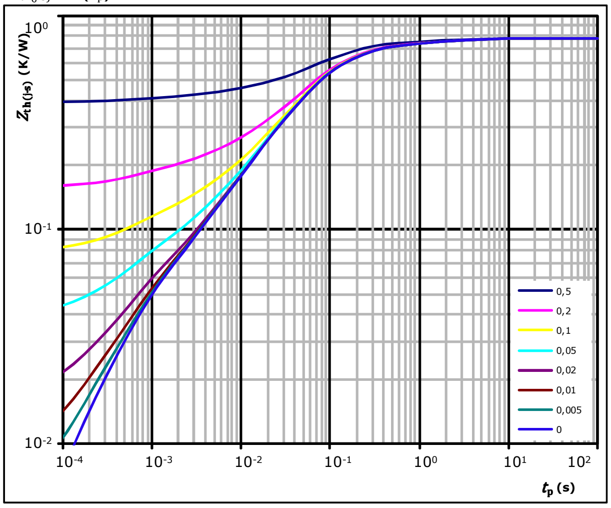
$t_p =$ 250 µs

T_j: 25 °C; 125 °C; 150 °C

figure 2. **FWD**

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$

$R_{th(j-s)} =$ 0,79 K/W

FWD thermal model values

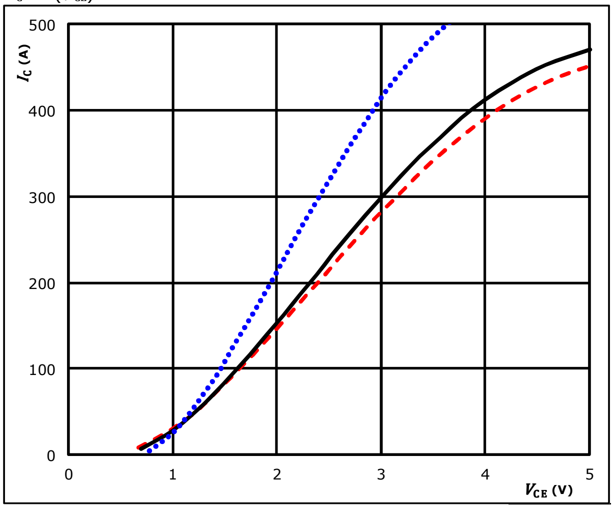
R (K/W)	τ (s)
4,05E-02	3,25E+00
9,02E-02	5,38E-01
3,71E-01	8,95E-02
1,97E-01	3,04E-02
5,23E-02	4,59E-03
3,58E-02	6,26E-04

Neutral Point Switch Characteristics

figure 1. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

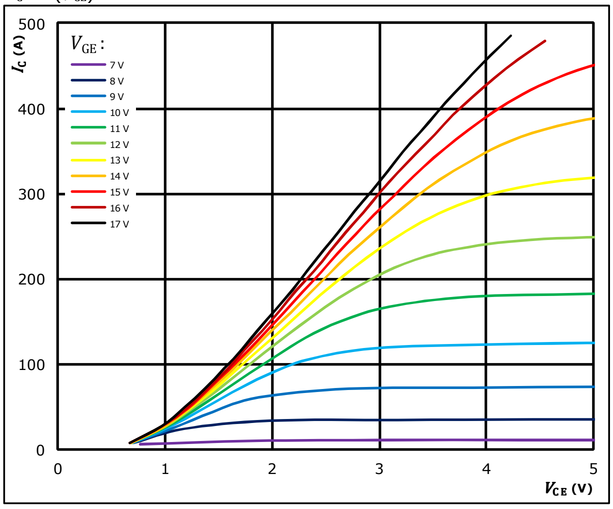


t_p =	250	µs		25 °C	············
V_{GE} =	15	V	T_j:	125 °C	———
				150 °C	– – –

figure 2. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

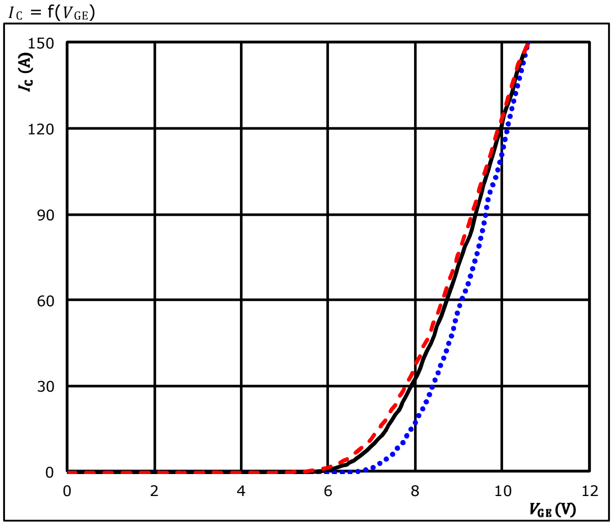


t_p =	250	µs
T_j =	150	°C
V_{GE} from	7 V to 17 V in steps of 1 V	

figure 3. **IGBT**

Typical transfer characteristics

$I_C = f(V_{GE})$

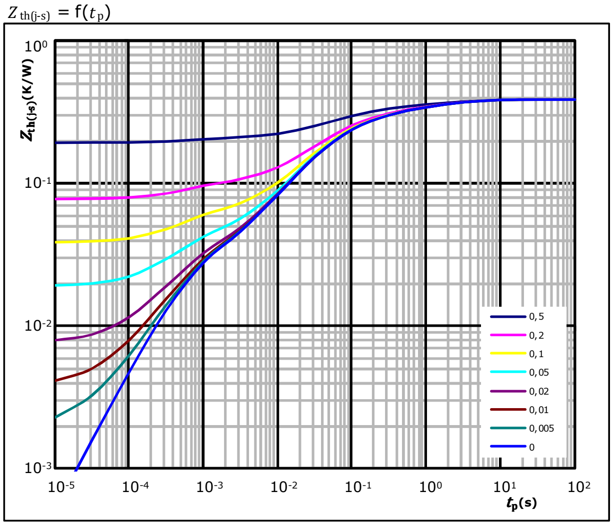


t_p =	100	µs		25 °C	············
V_{CE} =	10	V	T_j:	125 °C	———
				150 °C	– – –

figure 4. **IGBT**

Transient thermal impedance as function of pulse duration

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



D = t_p / T

$R_{th(j\text{-}s)}$ = 0,41 K/W

IGBT thermal model values

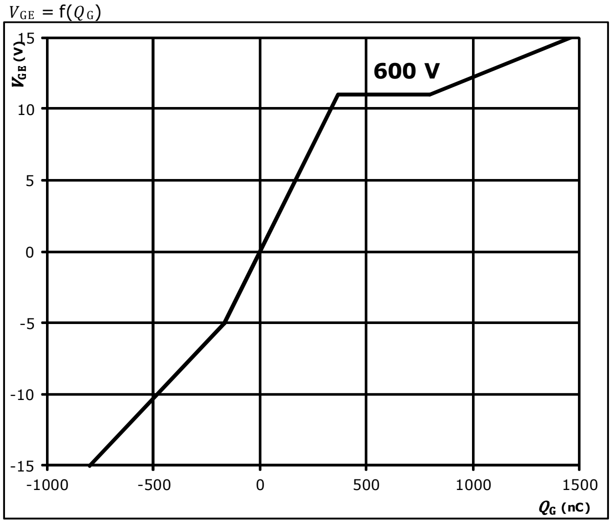
R (K/W)	τ (s)
4,47E-02	2,80E+00
9,73E-02	5,59E-01
2,47E-01	1,59E-01
3,88E-02	2,12E-02
1,13E-02	5,12E-03
1,42E-02	6,59E-04

Neutral Point Switch Characteristics

figure 5.	**IGBT**

Gate voltage vs gate charge

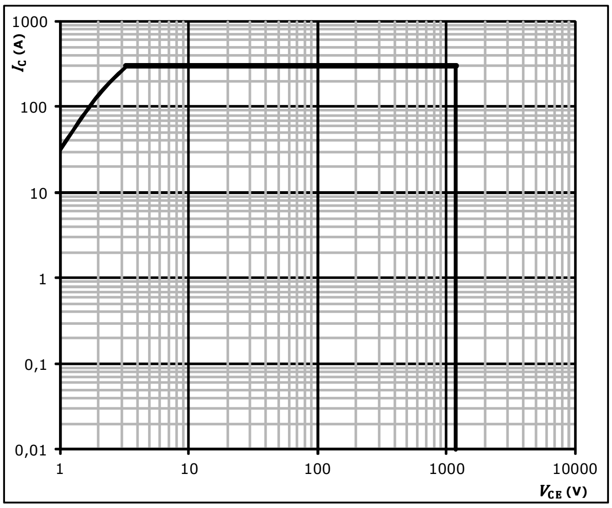
$V_{GE} = f(Q_G)$



I_C=	150	A
V_{GE} =	±15	V
V_{CC} =	600	V

figure 6.	**IGBT**

Safe operating area



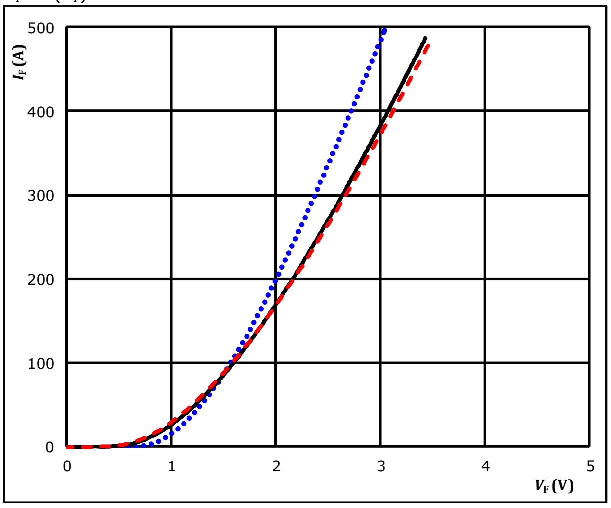
D =	single pulse	
T_s =	80	ºC
V_{GE} =	±15	V
T_j =	T_{jmax}	

Neutral Point Diode Characteristics

figure 1. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



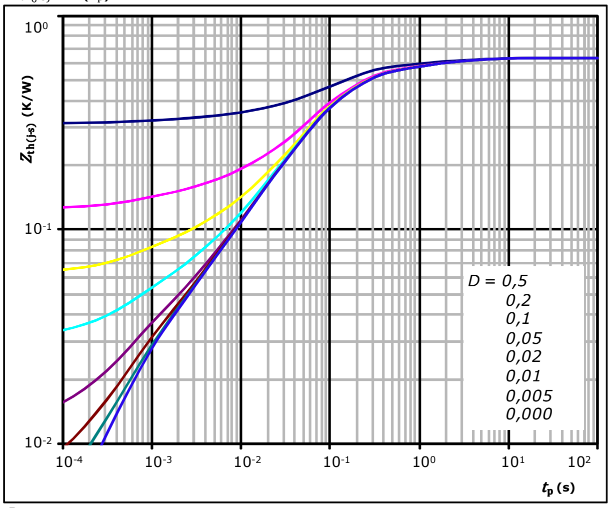
t_p = 250 µs

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

$R_{th(j-s)}$ = 0,63 K/W

FWD thermal model values

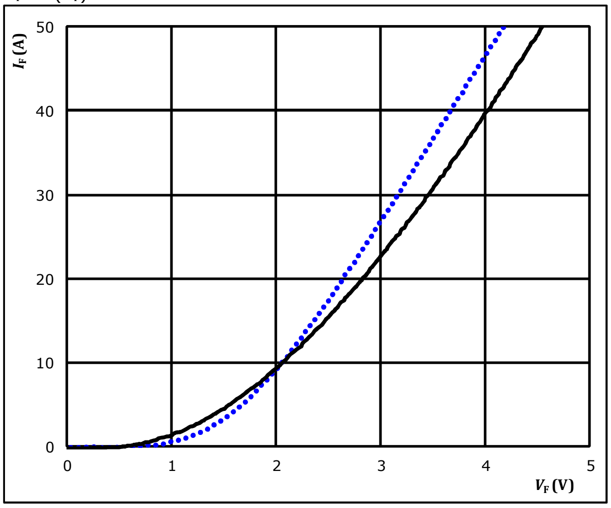
R (K/W)	τ (s)
5,76E-02	2,80E+00
9,23E-02	5,30E-01
3,12E-01	1,04E-01
1,04E-01	3,96E-02
4,08E-02	6,94E-03
2,31E-02	8,04E-04

Neutral Point Switch Prot. Diode Characteristics

figure 1. **FWD**

Typical forward characteristics

$I_F = f(V_F)$

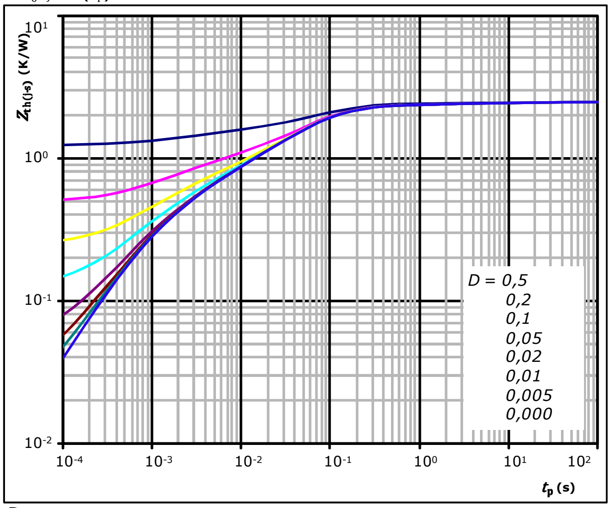


t_p =	250	μs	25 °C	dotted
		T_j:	125 °C	solid

figure 2. **FWD**

Transient thermal impedance as a function of pulse width

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



D = t_p / T

$R_{th(j-s)}$ = 2,46 K/W

FWD thermal model values

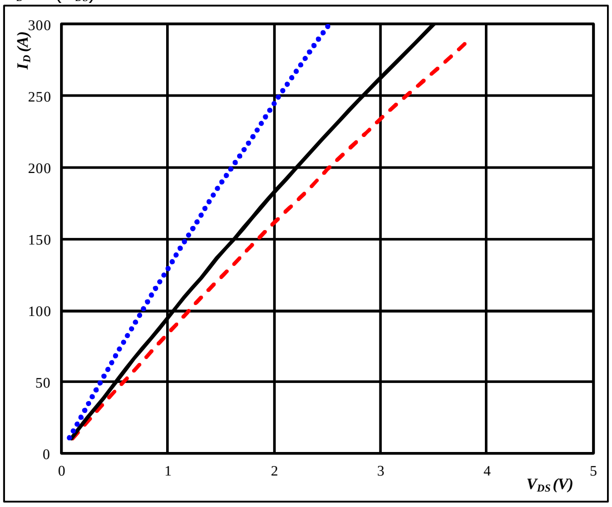
R (K/W)	τ (s)
8,08E-02	9,59E+00
1,72E-01	5,73E-01
1,10E+00	7,81E-02
5,04E-01	2,68E-02
3,53E-01	4,22E-03
2,53E-01	8,77E-04

AC Switch Characteristics

figure 1. **MOSFET**

Typical output characteristics

$I_D = f(V_{DS})$

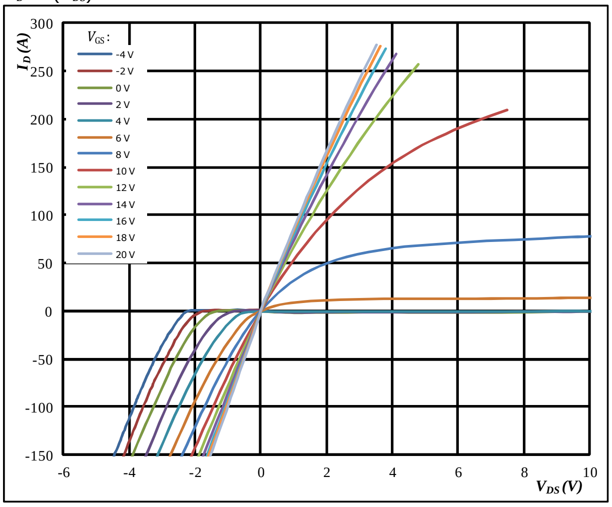


t_p =	250	µs		25 °C	•••••••••
V_{GS} =	18	V	T_j:	125 °C	———
				150 °C	– – –

figure 2. **MOSFET**

Typical output characteristics

$I_D = f(V_{DS})$

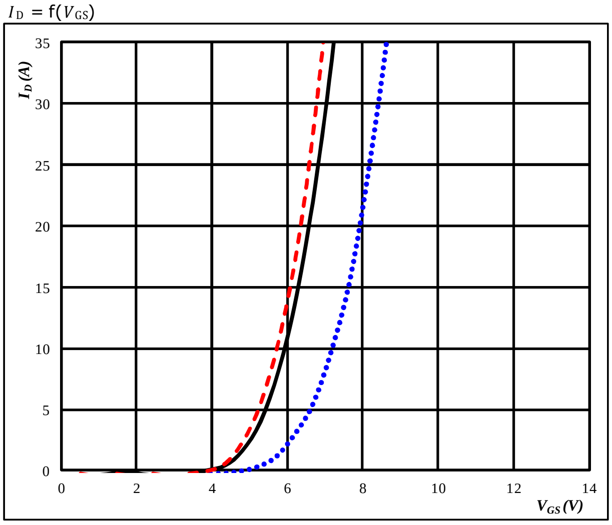


t_p = 250 µs
T_j = 150 °C
V_{GS} from -4 V to 20 V in steps of 2 V

figure 3. **MOSFET**

Typical transfer characteristics

$I_D = f(V_{GS})$

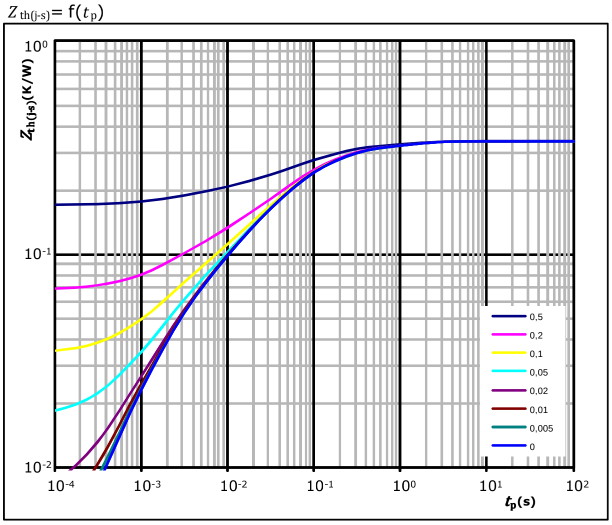


t_p =	100	µs		25 °C	•••••••••
V_{DS} =	10	V	T_j:	125 °C	———
				150 °C	– – –

figure 4. **MOSFET**

Transient thermal impedance as a function of pulse width

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



D = t_p / T
$R_{th(j-s)}$ = 0,34 K/W

MOSFET thermal model values

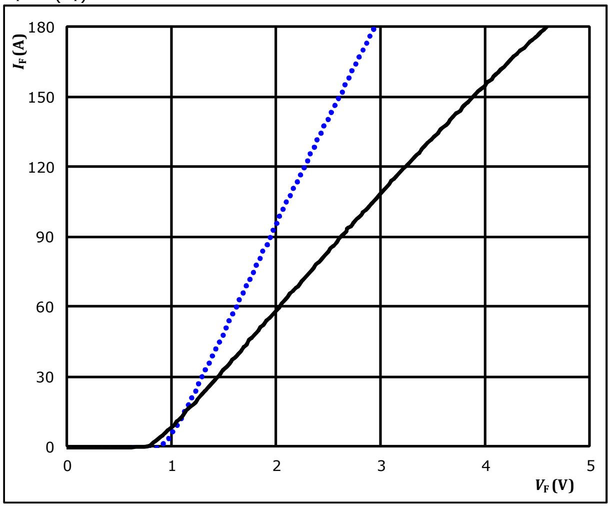
R (K/W)	τ (s)
3,91E-02	1,04E+00
1,00E-01	1,44E-01
1,17E-01	4,34E-02
5,18E-02	8,88E-03
3,26E-02	1,76E-03

AC Diode Characteristics

figure 1. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



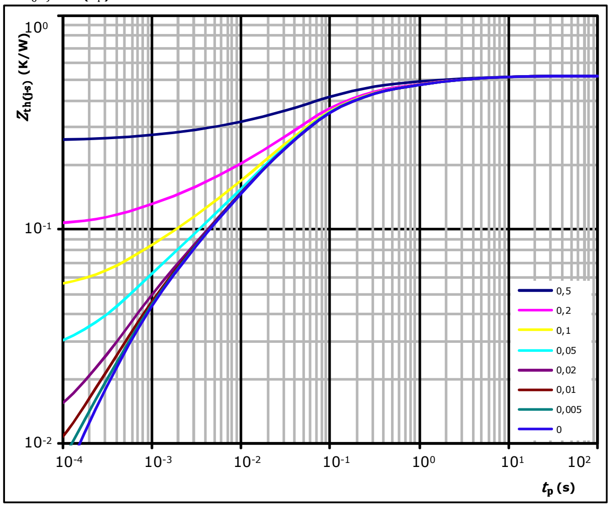
t_p = 250 µs

T_j: 25 °C / 125 °C

figure 2. **FWD**

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$

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

FWD thermal model values

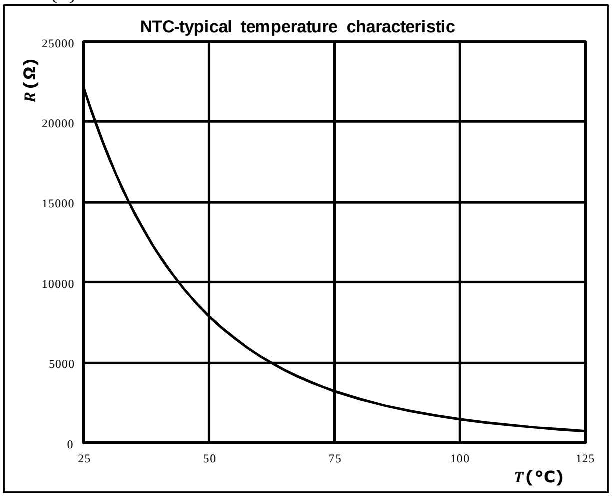
R (K/W)	τ (s)
2,95E-02	5,33E+00
6,00E-02	9,85E-01
1,02E-01	1,79E-01
1,92E-01	5,14E-02
7,17E-02	1,10E-02
3,93E-02	2,74E-03
2,53E-02	5,68E-04

Thermistor Characteristics

figure 1. **Thermistor**

Typical NTC characteristic
as a function of temperature

$R = f(T)$

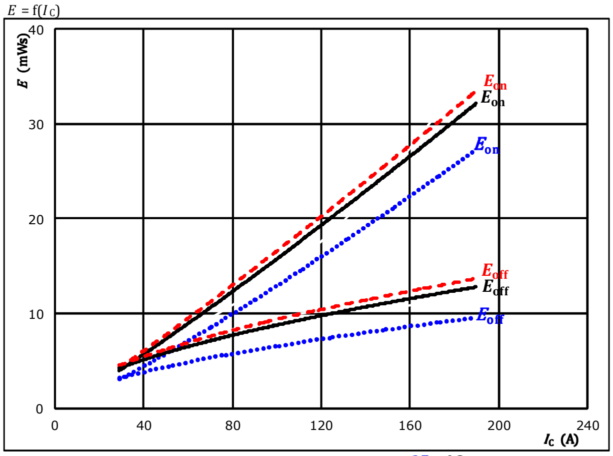


Neutral Point Switching Characteristics

figure 1. **IGBT**

Typical switching energy losses as a function of collector current

$E = f(I_C)$



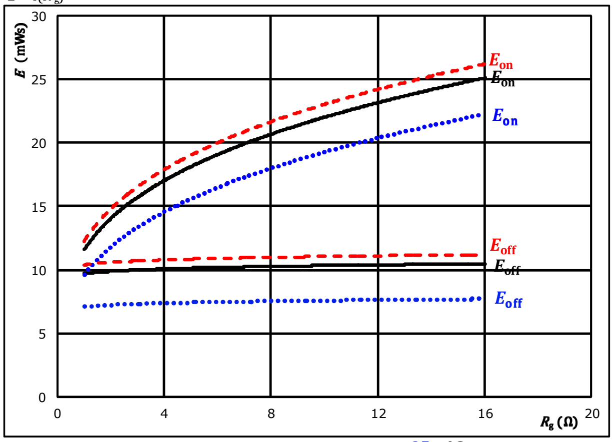
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C	dotted
V_{GE} =	±15	V		125 °C	solid
R_{gon} =	4	Ω		150 °C	dashed
R_{goff} =	4	Ω			

figure 2. **IGBT**

Typical switching energy losses as a function of gate resistor

$E = f(R_g)$



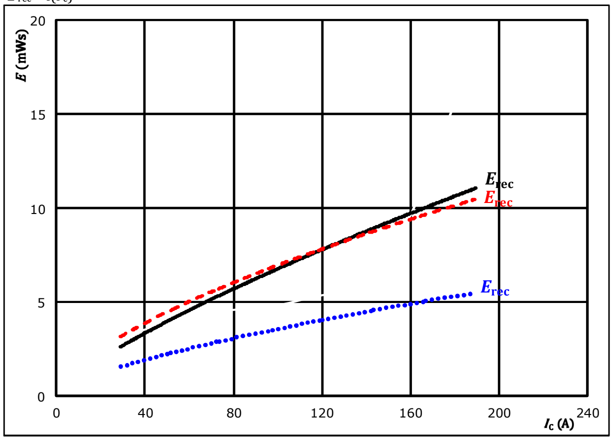
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C	dotted
V_{GE} =	±15	V		125 °C	solid
I_C =	110	A		150 °C	dashed

figure 3. **FWD**

Typical reverse recovered energy loss as a function of collector current

$E_{rec} = f(I_C)$



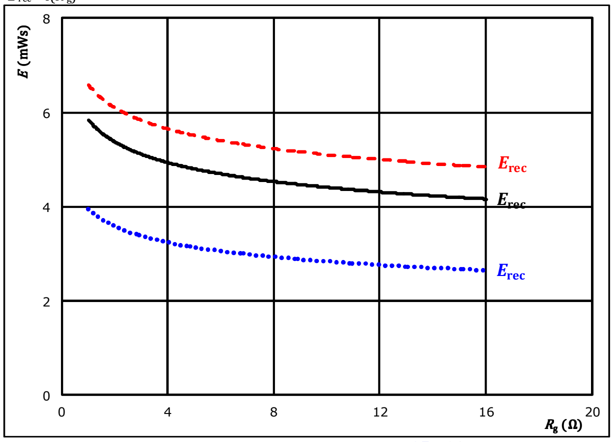
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C	dotted
V_{GE} =	±15	V		125 °C	solid
R_{gon} =	4	Ω		150 °C	dashed

figure 4. **FWD**

Typical reverse recovered energy loss as a function of gate resistor

$E_{rec} = f(R_g)$



With an inductive load at

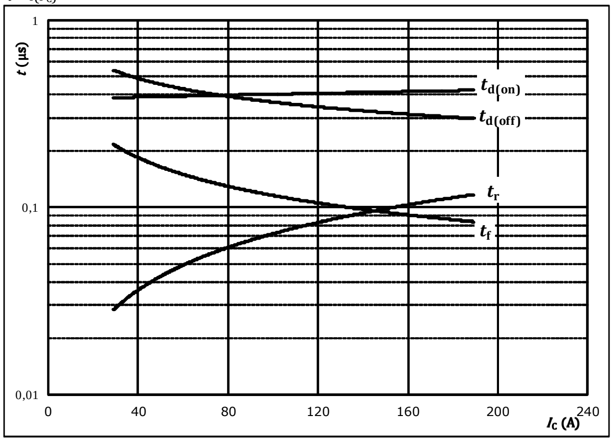
V_{CE} =	600	V	T_j:	25 °C	dotted
V_{GE} =	±15	V		125 °C	solid
I_C =	110	A		150 °C	dashed

Neutral Point Switching Characteristics

figure 5. **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



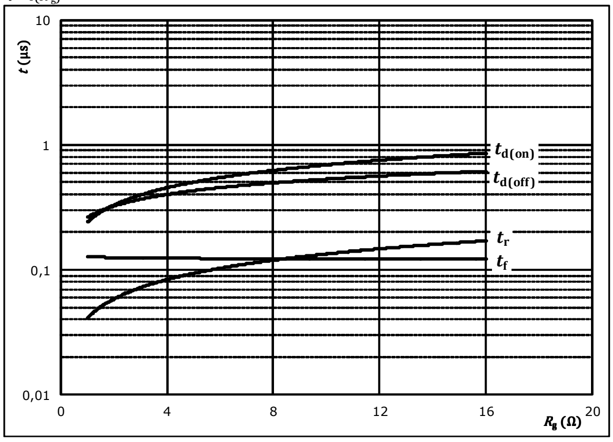
With an inductive load at

T_j =	150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	4	Ω
R_{goff} =	4	Ω

figure 6. **IGBT**

Typical switching times as a function of gate resistor

$t = f(R_g)$



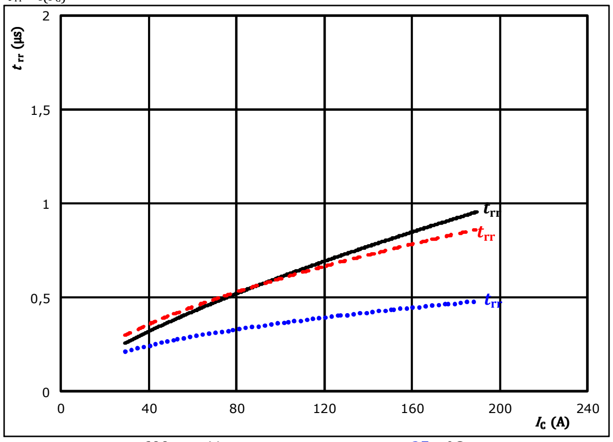
With an inductive load at

T_j =	150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	110	A

figure 7. **FWD**

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$

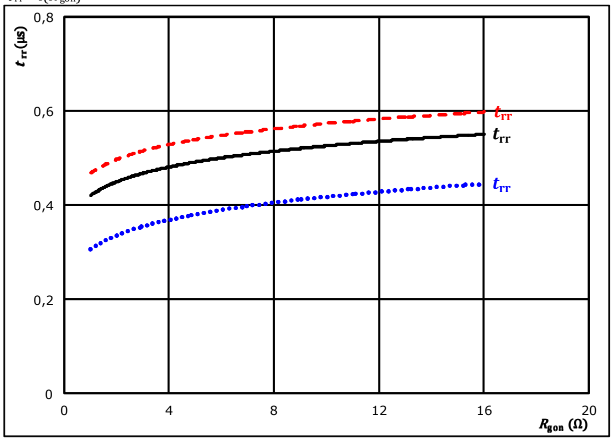


At						
V_{CE} =	600	V		25	°C	···········
V_{GE} =	±15	V	T_j:	125	°C	———
R_{gon} =	4	Ω		150	°C	– – –

figure 8. **FWD**

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

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



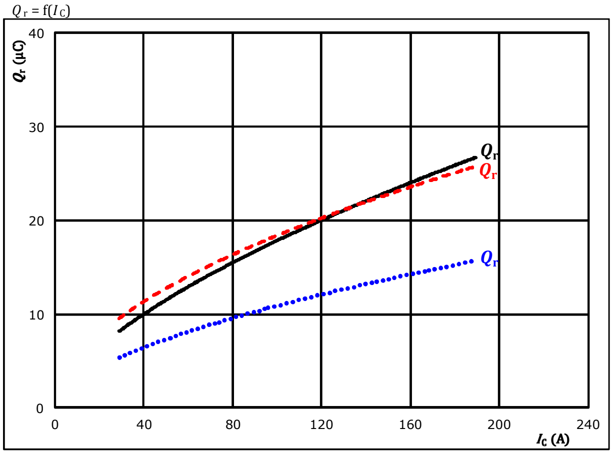
At						
V_{CE} =	600	V		25	°C	···········
V_{GE} =	±15	V	T_j:	125	°C	———
I_C =	110	A		150	°C	– – –

Neutral Point Switching Characteristics

figure 9. **FWD**

Typical recovered charge as a function of collector current

$Q_r = f(I_C)$

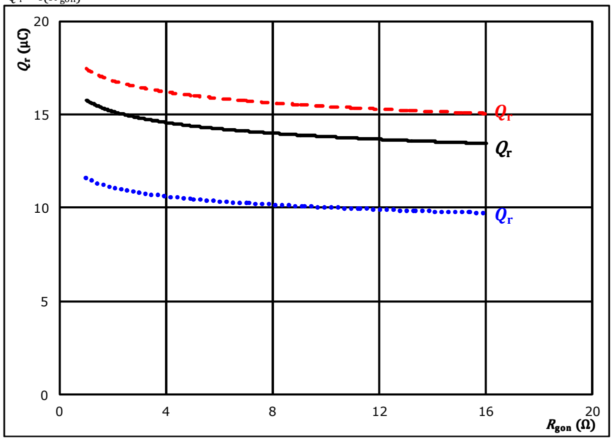


At					
V_{CE} =	600	V	T_j:	25 °C	dotted
V_{GE} =	±15	V		125 °C	solid
R_{gon} =	4	Ω		150 °C	dashed

figure 10. **FWD**

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

$Q_r = f(R_{gon})$

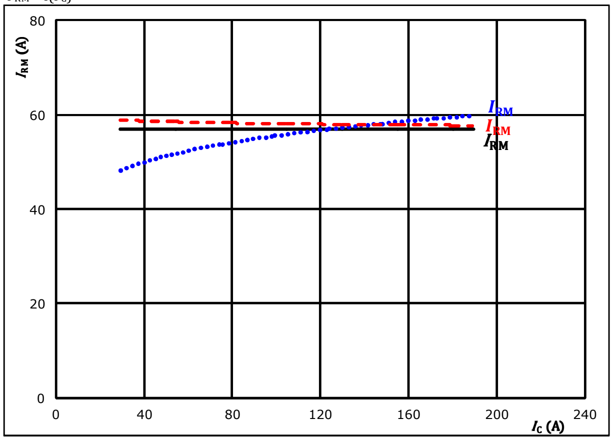


At					
V_{CE}=	600	V	T_j:	25 °C	dotted
V_{GE} =	±15	V		125 °C	solid
I_C=	110	A		150 °C	dashed

figure 11. **FWD**

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

$I_{RM} = f(I_C)$

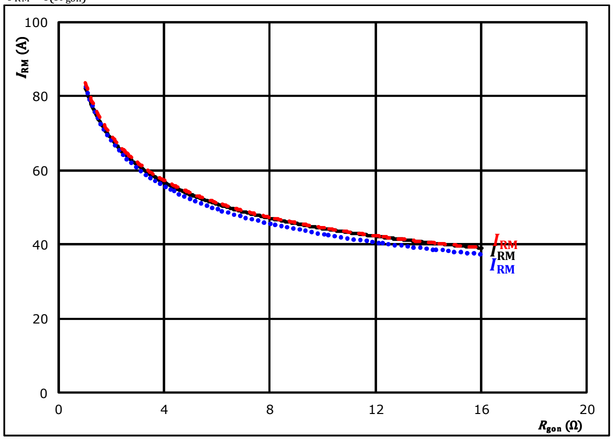


At					
V_{CE}:	600	V	T_j:	25 °C	dotted
V_{GE} =	±15	V		125 °C	solid
R_{gon} =	4	Ω		150 °C	dashed

figure 12. **FWD**

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

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



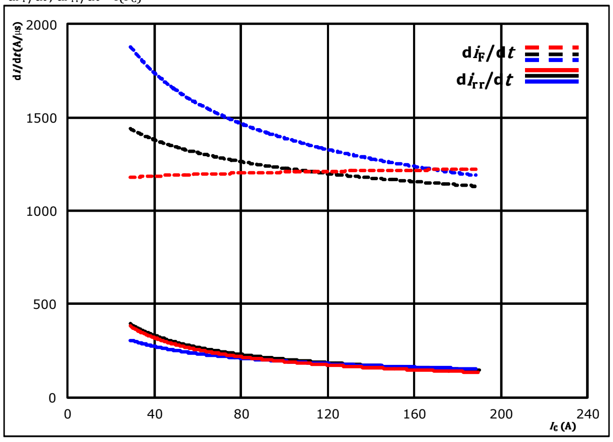
At					
V_{CE} =	600	V	T_j:	25 °C	dotted
V_{GE} =	±15	V		125 °C	solid
I_C =	110	A		150 °C	dashed

Neutral Point 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)

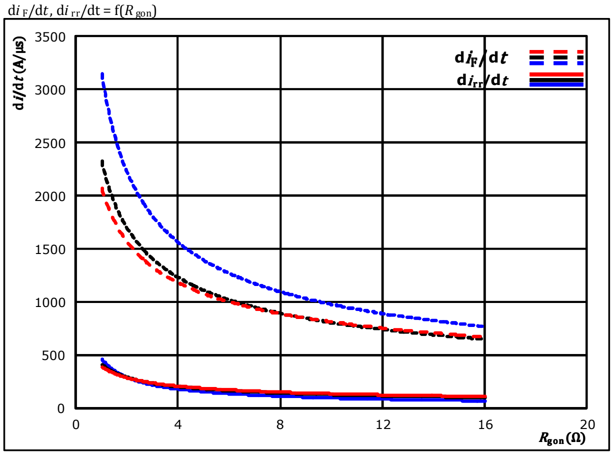


At					
V_{CE} =	600	V		25 °C	··············
V_{GE} =	±15	V	T_j:	125 °C	———
R_{gon} =	4	Ω		150 °C	– – –

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})

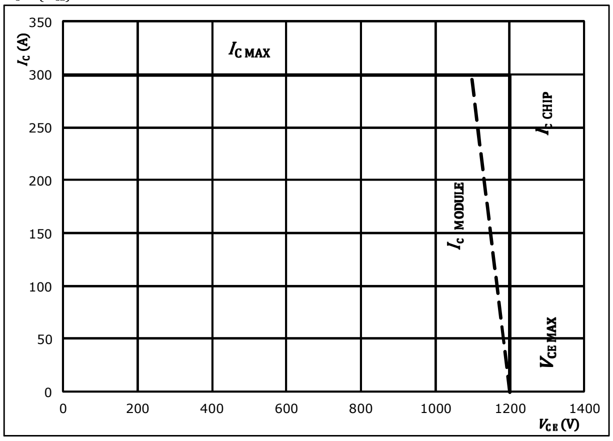


At					
V_{CE} =	600	V		25 °C	··············
V_{GE} =	±15	V	T_j:	125 °C	———
I_C =	110	A		150 °C	– – –

figure 15. **IGBT**

Reverse bias safe operating area

I_C = f(V_{CE})



At		
T_j =	175	°C
R_{gon} =	4	Ω
R_{goff} =	4	Ω

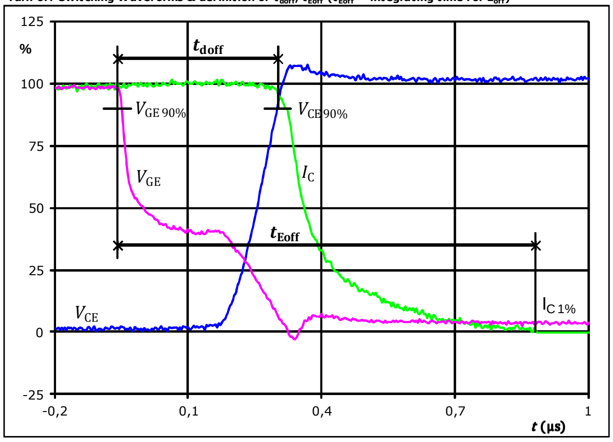
Neutral Point Switching Definitions

General conditions

T_j	=	125 °C
R_{gon}	=	4 Ω
R_{goff}	=	4 Ω

figure 1. IGBT

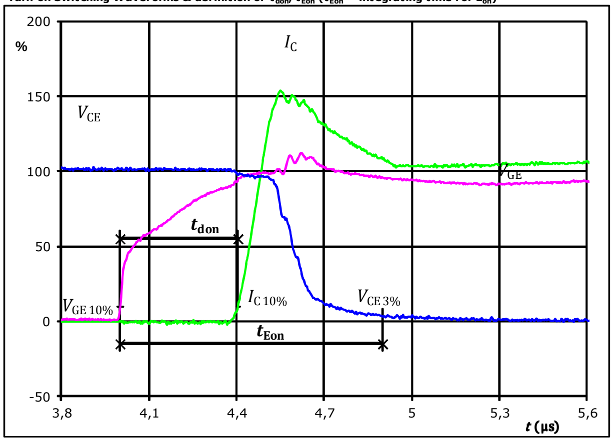
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff} (t_{Eoff} = integrating time for E_{off})



$V_{GE}(0\%)$ =	-15	V
$V_{GE}(100\%)$ =	15	V
$V_C(100\%)$ =	600	V
$I_C(100\%)$ =	110	A
t_{doff} =	0,348	µs
t_{Eoff} =	0,940	µs

figure 2. IGBT

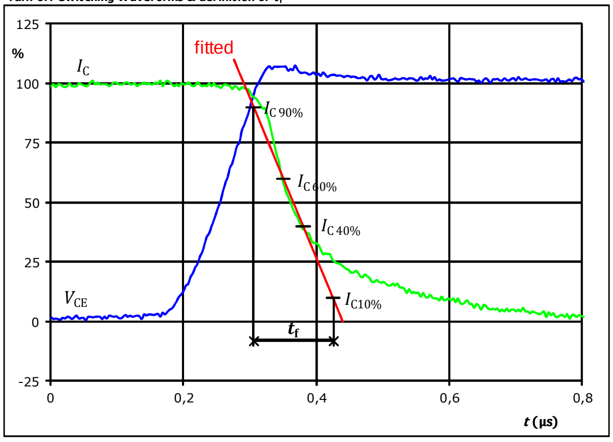
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon} (t_{Eon} = integrating time for E_{on})



$V_{GE}(0\%)$ =	-15	V
$V_{GE}(100\%)$ =	15	V
$V_C(100\%)$ =	600	V
$I_C(100\%)$ =	110	A
t_{don} =	0,403	µs
t_{Eon} =	0,899	µs

figure 3. IGBT

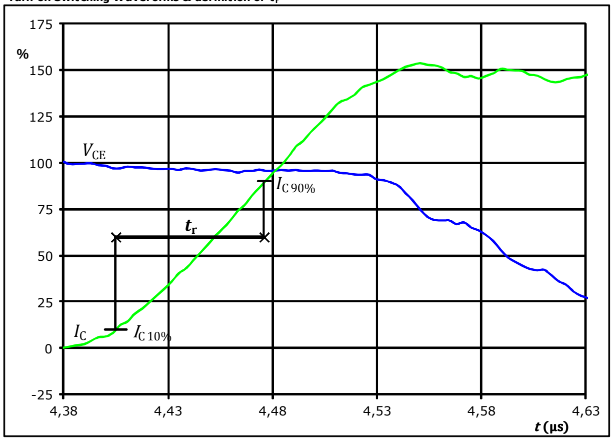
Turn-off Switching Waveforms & definition of t_f



$V_C(100\%)$ =	600	V
$I_C(100\%)$ =	110	A
t_f =	0,119	µs

figure 4. IGBT

Turn-on Switching Waveforms & definition of t_r

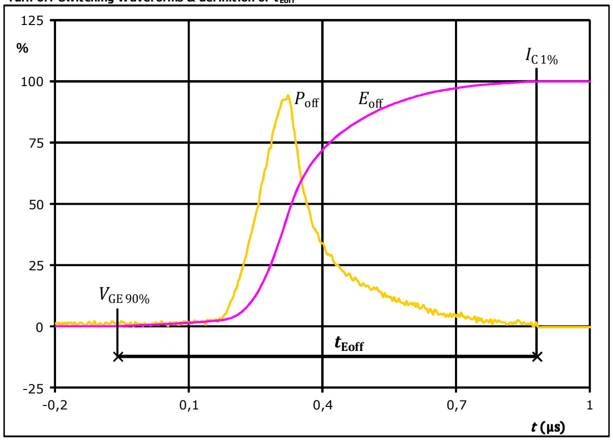


$V_C(100\%)$ =	600	V
$I_C(100\%)$ =	110	A
t_r =	0,071	µs

Neutral Point Switching Characteristics

figure 5. **IGBT**

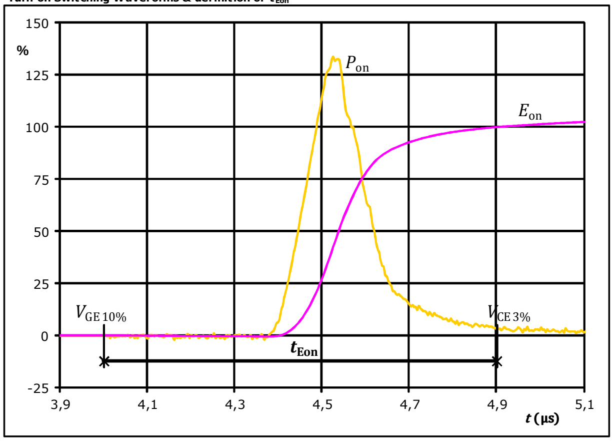
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	66,19	kW
E_{off} (100%) =	9,98	mJ
t_{Eoff} =	0,94	µs

figure 6. **IGBT**

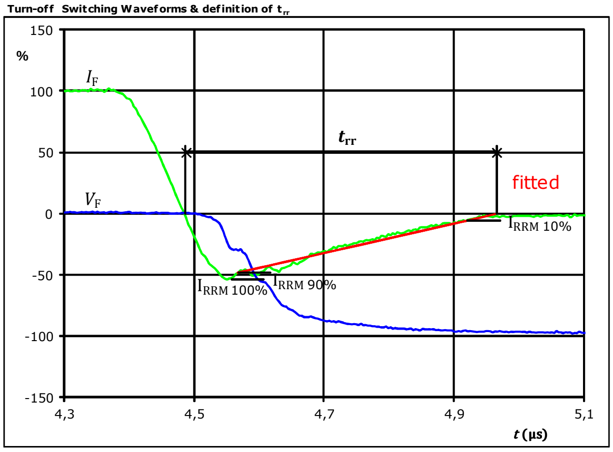
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	66,19	kW
E_{on} (100%) =	15,74	mJ
t_{Eon} =	0,90	µs

figure 7. **FWD**

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

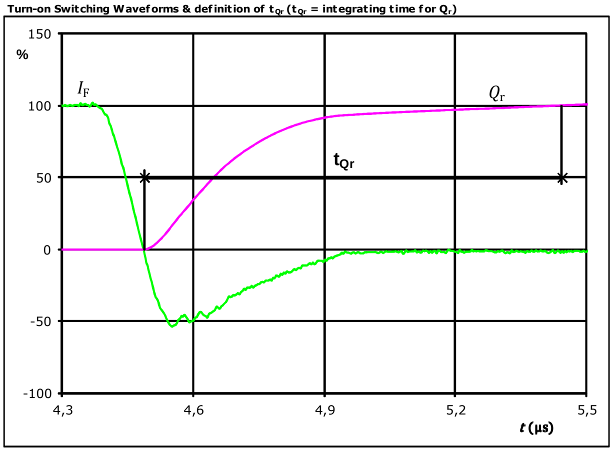


V_F (100%) =	600	V
I_F (100%) =	110	A
I_{RRM} (100%) =	-61	A
t_{rr} =	0,471	µs

Neutral Point Switching Characteristics

figure 8. **FWD**

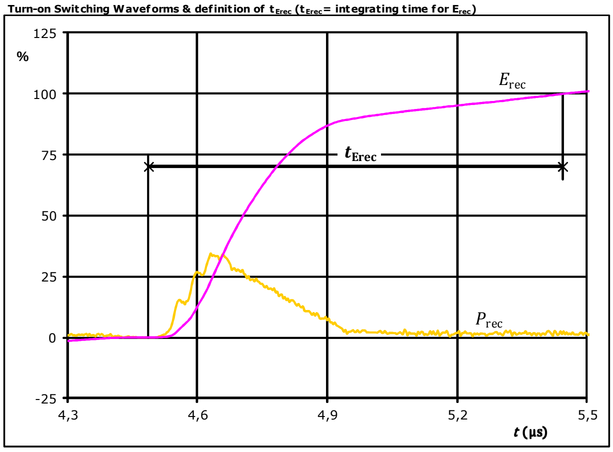
Turn-on Switching Waveforms & definition of t_{Qr} (t_{Qr} = integrating time for Q_r)



I_F (100%) =	110	A
Q_r (100%) =	14,82	µC
t_{Qr} =	0,96	µs

figure 9. **FWD**

Turn-on Switching Waveforms & definition of t_{Erec} (t_{Erec} = integrating time for E_{rec})



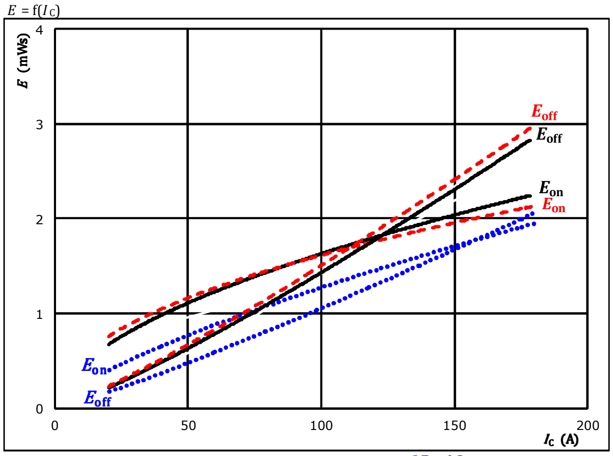
P_{rec} (100%) =	66,19	kW
E_{rec} (100%) =	5,16	mJ
t_{Erec} =	0,96	µs

AC Switching Characteristics

figure 1. **IGBT**

Typical switching energy losses as a function of collector current

$E = f(I_C)$



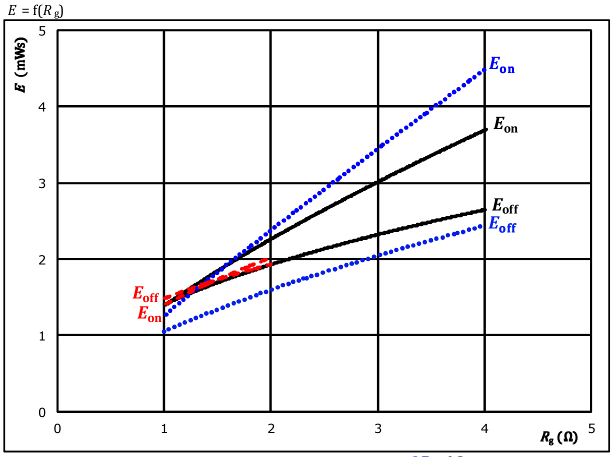
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C	
V_{GE} =	0/16	V		125 °C	
R_{gon} =	1	Ω		150 °C	
R_{goff} =	1	Ω			

figure 2. **IGBT**

Typical switching energy losses as a function of gate resistor

$E = f(R_g)$



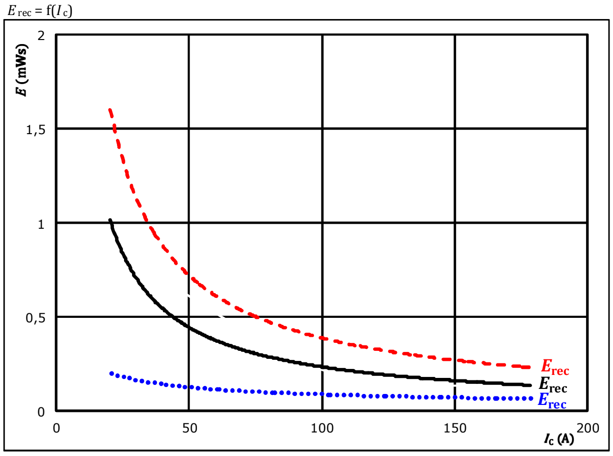
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C
V_{GE} =	0/16	V		125 °C
I_C =	99	A		150 °C

figure 3. **FWD**

Typical reverse recovered energy loss as a function of collector current

$E_{rec} = f(I_C)$



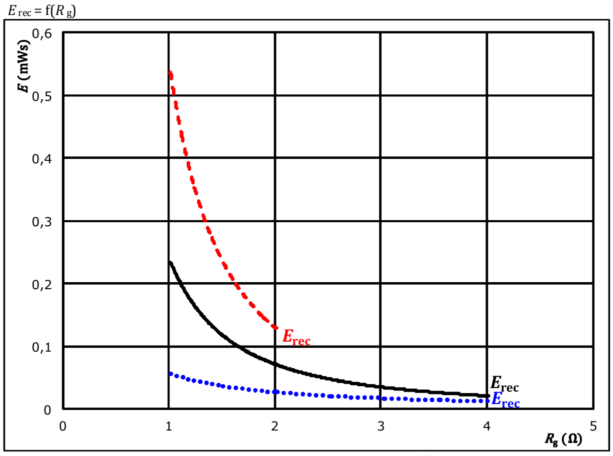
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C
V_{GE} =	0/16	V		125 °C
R_{gon} =	1	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

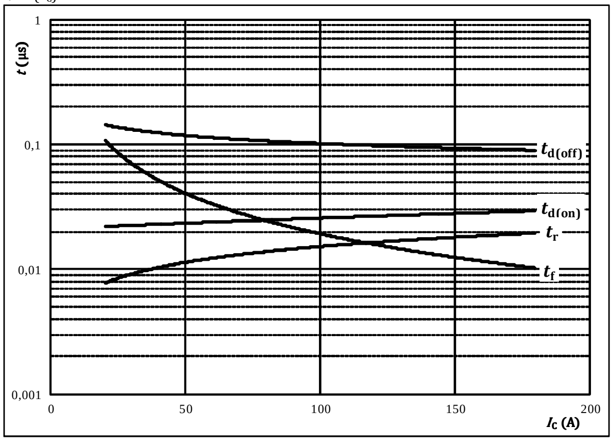
V_{CE} =	600	V	T_j:	25 °C
V_{GE} =	0/16	V		125 °C
I_C =	99	A		150 °C

AC Switching Characteristics

figure 5. **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



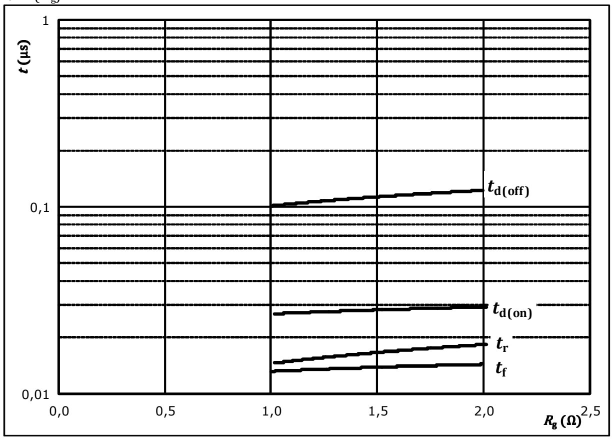
With an inductive load at

T_j =	150	°C
V_{CE} =	600	V
V_{GE} =	0/16	V
R_{gon} =	1	Ω
R_{goff} =	1	Ω

figure 6. **IGBT**

Typical switching times as a function of gate resistor

$t = f(R_g)$



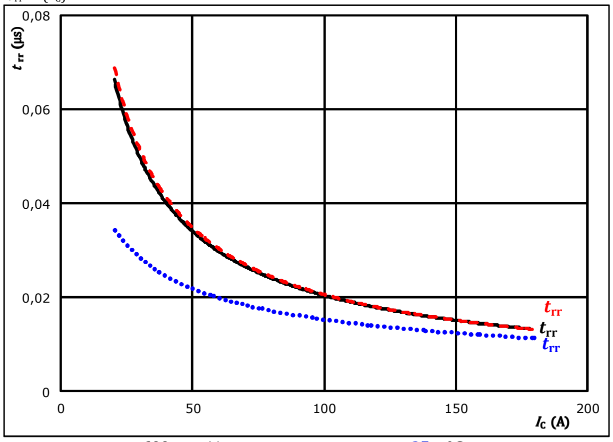
With an inductive load at

T_j =	150	°C
V_{CE} =	600	V
V_{GE} =	0/16	V
I_C =	99	A

figure 7. **FWD**

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$

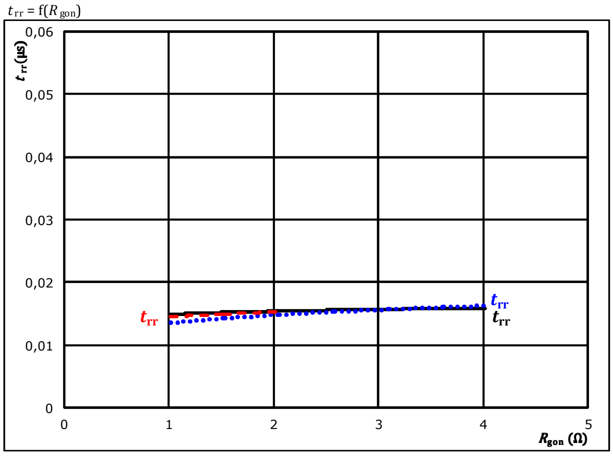


At					
V_{CE} =	600	V		25 °C	dotted blue
V_{GE} =	0/16	V	T_j:	125 °C	solid black
R_{gon} =	1	Ω		150 °C	dashed red

figure 8. **FWD**

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

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



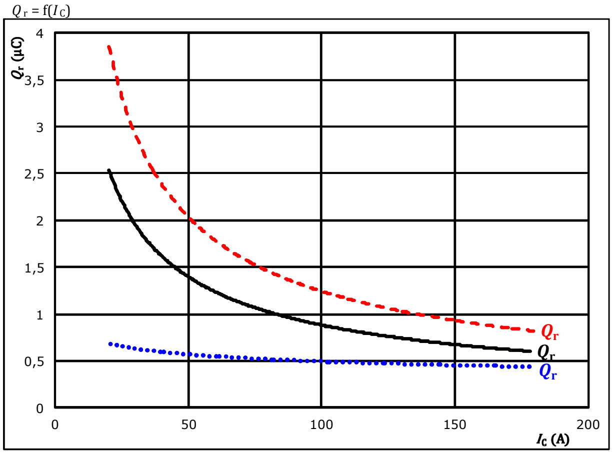
At					
V_{CE} =	600	V		25 °C	dotted blue
V_{GE} =	0/16	V	T_j:	125 °C	solid black
I_C =	99	A		150 °C	dashed red

AC Switching Characteristics

figure 9. **FWD**

Typical recovered charge as a function of collector current

$Q_r = f(I_C)$

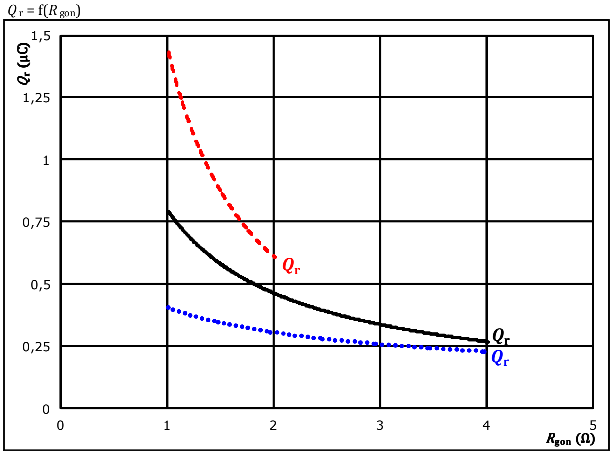


At	V_{CE} =	600	V	T_j:	25 °C	·············
	V_{GE} =	0/16	V		125 °C	———
	R_{gon} =	1	Ω		150 °C	– – – –

figure 10. **FWD**

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

$Q_r = f(R_{gon})$

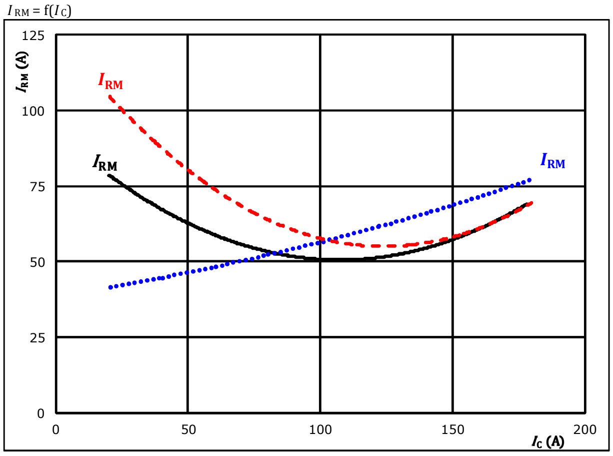


At	V_{CE}=	600	V	T_j:	25 °C	·············
	V_{GE} =	0/16	V		125 °C	———
	I_C=	99	A		150 °C	– – – –

figure 11. **FWD**

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

$I_{RM} = f(I_C)$

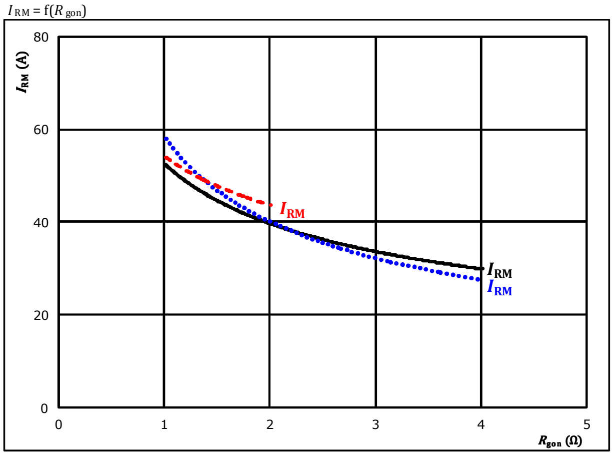


At	V_{CE}:	600	V	T_j:	25 °C	·············
	V_{GE} =	0/16	V		125 °C	———
	R_{gon} =	1	Ω		150 °C	– – – –

figure 12. **FWD**

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

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



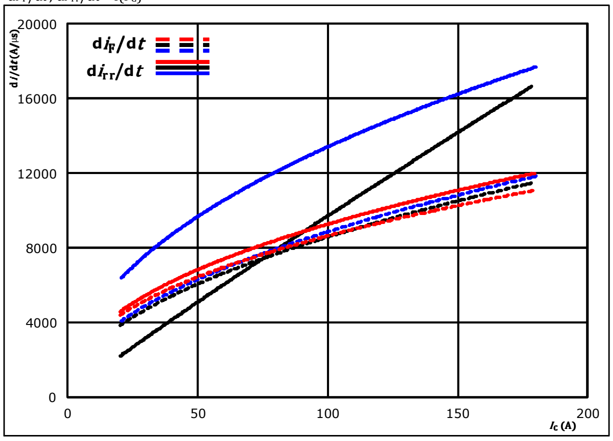
At	V_{CE} =	600	V	T_j:	25 °C	·············
	V_{GE} =	0/16	V		125 °C	———
	I_C =	99	A		150 °C	– – – –

AC Switching Characteristics

figure 13. **FWD**

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

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



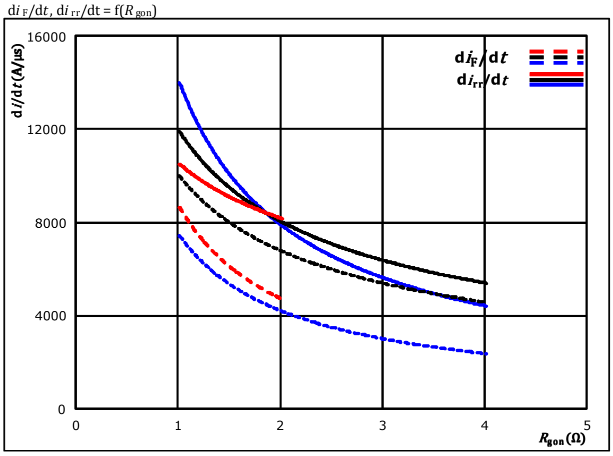
At

V_{CE} =	600	V	T_j:	25 °C	
V_{GE} =	0/16	V		125 °C	
R_{gon} =	1	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})



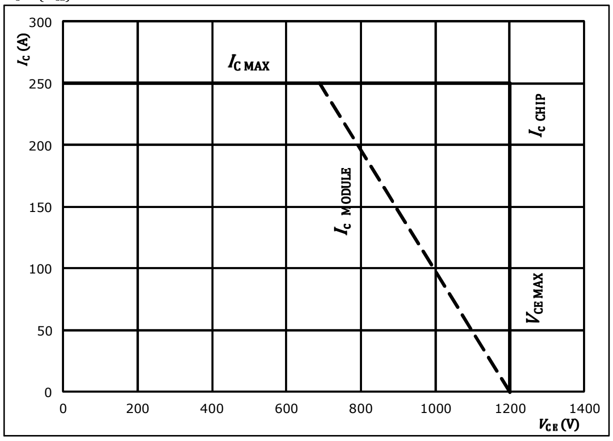
At

V_{CE} =	600	V	T_j:	25 °C	
V_{GE} =	0/16	V		125 °C	
I_C =	99	A		150 °C	

figure 15. **IGBT**

Reverse bias safe operating area

I_C = f(V_{CE})



At

T_j =	175	°C
R_{gon} =	1	Ω
R_{goff} =	1	Ω

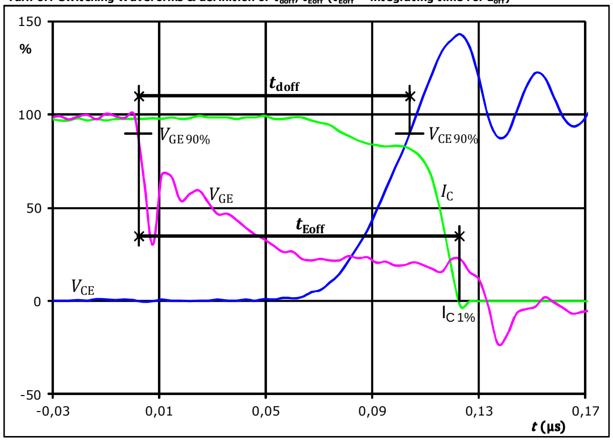
AC Switching Definitions

General conditions

T_j	=	125 °C
R_{gon}	=	1 Ω
R_{goff}	=	1 Ω

figure 1. IGBT

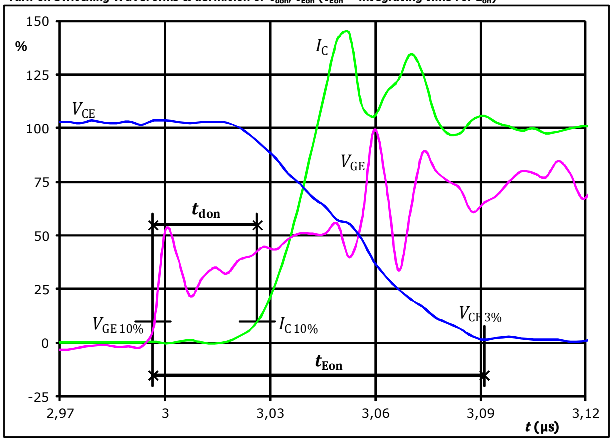
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff} (t_{Eoff} = integrating time for E_{off})



$V_{GE}(0\%)$ =	0	V
$V_{GE}(100\%)$ =	16	V
$V_C(100\%)$ =	600	V
$I_C(100\%)$ =	100	A
t_{doff} =	0,101	µs
t_{Eoff} =	0,120	µs

figure 2. IGBT

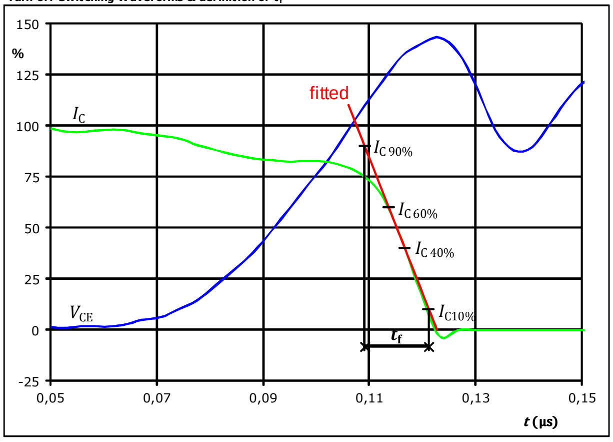
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon} (t_{Eon} = integrating time for E_{on})



$V_{GE}(0\%)$ =	0	V
$V_{GE}(100\%)$ =	16	V
$V_C(100\%)$ =	600	V
$I_C(100\%)$ =	100	A
t_{don} =	0,029	µs
t_{Eon} =	0,094	µs

figure 3. IGBT

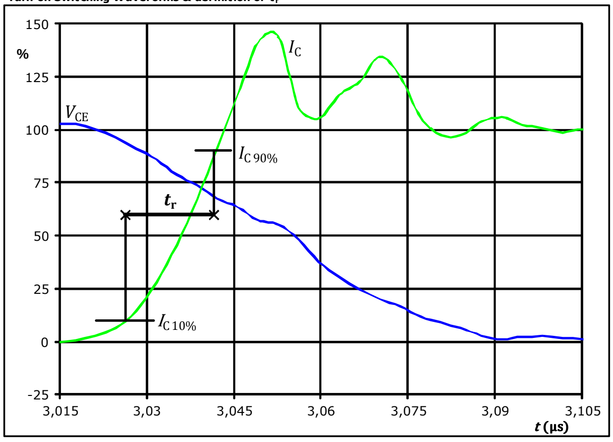
Turn-off Switching Waveforms & definition of t_f



$V_C(100\%)$ =	600	V
$I_C(100\%)$ =	100	A
t_f =	0,013	µs

figure 4. IGBT

Turn-on Switching Waveforms & definition of t_r



$V_C(100\%)$ =	600	V
$I_C(100\%)$ =	100	A
t_r =	0,015	µs

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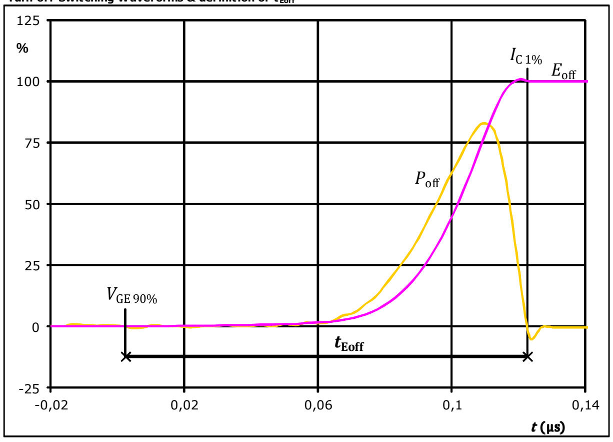
10-PH12NAC008MR01-LC69F28T
target datasheet

AC Switching Characteristics

figure 5. **IGBT**

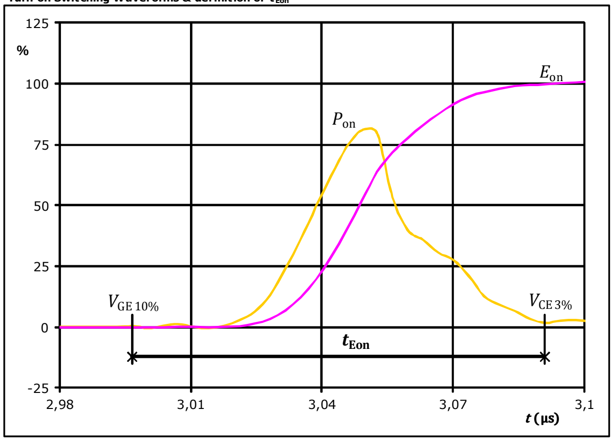
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	60,18	kW
E_{off} (100%) =	1,42	mJ
t_{Eoff} =	0,12	µs

figure 6. **IGBT**

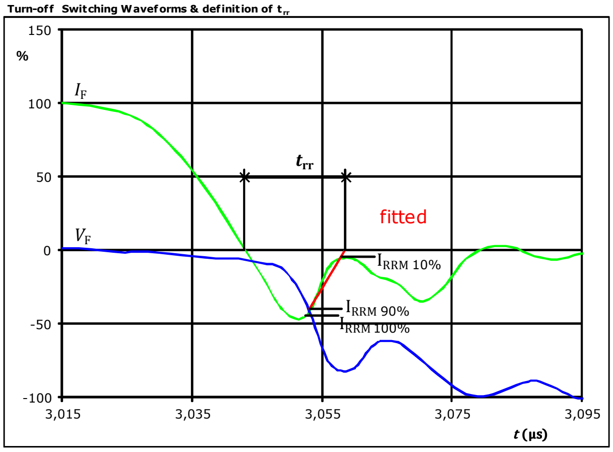
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	60,18	kW
E_{on} (100%) =	1,44	mJ
t_{Eon} =	0,09	µs

figure 7. **FWD**

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

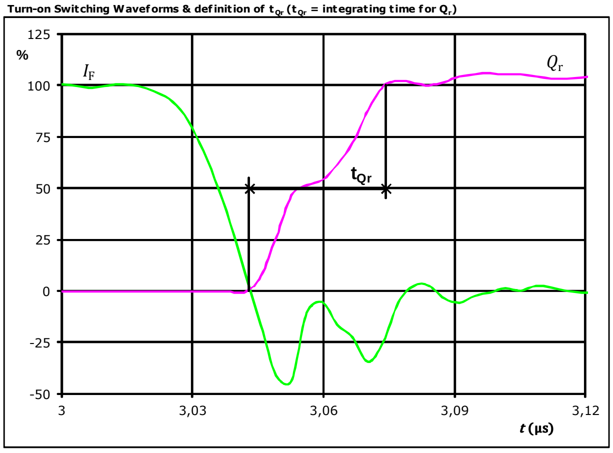


V_F (100%) =	600	V
I_F (100%) =	100	A
I_{RRM} (100%) =	-51	A
t_{rr} =	0,015	µs

AC Switching Characteristics

figure 8. **FWD**

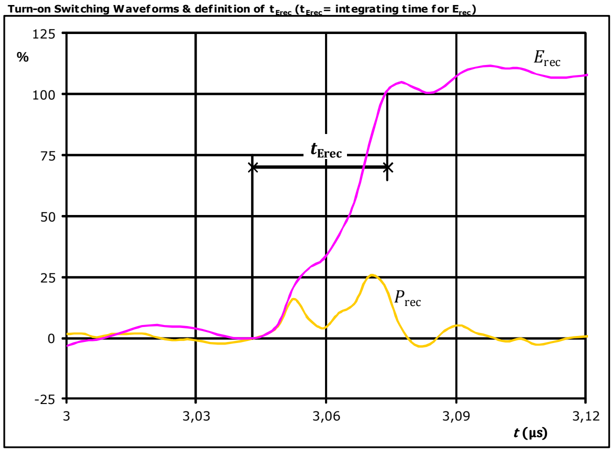
Turn-on Switching Waveforms & definition of t_{Qr} (t_{Qr} = integrating time for Q_r)



I_F (100%) =	100	A
Q_r (100%) =	0,79	µC
t_{Qr} =	0,03	µs

figure 9. **FWD**

Turn-on Switching Waveforms & definition of t_{Erec} (t_{Erec} = integrating time for E_{rec})

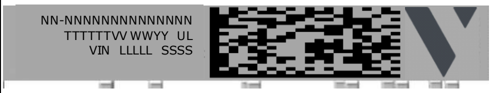


P_{rec} (100%) =	60,18	kW
E_{rec} (100%) =	0,22	mJ
t_{Erec} =	0,03	µs

10-PH12NAB008MR01-LC59F28T

Ordering Code & Marking

Version	Ordering Code
without thermal paste 12 mm housing with press-fit pins	10-PH12NAB008MR01-LC59F28T

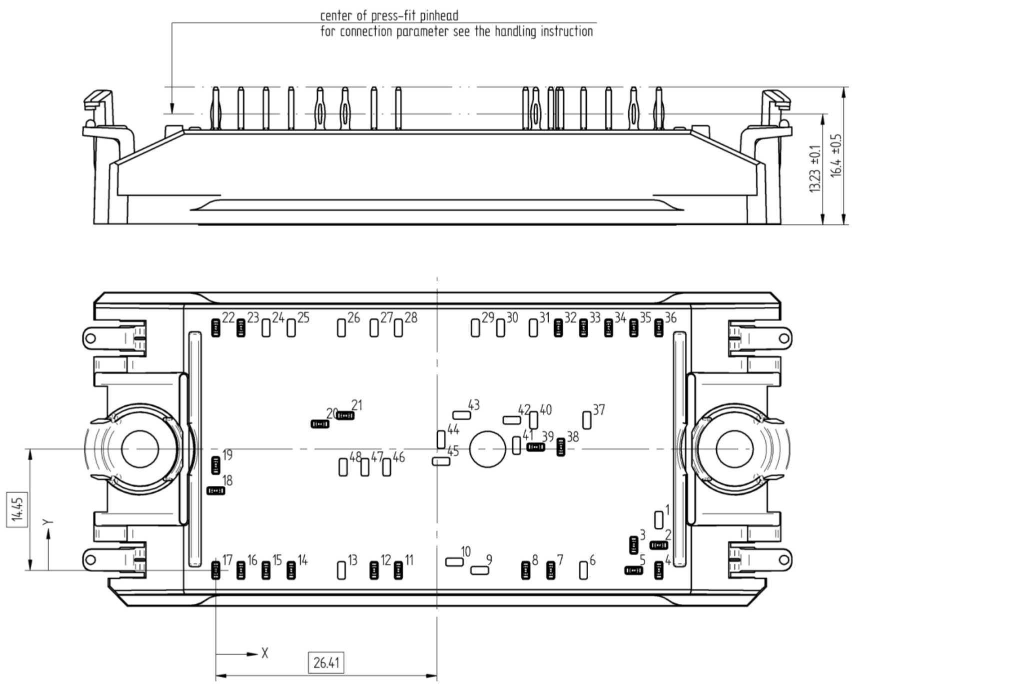


	Name		Date code	UL & VIN	Lot	Serial
Text	NN-NNNNNNNNNNNNNN-TTTTTTVV		WWYY	UL VIN	LLLLL	SSSS
Datamatrix	Type&Ver	Lot number	Serial	Date code		
	TTTTTTTVV	LLLLL	SSSS	WWYY		

Outline

Pin table

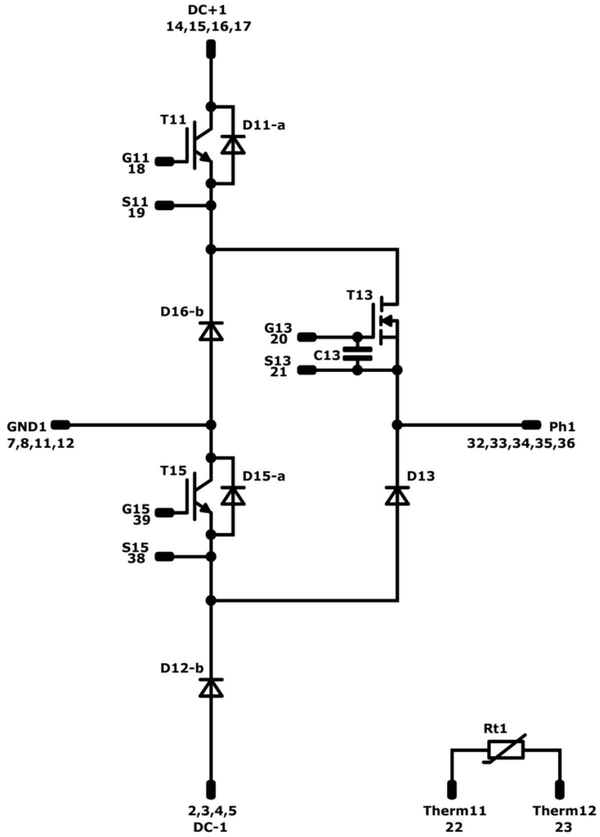
Pin	X	Y	Function
1	Not assembled		
2	52,9	3	DC-1
3	49,9	3	DC-1
4	52,9	0	DC-1
5	49,9	0	DC-1
6	Not assembled		
7	40	0	GND1
8	37	0	GND1
9	Not assembled		
10	Not assembled		
11	21,8	0	GND1
12	18,9	0	GND1
13	Not assembled		
14	9	0	DC+1
15	6	0	DC+1
16	3	0	DC+1
17	0	0	DC+1
18	0	9,5	G11
19	0	12,5	S11
20	12,45	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	Not assembled		
38	41,2	14,7	S15
39	38,2	14,7	G15
40	Not assembled		
41	Not assembled		
42	Not assembled		
43	Not assembled		
44	Not assembled		
45	Not assembled		
46	Not assembled		
47	Not assembled		
48	Not assembled		



Tolerance of pinpositions: ±0,5mm at the end of pins
Dimension of coordinate axis is only offset without tolerance

10-PH12NAB008MR01-LC59F28T

Pinout



Identification

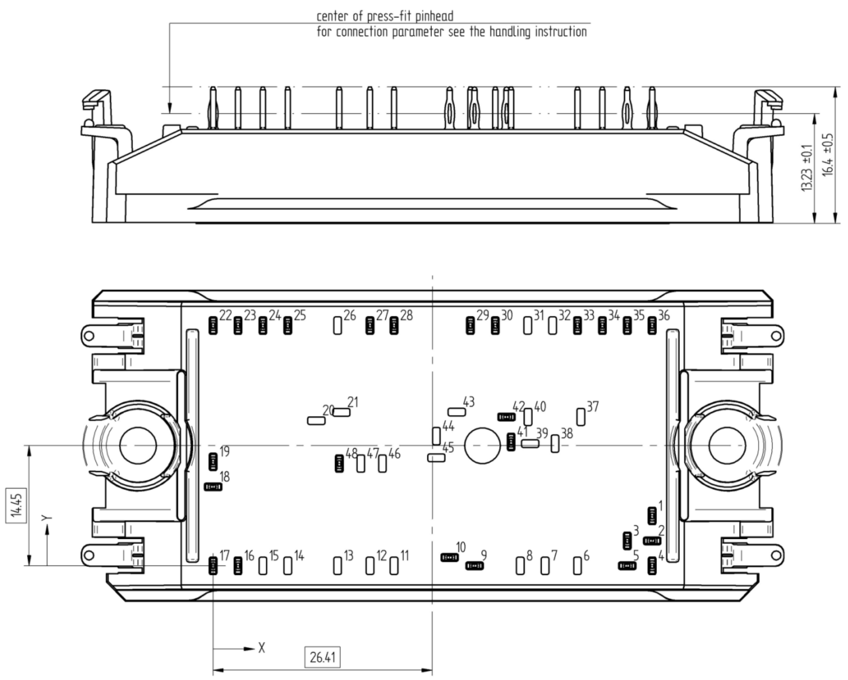
ID	Component	Voltage	Current	Function	Comment
T11	IGBT	1200 V	150 A	DC-Link Switch	
D12-b	FWD	1200 V	100 A	DC-Link Diode	
D11-a	FWD	1200 V	100 A	DC-Link Switch Inverse Diode	
T15	IGBT	1200 V	150 A	Neutral Point Switch	
D16-b	FWD	1200 V	150 A	Neutral Point Diode	
D15-a	FWD	1200 V	15 A	Neutral Point Switch Prot. Diode	
T13	MOSFET	1200 V	8 mΩ	AC Switch	
D13	FWD	1200 V	60 A	AC Diode	
C13	Capacitor	25 V		GS Capacitor	
Rt1	NTC			Thermistor	

10-PH12NAC008MR01-LC69F28T

Ordering Code & Marking						
Version			Ordering Code			
without thermal paste 12 mm housing with press-fit pins			10-PH12NAC008MR01-LC69F28T			
NN-NNNNNNNNNNNNNN TTTTTTVV WWYY UL VIN LLLLL SSSS	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	

Outline

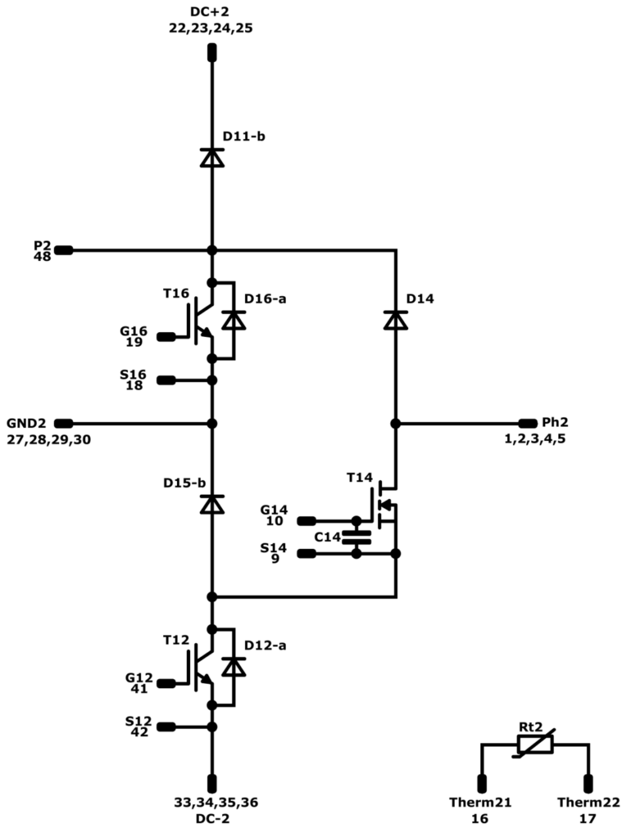
Pin table			
Pin	X	Y	Function
1	52,9	6	Ph2
2	52,9	3	Ph2
3	49,9	3	Ph2
4	52,9	0	Ph2
5	49,9	0	Ph2
6	Not assembled		
7	Not assembled		
8	Not assembled		
9	31,5	0	S14
10	28,5	1	G14
11	Not assembled		
12	Not assembled		
13	Not assembled		
14	Not assembled		
15	Not assembled		
16	3	0	Therm21
17	0	0	Therm22
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	Not assembled		
45	Not assembled		
46	Not assembled		
47	Not assembled		
48	15,2	12,3	P2



Tolerance of pinpositions: ±0,5mm at the end of pins
Dimension of coordinate axis is only offset without tolerance

10-PH12NAC008MR01-LC69F28T

Pinout



Identification

ID	Component	Voltage	Current	Function	Comment
T12	IGBT	1200 V	150 A	DC-Link Switch	
D11-b	FWD	1200 V	100 A	DC-Link Diode	
D12-a	FWD	1200 V	100 A	DC-Link Switch Inverse Diode	
T16	IGBT	1200 V	150 A	Neutral Point Switch	
D15-b	FWD	1200 V	150 A	Neutral Point Diode	
D16-a	FWD	1200 V	15 A	Neutral Point Switch Prot. Diode	
T14	MOSFET	1200 V	8 mΩ	AC Switch	
D14	FWD	1200 V	60 A	AC Diode	
C14	Capacitor	25 V		GS Capacitor	
Rt2	NTC			Thermistor	

Vincotech

10-PH12NAB008MR01-LC59F28T
10-PH12NAC008MR01-LC69F28T
target 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-PH12NAx008MR01-LCx9F28T-T1-14	13 Oct. 2017		

Product status definition		
Datasheet Status	**Product Status**	**Definition**
Target	Formative or In Design	This datasheet contains the design specifications for product development. Specifications may change in any manner without notice. The data contained is exclusively intended for technically trained staff.