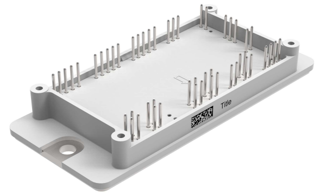
flow PACK 2 + R	1200 V / 50 A

Features

- Inverter, blocking diodes
- Built-in thermistor
- IGBT4 technology for low saturation losses

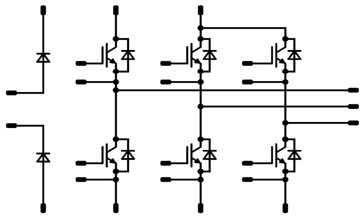
***flow* 2 17 mm housing**



Target Applications

- Industrial Drives

Schematic



Types

- 30-F212R6A050SC-M447E
- 30-F212R6A050SC01-M447E10

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
DC Blocking Diode					
Repetitive peak reverse voltage	V_{RRM}			1600	V
DC forward current	I_{FAV}	$T_j = T_{jmax}$	T_s = 80 °C	154	A
Surge forward current	I_{FSM}	t_p = 10 ms		1270	A
I²t-value	I^2t			2400	A²s
Power dissipation per Diode	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	189	W
Maximum Junction Temperature	T_{jmax}			150	°C
Inverter Switch					
Collector-emitter break down voltage	V_{CE}			1200	V
DC collector current	I_C	$T_j = T_{jmax}$	T_s = 80 °C	59	A
Pulsed collector current	I_{CRM}	t_p limited by T_{jmax}		150	A
Turn off safe operating area		V_{CE} ≤ 1200 V, $T_j \le T_{op\ max}$		100	A
Power dissipation per IGBT	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	163	W
Gate-emitter peak voltage	V_{GE}			20	V
Short circuit ratings	t_{SC} V_{CC}	T_j ≤ 150 °C V_{GE} = 15 V		10 800	µs V
Maximum Junction Temperature	T_{jmax}			175	°C

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Inverter Diode					
Peak Repetitive Reverse Voltage	V_{RRM}			1200	V
DC forward current	I_F	$T_j = T_{jmax}$	T_s = 80 °C	49	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}		70	A
Power dissipation per Diode	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	100	W
Maximum Junction Temperature	T_{jmax}			175	°C

Module Properties

Parameter	Symbol	Condition		Value	Unit
Thermal Properties					
Storage temperature	T_{stg}			-40…+125	°C
Operation temperature under switching condition	T_{op}			-40…+(T_{jmax} - 25)	°C
Insulation Properties					
Insulation voltage	V_{is}	DC Test Voltage*	t_p = 2 s	4000	V
		AC Voltage	t_p = 1 min.	2500	V
Creepage distance				min 12,7	mm
Clearance				min 12,7	mm
Comparative tracking index	CTI			>200	

* 100% Tested in production

Characteristic Values

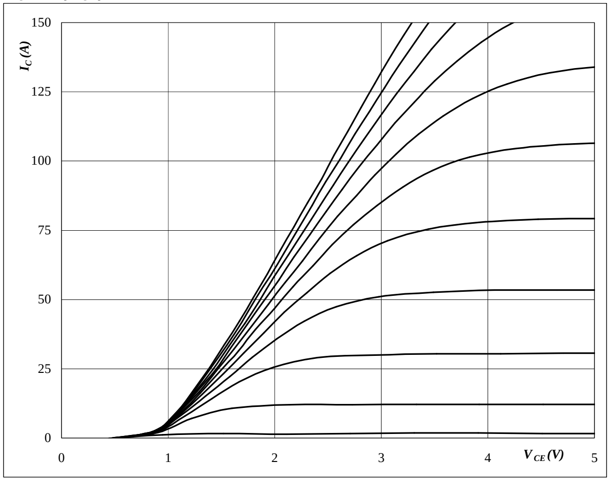
Parameter	Symbol	Conditions	V_{GE} [V] V_{GS} [V]	V_r [V] V_{CE} [V] V_{DS} [V]	I_C [A] I_F [A] I_D [A]	T_j [°C]	Min	Typ	Max	Unit
DC Blocking Diode										
Forward voltage	V_F				100	25 150		1,12 1,07	1,21	V
Threshold voltage (for power loss calc. only)	V_{to}				100	25 150		0,89 0,76		V
Slope resistance (for power loss calc. only)	r_t				100	25 150		2 3		mΩ
Reverse current	I_r			1600		25			0,05	mA
Thermal resistance chip to heatsink per chip	$R_{th(j-s)}$	phase-change material λ = 3,4 W/mK						0,37		K/W
Inverter Switch										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,0017	25	5	5,8	6,5	V
Collector-emitter saturation voltage	V_{CEsat}		15		50	25 150	1,6	1,86 2,3	2,1	V
Collector-emitter cut-off current incl. Diode	I_{CES}		0	1200		25			0,018	mA
Gate-emitter leakage current	I_{GES}		20	0		25			600	nA
Integrated Gate resistor	R_{gint}							4		Ω
Turn-on delay time	$t_{d(on)}$	R_{goff} = 8 Ω R_{gon} = 8 Ω	±15	600	50	25 150		106 110		ns
Rise time	t_r					25 150		23 26		
Turn-off delay time	$t_{d(off)}$					25 150		210 287		
Fall time	t_f					25 150		61 116		
Turn-on energy loss per pulse	E_{on}					25 150		2,97 4,44		mWs
Turn-off energy loss per pulse	E_{off}					25 150		2,55 4,54		
Input capacitance	C_{ies}	f = 1 MHz	0	25		25		2770		pF
Output capacitance	C_{oss}							205		
Reverse transfer capacitance	C_{rss}							160		
Gate charge	Q_G		±15	960	50	25		240		nC
Thermal resistance chip to heatsink per chip	$R_{th(j-s)}$	phase-change material λ = 3,4 W/mK						0,58		K/W
Inverter Diode										
Diode forward voltage	V_F				35	25 150	1,35	1,76 1,7	2,05	V
Peak reverse recovery current	I_{RRM}	R_{gon} = 8 Ω	±15	600	50	25 150		52,29 61,9		A
Reverse recovery time	t_{rr}					25 150		267 439,5		ns
Reverse recovered charge	Q_{rr}					25 150		4,3 8,86		μC
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 150		2183 758		A/μs
Reverse recovered energy	E_{rec}					25 150		1,67 3,66		mWs
Thermal resistance chip to heatsink per chip	$R_{th(j-s)}$	phase-change material λ = 3,4 W/mK						0,95		K/W
Thermistor										
Rated resistance	R					25		22000		Ω
Deviation of R_{100}	$\Delta_{R/R}$	R_{100} = 1486 Ω				100	-12		14	%
Power dissipation	P					25		200		mW
Power dissipation constant						25		2		mW/K
B-value	$B_{(25/50)}$	Tol. ±3%				25		3950		K
B-value	$B_{(25/100)}$	Tol. ±3%				25		3998		K
Vincotech NTC Reference									B	

Inverter Switch/Inverter Diode

Figure 1 Inverter IGBT

Typical output characteristics

$I_C = f(V_{CE})$



At

t_p = 250 µs

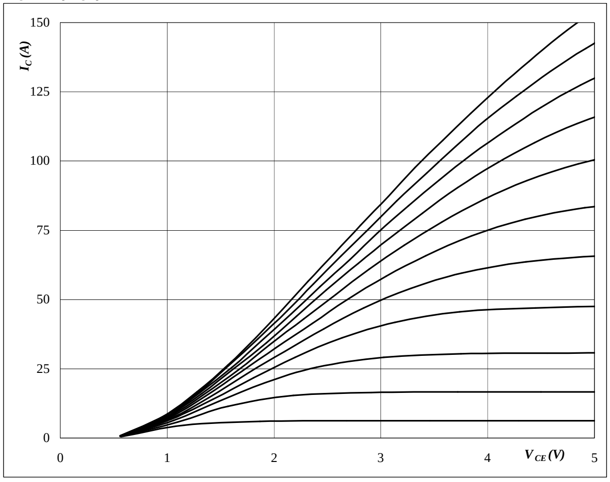
T_j = 25 °C

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

Figure 2 Inverter IGBT

Typical output characteristics

$I_C = f(V_{CE})$



At

t_p = 250 µs

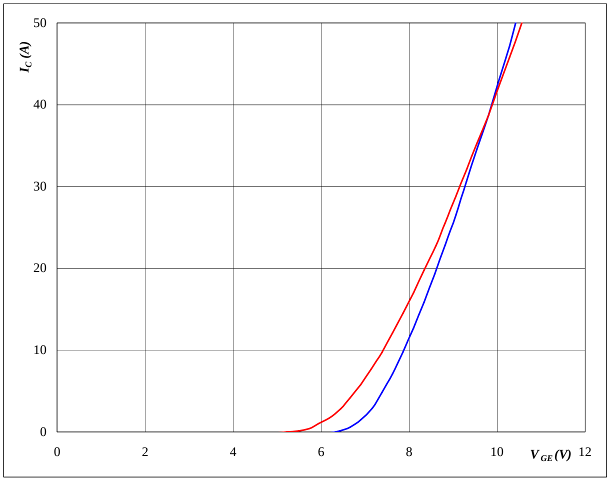
T_j = 150 °C

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

Figure 3 Inverter IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$



At

Tj = 25/150 °C

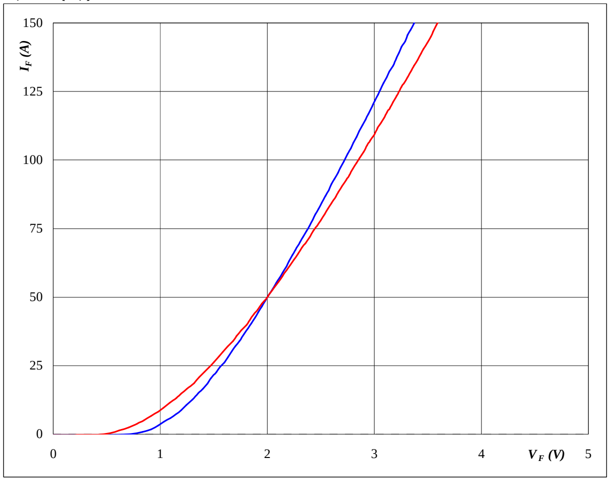
t_p = 250 µs

V_{CE} = 10 V

Figure 4 Inverter FWD

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

Tj = 25/150 °C

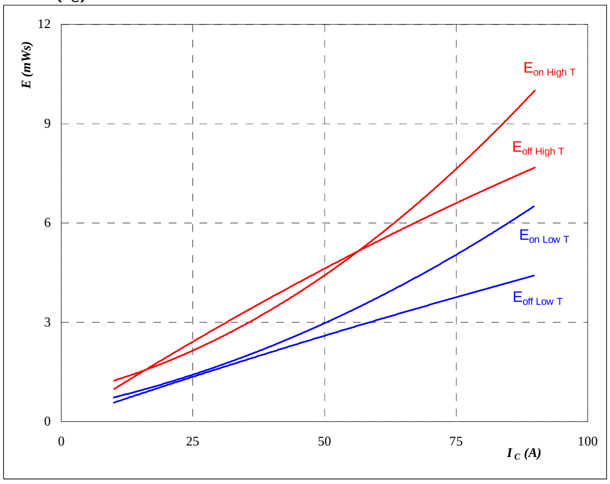
t_p = 250 µs

Inverter Switch/Inverter Diode

Figure 5 Inverter IGBT

Typical switching energy losses as a function of collector current

$E = f(I_C)$



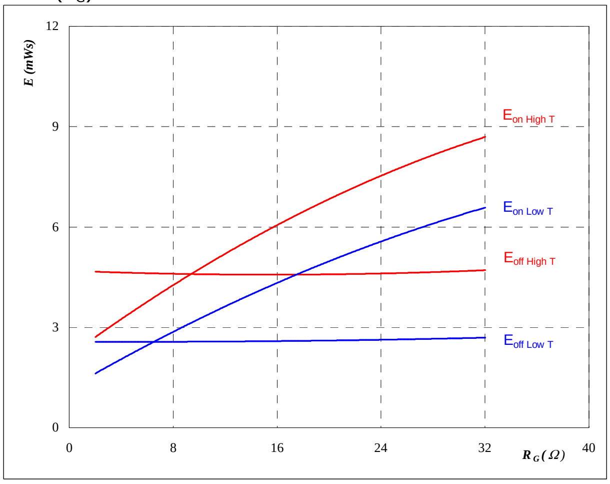
With an inductive load at

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	8	Ω
R_{goff} =	8	Ω

Figure 6 Inverter IGBT

Typical switching energy losses as a function of gate resistor

$E = f(R_G)$



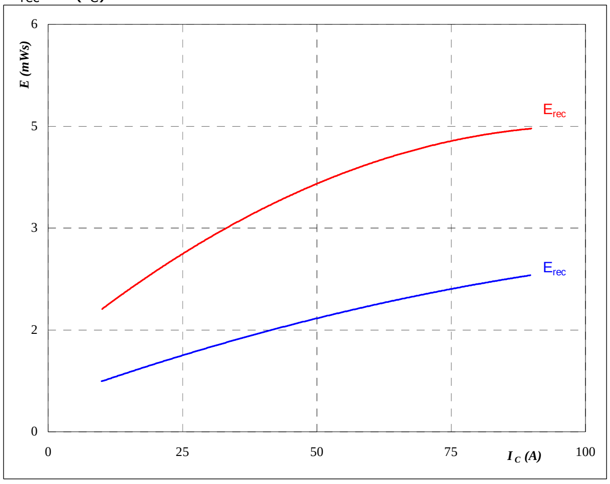
With an inductive load at

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	50	A

Figure 7 Inverter FWD

Typical reverse recovery energy loss as a function of collector current

$E_{rec} = f(I_C)$



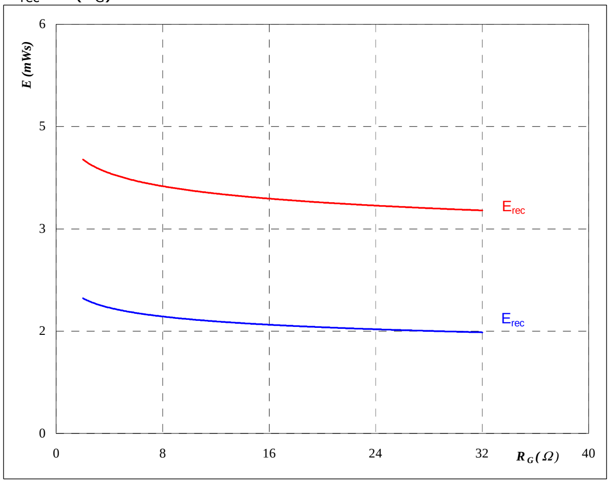
With an inductive load at

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	8	Ω

Figure 8 Inverter FWD

Typical reverse recovery energy loss as a function of gate resistor

$E_{rec} = f(R_G)$



With an inductive load at

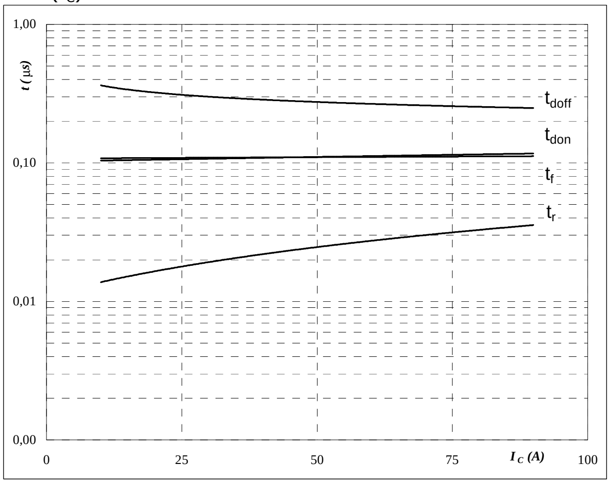
T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	50	A

Inverter Switch/Inverter Diode

Figure 9 Inverter IGBT

Typical switching times as a function of collector current

$t = f(I_C)$



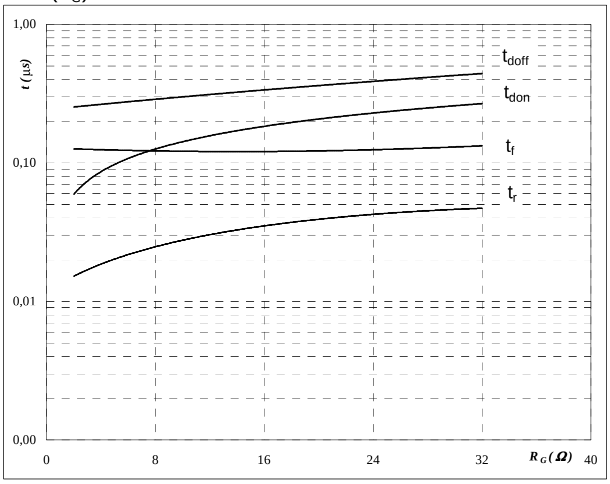
With an inductive load at

T_j =	150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	8	Ω
R_{goff} =	8	Ω

Figure 10 Inverter IGBT

Typical switching times as a function of gate resistor

$t = f(R_G)$



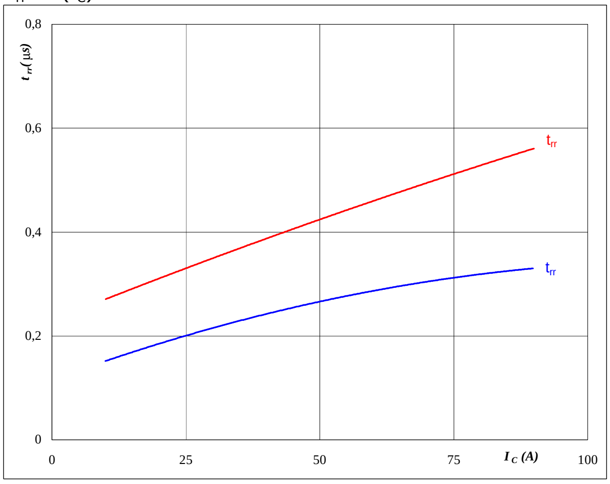
With an inductive load at

T_j =	150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	50	A

Figure 11 Inverter FWD

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$



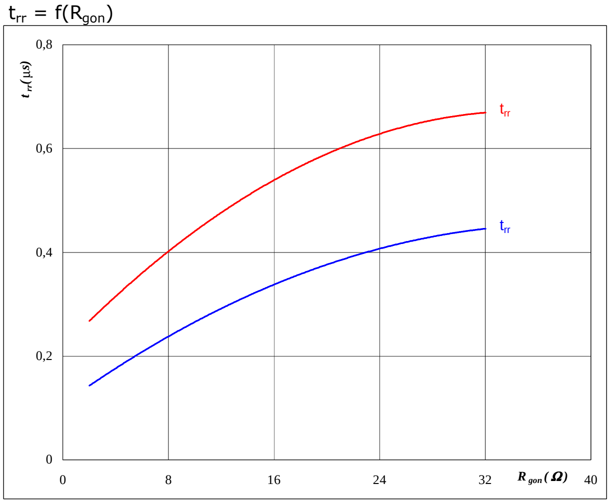
At

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	8	Ω

Figure 12 Inverter FWD

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

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



At

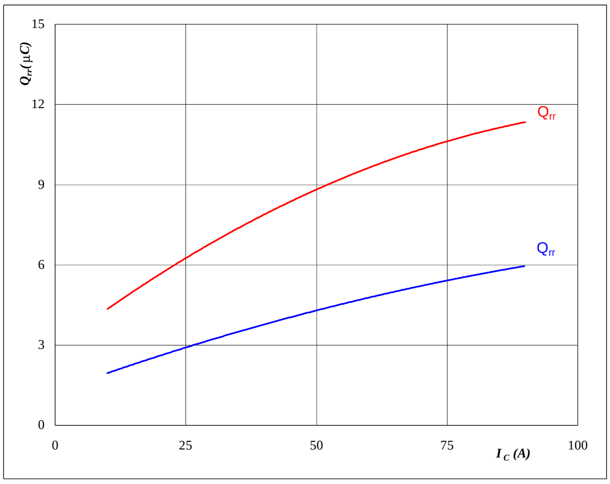
T_j =	25/150	°C
V_R =	600	V
I_F =	50	A
V_{GE} =	±15	V

Inverter Switch/Inverter Diode

Figure 13 Inverter FWD

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



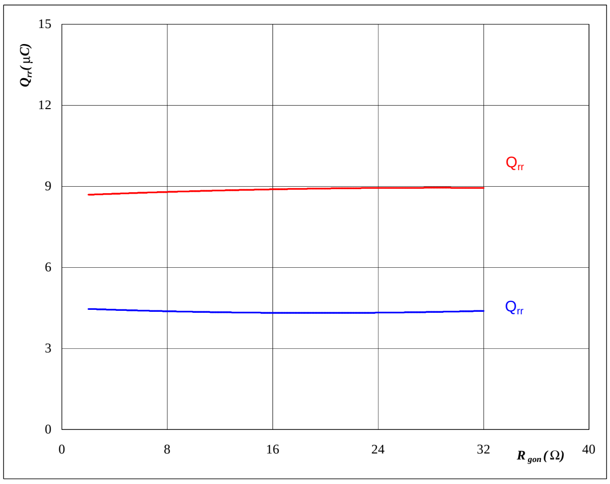
At

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	8	Ω

Figure 14 Inverter FWD

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

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



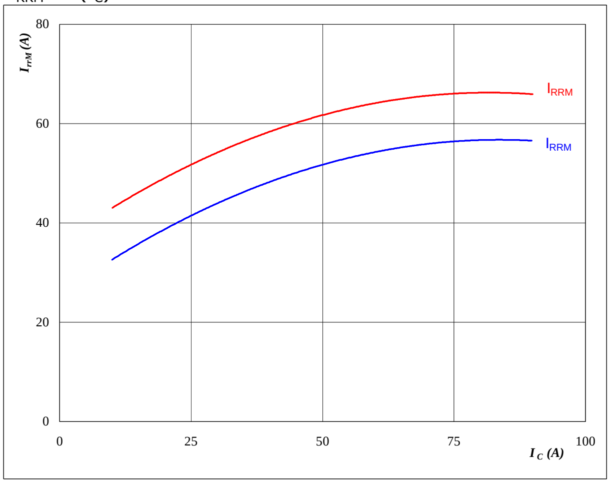
At

T_j =	25/150	°C
V_R =	600	V
I_F =	50	A
V_{GE} =	±15	V

Figure 15 Inverter FWD

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



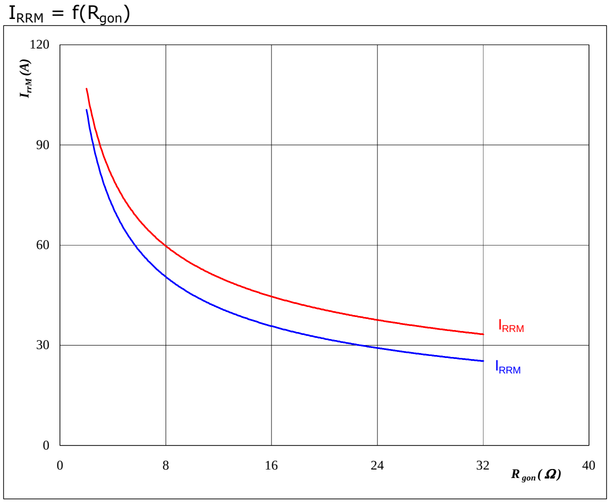
At

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	8	Ω

Figure 16 Inverter FWD

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

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



At

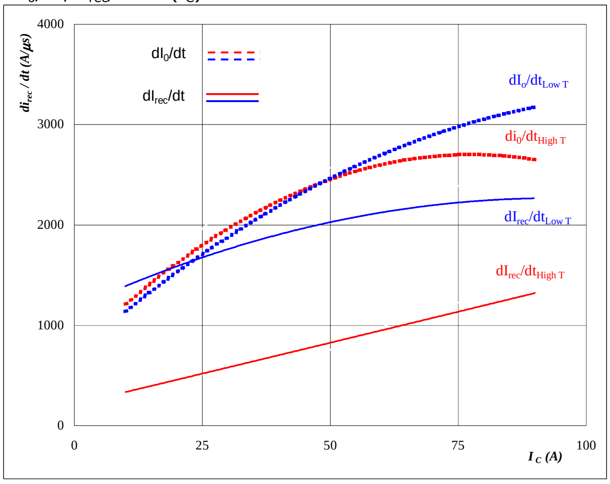
T_j =	25/150	°C
V_R =	600	V
I_F =	50	A
V_{GE} =	±15	V

Inverter Switch/Inverter Diode

Figure 17 Inverter FWD

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

$dI_0/dt, dI_{rec}/dt = f(I_C)$



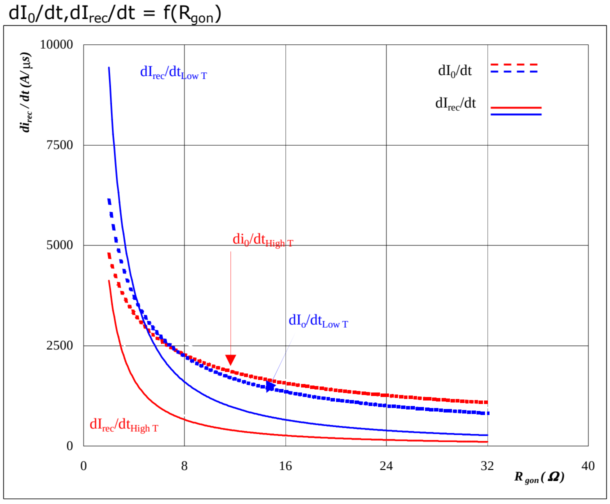
At

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	8	Ω

Figure 18 Inverter FWD

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

$dI_0/dt, dI_{rec}/dt = f(R_{gon})$



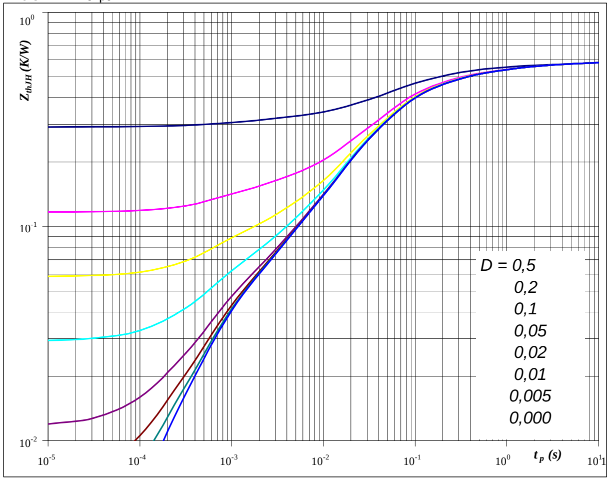
At

T_j =	25/150	°C
V_R =	600	V
I_F =	50	A
V_{GE} =	±15	V

Figure 19 Inverter IGBT

IGBT transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

D =	t_p / T	
R_{thJH} =	0,58	K/W

IGBT thermal model values

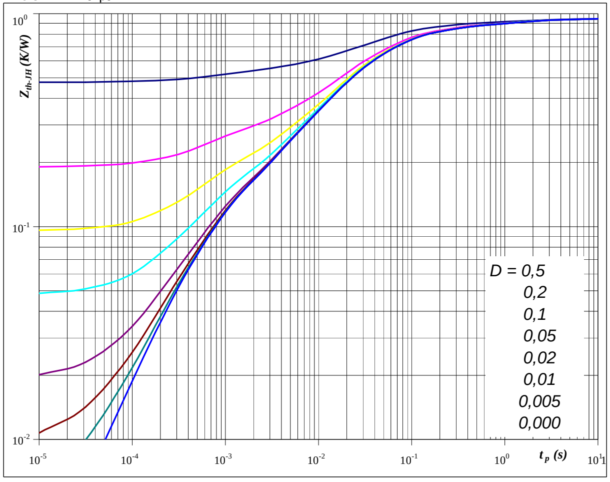
Phase-Change Material

R (C/W)	Tau (s)
0,07	2,10
0,13	0,24
0,27	0,05
0,08	0,01
0,04	0,00

Figure 20 Inverter FWD

FWD transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

D =	t_p / T	
R_{thJH} =	0,95	K/W

FWD thermal model values

Phase-Change Material

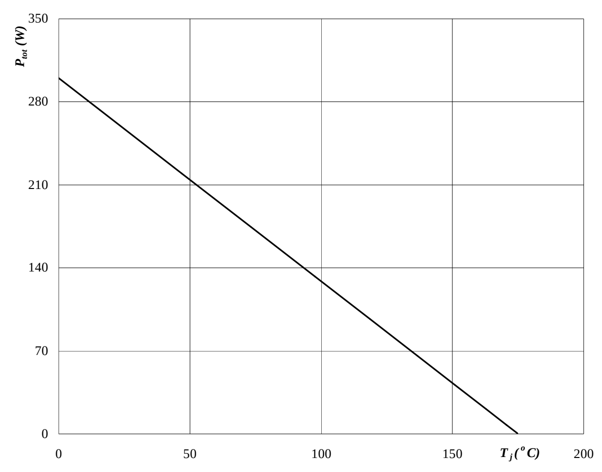
R (C/W)	Tau (s)
0,02	9,45
0,08	1,26
0,18	0,15
0,42	0,03
0,16	0,01
0,10	0,00

Inverter Switch/Inverter Diode

Figure 21 Inverter IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_j)$



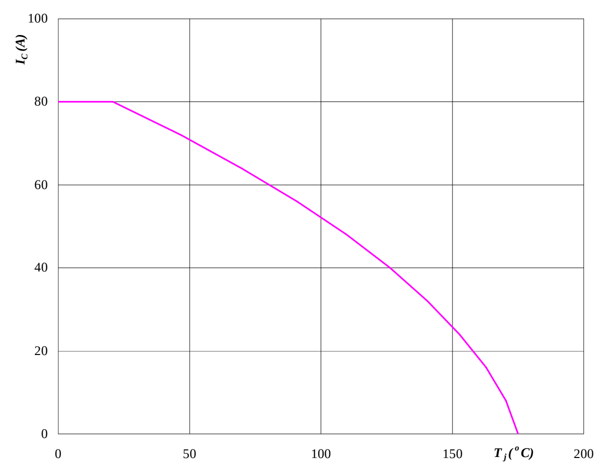
At

T_j = 175 °C

Figure 22 Inverter IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_j)$



At

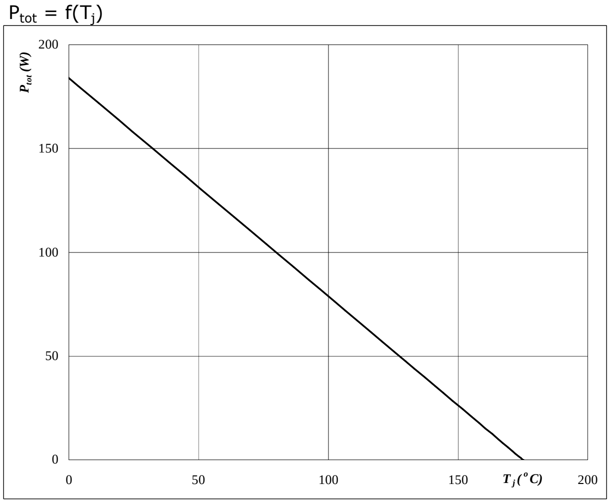
T_j = 175 °C

V_{GE} = 15 V

Figure 23 Inverter FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_j)$



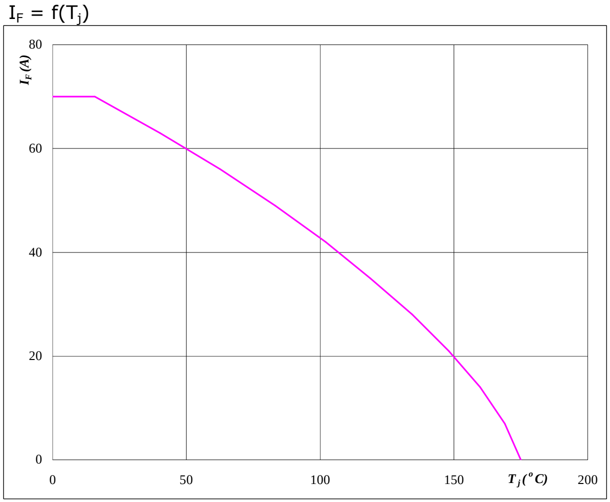
At

T_j = 175 °C

Figure 24 Inverter FWD

Forward current as a function of heatsink temperature

$I_F = f(T_j)$



At

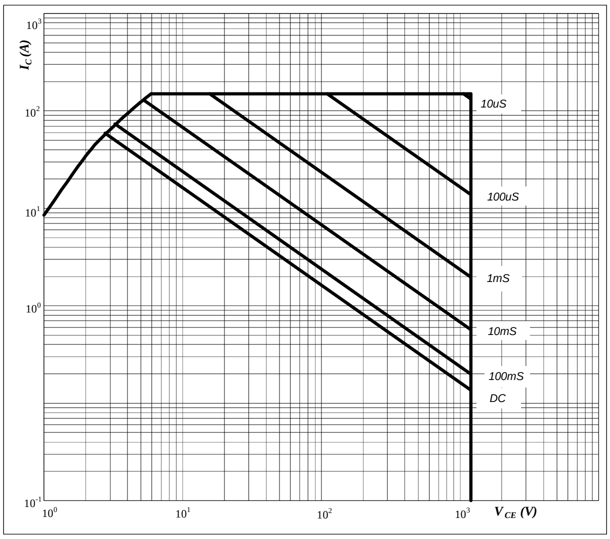
T_j = 175 °C

Inverter Switch/Inverter Diode

Figure 25 Inverter IGBT

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$



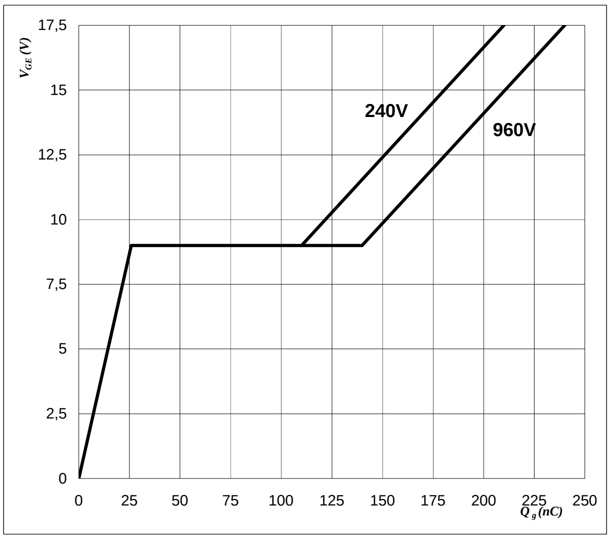
At

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

Figure 26 Inverter IGBT

Gate voltage vs Gate charge

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



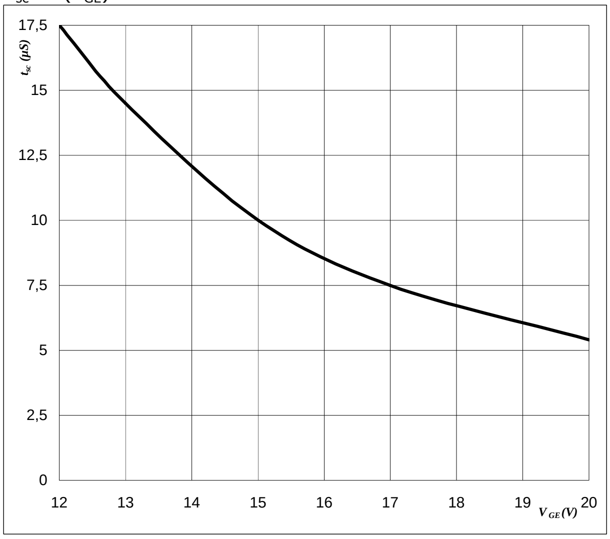
At

I_C =	50	A

Figure 27 Inverter IGBT

Short circuit withstand time as a function of gate-emitter voltage

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



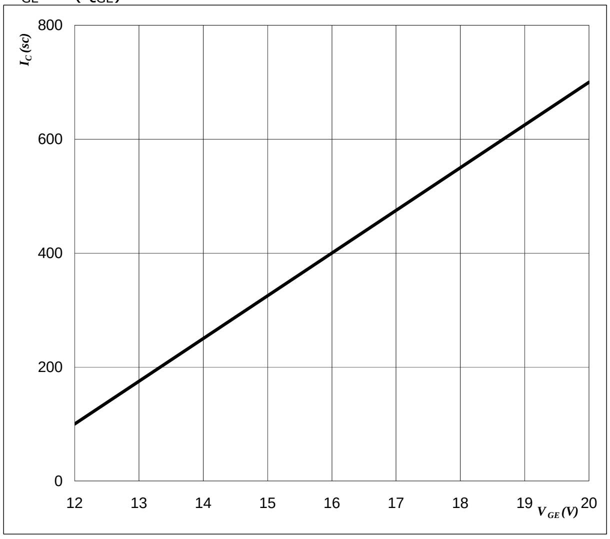
At

V_{CE} =	1200	V
T_j ≤	175	ºC

Figure 28 Inverter IGBT

Typical short circuit collector current as a function of gate-emitter voltage

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



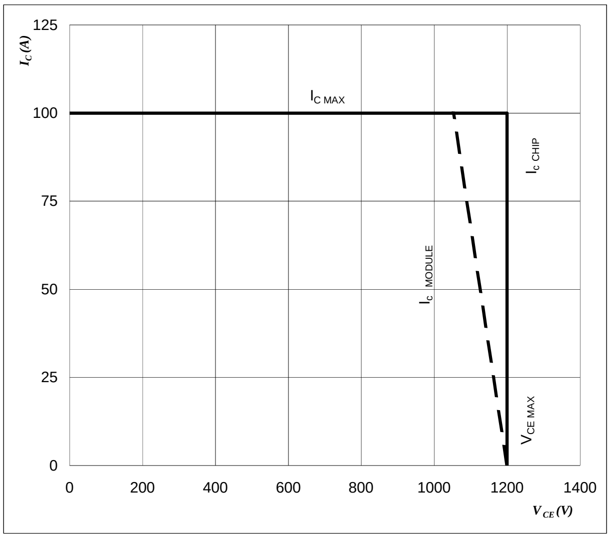
At

V_{CE} ≤	1200	V
T_j =	175	ºC

Figure 29 Inverter IGBT

Reverse bias safe operating area

$I_C = f(V_{CE})$



At

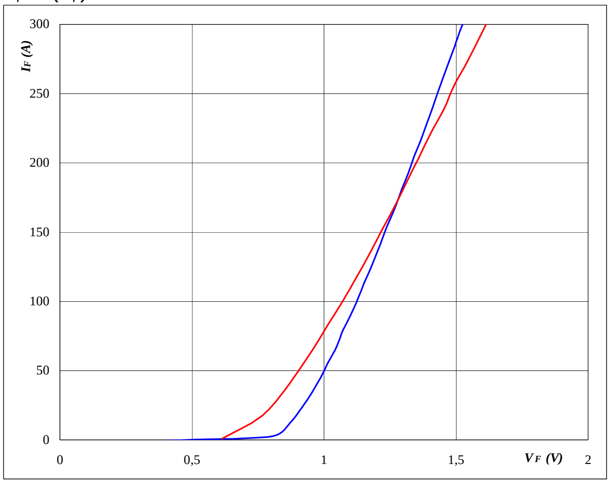
T_j =	150 °C
Rgon =	8 Ω
Rgoff =	8 Ω

DC Blocking Diode

Figure 1 DC Blocking Diode

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



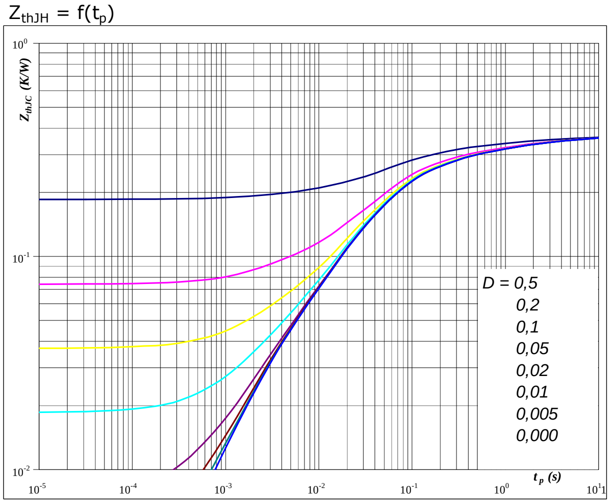
At

Tj =	25/125	°C
t_p =	250	µs

Figure 2 DC Blocking Diode

Diode transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



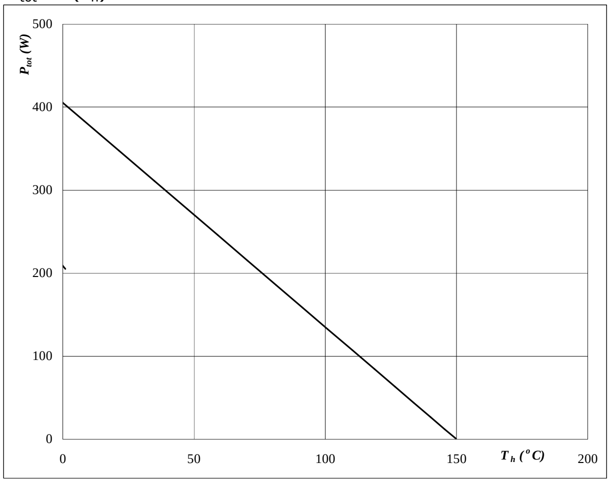
At

D =	t_p / T	
R_{thJH} =	0,37	K/W

Figure 3 DC Blocking Diode

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



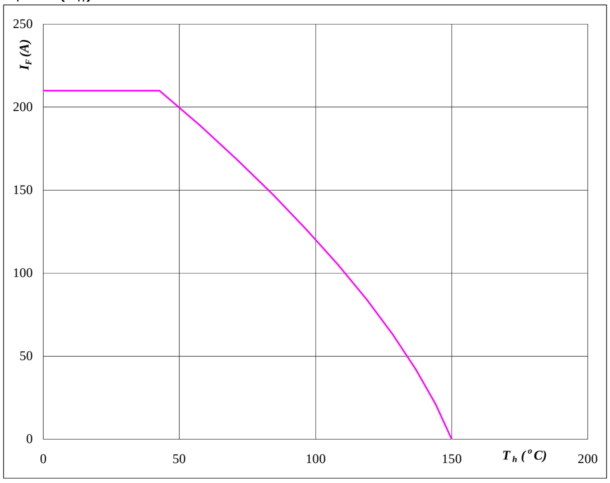
At

T_j =	150	ºC

Figure 4 DC Blocking Diode

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

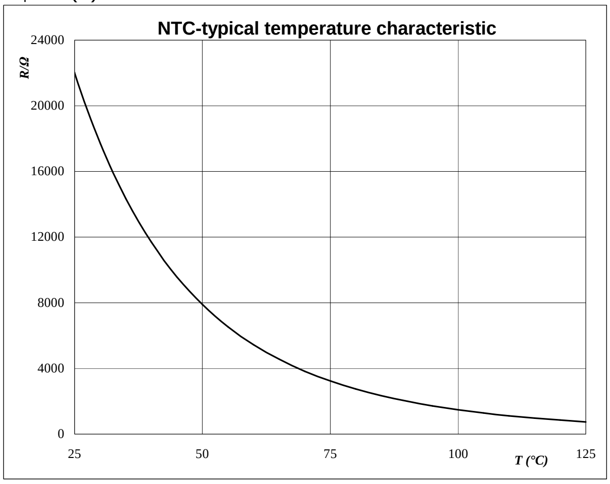
T_j =	150	ºC

Thermistor

Figure 1 Thermistor

Typical NTC characteristic
as a function of temperature

$R_T = f(T)$



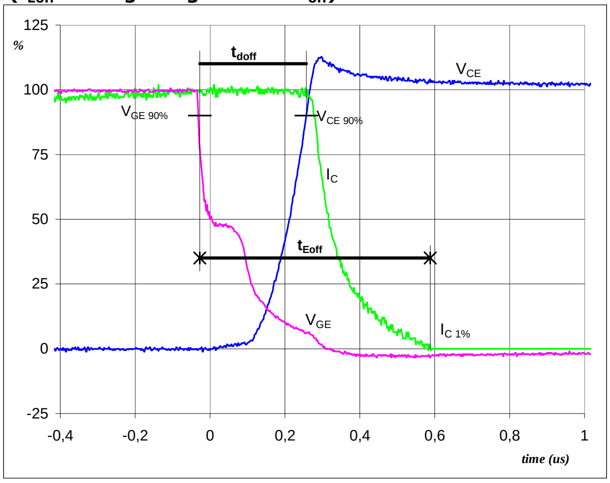
Switching Definitions Output Inverter

General conditions

T_j	=	150 °C
R_{gon}	=	8 Ω
R_{goff}	=	8 Ω

Figure 1 Inverter IGBT

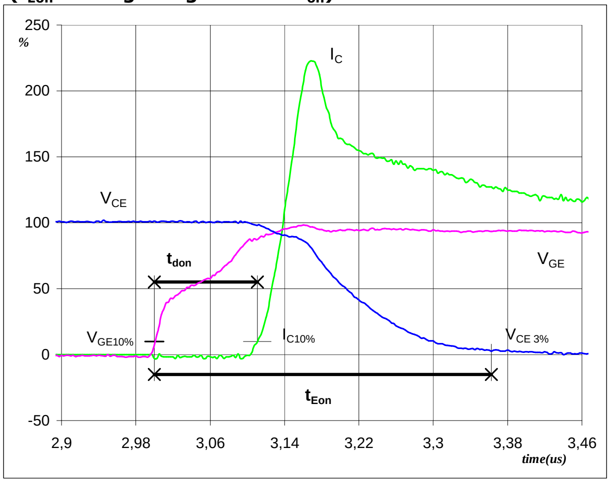
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff} (t_{Eoff} = integrating time for E_{off})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	50	A
t_{doff} =	0,29	μs
t_{Eoff} =	0,62	μs

Figure 2 Inverter IGBT

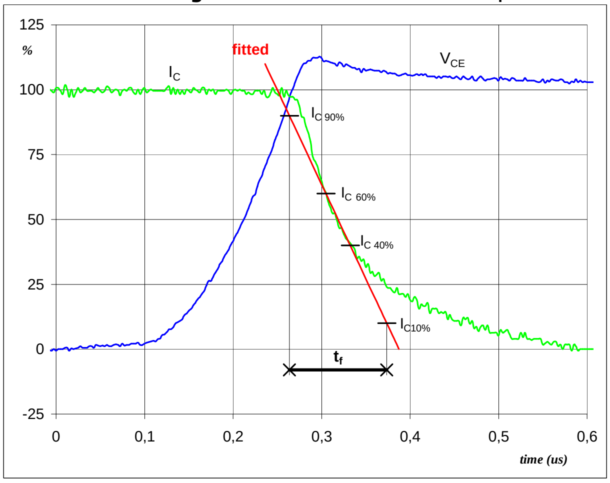
Turn-on Switching Waveforms & definition of tdon, t_{Eon} (t_{Eon} = integrating time for E_{on})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	50	A
t_{don} =	0,11	μs
t_{Eon} =	0,36	μs

Figure 3 Inverter IGBT

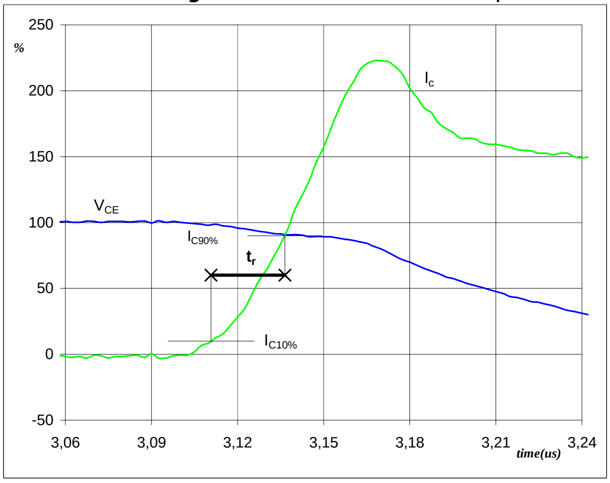
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	600	V
I_C (100%) =	50	A
t_f =	0,12	μs

Figure 4 Inverter IGBT

Turn-on Switching Waveforms & definition of t_r

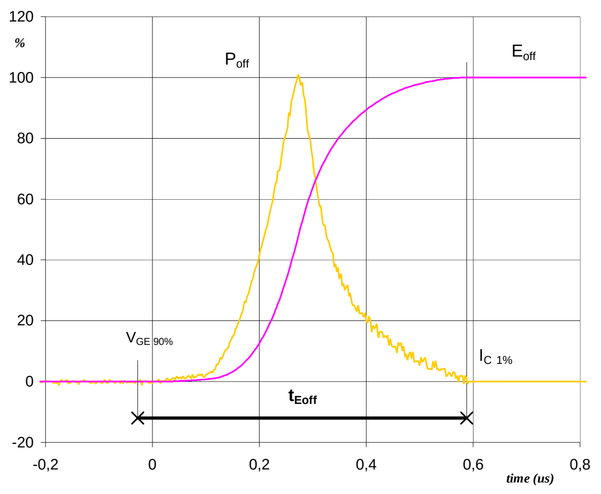


V_C (100%) =	600	V
I_C (100%) =	50	A
t_r =	0,03	μs

Switching Definitions Output Inverter

Figure 5 Inverter IGBT

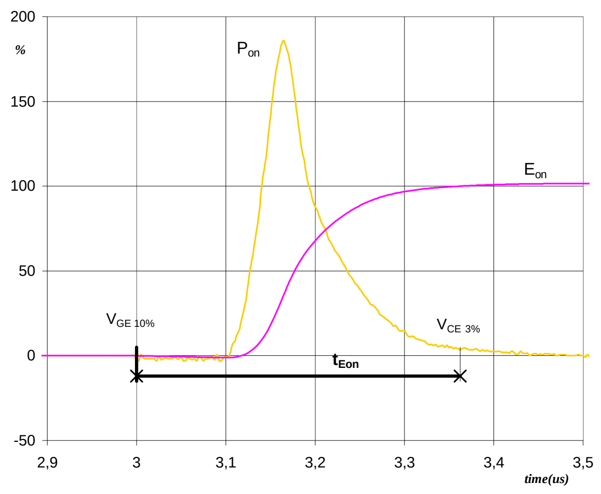
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	30,03	kW
E_{off} (100%) =	4,54	mJ
t_{Eoff} =	0,62	μs

Figure 6 Inverter IGBT

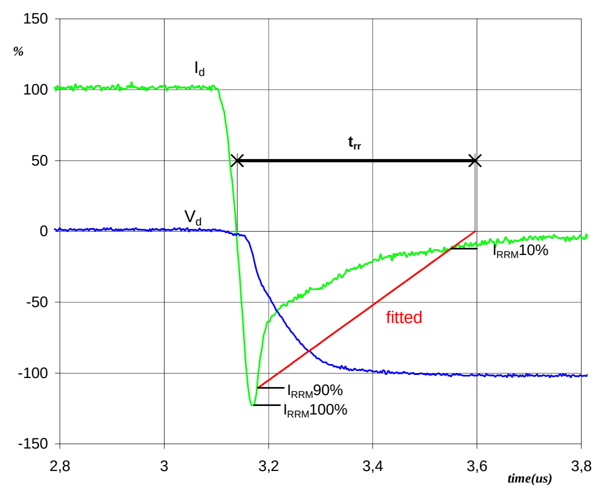
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	30,03	kW
E_{on} (100%) =	4,44	mJ
t_{Eon} =	0,36	μs

Figure 7 Inverter FWD

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

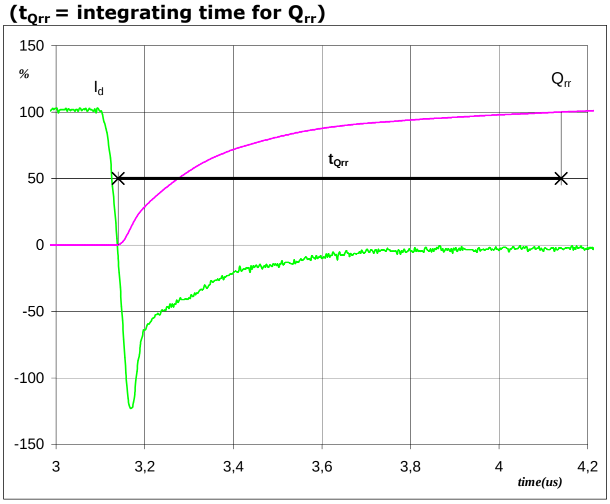


V_d (100%) =	600	V
I_d (100%) =	50	A
I_{RRM} (100%) =	-62	A
t_{rr} =	0,44	μs

Switching Definitions Output Inverter

Figure 8 Inverter FWD

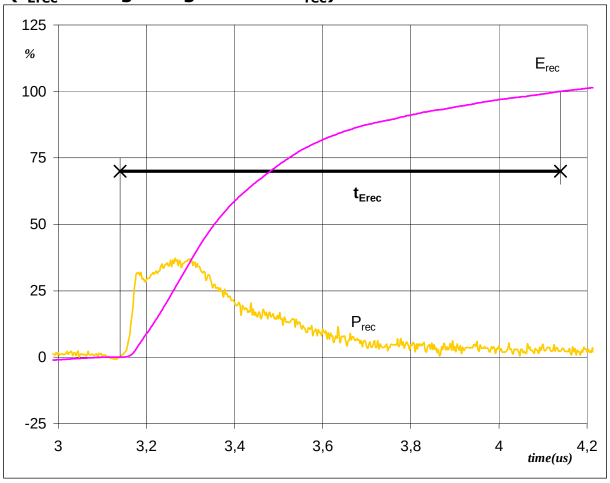
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})



I_d (100%) =	50	A
Q_{rr} (100%) =	8,86	µC
t_{Qrr} =	1,00	µs

Figure 9 Inverter FWD

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



P_{rec} (100%) =	30,03	kW
E_{rec} (100%) =	3,66	mJ
t_{Erec} =	1,00	µs

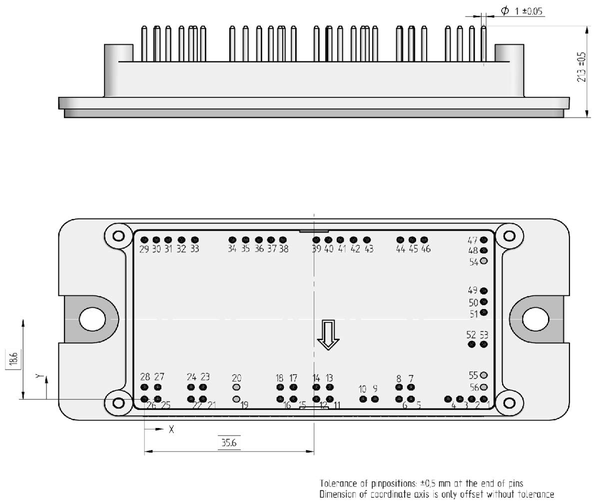
Ordering Code & Marking

Version	Ordering Code
without thermal paste 17 mm housing with solder pins	30-F212R6A050SC-M447E
without thermal paste 17 mm housing with solder pins	30-F212R6A050SC01-M447E10

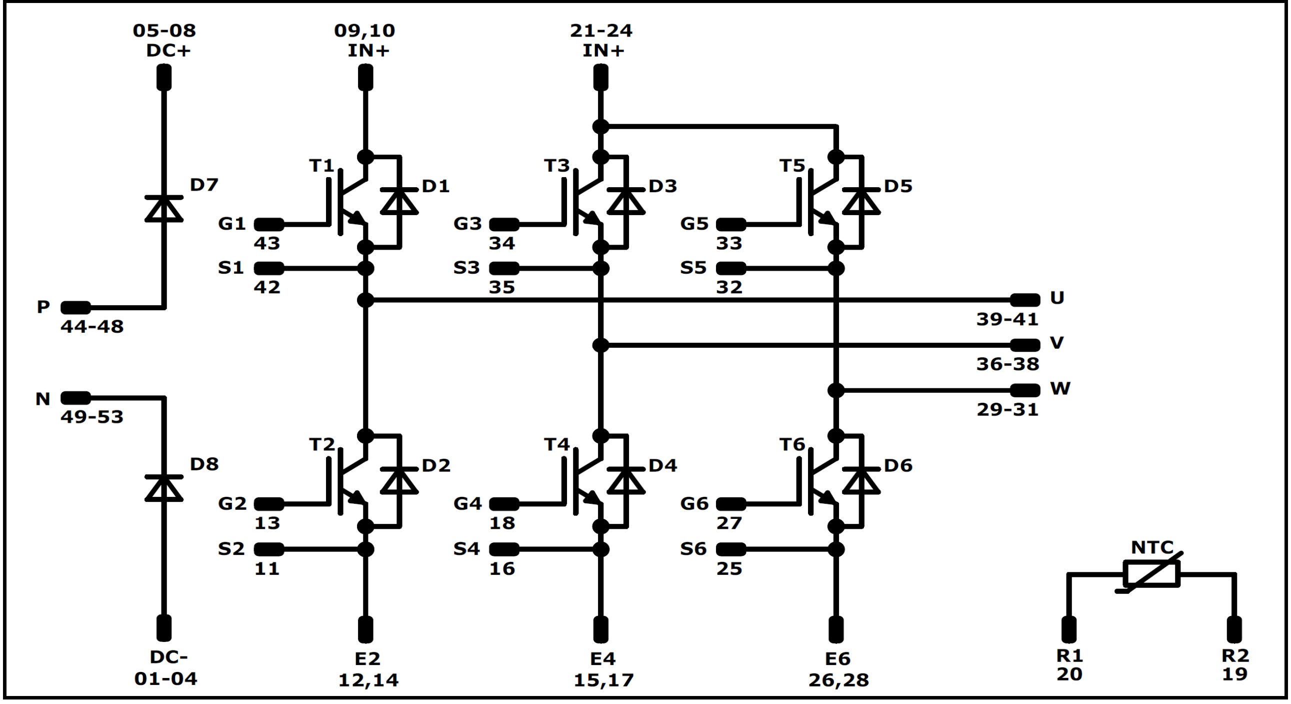
	Name	Date code	UL & VIN	Lot	Serial
Text	NN-NNNNNNNNNNNNNN-TTTTTTVV	WWYY	UL VIN	LLLLL	SSSS
	Type&Ver	**Lot number**	**Serial**	**Date code**	
Datamatrix	TTTTTTTVV	LLLLL	SSSS	WWYY	

Outline

Pin table [mm]				Pin table [mm]			
Pin	X	Y	Function	Pin	X	Y	Function
1	71,2	0	DC-	31	5	37,2	W
2	68,7	0	DC-	32	7,8	37,2	S5
3	66,2	0	DC-	33	10,6	37,2	G5
4	63,7	0	DC-	34	18,45	37,2	G3
5	55,95	0	DC+	35	21,25	37,2	G3
6	53,45	0	DC+	36	24,05	37,2	V
7	55,95	2,8	DC+	37	26,55	37,2	V
8	53,45	2,8	DC+	38	29,05	37,2	V
9	48,4	0	IN+	39	36,1	37,2	U
10	45,9	0	IN+	40	38,6	37,2	U
11	38,9	0	S2	41	41,1	37,2	U
12	36,1	0	E2	42	43,9	37,2	S1
13	38,9	2,8	G2	43	46,7	37,2	G1
14	36,1	2,8	E2	44	53,7	37,2	P
15	31,3	0	E4	45	56,2	37,2	P
16	28,5	0	S4	46	58,7	37,2	P
17	31,3	2,8	E4	47	71,2	37,2	P
18	28,5	2,8	G4	48	71,2	34,7	P
19	Not assembled			49	71,2	25,2	N
20				50	71,2	22,7	N
21	12,3	0	IN+	51	71,2	20,2	N
22	9,8	0	IN+	52	68,7	12,8	N
23	12,3	2,8	IN+	53	71,2	12,8	N
24	9,8	2,8	IN+	54	Not assembled		
25	2,8	0	S6	55			
26	0	0	E6	56			
27	2,8	2,8	G6				
28	0	2,8	E6				
29	0	37,2	W				
30	2,5	37,2	W				



Pinout



Identification

ID	Component	Voltage	Current	Function	Comment
D7 , D8	FWD	1600 V	100 A	DC Blocking Diode	
T1 - T6	IGBT	1200 V	50 A	Inverter Switch	
D1 - D6	FWD	1200 V	35 A	Inverter Diode	
NTC	Thermistor			Thermistor	

Packaging instruction					
Standard packaging quantity (SPQ)	**36**	>SPQ	Standard	<SPQ	Sample

Handling instruction
Handling instructions for *flow* 2 packages see vincotech.com website.

Package data
Package data for *flow* 2 packages see vincotech.com website.

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

Document No.:	Date:	Modification:	Pages
30-F212R6A050SC-M447E-D3-14	28 Jun. 2017	Logo, SPQ corrected	All