Vincotech

flow PACK 2 + R — 1200 V / 50 A

Features

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

Target Applications

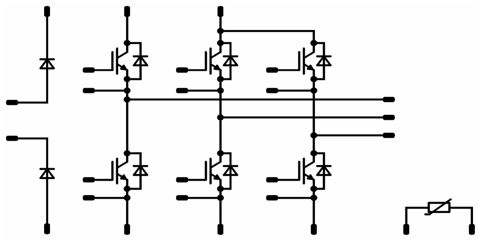
- Industrial Drives

Types

- 30-F212R6A050SC-M447E (with thermistor)
- 30-F212R6A050SC01-M447E10 (without thermistor)

flow 2 17 mm housing

Schematic



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
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					
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				12,01	mm
Comparative tracking index	CTI			>200	

* 100% Tested in production

Characteristic Values

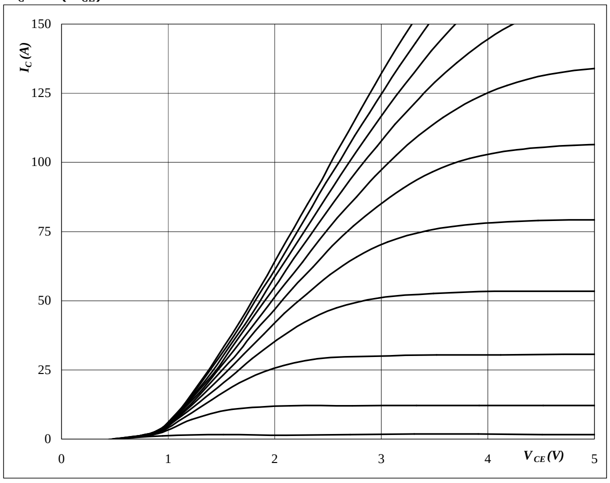
Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] V_{GS} [V]	V_r [V] V_{CE} [V] V_{DS} [V]	I_C [A] I_F [A] I_D [A]	T_j [°C]	Min	Typ	Max	
DC Blocking Diode										
Forward voltage	V_F				100	25 150		1,12 1,07	1,4	V
Threshold voltage (for power loss calc. only)	V_{to}				100	25 150		0,89 0,76		V
Slope resistance (for power loss calc. only)	r_t				100	25 150		2 3		mΩ
Reverse current	I_r			1500		25			0,1	mA
Thermal resistance chip to heatsink per chip	$R_{th(j-s)}$	λpaste = 3,4 W/mK (PSX)						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	$R_{th(j-s)}$	λpaste = 3,4 W/mK (PSX)						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	$R_{th(j-s)}$	λpaste = 3,4 W/mK (PSX)						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.	IGBT

Typical output characteristics

$I_C = f(V_{CE})$



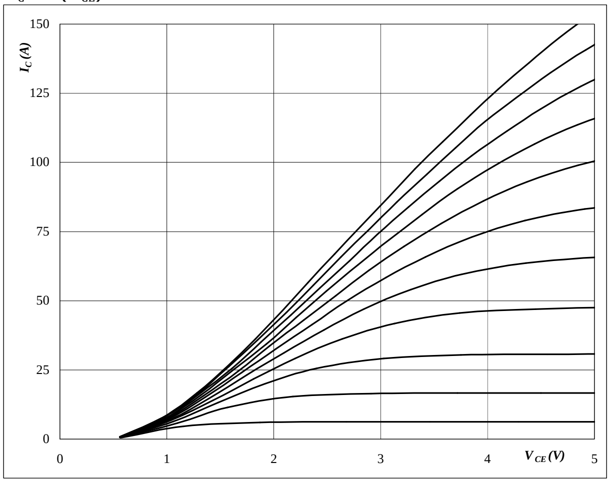
At

t_p =	250	μs
T_j =	25	°C
V_{GE} from	7 V to 17 V in steps of 1 V	

figure 2.	IGBT

Typical output characteristics

$I_C = f(V_{CE})$



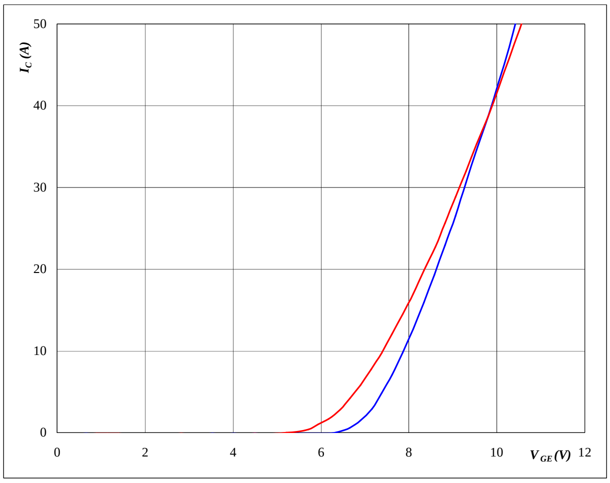
At

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

figure 3.	IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$



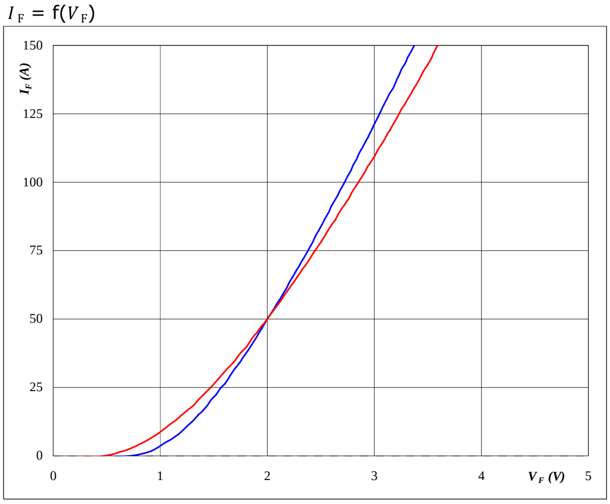
At

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

figure 4.	FWD

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

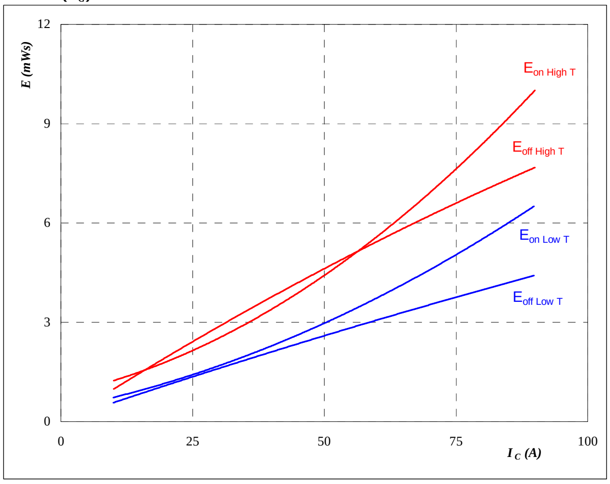
T_j =	25/150	°C
t_p =	250	μs

Inverter Switch/Inverter Diode

figure 5. **IGBT**

Typical switching energy losses
as a function of collector current

$E = f(I_C)$



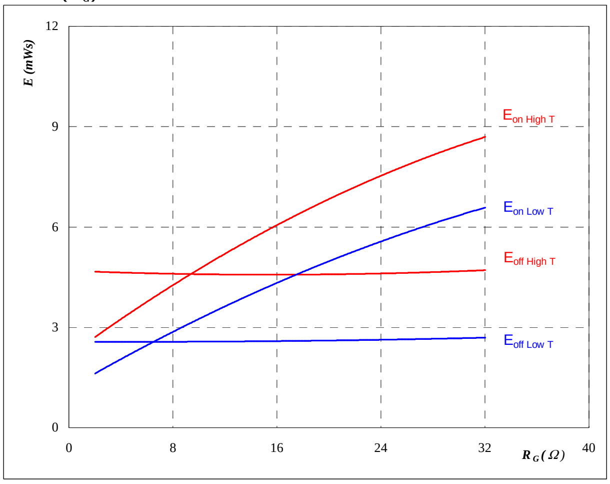
With an inductive load at

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

figure 6. **IGBT**

Typical switching energy losses
as a function of gate resistor

$E = f(R_G)$



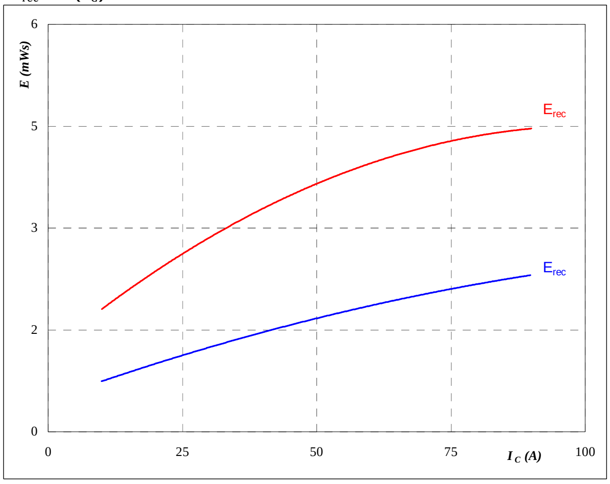
With an inductive load at

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

figure 7. **FWD**

Typical reverse recovery energy loss
as a function of collector current

$E_{rec} = f(I_C)$



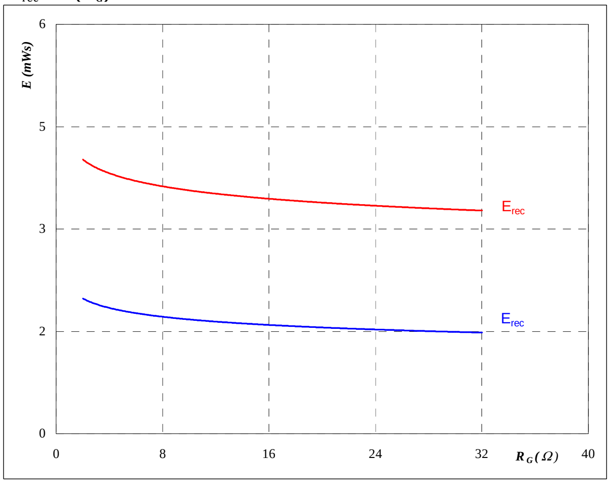
With an inductive load at

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

figure 8. **FWD**

Typical reverse recovery energy loss
as a function of gate resistor

$E_{rec} = f(R_G)$



With an inductive load at

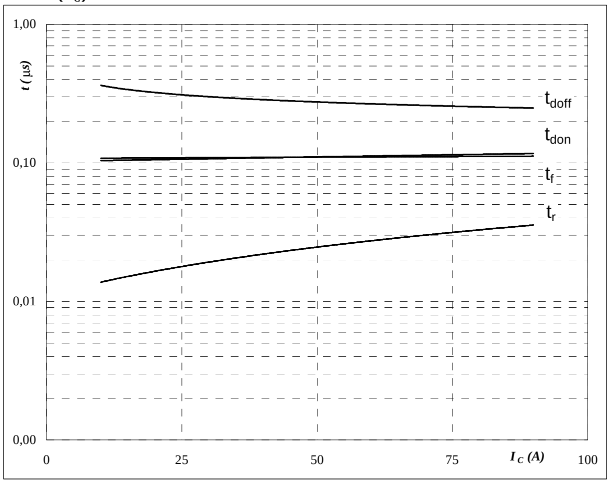
T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	50	A

Inverter Switch/Inverter Diode

figure 9. **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



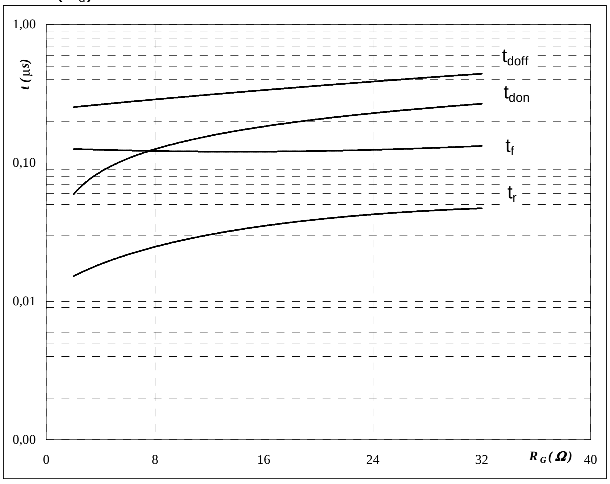
With an inductive load at

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

figure 10. **IGBT**

Typical switching times as a function of gate resistor

$t = f(R_G)$



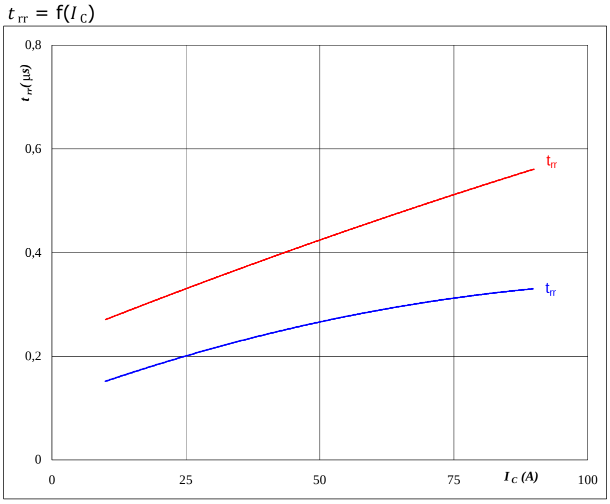
With an inductive load at

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

figure 11. **FWD**

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$



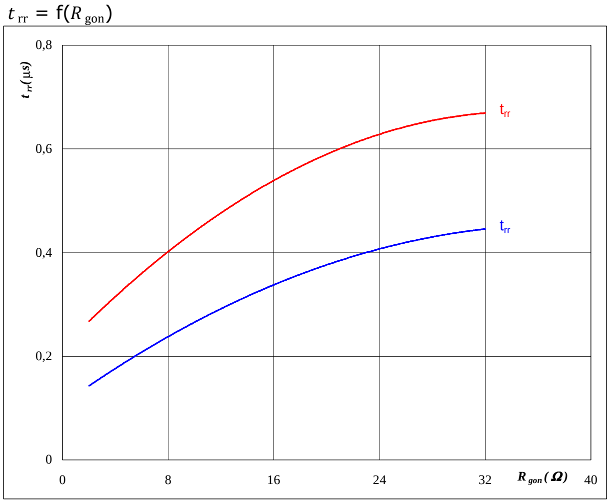
At

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

figure 12. **FWD**

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

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



At

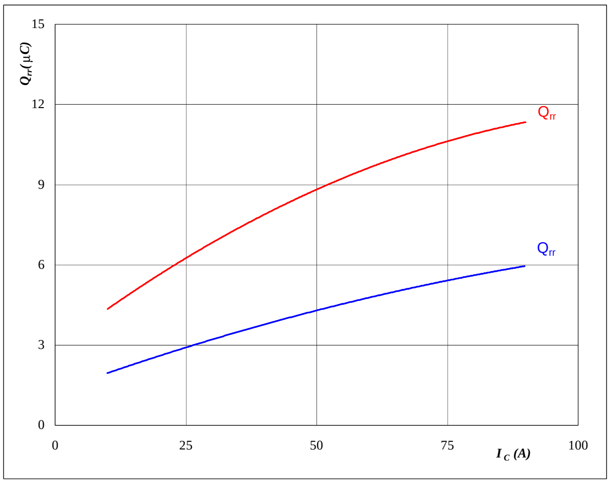
T_j =	25/150	°C
V_R =	600	V
I_F =	50	A
V_{GE} =	±15	V

Inverter Switch/Inverter Diode

figure 13. **FWD**

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



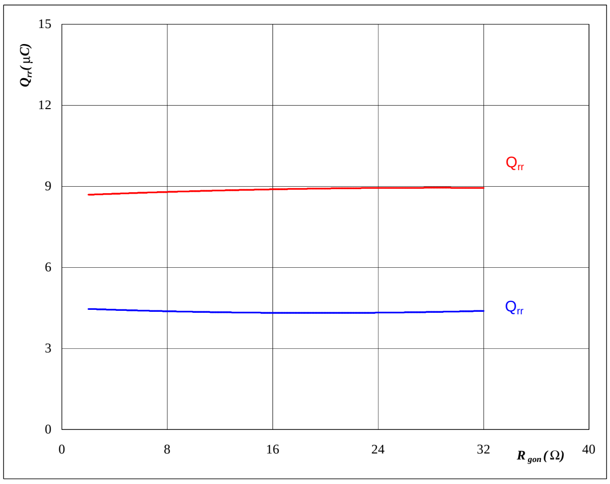
At

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

figure 14. **FWD**

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

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



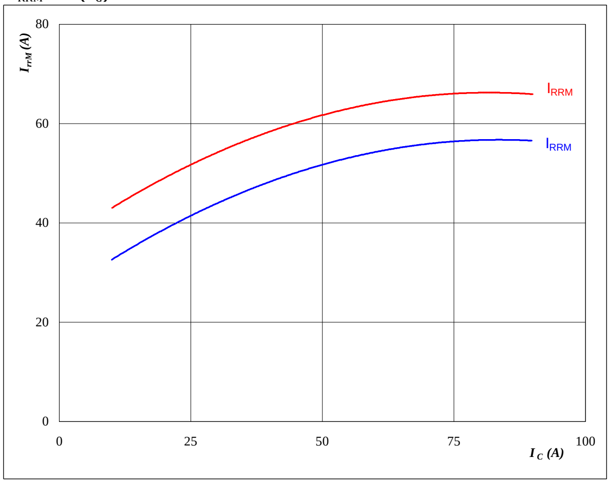
At

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

figure 15. **FWD**

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



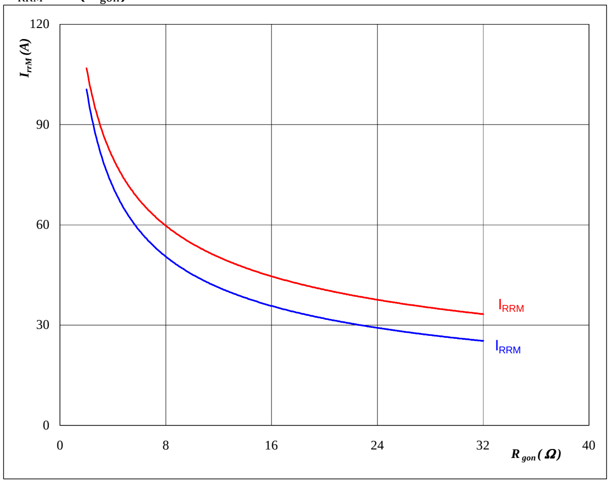
At

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

figure 16. **FWD**

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

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



At

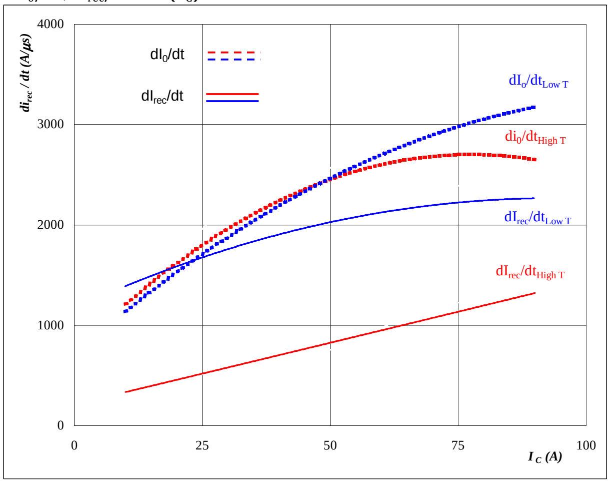
T_j = 25/150 °C
V_R = 600 V
I_F = 50 A
V_{GE} = ±15 V

Inverter Switch/Inverter Diode

figure 17.	FWD

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

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



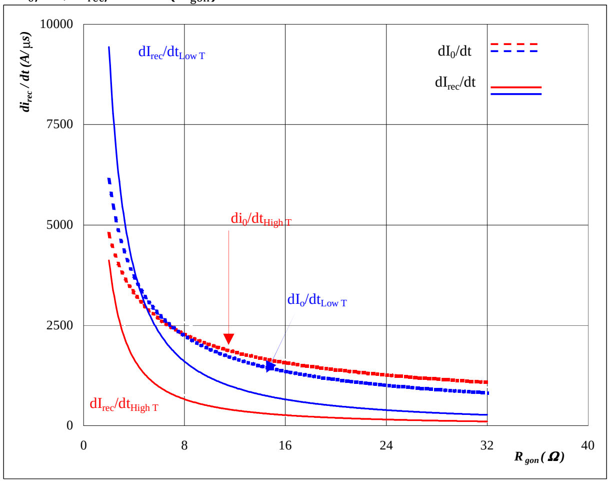
At

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

figure 18.	FWD

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

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



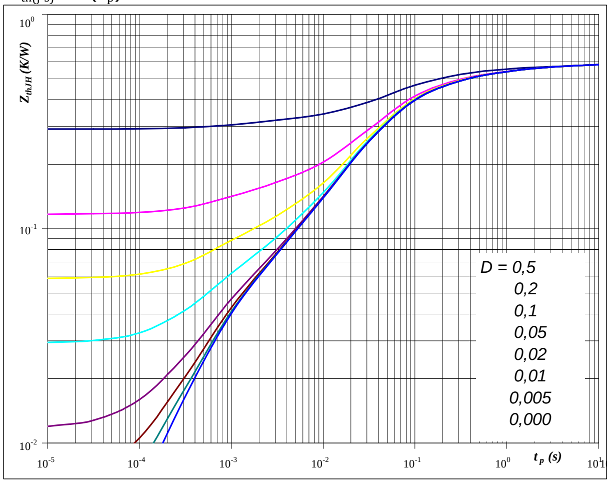
At

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

figure 19.	IGBT

IGBT transient thermal impedance as a function of pulse width

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



At

D =	t_p / T	
$R_{th(j-s)}$ =	0,58	K/W

IGBT thermal model values

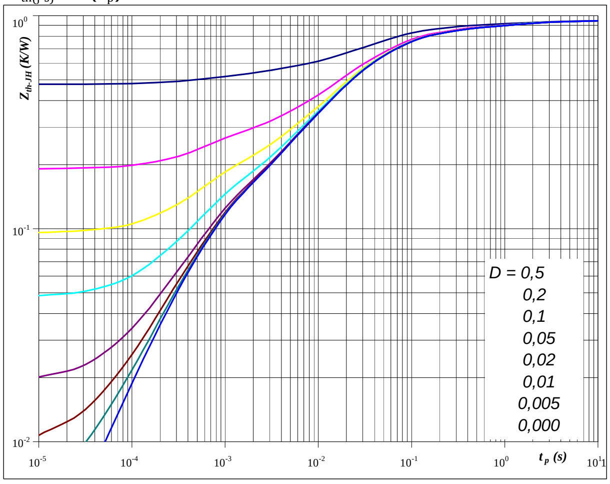
Phase-Change Material

R (K/W)	Tau (s)
6,70E-02	2,10E+00
1,25E-01	2,43E-01
2,70E-01	5,10E-02
7,97E-02	1,21E-02
4,11E-02	8,63E-04

figure 20.	FWD

FWD transient thermal impedance as a function of pulse width

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



At

D =	t_p / T	
$R_{th(j-s)}$ =	0,95	K/W

FWD thermal model values

Phase-Change Material

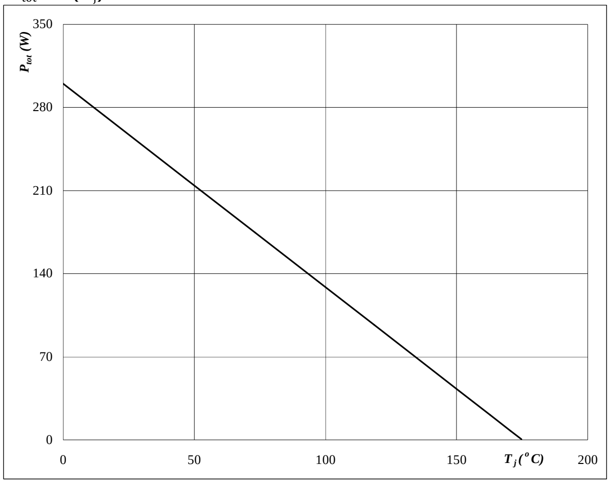
R (K/W)	Tau (s)
1,89E-02	9,45E+00
7,61E-02	1,26E+00
1,79E-01	1,49E-01
4,17E-01	3,08E-02
1,59E-01	7,12E-03
1,01E-01	6,22E-04

Inverter Switch/Inverter Diode

figure 21. **IGBT**

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_j)$



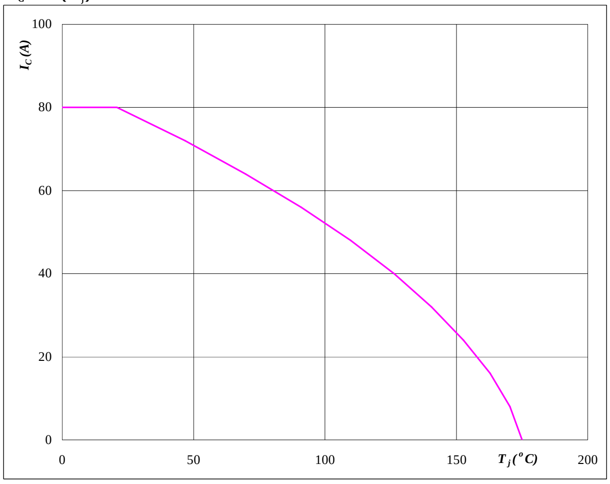
At

T_j =	175	°C

figure 22. **IGBT**

Collector current as a function of heatsink temperature

$I_C = f(T_j)$



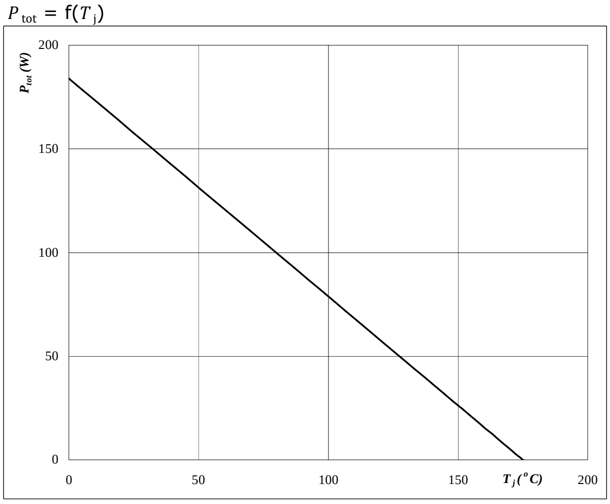
At

T_j =	175	°C
V_{GE} =	15	V

figure 23. **FWD**

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_j)$



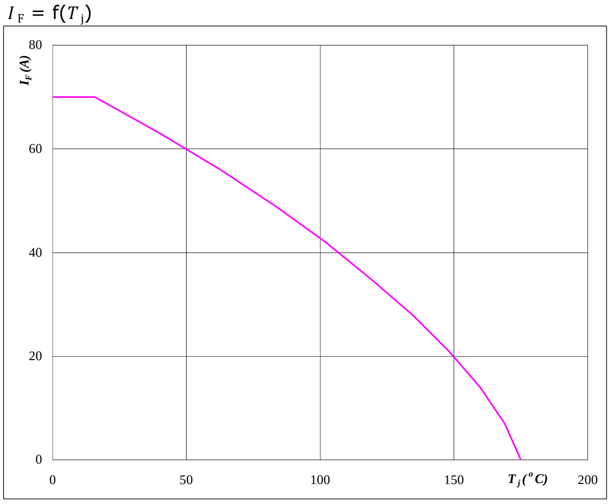
At

T_j =	175	°C

figure 24. **FWD**

Forward current as a function of heatsink temperature

$I_F = f(T_j)$



At

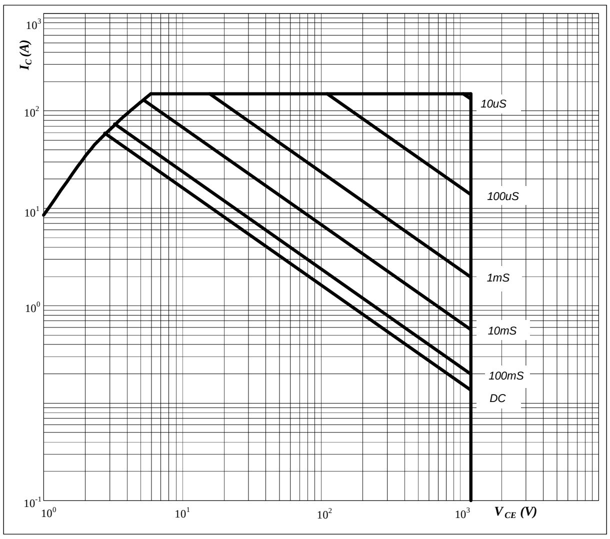
T_j =	175	°C

Inverter Switch/Inverter Diode

figure 25. **IGBT**

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$



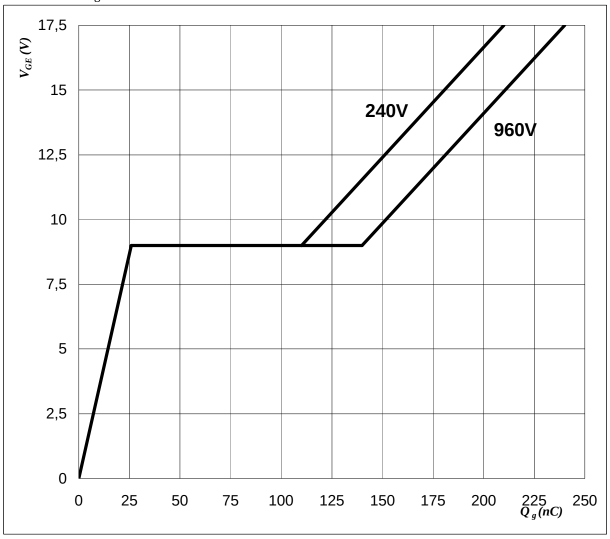
At

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

figure 26. **IGBT**

Gate voltage vs Gate charge

$V_{GE} = f(Q_g)$



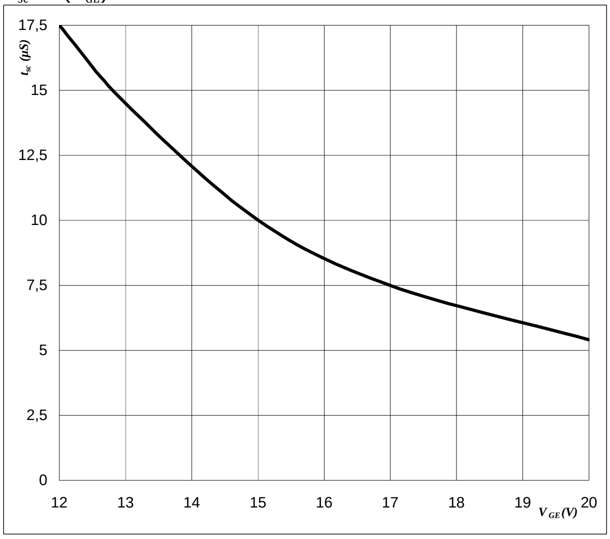
At

I_C =	50	A

figure 27. **IGBT**

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

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



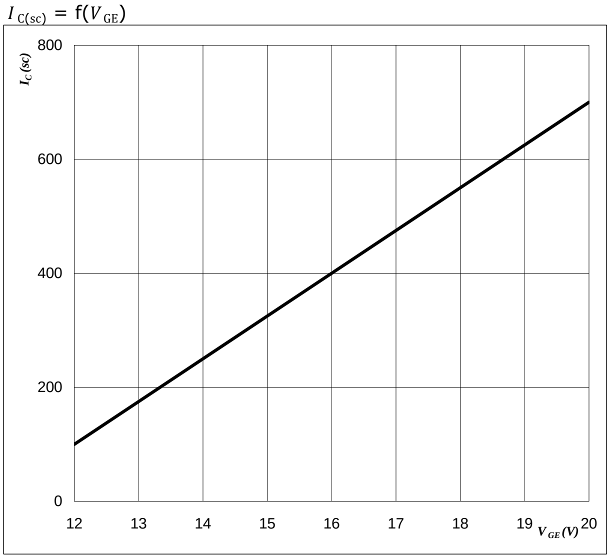
At

V_{CE} =	1200	V
T_j ≤	175	ºC

figure 28. **IGBT**

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

$I_{C(sc)} = f(V_{GE})$



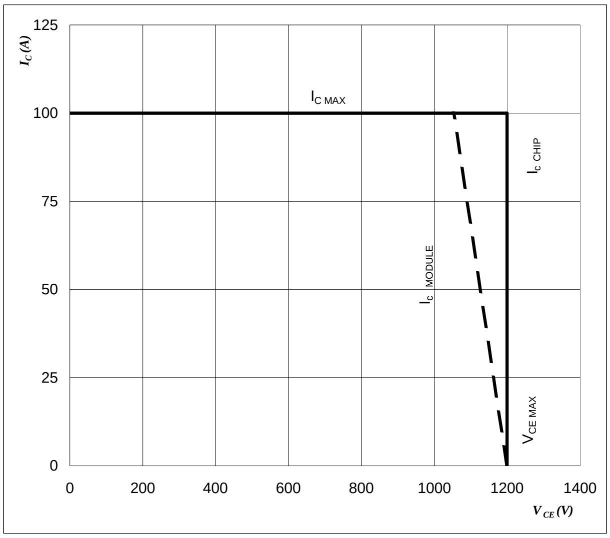
At

V_{CE} ≤	1200	V
T_j =	175	ºC

figure 29.	IGBT

Reverse bias safe operating area

$I_C = f(V_{CE})$



At

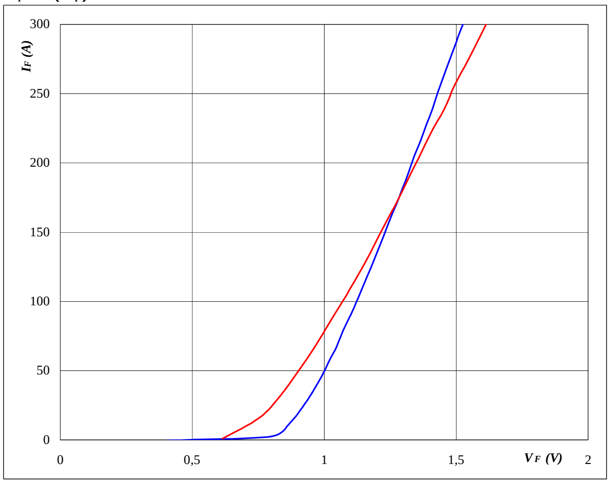
T_j =	150 °C
R_{gon} =	8 Ω
R_{goff} =	8 Ω

DC Blocking Diode

figure 1.	DC Blocking Diode

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

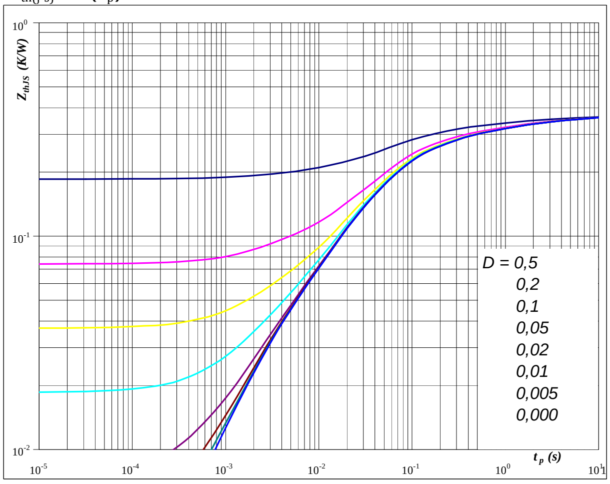
T_j = 25/125 °C

t_p = 250 μs

figure 2.	DC Blocking Diode

Diode transient thermal impedance as a function of pulse width

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



At

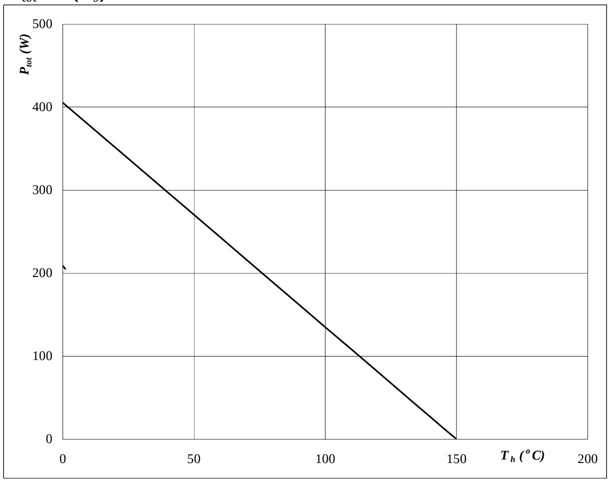
$D = t_p / T$

$R_{th(j-s)}$ = 0,37 K/W

figure 3.	DC Blocking Diode

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



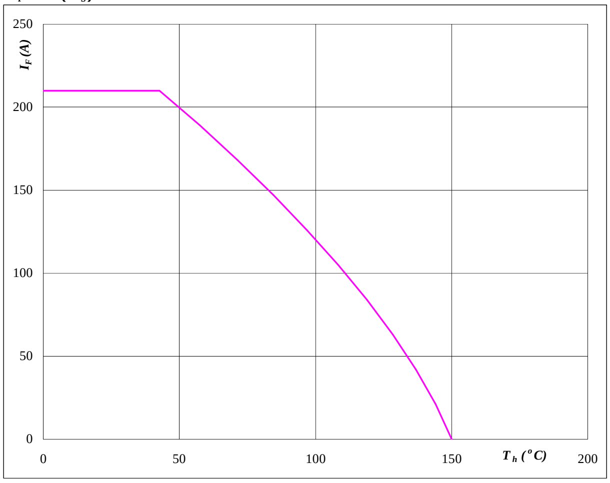
At

T_j = 150 ºC

figure 4.	DC Blocking Diode

Forward current as a function of heatsink temperature

$I_F = f(T_s)$



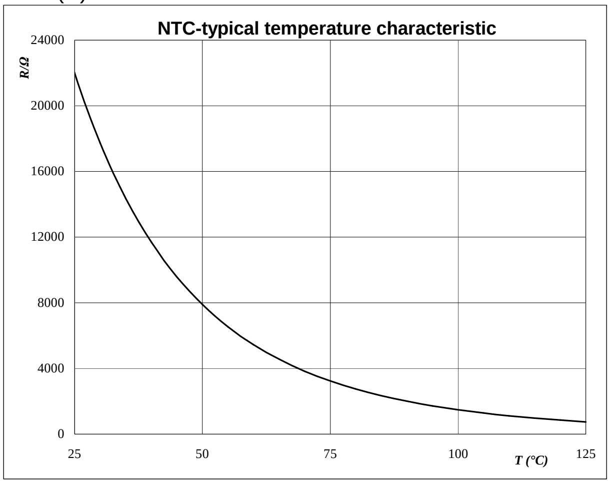
At

T_j = 150 ºC

Thermistor

figure 1.	Thermistor

Typical NTC characteristic
as a function of temperature
$R = \mathrm{f}(T)$



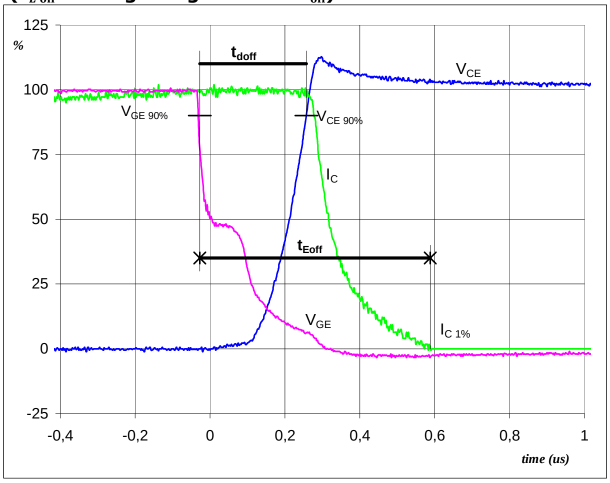
Switching Definitions Output Inverter

General conditions

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

figure 1. **IGBT**

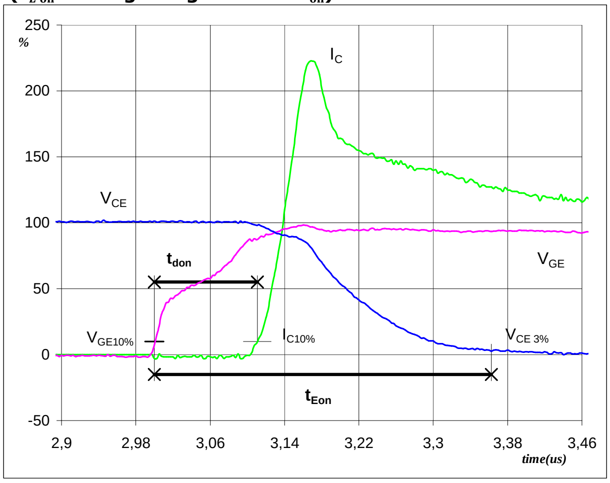
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
($t_{E\,off}$ = integrating time for E_{off})



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
$t_{E\,off}$ =	0,62	μs

figure 2. **IGBT**

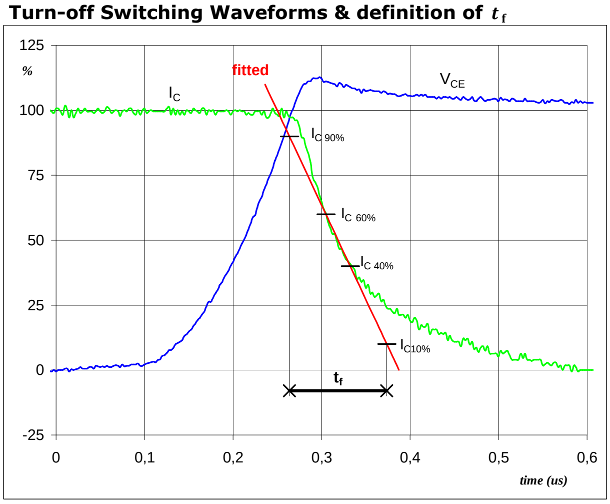
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
($t_{E\,on}$ = integrating time for E_{on})



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
$t_{E\,on}$ =	0,36	μs

figure 3. **IGBT**

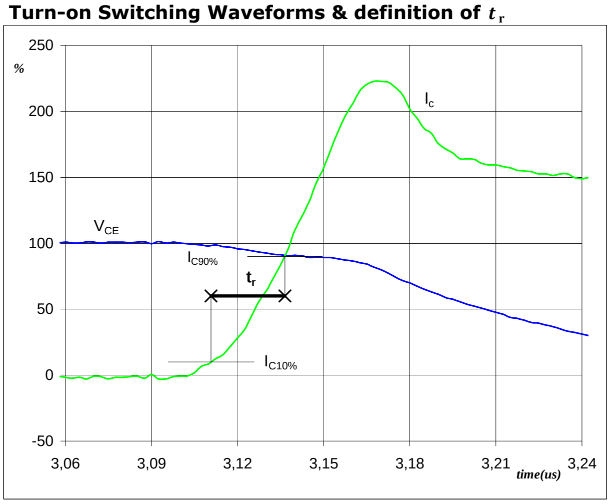
Turn-off Switching Waveforms & definition of t_f



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

figure 4. **IGBT**

Turn-on Switching Waveforms & definition of t_r

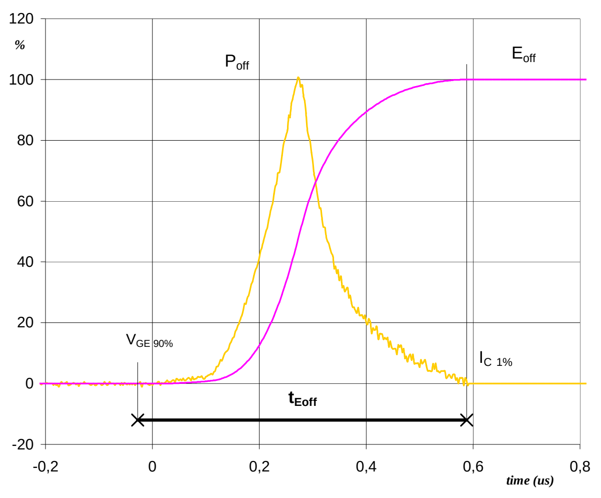


V_C (100%) =	600	V
I_C (100%) =	50	A
t_r =	0,03	μs

Switching Definitions Output Inverter

figure 5. **IGBT**

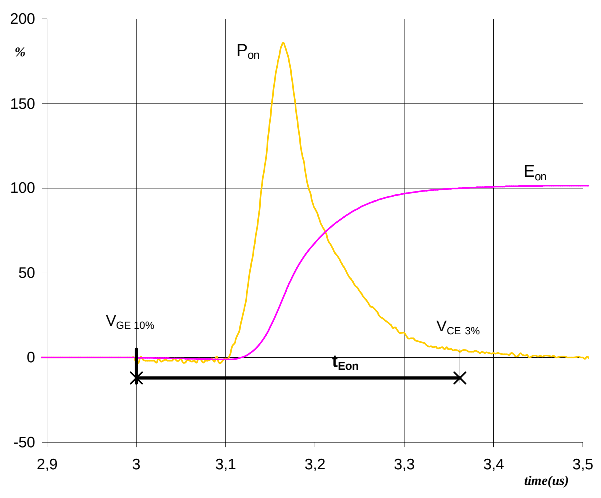
Turn-off Switching Waveforms & definition of t_{Eoff}



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

figure 6. **IGBT**

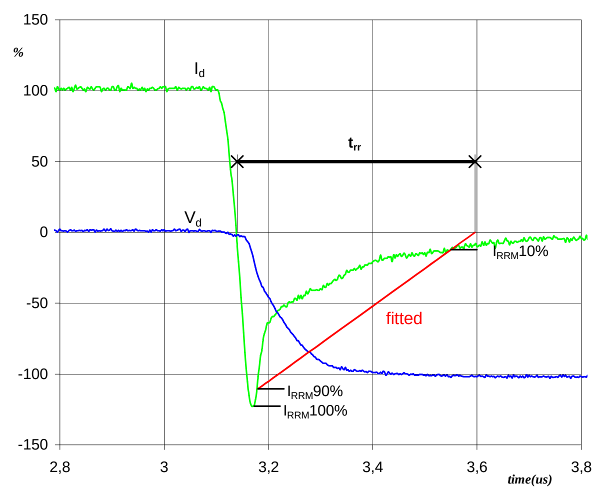
Turn-on Switching Waveforms & definition of t_{Eon}



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

figure 7. **FWD**

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

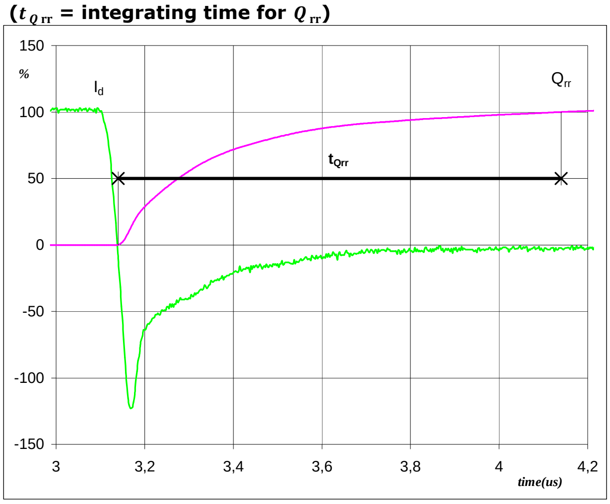


V_d (100%) =	600	V
I_d (100%) =	50	A
I_{RRM} (100%) =	-62	A
t_{rr} =	0,44	μs

Switching Definitions Output Inverter

figure 8. **FWD**

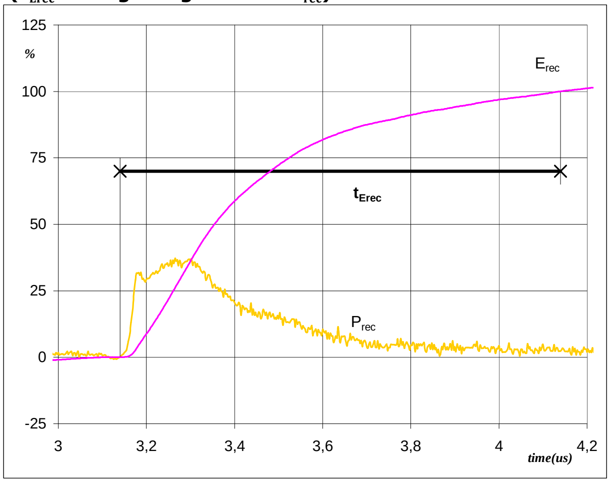
Turn-on Switching Waveforms & definition of t_{Qrr}
($t_{Q\,rr}$ = integrating time for Q_{rr})



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

figure 9. **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
$t_{E\,rec}$ =	1,00	μs

Ordering Code & Marking

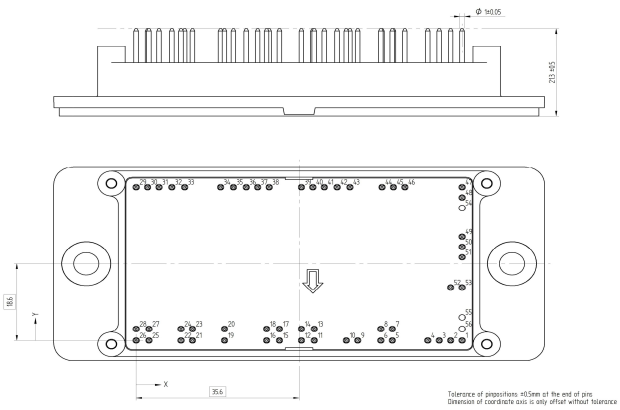
Version	Ordering Code
without thermal paste 17 mm housing with solder pins with thermistor	30-F212R6A050SC-M447E
with thermal paste 17 mm housing with solder pins with thermistor	30-F212R6A050SC-M447E-/3/
without thermal paste 17 mm housing with solder pins without thermistor	30-F212R6A050SC01-M447E10
with thermal paste 17 mm housing with solder pins without thermistor	30-F212R6A050SC01-M447E10-/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	TTTTTTTVV	LLLLL	SSSS	WWYY		

Outline

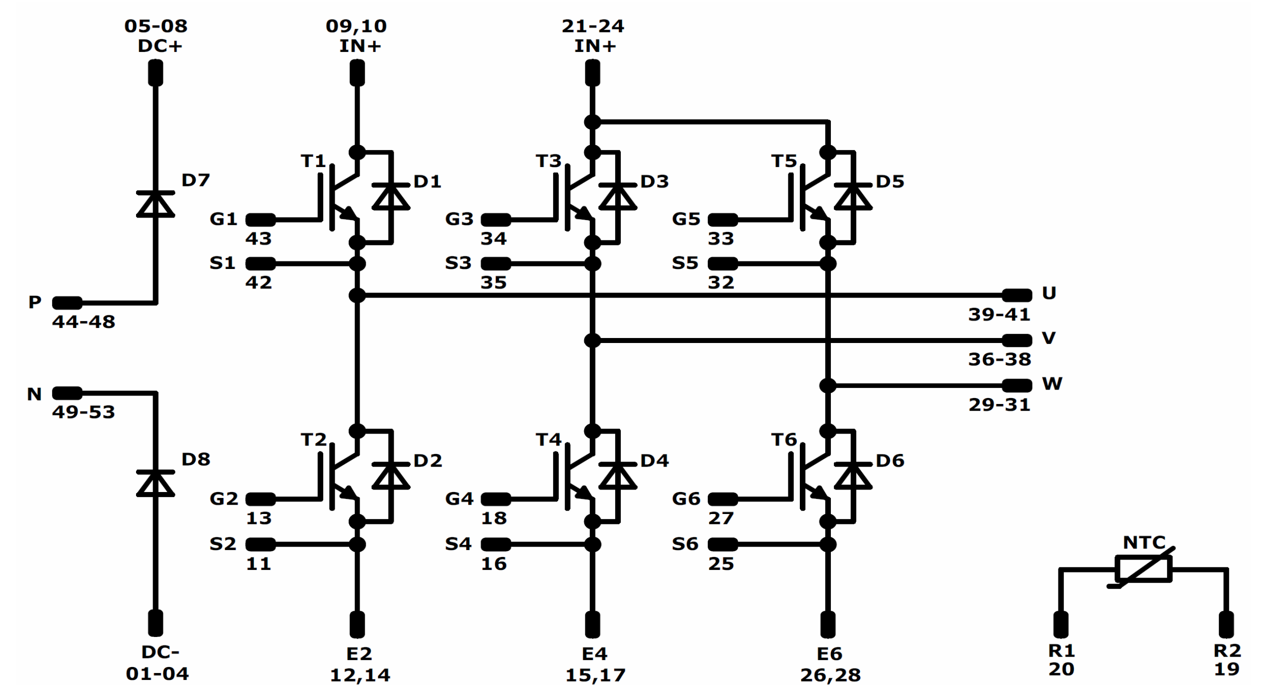
Pin table [mm]			
Pin	X	Y	Function
1	71,2	0	DC-
2	68,7	0	DC-
3	66,2	0	DC-
4	63,7	0	DC-
5	55,95	0	DC+
6	53,45	0	DC+
7	55,95	2,8	DC+
8	53,45	2,8	DC+
9	48,4	0	IN+
10	45,9	0	IN+
11	38,9	0	S2
12	36,1	0	E2
13	38,9	2,8	G2
14	36,1	2,8	E2
15	31,3	0	E4
16	28,5	0	S4
17	31,3	2,8	E4
18	28,5	2,8	G4
19*	19,3	0	R2
20*	19,3	2,8	R1
21	12,3	0	IN+
22	9,8	0	IN+
23	12,3	2,8	IN+
24	9,8	2,8	IN+
25	2,8	0	S6
26	0	0	E6
27	2,8	2,8	G6
28	0	2,8	E6
29	0	37,2	W
30	2,5	37,2	W

Pin table [mm]			
Pin	X	Y	Function
31	5	37,2	W
32	7,8	37,2	S5
33	10,6	37,2	G5
34	18,45	37,2	G3
35	21,25	37,2	G3
36	24,05	37,2	V
37	26,55	37,2	V
38	29,05	37,2	V
39	36,1	37,2	U
40	38,6	37,2	U
41	41,1	37,2	U
42	43,9	37,2	S1
43	46,7	37,2	G1
44	53,7	37,2	P
45	56,2	37,2	P
46	58,7	37,2	P
47	71,2	37,2	P
48	71,2	34,7	P
49	71,2	25,2	N
50	71,2	22,7	N
51	71,2	20,2	N
52	68,7	12,8	N
53	71,2	12,8	N
54	Not assembled		
55			
56			



* Not assembled in 30-F212R6A050SC01-M447E10

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	NTC			Thermistor	Not assembled in 30-F212R6A050SC01-M447E10

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-F212R6A050SCx-M447Ex-D5-14	20 Feb. 2019	flow2 frame modification	1,17