flow PACK 2 — 1200 V/50 A

Features

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

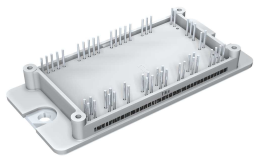
Target Applications

- Power Regeneration

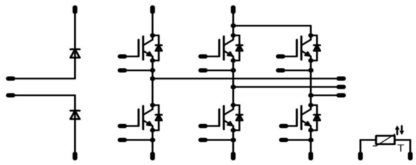
Types

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

flow 2 housing



Schematic



Maximum Ratings

T_j=25℃, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
D7a,b-D8a,b				
Repetitive peak reverse voltage	V_{RRM}		1600	V
DC forward current	I_{FAV}	$T_j=T_j$max T_h=80℃ T_c=80℃	154 208	A
Surge forward current	I_{FSM}	t_p=10ms T_j=25℃	1270	A
I2t-value	I^2t		2400	A^2s
Power dissipation per Diode	P_{tot}	$T_j=T_j$max T_h=80℃ T_c=80℃	189 287	W
Maximum Junction Temperature	$T_j$max		150	℃
T1a-b,T2a-b,T3a-b,T4a-b,T5a-b,T6a-b				
Collector-emitter break down voltage	V_{CE}		1200	V
DC collector current	I_C	$T_j=T_j$max T_h=80℃ T_c=80℃	59 76	A
Pulsed collector current	I_{Cpulse}	t_p limited by $T_j$max	150	A
Turn off safe operating area		VCE ≤ 1200V, Tj ≤ Top max	100	A
Power dissipation per IGBT	P_{tot}	$T_j=T_j$max T_h=80℃ T_c=80℃	163 247	W
Gate-emitter peak voltage	V_{GE}		20	V
Short circuit ratings	t_{SC} V_{CC}	T_j≤150℃ V_{GE}=15V	10 800	µs V
Maximum Junction Temperature	$T_j$max		175	℃

Maximum Ratings

T_j=25℃, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
D1,D2,D3,D4,D5,D6					
Peak Repetitive Reverse Voltage	V_{RRM}			1200	V
DC forward current	I_F	$T_j=T_j max$	T_h=80℃ T_c=80℃	49 64	A
Repetitive peak forward current	I_{FRM}	t_p limited by $T_j max$		70	A
Power dissipation per Diode	P_{tot}	$T_j=T_j max$	T_h=80℃ T_c=80℃	100 151	W
Maximum Junction Temperature	$T_j max$			175	℃
Thermal Properties					
Storage temperature	T_{stg}			-40…+125	℃
Operation temperature under switching condition	T_{op}			-40…+(Tjmax - 25)	℃
Insulation Properties					
Insulation voltage	V_{is}	t=2s	DC voltage	4000	V
Creepage distance				min 12,7	mm
Clearance				min 12,7	mm
Comparative tracking index	CTI			>200	

Characteristic Values

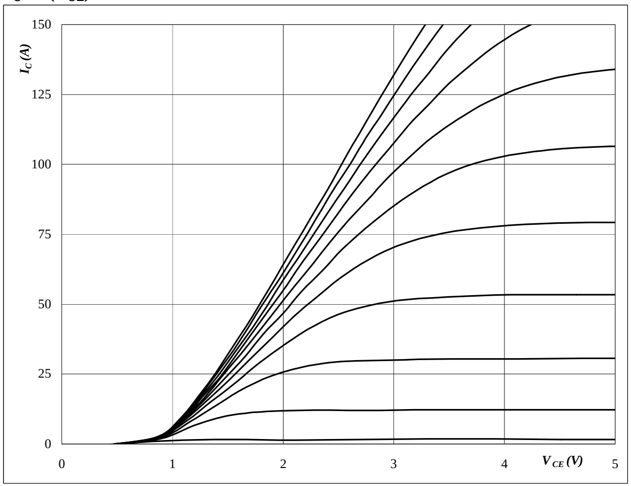
Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] or V_{GS} [V]	V_r [V] or V_{CE} [V] or V_{DS} [V]	I_C [A] or I_F [A] or I_D [A]	T_j	Min	Typ	Max	
D7a,b-D8a,b										
Forward voltage	V_F				100	Tj=25℃ Tj=150℃		1,12 1,07	1,21	V
Threshold voltage (for power loss calc. only)	V_{to}				100	Tj=25℃ Tj=150℃		0,89 0,76		V
Slope resistance (for power loss calc. only)	r_t				100	Tj=25℃ Tj=150℃		2 3		mΩ
Reverse current	I_r			1600		Tj=25℃ Tj=150℃			0,05	mA
Thermal resistance chip to heatsink per chip	R_{thJH}	Phase-Change Material						0,37		K/W
Thermal resistance chip to heatsink per chip	R_{thJC}							0,24		
T1a-b,T2a-b,T3a-b,T4a-b,T5a-b,T6a-b										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE}=V_{GE}$			0,0017	Tj=25℃ Tj=150℃	5	5,8	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		50	Tj=25℃ Tj=150℃	1,6	1,86 2,3	2,1	V
Collector-emitter cut-off current incl. Diode	I_{CES}		0	1200		Tj=25℃ Tj=150℃			0,018	mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25℃ Tj=150℃			600	nA
Integrated Gate resistor	R_{gint}							4		Ω
Turn-on delay time	$t_{d(on)}$	Rgoff=8 Ω Rgon=8 Ω	±15	600	50	Tj=25℃ Tj=150℃		106 110		ns
Rise time	t_r					Tj=25℃ Tj=150℃		23 26		
Turn-off delay time	$t_{d(off)}$					Tj=25℃ Tj=150℃		210 287		
Fall time	t_f					Tj=25℃ Tj=150℃		61 116		
Turn-on energy loss per pulse	E_{on}					Tj=25℃ Tj=150℃		2,97 4,44		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25℃ Tj=150℃		2,55 4,54		
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25℃		2770		pF
Output capacitance	C_{oss}							205		
Reverse transfer capacitance	C_{rss}							160		
Gate charge	Q_{Gate}		±15	960	50	Tj=25℃		240		nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Phase-Change Material						0,58		K/W
Thermal resistance chip to case per chip	R_{thJC}							0,38		
D1,D2,D3,D4,D5,D6										
Diode forward voltage	V_F				35	Tj=25℃ Tj=150℃	1,35	1,76 1,7	2,05	V
Peak reverse recovery current	I_{RRM}	Rgon=8 Ω	±15	600	50	Tj=25℃ Tj=150℃		52,29 61,9		A
Reverse recovery time	t_{rr}					Tj=25℃ Tj=150℃		267 439,5		ns
Reverse recovered charge	Q_{rr}					Tj=25℃ Tj=150℃		4,3 8,86		µC
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25℃ Tj=150℃		2183 758		A/µs
Reverse recovered energy	Erec					Tj=25℃ Tj=150℃		1,67 3,66		mWs
Thermal resistance chip to heatsink per chip	R_{thJH}	Phase-Change Material						0,95		K/W
Thermal resistance chip to case per chip	R_{thJC}							0,63		
Thermistor										
Rated resistance	R					T=25℃		22000		Ω
Deviation of R100	ΔR/R	R100=1486 Ω				T=100℃	-12		14	%
Power dissipation	P					T=25℃		200		mW
Power dissipation constant						T=25℃		2		mW/K
B-value	$B_{(25/50)}$	Tol. ±3%				T=25℃		3950		K
B-value	$B_{(25/100)}$	Tol. ±3%				T=25℃		3998		K
Vincotech NTC Reference									B	

T1,T2,T3,T4,T5,T6/D1,D2,D3,D4,D5,D6

Figure 1 T1,T2,T3,T4,T5,T6 IGBT

Typical output characteristics

$I_C = f(V_{CE})$



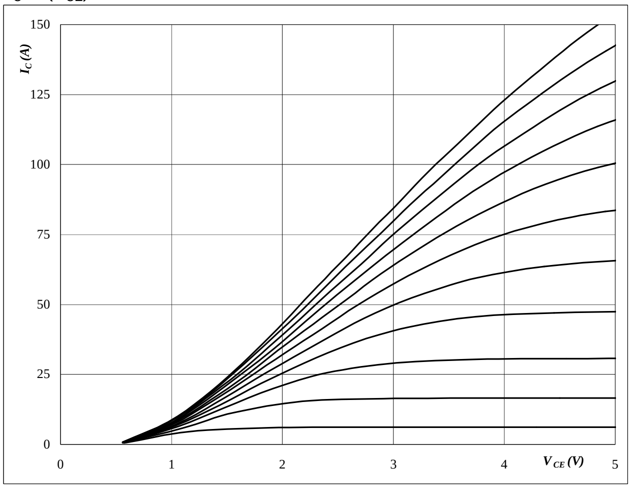
At

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

Figure 2 T1,T2,T3,T4,T5,T6 IGBT

Typical output characteristics

$I_C = f(V_{CE})$



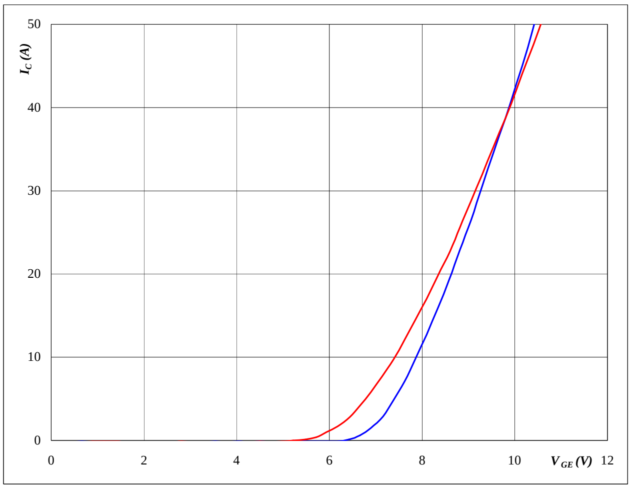
At

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

Figure 3 T1,T2,T3,T4,T5,T6 IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$



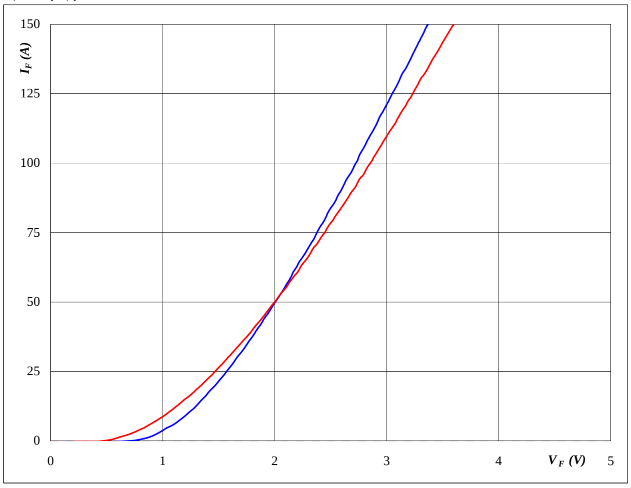
At

Tj =	25/150	℃
t_p =	250	μs
V_{CE} =	10	V

Figure 4 D1,D2,D3,D4,D5,D6 FWD

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

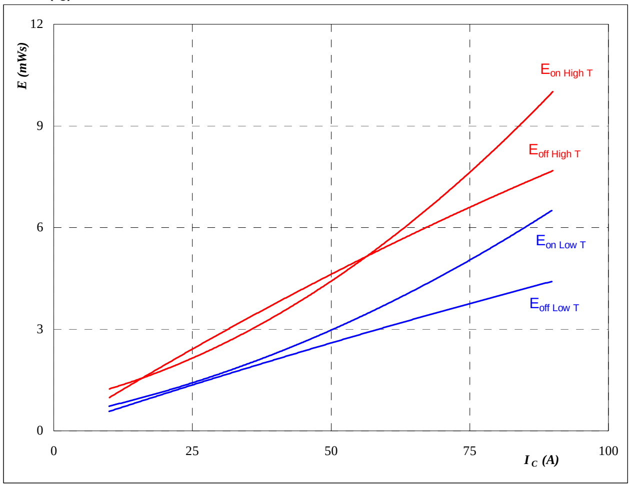
Tj =	25/150	℃
t_p =	250	μs

T1,T2,T3,T4,T5,T6/D1,D2,D3,D4,D5,D6

Figure 5 T1,T2,T3,T4,T5,T6 IGBT

Typical switching energy losses as a function of collector current

E = f(I_C)



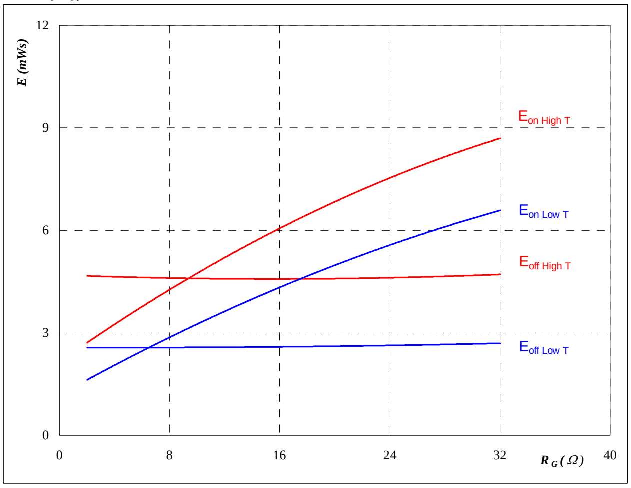
With an inductive load at

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

Figure 6 T1,T2,T3,T4,T5,T6 IGBT

Typical switching energy losses as a function of gate resistor

E = f(R_G)



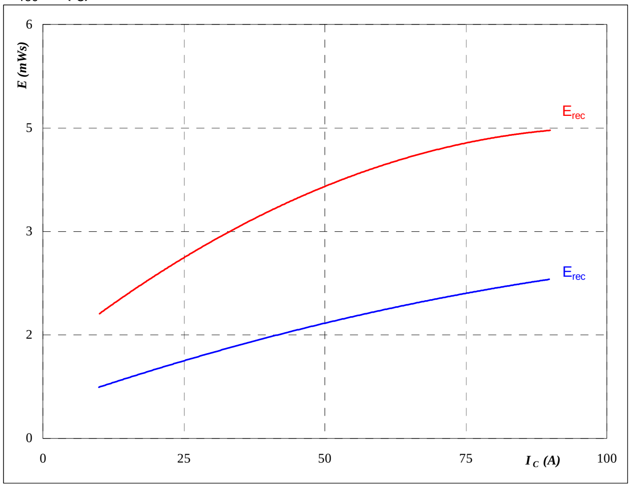
With an inductive load at

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

Figure 7 D1,D2,D3,D4,D5,D6 FWD

Typical reverse recovery energy loss as a function of collector current

E_{rec} = f(I_C)



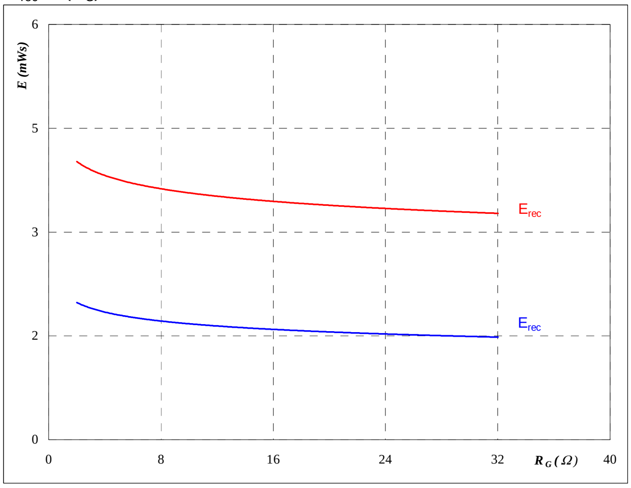
With an inductive load at

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

Figure 8 D1,D2,D3,D4,D5,D6 FWD

Typical reverse recovery energy loss as a function of gate resistor

E_{rec} = f(R_G)



With an inductive load at

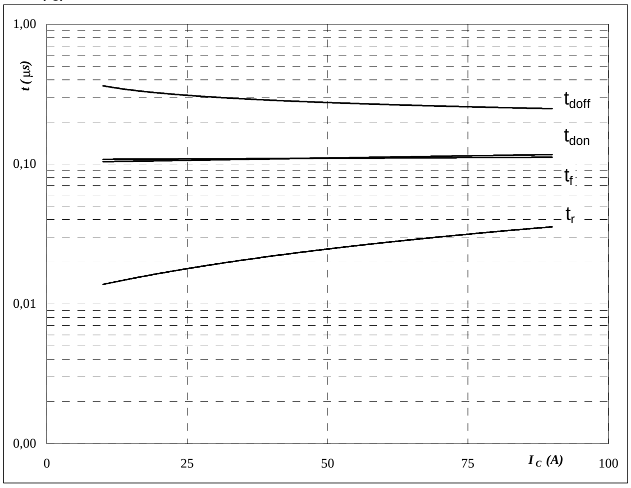
T_j =	25/150	℃
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	50	A

T1,T2,T3,T4,T5,T6/D1,D2,D3,D4,D5,D6

Figure 9 T1,T2,T3,T4,T5,T6 IGBT

Typical switching times as a function of collector current

t = f(I_C)



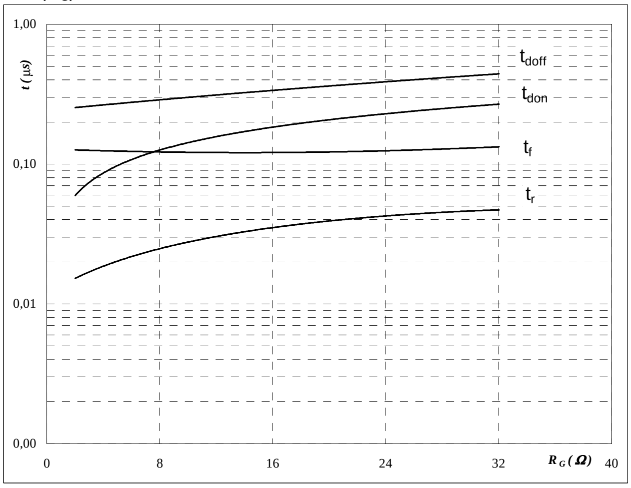
With an inductive load at

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

Figure 10 T1,T2,T3,T4,T5,T6 IGBT

Typical switching times as a function of gate resistor

t = f(R_G)



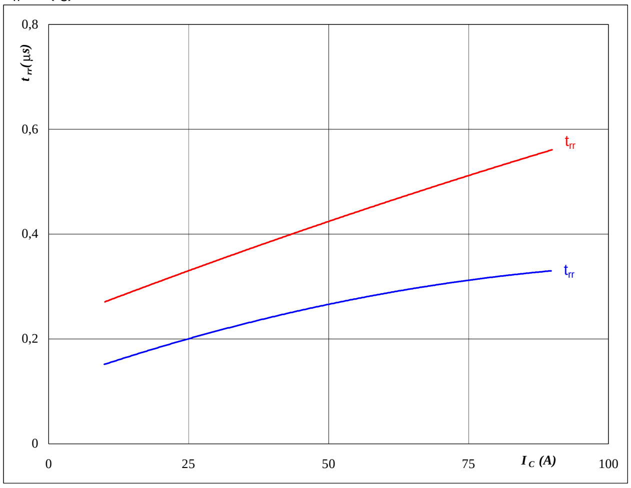
With an inductive load at

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

Figure 11 D1,D2,D3,D4,D5,D6 FWD

Typical reverse recovery time as a function of collector current

t_{rr} = f(I_C)



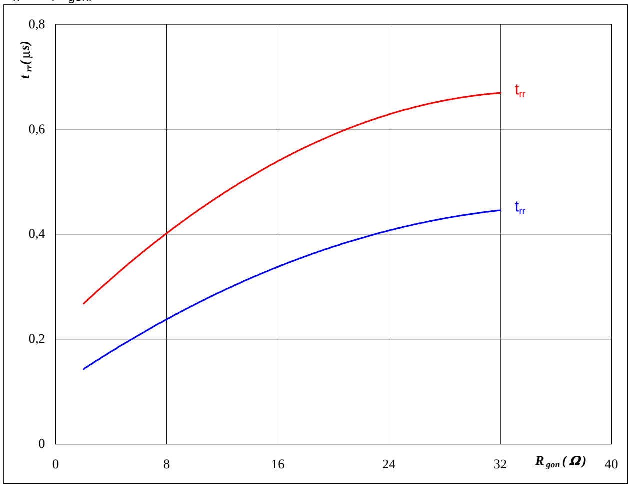
At

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

Figure 12 D1,D2,D3,D4,D5,D6 FWD

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

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



At

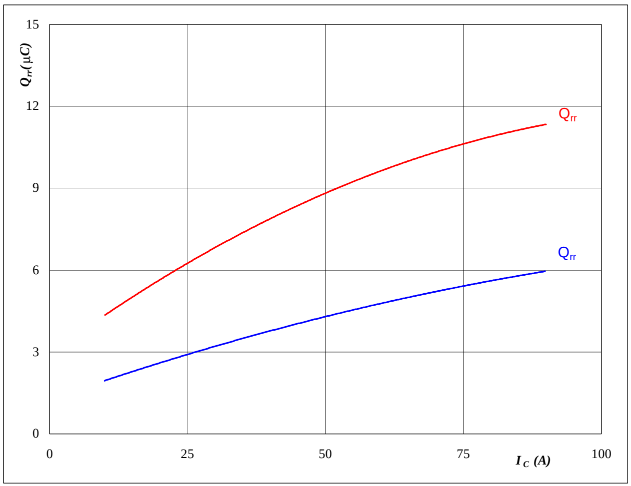
T_j =	25/150	℃
V_R =	600	V
I_F =	50	A
V_{GE} =	±15	V

T1,T2,T3,T4,T5,T6/D1,D2,D3,D4,D5,D6

Figure 13 D1,D2,D3,D4,D5,D6 FWD

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



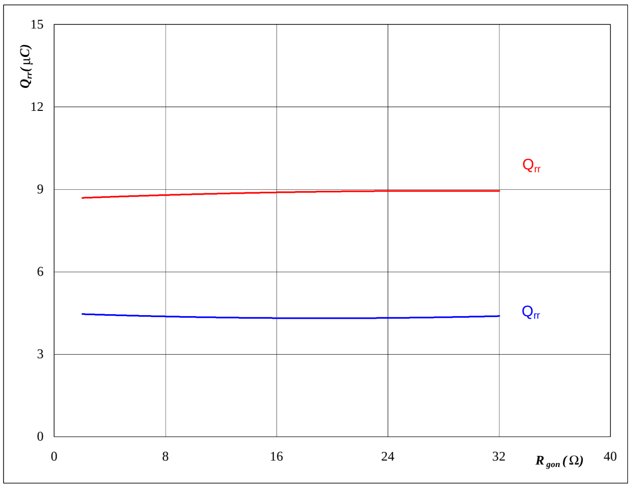
At

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

Figure 14 D1,D2,D3,D4,D5,D6 FWD

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

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



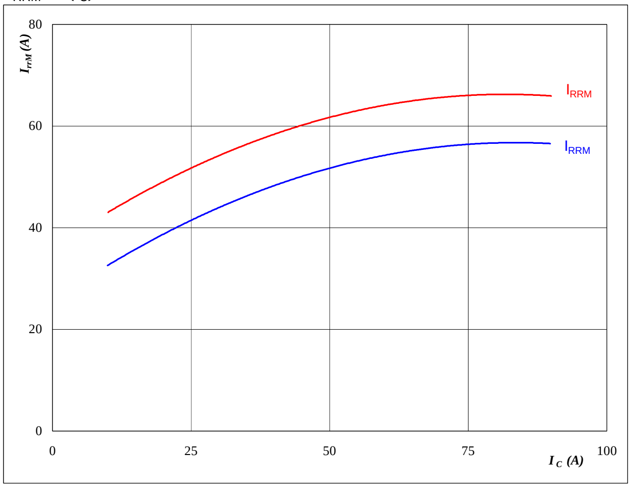
At

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

Figure 15 D1,D2,D3,D4,D5,D6 FWD

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



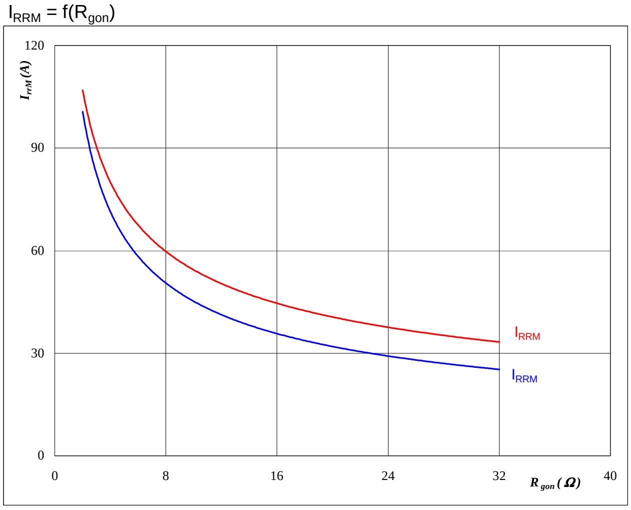
At

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

Figure 16 D1,D2,D3,D4,D5,D6 FWD

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

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



At

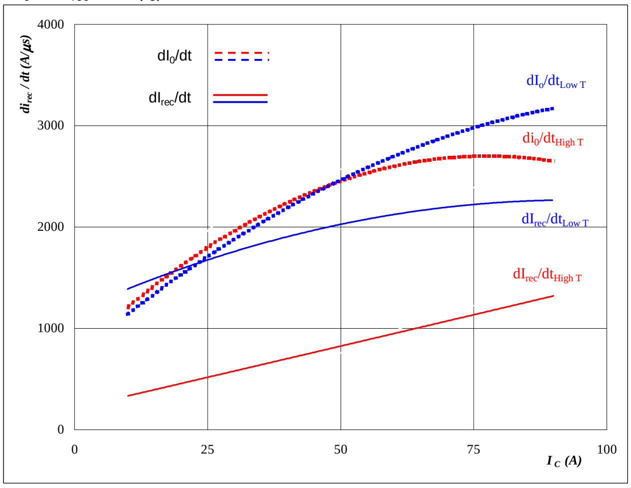
T_j =	25/150	℃
V_R =	600	V
I_F =	50	A
V_{GE} =	±15	V

T1,T2,T3,T4,T5,T6/D1,D2,D3,D4,D5,D6

Figure 17 D1,D2,D3,D4,D5,D6 FWD

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

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



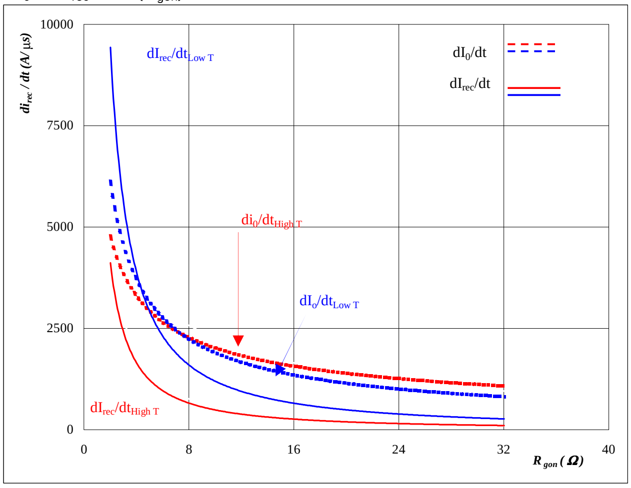
At

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

Figure 18 D1,D2,D3,D4,D5,D6 FWD

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

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



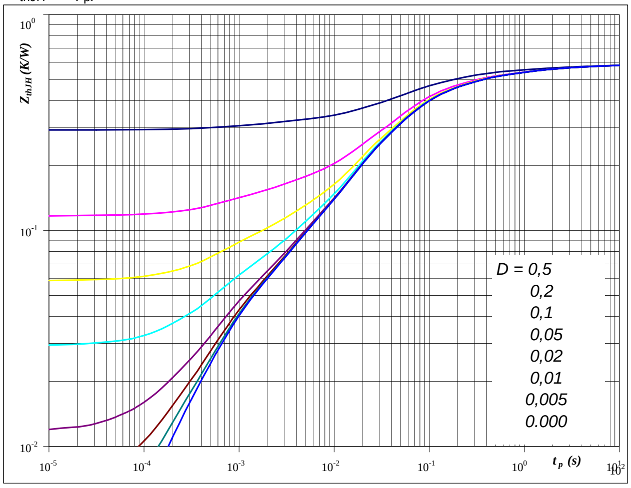
At

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

Figure 19 T1,T2,T3,T4,T5,T6 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

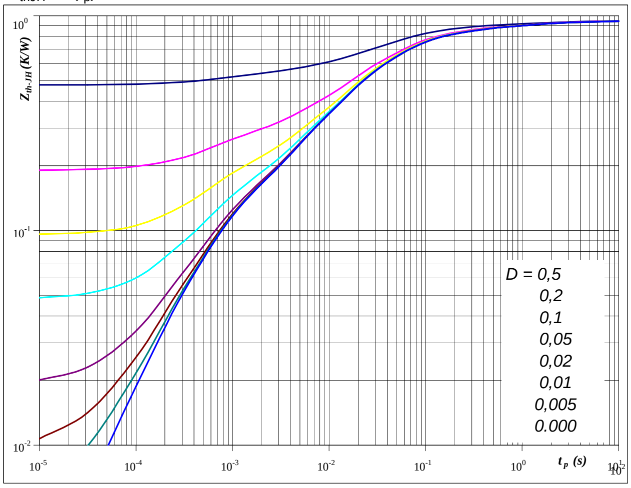
Phase-Change Material

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 D1,D2,D3,D4,D5,D6 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

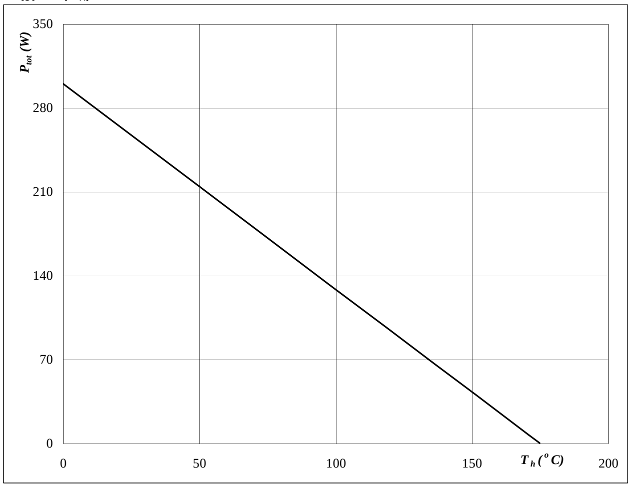
R (C/W)	Tau (s)
0,02	9,45
0,08	1,26
0,18	0,15
0,42	0,03
0,16	0,01
0,10	0,00

T1,T2,T3,T4,T5,T6/D1,D2,D3,D4,D5,D6

Figure 21 T1,T2,T3,T4,T5,T6 IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



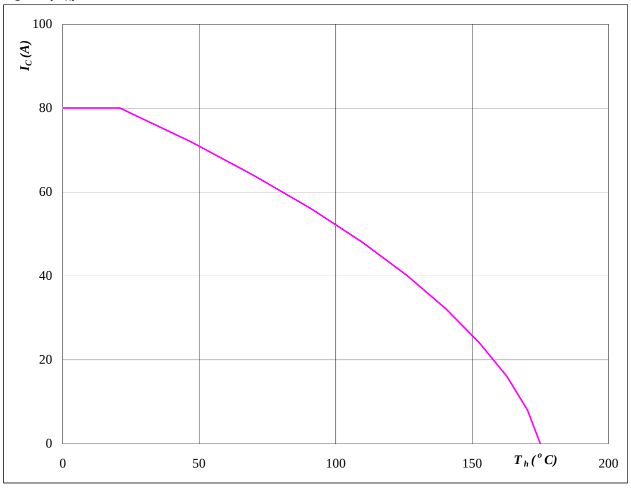
At

T_j = 175 ℃

Figure 22 T1,T2,T3,T4,T5,T6 IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



At

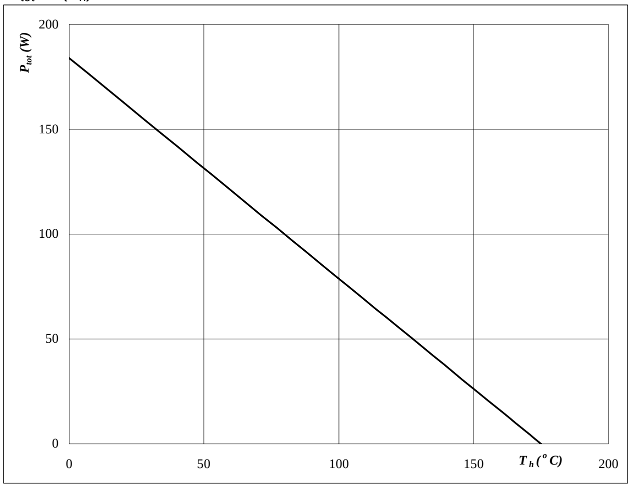
T_j = 175 ℃

V_{GE} = 15 V

Figure 23 D1,D2,D3,D4,D5,D6 FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



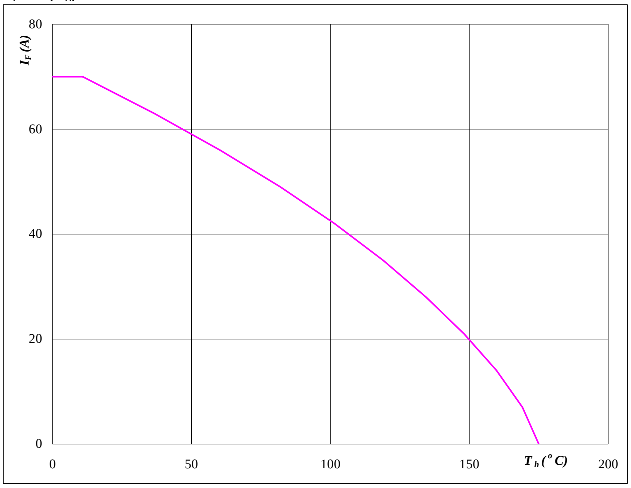
At

T_j = 175 ℃

Figure 24 D1,D2,D3,D4,D5,D6 FWD

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

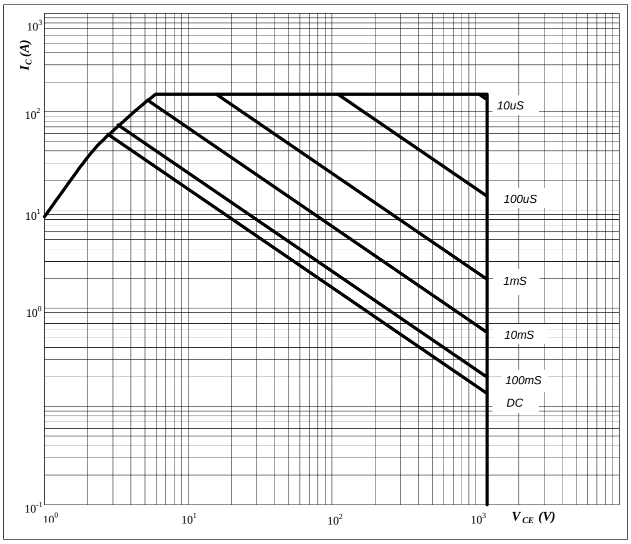
T_j = 175 ℃

T1,T2,T3,T4,T5,T6/D1,D2,D3,D4,D5,D6

Figure 25 T1,T2,T3,T4,T5,T6 IGBT

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$

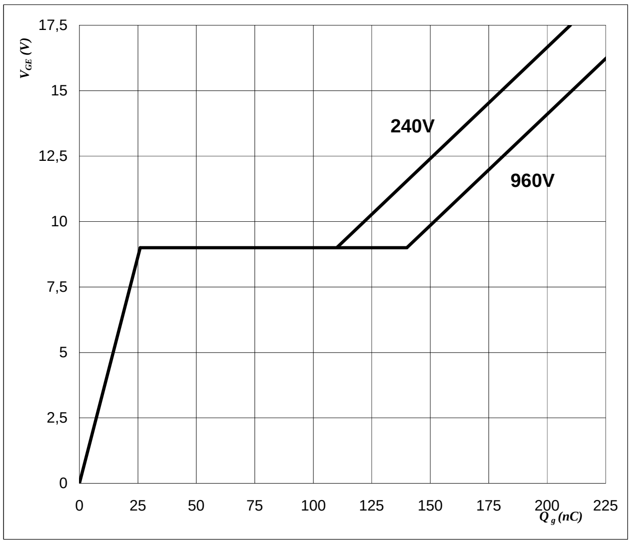


At		
D =	single pulse	
T_h =	80	ºC
V_{GE} =	±15	V
T_j =	T_{jmax}	ºC

Figure 26 T1,T2,T3,T4,T5,T6 IGBT

Gate voltage vs Gate charge

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

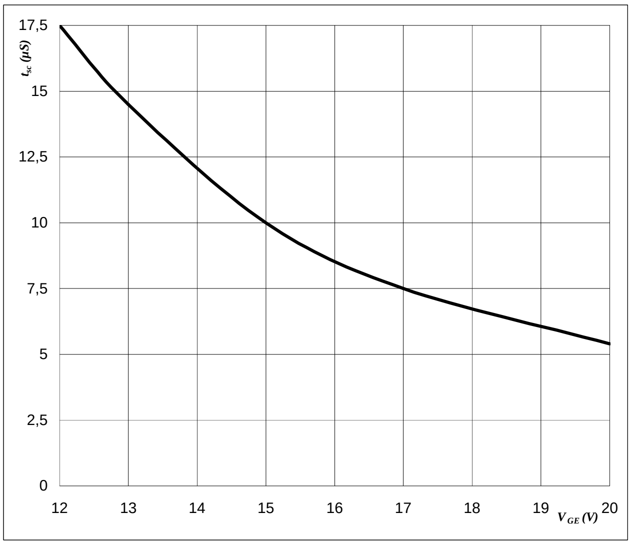


At		
I_C =	50	A

Figure 27 T1,T2,T3,T4,T5,T6 IGBT

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

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

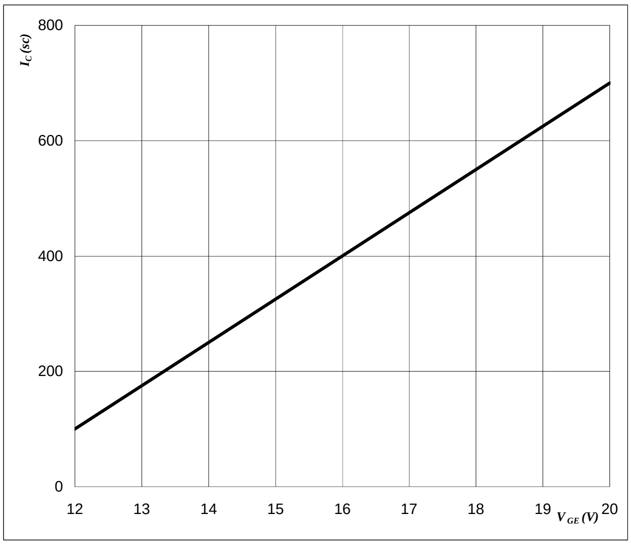


At		
V_{CE} =	1200	V
T_j ≤	175	ºC

Figure 28 T1,T2,T3,T4,T5,T6 IGBT

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

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

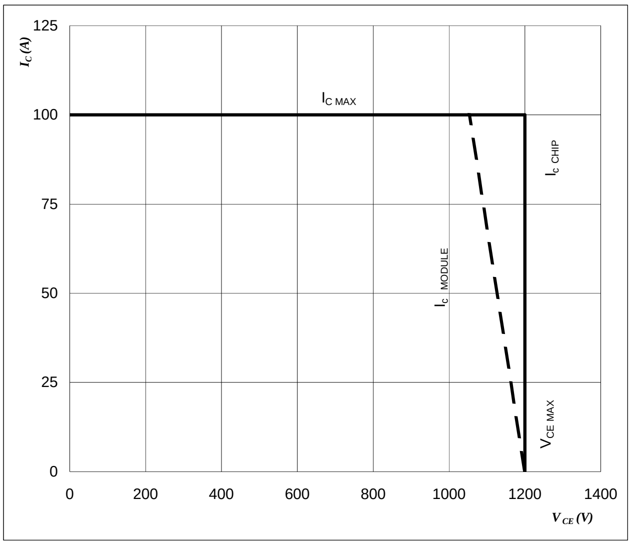


At		
V_{CE} ≤	1200	V
T_j =	175	ºC

Figure 29	T1,T2,T3,T4,T5,T6 IGBT

Reverse bias safe operating area

$I_C = f(V_{CE})$



At

T_j = 150 ℃

Rgon = 8 Ω

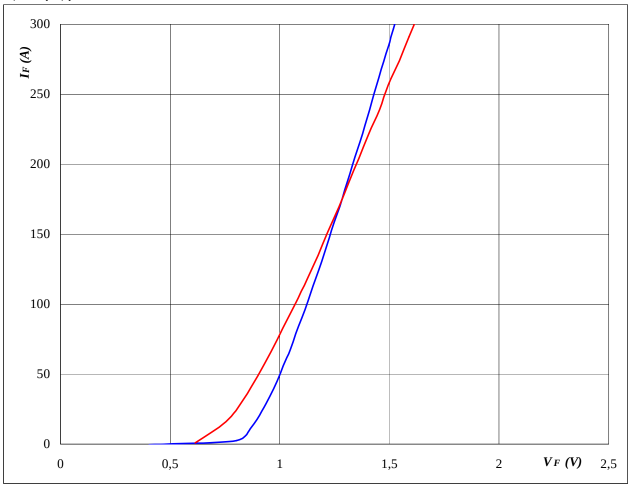
Rgoff = 8 Ω

D7a-b,D8a-b

Figure 1 D7a-b,D8a-b

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



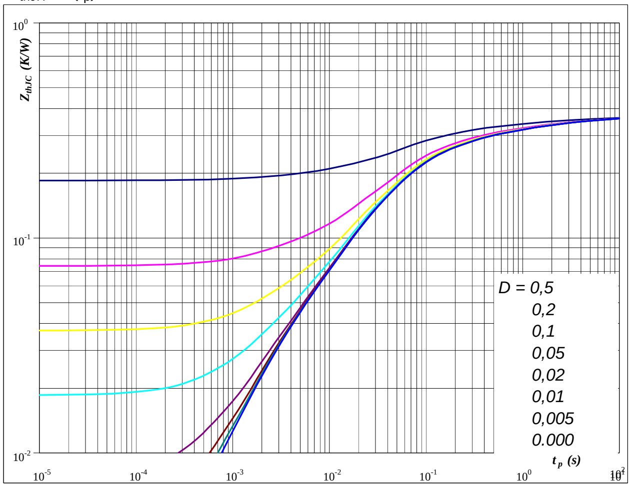
At

Tj =	25/125	℃
t_p =	250	µs

Figure 2 D7a-b,D8a-b

Diode transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



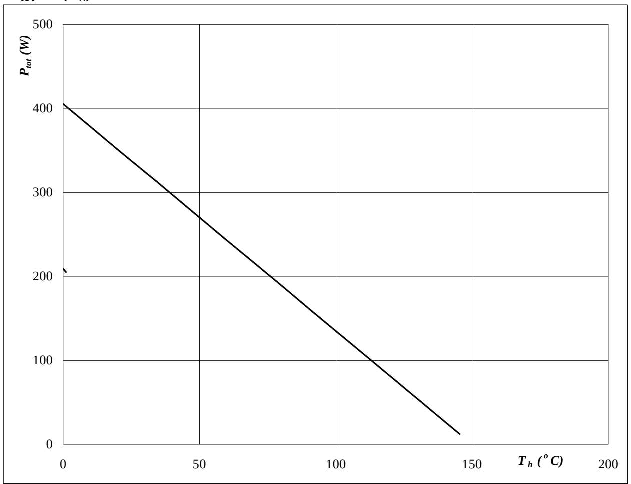
At

D =	t_p / T	
R_{thJH} =	0,370	K/W

Figure 3 D7a-b,D8a-b

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



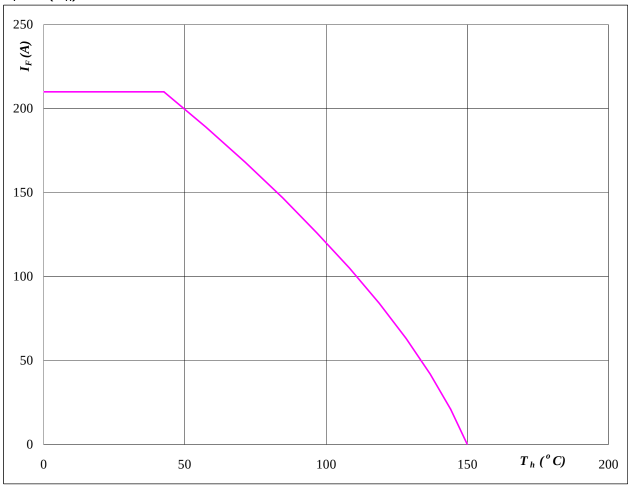
At

T_j = 150 ºC

Figure 4 D7a-b,D8a-b

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



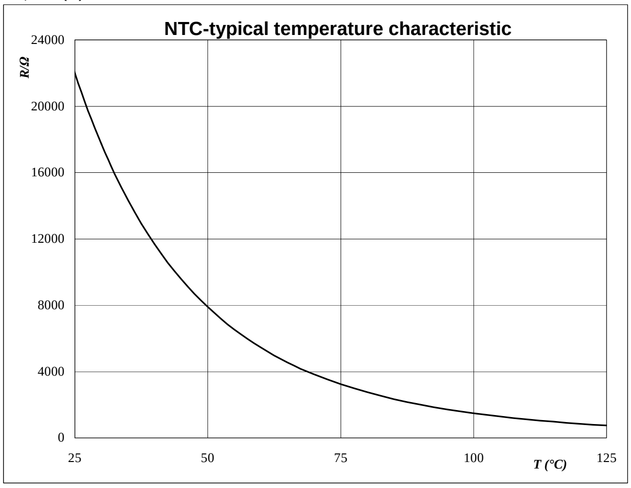
At

T_j = 150 ºC

Thermistor

Figure 1	Thermistor

Typical NTC characteristic
as a function of temperature
R_T = f(T)



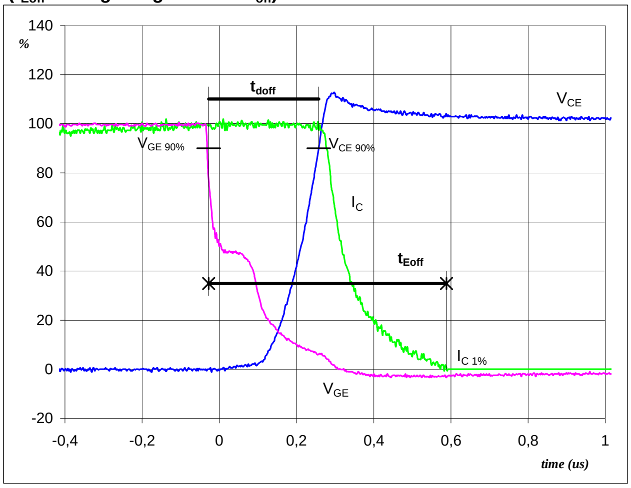
Switching Definitions Output Inverter

General conditions

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

Figure 1 T1,T2,T3,T4,T5,T6 IGBT

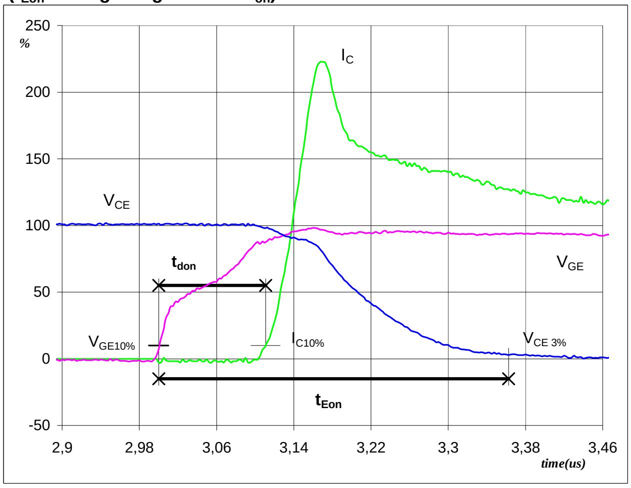
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
(t_{Eoff} = integrating time for E_{off})



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 T1,T2,T3,T4,T5,T6 IGBT

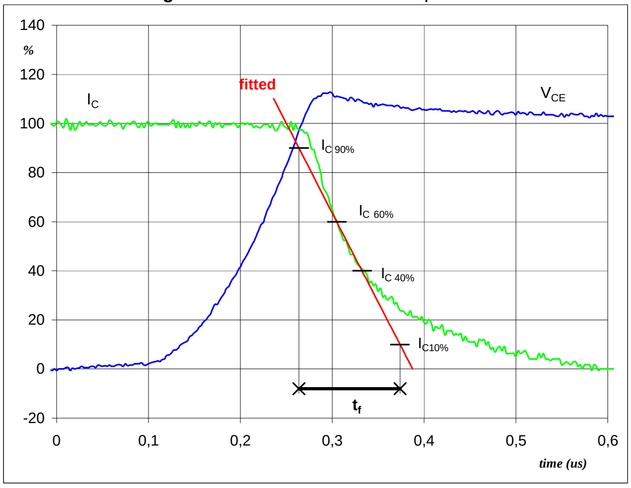
Turn-on Switching Waveforms & definition of tdon, t_{Eon}
(t_{Eon} = integrating time for E_{on})



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 T1,T2,T3,T4,T5,T6 IGBT

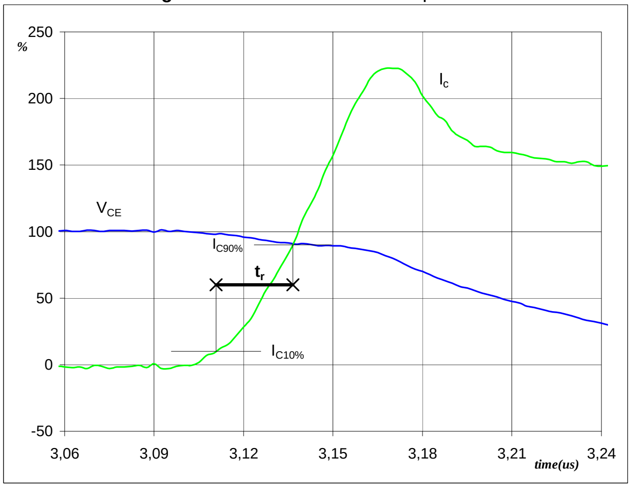
Turn-off Switching Waveforms & definition of t_f



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

Figure 4 T1,T2,T3,T4,T5,T6 IGBT

Turn-on Switching Waveforms & definition of t_r

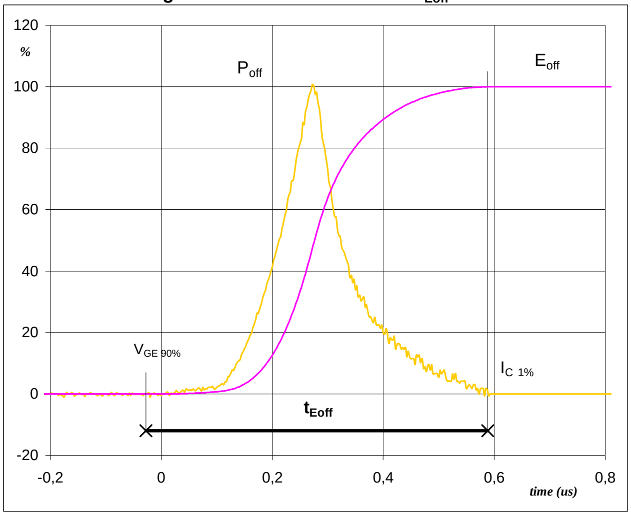


V_C (100%) =	600	V
I_C (100%) =	50	A
t_r =	0,03	μs

Switching Definitions Output Inverter

Figure 5 T1,T2,T3,T4,T5,T6 IGBT

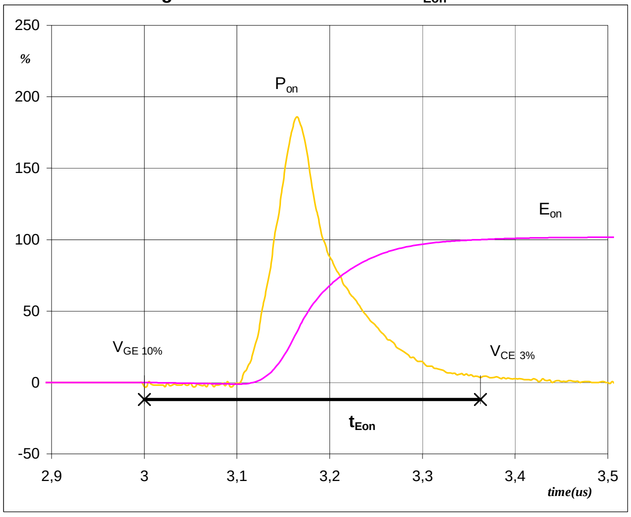
Turn-off Switching Waveforms & definition of t_{Eoff}



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

Figure 6 T1,T2,T3,T4,T5,T6 IGBT

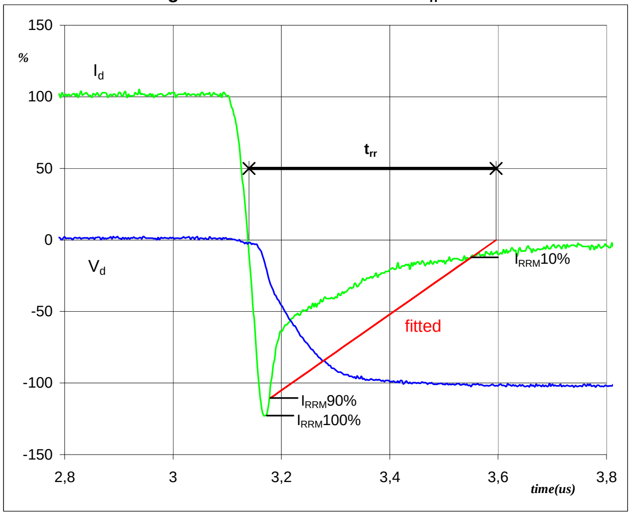
Turn-on Switching Waveforms & definition of t_{Eon}



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

Figure 7 D1,D2,D3,D4,D5,D6 FWD

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

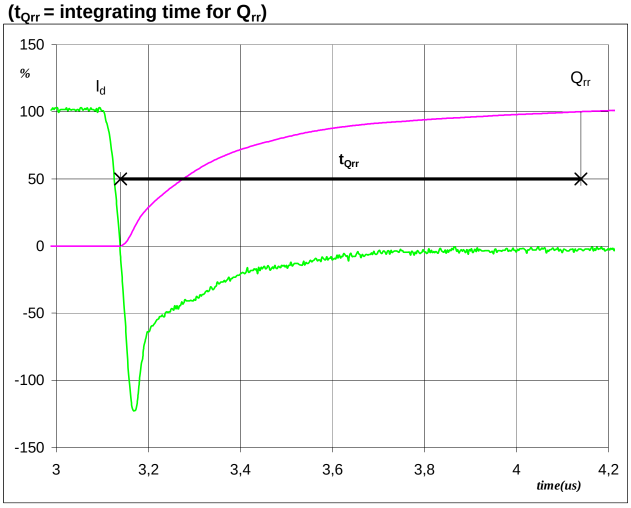


V_d (100%) =	600	V
I_d (100%) =	50	A
I_{RRM} (100%) =	-62	A
t_{rr} =	0,44	μs

Switching Definitions Output Inverter

Figure 8 D1,D2,D3,D4,D5,D6 FWD

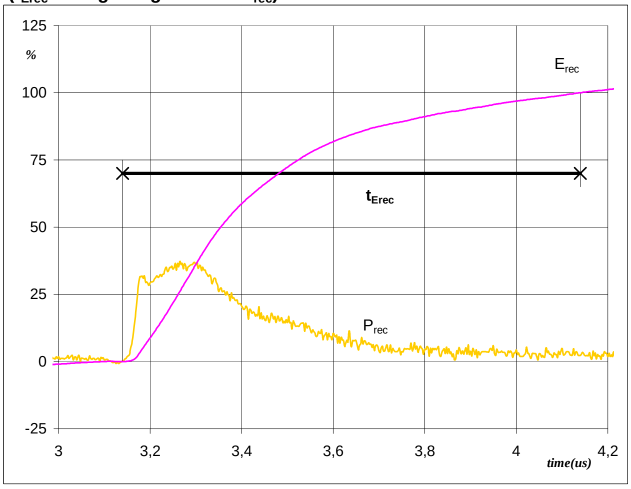
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})



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

Figure 9 D1,D2,D3,D4,D5,D6 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

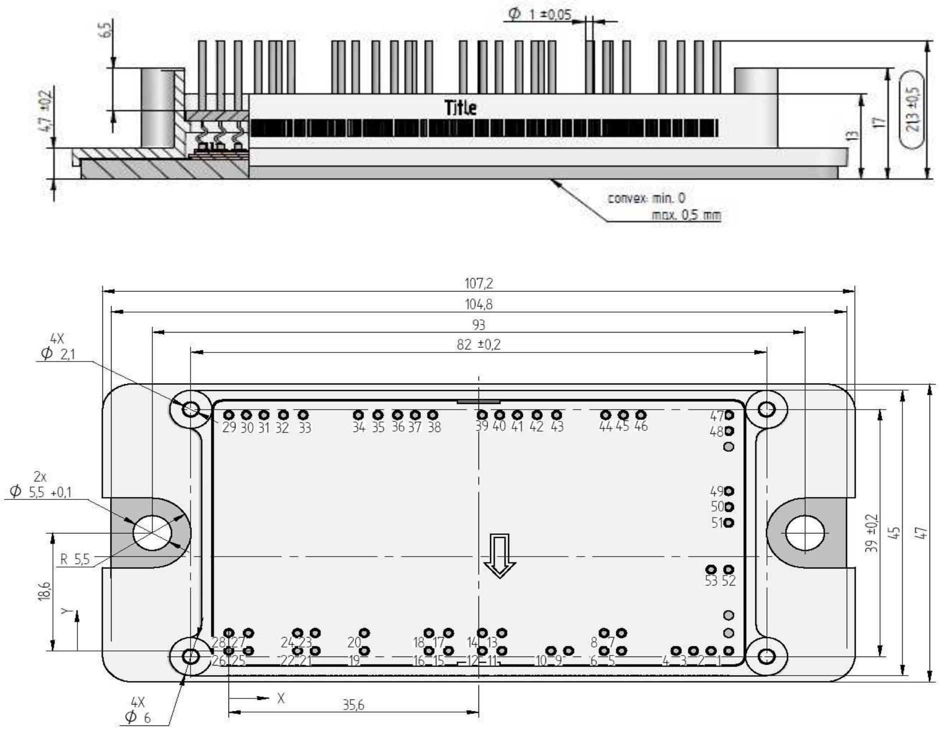
Ordering Code and Marking - Outline - Pinout

Ordering Code & Marking

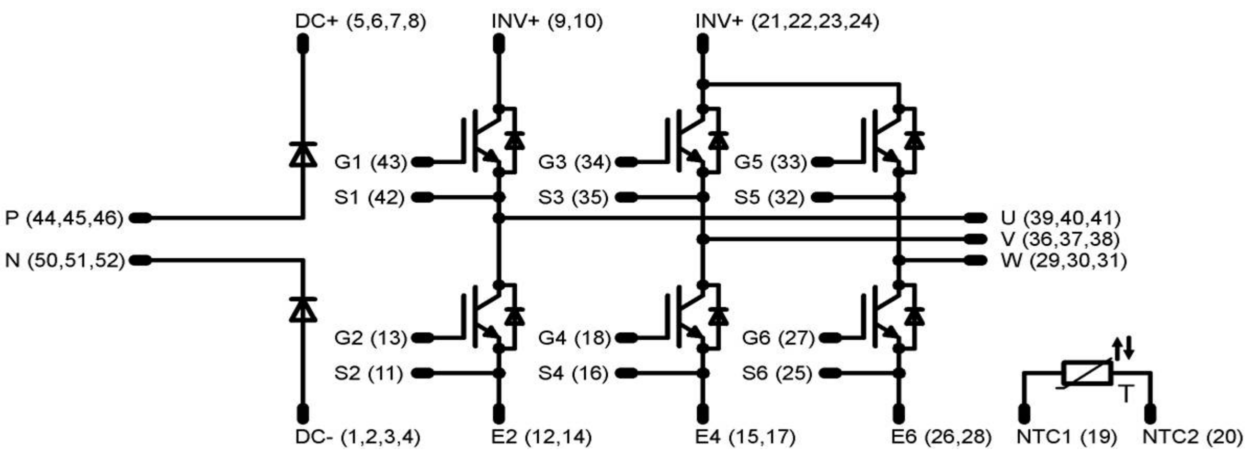
Version	Ordering Code	in DataMatrix as	in packaging barcode as
17mm housing	30-F212R6A050SC-M447E	M447-E	M447-E
17mm housing, without thermistor	30-F212R6A050SC01-M447E10	M447-E10	M447-E10

Outline

Pin table				Pin table		
Pin	X	Y		Pin	X	Y
1	71,2	0		29	0	37,2
2	68,7	0		30	2,5	37,2
3	66,2	0		31	5	37,2
4	63,7	0		32	7,8	37,2
5	55,95	0		33	10,6	37,2
6	53,45	0		34	18,45	37,2
7	55,95	2,8		35	21,25	37,2
8	53,45	2,8		36	24,05	37,2
9	48,4	0		37	26,55	37,2
10	45,9	0		38	29,05	37,2
11	38,9	0		39	36,1	37,2
12	36,1	0		40	38,6	37,2
13	38,9	2,8		41	41,1	37,2
14	36,1	2,8		42	43,9	37,2
15	31,3	0		43	46,7	37,2
16	28,5	0		44	53,7	37,2
17	31,3	2,8		45	56,2	37,2
18	28,5	2,8		46	58,7	37,2
19	19,3	0		47	71,2	37,2
20	19,3	2,8		48	71,2	34,7
21	12,3	0		49	71,2	25,2
22	9,8	0		50	71,2	22,7
23	12,3	2,8		51	71,2	20,2
24	9,8	2,8		52	71,2	12,8
25	2,8	0		53	68,7	12,8
26	0	0				
27	2,8	2,8				
28	0	2,8				



Pinout



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2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.