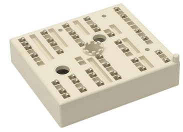
MiniSKiiP®2 PACK — 1200 V / 50 A

Features

- Solderless interconnection
- Trench Fieldstop IGBT4 technology

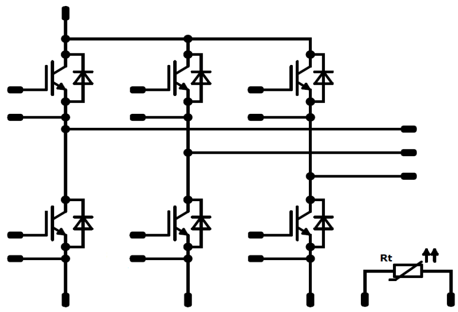
MiniSKiiP®2 housing



Target Applications

- Servo Drives
- Industrial Motor Drives
- UPS

Schematic



Types

- V23990-K359-F40-PM

Maximum Ratings

T_j=25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
T11,T12,T13,T14,T15,T16					
Collector-emitter break down voltage	V_{CE}			1200	V
DC collector current	I_C	$T_j=T_j$max	T_h=80°C	53	A
Repetitive peak collector current	I_{CRM}	t_p limited by $T_j$max		150	A
Turn off safe operating area		$V_{CE} \le$ 1200V, $T_j \le T_{op\ max}$		100	A
Power dissipation	P_{tot}	$T_j=T_j$max	T_h=80°C	133	W
Gate-emitter peak voltage	V_{GE}			±20	V
Short circuit ratings	t_{SC} V_{CC}	$T_j \le$150°C V_{GE}=15V		10 800	µs V
Maximum Junction Temperature	T_{jmax}			175	°C
D11,D12,D13,D14,D15,D16					
Peak Repetitive Reverse Voltage	V_{RRM}			1200	V
DC forward current	I_F	$T_j=T_j$max	T_h=80°C	47	A
Repetitive peak forward current	I_{FRM}	t_p limited by $T_j$max		94	A
Power dissipation	P_{tot}	$T_j=T_j$max	T_h=80°C	100	W
Maximum Junction Temperature	T_{jmax}			175	°C

Maximum Ratings

T_j=25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Thermal Properties					
Storage temperature	T_{stg}			-40…+125	°C
Operation temperature under switching condition	T_{op}			-40…+(Tjmax - 25)	°C
Insulation Properties					
Insulation voltage	V_{is}	t=2s	DC voltage	4000	V
Creepage distance				min 12.7	mm
Clearance				min 12.7	mm

Characteristic Values

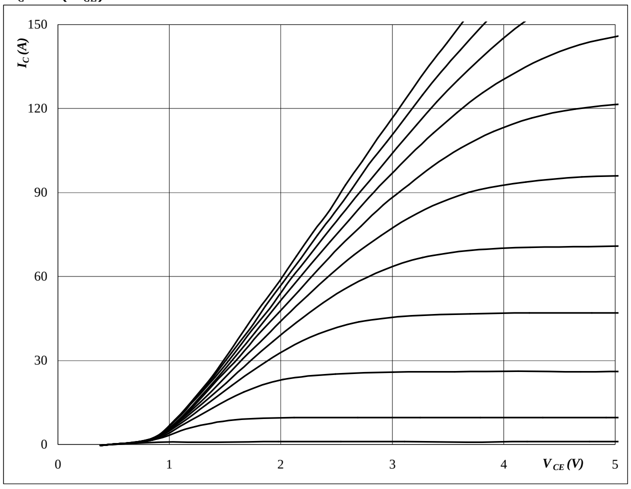
Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] or V_{GS} [V]	V_r [V] or V_{CE} [V] or V_{DS} [V]	I_C [A] or I_F [A] or I_D [A]	T_j	Min	Typ	Max	
T11,T12,T13,T14,T15,T16										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE}=V_{GE}$			0,0017	Tj=25°C Tj=150°C	5	5,8	6,5	V
Collector-emitter saturation voltage	V_{CEsat}		15		50	Tj=25°C Tj=150°C	1,6	1,92 2,33	2,15	V
Collector-emitter cut-off current incl. Diode	I_{CES}		0	1200		Tj=25°C Tj=150°C			0,06	mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25°C Tj=150°C			600	nA
Integrated Gate resistor	R_{gint}							4		Ω
Turn-on delay time	$t_{d(on)}$					Tj=25°C Tj=150°C		101 106		
Rise time	t_r					Tj=25°C Tj=150°C		19 25		ns
Turn-off delay time	$t_{d(off)}$	Rgoff=8Ω Rgon=8Ω	±15	600	50	Tj=25°C Tj=150°C		224 296		
Fall time	t_f					Tj=25°C Tj=150°C		89 116		
Turn-on energy loss per pulse	E_{on}					Tj=25°C Tj=150°C		2,64 4,62		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25°C Tj=150°C		2,89 4,75		
Input capacitance	C_{ies}							2770		
Output capacitance	C_{oss}	f=1MHz	0	25		Tj=25°C		205		pF
Reverse transfer capacitance	C_{rss}							160		
Gate charge	Q_G		±15			Tj=25°C		380		nC
Thermal resistance chip to heatsink per chip	$R_{th(j-s)}$	Thermal grease thickness≤50µm λ=1W/mK						0,71		K/W
D11,D12,D13,D14,D15,D16										
Diode forward voltage	V_F				50	Tj=25°C Tj=150°C	1,3	2,2 2,2	2,6	V
Peak reverse recovery current	I_{RRM}					Tj=25°C Tj=150°C		53,6 67		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=150°C		121 294		ns
Reverse recovered charge	Q_{rr}	Rgon=8Ω	±15	600	50	Tj=25°C Tj=150°C		3,25 8,66		µC
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					Tj=25°C Tj=150°C		2708 467		A/µs
Reverse recovered energy	E_{rec}					Tj=25°C Tj=150°C		1,12 3,35		mWs
Thermal resistance chip to heatsink per chip	$R_{th(j-s)}$	Thermal grease thickness≤50µm λ=1W/mK						0,95		K/W
Thermistor										
Rated resistance	R					T=25°C		1000		Ω
Deviation of R100	$\Delta_{R/R}$	R100=1670 Ω				T=100°C	-3		3	%
R100	P					T=100°C		1670,31		Ω
Power dissipation constant						T=25°C				mW/K
A-value	$B_{(25/50)}$					T=25°C		7,635*10-3		1/K
B-value	$B_{(25/100)}$					T=25°C		1,731*10-5		1/K²
Vincotech NTC Reference									E	

T11,T12,T13,T14,T15,T16/D11,D12,D13,D14,D15,D16

Figure 1 T11,T12,T13,T14,T15,T16 IGBT

Typical output characteristics

$I_C = f(V_{CE})$



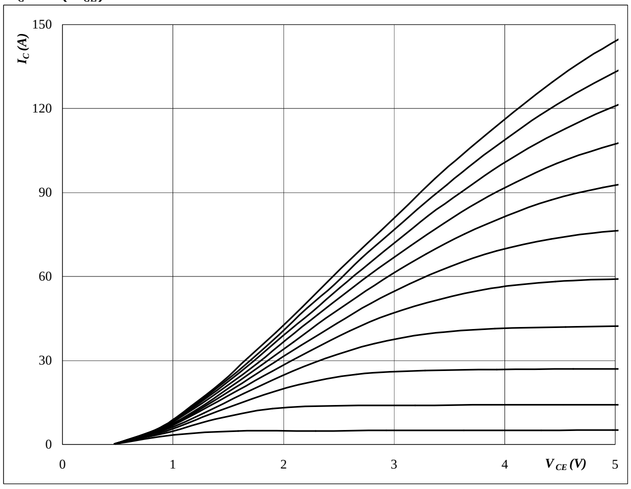
At

t_p =	350	μs
T_j =	25	°C
V_{GE} from	7 V to 17 V in steps of 1 V	

Figure 2 T11,T12,T13,T14,T15,T16 IGBT

Typical output characteristics

$I_C = f(V_{CE})$



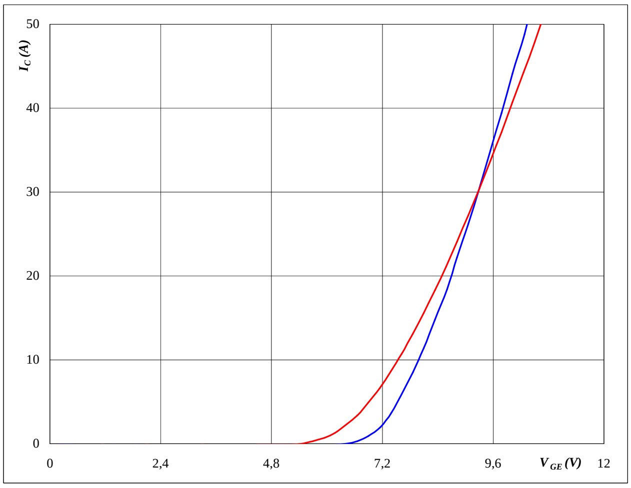
At

t_p =	350	μs
T_j =	150	°C
V_{GE} from	7 V to 17 V in steps of 1 V	

Figure 3 T11,T12,T13,T14,T15,T16 IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$



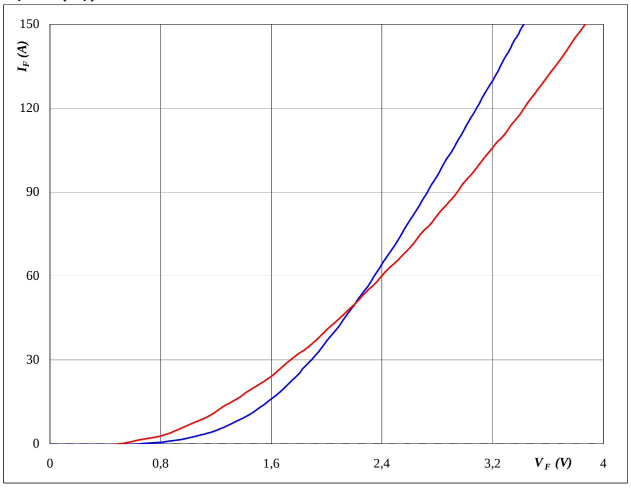
At

T_j =	25/150	°C
t_p =	350	μs
V_{CE} =	10	V

Figure 4 D11,D12,D13,D14,D15,D16 FWD

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

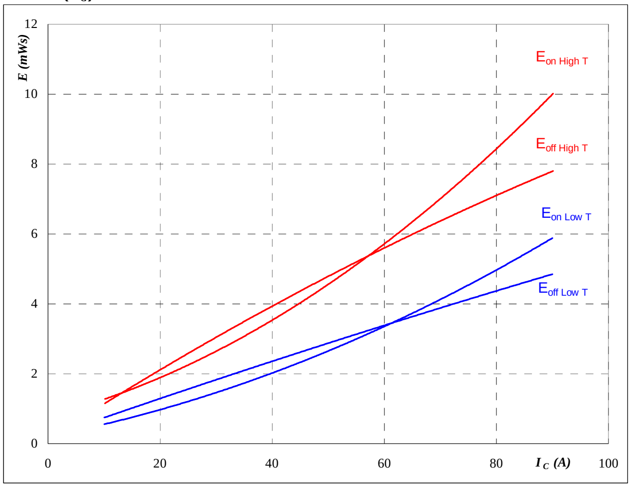
T_j =	25/150	°C
t_p =	350	μs

T11,T12,T13,T14,T15,T16/D11,D12,D13,D14,D15,D16

Figure 5 T11,T12,T13,T14,T15,T16 IGBT

Typical switching energy losses as a function of collector current

$E = f(I_C)$



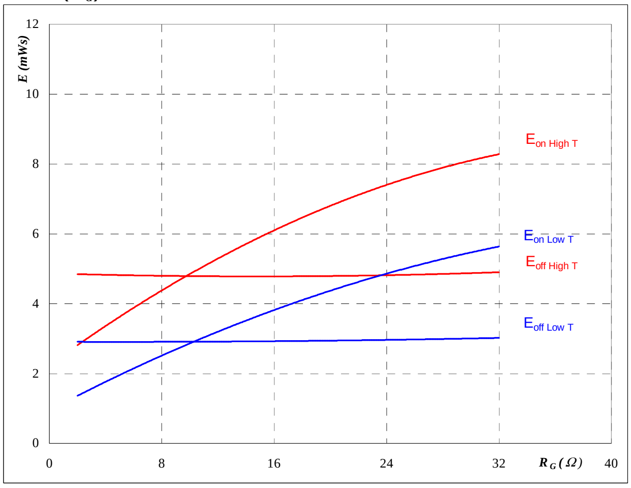
With an inductive load at

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

Figure 6 T11,T12,T13,T14,T15,T16 IGBT

Typical switching energy losses as a function of gate resistor

$E = f(R_G)$



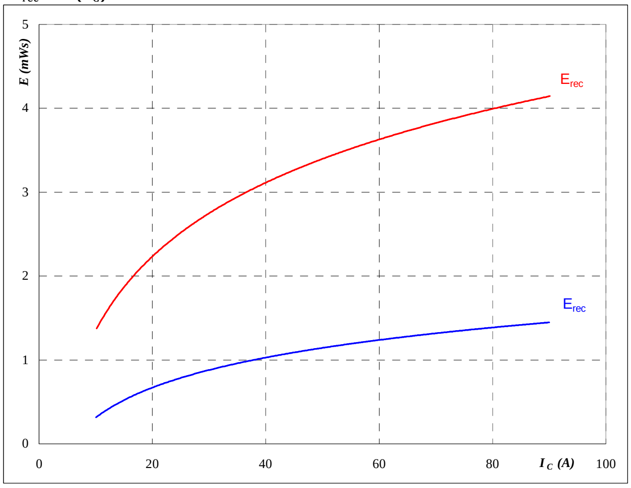
With an inductive load at

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

Figure 7 D11,D12,D13,D14,D15,D16 FWD

Typical reverse recovery energy loss as a function of collector current

$E_{rec} = f(I_C)$



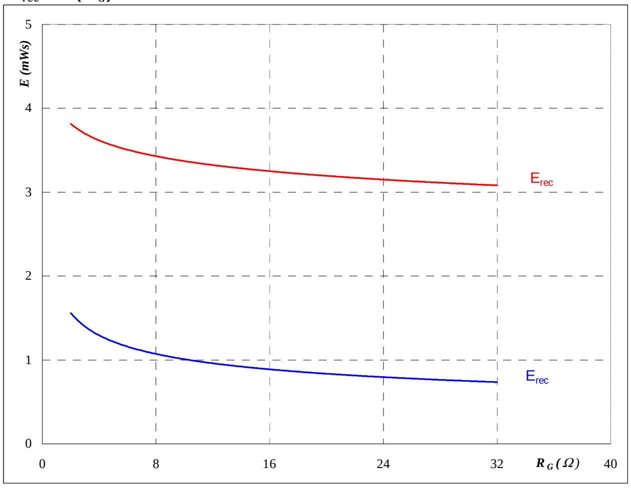
With an inductive load at

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

Figure 8 D11,D12,D13,D14,D15,D16 FWD

Typical reverse recovery energy loss as a function of gate resistor

$E_{rec} = f(R_G)$



With an inductive load at

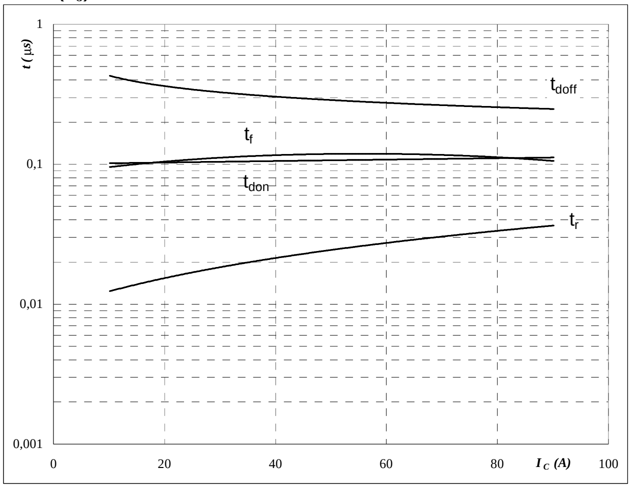
T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	50	A

T11,T12,T13,T14,T15,T16/D11,D12,D13,D14,D15,D16

Figure 9 T11,T12,T13,T14,T15,T16 IGBT

Typical switching times as a function of collector current

$t = f(I_C)$



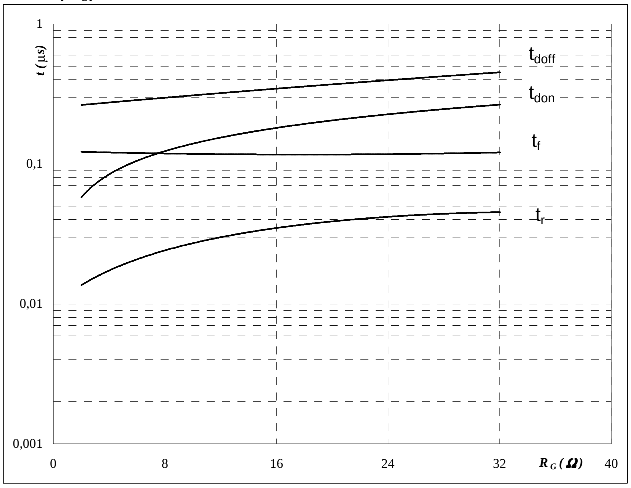
With an inductive load at

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

Figure 10 T11,T12,T13,T14,T15,T16 IGBT

Typical switching times as a function of gate resistor

$t = f(R_G)$



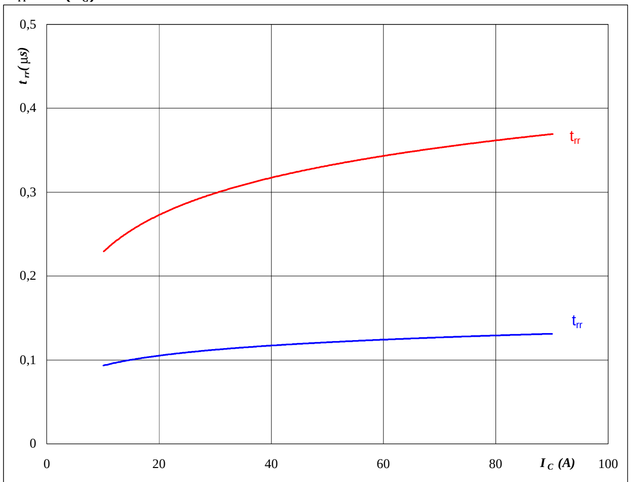
With an inductive load at

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

Figure 11 D11,D12,D13,D14,D15,D16 FWD

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$



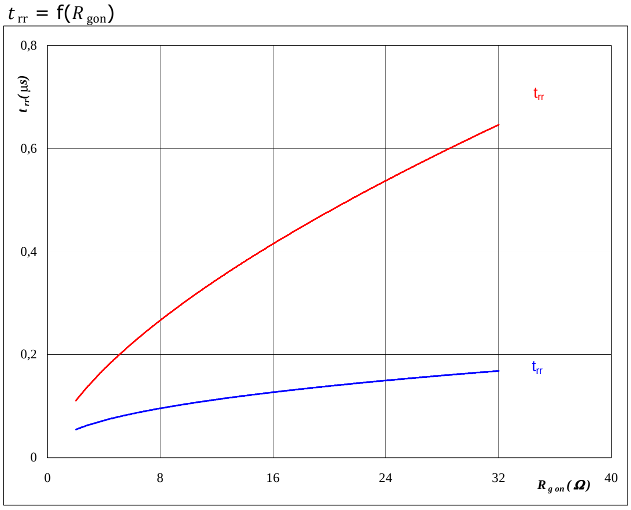
At

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

Figure 12 D11,D12,D13,D14,D15,D16 FWD

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

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



At

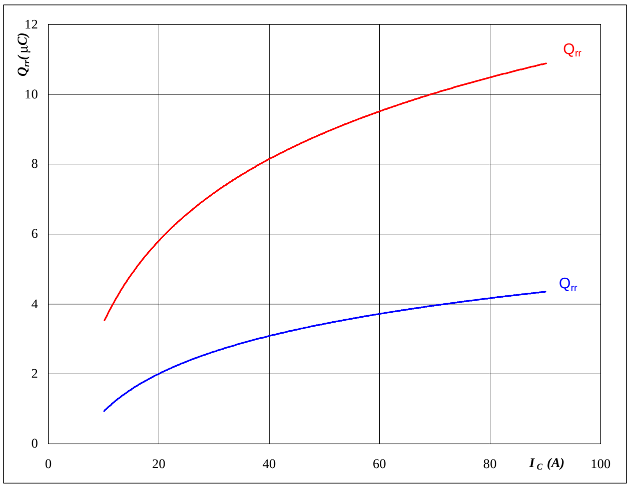
T_j =	25/150	°C
V_R =	600	V
I_F =	50	A
V_{GE} =	±15	V

T11,T12,T13,T14,T15,T16/D11,D12,D13,D14,D15,D16

Figure 13 D11,D12,D13,D14,D15,D16 FWD

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



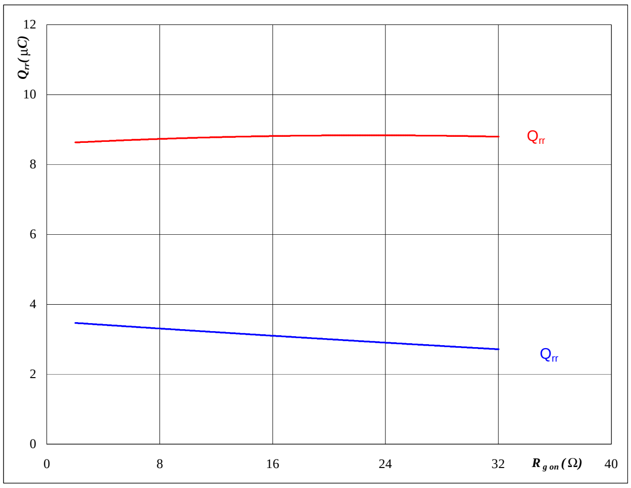
At

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

Figure 14 D11,D12,D13,D14,D15,D16 FWD

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

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



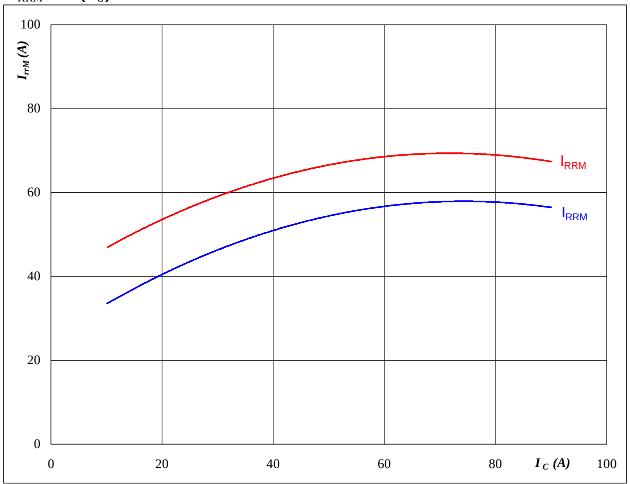
At

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

Figure 15 D11,D12,D13,D14,D15,D16 FWD

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



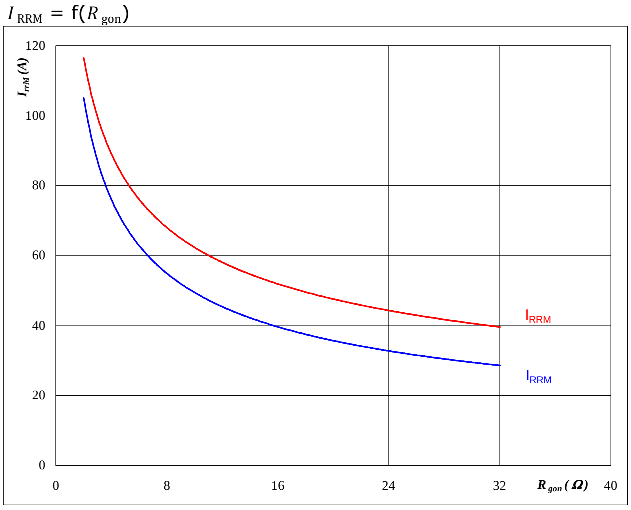
At

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

Figure 16 D11,D12,D13,D14,D15,D16 FWD

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

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



At

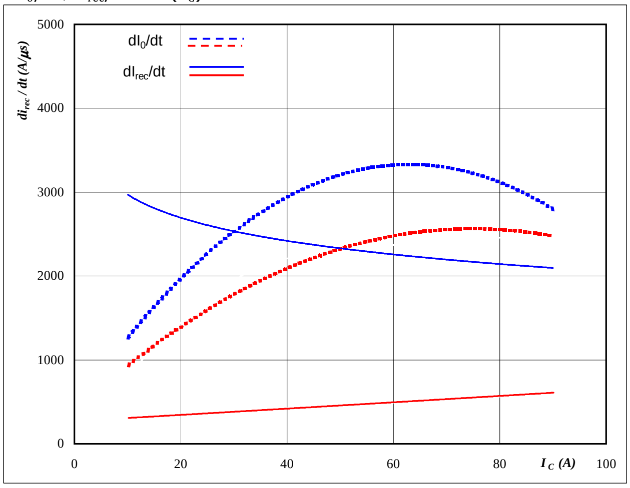
T_j =	25/150	°C
V_R =	600	V
I_F =	50	A
V_{GE} =	±15	V

T11,T12,T13,T14,T15,T16/D11,D12,D13,D14,D15,D16

Figure 17 D11,D12,D13,D14,D15,D16 FWD

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

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



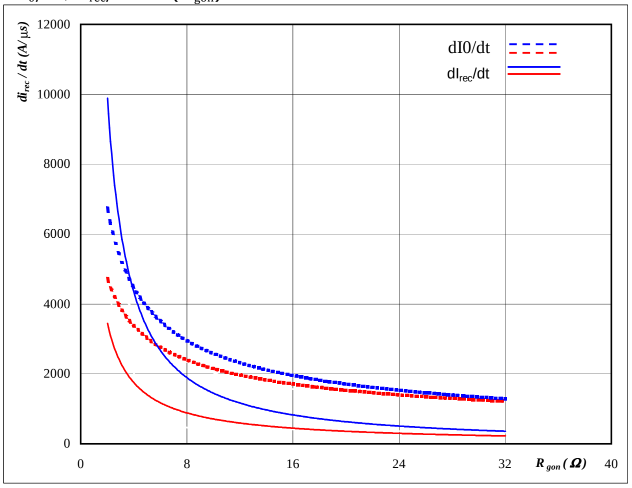
At

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

Figure 18 D11,D12,D13,D14,D15,D16 FWD

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

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



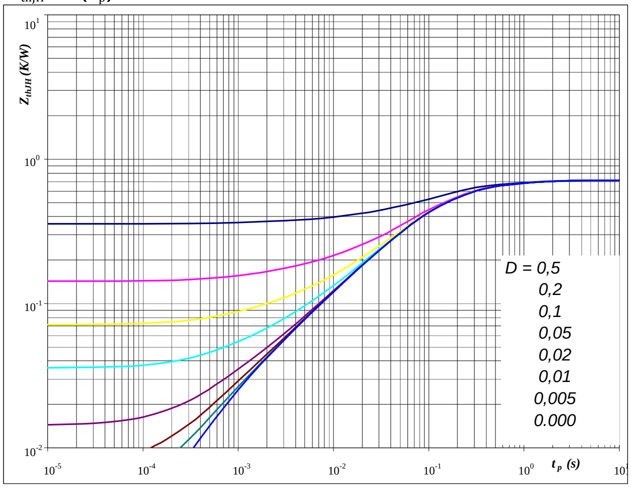
At

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

Figure 19 T11,T12,T13,T14,T15,T16 IGBT

IGBT transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

D =	t_p / T	
R_{thJH} =	0,71	K/W

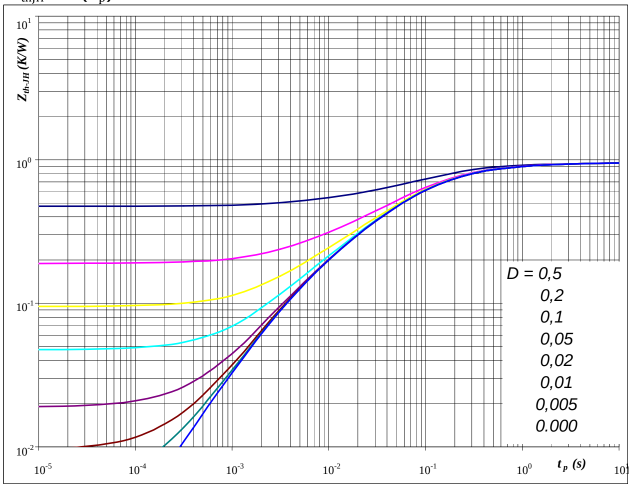
IGBT thermal model values

R (K/W)	Tau (s)
0,11	7,7E-01
0,36	1,3E-01
0,16	4,6E-02
0,06	8,2E-03
0,02	1,1E-03

Figure 20 D11,D12,D13,D14,D15,D16 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

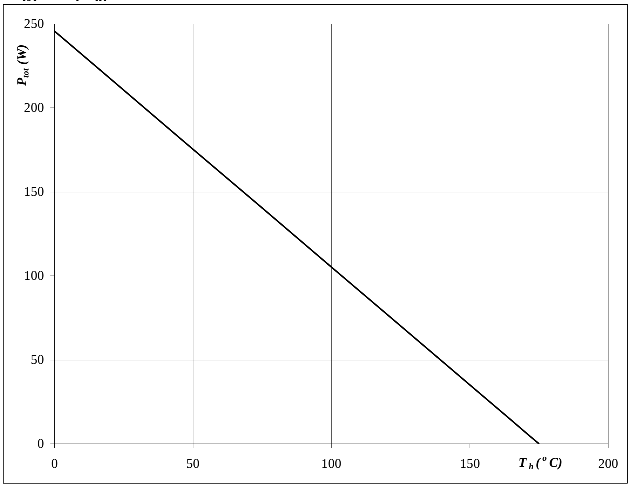
R (K/W)	Tau (s)
0,06	2,5E+00
0,21	3,5E-01
0,44	7,8E-02
0,17	1,7E-02
0,07	3,6E-03

T11,T12,T13,T14,T15,T16/D11,D12,D13,D14,D15,D16

Figure 21 T11,T12,T13,T14,T15,T16 IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



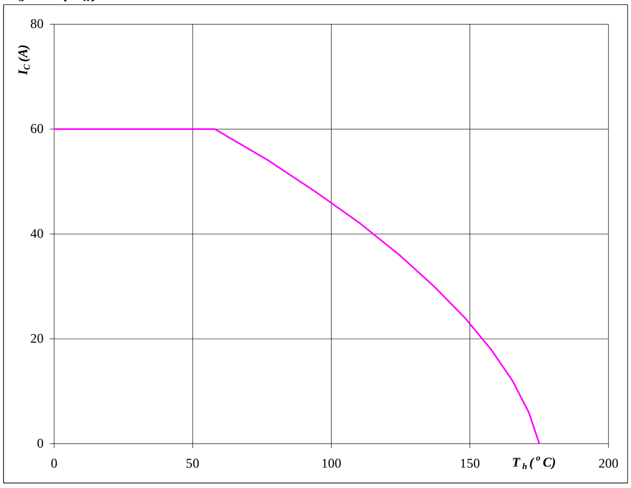
At

T_j =	175	°C

Figure 22 T11,T12,T13,T14,T15,T16 IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



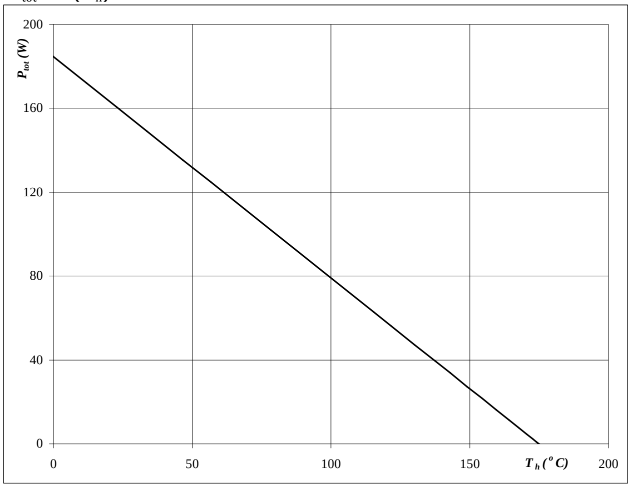
At

T_j =	175	°C
V_{GE} =	15	V

Figure 23 D11,D12,D13,D14,D15,D16 FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



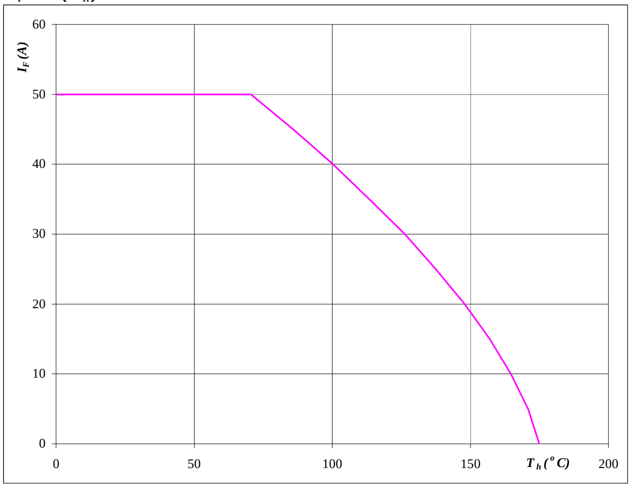
At

T_j =	175	°C

Figure 24 D11,D12,D13,D14,D15,D16 FWD

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

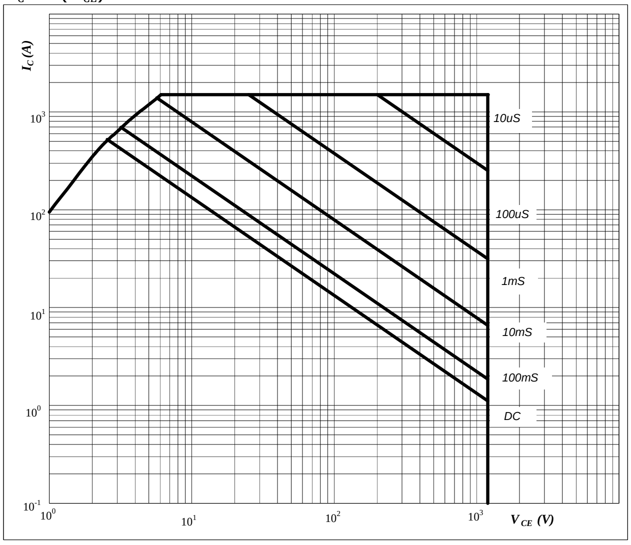
T_j =	175	°C

T11,T12,T13,T14,T15,T16/D11,D12,D13,D14,D15,D16

Figure 25 T11,T12,T13,T14,T15,T16 IGBT

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$



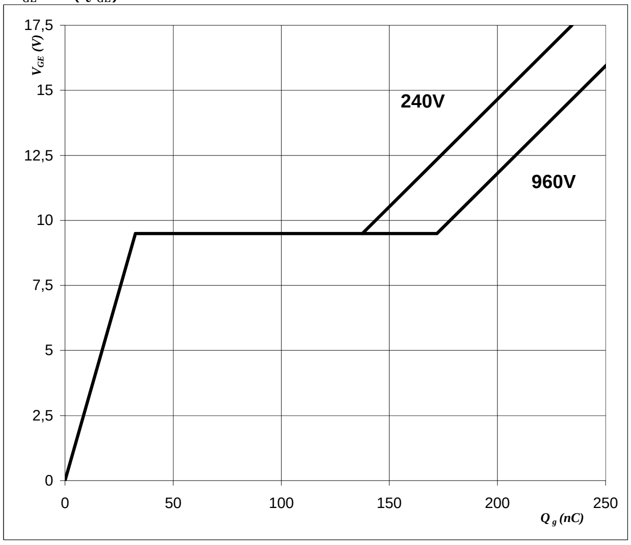
At

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

Figure 26 T11,T12,T13,T14,T15,T16 IGBT

Gate voltage vs Gate charge

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



At

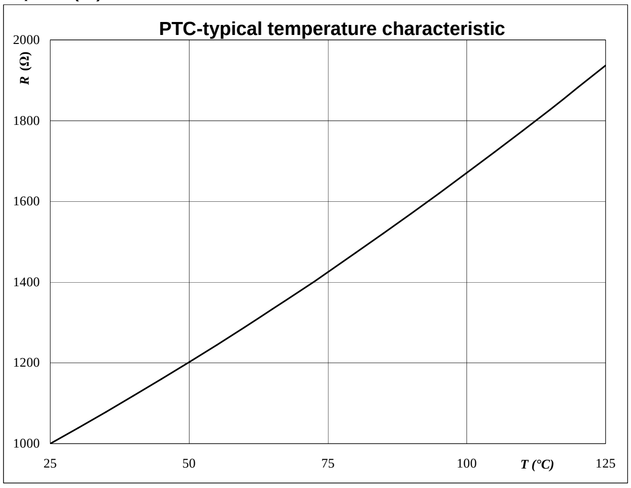
I_C =	50	A

Thermistor

Figure 1 Thermistor

Typical PTC characteristic as a function of temperature

$R_T = f(T)$



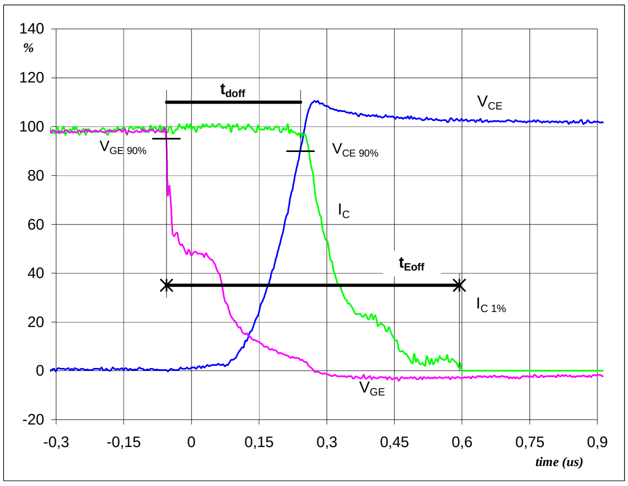
Switching Definitions Output Inverter

General conditions

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

Figure 1 T11,T12,T13,T14,T15,T16 IGBT

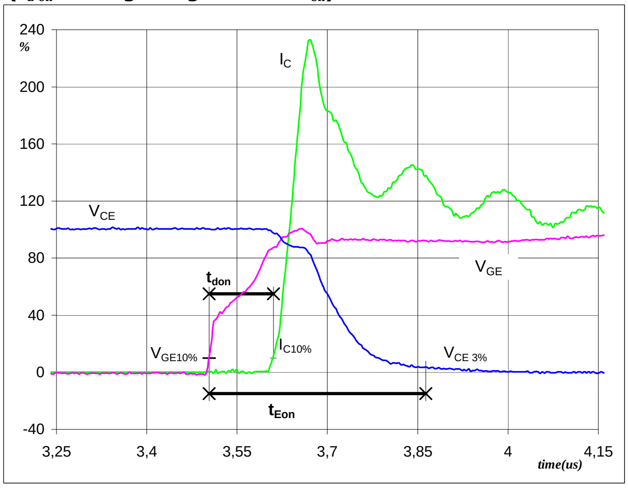
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
($t_{E\,off}$ = integrating time for E_{off})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	50	A
t_{doff} =	0,30	μs
$t_{E\,off}$ =	0,65	μs

Figure 2 T11,T12,T13,T14,T15,T16 IGBT

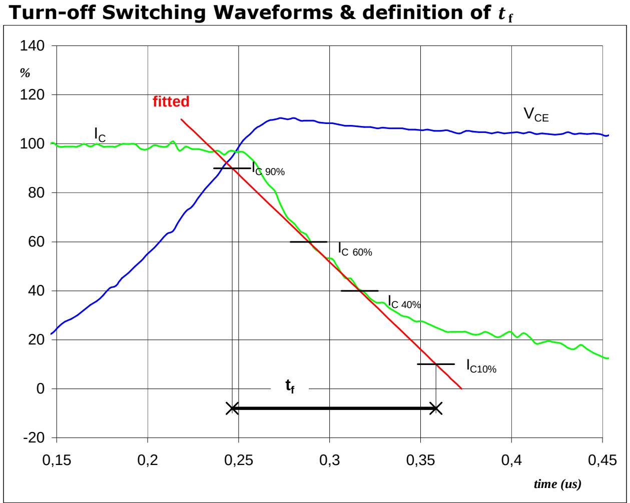
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
($t_{E\,on}$ = integrating time for E_{on})



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 T11,T12,T13,T14,T15,T16 IGBT

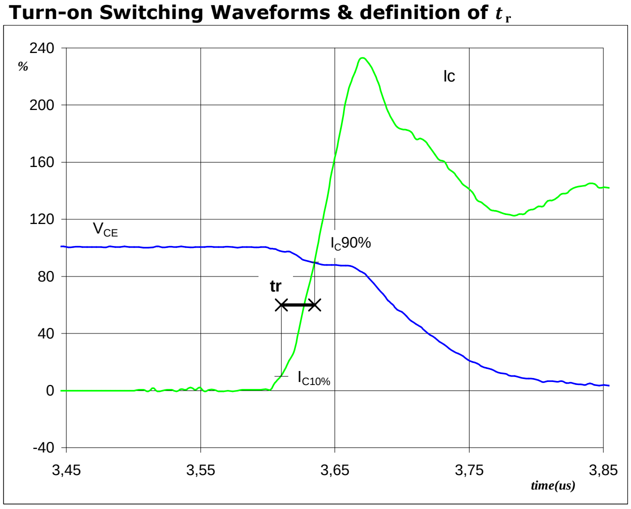
Turn-off Switching Waveforms & definition of t_f



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

Figure 4 T11,T12,T13,T14,T15,T16 IGBT

Turn-on Switching Waveforms & definition of t_r

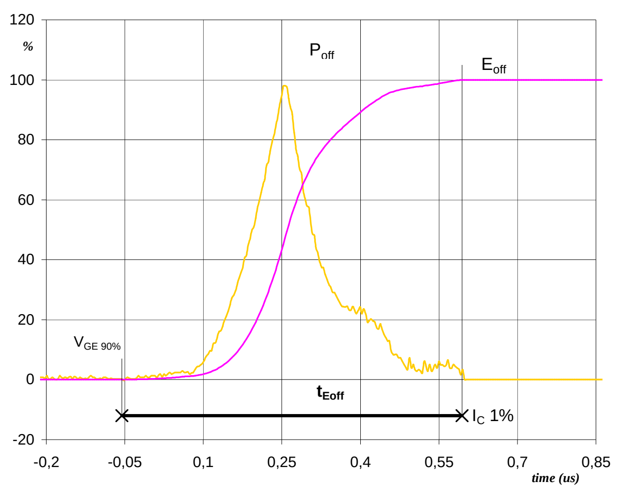


V_C (100%) =	600	V
I_C (100%) =	50	A
t_r =	0,03	μs

Switching Definitions Output Inverter

Figure 5 T11,T12,T13,T14,T15,T16 IGBT

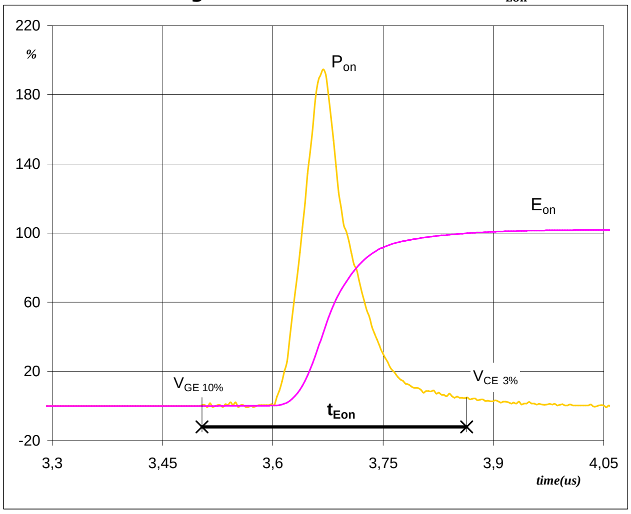
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	30,22	kW
E_{off} (100%) =	4,75	mJ
$t_{E\ off}$ =	0,65	μs

Figure 6 T11,T12,T13,T14,T15,T16 IGBT

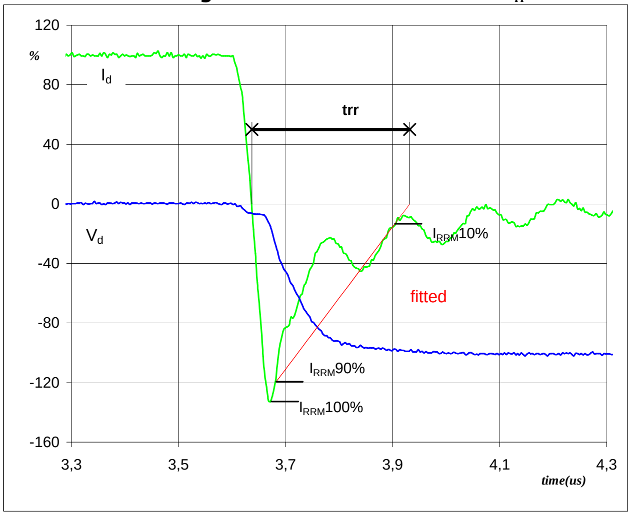
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	30,22	kW
E_{on} (100%) =	4,62	mJ
$t_{E\ on}$ =	0,36	μs

Figure 7 D11,D12,D13,D14,D15,D16 FWD

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

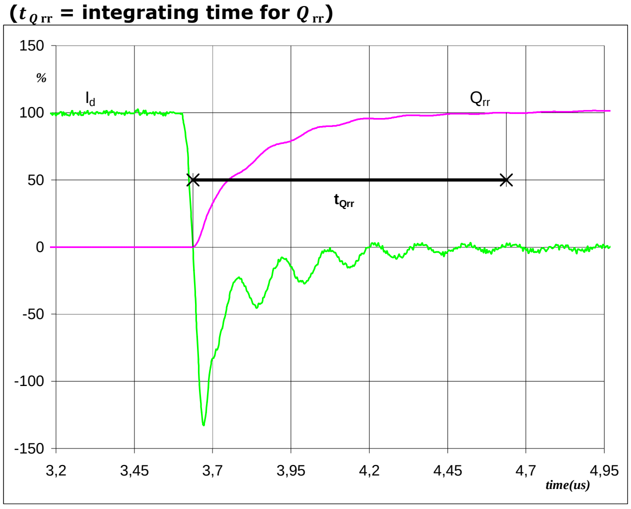


V_d (100%) =	600	V
I_d (100%) =	50	A
I_{RRM} (100%) =	-67	A
t_{rr} =	0,29	μs

Switching Definitions Output Inverter

Figure 8 D11,D12,D13,D14,D15,D16 FWD

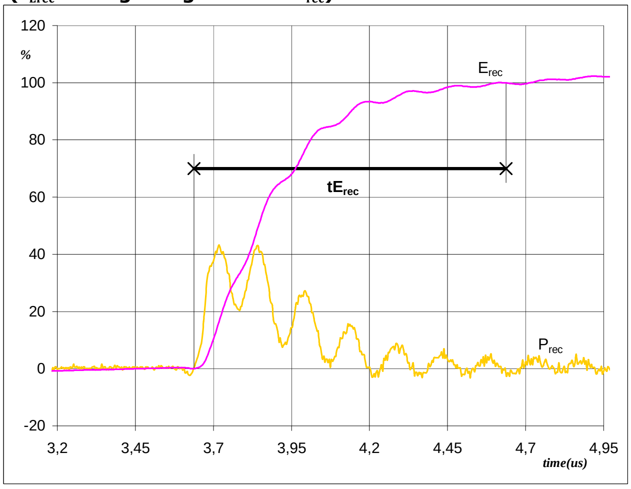
Turn-on Switching Waveforms & definition of t_{Qrr}
($t_{Q\,rr}$ = integrating time for Q_{rr})



I_d (100%) =	50	A
Q_{rr} (100%) =	8,66	μC
$t_{Q\,rr}$ =	1,00	μs

Figure 9 D11,D12,D13,D14,D15,D16 FWD

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



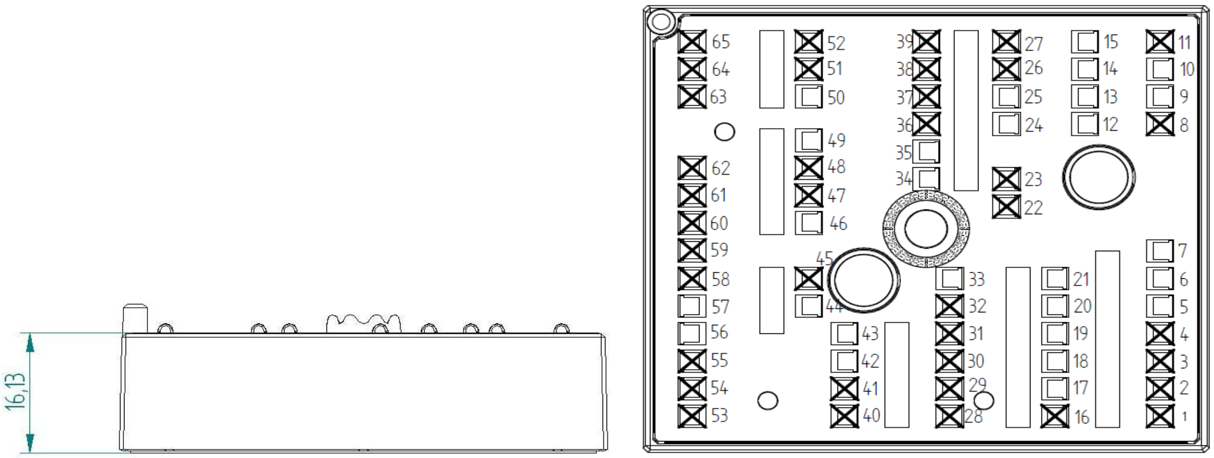
P_{rec} (100%) =	30,22	kW
E_{rec} (100%) =	3,35	mJ
$t_{E\,rec}$ =	1,00	μs

Ordering Code and Marking - Outline - Pinout

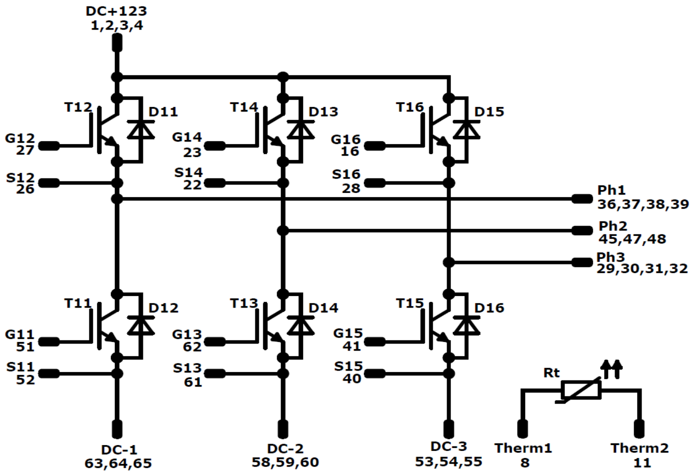
Ordering Code & Marking

Version	Ordering Code	in DataMatrix as	in packaging barcode as
with std lid (black V35990-K22-T-2-PM)	V35990-K359-F40-/0A/-PM	K359F40	K359F40-/0A/
with std lid (black V35990-K22-T-2-PM) and P12	V35990-K359-F40-/1A/-PM	K359F40	K359F40-/1A/
with thin lid (white V35990-K23-T-2-PM)	V35990-K359-F40-/0B/-PM	K359F40	K359F40-/0B/
with thin lid (white V35990-K23-T-2-PM) and P12	V35990-K359-F40-/1B/-PM	K359F40	K359F40-/1B/

Outline



Pinout



Identification

ID	Component	Voltage	Current	Function	Comment
T11,T12,T13, T14,T15,T16	IGBT	1200V	50A	Inverter Switch	IGC50T120T8RL
D11,D12,D13, D14,D15,D16	FWD	1200V	50A	Inverter Diode	SKCD31C120I4F
Rt	PTC	-	-	Thermistor	SKCS2-Temp100

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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.