Vincotech

V23990-P544-*2*-PM
datasheet

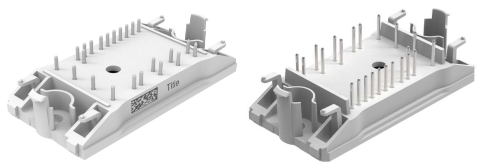
***flow* PIM 0** — **600 V / 15 A**

Features
- Vincotech clip-in housing
- Trench Fieldstop IGBT's for low saturation losses
- Optional w/o BRC

Target Applications
- Industrial drives
- Embedded drives

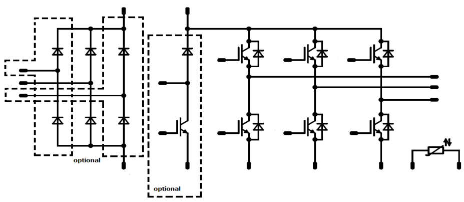
Types
- V23990-P544-A28-PM
- V23990-P544-A29-PM
- V23990-P544-B28-PM
- V23990-P544-B128-PM
- V23990-P544-B129-PM
- V23990-P544-C29-PM
- V23990-P544-C28-PM

flow 0 housing



12 mm housing — 17 mm housing

Schematic



Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
Rectifier Diode				
Repetitive peak reverse voltage	V_{RRM}		1600	V
DC forward current	I_{FAV}	$T_j = T_{jmax}$ T_s = 80 °C	35	A
Surge (non-repetitive) forward current	I_{FSM}	t_p = 10 ms, 50 Hz half sine wave T_j = 150 °C	200	A
I^2t-value	I^2t		200	A^2s
Power dissipation	P_{tot}	$T_j = T_{jmax}$ T_s = 80 °C	46	W
Maximum Junction Temperature	T_{jmax}		150	°C

Parameter	Symbol	Condition	Value	Unit
Inverter Switch				
Collector-emitter break down voltage	V_{CE}		600	V
DC collector current	I_C	$T_j = T_{jmax}$ T_s = 80 °C	21	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	45	A
Turn off safe operating area		V_{CE} ≤ 1200V, $T_j \le T_{op}$ max	45	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$ T_s = 80 °C	51	W
Gate-emitter peak voltage	V_{GE}		±20	V
Short circuit ratings	t_{SC} V_{CC}	T_j ≤ 150 °C V_{GE} = 15 V	6 360	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}			600	V
DC forward current	I_F	$T_j = T_{jmax}$	T_s = 80 °C	21	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}		30	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	44	W
Maximum Junction Temperature	T_{jmax}			175	°C
Brake Switch					
Collector-emitter break down voltage	V_{CE}			600	V
DC collector current	I_C	$T_j = T_{jmax}$	T_s = 80 °C	14	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}		30	A
Turn off safe operating area		V_{CE} ≤ 1200V, T_j ≤ T_{op} max		30	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	44	W
Gate-emitter peak voltage	V_{GE}			±20	V
Short circuit ratings	t_{SC} V_{CC}	T_j ≤ 150 °C V_{GE} = 15 V		6 360	μs V
Maximum Junction Temperature	T_{jmax}			175	°C
Brake Diode					
Peak Repetitive Reverse Voltage	V_{RRM}			600	V
DC forward current	I_F	$T_j = T_{jmax}$	T_s = 80 °C	14	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}		20	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	32	W
Maximum Junction Temperature	T_{jmax}			175	°C
Thermal Properties					
Storage temperature	T_{stg}			-40…+125	°C
Operation temperature under switching condition	T_{op}			-40…+(T_{jmax} - 25)	°C
Isolation Properties					
Isolation voltage	V_{isol}	t = 2 s	DC voltage	4000	V
Creepage distance				min 12,7	mm
Clearance		12 mm / 17 mm housing		9,7 / min 12,7	mm
Comparative tracking index	CTI			>200	

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	
Rectifier Diode										
Forward voltage	V_F				25	25 125	0,8	1,26 1,24	1,45	V
Threshold voltage (for power loss calc. only)	V_{to}				25	25 125		0,92 0,82		V
Slope resistance (for power loss calc. only)	r_t				25	25 125		11 14		mΩ
Reverse current	I_r			1600		25 145			0,05 1,1	mA
Thermal resistance junction to sink	$R_{th(j-s)}$	phase-change material λ = 3,4 W/mK						1,61		K/W
Inverter Switch										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,00021	25	5	5,8	6,5	V
Collector-emitter saturation voltage	V_{CEsat}		15		15	25 150	1,1	1,61 1,81	1,9	V
Collector-emitter cut-off current incl. Diode	I_{CES}		0	600		25			0,00085	mA
Gate-emitter leakage current	I_{GES}		20	0		25			300	nA
Integrated Gate resistor	R_{gint}							none		Ω
Turn-on delay time	$t_{d(on)}$					25 150		14 13		
Rise time	t_r					25 150		11 13		ns
Turn-off delay time	$t_{d(off)}$	R_{goff} = 8 Ω R_{gon} = 16 Ω	+15/0	300	15	25 150		127 146		
Fall time	t_f					25 150		86 86		
Turn-on energy loss	E_{on}					25 150		0,19 0,26		mWs
Turn-off energy loss	E_{off}					25 150		0,31 0,39		
Input capacitance	C_{ies}							860		
Output capacitance	C_{oss}	f = 1 MHz	0	25		25		55		pF
Reverse transfer capacitance	C_{rss}							24		
Gate charge	Q_G		15	480	15	25		87		nC
Thermal resistance junction to sink	$R_{th(j-s)}$	phase-change material λ = 3,4 W/mK						1,88		K/W
Inverter Diode										
Diode forward voltage	V_F				15	25 150	1,25	1,79 1,67	1,95	V
Peak reverse recovery current	I_{RRM}					25 150		15 17		A
Reverse recovery time	t_{rr}					25 150		100 184		ns
Reverse recovered charge	Q_{rr}	R_{gon} = 16 Ω	+15/0	300	15	25 150		0,52 1,01		µC
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 150		1448 773		A/µs
Reverse recovered energy	E_{rec}					25 150		0,10 0,21		mWs
Thermal resistance junction to sink	$R_{th(j-s)}$	phase-change material λ = 3,4 W/mK						2,67		K/W

Characteristic Values

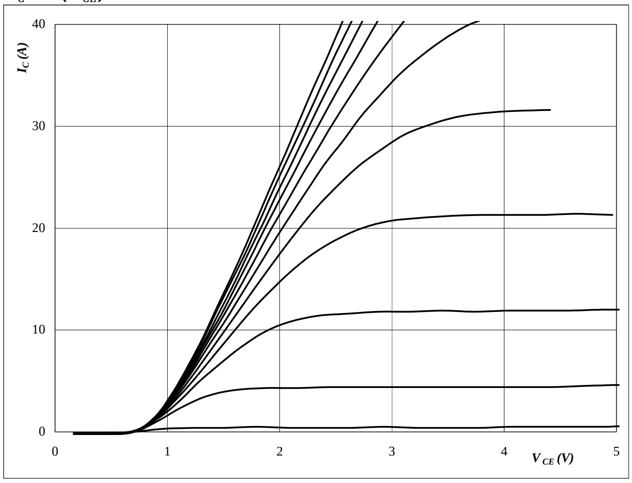
Parameter	Symbol	Conditions	V_{GE} [V] V_{GS} [V]	V_r [V] V_{CE} [V] V_{DS} [V]	I_C [A] I_F [A] I_D [A]	T_j [°C]	Min	Typ	Max	Unit
Brake Switch										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,00015	25	5	5,8	6,5	V
Collector-emitter saturation voltage	V_{CEsat}		15		10	25 150	1,1	1,66 1,87	1,9	V
Collector-emitter cut-off incl diode	I_{CES}		0	600		25			0,0006	mA
Gate-emitter leakage current	I_{GES}		20	0		25			300	nA
Integrated Gate resistor	R_{gint}							none		Ω
Turn-on delay time	$t_{d(on)}$	$R_{goff} = 16$ Ω $R_{gon} = 32$ Ω	+15/0	300	10	25 150		15 15		ns
Rise time	t_r					25 150		11 14		
Turn-off delay time	$t_{d(off)}$					25 150		147 163		
Fall time	t_f					25 150		101 97		
Turn-on energy loss	E_{on}					25 150		0,16 0,22		mWs
Turn-off energy loss	E_{off}					25 150		0,23 0,27		
Input capacitance	C_{ies}	f = 1 MHz	0	25		25		551		pF
Output capacitance	C_{oss}							40		
Reverse transfer capacitance	C_{rss}							17		
Gate charge	Q_G		15	480	10	25		62		nC
Thermal resistance junction to sink	$R_{th(j-s)}$	phase-change material λ = 3,4 W/mK						2,18		K/W
Brake Diode										
Diode forward voltage	V_F				10	25 150	1,25	1,67 1,61	1,95	V
Reverse leakage current	I_r			600		25			27	µA
Peak reverse recovery current	I_{RRM}	$R_{gon} = 32$ Ω	+15/0	300	10	25 150		10 10		A
Reverse recovery time	t_{rr}					25 150		149 208		ns
Reverse recovered charge	Q_{rr}					25 150		0,46 0,46		µC
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 150		620 340		A/µs
Reverse recovery energy	E_{rec}					25 150		0,09 0,16		mWs
Thermal resistance junction to sink	$R_{th(j-s)}$	phase-change material λ = 3,4 W/mK						2,95		K/W
Thermistor										
Rated resistance	R					25		22000		Ω
Deviation of R100	$\Delta_{R/R}$	$R_{100} = 1484$ Ω				100	-5		5	%
Power dissipation	P					25		210		mW
Power dissipation constant						25		3,5		mW/K
B-value	$B_{(25/50)}$	Tol. ±3%				25				K
B-value	$B_{(25/100)}$	Tol. ±3%				25		4000		K
Vincotech NTC Reference						25			A	

Inverter Characteristics

Figure 1 **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$



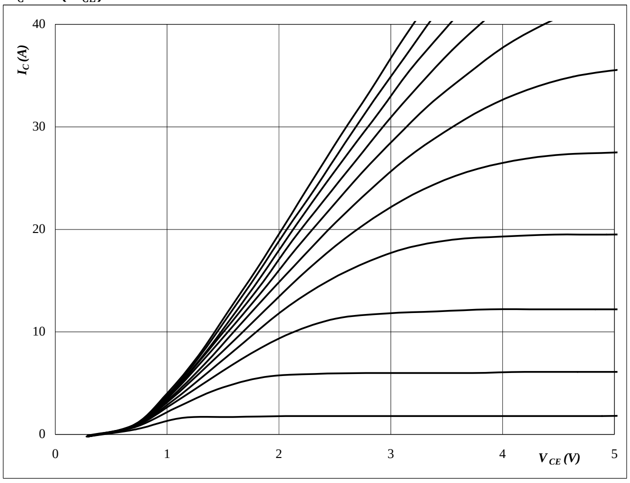
At

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

$I_C = f(V_{CE})$



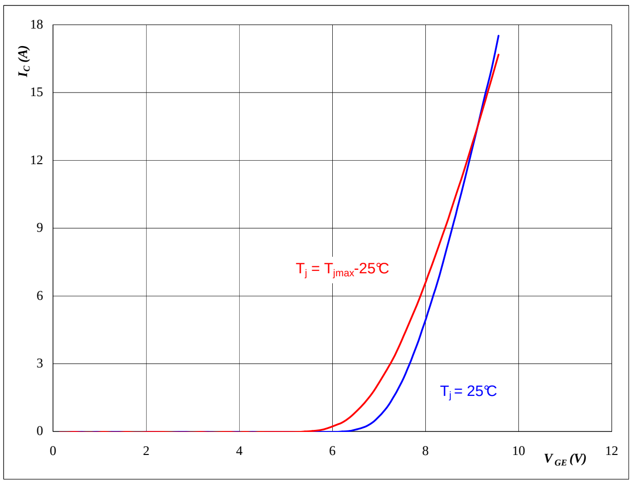
At

t_p =	250	μs
T_j =	125	°C
V_{GE} from	7 V to 17 V in steps of 1 V	

Figure 3 **IGBT**

Typical transfer characteristics

$I_C = f(V_{GE})$



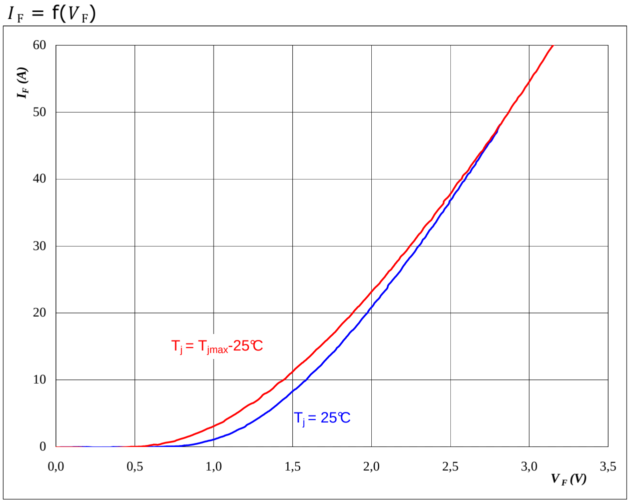
At

t_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

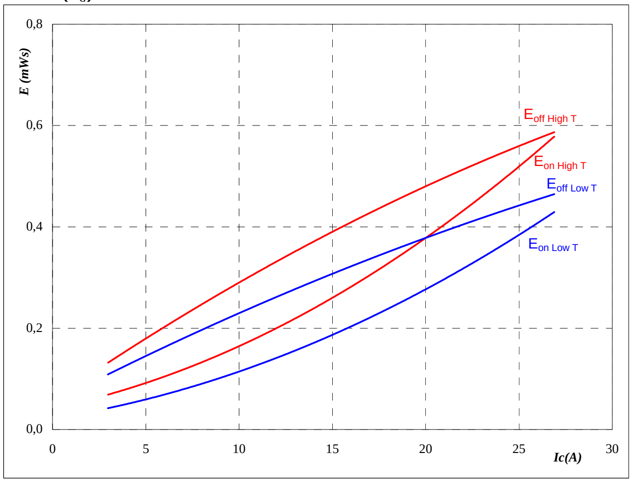
t_p =	250	μs

Inverter Characteristics

Figure 5 **IGBT**

Typical switching energy losses
as a function of collector current

$E = f(I_C)$



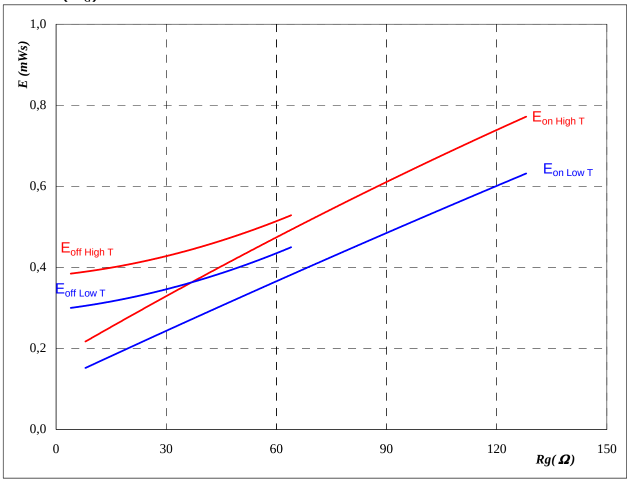
With an inductive load at

T_j =	25/125	°C
V_{CE} =	300	V
V_{GE} =	15	V
R_{gon} =	16	Ω
R_{goff} =	8	Ω

Figure 6 **IGBT**

Typical switching energy losses
as a function of gate resistor

$E = f(R_G)$



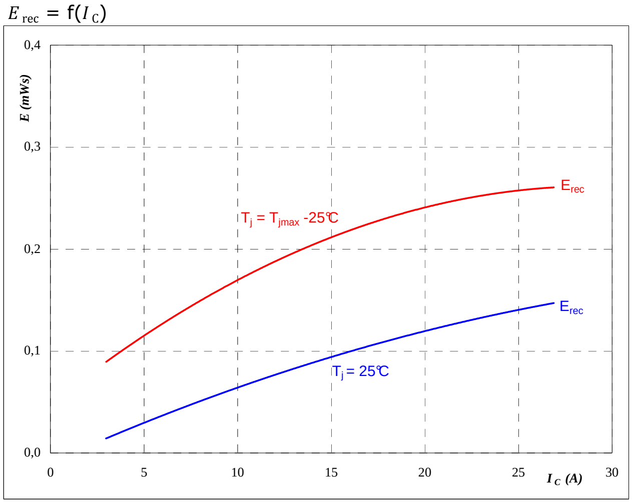
With an inductive load at

T_j =	25/125	°C
V_{CE} =	300	V
V_{GE} =	15	V
I_C =	15	A

Figure 7 **FWD**

Typical reverse recovery energy loss
as a function of collector current

$E_{rec} = f(I_C)$



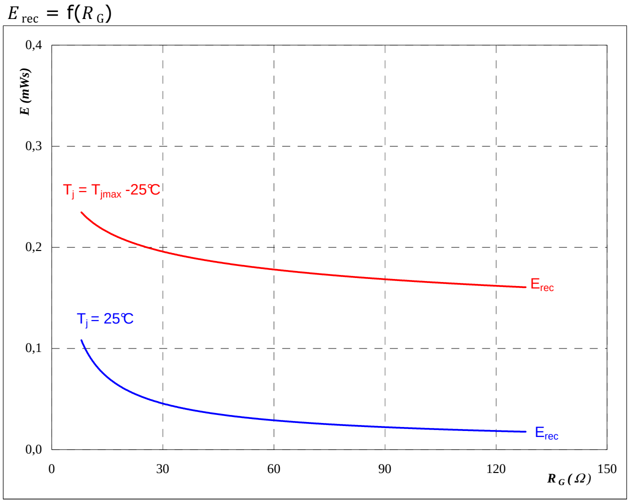
With an inductive load at

T_j =	25/125	°C
V_{CE} =	300	V
V_{GE} =	15	V
R_{gon} =	16	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

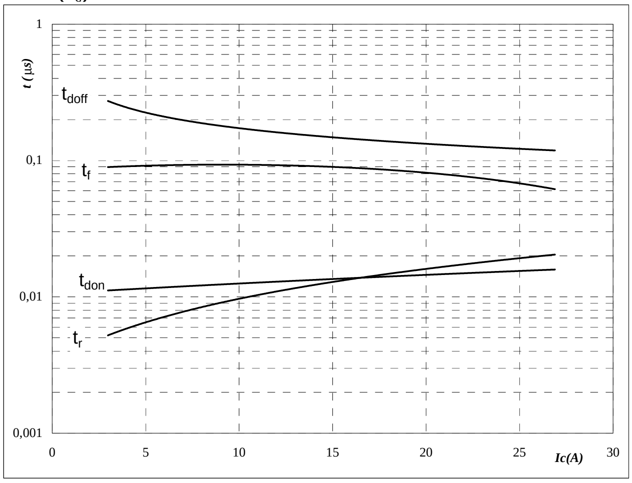
T_j =	25/125	°C
V_{CE} =	300	V
V_{GE} =	15	V
I_C =	15	A

Inverter Characteristics

Figure 9 **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



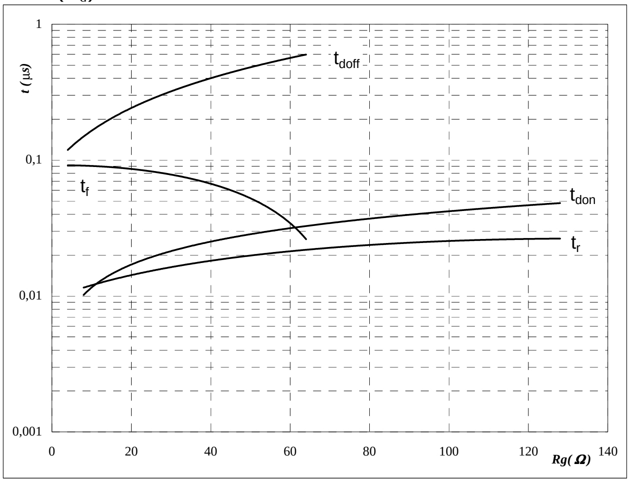
With an inductive load at

T_j =	125	°C
V_{CE} =	300	V
V_{GE} =	15	V
R_{gon} =	16	Ω
R_{goff} =	8	Ω

Figure 10 **IGBT**

Typical switching times as a function of gate resistor

$t = f(R_G)$



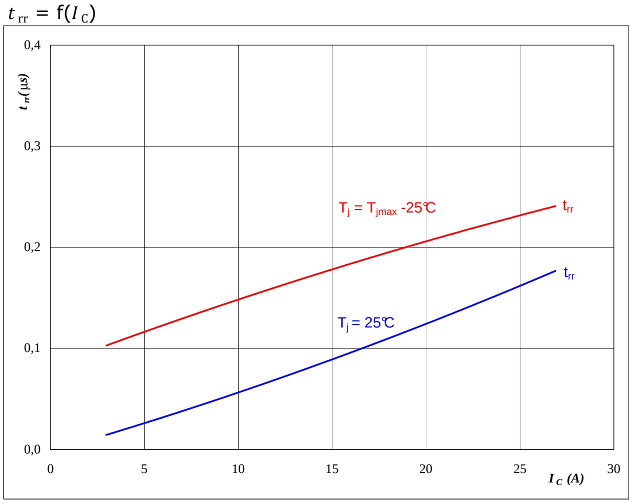
With an inductive load at

T_j =	125	°C
V_{CE} =	300	V
V_{GE} =	15	V
I_C =	15	A

Figure 11 **FWD**

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$



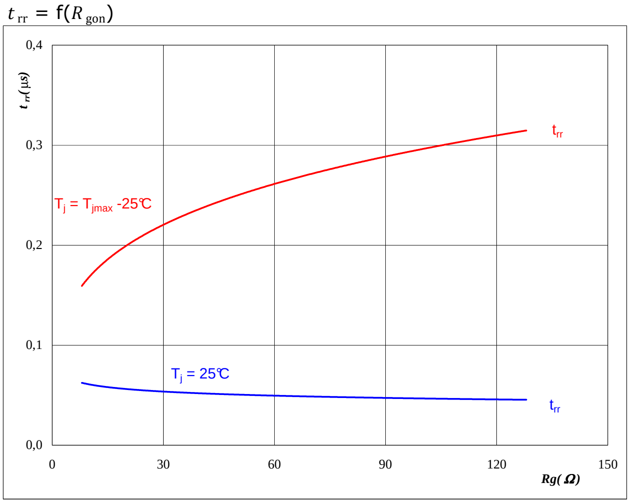
At

T_j =	25/125	°C
V_{CE} =	300	V
V_{GE} =	15	V
R_{gon} =	16	Ω

Figure 12 **FWD**

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

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



At

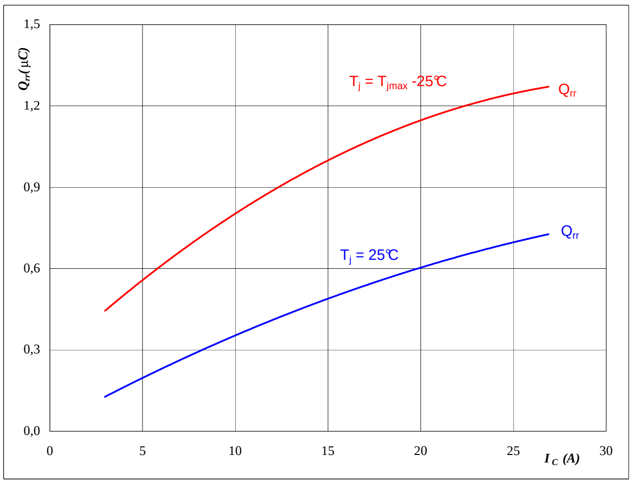
T_j =	25/125	°C
V_R =	300	V
I_F =	15	A
V_{GE} =	15	V

Inverter Characteristics

Figure 13 **FWD**

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



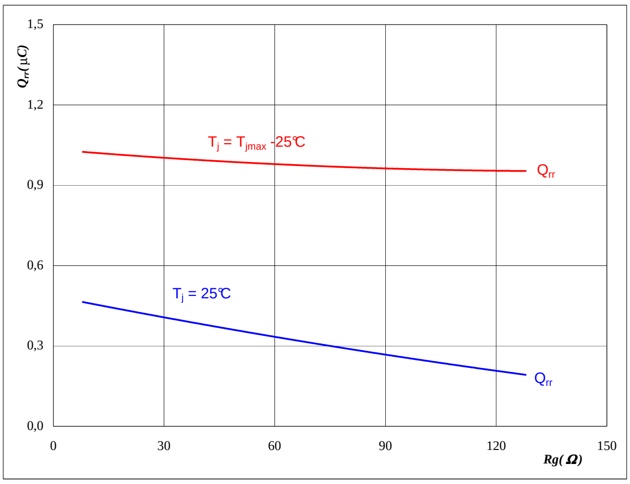
At

T_j =	25/125	°C
V_{CE} =	300	V
V_{GE} =	15	V
R_{gon} =	16	Ω

Figure 14 **FWD**

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

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



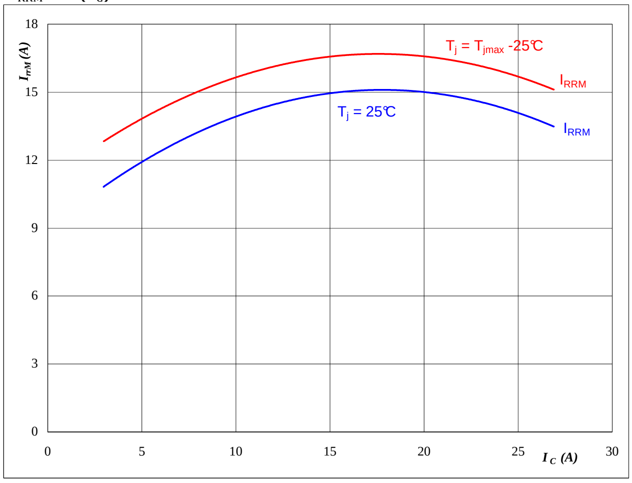
At

T_j =	25/125	°C
V_R =	300	V
I_F =	15	A
V_{GE} =	15	V

Figure 15 **FWD**

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



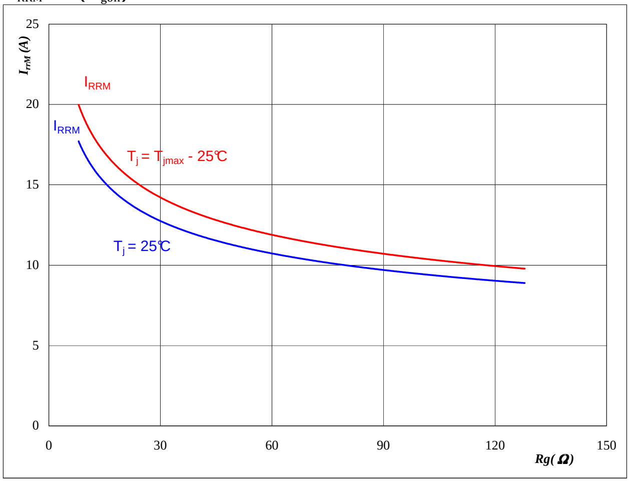
At

T_j =	25/125	°C
V_{CE} =	300	V
V_{GE} =	15	V
R_{gon} =	16	Ω

Figure 16 **FWD**

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

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



At

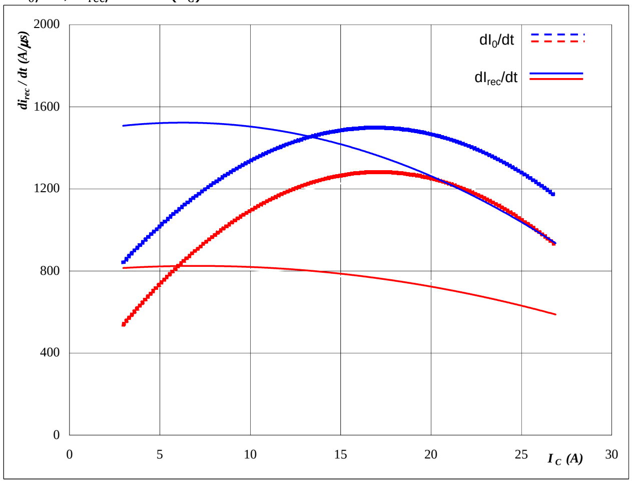
T_j =	25/125	°C
V_R =	300	V
I_F =	15	A
V_{GE} =	15	V

Inverter Characteristics

Figure 17 **FWD**

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

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



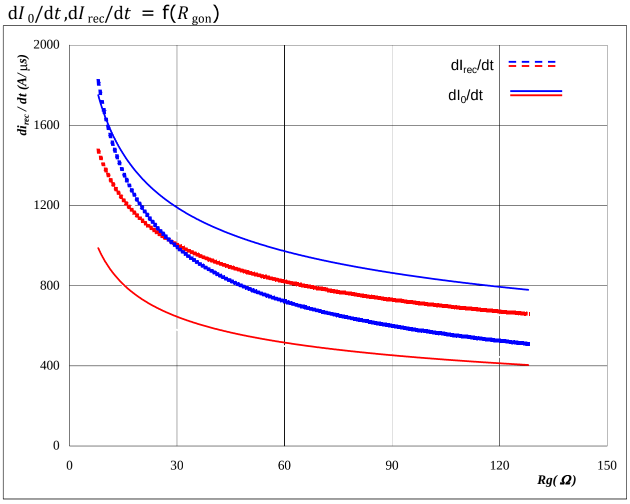
At

T_j =	25/125	°C
V_{CE} =	300	V
V_{GE} =	15	V
R_{gon} =	16	Ω

Figure 18 **FWD**

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

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



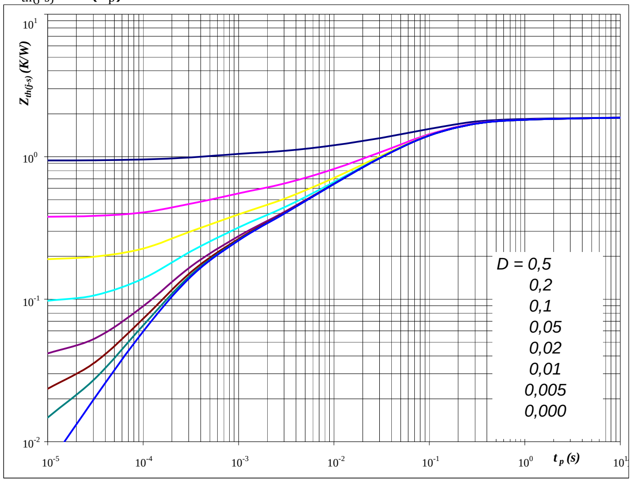
At

T_j =	25/125	°C
V_R =	300	V
I_F =	15	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	
$R_{th(j-s)}$ =	1,88	K/W

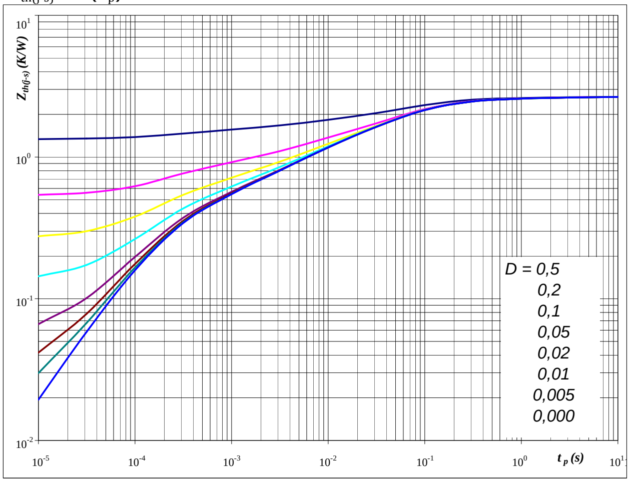
IGBT thermal model values

R (K/W)	Tau (s)
6,56E-02	3,42E+00
2,26E-01	3,66E-01
8,74E-01	7,63E-02
3,72E-01	1,39E-02
1,73E-01	2,53E-03
1,70E-01	2,96E-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	
$R_{th(j-s)}$ =	2,67	K/W

FWD thermal model values

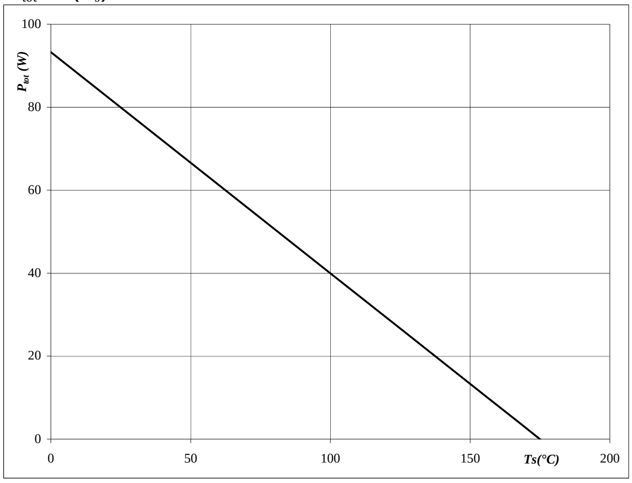
R (K/W)	Tau (s)
5,08E-02	8,17E+00
1,65E-01	7,39E-01
7,58E-01	1,07E-01
7,19E-01	3,13E-02
4,65E-01	5,42E-03
2,28E-01	8,46E-04
2,82E-01	1,76E-04

Inverter Characteristics

Figure 21 **IGBT**

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



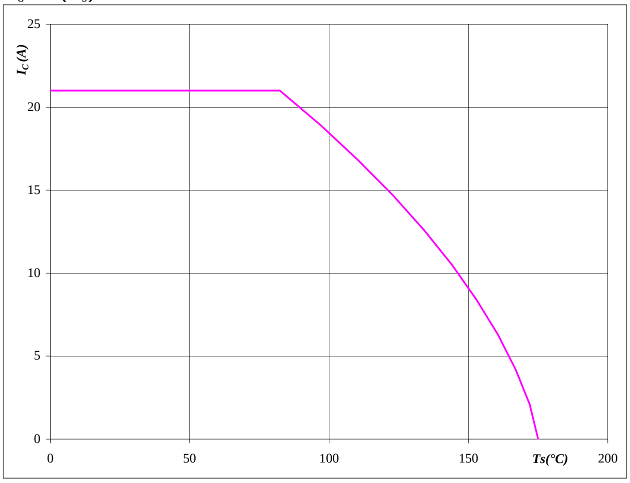
At

T_j = 175 °C

Figure 22 **IGBT**

Collector current as a function of heatsink temperature

$I_C = f(T_s)$



At

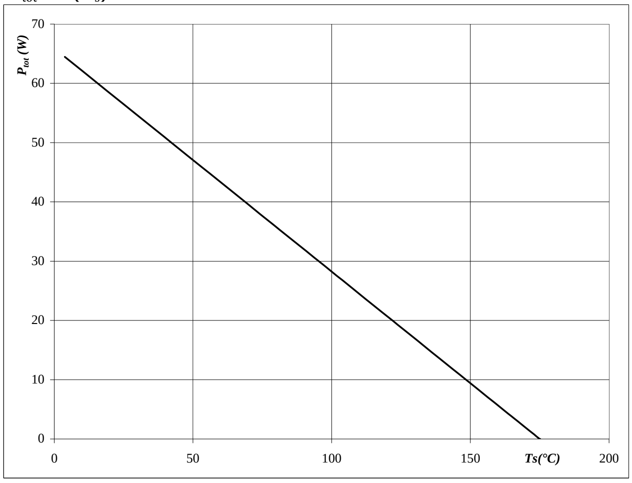
T_j = 175 °C

V_{GE} = 15 V

Figure 23 **FWD**

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



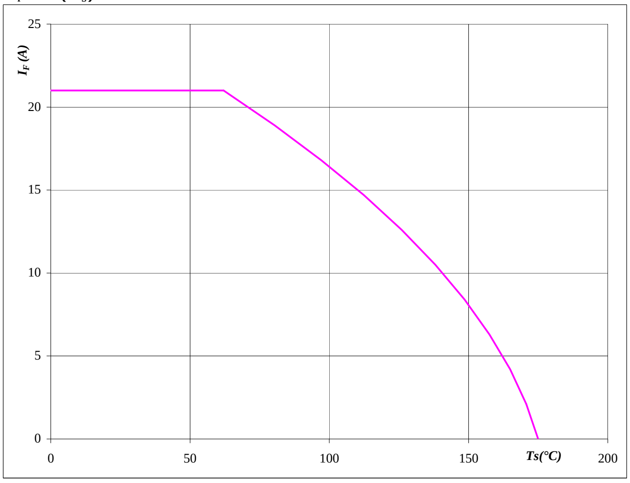
At

T_j = 175 °C

Figure 24 **FWD**

Forward current as a function of heatsink temperature

$I_F = f(T_s)$



At

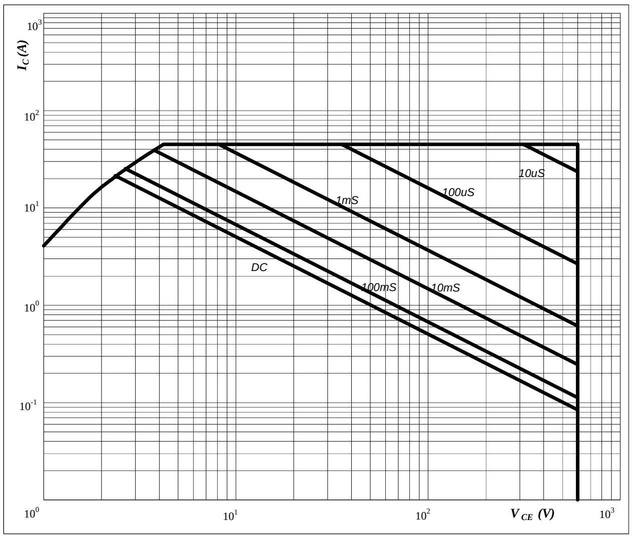
T_j = 175 °C

Inverter Characteristics

Figure 25	IGBT

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$



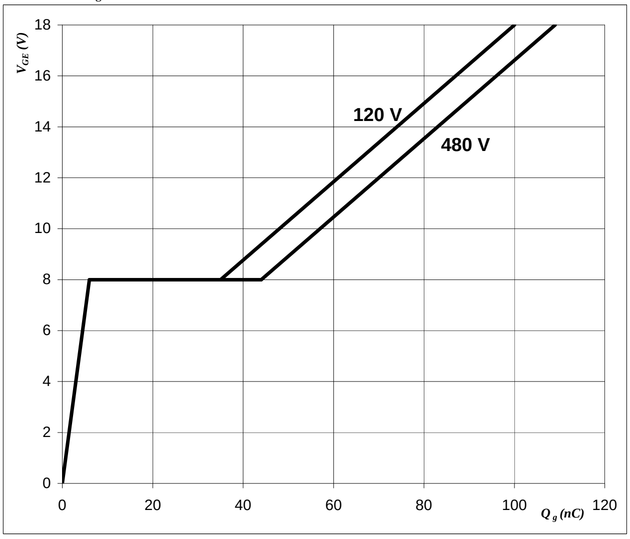
At

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

Figure 26	IGBT

Gate voltage vs Gate charge

$V_{GE} = f(Q_g)$



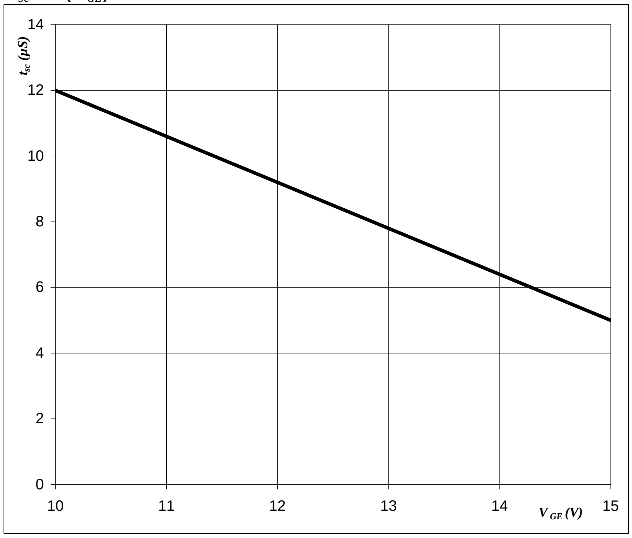
At

I_C =	15	A

Figure 27	IGBT

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

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



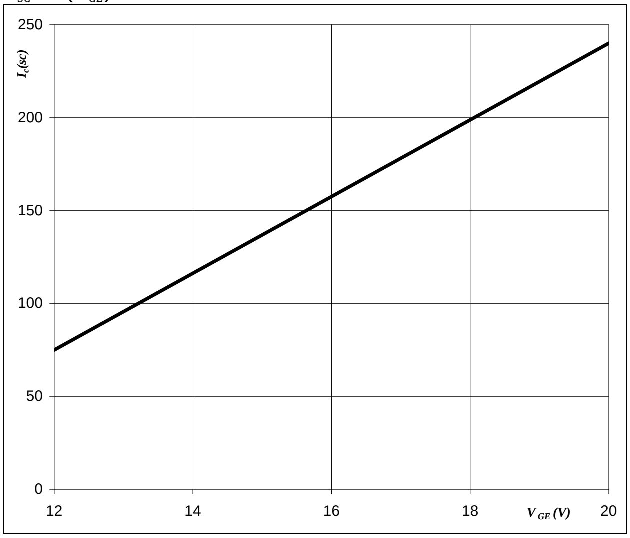
At

V_{CE} =	600	V
T_j ≤	175	ºC

Figure 28	IGBT

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

$I_{SC} = f(V_{GE})$



At

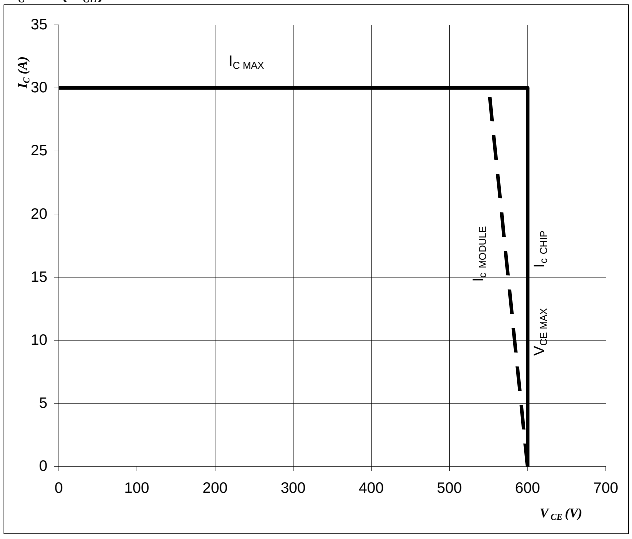
V_{CE} ≤	600	V
T_j =	175	ºC

Inverter Characteristics

Figure 29	**IGBT**

Reverse bias safe operating area

$I_C = f(V_{CE})$



At

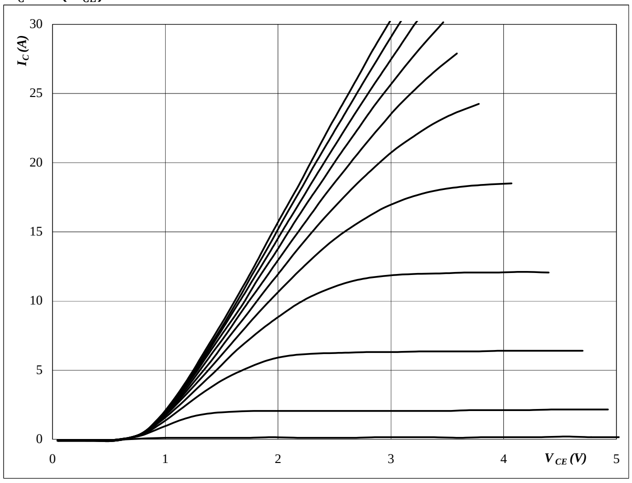
T_j = T_{jmax}-25 ºC

Brake Characteristics

Figure 1	IGBT

Typical output characteristics

$I_C = f(V_{CE})$



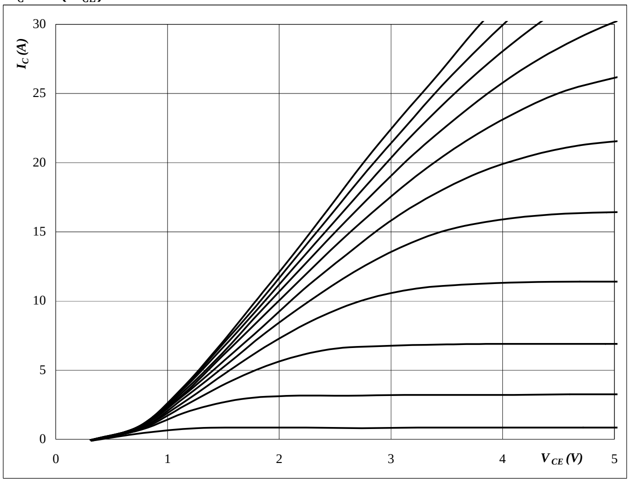
At

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

$I_C = f(V_{CE})$



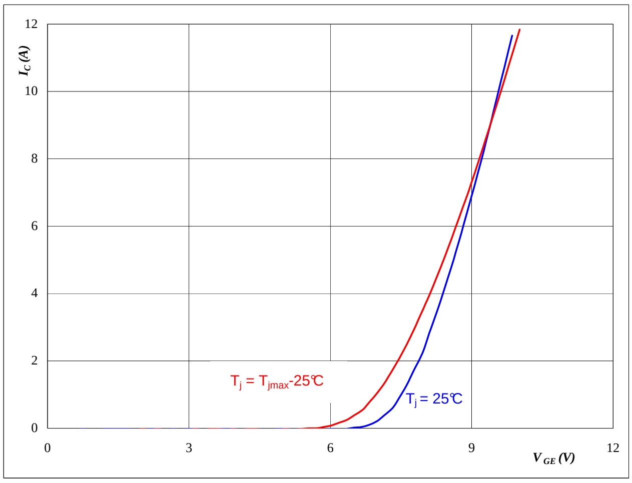
At

t_p =	250	µs
T_j =	125	°C
V_{GE} from	7 V to 17 V in steps of 1 V	

Figure 3	IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$



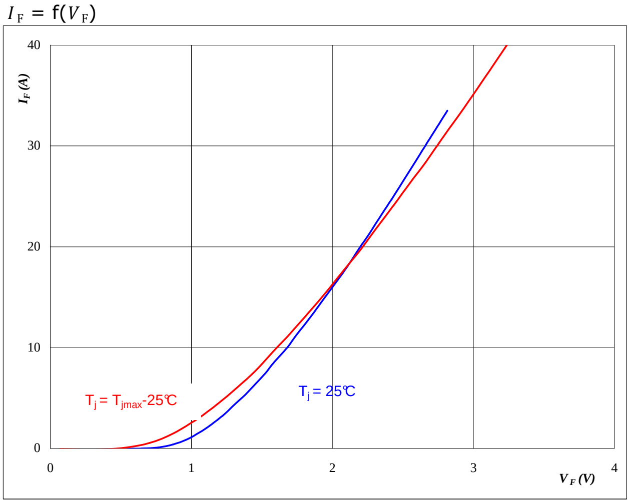
At

t_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

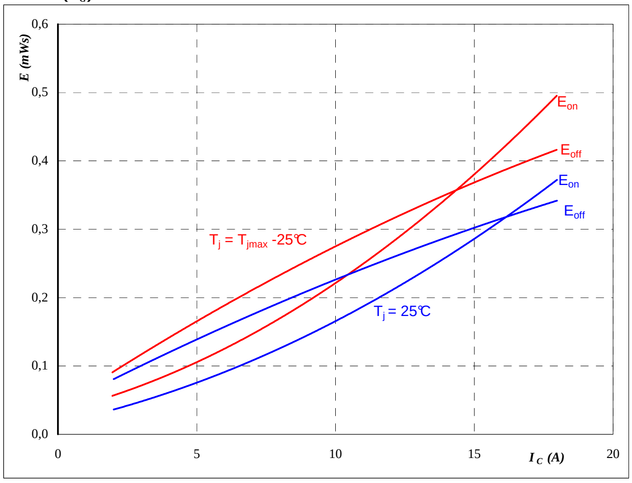
t_p =	250	µs

Brake Characteristics

Figure 5	**IGBT**

Typical switching energy losses
as a function of collector current

$E = f(I_C)$



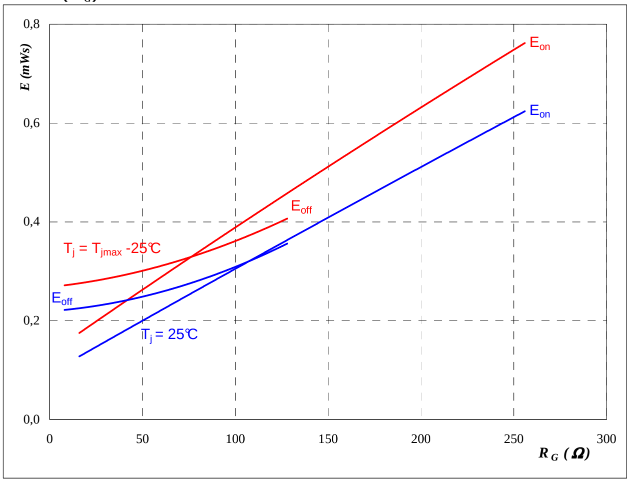
With an inductive load at

T_j =	25/125	°C
V_{CE} =	300	V
V_{GE} =	15	V
R_{gon} =	32	Ω
R_{goff} =	16	Ω

Figure 6	**IGBT**

Typical switching energy losses
as a function of gate resistor

$E = f(R_G)$



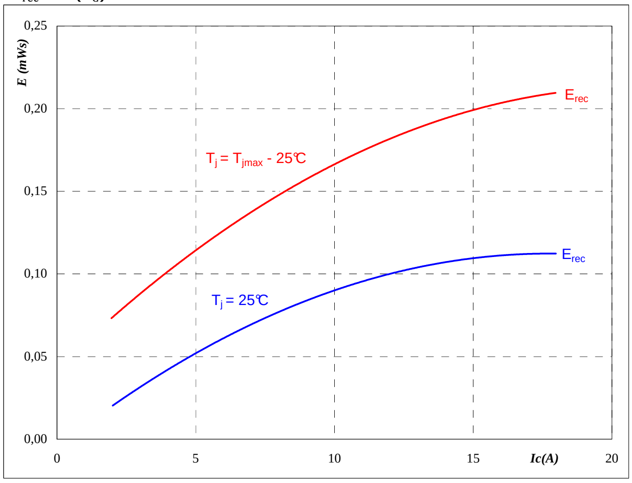
With an inductive load at

T_j =	25/125	°C
V_{CE} =	300	V
V_{GE} =	15	V
I_C =	10	A

Figure 7	**FWD**

Typical reverse recovery energy loss
as a function of collector current

$E_{rec} = f(I_C)$



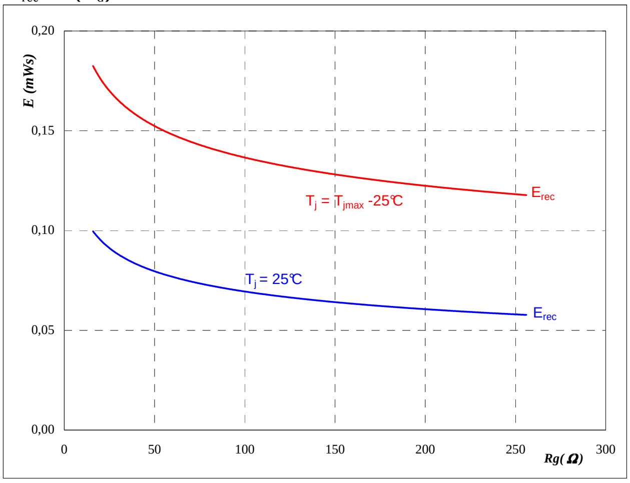
With an inductive load at

T_j =	25/125	°C
V_{CE} =	300	V
V_{GE} =	15	V
R_{gon} =	32	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

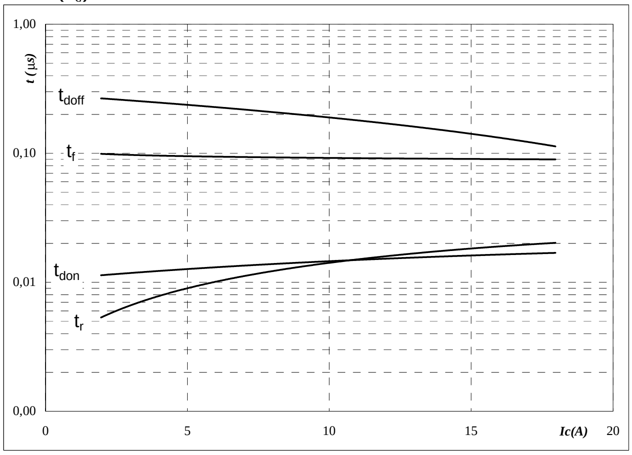
T_j =	25/125	°C
V_{CE} =	300	V
V_{GE} =	15	V
I_C =	10	A

Brake Characteristics

Figure 9 **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



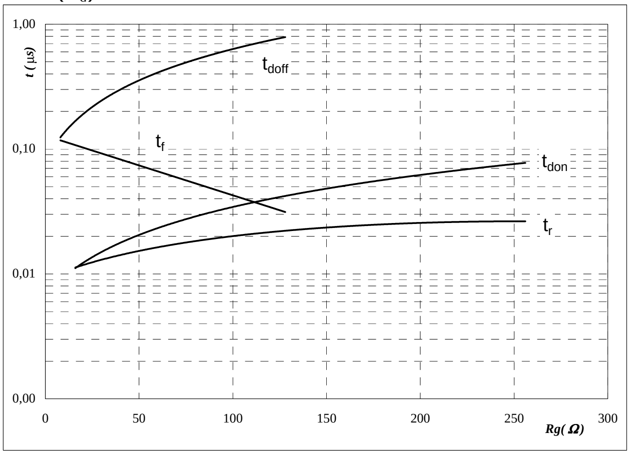
With an inductive load at

T_j =	25/125	°C
V_{CE} =	300	V
V_{GE} =	15	V
R_{gon} =	32	Ω
R_{goff} =	16	Ω

Figure 10 **IGBT**

Typical switching times as a function of gate resistor

$t = f(R_G)$



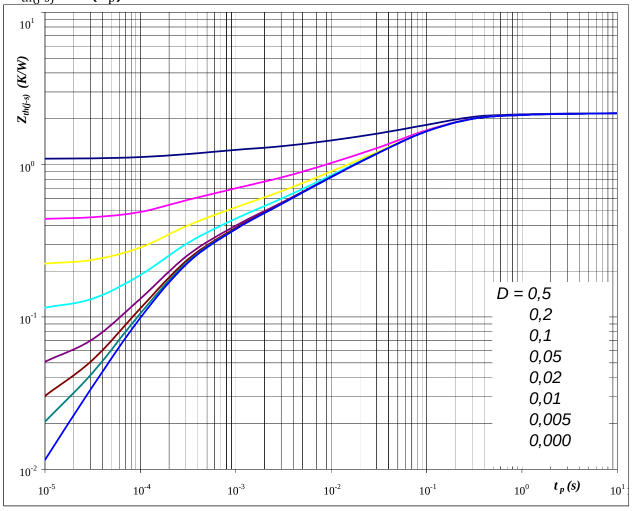
With an inductive load at

T_j =	25/125	°C
V_{CE} =	300	V
V_{GE} =	15	V
I_C =	10	A

Figure 11 **IGBT**

IGBT transient thermal impedance as a function of pulse width

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



At $D = t_p / T$

$R_{th(j\text{-}s)}$ = 2,18 K/W

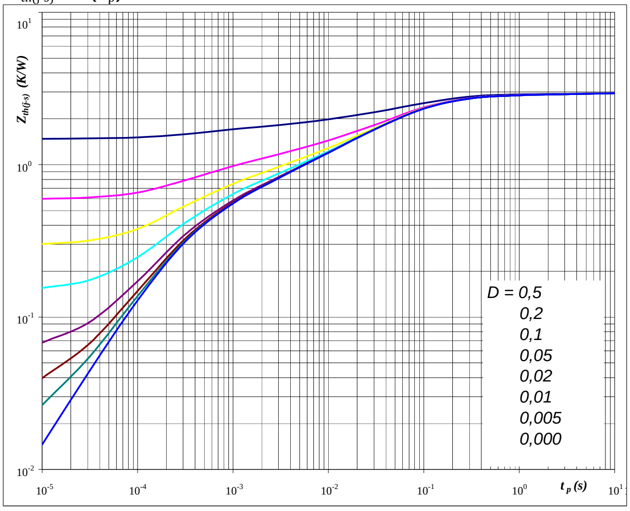
IGBT thermal model values

R (K/W)	Tau (s)
6,23E-02	3,85E+00
2,40E-01	3,55E-01
1,02E+00	7,88E-02
3,88E-01	1,12E-02
2,21E-01	2,12E-03
2,50E-01	2,46E-04

Figure 12 **FWD**

FWD transient thermal impedance as a function of pulse width

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



At $D = t_p / T$

$R_{th(j\text{-}s)}$ = 2,94 K/W

FWD thermal model values

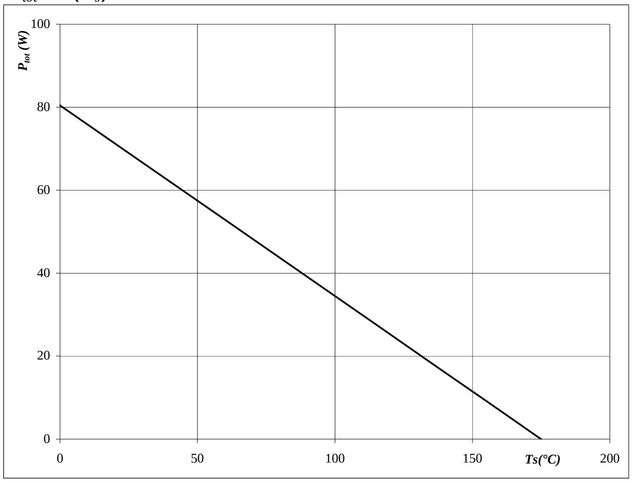
R (K/W)	Tau (s)
1,11E-01	4,12E+00
3,47E-01	2,83E-01
1,28E+00	6,32E-02
4,92E-01	1,17E-02
3,46E-01	1,99E-03
3,70E-01	2,99E-04

Brake Characteristics

Figure 13 **IGBT**

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



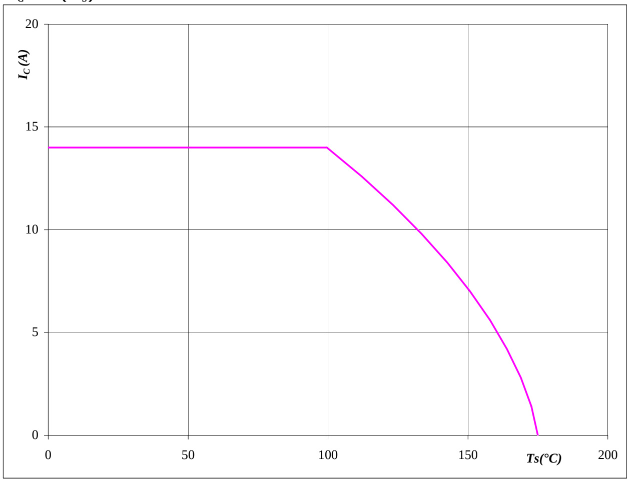
At

T_j = 175 ºC

Figure 14 **IGBT**

Collector current as a function of heatsink temperature

$I_C = f(T_s)$



At

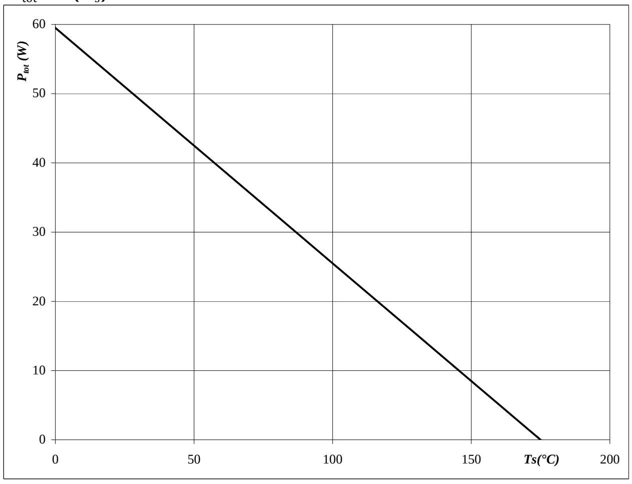
T_j = 175 ºC

V_{GE} = 15 V

Figure 15 **FWD**

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



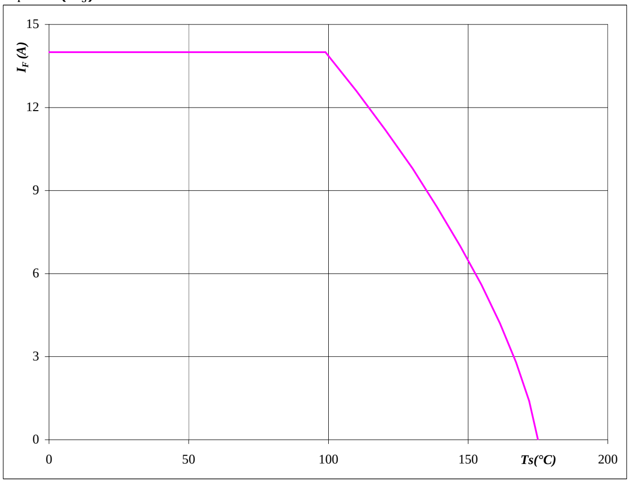
At

T_j = 175 ºC

Figure 16 **FWD**

Forward current as a function of heatsink temperature

$I_F = f(T_s)$



At

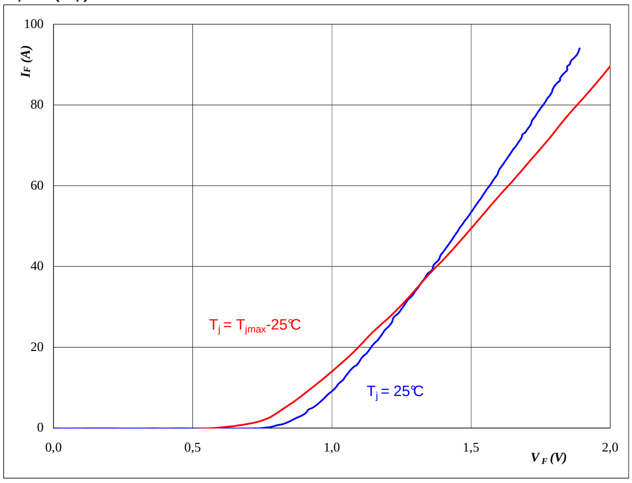
T_j = 175 ºC

Rectifier Characteristics

Figure 1 **Diode**

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



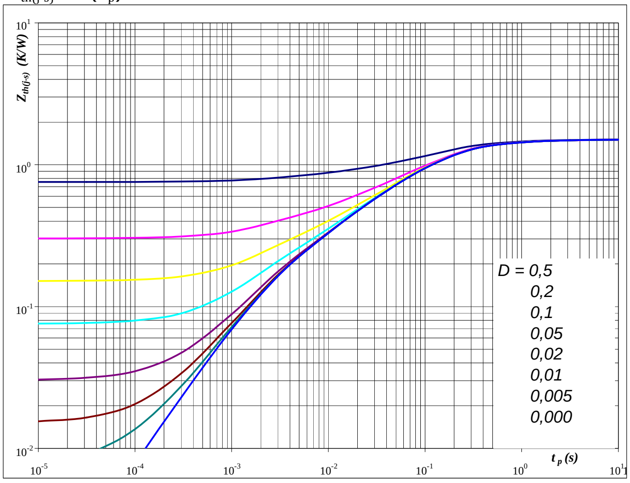
At

t_p = 250 µs

Figure 2 **Diode**

Diode transient thermal impedance as a function of pulse width

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



At

D = t_p / T

$R_{th(j\text{-}s)}$ = 1,51 K/W

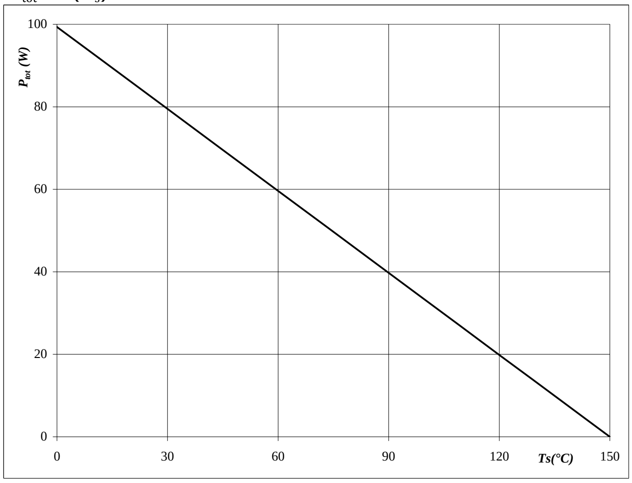
Diode thermal model values

R (K/W)	Tau (s)
3,85E-02	6,40E+00
2,39E-01	5,50E-01
7,82E-01	1,14E-01
3,05E-01	2,08E-02
1,45E-01	2,53E-03

Figure 3 **Diode**

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



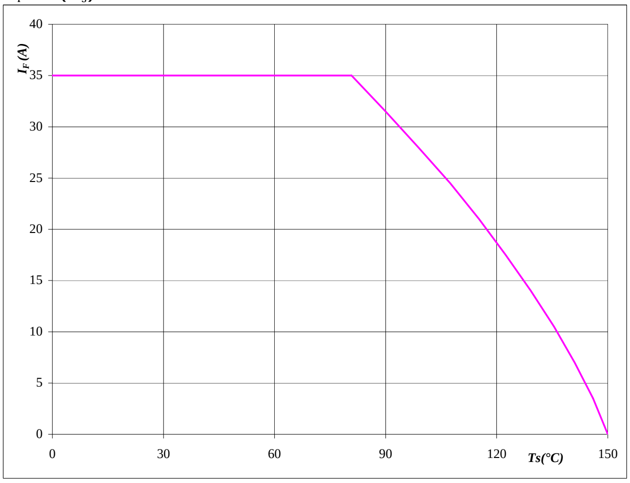
At

T_j = 150 ºC

Figure 4 **Diode**

Forward current as a function of heatsink temperature

$I_F = f(T_s)$



At

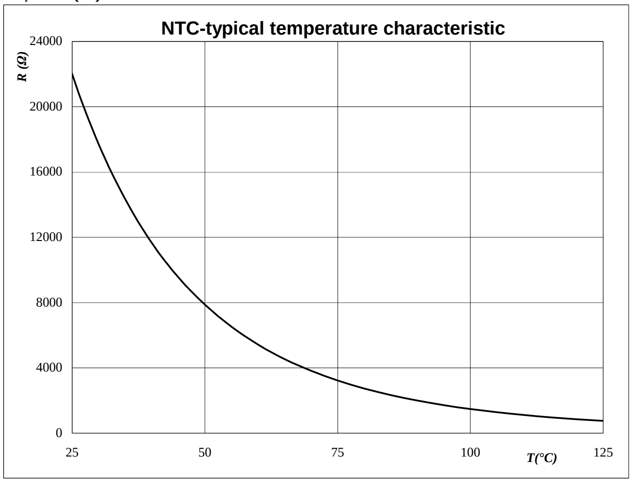
T_j = 150 ºC

Thermistor

Figure 1	**Thermistor**

Typical NTC characteristic as a function of temperature

$R_T = f(T)$



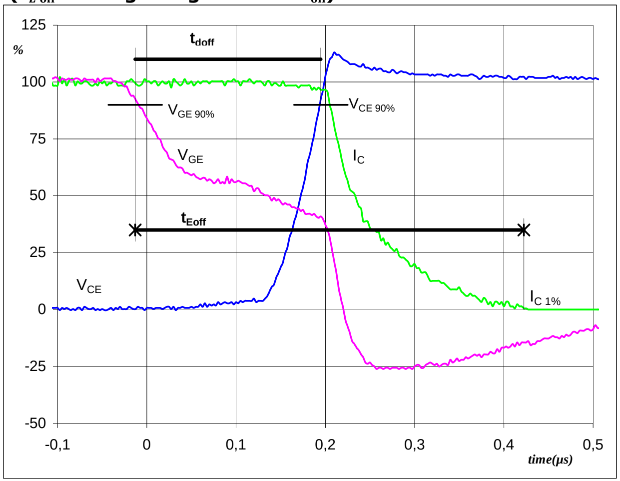
Switching Definitions Inverter

General conditions

T_j	=	125 °C
R_{gon}	=	32 Ω
R_{goff}	=	16 Ω

Figure 1 **IGBT**

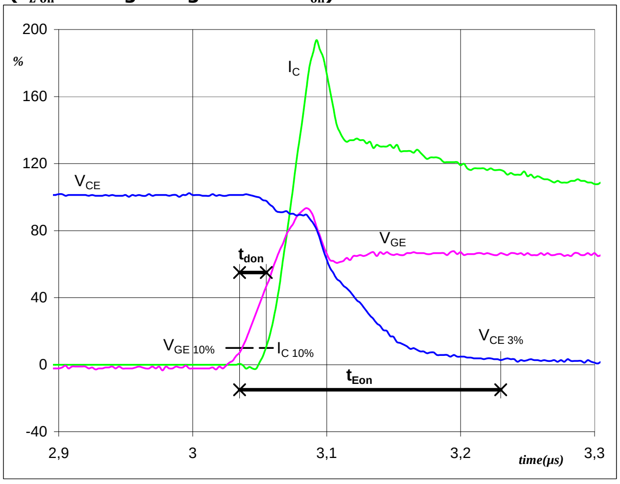
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
($t_{E\,off}$ = integrating time for E_{off})



V_{GE} (0%) =	0	V
V_{GE} (100%) =	15	V
V_C (100%) =	300	V
I_C (100%) =	15	A
t_{doff} =	0,21	µs
$t_{E\,off}$ =	0,44	µs

Figure 2 **IGBT**

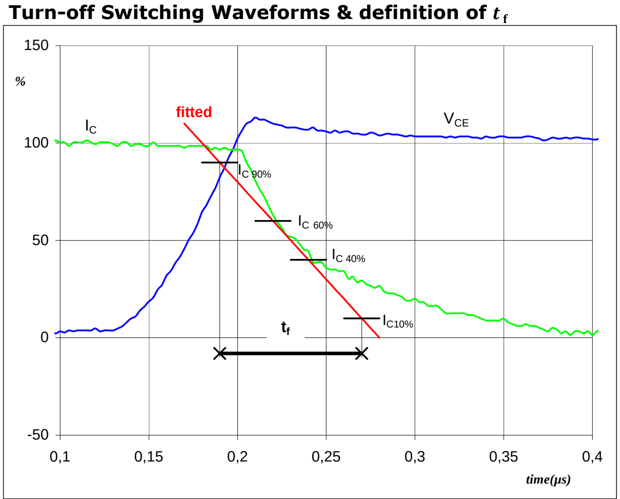
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
($t_{E\,on}$ = integrating time for E_{on})



V_{GE} (0%) =	0	V
V_{GE} (100%) =	15	V
V_C (100%) =	300	V
I_C (100%) =	15	A
t_{don} =	0,02	µs
$t_{E\,on}$ =	0,20	µs

Figure 3 **IGBT**

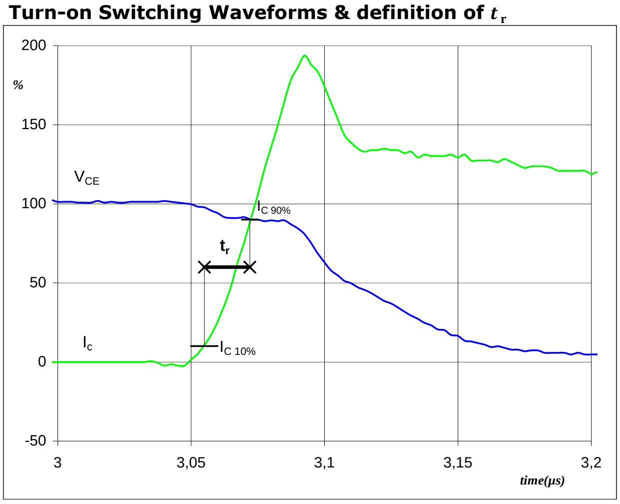
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	300	V
I_C (100%) =	15	A
t_f =	0,09	µs

Figure 4 **IGBT**

Turn-on Switching Waveforms & definition of t_r

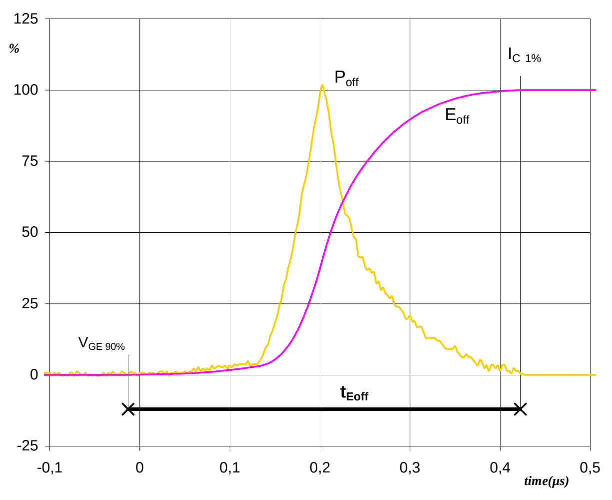


V_C (100%) =	300	V
I_C (100%) =	15	A
t_r =	0,02	µs

Switching Definitions Inverter

Figure 5 **IGBT**

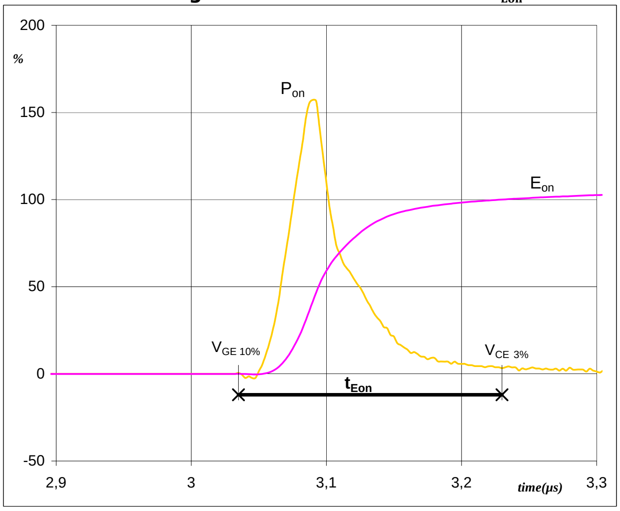
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	4,47	kW
E_{off} (100%) =	0,40	mJ
$t_{E\,off}$ =	0,44	µs

Figure 6 **IGBT**

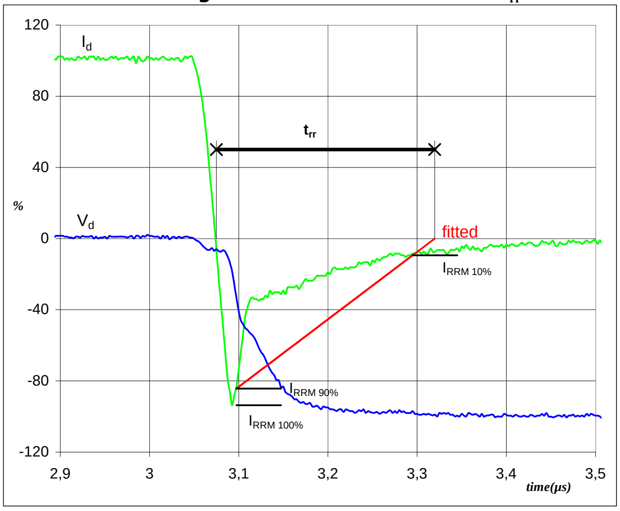
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	4,47	kW
E_{on} (100%) =	0,34	mJ
$t_{E\,on}$ =	0,20	µs

Figure 7 **FWD**

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

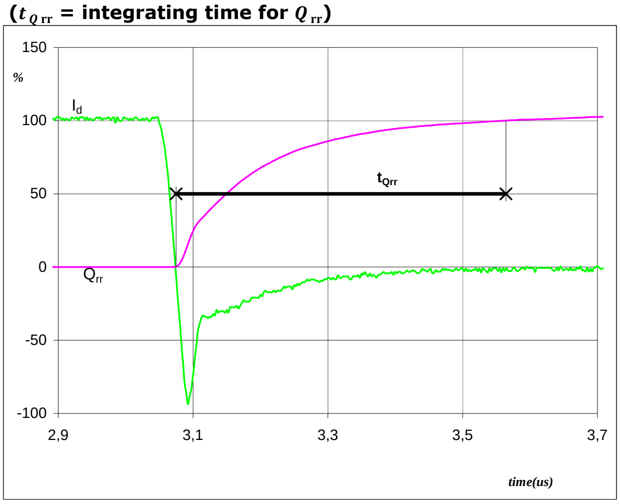


V_d (100%) =	300	V
I_d (100%) =	15	A
I_{RRM} (100%) =	14	A
t_{rr} =	0,21	µs

Switching Definitions Inverter

Figure 8	**FWD**

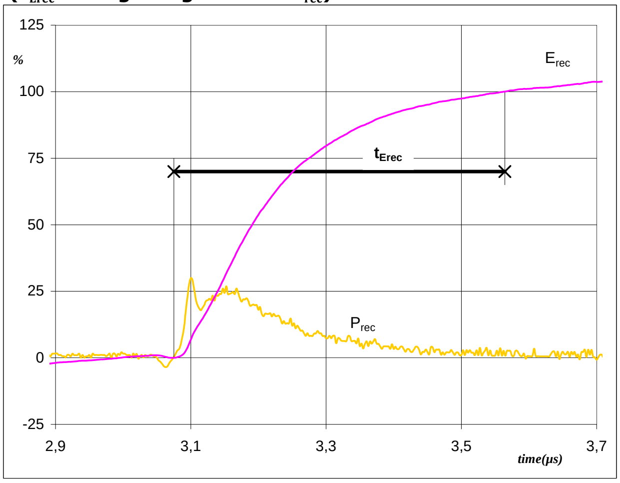
Turn-on Switching Waveforms & definition of t_{Qrr}
($t_{Q\,rr}$ = integrating time for Q_{rr})



I_d (100%) =	15	A
Q_{rr} (100%) =	1,01	µC
$t_{Q\,rr}$ =	0,49	µs

Figure 9	**FWD**

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



P_{rec} (100%) =	4,47	kW
E_{rec} (100%) =	0,20	mJ
$t_{E\,rec}$ =	0,49	µs

Ordering Code and Marking - Outline - Pinout

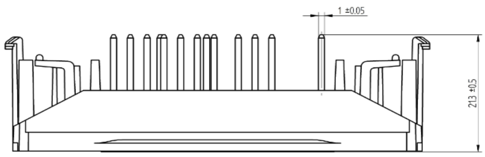
Ordering Code & Marking

Version	Ordering Code
without thermal paste 12mm housing	V23990-P544-A28-PM
with thermal paste 12mm housing	V23990-P544-A28-/3/-PM
without thermal paste 17mm housing	V23990-P544-A29-PM
without thermal paste 12mm housing 1 phase rectifier	V23990-P544-B28-PM
with thermal paste 12mm housing 1 phase rectifier	V23990-P544-B28-/3/-PM
with thermal paste 12mm housing 1 phase rectifier	V23990-P544-B128-/3/-PM
without thermal paste 17mm housing 1phase rectifier	V23990-P544-B129-PM
without thermal paste 17mm housing without brake	V23990-P544-C29-PM
without thermal paste 12mm housing	V23990-P544-C28-PM
with thermal paste 12mm housing	V23990-P544-C28-/3/-PM

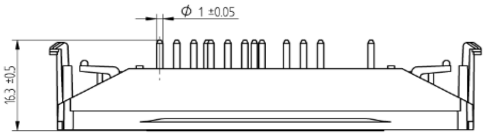
Text	**VIN**	**Date code**	**Name&Ver**	**UL**	**Lot**	**Serial**
	VIN	WWYY	NNNNNNVV	UL	LLLLL	SSSS
Datamatrix	**Name&Ver**	**Lot number**	**Serial**	**Date code**		
	NNNNNNVV	LLLLL	SSSS	WWYY		

Outline

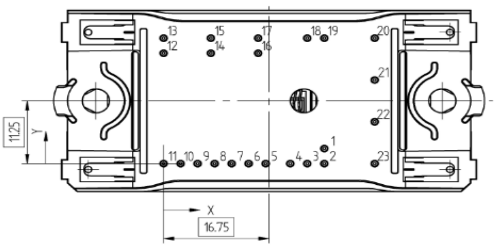
Pin	X	Y	Function
1	25,5	2,7	NTC1
2	25,5	0	NTC2
3	22,8	0	DC-
4	20,1	0	BRCG
5	16,2	0	BRCE
6	13,5	0	G6
7	10,8	0	E6
8	8,1	0	G5
9	5,4	0	E5
10	2,7	0	G4
11	0	0	E4
12	0	19,8	G1
13	0	22,5	U
14	7,5	19,8	G2
15	7,5	22,5	V
16	15	19,8	G3
17	15	22,5	W
18	22,8	22,5	INV+
19	25,5	22,5	DC+
20	33,5	22,5	BRC+
21	33,5	15	L1
22	33,5	7,5	L2
23	33,5	0	L3



17mm housing



12mm housing

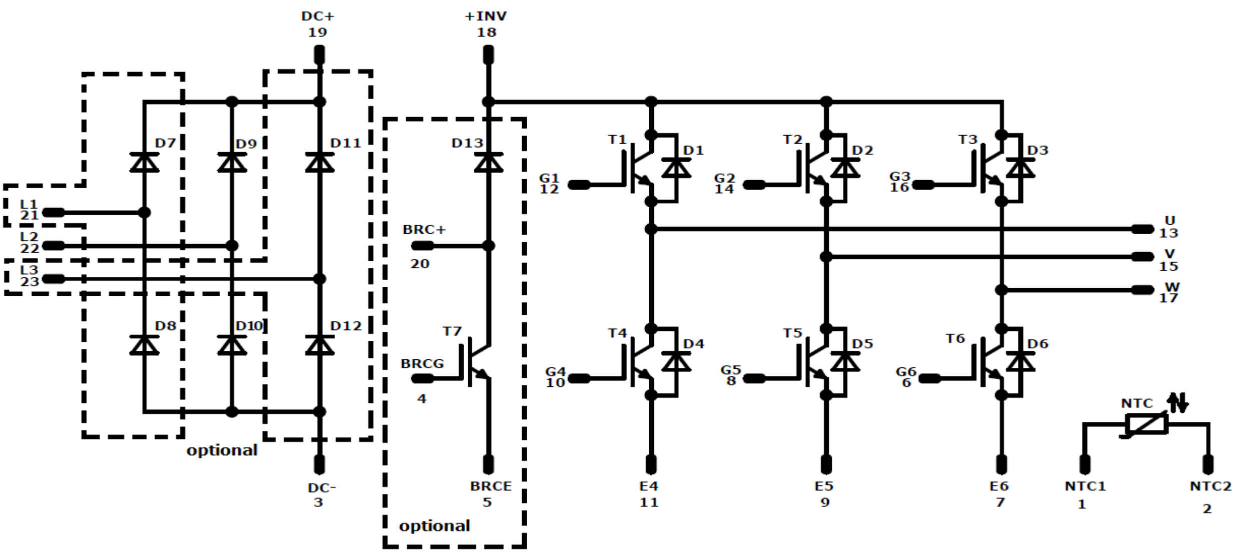


Pinout variation

Module subtype	Not assebled pins
V23990-P544-A28-PM	-
V23990-P544-A29-PM	-
V23990-P544-B28-PM	21
V23990-P544-B128-PM	23
V23990-P544-B129-PM	23
V23990-P544-C28-PM	4, 5, 20
V23990-P544-C29-PM	4, 5, 20

Ordering Code and Marking - Outline - Pinout

Pinout



Identification

ID	Component	Voltage	Current	Function	Comment
D7,D8,D9,D10,D11,D12	Diode	1600 V	25 A	Rectifier Diode	
T1,T2,T3,T4,T5,T6	IGBT	600 V	15 A	Inverter Switch	
D1,D2,D3,D4,D5,D6	FWD	600 V	15 A	Inverter Diode	
T7	IGBT	600 V	10 A	Brake Switch	
D13	FWD	600 V	10 A	Brake Diode	
NTC	NTC			Thermistor	

Packaging instruction					
Standard packaging quantity (SPQ)	**135**	>SPQ	Standard	<SPQ	Sample

Handling instruction
Handling instructions for *flow* 0 packages see vincotech.com website.

Package data
Package data for *flow* 0 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
V23990-P544-x2x-D8-14	27 Aug. 2019	P544-C28 added	1,22