V23990-P540-A01-PM
V23990-P540-C01-PM

datasheet

flow **PIM 0** — **1200 V / 15 A**

Features

- Clip in PCB mounting
- Trench Fieldstop IGBT's for low saturation losses

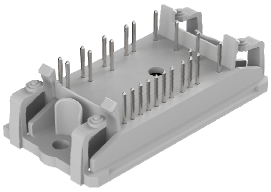
Target Applications

- Industrial Drives
- Embedded Generation

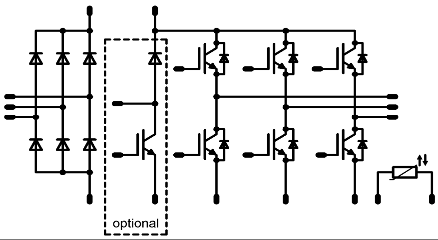
Types

- V23990-P540-A01-PM
- V23990-P540-C01-PM

flow 0 17mm 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	44	A
Surge (non-repetitive) forward current	I_{FSM}	t_p = 10 ms	T_j = 25 °C	270	A
I2t-value	I^2t			370	A^2s
Power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	56	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	23	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	59	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 1200	μs V
Maximum Junction Temperature	T_{jmax}			150	°C

Maximum Ratings

T_j = 25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Inverter Diode					
Peak Repetitive Reverse Voltage	V_{RRM}	T_j = 25 °C		1200	V
DC forward current	I_F	$T_j = T_{jmax}$	T_s = 80 °C	20	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	42	W
Maximum Junction Temperature	T_{jmax}			150	°C
Brake Switch					
Collector-emitter break down voltage	V_{CE}			1200	V
DC collector current	I_C	$T_j = T_{jmax}$	T_s = 80 °C	11	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}		24	A
Turn off safe operating area		V_{CE} ≤ 1200V, T_j ≤ T_{op} max		24	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	46	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 1200	μs V
Maximum Junction Temperature	T_{jmax}			150	°C
Brake Diode					
Peak Repetitive Reverse Voltage	V_{RRM}	T_j = 25 °C		1200	V
DC forward current	I_F	$T_j = T_{jmax}$	T_s = 80 °C	12	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}		18	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	32	W
Maximum Junction Temperature	T_{jmax}			150	°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_{is}	DC voltage	t = 2 s	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] 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				30	25 125	0,8	1,19 1,17	1,8	V
Threshold voltage (for power loss calc. only)	V_{to}				30	25 125		0,91 0,79		V
Slope resistance (for power loss calc. only)	r_t				30	25 125		8 11		mΩ
Reverse current	I_r			1500		25 150			0,05 1,1	mA
Thermal resistance junction to sink	$R_{th(j-s)}$	phase-change material λ = 3,4 W/mK						1,25		K/W
Inverter Switch										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,0006	25	5	5,8	6,5	V
Collector-emitter saturation voltage	V_{CEsat}		15		15	25 125	1,35	1,69 1,92	2,35	V
Collector-emitter cut-off current incl. Diode	I_{CES}		0	1200		25			0,002	mA
Gate-emitter leakage current	I_{GES}		20	0		25			120	nA
Integrated Gate resistor	R_{gint}							none		Ω
Turn-on delay time	$t_{d(on)}$	R_{goff} = 64 Ω R_{gon} = 64 Ω	±15	600	15	25 125		214 217		ns
Rise time	t_r					25 125		19 25		
Turn-off delay time	$t_{d(off)}$					25 125		326 394		
Fall time	t_f					25 125		124 184		
Turn-on energy loss	E_{on}					25 125		1,36 1,81		mWs
Turn-off energy loss	E_{off}					25 125		1,14 1,71		
Input capacitance	C_{ies}	f = 1 MHz	0	25		25		1090		pF
Output capacitance	C_{oss}							58		
Reverse transfer capacitance	C_{rss}							48		
Gate charge	Q_G		15	960	15	25		80		nC
Thermal resistance junction to case	$R_{th(j-s)}$	phase-change material λ = 3,4 W/mK						1,19		K/W
Inverter Diode										
Diode forward voltage	V_F				15	25 125	1	1,73 1,73	2,4	V
Peak reverse recovery current	I_{RRM}	R_{gon} = 64 Ω	±15	600	15	25 125		16 17		A
Reverse recovery time	t_{rr}					25 125		322 485		ns
Reverse recovered charge	Q_{rr}					25 125		1,86 3,11		μC
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125		221 85		A/μs
Reverse recovered energy	E_{rec}					25 125		0,65 1,18		mWs
Thermal resistance junction to case	$R_{th(j-s)}$	phase-change material λ = 3,4 W/mK						1,66		K/W

Characteristic Values

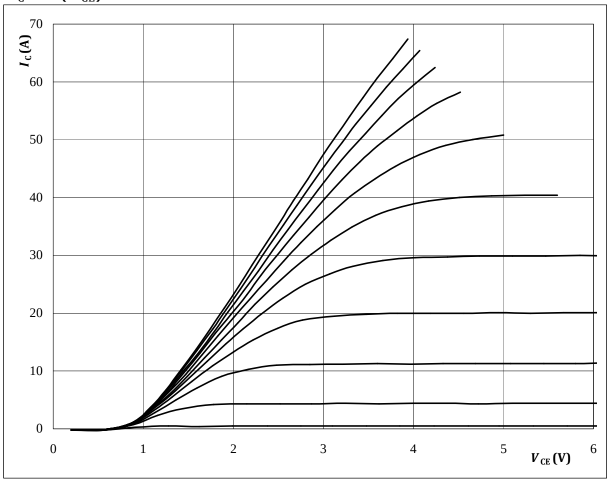
Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] V_{GS} [V]	V_r [V] V_{CE} [V] V_{DS} [V]	I_C [A] I_F [A] I_D [A]	T_j [°C]	Min	Typ	Max	
Brake Switch										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,0003	25	5	5,8	6,5	V
Collector-emitter saturation voltage	V_{CEsat}		15		8	25 125	1,35	1,65 1,85	2,05	V
Collector-emitter cut-off incl diode	I_{CES}		0	1200		25			0,05	mA
Gate-emitter leakage current	I_{GES}		20	0		25			120	nA
Integrated Gate resistor	R_{gint}							none		Ω
Turn-on delay time	$t_{d(on)}$					25 125		131 132		
Rise time	t_r					25 125		14 20		ns
Turn-off delay time	$t_{d(off)}$	R_{goff} = 64 Ω R_{gon} = 64 Ω	±15	600	8	25 125		254 315		
Fall time	t_f					25 125		99 177		
Turn-on energy loss	E_{on}					25 125		0,57 0,77		mWs
Turn-off energy loss	E_{off}					25 125		0,55 0,82		
Input capacitance	C_{ies}							605		
Output capacitance	C_{oss}	f = 1 MHz	0	25		25		37		pF
Reverse transfer capacitance	C_{rss}							29		
Gate charge	Q_G		15	960	8	25		52		nC
Thermal resistance junction to case	$R_{th(j-s)}$	phase-change material λ = 3,4 W/mK						1,51		K/W
Brake Diode										
Diode forward voltage	V_F				7,5	25 125	0,8	1,75 1,81	2,2	V
Reverse leakage current	I_r			1200		25			250	µA
Peak reverse recovery current	I_{RRM}					25 125		10 11		A
Reverse recovery time	t_{rr}					25 125		281 442		ns
Reverse recovered charge	Q_{rr}	R_{gon} = 64 Ω	±15	600	8	25 125		0,98 0,98		µC
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125		126 60		A/µs
Reverse recovery energy	E_{rec}					25 125		0,36 0,67		mWs
Thermal resistance junction to case	$R_{th(j-s)}$	phase-change material λ = 3,4 W/mK						2,20		K/W
Thermistor										
Rated resistance	R					25		22000		Ω
Deviation of R_{100}	$\Delta_{R/R}$	R_{100} = 1486 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

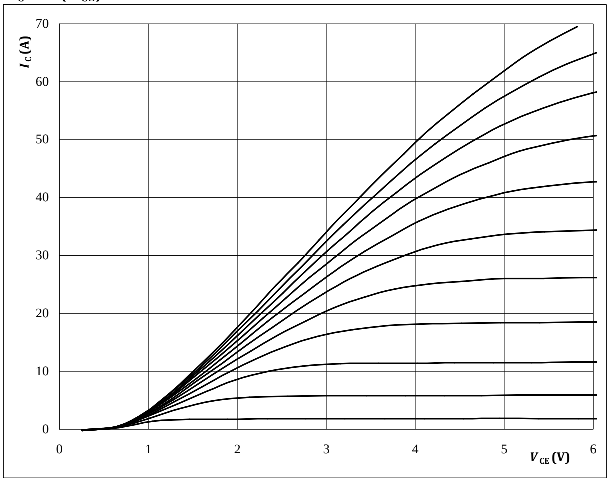
T_j = 25 °C

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

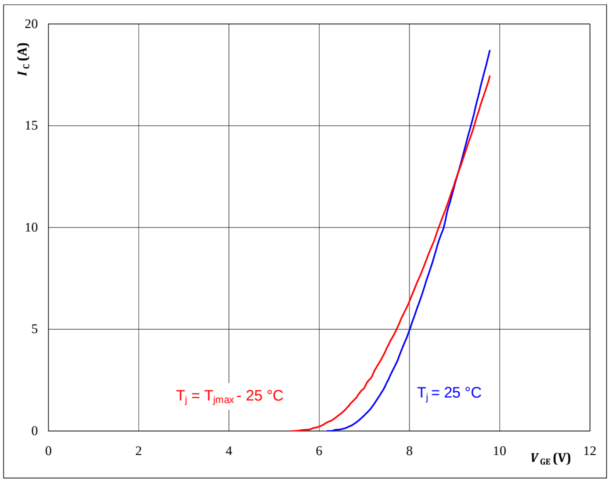
T_j = 125 °C

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

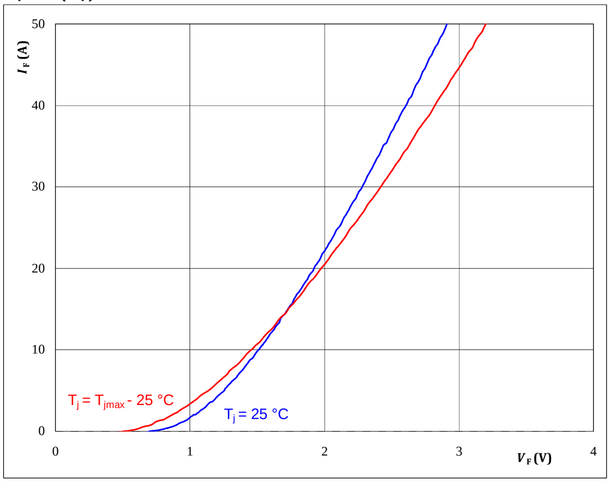
t_p = 250 µs

V_{CE} = 10 V

figure 4. **FWD**

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

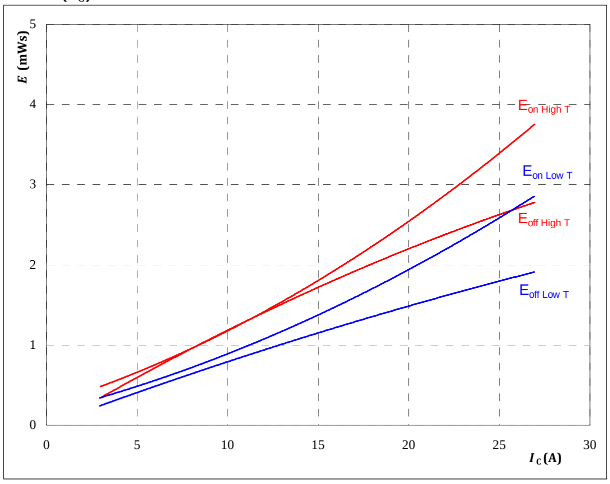
t_p = 250 µs

Inverter Characteristics

figure 5. **IGBT**

Typical switching energy losses
as a function of collector current

$E = f(I_C)$



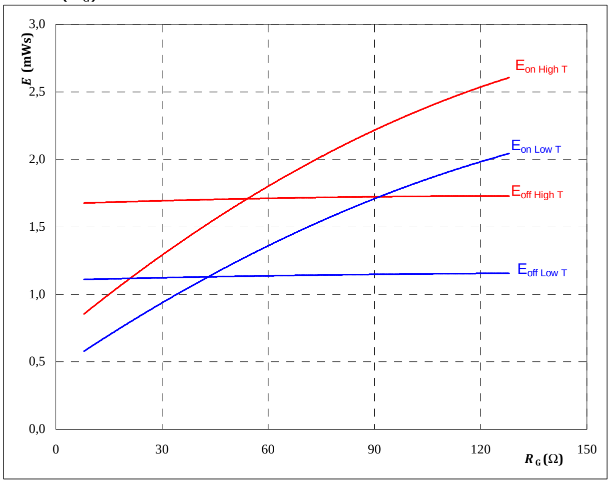
With an inductive load at

T_j =	25/125	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	64	Ω
R_{goff} =	64	Ω

figure 6. **IGBT**

Typical switching energy losses
as a function of gate resistor

$E = f(R_G)$



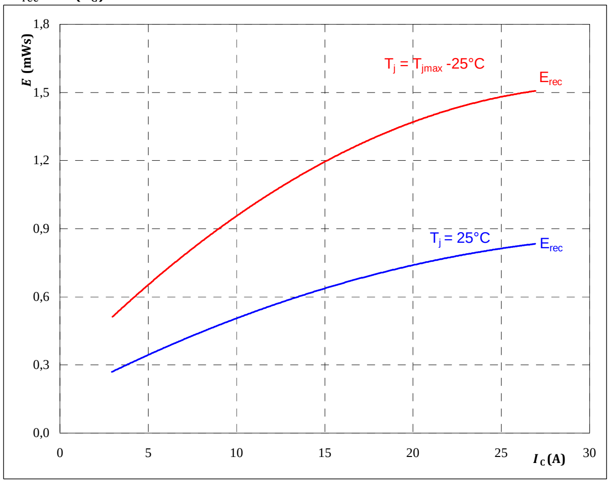
With an inductive load at

T_j =	25/125	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	15	A

figure 7. **FWD**

Typical reverse recovery energy loss
as a function of collector current

$E_{rec} = f(I_C)$



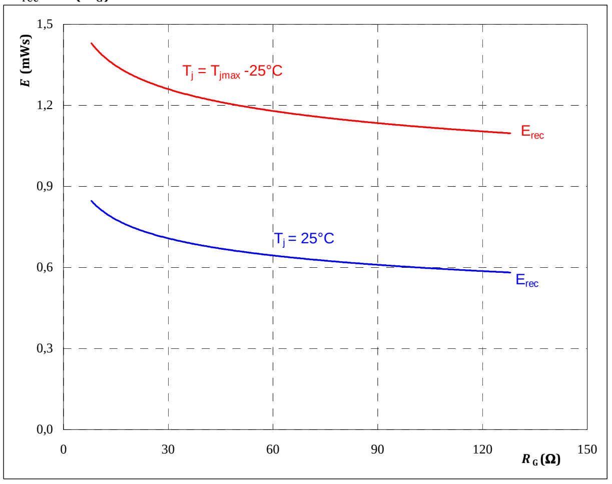
With an inductive load at

T_j =	25/125	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	64	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

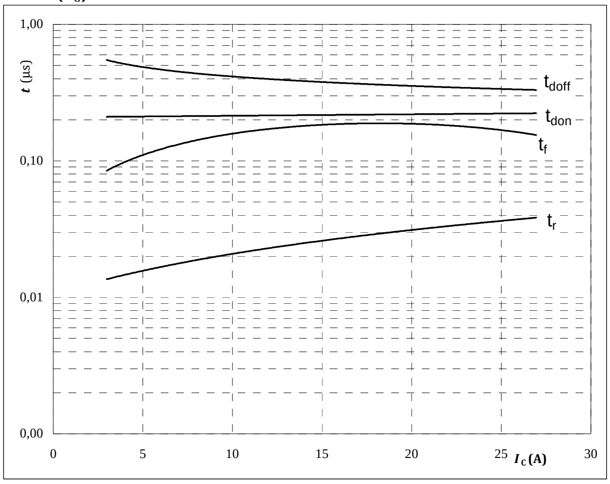
T_j =	25/125	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	15	A

Inverter Characteristics

figure 9. **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



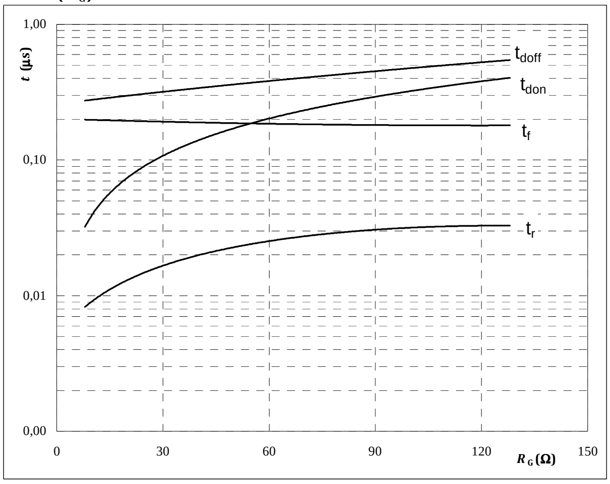
With an inductive load at

T_j =	125	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	64	Ω
R_{goff} =	64	Ω

figure 10. **IGBT**

Typical switching times as a function of gate resistor

$t = f(R_G)$



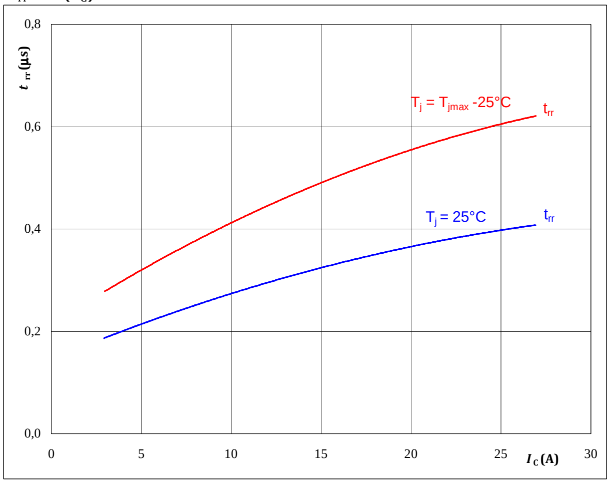
With an inductive load at

T_j =	125	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	15	A

figure 11. **FWD**

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$



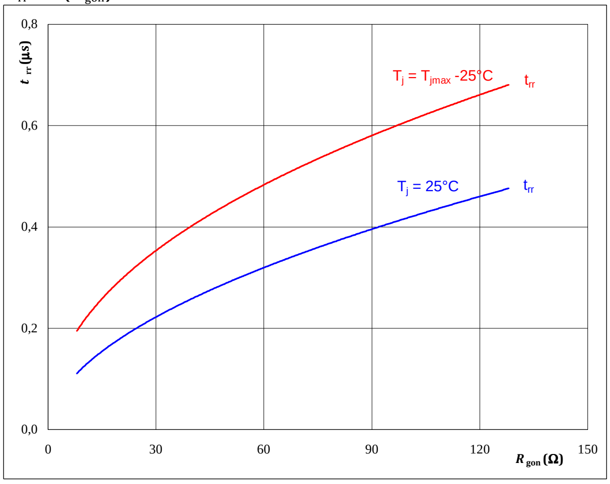
At

T_j =	25/125	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	64	Ω

figure 12. **FWD**

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

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



At

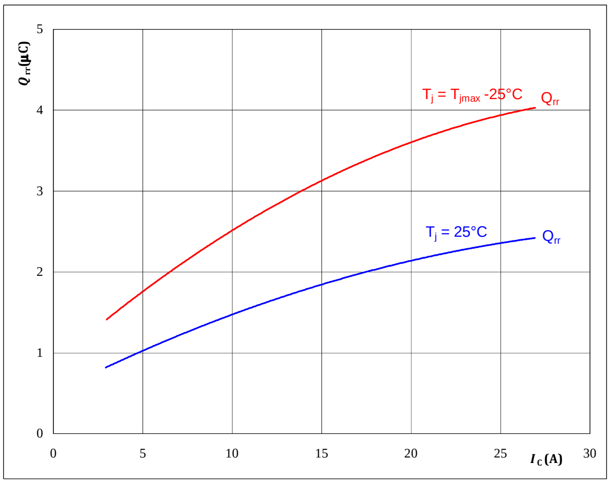
T_j =	25/125	°C
V_R =	600	V
I_F =	15	A
V_{GE} =	±15	V

Inverter Characteristics

figure 13. **FWD**

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



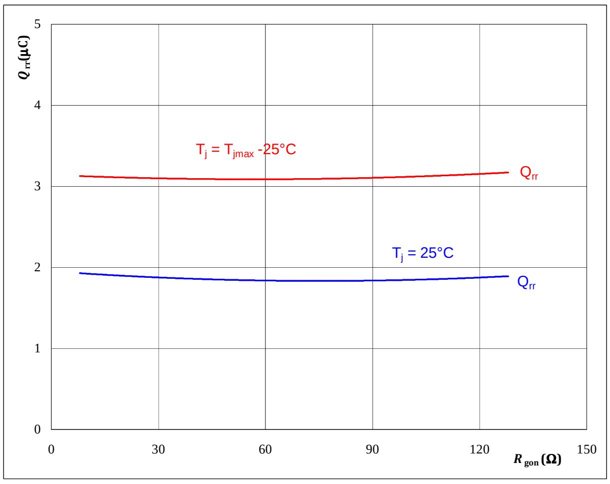
At

T_j =	25/125	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	64	Ω

figure 14. **FWD**

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

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



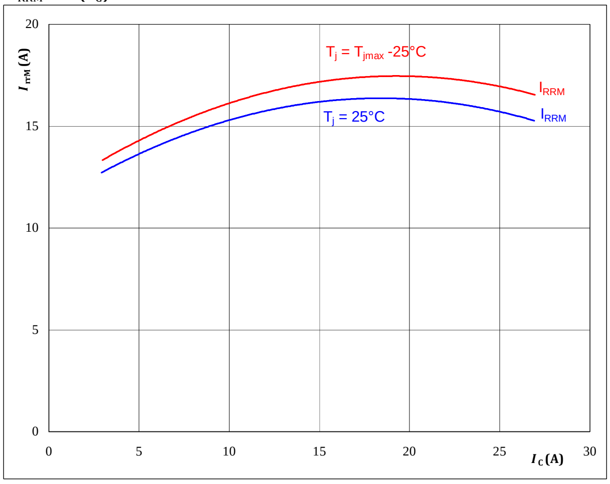
At

T_j =	25/125	°C
V_R =	600	V
I_F =	15	A
V_{GE} =	±15	V

figure 15. **FWD**

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



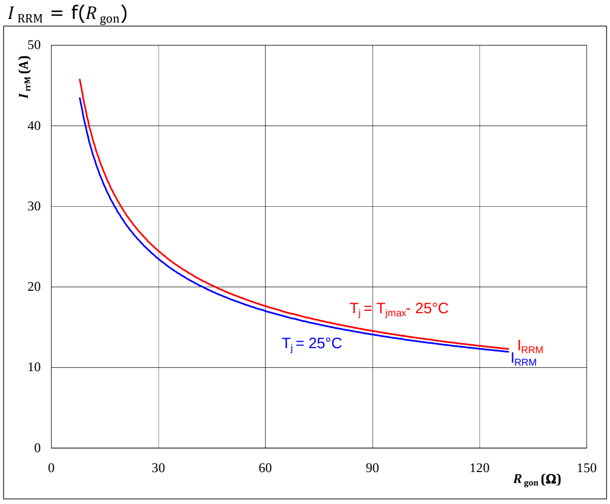
At

T_j =	25/125	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	64	Ω

figure 16. **FWD**

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

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



At

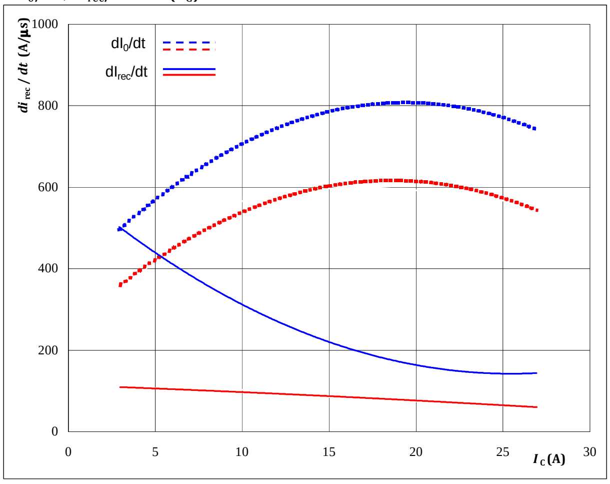
T_j =	25/125	°C
V_R =	600	V
I_F =	15	A
V_{GE} =	±15	V

Inverter Characteristics

figure 17. **FWD**

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

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



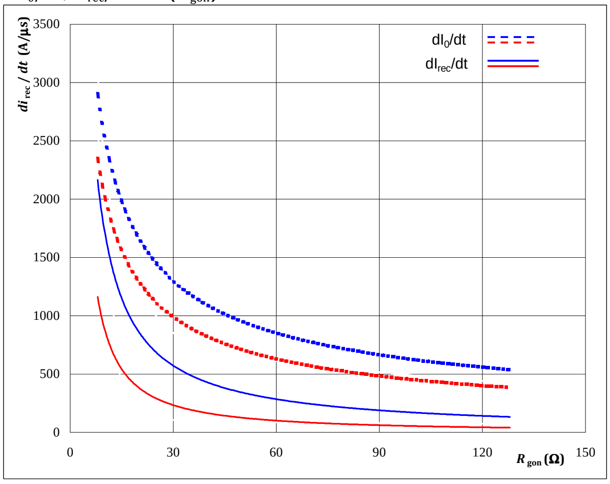
At

T_j =	25/125	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	64	Ω

figure 18. **FWD**

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

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



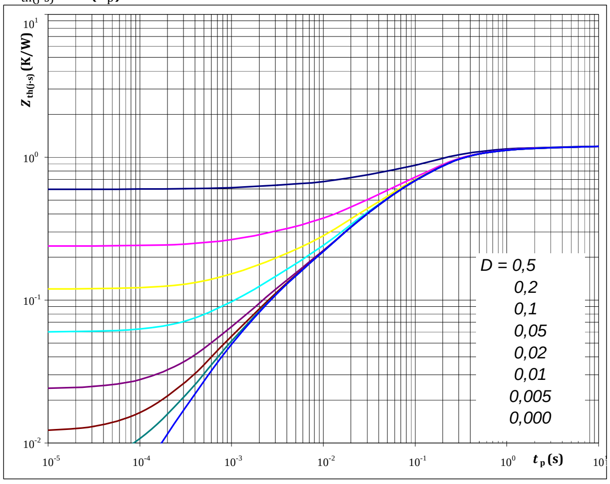
At

T_j =	25/125	°C
V_R =	600	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	
$R_{th(j-s)}$ =	1,19	K/W

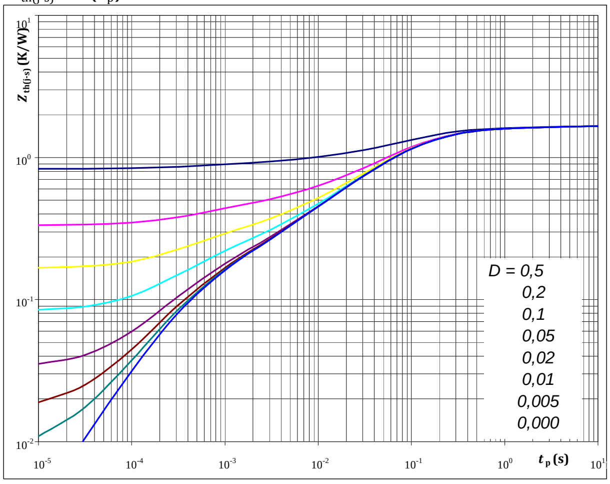
IGBT thermal model values

R (K/W)	Tau (s)
8,1E-02	2,9E+00
3,3E-01	3,8E-01
6,5E-01	1,0E-01
2,3E-01	1,6E-02
7,2E-02	1,5E-03

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	
$R_{th(j-s)}$ =	1,66	K/W

FWD thermal model values

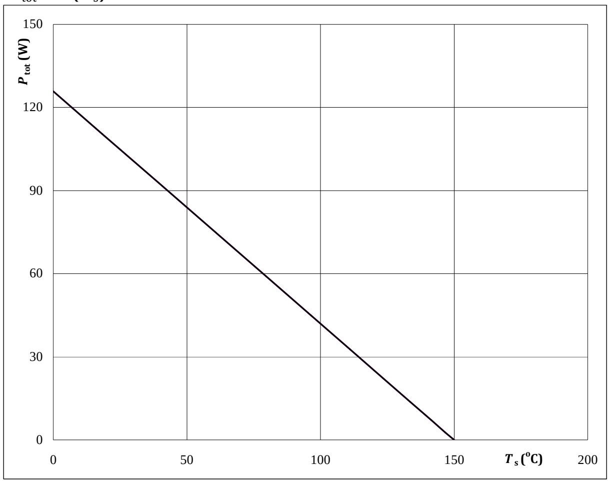
R (K/W)	Tau (s)
7,9E-02	3,0E+00
2,5E-01	3,7E-01
8,0E-01	8,4E-02
3,1E-01	1,7E-02
1,2E-01	2,7E-03
1,0E-01	3,8E-04

Inverter Characteristics

figure 21. **IGBT**

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



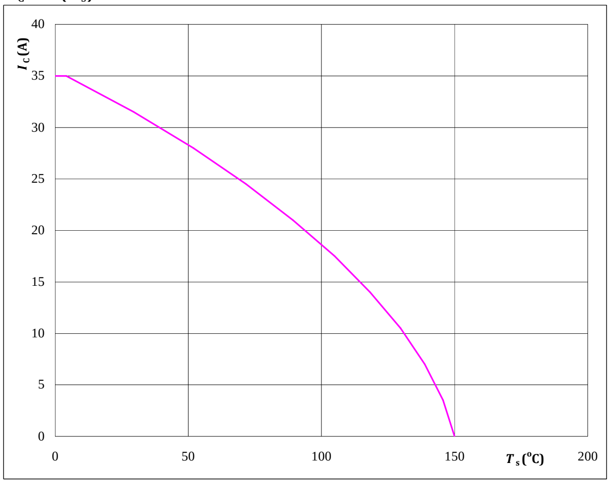
At

T_j = 150 °C

figure 22. **IGBT**

Collector current as a function of heatsink temperature

$I_C = f(T_s)$



At

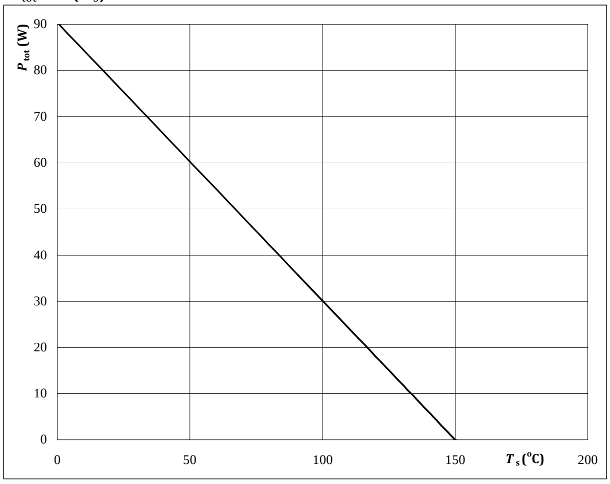
T_j = 150 °C

V_{GE} = 15 V

figure 23. **FWD**

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



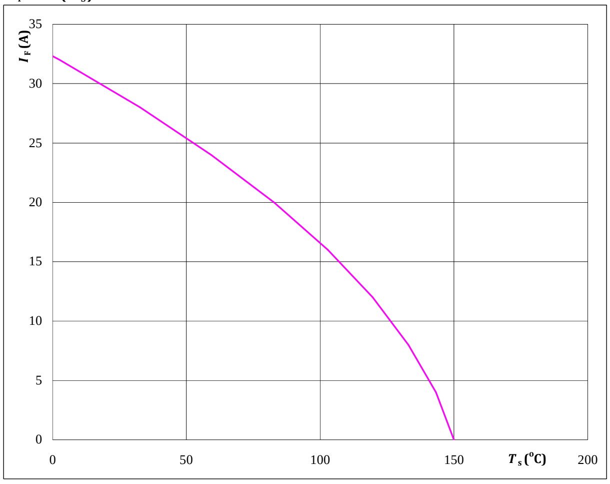
At

T_j = 150 °C

figure 24. **FWD**

Forward current as a function of heatsink temperature

$I_F = f(T_s)$



At

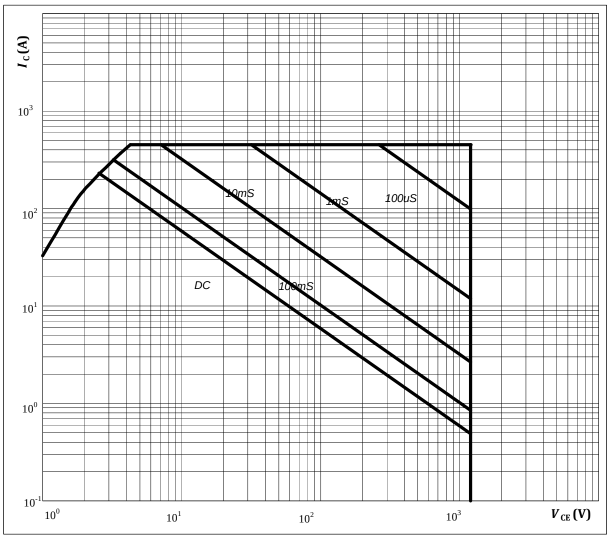
T_j = 150 °C

Inverter Characteristics

figure 25. **IGBT**

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$



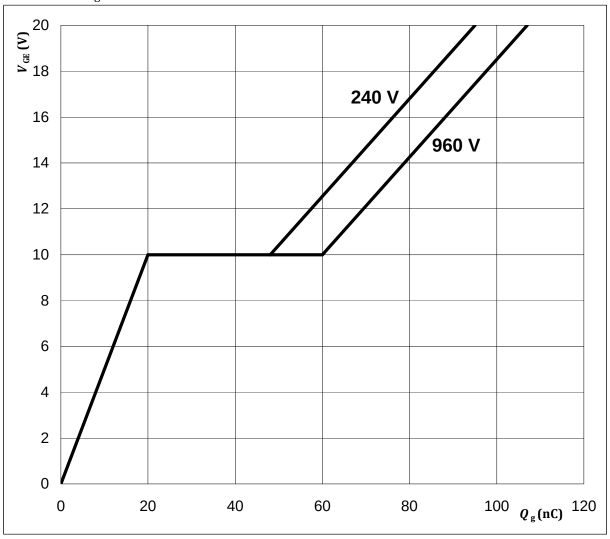
At

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

figure 26. **IGBT**

Gate voltage vs Gate charge

$V_{GE} = f(Q_g)$



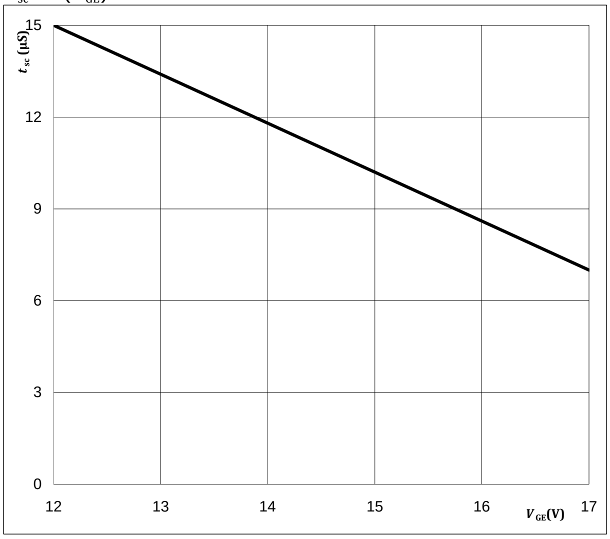
At

I_C =	15	A

figure 27. **IGBT**

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

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



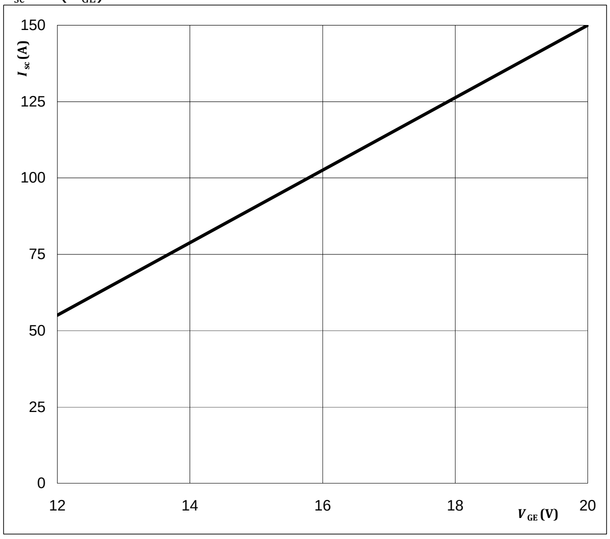
At

V_{CE} =	1200	V
T_j ≤	150	ºC

figure 28. **IGBT**

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

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



At

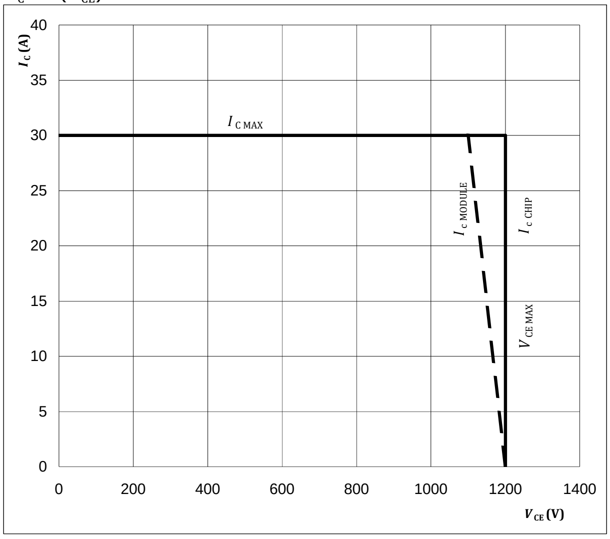
V_{CE} ≤	1200	V
T_j =	150	ºC

Inverter Characteristics

figure 29.	IGBT

Reverse bias safe operating area

$I_C = f(V_{CE})$



At

T_j = T_{jmax} - 25 ºC

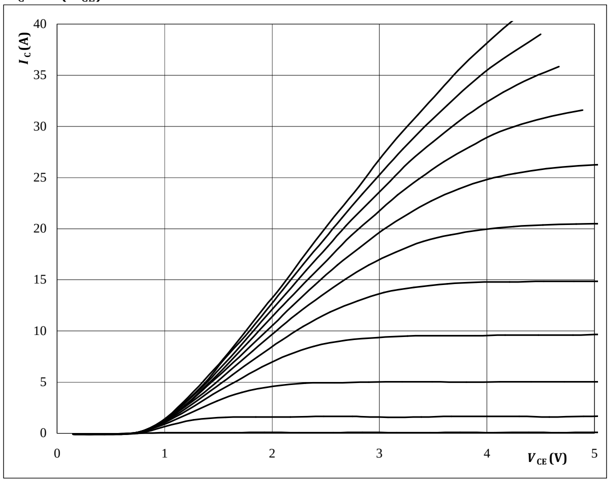
Switching mode: 3phase SPWM

Brake Characteristics

figure 1. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$



At

t_p = 250 µs

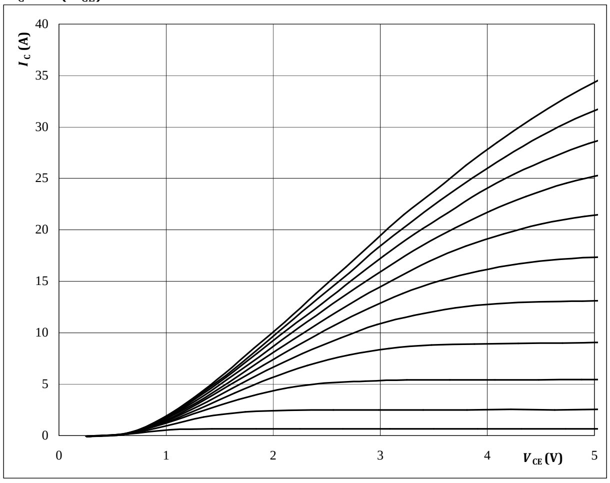
T_j = 25 °C

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

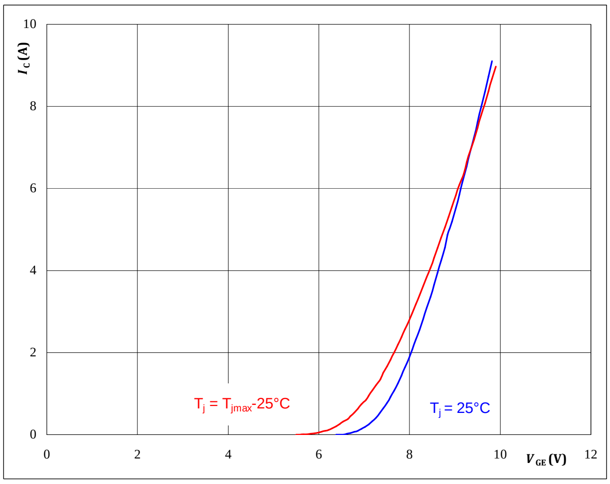
T_j = 125 °C

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

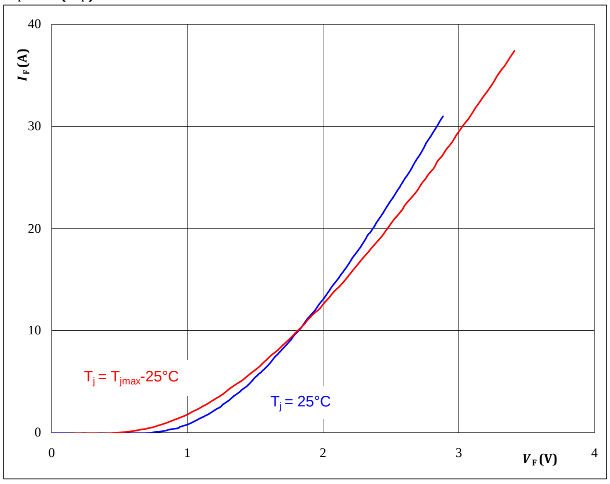
t_p = 250 µs

V_{CE} = 10 V

figure 4. **FWD**

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

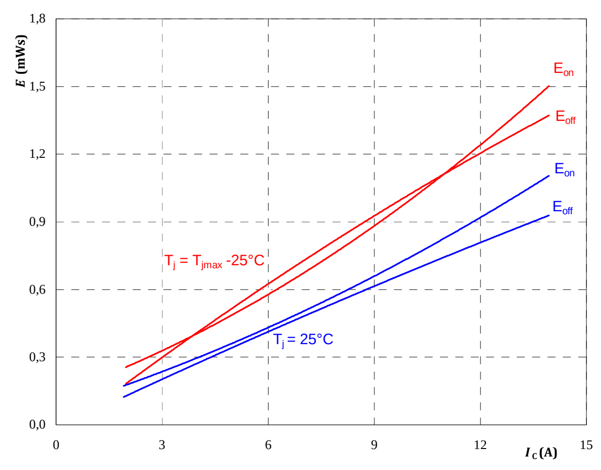
t_p = 250 µs

Brake Characteristics

figure 5.	IGBT

Typical switching energy losses as a function of collector current

$E = f(I_C)$



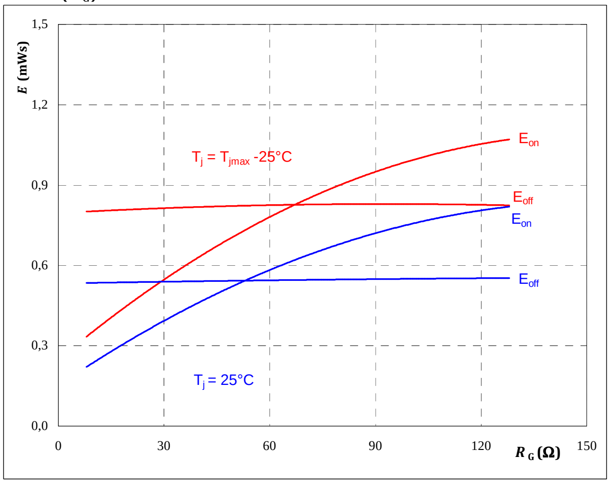
With an inductive load at

T_j =	25/125	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	64	Ω
R_{goff} =	64	Ω

figure 6.	IGBT

Typical switching energy losses as a function of gate resistor

$E = f(R_G)$



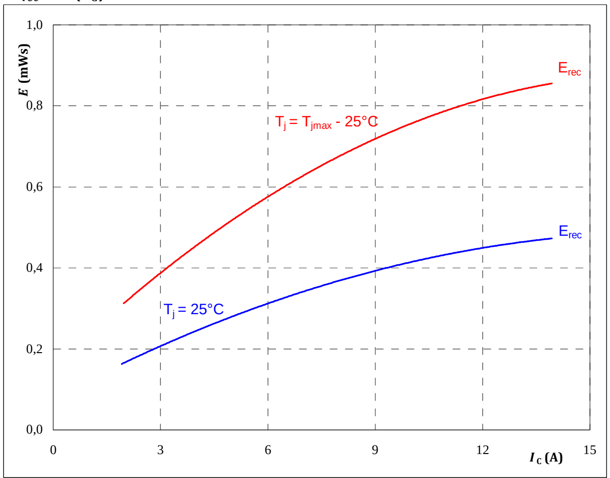
With an inductive load at

T_j =	25/125	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	8	A

figure 7.	FWD

Typical reverse recovery energy loss as a function of collector current

$E_{rec} = f(I_C)$



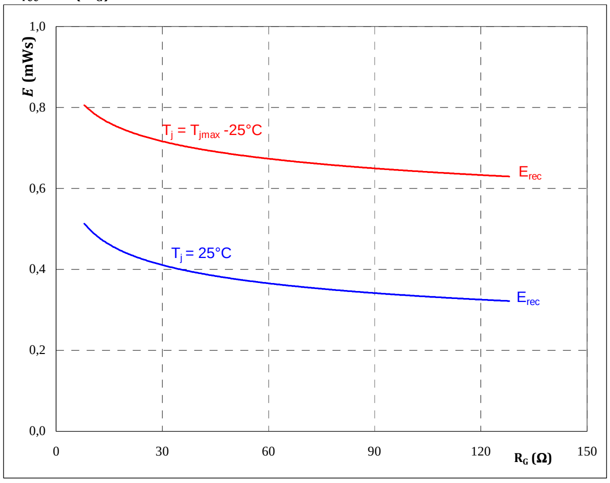
With an inductive load at

T_j =	25/125	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	64	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

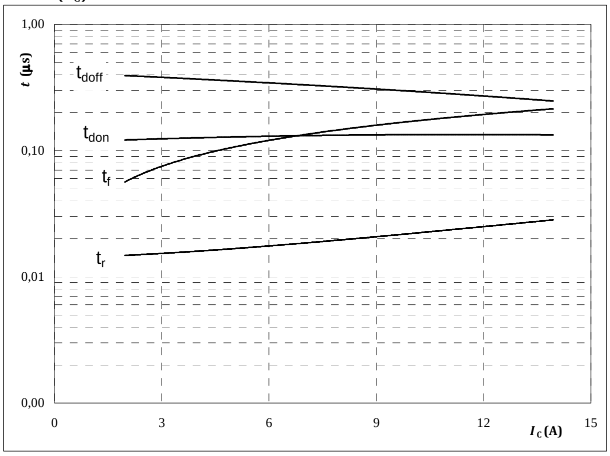
T_j =	25/125	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	8	A

Brake Characteristics

figure 9. **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



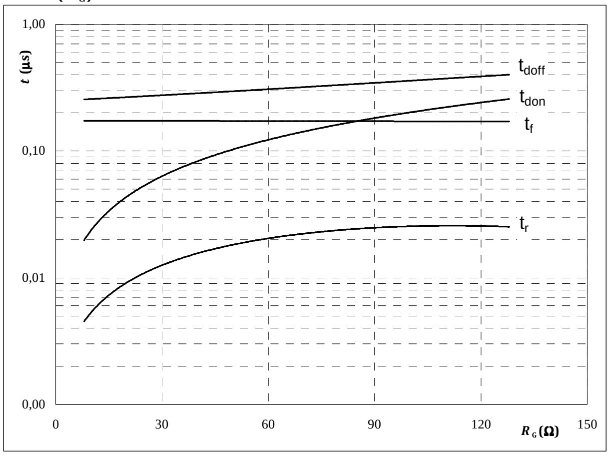
With an inductive load at

T_j =	25/125	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	64	Ω
R_{goff} =	64	Ω

figure 10. **IGBT**

Typical switching times as a function of gate resistor

$t = f(R_G)$



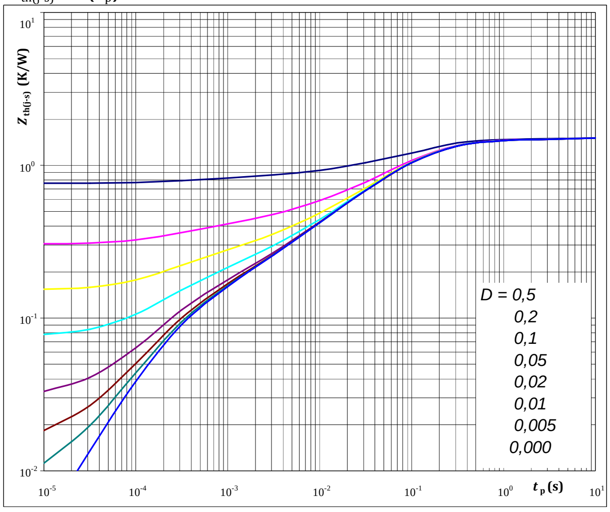
With an inductive load at

T_j =	25/125	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	8	A

figure 11. **IGBT**

IGBT transient thermal impedance as a function of pulse width

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



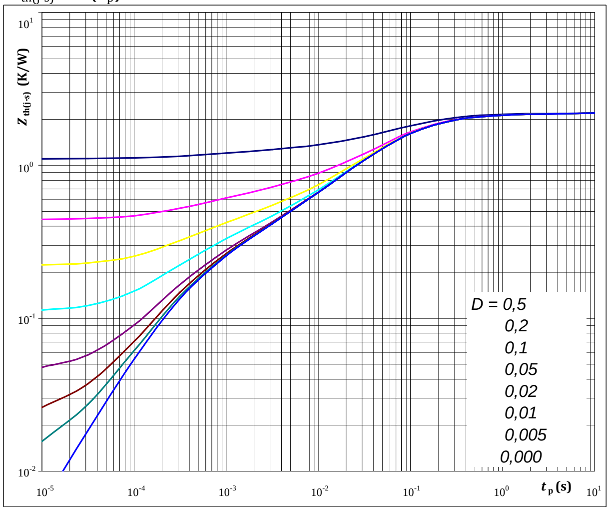
At

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

figure 12. **FWD**

FWD transient thermal impedance as a function of pulse width

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



At

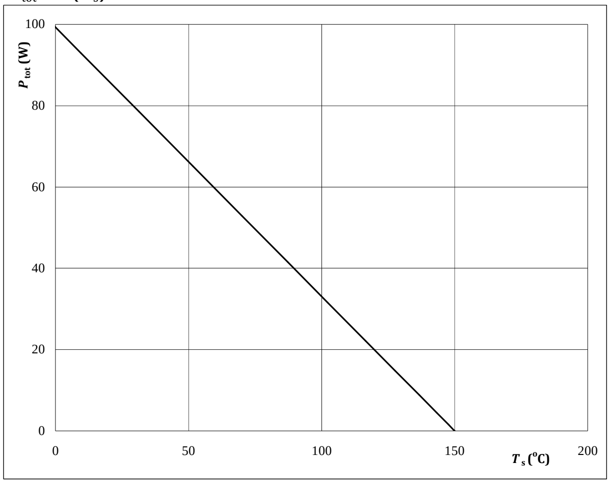
D =	t_p / T	
$R_{th(j\text{-}s)}$ =	2,20	K/W

Brake Characteristics

figure 13. **IGBT**

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



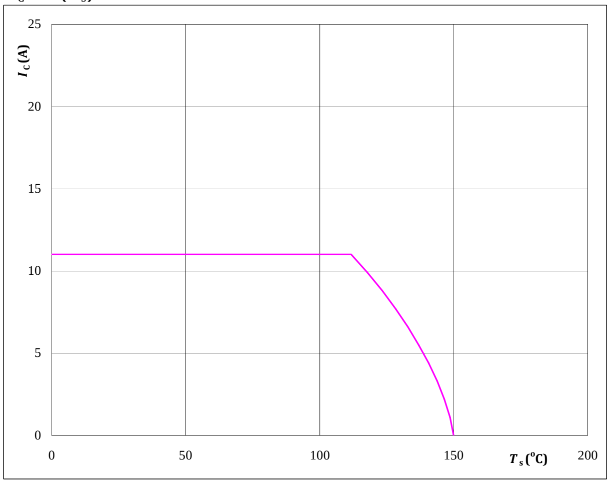
At

T_j = 150 °C

figure 14. **IGBT**

Collector current as a function of heatsink temperature

$I_C = f(T_s)$



At

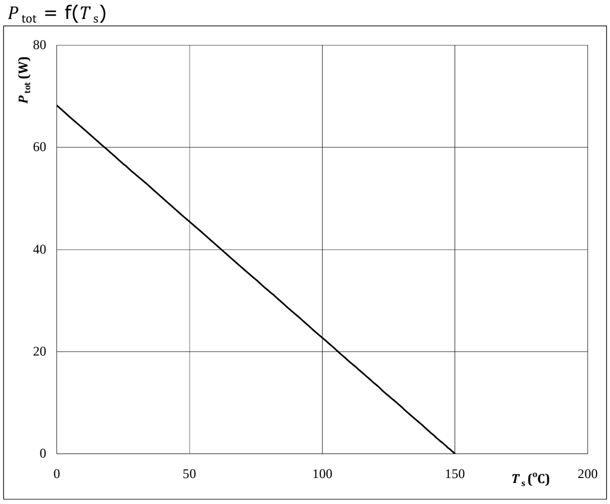
T_j = 150 °C

V_{GE} = 15 V

figure 15. **FWD**

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



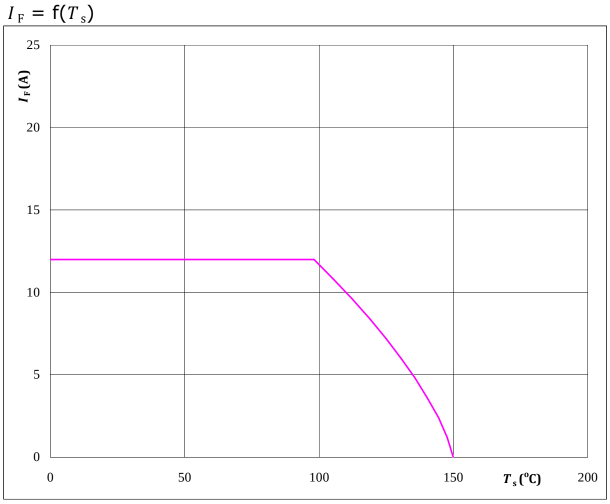
At

T_j = 150 °C

figure 16. **FWD**

Forward current as a function of heatsink temperature

$I_F = f(T_s)$



At

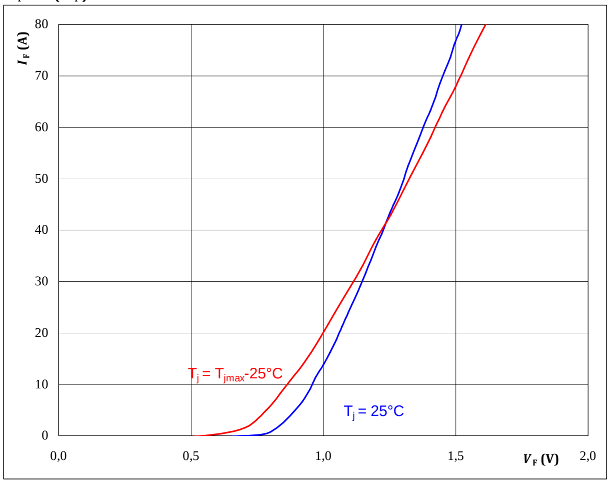
T_j = 150 °C

Rectifier Diode Characteristics

figure 1. **Rectifier Diode**

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



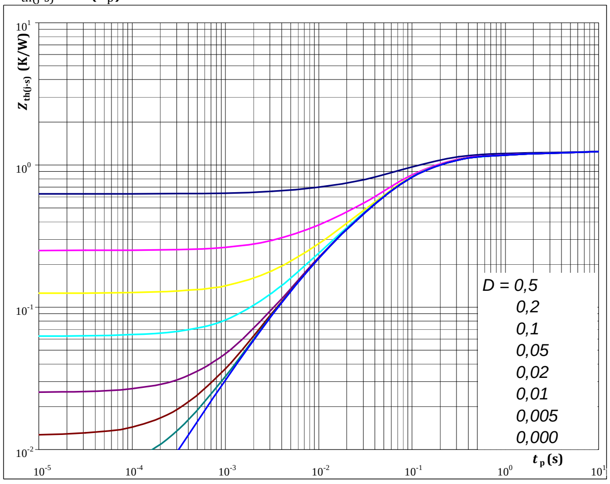
At

t_p = 250 µs

figure 2. **Rectifier Diode**

Diode transient thermal impedance as a function of pulse width

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



At

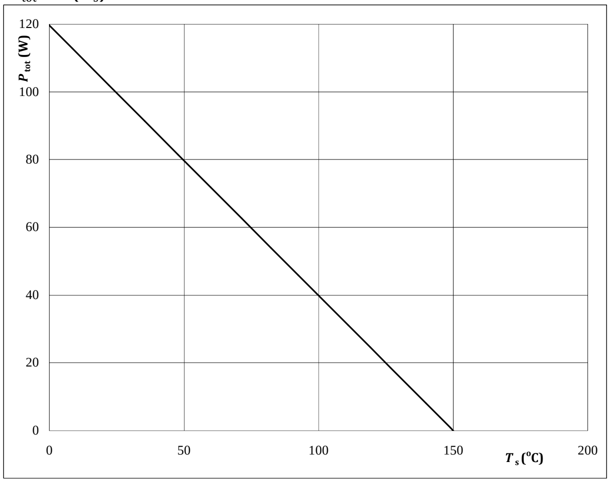
$D = t_p / T$

$R_{th(j-s)}$ = 1,25 K/W

figure 3. **Rectifier Diode**

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



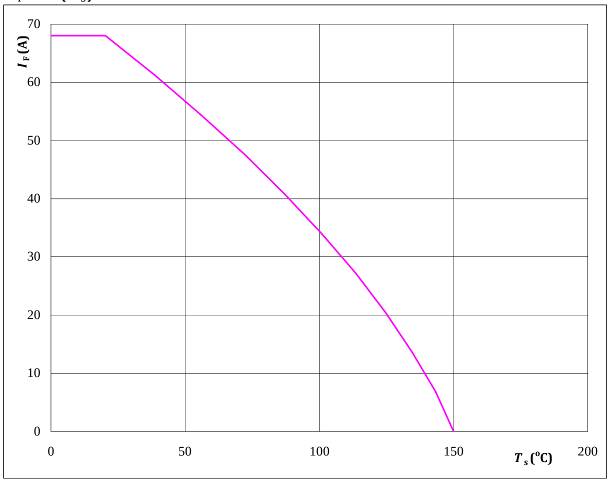
At

T_j = 150 ºC

figure 4. **Rectifier Diode**

Forward current as a function of heatsink temperature

$I_F = f(T_s)$



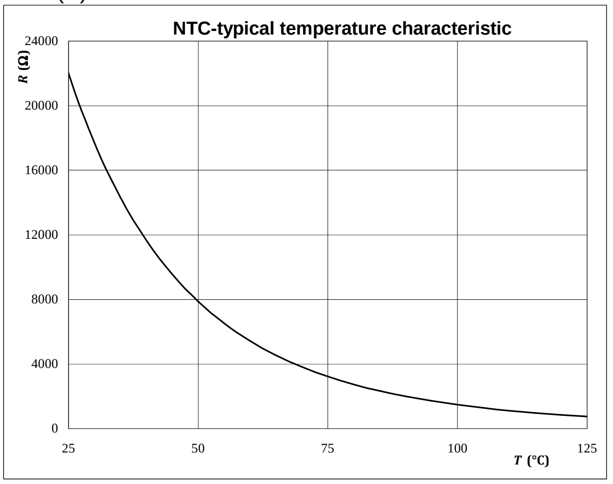
At

T_j = 150 ºC

Thermistor

figure 1.	Thermistor

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



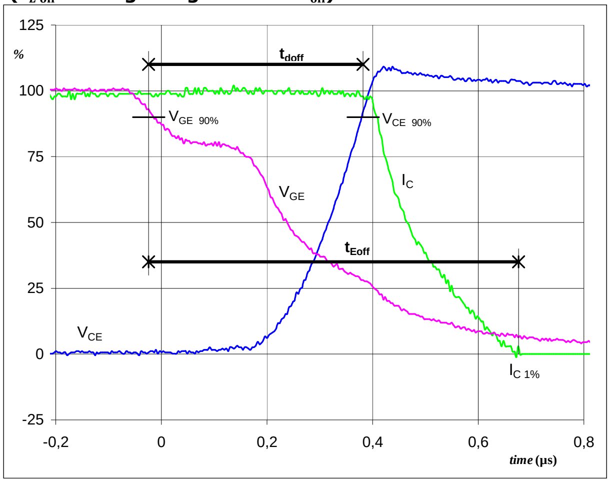
Switching Definitions Inverter

General conditions

T_j	=	125 °C
R_{gon}	=	64 Ω
R_{goff}	=	64 Ω

figure 1. **IGBT**

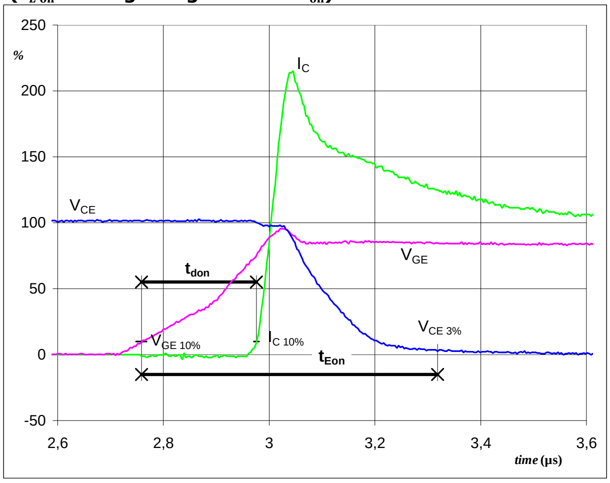
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff} (t_{Eoff} = integrating time for E_{off})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	15	A
t_{doff} =	0,39	μs
t_{Eoff} =	0,70	μs

figure 2. **IGBT**

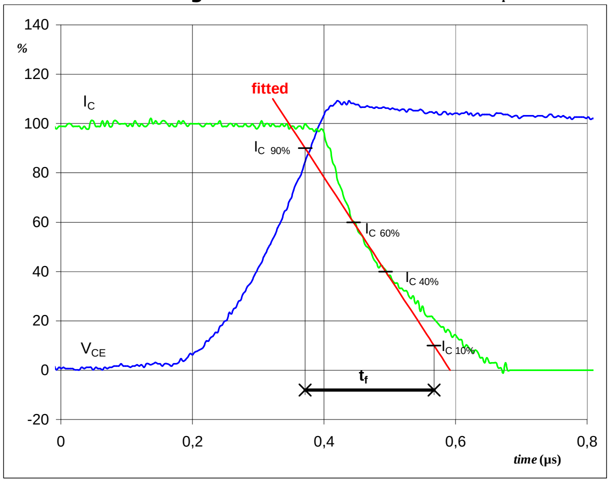
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon} (t_{Eon} = integrating time for E_{on})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	15	A
t_{don} =	0,22	μs
t_{Eon} =	0,56	μs

figure 3. **IGBT**

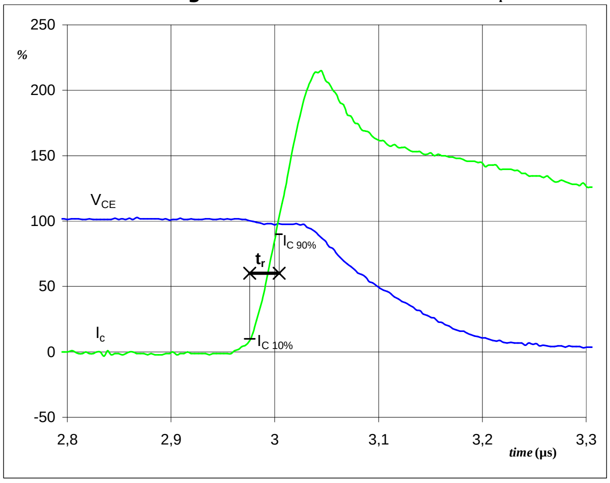
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	600	V
I_C (100%) =	15	A
t_f =	0,18	μs

figure 4. **IGBT**

Turn-on Switching Waveforms & definition of t_r

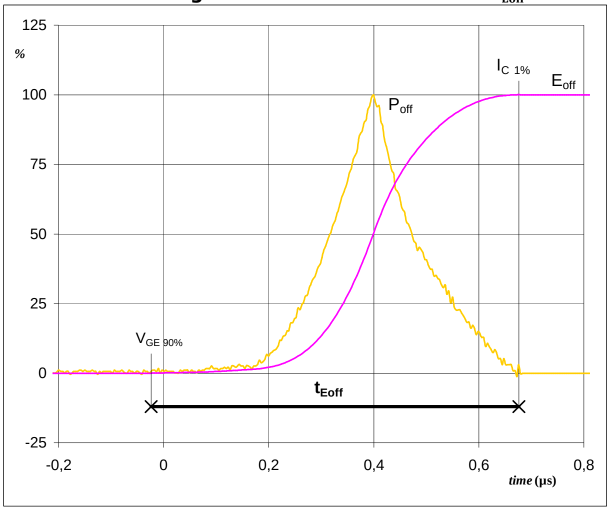


V_C (100%) =	600	V
I_C (100%) =	15	A
t_r =	0,03	μs

Switching Definitions Inverter

figure 5. **IGBT**

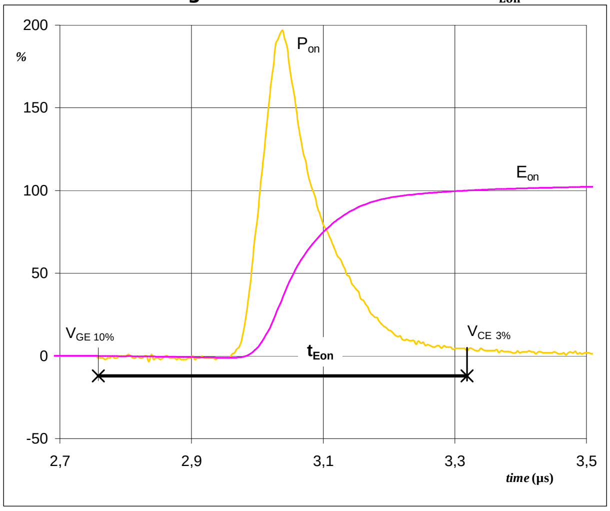
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	8,99	kW
E_{off} (100%) =	1,71	mJ
$t_{E\,off}$ =	0,70	µs

figure 6. **IGBT**

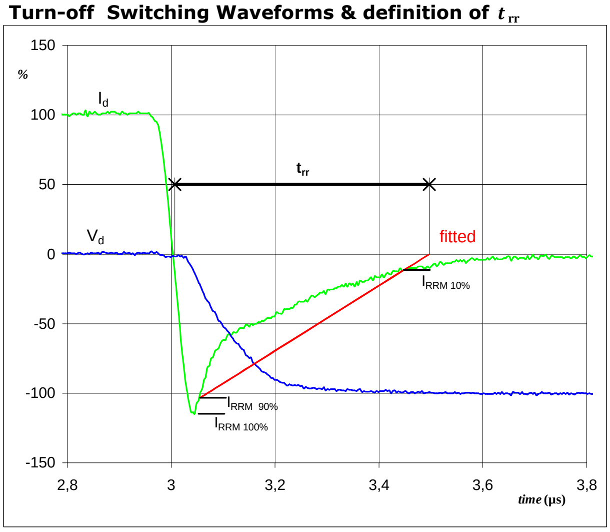
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	8,99	kW
E_{on} (100%) =	1,81	mJ
$t_{E\,on}$ =	0,56	µs

figure 7. **FWD**

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

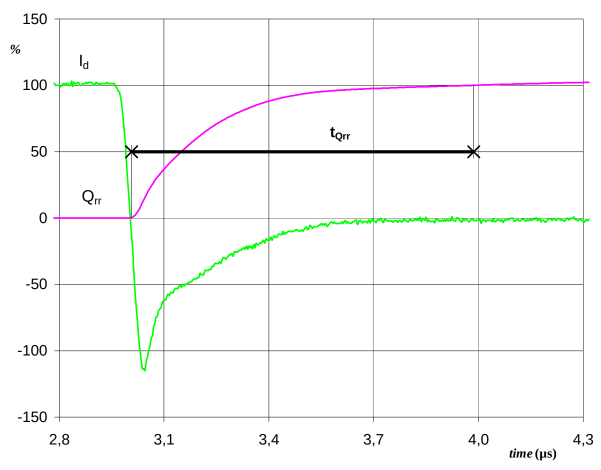


V_d (100%) =	600	V
I_d (100%) =	15	A
I_{RRM} (100%) =	17	A
t_{rr} =	0,48	µs

Switching Definitions Inverter

figure 8. **FWD**

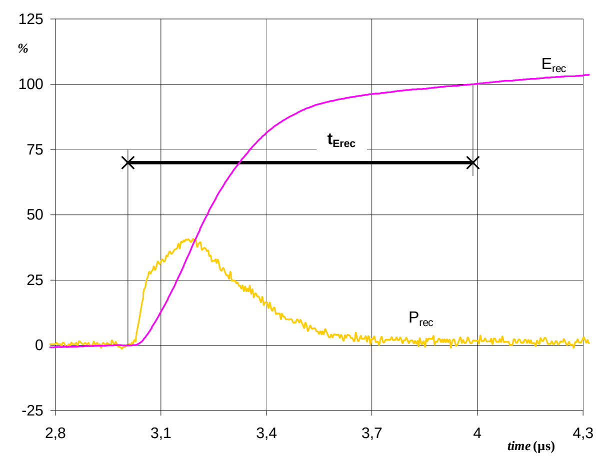
Turn-on Switching Waveforms & definition of t_{Qrr}
($t_{Q\,rr}$ = integrating time for Q_{rr})



I_d (100%) =	15	A
Q_{rr} (100%) =	3,11	µC
$t_{Q\,rr}$ =	0,98	µs

figure 9. **FWD**

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



P_{rec} (100%) =	8,99	kW
E_{rec} (100%) =	1,18	mJ
$t_{E\,rec}$ =	0,98	µs

Ordering Code and Marking - Outline - Pinout

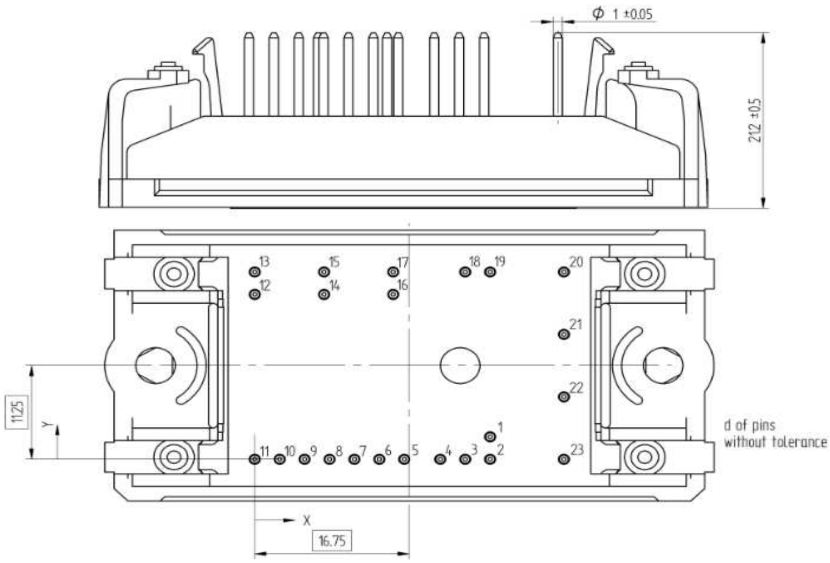
Ordering Code & Marking

Version	Ordering Code
Without phase-change material 17mm housing with solder pins	V23990-P540-A01-PM
With phase-change material 17mm housing with solder pins	V23990-P540-A01-/3/-PM
Without phase-change material 17mm housing with solder pins without BRC	V23990-P540-C01-PM

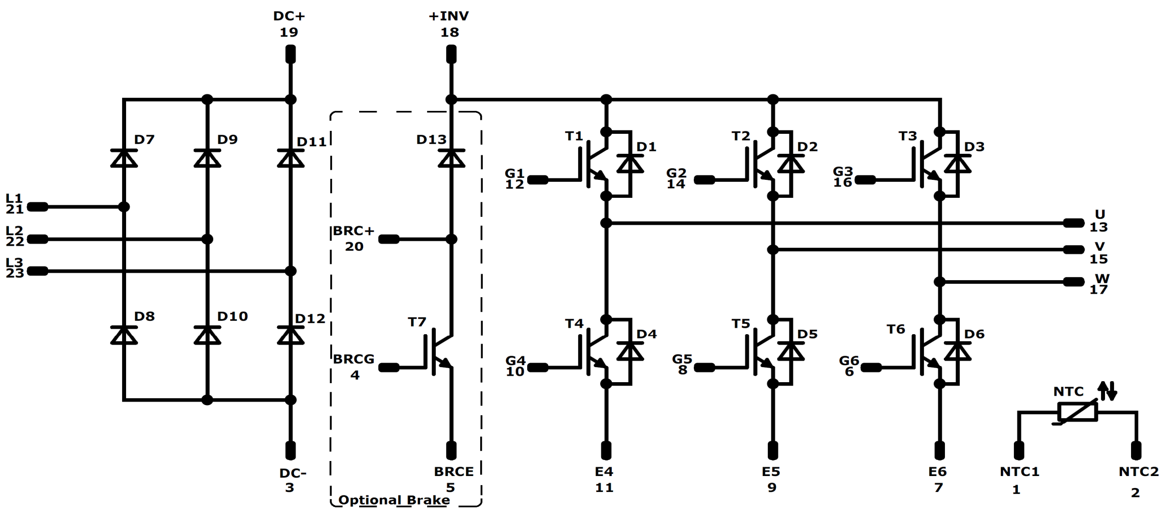
Text	VIN	Date code	Name&Ver	UL	Lot	Serial
	VIN	WWYY	NNNNNNNVV	UL	LLLLL	SSSS
Datamatrix	Type&Ver	Lot number	Serial	Date code		
	TTTTTTTVV	LLLLL	SSSS	WWYY		

Outline

Pin table				Pinout variation	
Pin	X	Y	Function	Modul subtype	Not assembled pins
1	25,5	2,7	NTC1	P540-A01	-
2	25,5	0	NTC2	P540-C01	4,5,20
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		



Pinout



Identification

ID	Component	Voltage	Current	Function	Comment
T1-T6	IGBT	1200 V	15 A	Inverter Switch	
D1-D6	FWD	1200 V	15 A	Inverter Diode	
T7	IGBT	1200 V	8 A	Brake Switch	
D13	FWD	1200 V	9 A	Brake Diode	
D7-D12	Rectifier	1600 V	35 A	Rectifier Diode	
NTC	Thernistor			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-P540-x01-D4-14	23 Jun. 2016	New brand	All