

**flow PIM 2 3rd****1200 V / 50 A****Features**

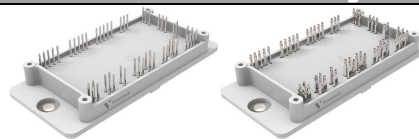
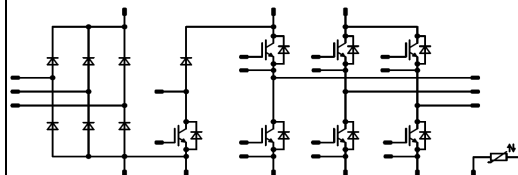
- 3~rectifier, BRC, Inverter, NTC
- Very Compact housing, easy to route
- IGBT4/ EmCon4 technology for low saturation losses and improved EMC behavior

Target Applications

- Motor Drives
- Power Generation

Types

- V23990-P768-A-PM
- V23990-P768-AY-PM

flow 2 17mm housing**Schematic**

Maximum Ratings

 $T_j = 25\text{ °C}$, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
-----------	--------	-----------	-------	------

Input Rectifier Diode

Repetitive peak reverse voltage	V_{RRM}		1600	V
Forward current	I_{FAV}	DC current $T_s = 80\text{ °C}$ $T_c = 80\text{ °C}$	80 80	A
Surge (non-repetitive) forward current	I_{FSM}	$t_p = 10\text{ ms}$ $T_j = 25\text{ °C}$	700	A
I ² t-value	I^2t		2450	A ² s
Power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$ $T_c = 80\text{ °C}$	95 144	W
Maximum Junction Temperature	T_{jmax}		150	°C

Inverter Switch

Collector-emitter breakdown voltage	V_{CE}		1200	V
DC collector current	I_C	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$ $T_c = 80\text{ °C}$	60 75	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	150	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$ $T_c = 80\text{ °C}$	163 247	W
Gate-emitter peak voltage	V_{GE}		±20	V
Short circuit ratings	t_{SC} V_{CC}	$T_j \leq 150\text{ °C}$ $V_{GE} = 15\text{ V}$	10 900	µs V
Maximum Junction Temperature	T_{jmax}		175	°C



Maximum Ratings

$T_j = 25\text{ }^{\circ}\text{C}$, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
-----------	--------	-----------	-------	------

Inverter Diode

Peak Repetitive Reverse Voltage	V_{RRM}		1200	V
DC forward current	I_F	$T_j = T_{jmax}$ $T_s = 80\text{ }^{\circ}\text{C}$ $T_c = 80\text{ }^{\circ}\text{C}$	60 80	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}	100	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ }^{\circ}\text{C}$ $T_c = 80\text{ }^{\circ}\text{C}$	114 173	W
Maximum Junction Temperature	T_{jmax}		175	$^{\circ}\text{C}$

Brake Switch

Collector-emitter breakdown voltage	V_{CE}		1200	V
DC collector current	I_C	$T_j = T_{jmax}$ $T_s = 80\text{ }^{\circ}\text{C}$ $T_c = 80\text{ }^{\circ}\text{C}$	44 45	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	105	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ }^{\circ}\text{C}$ $T_c = 80\text{ }^{\circ}\text{C}$	130 198	W
Gate-emitter peak voltage	V_{GE}		± 20	V
Short circuit ratings	t_{SC} V_{CC}	$T_j \leq 150\text{ }^{\circ}\text{C}$ $V_{GE} = 15\text{ V}$	10 900	μs V
Maximum Junction Temperature	T_{jmax}		175	$^{\circ}\text{C}$

Brake Inverse Diode

Peak Repetitive Reverse Voltage	V_{RRM}		1200	V
DC forward current	I_F	$T_j = T_{jmax}$ $T_s = 80\text{ }^{\circ}\text{C}$	10	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}	20	A
Brake Inverse Diode	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ }^{\circ}\text{C}$	50	W
Maximum Junction Temperature	T_{jmax}		175	$^{\circ}\text{C}$

Brake Diode

Peak Repetitive Reverse Voltage	V_{RRM}		1200	V
DC forward current	I_F	$T_j = T_{jmax}$ $T_s = 80\text{ }^{\circ}\text{C}$	25	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}	50	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ }^{\circ}\text{C}$	75	W
Maximum Junction Temperature	T_{jmax}		175	$^{\circ}\text{C}$



Maximum Ratings

$T_j = 25\text{ °C}$, 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

Isolation Properties

Isolation voltage	V_{is}	$t = 1\text{ min}$	4000	V_{DC}
Creepage distance			min 12,7	mm
Clearance		with Press-fit pins / with Solder pins	11,96 / 12,03	mm

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_i [°C]	Min	Typ	Max	
Input Rectifier Diode										
Forward voltage	V_F				50	$T_j=25^{\circ}\text{C}$ $T_j=125^{\circ}\text{C}$		1,1 1,05	1,7	V
Threshold voltage (for power loss calc. only)	V_{to}					$T_j=25^{\circ}\text{C}$ $T_j=125^{\circ}\text{C}$		0,89 0,78		V
Slope resistance (for power loss calc. only)	r_t					$T_j=25^{\circ}\text{C}$ $T_j=125^{\circ}\text{C}$		0,004 0,006		Ω
Reverse current	I_r			1500		$T_j=25^{\circ}\text{C}$ $T_j=125^{\circ}\text{C}$			0,05 1,1	mA
Thermal resistance junction to heatsink	$R_{th(j-s)}$	Thermal grease thickness≤50μm λ = 0,61 W/m·K						0,74		K/W
Thermal resistance junction to case	$R_{th(j-c)}$							0,49		
Inverter Switch										
Gate emitter threshold voltage	$V_{CE(th)}$	$V_{CE} = V_{GE}$			0,0017	$T_j=25^{\circ}\text{C}$ $T_j=150^{\circ}\text{C}$	5	5,8	6,5	V
Collector-emitter saturation voltage	V_{CEsat}		15		50	$T_j=25^{\circ}\text{C}$ $T_j=150^{\circ}\text{C}$		1,86 2,3	2,3	V
Collector-emitter cut-off current incl. Diode	I_{CES}		0	1200		$T_j=25^{\circ}\text{C}$ $T_j=150^{\circ}\text{C}$			0,02	mA
Gate-emitter leakage current	I_{GES}		20	0		$T_j=25^{\circ}\text{C}$ $T_j=150^{\circ}\text{C}$			200	nA
Integrated Gate resistor	R_{gint}							4		Ω
Turn-on delay time	$t_{d(on)}$	$R_{goff} = 8\ \Omega$ $R_{gon} = 8\ \Omega$	±15	600	50	$T_j=25^{\circ}\text{C}$ $T_j=150^{\circ}\text{C}$		104 100		ns
Rise time	t_r					$T_j=25^{\circ}\text{C}$ $T_j=150^{\circ}\text{C}$		19 23,8		
Turn-off delay time	$t_{d(off)}$					$T_j=25^{\circ}\text{C}$ $T_j=150^{\circ}\text{C}$		220 295		
Fall time	t_f					$T_j=25^{\circ}\text{C}$ $T_j=150^{\circ}\text{C}$		78 118		
Turn-on energy loss	E_{on}					$T_j=25^{\circ}\text{C}$ $T_j=150^{\circ}\text{C}$		2,86 4,5		mWs
Turn-off energy loss	E_{off}					$T_j=25^{\circ}\text{C}$ $T_j=150^{\circ}\text{C}$		2,69 4,48		
Input capacitance	C_{ies}	$f = 1\ \text{MHz}$	0	25		$T_j=25^{\circ}\text{C}$		2770		pF
Output capacitance	C_{oss}							205		
Reverse transfer capacitance	C_{rss}							160		
Gate charge	Q_G		±15	960		$T_j=25^{\circ}\text{C}$		290		nC
Thermal resistance junction to heatsink	$R_{th(j-s)}$	Thermal grease thickness≤50μm λ = 0,61 W/m·K						0,58		K/W
Thermal resistance junction to case	$R_{th(j-c)}$							0,38		
Coupled thermal resistance transistor-transistor	$R_{th(j)T-T}$							0,1		
Coupled thermal resistance diode-transistor	$R_{th(j)D-T}$							0,13		
Inverter Diode										
Diode forward voltage	V_F				50	$T_j=25^{\circ}\text{C}$ $T_j=150^{\circ}\text{C}$		1,75 1,71	2,2	V
Peak reverse recovery current	I_{RRM}	$R_{gon} = 8\ \Omega$	±15	600	50	$T_j=25^{\circ}\text{C}$ $T_j=150^{\circ}\text{C}$		65 82		A
Reverse recovery time	t_{rr}					$T_j=25^{\circ}\text{C}$ $T_j=150^{\circ}\text{C}$		162 313		ns
Reverse recovered charge	Q_{rr}					$T_j=25^{\circ}\text{C}$ $T_j=150^{\circ}\text{C}$		4,62 9,95		μC
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$					$T_j=25^{\circ}\text{C}$ $T_j=150^{\circ}\text{C}$		2298 1106		A/μs
Reverse recovered energy	E_{rec}					$T_j=25^{\circ}\text{C}$ $T_j=150^{\circ}\text{C}$		1,92 3,98		mWs
Thermal resistance junction to heatsink	$R_{th(j-s)}$	Thermal grease thickness≤50μm λ = 0,61 W/m·K						0,83		K/W
Thermal resistance junction to case	$R_{th(j-c)}$							0,55		
Coupled thermal resistance transistor-diode	$R_{th(j)T-D}$							0,12		

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_i [°C]	Min	Typ	Max	
Brake Switch										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,0012	Tj=25°C Tj=150°C	5	5,8	6,5	V
Collector-emitter saturation voltage	V_{CEsat}		15		35	Tj=25°C Tj=150°C		1,91 2,37	2,3	V
Collector-emitter cut-off incl diode	I_{CES}		0	1200		Tj=25°C Tj=150°C			0,25	mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25°C Tj=150°C			200	nA
Integrated Gate resistor	R_{gint}							none		Ω
Turn-on delay time	$t_{d(on)}$	$R_{goff} = 16\ \Omega$ $R_{gon} = 16\ \Omega$	±15	600	35	Tj=25°C Tj=150°C		92 84		ns
Rise time	t_r					Tj=25°C Tj=150°C		21 24		
Turn-off delay time	$t_{d(off)}$					Tj=25°C Tj=150°C		182 253		
Fall time	t_f					Tj=25°C Tj=150°C		76 116		
Turn-on energy loss	E_{on}					Tj=25°C Tj=150°C		1,86 2,64		mWs
Turn-off energy loss	E_{off}					Tj=25°C Tj=150°C		1,78 2,95		
Input capacitance	C_{ies}	$f = 1\text{ MHz}$	0	25		Tj=25°C		1950		pF
Output capacitance	C_{oss}							155		
Reverse transfer capacitance	C_{rss}							115		
Gate charge	Q_G		±15	960		Tj=25°C		200		nC
Thermal resistance junction to heatsink	$R_{th(j-s)}$	Thermal grease thickness≤50μm λ = 0,61 W/m·K						0,73		K/W
Thermal resistance junction to case	$R_{th(j-c)}$						0,48			
Brake Inverse Diode										
Diode forward voltage	V_F				10	Tj=25°C Tj=150°C	1,1	1,89 1,8	2,1	V
Thermal resistance junction to heatsink	$R_{th(j-s)}$	Thermal grease thickness≤50μm λ = 0,61 W/m·K						1,86		K/W
Thermal resistance junction to case	$R_{th(j-c)}$							1,23		K/W
Brake Diode										
Diode forward voltage	V_F				25	Tj=25°C Tj=150°C		1,9 1,88	2,2	V
Reverse leakage current	I_r		±15	600	35	Tj=25°C Tj=150°C			10	μA
Peak reverse recovery current	I_{RRM}	$R_{gon} = 16\ \Omega$	±15	600	35	Tj=25°C Tj=150°C		27,41 41,04		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=150°C		300 322		ns
Reverse recovered charge	Q_{rr}					Tj=25°C Tj=150°C		2,68 5,19		μC
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$					Tj=25°C Tj=150°C		254 259		A/μs
Reverse recovery energy	E_{rec}					Tj=25°C Tj=150°C		2,68 5,19		mWs
Thermal resistance junction to heatsink	$R_{th(j-s)}$	Thermal grease thickness≤50μm λ = 0,61 W/m·K						1,24		K/W
Thermal resistance junction to case	$R_{th(j-c)}$						0,82			
Thermistor										
Rated resistance	R_{25}					Tj=25°C		22		kΩ
Deviation of R_{100}	$D_{R/R}$	$R_{100} = 1486\ \Omega$				Tc=100°C	-12		12	%
Power dissipation	P					Tj=25°C		200		mW
Power dissipation constant						Tj=25°C		2		mW/K
B-value	$B_{(25/50)}$	Tol. ±3%				Tj=25°C		3950		K
B-value	$B_{(25/100)}$	Tol. ±3%				Tj=25°C		3998		K
Vincotech NTC Reference									B	



Output Inverter

figure 1. IGBT
Typical output characteristics

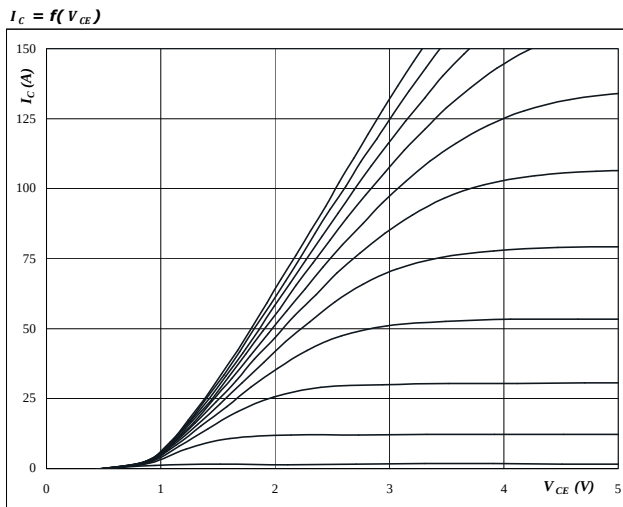


figure 2. IGBT
Typical output characteristics

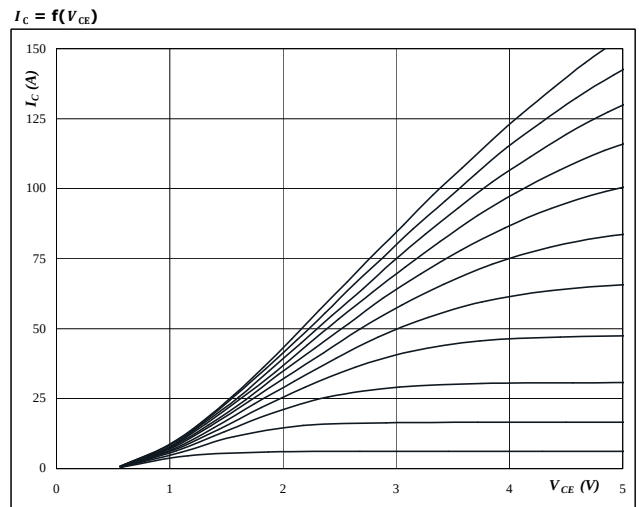


figure 3. IGBT
Typical transfer characteristics

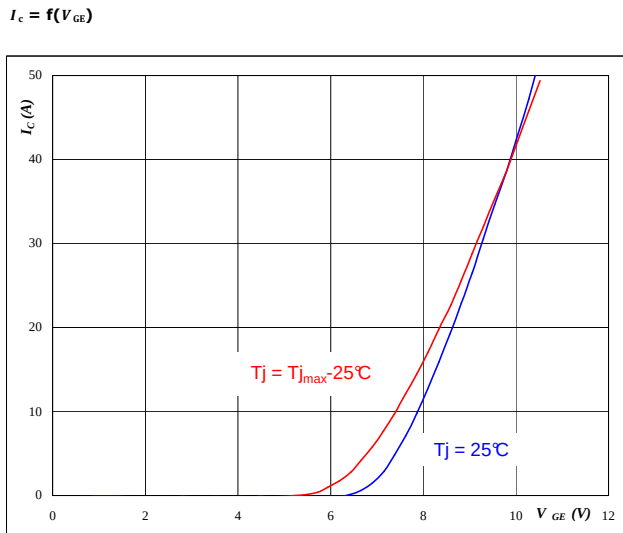
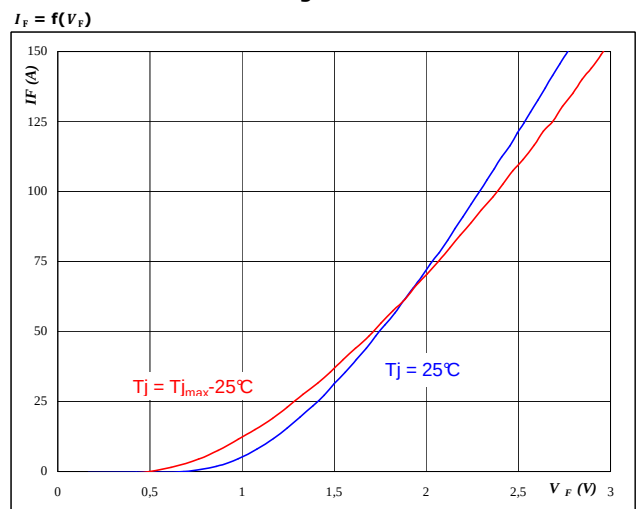


figure 4. FWD
Typical diode forward current as a function of forward voltage



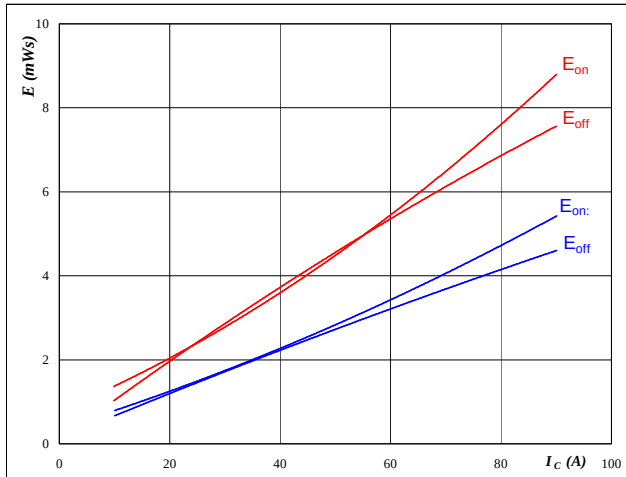


Output Inverter

figure 5. IGBT

Typical switching energy losses
as a function of collector current

$$E = f(I_c)$$



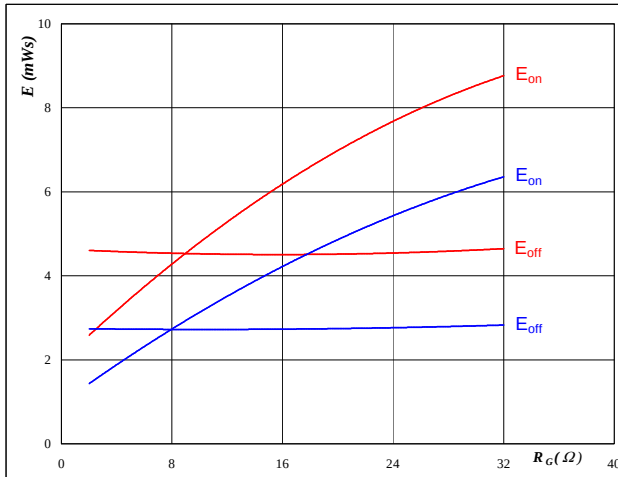
With an inductive load at

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

figure 6. IGBT

Typical switching energy losses
as a function of gate resistor

$$E = f(R_g)$$



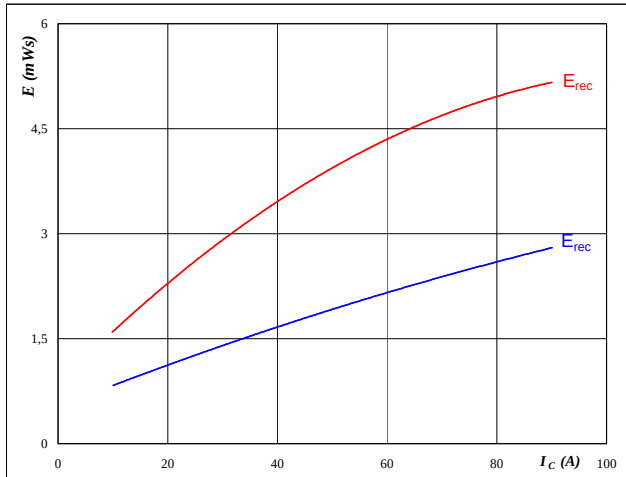
With an inductive load at

$T_j = 25/150$ °C
 $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $I_c = 50$ A

figure 7. IGBT

Typical reverse recovery energy loss
as a function of collector current

$$E_{rec} = f(I_c)$$



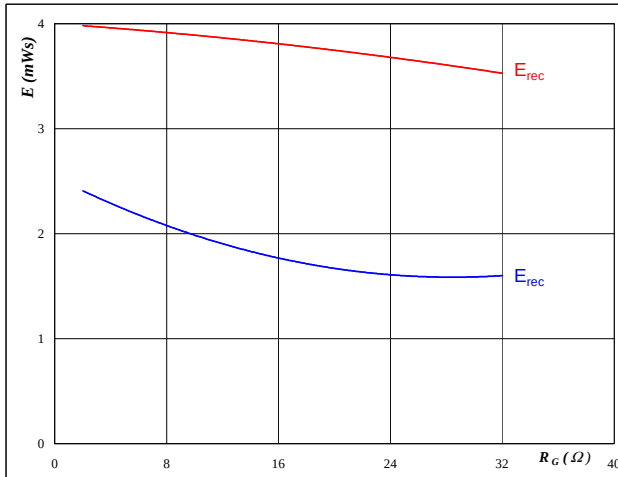
With an inductive load at

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

figure 8. IGBT

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
 $V_{GE} = \pm 15$ V
 $I_c = 50$ A

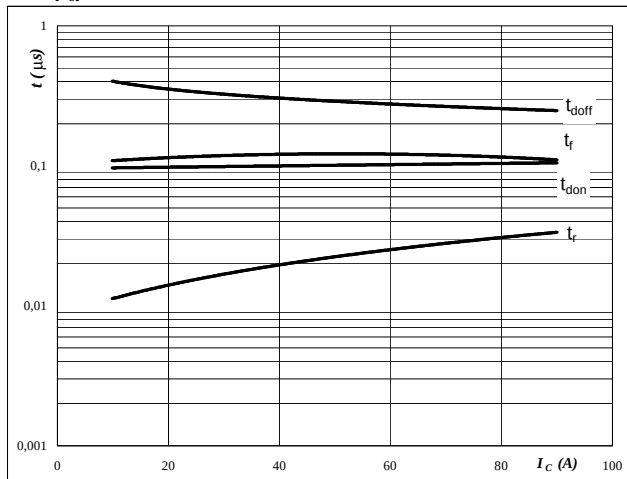


Output Inverter

figure 9. IGBT

Typical switching times as a function of collector current

$$t = f(I_C)$$



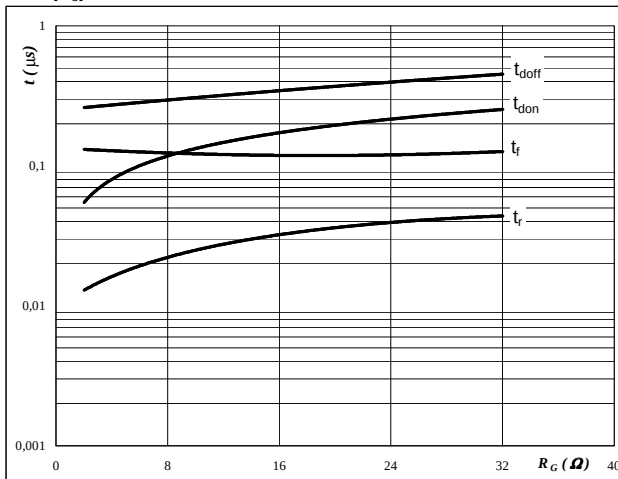
With an inductive load at

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

figure 10. IGBT

Typical switching times as a function of gate resistor

$$t = f(R_G)$$



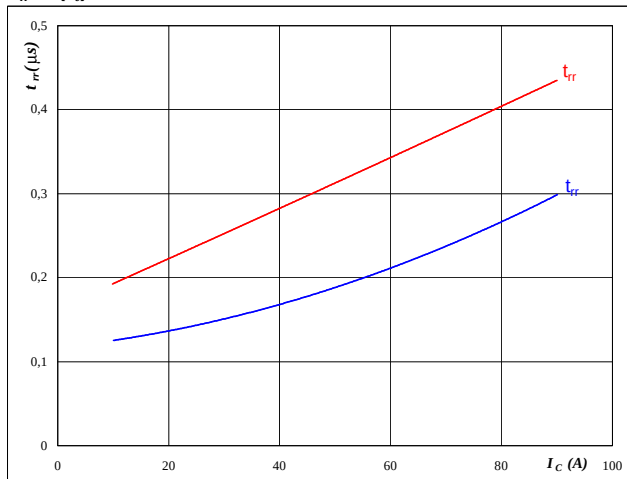
With an inductive load at

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

figure 11. FWD

Typical reverse recovery time as a function of collector current

$$t_{rr} = f(I_C)$$



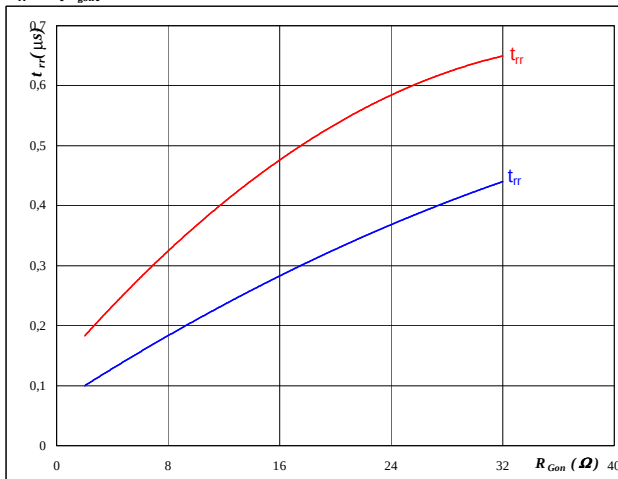
At

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

figure 12. FWD

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

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



At

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

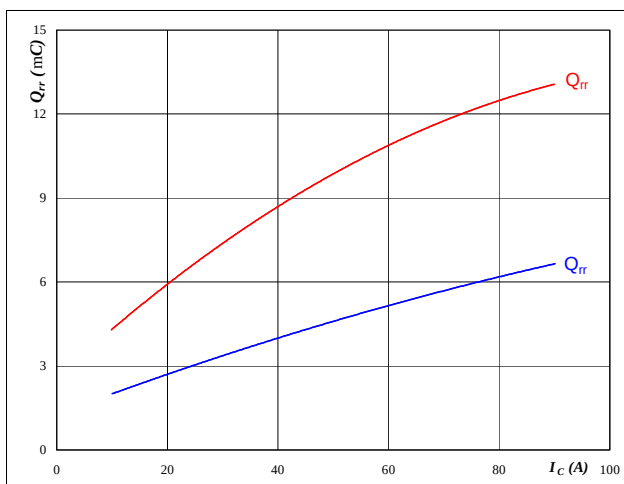


Output Inverter

figure 13. FWD

Typical reverse recovery charge as a function of collector current

$$Q_{rr} = f(I_C)$$

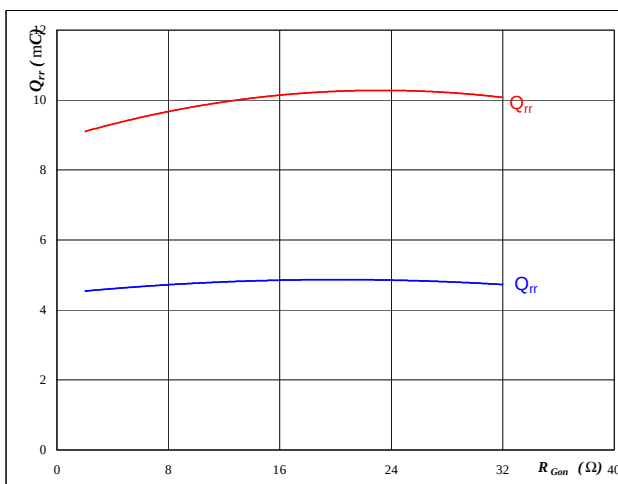


At
 $T_j = 25/150$ °C
 $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 8$ Ω

figure 14. FWD

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

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

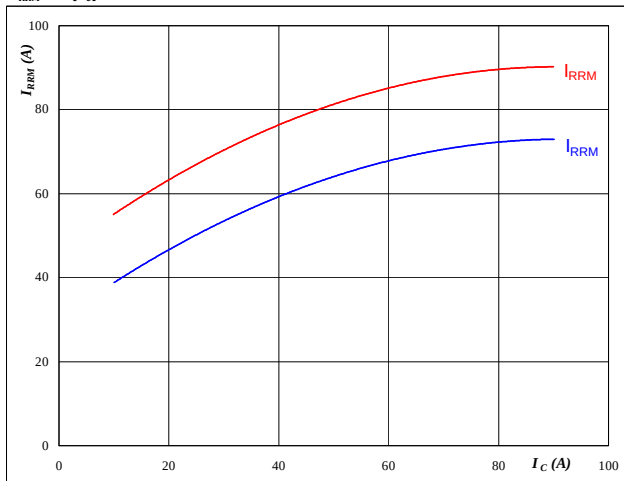


At
 $T_j = 25/150$ °C
 $V_R = 600$ V
 $I_F = 50$ A
 $V_{GE} = \pm 15$ V

figure 15. FWD

Typical reverse recovery current as a function of collector current

$$I_{RRM} = f(I_C)$$

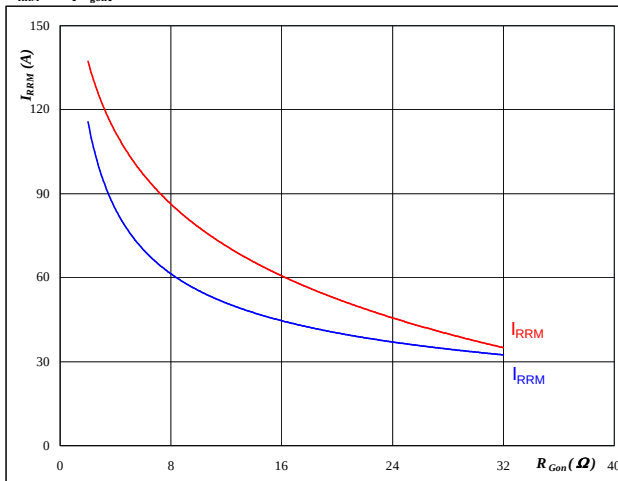


At
 $T_j = 25/150$ °C
 $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 8$ Ω

figure 16. FWD

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

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



At
 $T_j = 25/150$ °C
 $V_R = 600$ V
 $I_F = 50$ A
 $V_{GE} = \pm 15$ V

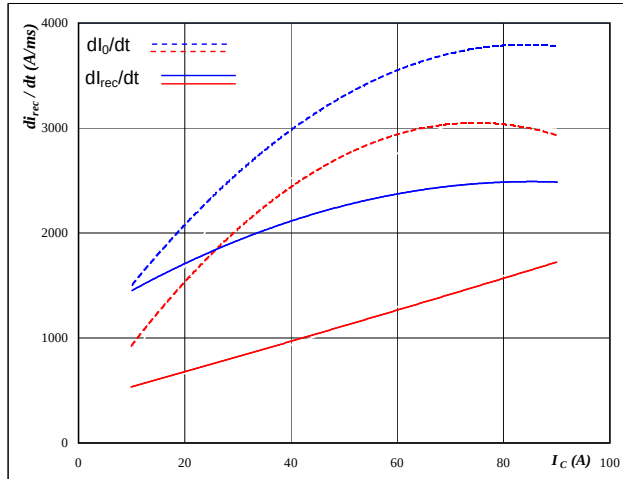


Output Inverter

figure 17. FWD

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

$$di_o/dt, di_{rec}/dt = f(I_c)$$

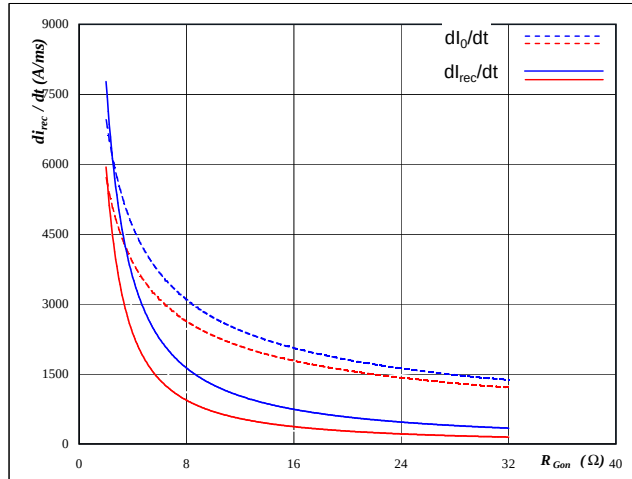


At
 $T_j = 25/150$ °C
 $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 8$ Ω

figure 18. FWD

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

$$di_o/dt, di_{rec}/dt = f(R_{gon})$$

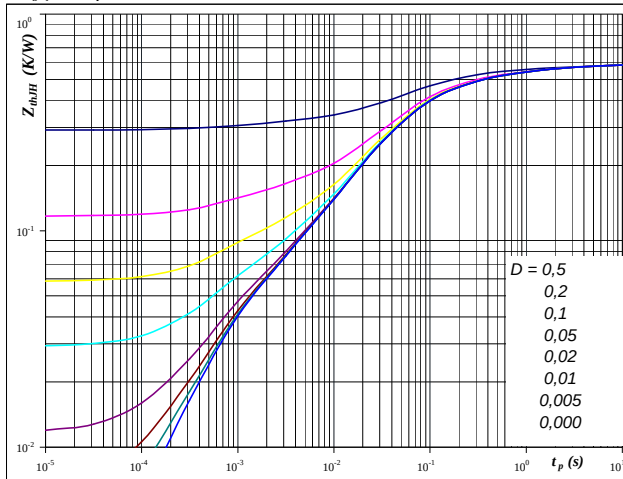


At
 $T_j = 25/150$ °C
 $V_R = 600$ V
 $I_F = 50$ A
 $V_{GE} = \pm 15$ V

figure 19. IGBT

IGBT transient thermal impedance
as a function of pulse width

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



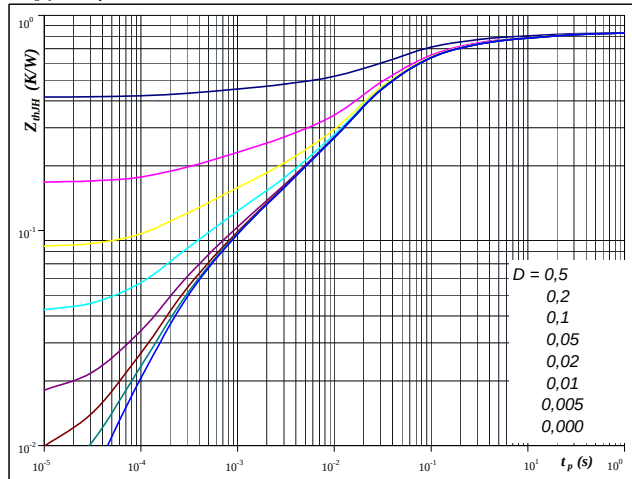
At
 $D = t_p / T$
 $R_{th(j-s)} = 0,583$ K/W $R_{th(j-s)} = 0,68$ K/W
Single device heated All devices heated
IGBT thermal model values

R (K/W)	Tau (s)	R (K/W)	Tau (s)
6,70E-02	2,10E+00	1,68E-01	2,10E+00
1,25E-01	2,43E-01	1,25E-01	2,43E-01
2,70E-01	5,10E-02	2,70E-01	5,10E-02
7,97E-02	1,21E-02	7,97E-02	1,21E-02
4,11E-02	8,63E-04	4,11E-02	8,63E-04

figure 20. FWD

FWD transient thermal impedance
as a function of pulse width

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



At
 $D = t_p / T$
 $R_{th(j-s)} = 0,83$ K/W $R_{th(j-s)} = 0,83$ K/W
Single device heated All devices heated
FWD thermal model values

R (K/W)	Tau (s)	R (K/W)	Tau (s)
2,00E-02	9,74E+00	2,00E-02	9,74E+00
7,74E-02	1,11E+00	7,74E-02	1,11E+00
2,22E-01	1,27E-01	2,22E-01	1,27E-01
3,93E-01	2,45E-02	3,93E-01	2,45E-02
6,96E-02	1,97E-03	6,96E-02	1,97E-03
5,24E-02	2,88E-04	5,24E-02	2,88E-04

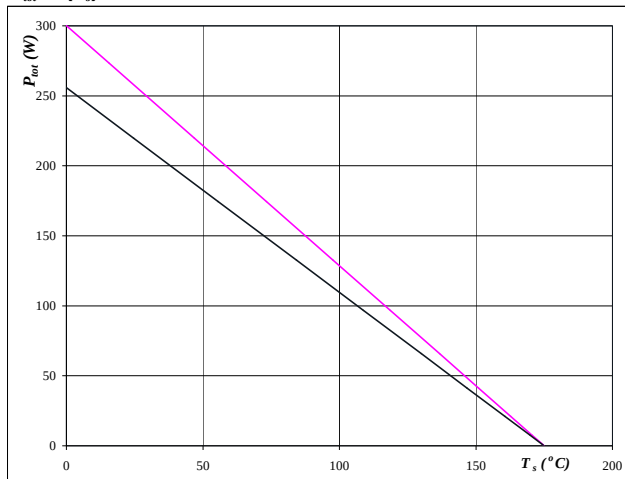


Output Inverter

figure 21. IGBT

Power dissipation as a function of heatsink temperature

$$P_{tot} = f(T_s)$$

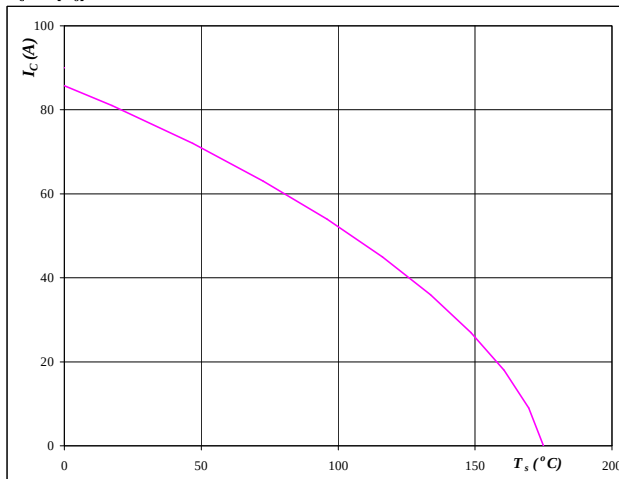


At
 $T_j = 175$ °C
— single heating
— overall heating

figure 22. IGBT

Collector current as a function of heatsink temperature

$$I_c = f(T_s)$$

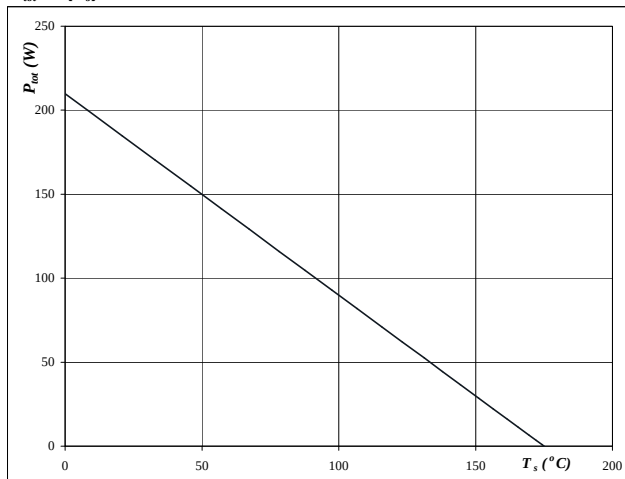


At
 $T_j = 175$ °C
 $V_{GE} = 15$ V

figure 23. FWD

Power dissipation as a function of heatsink temperature

$$P_{tot} = f(T_s)$$

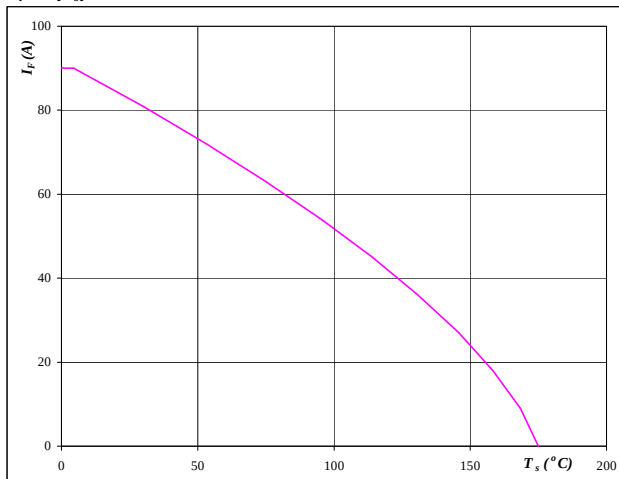


At
 $T_j = 175$ °C

figure 24. FWD

Forward current as a function of heatsink temperature

$$I_F = f(T_s)$$



At
 $T_j = 175$ °C



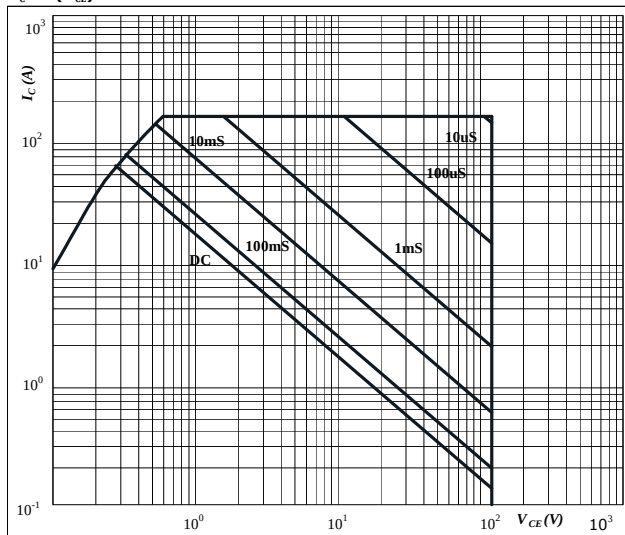
Output Inverter

figure 25.

IGBT

Safe operating area as a function
of collector-emitter voltage

$$I_C = f(V_{CE})$$

**At**

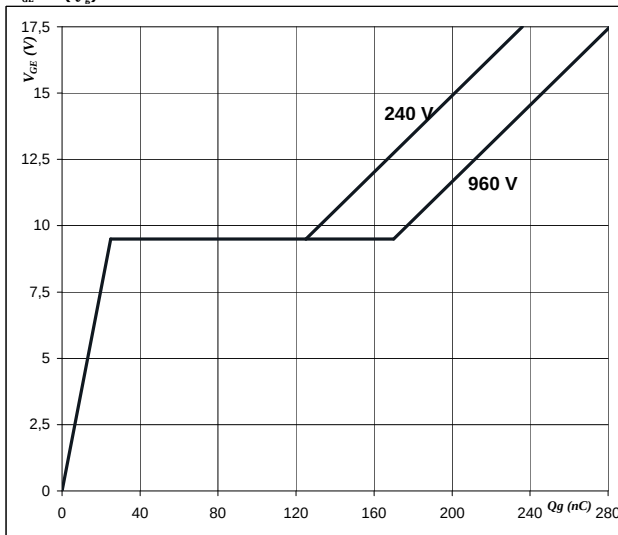
$D =$ single pulse
 $T_s =$ 80 °C
 $V_{GE} =$ ±15 V
 $T_j =$ T_{jmax} °C

figure 26.

IGBT

Gate voltage vs Gate charge

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

**At**

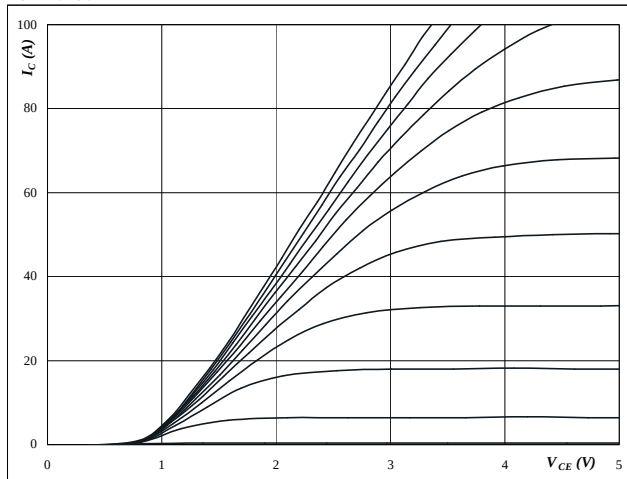
$I_C =$ 50 A



Brake

figure 1. IGBT**Typical output characteristics**

$$I_C = f(V_{CE})$$

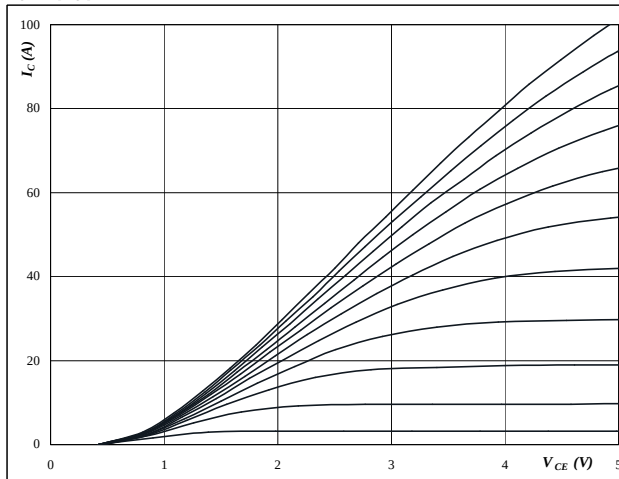
**At**

$$t_p = 250 \mu s$$
$$T_j = 25 ^\circ C$$

VGE from 7 V to 17 V in steps of 1 V

figure 2. IGBT**Typical output characteristics**

$$I_C = f(V_{CE})$$

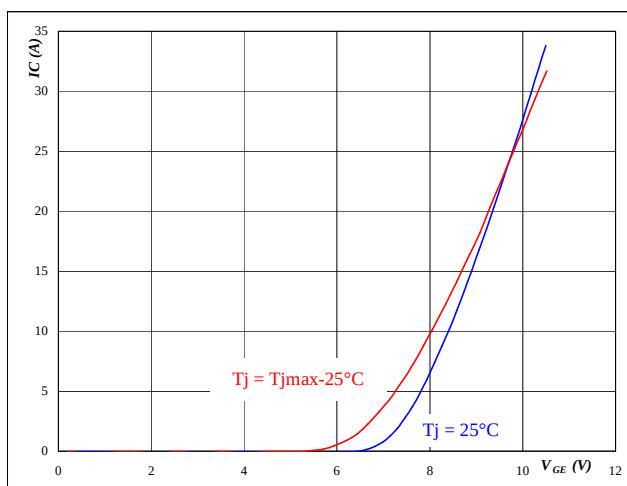
**At**

$$t_p = 250 \mu s$$
$$T_j = 150 ^\circ C$$

VGE from 7 V to 17 V in steps of 1 V

figure 3. IGBT**Typical transfer characteristics**

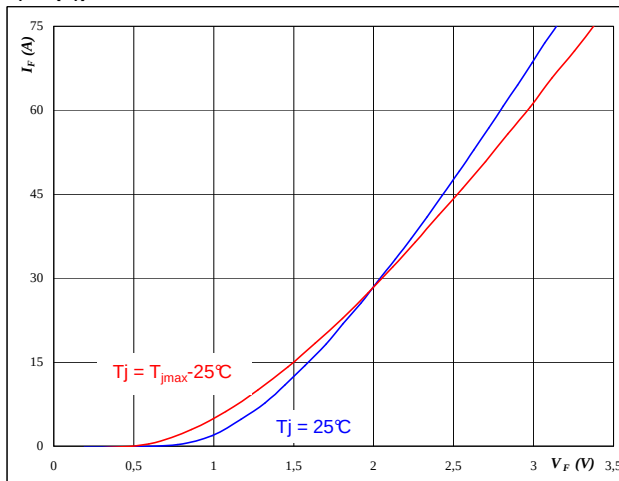
$$I_C = f(V_{GE})$$

**At**

$$t_p = 250 \mu s$$
$$V_{CE} = 10 V$$

figure 4. FWD**Typical diode forward current as a function of forward voltage**

$$I_F = f(V_F)$$

**At**

$$t_p = 250 \mu s$$

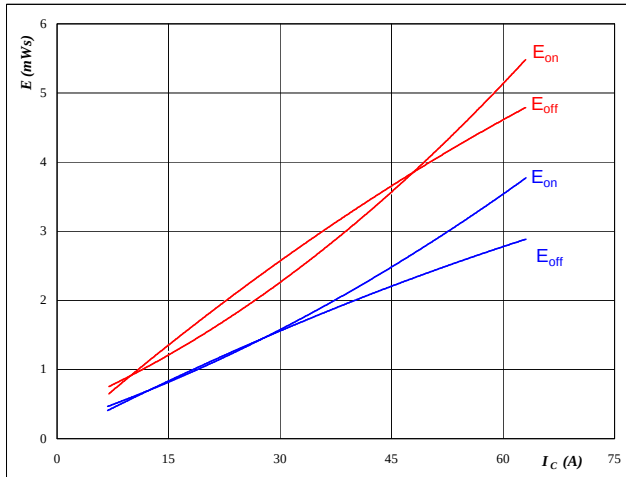


Brake

figure 5. IGBT

Typical switching energy losses
as a function of collector current

$$E = f(I_C)$$



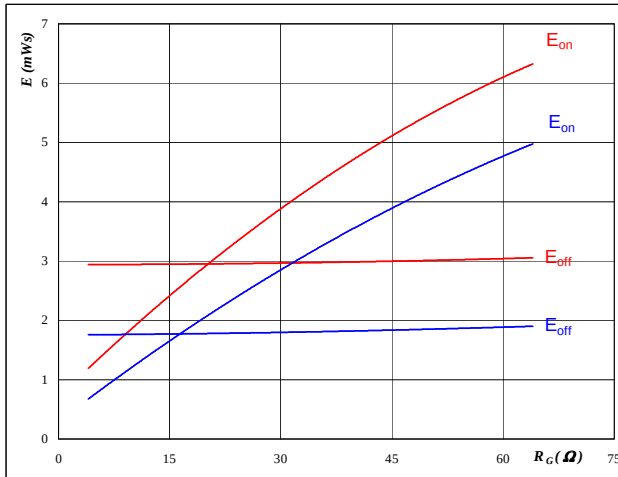
With an inductive load at

$T_j = 25/150$ °C
 $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 16$ Ω
 $R_{goff} = 16$ Ω

figure 6. IGBT

Typical switching energy losses
as a function of gate resistor

$$E = f(R_g)$$



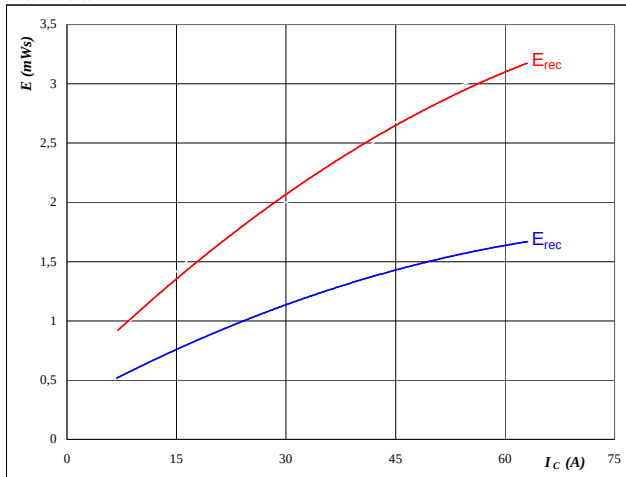
With an inductive load at

$T_j = 25/150$ °C
 $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $I_C = 35$ A

figure 7. IGBT

Typical reverse recovery energy loss
as a function of collector current

$$E_{rec} = f(I_C)$$



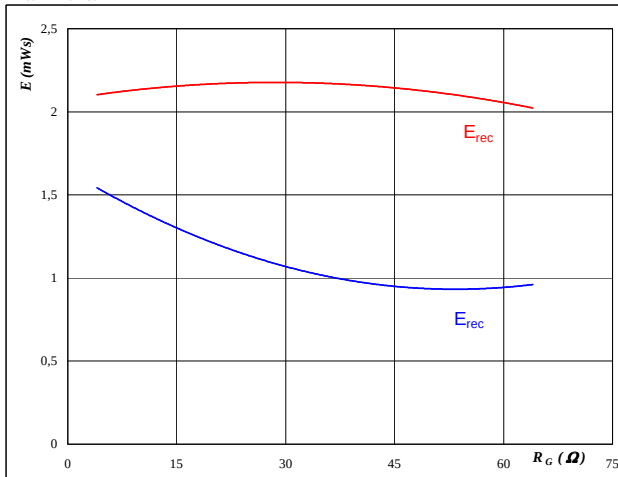
With an inductive load at

$T_j = 25/150$ °C
 $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 16$ Ω

figure 8. IGBT

Typical reverse recovery energy loss
as a function of gate resistor

$$E_{rec} = f(R_g)$$



With an inductive load at

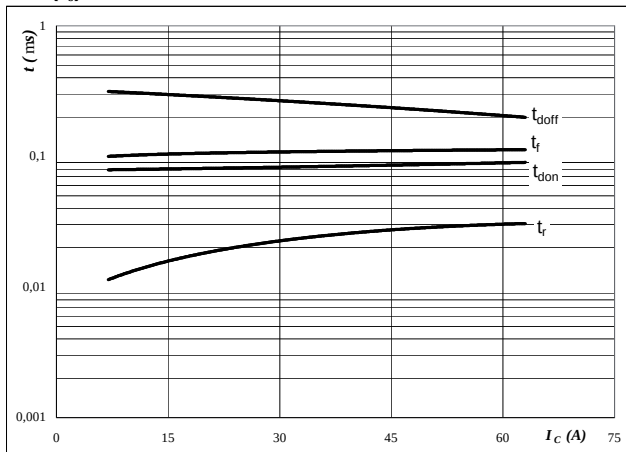
$T_j = 25/150$ °C
 $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $I_C = 35$ A



Brake

figure 9. IGBT**Typical switching times as a function of collector current**

$$t = f(I_C)$$



With an inductive load at

$$T_j = 150 \text{ } ^\circ\text{C}$$

$$V_{CE} = 600 \text{ V}$$

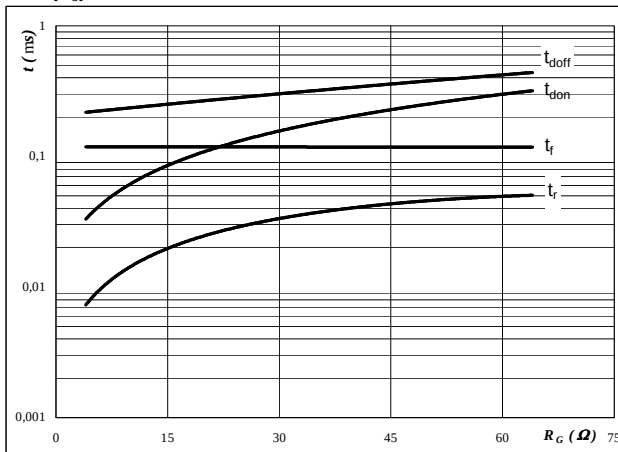
$$V_{GE} = \pm 15 \text{ V}$$

$$R_{gon} = 16 \text{ } \Omega$$

$$R_{goff} = 16 \text{ } \Omega$$

figure 10. IGBT**Typical switching times as a function of gate resistor**

$$t = f(R_G)$$



With an inductive load at

$$T_j = 150 \text{ } ^\circ\text{C}$$

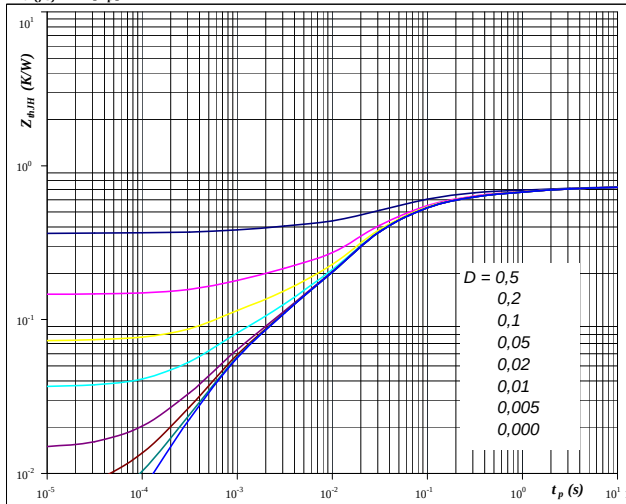
$$V_{CE} = 600 \text{ V}$$

$$V_{GE} = \pm 15 \text{ V}$$

$$I_C = 35 \text{ A}$$

figure 11. IGBT**IGBT transient thermal impedance as a function of pulse width**

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

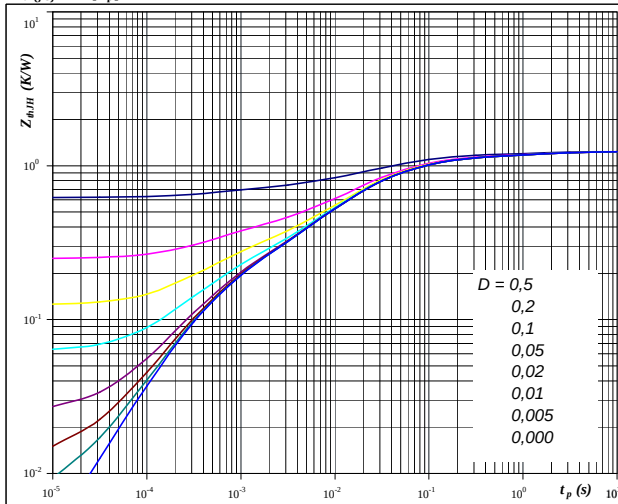
**At**

$$D = t_p / T$$

$$R_{th(j-s)} = 0,73 \text{ K/W}$$

figure 12. IGBT**FWD transient thermal impedance as a function of pulse width**

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

**At**

$$D = t_p / T$$

$$R_{th(j-s)} = 1,24 \text{ K/W}$$

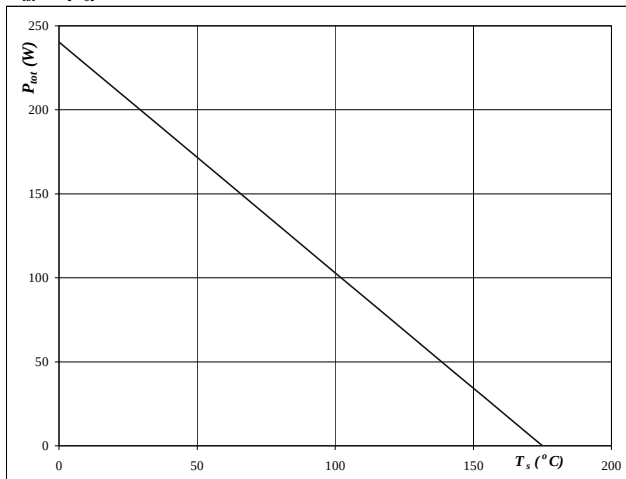


Brake

figure 13. IGBT

Power dissipation as a function of heatsink temperature

$$P_{\text{tot}} = f(T_s)$$

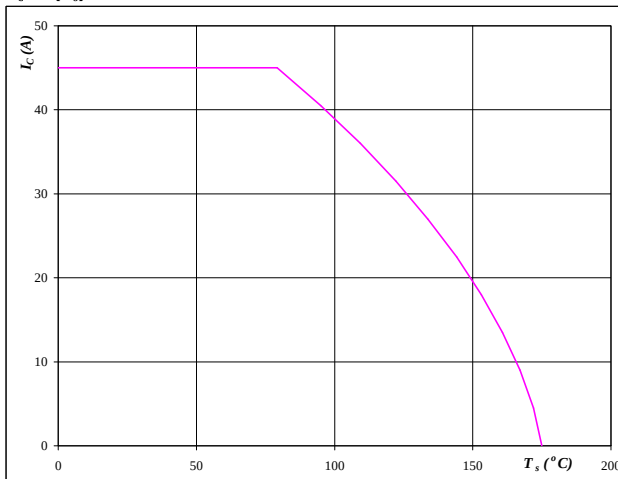


At
 $T_j = 175$ °C

figure 14. IGBT

Collector current as a function of heatsink temperature

$$I_c = f(T_s)$$

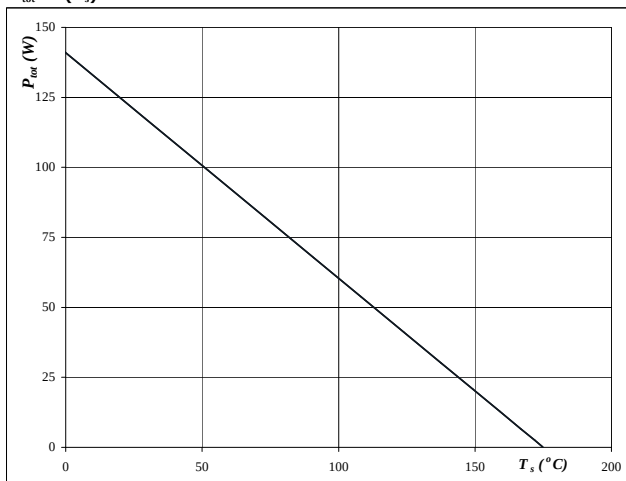


At
 $T_j = 175$ °C
 $V_{GE} = 15$ V

figure 15. FWD

Power dissipation as a function of heatsink temperature

$$P_{\text{tot}} = f(T_s)$$

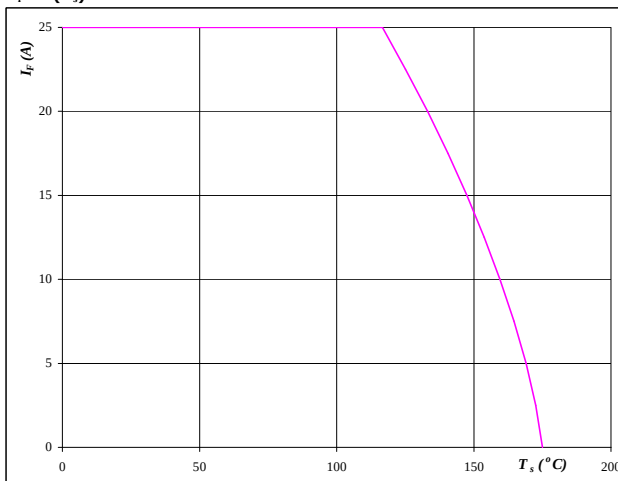


At
 $T_j = 175$ °C

figure 16. FWD

Forward current as a function of heatsink temperature

$$I_F = f(T_s)$$



At
 $T_j = 175$ °C

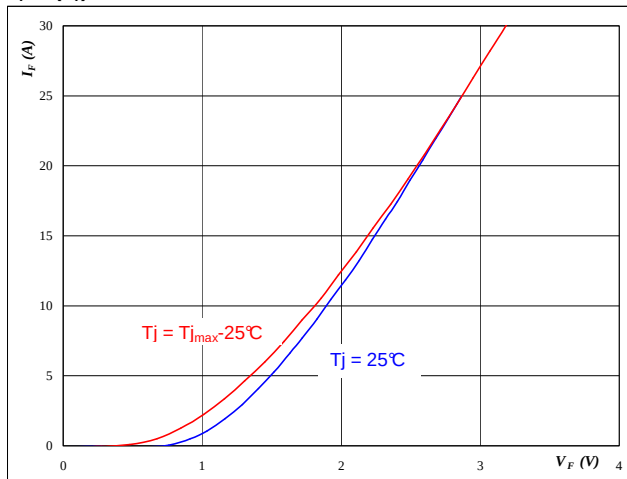


Brake Inverse Diode

figure 1. Brake inverse diode

Typical diode forward current as a function of forward voltage

$$I_F = f(V_F)$$



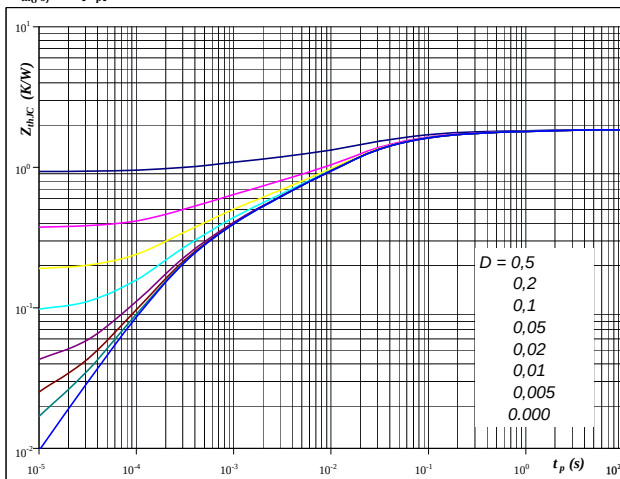
At

$$t_p = 250 \mu s$$

figure 2. Brake inverse diode

Diode transient thermal impedance as a function of pulse width

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



At

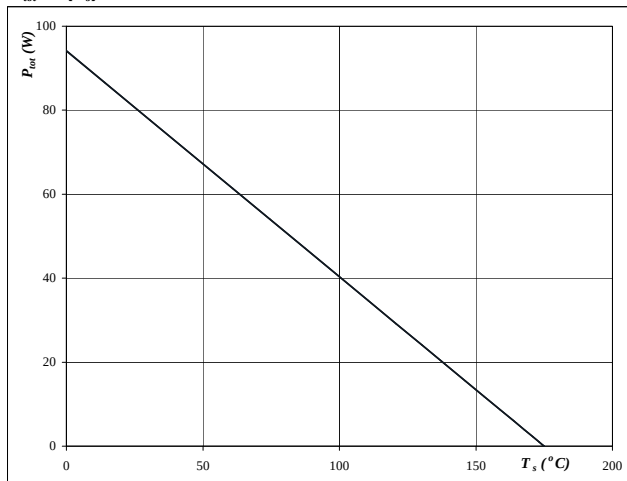
$$D = t_p / T$$

$$R_{th(j-s)} = 1,86 \text{ K/W}$$

figure 3. Brake inverse diode

Power dissipation as a function of heatsink temperature

$$P_{tot} = f(T_s)$$



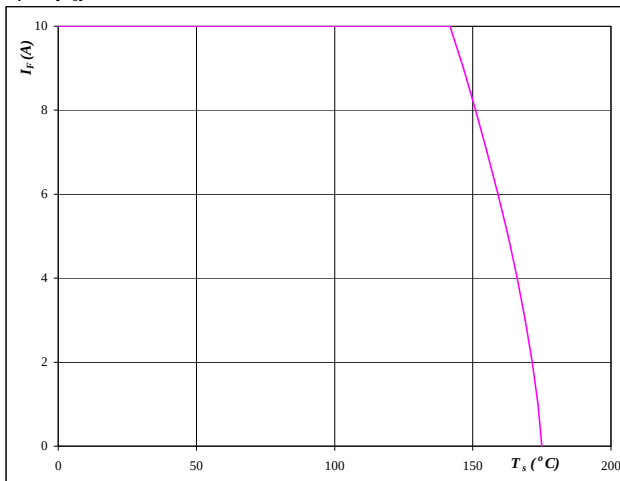
At

$$T_j = 175 \text{ °C}$$

figure 4. Brake inverse diode

Forward current as a function of heatsink temperature

$$I_F = f(T_s)$$



At

$$T_j = 175 \text{ °C}$$

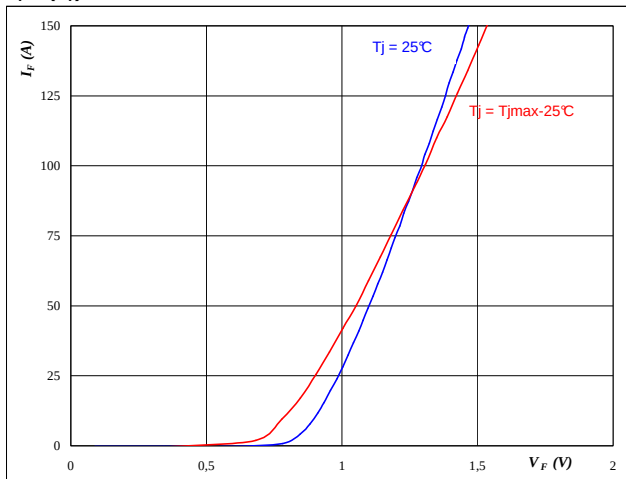


Input Rectifier Bridge

figure 1. Rectifier Diode

Typical diode forward current as a function of forward voltage

$$I_F = f(V_F)$$



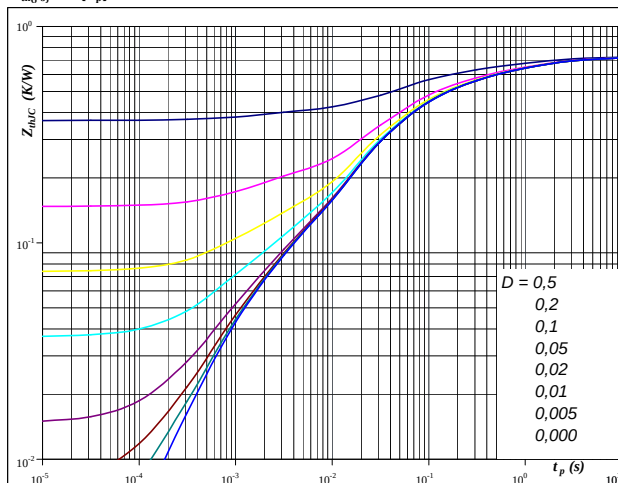
At

$$t_p = 250 \mu s$$

figure 2. Rectifier Diode

Diode transient thermal impedance as a function of pulse width

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



At

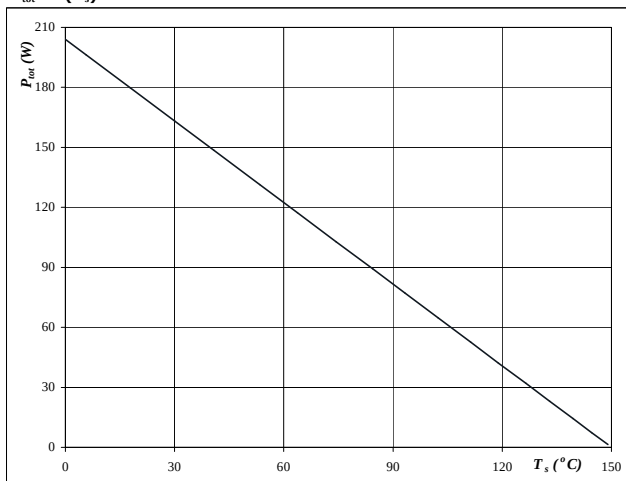
$$D = t_p / T$$

$$R_{th(j-s)} = 0,74 \text{ K/W}$$

figure 3. Rectifier Diode

Power dissipation as a function of heatsink temperature

$$P_{tot} = f(T_s)$$



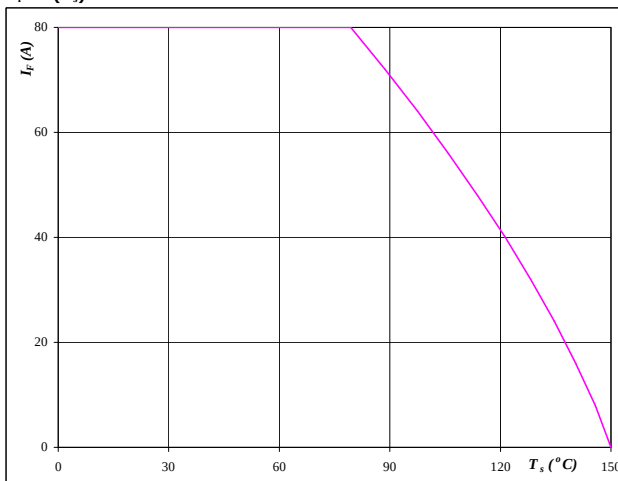
At

$$T_j = 150 \text{ } ^\circ\text{C}$$

figure 4. Rectifier Diode

Forward current as a function of heatsink temperature

$$I_F = f(T_s)$$



At

$$T_j = 150 \text{ } ^\circ\text{C}$$

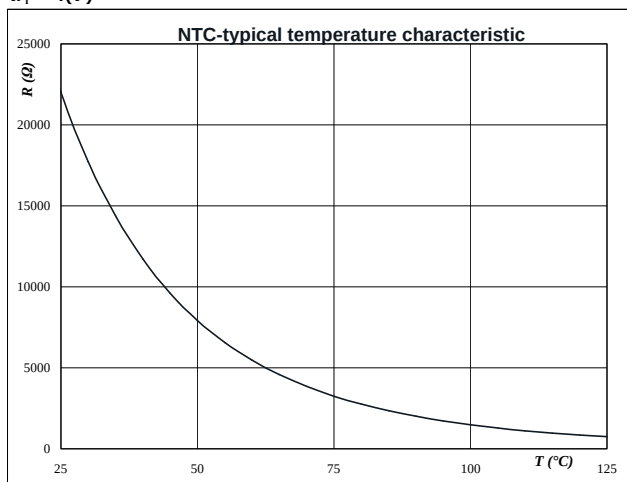


Thermistor

figure 1. Thermistor

**Typical NTC characteristic
as a function of temperature**

$$R_T = f(T)$$





Switching Definitions Output Inverter

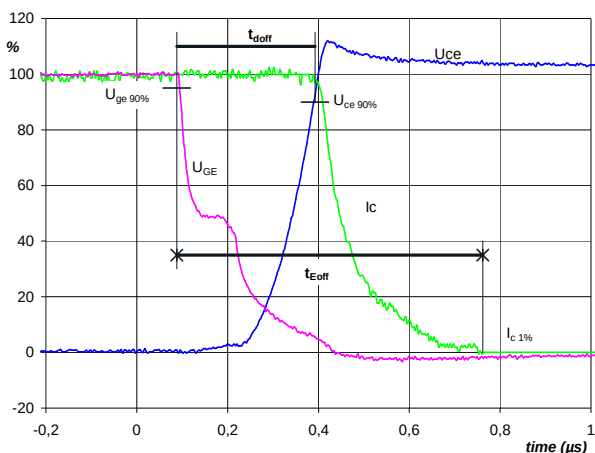
General conditions

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

figure 1. IGBT

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

(t_{Eoff} = integrating time for E_{off})

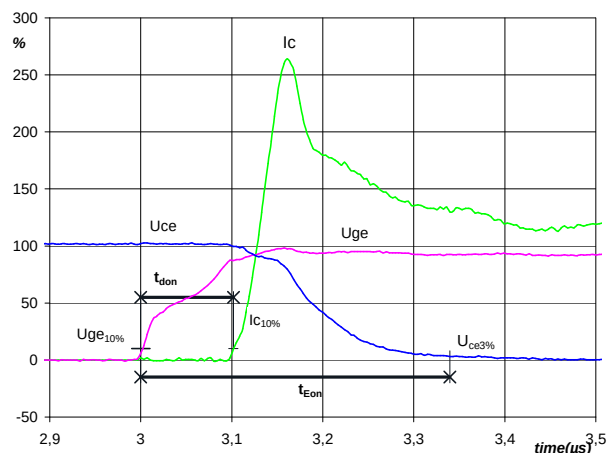


$V_{GE} (0\%) =$	-15	V
$V_{GE} (100\%) =$	15	V
$V_C (100\%) =$	600	V
$I_C (100\%) =$	50	A
$t_{doff} =$	0,30	μs
$t_{Eoff} =$	0,67	μs

figure 2. IGBT

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

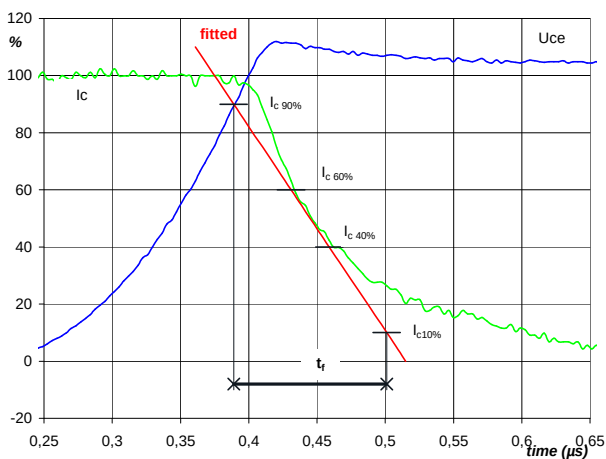
(t_{Eon} = integrating time for E_{on})



$V_{GE} (0\%) =$	-15	V
$V_{GE} (100\%) =$	15	V
$V_C (100\%) =$	600	V
$I_C (100\%) =$	50	A
$t_{donr} =$	0,10	μs
$t_{Eon} =$	0,34	μs

figure 3. IGBT

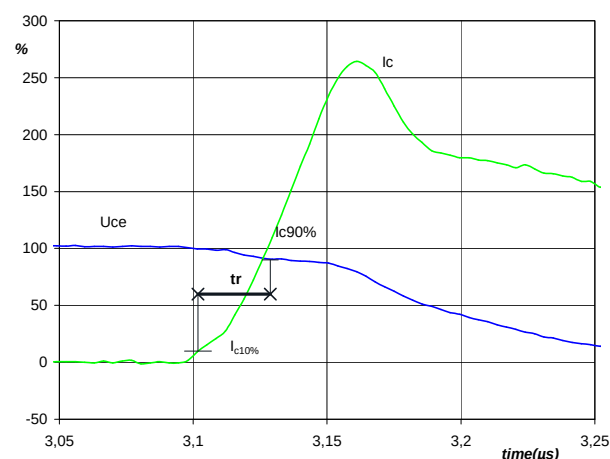
Turn-off Switching Waveforms & definition of t_f



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

figure 4. IGBT

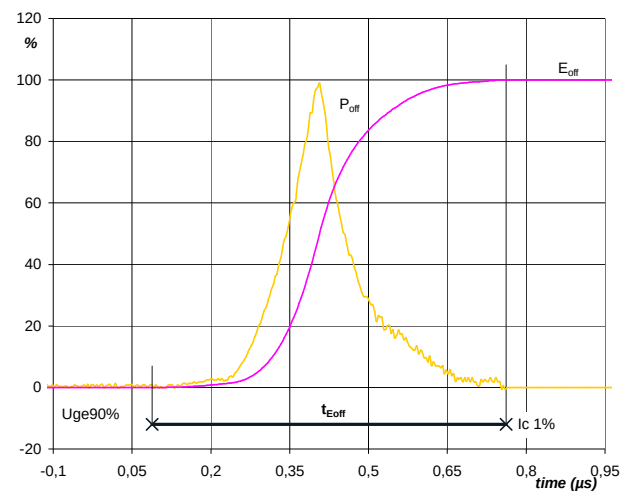
Turn-on Switching Waveforms & definition of t_r



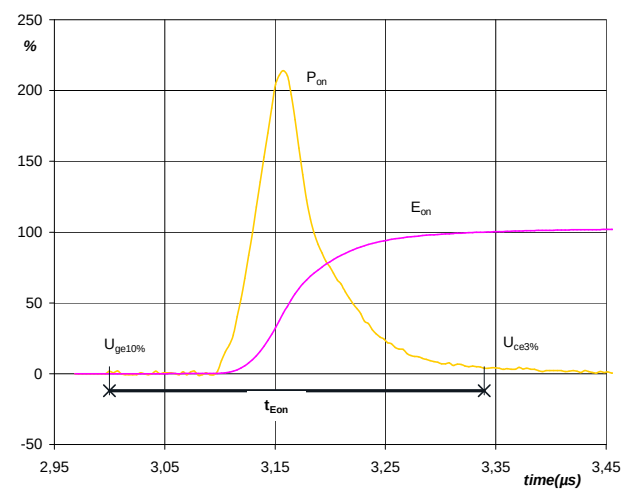
$V_C (100\%) =$	600	V
$I_C (100\%) =$	50	A
$t_r =$	0,02	μs



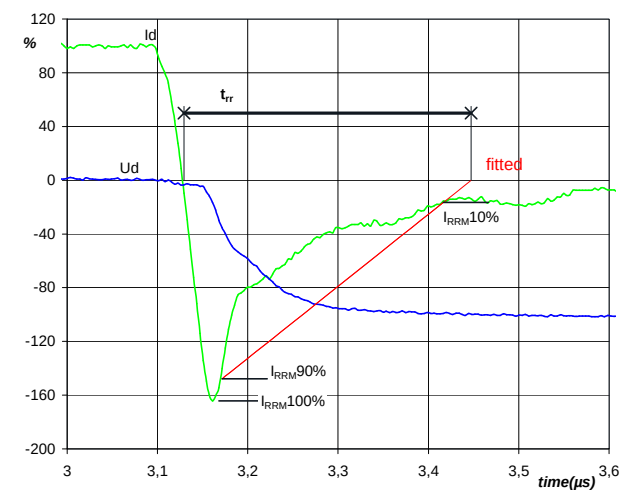
Switching Definitions Output Inverter

figure 5. IGBT
Turn-off Switching Waveforms & definition of t_{Eoff}


$P_{off} (100\%) =$	29,95	kW
$E_{off} (100\%) =$	4,48	mJ
$t_{Eoff} =$	0,67	μs

figure 6. IGBT
Turn-on Switching Waveforms & definition of t_{Eon}


$P_{on} (100\%) =$	29,95	kW
$E_{on} (100\%) =$	4,50	mJ
$t_{Eon} =$	0,34	μs

figure 7. FWD
Turn-off Switching Waveforms & definition of t_{rr}


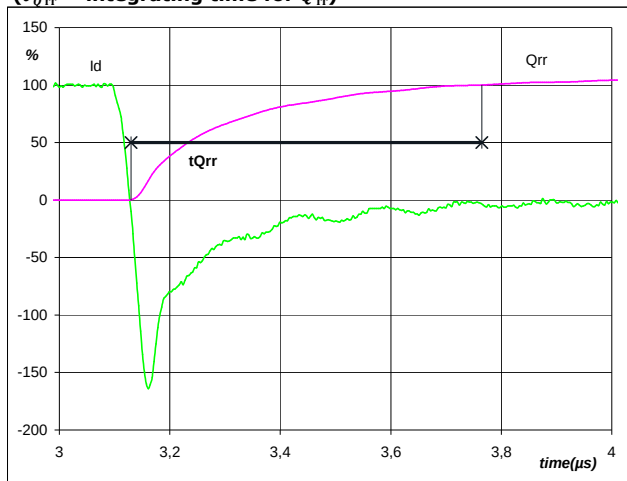
$V_d (100\%) =$	600	V
$I_d (100\%) =$	50	A
$I_{RRM} (100\%) =$	-82	A
$t_{rr} =$	0,31	μs



Switching Definitions Output Inverter

figure 8. FWD

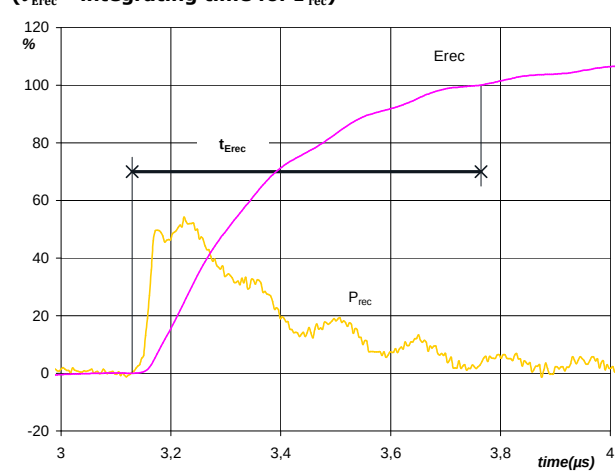
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})



I_d (100%) = 50 A
 Q_{rr} (100%) = 9,95 μC
 t_{Qint} = 0,64 μs

figure 9. FWD

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



P_{rec} (100%) = 29,95 kW
 E_{rec} (100%) = 3,98 mJ
 t_{Erec} = 0,64 μs

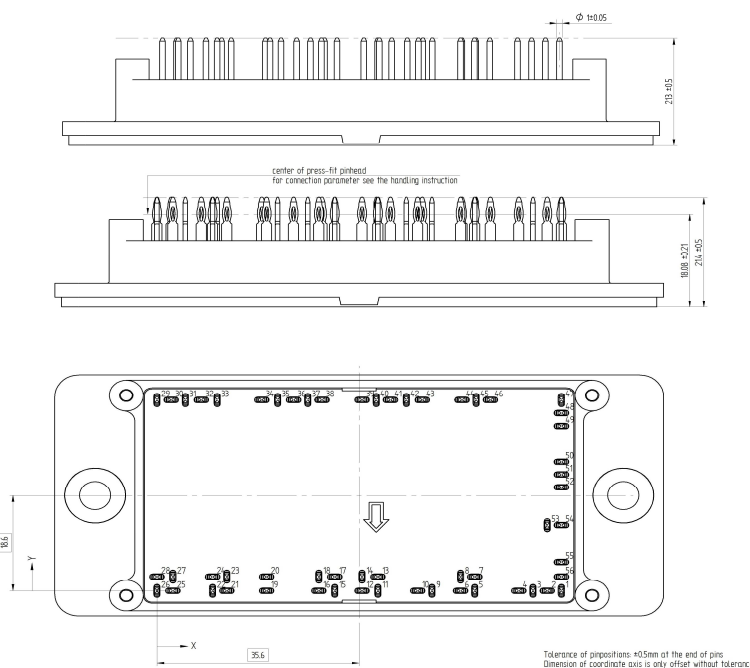
Ordering Code and Marking - Outline - Pinout

Ordering Code & Marking

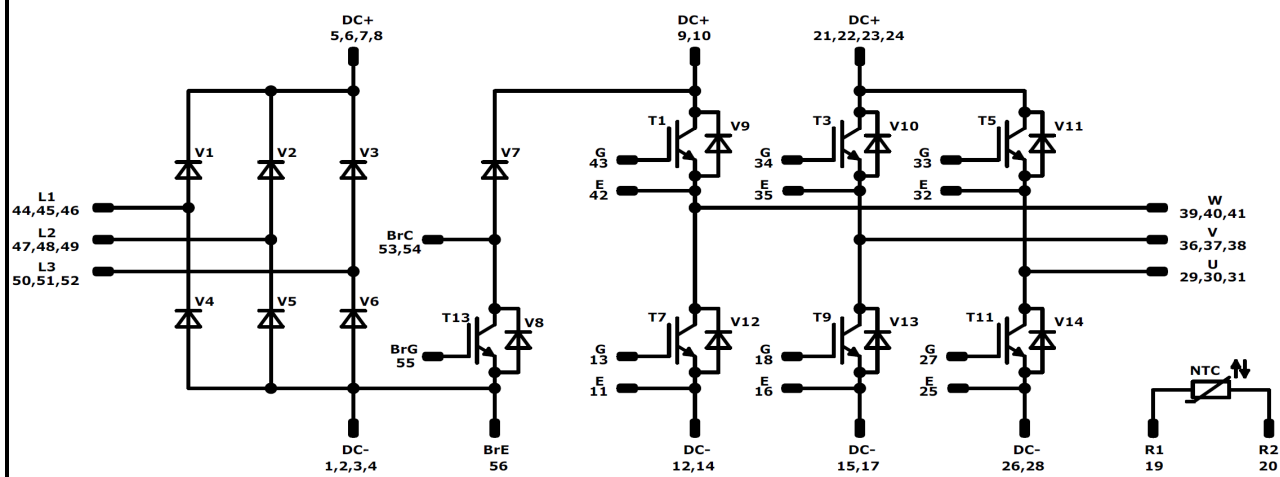
Version	Ordering Code	in DataMatrix as	in packaging barcode as
without thermal paste with Solder pins	V23990-P768-A-PM	P768A	P768A
without thermal paste with Press-fit pins	V23990-P768-AY-PM	P768AY	P768AY
with thermal paste with Solder pins	V23990-P768-A-/3/-PM	P768A	P768A-/3/
with thermal paste with Press-fit pins	V23990-P768-AY-/3/-PM	P768AY	P768AY-/3/

Outline

Pin table							
Pin		X	Y	Pin		X	Y
1	DC-	71,2	0	29	U	0	37,2
2	DC-	68,7	0	30	U	2,5	37,2
3	DC-	66,2	0	31	U	5	37,2
4	DC-	63,7	0	32	E	7,8	37,2
5	DC+	55,95	0	33	G	10,6	37,2
6	DC+	53,45	0	34	G	18,45	37,2
7	DC+	55,95	2,8	35	E	21,25	37,2
8	DC+	53,45	2,8	36	V	24,05	37,2
9	DC+	48,4	0	37	V	26,55	37,2
10	DC+	45,9	0	38	V	29,05	37,2
11	E	38,9	0	39	W	36,1	37,2
12	DC-	36,1	0	40	W	38,6	37,2
13	G	38,9	2,8	41	W	41,1	37,2
14	DC-	36,1	2,8	42	E	43,9	37,2
15	DC-	31,3	0	43	G	46,7	37,2
16	E	28,5	0	44	L1	53,7	37,2
17	DC-	31,3	2,8	45	L1	56,2	37,2
18	G	28,5	2,8	46	L1	58,7	37,2
19	R1	19,3	0	47	L2	71,2	37,2
20	R2	19,3	2,8	48	L2	71,2	34,7
21	DC+	12,3	0	49	L2	71,2	32,2
22	DC+	9,8	0	50	L3	71,2	25,2
23	DC+	12,3	2,8	51	L3	71,2	22,7
24	DC+	9,8	2,8	52	L3	71,2	20,2
25	E	2,8	0	53	BrC	71,2	12,8
26	DC-	0	0	54	BrC	68,7	12,8
27	G	2,8	2,8	55	BrG	71,2	5,6
28	DC-	0	2,8	56	BrE	71,2	2,8



Pinout



Identification

ID	Component	Voltage	Current	Function	Comment
T1,T3,T5,T7,T9,T11	IGBT	1200V	50A	Inverter Switch	
V9,V10,V11, V12,V13,V14	FWD	1200V	50A	Inverter Diode	
T13	IGBT	1200V	50A	Brake Switch	
V7	FWD	1200V	25A	Brake Diode	
V8	FWD	1200V	10A	Brake Inverse Diode	
V1,V2,V3,V4,V5,V6	Rectifier	1600V	50A	Rectifier	
NTC	NTC	-	-	Thermistor	



Packaging instruction			
Standard packaging quantity (SPQ)	36	>SPQ Standard	<SPQ Sample

Handling instruction
Handling instructions for <i>flow 2</i> packages see vincotech.com website.

Package data
Package data for <i>flow 2</i> 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-P768-Ax-D8-14	24 Jan. 2019	flow2 frame modification	1,23

DISCLAIMER

The information, specifications, procedures, methods and recommendations herein (together "information") are presented by Vincotech to reader in good faith, are believed to be accurate and reliable, but may well be incomplete and/or not applicable to all conditions or situations that may exist or occur. Vincotech reserves the right to make any changes without further notice to any products to improve reliability, function or design. No representation, guarantee or warranty is made to reader as to the accuracy, reliability or completeness of said information or that the application or use of any of the same will avoid hazards, accidents, losses, damages or injury of any kind to persons or property or that the same will not infringe third parties rights or give desired results. It is reader's sole responsibility to test and determine the suitability of the information and the product for reader's intended use.

LIFE SUPPORT POLICY

Vincotech products are not authorised for use as critical components in life support devices or systems without the express written approval of Vincotech.

As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, or (c) whose failure to perform when properly used in accordance with instructions for use provided in labelling can be reasonably expected to result in significant injury to the user.
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.