V23990-P640-G10-PM
datasheet

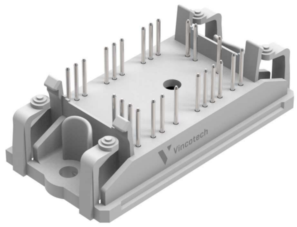
Vincotech

***flow*CON 0** | **1600 V / 42 A**

Features

- Three-phase half-controlled rectifier
- Brake chopper

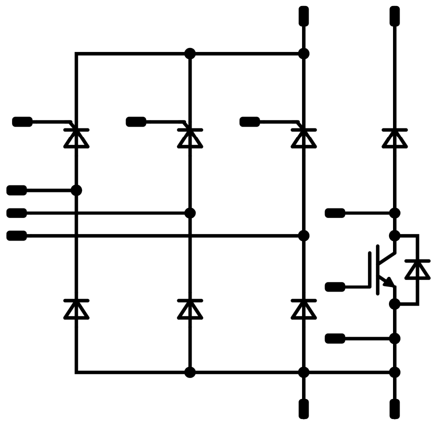
flow 0 17 mm housing



Target applications

- Industrial Drives
- Embedded Drives
- UPS

Schematic



Types

- V23990-P640-G10-PM

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Rectifier Diode					
Peak repetitive reverse voltage	V_{RRM}			1600	V
Continuous (direct) forward current	I_F	$T_j = T_{jmax}$	T_s = 80 °C	78	A
Surge (non-repetitive) forward current	I_{FSM}	50 Hz Single Half Sine Wave t_p = 10 ms	T_j = 150 °C	740	A
Surge current capability	I^2t	50 Hz Single Half Sine Wave t_p = 10 ms	T_j = 150 °C	2740	A^2s
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	88	W
Maximum junction temperature	T_{jmax}			150	°C

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Rectifier Thyristor					
Repetitive peak reverse voltage	V_{RRM}			1600	V
Forward average current	I_{FAV}	sine, d = 0,5 $T_j = T_{jmax}$	T_s = 80 °C	53	A
Surge forward current	I_{FSM}	t_p = 10 ms	T_j = 130 °C	450	A
I^2t value	I^2t			1010	A^2s
Mean total power loss	$P_{tot(AV)}$	$T_j = T_{jmax}$	T_s = 80 °C	67	W
Maximum Junction Temperature	T_{jmax}			130	°C
Brake Switch					
Collector-emitter voltage	V_{CES}			1200	V
Collector current	I_C			35	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}		70	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	72	W
Gate-emitter voltage	V_{GES}			±20	V
Maximum junction temperature	T_{jmax}			150	°C
Brake Diode					
Peak repetitive reverse voltage	V_{RRM}			1200	V
Continuous (direct) forward current	I_F	$T_j = T_{jmax}$	T_s = 80 °C	23	A
Repetitive peak forward current	I_{FRM}			50	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	41	W
Maximum junction temperature	T_{jmax}			150	°C
Brake Sw. Protection Diode					
Peak repetitive reverse voltage	V_{RRM}			1200	V
Continuous (direct) forward current	I_F			3	A
Repetitive peak forward current	I_{FRM}			6	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	19	W
Maximum junction temperature	T_{jmax}			150	°C

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Module Properties					
Thermal Properties					
Storage temperature	T_{stg}			-40…+125	°C
Operation temperature under switching condition	T_{jop}			-40…(T_{jmax} - 25)	°C
Isolation Properties					
Isolation voltage	V_{isol}	DC Test Voltage*	t_p = 2 s	6000	V
		AC Voltage	t_p = 1 min	2500	V
Creepage distance				min. 12,7	mm
Clearance				min. 12,7	mm
Comparative Tracking Index	CTI			> 200	

*100 % tested in production

Characteristic Values

Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] V_{GS} [V]	V_{CE} [V] V_{DS} [V] V_{F} [V]	I_{C} [A] I_{D} [A] I_{F} [A]	T_{j} [°C]	Min	Typ	Max	
Rectifier Diode										
Static										
Forward voltage	V_{F}				80	25 125		1,18 1,15	1,23	V
Reverse leakage current	I_{R}			1600		25 150			50 1500	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						0,79		K/W
Rectifier Thyristor										
Static										
Forward voltage	V_{F}				45	25 125		1,41 1,45		V
On-state threshold voltage	$V_{T(TO)}$				45	130			0,85	V
On-state slope resistance	r_{T}				45	130			7,9	mΩ
Critical rate of rise of off-state voltage	$(dv/dt)_{cr}$					130			50	V/µs
Critical rate of rise of on-state current	$(di_{T}/dt)_{cr}$					130			1000	A/µs
Circuit commutated turn-off time	t_{q}					130		150		µs
Holding current	I_{H}					25			165	mA
Latching current	I_{L}					25			330	mA
Gate trigger voltage	V_{GT}					25			1,98	V
Gate trigger current	I_{GT}					25			100	mA
Gate non-trigger voltage	V_{GD}					130	0,25			V
Gate non-trigger current	I_{GD}					115	6			mA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						0,75		K/W

Characteristic Values

Parameter	Symbol	Conditions	V_{GE} [V] / V_{GS} [V]	V_{CE} [V] / V_{DS} [V] / V_F [V]	I_C [A] / I_D [A] / I_F [A]	T_j [°C]	Min	Typ	Max	Unit
Brake Switch										
Static										
Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{GE} = V_{CE}$			0,0015	25	5	5,8	6,5	V
Collector-emitter saturation voltage	V_{CEsat}		15		35	25 125	1,35	1,74 1,98	2,05	V
Collector-emitter cut-off current	I_{CES}		0	1200		25			250	µA
Gate-emitter leakage current	I_{GES}		30	0		25			600	nA
Internal gate resistance	r_g							6		Ω
Input capacitance	C_{ies}	f = 1 Mhz	0	25		25		2530		pF
Output capacitance	C_{oes}							132		
Reverse transfer capacitance	C_{res}							115		
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						0,97		K/W
Dynamic										
Turn-on delay time	$t_{d(on)}$	R_{gon} = 32 Ω R_{goff} = 16 Ω	0 / 15	700	35	25 125		87 84		ns
Rise time	t_r					25 125		20 22		
Turn-off delay time	$t_{d(off)}$					25 125		521 615		
Fall time	t_f					25 125		50 142		
Turn-on energy (per pulse)	E_{on}	Q_{rFWD} = 2,8 µC Q_{rFWD} = 5 µC				25 125		3,49 4,47		mWs
Turn-off energy (per pulse)	E_{off}					25 125		2,68 4,32		

Characteristic Values

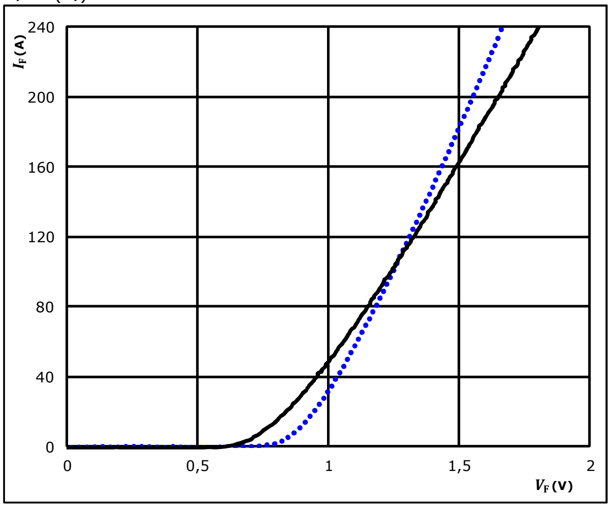
Parameter	Symbol	Conditions	V_{GE} [V] V_{GS} [V]	V_{CE} [V] V_{DS} [V] V_F [V]	I_C [A] I_D [A] I_F [A]	T_j [°C]	Min	Typ	Max	Unit
Brake Diode										
Static										
Forward voltage	V_F				25	25 125		1,79 1,80		V
Reverse leakage current	I_R			1200		25			27	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						1,72		K/W
Dynamic										
Peak recovery current	I_{RRM}	di/dt = 2239 A/µs di/dt = 2068 A/µs	0 / 15	700	35	25 125		37 45		A
Reverse recovery time	t_{rr}	di/dt = 2239 A/µs di/dt = 2068 A/µs	0 / 15	700	35	25 125		301 420		ns
Recovered charge	Q_r	di/dt = 2239 A/µs di/dt = 2068 A/µs	0 / 15	700	35	25 125		2,75 5,03		µC
Reverse recovered energy	E_{rec}	di/dt = 2239 A/µs di/dt = 2068 A/µs	0 / 15	700	35	25 125		1,04 2,06		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$	di/dt = 2239 A/µs di/dt = 2068 A/µs	0 / 15	700	35	25 125		2619 1765		A/µs
Brake Sw. Protection Diode										
Static										
Forward voltage	V_F				3	25 125		1,66 1,59		V
Reverse leakage current	I_R			1200		25			250	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						3,72		K/W

Rectifier Diode Characteristics

figure 1. **Rectifier Diode**

Typical forward characteristics

$I_F = f(V_F)$



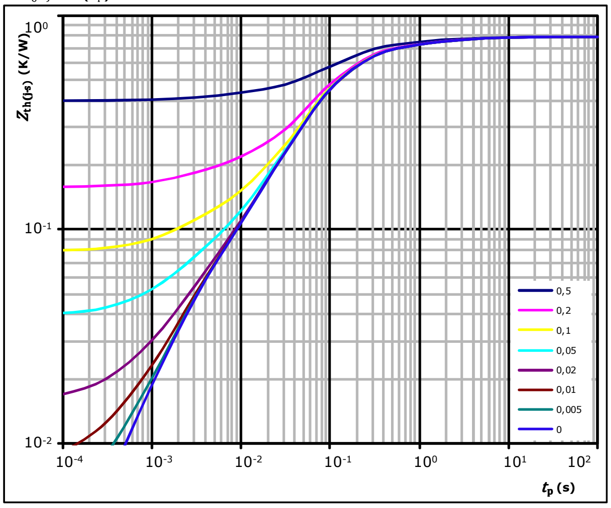
t_p = 250 µs

T_j: 25 °C (dotted) / 125 °C (solid)

figure 2. **Rectifier Diode**

Transient thermal impedance as a function of pulse width

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



D = t_p / T

$R_{th(j-s)}$ = 0,79 K/W

Diode thermal model values

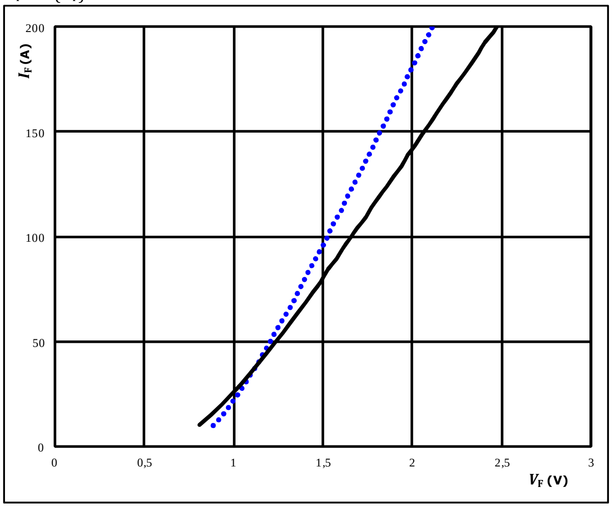
R (K/W)	τ (s)
3,05E-02	5,20E+00
8,93E-02	9,97E-01
2,82E-01	1,58E-01
3,51E-01	5,43E-02
3,93E-02	2,64E-03

Rectifier Thyristor Characteristics

figure 1. **Thyristor**

Typical forward characteristics

$I_F = f(V_F)$



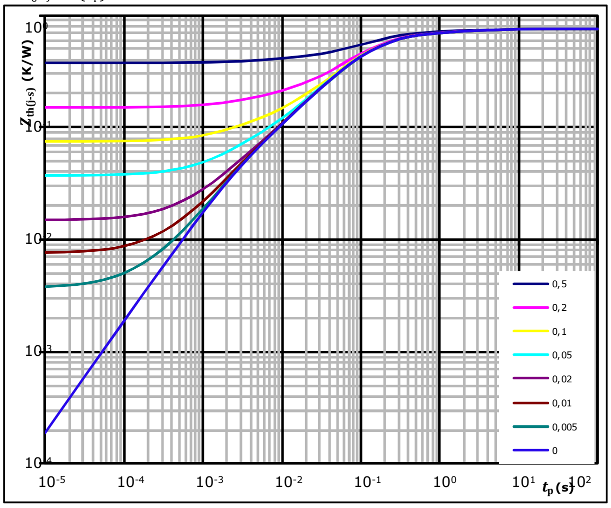
t_p = 250 µs

T_j: 25 °C (dotted); 125 °C (solid)

figure 2. **Thyristor**

Transient thermal impedance as a function of pulse width

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



D = t_p / T

$R_{th(j\text{-}s)}$ = 0,75 K/W

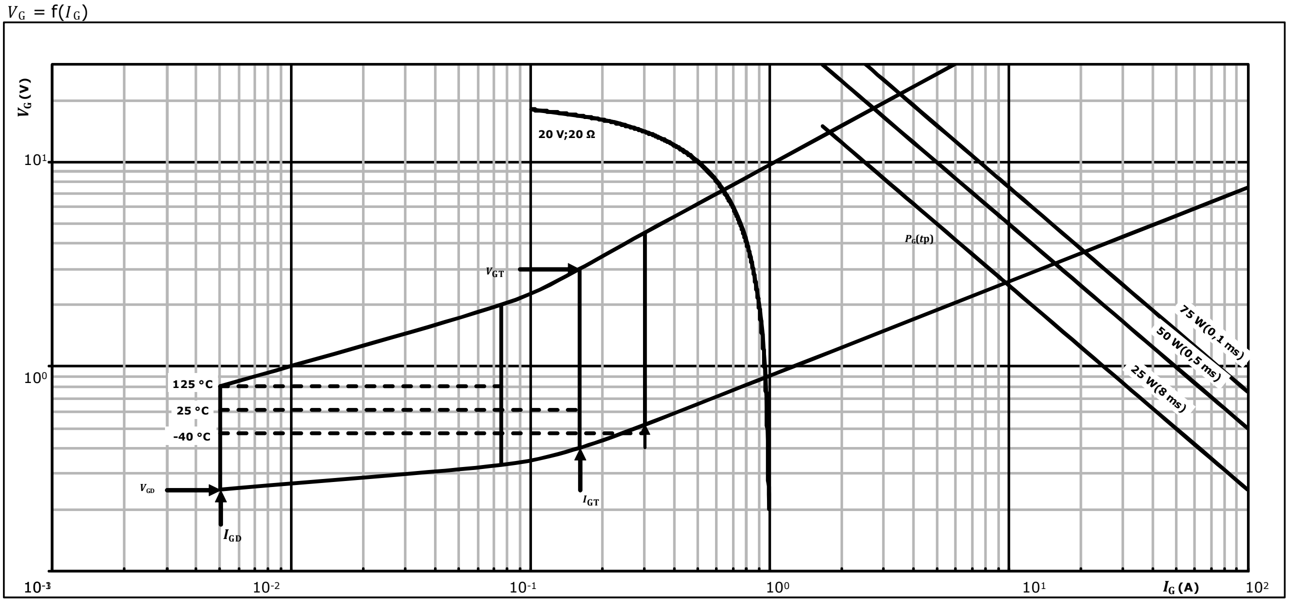
Thyristor thermal model values

R (K/W)	τ (s)
5,49E-02	3,07E+00
1,27E-01	4,52E-01
4,30E-01	9,34E-02
1,02E-01	2,77E-02
3,72E-02	3,01E-03

figure 3. **Thyristor**

Gate trigger characteristics

$V_G = f(I_G)$

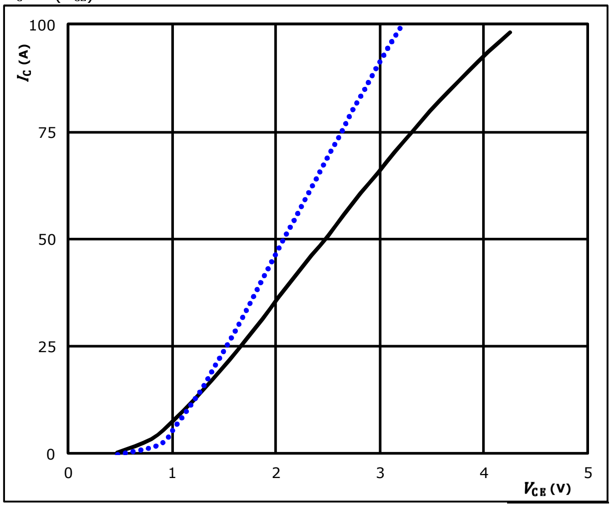


Brake Switch Characteristics

figure 1. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

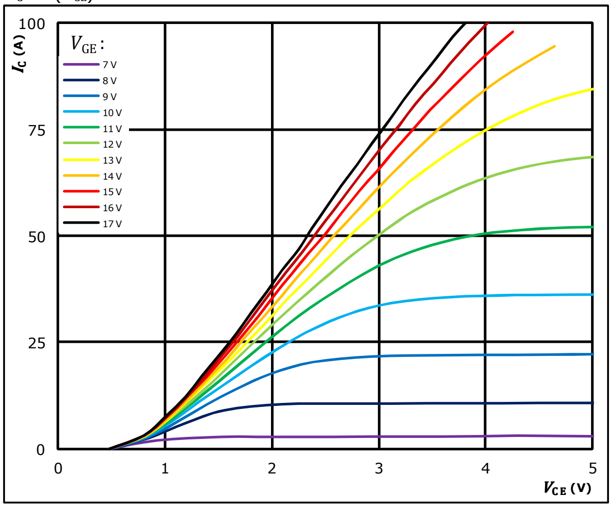


t_p =	250	µs	T_j:	25 °C	············
V_{GE} =	15	V		125 °C	———

figure 2. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

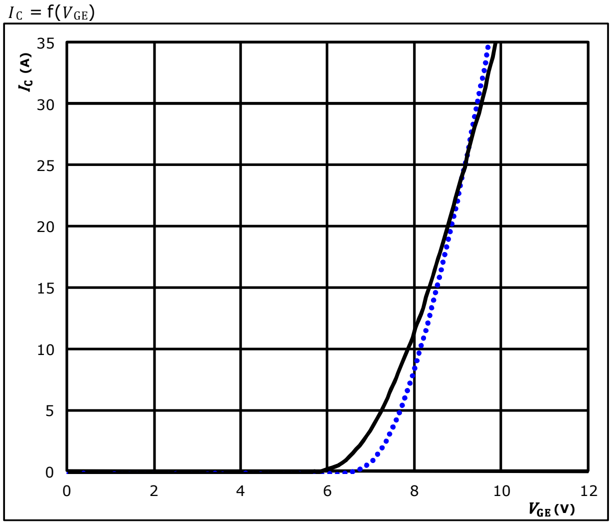


t_p = 250 µs
T_j = 125 °C
V_{GE} from 7 V to 17 V in steps of 1 V

figure 3. **IGBT**

Typical transfer characteristics

$I_C = f(V_{GE})$

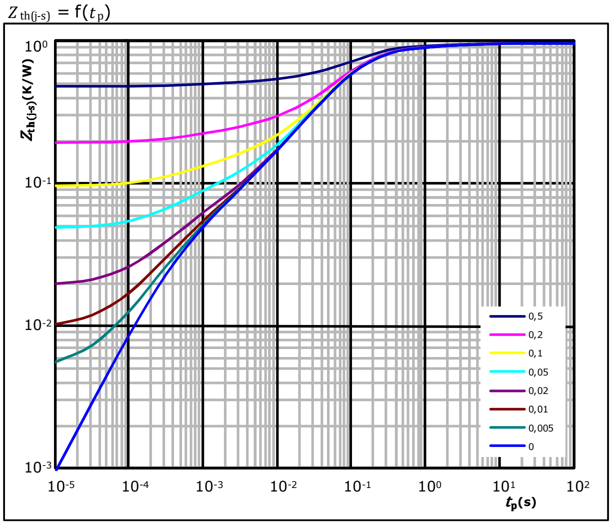


t_p =	100	µs	T_j:	25 °C	············
V_{CE} =	10	V		125 °C	———

figure 4. **IGBT**

Transient thermal impedance as function of pulse duration

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



D = t_p / T
$R_{th(j\text{-}s)}$ = 0,97 K/W

IGBT thermal model values

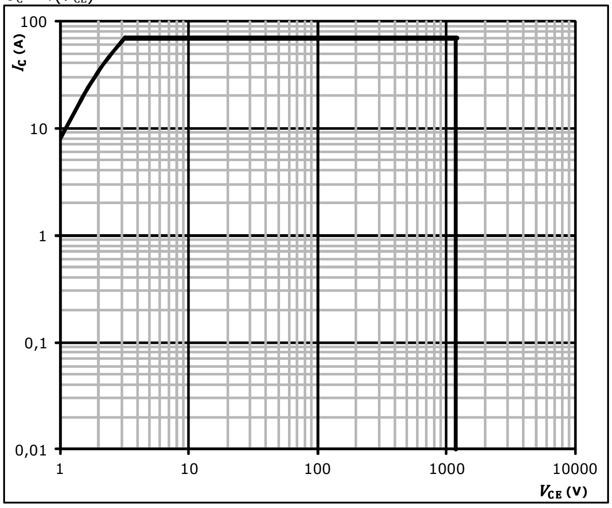
R (K/W)	τ (s)
6,59E-02	3,01E+00
1,61E-01	3,99E-01
6,07E-01	8,47E-02
7,79E-02	1,42E-02
3,57E-02	2,31E-03
2,73E-02	4,08E-04

Brake Switch Characteristics

figure 5. **IGBT**

Safe operating area

$I_C = f(V_{CE})$



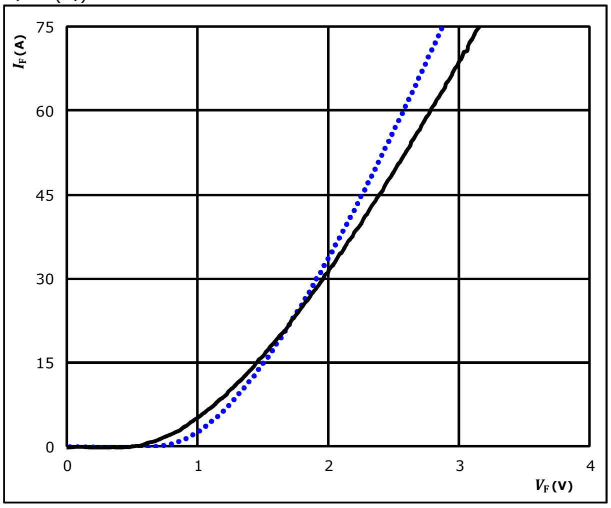
D =	single pulse	
T_s =	80	ºC
V_{GE} =	±15	V
T_j =	T_{jmax}	

Brake Diode Characteristics

figure 1. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



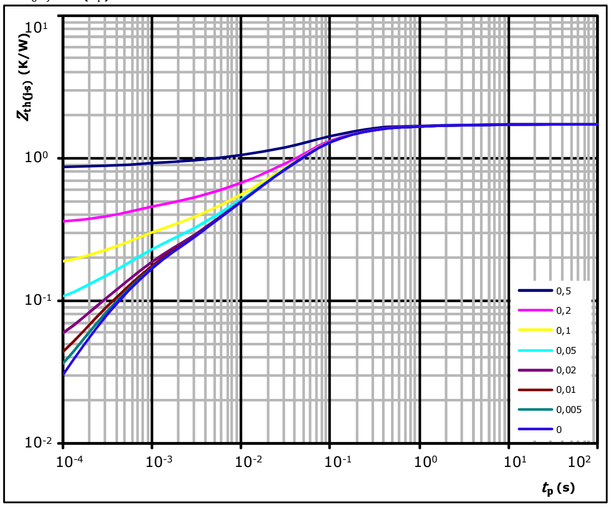
t_p = 250 µs

T_j: 25 °C
125 °C

figure 2. **FWD**

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$

$R_{th(j-s)}$ = 1,72 K/W

FWD thermal model values

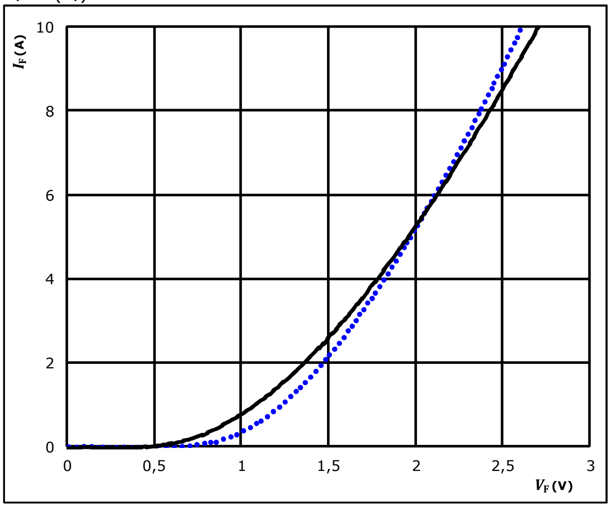
R (K/W)	τ (s)
5,74E-02	3,42E+00
1,85E-01	4,11E-01
9,45E-01	7,07E-02
2,69E-01	1,95E-02
1,43E-01	3,59E-03
1,19E-01	4,63E-04

Brake Sw. Protection Diode Characteristics

figure 1. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



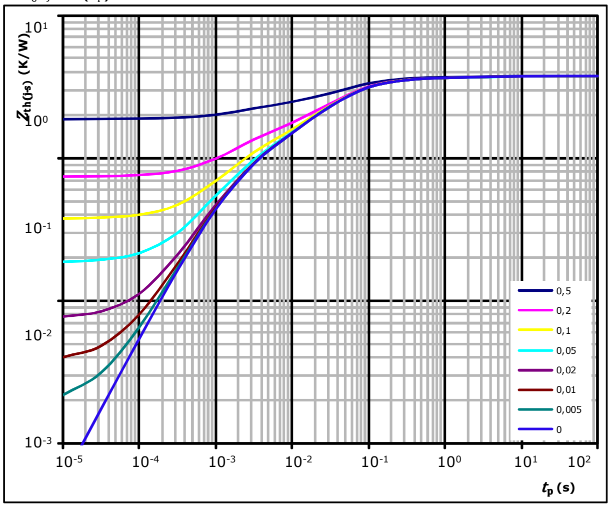
t_p = 250 µs

T_j: 25 °C (dotted line); 125 °C (solid line)

figure 2. **FWD**

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$

$R_{th(j\text{-}s)}$ = 3,72 K/W

FWD thermal model values

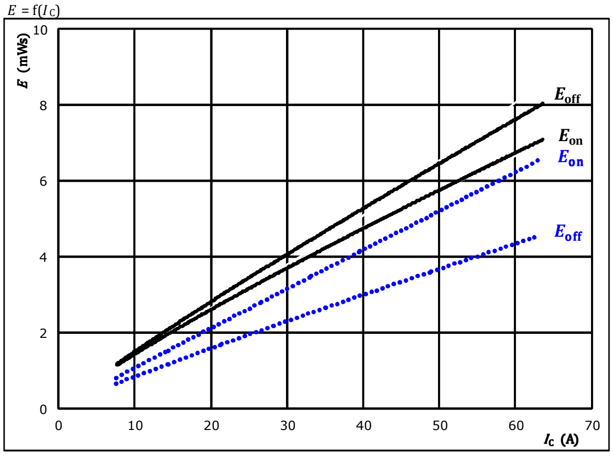
R (K/W)	τ (s)
1,58E-01	3,25E+00
5,74E-01	1,68E-01
1,74E+00	4,01E-02
5,91E-01	8,37E-03
6,54E-01	1,47E-03

Brake Switching Characteristics

figure 1. **IGBT**

Typical switching energy losses as a function of collector current

$E = f(I_C)$



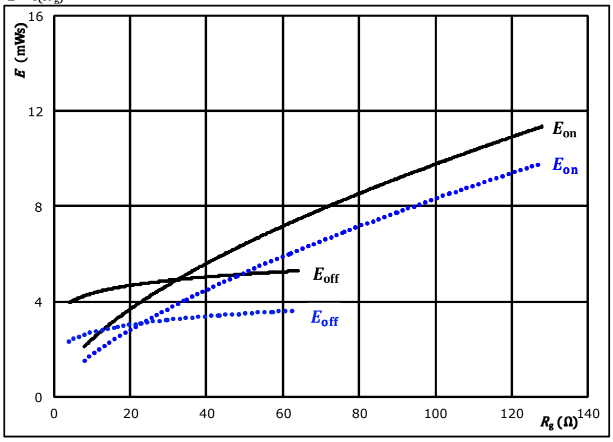
With an inductive load at

V_{CE} =	700	V	T_j:	25 °C (dotted)
V_{GE} =	0 / 15	V		125 °C (solid)
R_{gon} =	32	Ω		
R_{goff} =	16	Ω		

figure 2. **IGBT**

Typical switching energy losses as a function of gate resistor

$E = f(R_g)$



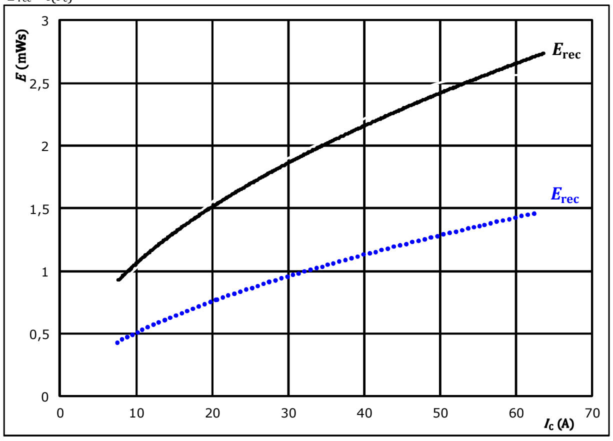
With an inductive load at

V_{CE} =	700	V	T_j:	25 °C (dotted)
V_{GE} =	0 / 15	V		125 °C (solid)
I_C =	35	A		

figure 3. **FWD**

Typical reverse recovered energy loss as a function of collector current

$E_{rec} = f(I_C)$



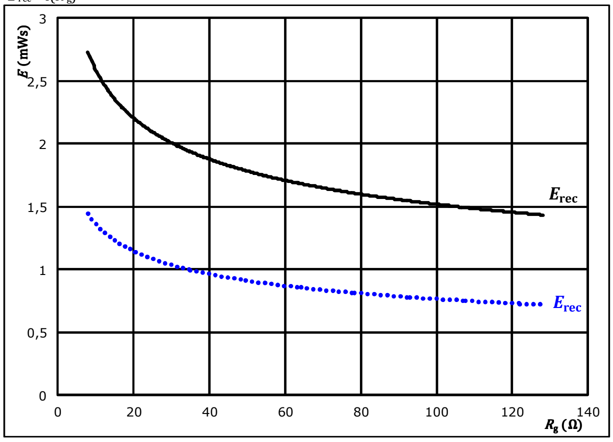
With an inductive load at

V_{CE} =	700	V	T_j:	25 °C (dotted)
V_{GE} =	0 / 15	V		125 °C (solid)
R_{gon} =	32	Ω		

figure 4. **FWD**

Typical reverse recovered energy loss as a function of gate resistor

$E_{rec} = f(R_g)$



With an inductive load at

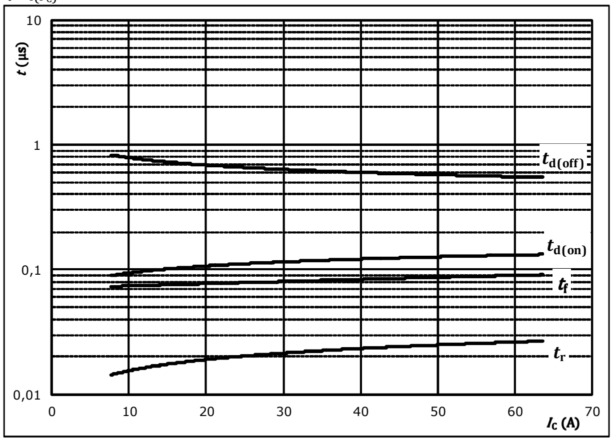
V_{CE} =	700	V	T_j:	25 °C (dotted)
V_{GE} =	0 / 15	V		125 °C (solid)
I_C =	35	A		

Brake Switching Characteristics

figure 5. **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



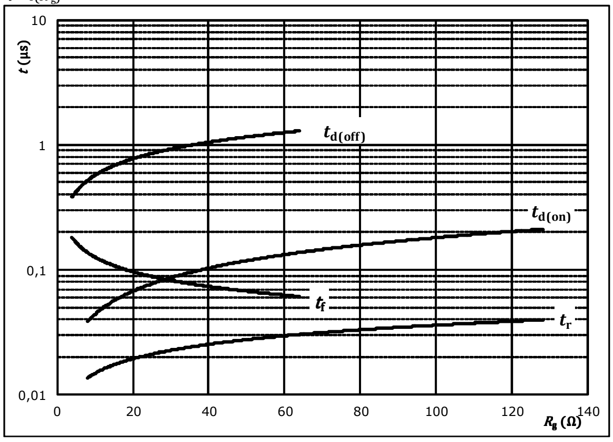
With an inductive load at

T_j =	0	°C
V_{CE} =	700	V
V_{GE} =	0 / 15	V
R_{gon} =	32	Ω
R_{goff} =	16	Ω

figure 6. **IGBT**

Typical switching times as a function of gate resistor

$t = f(R_g)$



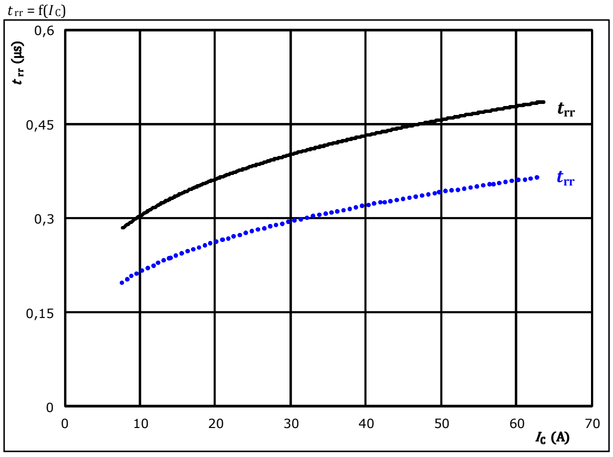
With an inductive load at

T_j =	0	°C
V_{CE} =	700	V
V_{GE} =	0 / 15	V
I_C =	35	A

figure 7. **FWD**

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$



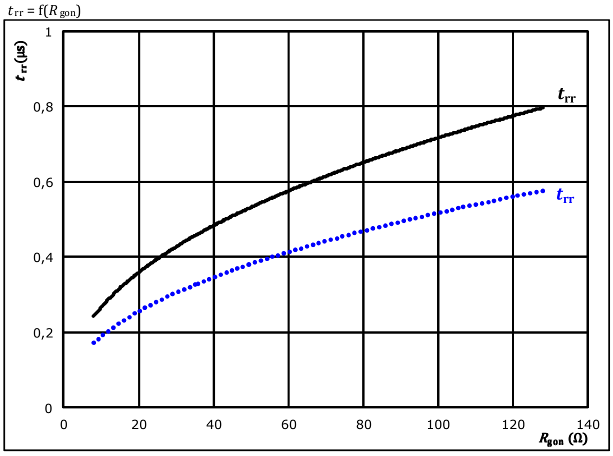
With an inductive load at

V_{CE}=	700	V	T_j:	25 °C (dotted)
V_{GE} =	0 / 15	V		125 °C (solid)
R_{gon} =	32	Ω		

figure 8. **FWD**

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

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



With an inductive load at

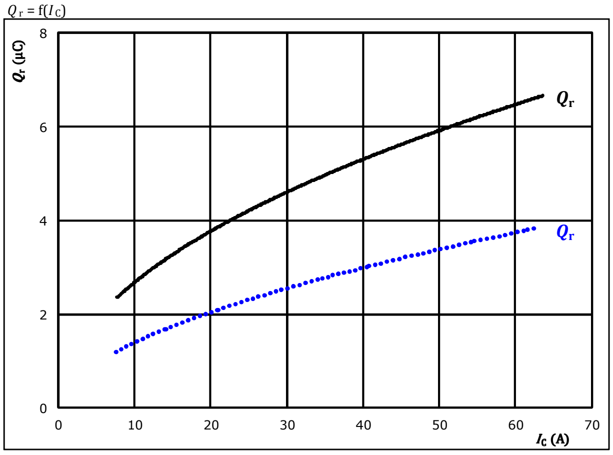
V_{CE} =	700	V	T_j:	25 °C (dotted)
V_{GE} =	0 / 15	V		125 °C (solid)
I_C =	35	A		

Brake Switching Characteristics

figure 9. FWD

Typical recovered charge as a function of collector current

$Q_r = f(I_C)$



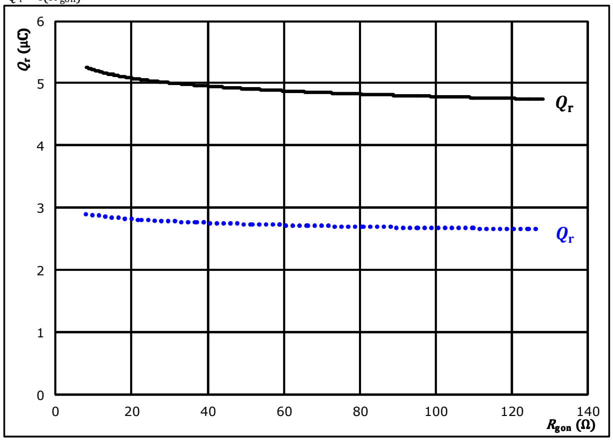
With an inductive load at

V_{CE} =	700	V	T_j:	25 °C	dotted
V_{GE} =	0 / 15	V		125 °C	solid
R_{gon} =	32	Ω			

figure 10. FWD

Typical recovered charge as a function of IGBT turn on gate resistor

$Q_r = f(R_{gon})$



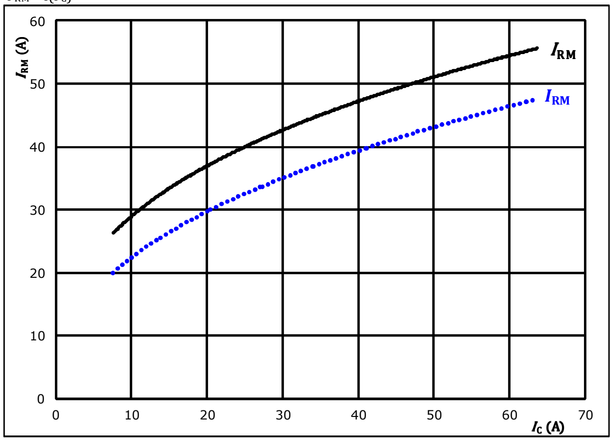
With an inductive load at

V_{CE} =	700	V	T_j:	25 °C	dotted
V_{GE} =	0 / 15	V		125 °C	solid
I_C =	35	A			

figure 11. FWD

Typical peak reverse recovery current current as a function of collector current

$I_{RM} = f(I_C)$



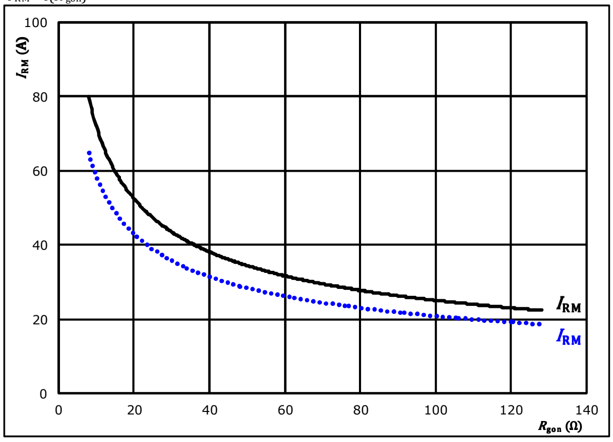
With an inductive load at

V_{CE} =	700	V	T_j:	25 °C	dotted
V_{GE} =	0 / 15	V		125 °C	solid
R_{gon} =	32	Ω			

figure 12. FWD

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

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



With an inductive load at

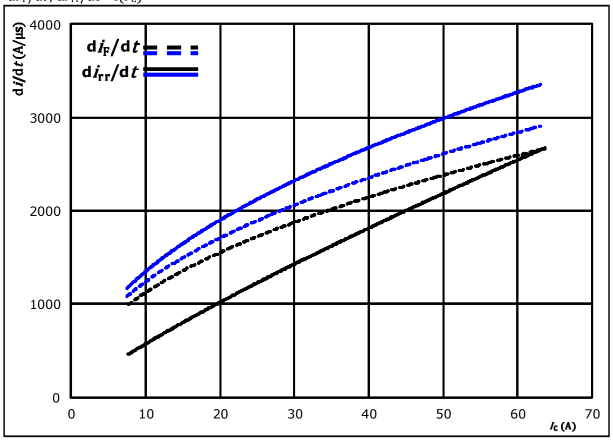
V_{CE} =	700	V	T_j:	25 °C	dotted
V_{GE} =	0 / 15	V		125 °C	solid
I_C =	35	A			

Brake Switching Characteristics

figure 13. **FWD**

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

di_F/dt, di_{rr}/dt = f(I_C)



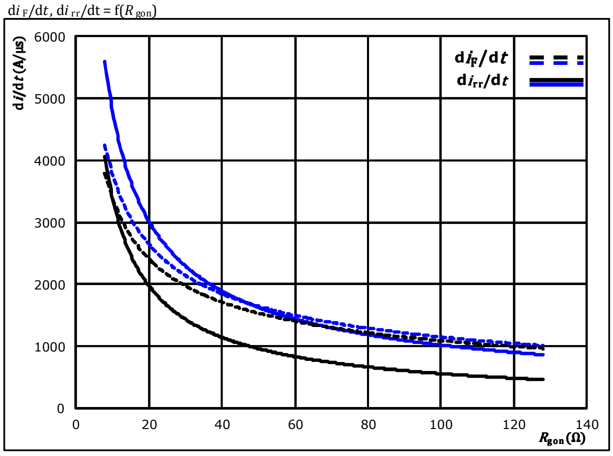
With an inductive load at

V_{CE} =	700	V	T_j:	25 °C
V_{GE} =	0 / 15	V		125 °C
R_{gon} =	32	Ω		

figure 14. **FWD**

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

di_F/dt, di_{rr}/dt = f(R_{gon})



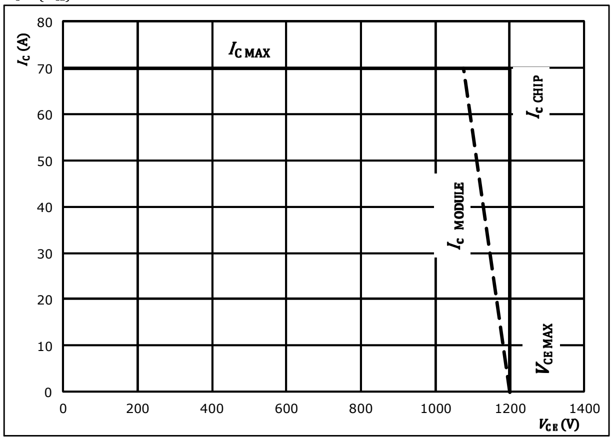
With an inductive load at

V_{CE} =	700	V	T_j:	25 °C
V_{GE} =	0 / 15	V		125 °C
I_C=	35	A		

figure 15. **IGBT**

Reverse bias safe operating area

I_C = f(V_{CE})



At

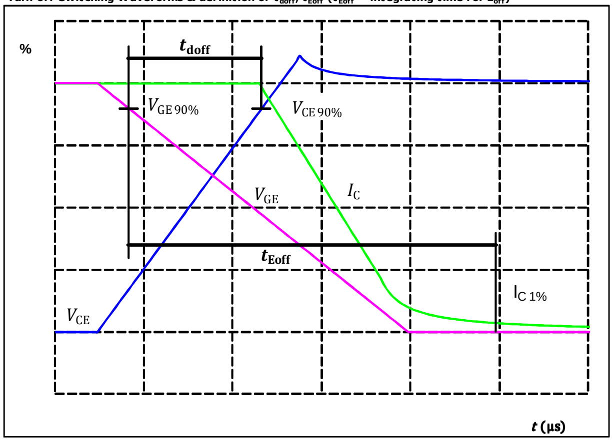
T_j =	125	°C
R_{gon} =	32	Ω
R_{goff} =	16	Ω

Brake Switching Definitions

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

figure 1. **IGBT**

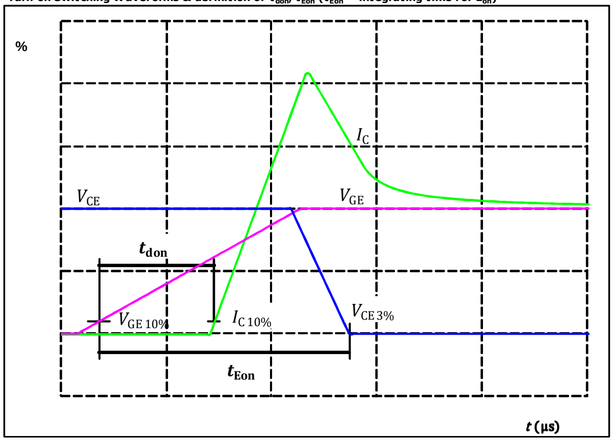
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff} (t_{Eoff} = integrating time for E_{off})



$V_{GE}(0\%)$ =	0	V
$V_{GE}(100\%)$ =	15	V
$V_C(100\%)$ =	700	V
$I_C(100\%)$ =	35	A
t_{doff} =	615	ns

figure 2. **IGBT**

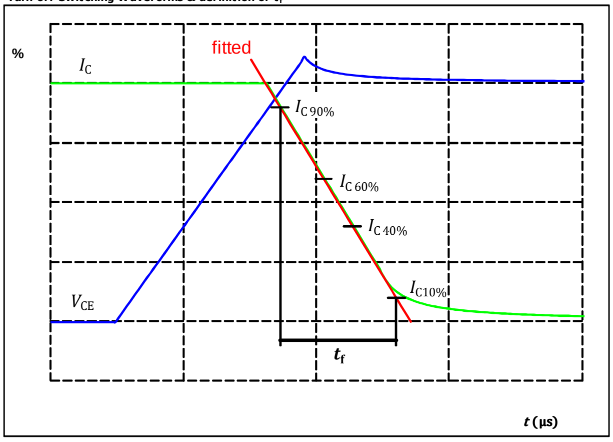
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon} (t_{Eon} = integrating time for E_{on})



$V_{GE}(0\%)$ =	0	V
$V_{GE}(100\%)$ =	15	V
$V_C(100\%)$ =	700	V
$I_C(100\%)$ =	35	A
t_{don} =	84	ns

figure 3. **IGBT**

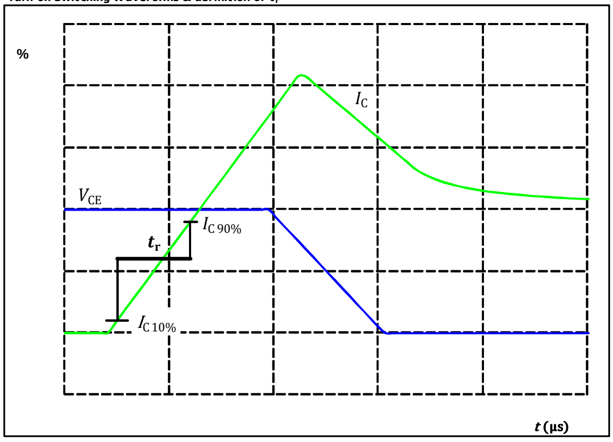
Turn-off Switching Waveforms & definition of t_f



$V_C(100\%)$ =	700	V
$I_C(100\%)$ =	35	A
t_f =	142	ns

figure 4. **IGBT**

Turn-on Switching Waveforms & definition of t_r

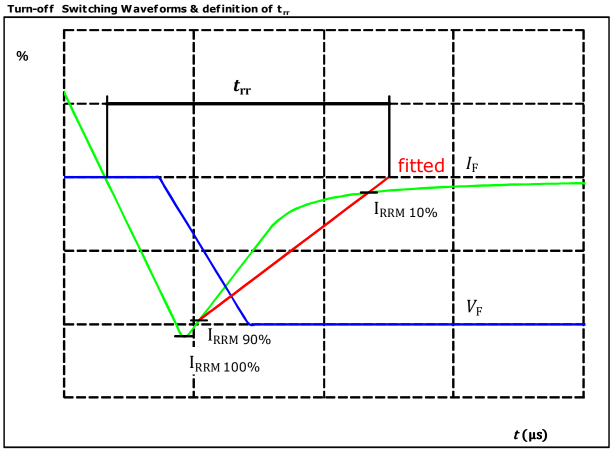


$V_C(100\%)$ =	700	V
$I_C(100\%)$ =	35	A
t_r =	22	ns

Brake Switching Characteristics

figure 5. **FWD**

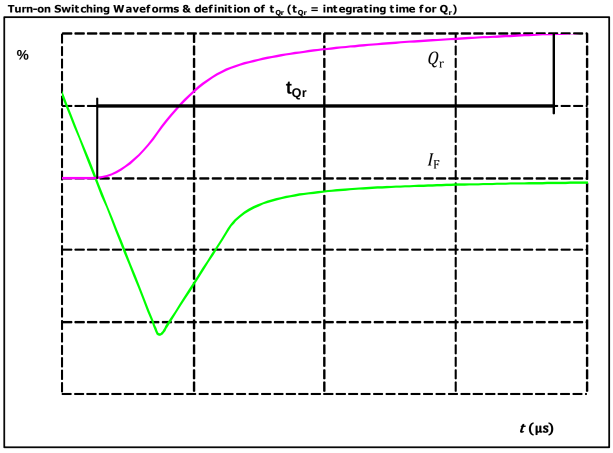
Turn-off Switching Waveforms & definition of t_{rr}



V_F (100%) =	700	V
I_F (100%) =	35	A
I_{RRM} (100%) =	45	A
t_{rr} =	420	ns

figure 6. **FWD**

Turn-on Switching Waveforms & definition of t_{Qr} (t_{Qr} = integrating time for Q_r)



I_F (100%) =	35	A
Q_r (100%) =	5,03	µC

Vincotech

Ordering Code & Marking

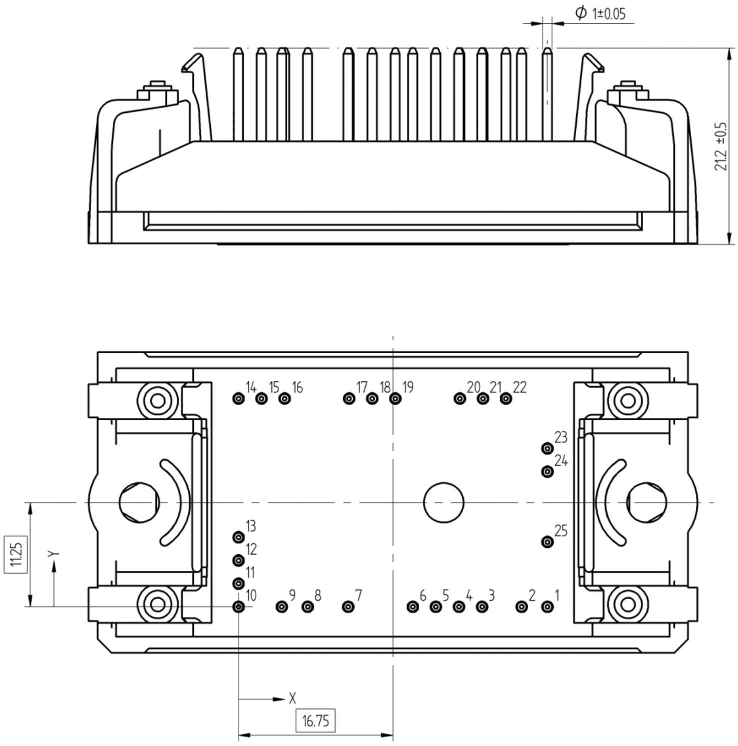
Version	Ordering Code
without thermal paste 17 mm housing with solder pins	V23990-P640-G10-PM

	**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

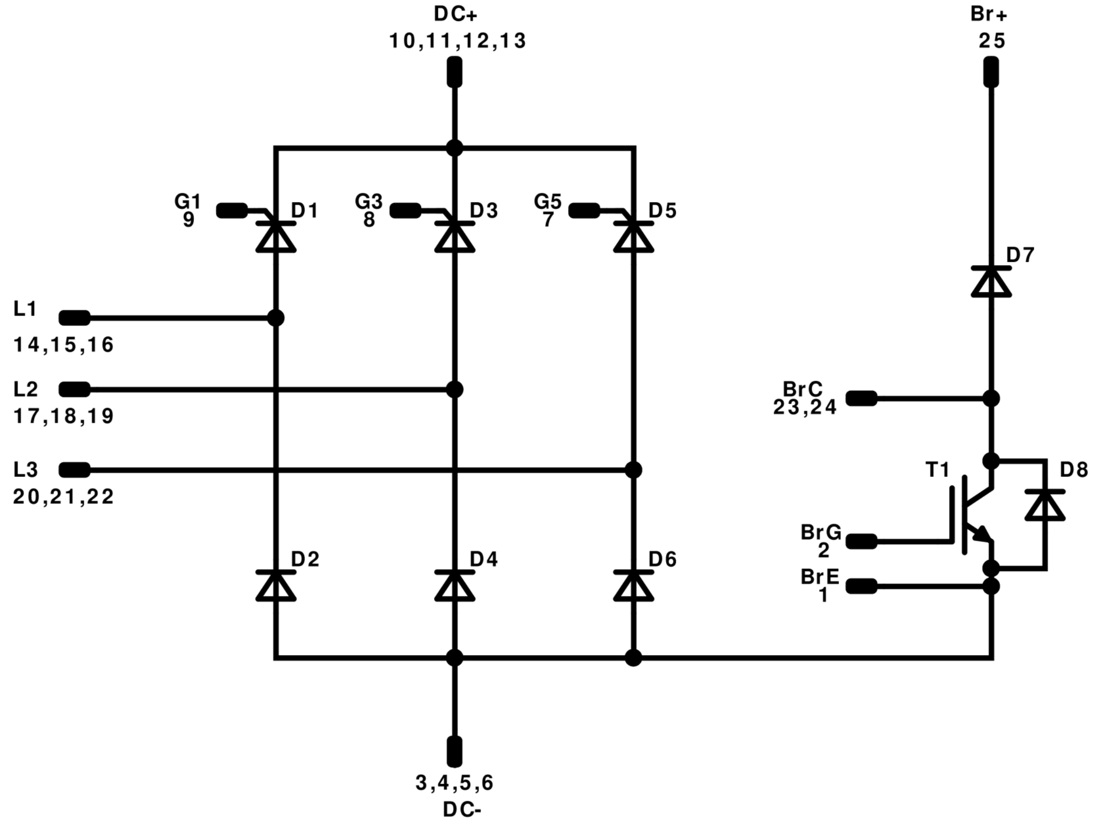
Pin	X	Y	Function
1	33,5	0	BrE
2	30,7	0	BrG
3	26,4	0	DC-
4	23,9	0	DC-
5	21,4	0	DC-
6	18,9	0	DC-
7	11,9	0	G5
8	7,5	0	G3
9	4,7	0	G1
10	0	0	DC+
11	0	2,5	DC+
12	0	5	DC+
13	0	7,5	DC+
14	0	22,5	L1
15	2,5	22,5	L1
16	5	22,5	L1
17	12	22,5	L2
18	14,5	22,5	L2
19	17	22,5	L2
20	24	22,5	L3
21	26,5	22,5	L3
22	29	22,5	L3
23	33,5	17,1	BrC
24	33,5	14,6	BrC
25	33,5	7	Br+

Pin table



Tolerance of pinpositions: ±0.5mm at the end of pins
Dimension of coordinate axis is only offset without tolerance

Pinout



Identification

ID	Component	Voltage	Current	Function	Comment
D2, D4, D6	Rectifier	1600 V	80 A	Rectifier Diode	
D1, D3, D5	Thyristor	1600 V	75 A	Rectifier Thyristor	
T1	IGBT	1200 V	35 A	Brake Switch	
D7	FWD	1200 V	25 A	Brake Diode	
D8	FWD	1200 V	3 A	Brake Sw. Protection Diode	

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-P640-G10-D1-14	12 Jul. 2018		