20-1C12IBA015SH-LB18A08

datasheet

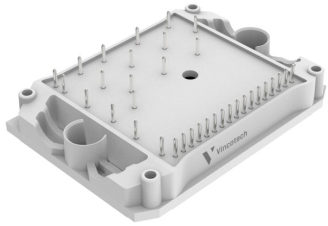
Vincotech

flow IPM 1C	1200 V / 15 A

Features

- Three-phase input rectifier
- Three-phase inverter with emitter shunts
- Gate drives with bootstrap circuit
- Brake chopper with gate drive
- Overcurrent protection
- Undervoltage lockout
- Temperature sensor

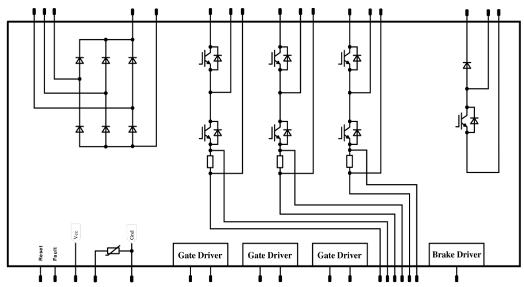
flow 1C 12 mm housing



Target applications

- Embedded Drives
- Industrial Drives

Schematic



Types

- 20-1C12IBA015SH-LB18A08

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	24	A
Surge (non-repetitive) forward current	I_{FSM}	50 Hz Single Half Sine Wave t_p = 10 ms	T_j = 150 °C	230	A
Surge current capability	I^2t			260	A^2s
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	27	W
Maximum Junction Temperature	T_{jmax}			150	°C

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Inverter Switch					
Collector-emitter voltage	V_{CES}			1200	V
Collector current	I_C	$T_j = T_{jmax}$	T_s = 80 °C	13	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}		45	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	29	W
Short circuit ratings	t_{SC} V_{CC}	$T_j \leq$ 150 °C V_{GE} = 15 V		10 800	µs V
Maximum junction temperature	T_{jmax}			175	°C
Inverter Diode					
Peak Repetitive Reverse Voltage	V_{RRM}			1200	V
Continuous (direct) forward current	I_F	$T_j = T_{jmax}$	T_s = 80°C	11	A
Repetitive peak forward current	I_{FRM}			30	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80°C	16	W
Maximum Junction Temperature	T_{jmax}			150	°C
Gate Driver Inverter					
Supply voltage	V_{CC}			-0,5…+24	V
Logic input voltage	V_{in}	UH, UL, VH, VL, WH, WL, FO, RST		-0,5…V_{cc}+0,5	V
Internal current limit	I_{MAX}			16,7	A
Inverter Shunt					
Max DC current	I_{MAX}		T_c = 25 °C	9	A
Brake Switch					
Collector-emitter voltage	V_{CES}			1200	V
Collector current	I_C	$T_j = T_{jmax}$	T_s = 80 °C	13	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}		45	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	29	W
Short circuit ratings	t_{SC} V_{CC}	$T_j \leq$ 150 °C V_{GE} = 15 V		10 800	µs V
Maximum junction temperature	T_{jmax}			175	°C

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
Brake Diode				
Peak Repetitive Reverse Voltage	V_{RRM}		1200	V
Continuous (direct) forward current	I_F	$T_j = T_{jmax}$ T_s = 80 °C	6	A
Repetitive peak forward current	I_{FRM}		15	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ T_s = 80 °C	12	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	$T_j = T_{jmax}$ T_s = 80 °C	4	A
Repetitive peak forward current	I_{FRM}		6	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ T_s = 80 °C	8	W
Maximum Junction Temperature	T_{jmax}		150	°C
Gate Driver Brake				
Supply voltage	V_{CC}		20	V
Logic input voltage	V_{in}		-0,3…V_{cc}+0,3	V
Junction Temperature	T_{jmax}		150	°C
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			7,18	mm
Comparative Tracking Index	CTI		> 200	

*100 % tested in production

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
Rectifier Diode										
Static										
Forward voltage	V_F				30	25 125		1,25 1,24	1,29	V
Reverse leakage current	I_r			1600		25 150			10 1000	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	phase-change material λ = 3,4 W/mK						2,60		K/W
Inverter Switch										
Static										
Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{GE} = V_{CE}$			0,0005	25	5,3	5,8	6,3	V
Collector-emitter saturation voltage	V_{CEsat}		15		15	25 150	1,78	1,89 2,28	2,42	V
Collector-emitter cut-off current	I_{CES}		0	1200		25			2	µA
Internal gate resistance	r_g							none		Ω
Input capacitance	C_{ies}	f = 1 MHz	0	25		25		875		pF
Output capacitance	C_{oes}							75		
Reverse transfer capacitance	C_{res}							45		
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	phase-change material λ = 3,4 W/mK						3,26		K/W
Dynamic										
Turn-on delay time*	$t_{d(on)}$		V_{CC} = 15 V V_{IN} = 5 V	600	9	25 125		1507 1938		ns
Rise time	t_r					25 125		17 19		
Turn-off delay time*	$t_{d(off)}$					25 125		1507 2012		
Fall time	t_f					25 125		25 88		
Turn-on energy (per pulse)	E_{on}	Q_{rFWD} = 1,3 µC Q_{rFWD} = 2,5 µC				25 125		0,559 0,816		mWs
Turn-off energy (per pulse)	E_{off}					25 125		0,395 0,730		

* times include gate driver propagation delay

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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
Inverter Diode										
Static										
Forward voltage	V_F				15	25 125		1,76 1,73		V
Reverse leakage current	I_r			1200		25			250	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	phase-change material λ = 3,4 W/mK						4,37		K/W
Dynamic										
Peak recovery current	I_{RRM}	di/dt = 595 A/µs di/dt = 536 A/µs	V_{CC} = 15 V V_{IN} = 5 V	600	9	25 125		9 12		A
Reverse recovery time	t_{rr}					25 125		285 464		ns
Recovered charge	Q_r					25 125		1,272 2,489		µC
Reverse recovered energy	E_{rec}					25 125		0,477 0,988		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125		38 40		A/µs

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
Gate Driver*										
Static										
Recommended supply voltage	V_{cc}						13,5	15	20	V
Power on reset trip voltage	V_{POR}						4,0	5,5	7,5	V
Internal current limit	I_{MAX}						13,3	16,7	20	A
Quiescent supply current	I_q							3	4,5	mA
Logic "1" input voltage	V_{IH}	UH, UL, VH, VL, WH, WL, RST					2,2	3	4	V
Logic "0" input voltage	V_{IL}	UH, UL, VH, VL, WH, WL, RST					0,6	1,5	2,1	V
Logic "1" input current	I_{inH}	V_{in} = 5 V					0,6	1	1,4	mA
Logic "0" input current	I_{inL}	V_{in} = 0 V					0	0	0,01	mA
Input signal filter time	t_{Filt}	UH, UL, VH,VL, WH, WL, FO (in), RST (pulse)					80	200	500	ns
Logic "1" FAULT output**	$V_{outFAULTH}$								0,95	V
Logic "1" FAULT input treshold voltage**	$V_{inFAULTH}$						0,6	1,5	2,1	V
Logic "0" FAULT input treshold voltage**	$V_{inFAULTL}$						2,2	3	4	V
Under voltage reset voltage	$V_{UVreset}$						10	10,8	11,6	V
Under voltage trip voltage	V_{UVtrip}						10,5	11,3	12,1	V
Under voltage hysteresis voltage	$V_{UVhysteresis}$						0,2	0,5	0,8	V

* For more information see Mitshubishi's M81738FP datasheet. The recommended minimum input pulse width is 2.47 µs.
** FAULT active low with pull up resistor to Vcc.

Inverter Shunt

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
Static										
Resistance	R							30		mΩ

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	$V_{GE(th)}$	$V_{GE} = V_{CE}$			0,0005	25	5,3	5,8	6,3	V
Collector-emitter saturation voltage	V_{CEsat}		15		15	25 150	1,78	1,89 2,28	2,42	V
Collector-emitter cut-off current	I_{CES}		0	1200		25			2	µA
Internal gate resistance	r_g							none		Ω
Input capacitance	C_{ies}	f = 1 MHz	0	25		25		875		pF
Output capacitance	C_{oes}							75		
Reverse transfer capacitance	C_{res}							45		
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	phase-change material λ = 3,4 W/mK						3,26		K/W
Dynamic										
Turn-on delay time*	$t_{d(on)}$		V_{IN} = 5 V V_{CC} = 15 V	600	10	25 125		44 49		ns
Rise time	t_r					25 125		17 20		
Turn-off delay time*	$t_{d(off)}$					25 125		299 369		
Fall time	t_f					25 125		16 43		
Turn-on energy (per pulse)	E_{on}	Q_{rFWD} = 1 µC Q_{rFWD} = 1,8 µC				25 125		0,579 0,771		mWs
Turn-off energy (per pulse)	E_{off}					25 125		0,339 0,598		

* times include gate driver deadtime

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	
Brake Diode										
Static										
Forward voltage	V_{F}				7,5	25 125 150		2,00 1,99 1,99		V
Reverse leakage current	I_{r}			1200		25			250	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	phase-change material λ = 3,4 W/mK						5,86		K/W
Dynamic										
Peak recovery current	I_{RRM}					25 125		8 9		A
Reverse recovery time	t_{rr}					25 125		327 494		ns
Recovered charge	Q_{r}	di/dt = 588 A/µs di/dt = 560 A/µs	V_{IN} = 5 V V_{CC} = 15 V	600	10	25 125		1,008 1,759		µC
Reverse recovered energy	E_{rec}					25 125		0,416 0,754		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125		31 40		A/µs
Brake Sw. Protection Diode										
Static										
Forward voltage	V_{F}				3	25 150		1,65 1,51	2,3	V
Reverse leakage current	I_{r}			1200		25			250	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	phase-change material λ = 3,4 W/mK						9,21		K/W

Characteristic Values

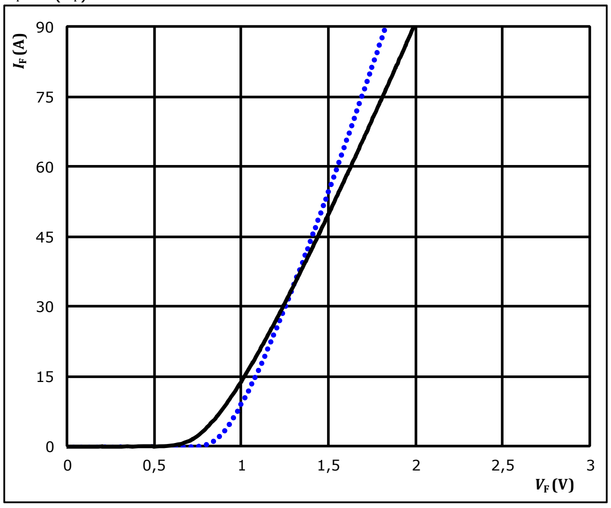
Parameter	Symbol	Conditions	V_{GE} [V] V_{GS} [V]	V_{CE} [V] V_{DS} [V] V_F [V]	I_C [A] I_D [A] I_F [A]	T_j [°C]	Min	Typ	Max	Unit
Gate Driver Brake										
Static										
Recommended supply voltage	V_{CC}						4,5	15	18	V
Turn-On Voltage	V_{ON}						3,5	3,9	4,3	V
Turn-Off Voltage	V_{OFF}						3,3	3,7	4,1	V
Logic "1" input threshold voltage	V_{inH}						30			$\%V_{DD}$
Logic "0" input threshold voltage	V_{inL}								70	$\%V_{DD}$
Logic "1" input current	I_{inH}	V_{in} = 5 V					-1		175	µA
Logic "0" input current	I_{inL}	V_{in} = 0 V					-175		1	µA
Logic Hysteresis Voltage	V_{HYS}							17		$\%V_{DD}$
Thermistor										
Rated resistance	R					25		22		kΩ
Deviation of R_{100}	$\Delta_{R/R}$	R_{100} = 1486 Ω				100	-12		+14	%
Power dissipation	P					25		200		mW
Power dissipation constant						25		2		mW/K
B-value	$B_{(25/50)}$	Tol. ±3%				25		3950		K
B-value	$B_{(25/100)}$	Tol. ±3%				25		3998		K
Vincotech NTC Reference									B	

Rectifier Diode Characteristics

figure 1. **Rectifier Diode**

Typical forward characteristics

$I_F = f(V_F)$



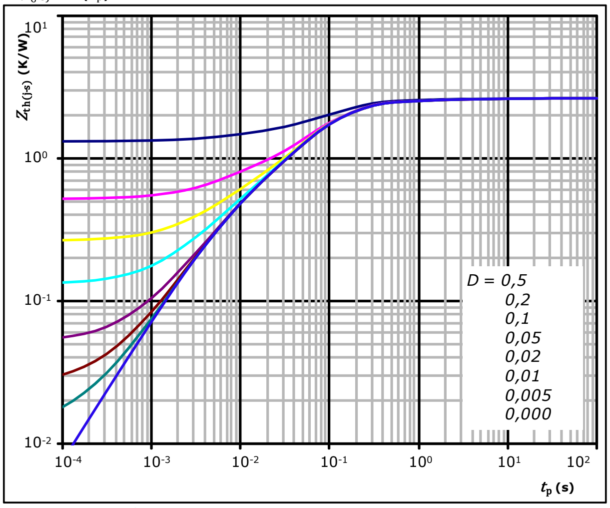
t_p = 250 µs

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

figure 2. **Rectifier Diode**

Transient thermal impedance as a function of pulse width

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



D = t_p / T

$R_{th(j-s)}$ = 2,60 K/W

Diode thermal model values

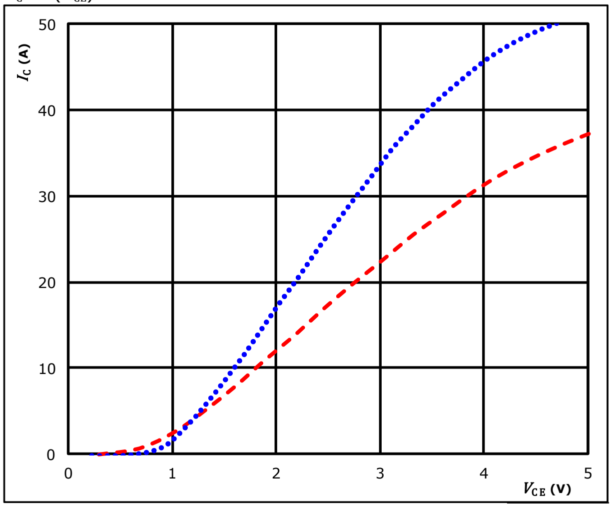
R (K/W)	τ (s)
6,39E-02	7,39E+00
1,82E-01	8,47E-01
1,37E+00	1,17E-01
7,19E-01	4,63E-02
2,48E-01	5,84E-03
2,07E-02	5,09E-03

Inverter Switch Characteristics

figure 1. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

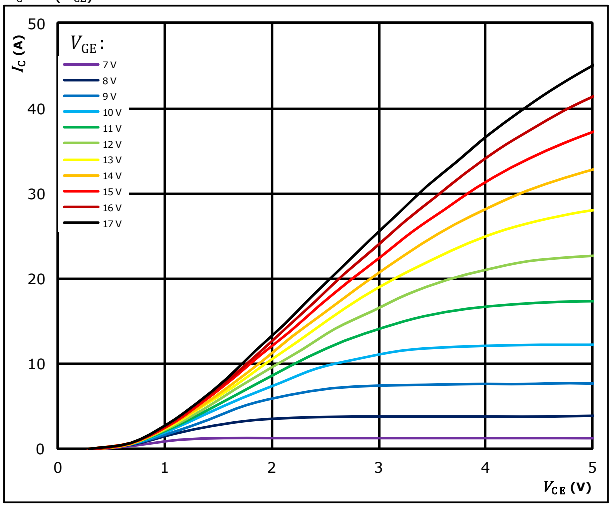


t_p = 250 µs
V_{GE} = 15 V
T_j: 25 °C (dotted), 150 °C (dashed)

figure 2. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

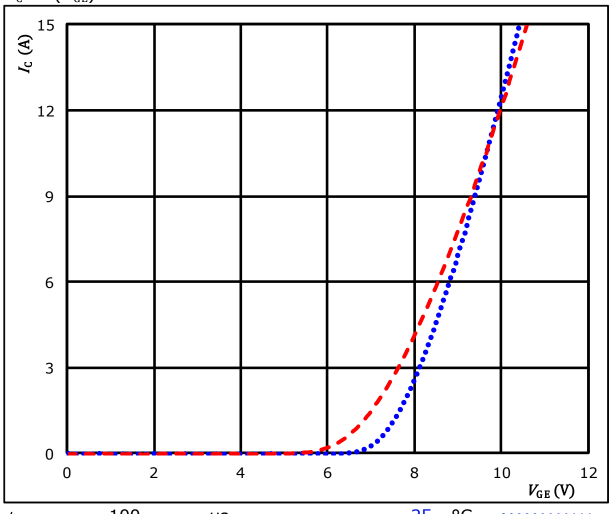


t_p = 250 µs
T_j = 150 °C
V_{GE} from 7 V to 17 V in steps of 1 V

figure 3. **IGBT**

Typical transfer characteristics

$I_C = f(V_{GE})$

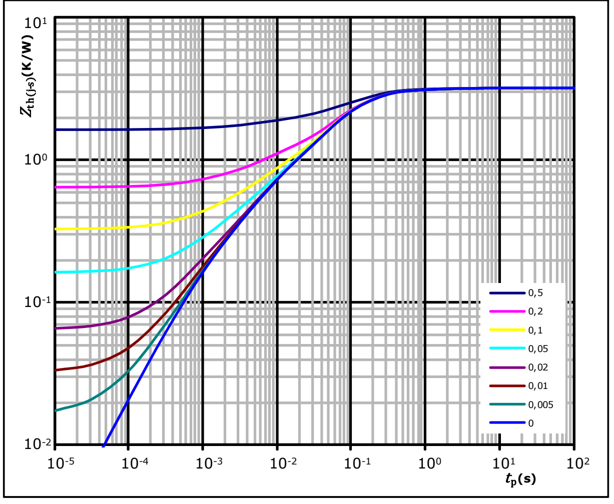


t_p = 100 µs
V_{CE} = 10 V
T_j: 25 °C (dotted), 150 °C (dashed)

figure 4. **IGBT**

Transient thermal impedance as function of pulse duration

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



D = t_p / T
$R_{th(j-s)}$ = 3,26 K/W

IGBT thermal model values

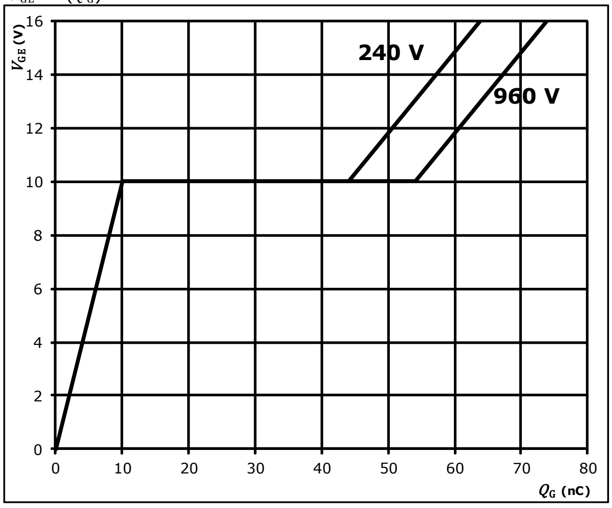
R (K/W)	τ (s)
1,47E-01	1,93E+00
8,10E-01	2,00E-01
1,77E+00	6,49E-02
4,28E-01	5,83E-03
9,86E-02	8,40E-04

Inverter Switch Characteristics

figure 5. IGBT

Gate voltage vs gate charge

$V_{GE} = f(Q_G)$

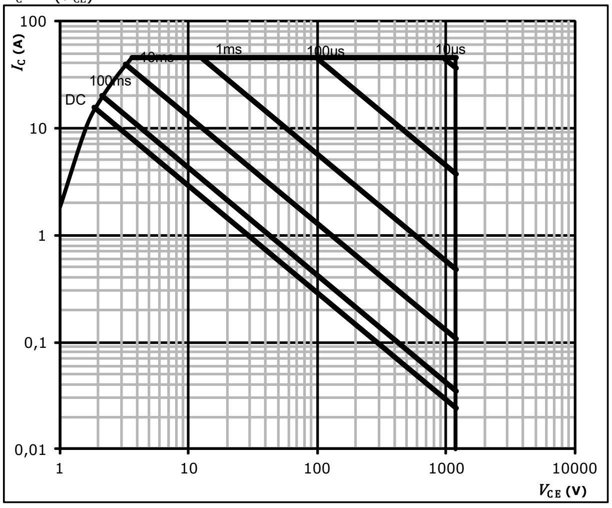


I_C= 15 A

figure 6. IGBT

Safe operating area

$I_C = f(V_{CE})$

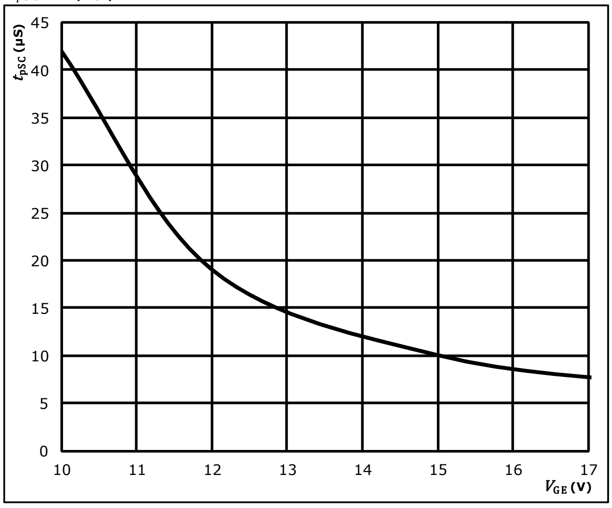


D = single pulse
T_s = 80 ºC
V_{GE} = ±15 V
T_j = T_{jmax}

figure 7. IGBT

Short circuit duration as a function of V_{GE}

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

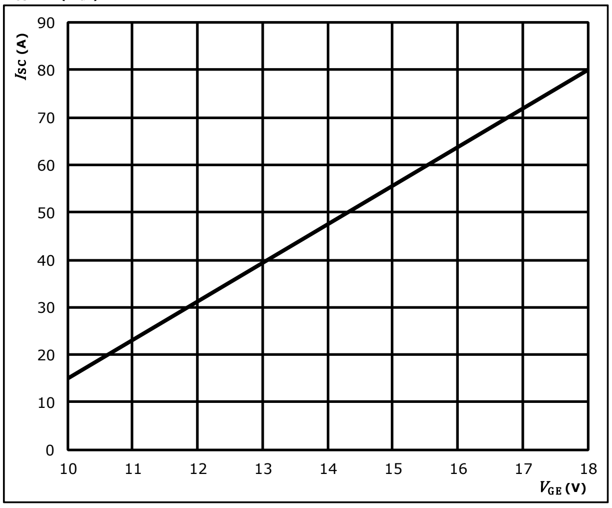


V_{CE} ≤ 600 V
T_j ≤ 150 ºC

figure 8. IGBT

Typical short circuit current as a function of V_{GE}

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



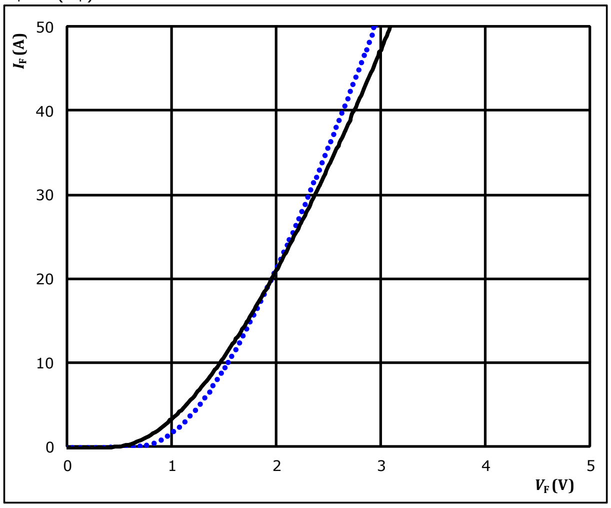
V_{CE} ≤ 600 V
T_j = 25 ºC

Inverter Diode Characteristics

figure 1. **FWD**

Typical forward characteristics

$I_F = f(V_F)$

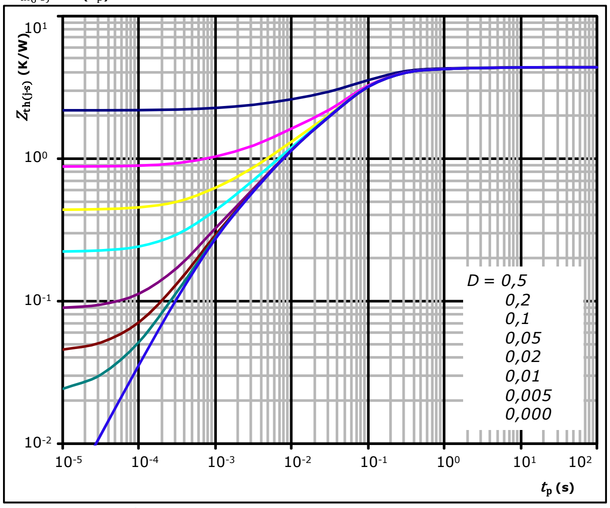


t_p =	250	µs		25	°C
			T_j:	125	°C

figure 2. **FWD**

Transient thermal impedance as a function of pulse width

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



D = t_p / T

$R_{th(j\text{-}s)}$ = 4,37 K/W

FWD thermal model values

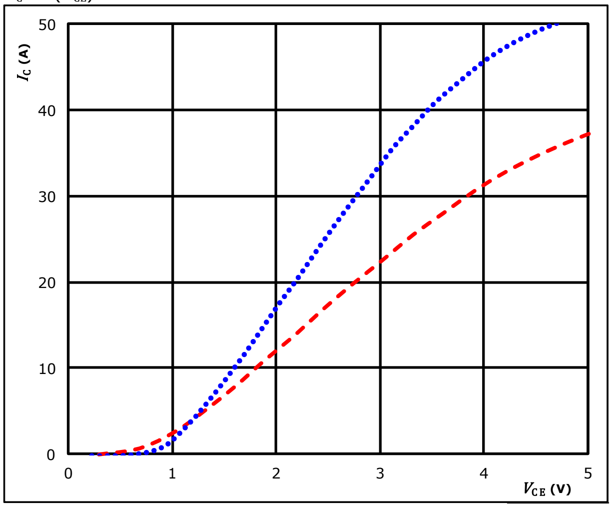
R (K/W)	τ (s)
1,74E-01	2,44E+00
8,11E-01	2,19E-01
2,50E+00	6,24E-02
7,01E-01	6,51E-03
1,90E-01	8,68E-04

Brake Switch Characteristics

figure 1. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

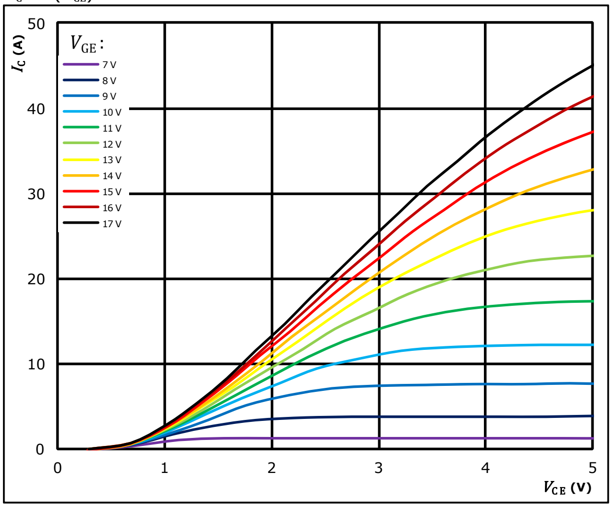


t_p = 250 µs
V_{GE} = 15 V
T_j: 25 °C (dotted); 150 °C (dashed)

figure 2. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

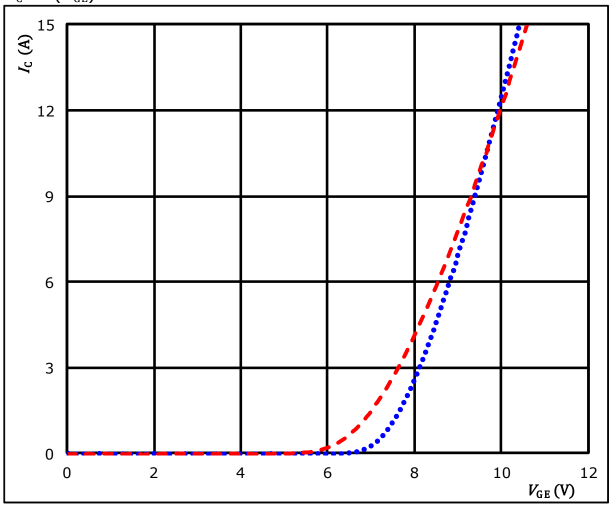


t_p = 250 µs
T_j = 150 °C
V_{GE} from 7 V to 17 V in steps of 1 V

figure 3. **IGBT**

Typical transfer characteristics

$I_C = f(V_{GE})$

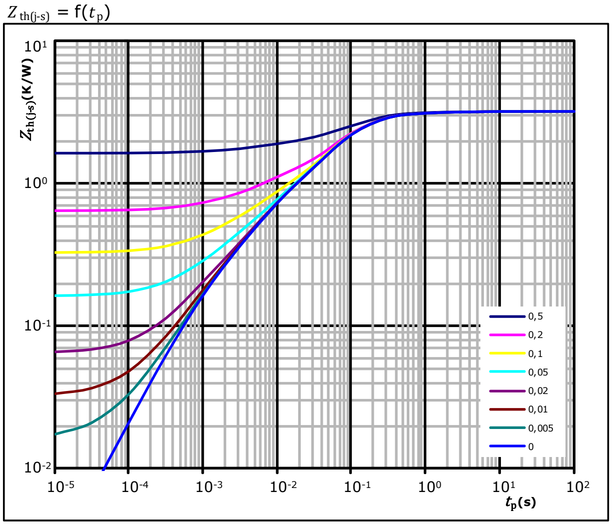


t_p = 100 µs
V_{CE} = 10 V
T_j: 25 °C (dotted); 150 °C (dashed)

figure 4. **IGBT**

Transient thermal impedance as function of pulse duration

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



D = t_p / T
$R_{th(j-s)}$ = 3,26 K/W

IGBT thermal model values

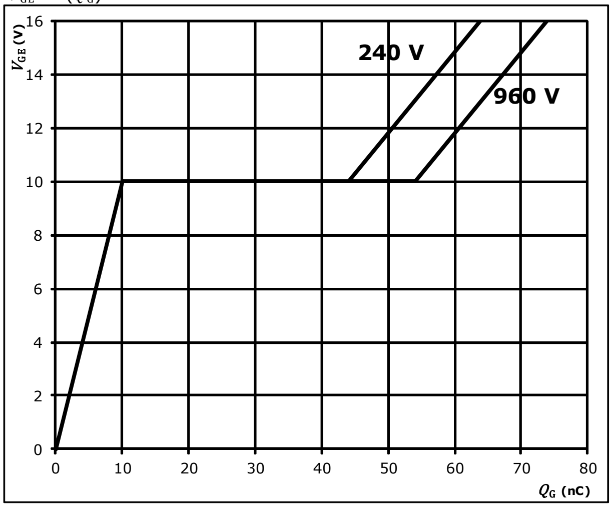
R (K/W)	τ (s)
1,47E-01	1,93E+00
8,10E-01	2,00E-01
1,77E+00	6,49E-02
4,28E-01	5,83E-03
9,86E-02	8,40E-04

Brake Switch Characteristics

figure 5. **IGBT**

Gate voltage vs gate charge

$V_{GE} = f(Q_G)$

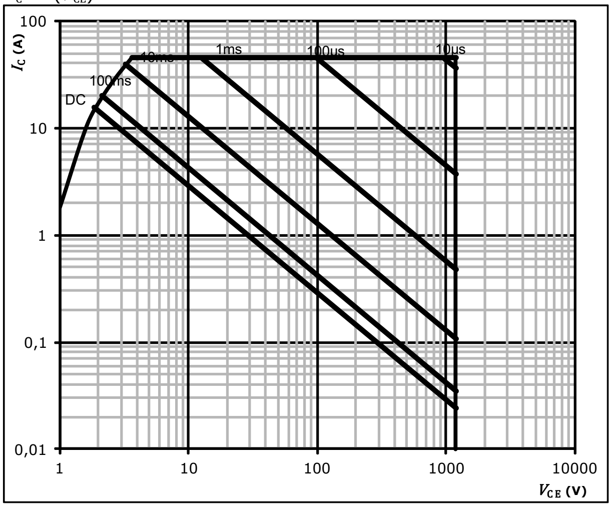


I_C= 15 A

figure 6. **IGBT**

Safe operating area

$I_C = f(V_{CE})$

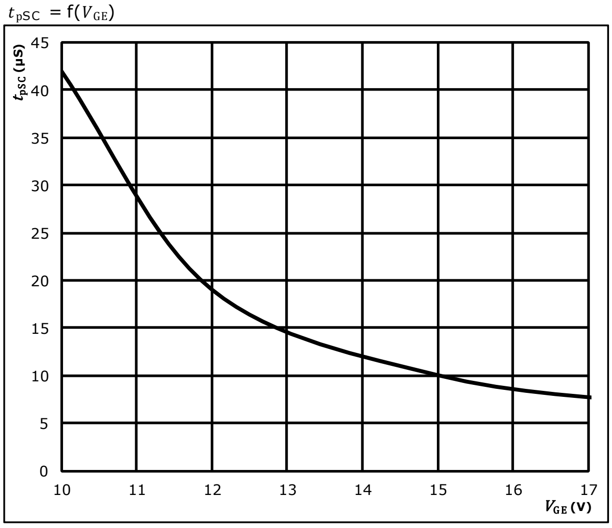


D =	single pulse	
T_s =	80	ºC
V_{GE} =	±15	V
T_j =	T_{jmax}	

figure 7. **IGBT**

Short circuit duration as a function of V_{GE}

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

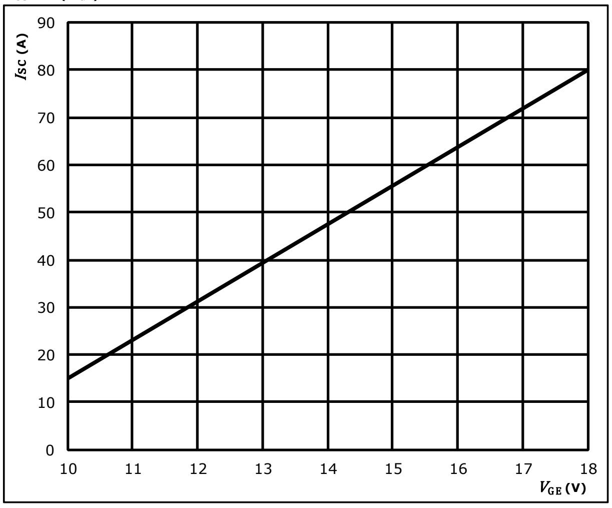


V_{CE} ≤	600	V
T_j ≤	150	ºC

figure 8. **IGBT**

Typical short circuit current as a function of V_{GE}

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



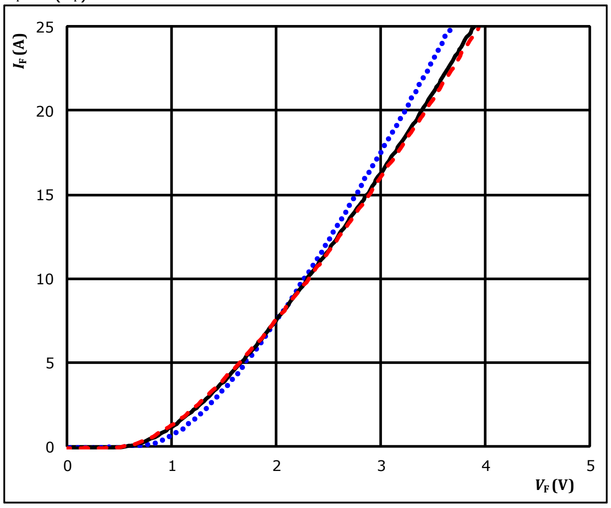
V_{CE} ≤	600	V
T_j =	25	ºC

Brake Diode Characteristics

figure 1. FWD

Typical forward characteristics

$I_F = f(V_F)$



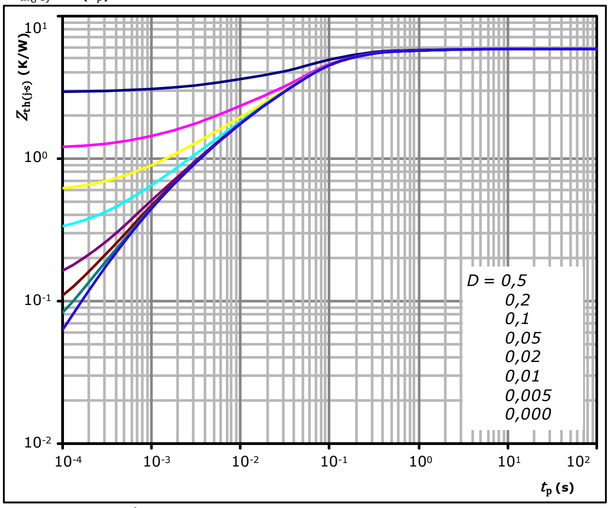
t_p = 250 µs

T_j: 25 °C, 125 °C, 150 °C

figure 2. FWD

Transient thermal impedance as a function of pulse width

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



D = t_p / T

$R_{th(j-s)}$ = 5,86 K/W

FWD thermal model values

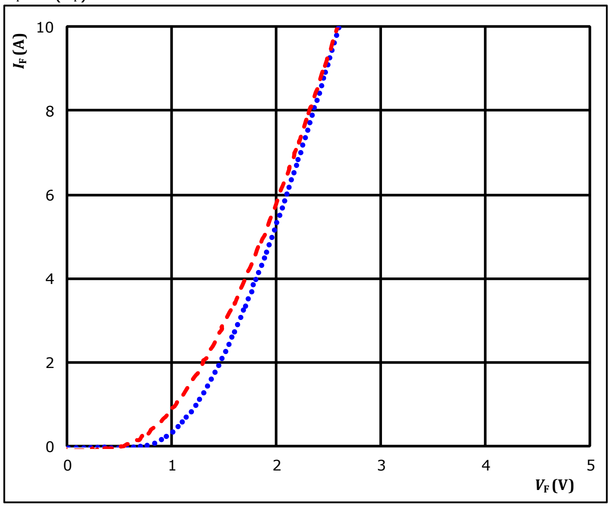
R (K/W)	τ (s)
8,94E-02	4,38E+00
3,15E-01	8,32E-01
2,01E+00	1,12E-01
2,33E+00	3,80E-02
9,08E-01	4,25E-03
2,13E-01	5,94E-04

Brake Sw. Protection Diode Characteristics

figure 1. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



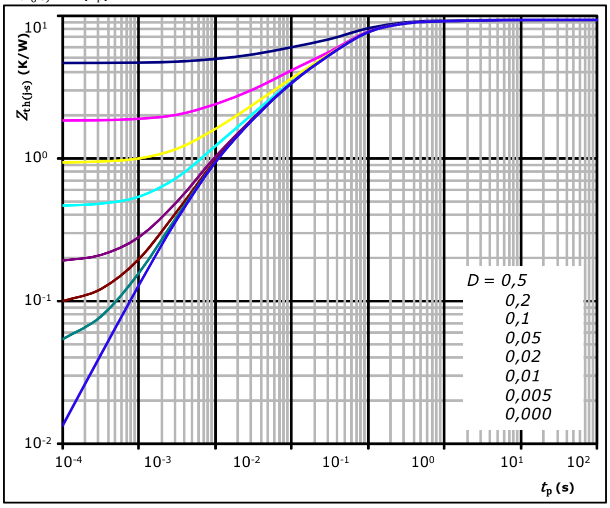
t_p = 250 μs

T_j: 25 °C (dotted); 150 °C (dashed)

figure 2. **FWD**

Transient thermal impedance as a function of pulse width

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



D = t_p / T

$R_{th(j-s)}$ = 9,21 K/W

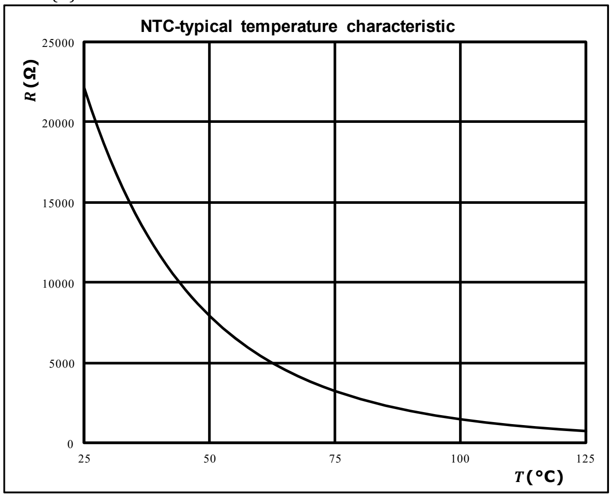
FWD thermal model values

R (K/W)	τ (s)
2,80E-01	2,78E+00
1,47E+00	1,77E-01
4,89E+00	4,55E-02
1,92E+00	5,08E-03
6,42E-01	7,39E-04

Thermistor Characteristics

figure 1.	Thermistor

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

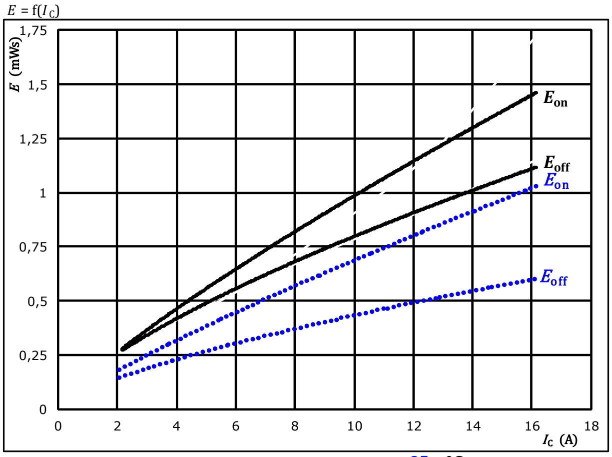


Inverter Switching Characteristics

figure 1. **IGBT**

Typical switching energy losses as a function of collector current

$E = f(I_C)$



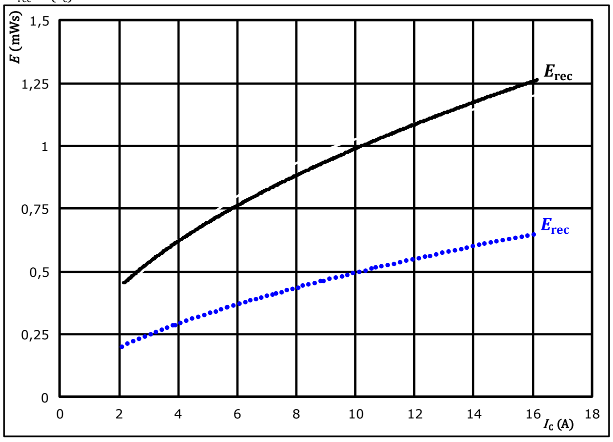
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C	············
V_{CC} =	15	V		125 °C	———
V_{IN} =	5	V			

figure 2. **FWD**

Typical reverse recovered energy loss as a function of collector current

$E_{rec} = f(I_C)$



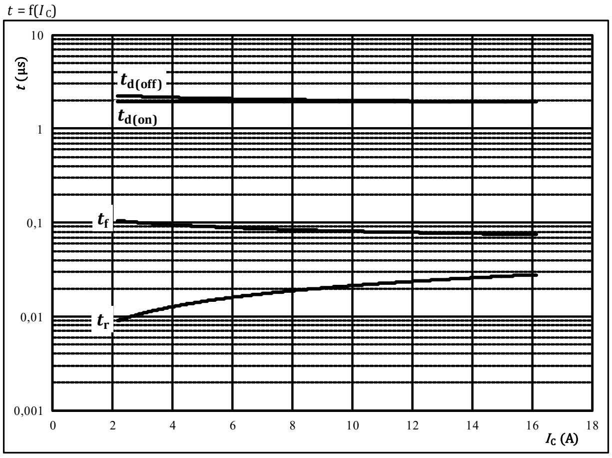
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C	············
V_{CC} =	15	V		125 °C	———
V_{IN} =	5	V			

figure 3. **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



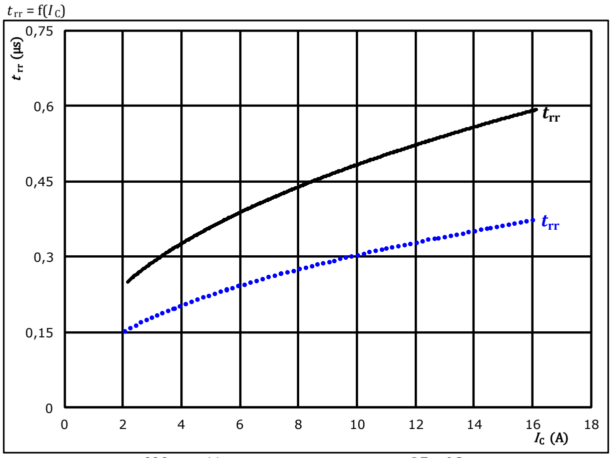
With an inductive load at

T_j =	125	°C
V_{CE} =	600	V
V_{CC} =	15	V
V_{IN} =	5	V

figure 4. **FWD**

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$



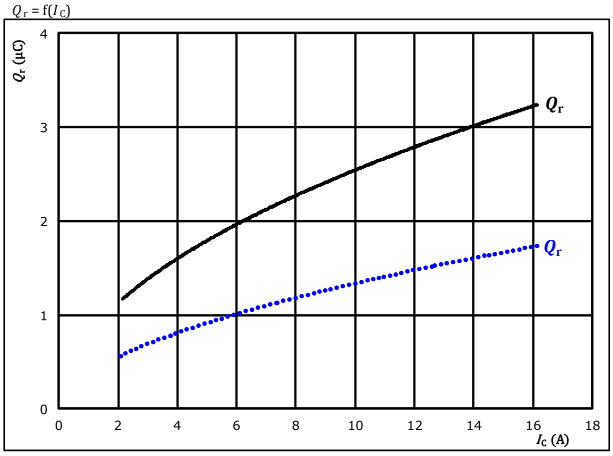
At	V_{CE} =	600	V	T_j:	25 °C	············
	V_{CC} =	15	V		125 °C	———
	V_{IN} =	5	V			

Inverter Switching Characteristics

figure 5. **FWD**

Typical recovered charge as a function of collector current

$Q_r = f(I_C)$

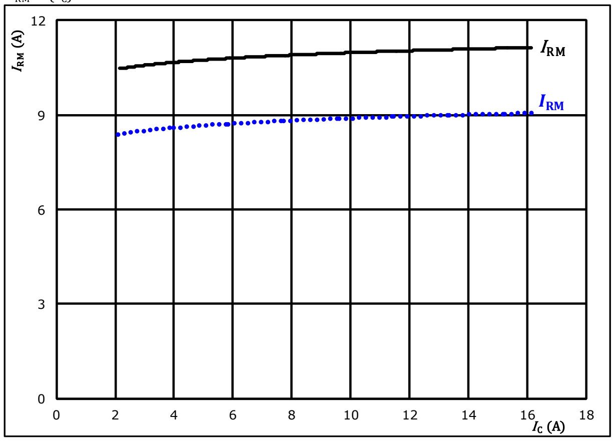


At				
V_{CE} =	600	V	T_j: 25 °C	dotted
V_{CC} =	15	V	T_j: 125 °C	solid
V_{IN} =	5	V		

figure 6. **FWD**

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

$I_{RM} = f(I_C)$

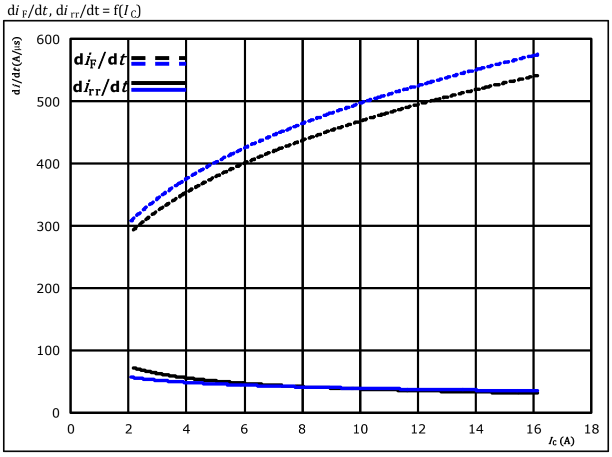


At				
V_{CE} =	600	V	T_j: 25 °C	dotted
V_{CC} =	15	V	T_j: 125 °C	solid
V_{IN} =	5	V		

figure 7. **FWD**

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

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

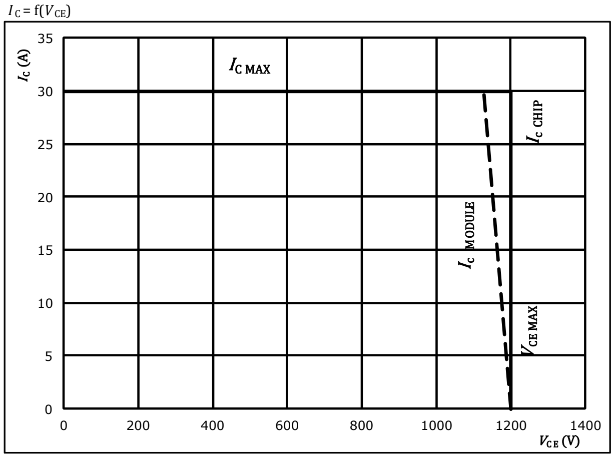


At				
V_{CE} =	600	V	T_j: 25 °C	dotted
V_{CC} =	15	V	T_j: 125 °C	solid
V_{IN} =	5	V		

figure 8. **IGBT**

Reverse bias safe operating area

$I_C = f(V_{CE})$



At

T_j = 175 °C

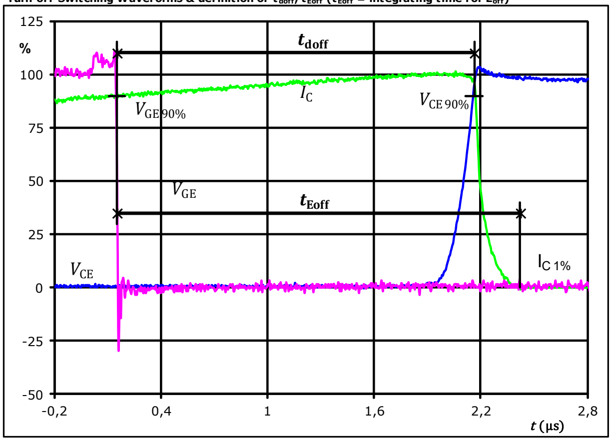
Inverter Switching Definitions

General conditions

T_j	=	125 °C
R_{gon}	=	0,5 Ω
R_{goff}	=	0,5 Ω

figure 1. **IGBT**

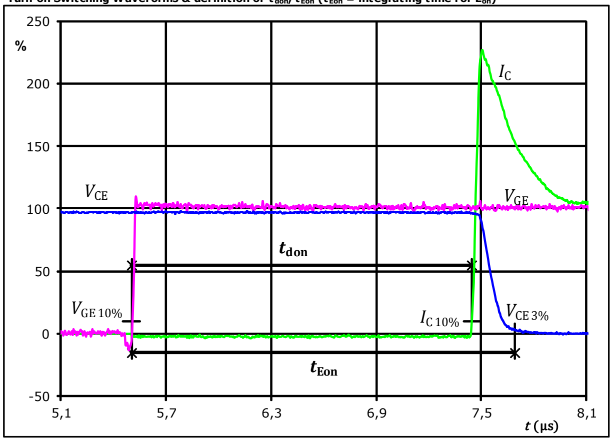
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff} (t_{Eoff} = integrating time for E_{off})



V_{GE} (0%) =	0	V
V_{GE} (100%) =	5	V
V_C (100%) =	600	V
I_C (100%) =	9	A
t_{doff} =	2,012	µs
t_{Eoff} =	2,271	µs

figure 2. **IGBT**

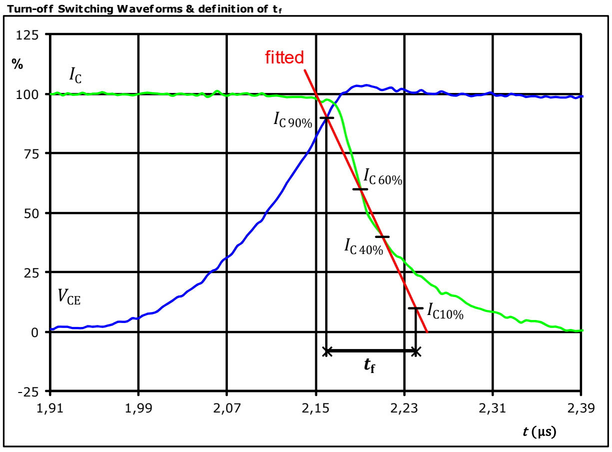
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon} (t_{Eon} = integrating time for E_{on})



V_{GE} (0%) =	0	V
V_{GE} (100%) =	5	V
V_C (100%) =	600	V
I_C (100%) =	9	A
t_{don} =	1,938	µs
t_{Eon} =	2,187	µs

figure 3. **IGBT**

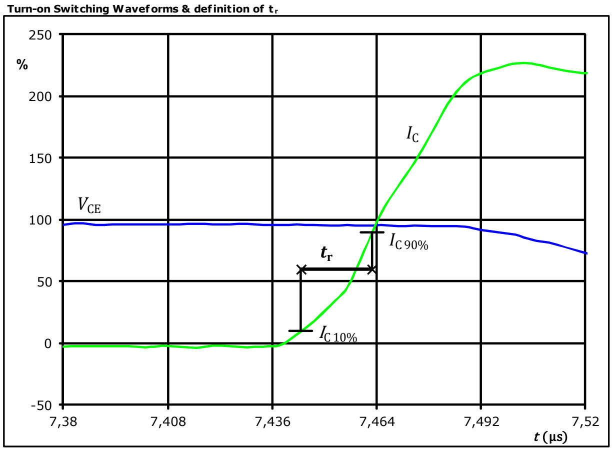
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	600	V
I_C (100%) =	9	A
t_f =	0,088	µs

figure 4. **IGBT**

Turn-on Switching Waveforms & definition of t_r



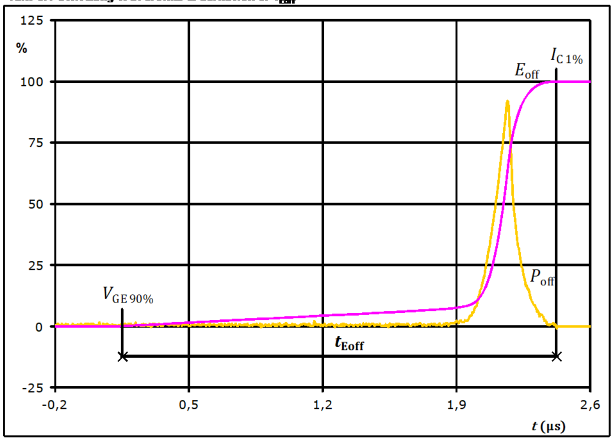
V_C (100%) =	600	V
I_C (100%) =	9	A
t_r =	0,019	µs

* t_{dON}, t_{dOFF} include gate driver propagation delay

Inverter Switching Characteristics

figure 5. **IGBT**

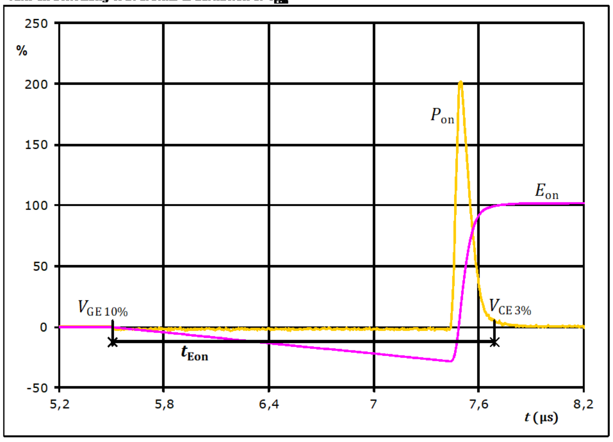
Turn-off Switching Waveforms & definition of t_{Eoff}



$P_{off}(100\%)$ =	5,43	kW
$E_{off}(100\%)$ =	0,73	mJ
t_{Eoff} =	2,27	µs

figure 6. **IGBT**

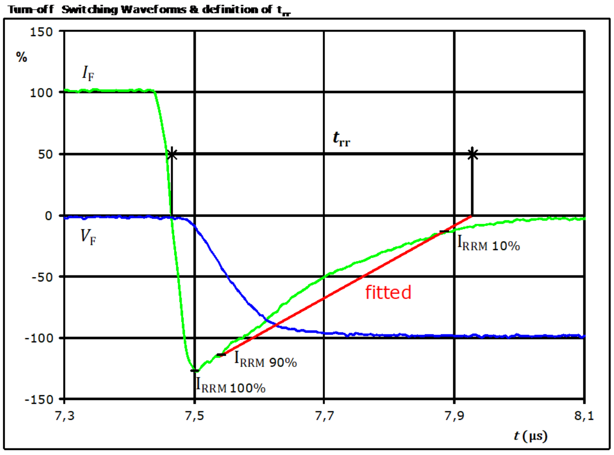
Turn-on Switching Waveforms & definition of t_{Eon}



$P_{on}(100\%)$ =	5,43	kW
$E_{on}(100\%)$ =	0,82	mJ
t_{Eon} =	2,19	µs

figure 7. **FWD**

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



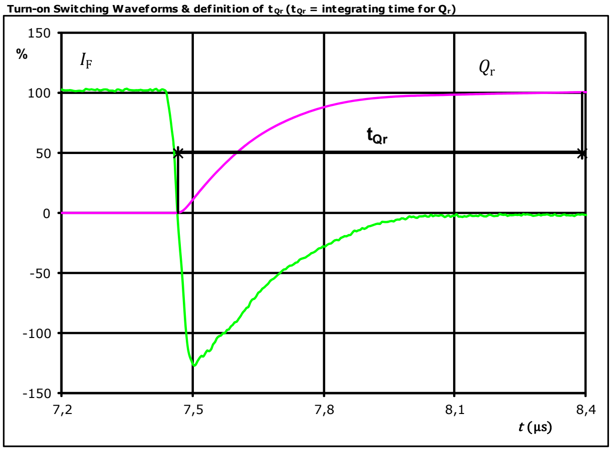
$V_F(100\%)$ =	600	V
$I_F(100\%)$ =	9	A
$I_{RRM}(100\%)$ =	-12	A
t_{rr} =	0,463	µs

Vincotech

Inverter Switching Characteristics

figure 8. **FWD**

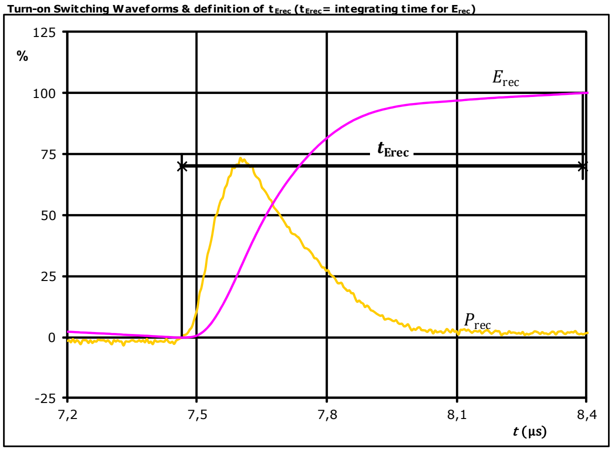
Turn-on Switching Waveforms & definition of t_{Qr} (t_{Qr} = integrating time for Q_r)



I_F (100%) =	9	A
Q_r (100%) =	2,49	µC
t_{Qr} =	0,93	µs

figure 9. **FWD**

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



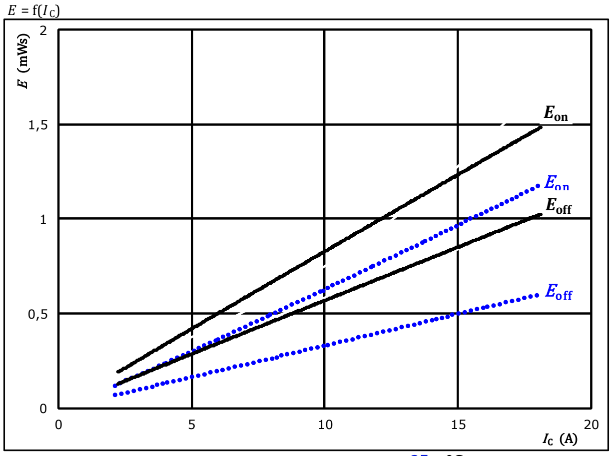
P_{rec} (100%) =	5,43	kW
E_{rec} (100%) =	0,99	mJ
t_{Erec} =	0,93	µs

Brake Switching Characteristics

figure 1. **IGBT**

Typical switching energy losses as a function of collector current

$E = f(I_C)$



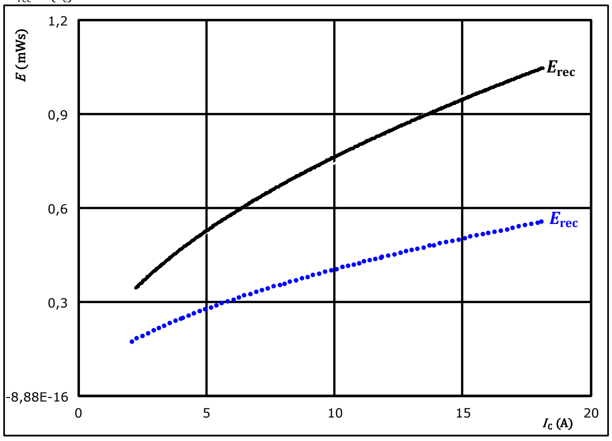
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C (dotted)
V_{IN} =	5	V		125 °C (solid)
V_{cc} =	15,0	V		

figure 2. **FWD**

Typical reverse recovered energy loss as a function of collector current

$E_{rec} = f(I_C)$



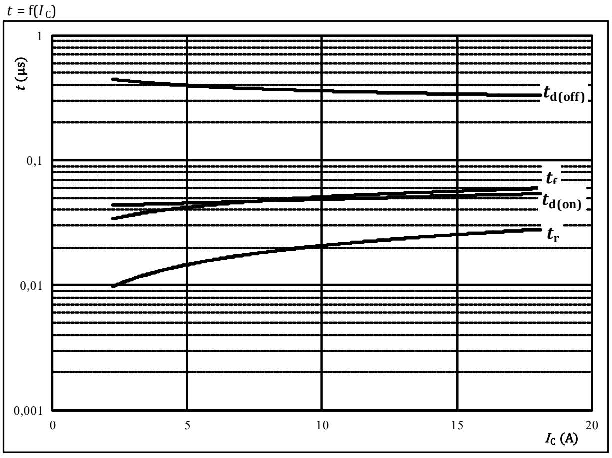
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C (dotted)
V_{IN} =	5	V		125 °C (solid)
V_{cc} =	15,0	V		

figure 3. **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



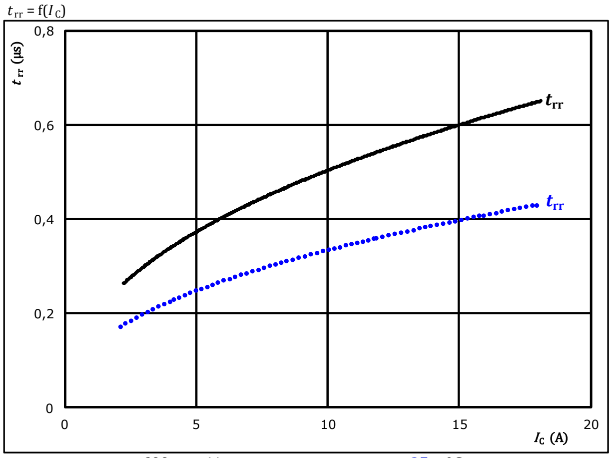
With an inductive load at

T_j =	125	°C
V_{CE} =	600	V
V_{IN} =	5	V
V_{cc} =	15,0	V

figure 4. **FWD**

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$



At

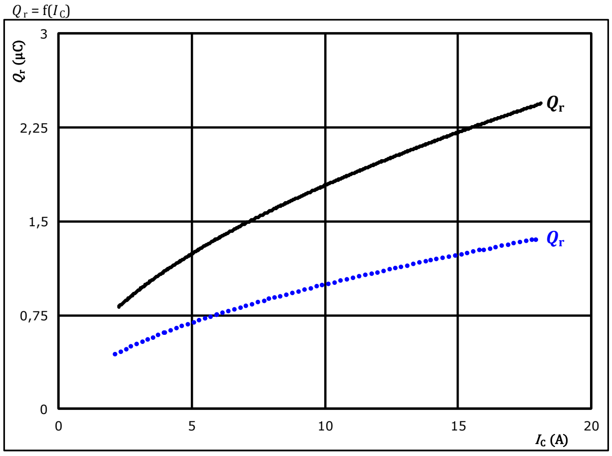
V_{CE} =	600	V	T_j:	25 °C (dotted)
V_{IN} =	5	V		125 °C (solid)
V_{cc} =	15,0	V		

Brake Switching Characteristics

figure 5. **FWD**

Typical recovered charge as a function of collector current

$Q_r = f(I_C)$

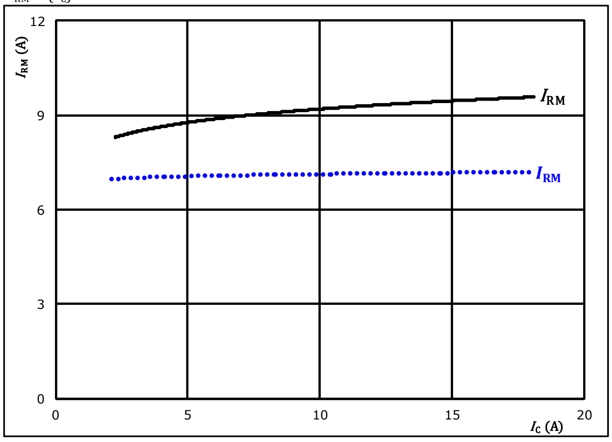


At				
V_{CE} =	600	V	T_j: 25 °C	dotted
V_{IN} =	5	V	T_j: 125 °C	solid
V_{cc} =	15,0	V		

figure 6. **FWD**

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

$I_{RM} = f(I_C)$

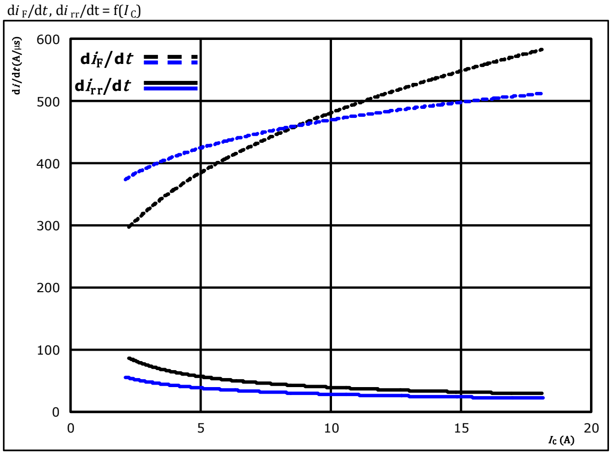


At				
V_{CE} =	600	V	T_j: 25 °C	dotted
V_{IN} =	5	V	T_j: 125 °C	solid
V_{cc} =	15,0	V		

figure 7. **FWD**

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

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

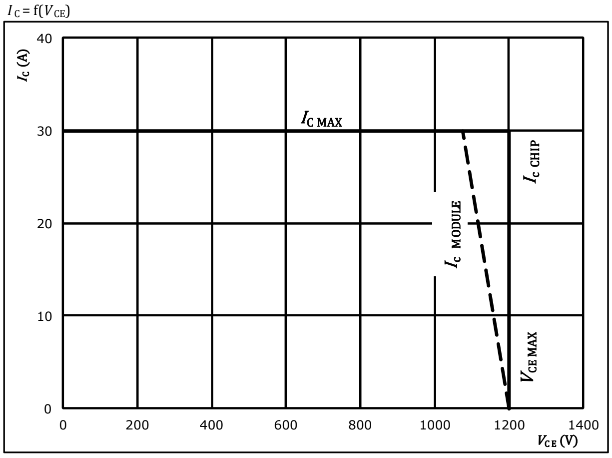


At				
V_{CE} =	600	V	T_j: 25 °C	dotted
V_{IN} =	5	V	T_j: 125 °C	solid
V_{cc} =	15,0	V		

figure 8. **IGBT**

Reverse bias safe operating area

$I_C = f(V_{CE})$



At

T_j = 175 °C

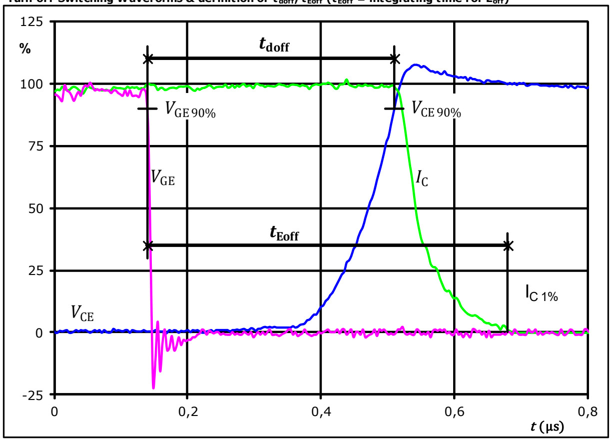
Brake Switching Definitions

General conditions

T_j	=	125 °C
V_{CC}	=	15 V

figure 1. IGBT

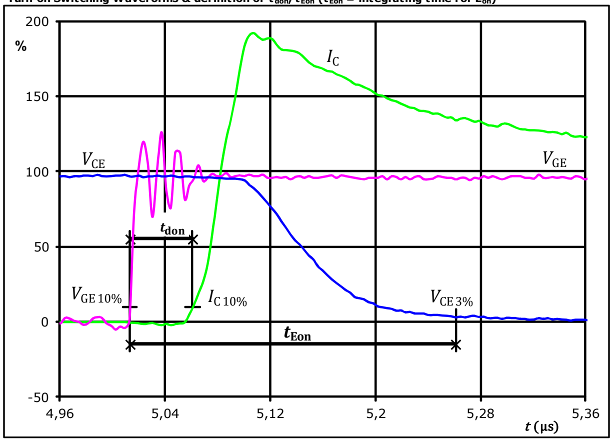
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff} (t_{Eoff} = integrating time for E_{off})



$V_{IN}(0\%)$ =	0	V
$V_{IN}(100\%)$ =	5	V
$V_C(100\%)$ =	600	V
$I_C(100\%)$ =	10	A
t_{doff} =	0,369	µs
t_{Eoff} =	0,541	µs

figure 2. IGBT

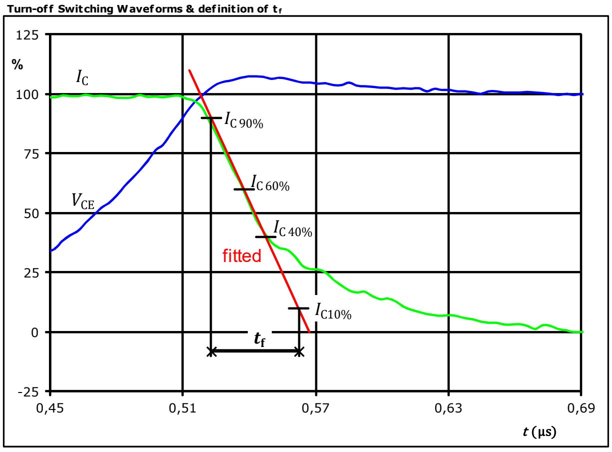
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon} (t_{Eon} = integrating time for E_{on})



$V_{IN}(0\%)$ =	0	V
$V_{IN}(100\%)$ =	5	V
$V_C(100\%)$ =	600	V
$I_C(100\%)$ =	10	A
t_{don} =	0,049	µs
t_{Eon} =	0,248	µs

figure 3. IGBT

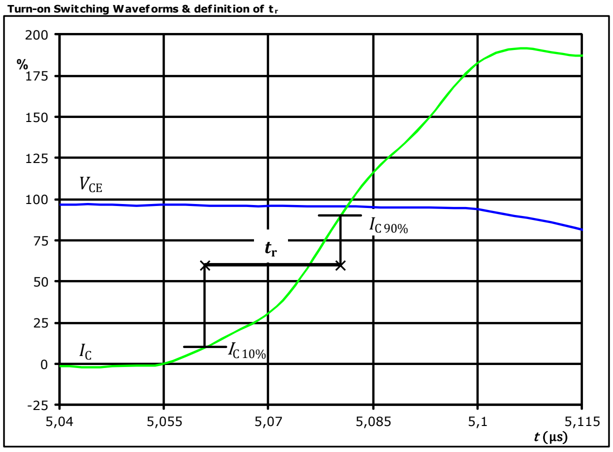
Turn-off Switching Waveforms & definition of t_f



$V_C(100\%)$ =	600	V
$I_C(100\%)$ =	10	A
t_f =	0,043	µs

figure 4. IGBT

Turn-on Switching Waveforms & definition of t_r

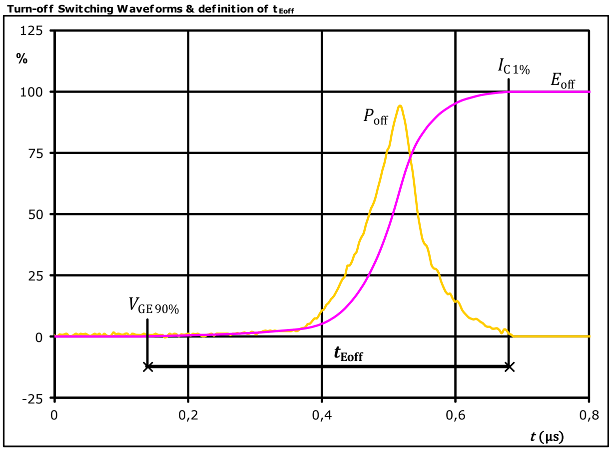


$V_C(100\%)$ =	600	V
$I_C(100\%)$ =	10	A
t_r =	0,020	µs

Brake Switching Characteristics

figure 5. **IGBT**

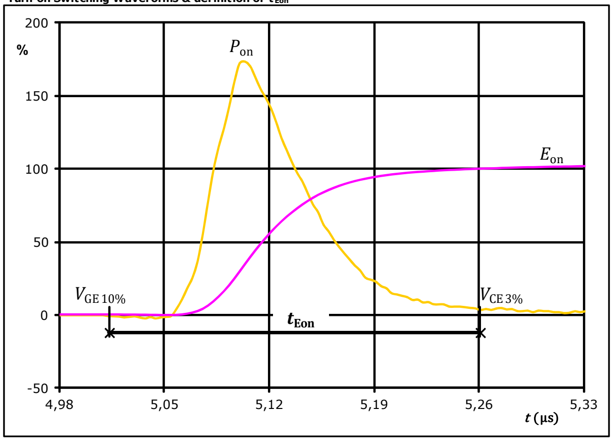
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	6,15	kW
E_{off} (100%) =	0,60	mJ
t_{Eoff} =	0,54	μs

figure 6. **IGBT**

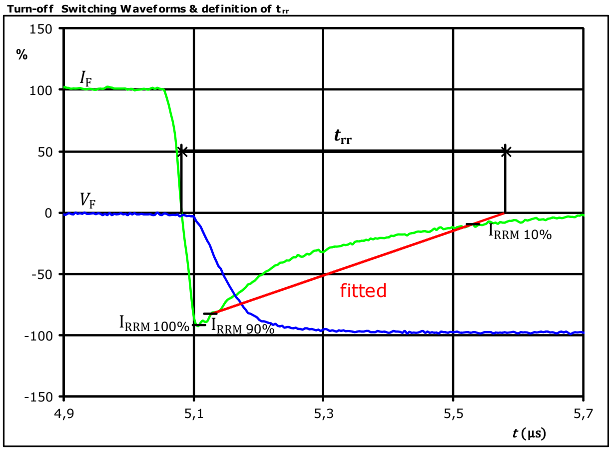
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	6,15	kW
E_{on} (100%) =	0,77	mJ
t_{Eon} =	0,25	μs

figure 7. **FWD**

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

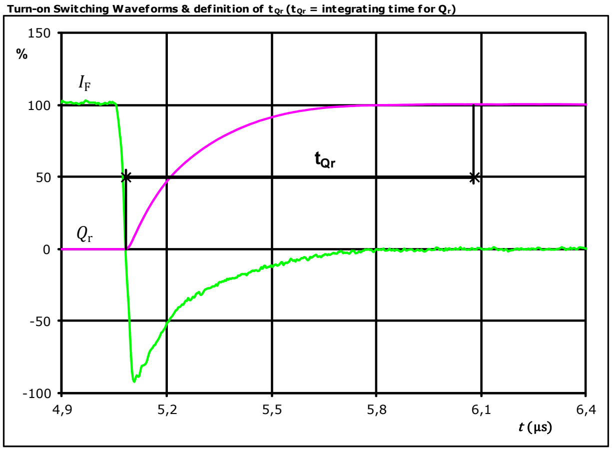


V_F (100%) =	600	V
I_F (100%) =	10	A
I_{RRM} (100%) =	-9	A
t_{rr} =	0,494	μs

Brake Switching Characteristics

figure 8. **FWD**

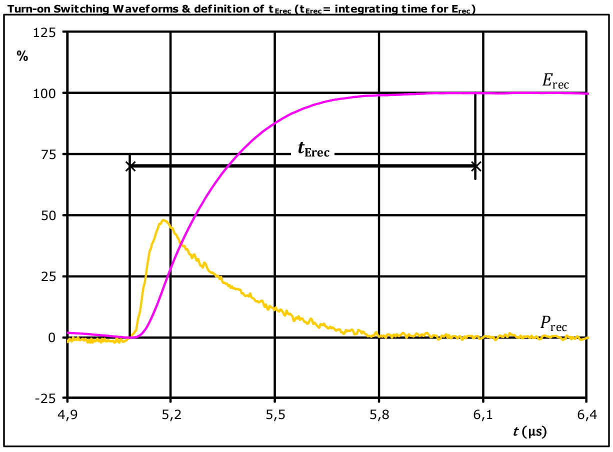
Turn-on Switching Waveforms & definition of t_{Qr} (t_{Qr} = integrating time for Q_r)



I_F (100%) =	10	A
Q_r (100%) =	1,76	µC
t_{Qr} =	1,00	µs

figure 9. **FWD**

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



P_{rec} (100%) =	6,15	kW
E_{rec} (100%) =	0,75	mJ
t_{Erec} =	1,00	µs

Ordering Code & Marking

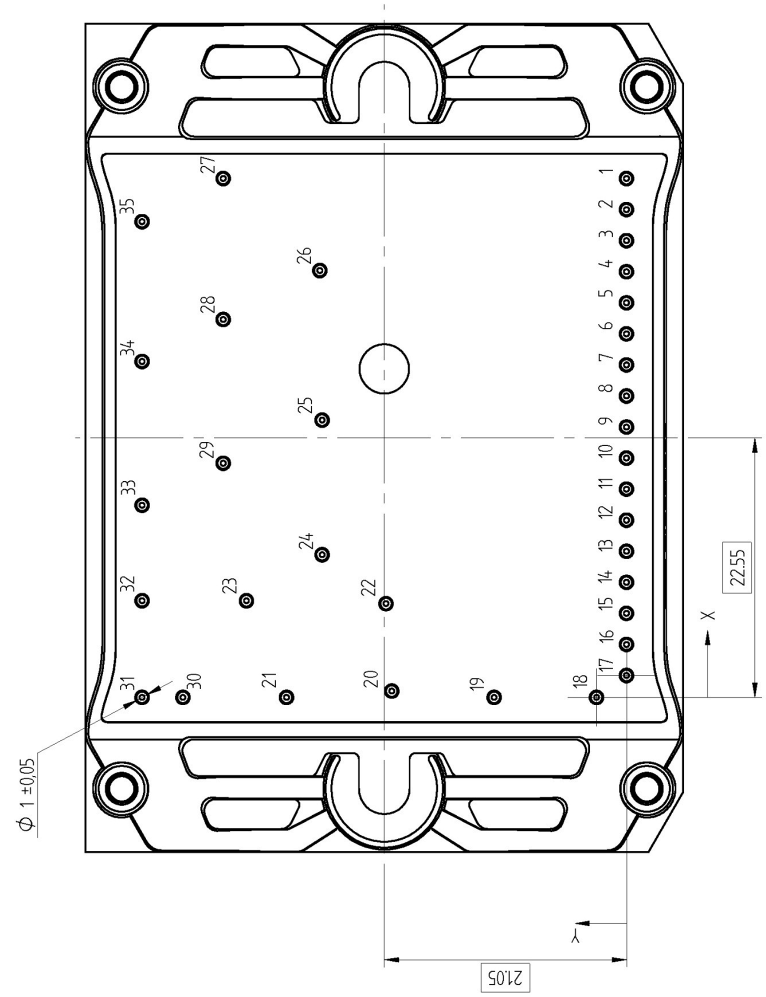
Version	Ordering Code
without thermal paste 12 mm housing with solder pins	20-1C12IBA015SH-LB18A08
with thermal paste 12 mm housing with solder pins	20-1C12IBA015SH-LB18A08-/3/

	Name		Date code	UL & VIN	Lot	Serial
Text	NN-NNNNNNNNNNNNNN-TTTTTTVV		WWYY	UL VIN	LLLLL	SSSS
	Type&Ver	**Lot number**	**Serial**	**Date code**		
Datamatrix	TTTTTTTVV	LLLLL	SSSS	WWYY		

Outline

Pin table

Pin	X	Y	Function
1	45,1	0	WH
2	42,4	0	WL
3	39,7	0	RW+
4	37	0	RW-
5	34,3	0	GND
6	31,6	0	VCC
7	28,9	0	VH
8	26,2	0	VL
9	23,5	0	RV+
10	20,8	0	RV-
11	18,1	0	UH
12	15,4	0	UL
13	12,7	0	RU+
14	10	0	RU-
15	7,3	0	RST
16	4,6	0	FO
17	1,9	0	NTC
18	0	2,6	BRCG
19	0	11,5	L3
20	0,55	20,4	L2
21	0	29,55	L1
22	8,15	20,9	DC1-
23	8,4	33,03	BRE
24	12,4	26,45	EU
25	24,1	26,45	EV
26	37,1	26,65	EW
27	45,1	35,05	DC2+
28	32,85	35,05	DC2+
29	20,35	35,05	DC2+
30	0	38,55	DC1+
31	0	42,1	BRC+
32	8,4	42,1	BRC
33	16,7	42,1	U
34	29,2	42,1	V
35	41,35	42,1	W



Tolerance of pinpositions: ±0,5mm at the end of pins
Dimension of coordinate axis is only offset without tolerance

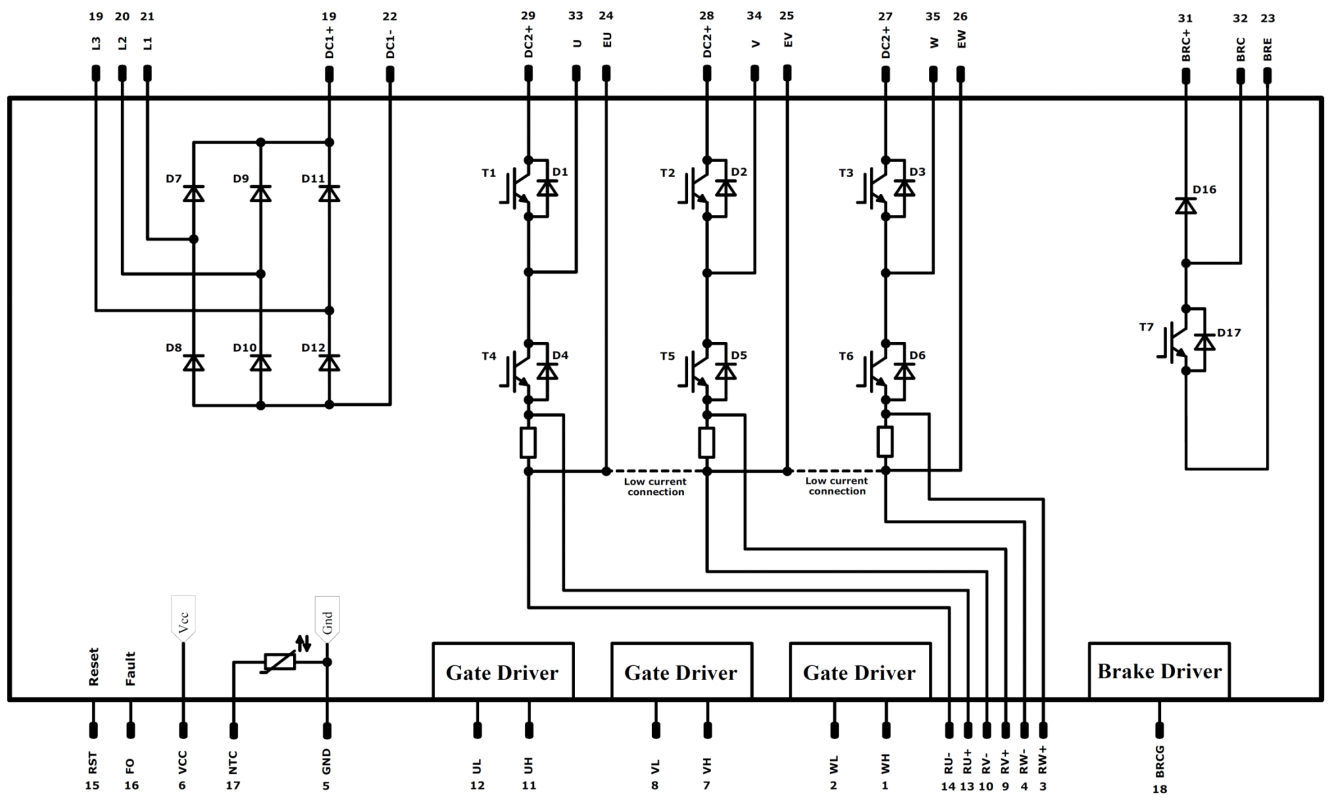
Pin Descriptions

Pin	Function	Description
1	WH	Signal input for high-side W phase
2	WL	Signal input for low-side W phase
3	RW+	W phase shunt +
4	RW-	W phase shunt -
5	GND	Signal ground
6	VCC	Driver circuit supply voltage
7	VH	Signal input for high-side V phase
8	VL	Signal input for low-side V phase
9	RV+	V phase shunt +
10	RV-	V phase shunt -
11	UH	Signal input for high-side U phase
12	UL	Signal input for low-side U phase
13	RU+	U phase shunt +
14	RU-	U phase shunt -
15	RST	Fault latch reset (min. 500ns pulse)
16	FO	Fault latch input/output (negative logic, open drain)
17	NTC	Temperature sensor connector
18	BRCG	Signal input for Brake gate drive

Power pin descriptions

Pin	Function	Description
19	L3	Rectifier input L3
20	L2	Rectifier input L2
21	L1	Rectifier input L1
22	DC1-	Rectifier output DC-
23	BRE	Brake Open emitter
24	EU	Open emitter U phase
25	EV	Open emitter V phase
26	EW	Open emitter W phase
27	DC2+	Inverter input DC+
28	DC2+	Inverter input DC+
29	DC2+	Inverter input DC+
30	DC1+	Rectifier output DC+
31	BRC+	Brake input DC+
32	BRC	Brake output
33	U	Output U phase
34	V	Output V phase
35	W	Output W phase

Pinout



Identification

ID	Component	Voltage	Current	Function	Comment
D8, D7, D10, D9, D12, D11	Rectifier	1600 V	30 A	Rectifier Diode	
T4, T1, T5, T2, T6, T3	IGBT	1200 V	15 A	Inverter Switch	
D1, D4, D2, D5, D3, D6	FWD	1200 V	15 A	Inverter Diode	
R1, R2, R3	Resistor		9 A	Inverter Shunt	
T7	IGBT	1200 V	15 A	Brake Switch	
D16	FWD	1200 V	7,5 A	Brake Diode	
D17	FWD	1200 V	3 A	Brake Sw. Protection Diode	

Packaging instruction				
Standard packaging quantity (SPQ) 90	>SPQ	Standard	<SPQ	Sample

Handling instruction
Handling instructions for *flow* 1C packages see vincotech.com website.

Package data
Package data for *flow* 1C 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
20-1C12IBA015SH-LB18A08-D3-14	07 Feb. 2020	Correct V_{CC} of Gate Driver Brake	3, 9