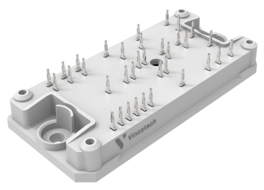
10-PG12APA015SH01-PB18E08T
datasheet

***flow*3xANPFC 1** **1200 V / 15 A**

Features

- 3xAdvanced Neutral Boost PFC
- Integrated DC capacitor
- Kelvin Emitter for improved switching performance
- Integrated sixpack with open emitter
- Built-in NTC

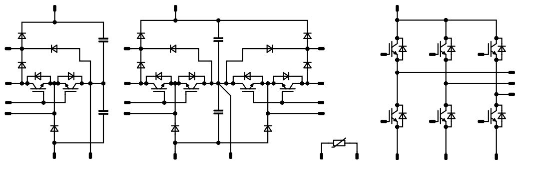
flow 1 12 mm housing



Target applications

- Embedded Drives
- Heat Pumps
- HVAC
- Industrial Drives

Schematic



Types

- 10-PG12APA015SH01-PB18E08T

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Conditions		Value	Unit
Inverter Switch					
Collector-emitter voltage	V_{CES}			1200	V
Collector current (DC current)	I_C	$T_j = T_{jmax}$	T_s = 80 °C	22	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}		45	A
Turn off safe operating area		T_j = 150°C, V_{CE} = 1200 V		60	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	68	W
Gate-emitter voltage	V_{GES}			±20	V
Short circuit ratings	t_{SC}	V_{GE} = 15 V, V_{CC} = 800 V	T_j = 150 °C	10	µs
Maximum junction temperature	T_{jmax}			175	°C
Negative Neutral Point Switch					
Collector-emitter voltage	V_{CES}			650	V
Collector current (DC current)	I_C	$T_j = T_{jmax}$	T_s = 80 °C	32	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}		90	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	68	W
Gate-emitter voltage	V_{GES}			±20	V
Maximum junction temperature	T_{jmax}			175	°C
Inverter Diode					
Peak repetitive reverse voltage	V_{RRM}			1200	V
Forward current (DC current)	I_F	$T_j = T_{jmax}$	T_s = 80 °C	16	A
Surge (non-repetitive) forward current	I_{FSM}	Single Half Sine Wave, t_p = 10 ms	T_j = 25 °C	65	A
Surge current capability	I^2t			21	A^2s
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	43	W
Maximum junction temperature	T_{jmax}			175	°C

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Conditions		Value	Unit
Positive Neutral Point Switch					
Collector-emitter voltage	V_{CES}			650	V
Collector current (DC current)	I_C	$T_j = T_{jmax}$	T_s = 80 °C	32	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}		90	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	68	W
Gate-emitter voltage	V_{GES}			±20	V
Maximum junction temperature	T_{jmax}			175	°C
Negative Neutral Point Diode					
Peak repetitive reverse voltage	V_{RRM}			1600	V
Forward current (DC current)	I_F	$T_j = T_{jmax}$	T_s = 80 °C	35	A
Surge (non-repetitive) forward current	I_{FSM}	Single Half Sine Wave, t_p = 10 ms	T_j = 150 °C	200	A
Surge current capability	I^2t			200	A^2s
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	44	W
Maximum junction temperature	T_{jmax}			150	°C
Positive Neutral Point Diode					
Peak repetitive reverse voltage	V_{RRM}			1600	V
Forward current (DC current)	I_F	$T_j = T_{jmax}$	T_s = 80 °C	35	A
Surge (non-repetitive) forward current	I_{FSM}	Single Half Sine Wave, t_p = 10 ms	T_j = 150 °C	200	A
Surge current capability	I^2t			200	A^2s
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	44	W
Maximum junction temperature	T_{jmax}			150	°C

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Conditions		Value	Unit
Positive Boost Diode					
Peak repetitive reverse voltage	V_{RRM}			650	V
Forward current (DC current)	I_F	$T_j = T_{jmax}$	T_s = 80 °C	18	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}		66	A
Surge (non-repetitive) forward current	I_{FSM}	Single Half Sine Wave, t_p = 10 ms	T_j = 25 °C	162	A
Surge current capability	I^2t			131	A^2s
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	40	W
Maximum junction temperature	T_{jmax}			175	°C
Positive Boost Blocking Diode					
Peak repetitive reverse voltage	V_{RRM}			1600	V
Forward current (DC current)	I_F	$T_j = T_{jmax}$	T_s = 80 °C	35	A
Surge (non-repetitive) forward current	I_{FSM}	Single Half Sine Wave, t_p = 10 ms	T_j = 150 °C	200	A
Surge current capability	I^2t			200	A^2s
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	44	W
Maximum junction temperature	T_{jmax}			150	°C
Positive Boost Diode Protection Diode					
Peak repetitive reverse voltage	V_{RRM}			650	V
Forward current (DC current)	I_F	$T_j = T_{jmax}$	T_s = 80 °C	16	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}		12	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	38	W
Maximum junction temperature	T_{jmax}			175	°C

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Conditions		Value	Unit
Negative Boost Diode					
Peak repetitive reverse voltage	V_{RRM}			650	V
Forward current (DC current)	I_F	$T_j = T_{jmax}$	T_s = 80 °C	18	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}		66	A
Surge (non-repetitive) forward current	I_{FSM}	Single Half Sine Wave, t_p = 10 ms	T_j = 25 °C	162	A
Surge current capability	I^2t			131	A^2s
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	40	W
Maximum junction temperature	T_{jmax}			175	°C
Capacitor (PFC)					
Maximum DC voltage	V_{MAX}			630	V
Operation Temperature	T_{op}			-55 ... 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
Isolation voltage	V_{isol}	AC Voltage	t_p = 1 min	2500	V
Creepage distance				>12,7	mm
Clearance				8.49	mm
Comparative Tracking Index	CTI			≥ 600	

*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
Inverter Switch										
Static										
Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,0005	25	5,3	5,8	6,3	V
Collector-emitter saturation voltage	V_{CEsat}		15		15	25 150	1,78	1,91 2,29	2,42(1)	V
Collector-emitter cut-off current	I_{CES}		0	1200		25			2	µA
Gate-emitter leakage current	I_{GES}		20	0		25			120	nA
Internal gate resistance	r_g							None		Ω
Input capacitance	C_{ies}	f = 1 Mhz	0	25		25		875		pF
Output capacitance	C_{oes}							75		pF
Reverse transfer capacitance	C_{res}							45		pF
Gate charge	Q_g	V_{CC} = 960 V	15		15	25		75		nC
Thermal										
Thermal resistance junction to sink (2)	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						1,39		K/W
Dynamic										
Turn-on delay time	$t_{d(on)}$	R_{gon} = 16 Ω R_{goff} = 16 Ω	±15	600	15	25 125 150		51,49 51,17 51,35		ns
Rise time	t_r					25 125 150		23,33 24,69 24,94		ns
Turn-off delay time	$t_{d(off)}$					25 125 150		142,18 193,22 205,43		ns
Fall time	t_f					25 125 150		56,92 95,01 106,08		ns
Turn-on energy (per pulse)	E_{on}	Q_{rFWD}=0,677 µC Q_{rFWD}=1,51 µC Q_{rFWD}=1,84 µC				25 125 150		0,741 1,08 1,2		mWs
Turn-off energy (per pulse)	E_{off}					25 125 150		0,615 1,01 1,12		mWs

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
Negative Neutral Point Switch										
Static										
Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,0003	25	3,3	4	4,7	V
Collector-emitter saturation voltage	V_{CEsat}		15		30	25 125 150		1,7 1,93 2	2,22(1)	V
Collector-emitter cut-off current	I_{CES}		0	650		25			40	µA
Gate-emitter leakage current	I_{GES}		20	0		25			120	nA
Internal gate resistance	r_g							None		Ω
Input capacitance	C_{ies}	f = 1 Mhz	0	25		25		1800		pF
Output capacitance	C_{oes}							45		pF
Reverse transfer capacitance	C_{res}							9		pF
Gate charge	Q_g	V_{CC} = 520 V	15		30	25		65		nC
Thermal										
Thermal resistance junction to sink (2)	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						1,39		K/W
Dynamic										
Turn-on delay time	$t_{d(on)}$	R_{gon} = 16 Ω R_{goff} = 16 Ω	±15	350	16	25 125 150		130,15 129,32 129,05		ns
Rise time	t_r					25 125 150		32 32,05 31,88		ns
Turn-off delay time	$t_{d(off)}$					25 125 150		101,63 121,36 126,1		ns
Fall time	t_f					25 125 150		1,47 2,37 2,59		ns
Turn-on energy (per pulse)	E_{on}	Q_{rFWD}=0,04 µC Q_{rFWD}=0,039 µC Q_{rFWD}=0,04 µC				25 125 150		0,196 0,208 0,206		mWs
Turn-off energy (per pulse)	E_{off}					25 125 150		0,086 0,145 0,16		mWs

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]	Values Min	Typ	Max	Unit
Inverter Diode										
Static										
Forward voltage	V_F				15	25 150		2,6 2,65	2,71(1) 2,77(1)	V
Reverse leakage current	I_R	V_r = 1200 V				25 150		 900	60 1800	µA
Thermal										
Thermal resistance junction to sink (2)	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						2,2		K/W
Dynamic										
Peak recovery current	I_{RRM}	d*i*/d*t*=589 A/µs d*i*/d*t*=568 A/µs d*i*/d*t*=588 A/µs	±15	600	15	25 125 150		11,25 13,58 14,49		A
Reverse recovery time	t_{rr}					25 125 150		166,79 367,13 420,17		ns
Recovered charge	Q_r					25 125 150		0,677 1,51 1,84		µC
Reverse recovered energy	E_{rec}					25 125 150		0,218 0,597 0,724		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125 150		186,15 145,21 134,05		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
Positive Neutral Point Switch										
Static										
Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,0003	25	3,3	4	4,7	V
Collector-emitter saturation voltage	V_{CEsat}		15		30	25 125 150		1,7 1,93 2	2,22(1)	V
Collector-emitter cut-off current	I_{CES}		0	650		25			40	µA
Gate-emitter leakage current	I_{GES}		20	0		25			120	nA
Internal gate resistance	r_g							None		Ω
Input capacitance	C_{ies}	f = 1 Mhz	0	25		25		1800		pF
Output capacitance	C_{oes}							45		pF
Reverse transfer capacitance	C_{res}							9		pF
Gate charge	Q_g	V_{CC} = 520 V	15		30	25		65		nC
Thermal										
Thermal resistance junction to sink (2)	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						1,39		K/W
Dynamic										
Turn-on delay time	$t_{d(on)}$	R_{gon} = 16 Ω R_{goff} = 16 Ω	±15	350	16	25 125 150		130,15 129,32 129,05		ns
Rise time	t_r					25 125 150		32 32,05 31,88		ns
Turn-off delay time	$t_{d(off)}$					25 125 150		101,63 121,36 126,1		ns
Fall time	t_f					25 125 150		1,47 2,37 2,59		ns
Turn-on energy (per pulse)	E_{on}	Q_{rFWD}=0,04 µC Q_{rFWD}=0,039 µC Q_{rFWD}=0,04 µC				25 125 150		0,196 0,208 0,206		mWs
Turn-off energy (per pulse)	E_{off}					25 125 150		0,086 0,145 0,16		mWs

Characteristic Values

Parameter	Symbol	Conditions					Values			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	
Negative Neutral Point Diode										
Static										
Forward voltage	V_F				5	25 125 150		0,928 0,813 0,784	1,1(1)	V
Reverse leakage current	I_R	V_r = 1600 V				25 150			100 1000	µA
Thermal										
Thermal resistance junction to sink (2)	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						1,6		K/W
Positive Neutral Point Diode										
Static										
Forward voltage	V_F				5	25 125 150		0,928 0,813 0,784	1,1(1)	V
Reverse leakage current	I_R	V_r = 1600 V				25 150			100 1000	µA
Thermal										
Thermal resistance junction to sink (2)	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						1,6		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
Positive Boost Diode										
Static										
Forward voltage	V_F				16	25 125 150		1,55 1,89 2	1,8(1)	V
Reverse leakage current	I_R	V_r = 650 V				25		18	95	µA
Thermal										
Thermal resistance junction to sink (2)	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						2,38		K/W
Dynamic										
Peak recovery current	I_{RRM}	d*i*/d*t*=746 A/µs d*i*/d*t*=734 A/µs d*i*/d*t*=757 A/µs	±15	350	16	25 125 150		4,16 3,84 3,85		A
Reverse recovery time	t_{rr}					25 125 150		18,07 19,68 20,15		ns
Recovered charge	Q_r					25 125 150		0,04 0,039 0,04		µC
Reverse recovered energy	E_{rec}					25 125 150		$3{,}772 \times 10^{-3}$ $3{,}75 \times 10^{-3}$ $3{,}974 \times 10^{-3}$		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125 150		622,41 544,86 437,94		A/µs

Characteristic Values

Parameter	Symbol	Conditions					Values			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	
Positive Boost Blocking Diode										
Static										
Forward voltage	V_F				5	25 125 150		0,928 0,813 0,784	1,1(1)	V
Reverse leakage current	I_R	V_r = 1600 V				25 150			100 1000	µA
Thermal										
Thermal resistance junction to sink (2)	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						1,6		K/W
Positive Boost Diode Protection Diode										
Static										
Forward voltage	V_F				6	25 125 150	1,23	1,72 1,58 1,54	1,87(1)	V
Reverse leakage current	I_R	V_r = 650 V				25			0,1	µA
Thermal										
Thermal resistance junction to sink (2)	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						2,53		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
Negative Boost Diode										
Static										
Forward voltage	V_F				16	25 125 150		1,55 1,89 2	1,8(1)	V
Reverse leakage current	I_R	V_r = 650 V				25		18	95	µA
Thermal										
Thermal resistance junction to sink (2)	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						2,38		K/W
Dynamic										
Peak recovery current	I_{RRM}	d*i*/d*t*=746 A/µs d*i*/d*t*=734 A/µs d*i*/d*t*=757 A/µs	±15	350	16	25 125 150		4,16 3,84 3,85		A
Reverse recovery time	t_{rr}					25 125 150		18,07 19,68 20,15		ns
Recovered charge	Q_r					25 125 150		0,04 0,039 0,04		µC
Reverse recovered energy	E_{rec}					25 125 150		$3,772x10^{-3}$ $3,75x10^{-3}$ $3,974x10^{-3}$		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125 150		622,41 544,86 437,94		A/µs

Characteristic Values

Parameter	Symbol	Conditions					Values			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	
Capacitor (PFC)										
Static										
Capacitance	C	DC bias voltage = 0 V				25		33		nF
Tolerance							-5		5	%
Thermistor										
Static										
Rated resistance	R					25		22		kΩ
Deviation of R_{100}	$\Delta_{R/R}$	R_{100} = 1484 Ω				100	-5		5	%
Power dissipation	P							5		mW
Power dissipation constant	d					25		1,5		mW/K
B-value	$B_{(25/50)}$	Tol. ±1 %						3962		K
B-value	$B_{(25/100)}$	Tol. ±1 %						4000		K
Vincotech Thermistor Reference									I	

(1) Value at chip level

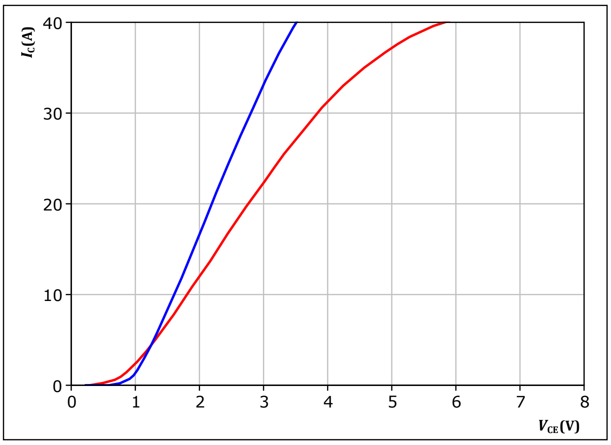
(2) Only valid with pre-applied Vincotech thermal interface material.

Inverter Switch Characteristics

figure 1. IGBT

Typical output characteristics

I_C = f(V_{CE})

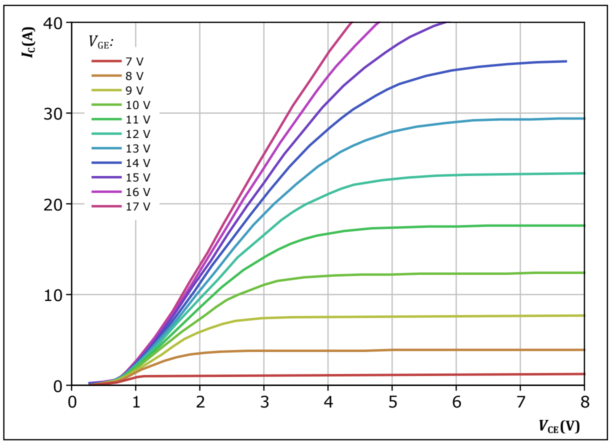


t_p = 250 µs
V_{GE} = 15 V
T_j: 25 °C, 150 °C

figure 2. IGBT

Typical output characteristics

I_C = f(V_{CE})

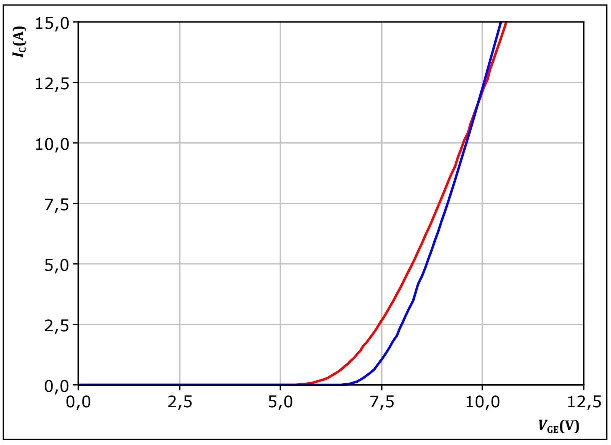


t_p = 250 µs
T_j = 150 °C
V_{GE} from 7 V to 17 V in steps of 1 V

figure 3. IGBT

Typical transfer characteristics

I_C = f(V_{GE})

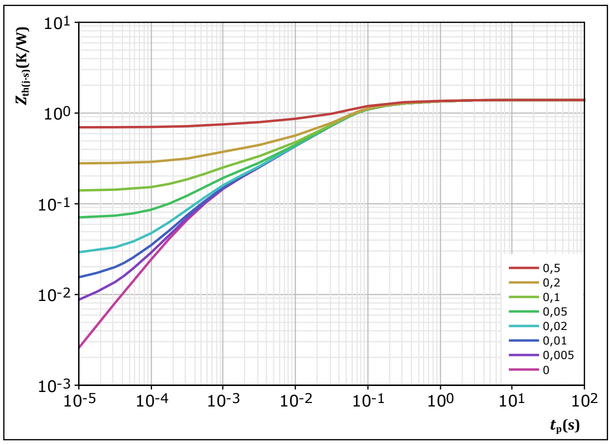


t_p = 250 µs
V_{CE} = 10 V
T_j: 25 °C, 150 °C

figure 4. IGBT

Transient thermal impedance as a function of pulse width

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



D = t_p / T
$R_{th(j-s)}$ = 1,392 K/W

IGBT thermal model values

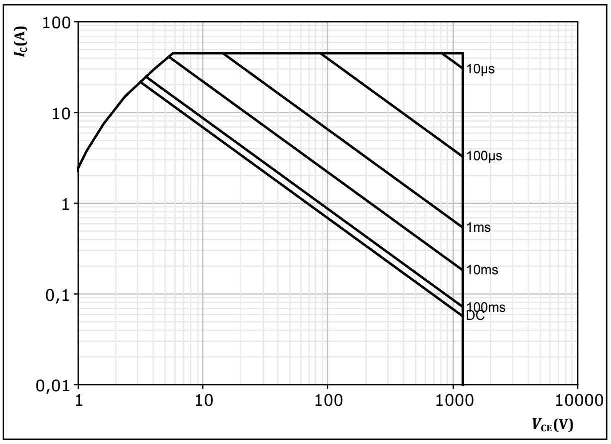
R (K/W)	τ (s)
9,77E-02	1,22E+00
1,79E-01	2,08E-01
8,34E-01	4,54E-02
1,64E-01	4,89E-03
1,17E-01	5,62E-04

Inverter Switch Characteristics

figure 5.	IGBT

Safe operating area

I_C = f(V_{CE})



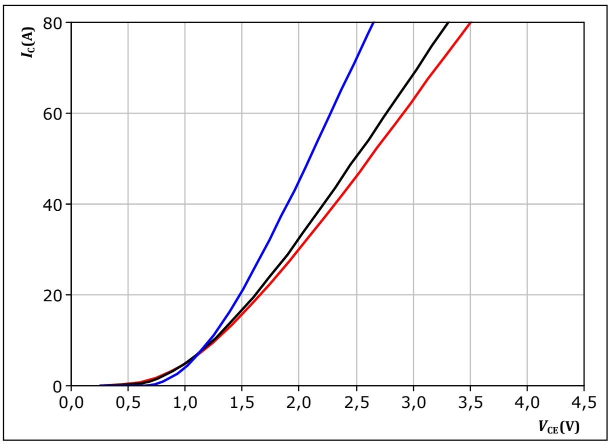
D =	single pulse	
T_s =	80	°C
V_{GE} =	15	V
T_j =	T_{jmax}	

Negative Neutral Point Switch Characteristics

figure 6. IGBT

Typical output characteristics

$I_C = f(V_{CE})$

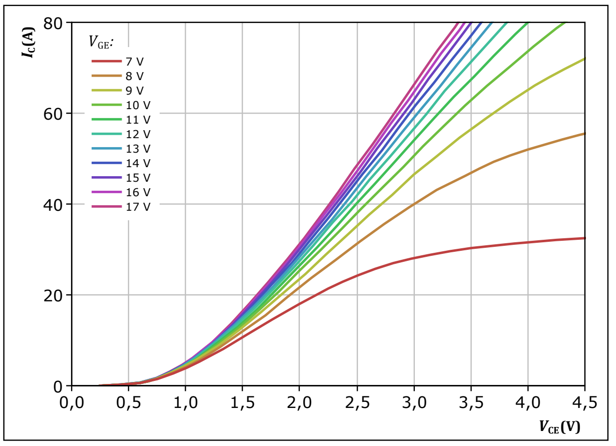


t_p =	250	μs	T_j:	25 °C
V_{GE} =	15	V		125 °C
				150 °C

figure 7. IGBT

Typical output characteristics

$I_C = f(V_{CE})$



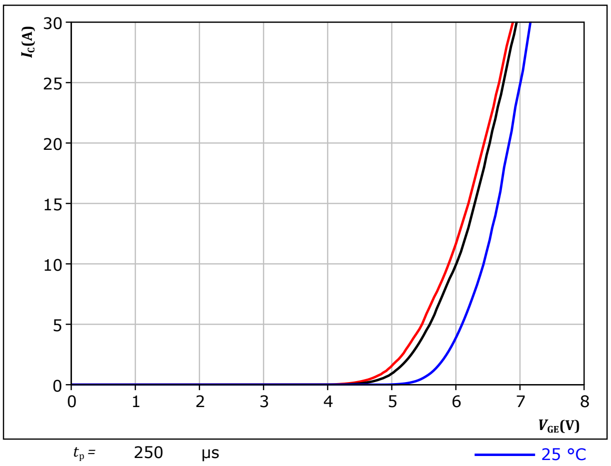
t_p =	250	μs
T_j =	150	°C

V_{GE} from 7 V to 17 V in steps of 1 V

figure 8. IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$

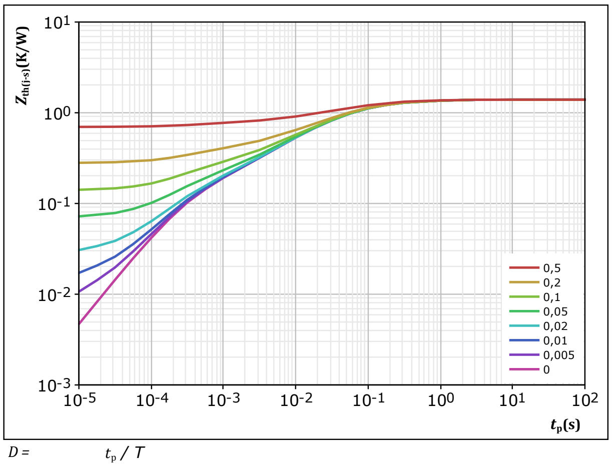


t_p =	250	μs	T_j:	25 °C
V_{CE} =	10	V		125 °C
				150 °C

figure 9. IGBT

Transient thermal impedance as a function of pulse width

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



D =	t_p / T	
$R_{th(j-s)}$ =	1,394	K/W

IGBT thermal model values

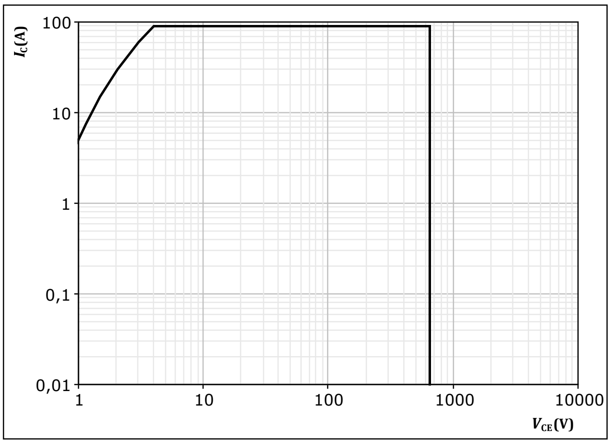
R (K/W)	τ (s)
8,66E-02	1,03E+00
1,95E-01	1,93E-01
5,59E-01	5,17E-02
3,47E-01	9,99E-03
9,37E-02	1,86E-03
1,12E-01	2,95E-04

Negative Neutral Point Switch Characteristics

figure 10. IGBT

Safe operating area

I_C = f(V_{CE})

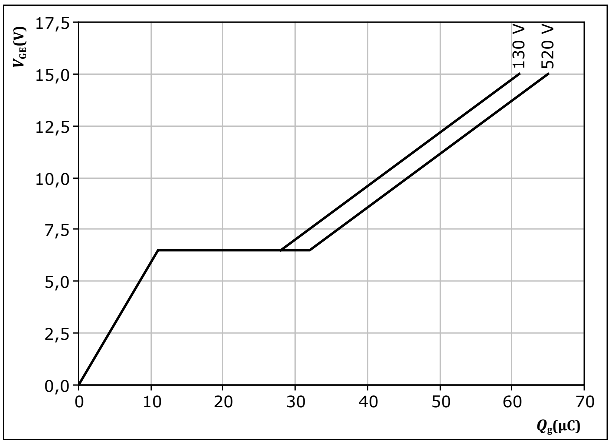


D = single pulse
T_s = 80 °C
V_{GE} = 15 V
T_j = T_{jmax}

figure 11. IGBT

Gate voltage vs gate charge

V_{GE} = f(Q_g)



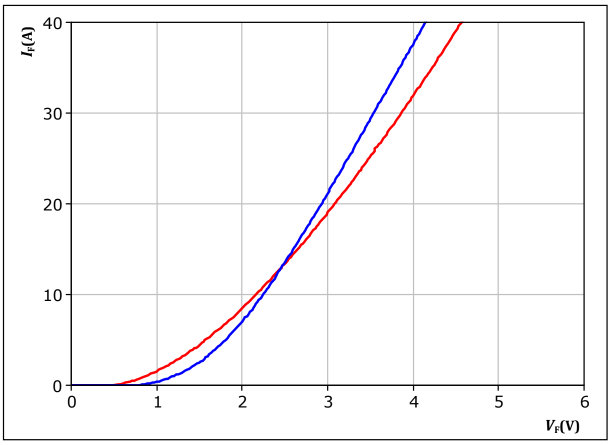
I_C = 30 A
T_j = 25 °C

Inverter Diode Characteristics

figure 12. **FWD**

Typical forward characteristics

I_F = f(V_F)



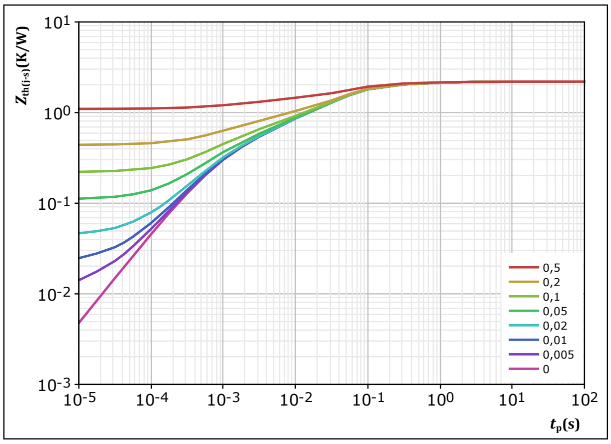
t_p = 250 µs

T_j: 25 °C, 150 °C

figure 13. **FWD**

Transient thermal impedance as a function of pulse width

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



D = t_p / T

$R_{th(j-s)}$ = 2,196 K/W

FWD thermal model values

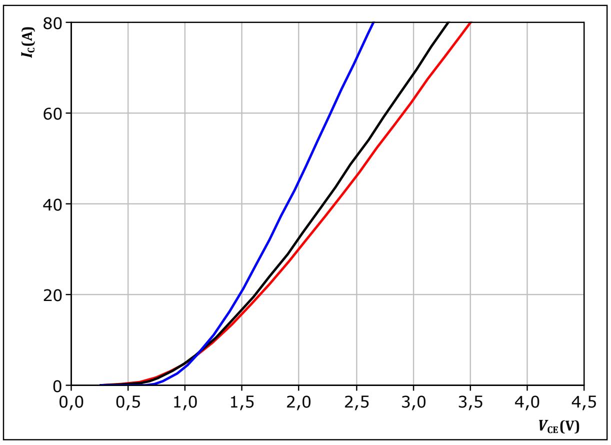
R (K/W)	τ (s)
1,03E-01	1,73E+00
3,30E-01	1,92E-01
1,14E+00	4,08E-02
3,82E-01	3,95E-03
2,46E-01	6,95E-04

Positive Neutral Point Switch Characteristics

figure 14. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$



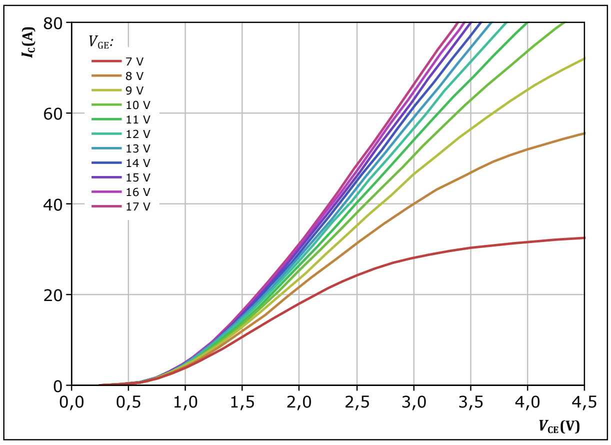
t_p =	250	μs
V_{GE} =	15	V

T_j: 25 °C, 125 °C, 150 °C

figure 15. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$



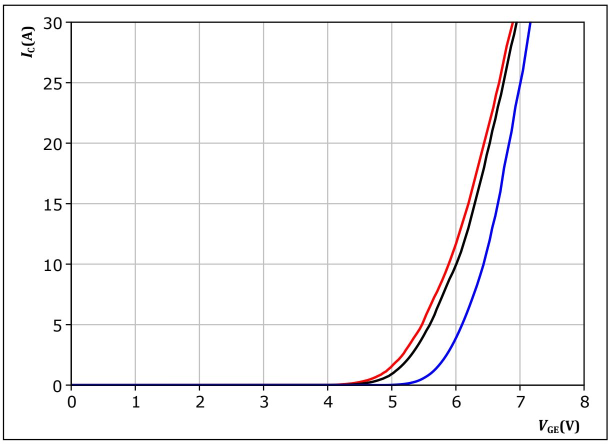
t_p =	250	μs
T_j =	150	°C

V_{GE} from 7 V to 17 V in steps of 1 V

figure 16. **IGBT**

Typical transfer characteristics

$I_C = f(V_{GE})$



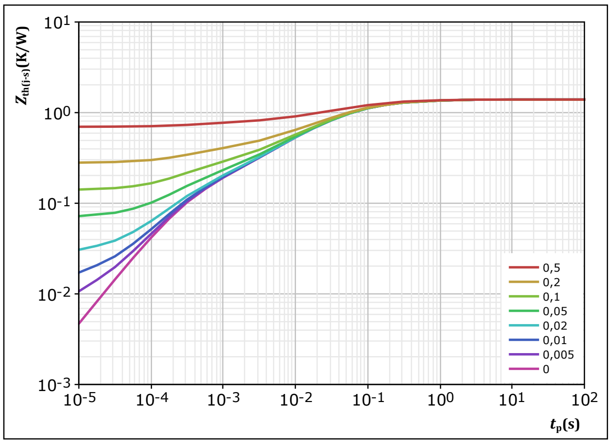
t_p =	250	μs
V_{CE} =	10	V

T_j: 25 °C, 125 °C, 150 °C

figure 17. **IGBT**

Transient thermal impedance as a function of pulse width

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



D =	t_p / T	
$R_{th(j-s)}$ =	1,394	K/W

IGBT thermal model values

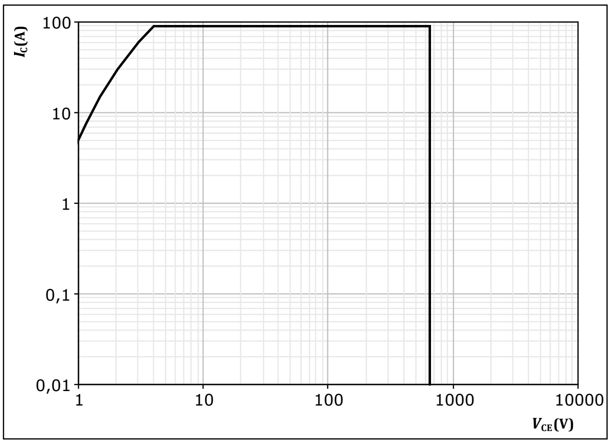
R (K/W)	τ (s)
8,66E-02	1,03E+00
1,95E-01	1,93E-01
5,59E-01	5,17E-02
3,47E-01	9,99E-03
9,37E-02	1,86E-03
1,12E-01	2,95E-04

Positive Neutral Point Switch Characteristics

figure 18. **IGBT**

Safe operating area

I_C = f(V_{CE})



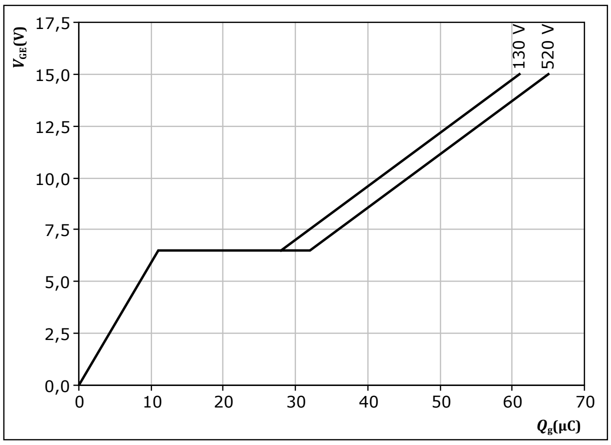
D = single pulse

T_s =	80	°C
V_{GE} =	15	V
T_j =	T_{jmax}	

figure 19. **IGBT**

Gate voltage vs gate charge

V_{GE} = f(Q_g)



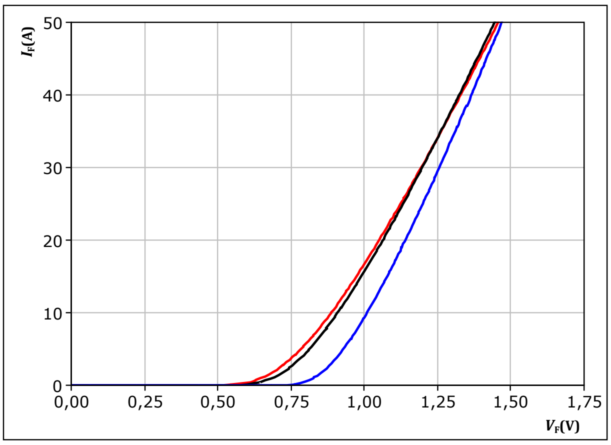
I_C =	30	A
T_j =	25	°C

Negative Neutral Point Diode Characteristics

figure 20.	Rectifier

Typical forward characteristics

I_F = f(V_F)



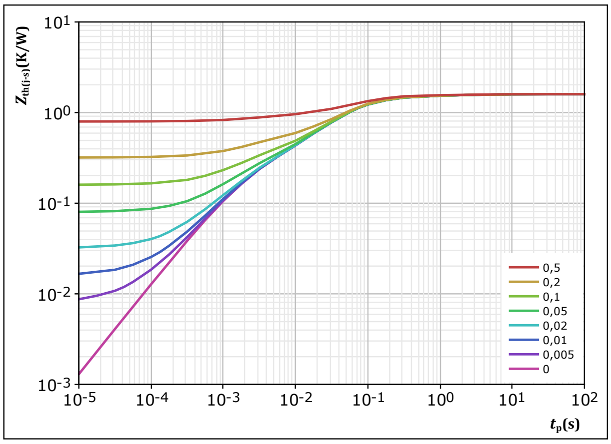
t_p = 250 µs

T_j: 25 °C, 125 °C, 150 °C

figure 21.	Rectifier

Transient thermal impedance as a function of pulse width

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



D = t_p / T

$R_{th(j-s)}$ = 1,595 K/W

Rectifier thermal model values

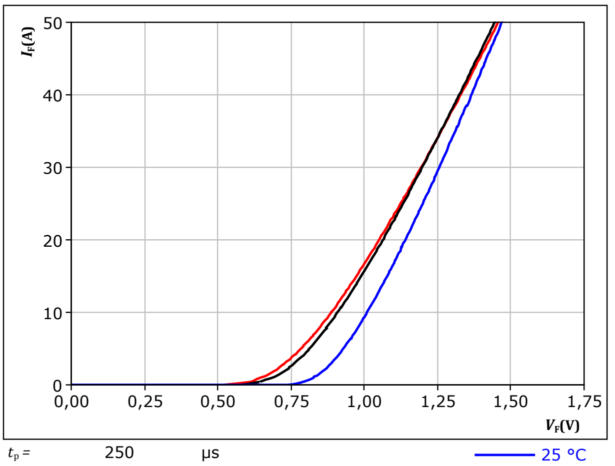
R (K/W)	τ (s)
5,74E-02	3,35E+00
1,49E-01	4,41E-01
9,92E-01	6,12E-02
2,25E-01	1,48E-02
1,72E-01	1,74E-03

Positive Neutral Point Diode Characteristics

figure 22. **Rectifier**

Typical forward characteristics

$I_F = f(V_F)$



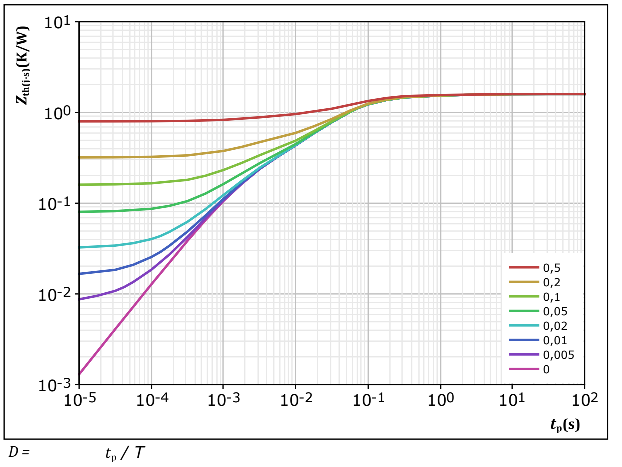
t_p = 250 µs

T_j: 25 °C, 125 °C, 150 °C

figure 23. **Rectifier**

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$

$R_{th(j\text{-}s)}$ = 1,595 K/W

Rectifier thermal model values

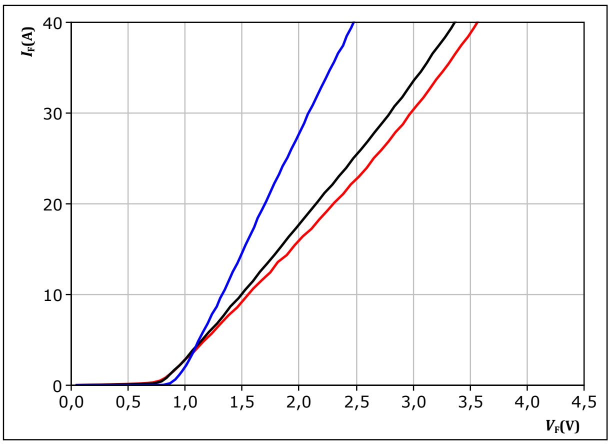
R (K/W)	τ (s)
5,74E-02	3,35E+00
1,49E-01	4,41E-01
9,92E-01	6,12E-02
2,25E-01	1,48E-02
1,72E-01	1,74E-03

Positive Boost Diode Characteristics

figure 24. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



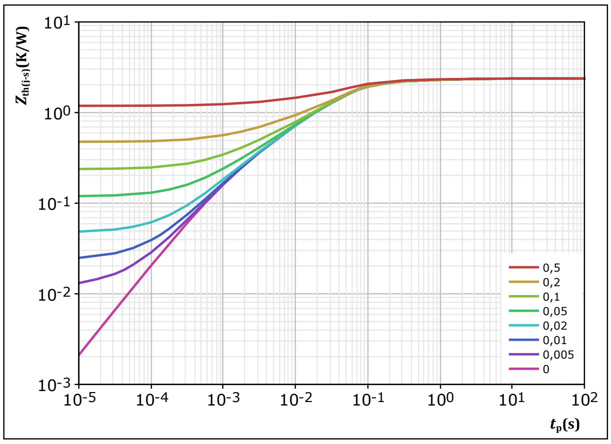
t_p = 250 µs

T_j: 25 °C, 125 °C, 150 °C

figure 25. **FWD**

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$

$R_{th(j-s)}$ = 2,375 K/W

FWD thermal model values

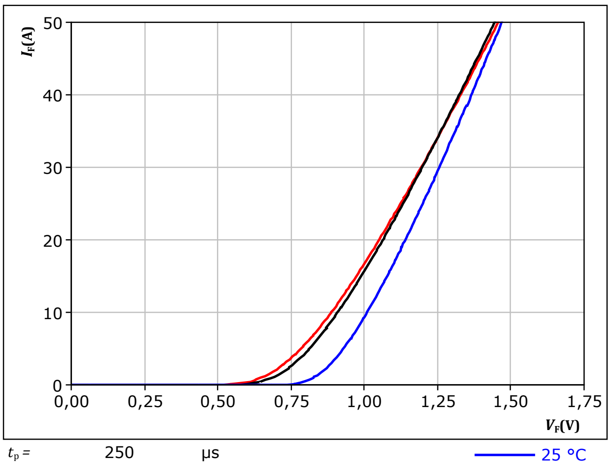
R (K/W)	τ (s)
1,22E-01	1,87E+00
3,54E-01	1,79E-01
1,50E+00	4,00E-02
3,30E-01	4,36E-03
7,38E-02	7,61E-04

Positive Boost Blocking Diode Characteristics

figure 26. **Rectifier**

Typical forward characteristics

$I_F = f(V_F)$



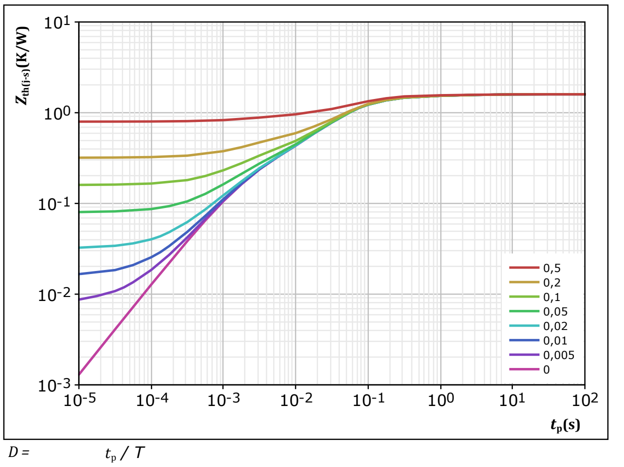
t_p = 250 µs

T_j: 25 °C, 125 °C, 150 °C

figure 27. **Rectifier**

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$

$R_{th(j-s)}$ = 1,595 K/W

Rectifier thermal model values

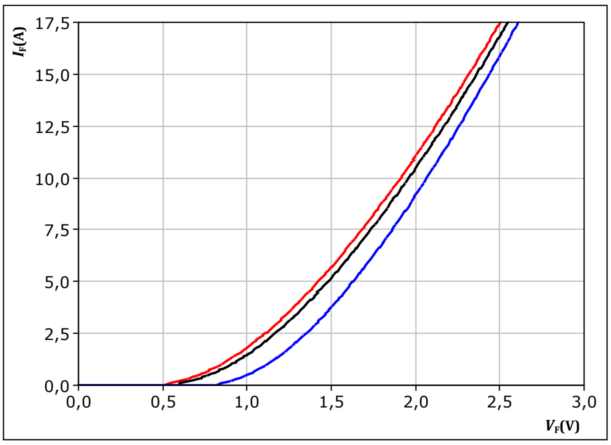
R (K/W)	τ (s)
5,74E-02	3,35E+00
1,49E-01	4,41E-01
9,92E-01	6,12E-02
2,25E-01	1,48E-02
1,72E-01	1,74E-03

Positive Boost Diode Protection Diode Characteristics

figure 28. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



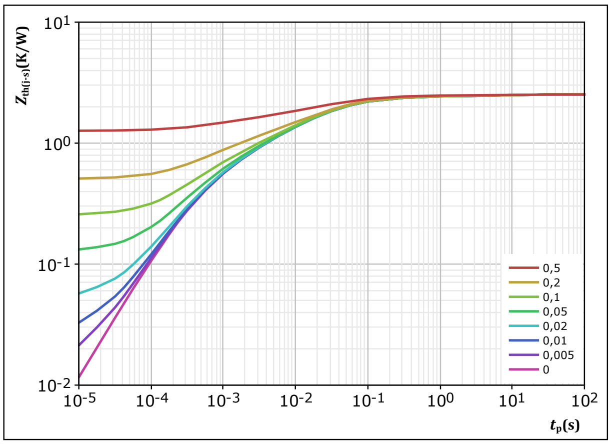
t_p = 250 µs

T_j: 25 °C, 125 °C, 150 °C

figure 29. **FWD**

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$

$R_{th(j-s)}$ = 2,527 K/W

FWD thermal model values

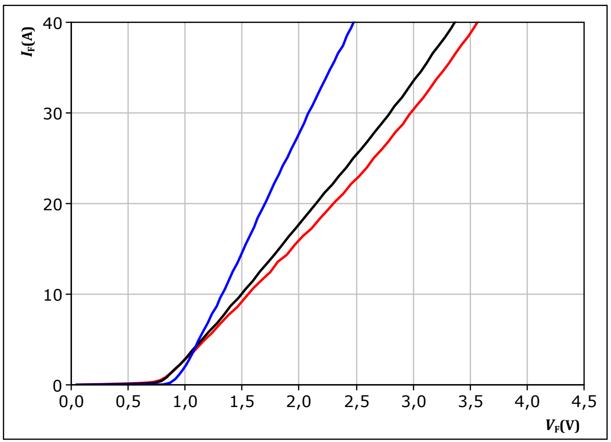
R (K/W)	τ (s)
9,24E-02	9,29E+00
1,75E-01	3,21E-01
7,31E-01	4,97E-02
7,14E-01	1,16E-02
4,89E-01	2,11E-03
3,27E-01	3,78E-04

Negative Boost Diode Characteristics

figure 30. **FWD**

Typical forward characteristics

I_F = f(V_F)

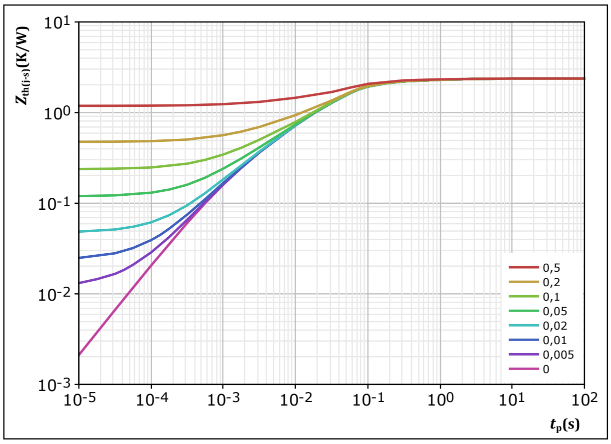


t_p =	250	µs		25 °C
			T_j:	125 °C
				150 °C

figure 31. **FWD**

Transient thermal impedance as a function of pulse width

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



D =	t_p / T	
$R_{th(j-s)}$ =	2,375	K/W

FWD thermal model values

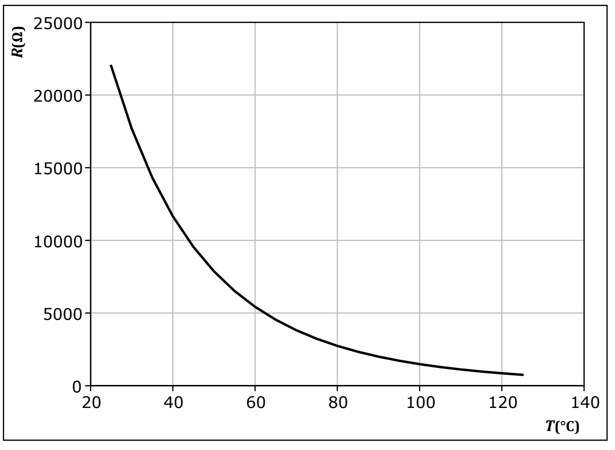
R (K/W)	τ (s)
1,22E-01	1,87E+00
3,54E-01	1,79E-01
1,50E+00	4,00E-02
3,30E-01	4,36E-03
7,38E-02	7,61E-04

Thermistor Characteristics

figure 32.	Thermistor

Typical NTC characteristic as function of temperature

R_T = f(T)

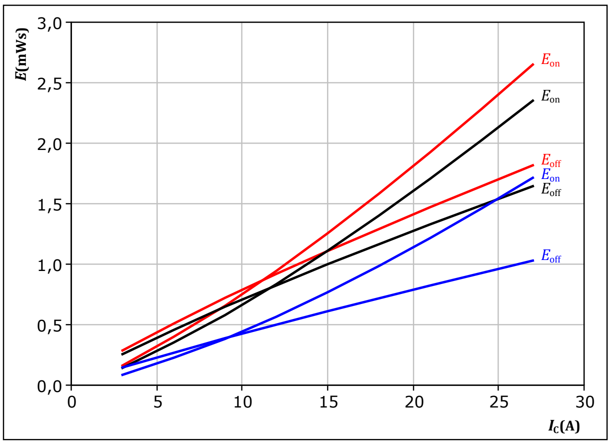


Inverter Switching Characteristics

figure 33.	IGBT

Typical switching energy losses as a function of collector current

$E = f(I_C)$



With an inductive load at

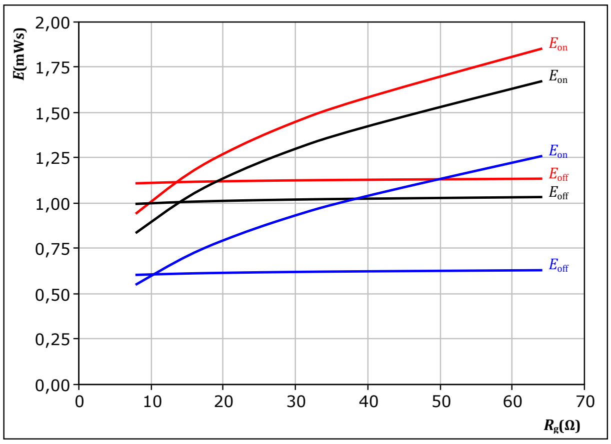
V_{CE} =	600	V	
V_{GE} =	±15	V	
R_{gon} =	16	Ω	
R_{goff} =	16	Ω	

T_j: 25 °C, 125 °C, 150 °C

figure 34.	IGBT

Typical switching energy losses as a function of gate resistor

$E = f(R_g)$



With an inductive load at

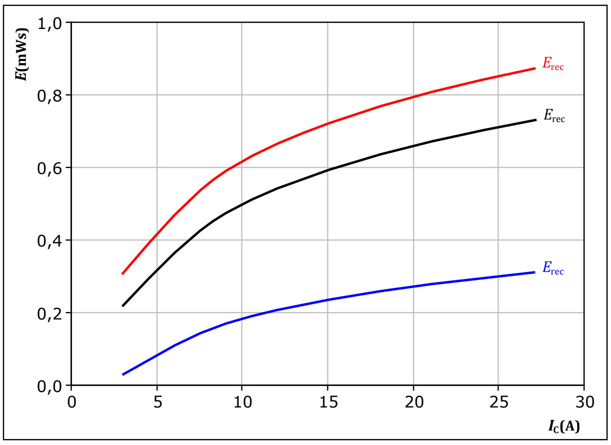
V_{CE} =	600	V	
V_{GE} =	±15	V	
I_C =	15	A	

T_j: 25 °C, 125 °C, 150 °C

figure 35.	FWD

Typical reverse recovered energy loss as a function of collector current

$E_{rec} = f(I_C)$



With an inductive load at

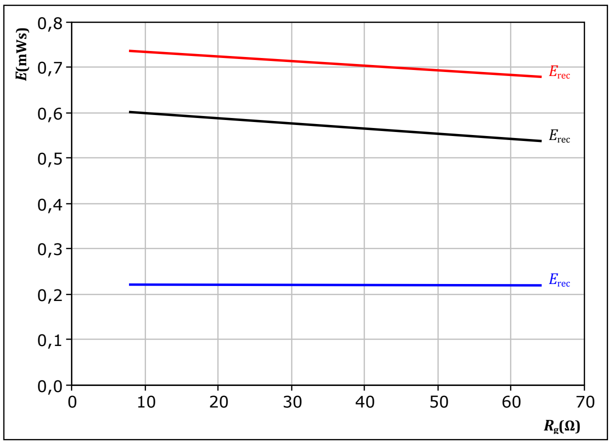
V_{CE} =	600	V	
V_{GE} =	±15	V	
R_{gon} =	16	Ω	

T_j: 25 °C, 125 °C, 150 °C

figure 36.	FWD

Typical reverse recovered energy loss as a function of gate resistor

$E_{rec} = f(R_g)$



With an inductive load at

V_{CE} =	600	V	
V_{GE} =	±15	V	
I_C =	15	A	

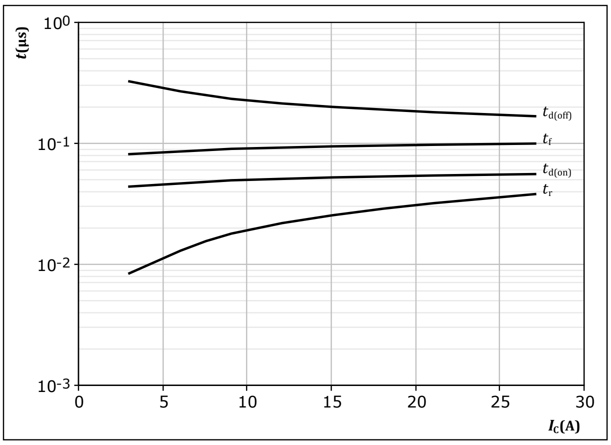
T_j: 25 °C, 125 °C, 150 °C

Inverter Switching Characteristics

figure 37. **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



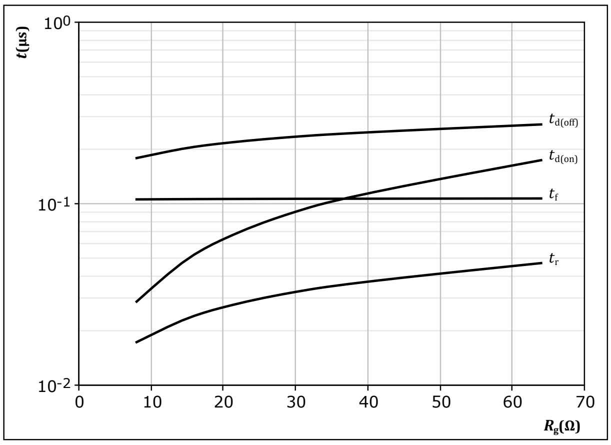
With an inductive load at

T_j =	150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	16	Ω
R_{goff} =	16	Ω

figure 38. **IGBT**

Typical switching times as a function of gate resistor

$t = f(R_g)$



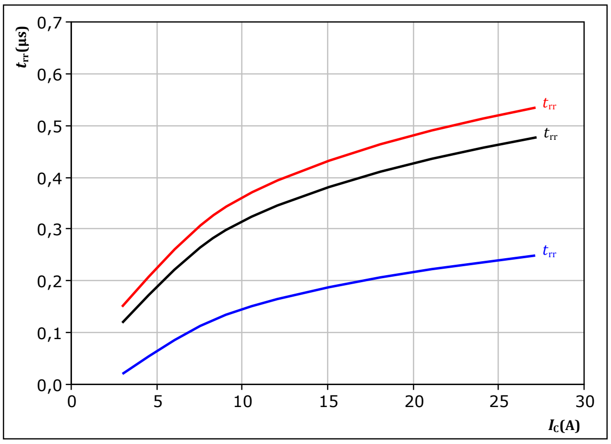
With an inductive load at

T_j =	150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	15	A

figure 39. **FWD**

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$



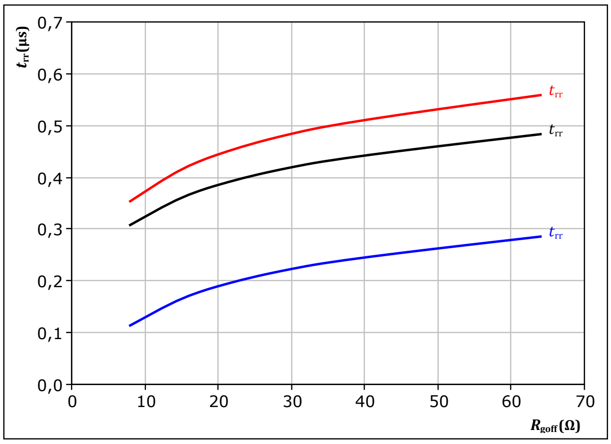
With an inductive load at

V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	16	Ω

figure 40. **FWD**

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

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



With an inductive load at

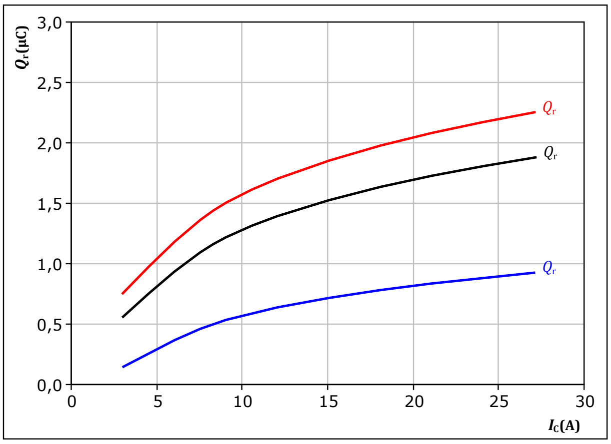
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	15	A

Inverter Switching Characteristics

figure 41. FWD

Typical recovered charge as a function of collector current

Q_r = f(I_C)



With an inductive load at

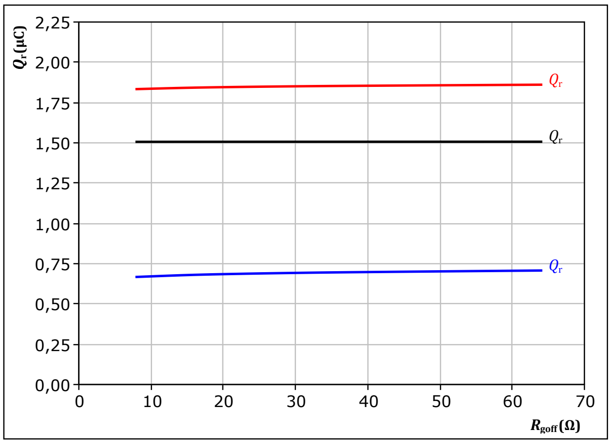
V_{CE} =	600	V	
V_{GE} =	±15	V	
R_{gon} =	16	Ω	

T_j: 25 °C / 125 °C / 150 °C

figure 42. FWD

Typical recovered charge as a function of turn off gate resistor

Q_r = f(R_{goff})



With an inductive load at

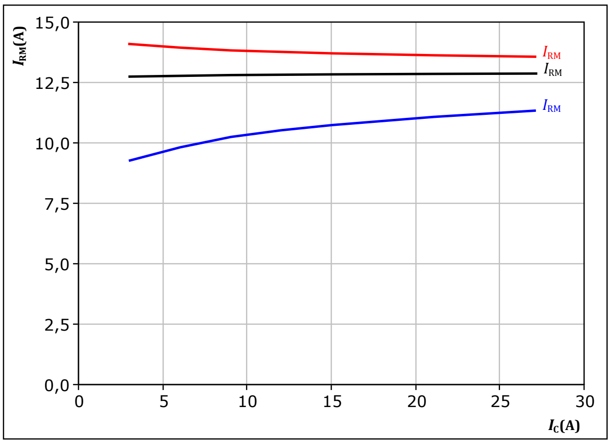
V_{CE} =	600	V	
V_{GE} =	±15	V	
I_C =	15	A	

T_j: 25 °C / 125 °C / 150 °C

figure 43. FWD

Typical peak reverse recovery current as a function of collector current

I_{RM} = f(I_C)



With an inductive load at

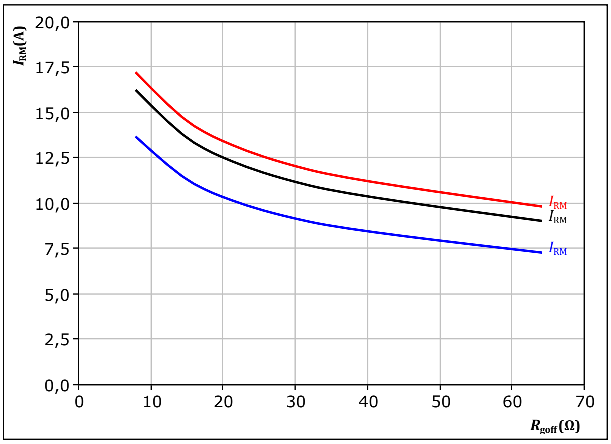
V_{CE} =	600	V	
V_{GE} =	±15	V	
R_{gon} =	16	Ω	

T_j: 25 °C / 125 °C / 150 °C

figure 44. FWD

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

I_{RM} = f(R_{goff})



With an inductive load at

V_{CE} =	600	V	
V_{GE} =	±15	V	
I_C =	15	A	

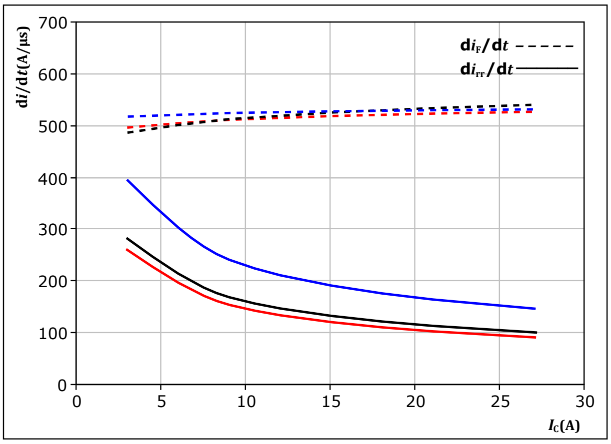
T_j: 25 °C / 125 °C / 150 °C

Inverter Switching Characteristics

figure 45. **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)



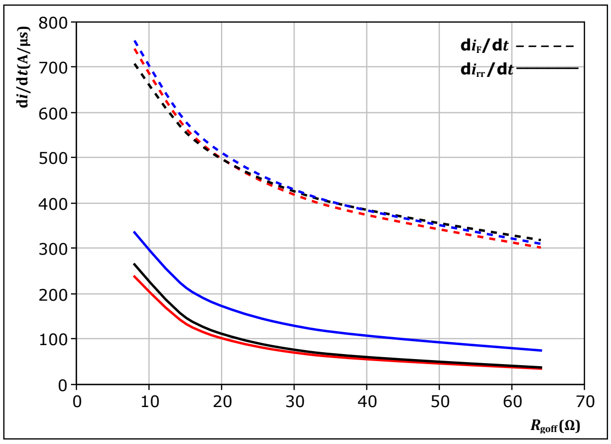
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C
V_{GE} =	±15	V		125 °C
R_{gon} =	16	Ω		150 °C

figure 46. **FWD**

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

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



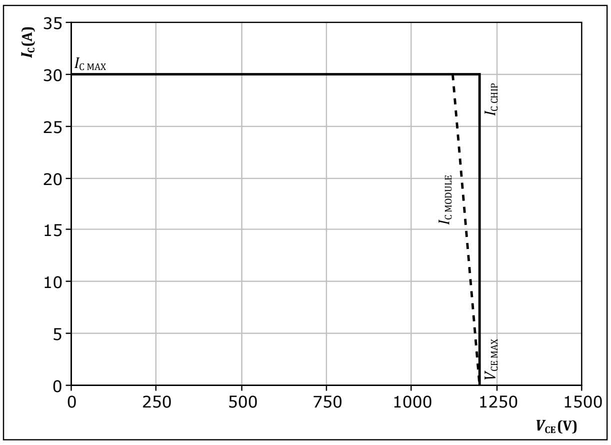
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C
V_{GE} =	±15	V		125 °C
I_C =	15	A		150 °C

figure 47. **IGBT**

Reverse bias safe operating area

I_C = f(V_{CE})



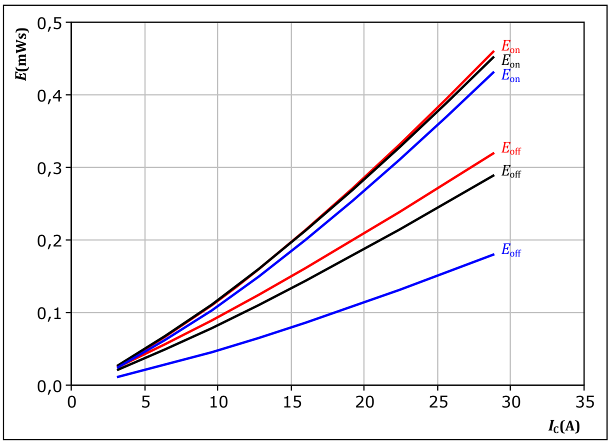
At	T_j =	150	°C
	R_{gon} =	16	Ω
	R_{goff} =	16	Ω

Negative Neutral Point Switching Characteristics

figure 48. **IGBT**

Typical switching energy losses as a function of collector current

$E = f(I_C)$



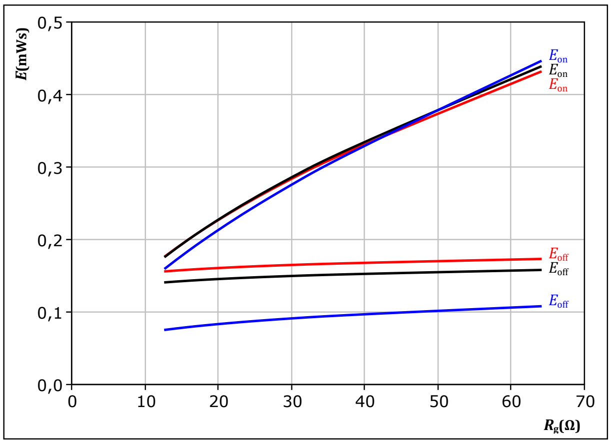
With an inductive load at

V_{CE} =	350	V	T_j:	25 °C
V_{GE} =	±15	V		125 °C
R_{gon} =	16	Ω		150 °C
R_{goff} =	16	Ω		

figure 49. **IGBT**

Typical switching energy losses as a function of gate resistor

$E = f(R_g)$



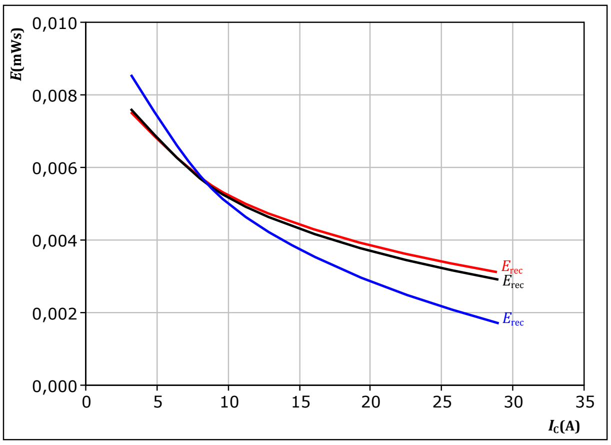
With an inductive load at

V_{CE} =	350	V	T_j:	25 °C
V_{GE} =	±15	V		125 °C
I_C =	16	A		150 °C

figure 50. **FWD**

Typical reverse recovered energy loss as a function of collector current

$E_{rec} = f(I_C)$



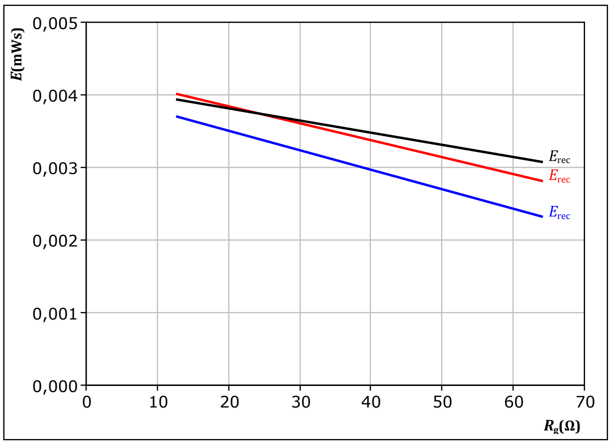
With an inductive load at

V_{CE} =	350	V	T_j:	25 °C
V_{GE} =	±15	V		125 °C
R_{gon} =	16	Ω		150 °C

figure 51. **FWD**

Typical reverse recovered energy loss as a function of gate resistor

$E_{rec} = f(R_g)$



With an inductive load at

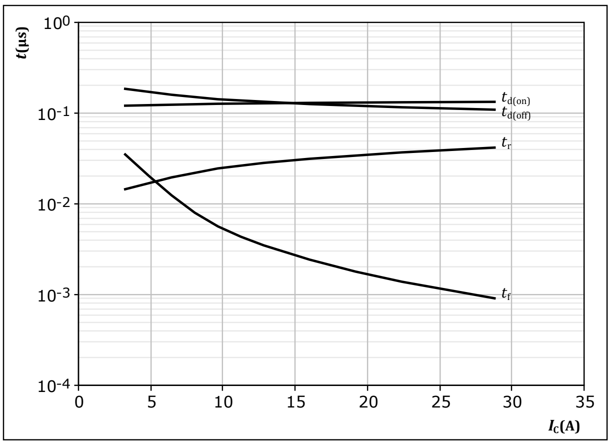
V_{CE} =	350	V	T_j:	25 °C
V_{GE} =	±15	V		125 °C
I_C =	16	A		150 °C

Negative Neutral Point Switching Characteristics

figure 52. **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



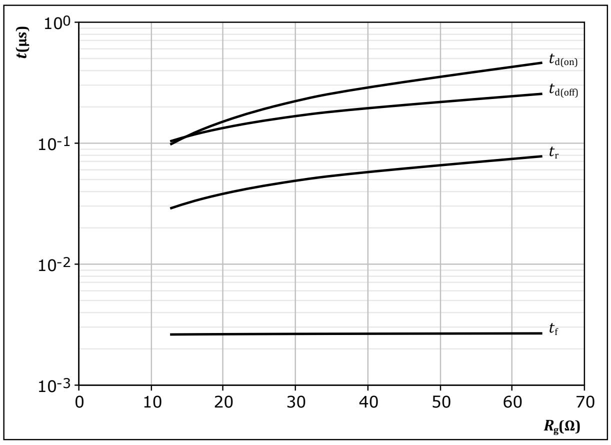
With an inductive load at

T_j =	150	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	16	Ω
R_{goff} =	16	Ω

figure 53. **IGBT**

Typical switching times as a function of gate resistor

$t = f(R_g)$



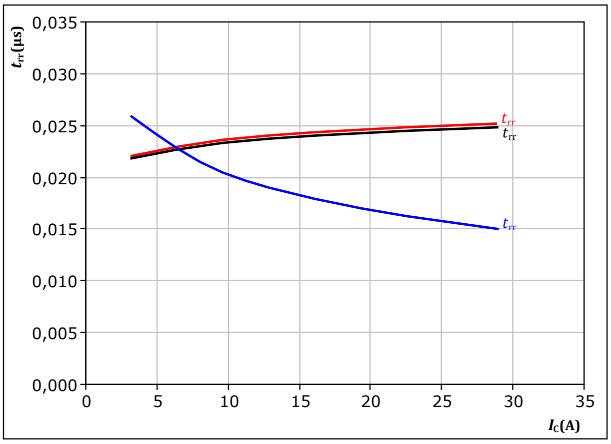
With an inductive load at

T_j =	150	°C
V_{CE} =	350	V
V_{GE} =	±15	V
I_C =	16	A

figure 54. **FWD**

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$



With an inductive load at

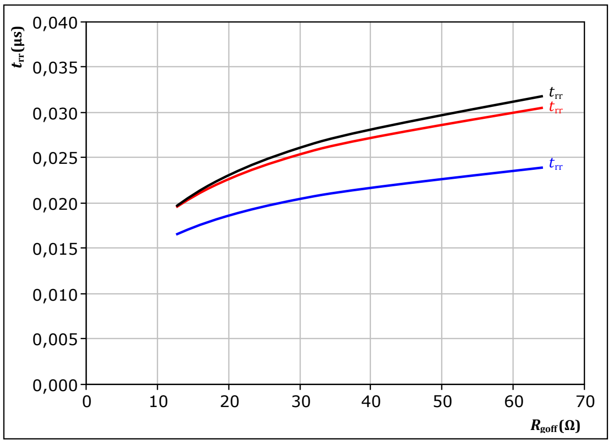
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	16	Ω

T_j: 25 °C, 125 °C, 150 °C

figure 55. **FWD**

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

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



With an inductive load at

V_{CE} =	350	V
V_{GE} =	±15	V
I_C =	16	A

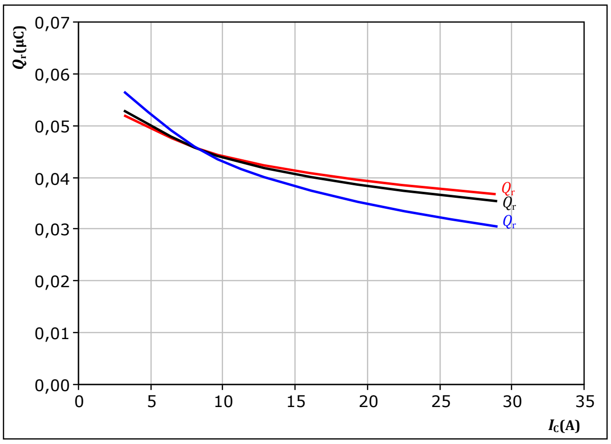
T_j: 25 °C, 125 °C, 150 °C

Negative Neutral Point Switching Characteristics

figure 56. **FWD**

Typical recovered charge as a function of collector current

Q_r = f(I_C)



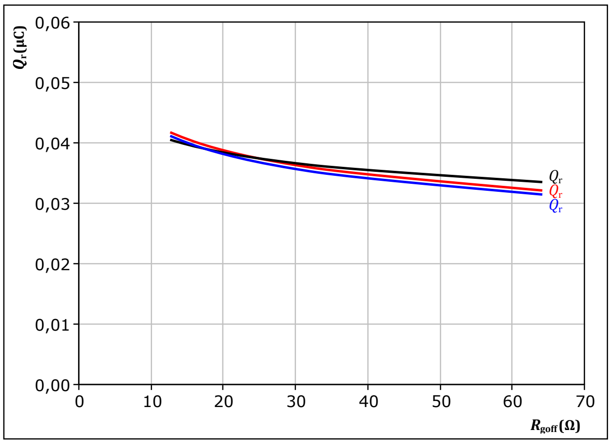
With an inductive load at

V_{CE} =	350	V	T_j:	25 °C / 125 °C / 150 °C
V_{GE} =	±15	V		
R_{gon} =	16	Ω		

figure 57. **FWD**

Typical recovered charge as a function of turn off gate resistor

Q_r = f(R_{goff})



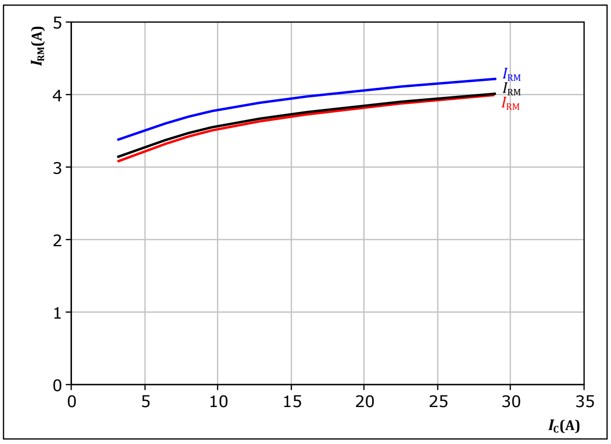
With an inductive load at

V_{CE} =	350	V	T_j:	25 °C / 125 °C / 150 °C
V_{GE} =	±15	V		
I_C =	16	A		

figure 58. **FWD**

Typical peak reverse recovery current as a function of collector current

I_{RM} = f(I_C)



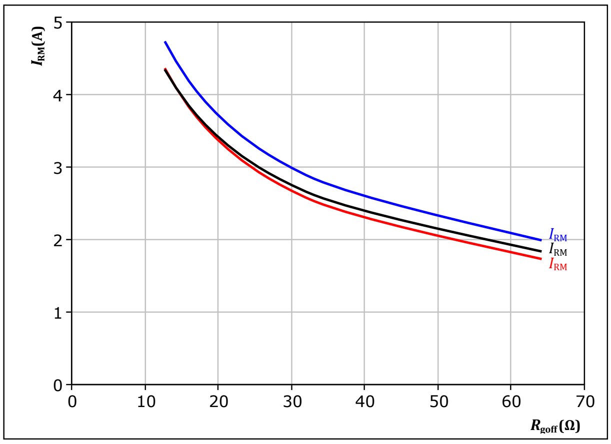
With an inductive load at

V_{CE} =	350	V	T_j:	25 °C / 125 °C / 150 °C
V_{GE} =	±15	V		
R_{gon} =	16	Ω		

figure 59. **FWD**

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

I_{RM} = f(R_{goff})



With an inductive load at

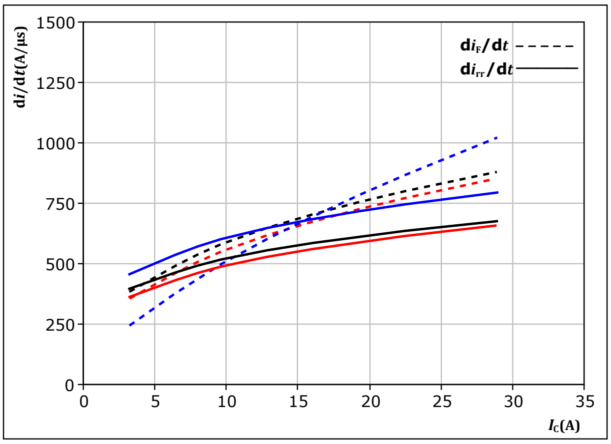
V_{CE} =	350	V	T_j:	25 °C / 125 °C / 150 °C
V_{GE} =	±15	V		
I_C =	16	A		

Negative Neutral Point Switching Characteristics

figure 60. **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)



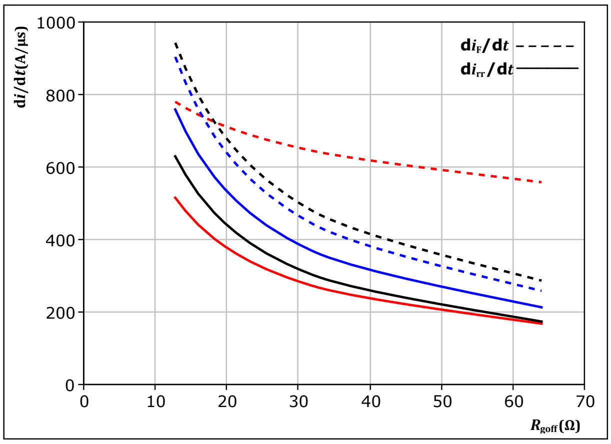
With an inductive load at

V_{CE} =	350	V	T_j:	25 °C
V_{GE} =	±15	V		125 °C
R_{gon} =	16	Ω		150 °C

figure 61. **FWD**

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

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



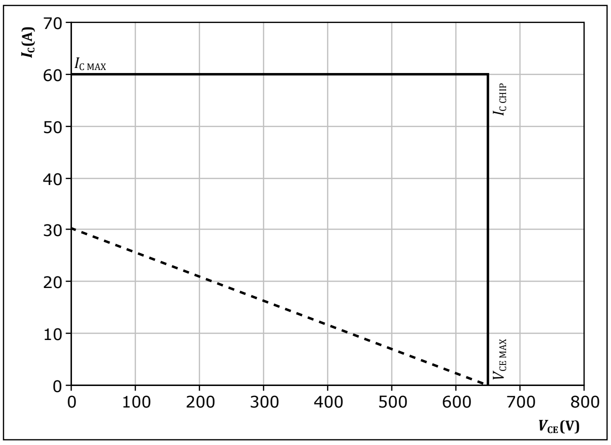
With an inductive load at

V_{CE} =	350	V	T_j:	25 °C
V_{GE} =	±15	V		125 °C
I_C =	16	A		150 °C

figure 62. **IGBT**

Reverse bias safe operating area

I_C = f(V_{CE})



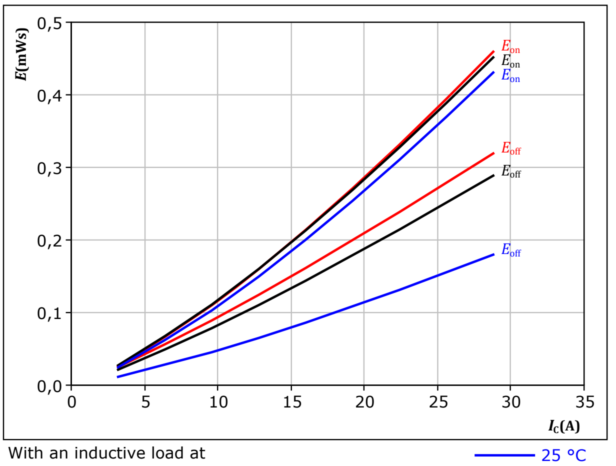
At	T_j =	150	°C
	R_{gon} =	16	Ω
	R_{goff} =	16	Ω

Positive Neutral Point Switching Characteristics

figure 63. **IGBT**

Typical switching energy losses as a function of collector current

$E = f(I_C)$



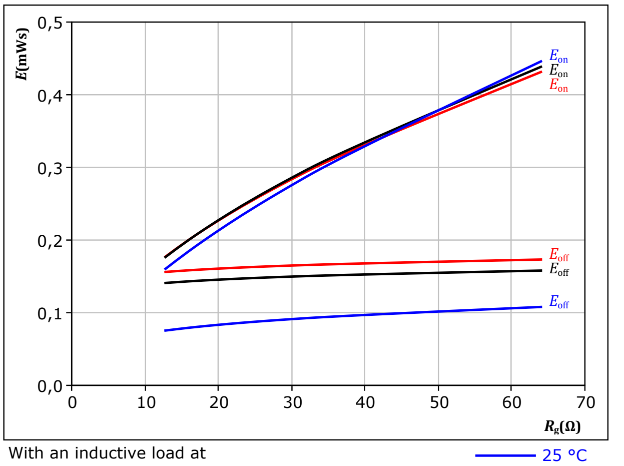
With an inductive load at

V_{CE} =	350	V	T_j:	25 °C
V_{GE} =	±15	V		125 °C
R_{gon} =	16	Ω		150 °C
R_{goff} =	16	Ω		

figure 64. **IGBT**

Typical switching energy losses as a function of gate resistor

$E = f(R_g)$



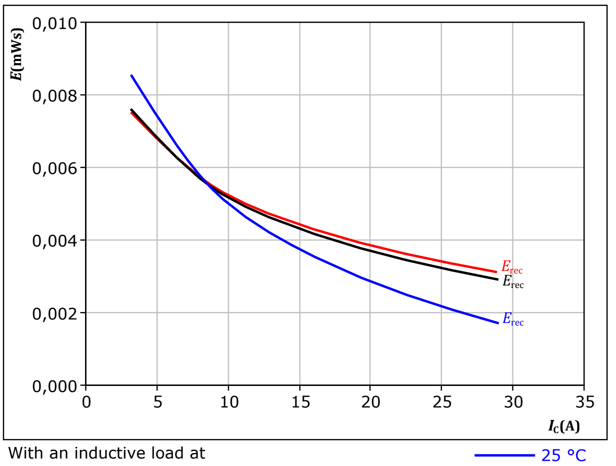
With an inductive load at

V_{CE} =	350	V	T_j:	25 °C
V_{GE} =	±15	V		125 °C
I_C =	16	A		150 °C

figure 65. **FWD**

Typical reverse recovered energy loss as a function of collector current

$E_{rec} = f(I_C)$



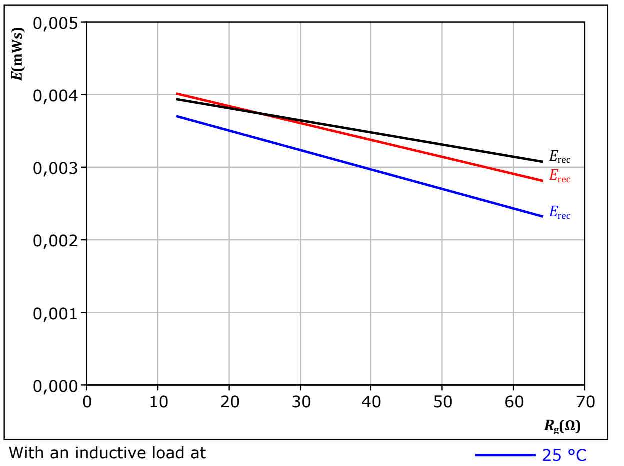
With an inductive load at

V_{CE} =	350	V	T_j:	25 °C
V_{GE} =	±15	V		125 °C
R_{gon} =	16	Ω		150 °C

figure 66. **FWD**

Typical reverse recovered energy loss as a function of gate resistor

$E_{rec} = f(R_g)$



With an inductive load at

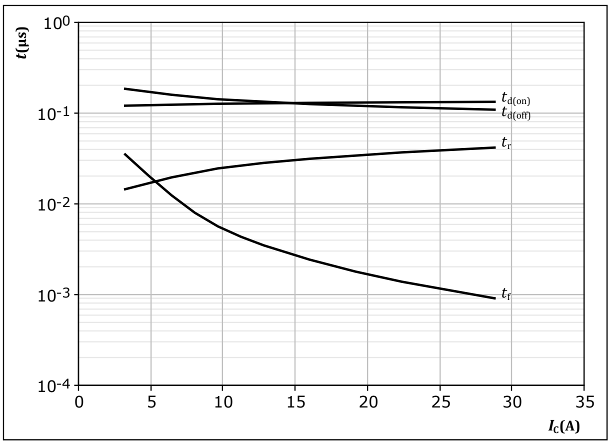
V_{CE} =	350	V	T_j:	25 °C
V_{GE} =	±15	V		125 °C
I_C =	16	A		150 °C

Positive Neutral Point Switching Characteristics

figure 67. **IGBT**

Typical switching times as a function of collector current

t = f(I_C)



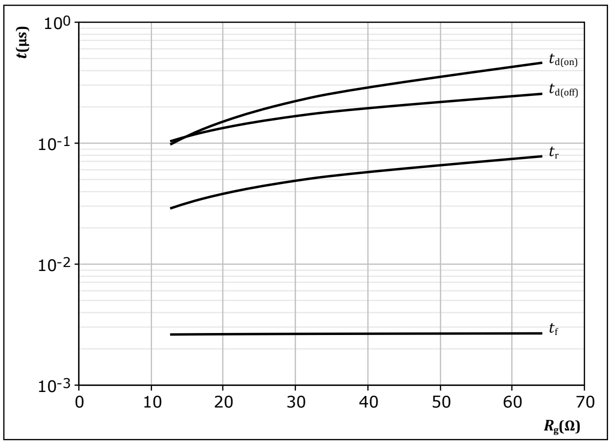
With an inductive load at

T_j =	150	°C
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	16	Ω
R_{goff} =	16	Ω

figure 68. **IGBT**

Typical switching times as a function of gate resistor

t = f(R_g)



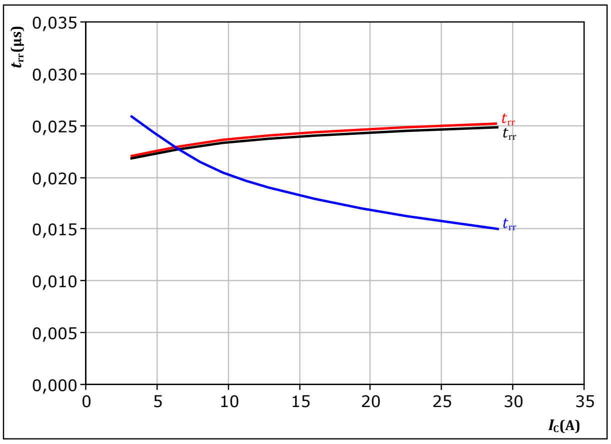
With an inductive load at

T_j =	150	°C
V_{CE} =	350	V
V_{GE} =	±15	V
I_C =	16	A

figure 69. **FWD**

Typical reverse recovery time as a function of collector current

t_{rr} = f(I_C)



With an inductive load at

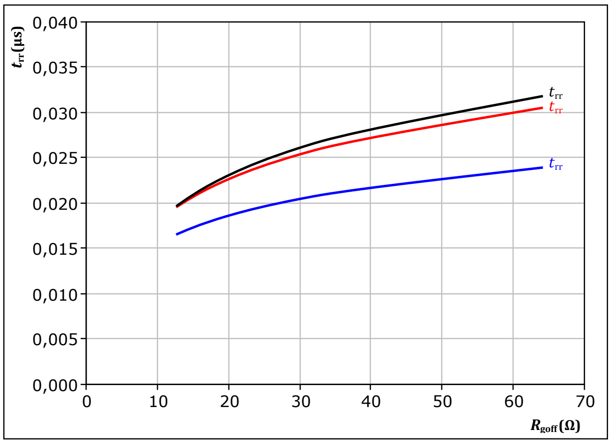
V_{CE} =	350	V
V_{GE} =	±15	V
R_{gon} =	16	Ω

T_j: 25 °C, 125 °C, 150 °C

figure 70. **FWD**

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

t_{rr} = f(R_{goff})



With an inductive load at

V_{CE} =	350	V
V_{GE} =	±15	V
I_C =	16	A

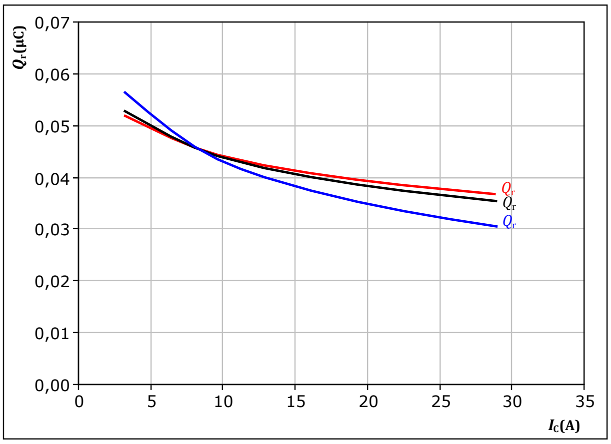
T_j: 25 °C, 125 °C, 150 °C

Positive Neutral Point Switching Characteristics

figure 71. FWD

Typical recovered charge as a function of collector current

Q_r = f(I_C)



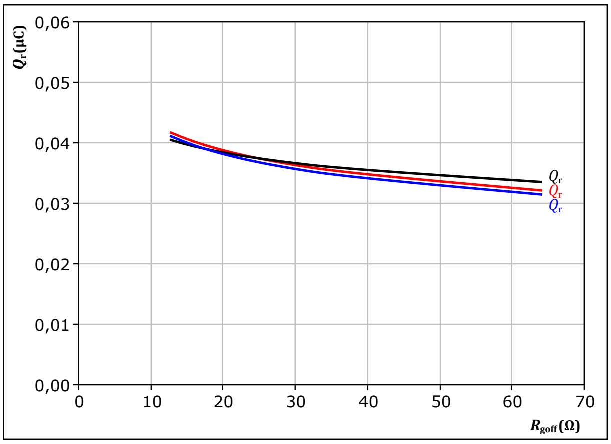
With an inductive load at

V_{CE} =	350	V	T_j:	25 °C / 125 °C / 150 °C
V_{GE} =	±15	V		
R_{gon} =	16	Ω		

figure 72. FWD

Typical recovered charge as a function of turn off gate resistor

Q_r = f(R_{goff})



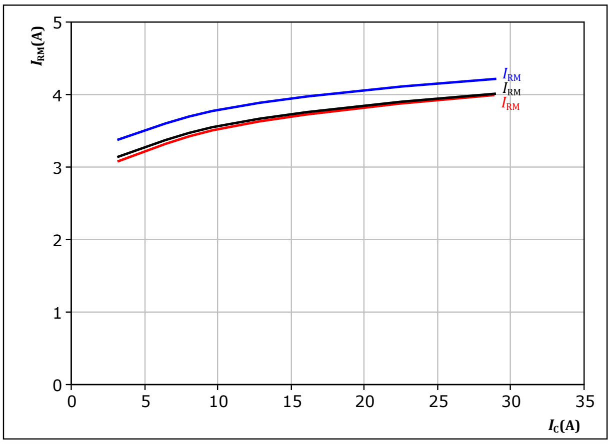
With an inductive load at

V_{CE} =	350	V	T_j:	25 °C / 125 °C / 150 °C
V_{GE} =	±15	V		
I_C =	16	A		

figure 73. FWD

Typical peak reverse recovery current as a function of collector current

I_{RM} = f(I_C)



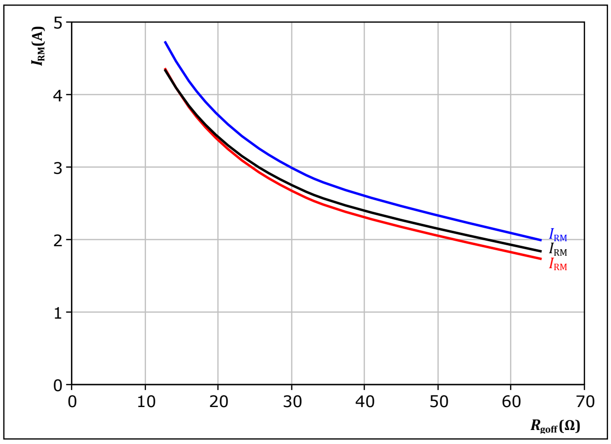
With an inductive load at

V_{CE} =	350	V	T_j:	25 °C / 125 °C / 150 °C
V_{GE} =	±15	V		
R_{gon} =	16	Ω		

figure 74. FWD

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

I_{RM} = f(R_{goff})



With an inductive load at

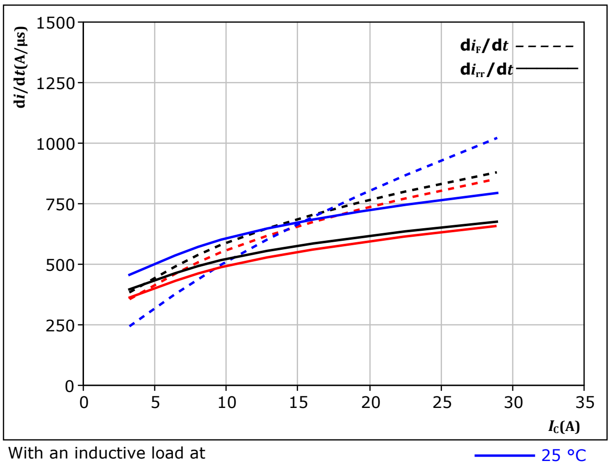
V_{CE} =	350	V	T_j:	25 °C / 125 °C / 150 °C
V_{GE} =	±15	V		
I_C =	16	A		

Positive Neutral Point Switching Characteristics

figure 75. **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)



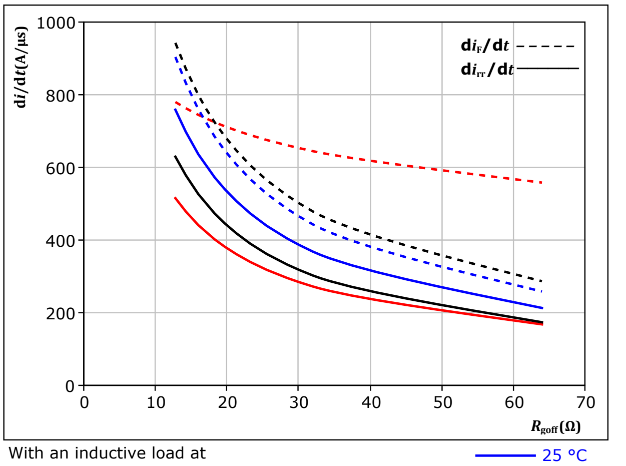
With an inductive load at

V_{CE} =	350	V	T_j:	25 °C
V_{GE} =	±15	V		125 °C
R_{gon} =	16	Ω		150 °C

figure 76. **FWD**

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

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



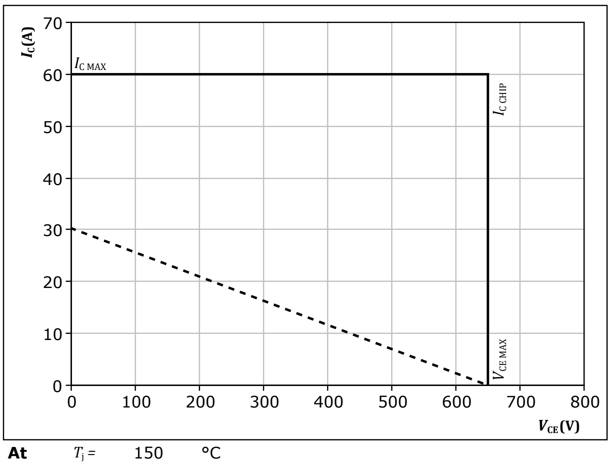
With an inductive load at

V_{CE} =	350	V	T_j:	25 °C
V_{GE} =	±15	V		125 °C
I_C =	16	A		150 °C

figure 77. **IGBT**

Reverse bias safe operating area

I_C = f(V_{CE})



At	T_j =	150	°C
	R_{gon} =	16	Ω
	R_{goff} =	16	Ω

Switching Definitions

figure 78. **IGBT**

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

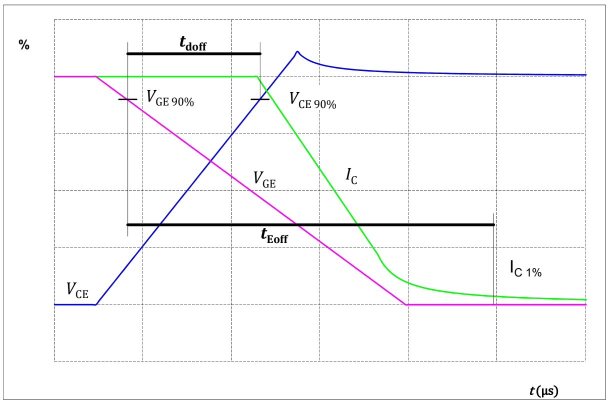


figure 79. **IGBT**

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

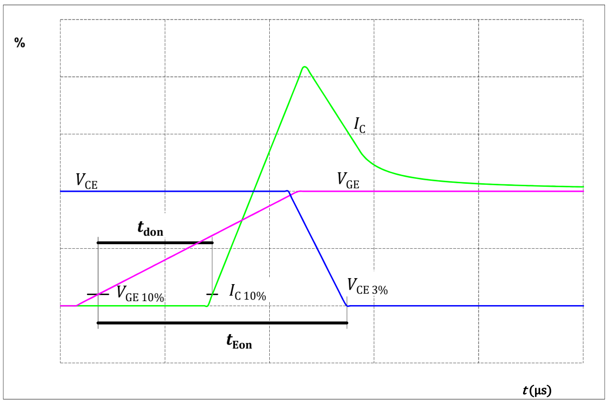


figure 80. **IGBT**

Turn-off Switching Waveforms & definition of t_f

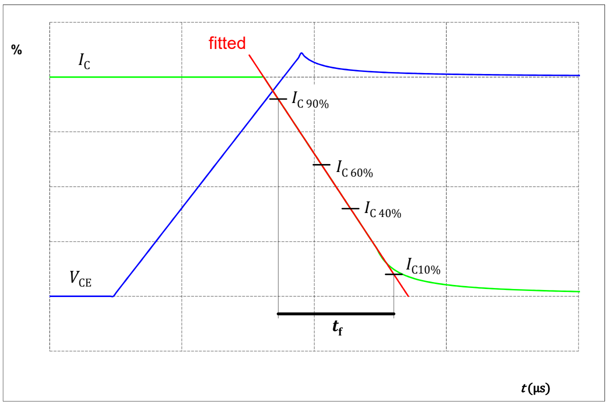
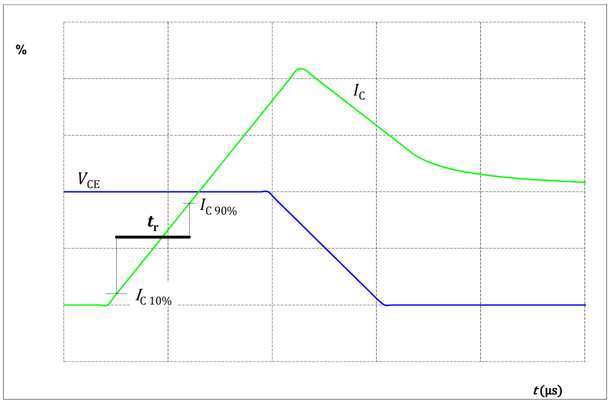


figure 81. **IGBT**

Turn-on Switching Waveforms & definition of t_r



Switching Definitions

figure 82. **FWD**

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

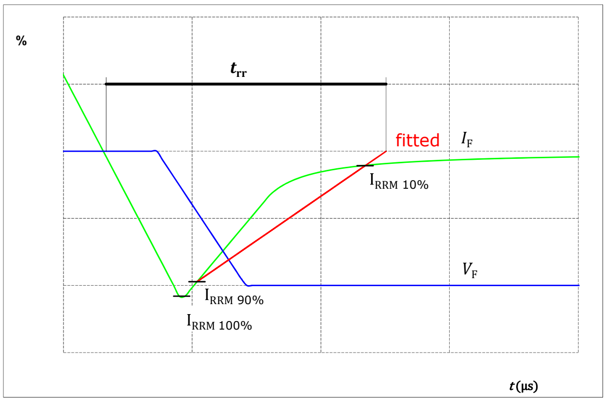
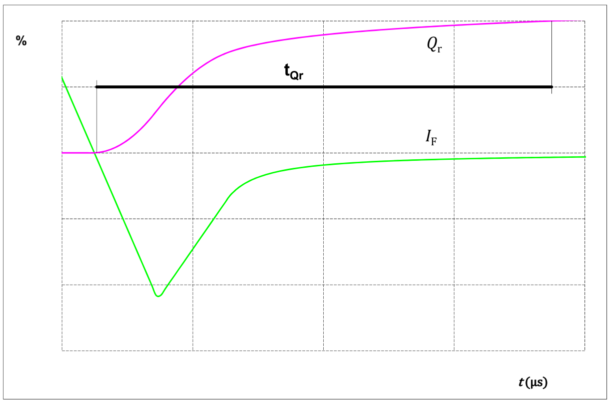


figure 83. **FWD**

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



Ordering Code

Version	Ordering Code
Without thermal paste	10-PG12APA015SH01-PB18E08T
With thermal paste (5,2 W/mK, PTM6000HV)	10-PG12APA015SH01-PB18E08T-/7/
With thermal paste (3,4 W/mK, PSX-P7)	10-PG12APA015SH01-PB18E08T-/3/

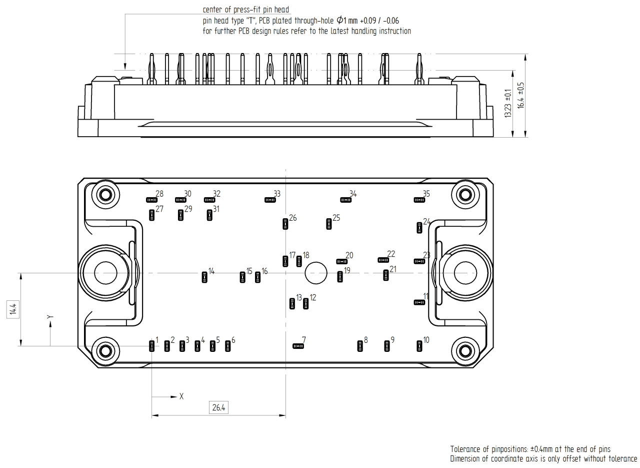
Marking

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

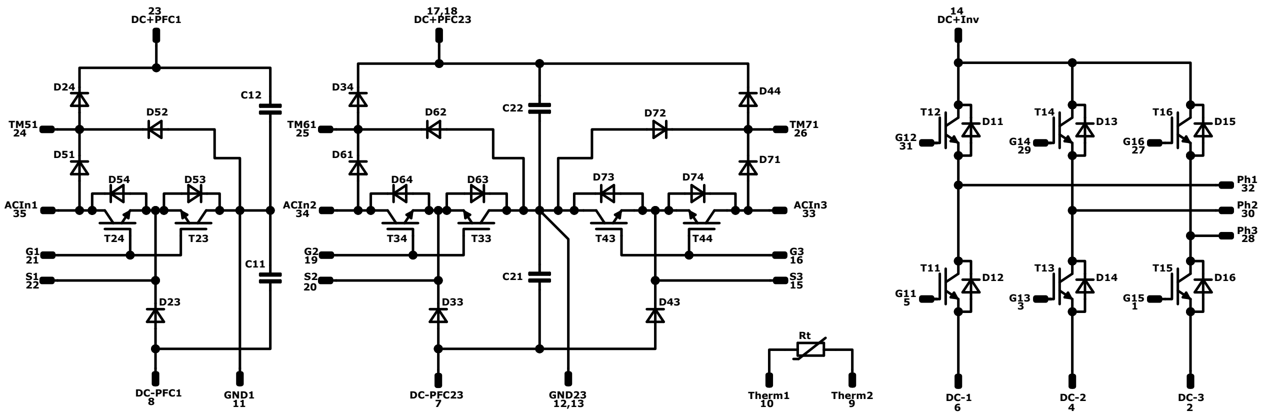
Outline

Pin	X	Y	Function
1	0	0	G15
2	3	0	DC-3
3	6	0	G13
4	9	0	DC-2
5	12	0	G11
6	15	0	DC-1
7	28,9	0	DC-PFC23
8	41,1	0	DC-PFC1
9	46,4	0	Therm2
10	52,8	0	Therm1
11	52,8	8,6	GND1
12	30,4	8,35	GND23
13	27,7	8,35	GND23
14	10,4	13,55	DC+Inv
15	17,9	13,55	S3
16	20,9	13,55	G3
17	26,35	16,7	DC+PFC23
18	29,05	16,7	DC+PFC23
19	37,15	13,65	G2
20	37,5	16,65	S2
21	46,2	13,95	G1
22	45,7	16,95	S1
23	52,8	16,7	DC+PFC1
24	52,8	23,3	TM51
25	34,95	24,05	TM61
26	26,35	24,05	TM71
27	0	25,8	G16
28	0	28,8	Ph3
29	5,7	25,8	G14
30	5,7	28,8	Ph2
31	11,4	25,8	G12
32	11,4	28,8	Ph1
33	23,35	28,8	ACin3
34	38,3	28,8	ACin2
35	52,8	28,8	ACin1

Pin table [mm]



Pinout



Identification

ID	Component	Voltage	Current	Function	Comment
T23, T33, T43	IGBT	650 V	30 A	Negative Neutral Point Switch	
T24, T34, T44	IGBT	650 V	30 A	Positive Neutral Point Switch	
D53, D63, D73	Rectifier	1600 V	18 A	Negative Neutral Point Diode	
D54, D64, D74	Rectifier	1600 V	18 A	Positive Neutral Point Diode	
T11, T12, T13, T14, T15, T16	IGBT	1200 V	15 A	Inverter Switch	
D11, D12, D13, D14, D15, D16	FWD	1200 V	15 A	Inverter Diode	
D24, D34, D44	FWD	650 V	16 A	Positive Boost Diode	
D51, D61, D71	Rectifier	1600 V	18 A	Positive Boost Blocking Diode	
D52, D62, D72	FWD	650 V	6 A	Positive Boost Diode Protection Diode	
D23, D33, D43	FWD	650 V	16 A	Negative Boost Diode	
C11, C12, C21, C22	Capacitor	630 V		Capacitor (PFC)	
Rt	Thermistor			Thermistor	

Packaging instruction				
Standard packaging quantity (SPQ) 100	>SPQ	Standard	<SPQ	Sample

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

Package data
Package data for *flow* 1 packages see vincotech.com website.

Vincotech thermistor reference
See Vincotech thermistor reference table at 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
10-PG12APA015SH01-PB18E08T-D1-14	4 Nov. 2021	Initial Release	