B0-SP12PPA040SH-PC88L41T
datasheet

***flow*PIM S3 + 3xPFC** | **1200 V / 40 A**

Topology features

- Current Synthesizing PFC + Booster + Inverter
- Integrated DC Link capacitors
- Kelvin Emitter for improved switching performance
- Temperature sensor
- Thin Al_2O_3 for easy thermal design

Component features

- Easy paralleling
- High speed switching
- Low switching losses

Housing features

- Base isolation: Al_2O_3
- CTI600 housing material
- Compact, baseplate-less housing
- VINcoPress Technology
- Thermo-mechanical push-and-pull force relief
- Press-fit pin
- Reliable cold welding connection

Target applications

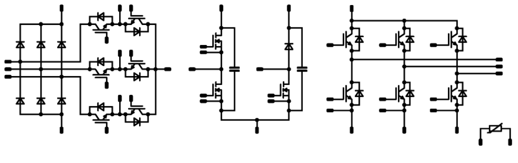
- Embedded Drives
- Heat Pumps
- HVAC
- Industrial Drives

Types

- B0-SP12PPA040SH-PC88L41T

flow S3 12 mm housing

Schematic



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	50	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}		120	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	137	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
Inverter Diode					
Peak repetitive reverse voltage	V_{RRM}			1200	V
Forward current (DC current)	I_F	$T_j = T_{jmax}$	T_s = 80 °C	30	A
Surge (non-repetitive) forward current	I_{FSM}	Single Half Sine Wave, t_p = 10 ms	T_j = 150 °C	170	A
Surge current capability	I^2t			145	A^2s
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	73	W
Maximum junction temperature	T_{jmax}			175	°C
Boost Switch					
Drain-source voltage	V_{DSS}			1200	V
Drain current (DC current)	I_D	$T_j = T_{jmax}$	T_s = 80 °C	42	A
Peak drain current	I_{DM}	t_p limited by T_{jmax}		120	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	87	W
Gate-source voltage	V_{GSS}			-4 / 15	V
		dynamic		-8 / 19	
Maximum Junction Temperature	T_{jmax}			175	°C

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Conditions		Value	Unit
Boost Diode					
Peak repetitive reverse voltage	V_{RRM}			1200	V
Forward current (DC current)	I_F	$T_j = T_{jmax}$	T_s = 80 °C	41	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}		136	A
Surge (non-repetitive) forward current	I_{FSM}	Single Half Sine Wave, t_p = 10 ms	T_j = 25 °C	200	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	106	W
Maximum junction temperature	T_{jmax}			175	°C
Half-Bridge Switch					
Drain-source voltage	V_{DSS}			1200	V
Drain current (DC current)	I_D	$T_j = T_{jmax}$	T_s = 80 °C	22	A
Peak drain current	I_{DM}	t_p limited by T_{jmax}		80	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	60	W
Gate-source voltage	V_{GSS}			-4 / 15	V
		dynamic		-8 / 19	
Maximum Junction Temperature	T_{jmax}			175	°C
AC Diode					
Peak repetitive reverse voltage	V_{RRM}			1600	V
Forward current (DC current)	I_F	$T_j = T_{jmax}$	T_s = 80 °C	55	A
Surge (non-repetitive) forward current	I_{FSM}	Single Half Sine Wave, t_p = 10 ms	T_j = 150 °C	270	A
Surge current capability	I^2t			370	A^2s
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	69	W
Maximum junction temperature	T_{jmax}			150	°C

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Conditions		Value	Unit
Mux Switch					
Collector-emitter voltage	V_{CES}			1200	V
Collector current (DC current)	I_C	$T_j = T_{jmax}$	T_s <= 80 °C	20 (1)	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}		20	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	55	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	9,5	μs
Maximum junction temperature	T_{jmax}			175	°C

(1) limited by I_{CRM}

Parameter	Symbol	Conditions		Value	Unit
Mux Diode					
Peak repetitive reverse voltage	V_{RRM}			1200	V
Forward current (DC current)	I_F	$T_j = T_{jmax}$	T_s <= 80 °C	20 (2)	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}		20	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	43	W
Maximum junction temperature	T_{jmax}			175	°C

(2) limited by I_{FRM}

Parameter	Symbol	Conditions		Value	Unit
Capacitor (DC)					
Maximum DC voltage	V_{MAX}			1000	V
Operation Temperature	T_{op}			-55 ... 125	°C

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Conditions		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
Isolation voltage	V_{isol}	AC Voltage	t_p = 1 min	2500	V
Creepage distance				9,4	mm
Clearance				7,46	mm
Comparative Tracking Index	CTI			≥ 600	

*100 % tested in production

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	
Inverter Switch										
Static										
Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,0015	25	5,3	5,8	6,3	V
Collector-emitter saturation voltage	V_{CEsat}		15		40	25 125 150	1,78	1,94 2,23 2,32	2,42[3]	V
Collector-emitter cut-off current	I_{CES}		0	1200		25			5	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		2330		pF
Output capacitance	C_{oes}							150		pF
Reverse transfer capacitance	C_{res}							130		pF
Gate charge	Q_g	V_{CC} = 960 V	15		40	25		185		nC
Thermal										
Thermal resistance junction to sink[4]	$R_{th(j-s)}$	λ_{paste} = 5,2 W/mK (PTM)						0,69		K/W
Dynamic										
Turn-on delay time	$t_{d(on)}$	R_{gon} = 8 Ω R_{goff} = 8 Ω	±15	600	40	25 125 150		70,35 70,92 70,49		ns
Rise time	t_r					25 125 150		23,1 25,45 26,39		ns
Turn-off delay time	$t_{d(off)}$					25 125 150		162,3 222,29 234,94		ns
Fall time	t_f					25 125 150		40,68 83,87 98,68		ns
Turn-on energy (per pulse)	E_{on}	Q_{rFWD}=2,12 µC Q_{rFWD}=4,47 µC Q_{rFWD}=5,34 µC				25 125 150		1,89 2,78 3,17		mWs
Turn-off energy (per pulse)	E_{off}					25 125 150		1,65 2,86 3,2		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	
Inverter Diode										
Static										
Forward voltage	V_F				35	25 125 150		2,53 2,67 2,58	2,62(3) 2,62(3)	V
Reverse leakage current	I_R	V_r = 1200 V				25 150		 2700	60 5500	µA
Thermal										
Thermal resistance junction to sink(4)	$R_{th(j-s)}$	λ_{paste} = 5,2 W/mK (PTM)						1,31		K/W
Dynamic										
Peak recovery current	I_{RM}	d*i*/d*t*=1850 A/µs d*i*/d*t*=1840 A/µs d*i*/d*t*=1910 A/µs	±15	600	40	25 125 150		38,6 47,09 50,15		A
Reverse recovery time	t_{rr}					25 125 150		170,77 338,21 376,13		ns
Recovered charge	Q_r					25 125 150		2,12 4,47 5,34		µC
Reverse recovered energy	E_{rec}					25 125 150		0,689 1,69 2,03		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125 150		1178,39 791,61 662,6		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
Boost Switch										
Static										
Drain-source on-state resistance	$r_{DS(on)}$		15		40	25 125 150	22,4	34,2 42,1 46,4	41,6[3]	mΩ
Gate-source threshold voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}$			0,0115	25	1,8	2,5	3,6	V
Gate to Source Leakage Current	I_{GSS}		15	0		25		10	250	nA
Zero Gate Voltage Drain Current	I_{DSS}		0	1200		25		1	19	µA
Internal gate resistance	r_g							1,7		Ω
Gate charge	Q_g		-4/15	800	40	25		118		nC
Short-circuit input capacitance	C_{iss}	f = 100 kHz	0	1000	0	25		3357		pF
Short-circuit output capacitance	C_{oss}							129		
Reverse transfer capacitance	C_{rss}							8		
Diode forward voltage	V_{SD}		0		20	25		4,6		V
Thermal										
Thermal resistance junction to sink[4]	$R_{th(j-s)}$	λ_{paste} = 5,2 W/mK (PTM)						1,09		K/W
Dynamic										
Turn-on delay time	$t_{d(on)}$	R_{gon} = 16 Ω R_{goff} = 16 Ω	0/15	700	30	25 125 150		31,36 25,93 25,01		ns
Rise time	t_r					25 125 150		20,23 18,12 17,55		ns
Turn-off delay time	$t_{d(off)}$					25 125 150		146,07 165,29 170,61		ns
Fall time	t_f					25 125 150		10,37 11,05 10,94		ns
Turn-on energy (per pulse)	E_{on}	Q_{rFWD}=0,093 µC Q_{rFWD}=0,104 µC Q_{rFWD}=0,108 µC				25 125 150		0,698 0,587 0,567		mWs
Turn-off energy (per pulse)	E_{off}					25 125 150		0,487 0,503 0,512		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
Boost Diode										
Static										
Forward voltage	V_F				30	25 125 150		1,59 1,89 2,02	1,8(3)	V
Reverse leakage current	I_R	V_r = 1200 V				25		70	400	µA
Thermal										
Thermal resistance junction to sink(4)	$R_{th(j-s)}$	λ_{paste} = 5,2 W/mK (PTM)						0,9		K/W
Dynamic										
Peak recovery current	I_{RM}	di/dt=1802 A/µs di/dt=2141 A/µs di/dt=2180 A/µs	0/15	700	30	25 125 150		10,95 12,21 12,58		A
Reverse recovery time	t_{rr}					25 125 150		15,81 15,65 15,84		ns
Recovered charge	Q_r					25 125 150		0,093 0,104 0,108		µC
Reverse recovered energy	E_{rec}					25 125 150		0,014 0,018 0,019		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125 150		1969,56 2090,45 2244,81		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]	Values Min	Typ	Max	Unit
Half-Bridge Switch										
Static										
Drain-source on-state resistance	$r_{DS(on)}$		15		20	25 125 150		81,5 105 117	90(3)	mΩ
Gate-source threshold voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}$			0,005	25	1,7	2,5	4	V
Gate to Source Leakage Current	I_{GSS}		15	0		25		10	250	nA
Zero Gate Voltage Drain Current	I_{DSS}		0	1200		25		1	100	µA
Internal gate resistance	r_g							10,5		Ω
Gate charge	Q_g		-4/15	800	20	25		54		nC
Short-circuit input capacitance	C_{iss}	f = 1 Mhz	0	1000	0	25		1350		pF
Short-circuit output capacitance	C_{oss}							58		
Reverse transfer capacitance	C_{rss}							3		
Diode forward voltage	V_{SD}		0		10	25		4,5		V
Thermal										
Thermal resistance junction to sink(4)	$R_{th(j-s)}$	λ_{paste} = 5,2 W/mK (PTM)						1,57		K/W

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	
Dynamic										
Turn-on delay time	$t_{d(on)}$	R_{gon} = 16 Ω R_{goff} = 16 Ω	-4/15	600	15	25 125 150		24,17 22,14 21,58		ns
Rise time	t_r					25 125 150		14,65 13,37 13,21		ns
Turn-off delay time	$t_{d(off)}$					25 125 150		71,33 79,12 80,83		ns
Fall time	t_f					25 125 150		16,95 16,92 16,27		ns
Turn-on energy (per pulse)	E_{on}	Q_{rFWD}=0,071 µC Q_{rFWD}=0,217 µC Q_{rFWD}=0,264 µC				25 125 150		0,225 0,256 0,274		mWs
Turn-off energy (per pulse)	E_{off}					25 125 150		0,085 0,088 0,087		mWs
Peak recovery current	I_{RRM}	d*i*/d*t*=1290 A/µs d*i*/d*t*=1472 A/µs d*i*/d*t*=1441 A/µs				25 125 150		8,65 11,79 13,59		A
Reverse recovery time	t_{rr}					25 125 150		15,07 42,64 44,12		ns
Recovered charge	Q_r					25 125 150		0,071 0,217 0,264		µC
Reverse recovered energy	E_{rec}					25 125 150		0,013 0,068 0,079		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125 150		1483,58 462,05 1008,94		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	
AC Diode										
Static										
Forward voltage	V_F				5	25 125 150		0,899 0,78 0,744	1,1(3)	V
Reverse leakage current	I_R	V_r = 1600 V				25 150			100 1000	µA
Thermal										
Thermal resistance junction to sink(4)	$R_{th(j-s)}$	λ_{paste} = 5,2 W/mK (PTM)						1,02		K/W
Mux Switch										
Static										
Gate-emitter threshold voltage	$V_{GE(th)}$			10	0,001	25	5,4	6	6,6	V
Collector-emitter saturation voltage	V_{CEsat}		15		10	25 125 150		1,66 1,9 1,96	2,1(3)	V
Collector-emitter cut-off current	I_{CES}		0	1200		25			35	µA
Gate-emitter leakage current	I_{GES}		20	0		25			200	nA
Internal gate resistance	r_g							None		Ω
Input capacitance	C_{ies}		0	10		25		2000		pF
Output capacitance	C_{oes}							86		pF
Reverse transfer capacitance	C_{res}							23		pF
Gate charge	Q_g	V_{CC} = 600 V	0/15		10	25		80		nC
Thermal										
Thermal resistance junction to sink(4)	$R_{th(j-s)}$	λ_{paste} = 5,2 W/mK (PTM)						1,71		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
Mux Diode										
Static										
Forward voltage	V_F				10	25 125 150		1,61 1,69 1,7	1,9(3)	V
Reverse leakage current	I_R	V_r = 1200 V				25			25	µA
Thermal										
Thermal resistance junction to sink(4)	$R_{th(j-s)}$	λ_{paste} = 5,2 W/mK (PTM)						2,23		K/W
Capacitor (DC)										
Static										
Capacitance	C	DC bias voltage = 0 V				25		10		nF
Tolerance							-10		10	%
Dissipation factor		f = 1 kHz				25		0,15		%
Thermistor										
Static										
Rated resistance	R					25		22		kΩ
Deviation of R100	$\Delta_{R/R}$	R_{100} = 1484 Ω				100	-5		5	%
Power dissipation	P					25		130		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	

(3) Value at chip level

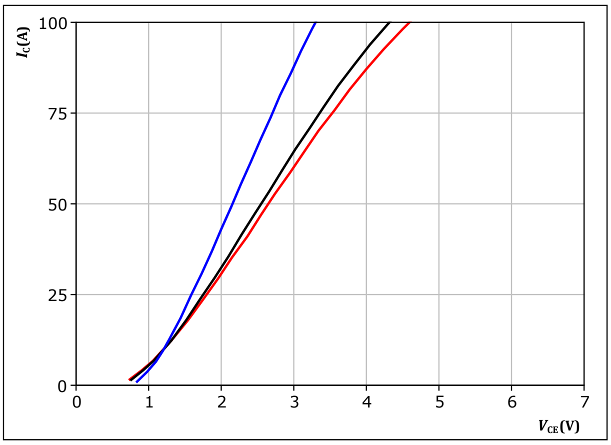
(4) Only valid with pre-applied Vincotech thermal interface material.

Inverter Switch Characteristics

figure 1. **IGBT**

Typical output characteristics

I_C = f(V_{CE})

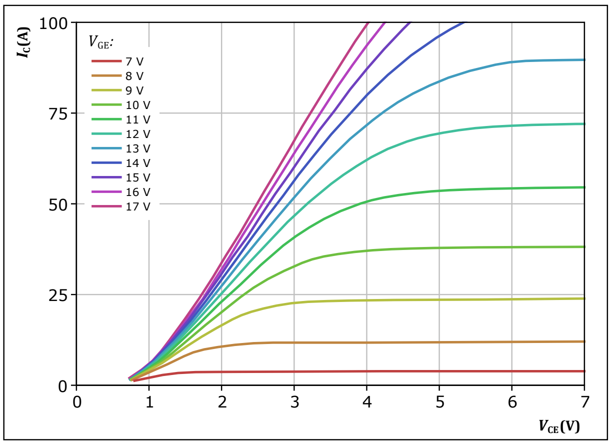


t_p =	250	µs		25 °C
V_{GE} =	15	V	T_j:	125 °C
				150 °C

figure 2. **IGBT**

Typical output characteristics

I_C = f(V_{CE})



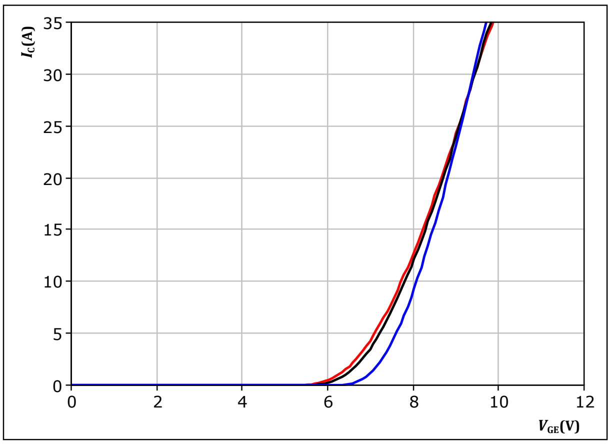
t_p =	250	µs
T_j =	150	°C

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

figure 3. **IGBT**

Typical transfer characteristics

I_C = f(V_{GE})

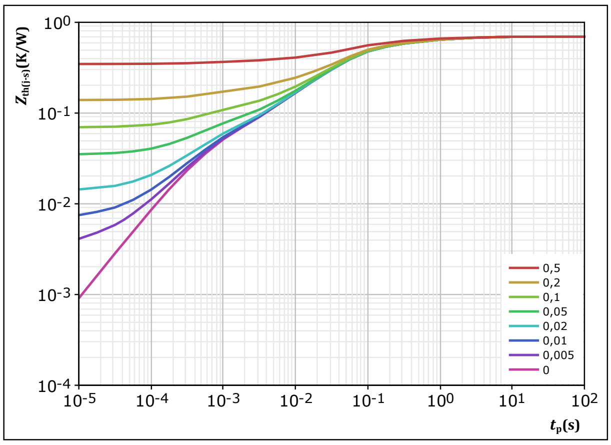


t_p =	250	µs		25 °C
V_{CE} =	10	V	T_j:	125 °C
				150 °C

figure 4. **IGBT**

Transient thermal impedance as a function of pulse width

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



D =	t_p / T	
$R_{th(j-s)}$ =	0,694	K/W

IGBT thermal model values

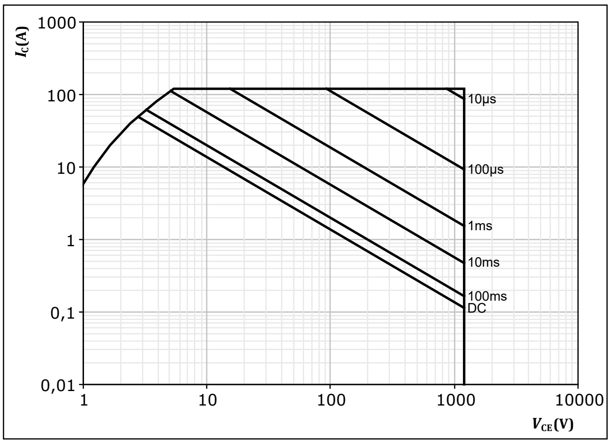
R (K/W)	τ (s)
6,77E-02	2,32E+00
1,39E-01	3,13E-01
3,75E-01	5,01E-02
7,19E-02	7,40E-03
4,13E-02	5,57E-04

Inverter Switch Characteristics

figure 5.	IGBT

Safe operating area

I_C = f(V_{CE})



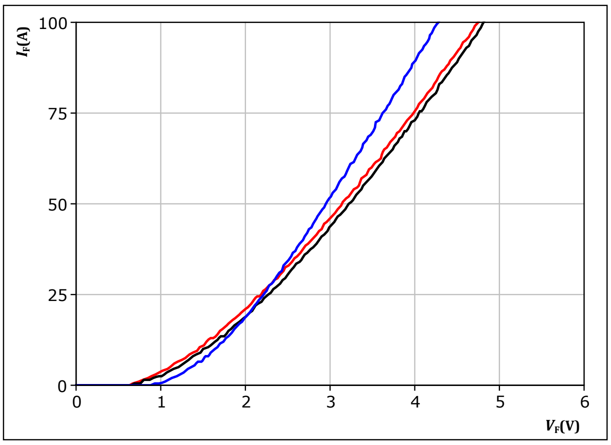
D =	single pulse	
T_s =	80	°C
V_{GE} =	15	V
T_j =	T_{jmax}	

Inverter Diode Characteristics

figure 6. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



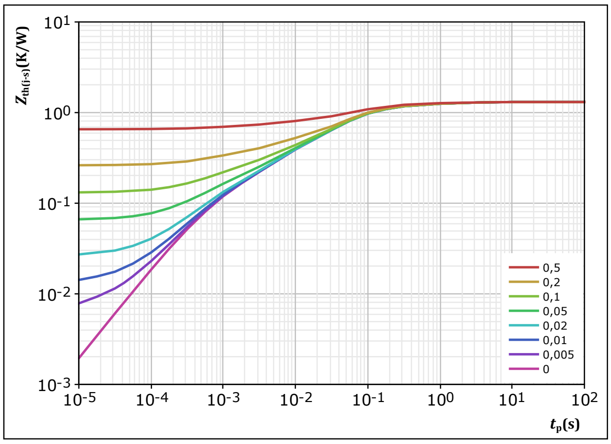
t_p = 250 µs

T_j: 25 °C, 125 °C, 150 °C

figure 7. **FWD**

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$

$R_{th(j-s)}$ = 1,308 K/W

FWD thermal model values

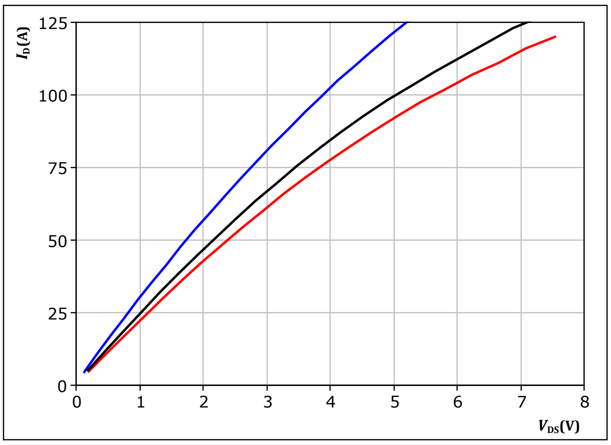
R (K/W)	τ (s)
9,18E-02	1,91E+00
2,59E-01	2,04E-01
6,72E-01	4,91E-02
1,98E-01	5,31E-03
8,79E-02	6,11E-04

Boost Switch Characteristics

figure 8. **MOSFET**

Typical output characteristics

$I_D = f(V_{DS})$



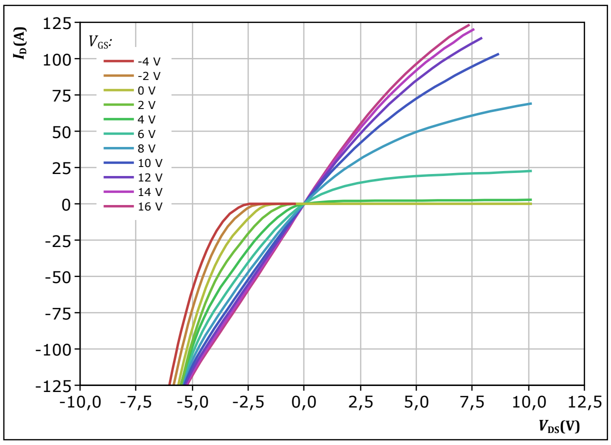
t_p =	250	µs
V_{GS} =	14	V

T_j: 25 °C / 125 °C / 150 °C

figure 9. **MOSFET**

Typical output characteristics

$I_D = f(V_{DS})$



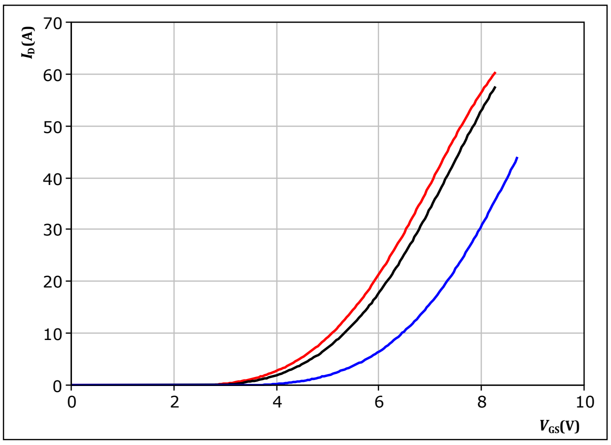
t_p =	250	µs
T_j =	150	°C

V_{GS} from -4 V to 16 V in steps of 2 V

figure 10. **MOSFET**

Typical transfer characteristics

$I_D = f(V_{GS})$



t_p =	250	µs
V_{DS} =	10	V

T_j: 25 °C / 125 °C / 150 °C

figure 11. **MOSFET**

Typical reverse drain current characteristics

$I_{SD} = f(V_{SD})$

t_p =	250	µs
V_{GS} =	14	V

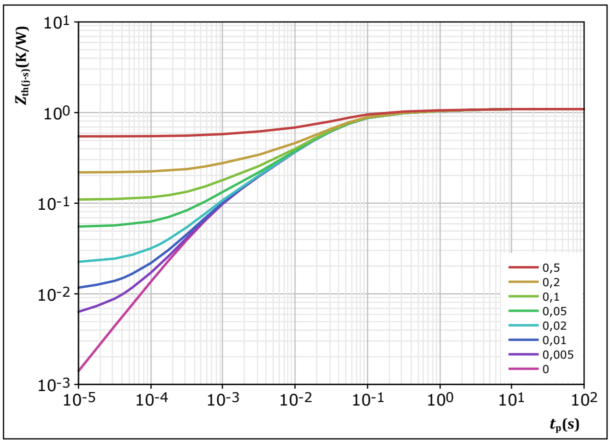
T_j: 25 °C / 125 °C / 150 °C

Boost Switch Characteristics

figure 12. **MOSFET**

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$

$R_{th(j-s)} =$ 1,092 K/W

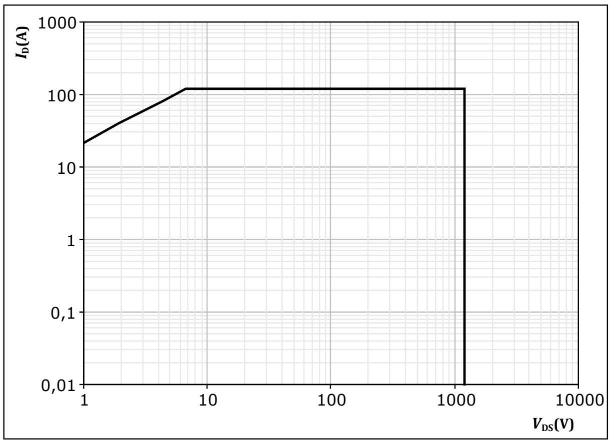
MOSFET thermal model values

R (K/W)	τ (s)
7,99E-02	2,12E+00
1,75E-01	1,98E-01
5,57E-01	3,73E-02
1,94E-01	7,57E-03
8,64E-02	8,67E-04

figure 13. **MOSFET**

Safe operating area

$I_D = f(V_{DS})$



$D =$ single pulse

$T_s =$ 80 °C

$V_{GS} =$ 14 V

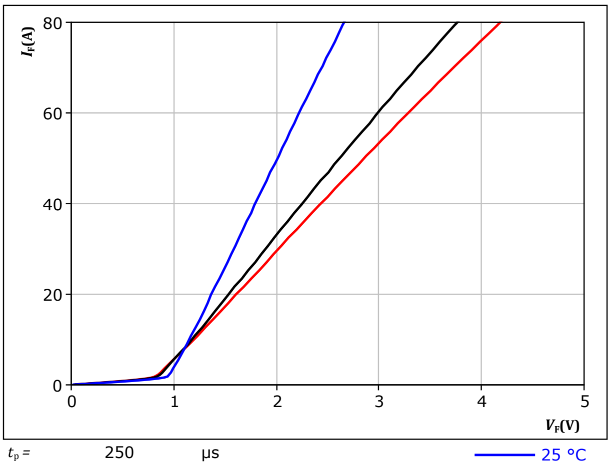
$T_j = T_{jmax}$

Boost Diode Characteristics

figure 14. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



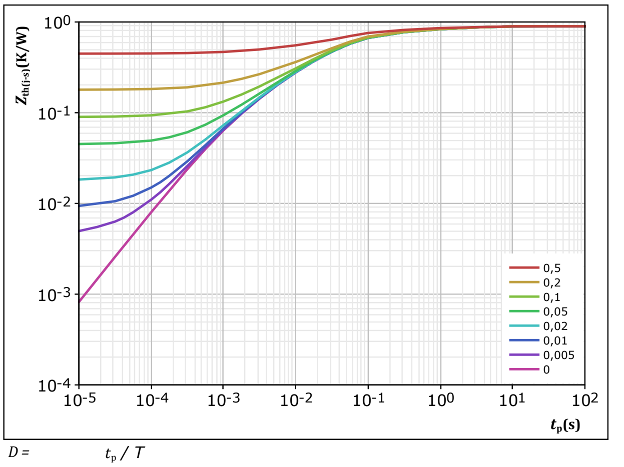
t_p = 250 µs

T_j: 25 °C, 125 °C, 150 °C

figure 15. **FWD**

Transient thermal impedance as a function of pulse width

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



D = t_p / T

$R_{th(j-s)}$ = 0,896 K/W

FWD thermal model values

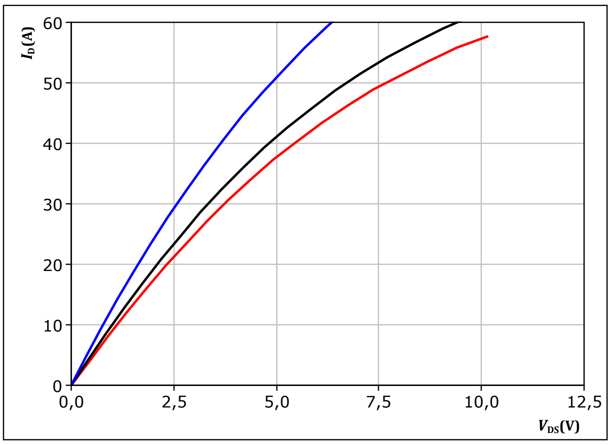
R (K/W)	τ (s)
9,26E-02	2,33E+00
1,76E-01	2,23E-01
4,37E-01	3,58E-02
1,44E-01	5,87E-03
4,57E-02	1,02E-03

Half-Bridge Switch Characteristics

figure 16. **MOSFET**

Typical output characteristics

$I_D = f(V_{DS})$



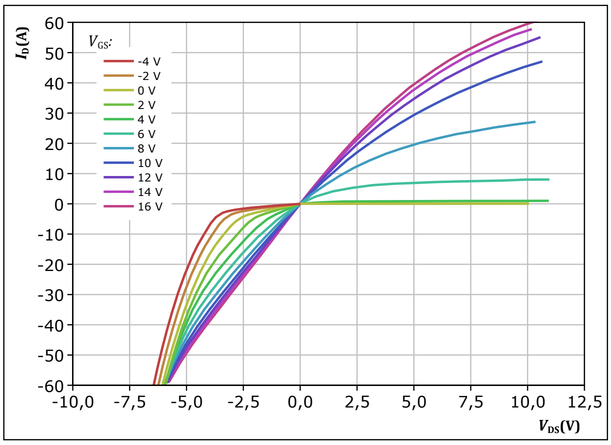
t_p =	250	µs
V_{GS} =	14	V

T_j: 25 °C, 125 °C, 150 °C

figure 17. **MOSFET**

Typical output characteristics

$I_D = f(V_{DS})$



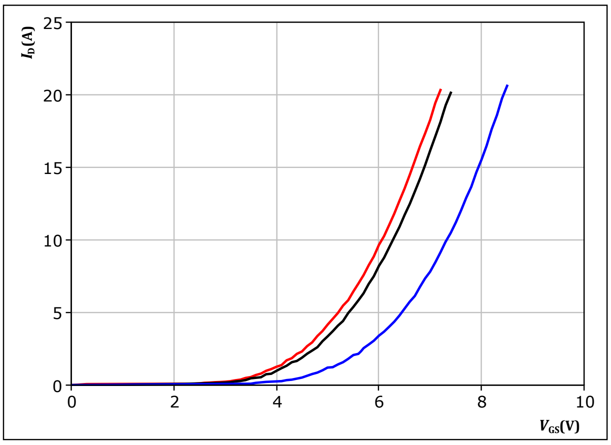
t_p =	250	µs
T_j =	150	°C

V_{GS} from -4 V to 16 V in steps of 2 V

figure 18. **MOSFET**

Typical transfer characteristics

$I_D = f(V_{GS})$



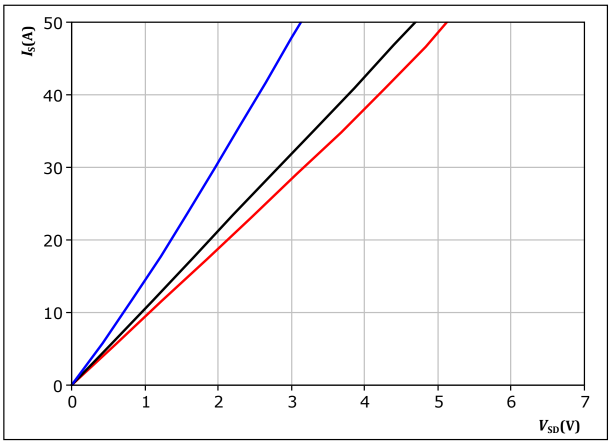
t_p =	250	µs
V_{DS} =	10	V

T_j: 25 °C, 125 °C, 150 °C

figure 19. **MOSFET**

Typical reverse drain current characteristics

$I_{SD} = f(V_{SD})$



t_p =	250	µs
V_{GS} =	14	V

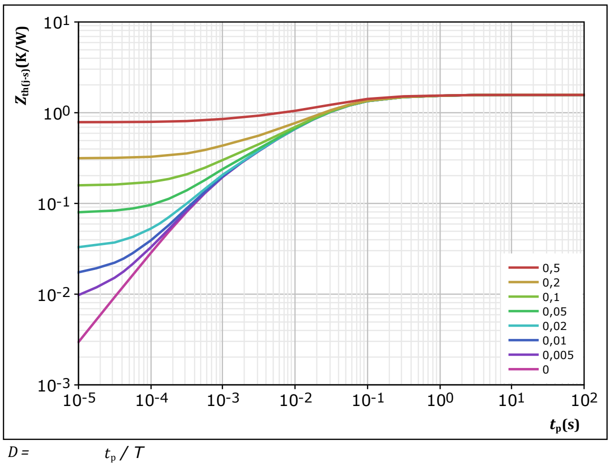
T_j: 25 °C, 125 °C, 150 °C

Half-Bridge Switch Characteristics

figure 20. MOSFET

Transient thermal impedance as a function of pulse width

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



D =	t_p / T	
$R_{th(j-s)}$ =	1,571	K/W

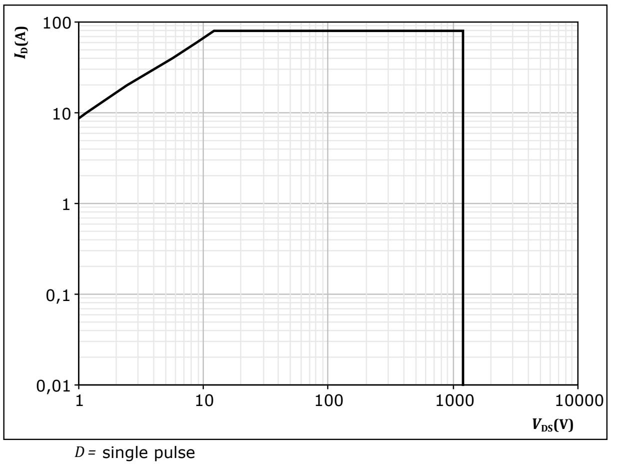
MOSFET thermal model values

R (K/W)	τ (s)
1,03E-01	9,16E-01
3,58E-01	9,48E-02
6,72E-01	2,46E-02
2,91E-01	4,80E-03
1,48E-01	7,19E-04

figure 21. MOSFET

Safe operating area

$I_D = f(V_{DS})$



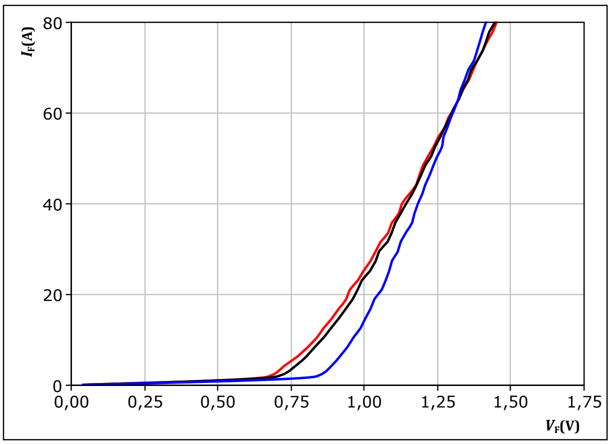
D =	single pulse	
T_s =	80	°C
V_{GS} =	14	V
T_j =	T_{jmax}	

AC Diode Characteristics

figure 22. **Rectifier**

Typical forward characteristics

$I_F = f(V_F)$



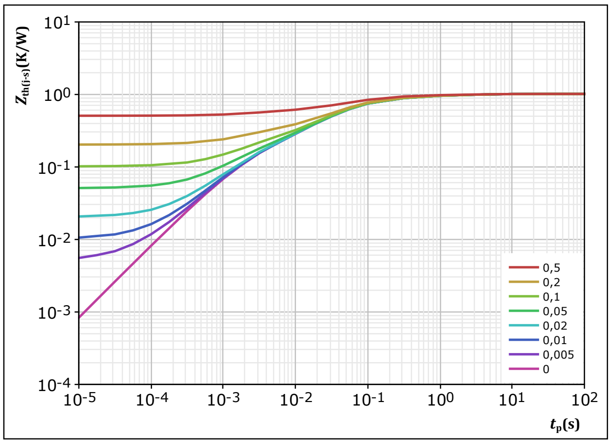
t_p = 250 µs

T_j: 25 °C, 125 °C, 150 °C

figure 23. **Rectifier**

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$

$R_{th(j-s)}$ = 1,017 K/W

Rectifier thermal model values

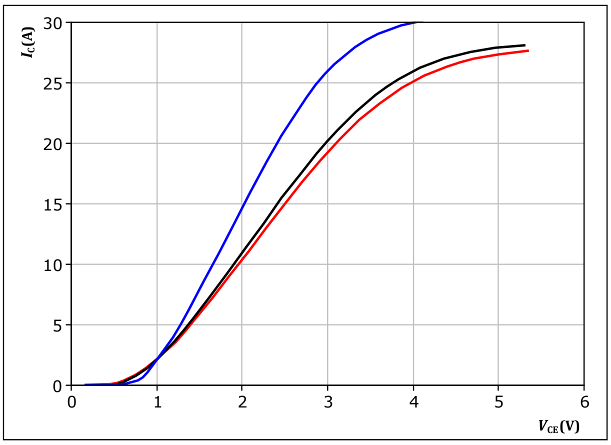
R (K/W)	τ (s)
5,73E-02	3,53E+00
1,49E-01	4,28E-01
5,23E-01	5,80E-02
1,80E-01	1,38E-02
1,08E-01	1,76E-03

Mux Switch Characteristics

figure 24. **IGBT**

Typical output characteristics

I_C = f(V_{CE})



t_p = 250 µs

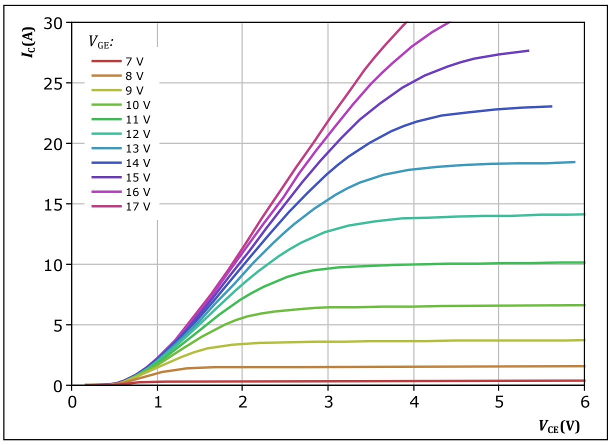
V_{GE} = 15 V

T_j: 25 °C, 125 °C, 150 °C

figure 25. **IGBT**

Typical output characteristics

I_C = f(V_{CE})



t_p = 250 µs

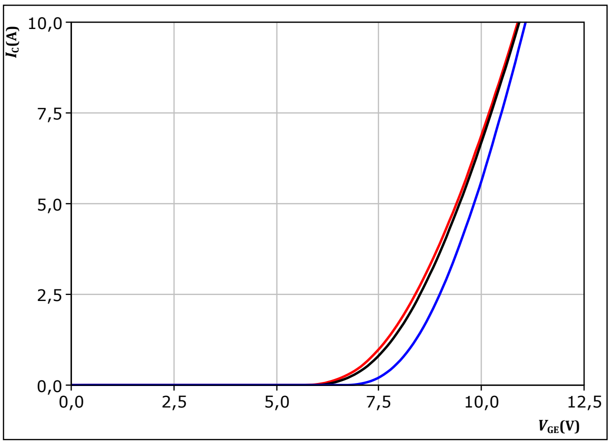
T_j = 150 °C

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

figure 26. **IGBT**

Typical transfer characteristics

I_C = f(V_{GE})



t_p = 250 µs

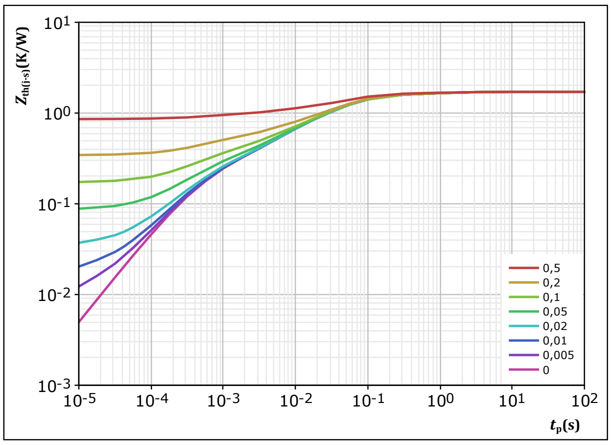
V_{CE} = 10 V

T_j: 25 °C, 125 °C, 150 °C

figure 27. **IGBT**

Transient thermal impedance as a function of pulse width

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



D = t_p / T

$R_{th(j-s)}$ = 1,714 K/W

IGBT thermal model values

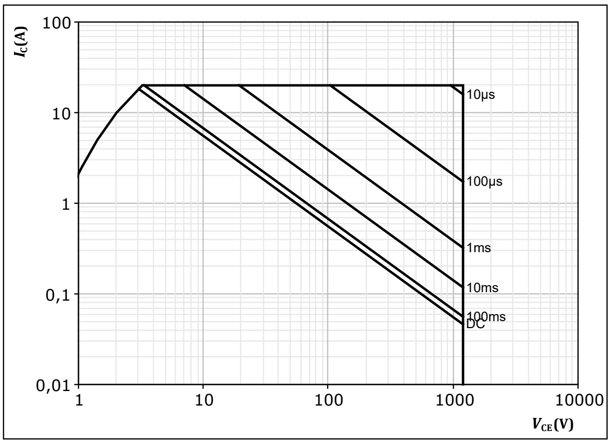
R (K/W)	τ (s)
1,07E-01	1,57E+00
3,68E-01	1,28E-01
7,94E-01	3,08E-02
2,71E-01	4,04E-03
1,75E-01	4,31E-04

Mux Switch Characteristics

figure 28. **IGBT**

Safe operating area

I_C = f(V_{CE})

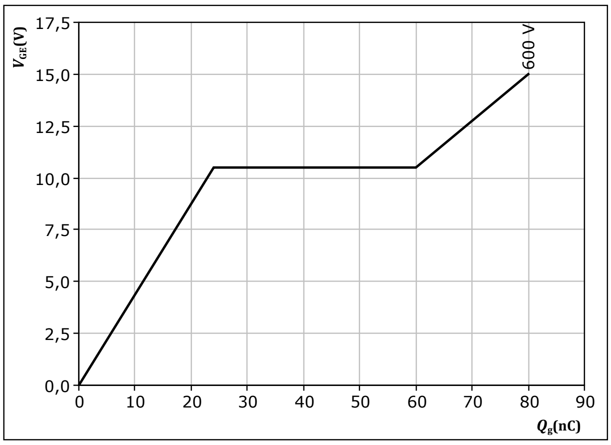


D =	single pulse	
T_s =	80	°C
V_{GE} =	15	V
T_j =	T_{jmax}	

figure 29. **IGBT**

Gate voltage vs gate charge

V_{GE} = f(Q_g)



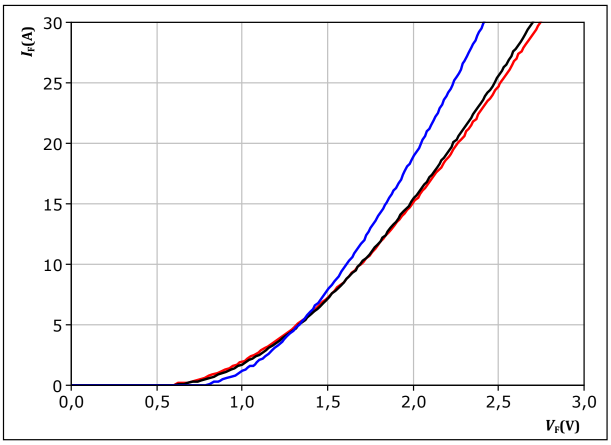
I_C =	10	A
T_j =	25	°C

Mux Diode Characteristics

figure 30. **FWD**

Typical forward characteristics

I_F = f(V_F)



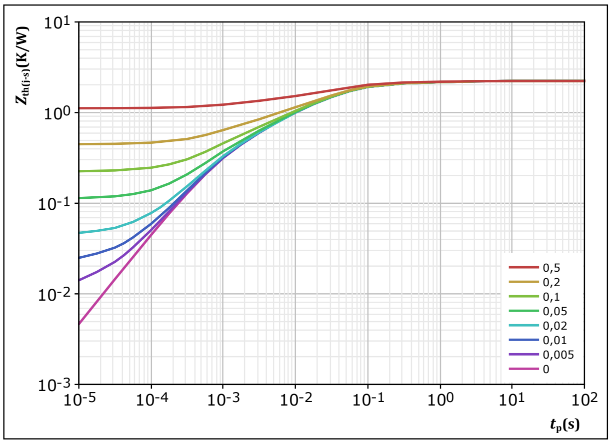
t_p = 250 µs

T_j: 25 °C, 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

$R_{th(j-s)}$ = 2,231 K/W

FWD thermal model values

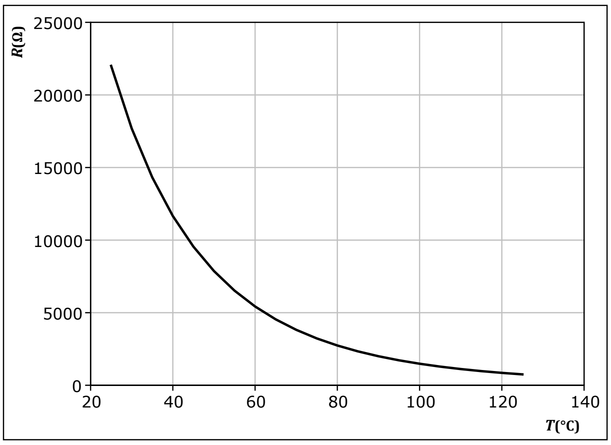
R (K/W)	τ (s)
1,16E-01	1,53E+00
3,27E-01	1,36E-01
9,79E-01	3,22E-02
5,15E-01	5,83E-03
2,94E-01	8,53E-04

Thermistor Characteristics

figure 32.	Thermistor

Typical NTC characteristic as function of temperature

R_T = f(T)

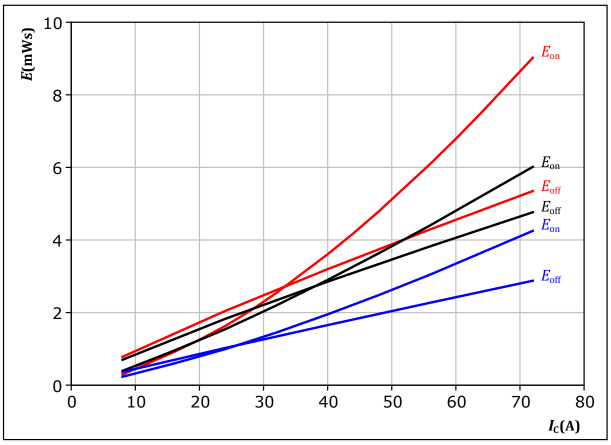


Inverter Switching Characteristics

figure 33. **IGBT**

Typical switching energy losses as a function of collector current

$E = f(I_C)$



With an inductive load at

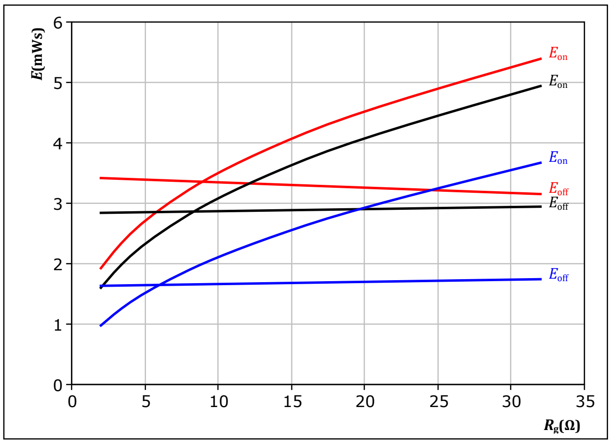
V_{CE} =	600	V	
V_{GE} =	±15	V	
R_{gon} =	8	Ω	
R_{goff} =	8	Ω	

T_j: 25 °C / 125 °C / 150 °C

figure 34. **IGBT**

Typical switching energy losses as a function of IGBT turn on gate resistor

$E = f(R_g)$



With an inductive load at

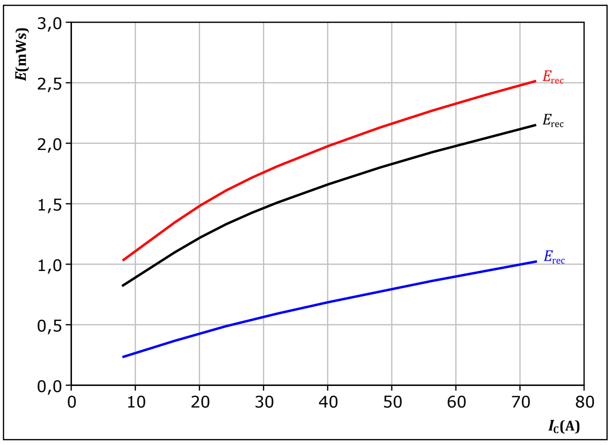
V_{CE} =	600	V	
V_{GE} =	±15	V	
I_C =	40	A	

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

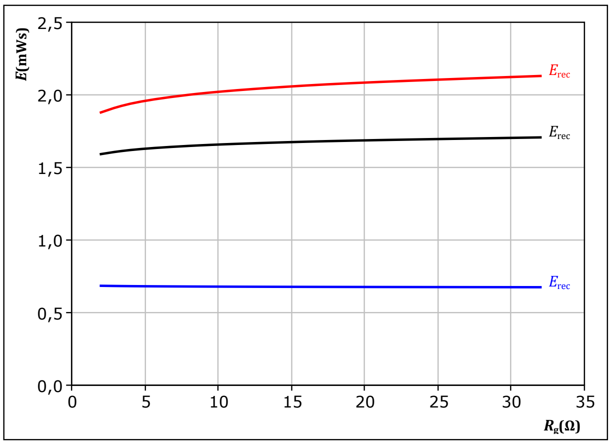
V_{CE} =	600	V	
V_{GE} =	±15	V	
R_{gon} =	8	Ω	

T_j: 25 °C / 125 °C / 150 °C

figure 36. **FWD**

Typical reverse recovered energy loss as a function of IGBT turn on gate resistor

$E_{rec} = f(R_g)$



With an inductive load at

V_{CE} =	600	V	
V_{GE} =	±15	V	
I_C =	40	A	

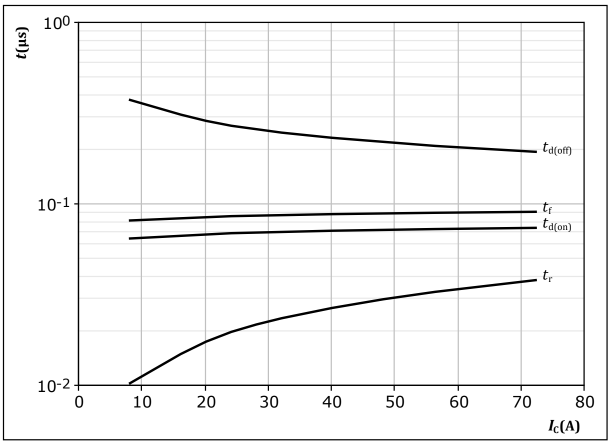
T_j: 25 °C / 125 °C / 150 °C

Inverter Switching Characteristics

figure 37. **IGBT**

Typical switching times as a function of collector current

t = f(I_C)



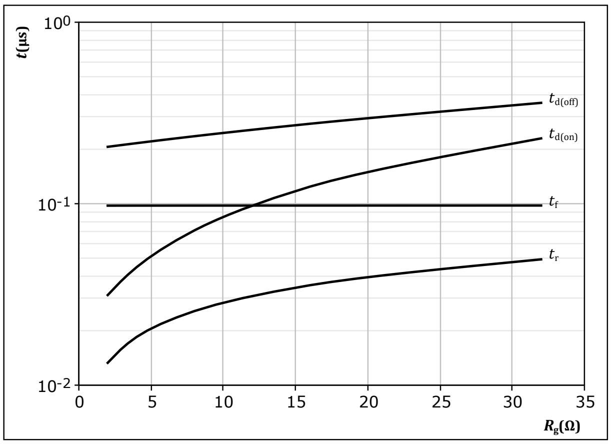
With an inductive load at

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

figure 38. **IGBT**

Typical switching times as a function of IGBT turn on gate resistor

t = f(R_g)



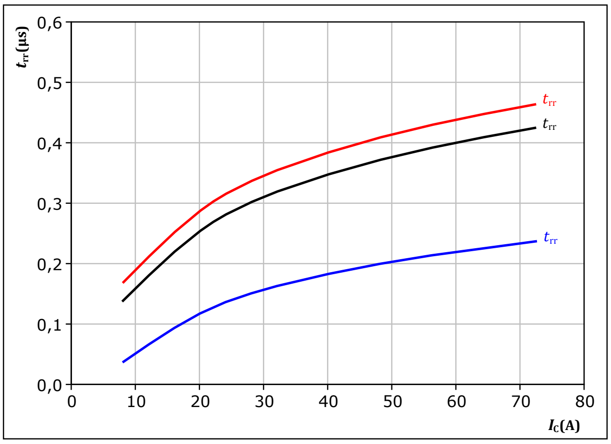
With an inductive load at

T_j =	150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	40	A

figure 39. **FWD**

Typical reverse recovery time as a function of collector current

t_{rr} = f(I_C)



With an inductive load at

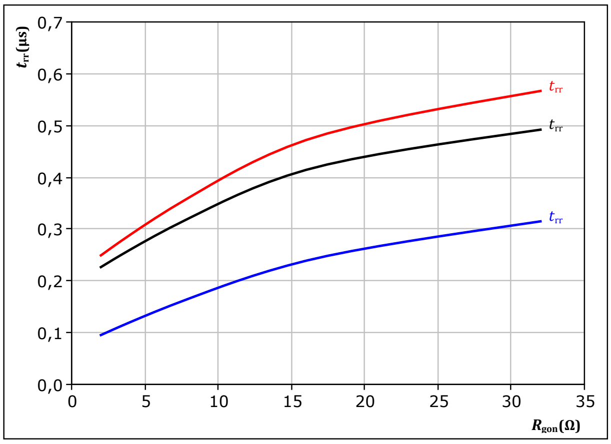
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	8	Ω

T_j: 25 °C, 125 °C, 150 °C

figure 40. **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} =	600	V
V_{GE} =	±15	V
I_C =	40	A

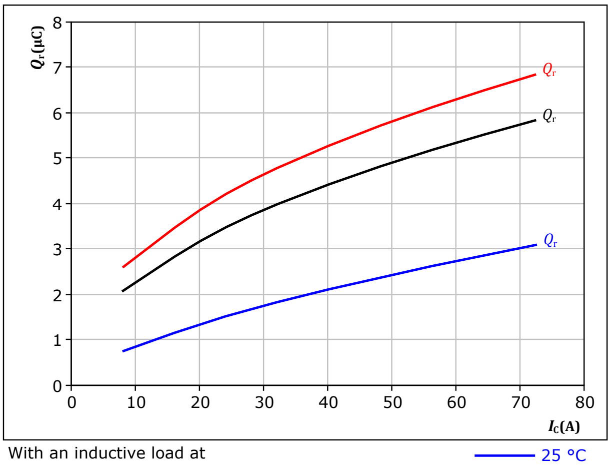
T_j: 25 °C, 125 °C, 150 °C

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

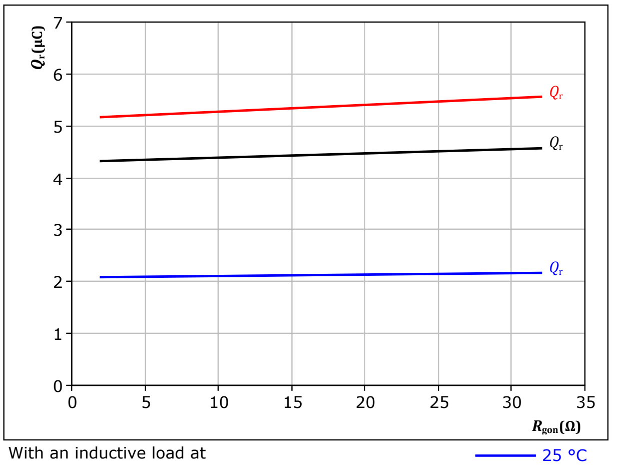
V_{CE} = 600 V
V_{GE} = ±15 V
R_{gon} = 8 Ω

T_j: 25 °C, 125 °C, 150 °C

figure 42. FWD

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

Q_r = f(R_{gon})



With an inductive load at

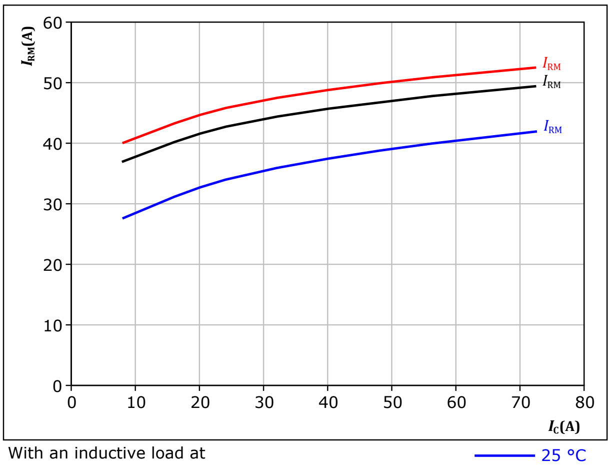
V_{CE} = 600 V
V_{GE} = ±15 V
I_C = 40 A

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

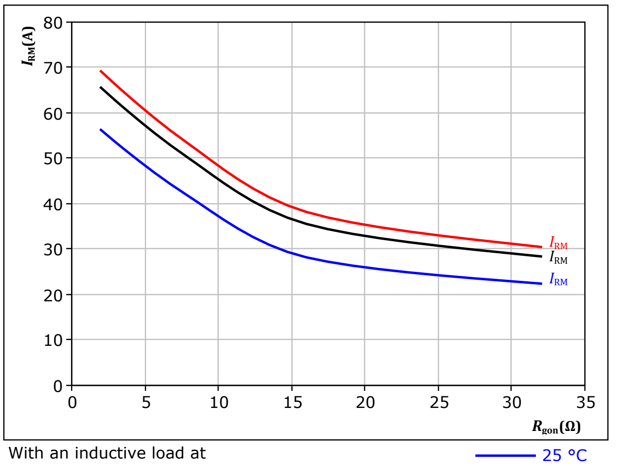
V_{CE} = 600 V
V_{GE} = ±15 V
R_{gon} = 8 Ω

T_j: 25 °C, 125 °C, 150 °C

figure 44. 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} = 600 V
V_{GE} = ±15 V
I_C = 40 A

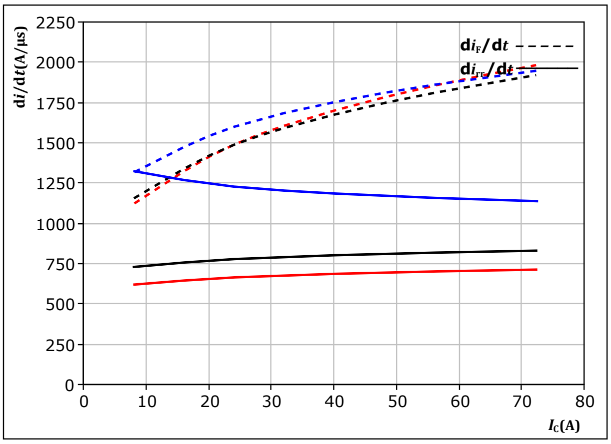
T_j: 25 °C, 125 °C, 150 °C

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



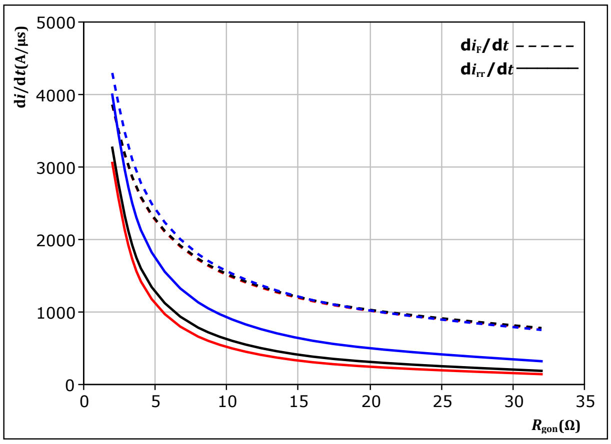
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C
V_{GE} =	±15	V		125 °C
R_{gon} =	8	Ω		150 °C

figure 46. **FWD**

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

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



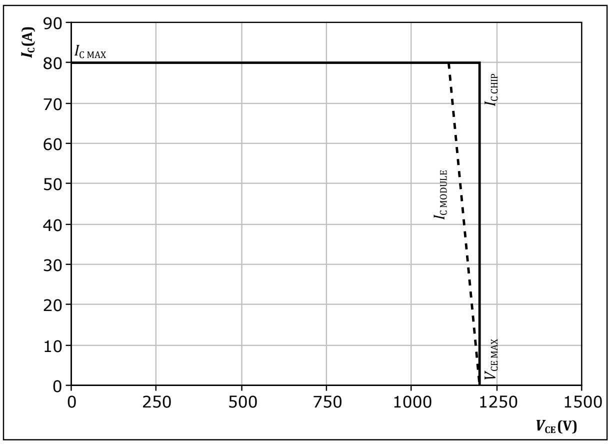
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C
V_{GE} =	±15	V		125 °C
I_C =	40	A		150 °C

figure 47. **IGBT**

Reverse bias safe operating area

$I_C = f(V_{CE})$



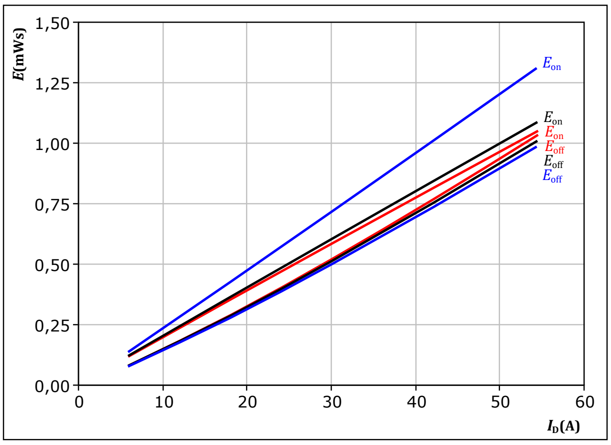
At	T_j =	150	°C
	R_{gon} =	8	Ω
	R_{goff} =	8	Ω

Boost Switching Characteristics

figure 48. **MOSFET**

Typical switching energy losses as a function of drain current

$E = f(I_D)$



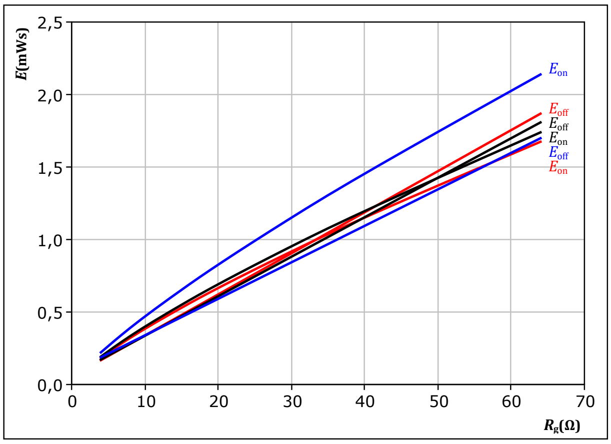
With an inductive load at

V_{DS} =	700	V	T_j:	25 °C
V_{GS} =	0/15	V		125 °C
R_{gon} =	16	Ω		150 °C
R_{goff} =	16	Ω		

figure 49. **MOSFET**

Typical switching energy losses as a function of MOSFET turn on gate resistor

$E = f(R_g)$



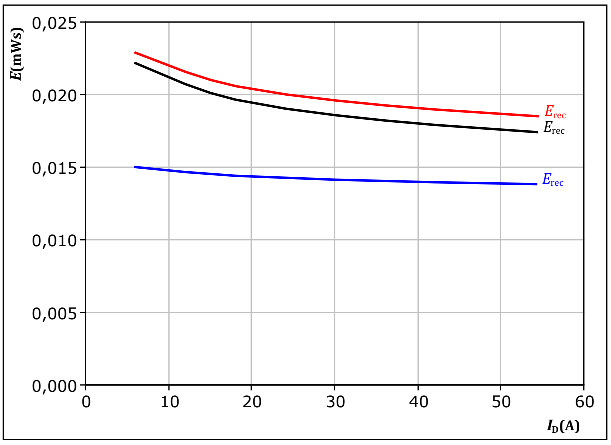
With an inductive load at

V_{DS} =	700	V	T_j:	25 °C
V_{GS} =	0/15	V		125 °C
I_D =	30	A		150 °C

figure 50. **FWD**

Typical reverse recovered energy loss as a function of drain current

$E_{rec} = f(I_D)$



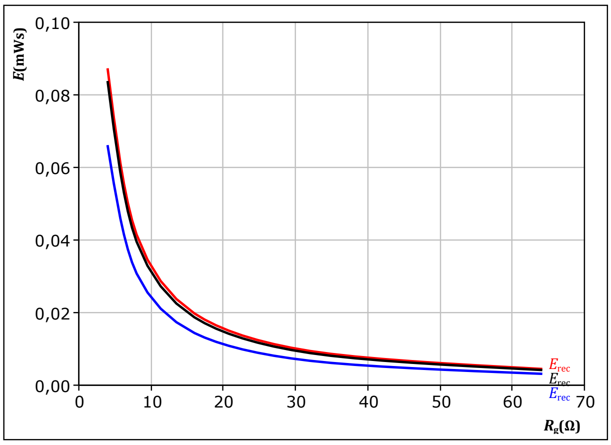
With an inductive load at

V_{DS} =	700	V	T_j:	25 °C
V_{GS} =	0/15	V		125 °C
R_{gon} =	16	Ω		150 °C

figure 51. **FWD**

Typical reverse recovered energy loss as a function of MOSFET turn on gate resistor

$E_{rec} = f(R_g)$



With an inductive load at

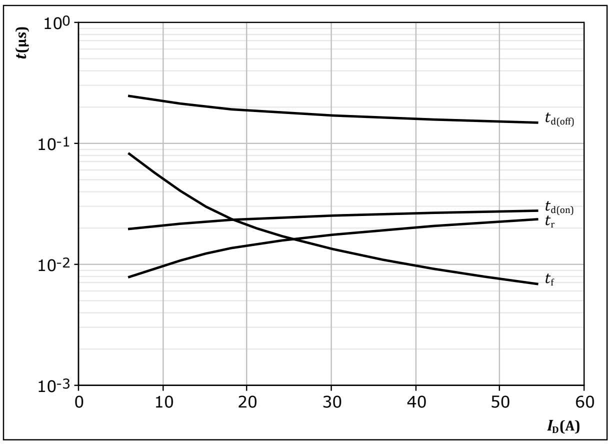
V_{DS} =	700	V	T_j:	25 °C
V_{GS} =	0/15	V		125 °C
I_D =	30	A		150 °C

Boost Switching Characteristics

figure 52. **MOSFET**

Typical switching times as a function of drain current

t = f(I_D)



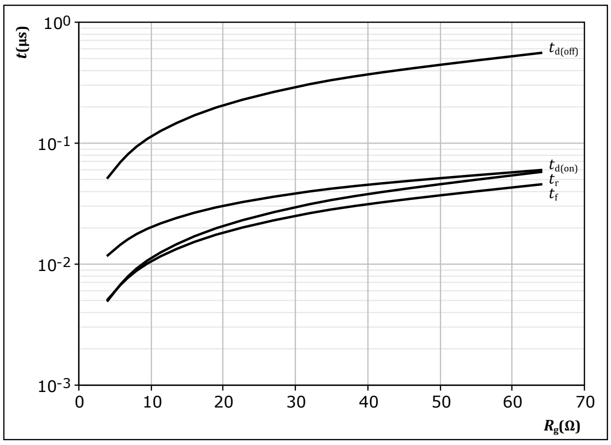
With an inductive load at

T_j =	150	°C
V_{DS} =	700	V
V_{GS} =	0/15	V
R_{gon} =	16	Ω
R_{goff} =	16	Ω

figure 53. **MOSFET**

Typical switching times as a function of MOSFET turn on gate resistor

t = f(R_g)



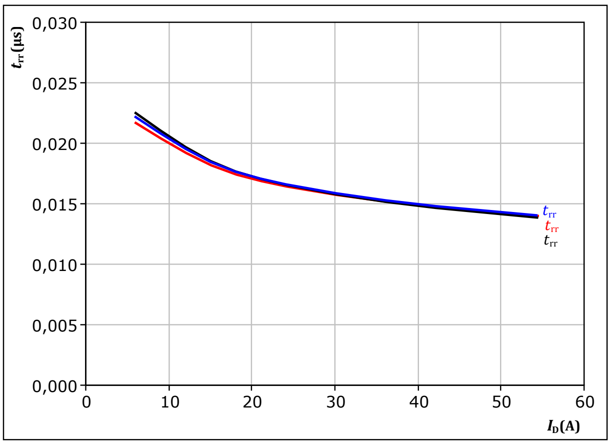
With an inductive load at

T_j =	150	°C
V_{DS} =	700	V
V_{GS} =	0/15	V
I_D =	30	A

figure 54. **FWD**

Typical reverse recovery time as a function of drain current

t_{rr} = f(I_D)



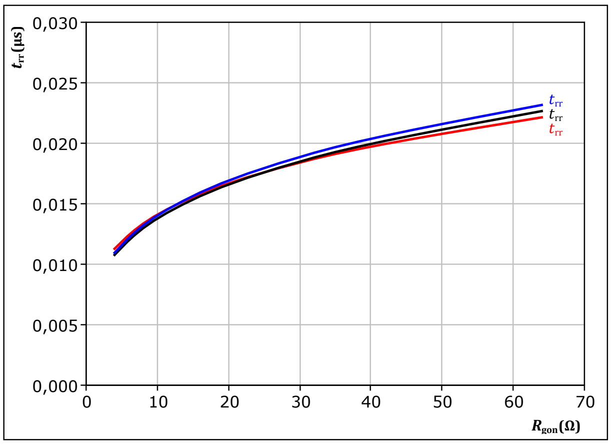
At			
	V_{DS} =	700	V
	V_{GS} =	0/15	V
	R_{gon} =	16	Ω

T_j: 25 °C, 125 °C, 150 °C

figure 55. **FWD**

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

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



At			
	V_{DS} =	700	V
	V_{GS} =	0/15	V
	I_D =	30	A

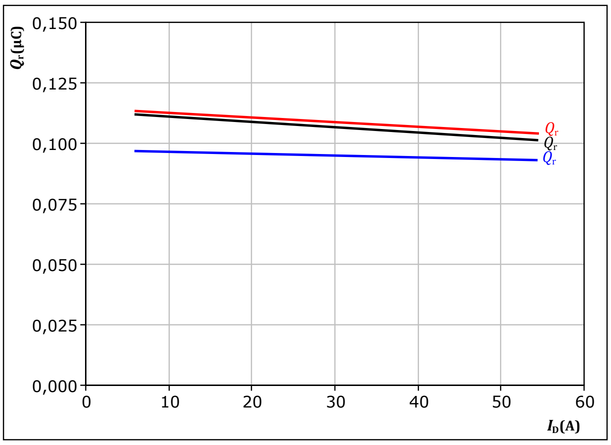
T_j: 25 °C, 125 °C, 150 °C

Boost Switching Characteristics

figure 56. FWD

Typical recovered charge as a function of drain current

Q_r = f(I_D)

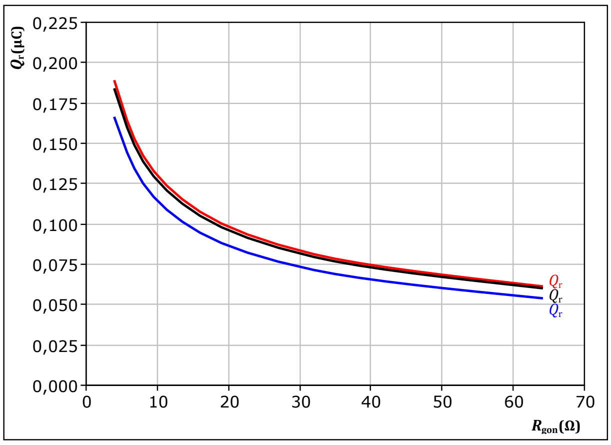


At				
V_{DS} =	700	V		25 °C
V_{GS} =	0/15	V	T_j:	125 °C
R_{gon} =	16	Ω		150 °C

figure 57. FWD

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

Q_r = f(R_{gon})

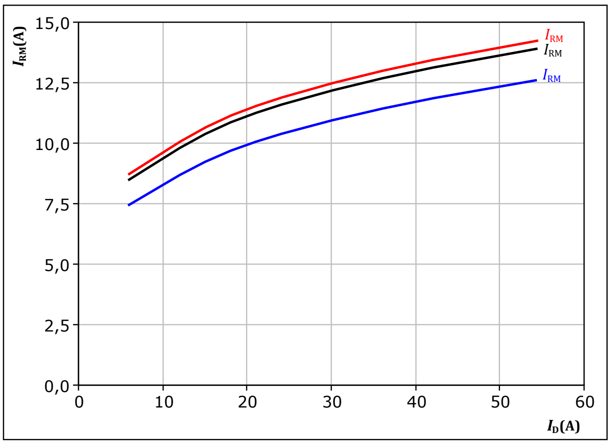


At				
V_{DS} =	700	V		25 °C
V_{GS} =	0/15	V	T_j:	125 °C
I_D =	30	A		150 °C

figure 58. FWD

Typical peak reverse recovery current as a function of drain current

I_{RM} = f(I_D)

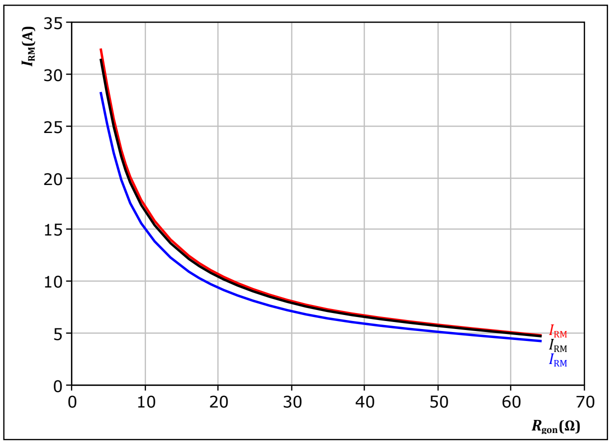


At				
V_{DS} =	700	V		25 °C
V_{GS} =	0/15	V	T_j:	125 °C
R_{gon} =	16	Ω		150 °C

figure 59. FWD

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

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



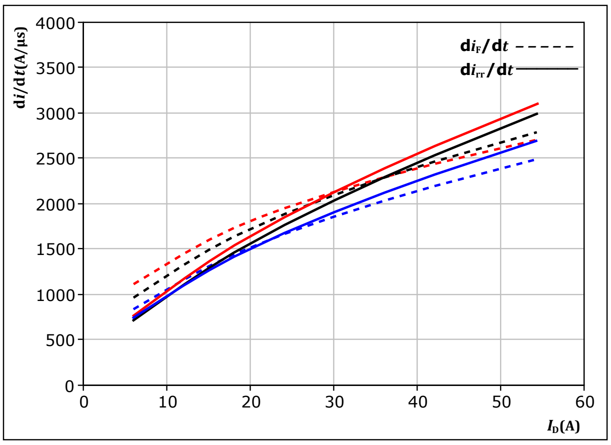
At				
V_{DS} =	700	V		25 °C
V_{GS} =	0/15	V	T_j:	125 °C
I_D =	30	A		150 °C

Boost Switching Characteristics

figure 60. **FWD**

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

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

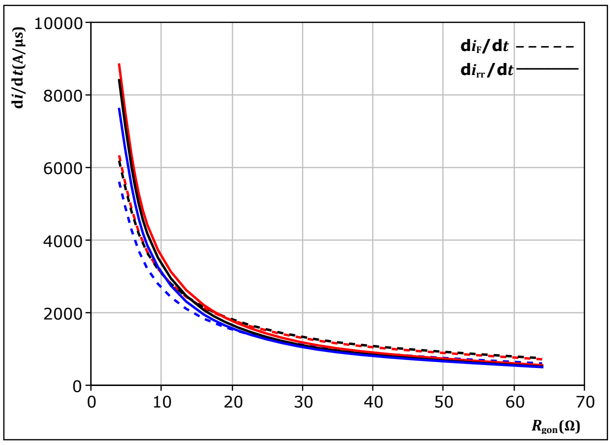


At					
	V_{DS} =	700	V		25 °C
	V_{GS} =	0/15	V	T_j:	125 °C
	R_{gon} =	16	Ω		150 °C

figure 61. **FWD**

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

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

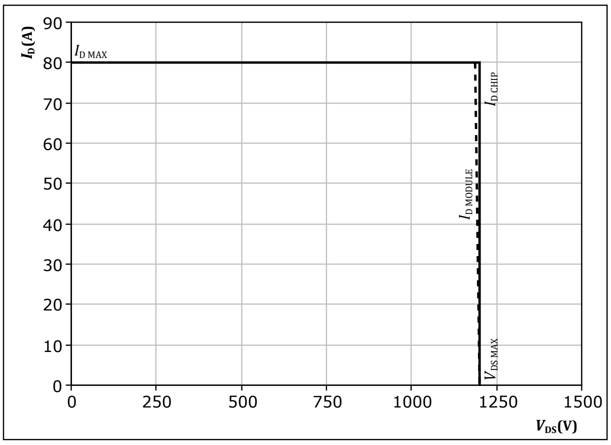


At					
	V_{DS} =	700	V		25 °C
	V_{GS} =	0/15	V	T_j:	125 °C
	I_D =	30	A		150 °C

figure 62. **MOSFET**

Reverse bias safe operating area

I_D = f(V_{DS})



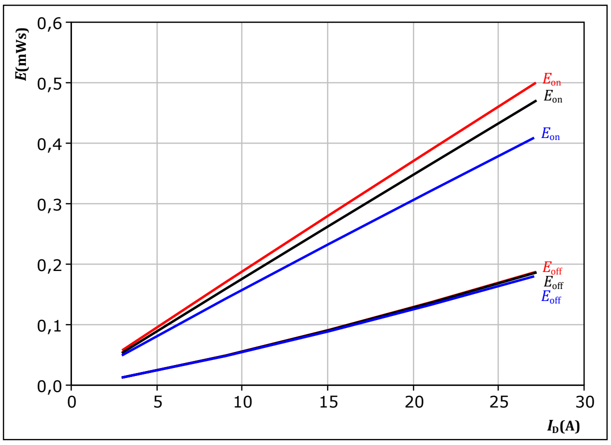
At			
	T_j =	150	°C
	R_{gon} =	16	Ω
	R_{goff} =	16	Ω

Half-Bridge Switching Characteristics

figure 63. **MOSFET**

Typical switching energy losses as a function of drain current

$E = f(I_D)$



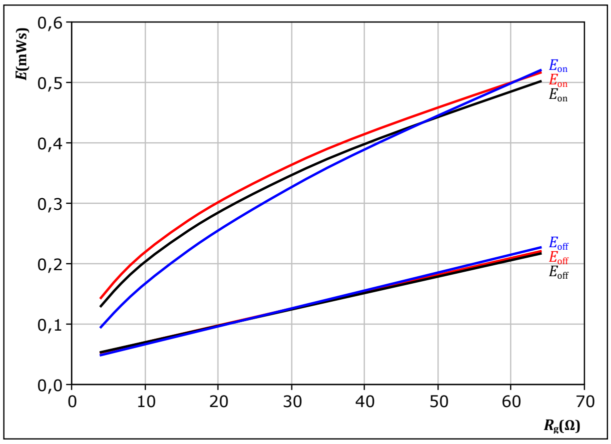
With an inductive load at

V_{DS} =	600	V	T_j:	25 °C (blue)
V_{GS} =	-4/15	V		125 °C (black)
R_{gon} =	16	Ω		150 °C (red)
R_{goff} =	16	Ω		

figure 64. **MOSFET**

Typical switching energy losses as a function of MOSFET turn on gate resistor

$E = f(R_g)$



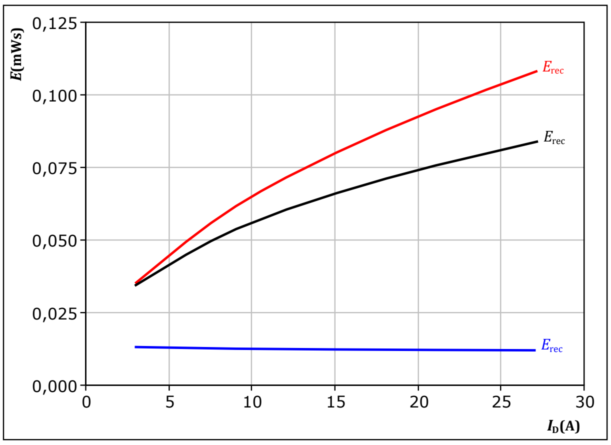
With an inductive load at

V_{DS} =	600	V	T_j:	25 °C (blue)
V_{GS} =	-4/15	V		125 °C (black)
I_D =	15	A		150 °C (red)

figure 65. **MOSFET**

Typical reverse recovered energy loss as a function of drain current

$E_{rec} = f(I_D)$



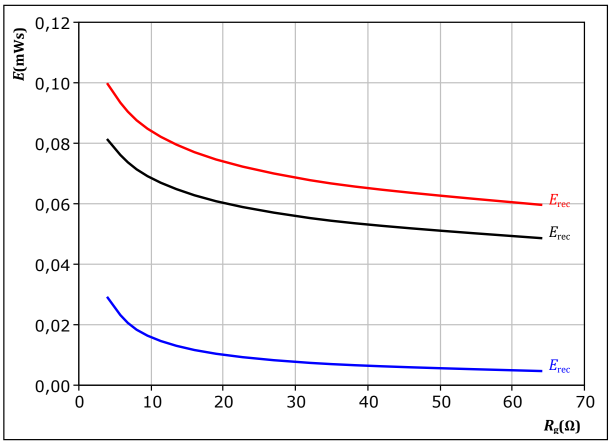
With an inductive load at

V_{DS} =	600	V	T_j:	25 °C (blue)
V_{GS} =	-4/15	V		125 °C (black)
R_{gon} =	16	Ω		150 °C (red)

figure 66. **MOSFET**

Typical reverse recovered energy loss as a function of MOSFET turn on gate resistor

$E_{rec} = f(R_g)$



With an inductive load at

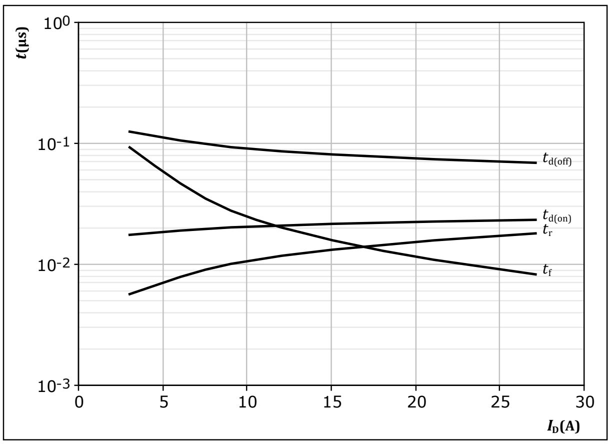
V_{DS} =	600	V	T_j:	25 °C (blue)
V_{GS} =	-4/15	V		125 °C (black)
I_D =	15	A		150 °C (red)

Half-Bridge Switching Characteristics

figure 67. **MOSFET**

Typical switching times as a function of drain current

t = f(I_D)



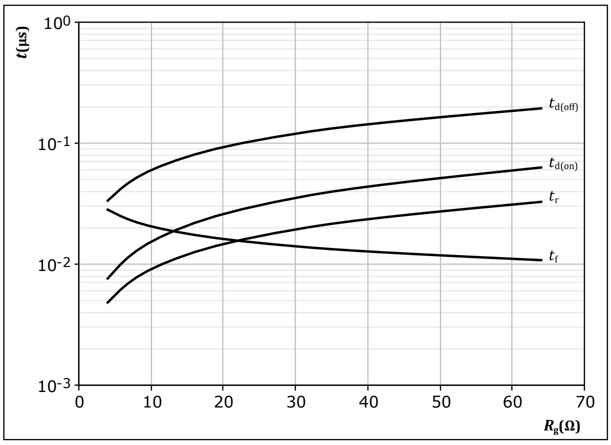
With an inductive load at

T_j =	150	°C
V_{DS} =	600	V
V_{GS} =	-4/15	V
R_{gon} =	16	Ω
R_{goff} =	16	Ω

figure 68. **MOSFET**

Typical switching times as a function of MOSFET turn on gate resistor

t = f(R_g)



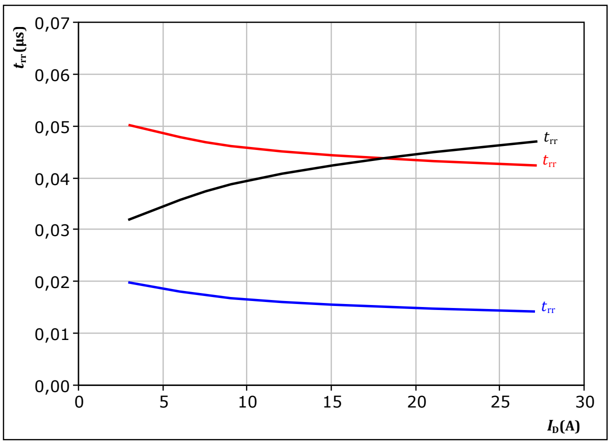
With an inductive load at

T_j =	150	°C
V_{DS} =	600	V
V_{GS} =	-4/15	V
I_D =	15	A

figure 69. **MOSFET**

Typical reverse recovery time as a function of drain current

t_{rr} = f(I_D)



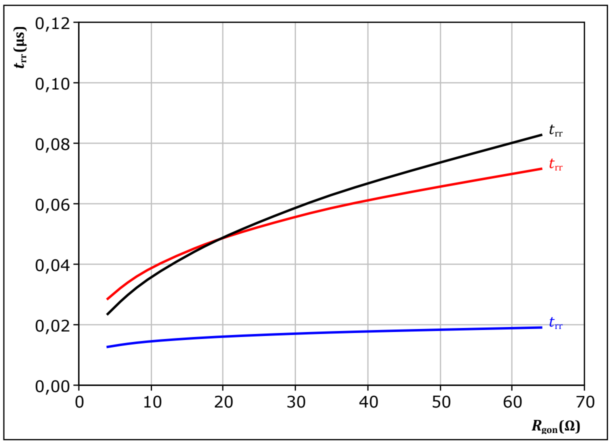
At	V_{DS} =	600	V
	V_{GS} =	-4/15	V
	R_{gon} =	16	Ω

T_j: 25 °C, 125 °C, 150 °C

figure 70. **MOSFET**

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

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



At	V_{DS} =	600	V
	V_{GS} =	-4/15	V
	I_D =	15	A

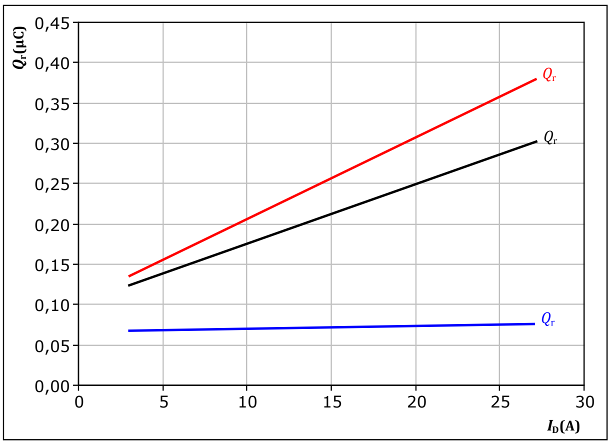
T_j: 25 °C, 125 °C, 150 °C

Half-Bridge Switching Characteristics

figure 71. MOSFET

Typical recovered charge as a function of drain current

$Q_r = f(I_D)$

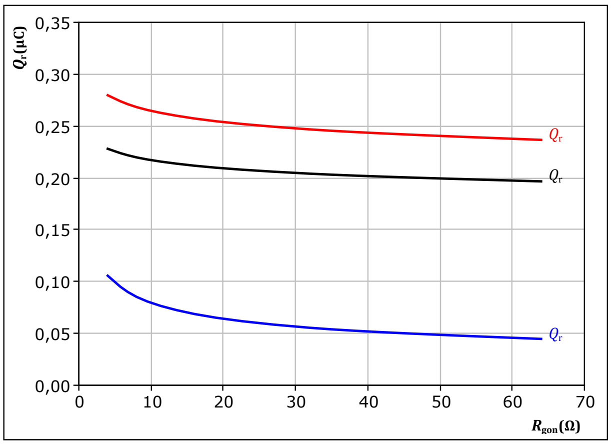


At				T_j:
	V_{DS} =	600	V	25 °C
	V_{GS} =	-4/15	V	125 °C
	R_{gon} =	16	Ω	150 °C

figure 72. MOSFET

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

$Q_r = f(R_{gon})$

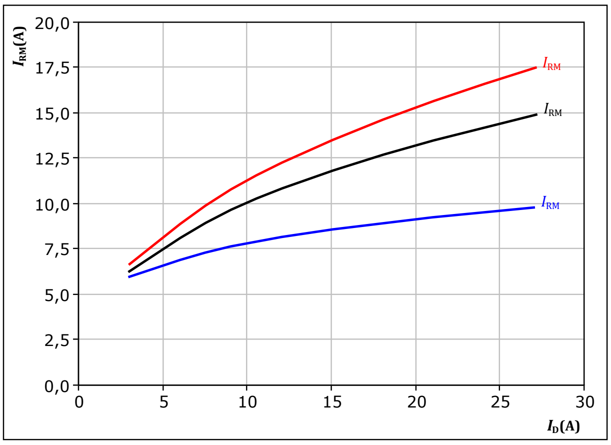


At				T_j:
	V_{DS} =	600	V	25 °C
	V_{GS} =	-4/15	V	125 °C
	I_D =	15	A	150 °C

figure 73. MOSFET

Typical peak reverse recovery current as a function of drain current

$I_{RM} = f(I_D)$

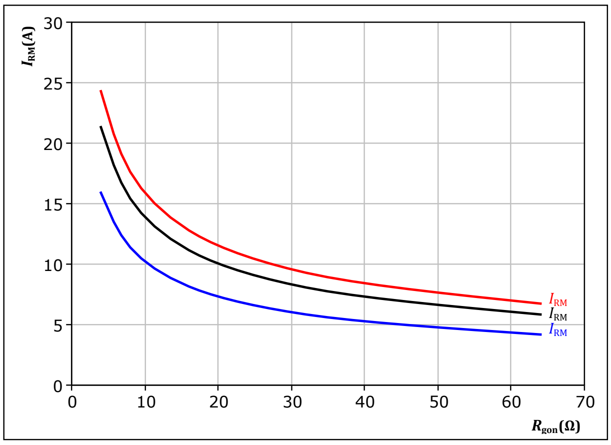


At				T_j:
	V_{DS} =	600	V	25 °C
	V_{GS} =	-4/15	V	125 °C
	R_{gon} =	16	Ω	150 °C

figure 74. MOSFET

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

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



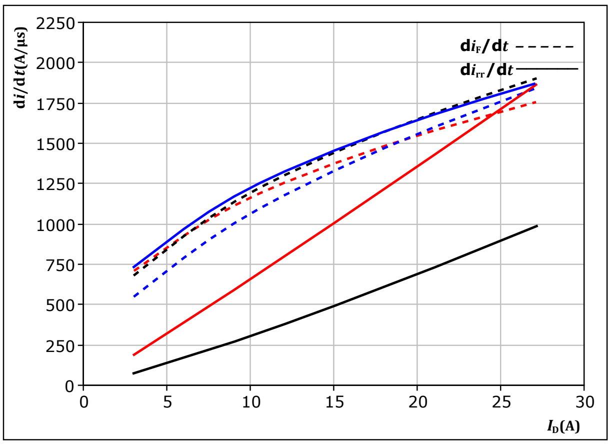
At				T_j:
	V_{DS} =	600	V	25 °C
	V_{GS} =	-4/15	V	125 °C
	I_D =	15	A	150 °C

Half-Bridge Switching Characteristics

figure 75. **MOSFET**

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

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

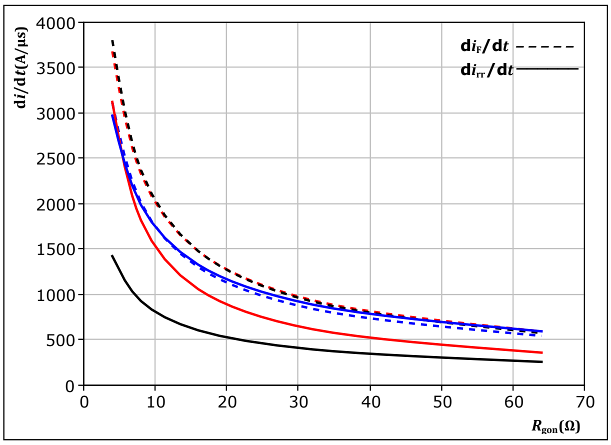


At				T_j:
	V_{DS} =	600	V	25 °C
	V_{GS} =	-4/15	V	125 °C
	R_{gon} =	16	Ω	150 °C

figure 76. **MOSFET**

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

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

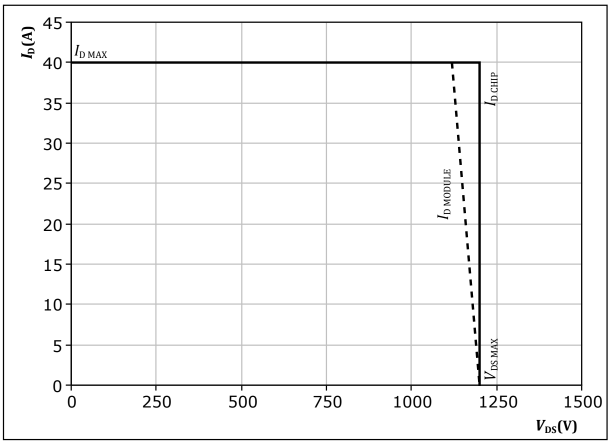


At				T_j:
	V_{DS} =	600	V	25 °C
	V_{GS} =	-4/15	V	125 °C
	I_D =	15	A	150 °C

figure 77. **MOSFET**

Reverse bias safe operating area

I_D = f(V_{DS})



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}**)**

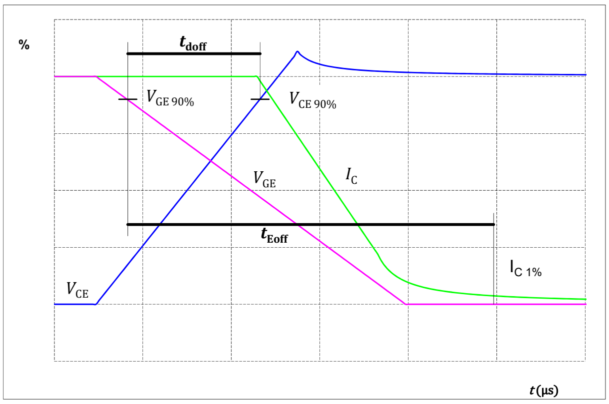


figure 79. **IGBT**

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

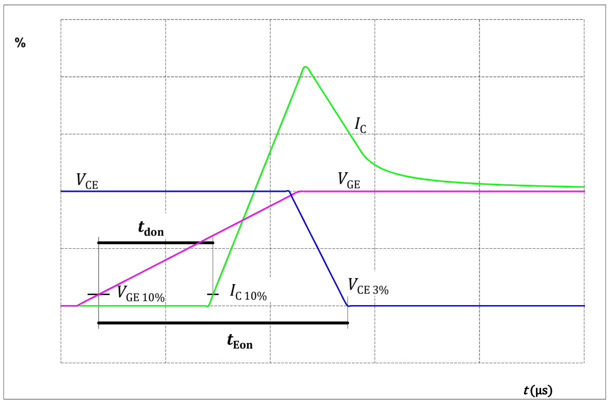


figure 80. **IGBT**

Turn-off Switching Waveforms & definition of t_f

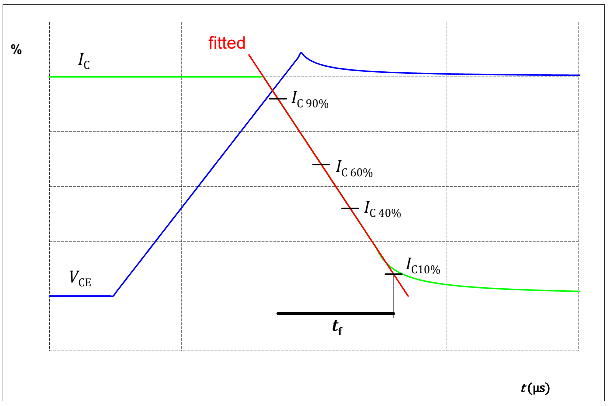
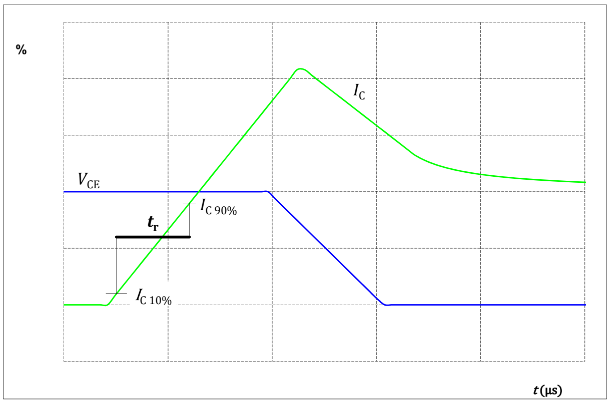


figure 81. **IGBT**

Turn-on Switching Waveforms & definition of t_r



Switching Definitions

figure 82. **FWD**

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

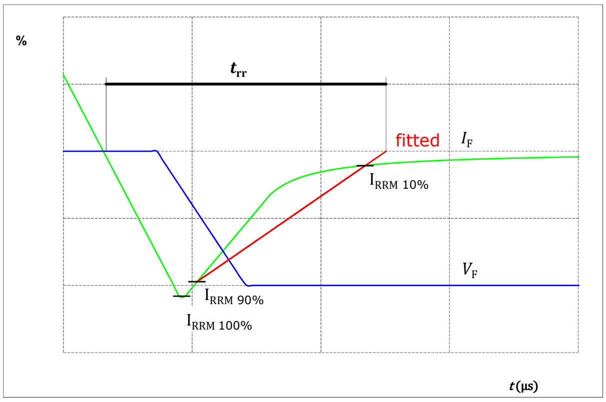
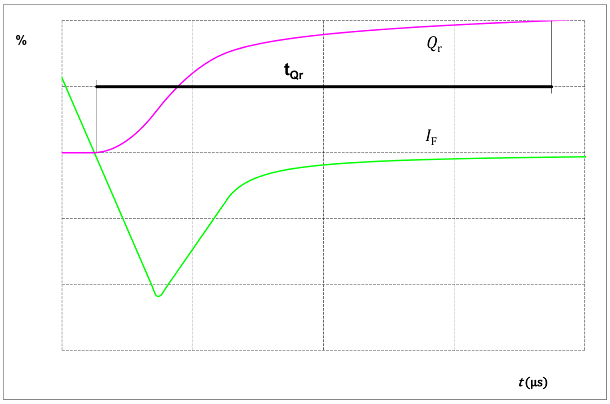


figure 83. **FWD**

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



Switching Definitions

figure 78. **MOSFET**

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

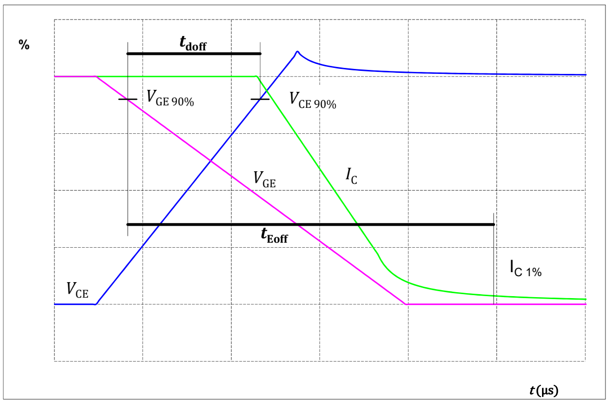


figure 79. **MOSFET**

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

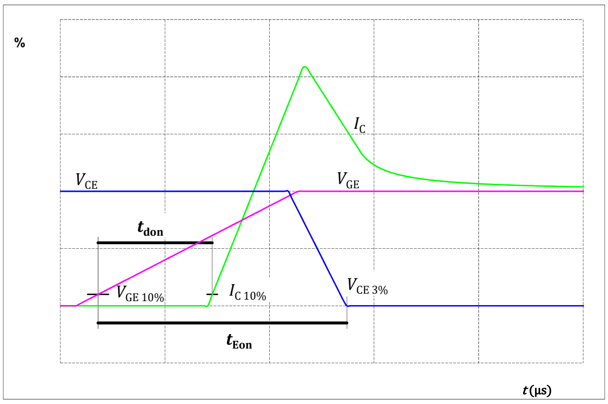


figure 80. **MOSFET**

Turn-off Switching Waveforms & definition of t_f

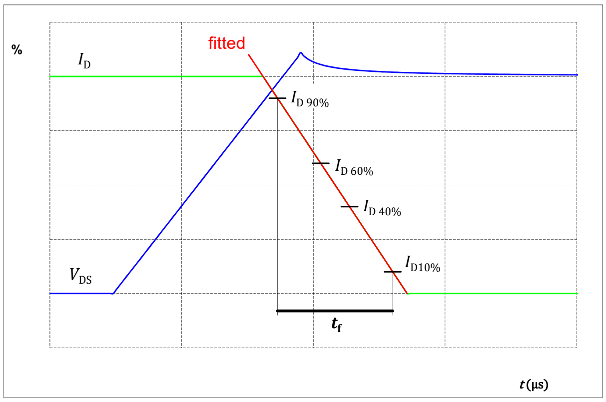
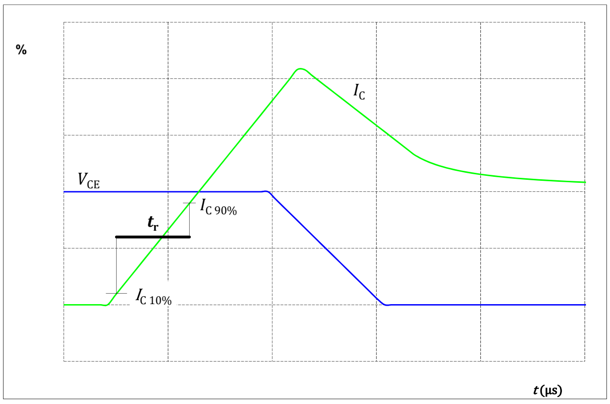


figure 81. **MOSFET**

Turn-on Switching Waveforms & definition of t_r



Switching Definitions

figure 82. **FWD**

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

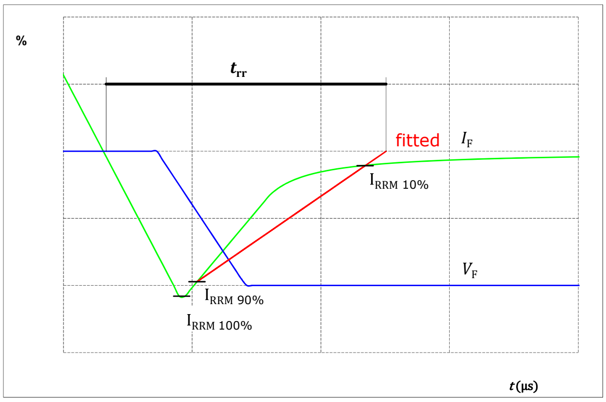


figure 83. **FWD**

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

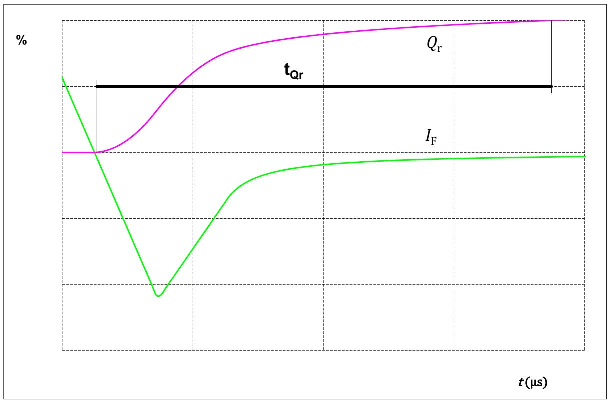
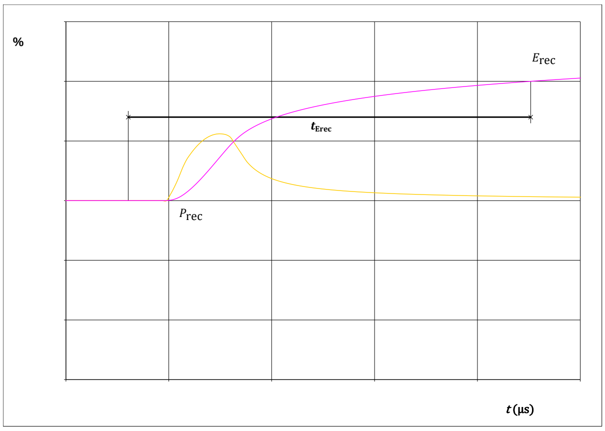


figure 84. **FWD**

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



Ordering Code

Version	Ordering Code
Without thermal paste	B0-SP12PPA040SH-PC88L41T
With thermal paste (5,2 W/mK, PTM6000HV)	B0-SP12PPA040SH-PC88L41T-/7/
With thermal paste (5,2 W/mK, PTM6000HV) and Protection Foil	B0-SP12PPA040SH-PC88L41T-/7F/

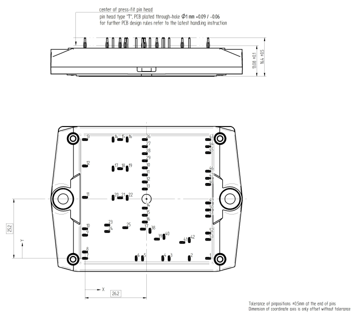
Marking

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

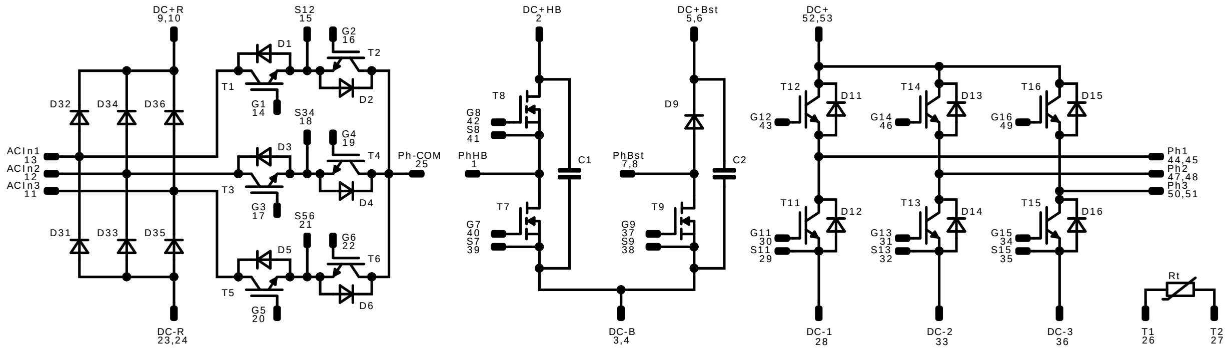
Outline

Pin table [mm]

Pin	X	Y	Function	28	25,45	44,4	DC-1
1	52,4	0	PhHB	29	25,45	41,4	S11
2	44,4	0	DC+HB	30	25,45	38,4	G11
3	35,8	0	DC-B	31	25,45	35,4	G13
4	33,1	0	DC-B	32	25,45	32,4	S13
5	24,5	0	DC+Bst	33	25,45	29,4	DC-2
6	21,8	0	DC+Bst	34	25,45	21,3	G15
7	0	0	PhBst	35	25,45	18,3	S15
8	0	2,7	PhBst	36	25,45	15,4	DC-3
9	0	9,85	DC+R	37	24,65	12,4	G9
10	0	12,55	DC+R	38	27,65	11,7	S9
11	0	25,9	ACIn3	39	30,6	8,15	S7
12	0	39,2	ACIn2	40	33,6	9,15	G7
13	0	50,4	ACIn1	41	41,4	6,75	S8
14	11,95	50,4	G1	42	44,4	7,75	G8
15	14,95	50,4	S12	43	52,4	50,4	G12
16	17,95	50,4	G2	44	52,4	47,4	Ph1
17	11,95	38,05	G3	45	52,4	44,8	Ph1
18	14,95	38,05	S34	46	52,4	36,95	G14
19	17,95	38,05	G4	47	52,4	33,95	Ph2
20	11,95	25,7	G5	48	52,4	31,35	Ph2
21	14,95	25,7	S56	49	52,4	23,5	G16
22	17,95	25,7	G6	50	52,4	20,5	Ph3
23	9,45	14,1	DC-R	51	52,4	17,9	Ph3
24	9,45	11,4	DC-R	52	52,4	10,7	DC+
25	17,15	13	Ph-COM	53	52,4	8	DC+
26	25,45	50,4	T1				
27	25,45	47,4	T2				



Pinout



Identification

ID	Component	Voltage	Current	Function	Comment
T11, T12, T13, T14, T15, T16	IGBT	1200 V	40 A	Inverter Switch	
D11, D12, D13, D14, D15, D16	FWD	1200 V	35 A	Inverter Diode	
T9	MOSFET	1200 V	32 mΩ	Boost Switch	
D9	FWD	1200 V	30 A	Boost Diode	
T7, T8	MOSFET	1200 V	75 mΩ	Half-Bridge Switch	
D31, D32, D33, D34, D35, D36	Rectifier	1600 V	28 A	AC Diode	
T1, T2, T3, T4, T5, T6	IGBT	1200 V	10 A	Mux Switch	
D1, D2, D3, D4, D5, D6	FWD	1200 V	10 A	Mux Diode	
C1, C2	Capacitor	1000 V		Capacitor (DC)	
Rt	Thermistor			Thermistor	

Packaging instruction				
Standard packaging quantity (SPQ) 45	>SPQ	Standard	<SPQ	Sample

Handling instruction
Handling instructions for *flow* S3 packages see vincotech.com website.

Package data
Package data for *flow* S3 packages see vincotech.com website.

Vincotech thermistor reference
See Vincotech thermistor reference table at vincotech.com website.

UL recognition and file number
Certification pending. For more information see vincotech.com website.

Document No.:	Date:	Modification:	Pages
B0-SP12PPA040SH-PC88L41T-D2-14	15 Jan. 2024	Change of Capacitor (DC)	