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Data sheet 1516-01 Aug 2024

5SNG 0450R170301

LoPak phase leg IGBT module

- V_{CE} = 1700 V
- I_C = 2x 450 A
- Solder Signal pins for reliable auxiliary contacts
- Ultra low-loss, rugged SPT++ chip-set
- NTC thermistor for temperature sensing
- Cu baseplate for low thermal resistance
- Industry standard package

Maximum rated values [1)]

Parameter	Symbol	Conditions	Min.	Max.	Unit
Collector-emitter voltage	V_{ces}	V_{GE} = 0 V, $T_{vj} \geq$ 25 °C		1700	V
DC collector current	I_c	T_C = 115 °C, T_{vj} = 175 °C		450	A
Peak collector current	I_{cm}	t_p = 1 ms		900	A
Gate-emitter voltage	V_{ges}		-20	20	V
DC forward current	I_f			450	A
Peak forward current	I_{frm}	t_p = 1 ms		900	A
Surge current	I_{fsm}	$T_{vj\ start}$ = 175 °C, t_p = 10 ms, half-sinewave		2250	A
IGBT short circuit SOA	t_{psc}	$V_{GE} \leq$ 15 V, V_{CC} = 1300 V $V_{CE,max} \leq$ 1700 V, $T_{vj,start} \leq$ 150 °C		10	µs
Isolation voltage	V_{isol}	1 min, f = 50 Hz		4000	V
Max Junction temperature	T_{vj}		-40	175	°C
Junction operating temperature	$T_{vj(op)}$		-40	175	°C
Case temperature	T_c		-40	125[2)] / 150	°C
Storage temperature	T_{stg}		-40	125	°C
Mounting torques [3)]	M_s	Base-heatsink, M5 screws	3	6	Nm
	M_{t1}	Main terminals, M6 screws	3	6	

[1)] Maximum rated values indicate limits beyond which damage to the device may occur per IEC 60747
[2)] For UL1557 compliance T_{Cmax} must be limited to 125°C
[3)] For detailed mounting instructions refer to application note 5SYA 2113

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IGBT characteristic values [4)]

Parameter	Symbol	Conditions		Min.	Typ.	Max.	Unit
Collector-emitter breakdown voltage	$V_{(BR)CES}$	V_{GE} = 0 V, I_C = 10 mA	T_{vj} = 25 °C	1700			V
Collector-emitter [5)] saturation voltage	V_{CEsat}	I_C = 450 A, V_{GE} = 15 V	T_{vj} = 25 °C		2.25	2.6	V
			T_{vj} = 125 °C		2.55		V
			T_{vj} = 175 °C		2.75		V
Collector cut-off current	I_{CES}	V_{CE} = 1700 V, V_{GE} = 0 V	T_{vj} = 25 °C			0.1	mA
			T_{vj} = 125 °C		1.2		mA
			T_{vj} = 175 °C		20		mA
Gate leakage current	I_{GES}	V_{CE} = 0 V, V_{GE} = ± 20 V	T_{vj} = 175 °C	-500		500	nA
Gate-emitter threshold voltage	$V_{GE(th)}$	I_C = 12 mA, V_{CE} = V_{GE}	T_{vj} = 25 °C	4.5	5.5	6.5	V
Gate charge	Q_G	I_C = 450 A, V_{CE} = 900 V, V_{GE} = -15 V ..15 V			3.2		µC
Input capacitance	C_{ies}	V_{CE} = 25 V, V_{GE} = 0 V, f = 1 MHz	T_{vj} = 25 °C		28.8		nF
Internal gate resistance	$R_{g,int}$	per switch			1		Ω
Turn-on delay time	$t_{d(on)}$	V_{CC} = 900 V, I_C = 450 A, R_G = 0.47 Ω, V_{GE} = ±15 V, $L_σ$ = 40 nH, inductive load	T_{vj} = 25 °C		245		ns
			T_{vj} = 125 °C		260		ns
			T_{vj} = 175 °C		270		ns
Rise time	t_r		T_{vj} = 25 °C		70		ns
			T_{vj} = 125 °C		90		ns
			T_{vj} = 175 °C		95		ns
Turn-off delay time	$t_{d(off)}$	V_{CC} = 900 V, I_C = 450 A, R_G = 0.47 Ω, V_{GE} = ±15 V, $L_σ$ = 40 nH, inductive load	T_{vj} = 25 °C		440		ns
			T_{vj} = 125 °C		540		ns
			T_{vj} = 175 °C		600		ns
Fall time	t_f		T_{vj} = 25 °C		110		ns
			T_{vj} = 125 °C		160		ns
			T_{vj} = 175 °C		165		ns
Turn-on switching energy	E_{on}	V_{CC} = 900 V, I_C = 450 A, R_G = 0.47 Ω, V_{GE} = ±15 V, $L_σ$ = 40 nH, inductive load	T_{vj} = 25 °C		95		mJ
			T_{vj} = 125 °C		145		mJ
			T_{vj} = 175 °C		185		mJ
Turn-off switching energy	E_{off}	V_{CC} = 900 V, I_C = 450 A, R_G = 0.47 Ω, V_{GE} = ±15 V, $L_σ$ = 40 nH, inductive load	T_{vj} = 25 °C		90		mJ
			T_{vj} = 125 °C		135		mJ
			T_{vj} = 175 °C		165		mJ
Short circuit current	I_{SC}	t_{psc} ≤ 10 µs, V_{GE} = 15 V, V_{CC} = 1300 V, $V_{CEM\ CHIP}$ ≤ 1700 V	T_{vj} = 150 °C		1500		A

[4)] Characteristic values according to IEC 60747 – 9
[5)] Collector-emitter saturation voltage is given at chip level

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Diode characteristic values [6]

Parameter	Symbol	Conditions		Min.	Typ.	Max.	Unit
Forward voltage [7]	V_F	I_F = 450 A	T_{vj} = 25 °C		1.6	2.2	V
			T_{vj} = 125 °C		1.75		V
			T_{vj} = 175 °C		1.7		V
Peak reverse recovery current	I_{rm}	V_{CC} = 900 V, I_F = 450 A, V_{GE} = ±15 V, R_G = 0.47 Ω, di/dt = 5.3 kA/µs L_σ = 40 nH, inductive load	T_{vj} = 25 °C		480		A
			T_{vj} = 125 °C		490		A
			T_{vj} = 175 °C		530		A
Recovered charge	Q_{rr}		T_{vj} = 25 °C		120		µC
			T_{vj} = 125 °C		190		µC
			T_{vj} = 175 °C		260		µC
Reverse recovery time	t_{rr}		T_{vj} = 25 °C		490		ns
			T_{vj} = 125 °C		790		ns
			T_{vj} = 175 °C		930		ns
Reverse recovery energy	E_{rec}		T_{vj} = 25 °C		75		mJ
			T_{vj} = 125 °C		115		mJ
			T_{vj} = 175 °C		155		mJ

[6] Characteristic values according to IEC 60747 – 2

[7] Forward voltage is given at chip level

NTC Thermistor

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Rated resistance	R_{25}	T_c = 25 °C		5		kΩ
R100	R_{100}	T_c = 100 °C	468		517	Ω
B-value	$B_{25/85}$	$R_{25} = R_{25}$ exp $[B_{25/85}(1/T_2 – 1/(298.15K))]$		3375		K
B-value	$B_{25/100}$	$R_{25} = R_{25}$ exp $[B_{25/100}(1/T_2 – 1/(298.15K))]$		3433		K

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Package properties

Parameter	Symbol	Conditions		Min.	Typ.	Max.	Unit
IGBT thermal resistance junction to case	$R_{th(j-c)IGBT}$	per switch				0.048	K/W
Diode thermal resistance junction to case	$R_{th(j-c)DIODE}$	per switch				0.087	K/W
IGBT thermal resistance case to heatsink	$R_{th(c-s)IGBT}$	IGBT per switch, λ grease = 5.2 W/m x K			0.025		K/W
Diode thermal resistance case to heatsink	$R_{th(c-s)DIODE}$	Diode per switch, λ grease = 5.2 W/m x K			0.041		K/W
Comparative tracking index	CTI			200			
Module stray inductance	$L_{\sigma\ CE}$	per switch			25		nH
Resistance, terminal-chip	$R_{CC'+EE'}$		T_C = 25 °C		0.95		mΩ
			T_C = 125 °C		1.35		
			T_C = 175 °C		1.55		

Mechanical properties [8)]

Parameter	Symbol	Conditions		Min.	Typ.	Max.	Unit
Dimensions	L x W x H	Typical			152 x 62 x 17		mm
Clearance distance in air	d_a	According to IEC 60664-1 and EN 50124-1	Term. to base:	12.5			mm
			Term. to base:	10			
Surface creepage distance	d_s		Term. to base:	14.5			
			Term. to base:	13			
Mass	m				350		g

8) Package and mechanical properties according to IEC 60747 – 15

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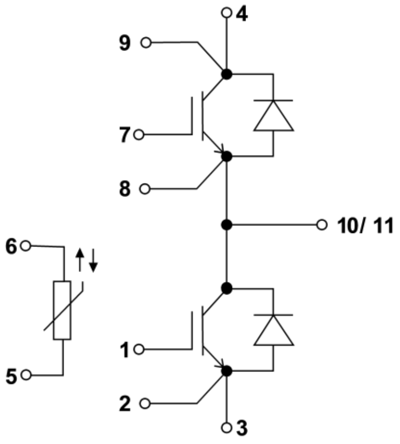
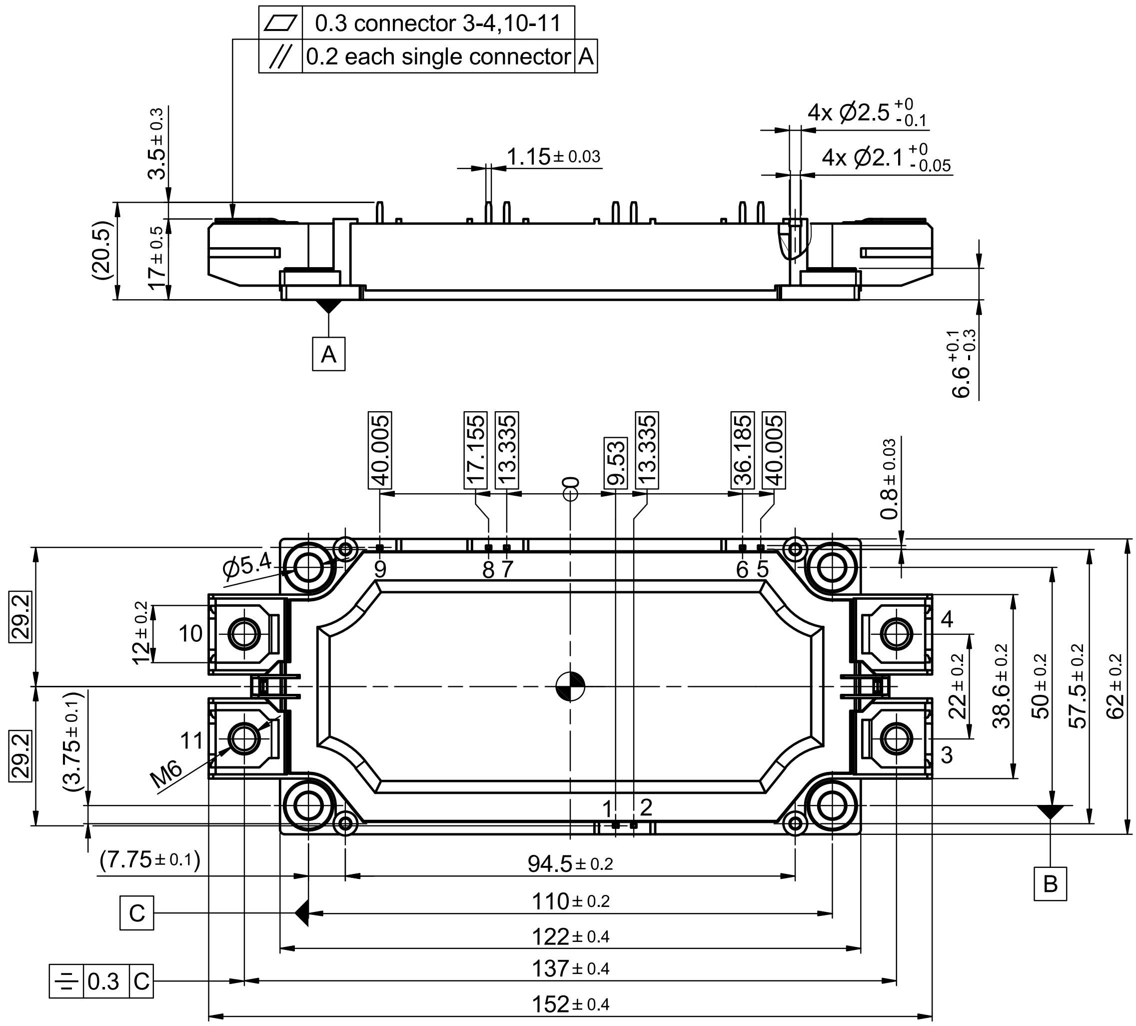
Electrical configuration



Mechanical drawing



Note: all dimensions are shown in millimeters

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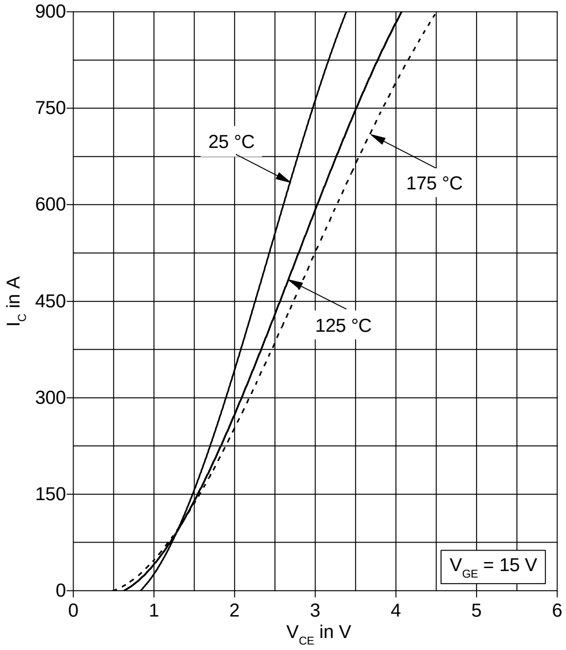

Fig. 1 Typical on-state characteristics, chip level

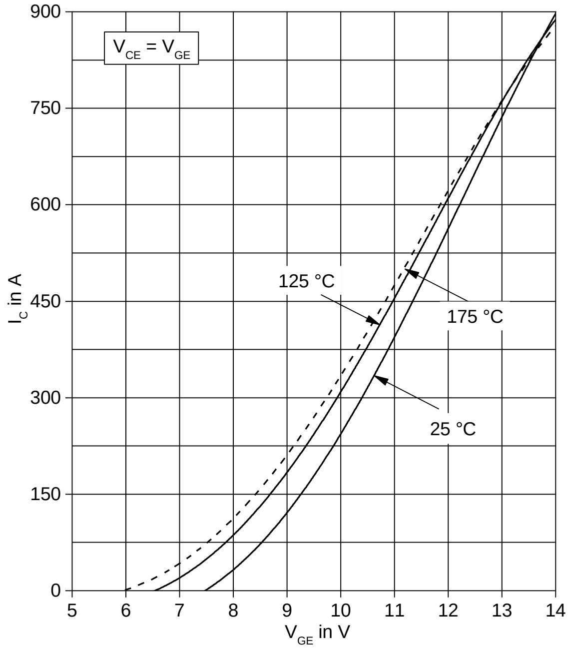

Fig. 2 Typical transfer characteristics, chip level

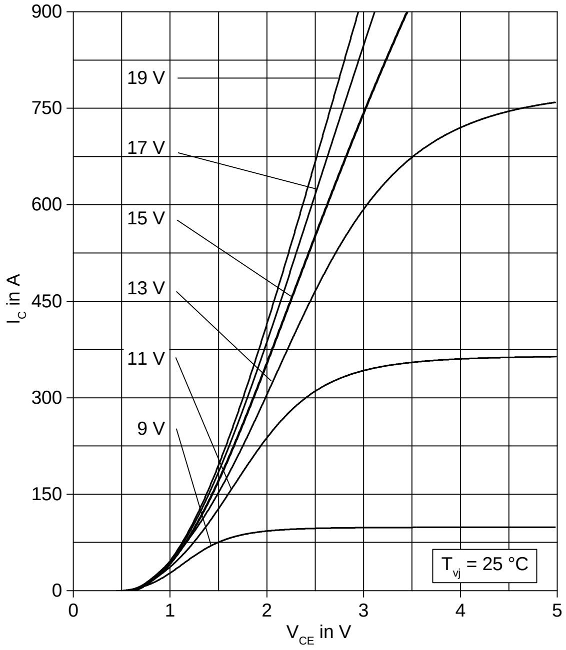

Fig. 3 Typical output characteristics, chip level

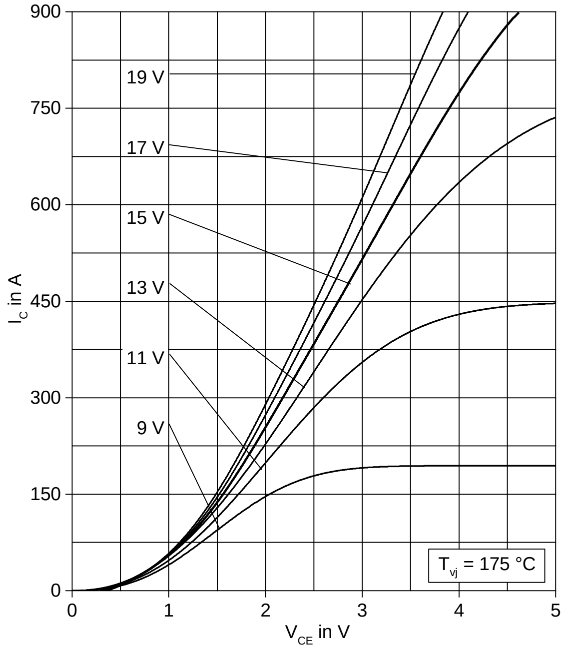

Fig. 4 Typical output characteristics, chip level

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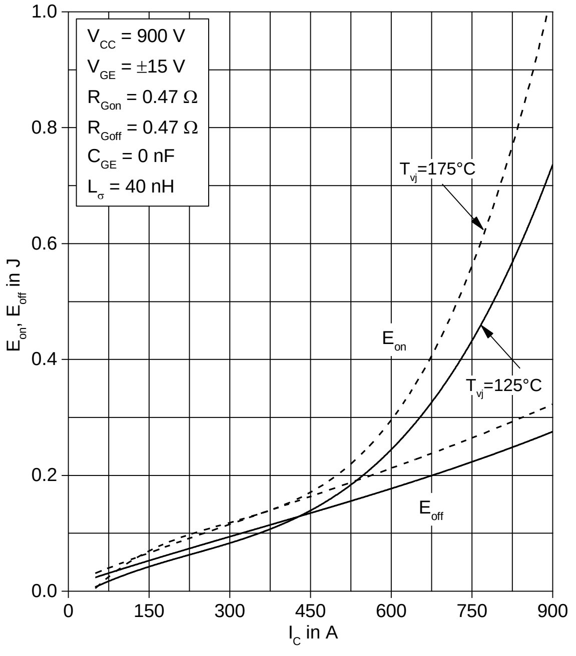

Fig. 5 Typical switching energies per pulse vs. collector current

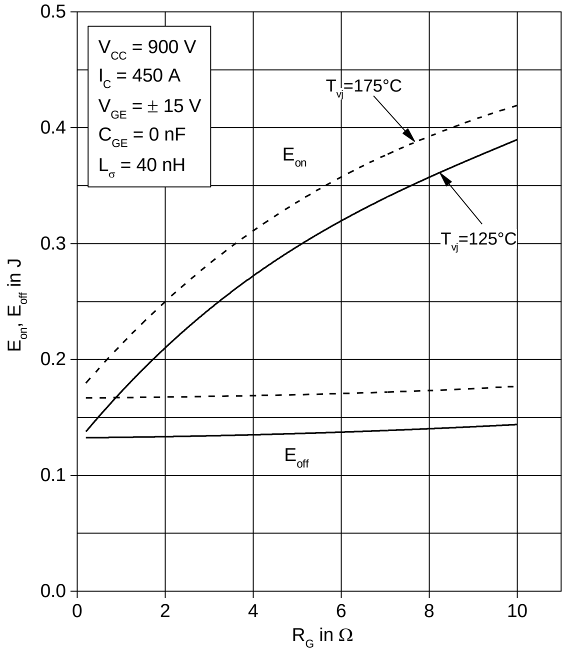

Fig. 6 Typical switching energies per pulse vs. gate resistor

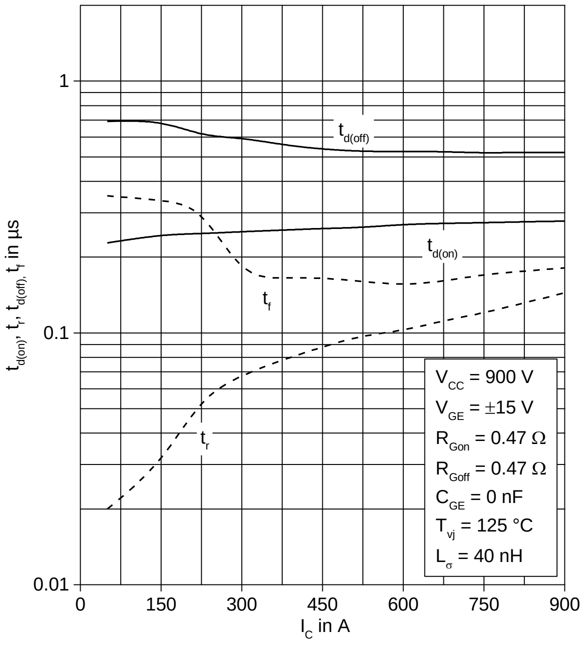

Fig. 7 Typical switching times vs. collector current

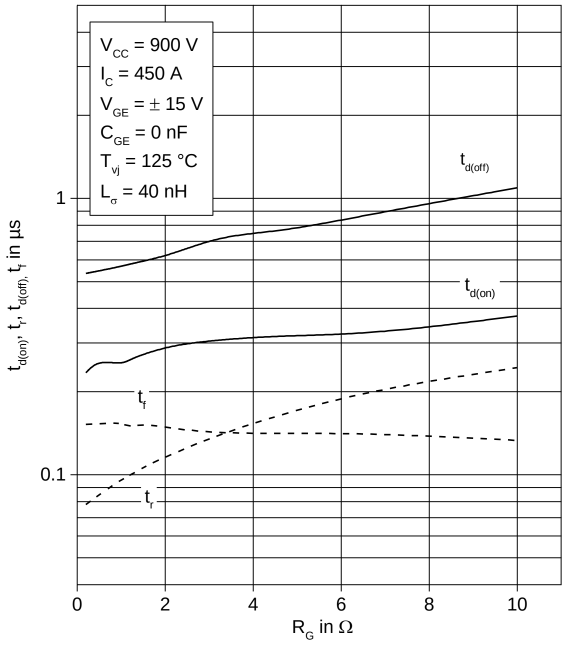

Fig. 8 Typical switching times vs. gate resistor

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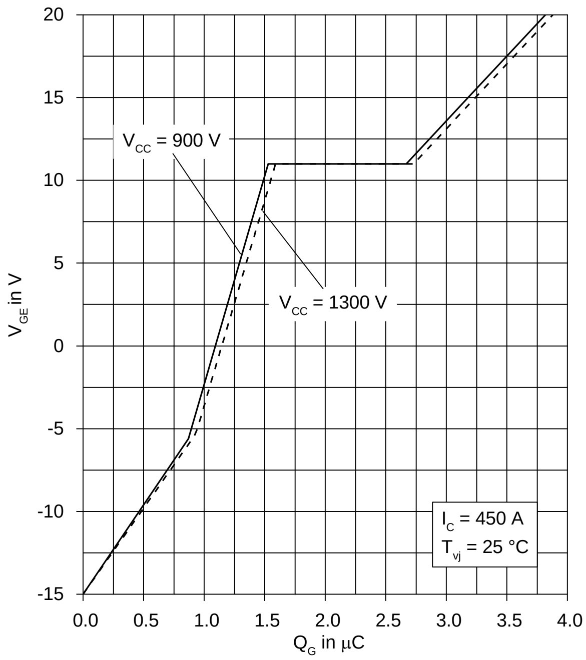

Fig. 9 Typical gate charge characteristics

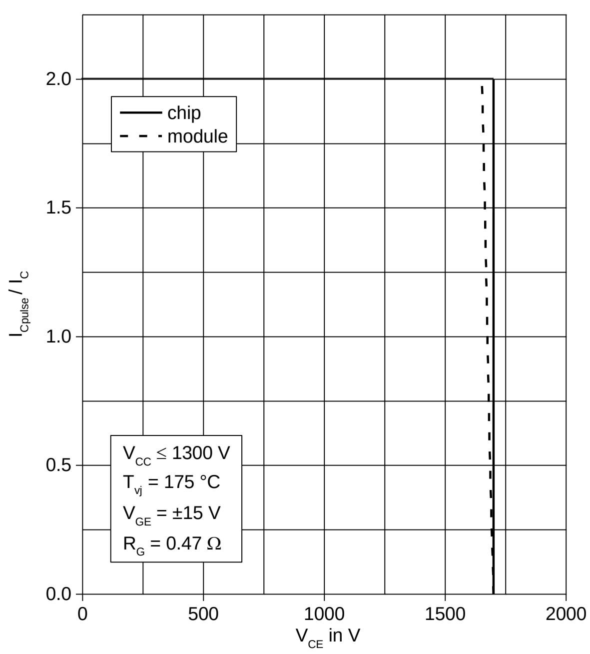

Fig. 10 Turn-off safe operating area (RBSOA)

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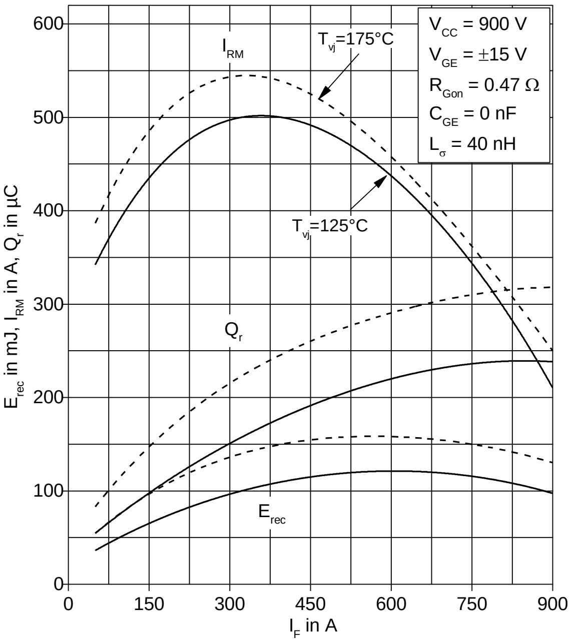

Fig. 11 Typical reverse recovery characteristics vs. forward current

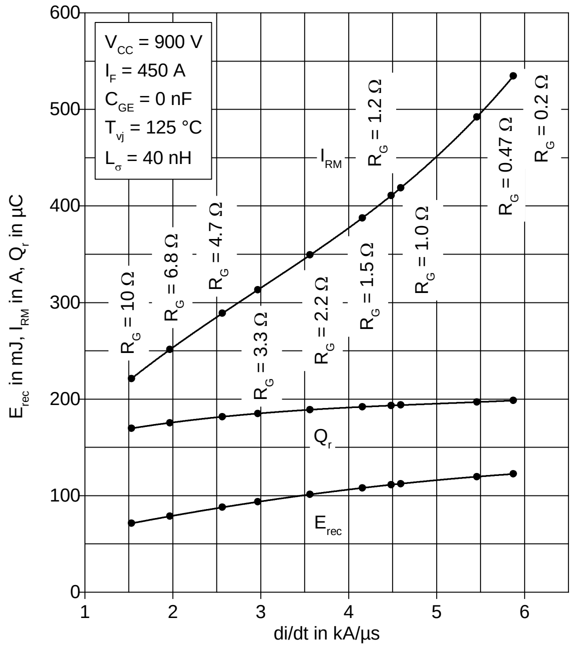

Fig. 12 Typical reverse recovery characteristics vs. di/dt

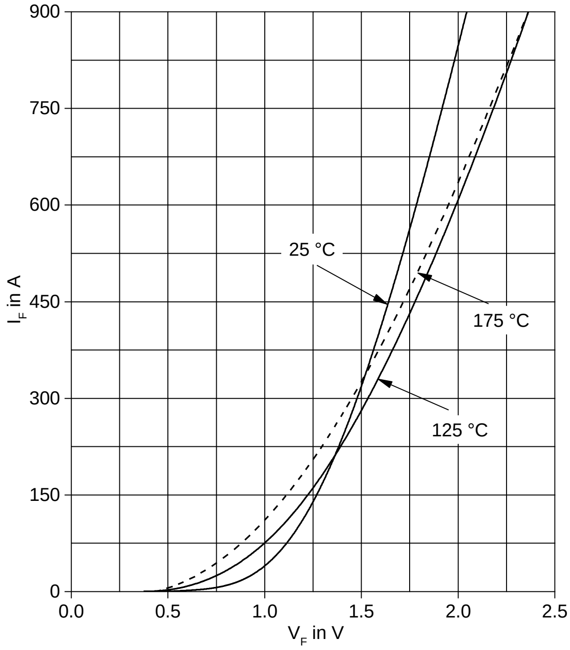

Fig. 13 Typicial diode forward characteristics chip level

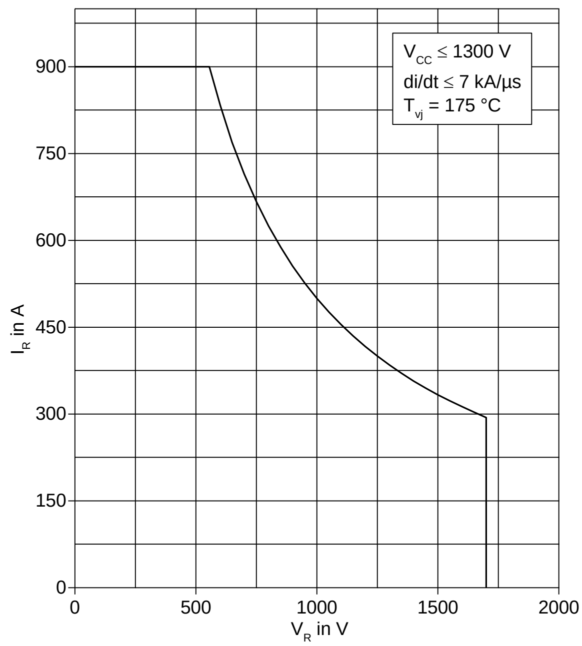

Fig. 14 Diode turn-off safe operating area (DSOA)

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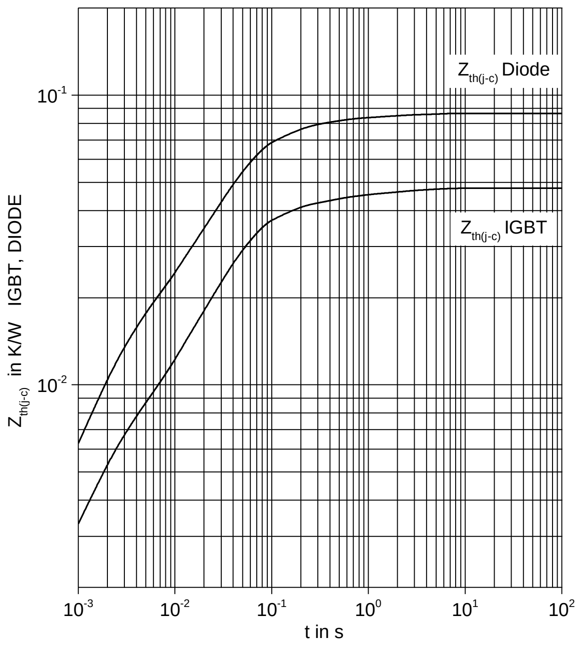

Fig. 16 Thermal impedance vs time

Analytical function for transient thermal impedance:

$$Z_{th\,(j\text{-}c)}(t) = \sum_{i=1}^{n} R_i \left(1 - e^{-t/\tau_i}\right)$$

	i	1	2	3	4	5
IGBT	Ri(K/kW)	4.97	33.5	6.07	3.29	
	τi(ms)	1.43	42	318	2400	
DIODE	Ri(K/kW)	11.7	58.9	11.9	3.99	
	τi(ms)	1.87	42.8	262	2290	

Related documents:

5SYA 2042 Failure rates of IGBT modules due to cosmic rays
5SYA 2045 Thermal runaway during blocking
5SYA 2053 Applying IGBT
5SYA 2057 IGBT diode safe operating area (SOA)
5SYA 2058 Surge currents for IGBT diodes
5SYA 2093 Thermal design of IGBT modules
5SYA 2098 Paralleling of IGBT modules
5SYA 2113 Mounting instructions for LoPak modules

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