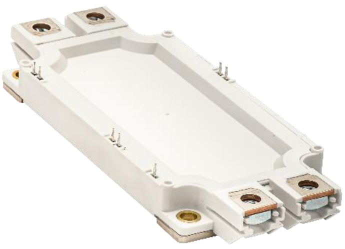
HITACHI
Inspire the Next

Data sheet 5SYA 1488-01 Jan 22

5SNG 0600R120500

LoPak phase leg IGBT module

- V_{CE} = 1200 V
- I_C = 2x 600 A
- Press-fit pins for reliable auxiliary contacts
- Ultra low-loss rugged Trench IGBT chipset
- 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} ≥ 25 °C			1200	V
DC collector current	I_C	T_C = 105 °C, T_{vj} = 175 °C			600	A
Peak collector current	I_{CM}	t_p = 1 ms			1200	A
Gate-emitter voltage	V_{GES}			-20	20	V
DC forward current	I_F				600	A
Peak forward current	I_{FRM}	t_p = 1 ms			1200	A
Surge current	I_{FSM}	$T_{vj\ start}$ = 175 °C, t_p = 10 ms, half-sinewave			2000	A
IGBT short circuit SOA	t_{psc}	V_{GE} ≤ 15 V, V_{CC} = 900 V $V_{CE,max}$ ≤ 1200 V	$T_{vjstart}$ ≤ 150 °C		8	µs
			$T_{vjstart}$ ≤ 175 °C		6	
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 2142

IGBT characteristic values [4)]

Parameter	Symbol	Conditions		Min.	Typ.	Max.	Unit
Collector-emitter breakdown voltage	$V_{(BR)CES}$	V_{GE} = 0 V, I_C = 5 mA	T_{vj} = 25 °C	1200			V
Collector-emitter [5)] saturation voltage	V_{CEsat}	I_C = 600 A, V_{GE} = 15 V	T_{vj} = 25 °C		1.53		V
			T_{vj} = 125 °C		1.71		V
			T_{vj} = 175 °C		1.83		V
Collector cut-off current	I_{CES}	V_{CE} = 1200 V, V_{GE} = 0 V	T_{vj} = 25 °C			0.1	mA
			T_{vj} = 125 °C		0.35		mA
			T_{vj} = 175 °C		12		mA
Gate leakage current	I_{GES}	V_{CE} = 0 V, V_{GE} = ± 20 V	T_{vj} = 125 °C	-150		150	nA
Gate-emitter threshold voltage	$V_{GE(th)}$	I_C = 24 mA, V_{CE} = V_{GE}	T_{vj} = 25 °C		5.5		V
Gate charge	Q_G	I_C = 600 A, V_{CE} = 600 V, V_{GE} = -15 V ..15 V			4.1		µC
Input capacitance	C_{ies}	per switch	T_{vj} = 25 °C		76		nF
Internal gate resistance	$R_{g,int}$	per switch			2		Ω
Turn-on delay time	$t_{d(on)}$	V_{CC} = 600 V, I_C = 600 A, R_G = 0.51 Ω, C_{GE} = 0 nF, V_{GE} = ±15 V, $L_σ$ = 30 nH, inductive load	T_{vj} = 25 °C		435		ns
			T_{vj} = 125 °C		488		ns
			T_{vj} = 175 °C		510		ns
Rise time	t_r		T_{vj} = 25 °C		156		ns
			T_{vj} = 125 °C		202		ns
			T_{vj} = 175 °C		225		ns
Turn-off delay time	$t_{d(off)}$	V_{CC} = 600 V, I_C = 600 A, R_G = 0.51 Ω, C_{GE} = 0 nF, V_{GE} = ±15 V, $L_σ$ = 30 nH, inductive load	T_{vj} = 25 °C		385		ns
			T_{vj} = 125 °C		417		ns
			T_{vj} = 175 °C		427		ns
Fall time	t_f		T_{vj} = 25 °C		112		ns
			T_{vj} = 125 °C		148		ns
			T_{vj} = 175 °C		176		ns
Turn-on switching energy	E_{on}	V_{CC} = 600 V, I_C = 600 A, R_G = 0.51 Ω, C_{GE} = 0 nF, V_{GE} = ±15 V, $L_σ$ = 30 nH, inductive load	T_{vj} = 25 °C		95		mJ
			T_{vj} = 125 °C		140		mJ
			T_{vj} = 175 °C		171		mJ
Turn-off switching energy	E_{off}	V_{CC} = 600 V, I_C = 600 A, R_G = 0.51 Ω, C_{GE} = 0 nF, V_{GE} = ±15 V, $L_σ$ = 30 nH, inductive load	T_{vj} = 25 °C		67		mJ
			T_{vj} = 125 °C		99		mJ
			T_{vj} = 175 °C		115		mJ
Short circuit current	I_{SC}	V_{CC} = 900 V, V_{GE} = 15 V, $V_{CEM\ CHIP}$ ≤ 1200 V	T_{vj} = 175 °C		2500		A

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

Hitachi Energy Switzerland Ltd
Semiconductors
Fabrikstrasse 3
5600 Lenzburg
Switzerland
Tel: +41 58 586 10 00

E-Mail: salesdesksem@hitachienergy.com

Diode characteristic values [6)]

Parameter	Symbol	Conditions		Min.	Typ.	Max.	Unit
Forward voltage [7)]	V_F	I_F = 600 A	T_{vj} = 25 °C		1.67		V
			T_{vj} = 125 °C		1.71		V
			T_{vj} = 175 °C		1.65		V
Peak reverse recovery current	I_{rm}	V_{CC} = 600 V, I_F = 600 A, V_{GE} = ±15 V, R_G = 0.51 Ω, C_{GE} = 0 nF, L_σ = 30 nH, dI/dt = 2.9 kA / µs, inductive load	T_{vj} = 25 °C		368		A
			T_{vj} = 125 °C		377		A
			T_{vj} = 175 °C		400		A
Recovered charge	Q_{rr}		T_{vj} = 25 °C		77		µC
			T_{vj} = 125 °C		105		µC
			T_{vj} = 175 °C		141		µC
Reverse recovery time	t_{rr}		T_{vj} = 25 °C		294		ns
			T_{vj} = 125 °C		498		ns
			T_{vj} = 175 °C		696		ns
Reverse recovery energy	E_{rec}		T_{vj} = 25 °C		18		mJ
			T_{vj} = 125 °C		26		mJ
			T_{vj} = 175 °C		34		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

Hitachi Energy Switzerland Ltd
Semiconductors
Fabrikstrasse 3
5600 Lenzburg
Switzerland
Tel: +41 58 586 10 00

E-Mail: salesdesksem@hitachienergy.com

www.hitachienergy.com/semiconductors

Package properties

Parameter	Symbol	Conditions		Min.	Typ.	Max.	Unit
IGBT thermal resistance junction to case	$R_{th(j-c)IGBT}$	per switch				0.0645	K/W
Diode thermal resistance junction to case	$R_{th(j-c)DIODE}$	per switch				0.1425	K/W
IGBT thermal resistance case to heatsink [8]	$R_{th(c-s)IGBT}$	IGBT per switch, λ_{Grease} = 1 W/m x K			0.029		K/W
Diode thermal resistance case to heatsink [8]	$R_{th(c-s)DIODE}$	Diode per switch, λ_{Grease} = 1 W/m x K			0.036		K/W
Comparative tracking index	CTI			200			
Module stray inductance	$L_{\sigma CE}$	per switch			20		nH
Resistance, terminal-chip	$R_{CC'-EE'}$	per switch	T_C = 25 °C		0.95		mΩ
			T_C = 125 °C		1.35		
			T_C = 175 °C		1.55		

[8] Depends on heatsink design

Mechanical properties [9]

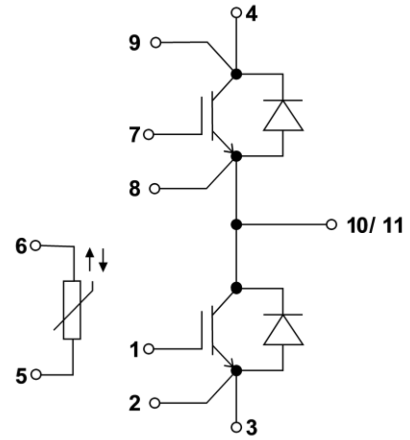
Parameter	Symbol	Conditions		Min.	Typ.	Max.	Unit
Dimensions	L x W x H	Typical			152 x 62 x 17		mm
Clearance distance in air	d_a	According to IEC 60664-1 and EN 50124-1	Term. to base:	12.5			mm
			Term. to base:	10			
Surface creepage distance	d_s		Term. to base:	14.5			
			Term. to base:	13			
Mass	m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

[9] Package and mechanical properties according to IEC 60747 – 15

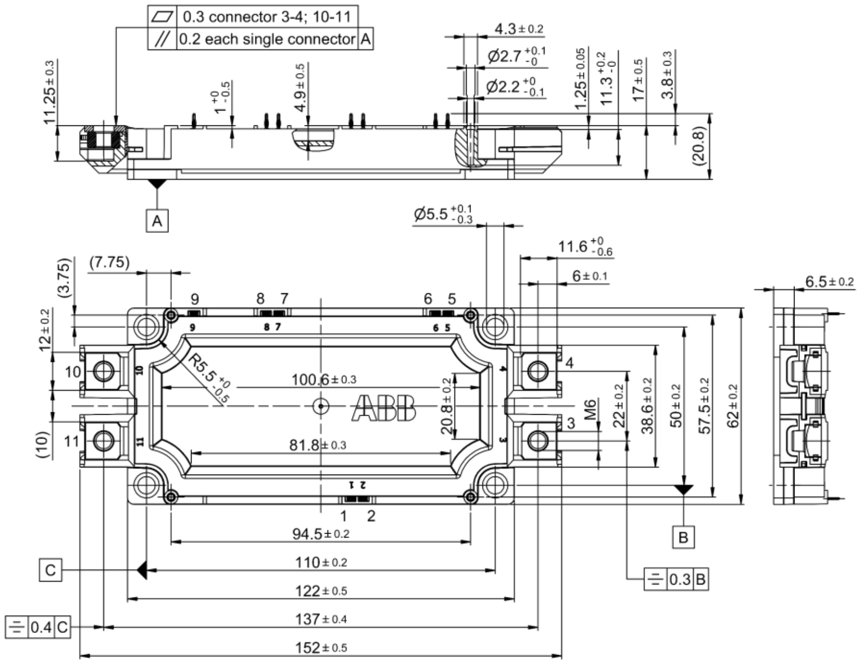
Hitachi Energy Switzerland Ltd
Semiconductors
Fabrikstrasse 3
5600 Lenzburg
Switzerland
Tel: +41 58 586 10 00

E-Mail: salesdesksem@hitachienergy.com

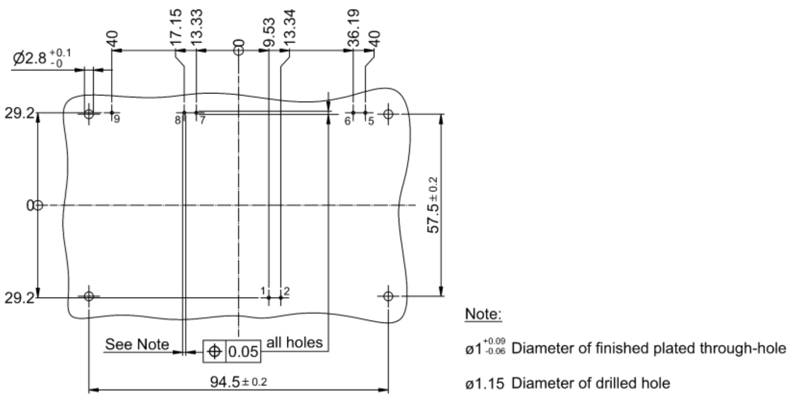
Electrical configuration



Mechanical drawing



PCB drill hole pattern for press-fit



Note: all dimensions are shown in millimeters

Hitachi Energy Switzerland Ltd
Semiconductors
Fabrikstrasse 3
5600 Lenzburg
Switzerland
Tel: +41 58 586 10 00

E-Mail: salesdesksem@hitachienergy.com

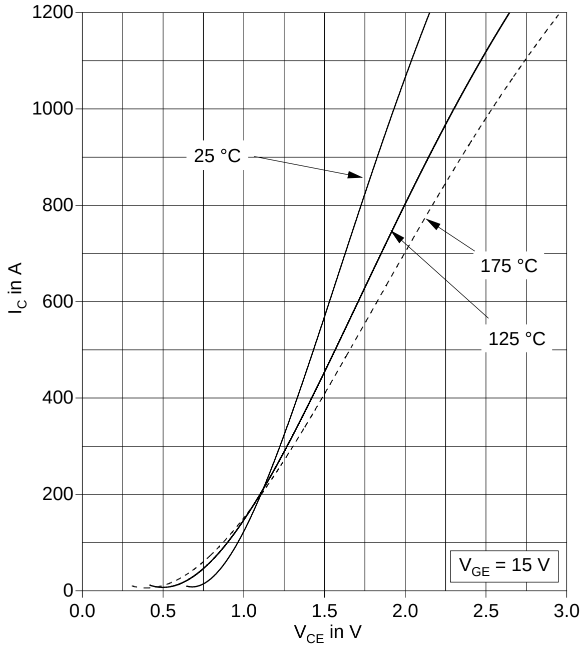


Fig. 1 Typical on-state characteristics, chip level

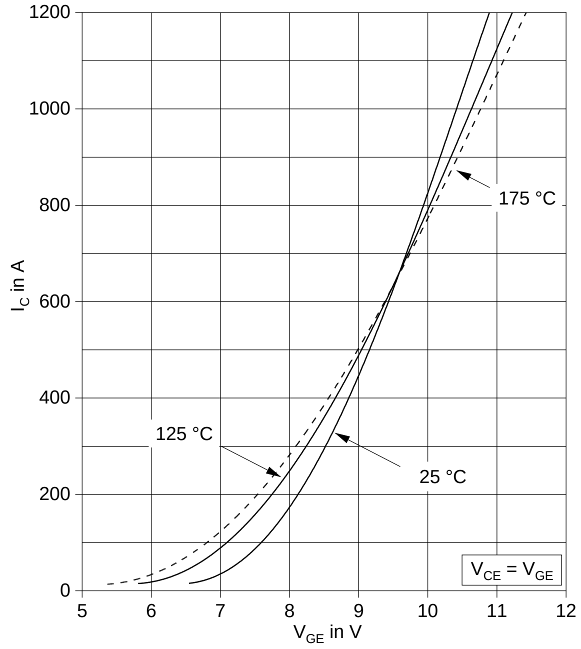


Fig. 2 Typical transfer characteristics, chip level

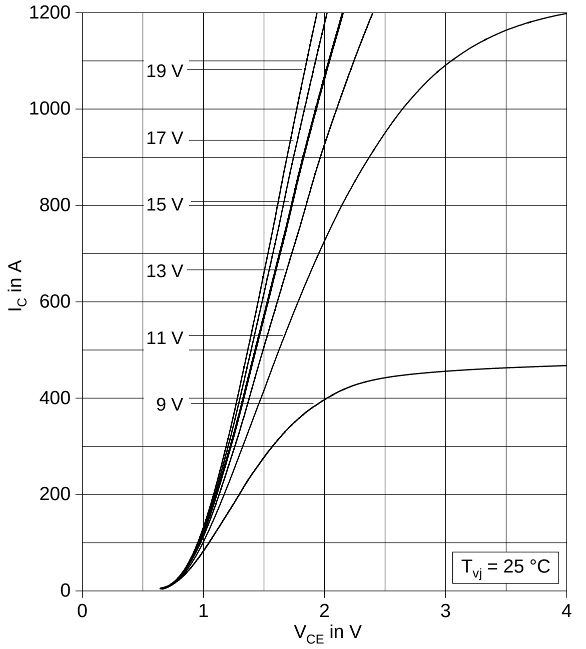


Fig. 3 Typical output characteristics, chip level

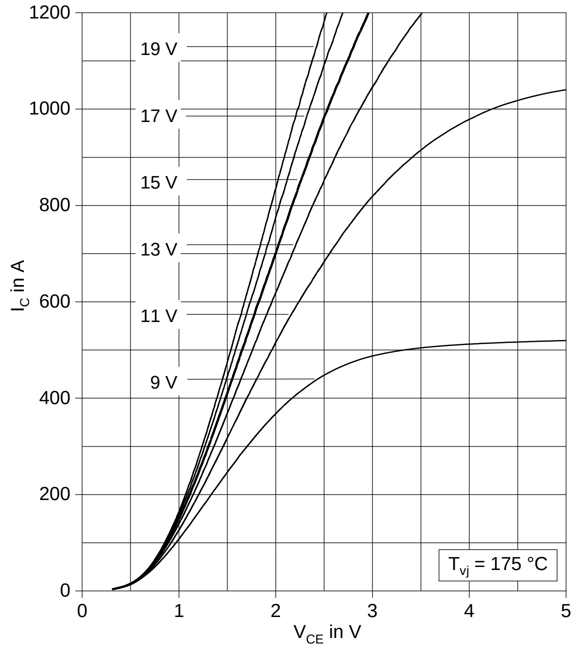


Fig. 4 Typical output characteristics, chip level

Hitachi Energy Switzerland Ltd
Semiconductors
Fabrikstrasse 3
5600 Lenzburg
Switzerland
Tel: +41 58 586 10 00

E-Mail: salesdesksem@hitachienergy.com

www.hitachienergy.com/semiconductors

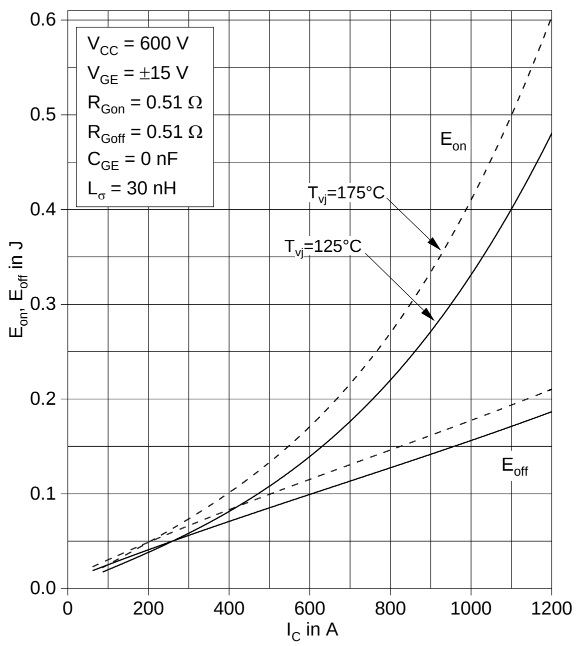


Fig. 5 Typical switching energies per pulse vs. collector current

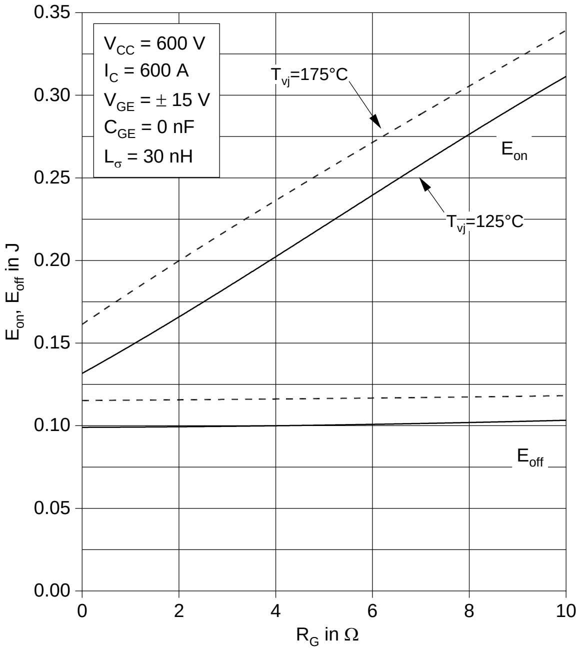


Fig. 6 Typical switching energies per pulse vs. gate resistor

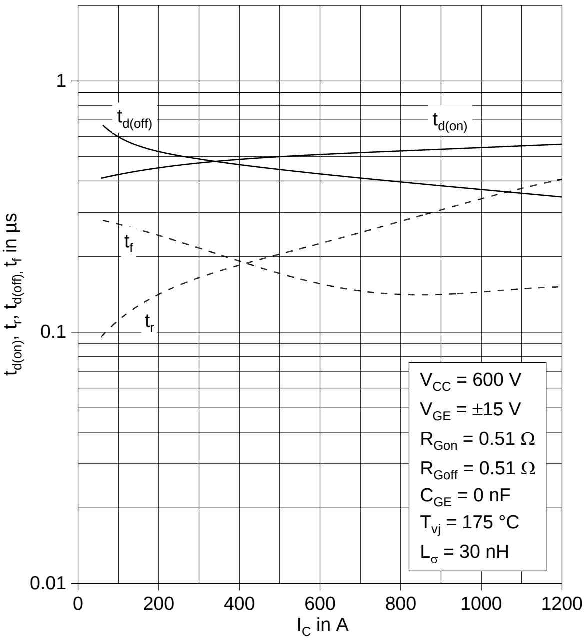


Fig. 7 Typical switching times vs. collector current

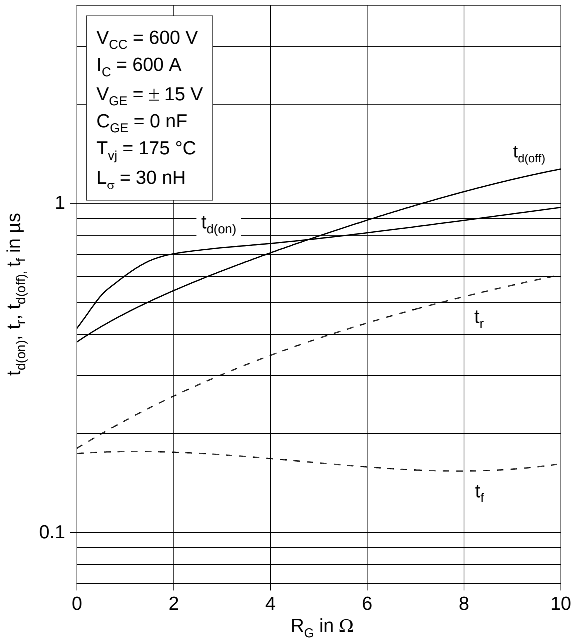


Fig. 8 Typical switching times vs. gate resistor

Hitachi Energy Switzerland Ltd
Semiconductors
Fabrikstrasse 3
5600 Lenzburg
Switzerland
Tel: +41 58 586 10 00

E-Mail: salesdesksem@hitachienergy.com

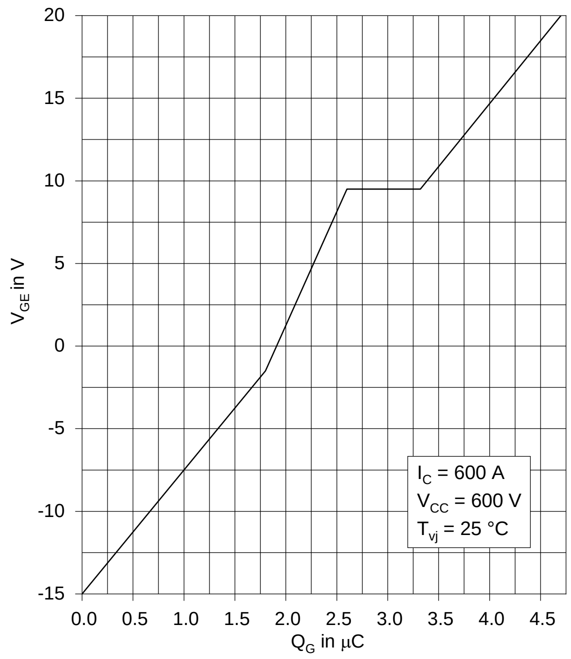


Fig. 9 Typical gate charge characteristics

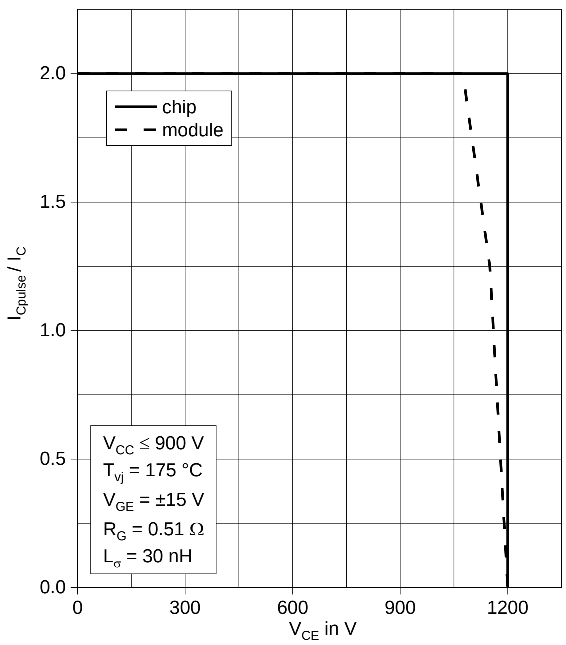


Fig. 10 Turn-off safe operating area (RBSOA)

Hitachi Energy Switzerland Ltd
Semiconductors
Fabrikstrasse 3
5600 Lenzburg
Switzerland
Tel: +41 58 586 10 00

E-Mail: salesdesksem@hitachienergy.com

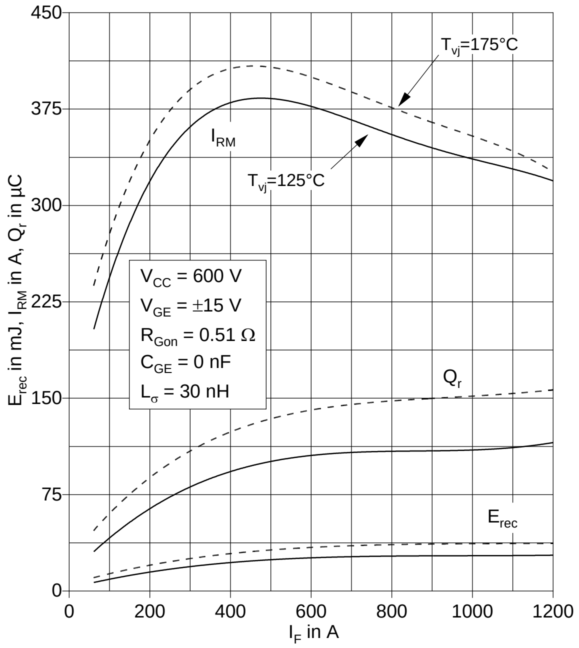


Fig. 11 Typical reverse recovery characteristics vs. forward current

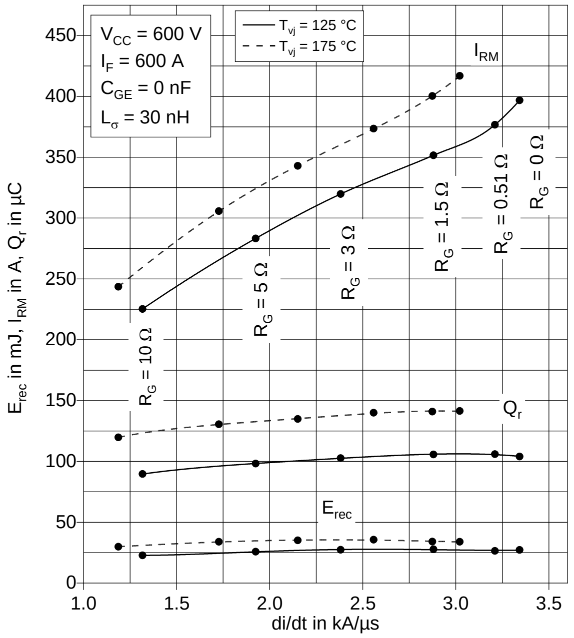


Fig. 12 Typical reverse recovery characteristics vs. di/dt

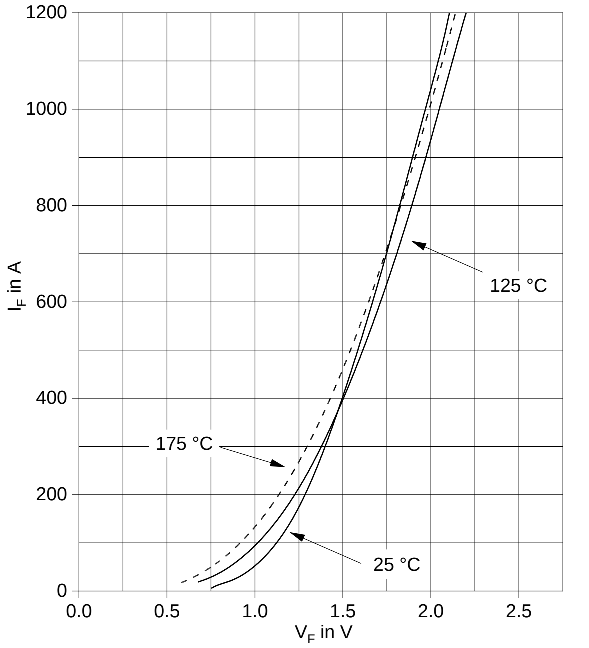


Fig. 13 Typical diode forward characteristics, chip level

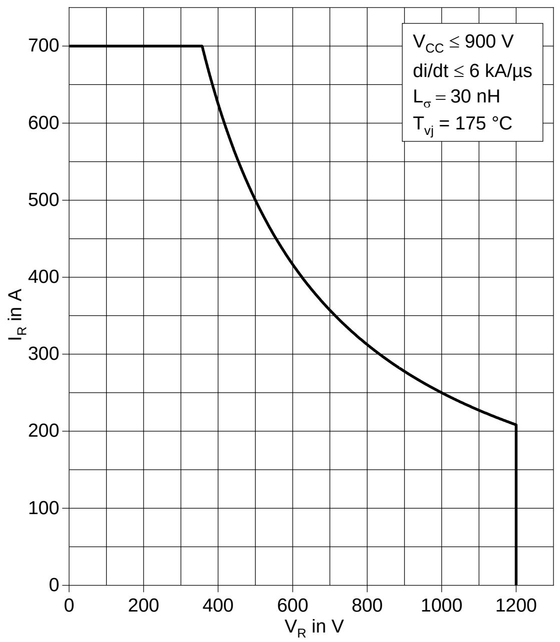


Fig. 14 Diode turn-off safe operating area (DSOA)

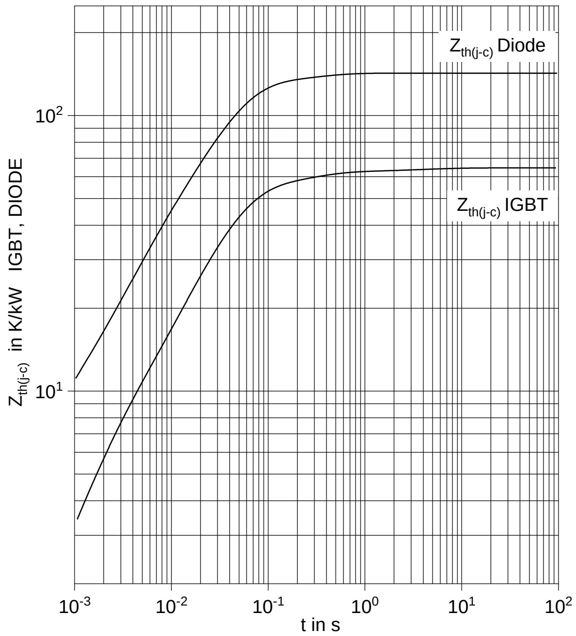
Hitachi Energy Switzerland Ltd
Semiconductors
Fabrikstrasse 3
5600 Lenzburg
Switzerland
Tel: +41 58 586 10 00

E-Mail: salesdesksem@hitachienergy.com

www.hitachienergy.com/semiconductors

We reserve the right to make technical changes or modify the contents of this document without prior notice. With regard to purchase orders, the agreed particulars shall prevail.

Hitachi Energy Ltd. does not accept any responsibility whatsoever for potential errors or possible lack of information in this document.



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)	4.58	9.97	47.7	2.3	
	τi(ms)	1.92	229.4	35.1	3922	
DIODE	Ri(K/kW)	5.29	14.9	108	14.3	
	τi(ms)	0.36	263.8	35.5	4.4	

Fig. 16 Thermal impedance vs time

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 2142 LoPak modules use and installation

Hitachi Energy Switzerland Ltd
Semiconductors
Fabrikstrasse 3
5600 Lenzburg
Switzerland
Tel: +41 58 586 10 00

E-Mail: salesdesksem@hitachienergy.com

www.hitachienergy.com/semiconductors