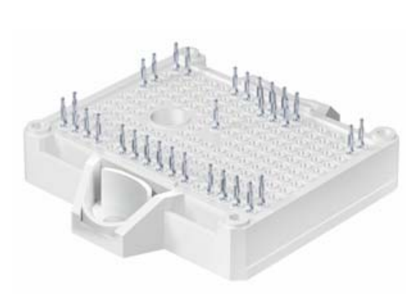

SEMITOP®E2

3-Level NPC

SK150MLI07S5TD1E2

Features*

- Optimized design for superior thermal performance
- Low inductive design
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- Split IGBT gates for optimized driving
- 650V Trench5 IGBT (S5/L5)
- Rapid switching diode technology
- Integrated NTC temperature sensor
- UL recognized file no. E 63 532

Typical Applications

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- Solar

Remarks*

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- IGBTs characteristics are valid for paralleled chips (split gates connected)
- IGBT1: outer IGBTs T1 & T4
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- Diode1: outer Diodes D1 & D4
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- Diode5: clamping Diodes D5 & D6

Footnotes

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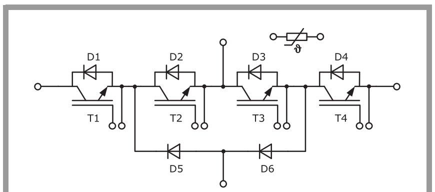
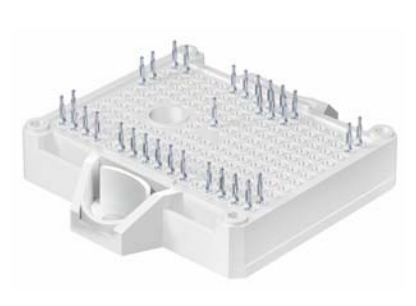


MLI-T

Absolute Maximum Ratings				
Symbol	**Conditions**		**Values**	**Unit**
IGBT1				
V_{CES}	T_j = 25 °C		650	V
I_C	λ_{paste}=0.8 W/(mK)	T_s = 25 °C	127	A
	T_j = 175 °C	T_s = 70 °C	99	A
I_C	λ_{paste}=2.5 W/(mK)	T_s = 25 °C	157	A
	T_j = 175 °C	T_s = 70 °C	124	A
I_{Cnom}			150	A
I_{CRM}			300	A
V_{GES}			-20 ... 20	V
t_{psc}	V_{CC} = 360 V, V_{GE} ≤ 15 V, T_j = 150 °C, V_{CES} ≤ 650 V		not capable	µs
T_j			-40 ... 175	°C
IGBT2				
V_{CES}	T_j = 25 °C		650	V
I_C	λ_{paste}=0.8 W/(mK)	T_s = 25 °C	189	A
	T_j = 175 °C	T_s = 70 °C	147	A
I_C	λ_{paste}=2.5 W/(mK)	T_s = 25 °C	240	A
	T_j = 175 °C	T_s = 70 °C	189	A
I_{Cnom}			150	A
I_{CRM}			300	A
V_{GES}			-20 ... 20	V
t_{psc}	V_{CC} = 360 V, V_{GE} ≤ 15 V, T_j = 150 °C, V_{CES} ≤ 650 V		not capable	µs
T_j			-40 ... 175	°C
Diode1				
V_{RRM}	T_j = 25 °C		650	V
I_F	λ_{paste}=0.8 W/(mK)	T_s = 25 °C	107	A
	T_j = 175 °C	T_s = 70 °C	82	A
I_F	λ_{paste}=2.5 W/(mK)	T_s = 25 °C	127	A
	T_j = 175 °C	T_s = 70 °C	98	A
I_{FRM}			200	A
I_{FSM}	10 ms, sin 180°, T_j = 25 °C		630	A
T_j			-40 ... 175	°C
Diode2				
V_{RRM}	T_j = 25 °C		650	V
I_F	λ_{paste}=0.8 W/(mK)	T_s = 25 °C	107	A
	T_j = 175 °C	T_s = 70 °C	82	A
I_F	λ_{paste}=2.5 W/(mK)	T_s = 25 °C	127	A
	T_j = 175 °C	T_s = 70 °C	98	A
I_{FRM}			200	A
I_{FSM}	10 ms, sin 180°, T_j = 25 °C		630	A
T_j			-40 ... 175	°C



SEMITOP®E2

3-Level NPC

SK150MLI07S5TD1E2

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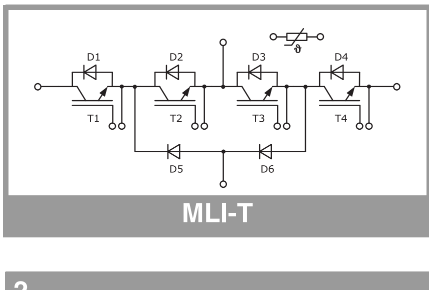
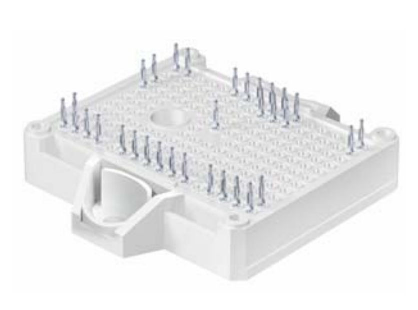


MLI-T

Absolute Maximum Ratings				
Symbol	**Conditions**		**Values**	**Unit**
Diode5				
V_{RRM}	T_j = 25 °C		650	V
I_F	λ_{paste}=0.8 W/(mK) T_j = 175 °C	T_s = 25 °C	126	A
		T_s = 70 °C	99	A
I_F	λ_{paste}=2.5 W/(mK) T_j = 175 °C	T_s = 25 °C	153	A
		T_s = 70 °C	120	A
I_{FRM}			300	A
I_{FSM}	10 ms, sin 180°, T_j = 25 °C		810	A
T_j			-40 ... 175	°C
Module				
$I_{t(RMS)}$	$\Delta T_{terminal}$ at PCB joint = 30 K, per pin		30	A
T_{stg}	module without TIM		-40 ... 125	°C
V_{isol}	AC, sinusoidal, t = 1 min		2500	V

Characteristics						
Symbol	**Conditions**		**min.**	**typ.**	**max.**	**Unit**
IGBT1						
$V_{CE(sat)}$	I_C = 150 A V_{GE} = 15 V chiplevel	T_j = 25 °C		1.42	1.75	V
		T_j = 150 °C		1.61	2.06	V
V_{CE0}	chiplevel	T_j = 25 °C		0.95	1.05	V
		T_j = 150 °C		0.85	1.00	V
r_{CE}	V_{GE} = 15 V chiplevel	T_j = 25 °C		3.1	4.7	mΩ
		T_j = 150 °C		5.1	7.1	mΩ
$V_{GE(th)}$	V_{GE} = V_{CE}, I_C = 1.5 mA		3.2	4	4.8	V
I_{CES}	V_{GE} = 0 V, V_{CE} = 650 V, T_j = 25 °C				0.45	mA
C_{ies}	V_{CE} = 25 V V_{GE} = 0 V	f = 1 MHz		9		nF
C_{oes}		f = 1 MHz		0.26		nF
C_{res}		f = 1 MHz		0.034		nF
Q_G	V_{GE} = -15V ... +15V			720		nC
R_{Gint}	T_j = 25 °C			0		Ω
$t_{d(on)}$	V_{CE} = 300 V I_C = 150 A V_{GE} = +15/-15 V $R_{G\ on}$ = 1 Ω $R_{G\ off}$ = 1 Ω di/dt_{on} = 6250 A/µs di/dt_{off} = 4400 A/µs dv/dt = 7710 V/µs	T_j = 150 °C		27		ns
t_r		T_j = 150 °C		22		ns
E_{on}		T_j = 150 °C		0.54		mJ
$t_{d(off)}$		T_j = 150 °C		107		ns
t_f		T_j = 150 °C		29		ns
E_{off}		T_j = 150 °C		2.45		mJ
$R_{th(j-s)}$	per IGBT, λ_{paste}=0.8 W/(mK)			0.61		K/W
$R_{th(j-s)}$	per IGBT, λ_{paste}=2.5 W/(mK)			0.44		K/W



SEMITOP®E2

3-Level NPC

SK150MLI07S5TD1E2

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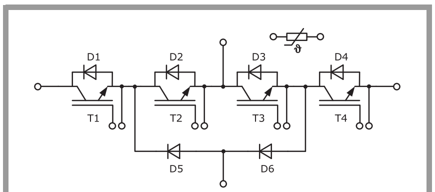
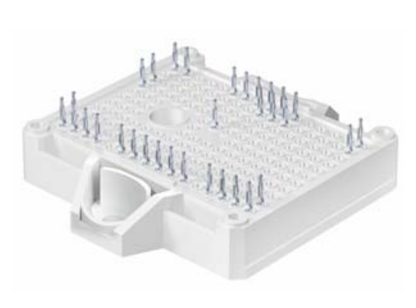


MLI-T

Characteristics

Symbol	Conditions		min.	typ.	max.	Unit
IGBT2						
$V_{CE(sat)}$	I_C = 150 A, V_{GE} = 15 V, chiplevel	T_j = 25 °C		1.10	1.45	V
		T_j = 150 °C		1.12	1.38	V
V_{CE0}	chiplevel	T_j = 25 °C		0.78	0.98	V
		T_j = 150 °C		0.65	0.85	V
r_{CE}	V_{GE} = 15 V, chiplevel	T_j = 25 °C		2.1	3.1	mΩ
		T_j = 150 °C		3.1	3.5	mΩ
$V_{GE(th)}$	V_{GE} = V_{CE}, I_C = 2 mA		4.2	5	5.8	V
I_{CES}	V_{GE} = 0 V, V_{CE} = 650 V, T_j = 25 °C				0.6	mA
C_{ies}	V_{CE} = 25 V, V_{GE} = 0 V	f = 1 MHz		24.2		nF
C_{oes}		f = 1 MHz		0.3		nF
C_{res}		f = 1 MHz		0.084		nF
Q_G	V_{GE} = -15V ... +15V			2000		nC
R_{Gint}	T_j = 25 °C			0		Ω
$t_{d(on)}$	V_{CC} = 300 V, I_C = 150 A, V_{GE} = +15/-15 V, $R_{G\,on}$ = 1 Ω, $R_{G\,off}$ = 1 Ω, di/dt_{on} = 6020 A/µs, di/dt_{off} = 1210 A/µs, dv/dt = 2870 V/µs	T_j = 150 °C		23		ns
t_r		T_j = 150 °C		25		ns
E_{on}		T_j = 150 °C		0.08		mJ
$t_{d(off)}$		T_j = 150 °C		222		ns
t_f		T_j = 150 °C		110		ns
E_{off}		T_j = 150 °C		9.59		mJ
$R_{th(j-s)}$	per IGBT, λ_{paste}=0.8 W/(mK)			0.53		K/W
$R_{th(j-s)}$	per IGBT, λ_{paste}=2.5 W/(mK)			0.37		K/W
Diode1						
$V_F = V_{EC}$	I_F = 100 A, chiplevel	T_j = 25 °C		1.55	1.82	V
		T_j = 150 °C		1.45	1.75	V
V_{F0}	chiplevel	T_j = 25 °C		1.10	1.32	V
		T_j = 150 °C		0.95	1.14	V
r_F	chiplevel	T_j = 25 °C		4.5	5.0	mΩ
		T_j = 150 °C		5.0	6.1	mΩ
I_{RRM}	I_F = 150 A, di/dt_{off} = 6000 A/µs, V_R = 300 V, V_{GE} = +15/-15 V	T_j = 150 °C		111		A
Q_{rr}		T_j = 150 °C		9.6		µC
E_{rr}		T_j = 150 °C		1.55		mJ
$R_{th(j-s)}$	per Diode, λ_{paste}=0.8 W/(mK)			0.79		K/W
$R_{th(j-s)}$	per Diode, λ_{paste}=2.5 W/(mK)			0.62		K/W
Diode2						
$V_F = V_{EC}$	I_F = 100 A, chiplevel	T_j = 25 °C		1.55	1.82	V
		T_j = 150 °C		1.45	1.75	V
V_{F0}	chiplevel	T_j = 25 °C		1.10	1.32	V
		T_j = 150 °C		0.95	1.14	V
r_F	chiplevel	T_j = 25 °C		4.5	5.0	mΩ
		T_j = 150 °C		5.0	6.1	mΩ
I_{RRM}	V_{GE} = +15/-15 V			-		A
Q_{rr}				-		µC
E_{rr} 1)				-		mJ
$R_{th(j-s)}$	per Diode, λ_{paste}=0.8 W/(mK)			0.79		K/W
$R_{th(j-s)}$	per Diode, λ_{paste}=2.5 W/(mK)			0.62		K/W



SEMITOP®E2

3-Level NPC

SK150MLI07S5TD1E2

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Footnotes

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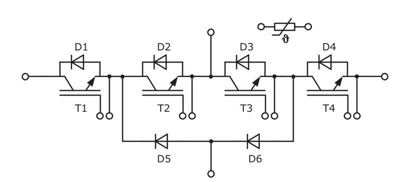


MLI-T

Characteristics						
Symbol	**Conditions**		**min.**	**typ.**	**max.**	**Unit**
Diode5						
$V_F = V_{EC}$	I_F = 150 A	T_j = 25 °C		1.35	1.92	V
	chiplevel	T_j = 150 °C		1.30	1.89	V
V_{F0}	chiplevel	T_j = 25 °C		0.90	1.10	V
		T_j = 150 °C		0.71	0.94	V
r_F	chiplevel	T_j = 25 °C		3.0	5.5	mΩ
		T_j = 150 °C		3.9	6.3	mΩ
I_{RRM}	I_F = 150 A di/dt_{off} = 6320 A/µs V_R = 300 V V_{GE} = +15/-15 V	T_j = 150 °C		172		A
Q_{rr}		T_j = 150 °C		9.68		µC
E_{rr}		T_j = 150 °C		2.68		mJ
$R_{th(j-s)}$	per Diode, λ_{paste}=0.8 W/(mK)			0.69		K/W
$R_{th(j-s)}$	per Diode, λ_{paste}=2.5 W/(mK)			0.52		K/W
Module						
L_{sCE1}				10		nH
L_{sCE2}				12		nH
$R_{CC'+EE'}$		T_s = 25 °C		-		mΩ
		T_s = 150 °C		-		mΩ
M_s	to heatsink		1.6		2.3	Nm
M_t				-		Nm
				-		Nm
w				35		g
Temperature Sensor						
R_{25}	T_r=25°C			22 ±5%		kΩ
$B_{25/50}$	$R(T)=R_{25}exp[B_{25/50}(1/T-1/T_{25})]; T[K]$			3950 ±3%		K

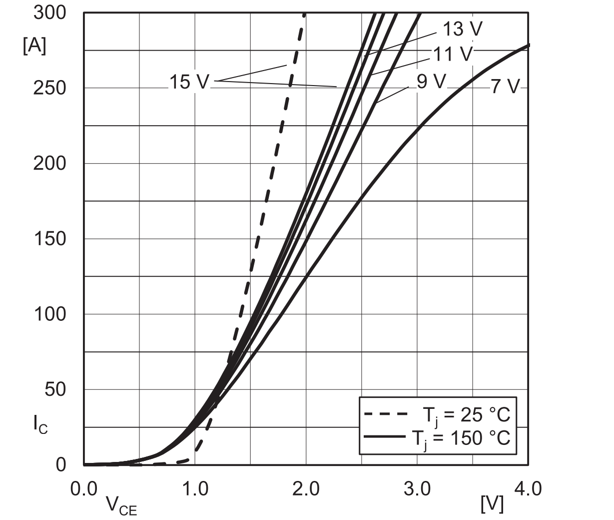


Fig. 1: Typ. IGBT1 output characteristic, incl. $R_{CC'+ EE'}$

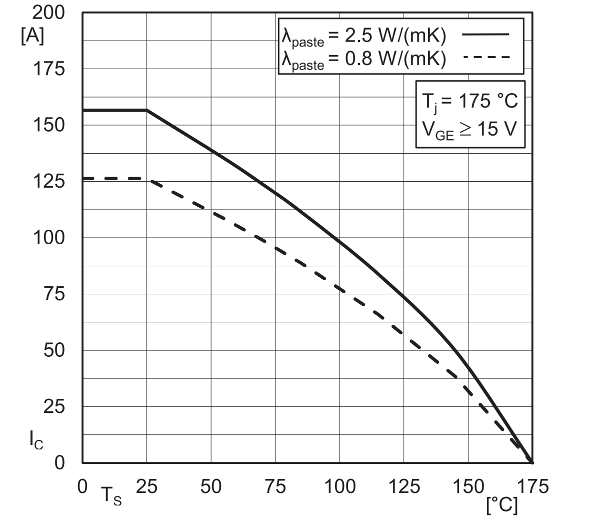


Fig. 2: IGBT1 rated current vs. Temperature I_c=f(T_s)

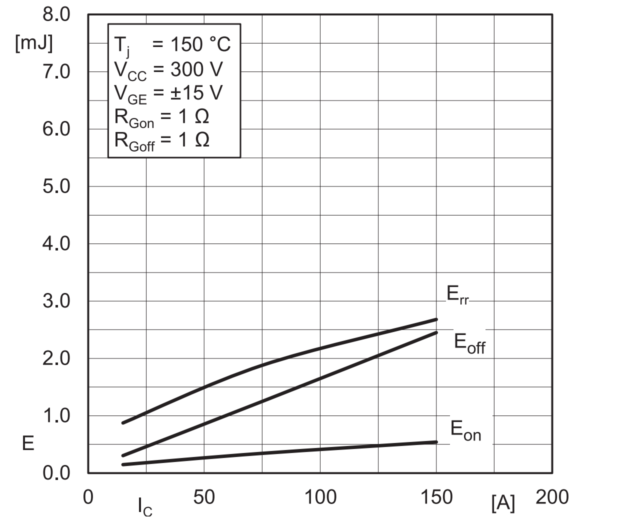


Fig. 3: Typ. IGBT1 & Diode5 turn-on /-off energy = f (I_C)

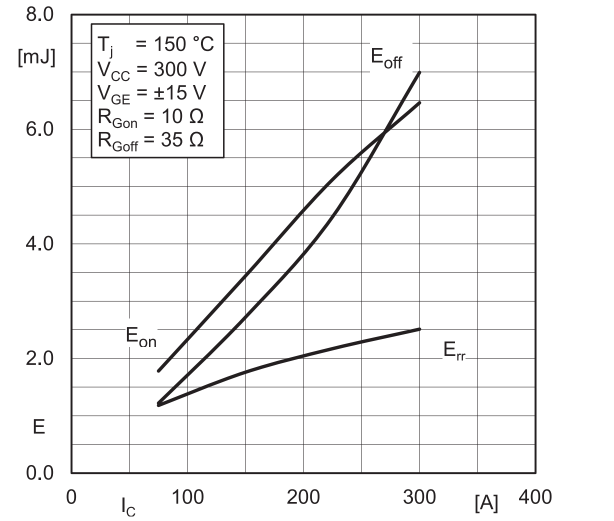


Fig. 3a: Typ. IGBT1 & Diode5 turn-on /-off energy = f (I_C)

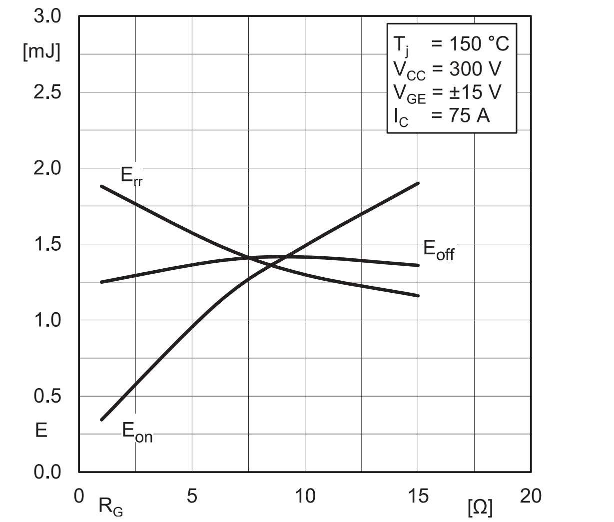


Fig. 4: Typ. IGBT1 & Diode5 turn-on /-off energy = f(R_G)

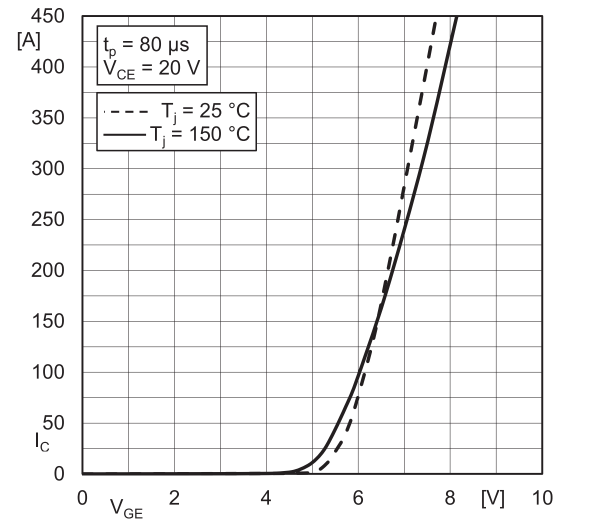


Fig. 5: Typ. IGBT1 transfer characteristic

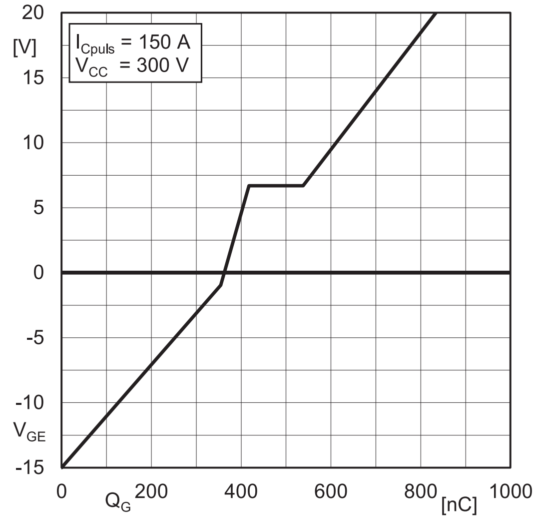


Fig. 6: Typ. IGBT1 gate charge characteristic

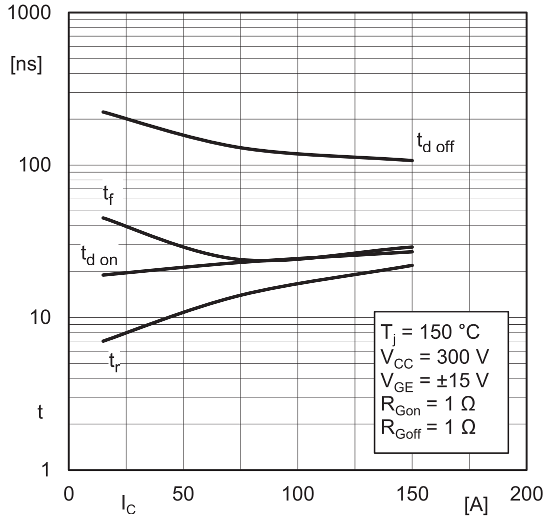


Fig. 7: Typ. IGBT1 switching times vs. I_C

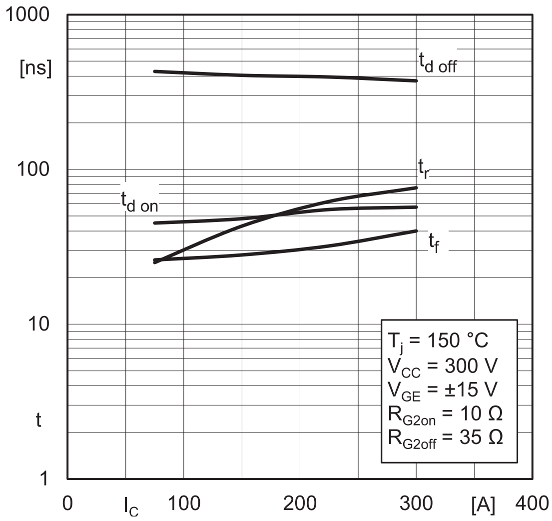


Fig. 7a: Typ. IGBT1 switching times vs. I_C

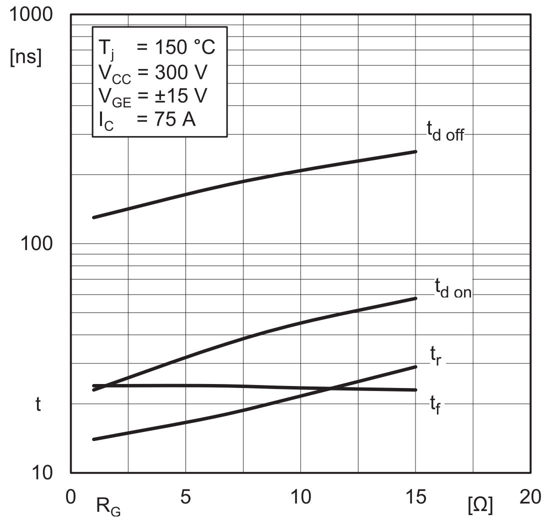


Fig. 8: Typ. IGBT1 switching times vs. gate resistor R_G

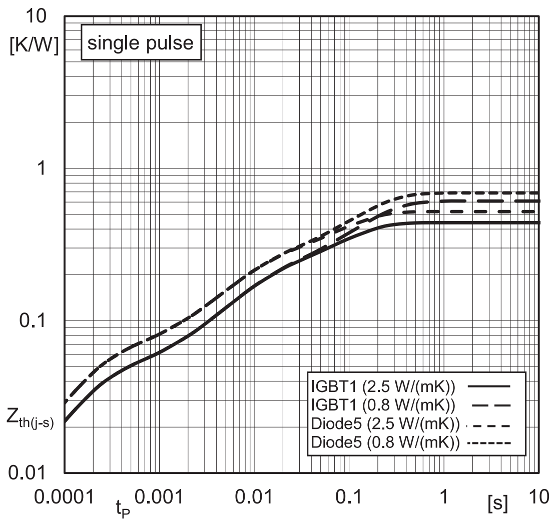


Fig. 9: Typ. transient thermal impedance

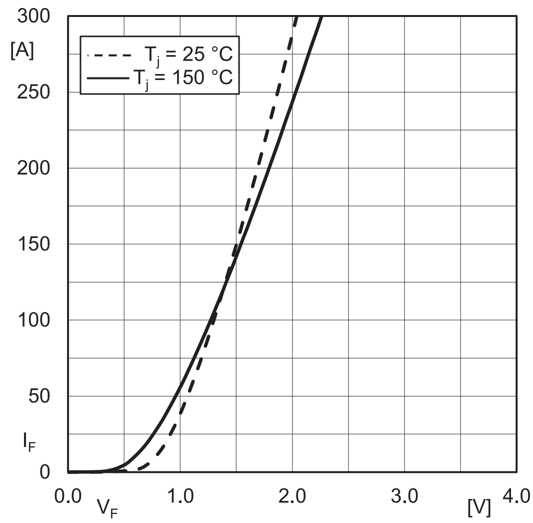


Fig. 10: Typ. Diode5 forward characteristic, incl. $R_{CC'+EE'}$

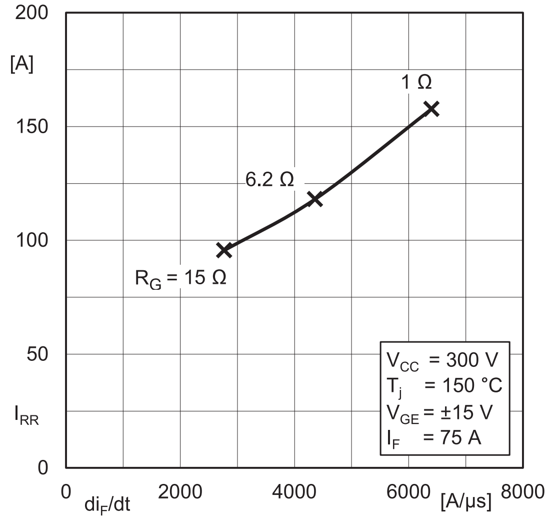


Fig. 11: Typ. Diode5 peak reverse recovery current

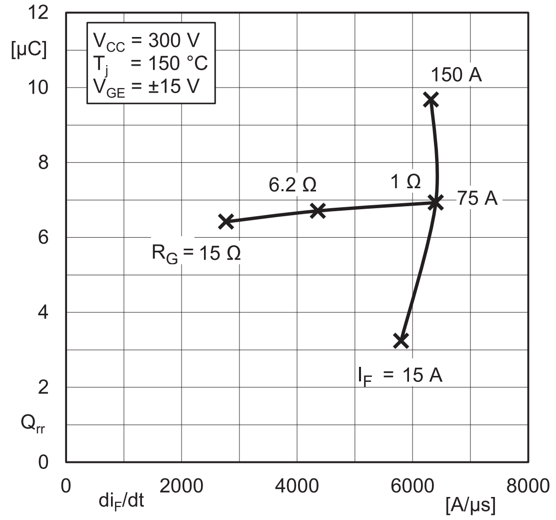


Fig. 12: Typ. Diode5 reverse recovery charge

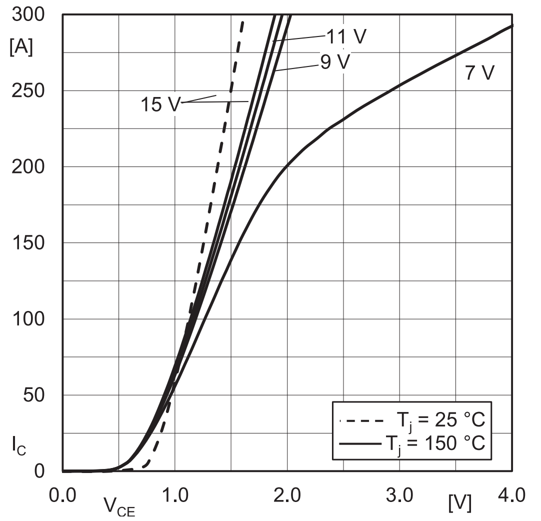


Fig. 13: Typ. IGBT2 output characteristic, incl. $R_{CC'+ EE'}$

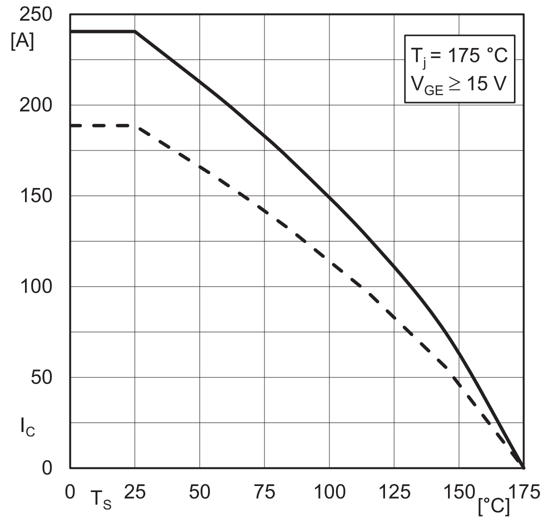


Fig. 14: IGBT2 Rated current vs. Temperature $I_c = f(T_s)$

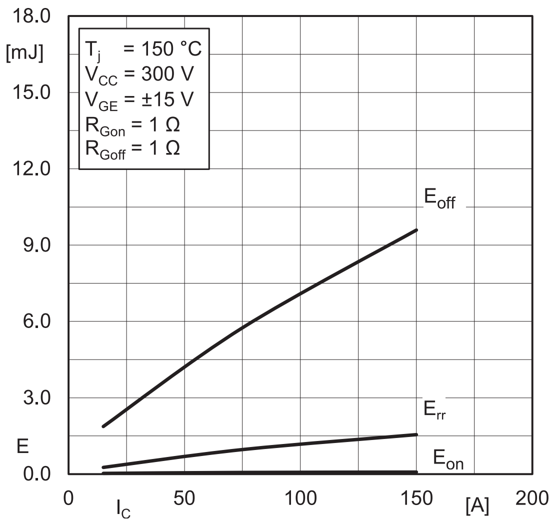


Fig. 15: Typ. IGBT2 & Diode1 turn-on /-off energy = f (I_C)

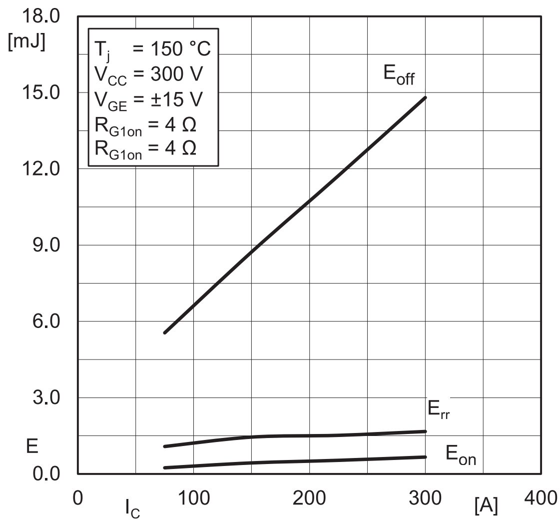


Fig. 15a: Typ. IGBT2 & Diode1 turn-on /-off energy = f ($_C$)

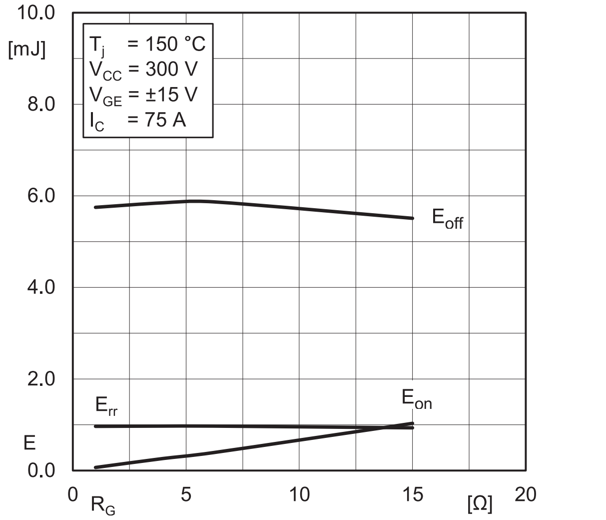


Fig. 16: Typ. IGBT2 & Diode1 turn-on / -off energy = f(R_G)

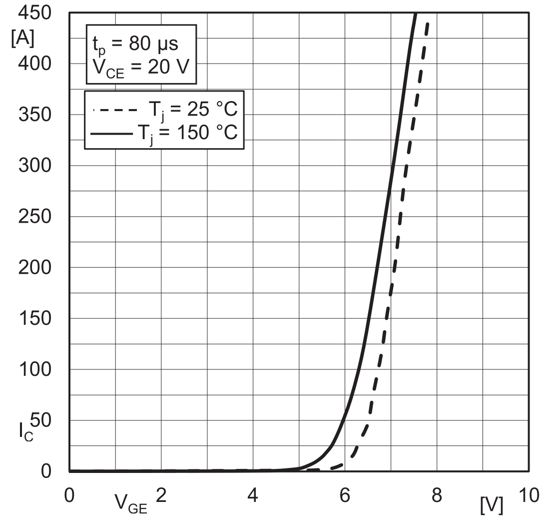


Fig. 17: Typ. IGBT2 transfer characteristic

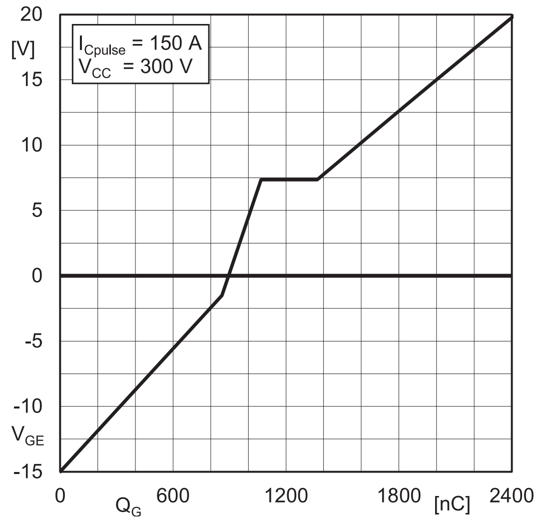


Fig. 18: Typ. IGBT2 gate charge characteristic

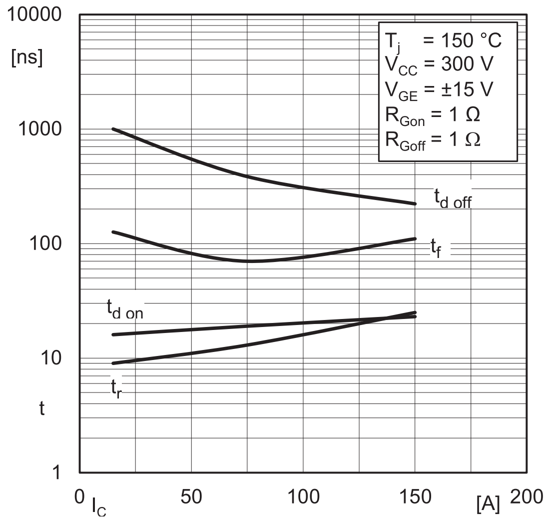


Fig. 19: Typ. IGBT2 switching times vs. I_C

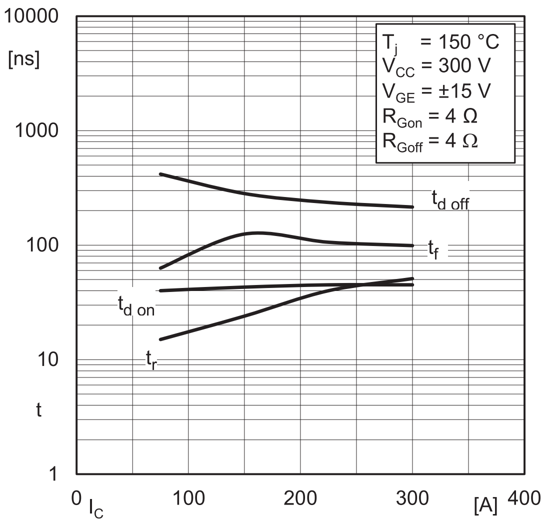


Fig. 19a: Typ. IGBT2 switching times vs. I_C

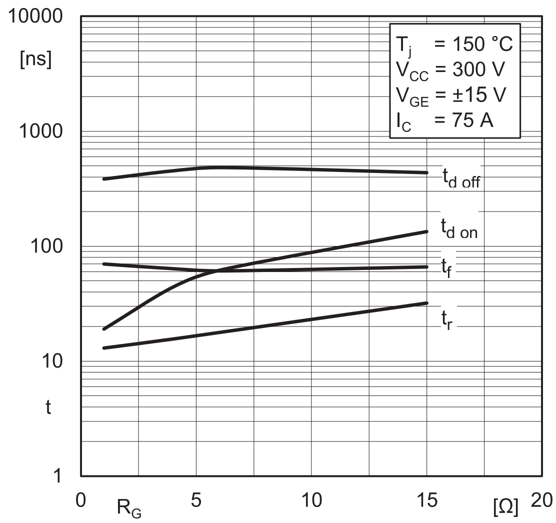


Fig. 20: Typ. IGBT2 switching times vs. gate resistor R_G

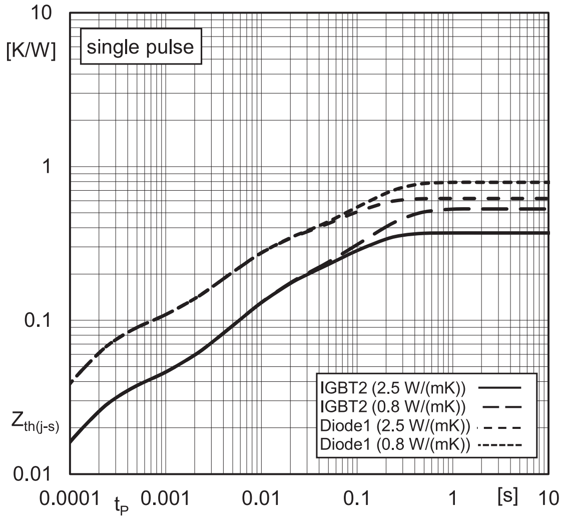


Fig. 21: Typ. transient thermal impedance

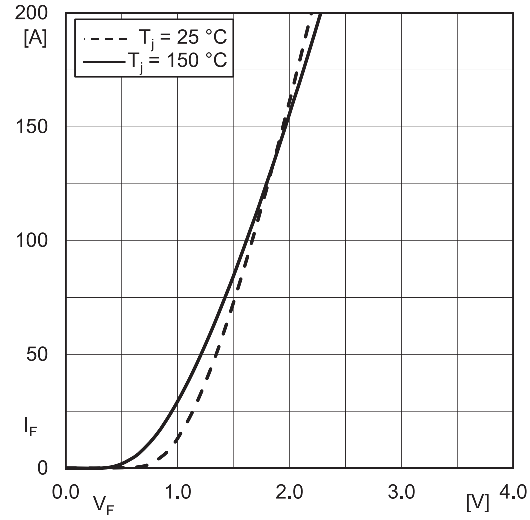


Fig. 22: Typ. Diode1 & Diode2 forward characteristic, incl. $R_{CC'+EE'}$

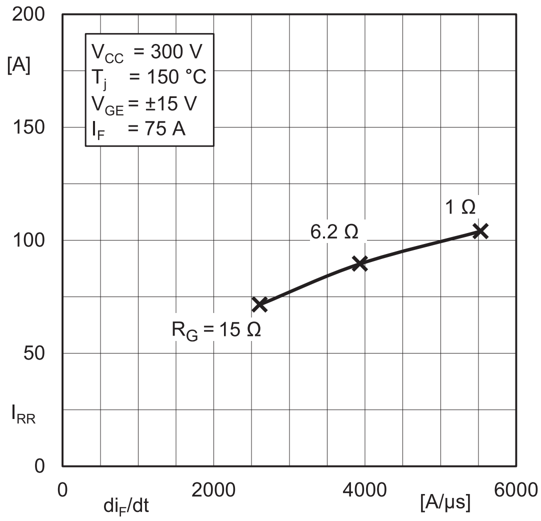


Fig. 23: Typ. Diode1 peak reverse recovery current

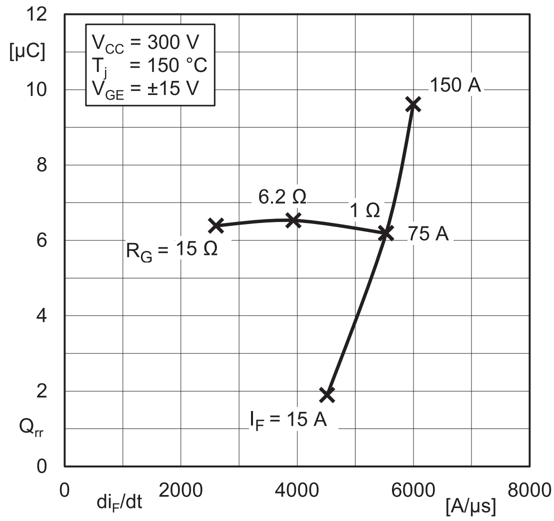
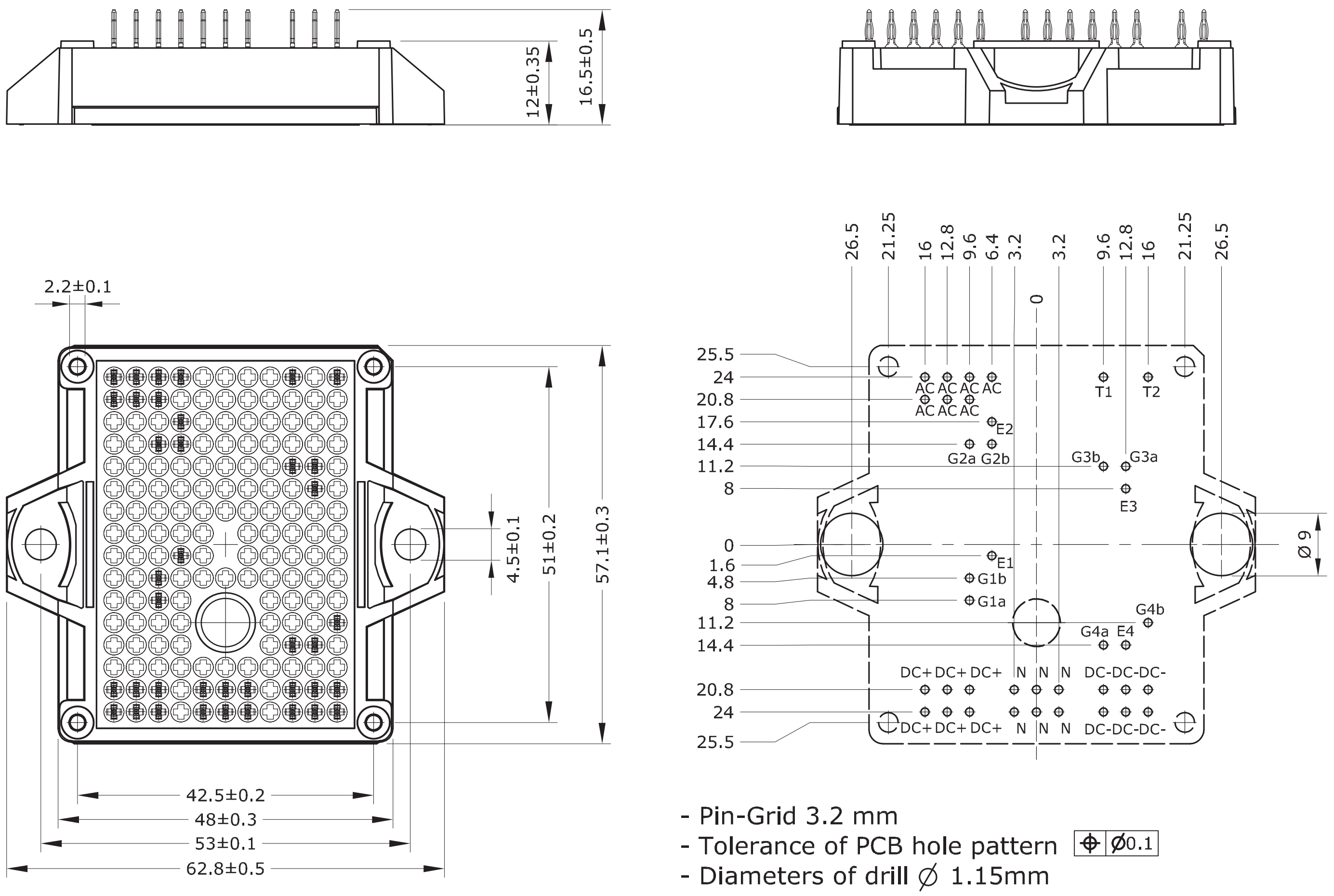
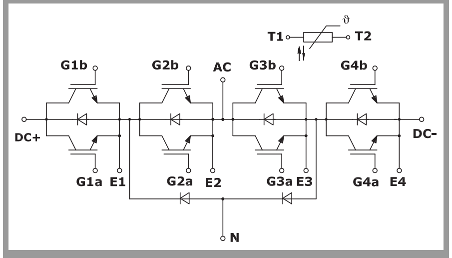


Fig. 24: Typ. Diode1 reverse recovery charge



- Pin-Grid 3.2 mm
- Tolerance of PCB hole pattern ⌖ Ø0.1
- Diameters of drill Ø 1.15mm
- Copper thickness in hole 25 - 50 µm
- Hole specification for contacts:
  refer to SEMITOP E1/E2 Mounting Instruction

SEMITOP®E2



MLI-T

This is an electrostatic discharge sensitive device (ESDS) due to international standard IEC 61340.

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