

# SK25DGDL12T7ETE1



SEMITOP®E1

## 3-phase Converter-Inverter-Brake (CIB)

### SK25DGDL12T7ETE1

#### Features\*

- Optimized design for superior thermal performance
- Low inductive design
- Press-Fit contact technology
- 1200V Generation 7 IGBT (T7)
- Robust and soft switching CAL4F diode technology
- PEP rectifier diode technology for enhanced power and environmental robustness
- Integrated NTC temperature sensor
- UL recognized file no. E 63 532

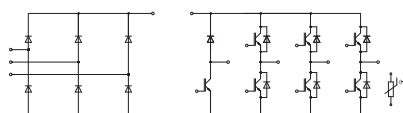
#### Typical Applications

- Motor drives
- Air conditioning
- Auxiliary Inverters

#### Remarks

- Recommended  $T_{j,op} = -40 \dots +150 \text{ }^\circ\text{C}$
- $T_{j,op} > 150 \text{ }^\circ\text{C}$  during overload (details on AN19-002)

Absolute Maximum Ratings				
Symbol	Conditions		Values	Unit
<b>Inverter - IGBT</b>				
$V_{CES}$	$T_j = 25 \text{ }^\circ\text{C}$		1200	V
$I_C$	$\lambda_{paste}=0.8 \text{ W/(mK)}$	$T_s = 70 \text{ }^\circ\text{C}$	33	A
		$T_j = 175 \text{ }^\circ\text{C}$	27	A
$I_C$	$\lambda_{paste}=2.5 \text{ W/(mK)}$	$T_s = 70 \text{ }^\circ\text{C}$	38	A
		$T_j = 175 \text{ }^\circ\text{C}$	31	A
$I_{Chom}$			25	A
$I_{CRM}$			50	A
$V_{GES}$			-20 ... 20	V
$t_{psc}$	$V_{CC} = 800 \text{ V}$ $V_{GE} \leq 15 \text{ V}$ $V_{CES} \leq 1200 \text{ V}$	$T_j = 175 \text{ }^\circ\text{C}$	7	$\mu\text{s}$
$T_j$			-40 ... 175	$^\circ\text{C}$
<b>Chopper - IGBT</b>				
$V_{CES}$	$T_j = 25 \text{ }^\circ\text{C}$		1200	V
$I_C$	$\lambda_{paste}=0.8 \text{ W/(mK)}$	$T_s = 70 \text{ }^\circ\text{C}$	33	A
		$T_j = 175 \text{ }^\circ\text{C}$	27	A
$I_C$	$\lambda_{paste}=2.5 \text{ W/(mK)}$	$T_s = 70 \text{ }^\circ\text{C}$	38	A
		$T_j = 175 \text{ }^\circ\text{C}$	31	A
$I_{Chom}$			25	A
$I_{CRM}$			50	A
$V_{GES}$			-20 ... 20	V
$t_{psc}$	$V_{CC} = 800 \text{ V}$ $V_{GE} \leq 15 \text{ V}$ $V_{CES} \leq 1200 \text{ V}$	$T_j = 175 \text{ }^\circ\text{C}$	7	$\mu\text{s}$
$T_j$			-40 ... 175	$^\circ\text{C}$
<b>Inverse - Diode</b>				
$V_{RRM}$	$T_j = 25 \text{ }^\circ\text{C}$		1200	V
$I_F$	$\lambda_{paste}=0.8 \text{ W/(mK)}$	$T_s = 70 \text{ }^\circ\text{C}$	17	A
		$T_j = 175 \text{ }^\circ\text{C}$	14	A
$I_F$	$\lambda_{paste}=2.5 \text{ W/(mK)}$	$T_s = 70 \text{ }^\circ\text{C}$	20	A
		$T_j = 175 \text{ }^\circ\text{C}$	16	A
$I_{FRM}$			45	A
$I_{FSM}$	$t_p = 10 \text{ ms, sin } 180^\circ, T_j = 150 \text{ }^\circ\text{C}$		65	A
$T_j$			-40 ... 175	$^\circ\text{C}$
<b>Freewheeling - Diode</b>				
$V_{RRM}$	$T_j = 25 \text{ }^\circ\text{C}$		1200	V
$I_F$	$\lambda_{paste}=0.8 \text{ W/(mK)}$	$T_s = 70 \text{ }^\circ\text{C}$	12	A
		$T_j = 175 \text{ }^\circ\text{C}$	10	A
$I_F$	$\lambda_{paste}=2.5 \text{ W/(mK)}$	$T_s = 70 \text{ }^\circ\text{C}$	13	A
		$T_j = 175 \text{ }^\circ\text{C}$	11	A
$I_{FRM}$			20	A
$I_{FSM}$	$t_p = 10 \text{ ms, sin } 180^\circ, T_j = 150 \text{ }^\circ\text{C}$		36	A
$T_j$			-40 ... 175	$^\circ\text{C}$



DGDL-ET

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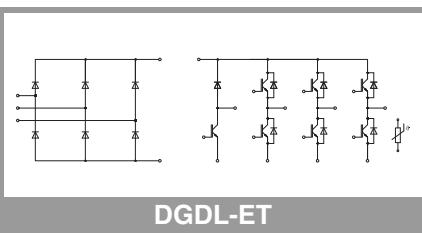
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#### Typical Applications

- Motor drives
- Air conditioning
- Auxiliary Inverters

#### Remarks

- Recommended  $T_{j,op} = -40 \dots +150 \text{ °C}$
- $T_{j,op} > 150 \text{ °C}$  during overload (details on AN19-002)



Absolute Maximum Ratings				
Symbol	Conditions		Values	Unit
<b>Rectifier - Diode</b>				
$V_{RRM}$	$T_j = 25 \text{ °C}$		1600	V
$I_F$	$\lambda_{paste}=0.8 \text{ W/(mK)}$	$T_s = 70 \text{ °C}$	47	A
		$T_s = 100 \text{ °C}$	37	A
$I_F$	$\lambda_{paste}=2.5 \text{ W/(mK)}$	$T_s = 70 \text{ °C}$	57	A
		$T_s = 100 \text{ °C}$	45	A
$I_{FSM}$	$t_p = 10 \text{ ms}$ $\sin 180^\circ$	$T_j = 25 \text{ °C}$	370	A
		$T_j = 150 \text{ °C}$	270	A
$i^2t$	$t_p = 10 \text{ ms}$ $\sin 180^\circ$	$T_j = 25 \text{ °C}$	685	A <sup>2</sup> s
		$T_j = 150 \text{ °C}$	365	A <sup>2</sup> s
$T_j$			-40 ... 175	°C
<b>Module</b>				
$I_{t(RMS)}$	, $\Delta T_{terminal}$ at PCB joint = 30 K, per pin		30	A
$T_{stg}$	module without TIM		-40 ... 125	°C
$V_{isol}$	AC, sinusoidal, 1 min		2500	V

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
<b>Inverter - IGBT</b>						
$V_{CE(sat)}$	$I_C = 25 \text{ A}$ $V_{GE} = 15 \text{ V}$ chiplevel	$T_j = 25 \text{ °C}$	1.60	1.75		V
		$T_j = 150 \text{ °C}$	1.78	1.93		V
		$T_j = 175 \text{ °C}$	1.82	1.97		V
$V_{CE0}$	chiplevel	$T_j = 25 \text{ °C}$	1.00	1.05		V
		$T_j = 150 \text{ °C}$	0.80	0.85		V
		$T_j = 175 \text{ °C}$	0.75	0.80		V
$r_{CE}$	$V_{GE} = 15 \text{ V}$ chiplevel	$T_j = 25 \text{ °C}$	24	28		mΩ
		$T_j = 150 \text{ °C}$	39	43		mΩ
		$T_j = 175 \text{ °C}$	43	47		mΩ
$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 0.53 \text{ mA}$		5.15	5.8	6.45	V
$I_{CES}$	$V_{GE} = 0 \text{ V}, V_{CE} = 1200 \text{ V}, T_j = 25 \text{ °C}$				1	mA
$C_{ies}$	$V_{CE} = 25 \text{ V}$ $V_{GE} = 0 \text{ V}$	$f = 1 \text{ MHz}$	4.80			nF
$C_{oes}$		$f = 1 \text{ MHz}$	0.06			nF
$C_{res}$		$f = 1 \text{ MHz}$	0.02			nF
$Q_G$	$V_{GE} = -15 \text{ V} \dots +15 \text{ V}$		354			nC
$R_{Gint}$	$T_j = 25 \text{ °C}$		0			Ω
$t_{d(on)}$	$V_{CC} = 600 \text{ V}$ $I_C = 25 \text{ A}$ $R_{G on} = 6.2 \text{ Ω}$	$T_j = 25 \text{ °C}$	28			ns
		$T_j = 150 \text{ °C}$	30			ns
		$T_j = 175 \text{ °C}$	32			ns
$t_r$	$R_{G off} = 6.2 \text{ Ω}$ $V_{GE} = +15/-15 \text{ V}$	$T_j = 25 \text{ °C}$	23			ns
		$T_j = 150 \text{ °C}$	25			ns
		$T_j = 175 \text{ °C}$	26			ns
$E_{on}$	$di/dt_{on} = 880 \text{ A/μs}$ $di/dt_{off} = 210 \text{ A/μs}$ $dv/dt = 5400 \text{ V/μs}$	$T_j = 25 \text{ °C}$	1.41			mJ
		$T_j = 150 \text{ °C}$	2.06			mJ
		$T_j = 175 \text{ °C}$	2.32			mJ

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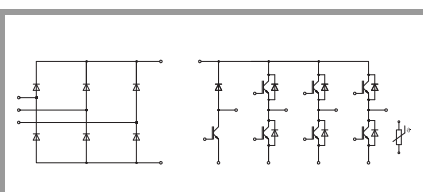
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#### Remarks

- Recommended  $T_{j,op} = -40 \dots +150 \text{ }^\circ\text{C}$
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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
<b>Inverter - IGBT</b>						
$t_{d(off)}$	$V_{CC} = 600 \text{ V}$ $I_C = 25 \text{ A}$ $R_{G\ on} = 6.2 \ \Omega$	$T_j = 25 \text{ }^\circ\text{C}$		191		ns
		$T_j = 150 \text{ }^\circ\text{C}$		231		ns
		$T_j = 175 \text{ }^\circ\text{C}$		251		ns
$t_f$	$R_{G\ off} = 6.2 \ \Omega$ $V_{GE} = +15/-15 \text{ V}$	$T_j = 25 \text{ }^\circ\text{C}$		66		ns
		$T_j = 150 \text{ }^\circ\text{C}$		101		ns
		$T_j = 175 \text{ }^\circ\text{C}$		108		ns
$E_{off}$	$di/dt_{on} = 880 \text{ A}/\mu\text{s}$ $di/dt_{off} = 210 \text{ A}/\mu\text{s}$ $dv/dt = 5400 \text{ V}/\mu\text{s}$	$T_j = 25 \text{ }^\circ\text{C}$		2.04		mJ
		$T_j = 150 \text{ }^\circ\text{C}$		2.71		mJ
		$T_j = 175 \text{ }^\circ\text{C}$		3.09		mJ
$R_{th(j-s)}$	per IGBT, $\lambda_{paste}=0.8 \text{ W}/(\text{mK})$			1.32		K/W
$R_{th(j-s)}$	per IGBT, $\lambda_{paste}=2.5 \text{ W}/(\text{mK})$			1.06		K/W
<b>Chopper - IGBT</b>						
$V_{CE(sat)}$	$I_C = 25 \text{ A}$ $V_{GE} = 15 \text{ V}$ chipelevel	$T_j = 25 \text{ }^\circ\text{C}$		1.60	1.75	V
		$T_j = 150 \text{ }^\circ\text{C}$		1.78	1.93	V
		$T_j = 175 \text{ }^\circ\text{C}$		1.82	1.97	V
$V_{CE0}$	chipelevel	$T_j = 25 \text{ }^\circ\text{C}$		1.00	1.05	V
		$T_j = 150 \text{ }^\circ\text{C}$		0.80	0.85	V
		$T_j = 175 \text{ }^\circ\text{C}$		0.75	0.80	V
$r_{CE}$	$V_{GE} = 15 \text{ V}$ chipelevel	$T_j = 25 \text{ }^\circ\text{C}$		24	28	m $\Omega$
		$T_j = 150 \text{ }^\circ\text{C}$		39	43	m $\Omega$
		$T_j = 175 \text{ }^\circ\text{C}$		43	47	m $\Omega$
$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 0.53 \text{ mA}$		5.15	5.8	6.45	V
$I_{CES}$	$V_{GE} = 0 \text{ V}, V_{CE} = 1200 \text{ V}, T_j = 25 \text{ }^\circ\text{C}$				1	mA
$C_{ies}$	$V_{CE} = 25 \text{ V}$ $V_{GE} = 0 \text{ V}$	$f = 1 \text{ MHz}$		4.80		nF
$C_{oes}$		$f = 1 \text{ MHz}$		0.06		nF
$C_{res}$		$f = 1 \text{ MHz}$		0.02		nF
$Q_G$	$V_{GE} = -15 \text{ V} \dots +15 \text{ V}$			354		nC
$R_{Gint}$	$T_j = 25 \text{ }^\circ\text{C}$			0		$\Omega$
$t_{d(on)}$		$T_j = 25 \text{ }^\circ\text{C}$		28		ns
		$T_j = 150 \text{ }^\circ\text{C}$		30		ns
		$T_j = 175 \text{ }^\circ\text{C}$		32		ns
$t_r$		$T_j = 25 \text{ }^\circ\text{C}$		23		ns
		$T_j = 150 \text{ }^\circ\text{C}$		25		ns
		$T_j = 175 \text{ }^\circ\text{C}$		26		ns
$E_{on}$	$V_{CC} = 600 \text{ V}$ $I_C = 25 \text{ A}$ $R_{G\ on} = 6.2 \ \Omega$ $R_{G\ off} = 6.2 \ \Omega$ $V_{GE} = +15/-15 \text{ V}$	$T_j = 25 \text{ }^\circ\text{C}$		1.41		mJ
		$T_j = 150 \text{ }^\circ\text{C}$		2.06		mJ
		$T_j = 175 \text{ }^\circ\text{C}$		2.32		mJ
$t_{d(off)}$	$(T_j = 150 \text{ }^\circ\text{C})$ $di/dt_{on} = 880 \text{ A}/\mu\text{s}$ $di/dt_{off} = 210 \text{ A}/\mu\text{s}$ $dv/dt = 5400 \text{ V}/\mu\text{s}$	$T_j = 25 \text{ }^\circ\text{C}$		191		ns
		$T_j = 150 \text{ }^\circ\text{C}$		231		ns
		$T_j = 175 \text{ }^\circ\text{C}$		251		ns
$t_f$		$T_j = 25 \text{ }^\circ\text{C}$		66		ns
		$T_j = 150 \text{ }^\circ\text{C}$		101		ns
		$T_j = 175 \text{ }^\circ\text{C}$		108		ns
$E_{off}$		$T_j = 25 \text{ }^\circ\text{C}$		2.04		mJ
		$T_j = 150 \text{ }^\circ\text{C}$		2.71		mJ
		$T_j = 175 \text{ }^\circ\text{C}$		3.09		mJ
$R_{th(j-s)}$	per IGBT, $\lambda_{paste}=0.8 \text{ W}/(\text{mK})$			1.32		K/W
$R_{th(j-s)}$	per IGBT, $\lambda_{paste}=2.5 \text{ W}/(\text{mK})$			1.06		K/W

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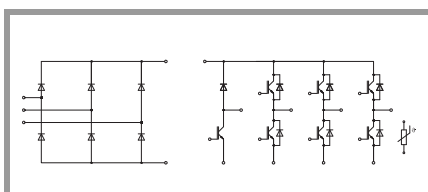
#### Typical Applications

- Motor drives
- Air conditioning
- Auxiliary Inverters

#### Remarks

- Recommended  $T_{j,op} = -40 \dots +150 \text{ }^\circ\text{C}$
- $T_{j,op} > 150 \text{ }^\circ\text{C}$  during overload (details on AN19-002)

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
<b>Inverse - Diode</b>						
$V_F = V_{EC}$	$I_F = 15 \text{ A}$	$T_j = 25 \text{ }^\circ\text{C}$		2.38	2.71	V
		$T_j = 150 \text{ }^\circ\text{C}$		2.44	2.77	V
		chipelevel	$T_j = 175 \text{ }^\circ\text{C}$		2.26	2.58
$V_{F0}$	chipelevel	$T_j = 25 \text{ }^\circ\text{C}$		1.30	1.50	V
		$T_j = 150 \text{ }^\circ\text{C}$		0.90	1.10	V
		$T_j = 175 \text{ }^\circ\text{C}$		0.82	0.98	V
$r_F$	chipelevel	$T_j = 25 \text{ }^\circ\text{C}$		72	81	m $\Omega$
		$T_j = 150 \text{ }^\circ\text{C}$		103	111	m $\Omega$
		$T_j = 175 \text{ }^\circ\text{C}$		96	107	m $\Omega$
$I_{RRM}$		$T_j = 25 \text{ }^\circ\text{C}$		16		A
		$T_j = 150 \text{ }^\circ\text{C}$		23		A
		$T_j = 175 \text{ }^\circ\text{C}$		24		A
$Q_{rr}$	$V_{CC} = 600 \text{ V}$ $I_F = 25 \text{ A}$	$T_j = 25 \text{ }^\circ\text{C}$		1.01		$\mu\text{C}$
		$T_j = 150 \text{ }^\circ\text{C}$		2.69		$\mu\text{C}$
		$T_j = 175 \text{ }^\circ\text{C}$		3.04		$\mu\text{C}$
$E_{rr}$	$V_{GE} = -15 \text{ V}$ ( $T_j = 150 \text{ }^\circ\text{C}$ ) $di/dt_{off} = 1050 \text{ A}/\mu\text{s}$	$T_j = 25 \text{ }^\circ\text{C}$		0.37		mJ
		$T_j = 150 \text{ }^\circ\text{C}$		1.17		mJ
		$T_j = 175 \text{ }^\circ\text{C}$		1.79		mJ
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=0.8 \text{ W}/(\text{mK})$			2.13		K/W
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=2.5 \text{ W}/(\text{mK})$			1.74		K/W
<b>Freewheeling - Diode</b>						
$V_F = V_{EC}$	$I_F = 10 \text{ A}$	$T_j = 25 \text{ }^\circ\text{C}$		2.59	2.94	V
		$T_j = 150 \text{ }^\circ\text{C}$		2.71	3.08	V
		chipelevel	$T_j = 175 \text{ }^\circ\text{C}$		2.53	2.89
$V_{F0}$	chipelevel	$T_j = 25 \text{ }^\circ\text{C}$		1.30	1.50	V
		$T_j = 150 \text{ }^\circ\text{C}$		0.90	1.10	V
		$T_j = 175 \text{ }^\circ\text{C}$		0.82	0.98	V
$r_F$	chipelevel	$T_j = 25 \text{ }^\circ\text{C}$		129	144	m $\Omega$
		$T_j = 150 \text{ }^\circ\text{C}$		181	198	m $\Omega$
		$T_j = 175 \text{ }^\circ\text{C}$		171	191	m $\Omega$
$I_{RRM}$		$T_j = 25 \text{ }^\circ\text{C}$		8		A
		$T_j = 150 \text{ }^\circ\text{C}$		14		A
		$T_j = 175 \text{ }^\circ\text{C}$		16		A
$Q_{rr}$	$V_{CC} = 600 \text{ V}$ $I_F = 10 \text{ A}$	$T_j = 25 \text{ }^\circ\text{C}$		0.58		$\mu\text{C}$
		$T_j = 150 \text{ }^\circ\text{C}$		2.01		$\mu\text{C}$
		$T_j = 175 \text{ }^\circ\text{C}$		2.37		$\mu\text{C}$
$E_{rr}$	$V_{GE} = -15 \text{ V}$ ( $T_j = 150 \text{ }^\circ\text{C}$ ) $di/dt_{off} = 790 \text{ A}/\mu\text{s}$	$T_j = 25 \text{ }^\circ\text{C}$		0.36		mJ
		$T_j = 150 \text{ }^\circ\text{C}$		0.91		mJ
		$T_j = 175 \text{ }^\circ\text{C}$		1.16		mJ
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=0.8 \text{ W}/(\text{mK})$			2.64		K/W
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=2.5 \text{ W}/(\text{mK})$			2.24		K/W



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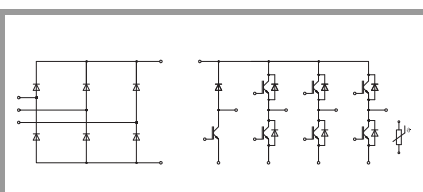
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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
<b>Rectifier - Diode</b>						
$V_F$	$I_F = 25 \text{ A}$ chiplevel	$T_j = 25 \text{ }^\circ\text{C}$		1.04	1.30	V
		$T_j = 150 \text{ }^\circ\text{C}$		0.95	1.21	V
		$T_j = 175 \text{ }^\circ\text{C}$		0.94	1.21	V
$V_{F0}$	chiplevel	$T_j = 25 \text{ }^\circ\text{C}$		0.89	1.09	V
		$T_j = 150 \text{ }^\circ\text{C}$		0.73	0.92	V
		$T_j = 175 \text{ }^\circ\text{C}$		0.69	0.88	V
$r_F$	chiplevel	$T_j = 25 \text{ }^\circ\text{C}$		6.2	8.5	m $\Omega$
		$T_j = 150 \text{ }^\circ\text{C}$		8.8	12	m $\Omega$
		$T_j = 175 \text{ }^\circ\text{C}$		10.0	13	m $\Omega$
$I_R$	$T_j = 150 \text{ }^\circ\text{C}, V_{RRM}$				2	mA
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=0.8 \text{ W/(mK)}$			1.48		K/W
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=2.5 \text{ W/(mK)}$			1.14		K/W
<b>Module</b>						
$M_s$	to heatsink		1.6		2.3	Nm
w				25		g
$L_{CE}$				30		nH
<b>Temperature Sensor</b>						
$R_{100}$	$T_c=100^\circ\text{C} (R_{25}=5 \text{ k}\Omega)$			$493 \pm 5\%$		$\Omega$
$B_{25/85}$	$R_{(T)}=R_{25} \cdot \exp[B_{25/85} \cdot (1/T - 1/298)]$ , T[K]			3420		K



DGDL-ET

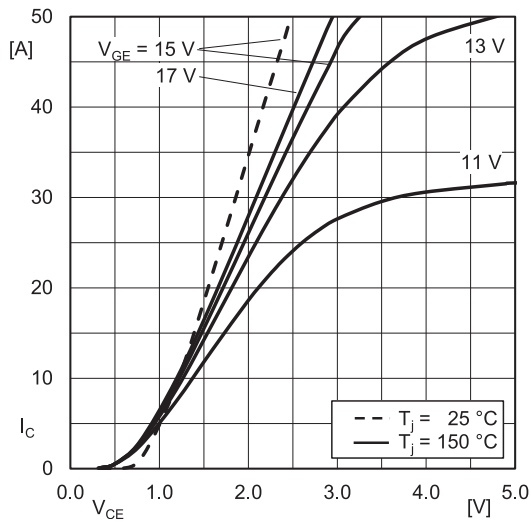


Fig. 1: Typ. IGBT output characteristic, incl.  $R_{CC+EE'}$

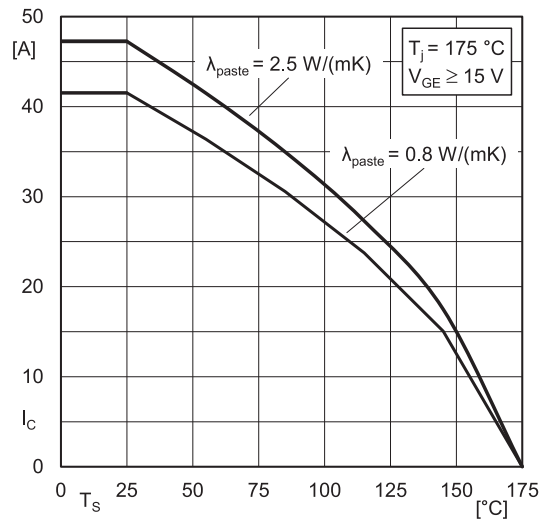


Fig. 2: IGBT rated current vs. temperature  $I_C=f(T_s)$

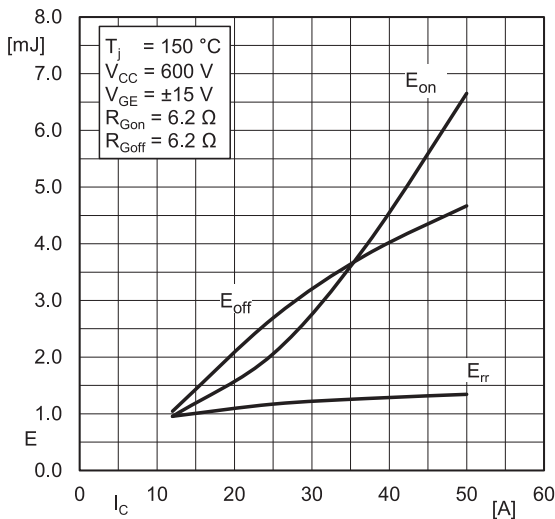


Fig. 3: Typ. turn-on /-off energy =  $f(I_C)$

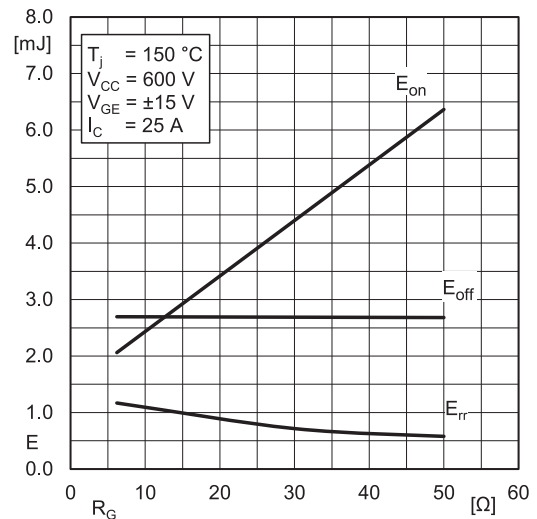


Fig. 4: Typ. turn-on /-off energy =  $f(R_G)$

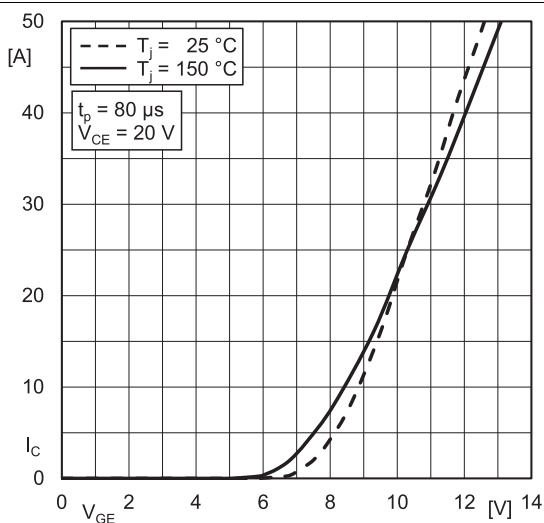


Fig. 5: Typ. IGBT transfer characteristic

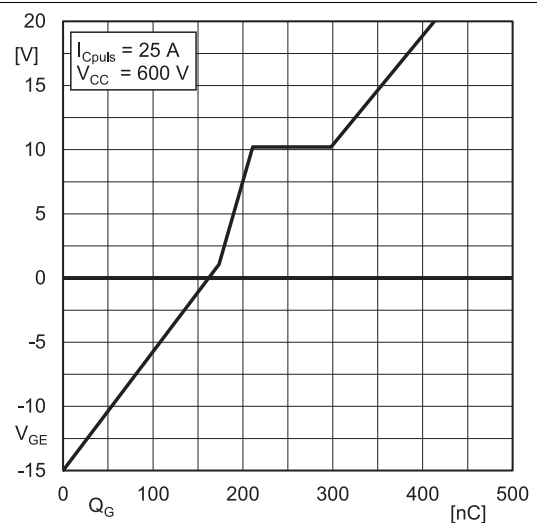


Fig. 6: Typ. IGBT gate charge characteristic

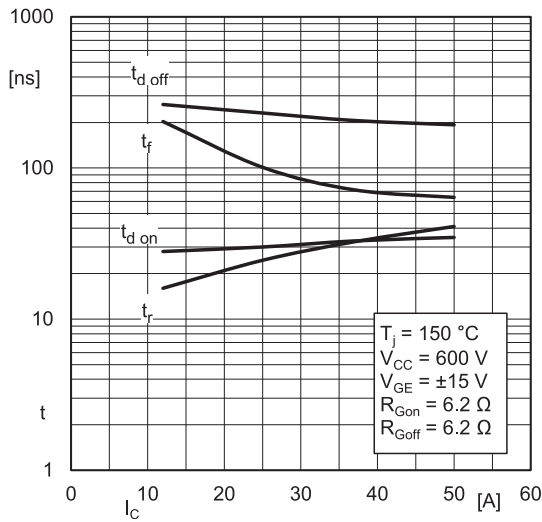


Fig. 7: Typ. switching times =  $f(I_C)$

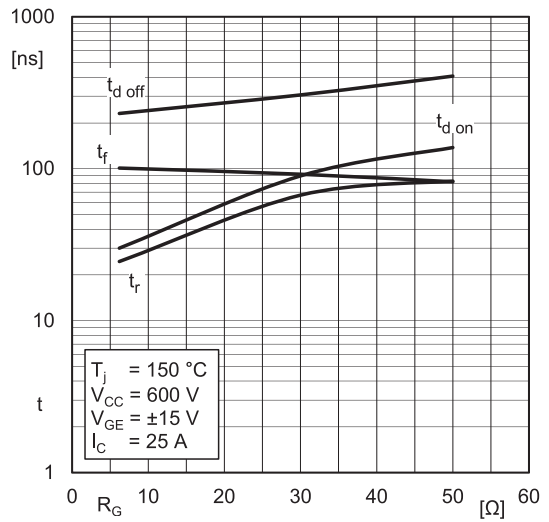


Fig. 8: Typ. switching times =  $f(R_G)$

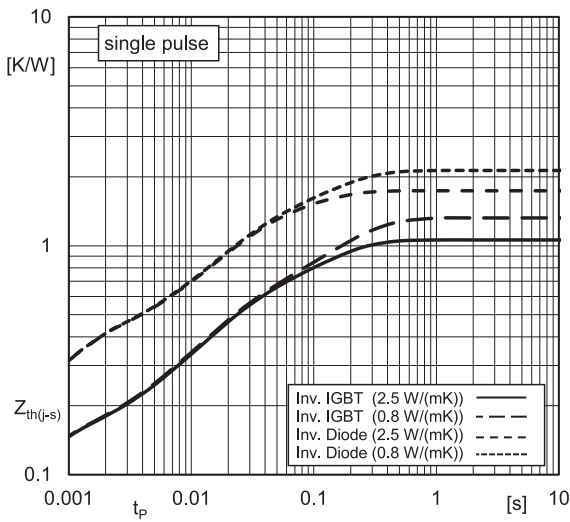


Fig. 9: Typ. transient thermal impedance

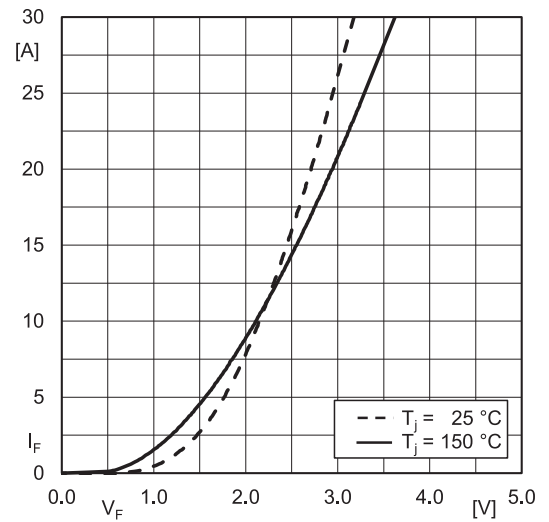


Fig. 10: Typ. Inv. diode forward charact., incl.  $R_{CC+EE}$

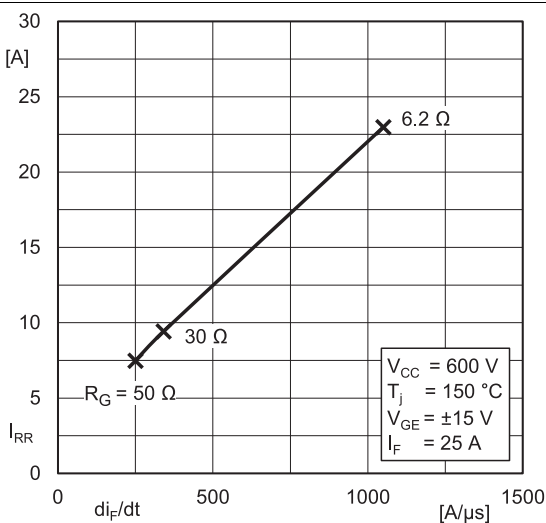


Fig. 11: Typ. Inv. diode peak reverse recovery current

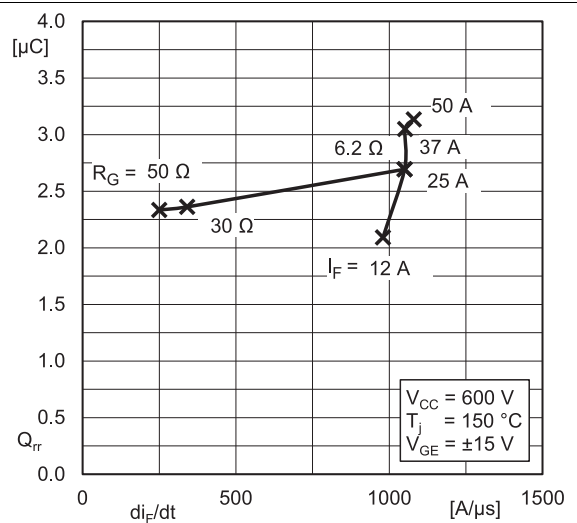


Fig. 12: Typ. Inv. diode reverse recovery charge

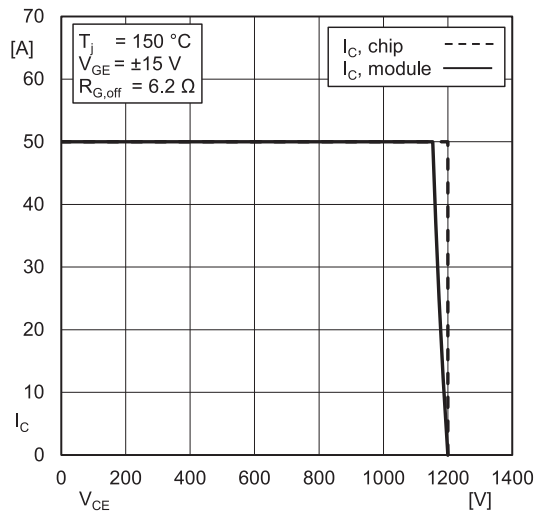


Fig. 13: IGBT Reverse Bias Safe Operating Area (RBSOA)

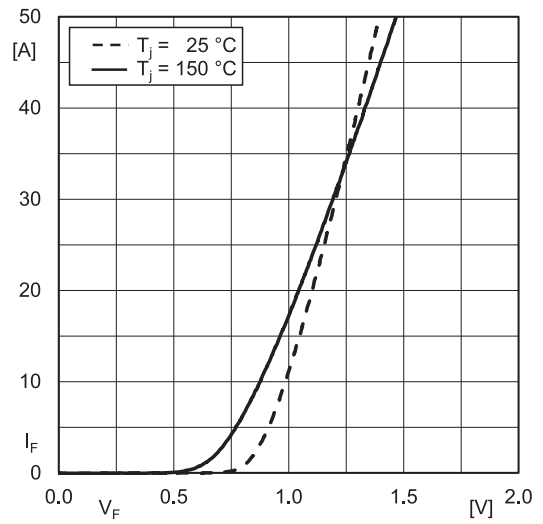
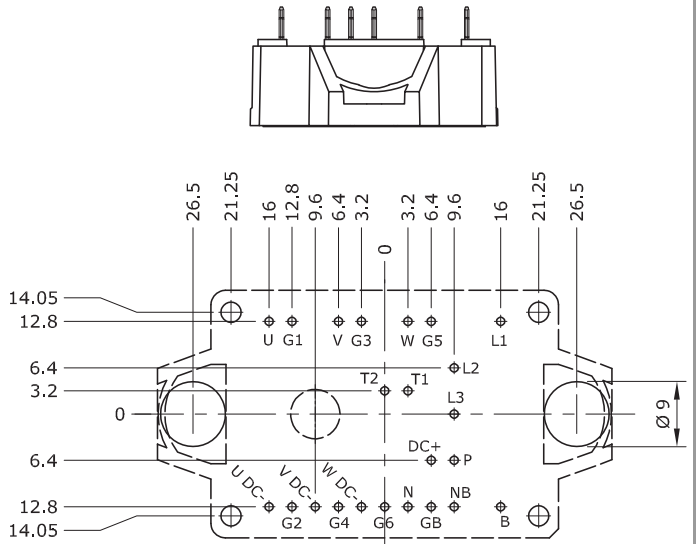
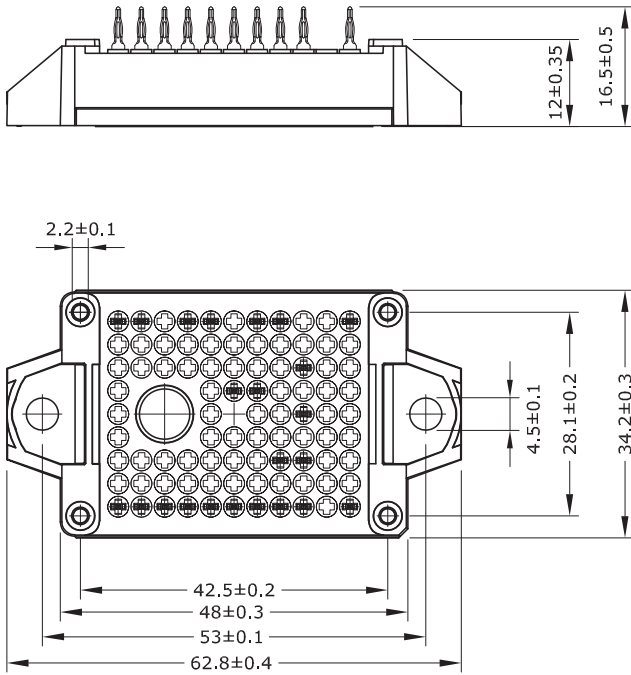


Fig. 14: Typ. Rect. diode forward charact., incl.  $R_{CC'+EE'}$

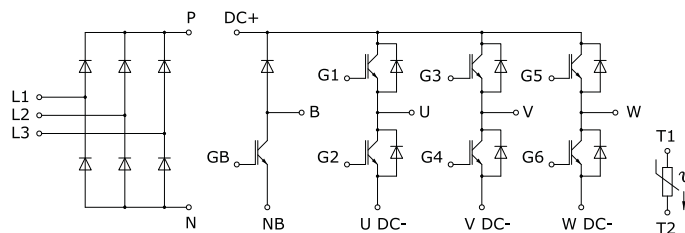


# SK25DGDL12T7ETE1



- Pin-Grid 3.2 mm
- Tolerance of PCB hole pattern  $\phi \pm 0.1$
- Diameters of drill  $\phi$  1.15mm
- Copper thickness in hole 25 - 50  $\mu$ m
- Hole specification for contacts:  
refer to SEMITOP E1/E2 Mounting Instruction

SEMITOP®E1



DGDLE-T

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

## **\*IMPORTANT INFORMATION AND WARNINGS**

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