

# SKiiP 12ACC12T4V10



MiniSKiiP® 1

## Twin 6-pack

### SKiiP 12ACC12T4V10

#### Features

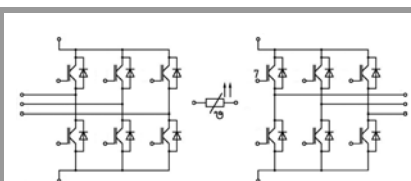
- Trench 4 IGBTs
- Robust and soft freewheeling diodes in CAL technology
- Highly reliable spring contacts for electrical connections
- UL recognised: File no. E63532

#### Typical Applications\*

- 4Q inverters

#### Remarks

- Max. case temperature limited to  $T_C=125^\circ\text{C}$
- Terminal distances sufficient for basic insulation in 3-phase 480VAC TN systems
- DC-link voltage  $V_{DC}\leq 800\text{V}$
- Max. 500V potential difference between +rect and +DC
- Max. 500V potential difference between -rect and -DC
- Temperature sensor: no basic insulation to main circuit, signal processing with reference to -DC potential
- Please refer to MiniSKiiP "Technical Explanations" and "Mounting Instructions" for further information



ACC

#### Absolute Maximum Ratings

Symbol	Conditions	Values	Unit	
<b>IGBT 1 - 6</b>				
$V_{CES}$	$T_j = 25^\circ\text{C}$	1200	V	
$I_C$	$\lambda_{paste}=0.8\text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	18	A
	$T_j = 175^\circ\text{C}$	$T_s = 70^\circ\text{C}$	15	A
$I_C$	$\lambda_{paste}=2.5\text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	19	A
	$T_j = 175^\circ\text{C}$	$T_s = 70^\circ\text{C}$	16	A
$I_{Cnom}$		8	A	
$I_{CRM}$	$I_{CRM} = 3 \times I_{Cnom}$	24	A	
$V_{GES}$		-20 ... 20	V	
$t_{psc}$	$V_{CC} = 800\text{ V}$	$T_j = 150^\circ\text{C}$	10	$\mu\text{s}$
	$V_{GE} \leq 15\text{ V}$			
	$V_{CES} \leq 1200\text{ V}$			
$T_j$		-40 ... 175	$^\circ\text{C}$	
<b>IGBT 7 - 12</b>				
$V_{CES}$	$T_j = 25^\circ\text{C}$	1200	V	
$I_C$	$\lambda_{paste}=0.8\text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	28	A
	$T_j = 175^\circ\text{C}$	$T_s = 70^\circ\text{C}$	23	A
$I_C$	$\lambda_{paste}=2.5\text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	31	A
	$T_j = 175^\circ\text{C}$	$T_s = 70^\circ\text{C}$	26	A
$I_{Cnom}$		15	A	
$I_{CRM}$	$I_{CRM} = 3 \times I_{Cnom}$	45	A	
$V_{GES}$		-20 ... 20	V	
$t_{psc}$	$V_{CC} = 800\text{ V}$	$T_j = 150^\circ\text{C}$	10	$\mu\text{s}$
	$V_{GE} \leq 15\text{ V}$			
	$V_{CES} \leq 1200\text{ V}$			
$T_j$		-40 ... 175	$^\circ\text{C}$	
<b>Diode 1 - 6</b>				
$V_{RRM}$	$T_j = 25^\circ\text{C}$	1200	V	
$I_F$	$\lambda_{paste}=0.8\text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	14	A
	$T_j = 150^\circ\text{C}$	$T_s = 70^\circ\text{C}$	11	A
$I_F$	$\lambda_{paste}=2.5\text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	15	A
	$T_j = 150^\circ\text{C}$	$T_s = 70^\circ\text{C}$	12	A
$I_{Fnom}$		8	A	
$I_{FRM}$	$I_{FRM} = 2 \times I_{Fnom}$	16	A	
$I_{FSM}$	10 ms, sin 180°, $T_j = 150^\circ\text{C}$	55	A	
$T_j$		-40 ... 150	$^\circ\text{C}$	
<b>Diode 7 - 12</b>				
$V_{RRM}$	$T_j = 25^\circ\text{C}$	1200	V	
$I_F$	$\lambda_{paste}=0.8\text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	23	A
	$T_j = 175^\circ\text{C}$	$T_s = 70^\circ\text{C}$	18	A
$I_F$	$\lambda_{paste}=2.5\text{ W/(mK)}$	$T_s = 25^\circ\text{C}$	24	A
	$T_j = 175^\circ\text{C}$	$T_s = 70^\circ\text{C}$	20	A
$I_{Fnom}$		15	A	
$I_{FRM}$	$I_{FRM} = 3 \times I_{Fnom}$	45	A	
$I_{FSM}$	10 ms, sin 180°, $T_j = 150^\circ\text{C}$	65	A	
$T_j$		-40 ... 175	$^\circ\text{C}$	
<b>Module</b>				
$I_{t(RMS)}$	20 A per spring	20	A	
$T_{stg}$		-40 ... 125	$^\circ\text{C}$	
$V_{isol}$	AC sinus 50 Hz, 1 min	2500	V	

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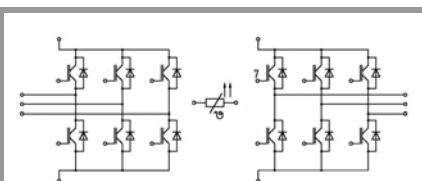
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ACC

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
<b>IGBT 1 - 6</b>						
$V_{CE(sat)}$	$I_C = 8\text{ A}$ $V_{GE} = 15\text{ V}$ chipelevel	$T_j = 25^\circ\text{C}$		1.85	2.10	V
		$T_j = 150^\circ\text{C}$		2.25	2.45	V
$V_{CE0}$	chipelevel	$T_j = 25^\circ\text{C}$		0.80	0.90	V
		$T_j = 150^\circ\text{C}$		0.70	0.80	V
$r_{CE}$	$V_{GE} = 15\text{ V}$ chipelevel	$T_j = 25^\circ\text{C}$		131	150	m $\Omega$
		$T_j = 150^\circ\text{C}$		194	206	m $\Omega$
$V_{GE(th)}$	$V_{GE} = V_{CE}\text{ V}, I_C = 1\text{ mA}$		5	5.8	6.5	V
$I_{CES}$	$V_{GE} = 0\text{ V}$ $V_{CE} = 1200\text{ V}$	$T_j = 25^\circ\text{C}$		0.1	0.3	mA
						mA
$C_{ies}$	$V_{CE} = 25\text{ V}$ $V_{GE} = 0\text{ V}$	$f = 1\text{ MHz}$		0.49		nF
$C_{oes}$		$f = 1\text{ MHz}$		0.05		nF
$C_{res}$		$f = 1\text{ MHz}$		0.03		nF
$Q_G$	$V_{GE} = -8\text{ V...}+15\text{ V}$			45		nC
$R_{Gint}$	$T_j = 25^\circ\text{C}$			0.0		$\Omega$
$t_{d(on)}$	$V_{CC} = 600\text{ V}$ $I_C = 8\text{ A}$	$T_j = 125^\circ\text{C}$		117		ns
$t_r$	$R_{G\ on} = 51\ \Omega$ $R_{G\ off} = 51\ \Omega$	$T_j = 125^\circ\text{C}$		70		ns
$E_{on}$		$T_j = 125^\circ\text{C}$		1		mJ
$t_{d(off)}$	$di/dt_{on} = 97\text{ A}/\mu\text{s}$	$T_j = 125^\circ\text{C}$		300		ns
$t_f$	$di/dt_{off} = 106\text{ A}/\mu\text{s}$ $du/dt = 3300\text{ V}/\mu\text{s}$	$T_j = 125^\circ\text{C}$		120		ns
$E_{off}$	$V_{GE} = +15/-15\text{ V}$ $L_s = 22\text{ nH}$	$T_j = 125^\circ\text{C}$		0.7		mJ
$R_{th(j-s)}$	per IGBT, $\lambda_{paste}=0.8\text{ W}/(\text{mK})$			1.84		K/W
$R_{th(j-s)}$	per IGBT, $\lambda_{paste}=2.5\text{ W}/(\text{mK})$			1.6		K/W
<b>IGBT 7 - 12</b>						
$V_{CE(sat)}$	$I_C = 15\text{ A}$ $V_{GE} = 15\text{ V}$ chipelevel	$T_j = 25^\circ\text{C}$		1.85	2.10	V
		$T_j = 150^\circ\text{C}$		2.25	2.45	V
$V_{CE0}$	chipelevel	$T_j = 25^\circ\text{C}$		0.80	0.90	V
		$T_j = 150^\circ\text{C}$		0.70	0.80	V
$r_{CE}$	$V_{GE} = 15\text{ V}$ chipelevel	$T_j = 25^\circ\text{C}$		70	80	m $\Omega$
		$T_j = 150^\circ\text{C}$		103	110	m $\Omega$
$V_{GE(th)}$	$V_{GE} = V_{CE}\text{ V}, I_C = 1\text{ mA}$		5	5.8	6.5	V
$I_{CES}$	$V_{GE} = 0\text{ V}$ $V_{CE} = 1200\text{ V}$	$T_j = 25^\circ\text{C}$		0.1	0.3	mA
				-		mA
$C_{ies}$	$V_{CE} = 25\text{ V}$ $V_{GE} = 0\text{ V}$	$f = 1\text{ MHz}$		0.90		nF
$C_{oes}$		$f = 1\text{ MHz}$		0.08		nF
$C_{res}$		$f = 1\text{ MHz}$		0.06		nF
$Q_G$	$V_{GE} = -8\text{ V...}+15\text{ V}$			85		nC
$R_{Gint}$	$T_j = 25^\circ\text{C}$			0		$\Omega$
$t_{d(on)}$	$V_{CC} = 600\text{ V}$ $I_C = 15\text{ A}$	$T_j = 150^\circ\text{C}$		92		ns
$t_r$	$R_{G\ on} = 39\ \Omega$ $R_{G\ off} = 39\ \Omega$	$T_j = 150^\circ\text{C}$		74		ns
$E_{on}$		$T_j = 150^\circ\text{C}$		2.1		mJ
$t_{d(off)}$	$di/dt_{on} = 188\text{ A}/\mu\text{s}$	$T_j = 150^\circ\text{C}$		319		ns
$t_f$	$di/dt_{off} = 200\text{ A}/\mu\text{s}$ $du/dt = 3500\text{ V}/\mu\text{s}$	$T_j = 150^\circ\text{C}$		77		ns
$E_{off}$	$V_{GE} = +15/-15\text{ V}$ $L_s = 22\text{ nH}$	$T_j = 150^\circ\text{C}$		1.6		mJ
$R_{th(j-s)}$	per IGBT, $\lambda_{paste}=0.8\text{ W}/(\text{mK})$			1.3		K/W
$R_{th(j-s)}$	per IGBT, $\lambda_{paste}=2.5\text{ W}/(\text{mK})$			1.1		K/W

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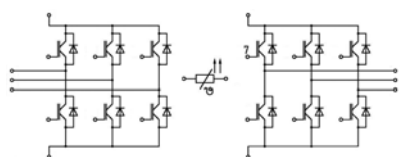
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- 4Q inverters

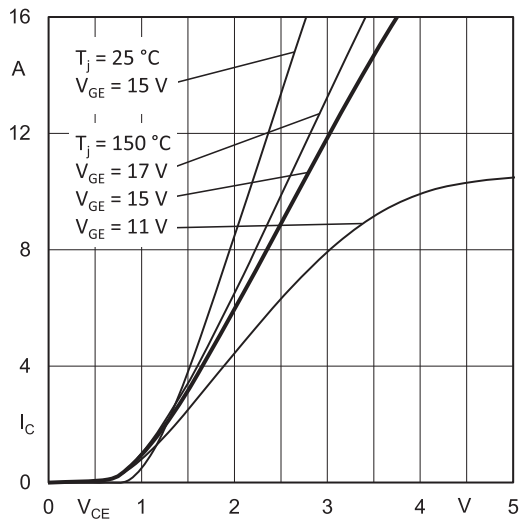
#### Remarks

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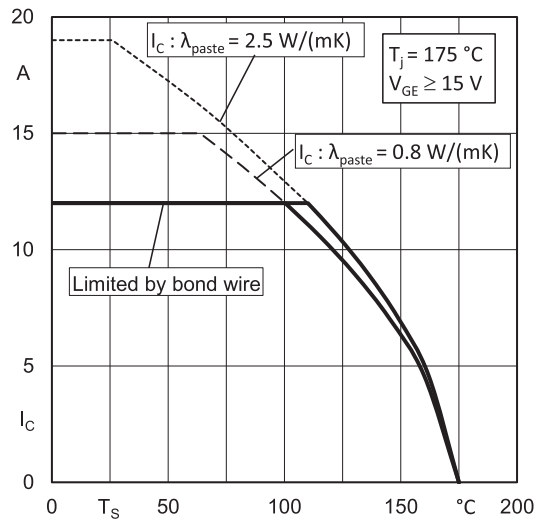
Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
<b>Diode 1 - 6</b>						
$V_F = V_{EC}$	$I_F = 8\text{ A}$ $V_{GE} = 0\text{ V}$ chipelevel	$T_j = 25^\circ\text{C}$		1.96	2.22	V
		$T_j = 125^\circ\text{C}$		2.08	2.34	V
$V_{F0}$	chipelevel	$T_j = 25^\circ\text{C}$		1.00	1.10	V
		$T_j = 125^\circ\text{C}$		0.80	0.90	V
$r_F$	chipelevel	$T_j = 25^\circ\text{C}$		120	140	m $\Omega$
		$T_j = 125^\circ\text{C}$		160	180	m $\Omega$
$I_{RRM}$	$I_F = 8\text{ A}$	$T_j = 125^\circ\text{C}$		5.4		A
$Q_{rr}$	$di/dt_{off} = 93\text{ A}/\mu\text{s}$ $V_{GE} = -15\text{ V}$	$T_j = 125^\circ\text{C}$		1.9		$\mu\text{C}$
$E_{rr}$	$V_{CC} = 600\text{ V}$	$T_j = 125^\circ\text{C}$		0.8		mJ
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=0.8\text{ W}/(\text{mK})$			2.5		K/W
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=2.5\text{ W}/(\text{mK})$			2.2		K/W
<b>Diode 7 - 12</b>						
$V_F = V_{EC}$	$I_F = 15\text{ A}$ $V_{GE} = 0\text{ V}$ chipelevel	$T_j = 25^\circ\text{C}$		2.38	2.71	V
		$T_j = 150^\circ\text{C}$		2.44	2.77	V
$V_{F0}$	chipelevel	$T_j = 25^\circ\text{C}$		1.30	1.50	V
		$T_j = 150^\circ\text{C}$		0.90	1.10	V
$r_F$	chipelevel	$T_j = 25^\circ\text{C}$		72	81	m $\Omega$
		$T_j = 150^\circ\text{C}$		103	111	m $\Omega$
$I_{RRM}$	$I_F = 15\text{ A}$	$T_j = 150^\circ\text{C}$		8.9		A
$Q_{rr}$	$di/dt_{off} = 220\text{ A}/\mu\text{s}$ $V_{GE} = -15\text{ V}$	$T_j = 150^\circ\text{C}$		2.2		$\mu\text{C}$
$E_{rr}$	$V_{CC} = 600\text{ V}$	$T_j = 150^\circ\text{C}$		0.8		mJ
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=0.8\text{ W}/(\text{mK})$			1.92		K/W
$R_{th(j-s)}$	per Diode, $\lambda_{paste}=2.5\text{ W}/(\text{mK})$			1.7		K/W
<b>Module</b>						
$L_{CE}$				60		nH
$M_s$	to heat sink		2		2.5	Nm
w				30		g
<b>Temperature Sensor</b>						
$R_{100}$	$T_r=100^\circ\text{C}$ ( $R_{25}=1000\Omega$ )			$1670 \pm 3\%$		$\Omega$
$R(T)$	$R(T)=1000\Omega[1+A(T-25^\circ\text{C})+B(T-25^\circ\text{C})^2]$ $A = 7.635 \cdot 10^{-3} \text{ }^\circ\text{C}^{-1}$ , $B = 1.731 \cdot 10^{-5} \text{ }^\circ\text{C}^{-2}$					



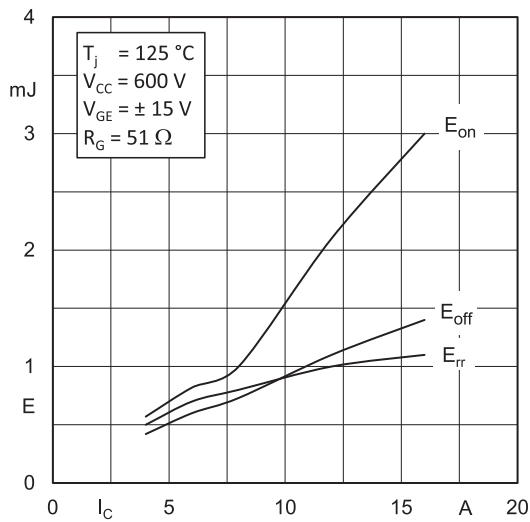
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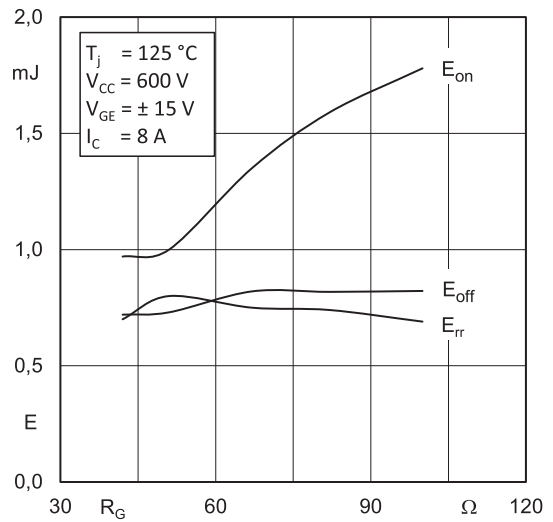
IGBT 1-6 - Fig. 1:  
Typ. output characteristic



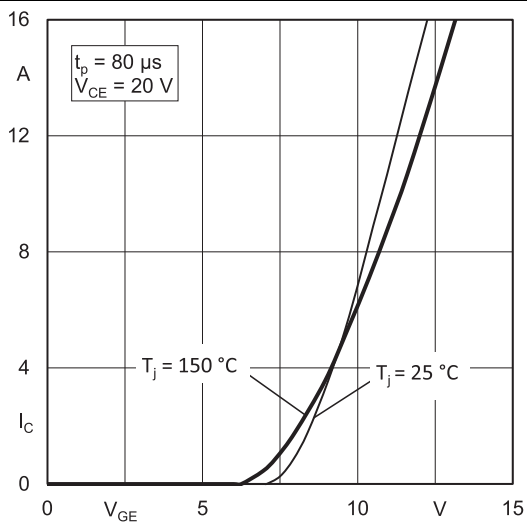
IGBT 1-6 - Fig. 2:  
Typ. rated current vs. temperature  $I_C = f(T_S)$



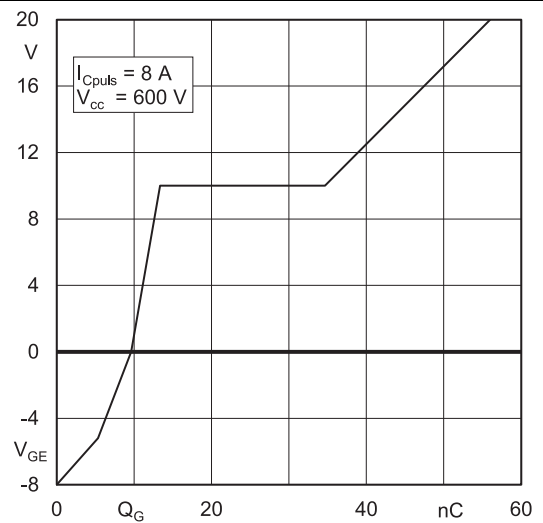
IGBT 1-6 - Fig. 3:  
Typ. turn-on /-off energy =  $f(I_C)$



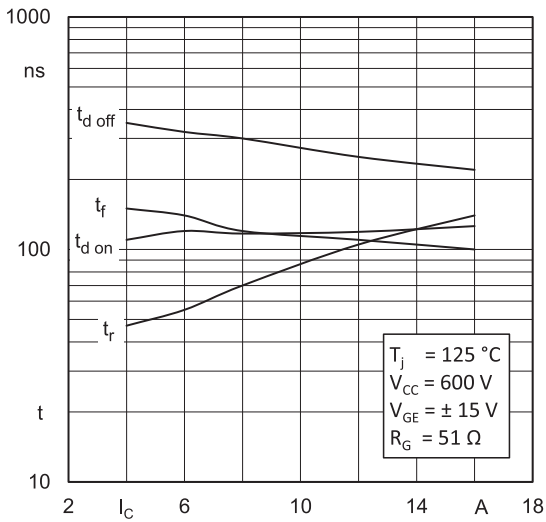
IGBT 1-6 - Fig. 4:  
Typ. turn-on /-off energy =  $f(R_G)$



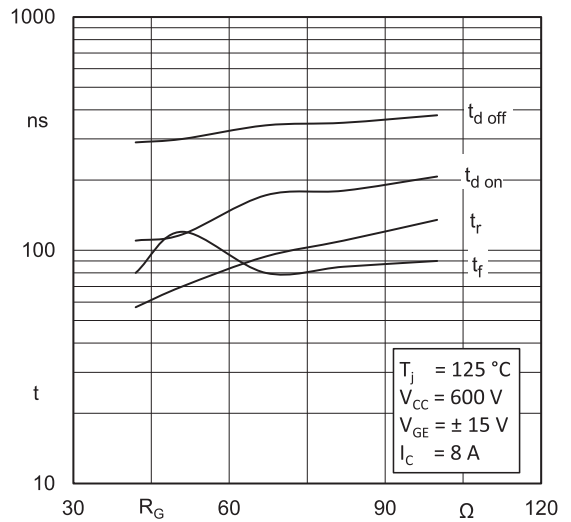
IGBT 1-6 - Fig. 5:  
Typ. transfer characteristic



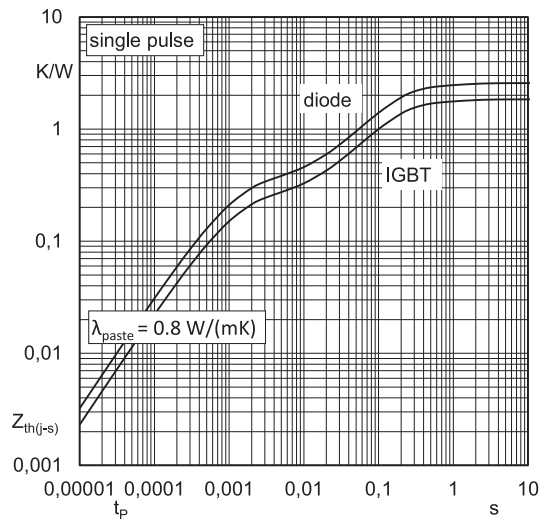
IGBT 1-6 - Fig. 6:  
Typ. gate charge characteristic



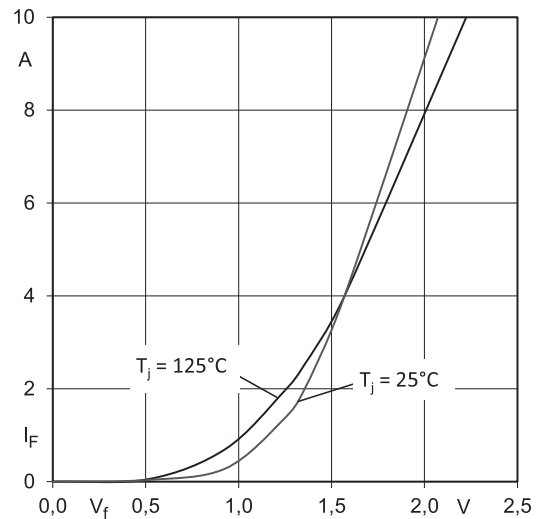
IGBT 1-6 - Fig. 7:  
Typ. switching times vs.  $I_C$



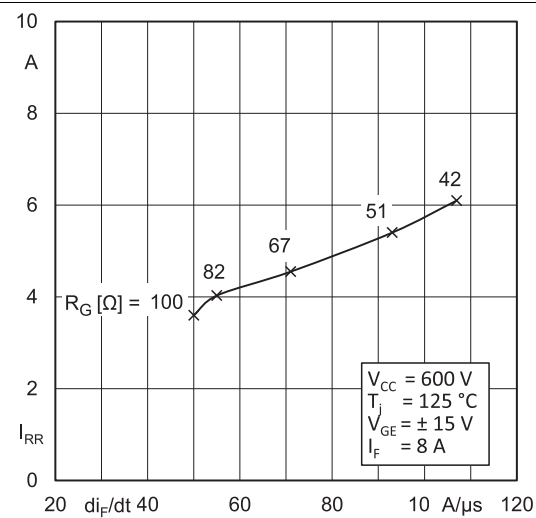
IGBT 1-6 - Fig. 8:  
Typ. switching times vs. gate resistor  $R_G$



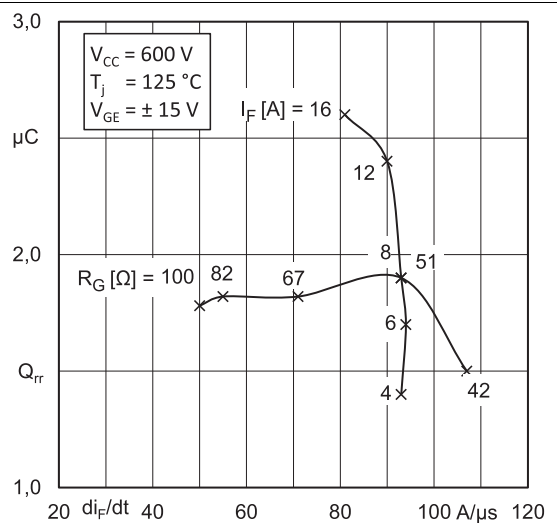
IGBT 1-6 - Fig. 9:  
Transient thermal impedance of IGBT and Diode



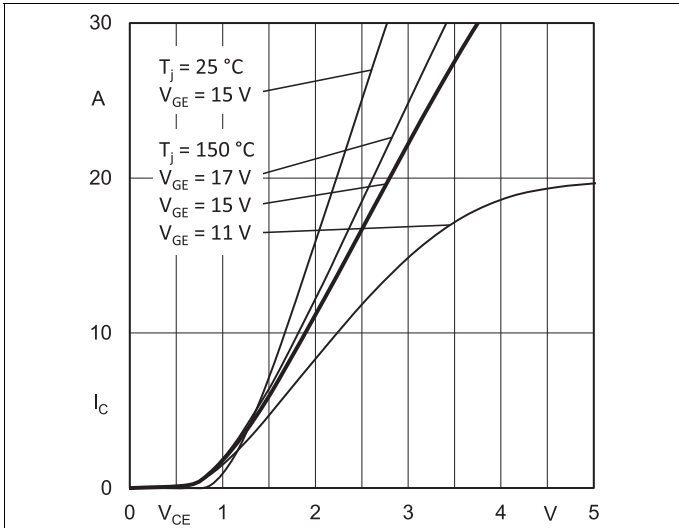
IGBT 1-6 - Fig. 10:  
CAL diode forward characteristic



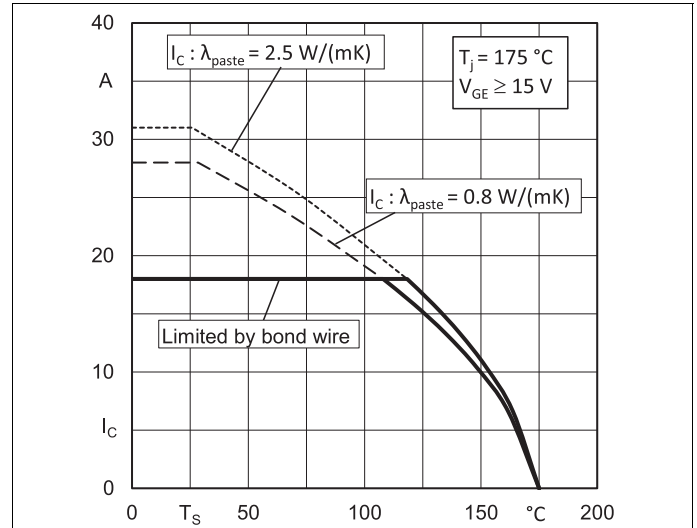
IGBT 1-6 - Fig. 11:  
Typ. CAL diode peak reverse recovery current



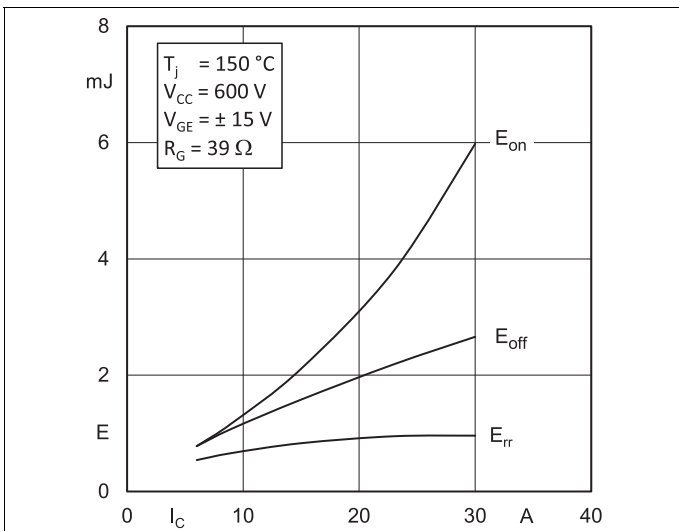
IGBT 1-6 - Fig. 12:  
Typ. CAL diode recovery charge



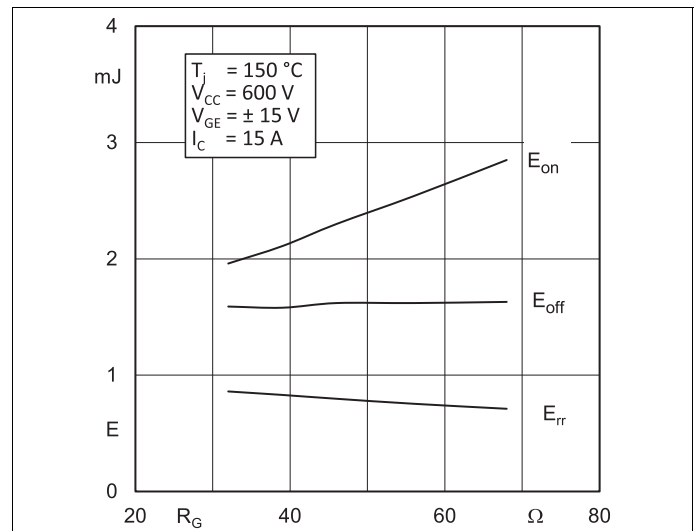
IGBT 7-12 - Fig. 1:  
Typ. output characteristic



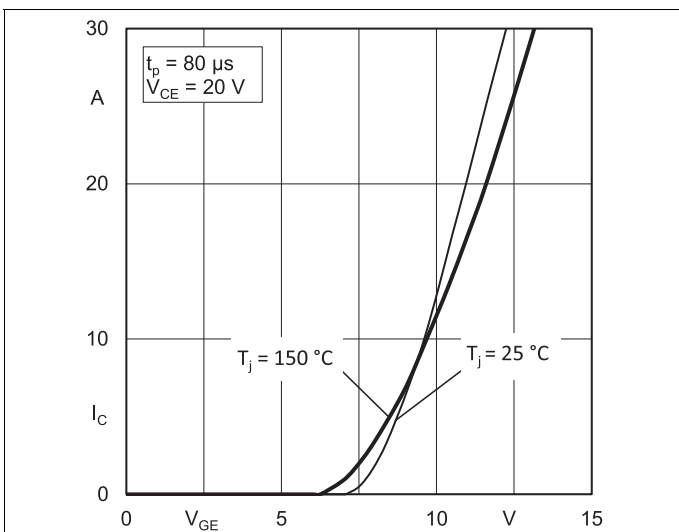
IGBT 7-12 - Fig. 2:  
Typ. rated current vs. temperature  $I_C = f(T_S)$



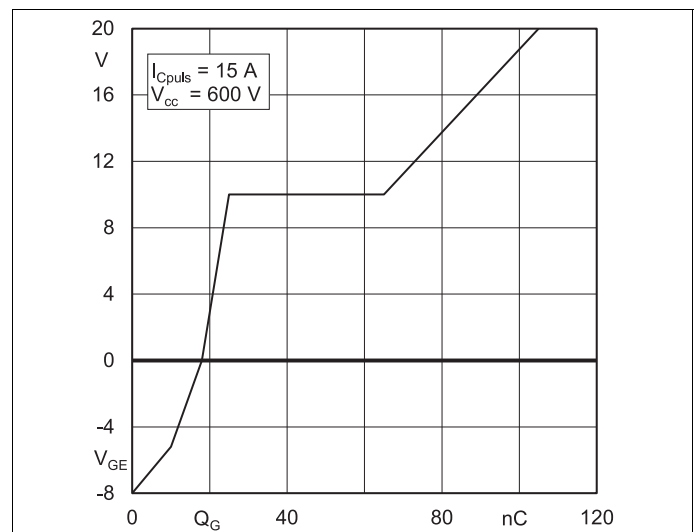
IGBT 7-12 - Fig. 3:  
Typ. turn-on /-off energy =  $f(I_C)$



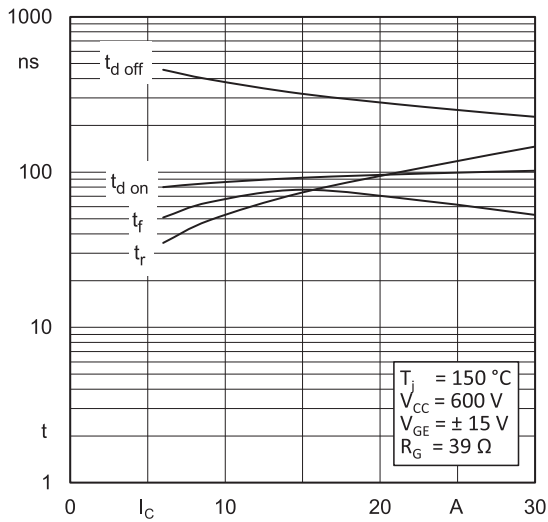
IGBT 7-12 - Fig. 4:  
Typ. turn-on /-off energy =  $f(R_G)$



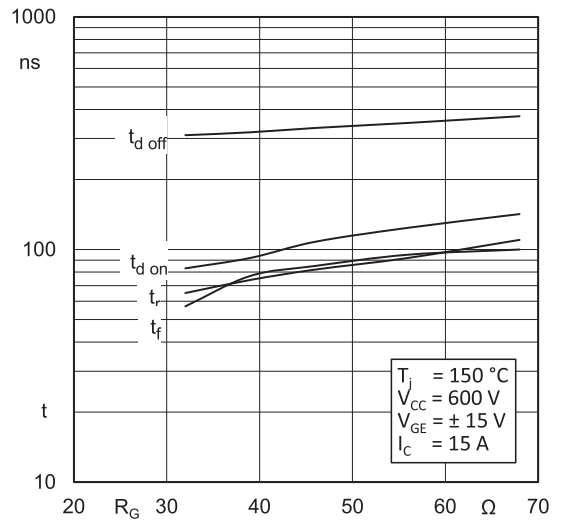
IGBT 7-12 - Fig. 5:  
Typ. transfer characteristic



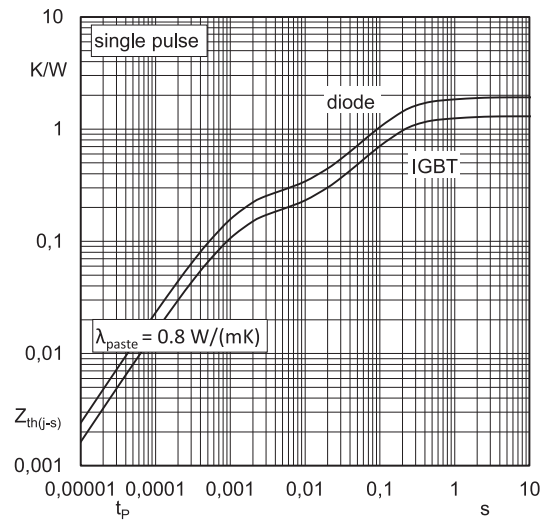
IGBT 7-12 - Fig. 6:  
Typ. gate charge characteristic



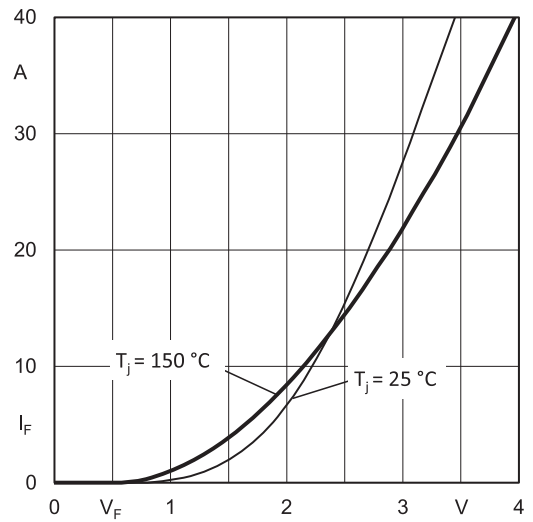
IGBT 7-12 - Fig. 7:  
Typ. switching times vs.  $I_C$



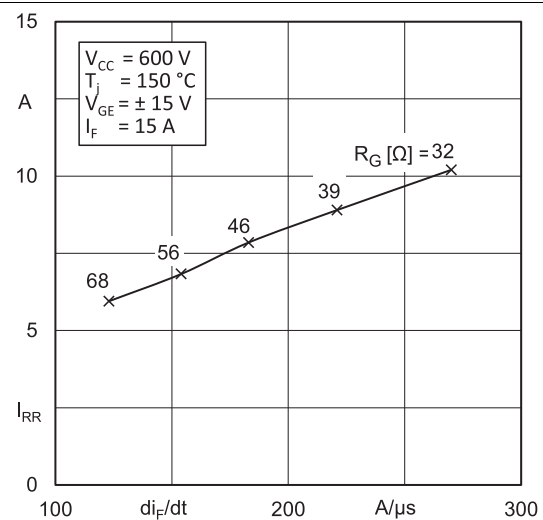
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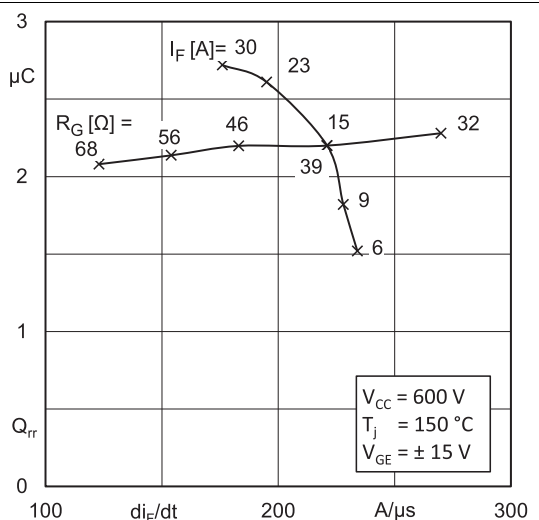
IGBT 7-12 - Fig. 9:  
Transient thermal impedance of IGBT and Diode



IGBT 7-12 - Fig. 10:  
CAL diode forward characteristic



IGBT 7-12 - Fig. 11:  
Typ. CAL diode peak reverse recovery current



IGBT 7-12 - Fig. 12:  
Typ. CAL diode recovery charge





This is an electrostatic discharge sensitive device (ESDS), international standard IEC 60747-1, chapter IX.

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

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