

# SEMiX604GAL12E4s



SEMiX® 4s

## Trench IGBT Modules

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#### Features

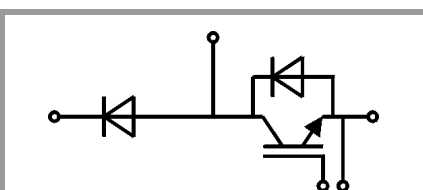
- Homogeneous Si
- Trench = Trenchgate technology
- $V_{CE(sat)}$  with positive temperature coefficient
- High short circuit capability
- UL recognized, file no. E63532

#### Typical Applications\*

- AC inverter drives
- UPS
- Electronic Welding

#### Remarks

- Case temperature limited to  $T_C=125^\circ\text{C}$  max.
- Product reliability results are valid for  $T_j=150^\circ\text{C}$
- Dynamic values apply to the following combination of resistors:  
 $R_{Gon,main} = 1,0 \Omega$   
 $R_{Goff,main} = 6,2 \Omega$   
 $R_{G,X} = 2,2 \Omega$   
 $R_{E,X} = 0,5 \Omega$



GAL

Absolute Maximum Ratings					
Symbol	Conditions		Values	Unit	
<b>IGBT</b>					
$V_{CES}$			1200	V	
$I_C$	$T_j = 175^\circ\text{C}$	$T_c = 25^\circ\text{C}$	916	A	
		$T_c = 80^\circ\text{C}$	704	A	
$I_{Cnom}$			600	A	
$I_{CRM}$	$I_{CRM} = 3 \times I_{Cnom}$		1800	A	
$V_{GES}$			-20 ... 20	V	
$t_{psc}$	$V_{CC} = 800\text{ V}$ $V_{GE} \leq 20\text{ V}$ $V_{CES} \leq 1200\text{ V}$	$T_j = 150^\circ\text{C}$	10		$\mu\text{s}$
$T_j$			-40 ... 175	$^\circ\text{C}$	
<b>Inverse diode</b>					
$I_F$	$T_j = 175^\circ\text{C}$	$T_c = 25^\circ\text{C}$	707	A	
		$T_c = 80^\circ\text{C}$	529	A	
$I_{Fnom}$			600	A	
$I_{FRM}$	$I_{FRM} = 3 \times I_{Fnom}$		1800	A	
$I_{FSM}$	$t_p = 10\text{ ms, sin } 180^\circ, T_j = 25^\circ\text{C}$		3240	A	
$T_j$			-40 ... 175	$^\circ\text{C}$	
<b>Freewheeling diode</b>					
$I_F$	$T_j = 175^\circ\text{C}$	$T_c = 25^\circ\text{C}$	707	A	
		$T_c = 80^\circ\text{C}$	529	A	
$I_{Fnom}$			600	A	
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$T_j$			-40 ... 175	$^\circ\text{C}$	
<b>Module</b>					
$I_{t(RMS)}$			600	A	
$T_{stg}$			-40 ... 125	$^\circ\text{C}$	
$V_{isol}$	AC sinus 50Hz, $t = 1\text{ min}$		4000	V	

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
<b>IGBT</b>						
$V_{CE(sat)}$	$I_C = 600\text{ A}$ $V_{GE} = 15\text{ V}$ chipelevel	$T_j = 25^\circ\text{C}$	1.8	2.05		V
		$T_j = 150^\circ\text{C}$	2.2	2.4		V
$V_{CE0}$		$T_j = 25^\circ\text{C}$	0.8	0.9		V
		$T_j = 150^\circ\text{C}$	0.7	0.8		V
$r_{CE}$	$V_{GE} = 15\text{ V}$	$T_j = 25^\circ\text{C}$	1.7	1.9		$\text{m}\Omega$
		$T_j = 150^\circ\text{C}$	2.5	2.7		$\text{m}\Omega$
$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 24\text{ mA}$		5	5.8	6.5	V
$I_{CES}$	$V_{GE} = 0\text{ V}$ $V_{CE} = 1200\text{ V}$	$T_j = 25^\circ\text{C}$	0.12	0.36		$\text{mA}$
		$T_j = 150^\circ\text{C}$				$\text{mA}$
$C_{ies}$	$V_{CE} = 25\text{ V}$ $V_{GE} = 0\text{ V}$	$f = 1\text{ MHz}$	37.2			$\text{nF}$
$C_{oes}$		$f = 1\text{ MHz}$	2.32			$\text{nF}$
$C_{res}$		$f = 1\text{ MHz}$	2.04			$\text{nF}$
$Q_G$	$V_{GE} = -8\text{ V...} + 15\text{ V}$		3400			$\text{nC}$
$R_{Gint}$	$T_j = 25^\circ\text{C}$		1.25			$\Omega$

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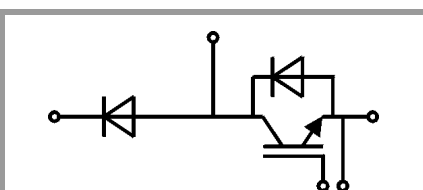
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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
$t_{d(on)}$	$V_{CC} = 600 \text{ V}$	$T_J = 150^\circ\text{C}$		374		ns
$t_r$	$I_C = 600 \text{ A}$	$T_J = 150^\circ\text{C}$		85		ns
$E_{on}$	$R_{G on} = 1.7 \Omega$	$T_J = 150^\circ\text{C}$		35		mJ
$t_{d(off)}$	$R_{G off} = 6.9 \Omega$	$T_J = 150^\circ\text{C}$		1277		ns
$t_f$	$di/dt_{on} = 7100 \text{ A}/\mu\text{s}$	$T_J = 150^\circ\text{C}$		114		ns
$E_{off}$	$di/dt_{off} = 6350 \text{ A}/\mu\text{s}$	$T_J = 150^\circ\text{C}$		110.4		mJ
$R_{th(j-c)}$	per IGBT				0.049	K/W
Inverse diode						
$V_F = V_{EC}$	$I_F = 600 \text{ A}$	$T_J = 25^\circ\text{C}$		2.1	2.46	V
	$V_{GE} = 0 \text{ V}$ chip	$T_J = 150^\circ\text{C}$		2.1	2.4	V
$V_{F0}$		$T_J = 25^\circ\text{C}$	1.1	1.3	1.5	V
		$T_J = 150^\circ\text{C}$	0.7	0.9	1.1	V
$r_F$		$T_J = 25^\circ\text{C}$	1.1	1.4	1.6	m $\Omega$
		$T_J = 150^\circ\text{C}$	1.7	1.9	2.1	m $\Omega$
$I_{RRM}$	$I_F = 600 \text{ A}$	$T_J = 150^\circ\text{C}$		430		A
$Q_{rr}$	$di/dt_{off} = 6000 \text{ A}/\mu\text{s}$	$T_J = 150^\circ\text{C}$		100		$\mu\text{C}$
$E_{rr}$	$V_{GE} = -15 \text{ V}$	$T_J = 150^\circ\text{C}$		44		mJ
	$V_{CC} = 600 \text{ V}$	$T_J = 150^\circ\text{C}$				
$R_{th(j-c)}$	per diode				0.086	K/W
Freewheeling diode						
$V_F = V_{EC}$	$I_F = 600 \text{ A}$	$T_J = 25^\circ\text{C}$		2.1	2.46	V
	$V_{GE} = 0 \text{ V}$ chip	$T_J = 150^\circ\text{C}$		2.1	2.4	V
$V_{F0}$		$T_J = 25^\circ\text{C}$	1.1	1.3	1.5	V
		$T_J = 150^\circ\text{C}$	0.7	0.9	1.1	V
$r_F$		$T_J = 25^\circ\text{C}$	1.1	1.4	1.6	m $\Omega$
		$T_J = 150^\circ\text{C}$	1.7	1.9	2.1	m $\Omega$
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$E_{rr}$	$V_{GE} = -15 \text{ V}$	$T_J = 150^\circ\text{C}$		44		mJ
	$V_{CC} = 600 \text{ V}$	$T_J = 150^\circ\text{C}$				
$R_{th(j-c)}$	per diode				0.086	K/W
Module						
$L_{CE}$				22		nH
$R_{CC+EE}$	res., terminal-chip	$T_C = 25^\circ\text{C}$		0.7		m $\Omega$
		$T_C = 125^\circ\text{C}$		1		m $\Omega$
$R_{th(c-s)}$	per module			0.03		K/W
$M_s$	to heat sink (M5)		3		5	Nm
$M_t$		to terminals (M6)	2.5		5	Nm
						Nm
w					400	g
Temperatur Sensor						
$R_{100}$	$T_C=100^\circ\text{C}$ ( $R_{25}=5 \text{ k}\Omega$ )			$493 \pm 5\%$		$\Omega$
$B_{100/125}$	$R(T)=R_{100}\exp[B_{100/125}(1/T-1/T_{100})]$ ; $T[\text{K}]$ ;			$3550 \pm 2\%$		K



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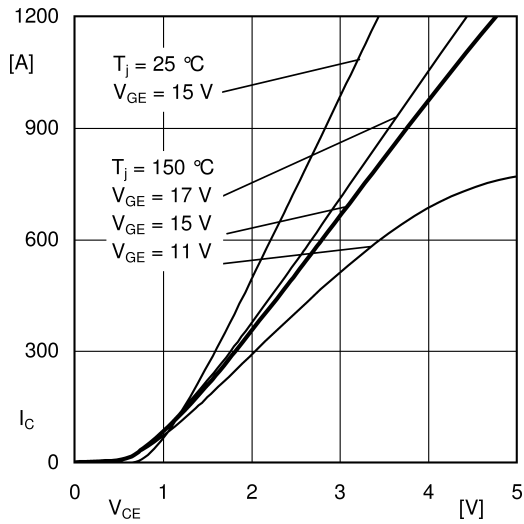


Fig. 1: Typ. output characteristic, inclusive  $R_{CC+EE}$

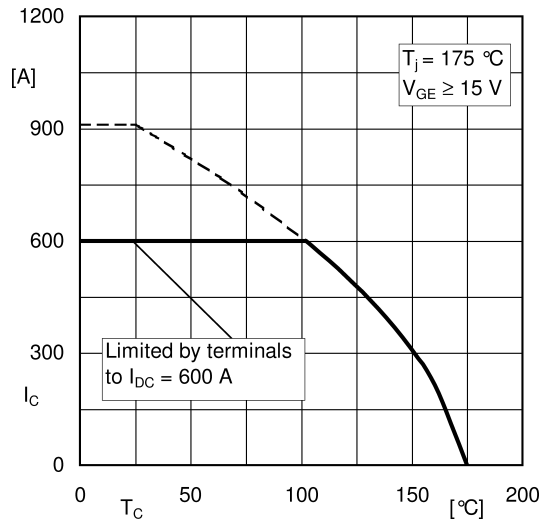


Fig. 2: Rated current vs. temperature  $I_C = f(T_C)$

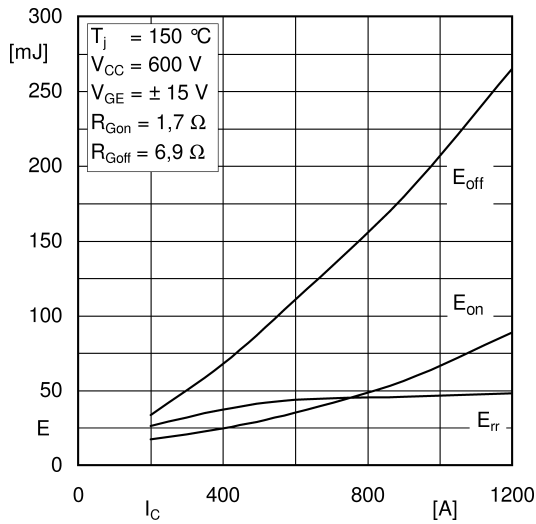


Fig. 3: Typ. turn-on /-off energy =  $f(I_C)$

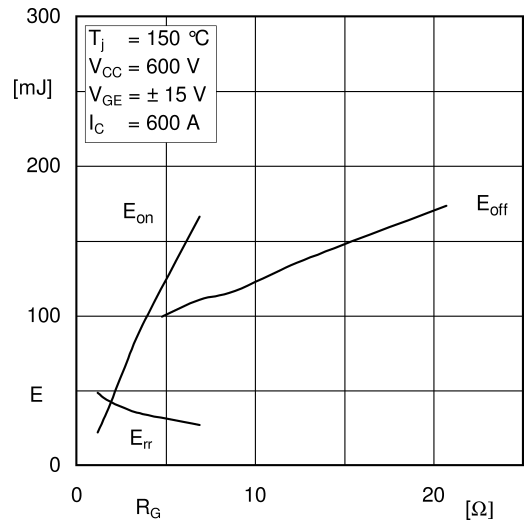


Fig. 4: Typ. turn-on /-off energy =  $f(R_G)$

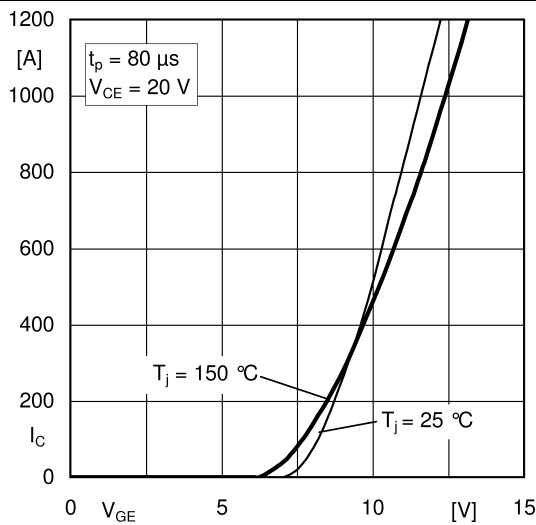


Fig. 5: Typ. transfer characteristic

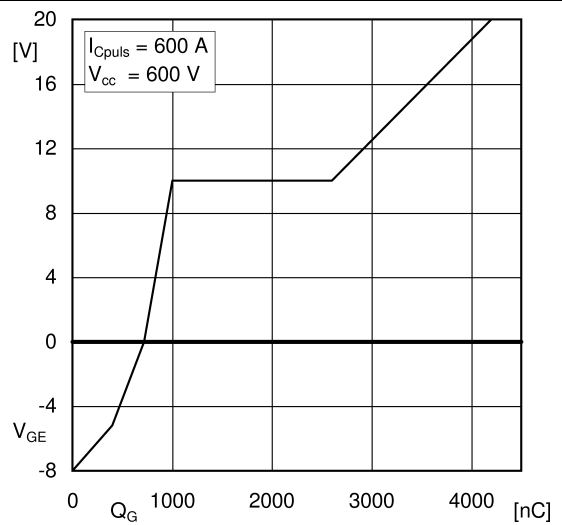


Fig. 6: Typ. gate charge characteristic

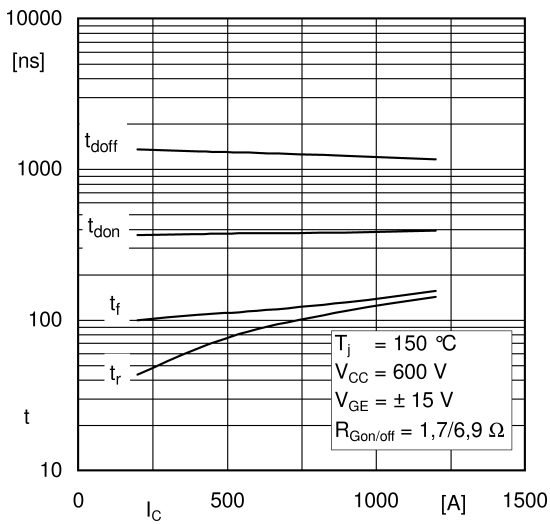


Fig. 7: Typ. switching times vs.  $I_C$

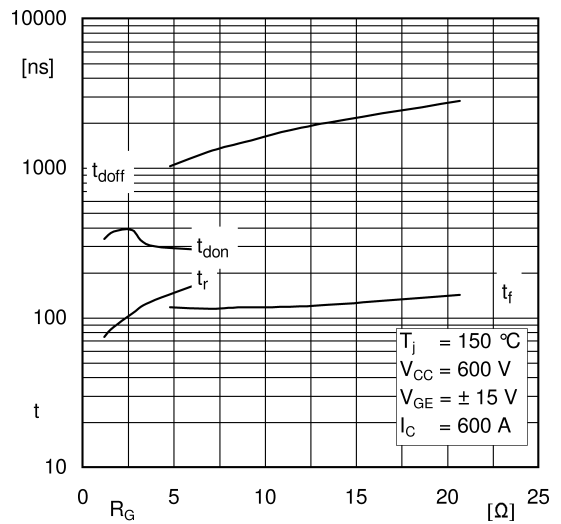


Fig. 8: Typ. switching times vs. gate resistor  $R_G$

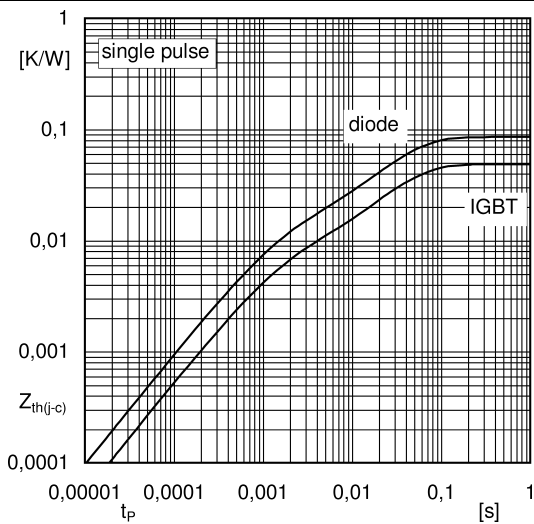


Fig. 9: Typ. transient thermal impedance

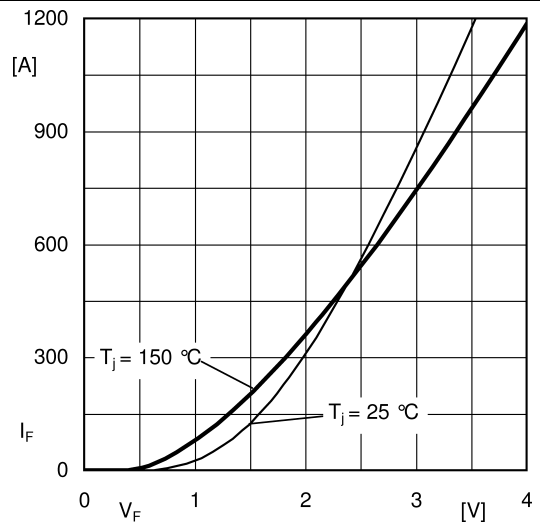


Fig. 10: Typ. CAL diode forward charact., incl.  $R_{CC+EE}$

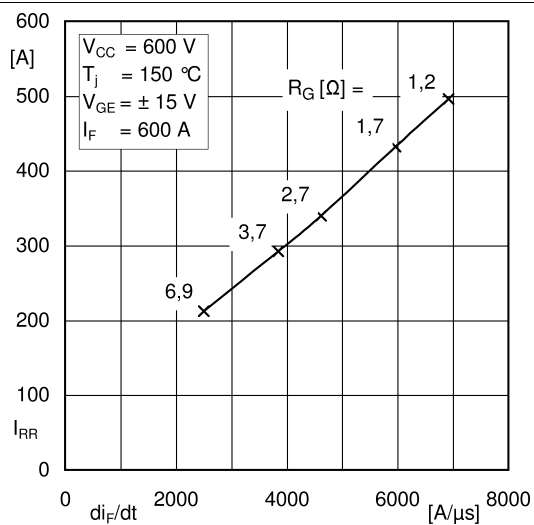


Fig. 11: Typ. CAL diode peak reverse recovery current

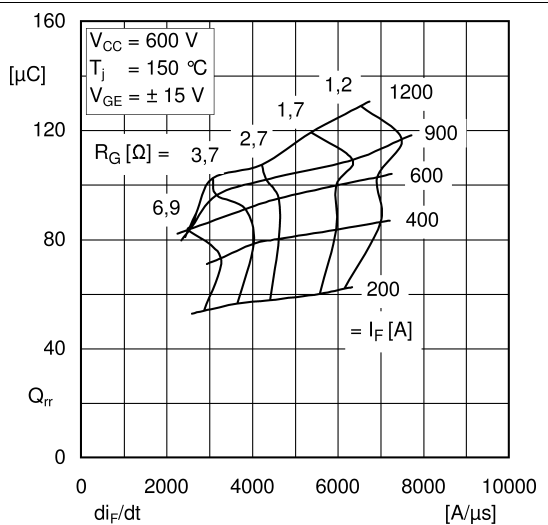


Fig. 12: Typ. CAL diode recovery charge

