

# SEMiX402GAL066HDs



SEMiX® 2s

## Trench IGBT Modules

### SEMiX402GAL066HDs

#### Features

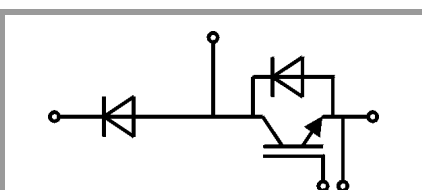
- Homogeneous Si
- Trench = Trenchgate technology
- $V_{CE(sat)}$  with positive temperature coefficient
- UL recognised file no. E63532

#### Typical Applications\*

- Matrix Converter
- Resonant Inverter
- Current Source Inverter

#### Remarks

- Case temperature limited to  $T_C=125^\circ\text{C}$  max.
- Product reliability results are valid for  $T_j=150^\circ\text{C}$
- For short circuit: Soft  $R_{Goff}$  recommended
- Take care of over-voltage caused by stray inductance



GAL

Absolute Maximum Ratings				
Symbol	Conditions		Values	Unit
<b>IGBT</b>				
$V_{CES}$	$T_j = 25^\circ\text{C}$		600	V
$I_C$	$T_j = 175^\circ\text{C}$	$T_c = 25^\circ\text{C}$	502	A
		$T_c = 80^\circ\text{C}$	379	A
$I_{Cnom}$			400	A
$I_{CRM}$	$I_{CRM} = 2 \times I_{Cnom}$		800	A
$V_{GES}$			-20 ... 20	V
$t_{psc}$	$V_{CC} = 360\text{ V}$	$T_j = 150^\circ\text{C}$	6	$\mu\text{s}$
	$V_{GE} \leq 15\text{ V}$			
	$V_{CES} \leq 600\text{ V}$			
$T_j$			-40 ... 175	$^\circ\text{C}$
<b>Inverse diode</b>				
$I_F$	$T_j = 175^\circ\text{C}$	$T_c = 25^\circ\text{C}$	543	A
		$T_c = 80^\circ\text{C}$	397	A
$I_{Fnom}$			400	A
$I_{FRM}$	$I_{FRM} = 2 \times I_{Fnom}$		800	A
$I_{FSM}$	$t_p = 10\text{ ms, sin } 180^\circ, T_j = 25^\circ\text{C}$		1800	A
$T_j$			-40 ... 175	$^\circ\text{C}$
<b>Freewheeling diode</b>				
$I_F$	$T_j = 175^\circ\text{C}$	$T_c = 25^\circ\text{C}$	566	A
		$T_c = 80^\circ\text{C}$	412	A
$I_{Fnom}$			400	A
$I_{FRM}$	$I_{FRM} = 2 \times I_{Fnom}$		800	A
$I_{FSM}$	$t_p = 10\text{ ms, sin } 180^\circ, T_j = 25^\circ\text{C}$		1800	A
$T_j$			-40 ... 175	$^\circ\text{C}$
<b>Module</b>				
$I_{t(RMS)}$	$T_{terminal} = 80^\circ\text{C}$		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>						
$V_{CE(sat)}$	$I_C = 400\text{ A}$ $V_{GE} = 15\text{ V}$ chipllevel	$T_j = 25^\circ\text{C}$	1.45	1.85		V
		$T_j = 150^\circ\text{C}$	1.7	2.1		V
$V_{CE0}$		$T_j = 25^\circ\text{C}$	0.9	1		V
		$T_j = 150^\circ\text{C}$	0.85	0.9		V
$r_{CE}$	$V_{GE} = 15\text{ V}$	$T_j = 25^\circ\text{C}$	1.4	2.1		$\text{m}\Omega$
		$T_j = 150^\circ\text{C}$	2.1	3.0		$\text{m}\Omega$
$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 6.4\text{ mA}$		5	5.8	6.5	V
$I_{CES}$	$V_{GE} = 0\text{ V}$ $V_{CE} = 600\text{ V}$	$T_j = 25^\circ\text{C}$	0.15	0.45		mA
		$T_j = 150^\circ\text{C}$				mA
$C_{ies}$	$V_{CE} = 25\text{ V}$ $V_{GE} = 0\text{ V}$	$f = 1\text{ MHz}$	24.7			nF
$C_{oes}$		$f = 1\text{ MHz}$	1.54			nF
$C_{res}$		$f = 1\text{ MHz}$	0.73			nF
$Q_G$	$V_{GE} = -8\text{ V...} + 15\text{ V}$		3200			nC
$R_{Gint}$	$T_j = 25^\circ\text{C}$		1.00			$\Omega$

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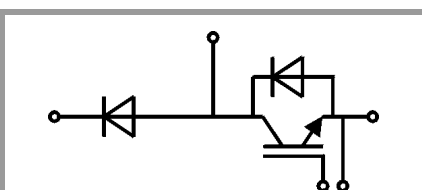
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#### Remarks

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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
$t_{d(on)}$	$V_{CC} = 300\text{ V}$	$T_j = 150^\circ\text{C}$		150		ns
$t_r$	$I_C = 400\text{ A}$	$T_j = 150^\circ\text{C}$		125		ns
$E_{on}$	$V_{GE} = \pm 15\text{ V}$	$T_j = 150^\circ\text{C}$		22		mJ
$t_{d(off)}$	$R_{G\ on} = 4.5\ \Omega$	$T_j = 150^\circ\text{C}$		900		ns
$t_f$	$R_{G\ off} = 4.5\ \Omega$	$T_j = 150^\circ\text{C}$		65		ns
$E_{off}$		$T_j = 150^\circ\text{C}$		24		mJ
$R_{th(j-c)}$	per IGBT				0.12	K/W
Inverse diode						
$V_F = V_{EC}$	$I_F = 400\text{ A}$	$T_j = 25^\circ\text{C}$		1.4	1.60	V
	$V_{GE} = 0\text{ V}$ chip	$T_j = 150^\circ\text{C}$		1.4	1.6	V
$V_{F0}$		$T_j = 25^\circ\text{C}$	0.9	1	1.1	V
		$T_j = 150^\circ\text{C}$	0.75	0.85	0.95	V
$r_F$		$T_j = 25^\circ\text{C}$	0.8	1.0	1.3	m $\Omega$
		$T_j = 150^\circ\text{C}$	1.1	1.4	1.6	m $\Omega$
$I_{RRM}$	$I_F = 400\text{ A}$	$T_j = 150^\circ\text{C}$		250		A
$Q_{rr}$	$di/dt_{off} = 3700\text{ A}/\mu\text{s}$	$T_j = 150^\circ\text{C}$		47		$\mu\text{C}$
$E_{rr}$	$V_{GE} = -8\text{ V}$	$T_j = 150^\circ\text{C}$		10		mJ
	$V_{CC} = 300\text{ V}$	$T_j = 150^\circ\text{C}$				
$R_{th(j-c)}$	per diode				0.15	K/W
Freewheeling diode						
$V_F = V_{EC}$	$I_F = 400\text{ A}$	$T_j = 25^\circ\text{C}$		1.3	1.53	V
	$V_{GE} = 0\text{ V}$ chip	$T_j = 150^\circ\text{C}$		1.3	1.5	V
$V_{F0}$		$T_j = 25^\circ\text{C}$	0.9	1	1.1	V
		$T_j = 150^\circ\text{C}$	0.75	0.85	0.95	V
$r_F$		$T_j = 25^\circ\text{C}$	0.7	0.9	1.1	m $\Omega$
		$T_j = 150^\circ\text{C}$	1.0	1.2	1.4	m $\Omega$
$I_{RRM}$	$I_F = 400\text{ A}$	$T_j = 150^\circ\text{C}$		250		A
$Q_{rr}$	$di/dt_{off} = 3700\text{ A}/\mu\text{s}$	$T_j = 150^\circ\text{C}$		47		$\mu\text{C}$
$E_{rr}$	$V_{GE} = -8\text{ V}$	$T_j = 150^\circ\text{C}$		10		mJ
	$V_{CC} = 300\text{ V}$	$T_j = 150^\circ\text{C}$				
$R_{th(j-c)}$	per diode				0.15	K/W
Module						
$L_{CE}$				18		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			0.045		K/W
$M_s$	to heat sink (M5)		3		5	Nm
$M_t$		to terminals (M6)	2.5		5	Nm
						Nm
w					250	g
Temperatur Sensor						
$R_{100}$	$T_C=100^\circ\text{C}$ ( $R_{25}=5\text{ k}\Omega$ )			$493 \pm 5\%$		$\Omega$
$B_{100/125}$	$R(T)=R_{100}\exp[B_{100/125}(1/T-1/T_{100})]$ ; $T[K]$ ;			$3550 \pm 2\%$		K



GAL

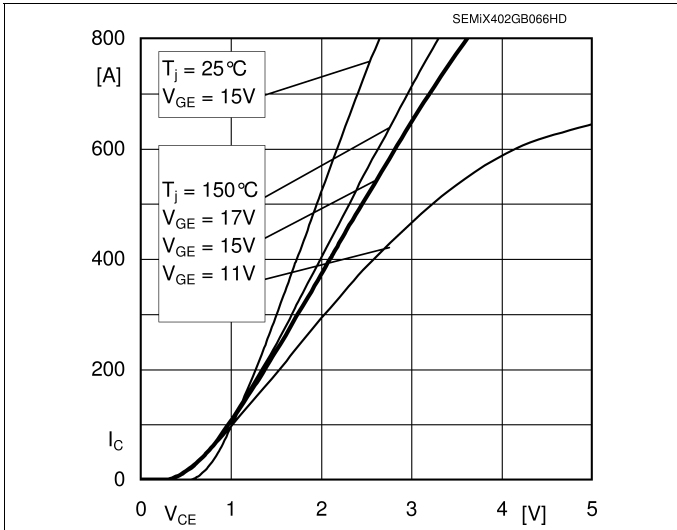


Fig. 1: Typ. output characteristic, inclusive  $R_{CC'+EE'}$

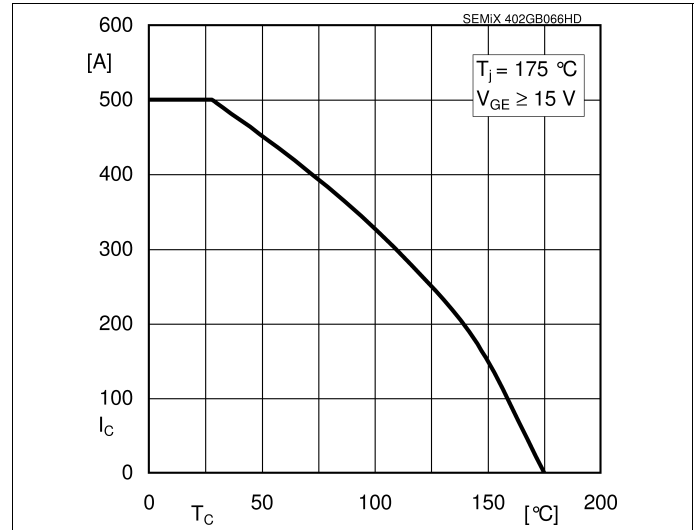


Fig. 2: Rated current vs. temperature  $I_C = f(T_C)$

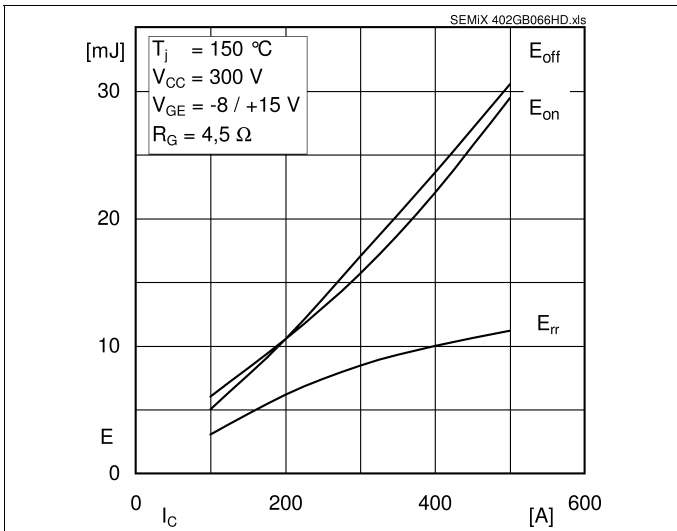


Fig. 3: Typ. turn-on /-off energy =  $f(I_C)$

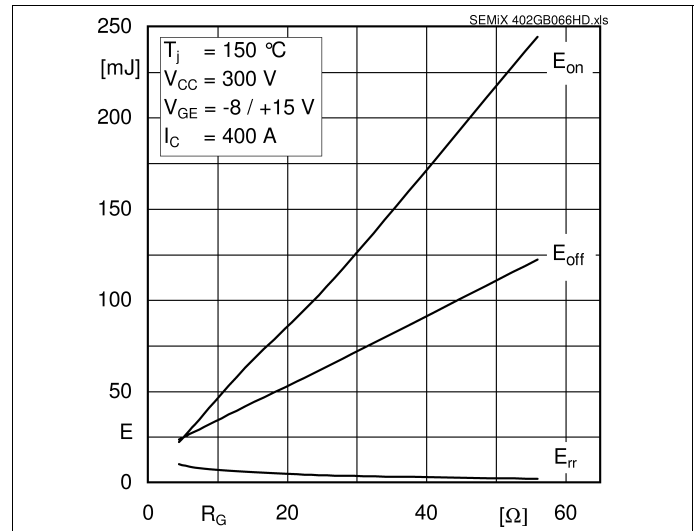


Fig. 4: Typ. turn-on /-off energy =  $f(R_G)$

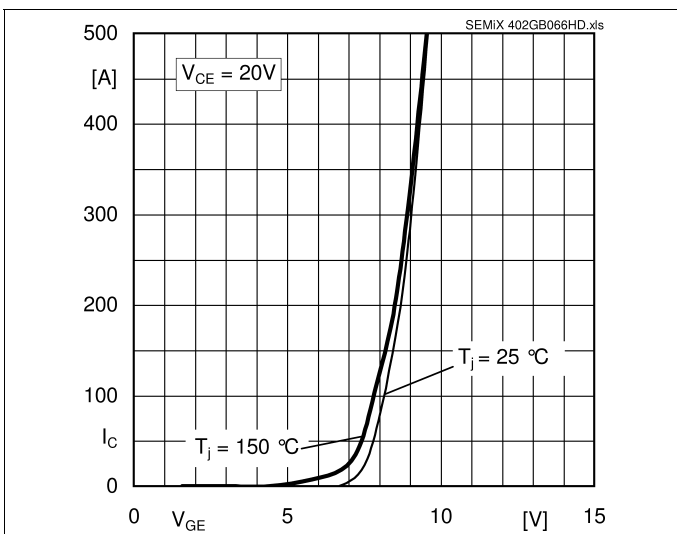


Fig. 5: Typ. transfer characteristic

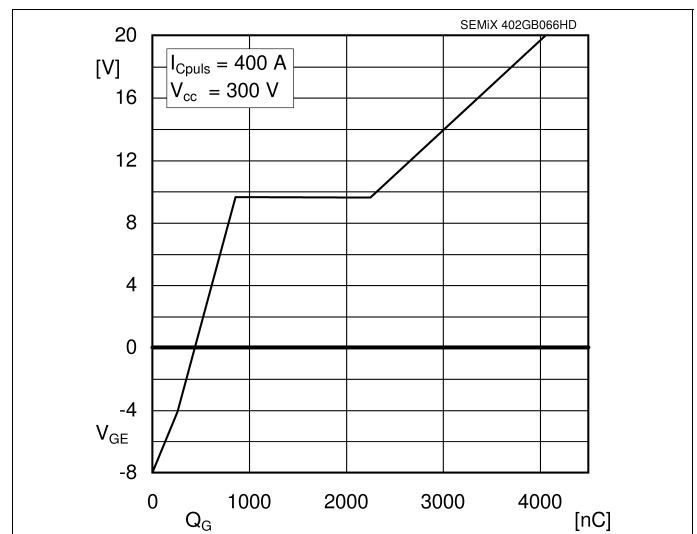


Fig. 6: Typ. gate charge characteristic

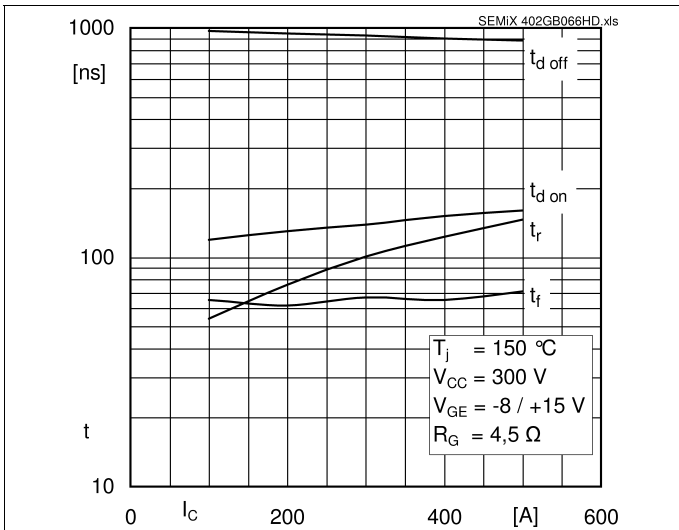


Fig. 7: Typ. switching times vs.  $I_C$

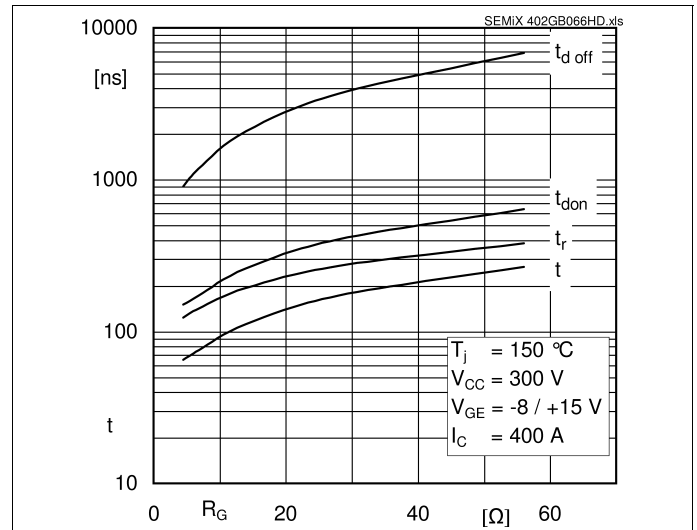


Fig. 8: Typ. switching times vs. gate resistor  $R_G$

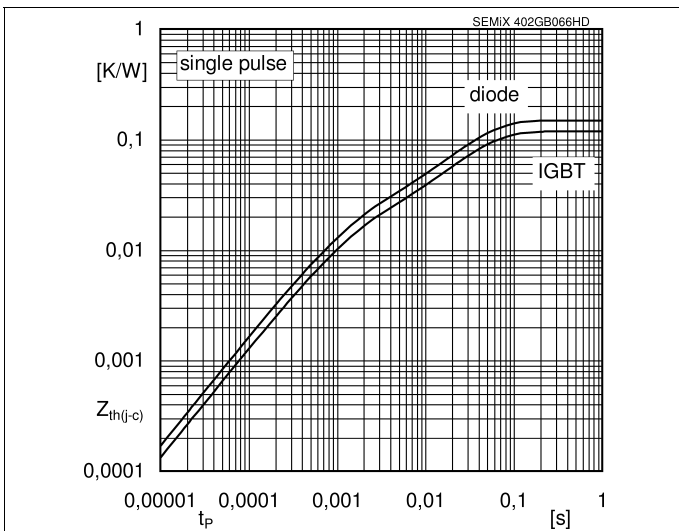


Fig. 9: Typ. transient thermal impedance

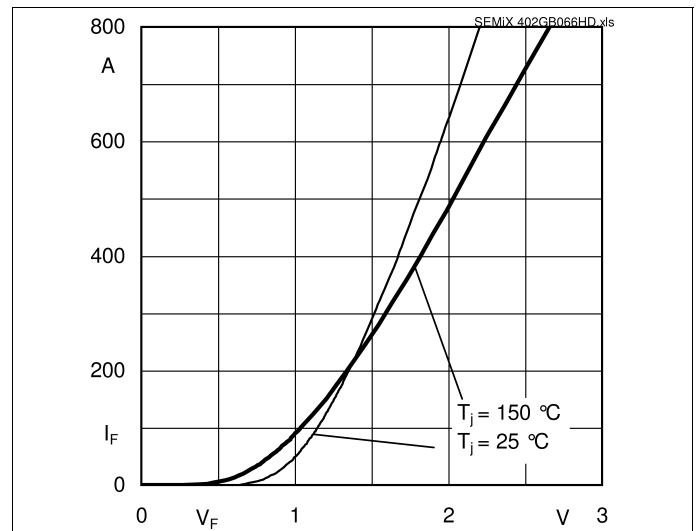


Fig. 10: Typ. CAL diode forward charact., incl.  $R_{CC+EE}$

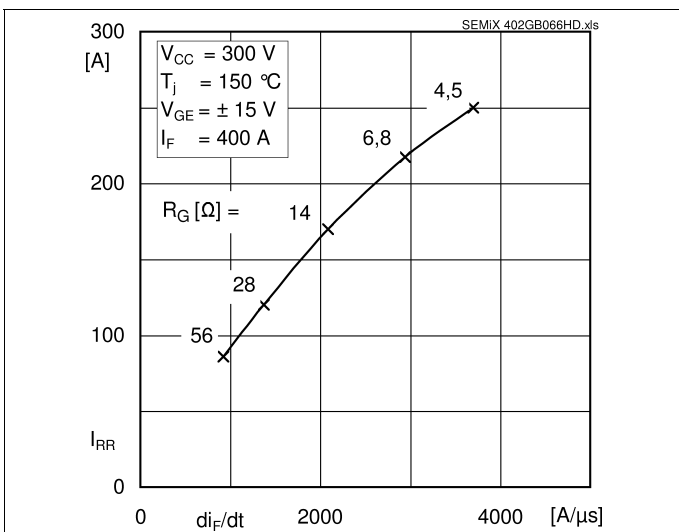


Fig. 11: Typ. CAL diode peak reverse recovery current

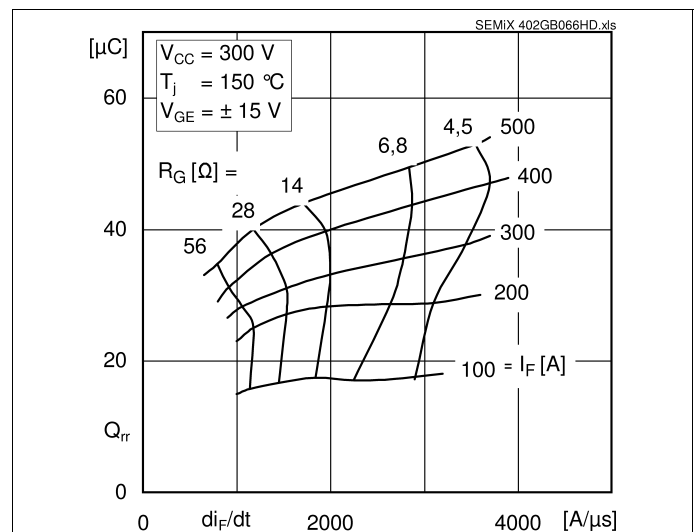
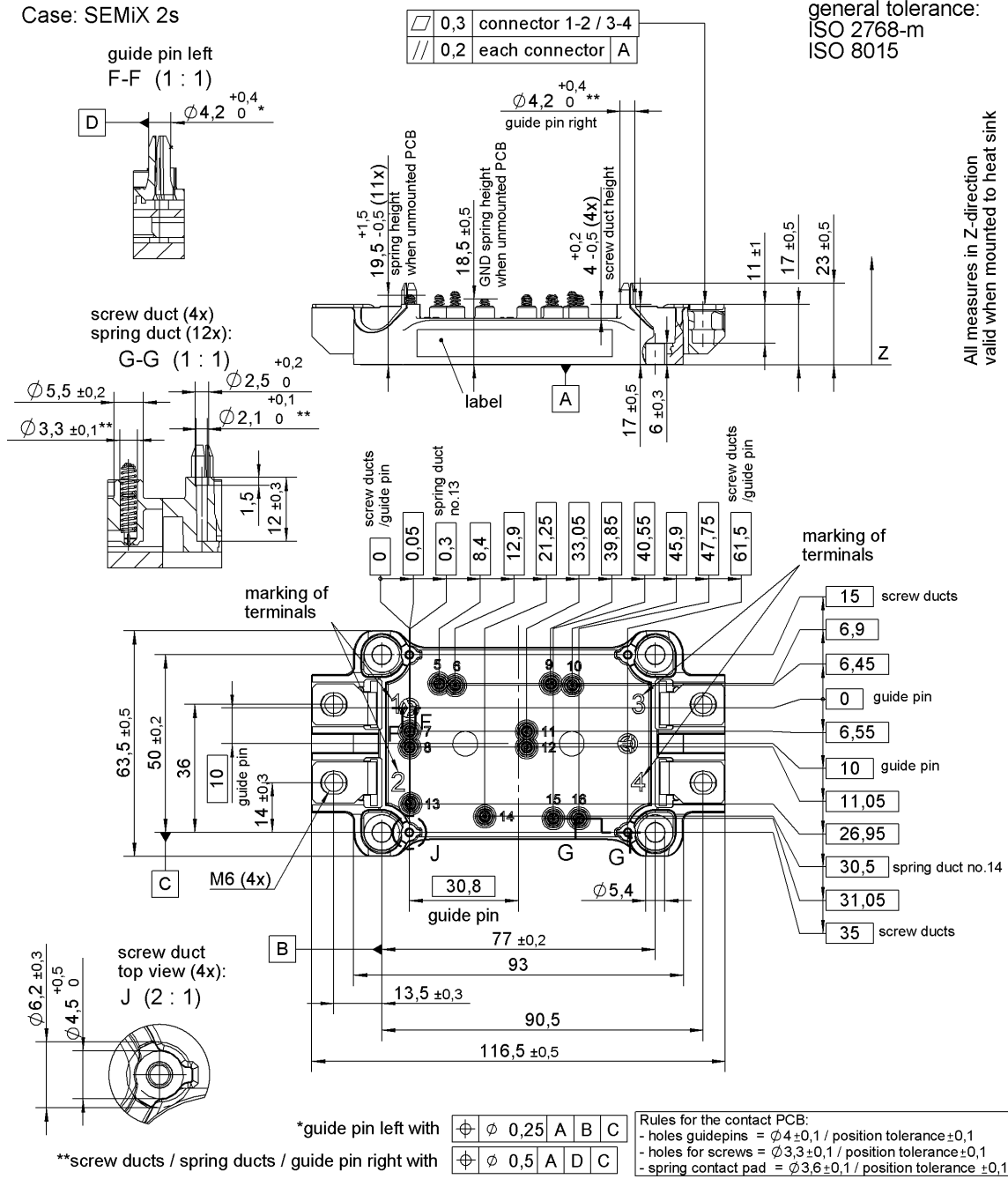


Fig. 12: Typ. CAL diode recovery charge

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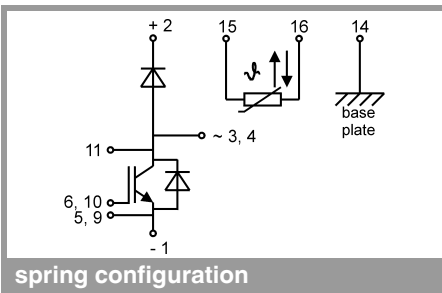
Case: SEMiX 2s

general tolerance:  
ISO 2768-m  
ISO 8015



All measures in Z-direction valid when mounted to heat sink

## SEMIX 2s



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

\* The specifications of our components may not be considered as an assurance of component characteristics. Components have to be tested for the respective application. Adjustments may be necessary. The use of SEMIKRON products in life support appliances and systems is subject to prior specification and written approval by SEMIKRON. We therefore strongly recommend prior consultation of our staff.