

# SEMiX653GAR176HDs



SEMiX® 3s

## Trench IGBT Modules

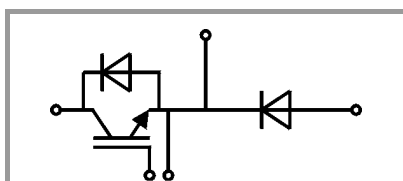
### SEMiX653GAR176HDs

#### Features

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

#### Typical Applications\*

- AC inverter drives
- UPS
- Electronic welders



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Absolute Maximum Ratings					
Symbol	Conditions		Values	Unit	
<b>IGBT</b>					
$V_{CES}$	$T_j = 25\text{ °C}$		1700	V	
$I_C$	$T_j = 150\text{ °C}$	$T_c = 25\text{ °C}$	619	A	
		$T_c = 80\text{ °C}$	438	A	
$I_{Cnom}$			450	A	
$I_{CRM}$	$I_{CRM} = 2 \times I_{Cnom}$		900	A	
$V_{GES}$			-20 ... 20	V	
$t_{psc}$	$V_{CC} = 1000\text{ V}$ $V_{GE} \leq 20\text{ V}$ $V_{CES} \leq 1700\text{ V}$	$T_j = 125\text{ °C}$	10		$\mu\text{s}$
$T_j$			-55 ... 150	$^{\circ}\text{C}$	
<b>Inverse diode</b>					
$I_F$	$T_j = 150\text{ °C}$	$T_c = 25\text{ °C}$	545	A	
		$T_c = 80\text{ °C}$	365	A	
$I_{Fnom}$			450	A	
$I_{FRM}$	$I_{FRM} = 2 \times I_{Fnom}$		900	A	
$I_{FSM}$	$t_p = 10\text{ ms, sin } 180^{\circ}, T_j = 25\text{ °C}$		2900	A	
$T_j$			-40 ... 150	$^{\circ}\text{C}$	
<b>Freewheeling diode</b>					
$I_F$	$T_j = 150\text{ °C}$	$T_c = 25\text{ °C}$	545	A	
		$T_c = 80\text{ °C}$	365	A	
$I_{Fnom}$			450	A	
$I_{FRM}$	$I_{FRM} = 2 \times I_{Fnom}$		900	A	
$I_{FSM}$	$t_p = 10\text{ ms, sin } 180^{\circ}, T_j = 25\text{ °C}$		2900	A	
$T_j$			-40 ... 150	$^{\circ}\text{C}$	
<b>Module</b>					
$I_{t(RMS)}$	$T_{terminal} = 80\text{ °C}$		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>						
$V_{CE(sat)}$	$I_C = 450\text{ A}$ $V_{GE} = 15\text{ V}$ chiplevel	$T_j = 25\text{ °C}$		2	2.45	V
		$T_j = 125\text{ °C}$		2.5	2.9	V
$V_{CE0}$		$T_j = 25\text{ °C}$		1	1.2	V
		$T_j = 125\text{ °C}$		0.9	1.1	V
$r_{CE}$	$V_{GE} = 15\text{ V}$	$T_j = 25\text{ °C}$		2.2	2.8	$\text{m}\Omega$
		$T_j = 125\text{ °C}$		3.4	4.0	$\text{m}\Omega$
$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 18\text{ mA}$		5.2	5.8	6.4	V
$I_{CES}$	$V_{GE} = 0\text{ V}$ $V_{CE} = 1700\text{ V}$	$T_j = 25\text{ °C}$			3	mA
		$T_j = 125\text{ °C}$				mA
$C_{ies}$	$V_{CE} = 25\text{ V}$ $V_{GE} = 0\text{ V}$	$f = 1\text{ MHz}$		39.6		nF
$C_{oes}$		$f = 1\text{ MHz}$		1.65		nF
$C_{res}$		$f = 1\text{ MHz}$		1.31		nF
$Q_G$	$V_{GE} = -8\text{ V...} + 15\text{ V}$			4200		nC
$R_{Gint}$	$T_j = 25\text{ °C}$			1.67		$\Omega$

# SEMiX653GAR176HDs



SEMiX® 3s

## Trench IGBT Modules

### SEMiX653GAR176HDs

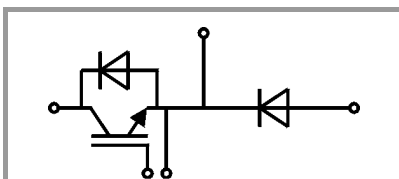
#### Features

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

#### Typical Applications\*

- AC inverter drives
- UPS
- Electronic welders

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
$t_{d(on)}$	$V_{CC} = 1200\text{ V}$ $I_C = 450\text{ A}$	$T_j = 125\text{ °C}$		290		ns
$t_r$	$V_{GE} = \pm 15\text{ V}$	$T_j = 125\text{ °C}$		90		ns
$E_{on}$	$R_{G\ on} = 3.6\ \Omega$	$T_j = 125\text{ °C}$		300		mJ
$t_{d(off)}$	$R_{G\ off} = 3.6\ \Omega$	$T_j = 125\text{ °C}$		975		ns
$t_f$		$T_j = 125\text{ °C}$		190		ns
$E_{off}$		$T_j = 125\text{ °C}$		180		mJ
$R_{th(j-c)}$	per IGBT				0.054	K/W
Inverse diode						
$V_F = V_{EC}$	$I_F = 450\text{ A}$ $V_{GE} = 0\text{ V}$ chip	$T_j = 25\text{ °C}$		1.7	1.90	V
		$T_j = 125\text{ °C}$		1.7	1.9	V
$V_{F0}$		$T_j = 25\text{ °C}$	0.9	1.1	1.3	V
		$T_j = 125\text{ °C}$	0.7	0.9	1.1	V
$r_F$		$T_j = 25\text{ °C}$	1.3	1.3	1.3	m $\Omega$
		$T_j = 125\text{ °C}$	1.8	1.8	1.8	m $\Omega$
$I_{RRM}$	$I_F = 450\text{ A}$	$T_j = 125\text{ °C}$		380		A
$Q_{rr}$	$di/dt_{off} = 4200\text{ A}/\mu\text{s}$ $V_{GE} = -15\text{ V}$	$T_j = 125\text{ °C}$		130		$\mu\text{C}$
$E_{rr}$	$V_{CC} = 1200\text{ V}$	$T_j = 125\text{ °C}$		73		mJ
$R_{th(j-c)}$	per diode				0.11	K/W
Freewheeling diode						
$V_F = V_{EC}$	$I_F = 450\text{ A}$ $V_{GE} = 0\text{ V}$ chip	$T_j = 25\text{ °C}$		1.7	1.90	V
		$T_j = 125\text{ °C}$		1.7	1.9	V
$V_{F0}$		$T_j = 25\text{ °C}$	0.9	1.1	1.3	V
		$T_j = 125\text{ °C}$	0.7	0.9	1.1	V
$r_F$		$T_j = 25\text{ °C}$	1.3	1.3	1.3	m $\Omega$
		$T_j = 125\text{ °C}$	1.8	1.8	1.8	m $\Omega$
$I_{RRM}$	$I_F = 450\text{ A}$	$T_j = 125\text{ °C}$		380		A
$Q_{rr}$	$di/dt_{off} = 4200\text{ A}/\mu\text{s}$ $V_{GE} = -15\text{ V}$	$T_j = 125\text{ °C}$		130		$\mu\text{C}$
$E_{rr}$	$V_{CC} = 1200\text{ V}$	$T_j = 125\text{ °C}$		73		mJ
$R_{th(j-c)}$	per diode				0.11	K/W
Module						
$L_{CE}$				20		nH
$R_{CC+EE}$	res., terminal-chip	$T_C = 25\text{ °C}$		0.7		m $\Omega$
		$T_C = 125\text{ °C}$		1		m $\Omega$
$R_{th(c-s)}$	per module			0.04		K/W
$M_s$	to heat sink (M5)		3		5	Nm
$M_t$		to terminals (M6)	2.5		5	Nm
						Nm
w					300	g
Temperatur Sensor						
$R_{100}$	$T_C = 100\text{ °C}$ ( $R_{25} = 5\text{ k}\Omega$ )			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



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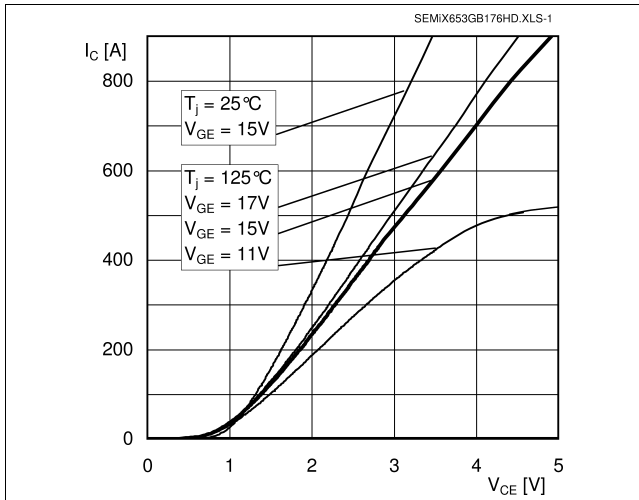


Fig. 1: Typ. output characteristic, inclusive  $R_{CC} + E_{E'}$

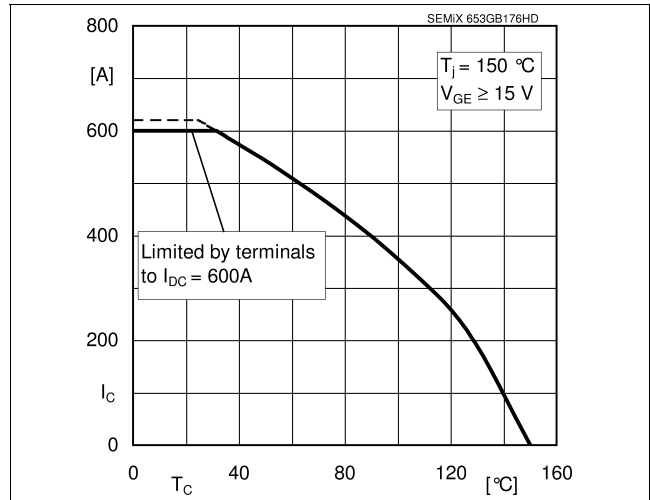


Fig. 2: Rated current vs. temperature  $I_C = f(T_C)$

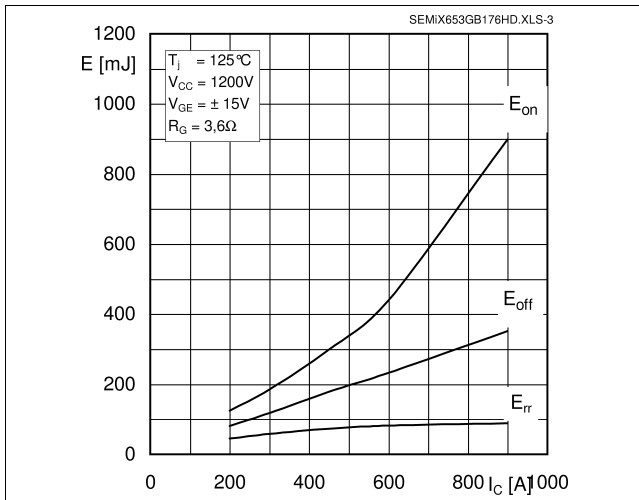


Fig. 3: Typ. turn-on /-off energy =  $f(I_C)$

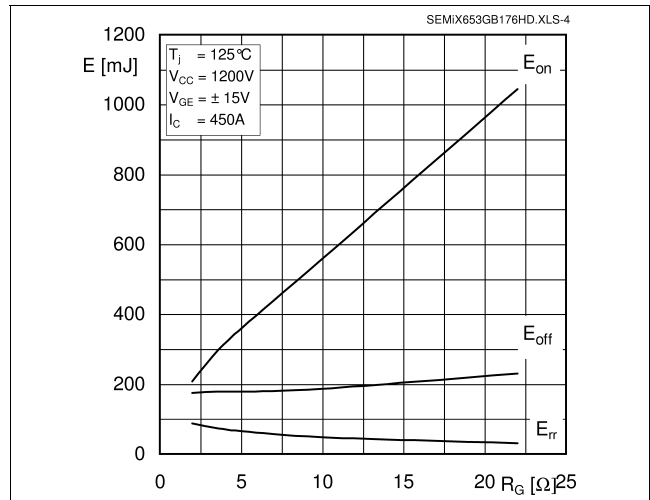


Fig. 4: Typ. turn-on /-off energy =  $f(R_G)$

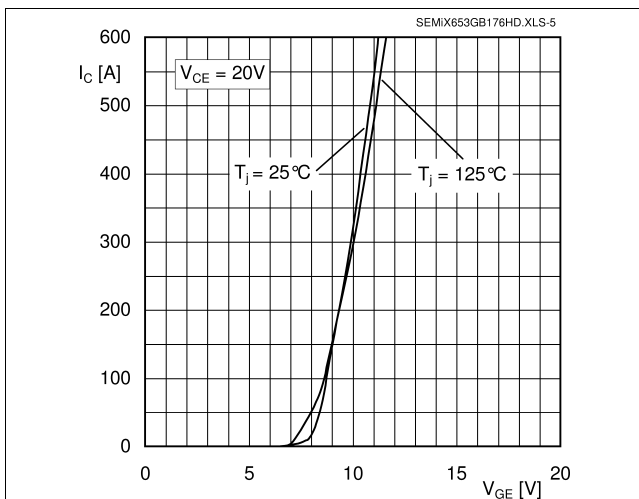


Fig. 5: Typ. transfer characteristic

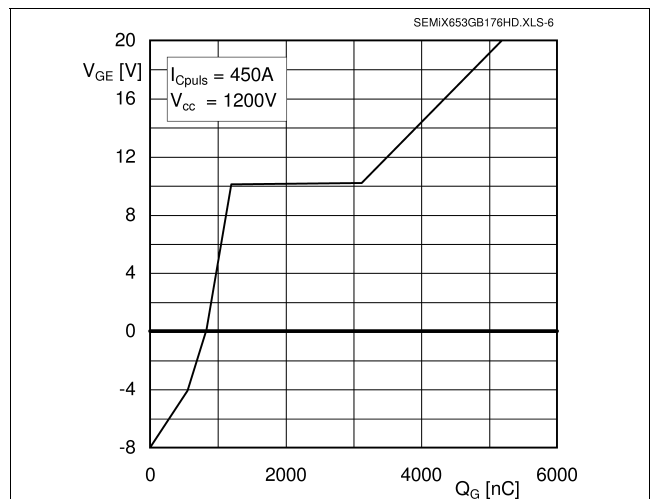


Fig. 6: Typ. gate charge characteristic

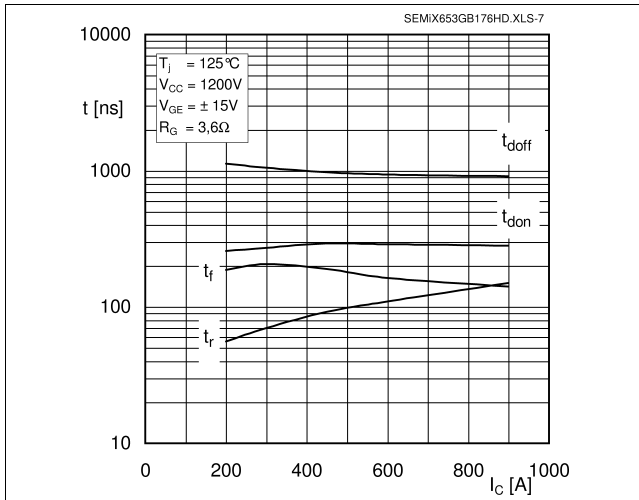


Fig. 7: Typ. switching times vs.  $I_C$

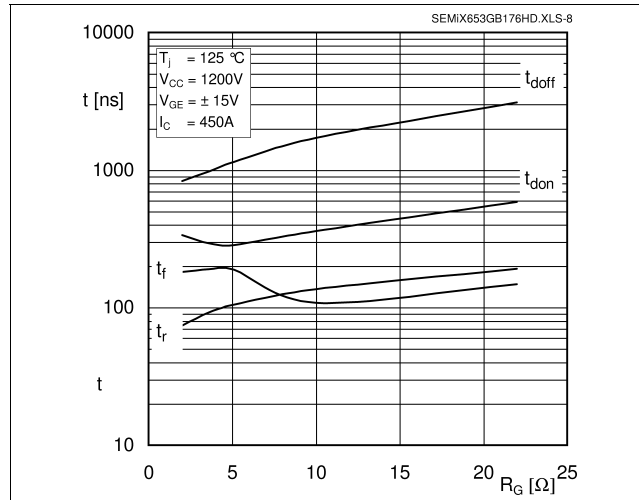


Fig. 8: Typ. switching times vs. gate resistor  $R_G$

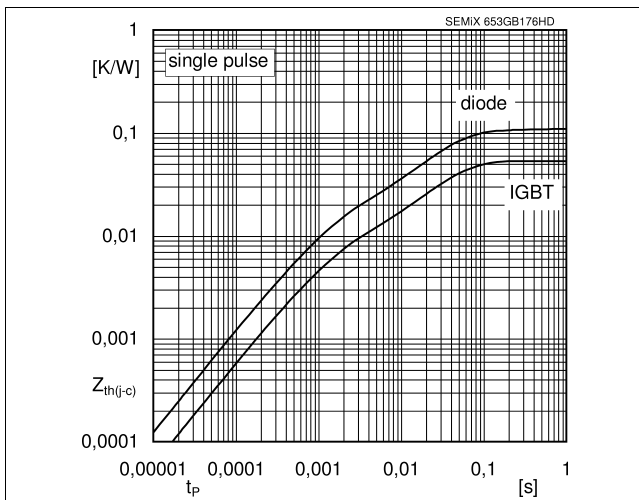


Fig. 9: Typ. transient thermal impedance

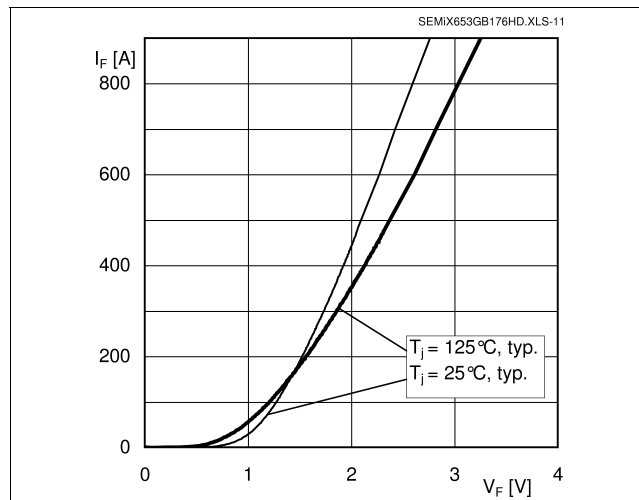


Fig. 10: Typ. CAL diode forward charact., incl.  $R_{CC+EE'}$

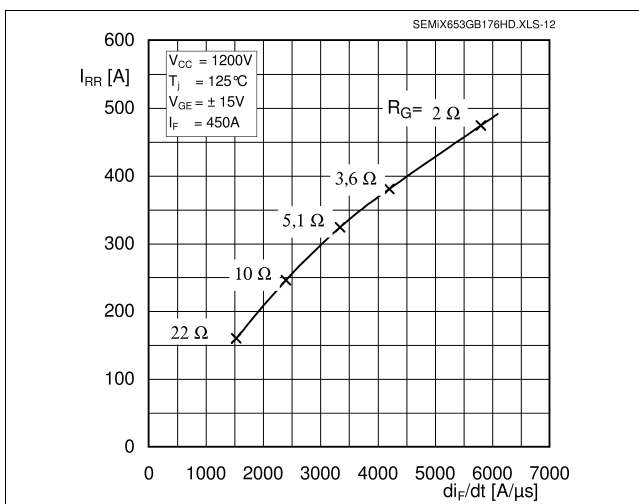


Fig. 11: Typ. CAL diode peak reverse recovery current

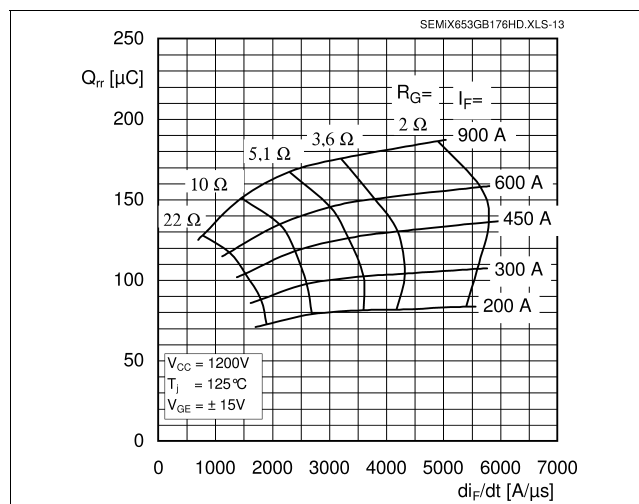
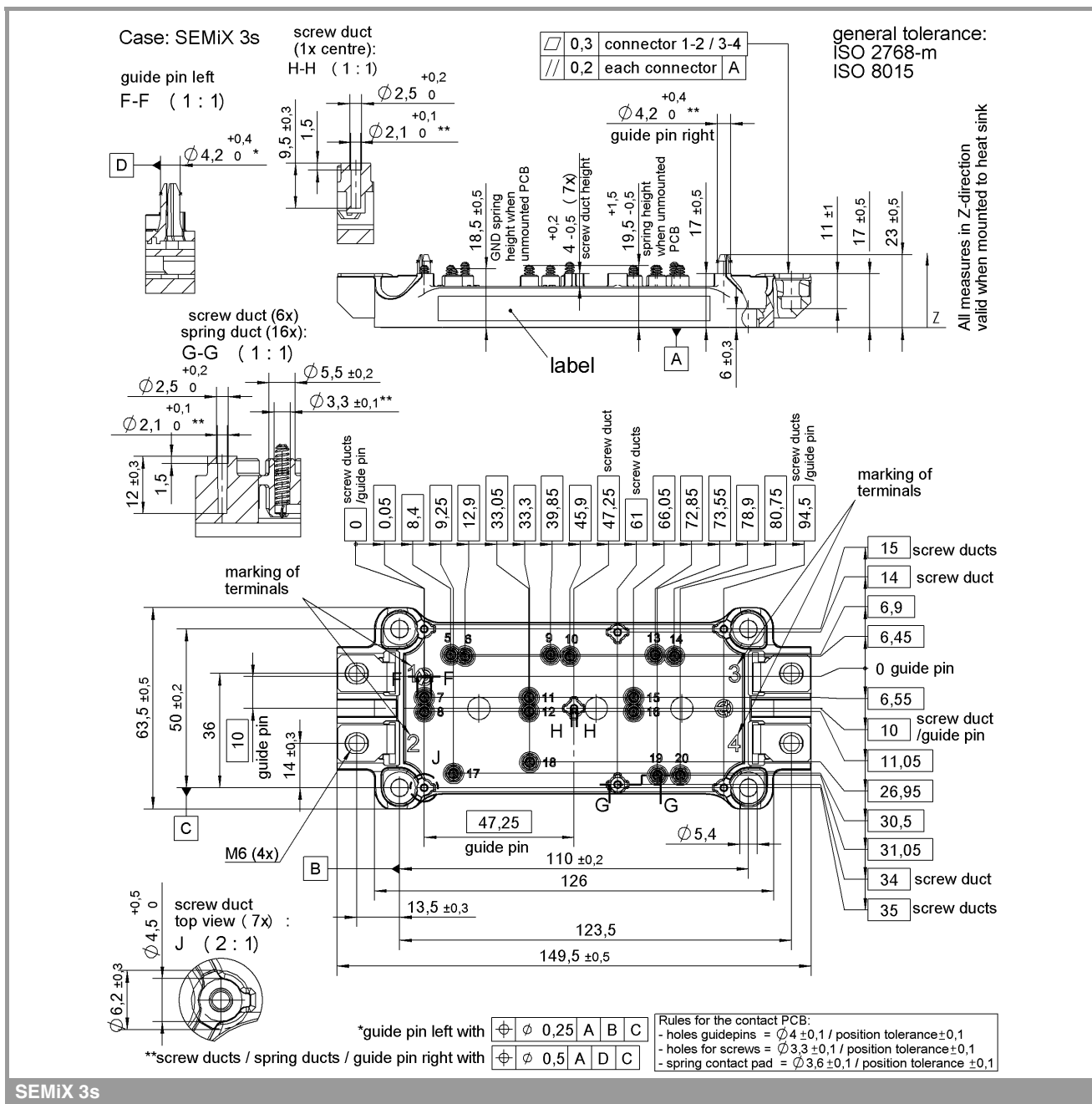
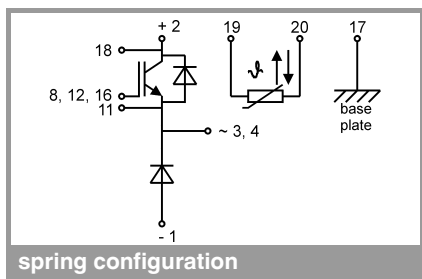


Fig. 12: Typ. CAL diode recovery charge

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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.