

# SEMiX402GAL066HDs



SEMiX<sup>®</sup> 2s

## Trench IGBT Modules

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#### Features

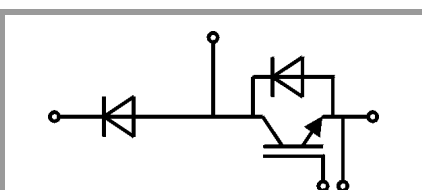
- Homogeneous Si
- Trench = Trenchgate technology
- $V_{CE(sat)}$  with positive temperature coefficient
- UL recognised file no. E63532

#### 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>				
$V_{CES}$			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
$t_{psc}$	$V_{CC} = 360\text{ V}$ $V_{GE} \leq 15\text{ V}$ $V_{CES} \leq 600\text{ V}$	$T_j = 150^{\circ}\text{C}$	6	
				$\mu\text{s}$
$T_j$			-40 ... 175	$^{\circ}\text{C}$
<b>Inverse diode</b>				
$I_F$	$T_j = 175^{\circ}\text{C}$	$T_c = 25^{\circ}\text{C}$	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>				
$I_{t(RMS)}$			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		$\text{mA}$
		$T_j = 150^{\circ}\text{C}$				$\text{mA}$
$C_{ies}$	$V_{CE} = 25\text{ V}$ $V_{GE} = 0\text{ V}$	$f = 1\text{ MHz}$		24.7		$\text{nF}$
$C_{oes}$		$f = 1\text{ MHz}$		1.54		$\text{nF}$
$C_{res}$		$f = 1\text{ MHz}$		0.73		$\text{nF}$
$Q_G$	$V_{GE} = -8\text{ V} \dots +15\text{ V}$			3200		$\text{nC}$
$R_{Gint}$	$T_j = 25^{\circ}\text{C}$			1.00		$\Omega$

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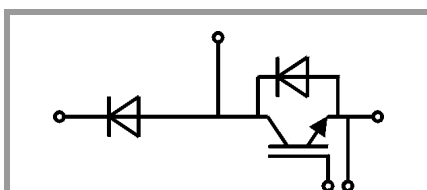
#### Typical Applications\*

- 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

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
$E_{on}$	$R_{G\ on} = 4.5\ \Omega$	$T_j = 150^\circ\text{C}$		22		mJ
$t_{d(off)}$	$R_{G\ off} = 4.5\ \Omega$	$T_j = 150^\circ\text{C}$		900		ns
$t_f$		$T_j = 150^\circ\text{C}$		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		$\mu\text{C}$
$E_{rr}$	$V_{GE} = -8\text{ V}$ $V_{CC} = 300\text{ V}$	$T_j = 150^\circ\text{C}$		10		mJ
$R_{th(j-c)}$	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	1.5	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		$\mu\text{C}$
$E_{rr}$	$V_{GE} = -8\text{ V}$ $V_{CC} = 300\text{ V}$	$T_j = 150^\circ\text{C}$		10		mJ
$R_{th(j-c)}$	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%		$\Omega$
$B_{100/125}$	$R(T)=R_{100}\exp[B_{100/125}(1/T-1/T_{100})]$ ; $T[\text{K}]$ ;			3550 $\pm$ 2%		K



GAL

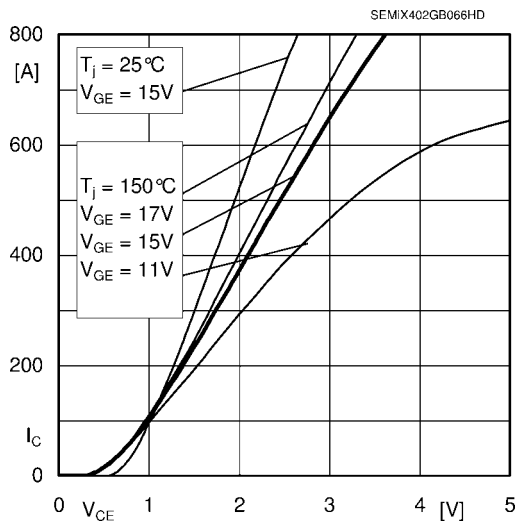


Fig. 1: Typ. output characteristic, inclusive  $R_{CC'+EE'}$

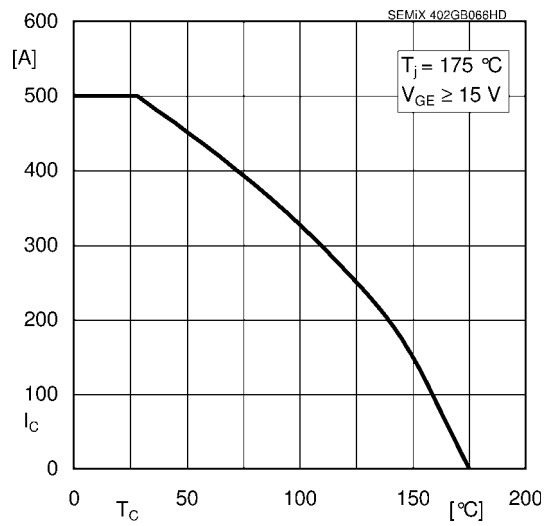


Fig. 2: Rated current vs. temperature  $I_c = f(T_c)$

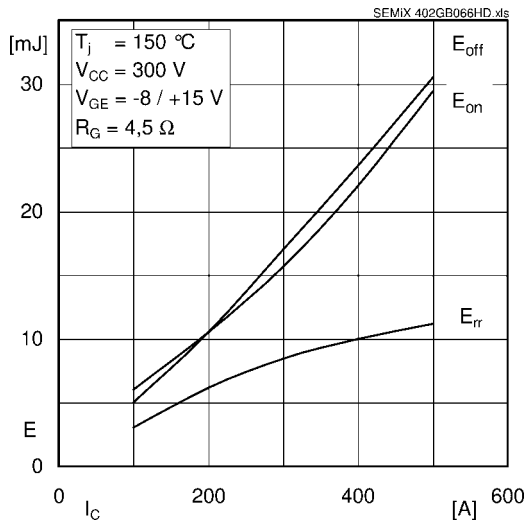


Fig. 3: Typ. turn-on /-off energy =  $f(I_c)$

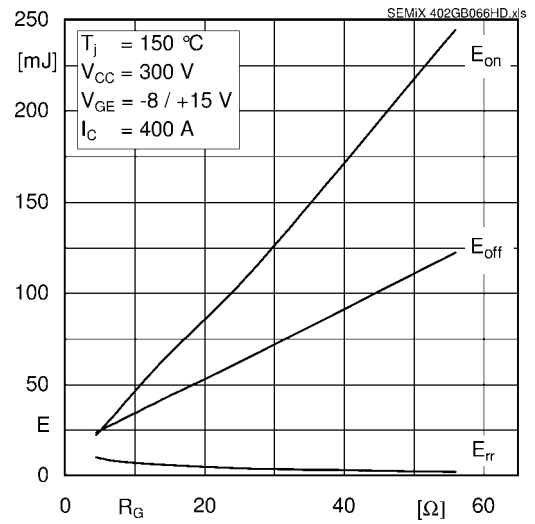


Fig. 4: Typ. turn-on /-off energy =  $f(R_G)$

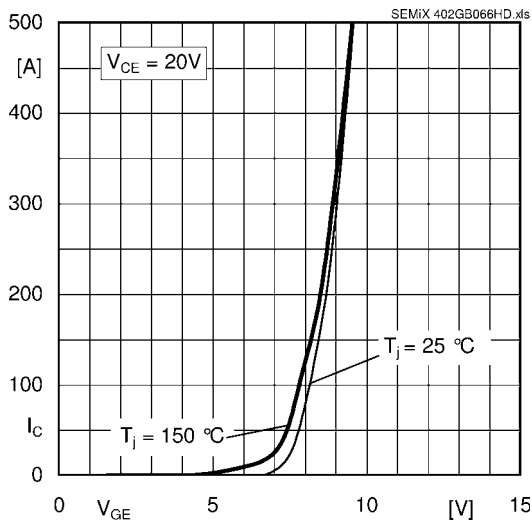


Fig. 5: Typ. transfer characteristic

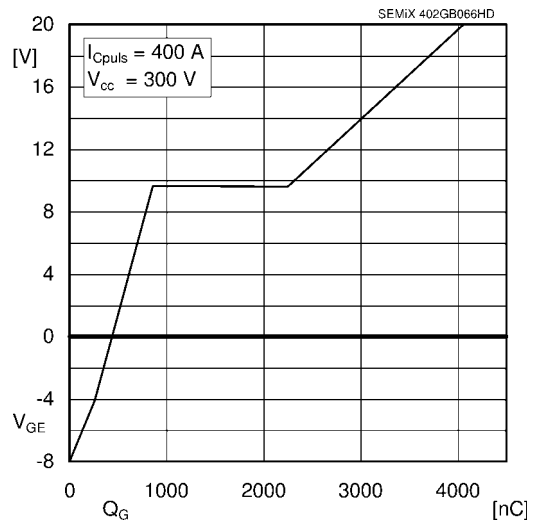


Fig. 6: Typ. gate charge characteristic

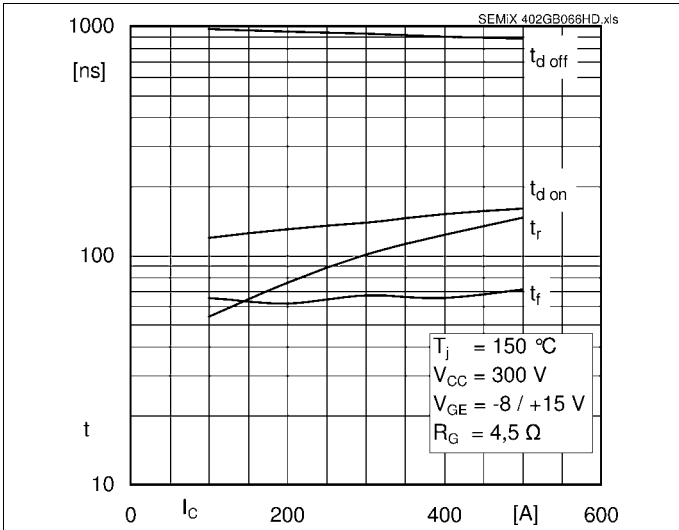


Fig. 7: Typ. switching times vs.  $I_C$

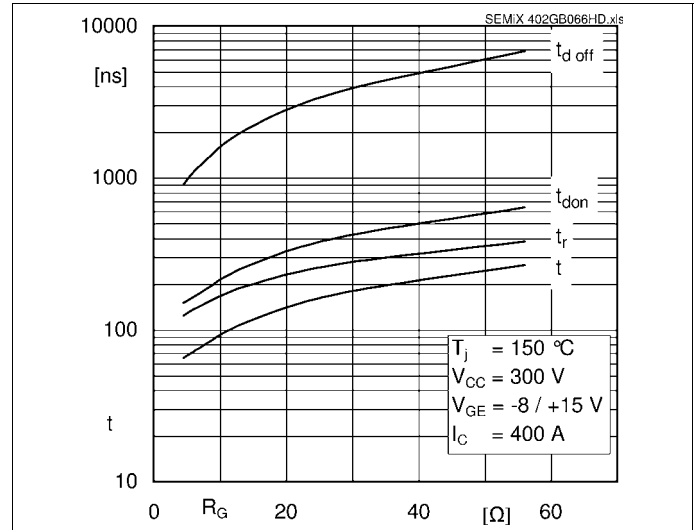


Fig. 8: Typ. switching times vs. gate resistor  $R_G$

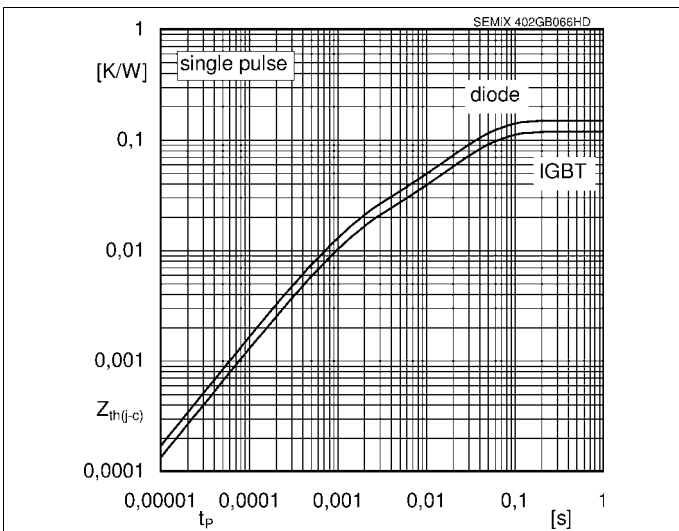


Fig. 9: Typ. transient thermal impedance

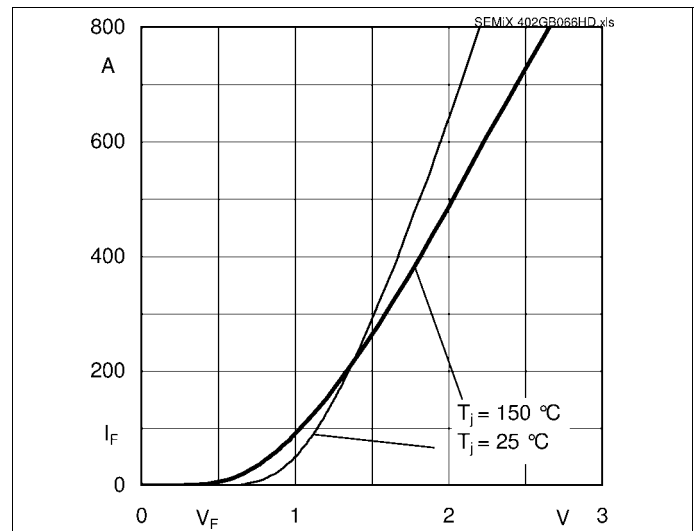


Fig. 10: Typ. CAL diode forward charact., incl.  $R_{CC+EE}$

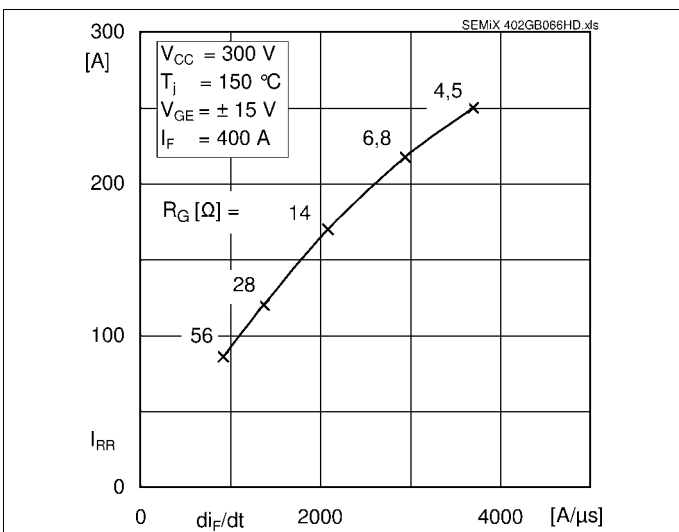


Fig. 11: Typ. CAL diode peak reverse recovery current

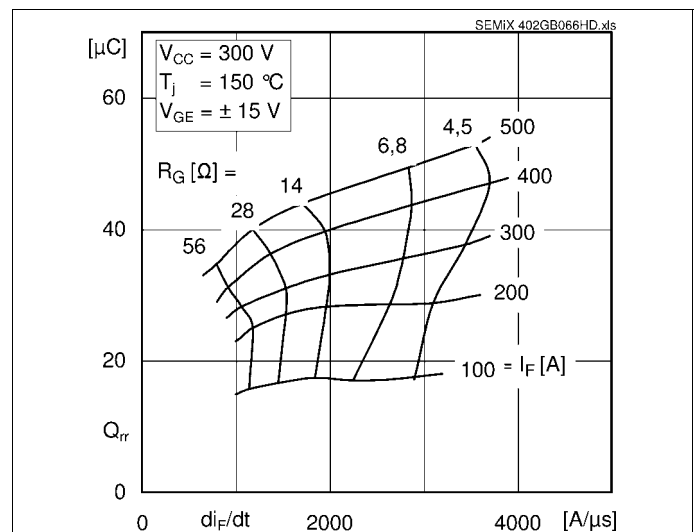


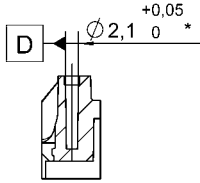
Fig. 12: Typ. CAL diode recovery charge

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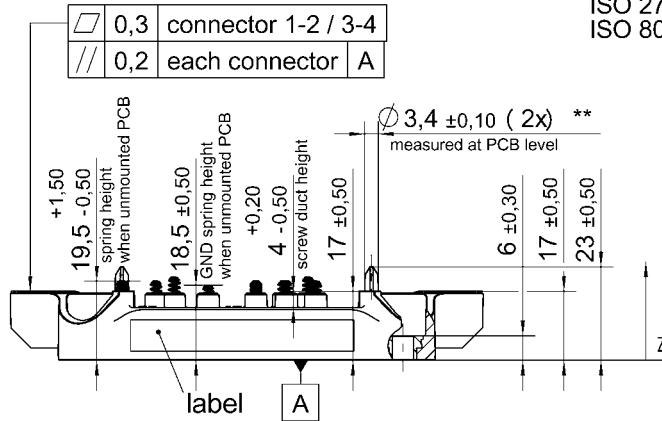
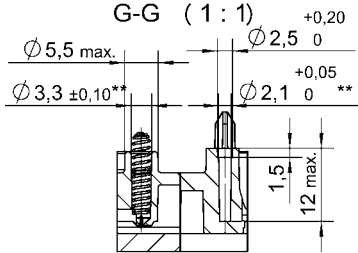
Case: SEMiX 2s

general tolerance:  
ISO 2768-mK  
ISO 8015

screw duct  
(left top) :  
F-F (1:1)

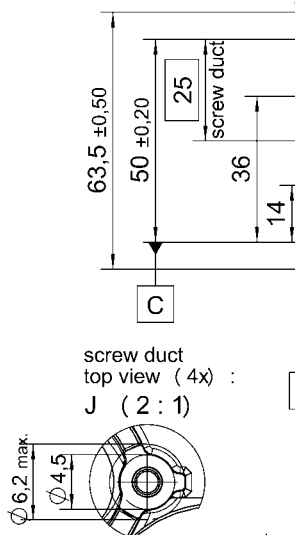


screw duct (4x)  
spring duct (12x) :  
G-G (1:1)

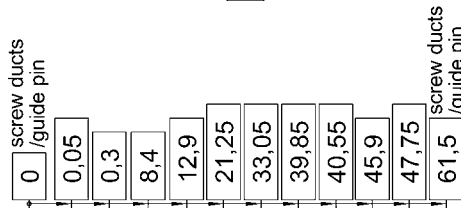
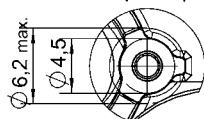


All measures in Z-direction  
valid when mounted to heat sink

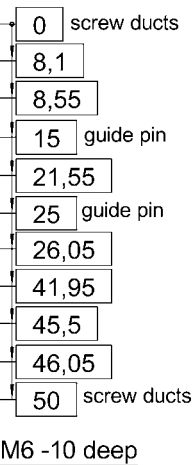
marking of  
terminals



screw duct  
top view (4x) :  
J (2:1)



marking of  
terminals



\*screw duct left / top with

⊕	⊕	⊕	⊕	⊕	⊕
⊕	⊕	⊕	⊕	⊕	⊕
A	B	C	A	B	C

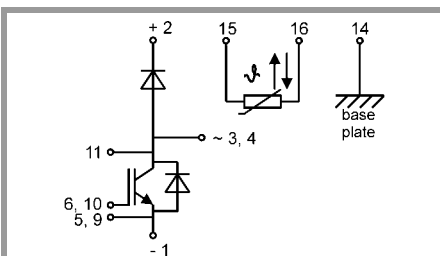
Rules for the contact PCB:

- holes guidepins =  $\varnothing 4 \pm 0,1$  / position tolerance  $\pm 0,1$
- holes for screws =  $\varnothing 2,9 \pm 0,1$  / position tolerance  $\pm 0,1$
- spring contact pad =  $\varnothing 3,6 \pm 0,1$  / position tolerance  $\pm 0,1$

\*\*screw ducts / guide pins / spring ducts with

⊕	⊕	⊕	⊕	⊕	⊕
⊕	⊕	⊕	⊕	⊕	⊕
A	D	C	A	D	C

SEMiX 2s



spring configuration

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 personal.