

# SKiiP 3614 GB17E4-6DUL



SKiiP® 4

## 2-pack-integrated intelligent Power System

### SKiiP 3614 GB17E4-6DUL

#### Features

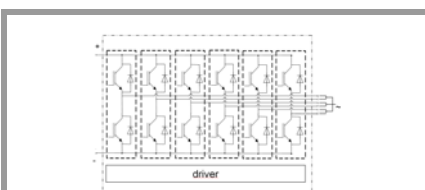
- Intelligent Power Module
- Integrated current and temperature measurement
- Integrated DC-link measurement
- Solder free power section
- IGBT4 and CAL4F technology
- $T_{jmax} = 175^{\circ}\text{C}$
- Safety isolated switching and sensor signals
- Digital signal transmission
- 100% tested IPM
- RoHS compliant
- UL recognition in progress, file no. E242581

#### Typical Applications\*

- Renewable energies
- Traction
- Elevators
- Industrial drives

#### Remarks

For further information please refer to SKiiP®4 Technical Explanation



S64

Absolute Maximum Ratings				
Symbol	Conditions	Values	Unit	
<b>System</b>				
$V_{CC}$	Operating DC link voltage	1300	V	
$V_{isol}$	DC, $t = 1$ s, each polarity	5600	V	
$I_{t(RMS)}$	per AC terminal, rms, sinusoidal current	500	A	
$I_{max (peak)}$	Max. peak current of power section	5400	A	
$f_{out}$	fundamental output frequency	1	kHz	
$T_{stg}$	storage temperature	-40 ... 85	$^{\circ}\text{C}$	
<b>IGBT</b>				
$V_{CES}$	$T_j = 25^{\circ}\text{C}$	1700	V	
$I_C$	$T_j = 175^{\circ}\text{C}$	$T_s = 25^{\circ}\text{C}$	5078	A
		$T_s = 70^{\circ}\text{C}$	4085	A
$I_{Cnom}$		3600	A	
$T_j$	junction temperature	-40 ... 175	$^{\circ}\text{C}$	
<b>Diode</b>				
$V_{RRM}$	$T_j = 25^{\circ}\text{C}$	1700	V	
$I_F$	$T_j = 175^{\circ}\text{C}$	$T_s = 25^{\circ}\text{C}$	3547	A
		$T_s = 70^{\circ}\text{C}$	2807	A
$I_{Fnom}$		3600	A	
$T_j$	junction temperature	-40 ... 175	$^{\circ}\text{C}$	
<b>Driver</b>				
$V_s$	power supply	19.2 ... 28.8	V	
$V_{iH}$	input signal voltage (high)	$V_s + 0.3$	V	
$dv/dt$	secondary to primary side	75	kV/ $\mu\text{s}$	
$f_{sw}$	switching frequency	5	kHz	

Characteristics					
Symbol	Conditions	min.	typ.	max.	Unit
<b>IGBT</b>					
$V_{CE(sat)}$	$I_C = 3600$ A at terminal	$T_j = 25^{\circ}\text{C}$	2.12	2.49	V
		$T_j = 150^{\circ}\text{C}$	2.58	2.79	V
$V_{CE0}$		$T_j = 25^{\circ}\text{C}$	1.10	1.20	V
		$T_j = 150^{\circ}\text{C}$	1.00	1.10	V
$r_{CE}$	at terminal	$T_j = 25^{\circ}\text{C}$	0.28	0.36	$\text{m}\Omega$
		$T_j = 150^{\circ}\text{C}$	0.44	0.47	$\text{m}\Omega$
$E_{on} + E_{off}$	$I_C = 3600$ A $T_j = 150^{\circ}\text{C}$	$V_{CC} = 900$ V	4288		mJ
		$V_{CC} = 1300$ V	6840		mJ
$R_{th(j-s)}$	per IGBT switch			0.0092	K/W
$R_{th(j-r)}$	per IGBT switch			0.0035	K/W

# SKiiP 3614 GB17E4-6DUL



SKiiP® 4

## 2-pack-integrated intelligent Power System

### SKiiP 3614 GB17E4-6DUL

#### Features

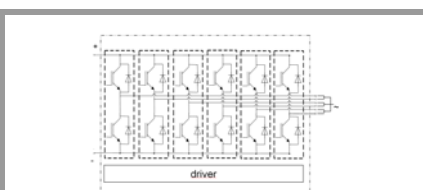
- Intelligent Power Module
- Integrated current and temperature measurement
- Integrated DC-link measurement
- Solder free power section
- IGBT4 and CAL4F technology
- $T_{jmax} = 175^{\circ}\text{C}$
- Safety isolated switching and sensor signals
- Digital signal transmission
- 100% tested IPM
- RoHS compliant
- UL recognition in progress, file no. E242581

#### Typical Applications\*

- Renewable energies
- Traction
- Elevators
- Industrial drives

#### Remarks

For further information please refer to SKiiP®4 Technical Explanation



S64

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
<b>Diode</b>						
$V_F = V_{EC}$	$I_F = 3600\text{ A}$ at terminal	$T_j = 25^{\circ}\text{C}$		2.02	2.34	V
		$T_j = 150^{\circ}\text{C}$		2.27	2.62	V
$V_{F0}$		$T_j = 25^{\circ}\text{C}$		1.21	1.36	V
		$T_j = 150^{\circ}\text{C}$		0.99	1.12	V
$r_F$	at terminal	$T_j = 25^{\circ}\text{C}$		0.23	0.27	m $\Omega$
		$T_j = 150^{\circ}\text{C}$		0.36	0.42	m $\Omega$
$E_{rr}$	$I_F = 3600\text{ A}$ $T_j = 150^{\circ}\text{C}$	$V_R = 900\text{ V}$		424		mJ
		$V_R = 1300\text{ V}$		684		mJ
$R_{th(j-s)}$	per diode switch				0.0187	K/W
$R_{th(j-r)}$	per diode switch				0.011	K/W
<b>Driver</b>						
$V_s$	supply voltage non stabilized		19.2	24	28.8	V
$I_{SO}$	bias current @ $V_s = 24\text{ V}$ , $f_{sw} = 0$ , $I_{AC} = 0$			430		mA
$I_S$	$k_1 = 66\text{ mA/kHz}$ , $k_2 = 0.286\text{ mA/A}$		= 430	$+ k_1 * f_{sw}$	$+ k_2 * I_{AC}$	mA
$V_{IT+}$	input threshold voltage (HIGH)		0,7* $V_s$			V
$V_{IT-}$	Input threshold voltage (LOW)				0,3* $V_s$	V
$R_{IN}$	input resistance			13		k $\Omega$
$C_{IN}$	input capacitance			1		nF
$t_{pRESET}$	error memory reset time		1.3		2.9	s
$t_{pReset(OCP)}$	Over current reset time					$\mu\text{s}$
$t_{TD}$	top / bottom switch interlock time			3		$\mu\text{s}$
$t_{jitter}$	jitter clock time			52	58	ns
$t_{SIS}$	short pulse suppression time			0.6		$\mu\text{s}$
$t_{POR}$	Power-On-Reset completed			3.5		s
$V_{CEstat}$	Collector-Emitter Threshold Static Monitoring Voltage			7.5		V
$t_{bl}$	Collector-Emitter Threshold Static Monitoring Blanking Time			6		$\mu\text{s}$
$I_{digiout}$	digital output sink current (HALT-signal)				16	mA
$V_{it+ HALT}$	input threshold voltage HIGH HALT (Low -->High)		0,6* $V_s$			V
$V_{it- HALT}$	input threshold voltage LOW HALT (High --> Low)				0,4* $V_s$	V
$t_{d(Err)}$	Error delay time (from detection to HALT), (depends on kind of error)		1.8		170	$\mu\text{s}$
$I_{TRIPSC}$	over current trip level		5290	5400	5510	A <sub>PEAK</sub>
$T_{trip}$	over temperature trip level		126	130	134	$^{\circ}\text{C}$
$T_{DriverTrip}$	over temperature PCB trip level		113	120	124	$^{\circ}\text{C}$
$V_{DCtrip}$	over voltage trip level,		1300	1340	1380	V
$f_{0Uana}$	bandwidth of DC-voltage measurement @ $V_{DCtrip}$ (-3dB)			2		kHz
$f_{0Iana}$	bandwidth of current measurement @ $I_{TRIPSC}$ (-3dB),			50		kHz
$f_{0Tana}$	bandwidth of temperature measurement @ $T_{trip}$ (-3dB)			5		Hz

# SKiiP 3614 GB17E4-6DUL



SKiiP® 4

## 2-pack-integrated intelligent Power System

### SKiiP 3614 GB17E4-6DUL

#### Features

- Intelligent Power Module
- Integrated current and temperature measurement
- Integrated DC-link measurement
- Solder free power section
- IGBT4 and CAL4F technology
- $T_{jmax} = 175^{\circ}\text{C}$
- Safety isolated switching and sensor signals
- Digital signal transmission
- 100% tested IPM
- RoHS compliant
- UL recognition in progress, file no. E242581

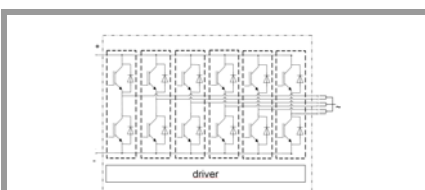
#### Typical Applications\*

- Renewable energies
- Traction
- Elevators
- Industrial drives

#### Remarks

For further information please refer to SKiiP®4 Technical Explanation

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
<b>System</b>						
$t_{d(on)IO}$	$V_{CC} = 1300\text{ V}$ $I_C = 3600\text{ A}$	turn on propagation delay time		2.8		$\mu\text{s}$
$t_{d(off)IO}$	$T_j = 25^{\circ}\text{C}$	turn off propagation delay time		2.6		$\mu\text{s}$
$dV_{CE}/dt_{on}$	$T_j = 25^{\circ}\text{C}$ $V_{CC} = 1300\text{ V}$	$I_C = 0\text{ A}$		10		$\text{kV}/\mu\text{s}$
		$I_C = 3600\text{ A}$		3		$\text{kV}/\mu\text{s}$
$dV_{CE}/dt_{off}$		$I_C = 3600\text{ A}$		4		$\text{kV}/\mu\text{s}$
$R_{th(s-a)}$	flow rate = $500\text{ m}^3/\text{h}$ , $T_a=25^{\circ}\text{C}$ , 500m above sea level				0.0188	$\text{K}/\text{W}$
$R_{CC'+EE'}$	terminals to chip, $T_s = 25^{\circ}\text{C}$			0.045		$\text{m}\Omega$
$L_{CE}$	commutation inductance			3		$\text{nH}$
$C_{CHC}$	coupling capacitance secondary to heat sink			8.4		$\text{nF}$
$C_{ps}$	coupling capacitance primary to secondary			0.102		$\text{nF}$
$I_{CES} + I_{RD}$	$V_{GE} = 0\text{ V}$ , $V_{CE} = 1700\text{ V}$ , $T_j = 25^{\circ}\text{C}$			0.226		$\text{mA}$
$M_{dc}$	DC terminals		6		8	$\text{Nm}$
$M_{ac}$	AC terminals		13		15	$\text{Nm}$
w	SKiiP System w/o heat sink			4.84		$\text{kg}$
$w_h$	heat sink			9.9		$\text{kg}$



S64

## Isolation coordination acc. to EN 50178 and IEC 61800-5-1

Maximum grid RMS voltage, line-to-line, grounded delta mains	690V+20%
Installation altitude for maximum grid RMS voltage, line-to-line, grounded delta mains	2000m
Maximum grid RMS voltage, line-to-line, star point grounded mains	690V+20%
Installation altitude for maximum grid RMS voltage, line-to-line, star point grounded mains	4000m
Maximum transient peak voltage between low voltage circuit and mains	1900V
Pollution degree acc. to IEC 60664-1 outside the moulded power section	2
Overvoltage cat. acc. to IEC 60664-1 for mains	III
Overvoltage cat. acc. to UL 840 within mains	I
Overvoltage cat. acc. to UL 840 between mains and ground	III
Overvoltage cat. acc. to UL 840 between mains and low voltage circuit	III
Basic isolation	between heat sink and mains
Reinforced isolation	between low voltage circuit and mains
Protection level acc. to IEC 60529	IP00

## Environmental conditions acc. to IEC 60721

	Storage	Transportation	Operation - stationary use at weatherprotected locations	Operation - ground vehicle installations	Operation - ship environment
Climatic conditions	1K2	2K2	3K3 <sub>(1)</sub>	5K1	6K1
Biological conditions	1B1	2B1	3B1	5B1	6B1
Chemically active substances (excluded: salt spray)	1C2	2C1	3C2	5C2	6C2
Mechanically active substances	1S1	2S1	3S1	5S1	6S1
Mechanical conditions	1M3	<sub>(4)</sub>	3M6 <sub>(2)</sub>	5M3 <sub>(3)</sub>	6M3
Contaminating fluids	---	---	---	5F1	---

(1) 3K3: expanded temperature range: -40°C / +85°C

(2) 3M7 possible, but due to mechanic load capacity of external components like DC-Link capacitors limited to 3M6

(3) 5M3, shock only 5M2, without impact from foreign bodies, stones

(4) no declaration due to customer-specific packing

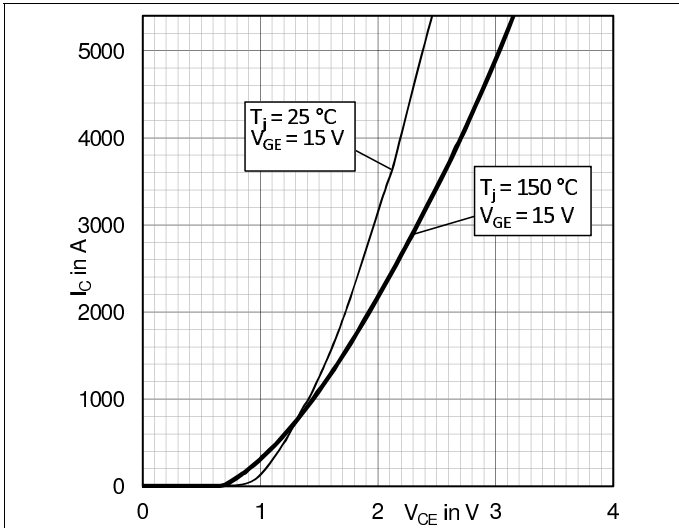


Fig. 1: Typical IGBT output characteristics

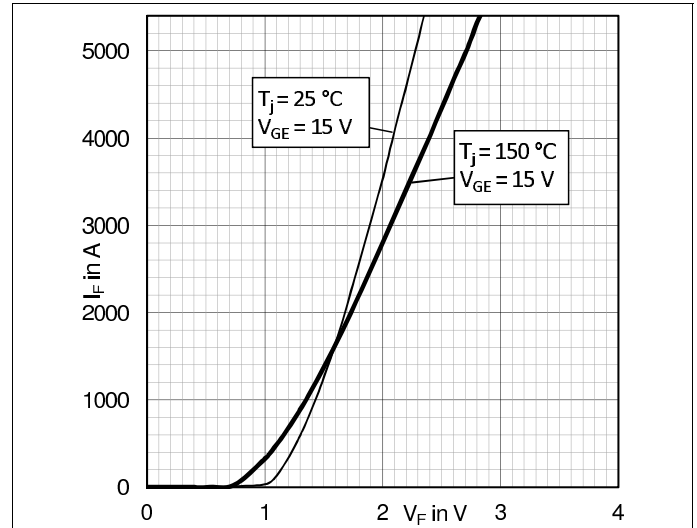


Fig. 2: Typical diode output characteristics

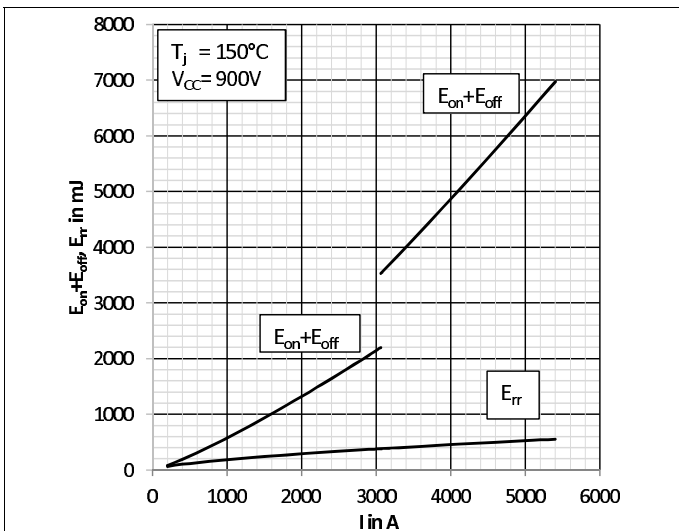


Fig. 3: Typical energy losses  $E = f(I_C, V_{CC}, T_j)$

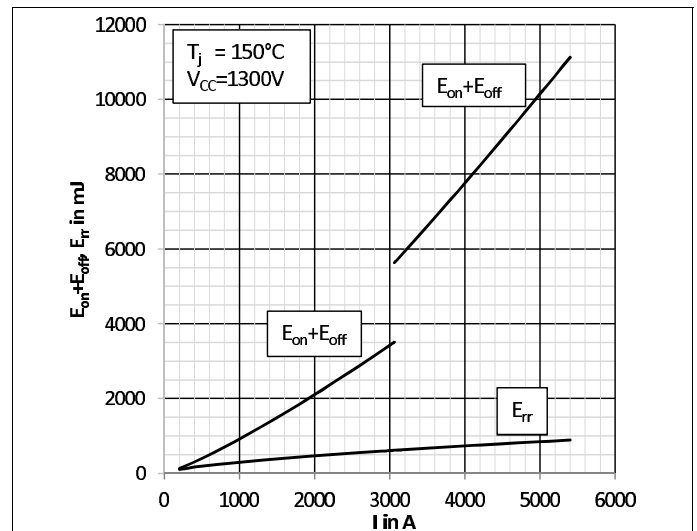


Fig. 4: Typical energy losses  $E = f(I_C, V_{CC}, T_j)$

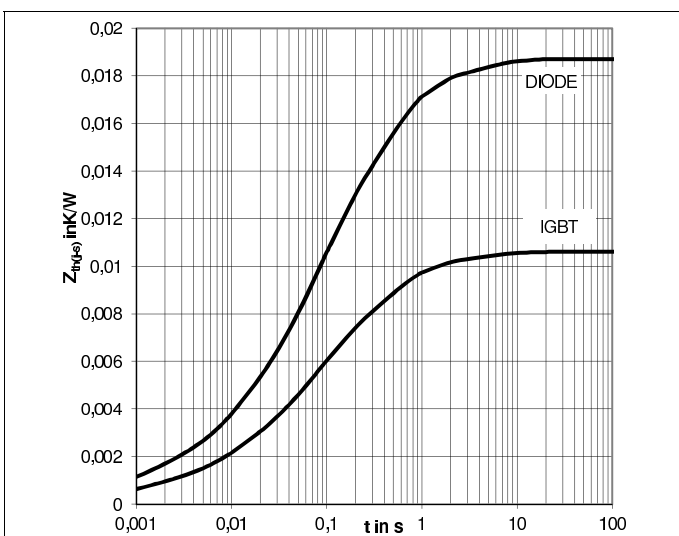


Fig. 5: Transient thermal impedance  $Z_{th}(j-s)$

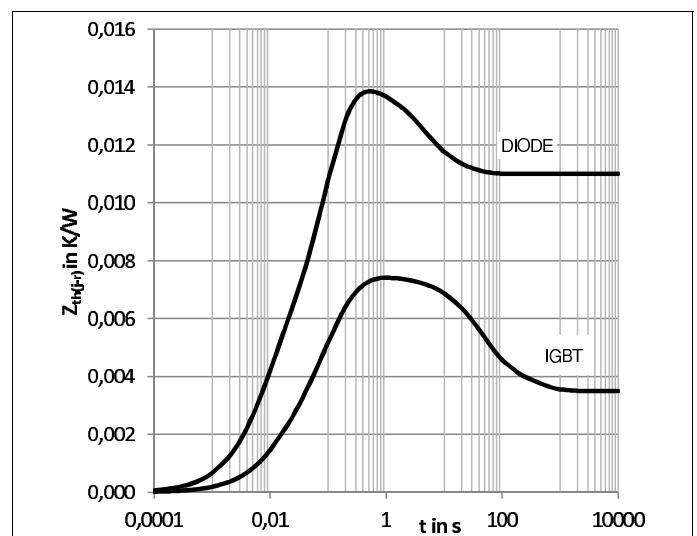


Fig. 6: Transient thermal impedance  $Z_{th}(j-r)$

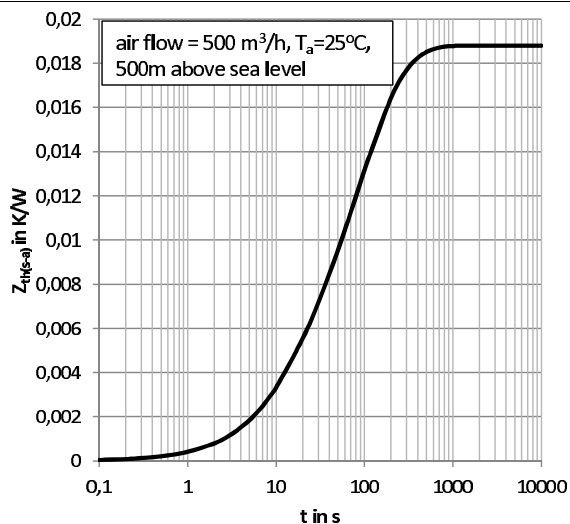


Fig. 7: Transient thermal impedance  $Z_{th}(s-a)$

	$R_{th} [K/W]$				
	1	2	3	4	5
$Z_{th(j-s)} I$	0,0007	0,0038	0,0042	0,0013	0,0006
$Z_{th(j-s)} D$	0,0013	0,0067	0,0074	0,0022	0,0011
$Z_{th(j-r)} I$	0,0014	0,0038	0,0023	-0,0030	-0,0010
$Z_{th(j-r)} D$	0,0041	0,0035	0,0066	-0,0023	-0,0009
$Z_{th(s-a)}$	0,0032	0,0097	0,0003	0,0056	
	$\tau [s]$				
	1	2	3	4	5
$Z_{th(j-s)} I$	3,6500	0,4100	0,0650	0,0090	0,0008
$Z_{th(j-s)} D$	3,6500	0,4100	0,0650	0,0090	0,0008
$Z_{th(j-r)} I$	0,0110	0,0700	0,2000	44,900	337,00
$Z_{th(j-r)} D$	0,0070	0,0620	0,1100	4,2000	20,000
$Z_{th(s-a)}$	13,100	73,000	73,000	168,00	

Fig. 8: Coefficients of thermal impedances

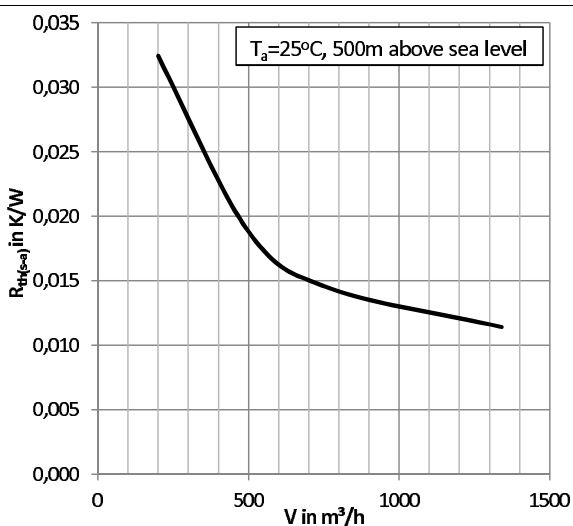


Fig. 9: Thermal resistance  $R_{th}(s-a)$  versus flow rate  $V$

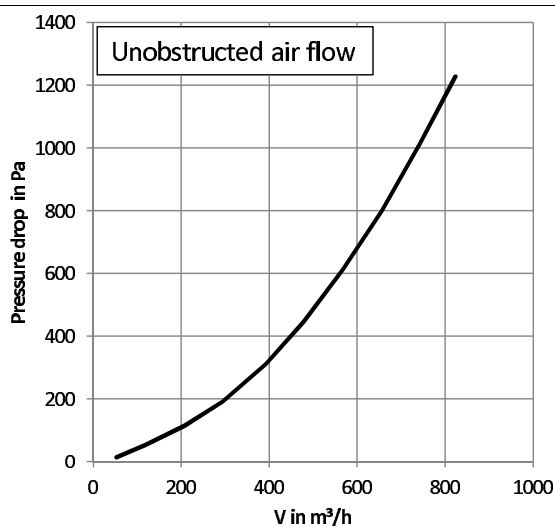
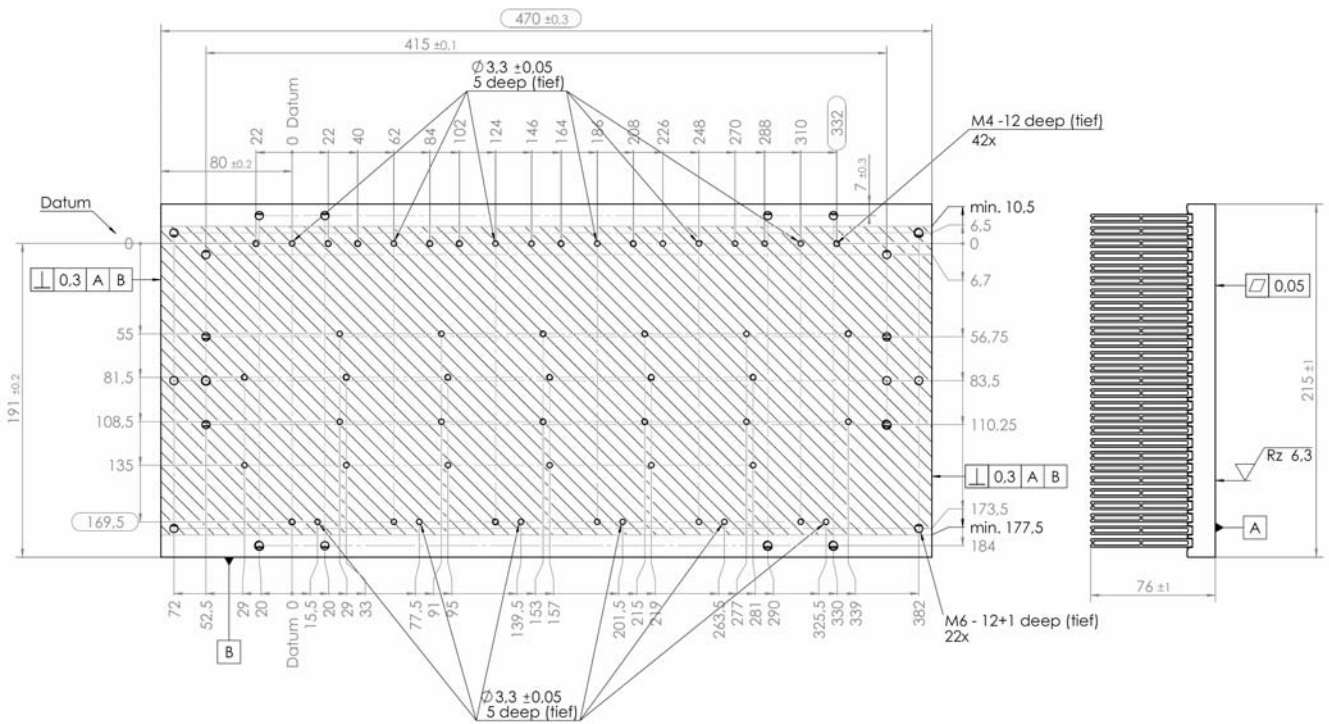


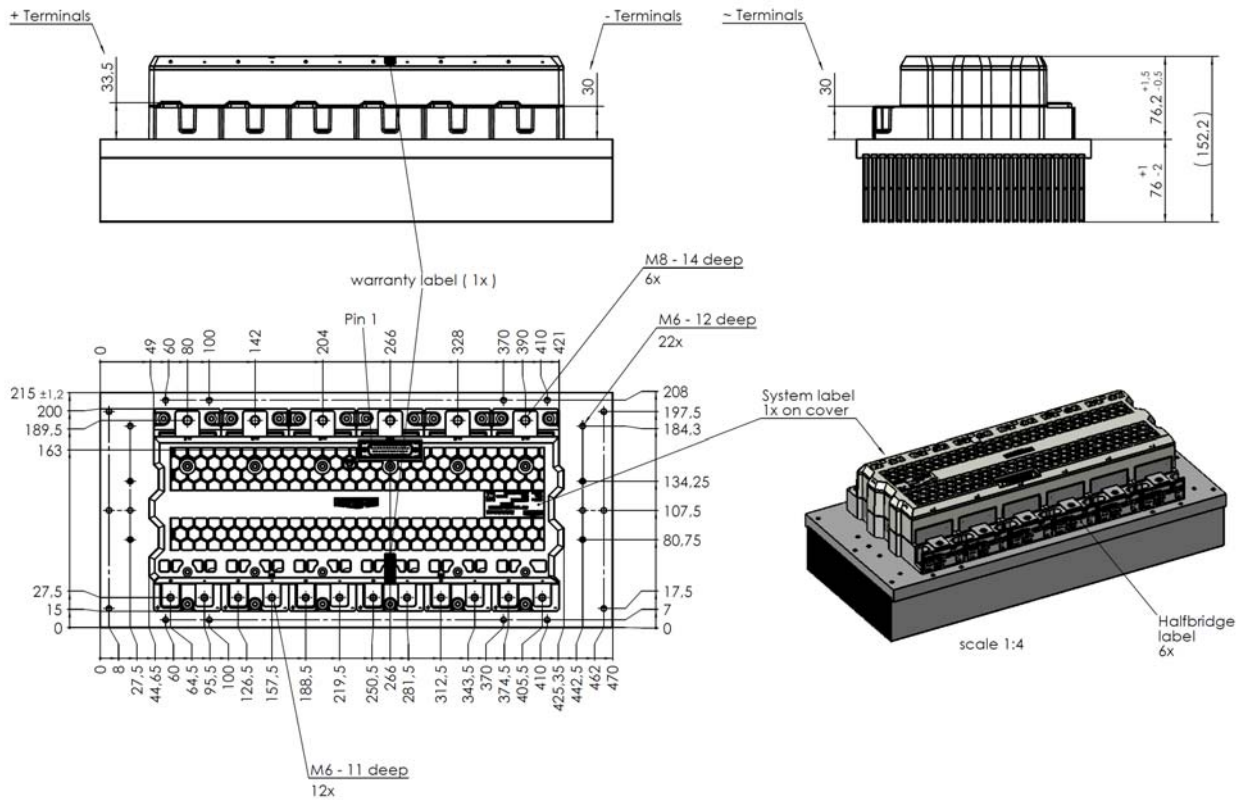
Fig. 10: Pressure drop  $\Delta p$  versus flow rate  $V$

# SKiP 3614 GB17E4-6DUL



Heat sink

# SKiP 3614 GB17E4-6DUL



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.