



**SEMITRANS®4**

## IGBT4 Modules

SKM600GA12E4

### Features

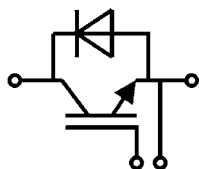
- IGBT4 = 4. Generation (Trench)IGBT
- VCEsat with positive temperature coefficient
- High short circuit capability, self limiting to 6 x ICNOM
- Soft switching 4. Generation CAL diode (CAL4)

### Typical Applications

- AC inverter drives
- UPS
- Electronic welders at fsw up to 20 kHz

### Remarks

- Case temperature limited to Tc = 125°C max, recomm. Top = -40 ... +150°C, product rel. results valid for Tj = 150°
- Short circuit: Soft Turn-off recommended RGoff > 20 Ω
- With RG = 2 Ω the RBSOA is limited to 1 x ICnom = 600 A



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Absolute Maximum Ratings				
Symbol	Conditions		Values	Unit
<b>IGBT</b>				
V <sub>CES</sub>			1200	V
I <sub>C</sub>	T <sub>j</sub> = 175 °C	T <sub>c</sub> = 25 °C	916	A
		T <sub>c</sub> = 80 °C	704	A
I <sub>Cnom</sub>			600	A
I <sub>CRM</sub>	I <sub>CRM</sub> = 3xI <sub>Cnom</sub>		1800	A
V <sub>GES</sub>			-20 ... 20	V
t <sub>psc</sub>	V <sub>CC</sub> = 800 V	T <sub>j</sub> = 150 °C	10	μs
	V <sub>GE</sub> ≤ 15 V V <sub>CES</sub> ≤ 1200 V			
T <sub>j</sub>			-40 ... 175	°C
<b>Inverse diode</b>				
I <sub>F</sub>	T <sub>j</sub> = 175 °C	T <sub>c</sub> = 25 °C	707	A
		T <sub>c</sub> = 80 °C	529	A
I <sub>Fnom</sub>			600	A
I <sub>FRM</sub>	I <sub>FRM</sub> = 3xI <sub>Fnom</sub>		1800	A
I <sub>FSM</sub>	t <sub>p</sub> = 10 ms, sin 180°, T <sub>j</sub> = 25 °C		3240	A
T <sub>j</sub>			-40 ... 175	°C
<b>Module</b>				
I <sub>t(RMS)</sub>			500	A
T <sub>stg</sub>			-40 ... 125	°C
V <sub>isol</sub>	AC sinus 50Hz, t = 1 min		4000	V

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
<b>IGBT</b>						
V <sub>CE(sat)</sub>	I <sub>C</sub> = 600 A V <sub>GE</sub> = 15 V chipelevel	T <sub>j</sub> = 25 °C	1.8	2.05		V
		T <sub>j</sub> = 150 °C	2.2	2.4		V
V <sub>CE0</sub>		T <sub>j</sub> = 25 °C	0.8	0.9		V
		T <sub>j</sub> = 150 °C	0.7	0.8		V
r <sub>CE</sub>	V <sub>GE</sub> = 15 V	T <sub>j</sub> = 25 °C	1.7	1.9		mΩ
		T <sub>j</sub> = 150 °C	2.5	2.7		mΩ
V <sub>GE(th)</sub>	V <sub>GE</sub> =V <sub>CE</sub> , I <sub>C</sub> = 24 mA		5	5.8	6.5	V
I <sub>CES</sub>	V <sub>GE</sub> = 0 V V <sub>CE</sub> = 1200 V	T <sub>j</sub> = 25 °C	0.1	0.3		mA
		T <sub>j</sub> = 150 °C				mA
C <sub>ies</sub>	V <sub>CE</sub> = 25 V V <sub>GE</sub> = 0 V	f = 1 MHz	37.2			nF
C <sub>oes</sub>		f = 1 MHz	2.32			nF
C <sub>res</sub>		f = 1 MHz	2.04			nF
Q <sub>G</sub>	V <sub>GE</sub> = - 8 V...+ 15 V		3400			nC
R <sub>Gint</sub>	T <sub>j</sub> = 25 °C		1.3			Ω
t <sub>d(on)</sub>	V <sub>CC</sub> = 600 V	T <sub>j</sub> = 150 °C	195			ns
t <sub>r</sub>	I <sub>C</sub> = 600 A V <sub>GE</sub> = ±15 V	T <sub>j</sub> = 150 °C	90			ns
		T <sub>j</sub> = 150 °C	74			mJ
E <sub>on</sub>	R <sub>G on</sub> = 2 Ω	T <sub>j</sub> = 150 °C	690			ns
t <sub>d(off)</sub>	R <sub>G off</sub> = 2 Ω	T <sub>j</sub> = 150 °C	130			ns
t <sub>f</sub>	di/dt <sub>on</sub> = 6000 A/μs	T <sub>j</sub> = 150 °C	84			mJ
E <sub>off</sub>	di/dt <sub>off</sub> = 5200 A/μs	T <sub>j</sub> = 150 °C				mJ
R <sub>th(j-c)</sub>	per IGBT			0.049		K/W



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- High short circuit capability, self limiting to  $6 \times I_{CNOM}$
- Soft switching 4. Generation CAL diode (CAL4)

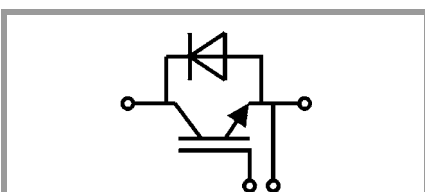
### Typical Applications

- AC inverter drives
- UPS
- Electronic welders at fsw up to 20 kHz

### Remarks

- Case temperature limited to  $T_c = 125^\circ\text{C}$  max, recomm.  
 $T_{op} = -40 \dots +150^\circ\text{C}$ , product rel. results valid for  $T_j = 150^\circ$
- Short circuit: Soft Turn-off recommended  $R_{Goff} > 20 \Omega$
- With  $R_G = 2 \Omega$  the RBSOA is limited to  $1 \times I_{Cnom} = 600 \text{ A}$

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
<b>Inverse diode</b>						
$V_F = V_{EC}$	$I_F = 600 \text{ A}$ $V_{GE} = 0 \text{ V}$ chip	$T_j = 25^\circ\text{C}$		2.14	2.46	V
		$T_j = 150^\circ\text{C}$		2.07	2.38	V
$V_{F0}$		$T_j = 25^\circ\text{C}$		1.3	1.5	V
		$T_j = 150^\circ\text{C}$		0.9	1.1	V
$r_F$		$T_j = 25^\circ\text{C}$		1.4	1.6	m $\Omega$
		$T_j = 150^\circ\text{C}$		1.9	2.1	m $\Omega$
$I_{RRM}$	$I_F = 600 \text{ A}$	$T_j = 150^\circ\text{C}$		420		A
$Q_{rr}$	$di/dt_{off} = 5500 \text{ A}/\mu\text{s}$	$T_j = 150^\circ\text{C}$		92		$\mu\text{C}$
$E_{rr}$	$V_{GE} = \pm 15 \text{ V}$ $V_{CC} = 600 \text{ V}$	$T_j = 150^\circ\text{C}$		38		mJ
$R_{th(j-c)}$	per diode				0.086	K/W
<b>Module</b>						
$L_{CE}$				15	20	nH
$R_{CC'+EE'}$	terminal-chip	$T_c = 25^\circ\text{C}$		0.18		m $\Omega$
		$T_c = 125^\circ\text{C}$		0.22		m $\Omega$
$R_{th(c-s)}$	per module			0.02	0.038	K/W
$M_s$	to heat sink M6			3	5	Nm
$M_t$		to terminals M6, M4		2.5	5	Nm
						Nm
$w$					330	g



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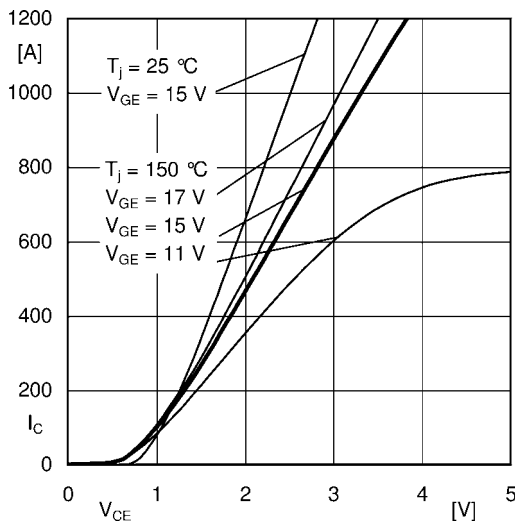


Fig. 1: Typ. output characteristic, inclusive  $R_{CC'+EE}$

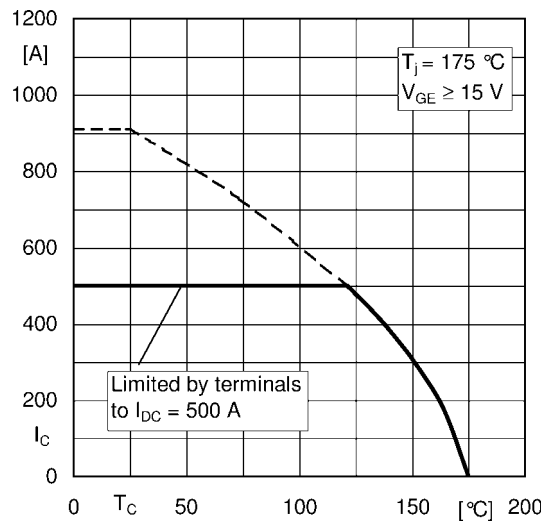


Fig. 2: Rated current vs. temperature  $I_C = f(T_C)$

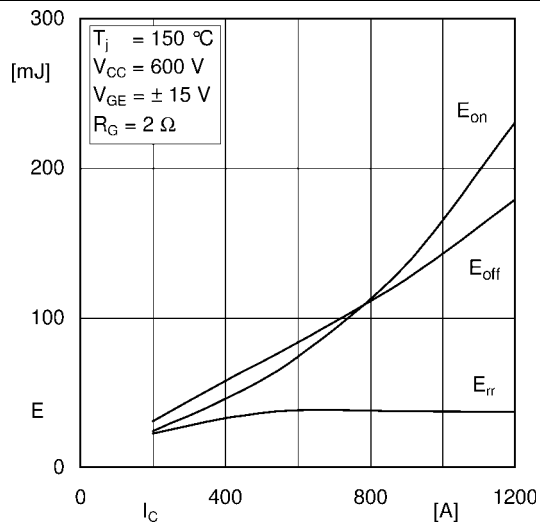


Fig. 3: Typ. turn-on /-off energy =  $f(I_C)$

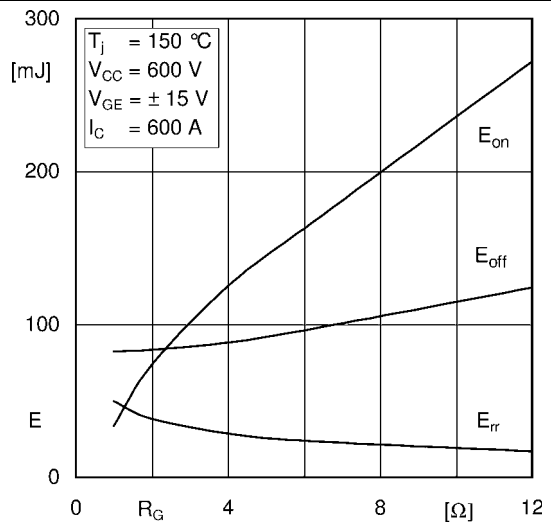


Fig. 4: Typ. turn-on /-off energy =  $f(R_G)$

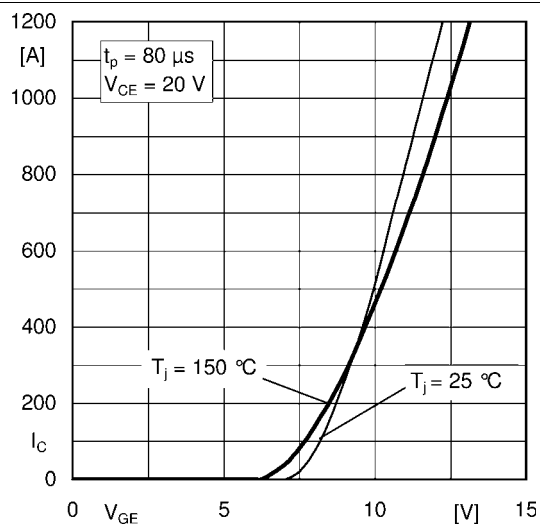


Fig. 5: Typ. transfer characteristic

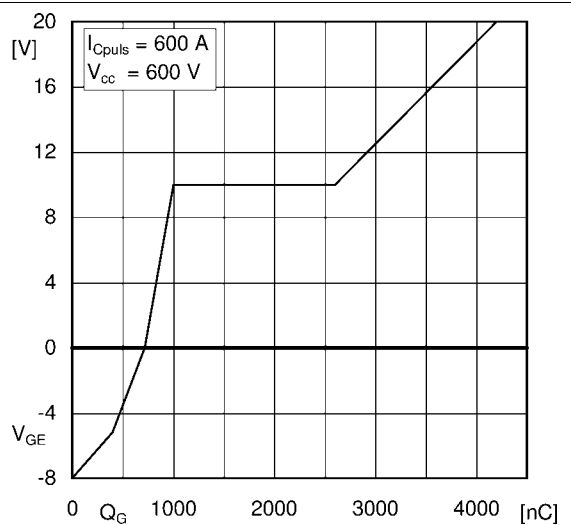


Fig. 6: Typ. gate charge characteristic

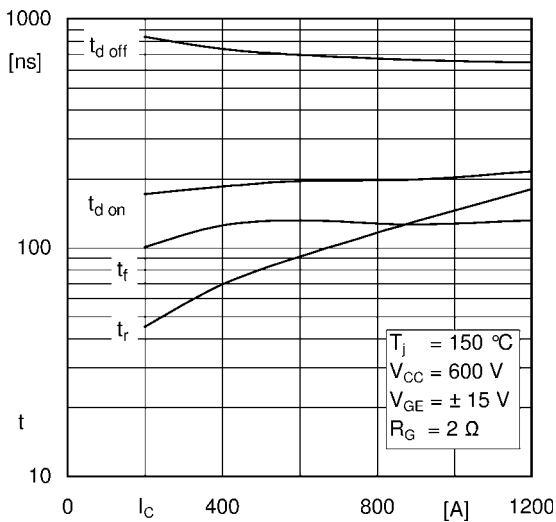


Fig. 7: Typ. switching times vs.  $I_C$

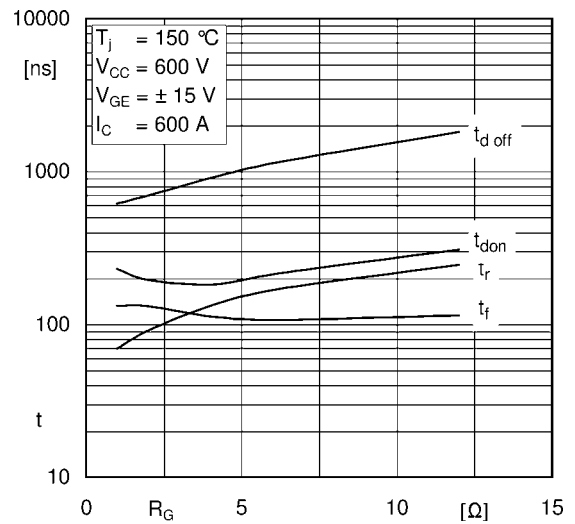


Fig. 8: Typ. switching times vs. gate resistor  $R_G$

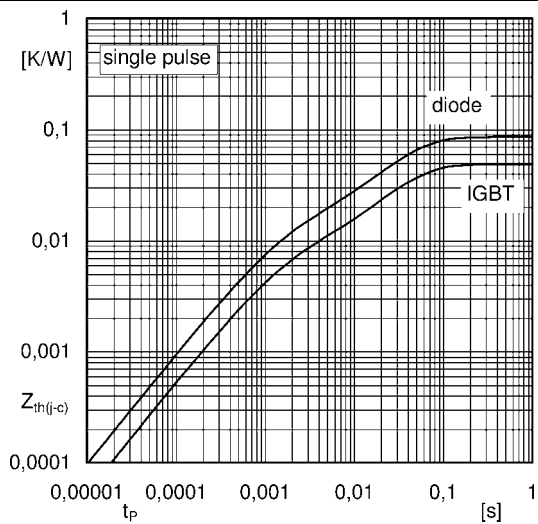


Fig. 9: Transient thermal impedance

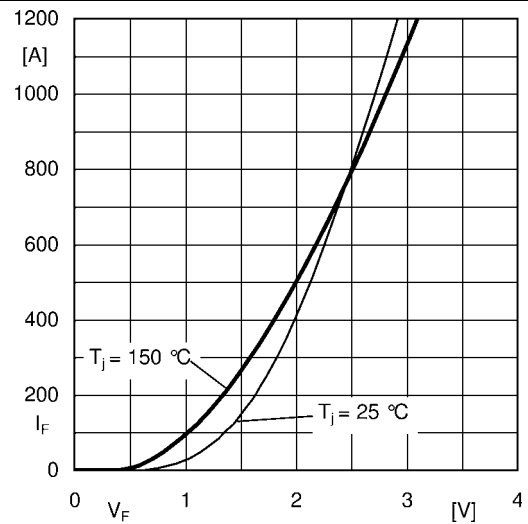


Fig. 10: CAL diode forward characteristic

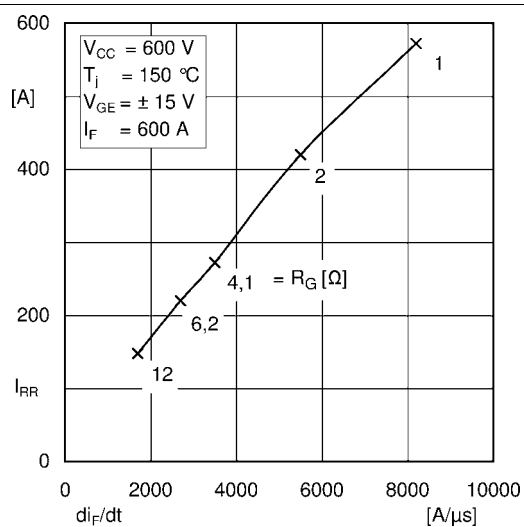


Fig. 11: CAL diode peak reverse recovery current

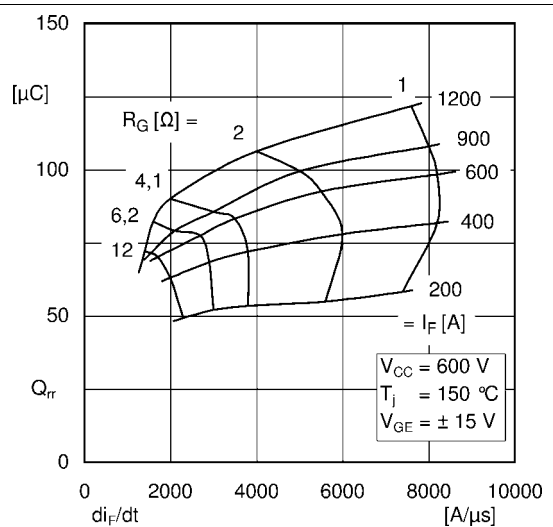
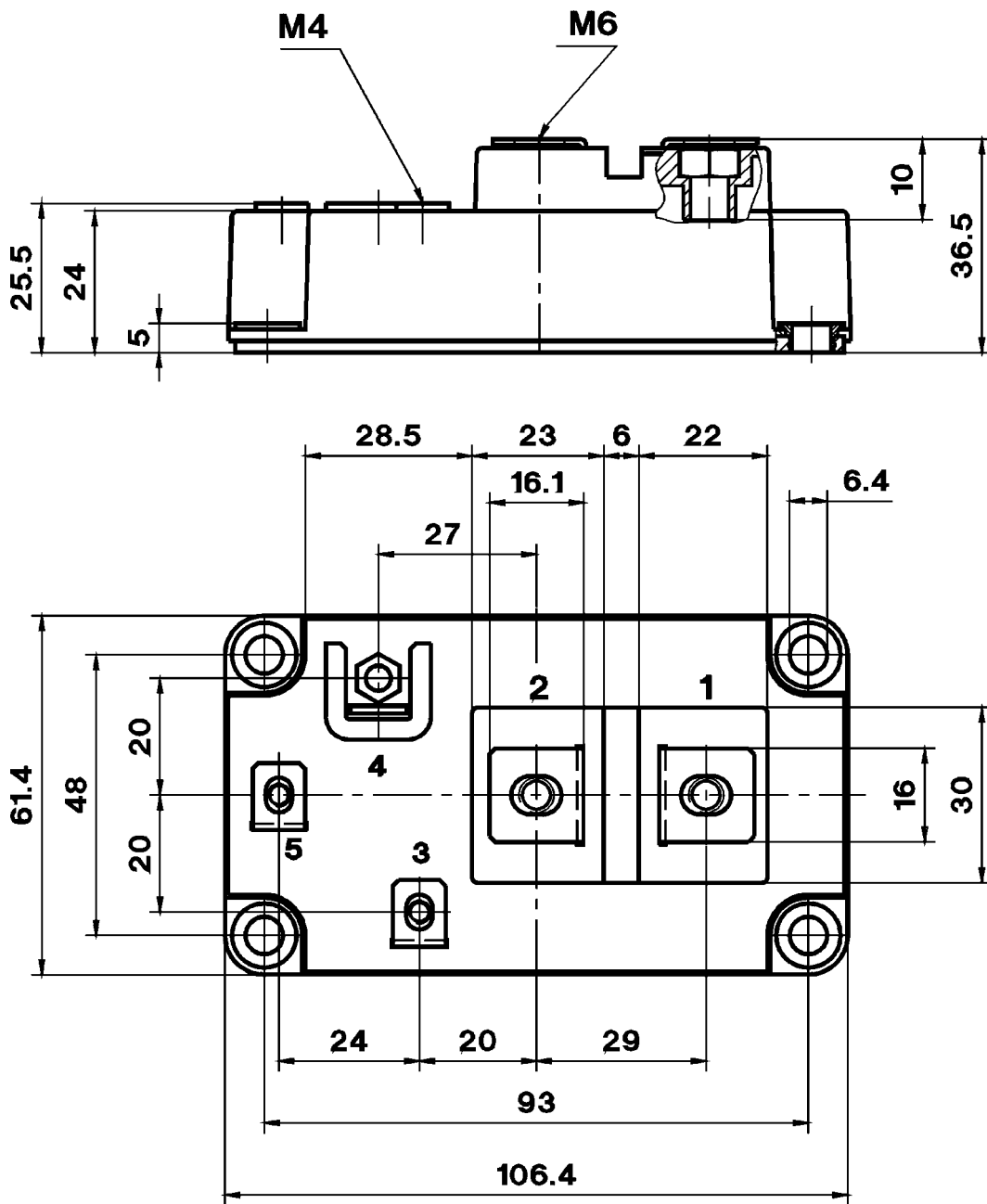
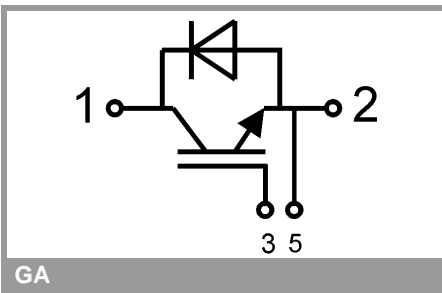


Fig. 12: Typ. CAL diode peak reverse recovery charge



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

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