

## SiC MOSFET Module

## SK45MLET12SCp

## Features\*

- One screw mounting module
- Fully compatible with other SEMITOP® Press-Fit types
- Improved thermal performance by aluminum oxide substrate
- Three separated Boost legs in very compact solution
- Ultra Low inductance design
- SiC 1200V Planar MOSFET
- SiC 1200V Schottky FWD
- By-pass Rectifier diodes
- Extremely high switching frequency
- UL recognized, file no. E63 532

## Typical Applications

- Interleaved PFC
- Solar inverter
- UPS
- Power Supply

## Remarks

By-pass diode = Diode1

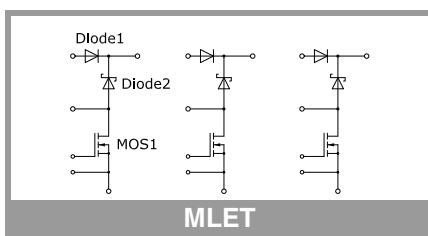
FWD = Diode2

Absolute Maximum Ratings		Values	Unit
Symbol	Conditions		
<b>MOSFET 1</b>			
$V_{DSS}$		1200	V
$I_D$	$T_j = 175 \text{ }^\circ\text{C}$	39	A
	$T_s = 25 \text{ }^\circ\text{C}$	32	A
$T_s = 70 \text{ }^\circ\text{C}$			
$I_{DM}$	$PW \leq 10\mu\text{s}$ , Duty cycle $\leq 1\%$	160	A
$I_{DM,\text{repetitive}}$		113	A
$V_{GS}$		-6 ... 22	V
$T_j$		-40 ... 175	$^\circ\text{C}$
<b>Integrated body diode</b>			
$I_{FM}$	$PW \leq 10\mu\text{s}$ , Duty cycle $\leq 1\%$	160	A
$I_{FM,\text{repetitive}}$		113	A

Absolute Maximum Ratings		Values	Unit
Symbol	Conditions		
<b>Diode 1</b>			
$V_{RRM}$	$T_j = 25 \text{ }^\circ\text{C}$	1600	V
$I_F$	$T_j = 150 \text{ }^\circ\text{C}$	43	A
	$T_s = 25 \text{ }^\circ\text{C}$	32	A
	$T_s = 70 \text{ }^\circ\text{C}$		
$I_{FSM}$	$10 \text{ ms}$ , $T_j = 150 \text{ }^\circ\text{C}$	270	A
$i^2t$	$10 \text{ ms}$ , $T_j = 150 \text{ }^\circ\text{C}$	364	$\text{A}^2\text{s}$
$T_j$		-40 ... 150	$^\circ\text{C}$

Absolute Maximum Ratings		Values	Unit
Symbol	Conditions		
<b>Diode 2</b>			
$V_{RRM}$	$T_j = 25 \text{ }^\circ\text{C}$	1200	V
$I_F$	$T_j = 175 \text{ }^\circ\text{C}$	56	A
	$T_s = 25 \text{ }^\circ\text{C}$	44	A
	$T_s = 70 \text{ }^\circ\text{C}$		
$I_{FRM}$		113	A
$I_{FSM}$	$10 \text{ ms}$	190	A
	$\sin 180^\circ$	140	A
$T_j$		-40 ... 175	$^\circ\text{C}$

Absolute Maximum Ratings		Values	Unit
Symbol	Conditions		
<b>Module</b>			
$I_{t(\text{RMS})}$	$\Delta T_{\text{terminal}}$ at PCB joint = 30 K, per pin	35	A
$T_{\text{stg}}$	module without TIM	-40 ... 125	$^\circ\text{C}$
$V_{\text{isol}}$	AC, sinusoidal, $t = 1 \text{ min}$	2500	V





**SEMITOP® 3 Press-Fit**

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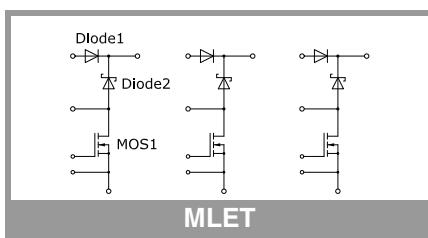
#### Remarks

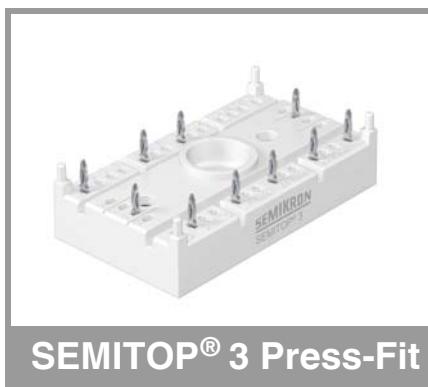
By-pass diode = Diode1

FWD = Diode2

Characteristics			min.	typ.	max.	Unit
<b>MOSFET 1</b>						
$V_{(BR)DSS}$	$V_{GS} = 0 \text{ V}, I_D = 1 \text{ mA}, T_j = 25 \text{ °C}$		1200			V
$V_{GS(\text{th})}$	$V_{DS} = V_{GS}, I_D = 8.9 \text{ mA}, T_j = 25 \text{ °C}$		1.6		4	V
$I_{DSS}$	$V_{GS} = 0 \text{ V}, V_{DS} = 1200 \text{ V}, T_j = 25 \text{ °C}$			1		mA
$I_{GSS}$	$V_{DS} = 0 \text{ V}, V_{GS} = 22 \text{ V}, T_j = 25 \text{ °C}$			100		nA
$R_{DS(\text{on})}$	$V_{GS} = 18 \text{ V}$	$T_j = 25 \text{ °C}$		45	56	$\text{m}\Omega$
	$I_D = 22 \text{ A}$	$T_j = 150 \text{ °C}$		76		$\text{m}\Omega$
$C_{iss}$	$V_{GS} = 0 \text{ V}, V_{DS} = 800 \text{ V}, f = 1 \text{ MHz}$		4310			$\text{pF}$
$C_{oss}$	$V_{GS} = 0 \text{ V}, V_{DS} = 800 \text{ V}, f = 1 \text{ MHz}$		137			$\text{pF}$
$C_{rss}$	$V_{GS} = 0 \text{ V}, V_{DS} = 800 \text{ V}, f = 1 \text{ MHz}$		19			$\text{pF}$
$R_{Gint}$	$T_j = 25 \text{ °C}$		4.7			$\Omega$
$Q_G$	$V_{DS}=600\text{V}, V_{GS}=-5\text{V}...+20\text{V}, I_D = 45 \text{ A}$		215			$\text{nC}$
$t_{d(\text{on})}$	$V_{DD} = 600 \text{ V}$	$T_j = 150 \text{ °C}$	12			ns
$t_{d(\text{off})}$	$V_{GS} = 20/-5 \text{ V}$	$T_j = 150 \text{ °C}$	64			ns
$t_r$	$I_D = 45 \text{ A}$	$T_j = 150 \text{ °C}$	17			ns
$t_f$	$R_{Gon} = 0.5 \Omega$	$T_j = 150 \text{ °C}$	16			ns
$E_{on}$	$R_{Goff} = 0.5 \Omega$	$T_j = 150 \text{ °C}$	0.16			$\text{mJ}$
$E_{off}$	$\text{di/dt}_{\text{off}} = 2.2 \text{ kA}/\mu\text{s}$	$T_j = 150 \text{ °C}$	0.37			$\text{mJ}$
$R_{th(j-s)}$	$\text{di/dt}_{\text{on}} = 3.9 \text{ kA}/\mu\text{s}$	$T_j = 150 \text{ °C}$				
	per MOSFET		1.04			K/W
<b>Integrated body diode</b>						
$V_F = V_{SD}$	$-I_D = 22 \text{ A}$	$T_j = 25 \text{ °C}$	4.10			V
	$V_{GS} = 0 \text{ V}$	$T_j = 150 \text{ °C}$	3.90			V
$V_{F0} = V_{SD0}$	chiplevel	$T_j = 25 \text{ °C}$	2.60			V
		$T_j = 150 \text{ °C}$	2.10			V
$r_F = r_{SD}$	chiplevel	$T_j = 25 \text{ °C}$	68			$\text{m}\Omega$
		$T_j = 150 \text{ °C}$	82			$\text{m}\Omega$
$t_{rr}$	$V_{DD} = 600 \text{ V}$	$T_j = 150 \text{ °C}$	-			ns
$Q_{rr}$	$-I_D = 45 \text{ A}$	$T_j = 150 \text{ °C}$	-			$\mu\text{C}$
$I_{rr}$	$V_{GS} = -5 \text{ V}$	$T_j = 150 \text{ °C}$	-			A
$E_{rr}$	$R_{Gon} = 0.5 \Omega$	$T_j = 150 \text{ °C}$	-			$\text{mJ}$

Characteristics			min.	typ.	max.	Unit
<b>Diode 1</b>						
$V_F$	$I_F = 35 \text{ A}$	$T_j = 25 \text{ °C}$	1.20	1.60		V
	chiplevel	$T_j = 125 \text{ °C}$	1.19	1.56		V
$V_{F0}$	chiplevel	$T_j = 25 \text{ °C}$	0.88	0.98		V
		$T_j = 125 \text{ °C}$	0.73	0.83		V
$r_F$	chiplevel	$T_j = 25 \text{ °C}$	9.2	18		$\text{m}\Omega$
		$T_j = 125 \text{ °C}$	13	21		$\text{m}\Omega$
$I_R$	$T_j = 145 \text{ °C}, V_{RRM}$			1.1		$\text{mA}$
$R_{th(j-s)}$	per Diode, $\lambda_{\text{paste}}=0.8 \text{ W}/(\text{mK})$		1.7			K/W





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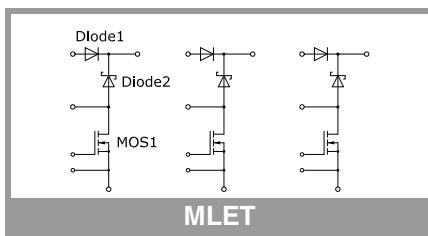
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## Remarks

By-pass diode = Diode1  
FWD = Diode2

Characteristics		Symbol	Conditions	min.	typ.	max.	Unit			
Diode 2										
$V_F$	$I_F = 50 \text{ A}$ chiplevel	$T_j = 25 \text{ }^\circ\text{C}$ $T_j = 150 \text{ }^\circ\text{C}$		1.40	1.60	1.80	V			
$V_{FO}$	chiplevel	$T_j = 25 \text{ }^\circ\text{C}$ $T_j = 150 \text{ }^\circ\text{C}$		0.95	1.05	0.80	V			
$r_F$	chiplevel	$T_j = 25 \text{ }^\circ\text{C}$ $T_j = 150 \text{ }^\circ\text{C}$		9.0	11	20	$\text{m}\Omega$			
$C_j$	$V_R = 800 \text{ V}, f = 1 \text{ MHz}, T_j = 25 \text{ }^\circ\text{C}$			0.210			$\text{nF}$			
$Q_c$	$V_R = 800 \text{ V}, dI/dt_{off} = 500 \text{ A}/\mu\text{s}, T_j = 25 \text{ }^\circ\text{C}$			0.088			$\mu\text{C}$			
$R_{th(j-s)}$	per Diode			1.14			$\text{K/W}$			

Characteristics		Symbol	Conditions	min.	typ.	max.	Unit
Module							
$M_s$	to heatsink			2.25	2.5	30	$\text{Nm}$
$w$	weight						g



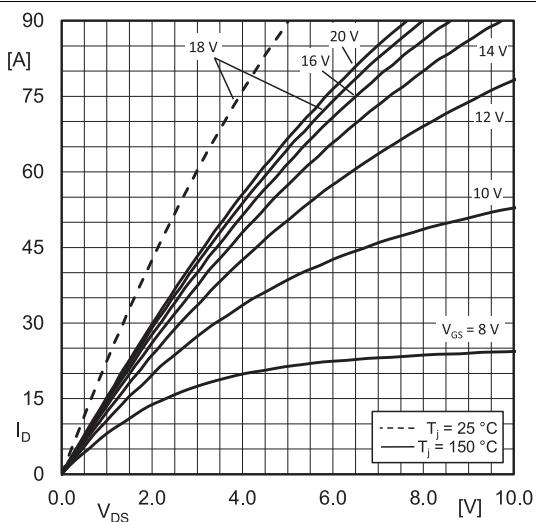


Fig. 1: Typ. MOSFET forward output characteristic, incl.  $R_{DD'}$  +  $SS'$

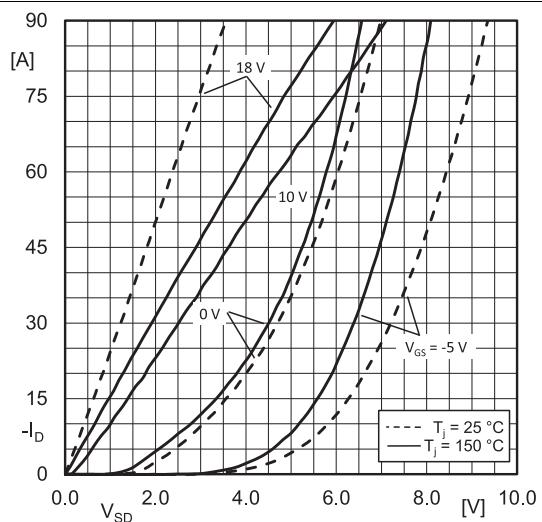


Fig. 2: Typ. reverse output characteristic, incl.  $R_{DD'}$  +  $SS'$

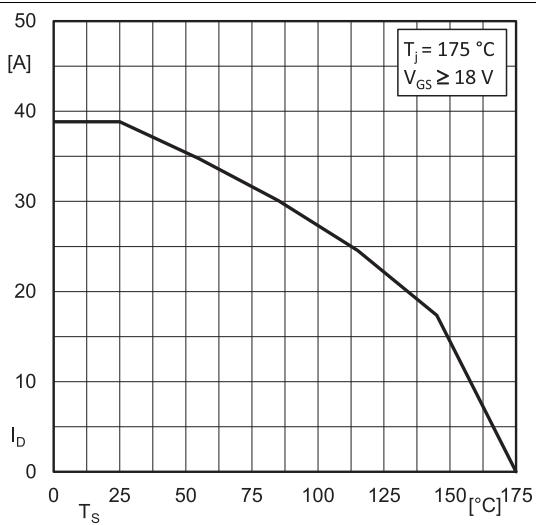


Fig. 3: Rated current vs. temperature  $I_D = f(T_s)$

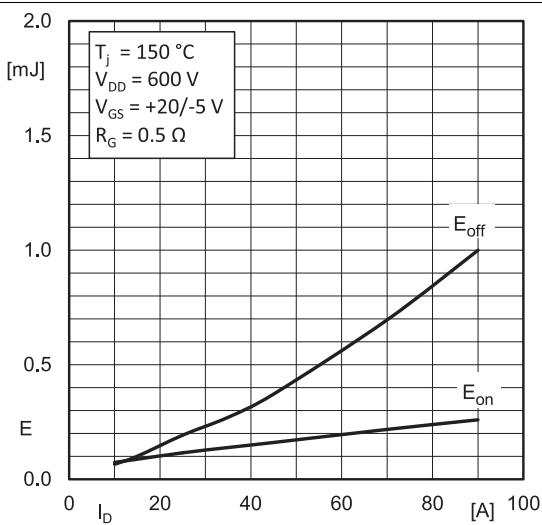


Fig. 4: Typ. turn-on/-off energy  $E = f(I_D)$

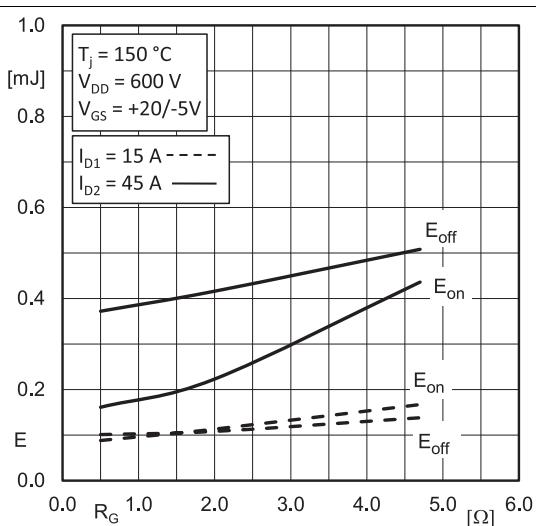


Fig. 5: Typ. turn-on /-off energy  $E = f(R_G)$

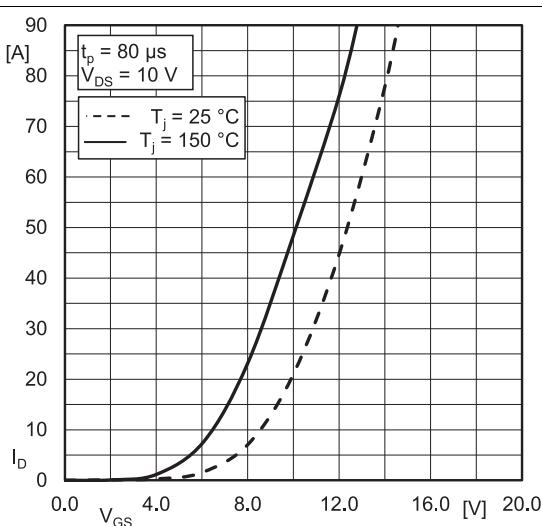


Fig. 6: Typ. MOSFET transfer characteristic

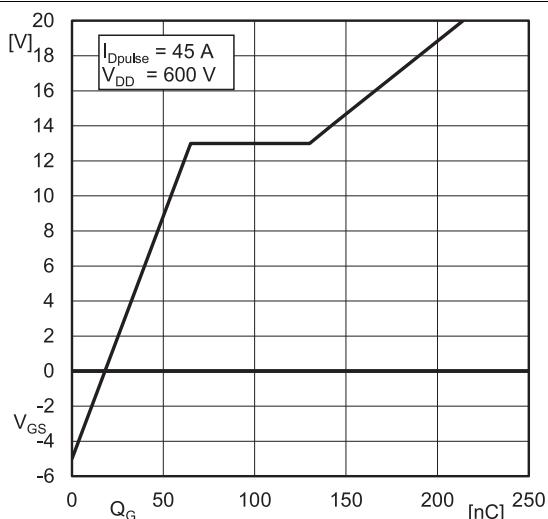


Fig 7: Typ. MOSFET gate charge characteristic

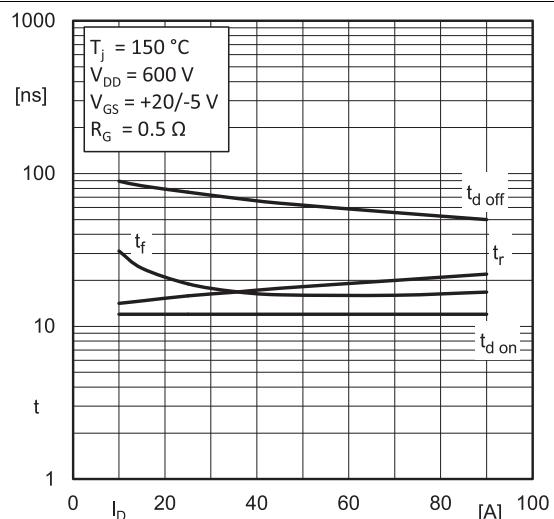


Fig. 8: Typ. switching times vs.  $I_D$

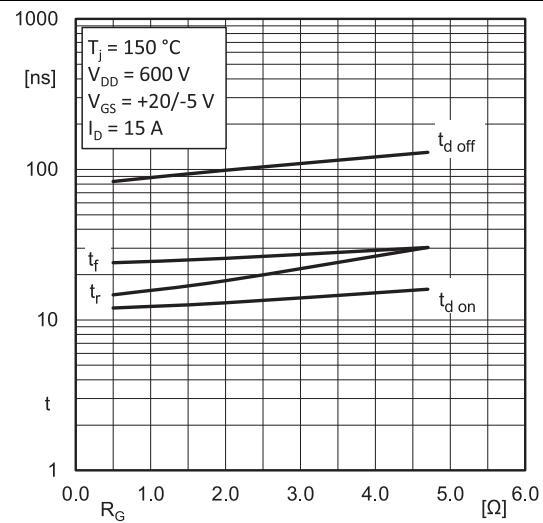


Fig. 9: Typ. switching times vs. gate resistor  $R_G$  at  $I_D1$

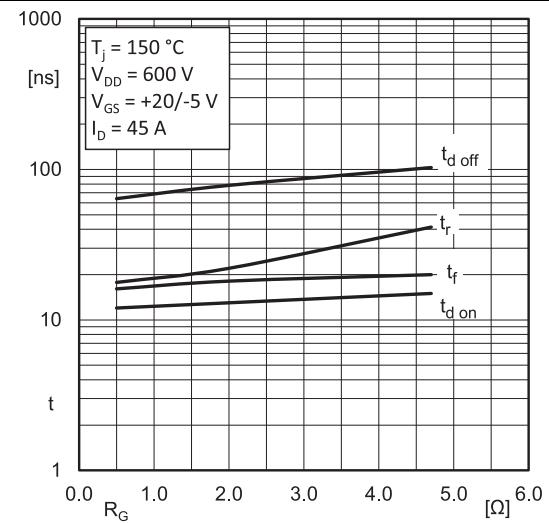


Fig. 10: Typ. switching times vs. gate resistor  $R_G$  at  $I_D2$

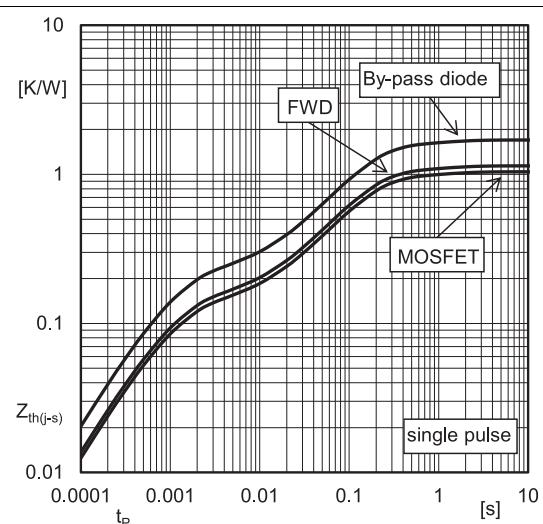


Fig. 11: Typ. transient thermal impedances

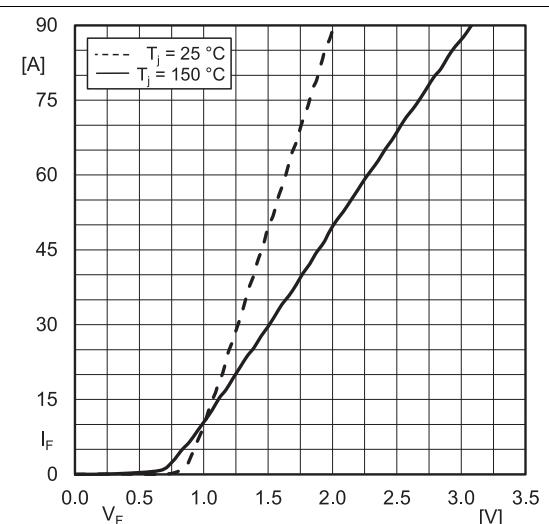


Fig. 12: Typ. FWD output characteristic, incl.  $R_{DD} + SS$

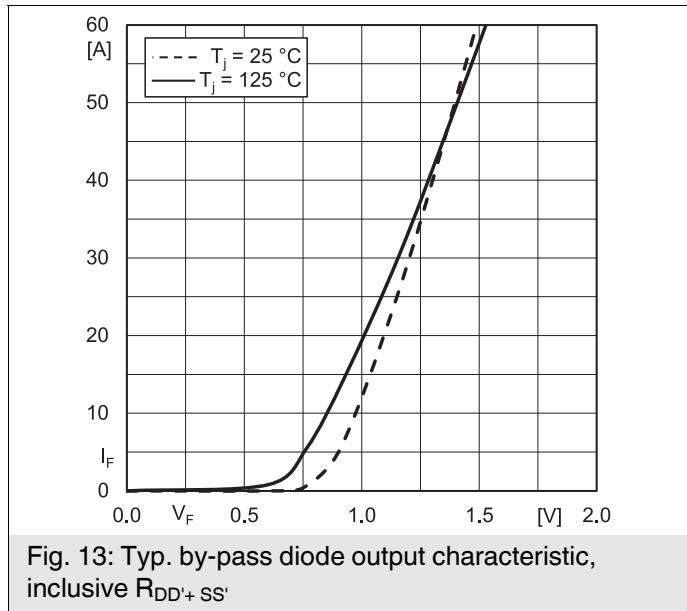
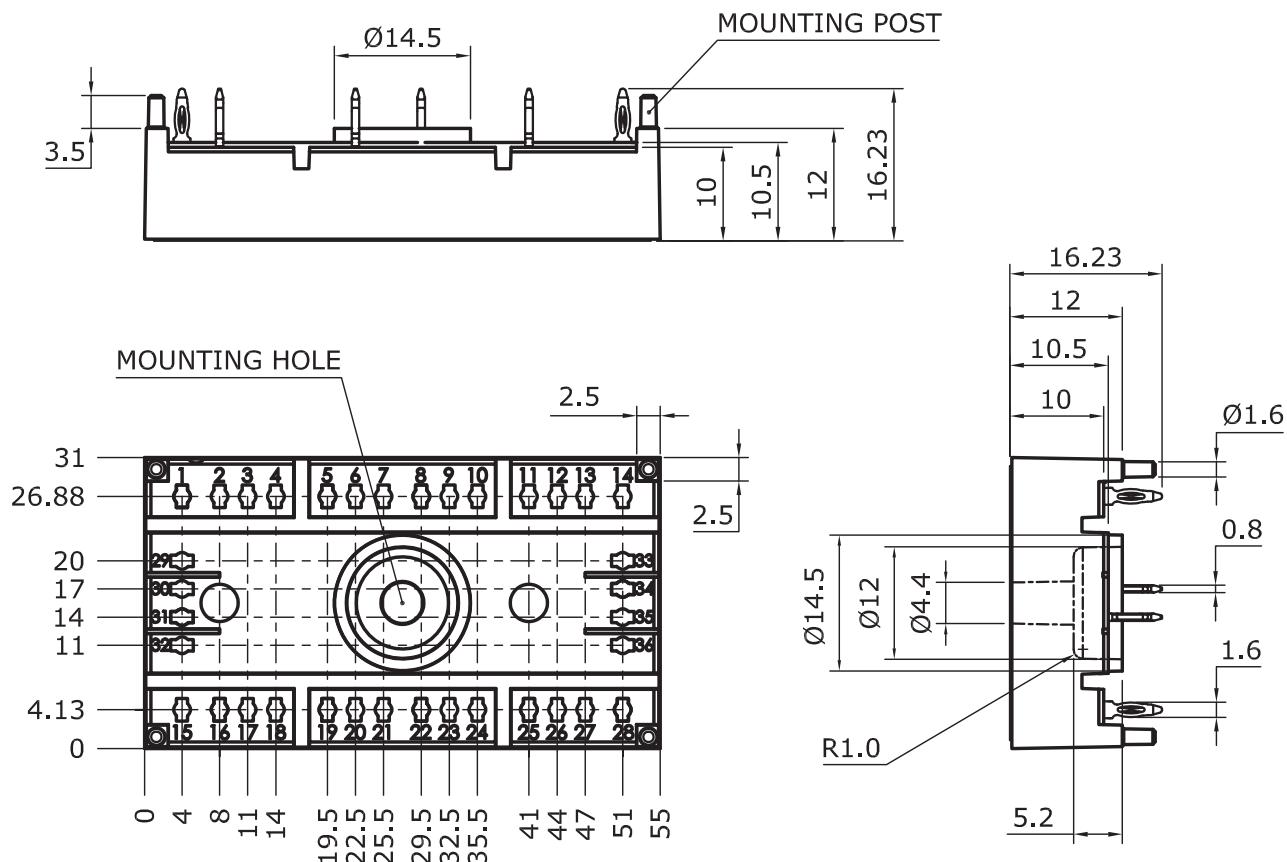


Fig. 13: Typ. by-pass diode output characteristic, inclusive  $R_{DD'} + ss'$

Dimensions: mm

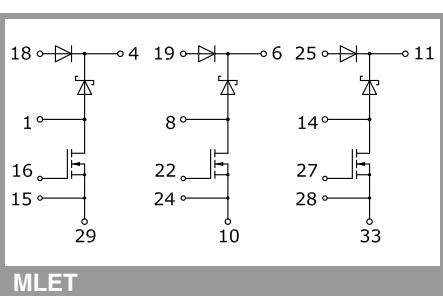
Tolerance system: ISO 2768-m



Suggested drilled hole diameter for terminal pins in the circuit board:  
 - refer Mounting Instruction SEMITOP® Classic

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SEMITOP 3 Press-Fit



This is an electrostatic discharge sensitive device (ESDS) due to international standard IEC 61340.

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