

### Description

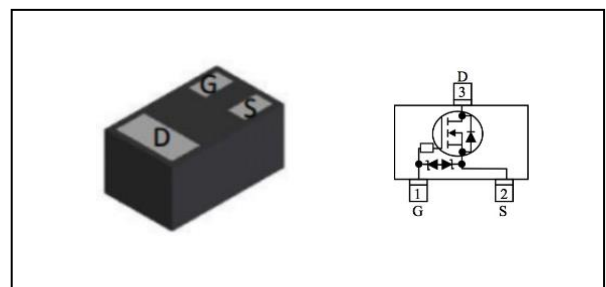
The HSBG2024 is the high cell density trenched N-ch MOSFETs, which provides excellent R<sub>DS(ON)</sub> and efficiency for most of the small power switching and load switch applications. The HSBG2024 meets the RoHS and Green Product requirement with full function reliability approved.

- Small Single Switch
- Load Switch
- ESD Protected Gate
- Low Gate Threshold Voltage

### Product Summary

V <sub>DS</sub>	20	V
R <sub>DS(ON),typ</sub>	190	mΩ
I <sub>D</sub>	1.4	A

### DFN1006 Pin Configuration



### Absolute Maximum Ratings

Symbol	Parameter	Rating	Units
V <sub>DS</sub>	Drain-Source Voltage	20	V
V <sub>GS</sub>	Gate-Source Voltage	±8	V
I <sub>D</sub> @T <sub>A</sub> =25°C	Continuous Drain Current, V <sub>GS</sub> @ 4.5V <sub>1</sub>	1.4	A
I <sub>D</sub> @T <sub>A</sub> =70°C	Continuous Drain Current, V <sub>GS</sub> @ 4.5V <sub>1</sub>	1.11	A
I <sub>DM</sub>	Pulsed Drain Current <sub>2</sub>	3.5	A
P <sub>D</sub> @T <sub>A</sub> =25°C	Total Power Dissipation <sub>3</sub>	0.7	W
T <sub>STG</sub>	Storage Temperature Range	-55 to 150	°C
T <sub>J</sub>	Operating Junction Temperature Range	-55 to 150	°C

### Thermal Data

Symbol	Parameter	Typ.	Max.	Unit
R <sub>θJA</sub>	Thermal Resistance Junction-ambient <sub>1</sub>	---	200	°C/W

**Electrical Characteristics (T<sub>J</sub>=25 °C, unless otherwise noted)**

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
BV <sub>DSS</sub>	Drain-Source Breakdown Voltage	V <sub>GS</sub> =0V, I <sub>D</sub> =250uA	20	---	---	V
R <sub>DS(ON)</sub>	Static Drain-Source On-Resistance <sup>2</sup>	V <sub>GS</sub> =4.5V, I <sub>D</sub> =550mA	---	190	230	mΩ
		V <sub>GS</sub> =2.5V, I <sub>D</sub> =450mA	---	234	305	
		V <sub>GS</sub> =1.8V, I <sub>D</sub> =350mA	---	303	455	
V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>GS</sub> =V <sub>DS</sub> , I <sub>D</sub> =250uA	0.5	---	1	V
I <sub>DSS</sub>	Drain-Source Leakage Current	V <sub>DS</sub> =16V, V <sub>GS</sub> =0V, T <sub>J</sub> =25°C	---	---	1	uA
		V <sub>DS</sub> =16V, V <sub>GS</sub> =0V, T <sub>J</sub> =55°C	---	---	5	
I <sub>GSS</sub>	Gate-Source Leakage Current	V <sub>GS</sub> =±8V, V <sub>DS</sub> =0V	---	---	±10	uA
g <sub>fs</sub>	Forward Transconductance	V <sub>DS</sub> =5V, I <sub>D</sub> =550mA	1	---	---	S
Q <sub>g</sub>	Total Gate Charge (4.5V)	V <sub>DS</sub> =10V, V <sub>GS</sub> =4.5V, I <sub>D</sub> =1000mA	---	1.2	---	nC
Q <sub>gs</sub>	Gate-Source Charge		---	2.1	---	
Q <sub>gd</sub>	Gate-Drain Charge		---	0.31	---	
T <sub>d(on)</sub>	Turn-On Delay Time	V <sub>DD</sub> =10V, V <sub>GS</sub> =4.5V, R <sub>G</sub> =6Ω, I <sub>D</sub> =500mA	---	1.2	---	ns
T <sub>r</sub>	Rise Time		---	24	---	
T <sub>d(off)</sub>	Turn-Off Delay Time		---	15	---	
T <sub>f</sub>	Fall Time		---	14	---	
C <sub>iss</sub>	Input Capacitance	V <sub>DS</sub> =10V, V <sub>GS</sub> =0V, f=1MHz	---	44	---	pF
C <sub>oss</sub>	Output Capacitance		---	9	---	
C <sub>rss</sub>	Reverse Transfer Capacitance		---	5	---	

**Diode Characteristics**

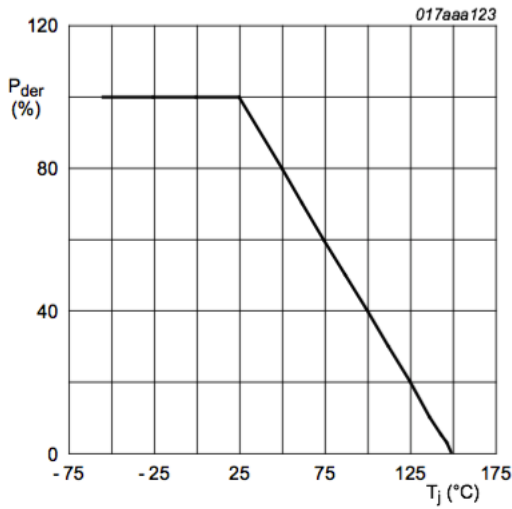
Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
I <sub>s</sub>	Continuous Source Current <sup>1,4</sup>	V <sub>G</sub> =V <sub>D</sub> =0V, Force Current	---	---	1.4	A
V <sub>SD</sub>	Diode Forward Voltage <sup>2</sup>	V <sub>GS</sub> =0V, I <sub>s</sub> =1A, T <sub>J</sub> =25°C	---	---	1.1	V

Note :

- 1.The data tested by surface mounted on a 1 inch<sup>2</sup> FR-4 board with 2OZ copper.
- 2.The data tested by pulsed, pulse width ≤ 300us, duty cycle ≤ 2%
- 3.The power dissipation is limited by 150°C junction temperature
- 4.The data is theoretically the same as I<sub>D</sub> and I<sub>DM</sub>, in real applications, should be limited by total power dissipation.

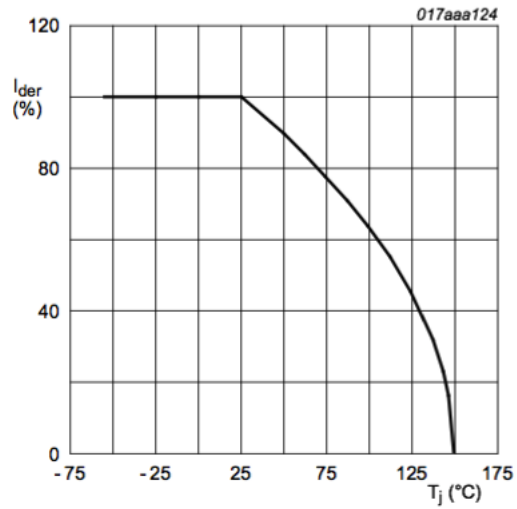


**Typical Characteristics**



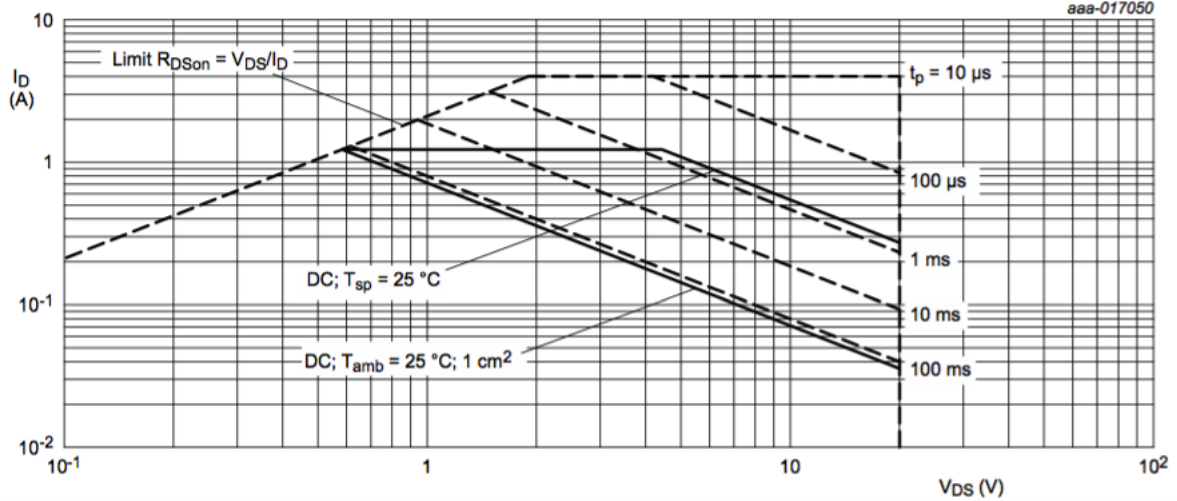
**Fig. 1. Normalized total power dissipation as a function of junction temperature**

$$P_{der} = \frac{P_{tot}}{P_{tot(25^{\circ}\text{C})}} \times 100 \%$$

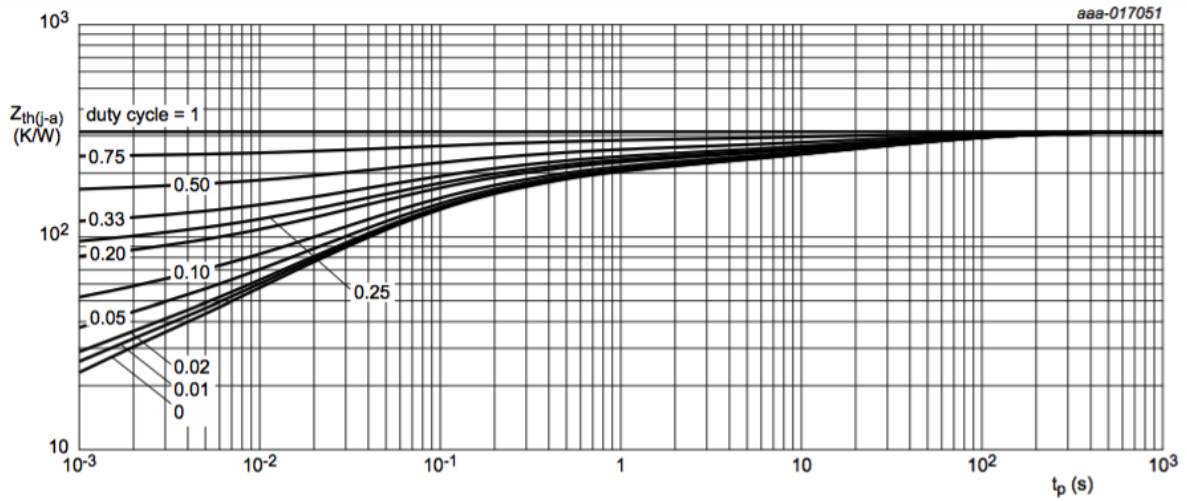


**Fig. 2. Normalized continuous drain current as a function of junction temperature**

$$I_{der} = \frac{I_D}{I_{D(25^{\circ}\text{C})}} \times 100 \%$$

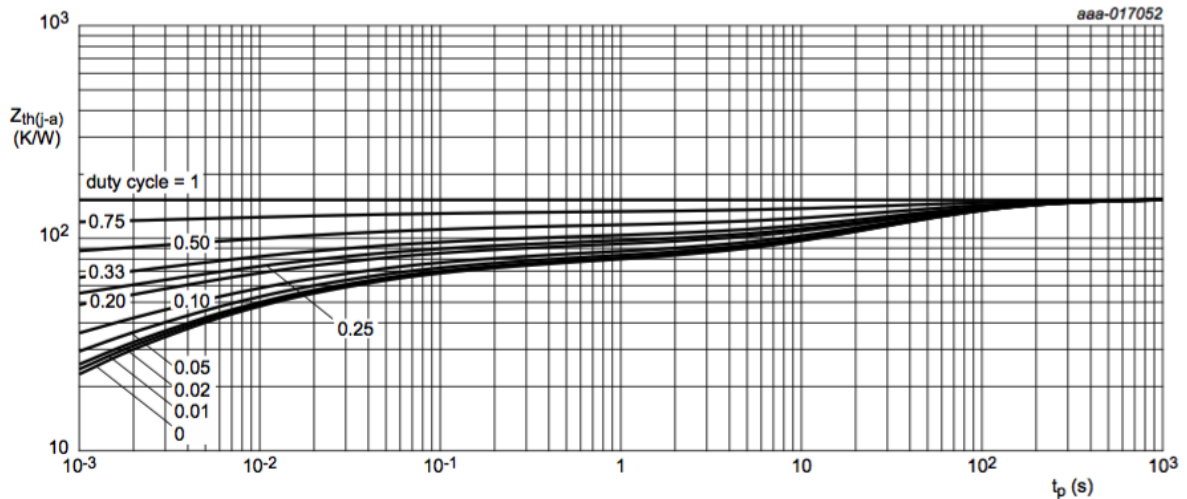


**Fig. 3. Safe operating area; junction to ambient; continuous and peak drain currents as a function of drain-source voltage**



FR4 PCB, standard footprint

Fig. 4. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values



FR4 PCB, mounting pad for drain = 1 cm<sup>2</sup>

Fig. 5. Transient thermal impedance from junction to ambient as a function of pulse duration; typical values

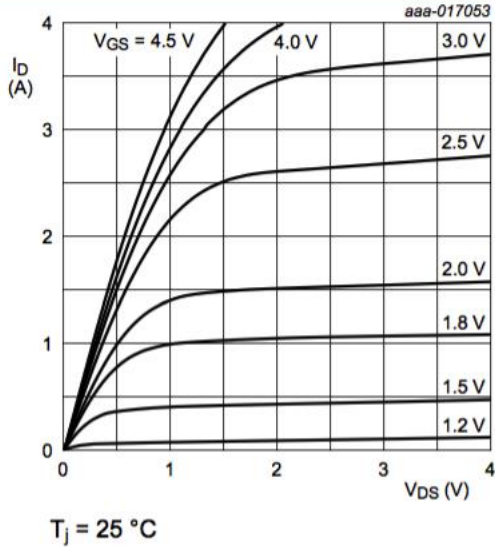


Fig. 6. Output characteristics: drain current as a function of drain-source voltage; typical values

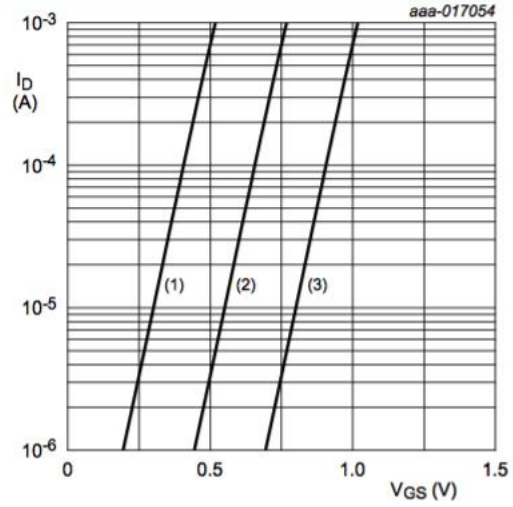


Fig. 7. Sub-threshold drain current as a function of gate-source voltage

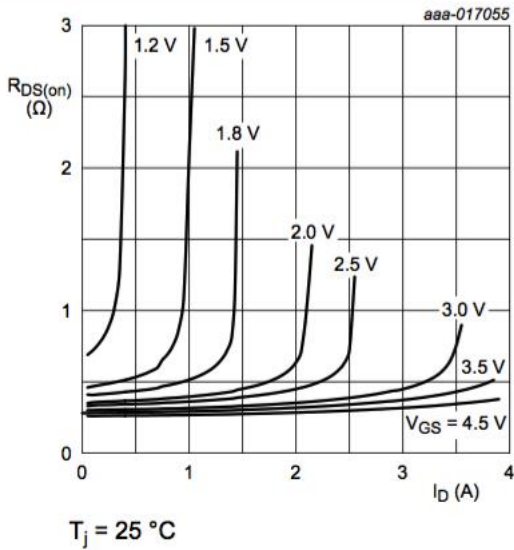


Fig. 8. Drain-source on-state resistance as a function of drain current; typical values

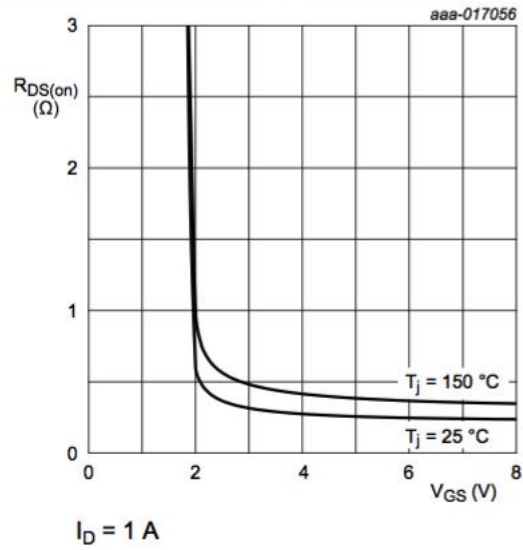
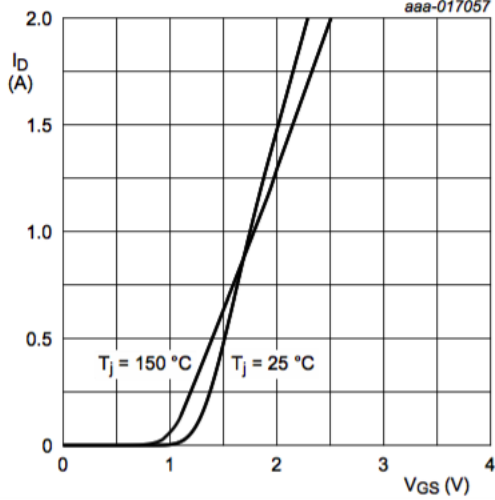
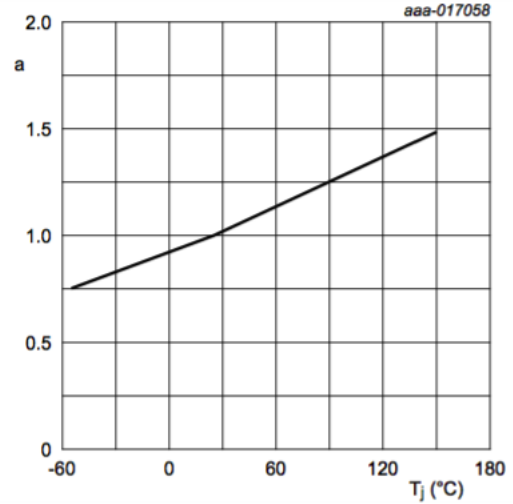


Fig. 9. Drain-source on-state resistance as a function of gate-source voltage; typical values

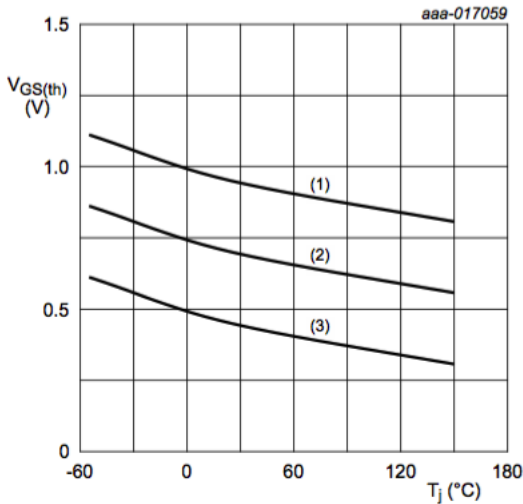


**Fig. 10. Transfer characteristics: drain current as a function of gate-source voltage; typical values**



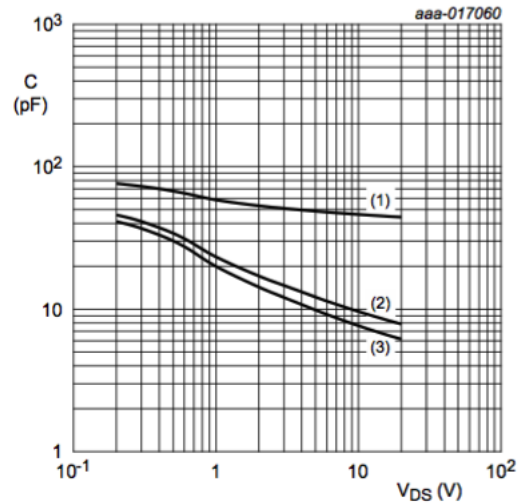
**Fig. 11. Normalized drain-source on-state resistance as a function of ambient temperature; typical values**

$$a = \frac{R_{DSon}}{R_{DSon(25^{\circ}C)}}$$



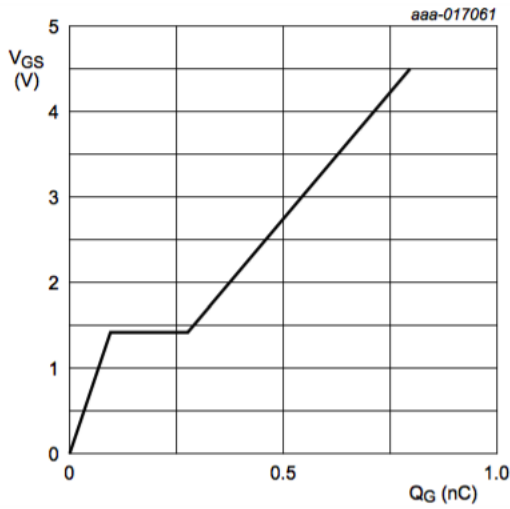
$I_D = 250 \mu A$ ;  $V_{DS} = V_{GS}$   
 (1) maximum values  
 (2) typical values  
 (3) minimum values

**Fig. 12. Gate-source threshold voltage as a function of ambient temperature**



$f = 1 \text{ MHz}$ ;  $V_{GS} = 0 \text{ V}$   
 (1)  $C_{iss}$   
 (2)  $C_{oss}$   
 (3)  $C_{rss}$

**Fig. 13. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values**



$V_{DS} = 10\text{ V}; I_D = 0.5\text{ A}$   
 $T_{amb} = 25\text{ }^\circ\text{C}$

Fig. 14. Gate-source voltage as a function of gate charge; typical values

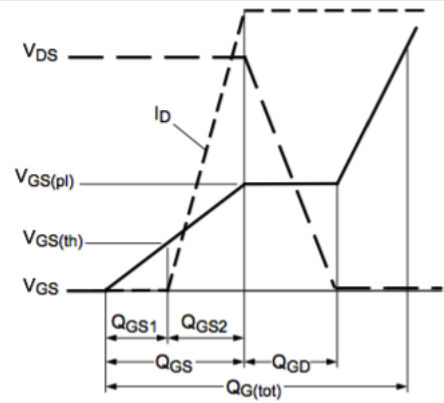
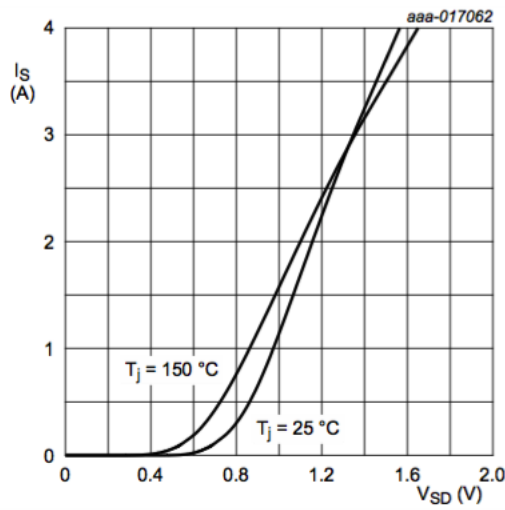


Fig. 15. Gate charge waveform definitions

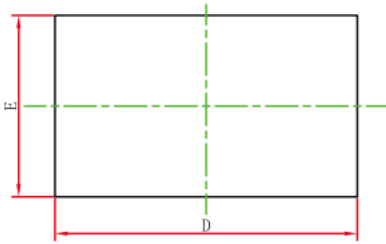


$V_{GS} = 0\text{ V}$

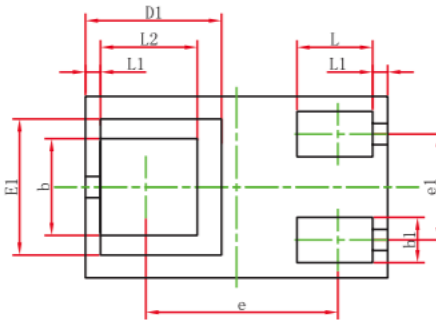
Fig. 16. Source current as a function of source-drain voltage; typical values

## Ordering Information

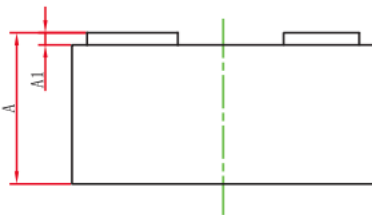
Part Number	Package code	Packaging
HSBG2024	DFN1006-3	10000/Tape&Reel



TOP VIEW



BOTTOM VIEW



SIDE VIEW

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	0.450	0.550	0.018	0.022
A1	0.010	0.100	0.000	0.004
D	0.950	1.050	0.037	0.041
E	0.550	0.650	0.022	0.026
D1	0.450REF.		0.018REF.	
E1	0.450REF.		0.018REF.	
b	0.270	0.370	0.011	0.015
b1	0.100	0.200	0.004	0.008
e	0.635REF.		0.025REF.	
e1	0.300	0.400	0.012	0.016
L	0.200	0.300	0.008	0.012
L1	0.050REF.		0.002REF.	
L2	0.270	0.370	0.011	0.015