

**Description**

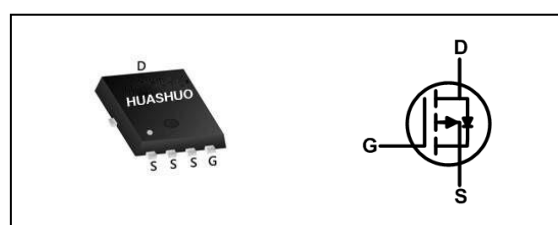
The HSBB4113 is the high cell density trenched P-ch MOSFETs, which provide excellent RDSON and gate charge for most of the synchronous buck converter applications.

The HSBB4113 meet the RoHS and Green Product requirement, 100% EAS guaranteed with full function reliability approved.

- 100% EAS Guaranteed
- Green Device Available
- Super Low Gate Charge
- Excellent CdV/dt effect decline
- Advanced high cell density Trench technology

**Product Summary**

|                         |     |    |
|-------------------------|-----|----|
| V <sub>DS</sub>         | -40 | V  |
| R <sub>DS(ON),max</sub> | 40  | mΩ |
| I <sub>D</sub>          | -15 | A  |

**PRPAK3\*3 Pin Configuration**

**Absolute Maximum Ratings**

| Symbol                                | Parameter  | Rating     | Units |
|---------------------------------------|--|------------|-------|
| V <sub>DS</sub>                       | Drain-Source Voltage   | -40        | V     |
| V <sub>GS</sub>                       | Gate-Source Voltage  | ±20        | V     |
| I <sub>D</sub> @T <sub>C</sub> =25°C  | Continuous Drain Current, -V <sub>GS</sub> @ -10V <sup>1</sup> | -15        | A     |
| I <sub>D</sub> @T <sub>C</sub> =100°C | Continuous Drain Current, -V <sub>GS</sub> @ -10V <sup>1</sup> | -10        | A     |
| I <sub>DM</sub>                       | Pulsed Drain Current <sup>2</sup>                              | -46        | A     |
| EAS                                   | Single Pulse Avalanche Energy <sup>3</sup>                     | 37         | mJ    |
| I <sub>AS</sub>                       | Avalanche Current  | -27.2      | A     |
| P <sub>D</sub> @T <sub>C</sub> =25°C  | Total Power Dissipation <sup>4</sup>                           | 32         | 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 <sup>1</sup> | ---  | 62   | °C/W |
| R <sub>θJC</sub> | Thermal Resistance Junction-Case <sup>1</sup>    | ---  | 4    | °C/W |

**P-Channel Electrical Characteristics ( $T_J=25\text{ }^\circ\text{C}$ , unless otherwise noted)**

| Symbol                       | Parameter                                      | Conditions  | Min. | Typ.   | Max.      | Unit                       |
|------------------------------|--|---|------|--------|-----------|----------------------------|
| $BV_{DSS}$                   | Drain-Source Breakdown Voltage                 | $V_{GS}=0V, I_D=-250\mu A$                          | -40  | ---    | ---       | V                          |
| $\Delta BV_{DSS}/\Delta T_J$ | $BV_{DSS}$ Temperature Coefficient             | Reference to $25^\circ\text{C}$ , $I_D=-1\text{mA}$ | ---  | -0.012 | ---       | $V/^\circ\text{C}$         |
| $R_{DS(ON)}$                 | Static Drain-Source On-Resistance <sup>2</sup> | $V_{GS}=-10V, I_D=-12A$                             | ---  | ---    | 40        | m $\Omega$                 |
|                              |  | $V_{GS}=-4.5V, I_D=-10A$                            | ---  | ---    | 65        |                            |
| $V_{GS(th)}$                 | Gate Threshold Voltage                         | $V_{GS}=V_{DS}, I_D=-250\mu A$                      | -1.0 | ---    | -2.5      | V                          |
| $\Delta V_{GS(th)}$          | $V_{GS(th)}$ Temperature Coefficient           |   | ---  | 4.32   | ---       | $\text{mV}/^\circ\text{C}$ |
| $I_{DSS}$                    | Drain-Source Leakage Current                   | $V_{DS}=-32V, V_{GS}=0V, T_J=25^\circ\text{C}$      | ---  | ---    | 1         | $\mu\text{A}$              |
|                              |  | $V_{DS}=-32V, V_{GS}=0V, T_J=55^\circ\text{C}$      | ---  | ---    | 5         |                            |
| $I_{GSS}$                    | Gate-Source Leakage Current                    | $V_{GS}=\pm 20V, V_{DS}=0V$                         | ---  | ---    | $\pm 100$ | nA                         |
| $g_{fs}$                     | Forward Transconductance                       | $V_{DS}=-5V, I_D=-12A$                              | ---  | 15     | ---       | S                          |
| $R_g$                        | Gate Resistance                                | $V_{DS}=0V, V_{GS}=0V, f=1\text{MHz}$               | ---  | 13     | ---       | $\Omega$                   |
| $Q_g$                        | Total Gate Charge (-4.5V)                      | $V_{DS}=-20V, V_{GS}=-4.5V, I_D=-6A$                | ---  | 9      | ---       | nC                         |
| $Q_{gs}$                     | Gate-Source Charge                             |   | ---  | 2.54   | ---       |                            |
| $Q_{gd}$                     | Gate-Drain Charge                              |   | ---  | 3.1    | ---       |                            |
| $T_{d(on)}$                  | Turn-On Delay Time                             | $V_{DD}=-15V, V_{GS}=-10V, R_G=3.3\Omega, I_D=-1A$  | ---  | 19.2   | ---       | ns                         |
| $T_r$                        | Rise Time                                      |   | ---  | 12.8   | ---       |                            |
| $T_{d(off)}$                 | Turn-Off Delay Time                            |   | ---  | 48.6   | ---       |                            |
| $T_f$                        | Fall Time                                      |   | ---  | 4.6    | ---       |                            |
| $C_{iss}$                    | Input Capacitance                              | $V_{DS}=-15V, V_{GS}=0V, f=1\text{MHz}$             | ---  | 1004   | ---       | pF                         |
| $C_{oss}$                    | Output Capacitance                             |   | ---  | 108    | ---       |                            |
| $C_{rss}$                    | Reverse Transfer Capacitance                   |   | ---  | 80     | ---       |                            |

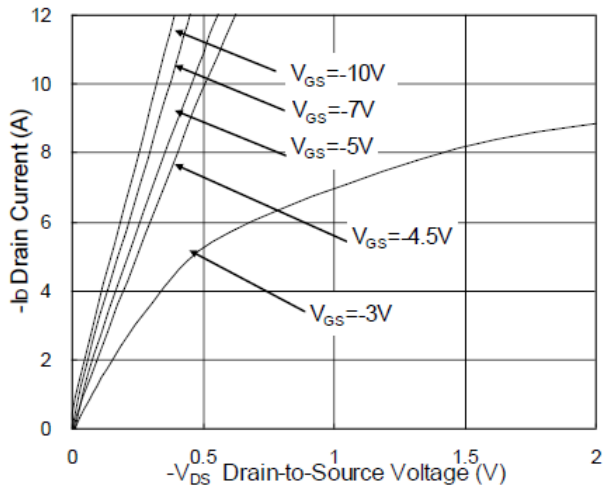
**Diode Characteristics**

| Symbol   | Parameter                                | Conditions                                 | Min. | Typ. | Max. | Unit |
|----------|--|--|------|------|------|------|
| $I_S$    | Continuous Source Current <sup>1,5</sup> | $V_G=V_D=0V$ , Force Current               | ---  | ---  | -10  | A    |
| $V_{SD}$ | Diode Forward Voltage <sup>2</sup>       | $V_{GS}=0V, I_S=-1A, T_J=25^\circ\text{C}$ | ---  | ---  | -1   | V    |

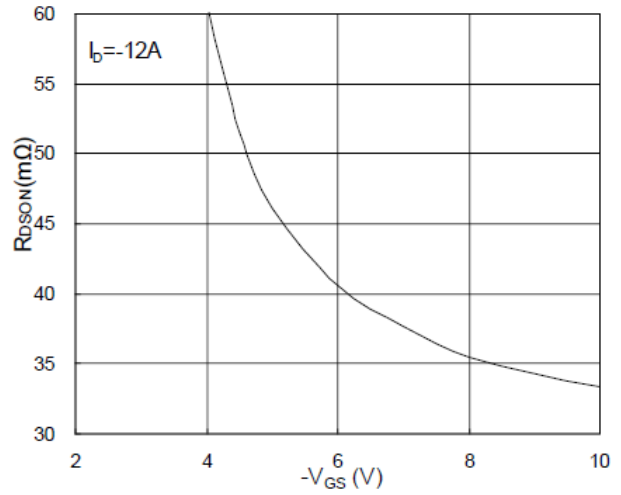
Note :

- 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  $\leq 300\mu\text{s}$  , duty cycle  $\leq 2\%$
- 3.The EAS data shows Max. rating . The test condition is  $V_{DD}=-25V, V_{GS}=-10V, L=0.1\text{mH}, I_{AS}=-27.2A$
- 4.The power dissipation is limited by  $150^\circ\text{C}$  junction temperature
- 5.The data is theoretically the same as  $I_D$  and  $I_{DM}$  , in real applications , should be limited by total power dissipation.

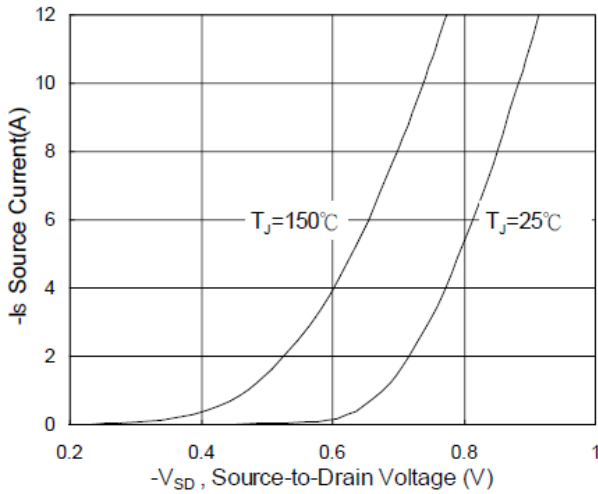
**P-Channel Typical Characteristics**



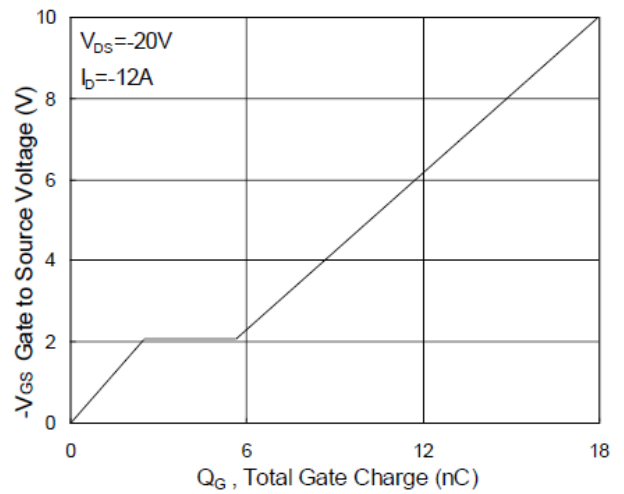
**Fig.1 Typical Output Characteristics**



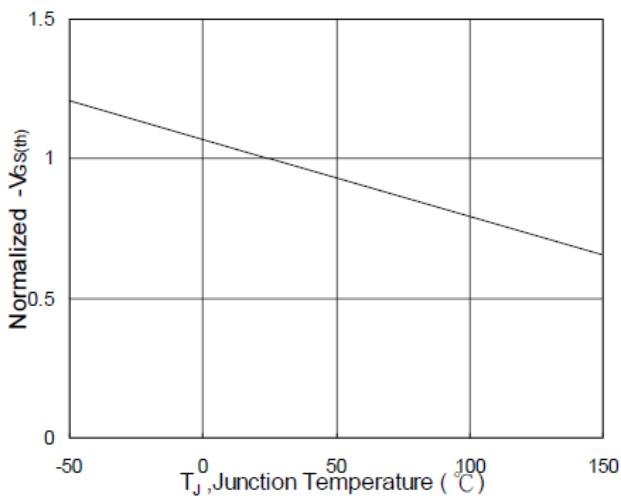
**Fig.2 On-Resistance v.s Gate-Source**



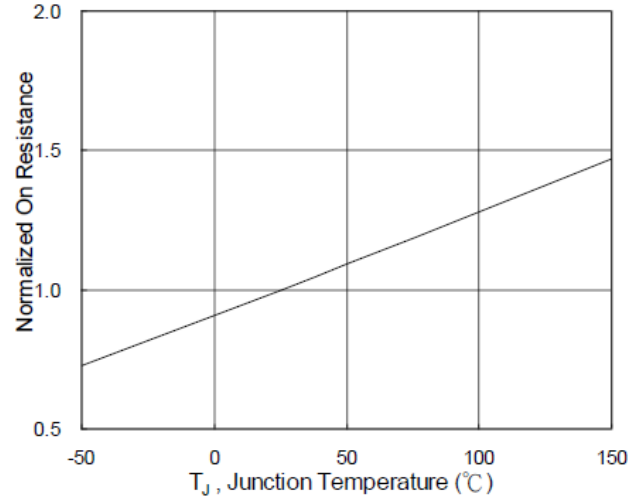
**Fig.3 Forward Characteristics of Reverse**



**Fig.4 Gate-Charge Characteristics**



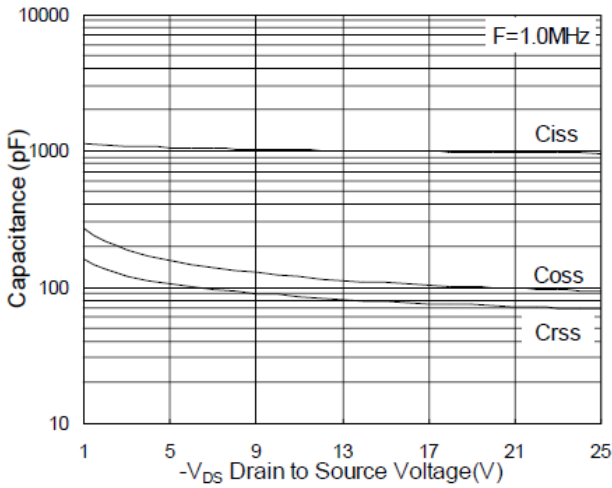
**Fig.5 Normalized  $V_{GS(th)}$  v.s  $T_J$**



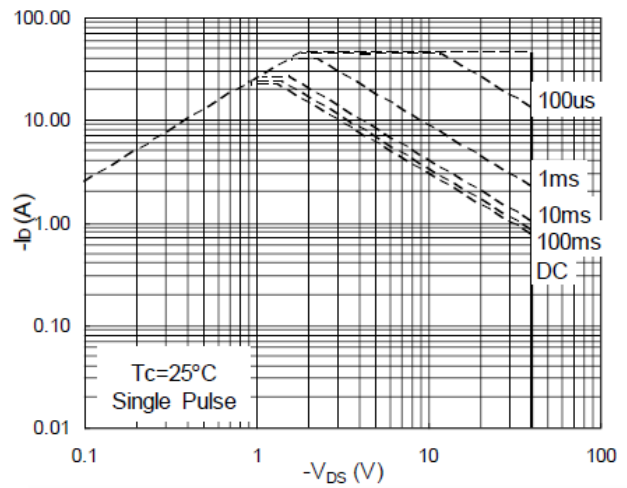
**Fig.6 Normalized  $R_{DS(on)}$  v.s  $T_J$**



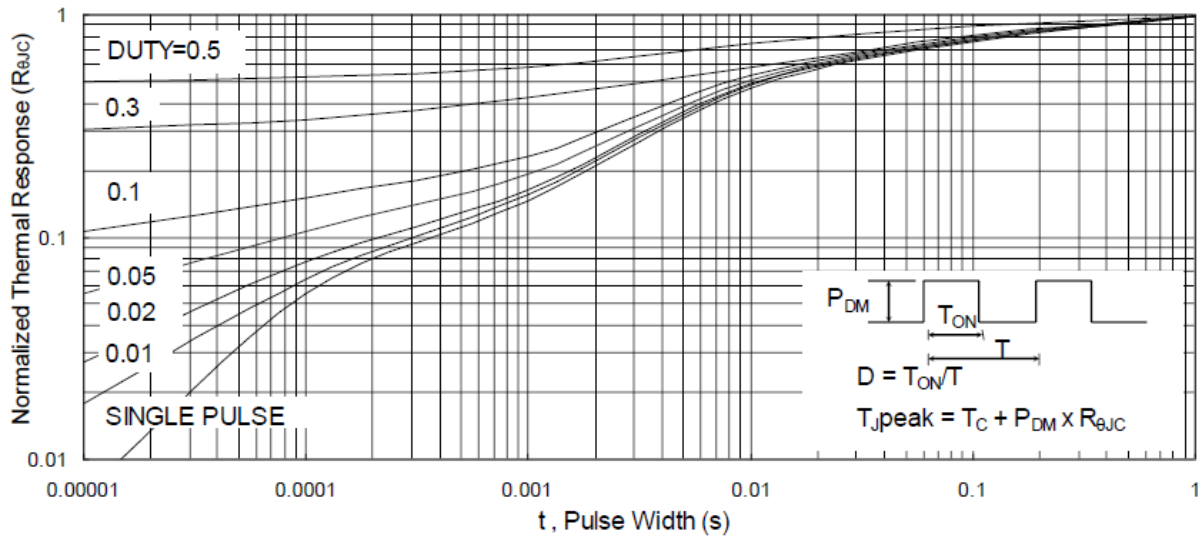
**P-Ch 40V Fast Switching MOSFETs**



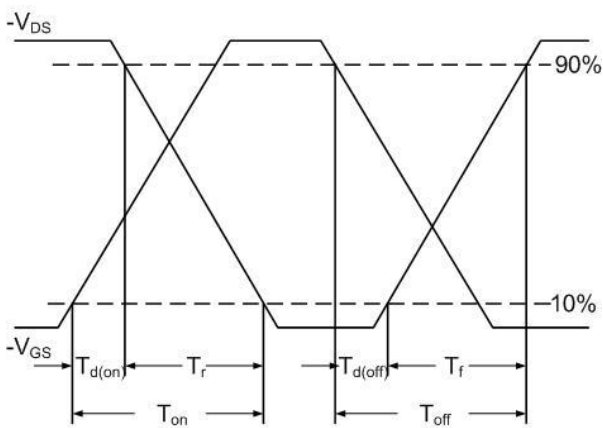
**Fig.7 Capacitance**



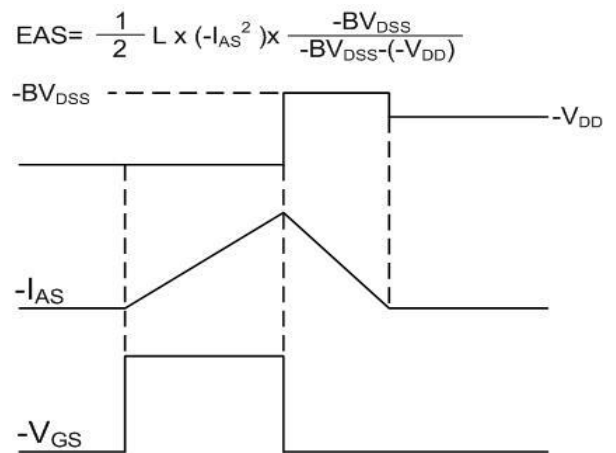
**Fig.8 Safe Operating Area**



**Fig.9 Normalized Maximum Transient Thermal Impedance**



**Fig.10 Switching Time Waveform**

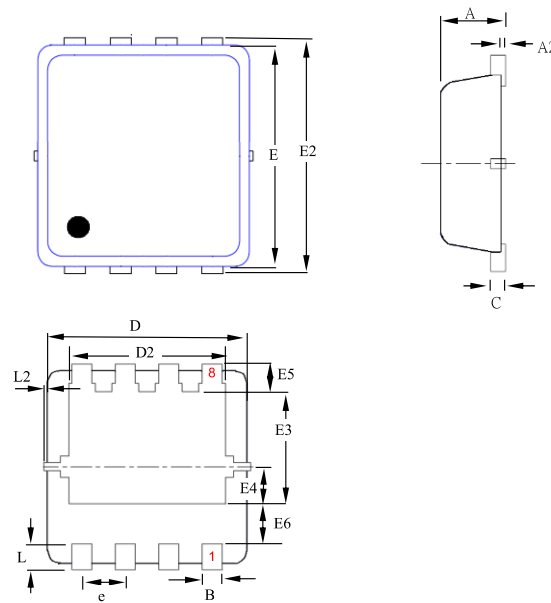


**Fig.11 Unclamped Inductive Waveform**

## Ordering Information

| Part Number | Package code | Packaging      |
|-------------|--------------|----------------|
| HSBB4113    | PRPAK3*3     | 3000/Tape&Reel |

**PRPAK 3\*3(E) Single Outline**



| SYMBOLS | MILLIMETERS |      |      | INCHES |       |       |
|---------|-------------|------|------|--------|-------|-------|
|         | MIN         | NOM  | MAX  | MIN    | NOM   | MAX   |
| A       | 0.70        | 0.80 | 0.90 | 0.028  | 0.031 | 0.035 |
| A2      | 0.00        | —    | 0.05 | 0.000  | —     | 0.002 |
| B       | 0.24        | 0.30 | 0.35 | 0.009  | 0.012 | 0.014 |
| C       | 0.10        | 0.15 | 0.25 | 0.004  | 0.006 | 0.010 |
| D       | 2.90        | 3.00 | 3.20 | 0.114  | 0.118 | 0.126 |
| D2      | 2.15        | 2.35 | 2.59 | 0.085  | 0.093 | 0.102 |
| E       | 2.90        | 3.00 | 3.12 | 0.114  | 0.118 | 0.123 |
| E2      | 3.05        | 3.20 | 3.45 | 0.120  | 0.126 | 0.136 |
| E3      | 1.55        | 1.75 | 1.95 | 0.061  | 0.069 | 0.077 |
| E4      | 0.48        | 0.58 | 0.68 | 0.019  | 0.023 | 0.027 |
| E5      | 0.28        | 0.43 | 0.58 | 0.011  | 0.017 | 0.023 |
| E6      | 0.43        | 0.63 | 0.87 | 0.017  | 0.025 | 0.034 |
| L       | 0.30        | 0.40 | 0.50 | 0.012  | 0.016 | 0.020 |
| L2      | 0.00        | —    | 0.10 | 0.000  | —     | 0.004 |
| e       | —           | 0.65 | —    | —      | 0.026 | —     |