

# ASC800N1200HPDL

1200V, 800A, 2.0mΩ, Six-pack (Three-phase), Silicon Carbide MOSFET Module

Product Data Sheet

ASTC-3T03-93A A/0



## General Description

The AST-HPD module incorporates AST's 1200V Gen3 N-channel SiC MOSFET. NTC temperature sensor inside.

## Features

- High Temperature, Humidity, and Bias Operation
- Ultra Low Loss <10nH
- High-Frequency Operation
- Zero Turn-off Tail Current from MOSFET
- Normally-off, Fail-safe Device Operation
- Copper Baseplate and Silicon Nitride Insulator

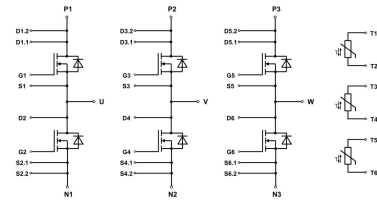
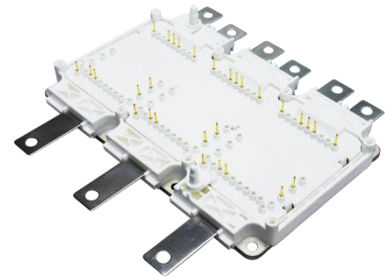
## Benefits

- Enables Compact, Lightweight, Efficient Systems
- Harsh Outdoor Environment Installation
- Mitigates Over-Voltage Protection
- Reduced Thermal Requirements and System Cost

## Applications

- New Energy Vehicle Main Drive Inverter
- Aviation Controller
- Industrial Controller

## Key Parameters



## Ordering Informations

|                        |                 |
|------------------------|-----------------|
| Order Number / Marking | ASC800N1200HPDL |
| Package Type           | HPDL            |

| Symbol                  | Parameter                         | Values |      |      | Unit | Test Conditions                                                                                                                |
|-------------------------|-----------------------------------|--------|------|------|------|--------------------------------------------------------------------------------------------------------------------------------|
| Absolute maximum rating |                                   |        |      |      |      |                                                                                                                                |
| V <sub>DS</sub>         | Drain-Source Voltage              | 1200   |      |      | V    | T <sub>C</sub> =25°C                                                                                                           |
| I <sub>D</sub>          | Drain Current (Continuous)        | 800    |      |      | A    | T <sub>C</sub> =25°C                                                                                                           |
| T <sub>J</sub>          | Junction Temperature              | 175    |      |      | °C   |                                                                                                                                |
| Symbol                  | Parameter                         | Min.   | Typ. | Max. | Unit | Test Conditions                                                                                                                |
| Static characteristics  |                                   |        |      |      |      |                                                                                                                                |
| R <sub>DS(on)</sub>     | Static Drain-Source On Resistance | -      | 2.0  | 2.7  | mΩ   | V <sub>GS</sub> =18V; I <sub>D</sub> =400A; T <sub>C</sub> =25°C                                                               |
| Dynamic characteristics |                                   |        |      |      |      |                                                                                                                                |
| Q <sub>G</sub>          | Total Gate Charge                 | -      | 1904 | -    | nC   | V <sub>DD</sub> =800V; V <sub>GS</sub> =-5/+18V; I <sub>D</sub> =400A; T <sub>C</sub> =25°C                                    |
| Q <sub>GD</sub>         | Gate-Drain Charge                 | -      | 626  | -    |      |                                                                                                                                |
| Source-drain diode      |                                   |        |      |      |      |                                                                                                                                |
| Q <sub>RR</sub>         | Reverse Recovery Charge           | -      | 2100 | -    | nC   | V <sub>GS</sub> =-5/+18V; I <sub>F</sub> =400A; V <sub>R</sub> =800V; Load=50μH; R <sub>G(off)</sub> =5Ω; T <sub>J</sub> =25°C |

## Absolute Maximum Ratings (at $T_c=25^{\circ}\text{C}$ unless otherwise specified)

| Symbol            | Parameter                                                            | Value       | Unit                        |
|-------------------|----------------------------------------------------------------------|-------------|-----------------------------|
| $V_{DS}$          | Drain-Source Voltage                                                 | 1200        | V                           |
| $V_{GS}$          | Gate-Source Voltage (Dynamic)                                        | -10/+22     | V                           |
| $I_D$             | Drain Current (Continuous)                                           | 800         | A                           |
| $I_{DM}$          | Drain Current (Pulsed)                                               | 1600        | A                           |
| $T_{op}, T_{stg}$ | Operating and Storage Temperature Range                              | -40 to +175 | $^{\circ}\text{C}$          |
| $T_J$             | Junction Temperature                                                 | 175         | $^{\circ}\text{C}$          |
| $L_{Stray}$       | Stray Inductance                                                     | 8.5         | nH                          |
| $V_{isol}$        | Isolation Test Voltage (DC; 2mA; t=10s)                              | 4.2         | kV                          |
| $R_{thJC}$        | Thermal Resistance, Junction to Cooling Fluid                        | 0.085       | $^{\circ}\text{C}/\text{W}$ |
| M                 | Mounting Torque for Module Mounting (Screw M4 Baseplate to Heatsink) | 2.0         | Nm                          |

## MOSFET Characteristics

| Symbol                                                                                             | Parameter                         | Min. | Typ. | Max. | Unit             | Test Conditions                                                                                               |
|----------------------------------------------------------------------------------------------------|-----------------------------------|------|------|------|------------------|---------------------------------------------------------------------------------------------------------------|
| <b>Static characteristics (at <math>T_c=25^{\circ}\text{C}</math> unless otherwise specified)</b>  |                                   |      |      |      |                  |                                                                                                               |
| $BV_{DS}$                                                                                          | Drain-Source Breakdown Voltage    | 1200 | -    | -    | V                | $V_{GS}=0\text{V}$                                                                                            |
| $I_{DSS}$                                                                                          | Zero Gate Voltage Drain Current   | -    | -    | 400  | $\mu\text{A}$    | $V_{DS}=1200\text{V}; V_{GS}=0\text{V}$                                                                       |
| $I_{GSS}$                                                                                          | Gate-Body Leakage Current         | -    | -    | 4.0  | $\mu\text{A}$    | $V_{GS}=-10/+20\text{V}; V_{DS}=0\text{V}$                                                                    |
| $V_{GS(th)}$                                                                                       | Gate Threshold Voltage            | 2.0  | -    | 4.0  | V                | $V_{DS}=V_{GS}; I_D=80\text{mA}$                                                                              |
| $R_{DS(on)}$                                                                                       | Static Drain-Source On Resistance | -    | 2.0  | 2.7  | $\text{m}\Omega$ | $V_{GS}=18\text{V}; I_D=400\text{A}$                                                                          |
| $V_{GS(on)}$                                                                                       | Recommended Turn-on Voltage       | -    | 18   | -    | V                | Static                                                                                                        |
| $V_{GS(off)}$                                                                                      | Recommended Turn-off Voltage      | -    | -5   | -    | V                |                                                                                                               |
| $R_G$                                                                                              | Gate Resistance                   | -    | 0.27 | -    | $\Omega$         | $V_{AC}=25\text{mV}; f=1\text{MHz}$                                                                           |
| <b>Dynamic characteristics (at <math>T_c=25^{\circ}\text{C}</math> unless otherwise specified)</b> |                                   |      |      |      |                  |                                                                                                               |
| $C_{iss}$                                                                                          | Input Capacitance                 | -    | 55.0 | -    | nF               | $V_{DS}=1000\text{V}; f=100\text{kHz}; V_{AC}=25\text{mV}$                                                    |
| $C_{oss}$                                                                                          | Output Capacitance                | -    | 2.3  | -    |                  |                                                                                                               |
| $C_{rss}$                                                                                          | Reverse Transfer Capacitance      | -    | 104  | -    | pF               |                                                                                                               |
| $E_{on}$                                                                                           | Turn-on Switching Energy          | -    | 25.3 | -    | mJ               | $V_{DD}=800\text{V}; V_{GS}=-5/+18\text{V}; I_D=400\text{A}; R_{G(ext)}=5.0\Omega; \text{Load}=50\mu\text{H}$ |
| $E_{off}$                                                                                          | Turn-off Switching Energy         | -    | 20.1 | -    |                  |                                                                                                               |
| $Q_{GS}$                                                                                           | Gate-Source Charge                | -    | 613  | -    | nC               | $V_{DD}=800\text{V}; V_{GS}=-5/+18\text{V}; I_D=400\text{A}$                                                  |
| $Q_{GD}$                                                                                           | Gate-Drain Charge                 | -    | 626  | -    |                  |                                                                                                               |
| $Q_G$                                                                                              | Total Gate Charge                 | -    | 1904 | -    |                  |                                                                                                               |
| $t_{d(on)}$                                                                                        | Turn-on Delay Time                | -    | 138  | -    | ns               | $V_{DD}=800\text{V}; V_{GS}=-5/+18\text{V}; I_D=400\text{A}; R_{G(ext)}=5.0\Omega; \text{Load}=50\mu\text{H}$ |
| $t_r$                                                                                              | Rise Time                         | -    | 118  | -    |                  |                                                                                                               |
| $t_{d(off)}$                                                                                       | Turn-off Delay Time               | -    | 492  | -    |                  |                                                                                                               |
| $t_f$                                                                                              | Fall Time                         | -    | 78   | -    |                  |                                                                                                               |

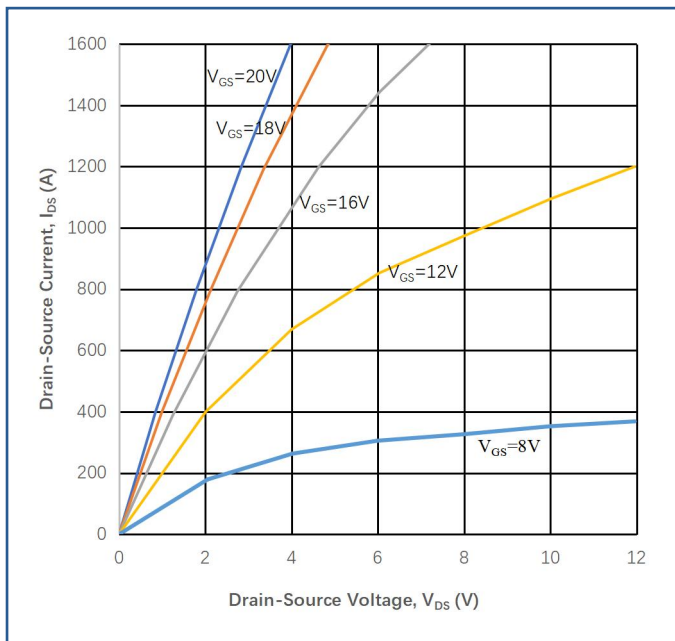
## Body Diode Characteristics (at $T_J=25^{\circ}\text{C}$ unless otherwise specified)

| Symbol           | Parameter                        | Min. | Typ. | Max. | Unit | Test Conditions                                                                                                                           |
|------------------|----------------------------------|------|------|------|------|-------------------------------------------------------------------------------------------------------------------------------------------|
| $V_{\text{FSD}}$ | Forward Voltage                  | -    | -    | 6    | V    | $V_{\text{GS}}=0\text{V}; I_{\text{F}}=400\text{A}$                                                                                       |
| $I_{\text{S}}$   | Continuous Diode Forward Current | -    | 400  | -    | A    | $V_{\text{GS}}=0\text{V}; T_{\text{C}}=25^{\circ}\text{C}$                                                                                |
| $t_{\text{RR}}$  | Reverse Recovery Time            | -    | 71   | -    | ns   | $V_{\text{GS}}=-5/+18\text{V}; I_{\text{F}}=400\text{A}; V_{\text{R}}=800\text{V}; R_{\text{G(off)}}=5\Omega; \text{Load}=100\mu\text{H}$ |
| $Q_{\text{RR}}$  | Reverse Recovery Charge          | -    | 2100 | -    | nC   |                                                                                                                                           |
| $I_{\text{RRM}}$ | Peak Reverse Recovery Current    | -    | 120  | -    | A    |                                                                                                                                           |

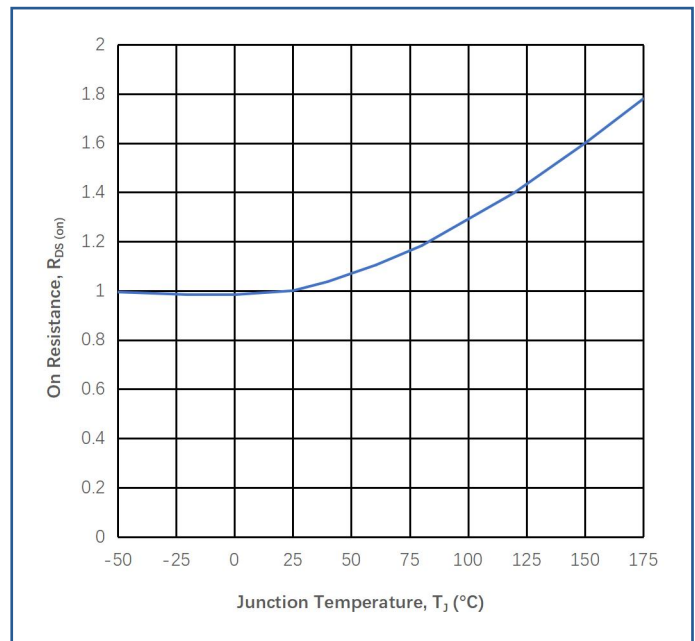
## NTC Thermistor Characteristics

| Symbol       | Parameter                                                    | Min. | Typ. | Max. | Unit       | Test Conditions                                           |
|--------------|--------------------------------------------------------------|------|------|------|------------|-----------------------------------------------------------|
| $R_{25}$     | Rated Resistance                                             | -    | 5.00 | -    | k $\Omega$ | $T_{\text{NTC}}=25^{\circ}\text{C}$                       |
| $\Delta R/R$ | Deviation of $R_{100}$                                       | -5   | -    | 5    | %          | $T_{\text{NTC}}=100^{\circ}\text{C}; R_{100}=493.3\Omega$ |
| $B_{25/50}$  | Beta Value for $25^{\circ}\text{C}$ to $50^{\circ}\text{C}$  | -    | 3375 | -    | K          | $R_2=R_{25}\exp[B_{25/50}(1/T_2-1/(298.15\text{K}))]$     |
| $B_{25/80}$  | Beta Value for $25^{\circ}\text{C}$ to $80^{\circ}\text{C}$  | -    | 3414 | -    | K          | $R_2=R_{25}\exp[B_{25/80}(1/T_2-1/(298.15\text{K}))]$     |
| $B_{25/100}$ | Beta Value for $25^{\circ}\text{C}$ to $100^{\circ}\text{C}$ | -    | 3436 | -    | K          | $R_2=R_{25}\exp[B_{25/100}(1/T_2-1/(298.15\text{K}))]$    |

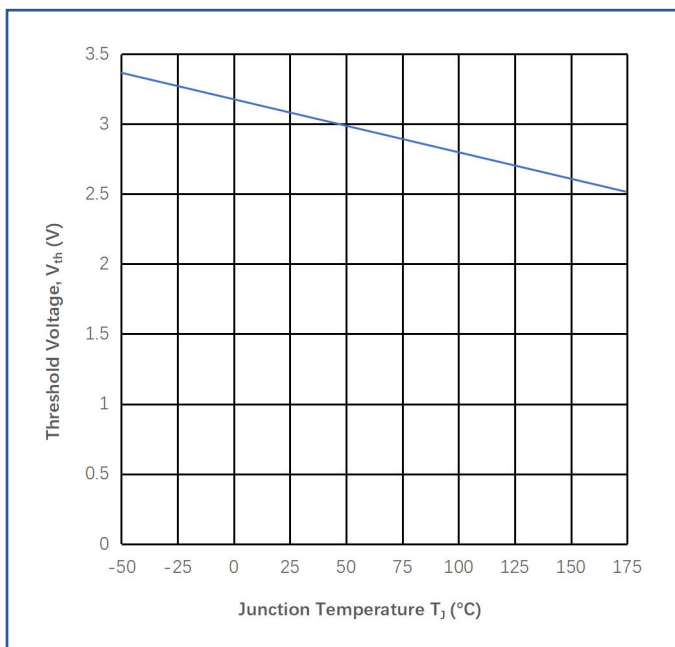
## Typical Performance



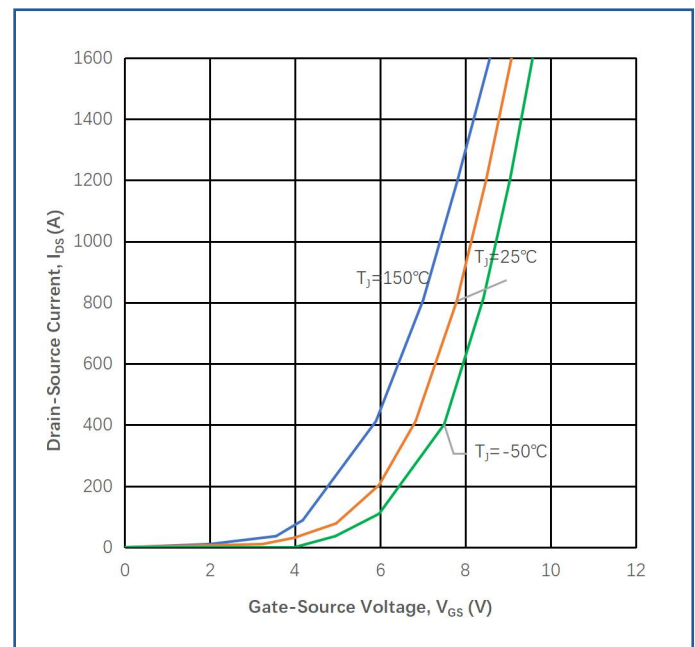
**Figure 1**  
Output Characteristics ( $T_J = 25^\circ\text{C}$ )



**Figure 2**  
Normalized On-resistance vs. Temperature

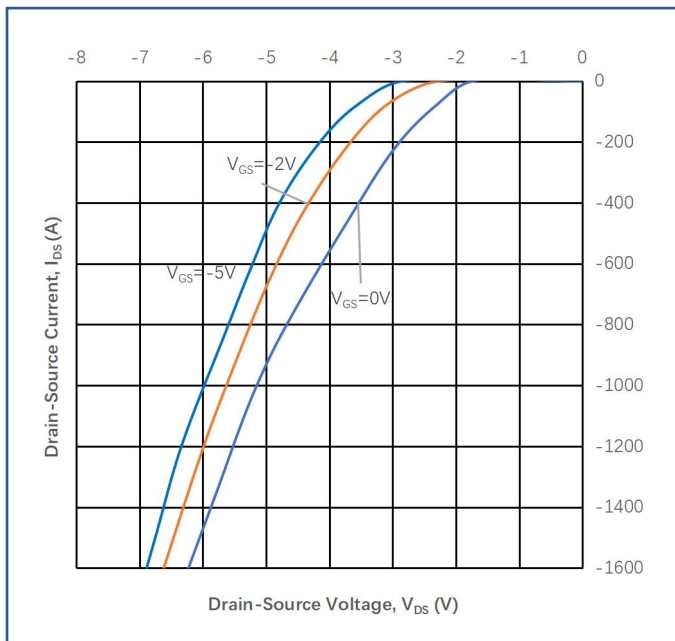


**Figure 3**  
Threshold Voltage vs. Temperature

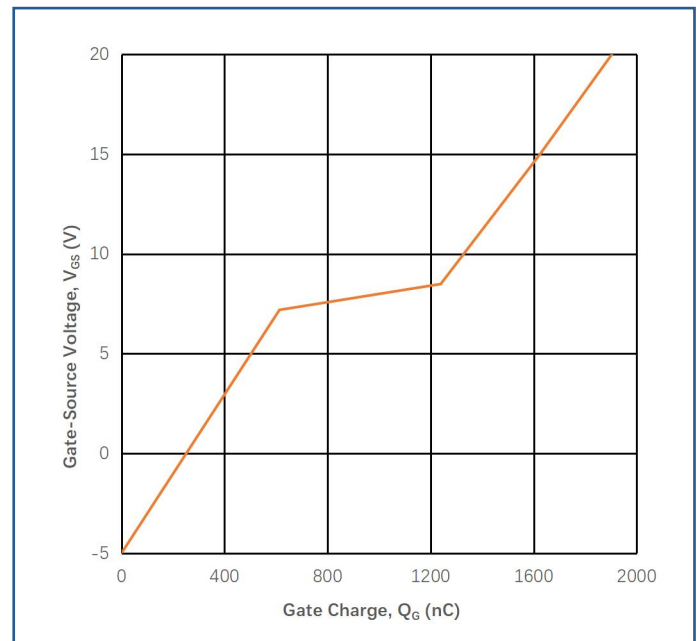


**Figure 4**  
Transfer Characteristic for Various  $T_J$

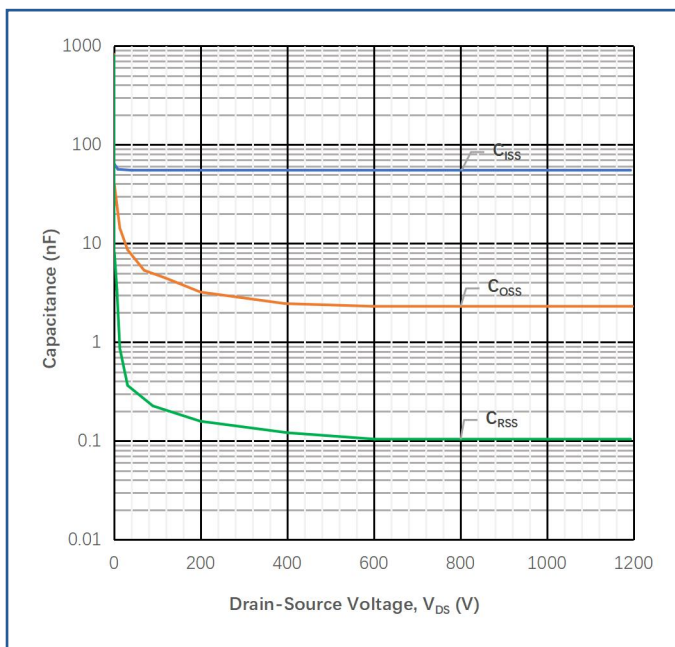
## Typical Performance



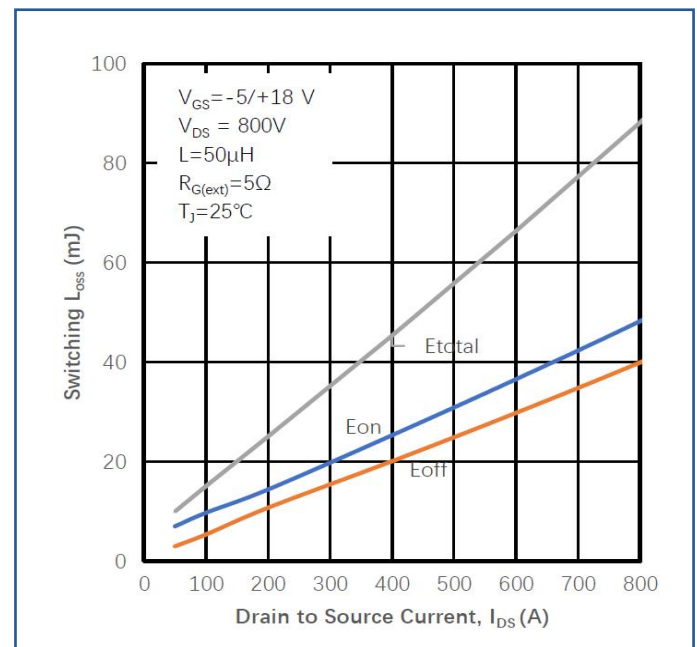
**Figure 5**  
Diode Characteristic at 25 °C



**Figure 6**  
Typical Gate Charge Characteristics

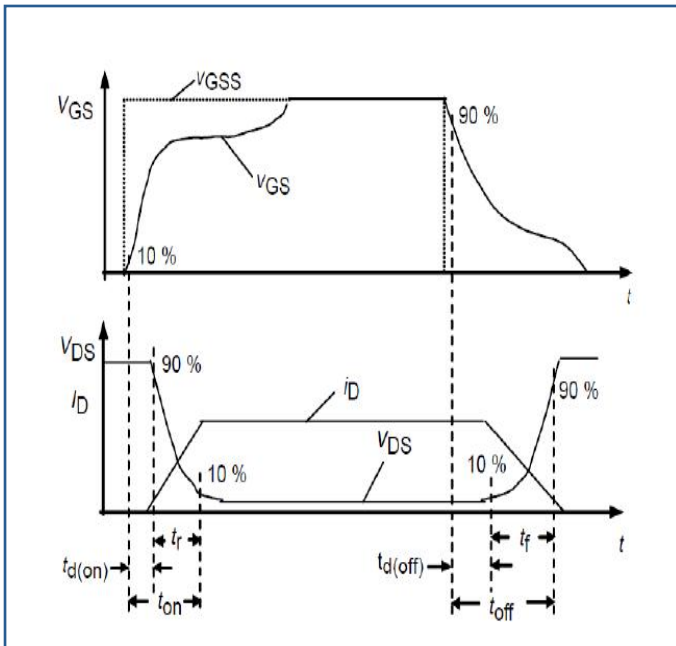


**Figure 7**  
Typical Capacitances vs. Drain-source Voltage



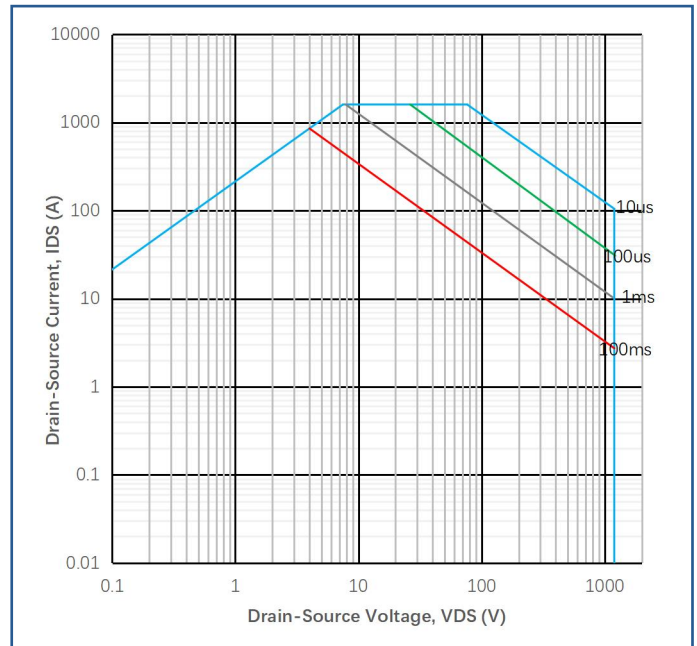
**Figure 8**  
Inductive Switching Energy vs. Drain Current

## Typical Performance



**Figure 9**

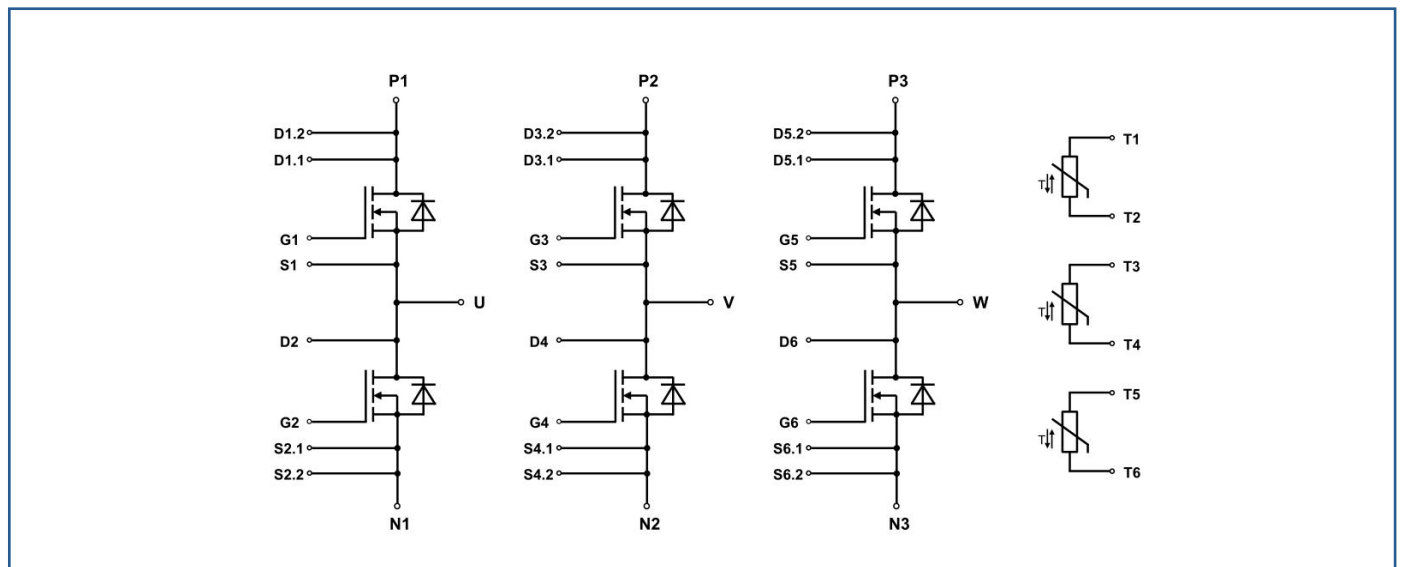
Switching Time Description



**Figure 10**

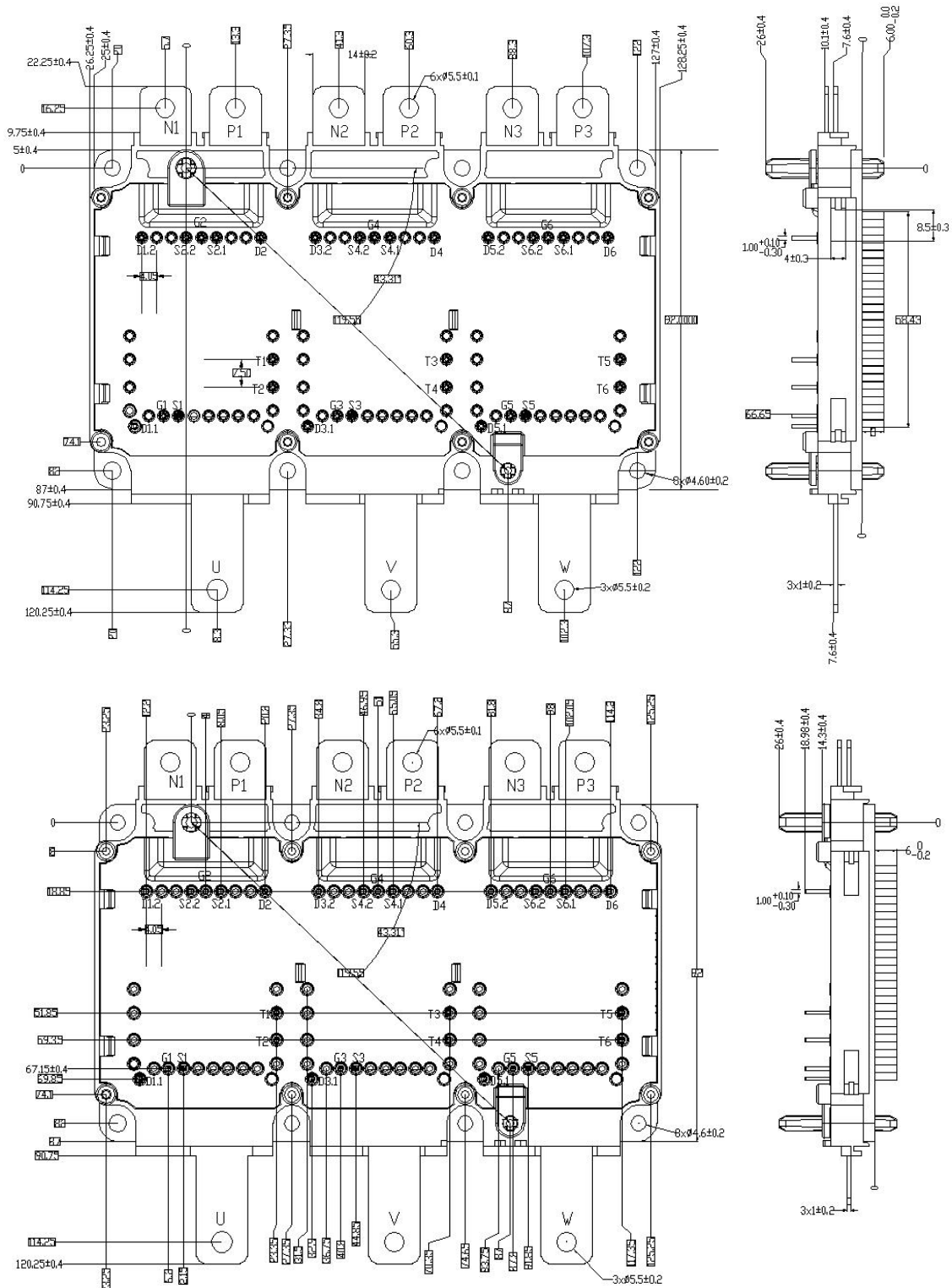
Safe Operating Area

## Circuit Diagram Headline



## Package Dimensions (mm)

### Package Type: HPDL



| 未标注线性公差按<br>GB/1804-2000c 级执行 | 公差分段 | 0.5-3 | 3-6  | 6-30 | 30-120 | 120-400 |
|-------------------------------|------|-------|------|------|--------|---------|
|                               | c 级  | ±0.2  | ±0.3 | ±0.5 | ±0.8   | ±1.2    |

## Notes & Disclaimer

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