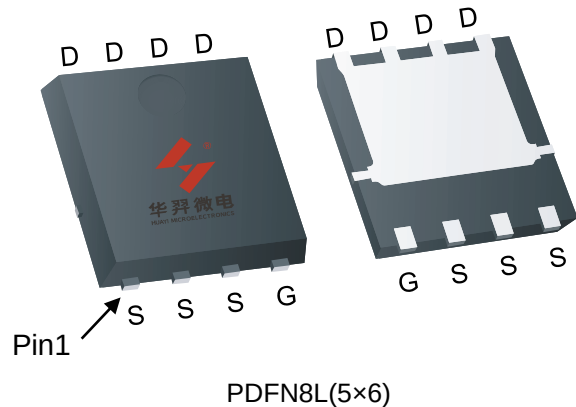


## N-Channel Enhancement Mode MOSFET

## Feature

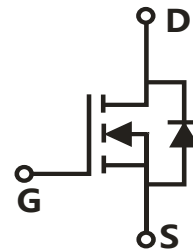
- 100V/58A  
 $R_{DS(ON)} = 10 \text{ m}\Omega(\text{typ.}) @ V_{GS} = 10\text{V}$   
 $R_{DS(ON)} = 12.5 \text{ m}\Omega(\text{typ.}) @ V_{GS} = 4.5\text{V}$
- 100% Avalanche Tested
- 100% DVDS
- Reliable and Rugged
- MSL1 up to 260°C Peak Reflow
- AEC-Q101 Qualified
- 175°C operating temperature
- Halogen Free and Green Devices Available  
 (RoHS Compliant)

## Pin Description



## Applications

- Switching application
- Li-battery protection
- DC-DC Converters
- Automotive application



Single N-Channel MOSFET

## Ordering and Marking Information

|                                                                                                                 |                                                              |
|-----------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|
| HYA <br>110N10LS<br>XXXXXXXX | Package Code<br>C2: PDFN8L(5x6)<br><br>Date Code<br>XXXXXXXX |
|-----------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|

Note: HUAYI halogen free products contain molding compounds and 100% matte tin plate Termination finish; which are fully compliant with RoHS. HUAYI halogen free products meet or exceed the halogen free requirements of IPC/JEDEC J-STD-020 for MSL classification at halogen free peak reflow temperature. HUAYI defines "Green" to mean halogen free (RoHS compliant) and halogen free (Br or Cl does not exceed 900ppm by weight in homogeneous material and total of Br and Cl does not exceed 1500ppm by weight).

HUAYI reserves the right to make changes, corrections, enhancements, modifications, and improvements to this product and/or to this document at any time without notice.

## Absolute Maximum Ratings

| Symbol                                                       | Parameter                                  |                       | Rating     | Unit |
|--------------------------------------------------------------|--------------------------------------------|-----------------------|------------|------|
| Common Ratings (T <sub>C</sub> =25°C Unless Otherwise Noted) |                                            |                       |            |      |
| V <sub>DSS</sub>                                             | Drain-Source Voltage                       |                       | 100        | V    |
| V <sub>GSS</sub>                                             | Gate-Source Voltage                        |                       | ±20        | V    |
| T <sub>J</sub>                                               | Junction Temperature Range                 |                       | -55 to 175 | °C   |
| T <sub>STG</sub>                                             | Storage Temperature Range                  |                       |            | °C   |
| I <sub>S</sub>                                               | Source Current-Continuous(Body Diode)      | T <sub>C</sub> =25°C  | 58         | A    |
| Mounted on Large Heat Sink                                   |                                            |                       |            |      |
| I <sub>DM</sub>                                              | Pulsed Drain Current *                     | T <sub>C</sub> =25°C  | 174        | A    |
| I <sub>D</sub>                                               | Continuous Drain Current                   | T <sub>C</sub> =25°C  | 58         | A    |
|                                                              |                                            | T <sub>C</sub> =100°C | 41         | A    |
| P <sub>D</sub>                                               | Maximum Power Dissipation                  | T <sub>C</sub> =25°C  | 88         | W    |
|                                                              |                                            | T <sub>C</sub> =100°C | 44         | W    |
| R <sub>θJC</sub>                                             | Thermal Resistance, Junction-to-Case       |                       | 1.71       | °C/W |
| R <sub>θJA</sub>                                             | Thermal Resistance, Junction-to-Ambient ** |                       | 80         | °C/W |
| E <sub>AS</sub>                                              | Single Pulsed-Avalanche Energy ***         | L=0.3mH               | 34         | mJ   |

Note: \* Repetitive rating; pulse width limited by max.junction temperature.

\*\* Surface mounted on 1in2 FR-4 board.

\*\*\* Limited by  $T_{Jmax}$ , starting  $T_J=25^{\circ}\text{C}$ ,  $L=0.3\text{mH}$ ,  $R_G=25\Omega$ ,  $V_{GS}=10\text{V}$ .

## Electrical Characteristics ( $T_C=25^{\circ}\text{C}$ Unless Otherwise Noted)

| Symbol                 | Parameter                        | Test Conditions                                           | HYA110N10LS5 |      |      | Unit |
|------------------------|----------------------------------|-----------------------------------------------------------|--------------|------|------|------|
|                        |                                  |                                                           | Min.         | Typ. | Max. |      |
| Static Characteristics |                                  |                                                           |              |      |      |      |
| BV <sub>DSS</sub>      | Drain-Source Breakdown Voltage   | V <sub>GS</sub> =0V, I <sub>DS</sub> =250μA               | 100          | -    | -    | V    |
| I <sub>DSS</sub>       | Drain-to-Source Leakage Current  | V <sub>DS</sub> =100V, V <sub>GS</sub> =0V                | -            | -    | 1    | μA   |
|                        |                                  | T <sub>J</sub> =125°C                                     | -            | -    | 50   | μA   |
| V <sub>GS(th)</sub>    | Gate Threshold Voltage           | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>DS</sub> =250μA | 1.0          | 1.8  | 3.0  | V    |
| I <sub>GSS</sub>       | Gate-Source Leakage Current      | V <sub>GS</sub> =±20V, V <sub>DS</sub> =0V                | -            | -    | ±100 | nA   |
| R <sub>DS(ON)</sub>    | Drain-Source On-State Resistance | V <sub>GS</sub> =10V, I <sub>DS</sub> =20A                | -            | 10   | 13   | mΩ   |
|                        |                                  | V <sub>GS</sub> =4.5V, I <sub>DS</sub> =20A               | -            | 12.5 | 16   | mΩ   |
| Diode Characteristics  |                                  |                                                           |              |      |      |      |
| V <sub>SD</sub>        | Diode Forward Voltage            | I <sub>SD</sub> =20A, V <sub>GS</sub> =0V                 | -            | 0.88 | 1.2  | V    |
| t <sub>rr</sub>        | Reverse Recovery Time            | I <sub>SD</sub> =20A, dI <sub>SD</sub> /dt=100A/μs        | -            | 30   | -    | ns   |
| Q <sub>rr</sub>        | Reverse Recovery Charge          |                                                           | -            | 22   | -    | nC   |

**Electrical Characteristics (Cont.)** ( $T_C = 25^\circ\text{C}$  Unless Otherwise Noted)

| Symbol                      | Parameter                                | Test Conditions                                                                           | HYA110N10LS5 |      |      | Unit |
|-----------------------------|------------------------------------------|-------------------------------------------------------------------------------------------|--------------|------|------|------|
|                             |                                          |                                                                                           | Min.         | Typ. | Max. |      |
| Dynamic Characteristics     |                                          |                                                                                           |              |      |      |      |
| R <sub>G</sub>              | Gate Resistance                          | V <sub>GS</sub> =0V,V <sub>DS</sub> =0V,f=1MHz                                            | -            | 0.4  | -    | Ω    |
| C <sub>iss</sub>            | Input Capacitance                        | V <sub>GS</sub> =0V,<br>V <sub>DS</sub> =50V,<br>f=300kHz                                 | -            | 1104 | -    | pF   |
| C <sub>oss</sub>            | Output Capacitance                       |                                                                                           | -            | 406  | -    |      |
| C <sub>rss</sub>            | Reverse Transfer Capacitance             |                                                                                           | -            | 9.0  | -    |      |
| t <sub>d(ON)</sub>          | Turn-on Delay Time                       | V <sub>DD</sub> =50V, R <sub>G</sub> =2.5Ω,<br>I <sub>DS</sub> =20A, V <sub>GS</sub> =10V | -            | 9.0  | -    | ns   |
| t <sub>r</sub>              | Turn-on Rise Time                        |                                                                                           | -            | 20   | -    |      |
| t <sub>d(OFF)</sub>         | Turn-off Delay Time                      |                                                                                           | -            | 20   | -    |      |
| t <sub>f</sub>              | Turn-off Fall Time                       |                                                                                           | -            | 5.7  | -    |      |
| Gate Charge Characteristics |                                          |                                                                                           |              |      |      |      |
| Q <sub>g</sub>              | Total Gate Charge(V <sub>GS</sub> =10V)  | V <sub>DS</sub> =80V, I <sub>DS</sub> =20A                                                | -            | 21   | -    | nC   |
|                             | Total Gate Charge(V <sub>GS</sub> =4.5V) |                                                                                           | -            | 11   | -    |      |
| Q <sub>gs</sub>             | Gate-Source Charge                       |                                                                                           | -            | 4.2  | -    |      |
| Q <sub>gd</sub>             | Gate-Drain Charge                        |                                                                                           | -            | 4.0  | -    |      |
| V <sub>plateau</sub>        | Gate plateau voltage                     |                                                                                           |              | -    | 3.2  | -    |

Note: \*Pulse test, pulse width  $\leq 300\mu\text{s}$ , duty cycle  $\leq 2\%$

## Typical Operating Characteristics

Figure 1: Power Dissipation

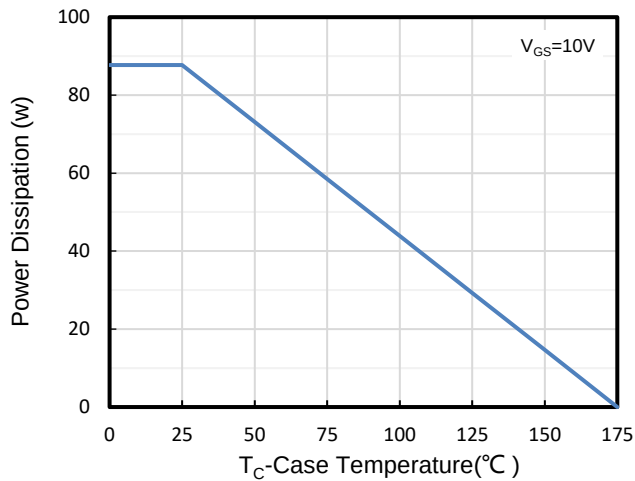


Figure 2: Drain Current

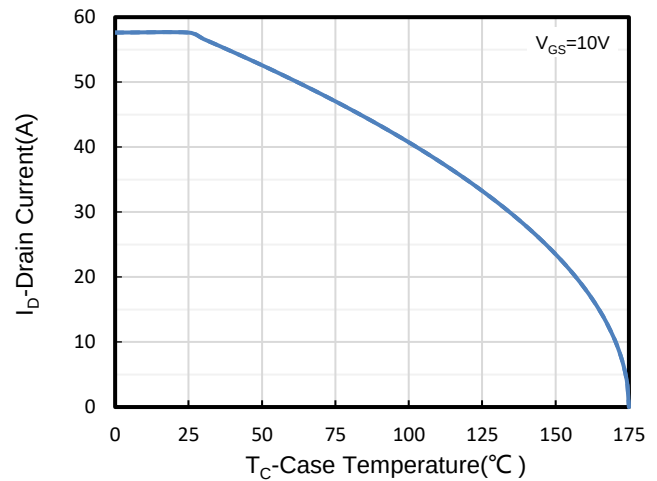


Figure 3: Safe Operation Area

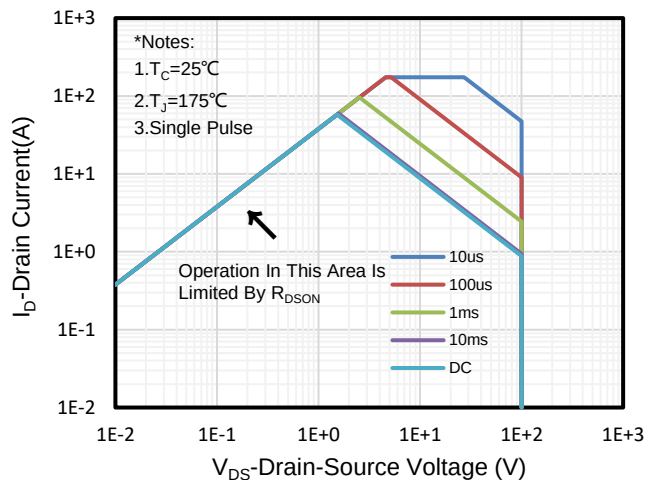


Figure 4: Thermal Transient Impedance

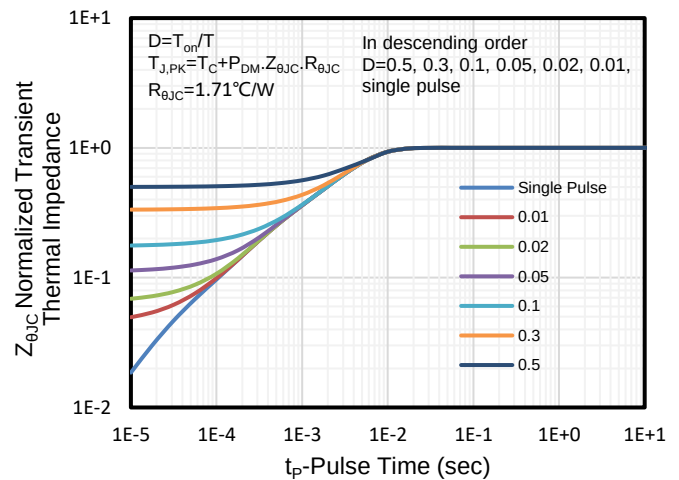


Figure 5: Output Characteristics

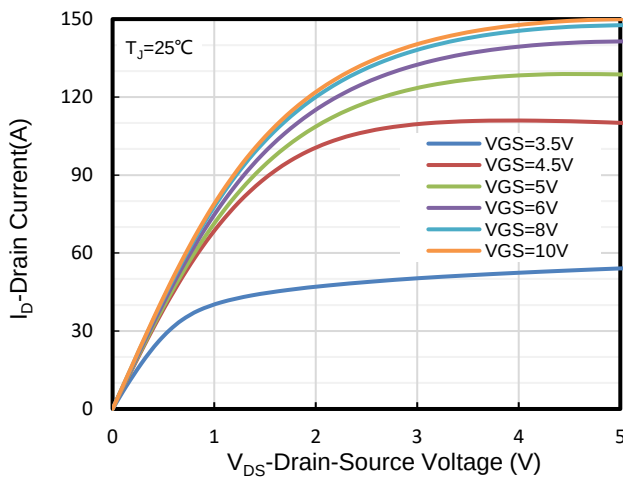
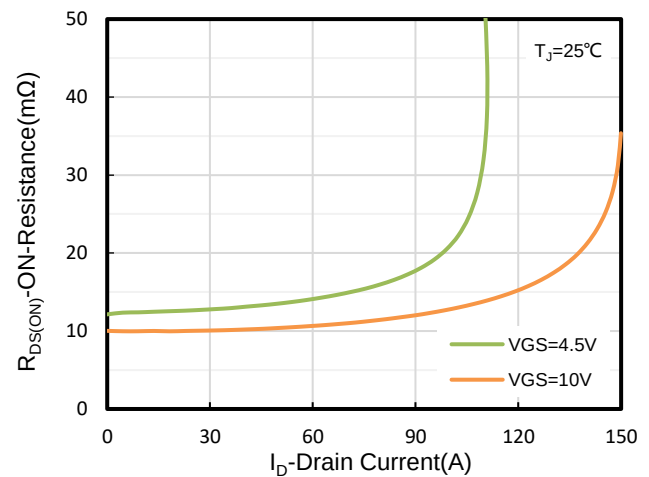


Figure 6: Drain-Source On Resistance



## Typical Operating Characteristics(Cont.)

Figure 7: On-Resistance vs. Temperature

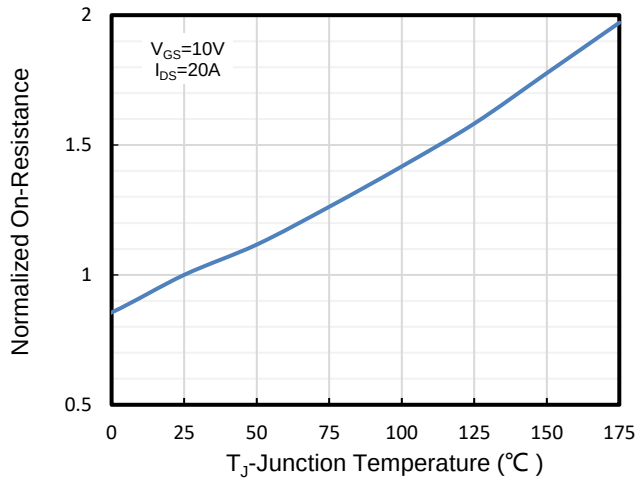


Figure 8: Source-Drain Diode Forward

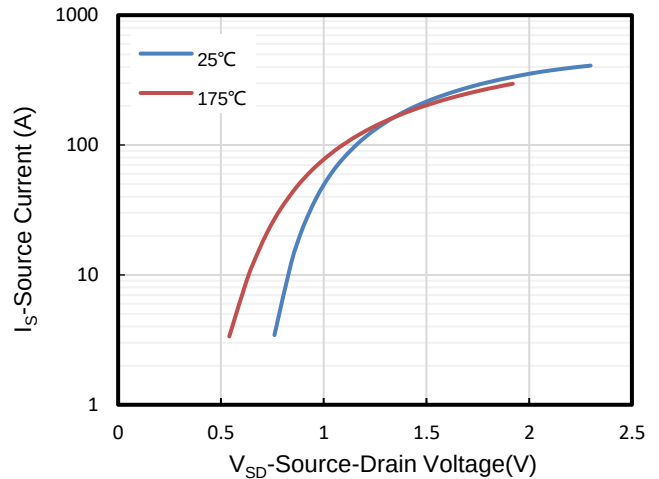


Figure 9: Capacitance Characteristics

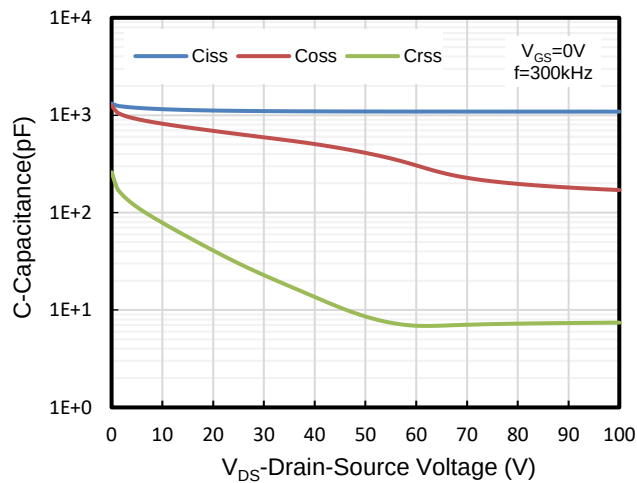


Figure 10: Gate Charge Characteristics

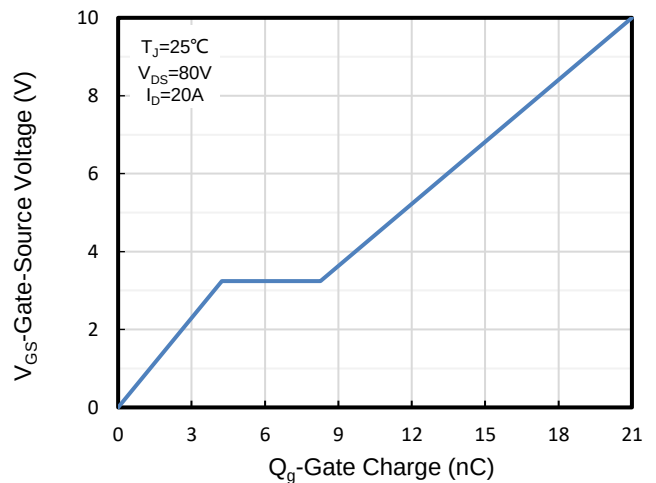


Figure 11: Transfer Characteristics

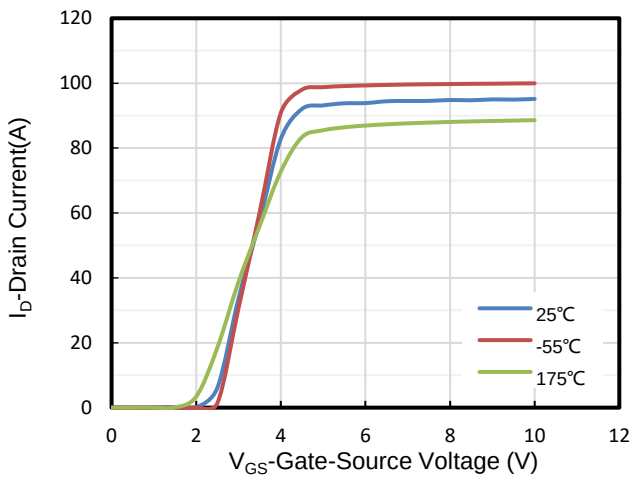
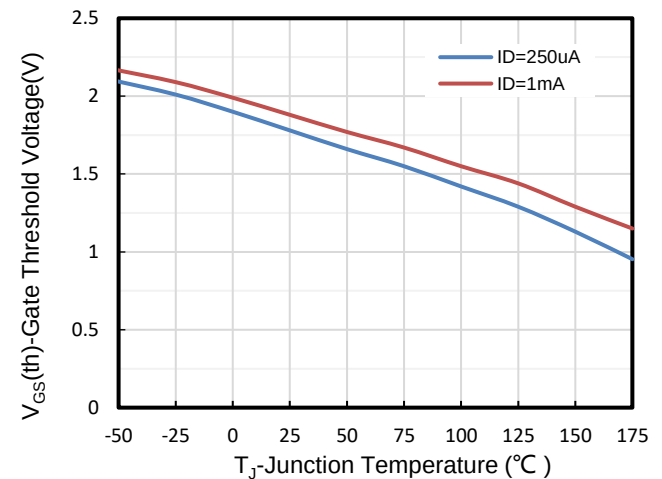


Figure 12: Gate Threshold Voltage



## Typical Operating Characteristics(Cont.)

Figure 13: Drain-Source Breakdown

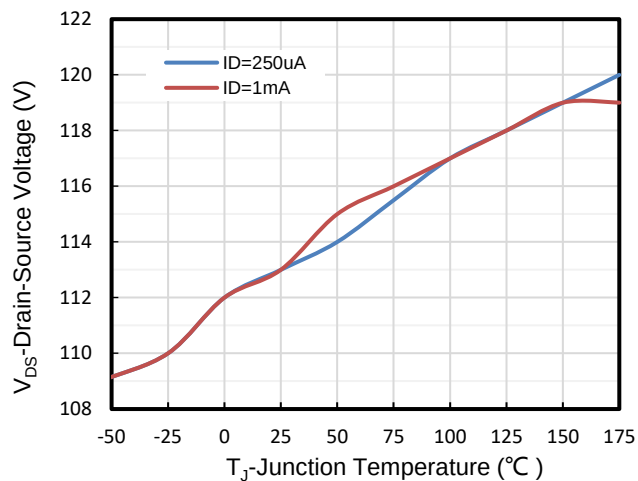


Figure 14:  $R_{DS(ON)}$  vs. Gate Voltage

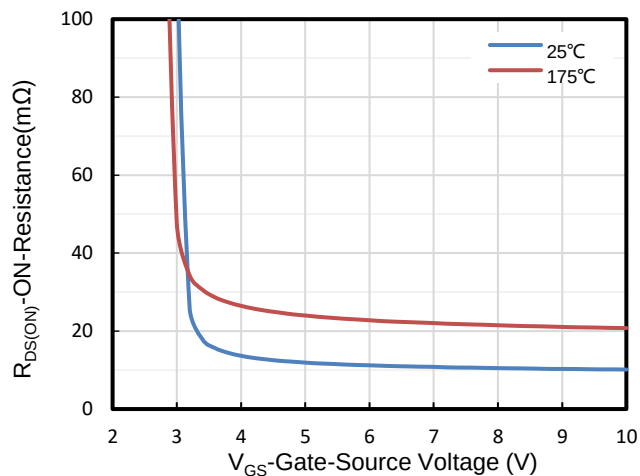
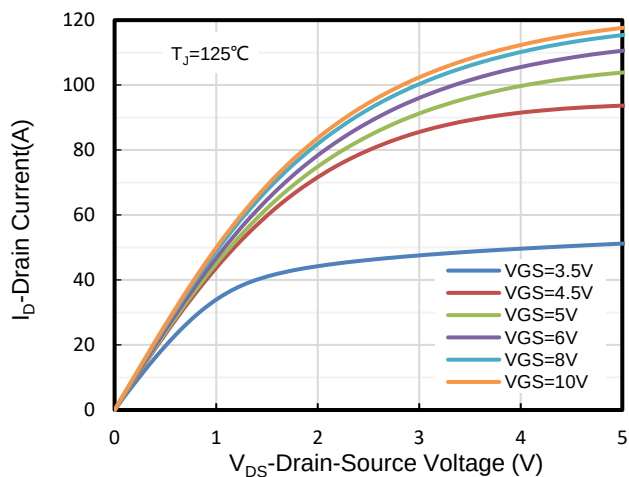
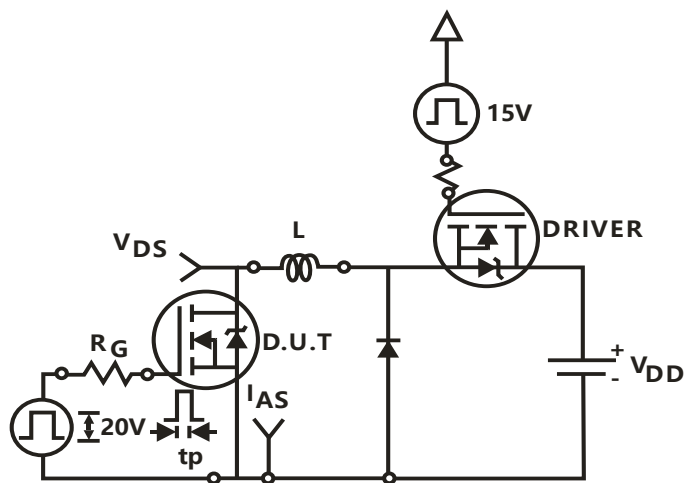


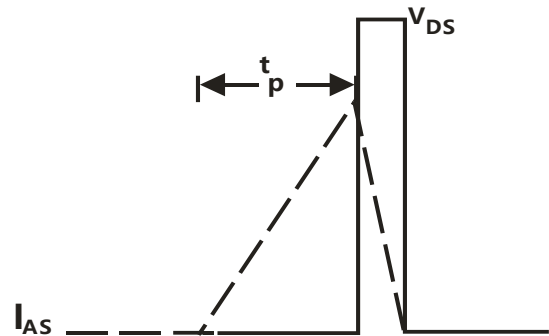
Figure 15: Output Characteristics (125°C)



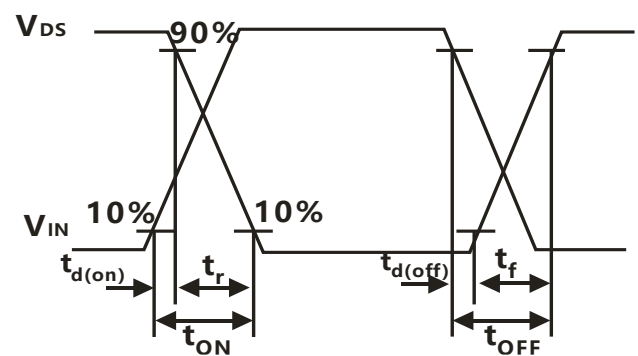
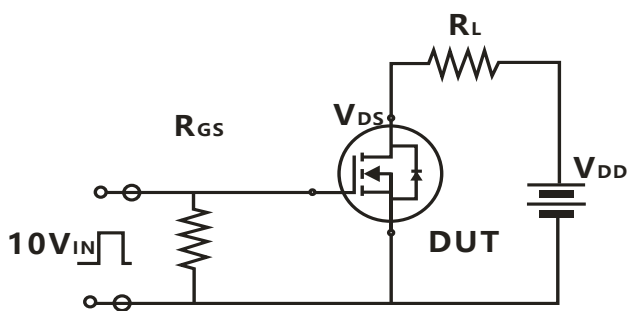
## Avalanche Test Circuit



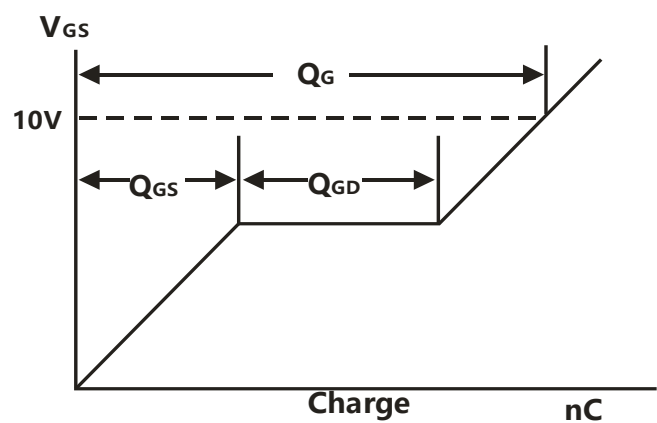
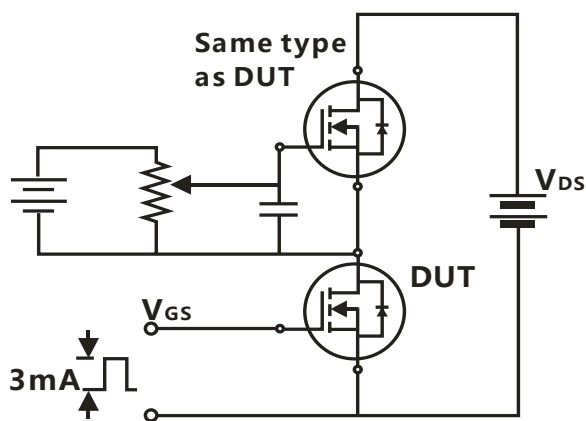
$$E_{AS} = \frac{1}{2} L I_{AS}^2$$



## Switching Time Test Circuit



## Gate Charge Test Circuit



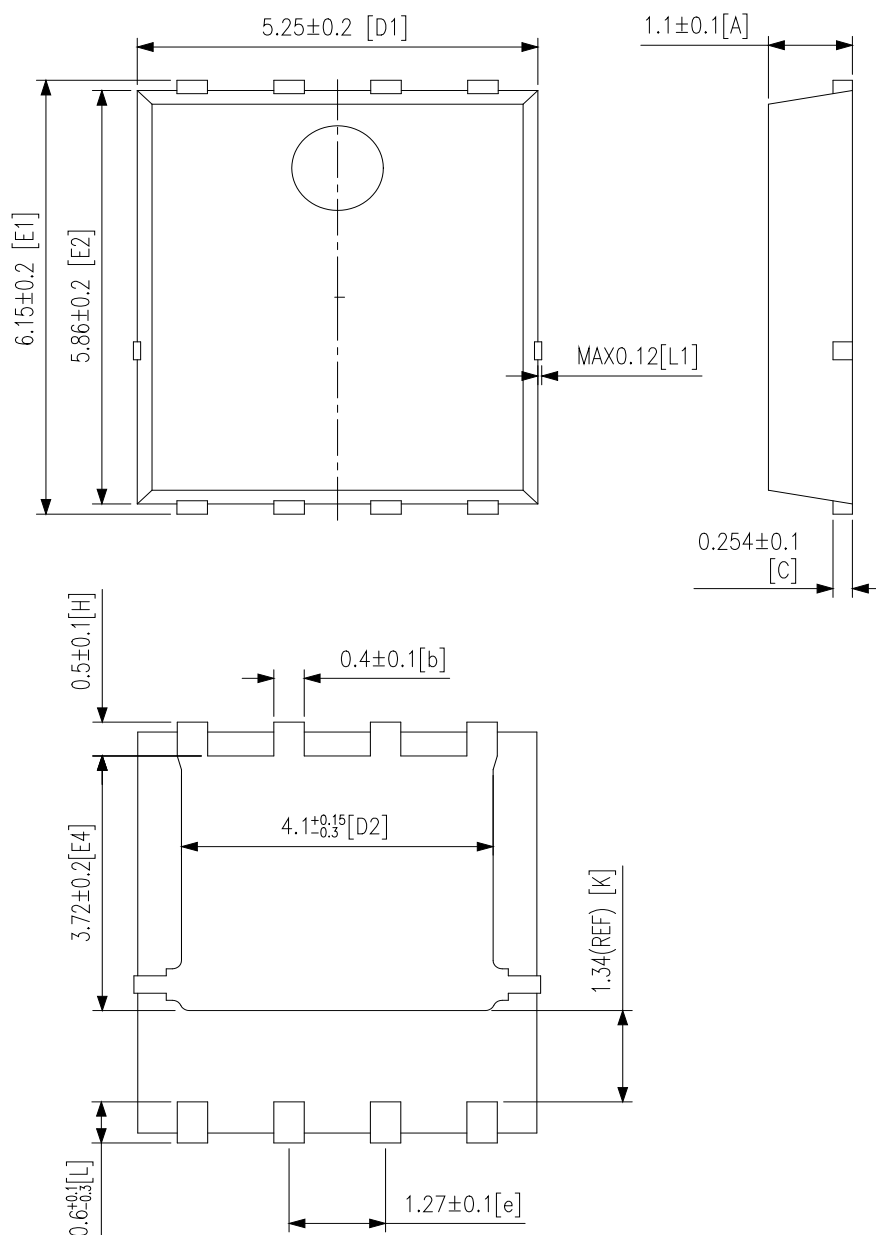
## Device Per Unit

| Package Type | Unit | Quantity |
|--------------|------|----------|
| PDFN8L(5×6)  | Reel | 5000     |

## Package Information

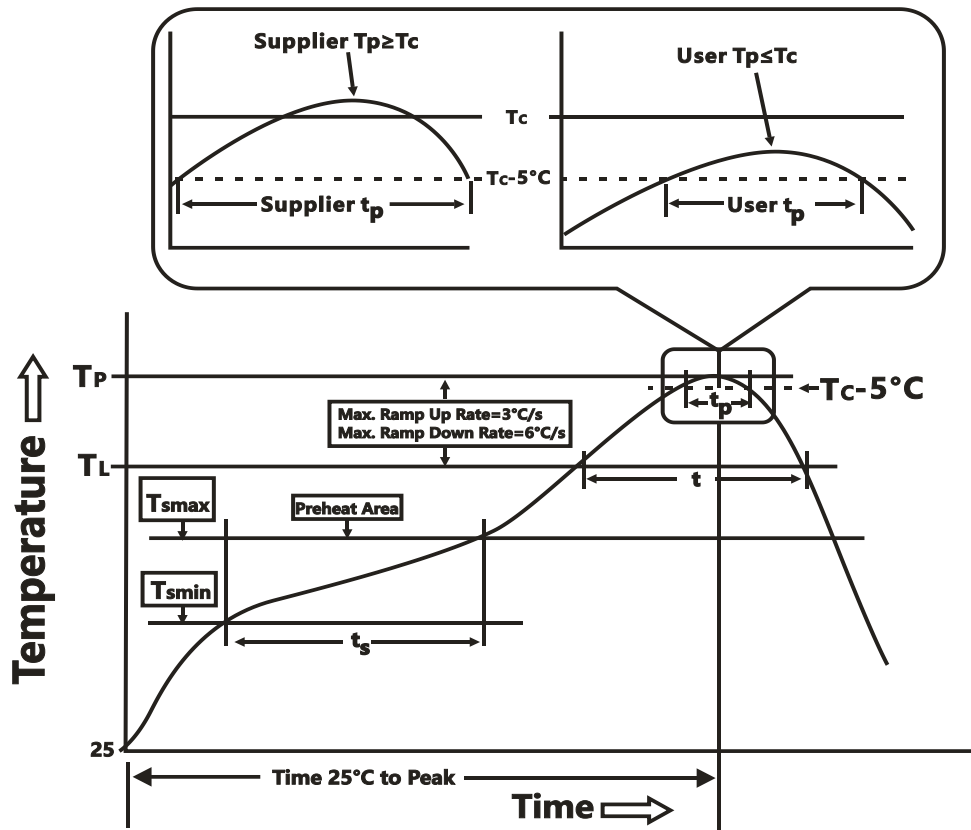
PDFN8L(5×6)

(unit:mm)





## Classification Profile



## Classification Reflow Profiles

| Profile Feature                                                                                                  | Sn-Pb Eutectic Assembly           | Pb-Free Assembly                  |
|------------------------------------------------------------------------------------------------------------------|-----------------------------------|-----------------------------------|
| <b>Preheat &amp; Soak</b>                                                                                        |                                   |                                   |
| Temperature min ( $T_{smin}$ )                                                                                   | 100 °C                            | 150 °C                            |
| Temperature max ( $T_{smax}$ )                                                                                   | 150 °C                            | 200 °C                            |
| Time ( $T_{smin}$ to $T_{smax}$ ) ( $t_s$ )                                                                      | 60-120 seconds                    | 60-120 seconds                    |
| Average ramp-up rate ( $T_{smax}$ to $T_P$ )                                                                     | 3 °C/second max.                  | 3°C/second max.                   |
| Liquidous temperature ( $T_L$ )                                                                                  | 183 °C                            | 217 °C                            |
| Time at liquidous ( $t_L$ )                                                                                      | 60-150 seconds                    | 60-150 seconds                    |
| Peak package body Temperature ( $T_P$ )*                                                                         | See Classification Temp in table1 | See Classification Temp in table2 |
| Time ( $t_p$ )** within 5°C of the specified classification temperature ( $T_C$ )                                | 20** seconds                      | 30** seconds                      |
| Average ramp-down rate ( $T_P$ to $T_{smax}$ )                                                                   | 6 °C/second max.                  | 6 °C/second max.                  |
| Time 25°C to peak temperature                                                                                    | 6 minutes max.                    | 8 minutes max.                    |
| * Tolerance for peak profile Temperature ( $T_P$ ) is defined as a supplier minimum and a user maximum.          |                                   |                                   |
| ** Tolerance for time at peak profile temperature ( $t_p$ ) is defined as a supplier minimum and a user maximum. |                                   |                                   |

Table 1. SnPb Eutectic Process – Classification Temperatures ( $T_C$ )

| Package   | Volume mm <sup>3</sup> | Volume mm <sup>3</sup> |
|-----------|------------------------|------------------------|
| Thickness | <350                   | ≥350                   |
| <2.5 mm   | 235 °C                 | 220 °C                 |
| ≥2.5 mm   | 220 °C                 | 220 °C                 |

Table 2. Pb-free Process – Classification Temperatures ( $T_C$ )

| Package         | Volume mm <sup>3</sup> | Volume mm <sup>3</sup> | Volume mm <sup>3</sup> |
|-----------------|------------------------|------------------------|------------------------|
| Thickness       | <350                   | 350-2000               | ≥2000                  |
| <1.6 mm         | 260 °C                 | 260 °C                 | 260 °C                 |
| 1.6 mm – 2.5 mm | 260 °C                 | 250 °C                 | 245 °C                 |
| ≥2.5 mm         | 250 °C                 | 245 °C                 | 245 °C                 |

## Reliability Test Program

| Test item | Method       | Description                            |
|-----------|--------------|----------------------------------------|
| PCT       | JESD22-A102  | 121°C, 100%RH, 96hours, 205kPa         |
| TCT       | JESD22-A104  | 500/1000 Cycles, -55°C~150°C           |
| HTRB      | JESD22-A108B | 500/1000 Hrs, 100% BVDSS @ 175°C       |
| HTGB      | JESD22-A108B | 500/1000 Hrs, 100% $V_{GS}$ @ 175°C    |
| BHAST     | JESD22-A110D | 130°C, 85%RH, 230kPa; U=80% $BV_{DSS}$ |

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