

## 40V N-Channel Power MOSFET

|                          |             |                               |              |
|--------------------------|-------------|-------------------------------|--------------|
| <b>BV<sub>DSS</sub></b>  | <b>40V</b>  | <b>R<sub>DS(ON)_MAX</sub></b> | <b>2.4mΩ</b> |
| <b>I<sub>D_MAX</sub></b> | <b>181A</b> | <b>Q<sub>g_TYP</sub></b>      | <b>38nC</b>  |

### Feature

- Maximum R<sub>DS(ON)</sub> < 2.4mΩ at V<sub>GS</sub> = 10V
- Maximum R<sub>DS(ON)</sub> < 3mΩ at V<sub>GS</sub> = 7V
- N channel MOSFET - Standard Level
- Excellent FoM (R<sub>DS(on)</sub> × Qg)
- 175°C operating temperature
- 100% Avalanche & Rg tested
- Package with Side Wettable Flanks (SWF) for automated optical solder inspection (AOI)
- AEC-Q101 qualified and PPAP capable
- Lead free in compliance with EU RoHS 2.0
- Green molding compound as per IEC 61249 standard

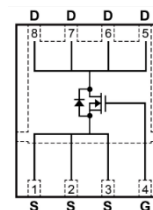
### Mechanical Data

- Case: Advanced DFN5060SW-8L Package (Patented)
- Terminals: Solderable per MIL-STD-750, Method 2026
- Approx. Weight: 0.095 gram

### Application

- DC-DC Converters
- Motor Drivers
- Automotive Applications

### DFN5060SW-8L



Top side view

### Absolute Maximum Ratings (T<sub>J</sub>=25°C unless otherwise specified)

| PARAMETER                               |                                             | SYMBOL          | VALUE | UNIT |
|-----------------------------------------|---------------------------------------------|-----------------|-------|------|
| Drain-Source Voltage                    |                                             | V <sub>DS</sub> | 40    | V    |
| Gate-Source Voltage                     |                                             | V <sub>GS</sub> | ±20   |      |
| Continuous Drain Current <sup>(1)</sup> | T <sub>C</sub> =25°C                        | I <sub>D</sub>  | 181   | A    |
|                                         | T <sub>C</sub> =75°C                        |                 | 148   |      |
|                                         | T <sub>C</sub> =100°C                       |                 | 128   |      |
| Pulsed Drain Current                    | T <sub>C</sub> =25°C, t <sub>p</sub> ≤100us | I <sub>DM</sub> | 669   |      |
| Power Dissipation                       | T <sub>C</sub> =25°C                        | P <sub>D</sub>  | 150   | W    |
|                                         | T <sub>C</sub> =75°C                        |                 | 100   |      |
|                                         | T <sub>C</sub> =100°C                       |                 | 75    |      |

| PARAMETER                                        |                                                     | SYMBOL                            | VALUE   | UNIT |
|--------------------------------------------------|-----------------------------------------------------|-----------------------------------|---------|------|
| Continuous Drain Current <sup>(1)</sup>          | T <sub>A</sub> =25°C                                | I <sub>D</sub>                    | 33.1    | A    |
|                                                  | T <sub>A</sub> =75°C                                |                                   | 27      |      |
|                                                  | T <sub>A</sub> =100°C                               |                                   | 23.4    |      |
| Power Dissipation                                | T <sub>A</sub> =25°C                                | P <sub>D</sub>                    | 5       | W    |
|                                                  | T <sub>A</sub> =75°C                                |                                   | 3.3     |      |
|                                                  | T <sub>A</sub> =100°C                               |                                   | 2.5     |      |
| Body Diode Continuous Current <sup>(1)</sup>     | T <sub>C</sub> =25°C                                | I <sub>S</sub>                    | 154     | A    |
| Body Diode Pulse Current                         | T <sub>C</sub> =25°C, t <sub>p</sub> ≤100us         | I <sub>SM</sub>                   | 669     |      |
| Single Pulse Avalanche Current <sup>(2)</sup>    |                                                     | I <sub>AS</sub>                   | 40      |      |
| Single Pulse Avalanche Energy                    | I <sub>AS</sub> =20A, limited by T <sub>J_MAX</sub> | E <sub>AS</sub>                   | 311     | mJ   |
| Operating Junction and Storage Temperature Range |                                                     | T <sub>J</sub> , T <sub>STG</sub> | -55~175 | °C   |

## Thermal Characteristics

| PARAMETER          |                                    | SYMBOL               | MIN. | TYP. | MAX. | UNIT |
|--------------------|------------------------------------|----------------------|------|------|------|------|
| Thermal Resistance | Junction to Ambient <sup>(3)</sup> | R <sub>θJA</sub>     | —    | 30   | —    | °C/W |
|                    | Junction to Case                   | R <sub>θJC</sub>     | —    | 0.77 | 1    |      |
|                    | Junction to Case (TOP)             | R <sub>θJC_top</sub> | —    | —    | 18   |      |

### Notes :

- (1). The maximum continuous current of chip capability is calculated by maximum junction temperature and thermal resistance, and it will vary depending on the application and environment.
- (2). L=0.1mH, 100% test in production.
- (3). Surface mounted on 4 layers (2s2p) FR4 PCB defined in accordance with JESD51-5/ JESD51-7.

**Electrical Characteristics** ( $T_J=25^\circ\text{C}$  unless otherwise specified)

| PARAMETER                               | SYMBOL               | TEST CONDITION                                                                      | MIN. | TYP. | MAX. | UNIT |
|-----------------------------------------|----------------------|-------------------------------------------------------------------------------------|------|------|------|------|
| Static Characteristics                  |                      |                                                                                     |      |      |      |      |
| Drain-Source Breakdown Voltage          | BV <sub>DSS</sub>    | V <sub>GS</sub> =0V, I <sub>D</sub> =1mA                                            | 40   | —    | —    | V    |
| Gate Threshold Voltage                  | V <sub>GS(TH)</sub>  | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250μA                            | 2.2  | 2.7  | 3.2  |      |
| Drain-Source ON Resistance              | R <sub>DS(ON)</sub>  | V <sub>GS</sub> =10V, I <sub>D</sub> =20A                                           | —    | 2.0  | 2.4  | mΩ   |
|                                         |                      | V <sub>GS</sub> =7V, I <sub>D</sub> =10A                                            | —    | 2.3  | 3.0  |      |
| Zero Gate Voltage Drain Current         | I <sub>DSS</sub>     | V <sub>DS</sub> =40V, V <sub>GS</sub> =0V                                           | —    | —    | 1    | μA   |
|                                         |                      | V <sub>DS</sub> =40V, V <sub>GS</sub> =0V, T <sub>J</sub> =125°C <sup>(4)</sup>     | —    | —    | 100  |      |
| Gate-Source Leakage Current             | I <sub>GSS</sub>     | V <sub>GS</sub> =±20V, V <sub>DS</sub> =0V                                          | —    | —    | ±100 | nA   |
| Gate Resistance                         | R <sub>g</sub>       | f =1MHz                                                                             | —    | 1    | —    | Ω    |
| Transfer characteristics <sup>(4)</sup> | g <sub>fs</sub>      | V <sub>DS</sub> =5V, I <sub>D</sub> =20A                                            | —    | 100  | —    | S    |
| Dynamic Characteristics <sup>(4)</sup>  |                      |                                                                                     |      |      |      |      |
| Input Capacitance                       | C <sub>iss</sub>     | V <sub>DS</sub> =20V, V <sub>GS</sub> =0V, f=1MHz                                   | —    | 2400 | 3120 | pF   |
| Output Capacitance                      | C <sub>oss</sub>     |                                                                                     | —    | 760  | 988  |      |
| Reverse Transfer Capacitance            | C <sub>rss</sub>     |                                                                                     | —    | 50   | 75   |      |
| Output Charge                           | Q <sub>oss</sub>     | V <sub>DD</sub> =20V, V <sub>GS</sub> =0V                                           | —    | 29   | —    | nC   |
| Total Gate Charge                       | Q <sub>g</sub>       | V <sub>DD</sub> =20V, I <sub>D</sub> =20A, V <sub>GS</sub> =0~10V                   | —    | 38   | 49   |      |
| Gate-Source Charge                      | Q <sub>gs</sub>      |                                                                                     | —    | 9.5  | 14.3 |      |
| Gate-Drain Charge                       | Q <sub>gd</sub>      |                                                                                     | —    | 6.9  | 10.4 |      |
| Threshold Gate Charge                   | Q <sub>g(th)</sub>   |                                                                                     | —    | 6.3  | —    |      |
| Switching Charge                        | Q <sub>sw</sub>      |                                                                                     | —    | 10.1 | —    |      |
| Gate Plateau Voltage                    | V <sub>plateau</sub> |                                                                                     | —    | 3.9  | —    | V    |
| Total Gate Charge, sync. FET            | Q <sub>g(sync)</sub> | V <sub>DD</sub> =0.1V, I <sub>D</sub> =20A, V <sub>GS</sub> =0~10V                  | —    | 31.1 | —    | nC   |
| Turn-On Delay Time                      | t <sub>d(on)</sub>   | V <sub>DD</sub> =20V, V <sub>GS</sub> =10V, I <sub>D</sub> =20A, R <sub>G</sub> =3Ω | —    | 12   | —    | ns   |
| Rise Time                               | t <sub>r</sub>       |                                                                                     | —    | 3    | —    |      |
| Turn-Off Delay Time                     | t <sub>d(off)</sub>  |                                                                                     | —    | 28   | —    |      |
| Fall Time                               | t <sub>f</sub>       |                                                                                     | —    | 5    | —    |      |
| Body Diode                              |                      |                                                                                     |      |      |      |      |
| Diode Forward Voltage                   | V <sub>SD</sub>      | I <sub>S</sub> =20A, V <sub>GS</sub> =0V                                            | —    | 0.8  | 0.96 | V    |
| Reverse Recovery Charge <sup>(4)</sup>  | Q <sub>rr</sub>      | I <sub>S</sub> =20A, di/dt=100A/μs                                                  | —    | 16   | —    | nC   |
| Reverse Recovery Time <sup>(4)</sup>    | T <sub>rr</sub>      |                                                                                     | —    | 27   | —    | ns   |

**Notes :**

(4). Guaranteed by design, not subject to production testing.

**TYPICAL CHARACTERISTIC CURVES**

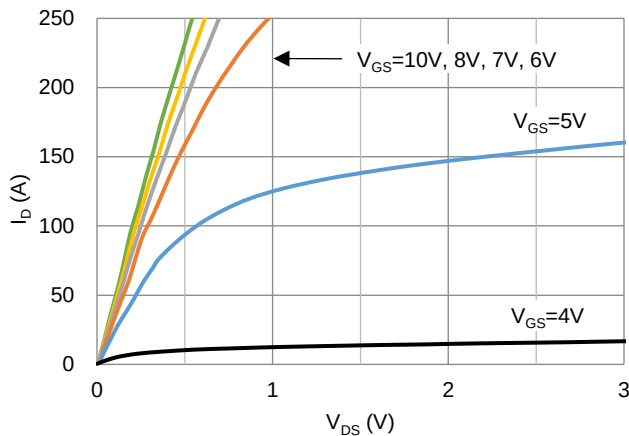


**Fig.1 Output Characteristics**

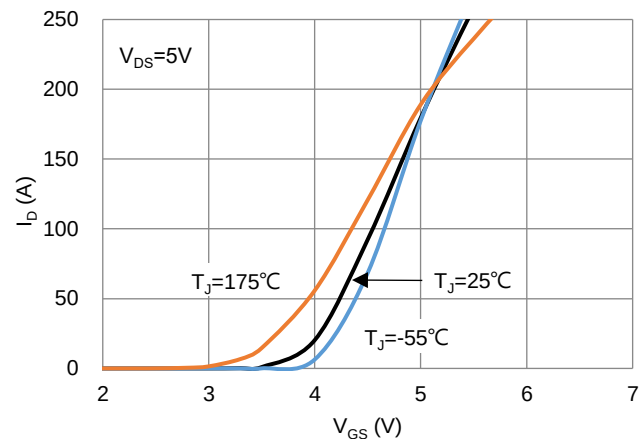


**Fig.2 Transfer Characteristics**

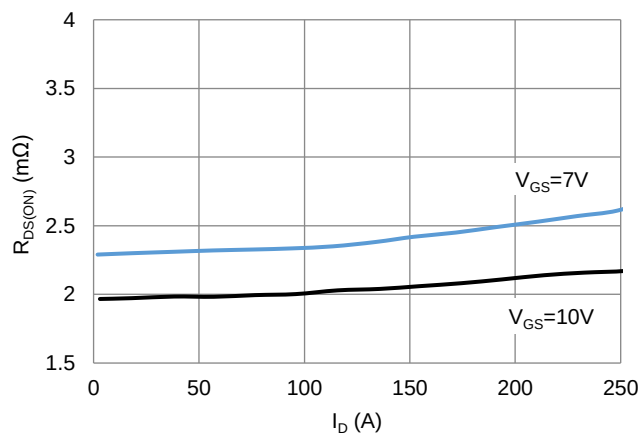


**Fig.3 On-Resistance vs. Drain Current**

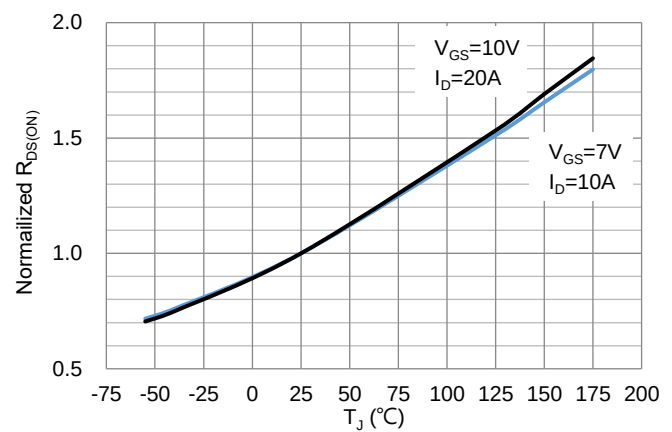


**Fig.4 On-Resistance vs. Junction temperature**

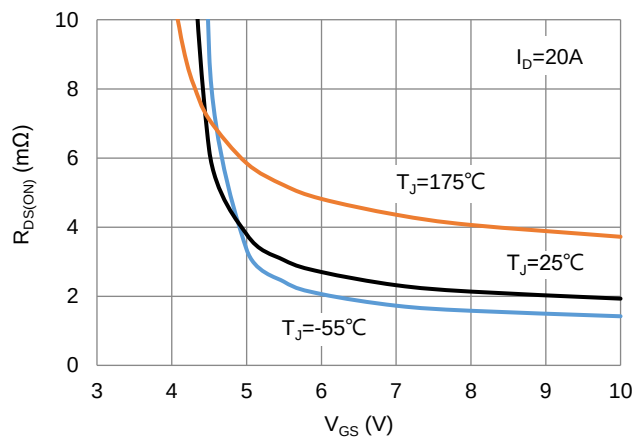


**Fig.5 On-Resistance vs. Gate Voltage**

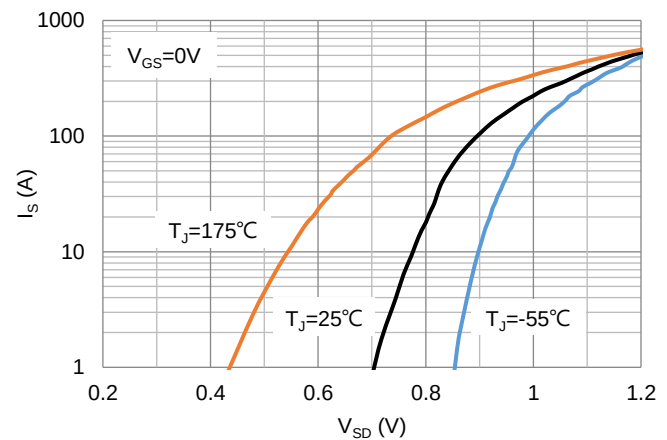


**Fig.6 Body Diode Characteristics**

**TYPICAL CHARACTERISTIC CURVES**

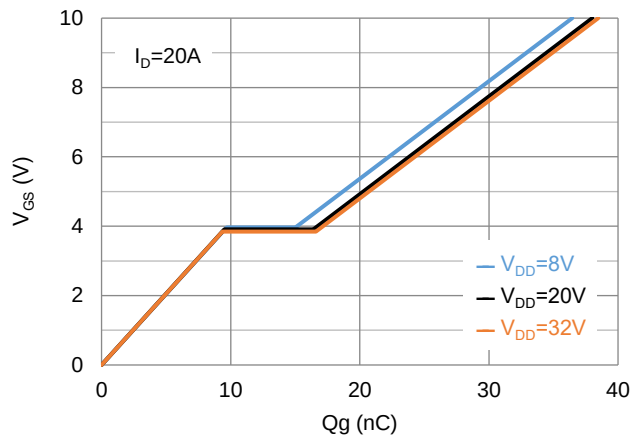


**Fig.7 Gate-Charge Characteristics**

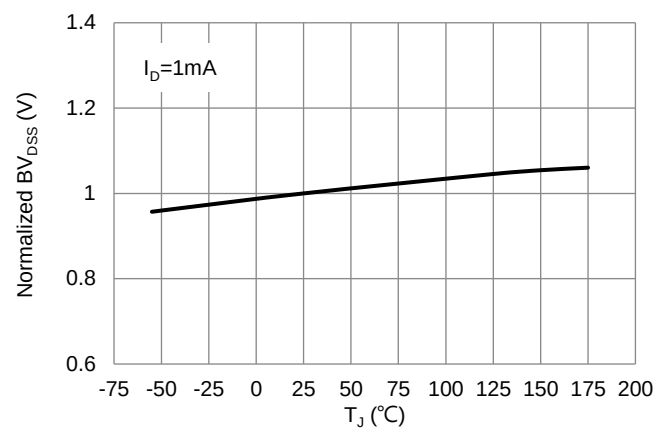


**Fig.8 Breakdown Voltage vs. Junction Temperature**

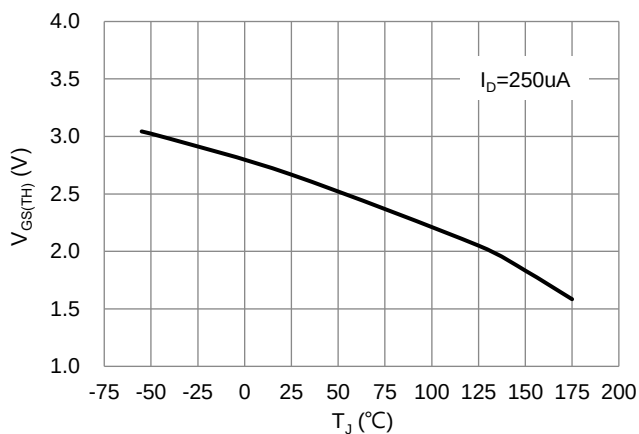


**Fig.9 Threshold Voltage vs. Junction Temperature**

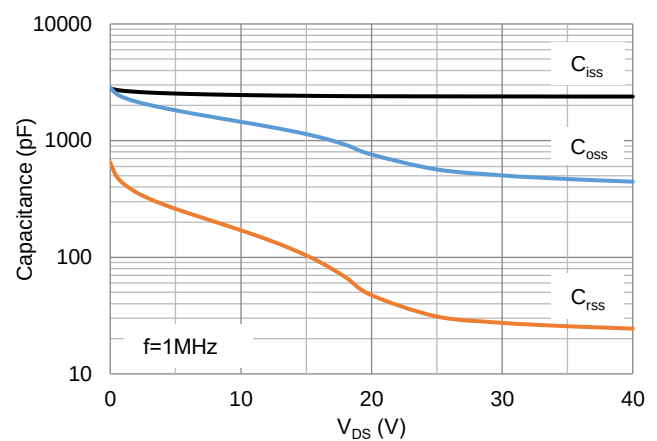


**Fig.10 Capacitance vs. Drain-Source Voltage**

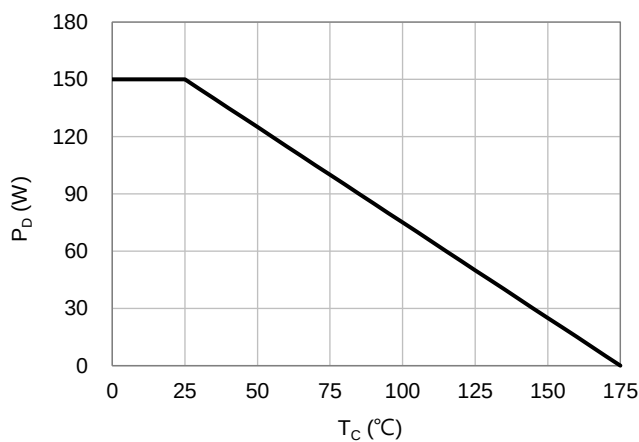


**Fig.11 Power Dissipation vs. Case Temperature**

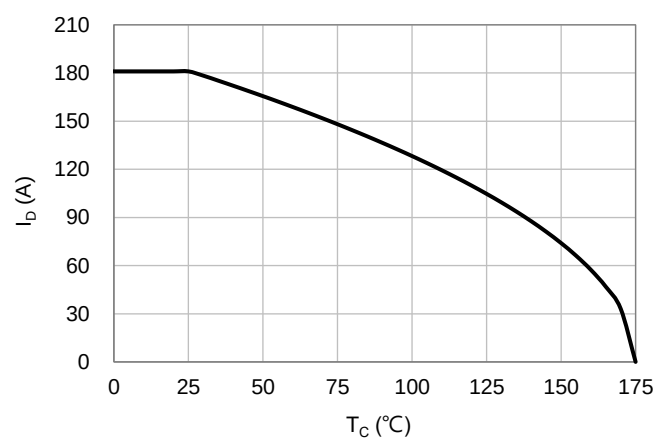


**Fig.12 Drain Current vs. Case Temperature**

**TYPICAL CHARACTERISTIC CURVES**

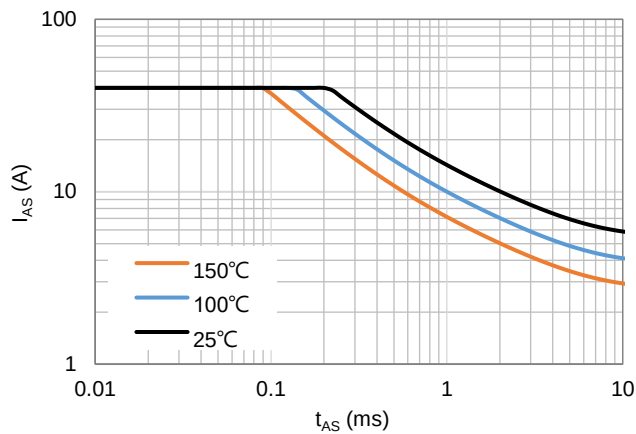


**Fig.13 Avalanche characteristics**

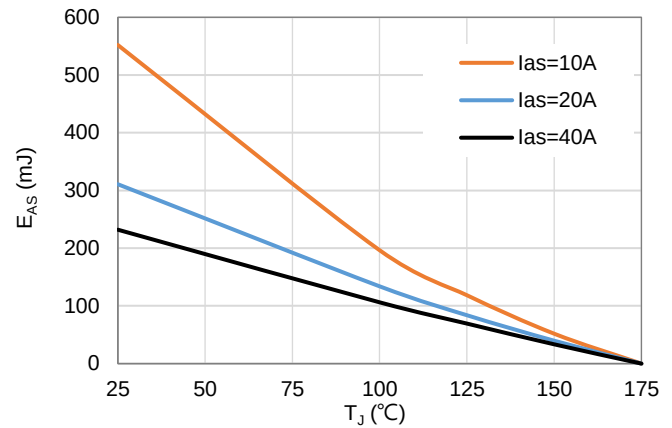


**Fig.14 Avalanche Energy**

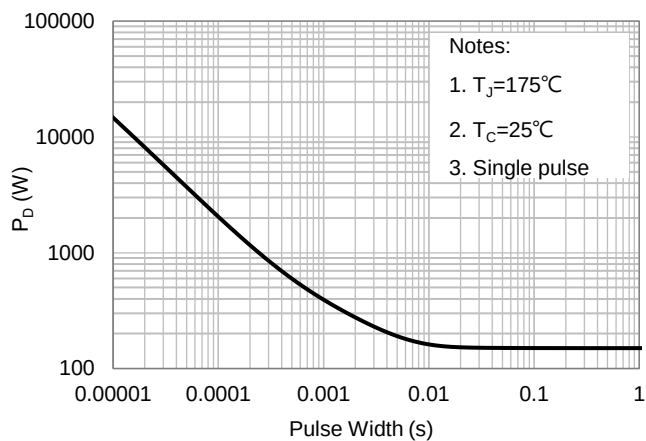


**Fig.15 Power Dissipation vs. Pulse Width**

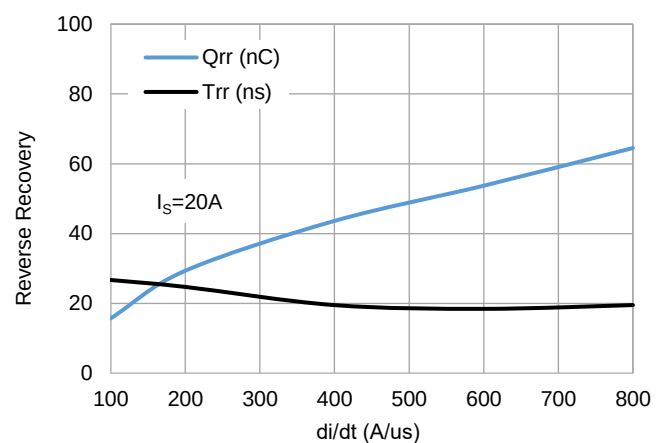


**Fig.16 Body Diode Reverse Recovery characteristics**

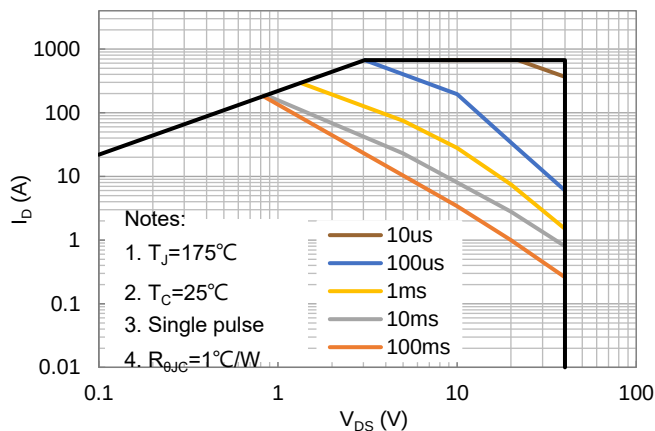


**Fig.17 Maximum Safe Operating Area**

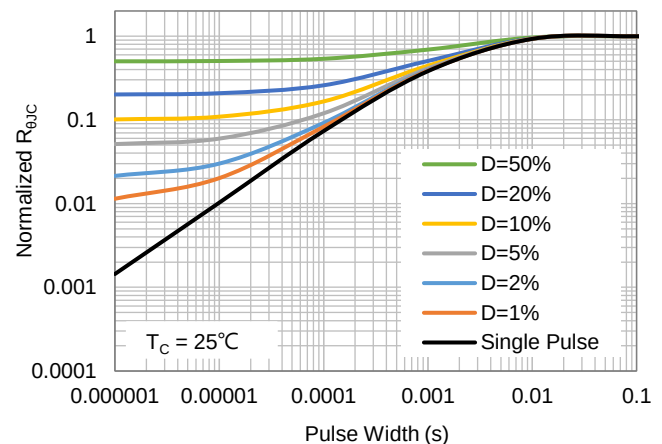


**Fig.18 Normalized Thermal Impedance**

**TEST CIRCUITS AND WAVEFORMS**

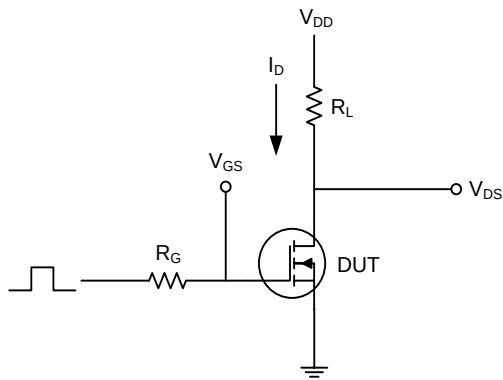


**Fig.19 Switching Time Test Circuit**

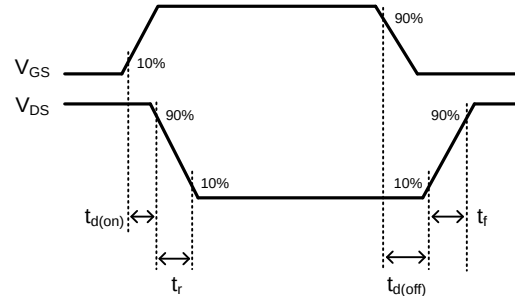


**Fig.20 Switching Time Waveform**

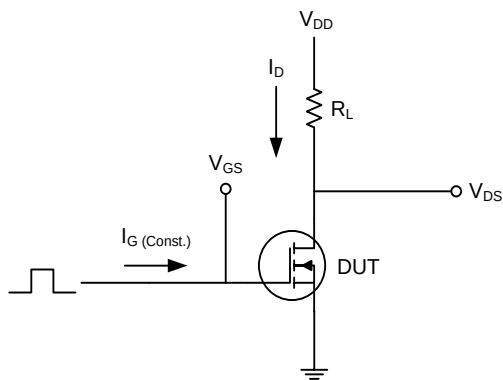


**Fig.21 Gate Charge Test Circuit**

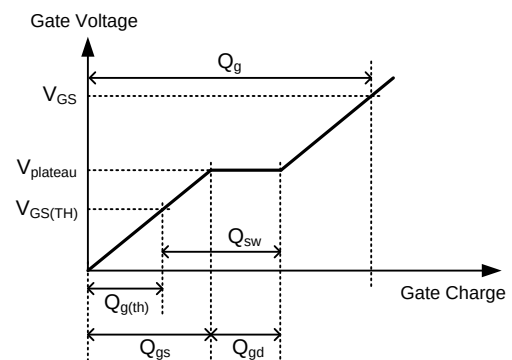


**Fig.22 Gate Charge Waveform**

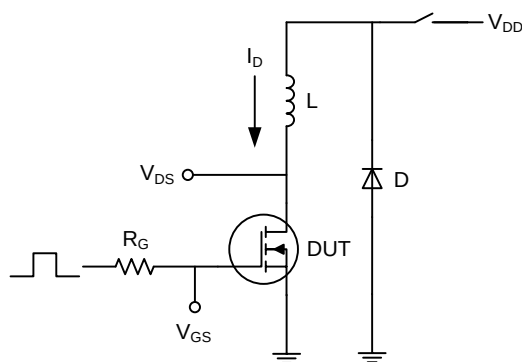


**Fig.23 Avalanche Test Circuit**

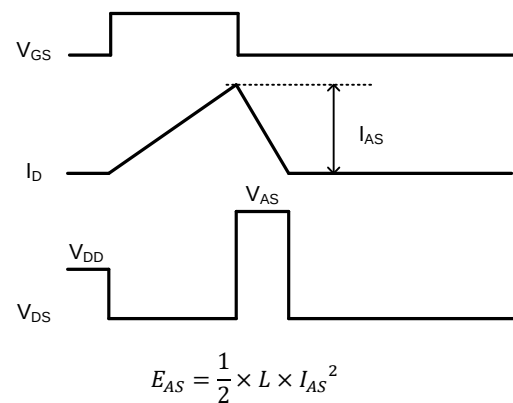
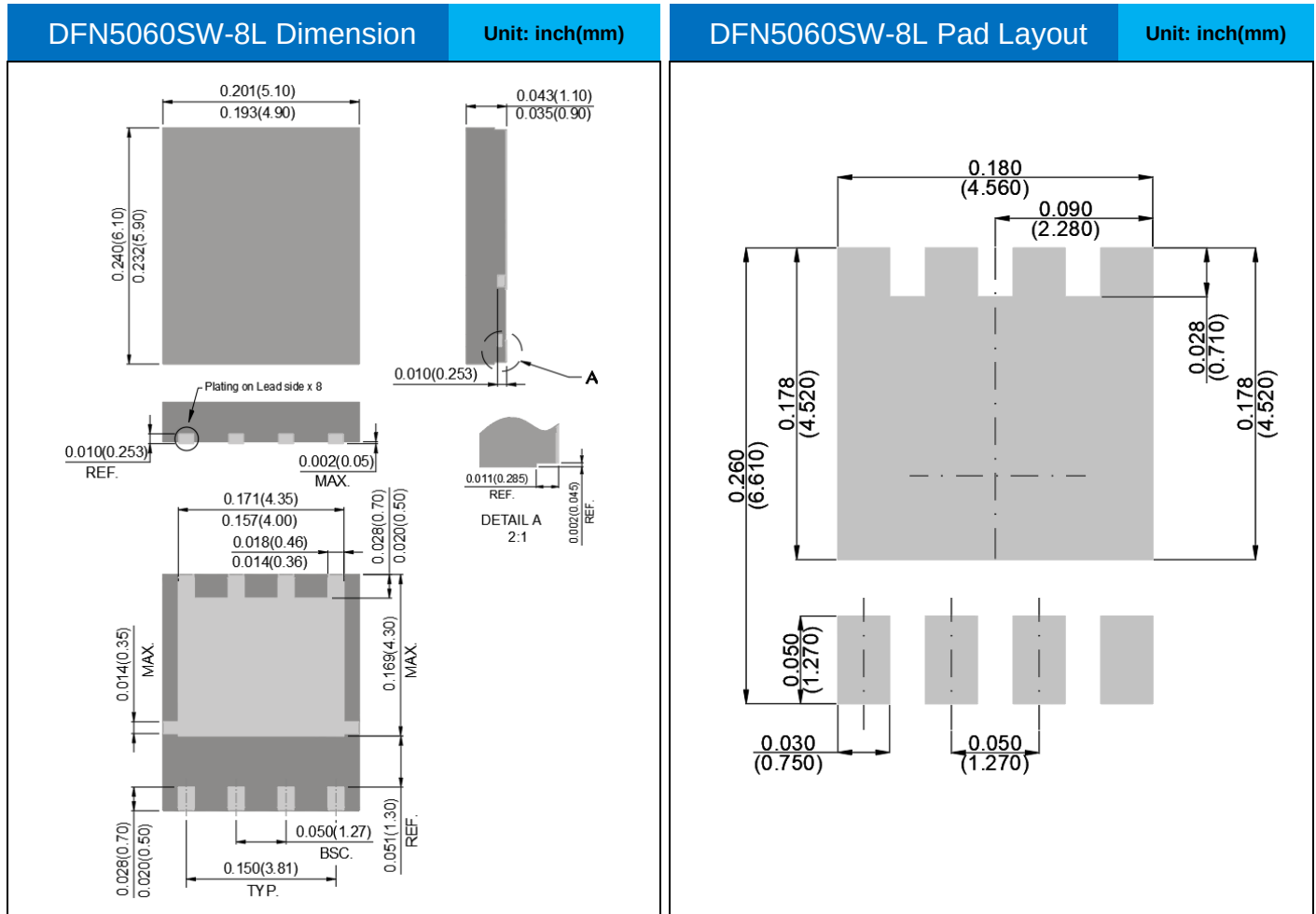


**Fig.24 Avalanche Waveform**

## Product and Packing Information

| Part No.          | Package Type | Packing Type      | Marking  |
|-------------------|--------------|-------------------|----------|
| PSMWF024N04NS3-AU | DFN5060SW-8L | 3K pcs / 13" reel | 024N04NS |

## Packaging Information & Mounting Pad Layout



## Marking Diagram

|                                               |                                 |
|-----------------------------------------------|---------------------------------|
| <b>PJ</b><br><b>024N04NS</b><br><b>YWLL x</b> | <b>Y</b> = Year Code            |
|                                               | <b>W</b> = Week Code (A~Z)      |
|                                               | <b>LL</b> = Lot Code (00~99)    |
|                                               | <b>x</b> = Production Line Code |

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