

# TM20H04DF

## N+N-Channel Enhancement Mosfet

### General Description

- Low  $R_{DS(ON)}$
- RoHS and Halogen-Free Compliant

### Applications

- Load switch
- PWM

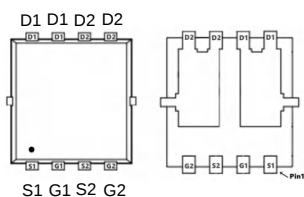
### General Features

$V_{DS} = 40V$   $I_D = 20A$

$R_{DS(ON)} = 17 m\Omega$  (Typ.) @  $V_{GS} = 10V$

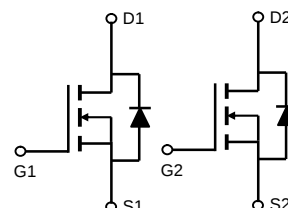
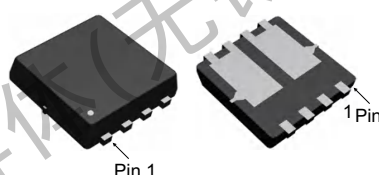
100% UIS Tested

100%  $R_g$  Tested



Marking:4886

DF:DFN3x3-8L



### Absolute Maximum Ratings ( $T_C = 25^\circ C$ unless otherwise specified)

| Symbol                    | Parameter                                  | Rating     | Units      |
|---------------------------|--------------------------------------------|------------|------------|
| $V_{DS}$                  | Drain-Source Voltage                       | 40         | V          |
| $V_{GS}$                  | Gate-Source Voltage                        | $\pm 20$   | V          |
| $I_D @ T_C = 25^\circ C$  | Continuous Drain Current, $V_{GS} @ 10V^1$ | 20         | A          |
| $I_D @ T_C = 100^\circ C$ | Continuous Drain Current, $V_{GS} @ 10V^1$ | 14         | A          |
| $I_{DM}$                  | Pulsed Drain Current <sup>2</sup>          | 75         | A          |
| EAS                       | Single Pulse Avalanche Energy <sup>3</sup> | 22.1       | mJ         |
| $I_{AS}$                  | Avalanche Current                          | 10         | A          |
| $P_D @ T_C = 25^\circ C$  | Total Power Dissipation <sup>4</sup>       | 31.3       | W          |
| $T_{STG}$                 | Storage Temperature Range                  | -55 to 150 | $^\circ C$ |
| $T_J$                     | Operating Junction Temperature Range       | -55 to 150 | $^\circ C$ |

### Thermal Data

| Symbol          | Parameter                                        | Typ. | Max. | Unit         |
|-----------------|--------------------------------------------------|------|------|--------------|
| $R_{\theta JA}$ | Thermal Resistance Junction-Ambient <sup>1</sup> | ---  | 75   | $^\circ C/W$ |
| $R_{\theta JC}$ | Thermal Resistance Junction-Case <sup>1</sup>    | ---  | 5.4  | $^\circ C/W$ |

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### Electrical Characteristics ( $T_J=25^{\circ}\text{C}$ , 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         |
| $R_{DS(ON)}$ | Static Drain-Source On-Resistance <sup>2</sup> | $V_{GS}=10V, I_D=6A$                            | ---  | 17   | 24        | $m\Omega$ |
|              |                                                | $V_{GS}=4.5V, I_D=5A$                           | ---  | 25   | 33        |           |
| $V_{GS(th)}$ | Gate Threshold Voltage                         | $V_{GS}=V_{DS}, I_D=250\mu A$                   | 1.2  | 1.6  | 2.0       | V         |
| $I_{DSS}$    | Drain-Source Leakage Current                   | $V_{DS}=32V, V_{GS}=0V, T_J=25^{\circ}\text{C}$ | ---  | ---  | 1         | $\mu A$   |
|              |                                                | $V_{DS}=32V, V_{GS}=0V, T_J=55^{\circ}\text{C}$ | ---  | ---  | 5         |           |
| $I_{GSS}$    | Gate-Source Leakage Current                    | $V_{GS}=\pm 20V, V_{DS}=0V$                     | ---  | ---  | $\pm 100$ | nA        |
| $g_{fs}$     | Forward Transconductance                       | $V_{DS}=5V, I_D=12A$                            | ---  | 30   | ---       | S         |
| $R_g$        | Gate Resistance                                | $V_{DS}=0V, V_{GS}=0V, f=1\text{MHz}$           | ---  | 2.1  | ---       | $\Omega$  |
| $Q_g$        | Total Gate Charge (4.5V)                       | $V_{DS}=32V, V_{GS}=4.5V, I_D=6A$               | ---  | 3.8  | ---       | nC        |
| $Q_{gs}$     | Gate-Source Charge                             |                                                 | ---  | 2.8  | ---       |           |
| $Q_{gd}$     | Gate-Drain Charge                              |                                                 | ---  | 1.1  | ---       |           |
| $T_{d(on)}$  | Turn-On Delay Time                             | $V_{DD}=20V, V_{GS}=10V, R_G=3.3\Omega, I_D=1A$ | ---  | 12.2 | ---       | ns        |
| $T_r$        | Rise Time                                      |                                                 | ---  | 5.3  | ---       |           |
| $T_{d(off)}$ | Turn-Off Delay Time                            |                                                 | ---  | 18   | ---       |           |
| $T_f$        | Fall Time                                      |                                                 | ---  | 9    | ---       |           |
| $C_{iss}$    | Input Capacitance                              | $V_{DS}=15V, V_{GS}=0V, f=1\text{MHz}$          | ---  | 376  | ---       | pF        |
| $C_{oss}$    | Output Capacitance                             |                                                 | ---  | 240  | ---       |           |
| $C_{rss}$    | Reverse Transfer Capacitance                   |                                                 | ---  | 19   | ---       |           |

### 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                       | ---  | ---  | 20   | A    |
| $V_{SD}$ | Diode Forward Voltage <sup>2</sup>       | $V_{GS}=0V, I_S=1A, T_J=25^{\circ}\text{C}$        | ---  | ---  | 1.2  | V    |
| $t_{rr}$ | Reverse Recovery Time                    | $I_F=6A, dI/dt=100A/\mu s, T_J=25^{\circ}\text{C}$ | ---  | 20   | ---  | nS   |
| $Q_{rr}$ | Reverse Recovery Charge                  |                                                    | ---  | 35   | ---  | nC   |

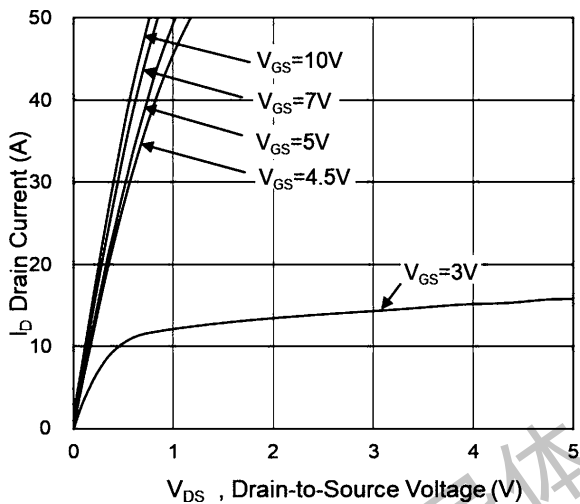
Note :

1. The data tested by surface mounted on a 1 inch<sup>2</sup> FR-4 board with 20Z copper.
2. The data tested by pulsed, pulse width  $\leq 300\mu s$ , duty cycle  $\leq 2\%$
3. The EAS data shows Max. rating. The test condition is  $V_{DD}=25V, V_{GS}=10V, L=0.1mH, I_{AS}=10A$
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.

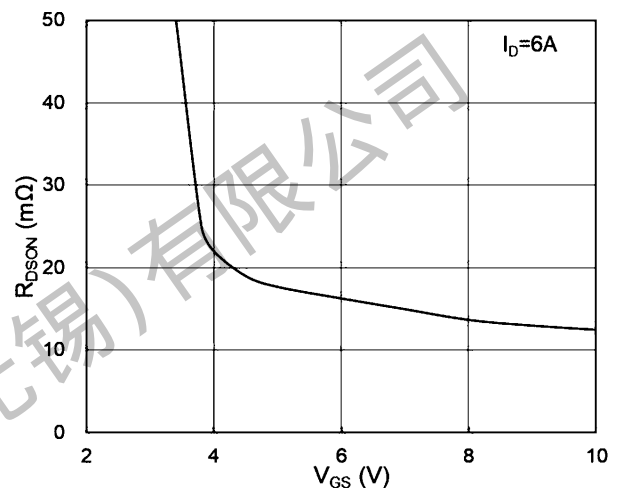
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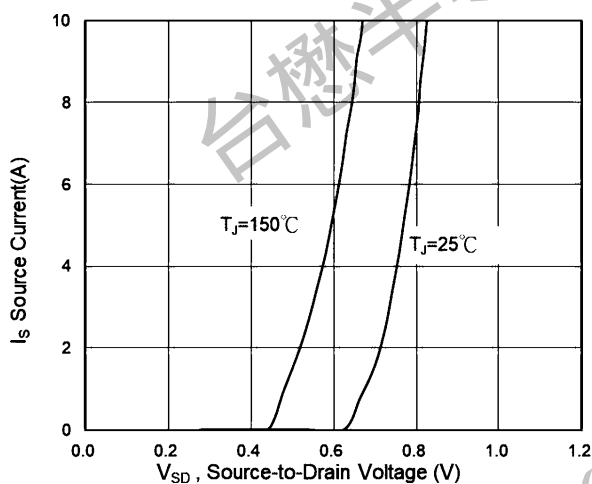
### Typical Characteristics



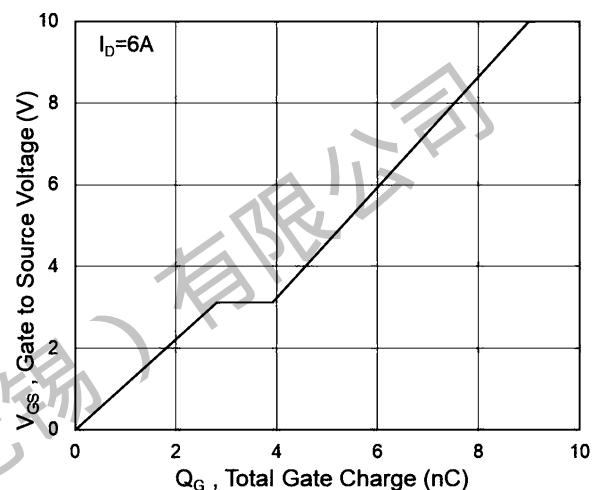
**Fig.1 Typical Output Characteristics**



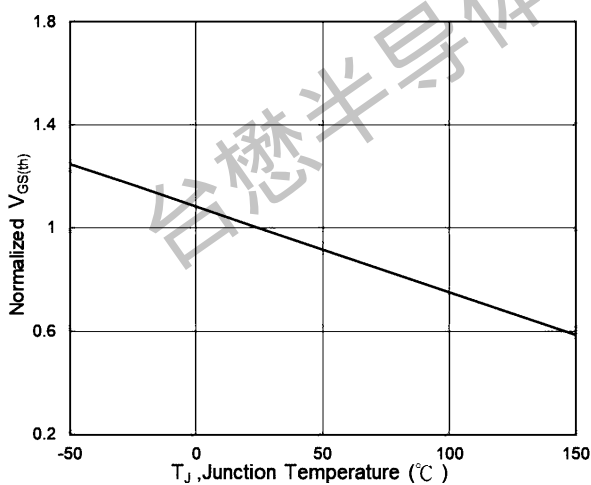
**Fig.2 On-Resistance vs G-S Voltage**



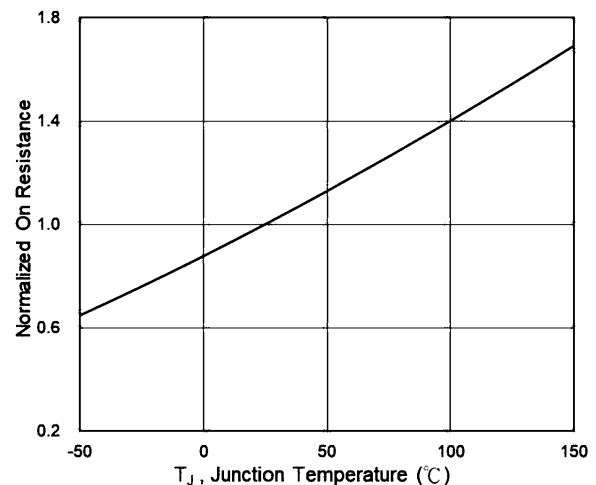
**Fig.3 Source Drain Forward Characteristics**



**Fig.4 Gate-Charge Characteristics**



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



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

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## N+N-Channel Enhancement Mosfet

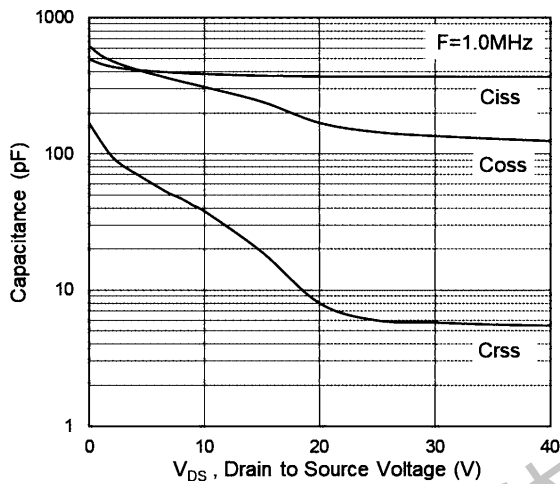


Fig.7 Capacitance

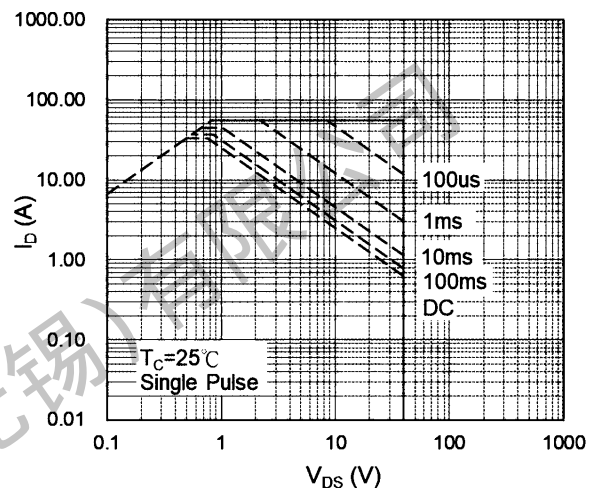


Fig.8 Safe Operating Area

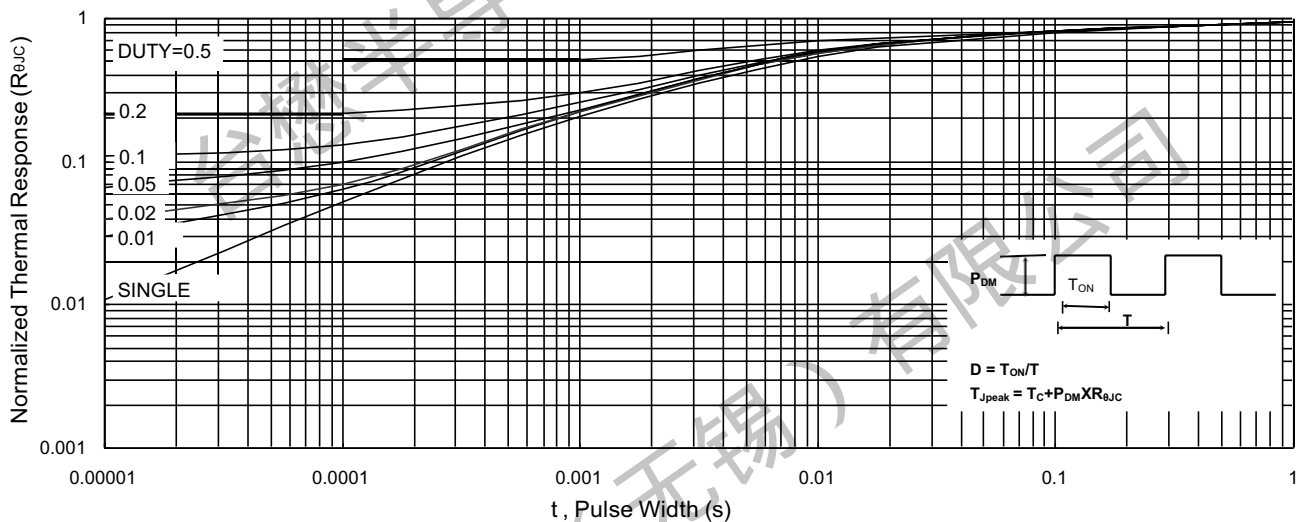


Fig.9 Normalized Maximum Transient Thermal Impedance

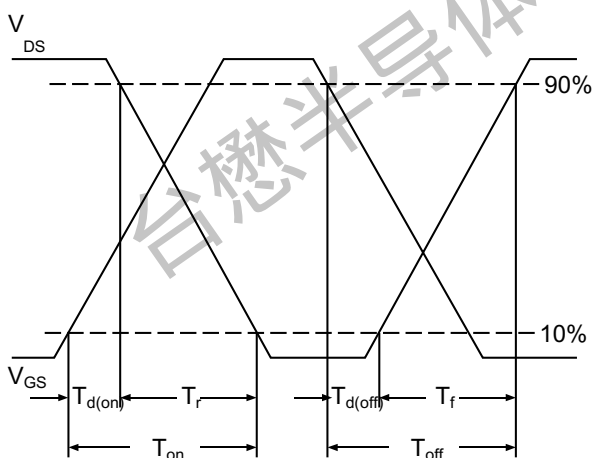


Fig.10 Switching Time Waveform

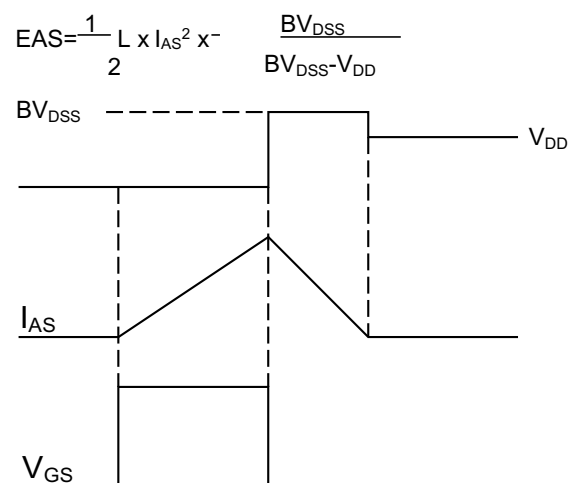
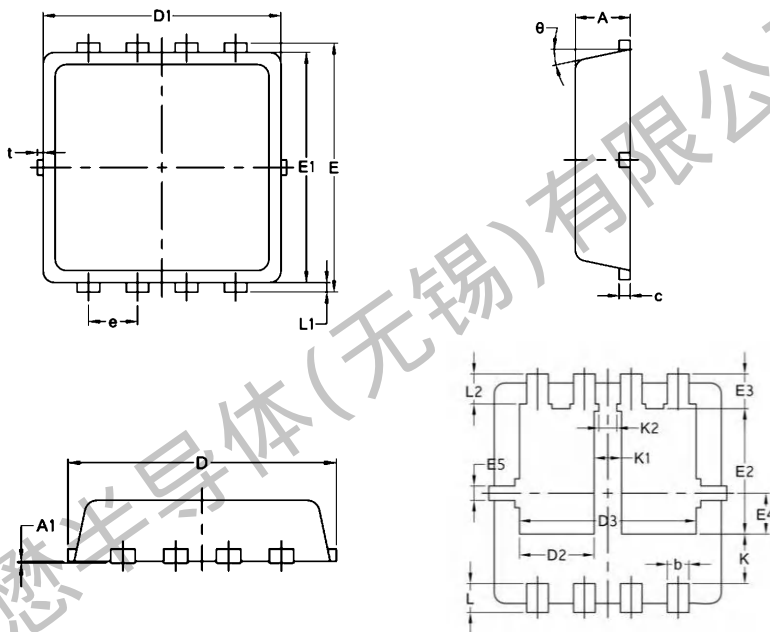


Fig.11 Unclamped Inductive Switching Waveform

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### Package Mechanical Data:DFN3x3-8L

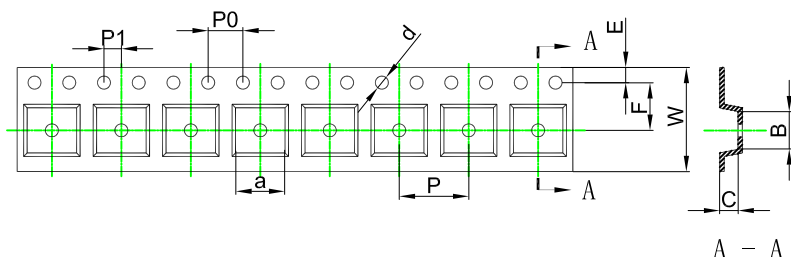


| Symbol | Common |           |      |
|--------|--------|-----------|------|
|        | Min    | Mm<br>Nom | Max  |
| A      | 0.70   | 0.75      | 0.85 |
| A1     | /      | /         | 0.05 |
| b      | 0.25   | 0.30      | 0.39 |
| c      | 0.14   | 0.152     | 0.20 |
| D      | 3.20   | 3.30      | 3.45 |
| D1     | 3.05   | 3.15      | 3.25 |
| D2     | 0.84   | 1.04      | 1.24 |
| D3     | 2.30   | 2.45      | 2.60 |
| E      | 3.20   | 3.30      | 3.40 |
| E1     | 2.95   | 3.05      | 3.15 |
| E2     | 1.60   | 1.74      | 1.90 |
| E3     | 0.28   | 0.48      | 0.65 |
| E4     | 0.37   | 0.57      | 0.77 |
| E5     | 0.10   | 0.20      | 0.30 |
| e      | 0.60   | 0.65      | 0.70 |
| K      | 0.50   | 0.69      | 0.80 |
| K1     | 0.30   | 0.38      | 0.53 |
| K2     | 0.15   | 0.25      | 0.35 |
| L      | 0.30   | 0.40      | 0.50 |
| L1     | 0.06   | 0.125     | 0.20 |
| L2     | 0.27   | 0.42      | 0.57 |
| t      | 0      | 0.075     | 0.13 |
| Φ      | 10°    | 12°       | 14°  |

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## N+N-Channel Enhancement Mosfet

### PDFN3×3-8L Embossed Carrier Tape



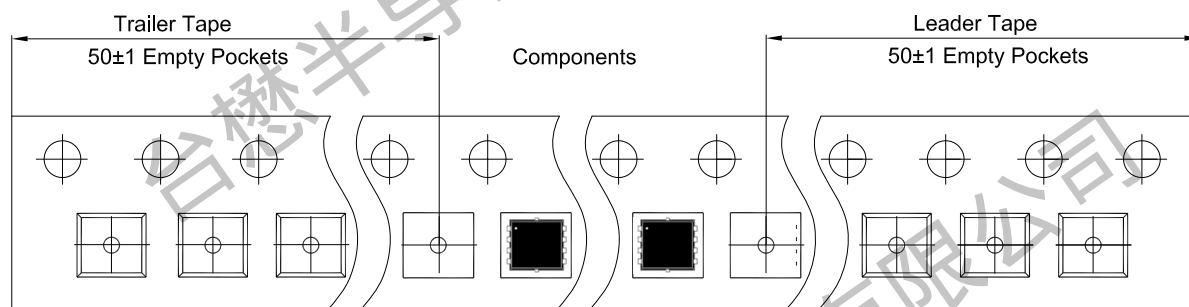
#### Packaging Description:

SOP-8L parts are shipped in tape. The carrier tape is made from a dissipative (carbon filled) polycarbonate resin. The cover tape is a multilayer film (Heat Activated Adhesive in nature) primarily composed of polyester film, adhesive layer, sealant, and anti-static sprayed agent. These reeled parts in standard option are shipped with 2,500 units per 13" or 33cm diameter reel. The reels are clear in color and is made of polystyrene plastic (anti-static coated).

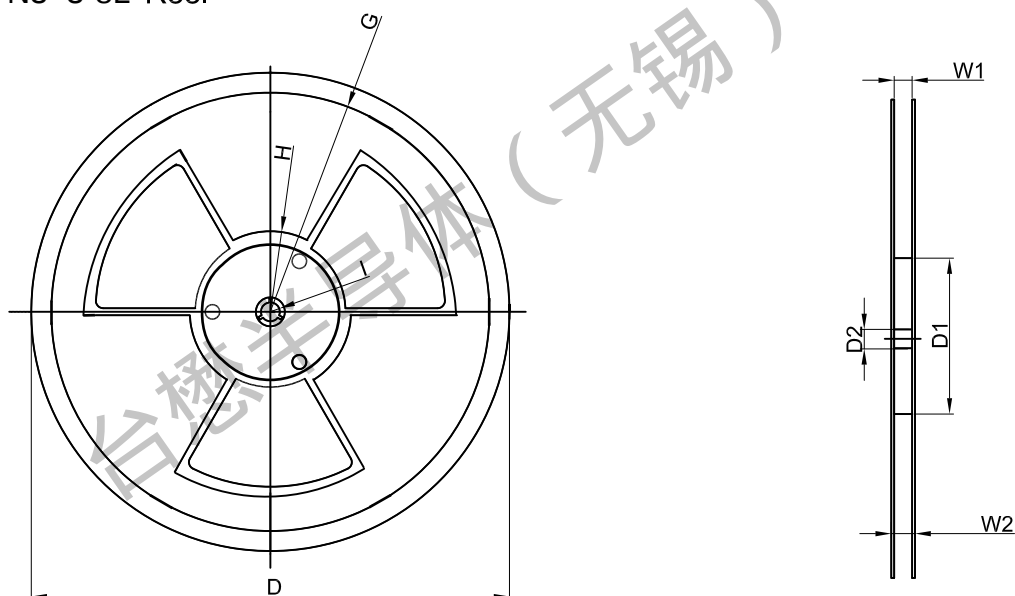
ALL DIM IN mm

| Dimensions are in millimeter |      |      |      |       |      |      |      |      |      |       |
|------------------------------|------|------|------|-------|------|------|------|------|------|-------|
| Pkg type                     | a    | B    | C    | d     | E    | F    | P0   | P    | P1   | W     |
| PDFN3×3-8L                   | 6.40 | 5.40 | 2.10 | Ø1.50 | 1.75 | 5.50 | 4.00 | 8.00 | 2.00 | 12.00 |

### PDFN3×3-8L Tape Leader and Trailer



### PDFN3×3-8L Reel



| Dimensions are in millimeter |         |        |       |         |        |       |       |       |
|------------------------------|---------|--------|-------|---------|--------|-------|-------|-------|
| Reel Option                  | D       | D1     | D2    | G       | H      | I     | W1    | W2    |
| 13"Dia                       | Ø330.00 | 100.00 | 13.00 | R135.00 | R55.00 | R6.50 | 12.00 | 14.00 |

| REEL      | Reel Size | Box        | Box Size(mm) | Carton     | Carton Size(mm) | G.W.(kg) |
|-----------|-----------|------------|--------------|------------|-----------------|----------|
| 5,000 pcs | 13 inch   | 10,000 pcs | 370×355×52   | 50,000 pcs | 400×360×368     |          |

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Revision history:

| Date       | Rev   | Description | Page |
|------------|-------|-------------|------|
| 2023.05.14 | 23.05 | Original    |      |