

# FDMS001N025DSD

## PowerTrench® Power Clip

### 25 V Asymmetric Dual N-Channel MOSFET

#### General Description

This device includes two specialized N-Channel MOSFETs in a dual package. The switch node has been internally connected to enable easy placement and routing of synchronous buck converters. The control MOSFET (Q1) and synchronous SyncFET (Q2) have been designed to provide optimal power efficiency.

#### Features

Q1: N-Channel

- Max  $r_{DS(on)}$  = 3.25 m $\Omega$  at  $V_{GS}$  = 10 V,  $I_D$  = 19 A
- Max  $r_{DS(on)}$  = 4 m $\Omega$  at  $V_{GS}$  = 4.5 V,  $I_D$  = 17 A

Q2: N-Channel

- Max  $r_{DS(on)}$  = 0.92 m $\Omega$  at  $V_{GS}$  = 10 V,  $I_D$  = 38 A
- Max  $r_{DS(on)}$  = 1.20 m $\Omega$  at  $V_{GS}$  = 4.5 V,  $I_D$  = 34 A
- Low Inductance Packaging Shortens Rise/Fall Times, Resulting in Lower Switching Losses
- MOSFET Integration Enables Optimum Layout for Lower Circuit Inductance and Reduced Switch Node Ringing
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

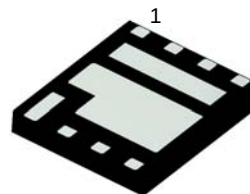
#### Applications

- Computing
- Communications
- General Purpose Point of Load

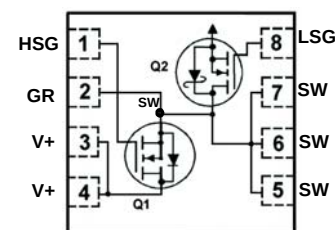
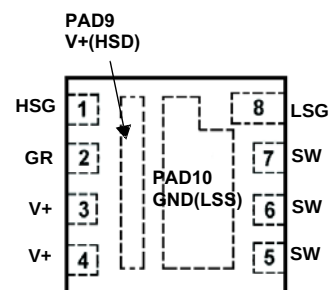


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PQFN8  
POWER CLIP  
CASE 483AR



#### PIN ASSIGNMENT

| Pin   | Name     | Description                    |
|-------|----------|--------------------------------|
| 1     | HSG      | High Side Gate                 |
| 2     | GR       | Gate Return                    |
| 3,4,9 | V+(HSD)  | High Side Drain                |
| 5,6,7 | SW       | Switching Node, Low Side Drain |
| 8     | LSG      | Low Side Gate                  |
| 10    | GND(LSS) | Low Side Source                |

#### ORDERING INFORMATION

See detailed ordering and shipping information on page 3 of this data sheet.

**Table 1. MAXIMUM RATINGS**  $T_A = 25^\circ\text{C}$  unless otherwise noted

| Symbol         | Parameter                                                       | Q1            | Q2            | Units            |
|----------------|-----------------------------------------------------------------|---------------|---------------|------------------|
| $V_{DS}$       | Drain to Source Voltage                                         | 25 (Note 1)   | 25            | V                |
| $V_{GS}$       | Gate to Source Voltage                                          | +16/-12V      | +16/-12V      | V                |
| $I_D$          | Drain Current –Continuous $T_C = 25^\circ\text{C}$ (Note 2)     | 69            | 165           | A                |
|                | –Continuous $T_C = 100^\circ\text{C}$ (Note 2)                  | 43            | 104           |                  |
|                | –Continuous $T_A = 25^\circ\text{C}$                            | 19 (Note 7a)  | 38 (Note 7b)  |                  |
|                | –Pulsed $T_A = 25^\circ\text{C}$ (Note 3)                       | 381           | 1240          |                  |
| $E_{AS}$       | Single Pulse Avalanche Energy (Note 4)                          | 121           | 337           | mJ               |
| $P_D$          | Power Dissipation for Single Operation $T_C = 25^\circ\text{C}$ | 26            | 42            | W                |
|                | Power Dissipation for Single Operation $T_A = 25^\circ\text{C}$ | 2.1 (Note 7a) | 2.3 (Note 7b) |                  |
| $T_J, T_{STG}$ | Operating and Storage Junction Temperature Range                | -55 to +150   |               | $^\circ\text{C}$ |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. The continuous  $V_{DS}$  rating is 25 V; However, a pulse of 30 V peak voltage for no longer than 100 ns duration at 600 KHz frequency can be applied.
2. Computed continuous current limited to Max Junction Temperature only, actual continuous current will be limited by thermal & electro-mechanical application board design.
3. Pulsed  $I_D$  please refer to Figure 11 and Figure 24 SOA graphs for more details.
4. Q1:  $E_{AS}$  of 121 mJ is based on starting  $T_J = 25^\circ\text{C}$ ; N-ch:  $L = 3\text{ mH}$ ,  $I_{AS} = 9\text{ A}$ ,  $V_{DD} = 25\text{ V}$ . 100% tested at  $L = 0.1\text{ mH}$ ,  $I_{AS} = 29\text{ A}$ .  
Q2:  $E_{AS}$  of 337 mJ is based on starting  $T_J = 25^\circ\text{C}$ ; N-ch:  $L = 3\text{ mH}$ ,  $I_{AS} = 15\text{ A}$ ,  $V_{DD} = 25\text{ V}$ . 100% tested at  $L = 0.1\text{ mH}$ ,  $I_{AS} = 48\text{ A}$ .

**Table 2. THERMAL CHARACTERISTICS**

| Symbol          | Parameter                               | Q1            | Q2            | Units              |
|-----------------|-----------------------------------------|---------------|---------------|--------------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case    | 4.9           | 3.0           | $^\circ\text{C/W}$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | 60 (Note 7a)  | 55 (Note 7b)  |                    |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | 130 (Note 7c) | 120 (Note 7d) |                    |

**Table 3. ELECTRICAL CHARACTERISTICS**  $T_J = 25^\circ\text{C}$  unless otherwise noted

| Symbol | Parameter | Test Conditions | Type | Min | Typ | Max | Units |
|--------|-----------|-----------------|------|-----|-----|-----|-------|
|--------|-----------|-----------------|------|-----|-----|-----|-------|

**OFF CHARACTERISTICS**

|                              |                                           |                                                                                                                              |          |          |          |                        |                                |
|------------------------------|-------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|----------|----------|----------|------------------------|--------------------------------|
| $BV_{DSS}$                   | Drain to Source Breakdown Voltage         | $I_D = 1\text{ mA}$ , $V_{GS} = 0\text{ V}$<br>$I_D = 1\text{ mA}$ , $V_{GS} = 0\text{ V}$                                   | Q1<br>Q2 | 25<br>25 |          |                        | V                              |
| $\Delta BV_{DSS}/\Delta T_J$ | Breakdown Voltage Temperature Coefficient | $I_D = 10\text{ mA}$ , referenced to $25^\circ\text{C}$<br>$I_D = 10\text{ mA}$ , referenced to $25^\circ\text{C}$           | Q1<br>Q2 |          | 15<br>28 |                        | mV/ $^\circ\text{C}$           |
| $I_{DSS}$                    | Zero Gate Voltage Drain Current           | $V_{DS} = 20\text{ V}$ , $V_{GS} = 0\text{ V}$<br>$V_{DS} = 20\text{ V}$ , $V_{GS} = 0\text{ V}$                             | Q1<br>Q2 |          |          | 1<br>500               | $\mu\text{A}$<br>$\mu\text{A}$ |
| $I_{GSS}$                    | Gate to Source Leakage Current            | $V_{GS} = +16\text{ V}/-12\text{ V}$ , $V_{DS} = 0\text{ V}$<br>$V_{GS} = +16\text{ V}/-12\text{ V}$ , $V_{DS} = 0\text{ V}$ | Q1<br>Q2 |          |          | $\pm 100$<br>$\pm 100$ | nA<br>nA                       |

**ON CHARACTERISTICS**

|                                |                                                          |                                                                                                                                                                           |          |            |                      |                      |                      |
|--------------------------------|----------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|------------|----------------------|----------------------|----------------------|
| $V_{GS(th)}$                   | Gate to Source Threshold Voltage                         | $V_{GS} = V_{DS}$ , $I_D = 320\text{ }\mu\text{A}$<br>$V_{GS} = V_{DS}$ , $I_D = 1\text{ mA}$                                                                             | Q1<br>Q2 | 0.8<br>1.0 | 1.3<br>1.5           | 2.5<br>3.0           | V                    |
| $\Delta V_{GS(th)}/\Delta T_J$ | Gate to Source Threshold Voltage Temperature Coefficient | $I_D = 1\text{ mA}$ , referenced to $25^\circ\text{C}$<br>$I_D = 10\text{ mA}$ , referenced to $25^\circ\text{C}$                                                         | Q1<br>Q2 |            | -4<br>-3             |                      | mV/ $^\circ\text{C}$ |
| $r_{DS(on)}$                   | Drain to Source On Resistance                            | $V_{GS} = 10\text{ V}$ , $I_D = 19\text{ A}$<br>$V_{GS} = 4.5\text{ V}$ , $I_D = 17\text{ A}$<br>$V_{GS} = 10\text{ V}$ , $I_D = 19\text{ A}$ , $T_J = 125^\circ\text{C}$ | Q1       |            | 2.5<br>3.0<br>3.5    | 3.25<br>4.0<br>5.0   | m $\Omega$           |
|                                |                                                          | $V_{GS} = 10\text{ V}$ , $I_D = 38\text{ A}$<br>$V_{GS} = 4.5\text{ V}$ , $I_D = 34\text{ A}$<br>$V_{GS} = 10\text{ V}$ , $I_D = 38\text{ A}$ , $T_J = 125^\circ\text{C}$ | Q2       |            | 0.70<br>0.92<br>0.96 | 0.92<br>1.20<br>1.38 |                      |

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**Table 3. ELECTRICAL CHARACTERISTICS**  $T_J = 25^\circ\text{C}$  unless otherwise noted

| Symbol | Parameter | Test Conditions | Type | Min | Typ | Max | Units |
|--------|-----------|-----------------|------|-----|-----|-----|-------|
|--------|-----------|-----------------|------|-----|-----|-----|-------|

## ON CHARACTERISTICS

|          |                          |                                          |    |  |     |  |   |
|----------|--------------------------|------------------------------------------|----|--|-----|--|---|
| $g_{FS}$ | Forward Transconductance | $V_{DS} = 5\text{ V}, I_D = 19\text{ A}$ | Q1 |  | 98  |  | S |
|          |                          | $V_{DS} = 5\text{ V}, I_D = 38\text{ A}$ | Q2 |  | 262 |  |   |

## DYNAMIC CHARACTERISTICS

|           |                              |                                                                                                                                              |    |     |      |     |          |
|-----------|------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|----|-----|------|-----|----------|
| $C_{iss}$ | Input Capacitance            | Q1:<br>$V_{DS} = 13\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$<br>Q2:<br>$V_{DS} = 13\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$ | Q1 |     | 1370 |     | pF       |
|           |                              |                                                                                                                                              | Q2 |     | 5105 |     |          |
| $C_{oss}$ | Output Capacitance           |                                                                                                                                              | Q1 |     | 625  |     | pF       |
|           |                              |                                                                                                                                              | Q2 |     | 1810 |     |          |
| $C_{rss}$ | Reverse Transfer Capacitance |                                                                                                                                              | Q1 |     | 44   |     | pF       |
|           |                              |                                                                                                                                              | Q2 |     | 173  |     |          |
| $R_g$     | Gate Resistance              |                                                                                                                                              | Q1 | 0.1 | 0.4  | 1.2 | $\Omega$ |
|           |                              |                                                                                                                                              | Q2 | 0.1 | 0.3  | 1.0 |          |

## SWITCHING CHARACTERISTICS

|                     |                               |                                                                                                                                                                  |                                                                                                                |          |  |            |           |    |
|---------------------|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|----------|--|------------|-----------|----|
| t <sub>d(on)</sub>  | Turn-On Delay Time            | Q1:<br>V <sub>DD</sub> = 13 V, I <sub>D</sub> = 19 A, R <sub>GEN</sub> = 6 Ω<br><br>Q2:<br>V <sub>DD</sub> = 13 V, I <sub>D</sub> = 38 A, R <sub>GEN</sub> = 6 Ω |                                                                                                                | Q1<br>Q2 |  | 8<br>15    | 16<br>26  | ns |
| t <sub>r</sub>      | Rise Time                     |                                                                                                                                                                  |                                                                                                                | Q1<br>Q2 |  | 2<br>5     | 10<br>10  | ns |
| t <sub>d(off)</sub> | Turn-Off Delay Time           |                                                                                                                                                                  |                                                                                                                | Q1<br>Q2 |  | 22<br>39   | 34<br>62  | ns |
| t <sub>f</sub>      | Fall Time                     |                                                                                                                                                                  |                                                                                                                | Q1<br>Q2 |  | 2<br>4     | 10<br>10  | ns |
| Q <sub>g</sub>      | Total Gate Charge             | V <sub>GS</sub> = 0 V to 10 V                                                                                                                                    | Q1<br>V <sub>DD</sub> = 13 V, I <sub>D</sub> = 19 A<br><br>Q2<br>V <sub>DD</sub> = 13 V, I <sub>D</sub> = 38 A | Q1<br>Q2 |  | 21<br>75   | 30<br>104 | nC |
| Q <sub>g</sub>      | Total Gate Charge             | V <sub>GS</sub> = 0 V to 4.5 V                                                                                                                                   |                                                                                                                | Q1<br>Q2 |  | 9.7<br>35  | 14<br>49  | nC |
| Q <sub>gs</sub>     | Gate to Source Gate Charge    |                                                                                                                                                                  |                                                                                                                | Q1<br>Q2 |  | 2.9<br>12  |           | nC |
| Q <sub>gd</sub>     | Gate to Drain “Miller” Charge |                                                                                                                                                                  |                                                                                                                | Q1<br>Q2 |  | 2.0<br>7.9 |           | nC |

## DRAIN-SOURCE DIODE CHARACTERISTICS

|               |                                       |                                                                                                                            |    |  |     |      |    |
|---------------|---------------------------------------|----------------------------------------------------------------------------------------------------------------------------|----|--|-----|------|----|
| $V_{SD}$      | Source to Drain Diode Forward Voltage | $V_{GS} = 0\text{ V}, I_S = 19\text{ A}$ (Note 6)<br>$V_{GS} = 0\text{ V}, I_S = 38\text{ A}$ (Note 6)                     | Q1 |  | 0.8 | 1.2  | V  |
|               |                                       |                                                                                                                            | Q2 |  | 0.8 | 1.2  |    |
| $I_S$         | Diode continuous forward current      | $T_C = 25^\circ\text{C}$ (Note 2)                                                                                          | Q1 |  |     | 69   | A  |
|               |                                       |                                                                                                                            | Q2 |  |     | 125  |    |
| $I_{S,pulse}$ | Diode pulse current                   | $T_C = 25^\circ\text{C}$ (Note 3)                                                                                          | Q1 |  |     | 381  | A  |
|               |                                       |                                                                                                                            | Q2 |  |     | 1240 |    |
| $t_{rr}$      | Reverse Recovery Time                 | Q1<br>$I_F = 19\text{ A}, di/dt = 100\text{ A}/\mu\text{s}$<br>Q2<br>$I_F = 38\text{ A}, di/dt = 300\text{ A}/\mu\text{s}$ | Q1 |  | 27  | 44   | ns |
|               |                                       |                                                                                                                            | Q2 |  | 39  | 62   |    |
| $Q_{rr}$      | Reverse Recovery Charge               |                                                                                                                            | Q1 |  | 12  | 21   | nC |
|               |                                       |                                                                                                                            | Q2 |  | 55  | 87   |    |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

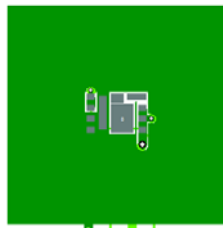
5.  $R_{\theta JA}$  is determined with the device mounted on a 1 in<sup>2</sup> pad 2 oz copper pad on a 1.5 x 1.5 in. board of FR-4 material.  $R_{\theta CA}$  is determined by the user's board design.

6. Pulse Test: Pulse Width < 300  $\mu\text{s}$ , Duty cycle < 2.0%.

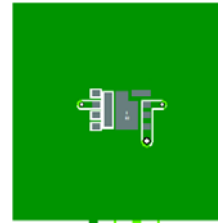
## PACKAGE MARKING AND ORDERING INFORMATION

| Device Marking | Device         | Package       | Reel Size | Tape Width | Quantity   |
|----------------|----------------|---------------|-----------|------------|------------|
| FDMS001N025DSD | FDMS001N025DSD | Power Clip 56 | 13"       | 12 mm      | 3000 units |

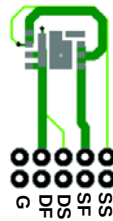
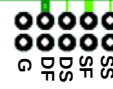
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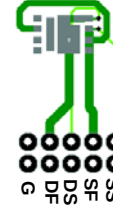
(Note 7a)



(Note 7b)



(Note 7c)



(Note 7d)

7. a) 60°C/W when mounted on a 1 in<sup>2</sup> pad of 2 oz copper
- b) 55°C/W when mounted on a 1 in<sup>2</sup> pad of 2 oz copper
- c) 130°C/W when mounted on a minimum pad of 2 oz copper
- d) 120°C/W when mounted on a minimum pad of 2 oz copper

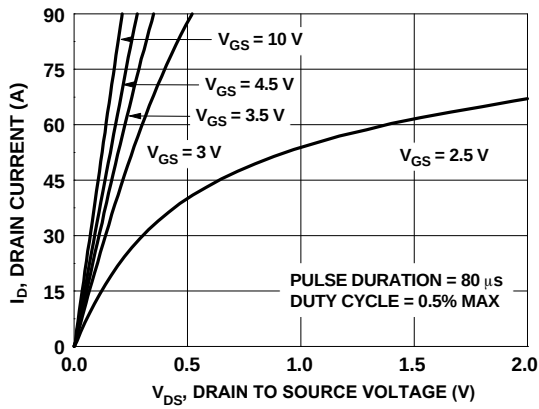
TYPICAL CHARACTERISTICS (Q1 N-Channel)  $T_J = 25^\circ\text{C}$  unless otherwise noted

Figure 1. On Region Characteristics

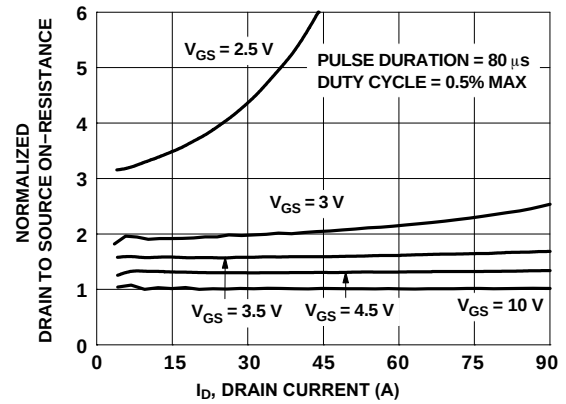


Figure 2. Normalized On-Resistance vs. Drain Current and Gate Voltage

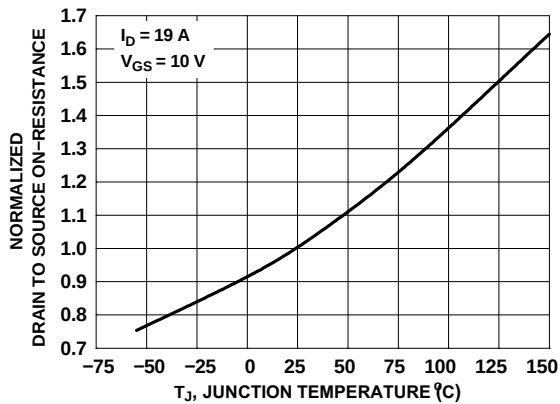


Figure 3. Normalized On Resistance vs. Junction Temperature

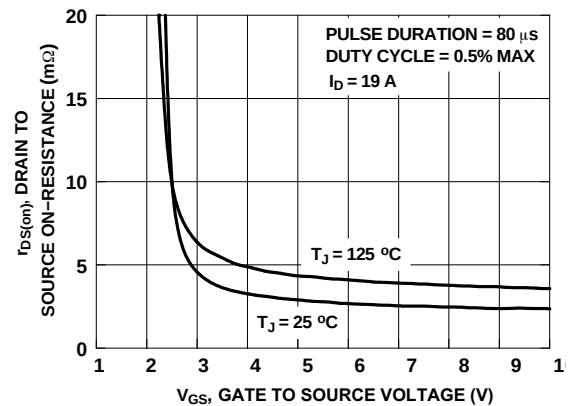


Figure 4. On-Resistance vs. Gate to Source Voltage

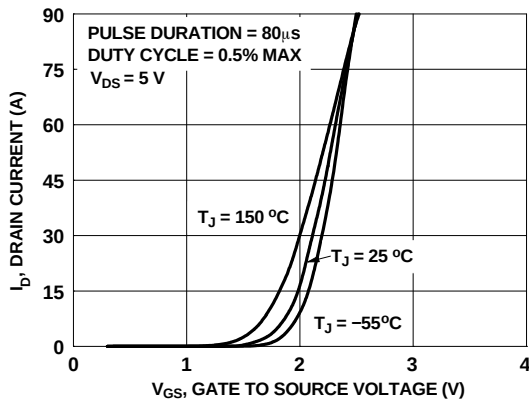


Figure 5. Transfer Characteristics

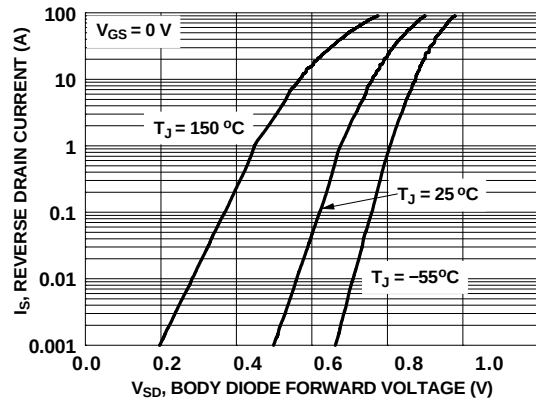


Figure 6. Source to Drain Diode Forward Voltage vs. Source Current

TYPICAL CHARACTERISTICS (Q1 N-Channel)  $T_J = 25^\circ\text{C}$  unless otherwise noted

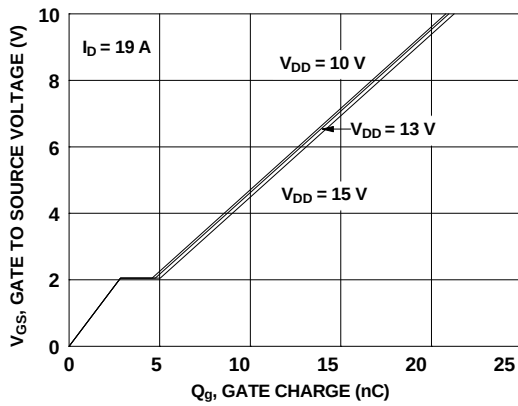


Figure 7. Gate Charge Characteristics

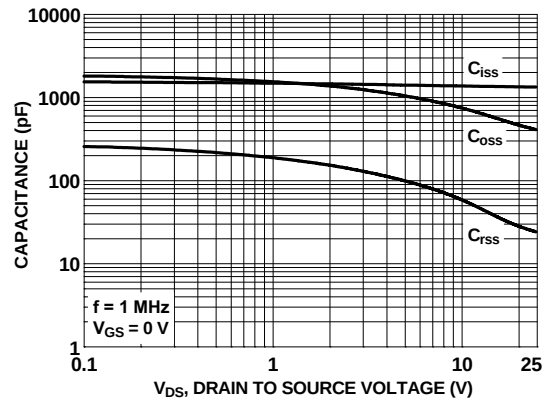


Figure 8. Capacitance vs. Drain to Source Voltage

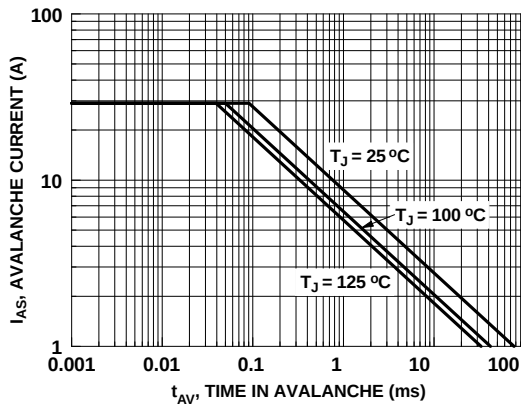


Figure 9. Unclamped Inductive Switching Capability

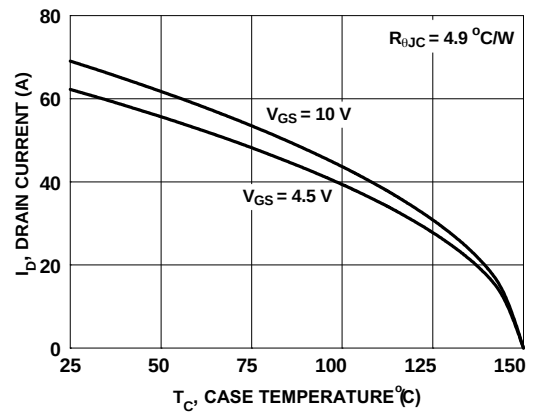


Figure 10. Maximum Continuous Drain Current vs. Case Temperature

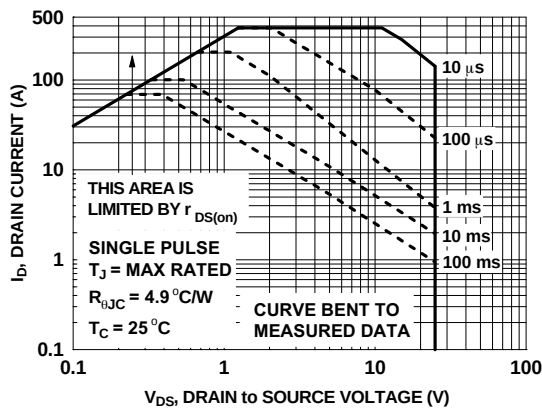


Figure 11. Forward Bias Safe Operating Area

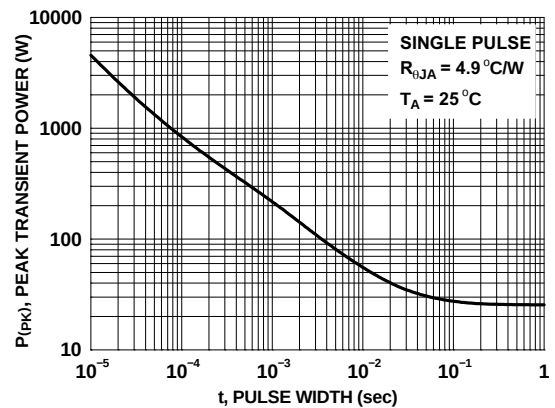


Figure 12. Single Pulse Maximum Power Dissipation

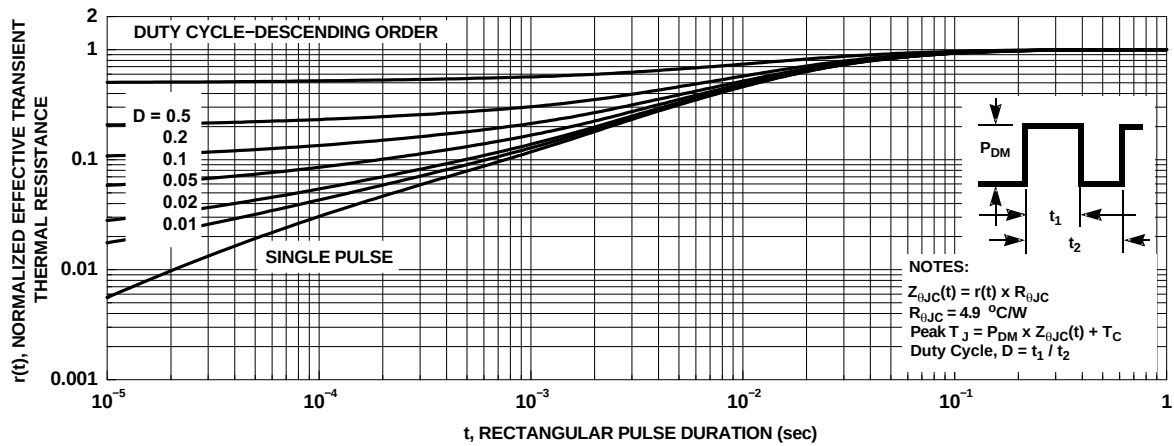
TYPICAL CHARACTERISTICS (Q1 N-Channel)  $T_J = 25^\circ\text{C}$  unless otherwise noted

Figure 13. Junction-to-Case Transient Thermal Response Curve

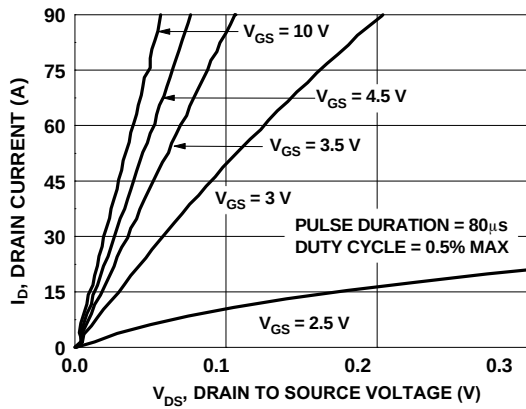
TYPICAL CHARACTERISTICS (Q2 N-Channel)  $T_J = 25^\circ\text{C}$  unless otherwise noted

Figure 14. On Region Characteristics

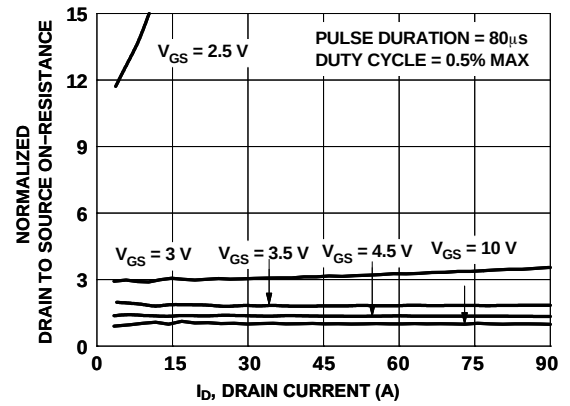


Figure 15. Normalized On-Resistance vs. Drain Current and Gate Voltage

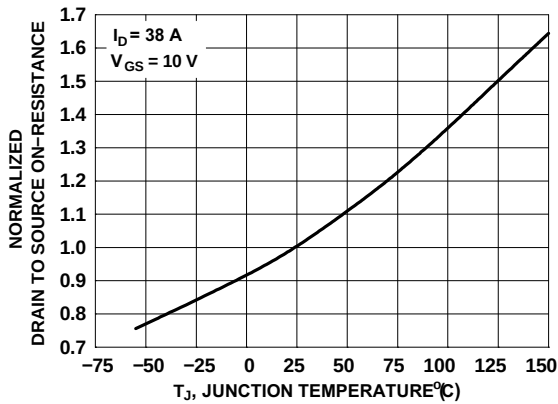


Figure 16. Normalized On Resistance vs. Junction Temperature

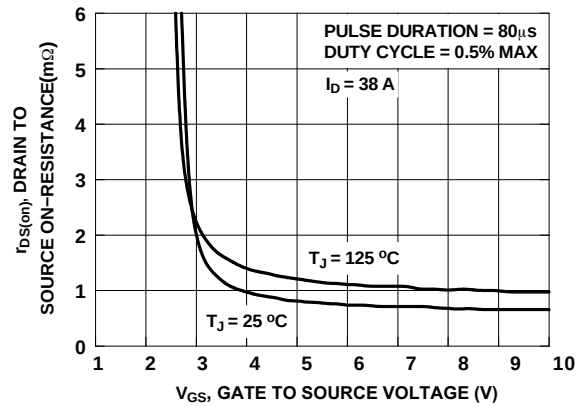


Figure 17. On-Resistance vs. Gate to Source Voltage

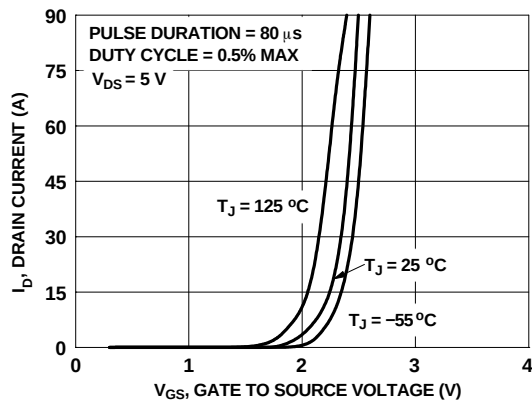


Figure 18. Transfer Characteristics

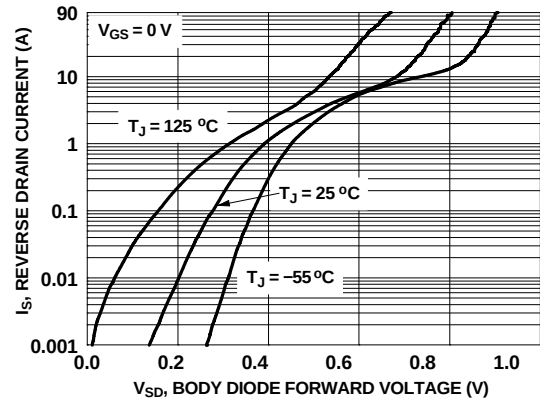


Figure 19. Source to Drain Diode Forward Voltage vs. Source Current



TYPICAL CHARACTERISTICS (Q2 N-Channel)  $T_J = 25^\circ\text{C}$  unless otherwise noted

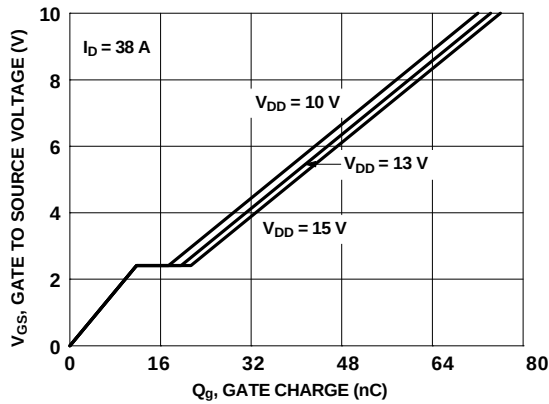


Figure 20. Gate Charge Characteristics

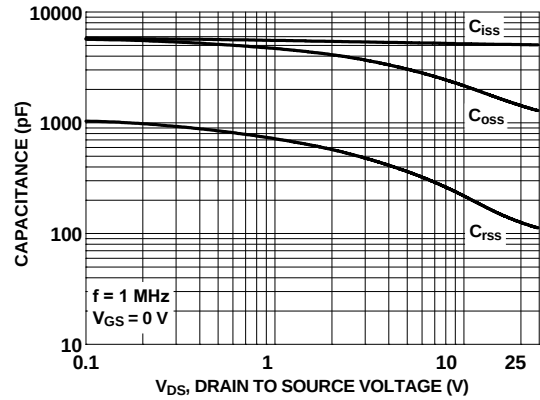


Figure 21. Capacitance vs. Drain to Source Voltage

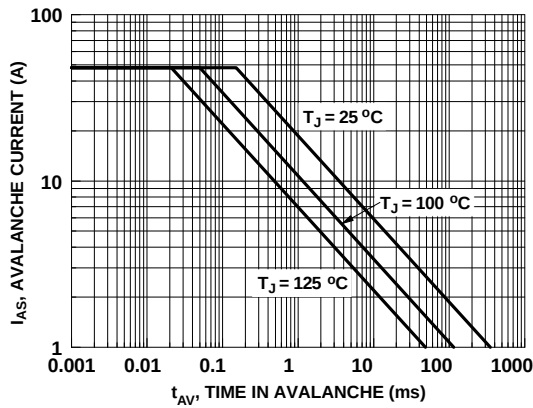


Figure 22. Unclamped Inductive Switching Capability

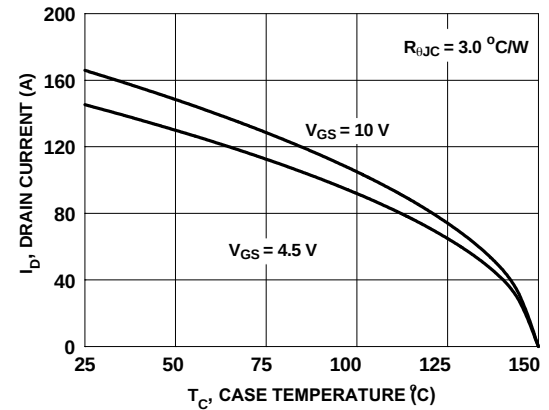


Figure 23. Maximum Continuous Drain Current vs. Case Temperature

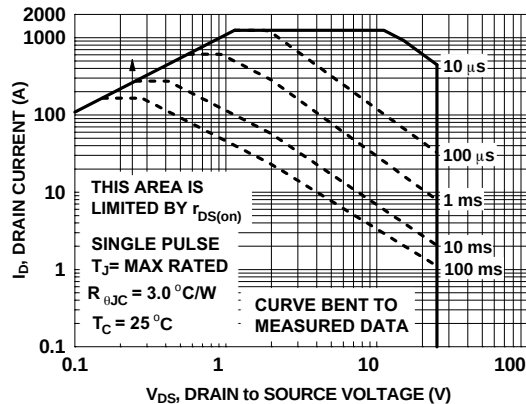


Figure 24. Forward Bias Safe Operating Area

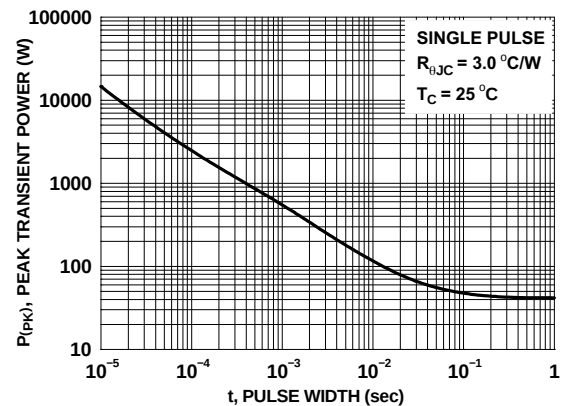


Figure 25. Single Pulse Maximum Power Dissipation

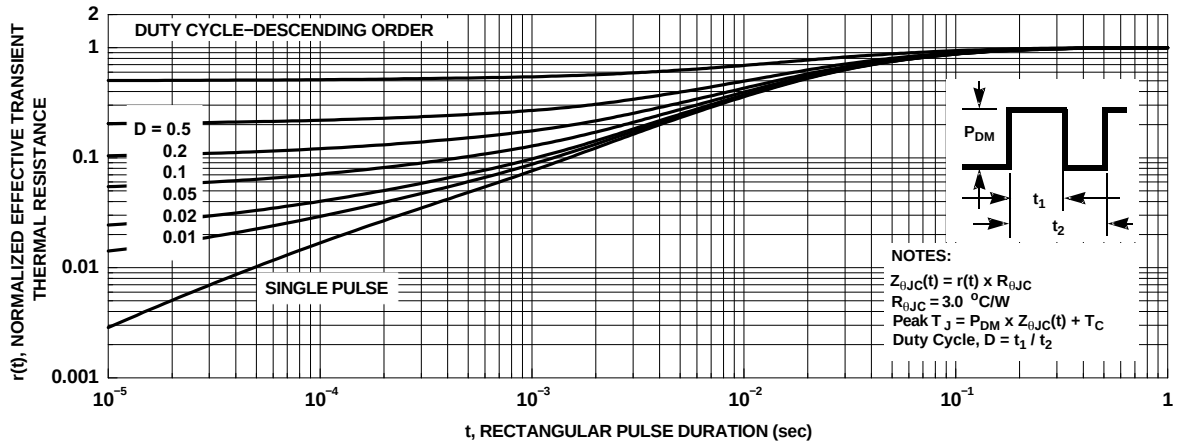
TYPICAL CHARACTERISTICS (Q2 N-Channel)  $T_J = 25^\circ\text{C}$  unless otherwise noted

Figure 26. Junction-to-Case Transient Thermal Response Curve

## TYPICAL CHARACTERISTICS (continued)

ON Semiconductor's SyncFET process embeds a Schottky diode in parallel with PowerTrench MOSFET. This diode exhibits similar characteristics to a discrete external Schottky diode in parallel with a MOSFET. Figure 27 shows the reverse recovery characteristic of the FDMS001N025DSD.

Schottky barrier diodes exhibit significant leakage at high temperature and high reverse voltage. This will increase the power in the device.

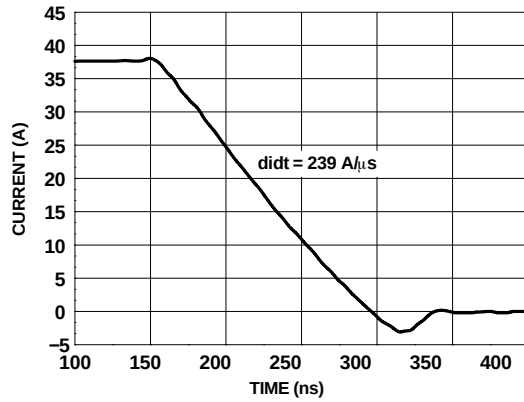


Figure 27. FDMS001N025DSD SyncFET Body Diode Reverse Recovery Characteristic

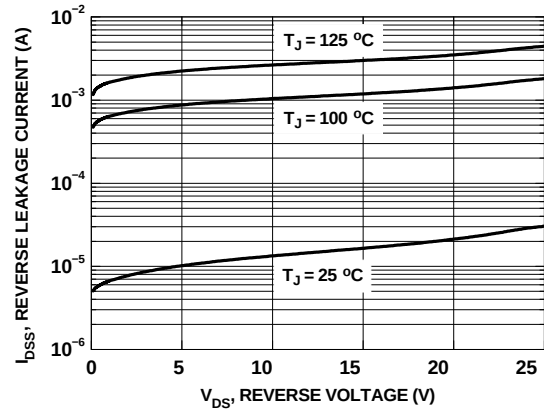
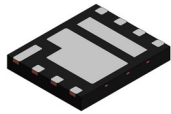


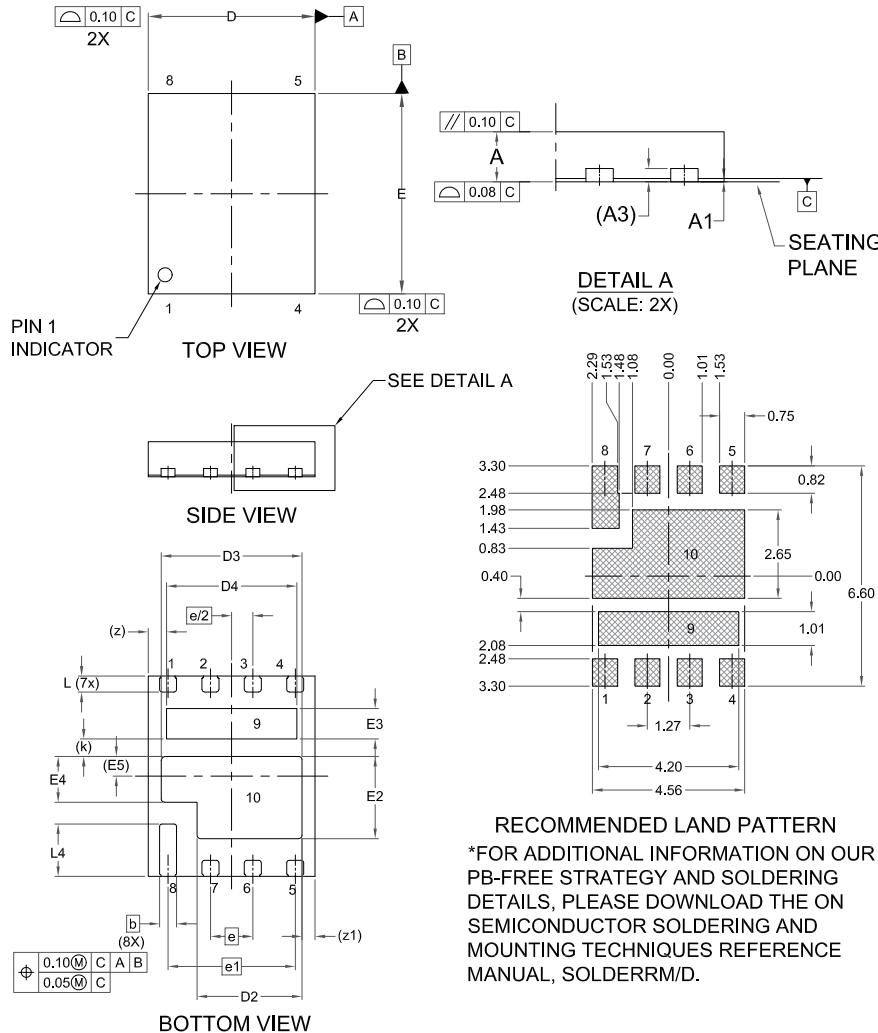
Figure 28. SyncFET Body Diode Reverse Leakage vs. Drain-Source Voltage

# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS



**PQFN8 5.00x6.00x0.75, 1.27P**  
**CASE 483AR**  
**ISSUE D**

DATE 06 NOV 2023



NOTES: UNLESS OTHERWISE SPECIFIED

- A) DOES NOT FULLY CONFORM TO JEDEC REGISTRATION, MO-229, DATED 11/2001.
- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DIMENSIONS DO NOT INCLUDE BURRS OR MOLD FLASH. MOLD FLASH OR BURRS DOES NOT EXCEED 0.10MM.
- D) DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994.

| DIM | MILLIMETERS |      |      |
|-----|-------------|------|------|
|     | MIN.        | NOM. | MAX. |
| A   | 0.70        | 0.75 | 0.80 |
| A1  | 0.00        | -    | 0.05 |
| A3  | 0.20 REF    |      |      |
| b   | 0.51 BSC    |      |      |
| D   | 4.90        | 5.00 | 5.10 |
| D2  | 3.05        | 3.15 | 3.25 |
| D3  | 4.12        | 4.22 | 4.32 |
| D4  | 3.80        | 3.90 | 4.00 |
| E   | 5.90        | 6.00 | 6.10 |
| E2  | 2.36        | 2.46 | 2.56 |
| E3  | 0.81        | 0.91 | 1.01 |
| E4  | 1.27        | 1.37 | 1.47 |
| E5  | 0.59 REF    |      |      |
| e   | 1.27 BSC    |      |      |
| e/2 | 0.635 BSC   |      |      |
| e1  | 3.81 BSC    |      |      |
| k   | 0.52 REF    |      |      |
| L   | 0.38        | 0.48 | 0.58 |
| L4  | 1.47        | 1.57 | 1.67 |
| z   | 0.55 REF    |      |      |
| z1  | 0.39 REF    |      |      |

**RECOMMENDED LAND PATTERN**  
\*FOR ADDITIONAL INFORMATION ON OUR PB-FREE STRATEGY AND SOLDERING DETAILS, PLEASE DOWNLOAD THE ON SEMICONDUCTOR SOLDERING AND MOUNTING TECHNIQUES REFERENCE MANUAL, SOLDERM/D.

|                         |                                    |                                                                                                                                                                                     |
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