

# MOSFET – N-Channel, DUAL COOL<sup>®</sup> 56, POWERTRENCH<sup>®</sup> 30 V, 100 A, 0.99 mΩ

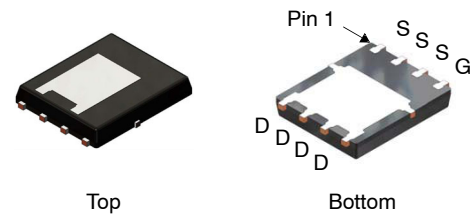
## FDMS7650DC

### General Description

This N-Channel MOSFET is produced using onsemi's advanced POWERTRENCH process. Advancements in both silicon and DUAL COOL package technologies have been combined to offer the lowest  $r_{DS(on)}$  while maintaining excellent switching performance by extremely low Junction-to-Ambient thermal resistance.

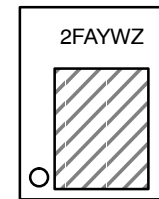
### Features

- DUAL COOL Top Side Cooling PQFN package
- Max  $r_{DS(on)} = 0.99 \text{ m}\Omega$  at  $V_{GS} = 10 \text{ V}$ ,  $I_D = 36 \text{ A}$
- Max  $r_{DS(on)} = 1.55 \text{ m}\Omega$  at  $V_{GS} = 4.5 \text{ V}$ ,  $I_D = 32 \text{ A}$
- High performance technology for extremely low  $r_{DS(on)}$
- This Device is Pb-Free and is RoHS Compliant

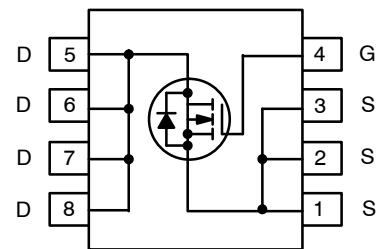


DFN8 5x6.15, 1.27P,  
DUAL COOL 56  
CASE 506EG

### MARKING DIAGRAM



2F = Specific Device Code  
A = Assembly Location  
Y = Year  
W = Work Week  
Z = Assembly Lot Code



N-Channel MOSFET

### ORDERING INFORMATION

See detailed ordering and shipping information on page 7 of this data sheet.

# FDMS7650DC

## MOSFET MAXIMUM RATINGS (T<sub>A</sub> = 25°C unless otherwise specified)

| Symbol                            | Parameter                                        |                                  | Rating      | Unit |
|-----------------------------------|--------------------------------------------------|----------------------------------|-------------|------|
| V <sub>DS</sub>                   | Drain to Source Voltage                          |                                  | 30          | V    |
| V <sub>GS</sub>                   | Gate to Source Voltage (Note 4)                  |                                  | +20         | V    |
| I <sub>D</sub>                    | Drain Current – Continuous (Package limited)     | T <sub>C</sub> = 25°C            | 100         | A    |
|                                   | – Continuous (Silicon limited)                   | T <sub>C</sub> = 25°C            | 289         |      |
|                                   | – Continuous                                     | T <sub>A</sub> = 25 °C (Note 1a) | 47          |      |
|                                   | – Pulsed                                         |                                  | 200         |      |
| E <sub>AS</sub>                   | Single Pulse Avalanche Energy (Note 3)           |                                  | 578         | mJ   |
| dv/dt                             | Peak Diode Recovery dv/dt (Note 5)               |                                  | 0.5         | V/ns |
| P <sub>D</sub>                    | Power Dissipation                                | T <sub>C</sub> = 25°C            | 125         | W    |
|                                   | Power Dissipation                                | T <sub>A</sub> = 25°C (Note 1a)  | 3.3         |      |
| T <sub>J</sub> , T <sub>STG</sub> | Operating and Storage Junction Temperature Range |                                  | –55 to +150 | °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.

## THERMAL CHARACTERISTICS

| Symbol           | Parameter                                           | Rating | Unit |
|------------------|-----------------------------------------------------|--------|------|
| R <sub>θJC</sub> | Thermal Resistance, Junction to Case (Top Source)   | 2.3    | °C/W |
| R <sub>θJC</sub> | Thermal Resistance, Junction to Case (Bottom Drain) | 1      |      |
| R <sub>θJA</sub> | Thermal Resistance, Junction to Ambient (Note 1a)   | 38     |      |
| R <sub>θJA</sub> | Thermal Resistance, Junction to Ambient (Note 1b)   | 81     |      |
| R <sub>θJA</sub> | Thermal Resistance, Junction to Ambient (Note 1i)   | 16     |      |
| R <sub>θJA</sub> | Thermal Resistance, Junction to Ambient (Note 1j)   | 23     |      |
| R <sub>θJA</sub> | Thermal Resistance, Junction to Ambient (Note 1k)   | 11     |      |

# FDMS7650DC

## ELECTRICAL CHARACTERISTICS (T<sub>J</sub> = 25°C unless otherwise noted)

| Symbol | Parameter | Test Condition | Min. | Typ. | Max. | Unit |
|--------|-----------|----------------|------|------|------|------|
|--------|-----------|----------------|------|------|------|------|

### ON CHARACTERISTICS

|                                      |                                           |                                                |    |    |     |       |
|--------------------------------------|-------------------------------------------|------------------------------------------------|----|----|-----|-------|
| BV <sub>DSS</sub>                    | Drain to Source Breakdown Voltage         | I <sub>D</sub> = 250 μA, V <sub>GS</sub> = 0 V | 30 | –  | –   | V     |
| $\frac{\Delta BV_{DSS}}{\Delta T_j}$ | Breakdown Voltage Temperature Coefficient | I <sub>D</sub> = 250 μA, referenced to 25°C    | –  | 12 | –   | mV/°C |
| I <sub>DSS</sub>                     | Zero Gate Voltage Drain Current           | V <sub>DS</sub> = 24 V, V <sub>GS</sub> = 0 V  | –  | –  | 1   | μA    |
| I <sub>GSS</sub>                     | Gate to Source Leakage Current, Forward   | V <sub>GS</sub> = 20 V, V <sub>DS</sub> = 0 V  | –  | –  | 100 | nA    |

### ON CHARACTERISTICS

|                                        |                                                          |                                                                       |     |     |      |       |
|----------------------------------------|----------------------------------------------------------|-----------------------------------------------------------------------|-----|-----|------|-------|
| V <sub>GS(th)</sub>                    | Gate to Source Threshold Voltage                         | V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = 250 μA           | 1.1 | 1.9 | 2.7  | V     |
| $\frac{\Delta V_{GS(th)}}{\Delta T_j}$ | Gate to Source Threshold Voltage Temperature Coefficient | I <sub>D</sub> = 250 μA, referenced to 25°C                           | –   | –7  | –    | mV/°C |
| r <sub>DS(on)</sub>                    | Static Drain to Source On Resistance                     | V <sub>GS</sub> = 10 V, I <sub>D</sub> = 36 A                         | –   | 0.6 | 0.99 | mΩ    |
|                                        |                                                          | V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 32 A                        | –   | 1   | 1.55 |       |
|                                        |                                                          | V <sub>GS</sub> = 10 V, I <sub>D</sub> = 36 A, T <sub>J</sub> = 125°C | –   | 0.9 | 1.5  |       |
| g <sub>FS</sub>                        | Forward Transconductance                                 | V <sub>DS</sub> = 5 V, I <sub>D</sub> = 36 A                          | –   | 225 | –    | S     |

### DYNAMIC CHARACTERISTICS

|                  |                              |                                                          |   |       |       |    |
|------------------|------------------------------|----------------------------------------------------------|---|-------|-------|----|
| C <sub>iss</sub> | Input Capacitance            | V <sub>DS</sub> = 15 V, V <sub>GS</sub> = 0 V, f = 1 MHz | – | 11100 | 14765 | pF |
| C <sub>oss</sub> | Output Capacitance           |                                                          | – | 3440  | 4575  | pF |
| C <sub>rss</sub> | Reverse Transfer Capacitance |                                                          | – | 205   | 310   | pF |
| R <sub>g</sub>   | Gate Resistance              |                                                          | – | 1.3   | –     | Ω  |

### SWITCHING CHARACTERISTICS

|                     |                               |                                                                                               |                                               |   |     |     |    |
|---------------------|-------------------------------|-----------------------------------------------------------------------------------------------|-----------------------------------------------|---|-----|-----|----|
| t <sub>d(on)</sub>  | Turn-On Delay Time            | V <sub>DD</sub> = 15 V, I <sub>D</sub> = 36 A, V <sub>GS</sub> = 10 V, R <sub>GEN</sub> = 6 Ω |                                               | – | 29  | 46  | ns |
| t <sub>r</sub>      | Rise Time                     |                                                                                               |                                               | – | 28  | 45  | ns |
| t <sub>d(off)</sub> | Turn-Off Delay Time           |                                                                                               |                                               | – | 81  | 130 | ns |
| t <sub>f</sub>      | Fall Time                     |                                                                                               |                                               | – | 20  | 32  | ns |
| Q <sub>g</sub>      | Total Gate Charge             | V <sub>GS</sub> = 0 V to 10 V                                                                 | V <sub>DD</sub> = 15 V, I <sub>D</sub> = 36 A | – | 147 | 206 | nC |
| Q <sub>g</sub>      | Total Gate Charge             | V <sub>GS</sub> = 0 V to 4.5 V                                                                |                                               | – | 62  | 87  | nC |
| Q <sub>gs</sub>     | Gate to Source Charge         | V <sub>DD</sub> = 15 V, I <sub>D</sub> = 36 A                                                 |                                               | – | 38  | –   | nC |
| Q <sub>gd</sub>     | Gate to Drain “Miller” Charge |                                                                                               |                                               | – | 9.7 | –   | nC |

### DRAIN-SOURCE DIODE CHARACTERISTICS

|                 |                                       |                                                        |   |     |     |    |
|-----------------|---------------------------------------|--------------------------------------------------------|---|-----|-----|----|
| V <sub>SD</sub> | Source to Drain Diode Forward Voltage | V <sub>GS</sub> = 0 V, I <sub>S</sub> = 2.1 A (Note 2) | – | 0.7 | 1.2 | V  |
|                 |                                       | V <sub>GS</sub> = 0 V, I <sub>S</sub> = 36 A (Note 2)  | – | 0.8 | 1.3 |    |
| t <sub>rr</sub> | Reverse Recovery Time                 | I <sub>F</sub> = 36 A, di/dt = 100 A/μs                | – | 75  | 120 | ns |
| Q <sub>rr</sub> | Reverse Recovery Charge               |                                                        | – | 61  | 98  | nC |

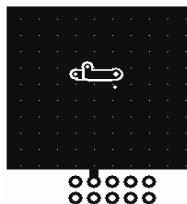
Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

## THERMAL CHARACTERISTICS

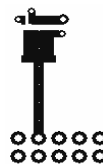
| Symbol          | Parameter                                           | Rating | Unit |
|-----------------|-----------------------------------------------------|--------|------|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case (Top Source)   | 2.3    | °C/W |
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case (Bottom Drain) | 1      |      |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient (Note 1a)   | 38     |      |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient (Note 1b)   | 81     |      |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient (Note 1c)   | 27     |      |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient (Note 1d)   | 34     |      |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient (Note 1e)   | 16     |      |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient (Note 1f)   | 19     |      |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient (Note 1g)   | 26     |      |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient (Note 1h)   | 61     |      |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient (Note 1i)   | 16     |      |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient (Note 1j)   | 23     |      |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient (Note 1k)   | 11     |      |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient (Note 1l)   | 13     |      |

## NOTES:

1.  $R_{\theta JA}$  is determined with the device mounted on a FR-4 board using a specified pad of 2 oz copper as shown below.  $R_{\theta JC}$  is guaranteed by design while  $R_{\theta CA}$  is determined by the user's board design.



a. 38°C/W when mounted on  
a 1 in² pad of 2 oz copper



b. 0°C/W when mounted on  
a minimum pad of 2 oz copper

- Still air, 20.9 x 10.4 x 12.7 mm Aluminum Heat Sink, 1 in² pad of 2 oz copper
- Still air, 20.9 x 10.4 x 12.7 mm Aluminum Heat Sink, minimum pad of 2 oz copper
- Still air, 45.2 x 41.4 x 11.7 mm Aavid Thermalloy Part # 10-L41B-11 Heat Sink, 1 in² pad of 2 oz copper
- Still air, 45.2 x 41.4 x 11.7 mm Aavid Thermalloy Part # 10-L41B-11 Heat Sink, minimum pad of 2 oz copper
- 200FPM Airflow, No Heat Sink, 1 in² pad of 2 oz copper
- 200FPM Airflow, No Heat Sink, minimum pad of 2 oz copper
- 200FPM Airflow, 20.9 x 10.4 x 12.7 mm Aluminum Heat Sink, 1 in² pad of 2 oz copper
- 200FPM Airflow, 20.9 x 10.4 x 12.7 mm Aluminum Heat Sink, minimum pad of 2 oz copper
- 200FPM Airflow, 45.2 x 41.4 x 11.7 mm Aavid Thermalloy Part # 10-L41B-11 Heat Sink, 1 in² pad of 2 oz copper
- 200FPM Airflow, 45.2 x 41.4 x 11.7 mm Aavid Thermalloy Part # 10-L41B-11 Heat Sink, minimum pad of 2 oz copper

- Pulse Test: Pulse Width < 300  $\mu$ s, Duty cycle < 2.0%.
- $E_{AS}$  of 578 mJ is based on starting  $T_J = 25^\circ\text{C}$ ; N-ch:  $L = 1$  mH,  $I_{AS} = 34$  A,  $V_{DD} = 27$  V,  $V_{GS} = 10$  V.
- As an N-ch device, the negative Vgs rating is for low duty cycle pulse occurrence only. No continuous rating is implied.
- $I_{SD} \leq 3$  36 A,  $di/dt \leq 3$  100 A/ $\mu$ s,  $V_{DD} \leq BV_{DSS}$ , Starting  $T_J = 25^\circ\text{C}$ .

TYPICAL CHARACTERISTICS ( $T_J = 25^\circ\text{C}$  UNLESS OTHERWISE NOTED)

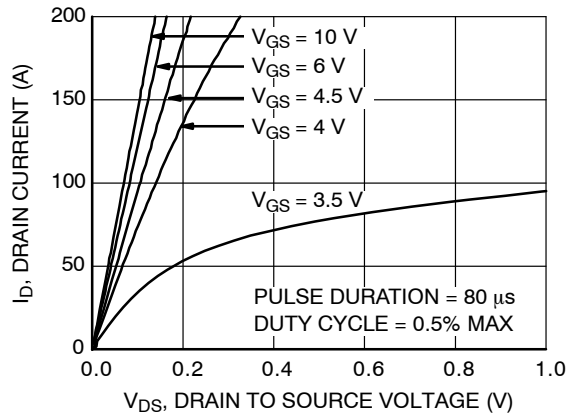


Figure 1. On Region Characteristics

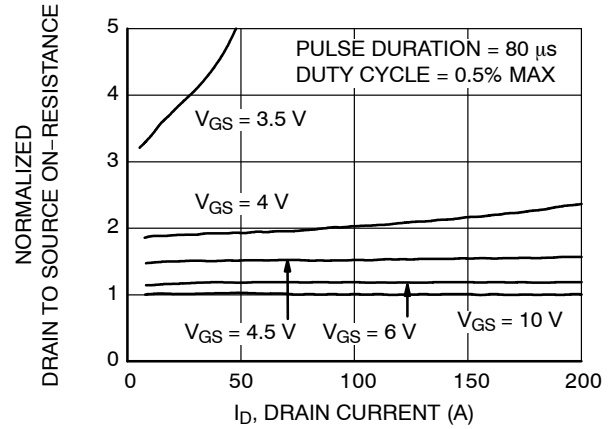


Figure 2. Normalized On-Resistance vs. Drain Current and Gate Voltage

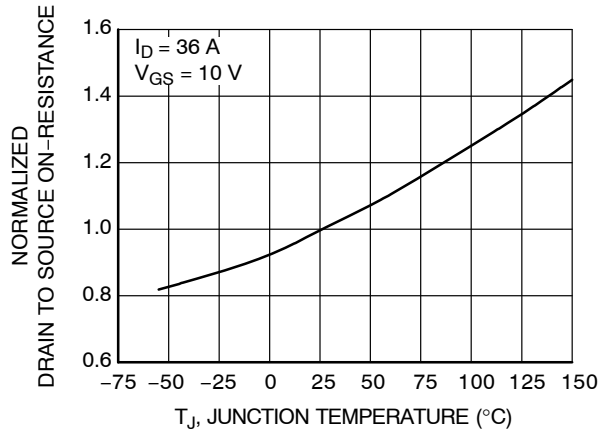


Figure 3. Normalized On Resistance vs. Junction Temperature

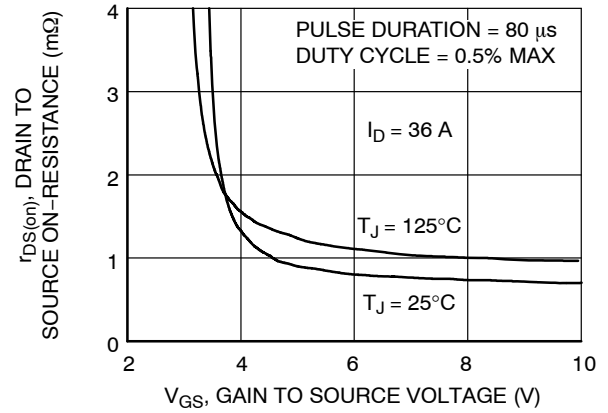


Figure 4. On-Resistance vs. Gate to Source Voltage

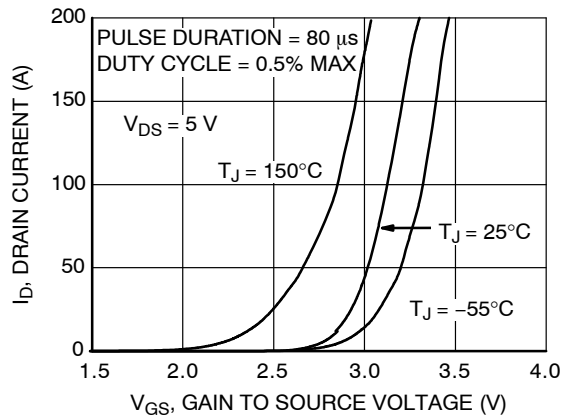


Figure 5. Transfer Characteristics

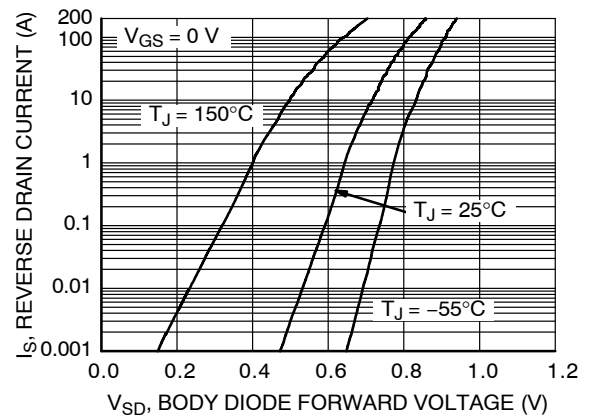


Figure 6. Source to Drain Diode Voltage vs. Source Current

# FDMS7650DC

## TYPICAL CHARACTERISTICS ( $T_J = 25^\circ\text{C}$ UNLESS OTHERWISE NOTED)

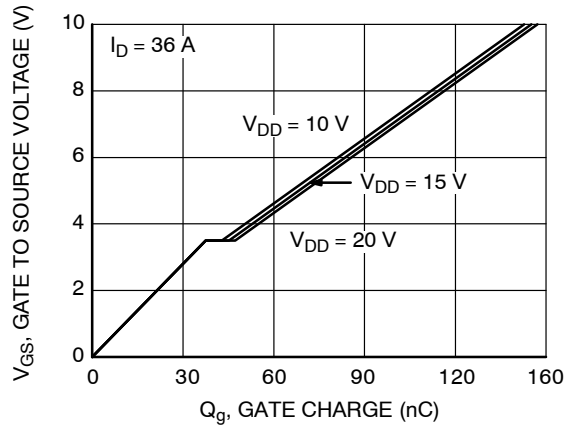


Figure 7. Gate Charge Characteristics

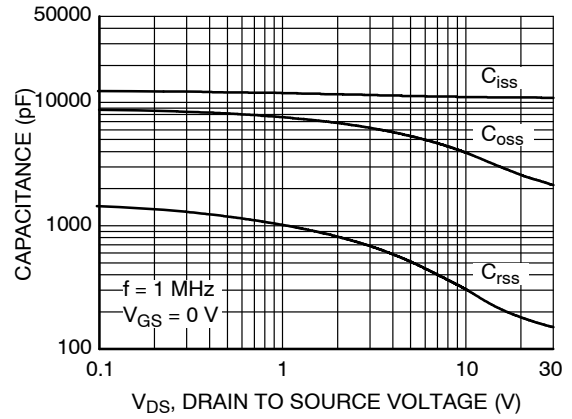


Figure 8. Capacitance vs. Drain to Source Voltage

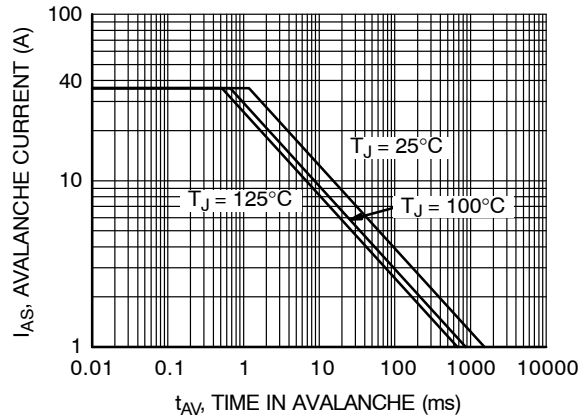


Figure 9. Unclamped Inductive Switching Capability

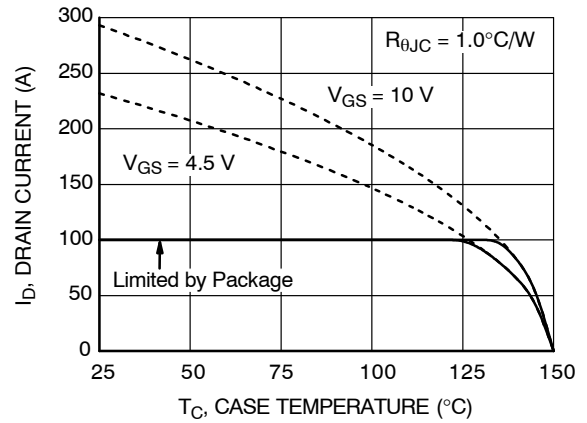


Figure 10. Maximum Continuous Drain Current vs. Case Temperature

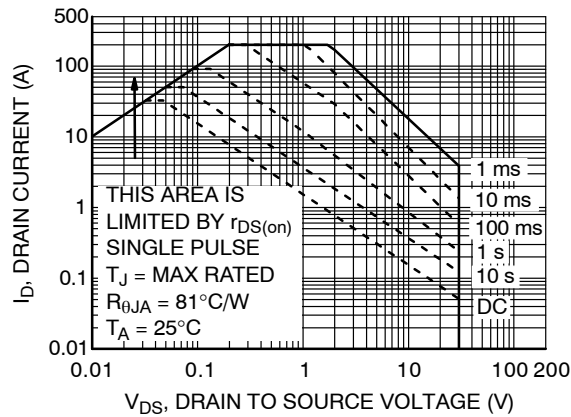


Figure 11. Forward Bias Safe Operating Area

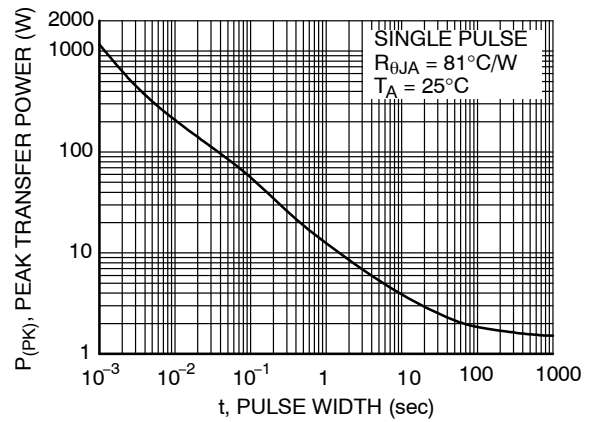


Figure 12. Single Pulse Maximum Power Dissipation

# FDMS7650DC

## TYPICAL CHARACTERISTICS ( $T_J = 25^\circ\text{C}$ UNLESS OTHERWISE NOTED)

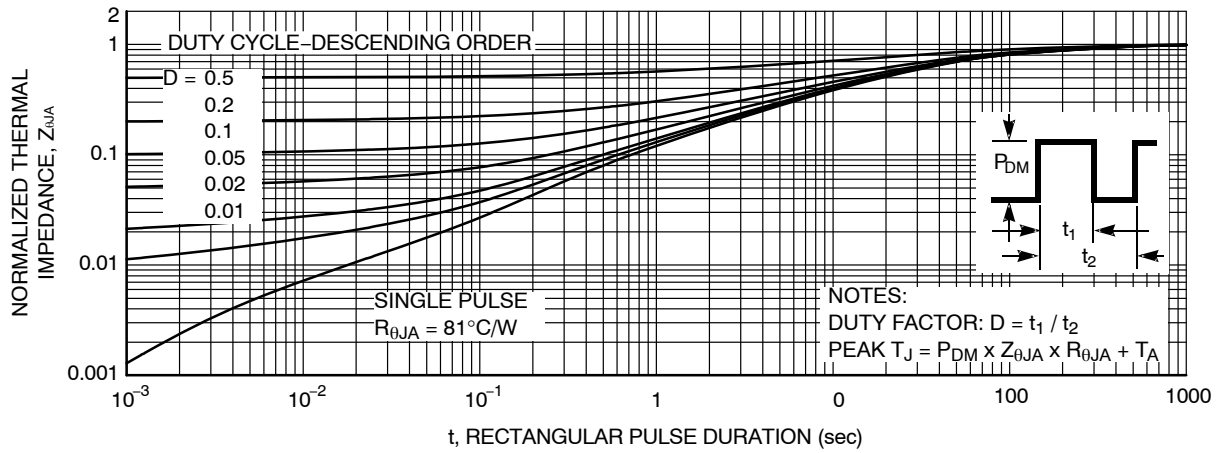


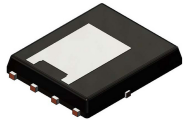
Figure 13. Junction-to-Ambient Transient Thermal Response Curve

### ORDERING INFORMATION

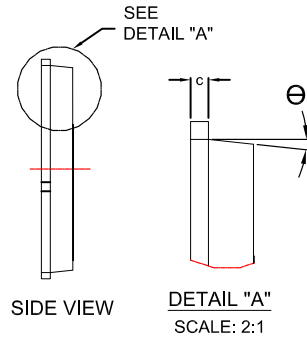
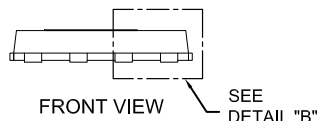
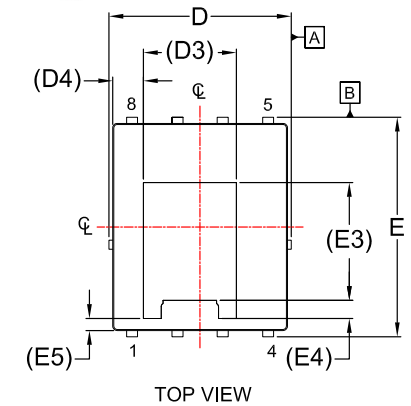
| Device     | Device Marking | Package                                    | Reel Size | Tape Width | Shipping <sup>†</sup> |
|------------|----------------|--------------------------------------------|-----------|------------|-----------------------|
| FDMS7650DC | 2F             | DFN8 5x6.15, 1.27P, DUAL COOL 56 (Pb-Free) | 13"       | 12 mm      | 3000 / Tape & Reel    |

<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

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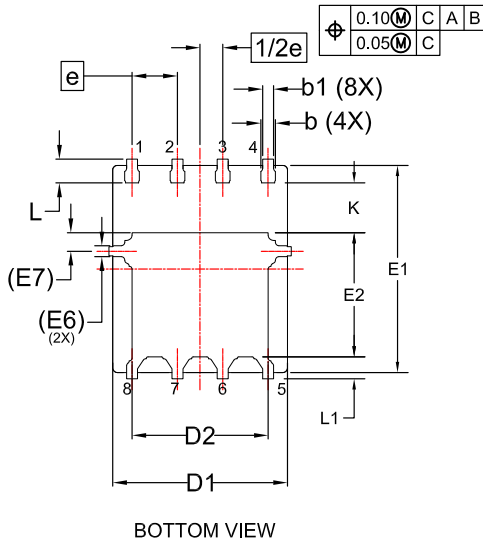
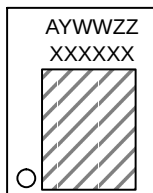

**DFN8 5x6.15, 1.27P, DUAL COOL**  
CASE 506EG  
ISSUE D

DATE 25 AUG 2020



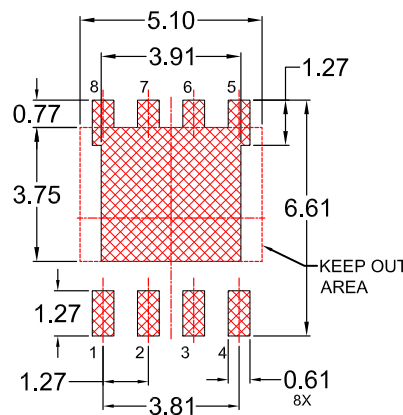
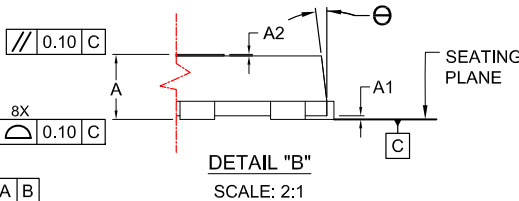
## NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: MILLIMETERS
3. COPLANARITY APPLIES TO THE EXPOSED PADS AS WELL AS THE TERMINALS.
4. DIMENSIONS D1 AND E1 DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.
5. SEATING PLANE IS DEFINED BY THE TERMINALS. "A1" IS DEFINED AS THE DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT ON THE PACKAGE BODY.


**GENERIC MARKING DIAGRAM\***


XXXX = Specific Device Code  
A = Assembly Location  
Y = Year  
WW = Work Week  
ZZ = Assembly Lot Code

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "•", may or may not be present. Some products may not follow the Generic Marking.



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

| DIM  | MILLIMETERS |      |      |
|------|-------------|------|------|
|      | MIN.        | NOM. | MAX. |
| A    | 0.85        | 0.90 | 0.95 |
| A1   | -           | -    | 0.05 |
| A2   | -           | -    | 0.05 |
| b    | 0.31        | 0.41 | 0.51 |
| b1   | 0.21        | 0.31 | 0.41 |
| c    | 0.20        | 0.25 | 0.30 |
| D    | 4.90        | 5.00 | 5.10 |
| D1   | 4.80        | 4.90 | 5.00 |
| D2   | 3.67        | 3.82 | 3.97 |
| D3   | 2.60 REF    |      |      |
| D4   | 0.86 REF    |      |      |
| E    | 6.05        | 6.15 | 6.25 |
| E1   | 5.70        | 5.80 | 5.90 |
| E2   | 3.38        | 3.48 | 3.58 |
| E3   | 3.30 REF    |      |      |
| E4   | 0.50 REF    |      |      |
| E5   | 0.34 REF    |      |      |
| E6   | 0.30 REF    |      |      |
| E7   | 0.52 REF    |      |      |
| e    | 1.27 BSC    |      |      |
| 1/2e | 0.635 BSC   |      |      |
| K    | 1.30        | 1.40 | 1.50 |
| L    | 0.56        | 0.66 | 0.76 |
| L1   | 0.52        | 0.62 | 0.72 |
| Θ    | 0°          | ---  | 12°  |

|                         |                                      |                                                                                                                                                                                     |
|-------------------------|--------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>DOCUMENT NUMBER:</b> | <b>98AON84257G</b>                   | Electronic versions are uncontrolled except when accessed directly from the Document Repository.<br>Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red. |
| <b>DESCRIPTION:</b>     | <b>DFN8 5x6.15, 1.27P, DUAL COOL</b> | <b>PAGE 1 OF 1</b>                                                                                                                                                                  |

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