

# GreenBridge™ 2 Series of High-Efficiency Bridge Rectifiers



ON Semiconductor®

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## FDMQ8205A

### General Description

FDMQ8205A is GreenBridge 2 series of quad MOSFETs for a bridge application so that the input will be insensitive to the polarity of a power source coupled to the device. Many known bridge rectifier circuits can be configured using typical diodes. The conventional diode bridge has relatively high power loss that is undesirable in many applications. Especially, Power over Ethernet (PoE) Power Device (PD) application requires high-efficiency bridges because it should be operated with the limited power delivered from Power Source Equipment (PSE) which is classified by IEEE802.3at. FDMQ8205A is configured with low  $r_{DS(on)}$  dual P-ch MOSFETs and N-ch MOSFETs so that it can reduce the power loss caused by the voltage drop, compared to the conventional diode bridge. FDMQ8205A enables the application to maximize the available power and voltage and to eliminate the thermal design problems in PoE PD applications.

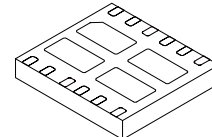
FDMQ8205A GreenBridge 2 is compatible with IEEE802.3at PoE standard by not compromising detection and classification requirement as well as small backfeed voltage.

### Features

- Low Power Loss GreenBridge Replaces Diode Bridge
- Self Driving Circuitry for MOSFETs
- Low  $r_{DS(on)}$  100 V Rated MOSFETs
- Maximizing Available Power and Voltage
- Eliminating Thermal Design Problems
- IEEE802.3af/at and 3bt Compatible
  - ◆ Meet Detection and Classification Requirement
  - ◆ Work with 2 and 4-pair Architecture
  - ◆ Small Backfeed Voltage
- Compact MLP 4.5x5 Package
- This is a Pb-Free Device

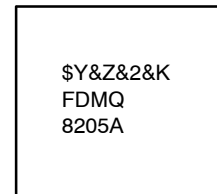
### Applications

- Power over Ethernet (PoE) Power Device (PD)
- IP Phones
- Network Cameras
- Wireless Access Points
- Thin Clients
- Microcell
- Femtocell



WDFN12 5x4.5, 0.8P  
CASE 511CS

### MARKING DIAGRAM



FDMQ8205A = Specific Device Code  
\$Y = ON Semiconductor Logo  
&Z = Assembly Plant Code  
&2 = 2-Digit Data Code  
&K = 2-Digits Lot Run Traceability Code

### ORDERING INFORMATION

See detailed ordering and shipping information on page 9 of this data sheet.

# FDMQ8205A

## TYPICAL APPLICATION

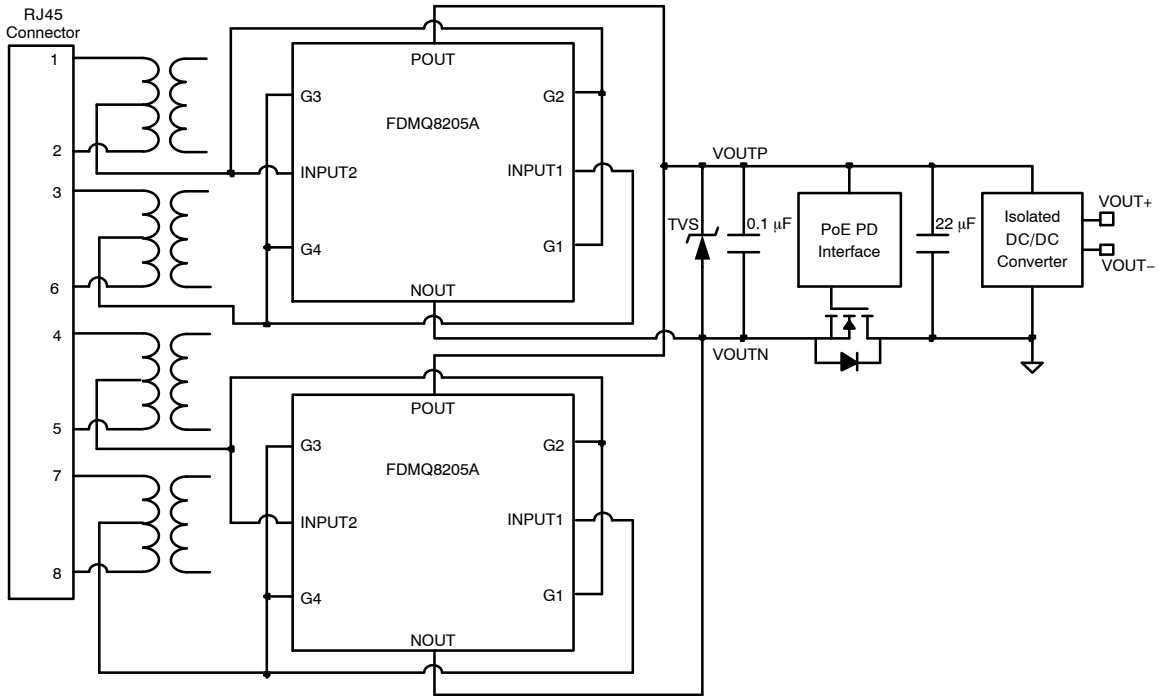


Figure 1. Typical Application of Power Device for 2-Pair Architecture of IEEE802.3af/at Power over Ethernet Standard

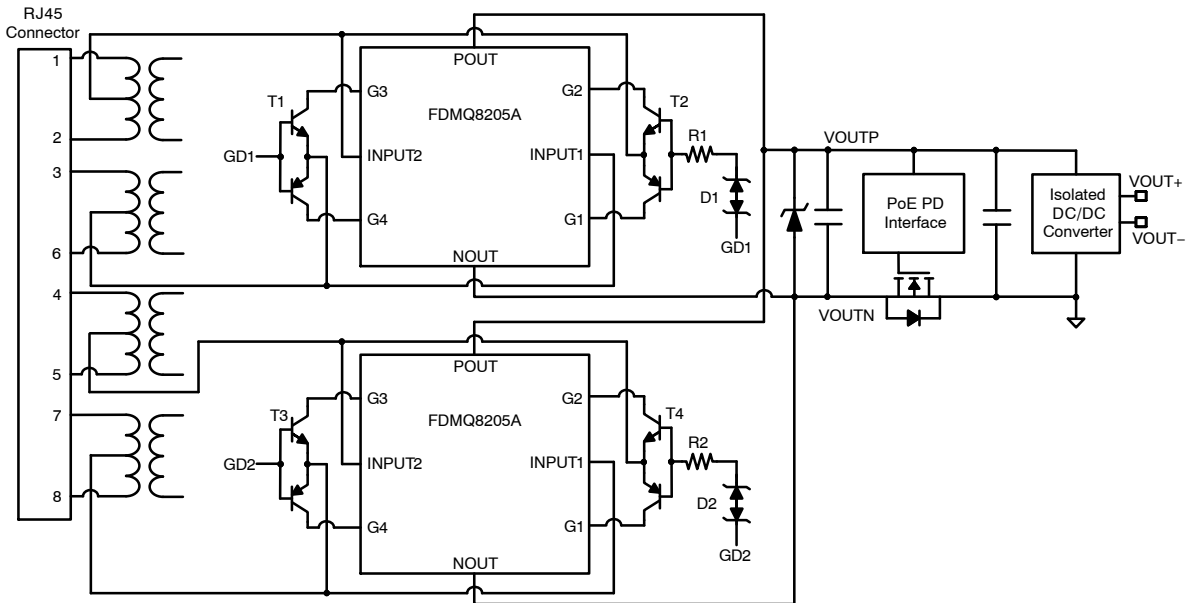


Figure 2. Typical Application of Power Device for IEEE802.3bt Power over Ethernet Standard

### TYPICAL BOM OF GATE DRIVING CIRCUITS

| Reference      | Description              | Part Name        |
|----------------|--------------------------|------------------|
| T1, T2, T3, T4 | NPN & PNP Transistors    | BC846BPDW1T1     |
| D1, D2         | Dual Common Anode Zeners | MMBZ27VALT1G     |
| R1, R2         | 162 kΩ Resistor          | RC0603FR-07162KL |

# FDMQ8205A

## BLOCK DIAGRAM

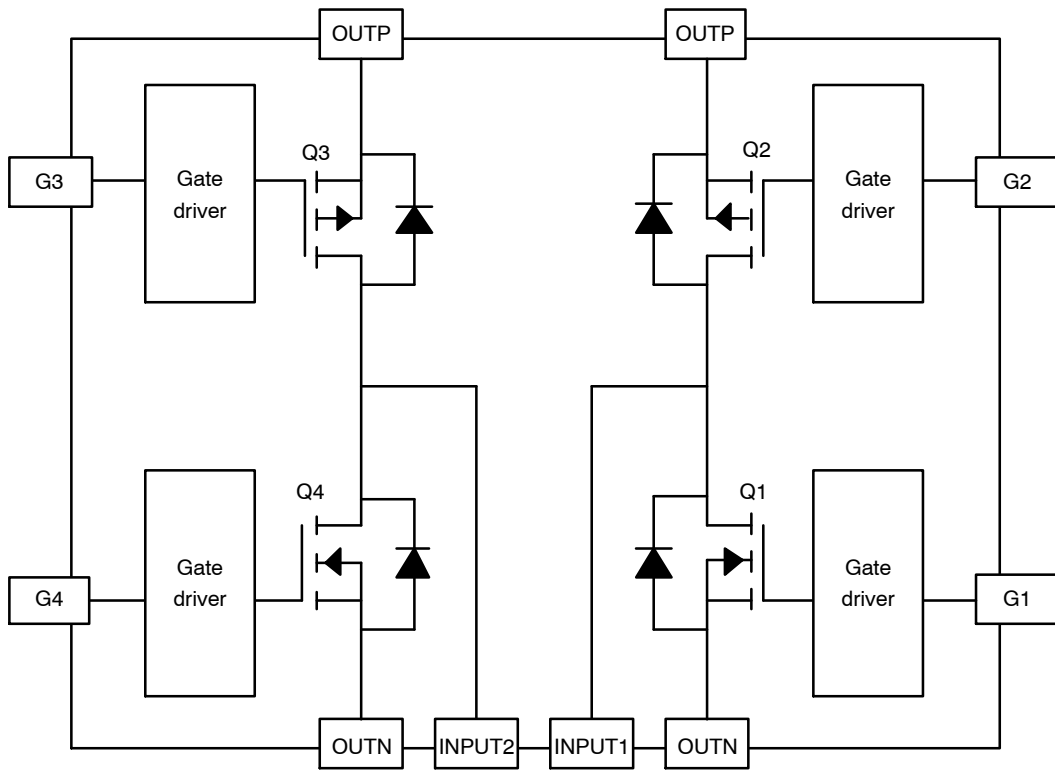
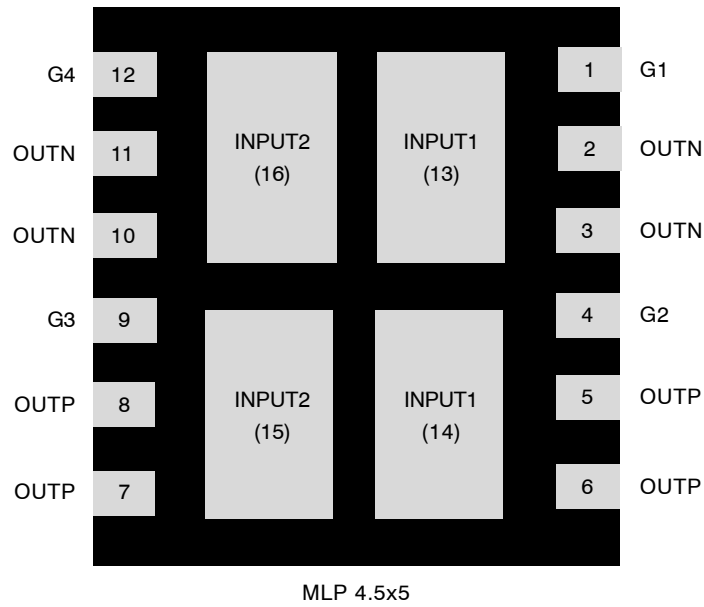


Figure 3. Block Diagram

# FDMQ8205A

## PIN CONFIGURATION



**Figure 4. Pin Assignment (Bottom View)**

### PIN DESCRIPTION

| Pin No.      | Name   | Description                    |
|--------------|--------|--------------------------------|
| 1            | G1     | Gate of Q1 N-ch MOSFET         |
| 4            | G2     | Gate of Q2 P-ch MOSFET         |
| 9            | G3     | Gate of Q3 P-ch MOSFET         |
| 12           | G4     | Gate of Q4 N-ch MOSFET         |
| 13, 14       | INPUT1 | Input1 of GreenBridge          |
| 15, 16       | INPUT2 | Input2 of GreenBridge          |
| 2, 3, 11, 10 | OUTN   | Negative Output of GreenBridge |
| 5, 6, 7, 8   | OUTP   | Positive Output of GreenBridge |

1. Show the feature that provides orientation or pin 1 location.

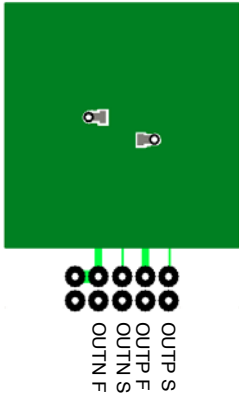
# FDMQ8205A

## ABSOLUTE MAXIMUM RATINGS

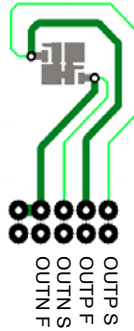
|  |  | Min | Max  | Unit             |
|--|--|-----|------|------------------|
| INPUT1, INPUT2 to OUTN   |  | -   | 100  | V                |
| OUTP to INPUT1, INPUT2   |  | -   | 100  | V                |
| INPUT1 to INPUT2   |  | -   | 100  | V                |
| INPUT2 to INPUT1   |  | -   | 100  | V                |
| OUTP to OUTN   |  | -   | 100  | V                |
| G1, G2, G3, G4 to OUTN   |  | -   | 70   | V                |
| OUTP to G1, G2, G3, G4   |  | -   | 70   | V                |
| VG_TRANSIENT   | Transient Gate Voltage, Pulse Width < 200 $\mu$ s, Duty Cycle < 0.003% | -   | 100  | V                |
| Continuous $I_{INPUT}$ (GreenBridge Current, Q1 + Q3 or Q2 + Q4) | $T_A = 25^\circ\text{C}$ (Note 2a)                                     | -   | 3.0  | A                |
|  | $T_A = 25^\circ\text{C}$ (Note 2b)                                     | -   | 1.7  | A                |
| Pulsed $I_{INPUT}$ (Q1 + Q3 or Q2 + Q4)                          | Pulse Width < 300 $\mu$ s, Duty Cycle < 2% (Note 3)                    | -   | 58   | A                |
| $P_D$ (Power Dissipation, Q1 + Q3 or Q2 + Q4)                    | $T_A = 25^\circ\text{C}$ (Note 2a)                                     | -   | 2.5  | W                |
|  | $T_A = 25^\circ\text{C}$ (Note 2b)                                     | -   | 0.78 | W                |
| Max Junction Temperature   |  | -   | 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.

2.  $R_{\theta JA}$  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.  $R_{\theta JC}$  is guaranteed by design while  $R_{\theta CA}$  is determined by the user's board design.



a. 50 $^\circ\text{C}/\text{W}$  when mounted on a 1 in<sup>2</sup> pad of 2 oz copper, the board designed Q1 + Q3 or Q2 + Q4.



b. 160 $^\circ\text{C}/\text{W}$  when mounted on a minimum pad of 2 oz copper, the board designed Q1 + Q3 or Q2 + Q4.

3. Pulse Id measured at  $t_d \leq 300 \mu\text{s}$ , refer to SOA graph for more details.

## THERMAL CHARACTERISTICS

| Symbol          | Parameter   | Min | Typ | Max | Unit                      |
|-----------------|---|-----|-----|-----|---------------------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case              | -   | 5.1 | -   | $^\circ\text{C}/\text{W}$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient (Note 2a) | -   | 50  | -   |                           |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient (Note 2b) | -   | 160 | -   |                           |

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## RECOMMENDED OPERATING CONDITIONS

| Symbol  | Parameter               | Conditions                                      | Min | Max | Unit |
|---|-------------------------|---|-----|-----|------|
| $V_{INPUT}$                                       | Input Voltage of Bridge | INPUT1 to INPUT2 or INPUT2 to INPUT1            | -   | 57  | V    |
| $V_G$   | Gate Voltage of MOSFETs | G1, G4 to OUTN G2, G3 to OUTP                   | -   | 57  | V    |
| $I_{INPUT}$                                       | Input Current of Bridge | Bridge Current through Q2 and Q4 or (Q3 and Q1) | -   | 1.7 | A    |
| Ambient Operation Temperature ( $T_A$ )           |                         |   | -40 | 85  | °C   |
| Junction Operating Temperature ( $T_J$ ) (Note 4) |                         |   | -40 | 125 | °C   |

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

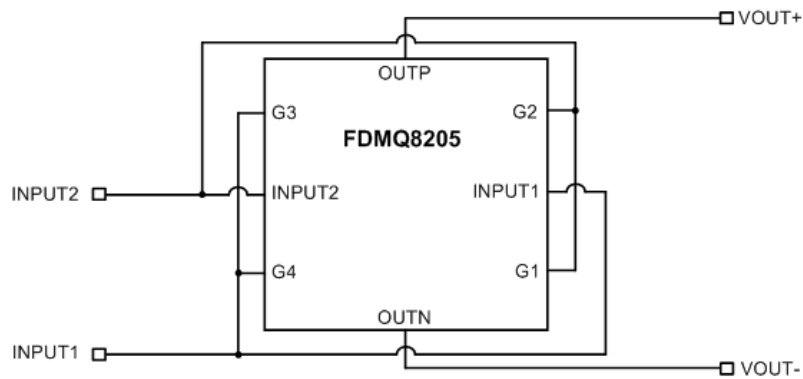
4. Backfeed Voltage can not be guaranteed for junction temperature in excess of 85°C. See  $V_{BF}$  in Electrical Characteristics Table.

## ELECTRICAL CHARACTERISTICS ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

| Symbol         | Parameter                  | Conditions  | Min | Typ | Max | Unit          |
|----------------|----------------------------|---|-----|-----|-----|---------------|
| $V_{INPUT}$    | Input Voltage of Bridge    | At INPUT1 to INPUT2 or INPUT2 to INPUT1   | -   | -   | 57  | V             |
| $V_G$          | Gate Voltage of MOSFETs    | At G1, G4 to OUTN and G2, G3 to OUTP  | -   | -   | 57  | V             |
| $I_Q$          | Quiescent Current          | Detection Mode<br>$1.5\text{ V} < V_{INPUT} = V_G < 10.1\text{ V}$ (Note 5)   | -   | -   | 5   | $\mu\text{A}$ |
|                |                            | Classification Mode<br>$10.2\text{ V} < V_{INPUT} = V_G < 23.9\text{ V}$ (Note 5)   | -   | -   | 400 | $\mu\text{A}$ |
|                |                            | Power On Mode<br>Maximum $V_{INPUT} = V_G = 57\text{ V}$ (Note 5)   | -   | -   | 3.2 | mA            |
| $V_{TURN\_ON}$ | Turn-On Voltage of MOSFETs | Turn-On of MOSFETs while $V_G$ Increases (Note 4)   | 32  | -   | 36  | V             |
| $I_{LEAKAGE}$  | Turn-Off Leakage Current   | $V_{OUTP} = 57\text{ V}$ , $V_{OUTN} = 0\text{ V}$ , $T_J = -40^\circ\text{C}$ to $85^\circ\text{C}$ (Note 5)   | -   | -   | 700 | $\mu\text{A}$ |
| $V_{BF}$       | Backfeed Voltage           | $V_{OUTP} = 57\text{ V}$ , $V_{OUTN} = 0\text{ V}$ , 100 k $\Omega$ between INPUT1 and INPUT2<br>$T_J = -40^\circ\text{C}$ to $85^\circ\text{C}$ (Note 5) | -   | -   | 2.7 | V             |
| $r_{DS(on)}$   | N-ch MOSFET                | $V_G = 42\text{ V}$ , $I_{INPUT} = 1.5\text{ A}$ , $T_A = 25^\circ\text{C}$   | -   | 35  | 51  | m $\Omega$    |
|                |                            | $V_G = 48\text{ V}$ , $I_{INPUT} = 1.5\text{ A}$ , $T_A = 25^\circ\text{C}$   | -   | 29  | 44  | m $\Omega$    |
|                |                            | $V_G = 57\text{ V}$ , $I_{INPUT} = 1.5\text{ A}$ , $T_A = 25^\circ\text{C}$   | -   | 26  | 37  | m $\Omega$    |
|                | P-ch MOSFET                | $V_G = -42\text{ V}$ , $I_{INPUT} = -1.5\text{ A}$ , $T_A = 25^\circ\text{C}$   | -   | 95  | 147 | m $\Omega$    |
|                |                            | $V_G = -48\text{ V}$ , $I_{INPUT} = -1.5\text{ A}$ , $T_A = 25^\circ\text{C}$   | -   | 83  | 125 | m $\Omega$    |
|                |                            | $V_G = -57\text{ V}$ , $I_{INPUT} = -1.5\text{ A}$ , $T_A = 25^\circ\text{C}$   | -   | 76  | 107 | m $\Omega$    |

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. INPUT1 is connected to G3 and G4 and also INPUT2 is connected to G1 and G2 like below.



TYPICAL CHARACTERISTICS (Q1 OR Q4 N-CHANNEL)

( $T_J = 25^\circ\text{C}$  unless otherwise noted.)

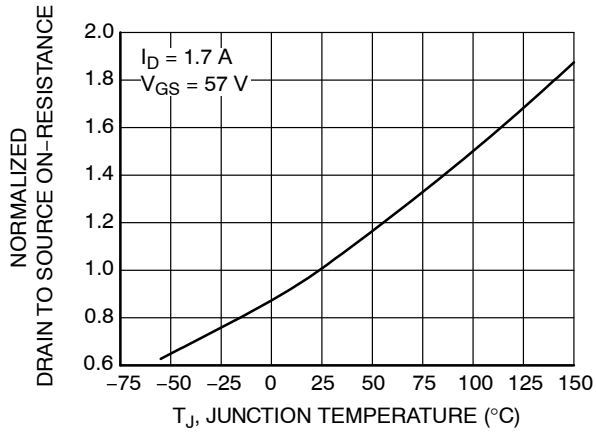


Figure 5. Normalized On Resistance vs. Junction Temperature

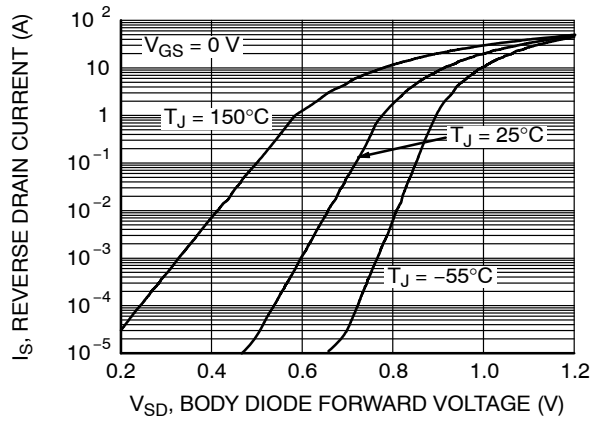


Figure 6. Source to Drain Diode Forward Voltage vs. Source Current

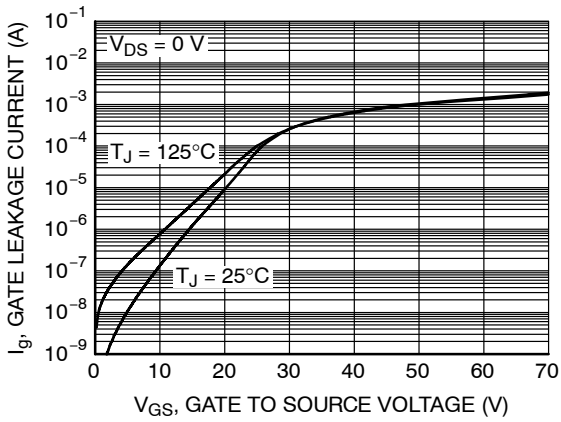


Figure 7. Gate Leakage Current vs. Gate to Source Voltage

TYPICAL CHARACTERISTICS (Q2 OR Q3 P-CHANNEL)

( $T_J = 25^\circ\text{C}$  unless otherwise noted.)

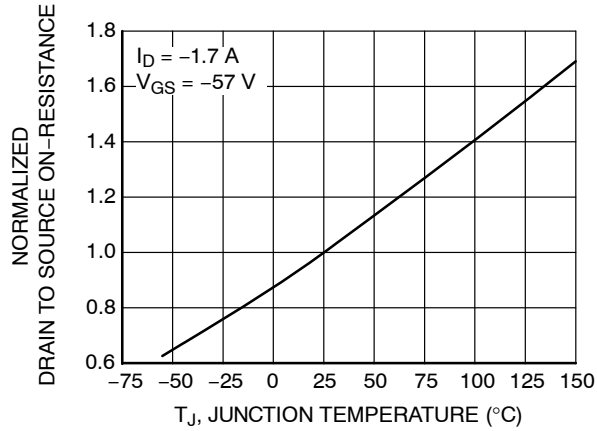


Figure 8. Normalized On Resistance vs. Junction Temperature

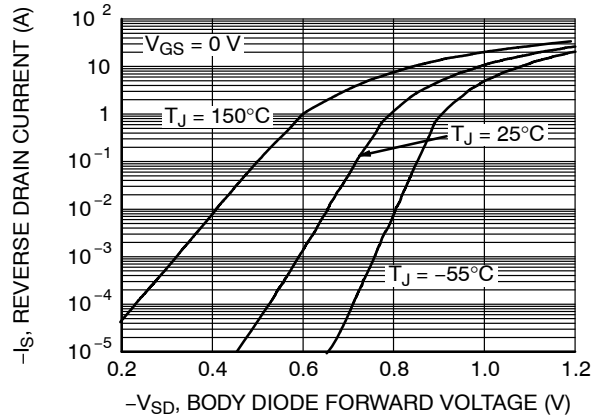


Figure 9. Source to Drain Diode Forward Voltage vs. Source Current

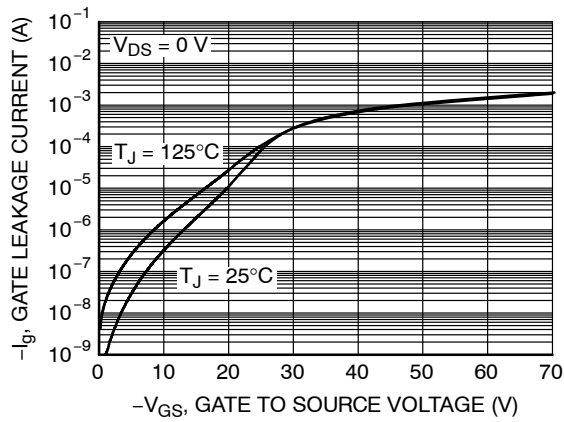


Figure 10. Gate Leakage Current vs. Gate to Source Voltage



# FDMQ8205A

## TYPICAL CHARACTERISTICS (Q1 + Q3 OR Q2 + Q4 IN SERIAL)

( $T_J = 25^\circ\text{C}$  unless otherwise noted.)

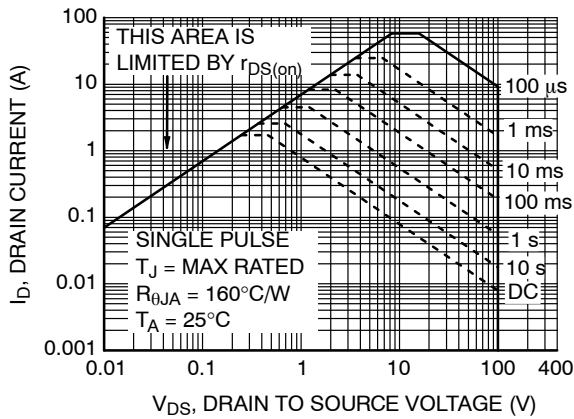


Figure 11. Forward Bias Safe Operating Area

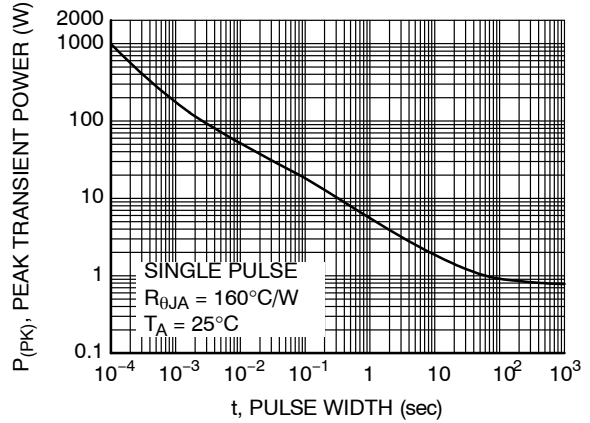


Figure 12. Single Pulse Maximum Power Dissipation

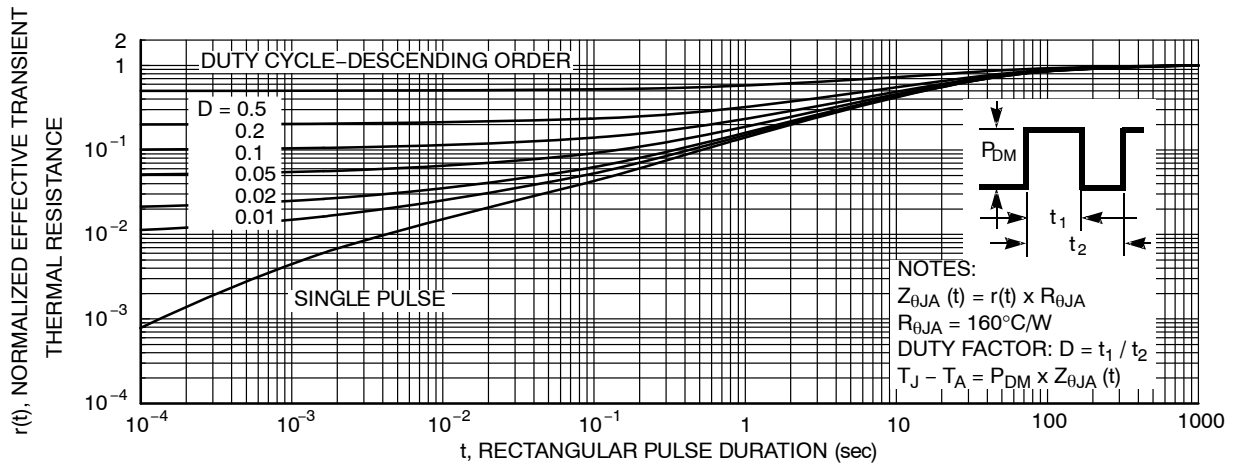


Figure 13. Junction-to-Ambient Transient Thermal Response Curve

### PACKAGE MARKING AND ORDERING INFORMATION

| Device Marking | Device    | Package                                     | Reel Size | Tape Width | Shipping <sup>†</sup> |
|----------------|-----------|---|-----------|------------|-----------------------|
| FDMQ8205A      | FDMQ8205A | WDFN12 5x4.5, 0.8P<br>MLP4.5x5<br>(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.

# MECHANICAL CASE OUTLINE

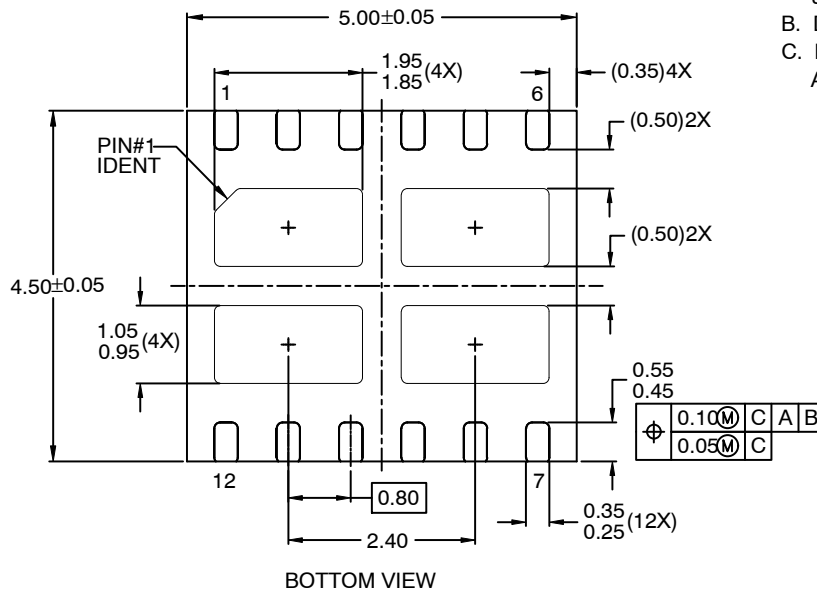
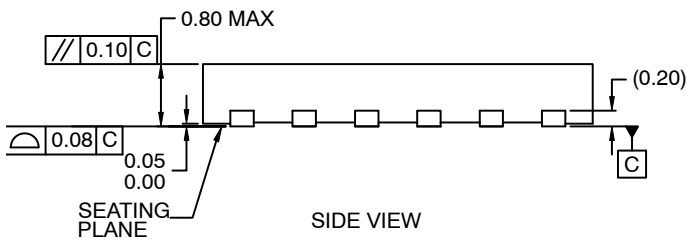
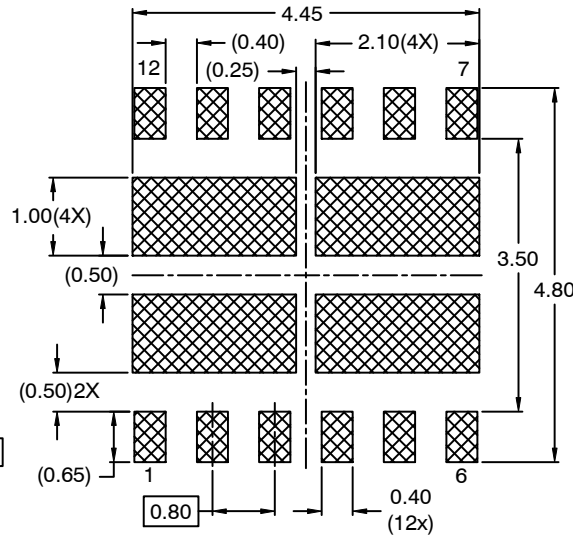
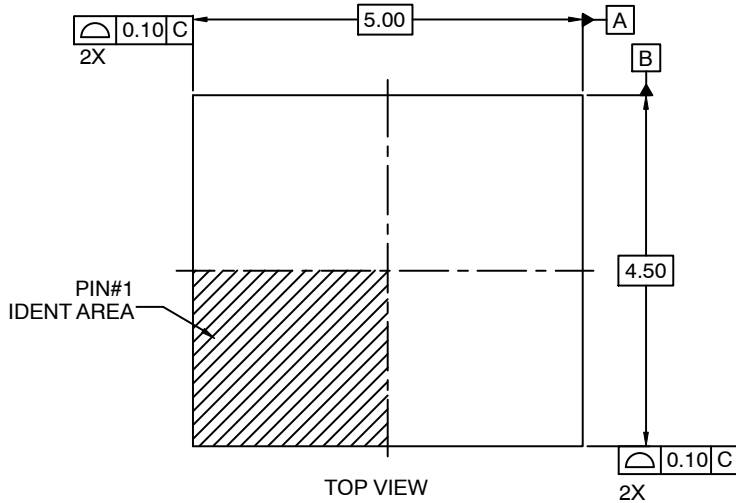
## PACKAGE DIMENSIONS

ON Semiconductor®



**WDFN12 5x4.5, 0.8P**  
CASE 511CS  
ISSUE O

DATE 31 AUG 2016



**NOTES:**

- A. PACKAGE DOES NOT FULLY CONFORM TO JEDEC MO-229 REGISTRATION
- B. DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.

|                         |                           |  |
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