

# FQD12N20LTM-F085 Datasheet



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|                              |  |
|------------------------------|--|
| DiGi Electronics Part Number | FQD12N20LTM-F085-DG  |
| Manufacturer                 | <a href="#">onsemi</a>   |
| Manufacturer Product Number  | FQD12N20LTM-F085   |
| Description                  | MOSFET N-CH 200V 9A DPAK   |
| Detailed Description         | N-Channel 200 V 9A (Tc) 2.5W (Ta), 55W (Tc) Surface Mount TO-252AA |



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## Purchase and inquiry

Manufacturer Product Number:

FQD12N20LTM-F085

Series:

QFET®

FET Type:

N-Channel

Drain to Source Voltage (Vdss):

200 V

Drive Voltage (Max Rds On, Min Rds On):

5V, 10V

Vgs(th) (Max) @ Id:

2V @ 250µA

Vgs (Max):

±20V

FET Feature:

-

Operating Temperature:

-55°C ~ 150°C (Tj)

Qualification:

AEC-Q101

Supplier Device Package:

TO-252AA

Base Product Number:

FQD12N20

Manufacturer:

onsemi

Product Status:

Not For New Designs

Technology:

MOSFET (Metal Oxide)

Current - Continuous Drain (Id) @ 25°C:

9A (Tc)

Rds On (Max) @ Id, Vgs:

280mOhm @ 4.5A, 10V

Gate Charge (Qg) (Max) @ Vgs:

21 nC @ 5 V

Input Capacitance (Ciss) (Max) @ Vds:

1080 pF @ 25 V

Power Dissipation (Max):

2.5W (Ta), 55W (Tc)

Grade:

Automotive

Mounting Type:

Surface Mount

Package / Case:

TO-252-3, DPAK (2 Leads + Tab), SC-63

## Environmental & Export classification

RoHS Status:

ROHS3 Compliant

REACH Status:

REACH Unaffected

HTSUS:

8541.29.0095

Moisture Sensitivity Level (MSL):

1 (Unlimited)

ECCN:

EAR99

# MOSFET – N-Channel, QFET

**200 V, 9.0 A, 280 mΩ**

## FQD12N20L

### Description

This N-Channel enhancement mode power MOSFET is produced using onsemi's proprietary planar stripe and DMOS technology. This advanced MOSFET technology has been especially tailored to reduce on-state resistance, and to provide superior switching performance and high avalanche energy strength. These devices are suitable for switched mode power supplies, active power factor correction (PFC), and electronic lamp ballasts.

### Features

- 9.0 A, 200 V,  $R_{DS(on)}$  = 280 mΩ (Max.) @  $V_{GS} = 10$  V,  $I_D = 4.5$  A
- Low Gate Charge (Typ. 16 nC)
- Low  $C_{rss}$  (Typ. 17 pF)
- 100% Avalanche Tested

### ABSOLUTE MAXIMUM RATINGS ( $T_C = 25^\circ\text{C}$ , unless otherwise noted)

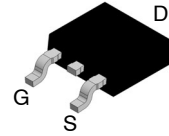
| Symbol         | Parameter  | Rating                                     | Unit                |
|----------------|--|--|---------------------|
| $V_{DSS}$      | Drain-Source Voltage   | 200  | V                   |
| $I_D$          | Drain Current  | - Continuous ( $T_C = 25^\circ\text{C}$ )  | 9.0 A               |
|                |  | - Continuous ( $T_C = 100^\circ\text{C}$ ) | 5.7 A               |
| $I_{DM}$       | Drain Current  | - Pulsed (Note 1)                          | 36 A                |
| $V_{GSS}$      | Gate-Source Voltage  | $\pm 20$                                   | V                   |
| $E_{AS}$       | Single Pulsed Avalanche Energy (Note 2)                              | 210  | mJ                  |
| $I_{AR}$       | Avalanche Current (Note 1)   | 9.0  | A                   |
| $E_{AR}$       | Repetitive Avalanche Energy (Note 1)                                 | 5.5  | mJ                  |
| dv/dt          | Peak Diode Recovery dv/dt (Note 3)                                   | 5.5  | V/ns                |
| $P_D$          | Power Dissipation ( $T_A = 25^\circ\text{C}$ ) *                     | 2.5  | W                   |
|                | Power Dissipation ( $T_C = 25^\circ\text{C}$ )                       | 55   | W                   |
|                | - Derate Above $25^\circ\text{C}$                                    | 0.44                                       | W/ $^\circ\text{C}$ |
| $T_J, T_{STG}$ | Operating and Storage Temperature Range                              | -55 to +150                                | $^\circ\text{C}$    |
| $T_L$          | Maximum Lead Temperature for Soldering, 1/8" from Case for 5 seconds | 300  | $^\circ\text{C}$    |

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.

### THERMAL CHARACTERISTICS

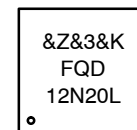
| Symbol          | Parameter   | Rating | Unit                      |
|-----------------|---|--------|---------------------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case, Max.  | 2.27   | $^\circ\text{C}/\text{W}$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient (Minimum Pad of 2-oz Copper), Max.            | 110    |                           |
|                 | Thermal Resistance, Junction to Ambient (*1 in <sup>2</sup> Pad of 2-oz Copper), Max. | 50     |                           |

| $V_{DSS}$ | $R_{DS(on)}$ MAX | $I_D$ MAX |
|-----------|------------------|-----------|
| 200 V     | 280 mΩ @ 10 V    | 9.0 A     |

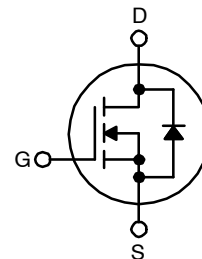


**DPAK3 (TO-252 3 LD)**  
**CASE 369AS**

### MARKING DIAGRAM



&Z = Assembly Plant Code  
 &3 = 3-Digit Date Code  
 &K = 2-Digits Lot Run Traceability Code  
 FQD12N20L = Device Code



**N-Channel MOSFET**

### ORDERING INFORMATION

See detailed ordering and shipping information on page 6 of this data sheet.

**FQD12N20L****ELECTRICAL CHARACTERISTICS** ( $T_C = 25^\circ\text{C}$  unless otherwise noted)

| Symbol                         | Parameter                                 | Test Condition  | Min | Typ  | Max  | Unit                      |
|--------------------------------|---|---|-----|------|------|---------------------------|
| <b>OFF CHARACTERISTICS</b>     |   |   |     |      |      |                           |
| $BV_{DSS}$                     | Drain-Source Breakdown Voltage            | $V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$               | 200 | -    | -    | V                         |
| $\Delta BV_{DSS} / \Delta T_J$ | Breakdown Voltage Temperature Coefficient | $I_D = 250\ \mu\text{A}$ , Referenced to $25^\circ\text{C}$ | -   | 0.14 | -    | $\text{V}/^\circ\text{C}$ |
| $I_{DSS}$                      | Zero Gate Voltage Drain Current           | $V_{DS} = 200\text{ V}, V_{GS} = 0\text{ V}$                | -   | -    | 1    | $\mu\text{A}$             |
|                                |   | $V_{DS} = 160\text{ V}, T_C = 125^\circ\text{C}$            | -   | -    | 10   | $\mu\text{A}$             |
| $I_{GSSF}$                     | Gate-Body Leakage Current, Forward        | $V_{GS} = 20\text{ V}, V_{DS} = 0\text{ V}$                 | -   | -    | 100  | nA                        |
| $I_{GSSR}$                     | Gate-Body Leakage Current, Reverse        | $V_{GS} = -20\text{ V}, V_{DS} = 0\text{ V}$                | -   | -    | -100 | nA                        |

**ON CHARACTERISTICS**

|              |                                   |   |     |              |              |          |
|--------------|-----------------------------------|---|-----|--------------|--------------|----------|
| $V_{GS(th)}$ | Gate Threshold Voltage            | $V_{DS} = V_{GS}, I_D = 250\ \mu\text{A}$   | 1.0 | -            | 2.0          | V        |
| $R_{DS(on)}$ | Static Drain-Source On-Resistance | $V_{GS} = 10\text{ V}, I_D = 4.5\text{ A}$<br>$V_{GS} = 5\text{ V}, I_D = 4.5\text{ A}$ | -   | 0.22<br>0.25 | 0.28<br>0.32 | $\Omega$ |
| $g_{FS}$     | Forward Transconductance          | $V_{DS} = 30\text{ V}, I_D = 4.5\text{ A}$  | -   | 11.6         | -            | S        |

**DYNAMIC CHARACTERISTICS**

|           |                              |   |   |     |      |    |
|-----------|------------------------------|---|---|-----|------|----|
| $C_{iss}$ | Input Capacitance            | $V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}$ | - | 830 | 1080 | pF |
| $C_{oss}$ | Output Capacitance           |   | - | 120 | 155  | pF |
| $C_{rss}$ | Reverse Transfer Capacitance |   | - | 17  | 22   | pF |

**SWITCHING CHARACTERISTICS**

|              |                     |   |   |     |     |    |
|--------------|---------------------|---|---|-----|-----|----|
| $t_{d(on)}$  | Turn-On Delay Time  | $V_{DD} = 100\text{ V}, I_D = 11.6\text{ A},$<br>$R_G = 25\ \Omega$ (Note 4)    | - | 15  | 40  | ns |
| $t_r$        | Turn-On Rise Time   |   | - | 190 | 390 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time |   | - | 60  | 130 | ns |
| $t_f$        | Turn-Off Fall Time  |   | - | 120 | 250 | ns |
| $Q_g$        | Total Gate Charge   | $V_{DS} = 160\text{ V}, I_D = 11.6\text{ A},$<br>$V_{GS} = 5\text{ V}$ (Note 4) | - | 16  | 21  | nC |
| $Q_{gs}$     | Gate-Source Charge  |   | - | 2.8 | -   | nC |
| $Q_{gd}$     | Gate-Drain Charge   |   | - | 7.6 | -   | nC |

**DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS**

|          |   |   |   |      |     |               |
|----------|---|---|---|------|-----|---------------|
| $I_S$    | Maximum Continuous Drain-Source Diode Forward Current | -   | - | 9.0  | A   |               |
| $I_{SM}$ | Maximum Pulsed Drain-Source Diode Forward Current     | -   | - | 36   | A   |               |
| $V_{SD}$ | Drain-Source Diode Forward Voltage                    | $V_{GS} = 0\text{ V}, I_S = 9.0\text{ A}$   | - | -    | 1.5 | V             |
| $t_{rr}$ | Reverse Recovery Time                                 | $V_{GS} = 0\text{ V}, I_S = 11.6\text{ A},$<br>$di_F/dt = 100\text{ A}/\mu\text{s}$ | - | 128  | -   | ns            |
| $Q_{rr}$ | Reverse Recovery Charge                               |   | - | 0.56 | -   | $\mu\text{C}$ |

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.

1. Repetitive rating: pulse-width limited by maximum junction temperature.
2.  $L = 3.9\text{ mH}, I_{AS} = 9.0\text{ A}, V_{DD} = 50\text{ V}, R_G = 25\ \Omega$ , starting  $T_J = 25^\circ\text{C}$ .
3.  $I_{SD} \leq 11.6\text{ A}, di/dt \leq 300\text{ A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$ , starting  $T_J = 25^\circ\text{C}$ .
4. Essentially independent of operating temperature.

# FQD12N20L

## TYPICAL CHARACTERISTICS

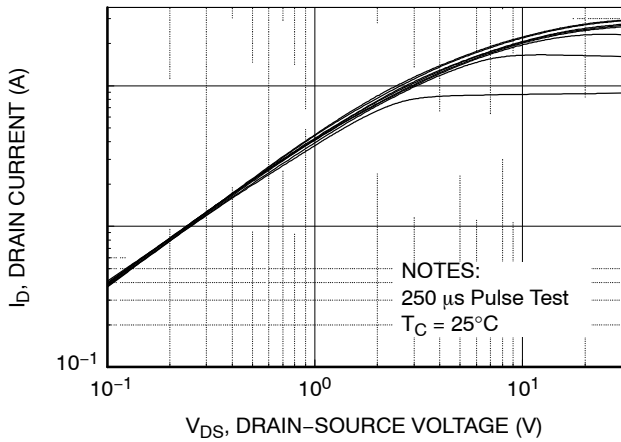


Figure 1. On-Region Characteristics

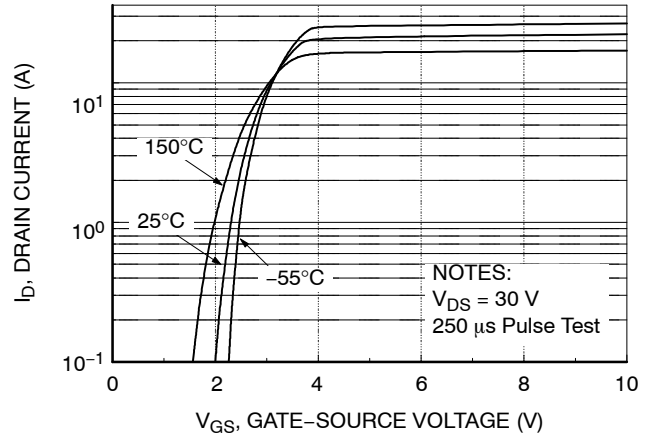


Figure 2. Transfer Characteristics

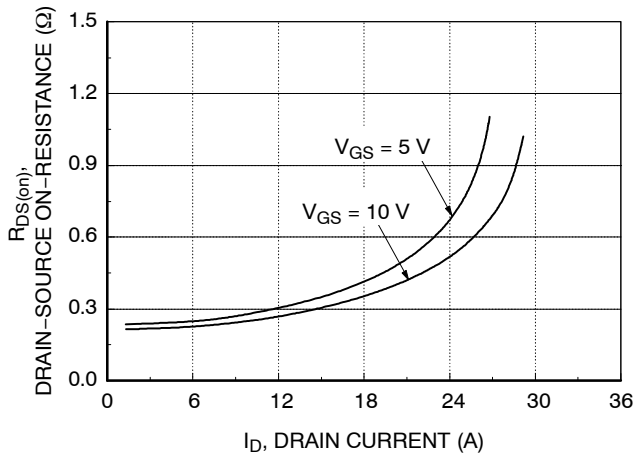


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

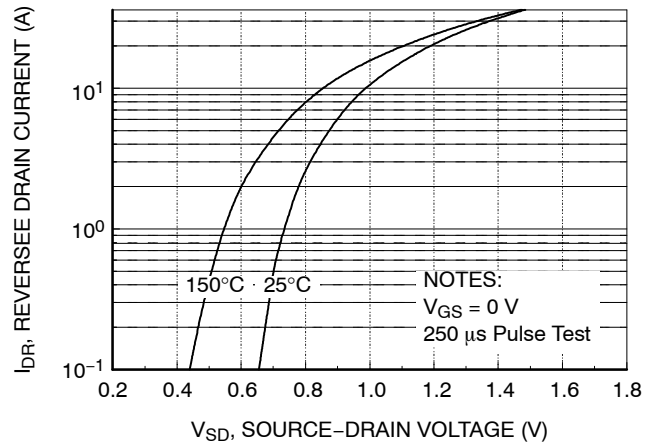


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

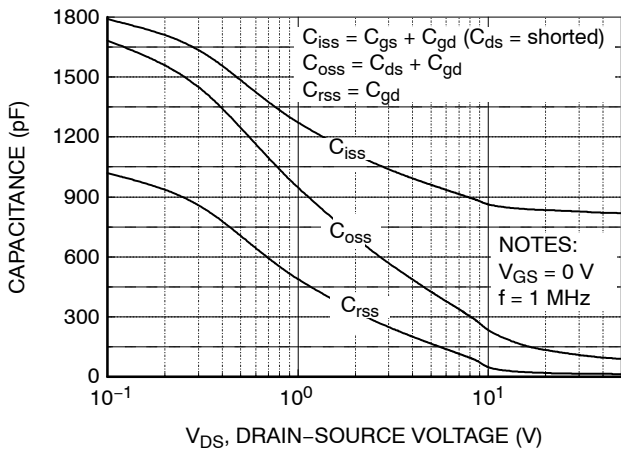


Figure 5. Capacitance Characteristics

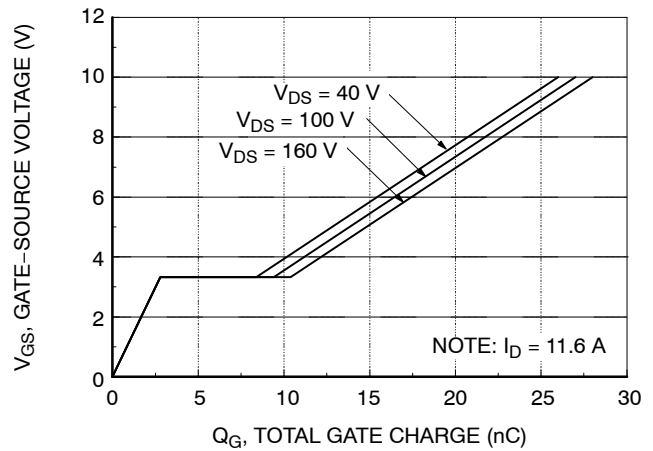
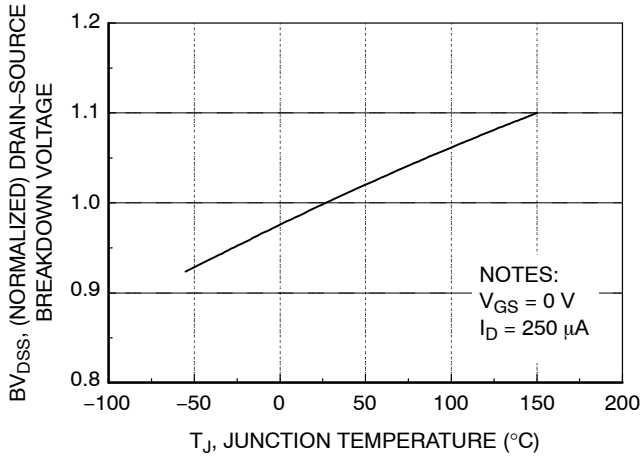


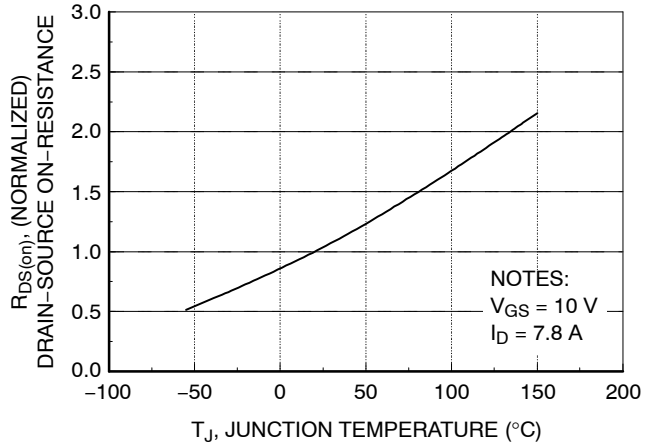
Figure 6. Gate Charge Characteristics

# FQD12N20L

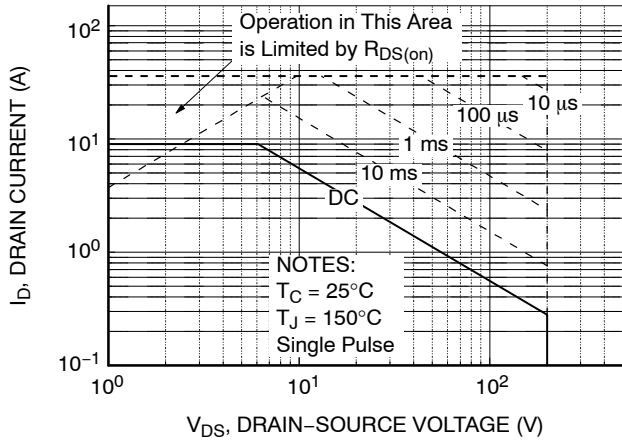
## TYPICAL CHARACTERISTICS (continued)



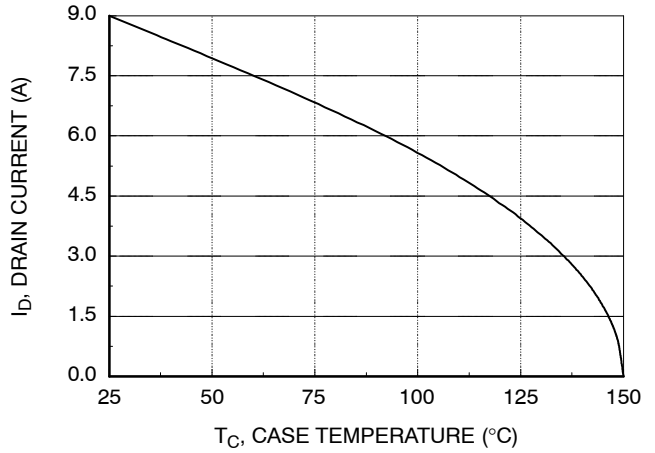
**Figure 7. Breakdown Voltage Variation vs. Temperature**



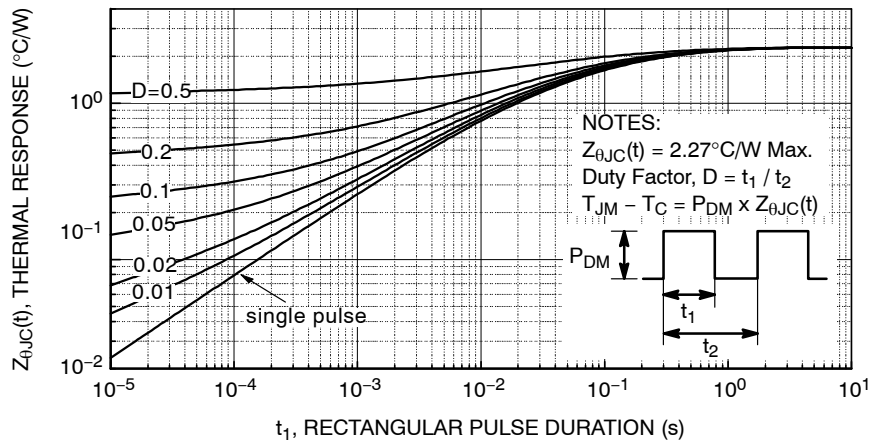
**Figure 8. On-Resistance Variation vs. Temperature**



**Figure 9. Maximum Safe Operating Area**



**Figure 10. Maximum Drain Current vs. Case Temperature**



**Figure 11. Transient Thermal Response Curve**

### FQD12N20L

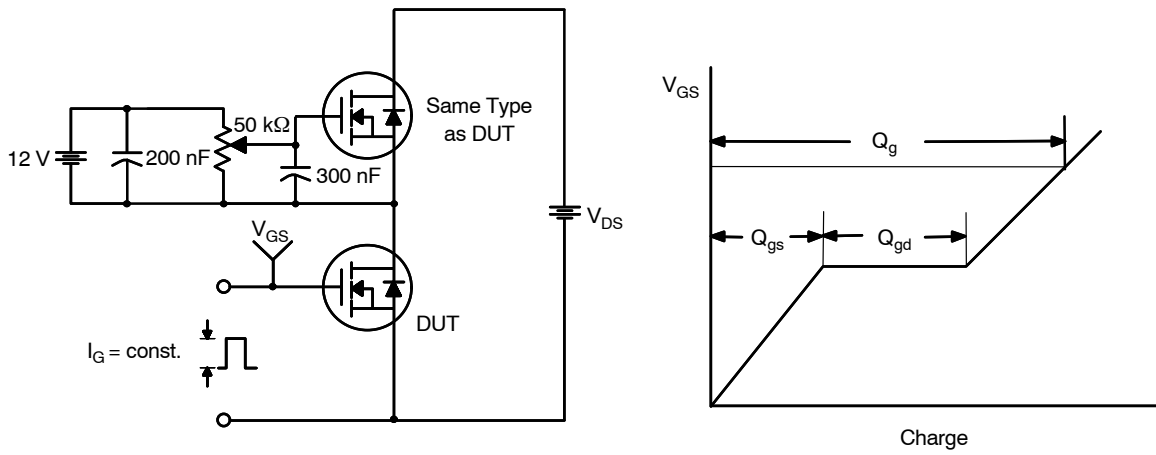


Figure 12. Gate Charge Test Circuit & Waveform

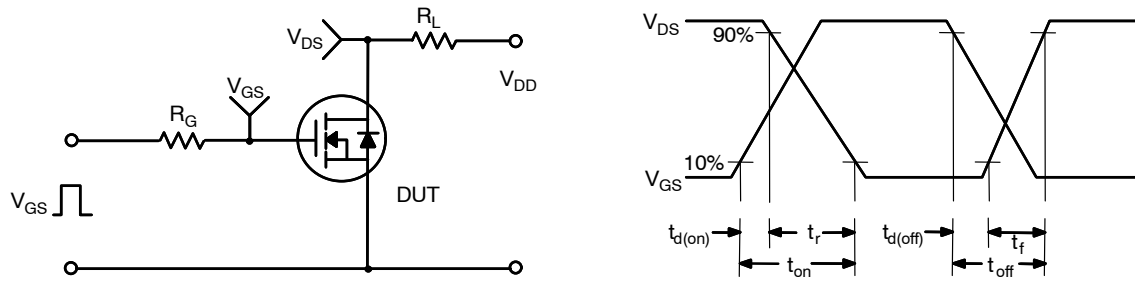


Figure 13. Resistive Switching Test Circuit & Waveforms

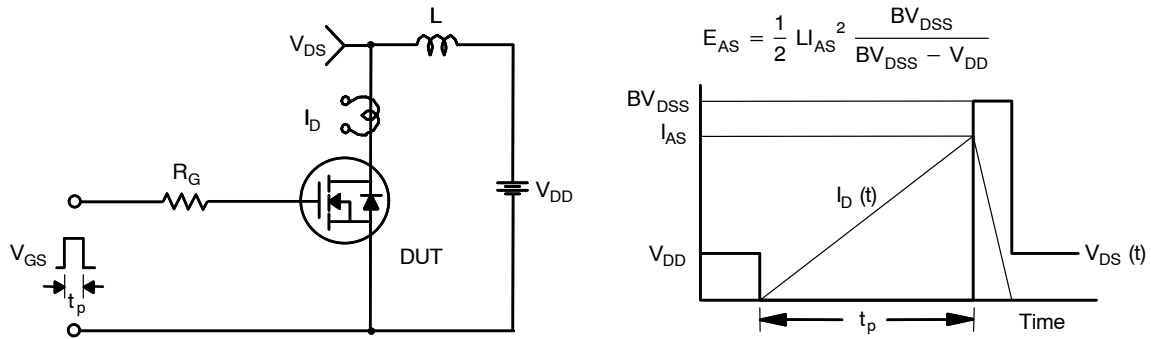
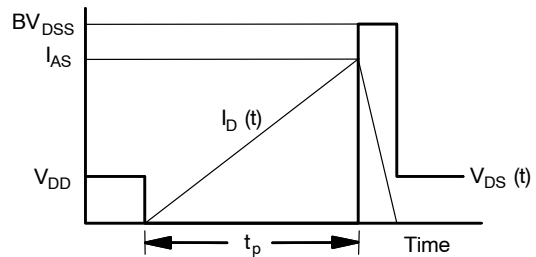


Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms

$$E_{AS} = \frac{1}{2} L I_{AS}^2 \frac{BV_{DSS}}{BV_{DSS} - V_{DD}}$$



### FQD12N20L

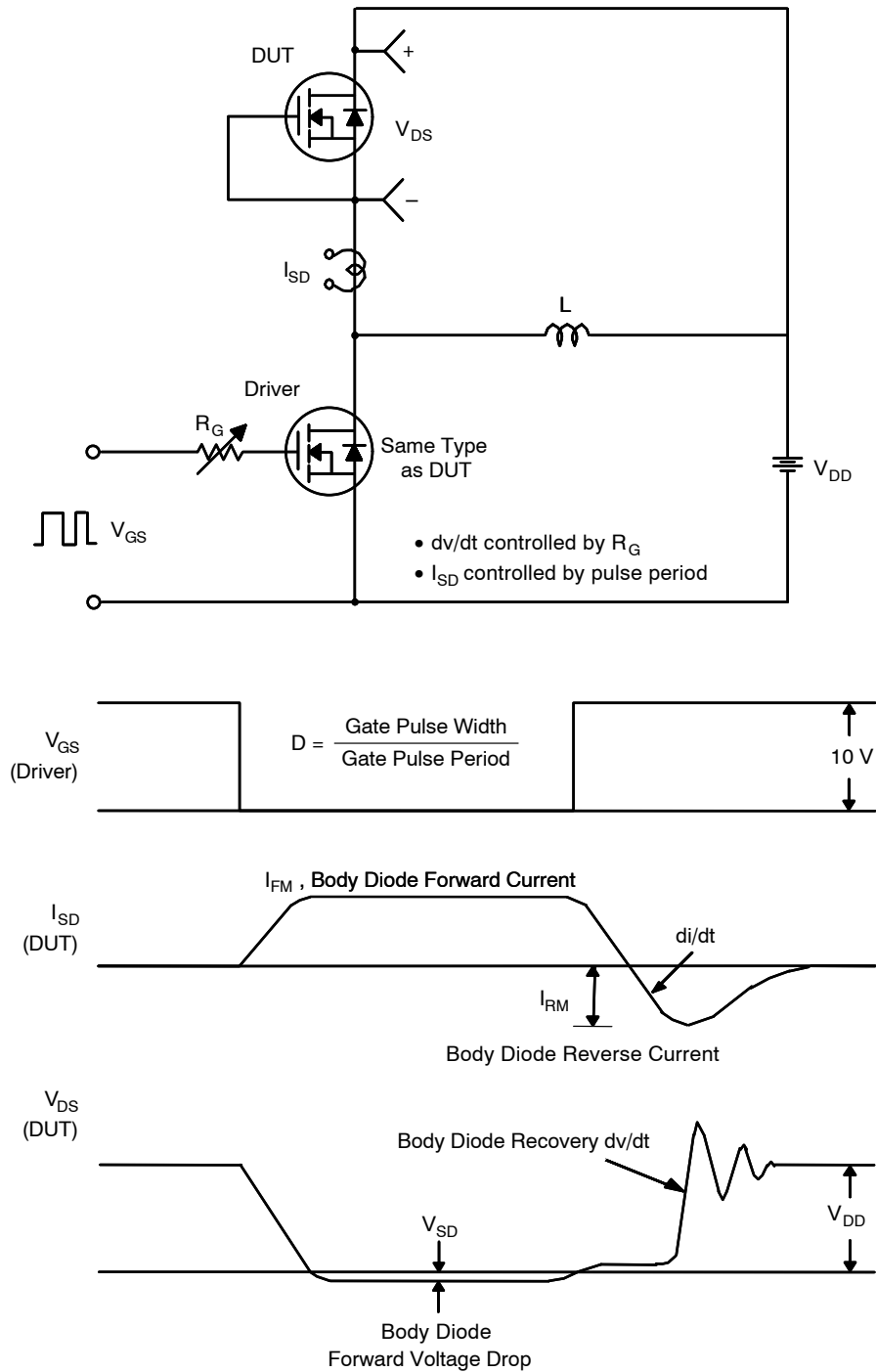


Figure 15. Peak Diode Recovery  $dv/dt$  Test Circuit & Waveforms

#### PACKAGE MARKING AND ORDERING INFORMATION

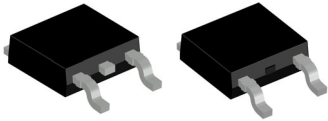
| Device      | Device Marking | Package             | Shipping†          |
|-------------|----------------|---------------------|--------------------|
| FQD12N20LTM | FQD12N20L      | DPAK3 (TO-252 3 LD) | 2500 / Tape & Reel |

†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.



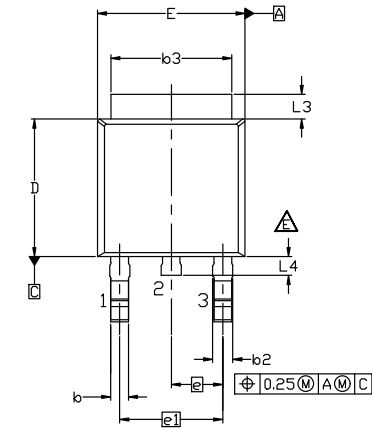


**MECHANICAL CASE OUTLINE  
PACKAGE DIMENSIONS**

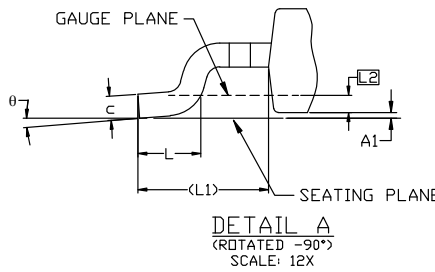
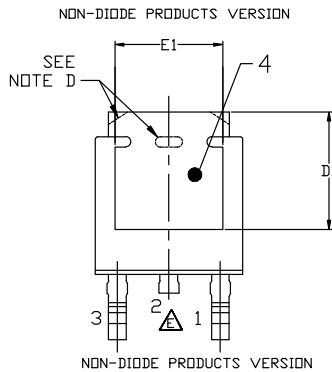


**DPAK3 6.10x6.54x2.29, 4.57P  
CASE 369AS  
ISSUE B**

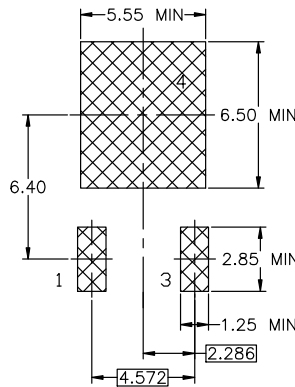
DATE 20 DEC 2023



- NOTES: UNLESS OTHERWISE SPECIFIED  
 A) THIS PACKAGE CONFORMS TO JEDEC, TO-252, ISSUE F, VARIATION AA.  
 B) ALL DIMENSIONS ARE IN MILLIMETERS.  
 C) DIMENSIONING AND TOLERANCING PER ASME Y14.5M-2018.  
 D) SUPPLIER DEPENDENT MOLD LOCKING HOLES OR CHAMFERED CORNERS OR EDGE PROTRUSION.  
 E) FOR DIODE PRODUCTS, L4 IS 0.25 MM MAX PLASTIC BODY STUB WITHOUT CENTER LEAD.  
 F) DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR EXTRUSIONS.  
 G) LAND PATTERN RECOMMENDATION IS BASED ON IPC7351A STD TD228P991X239-3N.



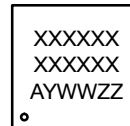
| DIM | MILLIMETERS |      |       |
|-----|-------------|------|-------|
|     | MIN.        | NOM. | MAX.  |
| A   | 2.18        | 2.29 | 2.39  |
| A1  | 0.00        | -    | 0.127 |
| b   | 0.64        | 0.77 | 0.89  |
| b2  | 0.76        | 0.95 | 1.14  |
| b3  | 5.21        | 5.34 | 5.46  |
| c   | 0.45        | 0.53 | 0.61  |
| c2  | 0.45        | 0.52 | 0.58  |
| D   | 5.97        | 6.10 | 6.22  |
| D1  | 5.21        | ---  | ---   |
| E   | 6.35        | 6.54 | 6.73  |
| E1  | 4.32        | ---  | ---   |
| e   | 2.286 BSC   |      |       |
| e1  | 4.572 BSC   |      |       |
| H   | 9.40        | 9.91 | 10.41 |
| L   | 1.40        | 1.59 | 1.78  |
| L1  | 2.90 REF    |      |       |
| L2  | 0.51 BSC    |      |       |
| L3  | 0.89        | 1.08 | 1.27  |
| L4  | ---         | ---  | 1.02  |
| θ   | 0°          | ---  | 10°   |



**LAND PATTERN RECOMMENDATION**

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

**GENERIC MARKING DIAGRAM\***



\*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.

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

|                         |                                    |  |
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| <b>DESCRIPTION:</b>     | <b>DPAK3 6.10x6.54x2.29, 4.57P</b> | <b>PAGE 1 OF 1</b>   |

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