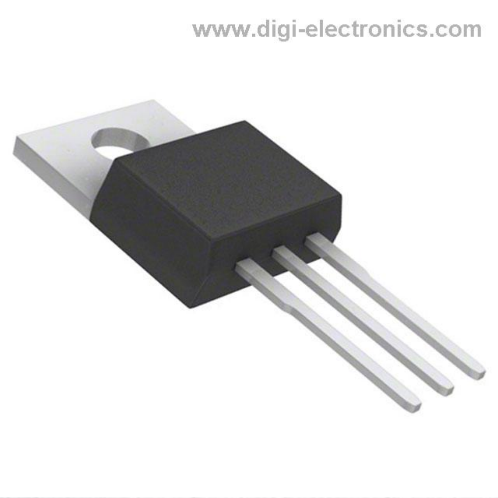
# FCP110N65F Datasheet




https://www.DiGi-Electronics.com

| | |
|---|---|
| DiGi Electronics Part Number | FCP110N65F-DG |
| Manufacturer | onsemi |
| Manufacturer Product Number | FCP110N65F |
| Description | MOSFET N-CH 650V 35A TO220-3 |
| Detailed Description | N-Channel 650 V 35A (Tc) 357W (Tc) Through Hole TO-220-3 |

## Purchase and inquiry

| | |
|---|---|
| Manufacturer Product Number: | Manufacturer: |
| FCP110N65F | onsemi |
| Series: | Product Status: |
| FRFET®, SuperFET® II | Not For New Designs |
| FET Type: | Technology: |
| N-Channel | MOSFET (Metal Oxide) |
| Drain to Source Voltage (Vdss): | Current - Continuous Drain (Id) @ 25°C: |
| 650 V | 35A (Tc) |
| Drive Voltage (Max Rds On, Min Rds On): | Rds On (Max) @ Id, Vgs: |
| 10V | 110mOhm @ 17.5A, 10V |
| Vgs(th) (Max) @ Id: | Gate Charge (Qg) (Max) @ Vgs: |
| 5V @ 3.5mA | 145 nC @ 10 V |
| Vgs (Max): | Input Capacitance (Ciss) (Max) @ Vds: |
| ±20V | 4895 pF @ 100 V |
| FET Feature: | Power Dissipation (Max): |
| - | 357W (Tc) |
| Operating Temperature: | Mounting Type: |
| -55°C ~ 150°C (TJ) | Through Hole |
| Supplier Device Package: | Package / Case: |
| TO-220-3 | TO-220-3 |
| Base Product Number: | |
| FCP110 | |

## Environmental & Export classification

| | |
|---|---|
| RoHS Status: | Moisture Sensitivity Level (MSL): |
| ROHS3 Compliant | Not Applicable |
| REACH Status: | ECCN: |
| REACH Unaffected | EAR99 |
| HTSUS: | |
| 8541.29.0095 | |

Is Now Part of

ON Semiconductor®

**To learn more about ON Semiconductor, please visit our website at www.onsemi.com**

Please note: As part of the Fairchild Semiconductor integration, some of the Fairchild orderable part numbers will need to change in order to meet ON Semiconductor's system requirements. Since the ON Semiconductor product management systems do not have the ability to manage part nomenclature that utilizes an underscore (_), the underscore (_) in the Fairchild part numbers will be changed to a dash (-). This document may contain device numbers with an underscore (_). Please check the ON Semiconductor website to verify the updated device numbers. The most current and up-to-date ordering information can be found at www.onsemi.com. Please email any questions regarding the system integration to Fairchild_questions@onsemi.com.

FAIRCHILD

**December 2014**

# FCP110N65F

## N-Channel SuperFET® II FRFET® MOSFET

**650 V, 35 A, 110 mΩ**

## Features

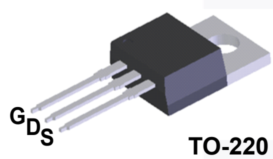
- 700 V @ $T_J$ = 150°C
- Typ. $R_{DS(on)}$ = 96 mΩ (Typ.)
- Ultra Low Gate Charge (Typ. $Q_g$ = 98 nC)
- Low Effective Output Capacitance (Typ. $C_{oss(eff.)}$ = 464 pF)
- 100% Avalanche Tested
- RoHS Compliant

## Applications

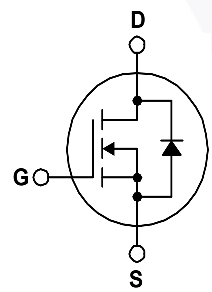
- LCD / LED / PDP TV
- Telecom / Server Power Supplies
- Solar Inverter
- AC - DC Power Supply

## Description

SuperFET® II MOSFET is Fairchild Semiconductor's brand-new high voltage super-junction (SJ) MOSFET family that is utilizing charge balance technology for outstanding low on-resistance and lower gate charge performance. This technology is tailored to minimize conduction loss, provide superior switching performance, dv/dt rate and higher avalanche energy. Consequently, SuperFET II MOSFET is very suitable for the switching power applications such as PFC, server/telecom power, FPD TV power, ATX power and industrial power applications. SuperFET II FRFET® MOSFET's optimized body diode reverse recovery performance can remove additional component and improve system reliability.




TO-220




## Absolute Maximum Ratings $T_C$ = 25°C unless otherwise noted.

| Symbol | Parameter | | FCP110N65F | Unit |
|---|---|---|---|---|
| $V_{DSS}$ | Drain to Source Voltage | | 650 | V |
| $V_{GSS}$ | Gate to Source Voltage | - DC | ±20 | V |
| | | - AC (f > 1 Hz) | ±30 | |
| $I_D$ | Drain Current | - Continuous ($T_C$ = 25°C) | 35 | A |
| | | - Continuous ($T_C$ = 100°C) | 24 | |
| $I_{DM}$ | Drain Current | - Pulsed (Note 1) | 105 | A |
| $E_{AS}$ | Single Pulsed Avalanche Energy (Note 2) | | 809 | mJ |
| $I_{AR}$ | Avalanche Current (Note 1) | | 8 | A |
| $E_{AR}$ | Repetitive Avalanche Energy (Note 1) | | 3.57 | mJ |
| dv/dt | MOSFET dv/dt | | 100 | V/ns |
| | Peak Diode Recovery dv/dt (Note 3) | | 50 | |
| $P_D$ | Power Dissipation | ($T_C$ = 25°C) | 357 | W |
| | | - Derate Above 25°C | 2.86 | W/°C |
| $T_J$, $T_{STG}$ | Operating and Storage Temperature Range | | -55 to +150 | °C |
| $T_L$ | Maximum Lead Temperature for Soldering, 1/8" from Case for 5 Seconds | | 300 | °C |

## Thermal Characteristics

| Symbol | Parameter | FCP110N65F | Unit |
|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case, Max. | 0.35 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient, Max. | 62.5 | |

## Package Marking and Ordering Information

| Part Number | Top Mark | Package | Packing Method | Reel Size | Tape Width | Quantity |
|---|---|---|---|---|---|---|
| FCP110N65F | FCP110N65F | TO-220 | Tube | N/A | N/A | 50 units |

## Electrical Characteristics $T_C$ = 25°C unless otherwise noted.

### Off Characteristics

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $BV_{DSS}$ | Drain to Source Breakdown Voltage | $V_{GS}$ = 0 V, $I_D$ = 10 mA, $T_J$ = 25°C | 650 | - | - | V |
| | | $V_{GS}$ = 0 V, $I_D$ = 10 mA, $T_J$ = 150°C | 700 | - | - | |
| $\Delta BV_{DSS}$ / $\Delta T_J$ | Breakdown Voltage Temperature Coefficient | $I_D$ = 10 mA, Referenced to 25°C | - | 0.72 | - | V/°C |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = 650 V, $V_{GS}$ = 0 V | - | - | 10 | μA |
| | | $V_{DS}$ = 520 V, $T_C$ = 125°C | - | 110 | - | |
| $I_{GSS}$ | Gate to Body Leakage Current | $V_{GS}$ = ±20 V, $V_{DS}$ = 0 V | - | - | ±100 | nA |

### On Characteristics

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{GS}$ = $V_{DS}$, $I_D$ = 3.5 mA | 3 | - | 5 | V |
| $R_{DS(on)}$ | Static Drain to Source On Resistance | $V_{GS}$ = 10 V, $I_D$ = 17.5 A | - | 96 | 110 | mΩ |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$ = 20 V, $I_D$ = 17.5 A | - | 30 | - | S |

### Dynamic Characteristics

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $C_{iss}$ | Input Capacitance | $V_{DS}$ = 100 V, $V_{GS}$ = 0 V, f = 1 MHz | - | 3680 | 4895 | pF |
| $C_{oss}$ | Output Capacitance | | - | 110 | 145 | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | - | 0.65 | - | pF |
| $C_{oss}$ | Output Capacitance | $V_{DS}$ = 380 V, $V_{GS}$ = 0 V, f = 1 MHz | - | 65 | - | pF |
| $C_{oss(eff.)}$ | Effective Output Capacitance | $V_{DS}$ = 0 V to 400 V, $V_{GS}$ = 0 V | - | 464 | - | pF |
| $Q_{g(tot)}$ | Total Gate Charge at 10V | $V_{DS}$ = 380 V, $I_D$ = 17.5 A, $V_{GS}$ = 10 V (Note 4) | - | 98 | 145 | nC |
| $Q_{gs}$ | Gate to Source Gate Charge | | - | 20 | - | nC |
| $Q_{gd}$ | Gate to Drain "Miller" Charge | | - | 43 | - | nC |
| ESR | Equivalent Series Resistance | f = 1 MHz | - | 0.7 | - | Ω |

### Switching Characteristics

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DD}$ = 380 V, $I_D$ = 17.5 A, $V_{GS}$ = 10 V, $R_g$ = 4.7 Ω (Note 4) | - | 31 | 72 | ns |
| $t_r$ | Turn-On Rise Time | | - | 21 | 52 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | - | 89 | 188 | ns |
| $t_f$ | Turn-Off Fall Time | | - | 5.7 | 21 | ns |

### Drain-Source Diode Characteristics

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $I_S$ | Maximum Continuous Drain to Source Diode Forward Current | | - | - | 35 | A |
| $I_{SM}$ | Maximum Pulsed Drain to Source Diode Forward Current | | - | - | 105 | A |
| $V_{SD}$ | Drain to Source Diode Forward Voltage | $V_{GS}$ = 0 V, $I_{SD}$ = 17.5 A | - | - | 1.2 | V |
| $t_{rr}$ | Reverse Recovery Time | $V_{GS}$ = 0 V, $I_{SD}$ = 17.5 A, $dI_F/dt$ = 100 A/μs | - | 133 | - | ns |
| $Q_{rr}$ | Reverse Recovery Charge | | - | 0.67 | - | μC |

**Notes:**

1. Repetitive rating: pulse width limited by maximum junction temperature.
2. $I_{AS}$ = 8 A, $R_G$ = 25 Ω, starting $T_J$ = 25°C.
3. $I_{SD}$ ≤ 17.5 A, di/dt ≤ 200 A/μs, $V_{DD}$ ≤ 380 V, starting $T_J$ = 25°C.
4. Essentially independent of operating temperature typical characteristics.

## Typical Performance Characteristics

**Figure 1. On-Region Characteristics**

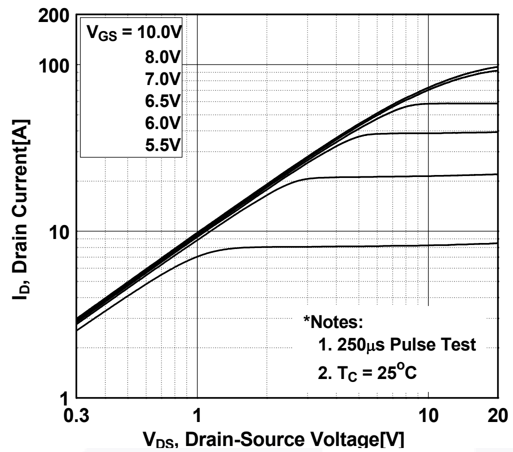



**Figure 2. Transfer Characteristics**

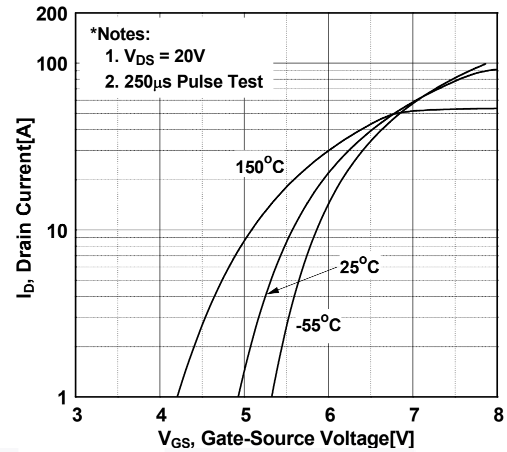



**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**

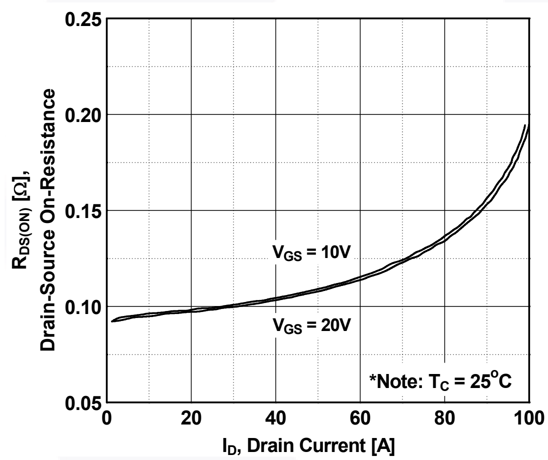



**Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature**

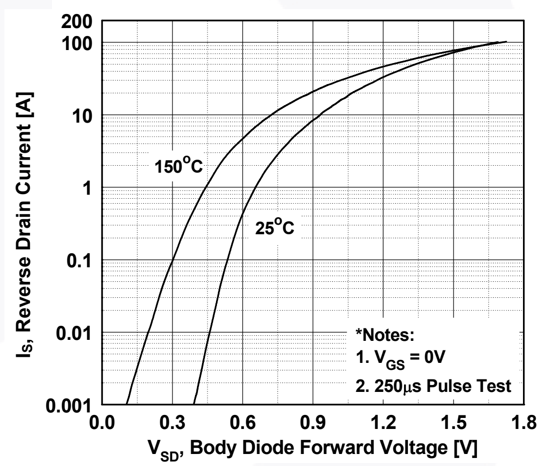



**Figure 5. Capacitance Characteristics**

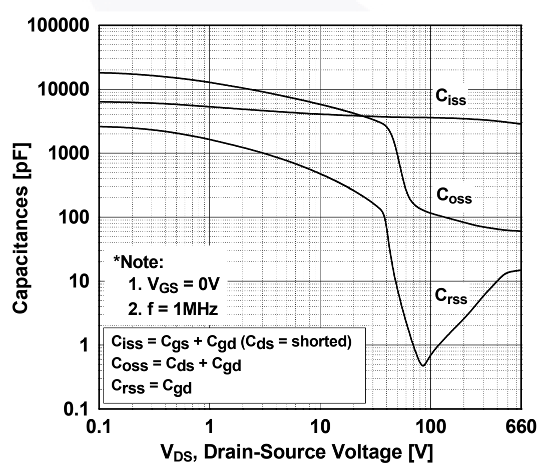
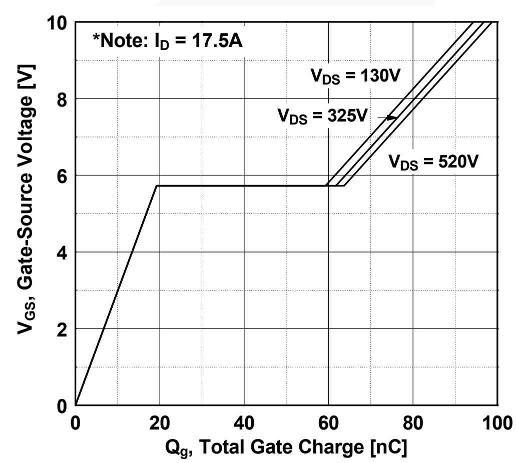



**Figure 6. Gate Charge Characteristics**



## Typical Performance Characteristics (Continued)

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

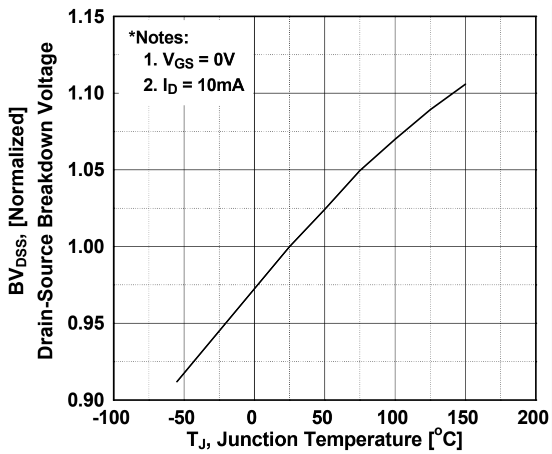



**Figure 8. On-Resistance Variation vs. Temperature**

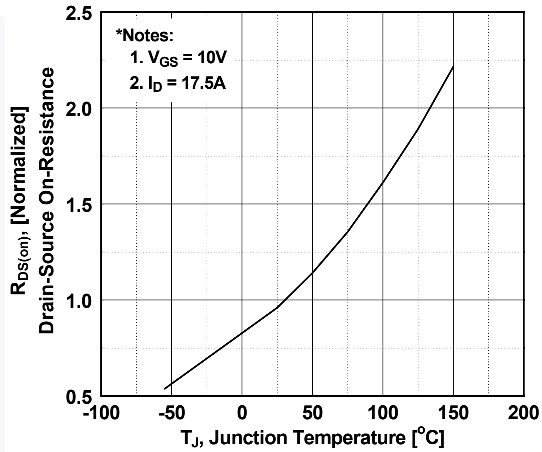



**Figure 9. Maximum Safe Operating Area**

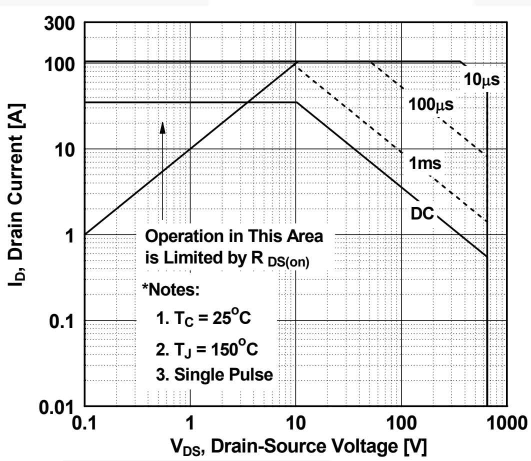



**Figure 10. Maximum Drain Current vs. Case Temperature**

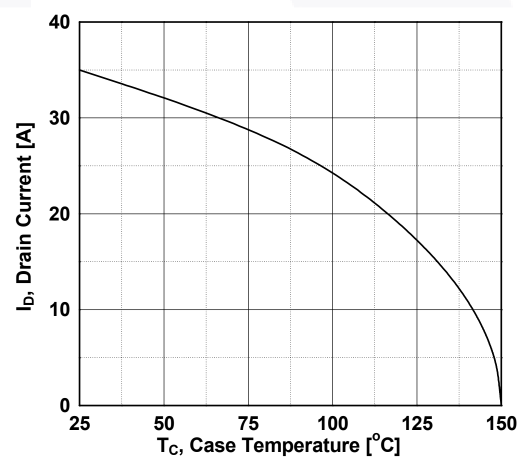
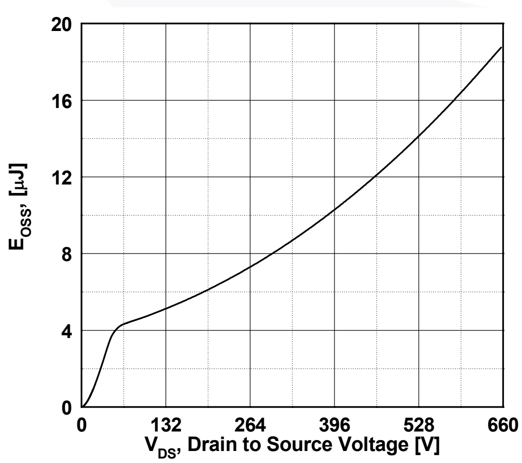
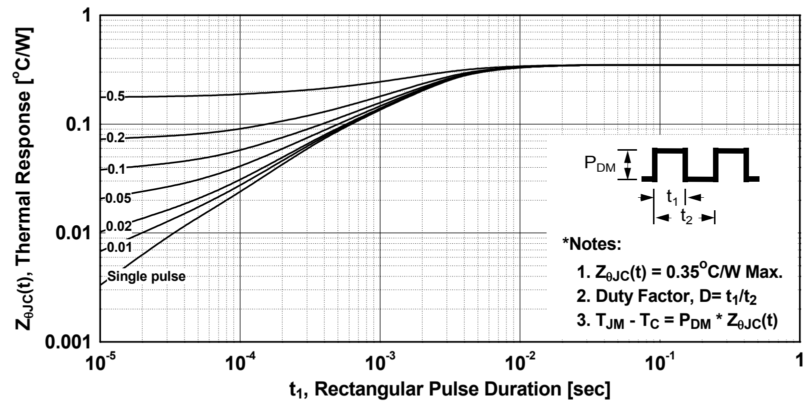



**Figure 11. Eoss vs. Drain to Source Voltage**



## Typical Performance Characteristics (Continued)

**Figure 12. Transient Thermal Response Curve**



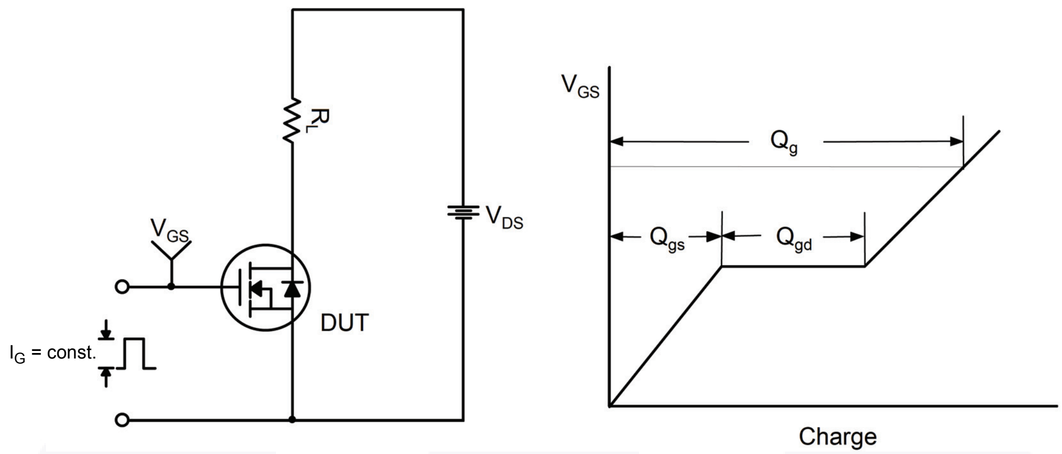



**Figure 13. Gate Charge Test Circuit & Waveform**

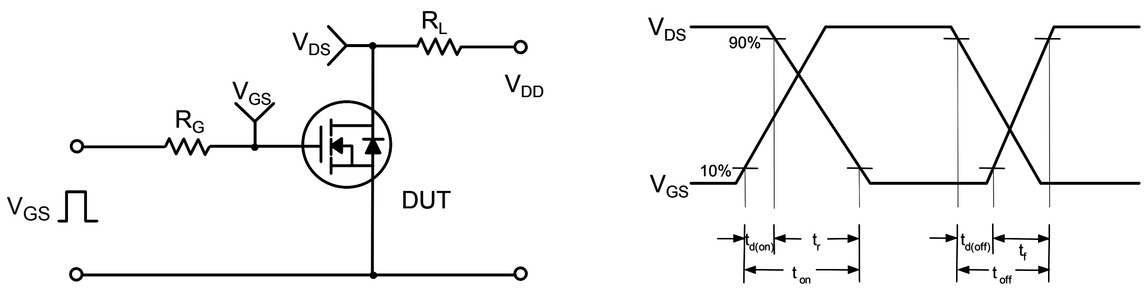



**Figure 14. Resistive Switching Test Circuit & Waveforms**

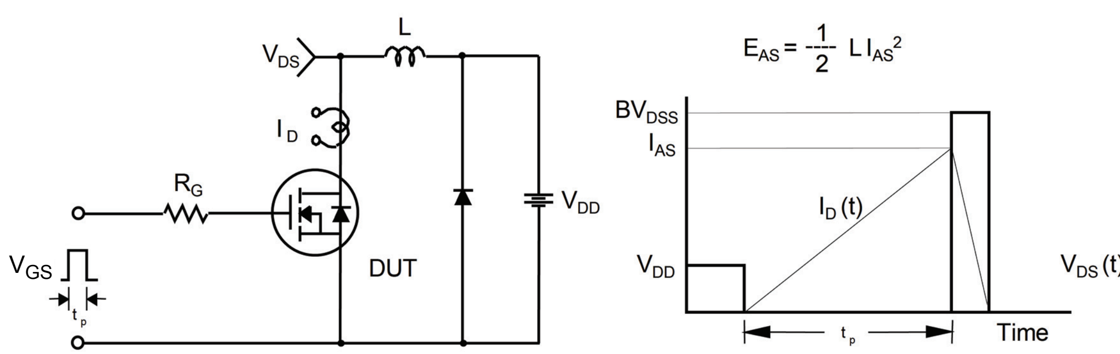



**Figure 15. Unclamped Inductive Switching Test Circuit & Waveforms**

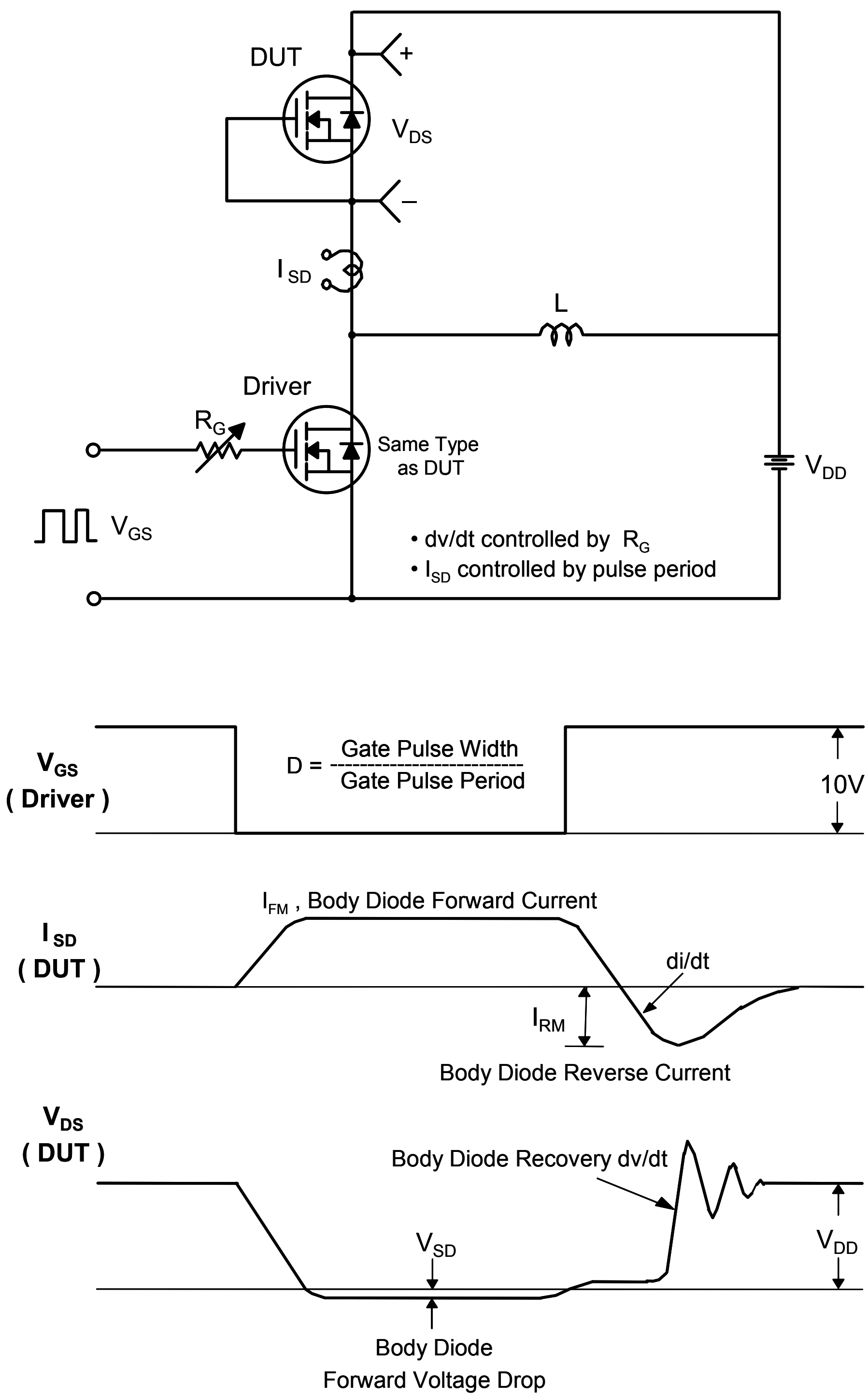
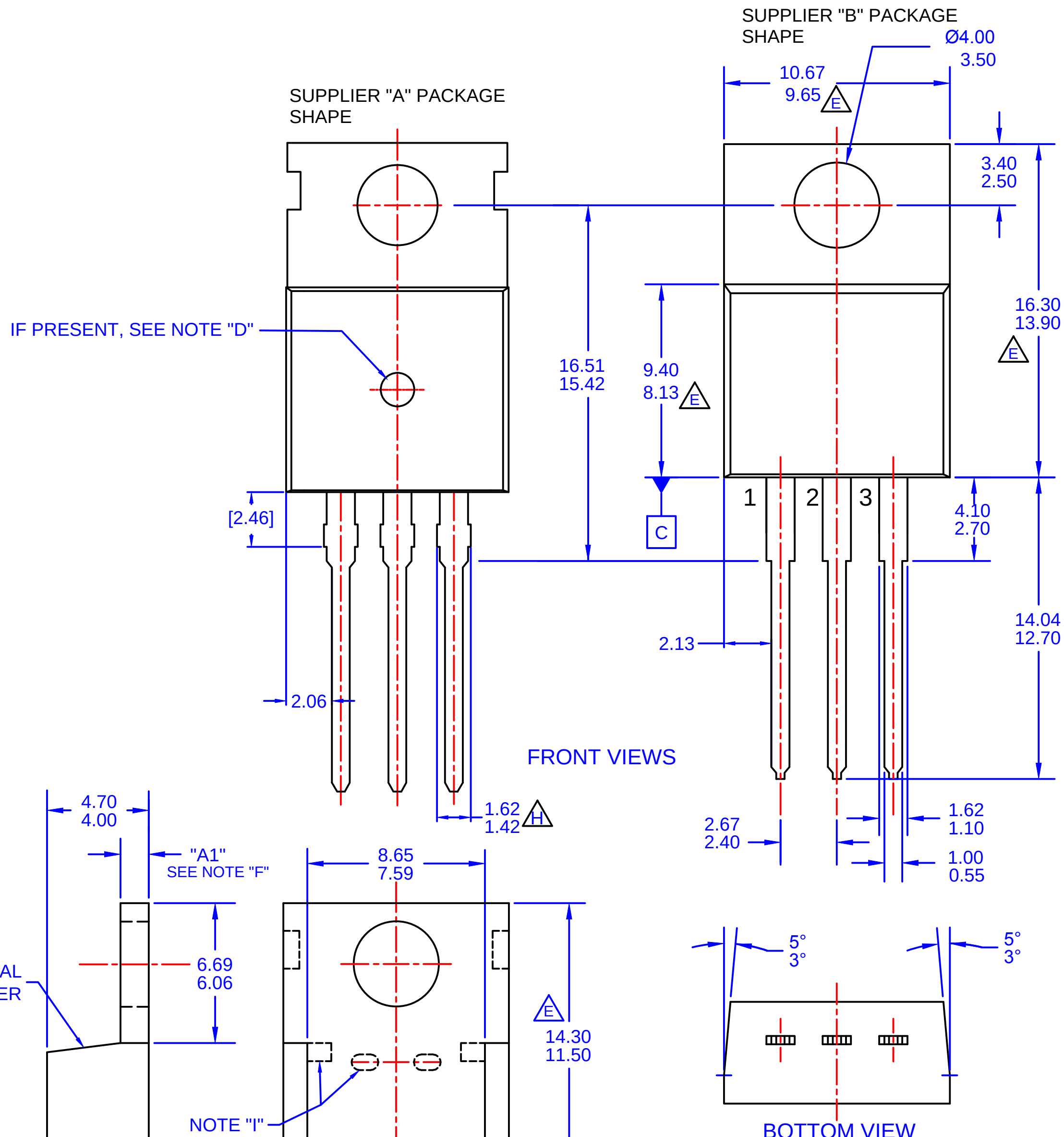
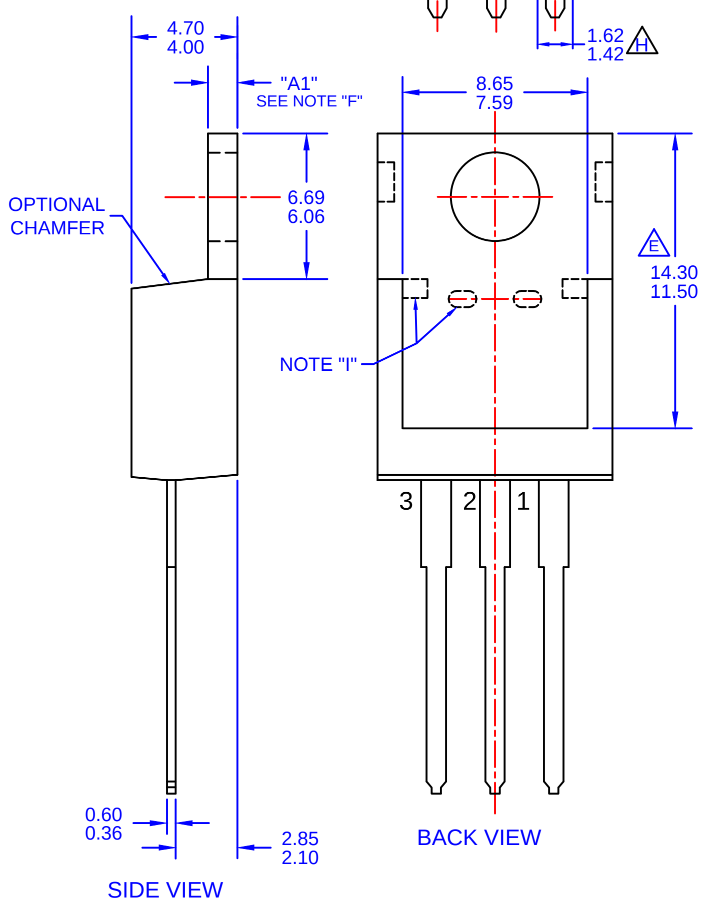



**Figure 16. Peak Diode Recovery dv/dt Test Circuit & Waveforms**




NOTES:

A) REFERENCE JEDEC, TO-220, VARIATION AB
B) ALL DIMENSIONS ARE IN MILLIMETERS.
C) DIMENSIONS COMMON TO ALL PACKAGE SUPPLIERS EXCEPT WHERE NOTED [ ].
D) LOCATION OF MOLDED FEATURE MAY VARY (LOWER LEFT CORNER, LOWER CENTER AND CENTER OF THE PACKAGE)
E) DOES NOT COMPLY JEDEC STANDARD VALUE.
F) "A1" DIMENSIONS AS BELOW:
   SINGLE GAUGE = 0.51 - 0.61
   DUAL GAUGE = 1.10 - 1.45
G) DRAWING FILE NAME: TO220B03REV9
H) PRESENCE IS SUPPLIER DEPENDENT
I) SUPPLIER DEPENDENT MOLD LOCKING HOLES IN HEATSINK.

## PUBLICATION ORDERING INFORMATION

**LITERATURE FULFILLMENT**:
Literature Distribution Center for ON Semiconductor
19521 E. 32nd Pkwy, Aurora, Colorado 80011 USA
**Phone**: 303−675−2175 or 800−344−3860 Toll Free USA/Canada
**Fax**: 303−675−2176 or 800−344−3867 Toll Free USA/Canada
**Email**: orderlit@onsemi.com

**N. American Technical Support**: 800−282−9855 Toll Free USA/Canada
**Europe, Middle East and Africa Technical Support:**
Phone: 421 33 790 2910
**Japan Customer Focus Center**
Phone: 81−3−5817−1050

**ON Semiconductor Website**: **www.onsemi.com**

**Order Literature**: http://www.onsemi.com/orderlit

For additional information, please contact your local Sales Representative

# OUR CERTIFICATE

DiGi provide top-quality products and perfect service for customer worldwide through standardization, technological innovation and continuous improvement.  DiGi through third-party certification, we striciy control the quality of products and services. Welcome your RFQ to Email: Info@DiGi-Electronics.com



Tel: +00 852-30501935

RFQ Email: Info@DiGi-Electronics.com


DiGi is a global authorized distributor of electronic components.