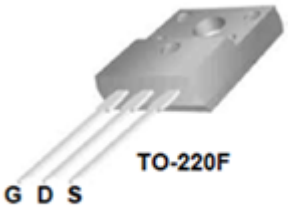
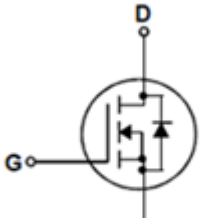
# 650V N-Channel MOSFET

**General Description**

This Power MOSFET is produced using advanced planar stripe DMOS technology. This advanced technology has been especially tailored to minimize on-state resistance, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode.
These devices are well suited for high efficiency switched mode power supplies, active power factor correction based on half bridge topology.




**Features**

7A, 650V, $R_{DS}$(on)typ. = 1.65Ω@VGS = 10 V
Advanced planar process
Low gate charge minimize switching loss
Fast switching
100% avalanche tested
Improved dv/dt capability

## Absolute Maximum Ratings $T_C$ = 25 ℃ unless otherwise noted

| Symbol | Parameter | | JFFC7N65E | Units |
|---|---|---|---|---|
| $V_{DSS}$ | Drain – Source Voltage | | 650 | V |
| $I_D$ | Drain Current | Continuous ( $T_C$ = 25 ℃ ) | 7* | A |
| | | Continuous ( $T_C$ = 100 ℃ ) | 4* | A |
| $I_{DM}$ | Drain Current - Pulsed | ( Note 1 ) | 25 | A |
| $V_{GSS}$ | Gate – Source Voltage | | ±30 | V |
| EAS | Single Pulsed Avalanche Energy | ( Note 2 ) | 106 | mJ |
| $I_{AR}$ | Avalanche Current | ( Note 1 ) | 7 | A |
| $E_{AR}$ | Repetitive Avalanche Energy | ( Note 1 ) | 10 | mJ |
| dv/dt | Peak Diode Recovery dv/dt | ( Note 3 ) | 5.0 | V/ns |
| $P_D$ | Power Dissipation ( $T_C$ = 25 ℃ ) | | 43 | W |
| | -Derate above 25 ℃ | | 0.34 | W/℃ |
| $T_J$,$T_{STG}$ | Operating and Storage Temperature Range | | -55 to +150 | ℃ |
| $T_L$ | Maximum lead temperature for soldering purposes 1/8" frome case for 5 seconds | | 300 | ℃ |

*Drain current limited by maximum junction temperature.

## Thermal characteristics

| Symbol | Parameter | JFFC7N65E | Units |
|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance, Junction-to-Case | 2.9 | ℃/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient | 62.5 | ℃/W |

## Electrical Characteristics $T_C$ = 25 ℃ unless otherwise noted

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| **Off Characteristics** | | | | | | |
| $BV_{DSS}$ | Drain – Source Breakdown Voltage | $V_{GS}$ = 0 V, $I_D$ = 250 uA | 650 | -- | -- | V |
| $\Delta BV_{DSS}/\Delta T_J$ | Breakdown Voltage Temperature Coefficient | $I_D$ = 250 uA, Referenced to 25℃ | -- | 0.5 | -- | V/℃ |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = 650 V, $V_{GS}$ = 0 V | -- | -- | 1 | uA |
| | | $V_{DS}$ = 520 V, Tc = 125 ℃ | -- | -- | 10 | uA |
| $I_{GSSF}$ | Gate-Body Leakage Current, Forward | $V_{GS}$ = 30 V, $V_{GS}$ = 0 V | -- | -- | 100 | nA |
| $I_{GSSR}$ | Gate-Body Leakage Current, Reverse | $V_{GS}$ = -30 V, $V_{GS}$ = 0 V | -- | -- | -100 | nA |
| **On Characteristics** | | | | | | |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 uA | 2.0 | -- | 4.0 | V |
| $R_{DS(on)}$ | Static Drain-Source on-Resistance | $V_{GS}$ = 10 V, $I_D$ = 3.5A | -- | 1.65 | 1.8 | Ω |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$ = 40 V, $I_D$ = 7 A ( Note 4 ) | -- | 10 | -- | S |
| **Dynamic Characteristics** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$ = 25 V, $V_{GS}$ = 0 V, f = 1.0 MHz | -- | 680 | -- | pF |
| $C_{oss}$ | Output Capacitance | | -- | 70 | -- | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | -- | 8.4 | -- | pF |
| **Switching Characteristics** | | | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DS}$ = 325 V, $I_D$ = 7.0 A , $R_G$ = 25Ω , $V_{GS}$ = 10 V (Note 4,5 ) | -- | 12 | -- | ns |
| $t_r$ | Turn-On Rise Time | | -- | 15 | -- | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | -- | 32 | -- | ns |
| $t_f$ | Turn-Off Fall Time | | -- | 16 | -- | ns |
| $Q_g$ | Total Gate Charge | $V_{DS}$ = 480 V, $I_D$ = 7.0 A $V_{GS}$ = 10 V (Note 4,5 ) | -- | 17 | -- | nC |
| $Q_{gs}$ | Gate-Source Charge | | -- | 4 | -- | nC |
| $Q_{gd}$ | Gate-Drain Charge | | -- | 7 | -- | nC |
| **Drain – Source Diode Characteristics and Maximum Ratings** | | | | | | |
| $I_S$ | Maximum Continuous Drain-Source Diode Forward Current | | -- | -- | 7 | A |
| $I_{SM}$ | Maximum Pulsed Drain-Source Diode Forward Current | | -- | -- | 25 | A |
| $V_{SD}$ | Drain-Source Diode Forward Voltage | $V_{GS}$ = 0 V, $I_S$ = 7.0 A | -- | -- | 1.2 | V |
| $t_{rr}$ | Reverse Recovery Time | $V_{GS}$ = 0 V, $I_S$ = 7.0 A $dI_F/dt$ = 100 A/us ( Note 4 ) | -- | 300 | -- | ns |
| $Q_{rr}$ | Reverse Recovery Charge | | -- | 3.1 | -- | uC |

**Notes:**

1. Repetitive Rating : Pulsed width limited by maximum junction temperature
2. L = 4.0mH , $I_{AS}$ = 7A, $V_{DD}$ = 50V,$R_G$ = 25Ω, Starting $T_J$ = 25℃
3. $I_{SD}$ ≤ 7.0A, di/dt ≤ 200A/us, $V_{DD}$ ≤ $BV_{DSS}$, Starting $T_J$ = 25°C
4. Pulsed Test : Pulsed width ≤300us, Duty cycle ≤ 2%
5. Essentially independent of operating temperature

## Typical Characteristics

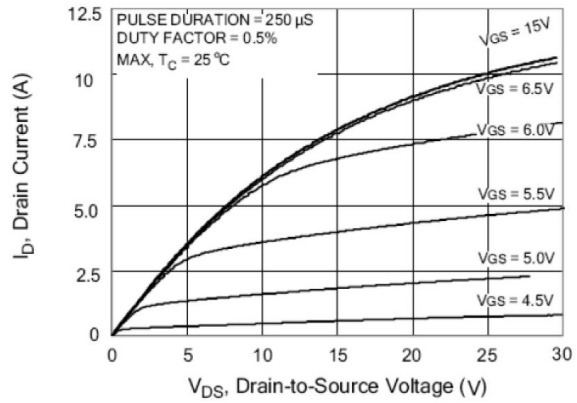



Figure 1. On-Region Characteristics

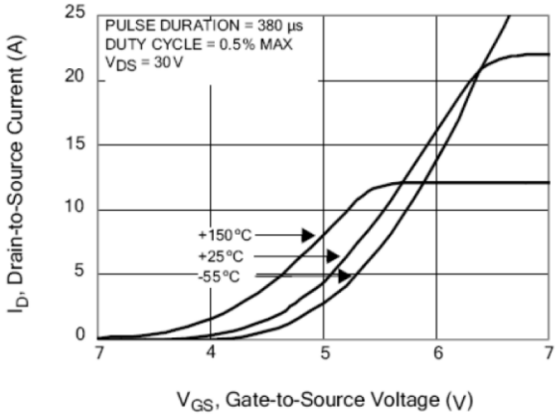



Figure 2. Transfer Characteristics

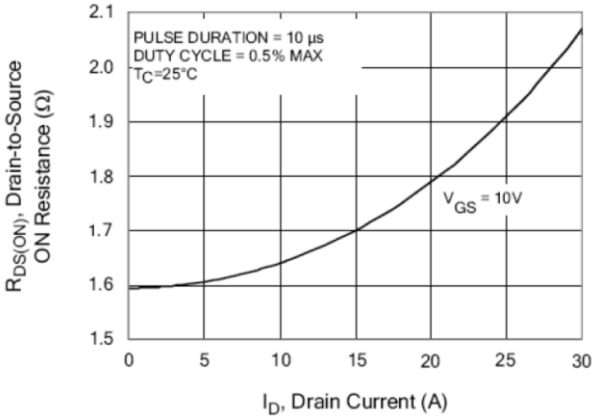



Figure 3. On-Resistance Variation vs Drain Current

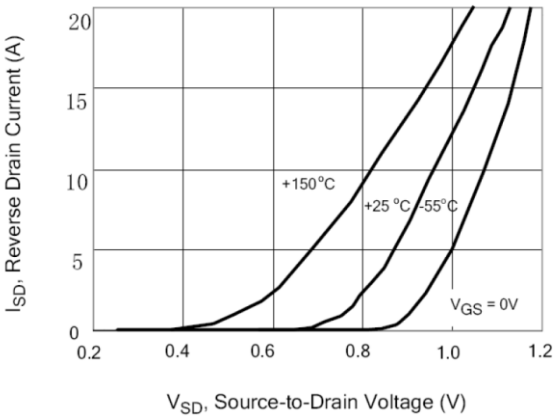



Figure 4. Body Diode Forward Voltage Variation with Source Current and Temperature

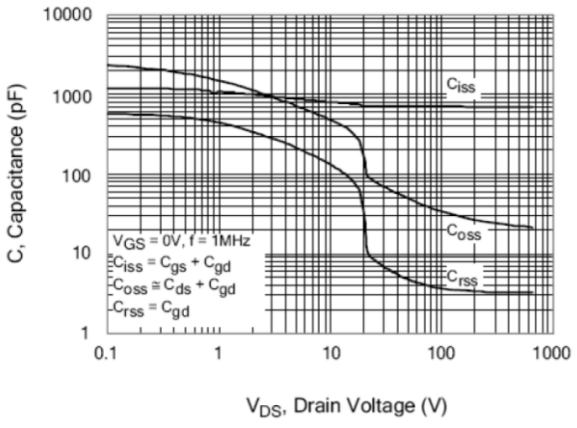



Figure 5. Capacitance Characteristics

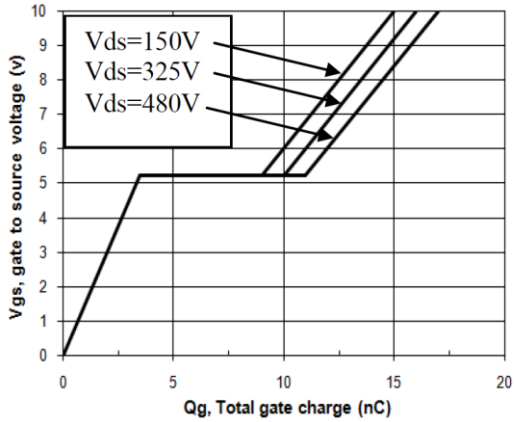



Figure 6. Gate Charge Characteristics

## Typical Characteristics

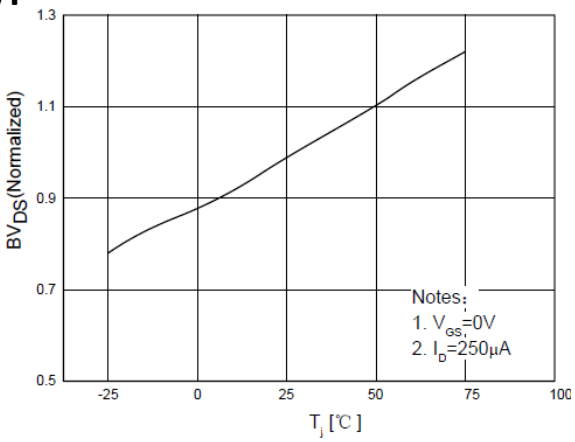



Figure 7. Breakdown Voltage Variation vs Temperature

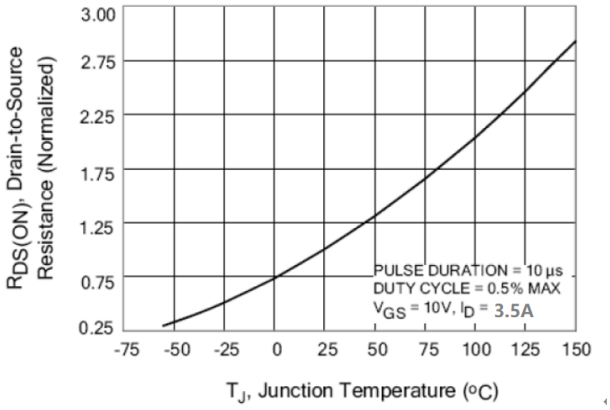



Figure 8. On-Resistance Variation vs Temperature

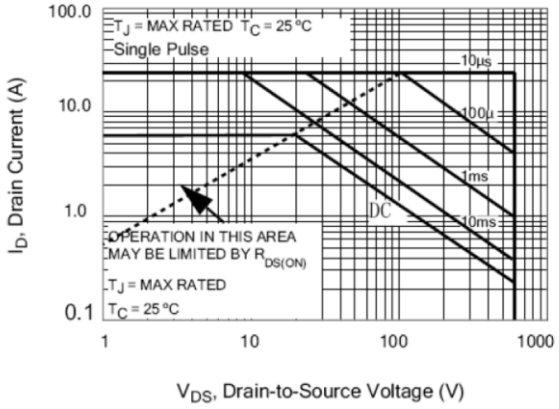



Figure 9-2. Maximum Safe Operating Area for JFFC7N65E

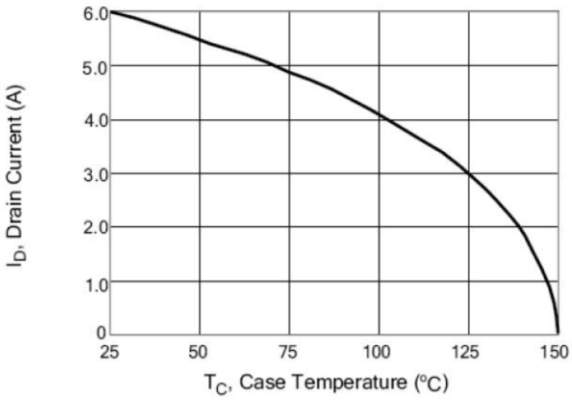



Figure 10. Maximum Drain Current vs Case Temperature

## Typical Characteristics

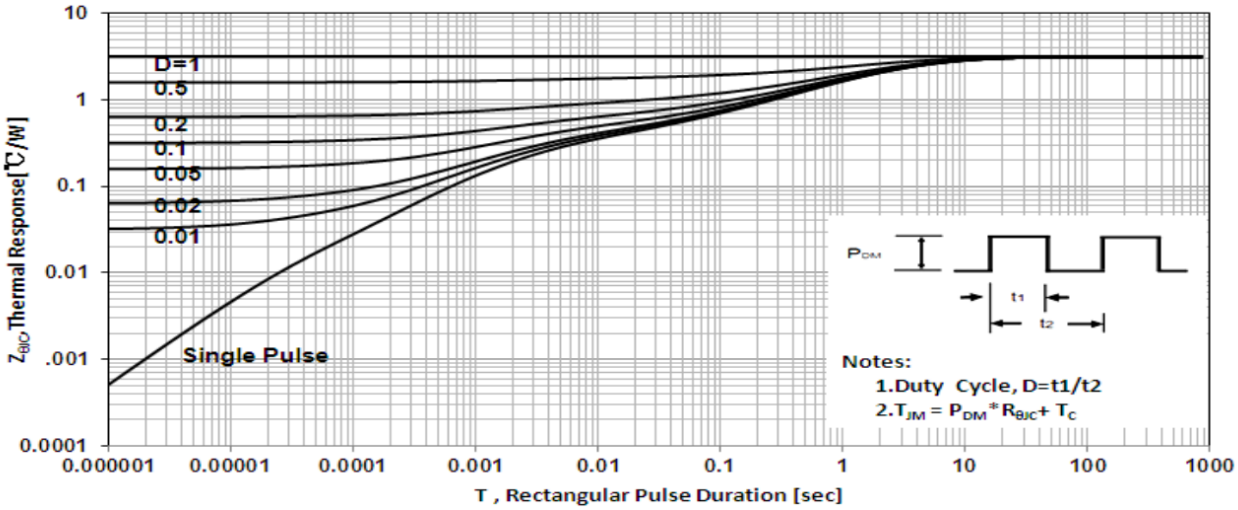
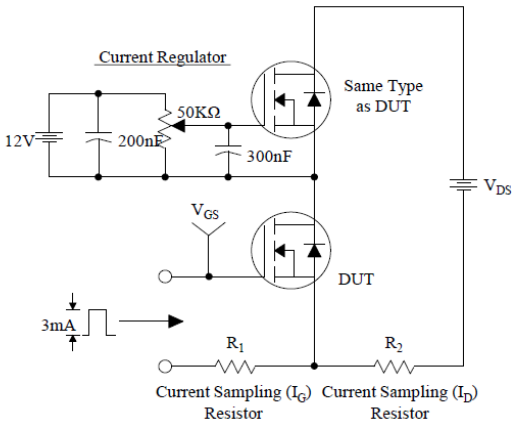
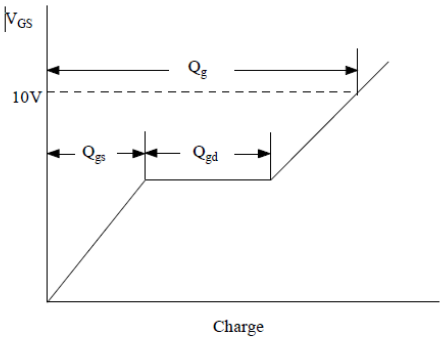


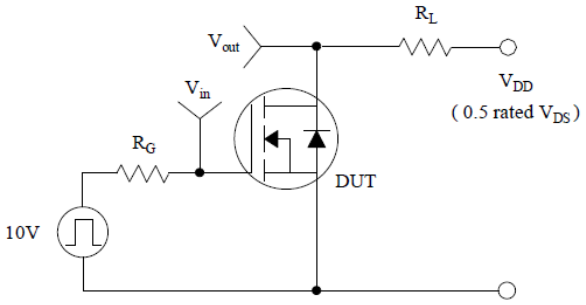

Figure 11-2. Transient Thermal Response Curve for JFFC7N65E

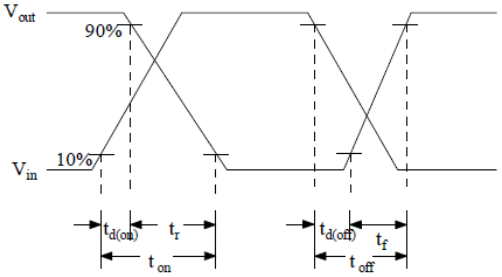
## Test Circuit & Waveform



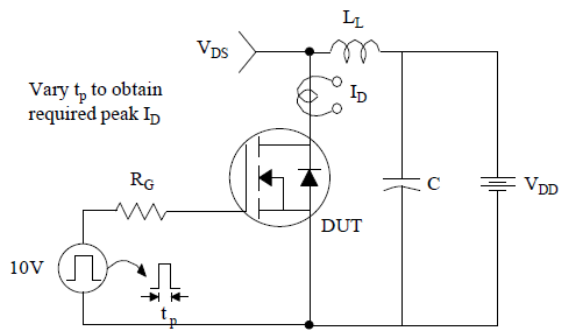



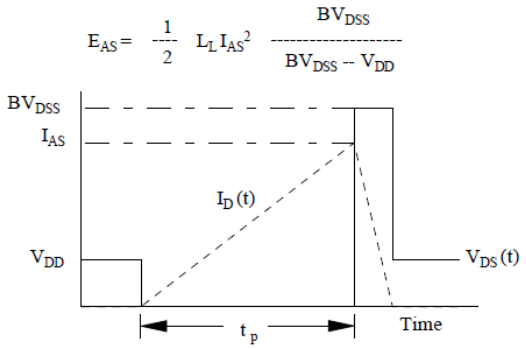

Gate Charge Test Circuit & Waveform



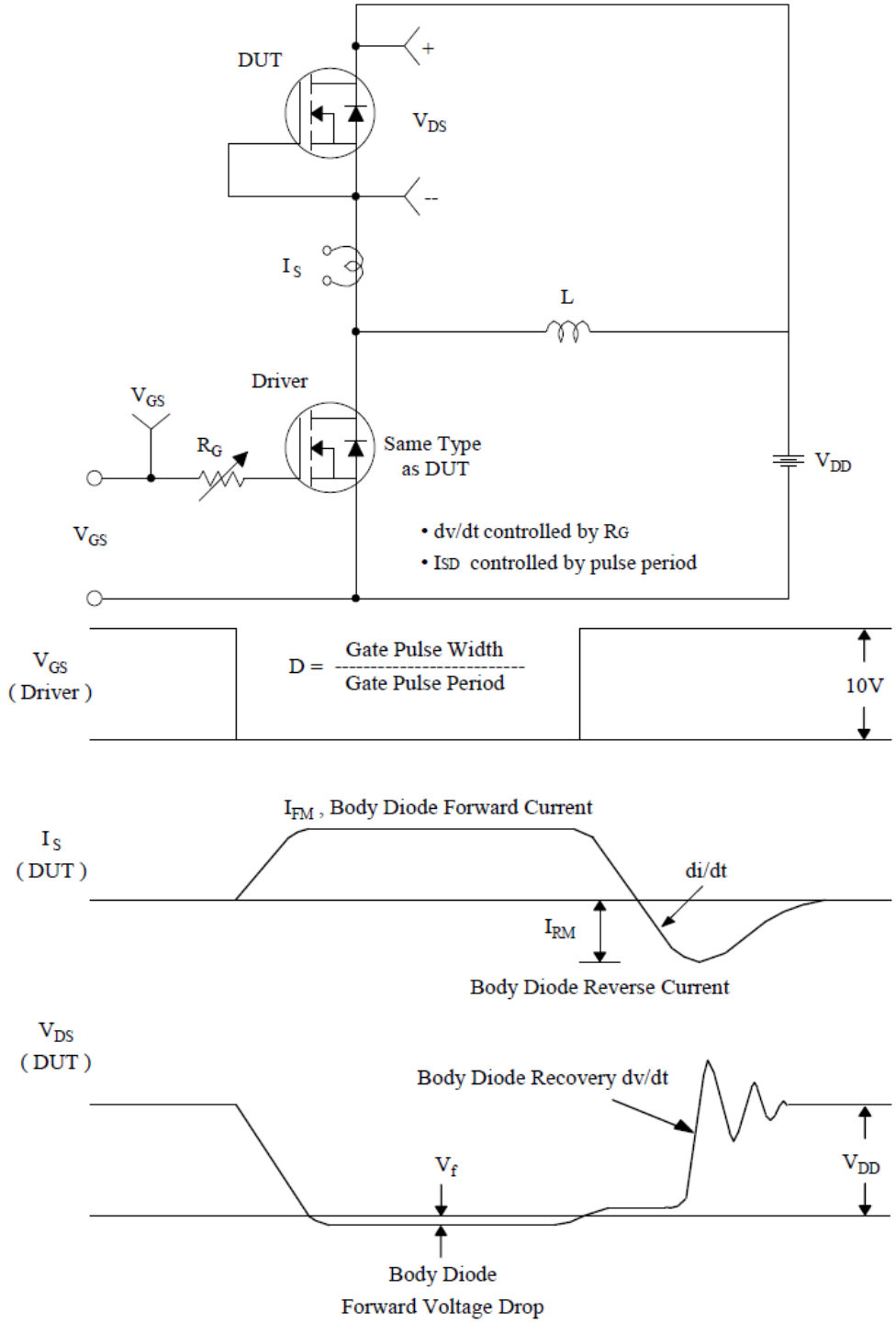

Resistive Switching Test Circuit & Waveforms



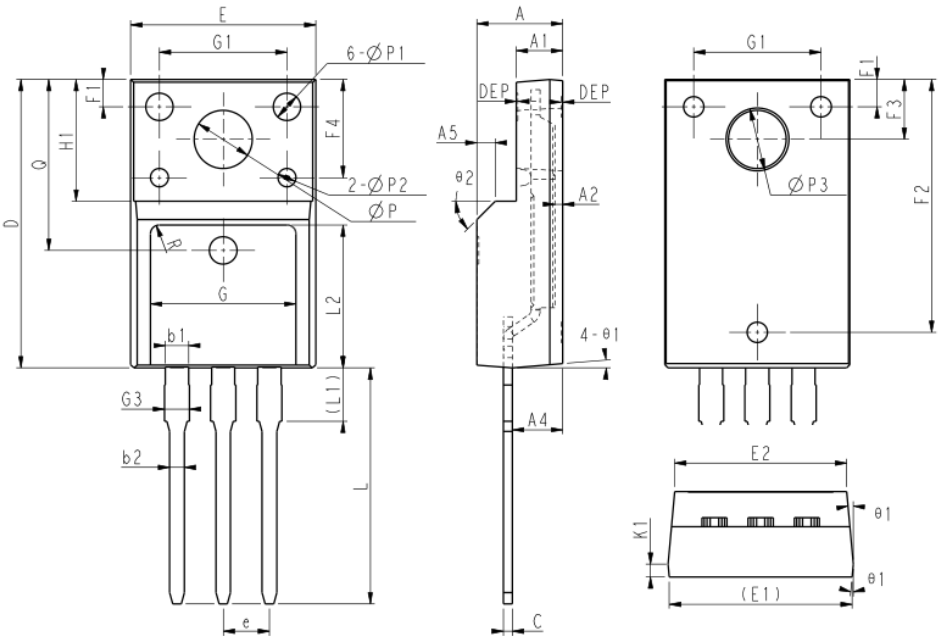

Unclamped Inductive Switching Test Circuit & Waveforms

## Test Circuit & Waveform




Peak Diode Recovery dv/dt Test Circuit & Waveforms

## Package




COMMON DIMENSIONS

| SYMBOL | MM | | |
|---|---|---|---|
| | MIN | NOM | MAX |
| E | 10.00 | 10.16 | 10.32 |
| E1 | 9.94 | 10.04 | 10.14 |
| E2 | 9.36 | 9.46 | 9.56 |
| A | 4.50 | 4.70 | 4.90 |
| A1 | 2.34 | 2.54 | 2.74 |
| A2 | 0.43 | - | 0.48 |
| A4 | 2.66 | 2.76 | 2.86 |
| A5 | | 1.00REF | |
| c | 0.45 | 0.50 | 0.60 |
| D | 15.67 | 15.87 | 16.07 |
| Q | | 9.40REF | |
| H1 | | 6.70REF | |
| e | | 2.54BSC | |
| ΦP | | 3.18REF | |
| L | 12.78 | 12.98 | 13.18 |
| L1 | 2.83 | 2.93 | 3.03 |
| L2 | 7.70 | 7.80 | 7.90 |
| ΦP1 | 1.40 | 1.50 | 1.60 |
| ΦP2 | 0.95 | 1.00 | 1.05 |
| ΦP3 | | 3.45REF | |
| θ1 | 3° | 5° | 7° |
| θ2 | - | 45° | - |
| DEP | 0.05 | 0.10 | 0.15 |
| F1 | 1.00 | 1.50 | 2.00 |
| F2 | 13.80 | 13.90 | 14.00 |
| F3 | 3.20 | 3.30 | 3.40 |
| F4 | 5.30 | 5.40 | 5.50 |
| G | 7.80 | 8.00 | 8.20 |
| G1 | 6.90 | 7.00 | 7.10 |
| G3 | 1.25 | 1.35 | 1.45 |
| b1 | 1.23 | 1.28 | 1.38 |
| b2 | 0.75 | 0.80 | 0.90 |
| K1 | 0.65 | 0.70 | 0.75 |
| R | | 0.50REF | |

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