# MOSFET – N-Channel, SUPERFET®

## 600 V, 35 A, 98 mΩ

# FCH35N60

### Description

SUPERFET MOSFET is ON Semiconductor's first generation of 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 MOSFET is very suitable for the switching power applications such as PFC, server/telecom power, FPD TV power, ATX power and industrial power applications.

### Features

- 650 V @ $T_J$ = 150°C
- Typ. $R_{DS(on)}$ = 79 mΩ
- Ultra Low Gate Charge (Typ. $Q_g$ = 139 nC)
- Low Effective Output Capacitance (Typ. $C_{oss(eff.)}$ = 340 pF)
- 100% Avalanche Tested
- This is a Pb−Free Device

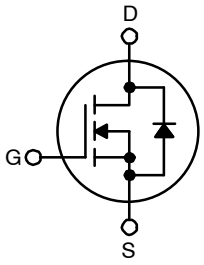
### Applications

- Solar Inverter
- AC−DC Power Supply

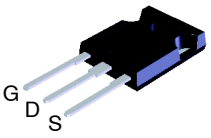
**ON Semiconductor®**

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| $V_{DS}$ | $R_{DS(ON)}$ MAX | $I_D$ MAX |
|---|---|---|
| 600 V | 98 mΩ @ 10 V | 35 A |

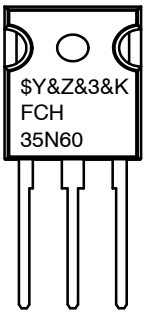



**N-CHANNEL MOSFET**




**TO−247−3LD**
**CASE 340CK**

### MARKING DIAGRAM




| | |
|---|---|
| $Y | = ON Semiconductor Logo |
| &Z | = Assembly Plant Code |
| &3 | = Numeric Date Code |
| &K | = Lot Code |
| FCH35N60 | = Specific Device Code |

### ORDERING INFORMATION

See detailed ordering and shipping information on page 2 of this data sheet.

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**ABSOLUTE MAXIMUM RATINGS** ($T_C$ = 25°C unless otherwise noted)

| Symbol | Parameter | | Value | Unit |
|---|---|---|---|---|
| $V_{DSS}$ | Drain to Source Voltage | | 600 | V |
| $V_{GSS}$ | Gate to Source Voltage | | ±30 | V |
| $I_D$ | Drain Current | – Continuous ($T_C$ = 25°C) | 35 | A |
| | | – Continuous ($T_C$ = 100°C) | 22.2 | |
| $I_{DM}$ | Drain Current | – Pulsed (Note 1) | 105 | A |
| $E_{AS}$ | Single Pulsed Avalanche Energy (Note 2) | | 1455 | mJ |
| $I_{AR}$ | Avalanche Current (Note 1) | | 35 | A |
| $E_{AR}$ | Repetitive Avalanche Energy (Note 1) | | 31.25 | mJ |
| dv/dt | Peak Diode Recovery dv/dt (Note 3) | | 20 | V/ns |
| $P_D$ | Power Dissipation | ($T_C$ = 25°C) | 312.5 | W |
| | | – Derate above 25°C | 2.5 | 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 Second | | 300 | °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.

1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. $I_{AS}$ = 17.5 A, $V_{DD}$ = 50 V, $R_G$ = 25 Ω, starting $T_J$ = 25°C
3. $I_{SD}$ ≤ 35 A, di/dt ≤ 200 A/μs, $V_{DD}$ ≤ $BV_{DSS}$, starting $T_J$ = 25°C

**PACKAGE MARKING AND ORDERING INFORMATION**

| Part Number | Top Mark | Package | Package Method | Reel Size | Tape Width | Quantity |
|---|---|---|---|---|---|---|
| FCH35N60 | FCH35N60 | TO−247−3LD | Tube | – | – | 30 Units |

**THERMAL CHARACTERISTICS**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case, Max. | 0.4 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient, Max. | 42 | |

**ELECTRICAL CHARACTERISTICS** ($T_C$ = 25°C unless otherwise noted)

| Symbol | Parameter | Test Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | | |
| $BV_{DSS}$ | Drain to Source Breakdown Voltage | $I_D$ = 250 μA, $V_{GS}$ = 0 V, $T_J$ = 25°C | 600 | – | – | V |
| | | $I_D$ = 250 μA, $V_{GS}$ = 0 V, $T_J$ = 150°C | – | 650 | – | |
| $\Delta BV_{DSS}$ / $\Delta T_J$ | Breakdown Voltage Temperature Coefficient | $I_D$ = 250 μA, Referenced to 25°C | – | 0.6 | – | V/°C |
| $BV_{DS}$ | Drain−Source Avalanche Breakdown Voltage | $V_{GS}$ = 0 V, $I_D$ = 16 A | – | 700 | – | V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = 600 V, $V_{GS}$ = 0 V | – | – | 1 | μA |
| | | $V_{DS}$ = 480 V, $T_C$ = 125°C | – | – | 10 | |
| $I_{GSS}$ | Gate to Body Leakage Current | $V_{GS}$ = ±30 V, $V_{DS}$ = 0 V | – | – | ±100 | nA |
| **ON CHARACTERISTICS** | | | | | | |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{GS}$ = $V_{DS}$, $I_D$ = 250 μA | 3.0 | – | 5.0 | V |
| $R_{DS(on)}$ | Static Drain to Source On Resistance | $V_{GS}$ = 10 V, $I_D$ = 17.5 A | – | 0.079 | 0.098 | Ω |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$ = 40 V, $I_D$ = 17.5 A | – | 28.8 | – | S |
| **DYNAMIC CHARACTERISTICS** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$ = 25 V, $V_{GS}$ = 0 V, f = 1 MHz | – | 4990 | 6640 | pF |
| $C_{oss}$ | Output Capacitance | | – | 2380 | 3170 | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | – | 140 | – | pF |
| $C_{oss}$ | Output Capacitance | $V_{DS}$ = 480 V, $V_{GS}$ = 0 V, f = 1 MHz | – | 113 | – | pF |
| $C_{oss}$eff. | Effective Output Capacitance | $V_{DS}$ = 0 V to 480 V, $V_{GS}$ = 0 V | – | 340 | – | pF |
| $Q_g$ | Total Gate Charge at 10 V | $V_{DS}$ = 480 V, $I_D$ = 35 A, $V_{GS}$ = 10 V (Note 4) | – | 139 | 181 | nC |
| $Q_{gs}$ | Gate to Source Gate Charge | | – | 31 | – | nC |
| $Q_{gd}$ | Gate to Drain “Miller” Charge | | – | 69 | – | nC |
| ESR | Equivalent Series Resistance (G−S) | Drain Open, f = 1 MHz | – | 1.4 | – | Ω |
| **SWITCHING CHARACTERISTICS** | | | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DD}$ = 300 V, $I_D$ = 35 A, $R_G$ = 4.7 Ω (Note 4) | – | 34 | 78 | ns |
| $t_r$ | Turn−On Rise Time | | – | 120 | 250 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | – | 105 | 220 | ns |
| $t_f$ | Turn−Off Fall Time | | – | 73 | 155 | ns |
| **DRAIN-SOURCE DIODE CHARACTERISTICS** | | | | | | |
| $I_S$ | 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, $I_{SD}$ = 35 A | – | – | 1.4 | V |
| $t_{rr}$ | Reverse Recovery Time | $V_{GS}$ = 0 V, $I_{SD}$ = 35 A, $dI_F/dt$ = 100 A/μs | – | 614 | – | ns |
| $Q_{rr}$ | Reverse Recovery Charge | | – | 16.3 | – | μC |

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.

4. Essentially independent of operating temperature.

## TYPICAL CHARACTERISTICS

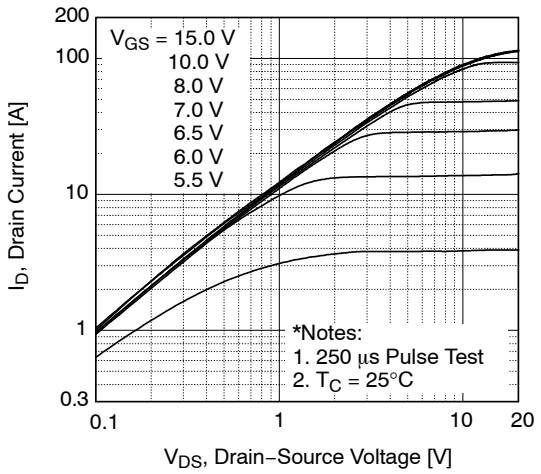



**Figure 1. On−Region Characteristics**

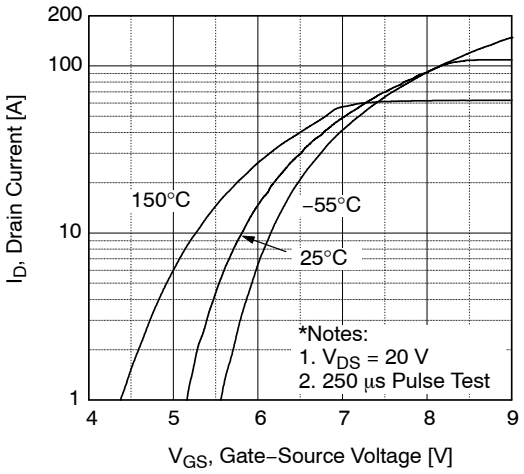



**Figure 2. Transfer Characteristics**

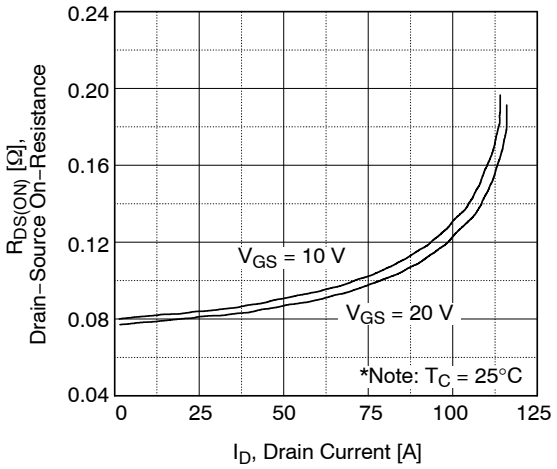



**Figure 3. On−Resistance Variation vs. Drain Current and Gate Voltage**

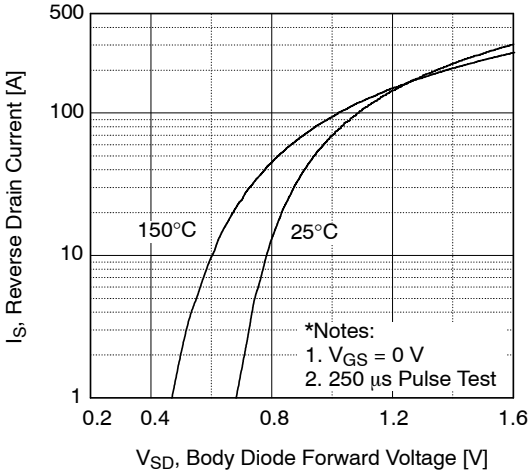



**Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature**

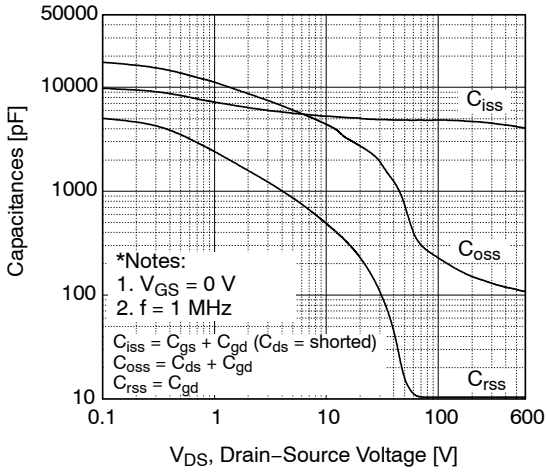



**Figure 5. Capacitance Characteristics**

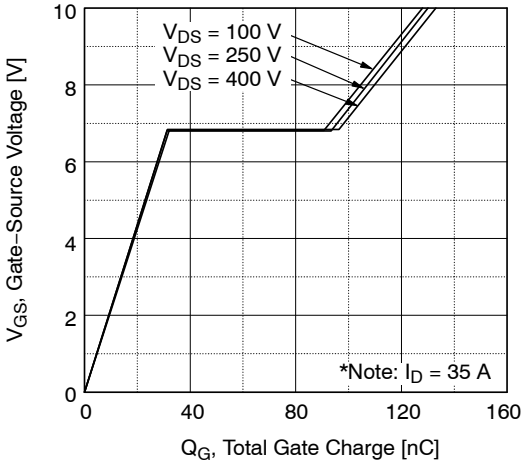



**Figure 6. Gate Charge Characteristics**

## TYPICAL CHARACTERISTICS

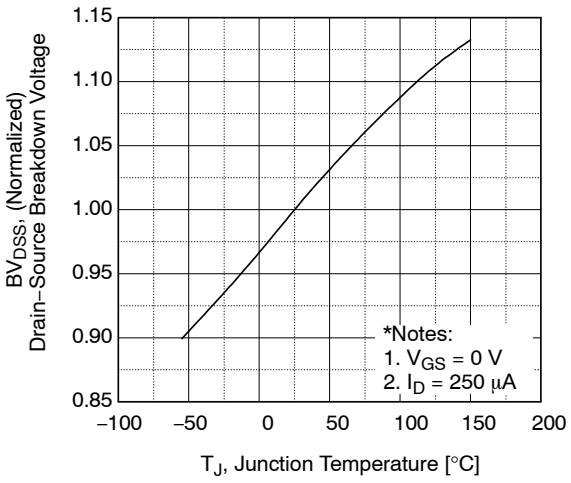



**Figure 7. Breakdown Voltage Variation vs. Temperature**

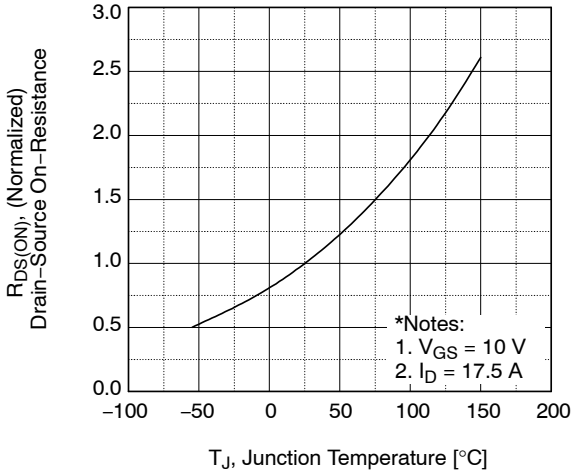



**Figure 8. On−Resistance Variation vs. Temperature**

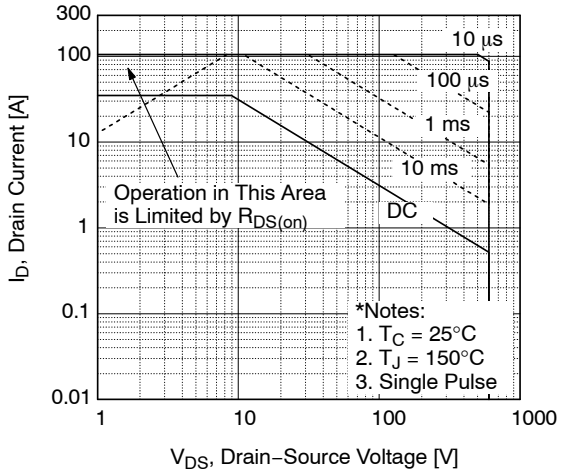



**Figure 9. Maximum Safe Operating Area**

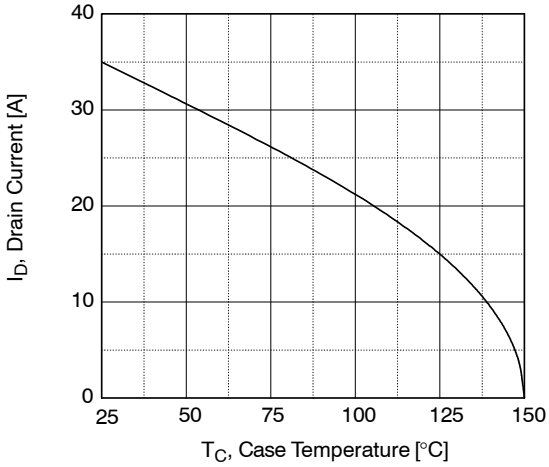



**Figure 10. Maximum Drain Current vs. Case Temperature**

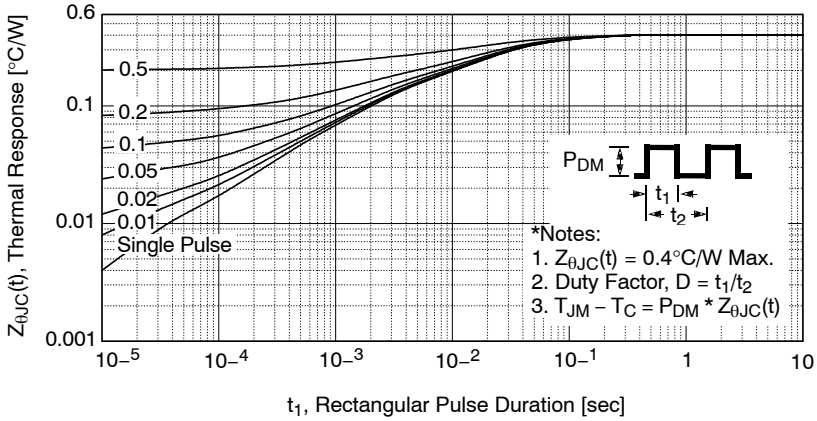



**Figure 11. Transient Thermal Response Curve**

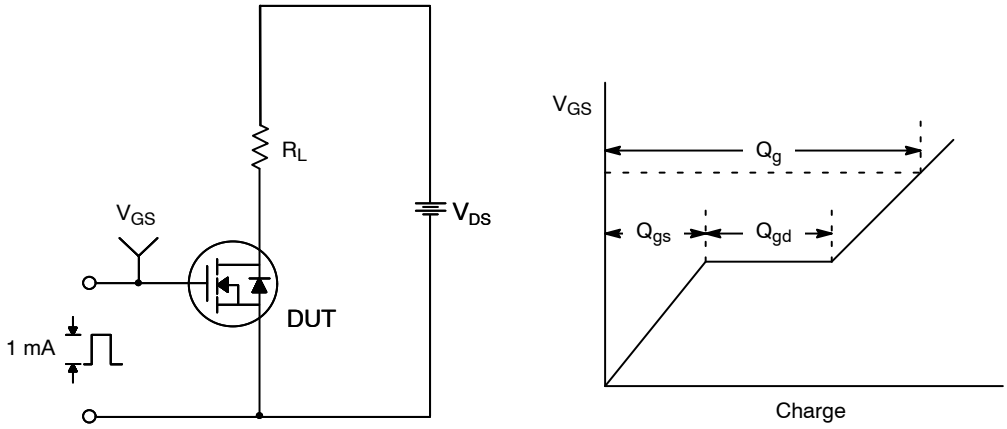



**Figure 12. Gate Charge Test Circuit & Waveform**

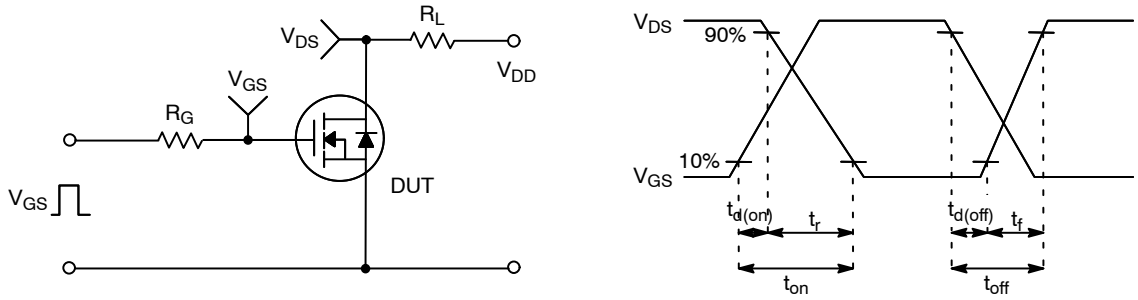



**Figure 13. Resistive Switching Test Circuit & Waveforms**

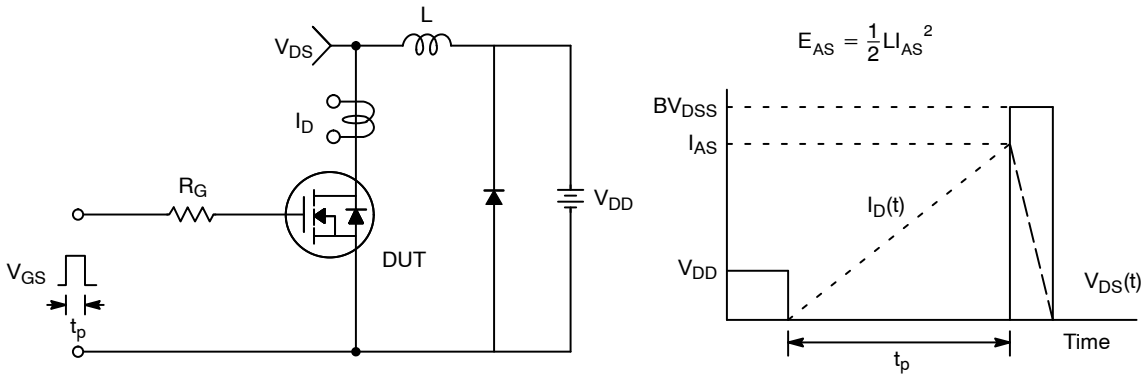



**Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms**

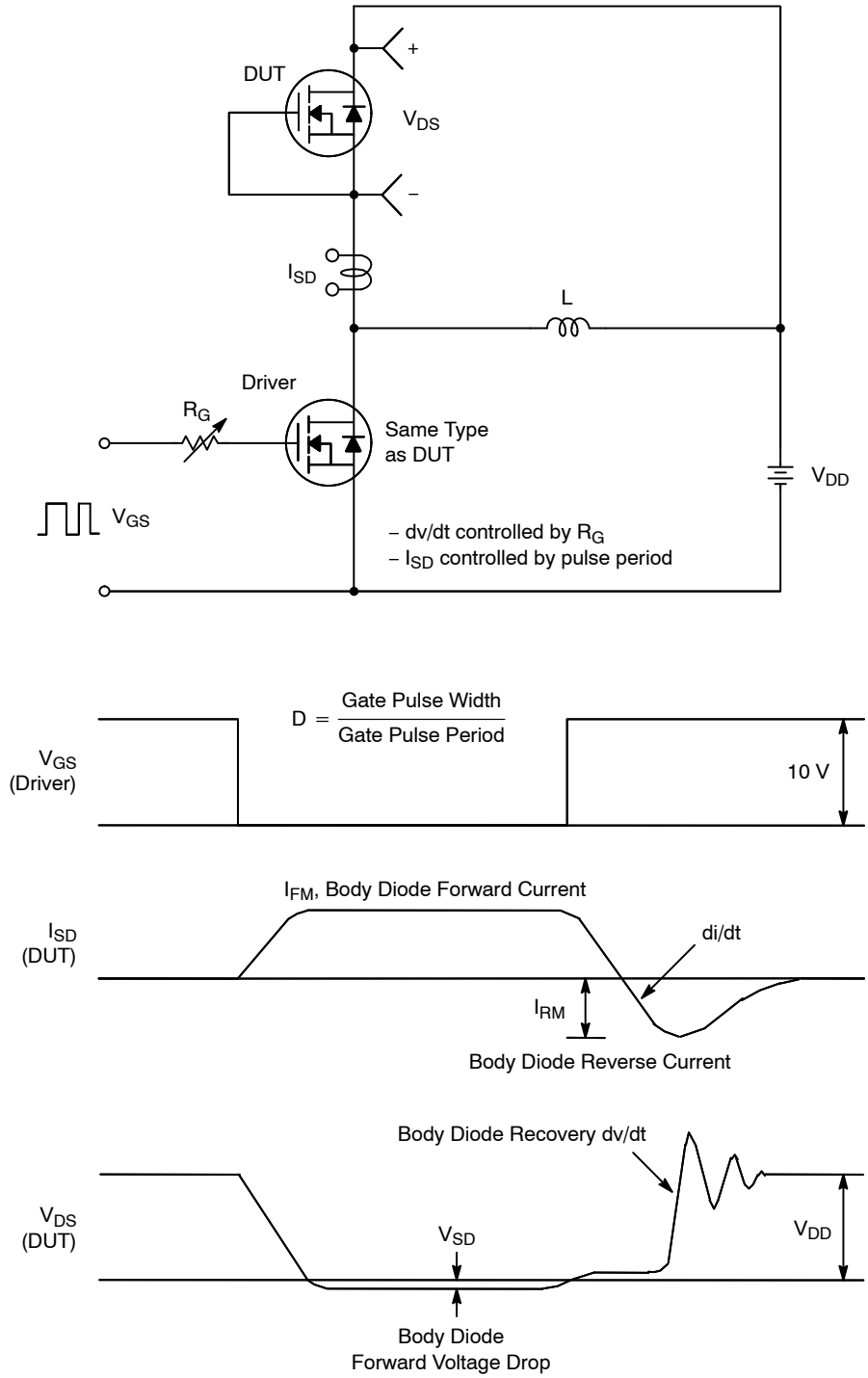



**Figure 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms**

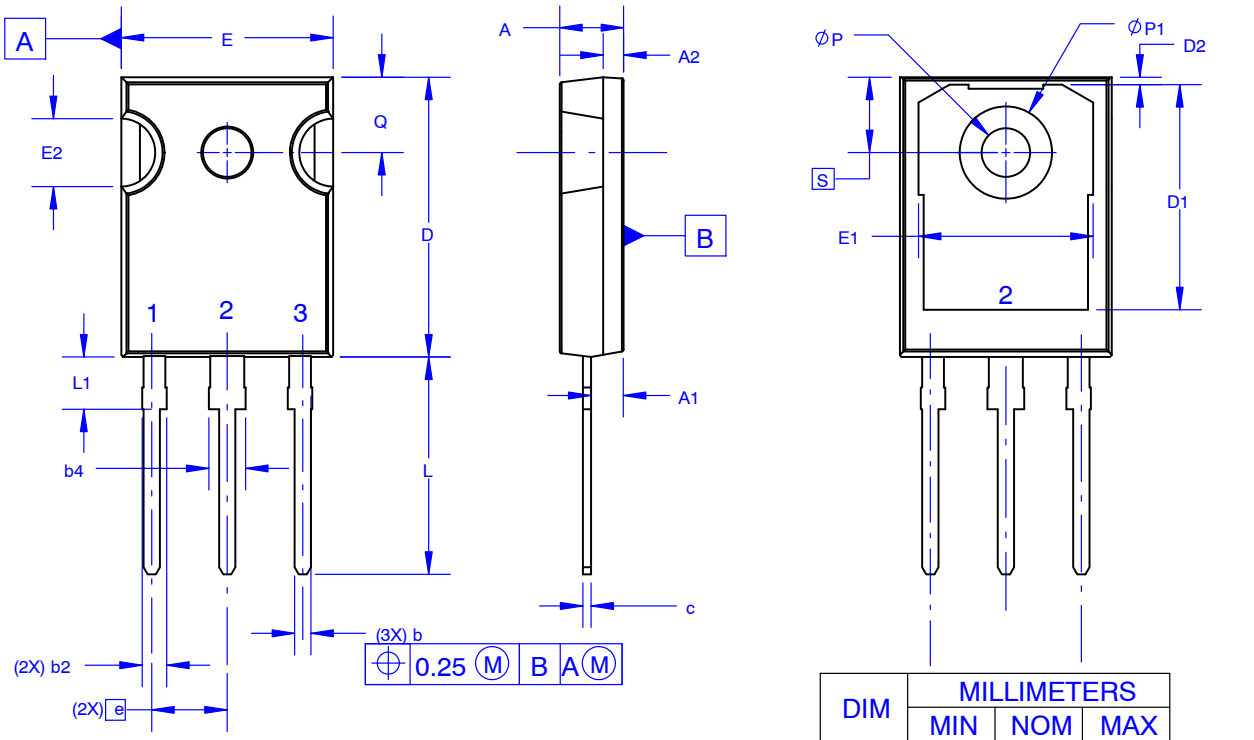
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# MECHANICAL CASE OUTLINE
## PACKAGE DIMENSIONS

ON Semiconductor®

**TO−247−3LD SHORT LEAD**
CASE 340CK
ISSUE A

DATE 31 JAN 2019

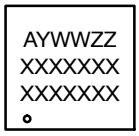



| DIM | MILLIMETERS | | |
|---|---|---|---|
| | MIN | NOM | MAX |
| A | 4.58 | 4.70 | 4.82 |
| A1 | 2.20 | 2.40 | 2.60 |
| A2 | 1.40 | 1.50 | 1.60 |
| b | 1.17 | 1.26 | 1.35 |
| b2 | 1.53 | 1.65 | 1.77 |
| b4 | 2.42 | 2.54 | 2.66 |
| c | 0.51 | 0.61 | 0.71 |
| D | 20.32 | 20.57 | 20.82 |
| D1 | 13.08 | ~ | ~ |
| D2 | 0.51 | 0.93 | 1.35 |
| E | 15.37 | 15.62 | 15.87 |
| E1 | 12.81 | ~ | ~ |
| E2 | 4.96 | 5.08 | 5.20 |
| e | ~ | 5.56 | ~ |
| L | 15.75 | 16.00 | 16.25 |
| L1 | 3.69 | 3.81 | 3.93 |
| ØP | 3.51 | 3.58 | 3.65 |
| ØP1 | 6.60 | 6.80 | 7.00 |
| Q | 5.34 | 5.46 | 5.58 |
| S | 5.34 | 5.46 | 5.58 |

NOTES: UNLESS OTHERWISE SPECIFIED.

A. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.
B. ALL DIMENSIONS ARE IN MILLIMETERS.
C. DRAWING CONFORMS TO ASME Y14.5 - 2009.
D. DIMENSION A1 TO BE MEASURED IN THE REGION DEFINED BY L1.
E. LEAD FINISH IS UNCONTROLLED IN THE REGION DEFINED BY L1.

**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.

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