

# FCH165N65S3R0

## Advance Information

# Power MOSFET, N-Channel, SUPERFET<sup>®</sup> III, Easy Drive, 650 V, 19 A, 165 mΩ

### Description

SUPERFET III MOSFET is ON 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 advanced technology is tailored to minimize conduction loss, provide superior switching performance, and withstand extreme dv/dt rate. Consequently, SUPERFET III MOSFET Easy drive series helps manage EMI issues and allows for easier design implementation.

### Features

- 700 V @  $T_J = 150^\circ\text{C}$
- Typ.  $R_{DS(on)} = 140\text{ m}\Omega$
- Ultra Low Gate Charge (Typ.  $Q_g = 39\text{ nC}$ )
- Low Effective Output Capacitance (Typ.  $C_{oss(eff.)} = 341\text{ pF}$ )
- 100% Avalanche Tested

### Applications

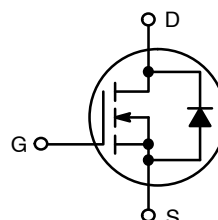
- Telecom / Server Power Supplies
- Industrial Power Supplies
- UPS / Solar



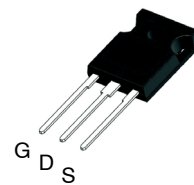
ON Semiconductor<sup>®</sup>

[www.onsemi.com](http://www.onsemi.com)

$V_{DSS}$	$R_{DS(ON)}\text{ MAX}$	$I_D\text{ MAX}$
650 V	165 mΩ @ 10 V	19 A

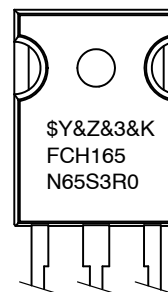


N-Channel MOSFET



TO-247-3LD  
CASE 340CH

### MARKING DIAGRAM



\$Y = ON Semiconductor Logo  
&Z = Assembly Plant Code  
&3 = Numeric Date Code  
&K = Lot Code  
FCH165N65S3R0 = Specific Device Code

This document contains information on a new product. Specifications and information herein are subject to change without notice.

### ORDERING INFORMATION

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

# FCH165N65S3R0

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

Symbol	Parameter		Value	Unit
$V_{DSS}$	Drain to Source Voltage		650	V
$V_{GSS}$	Gate to Source Voltage	DC	$\pm 30$	V
		AC ( $f > 1\text{ Hz}$ )	$\pm 30$	V
$I_D$	Drain Current	Continuous ( $T_C = 25^\circ\text{C}$ )	19	A
		Continuous ( $T_C = 100^\circ\text{C}$ )	12.3	
$I_{DM}$	Drain Current	Pulsed (Note 1)	47.5	A
$E_{AS}$	Single Pulsed Avalanche Energy (Note 2)		87	mJ
$I_{AS}$	Avalanche Current (Note 2)		2.7	A
$E_{AR}$	Repetitive Avalanche Energy (Note 1)		1.54	mJ
dv/dt	MOSFET dv/dt		100	V/ns
	Peak Diode Recovery dv/dt (Note 3)		20	
$P_D$	Power Dissipation	( $T_C = 25^\circ\text{C}$ )	154	W
		Derate Above $25^\circ\text{C}$	1.23	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 s		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.

1. Repetitive rating: pulse-width limited by maximum junction temperature.
2.  $I_{AS} = 2.7\text{ A}$ ,  $R_G = 25\ \Omega$ , starting  $T_J = 25^\circ\text{C}$ .
3.  $I_{SD} \leq 9.5\text{ A}$ ,  $di/dt \leq 200\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq 400\text{ V}$ , starting  $T_J = 25^\circ\text{C}$ .

## THERMAL CHARACTERISTICS

Symbol	Parameter	Value	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max.	0.81	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient, Max.	40	

## PACKAGE MARKING AND ORDERING INFORMATION

Part Number	Top Marking	Package	Shipping
FCH165N65S3R0-F155	FCH165N65S3R0	TO-247-3LD	30 Units / Tube

# FCH165N65S3R0

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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
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### OFF CHARACTERISTICS

BV <sub>DSS</sub>	Drain to Source Breakdown Voltage	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 1 mA, T <sub>J</sub> = 25°C	650	–	–	V
		V <sub>GS</sub> = 0 V, I <sub>D</sub> = 1 mA, T <sub>J</sub> = 150°C	700	–	–	V
ΔBV <sub>DSS</sub> /ΔT <sub>J</sub>	Breakdown Voltage Temperature Coefficient	I <sub>D</sub> = 1 mA, Referenced to 25°C	–	0.64	–	V/°C
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> = 650 V, V <sub>GS</sub> = 0 V	–	–	1	μA
		V <sub>DS</sub> = 520 V, T <sub>C</sub> = 125°C	–	0.85	–	
I <sub>GSS</sub>	Gate to Body Leakage Current	V <sub>GS</sub> = ±30 V, V <sub>DS</sub> = 0 V	–	–	±100	nA

### ON CHARACTERISTICS

V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = 1.9 mA	2.5	–	4.5	V
R <sub>DS(on)</sub>	Static Drain to Source On Resistance	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 9.5 A	–	140	165	mΩ
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> = 20 V, I <sub>D</sub> = 9.5 A	–	12	–	S

### DYNAMIC CHARACTERISTICS

C <sub>iss</sub>	Input Capacitance	V <sub>DS</sub> = 400 V, V <sub>GS</sub> = 0 V, f = 1 MHz	–	1500	–	pF
C <sub>oss</sub>	Output Capacitance		–	35	–	pF
C <sub>oss(eff.)</sub>	Effective Output Capacitance	V <sub>DS</sub> = 0 V to 400 V, V <sub>GS</sub> = 0 V	–	341	–	pF
C <sub>oss(er.)</sub>	Energy Related Output Capacitance	V <sub>DS</sub> = 0 V to 400 V, V <sub>GS</sub> = 0 V	–	49	–	pF
Q <sub>g(tot)</sub>	Total Gate Charge at 10 V	V <sub>DS</sub> = 400 V, I <sub>D</sub> = 9.5 A, V <sub>GS</sub> = 10 V (Note 4)	–	39	–	nC
Q <sub>gs</sub>	Gate to Source Gate Charge		–	11	–	nC
Q <sub>gd</sub>	Gate to Drain “Miller” Charge		–	16	–	nC
ESR	Equivalent Series Resistance	f = 1 MHz	–	0.5	–	Ω

### SWITCHING CHARACTERISTICS

t <sub>d(on)</sub>	Turn-On Delay Time	V <sub>DD</sub> = 400 V, I <sub>D</sub> = 9.5 A, V <sub>GS</sub> = 10 V, R <sub>g</sub> = 4.7 Ω (Note 4)	–	17	–	ns
t <sub>r</sub>	Turn-On Rise Time		–	15	–	ns
t <sub>d(off)</sub>	Turn-Off Delay Time		–	44	–	ns
t <sub>f</sub>	Turn-Off Fall Time		–	5	–	ns

### SOURCE-DRAIN DIODE CHARACTERISTICS

I <sub>S</sub>	Maximum Continuous Source to Drain Diode Forward Current		–	–	19	A
I <sub>SM</sub>	Maximum Pulsed Source to Drain Diode Forward Current		–	–	47.5	A
V <sub>SD</sub>	Source to Drain Diode Forward Voltage	V <sub>GS</sub> = 0 V, I <sub>SD</sub> = 9.5 A	–	–	1.2	V
t <sub>rr</sub>	Reverse Recovery Time	V <sub>GS</sub> = 0 V, I <sub>SD</sub> = 9.5 A, dI <sub>F</sub> /dt = 100 A/μs	–	339	–	ns
Q <sub>rr</sub>	Reverse Recovery Charge		–	5.8	–	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.

TYPICAL PERFORMANCE CHARACTERISTICS

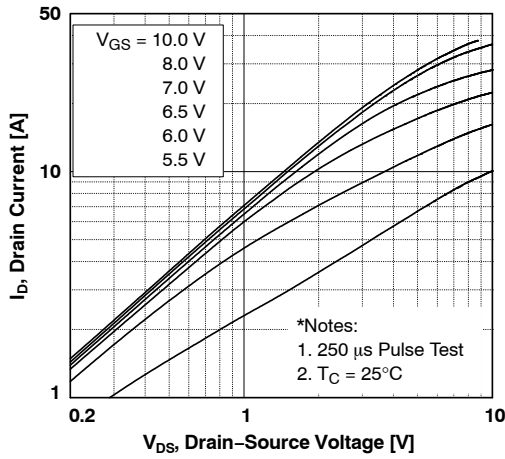


Figure 1. On-Region Characteristics

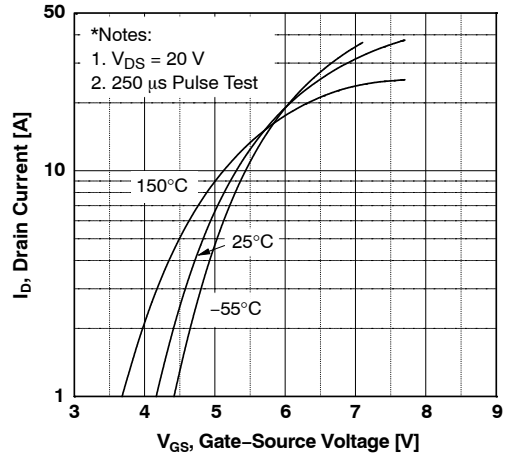


Figure 2. Transfer Characteristics

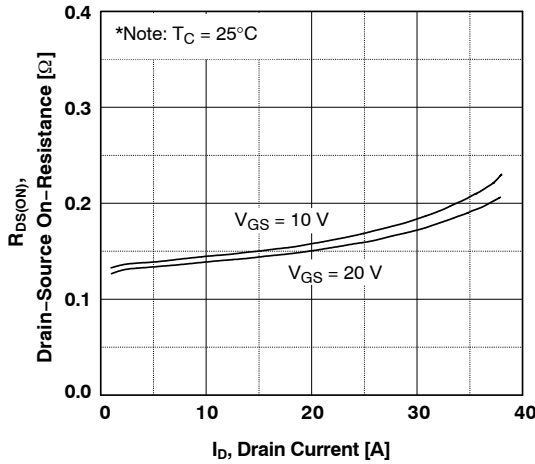


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

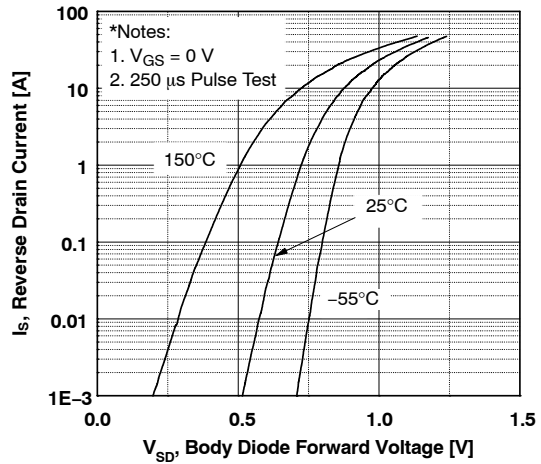


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

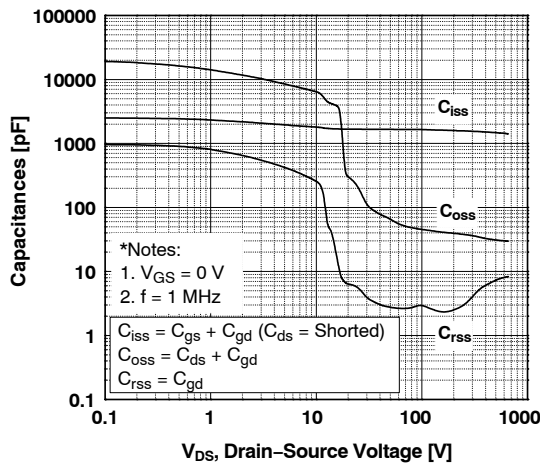


Figure 5. Capacitance Characteristics

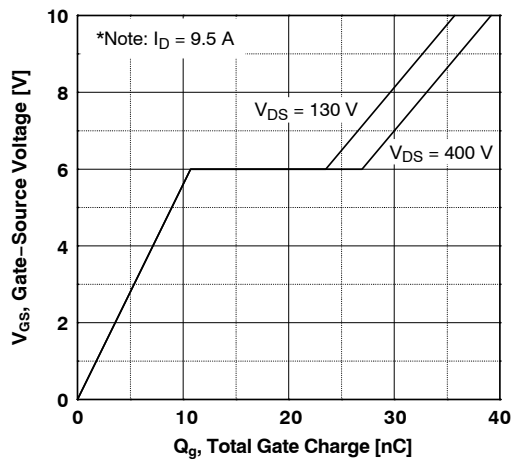


Figure 6. Gate Charge Characteristics

TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

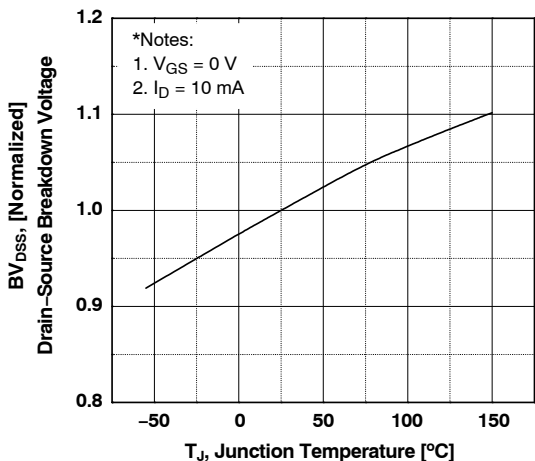


Figure 7. Breakdown Voltage Variation vs. Temperature

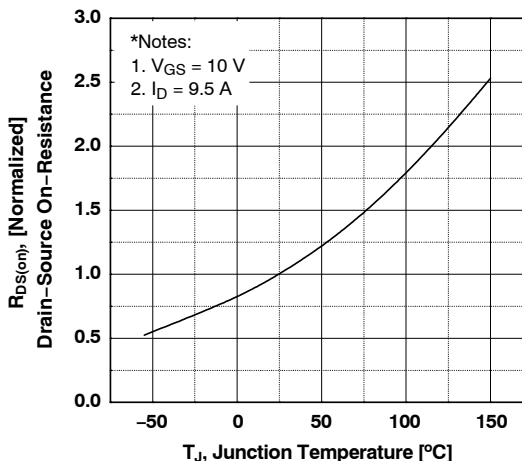


Figure 8. On-Resistance Variant vs. Temperature

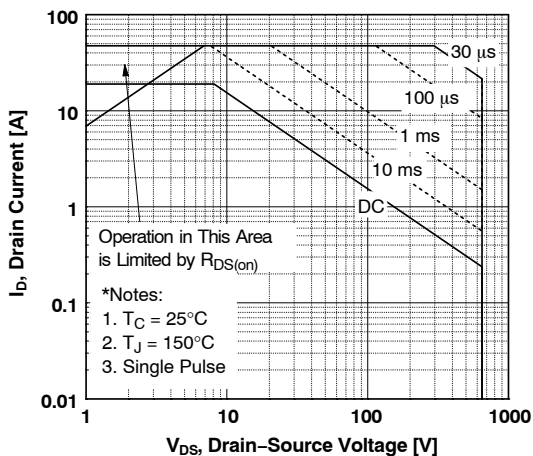


Figure 9. Maximum Safe Operation Area

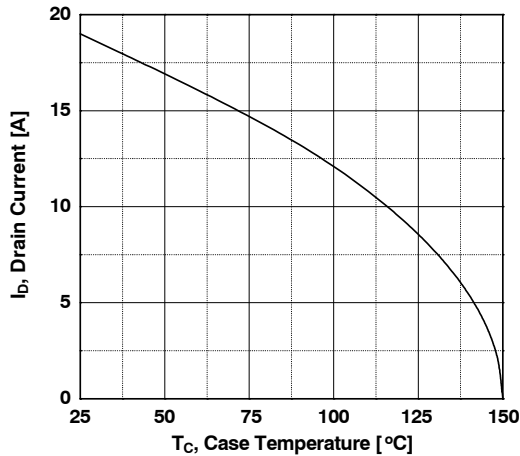


Figure 10. Maximum Drain Current vs. Case Temperature

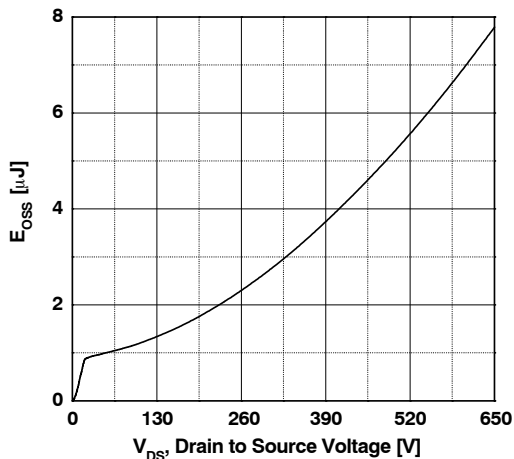


Figure 11.  $E_{OSS}$  vs. Drain to Source Voltage

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## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

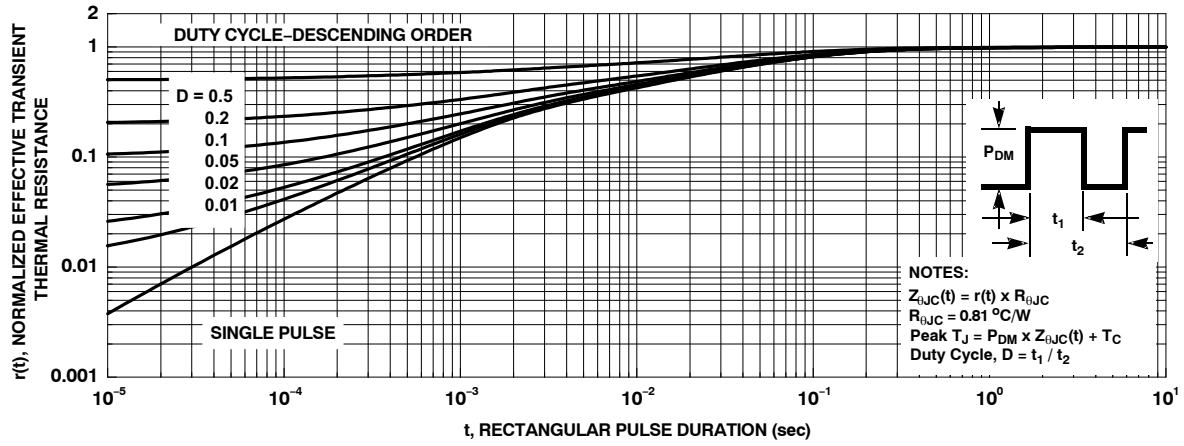


Figure 12. Transient Thermal Response Curve

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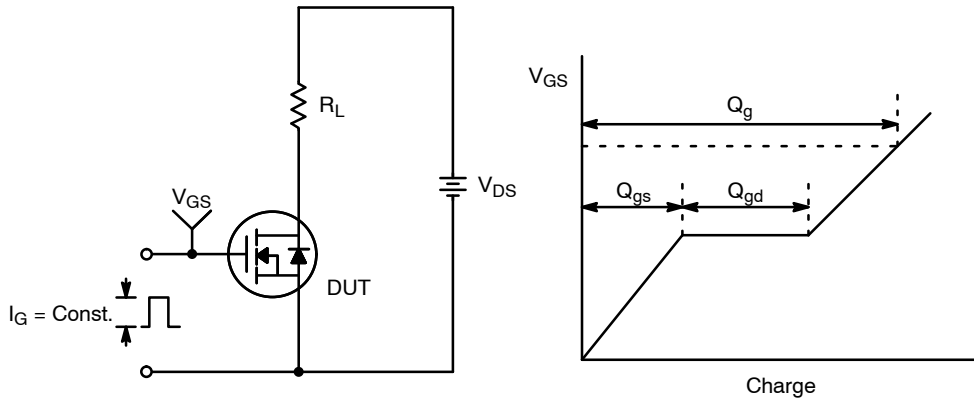


Figure 13. Gate Charge Test Circuit & Waveform

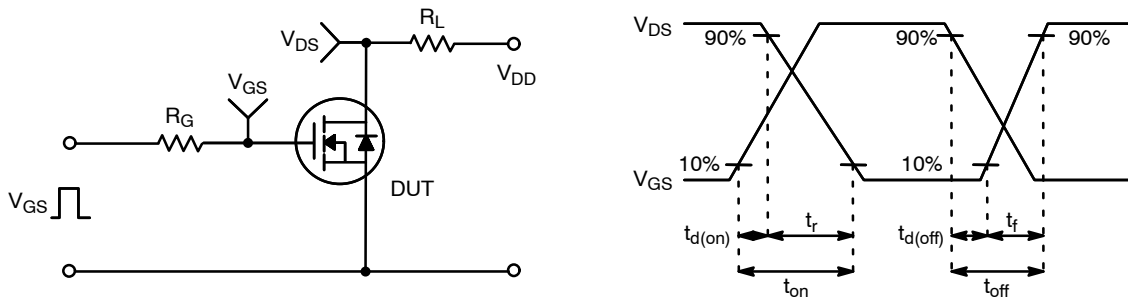


Figure 14. Resistive Switching Test Circuit & Waveforms

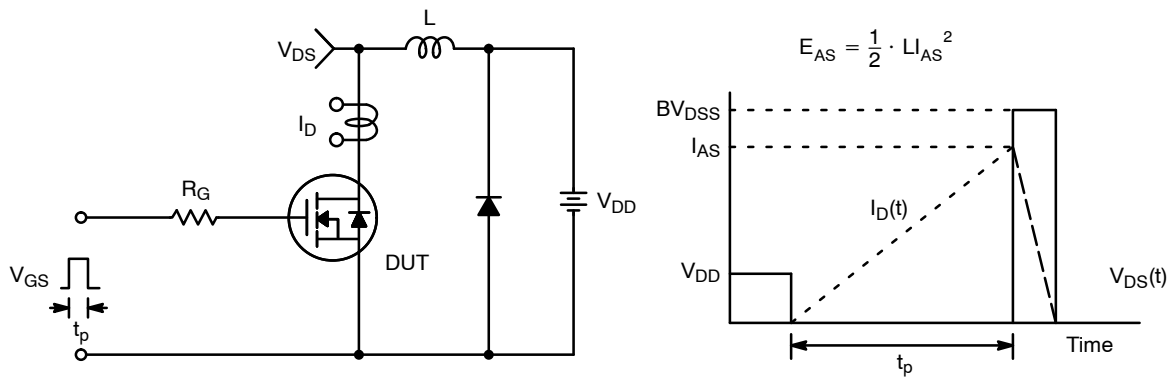
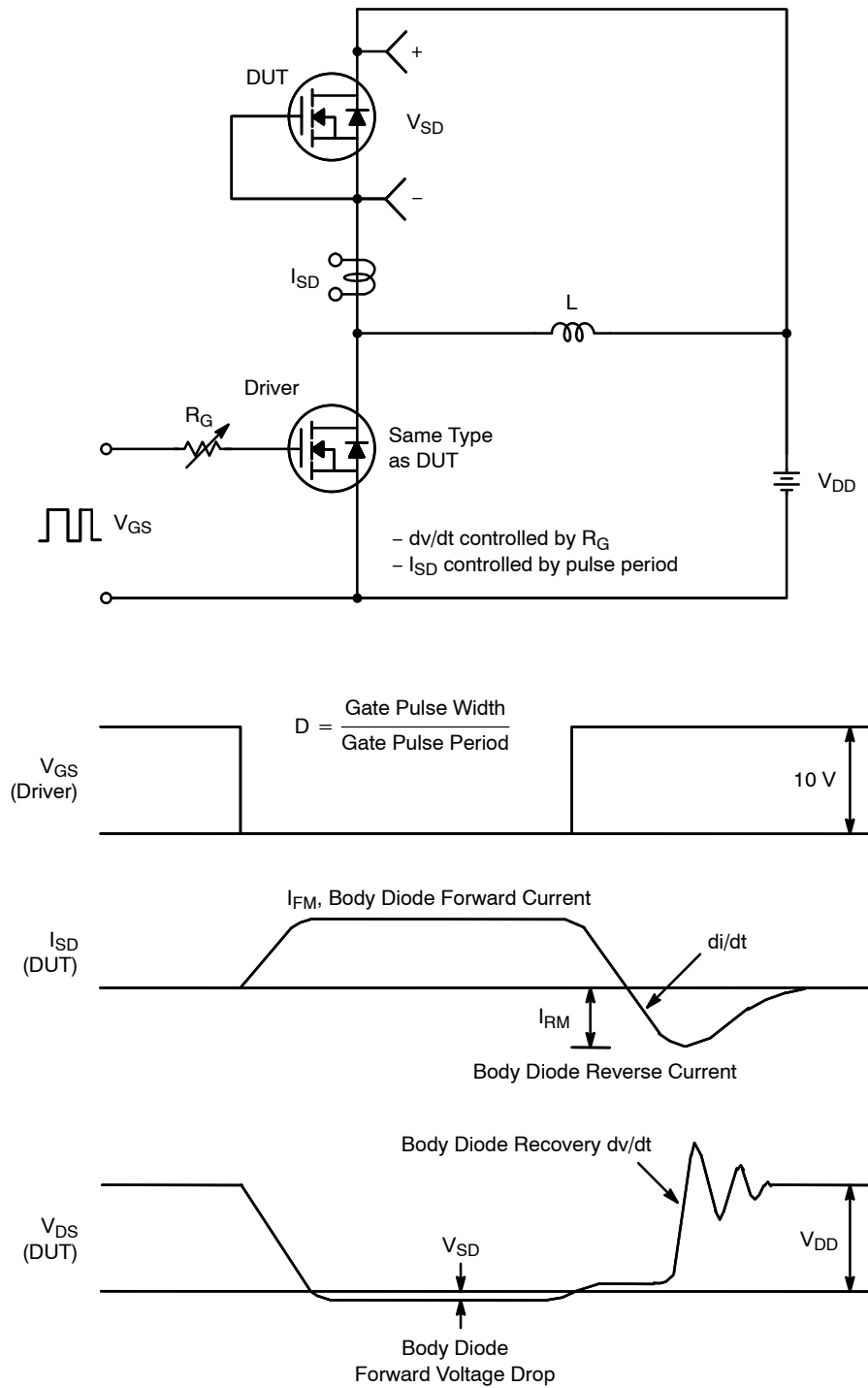


Figure 15. Unclamped Inductive Switching Test Circuit & Waveforms

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

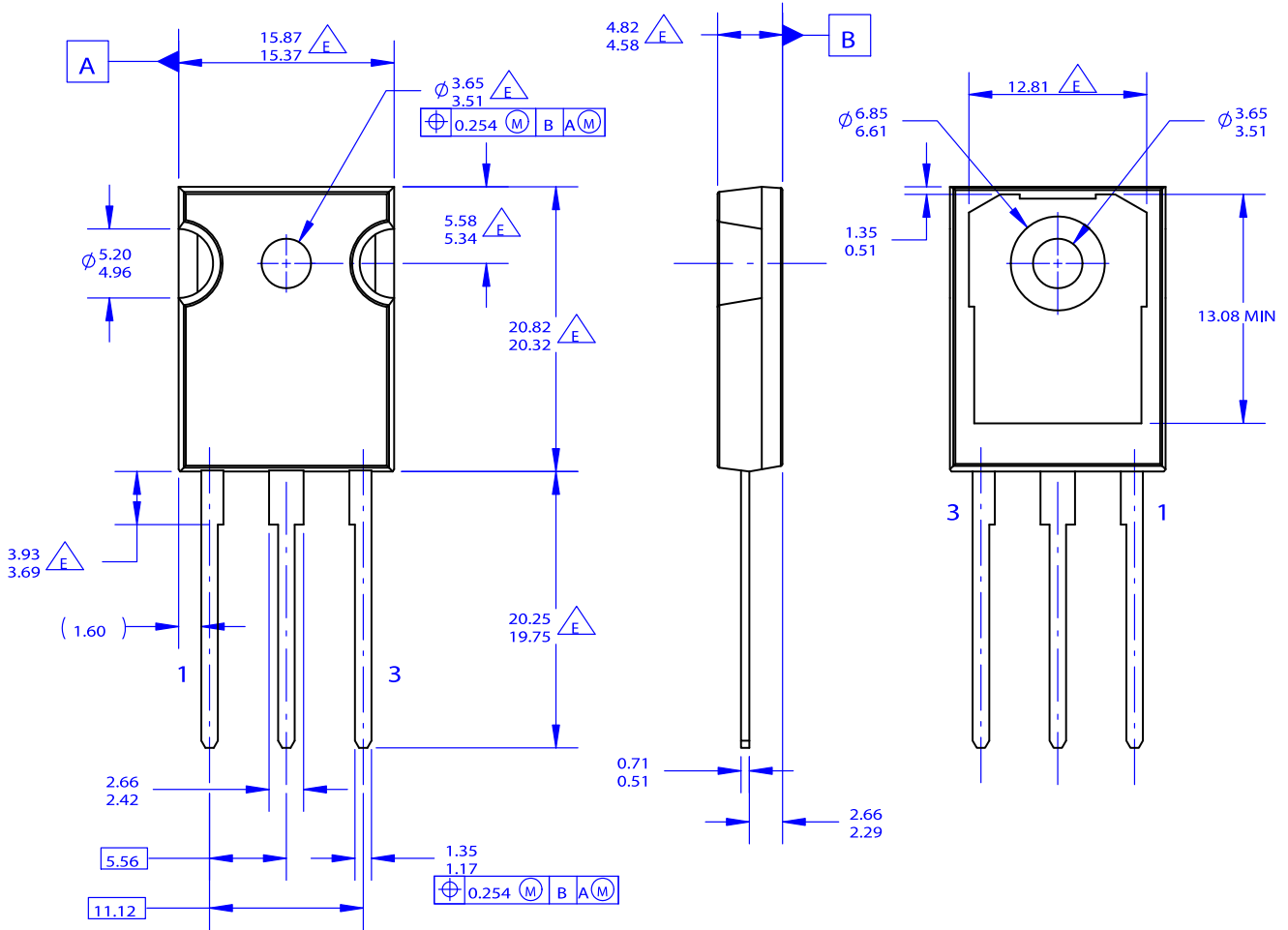


# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

TO-247-3LD  
CASE 340CH  
ISSUE O

DATE 31 OCT 2016



NOTES: UNLESS OTHERWISE SPECIFIED.

- A. PACKAGE REFERENCE: JEDEC TO-247, ISSUE E, VARIATION AB, DATED JUNE, 2004.
- B. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.
- C. ALL DIMENSIONS ARE IN MILLIMETERS.
- D. DRAWING CONFORMS TO ASME Y14.5 - 1994

 DOES NOT COMPLY JEDEC STANDARD VALUE

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<b>NEW STANDARD:</b>		
<b>DESCRIPTION:</b>	<b>TO-247-3LD</b>	<b>PAGE 1 OF 2</b>



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