

**MOSFET – N-Channel,  
SUPERFET II, FRFET®****650 V, 24 A, 150 mΩ****FCH150N65F****Description**

SUPERFET® II MOSFET is onsemi'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.

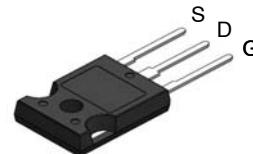
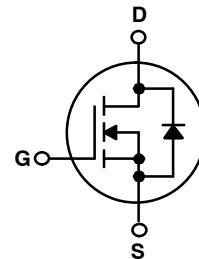
**Features**

- 700 V @  $T_J = 150^\circ\text{C}$
- Typ.  $R_{DS(on)} = 133 \text{ m}\Omega$
- Ultra Low Gate Charge (Typ.  $Q_g = 72 \text{ nC}$ )
- Low Effective Output Capacitance (Typ.  $C_{oss(\text{eff.})} = 361 \text{ pF}$ )
- 100% Avalanche Tested
- This Device is Pb-Free and is RoHS Compliant

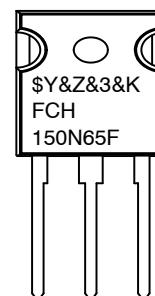
**Applications**

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

$V_{DS}$	$R_{DS(ON) \text{ MAX}}$	$I_D \text{ MAX}$
650 V	150 mΩ @ 10 V	24 A



TO-247-3LD  
CASE 340CH

**MARKING DIAGRAM**

\$Y = onsemi Logo  
 &Z = Assembly Plant Code  
 &3 = Numeric Date Code  
 &K = Lot Code  
 FCH150N65F = Specific Device Code

**ORDERING INFORMATION**

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

# FCH150N65F

## ABSOLUTE MAXIMUM RATINGS (T<sub>C</sub> = 25°C unless otherwise noted)

Symbol	Parameter		FCH150N65F-F155	Unit
V <sub>DSS</sub>	Drain to Source Voltage		650	V
V <sub>GSS</sub>	Gate to Source Voltage	-DC	±20	V
		-AC (f > 1 Hz)	±30	
I <sub>D</sub>	Drain Current	-Continuous (T <sub>C</sub> = 25°C)	24	A
		-Continuous (T <sub>C</sub> = 100°C)	14.9	
I <sub>DM</sub>	Drain Current	-Pulsed (Note 1)	72	A
E <sub>AS</sub>	Single Pulsed Avalanche Energy (Note 2)		663	mJ
I <sub>AR</sub>	Avalanche Current (Note 1)		4.7	A
E <sub>AR</sub>	Repetitive Avalanche Energy (Note 1)		2.98	mJ
dv/dt	MOSFET dv/dt		100	V/ns
	Peak Diode Recovery dv/dt (Note 3)		50	
P <sub>D</sub>	Power Dissipation	(T <sub>C</sub> = 25°C)	298	W
		-Derate Above 25°C	2.38	W/°C
T <sub>J</sub> , T <sub>STG</sub>	Operating and Storage Temperature Range		-55 to + 150	°C
T <sub>L</sub>	Maximum Lead Temperature for Soldering, 1/8 from Case for 5 Seconds		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<sub>AS</sub> = 4.7 A, R<sub>G</sub> = 25 Ω, Starting T<sub>J</sub> = 25°C
3. I<sub>SD</sub> ≤ 12 A, di/dt ≤ 200 A/μs, V<sub>DD</sub> ≤ 380 V, Starting T<sub>J</sub> = 25 °C.

## PACKAGE MARKING AND ORDERING INFORMATION

Part Number	Top Mark	Package	Packing Method	Reel Size	Tape Width	Quantity
FCH150N65F-F155	FCH150N65F	TO-247-3LD	Tube	N/A	N/A	30 Units

## THERMAL CHARACTERISTICS

Symbol	Parameter	FCH150N65F-F155	Unit
R <sub>θJC</sub>	Thermal Resistance, Junction to Case, Max.	0.42	°C/W
R <sub>θJA</sub>	Thermal Resistance, Junction to Ambient, Max.	40	



# FCH150N65F

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

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
<b>OFF CHARACTERISTICS</b>						
BV <sub>DSS</sub>	Drain to Source Breakdown Voltage	$V_{GS} = 0 \text{ V}$ , $I_D = 10 \text{ mA}$ , $T_J = 25^\circ\text{C}$	650	–	–	V
		$V_{GS} = 0 \text{ V}$ , $I_D = 10 \text{ mA}$ , $T_J = 150^\circ\text{C}$	700	–	–	
$\Delta BV_{DSS}/\Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 10 \text{ mA}$ , Referenced to $25^\circ\text{C}$	–	0.72	–	$\text{V}/^\circ\text{C}$
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	$V_{DS} = 650 \text{ V}$ , $V_{GS} = 0 \text{ V}$	–	–	10	$\mu\text{A}$
		$V_{DS} = 520 \text{ V}$ , $V_{GS} = 0 \text{ V}$ , $T_C = 125^\circ\text{C}$	–	86	–	
I <sub>GSS</sub>	Gate to Body Leakage Current	$V_{GS} = \pm 20 \text{ V}$ , $V_{DS} = 0 \text{ V}$	–	–	$\pm 100$	nA

## ON CHARACTERISTICS

$V_{GS(\text{th})}$	Gate Threshold Voltage	$V_{GS} = V_{DS}$ , $I_D = 2.4 \text{ mA}$	3	–	5	V
$R_{DS(\text{on})}$	Static Drain to Source On Resistance	$V_{GS} = 10 \text{ V}$ , $I_D = 12 \text{ A}$	–	133	150	$\text{m}\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS} = 20 \text{ V}$ , $I_D = 12 \text{ A}$	–	22	–	S

## DYNAMIC CHARACTERISTICS

$C_{iss}$	Input Capacitance	$V_{DS} = 100 \text{ V}$ , $V_{GS} = 0 \text{ V}$ , $f = 1 \text{ MHz}$	–	2810	3737	pF
$C_{oss}$	Output Capacitance		–	91	121	pF
$C_{rss}$	Reverse Transfer Capacitance		–	0.77	–	pF
$C_{oss}$	Output Capacitance	$V_{DS} = 380 \text{ V}$ , $V_{GS} = 0 \text{ V}$ , $f = 1 \text{ MHz}$	–	54	–	pF
$C_{oss(\text{eff.})}$	Effective Output Capacitance	$V_{DS} = 0 \text{ V}$ to $400 \text{ V}$ , $V_{GS} = 0 \text{ V}$	–	361	–	pF
$Q_{g(\text{tot})}$	Total Gate Charge at $10 \text{ V}$	$V_{DD} = 380 \text{ V}$ , $I_D = 12 \text{ A}$ , $V_{GS} = 10 \text{ V}$ (Note 4)	–	72	94	nC
$Q_{gs}$	Gate to Source Gate Charge		–	15	–	nC
$Q_{gd}$	Gate to Drain "Miller" Charge		–	31	–	nC
ESR	Equivalent Series Resistance	$f = 1 \text{ MHz}$	–	0.69	–	$\Omega$

## SWITCHING CHARACTERISTICS

$t_{d(\text{on})}$	Turn-On Delay Time	$V_{DD} = 380 \text{ V}$ , $I_D = 12 \text{ A}$ , $V_{GS} = 10 \text{ V}$ , $R_G = 4.7 \Omega$ (Note 4)	–	28	66	ns
$t_r$	Turn-On Rise Time		–	15	40	ns
$t_{d(\text{off})}$	Turn-Off Delay Time		–	73	156	ns
$t_f$	Turn-Off Fall Time		–	6	22	ns

## DRAIN-SOURCE DIODE CHARACTERISTICS

$I_S$	Maximum Continuous Drain to Source Diode Forward Current	–	–	24	A	
$I_{SM}$	Maximum Pulsed Drain to Source Diode Forward Current	–	–	72	A	
$V_{SD}$	Drain to Source Diode Forward Voltage	$V_{GS} = 0 \text{ V}$ , $I_{SD} = 12 \text{ A}$	–	–	1.2	V
$t_{rr}$	Reverse Recovery Time	$V_{GS} = 0 \text{ V}$ , $I_{SD} = 12 \text{ A}$ , $dI_F/dt = 100 \text{ A}/\mu\text{s}$	–	123	–	ns
$Q_{rr}$	Reverse Recovery Charge		–	597	–	nC

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

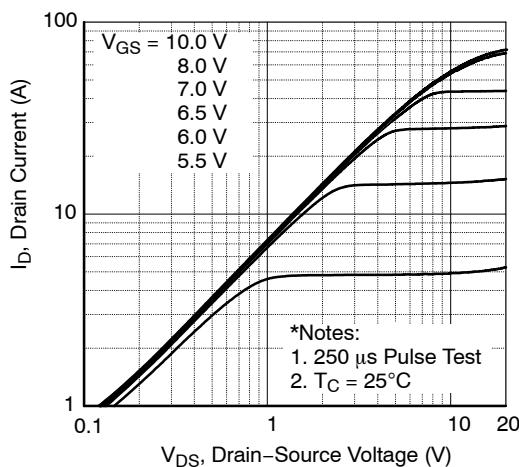


Figure 1. On-Region Characteristics

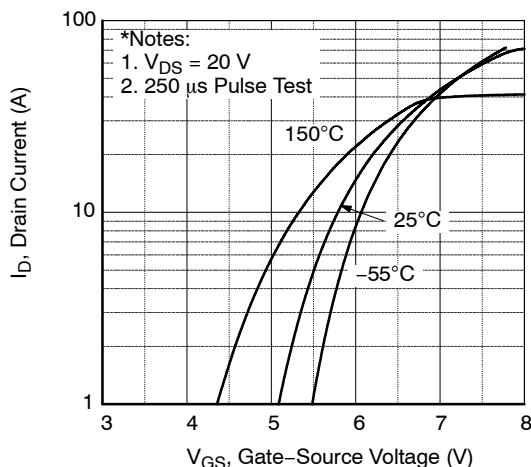


Figure 2. Transfer Characteristics

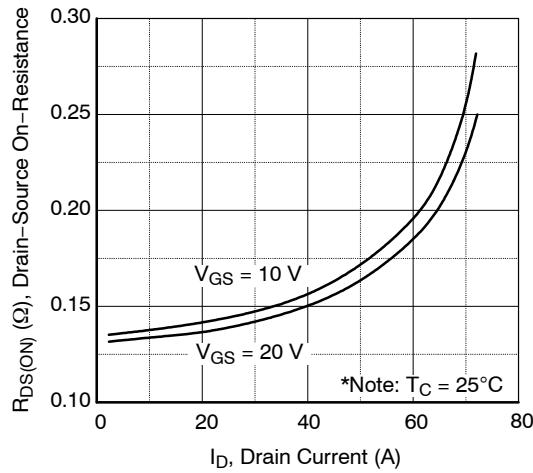


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

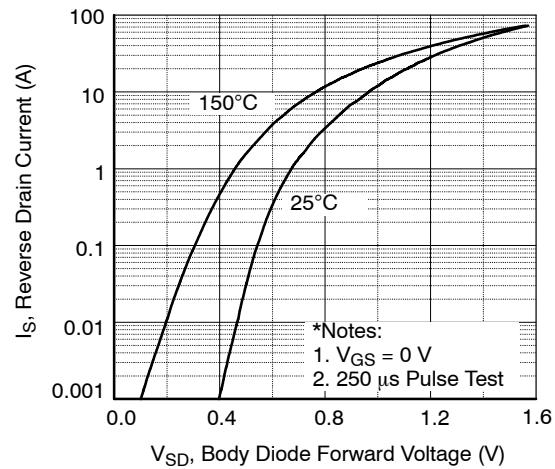


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

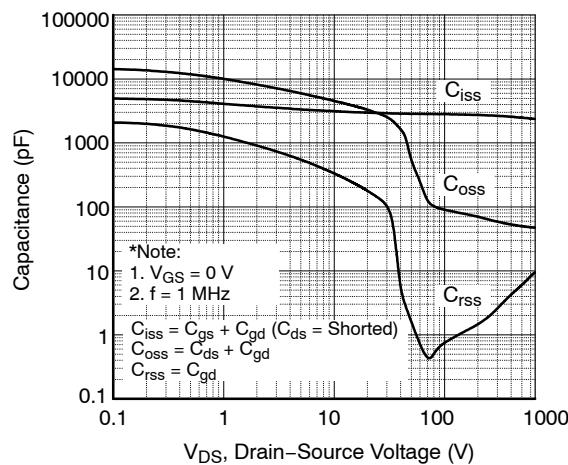


Figure 5. Capacitance Characteristics

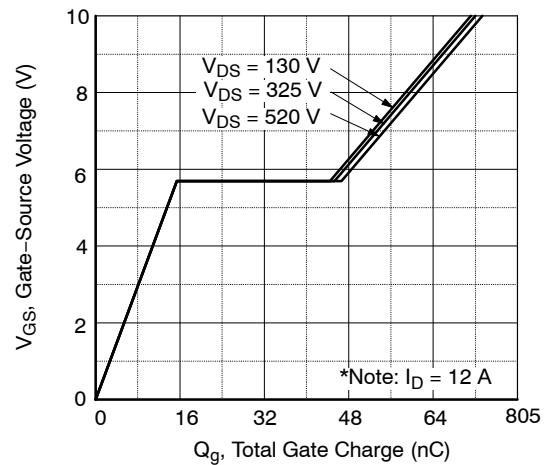
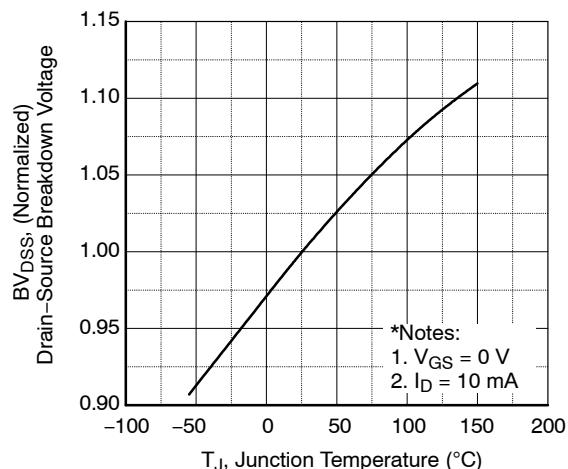
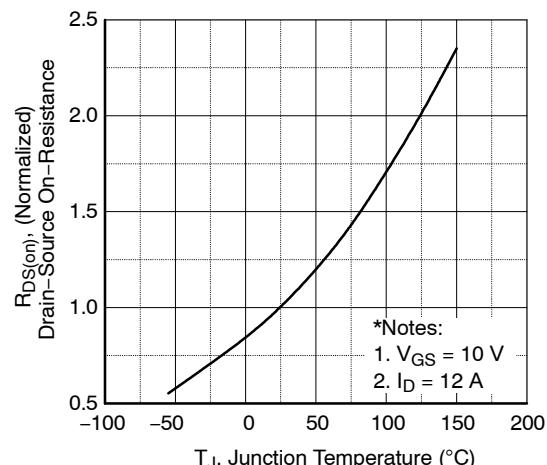


Figure 6. Gate Charge Characteristics

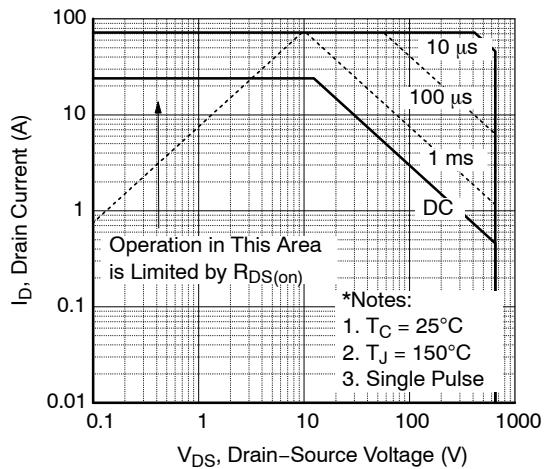
## TYPICAL PERFORMANCE CHARACTERISTICS (CONTINUED)



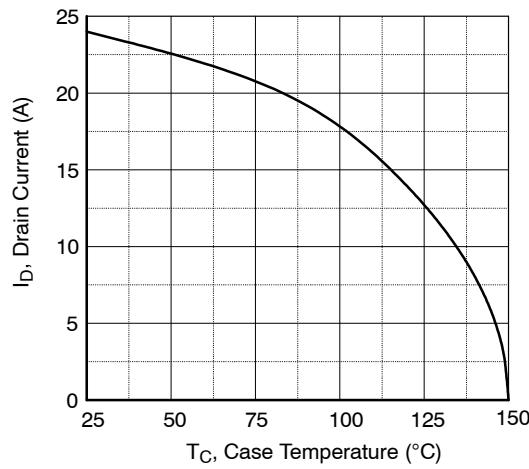
**Figure 7. Breakdown Voltage Variation vs. Temperature**



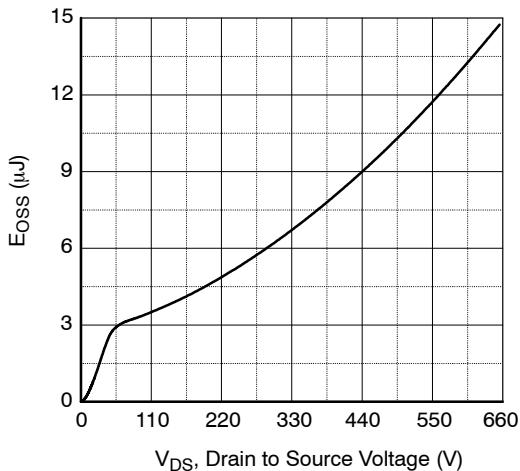
**Figure 8. On-Resistance Variation vs. Temperature**



**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)

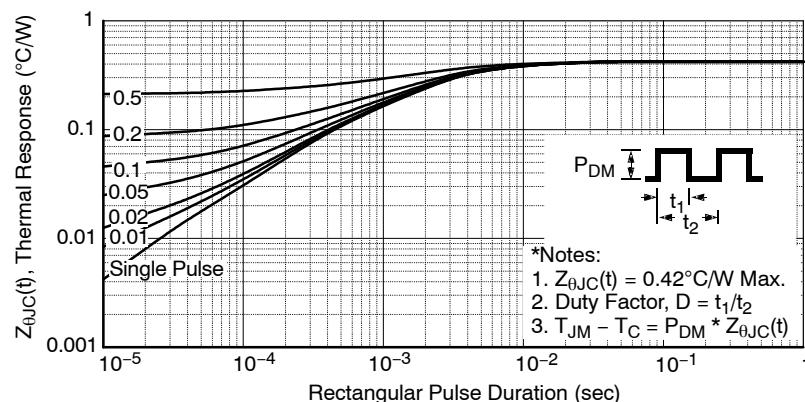


Figure 12. Transient Thermal Response Curve

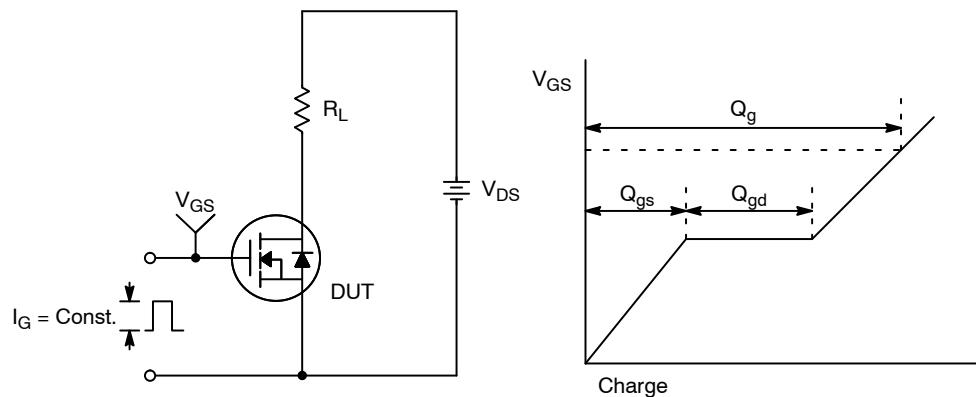


Figure 13. Transient Thermal Response Curve

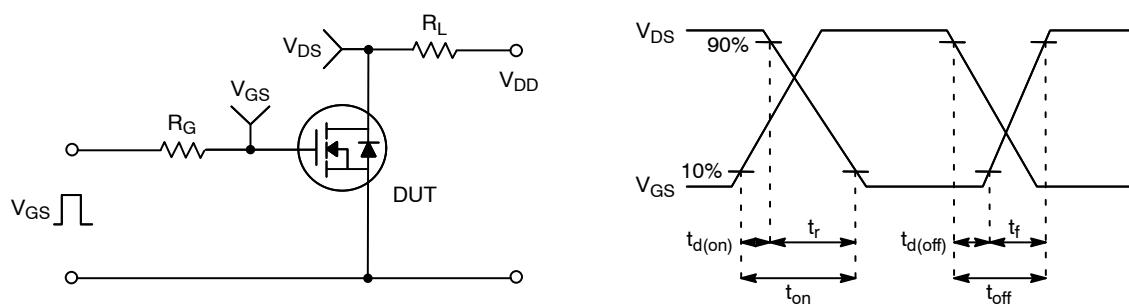


Figure 14. Resistive Switching Test Circuit & Waveforms

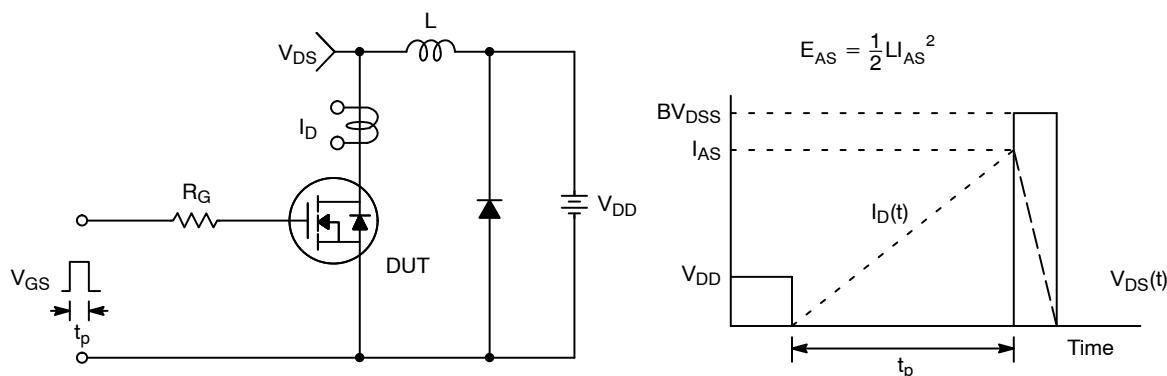


Figure 15. Unclamped Inductive Switching Test Circuit & Waveforms

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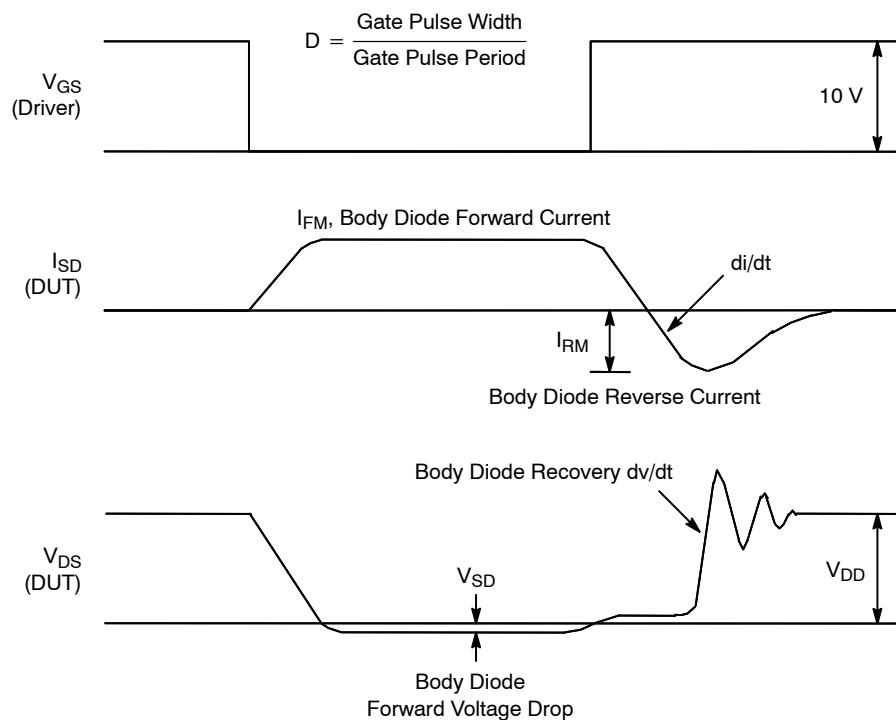
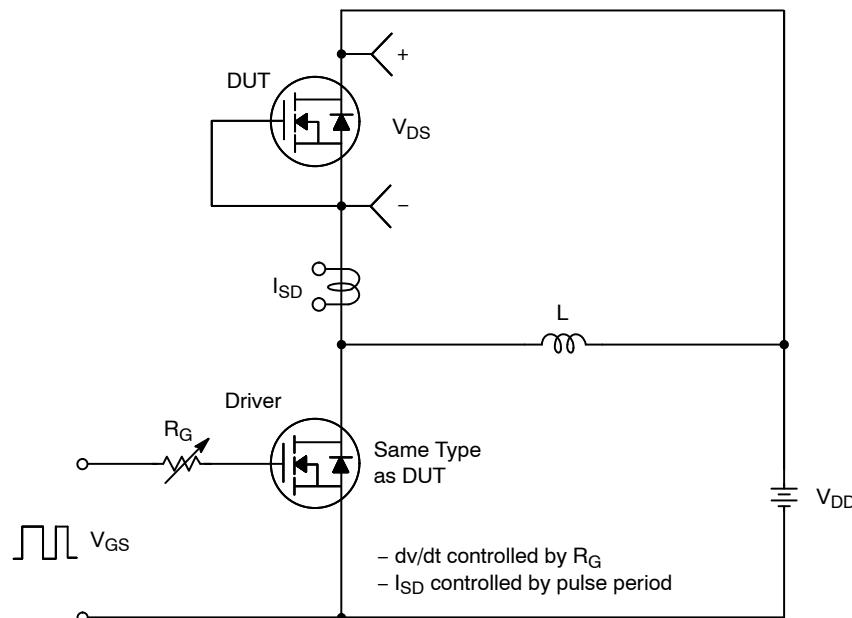
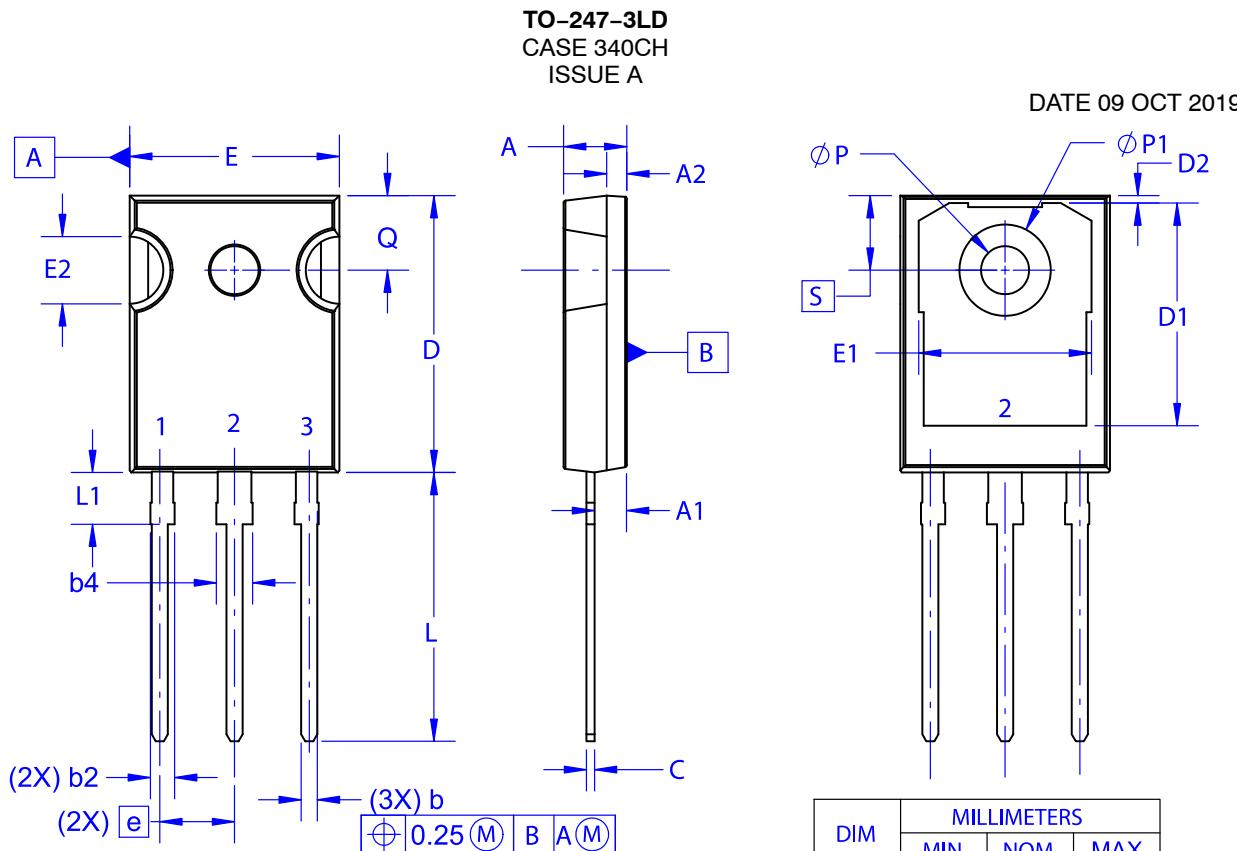


Figure 16. Peak Diode Recovery  $dv/dt$  Test Circuit & Waveforms

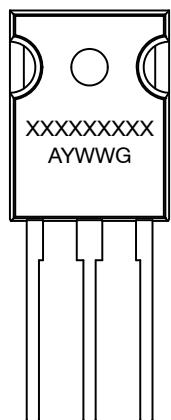
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- A. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.
- B. ALL DIMENSIONS ARE IN MILLIMETERS.
- C. DRAWING CONFORMS TO ASME Y14.5 - 2009.
- D. DIMENSION A1 TO BE MEASURED IN THE REGION DEFINED BY L1.
- E. LEAD FINISH IS UNCONTROLLED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

**GENERIC  
MARKING DIAGRAM\***



XXXX = Specific Device Code

A = Assembly Location

Y = Year

WW = Work Week

G = Pb-Free Package

\*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.

DIM	MILLIMETERS		
	MIN	NOM	MAX
A	4.58	4.70	4.82
A1	2.29	2.475	2.66
A2	1.40	1.50	1.60
D	20.32	20.57	20.82
E	15.37	15.62	15.87
E2	4.96	5.08	5.20
e	~	5.56	~
L	19.75	20.00	20.25
L1	3.69	3.81	3.93
ØP	3.51	3.58	3.65
Q	5.34	5.46	5.58
S	5.34	5.46	5.58
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
D1	13.08	~	~
D2	0.51	0.93	1.35
E1	12.81	~	~
ØP1	6.61	6.73	6.85

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