

# 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 @  $T_J = 150^\circ\text{C}$
- Typ.  $R_{DS(on)} = 79\text{ m}\Omega$
- Ultra Low Gate Charge (Typ.  $Q_g = 139\text{ nC}$ )
- Low Effective Output Capacitance (Typ.  $C_{oss(eff.)} = 340\text{ pF}$ )
- 100% Avalanche Tested
- This is a Pb-Free Device

### Applications

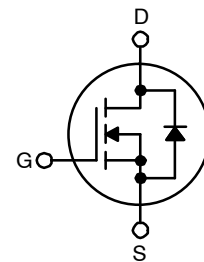
- Solar Inverter
- AC-DC Power Supply



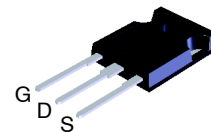
ON Semiconductor®

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$V_{DS}$	$R_{DS(on)}\text{ MAX}$	$I_D\text{ MAX}$
600 V	98 mΩ @ 10 V	35 A

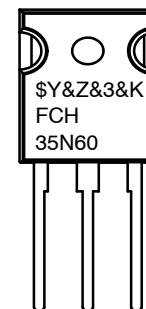


N-CHANNEL MOSFET



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.

# FCH35N60

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

Symbol	Parameter	Value	Unit
V <sub>DSS</sub>	Drain to Source Voltage	600	V
V <sub>GSS</sub>	Gate to Source Voltage	±30	V
I <sub>D</sub>	Drain Current	- Continuous (T <sub>C</sub> = 25°C)	35
		- Continuous (T <sub>C</sub> = 100°C)	22.2
I <sub>DM</sub>	Drain Current	- Pulsed (Note 1)	105
E <sub>AS</sub>	Single Pulsed Avalanche Energy (Note 2)	1455	mJ
I <sub>AR</sub>	Avalanche Current (Note 1)	35	A
E <sub>AR</sub>	Repetitive Avalanche Energy (Note 1)	31.25	mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	20	V/ns
P <sub>D</sub>	Power Dissipation	(T <sub>C</sub> = 25°C)	312.5
		- Derate above 25°C	2.5
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 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<sub>AS</sub> = 17.5 A, V<sub>DD</sub> = 50 V, R<sub>G</sub> = 25 Ω, starting T<sub>J</sub> = 25°C
3. I<sub>SD</sub> ≤ 35 A, di/dt ≤ 200 A/μs, V<sub>DD</sub> ≤ BV<sub>DSS</sub>, starting T<sub>J</sub> = 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 <sub>θJC</sub>	Thermal Resistance, Junction to Case, Max.	0.4	°C/W
R <sub>θJA</sub>	Thermal Resistance, Junction to Ambient, Max.	42	

# FCH35N60

## ELECTRICAL CHARACTERISTICS (T<sub>C</sub> = 25°C unless otherwise noted)

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
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### OFF CHARACTERISTICS

BV <sub>DSS</sub>	Drain to Source Breakdown Voltage	I <sub>D</sub> = 250 μA, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 25°C	600	–	–	V
		I <sub>D</sub> = 250 μA, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 150°C	–	650	–	
ΔBV <sub>DSS</sub> / ΔT <sub>J</sub>	Breakdown Voltage Temperature Coefficient	I <sub>D</sub> = 250 μA, Referenced to 25°C	–	0.6	–	V/°C
BV <sub>DS</sub>	Drain–Source Avalanche Breakdown Voltage	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 16 A	–	700	–	V
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> = 600 V, V <sub>GS</sub> = 0 V	–	–	1	μA
		V <sub>DS</sub> = 480 V, T <sub>C</sub> = 125°C	–	–	10	
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> = 250 μA	3.0	–	5.0	V
R <sub>DS(on)</sub>	Static Drain to Source On Resistance	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 17.5 A	–	0.079	0.098	Ω
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> = 40 V, I <sub>D</sub> = 17.5 A	–	28.8	–	S

### DYNAMIC CHARACTERISTICS

C <sub>iss</sub>	Input Capacitance	V <sub>DS</sub> = 25 V, V <sub>GS</sub> = 0 V, f = 1 MHz	–	4990	6640	pF
C <sub>oss</sub>	Output Capacitance		–	2380	3170	pF
C <sub>rss</sub>	Reverse Transfer Capacitance		–	140	–	pF
C <sub>oss</sub>	Output Capacitance	V <sub>DS</sub> = 480 V, V <sub>GS</sub> = 0 V, f = 1 MHz	–	113	–	pF
C <sub>oss</sub> eff.	Effective Output Capacitance	V <sub>DS</sub> = 0 V to 480 V, V <sub>GS</sub> = 0 V	–	340	–	pF
Q <sub>g</sub>	Total Gate Charge at 10 V	V <sub>DS</sub> = 480 V, I <sub>D</sub> = 35 A, V <sub>GS</sub> = 10 V (Note 4)	–	139	181	nC
Q <sub>gs</sub>	Gate to Source Gate Charge		–	31	–	nC
Q <sub>gd</sub>	Gate to Drain “Miller” Charge		–	69	–	nC
ESR	Equivalent Series Resistance (G–S)	Drain Open, f = 1 MHz	–	1.4	–	Ω

### SWITCHING CHARACTERISTICS

t <sub>d(on)</sub>	Turn-On Delay Time	V <sub>DD</sub> = 300 V, I <sub>D</sub> = 35 A, R <sub>G</sub> = 4.7 Ω (Note 4)	–	34	78	ns
t <sub>r</sub>	Turn–On Rise Time		–	120	250	ns
t <sub>d(off)</sub>	Turn-Off Delay Time		–	105	220	ns
t <sub>f</sub>	Turn–Off Fall Time		–	73	155	ns

### DRAIN-SOURCE DIODE CHARACTERISTICS

I <sub>S</sub>	Maximum Continuous Drain to Source Diode Forward Current	–	–	35	A	
I <sub>SM</sub>	Maximum Pulsed Drain to Source Diode Forward Current	–	–	105	A	
V <sub>SD</sub>	Drain to Source Diode Forward Voltage	V <sub>GS</sub> = 0 V, I <sub>SD</sub> = 35 A	–	–	1.4	V
t <sub>rr</sub>	Reverse Recovery Time	V <sub>GS</sub> = 0 V, I <sub>SD</sub> = 35 A, dI <sub>F</sub> /dt = 100 A/μs	–	614	–	ns
Q <sub>rr</sub>	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

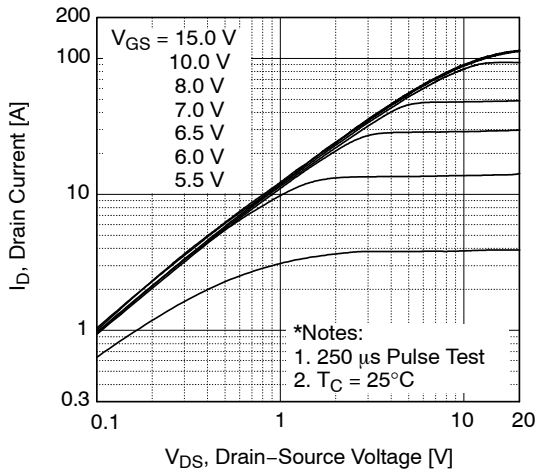


Figure 1. On-Region Characteristics

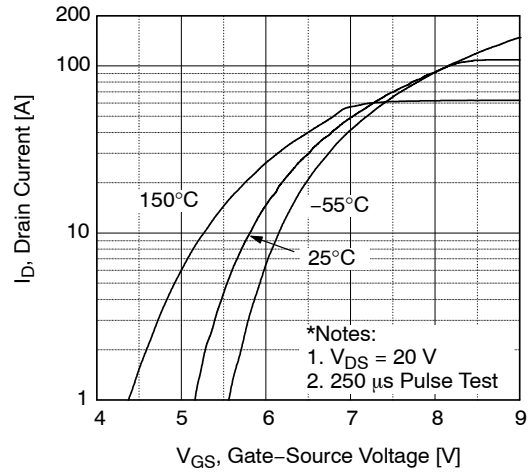


Figure 2. Transfer Characteristics

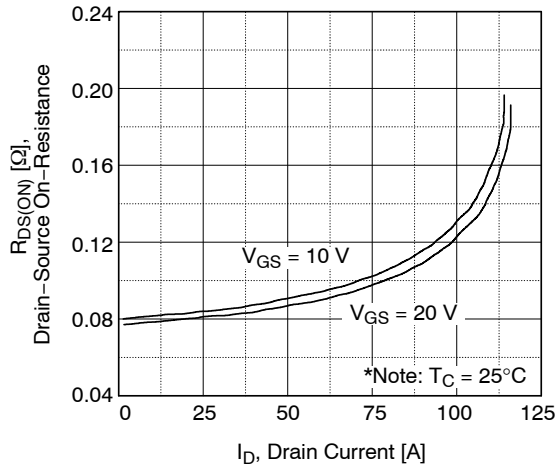


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

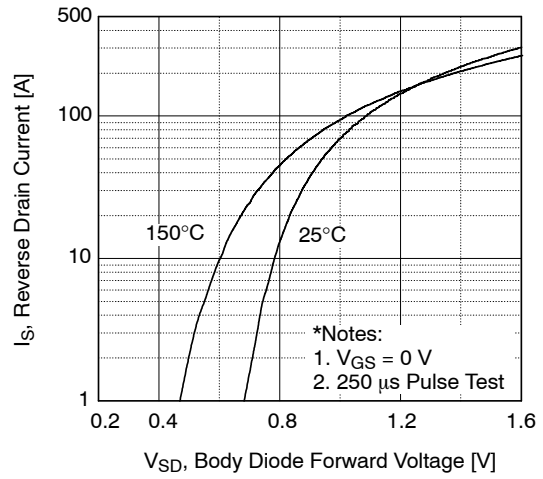


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

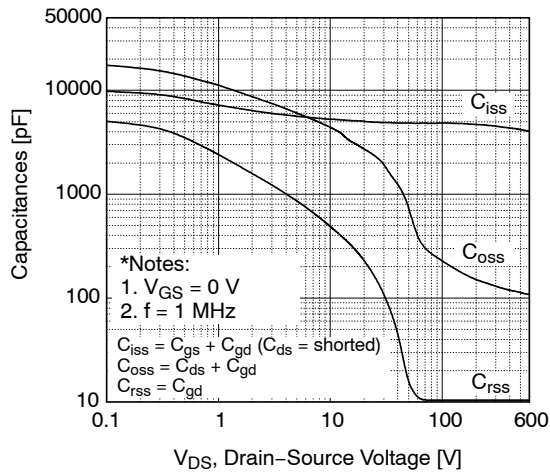


Figure 5. Capacitance Characteristics

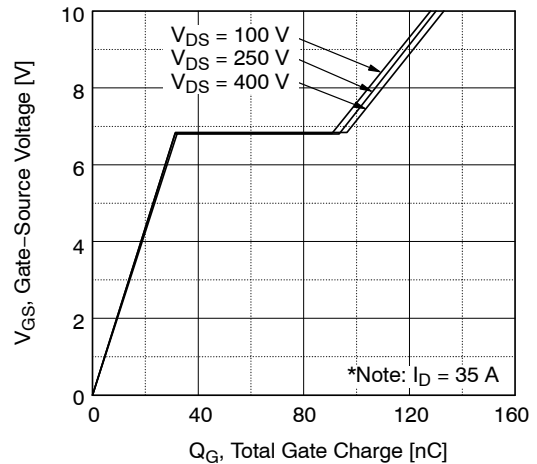


Figure 6. Gate Charge Characteristics

TYPICAL CHARACTERISTICS

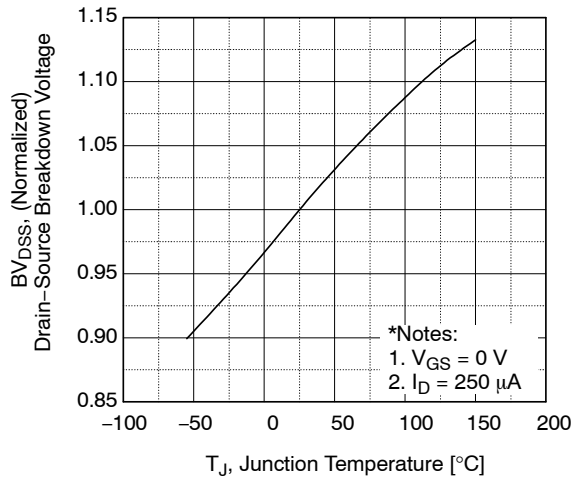


Figure 7. Breakdown Voltage Variation vs. Temperature

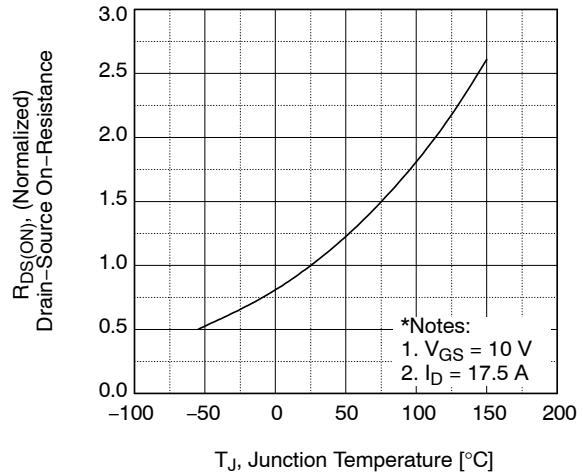


Figure 8. On-Resistance Variation vs. Temperature

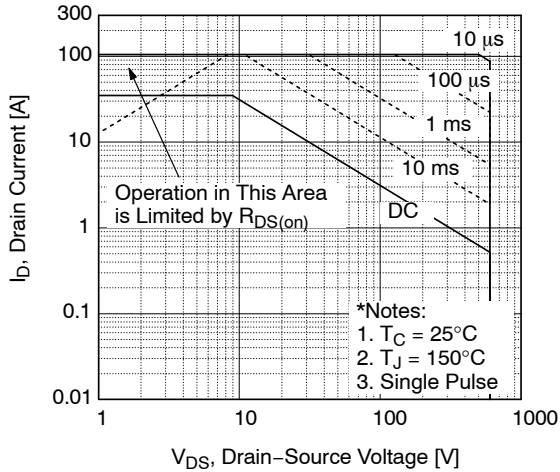


Figure 9. Maximum Safe Operating Area

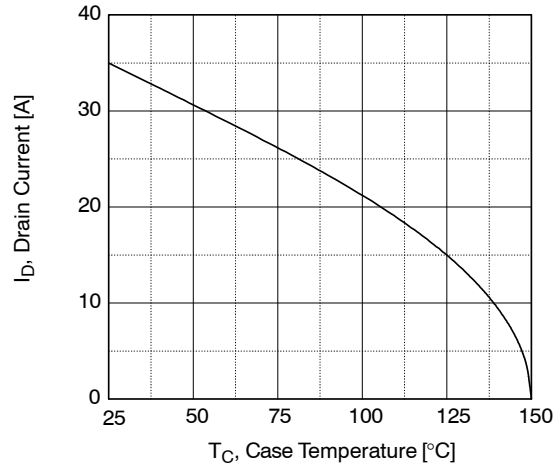


Figure 10. Maximum Drain Current vs. Case Temperature

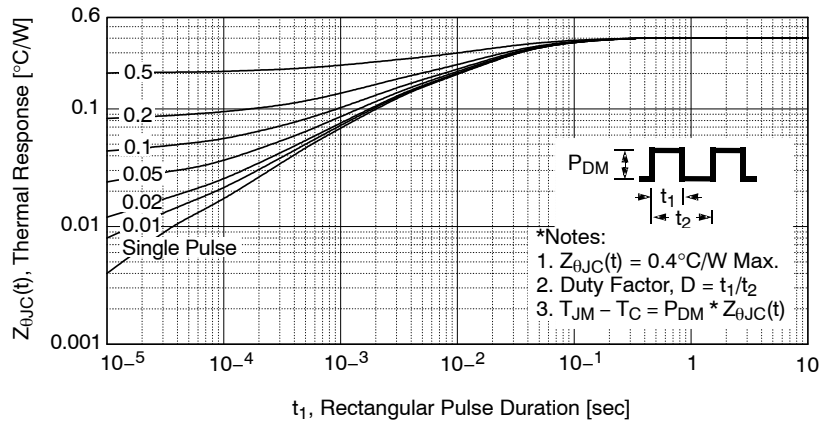


Figure 11. Transient Thermal Response Curve

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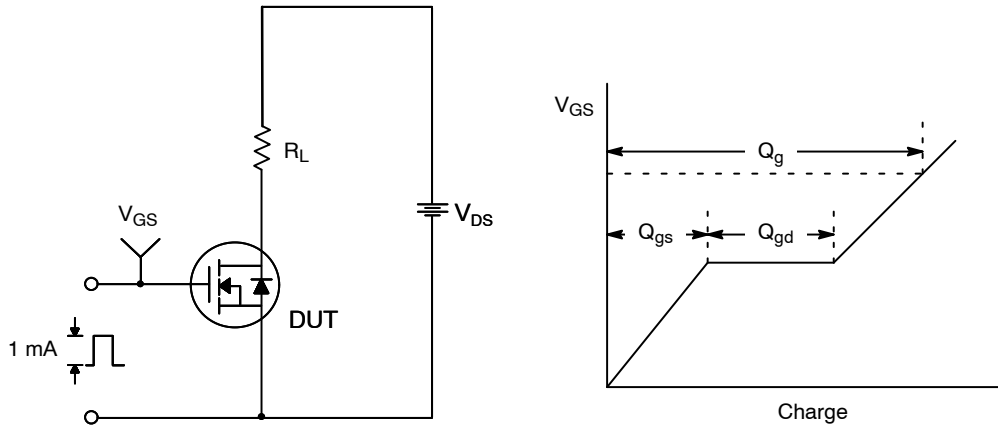


Figure 12. Gate Charge Test Circuit & Waveform

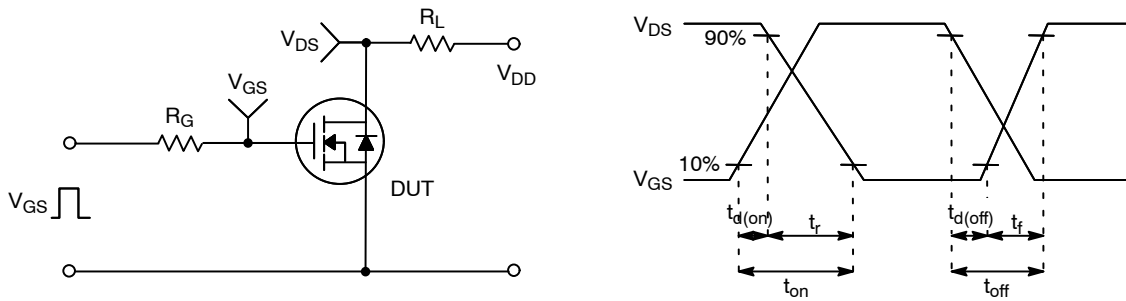


Figure 13. Resistive Switching Test Circuit & Waveforms

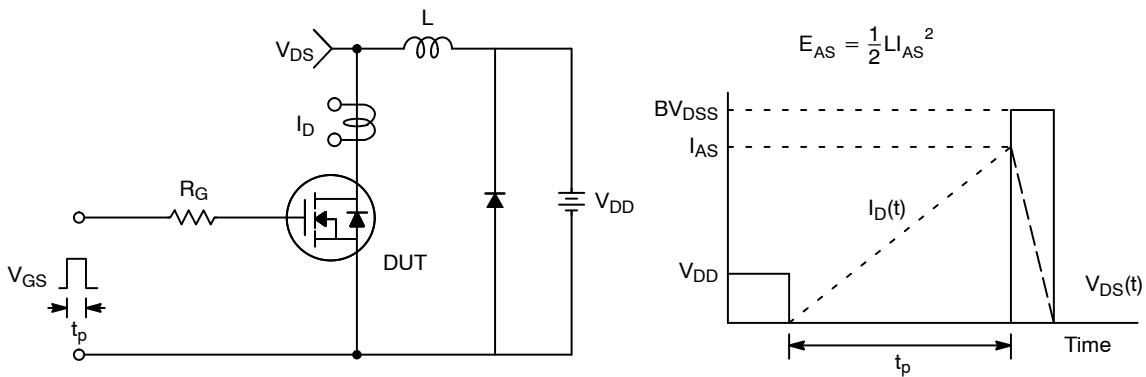
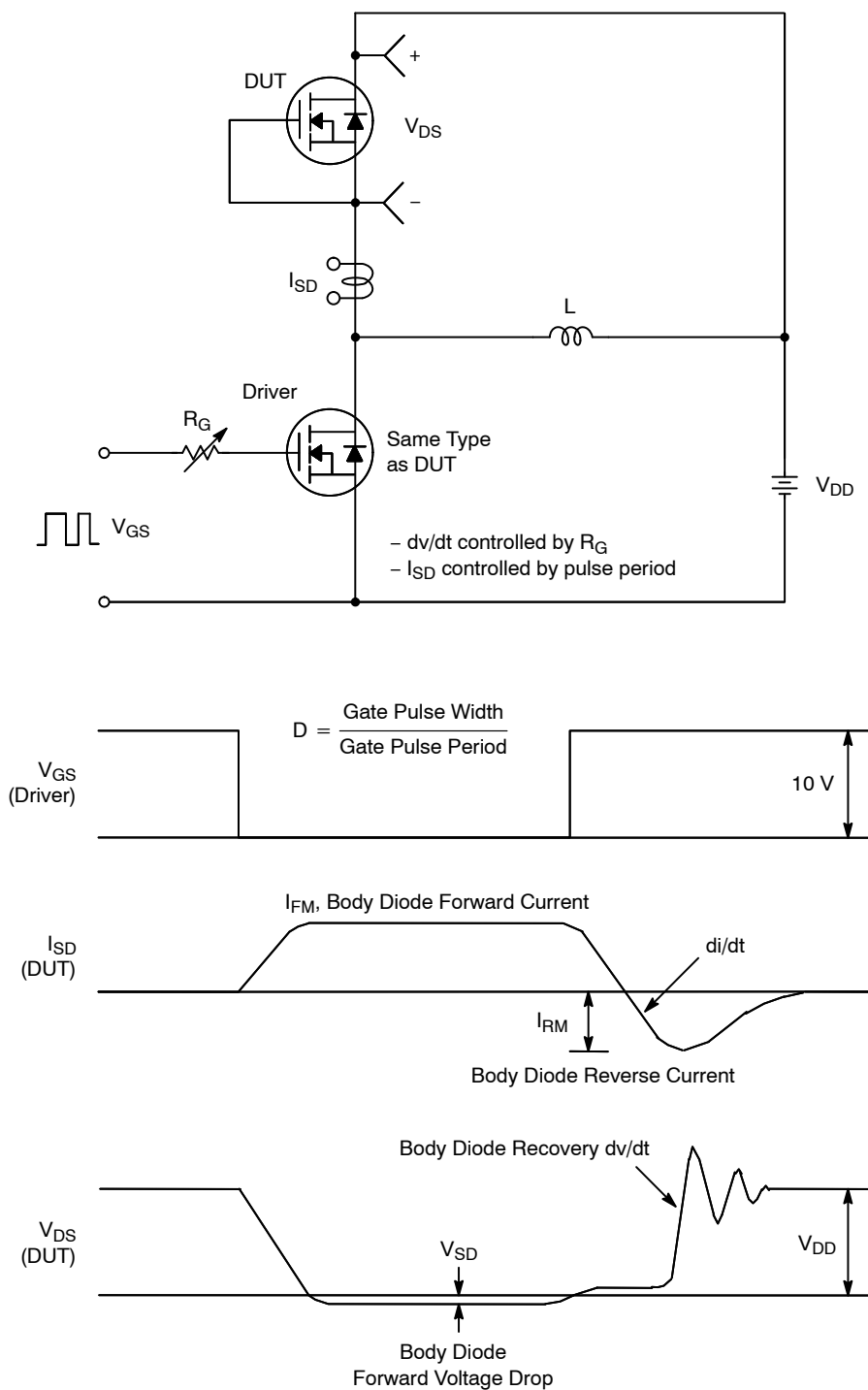


Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms

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

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

DATE 31 JAN 2019



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.

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
∅P	3.51	3.58	3.65
∅P1	6.60	6.80	7.00
Q	5.34	5.46	5.58
S	5.34	5.46	5.58

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