

# MOSFET – N-Channel, SUPERFET<sup>®</sup> II, FRFET<sup>®</sup> 650 V, 76 A, 41 mΩ



**ON Semiconductor<sup>®</sup>**

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## FCH041N65EFL4

### Description

SuperFET II 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 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 FREFET MOSFET's optimized body diode reverse recovery performance can remove additional component and improve system reliability.

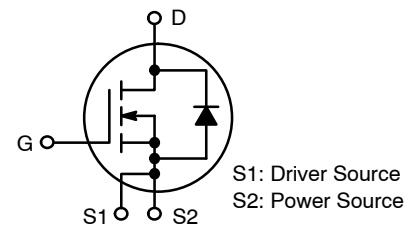
### Features

- Typ.  $R_{DS(on)} = 36 \text{ m}\Omega$
- 700 V @  $T_J = 150^\circ\text{C}$
- Ultra Low Gate Charge (Typ.  $Q_g = 229 \text{ nC}$ )
- Low Effective Output Capacitance (Typ.  $C_{oss(eff.)} = 631 \text{ pF}$ )
- 100% Avalanche Tested
- These Devices are Pb-Free and are RoHS Compliant

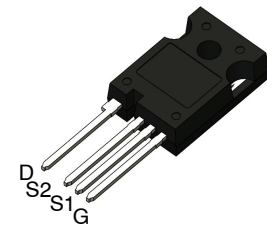
### Applications

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

$V_{DS}$	$R_{DS(on)} \text{ MAX}$	$I_D \text{ MAX}$
650 V	41 mΩ @ 10 V	76 A

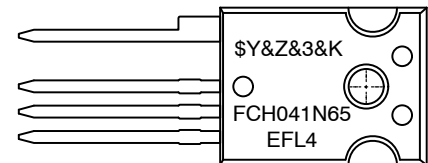


**N-CHANNEL MOSFET**



**TO-247-4LD  
CASE 340CJ**

### MARKING DIAGRAM



FCH041N65EFL4 = Specific Device Code  
 \$Y = ON Semiconductor Logo  
 &Z = Assembly Plant Code  
 &3 = Data Code (Week & Year)  
 K = Lot

### ORDERING INFORMATION

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

# FCH041N65EFL4

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

Symbol	Parameter	Value	Unit
V <sub>DSS</sub>	Drain to Source Voltage	650	V
V <sub>GSS</sub>	Gate to Source Voltage	- DC	±20
		- AC (f > 1 Hz)	±30
I <sub>D</sub>	Drain Current:	- Continuous (T <sub>C</sub> = 25°C)	76
		- Continuous (T <sub>C</sub> = 100°C)	48.1
I <sub>DM</sub>	Drain Current:	- Pulsed (Note 1)	228
E <sub>AS</sub>	Single Pulsed Avalanche Energy (Note 2)	2025	mJ
I <sub>AS</sub>	Avalanche Current (Note 2)	15	A
E <sub>AR</sub>	Repetitive Avalanche Energy (Note 1)	5.95	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)	595
		- Derate Above 25°C	4.76
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> = 15 A, R<sub>G</sub> = 25 Ω, starting T<sub>J</sub> = 25 °C.

3. I<sub>SD</sub> ≤ 38 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 Marking	Package	Packing Method	Reel Size	Tape Width	Quantity
FCH041N65EFL4	FCH041N65EF	TO-247 4L	Tube	N/A	N/A	30 Units

## THERMAL CHARACTERISTICS

Symbol	Parameter	FCH041N65EFL4	Unit
R <sub>θJC</sub>	Thermal Resistance, Junction to Case, Max.	0.21	°C/W
R <sub>θJA</sub>	Thermal Resistance, Junction to Ambient, Max.	40	

# FCH041N65EFL4

## 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	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 10 mA, T <sub>J</sub> = 25°C	650	–	–	V
		V <sub>GS</sub> = 0 V, I <sub>D</sub> = 10 mA, T <sub>J</sub> = 150°C	700	–	–	
ΔBV <sub>DSS</sub> / ΔT <sub>J</sub>	Breakdown Voltage Temperature Coefficient	I <sub>D</sub> = 10 mA, Referenced to 25°C	–	0.72	–	V/°C
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> = 650 V, V <sub>GS</sub> = 0 V	–	–	10	μA
		V <sub>DS</sub> = 520 V, T <sub>C</sub> = 125 °C	–	145	–	
I <sub>GSS</sub>	Gate to Body Leakage Current	V <sub>GS</sub> = ±20 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> = 7.6 mA	3	–	5	V
R <sub>DS(on)</sub>	Static Drain to Source On Resistance	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 38 A	–	36	4	mΩ
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> = 20 V, I <sub>D</sub> = 38 A	–	71.7	–	S

### DYNAMIC CHARACTERISTICS

C <sub>iss</sub>	Input Capacitance	V <sub>DS</sub> = 100 V, V <sub>GS</sub> = 0 V, f = 1 MHz	–	9446	12560	pF
C <sub>oss</sub>	Output Capacitance		–	366	490	pF
C <sub>rss</sub>	Reverse Transfer Capacitance		–	35	–	pF
C <sub>oss</sub>	Output Capacitance	V <sub>DS</sub> = 380 V, V <sub>GS</sub> = 0 V, f = 1 MHz	–	197	–	pF
C <sub>oss(eff.)</sub>	Effective Output Capacitance	V <sub>DS</sub> = 0 V to 400 V, V <sub>GS</sub> = 0 V	–	631	–	pF
Q <sub>g(tot)</sub>	Total Gate Charge at 10 V	V <sub>DS</sub> = 380 V, I <sub>D</sub> = 38 A, V <sub>GS</sub> = 10 V (Note 4)	–	229	298	nC
Q <sub>gs</sub>	Gate to Source Gate Charge		–	50	–	nC
Q <sub>gd</sub>	Gate to Drain "Miller" Charge		–	90	–	nC
ESR	Equivalent Series Resistance	f = 1 MHz	–	0.6	–	Ω

### SWITCHING CHARACTERISTICS

t <sub>d(on)</sub>	Turn-On Delay Time	V <sub>DD</sub> = 380 V, I <sub>D</sub> = 38 A, V <sub>GS</sub> = 10 V, R <sub>g</sub> = 4.7 Ω (Note 4)	–	55	120	ns
t <sub>r</sub>	Turn-On Rise Time		–	25	60	ns
t <sub>d(off)</sub>	Turn-Off Delay Time		–	169	348	ns
t <sub>f</sub>	Turn-Off Fall Time		–	18	46	ns

### DRAIN-SOURCE DIODE CHARACTERISTICS

I <sub>S</sub>	Maximum Continuous Source to Drain Diode Forward Current	–	–	76	A	
I <sub>SM</sub>	Maximum Pulsed Drain to Source Diode Forward Current	–	–	228	A	
V <sub>SD</sub>	Drain to Source Diode Forward Voltage	V <sub>GS</sub> = 0 V, I <sub>SD</sub> = 38 A	–	–	1.2	V
t <sub>rr</sub>	Reverse Recovery Time	V <sub>GS</sub> = 0 V, I <sub>SD</sub> = 38 A, di <sub>F</sub> /dt = 100 A/μs	–	207	–	ns
Q <sub>rr</sub>	Reverse Recovery Charge		–	1.5	–	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 CHARACTERISTICS

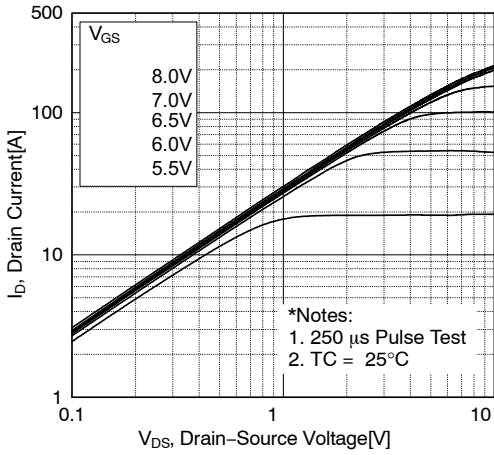


Figure 1. On-Region Characteristics

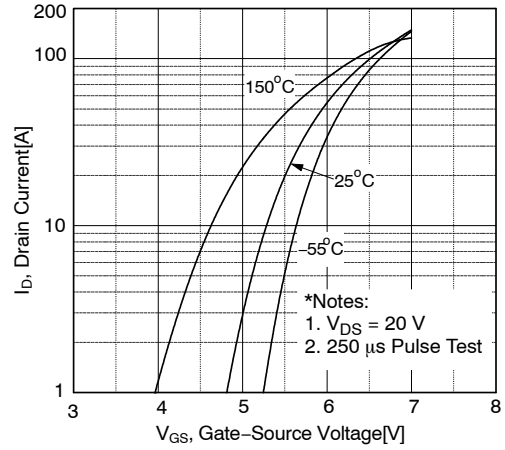


Figure 2. Transfer Characteristics

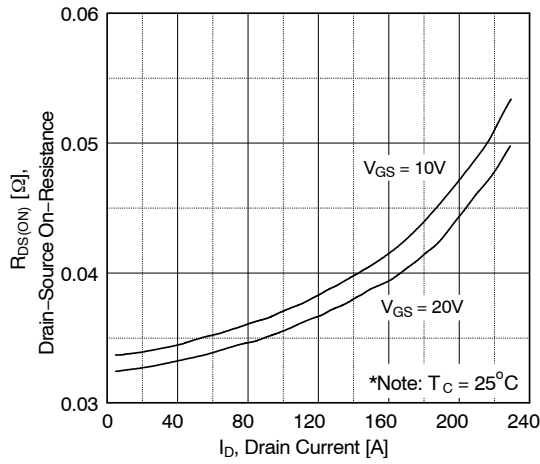


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

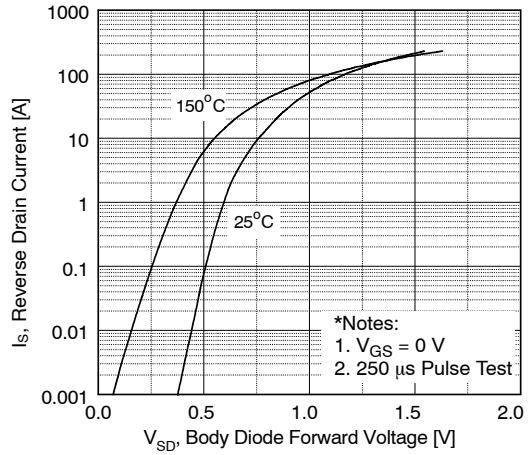


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

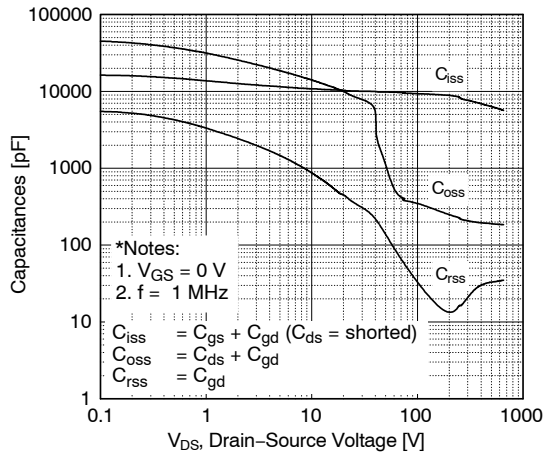


Figure 5. Capacitance Characteristics

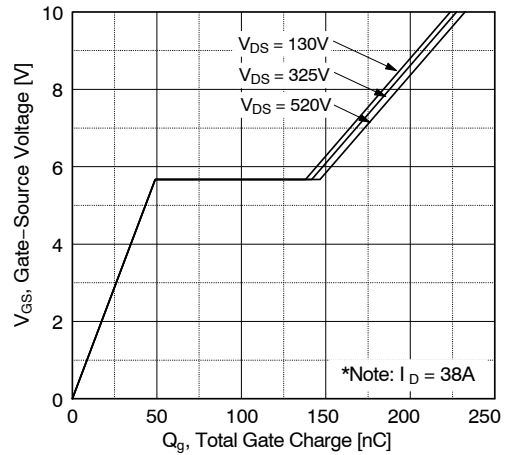


Figure 6. Gate Charge Characteristics

TYPICAL CHARACTERISTICS

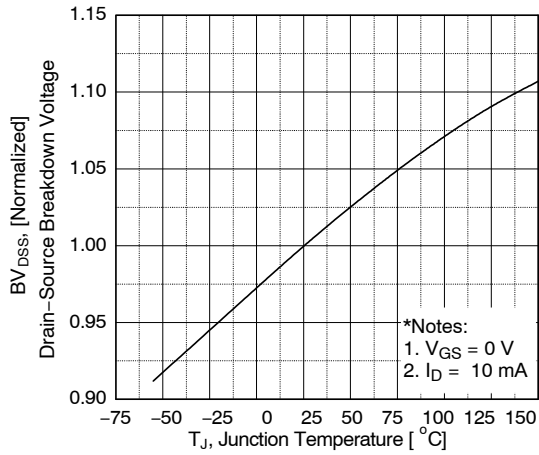


Figure 7. Breakdown Voltage Variation vs. Temperature

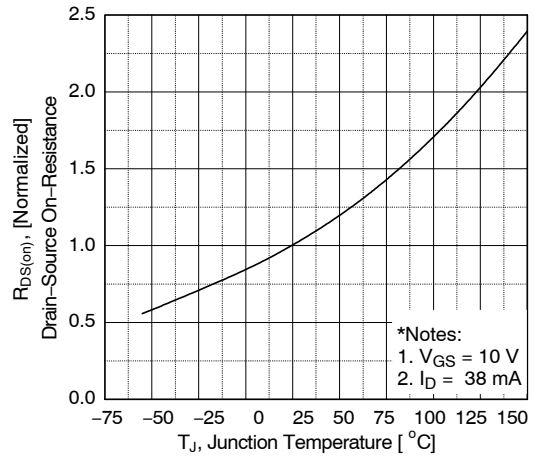


Figure 8. On-Resistance Variation vs. Temperature

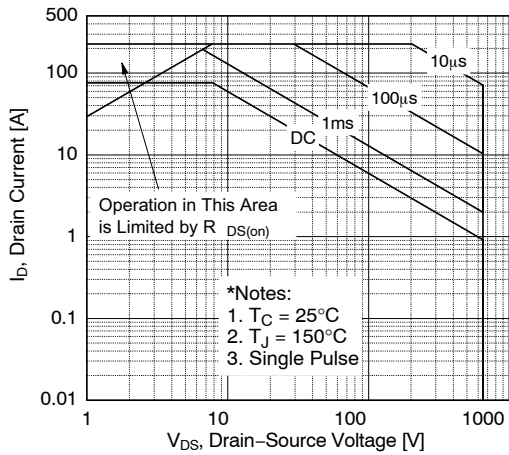


Figure 9. Maximum Safe Operating Area

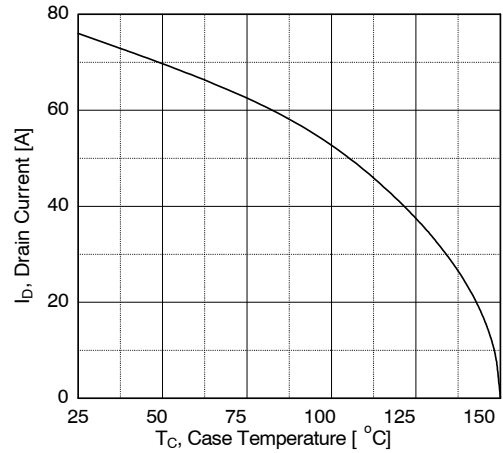


Figure 10. Maximum Drain Current vs. Case Temperature

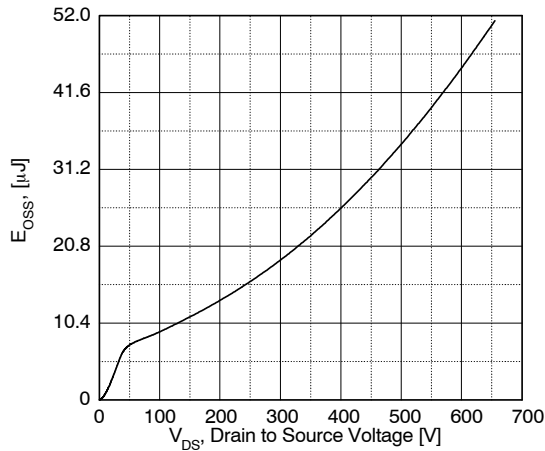


Figure 11. E<sub>oss</sub> vs. Drain to Source Voltage

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## TYPICAL CHARACTERISTICS

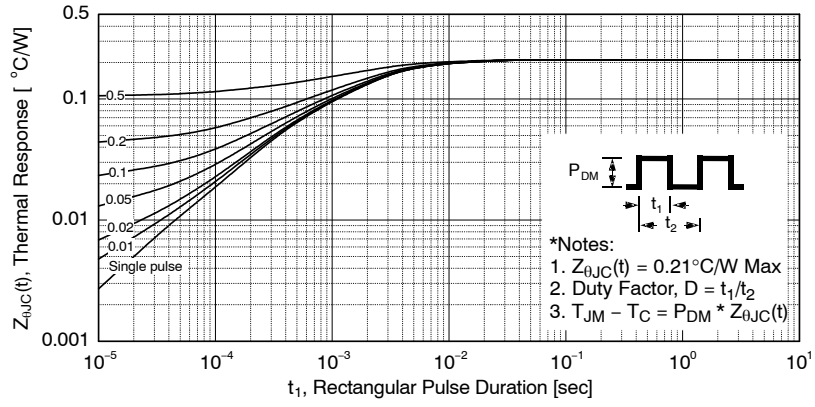


Figure 12. Transient Thermal Response Curve



Figure 13. Gate Charge Test Circuit & Waveform



Figure 14. Resistive Switching Test Circuit & Waveforms

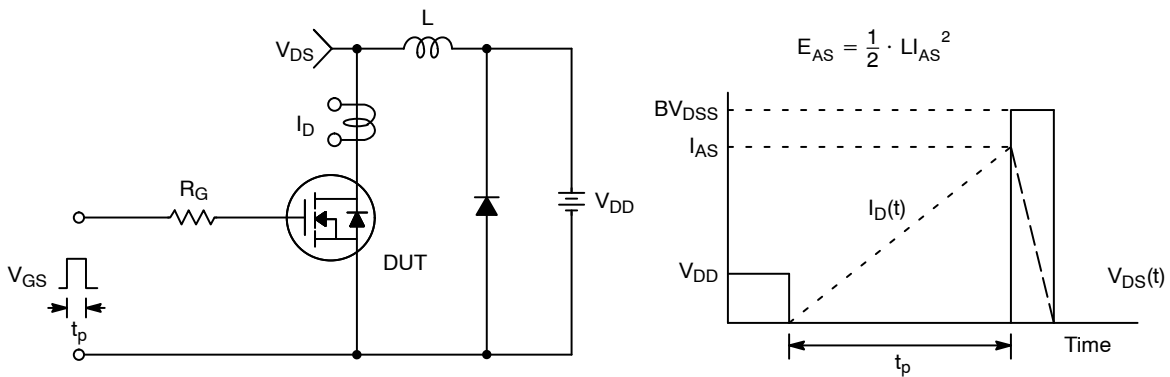
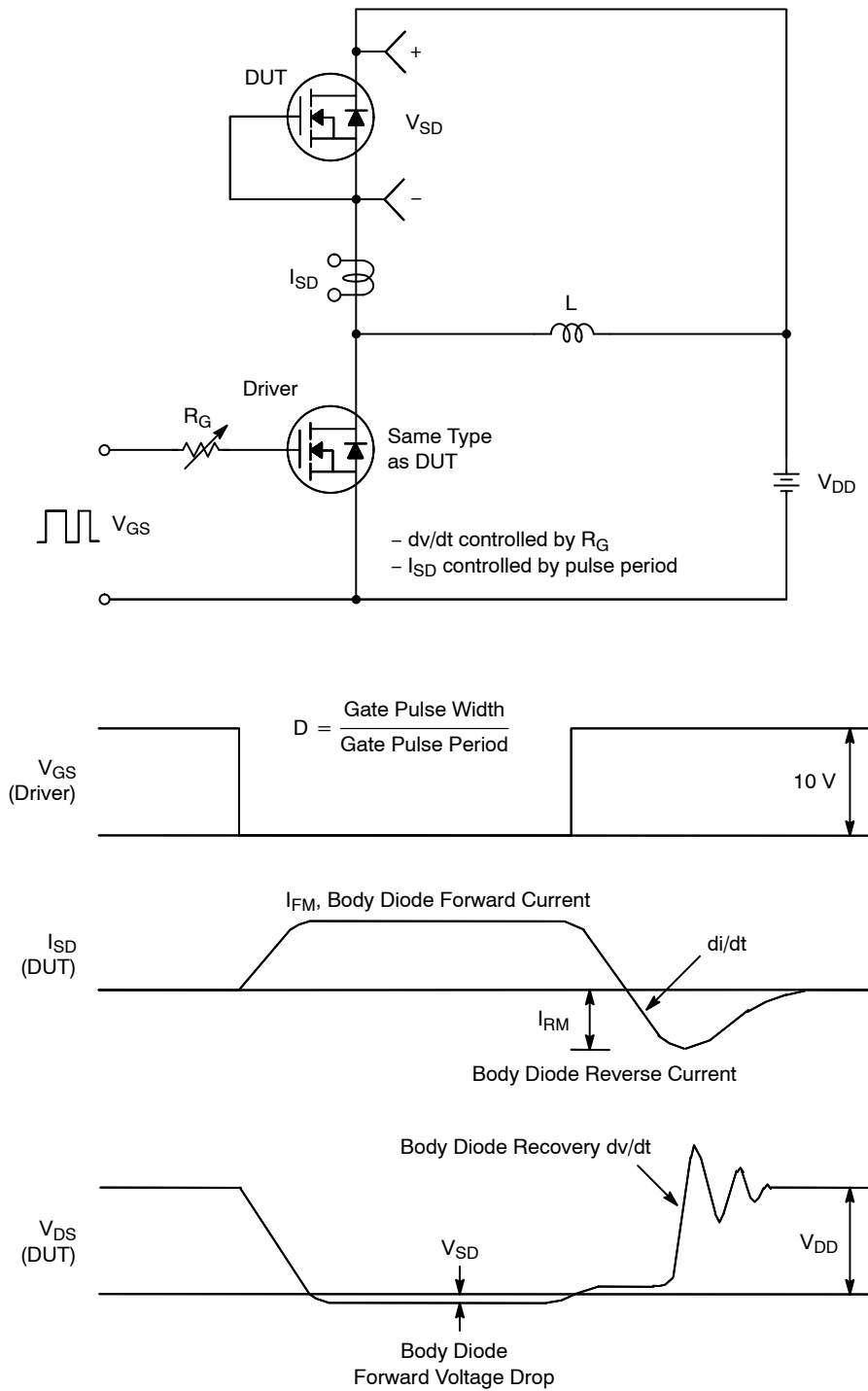


Figure 15. Unclamped Inductive Switching Test Circuit & Waveforms

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

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# MECHANICAL CASE OUTLINE

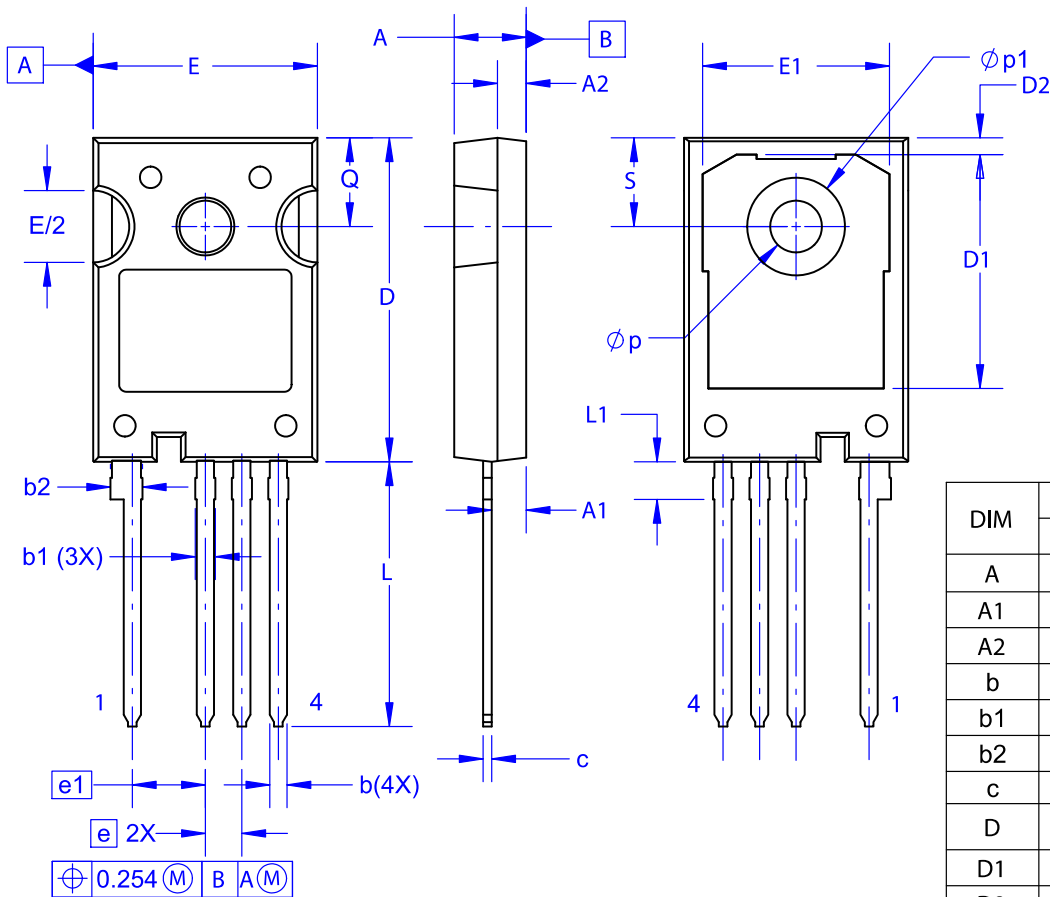
## PACKAGE DIMENSIONS

ON Semiconductor®



TO-247-4LD  
CASE 340CJ  
ISSUE A

DATE 16 SEP 2019



DIM	MILLIMETERS		
	MIN	NOM	MAX
A	4.80	5.00	5.20
A1	2.10	2.40	2.70
A2	1.80	2.00	2.20
b	1.07	1.20	1.33
b1	1.20	1.40	1.60
b2	2.02	2.22	2.42
c	0.50	0.60	0.70
D	22.34	22.54	22.74
D1	16.00	16.25	16.50
D2	0.97	1.17	1.37
e	2.54 BSC		
e1	5.08 BSC		
E	15.40	15.60	15.80
E1	12.80	13.00	13.20
E/2	4.80	5.00	5.20
L	18.22	18.42	18.62
L1	2.42	2.62	2.82
p	3.40	3.60	3.80
p1	6.60	6.80	7.00
Q	5.97	6.17	6.37
S	5.97	6.17	6.37

NOTES:

- A. NO INDUSTRY STANDARD APPLIES TO THIS PACKAGE.
- B. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.
- C. ALL DIMENSIONS ARE IN MILLIMETERS.
- D. DRAWING CONFORMS TO ASME Y14.5-2009.

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