

Thank you for your interest in **onsemi** products.
Your technical document begins on the following pages.



Your Feedback is Important to Us!

Please take a moment to participate in our short survey.
At **onsemi**, we are dedicated to delivering technical content that best meets your needs.

[Help Us Improve – Take the Survey](#)

This survey is intended to collect your feedback, capture any issues you may encounter, and to provide improvements you would like to suggest.

We look forward to your feedback.

To learn more about **onsemi**, please visit our website at
www.onsemi.com

onsemi and **onsemi** and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "**onsemi**" or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi** product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. **onsemi** reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as-is" and **onsemi** makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does **onsemi** assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using **onsemi** products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by **onsemi**. "Typical" parameters which may be provided in **onsemi** data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. **onsemi** does not convey any license under any of its intellectual property rights nor the rights of others. **onsemi** products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use **onsemi** products for any such unintended or unauthorized application, Buyer shall indemnify and hold **onsemi** and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that **onsemi** was negligent regarding the design or manufacture of the part. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner. Other names and brands may be claimed as the property of others.

MOSFET – N-Channel, SUPERFET® II, FRFET®

650 V, 76 A, 41 mΩ

FCH041N65EFL4

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

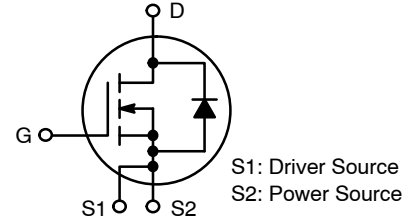
Features

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

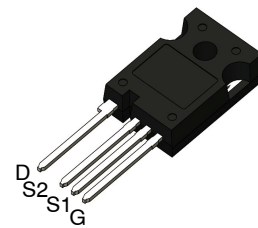
Applications

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

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

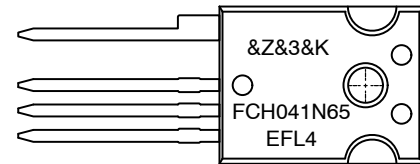


N-CHANNEL MOSFET



TO-247-4LD
CASE 340CJ

MARKING DIAGRAM



FCH041N65EFL4 = Specific Device Code
&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_C = 25°C unless otherwise noted)

Symbol	Parameter	Value	Unit
V _{DSS}	Drain to Source Voltage	650	V
V _{GSS}	Gate to Source Voltage	- DC	±20
		- AC (f > 1 Hz)	±30
I _D	Drain Current:	- Continuous (T _C = 25°C)	76
		- Continuous (T _C = 100°C)	48.1
I _{DM}	Drain Current:	- Pulsed (Note 1)	228
E _{AS}	Single Pulsed Avalanche Energy (Note 2)	2025	mJ
I _{AS}	Avalanche Current (Note 2)	15	A
E _{AR}	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 _D	Power Dissipation	(T _C = 25°C)	595
		- Derate Above 25°C	4.76
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 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_{AS} = 15 A, R_G = 25 Ω, starting T_J = 25 °C.
3. I_{SD} ≤ 38 A, di/dt ≤ 200 A/μs, V_{DD} ≤ 380 V, starting T_J = 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 _{θJC}	Thermal Resistance, Junction to Case, Max.	0.21	°C/W
R _{θJA}	Thermal Resistance, Junction to Ambient, Max.	40	

FCH041N65EFL4

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	V _{GS} = 0 V, I _D = 10 mA, T _J = 25°C	650	–	–	V
		V _{GS} = 0 V, I _D = 10 mA, T _J = 150°C	700	–	–	
ΔBV _{DSS} / ΔT _J	Breakdown Voltage Temperature Coefficient	I _D = 10 mA, Referenced to 25°C	–	0.72	–	V/°C
I _{DSS}	Zero Gate Voltage Drain Current	V _{DS} = 650 V, V _{GS} = 0 V	–	–	10	μA
		V _{DS} = 520 V, T _C = 125 °C	–	145	–	
I _{GSS}	Gate to Body Leakage Current	V _{GS} = ±20 V, V _{DS} = 0 V	–	–	±100	nA

ON CHARACTERISTICS

V _{GS(th)}	Gate Threshold Voltage	V _{GS} = V _{DS} , I _D = 7.6 mA	3	–	5	V
R _{DS(on)}	Static Drain to Source On Resistance	V _{GS} = 10 V, I _D = 38 A	–	36	4	mΩ
g _{FS}	Forward Transconductance	V _{DS} = 20 V, I _D = 38 A	–	71.7	–	S

DYNAMIC CHARACTERISTICS

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

SWITCHING CHARACTERISTICS

t _{d(on)}	Turn-On Delay Time	V _{DD} = 380 V, I _D = 38 A, V _{GS} = 10 V, R _g = 4.7 Ω (Note 4)	–	55	120	ns
t _r	Turn-On Rise Time		–	25	60	ns
t _{d(off)}	Turn-Off Delay Time		–	169	348	ns
t _f	Turn-Off Fall Time		–	18	46	ns

DRAIN-SOURCE DIODE CHARACTERISTICS

I _S	Maximum Continuous Source to Drain Diode Forward Current	–	–	76	A	
I _{SM}	Maximum Pulsed Drain to Source Diode Forward Current	–	–	228	A	
V _{SD}	Drain to Source Diode Forward Voltage	V _{GS} = 0 V, I _{SD} = 38 A	–	–	1.2	V
t _{rr}	Reverse Recovery Time	V _{GS} = 0 V, I _{SD} = 38 A, di _F /dt = 100 A/μs	–	207	–	ns
Q _{rr}	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.

FCH041N65EFL4

TYPICAL CHARACTERISTICS

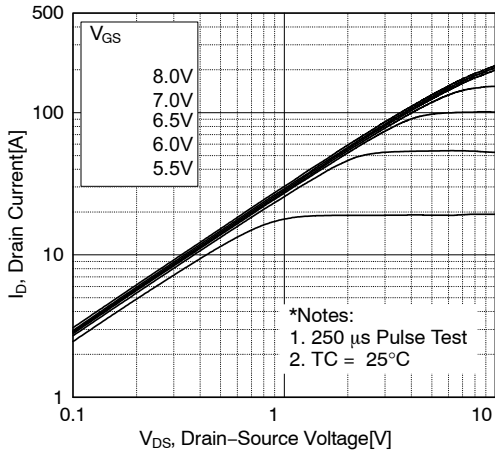


Figure 1. On-Region Characteristics

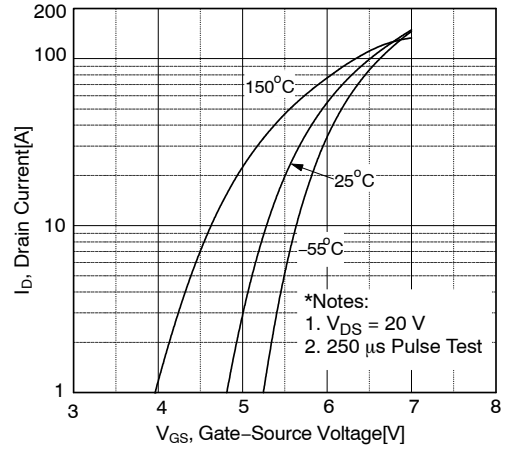


Figure 2. Transfer Characteristics

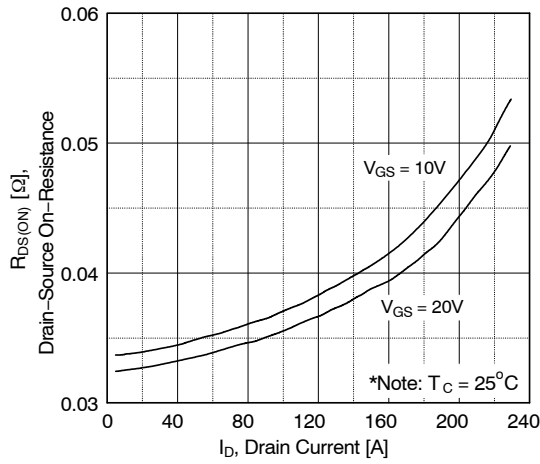


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

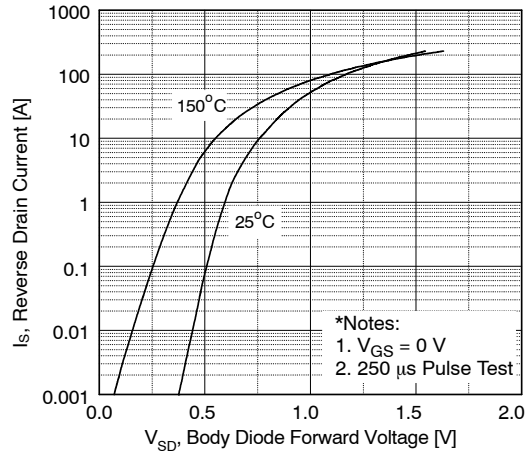


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

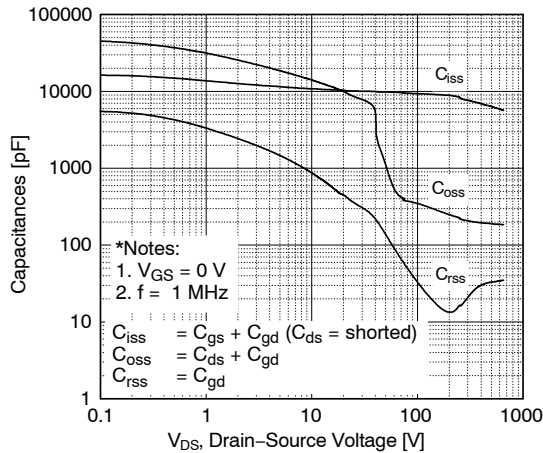


Figure 5. Capacitance Characteristics

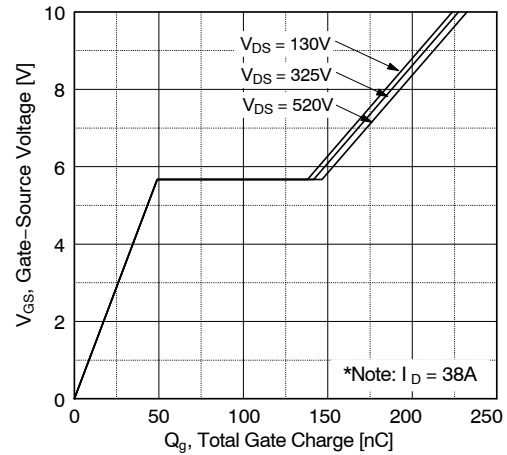


Figure 6. Gate Charge Characteristics

TYPICAL CHARACTERISTICS

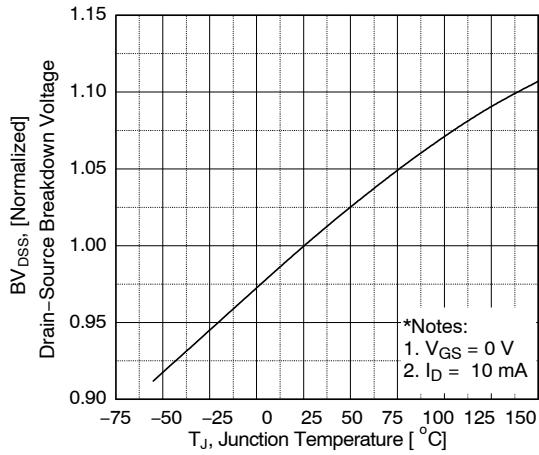


Figure 7. Breakdown Voltage Variation vs. Temperature

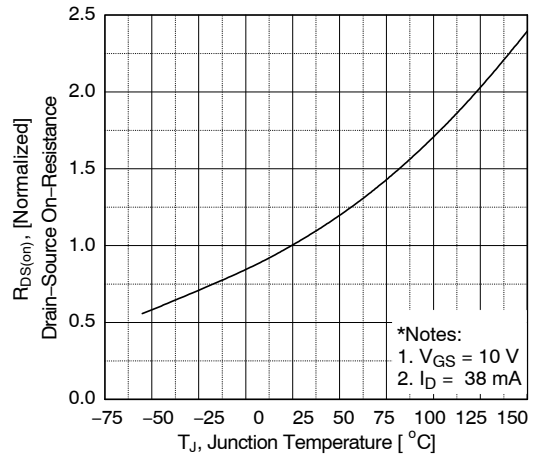


Figure 8. On-Resistance Variation vs. Temperature

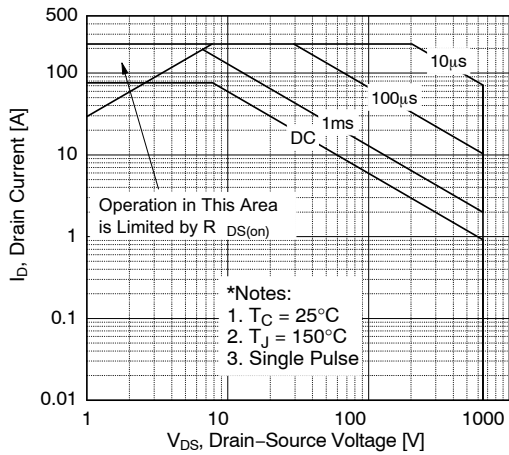


Figure 9. Maximum Safe Operating Area

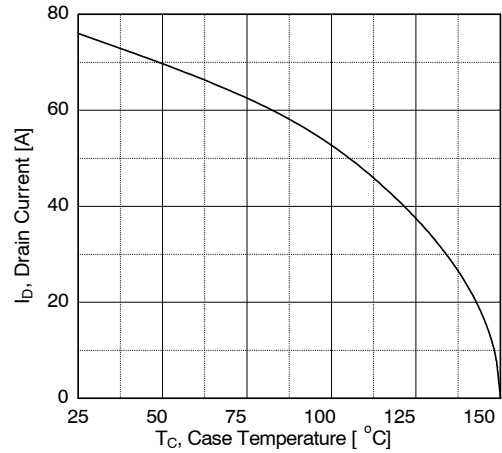


Figure 10. Maximum Drain Current vs. Case Temperature

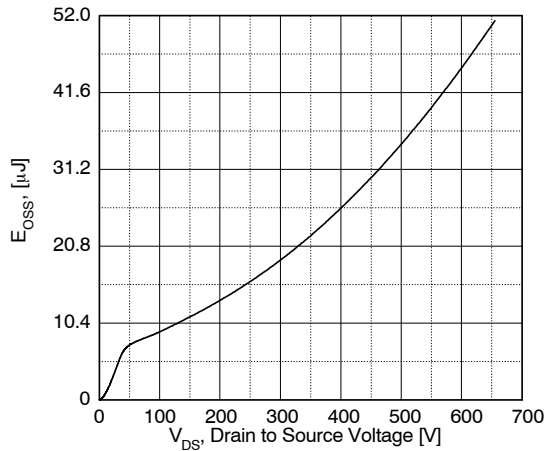


Figure 11. E_{oss} vs. Drain to Source Voltage

FCH041N65EFL4

TYPICAL CHARACTERISTICS

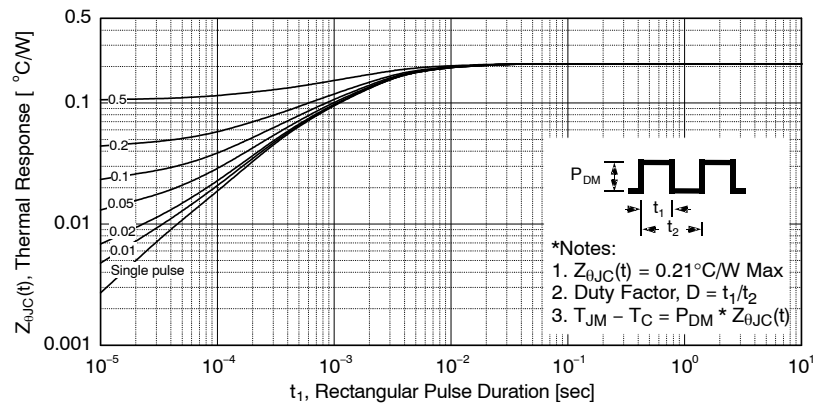


Figure 12. Transient Thermal Response Curve

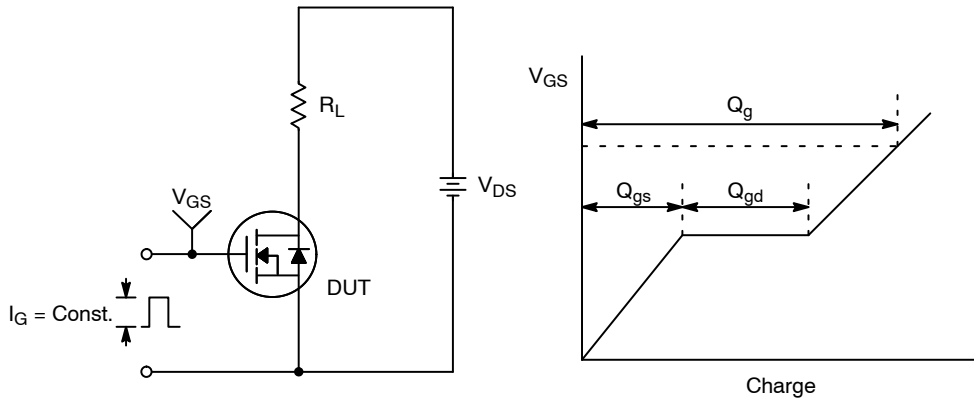


Figure 13. Gate Charge Test Circuit & Waveform

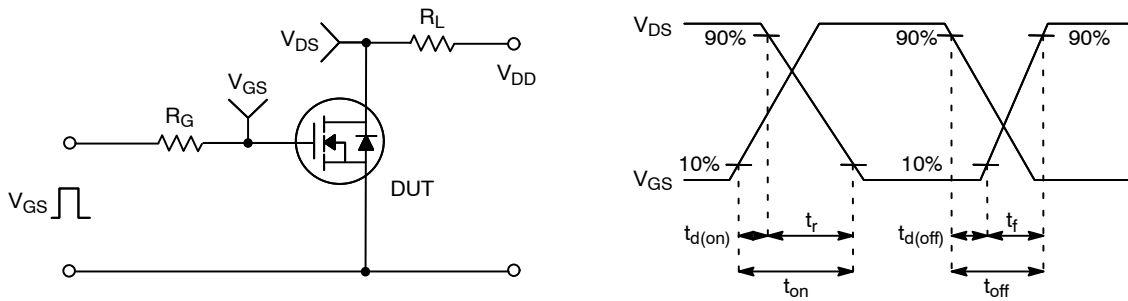


Figure 14. Resistive Switching Test Circuit & Waveforms

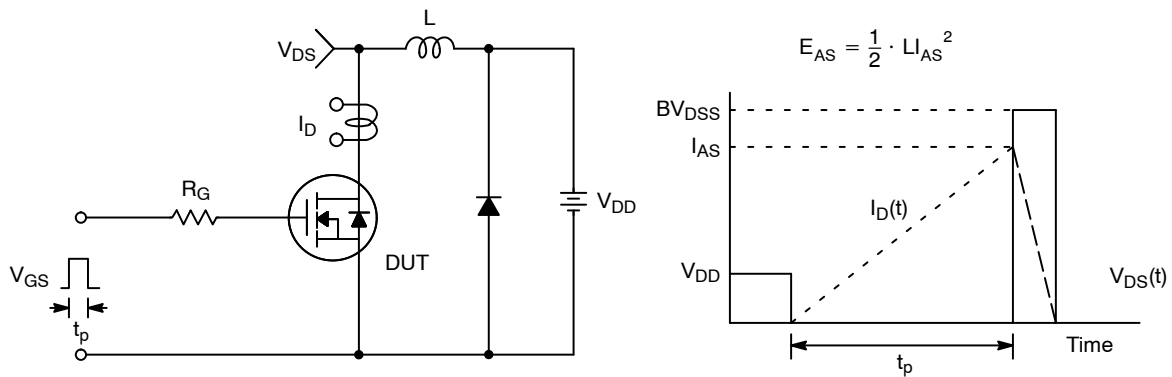


Figure 15. Unclamped Inductive Switching Test Circuit & Waveforms

FCH041N65EFL4

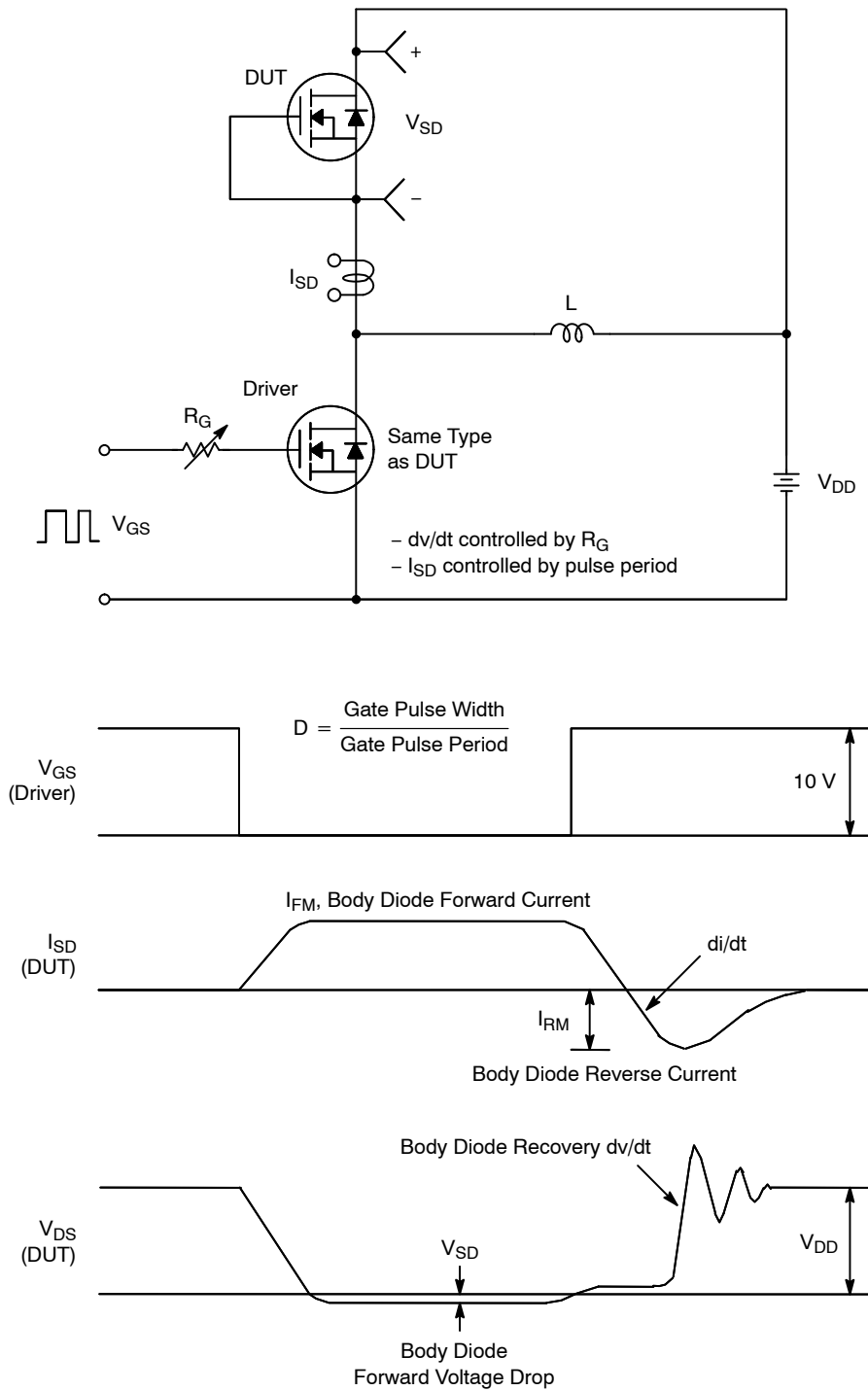


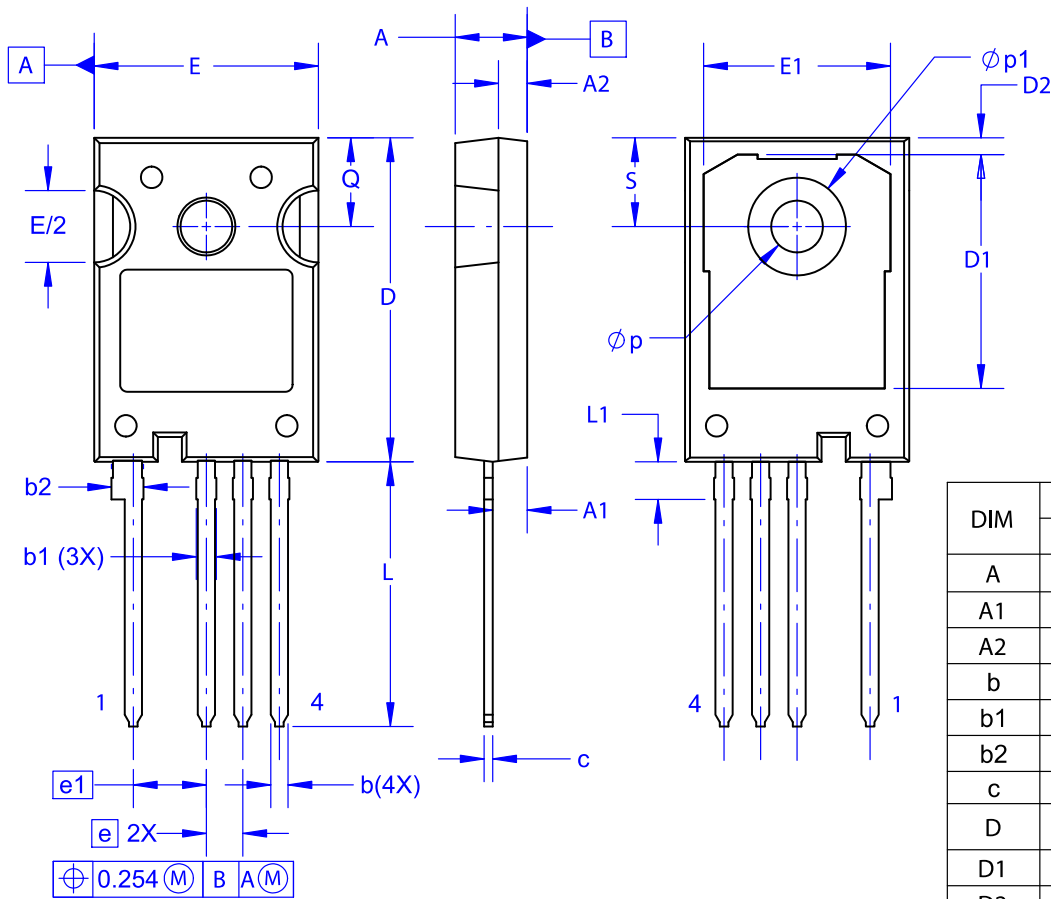
Figure 16. Peak Diode Recovery dv/dt Test Circuit & Waveforms

SUPERFET is a registered trademark of Semiconductor Components Industries, LLC (SCILLC) or its subsidiaries in the United States and/or other countries.

FRFET is a registered trademark of Semiconductor Components Industries, LLC (SCILLC) or its subsidiaries in the United States and/or other countries.

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.

DOCUMENT NUMBER:	98AON13852G	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
DESCRIPTION:	TO-247-4LD	PAGE 1 OF 1

onsemi and Onsemi are trademarks of Semiconductor Components Industries, LLC dba onsemi or its subsidiaries in the United States and/or other countries. onsemi reserves the right to make changes without further notice to any products herein. onsemi makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does onsemi assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. onsemi does not convey any license under its patent rights nor the rights of others.

onsemi, **Onsemi**, and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "**onsemi**" or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi**'s product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. **onsemi** reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as-is" and **onsemi** makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does **onsemi** assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using **onsemi** products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by **onsemi**. "Typical" parameters which may be provided in **onsemi** data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. **onsemi** does not convey any license under any of its intellectual property rights nor the rights of others. **onsemi** products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use **onsemi** products for any such unintended or unauthorized application, Buyer shall indemnify and hold **onsemi** and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that **onsemi** was negligent regarding the design or manufacture of the part. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

ADDITIONAL INFORMATION

TECHNICAL PUBLICATIONS:

Technical Library: www.onsemi.com/design/resources/technical-documentation
onsemi Website: www.onsemi.com

ONLINE SUPPORT: www.onsemi.com/support

For additional information, please contact your local Sales Representative at www.onsemi.com/support/sales

