

MOSFET – Power, N-Channel, SUPERFET® III, Easy Drive

650 V, 19 A, 165 mΩ

FCH165N65S3R0

Description

SUPERFET III 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 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.

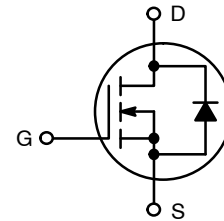
Features

- 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

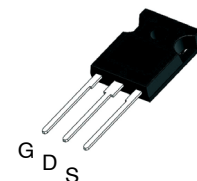
Applications

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

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



&Z	= Assembly Plant Code
&3	= Numeric Date Code
&K	= Lot Code
FCH165N65S3R0	= Specific Device Code

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	± 30	V
		AC ($f > 1\text{ Hz}$)	± 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°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 _{DSS}	Drain to Source Breakdown Voltage	V _{GS} = 0 V, I _D = 1 mA, T _J = 25°C	650			V
		V _{GS} = 0 V, I _D = 1 mA, T _J = 150°C	700			V
ΔBV _{DSS} /ΔT _J	Breakdown Voltage Temperature Coefficient	I _D = 1 mA, Referenced to 25°C		0.64		V/°C
I _{DSS}	Zero Gate Voltage Drain Current	V _{DS} = 650 V, V _{GS} = 0 V			1	μA
		V _{DS} = 520 V, T _C = 125°C		0.85		
I _{GSS}	Gate to Body Leakage Current	V _{GS} = ±30 V, V _{DS} = 0 V			±100	nA

ON CHARACTERISTICS

V _{GS(th)}	Gate Threshold Voltage	V _{GS} = V _{DS} , I _D = 0.44 mA	2.5		4.5	V
R _{DS(on)}	Static Drain to Source On Resistance	V _{GS} = 10 V, I _D = 9.5 A		140	165	mΩ
g _{FS}	Forward Transconductance	V _{DS} = 20 V, I _D = 9.5 A		12		S

DYNAMIC CHARACTERISTICS

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

SWITCHING CHARACTERISTICS

t _{d(on)}	Turn-On Delay Time	V _{DD} = 400 V, I _D = 9.5 A, V _{GS} = 10 V, R _g = 4.7 Ω (Note 4)		17		ns
t _r	Turn-On Rise Time			15		ns
t _{d(off)}	Turn-Off Delay Time			44		ns
t _f	Turn-Off Fall Time			5		ns

SOURCE-DRAIN DIODE CHARACTERISTICS

I _S	Maximum Continuous Source to Drain Diode Forward Current			19		A
I _{SM}	Maximum Pulsed Source to Drain Diode Forward Current			47.5		A
V _{SD}	Source to Drain Diode Forward Voltage	V _{GS} = 0 V, I _{SD} = 9.5 A			1.2	V
t _{rr}	Reverse Recovery Time	V _{DD} = 400 V, I _{SD} = 9.5 A, dI _F /dt = 100 A/μs		339		ns
Q _{rr}	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

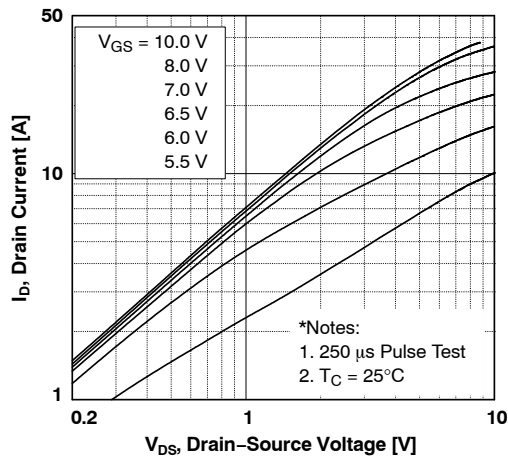


Figure 1. On-Region Characteristics

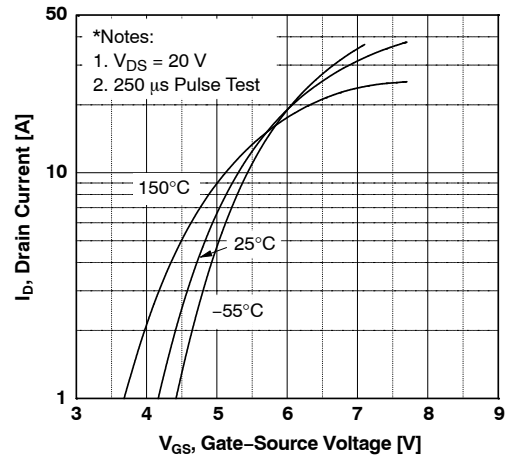


Figure 2. Transfer Characteristics

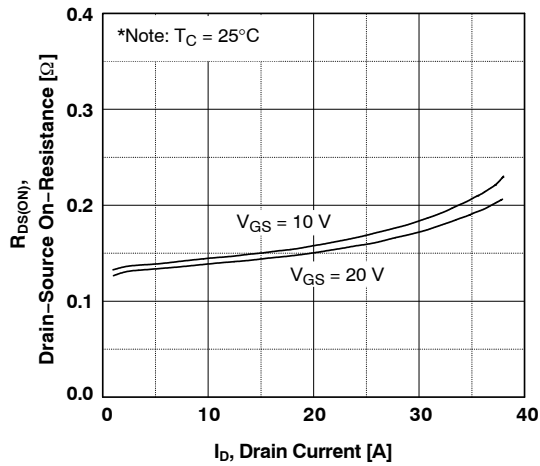


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

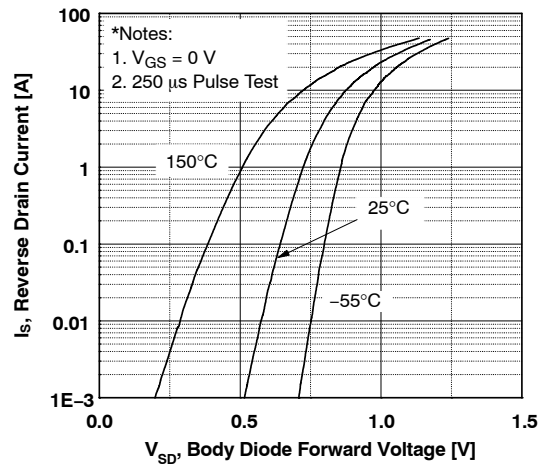


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

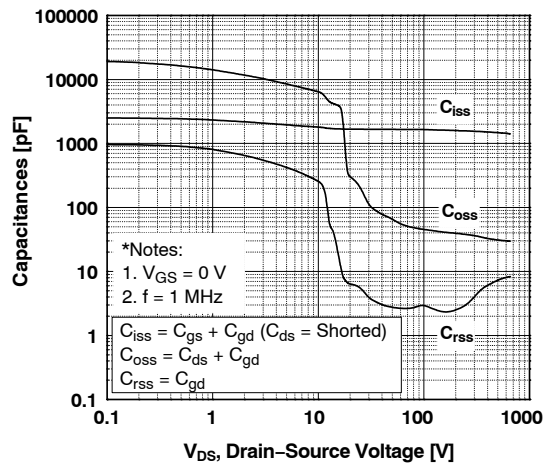


Figure 5. Capacitance Characteristics

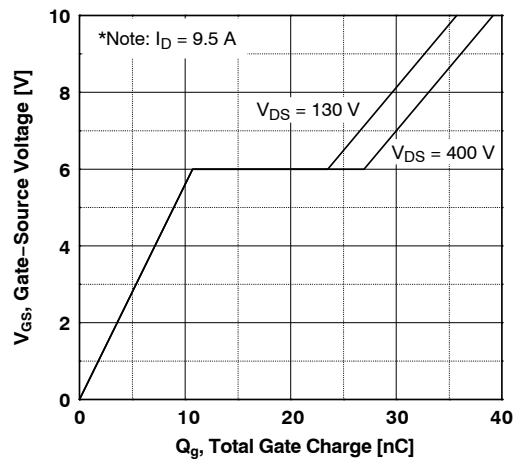


Figure 6. Gate Charge Characteristics

TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

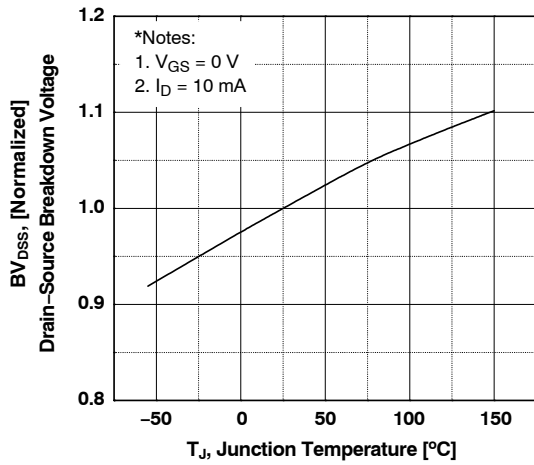


Figure 7. Breakdown Voltage Variation vs. Temperature

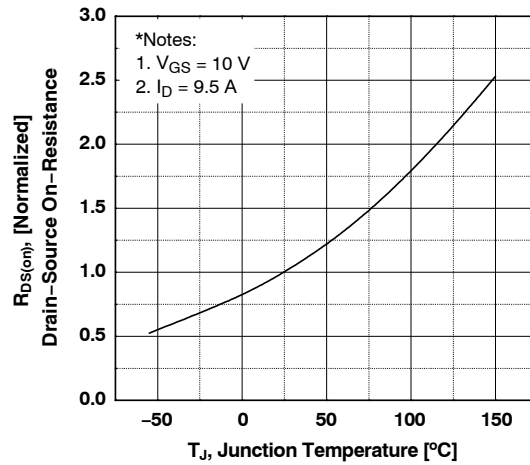


Figure 8. On-Resistance Variant vs. Temperature

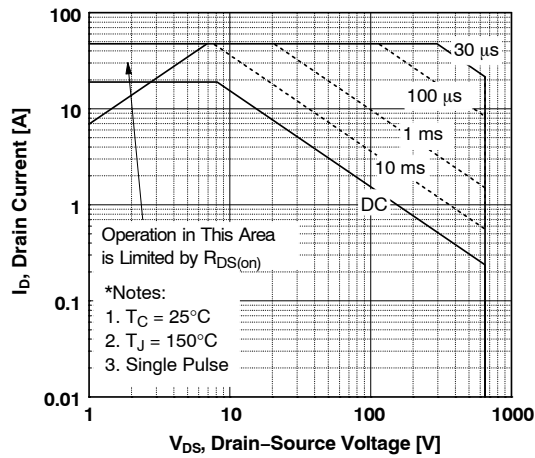


Figure 9. Maximum Safe Operation Area

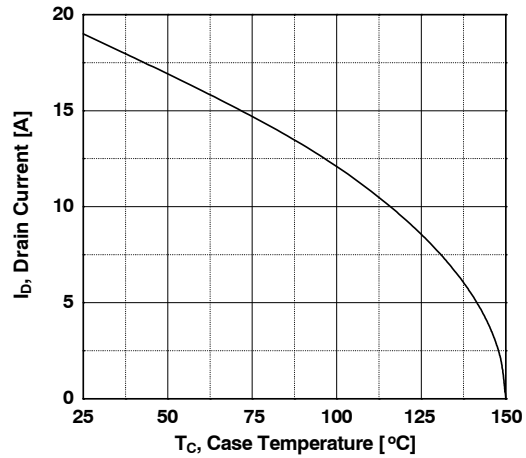
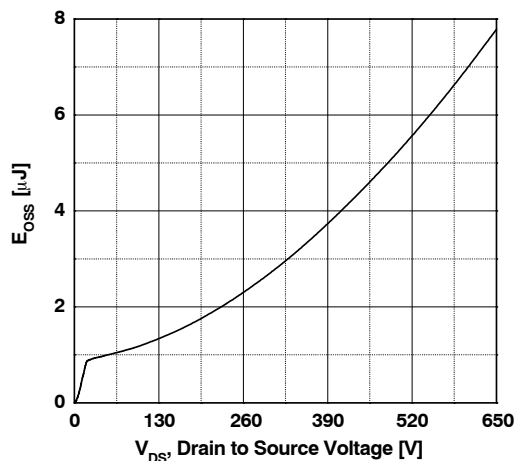


Figure 10. Maximum Drain Current vs. Case Temperature

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

TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

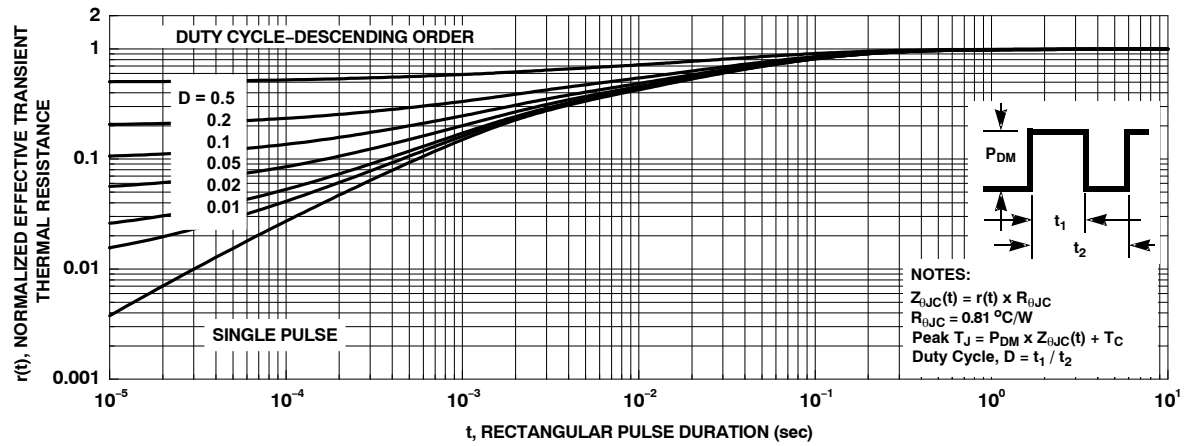


Figure 12. Transient Thermal Response Curve

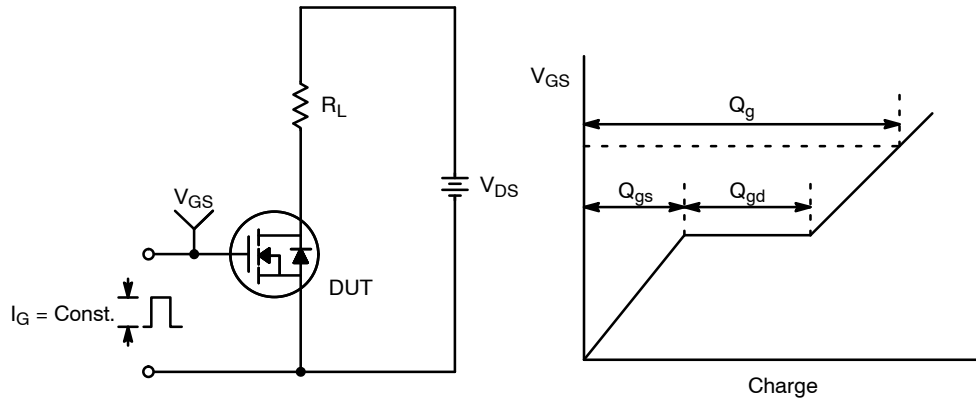


Figure 13. Gate Charge Test Circuit & Waveform

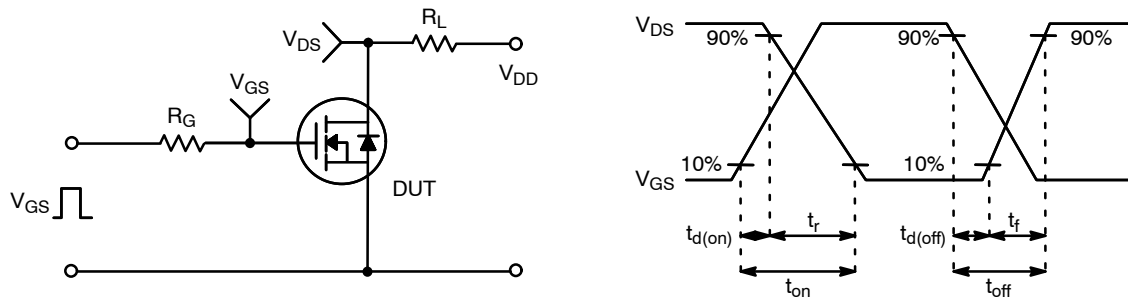


Figure 14. Resistive Switching Test Circuit & Waveforms

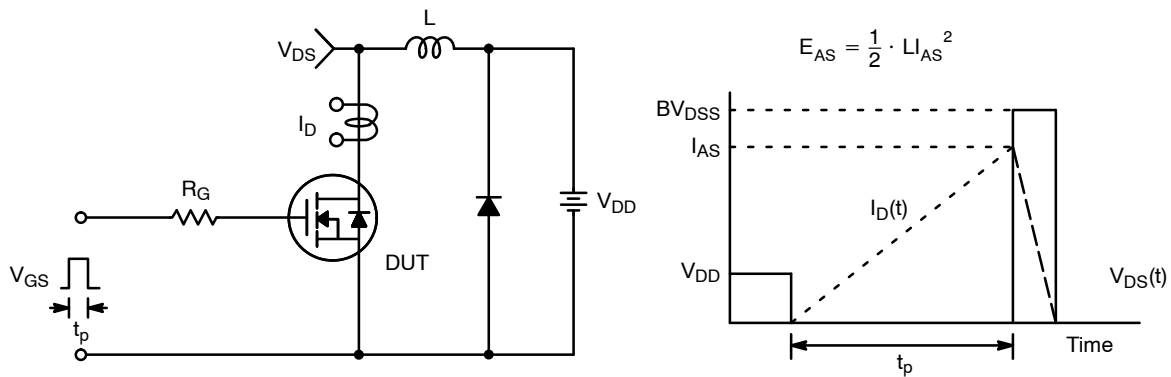


Figure 15. Unclamped Inductive Switching Test Circuit & Waveforms

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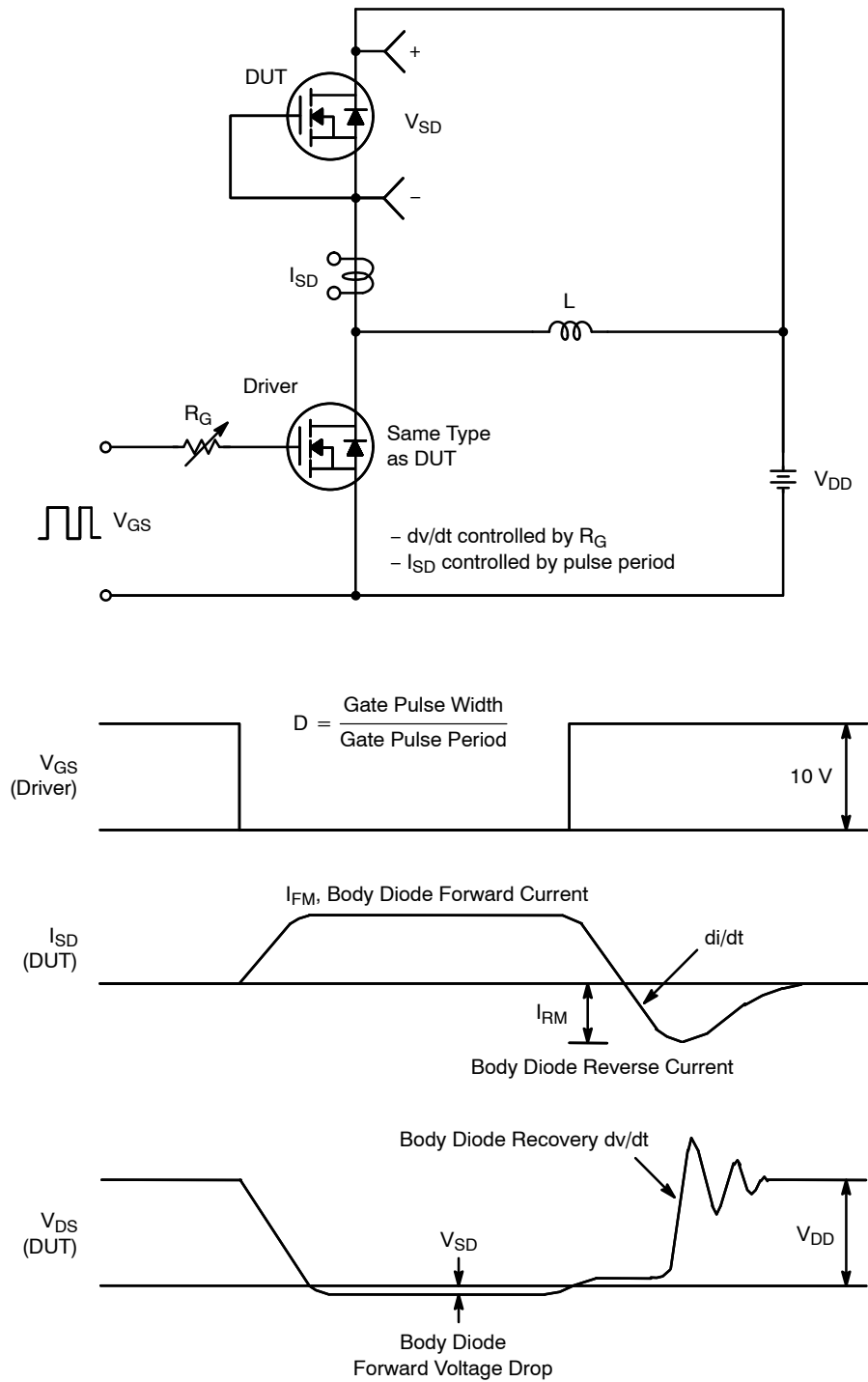


Figure 16. Peak Diode Recovery dv/dt Test Circuit & Waveforms

TO-247-3LD
CASE 340CH
ISSUE A

DATE 09 OCT 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
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
ϕP	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	~	~
$\phi P1$	6.61	6.73	6.85

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