

# FCHD040N65S3

## MOSFET – Power, N-Channel, SUPERFET® III, Easy Drive, 650 V, 65 A, 40 mΩ



ON Semiconductor®

[www.onsemi.com](http://www.onsemi.com)

### Description

SUPERFET III 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 advanced technology is tailored to minimize conduction loss, provides 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.

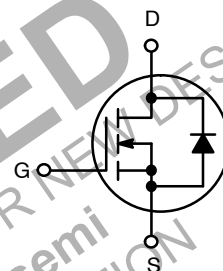
### Features

- 700 V @  $T_J = 150^\circ\text{C}$
- Typ.  $R_{DS(on)} = 35.4\text{ m}\Omega$
- Ultra Low Gate Charge (Typ.  $Q_g = 136\text{ nC}$ )
- Low Effective Output Capacitance (Typ.  $C_{oss(eff.)} = 1154\text{ pF}$ )
- 100% Avalanche Tested
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

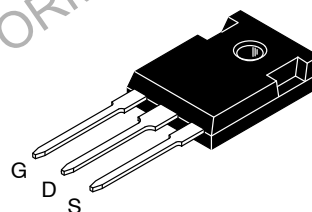
### Applications

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

$V_{DS}$	$R_{DS(on)}\text{ MAX}$	$I_D\text{ MAX}$
650 V	40 mΩ @ 10 V	65 A

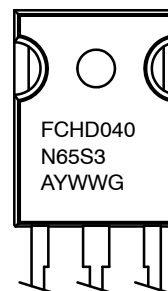


POWER MOSFET



TO-247AD  
CASE 340AL

### MARKING DIAGRAM



A = Assembly Location  
Y = Year  
WW = Work Week  
G = Pb-Free Package

### ORDERING INFORMATION

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

# FCHD040N65S3

## 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	V
		– AC (f > 1 Hz)	
I <sub>D</sub>	Drain Current	– Continuous (T <sub>C</sub> = 25°C)	A
		– Continuous (T <sub>C</sub> = 100°C)	
I <sub>DM</sub>	Drain Current	– Pulsed (Note 1)	A
E <sub>AS</sub>	Single Pulsed Avalanche Energy (Note 2)	358	mJ
I <sub>AS</sub>	Avalanche Current (Note 2)	8.1	A
E <sub>AR</sub>	Repetitive Avalanche Energy (Note 1)	4.17	mJ
dv/dt	MOSFET dv/dt	100	V/ns
	Peak Diode Recovery dv/dt (Note 3)	20	
P <sub>D</sub>	Power Dissipation	(T <sub>C</sub> = 25°C)	W
		– Derate Above 25°C	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> = 8.1 A, R<sub>G</sub> = 25 Ω, starting T<sub>J</sub> = 25°C.

3. I<sub>SD</sub> ≤ 32.5 A, di/dt ≤ 200 A/μs, V<sub>DD</sub> ≤ 400 V, starting T<sub>J</sub> = 25°C.

## THERMAL CHARACTERISTICS

Symbol	Parameter	Value	Unit
R <sub>θJC</sub>	Thermal Resistance, Junction to Case, Max.	0.3	°C/W
R <sub>θJA</sub>	Thermal Resistance, Junction to Ambient, Max.	40	

## PACKAGE MARKING AND ORDERING INFORMATION

Part Number	Top Marking	Package	Packing Method	Reel Size	Tape Width	Quantity
FCHD040N65S3–F155	FCHD040N65S3	TO–247	Tube	N/A	N/A	30 Units

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

Symbol	Parameter	Test Conditions	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> = 1 mA, T <sub>J</sub> = 25°C	650	–	–	V
		V <sub>GS</sub> = 0 V, I <sub>D</sub> = 1 mA, T <sub>J</sub> = 150°C	700	–	–	V
ΔBV <sub>DSS</sub> / ΔT <sub>J</sub>	Breakdown Voltage Temperature Coefficient	I <sub>D</sub> = 1 mA, Referenced to 25°C	–	0.64	–	V/°C
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> = 650 V, V <sub>GS</sub> = 0 V	–	–	1	μA
		V <sub>DS</sub> = 520 V, T <sub>C</sub> = 125°C	–	4.5	–	
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> = 1.7 mA	2.5	–	4.5	V
R <sub>DS(on)</sub>	Static Drain to Source On Resistance	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 32.5 A	–	35.4	40	mΩ
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> = 20 V, I <sub>D</sub> = 32.5 A	–	46	–	S

# FCHD040N65S3

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
<b>DYNAMIC CHARACTERISTICS</b>						
$C_{iss}$	Input Capacitance	$V_{DS} = 400\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	–	4740	–	pF
$C_{oss}$	Output Capacitance		–	120	–	pF
$C_{oss(eff.)}$	Effective Output Capacitance	$V_{DS} = 0\text{ V to } 400\text{ V}, V_{GS} = 0\text{ V}$	–	1154	–	pF
$C_{oss(er.)}$	Energy Related Output Capacitance	$V_{DS} = 0\text{ V to } 400\text{ V}, V_{GS} = 0\text{ V}$	–	171	–	pF
$Q_{g(tot)}$	Total Gate Charge at 10 V	$V_{DS} = 400\text{ V}, I_D = 32.5\text{ A}, V_{GS} = 10\text{ V}$ (Note 4)	–	136	–	nC
$Q_{gs}$	Gate to Source Gate Charge		–	33	–	nC
$Q_{gd}$	Gate to Drain “Miller” Charge		–	59	–	nC
ESR	Equivalent Series Resistance	$f = 1\text{ MHz}$	–	0.7	–	$\Omega$

## SWITCHING CHARACTERISTICS

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 400\text{ V}, I_D = 32.5\text{ A},$ $V_{GS} = 10\text{ V}, R_g = 3.3\text{ }\Omega$ (Note 4)	–	35	–	ns
$t_r$	Turn-On Rise Time		–	51	–	ns
$t_{d(off)}$	Turn-Off Delay Time		–	95	–	ns
$t_f$	Turn-Off Fall Time		–	30	–	ns

## SOURCE-DRAIN DIODE CHARACTERISTICS

I <sub>S</sub>	Maximum Continuous Drain to Source Diode Forward Current		–	–	65	A
I <sub>SM</sub>	Maximum Pulsed Drain to Source Diode Forward Current		–	–	162.5	A
V <sub>SD</sub>	Drain to Source Diode Forward Voltage	V <sub>GS</sub> = 0 V, I <sub>SD</sub> = 32.5 A	–	–	1.2	V
t <sub>rr</sub>	Reverse Recovery Time	V <sub>GS</sub> = 0 V, I <sub>SD</sub> = 32.5 A, dI <sub>F</sub> /dt = 100 A/μs	–	534	–	ns
Q <sub>rr</sub>	Reverse Recovery Charge		–	13.6	–	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

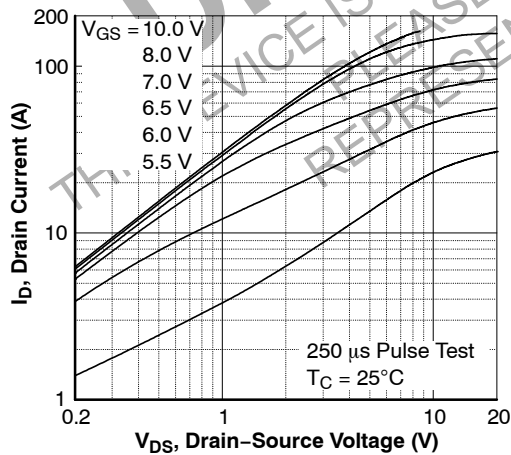


Figure 1. On-Region Characteristics

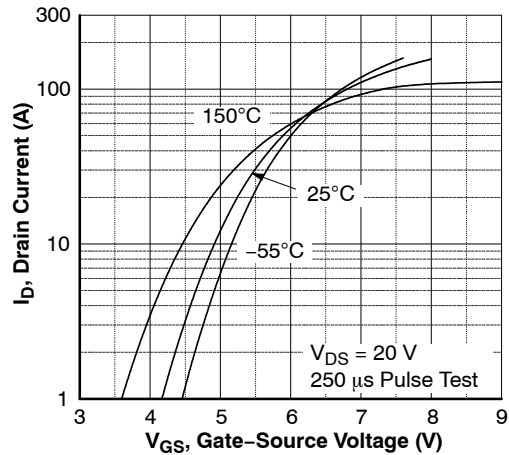


Figure 2. Transfer Characteristics

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

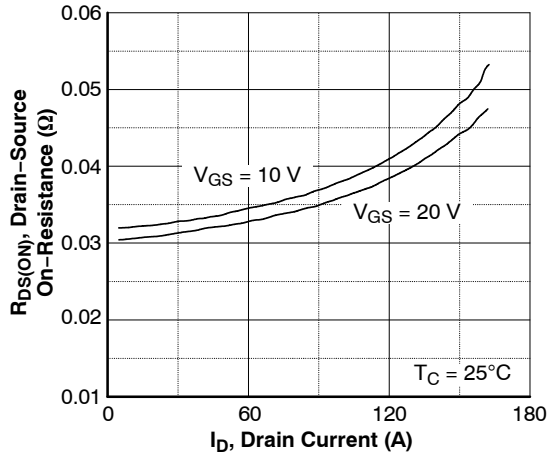


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

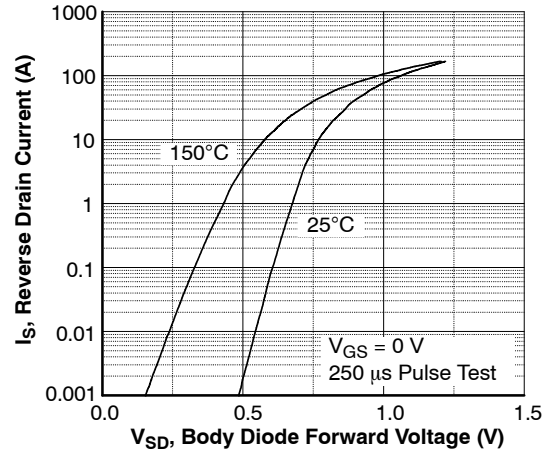


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

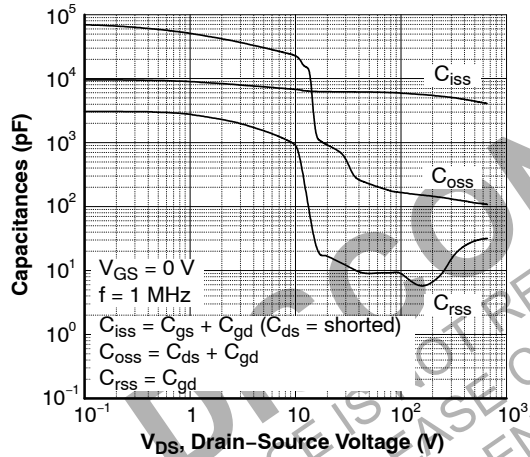


Figure 5. Capacitance Characteristics

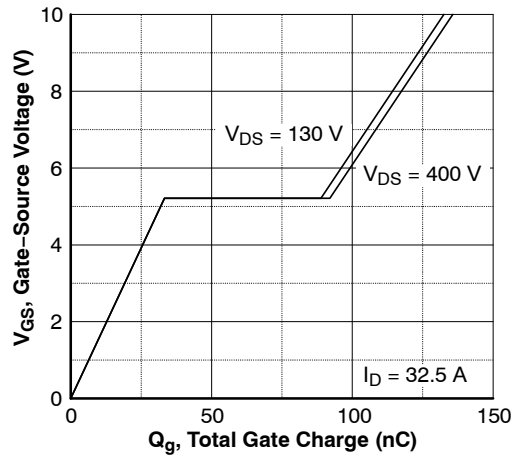


Figure 6. Gate Charge Characteristics

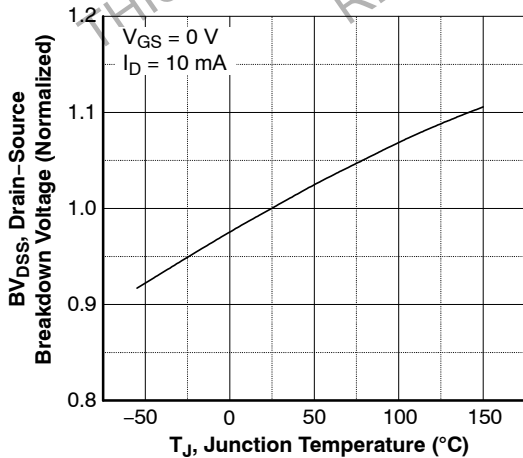


Figure 7. Breakdown Voltage Variation vs. Temperature

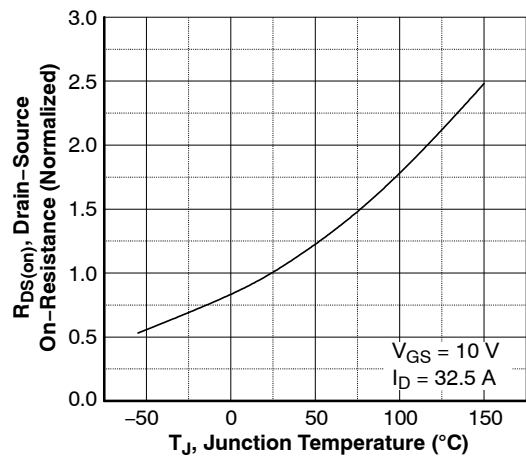


Figure 8. On-Resistance Variation vs. Temperature

## TYPICAL PERFORMANCE CHARACTERISTICS (continued)

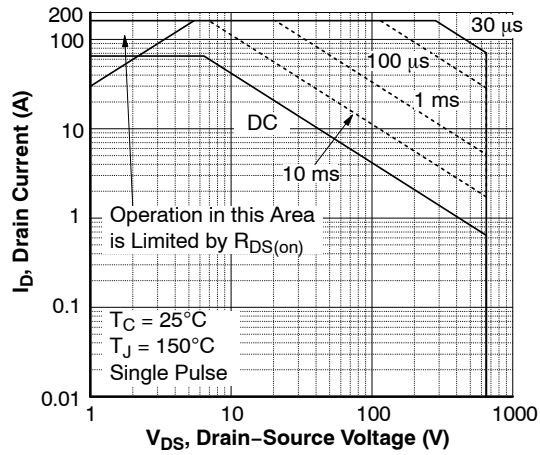


Figure 9. Maximum Safe Operating Area

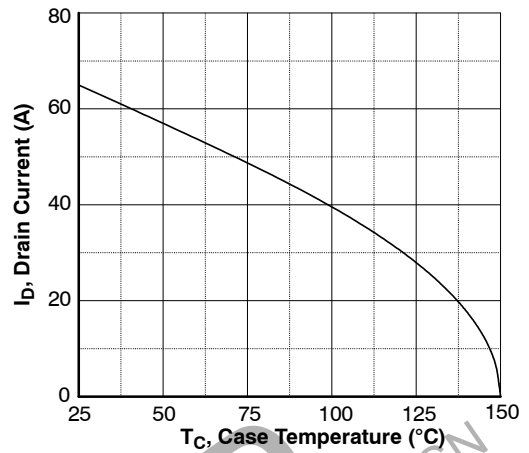


Figure 10. Maximum Drain Current vs. Case Temperature

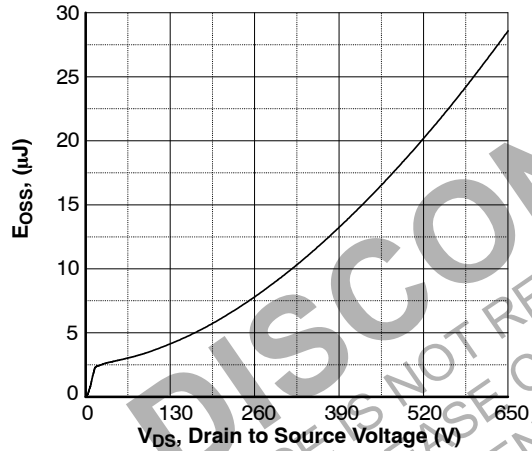
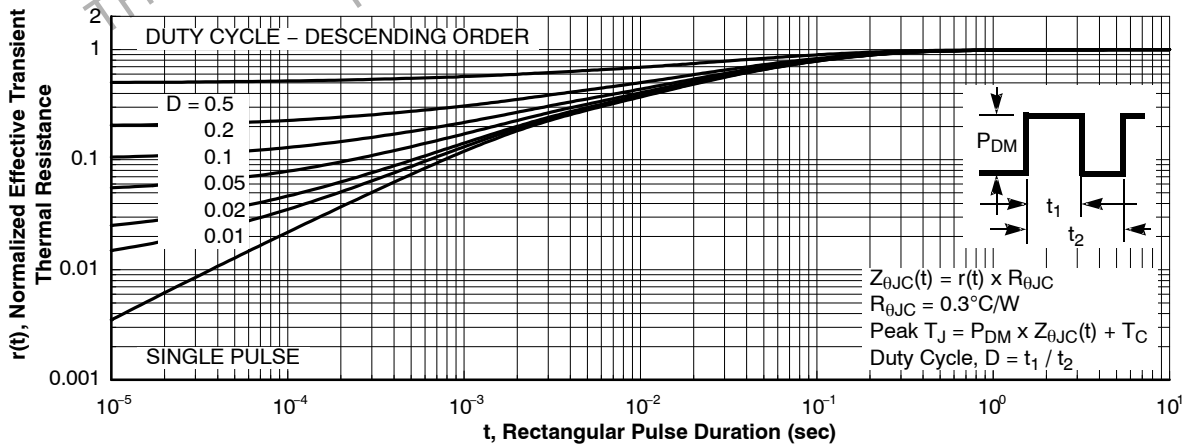
Figure 11.  $E_{oss}$  vs. Drain to Source Voltage

Figure 12. Transient Thermal Response Curve

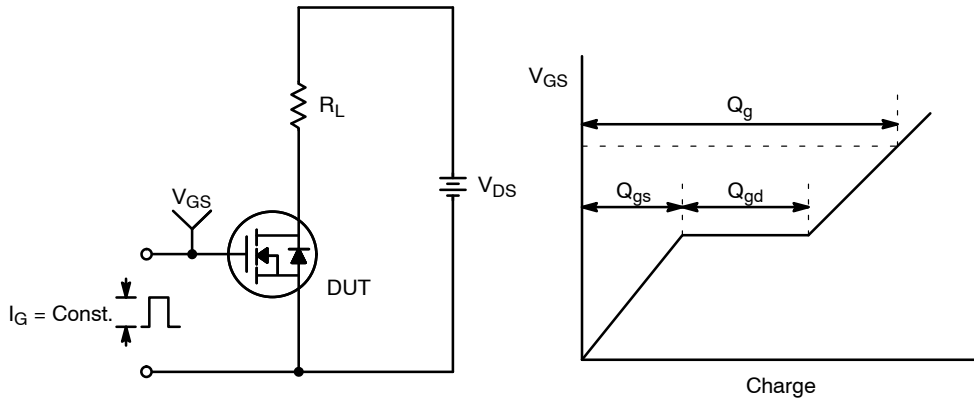


Figure 13. Gate Charge Test Circuit & Waveform

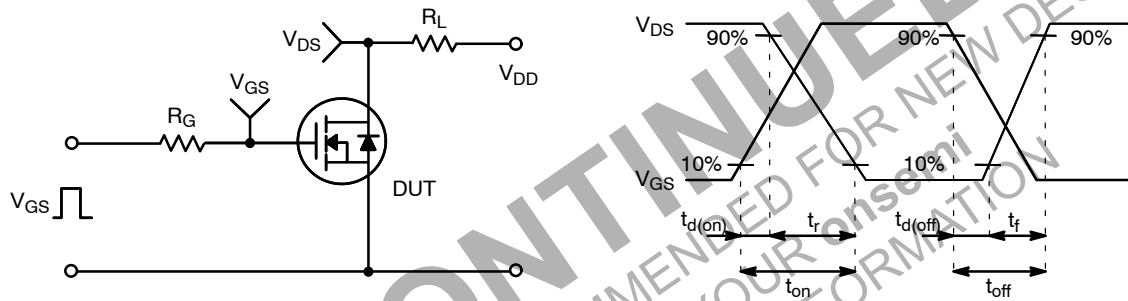


Figure 14. Resistive Switching Test Circuit & Waveforms

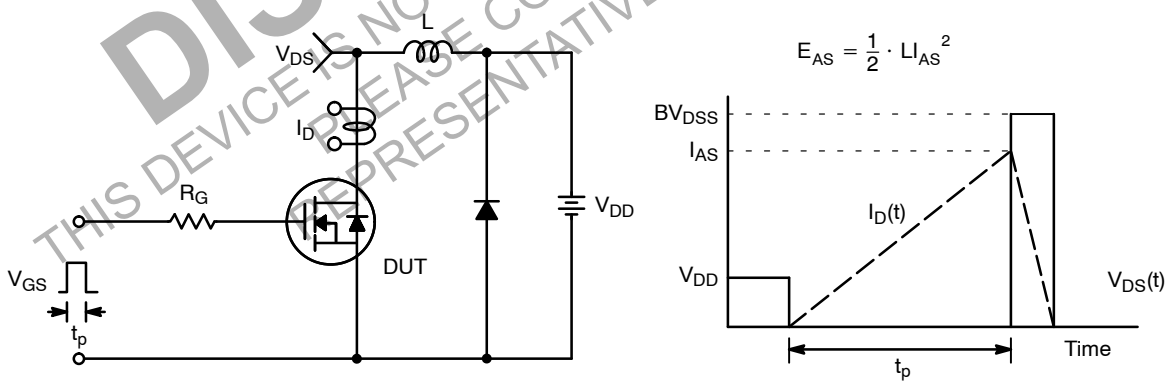
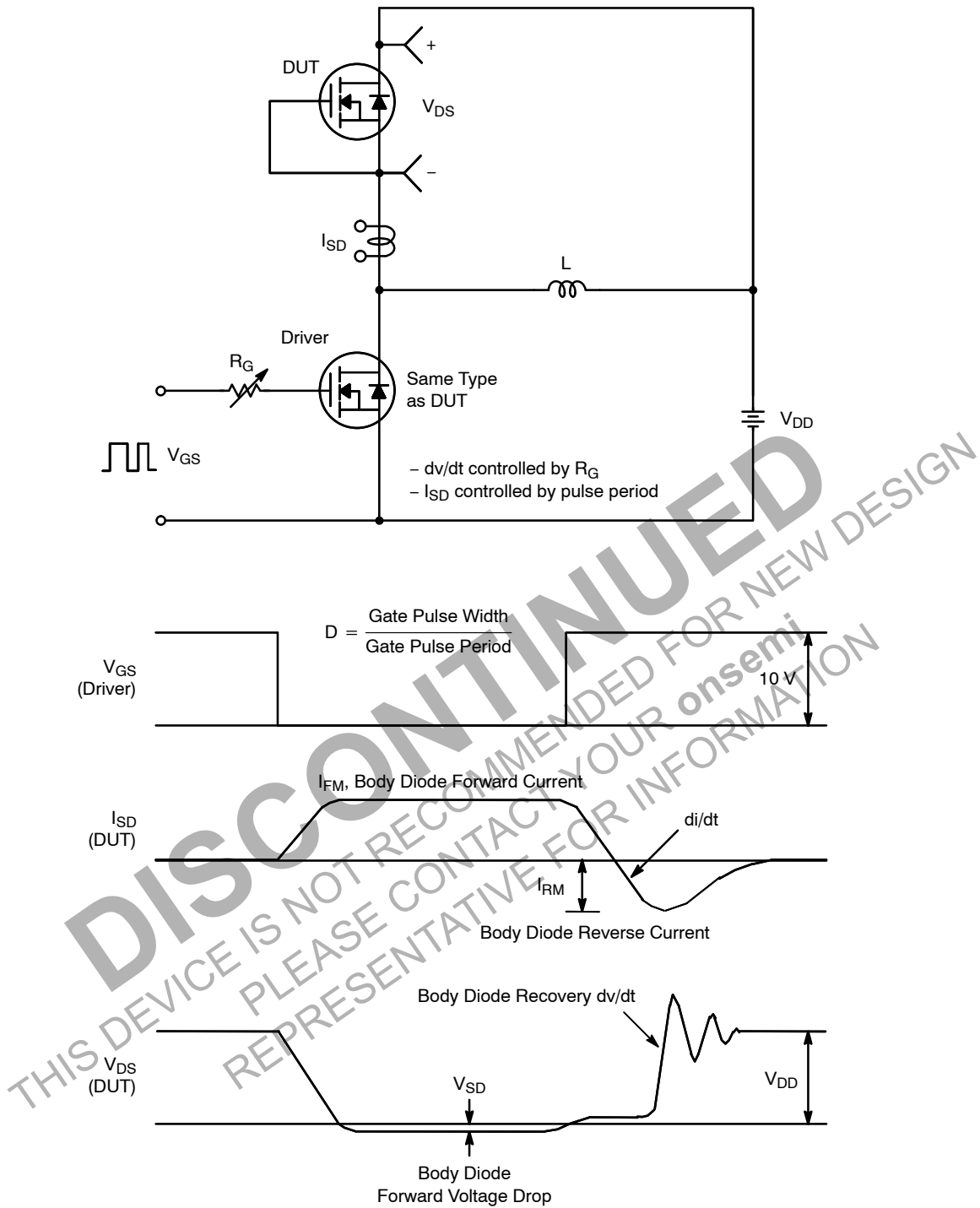
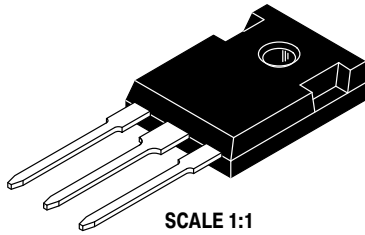


Figure 15. Unclamped Inductive Switching Test Circuit & Waveforms

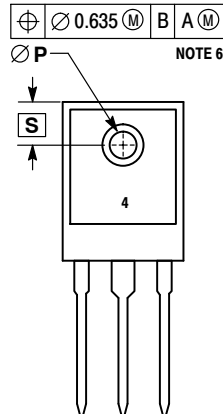
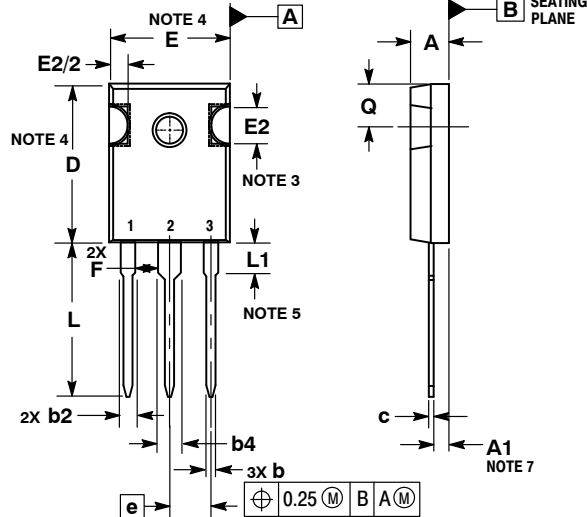


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**CASE 340AL**  
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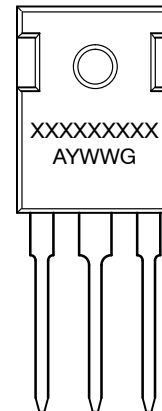
SCALE 1:1



## NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. SLOT REQUIRED, NOTCH MAY BE ROUNDED.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.13 PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREME OF THE PLASTIC BODY.
5. LEAD FINISH IS UNCONTROLLED IN THE REGION DEFINED BY L1.
6.  $\varnothing P$  SHALL HAVE A MAXIMUM DRAFT ANGLE OF 1.5° TO THE TOP OF THE PART WITH A MAXIMUM DIAMETER OF 3.91.
7. DIMENSION A1 TO BE MEASURED IN THE REGION DEFINED BY L1.

MILLIMETERS		
DIM	MIN	MAX
A	4.70	5.30
A1	2.20	2.60
b	1.07	1.33
b2	1.65	2.35
b4	2.60	3.40
c	0.45	0.68
D	20.80	21.34
E	15.50	16.25
E2	4.32	5.49
e	5.45 BSC	
F	2.655	---
L	19.80	20.80
L1	3.81	4.32
P	3.55	3.65
Q	5.40	6.20
S	6.15 BSC	

**GENERIC**  
**MARKING DIAGRAM\***


XXXXX = 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.

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