

# FCP125N65S3

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

**650 V, 24 A, 125 mΩ**

### 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.  $R_{DS(on)} = 105 \text{ m}\Omega$
- Ultra Low Gate Charge (Typ.  $Q_g = 46 \text{ nC}$ )
- Low Effective Output Capacitance (Typ.  $C_{oss(\text{eff.})} = 439 \text{ pF}$ )
- 100% Avalanche Tested
- These Devices are Pb-Free and are RoHS Compliant

### Applications

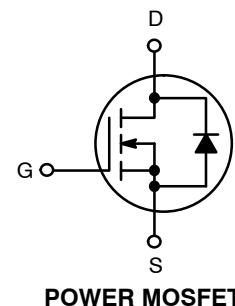
- Telecom / Server Power Supplies
- Industrial Power Supplies
- UPS / Solar

ON

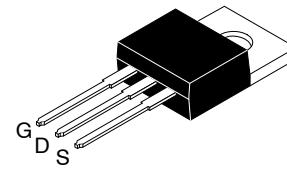
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$V_{DSS}$	$R_{DS(\text{ON}) \text{ MAX}}$	$I_D \text{ MAX}$
650 V	125 mΩ @ 10 V	24 A

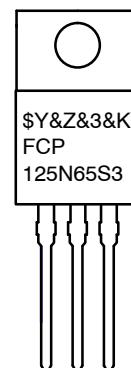


**POWER MOSFET**



**TO-220  
CASE 340AT**

### MARKING DIAGRAM



\$Y = ON Semiconductor Logo  
&Z = Assembly Plant Code  
&3 = Data Code (Year & Week)  
&K = Lot  
FCP125N65S3 = Specific Device Code

### ORDERING INFORMATION

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

# FCP125N65S3

## 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	±30	V
		– AC (f > 1 Hz)	±30	
I <sub>D</sub>	Drain Current	– Continuous (T <sub>C</sub> = 25°C)	24	A
		– Continuous (T <sub>C</sub> = 100°C)	15	
I <sub>DM</sub>	Drain Current	– Pulsed (Note 1)	60	A
E <sub>AS</sub>	Single Pulsed Avalanche Energy (Note 2)		115	mJ
I <sub>AS</sub>	Avalanche Current (Note 2)		3.7	A
E <sub>AR</sub>	Repetitive Avalanche Energy (Note 1)		1.81	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)	181	W
		– Derate Above 25°C	1.45	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> = 3.7 A, R<sub>G</sub> = 25 Ω, starting T<sub>J</sub> = 25°C.
3. I<sub>SD</sub> ≤ 12 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.	0.69	°C/W
R <sub>θJA</sub>	Thermal Resistance, Junction to Ambient, Max.	62.5	

## PACKAGE MARKING AND ORDERING INFORMATION

Part Number	Top Marking	Package	Packing Method	Reel Size	Tape Width	Quantity
FCP125N65S3	FCP125N65S3	TO-220	Tube	N/A	N/A	50 Units

# FCP125N65S3

## 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 <sub>DSS</sub>	Drain to Source Breakdown Voltage	$V_{GS} = 0 \text{ V}, I_D = 1 \text{ mA}, T_J = 25^\circ\text{C}$	650			V
		$V_{GS} = 0 \text{ V}, I_D = 1 \text{ mA}, T_J = 150^\circ\text{C}$	700			V
$\Delta BV_{DSS} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 1 \text{ mA}$ , Referenced to $25^\circ\text{C}$		0.68		$^\circ\text{C}$
Id <sub>SS</sub>	Zero Gate Voltage Drain Current	$V_{DS} = 650 \text{ V}, V_{GS} = 0 \text{ V}$		1		$\mu\text{A}$
		$V_{DS} = 520 \text{ V}, T_C = 125^\circ\text{C}$		1.35		
I <sub>GSS</sub>	Gate to Body Leakage Current	$V_{GS} = \pm 30 \text{ V}, V_{DS} = 0 \text{ V}$			$\pm 100$	nA

### ON CHARACTERISTICS

$V_{GS(\text{th})}$	Gate Threshold Voltage	$V_{GS} = V_{DS}, I_D = 0.59 \text{ mA}$	2.5		4.5	V
$R_{DS(\text{on})}$	Static Drain to Source On Resistance	$V_{GS} = 10 \text{ V}, I_D = 12 \text{ A}$		105	125	$\text{m}\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS} = 20 \text{ V}, I_D = 12 \text{ A}$		16		S

### DYNAMIC CHARACTERISTICS

$C_{iss}$	Input Capacitance	$V_{DS} = 400 \text{ V}, V_{GS} = 0 \text{ V}, f = 1 \text{ MHz}$		1940		pF
$C_{oss}$	Output Capacitance			40		pF
$C_{oss(\text{eff.})}$	Effective Output Capacitance	$V_{DS} = 0 \text{ V to } 400 \text{ V}, V_{GS} = 0 \text{ V}$		439		pF
$C_{oss(\text{er.})}$	Energy Related Output Capacitance	$V_{DS} = 0 \text{ V to } 400 \text{ V}, V_{GS} = 0 \text{ V}$		62		pF
$Q_{g(\text{tot})}$	Total Gate Charge at 10 V	$V_{DS} = 400 \text{ V}, I_D = 12 \text{ A}, V_{GS} = 10 \text{ V}$ (Note 4)		46		nC
$Q_{gs}$	Gate to Source Gate Charge			12		nC
$Q_{gd}$	Gate to Drain "Miller" Charge			19		nC
ESR	Equivalent Series Resistance	$f = 1 \text{ MHz}$		4		$\Omega$

### SWITCHING CHARACTERISTICS

$t_{d(\text{on})}$	Turn-On Delay Time	$V_{DD} = 400 \text{ V}, I_D = 12 \text{ A}, V_{GS} = 10 \text{ V}, R_g = 4.7 \Omega$ (Note 4)		25		ns
$t_r$	Turn-On Rise Time			26		ns
$t_{d(\text{off})}$	Turn-Off Delay Time			73		ns
$t_f$	Turn-Off Fall Time			17		ns

### SOURCE-DRAIN DIODE CHARACTERISTICS

$I_S$	Maximum Continuous Source to Drain Diode Forward Current			24		A
$I_{SM}$	Maximum Pulsed Source to Drain Diode Forward Current			60		A
$V_{SD}$	Source to Drain Diode Forward Voltage	$V_{GS} = 0 \text{ V}, I_{SD} = 12 \text{ A}$			1.2	V
$t_{rr}$	Reverse Recovery Time	$V_{DD} = 400 \text{ V}, I_{SD} = 12 \text{ A}, dI_F/dt = 100 \text{ A}/\mu\text{s}$		339		ns
$Q_{rr}$	Reverse Recovery Charge			5.7		$\mu\text{C}$

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

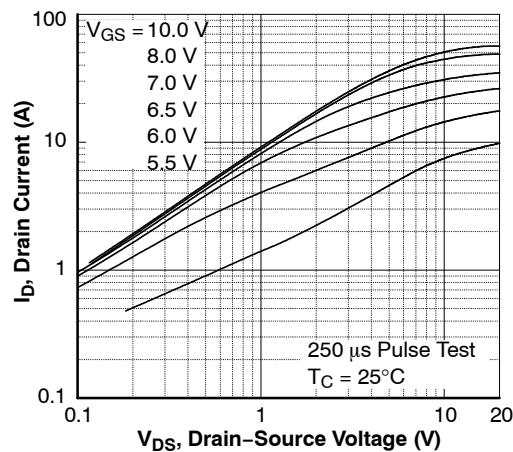


Figure 1. On-Region Characteristics

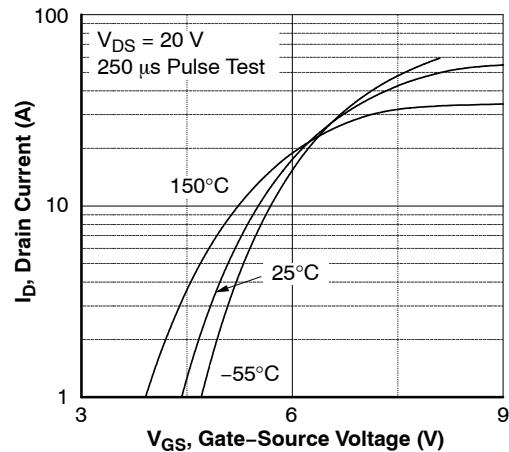


Figure 2. Transfer Characteristics

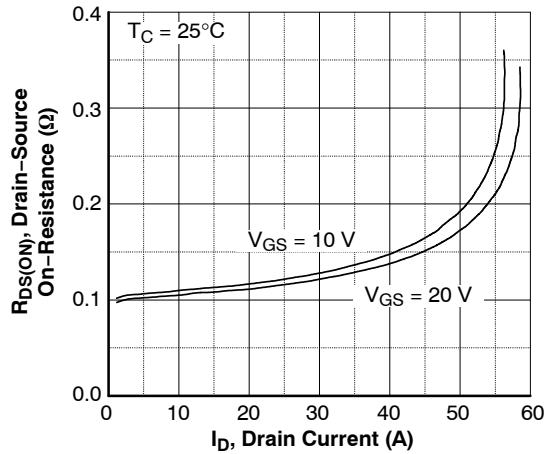


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

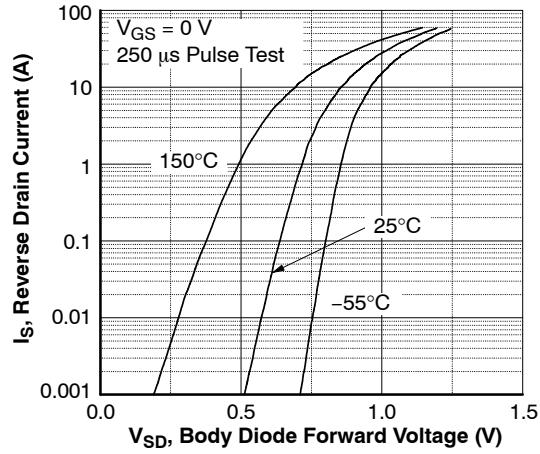


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

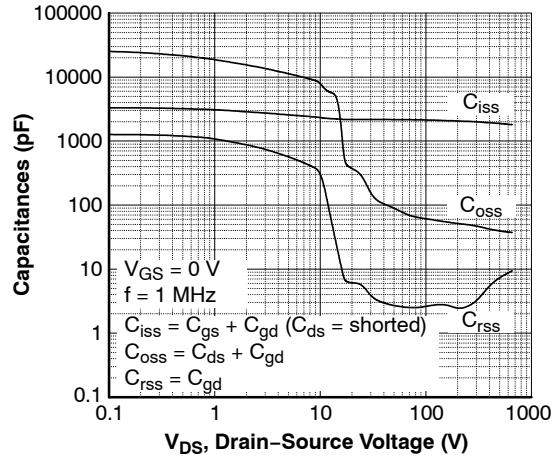


Figure 5. Capacitance Characteristics

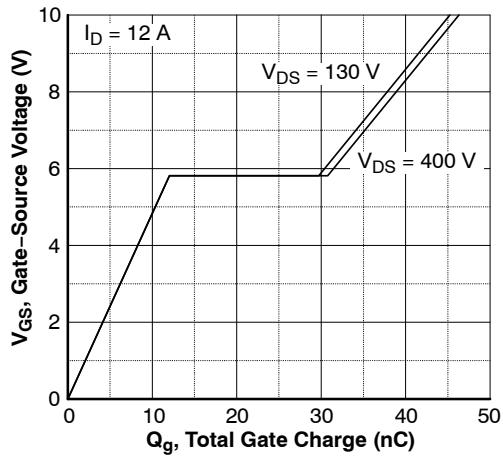


Figure 6. Gate Charge Characteristics

## TYPICAL PERFORMANCE CHARACTERISTICS (continued)

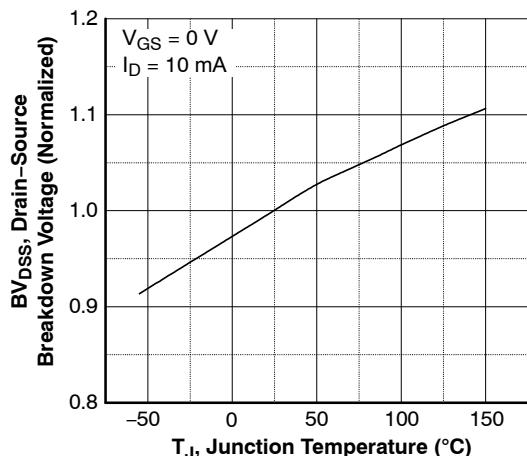


Figure 7. Breakdown Voltage Variation  
vs. Temperature

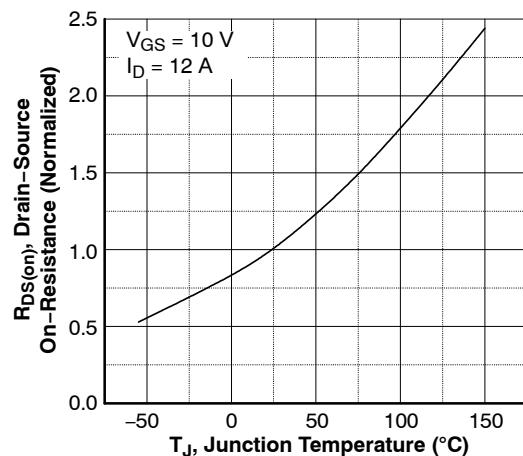


Figure 8. On-Resistance Variation  
vs. Temperature

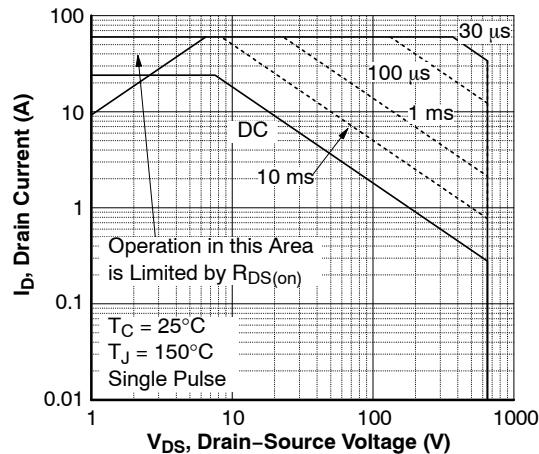


Figure 9. Maximum Safe Operating Area

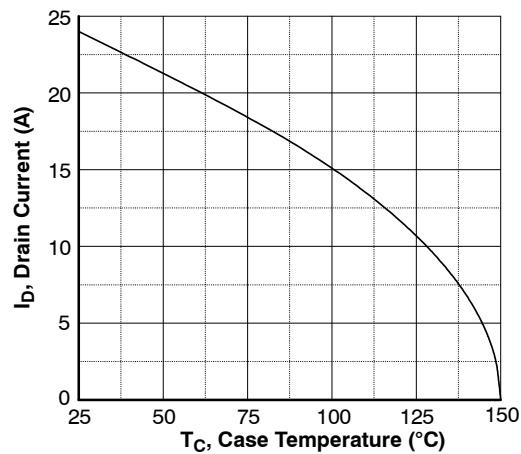


Figure 10. Maximum Drain Current  
vs. Case Temperature

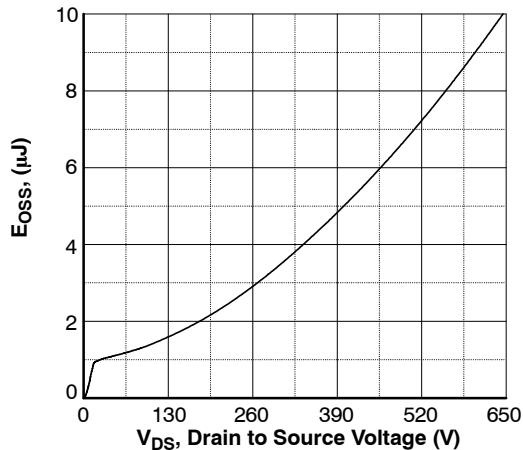


Figure 11. E\_OSS vs. Drain to Source Voltage

## TYPICAL PERFORMANCE CHARACTERISTICS (continued)

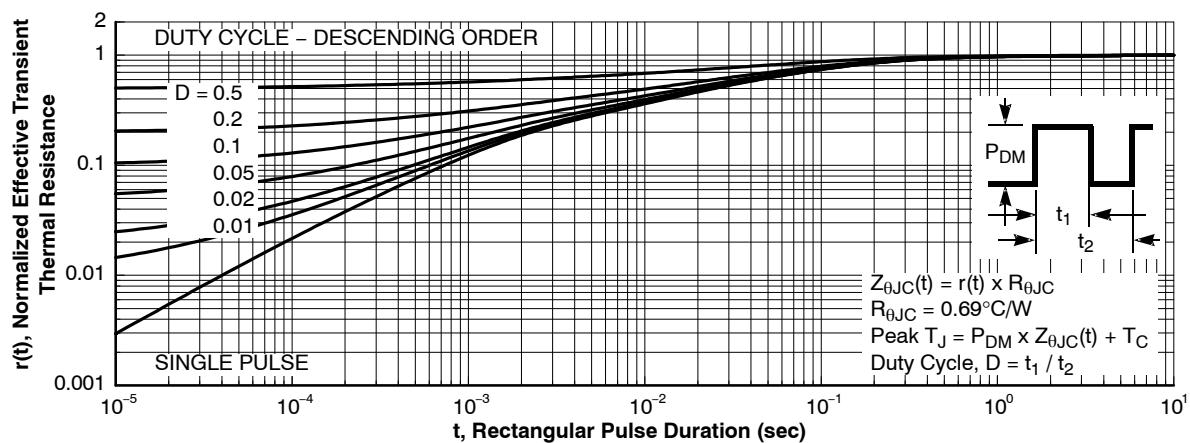


Figure 12. Transient Thermal Response Curve

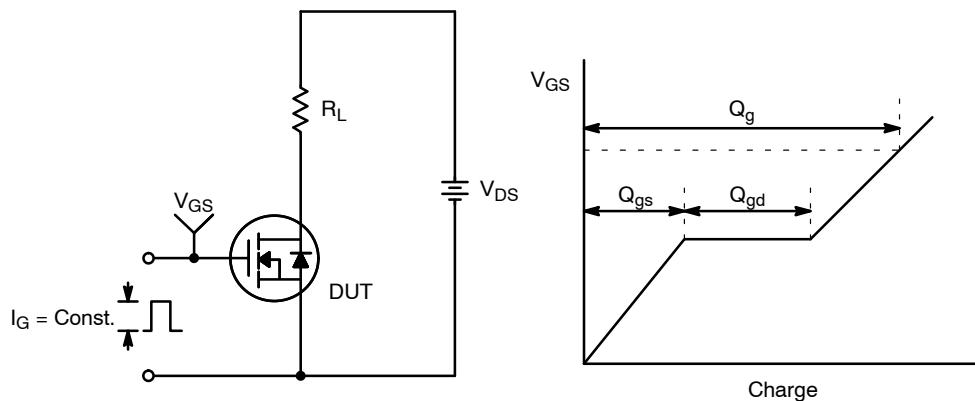


Figure 13. Gate Charge Test Circuit & Waveform

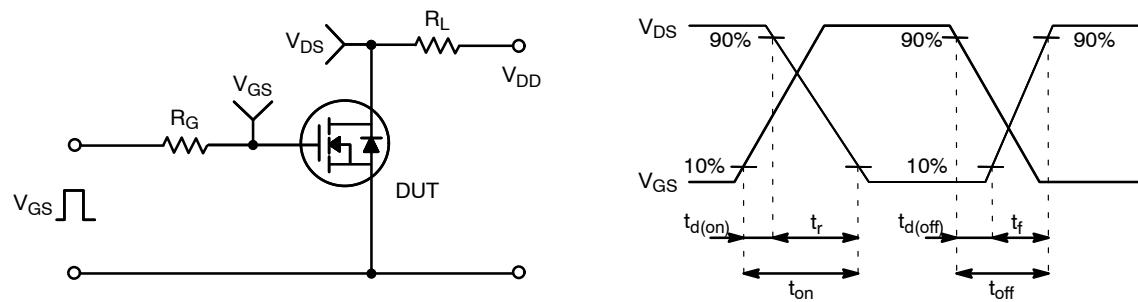


Figure 14. Resistive Switching Test Circuit & Waveforms

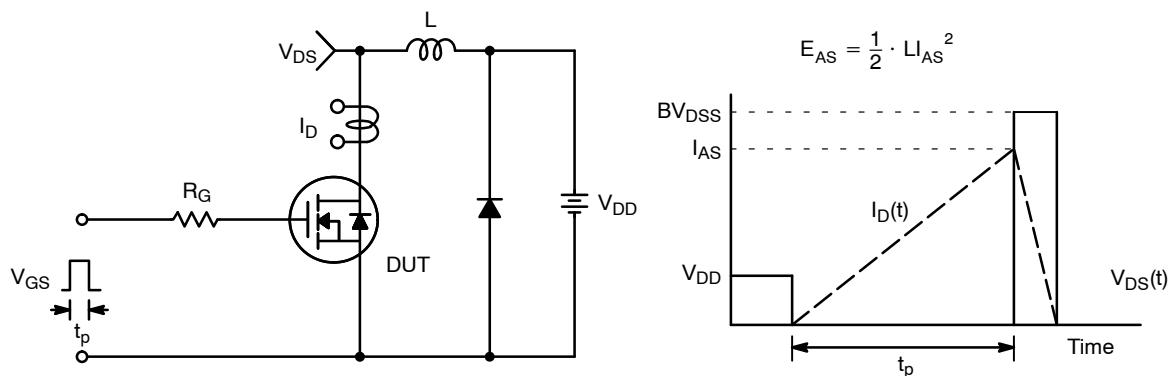


Figure 15. Unclamped Inductive Switching Test Circuit & Waveforms

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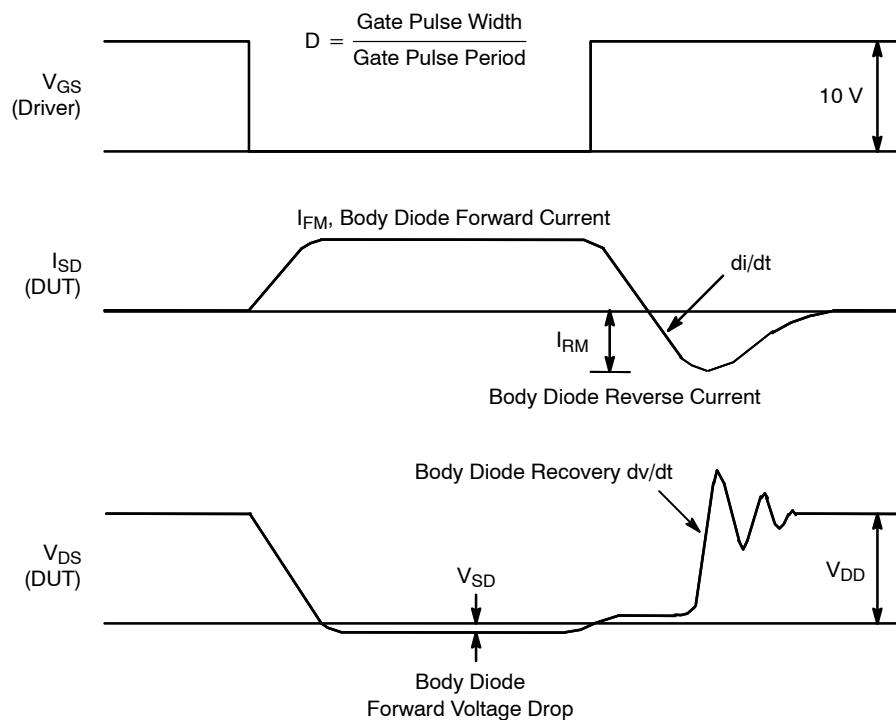
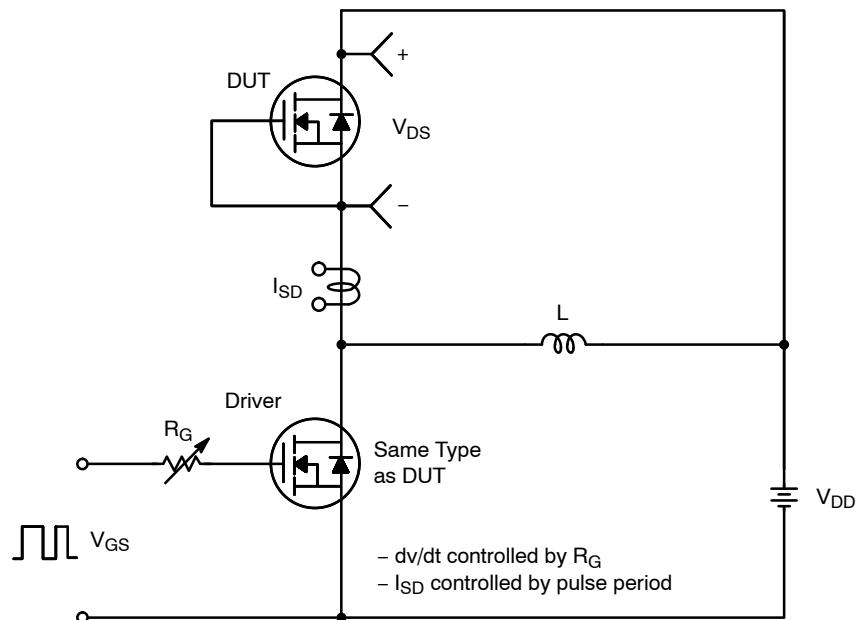


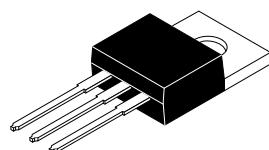
Figure 16. Peak Diode Recovery  $dv/dt$  Test Circuit & Waveforms

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# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

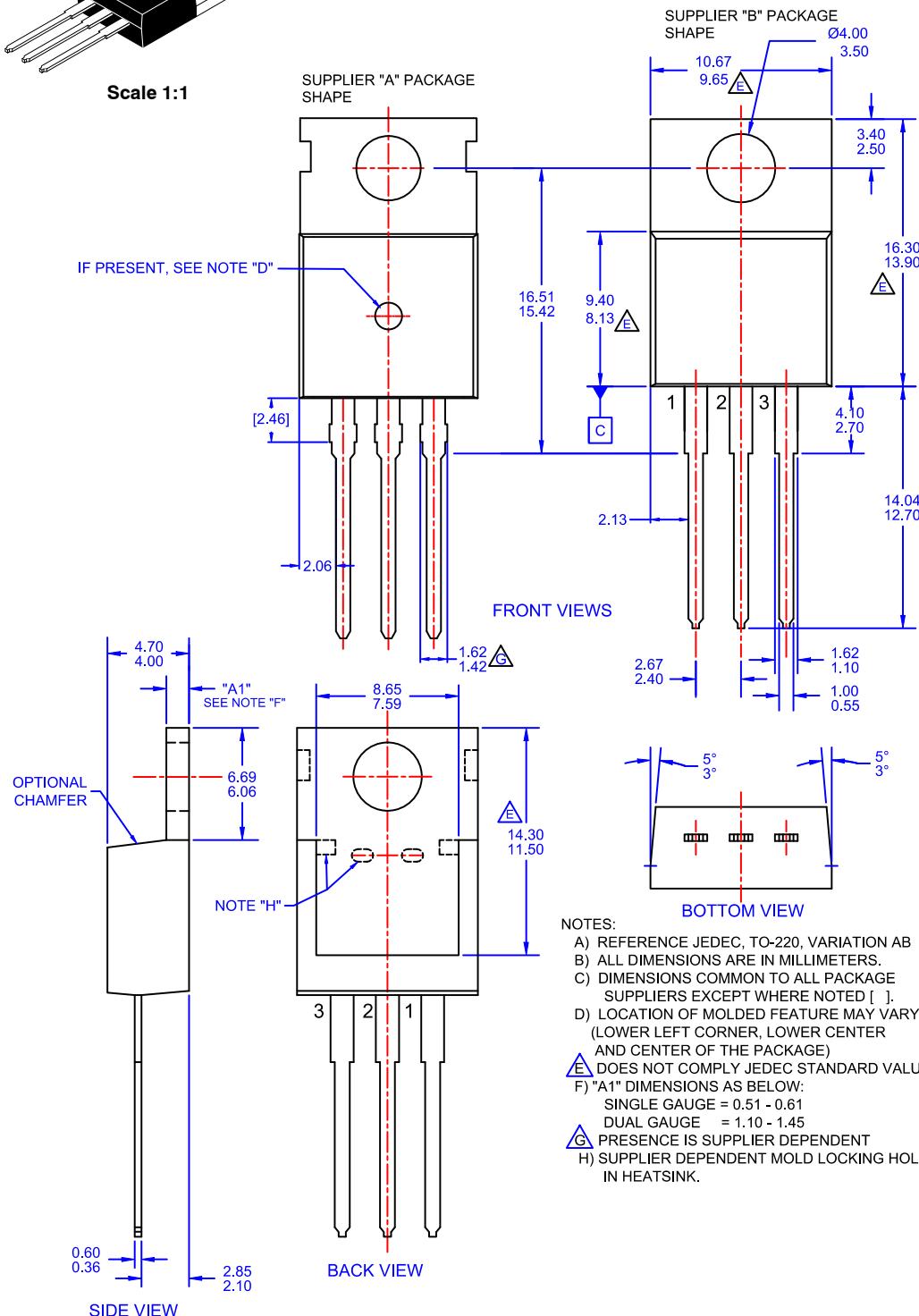
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Scale 1:1

TO-220-3LD  
CASE 340AT  
ISSUE A

DATE 03 OCT 2017



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