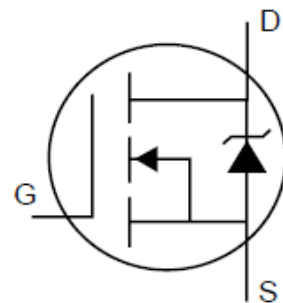
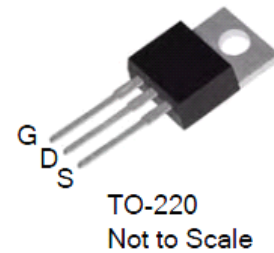


## 500V N-Channel MOSFET

### GENERAL DESCRIPTION

This Power MOSFET is produced using advanced planar stripe DMOS technology. This advanced technology has been especially tailored to minimize on-state resistance, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode. These devices are well suited for high efficiency switched mode power supplies, active power factor correction based on half bridge topology.

$V_{DSS}$	$R_{DS(ON)}$	$I_D$
500V	0.48Ω	13A



### Features

- 13A, 500V,  $R_{DS(on)} = 0.48\Omega$  @  $V_{GS} = 10V$
- Low gate charge ( typical 45nC)
- Fast switching
- 100% avalanche tested
- Improved dv/dt capability

### Ordering Information

PART NUMBER	PACKAGE	BRAND
13N50	TO-220	0GFD

**Absolute Maximum Ratings**

TC = 25°C unless otherwise noted

Symbol	Parameter	13N50	13N50F	Units
V <sub>DSS</sub>	Drain-Source Voltage	500		V
I <sub>D</sub>	Drain Current - Continuous (TC = 25°C) - Continuous (TC = 100°C)	13	13	A
		8.0	8.0	A
I <sub>DM</sub>	Drain Current- Pulsed (Note 1)	52	52	A
V <sub>GSS</sub>	Gate-Source Voltage	± 30		V
E <sub>AS</sub>	Single Pulsed Avalanche Energy (Note 2)	860		mJ
E <sub>AR</sub>	Repetitive Avalanche Energy (Note 1)	19.5		mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	4.5		V/ns
P <sub>D</sub>	Power Dissipation (TC = 25°C)	195	48	W
	Derate above 25°C	1.56	0.39	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 purposes, 1/8" from case for 5 seconds	300		°C

**Thermal Characteristics**

Symbol	Parameter	13N50	13N50F	Units
R <sub>θJC</sub>	Thermal Resistance, Junction-to-Case	0.64	2.58	°C/W
R <sub>θCS</sub>	Thermal Resistance, Case-to-Sink Typ.	0.5	--	°C/W
R <sub>θJA</sub>	Thermal Resistance, Junction-to-Ambient	62.5	62.5	°C/W

**Electrical Characteristics**

TC = 25°C unless otherwise noted

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
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**Off Characteristics**

$BV_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$	500	--	--	V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = 250\ \mu\text{A}$ , Referenced to 25°C	--	0.6	--	V/°C
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 500\text{ V}, V_{GS} = 0\text{ V}$	--	--	1	$\mu\text{A}$
		$V_{DS} = 400\text{ V}, T_C = 125^\circ\text{C}$	--	--	10	$\mu\text{A}$
$I_{GSSF}$	Gate-Body Leakage Current, Forward	$V_{GS} = 30\text{ V}, V_{DS} = 0\text{ V}$	--	--	100	nA
$I_{GSSR}$	Gate-Body Leakage Current, Reverse	$V_{GS} = -30\text{ V}, V_{DS} = 0\text{ V}$	--	--	-100	nA

**On Characteristics**

$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 250\ \mu\text{A}$	2.0	--	4.0	V
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = 10\text{ V}, I_D = 6.5\text{ A}$	--	0.40	0.48	$\Omega$

**Dynamic Characteristics**

$C_{iss}$	Input Capacitance	$V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}$	--	1600	--	pF
$C_{oss}$	Output Capacitance		--	200	--	pF
$C_{rss}$	Reverse Transfer Capacitance		--	20	--	pF

### Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 250\text{ V}, I_D = 13.0\text{ A}, R_G = 25\ \Omega$	--	25	--	ns
$t_r$	Turn-On Rise Time		--	100	--	ns
$t_{d(off)}$	Turn-Off Delay Time		--	130	--	ns
$t_f$	Turn-Off Fall Time		(Note 4, 5)	--	100	--
$Q_g$	Total Gate Charge	$V_{DS} = 400\text{ V}, I_D = 13.0\text{ A}, V_{GS} = 10\text{ V}$	--	45	--	nC
$Q_{gs}$	Gate-Source Charge		--	8	--	nC
$Q_{gd}$	Gate-Drain Charge		(Note 4, 5)	--	19	--

### Drain-Source Diode Characteristics and Maximum Ratings

$I_S$	Maximum Continuous Drain-Source Diode Forward Current		--	--	13.0	A
$I_{SM}$	Maximum Pulsed Drain-Source Diode Forward Current		--	--	52.0	A
$V_{SD}$	Drain-Source Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_S = 13.0\text{ A}$	--	--	1.5	V
$t_{rr}$	Reverse Recovery Time	$V_{GS} = 0\text{ V}, I_S = 13.0\text{ A}, di_F/dt = 100\text{ A}/\mu\text{s}$	--	410	--	ns
$Q_{rr}$	Reverse Recovery Charge		(Note 4)	--	4.5	--

#### Notes:

1. Repetitive Rating : Pulse width limited by maximum junction temperature
2.  $L = 6\text{ mH}, I_{AS} = 13.0\text{ A}, V_{DD} = 50\text{ V}, R_G = 25\ \Omega$ , Starting  $T_J = 25^\circ\text{C}$
3.  $I_{SD} \leq 13.0\text{ A}, di/dt \leq 200\text{ A}/\mu\text{s}, V_{DD} \leq BVDSS$ , Starting  $T_J = 25^\circ\text{C}$
4. Pulse Test : Pulse width  $\leq 300\ \mu\text{s}$ , Duty cycle  $\leq 2\%$
5. Essentially independent of operating temperature

Typical Characteristics

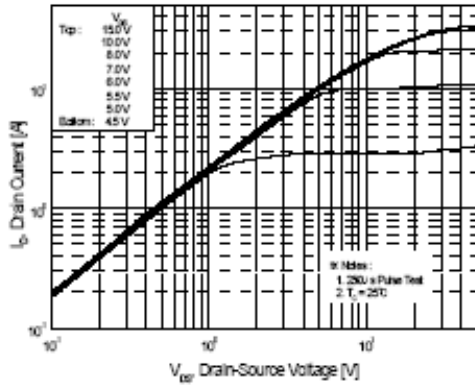


Figure 1. On-Region Characteristics

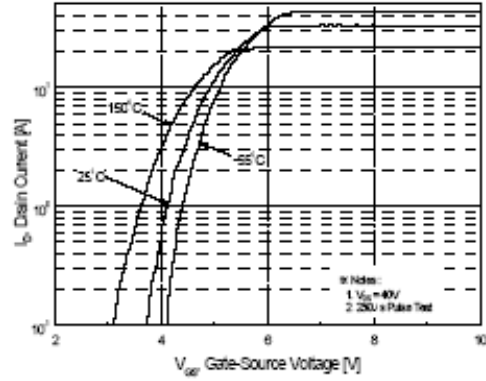


Figure 2. Transfer Characteristics

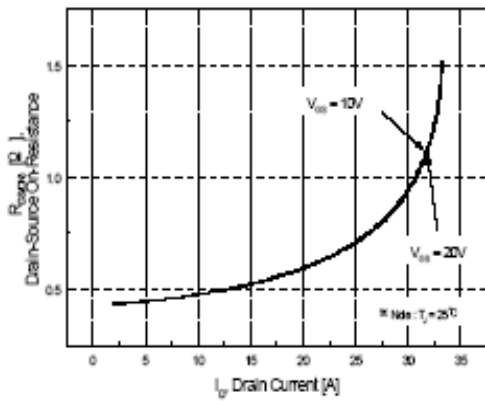


Figure 3. On-Resistance Variation vs Drain Current and Gate Voltage

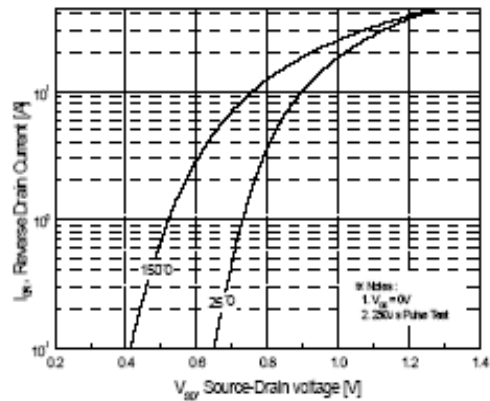


Figure 4. Body Diode Forward Voltage Variation with Source Current

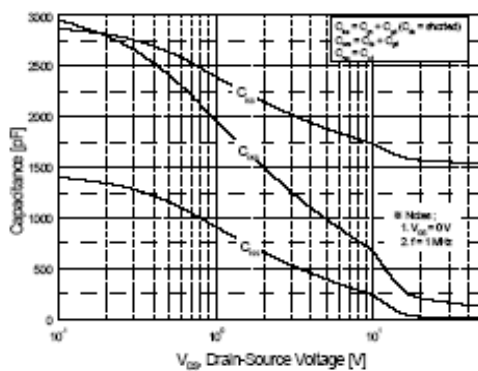


Figure 5. Capacitance Characteristics

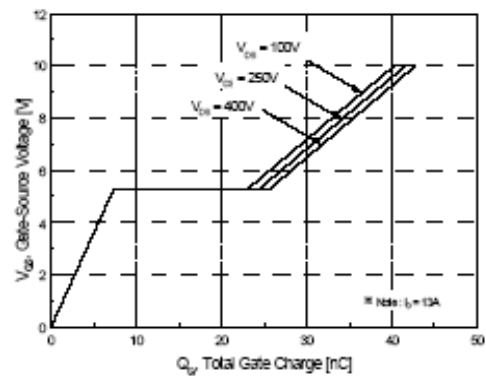


Figure 6. Gate Charge Characteristics

Typical Characteristics (Continued)

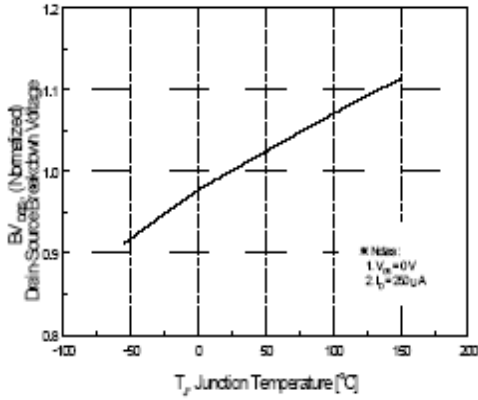


Figure 7. Breakdown Voltage Variation vs Temperature

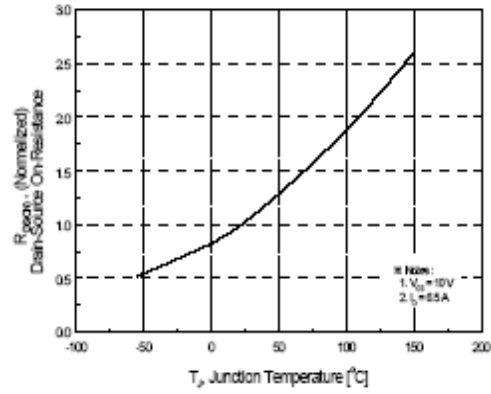


Figure 8. On-Resistance Variation vs Temperature

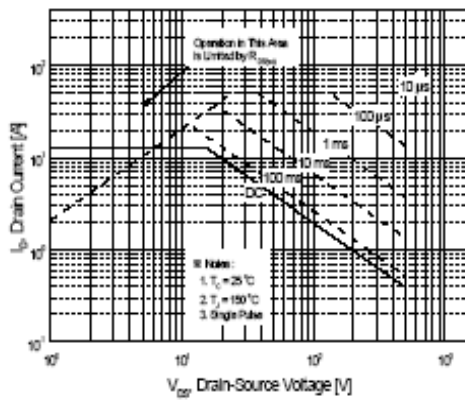


Figure 9-1. Maximum Safe Operating Area for 13N50

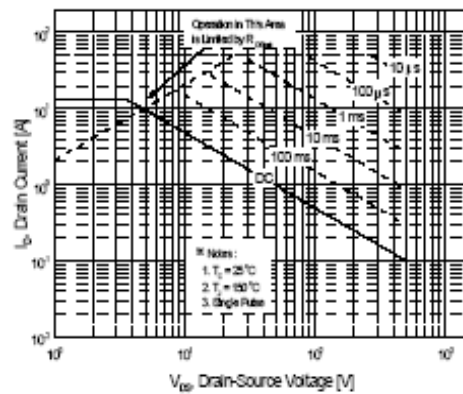


Figure 9-2. Maximum Safe Operating Area for 13N50F

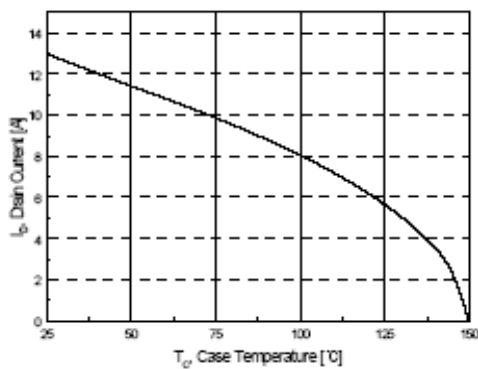


Figure 10. Maximum Drain Current vs Case Temperature

Typical Characteristics (Continued)

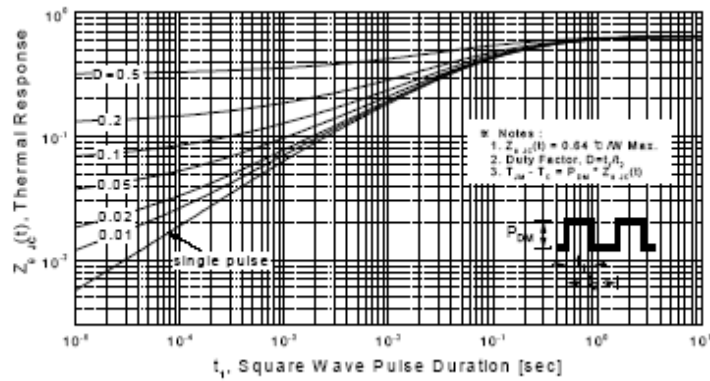


Figure 11-1. Transient Thermal Response Curve for 13N50

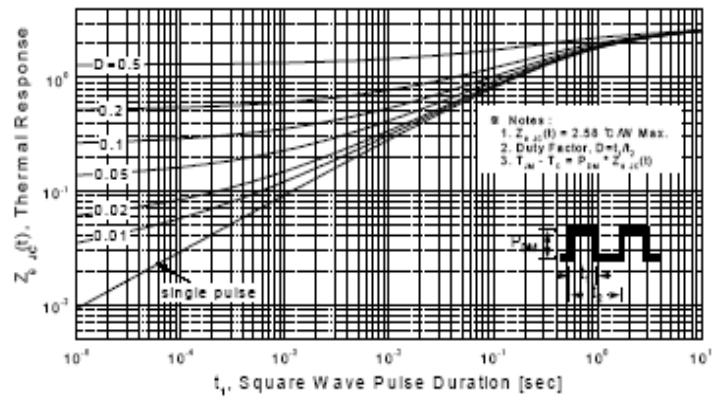
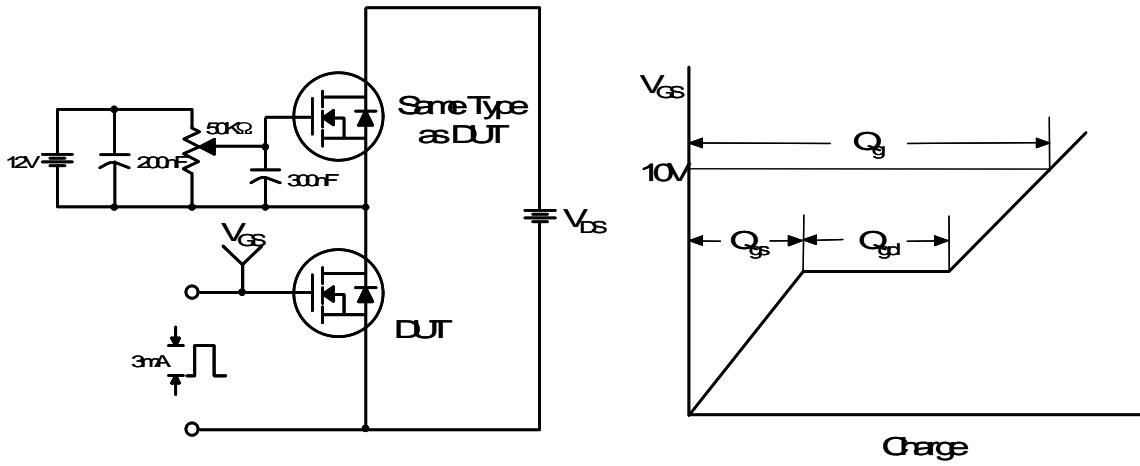
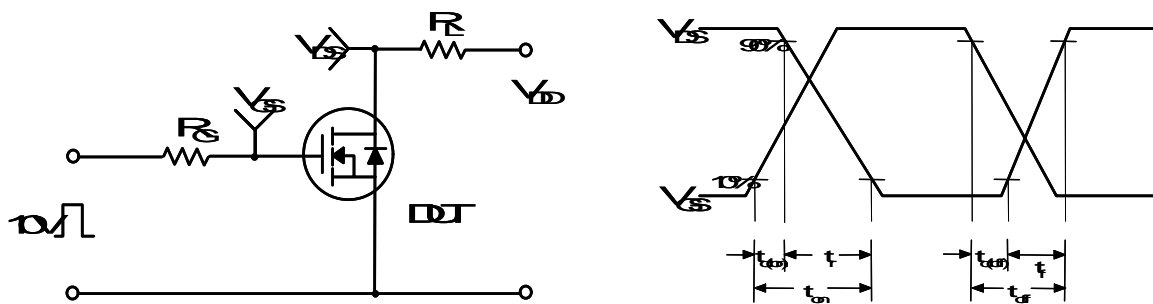


Figure 11-2. Transient Thermal Response Curve for 13N50F

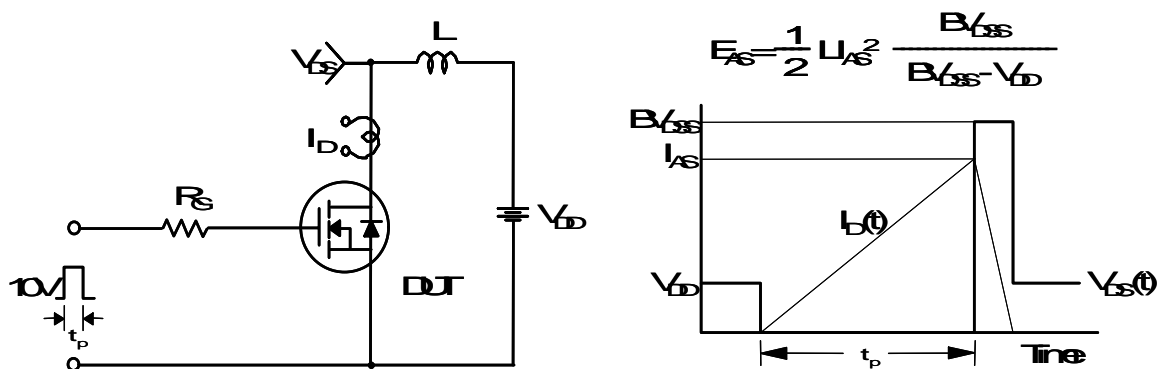
Gate Charge Test Circuit & Waveform



Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching Test Circuit & Waveforms





Peak Diode Recovery dv/dt Test Circuit & Waveforms

