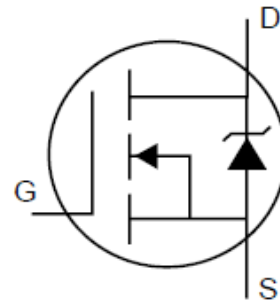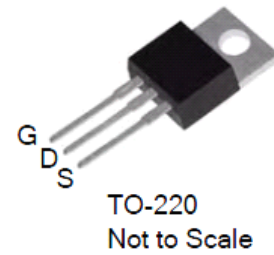# 200V N-Channel MOSFET

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
200V	0.18Ω	18A

TO-220
Not to Scale

Features

- 18A, 200V, RDS(on) = 0.18Ω @VGS = 10 V
- Low gate charge (typical   40nC)
- Fast switching
- 100% avalanche tested
- Improved dv/dt capability

Ordering Information

PART NUMBER	PACKAGE	BRAND
640	TO−220	0GFD

Absolute Maximum Ratings

TC = 25°Cunless otherwise noted

Symbol	Parameter		640	640F	Units
V_{DSS}	Drain-Source Voltage		200		V
I_D	Drain Current - Continuous (TC = 25°C)		18	18	A
	- Continuous (TC = 100°C)		12	12	A
I_{DM}	Drain Current- Pulsed	(Note 1)	72	72	A
V_{GSS}	Gate-Source Voltage		± 30		V
E_{AS}	Single Pulsed Avalanche Energy	(Note 2)	432		mJ
E_{AR}	Repetitive Avalanche Energy	(Note 1)	13.9		mJ
dv/dt	Peak Diode Recovery dv/dt	(Note 3)	5.5		V/ns
P_D	Power Dissipation (TC = 25°C)		139	43	W
	Derate above 25°C		1.11	0.34	W/°C
T_J, T_{STG}	Operating and Storage Temperature Range		-55 to +150		°C
T_L	Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds		300		°C

Thermal Characteristics

Symbol	Parameter	640	640F	Units
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	0.90	2.89	°C/W
$R_{\theta CS}$	Thermal Resistance, Case-to-Sink Typ.	0.5	--	°C/W
$R_{\theta JA}$	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

Off Characteristics

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
BV_{DSS}	Drain-Source Breakdown Voltage	$V_{GS} = 0$ V, $I_D = 250$ µA	200	--	--	V
$\Delta BV_{DSS}/\Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 250$ µA, Referenced to 25°C	--	0.25	--	V/°C
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 200$ V, $V_{GS} = 0$ V	--	--	1	µA
		$V_{DS} = 160$ V, $T_C = 125$°C	--	--	10	µA
I_{GSSF}	Gate-Body Leakage Current, Forward	$V_{GS} = 30$ V, $V_{DS} = 0$ V	--	--	100	nA
I_{GSSR}	Gate-Body Leakage Current, Reverse	$V_{GS} = -30$ V, $V_{DS} = 0$ V	--	--	-100	nA

On Characteristics

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}$, $I_D = 250$ µA	2.0	--	4.0	V
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = 10$ V, $I_D = 9.0$A	--	0.14	0.18	Ω

Dynamic Characteristics

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
C_{iss}	Input Capacitance	$V_{DS} = 25$ V, $V_{GS} = 0$ V, $f = 1.0$ MHz	--	850	--	pF
C_{oss}	Output Capacitance		--	190	--	pF
C_{rss}	Reverse Transfer Capacitance		--	80	--	pF

Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time		--	20	--	ns
t_r	Turn-On Rise Time	V_{DD} = 100 V, I_D = 18A, R_G = 25 Ω	--	150	--	ns
$t_{d(off)}$	Turn-Off Delay Time		--	140	--	ns
t_f	Turn-Off Fall Time	(Note 4, 5)	--	120	--	ns
Q_g	Total Gate Charge		--	40	-	nC
Q_{gs}	Gate-Source Charge	V_{DS} = 160 V, I_D = 18A, V_{GS} = 10 V	--	6.0	--	nC
Q_{gd}	Gate-Drain Charge	(Note 4, 5)	--	22	--	nC

Drain-Source Diode Characteristics and Maximum Ratings

I_S	Maximum Continuous Drain-Source Diode Forward Current		--	--	18.0	A
I_{SM}	Maximum Pulsed Drain-Source Diode Forward Current		--	--	72.0	A
V_{SD}	Drain-Source Diode Forward Voltage	V_{GS} = 0 V, I_S = 18 A	--	--	1.5	V
t_{rr}	Reverse Recovery Time	V_{GS} = 0 V, I_S = 18 A, d_{IF} / dt = 100 A/μs	--	200	--	ns
Q_{rr}	Reverse Recovery Charge	(Note 4)	--	1.6	--	μC

Notes:

1. Repetitive Rating : Pulse width limited by maximum junction temperature

2. L = 2 mH, IAS = 18 A, VDD = 50V, RG = 25 Ω, Starting TJ = 25°C

3. ISD ≤ 18A, di/dt ≤ 200A/μs, VDD ≤ BVDSS, Starting TJ = 25°C

4. Pulse Test : Pulse width ≤ 300μs, Duty cycle ≤ 2%

5. Essentially independent of operating temperature

Typical Characteristics

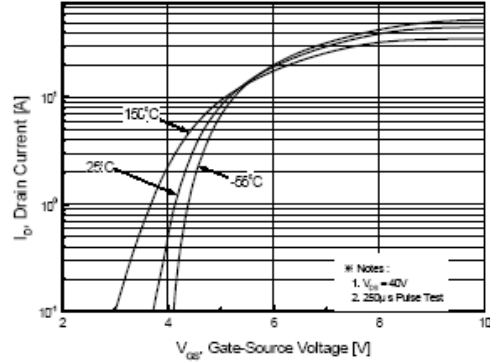**Figure 1. On-Region Characteristics**

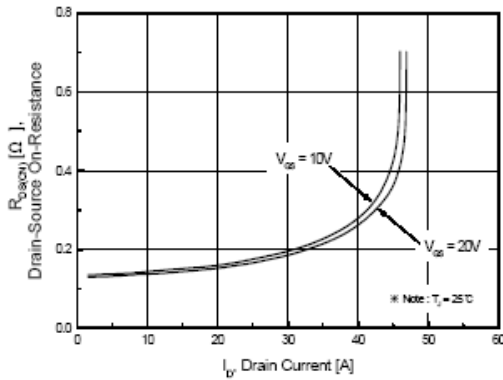**Figure 2. Transfer Characteristics**

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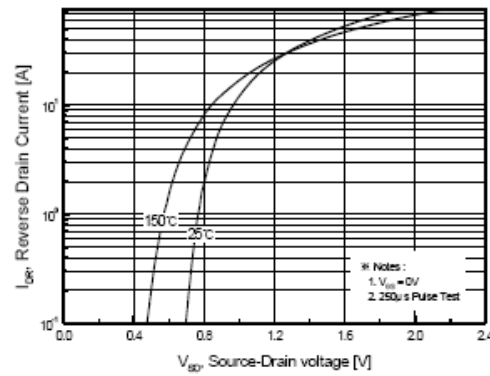

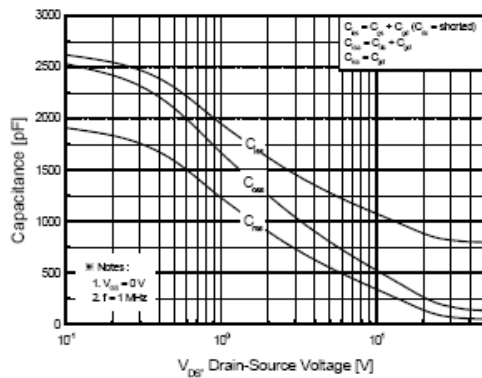**Figure 4. Body Diode Forward Voltage Variation with Source Current**
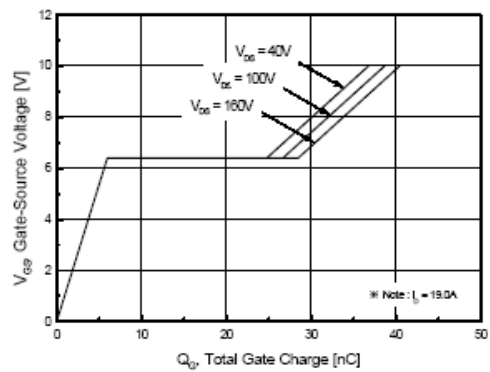

Figure 5. Capacitance Characteristics

Figure 6. Gate Charge Characteristics
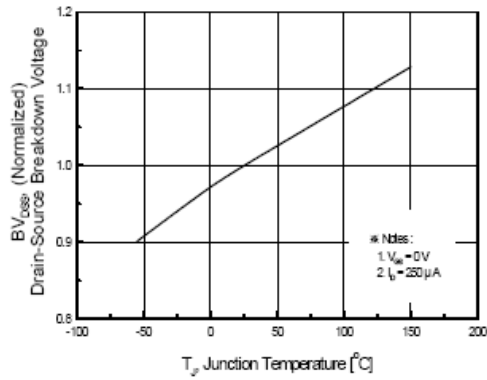
Typical Characteristics (Continued)
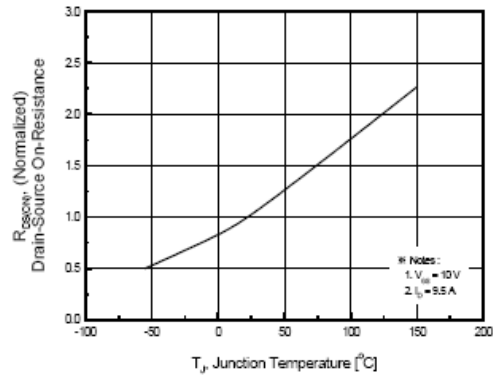

**Figure 7. Breakdown Voltage Variation
vs Temperature**

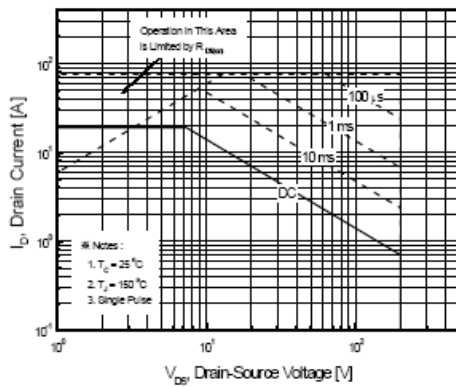**Figure 8. On-Resistance Variation
vs Temperature**
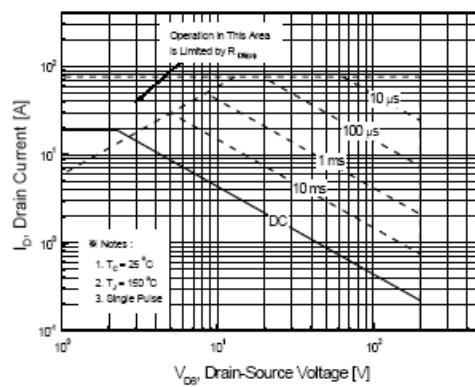

**Figure 9-1. Maximum Safe Operating Area
for TSP640M**

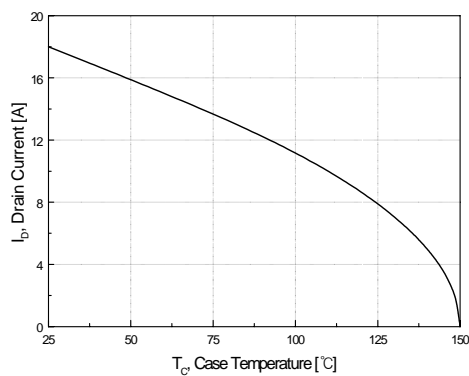**Figure 9-2. Maximum Safe Operating Area
for TSF640M**

**Figure 10. Maximum Drain Current
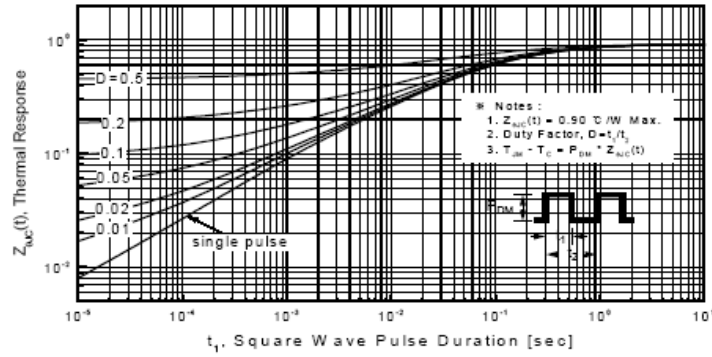vs Case Temperature**

Typical Characteristics (Continued)

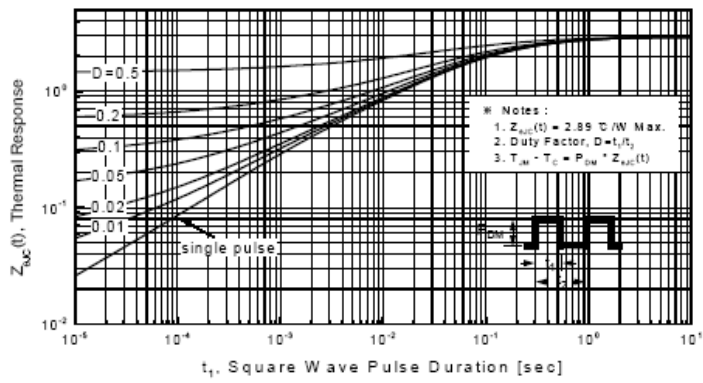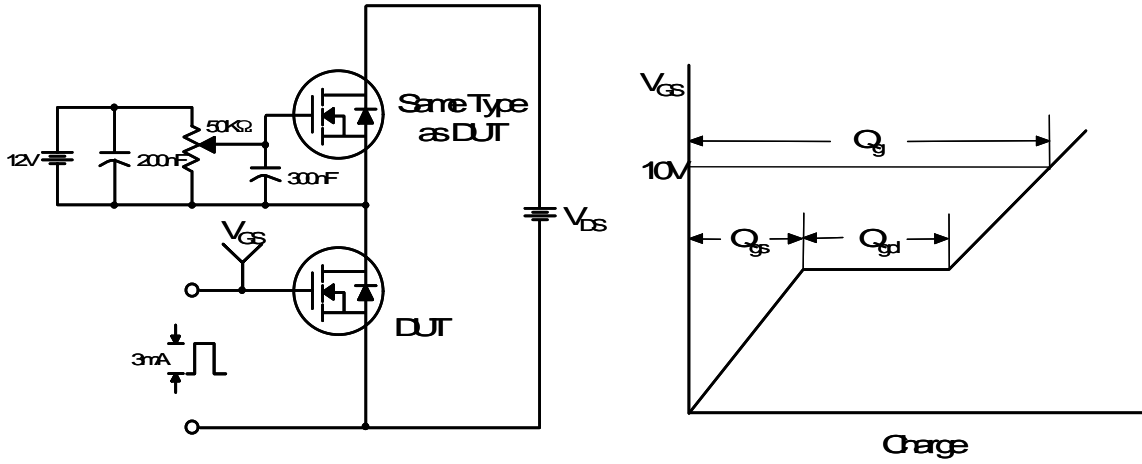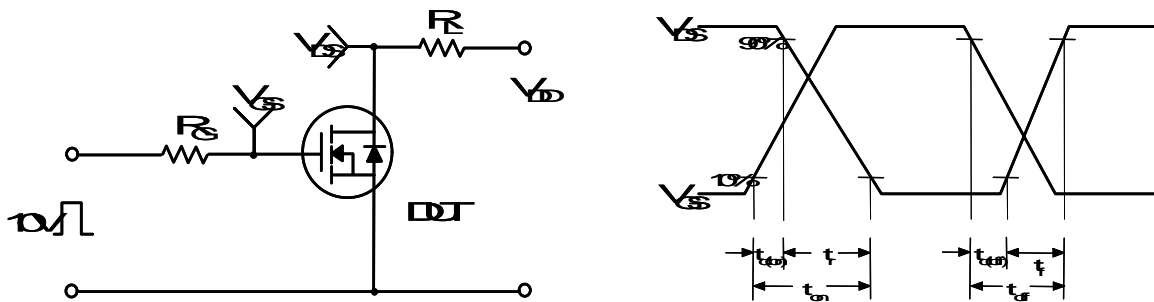**Figure 11-1. Transient Thermal Response Curve
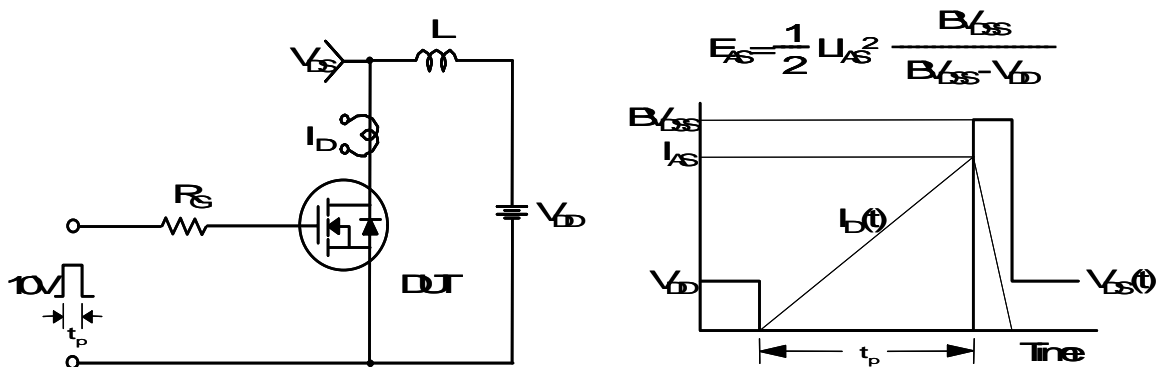for TSP640M**

**Figure 11-2. Transient Thermal Response Curve
for TSF640M**

Gate Charge Test Circuit & Waveform

Resistive Switching Test Circuit & Waveforms

Unclamped Inductive Switching Test Circuit & Waveforms

$$E_{AS} = \frac{1}{2} L I_{AS}^2 \frac{BV_{DSS}}{BV_{DSS} - V_{DD}}$$

Peak Diode Recovery dv/dt Test Circuit & Waveforms

DUT

V_{DS}

+

−

I_{SD}

L

Driver

R_G

Same Type
as DUT

V_{GS}

V_{DD}

• dv/dt controlled by R_G
• I_{SD} controlled by pulse period

V_{GS}
(Driver)

$$D = \frac{Gate\ Pulse\ Width}{Gate\ Pulse\ Period}$$

10 V

I_{SD}
(DUT)

I_{FM}, Body Diode Forward Current

di/dt

I_{RM}

Body Diode Reverse Current

V_{DS}
(DUT)

Body Diode Recovery dv/dt

V_{SD}

V_{DD}

Body Diode
Forward Voltage Drop