

# MSF4N65

## 650V N-Channel MOSFET

### Description

The MSF4N65 is a N-channel enhancement-mode MOSFET , providing the designer with the best combination of fast switching, ruggedized device design, low on-resistance and cost effectiveness. The TO-220F package is universally preferred for all commercial-industrial applications

### Features

- Originative New Design
- 100% EAS Test
- Rugged Gate Oxide Technology
- Extremely Low Intrinsic Capacitances
- Remarkable Switching Characteristics
- Unequalled Gate Charge: 15 nC (Typ.)
- Extended Safe Operating Area
- Lower RDS(ON) : 2.4 Ω (Typ.) @VGS=10V

### Application

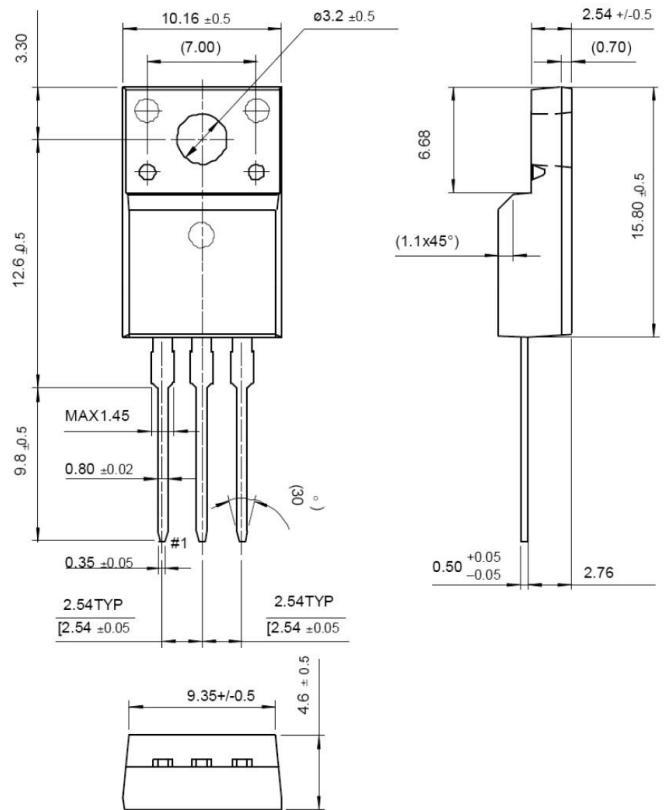
- Low power battery chargers
- Switch mode power supply (SMPS)
- DC-AC converters

### Packing & Order Information

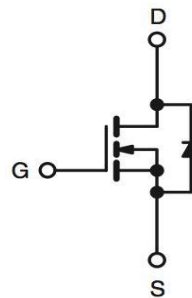
50/Tube ; 1,000/Box



**RoHS**  
COMPLIANT



### Graphic symbol



## MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS

### Absolute Maximum Ratings

Symbol	Parameter	Value	Unit
V <sub>DSS</sub>	Drain-Source Voltage	600	V
V <sub>GS</sub>	Gate-Source Voltage	±30	V
I <sub>D</sub>	Drain Current -Continuous (TC=25°C)	4.0	A
	Drain Current -Continuous (TC=100°C)	2.3	A
I <sub>DM</sub>	Drain Current Pulsed	14.4	A
I <sub>AR</sub>	Avalanche Current	4.5	A
E <sub>AS</sub>	Single Pulsed Avalanche Energy	240	mJ

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#### Absolute Maximum Ratings

Symbol	Parameter	Value	Unit
$E_{AR}$	Repetitive Avalanche Energy	3.6	mJ
dv/dt	Peak Diode Recovery dv/dt	5.5	V/ns
$P_D$	Total Power Dissipation ( $T_C=25^\circ\text{C}$ )	33	W
	Derating Factor above $25^\circ\text{C}$	0.26	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 purposes, 1/8" from case for 5 seconds	300	$^\circ\text{C}$

•Drain current limited by maximum junction temperature

#### Thermal Characteristics ( $T_C=25^\circ\text{C}$ unless otherwise noted)

Symbol	Parameter	Max.	Units
$R_{\theta JC}$	Junction-to-Case	3.3	$^\circ\text{C/W}$
$R_{\theta JA}$	Junction-to-Ambient	62.5	

#### On Characteristics

Symbol	Parameter	Test Conditions	Min	Typ.	Max.	Units
$V_{GS(th)}$	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	$V_{GS} = 10\text{ V}, I_D = 3.0\text{ A}$	--	2.0	2.5	$\Omega$

#### Off Characteristics

Symbol	Parameter	Test Conditions	Min	Typ.	Max.	Units
$BV_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 250\mu\text{A}$	600	710	--	V
$\Delta BV_{DSS} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 250\mu\text{A}$ , Referenced to $25^\circ\text{C}$	--	0.6	--	V/ $^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 600\text{ V}, V_{GS} = 0\text{ V}$ $V_{DS} = 480\text{ V}, T_C = 125^\circ\text{C}$	--	--	1 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

#### Dynamic Characteristics

Symbol	Parameter	Test Conditions	Min	Typ.	Max.	Units
$C_{ISS}$	Input Capacitance	$V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V},$ $f = 1.0\text{MHz}$	--	545	710	pF
$C_{OSS}$	Output Capacitance		--	60	80	pF
$C_{RSS}$	Reverse Transfer Capacitance		--	8	11	pF

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Switching Characteristics						
Symbol	Parameter	Test Conditions	Min	Typ.	Max.	Units
$t_{d(on)}$	Turn-On Time	$V_{DS} = 325\text{ V}, I_D = 4.0\text{ A},$ $R_G = 25\ \Omega$	--	10	30	ns
$t_r$	Turn-On Time		--	35	80	ns
$t_{d(off)}$	Turn-Off Delay Time		--	45	100	ns
$t_f$	Turn-Off Fall Time		--	40	90	ns
$Q_g$	Total Gate Charge	$V_{DS} = 520\text{ V}, I_D = 4.0\text{ A},$ $V_{GS} = 10\text{ V}$	--	15	20	nC
$Q_{gs}$	Gate-Source Charge		--	2.8	--	nC
$Q_{gd}$	Gate-Drain Charge		--	6.0	--	nC

Source-Drain Diode Maximum Ratings and Characteristics						
Symbol	Parameter	Test Conditions	Min	Typ.	Max.	Units
$I_S$	Continuous Source-Drain Diode Forward Current		--	--	3.6	A
$I_{SM}$	Pulsed Source-Drain Diode Forward Current		--	--	16	
$V_{SD}$	Source-Drain Diode Forward Voltage	$I_S = 4.0\text{ A}, V_{GS} = 0\text{ V}$	--	--	1.5	V
$t_{rr}$	Reverse Recovery Time	$I_F = 4.0\text{ A}, V_{GS} = 0\text{ V}$ $diF/dt = 100\text{ A}/\mu\text{s}$	--	300	--	ns
$Q_{rr}$	Reverse Recovery Charge		--	2.2	--	$\mu\text{C}$

#### Notes;

1. Repetitive Rating: Pulse width limited by maximum junction temperature
2.  $I_{AS} = 4\text{ A}, V_{DD} = 50\text{ V}, R_G = 25\text{ W},$  Starting  $T_J = 25^\circ\text{C}$
3.  $I_{SD} \leq 4\text{ A}, di/dt \leq 300\text{ A}/\mu\text{s}, V_{DD} \leq BV_{DSS},$  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

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#### ■ Characteristics Curve

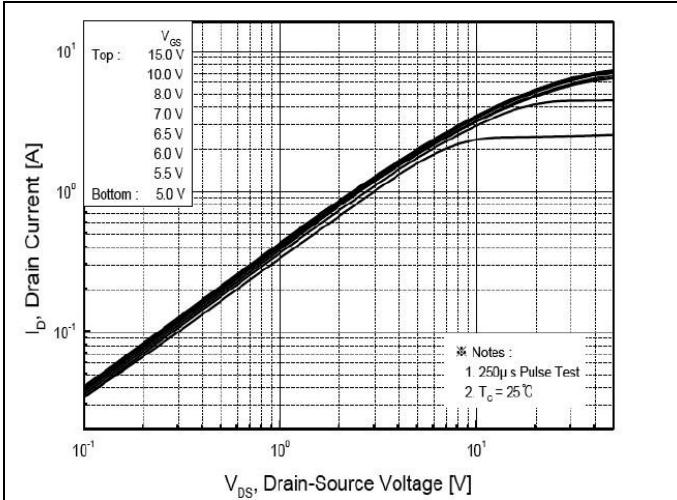


FIG.1-ON REGION CHARACTERISTICS

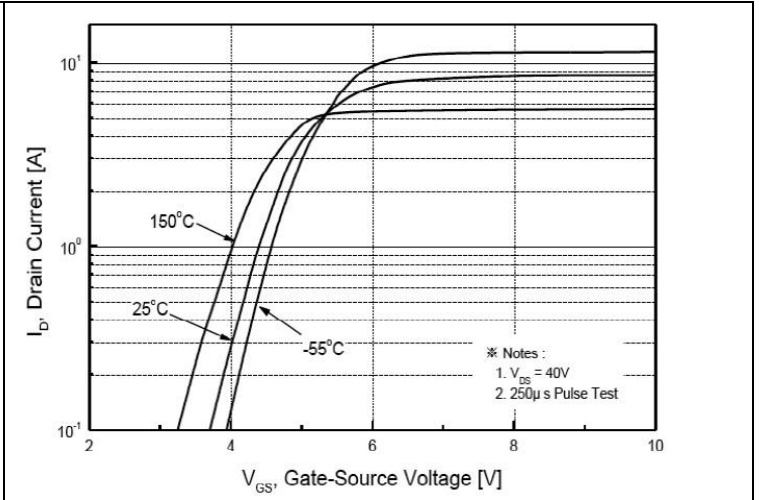


FIG.2-TRANSFER CHARACTERISTICS

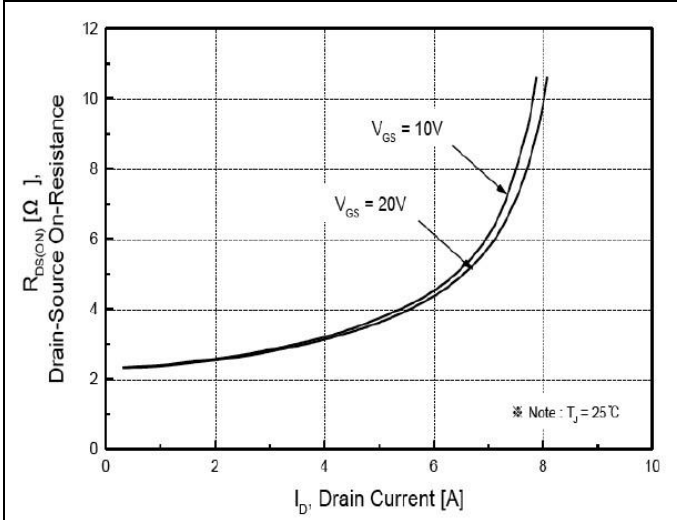


FIG.3-ON RESISTANCE VARIATION VS DRAIN CURRENT AND GATE VOLTAGE

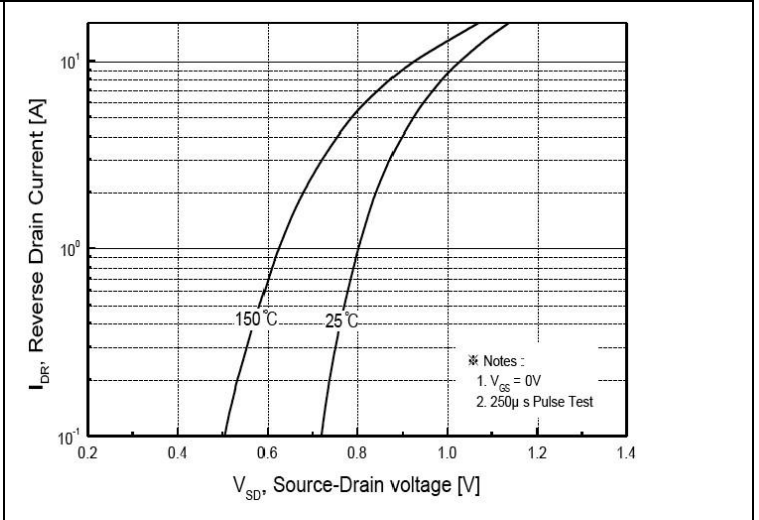


FIG.4-BODY DIODE FORWARD VOLTAGE VARIATION WITH SOURCE CURRENT AND TEMPERATURE

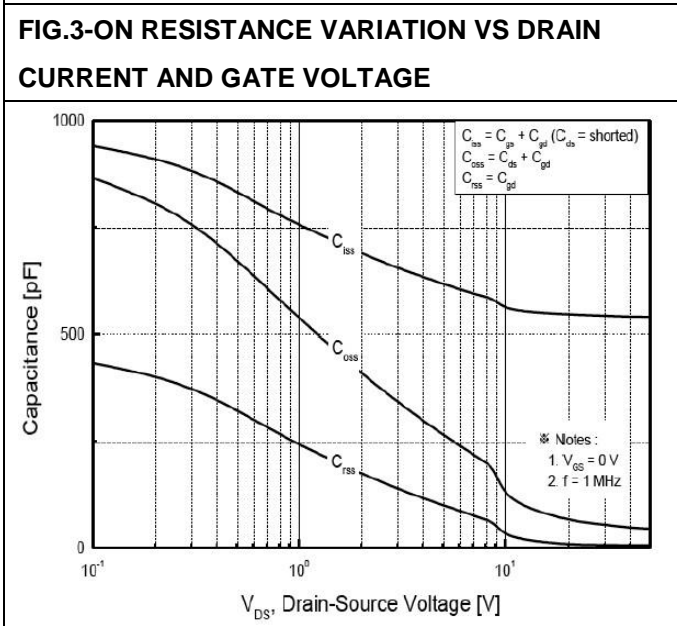


FIG.5-CAPACITANCE CHARACTERISTICS

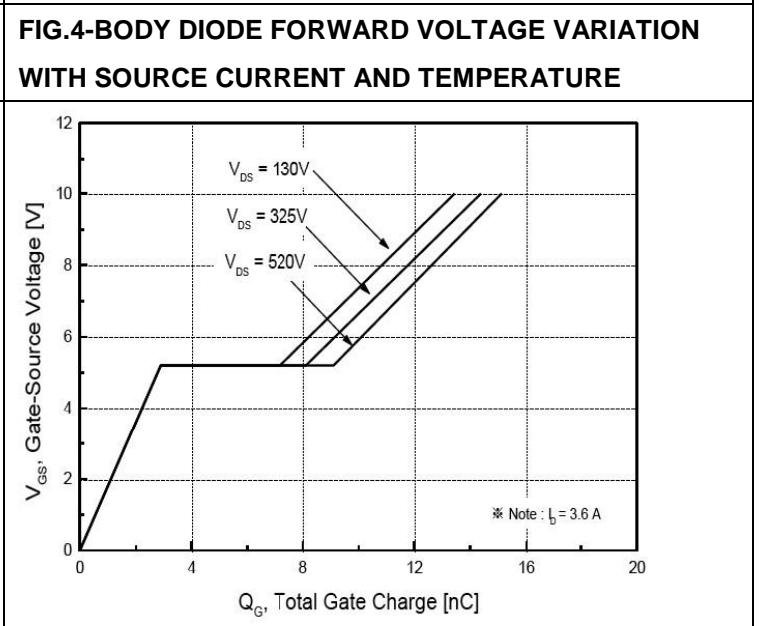


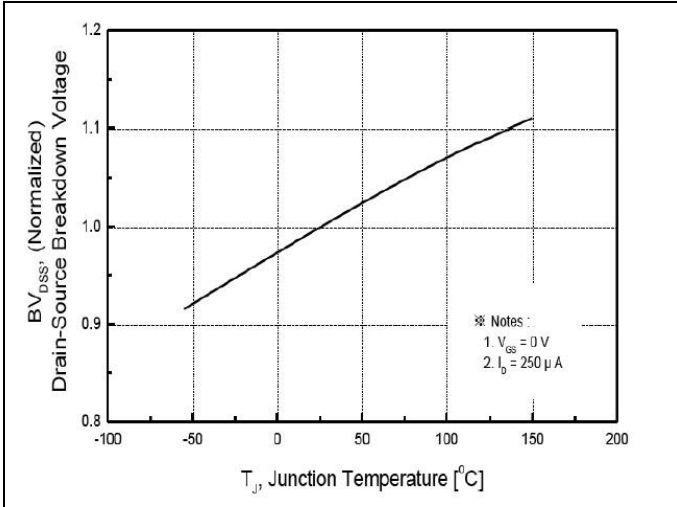
FIG.6-GATE CHARGE CHARACTERISTICS



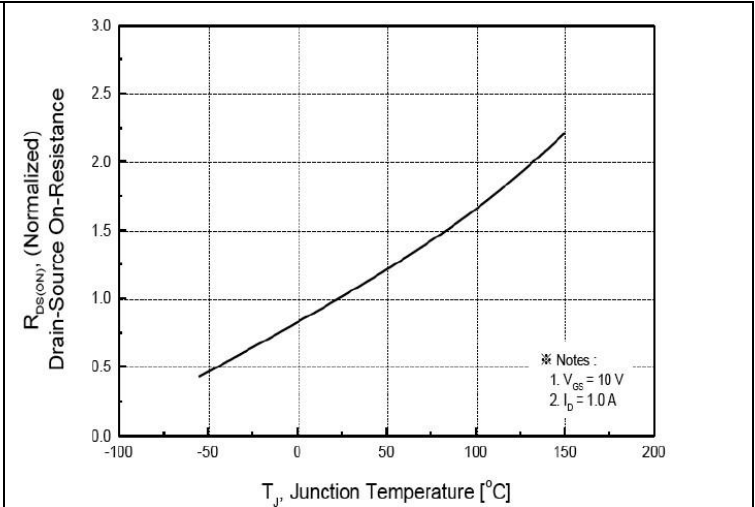
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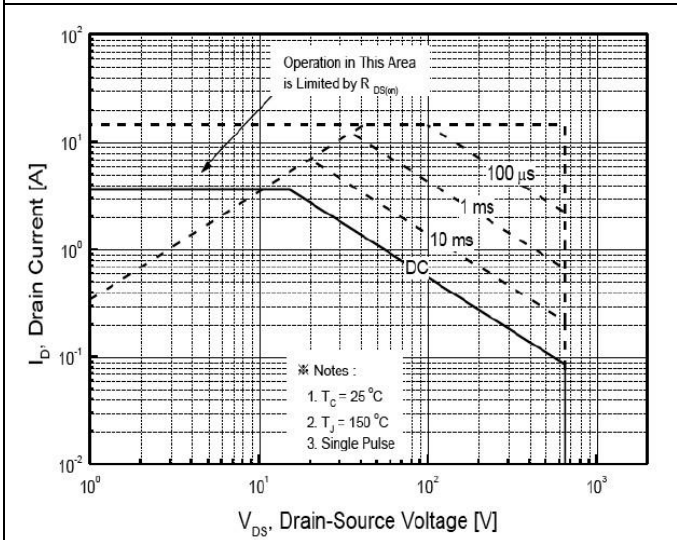
#### ■ Characteristics Curve



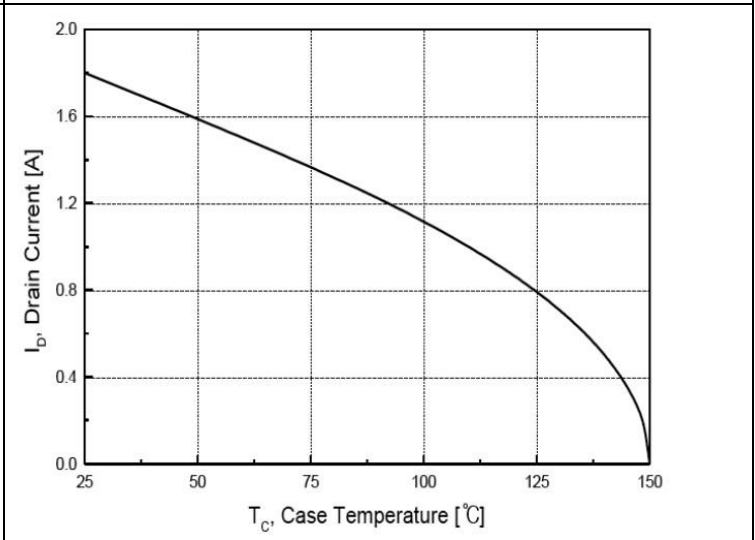
**FIG.7-BREAKDOWN VOLTAGE VARIATION VS TEMPERATURE**



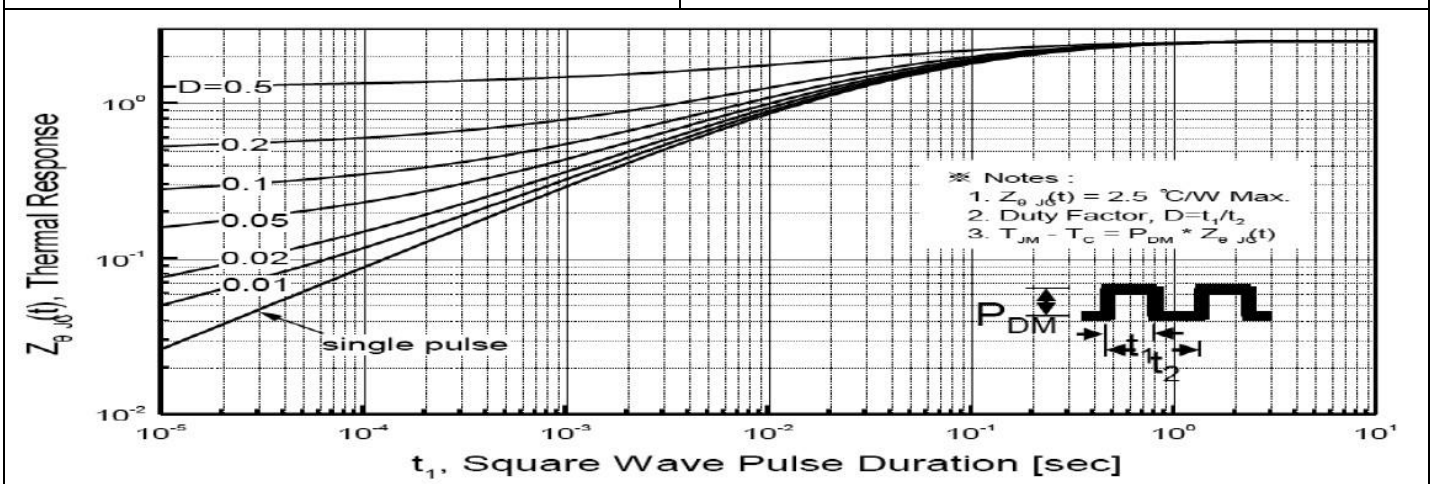
**FIG.8-ON-RESISTANCE VARIATION VS TEMPERATURE**



**FIG.9-MAXIMUM SAFE OPERATING AREA**



**FIG.10-MAXIMUM DRAIN CURRENT VS CASE TEMPERATURE**



**FIG.11-TRANSIENT THERMAL RESPONSE CURVE**

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