

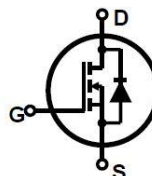
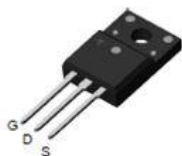
N-channel MOSFET

## Features

- Low gate charge
- Improved dv/dt capability
- RoHS compliant
- JEDEC Qualification

$BV_{DSS}$	$I_D$	$R_{DS(on)}$
500V	13A	<0.48Ω

Top view TO-220F



Ordering Part Number	Package	Marking	Remark
TMPF13N50A	TO-220F	TMPF13N50A	RoHS

## Absolute Maximum Ratings

Parameter	Symbol	Value	Unit
Drain-Source Voltage	$V_{DSS}$	500	V
Gate-Source Voltage	$V_{GS}$	±30	V
Continuous Drain Current	$I_D$	$T_C = 25\text{ °C}$	13
		$T_C = 100\text{ °C}$	8.2
Pulsed Drain Current (Note 1)	$I_{DM}$	52	A
Single Pulse Avalanche Energy (Note 2)	$E_{AS}$	657	mJ
Repetitive Avalanche Current (Note 1)	$I_{AR}$	13	A
Repetitive Avalanche Energy (Note 1)	$E_{AR}$	5.2	mJ
Power Dissipation	$P_D$	$T_C = 25\text{ °C}$	52
		Derate above 25 °C	0.41
Peak Diode Recovery dv/dt (Note 3)	dv/dt	4.5	V/ns
Operating Junction and Storage Temperature Range	$T_J, T_{STG}$	-55~150	°C
Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds	$T_L$	300	°C

\* Limited only by maximum junction temperature

## Thermal Characteristics

Parameter	Symbol	Value	Unit
Maximum Thermal resistance, Junction-to-Case	$R_{\theta JC}$	2.4	°C/W
Maximum Thermal resistance, Junction-to-Ambient	$R_{\theta JA}$	62.5	°C/W

**Electrical Characteristics :  $T_C=25^\circ\text{C}$ , unless otherwise noted**

Parameter	Symbol	Test condition	Min	Typ	Max	Unit
<b>OFF</b>						
Drain-Source Breakdown Voltage	$BV_{DSS}$	$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$	500	--	--	V
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 500\text{ V}, V_{GS} = 0\text{ V}$	--	--	1	$\mu\text{A}$
		$V_{DS} = 400\text{ V}, T_C = 125^\circ\text{C}$	--	--	10	$\mu\text{A}$
Forward Gate-Source Leakage Current	$I_{GSSF}$	$V_{GS} = 30\text{ V}, V_{DS} = 0\text{ V}$	--	--	100	nA
Reverse Gate-Source Leakage Current	$I_{GSSR}$	$V_{GS} = -30\text{ V}, V_{DS} = 0\text{ V}$	--	--	-100	nA

**ON**

Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250\ \mu\text{A}$	3.0	--	5.0	V
Drain-Source On-Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}, I_D = 6.5\text{ A}$	--	0.38	0.48	$\Omega$
Forward Transconductance <sup>(Note 4)</sup>	$g_{FS}$	$V_{DS} = 30\text{ V}, I_D = 6.5\text{ A}$	--	5	--	S

**DYNAMIC**

Input Capacitance	$C_{iss}$	$V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V},$ $f = 1.0\text{ MHz}$	--	1798	--	pF
Output Capacitance	$C_{oss}$		--	200	--	pF
Reverse Transfer Capacitance	$C_{rss}$		--	13	--	pF

**SWITCHING**

Turn-On Delay Time <sup>(Note 4,5)</sup>	$t_{d(on)}$	$V_{DD} = 250\text{ V}, I_D = 13\text{ A},$ $R_G = 25\ \Omega$	--	37	--	ns
Turn-On Rise Time <sup>(Note 4,5)</sup>	$t_r$		--	61	--	ns
Turn-Off Delay Time <sup>(Note 4,5)</sup>	$t_{d(off)}$		--	120	--	ns
Turn-Off Fall Time <sup>(Note 4,5)</sup>	$t_f$		--	42	--	ns
Total Gate Charge <sup>(Note 4,5)</sup>	$Q_g$	$V_{DS} = 400\text{ V}, I_D = 13\text{ A},$ $V_{GS} = 10\text{ V}$	--	35	--	nC
Gate-Source Charge <sup>(Note 4,5)</sup>	$Q_{gs}$		--	8	--	nC
Gate-Drain Charge <sup>(Note 4,5)</sup>	$Q_{gd}$		--	14	--	nC

**SOURCE DRAIN DIODE**

Maximum Continuous Drain-Source Diode Forward Current	$I_S$	----	--	--	13	A
Maximum Pulsed Drain-Source Diode Forward Current	$I_{SM}$	----	--	--	52	A
Drain-Source Diode Forward Voltage	$V_{SD}$	$V_{GS} = 0\text{ V}, I_S = 13\text{ A}$	--	--	1.5	V
Reverse Recovery Time <sup>(Note 4)</sup>	$t_{rr}$	$V_{GS} = 0\text{ V}, I_S = 13\text{ A}$ $di_F / dt = 100\text{ A}/\mu\text{s}$	--	540	--	ns
Reverse Recovery Charge <sup>(Note 4)</sup>	$Q_{rr}$		--	3.5	--	$\mu\text{C}$

Note :

1. Repeated rating : Pulse width limited by safe operating area
2.  $L=7\text{mH}, I_{AS} = 13\text{A}, V_{DD} = 50\text{V}, R_G = 25\ \Omega$ , Starting  $T_J = 25^\circ\text{C}$ , not subject to production test – verified by design/characterization
3.  $I_{SD} \leq 13\text{A}, di/dt \leq 200\text{A}/\mu\text{s}, V_{DD} \leq BV_{DS}$ , 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

Fig. 1 Output Characteristics

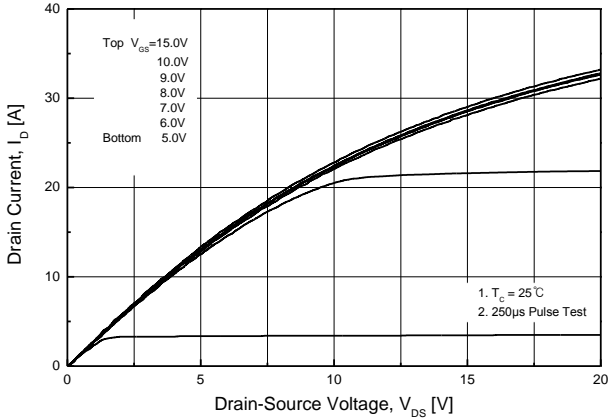


Fig. 2 Transfer Characteristics

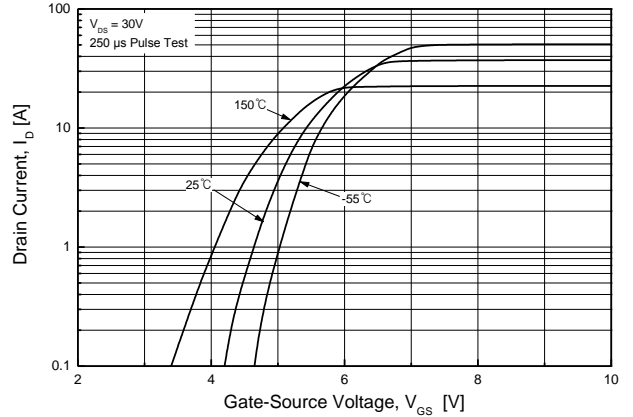


Fig. 3 On-Resistance vs. Drain Current and Gate voltage

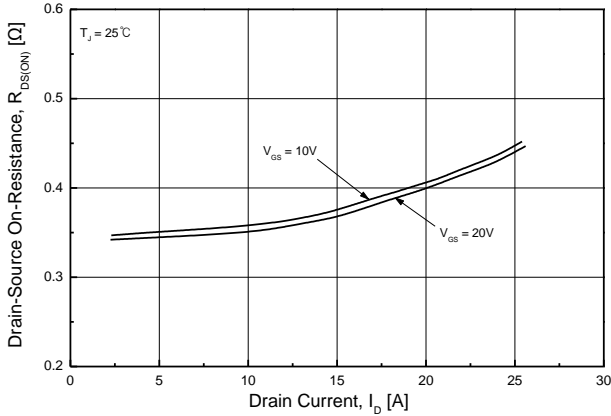


Fig. 4 Body Diode Forward Voltage vs. Source Current and Temperature

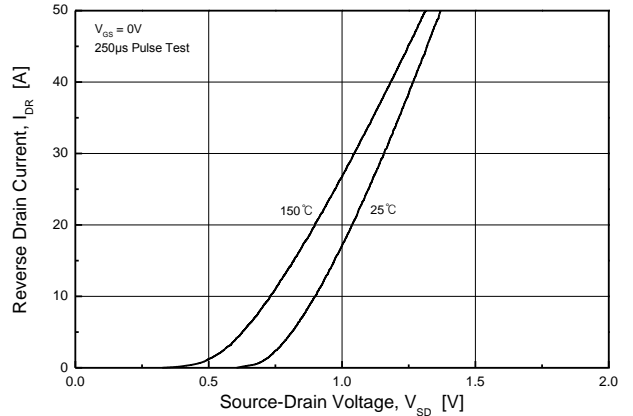


Fig. 5 Capacitance Characteristics

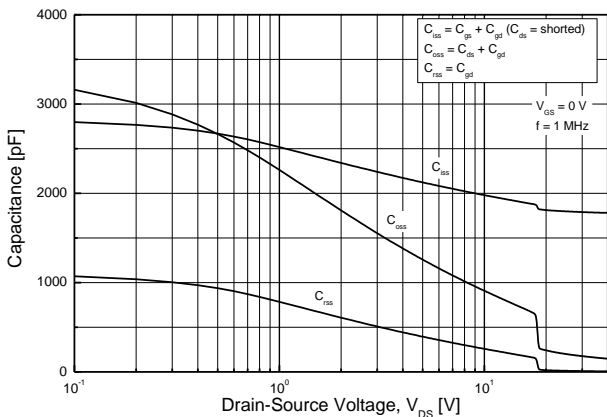


Fig. 6 Gate Charge Characteristics

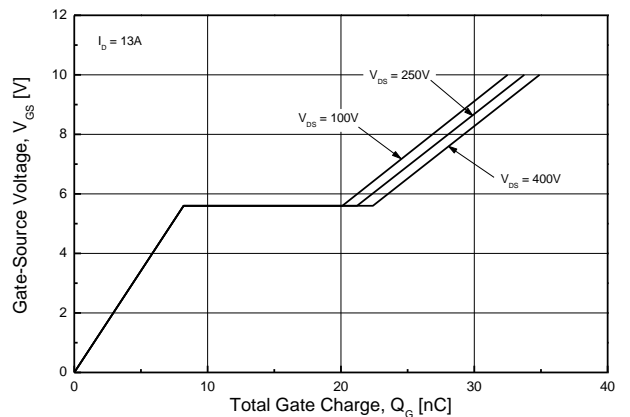


Fig. 7 Breakdown Voltage vs. Temperature

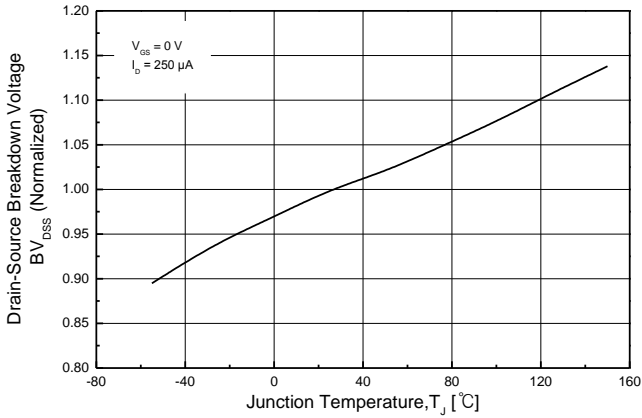


Fig. 8 On-Resistance vs. Temperature

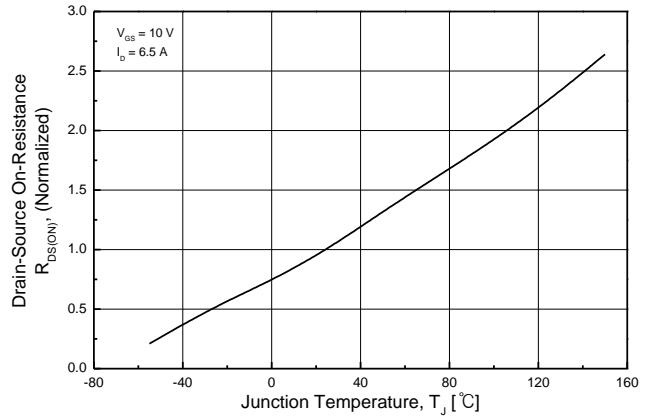


Fig. 9 Maximum Drain Current vs. Case Temperature

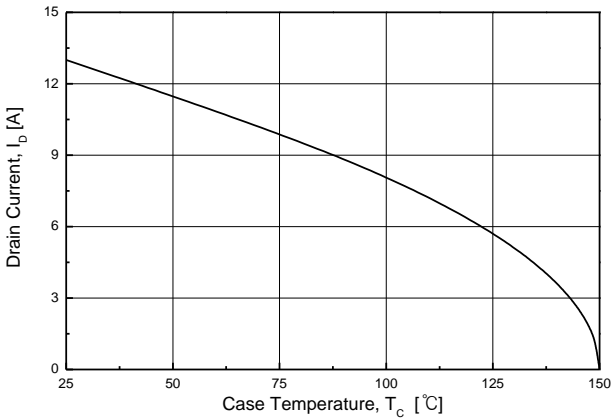


Fig. 10 Gate Threshold Voltage vs. Junction Temperature

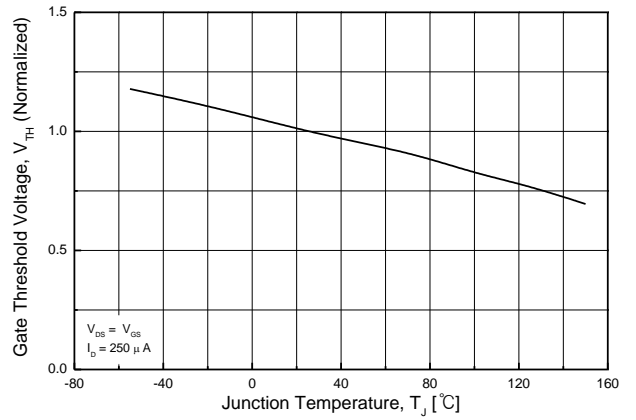


Fig. 11 Maximum Safe Operating Area

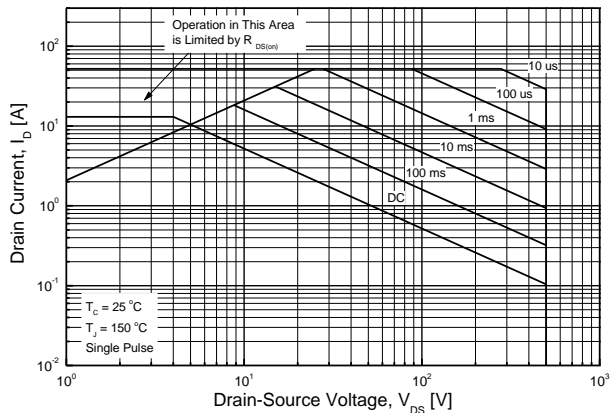
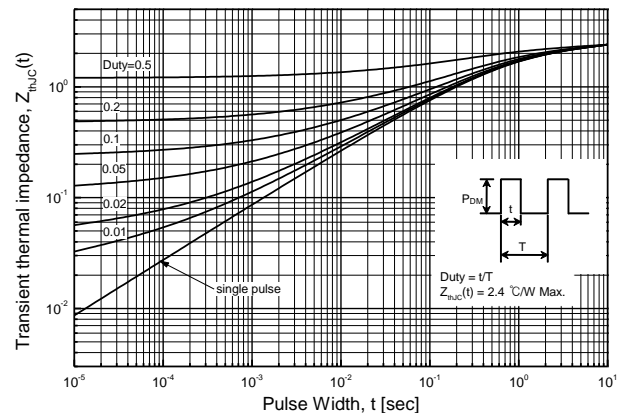
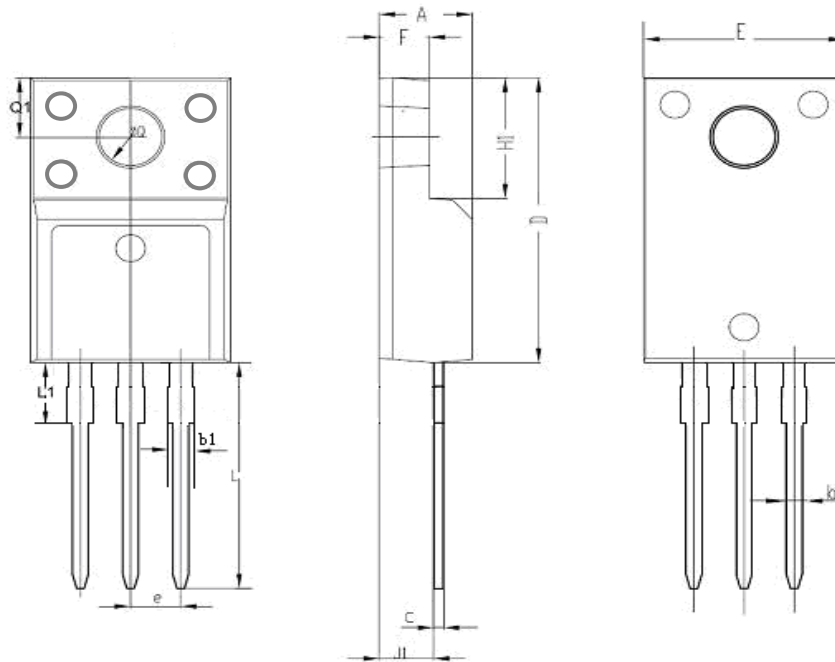


Fig. 12 Transient Thermal Response Curve



**TO-220F-3L MECHANICAL DATA**


SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	0.178	0.194	4.53	4.93	
b	0.028	0.036	0.71	0.91	
C	0.018	0.024	0.45	0.60	
D	0.617	0.633	15.67	16.07	
E	0.392	0.408	9.96	10.36	
e	0.100 TYP.		2.54TYP.		
H1	0.256	0.272	6.50	6.90	
J1	0.101	0.117	2.56	2.96	
L	0.503	0.519	12.78	13.18	
$\phi$ Q	0.117	0.133	2.98	3.38	
b1	0.045	0.055	1.15	1.39	
L1	0.114	0.130	2.9	3.3	
Q1	0.122	0.138	3.10	3.50	
F	0.092	0.108	2.34	2.74	

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