# TMP9N60/TMPF9N60
# TMP9N60G/TMPF9N60G

**Features**

- Low gate charge
- 100% avalanche tested
- Improved dv/dt capability
- RoHS compliant
- Halogen free package
- JEDEC Qualification
- Fast reverse recovery

**$V_{DSS}$ = 660 V @$T_{jmax}$**
**$I_D$ = 9A**
**$R_{DS(ON)}$ = 1.0 (max) @ $V_{GS}$= 10 V**

## Absolute Maximum Ratings

| Parameter | | Symbol | TMP9N60(G) | TMPF9N60(G) | Unit |
|---|---|---|---|---|---|
| Drain-Source Voltage | | $V_{DSS}$ | 600 | | V |
| Gate-Source Voltage | | $V_{GS}$ | ±30 | | V |
| Continuous Drain Current | $T_C$ = 25 ℃ | $I_D$ | 9 | 9 * | A |
| | $T_C$ = 100 ℃ | | 5 | 5 * | A |
| Pulsed Drain Current (Note 1) | | $I_{DM}$ | 44 | 44* | A |
| Single Pulse Avalanche Energy (Note 2) | | $E_{AS}$ | 662 | | mJ |
| Repetitive Avalanche Current (Note 1) | | $I_{AR}$ | 9 | | A |
| Repetitive Avalanche Energy (Note 1) | | $E_{AR}$ | 15.8 | | mJ |
| Power Dissipation | $T_C$ = 25 ℃ | $P_D$ | 158 | 51.4 | W |
| | Derate above 25 ℃ | | 1.26 | 0.41 | W/℃ |
| 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 | | ℃ |
| Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds | | $T_L$ | 300 | | ℃ |

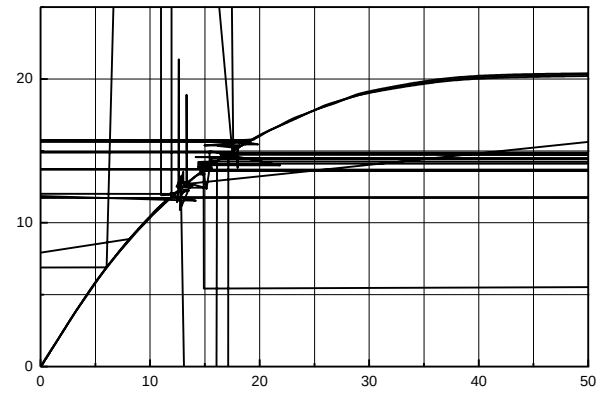
## Thermal Characteristics

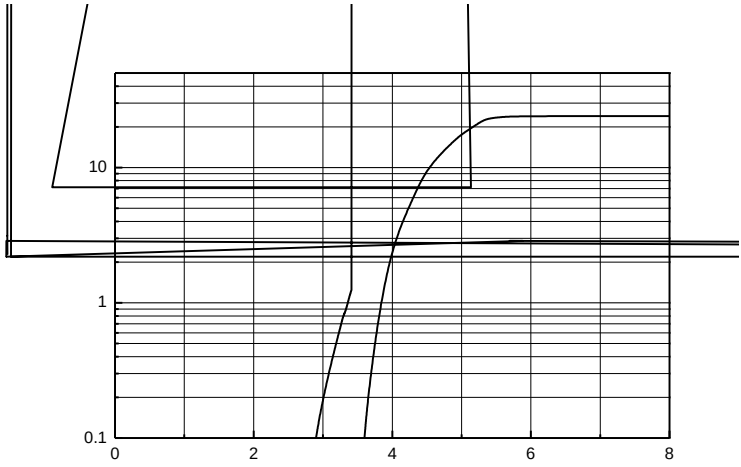
| | | | | |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |

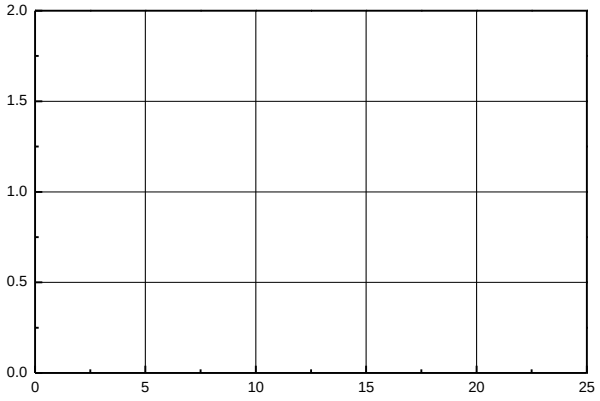
## Electrical Characteristics : $T_C$=25℃, unless otherwise noted

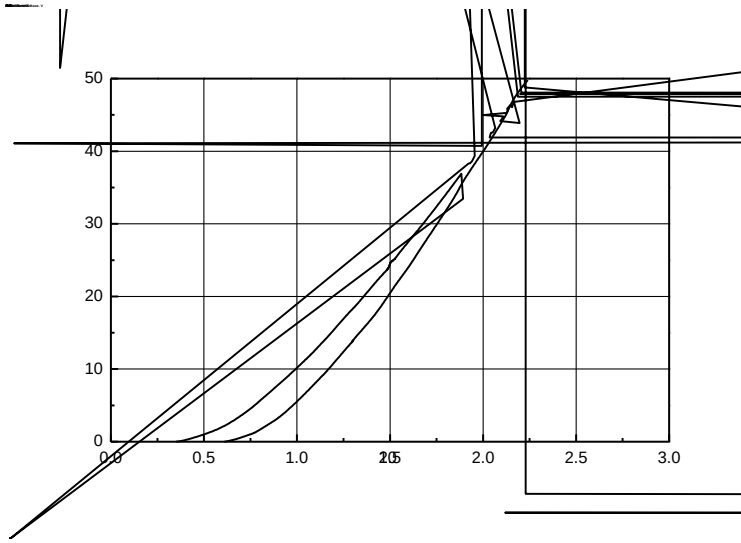
| Parameter | Symbol | Test condition | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| **OFF** | | | | | | |
| Drain-Source Breakdown Voltage | $BV_{DSS}$ | $V_{GS}$ = 0 V, $I_D$ = 250 µA | 600 | -- | -- | V |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{DS}$ = 600 V, $V_{GS}$ = 0 V | -- | -- | 1 | µA |
| | | $V_{DS}$ = 480 V, $T_C$ = 125°C | -- | -- | 10 | µA |
| Forward Gate-Source Leakage Current | $I_{GSSF}$ | $V_{GS}$ = 30 V, $V_{DS}$ = 0 V | -- | -- | 100 | nA |
| Reverse Gate-Source Leakage Current | $I_{GSSR}$ | $V_{GS}$ = -30 V, $V_{DS}$ = 0 V | -- | -- | -100 | nA |
| **ON** | | | | | | |
| Gate Threshold Voltage | $V_{GS(th)}$ | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 µA | 2 | -- | 4 | V |
| Drain-Source On-Resistance | $R_{DS(on)}$ | $V_{GS}$ = 10 V, $I_D$ = 4.5 A | -- | 0.83 | 1.0 | |
| Forward Transconductance (Note 4) | $g_{FS}$ | $V_{DS}$ = 30 V, $I_D$ = 4.5 A | -- | 10 | -- | S |
| **DYNAMIC** | | | | | | |
| Input Capacitance | $C_{iss}$ | $V_{DS}$ = 25 V, $V_{GS}$ = 0 V, f = 1.0 MHz | -- | 1440 | -- | pF |
| Output Capacitance | $C_{oss}$ | | -- | 123 | -- | pF |
| Reverse Transfer Capacitance | $C_{rss}$ | | -- | 8.1 | -- | pF |
| **SWITCHING** | | | | | | |
| Turn-On Delay Time (Note 4,5) | $t_{d(on)}$ | $V_{DD}$ = 250 V, $I_D$ = 9 A, $R_G$ = 25 Ω | -- | 50 | -- | ns |
| Turn-On Rise Time (Note 4,5) | $t_r$ | | -- | 39 | -- | ns |
| Turn-Off Delay Time (Note 4,5) | $t_{d(off)}$ | | -- | 133 | -- | ns |
| Turn-Off Fall Time (Note 4,5) | $t_f$ | | -- | 532 | -- | ns |
| Total Gate Charge (Note 4,5) | $Q_g$ | $V_{DS}$ = 400V, $I_D$ = 9 A, $V_{GS}$ = 10 V | -- | 27 | -- | nC |
| Gate-Source Charge (Note 4,5) | $Q_{gs}$ | | -- | 6.3 | -- | nC |
| Gate-Drain Charge (Note 4,5) | $Q_{gd}$ | | -- | 6.9 | -- | nC |
| **SOURCE DRAIN DIODE** | | | | | | |
| Maximum Continuous Drain-Source Diode Forward Current | $I_S$ | ---- | -- | -- | 9 | A |
| Maximum Pulsed Drain-Source Diode Forward Current | $I_{SM}$ | ---- | -- | -- | 36 | A |
| Drain-Source Diode Forward Voltage | $V_{SD}$ | $V_{GS}$ = 0 V, $I_S$ = 9 A | -- | -- | 1.5 | V |
| Reverse Recovery Time (Note 4) | $t_{rr}$ | $V_{GS}$ = 0 V, $I_S$ = 9 A, $dI_F$ / dt = 100 A/µs | -- | 350 | -- | ns |
| Reverse Recovery Charge (Note 4) | $Q_{rr}$ | | -- | 3.2 | -- | C |

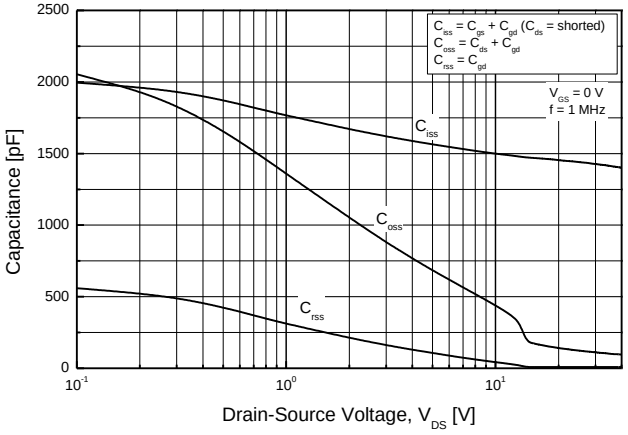
Note :
1. Repeated rating : Pulse width limited by safe operating area
2. L=15mH, $I_{AS}$ = 9A, $V_{DD}$ = 50V, $R_G$ = 25Ω, Starting $T_J$= 25 ℃
3 $I_{SD}$ ≤ 9A, di/dt ≤ 200A/µs , $V_{DD}$ ≤ $BV_{DS}$, Starting $T_J$= 25 ℃
4. Pulse Test :Pulse width ≤ 300µs, Duty Cycle ≤ 2%
5. Essentially Independent of Operating Temperature Typical Characteristics

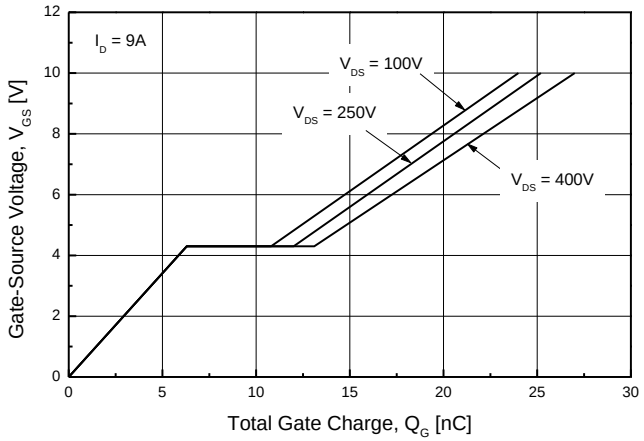

20
10
0
0
10
20
30
40
50

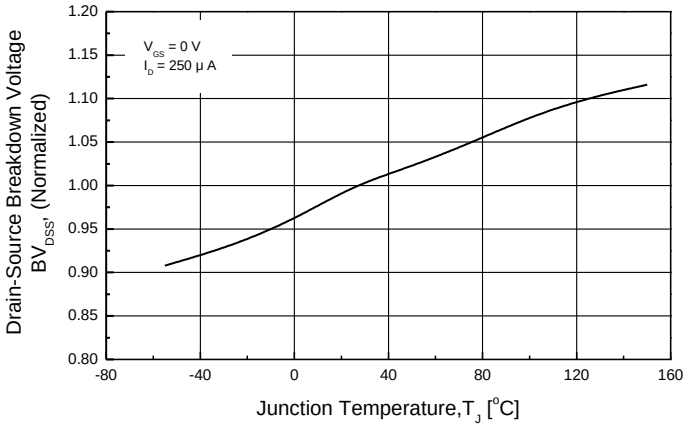

10
1
0.1
0
2
4
6
8

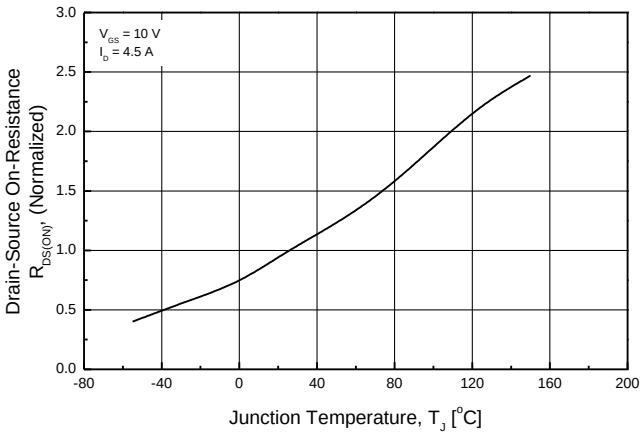

2.0
1.5
1.0
0.5
0.0
0
5
10
15
20
25

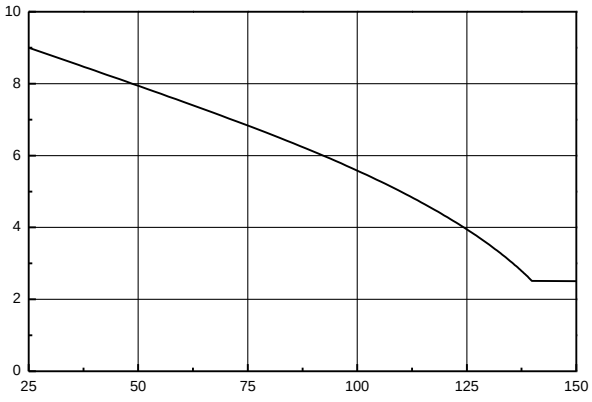

50
40
30
20
10
0
0.0
0.5
1.0
2.0
2.5
3.0


2500
2000
1500
1000
500
0
$C_{iss} = C_{gs} + C_{gd}$ ($C_{ds}$ = shorted)
$C_{oss} = C_{ds} + C_{gd}$
$C_{rss} = C_{gd}$
$V_{GS}$ = 0 V
f = 1 MHz
$C_{iss}$
$C_{oss}$
$C_{rss}$
$10^{-1}$
$10^{0}$
$10^{1}$
Capacitance [pF]
Drain-Source Voltage, $V_{DS}$ [V]

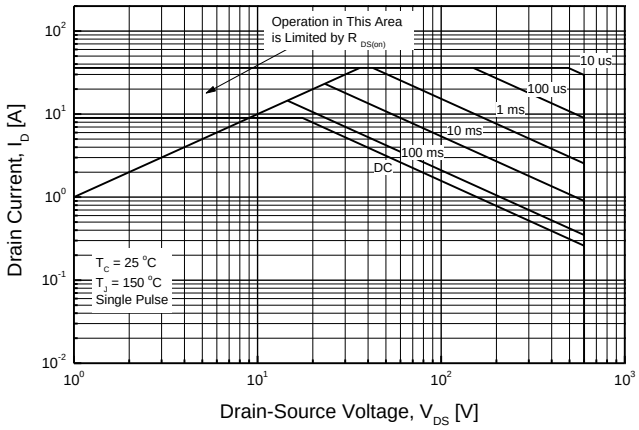

12
10
8
6
4
2
0
$I_D$ = 9A
$V_{DS}$ = 100V
$V_{DS}$ = 250V
$V_{DS}$ = 400V
0
5
10
15
20
25
30
Gate-Source Voltage, $V_{GS}$ [V]
Total Gate Charge, $Q_G$ [nC]



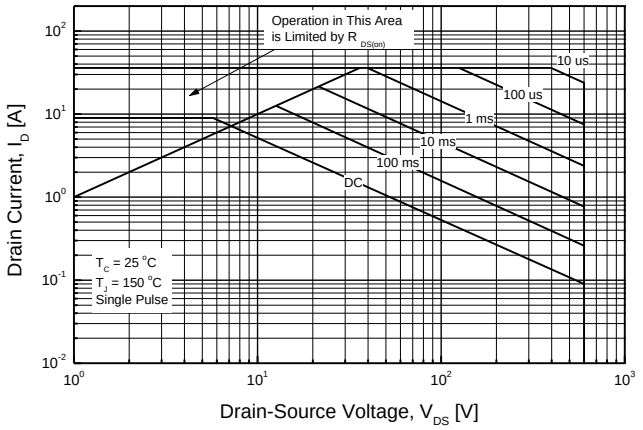



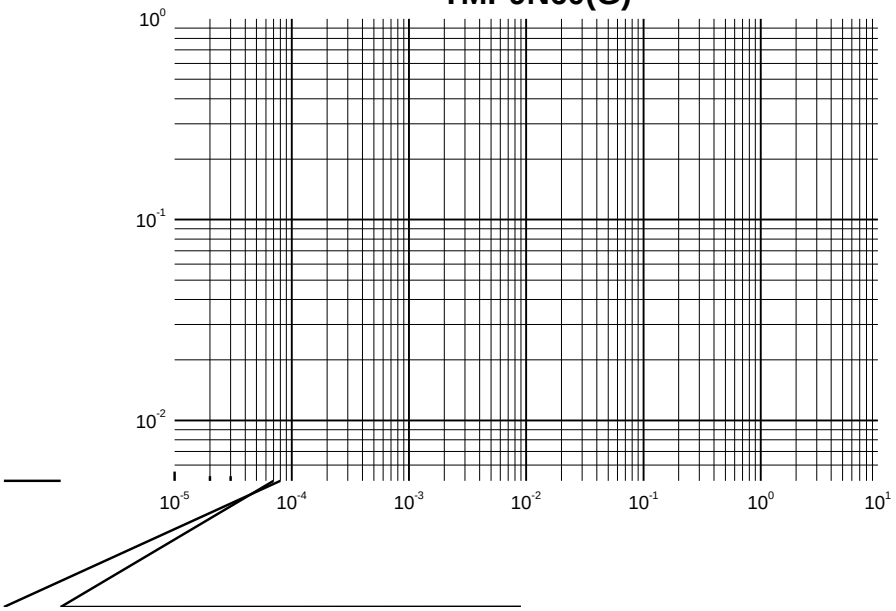
**TMP9N60(G)**

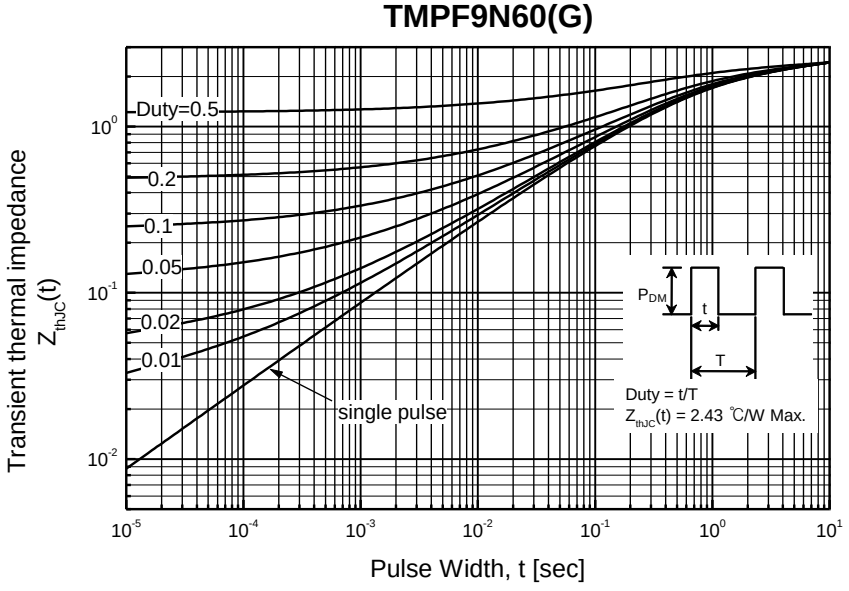



**TMPF9N60(G)**



## TMP9N60(G)




## TMPF9N60(G)