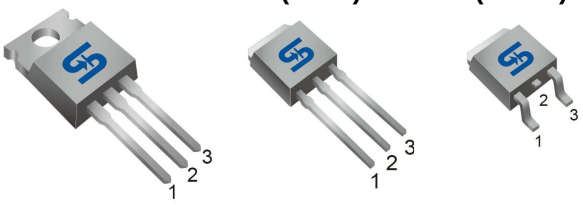
TAIWAN SEMICONDUCTOR

RoHS COMPLIANCE

# TSM2N70

700V N-Channel Power MOSFET

TO-220 | TO-251 (IPAK) | TO-252 (DPAK)



**Pin Definition:**
1. Gate
2. Drain
3. Source

**PRODUCT SUMMARY**

| $V_{DS}$ (V) | $R_{DS(on)}$(Ω) | $I_D$ (A) |
|---|---|---|
| 700 | 6.5 @ $V_{GS}$=10V | 1 |

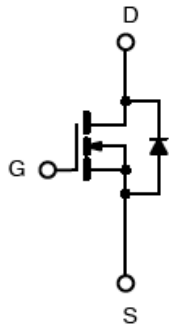
## General Description

The TSM2N70 N-Channel enhancement mode Power MOSFET is produced by 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 switch mode power supply, power factor correction, electronic lamp ballast based on half bridge.

## Features

- Low $R_{DS(ON)}$ 6.5Ω (Max.)
- Low gate charge typical @ 9.5nC (Typ.)
- Low Crss typical @ 4.5pF (Typ.)
- Fast Switching

## Block Diagram




N-Channel MOSFET

## Ordering Information

| Part No. | Package | Packing |
|---|---|---|
| TSM2N70CZ C0 | TO-220 | 50pcs / Tube |
| TSM2N70CH C5 | TO-251 | 70pcs / Tube |
| TSM2N70CP RO | TO-252 | 2.5Kpcs / 13” Reel |

## Absolute Maximum Rating (Ta = 25°C unless otherwise noted)

| Parameter | Symbol | Limit | Unit |
|---|---|---|---|
| Drain-Source Voltage | $V_{DS}$ | 700 | V |
| Gate-Source Voltage | $V_{GS}$ | ±30 | V |
| Continuous Drain Current | $I_D$ | 2 | A |
| Pulsed Drain Current * | $I_{DM}$ | 8 | A |
| Repetitive avalanche Current | $I_{AR}$ | 2 | A |
| Single Pulse Avalanche Energy (Note 2) | $E_{AS}$ | 110 | mJ |
| Maximum Power Dissipation @$T_C$ = 25°C | $P_{TOT}$ | 45 | W |
| Operating Junction Temperature | $T_J$ | 150 | ºC |
| Storage Temperature Range | $T_{STG}$ | -55 to +150 | °C |

* Limited by maximum junction temperature

## Thermal Performance

| Parameter | Symbol | Limit | Unit |
|---|---|---|---|
| Thermal Resistance - Junction to Case | $R\Theta_{JC}$ | 2.78 | °C/W |
| Thermal Resistance - Junction to Ambient | $R\Theta_{JA}$ | 100 | °C/W |

Notes: Surface mounted on FR4 board t ≤ 10sec

# TSM2N70

700V N-Channel Power MOSFET

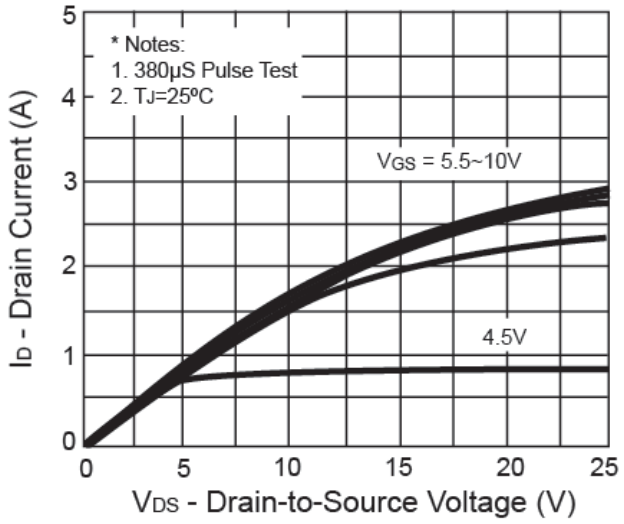
## Electrical Specifications (Ta = 25°C unless otherwise noted)

| Parameter | Conditions | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **Static** | | | | | | |
| Drain-Source Breakdown Voltage | $V_{GS}$ = 0V, $I_D$ = 1mA | $BV_{DSS}$ | 700 | -- | -- | V |
| Drain-Source On-State Resistance | $V_{GS}$ = 10V, $I_D$ = 1A | $R_{DS(ON)}$ | -- | 5.25 | 6.5 | Ω |
| Gate Threshold Voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 50uA | $V_{GS(TH)}$ | 2 | -- | 4 | V |
| Zero Gate Voltage Drain Current | $V_{DS}$ = 700V, $V_{GS}$ = 0V | $I_{DSS}$ | -- | -- | 1 | uA |
| Gate Body Leakage | $V_{GS}$ = ±20V, $V_{DS}$ = 0V | $I_{GSS}$ | -- | -- | ±100 | nA |
| Forward Transconductance | $V_{DS}$ = 15V, $I_D$ = 0.8A | $g_{fs}$ | -- | 1.7 | -- | S |
| Diode Forward Voltage | $I_S$ = 1.6A, $V_{GS}$ = 0V | $V_{SD}$ | -- | -- | 1.6 | V |
| **Dynamic** [b] | | | | | | |
| Total Gate Charge | $V_{DS}$ = 480V, $I_D$ = 2A, $V_{GS}$ = 10V | $Q_g$ | -- | 9.5 | 13 | nC |
| Gate-Source Charge | | $Q_{gs}$ | -- | 1.6 | -- | |
| Gate-Drain Charge | | $Q_{gd}$ | -- | 4.0 | -- | |
| Input Capacitance | $V_{DS}$ = 25V, $V_{GS}$ = 0V, f = 1.0MHz | $C_{iss}$ | -- | 320 | -- | pF |
| Output Capacitance | | $C_{oss}$ | -- | 35 | -- | |
| Reverse Transfer Capacitance | | $C_{rss}$ | -- | 4.5 | -- | |
| **Switching** [c] | | | | | | |
| Turn-On Delay Time | $V_{GS}$ = 10V, $I_D$ = 0.8A, $V_{DD}$ = 350V, $R_G$ = 4.7Ω | $t_{d(on)}$ | -- | 18.4 | -- | nS |
| Turn-On Rise Time | | $t_r$ | -- | 35 | -- | |
| Turn-Off Delay Time | | $t_{d(off)}$ | -- | 32 | -- | |
| Turn-Off Fall Time | | $t_f$ | -- | 34 | -- | |
| Reverse Recovery Time | $V_{GS}$ = 0V, $I_S$ = 1.3A, $V_{DD}$ = 25V, $dI_F/dt$ = 100A/us | $t_{fr}$ | -- | 474.2 | -- | nS |
| Reverse Recovery Charge | | $Q_{fr}$ | -- | 2067.8 | -- | uC |
| Reverse Recovery Current | | $I_{RRM}$ | -- | 5.16 | -- | A |

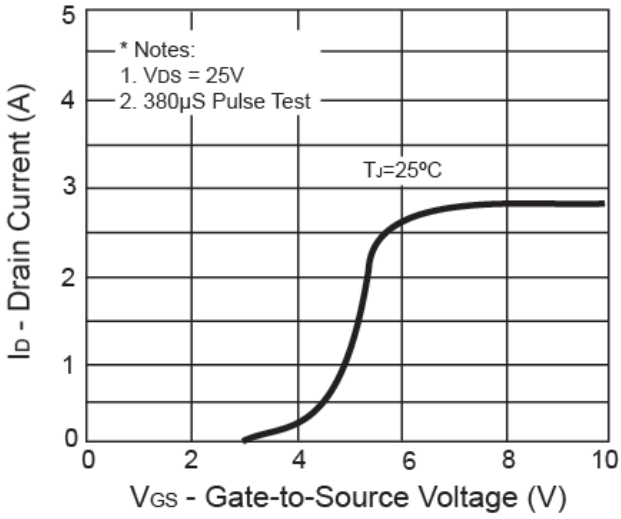
Notes:
1. Repetitive Rating: Pulse Width Limited by Maximum Junction Temperature
2. $V_{DD}$ = 50V, $I_{AS}$=2A, L=56mH, $R_G$=25Ω
3. Pulse test: pulse width ≤300uS, duty cycle ≤1.5%
4. Essentially Independent of Operating Temperature
5. For design reference only, not subject to production testing.
6. Switching time is essentially independent of operating temperature.

## Electrical Characteristics Curve (Ta = 25°C, unless otherwise noted)

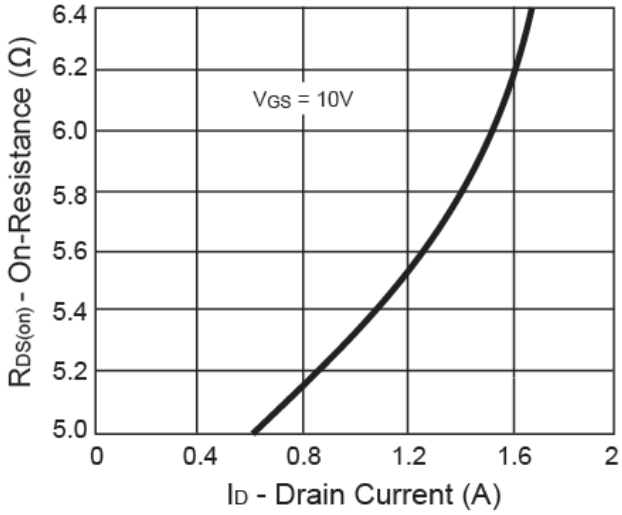
### Output Characteristics



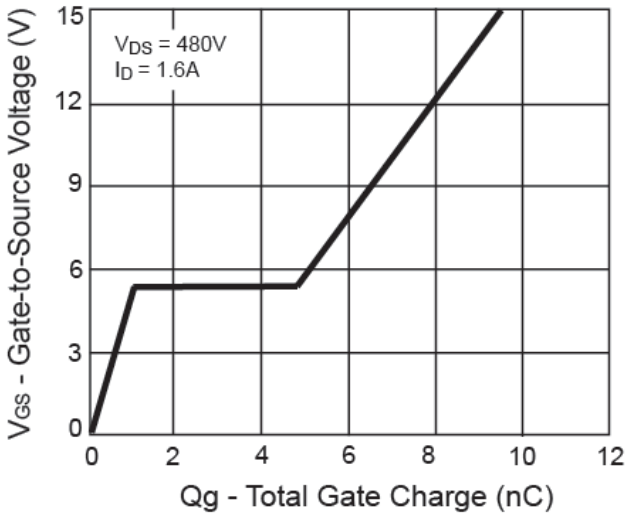

### Transfer Characteristics



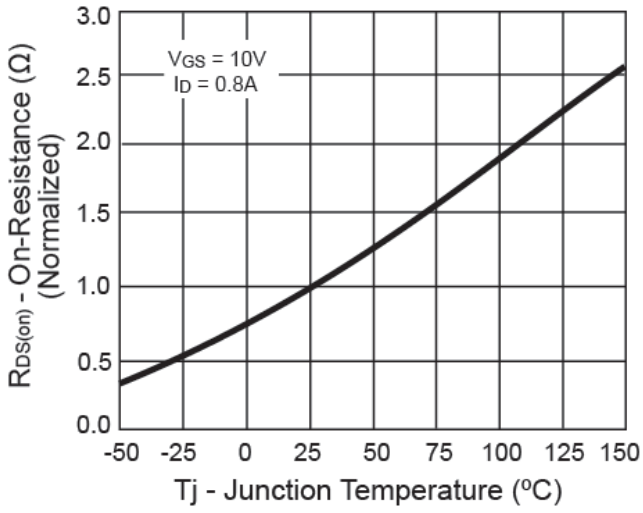

### On-Resistance vs. Drain Current



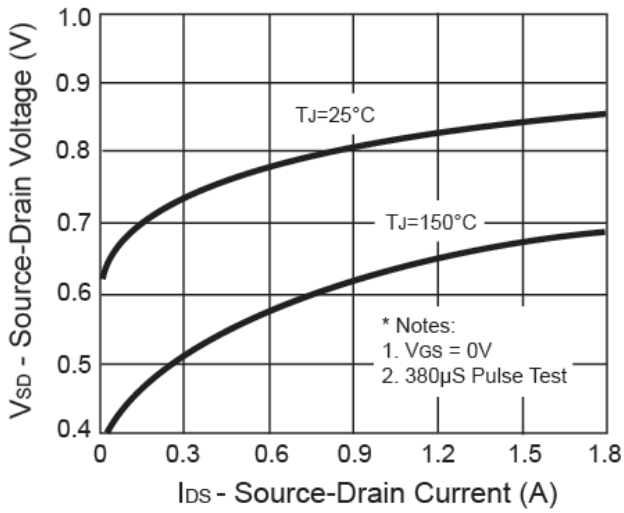

### Gate Charge




### On-Resistance vs. Junction Temperature

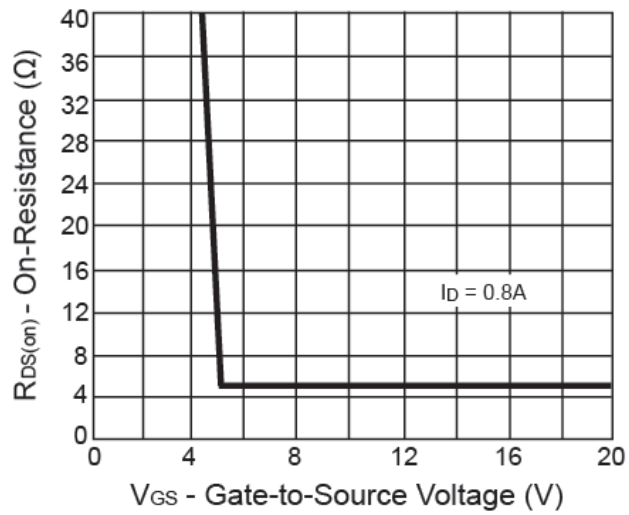



### Source-Drain Diode Forward Voltage

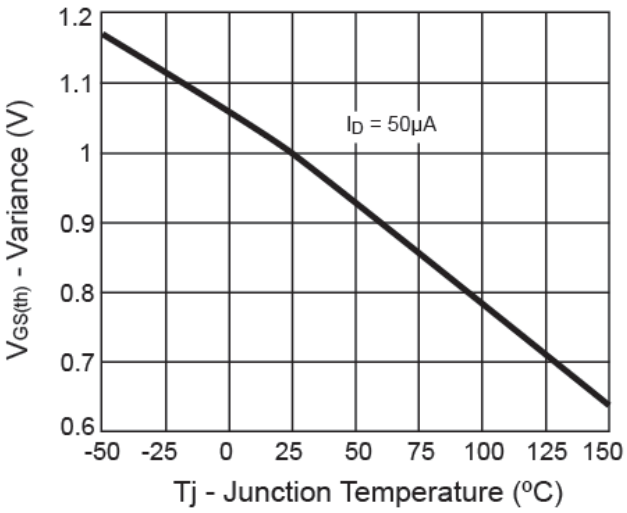


## Electrical Characteristics Curve (Ta = 25°C, unless otherwise noted)

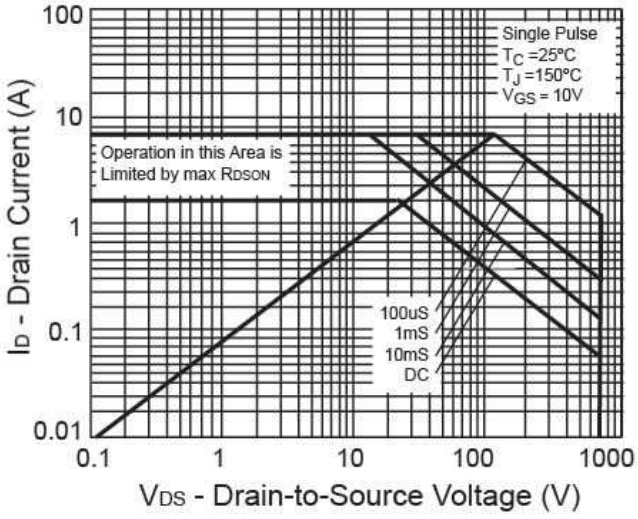
### On-Resistance vs. Gate-Source Voltage



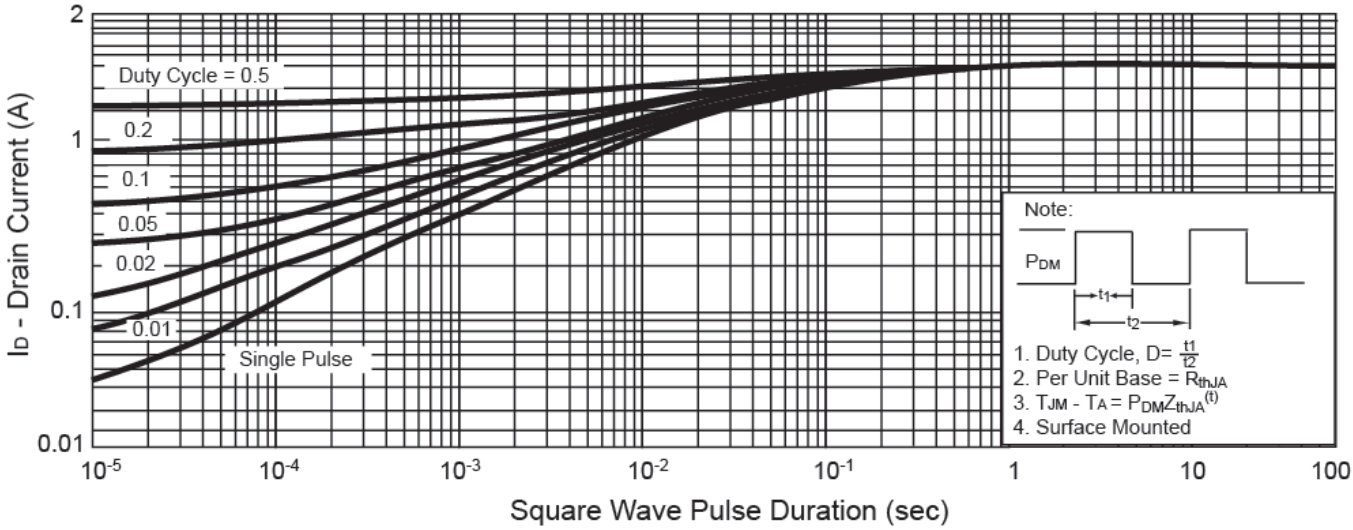

### Threshold Voltage



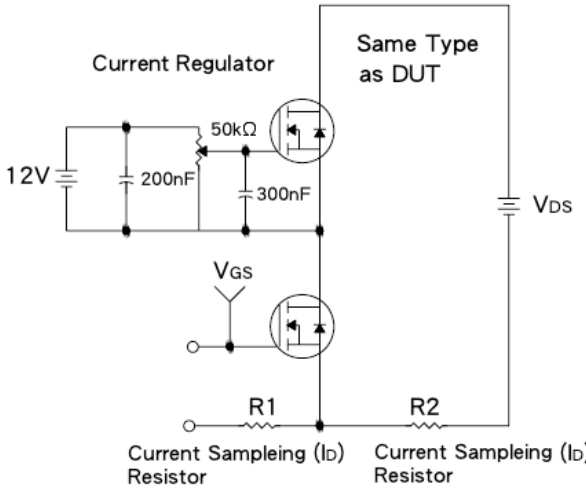

### Maximum Safe Operating Area

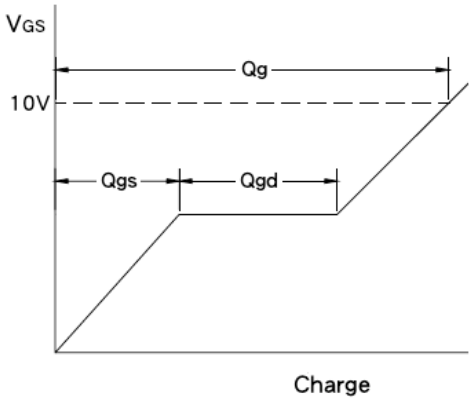



### Normalized Thermal Transient Impedance, Junction-to-Ambient

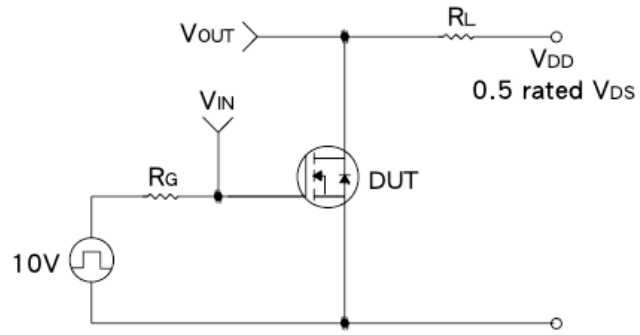


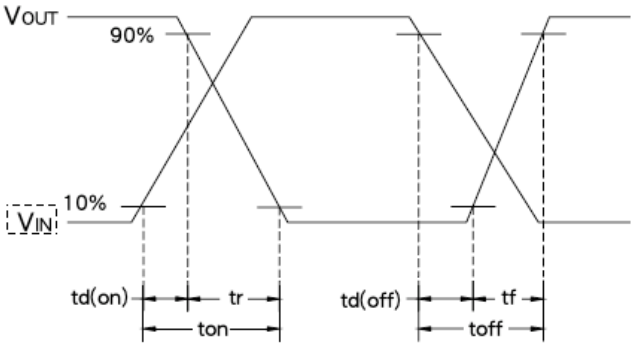
## Gate Charge Test Circuit & Waveform



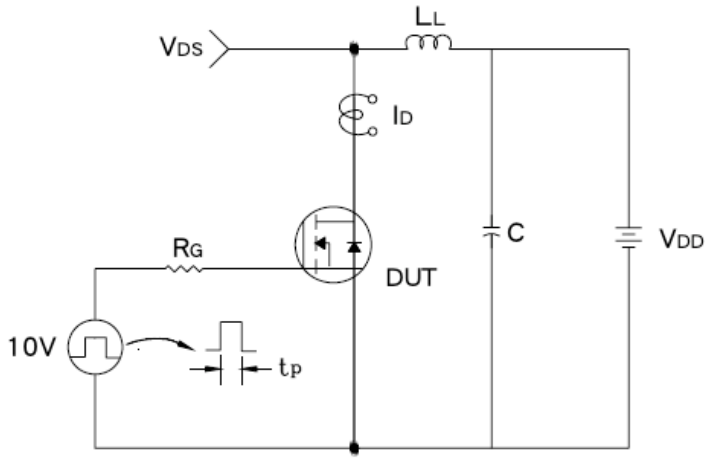



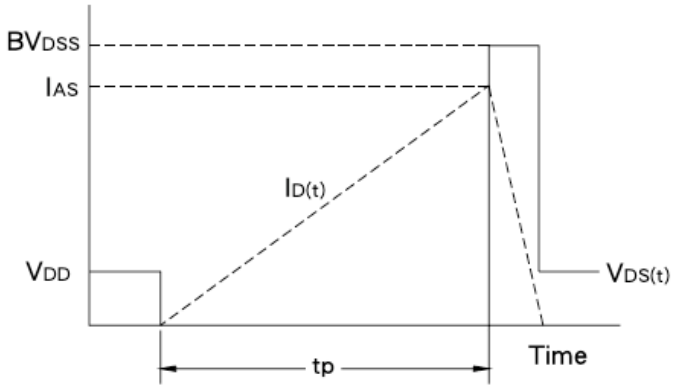

## Resistive Switching Test Circuit & Waveform



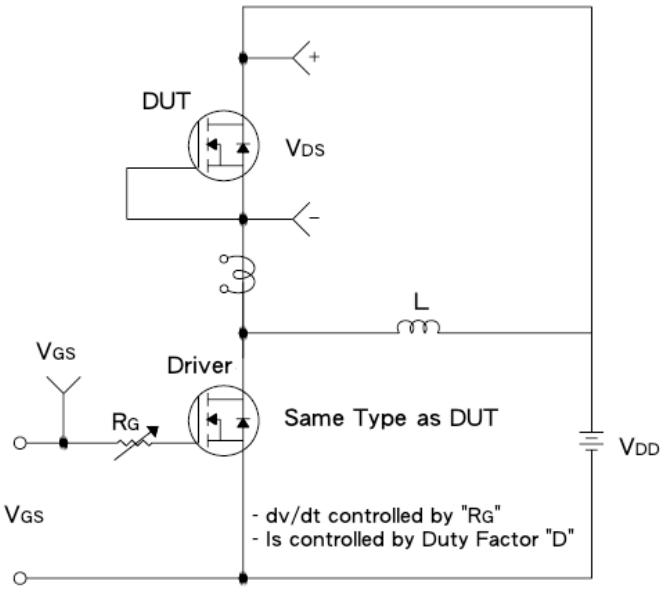



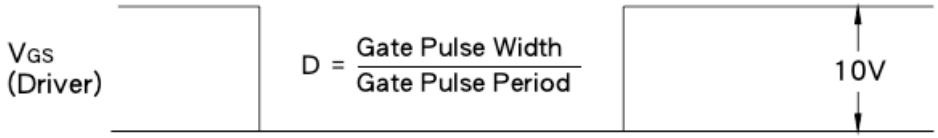

## $E_{AS}$ Test Circuit & Waveform

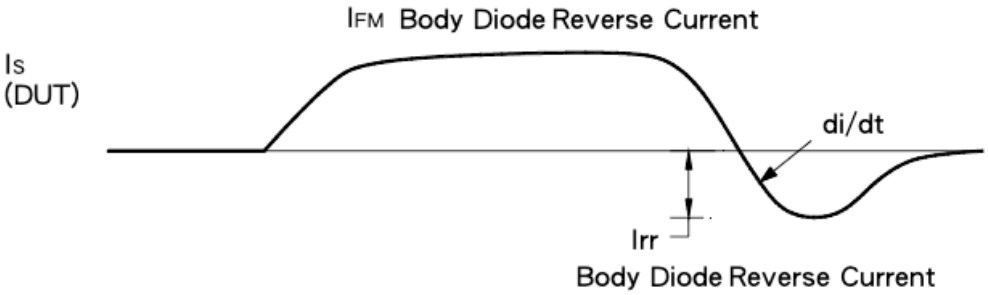


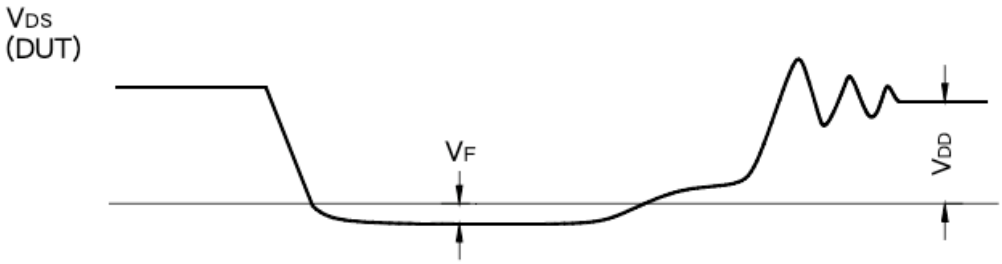



## Diode Reverse Recovery Time Test Circuit & Waveform



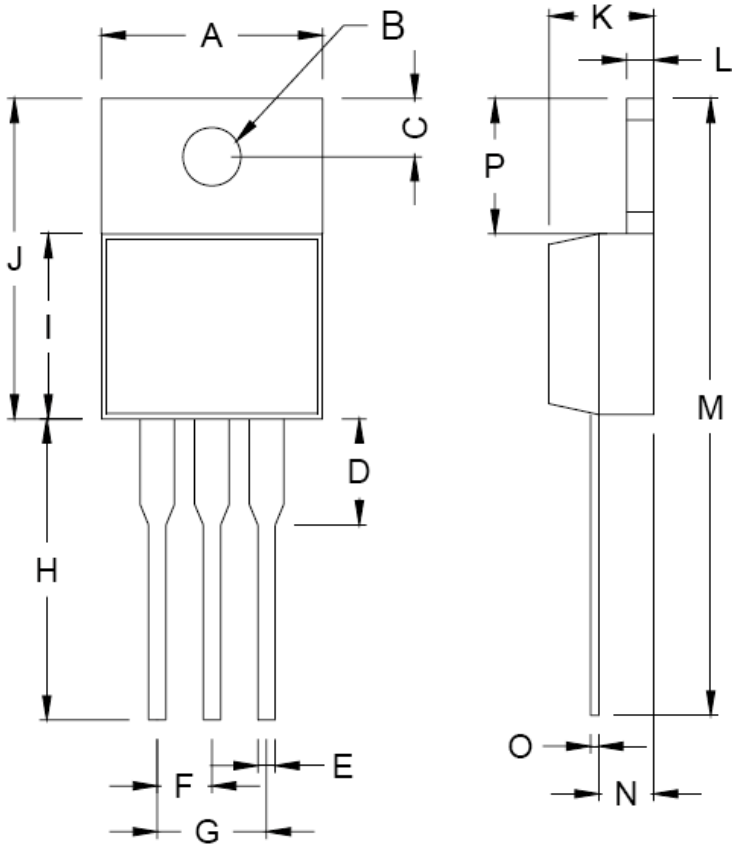



# TSM2N70

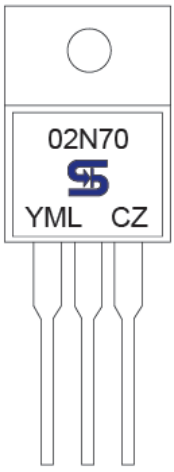
700V N-Channel Power MOSFET

## TO-220 Mechanical Drawing




| TO-220 DIMENSION | | | | |
|---|---|---|---|---|
| DIM | MILLIMETERS | | INCHES | |
| | MIN | MAX | MIN | MAX |
| A | 10.000 | 10.500 | 0.394 | 0.413 |
| B | 3.740 | 3.910 | 0.147 | 0.154 |
| C | 2.440 | 2.940 | 0.096 | 0.116 |
| D | - | 6.350 | - | 0.250 |
| E | 0.381 | 1.106 | 0.015 | 0.040 |
| F | 2.345 | 2.715 | 0.092 | 0.058 |
| G | 4.690 | 5.430 | 0.092 | 0.107 |
| H | 12.700 | 14.732 | 0.500 | 0.581 |
| J | 14.224 | 16.510 | 0.560 | 0.650 |
| K | 3.556 | 4.826 | 0.140 | 0.190 |
| L | 0.508 | 1.397 | 0.020 | 0.055 |
| M | 27.700 | 29.620 | 1.060 | 1.230 |
| N | 2.032 | 2.921 | 0.080 | 0.115 |
| O | 0.255 | 0.610 | 0.010 | 0.024 |
| P | 5.842 | 6.858 | 0.230 | 0.270 |

## Marking Diagram




**Y** = Year Code
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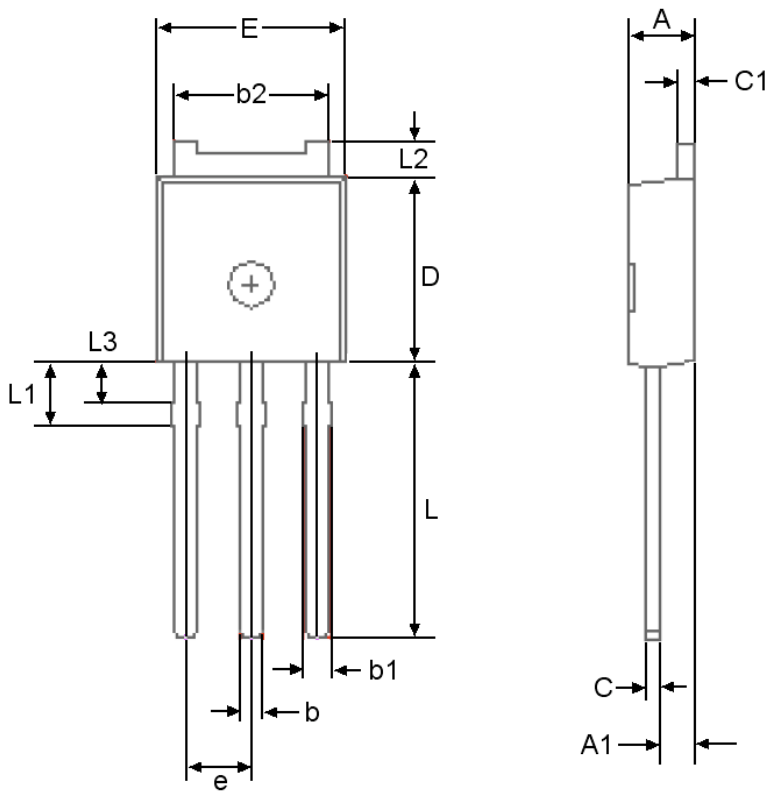
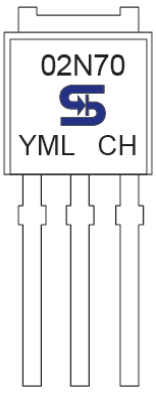
## SOT-251 Mechanical Drawing




| TO-251 DIMENSION | | | | |
|---|---|---|---|---|
| DIM | MILLIMETERS | | INCHES | |
| | MIN | MAX | MIN | MAX |
| A | 2.19 | 2.38 | 0.086 | 0.094 |
| A1 | 0.89 | 1.14 | 0.035 | 0.045 |
| b | 0.64 | 0.89 | 0.025 | 0.035 |
| b1 | 0.76 | 1.14 | 0.030 | 0.045 |
| b2 | 5.21 | 5.46 | 0.205 | 0.215 |
| C | 0.46 | 0.58 | 0.018 | 0.023 |
| C1 | 0.46 | 0.58 | 0.018 | 0.023 |
| D | 5.97 | 6.10 | 0.235 | 0.240 |
| E | 6.35 | 6.73 | 0.250 | 0.265 |
| e | 2.28 BSC. | | 0.90 BSC. | |
| L | 8.89 | 9.65 | 0.350 | 0.380 |
| L1 | 1.91 | 2.28 | 0.075 | 0.090 |
| L2 | 0.89 | 1.27 | 0.035 | 0.050 |
| L3 | 1.15 | 1.52 | 0.045 | 0.060 |

## Marking Diagram

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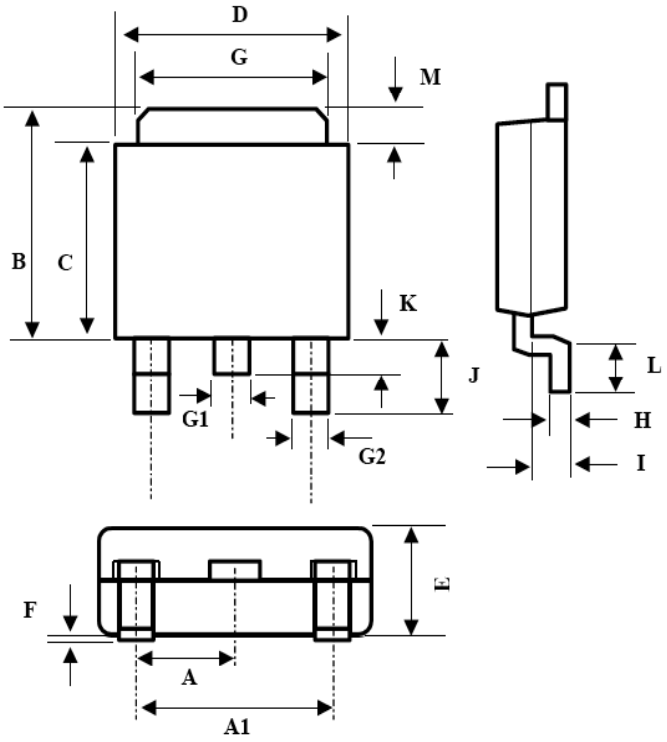
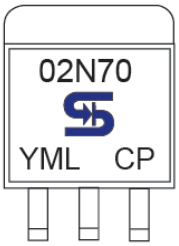
## TO-252 Mechanical Drawing




| TO-252 DIMENSION | | | | |
|---|---|---|---|---|
| DIM | MILLIMETERS | | INCHES | |
| | MIN | MAX | MIN | MAX |
| A | 2.290 BSC | | 0.090 BSC | |
| A1 | 4.600 BSC | | 0.180 BSC | |
| B | 7.000 | 7.200 | 0.275 | 0.283 |
| C | 6.000 | 6.200 | 0.236 | 0.244 |
| D | 6.400 | 6.604 | 0.252 | 0.260 |
| E | 2.210 | 2.387 | 0.087 | 0.094 |
| F | 0.010 | 0.127 | 0.000 | 0.005 |
| G | 5.232 | 5.436 | 0.206 | 0.214 |
| G1 | 0.666 | 0.889 | 0.026 | 0.035 |
| G2 | 0.633 | 0.889 | 0.025 | 0.035 |
| H | 0.508 REF | | 0.020 REF | |
| I | 0.900 | 1.500 | 0.035 | 0.059 |
| J | 2.743 REF | | 0.108 REF | |
| K | 0.660 | 0.940 | 0.026 | 0.037 |
| L | 1.397 | 1.651 | 0.055 | 0.065 |
| M | 1.100 REF | | 0.043 REF | |

## Marking Diagram

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